Improve I-70 P1

Columbia to Kingdom City Job No. JST0021
Boone and Callaway Counties, Missouri

Final Geotechnical Engineering Design Report (GEDR)

Bridges A9542 and A9543

Rev	Submittal Date	Description
A	07/23/2024	Preliminary GEDR for Bridges A9542 and A9543
B	11/25/2024	Final GEDR for Bridges A9542 and A9543
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Prepared by

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Contents

Acronyms and abbreviations iii
1. Introduction 1
1.1 Scope of Work 1
1.2 Project Description 1
2. Existing Conditions 3
2.1 Existing Subsurface Information at Bridge L0264 3
2.2 Existing Subsurface Information at Bridge A6951 1
3. Previous Subsurface Investigation 2
4. New Subsurface Investigation 3
5. Site and Subsurface Conditions 4
5.1 Site Topography 4
5.2 Geology 4
5.3 Subsurface Conditions 5
5.4 Surface Water and Groundwater 6
5.5 Scour 6
6. Seismic Design Recommendations 6
6.1 Site Class 6
6.2 Seismic Parameters 6
6.3 Liquefaction Potential 7
7. Bridge Foundation Recommendations 7
7.1 General 7
7.2 Pile Axial Resistance 8
7.2.1 Pile Structural Axial Resistances in Compression 8
7.2.2 Pile Geotechnical Axial Resistances in Compression 9
7.2.3 Required Nominal Pile Driving Resistance for Driven Piles 10
7.2.4 Concrete Encased Pile Axial Resistance 11
7.3 Pile Lateral Analysis 11
7.3.1 Pile Lateral Analysis at End Bents of Bridge A9542 11
7.3.2 Pile Lateral Analysis at End Bents of Bridge A9543 12
7.3.3 Pile Lateral Analysis at Intermediate Bents 13
7.3.4 Passive Resistance behind Abutment Backwall 14
7.4 Foundation Design Recommendations 15
8. Global Stability 18
9. Settlement 19

10. Construction Considerations 19
10.1 Site Preparation 19
10.2 Driven Pile Installation 19
10.2.1 General Considerations 19
10.2.2 Obstructions and Difficult Driving Conditions 20
10.3 Excavations 20
10.4 Subgrade Preparation 20
10.5 Site Drainage and Maintenance 20
10.6 Quality Control Services 20
11. Limitations 21
12. References 21

Appendices

Appendix A. Plans for Bridges A9542 and A9543
Appendix B. As-Built Plans for Bridges L0264 and A6951
B.1 As-Built Plans for Bridge L0264
B.2 As-Built Plans for Bridge A6951
Appendix C. I-70 and US-63 Interchange Geotechnical Data Report
Appendix D. New Subsurface Investigation Data
D.1 Boring Location Plan at I-70/US-63 Interchange
D.2 Subsurface Soil Profiles at Bridges A9542 and A9543
D.3 Geotechnical Data Report by TSi
Appendix E. Geotechnical Analysis
E.0 Foundation Recommendation Summary
E.1 Seismic Site Class Determination and Design Parameters
E.2 Liquefaction Evaluation
E.3 Passive Resistance behind Backwall
E.4 Preliminary Scour and Load Information for Substructure Design
E.5 Pile Lateral Analysis
E.6 Pile Drivability Analysis
E.7 Global Stability Analysis
E.8 Settlement Analysis

Acronyms and abbreviations

CECIP	Closed Ended Cast-In-Place Concrete Pile
CPT	cone penetration test
DBT	Design-Build Team
EB	Eastbound
EPG	Engineering Policy Guide
FHWA	Federal Highway Administration
Jacobs	Jacobs Engineering Group Inc.
LRFD	Load and Resistance Factor Design
MCE	Maximum Considered Earthquake
MoDOT	Missouri Department of Transportation
MW	Millstone Weber
MSE Wall	mechanically stabilized earth wall
NAVD	North American Vertical Datum
OECIP	Open Ended Cast-In-Place Concrete Pile
OSHA	Occupational Safety and Health Administration
pcf	pounds per cubic feet
PFR	Preliminary Foundation Report
psf	pounds per square feet
PGA	Peak Ground Acceleration
SDC	Seismic Design Category
SPT	standard penetration test
Su	undrained shear strength
tsf	tons per square foot
TSi	TSi Geotechnical, Inc.
USGS	U.S. Geological Survey
WB	Westbound

1. Introduction

1.1 Scope of Work

This Geotechnical Engineering Design Report (GEDR) presents our geotechnical recommendations for design and construction of the proposed new bridges A9542 and A9543 to replace the existing bridges L0264 and A6951 over Hinkson Creek as part of the Missouri Department of Transportation (MoDOT)'s Improve I-70 – Columbia to Kingdom City Design-Build Project (JST0021) in Boone & Callaway Counties, Missouri. The new bridges A9542 and A9543 correspond to Millstone Weber (MW) Design-Build Team (DBT) Bridge 2 and Bridge 4, respectively, which were designated during the proposal phase.

The scope of work included reviewing the available subsurface information for the project area, reviewing available as-built drawings for the existing bridges, reviewing the subsurface investigation performed for this project, performing the necessary engineering analyses, and formulating the conclusions and geotechnical recommendations for the new proposed bridges as presented in this report. The engineering analyses and reporting were performed in general accordance with MoDOT Engineering Policy Guide (MoDOT EPG) and AASHTO LRFD Bridge Design Specifications (2020, 9th Edition) (AASHTO LRFD BDS).

All elevations in this report are expressed in feet and are referenced to the North American Vertical Datum of 1988 (NAVD 88).

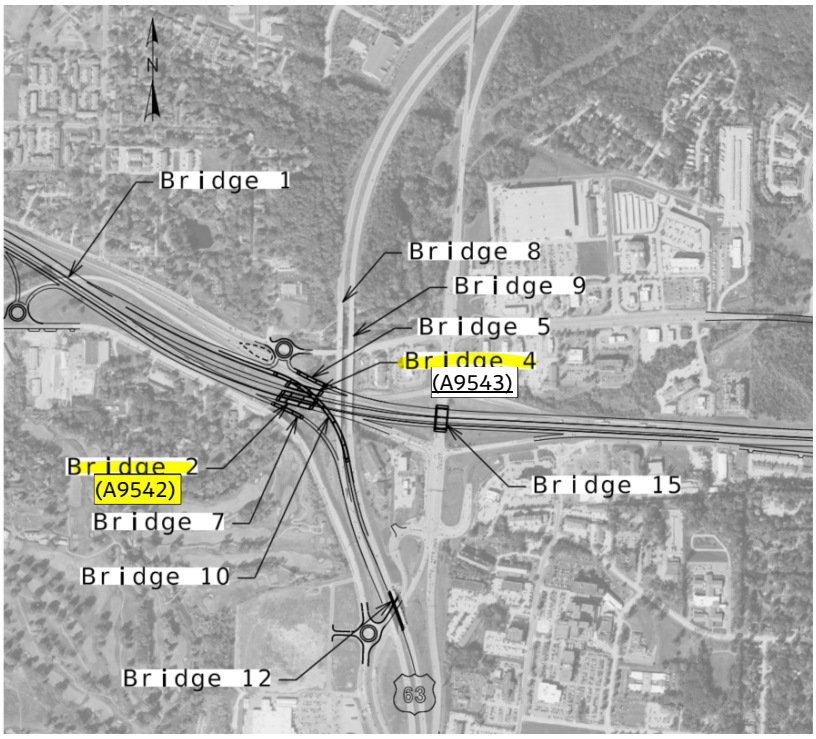
1.2 Project Description

MoDOT's Improve I-70 – Columbia to Kingdom City Design-Build program is to make improvements to the I-70 corridor from just west of US-63 in Boone County to just east of US-54 in Callaway County. The improvements include actions to expand I-70 by providing a third lane in each direction, reconstruct or rehabilitate pavement and bridges; improve traffic operations, geometrics, and safety; improve accessibility along and across to/from the corridor for freight, bicycles, and pedestrian; and make improvements to the interchanges of the I-70 corridor. The project location is shown in **Figure 1**.

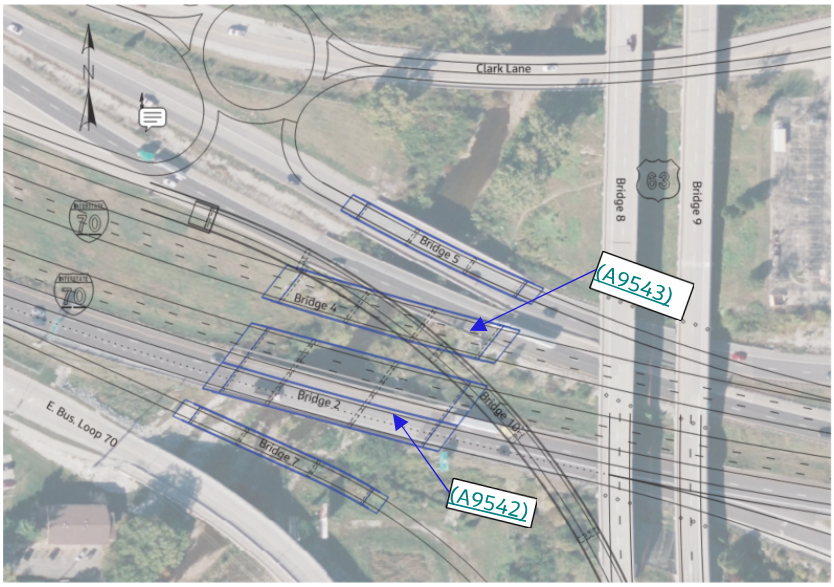


Figure 1. Project Location

The proposed new bridges A9542 and A9543 are located in Boone County, Missouri. **Figure 2** shows the locations of the proposed bridges.



a. Bridge Key Map



b. Proposed Bridges

Figure 2. Locations of Proposed Bridges A9542 and A9543

The proposed new bridge A9542 is a 3-span bridge with span lengths of approximately 54.6 feet, 99.8 feet, and 88.5 feet and a total bridge length of approximately 246.9 feet, which includes the thickness of the pile cap to the fill face at the integral abutments. The bridge width is approximately 90 feet and 2 inches. The proposed bridge has integral end bents which will be supported on galvanized steel H-Pile foundations (HP 12X53) and each intermediate bent will be supported by 24-inch diameter closed ended cast-in-place concrete (CECIP) piles or open ended cast-in-place concrete (OECIP) piles. Spill slope will be constructed at the bridge ends protected by MoDOT Type 2 Rock blankets with permanent geotextile for erosion and scour control.

The proposed new bridge A9543 is a 3-span bridge with each span length of approximately 80 feet and a total bridge length of approximately 240 feet. The bridge is approximately 48 feet and 9 inches wide. The proposed bridge has integral end bents which will be supported on galvanized steel H-Pile foundations (HP 12X53) and each intermediate bent will be supported by 24-inch diameter closed ended cast-in-place concrete (CECIP) piles or open ended cast-in-place concrete (OECIP) piles. Spill slope will be constructed at the bridge ends protected by Type 2 Rock blankets with permanent erosion control geotextile for erosion and scour control.

The preliminary bridge plans are included in **Appendix A**.

2. Existing Conditions

2.1 Existing Subsurface Information at Bridge L0264

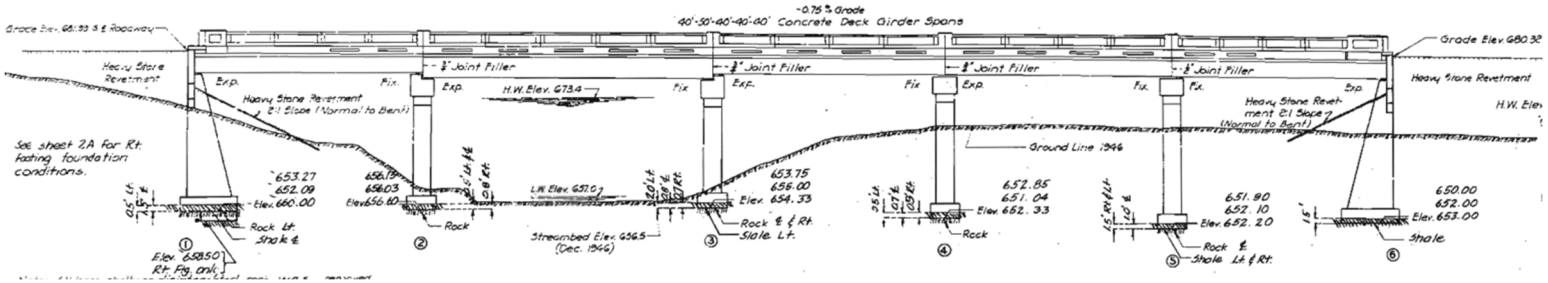
The existing bridge L0264 is a 5-span bridge carrying I-70 eastbound (EB) over Hinkson Creek. The bridge alignment is generally oriented east-west. It was first bult in 1949 with all six bents supported by shallow foundations bearing on shale (or some foundations possibly on limestone). Span lengths of the bridge range from about 42.5 to 52.5 feet, and the total length of the bridge is about 222.5 feet. In 1976, this bridge was widened to the south side and the north side of the structure, and the superstructure was replaced. The widened superstructure is supported by either steel H-pile (HP 10X42) or shallow foundations. HP 10X42 steel piles were driven to practical refusal in the underlying shale or limestone to support the superstructure loads. The elevation profile and plan view of the existing bridge (view to the north) are presented in **Figure** 3. The as-built bridge plan of Bridge L0264 is included in **Appendix** B.1.

Each of the end bents and intermediate bents of current bridge L0264 consists of three to five individual columns linked by a concrete beam at the top. The as-built foundation information is summarized in **Table** 1.

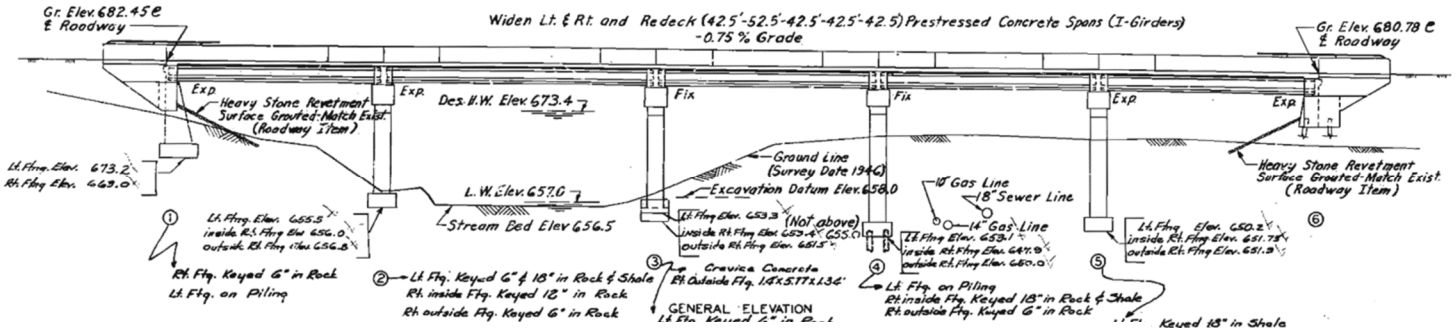
Table 1. Foundation Information of Existing Bridge L0264

Bent No.	Foundation Type	Design Bearing Capacity	Bottom of Shallow Foundation Elevation and Pile Information*
1	Shallow	4.0 tsf	652.1 ~ 660.0 ft
	HP10X42	10 tons	Pile Length 17 ~ 23 ft, Tip Elev. 653.0 ~ 659.0 ft
2	Shallow	4.5 tsf	Elev. 656.03 ~ 656.60 ft
3	Shallow	3.5 ~ 4.5 tsf	Elev. 653.75 ~ 655.00 ft
4	Shallow	5.0 tsf	Elev. 651.04 ~ 652.85 ft
	HP10X42	22 tons	Pile Length 34 ~ 35 ft, Tip Elev. 620.4 ~ 621.4 ft
5	Shallow	3.7 ~ 5.0 tsf	Elev. 651.9 ~ 652.2 ft
6	Shallow	-	Elev. 650.0 ~ 653.0 ft
	HP10X42	30 tons	Pile Length 25 ~ 33 ft, Tip Elev. 641.2 ~ 648.9 ft

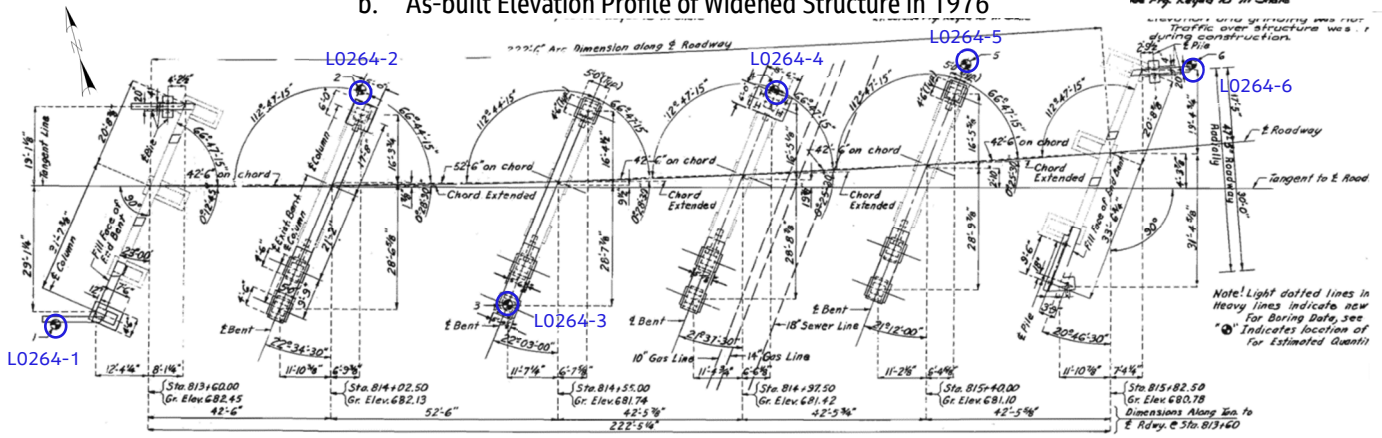
Notes: Pile tip elevations were approximately estimated based on the as-built plan of Bridge L0264.



a. As-built Elevation Profile in 1949



b. As-built Elevation Profile of Widened Structure in 1976



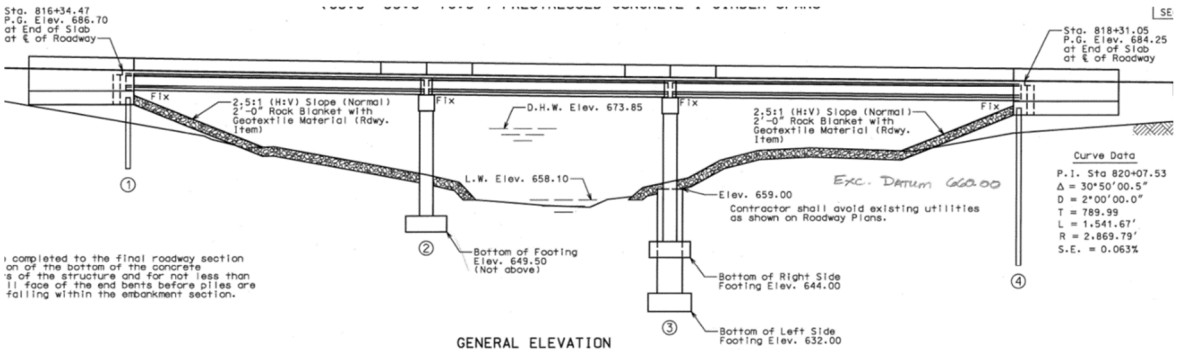
c. As-built Plan View in 1976

Figure 3. Elevation Profile and Plan View of Existing Bridge L0264

As shown in **Figure** 3, there were six (6) borings (boring number 1 through 6) drilled for design of widening Bridge L0264 in 1976. These borings were renamed as L0264-1 through L0264-6 in this report. The boring logs are included in **Appendix** B.1.

2.2 Existing Subsurface Information at Bridge A6951

The existing Bridge A6951 is a 3-span bridge carrying I-70 westbound (WB) over Hinkson Creek. The bridge alignment is generally oriented east-west. Based on the as-built drawings in 2003 (**Appendix B.2**), end bent 1 and end bent 4 were supported by six and seven HP 12X53 steel piles, respectively. All piles were driven to practical refusal. Each intermediate bent (bent 2 and bent 3) consisted of two columns which were supported by individual spread footings. Span lengths of the bridge are approximately 66.5 feet, 53.5 feet and 77.5 feet, and the total length of the bridge is about 197.5 feet. The elevation profile and plan view of the existing bridge (view to the north) are presented in **Figure** 4.



a. As-built Elevation Profile in 2003

b. As-built Plan View in 2003

Figure 4. Elevation Profile and Plan View of Existing Bridge A6951

As shown in **Figure** 4, there were four (4) borings (boring number 1 through 4) were drilled for design of Bridge A6951 in 2003. These borings were renamed as A6951-1 through A6951-4 in this report. The boring logs were included in **Appendix** B.2.

The as-built foundation information is summarized in **Table** 2.

Table 2. Foundation Information of Existing Bridge A6951

Bent No.	Foundation Type	Design Bearing Capacity	Bottom of Shallow Foundation Elevation or Pile Information
1	HP 12X53	69.2 tons	Pile length 13 ~ 18 ft, Tip Elev. 661 ~ 665 ft
2	Shallow	7.2 tsf	Elev. 649.5 ft
3	Shallow	7.6 tsf	Elev. 632.0 ft (left) and 644.0 ft (right)
4	HP 12X53	63.4 tons	Pile Length 34~ 48 ft, Elev. 629 ~641.5 ft

Notes: Pile tip elevations were approximately estimated based on the as-built plan of Bridge A6951. Prebore was required at End Bent 4 likely to penetrate existing fill/scour protection material and/or boulders.

3. Previous Subsurface Investigation

In addition to the borings shown on the as-built plans for Bridges L0264 and A6951 as stated in Section 2 of this report, MoDOT provided the geotechnical data report prepared by Geotechnology (2023) for the interchange of I-70 and US-63 during the proposal phase. This data report was included in **Appendix C.** There are five (5) borings (borings B-7 through B-11) in this report which are adjacent to the proposed bridges. **Figure** 5 shows the approximate boring locations of all the available borings as well as the planned borings for design of Bridges A9542 and A9543.

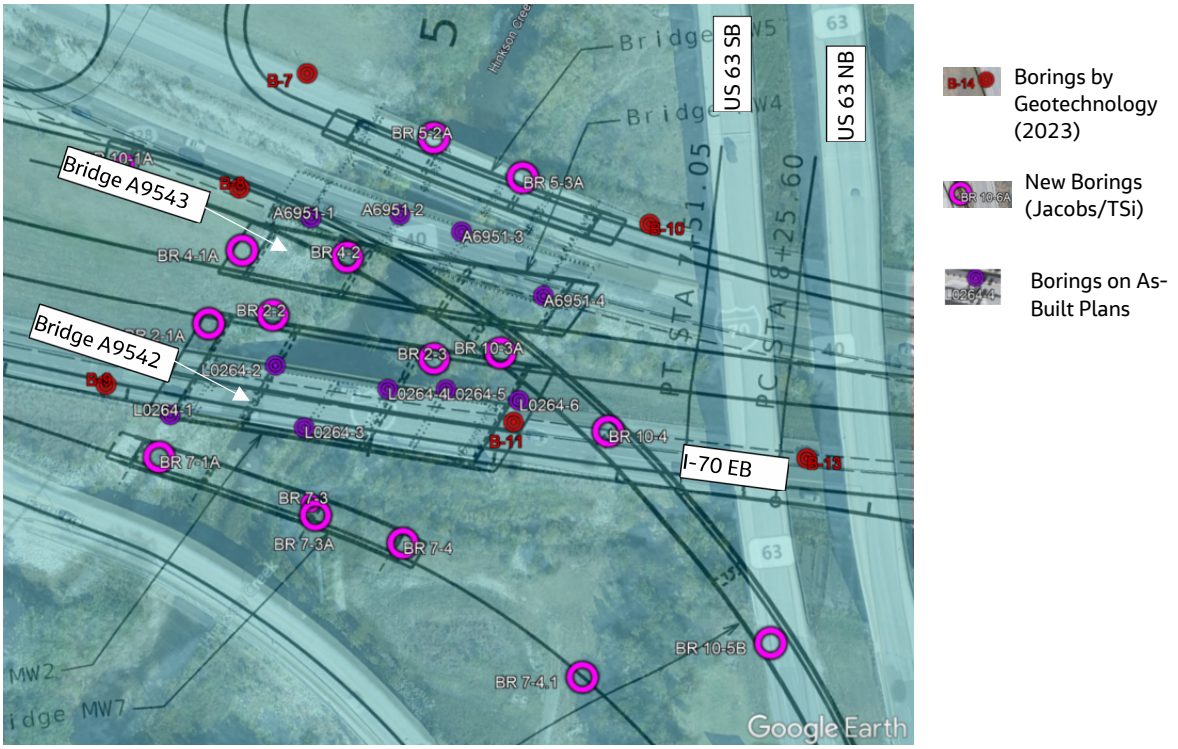


Figure 5. Boring Locations

4. New Subsurface Investigation

In consideration of the available borings provided in the as-built plans, Geotechnology's report (2023), and new borings proposed for design of the adjacent bridges, a total of five new borings (BR 2-1A, BR 2-2, BR 2-3, BR 4-1A, and BR 4-2) were proposed by Jacobs near the end bent and intermediate bent locations of Bridges A9542 and A9543 for design of the new bridges. TSi Geotechnical, Inc. (TSi) (subcontracted to Jacobs) performed the field investigation and laboratory testing on the soil and rock samples, as assigned by Jacobs geotechnical engineers. The new boring locations are shown in **Figure 5**.

The new borings drilled by TSi were advanced from 16.5 to 63.0 feet deep, with each boring cored approximately 9.3 feet to 33.0 feet into bedrock. Standard Penetration Resistance Tests (ASTM D1586) were typically conducted at 2.5-foot centers for the top 10 feet and 5-foot centers below in each boring using standard split-spoon samplers and a CME automatic hammer (hammer efficiency of 90%). In addition, undisturbed thin-wall samples (commonly known as Shelby tubes) were collected in the cohesive soils encountered by the borings. N-series wireline core drilling techniques were used to core the rock.

The boring logs of the new subsurface investigation by TSi are presented in **Appendix D**.3 A summary of the new borings by TSi and the borings by Geotechnology (2023) used for design for Bridges A9542 and A9543 is presented in **Table 3.** This table also includes borings drilled for adjacent proposed bridges that span Hinkson Creek very near A9542 and A9543.

Table 3. Summary of New Borings (TSi) and Existing Borings (Geotechnology, 2023)

Boring Number	Ground Elev.** (ft)	Bottom of Hole Depth (ft)	Bottom of Hole Elev. (ft)	Top of Fresh or Weathered Rock Depth (ft)	Top of Fresh or Weathered Rock Elev. (ft)	Rock Core Length (ft)	Groundwater Elev. (ft)
BR 2-1A	676.9	16.5	660.4	7.2	669.7	9.3	-
BR 2-2	669.0	30.0	639.0	7.3	661.7	17.7	-
BR 2-3	669	50.0	619.0	13.8	655.2	21.0	656.0
BR 4-1A	669.0	22.0	647.0	7.0	662.0	15.0	665.5
BR 4-2	667.7	26.2	641.5	11.2	656.5	15.0	659.2
BR 5-3A	683.2	50.3	632.9	33.5	649.7	15.0	-
BR 7-1A	671.1	22.0	649.1	12.0	659.1	10.0	-
BR 7-3A	668.7	35.0	633.7	23.5	645.2	11.0	650.2
BR 7-4	668.9	50.5	618.4	12.0	656.9	11.0	-
BR 10-3A	668.3	63.0	605.3	13.8	654.5	32.0	660.3
B-10*	680.6	59.5	621.1	23.0	657.6	20.0	657.1
B-11*	680.3	35.8	644.5	24.0	656.3	1.8	653.3

Notes: * From the report by Geotechnology (2023); **Ground elevations were estimated.

Laboratory tests have been assigned on selected soil and rock core samples for the new borings. These tests included moisture content determinations, Atterberg limits, unconfined compression tests and density testing of the soils, and unconfined compressive strength (UCS) tests and density determinations on the rock core. The test results are included in the Geotechnical Data Report by TSi in **Appendix** D.3.

5. Site and Subsurface Conditions

5.1 Site Topography

The proposed Bridges A9542 and A9543 will cross over Hinkson Creek and associated floodplains with roadway grade elevations approximately 683.0 to 685 feet. The Hinkson Creek bed elevation is about 658.0 feet. The creek bank is sloped at 2:1 (horizontal: vertical) or flatter and will be protected by MoDOT Type 2 Rock blankets with Permanent Geotextile for erosion and scour control.

5.2 Geology

A large part of the project alignment between Kingdom City and Columbia is covered by a glacial drift. Post-Kansan erosion has removed some of the glacial drift from the valleys and low inter divides. As shown in the contour map from Missouri DNR ARCGIS Map (**Figure** 6), depth to bedrock ranges from about 25 feet in the I-70/US-63 area to about 50 feet near Cedar Creek and Grand Prairie to nearly 75 feet in the vicinity of Kingdom City.

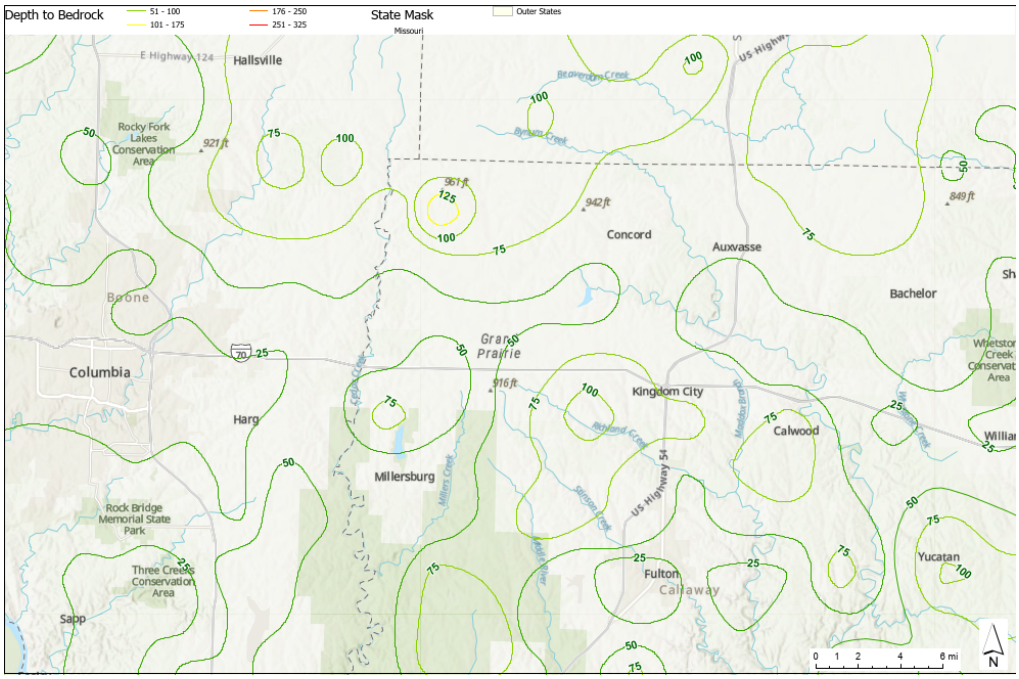


Figure 6. Depth to Bedrock (DNR ARCGIS Map)

Surficial materials include a mantle of windblown Pleistocene sediments, primarily Peoria Loess which is weathered and clay-enriched. The underlying glacial drift varies greatly in composition. Particle size ranges from clay to coarse gravel and large boulders. The drift often consists of reddish yellow to brown heterogeneous mixture of clay, sand, and gravel.

A copy of a section of the 2017 Geologic Map of Missouri along the alignment is shown in **Figure** 7 below. The stratigraphic sequence typically consists of the following (in descending order):

- Loess
- Glacial Drift
- Marmaton Formation (Pm)
- Cherokee Formation (Pc)
- Limestone (Mo)

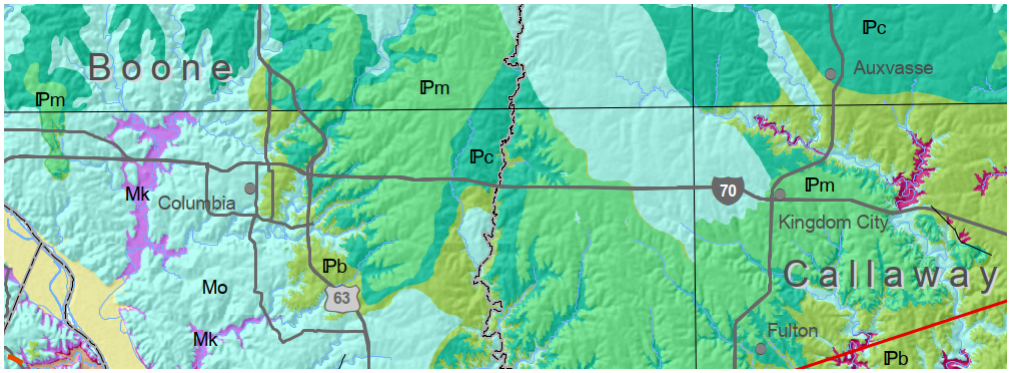


Figure 7. Geologic Map of Missouri for the Project

The Burlington Limestone (Mississippian) is the surface formation in much of Boone County, but it is unconformably overlain in large part of the area by Pennsylvanian deposits (clay, coal, shale, limestone, sandstone and conglomerate) of the Cherokee and Marmaton groups.

Structural geology is characterized by bedding which is nearly horizontal; there is a slight regional dip of 5 to 10 feet per mile to the northwest away from the Ozark Uplift.

5.3 Subsurface Conditions

The draft boring logs indicate that subsurface conditions encountered at the project site generally consist of overburden cohesive soils and granular soils underlain by interbedded limestone and shale. The overburden soils typically consist of medium stiff to very stiff, low plastic and high plastic clays, and medium dense to very dense granular soils. The underlying bedrock consisted of interbedded hard gray, finely crystalline to aphanitic, thin to medium bedded limestone and soft to hard, highly to slightly weathered shale.

At Bridge A9542, the bedrock conditions (shale and limestone) can be approximately divided into two zones separated by the approximate center line of Hinkson Creek. To the west side of this line (Bent 1 to Bent 2), the subsurface bedrock consists of a thin layer (about 0 to 2 feet) highly weathered and/or slightly weathered shale underlain by almost continuous thick sound limestone within the boring depths. To the east side of this line (Bent 3 to Bent 4), thicker shale layers (10 to 18 feet) were observed above the first sound limestone layer. It is to be noted that boulders were indicated in four borings L0264-3 through L0264-6 above approximate elevation 652.0 feet.

At Bridge A9543, the bedrock conditions (shale and limestone) are similar to those at Bridge A9542 which can also be approximately divided into two zones separated by the center line of Hinkson Creek. To the west side of this line (Bent 1 to Bent 2), a thin layer (about 1.4 feet at Boring A6951-1) or no appearance of shale layer (at BR 4-1A and BR 4-2) was observed above the almost continuous thick sound limestone within the boring depths. To the east side of this line (Bent 3 to Bent 4), thicker shale layers (greater than 15 feet) were

observed above the first sound limestone layer. It is to be noted that boulders were indicated in three borings A6951-1 through A6591-3 above approximate elevation 644.0 feet.

The subsurface profiles for Bridges A9542 and A9543 are provided in **Appendix** D.2.

5.4 Surface Water and Groundwater

Groundwater was encountered at elevations of 650.0 feet to 665.5 feet at the time of drilling as indicated in **Table** 3. It is anticipated that groundwater level will fluctuate at this location with changes in the water level of Hinkson Creek.

The area beneath Bridges A9542 and A9543 is located within the Hinkson Creek floodplain and is subject to occasional floods. The 100-year flood elevation at the proposed bridge site is El. 678.59 feet (NAVD 88) at Bridge A9542 and El. 678.52 feet at Bridge A9543.

5.5 Scour

In accordance with MoDOT EPG 750.3.1.9, all bridges shall be evaluated for the scour design flood (Q_{200}, 200-year discharge) and scour check flood (Q_{500}, 500-year discharge) frequencies. The scour information was provided by Hydraulic Engineer in **Appendix E.4** and summarized in **Table** 4.

Table 4. Scour Information at Bridges A9542 and A9543

Bridge	Bent	Ground Elev. (ft)	Design Flood (200-year)		Check Flood (500-year)	
			Total Scour Depth (ft)	Elev. (ft)	Total Scour Depth (ft)	Elev. (ft)
Bridge 2/A9542	Bent 2	664.0	6.6	657.4	13.3	650.7
	Bent 3	668.0	6.1	661.9	12.8	655.2
Bridge 4/A9543	Bent 2	665.8	5.8	660.0	15.6	650.2
	Bent 3	667.4	5.4	662.0	15.2	652.2

The scour information shown in **Table** 4 will be used for foundation design at the intermediate bents of Bridges A9542 and A9543.

6. Seismic Design Recommendations

6.1 Site Class

The site classification was evaluated in accordance with Section 3.10.3.1 of 2020 AASHTO Bridge Design Specifications (9th Edition) (AASHTO LRFD BDS) using the available boring data and the subject project site is classified as **Site Class C**. The detailed analysis is included in **Appendix E.1.1**.

6.2 Seismic Parameters

The seismic design parameters for Bridges A9542 and A9543 with seven (7) percent probability of exceedance in 75 years (approximately 1,000-year return period) and five (5) percent critical damping were determined using USGS Seismic Design Maps Web Services https://earthquake.usgs.gov/ws/designmaps/aashto-2009.html and summarized as follows:

$PGA = 0.050$ $S_s = 0.122$ $S_1 = 0.052$

where:

PGA: peak horizontal ground acceleration coefficient for Class B
S_s: short period (0.2-second) spectral acceleration coefficient for Class B
S_1: long period (1-second) spectral acceleration coefficient for Class B

The design parameters *PGA*, S_s, and S_1 are verified from Figures 3.10.2.1.1 through 3.10.2.1.3 of 2020 AASHTO LRFD BDS.

For Site Class C, the above seismic parameters shall be scaled by the following the zero-, short-, and long-period site factors, F_{PGA}, F_a, and F_v, respectively:

F_{PGA} = 1.2 F_a =1.2 F_v = 1.7

The design response spectrum for Bridges A9542 and A9543 shall be taken as specified in Figure 3.10.4.1-1 of 2020 AASHTO LRFD BDS with the following spectral acceleration coefficients:

A_s = 0.060 S_{DS} = 0.146 S_{D1} = 0.088

Where:

A_s: site-adjusted ground acceleration coefficient; = $F_{PGA} x\ PGA$
S_{DS}: design short period (0.2-second) spectral acceleration coefficient; = $F_a x\ S_s$
S_{D1}: design long period (0.2-second) spectral acceleration coefficient; = $F_v x\ S_1$

In accordance with **Table 3.5-1** of the 2011 AASHTO Guide Specifications for LRFD Seismic Bridge Design (2nd Edition) and the liquefaction evaluation as stated in **Section 6.3** of this report., the site is classified as Seismic Design Category (**SDC**) **A**.

The seismic design parameter calculation outputs are included in **Appendix E.1.2**.

6.3 Liquefaction Potential

Liquefaction potential of foundation soils within 75 feet of the ground surface in the vicinity of Bridges A9542 and A9543 were evaluated using the new boring information and included in **Appendix** E.2. The liquefaction analysis results indicate that there is minimal risk of liquefaction potential at this location and no lateral spreading or slope failure is anticipated for the design earthquake. The downdrag loads on piles under Extreme Event can be neglected.

7. Bridge Foundation Recommendations

7.1 General

The proposed new bridges A9542 and A9543 are 3-span bridges with integral end bents as shown in **Appendix** A. Based on the review of the available subsurface information and the projected bridge loadings, driven steel H-piles (HP) are recommended to support the end bents (Bent 1 and Bent 4) and 24-inch diameter closed ended cast-in-place (CECIP) piles or open ended cast-in-place (OECIP) piles are recommended to support the intermediate bents (Bent 2 and Bent 3).

The HP piles shall be ASTM A572 Grade 50 (yield strength f_y = 50 ksi), or equivalent, and shall be oriented with weak axis parallel to the center line of beam cap. For CIP piles, welded or seamless steel piles shall be

ASTM 252 Grade 3 (yield strength f_y = 45 ksi) and concrete shall be MoDOT Class B-1 concrete with minimum design compressive strength of 4,000 psi.

7.2 Pile Axial Resistance

Pile axial design includes pile axial structural resistance analysis and geotechnical resistance analysis under Strength Limit state and Extreme Limit state with corresponding resistance factors in accordance with 2020 AASHTO LRFD Bridge Design Specifications and MoDOT EPG.

The load information for Bridges A9542 and A9543 was provided by the project structure design team and is included in **Appendix E.4**. The factored axial load information under Strength Limit state for Bridge A9542 and Bridge A9543 is summarized in **Table** 5 and **Table** 6, respectively.

Table 5. Load Information for Bridge A9542

Item	Bent 1	Bent 2	Bent 3	Bent 4
Preliminary Pile Type and Size	HP 12X53	24" CIP	24" CECIP	HP 12X53
Pile Cutoff Elev. (ft)	679.96 ~ 682.38 ft	679.13 ~ 681.5 ft	678.06 ~ 680.43 ft	677.44 ~ 679.87 ft
Max. Factored Axial Load (kips) under Strength Limit	177.3	574.2	658.5	228.5

Table 6. Load Information for Bridge A9543

Item	Bent 1	Bent 2	Bent 3	Bent 4
Preliminary Pile Type and Size	HP 12X53	24" CIP	24" CECIP	HP 12X53
Pile Cutoff Elev. (ft)	TBD	TBD	TBD	TBD
Max. Factored Axial Load (kips) under Strength Limit	240	502.9	502.9	240

Based on the settlement analysis in **Section 9** of this report, the settlement at the abutment pile locations due to construction of the approach embankments to Bridges A9542 and A9543 is approximately 0.5 to 2.5 inches and most of the settlement is anticipated to be completed during construction period. Therefore, downdrag loads on piles at both abutments can be ignored for pile design under Strength Limit and Service Limit.

Since liquefaction potential under Extreme Event is minimal as stated in **Section 6.3**, downdrag loads on piles under Extreme Event condition can be ignored.

7.2.1 Pile Structural Axial Resistances in Compression

At the integral end bents (Bent 1 and Bent 4) of Bridges A9542 and A9543, the structural resistance factor of 0.35 (ϕ_c) shall be used for pile axial resistance in compression under Strength Limit states in accordance with MoDOT EPG Section 751.35. The axial resistance design values for individual HP piles presented in **Table 7** can be used in preliminary selection of pile size.

Table 7. Design Values for Individual HP Piles

Pile Size	Area (in^2)	Structural Nominal Compressive Resistance (kips)	Structural Resistance Factor, ϕ_c	Structural Factored Compressive Resistance (kips)	Maximum Nominal Driving Stress (ksi)
HP 12X53	15.5	775	0.35	271	45
HP 14X73	21.4	1,070	0.35	375	45

At the intermediate bents (Bent 2 and Bent 3) of Bridges A9542 and A9543, 24-inch diameter closed ended cast-in-place (CECIP) piles or open ended cast-in-place (OECIP) piles are recommended. The structural resistance factor of 0.6 (ϕ_c) shall be used for pile axial resistance in compression under Strength Limit states in accordance with MoDOT EPG Section 751.36. The axial resistance design values for individual CECIP and OECIP piles presented in **Table** 8 can be used in preliminary selection of pile size.

Table 8. Design Values for Individual Cast-In-Place (CIP) Piles

Pile Outside Diameter (in.)	Min. Wall Thickness (in.)	Unfilled Pipe			Concrete Filled Pipe*	
		Structural Nominal Compressive Resistance (kips)	Structural Factored Compressive Resistance (kips)	Maximum Nominal Driving Resistance (kips)	Structural Nominal Compressive Resistance (kips)	Structural Factored Compressive Resistance (kips)
24	0.5	1,450	870	1,305	2,652	1,591
24	0.625	1,801	1,081	1,621	2,973	1,784
24	0.75	2,148	1,289	1,933	3,290	1,974

Note: * Filled with MoDOT Class B-1 concrete.

The maximum factored load per pile under Strength Limit states shall not be greater than the structural factored compressive resistance shown in **Table** 7 and **Table** 8. During this design phase, HP 12X53 pile was selected to support the end bents and 24-inch diameter CECIP or OECIP pile was selected to support the intermediate bents for bridges A9542 and A9543. The pile type and size at each bent shall be determined based on the pile structural capacity requirements and the pile drivability analysis.

7.2.2 Pile Geotechnical Axial Resistances in Compression

The geotechnical resistance factors for pile axial design under Strength Limit state depend on the method to be used in the field during construction to verify nominal axial compressive resistance as stated in **Section 7.2.3** of this report. For Extreme Limit states, the resistance factor shall be taken as 1.0 for compression resistance in accordance with Section 10.5.5.3 of AASHTO LRFD BDS. These resistance factors shall be applied to the nominal driving resistance verified by the method in field. All driven piles shall require pile point reinforcement and be driven to practical refusal bearing on shale or limestone without overstressing the piles. Practical refusal is defined at 20 blows/in or 240 blows per foot using the selected hammer in accordance with MoDOT Standard Specifications Section 702. Since all driven piles are proposed to be driven to practical refusal on shale or limestone, pile axial resistance in compression will be most likely controlled by pile structural capacity rather than geotechnical capacity.

For concrete encased pile option installed in a prebored socket, the geotechnical resistance analysis is discussed in detail in **Section 7.2.4** of this report. Pile point reinforcement is not required.

The reduction in geotechnical resistance in compression from group effects can be ignored since all piles will be driven to practical refusal.

7.2.3 Required Nominal Pile Driving Resistance for Driven Piles

For driven piles, required nominal pile driving resistance (R_{ndr}) shall be determined by the maximum factored axial load demand under Strength Limit and an appropriate driving resistance factor (ϕ_{dyn}):

R_{ndr} = Maximum Factored Load/ϕ_{dyn}

Where ϕ_{dyn} shall be selected from AASHTO LRFD BDS Table 10.5.5.2.3-1 based on the method to be used in the field during construction to verify nominal axial compressive resistance as follows:

- ϕ_{dyn} = 0.40, FHWA-modified Gates Dynamic Pile Formula (End of Drive condition only)
- ϕ_{dyn} = 0.50, Wave Equation Analysis (WEAP)
- ϕ_{dyn} = 0.65, Dynamic Testing (PDA) on 1 to 10% piles

If the required nominal driving resistance R_{ndr} is less than 600 kips, FHWA-modified Gates Dynamic Pile Formula (DF) below can be used as a field verification method:

$$R_{ndr} = 1.75\sqrt{E_d}log_{10}(10N_b) - 100$$

Where:

R_{ndr} = nominal pile driving resistance measured during pile driving (kips);

E_d = developed hammer energy (ft-lb);

N_b = numbers of hammer blows for 1.0 inch of pile permanent set (blows/inch).

The pile installation contractor shall select an appropriate pile driving system to be able to drive the piles to the minimum pile tip elevation and achieve the required minimum nominal resistance using an appropriate driving resistance factor discussed above.

Based on the load information under Strength Limit (**Table 5** and **Table 6**) and subsurface conditions, Jacobs has performed the drivability analysis for piles at the intermediate bent (Bent 3) of Bridge A9542 with following conditions:

- Pile nominal side resistance distributions and tip resistance were generated using software APILE (Version 2018.8.2, Ensoft, Inc.).
- No prebore and prebore conditions were evaluated. For prebore condition, prebore to the minimum pile tip elevation shown in **Table 17** and then filled with sand prior to driving.
- DELMAG D19-42 and DELMAG D30-32 were evaluated.
- Drivability was evaluated for CECIP 24X0.5 (outside diameter of 24-inch and wall thickness of 0.5-inch) and CECIP 24X0.625.

The pile drivability analysis was included in **Appendix E.6**.

Based on the drivability analysis results, the following recommendations are concluded for piles at Bent 3 of Bridges A9542 and A9543:

- CECIP 24X0.625 (Outside diameter of 24-inch with wall thickness of 0.625-inch)
- If no prebore is selected, hammer size DELMAG D30-32 or equivalent is required.
- If prebore is selected, hammer size DELMAG D19-42 or equivalent is required. The hole shall be prebored to the minimum pile tip elevation shown in **Table 17** and **Table 18**, and then filled with sand prior to driving.

As per the load information for Bridges A9542 and A9543 shown in **Table** 5 and **Table** 6, FHWA-modified Gates Dynamic Pile Formula (DF) method and Dynamic Testing (PDA) method are proposed to be used in the field during construction to verify nominal axial compressive resistance for the piles at the end bents and intermediate bents, respectively, for Bridges A9542 and A9543.

7.2.4 Concrete Encased Pile Axial Resistance

As an alternative to the driven pile option at Bent 1 and Bent 2 of Bridges A9542 and A9543, the selected steel piles (HP piles and CIP piles) can be installed in prebored holes if the prebored holes are terminated at the fresh or slightly weathered limestone layer and meet the minimum pile tip elevations shown in **Table 17** and **Table** 18. After the piles are placed in the holes, MoDOT Class B-2 concrete shall be cast for HP piles and MoDOT Class B-1 concrete shall be cast for CIP piles. The geotechnical pile axial resistance verification is not required for this pile installation method and pile point reinforcement is not required.

7.3 Pile Lateral Analysis

Lateral responses of piles were performed at each bent location of Bridges A9542 and A9543 using the computer program LPile (Ensoft Inc., 2022) in which the p-y method is utilized. The load information provided by the project structure design team was used.

7.3.1 Pile Lateral Analysis at End Bents of Bridge A9542

As indicated in the load information for Bridge A9542 provided by the project structure design team (see **Appendix E.4**), there is a required thermal movement of 1.07 inches in the longitudinal direction at the end bents (Bent 1 and Bent 4) of Bridge A9542. Since Bent 1 and Bent 4 are skewed about 20°42'56" and 23°17'04", respectively, the corresponding thermal movements in the weak axis direction of HP piles are approximately 1.00 inch and 0.98 inch. The thermal movement of 1 inch is conservatively assumed at approximately the pile cutoff elevation at both abutments in the lateral analysis.

At Bent 1, the LPile soil/rock input parameters are estimated based on the boring log of BR 2-1A and summarized in **Table** 9.

Table 9. Soil/Rock Profile and Design Parameters for Bent 1 of Bridge A9542

Elevation (ft)	Soil Model Type	Total Unit Weight* (pcf)	Undrained Shear Strength (psf)	Effective Friction Angle (deg.)	E_{50}	k (pci)	Unconfined Compressive Strength (psi)	krm
680.0 to 678.6	Stiff Clay w/o Free Water	120	1,200	0	0.007	-	-	-
678.6 to 670.0	Stiff Clay w/o Free Water	120	1,200	0	0.007	-	-	-
Below 670.0	Strong Rock	164	-	-	-	-	7,500	-

Note: Refer to Boring BR 2-1A. * Effective unit weight shall be used below design groundwater elevation.

At Bent 4, the LPile soil/rock input parameters are estimated based on the boring logs of B-11, BR 10-3A, and L0264-6 and summarized in **Table** 10.

Table 10. Soil/Rock Profile and Design Parameters for Bent 4 of Bridge A9542

Elevation (ft)	Soil Model Type	Total Unit Weight* (pcf)	Undrained Shear Strength (psf)	Effective Friction Angle (deg.)	E_{50}	k (pci)	Unconfined Compressive Strength (psi)	krm
677.4 to 668.0	Stiff Clay w/o Free Water	120	1,200	0	0.007	-	-	-
668.0 to 653.0	Stiff Clay w/o Free Water	120	1,000	0	0.01	-	-	-
653.0 to 637.0	Stiff Clay w/o Free Water	133	3,000	-	0.005	-	-	-
Below 637.0	Strong Rock	164	-	-	-	-	7,500	-

Note: Refer to Boring B-11,BR 10-3A, and L0264-6. * Effective unit weight shall be used below design groundwater elevation.

In LPile analysis, the axial loads of 177.3 kips and 228.5 kips per pile were used at Bent 1 and Bent 4, respectively. The pile responses corresponding to 1-inch lateral thermal movement in the weak axis direction at the pile cutoff elevations are presented in **Appendix E.5.1**. The structure engineer should check the pile structural capacity based on these curves.

7.3.2 Pile Lateral Analysis at End Bents of Bridge A9543

As indicated in the load information for Bridge A9543 provided by the project structure design team (see **Appendix E.4**), there is a required thermal movement of 1.04 inches in the longitudinal direction at the end bents (Bent 1 and Bent 4) of Bridge A9543. Since Bent 1 and Bent 4 are skewed about 22°25′01″, the corresponding thermal movement in the weak axis direction of HP piles is approximately 0.96 inch. The thermal movement of 1 inch is conservatively assumed at approximately the pile cutoff elevation at both abutments in the lateral analysis.

The LPile soil/rock input parameters for Bent 1 of Bridge A9543 are estimated based on the boring log of BR 4-1A and summarized in **Table** 11.

Table 11. Soil/Rock Profile and Design Parameters for Bent 1 of Bridge A9543

Elevation (ft)	Soil Model Type	Total Unit Weight* (pcf)	Undrained Shear Strength (psf)	Effective Friction Angle (deg.)	E_{50}	k (pci)	Unconfined Compressive Strength (psi)	krm
680.0 to 674.4	Stiff Clay w/o Free Water	120	1,200	0	0.007	-	-	-
674.4 to 670.4	Sand	125	-	36	-	default	-	-
Below 670.4	Strong Rock	164	-	-	-	-	7,500	-

Note: Refer to boring BR 4-1A. * Effective unit weight shall be used below design groundwater elevation.

At Bent 4, the LPile soil/rock input parameters are estimated based on the boring logs of BR 10-3A and A6951-4 and summarized in **Table** 12.

Table 12. Soil/Rock Profile and Design Parameters for Bent 4 of Bridge A9543

Elevation (ft)	Soil Model Type	Total Unit Weight* (pcf)	Undrained Shear Strength (psf)	Effective Friction Angle (deg.)	E_{50}	k (pci)	Unconfined Compressive Strength (psi)	krm
676.4 to 654.0	Stiff Clay w/o Free Water	115	800	0	0.015	-	-	-
654.0 to 636.0	Stiff Clay w/o Free Water	133	3,000	0	0.005	-	-	-
Below 636.0	Strong Rock	164	-	-	-	-	7,500	-

Note: Refer to borings A6951-4 and BR 10-3A. * Effective unit weight shall be used below design groundwater elevation.

In LPile analysis, the axial load of 240 kips per pile was used at Bent 1 and Bent 4. The pile responses corresponding to 1-inch lateral thermal movement in the weak axis direction at the pile cutoff elevations are presented in **Appendix E.5.2**. The structure engineer should check the pile structural capacity based on these curves.

7.3.3 Pile Lateral Analysis at Intermediate Bents

The LPile soil/rock input parameters for the intermediate bents (Bent 2 and Bent 3) of bridges A9542 and A9543 are developed and summarized in **Table** 13 through **Table** 16.

Table 13. Soil/Rock Profile and Design Parameters for Bent 2 of Bridge A9542

Elevation (ft)	Soil Model Type	Total Unit Weight* (pcf)	Undrained Shear Strength (psf)	Effective Friction Angle (deg.)	E_{50}	k (pci)	Unconfined Compressive Strength (psi)	krm
669.0 ~ 657.0	Stiff Clay w/ Free Water	120	1,000	0	0.01	-	-	-
657.0 to 648.0	Stiff Clay w/ Free Water	120	1,000	0	0.01	-	-	-
Below 648.0	Strong Rock	164	-	-	-	-	7,500	-

Note: Refer to BR 2-2 and L0264-2. An additional soil profile shall be checked assuming "Strong Rock" for entire subsurface. * Effective unit weight shall be used below design groundwater elevation.

Table 14. Soil/Rock Profile and Design Parameters for Bent 3 of Bridge A9542

Elevation (ft)	Soil Model Type	Total Unit Weight* (pcf)	Undrained Shear Strength (psf)	Effective Friction Angle (deg.)	E_{50}	k (pci)	Unconfined Compressive Strength (psi)	krm
661.9 to 656.0	Stiff Clay w/ Free Water	120	1,200	0	0.007	-	-	-
656.0 to 652.0	Stiff Clay w/ Free Water	120	1,200	0	0.007	-	-	-
652.0 to 643.0	Stiff Clay w/ Free Water	133	3,000	-	0.005-	-	-	-
643.0 to 622.0	Sand	135	0	42	-	-	-	-
Below 622.0	Strong Rock	164	-		-	-	7,500	-

Note: Refer to BR-2-3. * Effective unit weight shall be used below design groundwater elevation.

Table 15. Soil/Rock Profile and Design Parameters for Bent 2 of Bridge A9543

Elevation (ft)	Soil Model Type	Total Unit Weight* (pcf)	Undrained Shear Strength (psf)	Effective Friction Angle (deg.)	E_{50}	k (pci)	Unconfined Compressive Strength (psi)	krm
665.8 ~ 660.0	Stiff Clay w/ Free Water	125	1,200	0	0.007	-	-	-
660.0 ~ 656.5	Sand	110	-	28	-	15	-	-
Below 656.5	Strong Rock	164	-	-	-	-	7,500	-

Note: Refer to boring BR 4-2. * Effective unit weight shall be used below design groundwater elevation.

Table 16. Soil/Rock Profile and Design Parameters for Bent 3 of Bridge A9543

Elevation (ft)	Soil Model Type	Total Unit Weight* (pcf)	Undrained Shear Strength (psf)	Effective Friction Angle (deg.)	E_{50}	k (pci)	Unconfined Compressive Strength (psi)	krm
667.4 to 663.5	Stiff Clay w/ Free Water	125	1,200	0	0.007	-	-	-
663.5 to 655.0	Stiff Clay w/ Free Water	125	2,000	0	0.007	-	-	-
655.0 to 642.0	Stiff Clay w/ Free Water	133	3,000	0	0.005	-	-	-
642.0 to 622.0	Sand	135	0	42	-	-	-	-
Below 622.0	Strong Rock	164	-		-	-	7,500	-

Note: Refer to boring BR 2-3 and A6951-3. * Effective unit weight shall be used below design groundwater elevation.

Groups of closely spaced piles will have reduced lateral capacity due to group interaction, and this capacity reduction is a function of the number of piles in the group and the center-to-center spacing. Group efficiency factors (p-multipliers) were estimated based on the specific pile group configuration in accordance with Section 10.7.2.4 of AASHTO LRFD BDS and used in LPile analyses. Pile lateral analysis results at the intermediate bents were included in **Appendix E.5.1** and **Appendix E.5.2**. The structure engineer should check the pile structural capacity based on the pile responses curves.

7.3.4 Passive Resistance behind Abutment Backwall

Abutment backwalls are typically designed to shear off when the bridge is displaced longitudinally to engage the abutment wall backfill for passive resistance. The ultimate lateral capacity of an abutment backwall is a function of the height of the abutment wall that is acted on by passive soil pressure. Passive resistance on the outside of the abutment backwalls was estimated by using a soil friction angle of 32 degrees and a wall friction angle of 21 degrees for the backfill materials behind the backwalls. Select

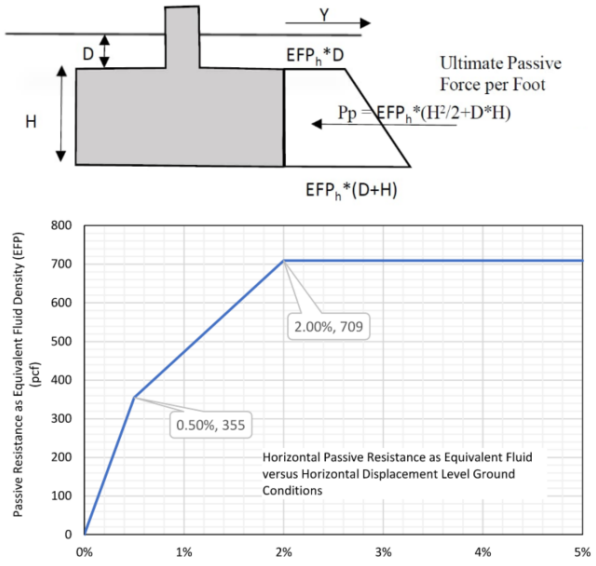


Figure 8. Passive Resistance behind Backwall

Granular Fill per MoDOT Section 1010 is recommended for the wedged zone from bottom of the backwall sloped up to the roadway with a slope of 3:1 (Horizontal: Vertical). With this assumption, passive resistance may be modeled as an equivalent fluid pressure (EFP_h) versus displacement (Δ) using the tri-linear plot shown in **Figure** 8 and **Appendix E.3**. The ultimate passive resistance was estimated to have an equivalent fluid density of 709 pcf. This pressure is fully mobilized at a lateral displacement of 0.02H (Table C3.11.1-1 of AASHTO LRFD BDS), where *H* is the backwall height with full backfill. The resistance varies from zero at zero displacement and increases linearly with displacement to the fully mobilized value at 0.02H. At smaller displacements, the tri-linear curve assumes that resistance increases from zero at zero displacement to half of the ultimate resistance at ¼ of the ultimate displacement, then increases linearly from this point to the ultimate resistance and displacement. At displacements larger than 0.02H, the ultimate value of the passive resistance is assumed to remain constant at the ultimate value. It is to be noted that *D* in **Figure** 8 denotes the minimum fill height above the backwall.

The passive resistance on the backwall may be added to the lateral resistance of the piles at the same deflection. The designer should adjust the values in **Figure** 8 as appropriate based on the actual fill height behind the backwall and the amount of available soil cover.

7.4 Foundation Design Recommendations

Based on the review of the subsurface exploration and the projected bridge loadings, HP piles are expected to be the preferred foundation option for the end bents (Bent 1 and Bent 4) of Bridges A9542 and A9543. For the intermediate bents (Bent 2 and Bent 3), 24-inch diameter closed ended cast-in-place (CECIP) or open ended cast-in-place (OECIP) piles are recommended. The minimum pile length requirements in accordance with MoDOT EPG Section 751.1.2.22 as below shall be satisfied:

- For HP piles, a minimum of 15 feet into natural ground is required. When prebore into rock is necessary to provide the minimum 15 feet embedment, a minimum prebore of 5 feet is required.
- For CECIP piles, a minimum of 15 feet below scour depth is required. When prebore into rock is necessary to provide the minimum 15 feet embedment, minimum prebore shall not be less than 5 feet into hard rock and 10 feet into weak rock regardless of overburden condition.

At Bent 1 of Bridge A9542, the natural ground elevation is approximately 673 feet which results in the corresponding minimum pile tip elevation of 658 feet. The adjacent boring log of BR 2-1A indicates that limestone was observed at an elevation of 670 feet. Installation of the HP piles at Bent 1 will require pre-drilling holes through limestone to meet the minimum pile length requirements. Driven in sand-filled drilled hole or placed in drilled hole and concrete encased steel HP piles is recommended. For the driven pile option, the prebored holes shall be filled with sand prior to driving. For concrete encased pile option, the prebored holes shall be terminated in slightly weathered or fresh limestone and pile point reinforcement is not required.

At Bent 2 of Bridge A9542, the estimated scour elevation under design flood is approximately at 657.4 feet as indicated in **Table** 4 which results in the corresponding minimum pile tip elevation of 642.4 feet. The adjacent boring log of BR 2-2 indicates that highly weathered limestone was observed at elevation 661.5 feet and slightly weathered limestone was observed below elevation 657 feet. Installation of the CIP piles at Bent 2 will require pre-drilling holes through limestone to meet the minimum pile length requirements. Driven in sand-filled drilled hole or placed in drilled hole and concrete encased pipe pile is recommended. For the driven pile option, the prebored holes shall be filled with sand prior to driving. For concrete encased pile option, the prebored holes shall be terminated in slightly weathered or fresh limestone and the opened ended CIP (OECIP) piles shall be used.

At Bent 3 of Bridge A9542, the estimated scour elevation under design flood is approximately at 661.9 feet as indicated in **Table** 4 which results in the corresponding minimum pile tip elevation of 646.9 feet. The

adjacent boring log of BR 2-3 indicates that weathered shale was observed from elevation 655. 0 to 643.0 underlain by a 21-foot thick highly weathered limestone layer before reaching the sound limestone. Installation of the CECIP piles at Bent 3 may require pre-drilling holes through the weathered shale and possibly highly weathered limestone to meet the minimum pile length requirements. The prebored holes shall be filled with sand prior to driving.

At Bent 4 of Bridge A9542, the natural ground elevation is approximately 669 feet which results in the corresponding minimum pile tip elevation of 654 feet. The adjacent boring logs of B-11, L0264-6, and BR 10-3A indicate that limestone was observed at approximate elevation of 637 to 646 feet, which is close to the required minimum pile tip elevation. However, L0264-6 boring log indicates boulders were observed below elevation 656.9 feet. It is likely that installation of some of the HP piles at Bent 4 may require pre-drilling holes through boulders and/or moderately weathered to unweathered shale to meet the minimum pile length requirements. If prebore is needed in field, the prebored holes shall be filled with sand prior to driving.

Pile design recommendations for Bridge A9542 are provided in **Table** 17.

Table 17. Pile Design Recommendations for Bridge A9542

Design Data		Bent Number			
		1	2	3	4
Pile Type and Size		HP12X53	OECIP[5]/ CECIP 24"	CECIP 24"	HP12X53
Number	ea	11	11	11	11
Approx. Length per Each	ft	22	38	38	32
Pile Point Reinforcement	ea	All[1]	All[1]	All	All
Min. Galvanized Penetration (Elev.)	ft	Full Length	Full Length	Full Length	Full Length
Est. Max. Scour Depth (Elev.)	ft	-	657.4[3]	661.9[3]	-
Minimum Tip Penetration	ft	658.0	642.4	646.0	654.0
Criteria for Min. Tip Penetration	ft	Min. Embed.	Min. Embed.	Min. Embed.	Min. Embed.
Approx. Prebore Depth per Each	ft	15	15	-	-
Approx. Prebore Length in Rock per Each	ft	8 ~12	10	-	-
Approx. Pile Tip Elev.	ft	658.0	642.4	642	646.0
Pile Driving Verification Method[4]		DF[2]	DT[2]	DT[2]	DF[2]
Resistance Factor		0.40	0.65	0.65	0.40
Min. Nominal Axial Compressive Resistance	kip	444	1,013	1,013	572

Note: [1] For driven pile option only. [2]DF= FHWA-modified Gates Dynamic Pile Formula, and only for nominal driving resistance less than 600 kips; DT = Dynamic Testing. [3] Design Flood scour elevations. [4] For concrete encased piles, the geotechnical pile axial resistance verification is not required. [5]For concrete encased piles only,

At Bent 1 of Bridge A9543, the natural ground elevation is approximately 678 feet which results in the corresponding minimum pile tip elevation of 663 feet. The adjacent boring log of BR 4-1A indicates that limestone was observed at elevation 670 feet. Installation of the HP piles at Bent 1 will require pre-drilling holes through limestone to meet the minimum pile length requirements. Driven in sand-filled drilled hole or placed in drilled hole and concrete encased steel HP pile is recommended. For the driven pile option, the prebored holes shall be filled with sand prior to driving. For concrete encased pile option, the prebored holes shall be terminated in slightly weathered or fresh limestone and pile point reinforcement is not required.

At Bent 2 of Bridge A9543, the estimated scour elevation under design flood is approximately at 660.0 feet as indicated in **Table 4** which results in the corresponding minimum pile tip elevation of 645.0 feet. The adjacent boring log of BR 4-2 indicates that slightly weathered limestone was observed at an elevation 656.5 feet. Installation of the CIP piles at Bent 2 will require pre-drilling holes through limestone to meet the minimum pile length requirements. Driven in sand-filled drilled hole or placed in drilled hole and concrete encased -pipe pile is recommended. For the driven pile option, the prebored holes shall be filled with sand prior to driving. For concrete encased pile option, the prebored holes shall be terminated in slightly weathered or fresh limestone and the opened ended CIP piles shall be used.

At Bent 3 of Bridge A9543, the estimated scour elevation under design flood is approximately at 662.0 feet as indicated in **Table 4** which results in the corresponding minimum pile tip elevation of 647.0 feet. The adjacent boring log of BR 2-3 indicates that weathered shale was observed from elevation 655. 0 to 643.0 underlain by a 21- foot thick highly weathered limestone layer before reaching the sound limestone. Boring log A6951-3 indicates cobbles and boulders were observed below elevation 658.7 feet. Installation of the CECIP piles at Bent 3 may require pre-drilling holes through the weathered shale and possibly highly weathered limestone to meet the minimum pile length requirements. The prebored holes shall be filled with sand prior to driving.

At Bent 4 of Bridge A9543, the natural ground elevation is approximately 676 feet which results in the corresponding minimum pile tip elevation of 661 feet. The adjacent boring log of A6951-4 indicates that weathered shale was observed between elevation 655.5 feet and elevation 640.0 feet followed by at least 16 feet thick weathered to slightly weathered limestone. Since boulders or cobbles were not reported from the adjacent boring logs (A6951-4 and BR 10-3A), prebore is not likely required to install the HP piles at Bent 4. However, if prebore is needed during pile installation, the prebored holes shall be filled with sand prior to driving.

Pile design recommendations for Bridge A9543 are provided in **Table** 18 **.**

Table 18. Pile Design Recommendations for Bridge A9543

Design Data		Bent Number			
		1	2	3	4
Pile Type and Size		HP12X53	OECIP[5]/ CECIP 24"	CECIP 24"	HP12X53
Number	ea	6	6	6	6
Approx. Length per Each	ft	17	35	38	42
Pile Point Reinforcement	ea	All[1]	All[1]	All	All
Min. Galvanized Penetration (Elev.)	ft	Full Length	Full Length	Full Length	Full Length
Est. Max. Scour Depth (Elev.)	ft	-	660.0[3]	662.0[3]	-
Minimum Tip Penetration	ft	663.0	645.0	647.0	661.0
Criteria for Min. Tip Penetration	ft	Min. Embed.	Min. Embed.	Min. Embed.	Min. Embed.
Approx. Prebore Depth per Each	ft	15	21	21	-
Approx. Prebore Length in Rock per Each	ft	~ 7	~ 12	~ 8	-
Approx. Pile Tip Elev.	ft	663.0	645.0	642.0	636.0
Pile Driving Verification Method[4]		DF[2]	DT[2]	DT[2]	DF[2]
Resistance Factor		0.40	0.65	0.65	0.40
Min. Nominal Axial Compressive Resistance	kip	600	774	774	600

Note: [1][3] For driven pile option only. [2]DF= FHWA-modified Gates Dynamic Pile Formula, and only for nominal driving resistance less than 600 kips; DT = Dynamic Testing. [3] Design scour elevation. [4] For concrete encased piles, the geotechnical pile axial resistance verification is not required. [5]For concrete encased piles only.

Foundation recommendations for Bridge A9542 and A943 are presented in **Appendix E.0**.

8. Global Stability

Global stability of the spill slopes in front of the abutments of bridges A9542 and A9543 was evaluated using software GeoStudio 2023.1.0 (SLOPE/W module) developed by Bentley Systems, Incorporated. Analyses were conducted for both Strength Limit and Extreme Event (rapid drawdown and seismic) conditions.

For Strength Limit loading condition, the resistance factor (ϕ) for overall and compound stability evaluation is required per Section 11.6.3.7 and Section 11.10.1 of AASHTO LRFD BDS as follows:

- ϕ =0.75, where the geotechnical parameters and subsurface stratigraphy are well defined.
- ϕ =0.65, where the geotechnical parameters and subsurface stratigraphy are highly variable or based on limited information.

The above specified resistance factors are essentially the inverse of the factor of safety (FS) that should be targeted in the slope stability program (i.e., ϕ =0.75 approximately corresponds to FS=1.3, and ϕ =0.65 approximately corresponds to FS= 1.5). At this design phase, FS =1.3 was targeted for the overall and compound stability evaluation of the abutments.

For Extreme Event (seismic), seismic horizontal acceleration coefficient was estimated as $k_h = 0.5A_s = 0.030g$ (Section 6.2 of this report) per Section 11.6.5.2.2 of AASHTO LRFD BDS in consideration of an allowable lateral displacement of 1- to 2-inches during earthquake. A resistance factor of 0.9 is required for global stability of abutment slopes or retaining walls when earthquake loading is induced per Section 11.5.8 of AASHTO LRFD BDS, which approximately corresponds to a single factor of safety (FS) of 1.1.

For rapid drawdown analysis, the calculated FS shall be greater than 1.1.

The results of the global stability analyses at the selected cross sections were summarized in **Table 19**.

Table 19. Summary of Global Stability Analysis Results

Location	Strength Limit			Extreme Event			
	Required FS	Calcul. FS		Seismic		Rapid Drawdown	
		Short Term	Long Term	Required FS	Calcul. FS	Required FS	Calcul. FS
East Abutment	1.3	2.78	1.40	1.1	2.54	1.1	1.40
East Creek Bank	1.3	5.88	1.33	1.1	5.32	1.1	1.34
West Abutment	1.3	2.87	1.32	1.1	2.72	1.1	1.27
West Creek Bank	1.3	5.99	2.01	1.1	5.35	1.1	1.95

The analyses indicate that the required global stability criteria under Strength Limit, Extreme Event, and rapid drawdown conditions are satisfied. Detailed global stability analyses are included in **Appendix E.7**.

9. Settlement

At the west and the east approach embankments to the end bents of Bridges A9542 and A9543, the maximum additional fills are approximately 7 feet and 11 feet, respectively. Settlement due to placement of additional fills was estimated using the adjacent boring data. The estimated maximum settlements at the west and east approach embankments are about 1.2 inches and 2.1 inches, respectively. The settlement analyses are included in **Appendix E.8**. These settlements are caused by compression of the overburden soils above the bed rock (top elevation ~ 670.0 feet on the west side, ~ 655 feet on the east side). Since groundwater was observed at elevations of 650.0 feet to 665.5 feet at the time of drilling as indicated in **Table** 3, it is anticipated that most of the overburden soils are unsaturated and most of the estimated settlements are expected to be completed during construction period.

However, because of the potential for variations in actual soil conditions and groundwater elevations across the site, the actual settlements may be smaller or larger than the estimated settlements. It is recommended that the settlement be monitored on the east approach embankment to Bridge A9542 in the field by the contractor during construction. The settlement point should be located near the maximum thickness of the additional fill and be monitored until primary consolidation is completed prior to construction of settlement sensitive features on top of the new embankment. The proposed approximate settlement plate location is shown in **Appendix E.8**. It is recommended that settlement readings be taken regularly during and after construction of the high fill areas proposed to be monitored. General guidance for determination of settlement acceptability is when the settlement rate per week is ¼ inch (6 mm) or less for four (4) consecutive weeks, though the geotechnical engineer will use judgement based on the total fill height, time frame to achieve max fill height, thickness of overburden soil column to top of rock, total predicted settlement, etc. which could possibly reduce this required monitoring period. The geotechnical engineer shall review the monitored settlement data in coordination with all other available data and decide if the primary consolidation settlement is complete and provide guidance on proceeding with further construction activities.

10. Construction Considerations

10.1 Site Preparation

Prior to performing the required site work and grading operations, the sides of the embankment fill within the work area should be stripped of vegetation, topsoil, and unsuitable soil. These materials should be placed in designated site spoil areas or disposed of offsite.

10.2 Driven Pile Installation

10.2.1 General Considerations

The pile installation Contractor should submit the pile driving equipment data to Jacobs for drivability analysis prior to pile installation. The piles should be installed in accordance with Section 702 of MoDOT Standard Specifications for Highway Construction 2023.

Prior to driving structural steel piles, the Contractor shall review the boring logs to determine the depth at which rock may be anticipated. The contractor shall be attentive to the physical conditions associated with pile refusal on hard rock. When indication of hard rock occurs, in no case shall the pile be driven more than 3 blows when the hammer is operating at maximum rated energy and the penetration per blow is equivalent

to or less than 10 blows per 0.5 inch. Driving shall cease immediately to avoid damage to the pile and to reduce the risk of injury.

10.2.2 Obstructions and Difficult Driving Conditions

Based on the subsurface conditions indicated in the available borings, preboring will be required at Bent 1 and Bent 2 of Bridges A9542 and A9543 prior to installation of piles, and possibly at Bent 3 and Bent 4 of both bridges as stated in **Section 7.4**. The prebored hole depths shall meet the minimum pile length requirements in **Table 17** and **Table 18** of this report. The prebored hole shall be of a diameter not less than that of the pile and the hole shall be filled with sand prior to pile placement. Since hard driving conditions may be encountered during pile installation, all driven piles should be equipped with pile points.

10.3 Excavations

It is anticipated that site soils can be excavated using conventional earthmoving and excavation methods. It is the contractor's responsibility to maintain safe and stable temporary slopes during construction and the appropriate OSHA regulations shall be followed. Where applicable, short-term, shallow, temporary slopes may be excavated to an inclination of 1.0 ~ 1.5 horizontal to 1 vertical depending on the soil types encountered in the field and classified per OSHA regulations.

Special care should be taken for excavations adjacent to existing roadway to prevent undermining, or loss of ground.

10.4 Subgrade Preparation

After site clearing and stripping, and excavations (where applicable) and prior to performing the required final grading operations, the exposed subgrade should be proof-rolled and inspected for pockets of excessively soft, wet, or disturbed soils. Soft areas and/or unsuitable soils observed during proof rolling or initial construction should be removed and replaced with stable material and properly compacted. Prior to placing fill in any area, the subgrade should be scarified to a depth of at least 12 inches, the moisture content of the soil adjusted to near its optimum moisture content, and the subgrade properly compacted. Following satisfactory compaction of the existing subgrade, controlled fill material may be placed to bring the site to the required grades.

When compacting fills against existing hillside slopes or the existing fill embankments, it is extremely important to cut benches in the slopes and key the fill into these benches to allow for adequate compaction and provide adequate bonding or keying. Benching should be of sufficient width to permit placing and compaction of fill material upon the existing site materials. Each bench cut should begin at the intersection of the existing hillside or embankment slope and the vertical side of the previous bench.

10.5 Site Drainage and Maintenance

During the construction phase, the site should be graded to carry surface runoff away from work areas. Drainage should be provided to prevent ponding around the work sites and to minimize any increase in the moisture content of the underlying soils.

10.6 Quality Control Services

It is recommended that all phases of soil and rock related construction be inspected by a Jacobs geotechnical engineer or qualified personnel with experience in these types of inspections as it relates to the design recommendations presented herein. These inspections or quality control services should minimize service life problems and costs by ensuring that the design assumptions are valid, and that the

construction is accomplished in accordance with the contract plans, specifications, and good engineering practice.

11. Limitations

The boring logs included in this report depict subsurface conditions only at the specific locations where samples were obtained. These logs are provided for information only and may not depict subsurface conditions over the full length of the proposed bridge alignment. Discrete sampling cannot be relied on to accurately reflect natural variations in stratigraphy that may exist between sample locations. General soil descriptions are based on an engineering interpretation of all available subsurface information. Field interpretation of conditions encountered in individual borings is shown on the logs provided in **Appendix C** and **Appendix D.3.**

These recommendations have been developed to aid in the design and construction of the project components affected by subsurface materials. These recommendations are limited to the scope of work and understanding of the proposed structures as detailed in this report. Significant changes in the anticipated project scope may invalidate these conclusions and recommendations. If, during construction, subsurface conditions different from those encountered in the borings are observed, or appear to be present beneath excavations, Jacobs should be advised at once to review the conditions and reconsider these recommendations, where necessary.

The groundwater levels indicated on the boring logs are as recorded at the noted time. Groundwater levels and/or conditions may vary considerably with time and other factors including precipitation events and seasonal variations.

12. References

AASHTO (2011). *AASHTO Guide Specifications for LRFD Seismic Bridge Design, 2nd Edition,* American Association of State Highway and Transportation Officials, Washington, D.C.

AASHTO (2020). *AASHTO LRFD Bridge Design Specifications,2020, 9th Edition,* American Association of State Highway and Transportation Officials, Washington, D.C.

Bentley Systems, Incorporated (2023). *GeoStudio 2023.1.0 Version 23.1.0.520*.

Cheney, R. and Chassie, R.G. (2000). *Soils and Foundations Workshop*, Reference Manual for NHI Course No. 132012, U.S. Department of Transportation, Federal Highway Administration, Washington D.C., FHWA NHI-00-045.

Ensoft, Inc. (2018). *APILE*, Version 2018.8.2.

Ensoft, Inc. (2022). *LPILE*, Version 2022.12.04.

FHWA (2011). *LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations*, Publication No. FHWA-NHI-11-032. FHWA GEC 03, August 2011.

Geotechnology, LLC (2023). *Geotechnical Drilling and Testing Report, I-70 Improvements, I-70 and US-63 Interchange*, MoDOT Job No. J5S3411, J5T0017, J5T0021, Bone County, Missouri, October 4, 2023.

MDNR *GeoSTRAT*. Missouri Department of Natural Resources, Division of Geology and Land Survey.

MoDOT *Engineering Policy Guide* http://epg.modot.org/.

MoDOT (2023). *Standard Specifications for Highway Construction*, 2023.

Pile Dynamics, Inc. (2015). *GRLWEAP*, 2010-6.

Starbuck, E. (2017). *Geologic Map of Missouri*.

Surficial Material Geologic Map of the Kingdom City 7.5' Quadrangle, Calloway County, Missouri (2008).

Thompson, T. L. (1995). *The stratigraphic succession in Missouri*, Missouri Department of Natural Resources, Division of Geology and Land Survey, 2nd series.

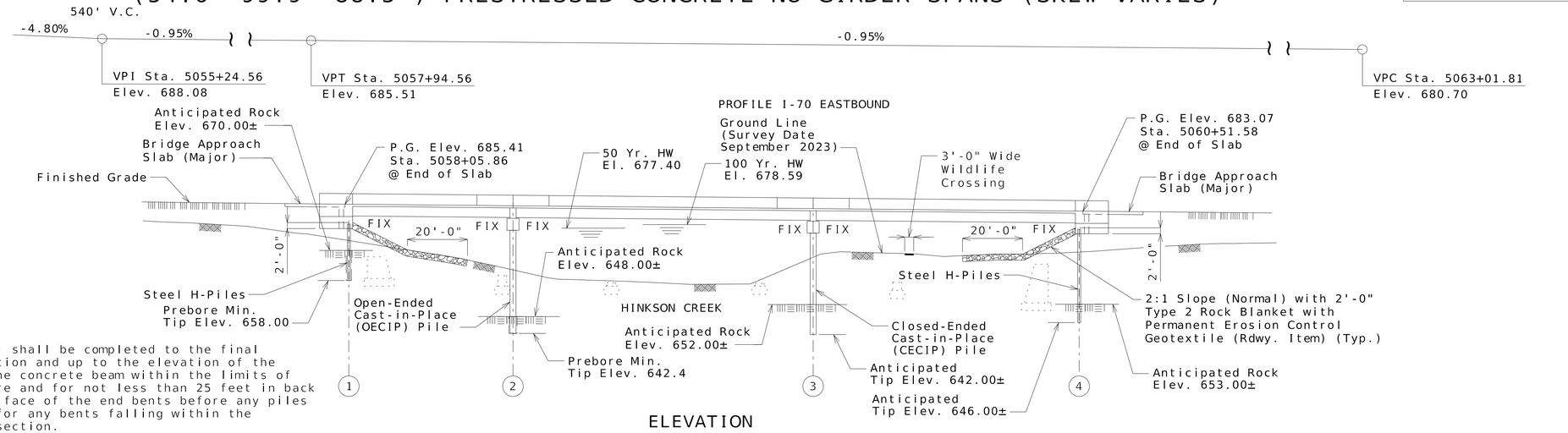
Unklesbay, A.G. (1951). *Geologic Map of Fulton Quadrangle, Missouri*, Report of Investigation No. 19, Missouri Geological Survey.

Unklesbay, A.G. (1952). *Geology of Boone County, Missouri*, Vol XXXIII, 2nd Series.

Appendix A. Plans for Bridges A9542 and A9543

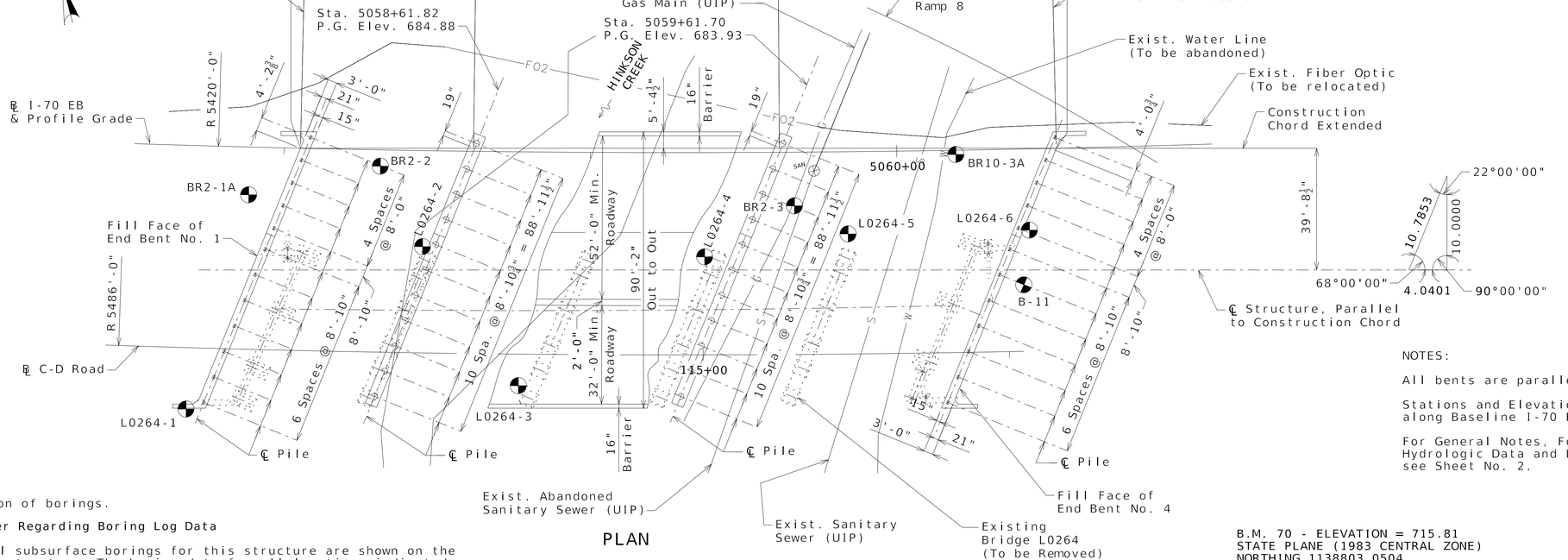
(54.6'-99.9'-88.5') PRESTRESSED CONCRETE NU GIRDER SPANS (SKEW VARIES)

SEC/SUR 8 TWP 48 N RGE 12 W



Roadway fill shall be completed to the final roadway section and up to the elevation of the bottom of the concrete beam within the limits of the structure and for not less than 25 feet in back of the fill face of the end bents before any piles are driven for any bents falling within the embankment section.

ELEVATION



PLAN

Indicates location of borings.

Notice and Disclaimer Regarding Boring Log Data

The locations of all subsurface borings for this structure are shown on the plan sheet for this structure. The boring data for all locations indicated, as well as any other boring logs or other factual records of subsurface data and investigations performed by the Design-Build Team for the design of the project, are shown on Sheet Nos. 52 thru 56 and may be included in the Electronic Bridge Deliverables. Additional borings performed by the department will also be available from the Project Contact upon written request. No greater significance or weight should be given to the boring data depicted on the plan sheets than is given to the subsurface data available from the district or elsewhere.

NOTES:

All bents are parallel.

Stations and Elevations are measured along Baseline I-70 Eastbound.

For General Notes, Foundation Data, Hydrologic Data and Location Sketch, see Sheet No. 2.

B.M. 70 - ELEVATION = 715.81
STATE PLANE (1983 CENTRAL ZONE)
NORTHING 1138803.0504
EASTING 1700592.2071
LATITUDE 38.96086552 DEGREES
LONGITUDE -92.28837098 DEGREES
POINT DESCRIPTION 74/IR

BRIDGE: I-70 EB OVER HINKSON CREEK

I-70 EB FROM ROUTE 63 TO ROUTE 54
ABOUT 0.1 MILES WEST OF ROUTE 63
BEG. STA. 5058+05.33

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Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1 of 56

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ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	1

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BOONE

JOB NO.
JST0021

CONTRACT ID.

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BRIDGE NO.
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06/10/24	REV. A-PRELIMINARY REVIEW
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General Notes:

Design Specifications:

2020 AASHTO LRFD Bridge Design Specifications (9th Ed.)
Seismic Design Category = A
Design earthquake response spectral acceleration coefficient at 1.0 second period, SD1 = 0.088
Acceleration Coefficient (effective peak ground acceleration coefficient), As = 0.060

Design Loading:

Vehicular = HL-93
Future Wearing Surface = 35 lb/sf
Earth = 120 lb/cf
Equivalent Fluid Pressure = 45 lb/cf
Superstructure: Non-Composite for dead load. Continuous Composite for live load.

Design Unit Stress:

Class B Concrete (Substructure)	f'c = 3,000 psi
Class B-1 Concrete (Barrier Curb and Median Barrier)	f'c = 4,000 psi
Class B-2 Concrete (Superstructure, except Prestressed Beams, Barrier Curb and Median Barrier)	f'c = 4,000 psi
Class B-1 Concrete (Substructure)	f'c = 4,000 psi
Reinforcing Steel (ASTM A615 Grade 60)	fy = 60,000 psi
Structural Steel HP Pile (ASTM A709 Grade 50)	fy = 50,000 psi
Welded or Seamless steel shell (pipe) for CIP pile (ASTM A252 Grade 3)	fy = 45,000 psi

For precast prestressed panel stresses, see Sheet No. 33.

For prestressed girder stresses, see Sheet Nos. 25 thru 30.

Neoprene Pads:

Neoprene bearing pads shall be 60 durometer and shall be in accordance with Sec 716.

Joint Filler:

All joint filler shall be in accordance with Sec 1057 for preformed sponge rubber expansion and partition joint filler, except as noted.

Reinforcing Steel:

Minimum clearance to reinforcing steel shall be 1 1/2", unless otherwise shown.

MBS refers to mechanical bar splices. Mechanical bar splices shall be in accordance with Sec 706 or 710.

Traffic Handling:

Structure to be closed during construction. During Stage 1 Construction, traffic to be maintained on I70 Eastbound. During Stage 2 Construction, traffic to be maintained on Stage 1 Construction. See roadway plans for traffic control details.

Miscellaneous:

Construction personnel will indicate the type of joint filler option used under the precast panels for this structure:
☐ Constant Joint Filler
☐ Variable Joint Filler

Method of forming the slab shall be as shown on the plans and in accordance with Sec 703. All hardware for forming the slab to be left in place as a permanent part of the structure shall be coated in accordance with ASTM A123 or ASTM B633 with a thickness class SC 4 and a finish type I, II or III.

Slab shall be cast-in-place with conventional forms or stay-in-place corrugated steel forms in bays located under the median barrier. Precast prestressed panels will not be permitted under the median barrier.

Stay-In-Place Corrugated Steel Forms:

Corrugated steel forms, supports, closure elements and accessories shall be in accordance with grade requirement and coating designation G165 of ASTM A653. Complete shop drawings of the permanent steel deck forms shall be required in accordance with Sec 1080.

Corrugations of stay-in-place forms shall be filled with an expanded polystyrene material. The polystyrene material shall be placed in the forms with an adhesive in accordance with the manufacturer's recommendations.

Form sheets shall not rest directly on the top of girder flanges. Sheets shall be securely fastened to form supports with a minimum bearing length of one inch on each end. Form supports shall be placed in direct contact with the flange. Welding on or drilling holes in the girder flanges will not be permitted. All steel fabrication and construction shall be in accordance with Sec 1080 and 712. Certified field welders will not be required for welding of the form supports.

The design of stay-in-place corrugated steel forms is per manufacturer which shall be in accordance with Sec 703 for false work and forms. Maximum actual weight of corrugated steel forms allowed shall be 4 psf assumed for girder loading.

Foundation Data

Type	Design Data		Bent Number 1	2	3	4
Load Bearing Pile	Pile Type and Size		HP 12x53	OECIP 24"	CECIP 24"	HP 12x53
	Number	ea	12	11	11	12
	Approximate Length Per Each	ft	24	39	38	33
	Pile Point Reinforcement	ea	All	All	All	All
	Min. Galvanized Penetration (Elev.)	ft	Full Length	Full Length	Full Length	Full Length
	Est. Max. Scour Depth (Elev.)	ft	----	657.4	661.9	----
	Minimum Tip Penetration (Elev.)	ft	658.0	642.4	646.0	654.0
	Criteria for Min. Tip Penetration		Min. Embed.	Min. Embed.	Min. Embed.	Min. Embed.
	Approximate Prebore Depth per Each	ft	15	15	----	----
	Approximate Prebore Length in Rock per Each	ft	12	10	----	----
	Pile Driving Verification Method		DF	DT	DT	DF
	Resistance Factor		0.4	0.65	0.65	0.4
	Minimum Nominal Axial Compressive Resistance	kip	444	884	1,013	572

DF = FHWA-Modified Gates Dynamic Pile Formula

DT = Dynamic Testing

CECIP = Closed Ended Cast-in-Place concrete pile.

OECIP = Open Ended Cast-in-Place concrete pile.

Minimum Nominal Axial Compressive Resistance = $\frac{\text{Maximum Factored Loads}}{\text{Resistance Factor}}$

Estimated Maxumum Scour Depth (Elevation) shown is for verifying Minimum Nominal Axial Compressive Resistance using dynamic testing only when pile resistance contribution above this elevation shall not be considered.

Pile point reinforcement need not be galvanized. Shop drawings will not be required for pile point reinforcement.

All piles shall be galvanized full length.

All piles shall be driven to practical refusal.

HP piles are anticipated to be driven to refusal on rock. Review all borings for depth of rock and restrict driving as appropriate to comply with hard rock driving criteria in accordance with Sec 702. When pile refusal on rock occurs, as approved by the engineer, the minimum nominal axial compressive resistance is verified and no additional pile driving verification method is required.

After any required excavation or grading, the contractor shall prebore the holes for the piles at Bents 1 and 2. Prebore shall extend a minimum of 5-feet into limestone. The prebored holes shall be filled with sand prior to being driven to practical refusal.

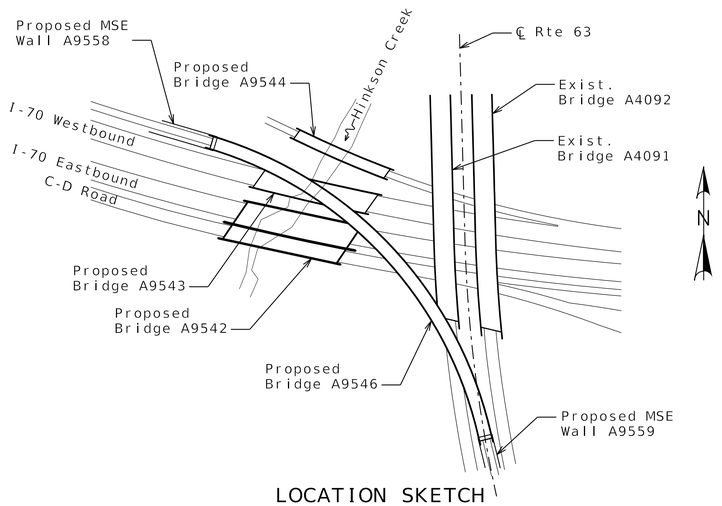
Piles at Bents 3 and 4 shall be driven to practical refusal at or below the minimum tip elevation. if the minimum tip elevation listed in the Foundation Data Table is not achieved, stop pile driving activities and notify the Engineer for further direction.

The contractor shall make every effort to achieve the minimum galvanized penetration (elevation) shown on the plans for all piles. Deviations in penetration less than 5 feet of the minimum will be considered acceptable provided the contractor makes the necessary corrections to ensure the minimum penetration is achieved on subsequent piles.

Pipe pile spacers shall meet the requirements in Sec 720.4.7.

Hydrologic Data

Drainage Area = 43.2 mi^2
Design Flood Frequency = 50 years
Design Flood Discharge = 12,907 cfs
Design Flood (D.F.) Elevation = 677.40
Base Flood (100-year)
Base Flood Elevation = 678.59
Base Flood Discharge = 15,085 cfs
Estimated Backwater = 0.10 ft
Average Velocity thru Opening = 5.4 ft/s
Freeboard (50-year)
Freeboard = 2.10 ft
Roadway Overtopping
Overtopping Flood Discharge = N/A
Overtopping Flood Frequency = 500 years
Overtopping Flood Elevation = N/A



LOCATION SKETCH

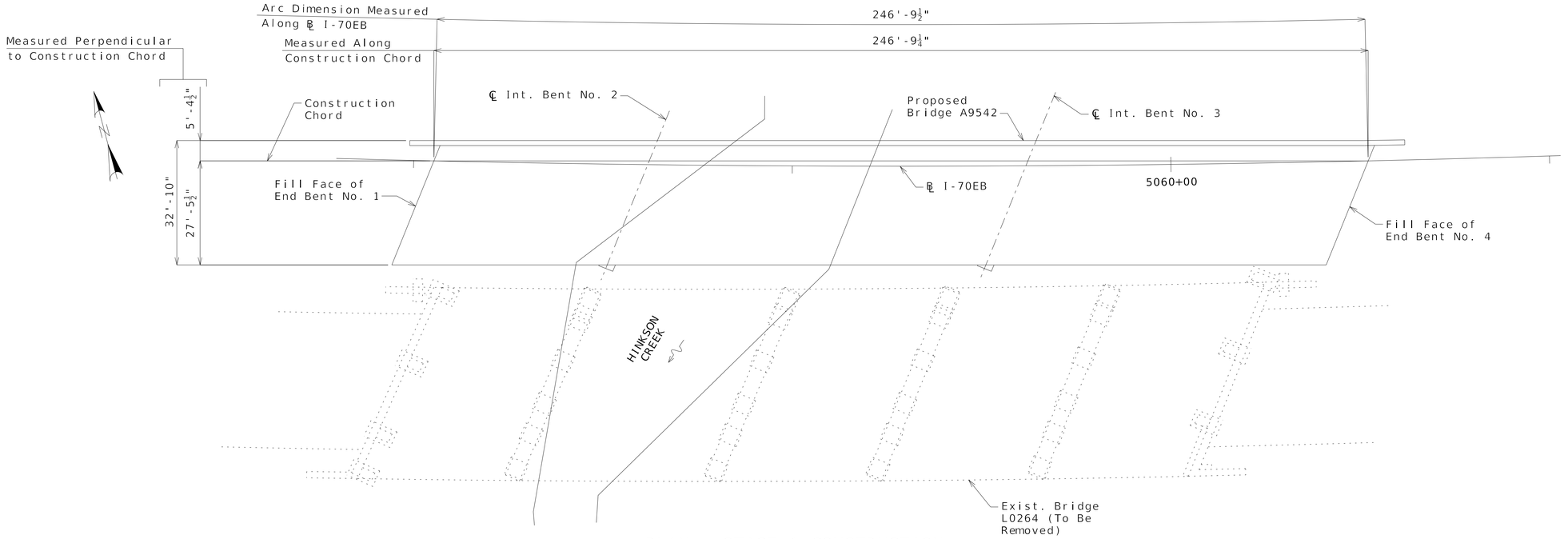
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MO PE-2017000338

DATE PREPARED: 1-OCT-2024
ROUTE: 70EB | STATE: MO
DISTRICT: BR | SHEET NO.: 2
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

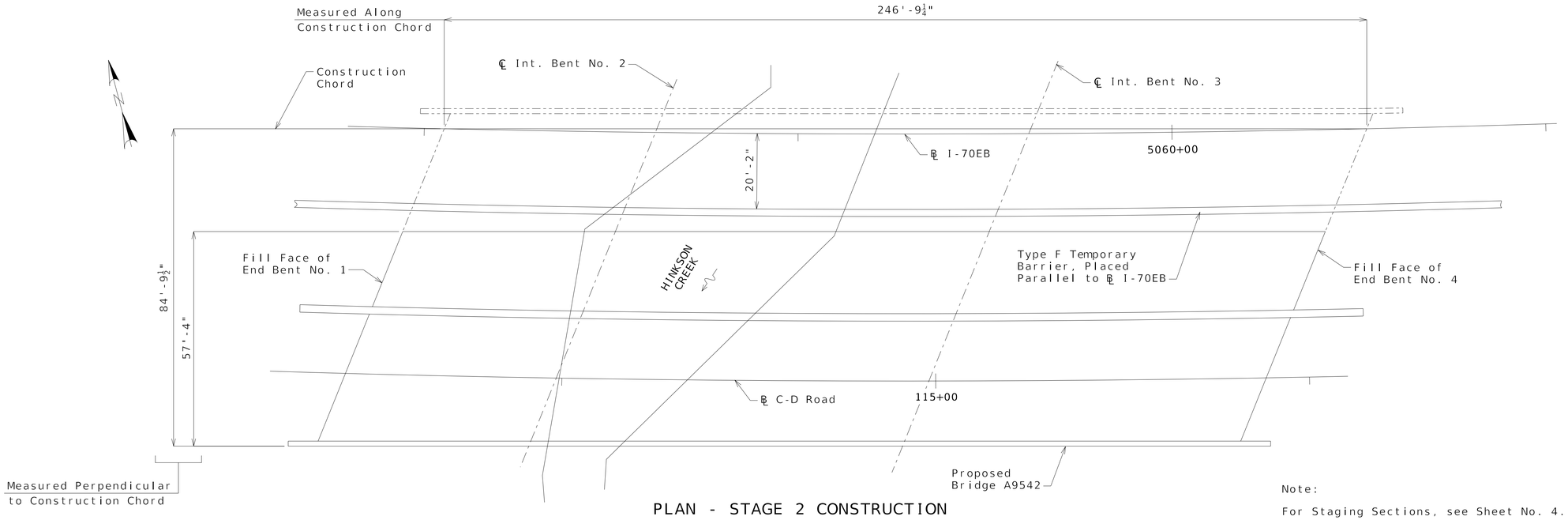
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PLAN - STAGE 1 CONSTRUCTION



PLAN - STAGE 2 CONSTRUCTION

Note:

For Staging Sections, see Sheet No. 4.

DETAILS OF STAGED CONSTRUCTION

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Note: This drawing is not to scale. Follow dimensions.

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70EB	MO
DISTRICT	SHEET NO.
BR	3

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

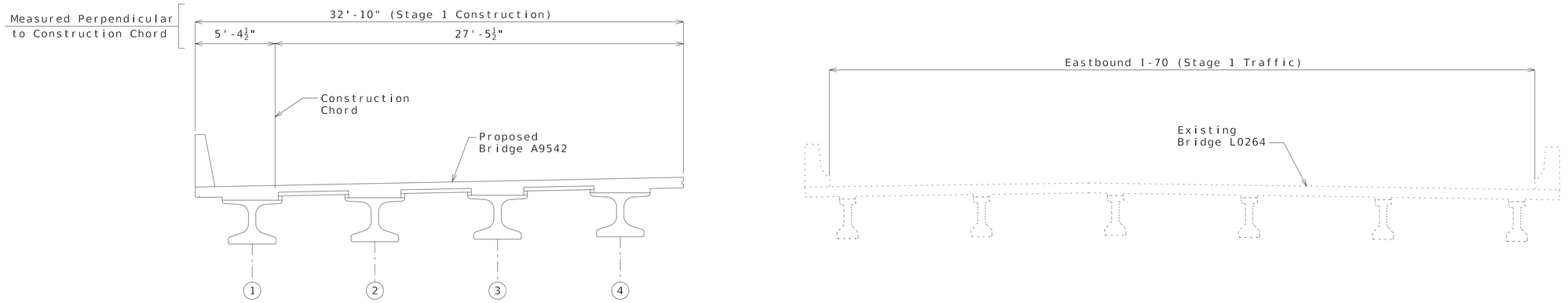
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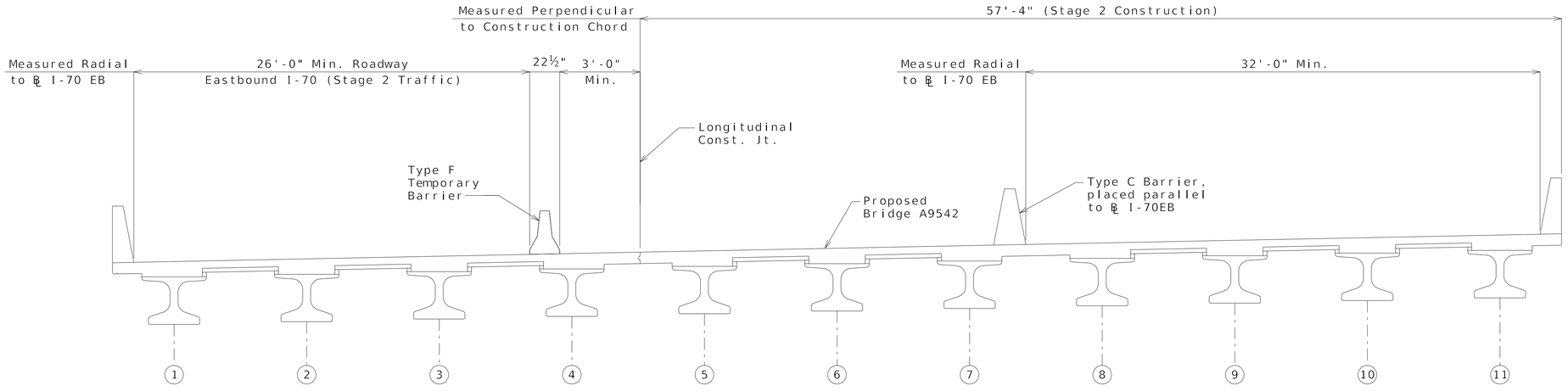
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STAGE 1 CONSTRUCTION



STAGE 2 CONSTRUCTION

Note:

1. After Eastbound Traffic has been routed to Bridge A9542 and prior to placement of Stage 2 Construction, contractor shall remove Existing Bridge L0264 with the approval of the Engineer, to complete Stage 2 Construction.

DETAILS OF STAGED CONSTRUCTION

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Note: This drawing is not to scale. Follow dimensions.

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ROUTE	STATE
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BR	4

COUNTY
Boone

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B	09/13/24	FINAL REVIEW
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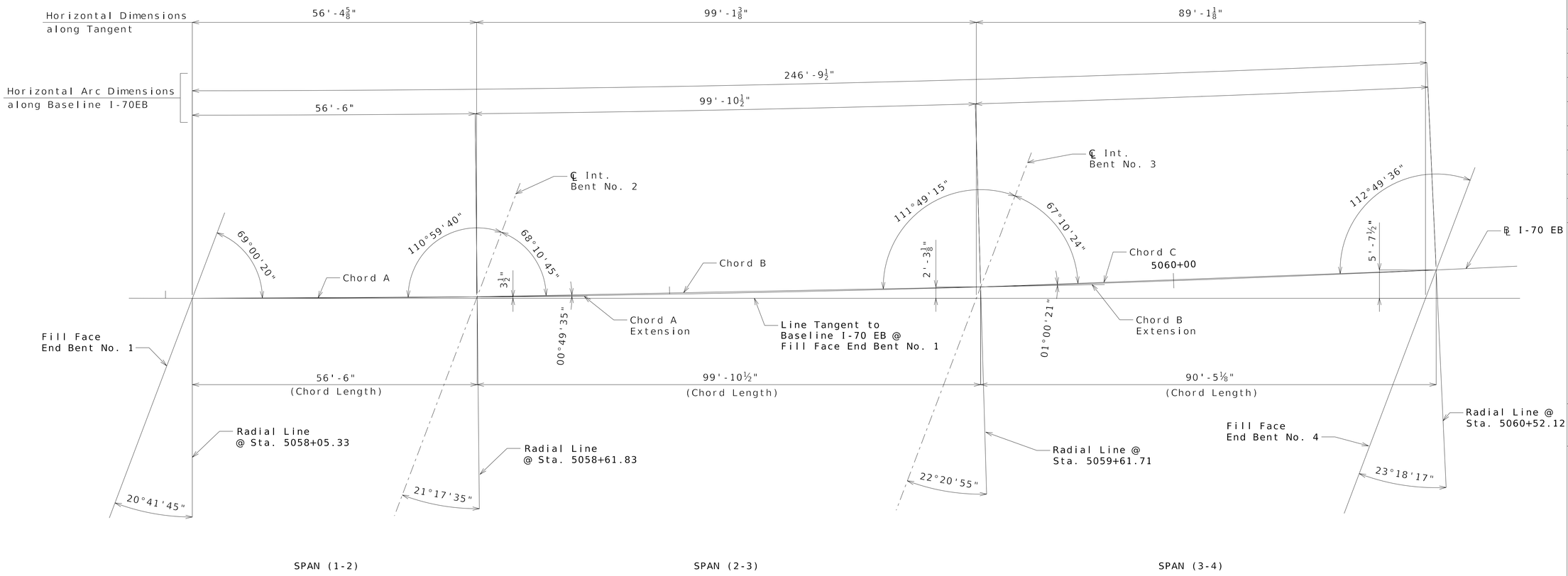
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

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REV.



PLAN

Notes:

All Bents are Parallel.
All Dimensions are Horizontal.

SUBSTRUCTURE LAYOUT

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER

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Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	5

COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DATE	DESCRIPTION
09/13/24	REV. A-FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

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Jacobs

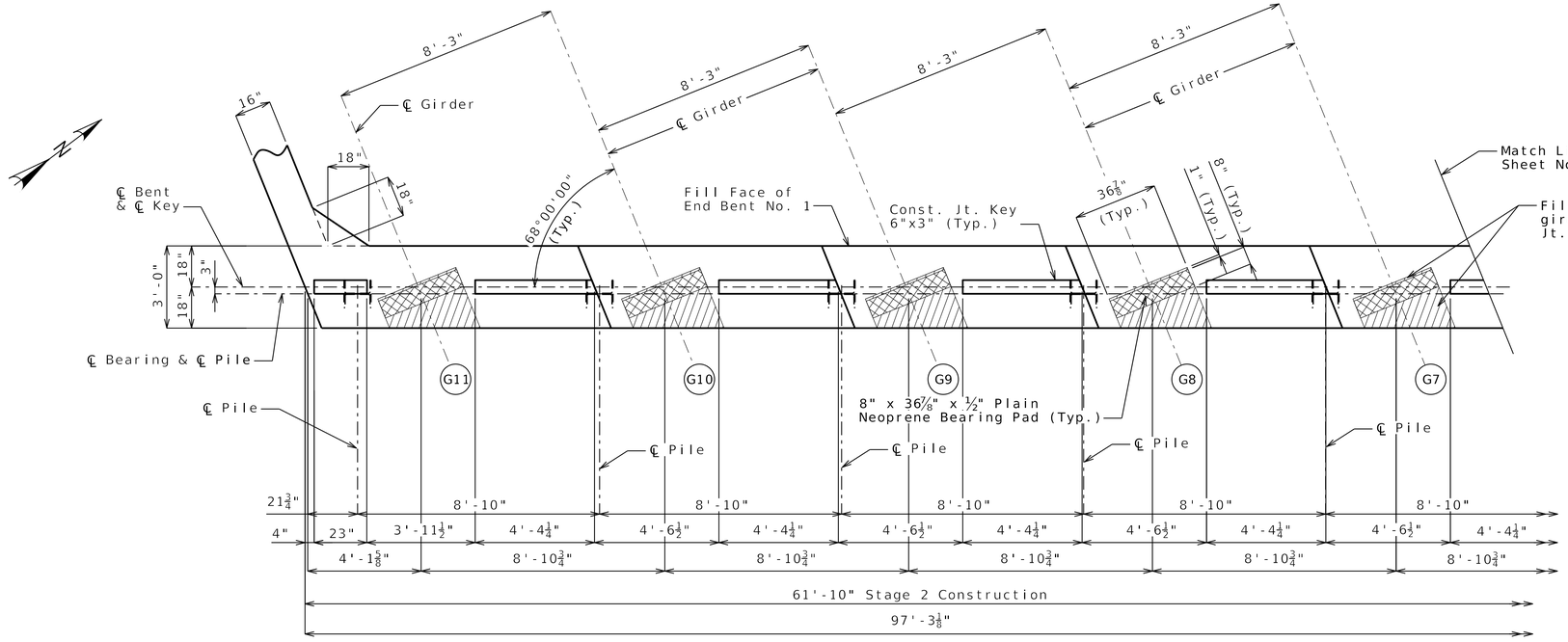
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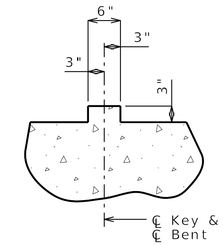
Detailed JULY 2024
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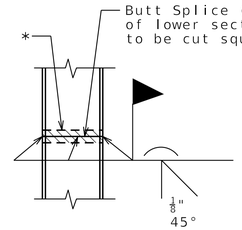
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PLAN OF BEAM



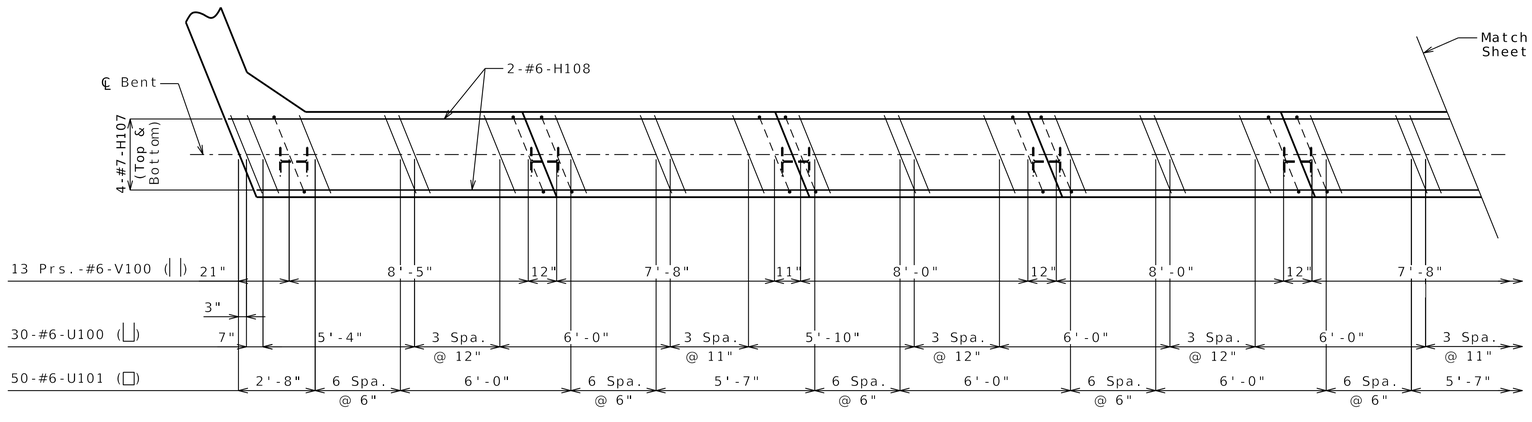
SECTION THRU KEY



STEEL PILE SPLICE

(If required)

* Galvanizing material shall be omitted or removed one inch clear of weld locations in accordance with Sec 702.



PLAN OF BEAM SHOWING REINFORCEMENT

Keys not shown for clarity.

Notes:

Work this sheet with Sheet Nos. 7 thru 10.

All U bars and pairs of V bars shall be placed parallel to construction chord.

Reinforcing steel shall be shifted to clear piles. U bars shall clear by at least 1 1/2 inches.

For details of Vertical Drain at End Bents, see Sheet No. 11.

DETAILS OF END BENT 1

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
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ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	6

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

DATE	DESCRIPTION
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10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER

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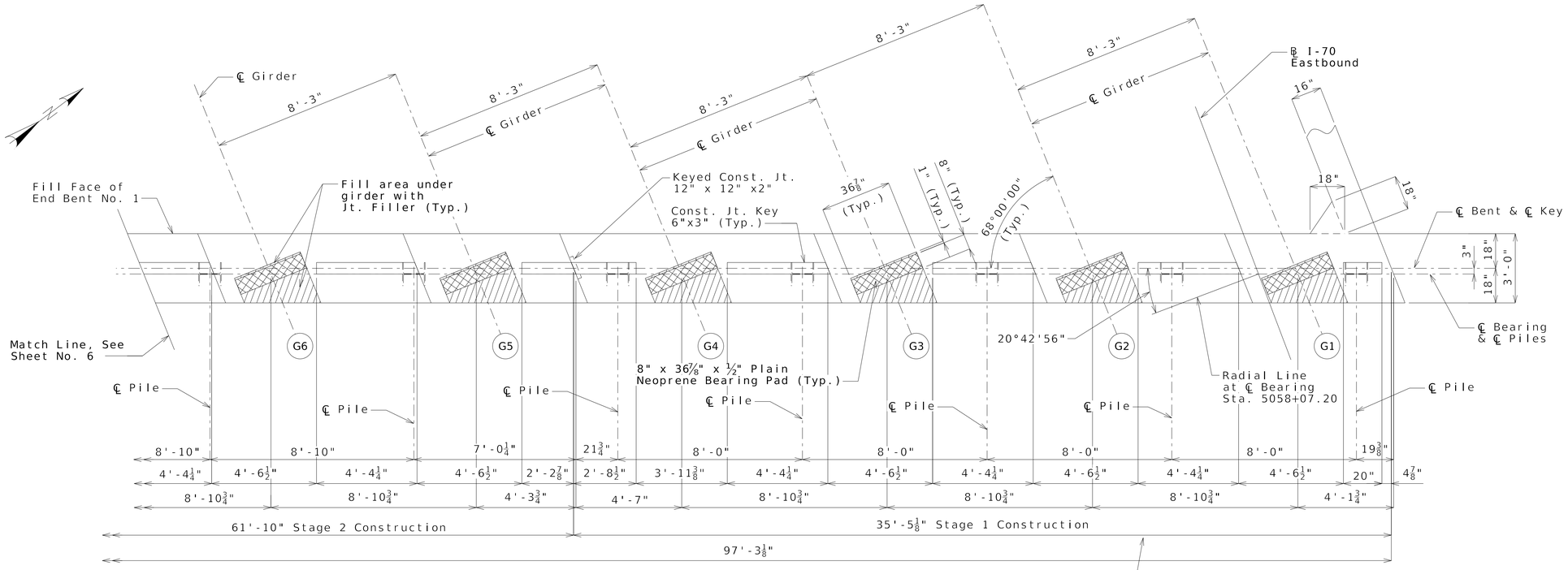
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REV.

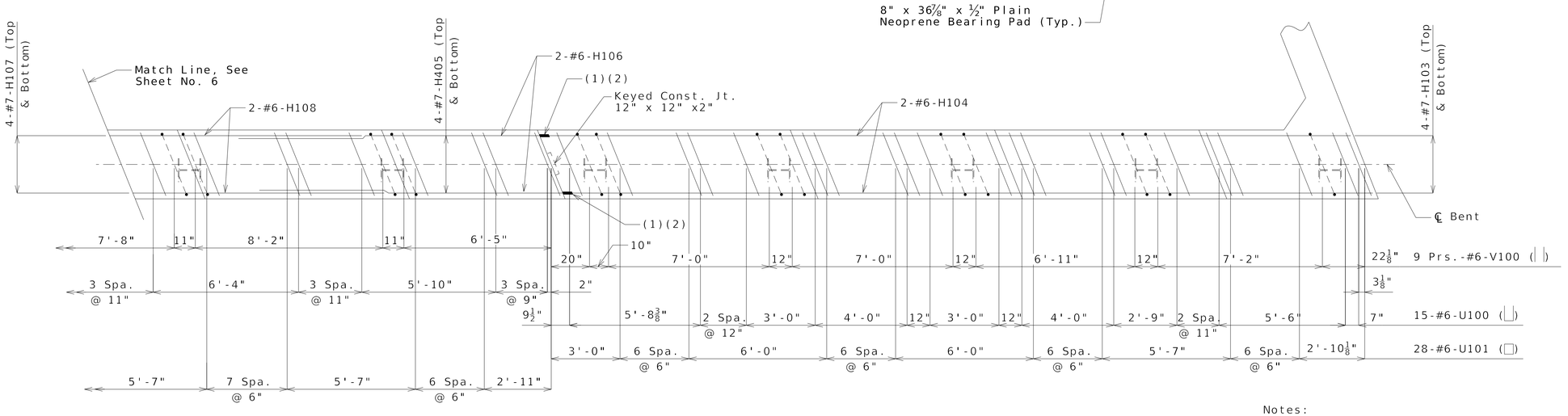
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PLAN OF BEAM



(1) 4-MBS H103-H105 (Top & Bott.)
(2) 2-MBS H104-H106 (Each Face)

PLAN OF BEAM SHOWING REINFORCEMENT

Keys not shown for clarity.

Notes:

Work this sheet with Sheet Nos. 6, 8 thru 10.

All U bars and pairs of V bars shall be placed parallel to construction chord.

Reinforcing steel shall be shifted to clear piles. U bars shall clear by at least 1 1/2 inches.

For details of Vertical Drain at End Bents, see Sheet No. 11.

DETAILS OF END BENT 1

Detailed AUG 2024
Checked AUG 2024

Note: This drawing is not to scale. Follow dimensions.

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DATE PREPARED
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ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	7

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

DESCRIPTION	DATE
REV. A - FINAL REVIEW	09/13/24
REV. 0 - RELEASED FOR CONSTRUCTION	10/01/24

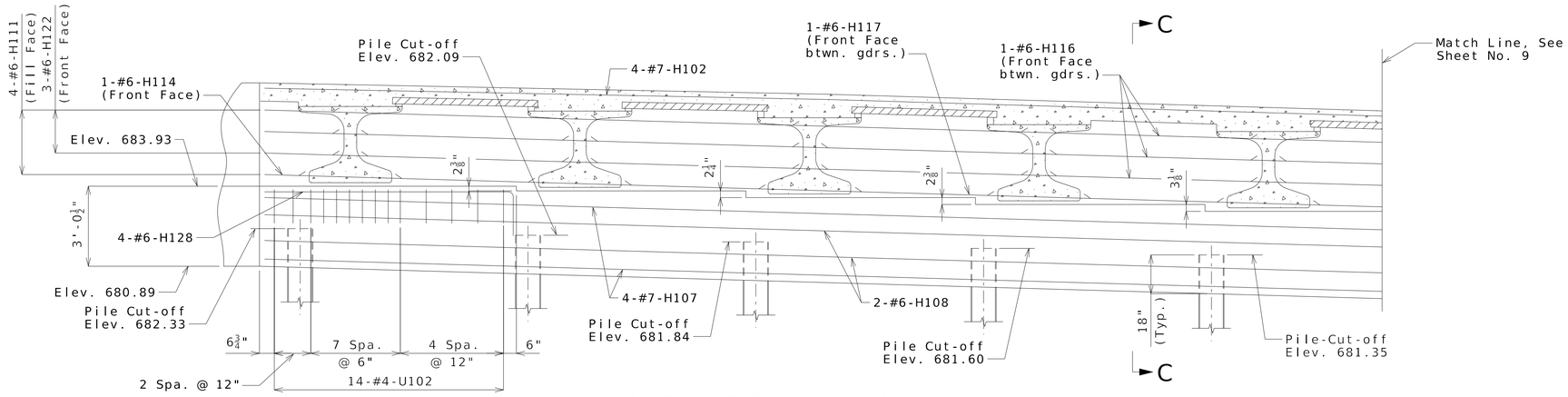
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

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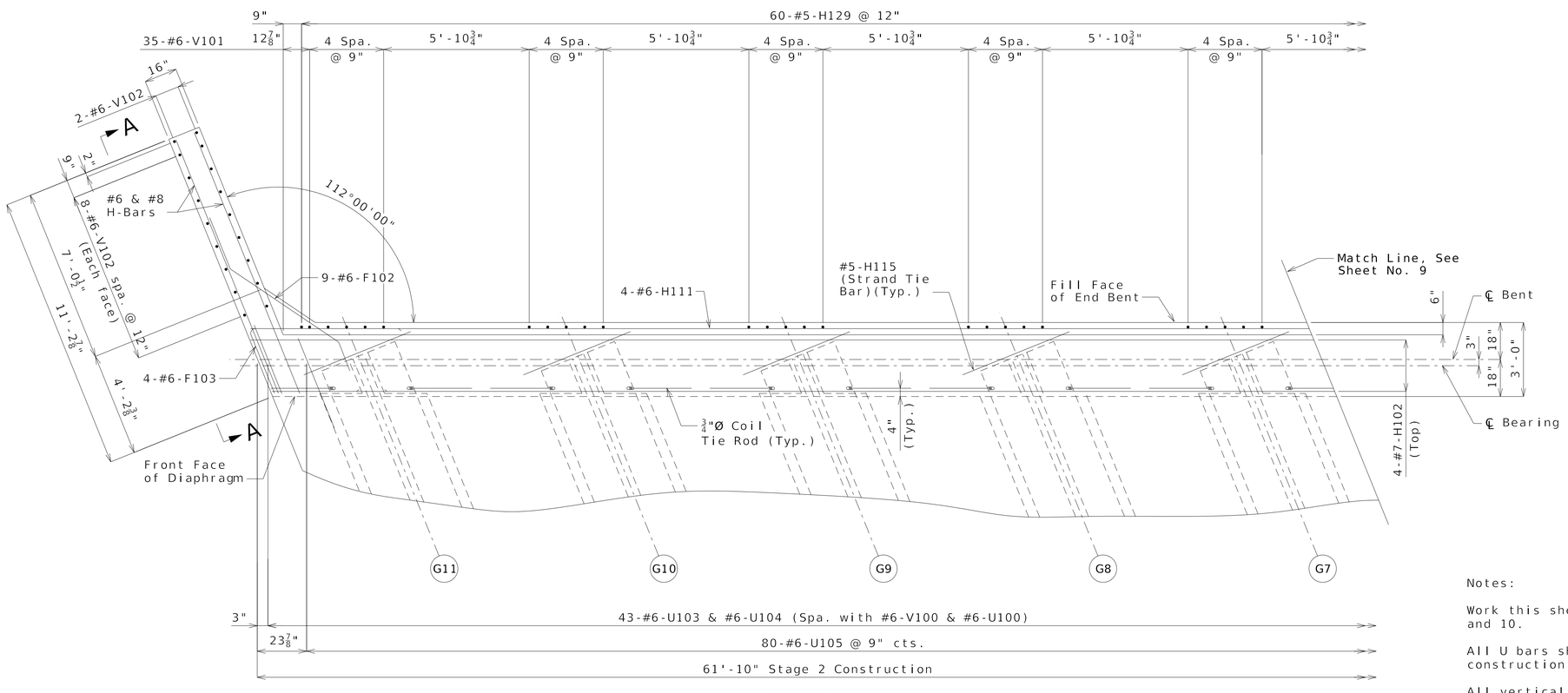
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REV.



PART SECTION NEAR END BENT



PART PLAN

Notes:

Work this sheet with Sheet Nos.6, 7, 9, and 10.

All U bars shall be placed parallel to construction chord.

All vertical reinforcing bars in the substructure beams or caps shall be field adjusted to clear piles by at least 1 1/2-inch.

For Elevation A-A and Section C-C, see Sheet No.10.

DETAILS OF END BENT 1

Detailed AUG 2024
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Note: This drawing is not to scale. Follow dimensions.

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STATE OF MISSOURI
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PROFESSIONAL ENGINEER

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Matthew Muenks
MO PE-2017000338

DATE PREPARED
1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	8

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

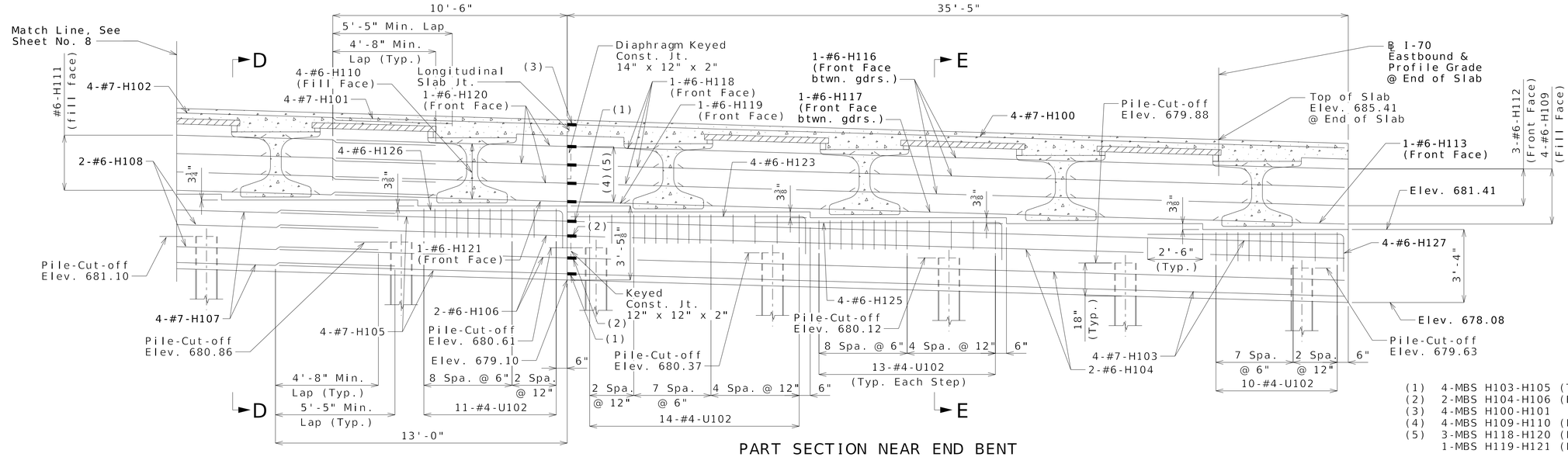
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A	FINAL REVIEW	09/13/24
0	RELEASED FOR CONSTRUCTION	10/01/24

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
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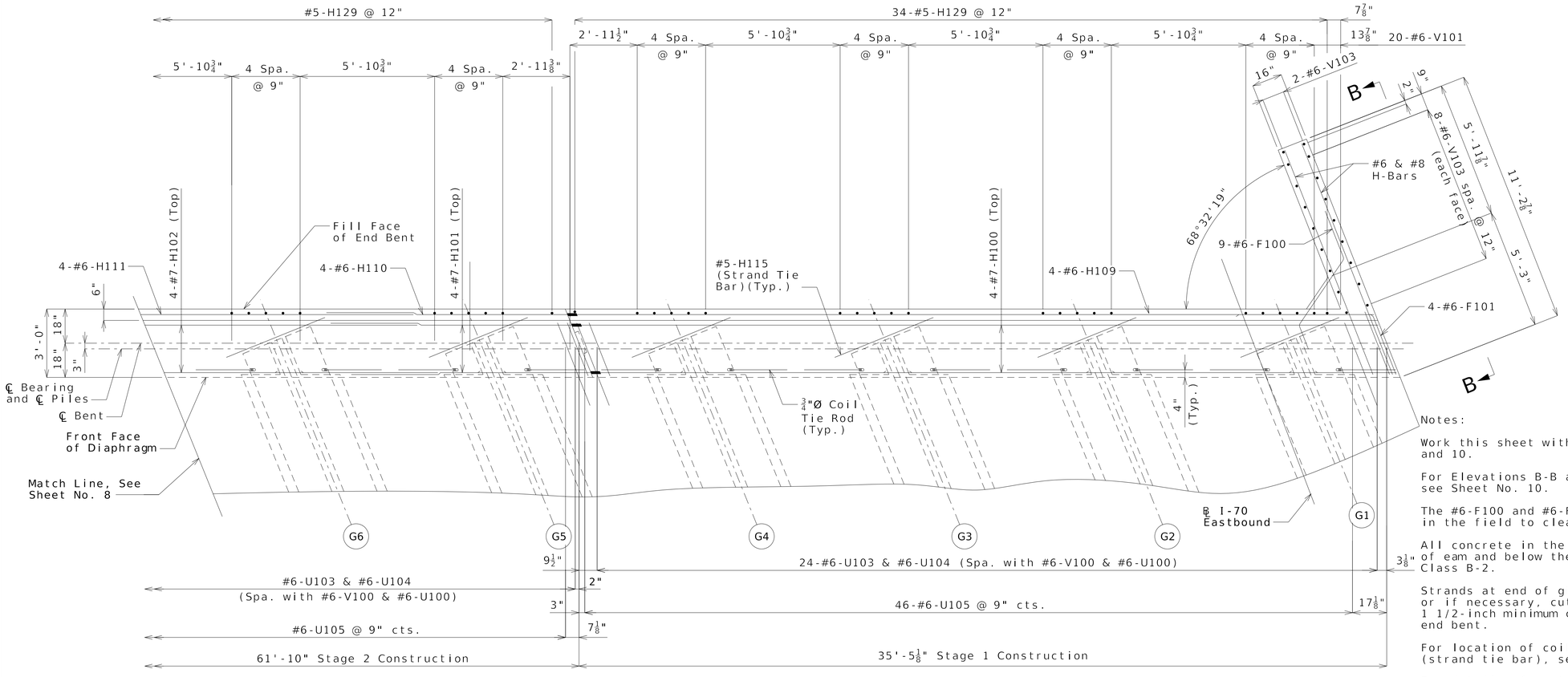
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(1) 4-MBS H103-H105 (Top & Bottom)
(2) 2-MBS H104-H106 (Each Face)
(3) 4-MBS H100-H101
(4) 4-MBS H109-H110 (Fill Face)
(5) 3-MBS H118-H120 (Front Face)
1-MBS H119-H121 (Front Face)

PART SECTION NEAR END BENT



PART PLAN

DETAILS OF END BENT 1

Notes:

Work this sheet with Sheet Nos. 6 thru 8 and 10.

For Elevations B-B and Sections D-D and E-E, see Sheet No. 10.

The #6-F100 and #6-F102 bars shall be bent in the field to clear girders.

All concrete in the end bent above the top of eam and below the top of slab shall be Class B-2.

Strands at end of girders shall be field bent, or if necessary, cut in field to maintain 1 1/2-inch minimum clearance to fill face of end bent.

For location of coil tie rods and #5-H115 (strand tie bar), see Sheets No. 25 and 26.

For details of vertical drain at end bents, see Sheet No. 11.

For details of bridge approach slab, see Sheet No. 47.

STATE OF MISSOURI
PROFESSIONAL ENGINEER
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DATE PREPARED: 1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	9

COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

REV.	DESCRIPTION	DATE
A	FINAL REVIEW	09/13/24
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MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
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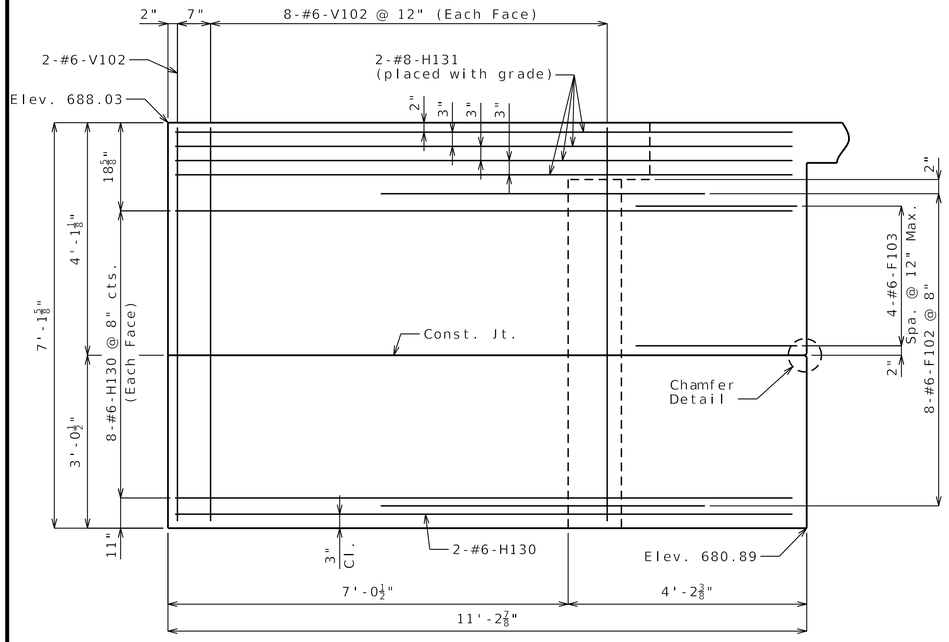
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Jacobs

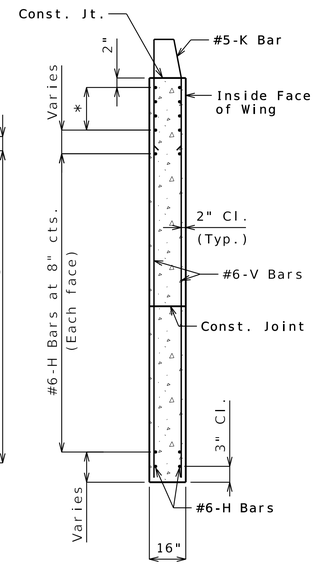
MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING REV.

Detailed AUG 2024
Checked AUG 2024

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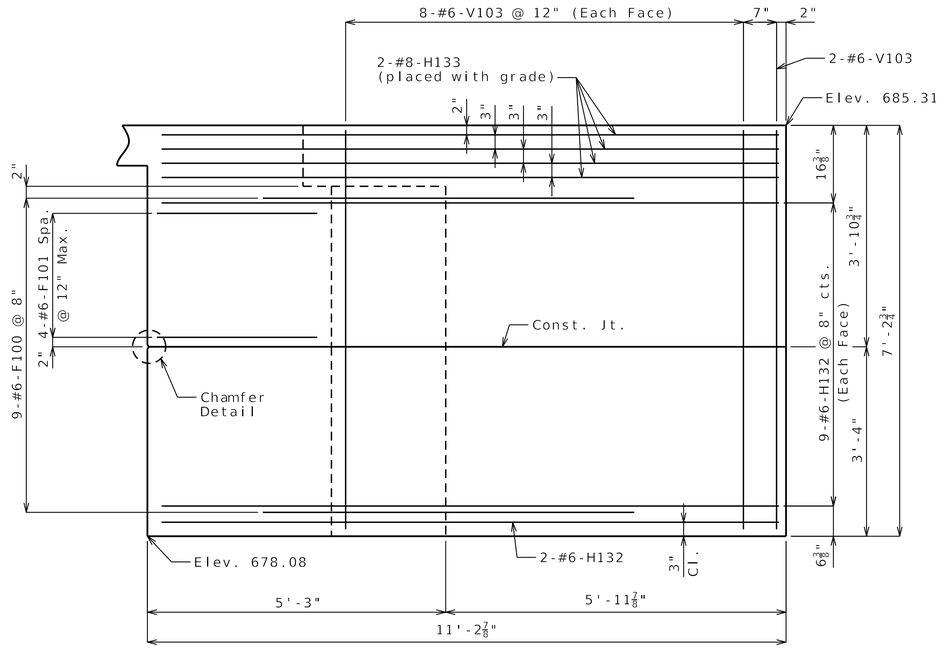


ELEVATION A-A

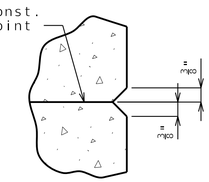


TYPICAL SECTION
THRU WING

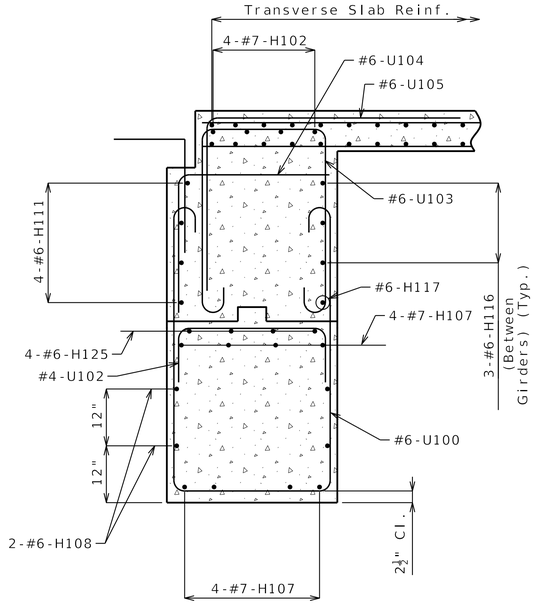
* #8-H Bars at 3" cts.
(Each face)(Place with grade)



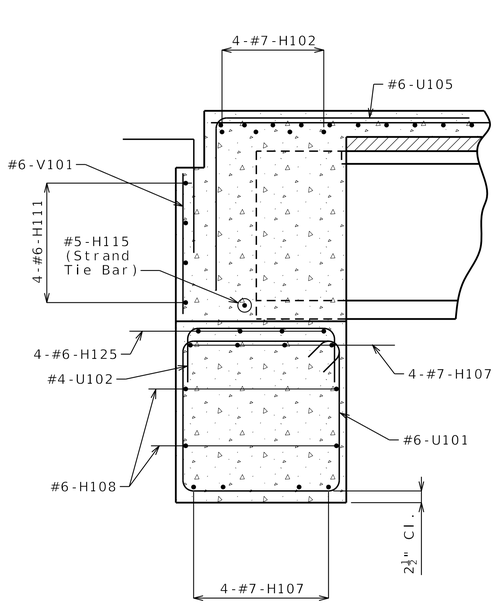
ELEVATION B-B



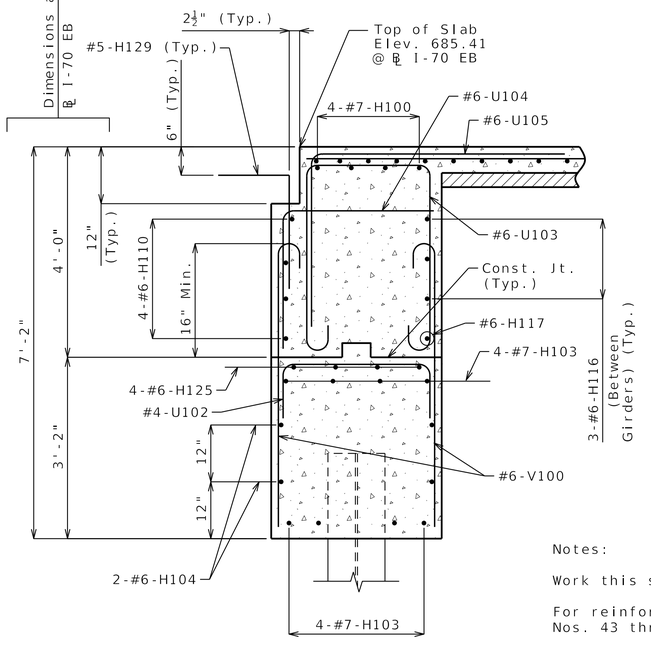
CHAMFER DETAIL



SECTION C-C



SECTION D-D



SECTION E-E

Notes:

Work this sheet with Sheet Nos. 6 thru 9.

For reinforcement of the barriers, see Sheet Nos. 43 thru 46.

DETAILS OF END BENT 1

Detailed AUG 2024
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Note: This drawing is not to scale. Follow dimensions.

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STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER

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Matthew Muenks
MO PE-2017000338

DATE PREPARED
1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	10

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

REV.	DATE	DESCRIPTION
A	09/13/24	FINAL REVIEW
0	10/01/24	RELEASED FOR CONSTRUCTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

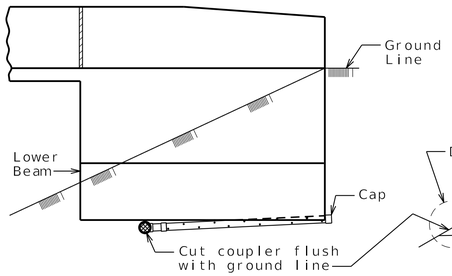
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

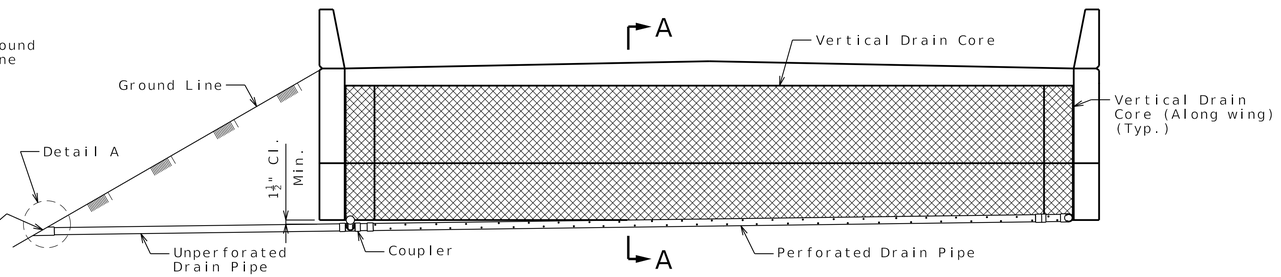
MILLSTONE WEBER

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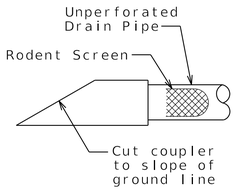
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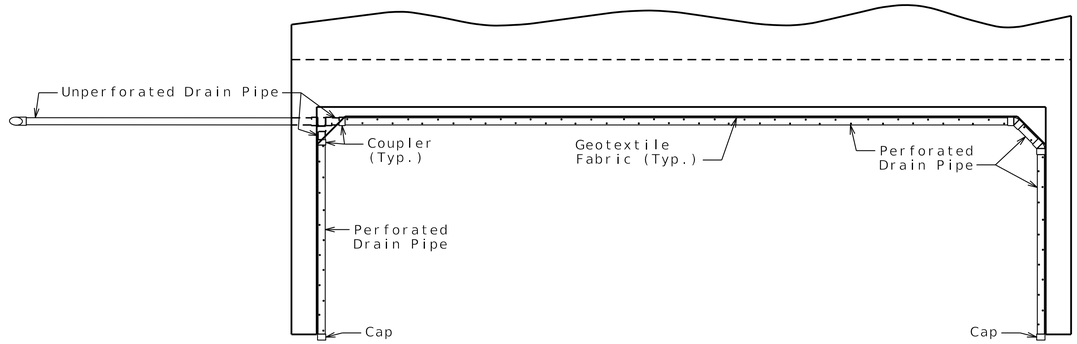
ELEVATION OF WING



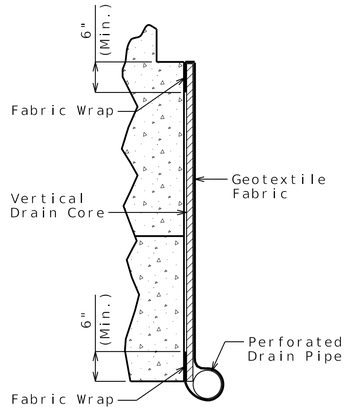
ELEVATION OF END BENT



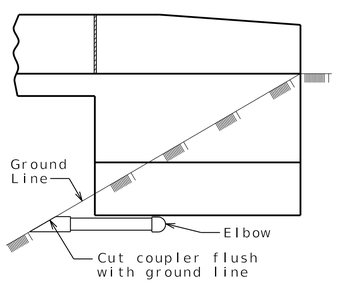
DETAIL A



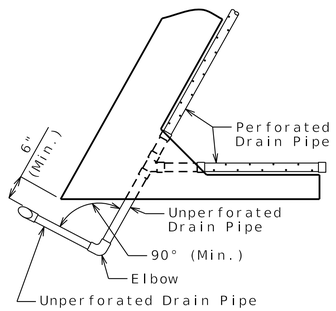
PLAN OF END BENT



PART SECTION A-A
(Section thru wing similar)



ELEVATION OF WING



PART PLAN

OPTIONAL TURNED DRAIN
(Use only when straight drain is not practical.)

General Notes:

All drain pipe shall be sloped 1 to 2 percent.

Drain pipe may be either 6-inch diameter corrugated metallic-coated steel pipe underdrain, 4-inch diameter corrugated polyvinyl chloride (PVC) drain pipe, or 4-inch diameter corrugated polyethylene (PE) drain pipe.

Drain pipe shall be placed at fill face of end bent and inside face of wings. The pipe shall slope to lowest grade of ground line, also missing the lower beam of end bent by a minimum of 1 1/2 inches.

Perforated pipe shall be placed at fill face side and inside face of wings at the bottom of end bent and plain pipe shall be used where the vertical drain ends to the exit at ground line.

VERTICAL DRAIN AT END BENTS
(Squared end bent shown, skewed end bent similar)

STATE OF MISSOURI
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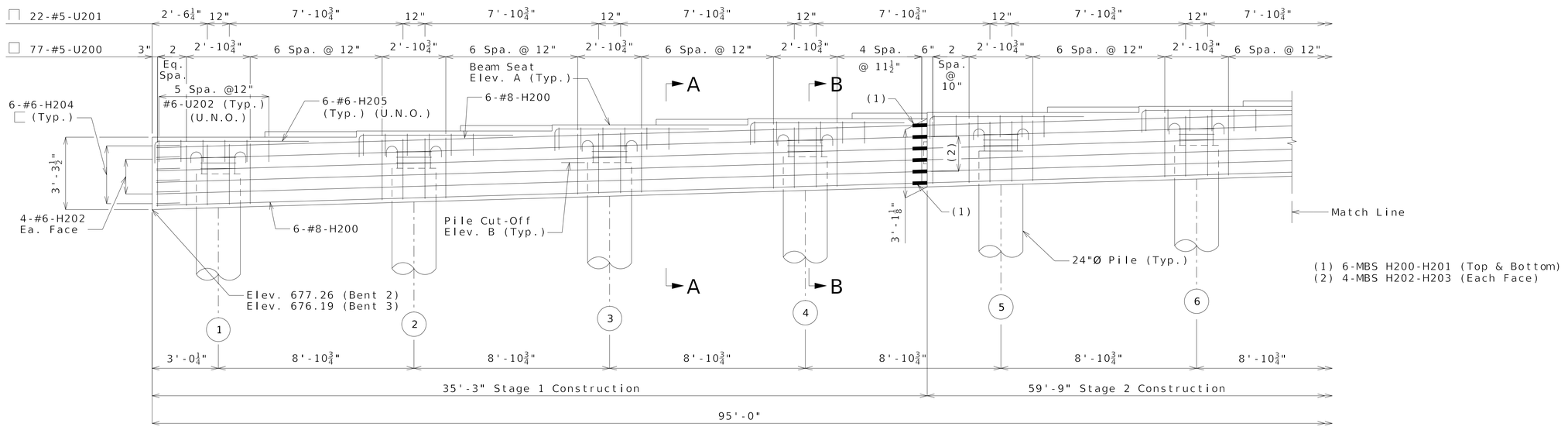
DATE PREPARED: 1-OCT-2024
ROUTE: 70EB | STATE: MO
DISTRICT: BR | SHEET NO.: 11
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DATE	DESCRIPTION
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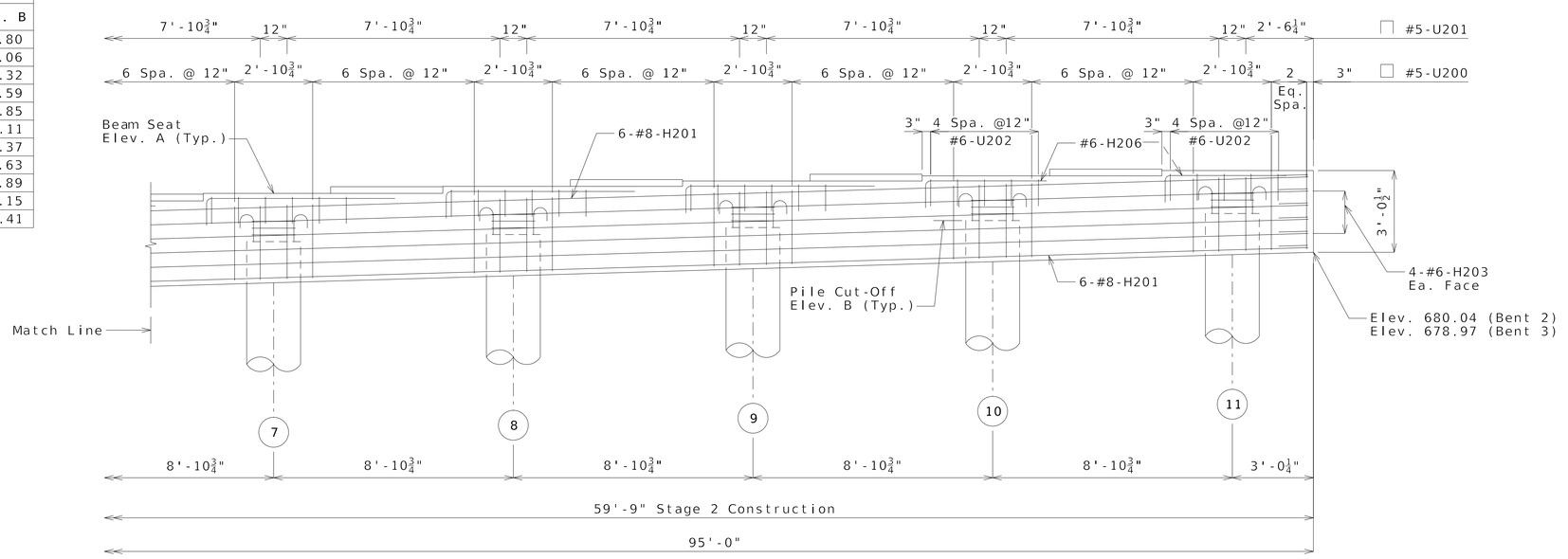
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
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MoDOT IMPROVE I-70 DB PROJECT 1
MILLSTONE WEBER
Jacobs
MO STATE CERTIFICATE OF AUTHORITY #025261 ENGINEERING

REV.



Beam Seat/ Pile	Int. Bent No. 2		Int. Bent No. 3	
	Elev. A	Elev. B	Elev. A	Elev. B
1	680.55	678.88	679.48	677.80
2	680.83	679.14	679.76	678.06
3	681.11	679.40	680.04	678.32
4	681.39	679.66	680.32	678.59
5	681.67	679.92	680.59	678.85
6	681.95	680.12	680.88	679.11
7	682.23	680.44	681.15	679.37
8	682.49	680.70	681.42	679.63
9	682.69	680.96	681.62	679.89
10	682.88	681.22	681.82	680.15
11	683.08	681.48	682.01	680.41



Notes:

For details of Intermediate Bents not shown, see Sheet Nos. 13 thru 15.

For Detail of Open Ended Cast-In-Place (OECIP) at Bent 2 see Sheet No. 16.

For Detail of Closed Ended Cast-In-Place (CECIP) at Bent 3 see Sheet No. 17.

DETAILS OF INTERMEDIATE BENTS 2 & 3

Detailed JULY 2024
Checked AUG 2024

Note: This drawing is not to scale. Follow dimensions.

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STATE OF MISSOURI
MATTHEW J. MUENKS
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Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	12

COUNTY: BOONE
JOB NO.: JST0021
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BRIDGE NO.: A9542

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10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

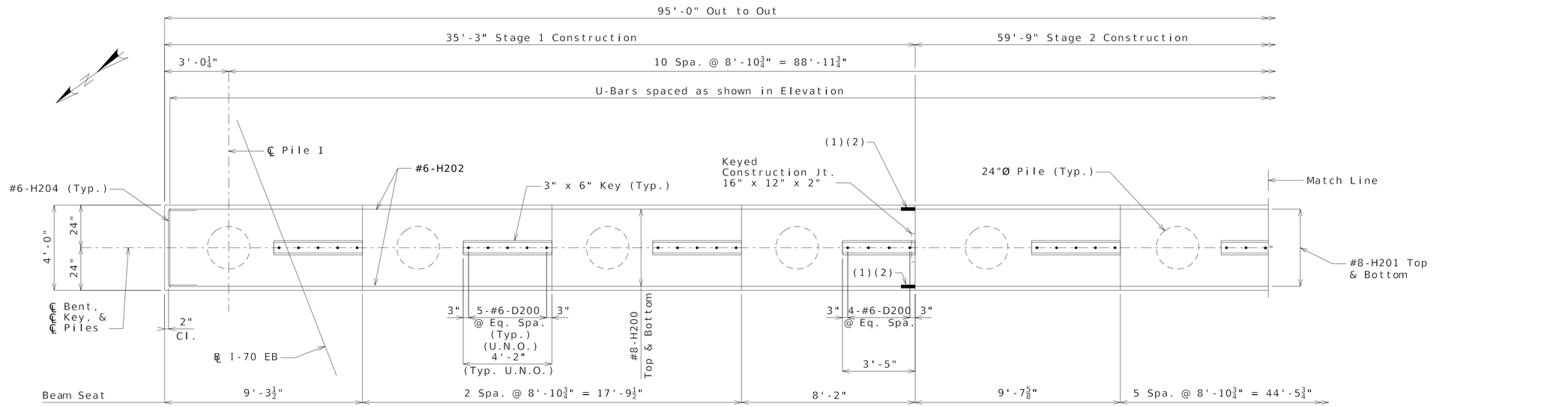
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

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Jacobs

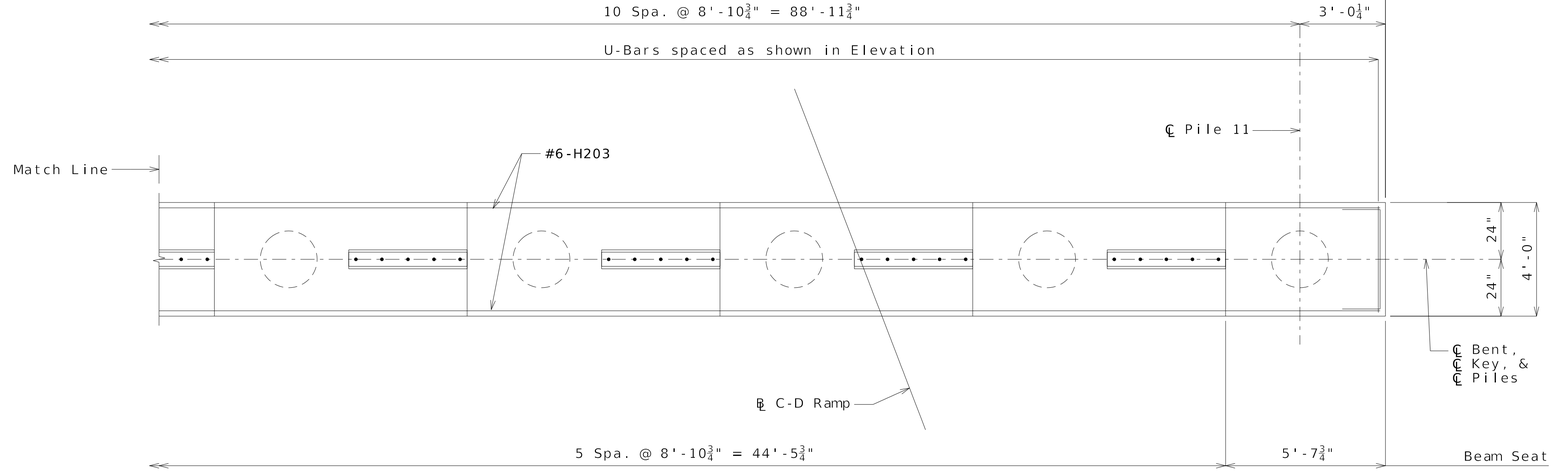
MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.



(1) 6-MBS H200-H201 (Top & Bottom)
(2) 4-MBS H202-H203 (Each Face)

PLAN OF BEAM



PLAN OF BEAM

Notes:

For details not shown, see Sheet Nos. 12, 14 and 15.

DETAILS OF INTERMEDIATE BENTS 2 & 3

Detailed JULY 2024
Checked AUG 2024

Note: This drawing is not to scale. Follow dimensions.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_013_JST0021_Int Bent_2-2.dgn 16:02 1-OCT-2024

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED
1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	13

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

DATE	DESCRIPTION
09/13/24	REV. A-FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

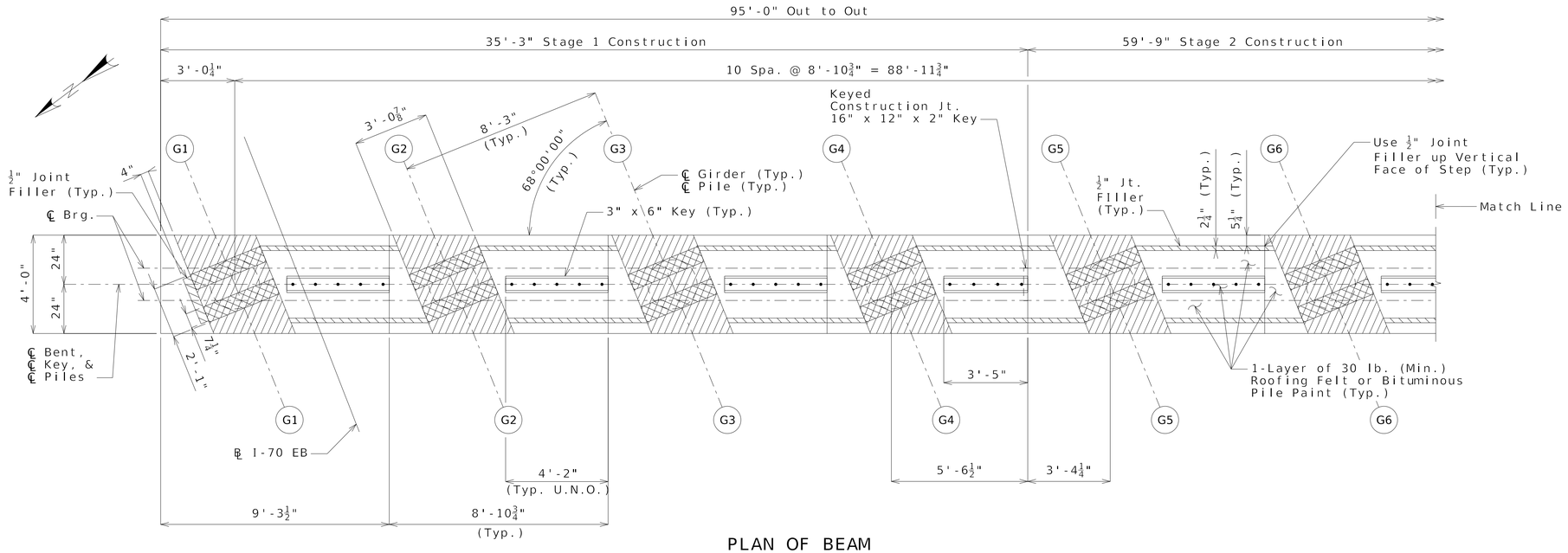
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

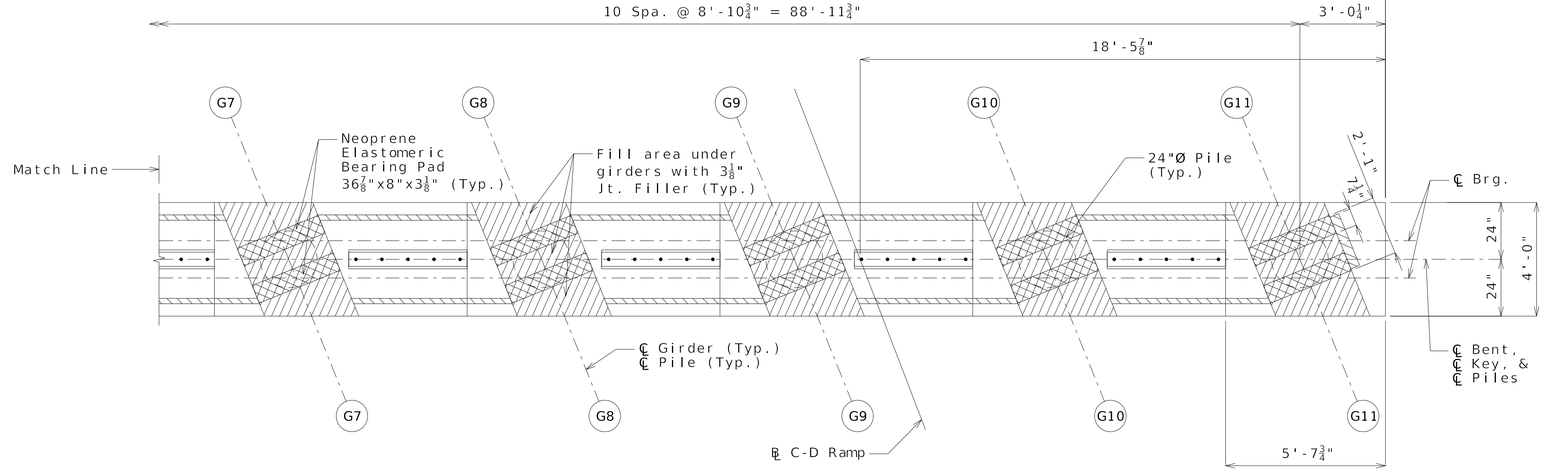
MILLSTONE WEBER
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MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.



PLAN OF BEAM



PLAN OF BEAM

Notes:

For details of Intermediate Bents not shown, Sheet Nos. 12, 13 and 15.

For details of Concrete Diaphragms see Sheet Nos. 31 and 32.

For Details of Laminated Neoprene bearing Pads see Sheet No. 23.

DETAILS OF INTERMEDIATE BENT 2

Detailed JULY 2024
Checked AUG 2024

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 14 of 56

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	14

COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DATE	DESCRIPTION
09/13/24	REV. A-FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

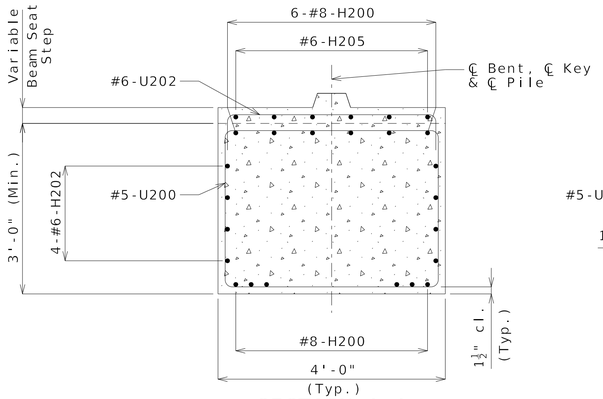
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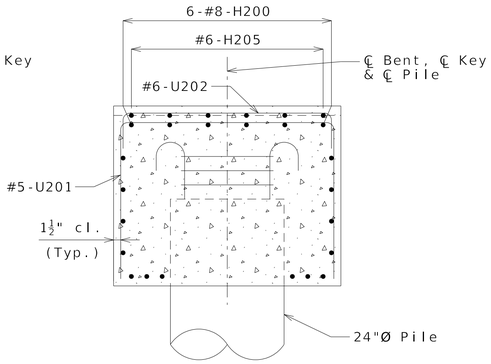
MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

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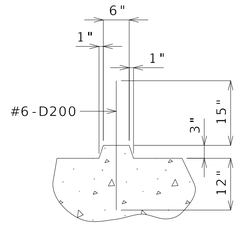
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SECTION A-A



SECTION B-B



SECTION THRU KEY

Notes:

For location of Elevations A-A & B-B, see Sheet No. 12.

For details of Intermediate Bents not shown, see Sheet Nos. 12 thru 14.

For details of Piles see Sheet Nos. 16 & 17.

Bar marks shown (200 Series) are for Intermediate Bent No. 2.
Bar marks for Intermediate Bent No. 3 are 300 series.

DETAILS OF INTERMEDIATE BENTS 2 & 3

Detailed JULY 2024
Checked AUG 2024

Note: This drawing is not to scale. Follow dimensions.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_015_JST0021_Int Bent_2-4.dgn 16:04 1-OCT-2024

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER

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Matthew Muenks
MO PE-2017000338

DATE PREPARED
1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	15

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

DESCRIPTION	DATE
REV. A-FINAL REVIEW	09/13/24
REV. 0 - RELEASED FOR CONSTRUCTION	10/01/24

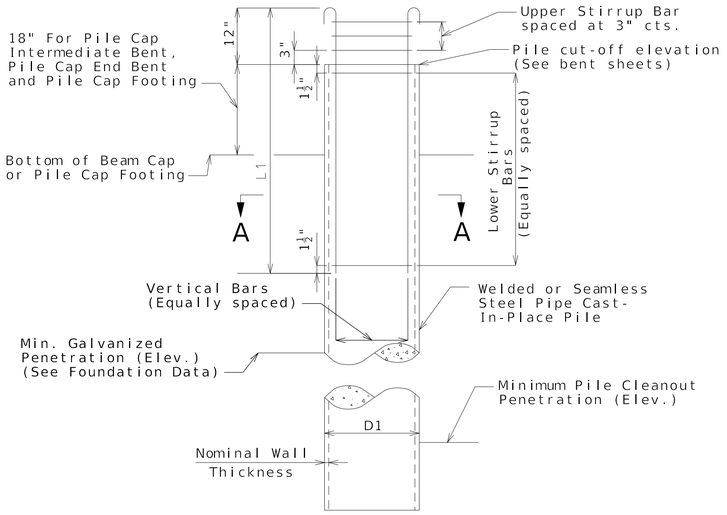
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

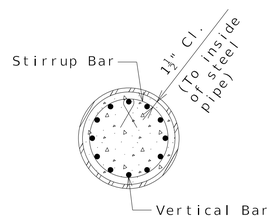
Jacobs
MILLSTONE WEBER

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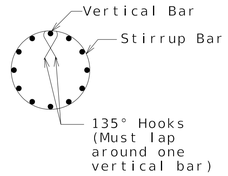
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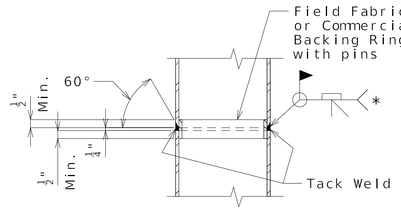
GALVANIZED OPEN ENDED CAST-IN-PLACE (OECIP)
CONCRETE PILE
WITHOUT PILE POINT REINFORCEMENT



SECTION A-A



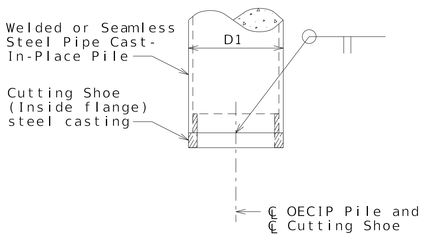
DETAIL OF SEISMIC
STIRRUP BAR



STEEL PIPE PILE SPLICE

* Galvanizing material shall be omitted or removed one inch clear of weld locations in accordance with Sec 702.

GALVANIZED OPEN ENDED CAST-IN-PLACE (OECIP) CONCRETE PILE DATA	
Bent Number	2
D1, OECIP Pile (O.D.)	24"
Min. Nominal Wall Thickness	5/8"
Pile Point Reinforcement	None
Min. Pile Cleanout Penetration (Elev.)	Bottom of Prebore
Vertical Bars	12-#6-V200
L1, Length of Vertical Bars	7'-3"
Upper Stirrup Bars	3-#4-P200
Lower Stirrup Bars	7-#4-P200



MANUFACTURED OPEN ENDED
CUTTING SHOE (INSIDE FLANGE)

Notes:

Welded or seamless steel shell (pipe) shall be ASTM A252 Grade 3 (fy = 45,000 psi).

Open ended pile shall be set in prebored holes and augered out to the minimum pile cleanout penetration elevation if necessary and filled with Class B-1 concrete.

Concrete for cast-in-place pile shall be Class B-1.

The minimum wall thickness of any spot or local area of any type shall not be more than 12.5% under the specified nominal wall thickness.

Splices of pipe for cast-in-place pipe pile shall be made watertight and to the full strength of the pipe above and below the splice to permit hard driving without damage. Pipe damaged during driving shall be replaced. Pipe sections used for splicing shall be at least 5 feet in length.

At the contractor's option, the hooks of vertical bars embedded in the beam cap may be oriented inward or outward.

Reinforcing steel for cast-in-place pile is included in the Bill of Reinforcing Steel.

For Foundation Data table, see Sheet No. 2.

GALVANIZED OPEN ENDED CAST-IN-PLACE (OECIP) CONCRETE PILE

Detailed JULY 2024
Checked AUG 2024

Note: This drawing is not to scale. Follow dimensions.

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STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED
1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	16

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

DESCRIPTION	DATE
REV. A - FINAL REVIEW	09/13/24
REV. 0 - RELEASED FOR CONSTRUCTION	10/01/24

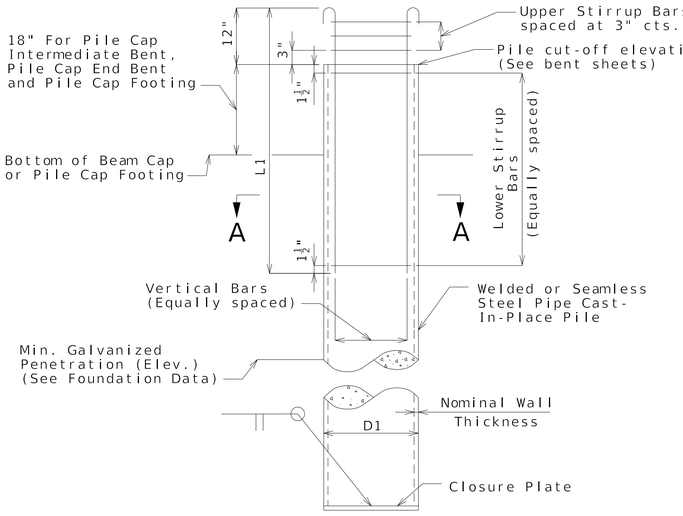
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
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MoDOT IMPROVE I-70 DB PROJECT 1

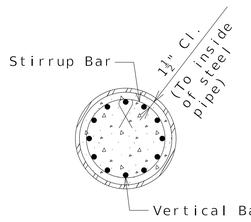
Jacobs MILLSTONE WEBER

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING LLC 102 36)

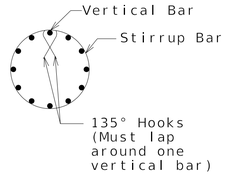
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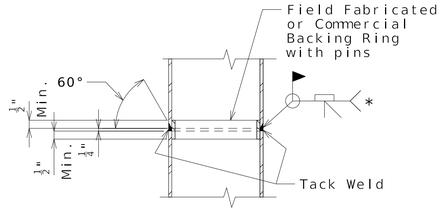
GALVANIZED CLOSED ENDED CAST-IN-PLACE (CECIP) CONCRETE PILE
WITHOUT PILE POINT REINFORCEMENT



SECTION A-A

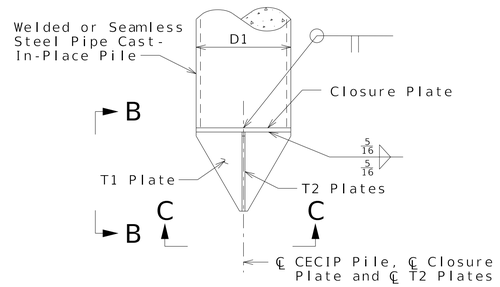


DETAIL OF SEISMIC STIRRUP BAR

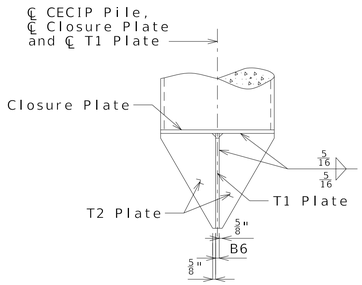


STEEL PIPE PILE SPLICE

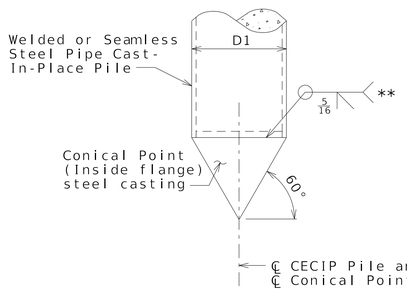
* Galvanizing material shall be omitted or removed one inch clear of weld locations in accordance with Sec 702.



CRUCIFORM PILE POINT



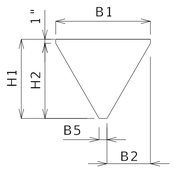
ELEVATION B-B



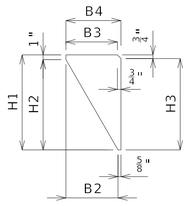
MANUFACTURED CONICAL PILE POINT

(Omit closure plate)

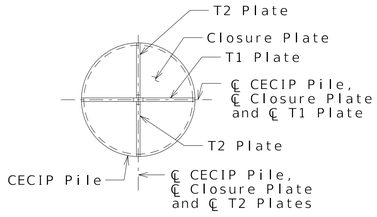
** If the conical pile point is not pre-beveled, place a 3/8" bevel at 40 degrees on the pipe.



T1 PLATE DETAILS



T2 PLATE DETAILS
(2 REQUIRED)



SECTION C-C

CRUCIFORM PILE POINT REINFORCEMENT

Cruciform Pile Point Reinforcement Data				
D1, CECIP Pile (O.D.)	14"	16"	20"	24"
B1	14"	16"	20"	24"
B2	6"	7"	8 7/8"	10 5/8"
B3	5 7/8"	6 7/8"	8 3/4"	10 1/2"
B4	6 5/8"	7 5/8"	9 1/2"	11 1/4"
B5	2"	2"	2 1/4"	2 3/4"
B6	3/4"	3/4"	1"	1 1/2"
H1	9 1/8"	10 1/2"	13"	15 3/8"
H2	8 1/8"	9 1/2"	12"	14 3/8"
H3	8 3/8"	9 3/4"	12 1/4"	14 5/8"
T1 and T2 Plate Thickness	3/4"	3/4"	1"	1 1/2"

Galvanized Closed Ended Cast-In-Place (CECIP) Concrete Pile Data	
Bent Number	3
D1, CECIP Pile (O.D.)	24"
Min. Nominal Wall Thickness	5/8"
Closure Plate Thickness	1 1/2"
Pile Point Reinforcement	Conical
Vertical Bars	12-#6-V300
L1, Length of Vertical Bars	7'-3"
Upper Stirrup Bars	3-#4-P300
Lower Stirrup Bars	7-#4-P300

Notes:

Welded or seamless steel shell (pipe) shall be ASTM A252 Grade 3 (fy = 45,000 psi).

Concrete for cast-in-place pile shall be Class B-1.

Steel for closure plate shall be ASTM A709 Grade 50.

Steel for cruciform pile point reinforcement shall be ASTM A709 Grade 50.

Steel casting for conical pile point reinforcement shall be ASTM A148 Grade 90-60.

The minimum wall thickness of any spot or local area of any type shall not be more than 12.5% under the specified nominal wall thickness.

Closure plate shall not project beyond the outside diameter of the pipe pile. Satisfactory weldments may be made by beveling tip end of pipe or by use of inside backing rings. In either case, proper gaps shall be used to obtain weld penetration full thickness of pipe.

Splices of pipe for cast-in-place concrete pile shall be made watertight and to the full strength of the pipe above and below the splice to permit hard driving without damage. Pipe damaged during driving shall be replaced. Pipe sections used for splicing shall be at least 5 feet in length.

At the contractor's option, the hooks of vertical bars embedded in the beam cap may be oriented inward or outward.

Closure plate need not be galvanized.

Reinforcing steel for cast-in-place piles is included in the Bill of Reinforcing Steel.

For Foundation Data table, see Sheet No. 2.

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024
ROUTE: 70EB | STATE: MO
DISTRICT: BR | SHEET NO.: 17
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DESCRIPTION	DATE
REV. A - FINAL REVIEW	09/13/24
REV. 0 - RELEASED FOR CONSTRUCTION	10/01/24

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
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MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
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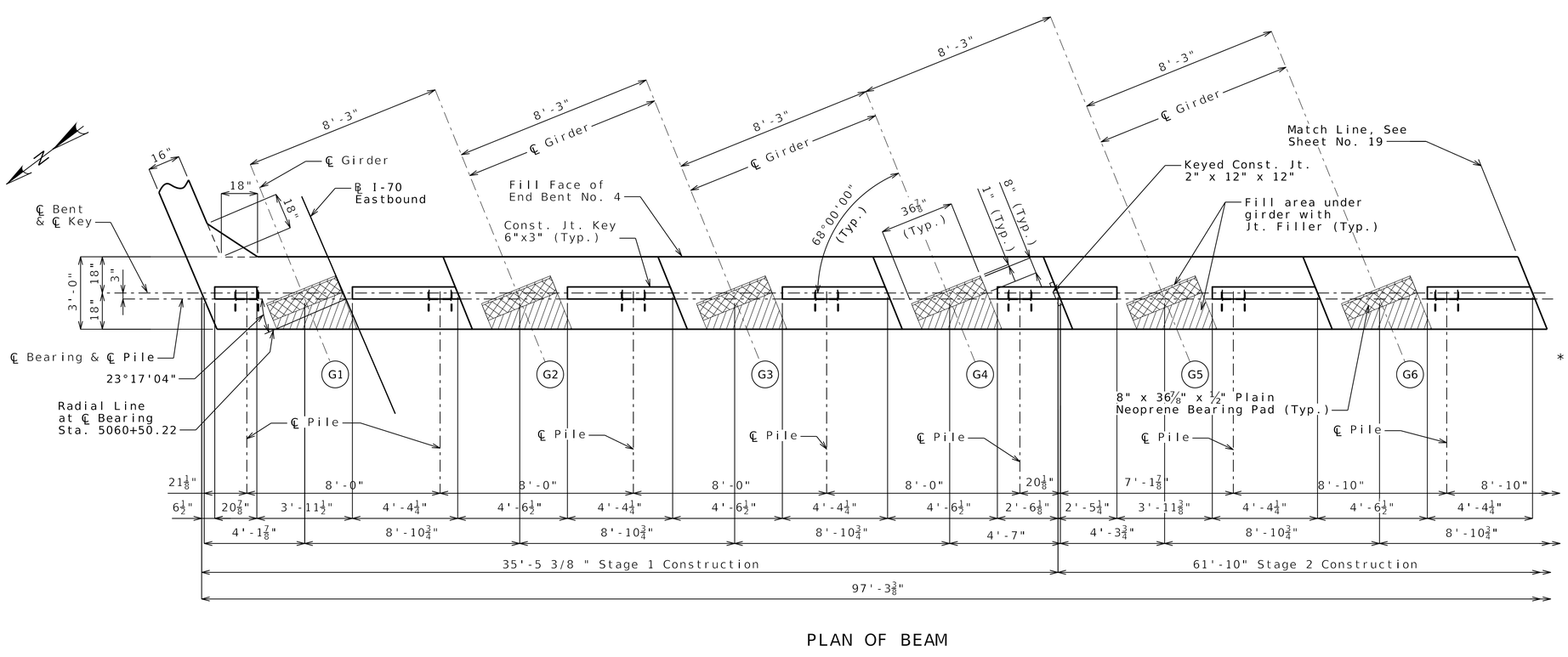
MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.

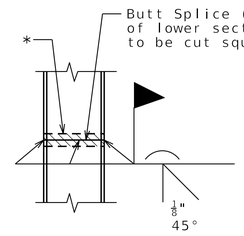
GALVANIZED CLOSED ENDED CAST-IN-PLACE (CECIP) CONCRETE PILE

Detailed AUG 2024
Checked AUG 2024

Note: This drawing is not to scale. Follow dimensions.



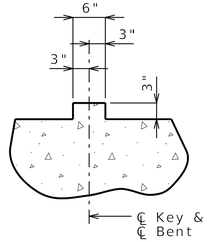
PLAN OF BEAM



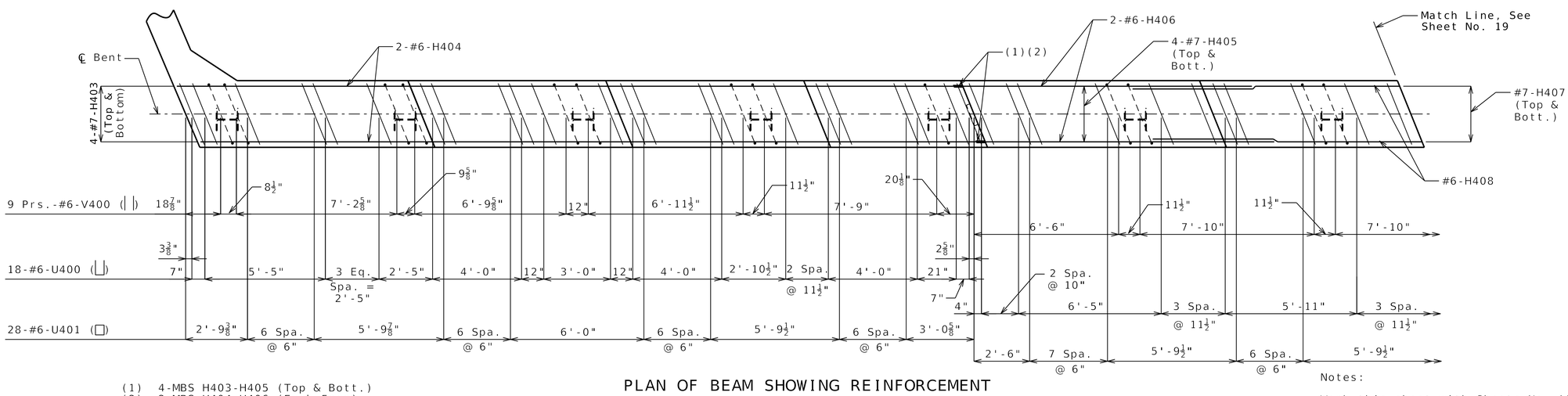
STEEL PILE SPLICE

(If required)

* Galvanizing material shall be omitted or removed one inch clear of weld locations in accordance with Sec 702.



SECTION THRU KEY



(1) 4-MBS H403-H405 (Top & Bott.)
(2) 2-MBS H404-H406 (Each Face)

PLAN OF BEAM SHOWING REINFORCEMENT

Keys not shown for clarity.

Notes:

Work this sheet with Sheets No. 19, 20, 21 and 22.

All U bars and pairs of V bars shall be placed parallel to construction chord.

Reinforcing steel shall be shifted to clear piles. U bars shall clear by at least 1 1/2 inches.

For details of Vertical Drain at End Bents, see Sheet No. 11.

DETAILS OF END BENT 4

Detailed AUG 2024
Checked AUG 2024

Note: This drawing is not to scale. Follow dimensions.

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16:07 1-OCT-2024

STATE OF MISSOURI
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NUMBER PE-2017000338
PROFESSIONAL ENGINEER
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Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024

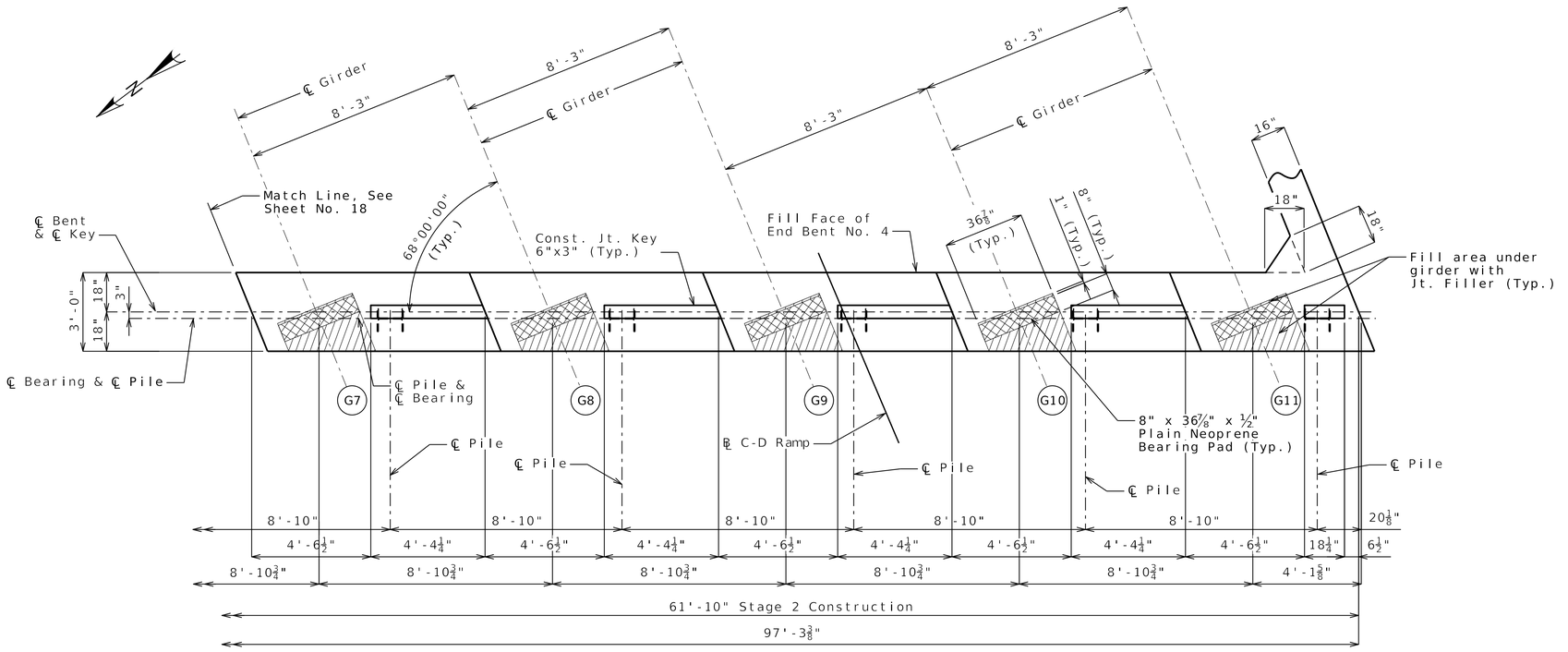
ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	18

COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

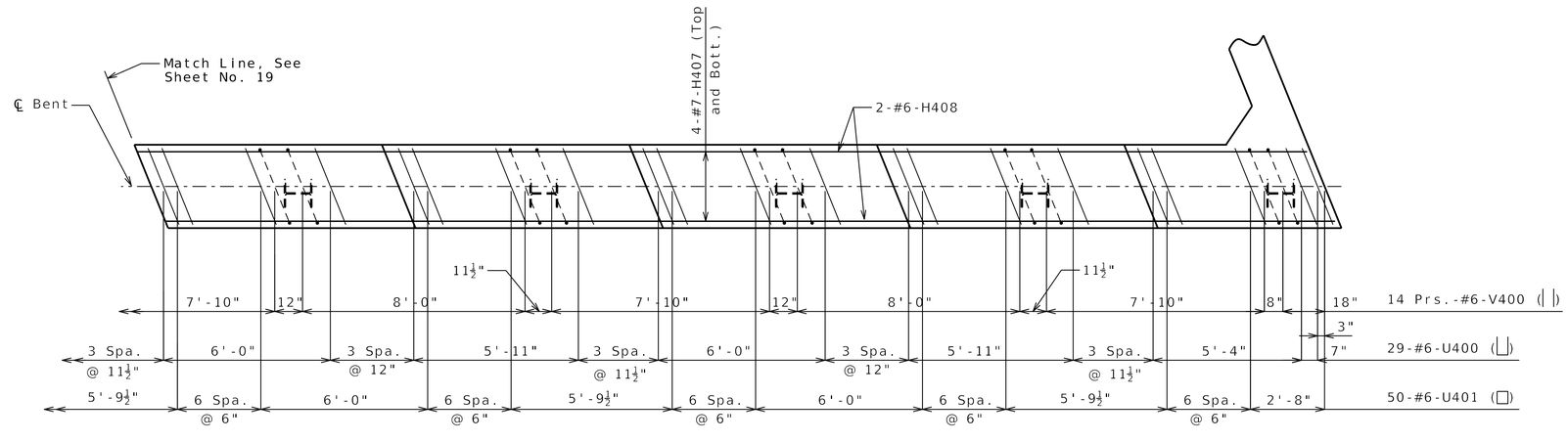
DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

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105 WEST CAPITOL
JEFFERSON CITY, MO 65102
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MoDOT IMPROVE I-70 DB PROJECT 1
MILLSTONE WEBER
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REV.



PLAN OF BEAM



PLAN OF BEAM SHOWING REINFORCEMENT

Keys not shown for clarity.

Notes:

Work this sheet with Sheets No. 18, 20 thru 22.

All U bars and pairs of V bars shall be placed parallel to construction chord.

Reinforcing steel shall be shifted to clear piles. U bars shall clear by at least 1 1/2 inches.

For details of Vertical Drain at End Bents, see Sheet No. 11.

DETAILS OF END BENT 4

Detailed AUG 2024
Checked AUG 2024

Note: This drawing is not to scale. Follow dimensions.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_019_JST0021_End Bent_4-2.dgn 16:08 1-OCT-2024

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER

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Matthew Muenks
MO PE-2017000338

DATE PREPARED
1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	19

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

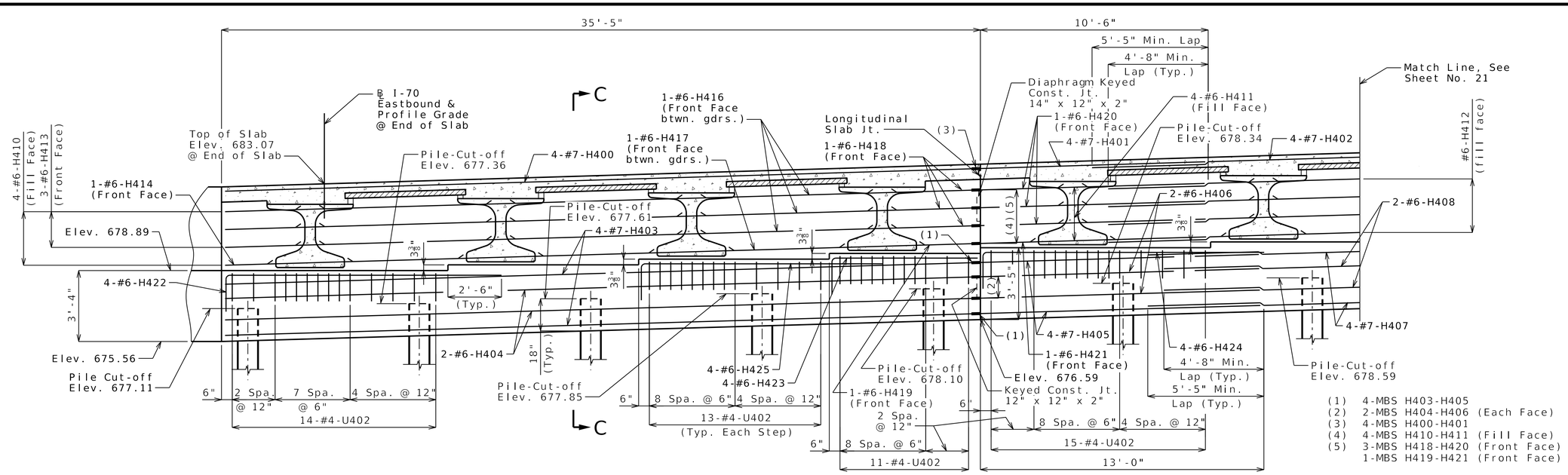
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
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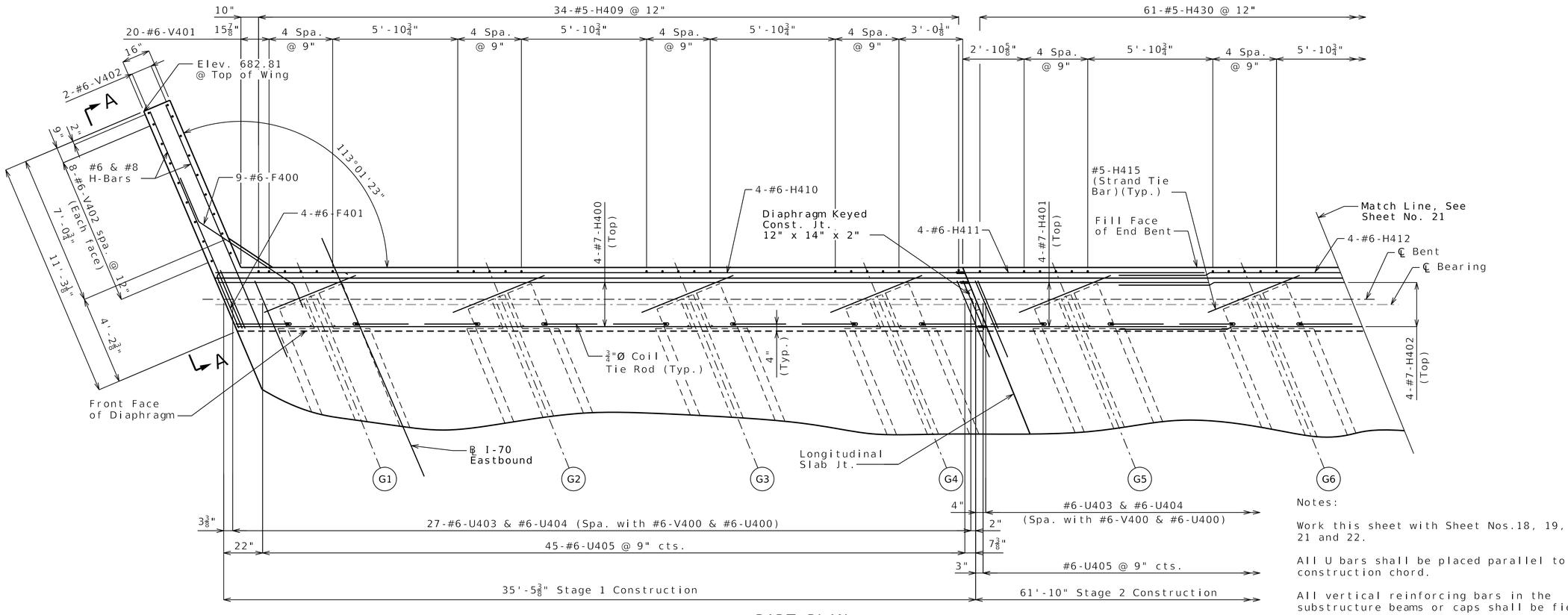
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REV.



PART SECTION NEAR END BENT



PART PLAN

DETAILS OF END BENT 4

Notes:

Work this sheet with Sheet Nos.18, 19, 21 and 22.

All U bars shall be placed parallel to construction chord.

All vertical reinforcing bars in the substructure beams or caps shall be field adjusted to clear piles by at least 1 1/2-inch.

For Elevation A-A and Section C-C, see Sheet No.22.

Detailed AUG 2024
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Note: This drawing is not to scale. Follow dimensions.

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ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	20

COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DESCRIPTION	DATE
REV. A - FINAL REVIEW	09/13/24
REV. 0 - RELEASED FOR CONSTRUCTION	10/01/24

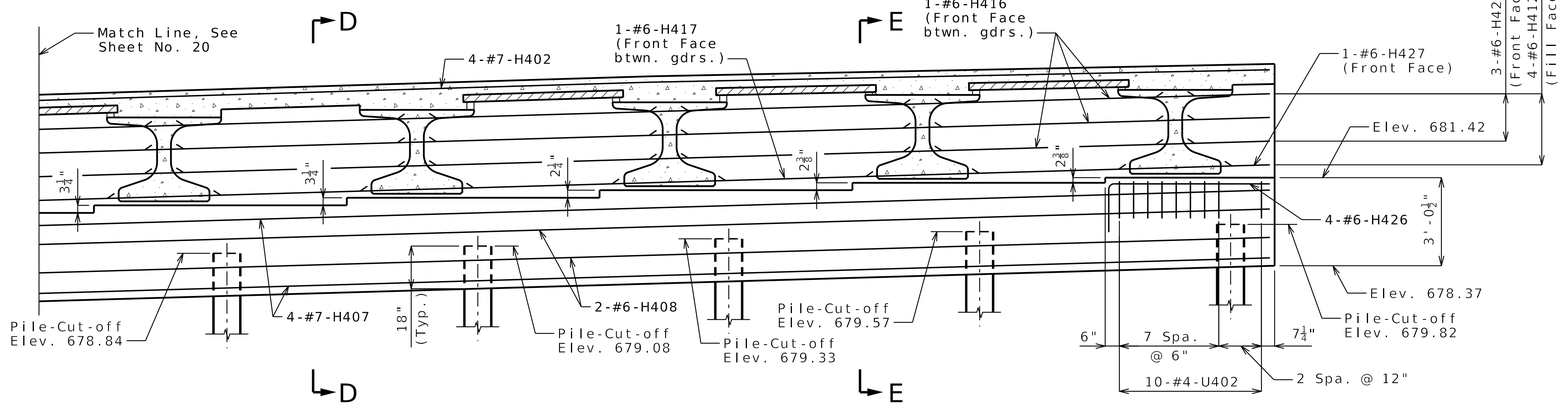
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
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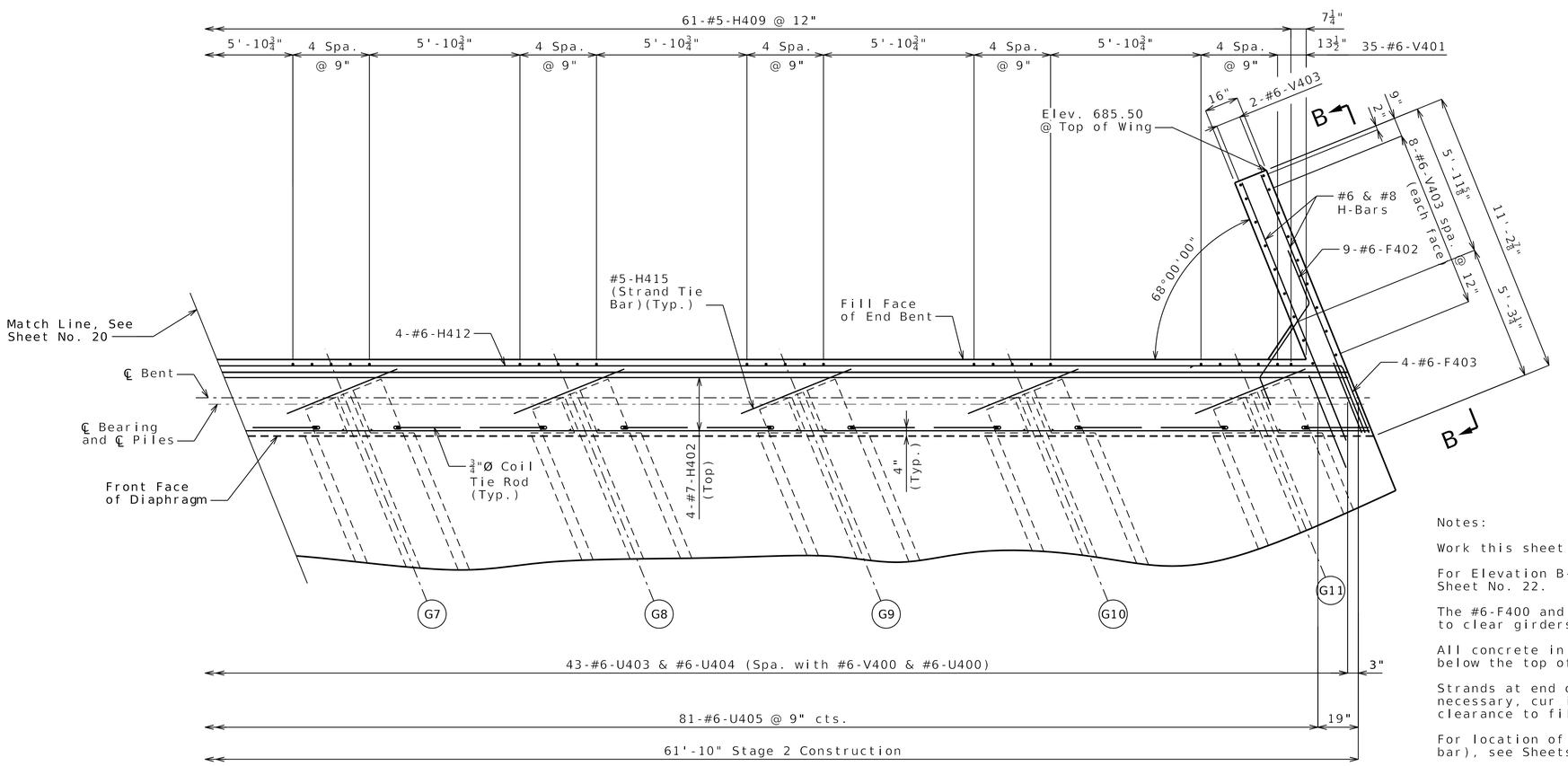
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REV.



PART SECTION NEAR END BENT



PART PLAN

DETAILS OF END BENT 4

Notes:

Work this sheet with Sheet Nos. 18 thru 20 and 22.

For Elevation B-B and Sections D-D and E-E, see Sheet No. 22.

The #6-F400 and #6-F402 bars shall be bent in the field to clear girders.

All concrete in the end bent above the top of beam and below the top of slab shall be Class B-2.

Strands at end of girders shall be field bent, or if necessary, cur in field to maintain 1 1/2-inch minimum clearance to fill face of end bent.

For location of coil tie rods and #5-H415 (strand tie bar), see Sheets No. 29 and 30.

For details of vertical drain at end bents, see Sheet No. 11.

For details of bridge approach slab, see Sheet No. 47.

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ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	21

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

DESCRIPTION	DATE
REV. A - FINAL REVIEW	09/13/24
REV. 0 - RELEASED FOR CONSTRUCTION	10/01/24

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
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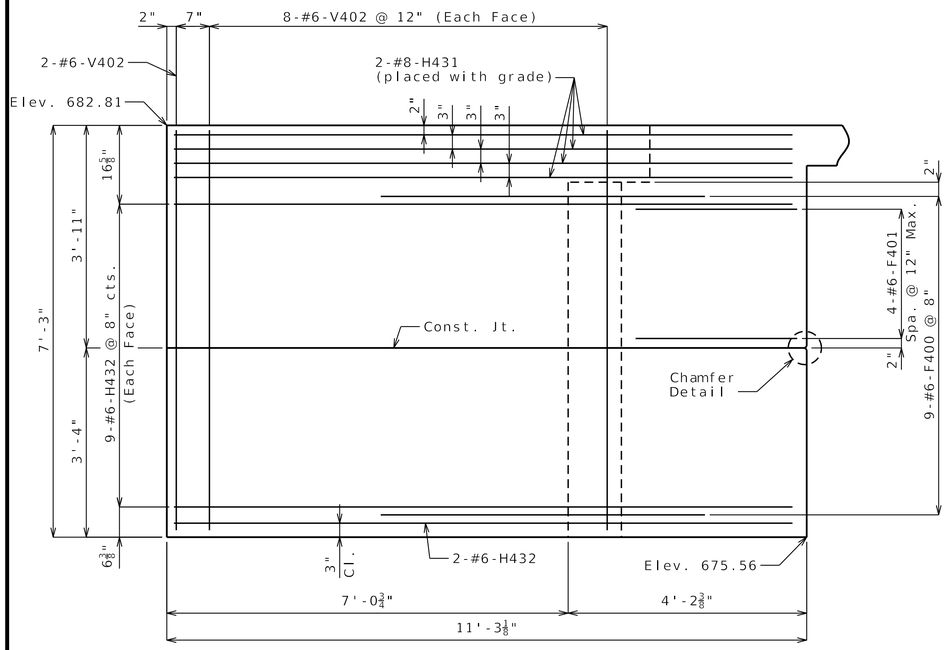
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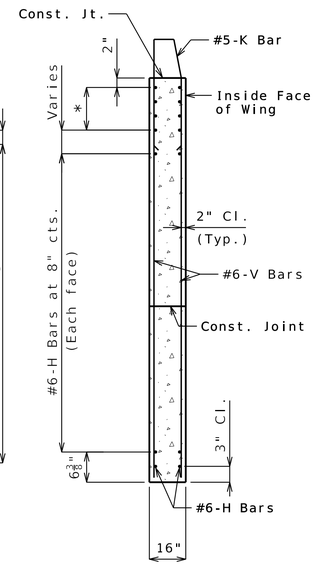
REV.

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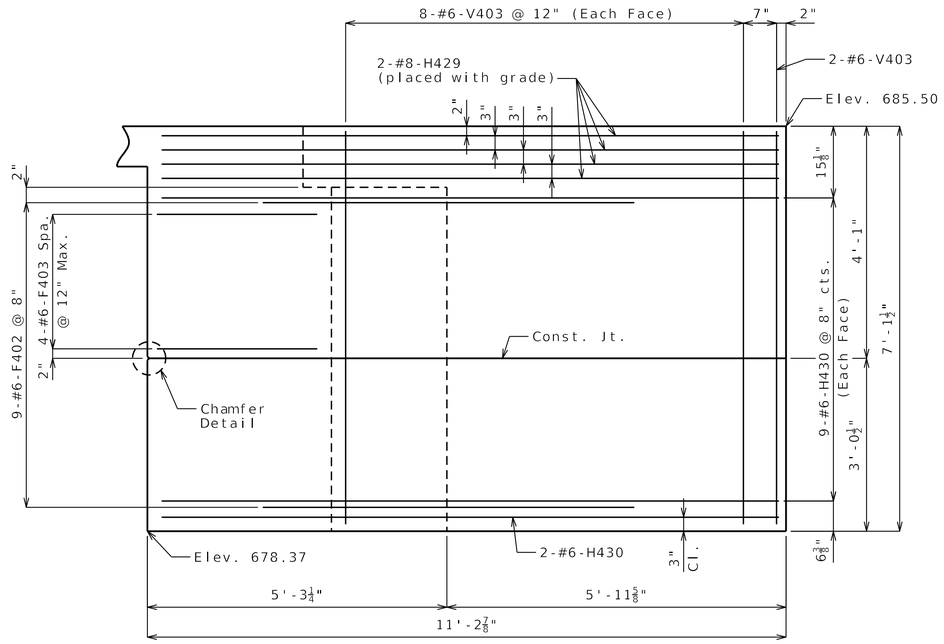


ELEVATION A-A

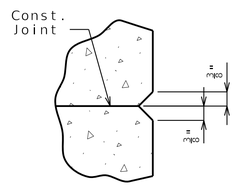


TYPICAL SECTION
THRU WING

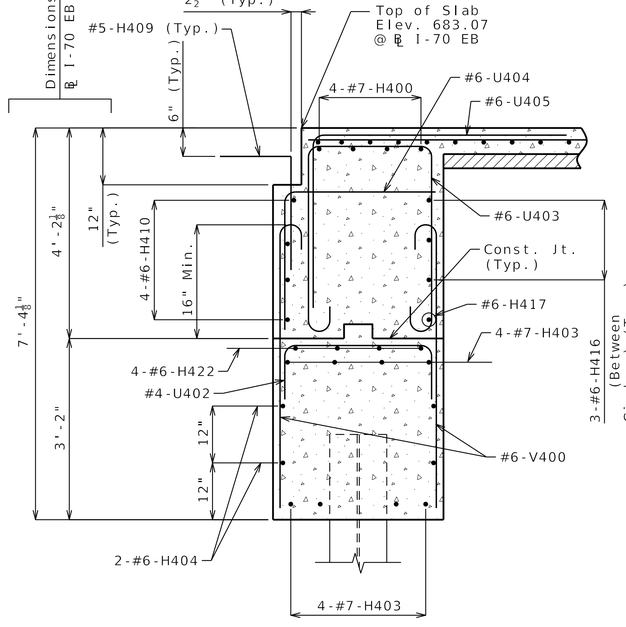
* #8-H Bars at 3" cts.
(Each face)(Place with grade)



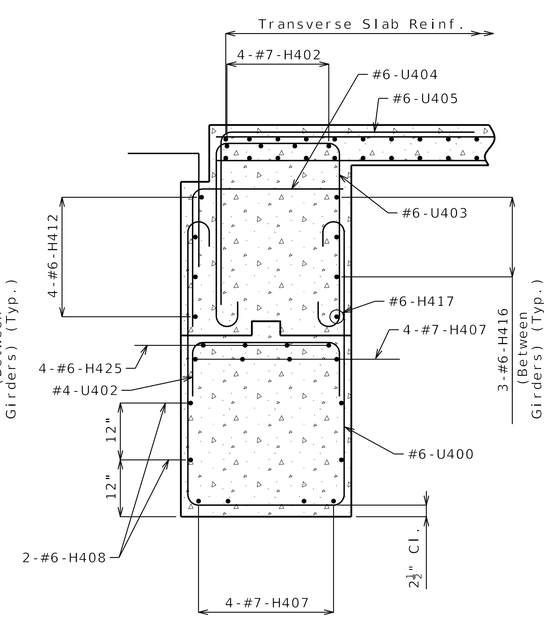
ELEVATION B-B



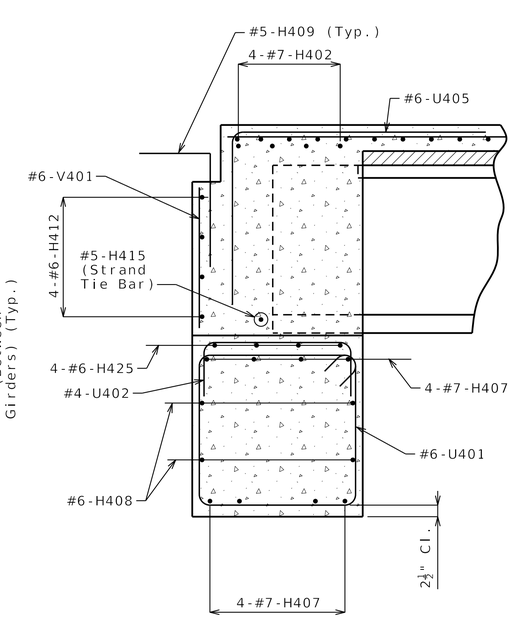
CHAMFER DETAIL



SECTION C-C



SECTION D-D



SECTION E-E

Notes:

Work this sheet with Sheet Nos. 18 thru 21.

For reinforcement of the barriers, see Sheet Nos. 43 thru 46.

DETAILS OF END BENT 4

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ROUTE	STATE
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BOONE

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A9542

REV.	DESCRIPTION	DATE
A	FINAL REVIEW	09/13/24
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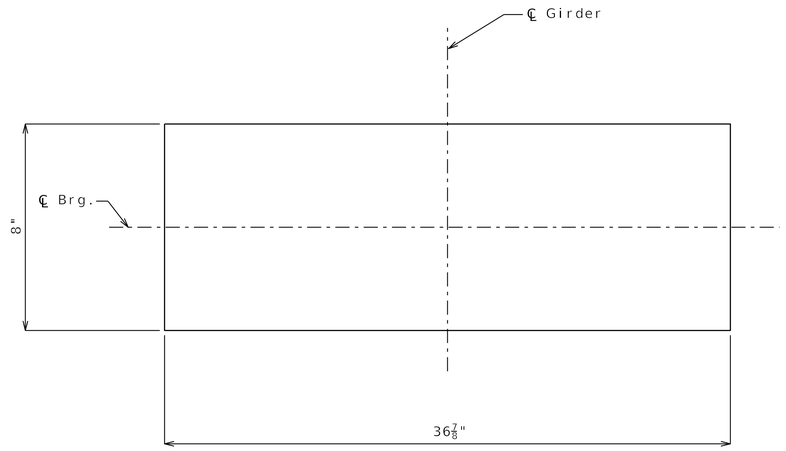
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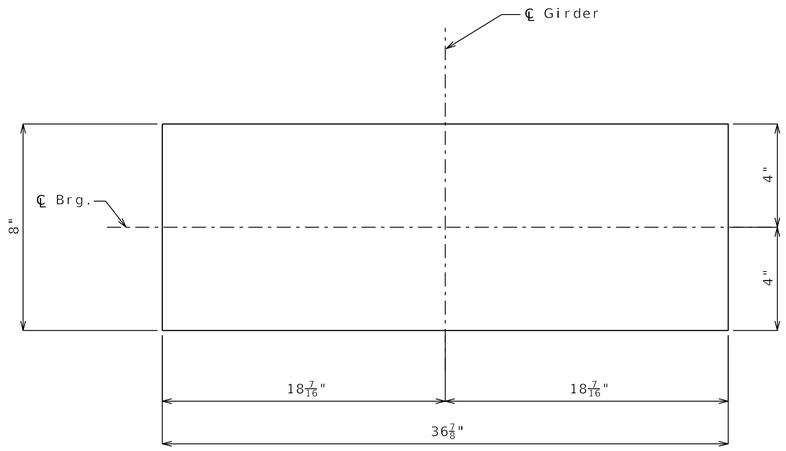
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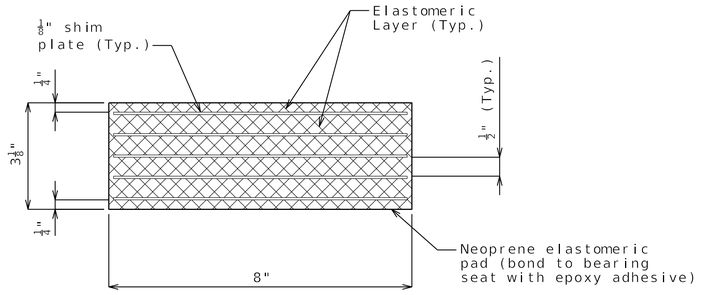
TYPICAL PLAN OF BEARINGS

Note: Neoprene Elastomeric Pads shall be 60 Durometer.



BEARING PADS AT END BENTS

Note: Neoprene Elastomeric Pads shall be $\frac{1}{2}$" 60 Durometer.



END VIEW OF BEARINGS

BEARING PADS AT FIXED BENTS

NEOPRENE BEARING PADS

Detailed APR 2024
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DATE PREPARED: 1-OCT-2024
ROUTE: 70EB
STATE: MO
DISTRICT: BR
SHEET NO.: 23
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
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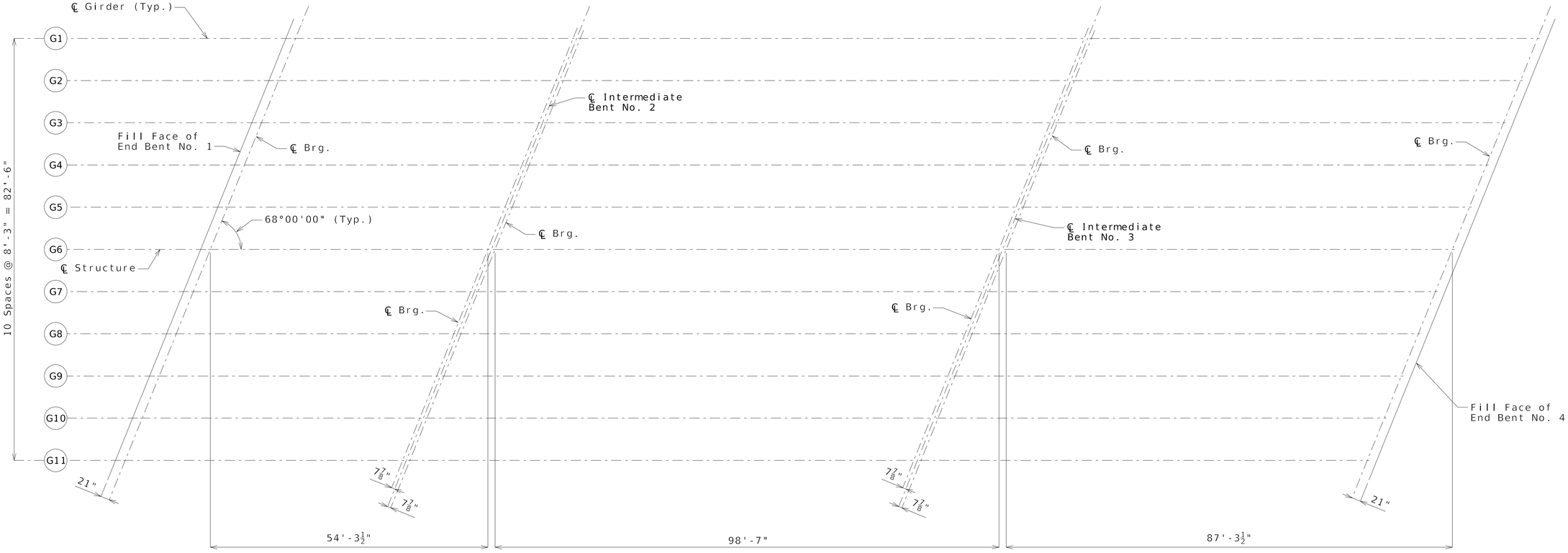
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MoDOT IMPROVE I-70 DB PROJECT 1

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REV.



PLAN SHOWING LOCATION OF GIRDERS

Longitudinal dimensions are horizontal.

GIRDER LAYOUT

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Checked JUN 2024

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ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	24

COUNTY
BOONE

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JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
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DESCRIPTION	DATE
REV. A - FINAL REVIEW	09/13/24
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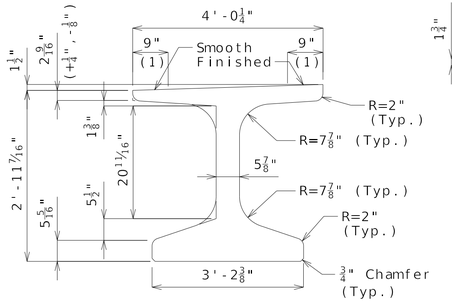
MoDOT IMPROVE I-70 DB PROJECT 1

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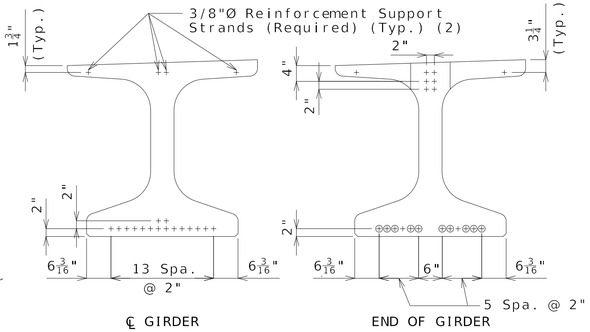
REV.

(1) Fabricator shall apply a bond breaker to this region excluding where joint filler will be applied.



DIMENSIONS

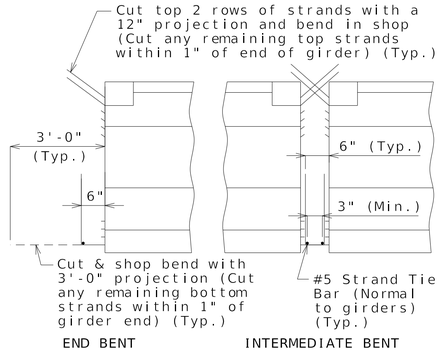
(2) Outer strands tensioned to 2.02 kips/strand and inner strands to 8 kips/strand. Placed symmetrical about ℄ Girder. May be moved laterally in pairs.



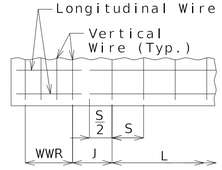
STRAND ARRANGEMENT

\+ Indicates prestressing strand.

○ Indicates cut & shop bend with 3'-0" projection.



STRANDS AT GIRDER ENDS



WELDED WIRE PLACEMENT

S = Vertical wire spacing

L = Length of WWR mats

J = Distance between WWR mats

Bill of Reinforcing Steel

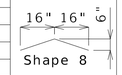
Bars Each Girder

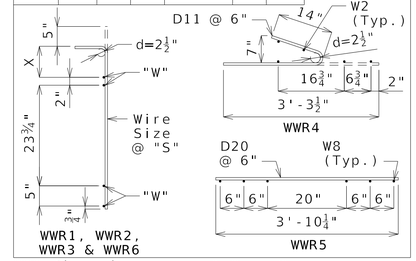
No.	Size/Mark	Length	Shape
76	3 G1	2'-10"	8
2	4 G3	4'-1⅞"	20
1	4 G4	2'-3"	20
1	4 G5	2'-10⅝"	20
6	4 G6	Varies	20

Welded Wire Each Girder

Mark	Size	S	W	L	J	X
WWR1	D31	4"	W12	10'-8"	8"	9½"
WWR2	D31	8"	W12	8'-0"	12"	8½"
WWR3	D31	12"	W12	11'-0"	--	8½"
WWR6	D31	2"	W12	16"	3"	8½"

Bending Diagrams





All dimensions are out to out.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

Actual bar lengths are measured along centerline of bar to the nearest inch.

Minimum clearance to reinforcing shall be 1", unless otherwise shown.

All bar reinforcement shall be Grade 60.

WWR shall not be epoxy coated.

G4 and G5 not required for interior girders. Half no. of G3 and G6 not required for exterior girders of end spans.

General Notes:

Concrete for prestressed beams shall be Class A-1 with f'c = 8000 psi and f'ci = 6500 psi.

Use 16 strands, 0.6"Ø Grade 270, with an initial prestress force of 703 kips.

Pretensioned members shall be in accordance with Sec 1029.

Fabricator shall be responsible for location and design of lifting devices.

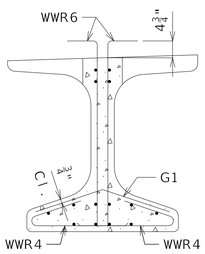
Exterior and interior girders are the same except: coil ties, top flange blockout, application of bond breaker, coil inserts for slab drains.

The contractor shall provide bracing necessary for lateral and torsional stability of the girders during construction of the concrete slab and remove the bracing after the slab has attained 75% design strength. Contractor shall not drill holes in the girders.

For Girder Camber Diagram, see Sheet No. 36.

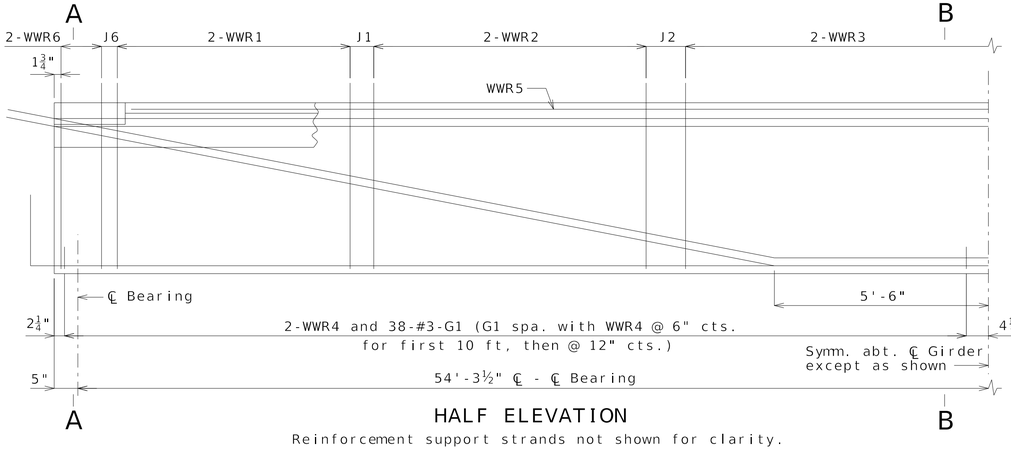
For location of coil inserts at slab drains, see Sheet No. 34.

For location of coil ties at concrete diaphragms and integral bents, see Sheets No. 8, 9, 31 and 32.



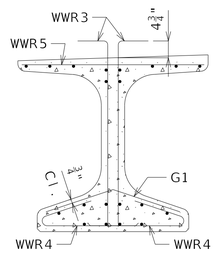
SECTION A-A

Strands not shown for clarity.



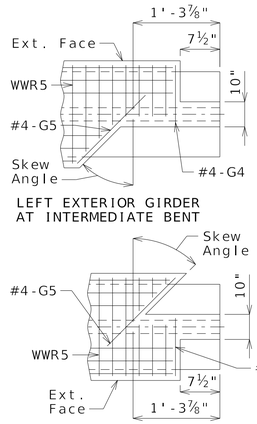
HALF ELEVATION

Reinforcement support strands not shown for clarity.



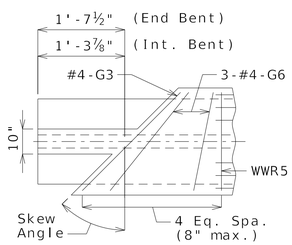
SECTION B-B

Strands not shown for clarity.



LEFT EXTERIOR GIRDER AT INTERMEDIATE BENT

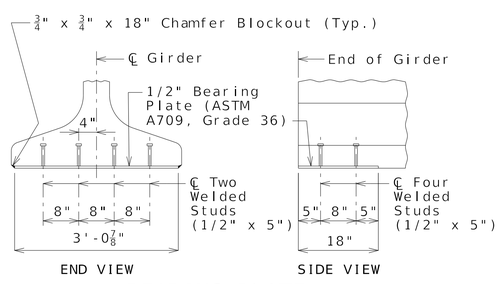
RIGHT EXTERIOR GIRDER AT INTERMEDIATE BENT



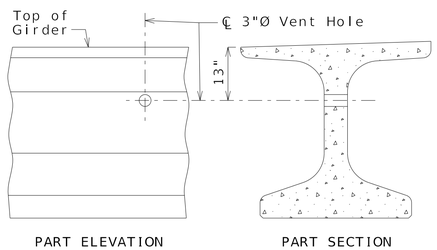
INTERIOR GIRDER AT ALL BENTS & EXTERIOR GIRDER AT END BENT

TOP FLANGE BLOCKOUT

Mirror for right advanced.

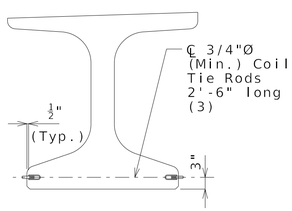


BEARING PLATE



VENT HOLE

Place vent holes at or near upgrade 1/3 point of girders and clear reinforcing steel or strands by 1 1/2" minimum.



COIL TIES

Exclude coil tie at exterior face of exterior girders except at integral end bents.

(3) 2'-0" at exterior face of exterior girders at end bents.

NU-GIRDERS - SPAN (1-2) GIRDERS 1-7

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DATE PREPARED: 1-OCT-2024

ROUTE: 70EB | STATE: MO
DISTRICT: BR | SHEET NO.: 25
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

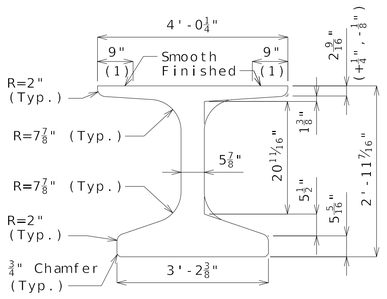
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10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)
MoDOT
MILLSTONE WEBER
Jacobs

MoDOT IMPROVE I-70 DB PROJECT 1

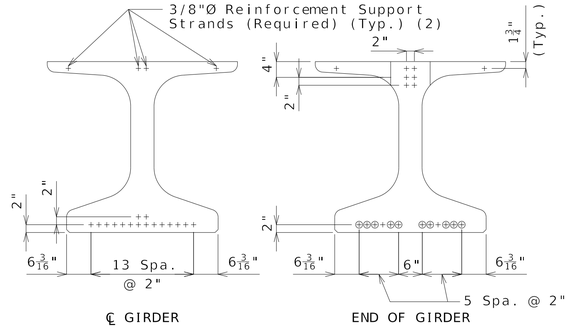
MO STATE CERTIFICATE OF AUTHORITY #025261 ENGINEERING

(1) Fabricator shall apply a bond breaker to this region excluding where joint filler will be applied.



DIMENSIONS

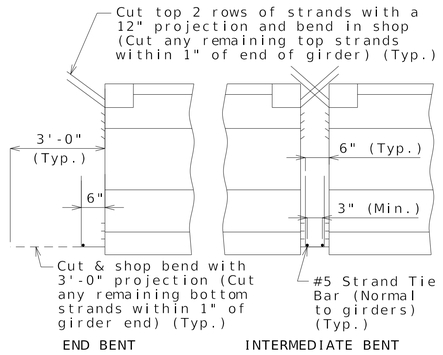
(2) Outer strands tensioned to 2.02 kips/strand and inner strands to 8 kips/strand. Placed symmetrical about ℄ Girder. May be moved laterally in pairs.



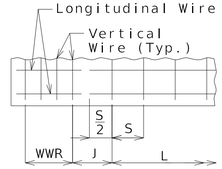
STRAND ARRANGEMENT

+ Indicates prestressing strand.

○ Indicates cut & shop bend with 3'-0" projection.



STRANDS AT GIRDER ENDS



WELDED WIRE PLACEMENT

S = Vertical wire spacing

L = Length of WWR mats

J = Distance between WWR mats

Bill of Reinforcing Steel

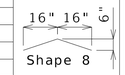
Bars Each Girder

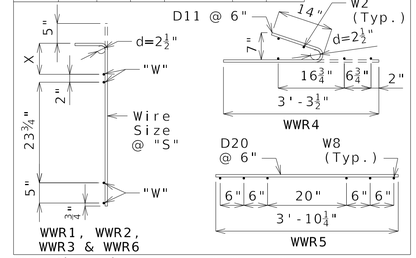
No.	Size/Mark		Length	Shape
76	3	G1	2'-10"	8
2	4	G3	4'-1⅞"	20
1	4	G4	2'-3"	20
1	4	G5	2'-10⅝"	20
6	4	G6	Varies	20

Welded Wire Each Girder

Mark	Size	S	W	L	J	X
WWR1	D31	4"	W12	10'-8"	8"	9½"
WWR2	D31	8"	W12	8'-0"	12"	8½"
WWR3	D31	12"	W12	11'-0"	--	8½"
WWR6	D31	2"	W12	16"	3"	8½"

Bending Diagrams





All dimensions are out to out.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

Actual bar lengths are measured along centerline of bar to the nearest inch.

Minimum clearance to reinforcing shall be 1", unless otherwise shown.

All bar reinforcement shall be Grade 60.

WWR shall not be epoxy coated.

G4 and G5 not required for interior girders. Half no. of G3 and G6 not required for exterior girders of end spans.

General Notes:

Concrete for prestressed beams shall be Class A-1 with f'c = 8000 psi and f'ci = 6500 psi.

Use 16 strands, 0.6"Ø Grade 270, with an initial prestress force of 703 kips.

Pretensioned members shall be in accordance with Sec 1029.

Fabricator shall be responsible for location and design of lifting devices.

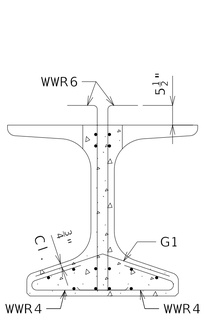
Exterior and interior girders are the same except: coil ties, top flange blockout, application of bond breaker, coil inserts for slab drains.

The contractor shall provide bracing necessary for lateral and torsional stability of the girders during construction of the concrete slab and remove the bracing after the slab has attained 75% design strength. Contractor shall not drill holes in the girders.

For Girder Camber Diagram, see Sheet No. 36

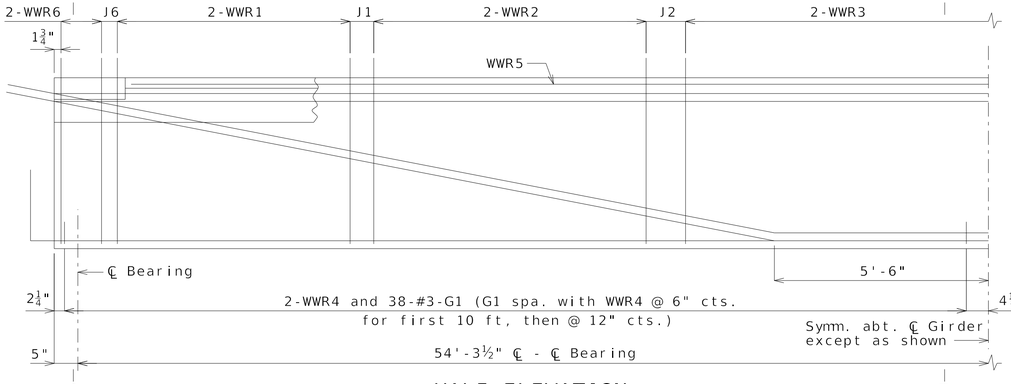
For location of coil inserts at slab drains, see Sheet No. 35.

For location of coil ties at concrete diaphragms and integral bents, see Sheets No. 8, 9, 31 and 32.



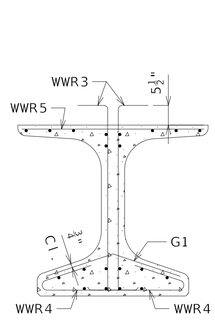
SECTION A-A

Strands not shown for clarity.



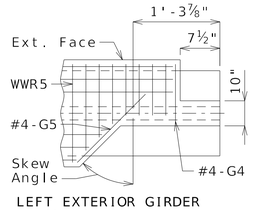
HALF ELEVATION

Reinforcement support strands not shown for clarity.

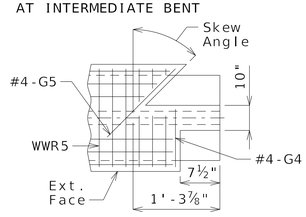


SECTION B-B

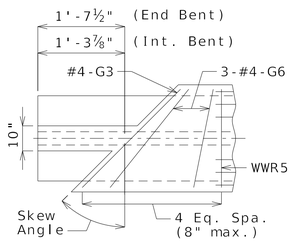
Strands not shown for clarity.



LEFT EXTERIOR GIRDER AT INTERMEDIATE BENT



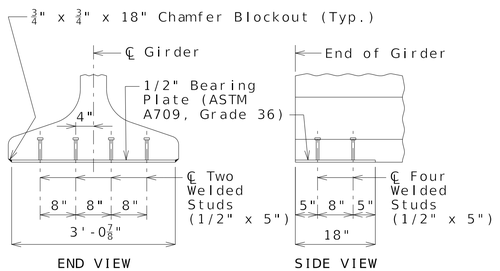
RIGHT EXTERIOR GIRDER AT INTERMEDIATE BENT



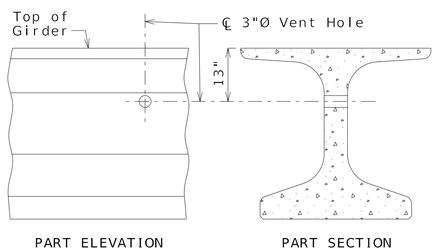
INTERIOR GIRDER AT ALL BENTS & EXTERIOR GIRDER AT END BENT

TOP FLANGE BLOCKOUT

Mirror for right advanced.

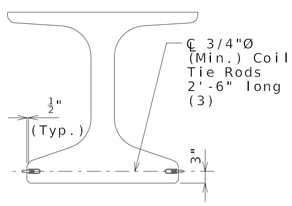


BEARING PLATE



VENT HOLE

Place vent holes at or near upgrade 1/3 point of girders and clear reinforcing steel or strands by 1 1/2" minimum.



COIL TIES

Exclude coil tie at exterior face of exterior girders except at integral end bents.

(3) 2'-0" at exterior face of exterior girders at end bents.

NU-GIRDERS - SPAN (1-2) GIRDERS 8-11

Detailed APR 2024
Checked JUNE 2024

Note: This drawing is not to scale. Follow dimensions.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_026_JST0021_NU35 GIRDERS SHEET 2.dgn 16:16 1-OCT-2024

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	26

COUNTY: BOONE

JOB NO.: JST0021

CONTRACT ID.:

PROJECT NO.:

BRIDGE NO.: A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

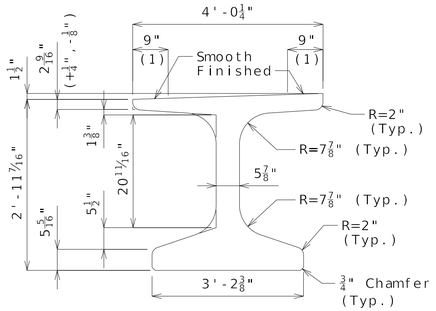
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
Jacobs

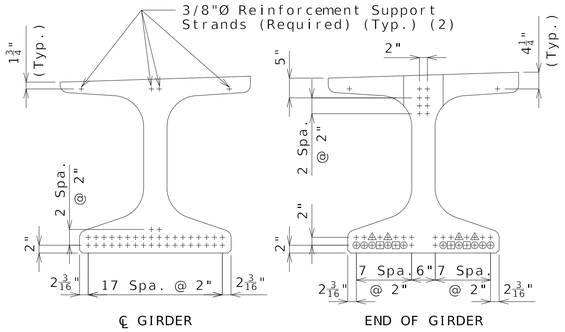
MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

(1) Fabricator shall apply a bond breaker to this region excluding where joint filler will be applied.



GIRDER DIMENSIONS AT ℄ GIRDER

(2) Outer strands tensioned to 2.02 kips/strand and inner strands to 8 kips/strand. Placed symmetrical about ℄ Girder. May be moved laterally in pairs.



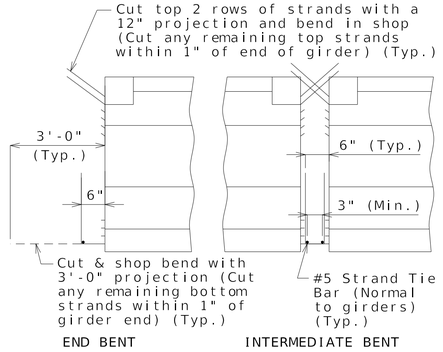
STRAND ARRANGEMENT

+ Indicates prestressing strand.

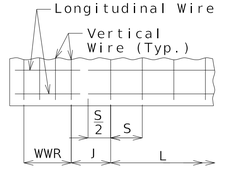
□ Indicates debonded for 7'-0" from end of girder

△ Indicates debonded for 3'-6" from end of girder

○ Indicates cut & shop bend with 3'-0" projection.



STRANDS AT GIRDER ENDS



WELDED WIRE PLACEMENT

S = Vertical wire spacing

L = Length of WWR mats

J = Distance between WWR mats

Bill of Reinforcing Steel

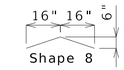
Bars Each Girder

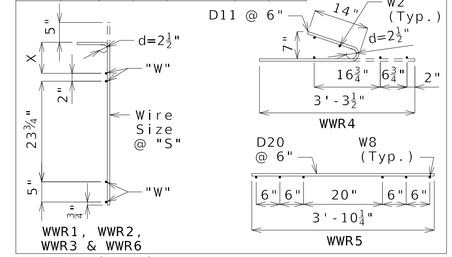
No.	Size	Mark	Length	Shape
120	3	G1	2'-10"	8
2	4	G3	4'-1⅞"	20
2	4	G4	2'-3"	20
2	4	G5	2'-10⅝"	20
3	4	G6	Varies	20

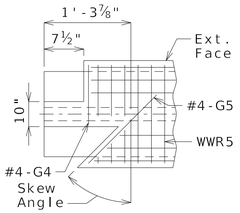
Welded Wire Each Girder

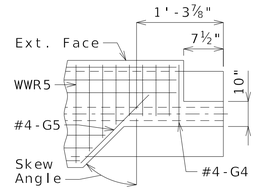
Mark	Size	S	W	L	J	X
WWR1	D31	4"	W12	10'-8"	6"	10½"
WWR2	D31	8"	W12	8'-0"	9¾"	10½"
WWR3	D31	12"	W12	56'-0"	--	9½"
WWR6	D31	2"	W12	16"	3"	8½"

Bending Diagrams

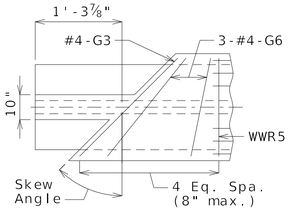








LEFT EXTERIOR GIRDER
Rotate 180° for right ext.



INTERIOR GIRDER AT ALL BENTS

TOP FLANGE BLOCKOUT
Mirror for right advanced.

All dimensions are out to out.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

Actual bar lengths are measured along centerline of bar to the nearest inch.

Minimum clearance to reinforcing shall be 1", unless otherwise shown.

All bar reinforcement shall be Grade 60.

WWR shall not be epoxy coated.

G4 and G5 not required for interior girders. G3 and G6 not required for exterior girders of intermediate spans.

General Notes:

Concrete for prestressed beams shall be Class A-1 with f'c = 8000 psi and f'ci = 6500 psi.

Use 38 strands, 0.6"Ø Grade 270, with an initial prestress force of 1670 kips.

Pretensioned members shall be in accordance with Sec 1029.

Fabricator shall be responsible for location and design of lifting devices.

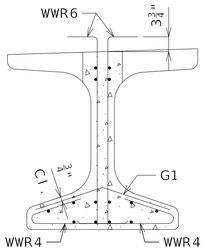
Exterior and interior girders are the same except: coil ties, top flange blockout, application of bond breaker, coil inserts for slab drains.

The contractor shall provide bracing necessary for lateral and torsional stability of the girders during construction of the concrete slab and remove the bracing after the slab has attained 75% design strength. Contractor shall not drill holes in the girders.

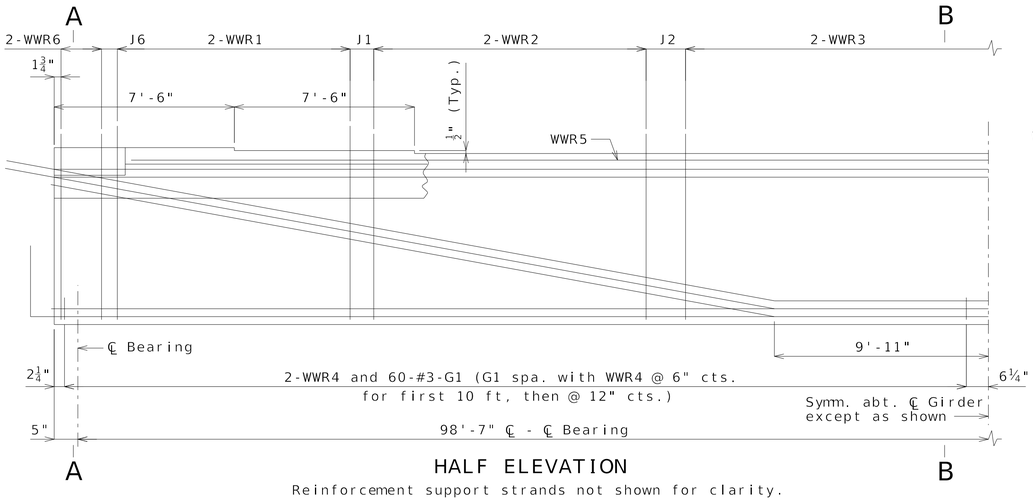
For Girder Camber Diagram, see Sheet No. 36.

For location of coil inserts at slab drains, see Sheet No. 35.

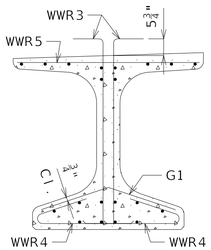
For location of coil ties at concrete diaphragms, see Sheet Nos. 31 and 32.



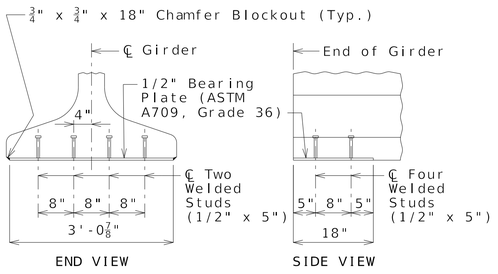
SECTION A-A
Strands not shown for clarity.



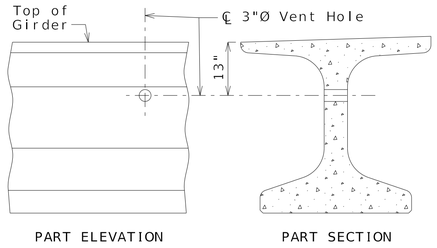
HALF ELEVATION
Reinforcement support strands not shown for clarity.



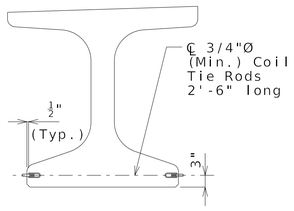
SECTION B-B
Strands not shown for clarity.



BEARING PLATE



VENT HOLE
Place vent holes at or near upgrade 1/3 point of girders and clear reinforcing steel or strands by 1 1/2" minimum.



COIL TIES
Exclude coil tie at exterior face of exterior girders.

NU-GIRDERS - SPAN (2-3)-GIRDERS 1-7

Detailed APR 2024
Checked JUNE 2024

Note: This drawing is not to scale. Follow dimensions.

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER

10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	27

COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

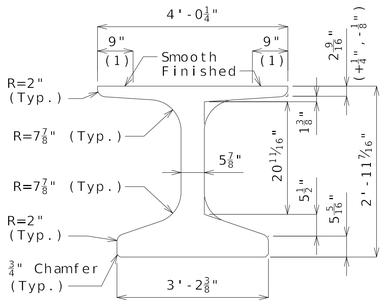
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
Jacobs

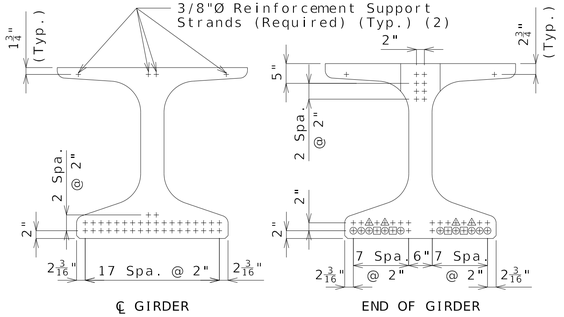
MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

(1) Fabricator shall apply a bond breaker to this region excluding where joint filler will be applied.



GIRDER DIMENSIONS AT ℄ GIRDER

(2) Outer strands tensioned to 2.02 kips/strand and inner strands to 8 kips/strand. Placed symmetrical about ℄ Girder. May be moved laterally in pairs.



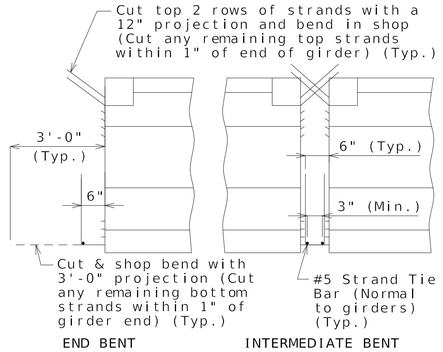
STRAND ARRANGEMENT

+ Indicates prestressing strand.

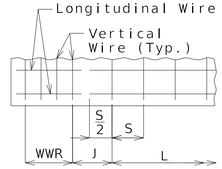
□ Indicates debonded for 7'-0" from end of girder

△ Indicates debonded for 3'-6" from end of girder

○ Indicates cut & shop bend with 3'-0" projection.



STRANDS AT GIRDER ENDS



WELDED WIRE PLACEMENT

S = Vertical wire spacing

L = Length of WWR mats

J = Distance between WWR mats

Bill of Reinforcing Steel

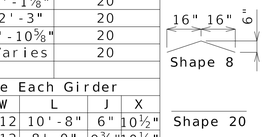
Bars Each Girder

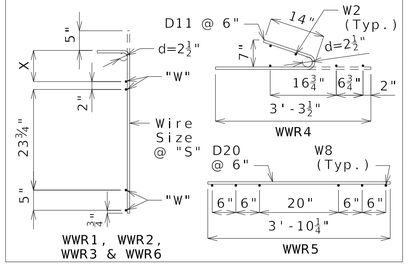
No.	Size/Mark	Length	Shape
120	3 G1	2'-10"	8
2	4 G3	4'-1⅞"	20
2	4 G4	2'-3"	20
2	4 G5	2'-10⅝"	20
3	4 G6	Varies	20

Welded Wire Each Girder

Mark	Size	S	W	L	J	X
WWR1	D31	4"	W12	10'-8"	6"	10½"
WWR2	D31	8"	W12	8'-0"	9¾"	10½"
WWR3	D31	12"	W12	56'-0"	--	9½"
WWR6	D31	2"	W12	16"	3"	8½"

Bending Diagrams





All dimensions are out to out.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

Actual bar lengths are measured along centerline of bar to the nearest inch.

Minimum clearance to reinforcing shall be 1", unless otherwise shown.

All bar reinforcement shall be Grade 60.

WWR shall not be epoxy coated.

G4 and G5 not required for interior girders. G3 and G6 not required for exterior girders of intermediate spans.

General Notes:

Concrete for prestressed beams shall be Class A-1 with f'c = 8000 psi and f'ci = 6500 psi.

Use 38 strands, 0.6"Ø Grade 270, with an initial prestress force of 1670 kips.

Pretensioned members shall be in accordance with Sec 1029.

Fabricator shall be responsible for location and design of lifting devices.

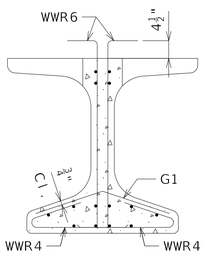
Exterior and interior girders are the same except: coil ties, top flange blockout, application of bond breaker, coil inserts for slab drains.

The contractor shall provide bracing necessary for lateral and torsional stability of the girders during construction of the concrete slab and remove the bracing after the slab has attained 75% design strength. Contractor shall not drill holes in the girders.

For Girder Camber Diagram, see Sheet No.36.

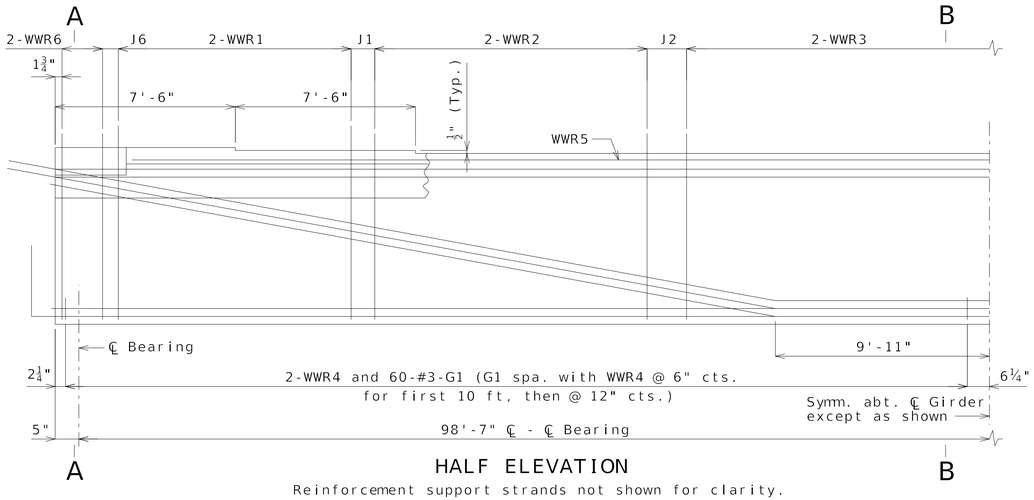
For location of coil inserts at slab drains, see Sheet No. 34.

For location of coil ties at concrete diaphragms, see Sheet Nos. 31 and 32.



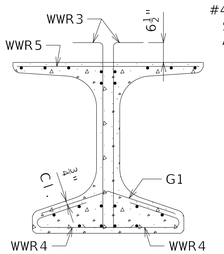
SECTION A-A

Strands not shown for clarity.



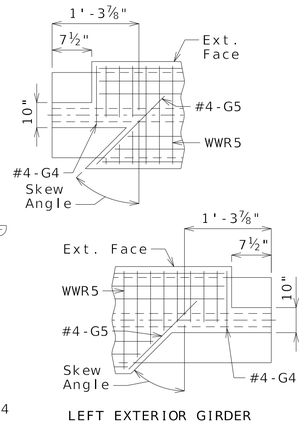
HALF ELEVATION

Reinforcement support strands not shown for clarity.



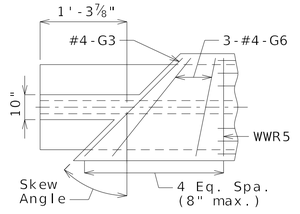
SECTION B-B

Strands not shown for clarity.



LEFT EXTERIOR GIRDER

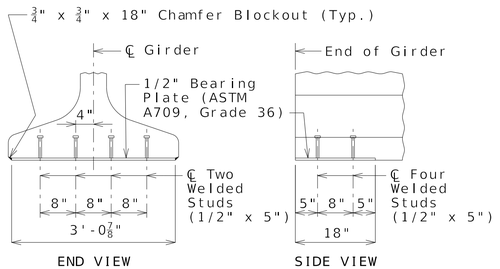
Rotate 180° for right ext.



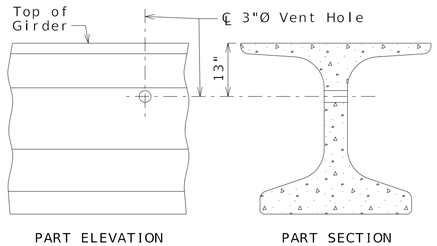
INTERIOR GIRDER AT ALL BENTS

TOP FLANGE BLOCKOUT

Mirror for right advanced.

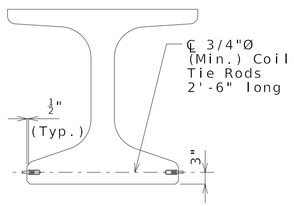


BEARING PLATE



VENT HOLE

Place vent holes at or near upgrade 1/3 point of girders and clear reinforcing steel or strands by 1 1/2" minimum.



COIL TIES

Exclude coil tie at exterior face of exterior girders.

NU-GIRDERS - SPAN (2-3) - GIRDERS 8-11

Detailed APR 2024
Checked JUNE 2024

Note: This drawing is not to scale. Follow dimensions.

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED
1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	28

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

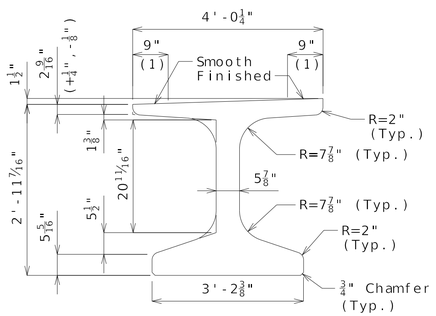
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
Jacobs

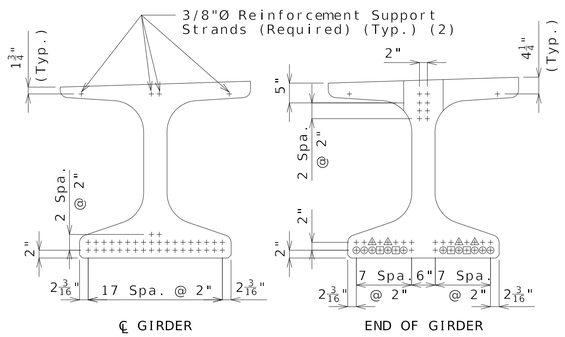
MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

(1) Fabricator shall apply a bond breaker to this region excluding where joint filler will be applied.



GIRDER DIMENSIONS AT ℄ GIRDER

(2) Outer strands tensioned to 2.02 kips/strand and inner strands to 8 kips/strand. Placed symmetrical about ℄ Girder. May be moved laterally in pairs.



℄ GIRDER END OF GIRDER

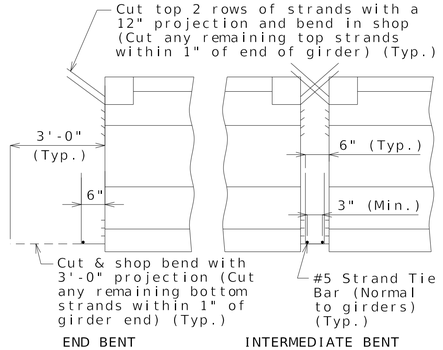
STRAND ARRANGEMENT

+ Indicates prestressing strand.

□ Indicates debonded for 7'-0" from end of girder

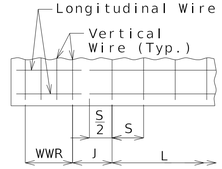
△ Indicates debonded for 3'-6" from end of girder

○ Indicates cut & shop bend with 3'-0" projection.



END BENT INTERMEDIATE BENT

STRANDS AT GIRDER ENDS



WELDED WIRE PLACEMENT

S = Vertical wire spacing

L = Length of WWR mats

J = Distance between WWR mats

Bill of Reinforcing Steel

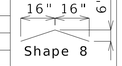
Bars Each Girder

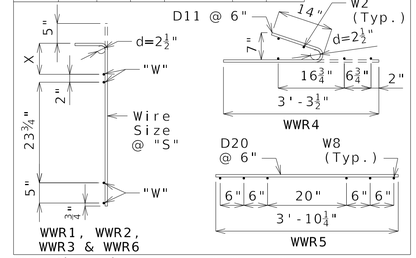
No.	Size/Mark	Length	Shape
110	3 G1	2'-10"	8
2	4 G3	4'-1⅞"	20
1	4 G4	2'-3"	20
1	4 G5	2'-10⅝"	20
6	4 G6	Varies	20

Welded Wire Each Girder

Mark	Size	S	W	L	J	X
WWR1	D31	4"	W12	10'-8"	8"	10½"
WWR2	D31	8"	W12	8'-0"	12"	9½"
WWR3	D31	12"	W12	44'-0"	--	9½"
WWR6	D31	2"	W12	16"	3"	8½"

Bending Diagrams





All dimensions are out to out.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

Actual bar lengths are measured along centerline of bar to the nearest inch.

Minimum clearance to reinforcing shall be 1", unless otherwise shown.

All bar reinforcement shall be Grade 60.

WWR shall not be epoxy coated.

G4 and G5 not required for interior girders. Half no. of G3 and G6 not required for exterior girders of end spans.

General Notes:

Concrete for prestressed beams shall be Class A-1 with f'c = 8000 psi and f'ci = 6500 psi.

Use 38 strands, 0.6"Ø Grade 270, with an initial prestress force of 1670 kips.

Pretensioned members shall be in accordance with Sec 1029.

Fabricator shall be responsible for location and design of lifting devices.

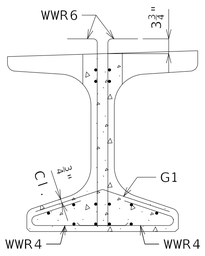
Exterior and interior girders are the same except: coil ties, top flange blockout, application of bond breaker, coil inserts for slab drains.

The contractor shall provide bracing necessary for lateral and torsional stability of the girders during construction of the concrete slab and remove the bracing after the slab has attained 75% design strength. Contractor shall not drill holes in the girders.

For Girder Camber Diagram, see Sheet No. 36.

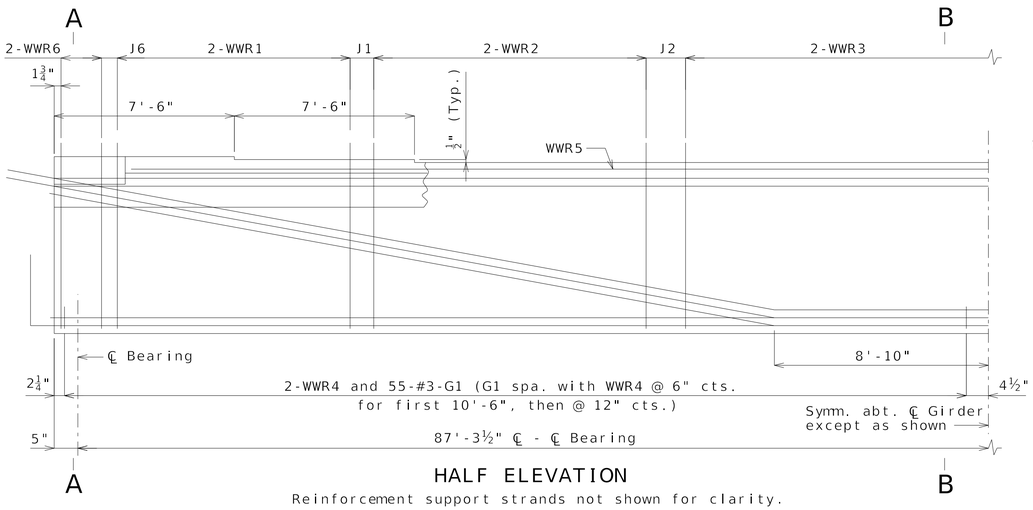
For location of coil inserts at slab drains, see Sheet No. 35.

For location of coil ties at concrete diaphragms and integral bents, see Sheets No. 20, 21, 31 AND 32.



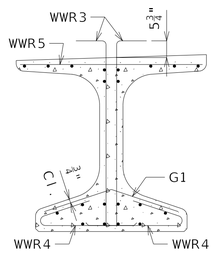
SECTION A-A

Strands not shown for clarity.



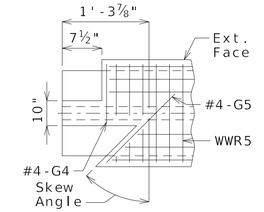
HALF ELEVATION

Reinforcement support strands not shown for clarity.

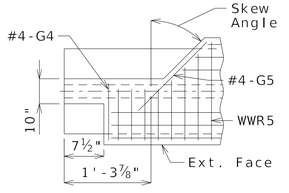


SECTION B-B

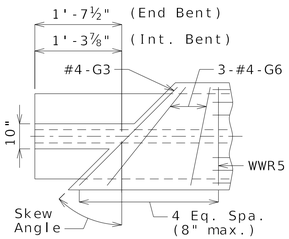
Strands not shown for clarity.



LEFT EXTERIOR GIRDER AT INTERMEDIATE BENT



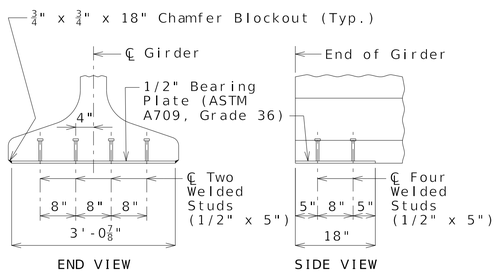
RIGHT EXTERIOR GIRDER AT INTERMEDIATE BENT



INTERIOR GIRDER AT ALL BENTS & EXTERIOR GIRDER AT END BENT

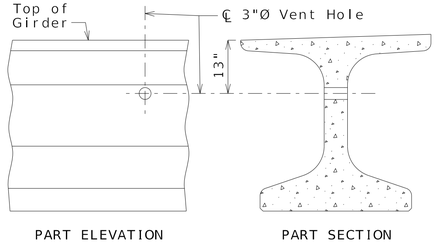
TOP FLANGE BLOCKOUT

Mirror for right advanced.



END VIEW SIDE VIEW

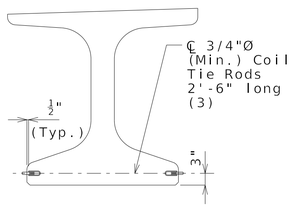
BEARING PLATE



PART ELEVATION PART SECTION

VENT HOLE

Place vent holes at or near upgrade 1/3 point of girders and clear reinforcing steel or strands by 1 1/2" minimum.



COIL TIES

Exclude coil tie at exterior face of exterior girders except at integral end bents.

(3) 2'-0" at exterior face of exterior girders at end bents.

NU-GIRDERS - SPAN (3-4)-GIRDERS 1-7

Detailed APR 2024
Checked JUNE 2024

Note: This drawing is not to scale. Follow dimensions.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_029_JST0021_NU35 GIRDERS SHEET 5.dgn 16:18 1-OCT-2024

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED
1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	29

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

MoDOT IMPROVE I-70 DB PROJECT 1

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

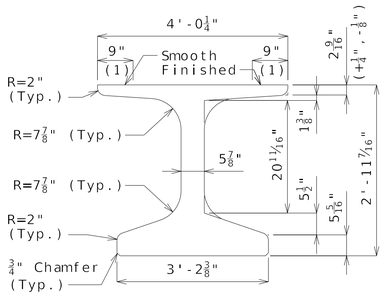
MILLSTONE WEBER

Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

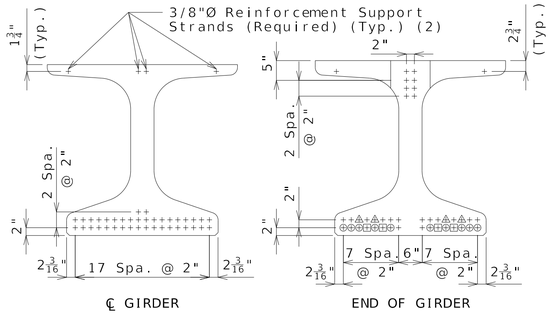
REV.

(1) Fabricator shall apply a bond breaker to this region excluding where joint filler will be applied.



GIRDER DIMENSIONS AT ℄ GIRDER

(2) Outer strands tensioned to 2.02 kips/strand and inner strands to 8 kips/strand. Placed symmetrical about ℄ Girder. May be moved laterally in pairs.



℄ GIRDER END OF GIRDER

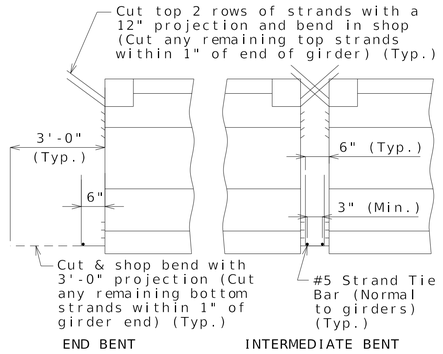
STRAND ARRANGEMENT

\+ Indicates prestressing strand.

□ Indicates debonded for 7'-0" from end of girder

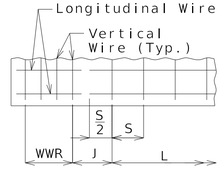
△ Indicates debonded for 3'-6" from end of girder

○ Indicates cut & shop bend with 3'-0" projection.



END BENT INTERMEDIATE BENT

STRANDS AT GIRDER ENDS



WELDED WIRE PLACEMENT

S = Vertical wire spacing

L = Length of WWR mats

J = Distance between WWR mats

Bill of Reinforcing Steel

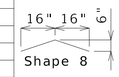
Bars Each Girder

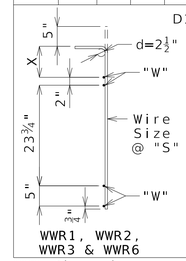
No.	Size/Mark	Length	Shape
110	3 G1	2'-10"	8
2	4 G3	4'-1⅞"	20
1	4 G4	2'-3"	20
1	4 G5	2'-10⅝"	20
6	4 G6	Varies	20

Welded Wire Each Girder

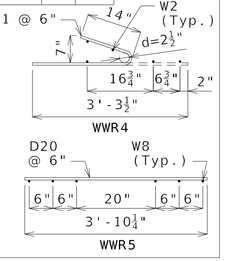
Mark	Size	S	W	L	J	X
WWR1	D31	4"	W12	10'-8"	8"	10½"
WWR2	D31	8"	W12	8'-0"	12"	9½"
WWR3	D31	12"	W12	44'-0"	--	9½"
WWR6	D31	2"	W12	16"	3"	8½"

Bending Diagrams





WWR1, WWR2, WWR3 & WWR6



All dimensions are out to out.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

Actual bar lengths are measured along centerline of bar to the nearest inch.

Minimum clearance to reinforcing shall be 1", unless otherwise shown.

All bar reinforcement shall be Grade 60.

WWR shall not be epoxy coated.

G4 and G5 not required for interior girders. Half no. of G3 and G6 not required for exterior girders of end spans.

General Notes:

Concrete for prestressed beams shall be Class A-1 with f'c = 8000 psi and f'ci = 6500 psi.

Use 38 strands, 0.6"Ø Grade 270, with an initial prestress force of 1670 kips.

Pretensioned members shall be in accordance with Sec 1029.

Fabricator shall be responsible for location and design of lifting devices.

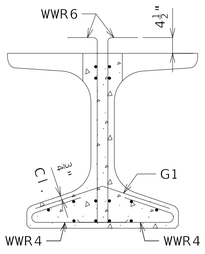
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The contractor shall provide bracing necessary for lateral and torsional stability of the girders during construction of the concrete slab and remove the bracing after the slab has attained 75% design strength. Contractor shall not drill holes in the girders.

For Girder Camber Diagram, see Sheet No. 36.

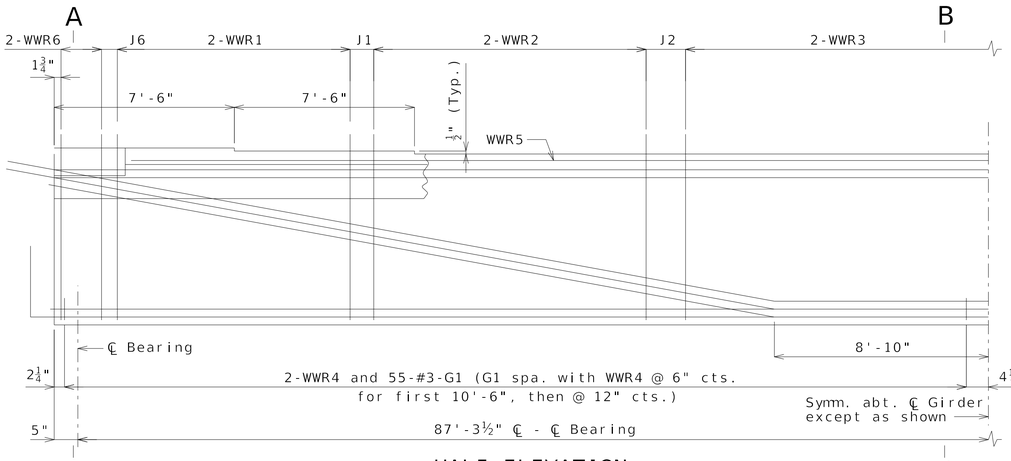
For location of coil inserts at slab drains, see Sheet No. 34.

For location of coil ties at concrete diaphragms and integral bents, see Sheets Nos. 20, 21, 31 and 32.



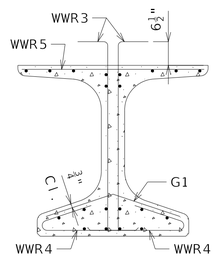
SECTION A-A

Strands not shown for clarity.



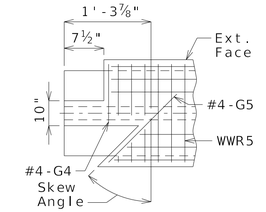
HALF ELEVATION

Reinforcement support strands not shown for clarity.

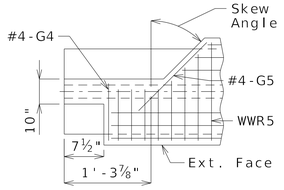


SECTION B-B

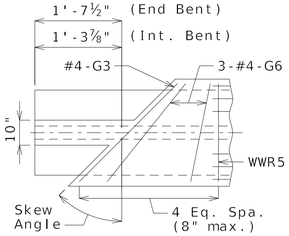
Strands not shown for clarity.



LEFT EXTERIOR GIRDER AT INTERMEDIATE BENT



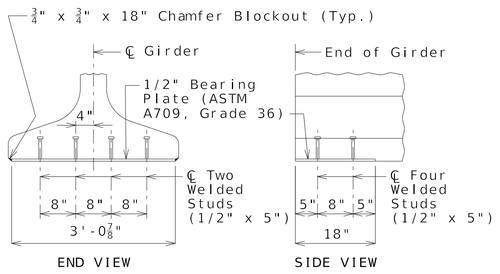
RIGHT EXTERIOR GIRDER AT INTERMEDIATE BENT



INTERIOR GIRDER AT ALL BENTS & EXTERIOR GIRDER AT END BENT

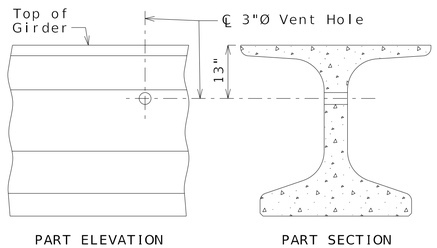
TOP FLANGE BLOCKOUT

Mirror for right advanced.



END VIEW SIDE VIEW

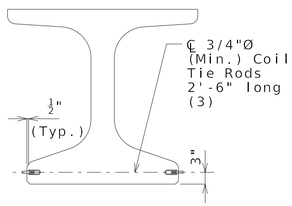
BEARING PLATE



PART ELEVATION PART SECTION

VENT HOLE

Place vent holes at or near upgrade 1/3 point of girders and clear reinforcing steel or strands by 1 1/2" minimum.



COIL TIES

Exclude coil tie at exterior face of exterior girders except at integral end bents.

(3) 2'-0" at exterior face of exterior girders at end bents.

NU-GIRDERS - SPAN (3-4)-GIRDERS 8-11

Detailed APR 2024
Checked JUNE 2024

Note: This drawing is not to scale. Follow dimensions.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_030_JST0021_NU35 GIRDERS SHEET 6.dgn 16:19 1-OCT-2024

STATE OF MISSOURI
MATTHEW J. MUENKS
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Matthew Muenks
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DATE PREPARED 1-OCT-2024

ROUTE 70EB | STATE MO

DISTRICT BR | SHEET NO. 30

COUNTY BOONE

JOB NO. JST0021

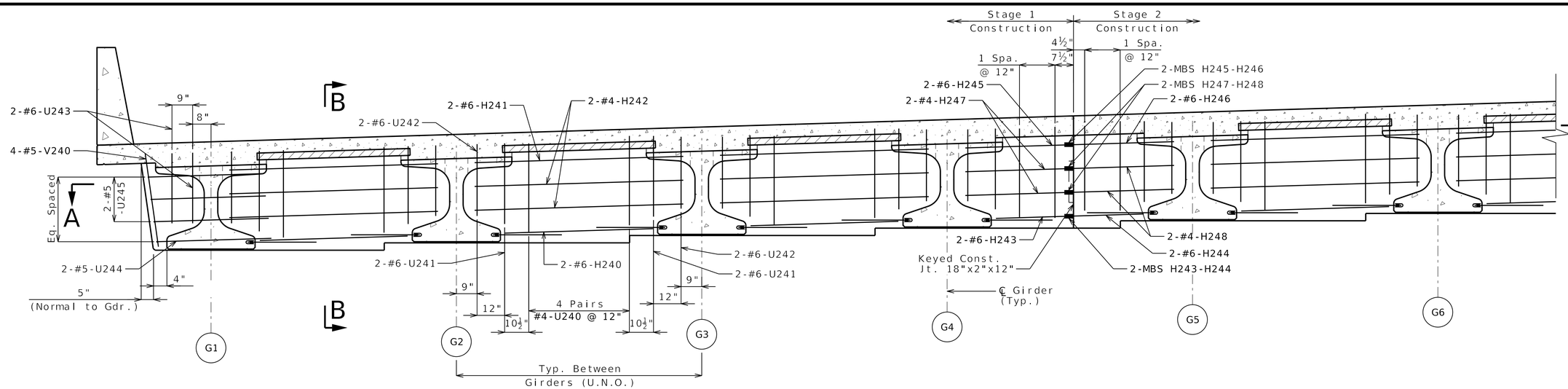
CONTRACT ID.

PROJECT NO.

BRIDGE NO. A9542

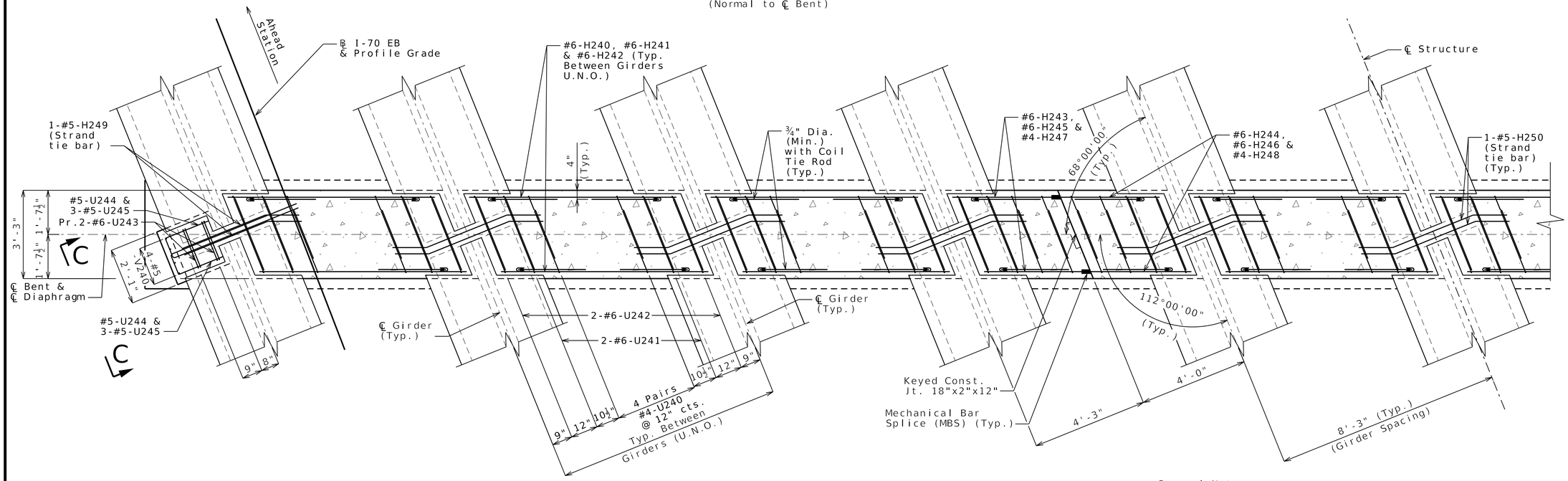
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A	FINAL REVIEW	09/13/24
0	RELEASED FOR CONSTRUCTION	10/01/24

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CONCRETE INTERMEDIATE DIAPHRAGM

(Normal to ℄ Bent)



SECTION A-A

DIAPHRAGM AT INTERMEDIATE BENTS

General Notes:

Longitudinal dimensions shown are horizontal.

Work this sheet with Sheet No. 32

For location of Strand Tie Bars and Coil Tie Rods, see Sheets No. 25 thru 30.

All U-Bars in diaphragms shall be placed parallel to ℄ Girders.

Diaphragms at intermediate bents shall be built vertical.

Bar marks shown (200 Series) are for Intermediate Bent No. 2. Bar marks for Intermediate Bent No. 3 are 300 Series.

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ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	31

COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DATE	DESCRIPTION
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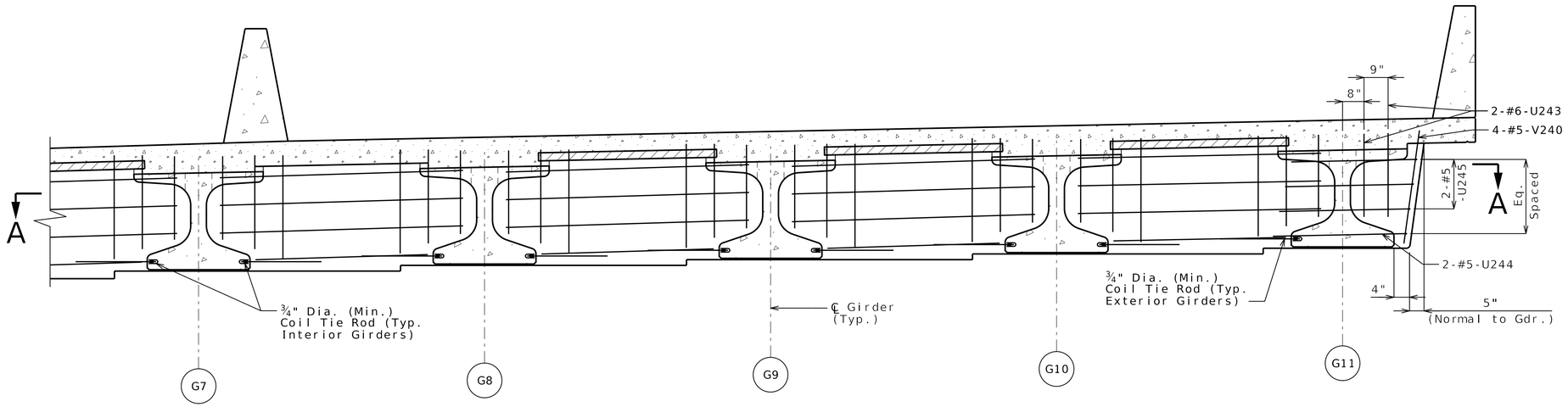
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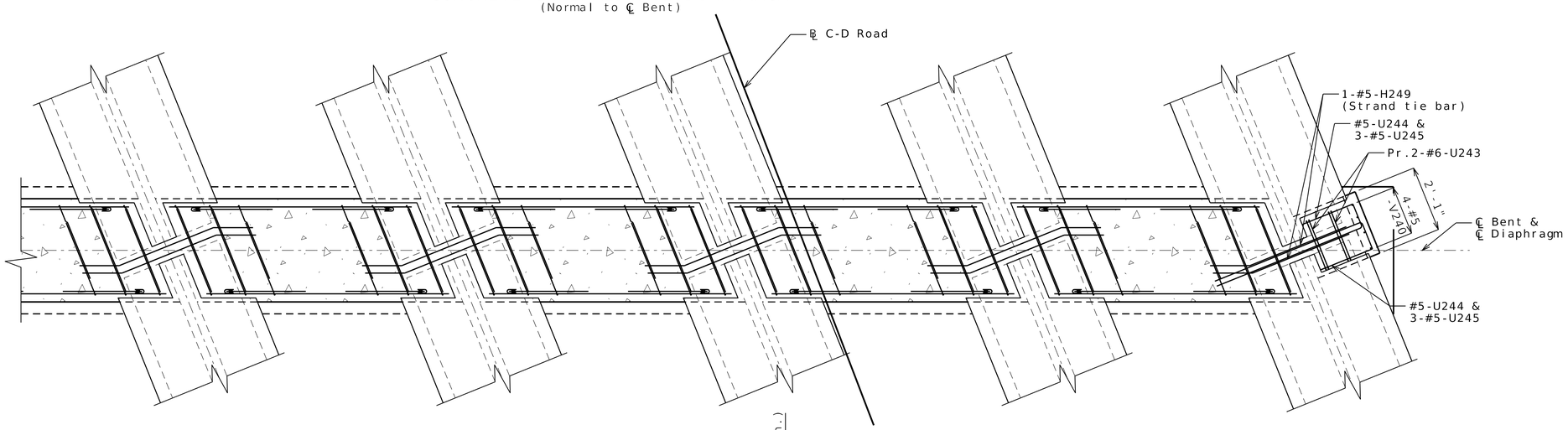
Detailed AUG 2024
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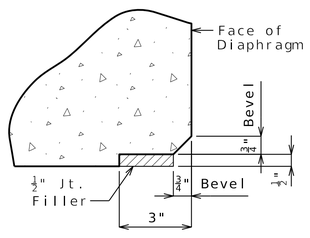
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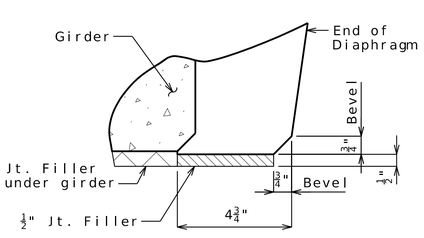
CONCRETE INTERMEDIATE DIAPHRAGM
(Normal to ℄ Bent)



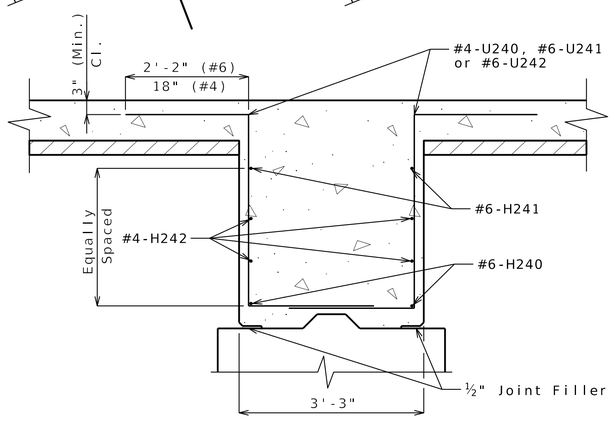
SECTION A-A



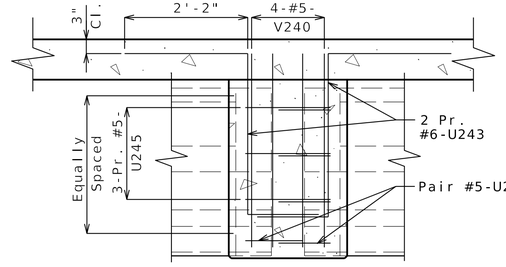
EDGE DETAIL



END DETAIL



SECTION B-B



ELEVATION C-C

Notes:
For Notes and Details not shown, see Sheet No. 31.

DIAPHRAGM AT INTERMEDIATE BENTS

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Note: This drawing is not to scale. Follow dimensions.

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STATE OF MISSOURI
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DATE PREPARED: 1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	32

COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

REV.	DATE	DESCRIPTION
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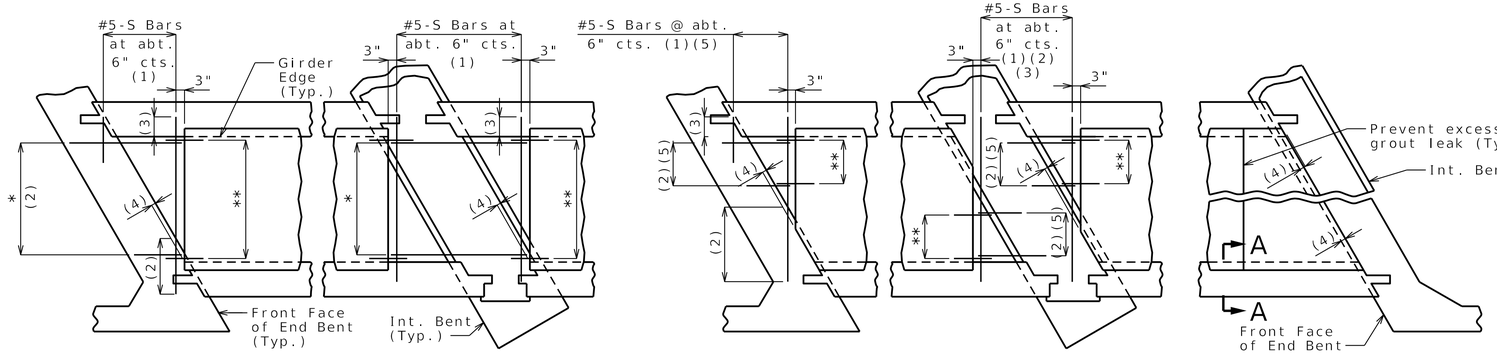
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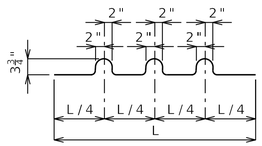
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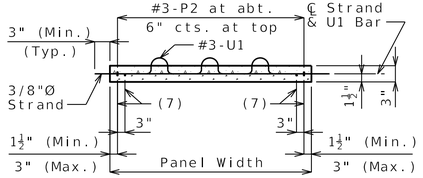


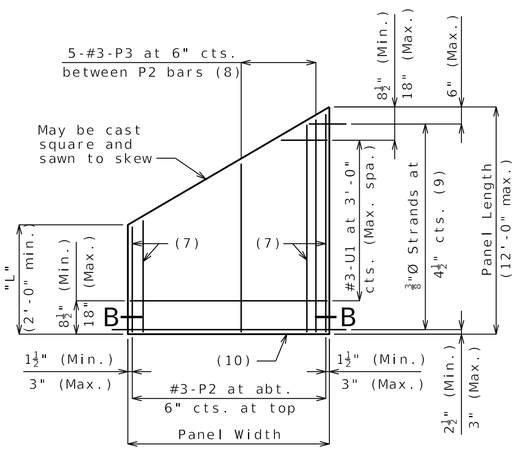
PLAN SHOWING PANEL PLACEMENT

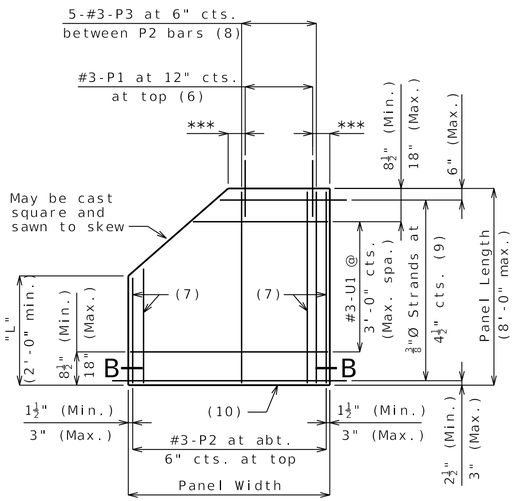
* #5-S Bars at abt. 9" cts. (1)
** #3-P1 at 12" cts. (End panels only)



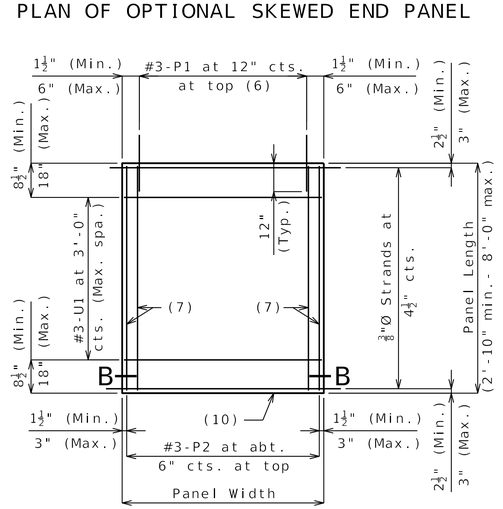
U1 Bars may be oriented at right angles to location and spacing shown. U1 Bars shall be placed between P1 bars.





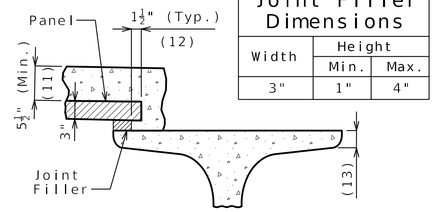


*** 3" (Min.), 6" (Max.)



SKEWED END PANELS

Joint Filler Dimensions		
Width	Height	
	Min.	Max.
3"	1"	4"



Reference Notes:

Plan of Panel Placement:
(1) S-bars shown are bottom steel in slab between panels and used with squared and truncated end panels only.

(2) Extend S-bars 18 inches beyond the front face of end bents and int. bents for squared and truncated end panels only.

(3) Extend S-bars 9 inches beyond edge of girder (Typ.).

(4) End panels shall be dimensioned 1/2" min. to 1 1/2" max. from the inside face of diaphragm.

(5) For truncated end panels, use a min. of #5-S bars at 6" crossings in openings, or min. 4x4-W7xW7.

Plans of Panels:
(6) For end panels only, P1 bars shall be 2'-0" in length and embedded 12". P1 bars will not be required for panels at squared integral end bents.

(7) #3-P2 bars near edge of panel at bottom (under strands).

(8) Use #3-P3 bars if panel is skewed 45° or greater.

(9) Any strand 2'-0" or shorter shall have a #4 reinforcing bar on each side of it, centered between strands. Strands 2'-0" or shorter may then be debonded at the fabricator's option.

(10) Optional 1/2" x 45° Chamfer one or both sides at bottom.

Section A-A:
(11) Slab thickness over prestressed panels varies due to girder camber. In order to maintain minimum slab thickness, it may be necessary to raise the grade uniformly throughout the structure.

(12) Contractor shall ensure proper consolidation under and between panels.

(13) At the contractor's option, the variation in slab thickness over prestressed panels may be eliminated or reduced by increasing and varying the girder top flange thickness. Dimensions shall be shown on the shop drawings.

General Notes:

Prestressed Panels:
Concrete for prestressed panels shall be Class A-1 with f'c = 6,000 psi, f'ci = 4,000 psi.

The top surface of all panels shall receive a scored finish with a depth of scoring of 1/8" perpendicular to the prestressing strands in the panels.

Prestressing tendons shall be high-tensile strength, uncoated, seven-wire, low-relaxation strands for prestressed concrete in accordance with AASHTO M 203 Grade 270, with nominal diameter of strand = 3/8" and nominal area = 0.085 sq.in. and minimum ultimate strength = 22.95 kips (270 ksi). Larger strands may be used with the same spacing and initial tension.

Initial prestressing force = 17.2 kips/strand.

The method and sequence of releasing the strands shall be shown on the shop drawings.

Suitable anchorage devices for lifting panels may be cast in panels, provided the devices are shown on the shop drawings and approved by the engineer. Panel lengths shall be determined by the contractor and shown on the shop drawings.

When squared end panels are used at skewed bents, the skewed portion shall be cast full depth.

Support from diaphragm forms is required under the optional skewed end until cast-in-place concrete has reached 3,000 psi compressive strength.

Prestressed panels shall be brought to saturated surface-dry (SSD) condition just prior to the deck pour. There shall be no free standing water on the panels or in the area to be cast.

Reinforcing Steel:
All dimensions are out to out.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

Minimum clearance to reinforcing steel shall be 1 1/2", unless otherwise shown.

If U1 bars interfere with placement of slab steel, U1 loops may be bent over, as necessary, to clear slab steel.

Deformed welded wire reinforcement (WWR) providing a minimum area of reinforcing perpendicular to strands of 0.22 sq in./ft, with spacing parallel to strands sufficient to ensure proper handling, may be used in lieu of the #3-P2 bars shown. Wire diameter shall not be larger than 0.375 inch. The above alternative reinforcement criteria may be used in lieu of the #3-P3 bars, when required, and placed over a width not less than 2 feet.

The following reinforcing steel shall be tied securely to the strands with the following maximum spacing in each direction:
#3-P2 bars at 16 inches.
WWR at 24 inches.

The #3-U1 bars shall be tied securely to #3-P2 bars, to WWR or to strands (when placed between P1 bars) at about 3-foot centers.

Minimum reinforcement steel length shall be 2'-0".

All reinforcement other than prestressing strands shall be epoxy coated.

Precast panels may be in contact with stirrup reinforcing in diaphragms.

S-bars are not listed in the bill of reinforcing.

Joint Filler:
Joint filler shall be preformed fiber expansion joint material in accordance with Sec 1057 or expanded or extruded polystyrene bedding material in accordance with Sec 1073.

Use Slab Haunching Diagram on Sheet No. 36 for determining thickness of joint filler within the limits noted in the table of Joint Filler Dimensions.

Thicker material may be used on one or both sides of the girder to reduce cast-in-place concrete thickness to within tolerances.

The same thickness of preformed fiber expansion joint material shall be used under any one edge of any panel except at locations where top flange thickness may be stepped. The maximum change in thickness between adjacent panels shall be 1/2 inch. The polystyrene bedding material may be cut with a transition to match haunch height above top of flange.

Joint filler shall be glued to the girder. When thickness exceeds 1 1/2 inches, the joint filler shall be glued top and bottom. The glue used shall be the type recommended by the joint filler manufacturer.

Edges of panels shall be uniformly seated on the joint filler before slab reinforcement is placed.

PRESTRESSED PANELS

STATE OF MISSOURI
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DATE PREPARED: 1-OCT-2024
ROUTE: 70EB | STATE: MO
DISTRICT: BR | SHEET NO.: 33
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DATE	DESCRIPTION
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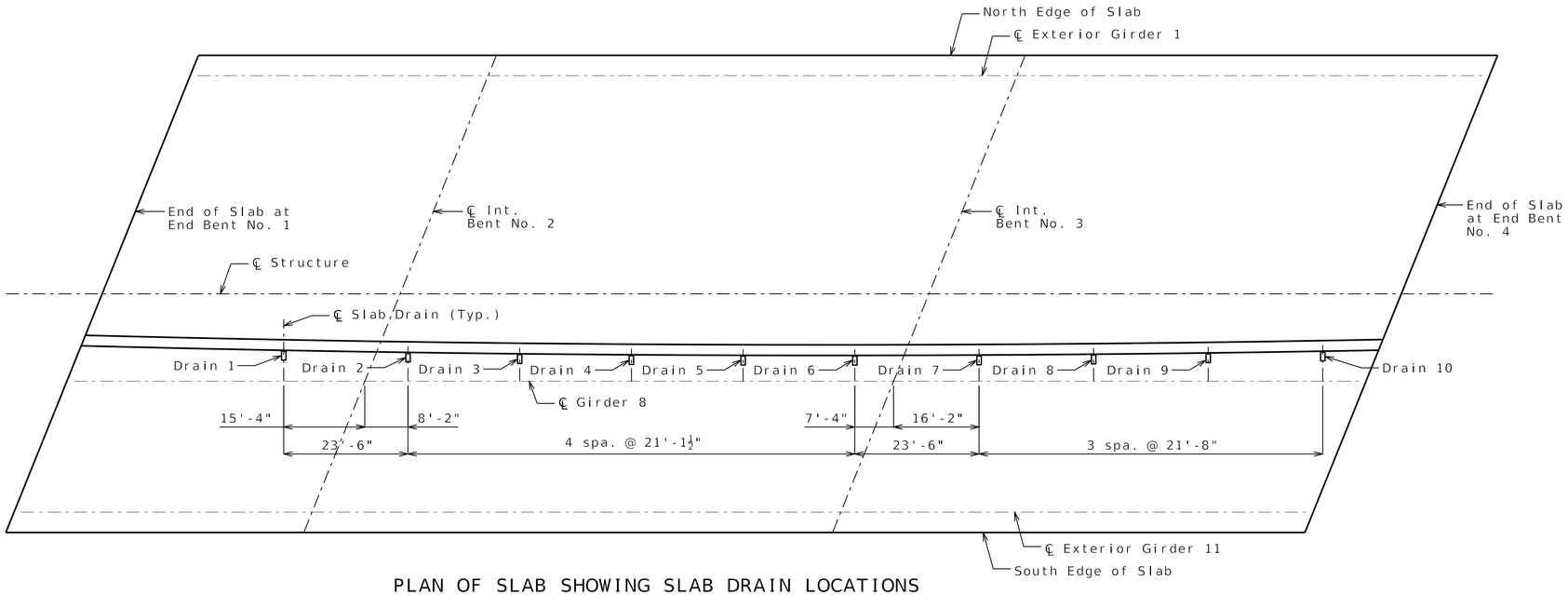
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Detailed APR. 2024
Checked JUNE 2024

Note: This drawing is not to scale. Follow dimensions.



PLAN OF SLAB SHOWING SLAB DRAIN LOCATIONS

Drain No.	Dim. A
1	4'-6"
2	4'-2¼"
3	3'-11 25/32"
4	3'-9 29/32"
5	3'-8 25/32"
6	3'-8¼"
7	3'-9 29/32"
8	3'-10 7/32"
9	4'-1¼"
10	4'-4¾"

General Notes:

Slab drain bracket assembly shall be ASTM A709 Grade 36 steel.

Locate drains in slab by dimensions shown in Part Section Near Drain.

Reinforcing steel shall be shifted to clear drains.

The coil inserts and bracket assembly shall be galvanized in accordance with ASTM A123.

All bolts, hardened washers, lock washers and nuts shall be galvanized in accordance with AASHTO M 232 (ASTM A153), Class C.

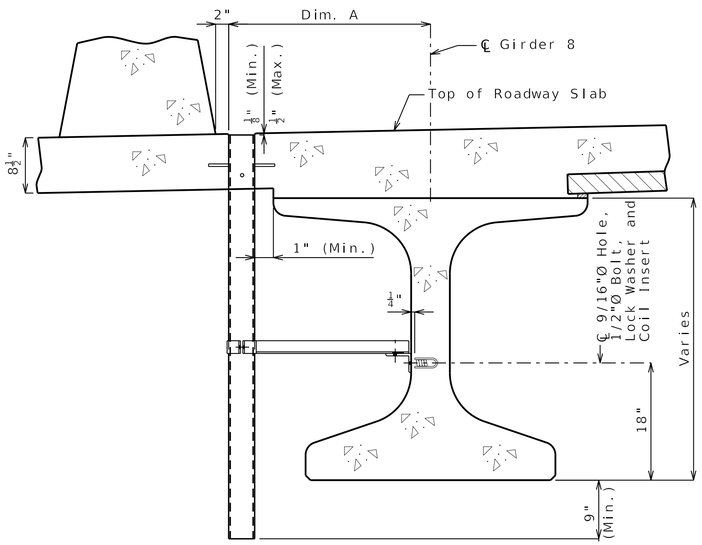
All 1/2"Ø bolts shall be ASTM A307.

Shop drawings will not be required for the slab drains and the bracket assembly.

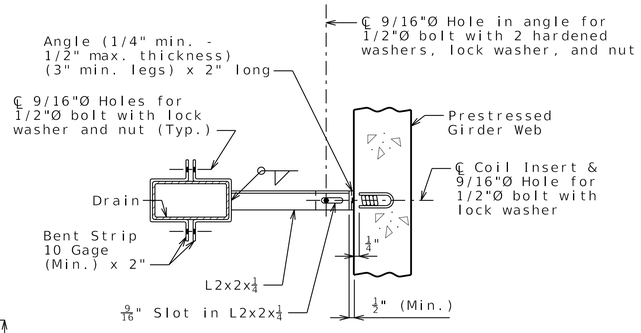
The coil insert required for the bracket assembly attachment shall be located on the prestressed girder shop drawings.

Coil inserts shall have a concrete pull-out strength (ultimate load) of at least 2,500 pounds in 5,000 psi concrete.

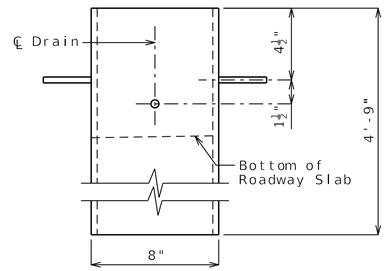
The bolt required to attach the slab drain bracket assembly to the prestressed girder web shall be supplied by the prestressed girder fabricator.



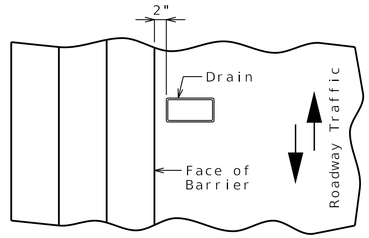
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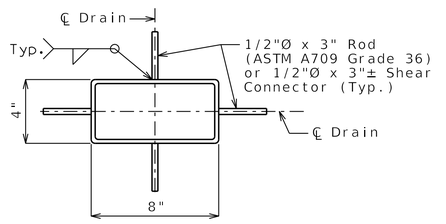
PART SECTION SHOWING BRACKET ASSEMBLY



ELEVATION OF DRAIN



PART PLAN OF SLAB AT DRAIN



PLAN OF STEEL DRAIN OPTION

Notes for Steel Drain:

Slab drains may be fabricated of either 1/4" welded sheets of ASTM A709 Grade 36 steel or from 1/4" structural steel tubing ASTM A500 or A501.

Outside dimensions of drains are 8" x 4".

The drains shall be galvanized in accordance with ASTM A123.

SLAB DRAINS

Detailed JULY 2024
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Note: This drawing is not to scale. Follow dimensions.

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MATTHEW J. MUENKS
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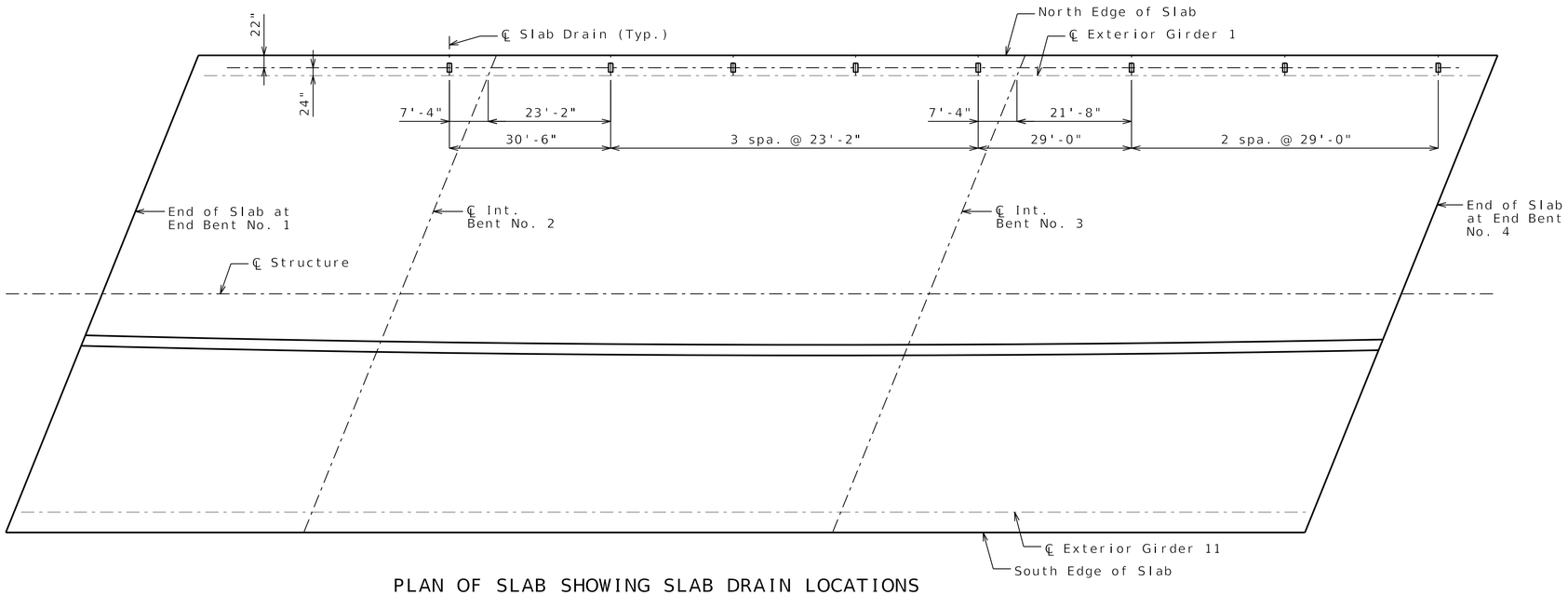
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70EB	MO
DISTRICT	SHEET NO.
BR	34

COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

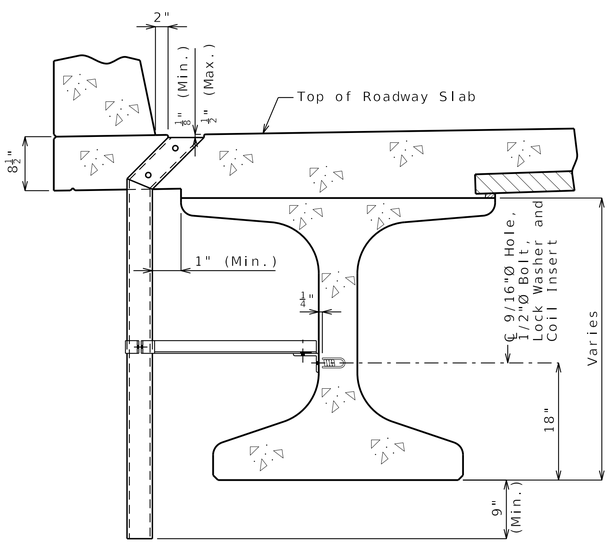
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10/01/24	0	RELEASED FOR CONSTRUCTION

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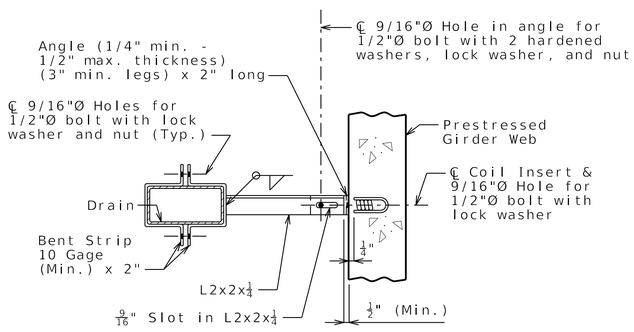
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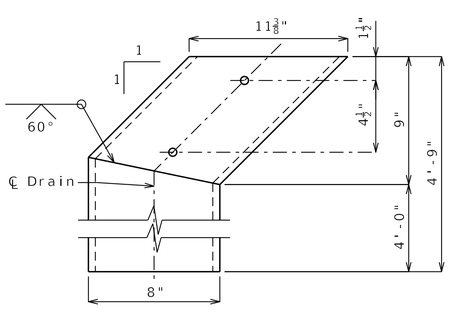
PLAN OF SLAB SHOWING SLAB DRAIN LOCATIONS



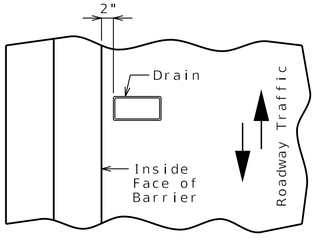
PART SECTION NEAR DRAIN



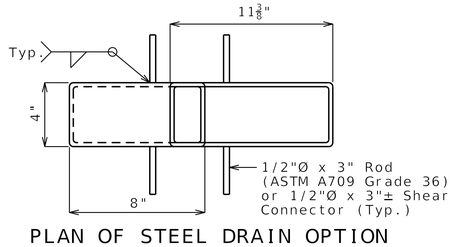
PART SECTION SHOWING BRACKET ASSEMBLY



ELEVATION OF DRAIN



PART PLAN OF SLAB AT DRAIN



PLAN OF STEEL DRAIN OPTION

General Notes:

Slab drain bracket assembly shall be ASTM A709 Grade 36 steel.

Locate drains in slab by dimensions shown in Part Section Near Drain.

Reinforcing steel shall be shifted to clear drains.

The coil inserts and bracket assembly shall be galvanized in accordance with ASTM A123.

All bolts, hardened washers, lock washers and nuts shall be galvanized in accordance with AASHTO M 232 (ASTM A153), Class C.

All 1/2"Ø bolts shall be ASTM A307.

Shop drawings will not be required for the slab drains and the bracket assembly.

The coil insert required for the bracket assembly attachment shall be located on the prestressed girder shop drawings.

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SLAB DRAINS

Detailed JULY 2024
Checked JULY 2024

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STATE OF MISSOURI
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NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	35

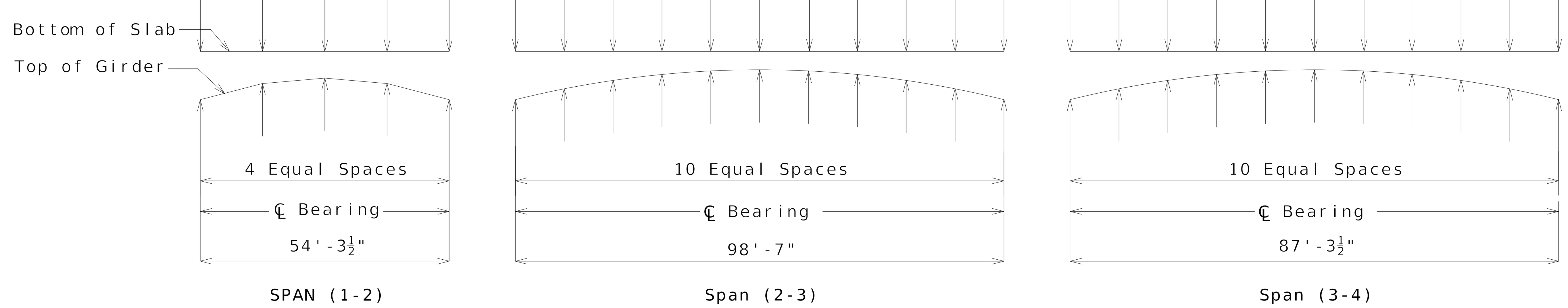
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
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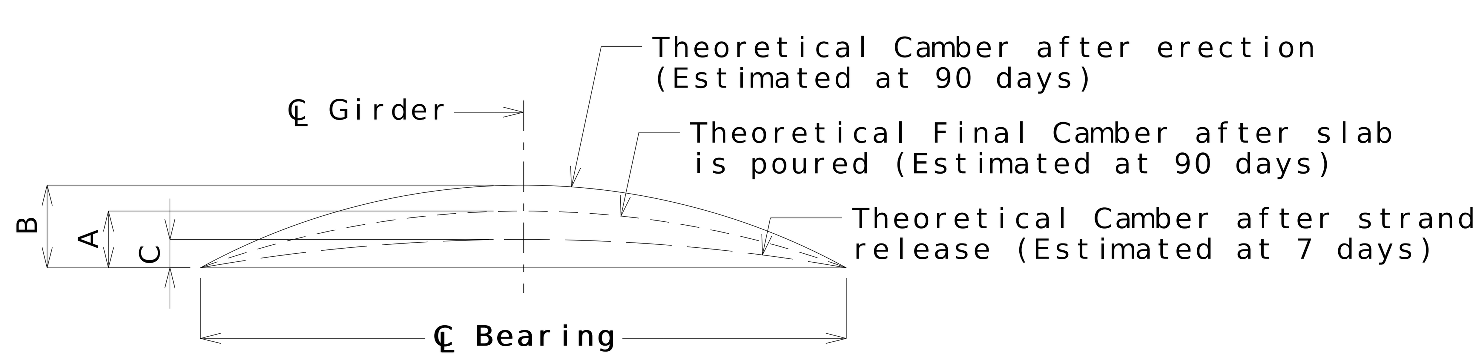
REV.

Girder	Span (1-2)					Span (2-3)											Span (3-4)										
Girder No. 1	2"	1 7/8"	1 7/8"	2 3/8"	3 1/8"	2"	2"	2 1/8"	1 7/8"	1 3/4"	1 3/4"	2"	2 3/8"	3"	3 1/4"	3 1/2"	3 3/8"	3"	2 5/8"	2"	1 1/2"	1 1/2"	1 5/8"	2 1/8"	2 3/4"	3"	3 1/2"
Girder No. 2	2"	1 7/8"	1 7/8"	2 3/8"	3 1/8"	2"	2"	2 1/8"	1 7/8"	1 3/4"	1 7/8"	2 1/8"	2 1/2"	3 1/8"	3 1/4"	3 1/2"	3 3/8"	3"	2 3/4"	2 1/8"	1 3/4"	1 5/8"	1 3/4"	2"	2 3/4"	3"	3 1/2"
Girder No. 3	2"	1 7/8"	1 7/8"	2 3/8"	3 1/8"	2"	2"	2 1/8"	1 7/8"	1 3/4"	1 7/8"	2 1/8"	2 1/2"	3 1/8"	3 1/4"	3 1/2"	3 3/8"	3"	2 3/4"	2 1/8"	1 3/4"	1 5/8"	1 3/4"	2"	2 3/4"	3"	3 1/2"
Girder No. 4	2"	1 7/8"	1 7/8"	2 3/8"	3 1/8"	2"	2"	2 1/8"	1 7/8"	1 3/4"	1 7/8"	2 1/8"	2 1/2"	3 1/8"	3 1/4"	3 1/2"	3 3/8"	3"	2 3/4"	2 1/8"	1 3/4"	1 5/8"	1 3/4"	2"	2 3/4"	3"	3 1/2"
Girder No. 5	2"	1 7/8"	1 7/8"	2 3/8"	3 1/8"	2"	2"	2 1/8"	1 7/8"	1 3/4"	1 7/8"	2 1/8"	2 1/2"	3 1/8"	3 1/4"	3 1/2"	3 3/8"	3"	2 3/4"	2 1/8"	1 3/4"	1 5/8"	1 3/4"	2"	2 3/4"	3"	3 1/2"
Girder No. 6	2"	1 7/8"	1 7/8"	2 3/8"	3 1/8"	2"	2"	2 1/8"	1 7/8"	1 3/4"	1 7/8"	2 1/8"	2 1/2"	3 1/8"	3 1/4"	3 1/2"	3 3/8"	2 7/8"	2 5/8"	2"	1 1/2"	1 1/2"	1 5/8"	2"	2 3/4"	3"	3 1/2"
Girder No. 7	2"	1 7/8"	1 7/8"	2 3/8"	3 1/8"	2"	2 1/8"	2 1/4"	2"	1 7/8"	1 7/8"	2 1/8"	2 1/2"	3 1/8"	3 1/4"	3 1/2"	3 3/8"	3"	2 3/4"	2 1/8"	1 3/4"	1 1/2"	1 5/8"	2"	2 3/4"	3"	3 1/2"
Girder No. 8	2"	1 7/8"	1 7/8"	2 3/8"	3 1/8"	2"	2 1/8"	2 1/4"	2"	1 7/8"	1 7/8"	2 1/8"	2 1/2"	3 1/8"	3 1/4"	3 1/2"	3 3/8"	3"	2 3/4"	2 1/8"	1 3/4"	1 5/8"	1 3/4"	2"	2 3/4"	3"	3 1/2"
Girder No. 9	2"	1 7/8"	1 7/8"	2 3/8"	3 1/8"	2"	2 1/8"	2 1/4"	1 7/8"	1 7/8"	1 7/8"	2 1/8"	2 1/2"	3 1/8"	3 1/4"	3 1/2"	3 3/8"	3"	2 3/4"	2 1/8"	1 3/4"	1 5/8"	1 3/4"	2"	2 3/4"	3"	3 1/2"
Girder No. 10	2"	1 7/8"	1 7/8"	2 3/8"	3 1/8"	2"	2 1/8"	2 1/4"	1 7/8"	1 7/8"	1 7/8"	2 1/8"	2 1/2"	3 1/8"	3 1/4"	3 1/2"	3 3/8"	2 7/8"	2 5/8"	2"	1 5/8"	1 1/2"	1 3/4"	2"	2 3/4"	3"	3 1/2"
Girder No. 11	2"	1 7/8"	1 7/8"	2 3/8"	3 1/8"	2"	2"	2 1/8"	1 7/8"	1 3/4"	1 3/4"	2"	2 1/2"	3 1/8"	3 1/4"	3 1/2"	3 3/8"	3"	2 5/8"	2"	1 3/4"	1 1/2"	1 5/8"	2"	2 3/4"	3"	3 1/2"



THEORETICAL SLAB HAUNCHING DIAGRAM (ESTIMATED AT 90 DAYS)

If girder camber is different from that shown in the camber diagram, in order to maintain minimum slab thickness, an adjustment of the slab haunches, an increase in slab thickness or a raise in grade uniformly throughout the structure shall be necessary. The haunch shall be limited to ensure the projecting girder reinforcement is embedded into slab at least 2 inches.

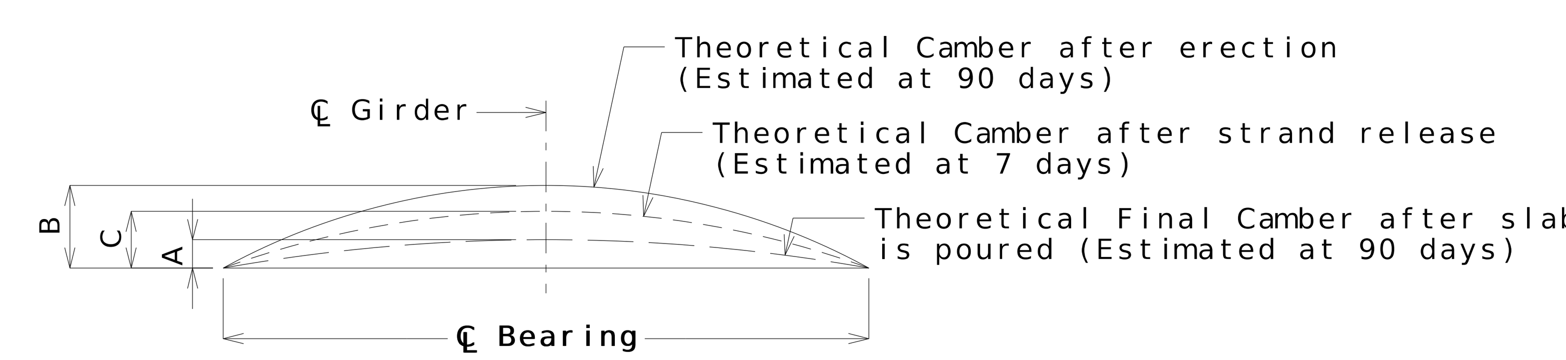


Girder	Span (1-2)		
	A	B	C
Exterior	5/8"	1"	1/2"
Interior			

GIRDER CAMBER DIAGRAM

Conversion Factors for Girder Camber (Estimated at 90 days):

0.25 pt. = 0.7125 x 0.5 pt.



Girder	Span (2-3)			Span (3-4)		
	A	B	C	A	B	C
Exterior	1 7/8"	5 1/2"	3 1/8"	2 7/8"	5 1/8"	2 7/8"
Interior	1 3/4"			2 3/4"		

GIRDER CAMBER DIAGRAM

Conversion Factors for Girder Camber (Estimated at 90 days):

0.1 pt. = 0.314 x 0.5 pt.
0.2 pt. = 0.593 x 0.5 pt.
0.3 pt. = 0.813 x 0.5 pt.
0.4 pt. = 0.952 x 0.5 pt.

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Note: This drawing is not to scale. Follow dimensions.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_036_JST0021_Haunch-Camber.dgn   16:22 1-OCT-2024

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER

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Matthew Muenks
MO PE-2017000338

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ROUTE 70EB	STATE MO
DISTRICT BR	SHEET NO. 36
COUNTY BOONE	
JOB NO. JST0021	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. A9542	

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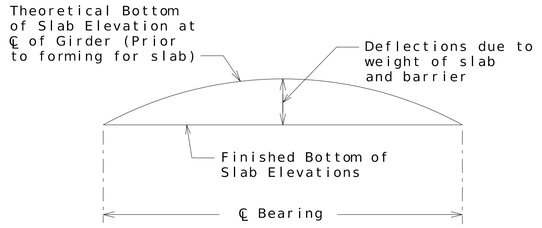
Theoretical Bottom of Slab Elevations at Centerline of Girder (Prior to forming for slab) (Estimated at 90 days)

Girder Number	Span (1-2) (54'-3½" ℄ Brg. - ℄ Brg.)				
	℄ Brg.	.25	.50	.75	℄ Brg.
1	684.63	684.51	684.38	684.24	684.09
2	684.91	684.79	684.67	684.52	684.37
3	685.19	685.08	684.94	684.80	684.65
4	685.47	685.35	685.22	685.08	684.93
5	685.75	685.63	685.50	685.36	685.21
6	686.03	685.91	685.78	685.64	685.48
7	686.31	686.19	686.06	685.92	685.76
8	686.50	686.39	686.26	686.12	685.97
9	686.70	686.58	686.46	686.32	686.16
10	686.89	686.78	686.65	686.51	686.36
11	687.09	686.97	686.85	686.71	686.56

Girder Number	Span (2-3) (98'-7" ℄ Brg. - ℄ Brg.)										
	℄ Brg.	.10	.20	.30	.40	.50	.60	.70	.80	.90	℄ Brg.
1	684.07	684.07	684.06	684.03	683.97	683.89	683.78	683.65	683.49	683.31	683.13
2	684.35	684.35	684.34	684.31	684.26	684.18	684.07	683.94	683.77	683.60	683.41
3	684.63	684.63	684.62	684.59	684.54	684.46	684.35	684.21	684.05	683.88	683.69
4	684.91	684.91	684.90	684.87	684.82	684.74	684.63	684.49	684.33	684.15	683.97
5	685.19	685.19	685.18	685.15	685.10	685.02	684.91	684.77	684.61	684.43	684.24
6	685.47	685.47	685.46	685.43	685.38	685.30	685.19	685.05	684.89	684.71	684.52
7	685.75	685.75	685.74	685.71	685.66	685.58	685.47	685.33	685.17	684.99	684.80
8	685.95	685.96	685.95	685.92	685.87	685.79	685.68	685.54	685.38	685.20	685.01
9	686.15	686.15	686.14	686.11	686.06	685.98	685.87	685.74	685.58	685.40	685.21
10	686.35	686.35	686.34	686.31	686.26	686.18	686.07	685.93	685.77	685.59	685.41
11	686.54	686.54	686.53	686.50	686.45	686.37	686.26	686.12	685.97	685.79	685.60

Girder Number	Span (3-4) (87'-3½" ℄ Brg. - ℄ Brg.)										
	℄ Brg.	.10	.20	.30	.40	.50	.60	.70	.80	.90	℄ Brg.
1	683.12	683.09	683.06	683.02	682.97	682.90	682.81	682.71	682.59	682.46	682.32
2	683.39	683.37	683.35	683.31	683.25	683.18	683.10	682.99	682.87	682.74	682.60
3	683.67	683.65	683.62	683.59	683.53	683.46	683.37	683.27	683.15	683.02	682.88
4	683.95	683.93	683.90	683.87	683.81	683.74	683.65	683.55	683.43	683.30	683.16
5	684.23	684.21	684.18	684.14	684.09	684.02	683.93	683.83	683.71	683.58	683.44
6	684.52	684.49	684.46	684.42	684.37	684.30	684.21	684.11	683.98	683.85	683.72
7	684.79	684.77	684.74	684.70	684.65	684.58	684.49	684.39	684.26	684.13	683.99
8	685.00	684.98	684.95	684.91	684.86	684.79	684.70	684.59	684.47	684.34	684.20
9	685.20	685.17	685.15	685.11	685.05	684.98	684.89	684.79	684.66	684.53	684.39
10	685.40	685.37	685.34	685.30	685.25	685.18	685.09	684.98	684.86	684.73	684.59
11	685.59	685.56	685.54	685.50	685.44	685.37	685.28	685.17	685.05	684.92	684.79

Elevations are based on a constant slab thickness of 8 1/2" and include allowance for theoretical dead load deflections due to weight of slab (including precast panel) and barrier.



TYPICAL SLAB ELEVATIONS DIAGRAM

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER

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Matthew Muenks
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DATE PREPARED: 1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	37

COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DESCRIPTION	DATE
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MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
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MoDOT IMPROVE I-70 DB PROJECT 1

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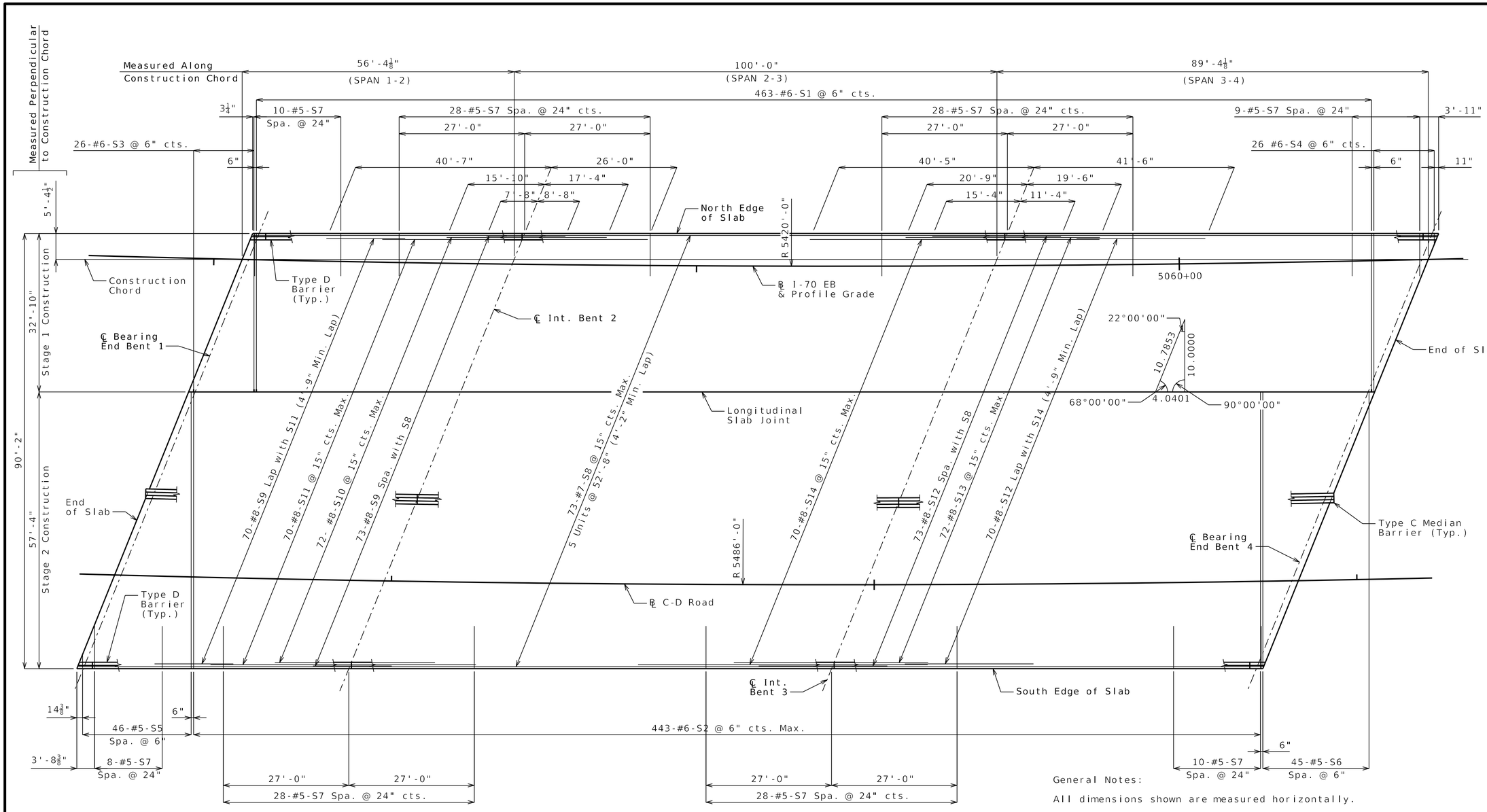
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Note: This drawing is not to scale. Follow dimensions.

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TOP SLAB REINFORCEMENT PLAN

General Notes:

All dimensions shown are measured horizontally.

For Plan of Slab showing Bottom Reinforcement, see Sheet 39.

For Sections Thru Slab and Details of Top Reinforcement not shown, see Slab Reinforcement Details, Sheet Nos. 40 & 41.

For Details and Reinforcement of MoDOT Type C Median Barrier not shown, see Sheet No. 46.

For Details and Reinforcement of MoDOT Type D Barrier not shown, see Sheet Nos. 43 & 44.

For Details of Precast Prestressed Panels, see Sheet No. 33.

For Theoretical Slab Haunching and Girder Camber Diagrams, see Sheet No. 36.

For Theoretical Bottom of Slab Elevations, see Sheet No. 37.

For Slab Pouring Sequences, see Sheet No. 42.

For details and locations of Slab Drains, see Sheet Nos. 34 & 35.

Transverse Reinforcement shall be placed perpendicular to the Construction Chord.

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ROUTE	STATE
70EB	MO
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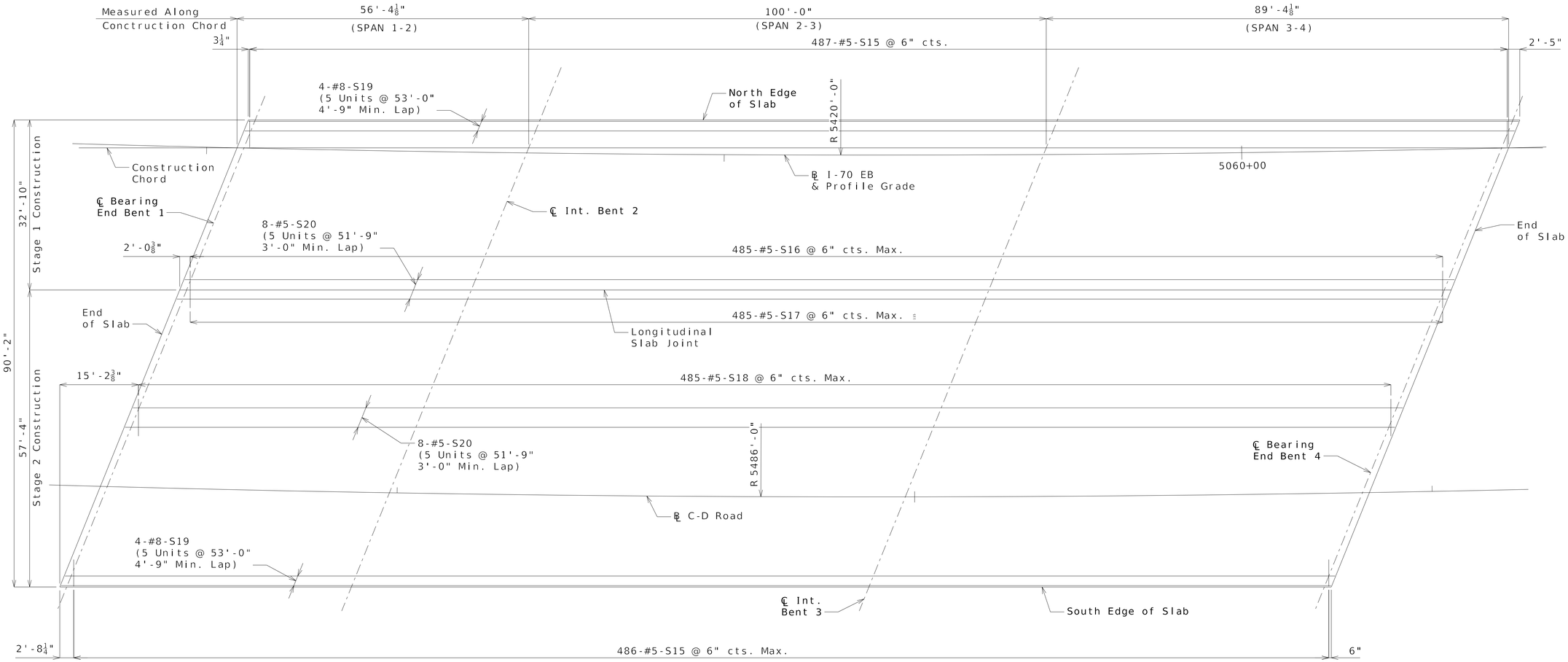
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Notes:
For General Notes and Details not shown, see Sheet No. 38.

BOTTOM SLAB REINFORCEMENT PLAN

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Sheet No. 39 of 56

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ROUTE	STATE
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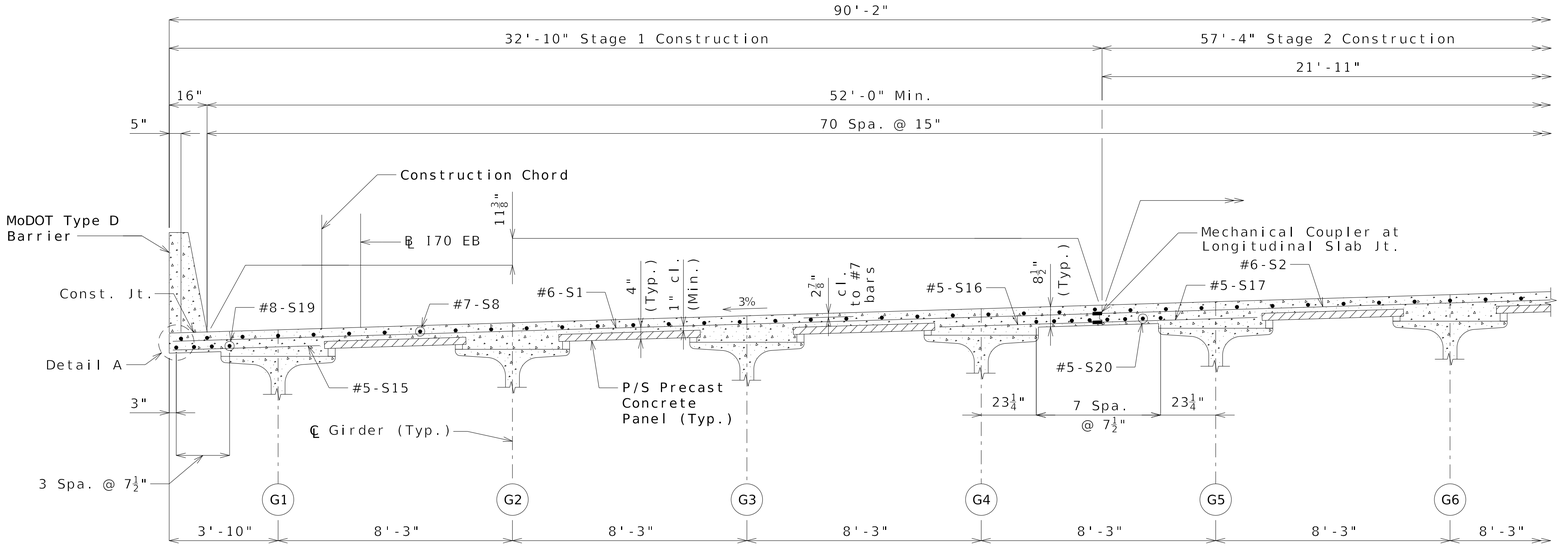
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JEFFERSON CITY, MO 65102
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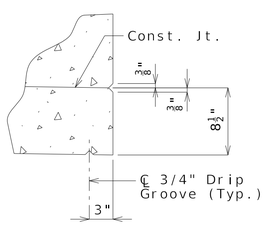
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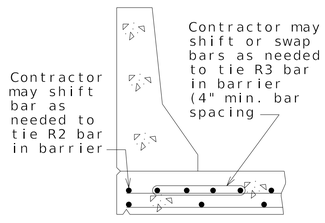
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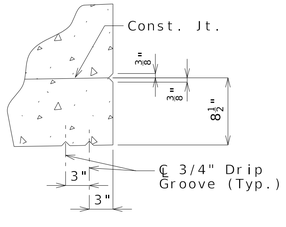




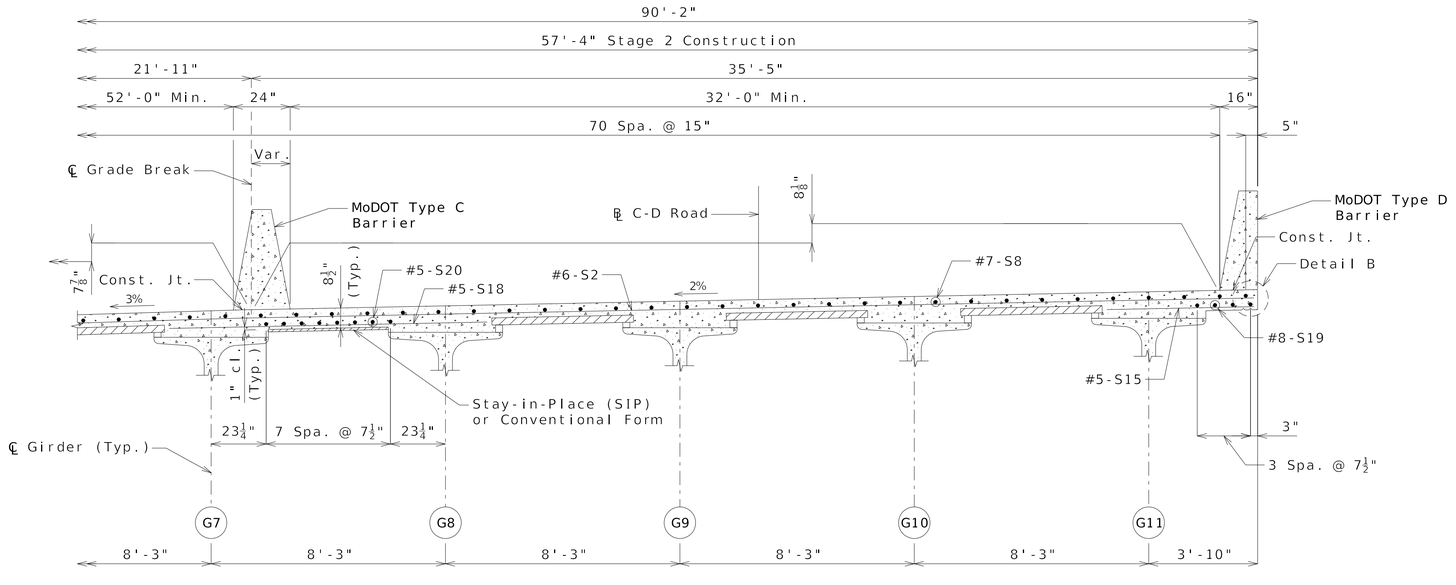
DETAIL A



OPTIONAL SHIFTING TOP BARS AT BARRIER



DETAIL B



TYPICAL SECTION NEAR MID-SPAN

Notes:

For General Notes, see Sheet No. 38.

For Slab Plans Showing Reinforcement, Details and Notes not shown here, see Sheet Nos. 38 & 39.

For Details of Slab Section Near Intermediate Bents not shown here, see Sheet No. 41.

SLAB REINFORCEMENT DETAILS

Detailed JUNE 2024
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ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	40

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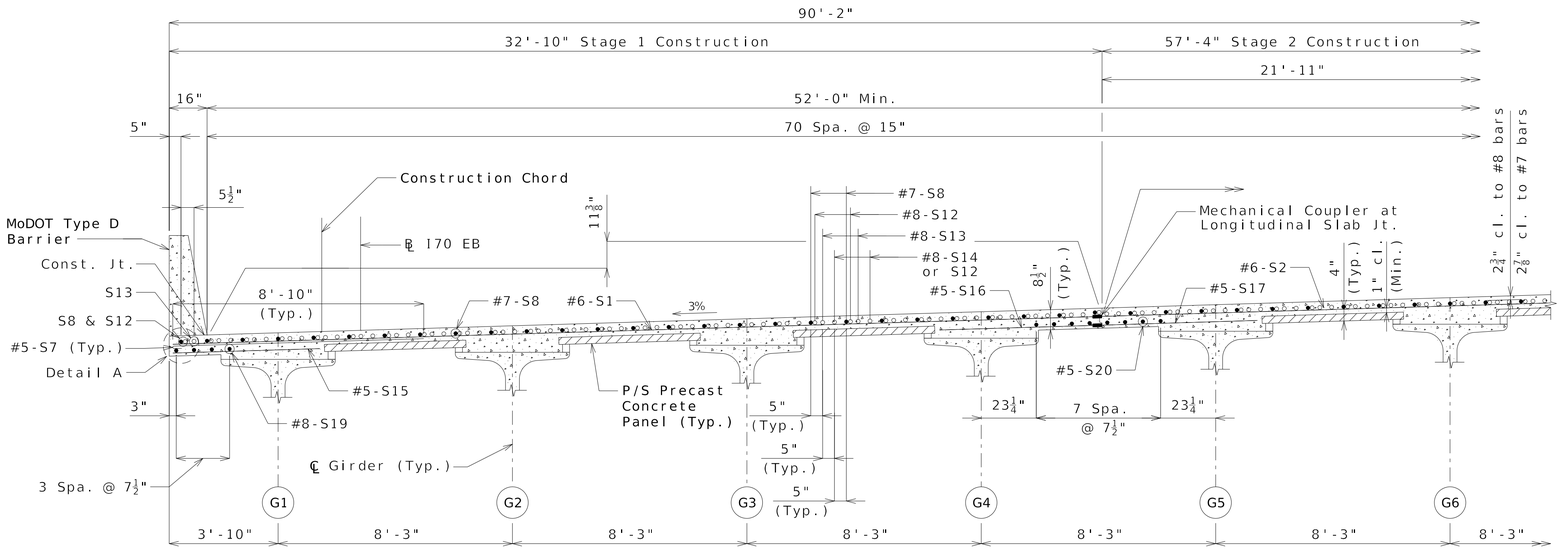
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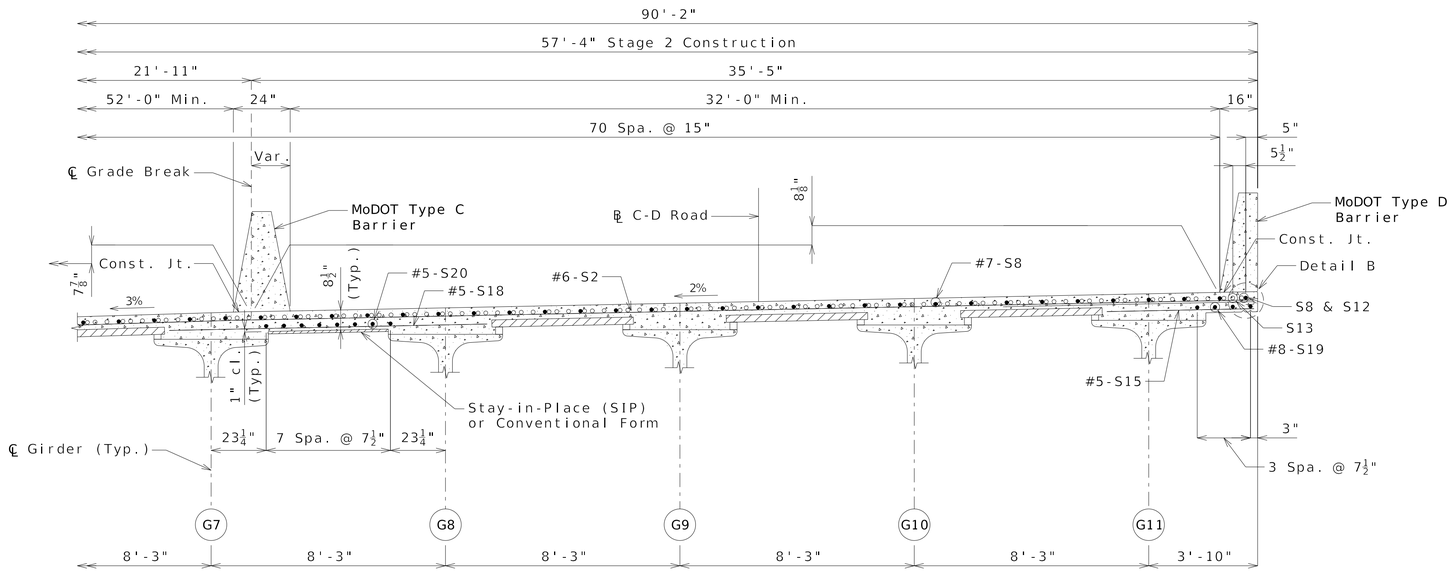
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TYPICAL SECTION NEAR INTERMEDIATE BENTS 2 & 3

(Section at Intermediate Bent 3 Shown, Section at Intermediate Bent 2 similar)

Notes:

For General Notes, see Sheet No. 38.

For Slab Plans Showing Reinforcement, Details and Notes not shown here, see Sheet Nos. 38 & 39.

For Details of Slab Section Near Mid Span not shown here, see Sheet No. 40.

SLAB REINFORCEMENT DETAILS

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STATE OF MISSOURI
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ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	41

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JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

DESCRIPTION	DATE
REV. A - FINAL REVIEW	09/13/24
REV. 0 - RELEASED FOR CONSTRUCTION	10/01/24

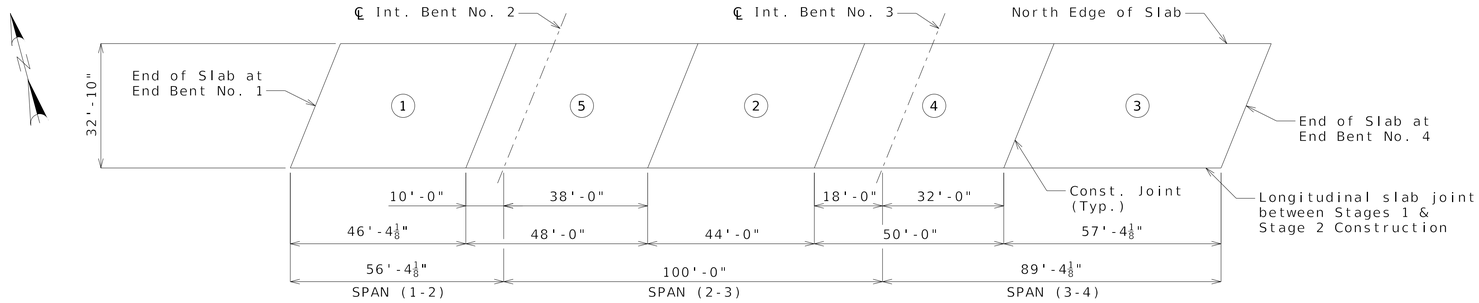
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
Jacobs

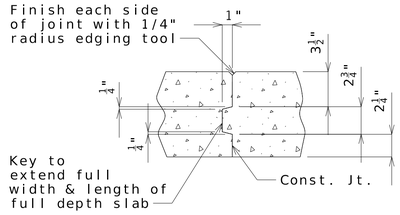
MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.

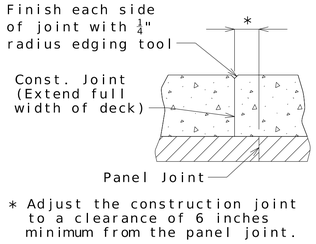


STAGE 1 CONSTRUCTION PLAN

	Sequence of Pours - Stage 1					Min. Rate of Pour Cu. Yds./Hr.
	Direction					With Retarder
Basic Sequence	1	2	3	4	5	25
	Either Direction					
Alternate pours to the basic skip sequence are subject to the approval of the engineer in accordance with Sec 703.						
Alternate A Pours	1	5 + 2		4 + 3		25
	End to 5	1 to 4		2 to End		
Alternate B Pours	1 + 5 + 2			4 + 3		25
	End to 4			2 to End		
Alternate C Pours	1 + 5 + 2 + 4 + 3					25
	End to End					

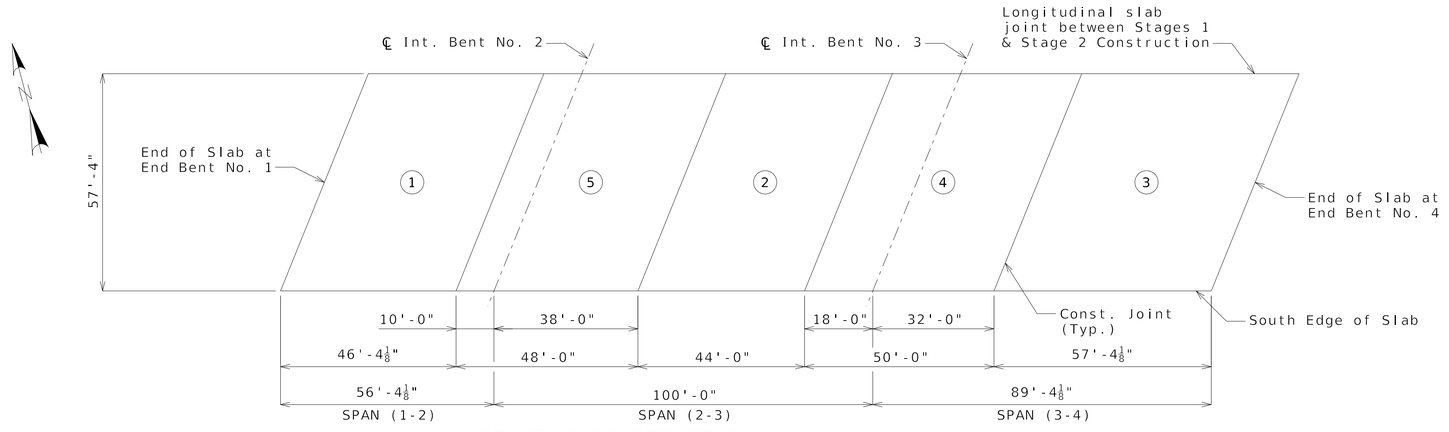


FULL DEPTH SLAB



SLAB ON PANELS

SLAB CONSTRUCTION JOINT



STAGE 2 CONSTRUCTION PLAN

	Sequence of Pours - Stage 2					Min. Rate of Pour Cu. Yds./Hr.
	Direction					With Retarder
Basic Sequence	1	2	3	4	5	25
	Either Direction					
Alternate pours to the basic skip sequence are subject to the approval of the engineer in accordance with Sec 703.						
Alternate A Pours	1	5 + 2		4 + 3		34
	End to 5	1 to 4		2 to End		
Alternate B Pours	1 + 5 + 2			4 + 3		34
	End to 4			2 to End		
Alternate C Pours	1 + 5 + 2 + 4 + 3					34
	End to End					

General Notes:

1. The contractor shall furnish an approved retarder to retard the set of the concrete to 2.5 hours and shall pour and satisfactorily finish the slab pours at the rate given.
2. The concrete diaphragm at the intermediate bent and integral end bents shall be poured a minimum of 30 minutes and a maximum of 2 hours before the slab is poured.

SLAB POURING SEQUENCE

Detailed AUG 2024
Checked AUG 2024

Note: This drawing is not to scale. Follow dimensions.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_042_JST0021_Slab Pouring Sequence 1.dgn 16:25 1-OCT-2024

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024
ROUTE: 70EB | STATE: MO
DISTRICT: BR | SHEET NO.: 42
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

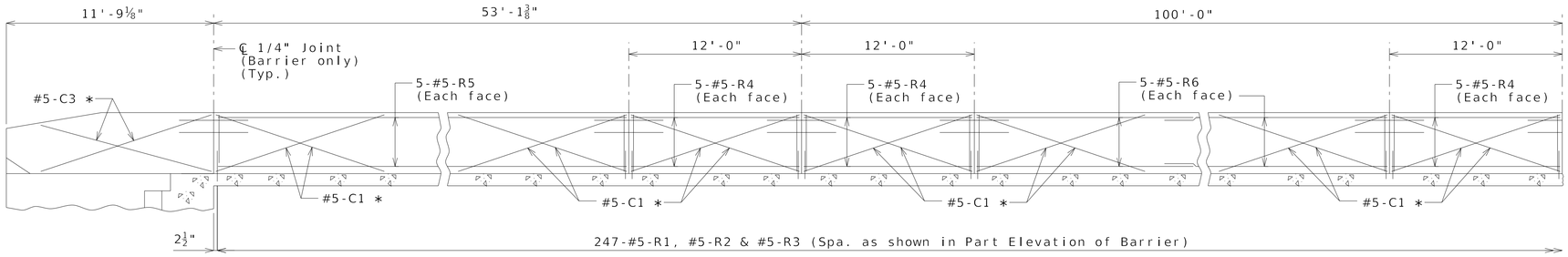
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10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

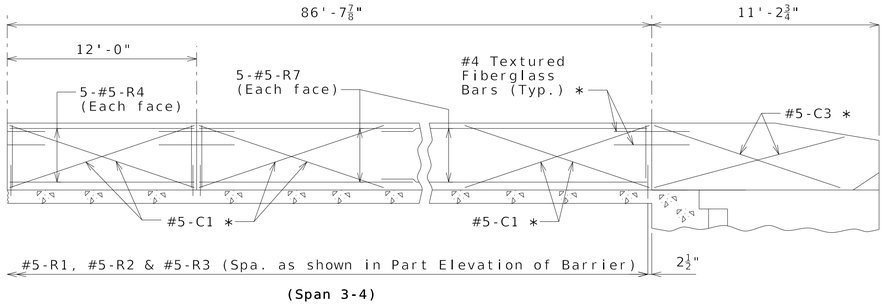
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

Jacobs
MILLSTONE WEBER

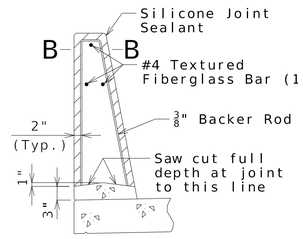
MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING



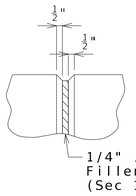


ELEVATION OF LEFT BARRIER

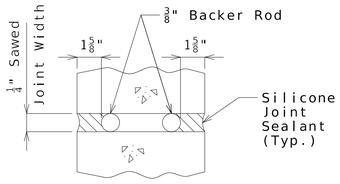
Longitudinal dimensions are horizontal.



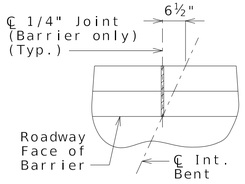
SECTION THRU
SAW CUT JOINT



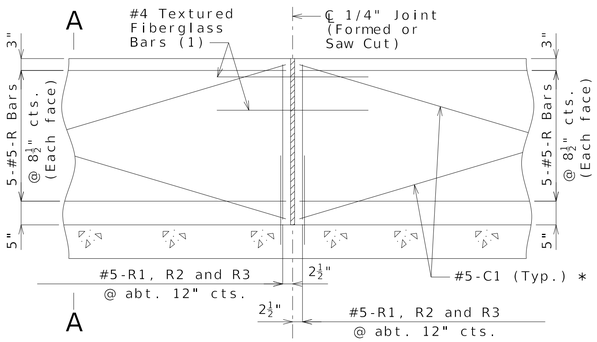
PART ELEVATION
AT FORMED JOINT



SECTION B-B

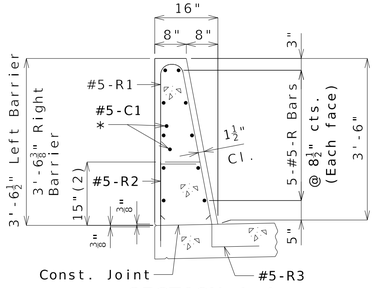


PART PLAN SHOWING
JOINT LOCATION



PART ELEVATION OF BARRIER

(1) Four feet long, centered on joint, slip-formed option only



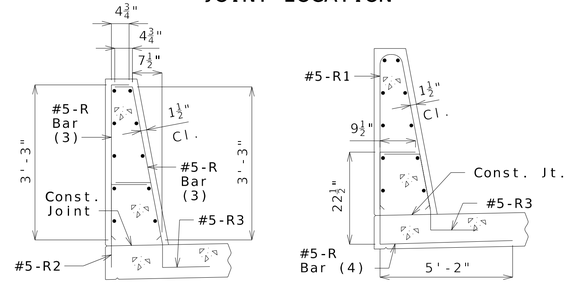
SECTION A-A

Use a minimum lap of 3'-1" for #5 horizontal barrier bars.

The cross-sectional area above the slab is 3.52 square feet for the Right Barrier.

The cross-sectional area above the slab is 3.53 square feet for the Left Barrier.

(2) To top of bar.



R-BAR PERMISSIBLE ALTERNATE SHAPE

(3) The R1 bar may be separated into two bars as shown, at the contractor's option, only when slip forming is not used. (All dimensions are out to out.)

(4) The R2 bar and #5 bottom transverse slab bar in cantilever (prestressed panels only) combination may be furnished as one bar as shown, at the contractor's option.

General Notes:

* Slip-formed option only.

Conventional forming or slip forming may be used. Saw cut joints may be used with conventional forming.

Top of barrier shall be built parallel to grade and barrier joints (except at end bents) normal to grade.

All exposed edges of barrier shall have either a 1/2-inch radius or a 3/8-inch bevel, unless otherwise noted.

Concrete in barrier shall be Class B-1.

Concrete traffic barrier delineators shall be placed on top of the barrier as shown on Missouri Standard Plan 617.10 and in accordance with Sec 617. Delineators on bridges with two-lane, two-way traffic shall have retroreflective sheeting on both sides.

Joint sealant and backer rods shall be in accordance with Sec 717 for silicone joint sealant for saw cut and formed joints.

For slip-formed option, both sides of barrier shall have a vertically broomed finish and the top shall have a transversely broomed finish.

For Elevation of Right Barrier, see Sheet No. 44.

TYPE D BARRIER

Detailed APR 2024
Checked JULY 2024

Note: This drawing is not to scale. Follow dimensions.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_043_JST0021_BarrierElevLeft.dgn 16:26 1-OCT-2024

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024
ROUTE: 70EB
STATE: MO
DISTRICT: BR
SHEET NO.: 43
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

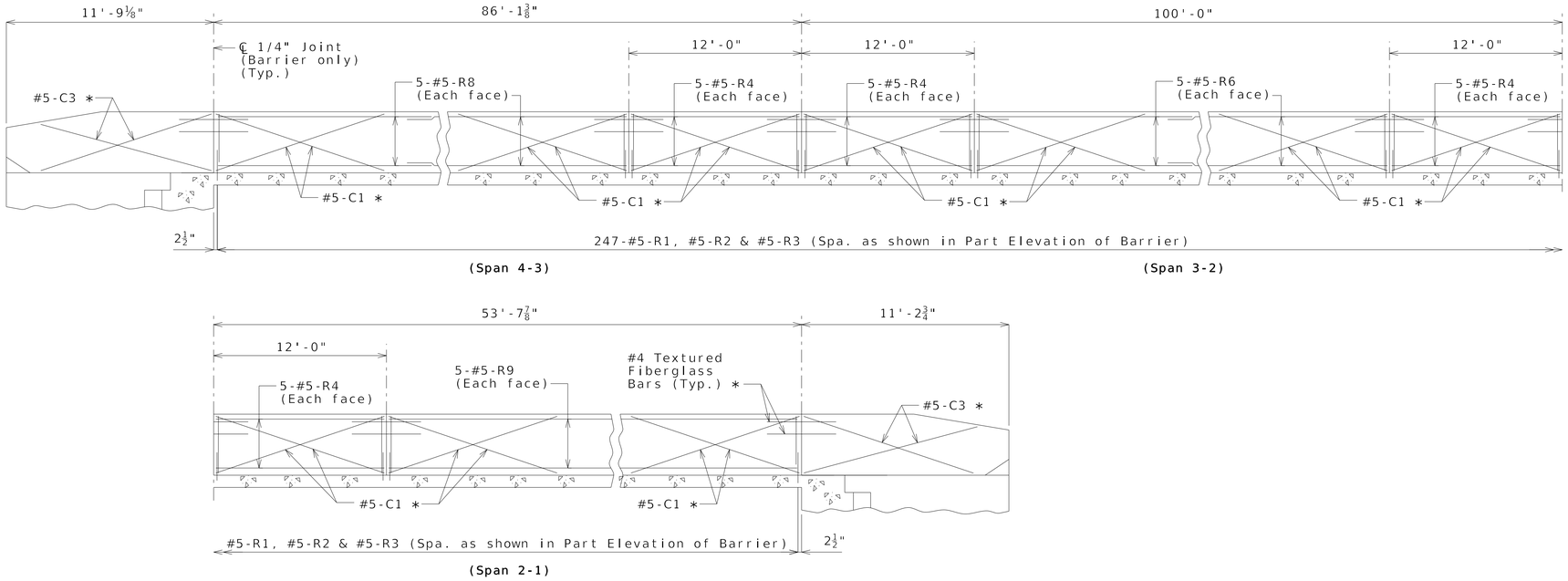
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

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REV.



ELEVATION OF RIGHT BARRIER

Longitudinal dimensions are horizontal.

Notes:
For General Notes and Details not shown,
see Sheet No. 43.

TYPE D BARRIER

Detailed APR 2024
Checked JULY 2024

Note: This drawing is not to scale. Follow dimensions.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_044_JST0021_BarrierElevRight.dgn 16:26 1-OCT-2024

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024
ROUTE: 70EB
STATE: MO
DISTRICT: BR
SHEET NO.: 44
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

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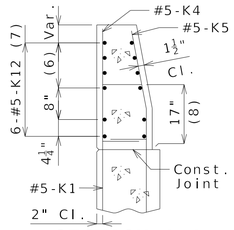
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105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

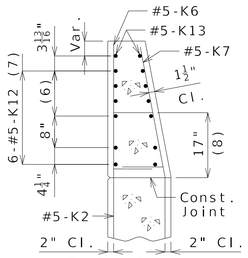
Jacobs MILLSTONE WEBER

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

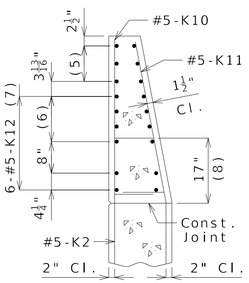
REV.



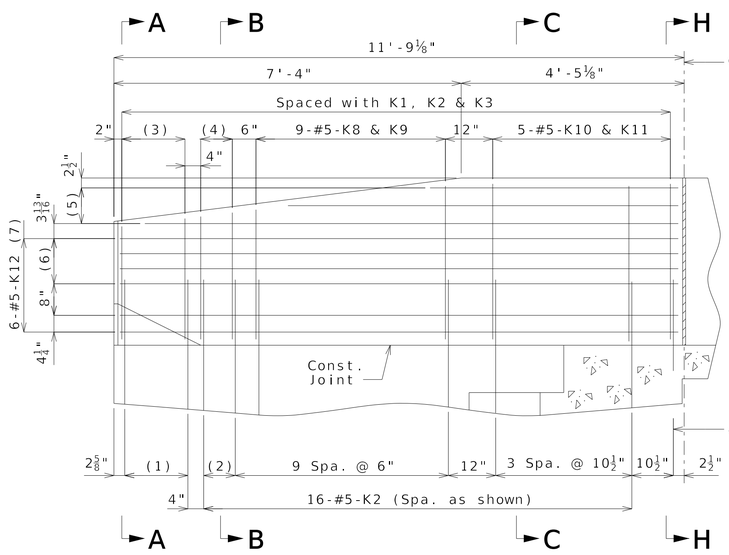
SECTION A-A



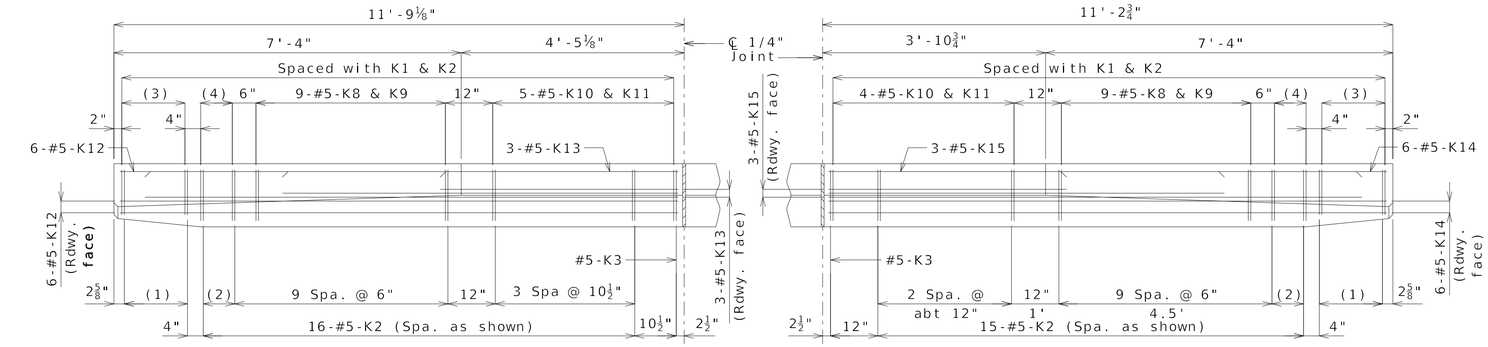
SECTION B-B



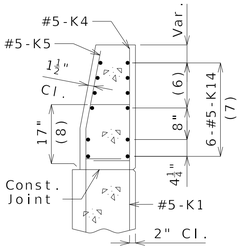
SECTION C-C



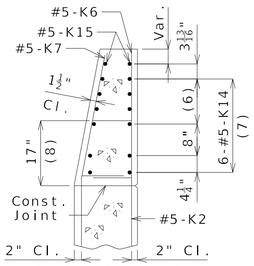
PART ELEVATION



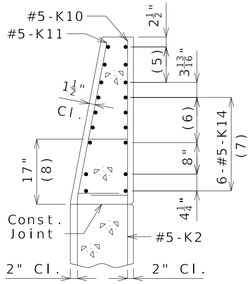
PART PLAN



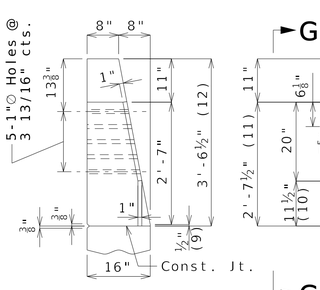
SECTION D-D



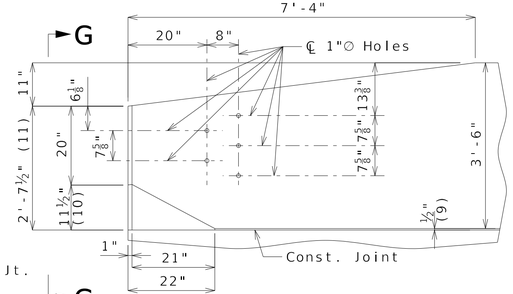
SECTION E-E



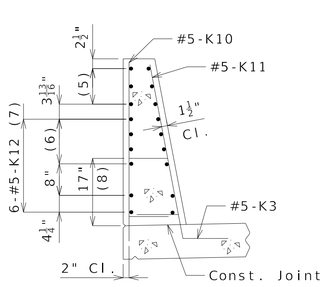
SECTION F-F



ELEVATION G-G



ELEVATION



SECTION H-H

(1) 5-#5-K1 @ 4" cts.

(2) 2 spaces @ 4"

(3) 5-#5-K4 & K5

(4) 3-#5-K6 & K7

(5) 3-#5-K13 or K15 @ 4½" cts., each face

(6) 3 spaces @ 3 13/16"

(7) Spaced as shown, each face

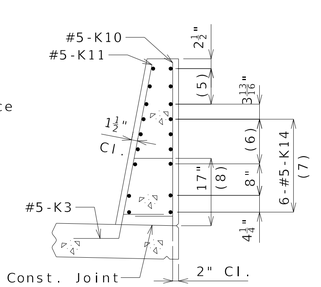
(8) To top of bar

(9) ⅜" at Right Barrier

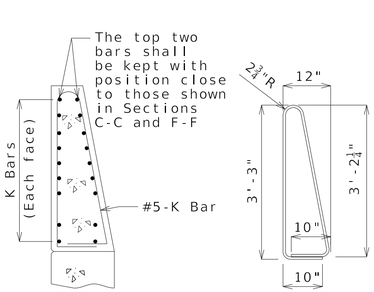
(10) 11⅜" at Right Barrier

(11) 2'-7⅞" at Right Barrier

(12) 3'-6⅜" at Right Barrier



SECTION I-I

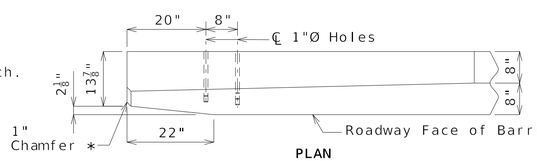


K10-K11 BAR PERMISSIBLE ALTERNATE SHAPE

(Other K bars not shown for clarity)

The K10-K11 bar combination may be furnished as one bar as shown, at the contractor's option.

All dimensions are out to out.



PLAN

DETAILS OF GUARD RAIL ATTACHMENT

* Transition to zero at Type A curb for gutter lines to match.

General Notes:

Concrete traffic barrier delineators shall be placed on top of the barrier as shown on Missouri Standard Plan 617.10 and in accordance with Sec 617. Delineators on bridges with two-lane, two-way traffic shall have retroreflective sheeting on both sides.

Reinforcing Steel:
Minimum clearance to reinforcing steel shall be 1 1/2" except as shown for bars embedded into end bent.

TYPE D BARRIER AT END BENTS

(Left barrier shown, right barrier similar)

Detailed APR. 2024
Checked AUG. 2024

Note: This drawing is not to scale. Follow dimensions.

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024
ROUTE: 70EB
STATE: MO
DISTRICT: BR
SHEET NO.: 45
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

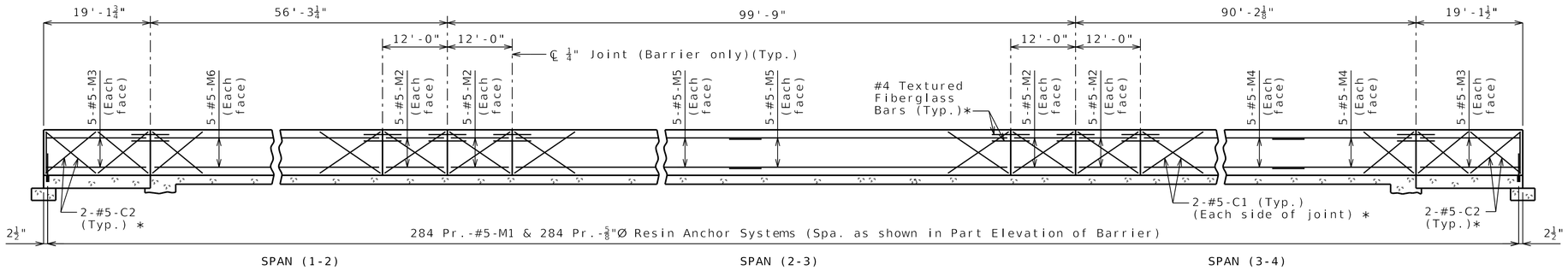
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0	10/01/24	RELEASED FOR CONSTRUCTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

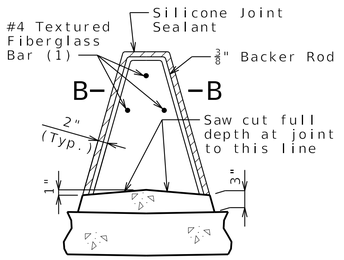
MILLSTONE WEBER
Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

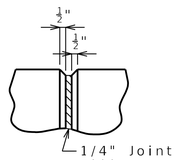


ELEVATION OF BARRIER

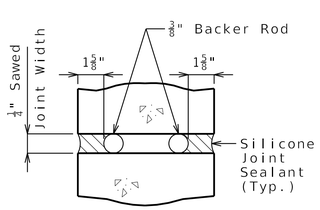
Longitudinal dimensions are horizontal along ℄ of barrier.



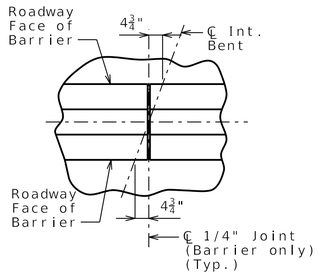
SECTION THRU SAW CUT JOINT



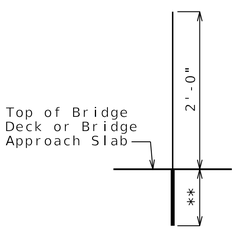
PART ELEVATION AT FORMED JOINT



SECTION B-B



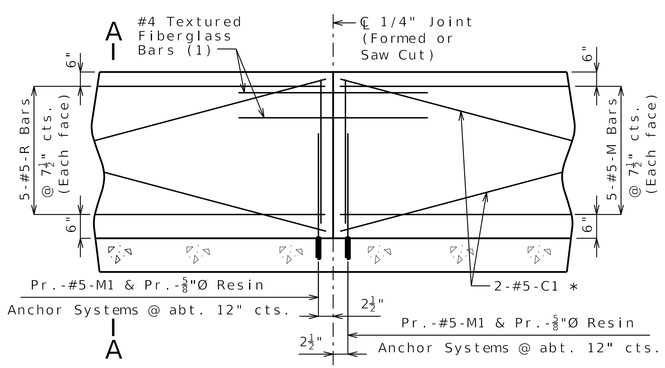
PART PLAN SHOWING JOINT LOCATION



RESIN ANCHOR SYSTEM

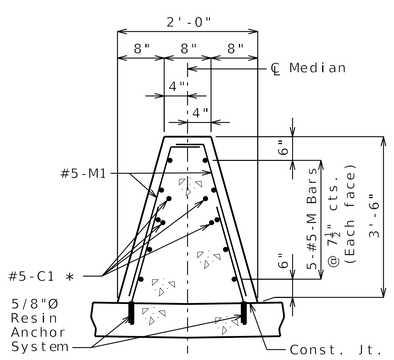
(568 required)

** Manufacturer's embedment length (5" minimum)



PART ELEVATION OF BARRIER

(1) Four feet long, centered on joint, slip-formed option only



SECTION A-A

Use a minimum lap of 3'-1" for #5 horizontal barrier bars.

The cross-sectional area above the slab is 4.69 square feet.

General Notes:

∗ Slip-formed option only.

Conventional forming or slip forming may be used. Saw cut joints may be used with conventional forming.

Top of barrier shall be built parallel to grade with barrier joints normal to grade.

All exposed edges of barrier shall have either a 1/2-inch radius or a 3/8-inch bevel, unless otherwise noted.

Concrete in the barrier shall be Class B-1.

Concrete traffic barrier delineators shall be placed on top of the barrier as shown on Missouri Standard Plan 617.10 and in accordance with Sec 617. Delineators shall have retroreflective sheeting on both sides.

Joint sealant and backer rods shall be in accordance with Sec 717 for silicone joint sealant for saw cut and formed joints.

For slip-formed option, both sides of barrier shall have a vertically broomed finish and the top shall have a transversely broomed finish.

The contractor shall use one of the qualified resin anchor systems in accordance with 1039.

The minimum embedment depth in concrete with f'c = 4,000 psi for the resin anchor system shall be that required to meet the minimum ultimate pullout strength in accordance with Sec 1039 but shall not be less than 5 inches.

An epoxy coated #5 Grade 60 reinforcing bar shall be substituted for the 5/8-inch diameter threaded rod.

TYPE C BARRIER

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	46

COUNTY: BOONE

JOB NO.: JST0021

CONTRACT ID.:

PROJECT NO.:

BRIDGE NO.: A9542

REV.	DATE	DESCRIPTION
A	09/13/24	FINAL REVIEW
0	10/01/24	RELEASED FOR CONSTRUCTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER

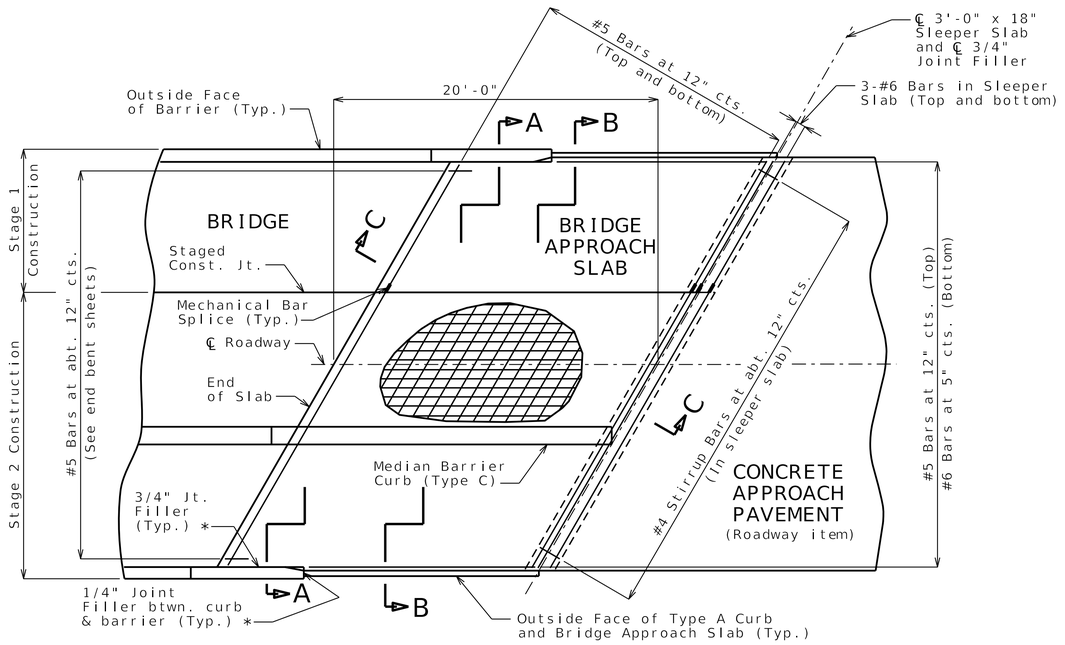
Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

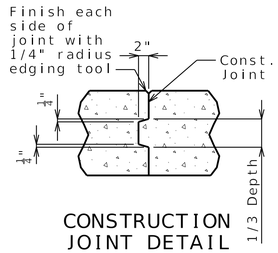
Detailed JULY 2024
Checked JULY 2024

Note: This drawing is not to scale. Follow dimensions.

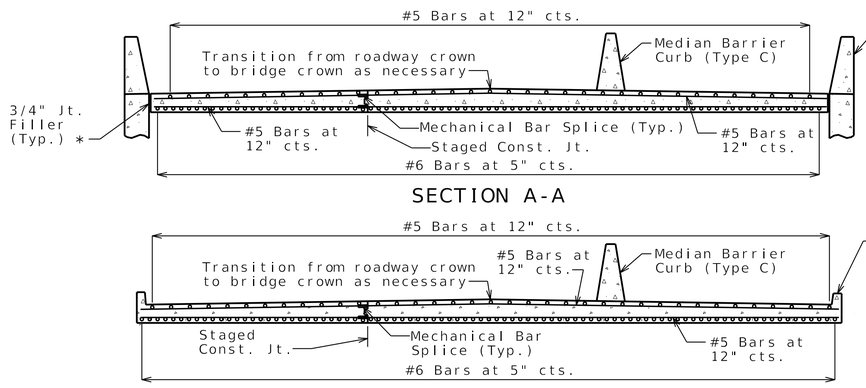
pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_046_JST0021_BarrierTypeC.dgn 16:28 1-OCT-2024



PART PLAN SHOWING REINFORCEMENT



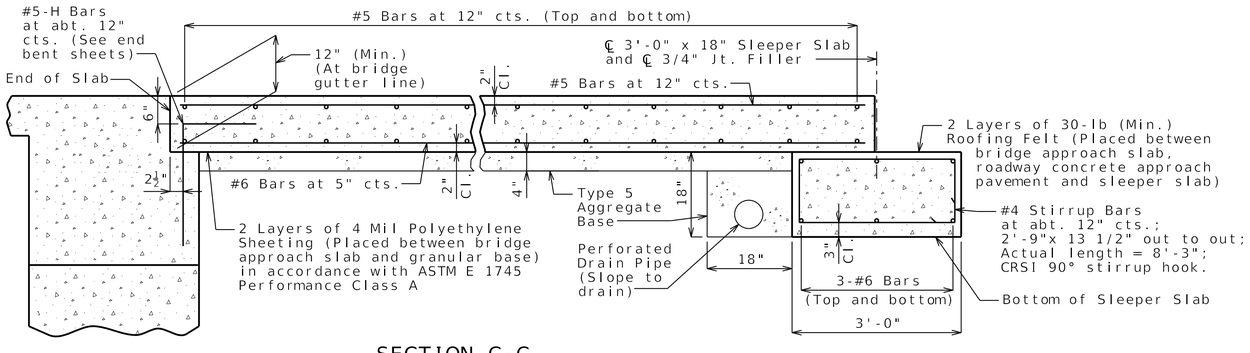
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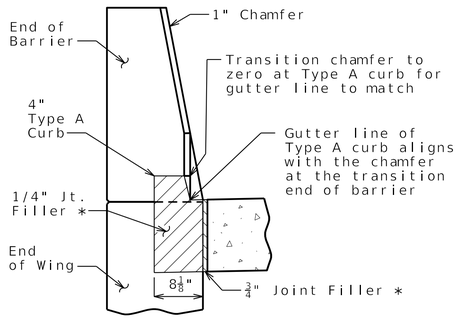
SECTION A-A

SECTION B-B

The contractor may crown the bottom of the approach slab to match the crown of the roadway surface.



SECTION C-C



SECTION BETWEEN CURB AND BARRIER

BRIDGE APPROACH SLAB (MAJOR)

General Notes:

All concrete for the bridge approach slab and sleeper slab shall be in accordance with Sec 503 (f'c = 4,000 psi).

The reinforcing steel in the bridge approach slab and the sleeper slab shall be epoxy coated Grade 60 with fy = 60,000 psi.

Drain pipe may be either 6" diameter corrugated metallic-coated pipe underdrain, 4" diameter corrugated polyvinyl chloride (PVC) drain pipe, or 4" diameter corrugated polyethylene (PE) drain pipe.

Minimum clearance to reinforcing steel shall be 1 1/2", unless otherwise shown.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be continuous. The transverse reinforcing steel may be made continuous by providing a minimum lap splice of 29 inches for #5 bars and 44 inches for #6 bars, or by mechanical bar splice.

Mechanical bar splices shall be in accordance with Sec 710. (Estimated 46 splices per slab.)

All joint filler shall be in accordance with Sec 1057 for preformed fiber expansion joint filler except as noted.

The contractor shall pour and satisfactorily finish the bridge slab before placing the bridge approach slab.

Longitudinal construction joints in approach slab and sleeper slab shall be aligned with longitudinal construction joints in bridge slab.

For concrete approach pavement details, see roadway plans.

See Missouri Standard Plan 609.00 for details of Type A curb.

* Seal joint between vertical face of approach slab and wing with sealant in accordance with Sec 717 for silicone joint sealant for saw cut and formed joints.

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	47

COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

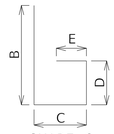
MILLSTONE WEBER
Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

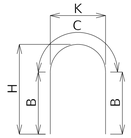
REV.

Detailed MAY 2024
Checked JUL. 2024

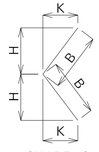
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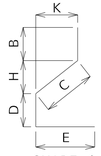
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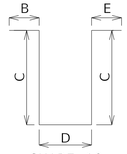
SHAPE 7



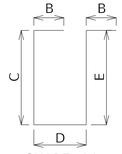
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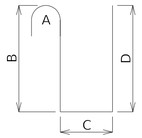
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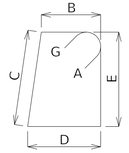
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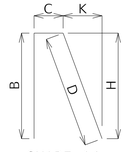
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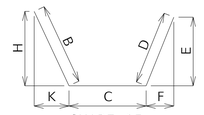
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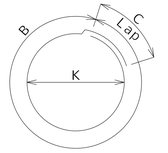
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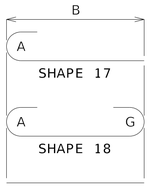
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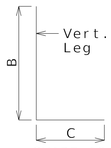
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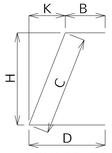
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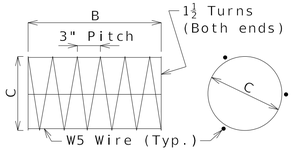
SHAPE 17
SHAPE 18
SHAPE 20



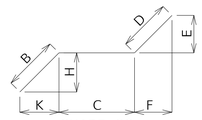
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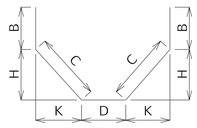
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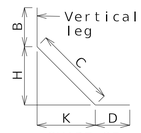
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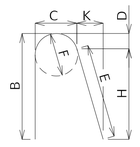
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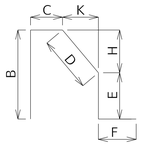
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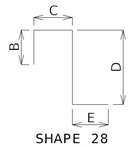
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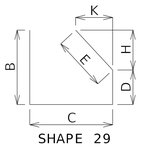
SHAPE 26



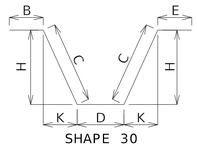
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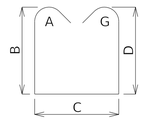
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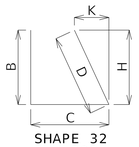
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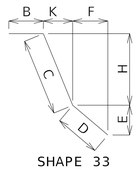
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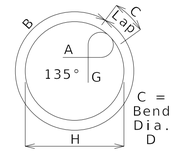
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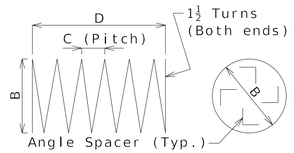
SHAPE 32 or 32S



SHAPE 33 or 33S



SHAPE 34S



SHAPE 35 (1)

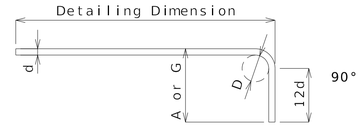


SHAPE 36

Finished Bend Diameters D and Hook Dimensions

Standard Pin Bend Shapes

Size	Case	D	A or G		J
			90°	180°	180°
#4	1	3"	8"	6"	4"
#5	1	3¾"	10"	7"	5"
#6	1	4½"	12"	8¼"	6"
#7	2	5¼"	14"	9¾"	7"
	3	7"	15"	11½"	8¾"
#8	2	6"	16"	11"	8"
	3	8"	17"	13¼"	10"
#9	1	9½"	19½"	15½"	11¾"
#10	1	10¾"	22"	17½"	13¼"
#11	1	12"	24½"	19½"	14⅞"
#14	1	18¼"	31¼"	27½"	21⅝"
#18	1	24"	41½"	36¾"	28½"

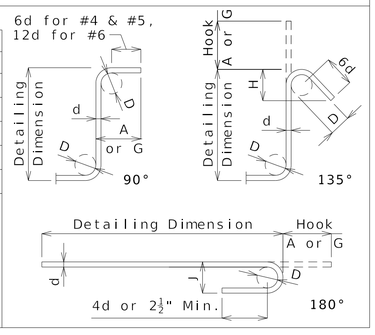


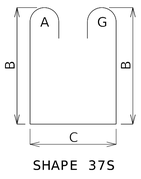
Stirrup Pin Bend Shapes (S)

Size	Case	D	A or G			H	J
			90°	135°	180°	135°	180°
#4	2	2"	4½"	4½"	5"	2⅝"	3"
	3	3"	5"	5¼"	6"	3"	4"
#5	2	2½"	5¾"	5¾"	5¾"	3⅝"	3¾"
	3	3¾"	6¼"	6½"	7"	3⅞"	5"
#6	1	4½"	12"	7¾"	8¼"	4⅝"	6"

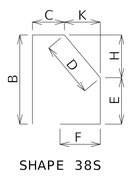
Applicable for all grades of steel.

Case 1 applies to all reinforcement. Case 2 applies to all reinforcement except for galvanized bars. Case 3 applies to galvanized bars only.





SHAPE 37S



SHAPE 38S

BENDING DIAGRAMS

All dimensions are out to out.

Shapes ending with an S shall be bent in accordance with stirrup pin bend shapes.

Unless otherwise noted, finished bending diameter D is the same for all bends of a shape.

(1) Shall be a deformed or plain spiral bar or wire.

Four angle or channel spacers are required for each column spiral. Spacers are to be placed on inside of spirals. Length and weight of column spirals do not include splices or spacers.

Reinforcing Steel Totals (Pounds)

	Size	Substructure		Superstructure				Entire Bridge	
				Slab			Slip		
		Plain	Epoxy	Plain	Epoxy	Barrier	Form	Plain	Epoxy
By Size	W5	0	0	0	0	0	0	0	0
	4	0	1,719	0	627	0	0	0	2,346
	5	0	3,348	0	20,549	19,718	907	0	44,522
	6	0	28,115	0	66,743	0	0	0	94,858
	7	0	5,023	0	39,292	0	0	0	44,315
	8	0	7,010	0	57,686	0	0	0	64,696
	9	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0
	11	0	0	0	0	0	0	0	0
	14	0	0	0	0	0	0	0	0
	18	0	0	0	0	0	0	0	0
By Type		0	45,215	0	184,897	19,718	907	0	250,737

All steel shall be epoxy coated unless otherwise specified.

BENDING DIAGRAMS AND REINFORCING STEEL TOTALS

Detailed SEP 2024
Checked SEP 2024

Note: This drawing is not to scale. Follow dimensions.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_048_JST0021_BarBending.dgn 16:29 1-OCT-2024

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024
ROUTE: 70EB
STATE: MO
DISTRICT: BR
SHEET NO.: 48
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

REV.	DATE	DESCRIPTION
A	09/13/24	REV. A - FINAL REVIEW
0	10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

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105 WEST CAPITOL
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MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.

No. Req.	Size/ Mark	Location	Codes C	SH	V	Dimensions B ft in.	C ft in.	D ft in.	E ft in.	F ft in.	H ft in.	K ft in.	Nom. Length ft in.	Actual Length ft in.	Weight lb
		SUBSTRUCTURE													
		End Bent 1													
9	6 F100	WINGWALL	E	23		2 3.000	3 6.000	1 2.000	0 11.500	0 7.875	1 10.375	1 3.125	6 11	6 10	92
4	6 F101	WINGWALL	E	9			6 0.000	2 10.000			2 3.000	5 6.750	8 10	8 8	52
9	6 F102	WINGWALL	E	23		2 3.000	5 4.375	1 2.000	0 8.000	0 11.500	1 3.000	1 10.500	8 9	8 9	118
4	6 F103	WINGWALL	E	21			2 10.125	6 0.000			2 7.375	1 1.375	8 10	8 6	51
4	7 H100	BEAM	E	20		35 3.000							35 3	35 3	288
4	7 H101	BEAM	E	20		10 6.000							10 6	10 6	86
4	7 H102	BEAM	E	20		56 7.000							56 7	56 7	463
8	7 H103	BEAM	E	20		35 3.000							35 3	35 3	576
4	6 H104	BEAM	E	20		35 3.000							35 3	35 3	212
8	7 H105	BEAM	E	20		13 0.000							13 0	13 0	213
4	6 H106	BEAM	E	20		13 0.000							13 0	13 0	78
8	7 H107	BEAM	E	20		54 1.000							54 1	54 1	884
4	6 H108	BEAM	E	20		53 4.000							53 4	53 4	320
4	6 H109	DIAPHRAGM	E	20		35 3.000							35 3	35 3	212
4	6 H110	DIAPHRAGM	E	20		10 6.000							10 6	10 6	63
4	6 H111	DIAPHRAGM	E	20		55 10.000							55 10	55 10	335
3	6 H112	DIAPHRAGM	E	20		3 6.000							3 6	3 6	16
1	6 H113	DIAPHRAGM	E	20		2 2.000							2 2	2 2	3
1	6 H114	DIAPHRAGM	E	20		2 2.000							2 2	2 2	3
11	5 H115	STRAND TIE BAR	E	20		5 8.000							5 8	5 8	65
27	6 H116	DIAPHRAGM	E	20		7 10.000							7 10	7 10	318
9	6 H117	DIAPHRAGM	E	20		5 0.000							5 0	5 0	68
3	6 H118	DIAPHRAGM	E	20		4 1.000							4 1	4 1	18
1	6 H119	DIAPHRAGM	E	20		2 8.000							2 8	2 8	4
3	6 H120	DIAPHRAGM	E	20		3 9.000							3 9	3 9	17
1	6 H121	DIAPHRAGM	E	20		2 5.000							2 5	2 5	4
3	6 H122	DIAPHRAGM	E	20		3 6.000							3 6	3 6	16
4	6 H123	BEAM	E	19		10 8.000	1 8.000						12 4	12 2	73
	H124	NOT USED													
28	6 H125	BEAM	E	19		11 3.000	1 8.000						12 11	12 9	536
4	6 H126	BEAM	E	19		9 2.000	1 8.000						10 10	10 8	64
4	6 H127	BEAM	E	19		9 0.000	1 8.000						10 8	10 6	63
4	6 H128	BEAM	E	19		10 2.000	1 8.000						11 10	11 8	70
94	5 H129	DIAPHRAGM	E	19		2 0.000	1 3.000						3 3	3 1	302
18	6 H130	WINGWALL	E	20		10 11.000							10 11	10 11	295
8	8 H131	WINGWALL	E	20		10 11.000							10 11	10 11	233
20	6 H132	WINGWALL	E	20		10 11.000							10 11	10 11	328
8	8 H133	WINGWALL	E	20		10 11.000							10 11	10 11	233
45	6 U100	BEAM	E	37S		5 0.000	2 9.000						14 2	14 0	946
78	6 U101	BEAM	E	13S		2 9.000	2 8.000	2 9.000	2 8.000				12 2	11 8	1367
140	4 U102	BEAM	E	10S			1 0.000	2 9.000					4 9	4 7	429
67	6 U103	DIAPHRAGM	E	37S		3 2.625	2 5.000						10 3	10 1	1015
67	6 U104	DIAPHRAGM	E	19S		2 11.000	2 7.000						5 6	5 4	537
125	6 U105	DIAPHRAGM	E	19S		3 0.000	4 6.000						7 6	7 4	1377
44	6 V100	BEAM	E	17		5 0.000							5 8	5 8	374
65	6 V101	DIAPHRAGM	E	20		2 6.000							2 6	2 6	244
18	6 V102	WINGWALL	E	20		6 8.000							6 8	6 8	180
18	6 V103	WINGWALL	E	20		6 10.000							6 10	6 10	185
		Int. Bent 2													
49	6 D200	KEY	E	20		2 6.000							2 6	2 6	184
12	8 H200	CAP	E	20		35 1.500							35 2	35 2	1,127
12	8 H201	CAP	E	20		59 7.500							59 8	59 8	1,912
8	6 H202	CAP	E	20		35 1.500							35 2	35 2	423
8	6 H203	CAP	E	20		59 7.500							59 8	59 8	717
12	6 H204	CAP	E	10S			1 10.000	3 7.750					7 4	7 0	126
54	6 H205	CAP	E	19S		7 0.000	1 6.000						8 6	8 4	676
12	6 H206	CAP	E	19S		4 6.000	1 6.000						6 0	5 10	105
110	4 P200	PILE	E	34S		5 2.000	0 0.500				1 7.750		5 11	5 10	429
77	5 U200	CAP	E	13S		3 9.000	2 9.000	3 9.000	2 9.000				14 0	13 8	1,098
22	5 U201	CAP	E	10S			2 9.000	3 9.000					9 3	9 0	207
64	6 U202	CAP	E	10S			1 0.000	3 9.000					5 9	5 5	521
132	6 V200	PILE	E	17		7 3.000							7 11	7 11	1,570

No. Req.	Size/ Mark	Location	Codes C	SH	V	Dimensions B ft in.	C ft in.	D ft in.	E ft in.	F ft in.	H ft in.	K ft in.	Nom. Length ft in.	Actual Length ft in.	Weight lb
		Int. Bent 3													
49	6 D300	KEY	E	20		2 6.000							2 6	2 6	184
12	8 H300	CAP	E	20		35 1.500							35 2	35 2	1,127
12	8 H301	CAP	E	20		59 7.500							59 8	59 8	1,912
8	6 H302	CAP	E	20		35 1.500							35 2	35 2	423
8	6 H303	CAP	E	20		59 7.500							59 8	59 8	717
12	6 H304	CAP	E	10S			1 10.000	3 7.750					7 4	7 0	126
54	6 H305	CAP	E	19S		7 0.000	1 6.000						8 6	8 4	676
12	6 H306	CAP	E	19S		4 6.000	1 6.000						6 0	5 10	105
110	4 P300	PILE	E	34S		5 2.000	0 0.500					1 7.750	5 11	5 10	429
77	5 U300	CAP	E	13S		3 9.000	2 9.000	3 9.000	2 9.000				14 0	13 8	1,098
22	5 U301	CAP	E	10S			2 9.000	3 9.000					9 3	9 0	207
64	6 U302	CAP	E	10S			1 0.000	3 9.000					5 9	5 5	521
132	6 V300	PILE	E	17		7 3.000							7 11	7 11	1,570
		End Bent 4													
9	6 F400	WINGWALL	E	23		2 3.000	5 4.375	1 2.000	0 8.000	0 11.500	1 3.000	1 10.500	8 9	8 9	118
4	6 F401	WINGWALL	E	21			2 10.125	6 0.000			2 7.375	2 1.375	8 10	8 6	51
9	6 F402	WINGWALL	E	23		2 3.000	3 6.000	1 2.375	1 0.000	0 7.875	1 10.375	1 3.125	6 11	6 10	92
4	6 F403	WINGWALL	E	9			3 0.000	6 0.000				1 1.375	1 9.375	9 0	8 10	53
4	7 H400	BEAM	E	20		35 3.000							35 3	35 3	288
4	7 H401	BEAM	E	20		10 6.000							10 6	10 6	86
4	7 H402	BEAM	E	20		56 7.000							56 7	56 7	463
8	7 H403	BEAM	E	20		35 3.000							35 3	35 3	576
4	6 H404	BEAM	E	20		35 3.000							35 3	35 3	212
8	7 H405	BEAM	E	20		13 0.000							13 0	13 0	213
4	6 H406	BEAM	E	20		13 0.000							13 0	13 0	78
8	7 H407	BEAM	E	20		54 3.000							54 3	54 3	887
4	6 H408	BEAM	E	20		53 6.000							53 6	53 6	321
95	5 H409	DIAPHRAGM	E	19		2 0.000	1 3.000						3 3	3 1	306
4	6 H410	DIAPHRAGM	E	20		35 3.000							35 3	35 3	212
4	6 H411	DIAPHRAGM	E	20		10 6.000							10 6	10 6	63
4	6 H412	DIAPHRAGM	E	20		56 0.000							56 0	56 0	336
3	6 H413	DIAPHRAGM	E	20		3 6.000							3 6	3 6	16
1	6 H414	DIAPHRAGM	E	20		2 2.000							2 2	2 2	3
11	5 H415	STRAND TIE BAR	E	20		5 8.000							5 8	5 8	65
27	6 H416	DIAPHRAGM	E	20		7 10.000							7 10	7 10	318
9	6 H417	DIAPHRAGM	E	20		5 0.000							5 0	5 0	68
3	6 H418	DIAPHRAGM	E	20		4 1.000							4 1	4 1	18
1	6 H419	DIAPHRAGM	E	20		2 8.000							2 8	2 8	4
3	6 H420	DIAPHRAGM	E	20		3 9.000							3 9	3 9	17
1	6 H421	DIAPHRAGM	E	20		2 5.000							2 5	2 5	4
4	6 H422	BEAM	E	19		15 7.000	1 8.000						17 3	17 1	103
4	6 H423	BEAM	E	19		6 8.000	1 8.000						8 4	8 2	49
4	6 H424	BEAM	E	19		12 10.000	1 8.000						14 6	14 4	86
28	6 H425	BEAM	E	19		11 3.000	1 8.000						12 11	12 9	536
4	6 H426	BEAM	E	19		6 0.000	1 8.000						7 8	7 6	45
1	6 H427	DIAPHRAGM	E	20		2 2.000							2 2	2 2	3
3	6 H428	DIAPHRAGM	E	20		3 6.000							3 6	3 6	16
8	8 H429	WINGWALL	E	20		10 11.000							10 11	10 11	233
20	6 H430	WINGWALL	E	20		10 11.000							10 11	10 11	328
8	8 H431	WINGWALL	E	20		10 11.000							10 11	10 11	233
20	6 H432	WINGWALL	E	20		10 11.000							10 11	10 11	328
47	6 U400	BEAM	E	37S		5 0.000	2 9.000						14 2	14 0	988
78	6 U401	BEAM	E	13S		2 9.000	2 8.000	2 9.000	2 8.000				12 2	11 8	1367
141	4 U402	BEAM	E	10S			1 0.000	2 9.000					4 9	4 7	432
70	6 U403	DIAPHRAGM	E	37S		3 2.625	2 5.000						10 3	10 1	1060
70	6 U404	DIAPHRAGM	E	19S		2 11.000	2 7.000						5 6	5 4	561
126	6 U405	DIAPHRAGM	E	19S		3 0.000	4 6.000						7 6	7 4	1388
46	6 V400	BEAM	E	17		5 0.000							5 8	5 8	392
55	6 V401	DIAPHRAGM	E	20		2 6.000							2 6	2 6	207
18	6 V402	WINGWALL	E	20		7 0.000							7 0	7 0	189
18	6 V403	WINGWALL	E	20		6 10.500							6 11	6 11	187

Nominal lengths are based on out to out dimensions shown in bending diagrams and are listed to the nearest inch for fabricator's use. Actual lengths are measured along centerline bar to the nearest inch. Weights are based on actual lengths.

For bending diagrams and steel reinforcing totals, see Sheet No. 48.

All bars shall be Grade 60.

BILL OF REINFORCING STEEL

Codes: C = Required coatings, where E = Epoxy Coated and G = Galvanized.

SH = Required shape, see bending diagrams.

V = Sets of varied bars and number of bars of each length. Bar dimensions vary in equal increments between dimensions shown on this line and the following line and the actual length dimension shown on this line and the following line vary by the specified increment.

Detailed SEP 2024
Checked SEP 2024

Note: This drawing is not to scale. Follow dimensions.

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER

10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	49

COUNTY: BOONE

JOB NO.: JST0021

CONTRACT ID.:

PROJECT NO.:

BRIDGE NO.: A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER

Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.

No. Req.	Size/ Mark	Location	Codes C	SH	V	Dimensions B ft in.	C ft in.	D ft in.	E ft in.	F ft in.	H ft in.	K ft in.	Nom. Length ft in.	Actual Length ft in.	Weight lb
		SUPERSTRUCTURE													
		Int. Diaphragm													
		at Int. Bent 2													
20	6 H240	DIAPHRAGM	E	20		5 1.000							5 1	5 1	153
20	6 H241	DIAPHRAGM	E	20		7 8.000							7 8	7 8	230
40	4 H242	DIAPHRAGM	E	20		8 0.000							8 0	8 0	214
2	6 H243	DIAPHRAGM	E	20		2 8.000							2 8	2 8	8
2	6 H244	DIAPHRAGM	E	20		2 5.000							2 5	2 5	7
2	6 H245	DIAPHRAGM	E	20		3 11.500							4 0	4 0	12
2	6 H246	DIAPHRAGM	E	20		3 8.500							3 9	3 9	11
4	4 H247	DIAPHRAGM	E	20		4 1.500							4 2	4 2	11
4	4 H248	DIAPHRAGM	E	20		3 10.500							3 11	3 11	10
4	5 H249	STRAND TIE	E	9S			1 3.125	3 6.000			1 2.000	0 5.625	4 9	4 9	20
18	5 H250	STRAND TIE	E	23S		1 3.125	3 6.000	1 3.125	0 5.625	1 2.000	0 5.625	1 2.000	6 0	6 0	113
80	4 U240	DIAPHRAGM	E	28S			1 6.000	3 5.500	2 7.000				7 7	7 4	392
40	6 U241	DIAPHRAGM	E	28S			2 2.000	3 1.000	3 0.000				8 3	7 11	476
40	6 U242	DIAPHRAGM	E	28S			2 2.000	2 7.000	3 0.000				7 9	7 5	446
8	6 U243	DIAPHRAGM	E	28S			2 2.000	2 7.000	1 6.000				6 3	5 11	71
4	5 U244	DIAPHRAGM	E	19S		5 0.000	1 0.000						6 0	5 11	25
12	5 U245	DIAPHRAGM	E	28S		1 6.000	1 0.000	5 0.000					7 6	7 3	91
8	5 V240	DIAPHRAGM	E	20		3 8.000							3 8	3 8	31
		Int. Diaphragm													
		at Int. Bent 3													
20	6 H340	DIAPHRAGM	E	20		5 1.000							5 1	5 1	153
20	6 H341	DIAPHRAGM	E	20		7 8.000							7 8	7 8	230
40	4 H342	DIAPHRAGM	E	20		8 0.000							8 0	8 0	214
2	6 H343	DIAPHRAGM	E	20		2 8.000							2 8	2 8	8
2	6 H344	DIAPHRAGM	E	20		2 5.000							2 5	2 5	7
2	6 H345	DIAPHRAGM	E	20		3 11.500							4 0	4 0	12
2	6 H346	DIAPHRAGM	E	20		3 8.500							3 9	3 9	11
4	4 H347	DIAPHRAGM	E	20		4 1.500							4 2	4 2	11
4	4 H348	DIAPHRAGM	E	20		3 10.500							3 11	3 11	10
4	5 H349	STRAND TIE	E	9S			1 3.125	3 6.000			1 2.000	0 5.625	4 9	4 9	20
18	5 H350	STRAND TIE	E	23S		1 3.125	3 6.000	1 3.125	0 5.625	1 2.000	0 5.625	1 2.000	6 0	6 0	113
80	4 U340	DIAPHRAGM	E	28S			1 6.000	3 7.000	2 7.000				7 8	7 6	401
40	6 U341	DIAPHRAGM	E	28S			2 2.000	3 2.000	3 0.000				8 4	8 0	481
40	6 U342	DIAPHRAGM	E	28S			2 2.000	3 8.500	3 0.000				7 11	7 7	456
8	6 U343	DIAPHRAGM	E	28S			2 2.000	2 8.500	1 6.000				6 5	6 1	73
4	5 U344	DIAPHRAGM	E	19S		5 0.000	1 0.000						6 0	5 11	25
12	5 U345	DIAPHRAGM	E	28S		1 6.000	1 0.000	5 0.000					7 6	7 3	91
8	5 V340	DIAPHRAGM	E	20		3 8.000							3 8	3 8	31
		Slab													
463	6 S1	SLAB	E	20		32 8.500							32 9	32 9	22,775
443	6 S2	SLAB	E	20		57 2.500							57 3	57 3	38,093
26	6 S3	SLAB	E	20	1	2 3.000							2 3	2 3	683
		INCR.=				32 8.500							32 9	32 9	
		14.625 in													
26	6 S4	SLAB	E	20	1	2 0.000							2 0	2 0	679
		INCR.=				32 8.500							32 9	32 9	
		14.75 in													
46	6 S5	SLAB	E	20	1	2 6.500							2 7	2 7	2,067
		INCR.=				57 2.500							57 3	57 3	
		14.625 in													
45	6 S6	SLAB	E	20	1	2 8.000							2 8	2 8	2,025
		INCR.=				57 2.500							57 3	57 3	
		14.875 in													
149	5 S7	SLAB	E	17		8 10.000							9 5	9 5	1,463
365	7 S8	SLAB	E	20		52 8.000							52 8	52 8	39,292
143	8 S9	SLAB	E	20		16 4.000							16 4	16 4	6,236
72	8 S10	SLAB	E	20		33 2.000							33 2	33 2	6,376
70	8 S11	SLAB	E	20		55 0.000							55 0	55 0	10,280
143	8 S12	SLAB	E	20		26 8.000							26 8	26 8	10,182
72	8 S13	SLAB	E	20		40 3.000							40 3	40 3	7,738
70	8 S14	SLAB	E	20		60 0.000							60 0	60 0	11,214

No. Req.	Size/ Mark	Location	Codes C	SH	V	Dimensions B ft in.	C ft in.	D ft in.	E ft in.	F ft in.	H ft in.	K ft in.	Nom. Length ft in.	Actual Length ft in.	Weight lb
		Slab (cont'd)													
973	5 S15	SLAB	E	20		5 3.000							5 3	5 3	5,328
485	5 S16	SLAB	E	20		5 9.500							5 10	5 10	2,951
485	5 S17	SLAB	E	20		5 6.500							5 7	5 7	2,824
485	5 S18	SLAB	E	20		11 3.000							11 3	11 3	5,691
40	8 S19	SLAB	E	20		53 0.000							53 0	53 0	5,660
40	5 S20	SLAB	E	20		51 9.000							51 9	51 9	2,159
		Type D													
		Barrier Curb													
20	5 K1	BARRIER CURB	E	27S		3 8.000	0 9.250	0 5.375	3 2.750		0 5.250	0 1.000	8 1	7 11	165
62	5 K2	BARRIER CURB	E	27S		3 8.000	0 9.250	1 2.500	2 5.750		1 2.250	0 2.750	8 2	7 11	512
4	5 K3	BARRIER CURB	E	27S		1 10.500	0 9.250	1 2.500	0 7.750	1 0.000	1 2.250	0 2.750	5 6	5 2	22
20	5 K4	BARRIER CURB	E	19S	4	2 4.250	0 10.000						3 2	3 1	66
	5 K4	INCR.=		19S		2 6.250	0 10.000						3 4	3 3	
		.5 in													
20	5 K5	BARRIER CURB	E	9S	4		1 6.500	0 9.500	0 8.250		1 6.000	0 4.000	3 0	2 11	63
	5 K5	INCR.=		9S			1 8.500	0 9.500	0 8.250		1 8.000	0 4.500	3 2	3 1	
		.5 in													
12	5 K6	BARRIER CURB	E	19S		2 6.750	0 10.000						3 5	3 4	42
12	5 K7	BARRIER CURB	E	32S			0 10.000	2 6.625			2 6.000	0 6.250	3 5	3 2	40
36	5 K8	BARRIER CURB	E	19S	4	2 8.500	0 10.000						3 7	3 5	138
	5 K8	INCR.=	E	19S		3 2.500	0 10.000						4 1	3 11	
		.75 in													
36	5 K9	BARRIER CURB	E	32S	4		0 10.000	2 8.500			2 7.750	0 6.750	3 7	3 3	131
	5 K9	INCR.=		32S			0 10.000	3 2.500			3 1.750	0 7.750	4 1	3 9	
		.75 in													
18	5 K10	BARRIER CURB	E	19S		3 3.000	0 10.000						4 1	4 0	75
18	5 K11	BARRIER CURB	E	32S			0 10.000	3 3.000			3 2.250	0 7.750	4 1	3 10	72
28	5 K12	BARRIER CURB	E	20		11 6.000							11 6	11 6	336
12	5 K13	BARRIER CURB	E	20	4	10 9.000							10 9	10 9	97
	5 K13	INCR.=		20		4 9.000							4 9	4 9	
		36. in													
28	5 K14	BARRIER CURB	E	20		10 11.750							11 0	11 0	321
12	5 K15	BARRIER CURB	E	20	4	10 2.750							10 3	10 3	91
	5 K15	INCR.=		20		4 2.750							4 3	4 3	
		36. in													
494	5 R1	BARRIER CURB	E	26		3 3.000	0 5.500	0 2.250	3 1.375	0 5.500	3 0.750	0 6.750	6 10	6 9	3,478
494	5 R2	BARRIER CURB	E	19S		1 8.500	0 9.500						2 6	2 5	1,245
494	5 R3	BARRIER CURB	E	27S			0 9.500	1 3.250	0 5.000	1 0.000	1 3.000	0 3.000	3 6	3 4	1,717
80	5 R4	BARRIER CURB	E	20		11 9.000							11 9	11 9	980
10	5 R5	BARRIER CURB	E	20		40 10.500							40 11	40 11	427
40	5 R6	BARRIER CURB	E	20		39 7.000							39 7	39 7	1,651
20	5 R7	BARRIER CURB	E	20		39 0.000							39 0	39 0	814
40	5 R8	BARRIER CURB	E	20		38 9.000							38 9	38 9	1,617
10	5 R9	BARRIER CURB	E	20		41 5.000							41 5	41 5	432
		Type C													
		Barrier Curb													
568	5 M1	BARRIER CURB	E	14S			0 5.000	3 3.750			3 3.000	0 7.500	3 9	3 8	2,172
40	5 M2	BARRIER CURB	E	20		11 9.000							11 9	11 9	490
20	5 M3	BARRIER CURB	E	20		18 10.750							18 11	18 11	395
20	5 M4	BARRIER CURB	E	20		40 8.000							40 8	40 8	848
20	5 M5	BARRIER CURB	E	20		39 5.000							39 5	39 5	822
10	5 M6	BARRIER CURB	E	20		44 0.000							44 0	44 0	459
		Slip Form													
		Barrier													
60	5 C1	SLIP FORM	E	20		12 0.000							12 0	12 0	751
8	5 C2	SLIP FORM	E	20		10 0.000							10 0	10 0	83
8	5 C3	SLIP FORM	E	20		8 9.000							8 9	8 9	73

Nominal lengths are based on out to out dimensions shown in bending diagrams and are listed to the nearest inch for fabricator's use. Actual lengths are measured along centerline bar to the nearest inch. Weights are based on actual lengths.

For bending diagrams and steel reinforcing totals, see Sheet No. 48.

All bars shall be Grade 60.

BILL OF REINFORCING STEEL

Codes: C = Required coatings, where E = Epoxy Coated and G = Galvanized.

SH = Required shape, see bending diagrams.

V = Sets of varied bars and number of bars of each length. Bar dimensions vary in equal increments between dimensions shown on this line and the following line and the actual length dimension shown on this line and the following line vary by the specified increment.

Detailed SEP 2024
Checked SEP 2024

Note: This drawing is not to scale. Follow dimensions.

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER

10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED
1-OCT-2024

ROUTE 70EB | STATE MO
DISTRICT BR | SHEET NO. 50
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

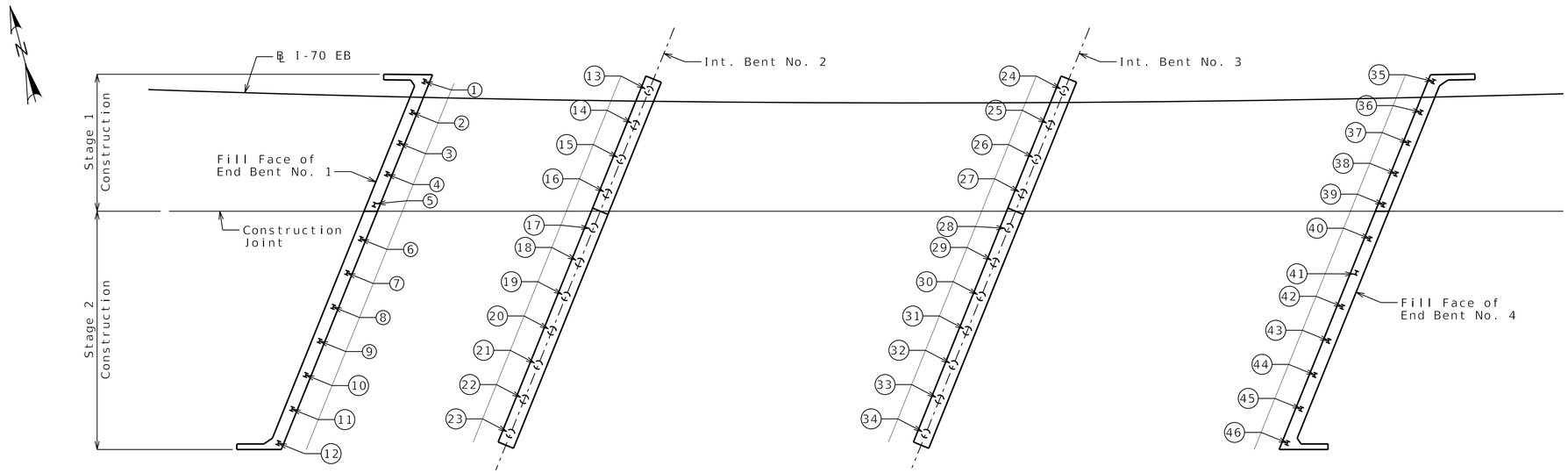
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.



PART PLAN SHOWING PILE NUMBERING FOR RECORDING AS-BUILT PILE DATA

As-Built Pile Data			
Pile No.	Length in Place (ft)	Computed Nominal Axial Compressive Resistance (kips)	Remarks
End Bent No. 1			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
-			
-			
End Bent No. 4			
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
-			

As-Built Pile Data					
Pile No.	Length in Place (ft)	PDA Nom. Axial Compressive Resistance (kips)	PDA End of Drive Blow Count (blows/in.)	Actual End of Drive Blow Count (blows/in.)	Remarks
Intermediate Bent No. 2					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
-					
-					
Intermediate Bent No. 3					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
-					
-					

Note:
Indicate in remarks column:
A. Pile type and grade
B. Batter
C. Driven to practical refusal
D. PDA test pile
E. Minimum tip elevation controlled
(Use when actual blow count is less than PDA blow count due to minimum tip elevation requirement. A plus sign (+) shall be placed after the PDA nominal axial compressive resistance value indicating actual value is higher than PDA value.)

This sheet to be completed by MoDOT construction personnel.

Detailed AUG. 2024
Checked AUG. 2024

Note: This drawing is not to scale. Follow dimensions.

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024
ROUTE: 70EB
STATE: MO
DISTRICT: BR
SHEET NO.: 51
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
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MoDOT IMPROVE I-70 DB PROJECT 1

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MILLSTONE WEBER

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.

Missouri Department of Transportation
Construction and Materials

BORING NO. BR 2-1A
Page 1 of 1

Job No.: 20241040.00
Design:
Bent:
Station:
Offset:
Elevation: 677 Estimated
Requested Station:
Requested Offset:
Requested Elevation:
Drill No.:

County: Boone
Skew:
Logged By: SO
Northing:
Easting:
Requested Northing:
Requested Easting:
Equipment: CME 550X,Split-Spoon Sampler, Shelby Tube
Location Note: (38.9623550°, -92.2964048°)
Hammer Efficiency: 90%

Route: I-70
Location: Columbia, Missouri
Operator: LRK
Date of Work: 04/16/24-04/16/24
Depth to Water:
Depth Hole Open:
Time Change:
Drilling Method: HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (ROD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-4.0' (CH) FILL: Brown, fat CLAY, trace sand, gravel, and concrete cobble	675		50	4-5-6 (17)		PP = 2.25 tsf	
					0				
5		4.0-6.3' (CH) FILL: Brown, fat CLAY, with gravel 4.0' -rough drilling below 4.0 ft.							
		6.3-7.2' LIMESTONE, highly weathered	670		75	50/0.3"		PP = 1.75 tsf	
		7.2-16.5' LIMESTONE, gray, hard to very hard, moderately to slightly weathered, finely crystalline to aphanitic, thin to thick bedded, dense, with chert nodules and seams			90 (40)				
10			665		100 (48)				
		12.7' -highly weathered chert seam from 12.7 to 13.2 ft.							
15					100 (67)				
		Refusal at 6.5 feet. Bottom of borehole at 16.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

* Persons using this information are cautioned that the materials shown are determined by the equipment noted and accuracy of the "log of materials" is limited thereby and by judgement of the operator. THIS INFORMATION IS FOR DESIGN PURPOSES ONLY.

LETTER BOREHOLE - MODOT 20160728.GDT - 4/25/24 15:34 - \\TSI\PROJECTS\2024\1040.00_I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040.GPJ

BORING LOGS

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED: 1-OCT-2024
ROUTE: 70EB | STATE: MO
DISTRICT: BR | SHEET NO.: 52
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
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MoDOT IMPROVE I-70 DB PROJECT 1

Jacobs | MILLSTONE WEBER

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.

Detailed SEP 2024
Checked SEP 2024

Note: This drawing is not to scale. Follow dimensions.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_052_JST0021_Boring_001.dgn 16:34 1-OCT-2024

Missouri Department of Transportation
Construction and Materials

BORING NO. BR 2-2
Page 1 of 2

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** **Date of Work:** 06/10/24-06/10/24
Offset: **Easting:** **Depth to Water:**
Elevation: 669.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9623850, -92.2961972)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-3.0' (CH) Brown and gray, fat CLAY, trace sand and gravel			39	3-2-2 (6)		PP = 2.00 tsf	
		3.0-7.3' (CL) Brown and gray, lean CLAY, with sand	665		100	3-2-3 (8)		PP = 1.50 tsf	
5		6.0' -with gravel below 6.0 ft.			100	3-3-48 (77)		PP = 1.50 tsf	
		7.3-10.0' LIMESTONE, highly weathered 7.5' -rough drilling from 7.5 to 8.5 ft.	660		0	50/0.1'			
		9.5' -10 " rod drop at 9.5 ft.			61 (39)				
10		10.0-12.3' Gray and brown, completely weathered clayey SHALE, with limestone fragments 10.0' -rotary wash from 10.0 to 12.3 ft.			71	15-13-50/0.4'			
		12.3-25.0' LIMESTONE, gray, moderately hard to very hard, slightly weathered, fine to medium crystalline, thin to medium bedded, dense, with occasional chert nodules or bands	655		88 (56)				
15		15.0' -fine to coarse crystalline below 15.0 ft.			98 (78)				
20			650						
					90 (60)				
25			645						

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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LETTER BOREHOLE - MODOT 20150728.GDT - 6/13/24 18:34 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\20241040.00 - I-70 THIRD LANE (KINGSDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040.GPJ

Missouri Department of Transportation
Construction and Materials

BORING NO. BR 2-2
Page 2 of 2

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** **Date of Work:** 06/10/24-06/10/24
Offset: **Easting:** **Depth to Water:**
Elevation: 669.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9623850, -92.2961972)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-30.0' LIMESTONE, gray, moderately hard to hard, slightly weathered, fine to coarse crystalline, thin to thick bedded, dense	640		100 (90)				
30		Refusal at 8.5 feet. Bottom of borehole at 30.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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LETTER BOREHOLE - MODOT 20150728.GDT - 6/13/24 18:34 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\20241040.00 - I-70 THIRD LANE (KINGSDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040.GPJ

BORING LOGS

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER

10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED
1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	53

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.

Detailed SEP 2024
Checked SEP 2024

Note: This drawing is not to scale. Follow dimensions.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_053_JST0021_Boring_002.dgn 16:35 1-OCT-2024

LETTER BOREHOLE - MODOT 20150728.GDT - 6/13/24 18:34 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\20241040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040.GPJ

TSi geotechnical, inc.

Missouri Department of Transportation
Construction and Materials

BORING NO. BR 2-3
Page 1 of 2

Job No.: 20241040.00	**County:** Boone	**Route:** I-70
Design:	**Skew:**	**Location:** Columbia, Missouri
Bent:	**Logged By:** SO	**Operator:** LRK
Station:	**Northing:**	**Date of Work:** 06/07/24-06/07/24
Offset:	**Easting:**	**Depth to Water:** 13.0
Elevation: 670.0	**Requested Northing:**	**Depth Hole Open:**
Requested Station:	**Requested Easting:**	**Time Change:**
Requested Offset:	**Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube	
Requested Elevation:	**Location Note:** (38.9622544, -92.2957516)	
Drill No.:	**Hammer Efficiency:** 90%	**Drilling Method:** HSA

Depth (ft)	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0	0.0-5.5' (CL) Brown, lean CLAY, with gravel, trace sand	670						
			Split spoon	11	4-4-4 (12)		PP = 2.00 tsf	
	3.5' -sandy below 3.5 ft.		Split spoon		4-6-5 (17)		PP = 3.50 tsf	
5		665						
	5.5-12.0' (SC) Brown, clayey SAND		Shelby tube	100			PP = 1.75 tsf	
	8.5' -with gravel below 8.5 ft.		Split spoon	44	7-15-10 (38)		PP = 0.50 tsf	
10		660						
	12.0-13.8' (GC) Gray, clayey GRAVEL, with sand ▽							
	13.8-25.0' Gray, highly weathered SHALE, with gravel		Split spoon	33	18-11-19 (45)			
15		655						
			Split spoon	56	7-9-15 (36)		PP >4.50 tsf	
20		650						
	23.5' -trace gravel below 23.5 ft.		Split spoon	100	50/0.1'			
25		645						

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: ______ **Coordinate Zone:** ______ **Coordinate Proj. Factor:** ______
Coordinate Datum: ______ **Coordinate Units:** U.S. Survey Feet

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LETTER BOREHOLE - MODOT 20150728.GDT - 6/13/24 18:34 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\20241040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040.GPJ

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Missouri Department of Transportation
Construction and Materials

BORING NO. BR 2-3
Page 2 of 2

Job No.: 20241040.00	**County:** Boone	**Route:** I-70
Design:	**Skew:**	**Location:** Columbia, Missouri
Bent:	**Logged By:** SO	**Operator:** LRK
Station:	**Northing:**	**Date of Work:** 06/07/24-06/07/24
Offset:	**Easting:**	**Depth to Water:** 13.0
Elevation: 670.0	**Requested Northing:**	**Depth Hole Open:**
Requested Station:	**Requested Easting:**	**Time Change:**
Requested Offset:	**Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube	
Requested Elevation:	**Location Note:** (38.9622544, -92.2957516)	
Drill No.:	**Hammer Efficiency:** 90%	**Drilling Method:** HSA

Depth (ft)	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25	25.0-27.0' Gray, highly weathered SHALE, trace gravel	645						
	27.0-29.0' Highly weathered LIMESTONE		Split spoon	100	50/0.1'			
	29.0-48.0' Cherty LIMESTONE, highly weathered, with shale		Core	21 (6)				
30		640						
35		635	Core	23 (12)				
40		630	Core	23 (0)				
45		625	Core	55 (10)				
	48.0-50.0' Cherty LIMESTONE,gray, moderately hard, slightly weathered, fine to medium crystalline, thin bedded, dense to pitted							
50		620						

Refusal at 29.0 feet.
Bottom of borehole at 50.0 feet.

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: ______ **Coordinate Zone:** ______ **Coordinate Proj. Factor:** ______
Coordinate Datum: ______ **Coordinate Units:** U.S. Survey Feet

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BORING LOGS

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER

10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED	1-OCT-2024
ROUTE 70EB	STATE MO
DISTRICT BR	SHEET NO. 54
COUNTY	BOONE
JOB NO.	JST0021
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	A9542

DATE	DESCRIPTION
09/13/24	REV. A - FINAL REVIEW
10/01/24	REV. 0 - RELEASED FOR CONSTRUCTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
MoDOT
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1
Jacobs
MILLSTONE WEBER
MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING
REV.

Detailed SEP 2024
Checked SEP 2024

Note: This drawing is not to scale. Follow dimensions.

Missouri Department of Transportation
Construction and Materials

BORING NO. BR 10-3A
Page 1 of 3

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** **Date of Work:** 06/06/24-06/06/24
Offset: **Easting:** **Depth to Water:** 8.0
Elevation: 670.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:**
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0	0.0-3.5' (CL) Brown, lean CLAY, with sand, gravel and coal	670						
				44	3-3-4 (11)		PP = 3.00 tsf	
	3.0' -with concrete below 3.0 ft.			100				
	3.5-5.0' CONCRETE			17	50/0.5'			
5	5.0-7.7' (ML) Brown and gray, sand SILT	665						
				67	0-0-0 (0)		PP = 0.50 tsf	
	7.7-13.8' (SP) Coarse SAND, with gravel			79				
10		660						
	13.8-25.0' Gray, SHALE, highly weathered			28	7-5-6 (17)		PP = 4.50 tsf	
15		655						
	18.5' -with crystalline lenses from 18.5 to 20.0 ft.			44	21-11-15 (39)		PP >4.50 tsf	
20		650						
	23.5' -slightly weathered below 23.5 ft.			100	50/0.3'		PP >4.50 tsf	
	24.0' -rough drilling from 24.0 to 25.0 ft.							
25		645						

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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LETTER BOREHOLE - MODOT 20150728.GDT - 6/13/24 18:34 - \\TSI\PROJECTS\TSILGEOTECH\2024 PROJECTS\2024\1040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040.GPJ

Missouri Department of Transportation
Construction and Materials

BORING NO. BR 10-3A
Page 2 of 3

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** **Date of Work:** 06/06/24-06/06/24
Offset: **Easting:** **Depth to Water:** 8.0
Elevation: 670.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:**
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25	25.0-31.0' Gray, SHALE, slightly weathered	645						
	28.5' -calcareous below 28.5 ft.			100	50/0.1'			
30	30.0' -rough drilling from 30.0 to 31.0 ft.	640						
	31.0-32.0' SHALE, gray, very soft							
	32.0-50.0' Cherty LIMESTONE, gray, moderately hard to very hard, slightly weathered, fine to medium crystalline, thin bedded, dense to pitted			94 (63)				
35		635						
	35.0' -highly weathered, interbedded shale below 35.0 ft.			30 (0)				
40		630						
				20 (10)				
45		625						
				32 (8)				
50		620						

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

* Persons using this information are cautioned that the materials shown are determined by the equipment noted and accuracy of the "log of materials" is limited thereby and by judgement of the operator. THIS INFORMATION IS FOR DESIGN PURPOSES ONLY.

LETTER BOREHOLE - MODOT 20150728.GDT - 6/13/24 18:34 - \\TSI\PROJECTS\TSILGEOTECH\2024 PROJECTS\2024\1040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040.GPJ

BORING LOGS

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER

10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED
1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	55

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

DESCRIPTION	DATE
REV. A - FINAL REVIEW	09/13/24
REV. 0 - RELEASED FOR CONSTRUCTION	10/01/24

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.

Detailed SEP 2024
Checked SEP 2024

Note: This drawing is not to scale. Follow dimensions.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/B2200 (Bridge 2-EB I-70 & CD Rd over Hinkson Creek)/B_A9542_055_JST0021_Boring_004.dgn 16:37 1-OCT-2024

Missouri Department of Transportation
Construction and Materials

BORING NO. BR 10-3A
Page 3 of 3

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** **Date of Work:** 06/06/24-06/06/24
Offset: **Easting:** **Depth to Water:** 8.0
Elevation: 670.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:**
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		50.0-63.0' LIMESTONE, gray, moderately hard, slightly weathered, fine to coarse crystalline, medium to thick bedded, dense to pitted	620						
					100 (100)				
55			615						
					100 (100)				
60		60.0' -fine to medium crystalline, thin to medium bedded below 60.0 ft.	610						
		61.6' -7" chert seam at 61.6 ft.			100 (100)				
		Refusal at 31.0 feet. Bottom of borehole at 63.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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BORING LOGS

STATE OF MISSOURI
MATTHEW J. MUENKS
NUMBER PE-2017000338
PROFESSIONAL ENGINEER
10/01/2024 4:59:52 PM
Matthew Muenks
MO PE-2017000338

DATE PREPARED
1-OCT-2024

ROUTE	STATE
70EB	MO
DISTRICT	SHEET NO.
BR	56

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9542

DESCRIPTION	DATE
REV. A - FINAL REVIEW	09/13/24
REV. 0 - RELEASED FOR CONSTRUCTION	10/01/24

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

Jacobs MILLSTONE WEBER

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.

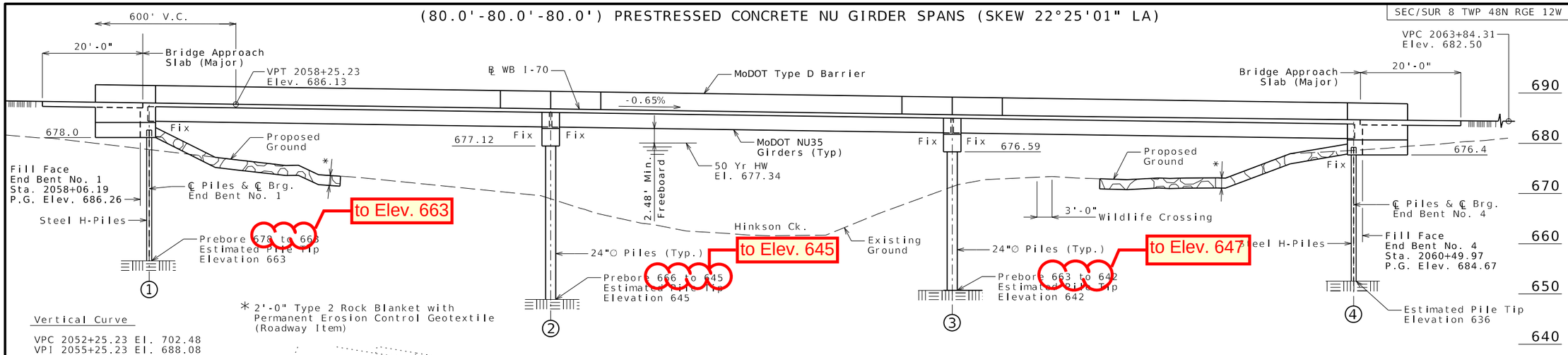
Detailed SEP 2024
Checked SEP 2024

Note: This drawing is not to scale. Follow dimensions.

(80.0'-80.0'-80.0') PRESTRESSED CONCRETE NU GIRDER SPANS (SKEW 22°25'01" LA)

SEC/SUR 8 TWP 48N RGE 12W

ELEVATION



* 2'-0" Type 2 Rock Blanket with Permanent Erosion Control Geotextile (Roadway Item)

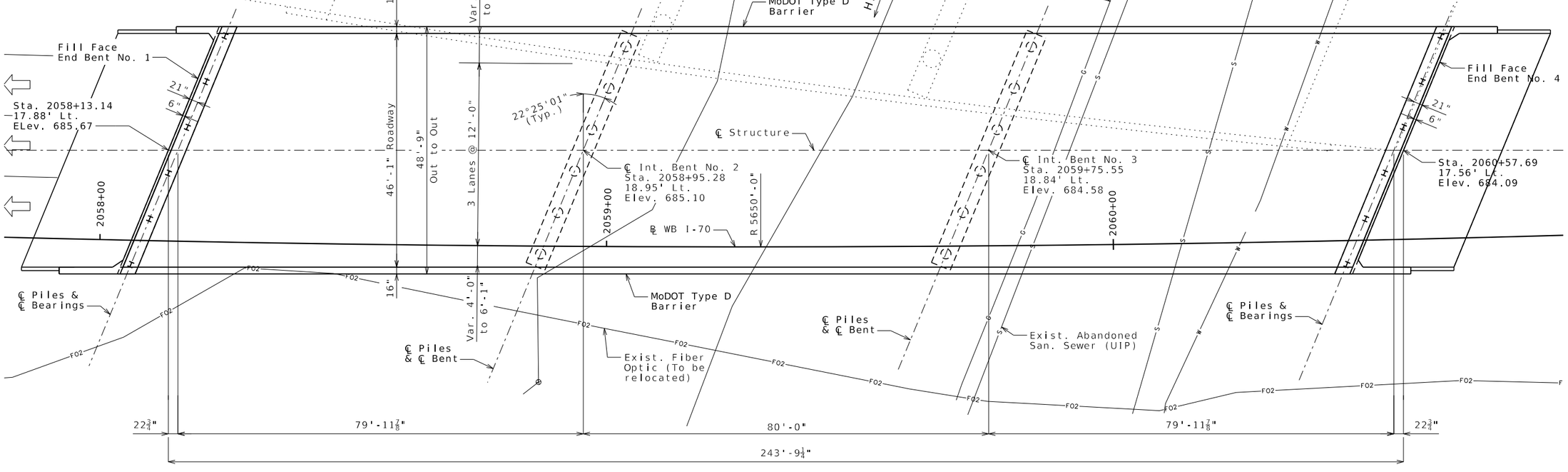
Vertical Curve

VPC 2052+25.23 El. 702.48
VPI 2055+25.23 El. 688.08
VPT 2058+25.23 El. 686.13
Curve Length = 600'
Ent. Grade = -4.8%
Exit Grade = -0.65%

CURVE DATA

PI 2057+50.64
PC 2042+14.63
PT 2072+14.15
Δ 30°25'04" (LT)
D 01°00'51"
L 2999.52
T 1536.01'
R 5650.00'
SE = 3.0%

PLAN



Note: All Bents are parallel.

B.M. 70 - ELEVATION = 715.81
STATE PLANE (1983 CENTRAL ZONE)
NORTHING 1138803.0504
EASTING 1700592.2071
LATITUDE 38.96086552 DEGREES
LONGITUDE -92.28837098 DEGREES
POINT DESCRIPTION 74/IR

BRIDGE 4: ROUTE WB I-70 OVER HINKSON CREEK

ROUTE WB I-70
ABOUT 0.0838 MILES WEST OF EX ℄ RTE 63
BEGINNING STATION 2058+06.19 ±

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 1
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

DATE	DESCRIPTION
10/10/24	REV. A-PRELIMINARY REVIEW

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)
MoDOT IMPROVE I-70 DB PROJECT 1
MILLSTONE WEBER
ABNA
MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

General Notes:

Design Specifications:

2020 AASHTO LRFD Bridge Design Specifications (9th Ed.)
Seismic Design Category = A
Design earthquake response spectral acceleration coefficient at 1.0 second period, SD1 = 0.088
Acceleration Coefficient (effective peak ground acceleration coefficient), As = 0.060

Design Loading:

Vehicular = HL-93
Future Wearing Surface = 35 lb/sf
Earth = 120 lb/cf
Equivalent Fluid Pressure = 45 lb/cf
Superstructure: Non-Composite for dead load. Continuous Composite for live load.

Design Unit Stress:

Class B Concrete (Substructure)	f'c = 3,000 psi
Class B-1 Concrete (Barrier Curb)	f'c = 4,000 psi
Class B-2 Concrete (Superstructure, except Prestressed Beams & Barrier)	f'c = 4,000 psi
Class B-1 Concrete (Substructure)	f'c = 4,000 psi
Reinforcing Steel (ASTM A615 Grade 60)	fy = 60,000 psi
Structural Steel HP Pile (ASTM A709 Grade 50S)	fy = 50,000 psi
Welded or Seamless steel shell (pipe) for CIP pile (ASTM A252 Grade 3)	fy = 45,000 psi

For precast prestressed panel stresses, see Sheet No. 19.

For prestressed girder stresses, see Sheet Nos. 15 thru 16.

Neoprene Pads:

Neoprene bearing pads shall be 60 durometer and shall be in accordance with Sec 716.

Joint Filler:

All joint filler shall be in accordance with Sec 1057 for preformed sponge rubber expansion and partition joint filler, except as noted.

Reinforcing Steel:

Minimum clearance to reinforcing steel shall be 1 1/2", unless otherwise shown.

MBS refers to mechanical bar splices. Mechanical bar splices shall be in accordance with Sec 706 or 710.

Traffic Handling:

Structure to be closed during construction. See roadway plans for traffic control details.

Miscellaneous:

Construction personnel will indicate the type of joint filler option used under the precast panels for this structure:
☐ Constant Joint Filler
☐ Variable Joint Filler

Method of forming the slab shall be as shown on the plans and in accordance with Sec 703. All hardware for forming the slab to be left in place as a permanent part of the structure shall be coated in accordance with ASTM A123 or ASTM B633 with a thickness class SC 4 and a finish type I, II or III.

Stay-In-Place Corrugated Steel Forms:

Corrugated steel forms, supports, closure elements and accessories shall be in accordance with grade requirement and coating designation G165 of ASTM A653. Complete shop drawings of the permanent steel deck forms shall be required in accordance with Sec 1080.

Corrugations of stay-in-place forms shall be filled with an expanded polystyrene material. The polystyrene material shall be placed in the forms with an adhesive in accordance with the manufacturer's recommendations.

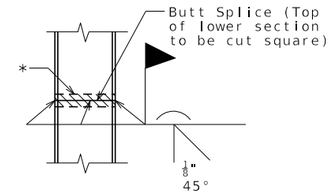
Form sheets shall not rest directly on the top of girder flanges. Sheets shall be securely fastened to form supports with a minimum bearing length of one inch on each end. Form supports shall be placed in direct contact with the flange. Welding on or drilling holes in the girder flanges will not be permitted. All steel fabrication and construction shall be in accordance with Sec 1080 and 712. Certified field welders will not be required for welding of the form supports.

The design of stay-in-place corrugated steel forms is per manufacturer which shall be in accordance with Sec 703 for false work and forms. Maximum actual weight of corrugated steel forms allowed shall be 4 psf assumed for girder loading.

INDEX OF DRAWINGS

1 General Plan and Elevation
2 General Notes & Index of Drawings
3 Substructure Layout Plan
4 End Bent No. 1 - Detail 01
5 End Bent No. 1 - Detail 02
6 End Bent No. 1 - Detail 03
7 Vertical Drain at End Bents
8 Intermediate Bents No. 2 & 3 - Detail 01
9 Intermediate Bents No. 2 & 3 - Detail 02
10 Galvanized Closed Ended Cast-in-Place (CECIP) Concrete Pile
11 End Bent No. 4 - Detail 01
12 End Bent No. 4 - Detail 02
13 End Bent No. 4 - Detail 03
14 Framing Plan
15 NU Girders Spans 1-2 & 3-4
16 NU Girders Span 2-3
17 Concrete Diaphragm at Intermediate Bents
18 Prestressed Panels
19 Slab Drains
20 Slab Elevations, Haunching, and Girder Camber
21 Slab Reinforcing Plan
22 Slab Reinforcing Section & Pouring Sequence
23 Type D Barrier
24 Type D Barrier at End Bents (Right)
25 Type D Barrier at End Bents (Left)
26 Bridge Approach Slab (Major)
27 Bill of Reinforcing Steel 01
28 Bill of Reinforcing Steel 02
29 Bending Diagrams and Reinforcing Steel Totals
30 As-Build Pile Data
31 Boring Data 01
32 Boring Data 02
33 Boring Data 03

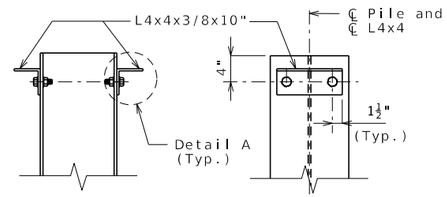
Hydrologic Data
Drainage Area = 43.0 mi²
Design Flood Frequency = 50 years
Design Flood Discharge = 12,900 cfs
Design Flood (D.F.) Elevation = 677.34
Base Flood (100-year)
Base Flood Elevation = 678.52
Base Flood Discharge = 15,100 cfs
Estimated Backwater = 0.16 ft
Average Velocity thru Opening = 7.2 ft/s
Freeboard (50-year)
Freeboard = 2.48 ft
Roadway Overtopping
Overtopping Flood Discharge = N/A cfs
Overtopping Flood Frequency => 500 years
Flood Elevation = N/A



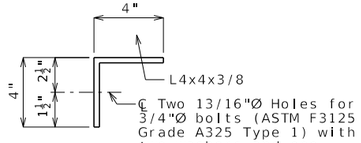
STEEL PILE SPLICE

(If required)

* Galvanizing material shall be omitted or removed one inch clear of weld locations in accordance with Sec 702.

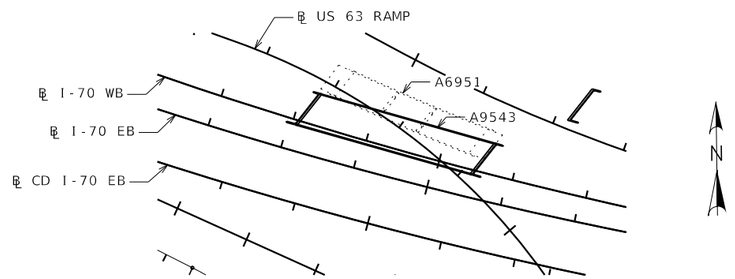


DETAILS OF HP PILE ANCHORS



DETAIL A

Angles shall be coated with a minimum of two coats of non-aluminum epoxy mastic primer to provide a dry film thickness of 4 mils minimum, 8 mils maximum, or galvanized in accordance with Sec 1081. Bolts, washers and nuts shall be galvanized in accordance with AASHTO M 232 (ASTM A153), Class C.



LOCATION SKETCH

DATE PREPARED: 11/21/2024
ROUTE: I-70 | STATE: MO
DISTRICT: BR | SHEET NO.: 2
COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9543

DATE	DESCRIPTION
10/10/24	REV. A-PRELIMINARY REVIEW

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
ABNA

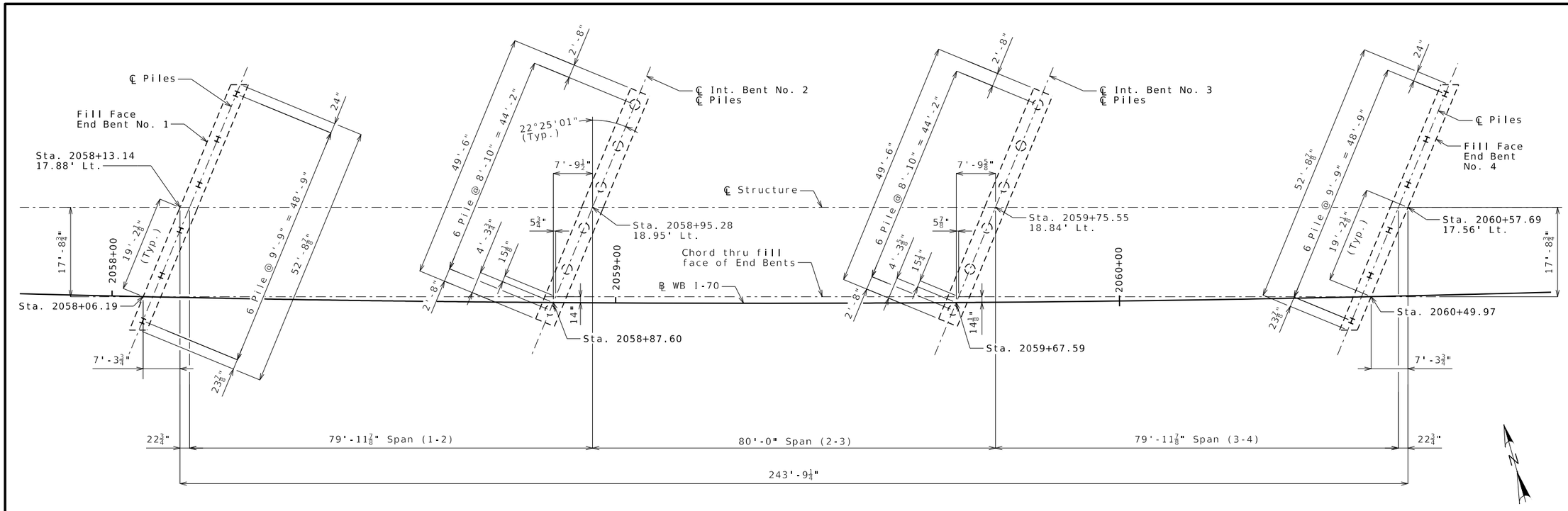
MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

GENERAL NOTES & INDEX OF DRAWINGS

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

B_A9543_002_JST0021_GEN_NOTES.dgn 11:45:50 AM 11/21/2024



LAYOUT DATA FOR SUBSTRUCTURE

Notes:

Estimated Maxumum Scour Depth (Elevation) shown is for verifying Minimum Nominal Axial Compressive Resistance using dynamic testing only when pile resistance contribution above this elevation shall not be considered.

Pile point reinforcement need not be galvanized. Shop drawings will not be required for pile point reinforcement.

All piles shall be galvanized full length.

All piles shall be driven to practical refusal.

HP piles are anticipated to be driven to refusal on rock. Review all borings for depth of rock and restrict driving as appropriate to comply with hard rock driving criteria in accordance with Sec 702. When pile refusal on rock occurs, as approved by the engineer, the minimum nominal axial compressive resistance is verified and no additional pile driving verification method is required.

After any required excavation or grading, the contractor shall prebore the holes for the piles at Bents 1 thru 3. Prebore shall extend a minimum of 5-feet into limestone. The prebored holes shall be filled with sand prior to being driven topractical refusal.

Piles at Bent 4 shall be driven to practical refusal at or below the minimum tip elevation. if the minimum tip elevation listed in the Foundation Data Table is not achieved, stop pile driving activities and notify the Engineerfor further direction.

The contractor shall make every effort to achieve the minimum galvanized penetration (elevation) shown on the plans for all piles. Deviations in penetration less than 5 feet of the minimum will be considered acceptable provided the contractor makes the necessary corrections to ensure the minimum penetration is achieved on subsequent piles.

Foundation Data

Type	Design Data		Bent Number 1	2	3	4
Load Bearing Pile	Pile Type and Size		HP 12x53	CECIP 24"	CECIP 24"	HP 12x53
	Number	ea	6	6	6	6
	Approximate Length Per Each	ft	17	35	38	42
	Pile Point Reinforcement	ea	All	All	All	All
	Min. Galvanized Penetration (Elev.)	ft	Full Length	Full Length	Full Length	Full Length
	Est. Max. Scour Depth (Elev.)	ft	-	660	662	-
	Minimum Tip Penetration (Elev.)	ft	663	645	642	636
	Criteria for Min. Tip Penetration		Min. Embed.	Min. Embed.	Min. Embed.	Min. Embed.
	Approximate Prebore Depth per Each	ft	15	21	21	-
	Approximate Prebore Length in Rock per Each	ft	7	12	8	-
	Pile Driving Verification Method		DF	DT	DT	DF
	Resistance Factor		0.40	0.65	0.65	0.40
	Minimum Nominal Axial Compressive Resistance	kip	x	x	x	x

DF = FHWA-Modified Gates Dynamic Pile Formula

DT = Dynamic Testing

CECIP = Closed Ended Cast-in-Place concrete pile.

OECIP = Open Ended Cast-in-Place concrete pile.

Minimum Nominal Axial Compressive Resistance = $\frac{\text{Maximum Factored Loads}}{\text{Resistance Factor}}$

SUBSTRUCTURE LAYOUT PLAN

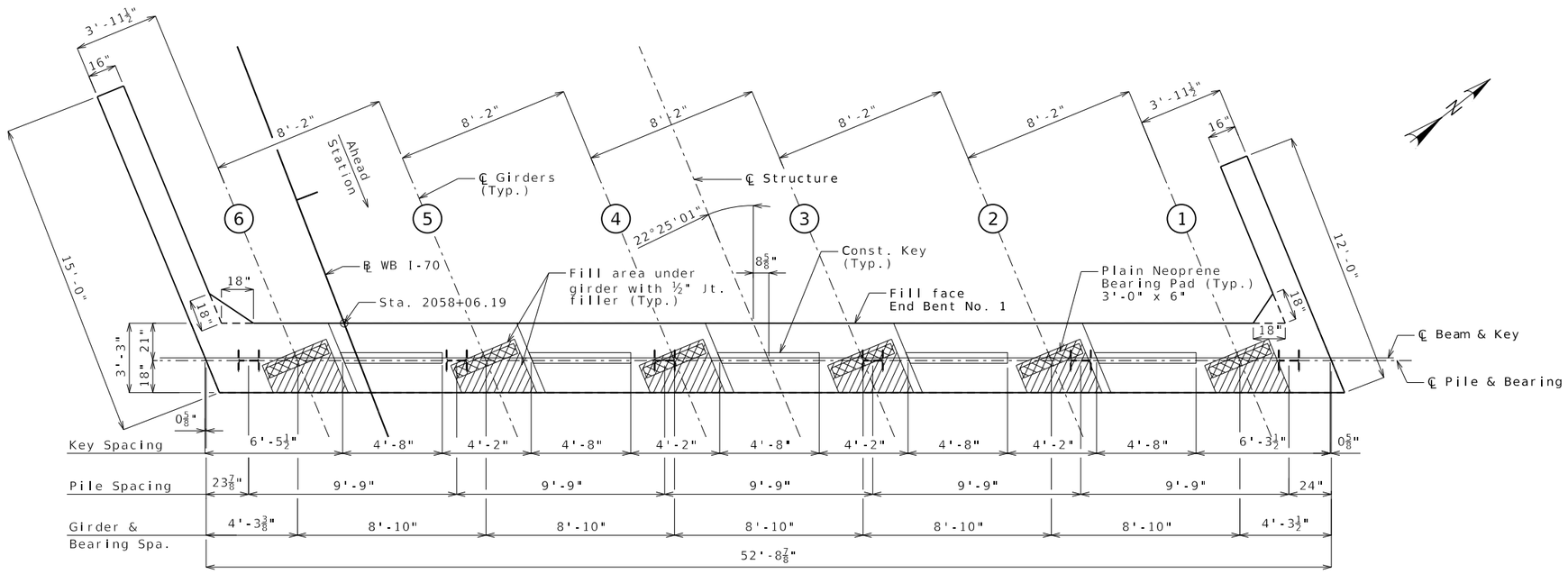
Detailed AUG. 2024
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Note: This drawing is not to scale. Follow dimensions.

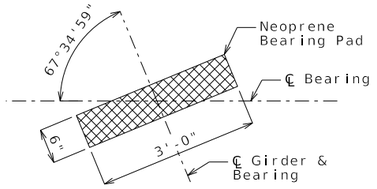
DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 3
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

DATE	DESCRIPTION
10/10/24	REV. A-PRELIMINARY REVIEW

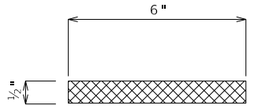
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)
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MoDOT IMPROVE I-70 DB PROJECT 1
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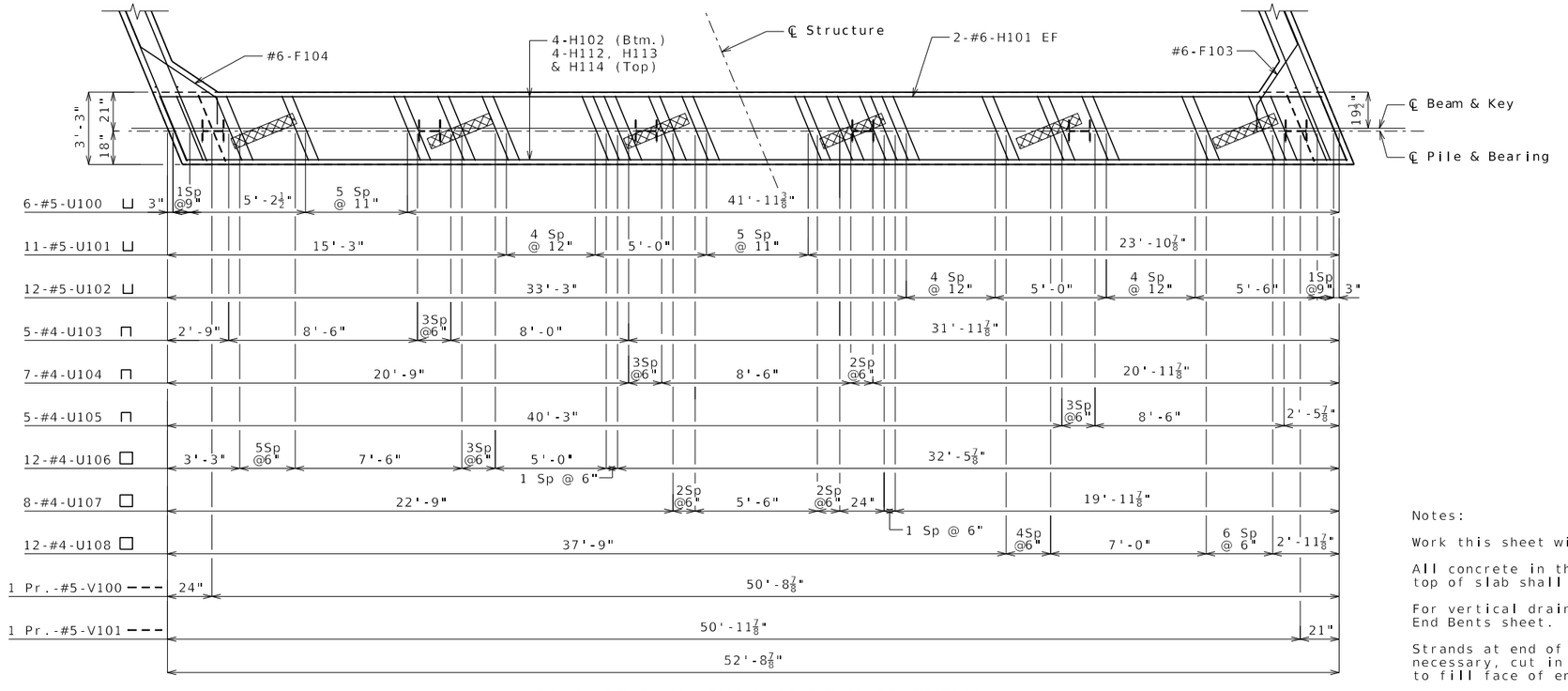
PLAN OF BEAM SHOWING DIMENSIONS



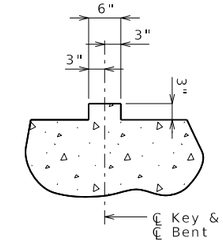
TYPICAL PLAN OF BEARINGS
6 Required



TYPICAL SECTION THRU NEOPRENE BEARING PAD



PLAN OF BEAM SHOWING REINFORCEMENT



SECTION THRU KEY

Notes:

Work this sheet with End Bent 1 Detail 02 and 03 sheets.

All concrete in the end bent above top of beam and below top of slab shall be Class B-2.

For vertical drain at end bents, see Vertical Drain at End Bents sheet.

Strands at end of the girders shall be field bent or, if necessary, cut in field to maintain 1½" minimum clearance to fill face of end bent.

Reinforcment shall be adjusted in the field to clear pile by 1½".

END BENT NO. 1 - DETAIL 01

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 4
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

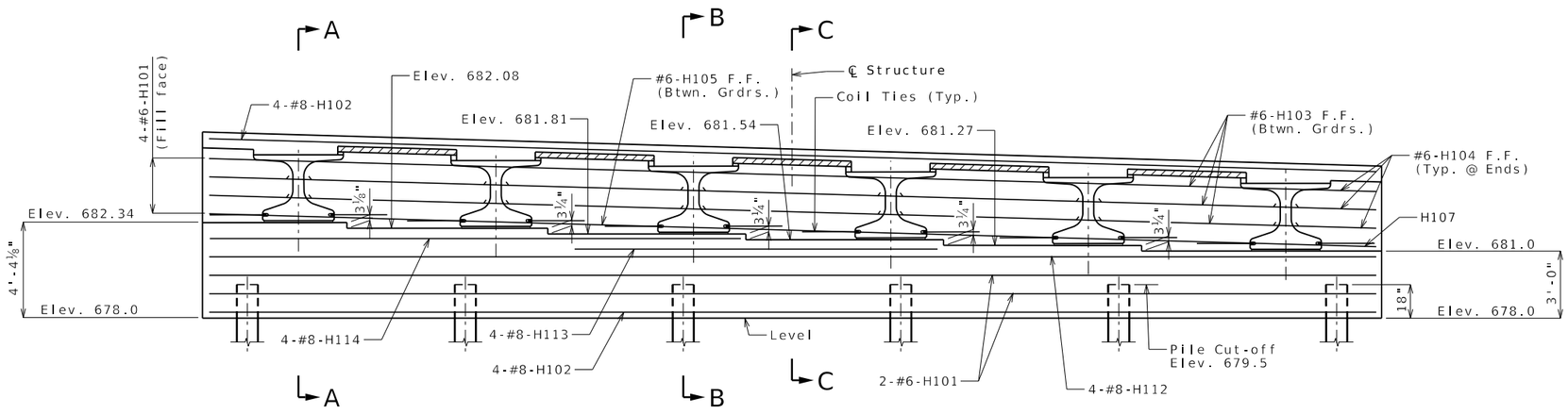
DATE	DESCRIPTION
10/10/24	REV. A-PRELIMINARY REVIEW

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
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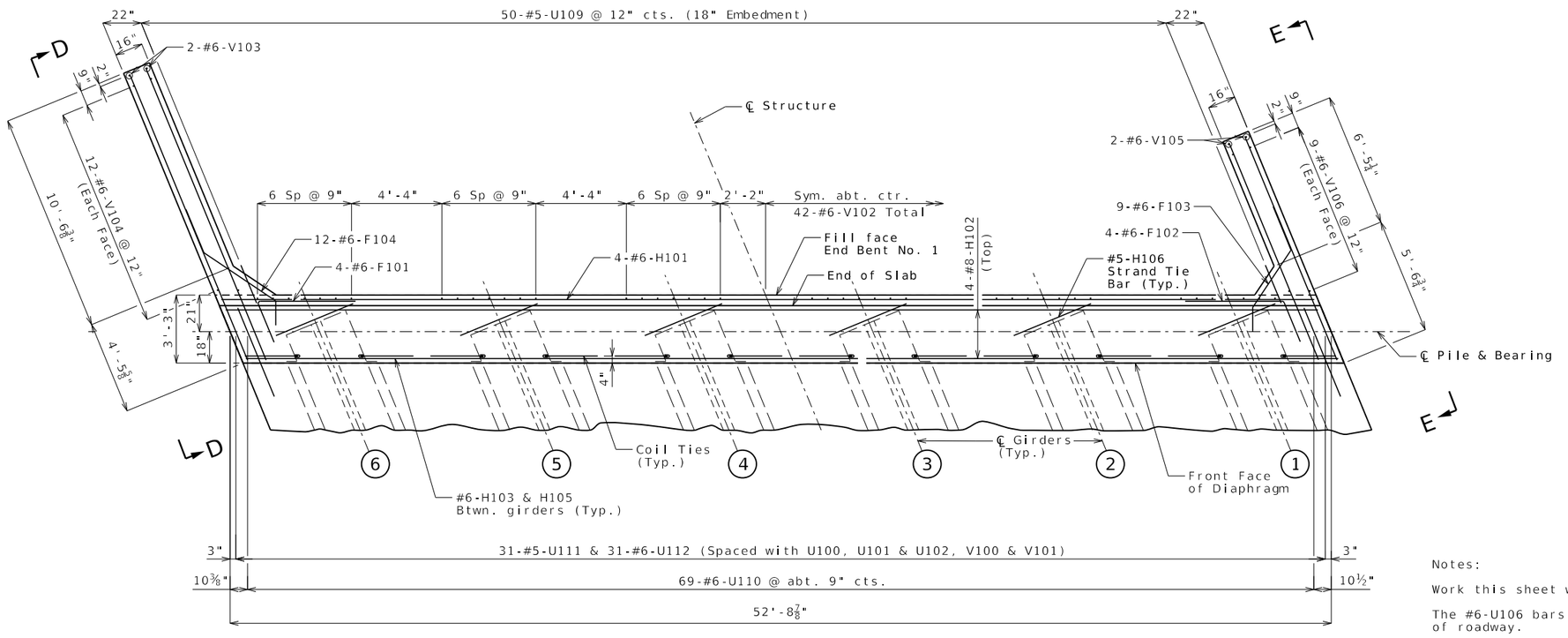
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ABNA

MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING



SECTION NEAR END BENT

(Looking West - Back Station)
(Construction Joint Key and Vertical Reinforcement not shown for clarity)



PART OF BEAM SHOWING REINFORCEMENT

Minimum. Lap

#8 = 6'-2"

Notes:

Work this sheet with End Bent 1 Detail 01 and 03 sheets.

The #6-U106 bars shall be placed parallel to centerline of roadway.

The #6-F101 and #6-F102 bars shall be bent in the field to clear girders.

All concrete in the end bent above top of beam and below top of slab shall be Class B-2.

Strands at the end of the girders shall be field bent or, if necessary, cut in field to maintain 1½" minimum clearance to fill face of end bent.

END BENT NO. 1 - DETAIL 02

Detailed AUG. 2024
Checked NOV. 2024

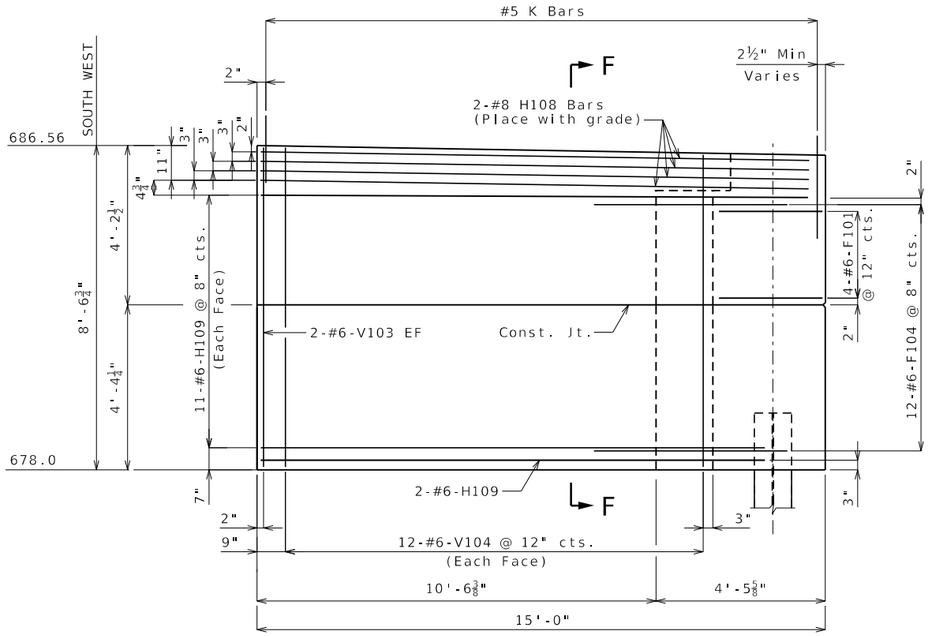
Note: This drawing is not to scale. Follow dimensions.

DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 5
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

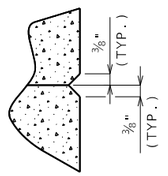
DESCRIPTION | DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)
MoDOT
MILLSTONE WEBER
ABNA
MoDOT IMPROVE I-70 DB PROJECT 1
MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

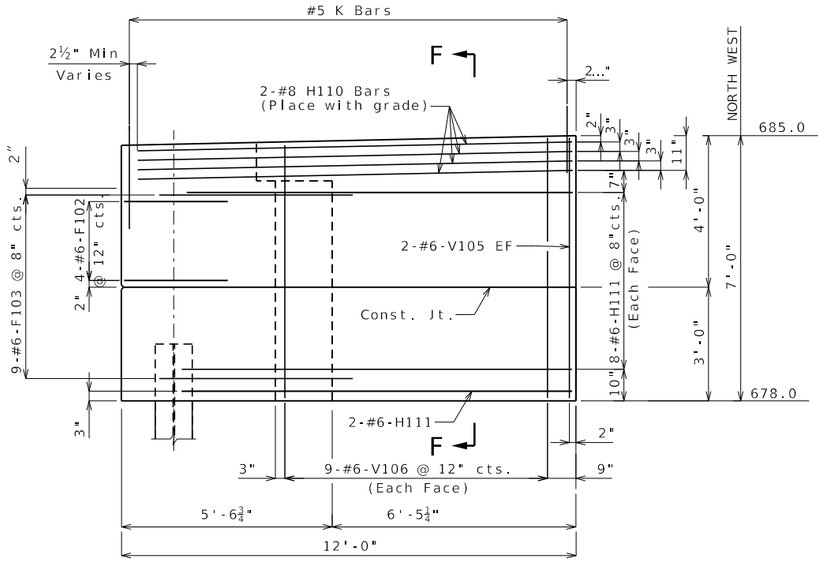
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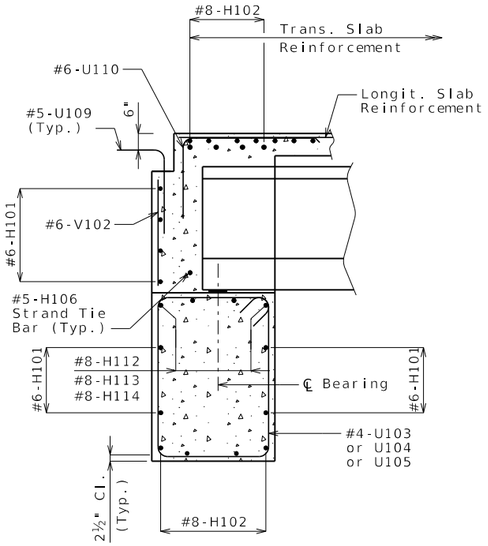
ELEVATION D-D



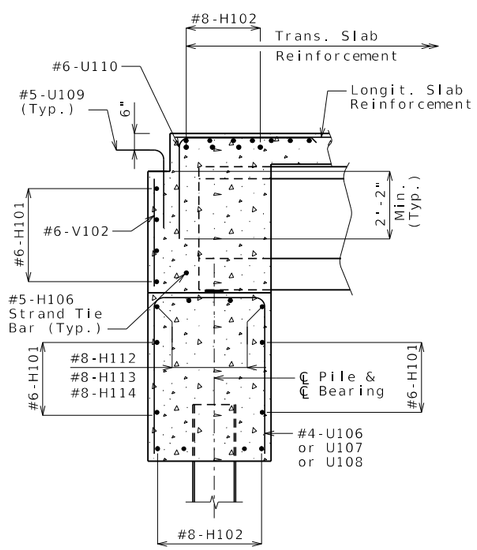
DETAIL "A"



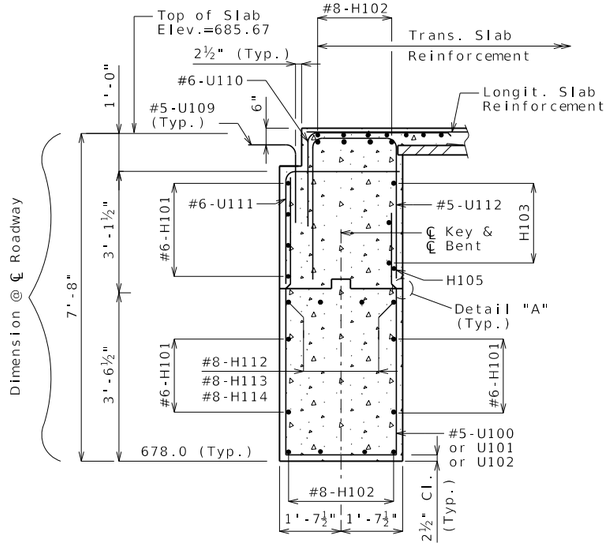
ELEVATION E-E



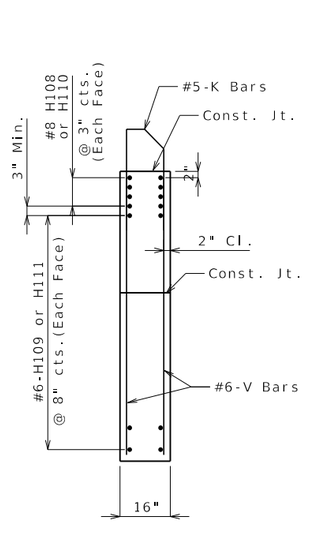
SECTION A-A



SECTION B-B



SECTION C-C



SECTION F-F

Notes:

Work this sheet with End Bent 1 Details 01 & 02 Sheets.

For details of Vertical Drain, see Vertical Drain at End Bents sheet.

For details of Approach Slab, see Approach Slab sheet.

END BENT NO. 1 - DETAIL 03

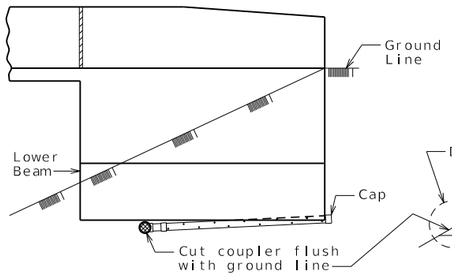
Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

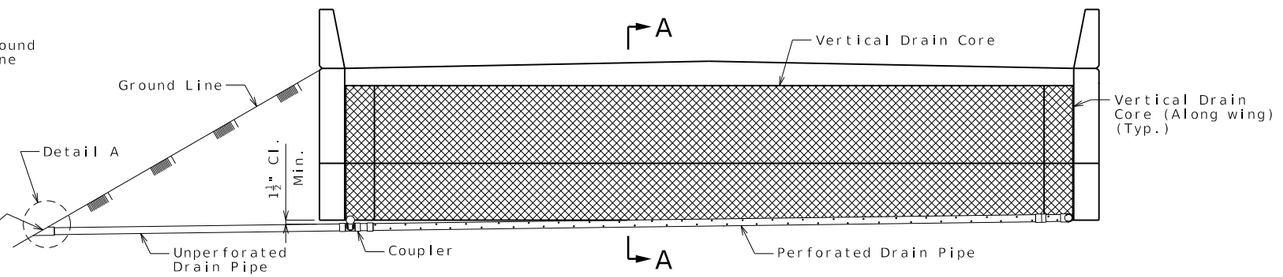
DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 6
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

DATE	DESCRIPTION
10/10/24	REV. A-PRELIMINARY REVIEW

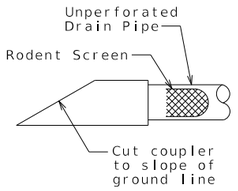
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)
MoDOT
MILLSTONE WEBER
ABNA
MoDOT IMPROVE I-70 DB PROJECT 1
MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING



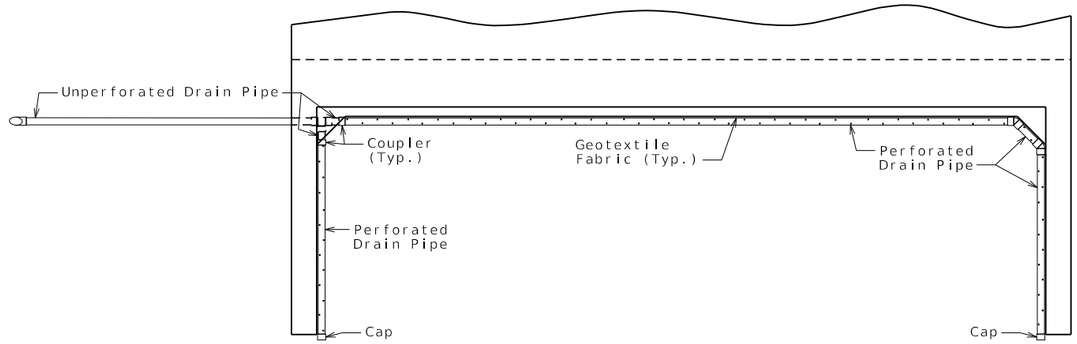
ELEVATION OF WING



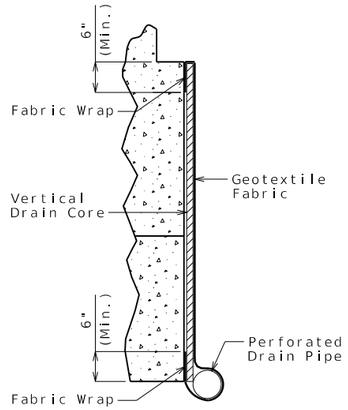
ELEVATION OF END BENT



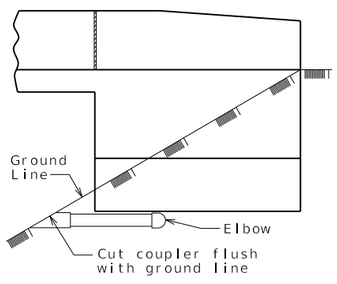
DETAIL A



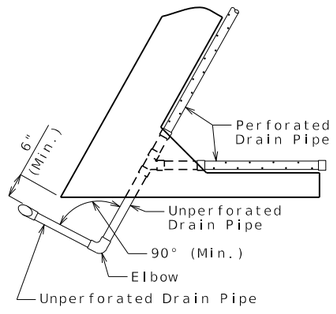
PLAN OF END BENT



PART SECTION A-A
(Section thru wing similar)



ELEVATION OF WING



PART PLAN

OPTIONAL TURNED DRAIN
(Use only when straight drain is not practical.)

General Notes:

All drain pipe shall be sloped 1 to 2 percent.

Drain pipe may be either 6-inch diameter corrugated metallic-coated steel pipe underdrain, 4-inch diameter corrugated polyvinyl chloride (PVC) drain pipe, or 4-inch diameter corrugated polyethylene (PE) drain pipe.

Drain pipe shall be placed at fill face of end bent and inside face of wings. The pipe shall slope to lowest grade of ground line, also missing the lower beam of end bent by a minimum of 1 1/2 inches.

Perforated pipe shall be placed at fill face side and inside face of wings at the bottom of end bent and plain pipe shall be used where the vertical drain ends to the exit at ground line.

VERTICAL DRAIN AT END BENTS

(Squared end bent shown, skewed end bent similar)

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 7
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

DESCRIPTION | DATE

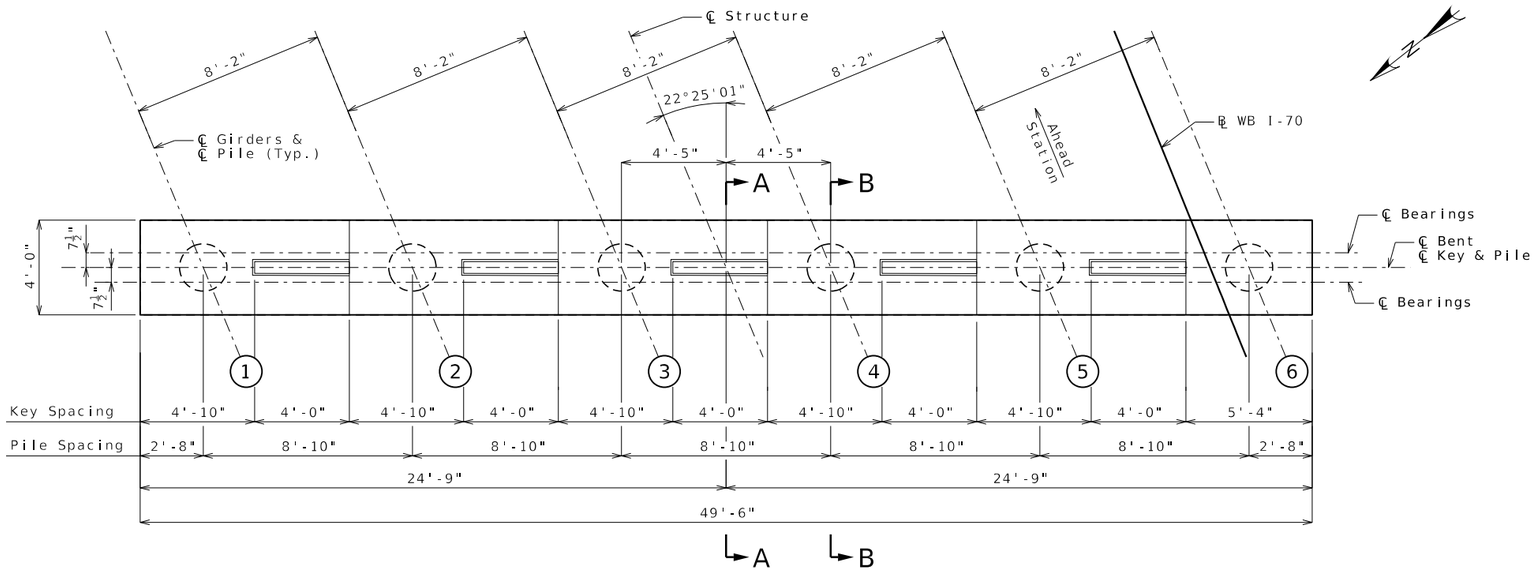
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
MoDOT
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

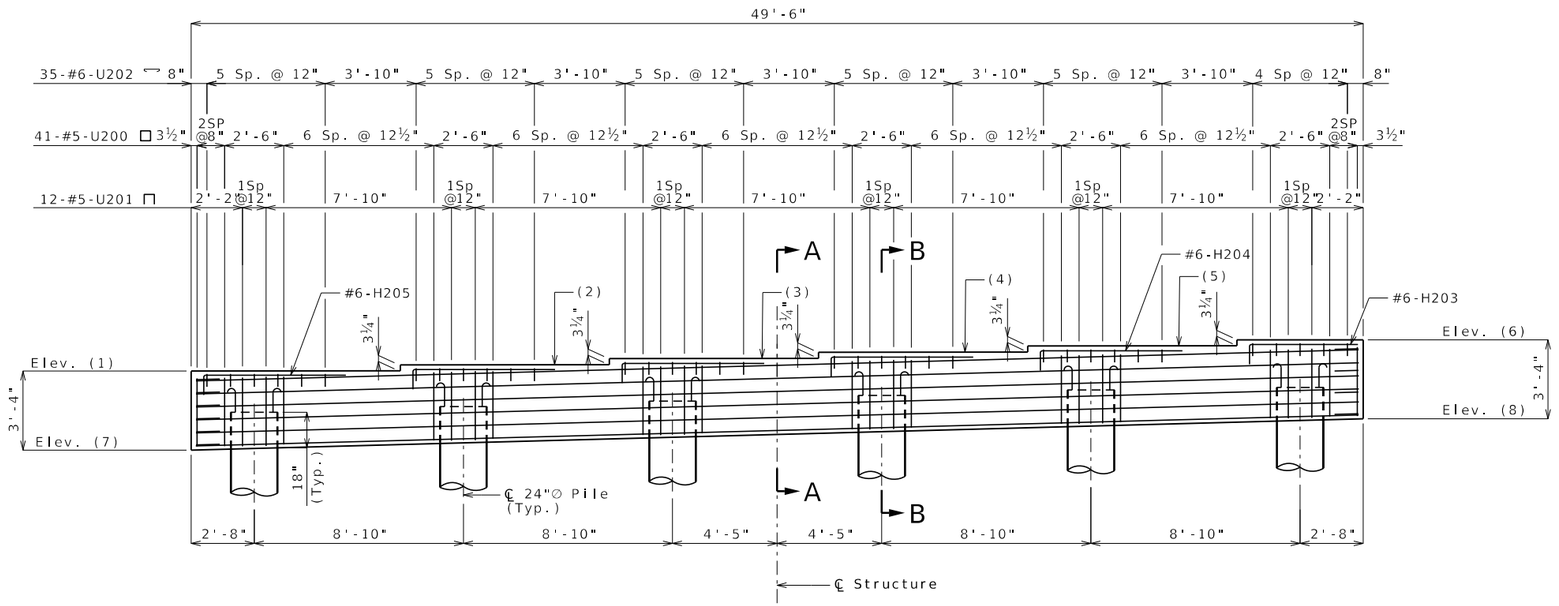
MILLSTONE WEBER
ABNA

MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

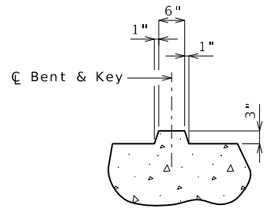
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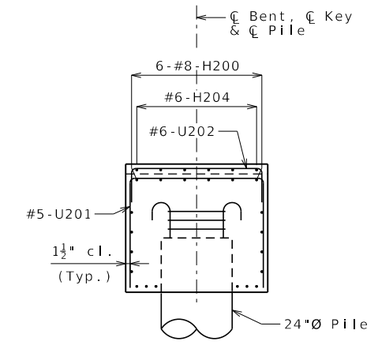
PLAN



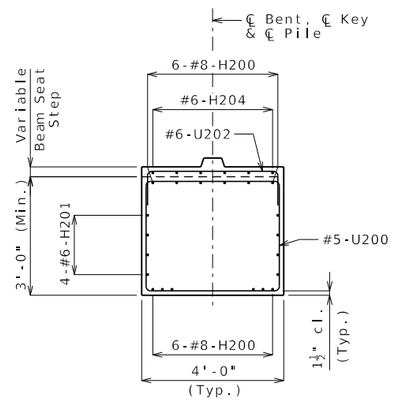
ELEVATION
(Construction Key not shown for clarity)



SECTION THRU KEY



SECTION B-B



SECTION A-A

Elevation No.	Int. Bent No. 2		Int. Bent No. 3	
	Beam Seat Elevation	T/Pile Elevation	Beam Seat Elevation	T/Pile Elevation
(1)	680.45	678.70	679.92	678.17
(2)	680.72	678.94	680.19	678.41
(3)	680.99	679.18	680.45	678.65
(4)	681.26	679.42	680.71	678.89
(5)	681.53	679.66	680.98	679.12
(6)	681.80	679.90	681.24	679.36
(7)	677.12	-	676.59	-
(8)	678.47	-	677.91	-

Notes:

Work this sheet with Intermediate Bent No. 2 & 3 Details 02, 03 & 04 sheets.

Protective Coating (Epoxy) on all exposed surfaces of columns, bottom and sides of cap in accordance with Sec 711

INTERMEDIATE BENTS NO. 2 & 3 - DETAIL 01

(Intermediate No. 2 shown, Int. Bent No. 3 similar - Use series 300 for Int. Bent No. 3)

Note: This drawing is not to scale. Follow dimensions.

Detailed AUG. 2024
Checked NOV. 2024

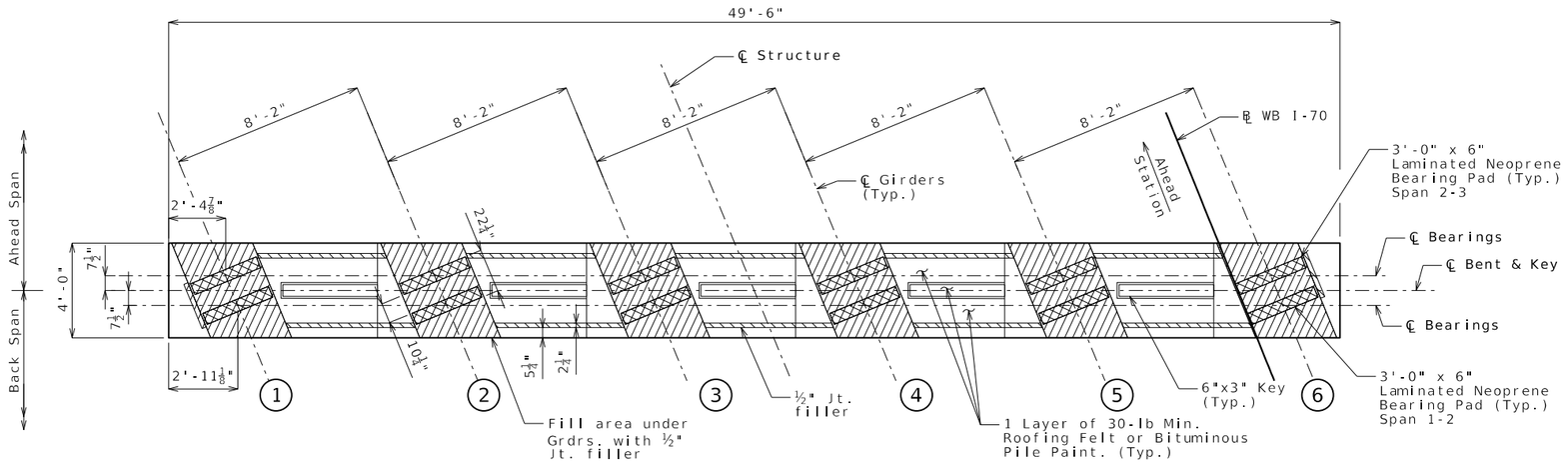
DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 8
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

DESCRIPTION
REV. A-PRELIMINARY REVIEW
DATE 10/10/24

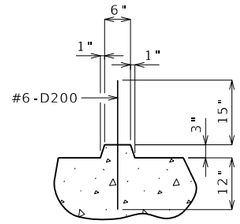
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)
MoDOT
MILLSTONE WEBER
ABNA

MoDOT IMPROVE I-70 DB PROJECT 1

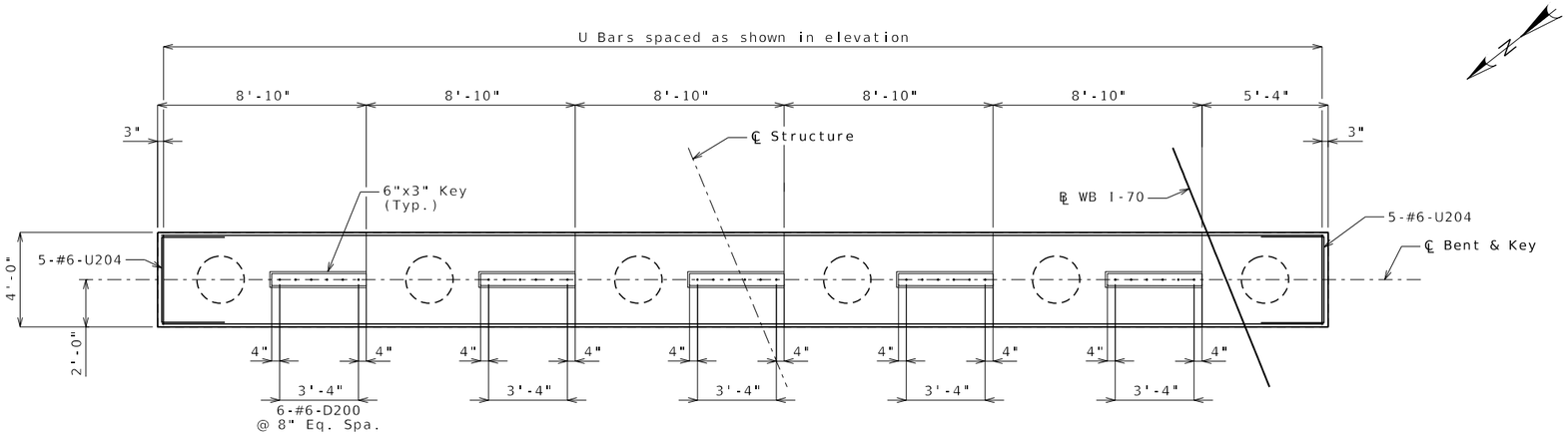
MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING



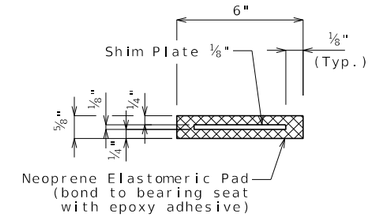
PLAN OF BEAM



SECTION THRU KEY



PLAN OF BEAM SHOWING REINFORCEMENT



SECTION THRU LAMINATED NEOPRENE BEARING PAD Span (1-2)

(Use the same Bearing for Span 2-3)

Notes:

Work this sheet with Intermediate Bents No. 2 & 3 Details 01 sheet.

All concrete in the intermediate bent shall be Class B-1, unless otherwise noted.

INTERMEDIATE BENTS NO. 2 & 3 - DETAIL 02

(Intermediate No. 2 shown, Int. Bent No. 3 similar - Use series 300 for Int. Bent No. 3)

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 9 of 3x

DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 9
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

DESCRIPTION: REV. A-PRELIMINARY REVIEW
DATE: 10/10/24

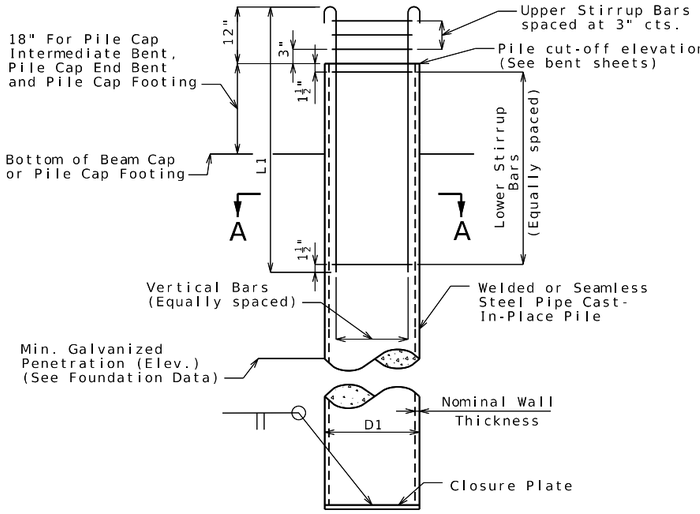
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105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

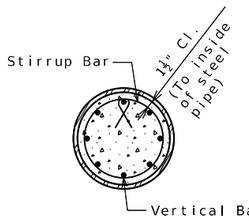
MILLSTONE WEBER
ABNA

MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

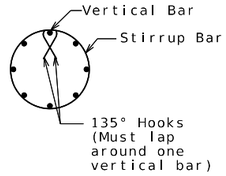
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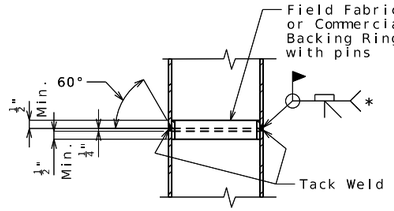
GALVANIZED CLOSED ENDED CAST-IN-PLACE (CECIP) CONCRETE PILE
WITHOUT PILE POINT REINFORCEMENT



SECTION A-A (6)



DETAIL OF SEISMIC (6) STIRRUP BAR



STEEL PIPE PILE SPLICE

* Galvanizing material shall be omitted or removed one inch clear of weld locations in accordance with Sec 702.

(1) Cruciform Pile Point Reinforcement Data				
D1, CECIP Pile (O.D.)	14"	16"	20"	24"
B1	14"	16"	20"	24"
B2	6"	7"	8 7/8"	10 5/8"
B3	5 7/8"	6 7/8"	8 3/4"	10 1/2"
B4	6 5/8"	7 5/8"	9 1/2"	11 1/4"
B5	2"	2"	2 1/4"	2 3/4"
B6	3/4"	3/4"	1"	1 1/2"
H1	9 1/8"	10 1/2"	13"	15 3/8"
H2	8 1/8"	9 1/2"	12"	14 3/8"
H3	8 3/8"	9 3/4"	12 1/4"	14 5/8"
T1 and T2 Plate Thickness	3/4"	3/4"	1"	1 1/2"

(1) Galvanized Closed Ended Cast-In-Place (CECIP) Concrete Pile Data				
Bent Number	1	2	3	4
D1, CECIP Pile (O.D.)	x			
Min. Nominal Wall Thickness	x			
Closure Plate Thickness	x			
Pile Point Reinforcement	x			
Vertical Bars	x			
L1, Length of Vertical Bars	x			
Upper Stirrup Bars	x			
Lower Stirrup Bars	x			

Notes:

Welded or seamless steel shell (pipe) shall be ASTM A252 Grade 3 (fy = 45,000 psi).

Concrete for cast-in-place pile shall be Class B-1.

Steel for closure plate shall be ASTM A709 Grade 50.

Steel for cruciform pile point reinforcement shall be ASTM A709 Grade 50.

(3) Steel casting for conical pile point reinforcement shall be ASTM A27 Grade 65-35 ASTM A148 Grade 90-60.

The minimum wall thickness of any spot or local area of any type shall not be more than 12.5% under the specified nominal wall thickness.

The contractor shall determine the pile wall thickness required to avoid damage from all driving activities, but wall thickness shall not be less than the minimum specified. No additional payment will be made for furnishing a thicker pile wall than specified on the plans.

Closure plate shall not project beyond the outside diameter of the pipe pile. Satisfactory weldments may be made by beveling tip end of pipe or by use of inside backing rings. In either case, proper gaps shall be used to obtain weld penetration full thickness of pipe. Payment for furnishing and installing closure plate will be considered completely covered by the contract unit price for Galvanized Cast-In-Place Concrete Piles.

Splices of pipe for cast-in-place concrete pile shall be made watertight and to the full strength of the pipe above and below the splice to permit hard driving without damage. Pipe damaged during driving shall be replaced without cost to the state. Pipe sections used for splicing shall be at least 5 feet in length.

(5) At the contractor's option, the hooks of vertical bars embedded in the beam cap may be oriented inward or outward.

The hooks of vertical bars embedded in the beam cap should not be turned outward, away from the pile core.

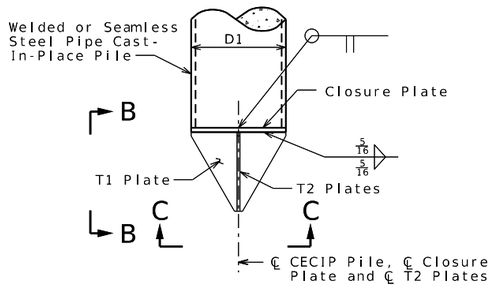
The hook of vertical bars embedded in the pile cap footing should be oriented outward for all seismic categories.

Closure plate need not be galvanized.

Reinforcing steel for cast-in-place piles is included in the Bill of Reinforcing Steel.

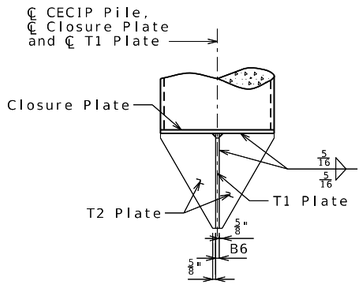
All reinforcement for cast-in-place pile is included in the estimated quantities for bents.

For Foundation Data table, see Sheet No. .

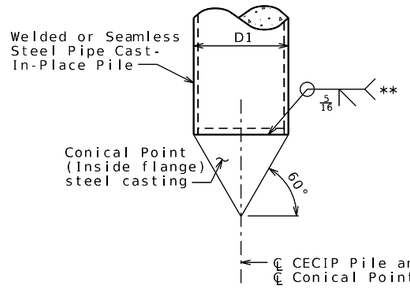


CRUCIFORM PILE POINT

Note: Cost of closure plate is included with cast-in-place concrete pile.



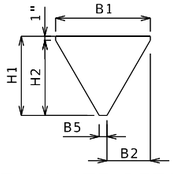
ELEVATION B-B



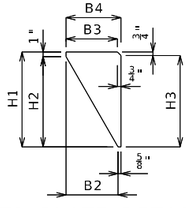
MANUFACTURED CONICAL PILE POINT

(Omit closure plate)

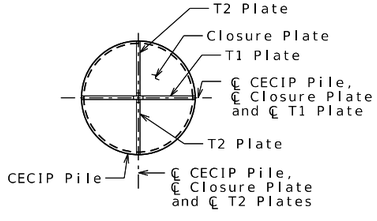
** If the conical pile point is not pre-beveled, place a 3/8" bevel at 40 degrees on the pipe.



T1 PLATE DETAILS



T2 PLATE DETAILS (2 REQUIRED)



SECTION C-C

CRUCIFORM PILE POINT REINFORCEMENT

GALVANIZED CLOSED ENDED CAST-IN-PLACE (CECIP) CONCRETE PILE

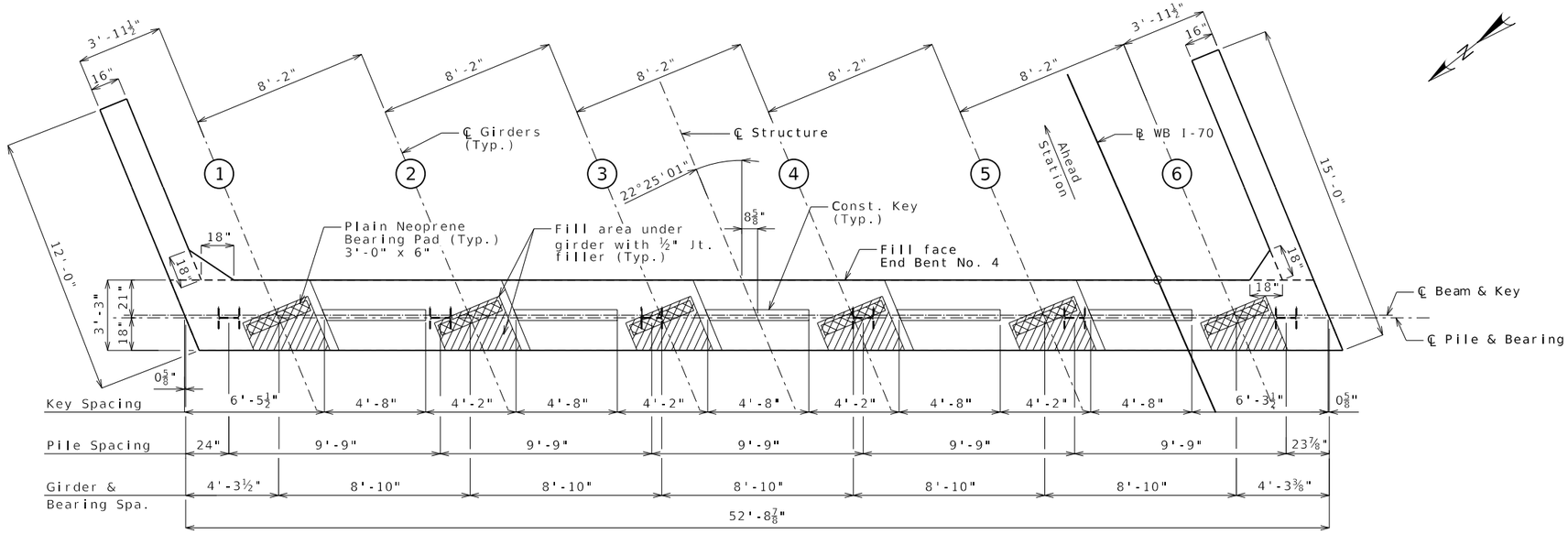
Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

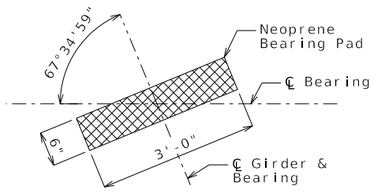
DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 10
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

DATE	DESCRIPTION
10/10/24	REV. A-PRELIMINARY REVIEW

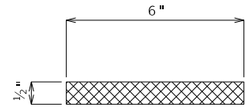
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)
MoDOT
MILLSTONE WEBER
ABNA
MoDOT IMPROVE I-70 DB PROJECT 1
MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING



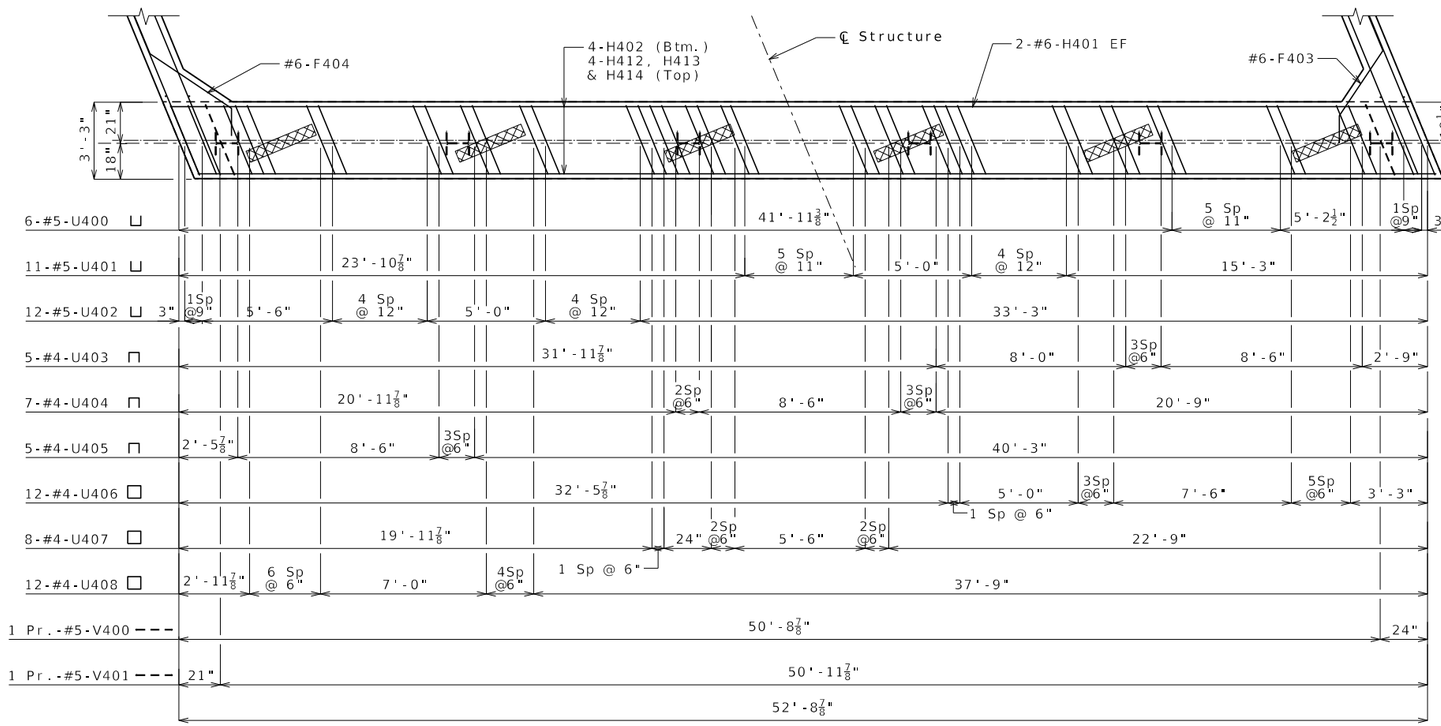
PLAN OF BEAM SHOWING DIMENSIONS



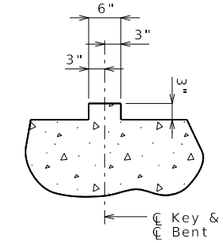
TYPICAL PLAN OF BEARINGS
6 Required



TYPICAL SECTION THRU NEOPRENE BEARING PAD



PLAN OF BEAM SHOWING REINFORCEMENT



SECTION THRU KEY

Notes:

Work this sheet with End Bent 4 Detail 02 and 03 sheets.

All concrete in the end bent above top of beam and below top of slab shall be Class B-2.

For vertical drain at end bents, see Vertical Drain at End Bents sheet.

Strands at end of the girders shall be field bent or, if necessary, cut in field to maintain 1½" minimum clearance to fill face of end bent.

Reinforcment shall be adjusted in the field to clear pile by 1½".

END BENT NO. 4 - DETAIL 01

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 11
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

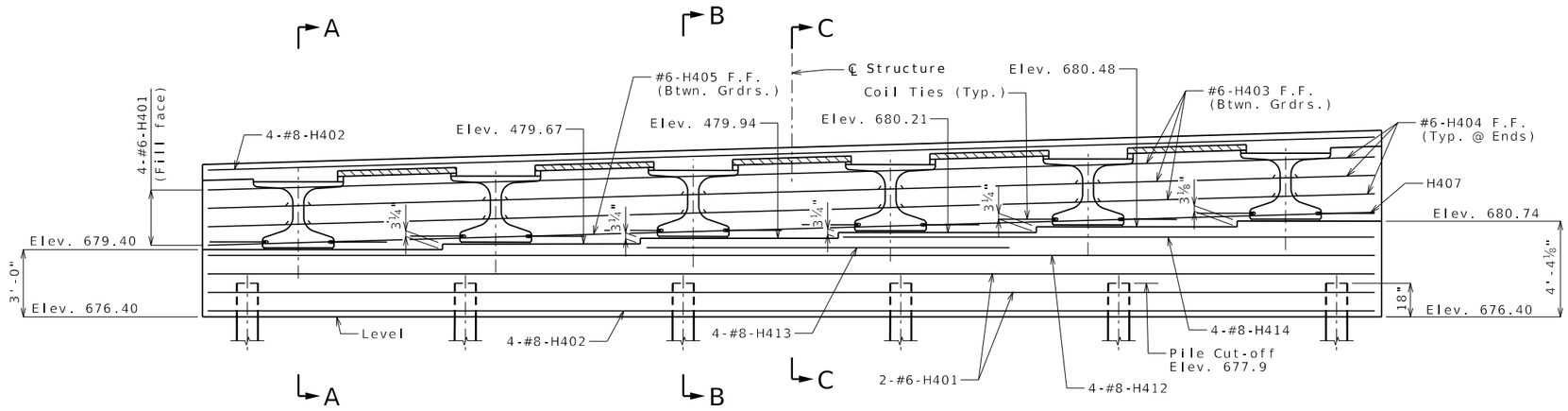
DESCRIPTION	DATE
REV. A-PRELIMINARY REVIEW	10/10/24

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
ABNA

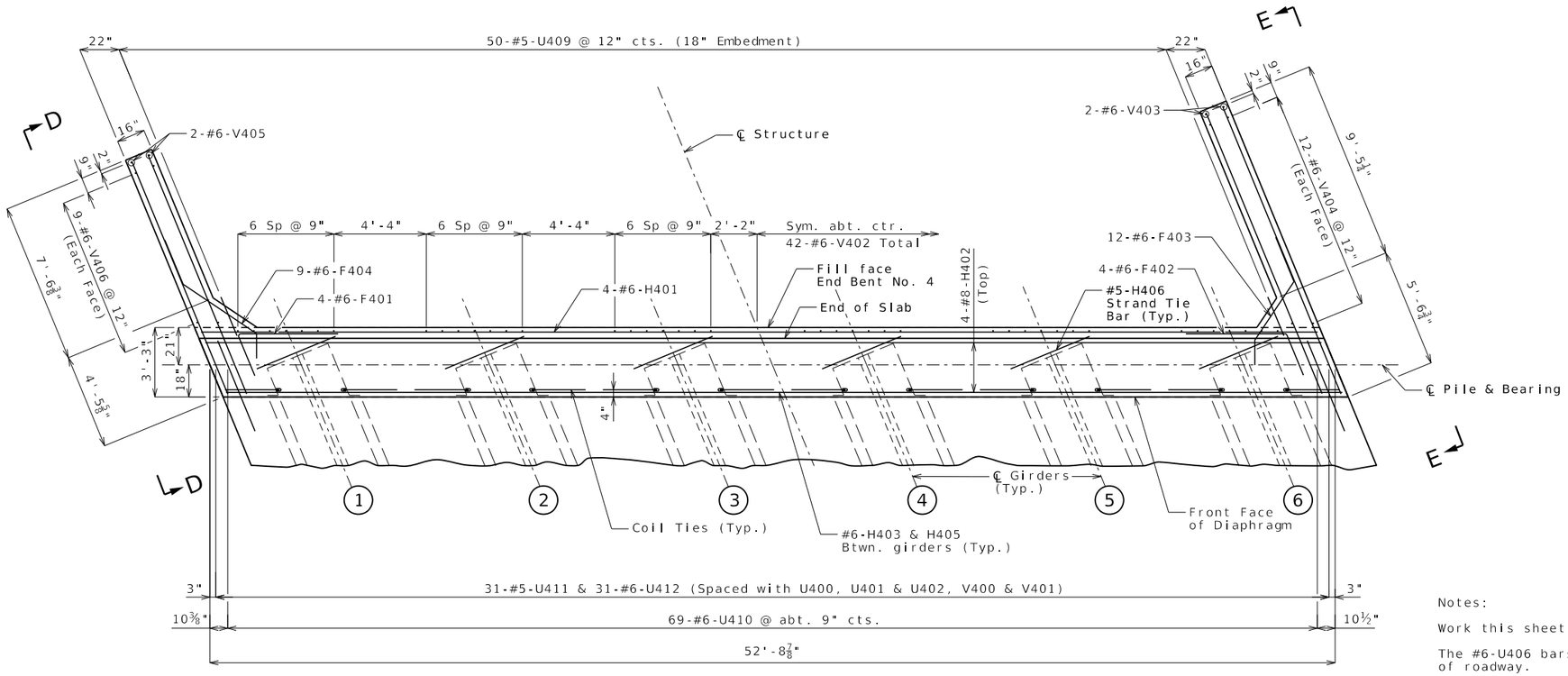
MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING



SECTION NEAR END BENT

(Looking East - Ahead Station)

(Construction Joint Key and Vertical Reinforcement not shown for clarity)



PART OF BEAM SHOWING REINFORCEMENT

Minimum. Lap

#8 = 6'-2"

Notes:

Work this sheet with End Bent 4 Detail 01 and 03 sheets.

The #6-U406 bars shall be placed parallel to centerline of roadway.

The #6-F401 and #6-F402 bars shall be bent in the field to clear girders.

All concrete in the end bent above top of beam and below top of slab shall be Class B-2.

Strands at the end of the girders shall be field bent or, if necessary, cut in field to maintain 1½" minimum clearance to fill face of end bent.

END BENT NO. 4 - DETAIL 02

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

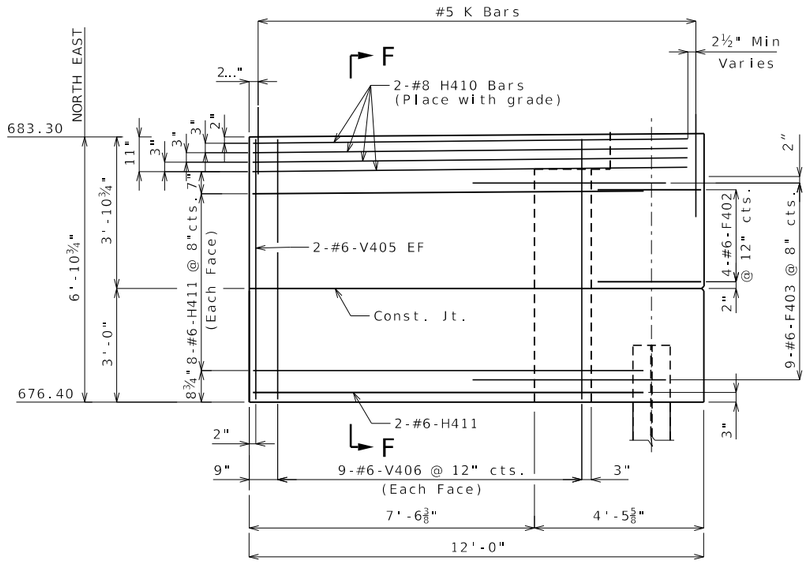
DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 12
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

DESCRIPTION | DATE

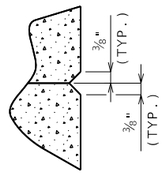
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)
MoDOT
MILLSTONE WEBER
ABNA

MoDOT IMPROVE I-70 DB PROJECT 1

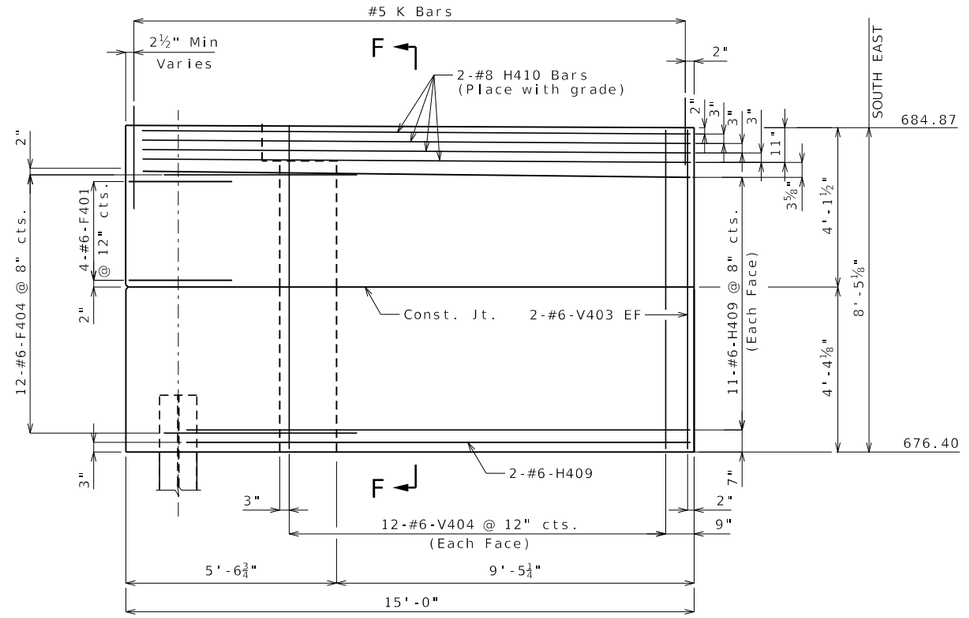
MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING



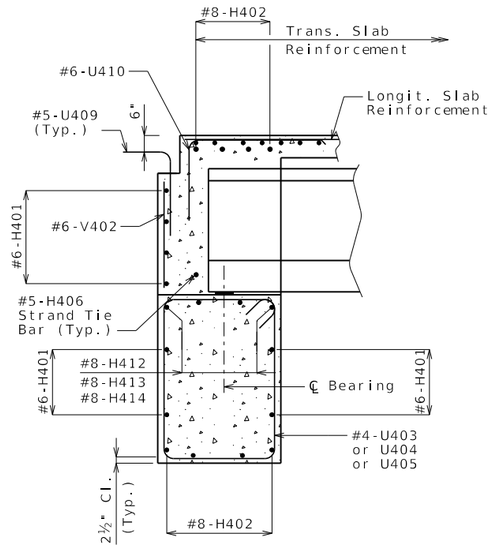
ELEVATION D-D



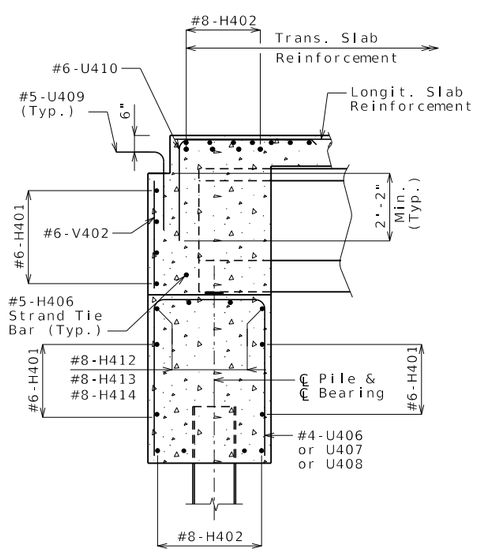
DETAIL "A"



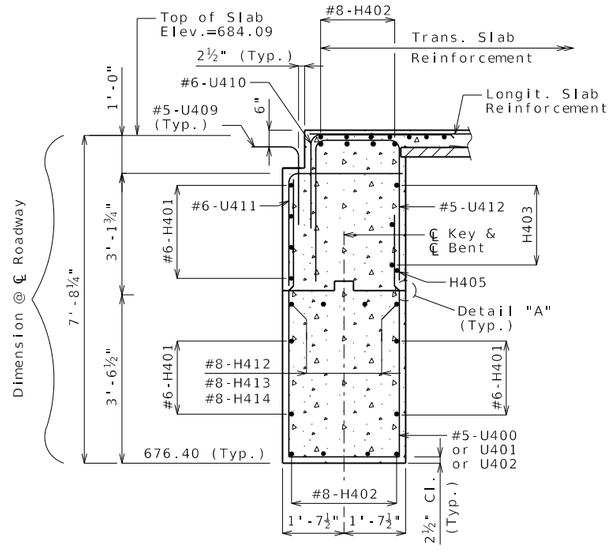
ELEVATION E-E



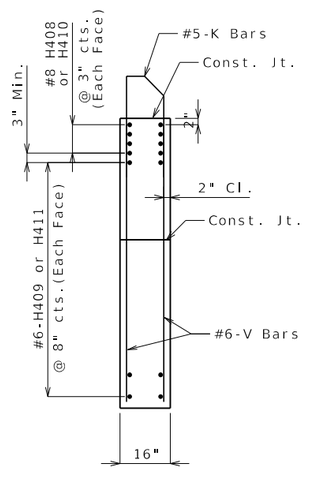
SECTION A-A



SECTION B-B



SECTION C-C



SECTION F-F

Notes:

Work this sheet with End Bent 4 Details 01 & 02 Sheets.

For details of Vertical Drain, see Vertical Drain at End Bents sheet.

For details of Approach Slab, see Approach Slab sheet.

END BENT NO. 4 - DETAIL 03

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

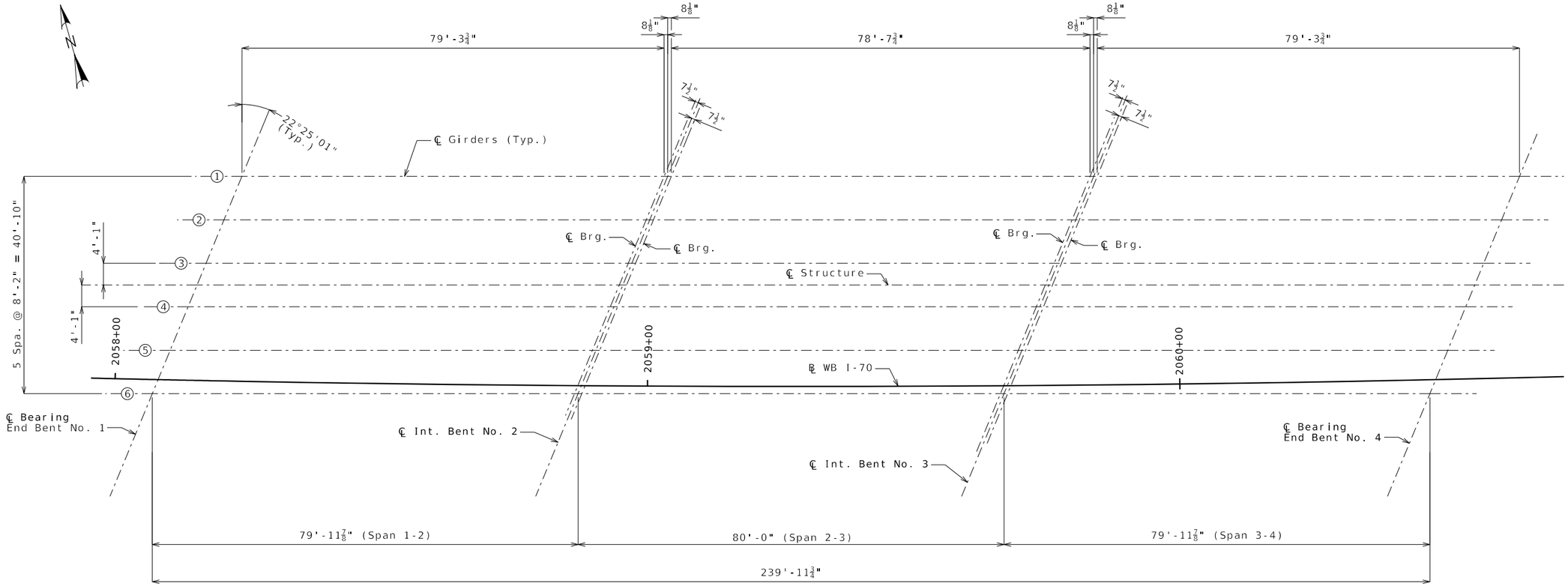
DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 13
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

DATE	DESCRIPTION
10/10/24	REV. A-PRELIMINARY REVIEW

MoDOT IMPROVE I-70 DB PROJECT 1

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)
MILLSTONE WEBER
ABNA

MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING



FRAMING PLAN

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 14 of 3x

DATE PREPARED
11/21/2024

ROUTE	STATE
I-70	MO
DISTRICT	SHEET NO.
BR	14

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9543

DATE	DESCRIPTION
10/10/24	REV. A-PRELIMINARY REVIEW

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

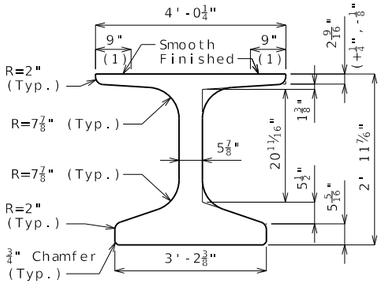
MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
ABNA

MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

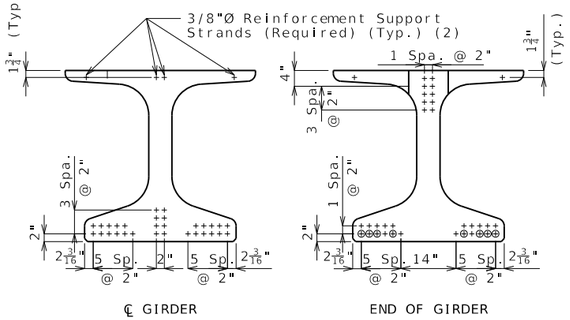
B_A9543_014_JST0021_FRAMING_PLAN.dgn 11:49:02 AM 11/21/2024

(1) Fabricator shall apply a bond breaker to this region excluding where joint filler will be applied.



DIMENSIONS

(2) Outer strands tensioned to 2.02 kips/strand and inner strands to 8 kips/strand. Placed symmetrical about ℄ Girder. May be moved laterally in pairs.

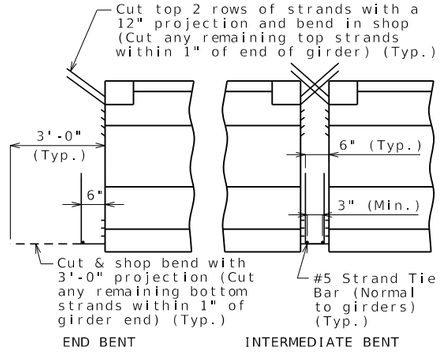


℄ GIRDER END OF GIRDER

STRAND ARRANGEMENT

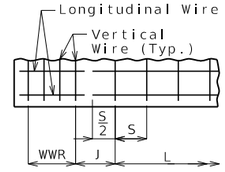
+ Indicates prestressing strand.

○ Indicates cut & shop bend with 3'-0" projection.



END BENT INTERMEDIATE BENT

STRANDS AT GIRDER ENDS



WELDED WIRE PLACEMENT

S = Vertical wire spacing

L = Length of WWR mats

J = Distance between WWR mats

Bill of Reinforcing Steel

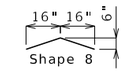
Bars Each Girder

No.	Size/Mark	Length	Shape
91	3 G1	2'-10"	8
2	4 G3	4'-2"	20
2	4 G4	2'-3"	20
2	4 G5	2'-10¾"	20
3	4 G6	Varies	20

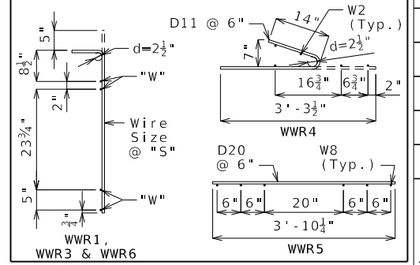
Welded Wire Each Girder

Mark	Size	S	W	L	J
WWR1	D31	4"	W12	6'-4"	11"
WWR2	D31	12"	W12	62'-0"	
WWR6	D31	2"	W12	16"	3⅛"

Bending Diagrams



Shape 20



All dimensions are out to out.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

Actual bar lengths are measured along centerline of bar to the nearest inch.

Minimum clearance to reinforcing shall be 1", unless otherwise shown.

All bar reinforcement shall be Grade 60.

WWR shall not be epoxy coated.

G4 and G5 not required for interior girders. G3 and G6 not required for exterior girders of intermediate spans. Half no. of G3, G4, G5 and G6 not required for ext. girders of end spans.

General Notes:

Concrete for prestressed beams shall be Class A-1 with f'c = 8000 psi and f'ci = 6500 psi.

Use 30 strands, 0.6"Ø Grade 270, with an initial prestress force of 1318 kips.

Pretensioned members shall be in accordance with Sec 1029.

Fabricator shall be responsible for location and design of lifting devices.

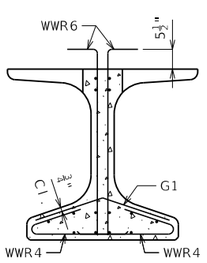
Exterior and interior girders are the same except: coil ties.

The contractor shall provide bracing necessary for lateral and torsional stability of the girders during construction of the concrete slab and remove the bracing after the slab has attained 75% design strength. Contractor shall not drill holes in the girders.

For Girder Camber Diagram, see Sheet No. .

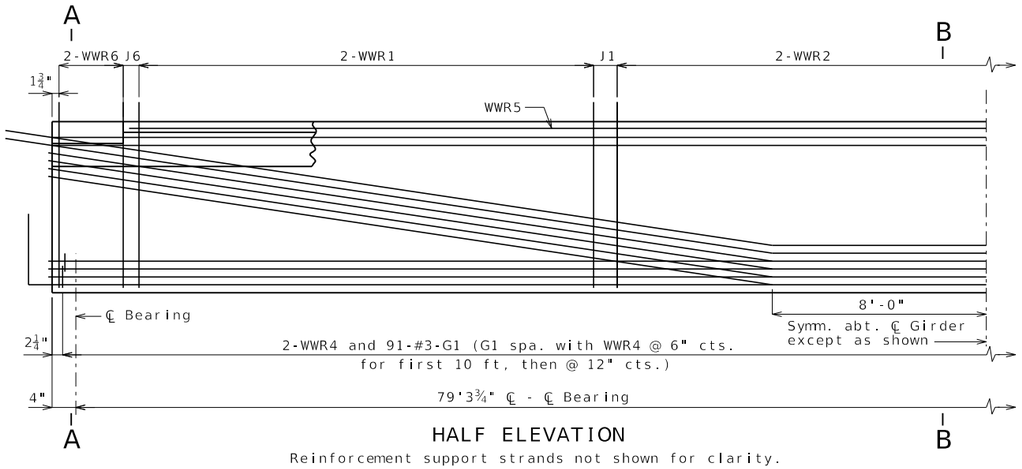
For location of coil inserts at slab drains, see Sheet No. .

For location of coil ties at integral bents, see Sheets No. and .



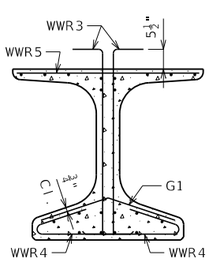
SECTION A-A

Strands not shown for clarity.



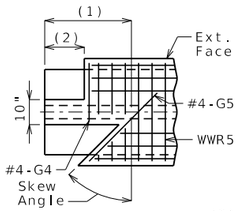
HALF ELEVATION

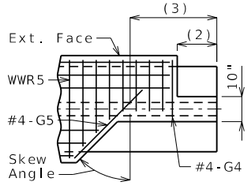
Reinforcement support strands not shown for clarity.



SECTION B-B

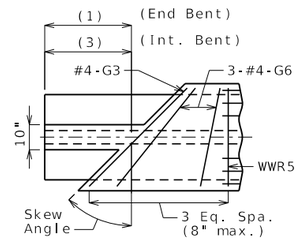
Strands not shown for clarity.





LEFT EXTERIOR GIRDER AT INTERMEDIATE BENT

Rotate 180° for right ext.



INTERIOR GIRDER AT ALL BENTS & EXTERIOR GIRDER AT END BENT

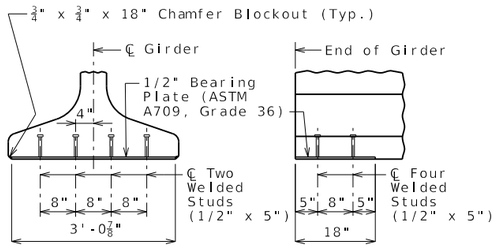
TOP FLANGE BLOCKOUT

Mirror for right advanced.

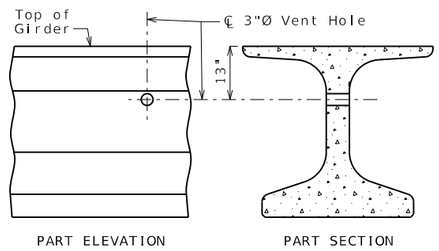
(1) 1'-9¾" @ EB 1
(1) 1'-10¼" @ EB 4

(2) x-x @ BT 2 1-2
(2) x-x @ BT 3 3-4

(3) 1'-3¾" @ BT 2 1-2
(3) 1'-3¼" @ BT 3 3/4



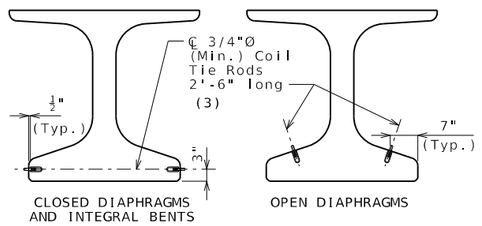
BEARING PLATE



PART ELEVATION PART SECTION

VENT HOLE

Place vent holes at or near upgrade 1/3 point of girders and clear reinforcing steel or strands by 1 1/2" minimum.



CLOSED DIAPHRAGMS AND INTEGRAL BENTS

OPEN DIAPHRAGMS

COIL TIES

Exclude coil tie at exterior face of exterior girders except at integral end bents.

(3) 10" at exterior face of exterior girders at end bents

NU-GIRDERS - SPANS (1-2) AND (3-4)

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 15 of 3x

DATE PREPARED	
11/21/2024	
ROUTE	STATE
I-70	MO
DISTRICT	SHEET NO.
BR	15
COUNTY	
BOONE	
JOB NO.	
JST0021	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	
A9543	

DESCRIPTION | DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

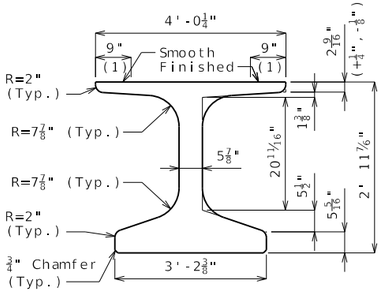
MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
ABNA

MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

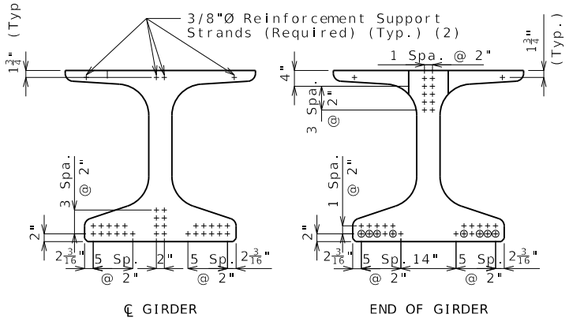
B_A9543_015_JST0021_GIRDER_DETL01.dgn 11:49:15 AM 11/21/2024

(1) Fabricator shall apply a bond breaker to this region excluding where joint filler will be applied.



DIMENSIONS

(2) Outer strands tensioned to 2.02 kips/strand and inner strands to 8 kips/strand. Placed symmetrical about ℄ Girder. May be moved laterally in pairs.

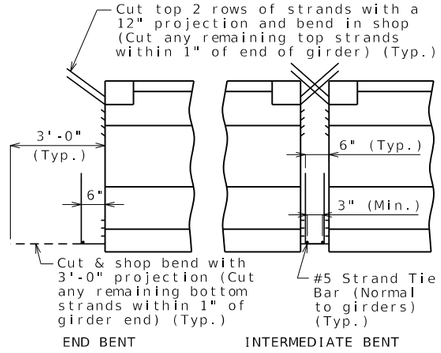


℄ GIRDER END OF GIRDER

STRAND ARRANGEMENT

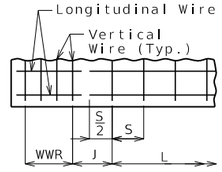
\+ Indicates prestressing strand.

○ Indicates cut & shop bend with 3'-0" projection.



END BENT INTERMEDIATE BENT

STRANDS AT GIRDER ENDS



WELDED WIRE PLACEMENT

S = Vertical wire spacing

L = Length of WWR mats

J = Distance between WWR mats

Bill of Reinforcing Steel

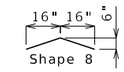
Bars Each Girder

No.	Size/Mark		Length	Shape
91	3	G1	2'-10"	8
2	4	G3	4'-2"	20
2	4	G4	2'-3"	20
2	4	G5	2'-10¾"	20
3	4	G6	Varies	20

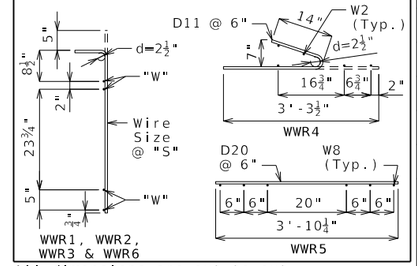
Welded Wire Each Girder

Mark	Size	S	W	L	J
WWR1	D31	12"	W12	6'-0"	11"
WWR2	D31	6"	W12	62'-0"	- -
WWR6	D31	2"	W12	16'-0"	3⅛"

Bending Diagrams



Shape 20



All dimensions are out to out.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

Actual bar lengths are measured along centerline of bar to the nearest inch.

Minimum clearance to reinforcing shall be 1", unless otherwise shown.

All bar reinforcement shall be Grade 60.

WWR shall not be epoxy coated.

G4 and G5 not required for interior girders. G3 and G6 not required for exterior girders of intermediate spans. Half no. of G3, G4, G5 and G6 not required for ext. girders of end spans.

General Notes:

Concrete for prestressed beams shall be Class A-1 with f'c = 8000 psi and f'ci = 6500 psi.

Use 30 strands, 0.6"Ø Grade 270, with an initial prestress force of 1318 kips.

Pretensioned members shall be in accordance with Sec 1029.

Fabricator shall be responsible for location and design of lifting devices.

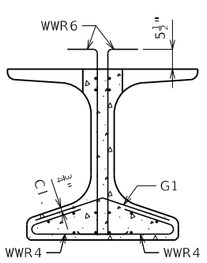
Exterior and interior girders are the same except: coil ties.

The contractor shall provide bracing necessary for lateral and torsional stability of the girders during construction of the concrete slab and remove the bracing after the slab has attained 75% design strength. Contractor shall not drill holes in the girders.

For Girder Camber Diagram, see Sheet No. .

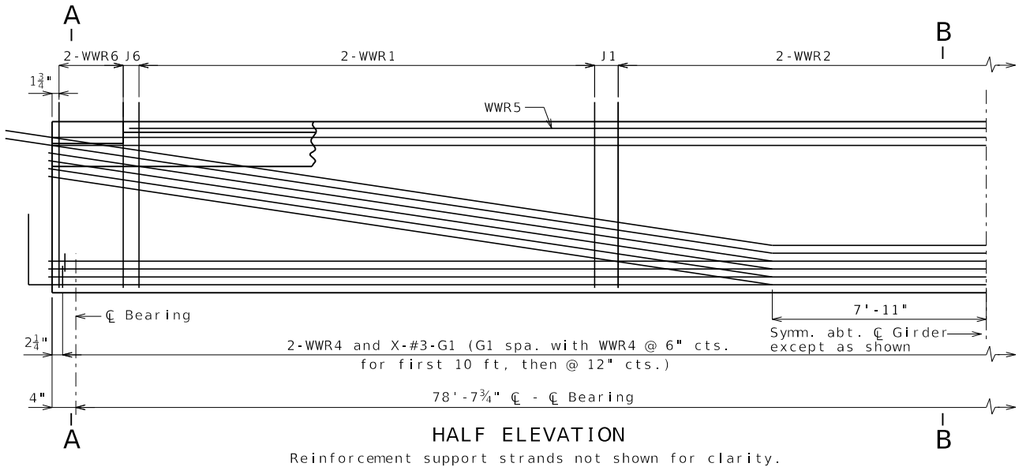
For location of coil inserts at slab drains, see Sheet No. .

For location of coil ties at concrete integral bents, see Sheets No. and .



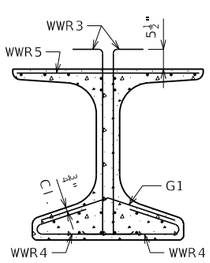
SECTION A-A

Strands not shown for clarity.



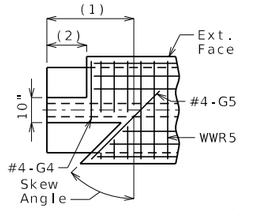
HALF ELEVATION

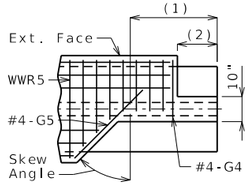
Reinforcement support strands not shown for clarity.



SECTION B-B

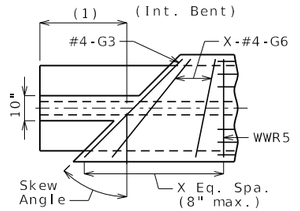
Strands not shown for clarity.





LEFT EXTERIOR GIRDER AT INTERMEDIATE BENT

Rotate 180° for right ext.



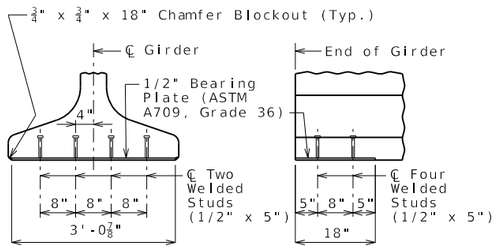
INTERIOR GIRDER AT ALL BENTS & EXTERIOR GIRDER AT END BENT

TOP FLANGE BLOCKOUT

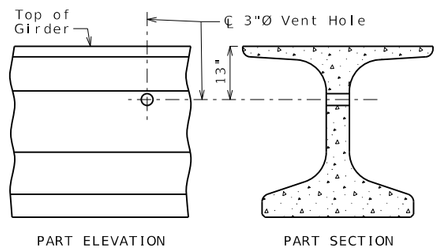
Mirror for right advanced.

(1) 1'-3¾" @ BT 2 2-3
(1) 1'-3¾" @ BT 3 2-3

(2) X-X" @ BT 2 2-3
(2) X-X" @ BT 3 2-3

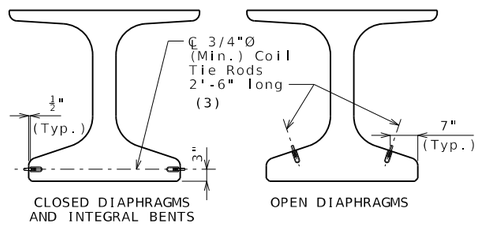


BEARING PLATE



VENT HOLE

Place vent holes at or near upgrade 1/3 point of girders and clear reinforcing steel or strands by 1 1/2" minimum.



COIL TIES

Exclude coil tie at exterior face of exterior girders except at integral end bents.

(3) 10" at exterior face of exterior girders at end bents

NU-GIRDERS - SPAN (2-3)

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 16 of 3x

DESCRIPTION | DATE

DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 16
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

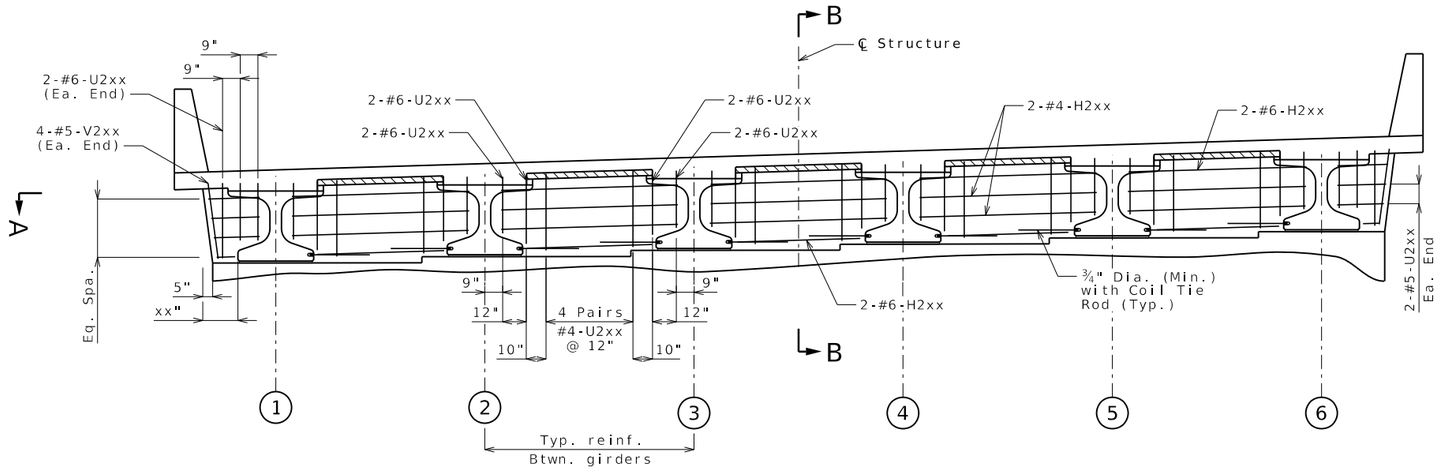
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

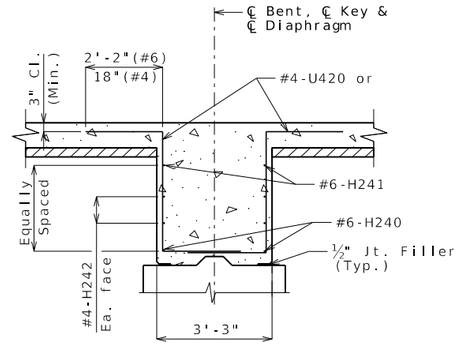
MILLSTONE WEBER
ABNA

MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

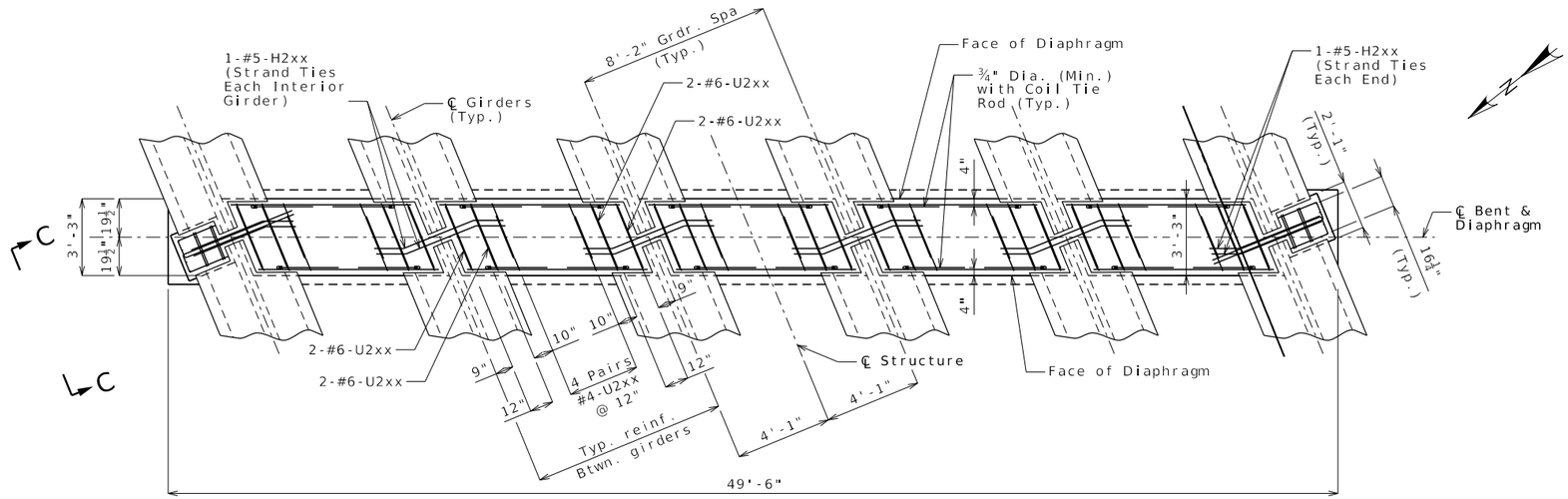
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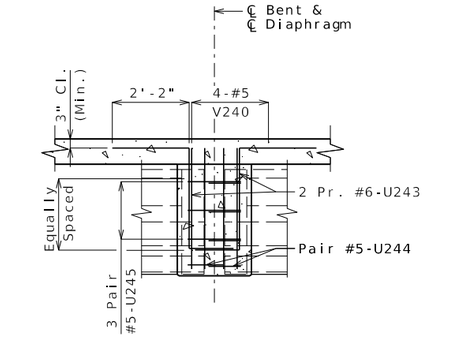
SECTION NEAR INTERMEDIATE BENT



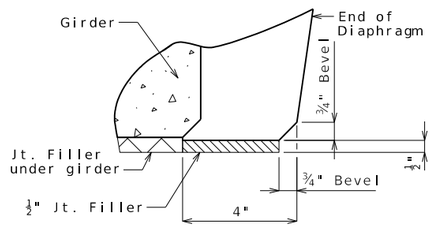
SECTION B-B



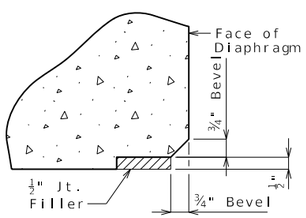
SECTION A-A



SECTION C-C



END DETAIL



EDGE DETAIL

Notes:

Diaphragms at Intermediate Bents shall be built vertical.

For location of #5-H244 and #5-H245 (Strand Tie Bars), see Sheet Nos. 15 and 16.

For location of Coil Ties, see Sheet No. 15 and 16.

Place U-bars parallel to Ë Structure.

CONCRETE DIAPHRAGMS AT INTERMEDIATE BENTS

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 17 of 3x

DATE

DATE PREPARED
11/21/2024

ROUTE	STATE
I-70	MO
DISTRICT	SHEET NO.
BR	17

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.

PROJECT NO.

BRIDGE NO.
A9543

DATE	REV.	DESCRIPTION
10/10/24	A	PRELIMINARY REVIEW

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
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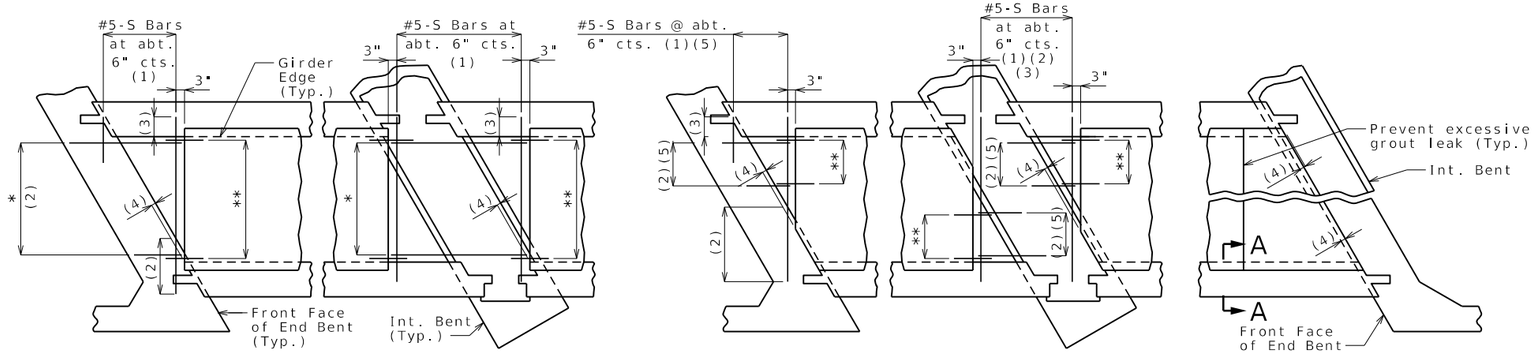
MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER

ABNA

MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

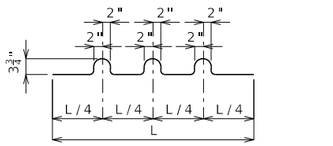
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SQUARED END PANELS OR TRUNCATED END PANELS

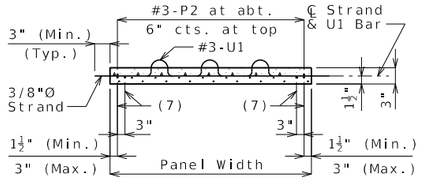
PLAN SHOWING PANEL PLACEMENT

* #5-S Bars at abt. 9" cts. (1)
** #3-P1 at 12" cts. (End panels only)

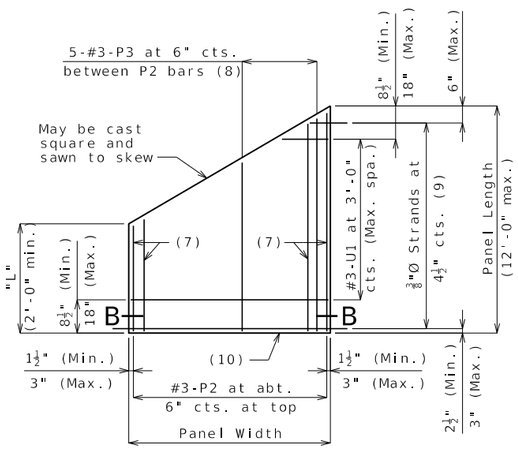


BENDING DIAGRAM FOR U1 BAR

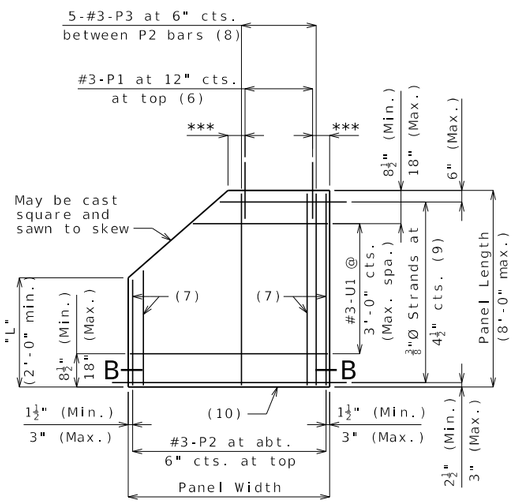
U1 Bars may be oriented at right angles to location and spacing shown. U1 Bars shall be placed between P1 bars.



SECTION B-B

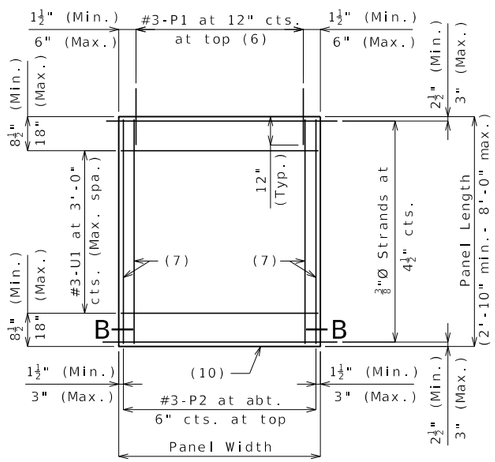


PLAN OF OPTIONAL SKEWED END PANEL



PLAN OF OPTIONAL TRUNCATED END PANEL

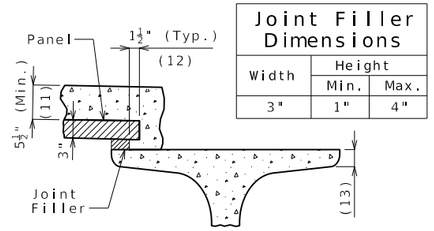
*** 3" (Min.), 6" (Max.)



PLAN OF SQUARED PANEL

SKEWED END PANELS

Joint Filler Dimensions		
Width	Height	
	Min.	Max.
3"	1"	4"



SECTION A-A

Reference Notes:

Plan of Panel Placement:
(1) S-bars shown are bottom steel in slab between panels and used with squared and truncated end panels only.

(2) Extend S-bars 18 inches beyond the front face of end bents and int. bents for squared and truncated end panels only.

(3) Extend S-bars 9 inches beyond edge of girder (Typ.).

(4) End panels shall be dimensioned 1/2" min. to 1 1/2" max. from the inside face of diaphragm.

(5) For truncated end panels, use a min. of #5-S bars at 6" crossings in openings, or min. 4x4-W7xW7.

Plans of Panels:
(6) For end panels only, P1 bars shall be 2'-0" in length and embedded 12". P1 bars will not be required for panels at squared integral end bents.

(7) #3-P2 bars near edge of panel at bottom (under strands).

(8) Use #3-P3 bars if panel is skewed 45° or greater.

(9) Any strand 2'-0" or shorter shall have a #4 reinforcing bar on each side of it, centered between strands. Strands 2'-0" or shorter may then be debonded at the fabricator's option.

(10) Optional 1/2" x 45° Chamfer one or both sides at bottom.

Section A-A:
(11) Slab thickness over prestressed panels varies due to girder camber. In order to maintain minimum slab thickness, it may be necessary to raise the grade uniformly throughout the structure. No payment will be made for additional labor or materials required for necessary grade adjustment.

(12) Contractor shall ensure proper consolidation under and between panels.

(13) At the contractor's option, the variation in slab thickness over prestressed panels may be eliminated or reduced by increasing and varying the girder top flange thickness. Dimensions shall be shown on the shop drawings.

General Notes:

Prestressed Panels:
Concrete for prestressed panels shall be Class A-1 with f'c = 6,000 psi, f'ci = 4,000 psi.

The top surface of all panels shall receive a scored finish with a depth of scoring of 1/8" perpendicular to the prestressing strands in the panels.

Prestressing tendons shall be high-tensile strength, uncoated, seven-wire, low-relaxation strands for prestressed concrete in accordance with AASHTO M 203 Grade 270, with nominal diameter of strand = 3/8" and nominal area = 0.085 sq.in. and minimum ultimate strength = 22.95 kips (270 ksi). Larger strands may be used with the same spacing and initial tension.

Initial prestressing force = 17.2 kips/strand.

The method and sequence of releasing the strands shall be shown on the shop drawings.

Suitable anchorage devices for lifting panels may be cast in panels, provided the devices are shown on the shop drawings and approved by the engineer. Panel lengths shall be determined by the contractor and shown on the shop drawings.

When squared end panels are used at skewed bents, the skewed portion shall be cast full depth. No separate payment will be made for additional concrete and reinforcing required.

Support from diaphragm forms is required under the optional skewed end until cast-in-place concrete has reached 3,000 psi compressive strength.

Prestressed panels shall be brought to saturated surface-dry (SSD) condition just prior to the deck pour. There shall be no free standing water on the panels or in the area to be cast.

The prestressed panel quantities are not included in the table of estimated quantities for the slab.

Reinforcing Steel:
All dimensions are out to out.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

Minimum clearance to reinforcing steel shall be 1 1/2", unless otherwise shown.

If U1 bars interfere with placement of slab steel, U1 loops may be bent over, as necessary, to clear slab steel.

Deformed welded wire reinforcement (WWR) providing a minimum area of reinforcing perpendicular to strands of 0.22 sq in./ft, with spacing parallel to strands sufficient to ensure proper handling, may be used in lieu of the #3-P2 bars shown. Wire diameter shall not be larger than 0.375 inch. The above alternative reinforcement criteria may be used in lieu of the #3-P3 bars, when required, and placed over a width not less than 2 feet.

The following reinforcing steel shall be tied securely to the strands with the following maximum spacing in each direction:
#3-P2 bars at 16 inches.
WWR at 24 inches.

The #3-U1 bars shall be tied securely to #3-P2 bars, to WWR or to strands (when placed between P1 bars) at about 3-foot centers.

Minimum reinforcement steel length shall be 2'-0".

All reinforcement other than prestressing strands shall be epoxy coated.

Precast panels may be in contact with stirrup reinforcing in diaphragms.

S-bars are not listed in the bill of reinforcing.

Cost of S-bars will be considered completely covered by the contract unit price for the slab.

Joint Filler:
Joint filler shall be preformed fiber expansion joint material in accordance with Sec 1057 or expanded or extruded polystyrene bedding material in accordance with Sec 1073.

Use Slab Haunching Diagram on Sheet No. XX for determining thickness of joint filler within the limits noted in the table of Joint Filler Dimensions.

Thicker material may be used on one or both sides of the girder to reduce cast-in-place concrete thickness to within tolerances.

The same thickness of preformed fiber expansion joint material shall be used under any one edge of any panel except at locations where top flange thickness may be stepped. The maximum change in thickness between adjacent panels shall be 1/2 inch. The polystyrene bedding material may be cut with a transition to match haunch height above top of flange.

Joint filler shall be glued to the girder. When thickness exceeds 1 1/2 inches, the joint filler shall be glued top and bottom. The glue used shall be the type recommended by the joint filler manufacturer.

Edges of panels shall be uniformly seated on the joint filler before slab reinforcement is placed.

PRESTRESSED PANELS

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

DATE

DATE PREPARED 11/21/2024

ROUTE	STATE
I-70	MO
DISTRICT	SHEET NO.
BR	18

COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9543

DATE	DESCRIPTION

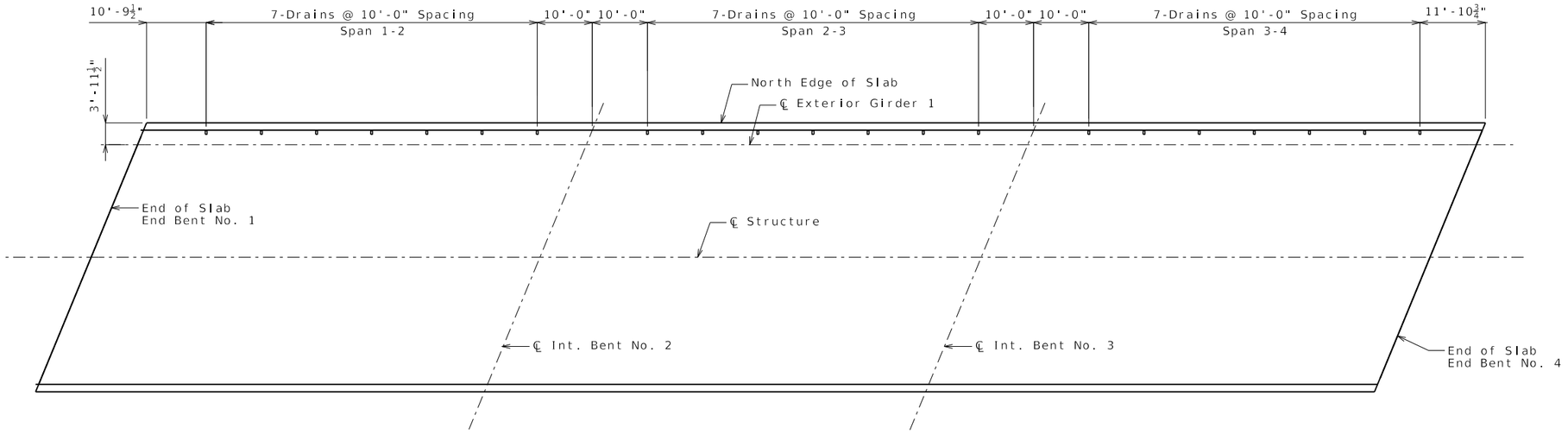
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

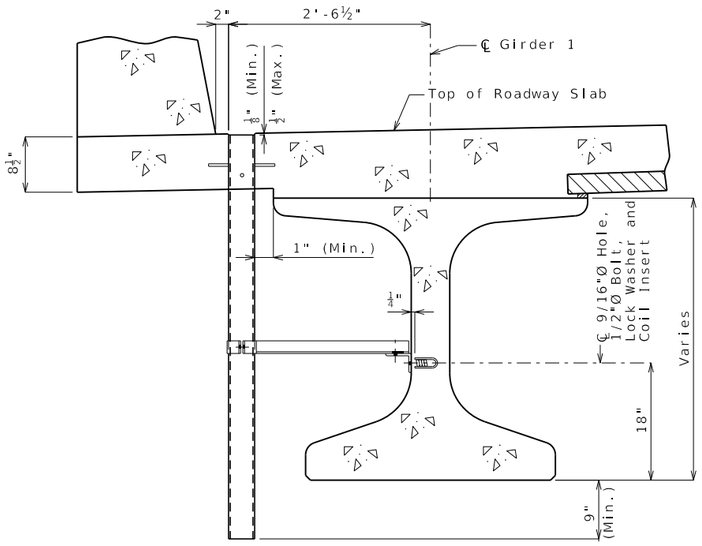
MILLSTONE WEBER
ABNA

MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

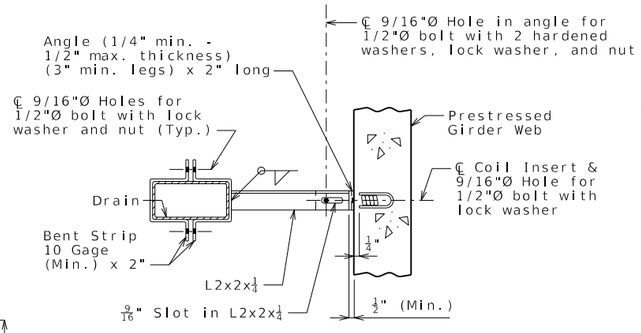
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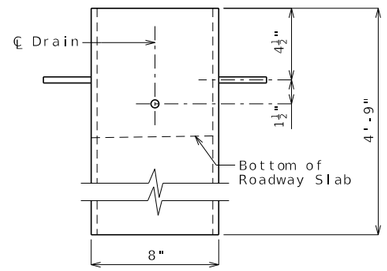
PLAN OF SLAB SHOWING SLAB DRAIN LOCATIONS



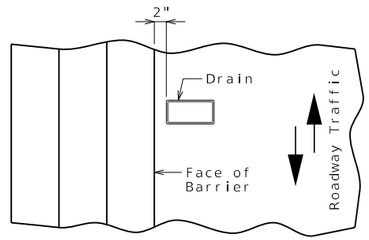
PART SECTION NEAR DRAIN



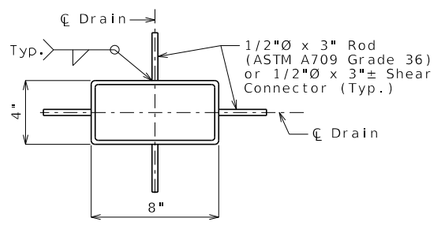
PART SECTION SHOWING BRACKET ASSEMBLY



ELEVATION OF DRAIN



PART PLAN OF SLAB AT DRAIN



PLAN OF STEEL DRAIN OPTION

General Notes:

Slab drain bracket assembly shall be ASTM A709 Grade 36 steel.

Locate drains in slab by dimensions shown in Part Section Near Drain.

Reinforcing steel shall be shifted to clear drains.

The coil inserts and bracket assembly shall be galvanized in accordance with ASTM A123.

All bolts, hardened washers, lock washers and nuts shall be galvanized in accordance with AASHTO M 232 (ASTM A153), Class C.

All 1/2"Ø bolts shall be ASTM A307.

Shop drawings will not be required for the slab drains and the bracket assembly.

The coil insert required for the bracket assembly attachment shall be located on the prestressed girder shop drawings.

Coil inserts shall have a concrete pull-out strength (ultimate load) of at least 2,500 pounds in 5,000 psi concrete.

The bolt required to attach the slab drain bracket assembly to the prestressed girder web shall be supplied by the prestressed girder fabricator.

Notes for Steel Drain:

Slab drains may be fabricated of either 1/4" welded sheets of ASTM A709 Grade 36 steel or from 1/4" structural steel tubing ASTM A500 or A501.

Outside dimensions of drains are 8" x 4".

The drains shall be galvanized in accordance with ASTM A123.

SLAB DRAINS

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 19
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

DESCRIPTION	DATE
REV. A-PRELIMINARY REVIEW	10/10/24

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

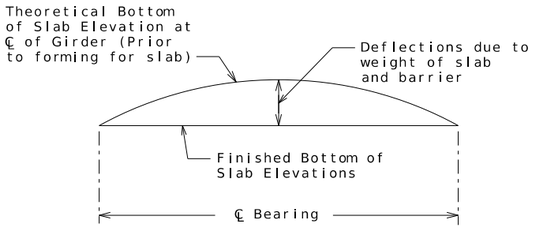
MILLSTONE WEBER
ABNA
MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

REV.

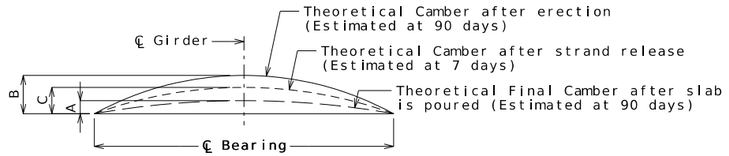
Theoretical Bottom of Slab Elevations at Centerline of Girder (Prior to forming for slab) (Estimated at 90 days)

Girder Number	Span (1-2)										
	℄ Brg.	.10	.20	.30	.40	.50	.60	.70	.80	.90	℄ Brg.
1	684.27	684.31	684.34	684.35	684.33	684.29	684.23	684.14	684.02	683.89	683.75
2	684.54	684.58	684.61	684.62	684.60	684.57	684.50	684.41	684.29	684.16	684.02
3	684.81	684.84	684.87	684.88	684.87	684.83	684.77	684.68	684.56	684.43	684.29
4	685.07	685.11	685.14	685.15	685.14	685.10	685.03	684.94	684.83	684.70	684.55
5	685.34	685.38	685.41	685.42	685.41	685.37	685.30	685.21	685.09	684.96	684.82
6	685.61	685.64	685.67	685.68	685.67	685.63	685.56	685.47	685.36	685.23	685.09
Girder Number	Span (2-3)										
	℄ Brg.	.10	.20	.30	.40	.50	.60	.70	.80	.90	℄ Brg.
1	683.72	683.76	683.78	683.79	683.78	683.74	683.67	683.58	683.47	683.34	683.21
2	683.99	684.03	684.05	684.06	684.05	684.01	683.94	683.85	683.74	683.61	683.47
3	684.26	684.29	684.32	684.33	684.31	684.28	684.21	684.12	684.01	683.88	683.74
4	684.53	684.56	684.59	684.59	684.58	684.54	684.48	684.39	684.28	684.15	684.01
5	684.79	684.83	684.85	684.86	684.85	684.81	684.74	684.65	684.54	684.41	684.28
6	685.06	685.09	685.12	685.13	685.11	685.07	685.01	684.92	684.81	684.68	684.54
Girder Number	Span (3-4)										
	℄ Brg.	.10	.20	.30	.40	.50	.60	.70	.80	.90	℄ Brg.
1	683.20	683.24	683.27	683.28	683.27	683.23	683.16	683.07	682.96	682.83	682.68
2	683.47	683.51	683.54	683.55	683.54	683.50	683.43	683.34	683.23	683.09	682.95
3	683.74	683.78	683.80	683.82	683.80	683.77	683.70	683.61	683.49	683.36	683.22
4	684.01	684.04	684.07	684.08	684.07	684.03	683.97	683.87	683.76	683.63	683.49
5	684.27	684.31	684.34	684.35	684.34	684.30	684.23	684.14	684.03	683.89	683.75
6	684.54	684.58	684.60	684.61	684.60	684.56	684.50	684.41	684.29	684.16	684.02

Elevations are based on a constant slab thickness of 8 1/2" and include allowance for theoretical dead load deflections due to weight of slab (including precast panel) and barrier.



TYPICAL SLAB ELEVATIONS DIAGRAM

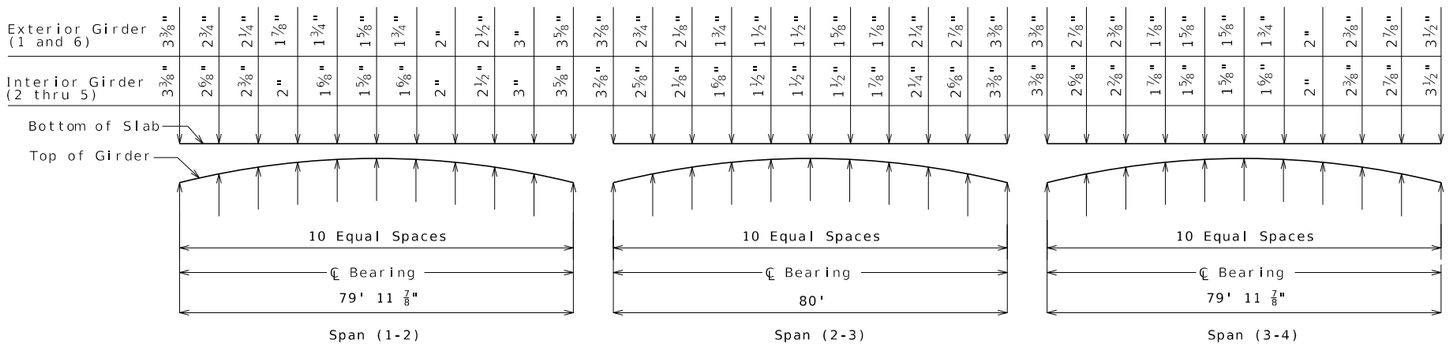


Girder	Span (1-2)			Span (2-3)			Span (3-4)		
	A	B	C	A	B	C	A	B	C
Exterior	1¾"	3¼"	1¾"	1¾"	3¼"	1¾"	1¾"	3¼"	1¾"
Interior	1¾"			1¾"			1¾"		

GIRDER CAMBER DIAGRAM

Conversion Factors for Girder Camber (Estimated at 90 days):

0.1 pt. = 0.314 x 0.5 pt.
0.2 pt. = 0.593 x 0.5 pt.
0.3 pt. = 0.813 x 0.5 pt.
0.4 pt. = 0.952 x 0.5 pt.



THEORETICAL SLAB HAUNCHING DIAGRAM (ESTIMATED AT 90 DAYS)

If girder camber is different from that shown in the camber diagram, in order to maintain minimum slab thickness, an adjustment of the slab haunches, an increase in slab thickness or a raise in grade uniformly throughout the structure shall be necessary. No payment will be made for additional labor or materials required for variation in haunching, slab thickness or grade adjustment.

Concrete in the slab haunches is included in the Estimated Quantities for Slab on Concrete NU-Girder.

SLAB ELEVATIONS, HAUNCHING AND GIRDER CAMBER

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

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ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 20
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CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

DESCRIPTION | DATE

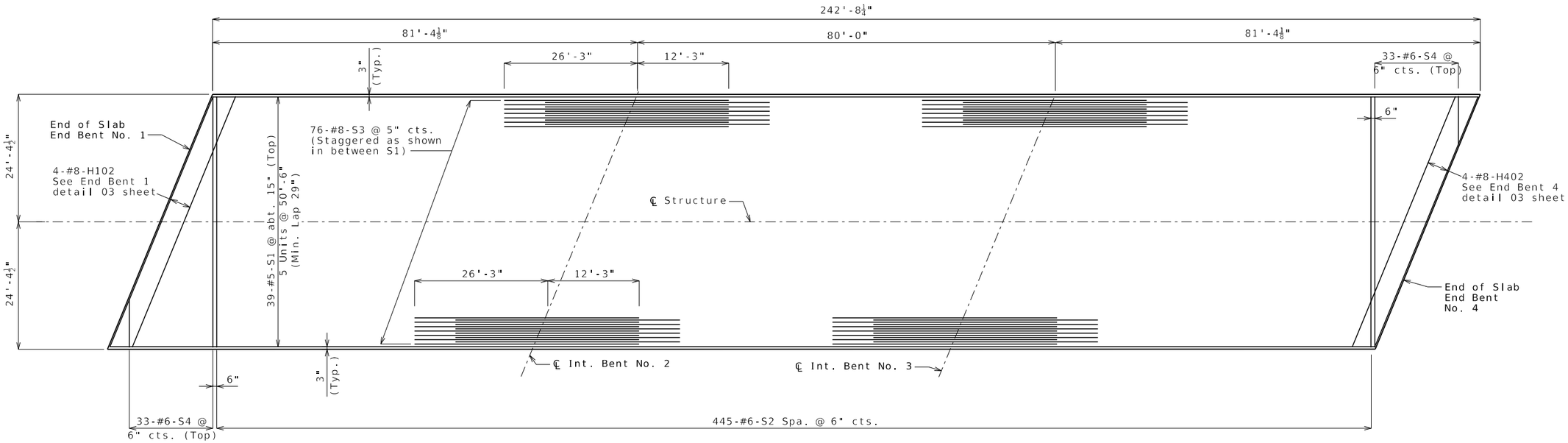
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

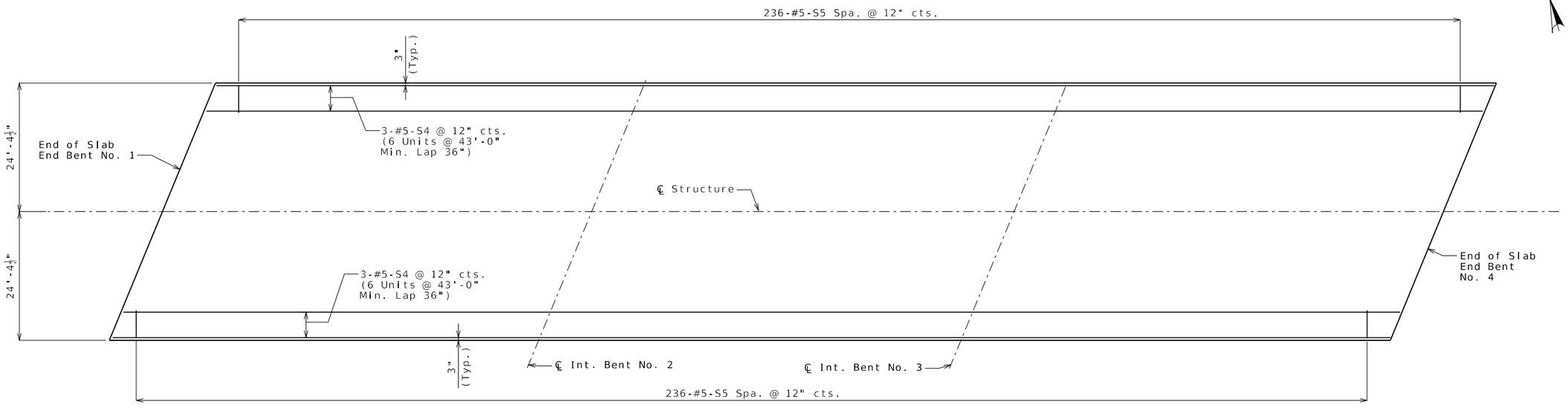
MILLSTONE WEBER
ABNA

MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

B_A9543_020_JST0021_SLAB_ELEV.dgn 11:50:25 AM 11/21/2024



PART OF SLAB SHOWING TOP REINFORCEMENT



PART OF SLAB SHOWING BOTTOM REINFORCEMENT

Notes:

Longitudinal dimensions are measured horizontal.

For details and reinforcement in Barrier Curb see Type D Barrier sheets.

For Theoretical Bottom of Slab Elevations, Beam Camber Diagram and Dead Load Deflection Diagram, see Slab Elevations sheet.

Work this sheet with the Slab Reinforcement Section sheet.

Longitudinal reinforcement shall be placed so that ends are not more than 1½" from vertical face of ends of slab.

For pour sequence see slab reinforcing section sheet.

SLAB PLAN SHOWING REINFORCEMENT

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 21
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

DESCRIPTION | DATE

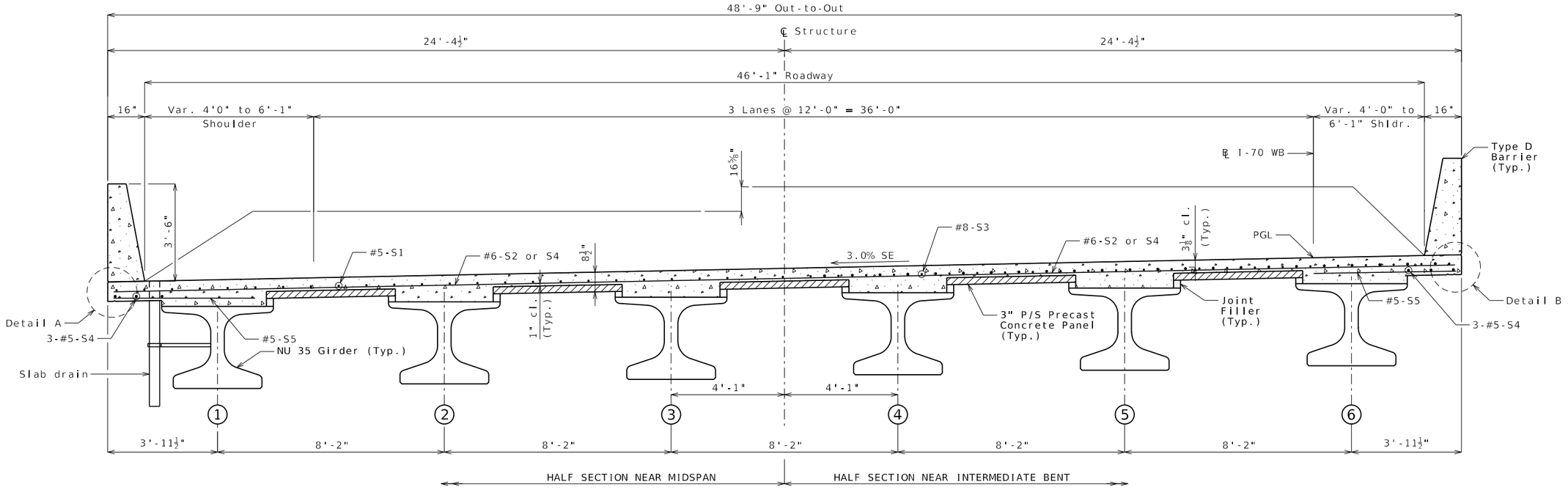
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
ABNA

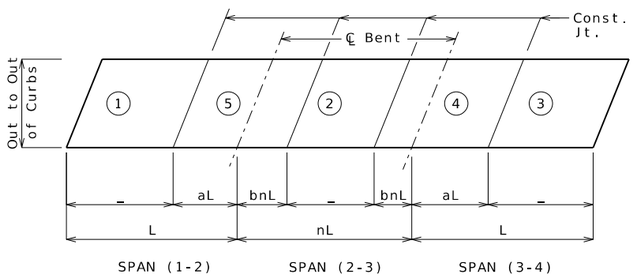
MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

B_A9543_021_JST0021_SLAB_REINF_PLAN.dgn 12:09:23 PM 11/21/2024



SECTION THRU SLAB

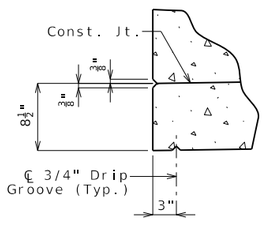
(Looking East - Upstation)



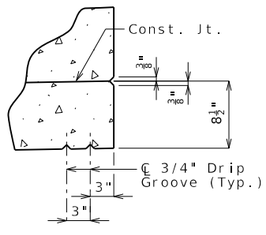
	Sequence of Pours					Min. Rate of Pour Cu. Yds./Hr.	
	Direction					With Retarder	No Retarder
Basic Sequence	1	2	3	4	5	25	25
	Either Direction						
Alternate pours to the basic skip sequence are subject to the approval of the engineer in accordance with Sec 703.							
Alternate A Pours	1		5 + 2		4 + 3		
	End to 5		1 to 4		2 to End		
Alternate B Pours	1 + 5 + 2			4 + 3			
	End to 4			2 to End			
Alternate C Pours	1 + 5 + 2 + 4 + 3						
	End to End						

The contractor shall pour and satisfactorily finish the slab pours at the rate given. Retarder, if used, shall be an approved type and retard the set of concrete to 2.5 hours.

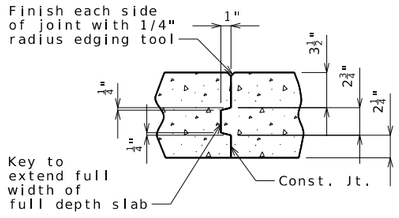
SLAB POURING SEQUENCE



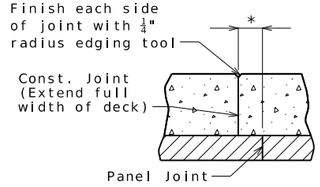
DETAIL A



DETAIL B



FULL DEPTH SLAB



* Adjust the construction joint to a clearance of 6 inches minimum from the panel joint.

SLAB ON PANELS

SLAB CONSTRUCTION JOINT

Notes:

For details of precast prestressed panels, see Sheet No. .

For reinforcement of barrier not shown, see Sheet No. .

For Theoretical Bottom of Slab Elevations, Girder Camber Diagram and Theoretical Slab Haunching Diagram, see Sheet No. .

For Plan of Slab Showing Reinforcement, see Sheet No. .

TYPICAL SLAB SECTION & POURING SEQUENCE

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 22
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

DESCRIPTION | DATE

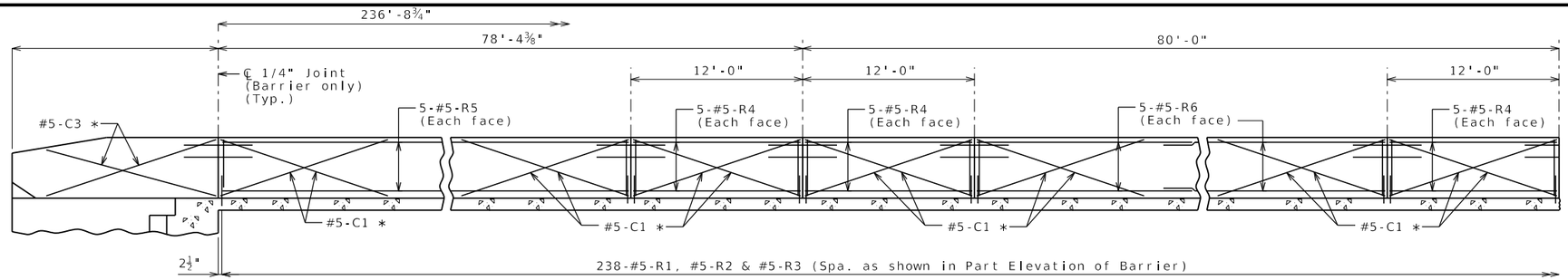
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

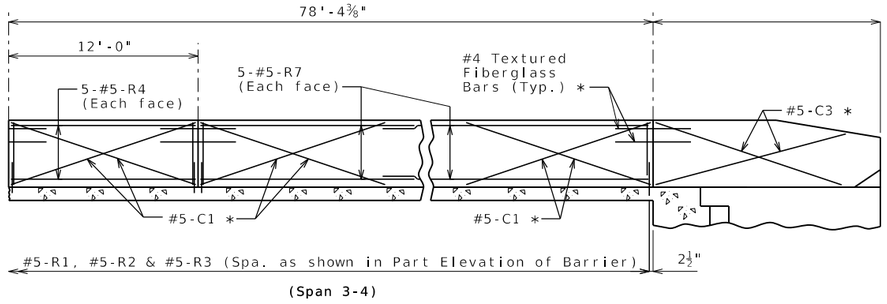
MILLSTONE WEBER
ABNA

MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

B_A9543_022_JST0021_SLAB_SECTION.dgn 2:37:26 PM 11/21/2024



(Span 1-2) (Span 2-3)

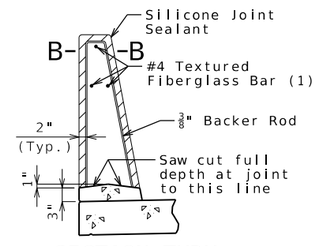


(Span 3-4)

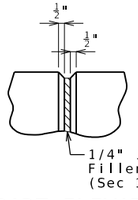
ELEVATION OF BARRIER

(Left barrier shown, right barrier similar)

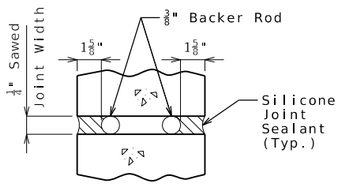
Longitudinal dimensions are horizontal.



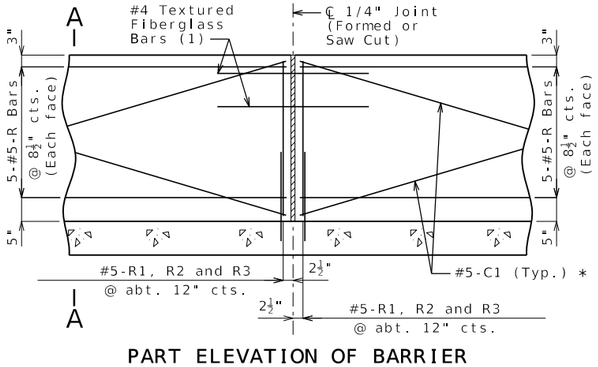
SECTION THRU SAW CUT JOINT



PART ELEVATION AT FORMED JOINT

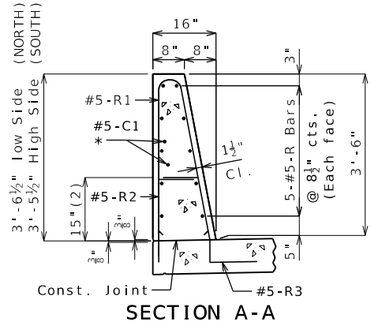


SECTION B-B



PART ELEVATION OF BARRIER

(1) Four feet long, centered on joint, slip-formed option only

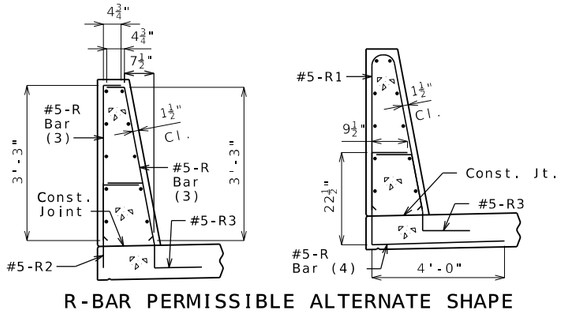


SECTION A-A

Use a minimum lap of 3'-1" for #5 horizontal barrier bars.

The cross-sectional area above the slab is 3.52 square feet.

(2) To top of bar



R-BAR PERMISSIBLE ALTERNATE SHAPE

(3) The R1 bar may be separated into two bars as shown, at the contractor's option, only when slip forming is not used. (All dimensions are out to out.)

(4) The R2 bar and #5 bottom transverse slab bar in cantilever (prestressed panels only) combination may be furnished as one bar as shown, at the contractor's option.

General Notes:

* Slip-formed option only.

Conventional forming or slip forming may be used. Saw cut joints may be used with conventional forming.

Top of barrier shall be built parallel to grade and barrier joints (except at end bents) normal to grade.

All exposed edges of barrier shall have either a 1/2-inch radius or a 3/8-inch bevel, unless otherwise noted.

Concrete in barrier shall be Class B-1.

Concrete traffic barrier delineators shall be placed on top of the barrier as shown on Missouri Standard Plan 617.10 and in accordance with Sec 617. Delineators on bridges with two-lane, two-way traffic shall have retroreflective sheeting on both sides.

Joint sealant and backer rods shall be in accordance with Sec 717 for silicone joint sealant for saw cut and formed joints.

For slip-formed option, both sides of barrier shall have a vertically broomed finish and the top shall have a transversely broomed finish.

Plastic waterstop shall not be used with saw cut joints.

TYPE D BARRIER

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 23
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

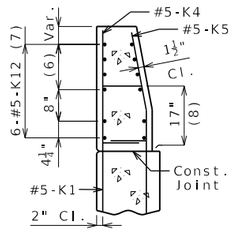
DESCRIPTION	DATE
REV. A-PRELIMINARY REVIEW	10/10/24

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

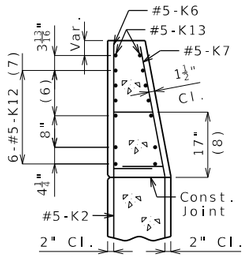
MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
ABNA

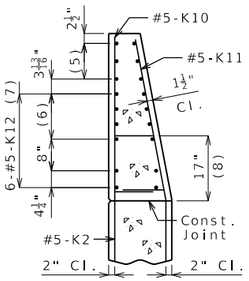
MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING



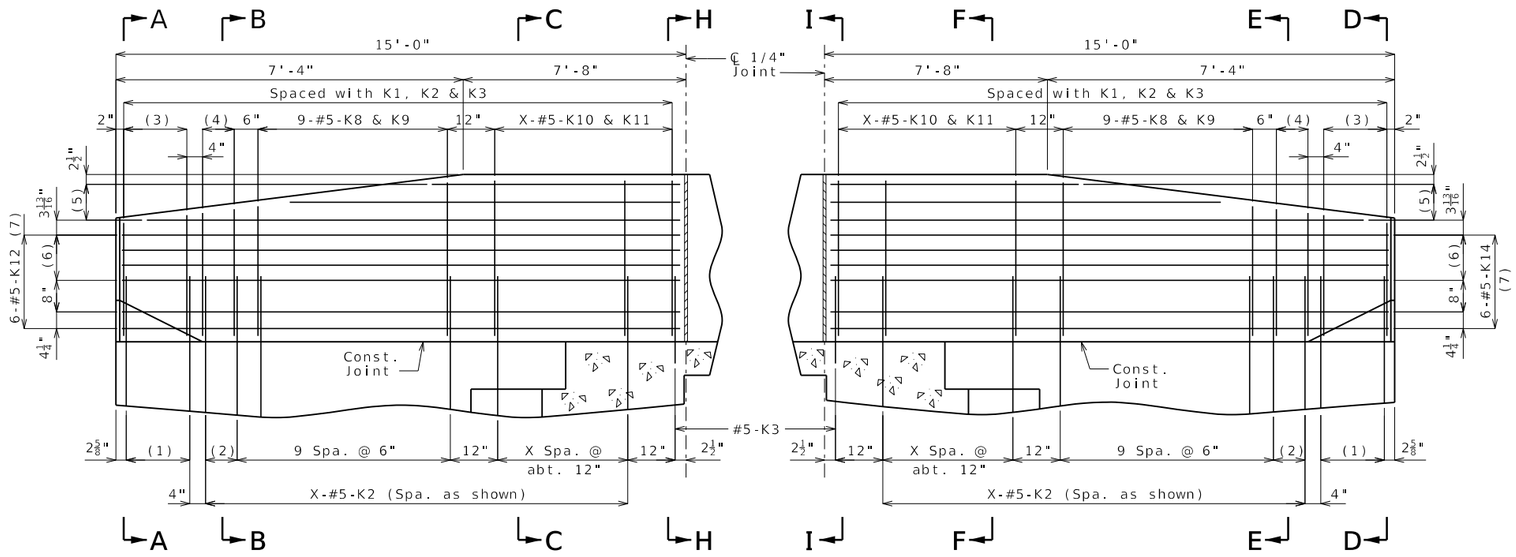
SECTION A-A



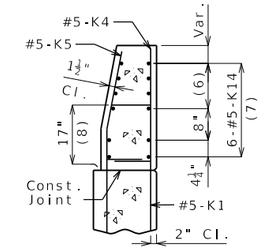
SECTION B-B



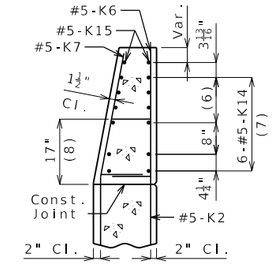
SECTION C-C



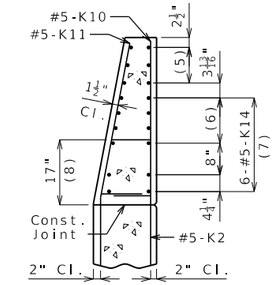
PART ELEVATION



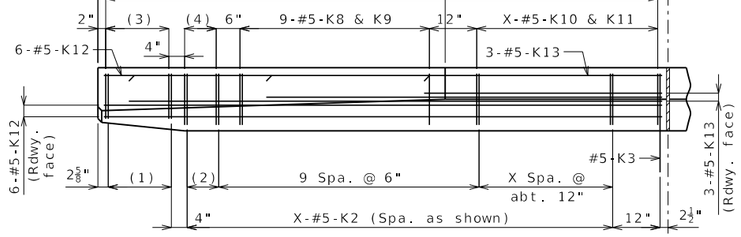
SECTION D-D

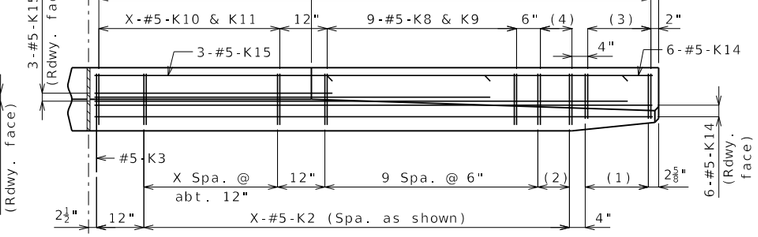


SECTION E-E

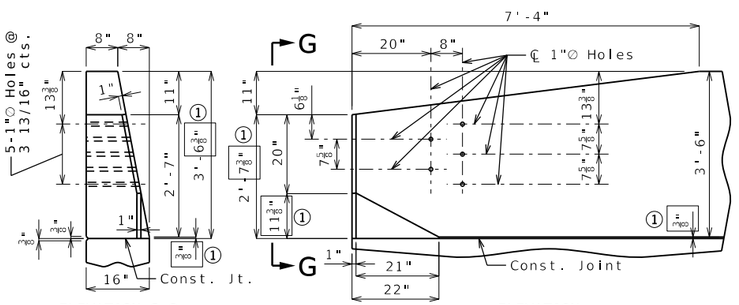


SECTION F-F



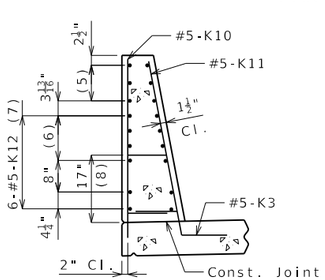


PART PLAN



ELEVATION G-G

ELEVATION



SECTION H-H

(1) 5-#5-K1 @ 4" cts.

(2) 2 spaces @ 4"

(3) 5-#5-K4 & K5

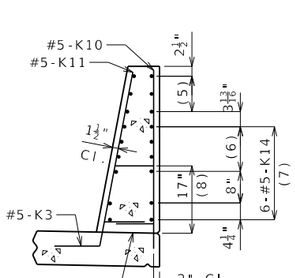
(4) 3-#5-K6 & K7

(5) 3-#5-K13 or K15 @ 4½" cts., each face

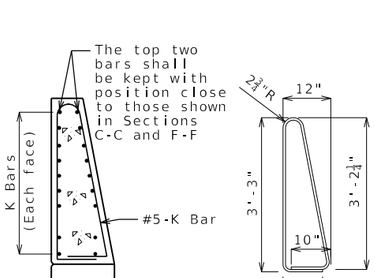
(6) 3 spaces @ 3 13/16"

(7) Spaced as shown, each face

(8) To top of bar



SECTION I-I

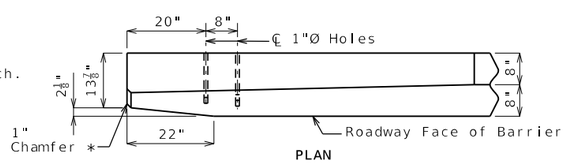


K10-K11 BAR PERMISSIBLE ALTERNATE SHAPE

(Other K bars not shown for clarity)

The K10-K11 bar combination may be furnished as one bar as shown, at the contractor's option.

All dimensions are out to out.



PLAN

* Transition to zero at Type A curb for gutter lines to match.

DETAILS OF GUARD RAIL ATTACHMENT

General Notes:

Concrete traffic barrier delineators shall be placed on top of the barrier as shown on Missouri Standard Plan 617.10 and in accordance with Sec 617. Delineators on bridges with two-lane, two-way traffic shall have retroreflective sheeting on both sides. Concrete traffic barrier delineators will be considered completely covered by the contract unit price for Type D Barrier.

Reinforcing Steel:
Minimum clearance to reinforcing steel shall be 1 1/2" except as shown for bars embedded into end bent.

TYPE D BARRIER AT END BENTS (RIGHT)

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

DESCRIPTION	DATE
REV. A-PRELIMINARY REVIEW	10/10/24

MoDOT IMPROVE I-70 DB PROJECT 1

DATE PREPARED 11/21/2024

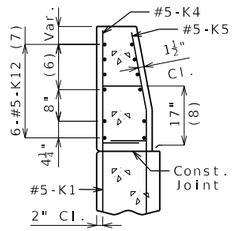
ROUTE	STATE
I-70	MO
DISTRICT	SHEET NO.
BR	24

COUNTY: BOONE
JOB NO.: JST0021
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.: A9543

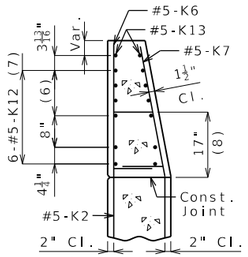
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT
MILLSTONE WEBER
ABNA

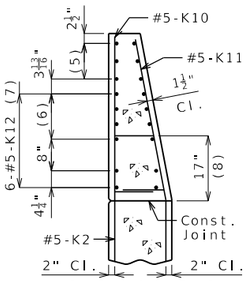
MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING



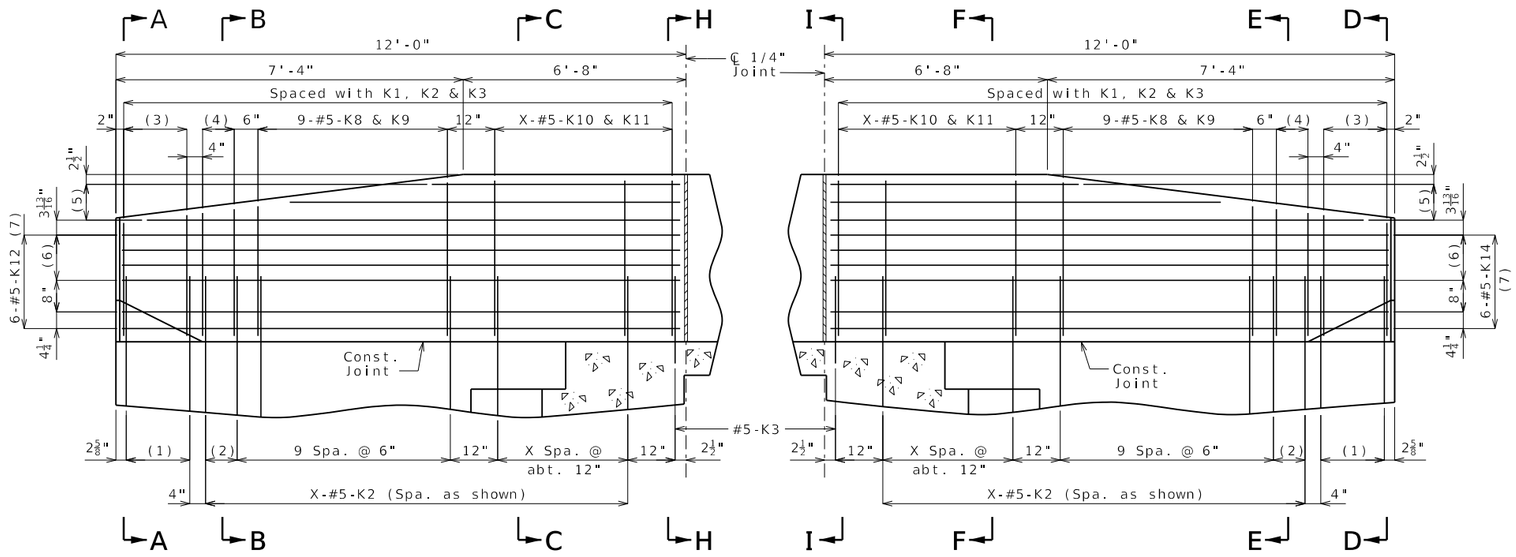
SECTION A-A



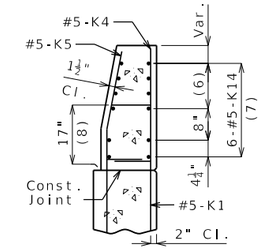
SECTION B-B



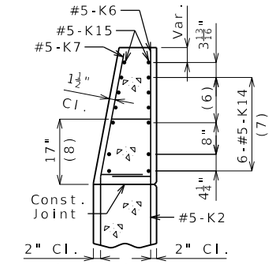
SECTION C-C



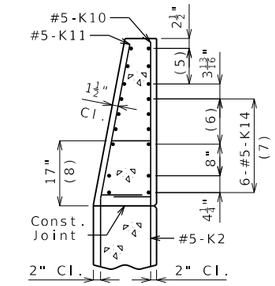
PART ELEVATION



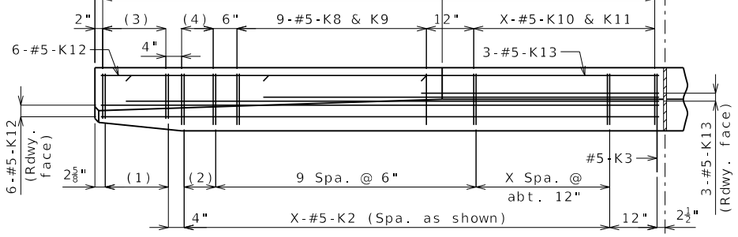
SECTION D-D

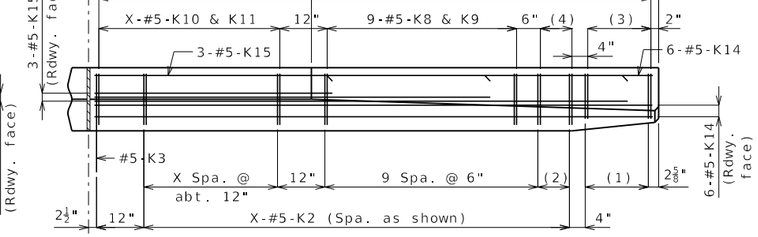


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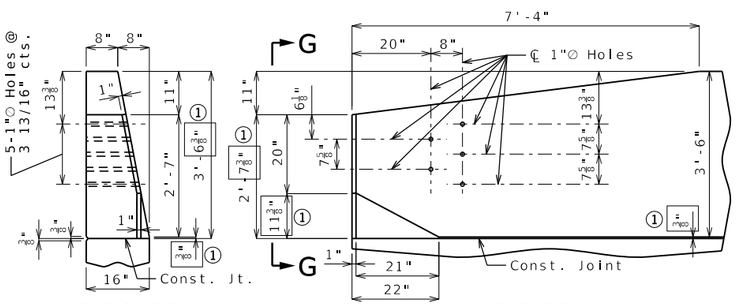


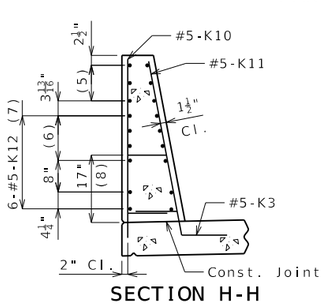
SECTION F-F





PART PLAN





SECTION H-H

(1) 5-#5-K1 @ 4" cts.

(2) 2 spaces @ 4"

(3) 5-#5-K4 & K5

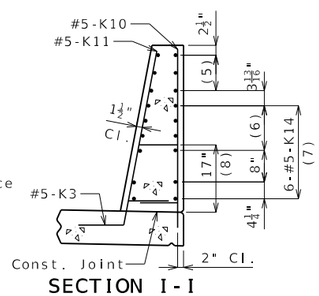
(4) 3-#5-K6 & K7

(5) 3-#5-K13 or K15 @ 4½" cts., each face

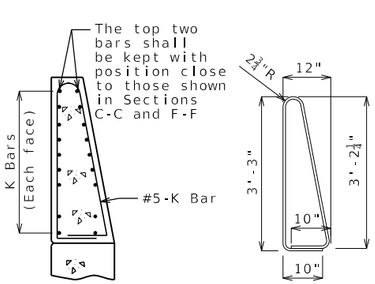
(6) 3 spaces @ 3 13/16"

(7) Spaced as shown, each face

(8) To top of bar



SECTION I-I

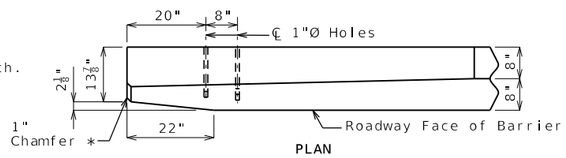


K10-K11 BAR PERMISSIBLE ALTERNATE SHAPE

(Other K bars not shown for clarity)

The K10-K11 bar combination may be furnished as one bar as shown, at the contractor's option.

All dimensions are out to out.



DETAILS OF GUARD RAIL ATTACHMENT

* Transition to zero at Type A curb for gutter lines to match.

General Notes:

Concrete traffic barrier delineators shall be placed on top of the barrier as shown on Missouri Standard Plan 617.10 and in accordance with Sec 617. Delineators on bridges with two-lane, two-way traffic shall have retroreflective sheeting on both sides. Concrete traffic barrier delineators will be considered completely covered by the contract unit price for Type D Barrier.

Reinforcing Steel:
Minimum clearance to reinforcing steel shall be 1 1/2" except as shown for bars embedded into end bent.

TYPE D BARRIER AT END BENTS (LEFT)

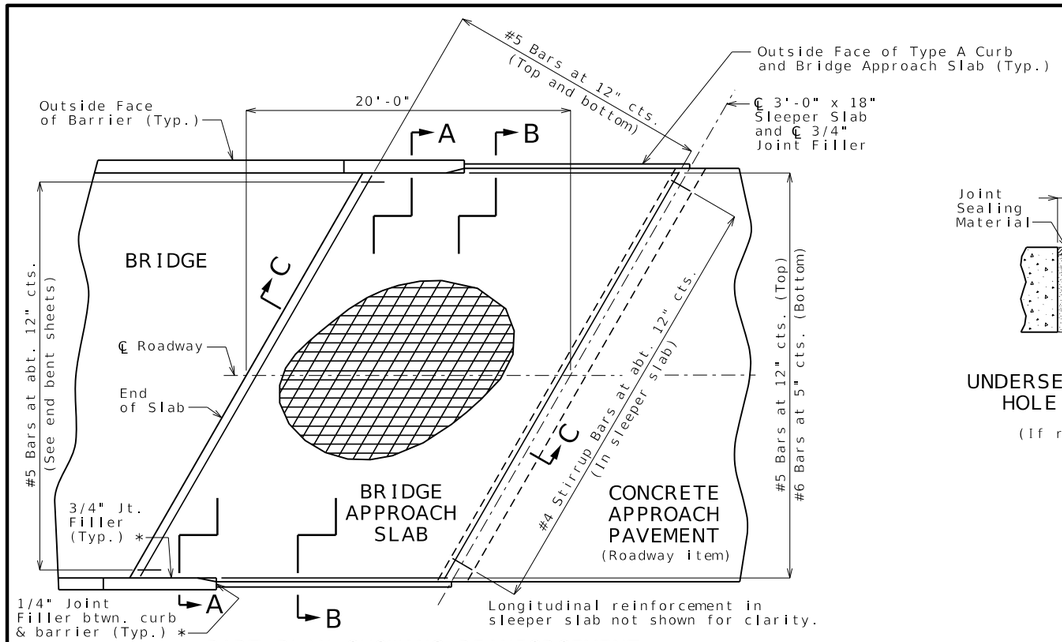
Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

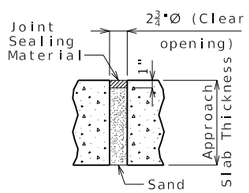
DATE PREPARED 11/21/2024
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 25
COUNTY BOONE
JOB NO. JST0021
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A9543

DATE	DESCRIPTION
10/10/24	REV. A-PRELIMINARY REVIEW

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)
MoDOT
MILLSTONE WEBER
ABNA
MoDOT IMPROVE I-70 DB PROJECT 1
MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

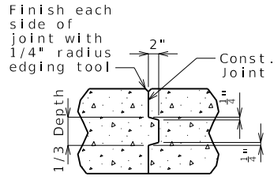


PART PLAN SHOWING REINFORCEMENT



UNDERSEAL ACCESS HOLE DETAIL

(If required)



CONSTRUCTION JOINT DETAIL

General Notes:

All concrete for the bridge approach slab and sleeper slab shall be in accordance with Sec 503 (f'c = 4,000 psi).

The reinforcing steel in the bridge approach slab and the sleeper slab shall be epoxy coated Grade 60 with fy = 60,000 psi.

Drain pipe may be either 6" diameter corrugated metallic-coated pipe underdrain, 4" diameter corrugated polyvinyl chloride (PVC) drain pipe, or 4" diameter corrugated polyethylene (PE) drain pipe.

Minimum clearance to reinforcing steel shall be 1 1/2", unless otherwise shown.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be continuous. The transverse reinforcing steel may be made continuous by providing a minimum lap splice of 29 inches for #5 bars and 44 inches for #6 bars, or by mechanical bar splice.

All joint filler shall be in accordance with Sec 1057 for preformed fiber expansion joint filler except as noted.

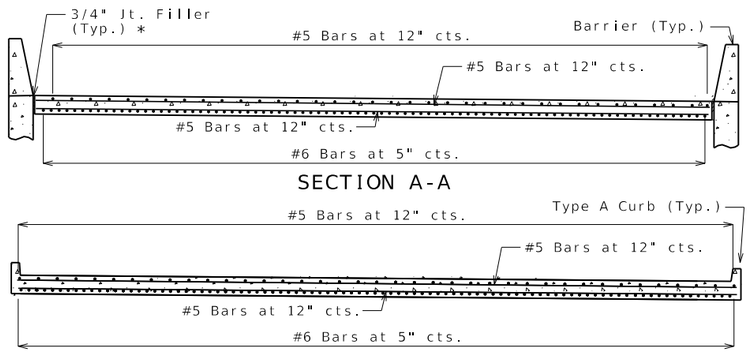
The contractor shall pour and satisfactorily finish the bridge slab before placing the bridge approach slab.

Longitudinal construction joints in approach slab and sleeper slab shall be aligned with longitudinal construction joints in bridge slab.

For concrete approach pavement details, see roadway plans.

See Missouri Standard Plan 609.00 for details of Type A curb.

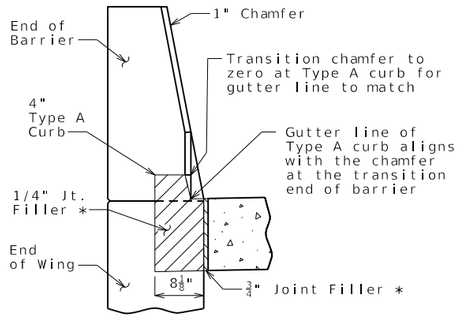
* Seal joint between vertical face of approach slab and wing with sealant in accordance with Sec 717 for silicone joint sealant for saw cut and formed joints.



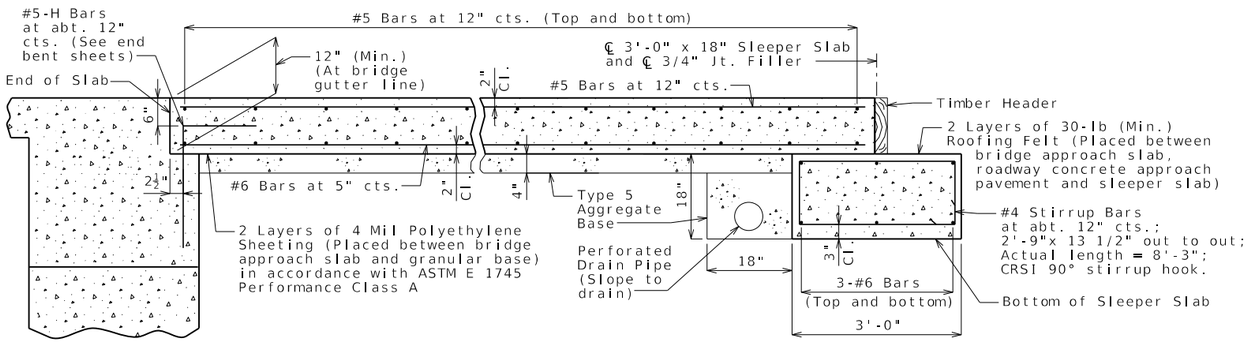
SECTION A-A

SECTION B-B

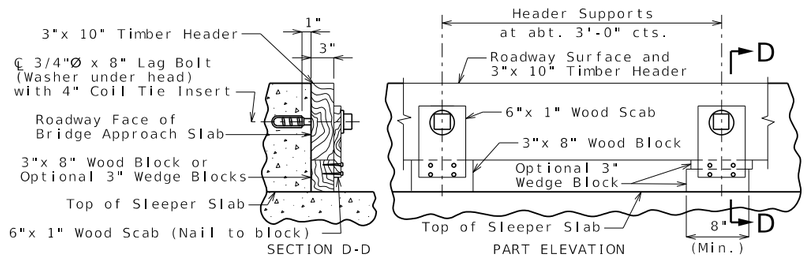
With the approval of the engineer, the contractor may crown the bottom of the approach slab to match the crown of the roadway surface.



SECTION BETWEEN CURB AND BARRIER



SECTION C-C



DETAILS OF TIMBER HEADER

Remove timber header when concrete pavement is placed.

BRIDGE APPROACH SLAB (MAJOR)

Detailed AUG. 2024
Checked NOV. 2024

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 26 of 3x

DATE PREPARED	11/21/2024
ROUTE	I-70
STATE	MO
DISTRICT	BR
SHEET NO.	26
COUNTY	BOONE
JOB NO.	JST0021
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	A9543

DESCRIPTION

DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER

ABNA

MO STATE CERTIFICATE OF AUTHORITY #001501 ENGINEERING

B_A9543_026_JST0021_APPR_SLAB.dgn 11:51:44 AM 11/21/2024

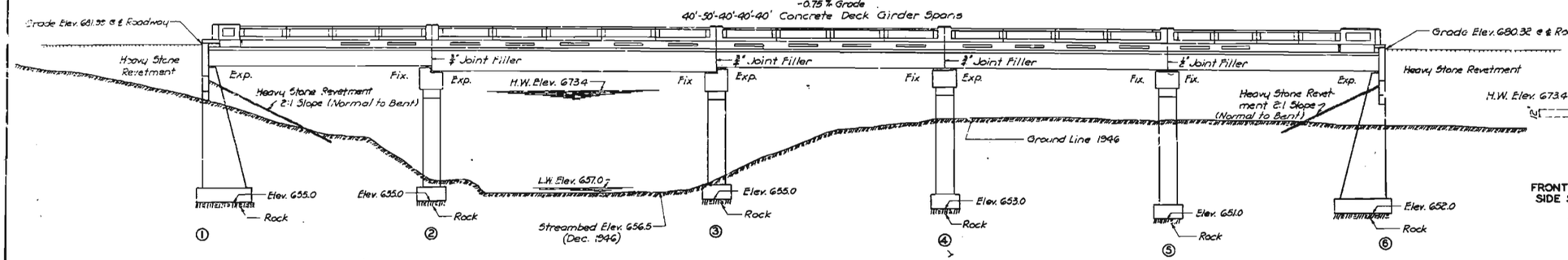
Appendix B. As-Built Plans for Bridges L0264 and A6951

B.1 As-Built Plans for Bridge L0264

B.2 As-Built Plans for Bridge A6951

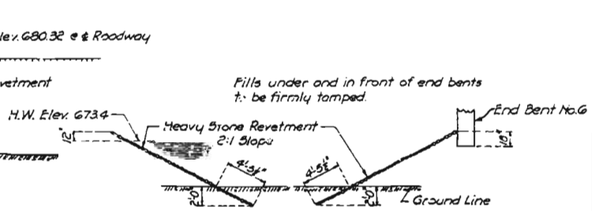
MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	FI-229(8) (U.S.40)	19		



GENERAL ELEVATION

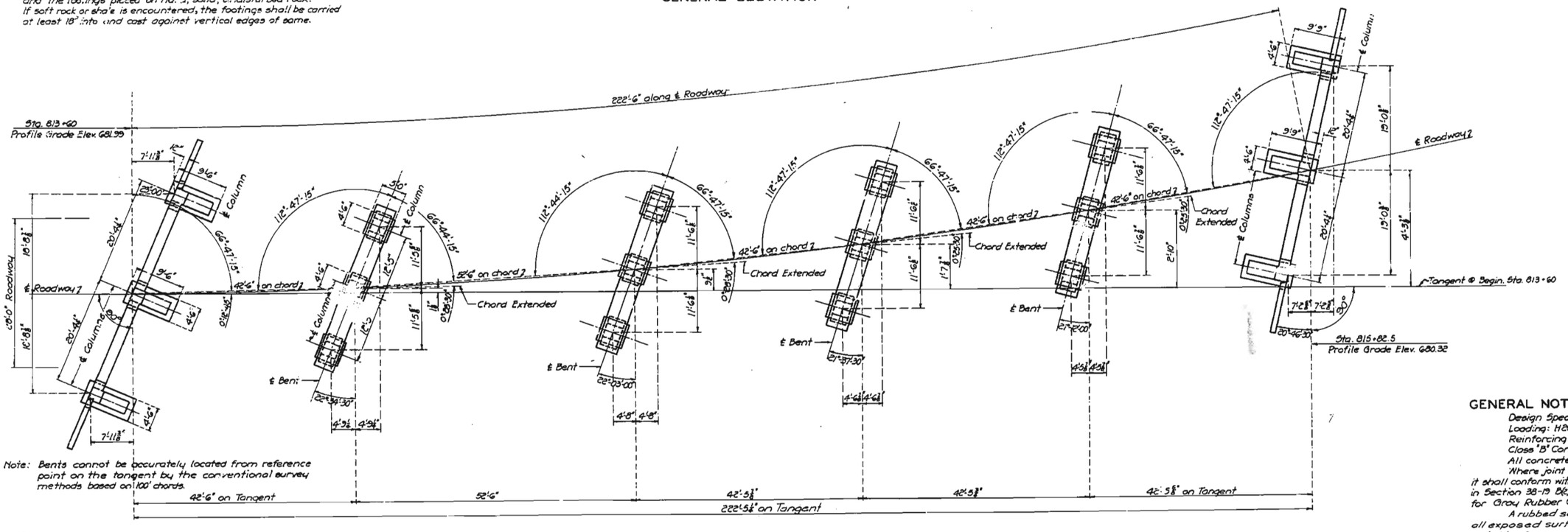
Note: All loose, shelly or disintegrated rock shall be removed and the footings placed on hard, solid, undisturbed rock. If soft rock or shale is encountered, the footings shall be carried at least 18" into and cast against vertical edges of same.



FRONT OF END BENT NO. 1 SIDE SLOPE OF FILL — **FRONT OF END BENT NO. 6**

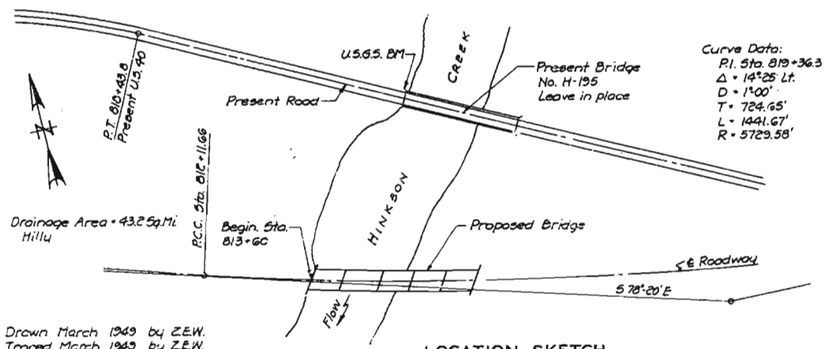
Heavy Stone Revetment shall be placed on fills at ends of bridge as shown in sketches. Approximately 520 Sq.Yds of Heavy Stone Revetment work included in road contract.

HEAVY STONE REVETMENT SKETCHES



Note: Bents cannot be accurately located from reference point on the tangent by the conventional survey methods based on 100' chords.

PLAN



Curve Data:
P.I. Sta. 813+36.3
Δ = 14°25' Lt.
D = 1°00'
T = 724.65'
L = 1441.67'
R = 5729.58'

Drawn March 1949 by Z.E.W.
Traced March 1949 by Z.E.W.
Checked April 1949 by E.M.H

LOCATION SKETCH

ESTIMATED QUANTITIES

Item		Substructure	Superstructure	Total
Class 1 Excavation for Structures	Cu. Yds.	371		371
Class 2 Excavation for Structures	Cu. Yds.	260		260
Class "B" Concrete (Handrail)	Cu. Yds.		26.4	26.4
Class "B" Concrete (Except Handrail)	Cu. Yds.	261.9	381.2	643.1
Reinforcing Steel	Lbs.	22,820	109,270	132,090
Phosphor Bronze Bearing Plates	16 Sets of 5 Plates each (10"x17") Flanged			
Phosphor Bronze Bearing Plates	4 Sets of 5 Plates each (10"x21") Flanged			

Note: Excavation for bridge made above Elev. 659.0 will be paid for as Class 1 Excavation for Structures. Excavation for bridge made below Elev. 659.0 will be paid for as Class 2 Excavation for Structures.

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1 of 6

GENERAL NOTES:

Design Specifications A.A.S.H.O. 1944 (Revised)
Loading: H20-S16-44
Reinforcing Steel Stress: 18,000 #/□"
Class "B" Concrete: 1,000 #/□"
All concrete shall be Class "B"
Where joint filler is specified on the plans it shall conform with the requirements as given in Section 38-19 B(2) of the Standard Specifications for Gray Rubber Compound Joints.
A rubbed surface finish will be required on all exposed surfaces of handrail and curbs and on outside faces of roadway slabs.
All concrete to be Air Entrained. See Special Provisions. Void.

B.M. Elev. 685.54 on N.W. Wingwall of Hinkson Creek Bridge = U.S.G.S. Elev. 685.24.

BRIDGE OVER HINKSON CREEK

STATE ROAD FROM COLUMBIA TO KINGDOM CITY
ABOUT 2.5 MILES EAST OF COLUMBIA
PROJECT NO. FI-229(8) (U.S. 40) STA. 813+60

BOONE COUNTY

SUBMITTED BY W. W. Ewald BRIDGE ENGINEER DATE 5/16/1949
APPROVED BY C. H. Brown CHIEF ENGINEER DATE 5/16/1949

HARRINGTON AND CORTELYOU
CONSULTING ENGINEERS — KANSAS CITY, MO.

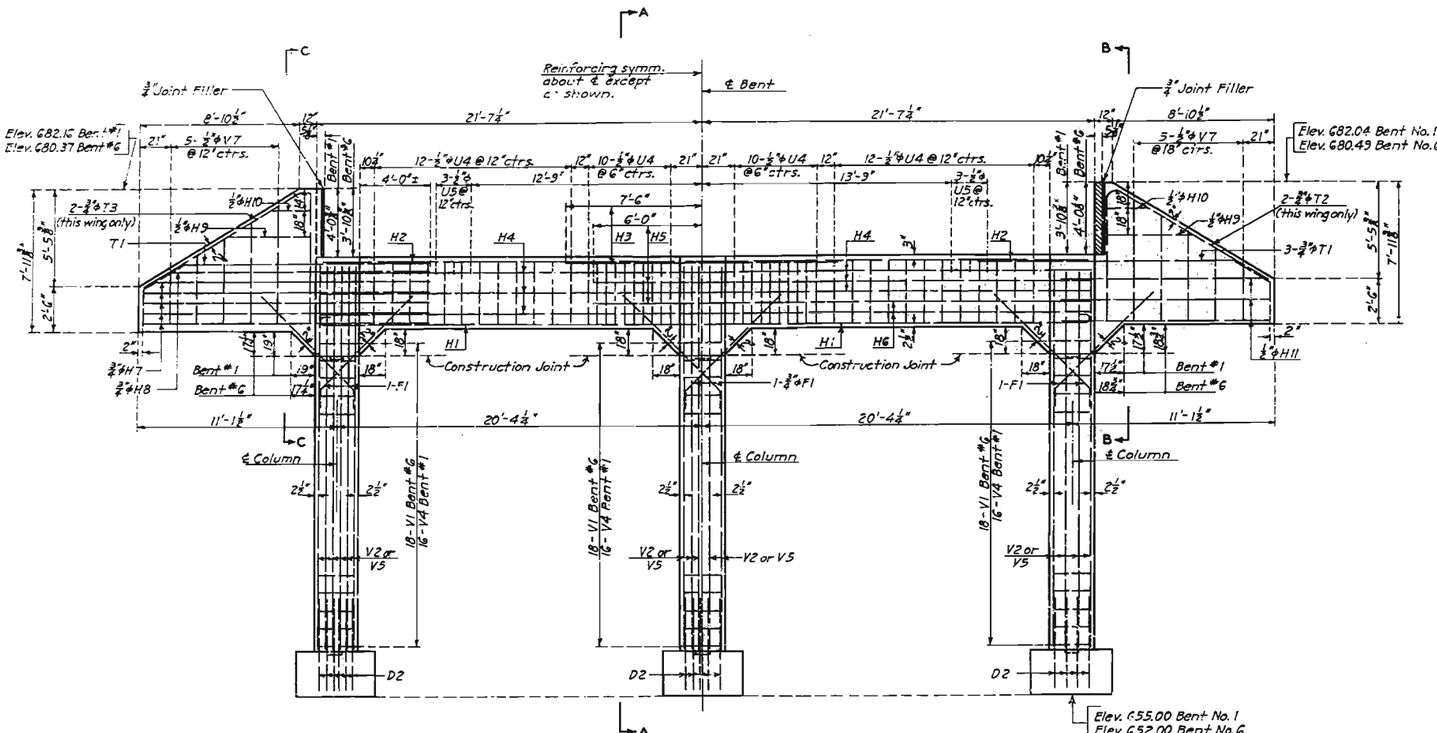
FINISHED

STD. C-110R3
L-264

SEE FINAL PLANS BROWN-LINES

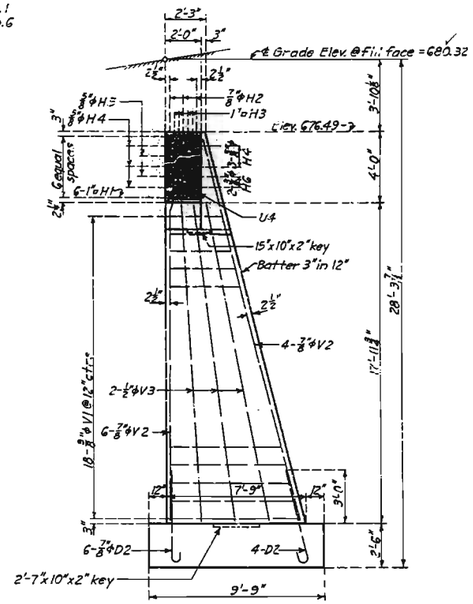
MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	FI-229(8) (U.S.40)	19		

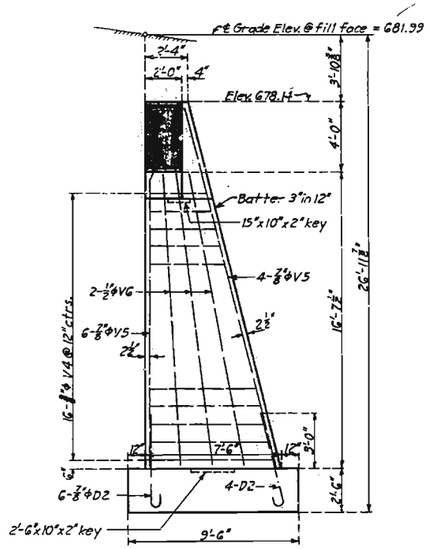


HALF ELEVATION
Showing reinforcing in fill face.

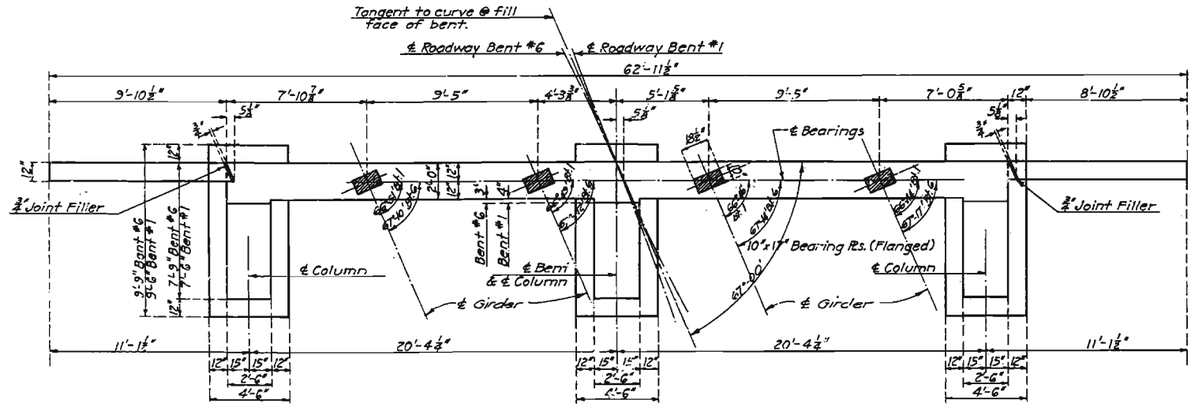
HALF ELEVATION
Showing reinforcing in front face.



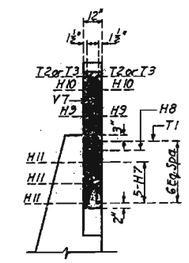
SECTION A-A BENT NO. 6



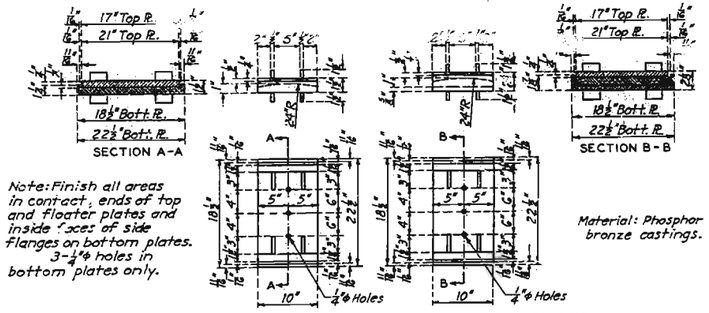
SECTION A-A BENT NO.1
Details not shown are same as for Bent No.6.



PLAN



SECTION B-B
SECTION C-C OPP. HAND



DECK GIRDER BEARING PLATES

4 Sets of 5 Plates each (10"x21") required for 50' Spans.
16 Sets of 5 Plates each (10"x17") required for 40' Spans.
Note: Each set consists of 1 top plate and 1 bottom plate for fixed end and 1 top plate, 1 floater plate and 1 bottom plate for expansion end.

DETAILS OF END BENTS NO. 1 & 6

BRIDGE OVER HINKSON CREEK

STATE ROAD FROM COLUMBIA TO KINGDOM CITY
ABOUT 2.5 MILES EAST OF COLUMBIA
PROJECT NO. FI-229(8) (U.S. 40) STA. 813+60

BOONE COUNTY

Drawn March 1949 by G.H.K.
Traced March 1949 by F.M.C.jr.
Checked April 1949 by E.M.N.

Note: This drawing is not to scale. Follow dimensions.

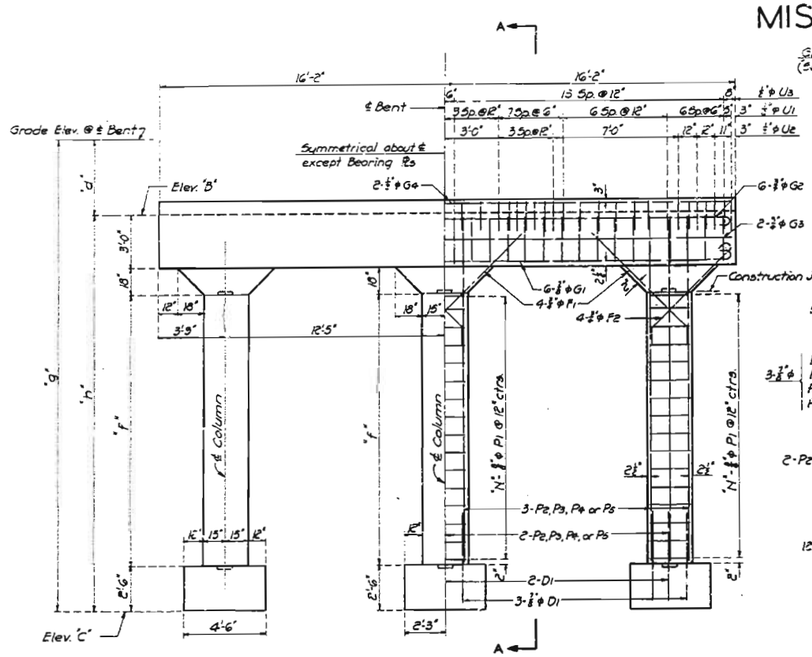
HARRINGTON AND CORTELYOU
CONSULTING ENGINEERS - KANSAS CITY, MO.

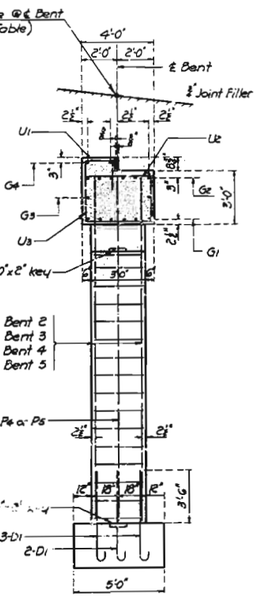
Sheet No. 2 of 6.

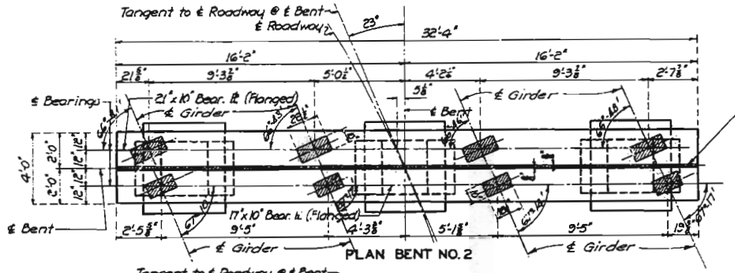
L-264

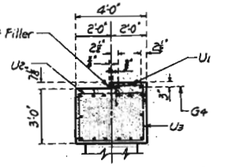
MISSOURI STATE HIGHWAY DEPARTMENT

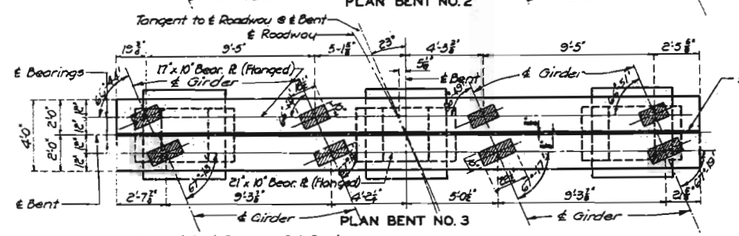
FED. ROAD DIST. NO.	STATE	FED AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	(F-229(8) (U340)	19		

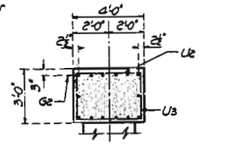


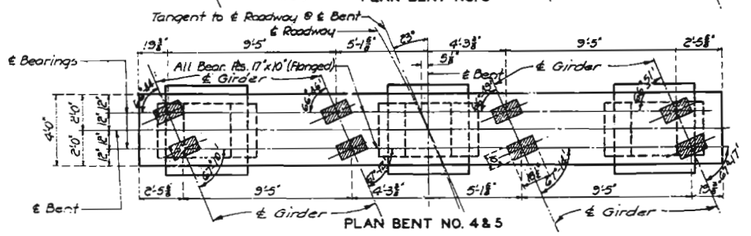










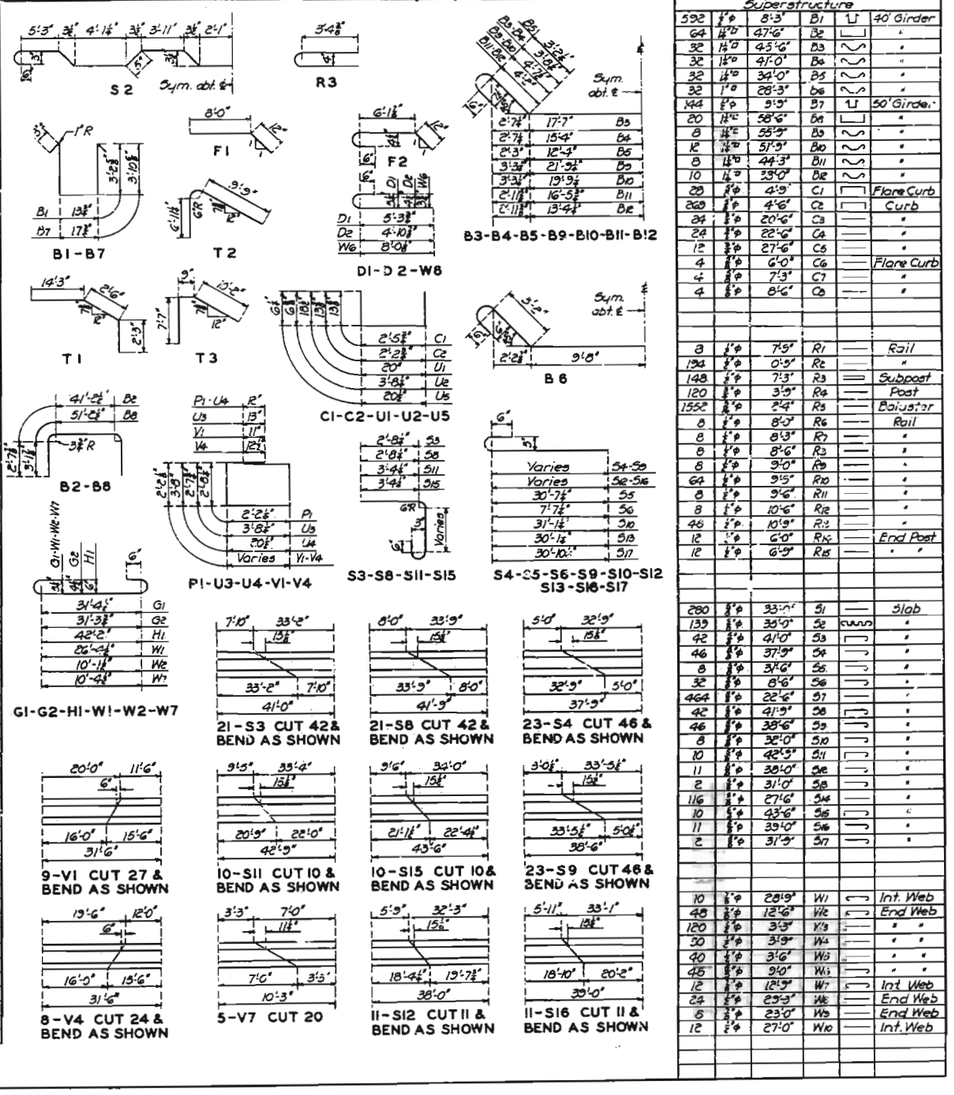


COMPLETE BILL OF REINFORCING STEEL

No.	Size	Length	Mark	Shape	Location
End Bents No. 1 & 6					
60	⅞" ϕ	6'0"	D2		Footing
24	⅞" ϕ	9'0"	F1		Haunch
12	1" ϕ	44'9"	H1		Beam
6	⅞" ϕ	42'9"	H2		"
8	1" ϕ	15'0"	H5		"
12	⅞" ϕ	42'9"	H4		"
4	⅞" ϕ	12'0"	H6		"
4	⅞" ϕ	42'9"	H6		"
20	¾" ϕ	16'3"	H7		Wing
4	¾" ϕ	14'9"	H8		"
8	⅞" ϕ	5'0"	H9		"
8	⅞" ϕ	2'6"	H10		"
12	⅞" ϕ	11'6"	H11		"
12	⅜" ϕ	191'3"	T1		Wing
4	⅜" ϕ	17'9"	T2		"
4	⅜" ϕ	18'6"	T3		"
88	⅝" ϕ	11'0"	U4		Beam
12	⅝" ϕ	2'9"	U5		"
27	⅝" ϕ	31'6"	V1		Column
30	⅝" ϕ	21'6"	V2		"
18	⅝" ϕ	17'9"	V3		"
28	⅝" ϕ	31'6"	V4		"
30	⅝" ϕ	20'2"	V5		"
18	⅝" ϕ	16'6"	V6		"
20	⅝" ϕ	10'3"	V7		Wing
Intermediate Bents No. 2-3-4-5					
36	⅞" ϕ	6'6"	D1		Footing
64	⅞" ϕ	3'0"	F1		Haunch
32	⅞" ϕ	8'3"	F2		"
24	1" ϕ	33'9"	G1		Beam
24	⅞" ϕ	33'6"	G2		"
8	⅞" ϕ	32'0"	G3		"
4	⅞" ϕ	32'0"	G4		"
210	⅞" ϕ	10'9"	P1		Column
24	⅞" ϕ	19'3"	P2		"
24	⅞" ϕ	19'6"	P3		"
24	⅞" ϕ	21'3"	P4		"
24	⅞" ϕ	23'0"	P5		"
24	⅝" ϕ	4'9"	U1		Beam
64	⅝" ϕ	4'9"	U2		"
128	⅝" ϕ	13'9"	U3		"

* See Cutting Diagrams

Bending Sketches and Cutting Diagrams



No.	Size	Length	Mark	Shape	Location
Superstructure					
592	⅝" ϕ	8'3"	B1	U	40' Girder
64	1¼" ϕ	47'6"	B2		"
32	1⅝" ϕ	45'6"	B3		"
32	1¾" ϕ	41'0"	B4		"
32	1¾" ϕ	34'0"	B5		"
32	1" ϕ	28'3"	B6		"
144	⅝" ϕ	9'9"	B7	U	50' Girder
20	1¼" ϕ	58'6"	B8		"
8	1½" ϕ	55'9"	B9		"
16	1¾" ϕ	51'9"	B10		"
8	1¾" ϕ	44'3"	B11		"
10	1½" ϕ	35'0"	B12		"
28	⅝" ϕ	4'9"	C1		Flare Curb
200	⅝" ϕ	4'6"	C2		Curb
84	⅝" ϕ	20'6"	C3		"
24	⅝" ϕ	22'6"	C4		"
12	⅝" ϕ	27'6"	C6		"
4	⅝" ϕ	6'0"	C6		Flare Curb
4	⅝" ϕ	7'3"	C7		"
4	⅝" ϕ	8'6"	C8		"
8	⅝" ϕ	7'9"	R1		Rail
192	⅝" ϕ	0'9"	R2		"
148	⅝" ϕ	7'3"	R3		Subpost
120	⅝" ϕ	3'9"	R4		Post
1552	⅝" ϕ	2'9"	R5		Baluster
8	⅝" ϕ	8'0"	R6		Rail
8	⅝" ϕ	8'3"	R7		"
8	⅝" ϕ	8'6"	R8		"
8	⅝" ϕ	9'0"	R9		"
64	⅝" ϕ	9'5"	R10		"
8	⅝" ϕ	9'6"	R11		"
8	⅝" ϕ	10'6"	R12		"
48	⅝" ϕ	10'9"	R13		"
12	⅝" ϕ	6'0"	R14		End Post
12	⅝" ϕ	6'9"	R15		" "
280	⅝" ϕ	33'0"	S1		Slab
139	⅝" ϕ	35'0"	S2		"
42	⅝" ϕ	41'0"	S3		"
46	⅝" ϕ	37'9"	S4		"
8	⅝" ϕ	31'6"	S5		"
32	⅝" ϕ	8'6"	S6		"
464	⅝" ϕ	22'6"	S7		"
42	⅝" ϕ	41'9"	S8		"
46	⅝" ϕ	38'6"	S9		"
8	⅝" ϕ	32'0"	S10		"
10	⅝" ϕ	42'9"	S11		"
11	⅝" ϕ	38'0"	S12		"
2	⅝" ϕ	31'0"	S13		"
116	⅝" ϕ	27'6"	S14		"
10	⅝" ϕ	43'6"	S15		"
11	⅝" ϕ	39'0"	S16		"
12	⅝" ϕ	31'9"	S17		"
10	⅝" ϕ	28'9"	W1		Int. Web
48	⅝" ϕ	12'6"	W2		End Web
120	⅝" ϕ	3'9"	W3		" "
30	⅝" ϕ	3'9"	W4		" "
40	⅝" ϕ	3'6"	W5		" "
45	⅝" ϕ	3'0"	W6		" "
12	⅝" ϕ	12'9"	W7		Int. Web
24	⅝" ϕ	25'3"	W8		End Web
6	⅝" ϕ	23'0"	W9		End Web
12	⅝" ϕ	27'0"	W10		Int. Web

DATA FOR INTERMEDIATE BENTS

Bent No.	Grade @ ℄ Bent	Elev. 'B'	Elev. 'C'	Dim. 'a'	Dim. 'h'	Dim. 'd'	Dim. 'f'	No. P1 bars 'N'
2	681.67	677.15	655.00	26'-0"	22'-8"	4'-6¾"	15'-11"	16
3	681.28	677.93	655.00	26'-3"	21'-10"	4'-5⅜"	14'-10"	16
4	680.56	677.10	653.00	27'-11"	24'-1"	3'-10"	17'-1"	18
5	681.64	676.83	651.00	29'-7"	25'-10"	3'-9"	18'-10"	20

676.83 21'-10" 4'-5 3/8" 14'10"

DETAILS OF INTERMEDIATE BENTS NO. 2,3,4 & 5

Drawn March 1949 by G.H.K.
Traced March 1949 by Z.E.W.
Checked April 1949 by E.M.N

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 3 of 6

BRIDGE OVER HINKSON CREEK

STATE ROAD FROM COLUMBIA TO KINGDOM CITY

ABOUT 2.5 MILES EAST OF COLUMBIA

PROJECT NO. FI-229(8) (U.S. 40) STA. 813+60

BOONE COUNTY

HARRINGTON AND CORTELYOU
CONSULTING ENGINEERS — KANSAS CITY, MO.

DRAWING NO. L-264

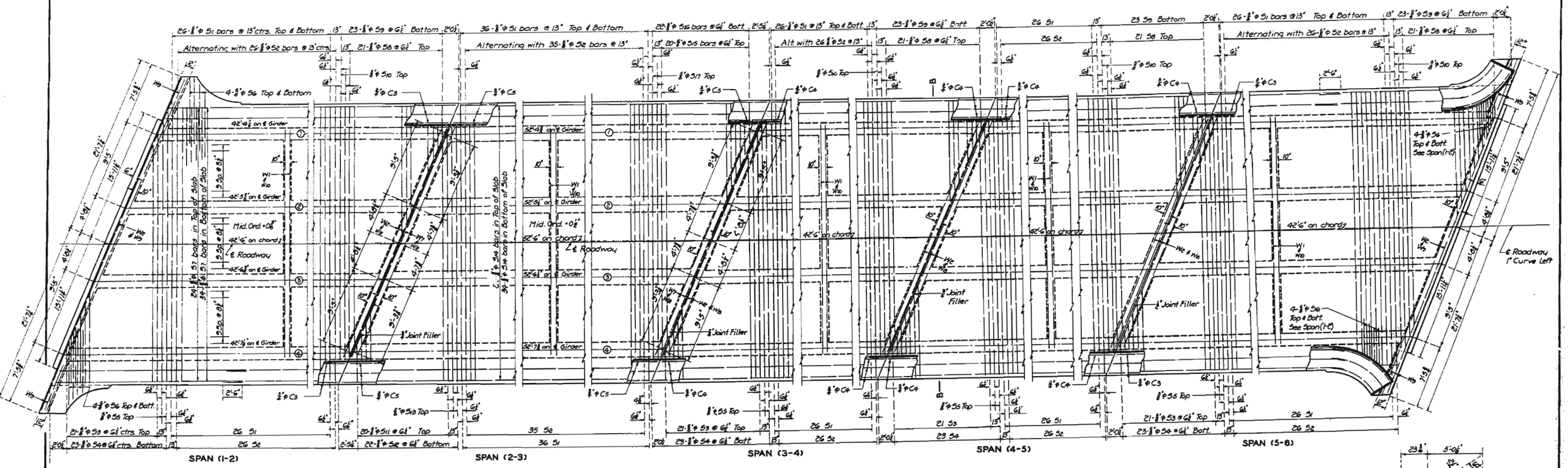
618

813 PAVING PLANS ENGINEERING

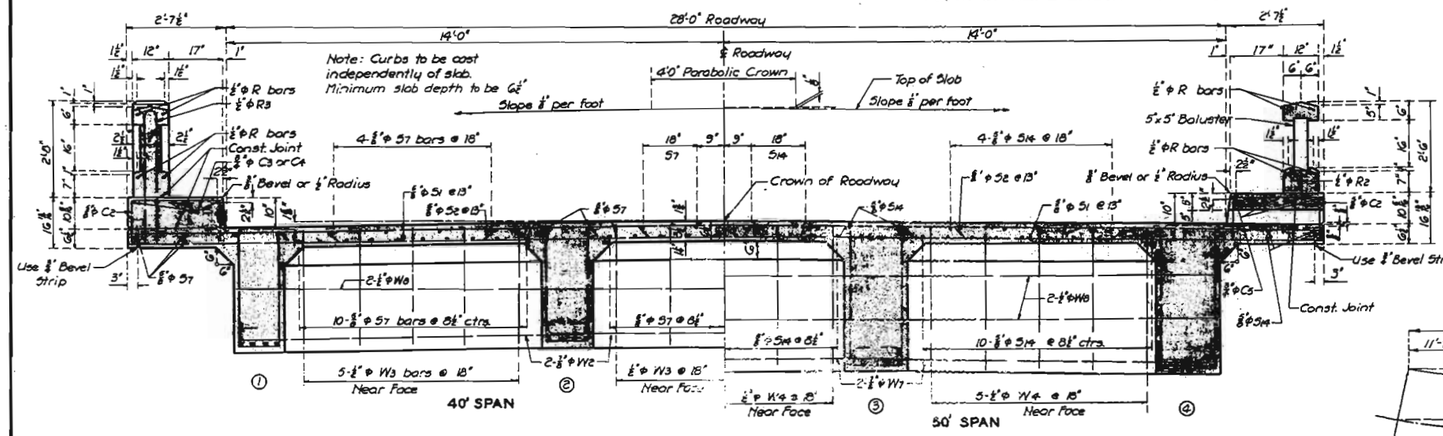
MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	FI-229(8) (U.S.40)	19		

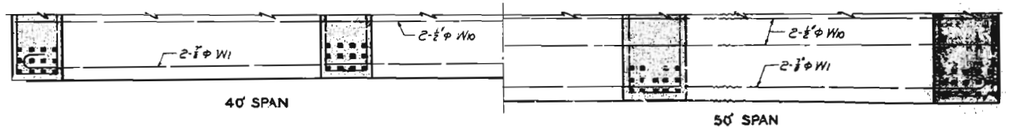
Note: Dimensions and reinforcement of 40' spans are identical except as shown.



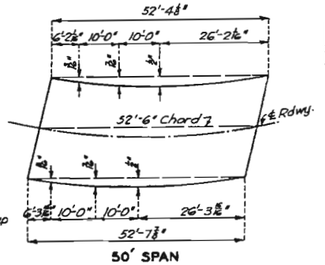
PLAN OF SLAB SHOWING REINFORCEMENT



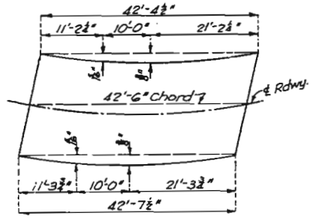
HALF SECTION NEAR INTERMEDIATE BENT



PART SECTION NEAR INTERMEDIATE WEB

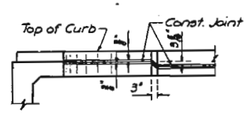


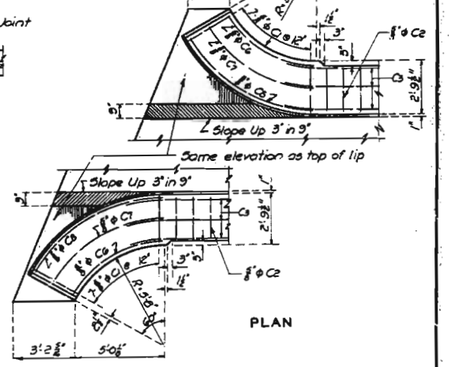
50' SPAN



40' SPANS

CURB ORDINATES





DETAIL OF CURB AND LIP

BRIDGE OVER HINKSON CREEK

STATE ROAD FROM COLUMBIA TO KINGDOM CITY

ABOUT 2.5 MILES EAST OF COLUMBIA

PROJECT NO. FI-229(8) (U.S. 40) STA. 813+60

BOONE COUNTY

Drawn March 1949 by Z.E.W.
Traced March 1949 by Z.E.W.
Checked April 1949 by F.M.C.

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 4 of 6

HARRINGTON AND CORTELYOU
CONSULTING ENGINEERS — KANSAS CITY, MO.

FINISHED

L-264

NO CONSTRUCTION SHEETS

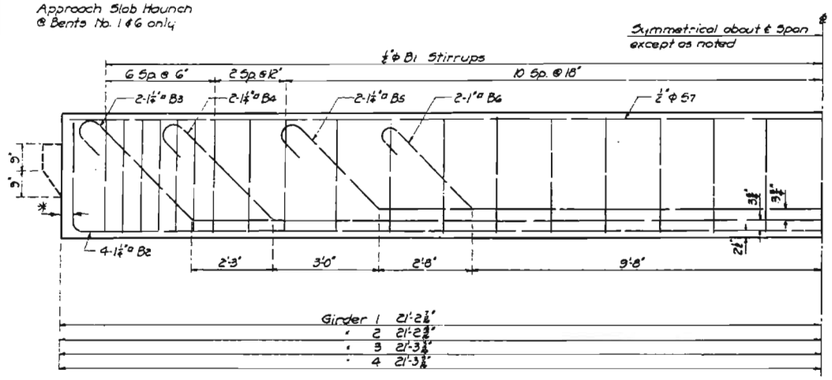
MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	FI-229(8) (U.S.40)	19		

VARIABLE HAUNCH DIMENSION

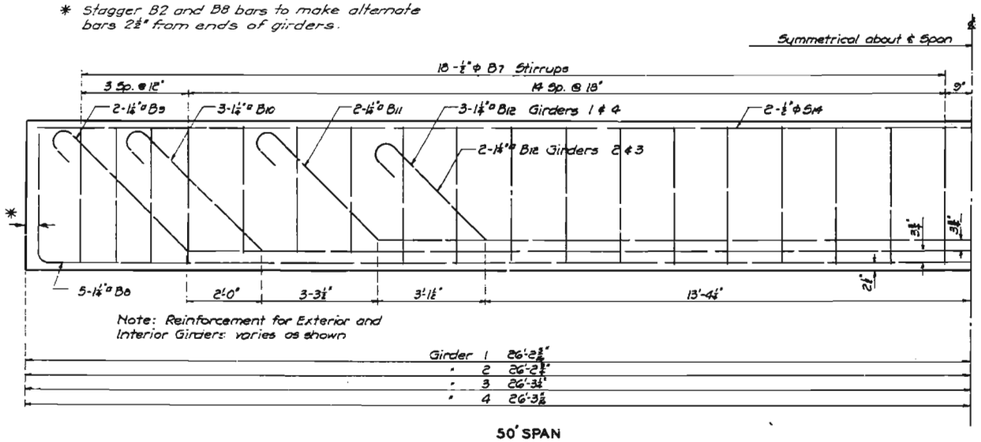
Bent No.	Var. Dim.	Girder No. 1	2	3	4
1	A	0	1½"	1½"	1"
2 & 3	B	0	1½"	1½"	1"
	A	0	1½"	1½"	1"
4	B	0¾"	2½"	2½"	1⅜"
	A	0	1½"	1½"	1"
5	B	0¾"	1⅝"	1⅝"	1⅜"
	A	0	1½"	1½"	1"
6	B	0	1½"	1½"	1"

Approach Slab Haunch @ Bents No. 1 & 6 only



40' SPANS

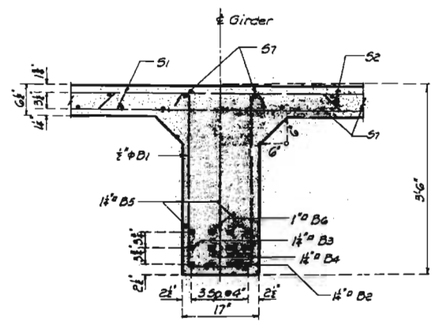
* Stagger B2 and B8 bars to make alternate bars 2⅜" from ends of girders.

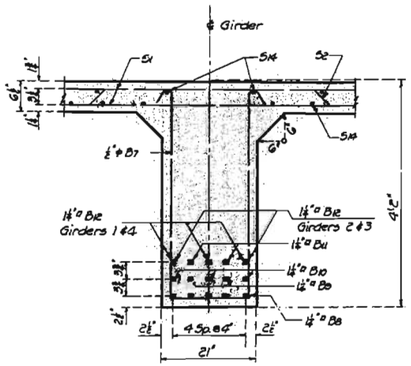


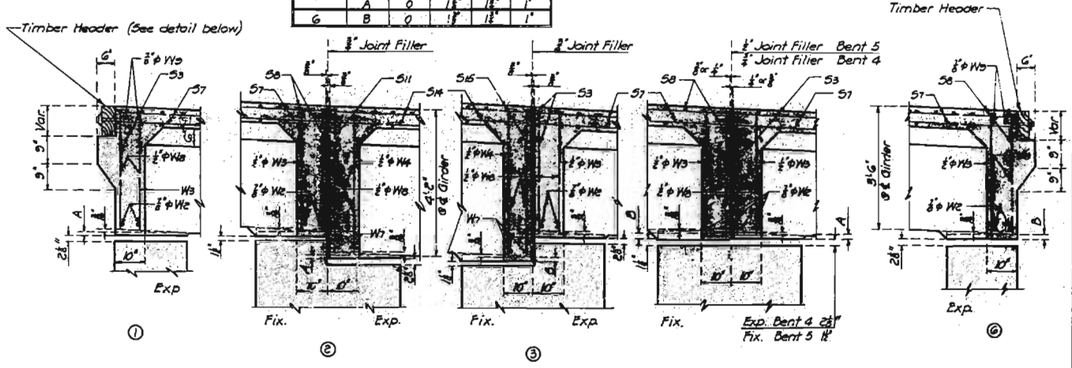
Note: Reinforcement for Exterior and Interior Girders varies as shown

50' SPAN

DETAILS OF GIRDER REINFORCEMENT

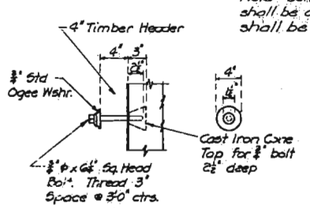




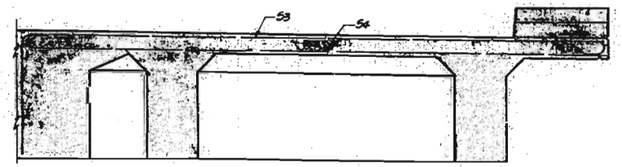


DETAILS OF GIRDER HAUNCHES
(Perpendicular to ℄ Bents)

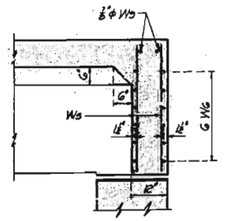
Note: Bottom of girders and top and bottom of slab shall be constructed parallel to grade. All bearings shall be horizontal.



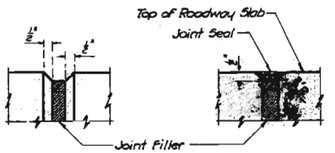
Note: Cost of timber headers complete in place to be included in price bid for concrete.



PART SECTION B-B
(From Sheet No. 4 of 6)

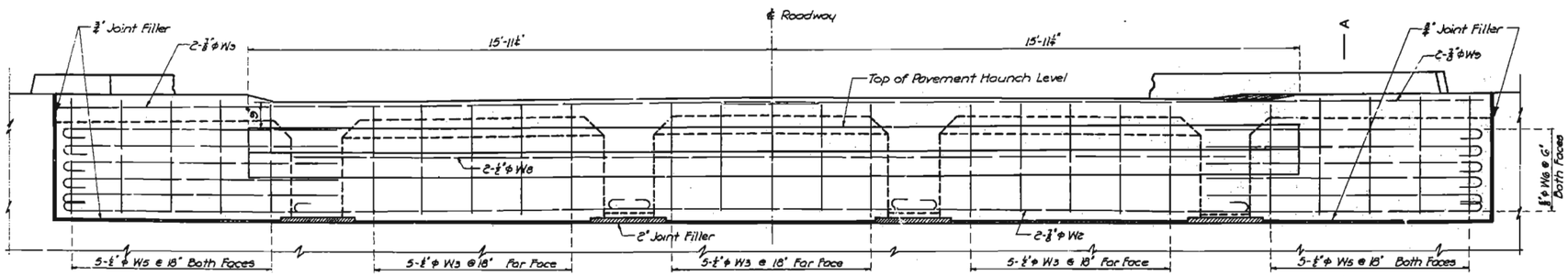


SECTION A-A

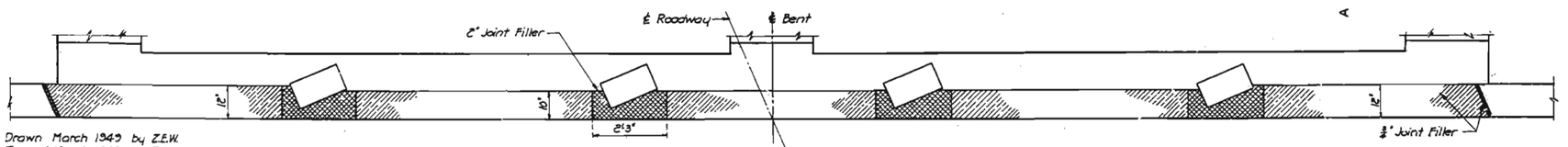


Note: Use bevel as shown for exposed faces of all filled joints except at top surface of roadway slab. Use edging tool with ½" radius at top surface of roadway slab each side of joint and fill with joint seal as shown.

DETAIL OF BEVEL FOR FILLED JOINTS



END VIEW OF SUPERSTRUCTURE AT END BENTS



DETAILS OF JOINT FILLER AT END BENTS

Drawn March 1949 by Z.E.W.
Traced March 1949 by Z.E.W.
Checked April 1949 by F.M.C.

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 3 of 6

BRIDGE OVER HINKSON CREEK

STATE ROAD FROM COLUMBIA TO KINGDOM CITY

ABOUT 2.5 MILES EAST OF COLUMBIA

PROJECT NO. FI-229(8) (U.S. 40) STA. 813+60

BOONE COUNTY

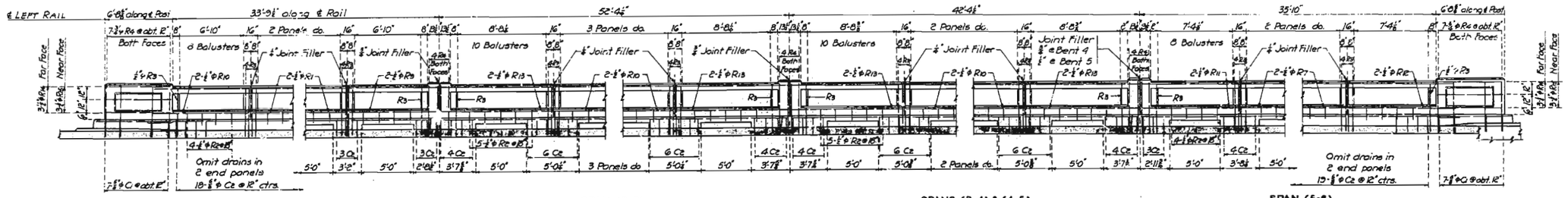
HARRINGTON AND CORTELYOU
CONSULTING ENGINEERS — KANSAS CITY, MO.

L-264

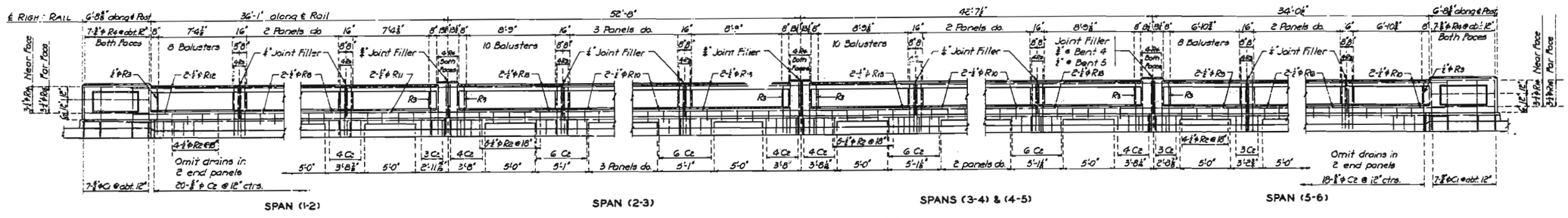
NO CONSTRUCTION

MISSOURI STATE HIGHWAY DEPARTMENT

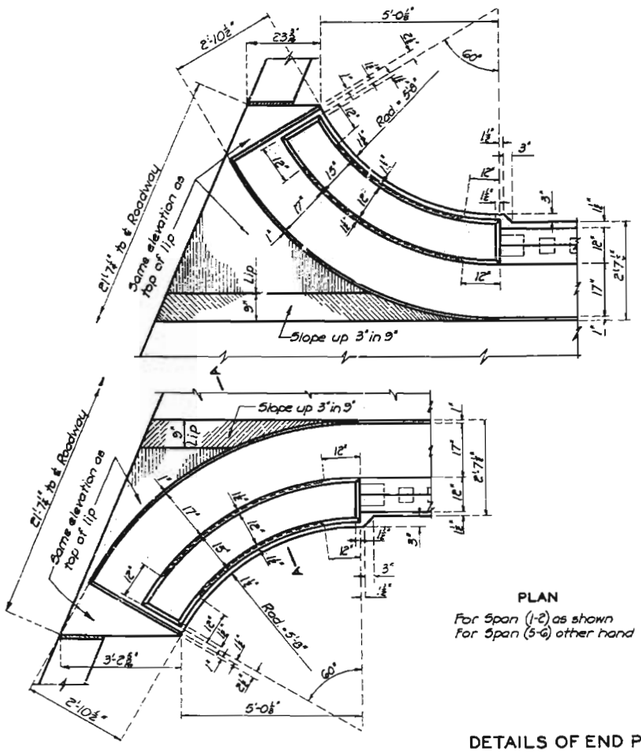
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	FI-229(8) (US 40)	19		



ELEVATION OF LEFT HANDRAIL



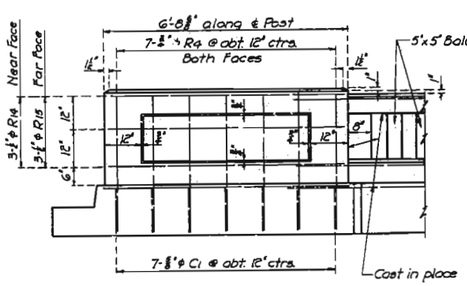
ELEVATION OF RIGHT HANDRAIL



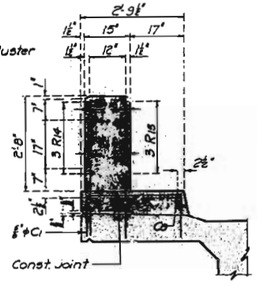
PLAN

For Span (1-2) as shown
For Span (5-6) other hand

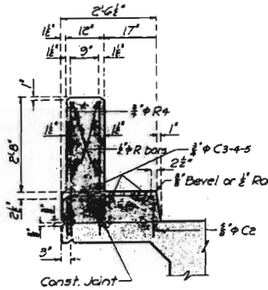
DETAILS OF END POSTS



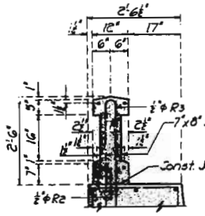
ELEVATION OF END POST



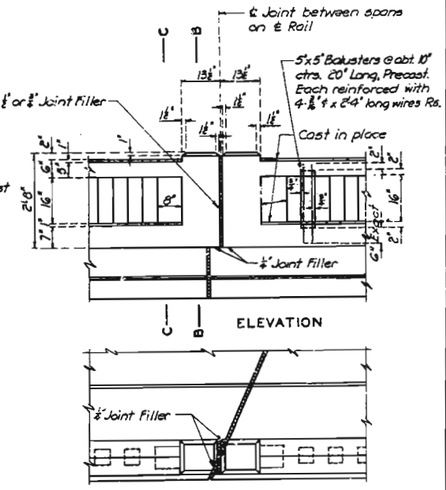
SECTION A-A



SECTION B-B



SECTION C-C



TYPICAL DETAILS OF HANDRAIL

Note. Vertical edges of posts and subposts and bottom of top rail to be beveled ½" Balusters to be beveled ¼"

GENERAL NOTES:

All concrete shall be Class B Tops of curbs, posts and rails to be built parallel to grade. Posts, subposts and balusters to be vertical.

BRIDGE OVER HINKSON CREEK

STATE ROAD FROM COLUMBIA TO KINGDOM CITY

ABOUT 2.5 MILES EAST OF COLUMBIA

PROJECT NO. FI-229(8) (U.S. 40) STA. 813+60

BOONE COUNTY

Drawn March 1949 by Z.E.W.
Traced March 1949 by Z.E.W.
Checked April 1949 by R.M.C.

Note: This drawing is not to scale. Follow dimensions

Sheet No. 6 of 6

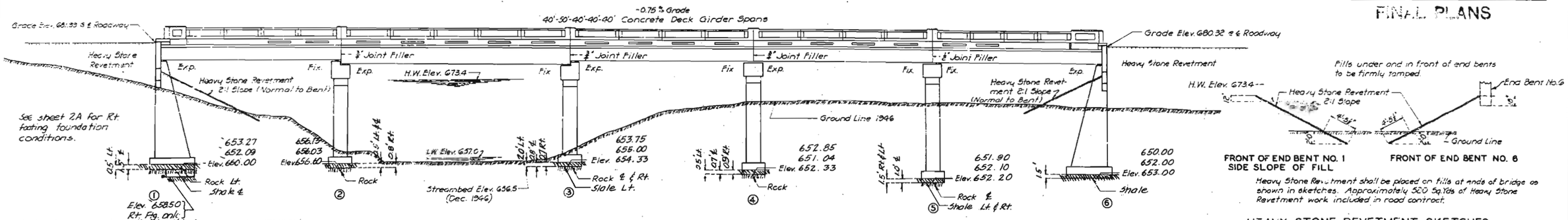
HARRINGTON AND CORTELYOU
CONSULTING ENGINEERS — KANSAS CITY, MO.

L-264

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	FI-229(8) (U.S.40)	19	102	

FINAL PLANS



GENERAL ELEVATION

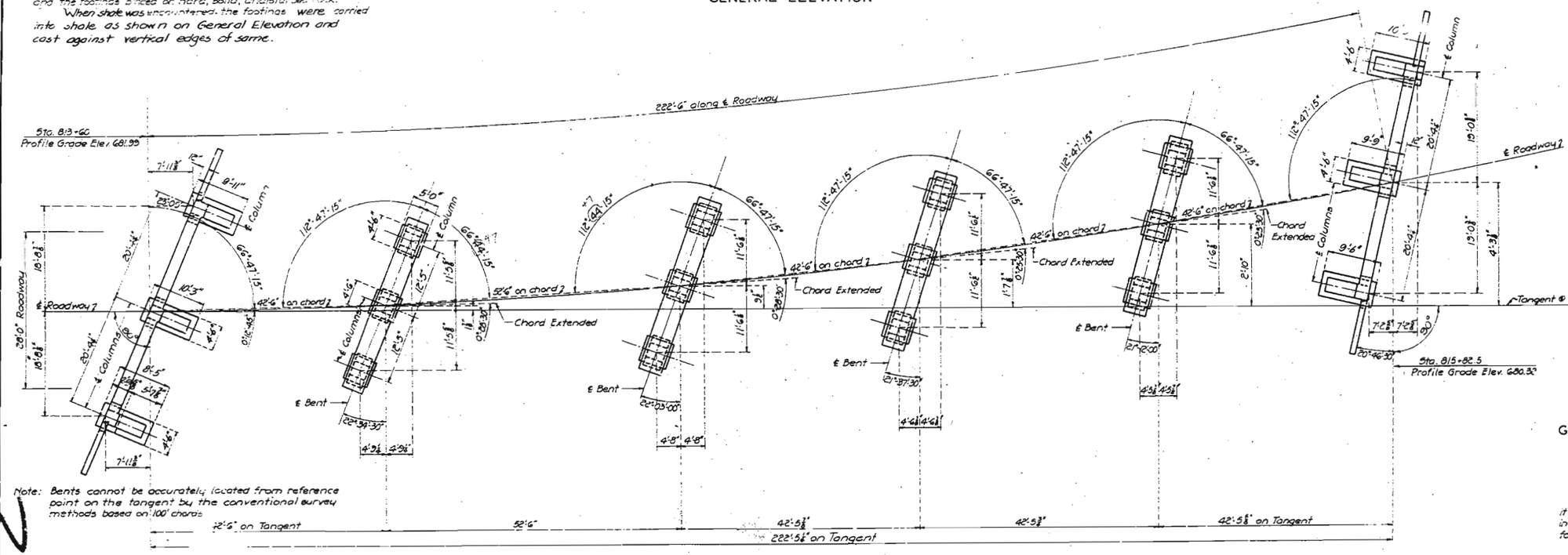
Note: All loose, shelly or disintegrated rock was removed and the footings placed on hard, solid, undisturbed rock.
When shale was encountered, the footings were carried into shale as shown on General Elevation and cast against vertical edges of same.

FRONT OF END BENT NO. 1 SIDE SLOPE OF FILL

FRONT OF END BENT NO. 6

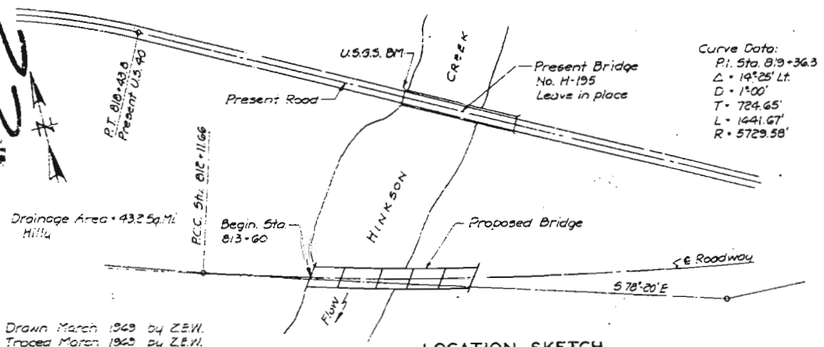
Heavy Stone Revetment shall be placed on fills at ends of bridge as shown in sketches. Approximately 320 Sq. Yds. of Heavy Stone Revetment work included in road contract.

HEAVY STONE REVETMENT SKETCHES



Note: Bents cannot be accurately located from reference point on the tangent by the conventional survey methods based on 100' chords.

PLAN



Curve Data:
P.I. Sta. 813+36.3
Δ = 19°25' Lt.
D = 1°00'
T = 724.65'
L = 1441.67'
R = 5729.58'

LOCATION SKETCH

Drawn March 1949 by Z.E.W.
Traced March 1949 by Z.E.W.
Checked April 1949 by E.M.N.

FINAL QUANTITIES

Item		Substructure	Superstructure	Total
Class 1 Excavation for Structures	Cu. Yds.	369.0		369.0
Class 2 Excavation for Structures Above Elev. 659.0 / Below Elev. 659.0	Cu. Yds.	2,038.8 / 23.0		2,038.8 / 23.0
Class "B" Concrete (Handrail)	Cu. Yds.		26.3	26.3
Class "B" Concrete (Except Handrail)	Cu. Yds.	281.1	382.3	663.4
Reinforcing Steel	Lbs.	24850	109270	134120
Phosphor Bronze Bearing Plates	16 Sets of 5 Plates each (10"x17") Flanged			
Phosphor Bronze Bearing Plates	4 Sets of 5 Plates each (10"x21") Flanged			
Test Holes	Lin. Ft.	72		72
Removing Cap Bent 3	F.A.	$2000.95		$2000.95

Note: Excavation for bridge made above Elev. 659.0 will be paid for as Class 1 Excavation for Structures. Excavation for bridge made below Elev. 659.0 will be paid for as Class 2 Excavation for Structures.

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1A of 5

GENERAL NOTES:

Design Specifications A.A.S.H.O. 1944 (Revised)
Loading: H20-S16-44
Reinforcing Steel Stress: 18,000 #/□"
Class "B" Concrete: 1,000 #/□"
All concrete shall be Class "B"
Where joint filler is specified on the plans it shall conform with the requirements as given in Section 38-18 B(2) of the Standard Specifications for Gray Rubber Compound Joints.
A rubbed surface finish will be required on all exposed surfaces of handrail and curbs and on outside faces of roadway slabs.

B.M. Elev. 685.54 ▫ on N.W. Wingwall of Hinkson Creek Bridge.
▫ U.S.G.S. Elev. 685.24.

BRIDGE OVER HINKSON CREEK

STATE ROAD FROM COLUMBIA TO KINGDOM CITY
ABOUT 2.5 MILES EAST OF COLUMBIA
PROJECT NO. FI-229(8) (U.S. 40) STA. 813+60

BOONE COUNTY

SUBMITTED BY V.W. Earnlow, BRIDGE ENGINEER, DATE 5/16/1949
APPROVED BY C.H.W. Brown, CHIEF ENGINEER, DATE 5/16/1949

HARRINGTON AND CORTELYOU
CONSULTING ENGINEERS — KANSAS CITY, MO.

STD. C-110R3
L-264

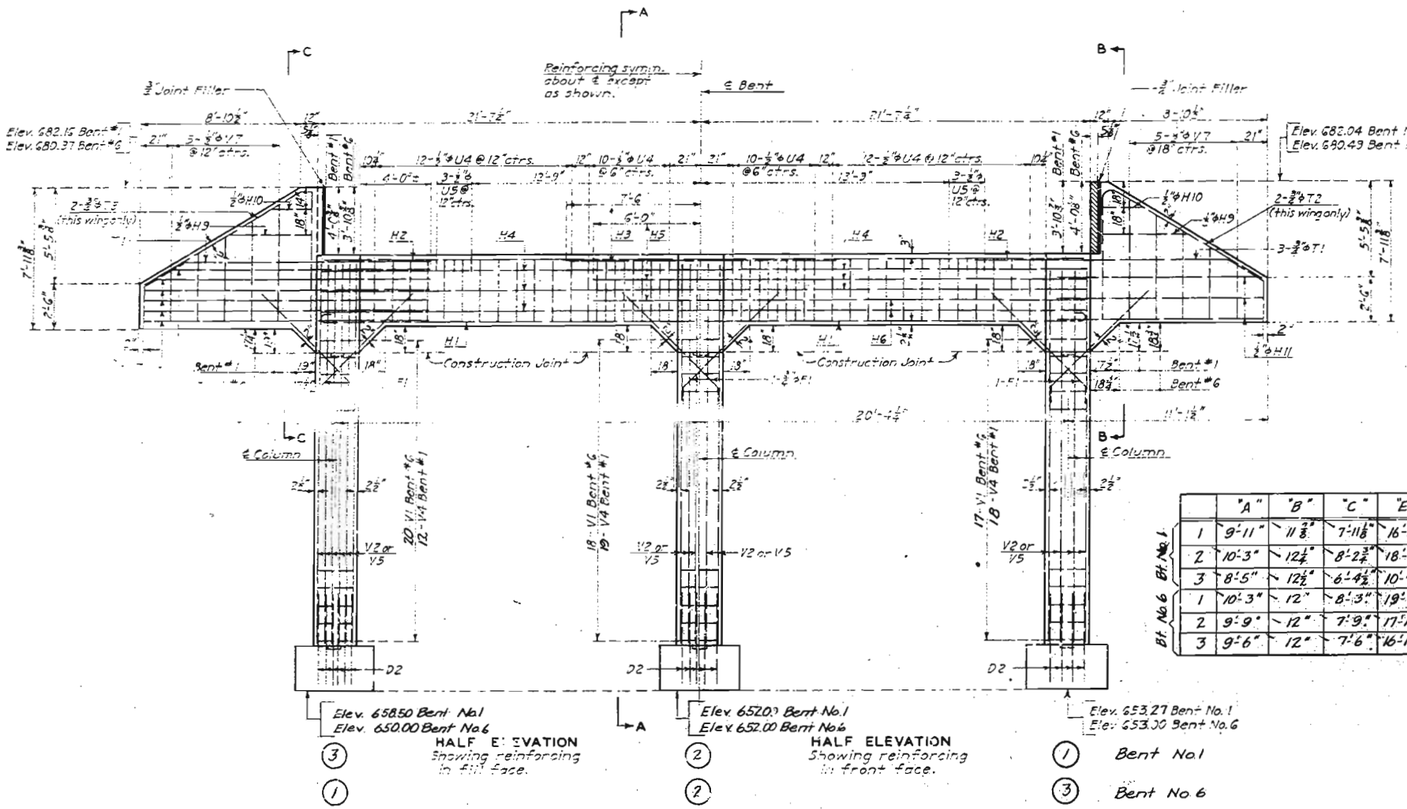
222

FINAL PLANS

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	F-229(8) (U.S.40)	19	103	1

FINAL PLANS



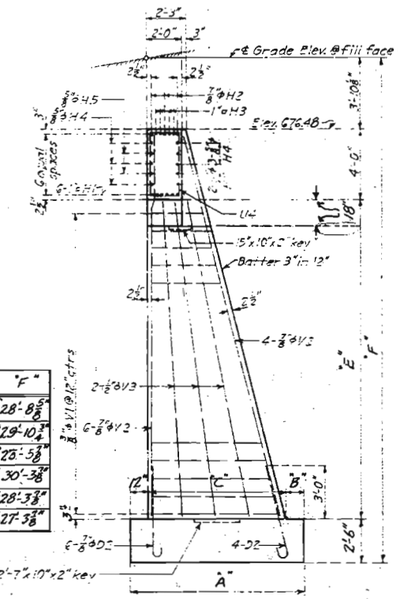
HALF ELEVATION
Showing reinforcing in fill face.

HALF ELEVATION
Showing reinforcing in front face.

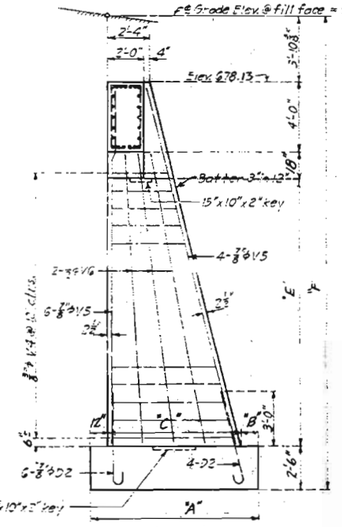
Bent No.1

Bent No.6

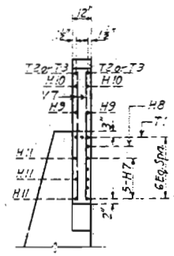
		"A"	"B"	"C"	"E"	"F"
Bt. No.6 Bt. No.1	1	9'-11"	11 3/8"	7'-11 5/8"	16'-10 1/4"	28'-8 5/8"
	2	10'-3"	12 1/4"	8'-2 3/4"	18'-0 3/8"	29'-10 1/4"
	3	8'-5"	12 1/2"	6'-4 1/2"	10'-7 1/2"	26'-5 3/8"
Bt. No.6	1	10'-3"	12"	8'-3"	19'-11 3/4"	30'-3 3/8"
	2	9'-9"	12"	7'-9"	17'-11 3/4"	28'-3 3/8"
	3	9'-6"	12"	7'-6"	16'-11 3/4"	27'-3 3/8"



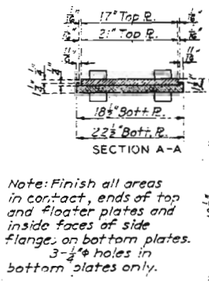
SECTION A-A BENT NO. 6



SECTION A-A BENT NO.1
Details not shown are same as for Bent No.6.



SECTION B-B
SECTION C-C OPP. HAND



SECTION A-A

SECTION B-B

Note: Finish all areas in contact, ends of top and floater plates and inside faces of side flanges on bottom plates. 3-¾ϕ holes in bottom plates only.

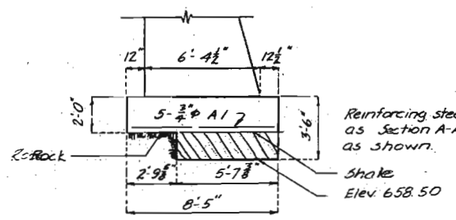
Material: Phosphor bronze castings.

FIXED END

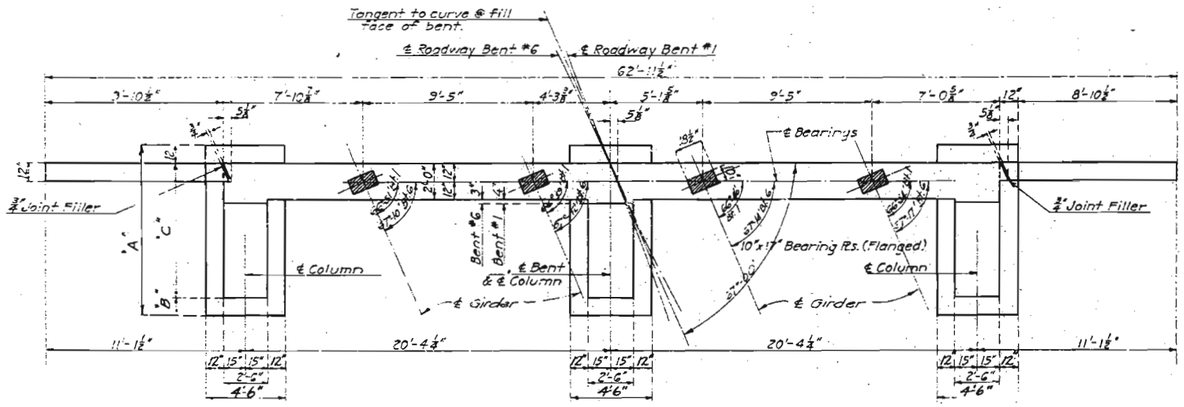
EXPANSION END

DECK G... BEARING PLATES

4 Sets of 5 Plates each (10"x21") required for 50' Spans.
16 Sets of 5 Plates each (10"x17") required for 40' Spans.
Note: Each set consists of 1 top plate and 1 bottom plate for fixed end and 1 top plate, 1 floater plate and 1 bottom plate for expansion end.



PART ELEVATION OF RIGHT COLUMN
BENT NO. 1



PLAN

DETAILS OF END BENTS NO. 1 & 6

223

Drawn March 1949 by G.H.K.
Traced March 1949 by E.M.C.Jr.
Checked April 1949 by E.M.N.

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 2A of 5

BRIDGE OVER HINKSON CREEK

STATE ROAD FROM COLUMBIA TO KINGDOM CITY

ABOUT 2.5 MILES EAST OF COLUMBIA

PROJECT NO. FI-229(8) (U.S. 40) STA. 813+60

BOONE COUNTY

HARRINGTON AND CORTELYOU
CONSULTING ENGINEERS - KANSAS CITY, MO.

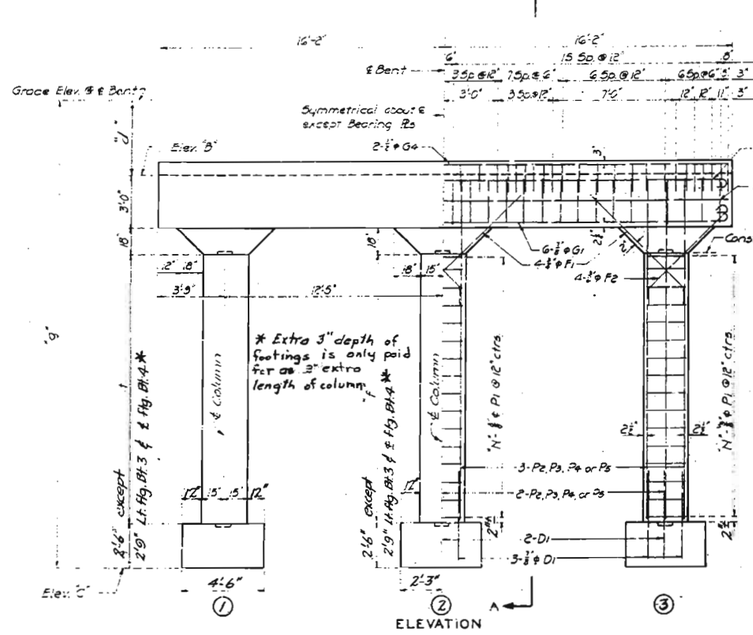
L-264

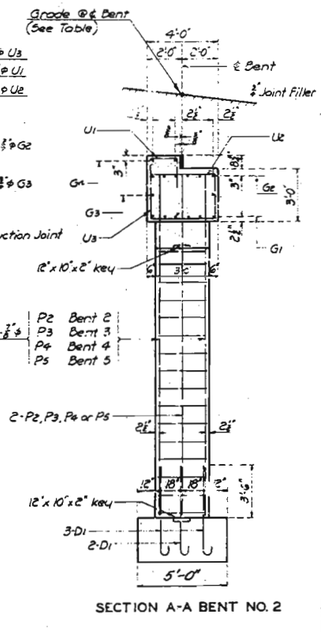
FINAL PLANS

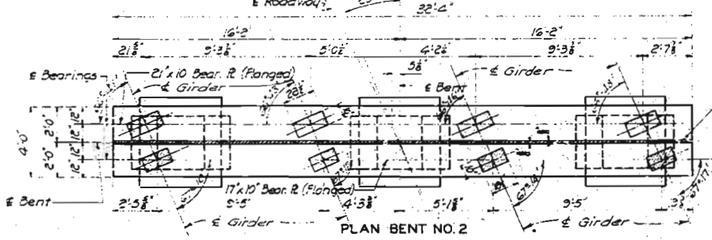
MISSOURI STATE HIGHWAY DEPARTMENT

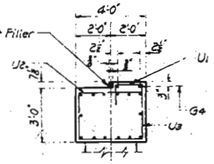
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	FI-229(8) (US 40)	19	194	

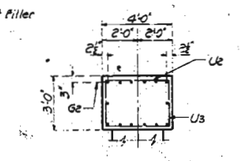
FINAL PLANS









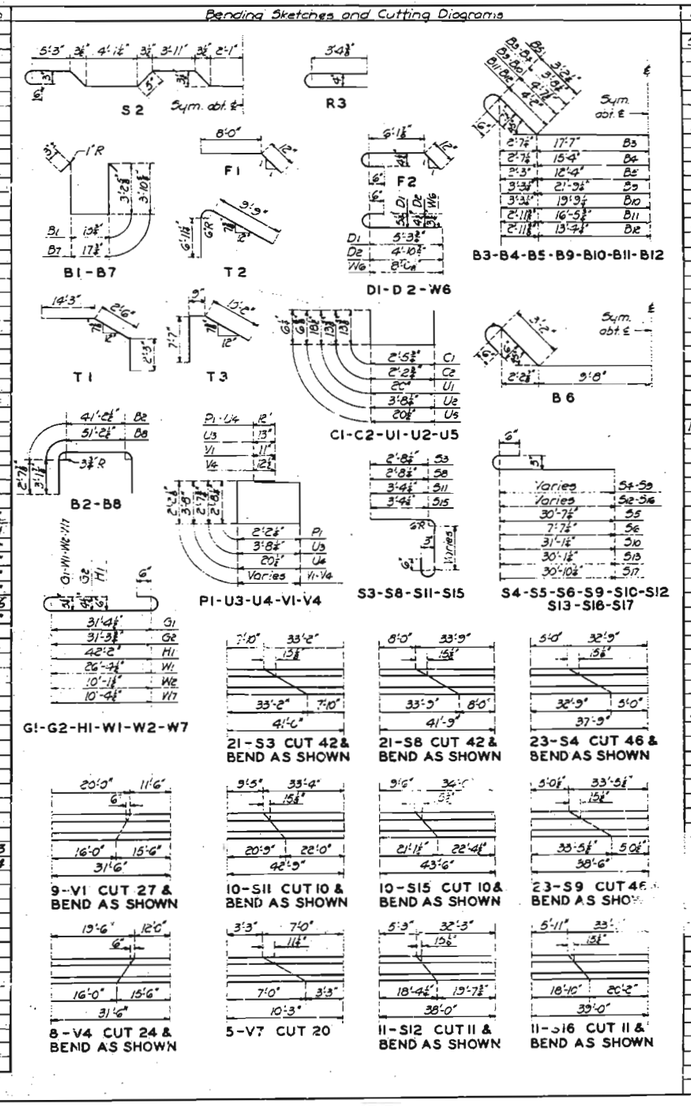


COMPLETE BILL OF REINFORCING STEEL

No.	Size	Length	Mark	Shape	Location
		End Bents No. 1 & 6			
50	⅝"φ	6'-0"	D2		Footing
24	⅜"φ	9'-0"	F1		Haunch
12	1"□	44'-9"	H1		Beam
6	⅝"φ	42'-9"	H2		"
8	1"□	15'-0"	H3		"
12	⅝"φ	42'-9"	H4		"
4	⅝"φ	12'-0"	H5		"
4	⅝"φ	42'-9"	H6		"
20	⅝"φ	16'-3"	H7		Wing
4	⅜"φ	14'-9"	H8		"
8	⅝"φ	5'-0"	H9		"
8	⅜"φ	2'-6"	H10		"
12	⅝"φ	11'-6"	H11		"
12	⅝"φ	19'-0"	T1		Wing
4	⅜"φ	17'-9"	T2		"
4	⅜"φ	18'-6"	T3		"
88	⅝"φ	11'-9"	U4		Beam
12	⅝"φ	2'-9"	U5		"
6	⅝"φ	3'-9"	V6a		4 Col. Bk 1
6	⅝"φ	5'-0"	V6a		2 Col. Bk 1
27	⅝"φ	31'-6"	V1		Column
30	⅝"φ	21'-6"	V2		"
18	⅝"φ	17'-9"	V3		"
24	⅝"φ	31'-6"	V4		"
30	⅝"φ	20'-3"	V5		"
18	⅝"φ	16'-6"	V6		"
20	⅝"φ	10'-3"	V7		Wing
6	⅝"φ	4'-0"	V8a		4 Col. Bk 6
5	⅝"φ	8'-0"	A1		Rt. Fdg. Bk 1
10	⅝"φ	5'-3"	V5a		4 Col. " " "
10	⅝"φ	6'-0"	V5a		" " " "
2	⅝"φ	+20'-3"	V4a		" " " "
3	⅝"φ	+20'-6"	V4a		" " " "
10	⅝"φ	5'-0"	V8a		4 Col. Bk 6
2	⅝"φ	+20'-9"	V1a		" " " "
Intermediate Bents No. 2-3-4-5					
96	⅝"φ	6'-6"	D1		Footing
64	⅜"φ	9'-0"	F1		Haunch
32	⅝"φ	8'-3"	P2		"
24	⅝"φ	33'-9"	G1		Beam
24	⅝"φ	33'-6"	G2		"
8	⅝"φ	32'-0"	G3		"
4	⅝"φ	32'-0"	G4		"
210	⅝"φ	10'-9"	P1		Column
24	⅝"φ	19'-3"	P2		"
24	⅝"φ	19'-6"	P3		"
24	⅝"φ	21'-3"	P4		"
24	⅝"φ	23'-0"	P5		"
8	⅝"φ	4'-8"	P3a		4 Col. Bk 3
8	⅝"φ	5'-6"	P4a		4 Col. Bk 4
54	⅝"φ	4'-9"	U1		Beam
64	⅝"φ	4'-9"	U2		"
128	⅝"φ	13'-9"	U3		"

* See Cutting Diagrams
\+ Average bar length.

Bending Sketches and Cutting Diagrams



No.	Size	Length	Mark	Shape	Location
		Superstructure			
592	⅝"φ	5'-3"	B1		40 Girder
64	1¼"□	47'-6"	B2		"
32	1¼"□	45'-6"	B3		"
32	1¼"□	41'-0"	B4		"
32	1¼"□	34'-0"	B5		"
32	1"□	28'-3"	B6		"
144	⅝"φ	9'-9"	B7		30 Girder
20	1¼"□	58'-6"	B8		"
8	1¼"□	55'-9"	B9		"
12	1¼"□	51'-3"	B10		"
9	1¼"□	44'-"	B11		"
10	1¼"□	38'-0"	B12		"
28	⅝"φ	4'-9"	C1		Flare Curb
269	⅝"φ	4'-6"	C2		Curb
24	⅝"φ	20'-2"	C3		"
24	⅝"φ	22'-6"	C4		"
12	⅝"φ	27'-6"	C5		"
4	⅝"φ	6'-0"	C6		Flare Curb
4	⅝"φ	7'-3"	C7		"
4	⅝"φ	8'-6"	C8		"
8	⅝"φ	7'-9"	R1		Rail
194	⅝"φ	0'-9"	R2		"
148	⅝"φ	7'-3"	R3		Subpost
120	⅝"φ	3'-9"	R4		Post
1552	⅝"φ	2'-4"	R5		Baluster
8	⅝"φ	8'-0"	R6		Rail
8	⅝"φ	8'-3"	R7		"
8	⅝"φ	8'-6"	R8		"
8	⅝"φ	9'-0"	R9		"
64	⅝"φ	9'-3"	R10		"
8	⅝"φ	9'-6"	R11		"
8	⅝"φ	10'-6"	R12		"
48	⅝"φ	10'-9"	R13		"
12	⅝"φ	6'-0"	R14		End Post
12	⅝"φ	6'-9"	R15		" "
280	⅝"φ	33'-0"	S1		Slab
133	⅝"φ	33'-0"	S2		"
42	⅝"φ	41'-0"	S3		"
46	⅝"φ	37'-9"	S4		"
8	⅝"φ	31'-6"	S5		"
32	⅝"φ	8'-6"	S6		"
464	⅝"φ	22'-6"	S7		"
42	⅝"φ	41'-9"	S8		"
46	⅝"φ	38'-6"	S9		"
8	⅝"φ	32'-0"	S10		"
10	⅝"φ	42'-9"	S11		"
11	⅝"φ	38'-0"	S12		"
2	⅝"φ	31'-0"	S13		"
116		27'-6"	S14		"
16			S15		"
		28'-9"	W1		Int. Web
48	⅝"φ	18'-6"	W2		End Web
120	⅝"φ	31'-3"	W3		" "
30	⅝"φ	31'-9"	W4		" "
40	⅝"φ	31'-6"	W5		" "
48	⅝"φ	9'-0"	W6		" "
12	⅝"φ	18'-9"	W7		Int. Web
24	⅝"φ	29'-3"	W8		End Web
8	⅝"φ	23'-0"	W9		End Web
12	⅝"φ	27'-0"	W10		Int. Web

DATA FOR INTERMEDIATE BENTS														
Bent No	Grade ℄ Bent	Elev. "B"	Elev. "C-1"	Elev. "C-2"	Elev. "C-3"	Dim. "d"	Dim. "f"	Dim. "g-1"	Dim. "f-2"	Dim. "g-2"	Dim. "f-3"	Dim. "g-3"	"N-1"	"N-2"	"N-3"
2	681.67	677.15	656.13	656.05	656.60	4'-6"	14'-0"	25'-6"	14'-1"	26'-7"	13'-6"	25'-05"	15	15	15
3	681.28	676.83	653.75	655.00	654.33	4'-5"	18'-10"	27'-6"	14'-10"	26'-3"	15'-6"	26'-11"	16	15	16
4	680.96	677.10	652.85	651.04	652.33	3'-10"	17'-3"	28'-1"	18'-8"	29'-11"	17'-6"	28'-7"	18	19	18
5	680.64	676.83	651.90	652.10	652.20	3'-9"	17'-11"	28'-8"	17'-8"	28'-6"	17'-7"	28'-5"	19	19	19

BRIDGE OVER HINKSON CREEK

STATE ROAD FROM COLUMBIA TO KINGDOM CITY

ABOUT 2.5 MILES EAST OF COLUMBIA

PROJECT NO. FI-229(8) (U.S. 40) STA. 813+60

BOONE COUNTY

DETAILS OF INTERMEDIATE BENTS NO. 2,3,4 & 5

Drawn March 1949 by G.H.K.
Traced March 1949 by Z.E.W.
Checked April 1949 by E.H.S.

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 3A of 5

HARRINGTON AND CORTELYOU
CONSULTING ENGINEERS — KANSAS CITY, MO.

L-264

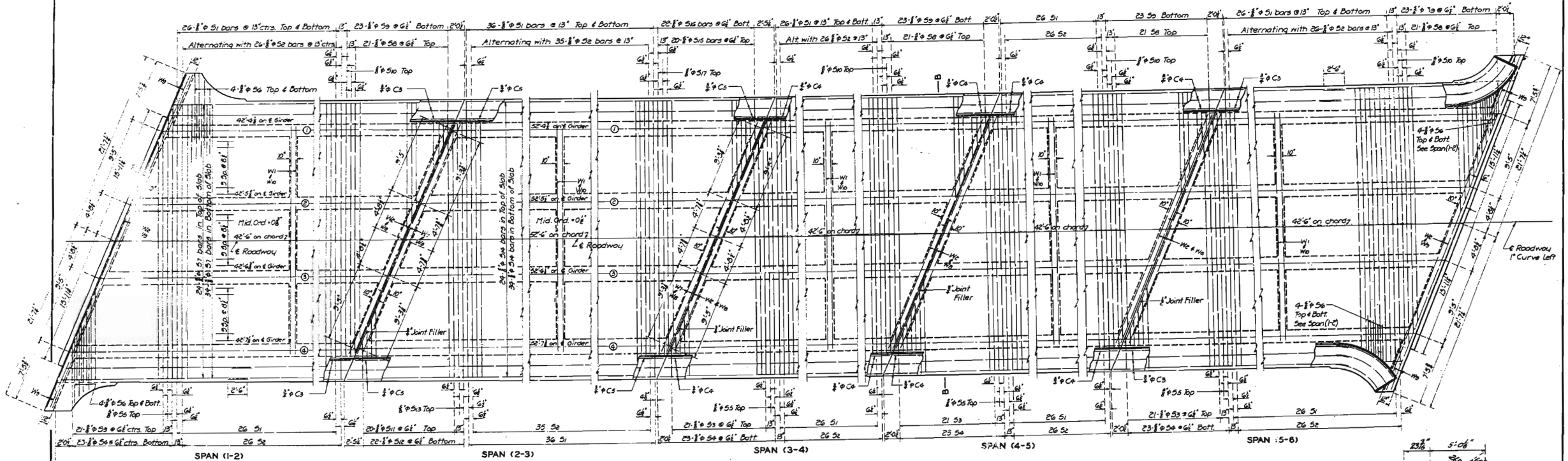
224

FINAL PLANS

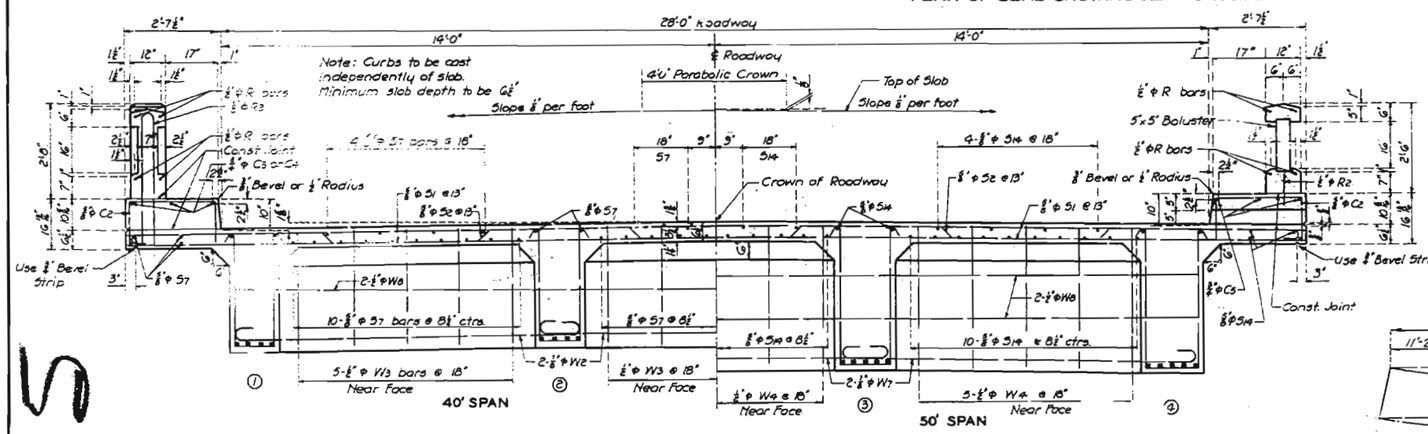
MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	FI-229(8) (US 40)	19	105	

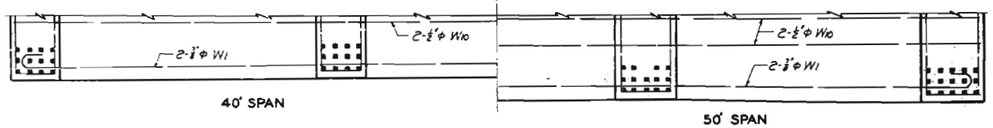
Note: Dimensions and reinforcement of 40' spans are identical except as shown.



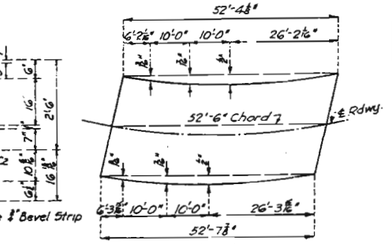
PLAN OF SLAB SHOWING REINFORCEMENT

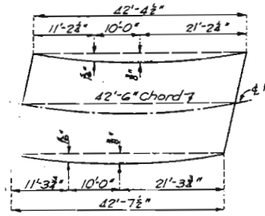


HALF SECTION NEAR INTERMEDIATE BENT

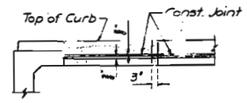


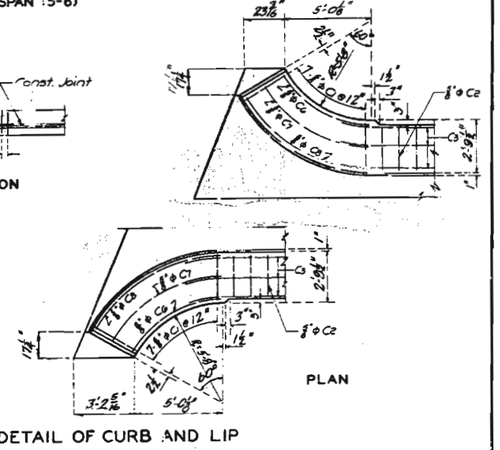
PART SECTION NEAR INTERMEDIATE WEB





CURB ORDINATES





DETAIL OF CURB AND LIP

BRIDGE OVER HINKSON CREEK

STATE ROAD FROM COLUMBIA TO KINGDOM CITY

ABOUT 2.5 MILES EAST OF COLUMBIA

PROJECT NO. FI-229(8) (U.S. 40) STA. 813+60

BOONE COUNTY

Drawn March 1949 by Z.E.W.
Traced March 1949 by Z.E.W.
Checked April 1949 by E.M.C.

Note: This drawing is not to scale, follow dimensions.

Sheet No. 4A of 5

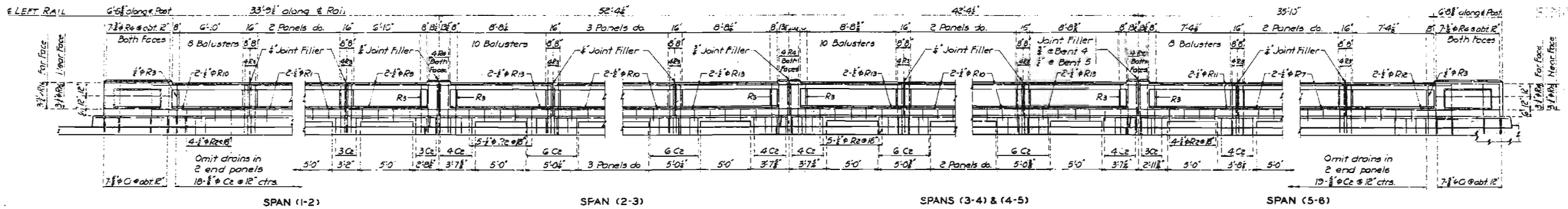
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CONSULTING ENGINEERS — KANSAS CITY, MO.

L-264

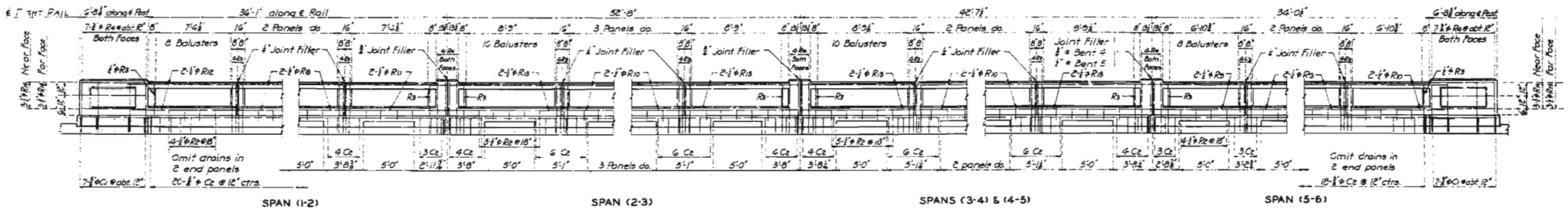
MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	FI-229(8) (U.S.40)	15	107	

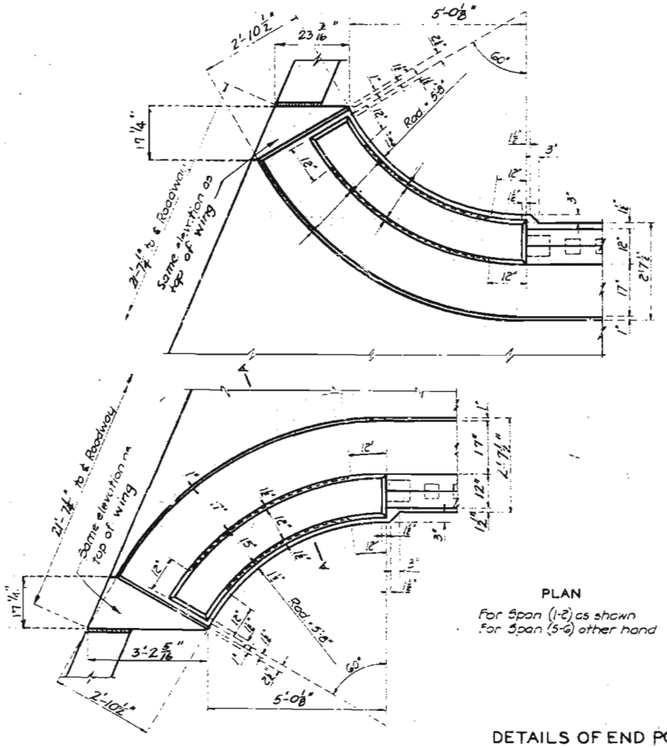
FINAL PLANS



ELEVATION OF LEFT HANDRAIL

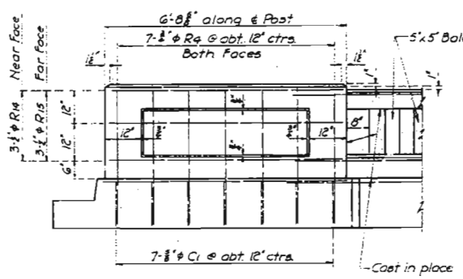


ELEVATION OF RIGHT HANDRAIL

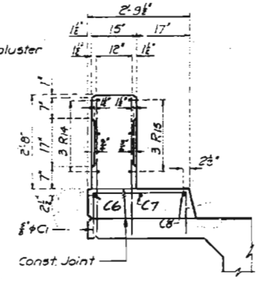


For Span (1-2) as shown
For Span (5-6) other hand

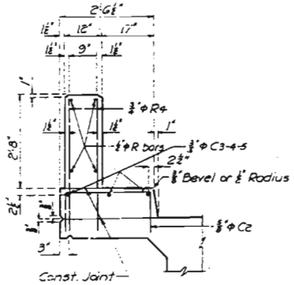
DETAILS OF END POSTS



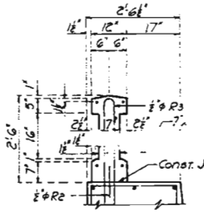
ELEVATION OF END POST



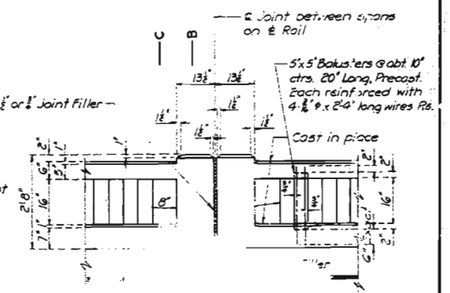
SECTION A-A

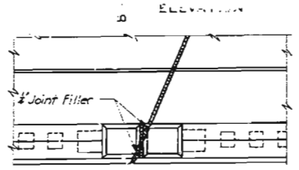


SECTION B-B



SECTION C-C





TYPICAL DETAILS OF HANDRAIL

Note: Vertical edges of posts and subposts and bottom of top rail to be beveled ⅛"
Balusters to be beveled ⅜"

GENERAL NOTES:

All concrete shall be Class 3
Tops of curbs, posts and rails to be built parallel to grade.
Posts, subposts and balusters to be vertical.

BRIDGE OVER HINKSON CREEK

STATE ROAD FROM COLUMBIA TO KINGDOM CITY

ABOUT 2.5 MILES EAST OF COLUMBIA

PROJECT NO. FI-229(8) (U.S. 40) STA. 813+60

BOONE COUNTY

Drawn March 1949 by Z.E.W.
Traced March 1949 by Z.E.W.
Checked April 1949 by F.N.C.

Note: This drawing is not to scale. Follow dimensions

Sheet No. 5A of 5

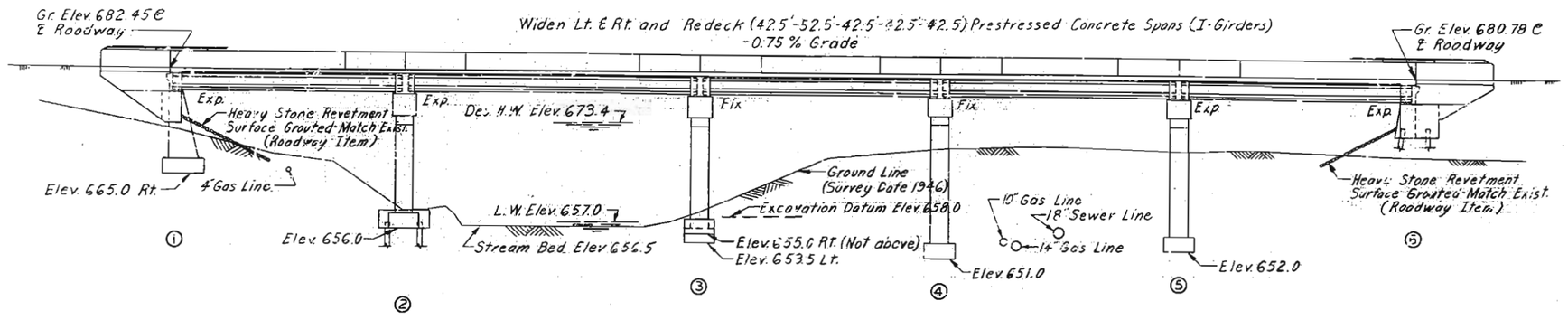
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L-264

226

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19	7	



GENERAL ELEVATION

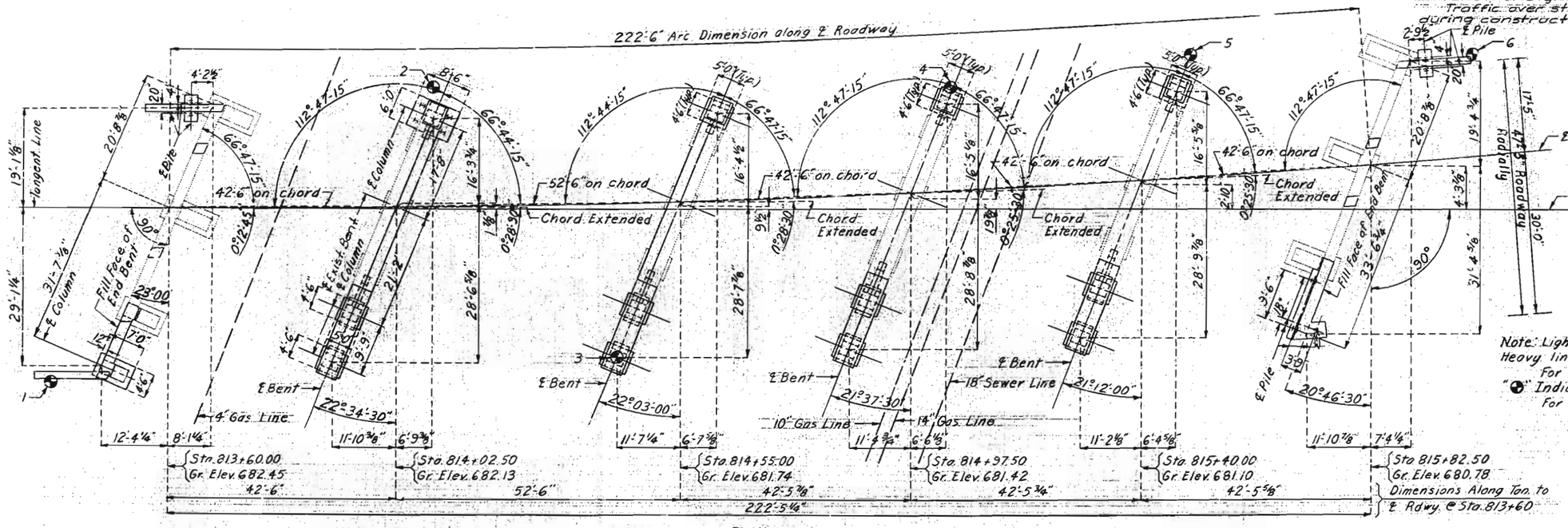
GENERAL NOTES:

Design Specifications: A.A.S.H.T.O. - 1973

Design Loading:
HS 20-44, No Future Wearing Surface
Modified 24,000# Tandem Axle
Earth 120#, Equivolent Fluid Pressure 30#
Superstructure: Simply supported non-composite for Dead Load. Continuous composite for Live Load.

Design Unit Stresses:
Class B Concrete (substructure) fc = 1,200 psi
Class B1 Concrete (superstructure except Prestressed Girders) fc = 1,600 psi
Reinforcing Steel (Grade 40) fs = 20,000 psi
Reinforcing Steel (Grade 60) (Superstructure, Slab and Safety Barrier Curb) fy = 60,000 psi
Steel Pile fb = 9,000 psi
For Pre-stressed Girder Stresses see Sheets No. 11 & 12.
Bearings shall be 60 durometer Neoprene Pads.
All joint filler shall meet the requirements of Std. Spec. 1057.2.4.

Reinforcing Steel:
Minimum clearance to reinforcing steel shall be 1½" unless otherwise shown.
Bridge seat areas for P/S Girders shall be given a smooth wood float finish. Finishing ⅛" above Plan Elevation and grinding will not be required.
Traffic over structure to be maintained during construction.



PLAN

Note: Light dotted lines indicate old work. Heavy lines indicate new work.
For Boring Data, see Sheet No. 3.
"●" Indicates location of boring.
For Estimated Quantities see Sheet No. 2.

Curve Data
P.I. = Sta. 819+36.31
Δ = 14° 25' Lt.
D = 1° 00'
T = 724.65'
L = 1441.67'
R = 5729.58'

Note: Bents cannot be accurately located from the reference point on the tangent by conventional survey methods based on 100' chords.

HYDRAULIC DATA		
Drainage Area	=	432 Sq. Miles
Des. Discharge	=	8240 cfs.
Des. H.W. Elev.	=	673.4
Frequency	=	50 years

PILE & FOOTING DATA

	BENT NO.	1	2	3	4	5	6WING	6BEAM
BEARING PILE	Pile Type and Size	HP10x42	HP10x42				HP10x42	HP10x42
	Number	2	4				2	3
	Approximate Length Ft.	11	11				19	19
	Design Bearing Tons.	10	22				10	30
	Hammer Energy req'd Ft.Lbs.	7000	7000				7000	7000
SPREAD FOOTINGS	Foundation Material	Rock	Rock	Rock	Rock	Rock		
	Design Bearing Tons/Sq. Ft.	4.0	4.5	Lt. 3.5 Rt. 4.5	Lt. 3.5 Rt. 5.0	Lt. 5.0 Rt. 5.0		

Note: Minimum energy requirement of hammer based on plan length and design bearing value of piles.
All pile shall be driven to practical refusal.

B.M. "2 Elev. 682.38 □ On N.W. Wingwall Bridge E.B.L. Rte. I-70 20' Lt. Sta. 813+68

BRIDGE OVER HINKSON CREEK
STATE ROAD: INTERSTATE ROUTE 70
IN COLUMBIA
PROJECT NO. I-70-3 (76) **STA.** 813+60
JOB NO. 5-I-116 **RTE.** I-70
BOONE **COUNTY**
DATE 5/26/76

STD.
STD. 706.35
L-264R

DESIGNED Dec 19 75
DETAILED Mar 1976
CHECKED Apr. 1976

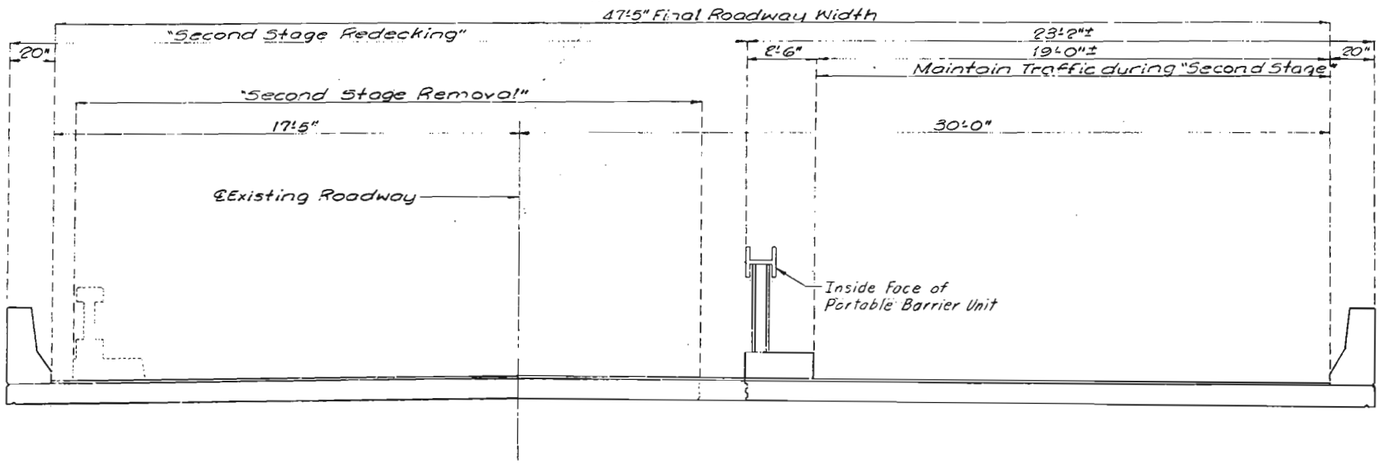
Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1 of 19.

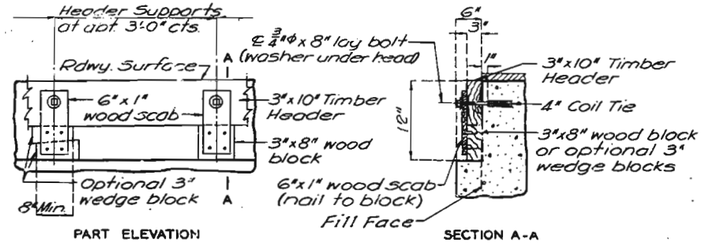
SEE FINAL PLANS

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19	8	



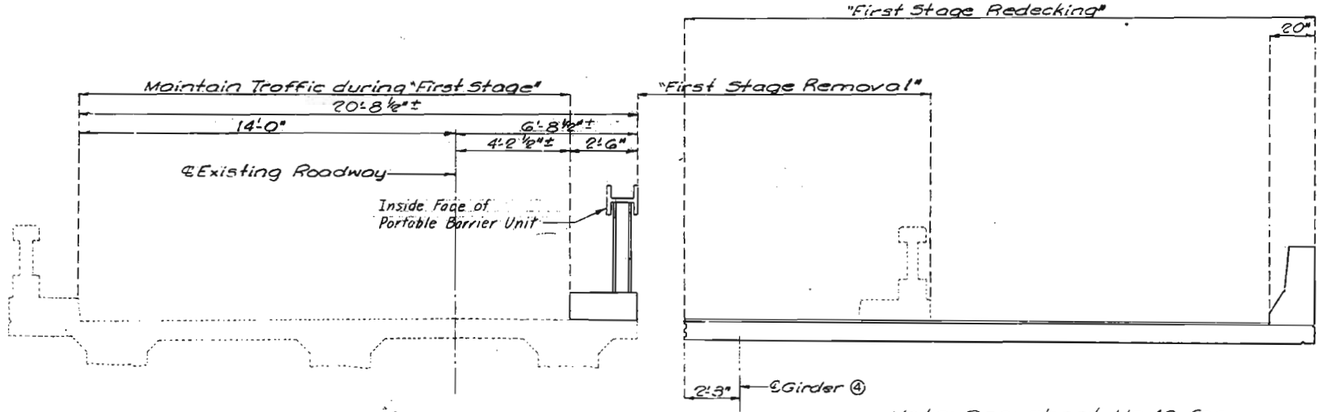
STAGE TWO CONSTRUCTION



PART ELEVATION — SECTION A-A

Note: Cost of timber headers complete in place to be included in price bid for concrete.

DETAILS OF TIMBER HEADER AT END BENTS



Note: See sheet No. 13 for details and reinforcement of proposed new bridge deck.

STAGE ONE CONSTRUCTION

PART SECTIONS SHOWING REMOVAL & CONSTRUCTION

ESTIMATED QUANTITIES				
ITEM		SUBSTR.	SUPERSTR.	TOTAL
Removal of Existing Bridge Deck	Sq. Ft.		7453	7453
Special Work	Lump Sum		1	1
Class I Excavation	Cu. Yd.	230		230
Asphalt Cement (Aspholtic Concrete)	Ton		7.3	7.3
Mineral Aggregate (Asphaltic Concrete)(Special Mix)	Ton		138	138
Structural Steel Pile (10")	Lin. Ft.	161		161
Class B Concrete	Cu. Yd.	201.5		201.5
Class B-1 Concrete	Cu. Yd.		454.0	454.0
Plain Neoprene Bearing Pads (1" thick)	Each		60	60
Prestressed Concrete Members, I Section, (42')	Each		24	24
Prestressed Concrete Members, I Section, (52')	Each		6	6
Reinforcing Steel	Lb.	15310		15310
Reinforcing Steel (Grade 60)	Lb.		102480	102480
Bridge Deck Waterproofing (Liquid)	Sq. Yd.		1174	1174
Bridge Rail (One Tube)	Lin. Ft.		490	490
Class 2 Excavation	Cu. Yd.	118		118
Prebore For Piling (Bt. No. 2)	Lin. Ft.	40		40

Note: All concrete and reinforcement in safety barrier curbs is included with superstructure quantities.
Cost of 3/4"Ø coil tie rods placed in diaphragms is included in price bid for P/S members.

SEE [illegible] PLANS

DETAILED APR. 1976
CHECKED APR 1976

Note: This drawing is not to scale. Follow dimensions.

BOONE COUNTY

L-264 R

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19	2	

Elev. 677.3
Clay and gravel.
Elev. 669.4
Limestone.
Elev. 667.3
Clay seam.
Elev. 665.6
Limestone.
Elev. 663.9
Limestone
① Limestone

Elev. 665.1
Brown silty clay.
Elev. 657.1
Brown sandy clay, wet.
Elev. 648.1
Limestone.
Elev. 647.8
Limestone
② Limestone

Elev. 659.2
Sand, gravel and boulders.
Elev. 655.8
Alternating layers of white chert and light brown limestone (cut with rock bit).
Elev. 652.2
Light gray fine grain limestone with large chert nodules.
Elev. 647.2
Limestone
③ Limestone

Elev. 666.7
Brown silty clay.
Elev. 656.1
Boulder and clay.
Elev. 652.1
Limestone.
Elev. 651.9
Limestone
④ Limestone

Standard Penetration Test

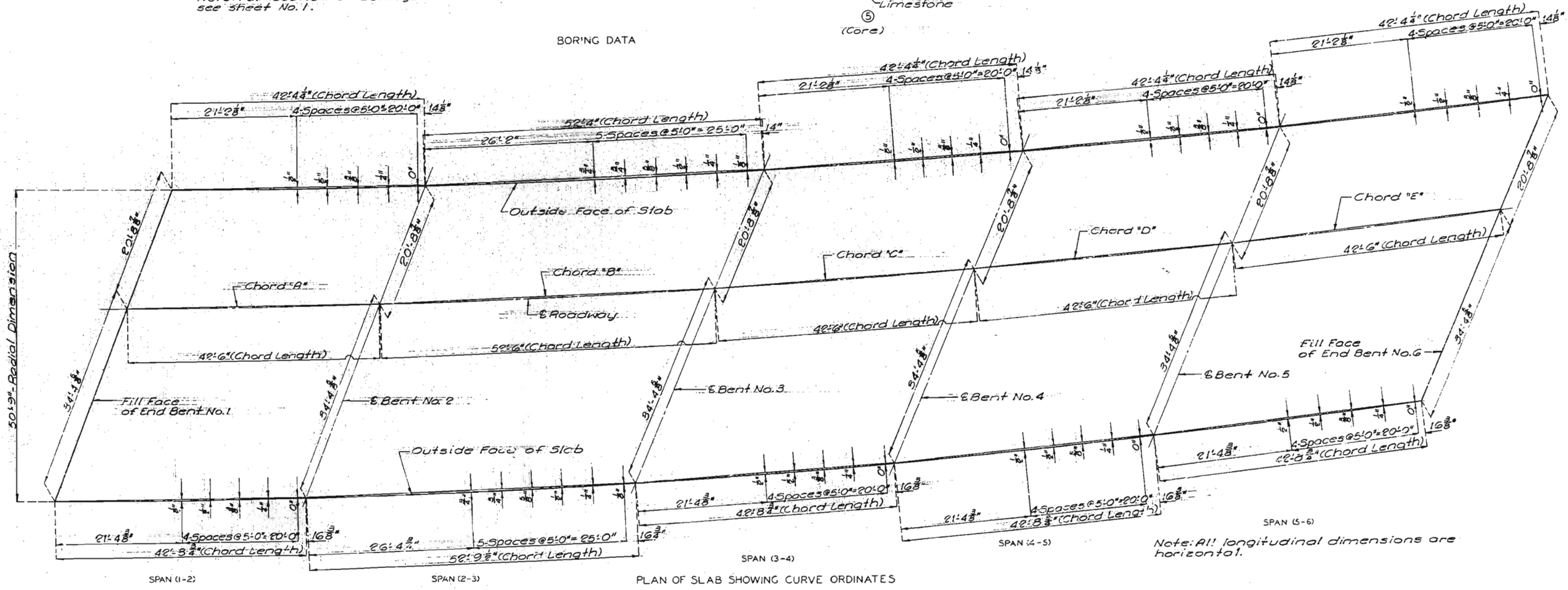
Depth	Blows/6"	RR (TSF)
15'	11/19/27	9+
20'	16/18/25	9+
25'	14/26/39	Lost Sample
30'	15/30/50	9+

Elev. 667.3
Brown silty and some sandy clay with an occasional boulder.
Elev. 656.3
Boulders and clay.
Elev. 654.1
Light gray shale, stiff, crumbly.
Elev. 643.5
Light greenish gray shale, stiff, crumbly.
Elev. 634.5
Limestone.
Elev. 629.4
Limestone
⑤ (Core)

Elev. 679.9
Brown silty clay (fill).
Elev. 667.9
Brown and dark gray, silty clay.
Elev. 656.9
Possible soft gray shale with boulders
Elev. 652.9
Gray shale, firm.
Elev. 644.3
Gray shale, hard.
Elev. 640.9
Shale
⑥

Note: For location of borings see sheet No. 1.

BORING DATA



PLAN OF SLAB SHOWING CURVE ORDINATES

Note: All longitudinal dimensions are horizontal.

DETAILED NOV. 19 75
CHECKED APR. 19 76

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 3 of 19.

BOONE COUNTY

L-264 R

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19	10	

SECTION J-J

PART SECTION K-K

ELEVATION

SECTION E-E

PART ELEVATION A-A

PART ELEVATION H-H

PART SECTION C-C

DETAIL OF STEEL PILE SPLICE

PART PLAN OF PROPOSED BEAM

PLAN

PART PLAN AT END OF EXISTING BEAM DETAIL "A" SHOWING LOCATION OF BENT ANCHORS

PART SECTION F-F

ELEVATION B-B

ELEVATION G-G

DETAIL "A"

PLAN OF FOOTING SHOWING REINFORCEMENT

SECTION D-D

DETAILS OF END BENT NO. 1

SEE FINAL PLANS

DETAILED APR. 1976

CHECKED APR. 1976

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 4 of 19.

BOONE COUNTY

L-264 R

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19	11	

ELEVATION A-A

SECTION B-B

SECTION C-C

SECTION D-D

ELEVATION E-E

Note: Light dotted lines indicate old work. Heavy lines indicate new work.

PART SECTION F-F

PART SECTION G-G

DETAIL OF BENT ANCHOR BOLTS

DETAIL OF HOOKED ANCHOR BOLTS

Note: Anchors shall be of the self drilling expansion type, made of casehardened and drawn carburized steel, with self-cutting annular broaching grooves.
Cost of furnishing and installing anchor bolt assemblies shall be included in price bid for concrete.

ELEVATION

PLAN OF LEFT FOOTING
(SHOWING PILE SPACING & REINFORCEMENT)

PLAN

DETAILS OF INT. BENT NO. 2

SEE FINAL PLANS

DETAILED Mar 19 76
CHECKED Apr. 19 76

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 5 of 19.

BOONE **COUNTY**

L-264R

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19	12	

ELEVATION A-A

SECTION B-B

ELEVATION

SECTION C-C

SECTION D-D

ELEVATION E-E

PART SECTION G-G

PART SECTION F-F

PLAN

DETAILS OF INT. BENT NO. 3

Note: Light dotted lines indicate old work. Heavy lines indicate new work. See sheet No. 5 for "Detail of Hooked Anchor Bolts."

DETAILED Mar. 1976

CHECKED Apr. 1976

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 6 of 19.

BOONE **COUNTY**

L-264 R

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. A'D PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19	13	

ELEVATION A-A

SECTION B-B

ELEVATION

SECTION C-C

SECTION D-D

SECTION E-E

PART SECTION G-G

PART SECTION F-F

PLAN

DETAILS OF INT. BENT NO. 4

Note: Light dotted lines indicate old work.
Heavy lines indicate new work.
See sheet No. 5 for "Details of Hooked Anchor Bolts."

DETAILED Feb 1976
CHECKED A.R. 1976

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 7 of 19.

SEE FINAL PLANS

BOONE **COUNTY**

L-264R

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		13	14	

ELEVATION A-A

SECTION B-B

ELEVATION

SECTION C-C

SECTION D-D

SECTION F-F

ELEVATION G-G

SECTION E-E

PLAN

DETAILS OF INT. BENT NO. 5

Note: Light dotted lines indicate old work.
Heavy lines indicate new work.
See sheet No. 5 for Details of Hooked Anchor Bolts.

DETAILED March, 1976
CHECKED Apr. 1976

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 8 of 19.

SEE FINAL PLANS

BOONE COUNTY

L-264R

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19	15	

Note: Bars bonded in old concrete not removed shall be cleanly stripped and embedded into new concrete where possible. If length is available, old bars shall extend into new concrete at least 40 diameters for smooth bars and 30 diameters for deformed bars.

Barrier Curbs on wings shall not be poured until slab has been poured in adjacent span.

Light dotted lines indicate old work, heavy lines indicate new work.

See sheet No. 4 for "Plan of Footing Showing Reinforcement" for wing pile footing.

ELEVATION

SECTION G-G

SECTION F-F

ELEVATION B-B

SECTION D-D

PART PLAN OF PROPOSED BEAM

PLAN

PART SECTION E-E

ELEVATION A-A

SECTION C-C

See sheet No. 4 for "Details Showing Location of Bent Anchors"

DETAILS OF END BENT NO. 6

DETAILED Mar. 1976

CHECKED Apr. 1976

Note: This drawing is not to scale. Follow dimensions.

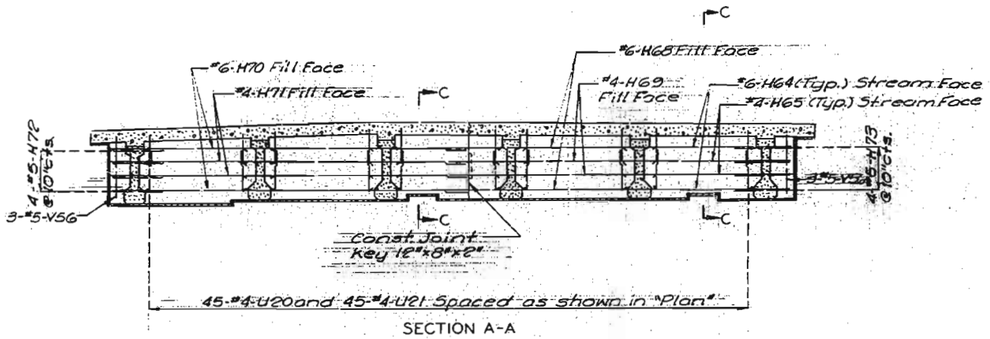
Sheet No. 9 of 19.

BOONE COUNTY

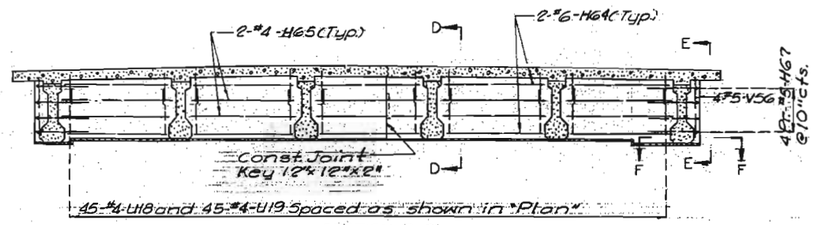
L-264 R

MISSOURI STATE HIGHWAY DEPARTMENT

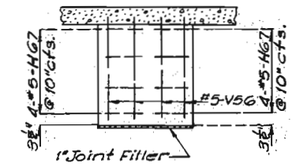
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19	16	



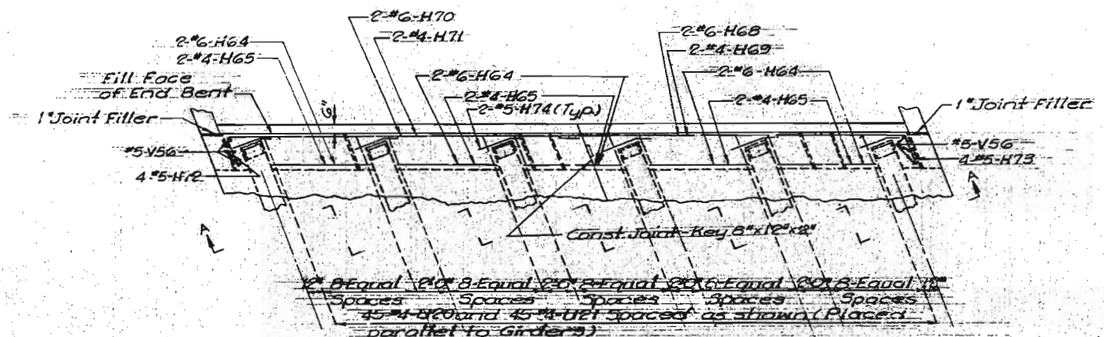
SECTION A-A



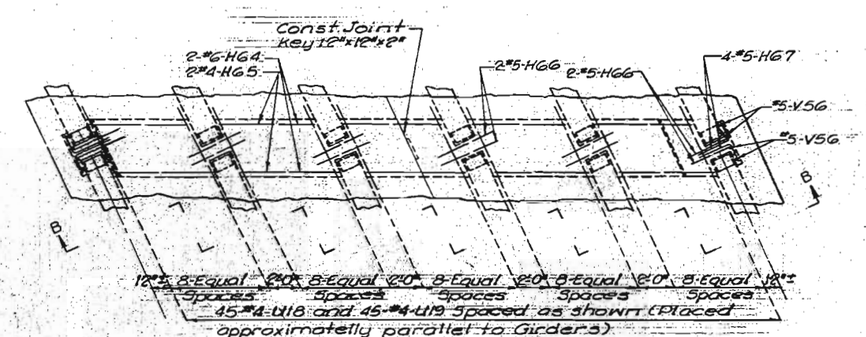
SECTION B-B



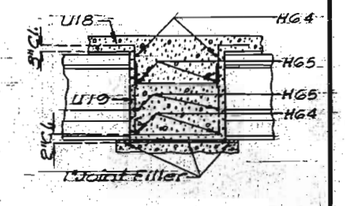
ELEVATION E-E



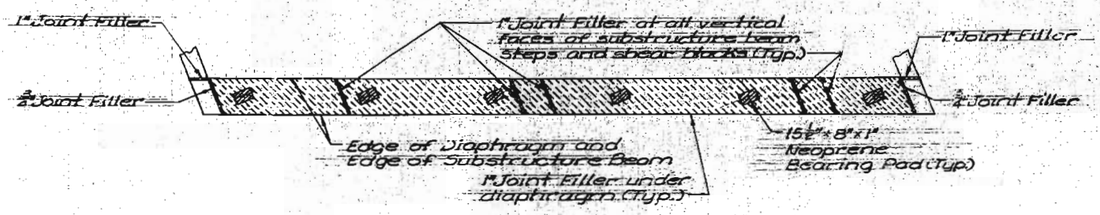
PLAN



PLAN



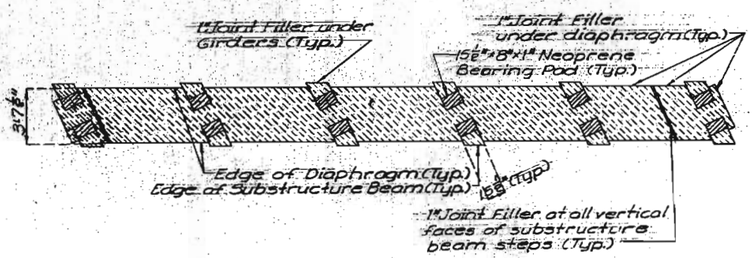
SECTION D-D



PLAN OF JOINT FILLER

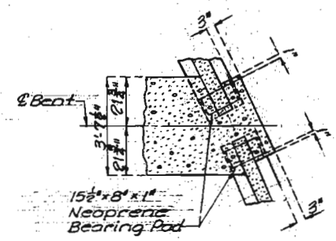
END BENTS

(BENT NO.1 SHOWN BENT NO.6 SIMILAR)



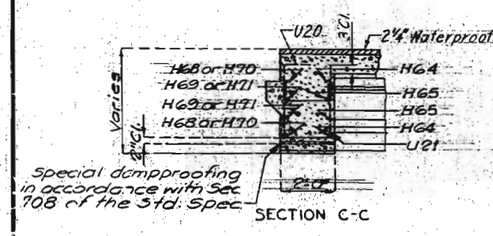
PLAN OF JOINT FILLER

INTERMEDIATE BENTS

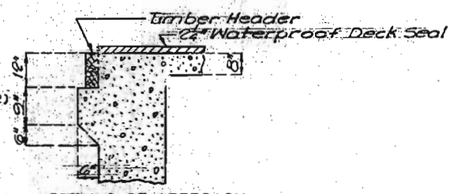


SECTION F-F

Note: Details and reinforcement shown are typical for all similar locations at all intermediate bents.



SECTION C-C



DETAILS OF APPROACH HAUNCH AT END BENTS

DETAILS OF END DIAPHRAGMS

DETAILED APR. 1976

CHECKED APR. 1976

Note: This drawing is not to scale. Follow dimensions.

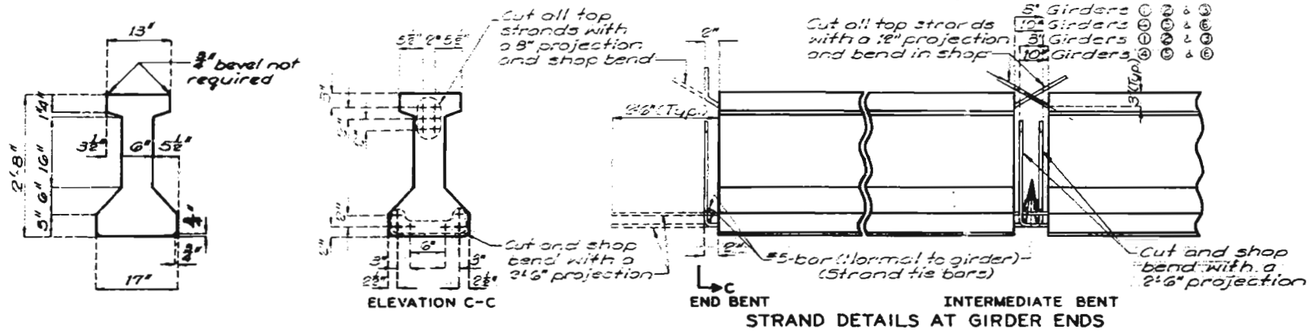
Sheet No. 10 of 19.

BOONE **COUNTY**

L-264 R

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19	17	



STRAND DETAILS AT GIRDER ENDS

GENERAL NOTES–PRESTRESSED GIRDERS:

Concrete for prestressed girders shall be Class AI with f'c=5,000 psi. Minimum compressive strength at transfer shall be 4,000 psi.

Prestressing tendons shall be high-tensile strength uncoated seven (7)-wire stress relieved strands for prestressed concrete conforming to A.S.T.M. A-416 except that nominal diameter of strand= ½"; nominal area= 0.153 sq. in. and minimum ultimate strength= 41,300 lbs. (270 Ksi).

(+) Indicates prestressed strand.

The method and sequence of releasing the strands shall be shown on the shop drawings.

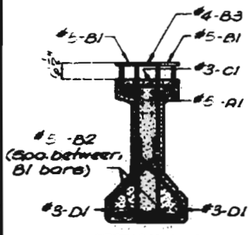
Use 12 strands with an initial prestress force of 347 Kips.

The portions of girders to be embedded in the diaphragms at supports shall be roughened by sandblasting or other approved methods to provide suitable bond between girder and diaphragm.

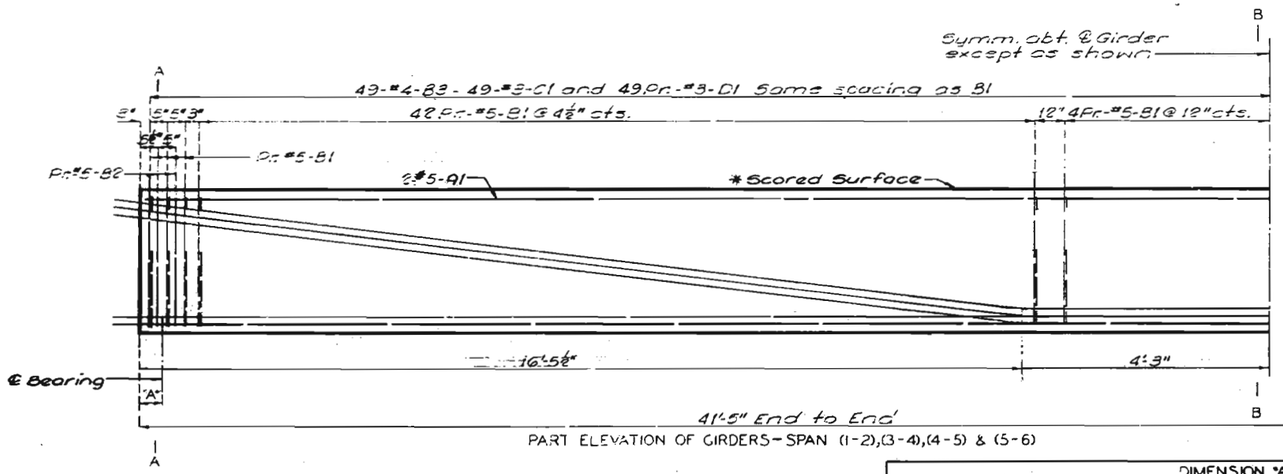
Coil ties shall be held in place in the forms by slotted-wire-setting-studs projecting thru forms. Studs are to be left in place, or replaced with plastic plugs, until girders are erected and then replaced by coil tie rods.

Coil ties shall have a concrete pull-out strength of 8,000 lbs. in 3,000 psi concrete and an ultimate tensile strength of 18,000 lbs. for the coil tie material.

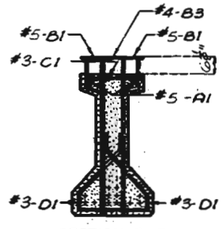
* Smooth finish a 3" wide strip at each end and at ¼ points across top flange, to accurate top flange depth, for use in measuring camber.



SECTION A-A



PART ELEVATION OF GIRDERS–SPAN (1-2),(3-4),(4-5) & (5-6)



SECTION B-B

BILL OF REINFORCING STEEL–EACH GIRDER

NO.	SIZE & MARK	LENGTH	SHAPE	BENDING DIAGRAMS
2	5A1	41-2	20	
134	5B1	3'-6"	19S	
8	5B2	3'-2"	9S	
97	4B3	2'-11"	50S	
97	3C1	13"	10	
194	3D1	2'-9"	9S	

SHAPE 10 · SHAPE 9S · SHAPE 50S · SHAPE 19S · SHAPE 20

NOTE: ALL DIMENSIONS ARE OUT TO OUT.

WHERE DEFLECTING STRANDS INTERFERE WITH PLACEMENT, SOME IN-PLACE BENDING MAY BE NECESSARY.

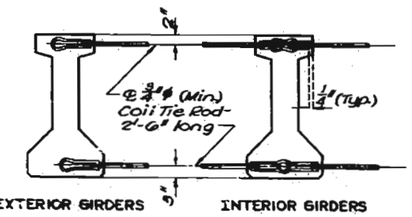
HOOKS AND BENDS SHALL BE IN ACCORDANCE WITH THE CRSI MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES.

THE LETTER S AFTER THE SHAPE NUMBER, IN BENDING SKETCHES, INDICATES BARS THAT ARE TO BE BENT ACCORDING TO CRSI STIRRUP AND TIE DIMENSIONS.

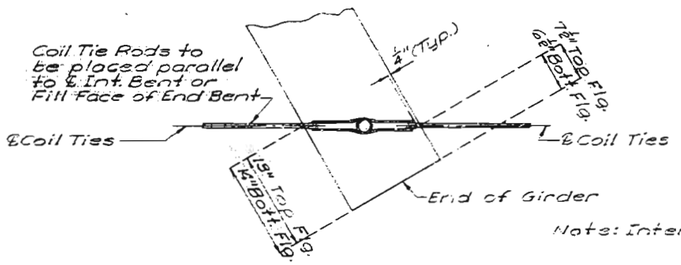
LENGTH - TOTAL LENGTHS ARE MEASURED ALONG CENTERLINE BAR TO THE NEAREST INCH.

MINIMUM CLEARANCE TO REINFORCING SHALL BE 1".

DIMENSION "A"								
GIRDER NO.	SPAN (1-2)		SPAN (3-4)		SPAN (4-5)		SPAN (5-6)	
	BT. NO. 1	BT. NO. 2	BT. NO. 3	BT. NO. 4	BT. NO. 4	BT. NO. 5	BT. NO. 5	BT. NO. 6
①	5"	9 3/4"	7 3/8"	7 3/8"	7 3/8"	7 3/8"	9 3/4"	5"
②	5"	8 7/8"	7"	6 7/8"	7"	6 7/8"	8 7/8"	5"
③	5"	7 7/8"	6 1/2"	6 3/8"	6 1/2"	6 3/8"	7 7/8"	5"
④	5"	7"	6"	6"	6"	6"	7"	5"
⑤	5"	6"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	6"	5"
⑥	5"	5"	5"	5"	5"	5"	5"	5"

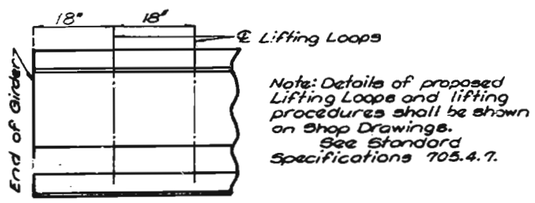


DETAILS OF COIL TIES



Note: Interior girder shown.

PLAN OF COIL TIES



Note: Details of proposed Lifting Loops and lifting procedures shall be shown on Shop Drawings. See Standard Specifications 705.4.7.

LOCATION OF LIFTING LOOPS

STD. 55.2.6 | APRIL 1973 | REVISED SEPT. 1975

2661

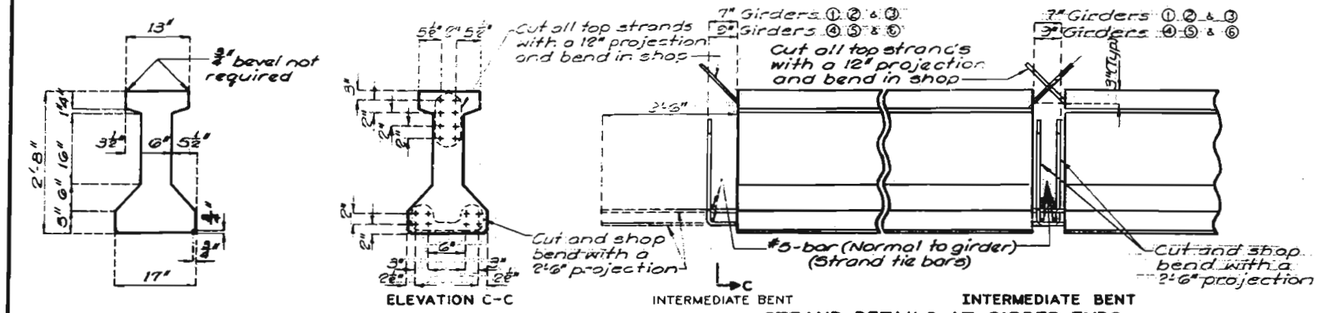
DETAILED APR. 1976
CHECKED APR. 1976

Note: This drawing is not to scale. Follow dimensions.

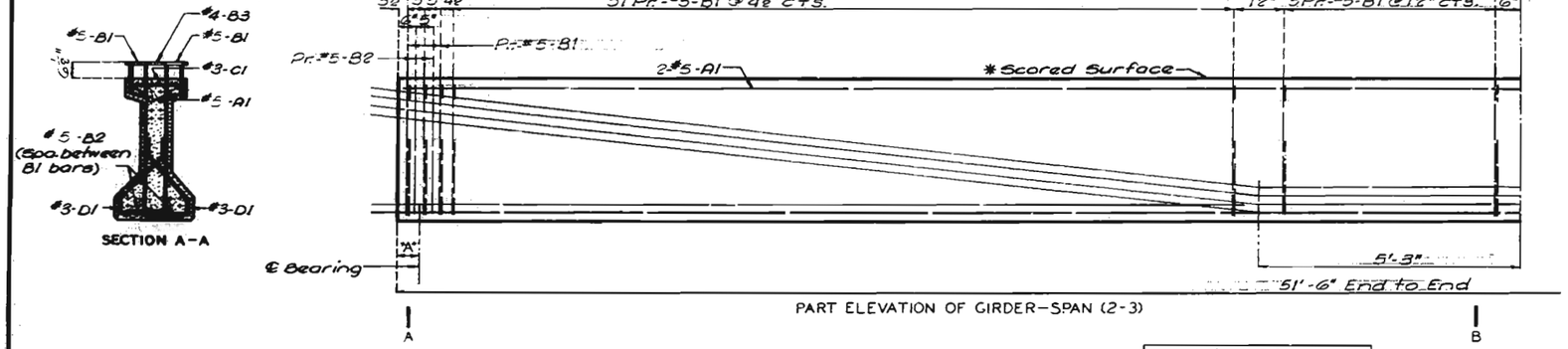
BOONE COUNTY L-264 R

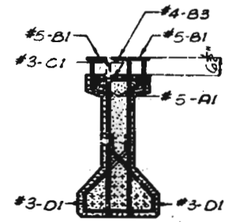
MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		13	18	



STRAND DETAILS AT GIRDER ENDS





DIMENSION "A"		
GIRDER NO	SPAN (2-3)	
	BT. NO. 2	BT. NO. 3
①	8 1/8"	8 1/8"
②	7 1/2"	7 1/2"
③	7"	6 7/8"
④	6 3/8"	6 3/8"
⑤	5 3/4"	5 3/4"
⑥	5 1/4"	5 1/8"

GENERAL NOTES-PRESTRESSED GIRDERS:

Concrete for prestressed girders shall be Class A1 with f'c=5,000 psi. Minimum compressive strength at transfer shall be 4,000 psi.

Prestressing tendons shall be high-tensile strength uncoated seven (7)-wire stress relieved strands for prestressed concrete conforming to A.S.T.M. A-416 except that nominal diameter of strands = ½"; nominal area = 0.153 sq. in. and minimum ultimate strength = 41,300 lbs. (270 Ksi)

(+) Indicates prestressed strand.

The method and sequence of releasing the strands shall be shown on the shop drawings.

Use 16 strands with an initial prestress force of 463 Kips.

The portions of girders to be embedded in the diaphragms at supports shall be roughened by sandblasting or other approved methods to provide suitable bond between girder and diaphragm.

Coil ties shall be held in place in the forms by slotted-wire-setting-studs projecting thru forms. Studs are to be left in place or replaced with plastic plugs, until girders are erected and then replaced by coil tie rods.

Coil ties shall have a concrete pull-out strength of 8,000 lbs. in 3,000 psi concrete and an ultimate tensile strength of 18,000 lbs. for the coil tie material.

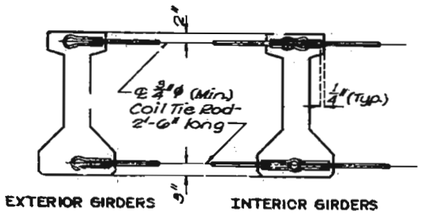
* Smooth finish a 3" wide strip at each end and at ¼ points across top flange, to accurate top flange depth, for use in measuring camber.

BILL OF REINFORCING STEEL-EACH GIRDER

NO.	SIZE & MARK	LENGTH	SHAPE	BENDING DIAGRAMS
2	5A1	51'-3"	20	
236	5B1	3'-6"	19S	
8	5B2	3'-2"	19S	
118	4B3	2'-11"	50S	
118	3C1	13"	10	
236	3D1	2'-9"	9S	

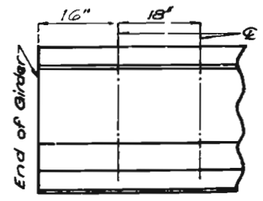
SHAPE 9S · SHAPE 10 · SHAPE 19S · SHAPE 20 · SHAPE 50S

NOTE: ALL DIMENSIONS ARE OUT TO OUT.
WHERE DEFLECTING STRANDS INTERFERE WITH PLACEMENT, SOME IN-PLACE BENDING MAY BE NECESSARY.
HOOKS AND BENDS SHALL BE IN ACCORDANCE WITH THE CRSI MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES.
THE LETTER S AFTER THE SHAPE NUMBER, IN BENDING SKETCHES, INDICATES BARS THAT ARE TO BE BENT ACCORDING TO CRSI STIRRUP AND TIE DIMENSIONS.
LENGTH - TOTAL LENGTHS ARE MEASURED ALONG CENTERLINE BAR TO THE NEAREST INCH.
MINIMUM CLEARANCE TO REINFORCING SHALL BE 1".



DETAILS OF COIL TIES

Note: See Sheet No. 11 for "Plan of Coil Ties".



Note: Details of proposed Lifting Loops and lifting procedures shall be shown on Shop Drawings. See Standard Specifications 705.4.7.

LOCATION OF LIFTING LOOPS

STD. 55.2.6 REVISED APRIL 1973 SEPT. 1975

DETAILED APR. 1976
CHECKED APR. 1976

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 12 of 19.

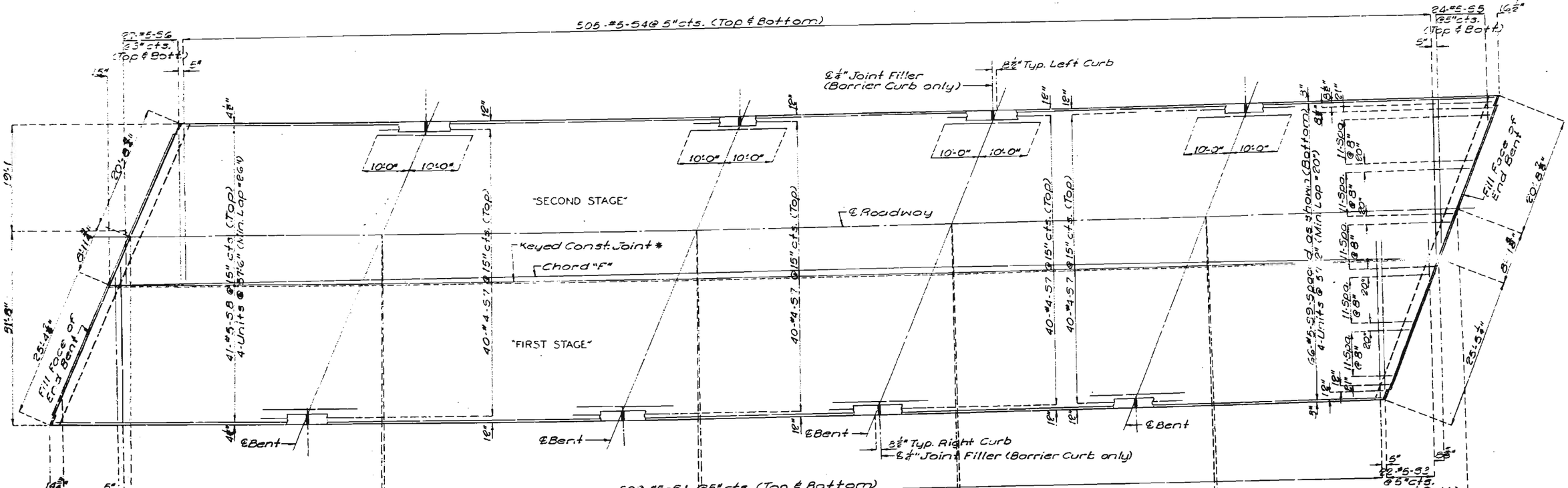
BOONE COUNTY L-264 R

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19	13	

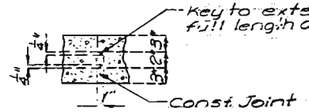
Note: All transverse reinforcing steel in the slab is spaced along and normal to Chord "F". Longitudinal reinforcing steel in the slab may be adjusted in the field to maintain a minimum clearance of 1½" at the longitudinal construction joint.

Note: Slab to be built parallel to grade and to a minimum thickness of 8". Slab haunches to be adjusted for any difference in girder camber from that shown in Camber Diagram. Concrete in the slab haunches is included in the Estimated Quantities as Class B1 Concrete.



SLAB POURING NOTE:
The contractor shall furnish an approved retarder to retard the set of concrete to 2.5 hours and shall pour and satisfactorily finish the slab pours at a rate of not less than 32 cubic yards per hour. Machine finishing as specified in section 703.3.14 will not be required.

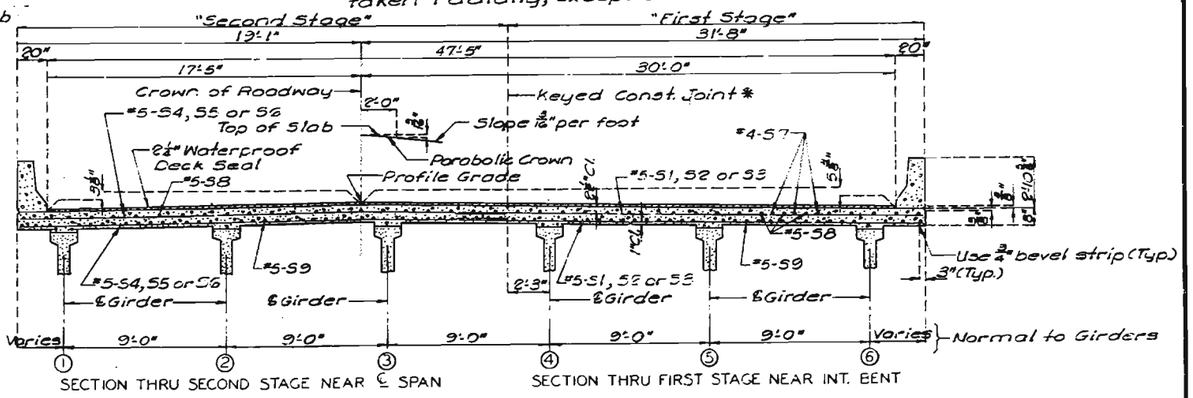
PLAN OF SLAB SHOWING REINFORCEMENT

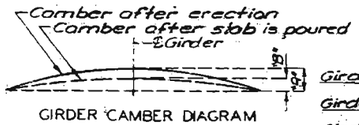


DETAIL OF LONGITUDINAL KEYED CONST. JOINT

Note: The diaphragm of the intermediate bents shall be poured a minimum of 30 minutes and a maximum of 2 hours before the slab is poured.

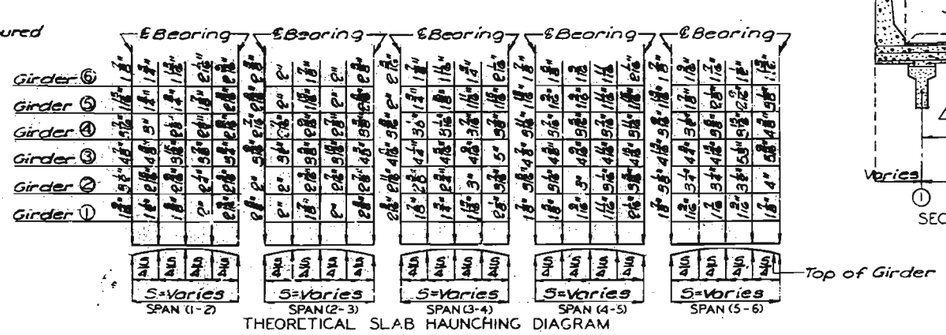
Note: Longitudinal dimensions shown are horizontal dimensions. Transverse dimensions shown are horizontal dimensions taken radially, except as shown.





GIRDER CAMBER DIAGRAM

	"A"	"B"
SPANS (1-2) (3-4) (4-5) (5-6)	3/16"	Girders ① & ⑥ 7/16"
		Girders ② & ⑤ 5/16"
		Girders ③ & ④ 3/16"
SPAN (2-3)	1 3/16"	Girders ① & ⑥ 1/16"
		Girders ② & ⑤ 1/16"
		Girders ③ & ④ 5/16"



THEORETICAL SLAB HAUNCHING DIAGRAM

*Longitudinal Keyed Const. Joint may be built along chords parallel to Girder No. 4 at dimension shown.

DETAILED Feb. 1976
CHECKED Apr. 1976

Note: This drawing is not to scale. Follow dimensions.

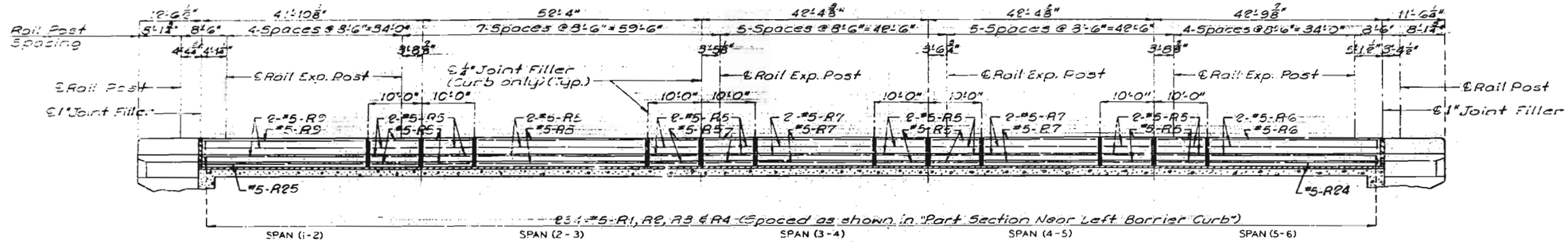
Sheet No. 13 of 19.

BOONE **COUNTY**

L-264 R

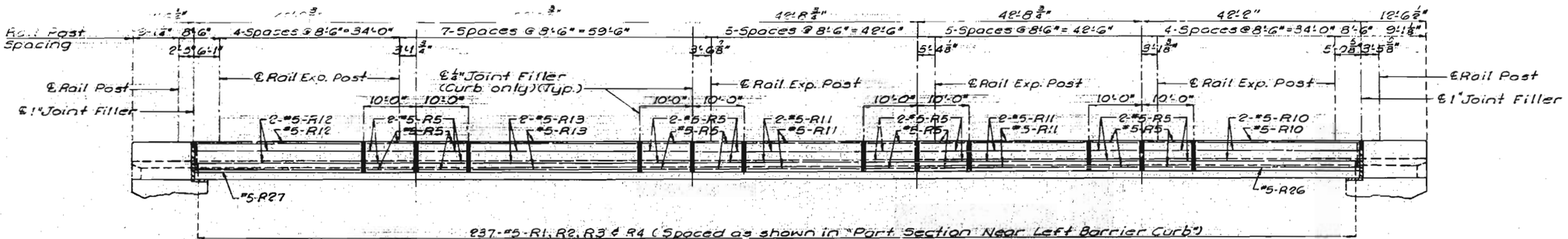
MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19	20	

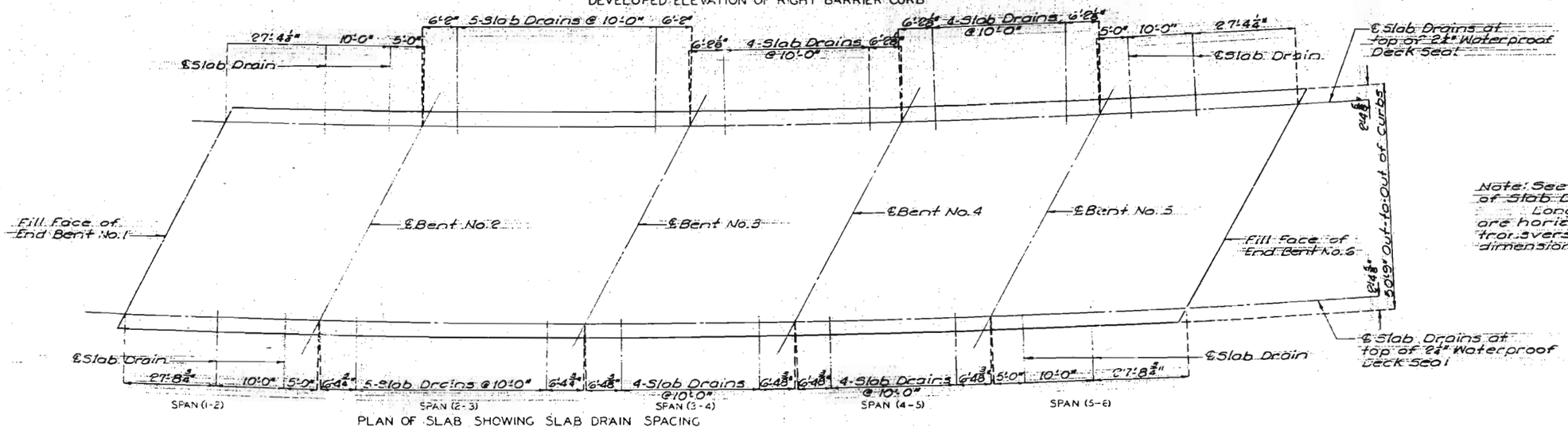


DEVELOPED SECTION NEAR LEFT BARRIER CURB

Note: Longitudinal dimensions are arc dimensions along centerline of top of barrier curb parallel to grade. See sheet No. 15 for Part Section Near Left Barrier Curb.



DEVELOPED ELEVATION OF RIGHT BARRIER CURB



PLAN OF SLAB SHOWING SLAB DRAIN SPACING

Note: See sheet No. 16 for Details of Slab Drains.
Longitudinal dimensions shown are horizontal arc dimensions. Transverse dimensions are horizontal dimensions taken radially.

DETAILED APR. 1976
CHECKED APR. 1976

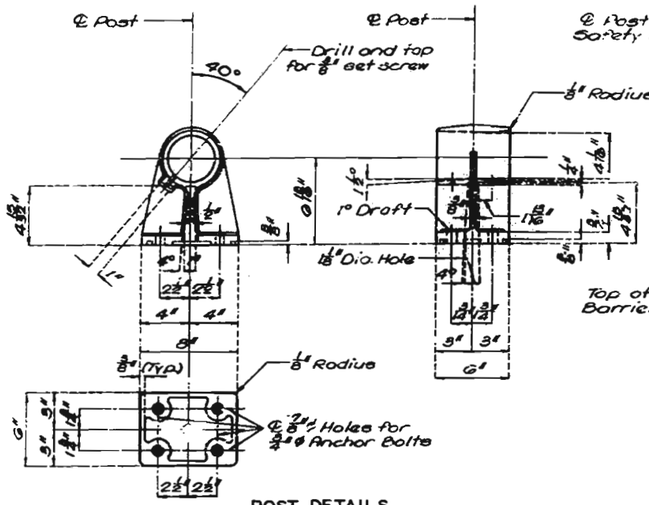
Note: This drawing is not to scale. Follow dimensions.

BOONE COUNTY

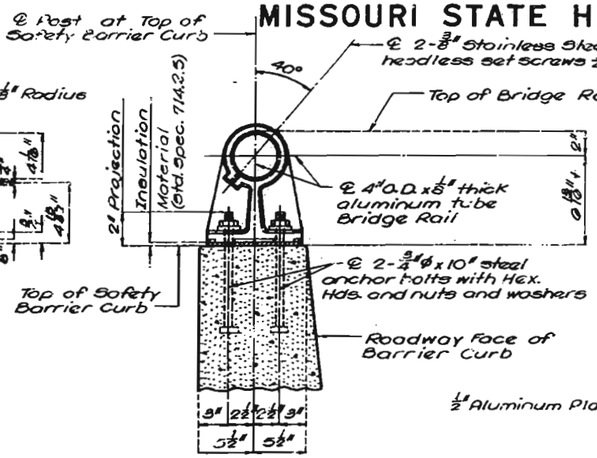
L-264 R

MISSOURI STATE HIGHWAY DEPARTMENT

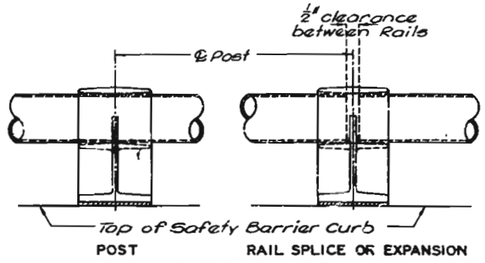
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		75	21	



POST DETAILS



SECTION THRU BRIDGE RAIL



TYPICAL BRIDGE RAIL DETAILS

GENERAL BRIDGE RAIL NOTES:

ALL BRIDGE RAIL POSTS SHALL BE SET NORMAL TO GRADE.

ALUMINUM TUBE BRIDGE RAIL SHALL BE BENT TO CONFORM TO VERTICAL AND HORIZONTAL ALIGNMENT OF BARRIER CURB.

ALUMINUM WASHER SHIMS BETWEEN TOP OF BARRIER CURB AND POST BASE MAY BE USED FOR ADJUSTING BRIDGE RAIL ALIGNMENT. MAXIMUM THICKNESS OF SHIMS TO BE 1/8". WHERE MORE TILTING OF POST IS REQUIRED FOR PROPER ALIGNMENT, CONCRETE BEARING AREAS SHALL BE GROUND DOWN.

ALL PARTS OF BRIDGE RAIL, EXCEPT ANCHOR BOLTS, NUTS, WASHERS, AND SET SCREWS ARE TO BE OF ALUMINUM MATERIAL.

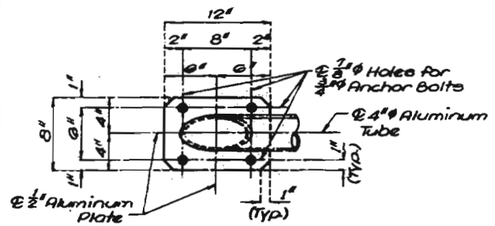
ALL FILLETS 1/4" EXCEPT AS NOTED.

ALL DRAFTS 3° EXCEPT AS NOTED.

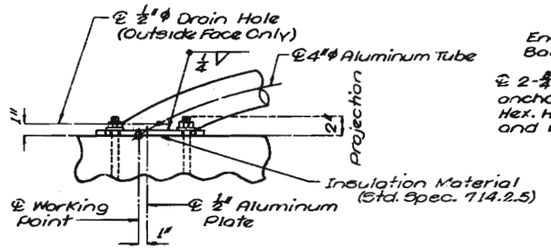
OMIT SET SCREW IN SIDE OF RAIL POST ADJACENT TO FILLED JOINTS IN BARRIER CURB AT RAIL EXPANSION POINTS.

TOP OF BARRIER CURB TO BE BUILT PARALLEL TO GRADE WITH BARRIER CURB JOINTS (EXCEPT AT END BENTS) NORMAL TO GRADE.

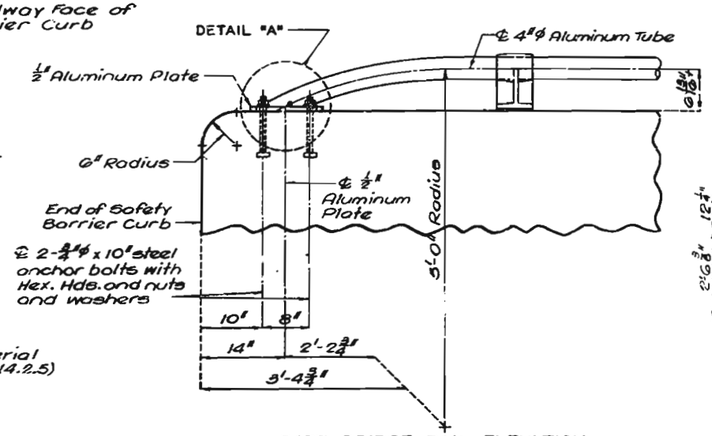
ALL EXPOSED EDGES OF BARRIER CURB SHALL HAVE 1/2" RADIUS OR 3/8" BEVEL UNLESS OTHERWISE NOTED



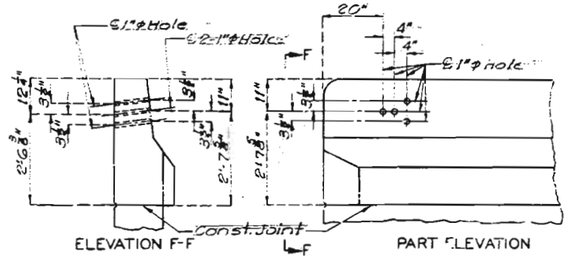
RAIL PLATE DETAILS



DETAIL "A"

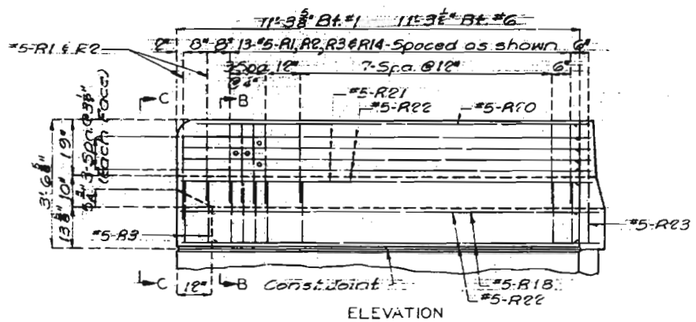


PART BRIDGE RAIL ELEVATION

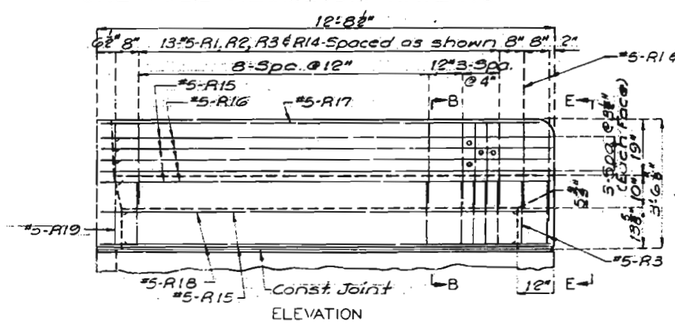


DETAILS OF GUARD RAIL ATTACHMENT

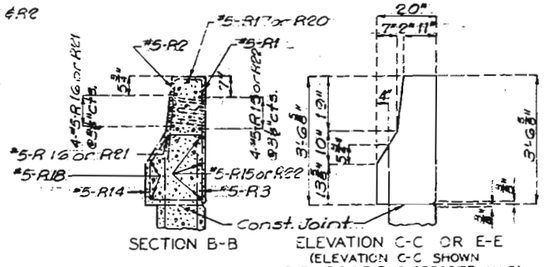
ONE TUBE ALUMINUM RAILING

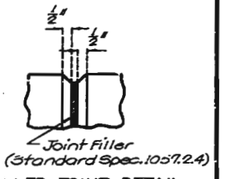


ELEVATION

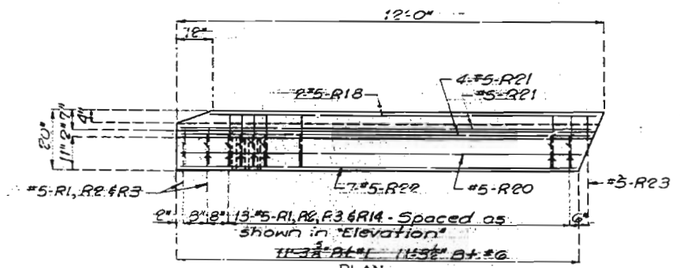


ELEVATION

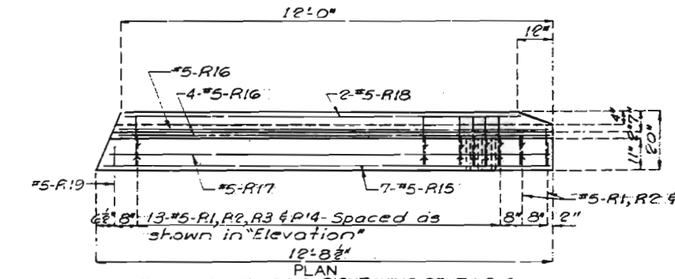




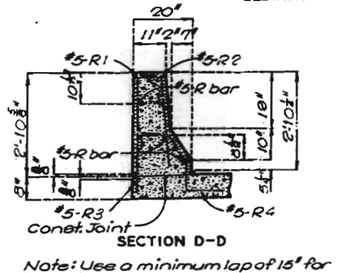
FILLED JOINT DETAIL



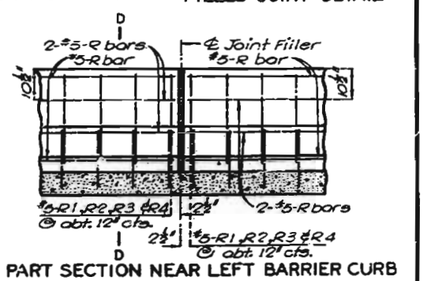
PLAN
RIGHT WING BENT NO. 1 & LEFT WING BENT NO. 6
(BENT NO 1 SHOWN)



PLAN
LEFT WING BENT NO. 1 & RIGHT WING BENT NO. 6
(BENT NO 1 SHOWN)



Note: Use a minimum lap of 15" for #5 horizontal barrier curb bars.



PART SECTION NEAR LEFT BARRIER CURB

DETAILS OF BARRIER CURB AT END BENT WINGS

Note: This drawing is not to scale. Follow dimensions.

STD. 1.7.1	REVISED
NOV. 1974	NOV. 1975

DETAILED March 1976
CHECKED Apr. 1976

Sheet No. 15 of 19.

BOONE **COUNTY** L-264R

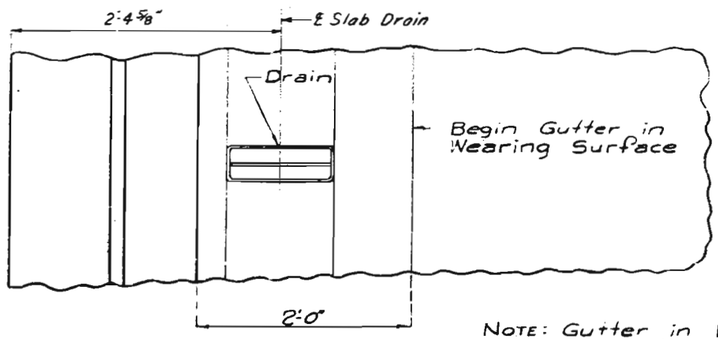
MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19	22	

DRAIN NOTES

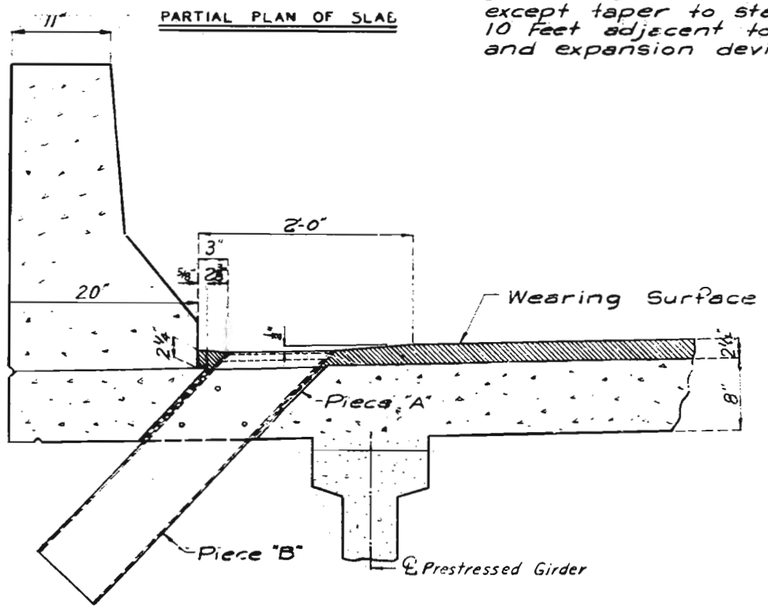
Slab Drains may be fabricated of either ¼" Welded Sheets of A.S.T.M. A36 Steel or from ¼" Structural Steel Tubing A.S.T.M. A501.

Outside dimensions of Drains are, Piece "A" 8¾"x4¾", Piece "B" 8" x 4".
Piece "A" shall be cast in the Concrete. Prior to placement of Wearing Surface, Piece "B" shall be inserted in Piece "A".
Locate Piece "A" in slab by dimensions shown in Partial Elevation.
Shift Reinforcing Steel in field where necessary to clear drains.
Pieces "A" and "B" shall be Galvanized in accordance with A.S.T.M. A123.
Cost of furnishing, fabricating, galvanizing and erecting Drains, complete in place, shall be included in price bid for other items.
Shop Drawings will not be required for the Slab Drains.

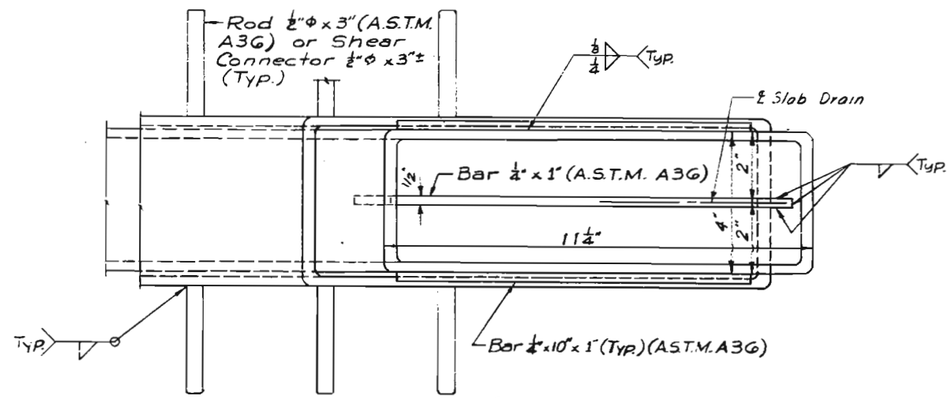


PARTIAL PLAN OF SLAB

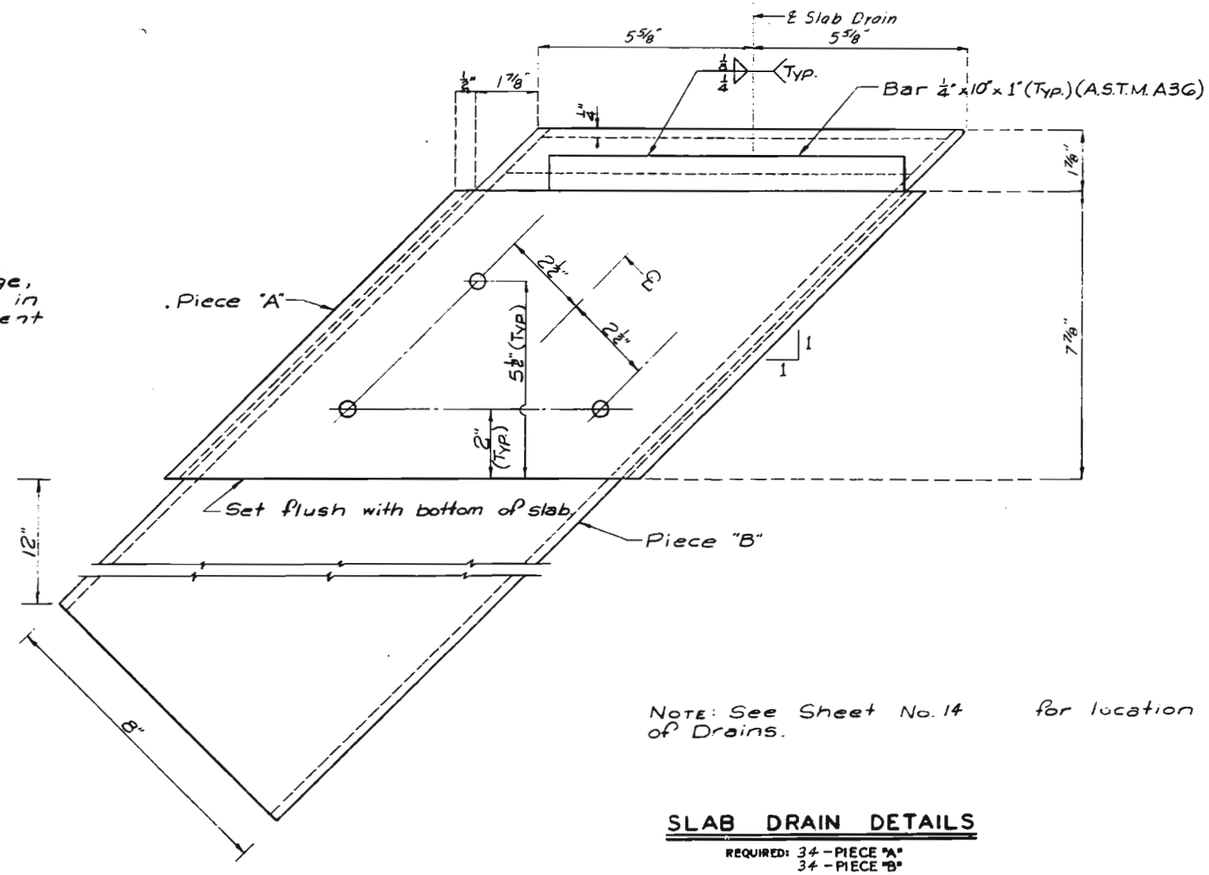
NOTE: Gutter in Wearing Surface shall be continuous across bridge, except taper to standard crown in 10 Feet adjacent to each end bent and expansion device.



PARTIAL ELEVATION OF SLAB



PLAN



ELEVATION

NOTE: See Sheet No. 14 for location of Drains.

SLAB DRAIN DETAILS

REQUIRED: 34 - PIECE "A"
34 - PIECE "B"

STD. S.D.-15.-W.S. REVISED
APRIL 1976

DETAILED Apr. 1976
CHECKED Apr. 1976

Note: This drawing is not to scale. Follow dimensions.

BOONE **COUNTY**

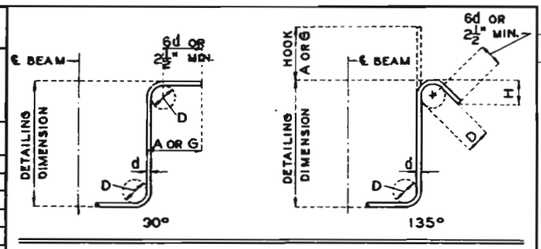
L-264R

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19 23		

COMPLETE BILL OF REINFORCING STEEL

NO. REQD.	MARK NO. SIZE MARK	LOCATION	GRADE &CL(H)	SHAPE NO.	STIRRUP (S)	SUBSTR. (X)	VARIES (V)	NO. EACH	DIMENSIONS B FT. IN.	C FT. IN.	D FT. IN.	E FT. IN.	F FT. IN.	H FT. IN.	K FT. IN.	NOMINAL LENGTH FT. IN.	ACTUAL LENGTH FT. IN.	WEIGHT LBS.
		END BENT NO 1																
8	5D1	FOOTING		20		X			2 6.000							2 6	2 6	21
2	5D2	FOOTING		10	S	X				2 11.000	22.625					7 9	7 6	16
7	6D3	FOOTING		20		X			3 0.000							3 0	3 0	32
3	6F1	BEAM		15		X			12.125	7 6.000	12.125	6.750	10.000	6.750	10.000	9 6	9 6	63
2	6W1	WING		20		X			13 8.000							13 8	13 8	41
6	6W2	WING		20		X	V	2	13 5.000							13 5	13 5	
		INCR = 22.500 IN							9 8.000							9 8	9 8	104
2	6W3	WING		20		X			4 7.000							4 7	4 7	14
2	6W4	WING		20		X			5 2.000							5 2	5 2	16
1	6W5	WING		20		X			5 9.000							5 9	5 9	9
1	6W6	WING		20		X			6 4.000							6 4	6 4	10
14	6W7	WING		20		X	V	2	12 1.300							12 1	12 1	
		INCR = 17.375 IN							3 5.000							3 5	3 5	163
2	6W8	WING		20		X			12 10.000							12 10	12 10	39
4	8M9	BEAM		20		X			14 2.000							14 2	14 2	151
4	8M10	BEAM		20		X			11 8.000							11 8	11 8	125
6	6M11	BEAM		20		X			11 8.000							11 8	11 8	105
1	6T1	WING		27		X				2 2.500	12 7.125	15.000		11 2.000	5 10.000	16 1	16 0	24
1	6T2	WING		27		X				2 2.500	12 7.125	9.000		11 2.000	5 10.000	15 7	15 6	23
2	6T3	WING		19		X			2 6.000	3 8.000						6 2	6 0	18
2	6T4	WING		27		X				2 2.500	12 9.375	2 1.000		10 4.500	7 5.500	17 1	17 0	51
2	6T5	WING		19		X			4 3.500	3 6.000						7 10	7 8	23
3	4W1	WING		50	S	X										8 2	8 0	16
3	4W2	WING		51	S	X										7 2	7 0	14
24	4W3	BEAM		10	S	X				3 1.500	21.000					8 0	7 10	126
8	4W4	BEAM		10	S	X				9.000	21.000					3 3	3 1	16
12	4W5	COLUMN		10	S	X	V	2		2 10.750	2 3.000					8 1	7 11	
		INCR = 2.750 IN								2 3.750	2 3.000					6 11	6 9	59
6	4W6	COLUMN		10	S	X				2 6.000	2 3.000					7 3	7 1	28
4	6W7	EXISTING BEAM		10		X				8.500	21.000					3 2	2 10	17
14	6W1	WING		20		X	V	2	5 10.000							5 10	5 10	
		INCR = 6.375 IN							2 8.000							2 8	2 8	89
4	6W2	WING		20		X			7 3.000							7 3	7 3	44
6	6W3	WING		20		X	V	2	7 5.000							7 5	7 5	
		INCR = 5.000 IN							8 3.000							8 3	8 3	71
4	4W4	WING		20		X			2 6.000							2 6	2 6	7
20	6W5	WING		20		X	V	2	9 3.000							9 3	9 3	
		INCR = 8.250 IN							3 1.000							3 1	3 1	185
4	4W6	WING		20		X			3 8.000							3 8	3 8	10
2	6W7	WING		20		X			9 9.000							9 9	9 9	29
3	6W8	COLUMN		20		X			11 0.250							11 0	11 0	50
4	6W9	COLUMN		20		X			6 10.000							6 10	6 10	41
4	4W10	COLUMN		20		X			6 4.000							6 4	6 4	17
		INT BENT NO 2																
24	7D4	FOOTINGS		20		X			3 6.000							3 6	3 6	172
4	7D5	FOOTING		10		X				4 9.000	18.000					11 0	10 8	87
4	6D6	FOOTING		11		X				3 3.000	18.000					8 0	7 8	46
8	6F2	COLUMNS		23		X			12.000	5 3.750	17.875	12.625	12.625	8.500	8.500	7 10	7 9	93
12	6F3	COLUMNS		23		X			12.000	6 9.000				8.500	8.500	7 9	7 9	140
8	6M12	BEAM		18		X			17 3.000							18 7	18 7	223
2	6M13	BEAM		20		X			17 3.000							17 3	17 3	52
14	4M14	WEB		20		X			7 3.000							7 3	7 3	68
2	4M15	WEB		20		X			7 0.000							7 0	7 0	9
2	4M16	WEB		20		X			4 4.000							4 4	4 4	6
10	6M17	BEAM		20		X			4 0.000							4 0	4 0	60
14	4M18	WEB		20		X			3 9.000							3 9	3 9	35
2	4M19	WEB		20		X			3 6.000							3 6	3 6	5
2	4M20	WEB		20		X			2 0.000							2 0	2 0	3
3	4M21	BEAM		17		X			23 6.000							24 0	24 0	48
3	4M22	BEAM		17		X			11 6.000							12 0	12 0	24
88	4P1	COLUMNS		10	S	X				2 6.000	2 3.000					7 3	7 1	416

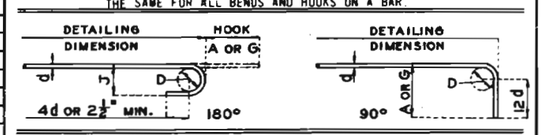


STIRRUP HOOK DIMENSIONS

GRADES 40 - 50 - 60 KSI

BAR SIZE	D (IN.)	90° HOOK A OR G	135° HOOK A OR G	135° HOOK APPROX. H
#3	1 1/2"	4"	4"	2 1/2"
#4	2"	4 1/2"	4 1/2"	3"
#5	2 1/2"	6"	5 1/2"	3 3/4"
#6	4 1/2"	8"	7"	4 1/2"

NOTE UNLESS OTHERWISE NOTED DIAMETER "D" IS THE SAME FOR ALL BENDS AND HOOKS ON A BAR.



SIZE OF 180° HOOKS (GRADE 40 KSI)
D = 5d FOR #3 THRU #11
D = 10d FOR #14 AND #18

SIZE OF 90° HOOKS (ALL GRADES) AND 180° HOOKS (GRADE 60 KSI)
D = 6d FOR #3 THRU #8
D = 8d FOR #9, #10 AND #11
D = 10d FOR #14 AND #18

END HOOK DIMENSIONS

BAR SIZE	180° HOOKS GRADE 40 A OR G	180° HOOKS GRADE 40 J	180° HOOKS GRADE 60 A OR G	180° HOOKS GRADE 60 J	90° HOOKS ALL GRADES A OR G
#3	5"	2 3/4"	5"	3"	6"
#4	6"	3 1/2"	6"	4"	8"
#5	7"	4 1/2"	7"	5"	10"
#6	8"	5 1/4"	8"	6"	12"
#7	9"	6 1/4"	10"	7"	14"
#8	10"	7"	11"	8"	16"
#9	12"	8"	15"	11 1/4"	18"
#10	13"	9"	17"	12 3/4"	22"
#11	14"	10"	19"	14 1/4"	2' 0"
#14	2' 2"	20 1/2"	2' 2"	20 1/2"	2' 7"
#18	2' 11"	2' 3"	2' 11"	2' 3"	3' 5"

NOTE ALL STANDARD HOOKS AND BENDS OTHER THAN 180 DEG TO BE BENT WITH SAME PROCEDURE AS FOR 90 DEG STANDARD HOOKS

NOTE HOOKS AND BENDS SHALL BE IN ACCORDANCE WITH THE PROCEDURES AS SHOWN ON THIS SHEET

NOMINAL LENGTHS ARE BASED ON OUT TO OUT DIMENSIONS SHOWN IN BENDING DIAGRAMS AND ARE LISTED FOR FABRICATORS USE

PAYWEIGHTS ARE BASED ON ACTUAL LENGTHS

H HIGH STRENGTH (ASTM A 615 GRADE 60)

S STIRRUP

X BAR IS INCLUDED IN SUBSTRUCTURE QUANTITIES

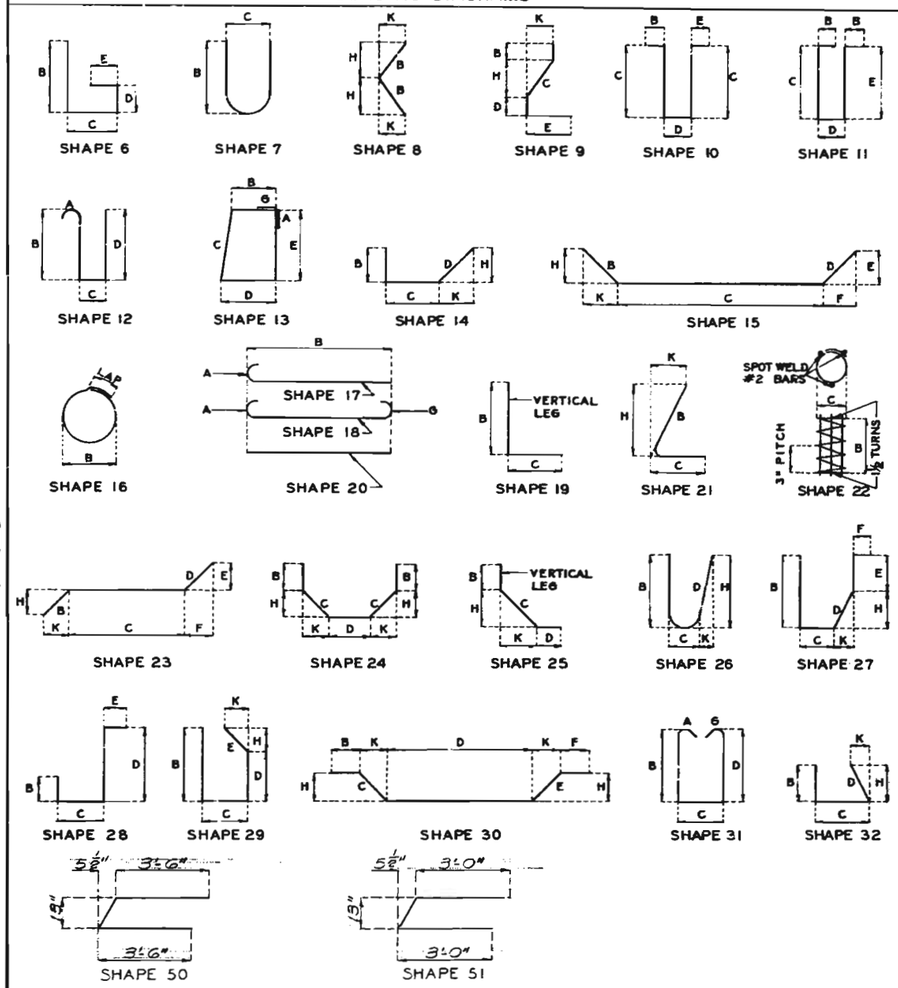
LENGTH TOTAL LENGTHS ARE MEASURED ALONG CENTERLINE BAR TO THE NEAREST INCH.

V BAR DIMENSIONS VARY IN EQUAL INCREMENTS BETWEEN DIMENSIONS SHOWN ON THIS LINE AND THE FOLLOWING LINE.

NO. EA NUMBER OF BARS OF EACH LENGTH

ALL HOOKS AND BENDS FOR SHAPE NO. 12 GRADE 40 (ONLY) ARE BASED ON D = 5d.

BENDING DIAGRAMS



STD.	90.8	REVISED
MAY	1974	JULY 1975

DETAILED APR. 1976
CHECKED APR. 1976

Note: This drawing is not to scale. Follow dimensions.

BOONE COUNTY L-264R

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO		19	24	

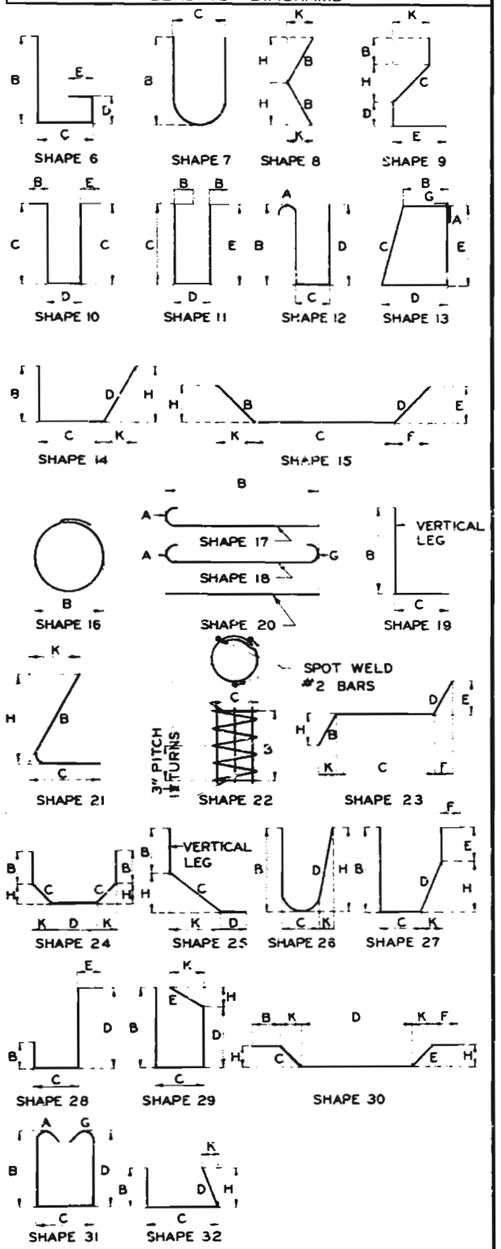
COMPLETE BILL OF REINFORCING STEEL

NO. REQD.	MARK NO. SIZE	MARK NO. MARK	LOCATION	GRADE 60 (H)	SHAPE NO.	STIRRUP (S)	SUBSTR. (X)	VARIES (V)	NO. EACH	DIMENSIONS B FT. IN.	C FT. IN.	D FT. IN.	E FT. IN.	F FT. IN.	H FT. IN.	K FT. IN.	NOMINAL LENGTH FT. IN.	ACTUAL LENGTH FT. IN.	WEIGHT LBS.
9	4U7		BEAM		10	S	X				6.000	3 9.000					4 9	4 7	28
46	4U8		BEAM		10	S	X				2 3.000	3 9.000					8 3	8 1	248
66	4U9		BEAM		19	S	X			*13.500*	15.000						*2 4*	2 3	99
16	7V11		COLUMN		20		X			17 5.000							17 5	17 5	570
8	7V12		COLUMN		20		X			*17 3.000*							*17 3*	*17 3*	*282*
8	4V13		WEB		20		X			16 6.000							16 6	16 6	88
2	4V14		WEB		20		X			13 3.000							13 3	13 3	18
2	4V15		WEB		20		X			14 3.000							14 3	14 3	19
2	4V16		WEB		20		X			14 9.000							14 9	14 9	20
2	4V17		WEB		20		X			15 3.000							15 3	15 3	20
2	4V18		WEB		20		X			14 9.000							14 9	14 9	20
2	4V19		WEB		20		X			13 9.000							13 9	13 5	18
			INT BENT NO 3																
24	704		FOOTINGS		20		X			3 6.000							3 6	3 6	172
8	6F2		COLUMNS		23		X			12.000	5 3.750	17.875	12.625	12.625	8.500	8.500	7 10	7 9	93
12	6F3		COLUMNS		23		X			12.000	6 9.000				8.500	8.500	7 9	7 9	140
8	6M12		BEAM		18		X			17 3.000							18 7	18 7	223
2	6M13		BEAM		20		X			17 3.000							17 3	17 3	52
15	4M14		WEB		20		X			7 3.000							7 3	7 3	73
2	4M15		WEB		20		X			7 3.000							7 0	7 0	9
2	4M16		WEB		20		X			4 4.000							4 4	4 4	6
10	6M17		BEAM		20		X			4 0.000							4 0	4 0	60
16	4M18		WEB		20		X			3 9.000							3 9	3 9	40
2	4M19		WEB		20		X			3 6.000							3 6	3 6	5
2	4M20		WEB		20		X			2 0.000							2 0	2 0	3
3	4M21		BEAM		17		X			23 6.000							24 0	24 0	48
3	4M22		BEAM		17		X			11 6.000							12 0	12 0	24
96	4P1		COLUMNS		10	S	X				2 6.000	2 3.000					7 3	7 1	445
9	4U7		BEAM		10	S	X				6.000	3 9.000					4 9	4 7	28
46	4U8		BEAM		10	S	X				2 3.000	3 9.000					8 3	8 1	248
66	4U9		BEAM		19	S	X			*13.500*	15.000						*2 4*	2 3	99
16	7V20		COLUMN		20		X			18 4.000							18 4	18 4	600
8	4V21		WEB		20		X			17 7.000							17 7	17 7	94
2	4V22		WEB		20		X			14 10.000							14 10	14 10	20
2	4V23		WEB		20		X			15 10.000							15 10	15 10	21
2	4V24		WEB		20		X			16 4.000							16 4	16 4	22
8	7V25		COLUMN		20		X			19 10.000							19 10	19 10	324
2	4V26		WEB		20		X			17 1.000							17 1	17 1	23
2	4V27		WEB		20		X			16 11.000							16 11	16 11	23
2	4V28		WEB		20		X			15 11.000							15 11	15 11	21
15	6Y29		BEAM		20		X			2 2.000							2 2	2 2	49
			INT BENT NO 4																
24	704		FOOTINGS		20		X			3 6.000							3 6	3 6	172
8	6F2		COLUMNS		23		X			12.000	5 3.750	17.875	12.625	12.625	8.500	8.500	7 10	7 9	93
12	6F3		COLUMNS		23		X			12.000	6 9.000				8.500	8.500	7 9	7 9	140
8	6M12		BEAM		18		X			17 3.000							18 7	18 7	223
2	6M13		BEAM		20		X			17 3.000							17 3	17 3	52
18	4M14		WEB		20		X			7 3.000							7 3	7 3	87
2	4M15		WEB		20		X			7 0.000							7 0	7 0	9
2	4M16		WEB		20		X			4 4.000							4 4	4 4	6
10	6M17		BEAM		20		X			4 0.000							4 0	4 0	60
16	4M18		WEB		20		X			3 9.000							3 9	3 9	45
2	4M19		WEB		20		X			3 6.000							3 6	3 6	5
2	4M20		WEB		20		X			2 0.000							2 0	2 0	3
120	4P1		COLUMNS		10	S	X				2 6.000	2 3.000					7 3	7 1	568
9	4U7		BEAM		10	S	X				6.000	3 9.000					4 9	4 7	28

COMPLETE BILL OF REINFORCING STEEL

NO. REQD.	MARK NO. SIZE	MARK NO. MARK	LOCATION	GRADE 60 (H)	SHAPE NO.	STIRRUP (S)	SUBSTR. (X)	VARIES (V)	NO. EACH	DIMENSIONS B FT. IN.	C FT. IN.	D FT. IN.	E FT. IN.	F FT. IN.	H FT. IN.	K FT. IN.	NOMINAL LENGTH FT. IN.	ACTUAL LENGTH FT. IN.	WEIGHT LBS.
46	4U10		BEAM		10	S	X				2 0.000	3 9.000					7 9	7 7	233
15	6Y29		BEAM		20		X			2 2.000							2 2	2 2	49
24	7V30		COLUMNS		20		X			22 7.000							22 7	22 7	1108
2	4V31		WEB		20		X			18 6.000							18 6	18 6	25
2	4V32		WEB		20		X			18 4.000							18 4	18 4	24
2	4V33		WEB		20		X			17 4.000							17 4	17 4	23
2	4V34		WEB		20		X			17 6.000							17 6	17 6	23
2	4V35		WEB		20		X			18 7.000							18 7	18 7	25
2	4V36		WEB		20		X			19 0.000							19 0	19 0	25
8	4V37		WEB		20		X			20 3.000							20 3	20 3	108
			INT BENT NO 5																
24	704		FOOTINGS		20		X			3 6.000							3 6	3 6	172
8	6F2		COLUMNS		23		X			12.000	5 3.750	2 1.750	18.250	18.250	8.500	8.500	8 6	8 5	101
12	6F3		COLUMNS		23		X			12.000	6 9.000				8.500	8.500	7 9	7 9	140
8	6M12		BEAM		18		X			17 3.000							18 7	18 7	223
2	6M13		BEAM		20		X			17 3.000							17 3	17 3	52
18	4M14		WEB		20		X			7 3.000							7 3	7 3	87
2	4M15		WEB		20		X			7 0.000							7 0	7 0	9
2	4M16		WEB		20		X			4 4.000							4 4	4 4	6
10	6M17		BEAM		20		X			4 0.000							4 0	4 0	60
18	4M18		WEB		20		X			3 9.000							3 9	3 9	45
2	4M19		WEB		20		X			3 6.000							3 6	3 6	5
2	4M20		WEB		20		X			2 0.000							2 0	2 0	3
108	4P1		COLUMNS		10	S	X				2 6.000	2 3.000					7 3	7 1	511
9	4U7		BEAM		10	S	X				6.000	3 9.000					4 9	4 7	28
46	4U11		BEAM		10	S	X				23.000	3 9.000					7 7	7 5	228
21	7V38		COLUMNS		20		X			21 3.000							21 3	21 3	347
2	4V39		WEB		20		X			18 1.000							18 1	18 1	24
2	4V40		WEB		20		X			19 1.000							19 1	19 1	25
2	4V41		WEB		20		X			19 3.000							19 3	19 3	26
2	4V42		WEB		20		X			17 6.000							17 6	17 6	23
2	4V43		WEB		20		X			18 6.000							18 6	18 6	25
2	4V44		WEB		20		X			18 10.000							18 10	18 10	25
8	4V45		WEB		20		X			20 1.000							20 1	20 1	107
16	7V46		COLUMN		20		X			21 4.000							21 4	21 4	698
			END BENT NO 6																
8	5D1		FOOTING		20		X			2 6.000							2 6	2 6	21
2	5D2		FOOTING		10	S	X				2 11.000	2 0.000					7 10	7 8	16
4	6M47		BEAM		17		X	V	1	15 7.000							16 3	16 3	
			INCR = 3.375 IN							14 9.000							15 5	15 5	95
2	6M48		BEAM		16		X			12 6.000							13 10	13 10	42
2	6M49		BEAM		18		X			13 4.000							14 8	14 8	44
2	6M50		BEAM		20		X			12 6.000							12 6	12 6	36
2	6M51		BEAM		20		X			13 4.0							13 4	13 4	40
2	6M52		WING		20		X			13 11.00							13 11	13 11	42
4	6M53		WING		20		X	V	2	13 2.000							13 2	13 2	
			INCR = 23.000 IN							11 3.000							11 3	11 3	74
4	6M54		WING		20		X	V	2	5 7.000							5 7	5 7	
			INCR = 23.000 IN							3 8.000							3 8	3 8	28
2	6M55		WING		20		X			12 9.000							12 9	12 9	38
2	6M56		WING		20		X			12 3.000							12 3	12 3	37
2	6M57		WING		20		X			10 6.000							10 6	10 6	32
1	6M58		WING		20		X			7 5.000							7 5	7 5	11
1	6M59		WING		20		X			6 11.000							6 11	6 11	10
1	6M60		WING		20		X			5 7.000							5 7	5 7	8
1	6M61		WING		20		X			5 2.000							5 2	5 2	8
2	6M62		WING		20		X			4 3.000							4 3	4 3	13
4	6M63		WING		20		X			3 10.000							3 10	3 10	12

BENDING DIAGRAMS



228

STD. 90.7 REVISED SEPT. 1974

DETAILED APR. 1976
CHECKED APR. 1976

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 18 of 19

BOONE COUNTY

L-264R

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO		19	25	

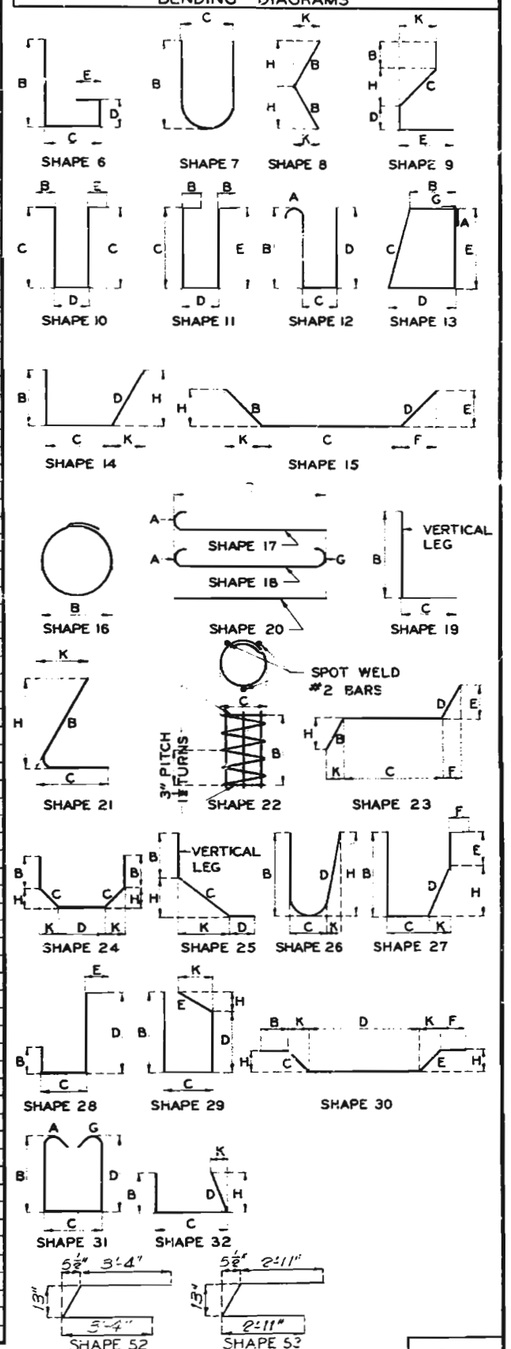
COMPLETE BILL OF REINFORCING STEEL

NO. REQD.	MARK NO. SIZE	MARK NO. MARK	LOCATION	GRADE 60(H)	SHAPE NO.	STIRRUP (S)	SUBSTR. (X)	VARIES (V)	NO. EACH	DIMENSIONS B	C	D	E	F	H	K	NOMINAL LENGTH	ACTUAL LENGTH	WEIGHT
										FT. IN.	FT. IN.	FT. IN.	FT. IN.	FT. IN.	FT. IN.	FT. IN.	FT. IN.	FT. IN.	LBS.
2	6T6		WING		27		X				2 4.500	8 11.375	23.000			4 2.000	7 11.000	13 3	13 2	40
2	6T7		WING		19		X			4 3.000	4 0.000							8 3	8 1	24
1	6T8		WING		27		X				14.000	11 9.000	23.000			5 8.000	10 3.500	14 10	14 9	22
1	6T9		WING		27		X				7.000	11 9.000	23.000			5 8.000	10 3.500	14 3	14 2	21
2	6T10		WING		19		X			2 9.000	3 6.000							6 0	5 10	18
4	6U7		EXISTING BEAM		10		X				8.500	21.000						3 2	2 10	17
12	4U12		BEAM		14	S	X			3 2.000	2 0.000	3 3.125				3 2.000	9.500	8 5	8 3	66
12	4U13		BEAM		32	S	X			3 2.000	3 4.500	3 3.125				3 2.000	9.500	9 10	9 7	77
10	4U14		BEAM		10	S	X				6.000	2 0.000						3 0	2 10	19
3	4U15		WING		52	S	X											7 10	7 8	15
3	4U16		WING		53	S	X											7 0	6 10	14
6	7U17		BEAM		10		X			4 0.000	2 9.000							10 9	10 5	128
16	6V47		WING		20		X	V	2	6 4.000								6 4	6 4	
			INCR = 6.375 IN							2 7.000								2 7	2 7	107
8	6V48		WING		20		X			6 8.000								6 8	6 8	80
2	6V49		BEAM		20		X			5 3.000								5 3	5 3	16
4	6V50		WING		20		X			3 10.000								3 10	3 10	10
14	6V51		WING		20		X	V	2	6 2.000								6 2	6 2	
			INCR = 6.875 IN							2 9.000								2 9	2 9	94
4	6V52		WING		20		X			7 9.000								7 9	7 9	47
2	6V53		WING		20		X			7 11.000								7 11	7 11	24
2	6V54		WING		20		X			8 4.000								8 4	8 4	25
4	4V55		WING		20		X			2 7.000								2 7	2 7	7
			SUPERSTRUCTURE																	
100	6H64		END DIAPHRAGM	H	20					8 0.000								8 0	8 0	1202
100	4H55		END DIAPHRAGM	H	20					8 0.000								8 0	8 0	534
96	5H66		END DIAPHRAGM	H	20					3 11.000								3 11	3 11	392
64	5H67		END DIAPHRAGM	H	16	S				16.000	2 0.000							3 2	3 1	206
4	6H68		END DIAPHRAGM	H	20					26 6.000								26 6	26 6	159
4	4H69		END DIAPHRAGM	H	20					26 6.000								24 6	26 6	71
4	6H70		END DIAPHRAGM	H	20					28 2.000								28 2	28 2	169
4	6H71		END DIAPHRAGM	H	20					28 2.000								28 2	28 2	169
8	5H72		END DIAPHRAGM	H	21	S				23.000	2 0.000				21.125	9.125		3 11	3 8	31
8	5H73		END DIAPHRAGM	H	23	S				23.000	2 0.000				21.125	9.125		3 11	3 10	32
24	5H74		END DIAPHRAGM	H	23	S				16.000	2 7.000				6.250	14.750		3 11	3 11	98
140	4U18		END DIAPHRAGM	H	10	S				12.000	17.000	3 8.000	12.000					8 6	8 2	982
180	4U19		END DIAPHRAGM	H	10	S					2 8.000	3 8.000						9 0	8 10	1062
90	4U20		END DIAPHRAGM	H	11	S				12.000	17.000	22.750	17.000					6 9	6 5	386
90	4U21		END DIAPHRAGM	H	10	S					2 8.000	22.750						7 3	7 1	426
44	5V56		END DIAPHRAGM	H	20					2 10.000								2 10	2 10	130
531	5R1		BARRIER CURB	H	19	S				2 8.000	6.000							3 2	3 1	1708
531	5R2		BARRIER CURB	H	15	S				2 8.125	6.000					2 8.000	3.000	3 2	3 1	1708
531	5R3		BARRIER CURB	H	19	S				19.000	9.000							2 4	2 3	1246
471	5R4		BARRIER CURB	H	27	S					9.000	11.125	9.000	12.000	9.125	6.375		3 5	3 3	1597
96	3R5		BARRIER CURB	H	20					9 9.000								9 9	9 9	976
5	5R6		BARRIER CURB	H	20					32 5.000								32 5	32 5	169
12	5R7		BARRIER CURB	H	20					22 1.000								22 1	22 1	276
6	5R8		BARRIER CURB	H	20					32 1.000								32 1	32 1	201
5	5R9		BARRIER CURB	H	20					31 5.000								31 5	31 5	164
5	5R10		BARRIER CURB	H	20					31 9.000								31 9	31 9	166
12	5R11		BARRIER CURB	H	20					22 5.000								22 5	22 5	181
5	5R12		BARRIER CURB	H	20					32 10.000								32 10	32 10	171
6	5R13		BARRIER CURB	H	20					32 6.000								32 6	32 6	203
52	5R14		BARRIER CURB	H	27	S				15.375	11.500	11.125	9.000		6.375	9.125		3 11	3 9	203
14	5R15		BARRIER CURB	H	20					12 5.000								12 5	12 5	181
10	5R16		BARRIER CURB	H	20					11 9.000								11 9	11 9	123
2	5R17		BARRIER CURB	H	20					12 1.000								12 1	12 1	25
8	5R18		BARRIER CURB	H	20					10 10.000								10 10	10 10	90
2	5R19		BARRIER CURB	H	19	S				3 3.500	6.000							3 12	5 8	8
2	5R20		BARRIER CURB	H	20					11 0.000								11 0	11 0	23
10	5R21		BARRIER CURB	H	20					11 3.000								11 3	11 3	117
14	5R22		BARRIER CURB	H	20					11 0.000								11 0	11 0	161

COMPLETE BILL OF REINFORCING STEEL

NO. REQD.	MARK NO. SIZE	MARK NO. MARK	LOCATION	GRADE 60(H)	SHAPE NO.	STIRRUP (S)	SUBSTR. (X)	VARIES (V)	NO. EACH	DIMENSIONS B	C	D	E	F	H	K	NOMINAL LENGTH	ACTUAL LENGTH	WEIGHT
										FT. IN.	FT. IN.	FT. IN.	FT. IN.	FT. IN.	FT. IN.	FT. IN.	FT. IN.	FT. IN.	LBS.
2	5R23		BARRIER CURB	H	27	S				9.375	11.500	11.125	3.000		6.375	9.125	2 11	2 9	6
1	5R24		BARRIER CURB	H	20					32 1.000							32 1	32 1	33
1	5R25		BARRIER CURB	H	20					31 11.000							31 11	31 11	33
1	5R26		BARRIER CURB	H	20					32 3.000							32 3	32 3	34
1	5R27		BARRIER CURB	H	20					32 4.000							32 4	32 4	34
1316	3S1		SLAB	H	20					26 3.000							26 3	26 3	27872
50	5S2		SLAB	H	20			V	2	2 6.000							2 6	2 6	
			INCR = 11.125 IN							24 10.000							24 10	24 10	713
44	5S3		SLAB	H	20			V	2	4 3.500							4 4	4 4	
			INCR = 12.375 IN							26 1.250							26 1	26 1	698
1019	5S4		SLAB	H	20					26 6.000							26 6	26 6	27916
48	5S5		SLAB	H	20			V	2	3 2.000							3 2	3 2	
			INCR = 12.375 IN							26 10.000							26 10	26 10	751
54	5S6		SLAB	H	20			V	2	2 6.500							2 7	2 7	
			INCR = 11.125 IN							26 9.250							26 9	26 9	826
160	4S7		SLAB	H	20					20 0.000							20 0	20 0	2138
164	5S8		SLAB	H	20					57 6.000							57 6	57 6	9835
264	5S9		SLAB	H	20					57 2.000							57 2	57 2	15741
			END OF BAR LIST																

BENDING DIAGRAMS



229

STD. 90.7	REVISED
SEPT. 1974	

DETAILED APR. 1976
CHECKED APR. 1976

Note: This drawing is not to scale. Follow dimensions.

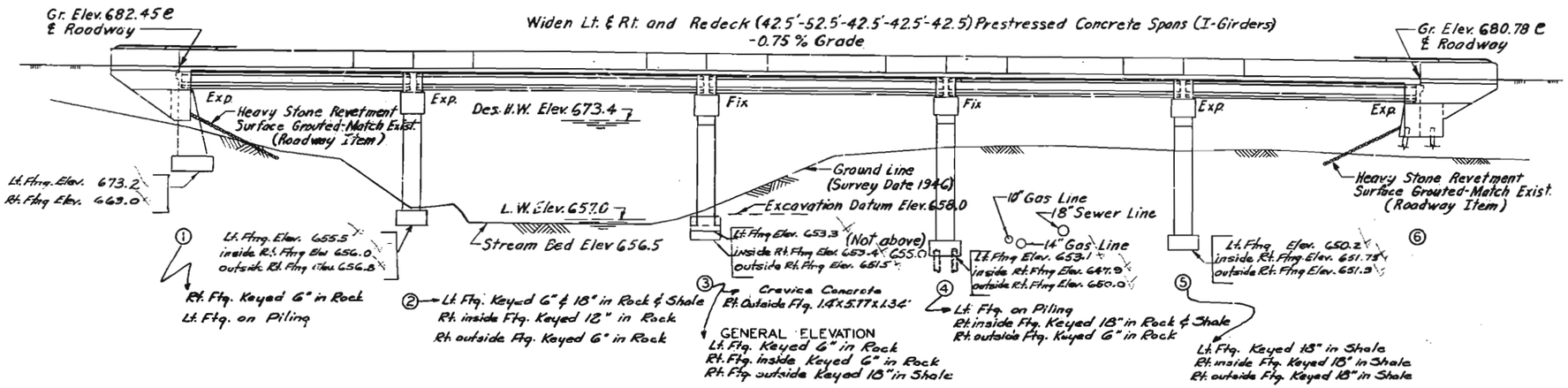
Sheet No. 19 of 19

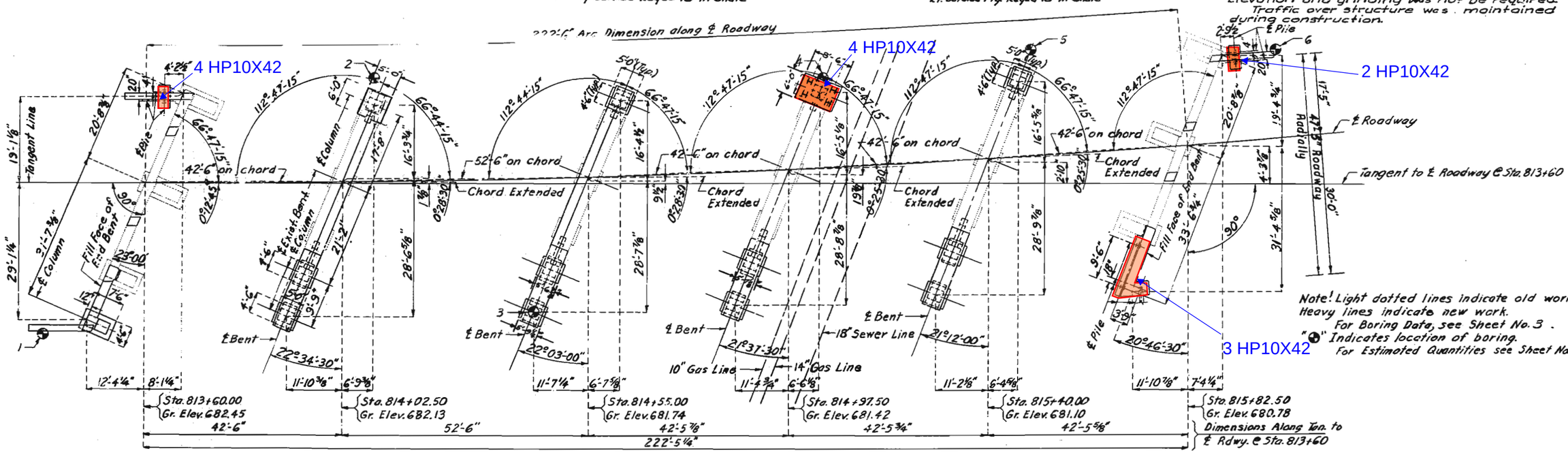
BOONE COUNTY

L-264R

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19		





PLAN

Note: Light dotted lines indicate old work. Heavy lines indicate new work.
For Boring Data, see Sheet No. 3 .
"⊕" Indicates location of boring.
For Estimated Quantities see Sheet No. 2

GENERAL NOTES:

Design Specifications: A.A.S.H.T.O. -1973

Design Loading:
HS 20-44, No future Wearing Surface
Modified 24,000# Tandem Axle
Earth 120#, Equivalent Fluid Pressure 30#
Superstructure: Simply supported non-composite for Dead Load. Continuous composite for Live Load.

Design Unit Stresses:
Class B Concrete (substructure) fc = 1,200 psi
Class B1 Concrete (superstructure except Prestressed Girders) fc = 1,600 psi
Reinforcing Steel (Grade 40) fs = 20,000 psi
Reinforcing Steel (Grade 60) (Superstructure Slab and Safety Barrier Curb) fy = 60,000 psi
Steel Pile fb = 9,000 psi
For Pre-stressed Girder Stresses see Sheets No. 11 & 12
Bearings Are 60 durometer Neoprene Pads.
All joint filler does meet the requirements of Std. Spec. 1057.24.

Reinforcing Steel:
Minimum clearance to reinforcing steel 1S 1½" unless otherwise shown.
Bridge seat areas for P/S Girders was given a smooth wood float finish. Finishing ⅛" above Plan Elevation and grinding was not be required.
Traffic over structure was maintained during construction.

Curve Data
P.I. = Sta. 819+36.31
Δ = 14°25' Lt.
D = 1°-00'
T = 724.65'
L = 1441.67'
R = 5729.58'

Note: Bents cannot be accurately located from the reference point on the tangent by conventional survey methods based on 100' chords.

HYDRAULIC DATA		
Drainage Area	=	432 Sq. Miles
Des. Discharge	=	8240 cfs.
Des. H.W. Elev.	=	673.4
Frequency	=	50 years

PILE & FOOTING DATA									
BENT NO.		1	2	3	4	5	6WING	6BEAM
BEARING PILE	Pile Type and Size	HP10x42			HP10x42		HP10x42	HP10x42
	Number	2			4		2	3
	Approximate Length Ft.	17-23			34-35		25-33	25-33
	Design Bearing Tons	10			22		10	30
	Hammer Energy req'd Ft Lbs.	7000			7000		7000	7000
SPREAD FOOTINGS	Foundation Material	Rock	Rock	Rock	Rock	Rock		
	Design Bearing Tons/Sq. Ft.	4.0	4.5	Lt 3.5 Rt 4.5	Rt 5.0	Lt 5.7 Rt 4.0		

Note: Minimum energy requirement of hammer based on plan length and design bearing value of piles.
All pile were driven to practical refusal.

B.M. TOP OF N.E. ANCHOR BOLT SIGN Fthg. Rt. STA. 812+50
Elev. 677.59
CHISLED □ E. END BRIDGE RAIL POST Lt. STA. 815+32
Elev. 684.34

BRIDGE OVER HINKSON CREEK

STATE ROAD: INTERSTATE ROUTE 70

IN COLUMBIA

PROJECT NO. I-70-3 (76) **STA.** 813+60

JOB NO. 5-I-116 **RTE.** I-70

BOONE **COUNTY**

DATE 5/26/76

STD.
STD. 706.35
L-264 R

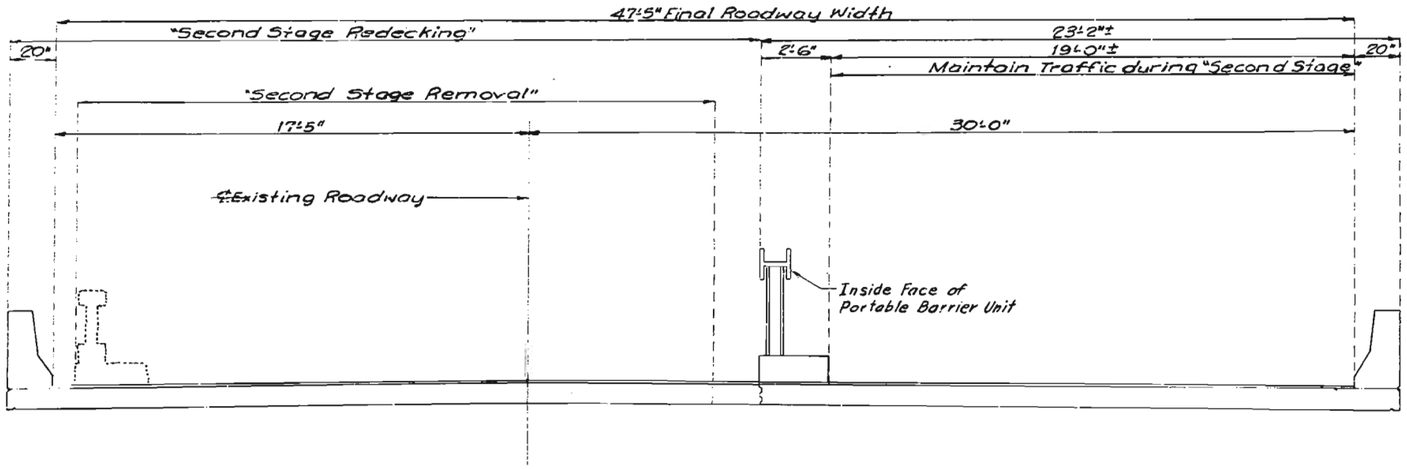
DESIGNED Dec 1975
DETAILED Mar 1976
CHECKED Apr. 1976

Note: This drawing is not to scale. Follow dimensions.

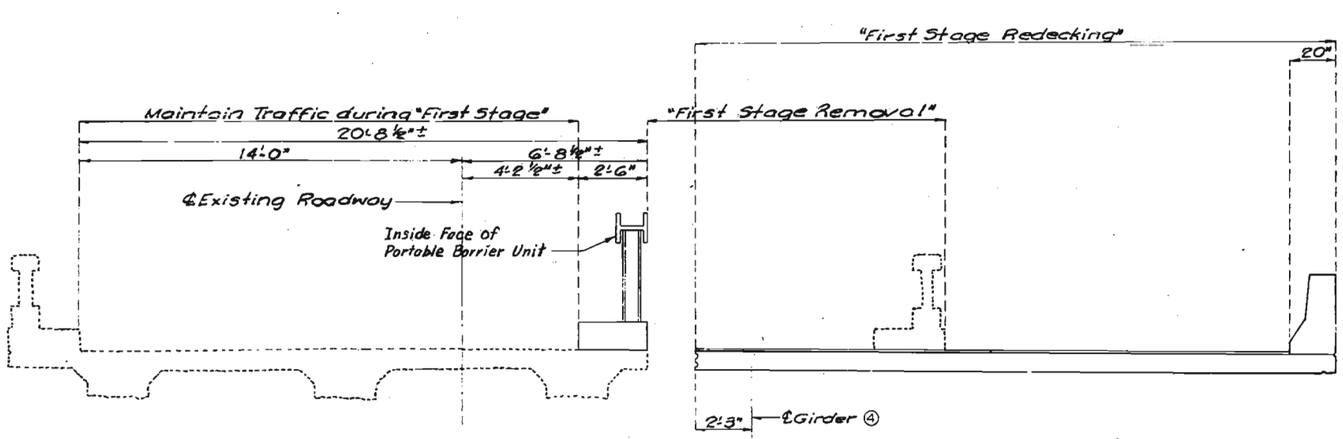
FINAL PLANS

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19		



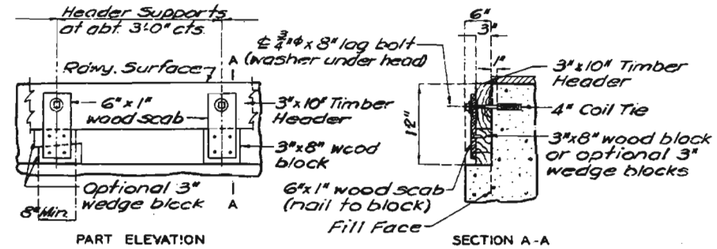
STAGE TWO CONSTRUCTION



Note: See sheet No. 13 for details and reinforcement of new bridge deck.

STAGE ONE CONSTRUCTION

PART SECTIONS SHOWING REMOVAL & CONSTRUCTION



Note: Cost of timber headers complete in place was included in price bid for concrete.

DETAILS OF TIMBER HEADER AT END BENTS

FINAL QUANTITIES

ITEM		SUBSTR.	SUPERSTR.	TOTAL
Removal of Existing Bridge Deck	Sq. Ft.		7453	7453
Special Work	Lump Sum		1	1
Class I Excavation	Cu. Yd.	232.5		232.5
Asphalt Cement (Asphaltic Concrete)	Ton		7.3	7.3
Mineral Aggregate (Asphaltic Concrete)(Special Mix)	Ton		144	144
Structural Steel Pile (10")	Lin. Ft.	177		177
Class B Concrete	Cu. Yd.	207.2		207.2
Class B-1 Concrete	Cu. Yd.		454.0	454.0
Plain Neoprene Bearing Pads (1" thick)	Each		60	60
Prestressed Concrete Members, I Section, (42')	Each		24	24
Prestressed Concrete Members, I Section, (52')	Each		6	6
Reinforcing Steel	Lb.	15850		15850
Reinforcing Steel (Grade 60)	Lb.		102480	102480
Bridge Deck Waterproofing (Liquid)	Sq. Yd.		1174	1174
Bridge Rail (One Tube)	Lin. Ft.		490	490
Class 2 Excavation	Cu. Yd.	139.0		139.0
Prebore For Piling (Bt. No. 2)	Lin. Ft.	0		0
Contingent Items				
Class I Excavation ± 125	Cu. Yd.	5.0		5.0
Class 2 Excavation ±150	Cu. Yd.	27.0		27.0
Test Holes	Lin. Ft.	52		52
Structural Steel Pile (10") @ 90% Unit Bid Price	Lin. Ft.	142		142
Crevice Concrete	Cu. Yd.	0.4		0.4

Cost of ¾"ϕ coil tie rods placed in diaphragms is included in price bid for P/S members.
Note: All concrete and reinforcement in safety barrier curbs is included with superstructure quantities.

DETAILED APR. 1976
CHECKED APR 1976

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 2A of 19.

BOONE COUNTY

L-264 R

FINAL PLANS

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19		

SECTION J-J

PART SECTION K-K

ELEVATION

PART ELEVATION A-A

SECTION E-E

PART ELEVATION H-H

PART SECTION C-C

PART PLAN AT END OF EXISTING BEAM DETAIL "A" SHOWING LOCATION OF BENT ANCHORS

DETAIL OF STEEL PILE SPLICE

PART PLAN OF BEAM

PLAN

PART SECTION F-F

ELEVATION G-G

PLAN OF FOOTING SHOWING REINFORCEMENT

SECTION D-D

ELEVATION B-B

DETAILS OF END BENT NO. 1

DETAILED APR 1976

CHECKED APR 1976

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 4A of 19.

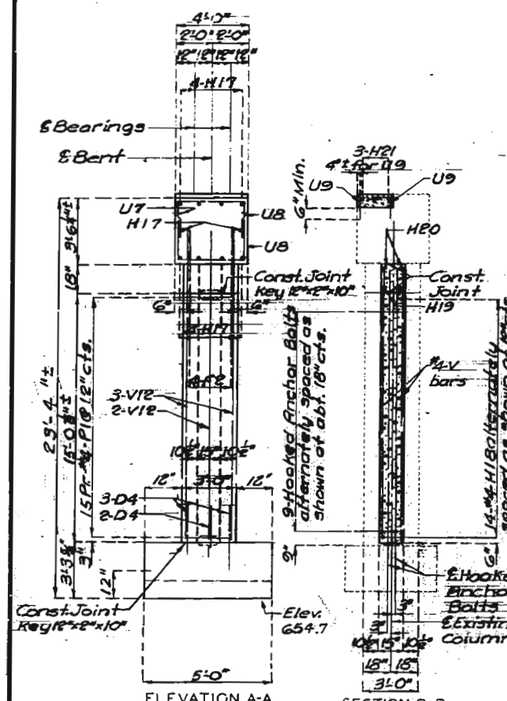
BOONE COUNTY

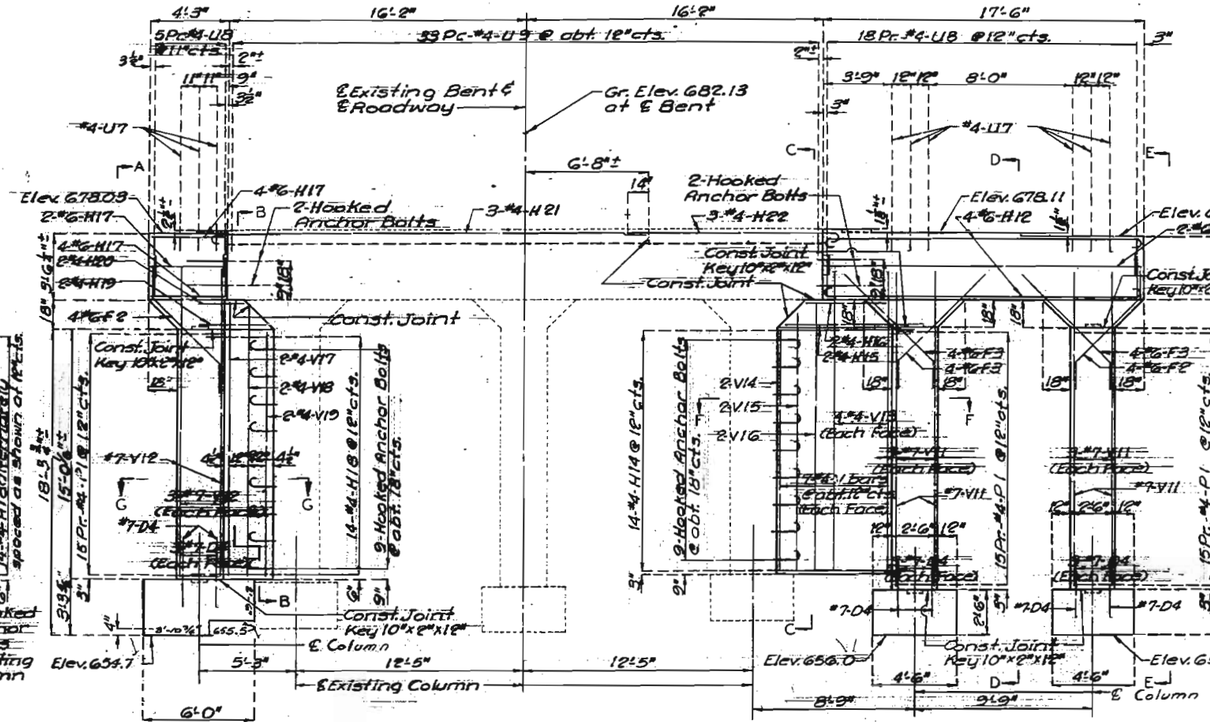
L-264 R

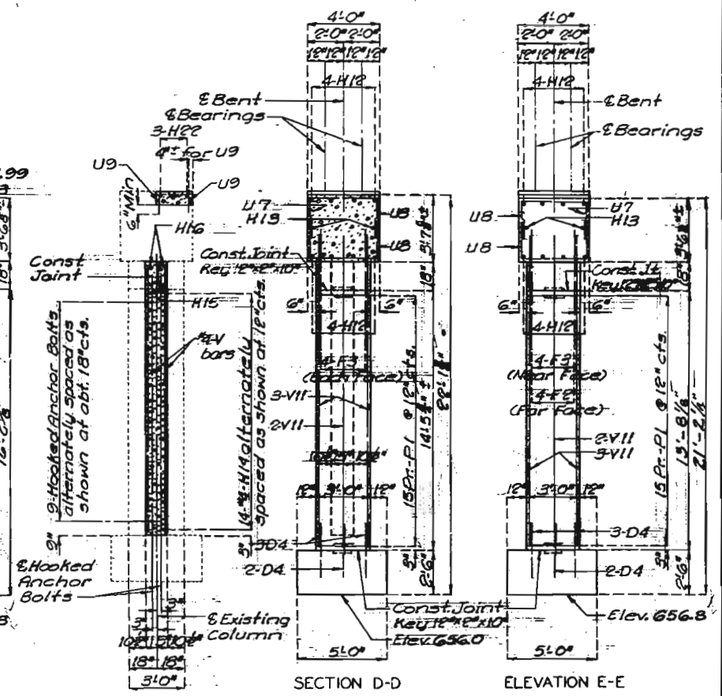
FINAL PLANS

MISSOURI STATE HIGHWAY DEPARTMENT

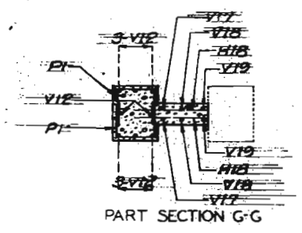
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19		



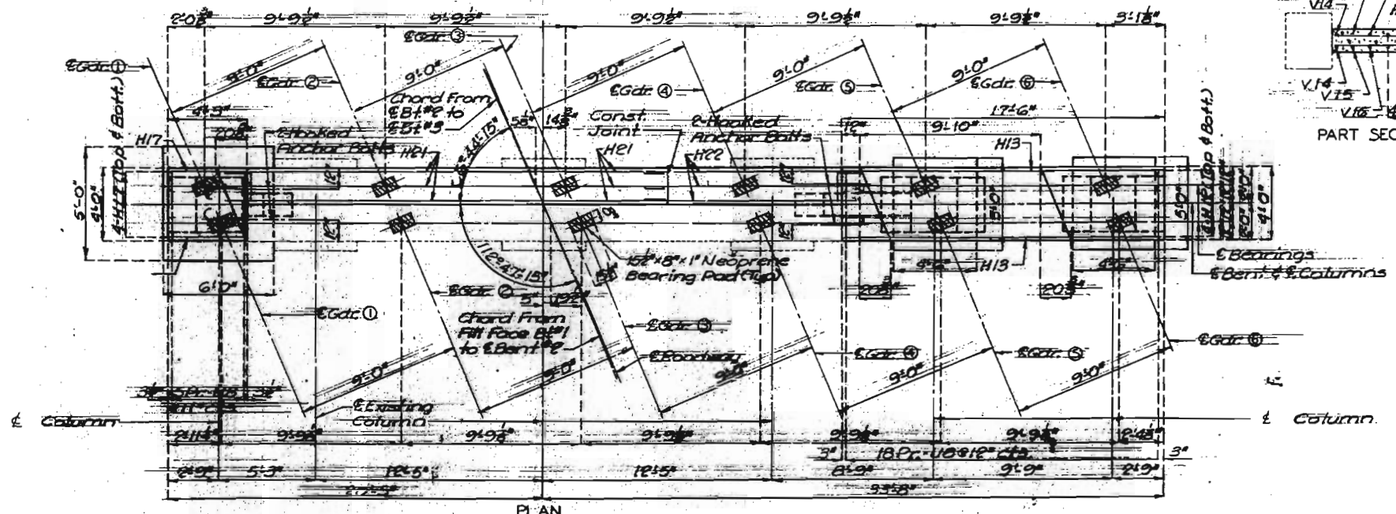


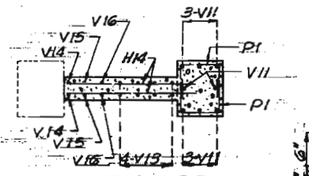


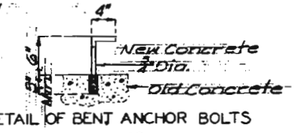
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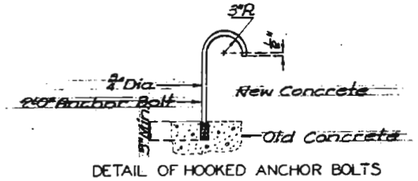


Contractor elected to pour footings to plan elevation in lieu of extending columns. Payment made for column extensions.









Note: Anchors are of the self drilling expansion type, made of case hardened and drawn carburized steel, with self-cutting annular broaching grooves.
Cost of furnishing and installing anchor bolt assemblies are included in price bid for concrete.

DETAILED Mar 1976
CHECKED Apr. 1976

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 5A of 19.

BOONE COUNTY

L-264R

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19		

ELEVATION A-A

SECTION B-B

ELEVATION

SECTION D-D

ELEVATION E-E

SECTION C-C

PART SECTION G-G

PART SECTION F-F

Footing – Top View

PLAN

DETAILS OF INT. BENT NO. 3

Contractor elected to pour footings to plan elevation in lieu of extending columns. Payment made for column extensions.

Note: Light dotted lines indicate old work. Heavy lines indicate new work. See sheet No. 5 for "Details of Hooked Anchor Bolts.

DETAILED Apr. 1976

CHECKED Apr. 1976

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 6 of 19 Sh.

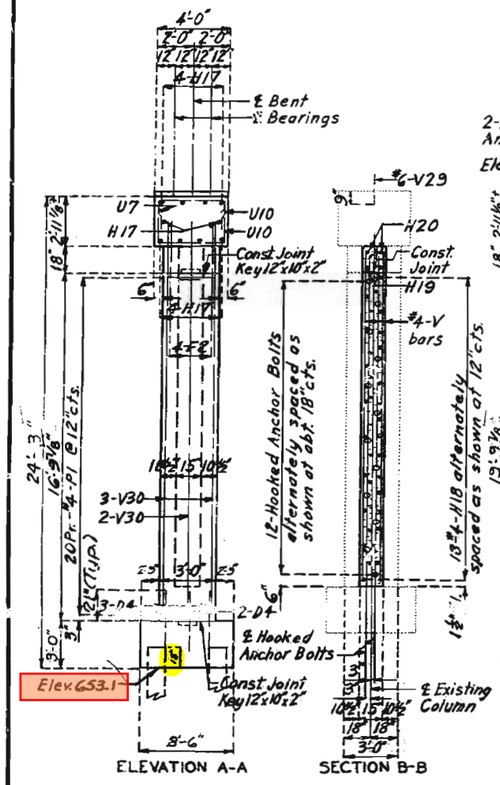
BOONE COUNTY

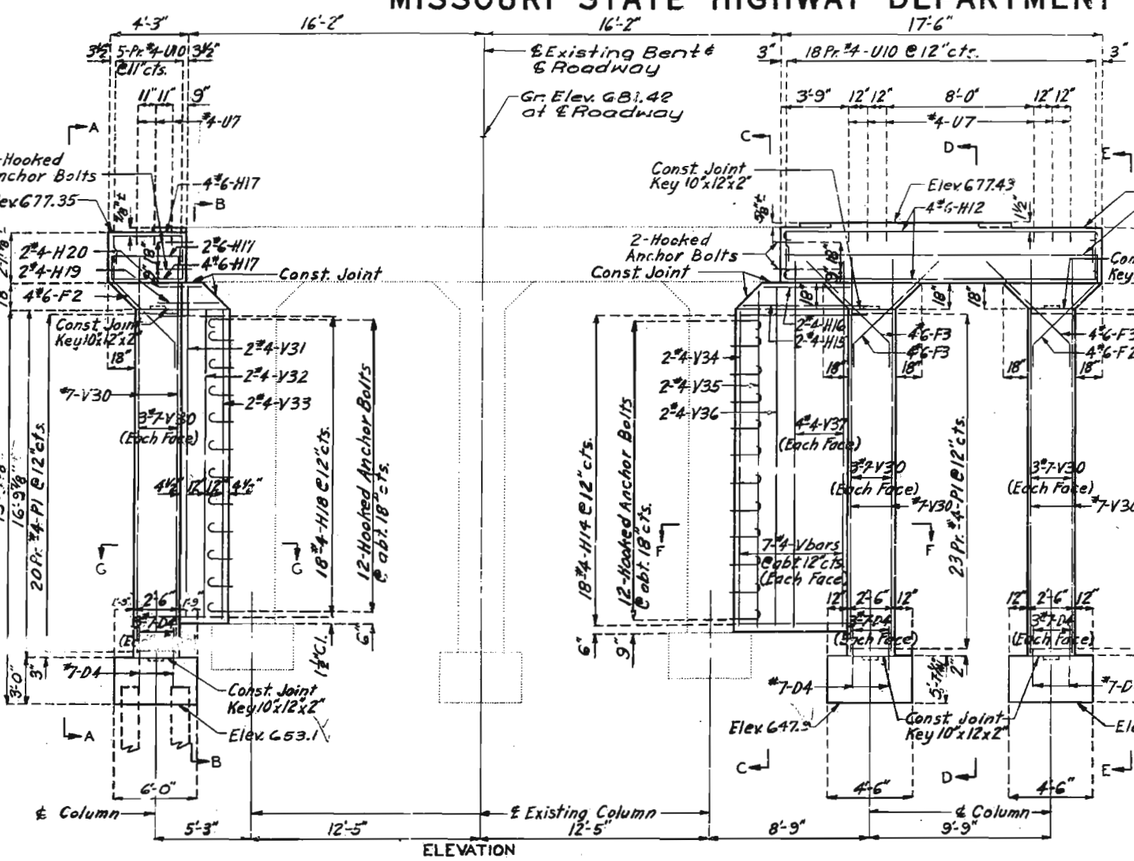
L-264 R

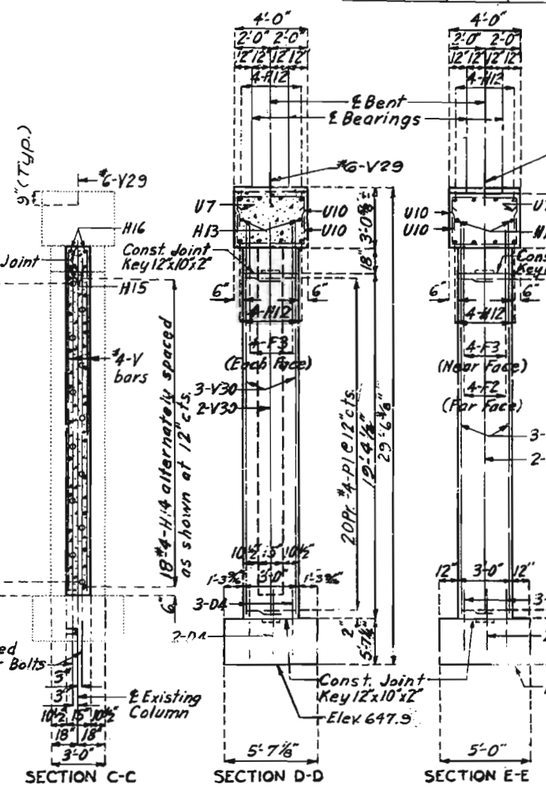
FINAL PLANS

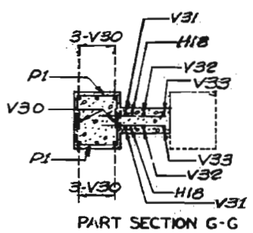
MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19		



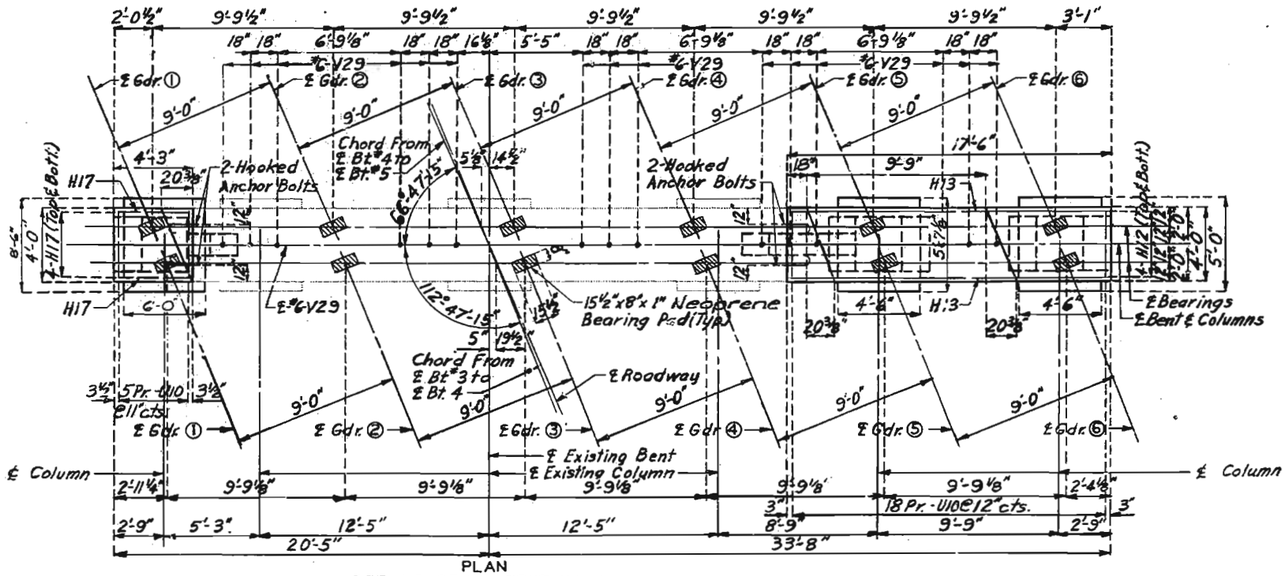




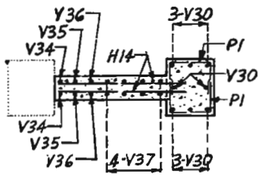


PART SECTION G-G

Contractor elected to pour footings to plan elevation, in lieu of extending columns. Payment made for column extensions.



DETAILS OF INT. BENT NO. 4



PART SECTION F-F

Note: Light dotted lines indicate old work. Heavy lines indicate new work. See sheet No. 5 for "Details of Hooked Anchor Bolts."

DETAILED Feb 1976
CHECKED Apr. 1976

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 7A of 19.

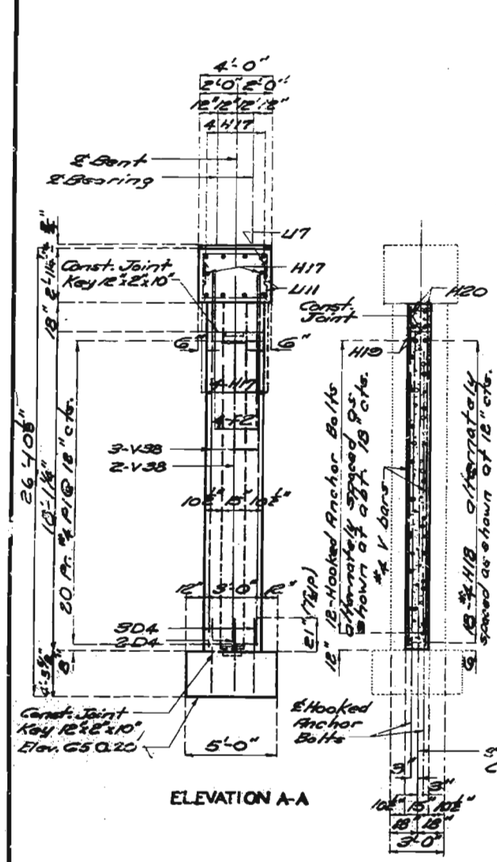
BOONE **COUNTY**

L-264R

FINAL PLANS

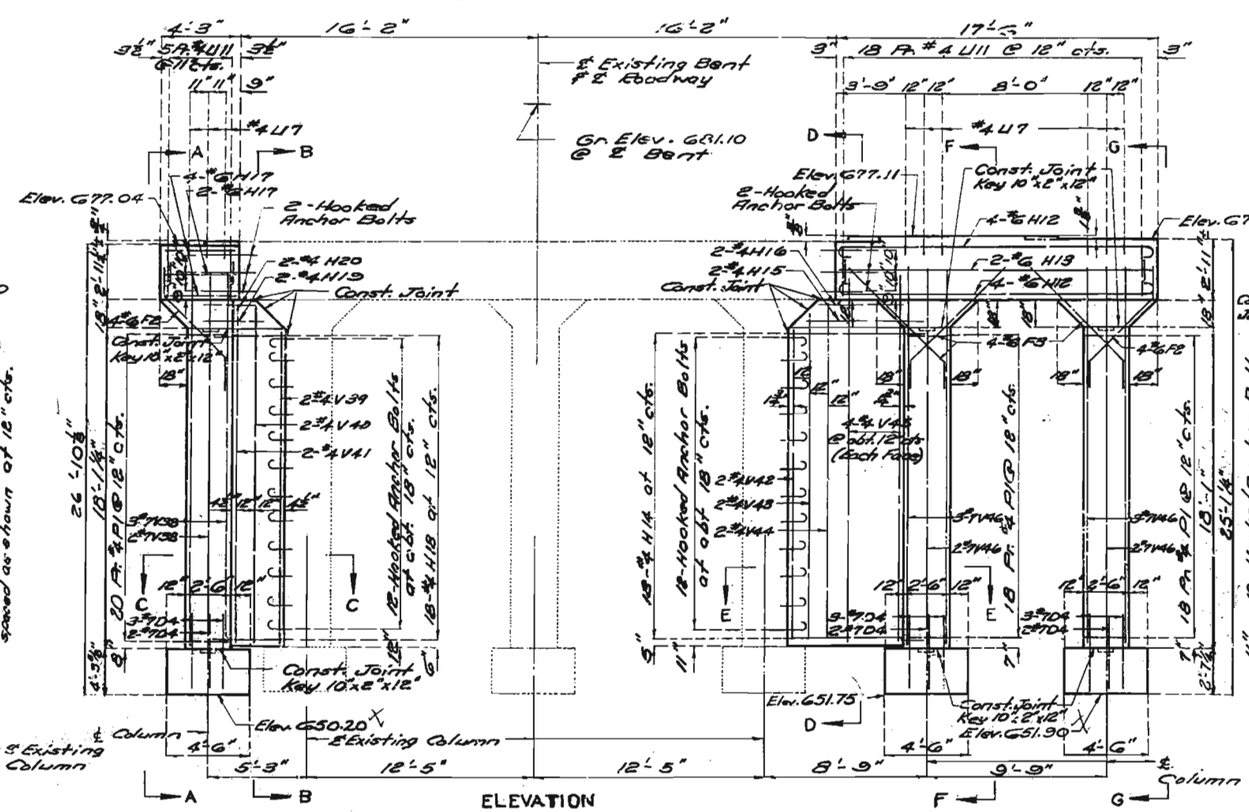
MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.		19		

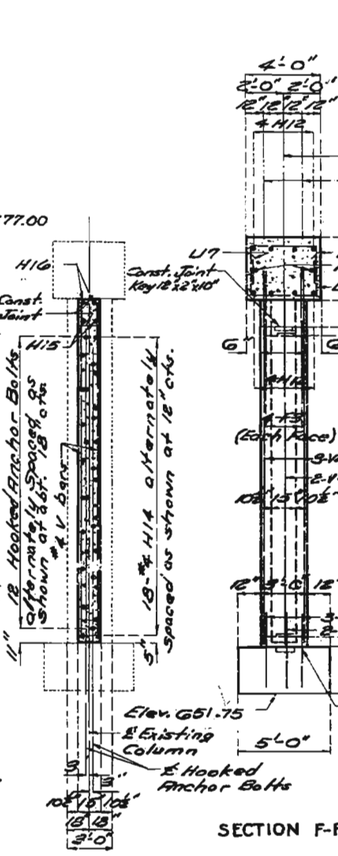


ELEVATION A-A

SECTION B-B

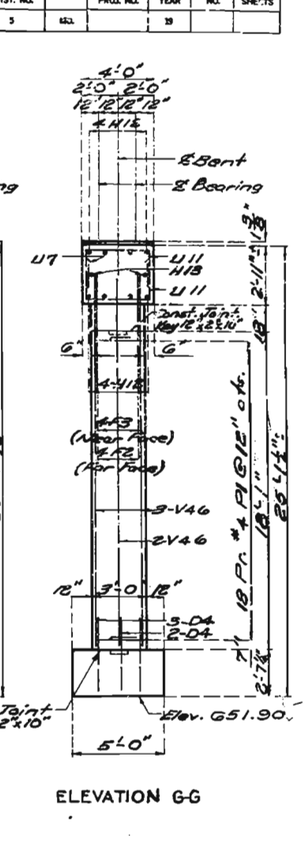


ELEVATION

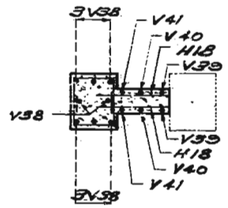


SECTION D-D

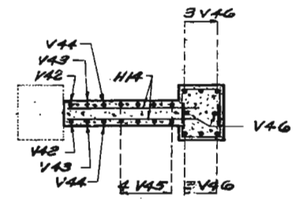
SECTION F-F



ELEVATION G-G

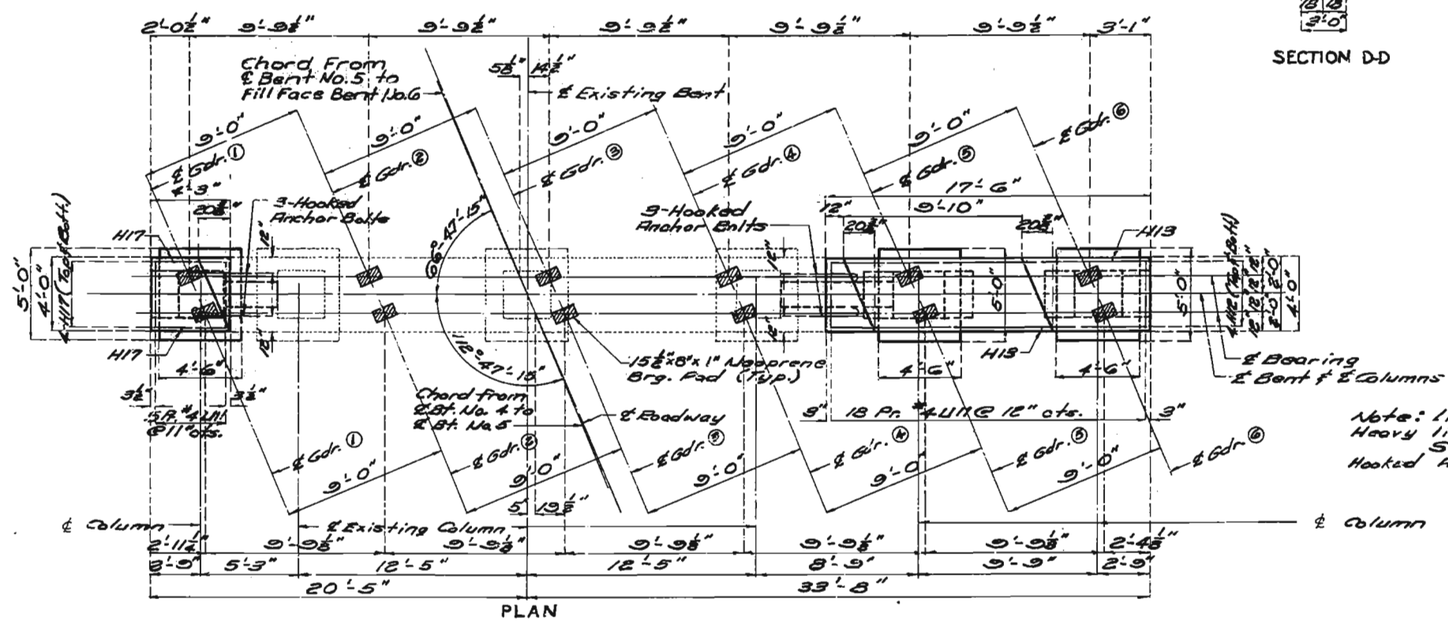


SECTION C-C



SECTION E-E

Contractor elected to pour footings to plan elevation in lieu of extending columns. Payment made for column extensions.



PLAN

DETAILS OF INT. BENT NO. 5

Note: light dotted lines indicate old work. Heavy lines indicate new work. See sheet No. 5 for details of Hooked Anchor Bolts.

DETAILED March, 19 76
CHECKED Apr. 1976

Note: This drawing is not to scale. Follow dimensions.

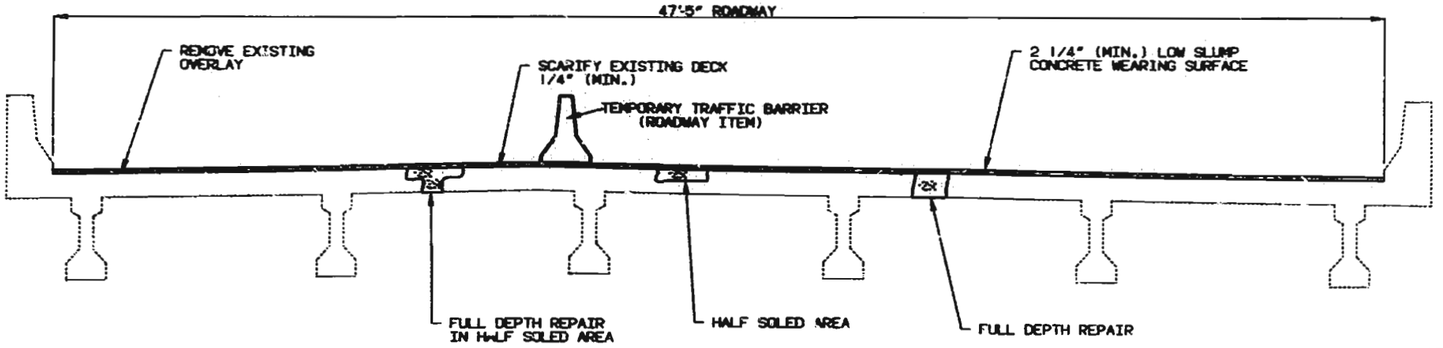
Sheet No. 8A of 19.

BOONE **COUNTY**

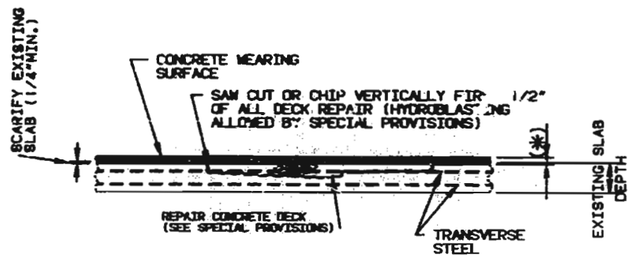
L-264R

MISSOURI HIGHWAY AND TRANSPORTATION COMMISSION

STATE	PROJ. NO.	SHEET NO.
MO.	FAI-70-3(158)	19
SEC./SUR. 8	TWP. 48N	RGE. 12W

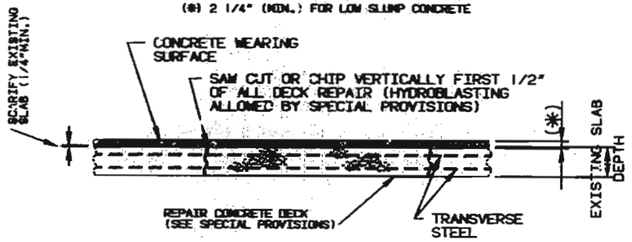


TYPICAL SECTION THRU SLAB



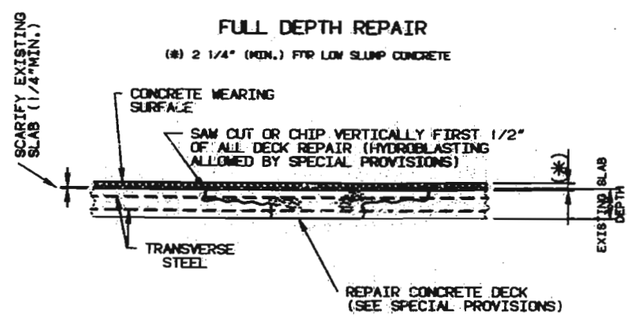
HALF-SOLED AREA

(*) 2 1/4" (MIN.) FOR LOW SLUMP CONCRETE



FULL DEPTH REPAIR

(*) 2 1/4" (MIN.) FOR LOW SLUMP CONCRETE



FULL DEPTH REPAIR HALF-SOLED AREA

(*) 2 1/4" (MIN.) FOR LOW SLUMP CONCRETE

GENERAL NOTES:

DESIGN SPECIFICATIONS: A.A.S.H.T.O. 1989 AND INTERIM 1990

DESIGN UNIT STRESSES:
CLASS B1 CONCRETE (SUPERSTRUCTURE) F'C=4,000 PSI.
REINFORCING STEEL (GRADE 60) FY=60,000 PSI.

REINFORCING STEEL:
MINIMUM CLEARANCE TO REINFORCING STEEL [illegible] 1/2", UNLESS OTHERWISE SHOWN. DIMENSIONING TO REINFORCEMENT IS TO ℄ OF BAR UNLESS OTHERWISE SHOWN.

TRAFFIC MAINTAINED: TWO LANES OF TRAFFIC OVER STRUCTURE TO BE MAINTAINED DURING CONSTRUCTION.

OUTLINE OF OLD WORK IS INDICATED BY LIGHT DASHED LINES. HEAVY LINES INDICATE NEW WORK.

ALL JOINT FILLER SHALL MEET THE REQUIREMENTS OF STD. SPEC. 1057.2.4, EXCEPT AS NOTED.

COST OF ANY REQUIRED EXCAVATION FOR BRIDGE SHALL BE INCLUDED IN THE CONTRACT UNIT PRICE FOR OTHER ITEMS.

CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN FIELD BEFORE ORDERING NEW STEEL.

BARS BONDED IN OLD CONCRETE NOT REMOVED SHALL BE CLEANLY STRIPPED AND EMBEDDED INTO NEW CONCRETE WHERE POSSIBLE. IF LENGTH IS AVAILABLE, OLD BARS SHALL EXTEND INTO NEW CONCRETE AT LEAST 40 DIAMETERS FOR SMOOTH BARS AND 30 DIAMETERS FOR DEFORMED BARS, UNLESS OTHERWISE NOTED.

ESTIMATED QUANTITIES

ITEM		TOTAL
SPECIAL WORK (BRIDGES)	LUMP SUM	1
ASPHALT REMOVAL (BRIDGES)	SQ. FT.	10,550
SUBSTRUCTURE REPAIR (FORMED)	SQ. FT.	30
SUBSTRUCTURE REPAIR (UNFORMED)	SQ. FT.	15
REPAIRING CONCRETE DECK (HALF-SOLING)	SQ. FT.	500
FULL DEPTH REPAIR	SQ. FT.	300
LOW SLUMP CONCRETE WEARING SURFACE	SQ. YD.	1,173
REINFORCING STEEL (GRADE 60) (EPOXY COATED)	LB.	1,040
CLASS B1 CONCRETE	CU. YD.	7.9
REINFORCING STEEL (GRADE 60)	LB.	240

SEE FINAL PLANS

REPAIRS TO:
BRIDGE OVER HINKSON CREEK

STATE ROAD: INTERSTATE 70
IN COLUMBIA
PROJECT NO. F.A.I.-70-3(158) STA. 813+60
JOB NO. J5I0449 RTE. I-70 E.B.L.

BOONE COUNTY

DATE: 11/20/91

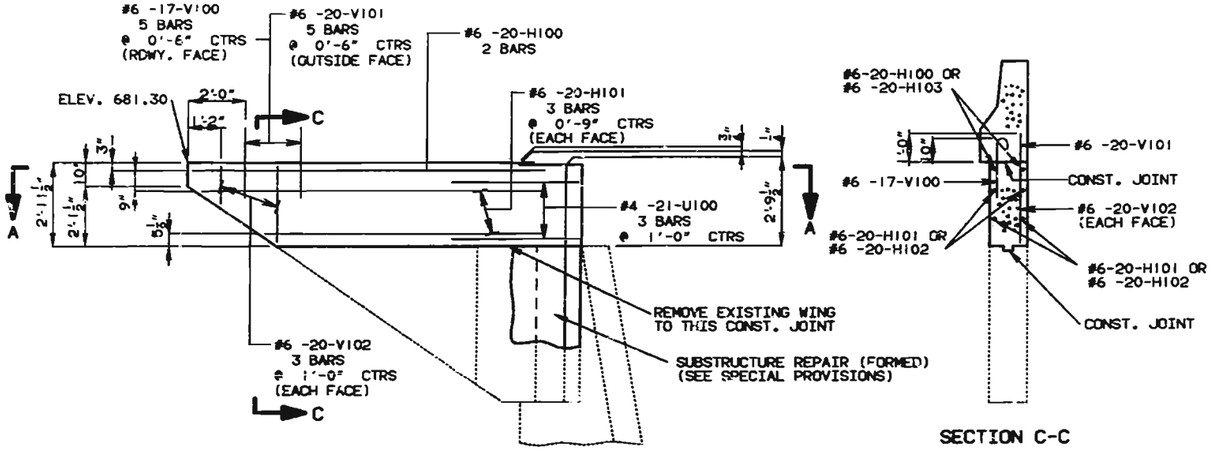
STD. L-264R1

DESIGNED JULY 1991
DETAILED JULY 1991
CHECKED OCT. 1991

NOTE: THIS DRAWING IS NOT TO SCALE. FOLLOW DIMENSIONS.

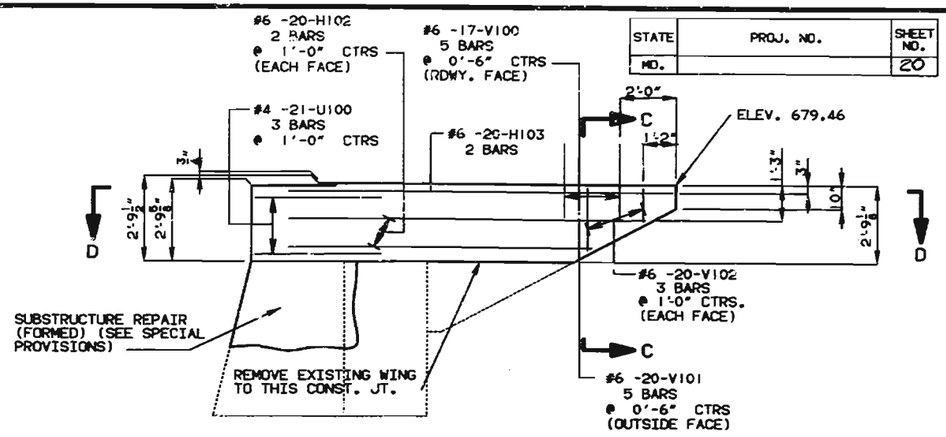
355 475

STATE	PROJ. NO.	SHEET NO.
MO.		20

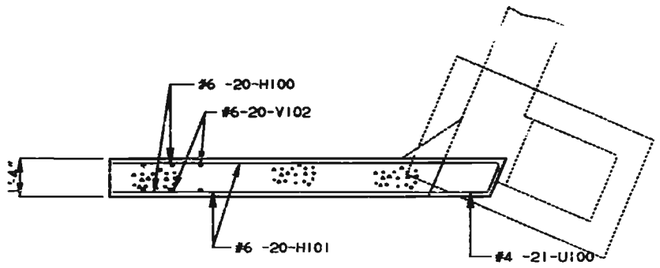


ELEVATION OF RIGHT WING AT BENT NO. 1

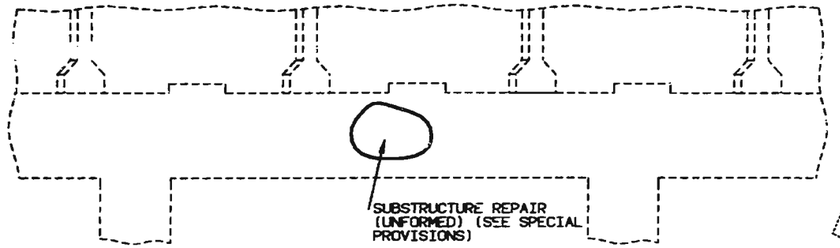
SECTION C-C



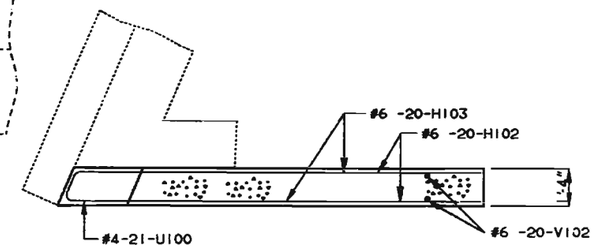
ELEVATION OF RIGHT WING AT BENT NO. 6



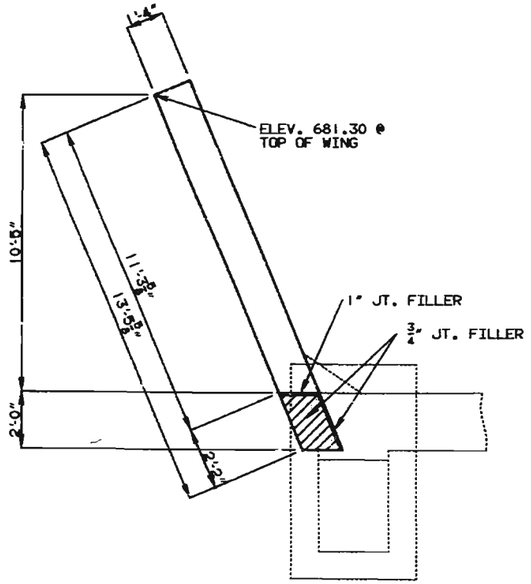
SECTION A-A



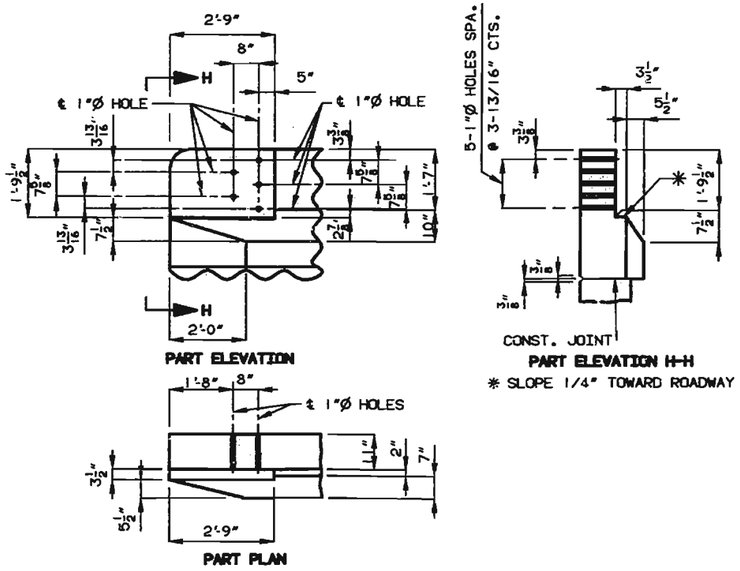
PART SECTION NEAR END BENTS



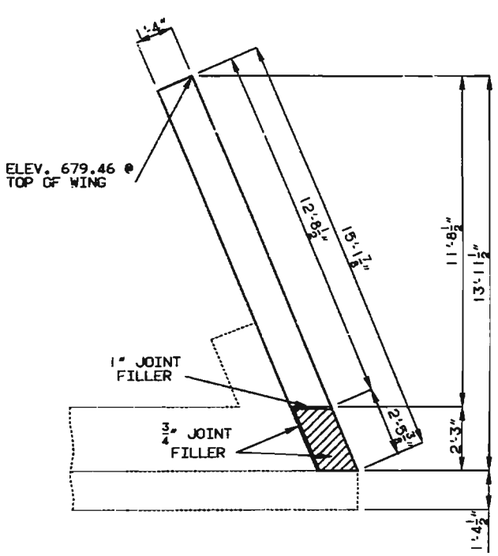
SECTION D-D



PLAN OF RIGHT WING AT BENT NO. 1



DETAILS OF GUARD RAIL ATTACHMENT



PLAN OF RIGHT WING AT BENT NO. 6

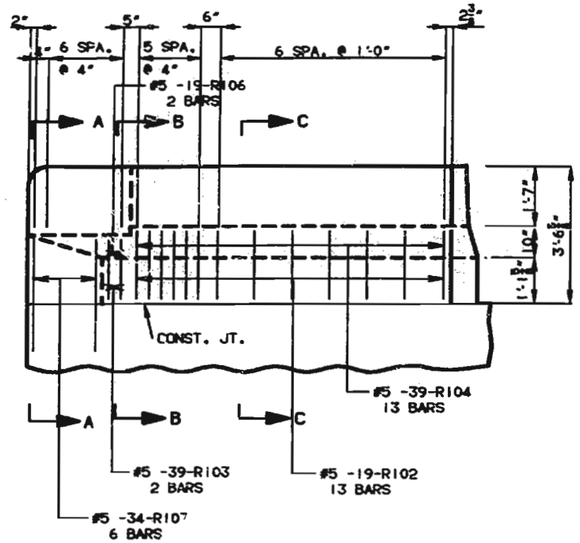
NOTE: FOR DETAILS AND REINFORCEMENT OF SAFETY BARRIER CURB SEE SHEET NO. 3.

DETAILED SEPT. 1991
CHECKED SEPT. 1991

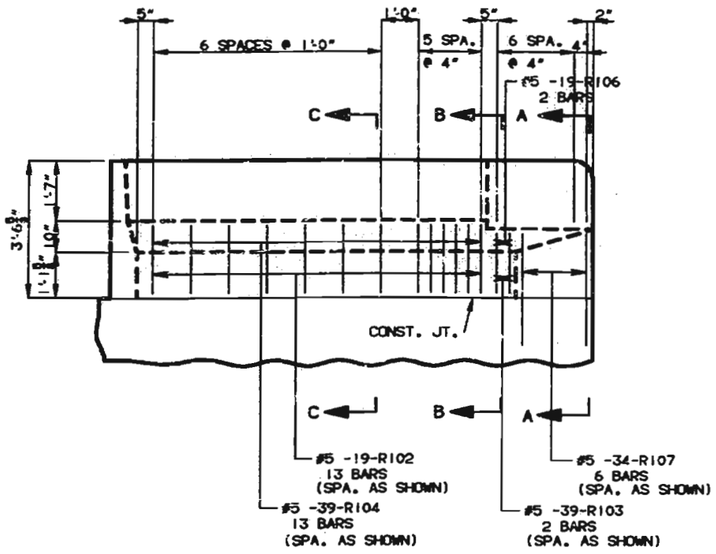
NOTE: THIS DRAWING IS NOT TO SCALE. FOLLOW DIMENSIONS.

BOONE COUNTY L-264R1

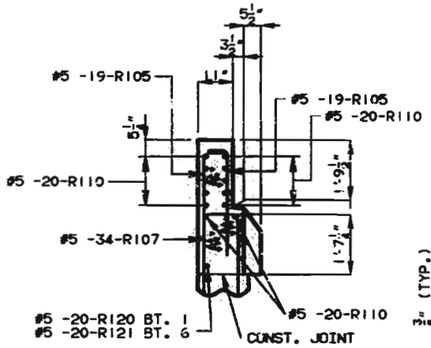
STATE	PROJ. NO.	SHEET NO.
NO.		2f



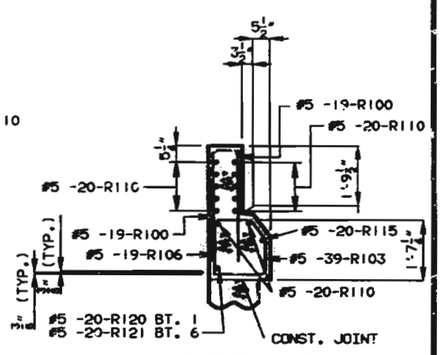
ELEVATION
(LOWER REINFORCEMENT)



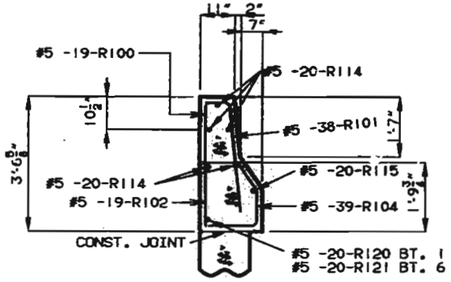
ELEVATION
(LOWER REINFORCEMENT)



PART SECTION A-A



PART SECTION B-B



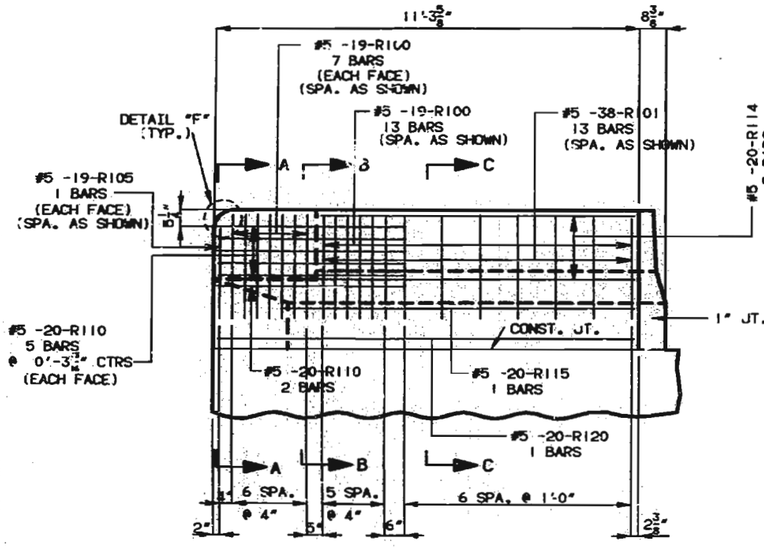
PART SECTION C-C



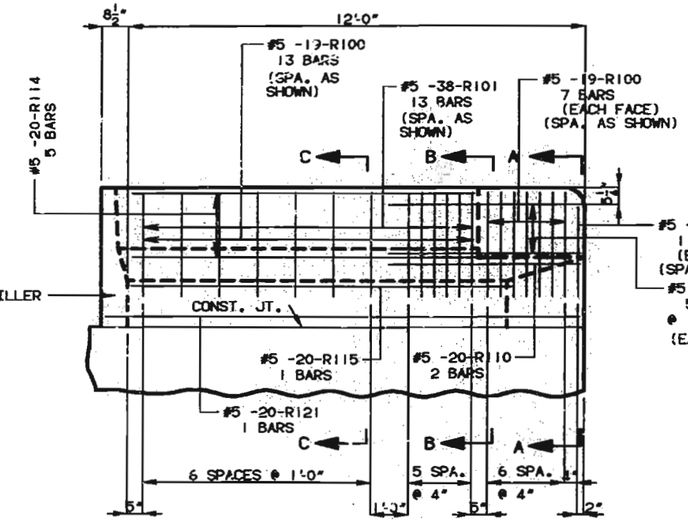
DETAIL "F"
(TYPICAL)

NOTE: FOR DETAILS OF GUARD RAIL ATTACHMENT SEE SHEET NO. 2

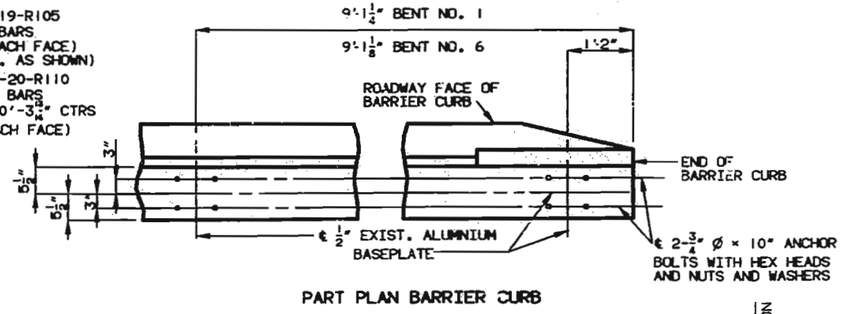
NOTE: INSULATION MATERIAL SHALL BE INSTALLED BETWEEN THE RAIL POST AND BARRIER CURB IN ACCORDANCE WITH STD. SPEC 714.2.5
CONTRACTOR SHALL VERIFY POST LOCATIONS BEFORE INSTALLING ANCHOR BOLTS IN NEW SAFETY BARRIER CURB.



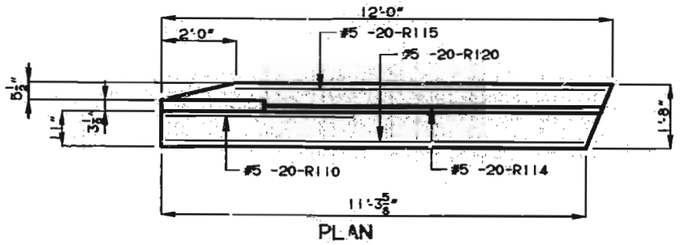
ELEVATION
(UPPER REINFORCEMENT)



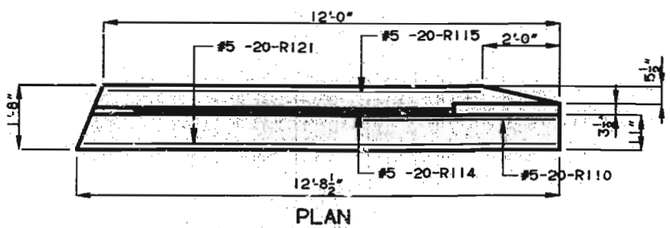
ELEVATION
(UPPER REINFORCEMENT)



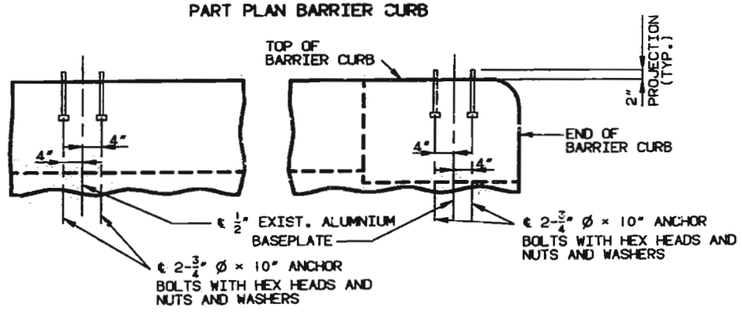
PART PLAN BARRIER CURB



PLAN
RIGHT BARRIER CURB OF BENT NO. 1



PLAN
RIGHT BARRIER CURB OF BENT NO. 6



PART ELEVATION OF BARRIER CURB

REVISED

DETAILED SEPT. 1991
CHECKED OCT. 1991

DETAILS OF RIGHT SAFETY BARRIER CURB AT END BENTS

NOTE: THIS DRAWING IS NOT TO SCALE. FOLLOW DIMENSIONS.

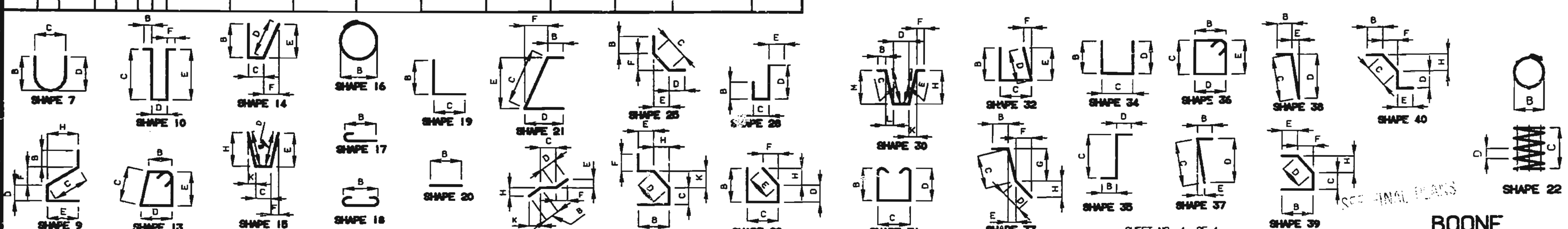
BOONE COUNTY L-264R1

STATE	PROJ. NO.	SHEET NO.
MO.		22

COMPLETE BILL OF REINFORCING STEEL

NO. REQD	SIZE	MARK	SHAPE	GRADE	STIRRUP	EPOXY	DIMENSIONS (FEET) B	C	D	E	F	H	K	UNIT LENGTH (FEET)	TOTAL LENGTH (FT)	(IN)	TOTAL WEIGHT
END BTS. 1 & 6																	
4	6	H100	20	60		E	12.583							12.583	50	4	76
	6	H101	20	60			9.971							9.971			
3							12.195							12.195	33	3	50
	6	H101	20	60			9.971							9.971			
3							12.195							12.195	33	3	50
	6	H102	20	60			10.832							10.832			
2							12.740							12.740	23	7	35
	6	H102	20	60			10.832							10.832			
2							12.740							12.740	23	7	35
2	6	H103	20	60		E	13.716							13.716	27	6	41
6	4	U100	21	60	S		3.917	1.177	4.252	1.083	0.460			9.131	54	10	37
10	6	V100	17	60		E	2.120							2.807	28	1	42
10	6	V101	20	60		E	2.260							2.260	22	8	34
	6	V102	20	60			1.338							1.338			
3							2.688							2.688	6	1	9
	6	V102	20	60			1.338							1.338			
3							2.688							2.688	6	1	9
	6	V102	20	60			1.338							1.338			
3							2.688							2.688	6	1	9
	6	V102	20	60			1.338							1.338			
3							2.688							2.688	6	1	9
															TOTAL		436
BARRIER CURB																	
54	5	R100	19	60	S	E	0.583	2.917						3.392	183	3	191
26	5	R101	38	60	S	E	0.648	2.930	2.916	0.292				3.487	90	8	95
26	5	R102	19	60	S	E	0.625	1.719						2.236	58	2	61
4	5	R103	39	60	S	E	1.290	0.968	0.654	0.895	0.395	0.521		3.644	14	7	15
26	5	R104	39	60	S	E	1.292	0.971	0.912	0.768	0.523	0.747		3.779	98	4	102
4	5	R105	19	60	S	E	0.583	2.735						3.210	12	11	13
4	5	R106	19	60	S	E	0.635	1.490						2.017	8	1	8
12	5	R107	34	60	S	E	2.865	0.958	2.865					6.472	77	8	81
24	5	R110	20	60		E	5.000							5.000	120	1	125
10	5	R114	20	60		E	8.302							8.302	83	1	87
2	5	R115	20	60		E	9.808							9.808	19	8	20
3	5	R120	20	60		E	11.103							11.103	33	4	35
1	5	R121	20	60		E	12.372							12.372	12	5	13
															TOTAL		847

358 478



SHEET NO. 4 OF 4.

NOTES:

ALL STANDARD HOOKS AND BENDS OTHER THAN 180 DEG. TO BE BENT WITH SAME PROCEDURE AS FOR 90 DEG. STD. HOOKS.

HOOKS AND BENDS SHALL BE IN ACCORDANCE WITH THE PROCEDURES AS SHOWN ON THIS SHEET.

VARIES BAR DIMENSIONS VARY IN EQUAL INCREMENTS BETWEEN DIMENSIONS SHOWN ON THIS LINE AND THE FOLLOWING LINE.

NO. EA. - NUMBER OF BARS OF EACH LENGTH.

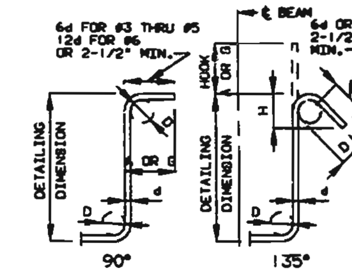
UNIT LENGTHS ARE MEASURED ALONG CENTER-LINE BAR.

FOUR ANGLE OR CHANNEL SPACERS ARE REQUIRED FOR EACH COLUMN SPIRAL. SPACERS ARE TO BE PLACED ON THE INSIDE OF SPIRALS. LENGTH AND WIDTH OF SPIRAL DOES NOT INCLUDE SPLICES OR SPACERS.

E=EPOXY COATED REINFORCEMENT.
S=STIRRIP.

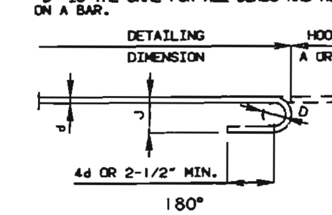
PAYWEIGHT IS BASED ON ACTUAL LENGTHS.

REINFORCING STEEL (GRADE 60) = FY 60,000 PSI

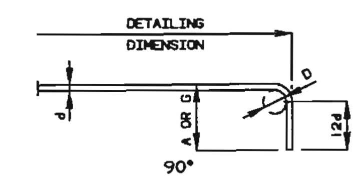


STIRRUP HOOK DIMENSIONS				
GRADES 40 - 50 - 60 KSI				
BAR SIZE	D (IN.)	90° HOOK	135° HOOK	
		HOOK A OR G	HOOK A OR G	APPROX. H
#3	1-1/2"	4"	4"	2-1/2"
#4	2"	4-1/2"	4-1/2"	3"
#5	2-1/2"	6"	5-1/2"	3-3/4"
#6	4-1/2"	12"	7-3/4"	4-1/2"

NOTE: UNLESS OTHERWISE NOTED DIAMETER "D" IS THE SAME FOR ALL BENDS AND HOOKS ON A BAR.



SIZE OF 180° HOOKS



SIZE OF 90° HOOKS

END HOOK DIMENSIONS				
BAR SIZE	D (IN.)	180° HOOKS		90° HOOKS
		ALL GRADES		ALL GRADES
		A OR G	J	A OR G
#3	2-1/4"	5"	3"	6"
#4	3"	6"	4"	8"
#5	3-3/4"	7"	5"	10"
#6	4-1/2"	8"	6"	12"
#7	5-1/4"	10"	7"	14"
#8	6"	11"	8"	16"
#9	9-1/2"	15"	11-3/4"	19"
#10	10-3/4"	17"	13-1/4"	22"
#11	12"	19"	14-3/4"	2'-0"
#14	18-1/4"	2'-3"	21-3/4"	2'-7"

NOTE: TWO ADDITIONAL #5R120 AND #6H100 ARE INCLUDED IN BAR BILL FOR TESTING PURPOSES.

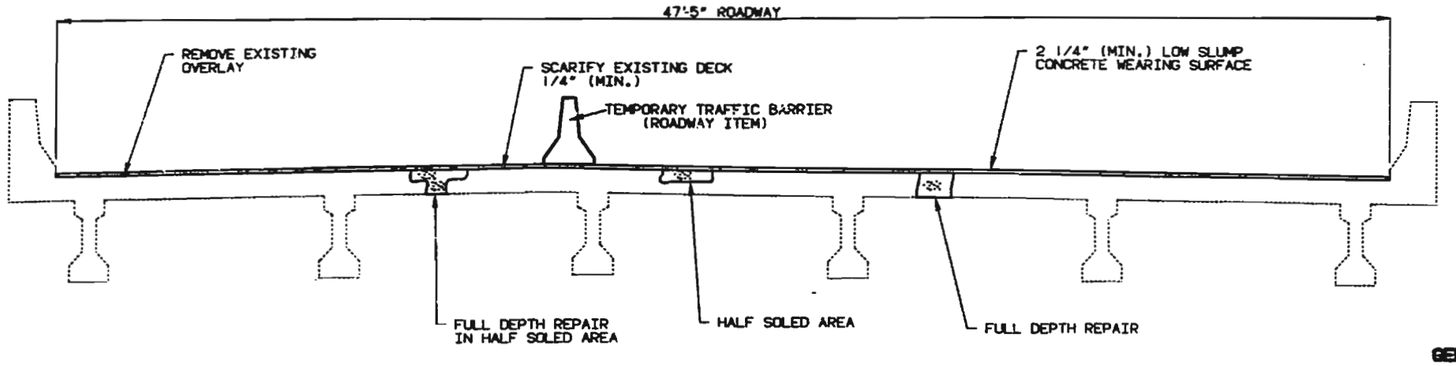
SEE FINAL PLANS

BOONE COUNTY

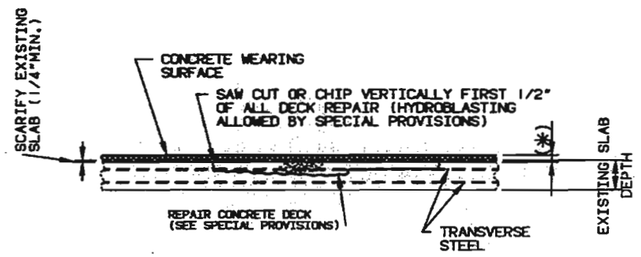
L-264R1

MISSOURI HIGHWAY AND TRANSPORTATION COMMISSION

STATE	PROJ. NO.	SHEET NO.
MO.	IM-70-3(158)	19
SEC./SUR. 8	TWP. 48N	RGE. 12W

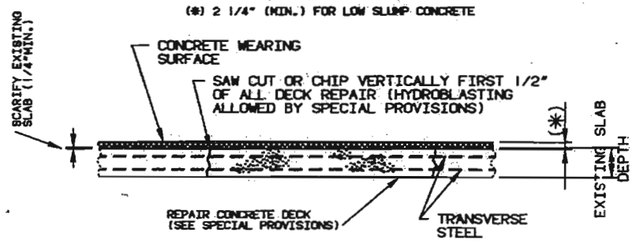


TYPICAL SECTION THRU SLAB



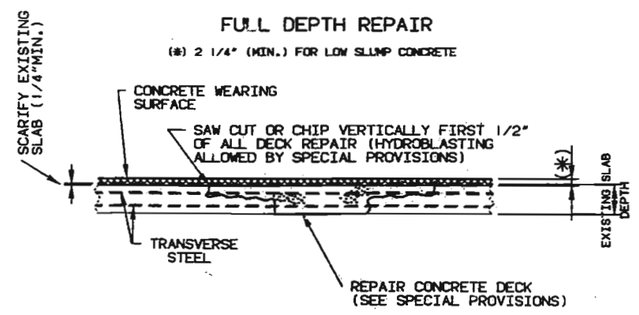
HALF-SOLED AREA

(*) 2 1/4" (MIN.) FOR LOW SLUMP CONCRETE



FULL DEPTH REPAIR

(*) 2 1/4" (MIN.) FOR LOW SLUMP CONCRETE



FULL DEPTH REPAIR
HALF-SOLED AREA

(*) 2 1/4" (MIN.) FOR LOW SLUMP CONCRETE

GENERAL NOTES:

DESIGN SPECIFICATIONS: A.A.S.H.T.O. 1989 AND INTERIM 1990

DESIGN UNIT STRESSES:
CLASS B1 CONCRETE (SUPERSTRUCTURE) F'C=4,000 PSI.
REINFORCING STEEL (GRADE 60) FY=60,000 PSI.

REINFORCING STEEL:
MINIMUM CLEARANCE TO REINFORCING STEEL SHALL BE 1 1/2", UNLESS OTHERWISE SHOWN. DIMENSIONING TO REINFORCEMENT IS TO ℄ OF BAR UNLESS OTHERWISE SHOWN.

TRAFFIC MAINTAINED: TWO LANES OF TRAFFIC OVER STRUCTURE TO BE MAINTAINED DURING CONSTRUCTION.

OUTLINE OF OLD WORK IS INDICATED BY LIGHT DASHED LINES. HEAVY LINES INDICATE NEW WORK.

ALL JOINT FILLER SHALL MEET THE REQUIREMENTS OF STD. SPEC. 1057.2.4, EXCEPT AS NOTED.

COST OF ANY REQUIRED EXCAVATION FOR BRIDGE SHALL BE INCLUDED IN THE CONTRACT UNIT PRICE FOR OTHER ITEMS.

CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN FIELD BEFORE ORDERING NEW STEEL.

BARS BONDED IN OLD CONCRETE NOT REMOVED SHALL BE CLEANLY STRIPPED AND EMBEDDED INTO NEW CONCRETE WHERE POSSIBLE. IF LENGTH IS AVAILABLE, OLD BARS SHALL EXTEND INTO NEW CONCRETE AT LEAST 40 DIAMETERS FOR SMOOTH BARS AND 30 DIAMETERS FOR DEFORMED BARS, UNLESS OTHERWISE NOTED.

ESTIMATED QUANTITIES

ITEM		TOTAL
SPECIAL WORK (BRIDGES)	LUMP SUM	1
ASPHALT REMOVAL (BRIDGES)	SQ. FT.	10,550
SUBSTRUCTURE REPAIR (FORMED)	SQ. FT.	21
SUBSTRUCTURE REPAIR (UNFORMED)	SQ. FT.	109
REPAIRING CONCRETE DECK (HALF-SOLING)	SQ. FT.	0
FULL DEPTH REPAIR	SQ. FT.	0
LOW SLUMP CONCRETE WEARING SURFACE	SQ. YD.	1,173
REINFORCING STEEL (GRADE 60) (EPOXY COATED)	LB.	500
CLASS B1 CONCRETE	CU. YD.	4.1
REINFORCING STEEL (GRADE 60)	LB.	110

REPAIRS TO:
BRIDGE OVER HINKSON CREEK

STATE ROAD: INTERSTATE 70
IN COLUMBIA
PROJECT NO. IM-70-3(158) STA. 813+60
JOB NO. J5I0449 RTE. I-70 E.B.L.
BOONE COUNTY

STD. L-264R1

DESIGNED JULY 1991
DETAILED JULY 1991
CHECKED OCT. 1991

NOTE: THIS DRAWING IS NOT TO SCALE. FOLLOW DIMENSIONS.

SHEET NO. 1A OF 4.

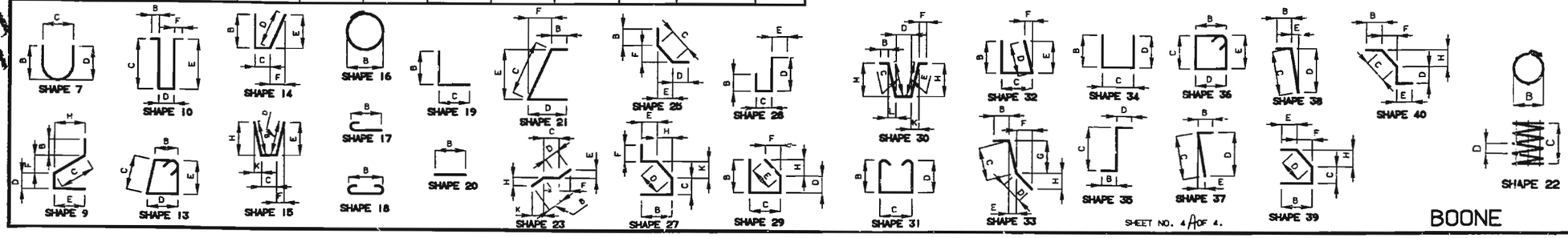
DATE: 11/20/91

339 479

COMPLETE BILL OF REINFORCING STEEL

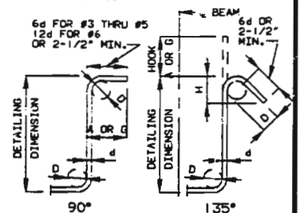
NO. REQD	SIZE	MARK	SHAPE	GRADE	STIRRUP EPOXY	DIMENSIONS (FEET) B	C	D	E	F	H	K	UNIT LENGTH (FEET)	TOTAL LENGTH (FT) (IN)	TOTAL WEIGHT
END BT. NO. 6															
2	6	H102	20	60		10.832							10.832	21 8	33
2	6	H102	20	60		12.740							12.740	25 6	38
2	6	H103	20	60	E	13.716							13.716	27 6	41
3	4	U100	21	60	S	3.917	1.177	4.252	1.083	0.460			9.131	27 5	18
3	6	V100	17	60	E	2.120							2.807	14 1	21
5	6	V101	20	60	E	2.260							2.260	11 4	17
2	6	V102	20	60		1.338							1.338	2 8	4
2	6	V102	20	60		2.013							2.013	4 1	6
2	6	V102	20	60		2.688							2.688	5 5	8
														TOTAL	186
BARRIER CURB															
27	5	R100	19	60	S E	0.583	2.917						3.392	91 8	96
13	5	R101	38	60	S E	0.648	2.930	2.916	0.292				3.487	45 4	48
13	5	R102	19	60	S E	0.325	1.719						2.236	29 1	31
2	5	R103	39	60	S E	1.290	0.968	0.654	0.895	0.395	0.521		3.644	7 4	8
13	5	R104	39	60	S E	1.292	0.971	0.912	0.768	0.523	0.747		3.779	49 2	51
2	5	R105	19	60	S E	0.583	2.735						3.210	6 5	7
2	5	R106	19	60	S E	0.635	1.490						2.017	4 1	4
6	5	R107	34	60	S E	2.865	0.958	2.865					6.472	38 10	41
12	5	R110	20	60	E	5.000							5.000	60 0	63
5	5	R114	20	60	E	8.302							8.302	41 6	44
1	5	R115	20	60	E	9.808							9.808	9 10	10
1	5	R121	20	60	E	12.372							12.372	12 5	13
														TOTAL	416

358 480



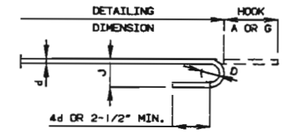
STATE	PROJ. NO.	SHEET NO.
MO.	IM-70-3(158)	22

NOTES:
ALL STANDARD HOOKS AND BENDS OTHER THAN 180 DEG. TO BE BENT WITH SAME PROCEDURE AS FOR 90 DEG. STD. HOOKS.
HOOKS AND BENDS SHALL BE IN ACCORDANCE WITH THE PROCEDURES AS SHOWN ON THIS SHEET.
VARIES BAR DIMENSIONS VARY IN EQUAL INCREMENTS BETWEEN DIMENSIONS SHOWN ON THIS LINE AND THE FOLLOWING LINE.
NO. EA. - NUMBER OF BARS OF EACH LENGTH.
UNIT LENGTHS ARE MEASURED ALONG CENTER-LINE BAR.
FOUR ANGLE OR CHANNEL SPACERS ARE REQUIRED FOR EACH COLUMN SPIRAL. SPACERS ARE TO BE PLACED ON THE INSIDE OF SPIRALS. LENGTH AND WIDTH OF SPIRAL DOES NOT INCLUDE SPLICES OR SPACERS.
E=EPOXY COATED REINFORCEMENT.
S=STIRRIP.
PAYWEIGHT IS BASED ON ACTUAL LENGTHS.
REINFORCING STEEL (GRADE 60)
= FY 60,000 PSI

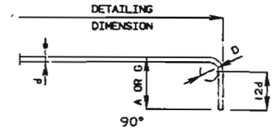


STIRRUP HOOK DIMENSIONS GRADES 40 - 50 - 60 KSI				
BAR SIZE	D (IN.)	90° HOOK	135° HOOK	
		HOOK A OR G	HOOK A OR G	APPROX. H
#3	1-1/2"	4"	4"	2-1/2"
#4	2"	4-1/2"	4-1/2"	3"
#5	2-1/2"	6"	5-1/2"	3-3/4"
#6	4-1/2"	12"	7-3/4"	4-1/2"

NOTE: UNLESS OTHERWISE NOTED DIAMETER "D" IS THE SAME FOR ALL BENDS AND HOOKS ON A BAR.



SIZE OF 180° HOOKS



SIZE OF 90° HOOKS

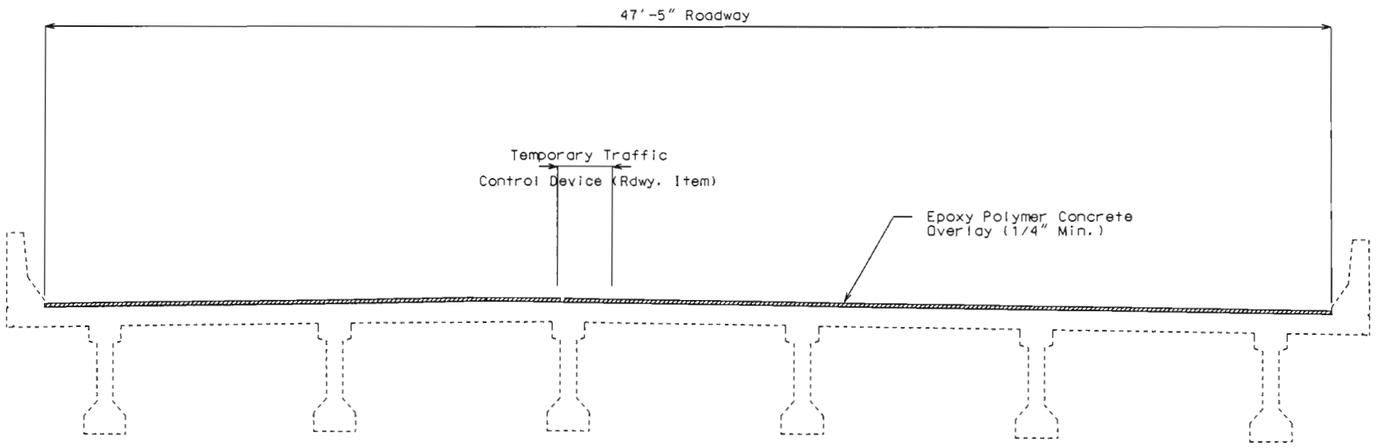
END HOOK DIMENSIONS				
BAR SIZE	D (IN.)	180° HOOKS ALL GRADES		90° HOOKS ALL GRADES
		A OR G	J	A OR G
#3	2-1/4"	5"	3"	6"
#4	3"	6"	4"	8"
#5	3-3/4"	7"	5"	10"
#6	4-1/2"	8"	6"	12"
#7	5-1/4"	10"	7"	14"
#8	6"	11"	8"	16"
#9	9-1/2"	15"	11-3/4"	19"
#10	10-3/4"	17"	13-1/4"	22"
#11	12"	19"	14-3/4"	2'-0"
#14	18-1/4"	2'-3"	21-3/4"	2'-7"

NOTE: TWO ADDITIONAL #5R120 AND #6H100 ARE INCLUDED IN BAR BILL FOR TESTING PURPOSES.

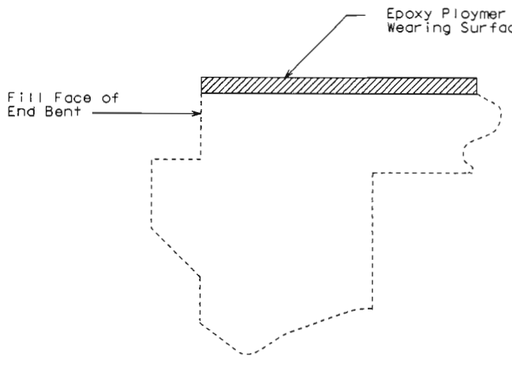
BOONE COUNTY L-264R1

MISSOURI HIGHWAY AND TRANSPORTATION COMMISSION

State	Proj. No.	Sheet No.
MO		812A
SEC/SUR 8	TWP 48 N	RGE 12 W



SECTION THRU SLAB



TYPICAL SECTION THRU END BENTS

Note: The contractor shall exercise care to ensure spillage over joint edges is prevented and that a neat line is obtained along any terminating edge of the epoxy polymer concrete.

GENERAL NOTES:

OLD WORK:
Outline of old work is indicated by light dashed lines. Heavy lines indicate new work.

TRAFFIC CONTROL:
See roadway plans for traffic control during construction.

ESTIMATED QUANTITIES

ITEM		TOTAL
EPOXY POLYMER CONCRETE OVERLAY	SQ. YD.	1172

9-10-99

REPAIRS TO
BRIDGE OVER HINKSON CREEK

STATE ROAD RTE. I-70
IN COLUMBIA
PROJECT NO.
JOB NO. J5I0475

℄ ROADWAY
STA. 813+60.00 ±
(MATCH EXIST.)
RTE. I-70 EBL

BOONE COUNTY
Date: / /

STD.
L02643
REV.

Detailed SEPT. 1999
Checked SEPT. 1999

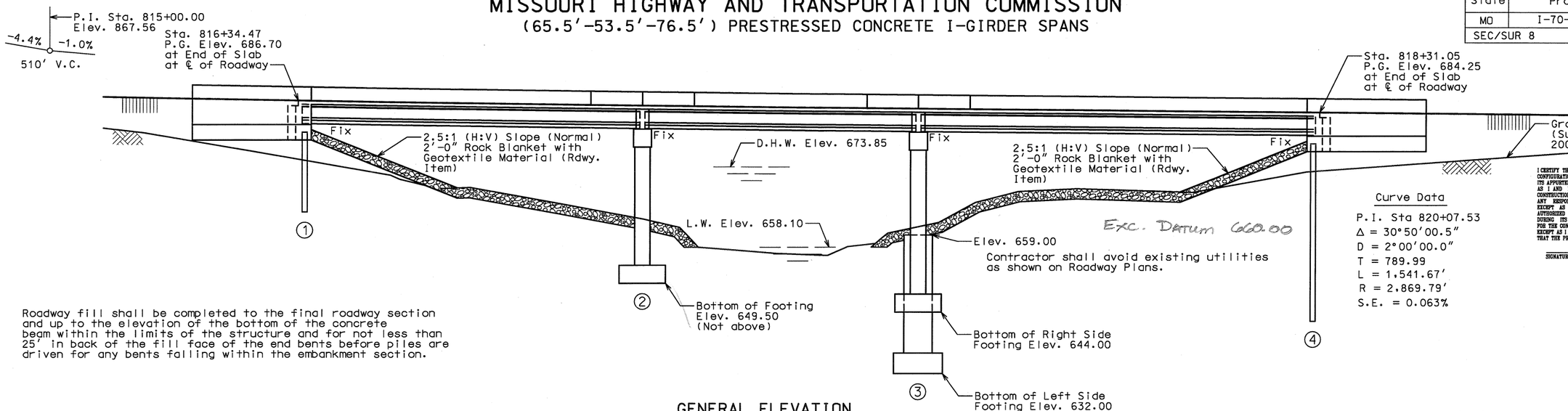
Note: This drawing is not to scale. Follow dimensions.

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MISSOURI HIGHWAY AND TRANSPORTATION COMMISSION

(65.5′-53.5′-76.5′) PRESTRESSED CONCRETE I-GIRDER SPANS

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B18
SEC/SUR 8	TWP 48N	RGE 12W



Roadway fill shall be completed to the final roadway section and up to the elevation of the bottom of the concrete beam within the limits of the structure and for not less than 25′ in back of the fill face of the end bents before piles are driven for any bents falling within the embankment section.

GENERAL ELEVATION

Curve Data

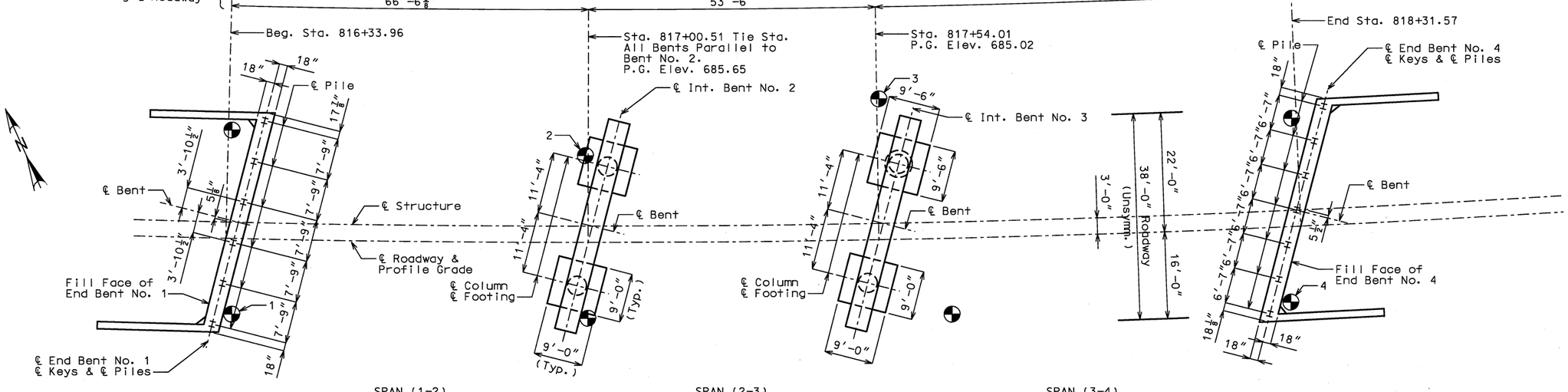
P.I. Sta 820+07.53
Δ = 30°50′00.5″
D = 2°00′00.0″
T = 789.99
L = 1,541.67′
R = 2,869.79′
S.E. = 0.063%

FINAL PLANS

I CERTIFY THAT THIS PLAN SHEET ACCURATELY DEPICTS THE CONFIGURATION AND LOCATION OF THE ROADWAY AND ALL ITS APPURTENANT FEATURES TO THE BEST OF MY KNOWLEDGE. AS I AND MY STAFF HAVE OBSERVED THE CONTRACTOR'S CONSTRUCTION OF THIS PROJECT, I SPECIFICALLY DISCLAIM ANY RESPONSIBILITY FOR THE DESIGN OF THIS PROJECT, EXCEPT AS I AND MY STAFF MAY HAVE MODIFIED OR AUTHORIZED THE MODIFICATION OF THE PROJECT DESIGN DURING ITS CONSTRUCTION AND I DISCLAIM RESPONSIBILITY FOR THE CONTRACTOR'S ACTUAL CONSTRUCTION OF THE PROJECT, EXCEPT AS I AND MY STAFF MAY HAVE DIRECTED OR OBSERVED THAT THE PROJECT BE CONSTRUCTED.

SIGNATURE _____ DATE _____

Temporary shoring required at Left Wing of End Bent No. 4 as shown on Roadway Plans. (Rdwy. Item)



PLAN

"⊕" Indicates location of borings.

Notice and Disclaimer Regarding Boring Log Data

The locations of all subsurface borings for this structure are shown on the bridge plan sheet for this structure. Boring data for the numbered locations is shown on Sheet No. 3. The boring data for all locations indicated, as well as any other boring logs or other factual records of subsurface data and investigations performed by the department for the design of the project, is available from the Project Contact upon written request as outlined in the Project Special Provisions. No greater significance or weight should be given to the boring data depicted on the plan sheets than is subsurface data available from the district or elsewhere.

The Commission does not represent or warrant that any such boring data accurately depicts the conditions to be encountered in constructing this project. A contractor assumes all risks it may encounter in basing its bid prices, time or schedule of performance on the boring data depicted here or those available from the district, or on any other documentation not expressly warranted, which the contractor may obtain from the Commission.

Note: For General Notes, Pile Data, Hydraulic Data, Location sketch and Estimated Quantity Tables, see Sheet No. 2.

B.M. – BOLT HEAD ON SW BARRIER WALL OF WESTBOUND BRIDGE A-6951 ON RTE. I-70 OVER HINKSON CREEK ELEV. = 690.80

B.M. #1 – CHISLED "□" IN THE SW CORNER OF SW WINGWALL OF WESTBOUND BRIDGE (L-942) ON RTE. I70 OVER HINKSON CREEK ELEV. = 686.71

BRIDGE OVER HINKSON CREEK

STATE ROAD FROM RTE 763 TO CALLAWAY COUNTY LINE

ABOUT 0.2 MILES WEST OF RTE 63

PROJECT NO. I-70-3(200) **STA. 816+33.96**

JOB NO. J5I0789 **RTE. I-70 WBL**

BOONE COUNTY

Date: / /

STD. 609.00	
STD. 706.35	
A6951	REV.

Designed May 2003
Detailed June 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1A of 38

1 ADD THIS SHEET 03-29-04

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State	Proj. No.	Sheet No.
MO	I-70-3(200)	B19

FINAL PLANS

I CERTIFY THAT THIS PLAN SHEET ACCURATELY DEPICTS THE CONFIGURATION AND LOCATION OF THE ROADWAY AND ALL ITS APPURTENANT FEATURES, TO THE BEST OF MY KNOWLEDGE, AS I AND MY STAFF HAVE OBSERVED THE CONTRACTOR'S CONSTRUCTION OF THIS PROJECT. I SPECIFICALLY DISCLAIM ANY RESPONSIBILITY FOR THE DESIGN OF THIS PROJECT, EXCEPT AS I AND MY STAFF MAY HAVE MODIFIED OR AUTHORIZED THE MODIFICATION OF THE PROJECT DESIGN DURING ITS CONSTRUCTION; AND I DISCLAIM RESPONSIBILITY FOR THE CONTRACTOR'S ACTUAL CONSTRUCTION OF THE PROJECT, EXCEPT AS I AND MY STAFF MAY HAVE DIRECTED OR ORDERED THAT THE PROJECT BE CONSTRUCTED.

SIGNATURE _____ DATE _____

Final Quantities

Item		Substr.	Superstr.	Total
Class 1 Excavation	cu. yard	45		45
Class 2 Excavation	cu. yard	158		158
Class 2 Excavation in Rock	cu. yard	131		131
Cofferdams - Bent 2	lump sum	1		1
Cofferdams - Bent 3	lump sum	1		1
Bridge Approach Slab (Bridge)	sq. yard		213	213
Structural Steel Pile (12 in)	linear foot	379		379
Pile Point Reinforcement	each	13		13
Class B Concrete (Substr)	cu. yard	192.6		192.6
Slab on Concrete I-Girder	sq. yard		891	891
* Safety Barrier Curb	linear foot		480	480
Laminated Neoprene Bearing Pad (Tapered)	each		30	30
Prestressed Concrete I-Girder (65.5 ft. span)	each		5	5
Prestressed Concrete I-Girder (53.5 ft. span)	each		5	5
Prestressed Concrete I-Girder (76.5 ft. span)	each		5	5
Diamond Grinding of Bridge Deck	sq. yard		932	932
Reinforcing Steel (Bridges)	pound	23,340		23,340
Vertical Drain at End Bents	each			2
Prebore (#5004)	linear foot	32		32
Excavation, Bent 3, Left Footing (#5022)	cu. yard	69.5		69.5
Bearing Pile, Bent 1, Pile #2 (#5023)	each	2395.46		2395.46
Supplementary Foundation Test Holes (#5024)	each	36		36

* Safety barrier curb shall be cast-in-place option or slip-form option.

All reinforcement in the end bents is included in the Estimated Quantities for Slab on Concrete I-Girder.

All concrete above the intermediate beam cap is included in the Estimated Quantities for Slab on Concrete I-Girder.

All concrete above the construction joint in the end bents is included in the Estimated Quantities for Slab on Concrete I-Girder.

The cost of furnishing, fabricating and installing Neoprene Bearing Pads, complete-in-place, will be paid for at the contract unit price for Laminated Neoprene Bearing Pads (Tapered) per each.

General Notes:

Design Specifications:
2002 - AASHTO 17th Edition
Load Factor Design
Seismic Performance Category A

Design Loading:
HS20 Modified (Alt. Military)
35#/Sq. Ft. Future Wearing Surface
Earth 120 #/Cu. Ft., Equivalent Fluid Pressure 45#/Cu. Ft.
Superstructure: Simply-supported, non-composite for dead load.
Continuous composite for live load.

Design Unit Stresses:

Class B Concrete (Substructure)	f'c = 3,000 psi
Class B-2 Concrete (Superstructure, except Prestressed Girders and Safety Barrier Curb)	f'c = 4,000 psi
Class B-1 Concrete (Safety Barrier Curb)	f'c = 4,000 psi
Reinforcing Steel (Grade 60)	fy = 60,000 psi

For Precast Prestressed Panel Stresses, see Sheet No. 23.
For Prestressed Girder Stresses, see Sheets No. 18, 19, & 20.

Neoprene Pads:
Bearings shall be 60 durometer neoprene pads. The neoprene pad shall be bonded to the bearing seat with an epoxy adhesive as approved by the bearing manufacturer for bonding neoprene to concrete.

Joint Filler:
All joint filler shall meet the requirements of Section 1057.2.4 of the Missouri Standard Specifications, except as noted.

Reinforcing Steel:
Minimum clearance to reinforcing steel shall be 1-1/2", unless otherwise shown.

Traffic Handling:
Use existing bridge L-942 during construction.

Quantities for Slab on Concrete I-Girder

Item		Total	
Reinforcing Steel	pound	13,100	
Reinforcing Steel (Epoxy Coated)	pound	57,290	
Class B-2 Concrete	cu. yard	278.3	(**)

The table of Estimated Quantities for Slab on Concrete I-Girder represents the quantities used by the state in preparing the cost estimate for concrete slabs. Variations may be encountered in these estimated quantities but these variations cannot be used for an adjustment in the contract unit price per square yard of Slab on Concrete I-Girder.

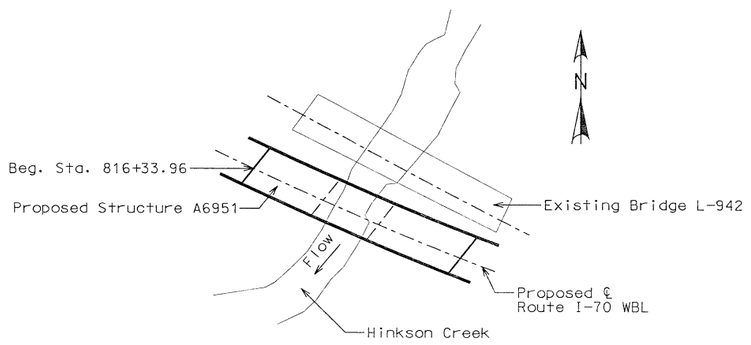
The Estimated Quantities for Slab on Concrete I-Girder are based on skewed precast prestressed end panels.

The prestressed panel quantities are not included in the table of Estimated Quantities for Slab on Concrete I-Girder.

See Special Provisions for method of forming slab.

(**) Based on minimum top flange thickness and minimum joint filler thickness.

HYDROLOGIC DATA		
Drainage Area	=	43.2 sq. miles (Hilly)
Design Discharge	=	15,000 cu. ft./sec. (100 years)
Design H.W. Elev.	=	673.85 feet (100 years)
Estimated Backwater	=	Negligible
OVERTOPPING FLOOD DATA		
Discharge	=	Greater than 500 years



LOCATION SKETCH

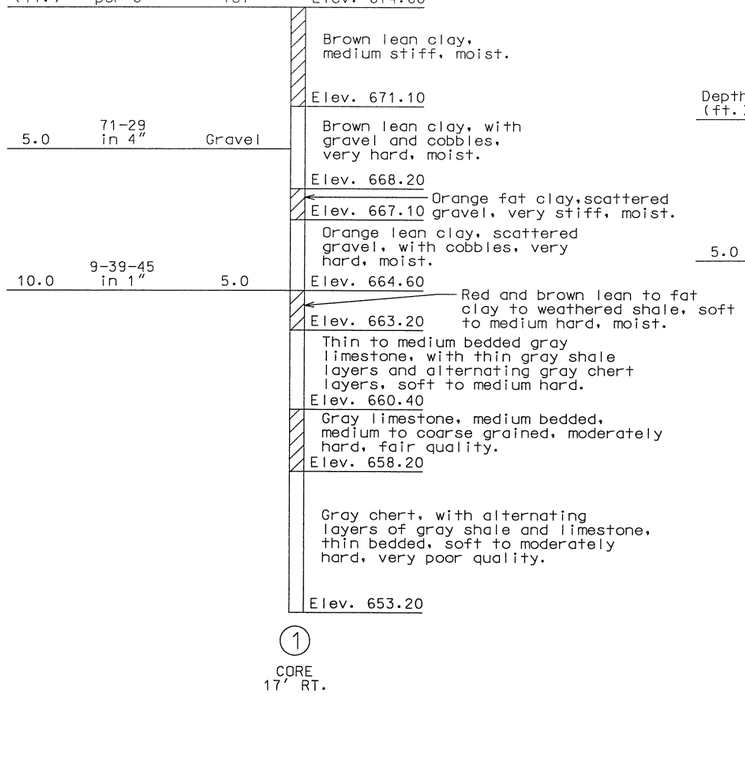
Pile and Footing Data

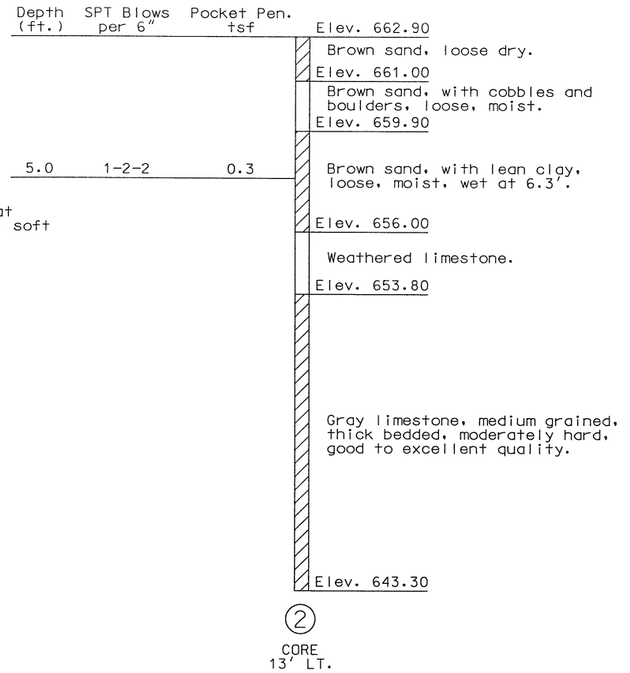
Bent No.		1	2	3	4
Bearing Pile	Pile Type and Size	HP12 X 53			HP12 X 53
	Number	6			7
	Average Length foot	15			49
	Design Bearing ton	69.2			63.4
	Hammer Energy Required foot-pound	15,600			14,300
Spread Footings	Foundation Material		Rock	Rock	
	Design Bearing ton/sq. foot		7.2	7.6	

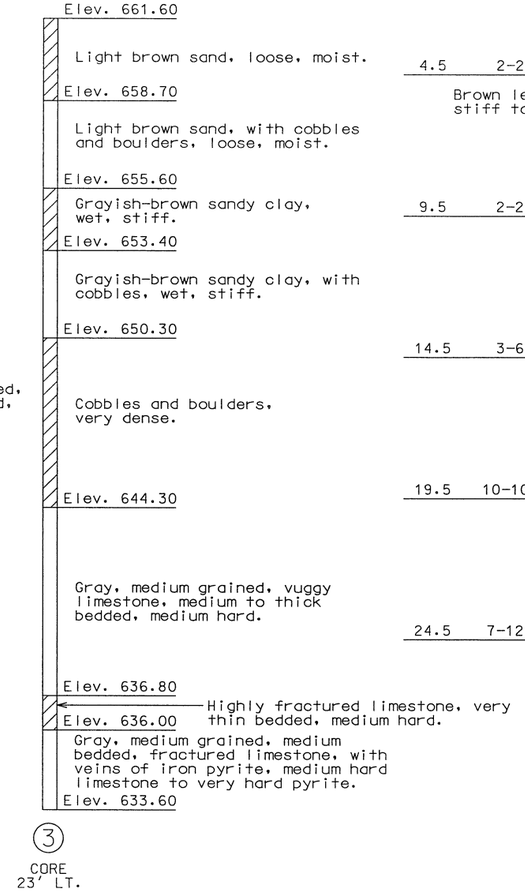
Minimum energy requirement of hammer is based on plan length and design bearing value of piles.

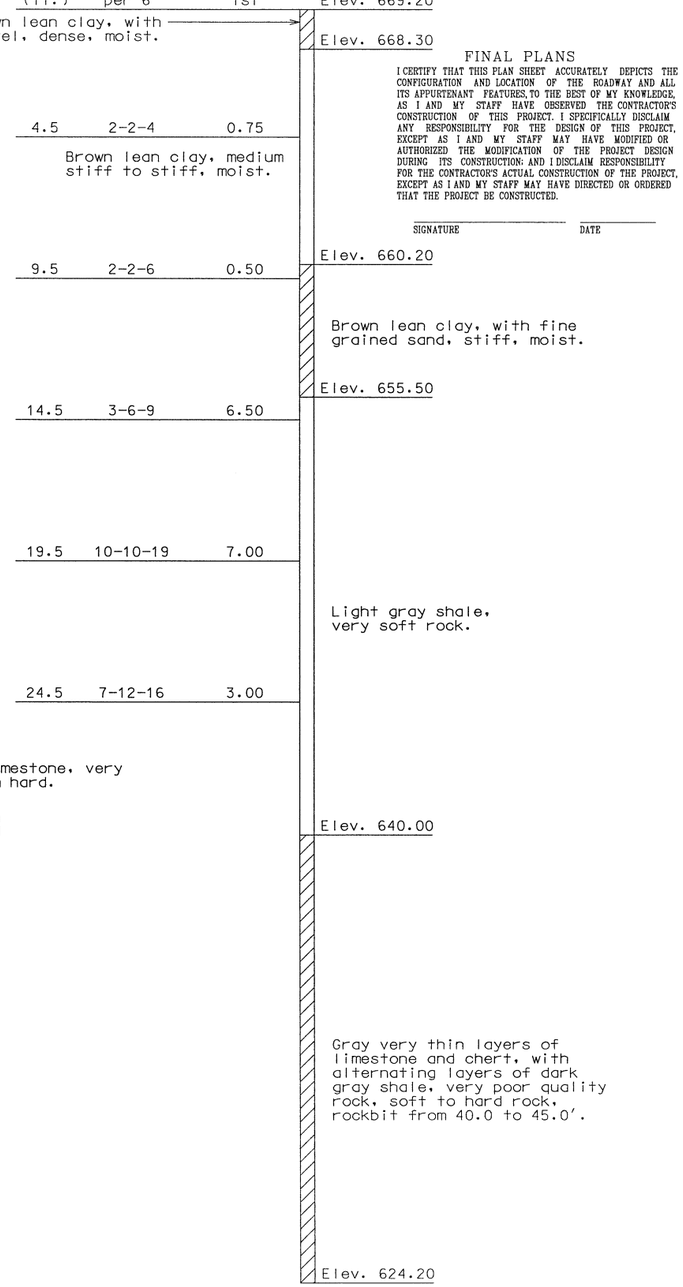
All piles shall be driven to practical refusal.

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B20









FINAL PLANS

I CERTIFY THAT THIS PLAN SHEET ACCURATELY DEPICTS THE CONFIGURATION AND LOCATION OF THE ROADWAY AND ALL ITS APPURTENANT FEATURES, TO THE BEST OF MY KNOWLEDGE, AS I AND MY STAFF HAVE OBSERVED THE CONTRACTOR'S CONSTRUCTION OF THIS PROJECT. I SPECIFICALLY DISCLAIM ANY RESPONSIBILITY FOR THE DESIGN OF THIS PROJECT, EXCEPT AS I AND MY STAFF MAY HAVE MODIFIED OR AUTHORIZED THE MODIFICATION OF THE PROJECT DESIGN DURING ITS CONSTRUCTION; AND I DISCLAIM RESPONSIBILITY FOR THE CONTRACTOR'S ACTUAL CONSTRUCTION OF THE PROJECT, EXCEPT AS I AND MY STAFF MAY HAVE DIRECTED OR ORDERED THAT THE PROJECT BE CONSTRUCTED.

SIGNATURE _____ DATE _____

Note:

For location of borings and Notice and Disclaimer Regarding Boring Data, see sheet No. 1.

W.O.H. = Weight of Hammer

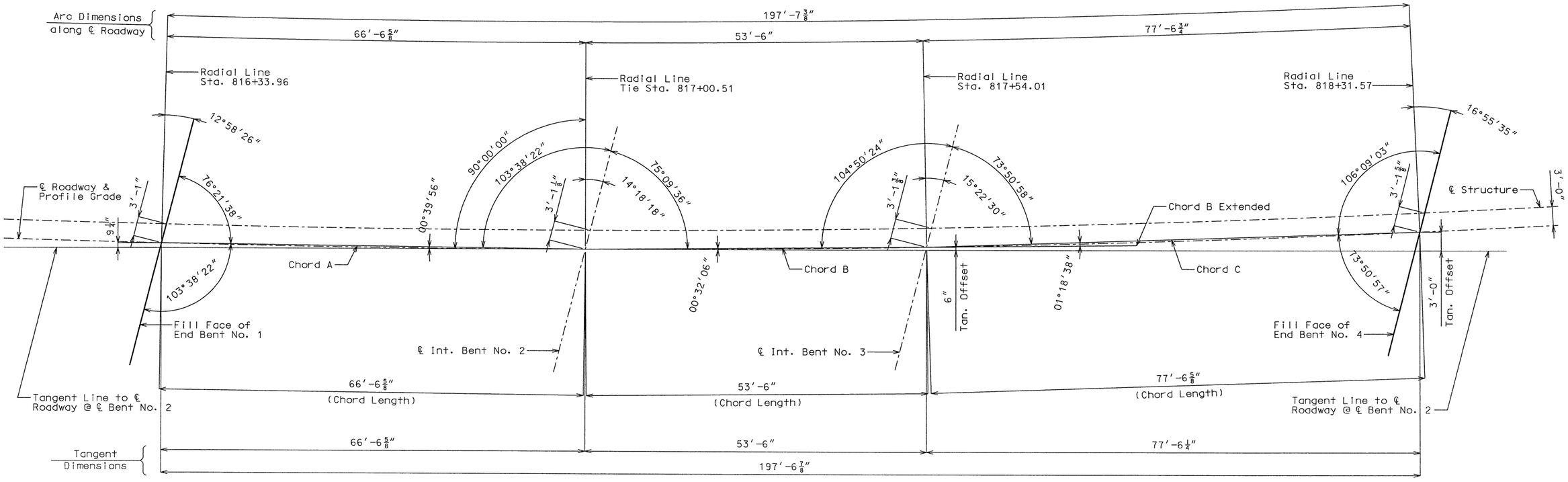
BORING DATA

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B21

FINAL PLANS

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SIGNATURE _____ DATE _____



PLAN SHOWING SUBSTRUCTURE LAYOUT

Note: All bents are parallel.
All dimensions are horizontal.

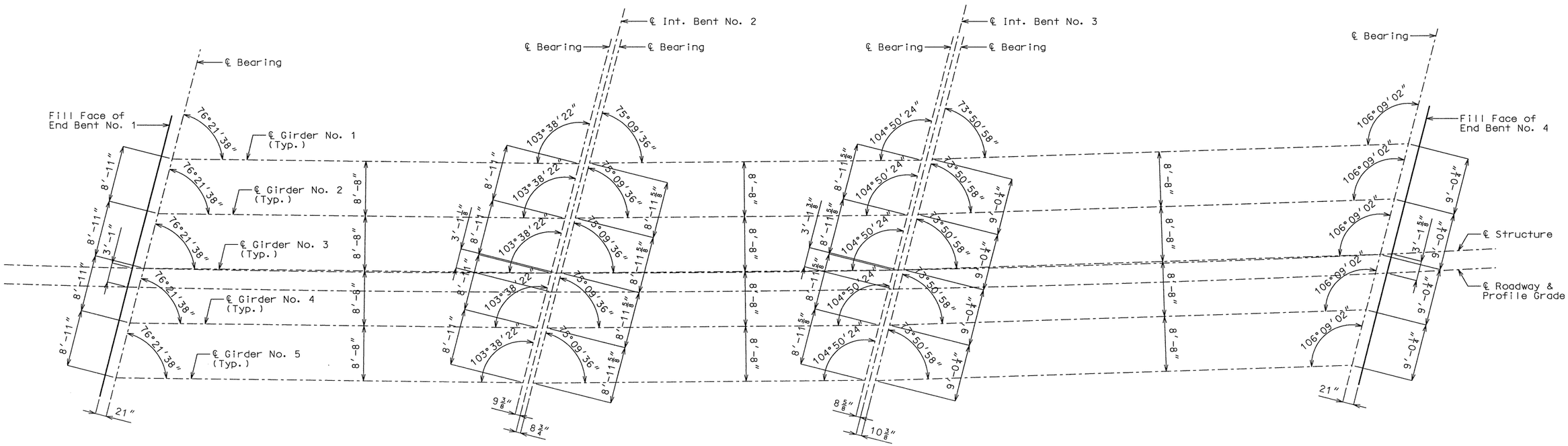
Detailed July 2003
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Note: This drawing is not to scale. Follow dimensions.

BOONE COUNTY A6951 REV.

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State	Proj. No.	Sheet No.
MO	I-70-3(200)	B22



SPAN (1-2) SPAN (2-3) SPAN (3-4)

PLAN SHOWING PRESTRESSED GIRDER LAYOUT AND BEARING ALIGNMENT

Note: All dimesions are horizontal.
All bents are parallel.

Detailed July 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

BOONE COUNTY A6951 REV.

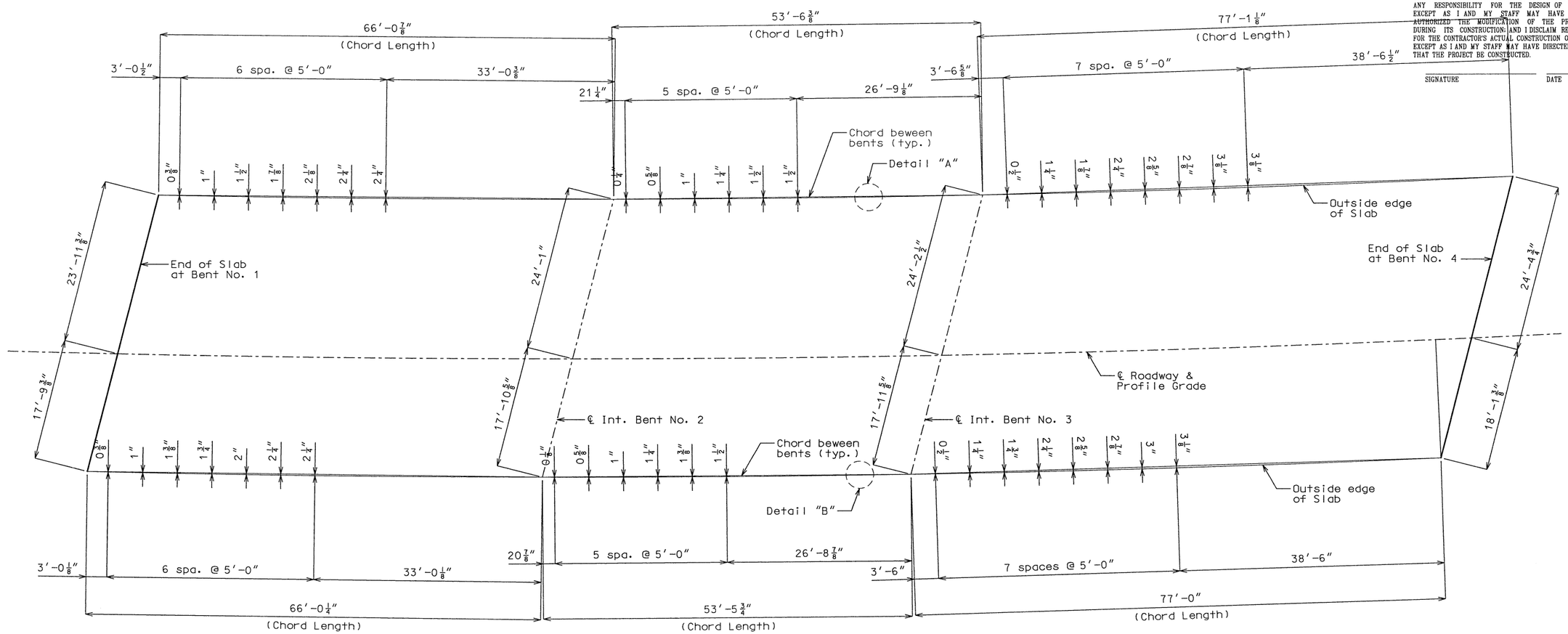
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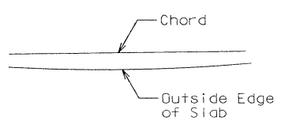
FINAL PLANS

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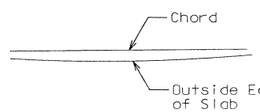
SIGNATURE _____ DATE _____



SPAN (1–2) SPAN (2–3) SPAN (3–4)



DETAIL "A"



DETAIL "B"

PLAN OF SLAB SHOWING CURVE ORDINATES

Note: All dimesions are horizontal.
All bents are parallel.

Detailed July 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

BOONE COUNTY A6951 REV.

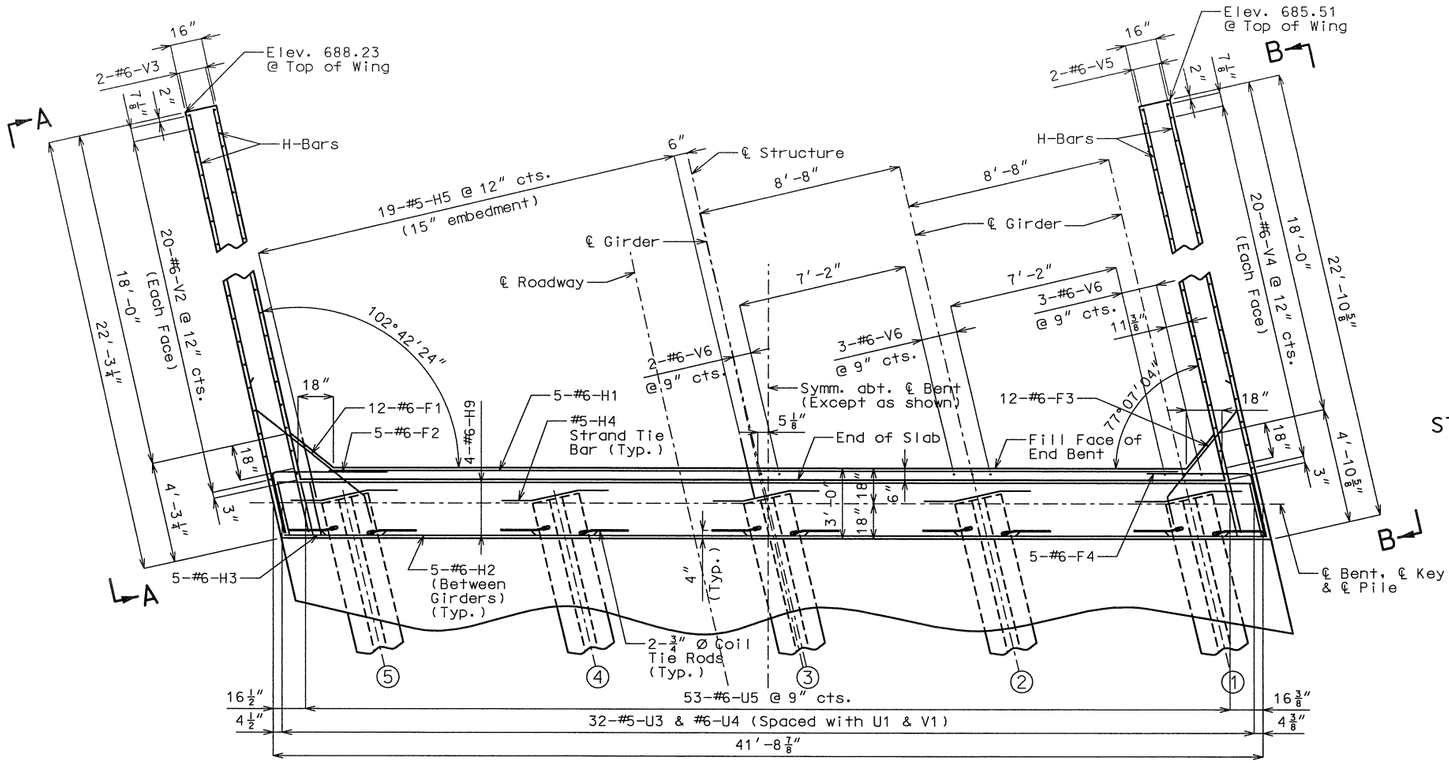
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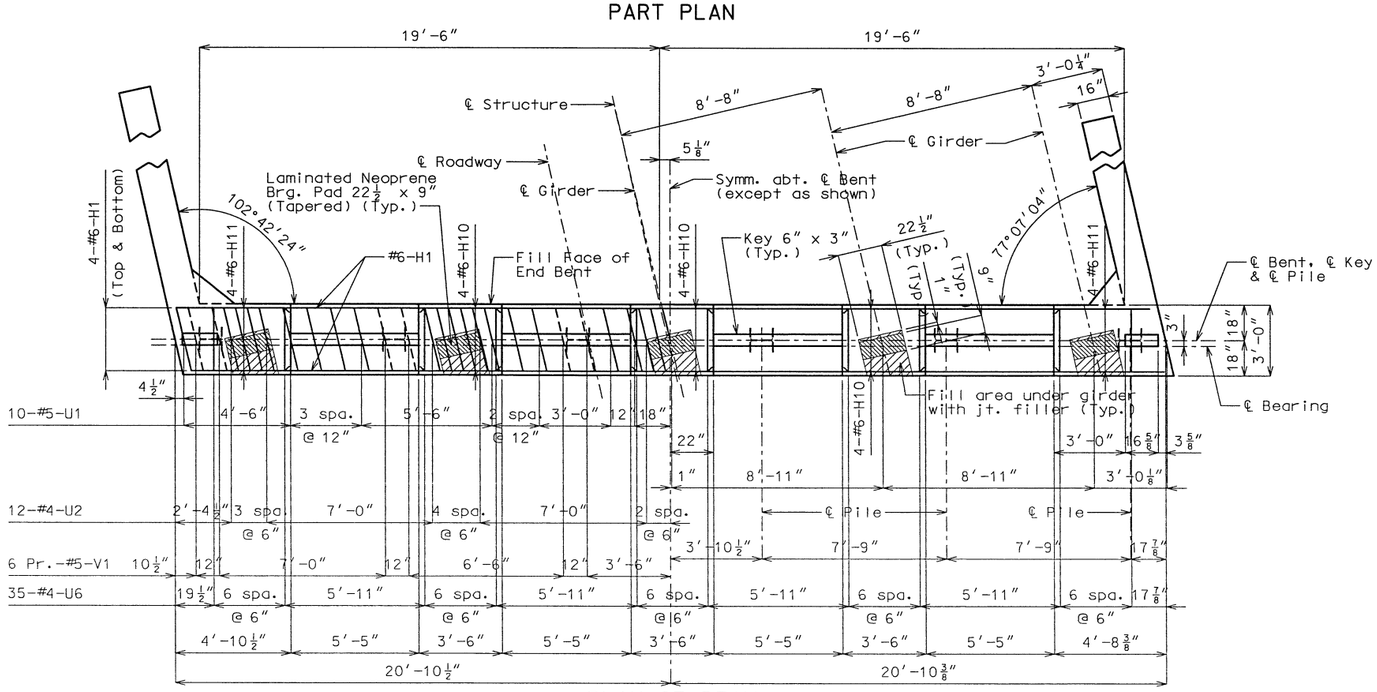
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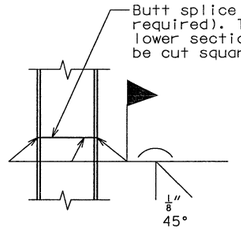


PART PLAN

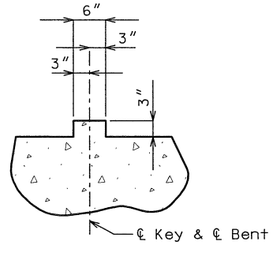


PLAN OF BEAM

DETAILS OF END BENT NO. 1



STEEL PILE SPLICE



TYPICAL SECTION
THRU KEY

Note:

For Elevations A-A & B-B and Section Thru Wing, see Sheet No. 9.

For location of #5-H4 (Strand Tie Bar), see Sheet No. 18.

For details and reinforcement of Safety Barrier Curb not shown, see Sheet Nos. 27 thru 32.

For details of approach slab, see Sheet No. 33.

For details of Vertical Drain at End Bent, see Sheet No. 10.

Bend #6-F1 & F3 bars in field to clear Prestressed Girders.

All strands at ends of girders shall be field bent or, if necessary, cut in field to maintain 1-1/2″ minimum clearance to fill face of end bent.

For location of Coil Tie Rods, see Sheet No. 18.

All U bars in End Bent to be placed parallel to ℄ Roadway.

All concrete in the end bent above top of beam and below top of slab shall be class B-2.

For Substructure Quantity Table and Section Near End Bent, see Sheet No. 8.

Detailed June 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 7 of 38

BOONE COUNTY A6951 REV.

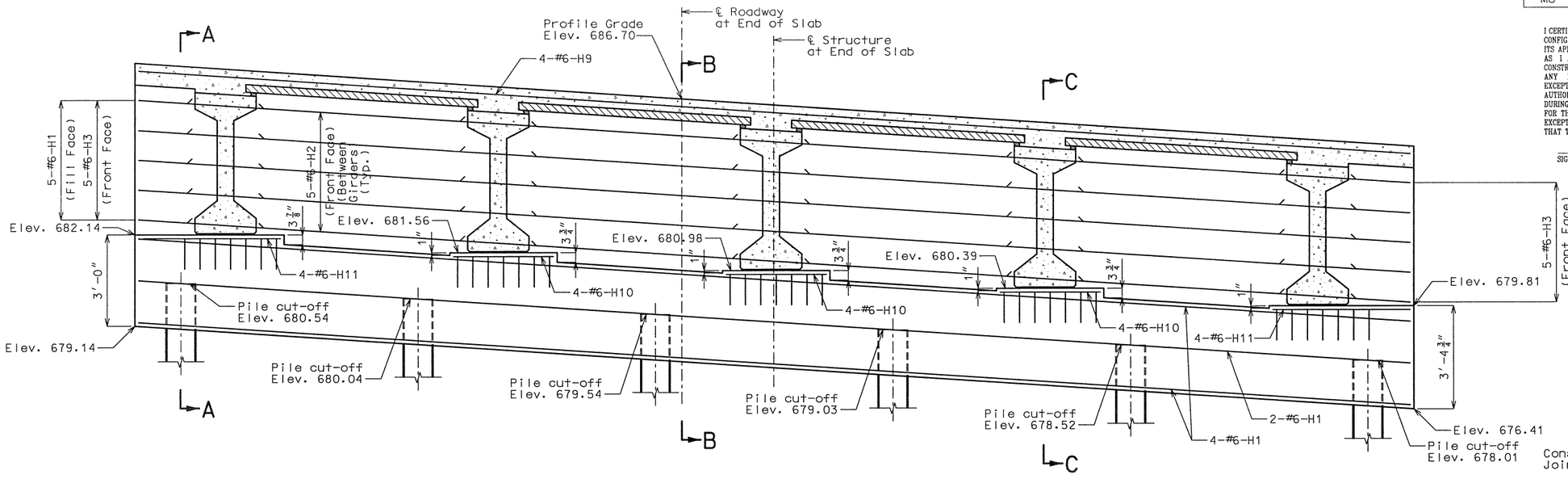
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State	Proj. No.	Sheet No.
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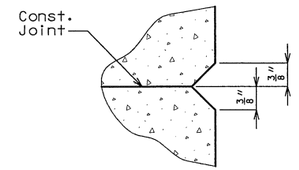
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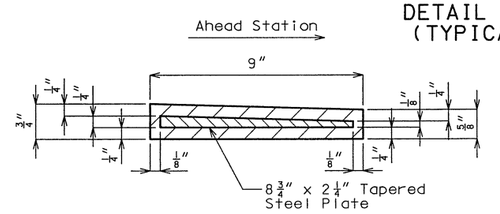
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SECTION NEAR END BENT

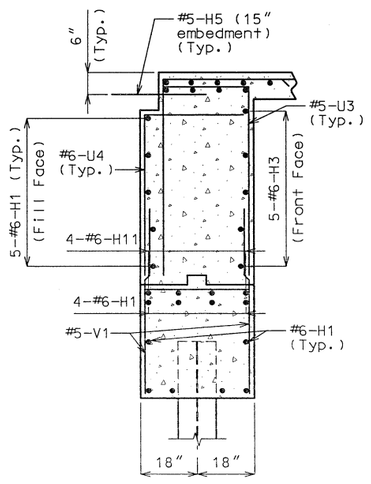


DETAIL "A" (TYPICAL)

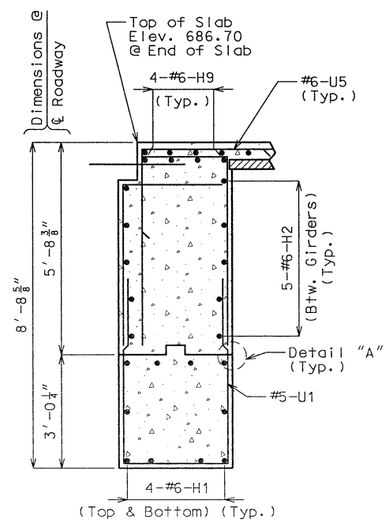


TYP. SECTION THRU LAMINATED NEOPRENE BEARING PAD (TAPERED)

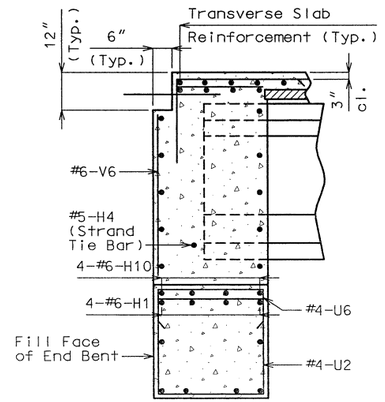
Note:
The required shim plate shall be placed between layers of elastomer and molded together to form an integral unit. Shop drawings are not required for laminated neoprene bearings on structures without sole plates.



SECTION A-A



SECTION B-B



SECTION C-C

Substructure Quantity Table for Bent No. 1

Item		Quantity
Class 1 Excavation	cu. yard	0
Structural Steel Pile (12in.)	linear foot	88
Pile Point Reinforcement	each	6
Class B Concrete (Substructure)	cu. yard	21.0

Note: These quantities are included in the Estimated Quantities Table on Sheet No. 2

DETAILS OF END BENT NO. 1

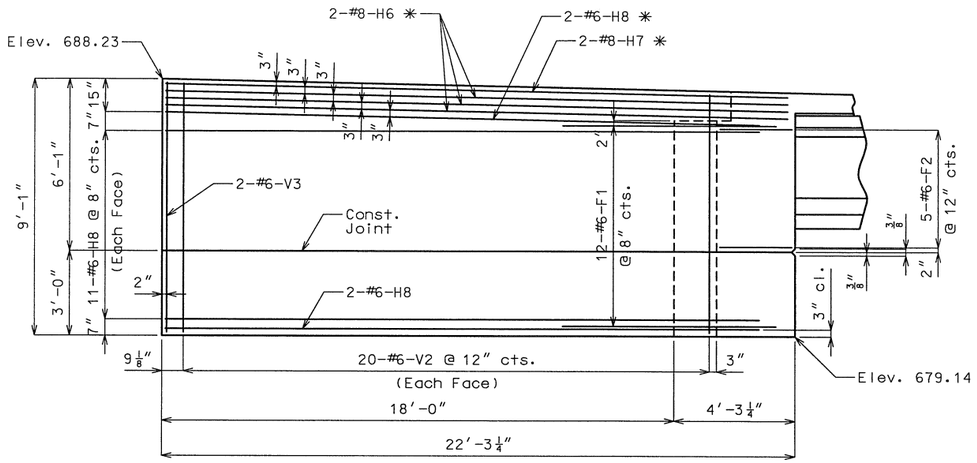
State	Proj. No.	Sheet No.
MO	I-70-3(200)	B26

FINAL PLANS

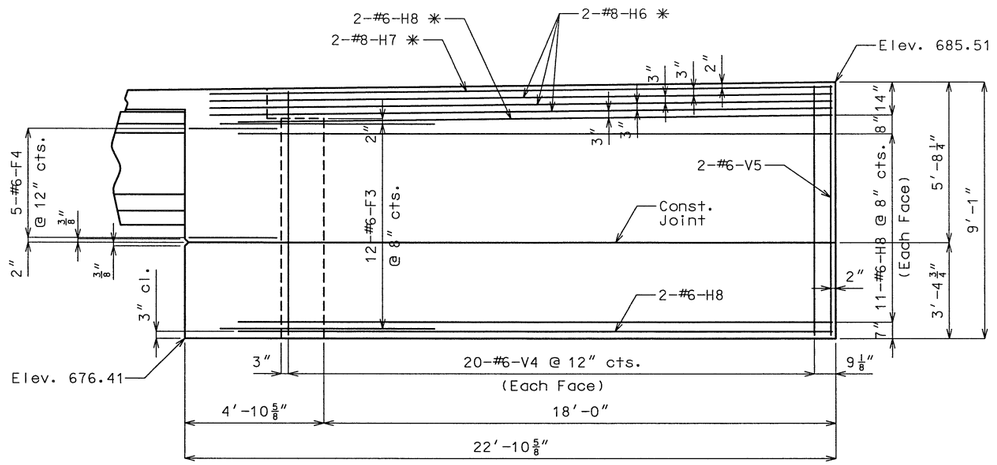
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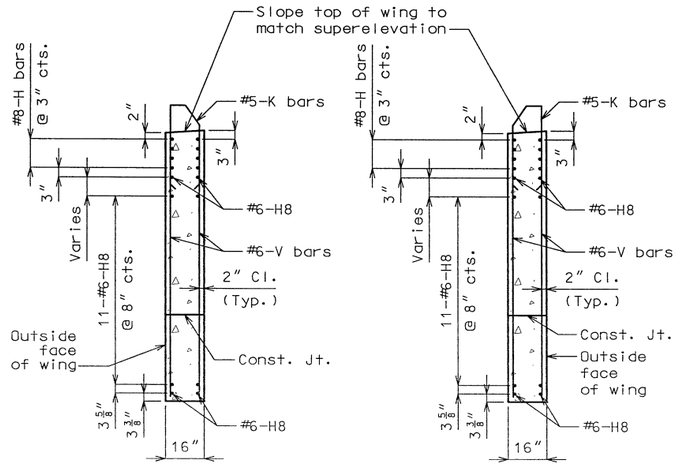
* Placed with grade



ELEVATION A-A



ELEVATION B-B



TYPICAL SECTION THRU LEFT WING

TYPICAL SECTION THRU RIGHT WING

Note:
For details and reinforcement of Safety Barrier Curb not shown, see Sheets No. 29 & 30.
For location of Elevations A-A and B-B, see Sheet No. 7.

DETAILS OF END BENT NO. 1

Detailed June 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

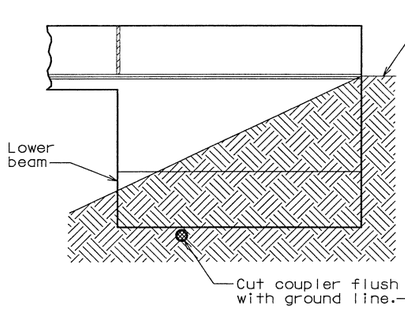
BOONE COUNTY A6951 REV.

State	Proj. No.	Sheet No.
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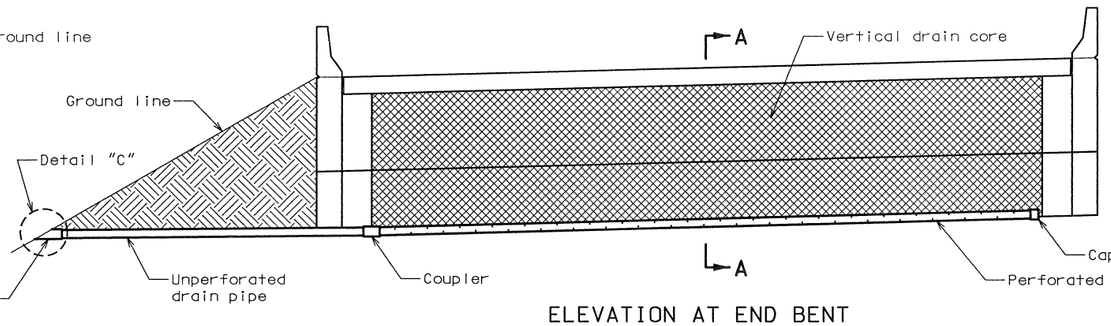
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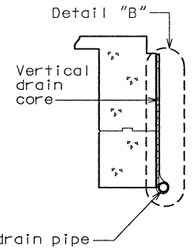
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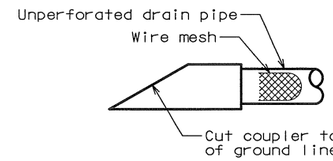
ELEVATION OF WING



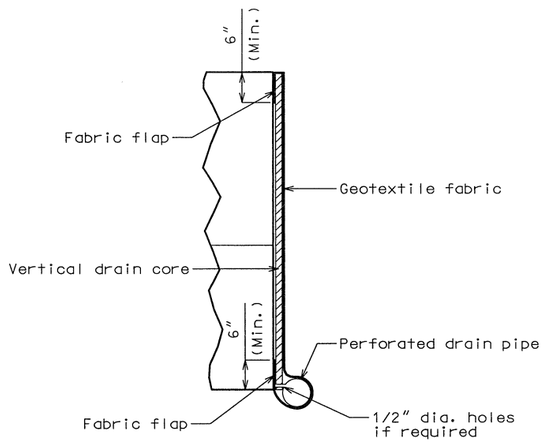
ELEVATION AT END BENT



SECTION A-A



DETAIL "C"



DETAIL "B"

Note:
Drain pipe may be either 6" diameter corrugated metallic-coated steel pipe underdrain, 4" diameter corrugated polyvinyl chloride (PVC) drain pipe, or 4" diameter corrugated polyethylene (PE) drain pipe.

Place drain pipe at fill face of end bent and slope to lowest grade of ground line, also missing the lower beam of end bent by 1-1/2". (See elevation at end bent.)

Perforated pipe shall be placed at fill face side at the bottom of end bent and plain pipe shall be used where the vertical drain ends to the exit at ground line.

VERTICAL DRAIN AT END BENTS

Detailed June 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

BOONE COUNTY A6951

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B28

FINAL PLANS

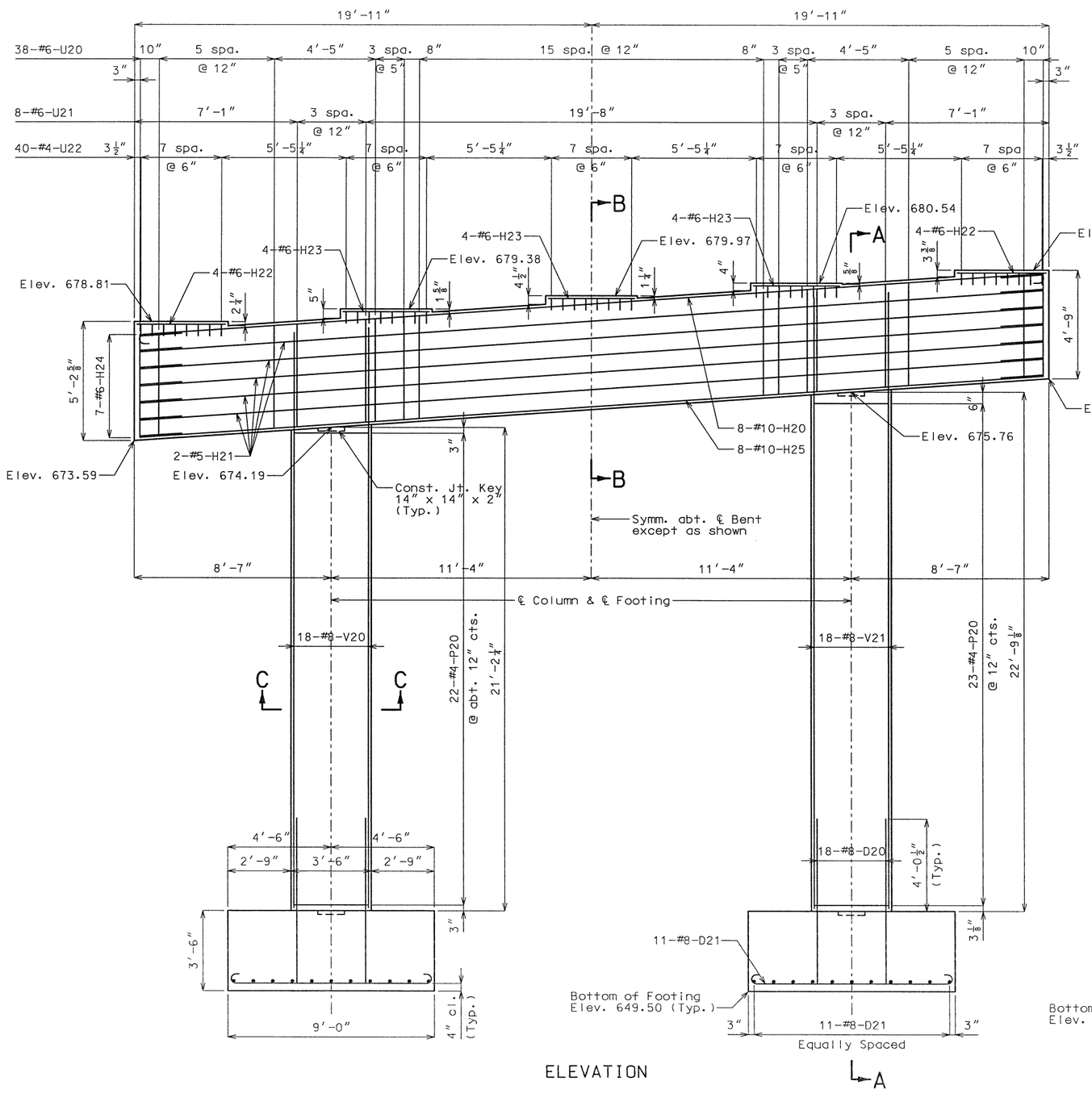
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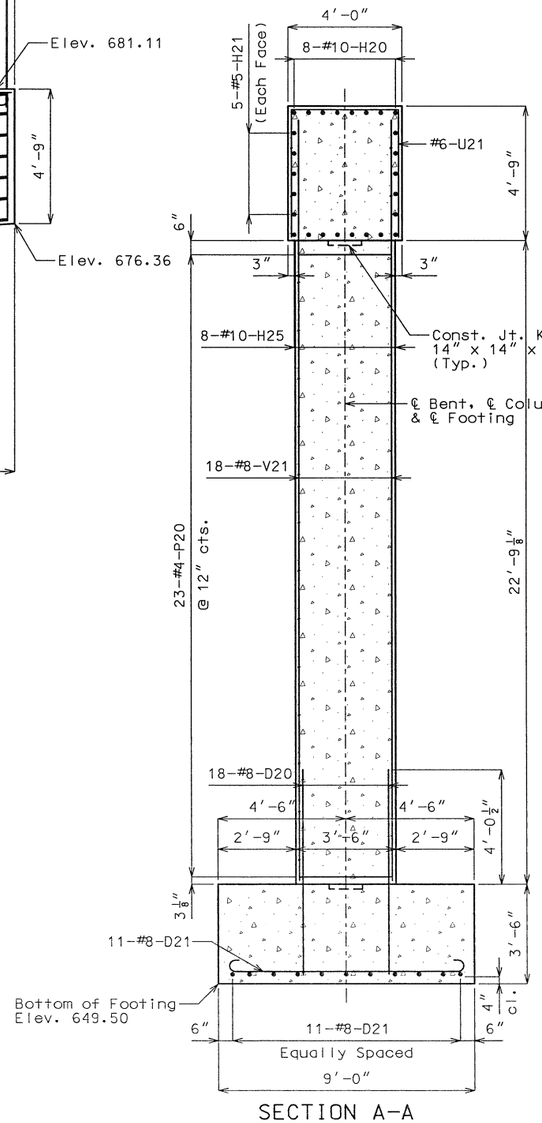
Notes:

For details of Intermediate Bent No. 2 not shown, see Sheet No 12.

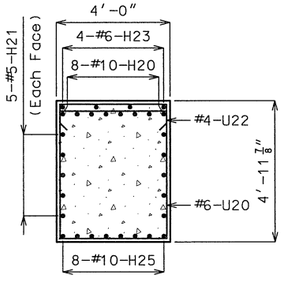
For Substructure Quantity Table for Intermediate Bent No. 2, see Sheet No. 12.



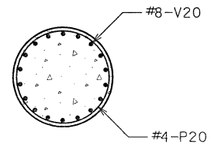
ELEVATION



SECTION A-A



SECTION B-B



SECTION C-C

DETAILS OF INTERMEDIATE BENT NO. 2

Detailed June 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 11 of 38

BOONE COUNTY | A6951

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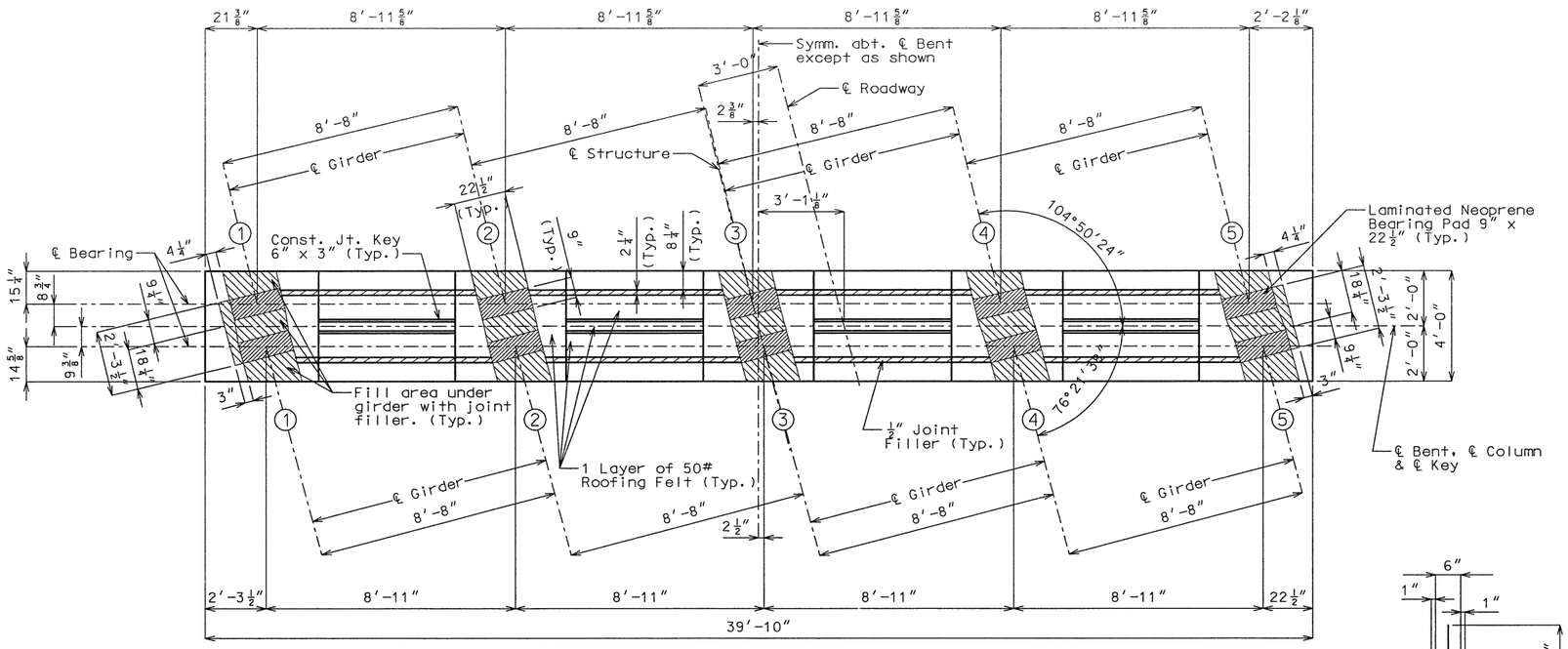
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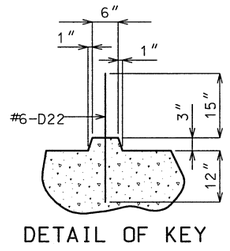
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PLAN OF BEAM



DETAIL OF KEY

Substructure Quantity Table for Bent No. 2

Item		Quantity
Class 1 Excavation	cu. yard	45
Class 2 Excavation	cu. yard	50
Class 2 Excavation in Rock	cu. yard	62
Cofferdams - Bent 2	lump sum	1
Class B Concrete (Substructure)	cu. yard	65.5
Reinforcing Steel (Bridges)	pound	9610

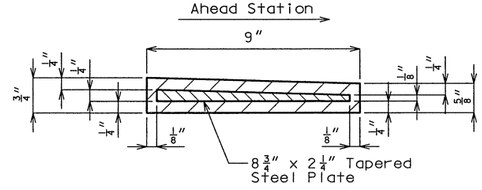
Notes: These Quantities are included in the Final Quantities Table on Sheet No. 2.

For Details of Intermediate Bent No. 2 not shown, see Sheet No. 11.

For steps 2" or more, use 2-1/4" x ½" joint filler up vertical face.

For plan showing substructure layout, see Sheet No. 4.

For plan showing prestressed girder layout and bearing alignment, see Sheet No. 5.

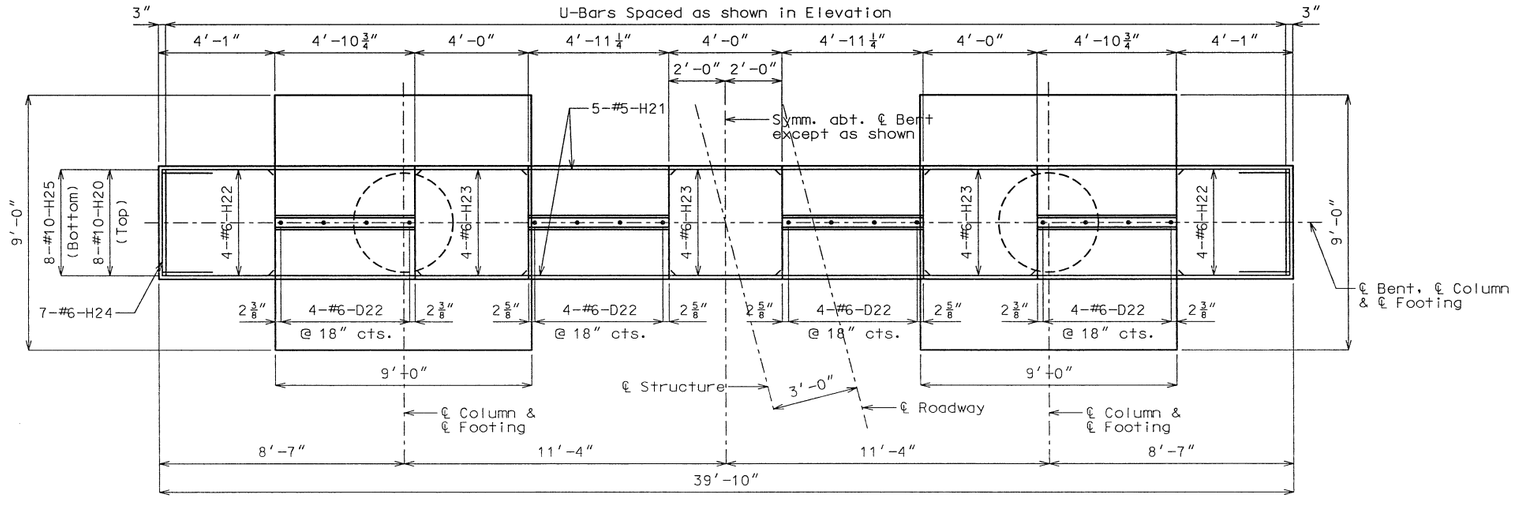


TYP. SECTION THRU LAMINATED NEOPRENE BEARING PAD (TAPERED)

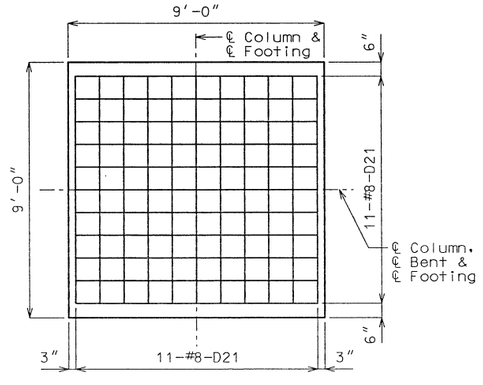
Notes:

The required shim plate shall be placed between layers of elastomer and molded together to form an integral unit.

Shop drawings are not required for laminated neoprene bearings on structures without sole plates.



PLAN SHOWING REINFORCEMENT



PLAN OF FOOTING SHOWING REINFORCEMENT

DETAILS OF INTERMEDIATE BENT NO. 2

Detailed June 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

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MO	I-70-3(200)	B20

FINAL PLANS

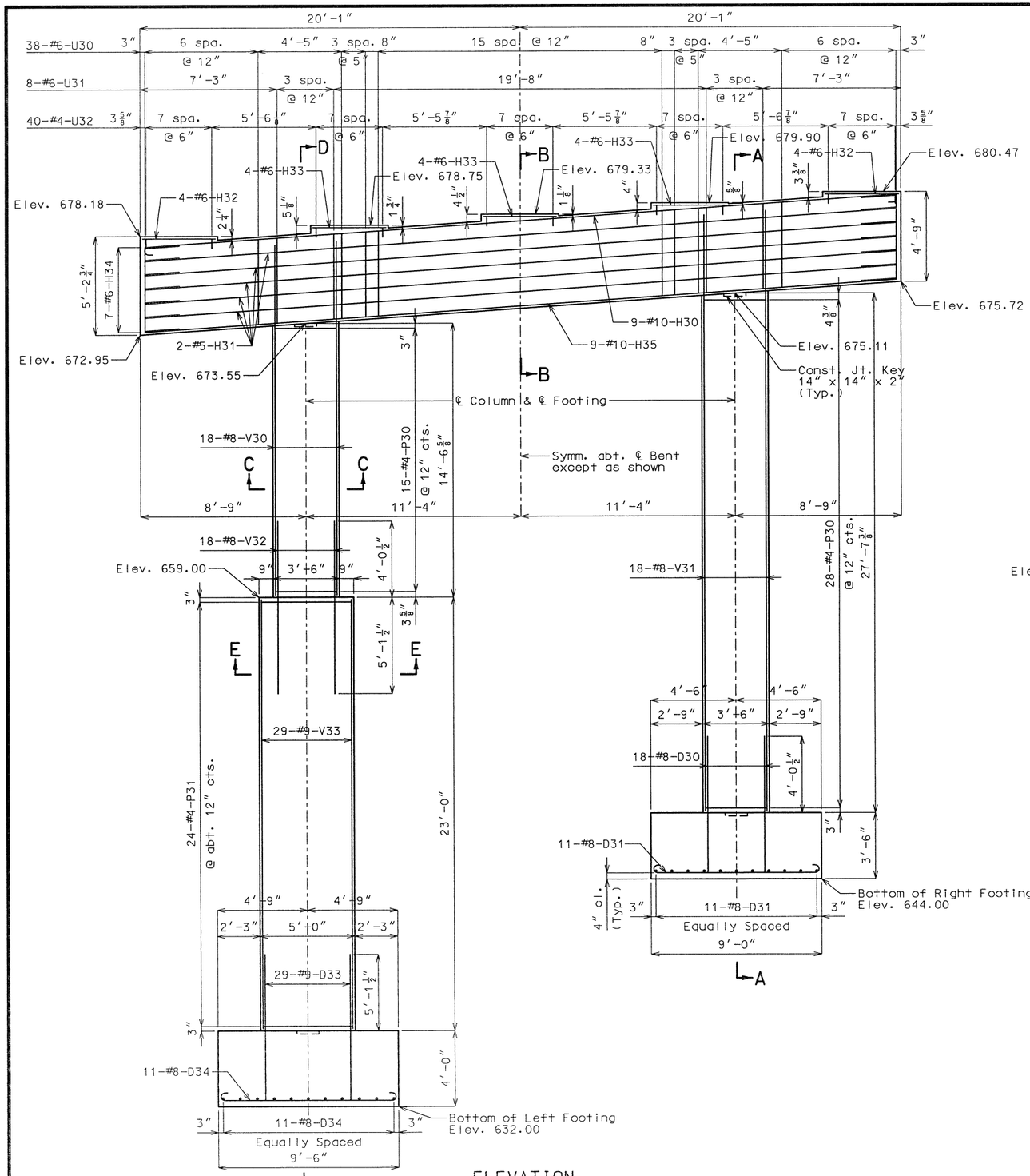
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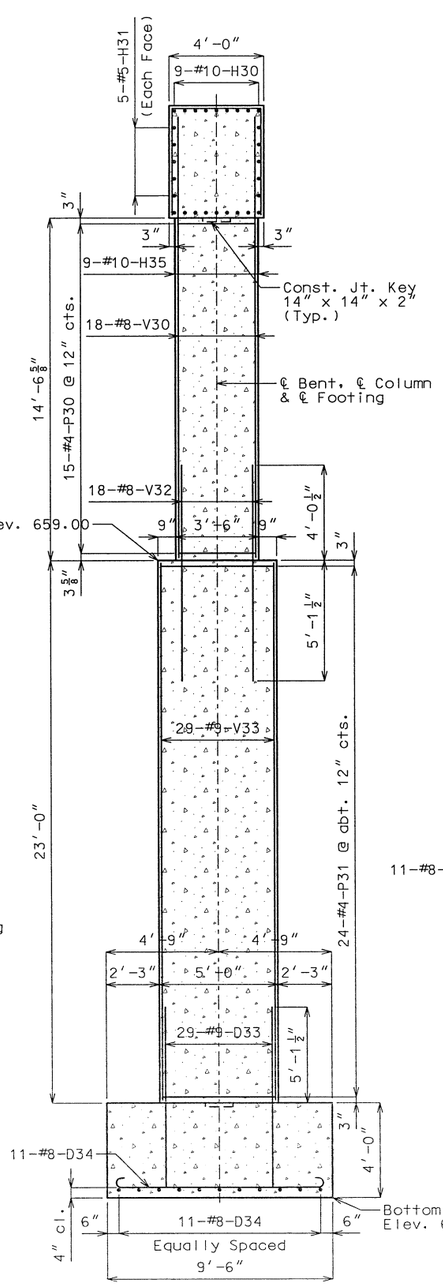
Notes:

For details of Intermediate Bent No. 3 not shown, see Sheet No. 14.

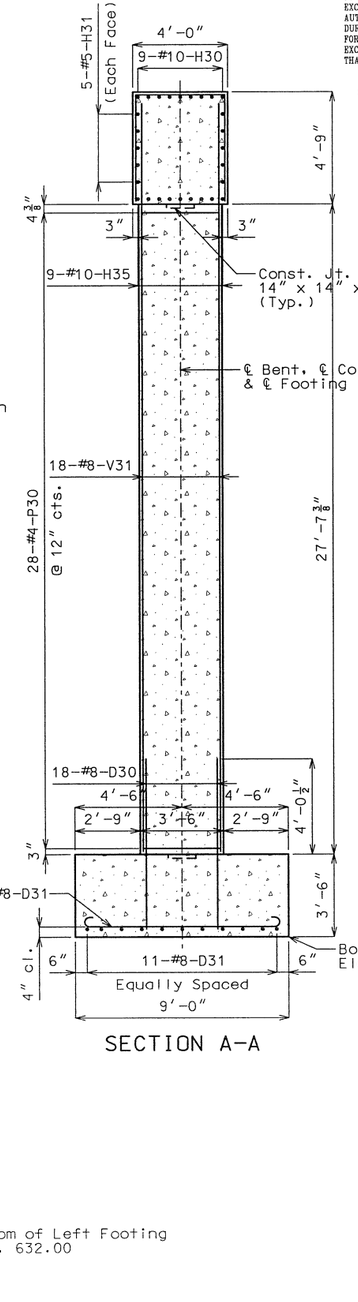
For Substructure Quantity Table for Intermediate Bent No. 3, see Sheet No. 14.



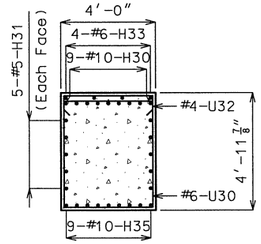
ELEVATION



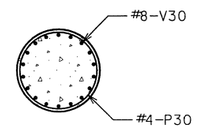
SECTION D-D



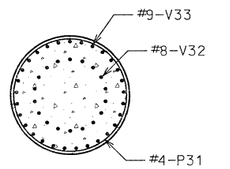
SECTION A-A



SECTION B-B



SECTION C-C



SECTION E-E

DETAILS OF INTERMEDIATE BENT NO. 3

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 13A of 38

1 ADD THIS SHEET 03-29-2004

BOONE COUNTY A6951 REV.

188

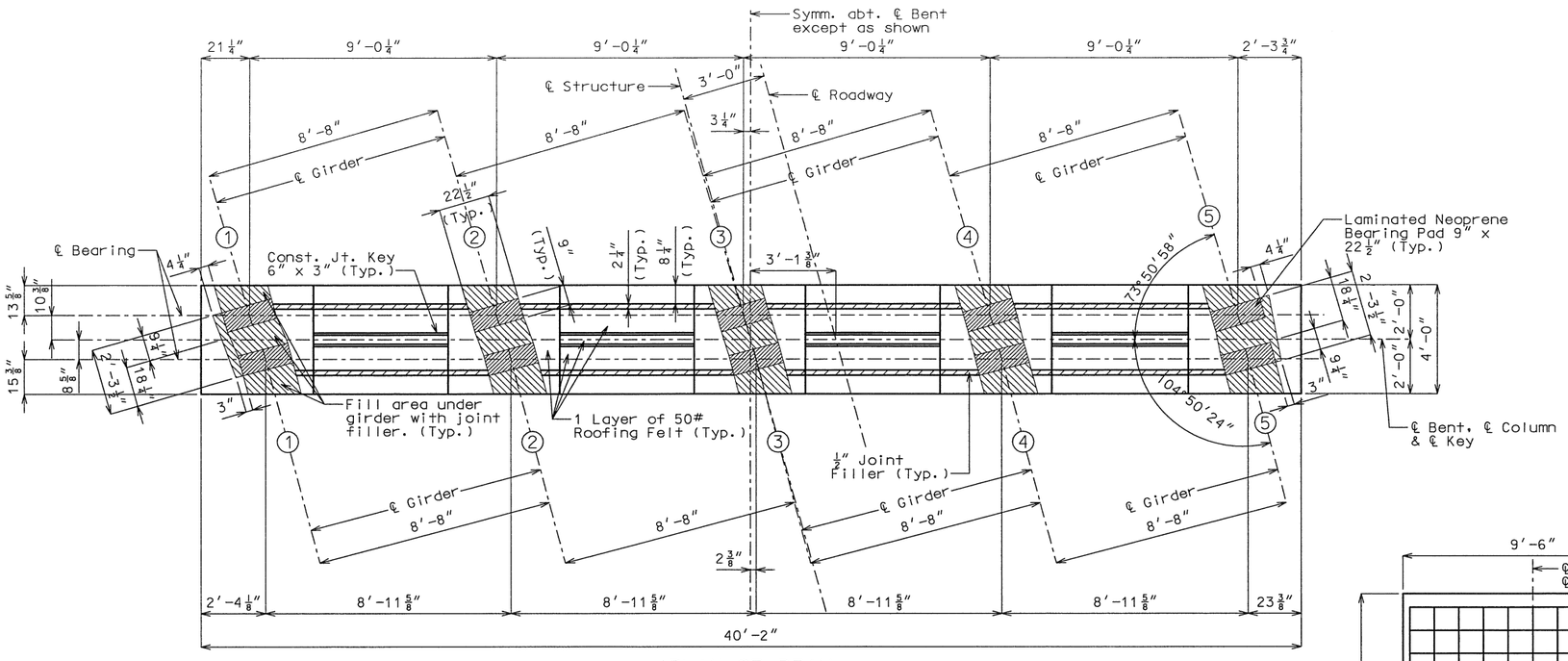
Detailed Mar. 2004
Checked Mar. 2004

FINAL PLANS

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SIGNATURE _____ DATE _____

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B31



PLAN OF BEAM

Substructure Quantity Table for Bent No. 3

Item		Quantity
Class 1 Excavation	cu. yard	0
Class 2 Excavation	cu. yard	108
Cofferdams - Bent 3	lump sum	1
Class B Concrete (Substructure)	cu. yard	84.7
Reinforcing Steel (Bridges)	pound	13,730
Cl 2 Exc. in Rock Lt Footing		68.7
Cl 2 Exc. in Rock Lt Footing, PAID AS C.I. 5022		69.5

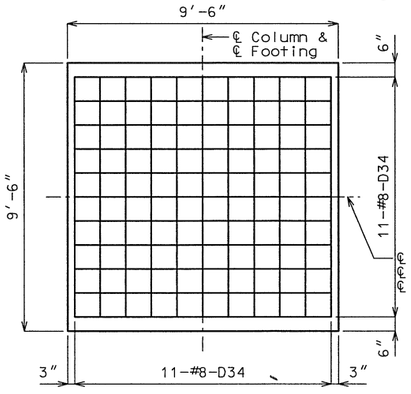
Notes: These Quantities are included in the Final Quantities Table on Sheet No. 2.

For Details of Intermediate Bent No. 3 not shown, see Sheet No. 13.

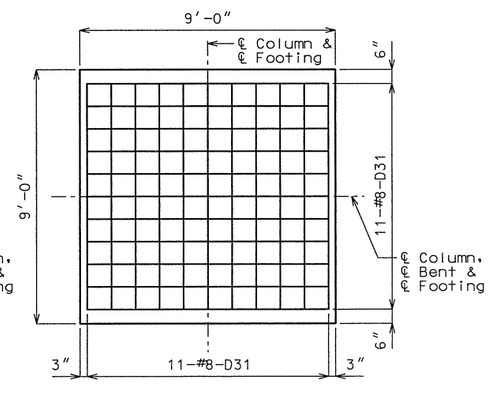
For steps 2" or more, use 2-1/4" x 1/2" joint filler up vertical face.

For plan showing substructure layout, see Sheet No. 4.

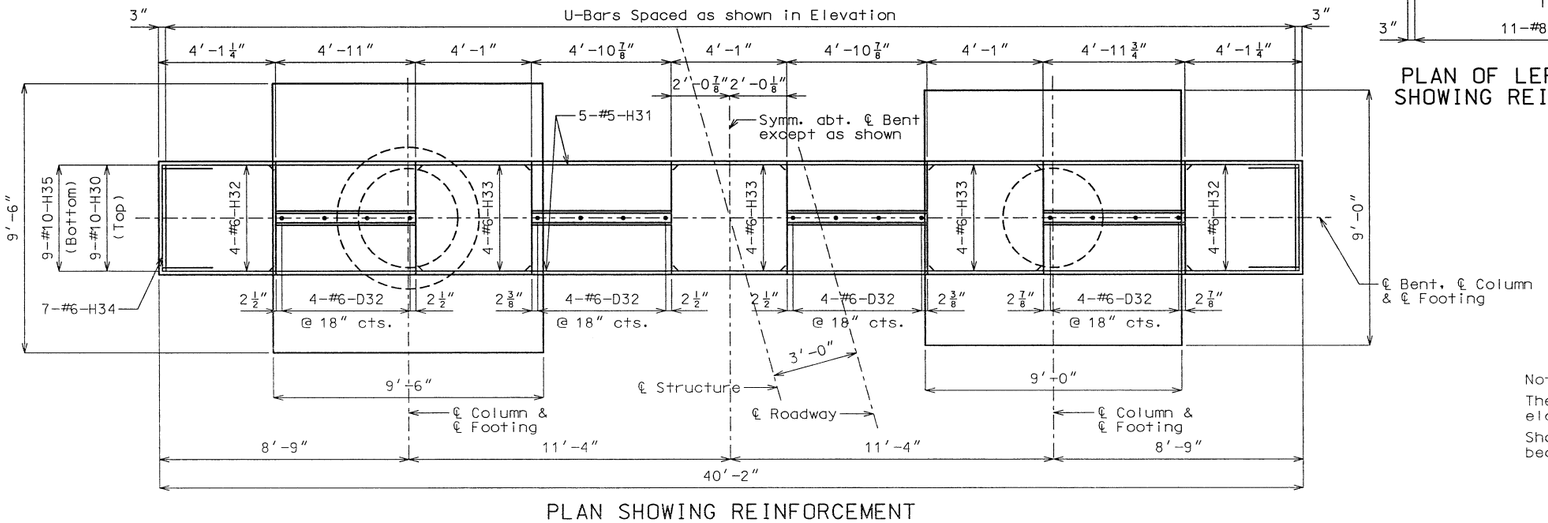
For plan showing prestressed girder layout and bearing alignment, see Sheet No. 5.



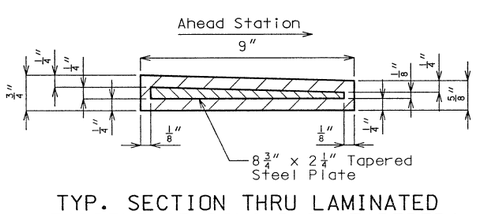
PLAN OF LEFT FOOTING SHOWING REINFORCEMENT



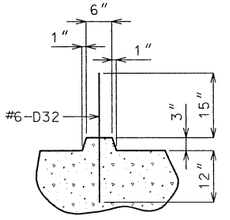
PLAN OF RIGHT FOOTING SHOWING REINFORCEMENT



PLAN SHOWING REINFORCEMENT



TYP. SECTION THRU LAMINATED NEOPRENE BEARING PAD (TAPERED)



DETAIL OF KEY

Notes:

The required shim plate shall be placed between layers of elastomer and molded together to form an integral unit.

Shop drawings are not required for laminated neoprene bearings on structures without sole plates.

DETAILS OF INTERMEDIATE BENT NO. 3

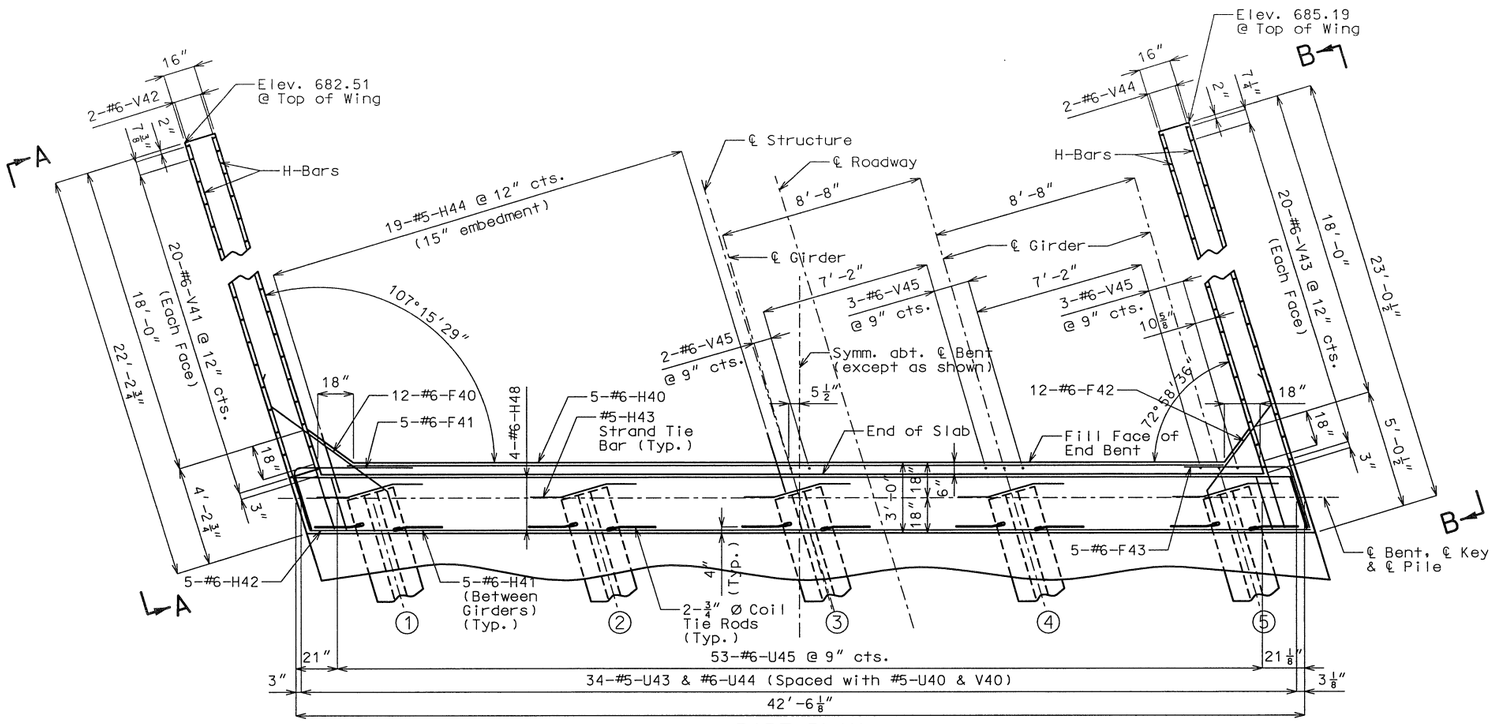
1 ADD THIS SHEET 03-29-2004

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B32

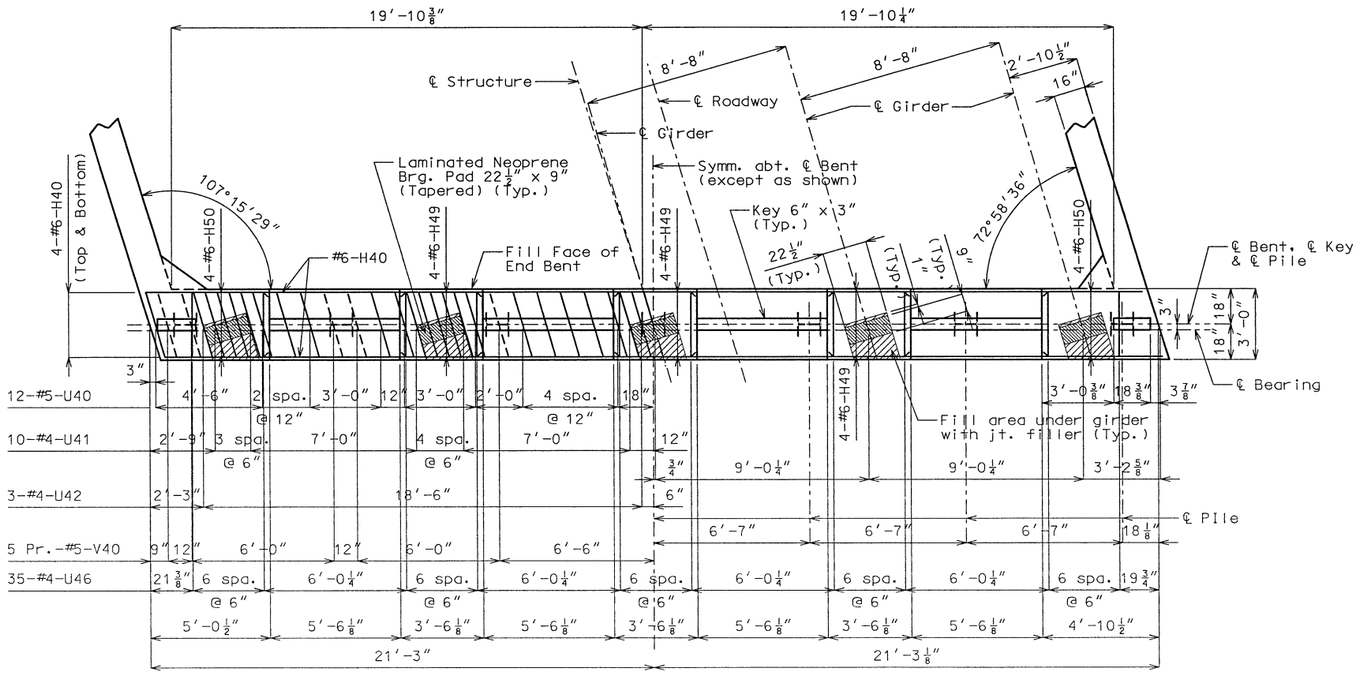
FINAL PLANS

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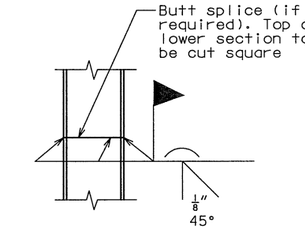
SIGNATURE _____ DATE _____



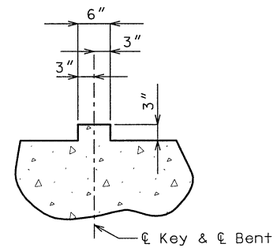
PART PLAN



PLAN OF BEAM



STEEL PILE SPLICE



TYPICAL SECTION THRU KEY

Note:

For Elevations A-A & B-B and Section Thru Wing, see Sheet No. 17.

For location of #5-H43 (Strand Tie Bar), see Sheet No. 20.

For details and reinforcement of Safety Barrier Curb not shown, see Sheet Nos. 27 thru 32.

For details of approach slab, see Sheet No. 34.

For details of Vertical Drain at End Bent, see Sheet No. 10.

Bend #6-F40 & F42 bars in field to clear Prestressed Girders.

All strands at ends of girders shall be field bent or, if necessary, cut in field to maintain 1-1/2" minimum clearance to fill face of end bent.

For location of Coil Tie Rods, see Sheet No. 20.

All U bars in End Bent to be placed parallel to ℄ Roadway.

All concrete in the end bent above top of beam and below top of slab shall be class B-2.

For Substructure Quantity Table and Section Near End Bent, see Sheet No. 16.

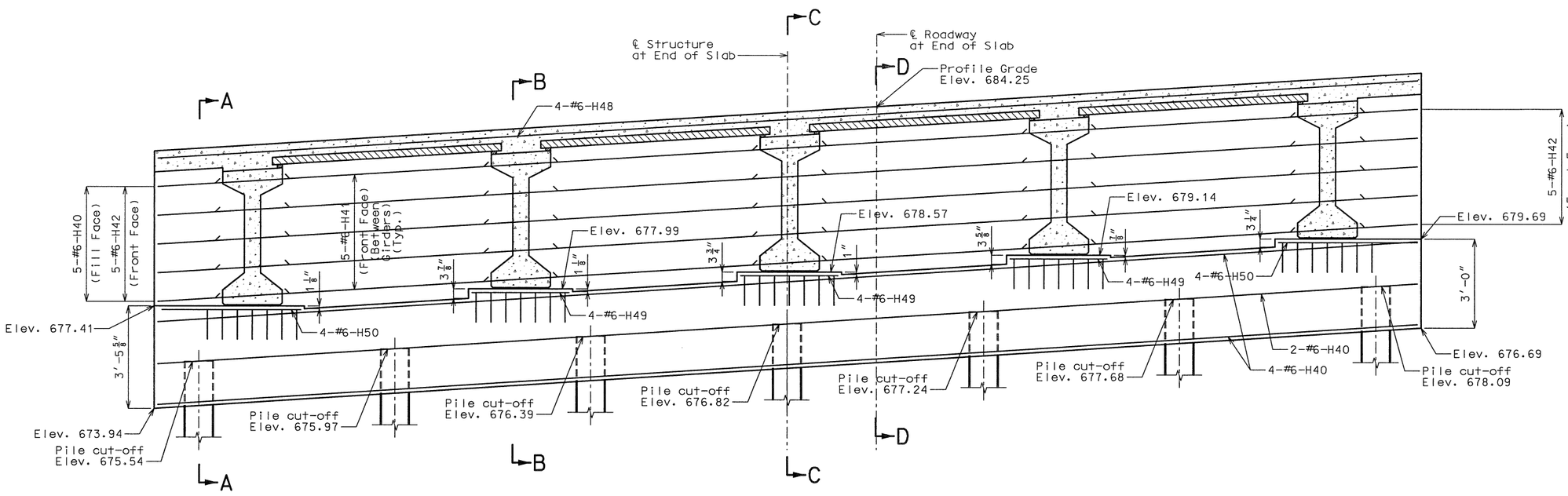
DETAILS OF END BENT NO. 4

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B33

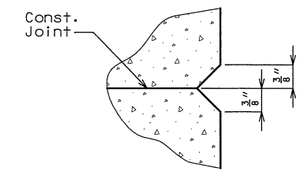
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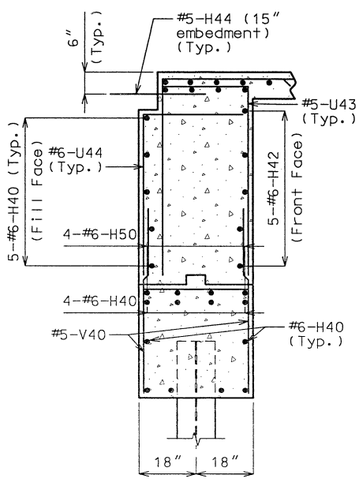
SIGNATURE _____ DATE _____



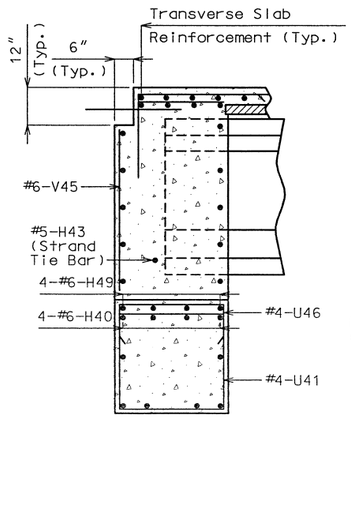
SECTION NEAR END BENT



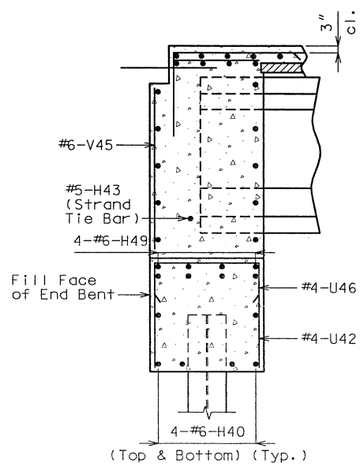
DETAIL "A" (TYPICAL)



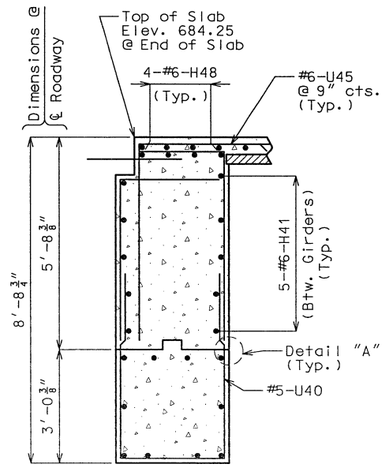
SECTION A-A



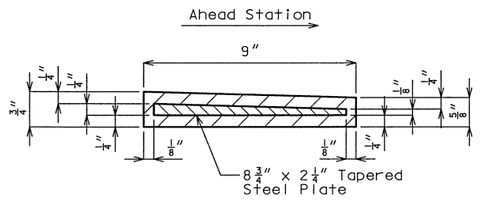
SECTION B-B



SECTION C-C



SECTION D-D



TYP. SECTION THRU LAMINATED NEOPRENE BEARING PAD (TAPERED)

Note:
The required shim plate shall be placed between layers of elastomer and molded together to form an integral unit. Shop drawings are not required for laminated neoprene bearings on structures without sole plates.

Substructure Quantity Table for Bent No. 4		
Item		Quantity
Class 1 Excavation	cu. yard	0
Structural Steel Pile (12in.)	linear foot	291
Pile Point Reinforcement	each	7
Class B Concrete (Substructure)	cu. yard	21.4
PRE-Bore C.I.-5004	L.F.	32.0

Note: These quantities are included in the Estimated Quantities Table on Sheet No. 2

DETAILS OF END BENT NO. 4

Detailed July 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

T:\de-proj\boone\j5i0789\plan_sheets\Bridge Final\A6951\A6951_016F.dgn 01:27:30 PM 07/27/2006

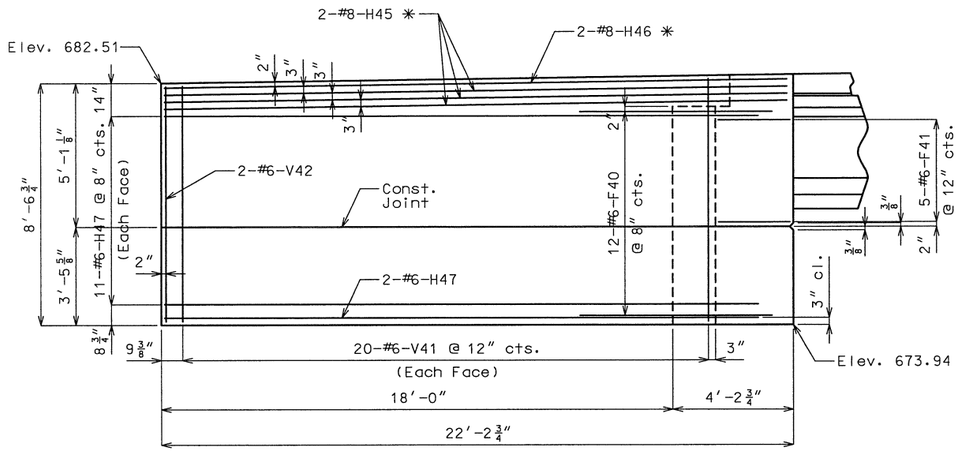
State	Proj. No.	Sheet No.
MO	I-70-3(200)	B34

FINAL PLANS

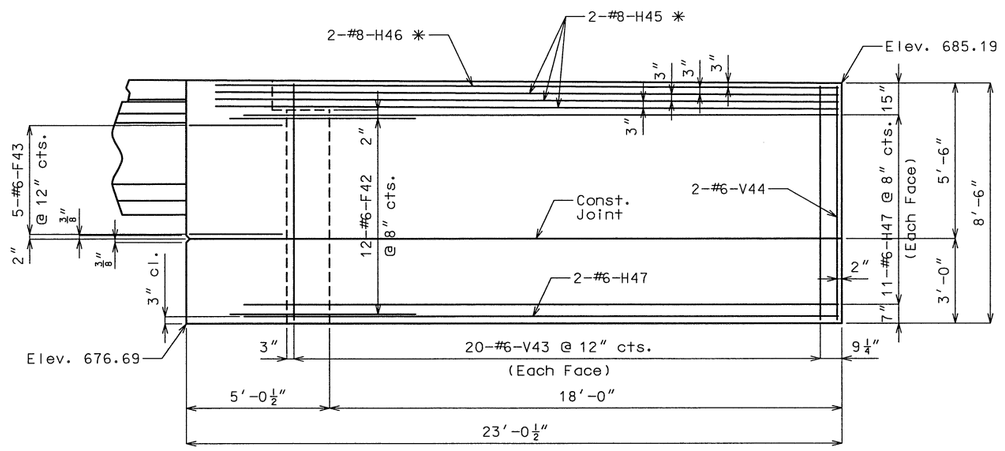
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SIGNATURE _____ DATE _____

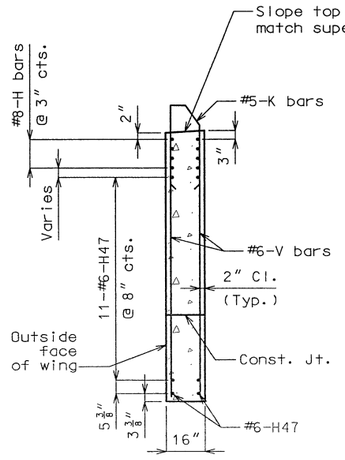
✳ Placed with grade.



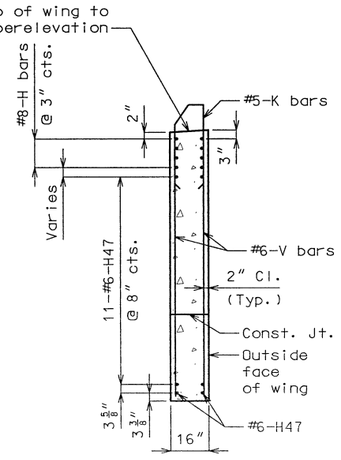
ELEVATION A-A



ELEVATION B-B



TYPICAL SECTION THRU LEFT WING



TYPICAL SECTION THRU RIGHT WING

Note:
For details and reinforcement of Safety Barrier Curb not shown, see Sheets No. 29 & 30.
For location of Elevations A-A and B-B, see Sheet No. 15.

DETAILS OF END BENT NO. 4

Concrete for prestressed girders shall be Class A-1 with f'c = 5000 psi and f'ci = 4000 psi.

(+) Indicates prestressing strand.

Use 16 strands with an initial prestress force of 496 kips.

Prestressing tendons shall be uncoated, seven-wire, low-relaxation strands, 1/2 inch diameter conforming to AASHTO M203, Grade 270. See Section 705.4.8 of the Missouri Standard Specifications.

One strand tie bar is required for each layer of bent-up strands except at end bents which require one bar on the bottom layer of strands only. No additional payment will be made if additional strand tie bars are required.

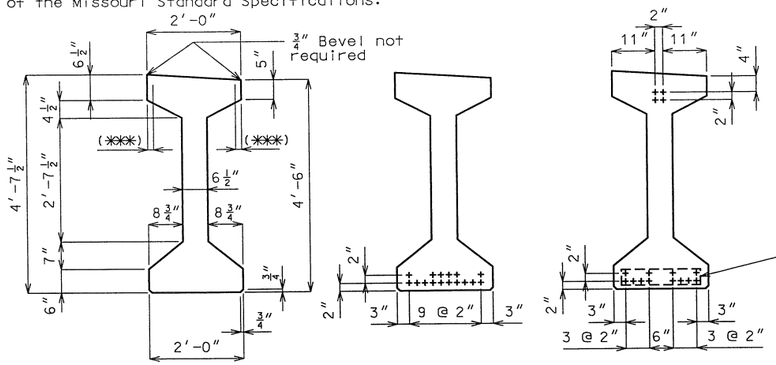
✱✱✱ At contractor's option, a 1-1/2" to 1-3/4" smooth finish strip is permitted to facilitate placement of joint filler for prestressed panels.

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B35

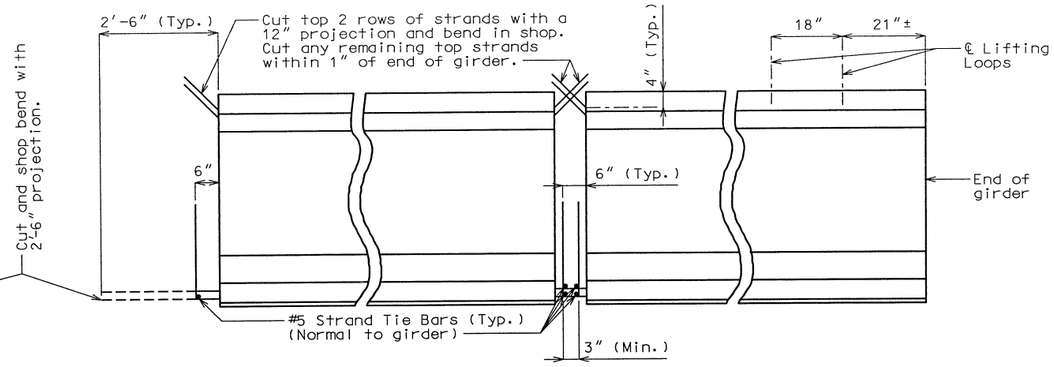
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SIGNATURE DATE



GIRDER DIMENSIONS ℄ GIRDER END OF GIRDER

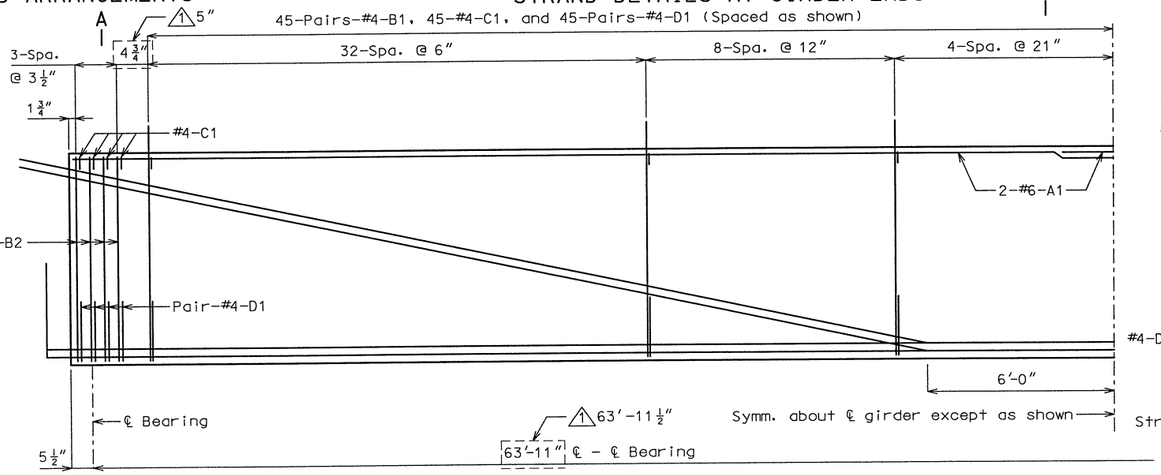


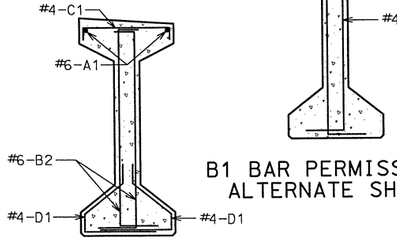
END BENT INTERMEDIATE BENT

LOCATION OF LIFTING LOOPS

STRAND ARRANGEMENTS

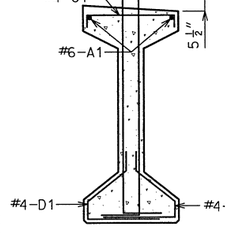
STRAND DETAILS AT GIRDER ENDS





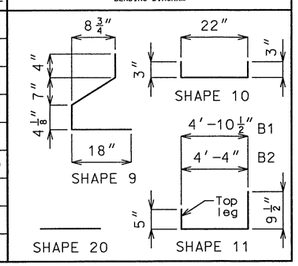
SECTION A-A
Strands not shown for clarity.

B1 BAR PERMISSIBLE ALTERNATE SHAPE



SECTION B-B
Strands not shown for clarity.

BILL OF REINFORCING STEEL - EACH GIRDER				
NO.	SIZE & MARK	ACTUAL LENGTH	SHAPE	BENDING DIAGRAM
4	6 A1	35'-5"	20	
178	4 B1	5'-11"	11	
16	6 B2	5'-4"	11	
97	4 C1	2'-2"	10	
194	4 D1	3'-0"	9	



All dimensions in bending diagram are out to out.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

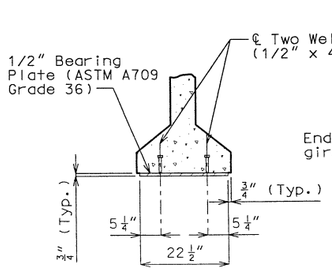
Actual lengths are measured along centerline of bar to the nearest inch.

Minimum clearance to reinforcing shall be 1".

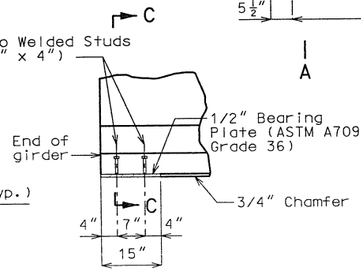
All reinforcement shall be Grade 60.

The two D1 bars may be furnished as one bar at the fabricator's option.

All B1 bars shall be epoxy coated.



SECTION C-C



PART ELEVATION AT END OF GIRDER

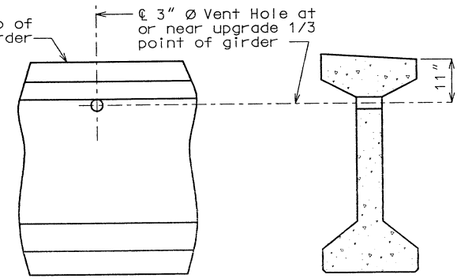
BEARING PLATE DETAILS

Galvanize the 1/2" bearing plate (ASTM A709 Grade 36) in accordance with ASTM A123.

Cost of furnishing, galvanizing, and installing the 1/2" bearing plate (ASTM A709 Grade 36) and welded studs in the prestressed girder shall be included in the price bid for Prestressed Concrete I-girder per each.

HALF ELEVATION OF GIRDER SPAN (1-2)

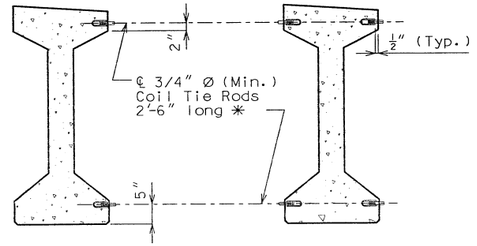
Exterior and interior girders are the same except for coil ties and holes for steel intermediate diaphragms.



PART ELEVATION OF GIRDER

PART SECTION NEAR VENT HOLE

Place vent holes at or near upgrade 1/3 point of girders and clear reinforcing steel or strands by 1-1/2" minimum and steel intermediate diaphragm bolt connections by 6" minimum.



EXTERIOR GIRDERS AT INT. BENTS

EXTERIOR GIRDERS AT END BENTS INTERIOR GIRDERS AT ALL BENTS

DETAILS OF COIL TIES

Cost of 3/4" Ø coil tie rods placed in diaphragms is included in contract unit price for Prestressed Concrete I-Girder.

Coil ties shall be held in place in the forms by slotted wire-setting-studs projecting thru forms. Studs are to be left in place or replaced with temporary plugs until girders are erected, then replaced by coil tie rods.

For location of coil ties, see Sheets No. 7 & 22.

The 1-1/2" Ø holes shall be cast in the web for steel intermediate diaphragms. Drilling is not allowed.

For detail of diaphragms, see Sheets No. 21 & 22.

For Girder Camber Diagram, see Sheet No. 24.

✱ Length of coil tie rods at exterior girders at end bent = 2'-0".

1 Revised 3-12-2004

Note: This drawing is not to scale. Follow dimensions.

Concrete for prestressed girders shall be Class A-1 with f'c = 5000 psi and f'ci = 4000 psi.

(+) Indicates prestressing strand.

Use 16 strands with an initial prestress force of 496 kips.

Prestressing tendons shall be uncoated, seven-wire, low-relaxation strands, 1/2 inch diameter conforming to AASHTO M203, Grade 270. See Section 705.4.8 of the Missouri Standard Specifications.

One strand tie bar is required for each layer of bent-up strands except at end bents which require one bar on the bottom layer of strands only. No additional payment will be made if additional strand tie bars are required.

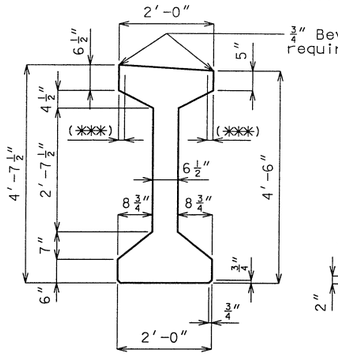
✱✱✱ At contractor's option, a 1-1/2" to 1-3/4" smooth finish strip is permitted to facilitate placement of joint filler for prestressed panels.

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B36

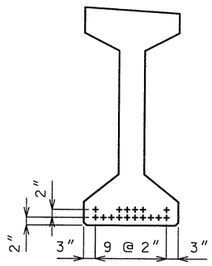
FINAL PLANS

I CERTIFY THAT THIS PLAN SHEET ACCURATELY DEPICTS THE CONFIGURATION AND LOCATION OF THE ROADWAY AND ALL ITS APPURTENANT FEATURES, TO THE BEST OF MY KNOWLEDGE, AS I AND MY STAFF HAVE OBSERVED THE CONTRACTOR'S CONSTRUCTION OF THIS PROJECT. I SPECIFICALLY DISCLAIM ANY RESPONSIBILITY FOR THE DESIGN OF THIS PROJECT, EXCEPT AS I AND MY STAFF MAY HAVE MODIFIED OR AUTHORIZED THE MODIFICATION OF THE PROJECT DESIGN DURING ITS CONSTRUCTION; AND I DISCLAIM RESPONSIBILITY FOR THE CONTRACTOR'S ACTUAL CONSTRUCTION OF THE PROJECT, EXCEPT AS I AND MY STAFF MAY HAVE DIRECTED OR ORDERED THAT THE PROJECT BE CONSTRUCTED.

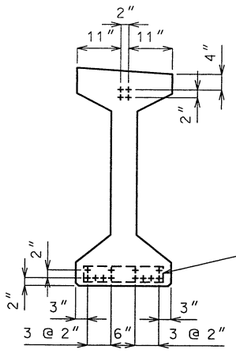
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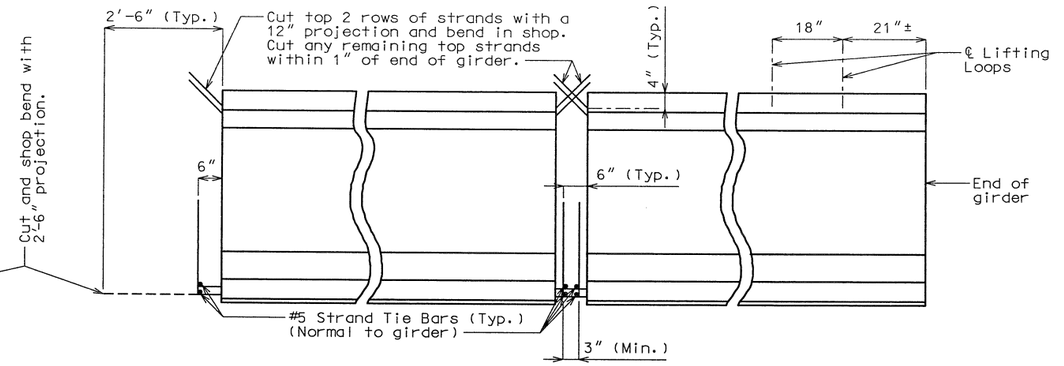
GIRDER DIMENSIONS



℄ GIRDER



END OF GIRDER



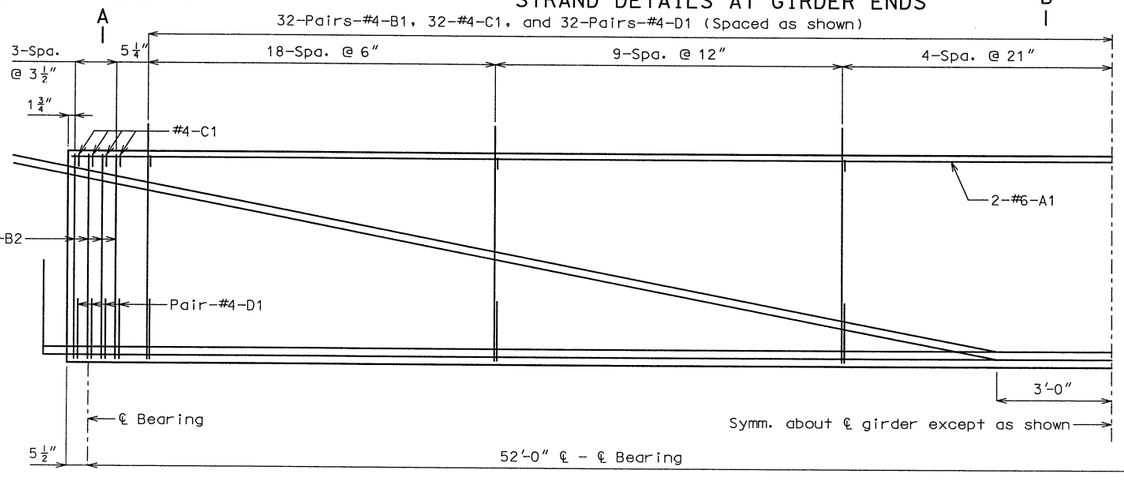
INTERMEDIATE BENT

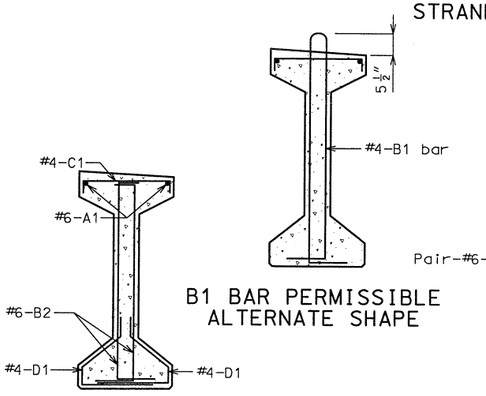
INTERMEDIATE BENT

LOCATION OF LIFTING LOOPS

STRAND ARRANGEMENTS

STRAND DETAILS AT GIRDER ENDS

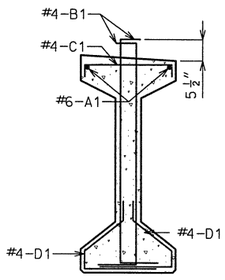




SECTION A-A

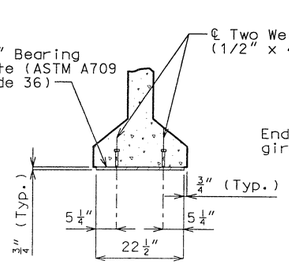
Strands not shown for clarity.

B1 BAR PERMISSIBLE ALTERNATE SHAPE

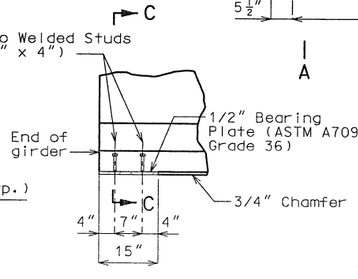


SECTION B-B

Strands not shown or clarity.



SECTION C-C



PART ELEVATION AT END OF GIRDER

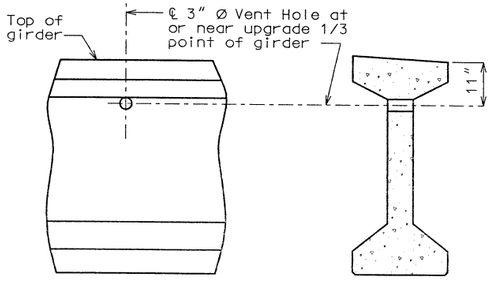
BEARING PLATE DETAILS

Galvanize the 1/2" bearing plate (ASTM A709 Grade 36) in accordance with ASTM A123.

Cost of furnishing, galvanizing, and installing the 1/2" bearing plate (ASTM A709 Grade 36) and welded studs in the prestressed girder shall be included in the price bid for Prestressed Concrete I-girder per each.

HALF ELEVATION OF GIRDER SPAN (2-3)

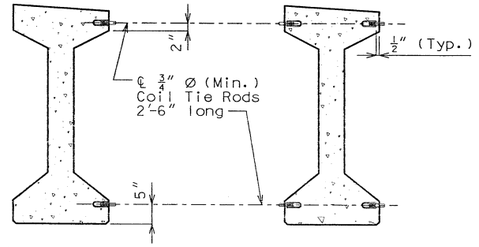
Exterior and interior girders are the same except for coil ties and holes for steel intermediate diaphragms.



PART ELEVATION OF GIRDER

PART SECTION NEAR VENT HOLE

Place vent holes at or near upgrade 1/3 point of girders and clear reinforcing steel or strands by 1-1/2" minimum and steel intermediate diaphragm bolt connections by 6" minimum.



EXTERIOR GIRDERS AT INT. BENTS

INTERIOR GIRDERS AT INT. BENTS

DETAILS OF COIL TIES

Cost of 3/4" Ø coil tie rods placed in diaphragms is included in contract unit price for Prestressed Concrete I-Girder.

Coil ties shall be held in place in the forms by slotted wire-setting-studs projecting thru forms. Studs are to be left in place or replaced with temporary plugs until girders are erected, then replaced by coil tie rods.

For location of coil ties, see Sheet No. 22.

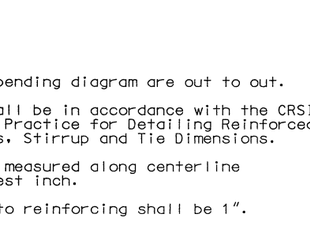
The 1-1/2" Ø holes shall be cast in the web for steel intermediate diaphragms. Drilling is not allowed.

For detail of diaphragms, see Sheets No. 21 & 22.

For Girder Camber Diagram, see Sheet No. 24.

BILL OF REINFORCING STEEL - EACH GIRDER

NO.	SIZE & MARK	ACTUAL LENGTH	SHAPE	BENDING DIAGRAM
2	6 A1	52'-8"	20	
126	4 B1	5'-11"	11	
16	6 B2	5'-4"	11	
71	4 C1	2'-2"	10	
142	4 D1	3'-0"	9	



All dimensions in bending diagram are out to out.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

Actual lengths are measured along centerline of bar to the nearest inch.

Minimum clearance to reinforcing shall be 1".

All reinforcement shall be Grade 60.

The two D1 bars may be furnished as one bar at the fabricator's option.

All B1 bars shall be epoxy coated.

Detailed June 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

Concrete for prestressed girders shall be Class A-1 with f'c = 5000 psi and f'ci = 4000 psi.

(+) Indicates prestressing strand.

Use 22 strands with an initial prestress force of 682 kips.

Prestressing tendons shall be uncoated, seven-wire, low-relaxation strands, 1/2 inch diameter conforming to AASHTO M203, Grade 270. See Section 705.4.8 of the Missouri Standard Specifications.

✻ At the contractor's option, the location for bent-up strands may be varied from that shown. The total number of bent-up strands shall not be changed.
One strand tie bar is required for each layer of bent-up strands except at end bents which require one bar on the bottom layer of strands only. No additional payment will be made if additional strand tie bars are required.

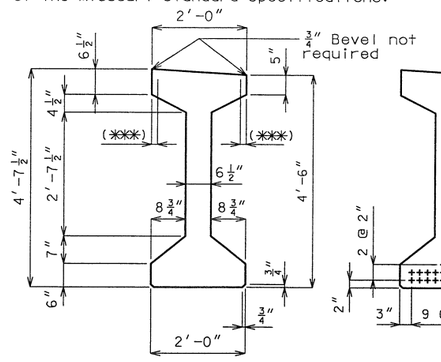
✻✻ At contractor's option, a 1-1/2" to 1-3/4" smooth finish strip is permitted to facilitate placement of joint filler for prestressed panels.

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B37

FINAL PLANS

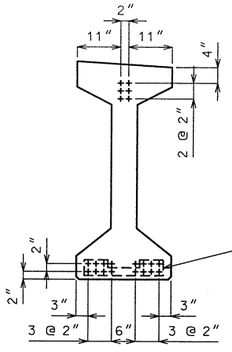
I CERTIFY THAT THIS PLAN SHEET ACCURATELY DEPICTS THE CONFIGURATION AND LOCATION OF THE ROADWAY AND ALL ITS APPURTENANT FEATURES, TO THE BEST OF MY KNOWLEDGE, AS I AND MY STAFF HAVE OBSERVED THE CONTRACTOR'S CONSTRUCTION OF THIS PROJECT. I SPECIFICALLY DISCLAIM ANY RESPONSIBILITY FOR THE DESIGN OF THIS PROJECT, EXCEPT AS I AND MY STAFF MAY HAVE MODIFIED OR AUTHORIZED THE MODIFICATION OF THE PROJECT DESIGN DURING ITS CONSTRUCTION; AND I DISCLAIM RESPONSIBILITY FOR THE CONTRACTOR'S ACTUAL CONSTRUCTION OF THE PROJECT, EXCEPT AS I AND MY STAFF MAY HAVE DIRECTED OR ORDERED THAT THE PROJECT BE CONSTRUCTED.

SIGNATURE _____ DATE _____



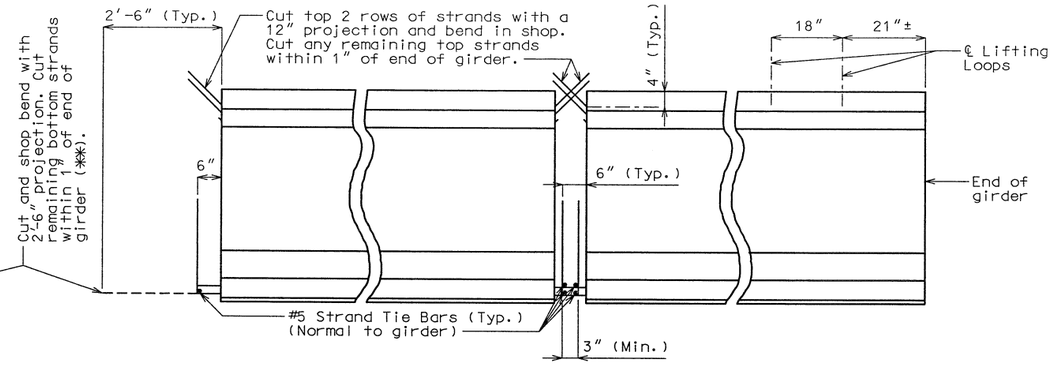
GIRDER DIMENSIONS

℄ GIRDER



END OF GIRDER

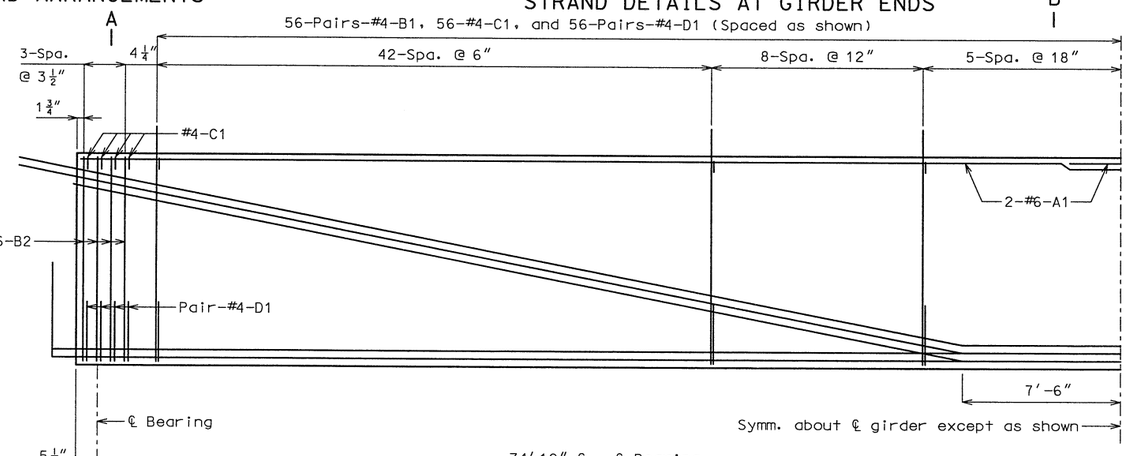
STRAND ARRANGEMENTS



END BENT INTERMEDIATE BENT

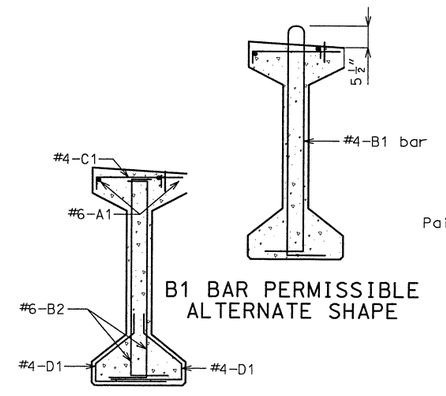
LOCATION OF LIFTING LOOPS

STRAND DETAILS AT GIRDER ENDS



HALF ELEVATION OF GIRDER SPAN (3-4)

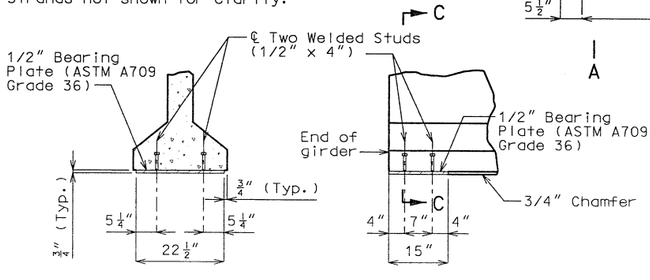
Exterior and interior girders are the same except for coil ties and holes for steel intermediate diaphragms.



B1 BAR PERMISSIBLE ALTERNATE SHAPE

SECTION A-A

Strands not shown for clarity.



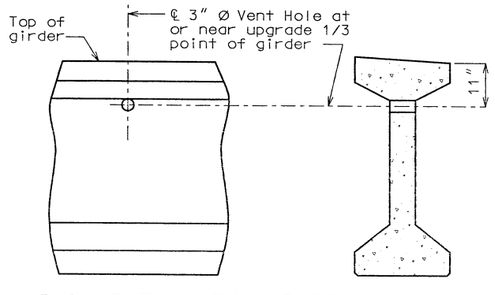
SECTION C-C

PART ELEVATION AT END OF GIRDER

BEARING PLATE DETAILS

Galvanize the 1/2" bearing plate (ASTM A709 Grade 36) in accordance with ASTM A123.

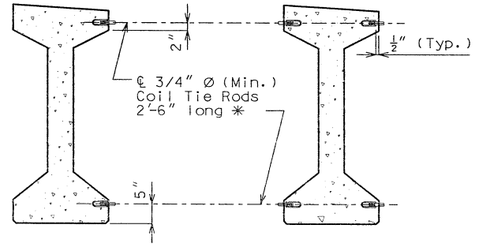
Cost of furnishing, galvanizing, and installing the 1/2" bearing plate (ASTM A709 Grade 36) and welded studs in the prestressed girder shall be included in the price bid for Prestressed Concrete I-girder per each.



PART ELEVATION OF GIRDER

PART SECTION NEAR VENT HOLE

Place vent holes at or near upgrade 1/3 point of girders and clear reinforcing steel or strands by 1-1/2" minimum and steel intermediate diaphragm bolt connections by 6" minimum.



EXTERIOR GIRDERS AT INT. BENTS

EXTERIOR GIRDERS AT END BENTS
INTERIOR GIRDERS AT ALL BENTS

DETAILS OF COIL TIES

Cost of 3/4" Ø coil tie rods placed in diaphragms is included in contract unit price for Prestressed Concrete I-Girder.

Coil ties shall be held in place in the forms by slotted wire-setting-studs projecting thru forms. Studs are to be left in place or replaced with temporary plugs until girders are erected, then replaced by coil tie rods.

For location of coil ties, see Sheets No. 15 & 22.

The 1-1/2" Ø holes shall be cast in the web for steel intermediate diaphragms. Drilling is not allowed.

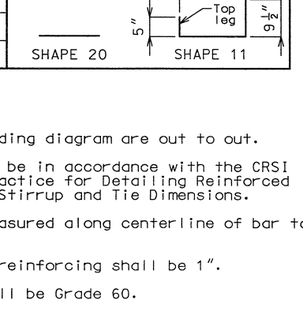
For detail of diaphragms, see Sheets No. 21 & 22.

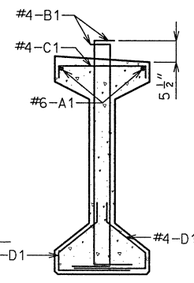
For Girder Camber Diagram, see Sheet No. 24.

✻ Length of coil tie rods at exterior girders at end bent = 2'-2".

BILL OF REINFORCING STEEL - EACH GIRDER

NO.	SIZE & MARK	ACTUAL LENGTH	SHAPE	BENDING DIAGRAM
4	6 A1	38'-10"	20	
222	4 B1	5'-11"	11	
16	6 B2	5'-4"	11	
119	4 C1	2'-2"	10	
238	4 D1	3'-0"	9	





SECTION B-B

Strands not shown for clarity.

All dimensions in bending diagram are out to out.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

Actual lengths are measured along centerline of bar to the nearest inch.

Minimum clearance to reinforcing shall be 1".

All reinforcement shall be Grade 60.

The two D1 bars may be furnished as one bar at the fabricator's option.

All B1 bars shall be epoxy coated.

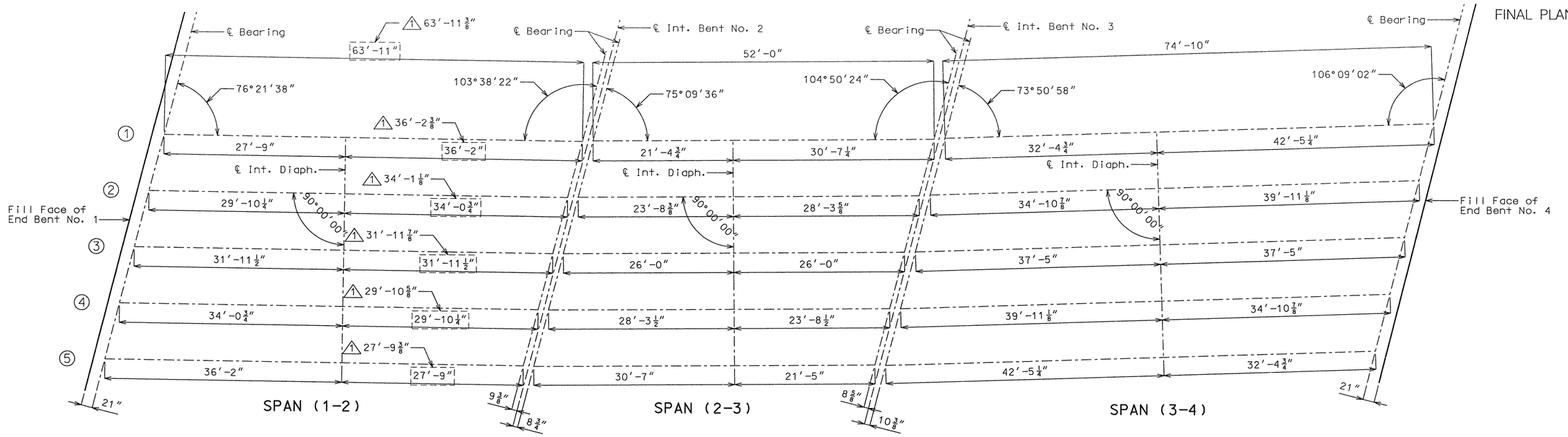
Detailed June 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

BOONE COUNTY A6951

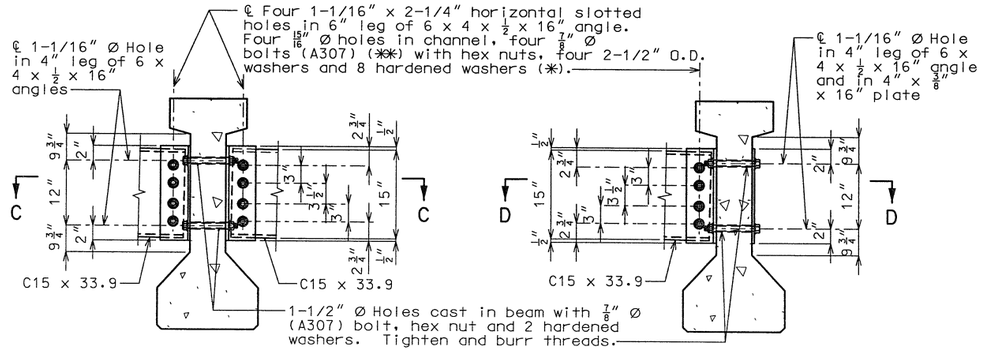
State	Proj. No.	Sheet No.
MO	I-70-3(200)	B38

FINAL PLANS

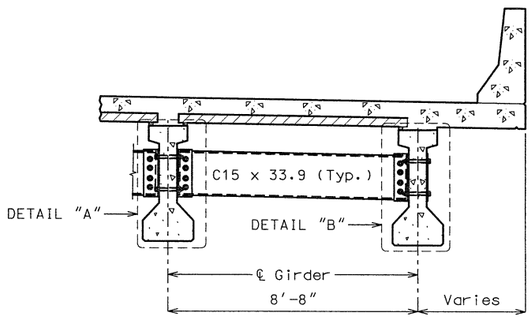


PLAN SHOWING LOCATION OF INTERMEDIATE DIAPHRAGMS

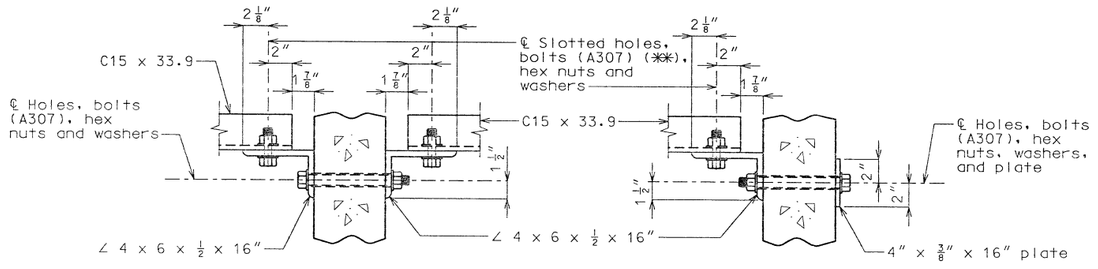
Notes: All dimensions are horizontal.
All bents are parallel.



DETAIL "A" DETAIL "B"



PART SECTION SHOWING INTERMEDIATE DIAPHRAGMS



SECTION C-C SECTION D-D

STEEL DIAPHRAGM NOTES:

(*) In lieu of 2-1/2″ outside diameter washers, contractor may substitute a 3/16″ (Min. thickness) plate with four 15/16″ Ø holes and one hardened washer per bolt.

(**) These bolts shall be tightened to provide a tension of one-half that specified by Section 712.10.2. of the Missouri Standard Specifications. A325 bolts may be substituted for and installed in accordance with the requirements for the specified A307 bolts.

All diaphragm materials including bolts, nuts, and washers shall be galvanized.

Fabricated structural steel shall be ASTM A709 Grade 36 except as noted.

Payment for furnishing and installing steel intermediate diaphragms shall be included in the contract unit price for Prestressed Concrete I-Girders.

Shop drawings will not be required for steel intermediate diaphragms and angle connections.

STEEL INTERMEDIATE DIAPHRAGM DETAILS

Revised 3-12-2004

Detailed June 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

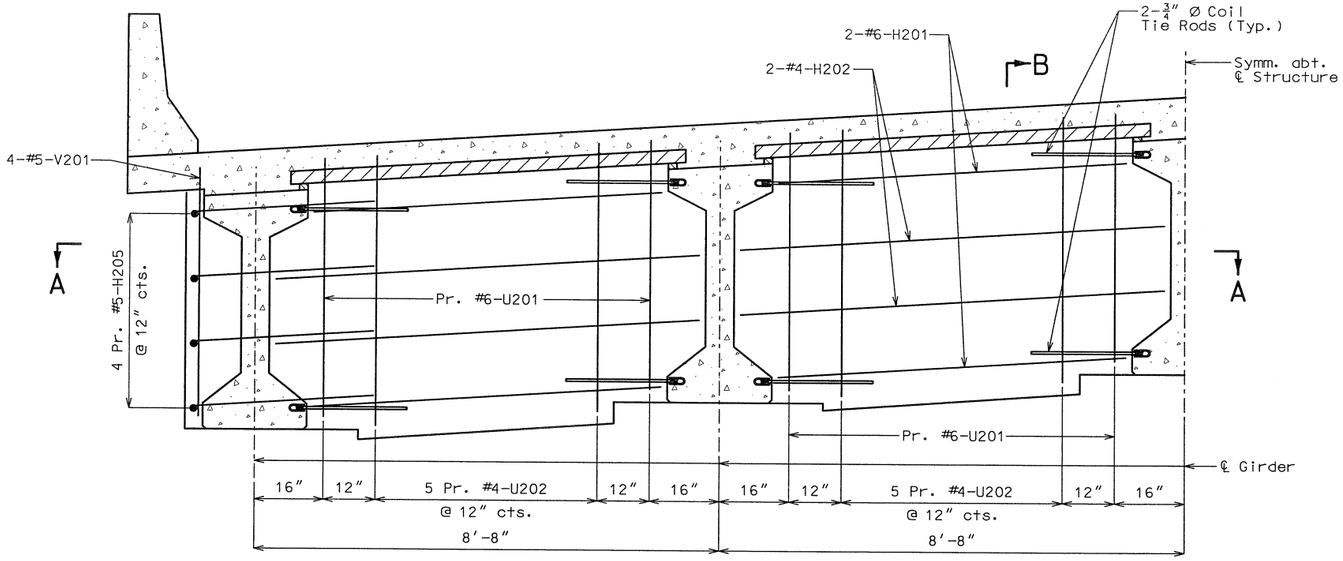
Sheet No. 21 of 38

BOONE COUNTY A6951 REV.

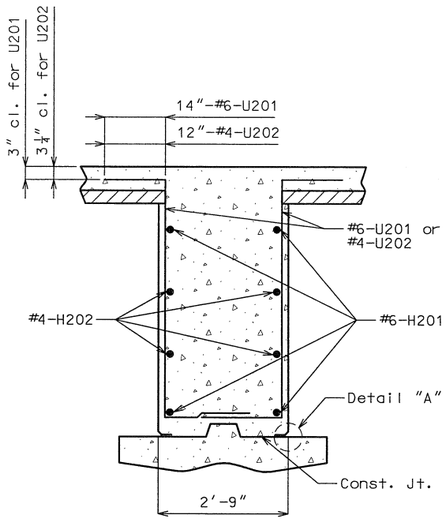
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State	Proj. No.	Sheet No.
MO	I-70-3(200)	B39

FINAL PLANS

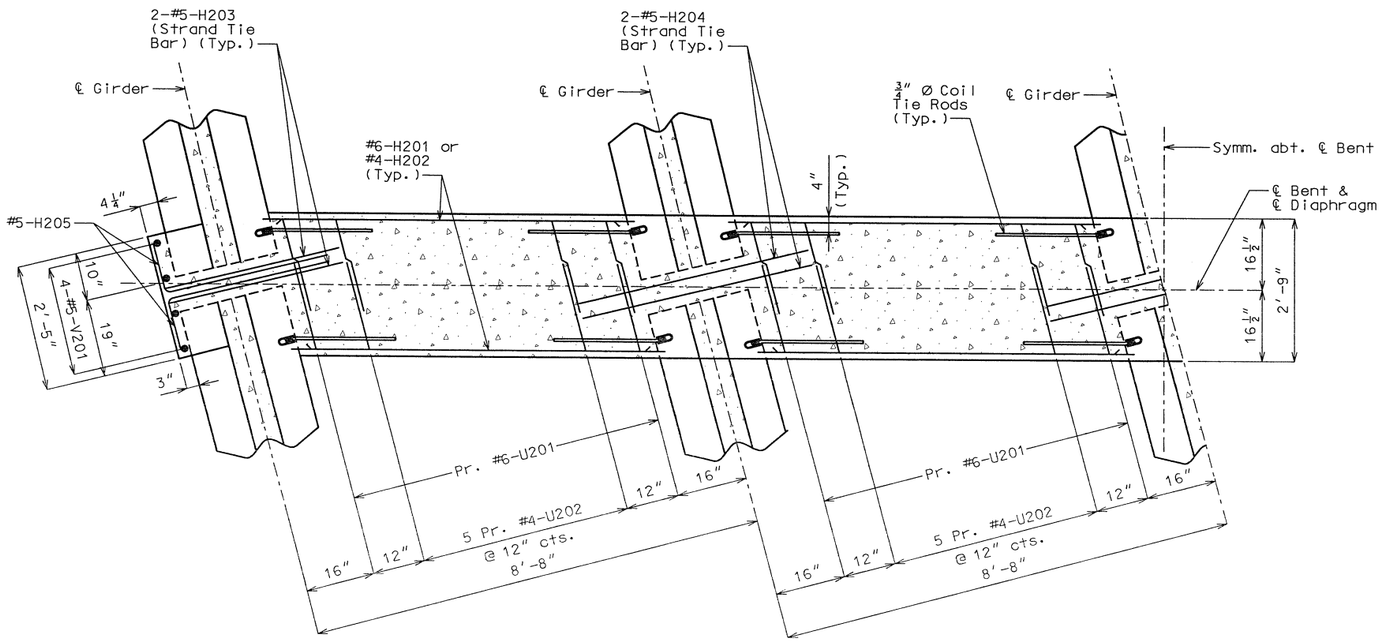


SECTION NEAR INTERMEDIATE BENT
(Normal to ℄ Structure)

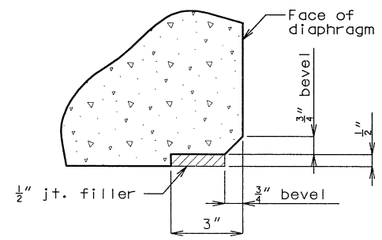


SECTION B-B

Note:
Diaphragms at Intermediate Bents shall be built vertical.
For location of #5-H203 & #5-H204 (Strand Tie Bars), see Sheets No. 18, 19, and 20.



SECTION A-A



DETAIL "A"

DETAILS OF DIAPHRAGMS AT INTERMEDIATE BENTS 2 & 3

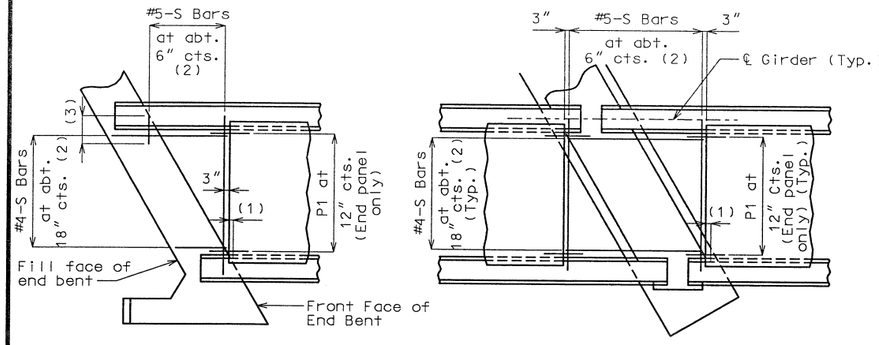
Detailed June 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

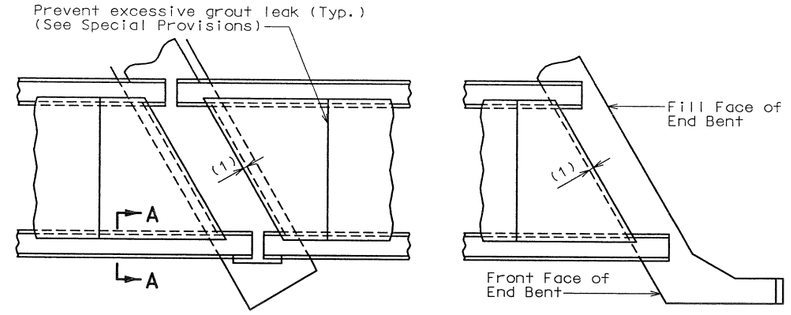
Sheet No. 22 of 38

BOONE COUNTY A6951 REV.

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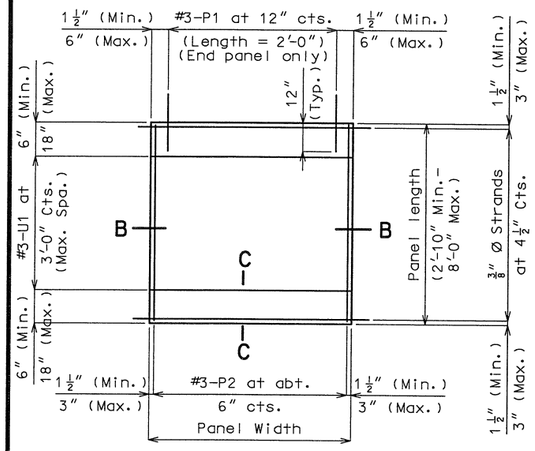


PANELS-SQUARED ENDS

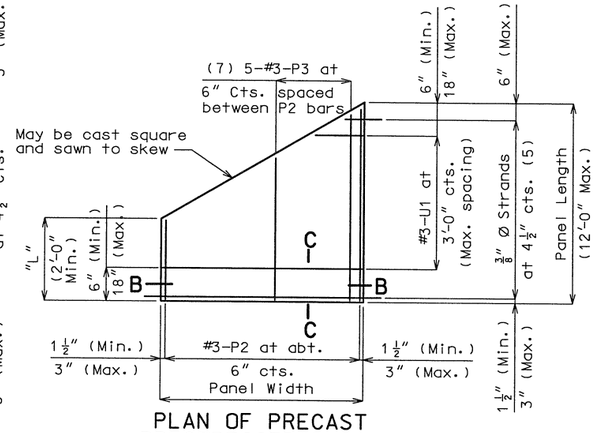


PANELS-SKEWED ENDS

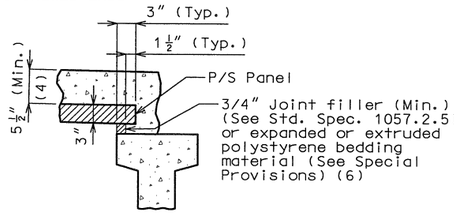
PLAN OF PRECAST PRESTRESSED PANELS PLACEMENT



PLAN OF PRECAST PRESTRESSED PANEL

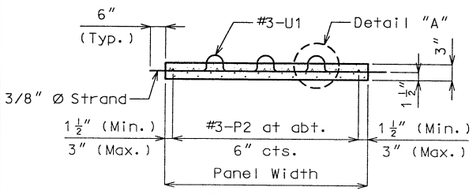


PLAN OF PRECAST PRESTRESSED PANEL (SKEWED END-OPTIONAL)

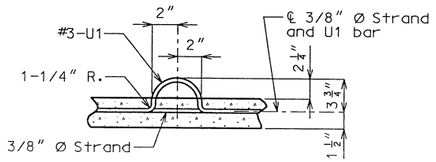


SECTION A-A

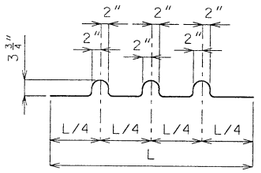
Note: Use slab haunching diagram on Sheet No. 24 for determining thickness of joint filler or polystyrene bedding material within the limits noted in general notes.



SECTION B-B

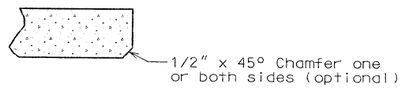


DETAIL "A"



BENDING DIAGRAM FOR U1 BAR

(U1 Bars may be oriented at right angles to location and spacing shown. U1 Bars shall be placed between P1 bars).



SECTION C-C

NOTES:

Cost of S-bars shall be included in the price bid for Slab on Concrete I-Girder per square yard.

S-bars are not listed in the bill of reinforcing.

(1) End panels shall be dimensioned 1" min. to 1-1/2" max. from the inside face of diaphragm.

(2) S-bars shown are bottom steel in slab between panels and used with squared end panels only.

(3) Extend S-Bars 18 inches beyond the front face of end bents only.

(4) In order to maintain minimum slab thickness, it may be necessary to raise the grade uniformly throughout the structure. No payment will be made for additional labor or materials required for necessary grade adjustment.

(5) Any strand 2'-0" or shorter shall have a #4 reinforcing bar on each side of it, centered between strands. Strands 2'-0" or shorter may then be debonded at the fabricator's option.

(6) All panel support pads shall be glued to the girder. When support thickness exceeds 1-1/2 inches, the pads shall be glued top and bottom. The glue used shall be the type recommended by the panel support pads manufacturer.

(7) Use #3-P3 bars if panel is skewed 45° or greater.

FINAL PLANS

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B40

GENERAL NOTES:

PRESTRESSED PANELS:

Concrete for prestressed panels shall be Class A-1 with f'c = 6,000 psi, f'ci = 3,500 psi.

The top surface of all panels shall receive a scored finish with a depth of scoring of 1/8" perpendicular to the prestressing strands in the panels (See Special Provisions).

Prestressing tendons shall be high-tensile strength uncoated seven-wire (7), low-relaxation strands for prestressed concrete conforming to AASHTO M203 Grade 270, with nominal diameter of strand = 3/8" and nominal area = 0.085 sq. in. and minimum ultimate strength = 22.95 kips (270 ksi). Larger strands may be used with the same spacing and initial tension.

Initial prestressing force = 17.2 kips/strand.

The method and sequence of releasing the strands shall be shown on the shop drawings.

Suitable anchorage devices for lifting panels may be cast in panels, provided they are shown on the shop drawings and approved by the engineer. Panel lengths shall be determined by the contractor and shown on the shop drawings.

When square end panels are used at skewed bents, it is required that the skewed portion be cast full depth. No separate payment will be made for additional concrete and reinforcing required.

Support from diaphragm forms is required under the optional skewed end until cast-in-place concrete has reached 3,000 psi compressive strength.

Minimum joint filler or polystyrene bedding material thickness shall be 3/4 inch. Thicker joint filler or polystyrene bedding material may be used on one or both sides of the girder to reduce cast-in-place concrete thickness, within tolerances. No more than 2 inches total thickness of joint filler or polystyrene bedding material shall be used.

The same thickness of joint filler material shall be used under any one edge of any panel except at locations where top flange thickness may be stepped. The maximum change in thickness between adjacent panels shall be 1/4 inch. The polystyrene bedding material may be cut to match haunch height above top of flange.

Slab thickness over prestressed panels varies due to girder camber.

At the contractor's option, the variation in slab thickness over prestressed panels may be eliminated or reduced by increasing and varying the girder top flange thickness. Dimensions shall be shown on the shop drawings.

REINFORCING STEEL:

All dimensions are out to out.

Minimum clearance to reinforcing steel shall be 1-1/2", unless otherwise shown.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

Actual lengths are measured along centerline of bar to the nearest inch.

The prestressed panel quantities are not included in the table of Estimated Quantities for Slab on Concrete I-Girder.

If U1 bars interfere with placement of slab steel, U1 loops may be bent over, as necessary, to clear slab steel.

Welded wire fabric or welded deformed bar mats providing a minimum area of reinforcing perpendicular to strands of 0.22 sq. in./ft., with spacing parallel to strands sufficient to insure proper handling, may be used in lieu of the #3-P2 bars shown. Wire or bar diameter shall not be larger then 0.375 inch. The above alternative reinforcement criteria may be used in lieu of the #3-P3 bars, when required, and placed over a width not less than 2 feet.

The reinforcing steel shall be tied securely to the 3/8" Ø strands with the following maximum spacing in each direction:
#3-P2 bars at 16 inches.
Welded wire fabric or welded deformed bar mats at 24 inches.

Tie the #3-U1 bars to the #3-P2 bars, to the welded wire fabric or the welded deformed bar mats at about 36 inch centers.

All reinforcement other than prestressing strands shall be epoxy coated.

Precast panels may be in contact with stirrup reinforcing in diaphragms.

DETAILS OF PRECAST PRESTRESSED PANELS

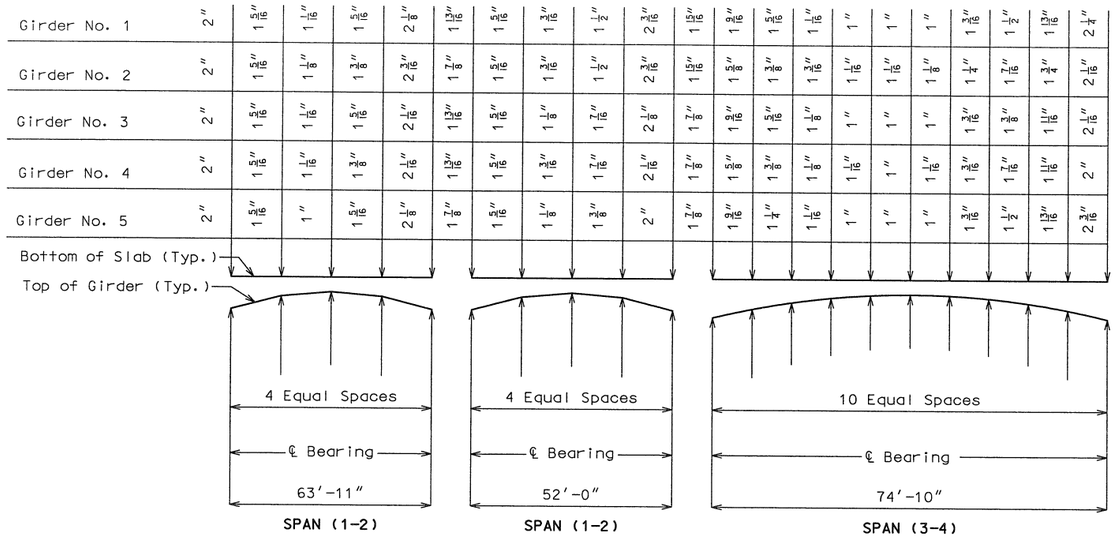
Detailed July 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

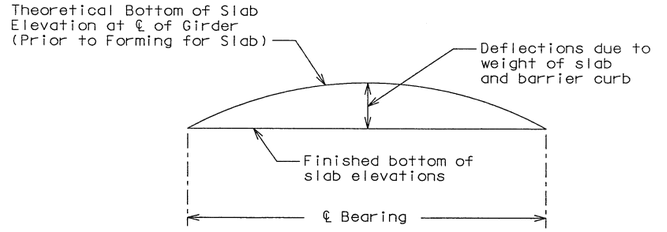
BOONE COUNTY A6951

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B41

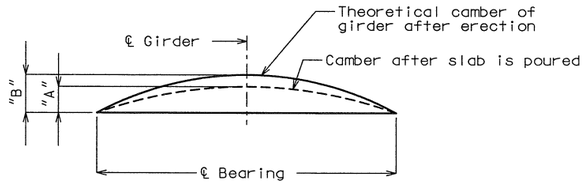
FINAL PLANS



THEORETICAL SLAB HAUNCHING DIAGRAM



TYPICAL SLAB ELEVATIONS DIAGRAM



	Span (1-2)		Span (2-3)		Span (3-4)	
	"A"	"B"	"A"	"B"	"A"	"B"
Girders No. 1 & 5	$\frac{1}{2}$"	$\frac{13}{16}$"	$\frac{1}{2}$"	$\frac{5}{8}$"	$\frac{15}{16}$"	$1\frac{7}{16}$"
Girders No. 2 & 4	$\frac{7}{16}$"		$\frac{7}{16}$"		$\frac{3}{4}$"	
Girder No. 3	$\frac{7}{16}$"		$\frac{7}{16}$"		$\frac{13}{16}$"	

GIRDER CAMBER DIAGRAM

Theoretical Bottom of Slab Elevations at ℄ of Girder (Prior to Forming for Slab) ✳✳

	Span (1-2) (63′-11″ ℄ brg – ℄ brg.)				
	℄ brg.	.25	.50	.75	℄ brg.
Girder No. 1	684.60	684.34	684.08	683.84	683.61
Girder No. 2	685.18	684.92	684.67	684.42	684.18
Girder No. 3	685.76	685.50	685.25	685.00	684.76
Girder No. 4	686.35	686.08	685.83	685.57	685.33
Girder No. 5	686.93	686.66	686.40	686.15	685.91

	Span (2-3) (52′-0″ ℄ brg – ℄ brg.)				
	℄ brg.	.25	.50	.75	℄ brg.
Girder No. 1	683.58	683.42	683.26	683.12	682.98
Girder No. 2	684.16	683.99	683.84	683.69	683.55
Girder No. 3	684.73	684.57	684.41	684.26	684.12
Girder No. 4	685.31	685.15	684.99	684.83	684.69
Girder No. 5	685.89	685.72	685.56	685.40	685.26

	Span (3-4) (74′-10″ ℄ brg – ℄ brg.)										
	℄ brg.	.10	.20	.30	.40	.50	.60	.70	.80	.90	℄ brg.
Girder No. 1	682.96	682.89	682.83	682.76	682.69	682.61	682.54	682.46	682.38	682.30	682.22
Girder No. 2	683.53	683.47	683.41	683.34	683.27	683.20	683.12	683.04	682.96	682.87	682.79
Girder No. 3	684.10	684.04	683.98	683.91	683.84	683.77	683.69	683.61	683.53	683.44	683.36
Girder No. 4	684.68	684.61	684.55	684.48	684.42	684.34	684.27	684.18	684.10	684.01	683.93
Girder No. 5	685.25	685.18	685.11	685.04	684.97	684.90	684.82	684.74	684.66	684.58	684.50

✳✳ Elevations are based on a constant slab thickness of 8 1/2" and include allowance for theoretical dead load deflections due to weight of slab (including precast panel) and barrier curb.

Note:

Concrete in the slab haunches is included in the Estimated Quantities for Slab on Concrete I-Girder.

If girder camber is different from that shown in the camber diagram, it shall be necessary to adjust the slab haunches, increase the slab thickness or raise the grade uniformly throughout the structure. No payment will be made for additional labor or materials required for variation in haunching, slab thickness or grade adjustment.

Longitudinal dimensions are horizontal.

Conversion factors for girder camber
0.1 pt. = 0.314 x 0.5 pt.
0.2 pt. = 0.593 x 0.5 pt.
0.3 pt. = 0.813 x 0.5 pt.
0.4 pt. = 0.952 x 0.5 pt.

0.25 pt. = 0.7125 x 0.5 pt.

Detailed June 2003
Checked July 2003

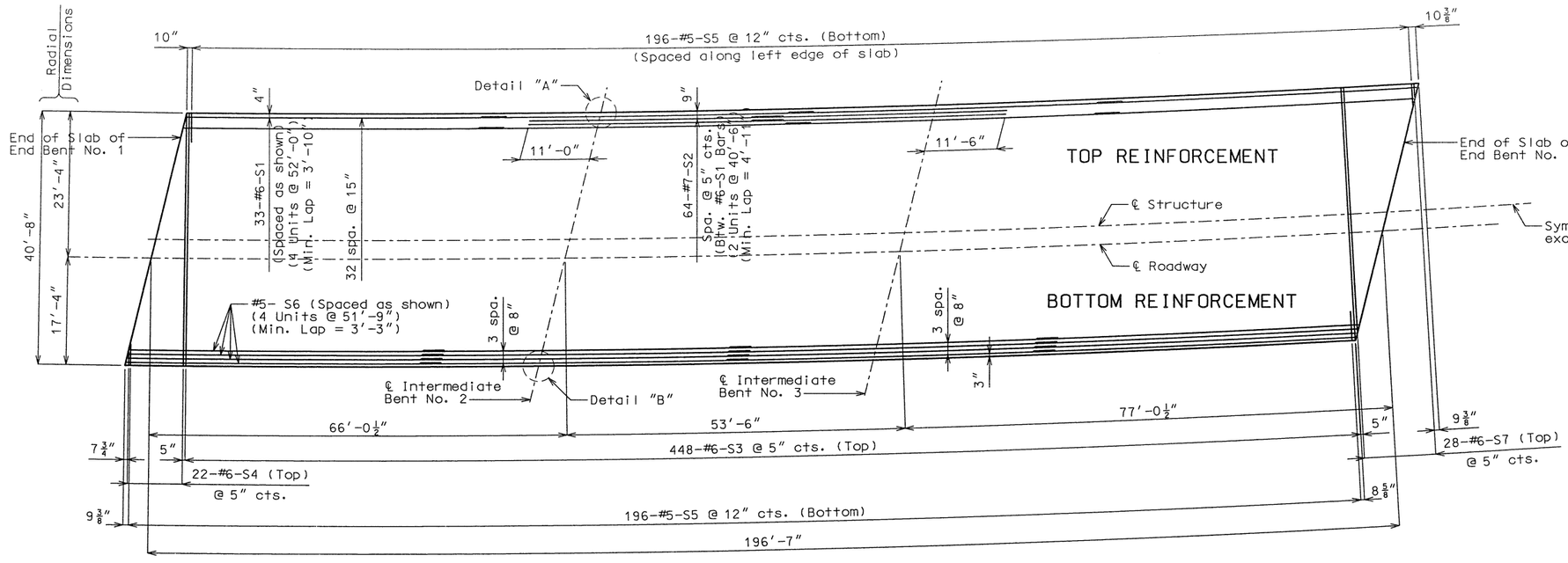
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BOONE COUNTY A6951 REV.

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State	Proj. No.	Sheet No.
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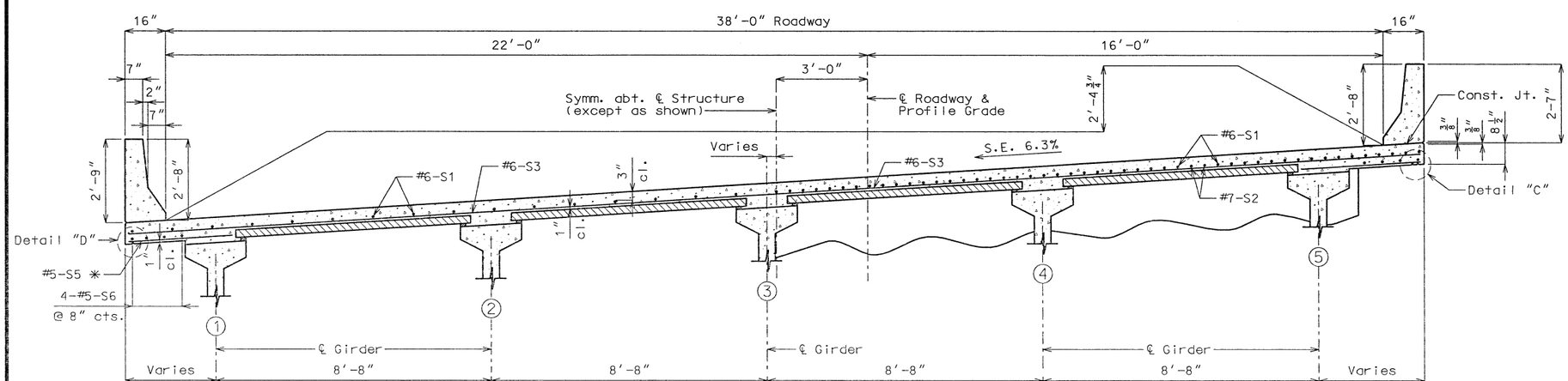
FINAL PLANS



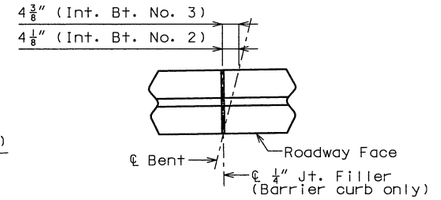
PLAN OF SLAB SHOWING REINFORCEMENT

Note:
All longitudinal dimensions shown are horizontal arc dimensions.
Transverse reinforcement to be placed radially and spaced along right edge of slab except as shown.
Longitudinal reinforcement to be placed parallel to ℄ roadway.

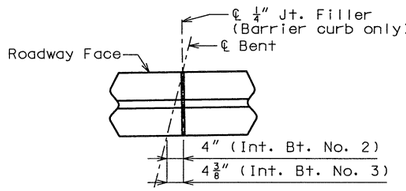
Note:
For details of Precast Prestressed Panels, see Sheet No. 23.
For Theoretical Bottom of Slab Elevation, Theoretical Slab Haunching Diagram, and Girder Camber Diagram, see Sheet No. 24.
For details and reinforcement of Safety Barrier Curb not shown, see Sheets No. 27 thru 32.
For Slab Pouring Sequence and Slab Construction Details, see Sheet No. 26.



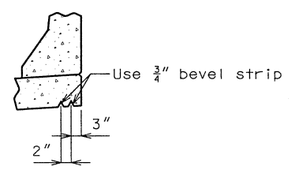
* Alternate bar shape allowed, see Sheet Nos. 27 thru 31.



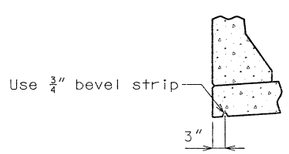
DETAIL "A"



DETAIL "B"



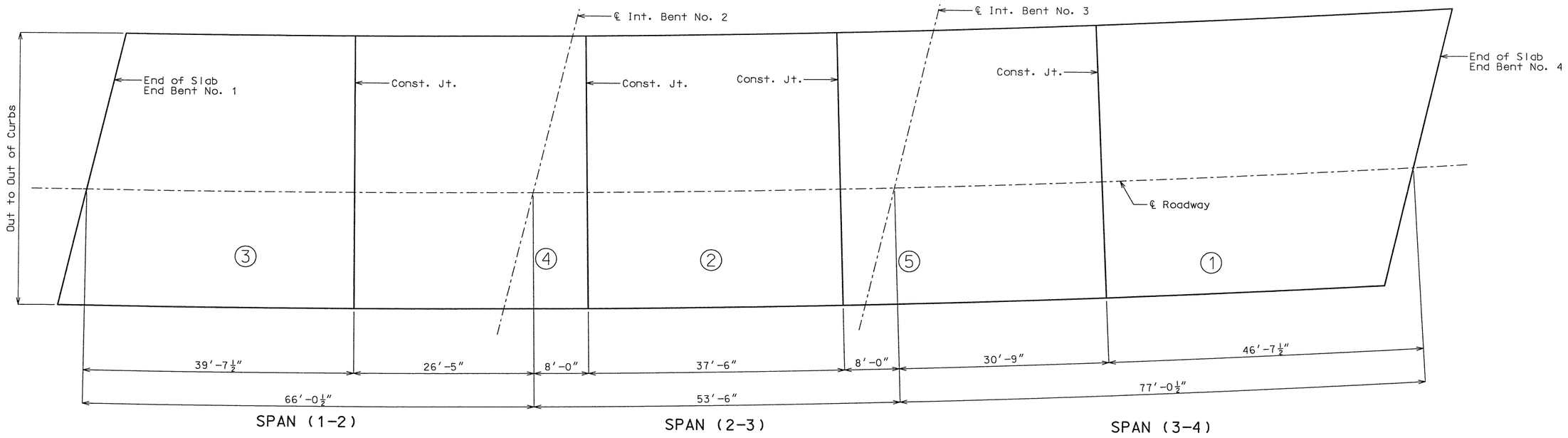
DETAIL "C"



DETAIL "D"

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B43

FINAL PLANS

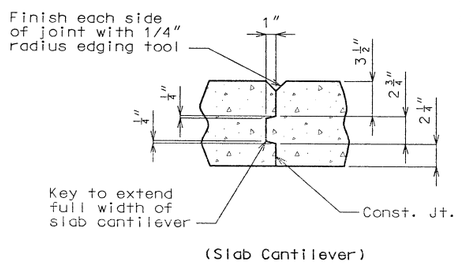


	Sequence of Pours					Min. rate of pour cu. yds./hr.
	Direction					With retarder
Basic sequence	1	2	3	4	5	25
	Either direction					
Alternate pours to the basic skip sequence are subject to the approval of the engineer in accordance with Section 703.3.12.4 of Missouri Standard Specifications.						
Alternate "A" pours	1		5 + 2		4 + 3	25
	End to 5		1 to 4		2 to end	
Alternate "B" pours	1 + 5 + 2			4 + 3		25
	End to 4			2 to end		
Alternate "C" pours	1 + 5 + 2 + 4 + 3					25
	End to end					

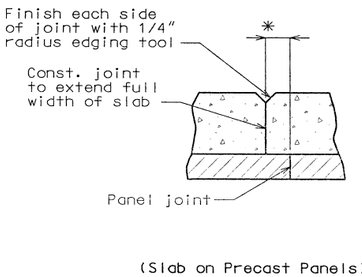
Note: The contractor shall pour and satisfactorily finish the slab pours at the rate given. Retarder, if used, shall be an approved type and retard the set of concrete to 2.5 hours.

The concrete diaphragm at the intermediate bents and integral end bents shall be poured a minimum of 30 minutes and a maximum of 2 hours before the slab is poured.

SLAB POURING SEQUENCE



(Slab Cantilever)



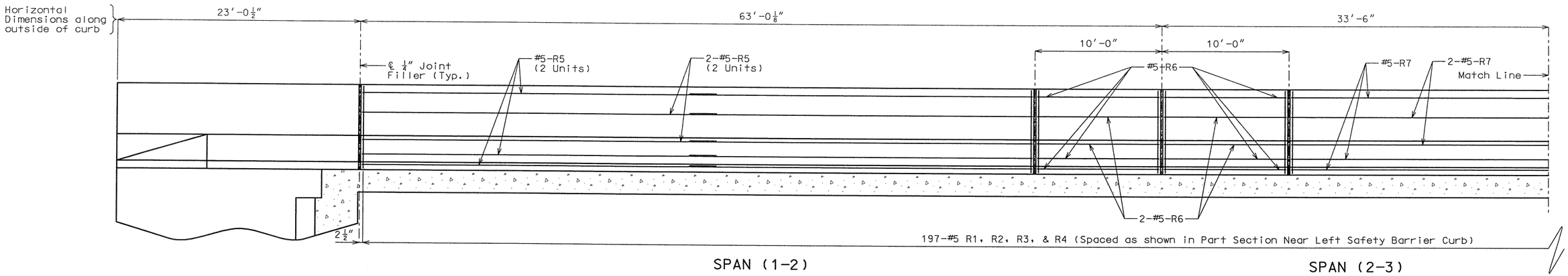
(Slab on Precast Panels)

SLAB CONSTRUCTION JOINT DETAILS

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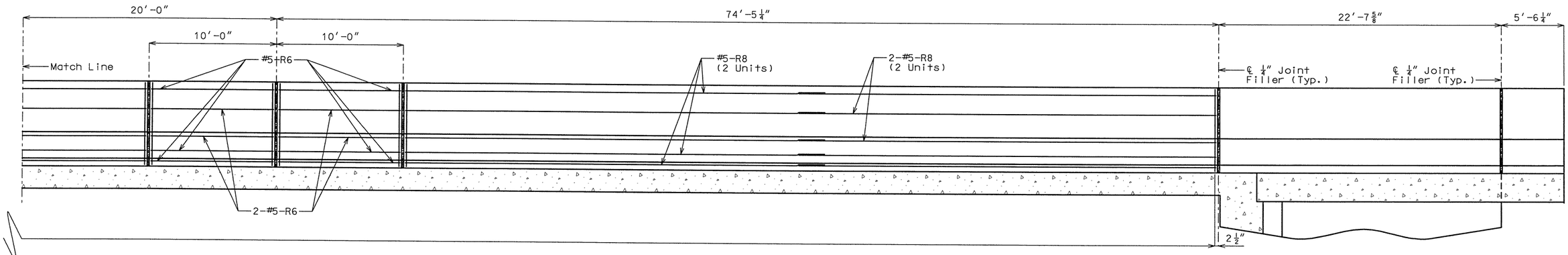
State	Proj. No.	Sheet No.
MO	I-70-3(200)	B44

FINAL PLANS



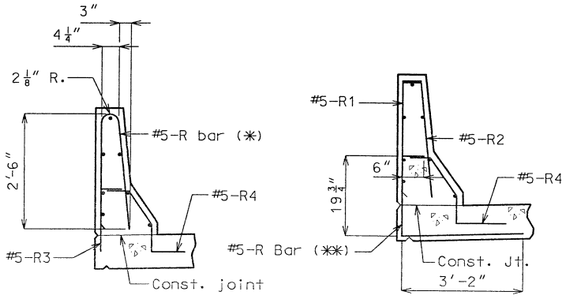
SPAN (1-2)

SPAN (2-3)



SPAN (3-4)

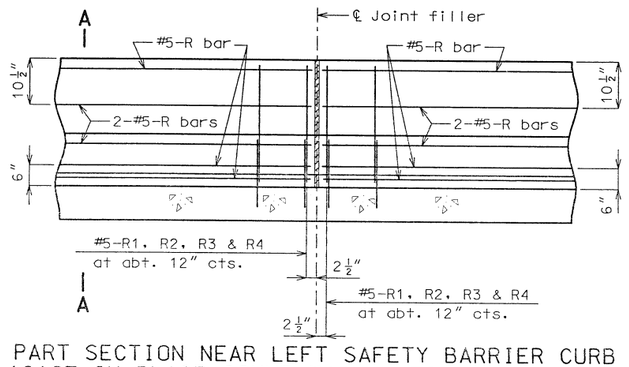
SECTION NEAR LEFT SAFETY BARRIER CURB



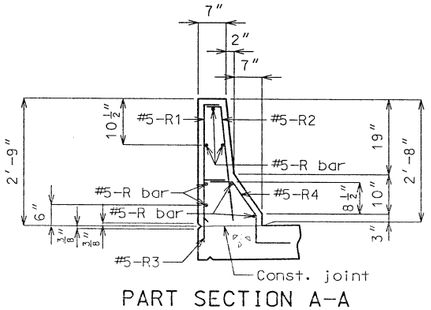
R-BAR PERMISSIBLE ALTERNATE SHAPE

(*) The R1 and R2 bar combination may be furnished as one bar, as shown, at the contractor's option. (All dimensions are out to out.)

(**) The R3 bar and #5 bottom transverse slab bar in cantilever (P/S panels only) combination may be furnished as one bar as shown, at the contractor's option.



PART SECTION NEAR LEFT SAFETY BARRIER CURB (CAST-IN-PLACE CONVENTIONAL FORMING OPTION)



PART SECTION A-A

Notes:

Use a minimum lap of 2′-11″ for #5 horizontal safety barrier curb bars.

The cross-sectional area above the slab = 2.31 sq. ft.

Notes:

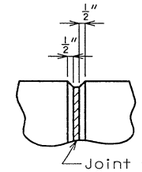
Top of safety barrier curb shall be built parallel to grade with safety barrier curb joints (except at end bents) normal to grade.

All exposed edges of safety barrier curb shall have either a 1/2″ radius or a 3/8″ bevel, unless otherwise noted.

When the safety barrier curb is bid by linear feet, the contract unit price shall include the cost of all concrete and reinforcement, complete in place.

Concrete in the safety barrier curb shall be Class B-1.

Measurement of safety barrier curb is to the nearest linear foot for each structure, measured along the outside top of slab from end of wing to end of wing.



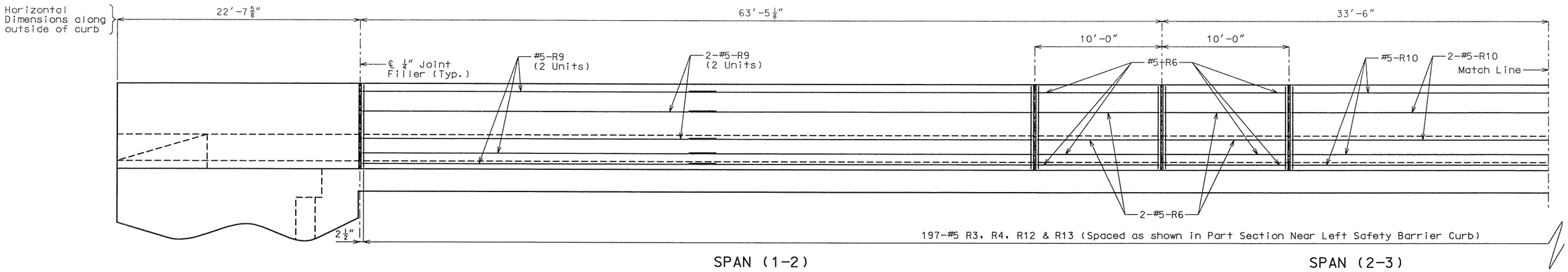
FILLED JOINT DETAIL

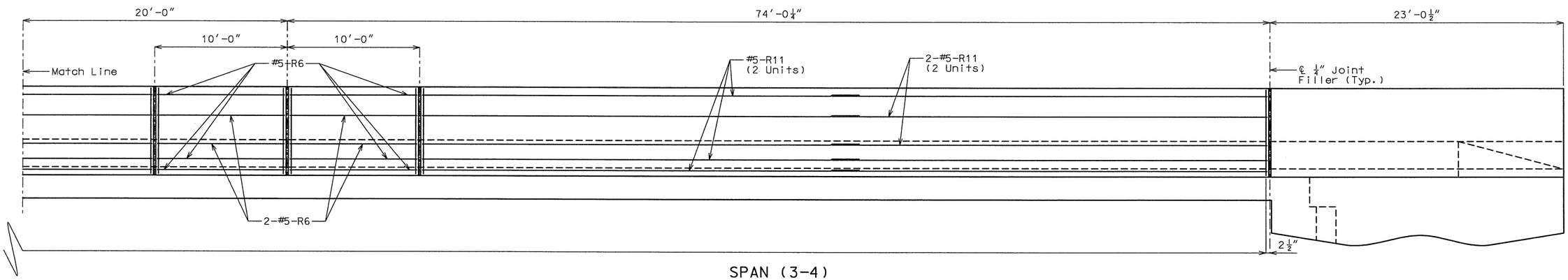
Detailed July 2003
Checked July 2003

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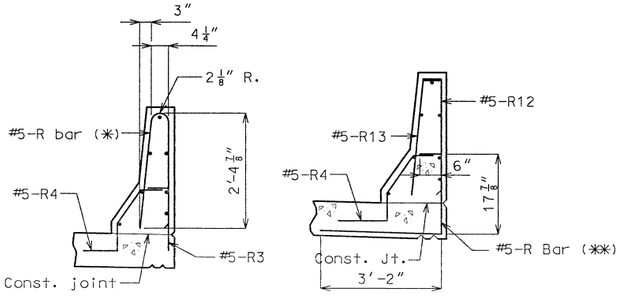
State	Proj. No.	Sheet No.
MO	I-70-3(200)	B45

FINAL PLANS





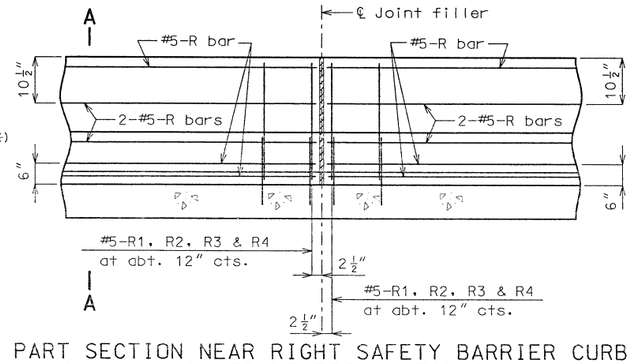
ELEVATION NEAR RIGHT SAFETY BARRIER CURB



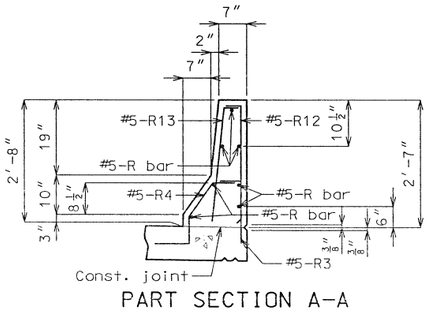
R-BAR PERMISSIBLE ALTERNATE SHAPE

(*) The R12 and R13 bar combination may be furnished as one bar, as shown, at the contractor's option. (All dimensions are out to out.)

(**) The R3 bar and #5 bottom transverse slab bar in cantilever (P/S panels only) combination may be furnished as one bar as shown, at the contractor's option.



PART SECTION NEAR RIGHT SAFETY BARRIER CURB (CAST-IN-PLACE CONVENTIONAL FORMING OPTION)



PART SECTION A-A

Notes:

Use a minimum lap of 2′-11″ for #5 horizontal safety barrier curb bars.

The cross-sectional area above the slab = 2.20 sq. ft.

Notes:

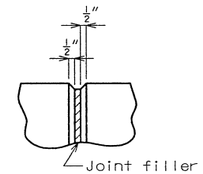
Top of safety barrier curb shall be built parallel to grade with safety barrier curb joints (except at end bents) normal to grade.

All exposed edges of safety barrier curb shall have either a 1/2″ radius or a 3/8″ bevel, unless otherwise noted.

When the safety barrier curb is bid by linear feet, the contract unit price shall include the cost of all concrete and reinforcement, complete in place.

Concrete in the safety barrier curb shall be Class B-1.

Measurement of safety barrier curb is to the nearest linear foot for each structure, measured along the outside top of slab from end of wing to end of wing.



FILLED JOINT DETAIL

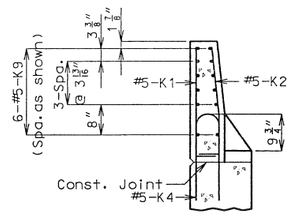
Detailed July 2003
Checked July 2003

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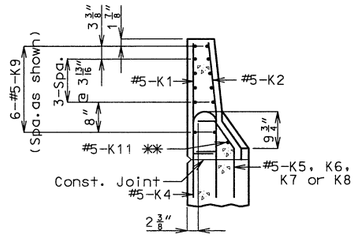
BOONE COUNTY A6951

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B46

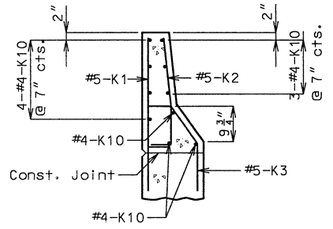
FINAL PLANS



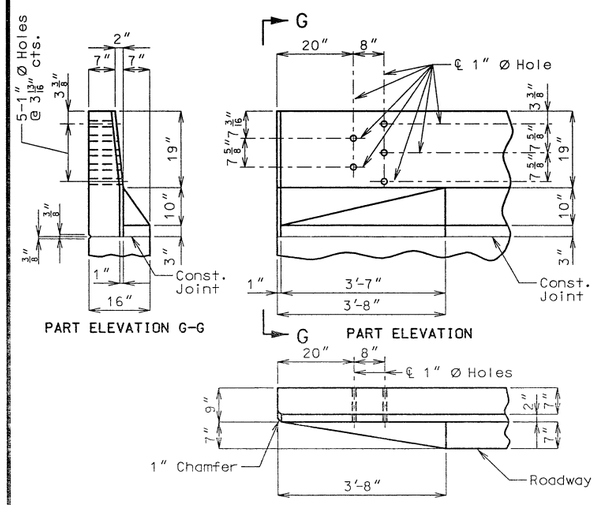
SECTION A-A



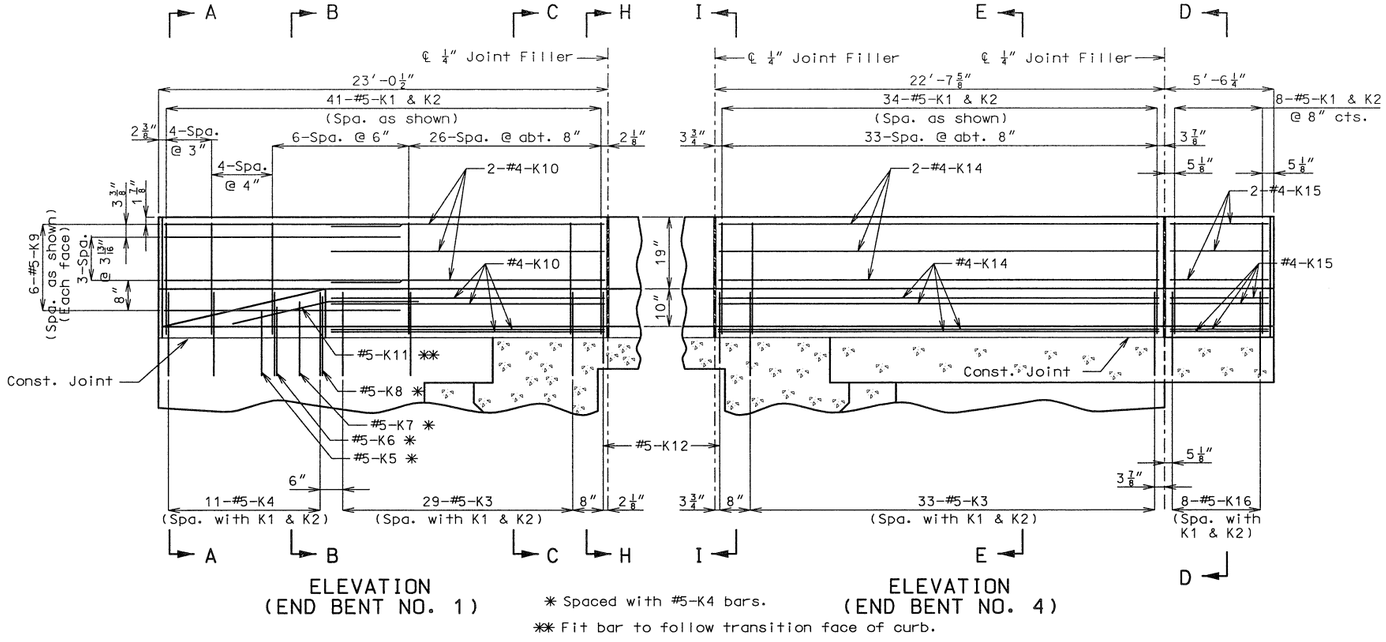
SECTION B-B



SECTION C-C



DETAILS OF GUARD RAIL ATTACHMENT

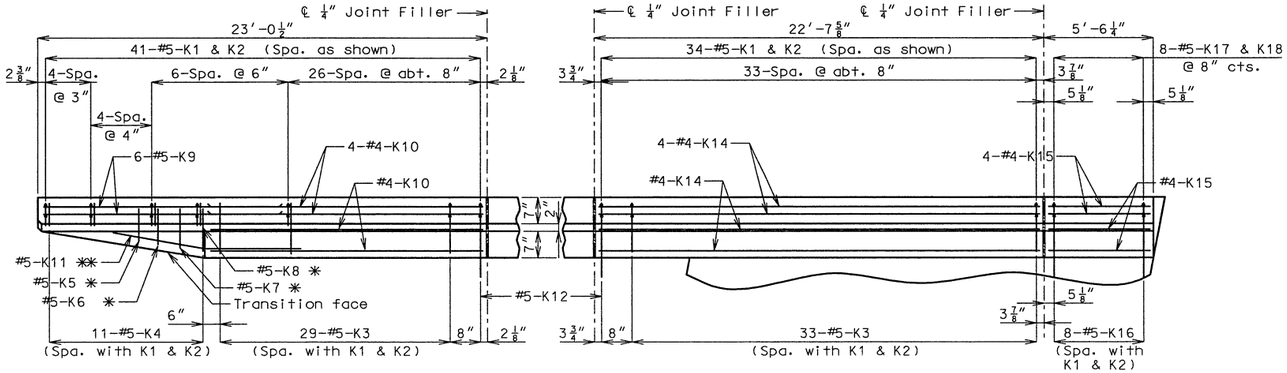


ELEVATION (END BENT NO. 1)

ELEVATION (END BENT NO. 4)

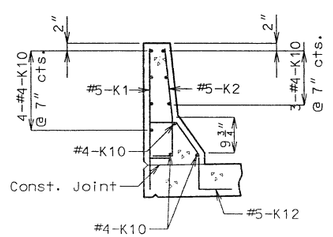
* Spaced with #5-K4 bars.

** Fit bar to follow transition face of curb.

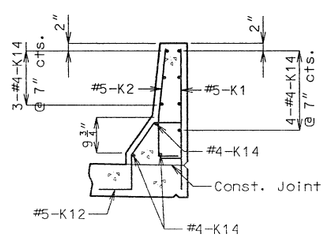


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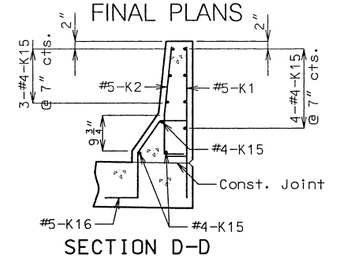


SECTION H-H

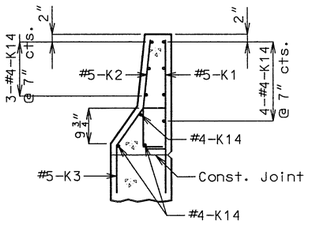


SECTION I-I

NOTE: Use a minimum lap of 2'-0" between K9 and K10 bars.

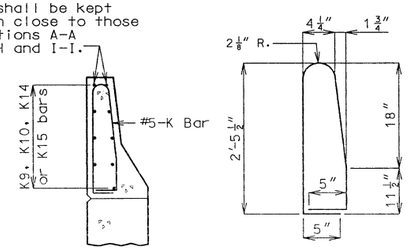


SECTION D-D



SECTION E-E

The top two K9, K10, K14 or K15 bars shall be kept with position close to those shown in Sections A-A thru E-E, H-H and I-I.



(K3 or K4 thru K8 bars not shown for clarity)

K1-K2 BAR PERMISSIBLE ALTERNATE SHAPE (***)

(***) The K1 and K2 bar combination may be furnished as one bar as shown, at the contractor's option.

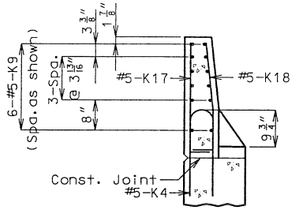
DETAILS OF LEFT SAFETY BARRIER CURB AT END BENTS

Detailed Oct. 2003
Checked

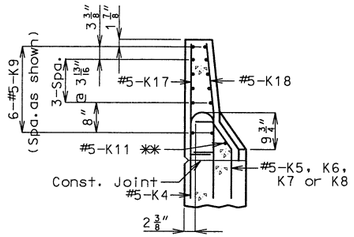
NOTE: THIS DRAWING IS NOT TO SCALE. FOLLOW DIMENSIONS.

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B47

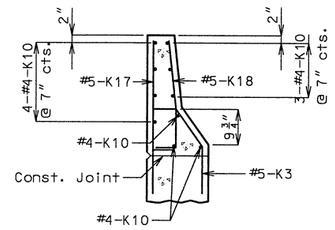
FINAL PLANS



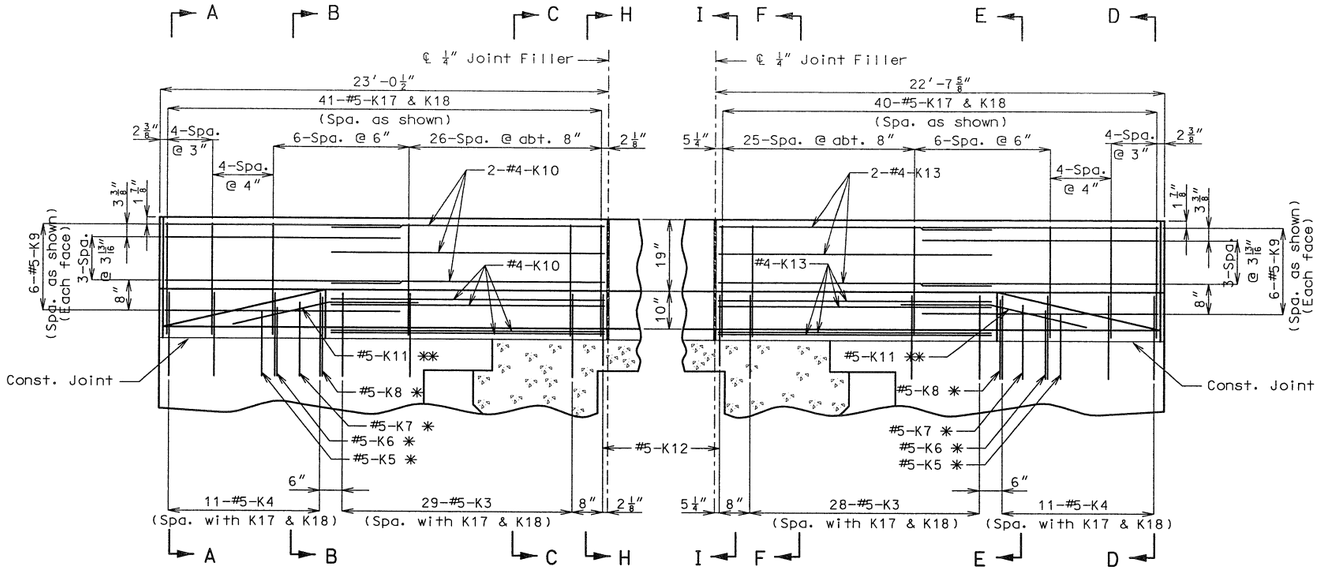
SECTION A-A



SECTION B-B



SECTION C-C

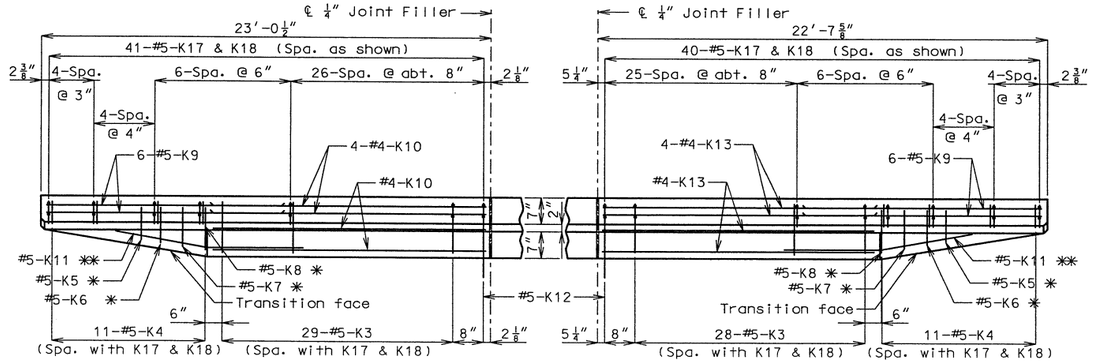


ELEVATION (END BENT NO. 4)

ELEVATION (END BENT NO. 1)

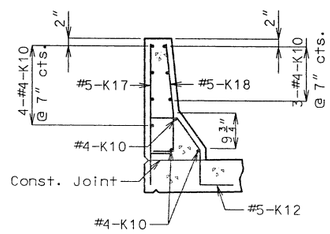
* Spaced with #5-K4 bars.

** Fit bar to follow transition face of curb.

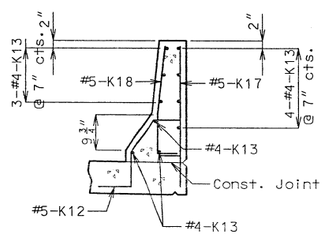


PLAN

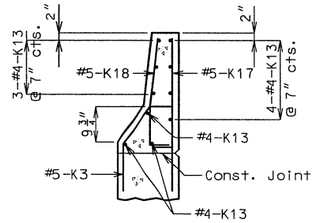
PLAN



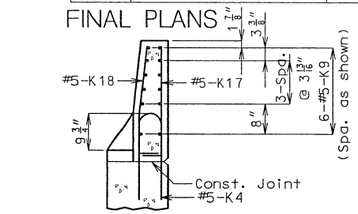
SECTION H-H



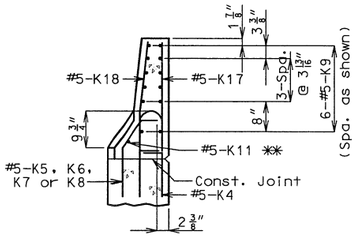
SECTION I-I



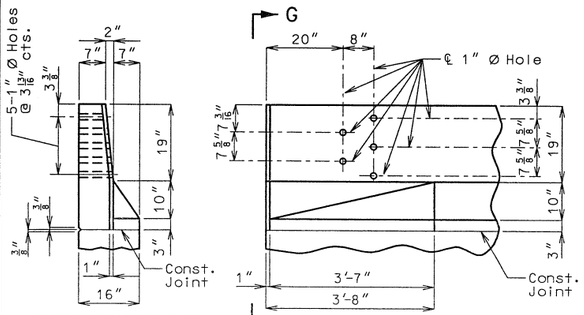
SECTION F-F



SECTION D-D



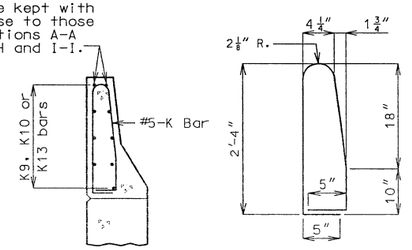
SECTION E-E



DETAILS OF GUARD RAIL ATTACHMENT

NOTE: Use a minimum lap of 2'-0" between K9 and K10 bars and between K9 and K13 bars.

The top two K9, K10 or K13 bars shall be kept with position close to those shown in Sections A-A thru F-F, H-H and I-I.



(K3 or K4 thru K8 bars not shown for clarity)

K17-K18 BAR PERMISSIBLE ALTERNATE SHAPE (***)

(***) The K1 and K2 bar combination may be furnished as one bar as shown, at the contractor's option.

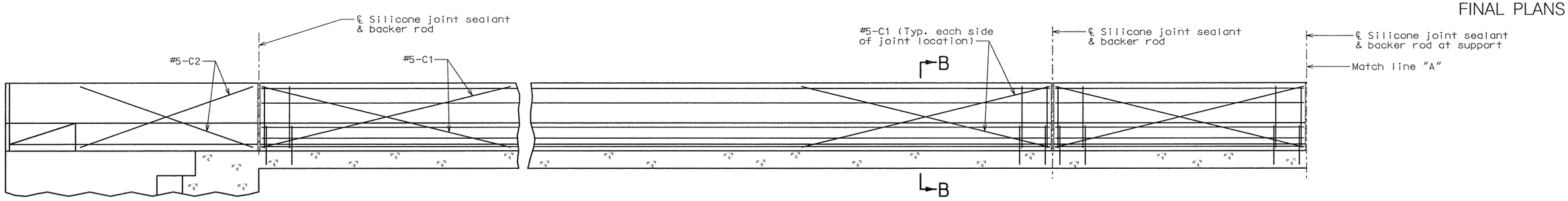
DETAILS OF RIGHT SAFETY BARRIER CURB AT END BENTS

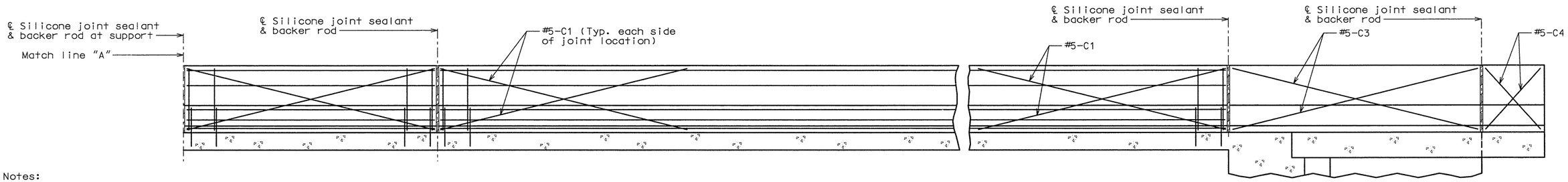
Detailed July 2003
Checked July 2003

NOTE: THIS DRAWING IS NOT TO SCALE. FOLLOW DIMENSIONS.

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B48

FINAL PLANS





TYPICAL SECTION NEAR LEFT SAFETY BARRIER CURB AT SUPPORT LOCATIONS (OPTIONAL SLIP-FORM BRIDGE SAFETY BARRIER CURB)

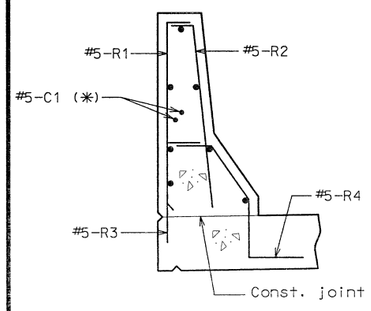
Notes:

Top of safety barrier curb shall be built parallel to grade with safety barrier curb joints (except at end bents) normal to grade.

When the safety barrier curb is bid by linear feet, the contract unit price shall include the cost of all concrete and reinforcement, complete-in-place.

Concrete in the safety barrier curb shall be Class B-1.

Measurement of safety barrier curb is to the nearest linear foot for each structure, measured along the outside top of slab from end of wing to end of wing.



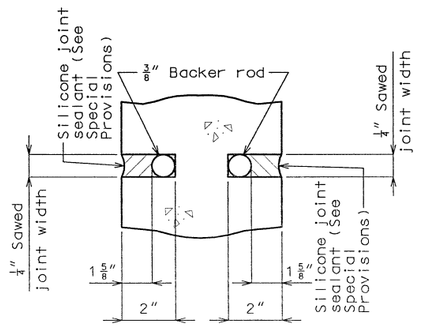
PART SECTION B-B

Notes:

(*) Each side of joint location.

(**) The R1 and R2 bar combination may be furnished as one bar, as shown, at the contractor's option. (All dimensions are out to out.)

(***) The R3 bar and #5 bottom transverse slab bar in cantilever (P/S panels only) combination may be furnished as one bar as shown, at the contractor's option.



SECTION A-A

Note

Cost of silicone joint sealant and backer rod complete in place to be included in the contract unit price for Safety Barrier Curb.

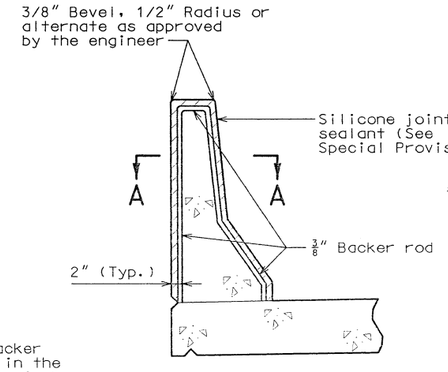
Note:

Joint sealant and backer rods shall be used on all slip-form bridge safety barrier curbs instead of joint filler.

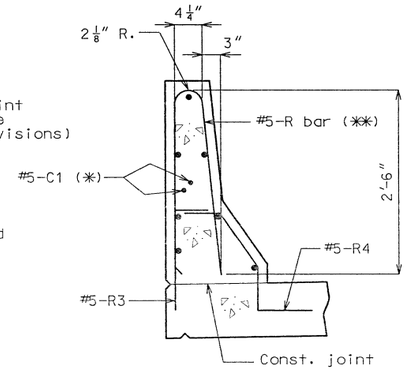
Plastic waterstop shall not be used with slip-form option.

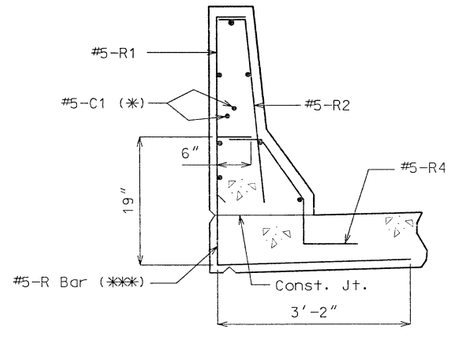
C Bars (Slip-form option only) shall be used in addition to cast-in-place conventional forming reinforcement for bridge safety barrier curb.

For Slip-Form option, all sides of the safety barrier curb shall have a vertically broomed finish and the curb top shall have a tranversely broomed finish.



SECTION THRU JOINT





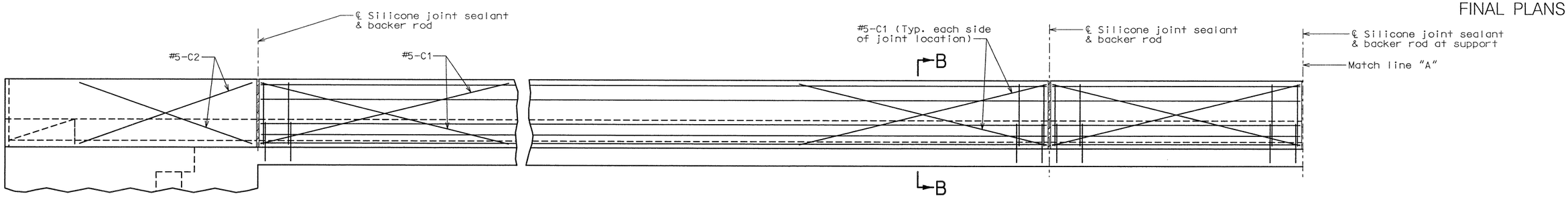
R-BAR PERMISSIBLE ALTERNATE SHAPE

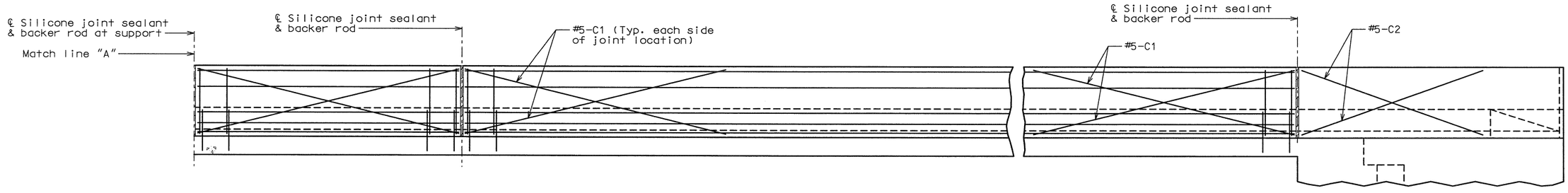
OPTIONAL SLIP-FORM BRIDGE SAFETY BARRIER CURB

(Left barrier curb)

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B49

FINAL PLANS





Notes:

Top of safety barrier curb shall be built parallel to grade with safety barrier curb joints (except at end bents) normal to grade.

When the safety barrier curb is bid by linear feet, the contract unit price shall include the cost of all concrete and reinforcement, complete-in-place.

Concrete in the safety barrier curb shall be Class B-1.

Measurement of safety barrier curb is to the nearest linear foot for each structure, measured along the outside top of slab from end of wing to end of wing.

TYPICAL ELEVATION NEAR RIGHT SAFETY BARRIER CURB AT SUPPORT LOCATIONS (OPTIONAL SLIP-FORM BRIDGE SAFETY BARRIER CURB)

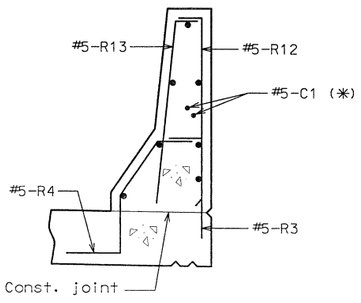
Note:

Joint sealant and backer rods shall be used on all slip-form bridge safety barrier curbs instead of joint filler.

Plastic waterstop shall not be used with slip-form option.

C Bars (Slip-form option only) shall be used in addition to cast-in-place conventional forming reinforcement for bridge safety barrier curb.

For Slip-Form option, all sides of the safety barrier curb shall have a vertically broomed finish and the curb top shall have a tranversely broomed finish.



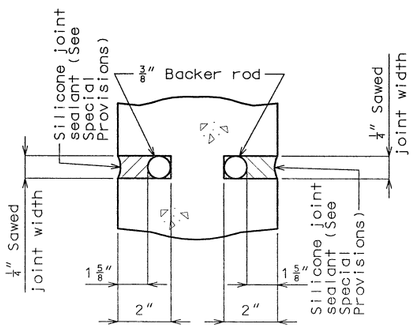
PART SECTION B-B

Notes:

(*) Each side of joint location.

(**) The R12 and R13 bar combination may be furnished as one bar, as shown, at the contractor's option. (All dimensions are out to out.)

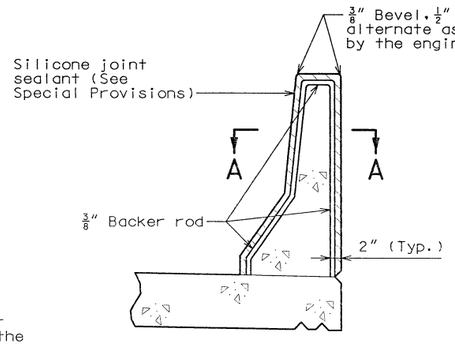
(***) The R3 bar and #5 bottom transverse slab bar in cantilever (P/S panels only) combination may be furnished as one bar as shown, at the contractor's option.



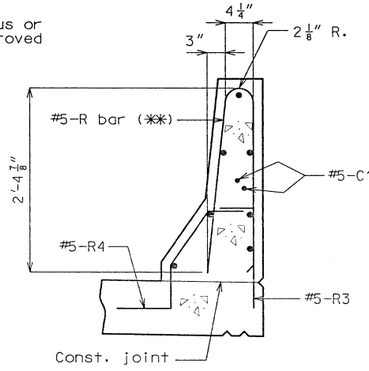
SECTION A-A

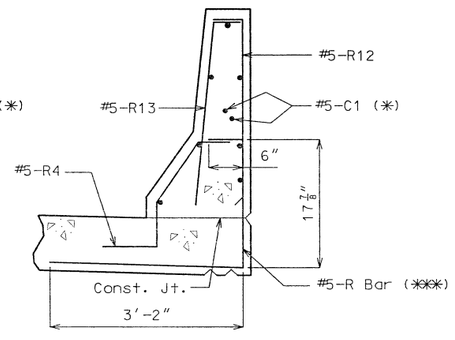
Note

Cost of silicone joint sealant and backer rod complete in place to be included in the contract unit price for Safety Barrier Curb.



SECTION THRU JOINT





R-BAR PERMISSIBLE ALTERNATE SHAPE

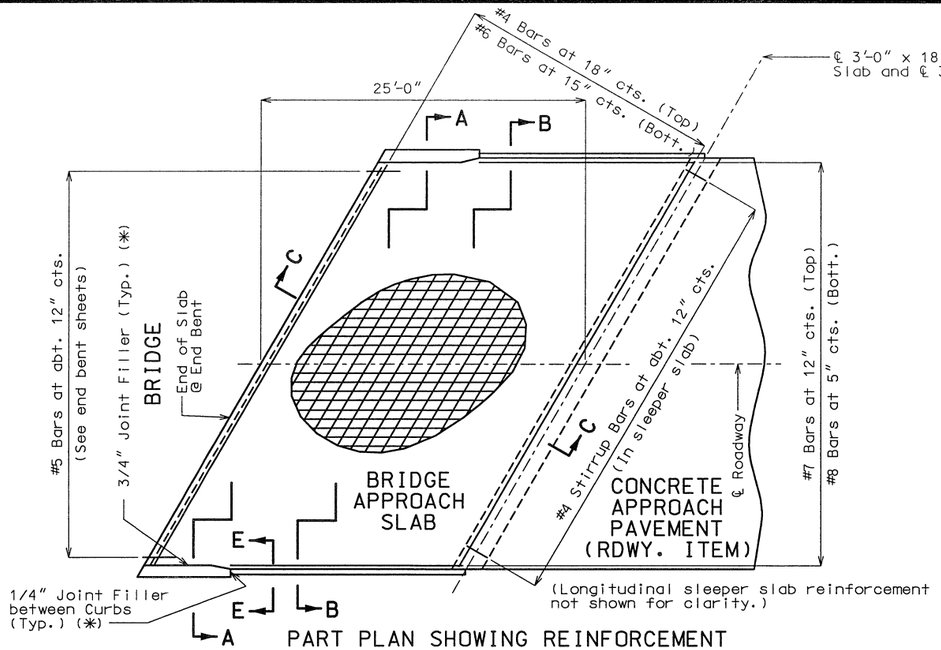
OPTIONAL SLIP-FORM BRIDGE SAFETY BARRIER CURB

(Right barrier curb)

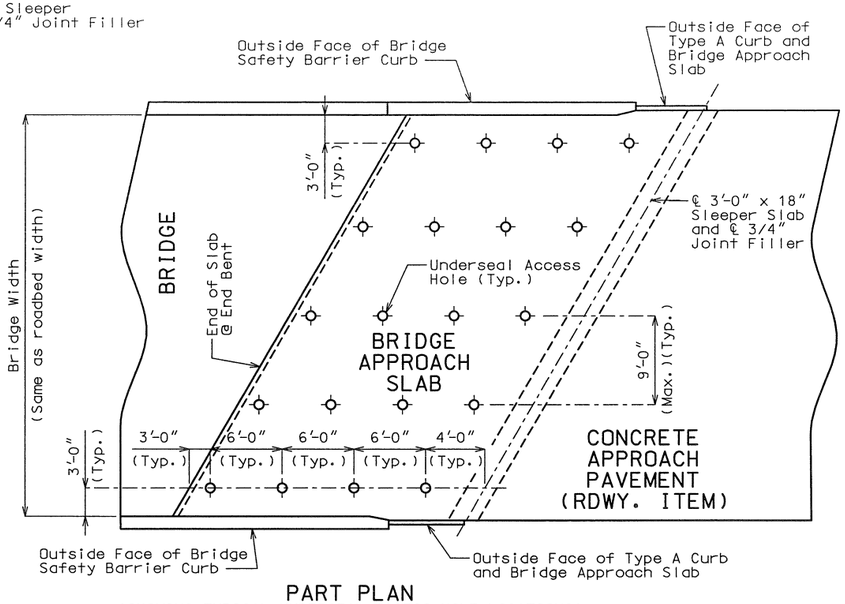
Note: This drawing is not to scale. Follow dimensions.

Detailed July 2003
Checked July 2003

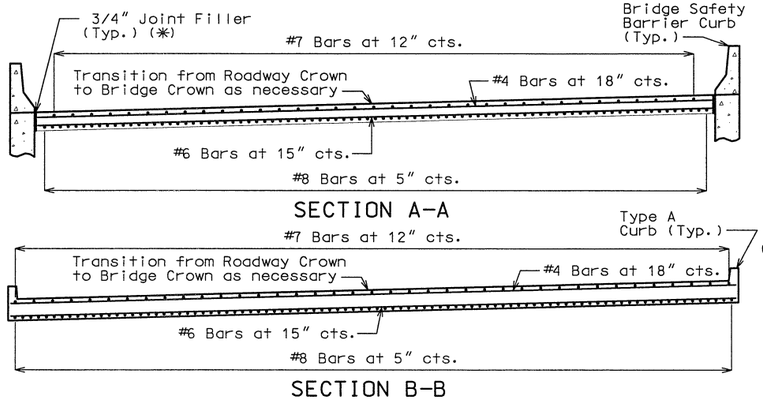
BOONE COUNTY | A6951



PART PLAN SHOWING REINFORCEMENT



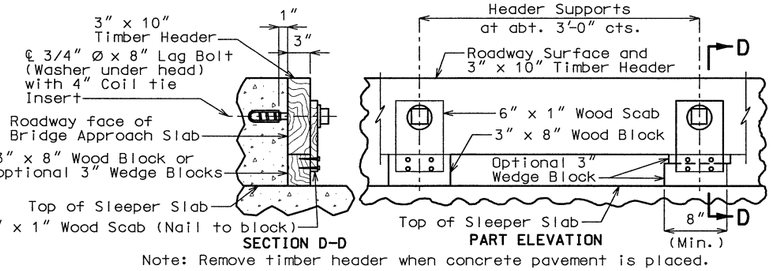
PART PLAN
(SHOWING TYPICAL UNDERSEAL ACCESS HOLE LOCATIONS)



SECTION A-A

SECTION B-B

Note: With the approval of the Engineer, the contractor may crown the bottom of the approach slab to match the crown of the roadway surface.



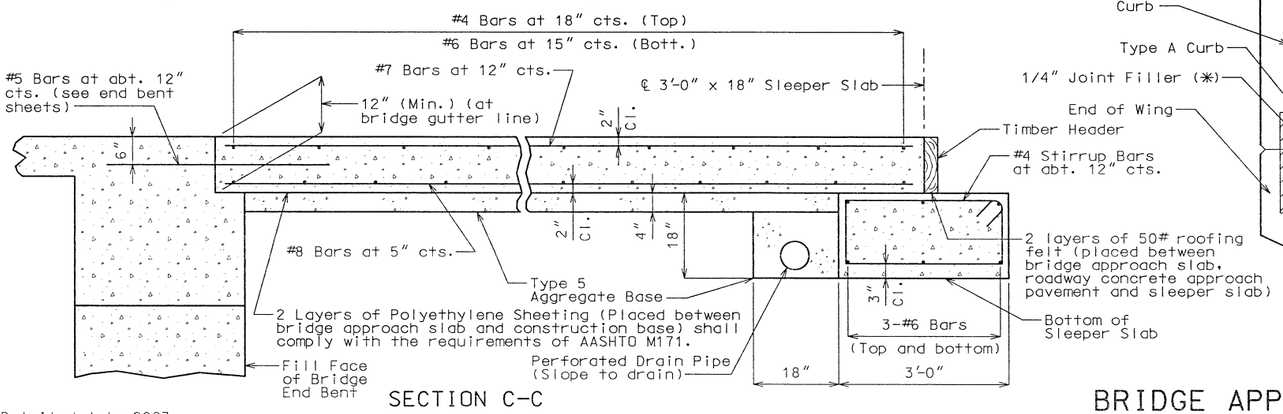
SECTION D-D

PART ELEVATION

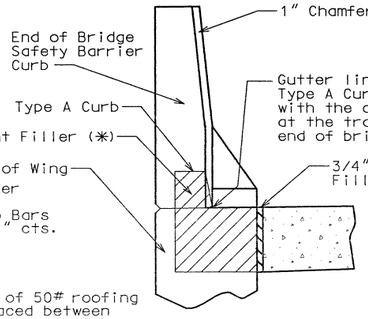
Note: Remove timber header when concrete pavement is placed.

DETAILS OF TIMBER HEADER

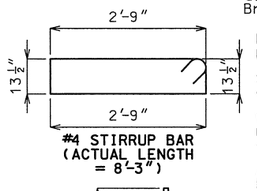
(*) Use 3/4" Joint Filler between vertical face of Approach Slab and Wing, except at the end of Safety Barrier Curb/Wing face use 1/4" Joint Filler. Seal joint with joint sealant. See Special Provisions.



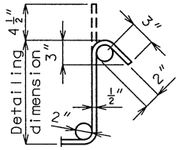
SECTION C-C



SECTION E-E
(BETWEEN CURBS)

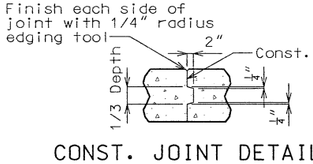


#4 STIRRUP BAR (ACTUAL LENGTH = 8'-3")

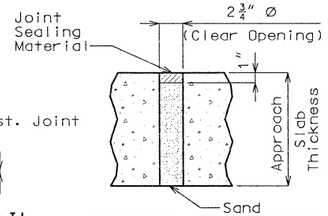


TYPICAL 135° STIRRUP HOOK DIMENSIONS BENDING DIAGRAM

Note:
Nominal lengths are based on out to out dimensions shown in bending diagram and are listed for fabricators use (nearest inch).



CONST. JOINT DETAIL
(IF REQUIRED)



TYPICAL UNDERSEAL ACCESS HOLE DETAIL

GENERAL NOTES:

FINAL PLANS	State	Proj. No.	Sheet No.
	MO	I-70-3(200)	B50

All concrete for the bridge approach slab and sleeper slab shall be in accordance with Section 503 (f'c = 4,000 psi) of the Missouri Standard Specifications.

All joint filler shall meet the requirements of Section 1057.2.5 of the Missouri Standard Specifications, except as noted.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be epoxy coated Grade 60 with Fy = 60,000 psi.

Minimum clearance to reinforcing steel shall be 1-1/2", unless otherwise shown.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be continuous. The transverse reinforcing steel may be made continuous by lap splicing the #4 & #6 bars 18" and 26" respectively.

Mechanical bar splices will be permitted and shall develop at least 125 percent of the specified yield strength of the reinforcing bars being spliced. The contractor shall furnish the Engineer the manufacture's certification that this requirement is met and is required to follow the manufacturer's recommendation for installation.

Mechanical bar splices shall be epoxy coated in accordance with Section 710 of the Missouri Standard Specifications.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

The contractor shall pour and satisfactorily finish the bridge slab before pouring the bridge approach slabs.

Longitudinal construction joints in approach slab and sleeper slab shall be aligned with longitudinal construction joints in bridge slab.

Payment for furnishing all materials, labor and excavation necessary to construct the approach slab, including the timber header, sleeper slab, underdrain, Type A curb, Type 5 aggregate base, joint filler and all other appurtenances and incidental work as shown on this sheet, complete in place, shall be considered as completely covered under the contract unit price for Bridge Approach Slab (Bridge), per square yard.

For Concrete Approach Pavement details, see roadway plans.

See Missouri Standard Plans Drawing 609.00 for details of Type A Curb.

When a lap splice is required for the use of a mechanical bar splice, the minimum lap length shall be 40" for transverse approach slab bar splices.

At the contractor's option, Grade 40 reinforcement may be substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment. No additional payment will be made for this substitution.

When Grade 40 reinforcement is substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment, the reinforcement may be bent up to 90 degrees with a 2" minimum radius near the abutment to allow compaction of the backfill material near the abutment. Damage to epoxy coating shall be repaired according to Section 710.3.3 of the Missouri Standard Specifications.

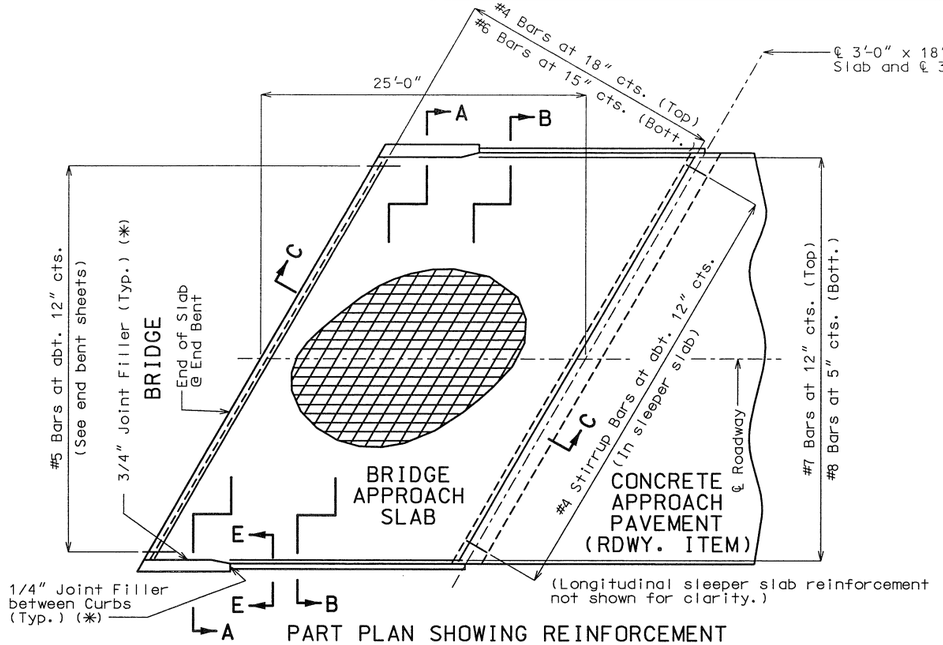
Drain pipe may be either 6" diameter corrugated metallic-coated pipe underdrain, 4" diameter corrugated polyvinyl chloride (PVC) drain pipe, or 4" diameter corrugated polyethylene (PE) drain pipe.

BRIDGE APPROACH SLAB AT END BENT NO. 1

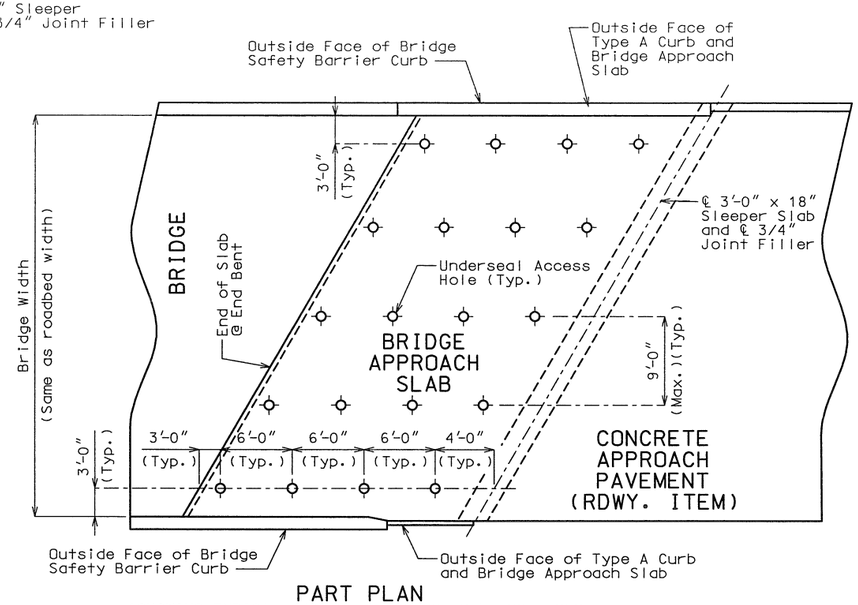
Detailed July 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

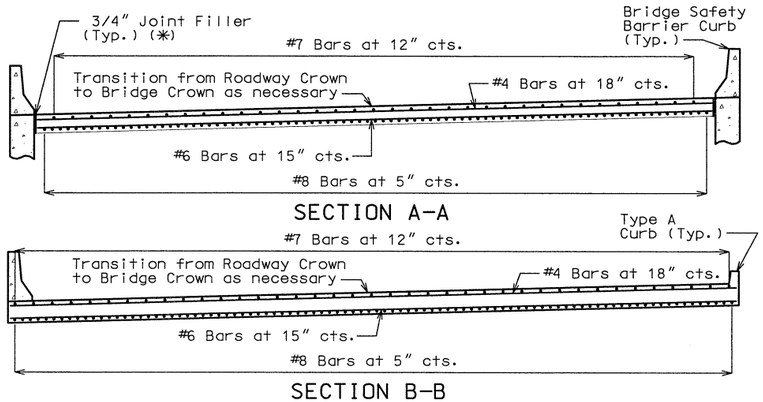
BOONE COUNTY A6951



PART PLAN SHOWING REINFORCEMENT



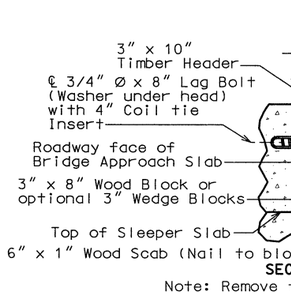
PART PLAN
(SHOWING TYPICAL UNDERSEAL ACCESS HOLE LOCATIONS)



SECTION A-A

SECTION B-B

Note: With the approval of the Engineer, the contractor may crown the bottom of the approach slab to match the crown of the roadway surface.

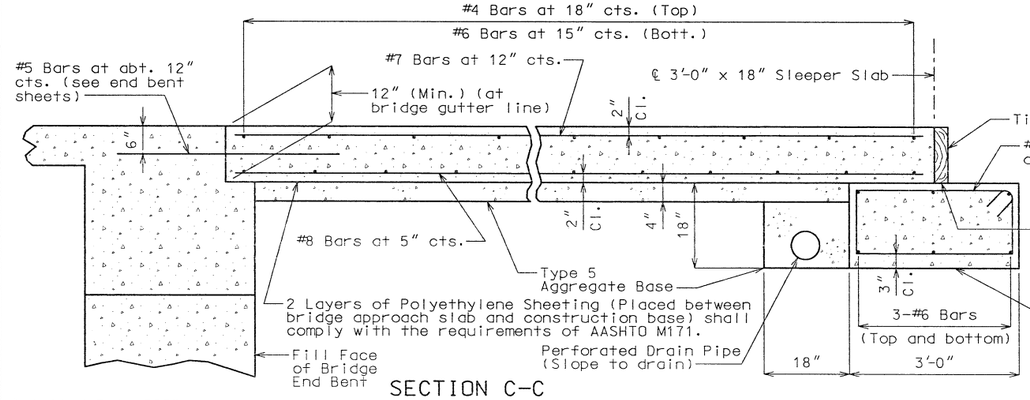


SECTION D-D PART ELEVATION

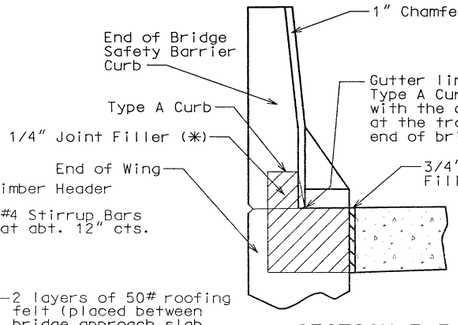
Note: Remove timber header when concrete pavement is placed.

DETAILS OF TIMBER HEADER

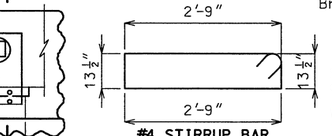
(*) Use 3/4" Joint Filler between vertical face of Approach Slab and Wing, except at the end of Safety Barrier Curb/Wing face use 1/4" Joint Filler. Seal joint with joint sealant. See Special Provisions.



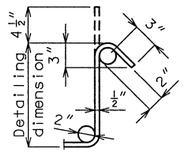
SECTION C-C



SECTION E-E
(BETWEEN CURBS)

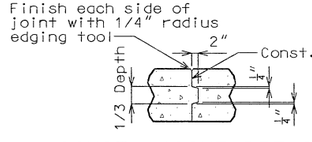


#4 STIRRUP BAR (ACTUAL LENGTH = 8'-3")

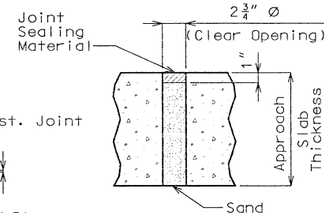


TYPICAL 135° STIRRUP HOOK DIMENSIONS BENDING DIAGRAM

Note:
Nominal lengths are based on out to out dimensions shown in bending diagram and are listed for fabricators use (nearest inch).



CONST. JOINT DETAIL
(IF REQUIRED)



TYPICAL UNDERSEAL ACCESS HOLE DETAIL

FINAL PLANS

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B51

GENERAL NOTES:

All concrete for the bridge approach slab and sleeper slab shall be in accordance with Section 503 (f'c = 4,000 psi) of the Missouri Standard Specifications.

All joint filler shall meet the requirements of Section 1057.2.5 of the Missouri Standard Specifications, except as noted.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be epoxy coated Grade 60 with Fy = 60,000 psi.

Minimum clearance to reinforcing steel shall be 1-1/2", unless otherwise shown.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be continuous. The transverse reinforcing steel may be made continuous by lap splicing the #4 & #6 bars 18" and 26" respectively.

Mechanical bar splices will be permitted and shall develop at least 125 percent of the specified yield strength of the reinforcing bars being spliced. The contractor shall furnish the Engineer the manufacture's certification that this requirement is met and is required to follow the manufacturer's recommentation for installation.

Mechanical bar splices shall be epoxy coated in accordance with Section 710 of the Missouri Standard Specifications.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

The contractor shall pour and satisfactorily finish the bridge slab before pouring the bridge approach slabs.

Longitudinal construction joints in approach slab and sleeper slab shall be aligned with longitudinal construction joints in bridge slab.

Payment for furnishing all materials, labor and excavation necessary to construct the approach slab, including the timber header, sleeper slab, underdrain, Type A curb, Type 5 aggregate base, joint filler and all other appurtenances and incidental work as shown on this sheet, complete in place, shall be considered as completely covered under the contract unit price for Bridge Approach Slab (Bridge), per square yard.

For Concrete Approach Pavement details, see roadway plans.

See Missouri Standard Plans Drawing 609.00 for details of Type A Curb.

When a lap splice is required for the use of a mechanical bar splice, the minimum lap length shall be 40" for transverse approach slab bar splices.

At the contractor's option, Grade 40 reinforcement may be substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment. No additional payment will be made for this substitution.

When Grade 40 reinforcement is substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment, the reinforcement may be bent up to 90 degrees with a 2" minimum radius near the abutment to allow compaction of the backfill material near the abutment. Damage to epoxy coating shall be repaired according to Section 710.3.3 of the Missouri Standard Specifications.

Drain pipe may be either 6" diameter corrugated metallic-coated pipe underdrain, 4" diameter corrugated polyvinyl chloride (PVC) drain pipe, or 4" diameter corrugated polyethylene (PE) drain pipe.

Detailed Oct. 2003
Checked

Note: This drawing is not to scale. Follow dimensions.

BRIDGE APPROACH SLAB AT END BENT NO. 4

Sheet No. 34 of 38

BOONE COUNTY | A6951

BILL OF REINFORCING STEEL

NO. REQ'D.	MARK NO. SIZE	MARK	LOCATION	EPOXY (E)	SHAPE NO.	STIRRUP (S)	SUBSTR. (X)	VARIES (V)	NO. EACH	DIMENSIONS B FT. IN.	C FT. IN.	D FT. IN.	E FT. IN.	F FT. IN.	H FT. IN.	K FT. IN.	NOMINAL LENGTH FT. IN.	ACTUAL LENGTH FT. IN.	WEIGHT LBS.
			SUBSTR.																
			INT. BENT																
			NO. 2																
36	8	D20	COL/FOOTING		20		X			7 3.000							7 3	7 3	697
44	8	D21	FOOTING		18		X			8 8.000							10 6	10 6	1234
16	6	D22	BEAM KEY		20		X			2 6.000							2 6	2 6	60
8	10	H20	BEAM		18		X			39 7.000							42 5	42 5	1460
10	5	H21	BEAM		20		X			39 7.000							39 7	39 7	413
8	6	H22	BEAM		20		X			3 10.000							3 10	3 10	46
12	6	H23	BEAM		20		X			3 9.000							3 9	3 9	68
14	6	H24	BEAM		10	S	X				22.000	3 9.000					7 5	7 1	149
8	10	H25	BEAM		20		X			39 7.000							39 7	39 7	1363
45	4	P20	COLUMN		16		X			3 3.000							11 1	11 1	333
38	6	U20	BEAM		13	S	X			3 9.000	4 6.000	3 9.000	4 6.000				17 10	17 4	989
8	6	U21	BEAM		10	S	X				4 6.000	3 9.000					12 9	12 5	149
40	4	U22	BEAM		10	S	X				12.000	3 9.000					5 9	5 7	149
18	8	V20	COLUMN		20		X			25 2.000							25 2	25 2	1210
18	8	V21	COLUMN		20		X			26 9.000							26 9	26 9	1286
1 22			INT. BENT										1 ADDED						
			NO. 3																
29	9	D33	COL/FOOTING		20		X			8 9.500							8 10	8 10	871
36	8	D30	COL/FOOTING		20		X			7 3.000							7 3	7 3	697
44	8	D31	FOOTING		18		X			8 8.000			1 ADDED				10 6	10 6	1234
16	6	D32	BEAM KEY		20		X			2 6.000							2 6	2 6	60
22	8	D34	FOOTING		18		X			9 2.000							11 0	11 0	646
9	10	H30	BEAM		18		X			39 11.000							42 9	42 9	1656
10	5	H31	BEAM		20		X			39 11.000							39 11	39 11	416
8	6	H32	BEAM		20		X			3 10.000							3 10	3 10	46
12	6	H33	BEAM		20		X			3 10.000							3 10	3 10	69
14	6	H34	BEAM		10	S	X				22.000	3 9.000					7 5	7 1	149
9	10	H35	BEAM		20		X			39 11.000							39 11	39 11	1546
1 43													1 ADDED					1 318	
55	4	P30	COLUMN		16		X			3 3.000							11 1	11 1	407
24	4	P31	COLUMN		16		X			4 9.000							15 9	15 9	253
38	6	U30	BEAM		13	S	X			3 9.000	4 6.000	3 9.000	4 6.000				17 10	17 4	989
8	6	U31	BEAM		10	S	X				4 6.000	3 9.000					12 9	12 5	149
40	4	U32	BEAM		10	S	X	1 ADDED			12.000	3 9.000					5 9	5 7	149
																1 18 7	1 18 7	1 893	
18	8	V30	COLUMN		20		X			30 0.000	1 18 7.000		1 ADDED				30 0	30 0	1442
18	8	V31	COLUMN		20		X			31 7.000							31 7	31 7	1518
18	8	V32	COLUMN		20		X			9 2.000							9 2	9 2	441
29	9	V33	COLUMN		20		X			22 9.000							22 9	22 9	2243
													1 ADDED						
			SUPERSTR.																
			END BEAM																
			NO. 1																
12	6	F1	WING BRACE		23	S				14.000	5 10.000	14.000	8.750	10.875	8.750	10.875	8 2	8 1	146
5	6	F2	DIAPHRAGM		21	S				2 9.875	4 11.500			2 9.000	7.500		7 9	7 7	57
12	6	F3	WING BRACE		23	S				14.000	4 8.500	14.000	11.000	8.625	11.000	8.625	7 1	6 11	125

BILL OF REINFORCING STEEL

FINAL PLANS

NO. REQ'D.	MARK NO. SIZE	MARK	LOCATION	EPOXY (E)	SHAPE NO.	STIRRUP (S)	SUBSTR. (X)	VARIES (V)	NO. EACH	DIMENSIONS B FT. IN.	C FT. IN.	D FT. IN.	E FT. IN.	F FT. IN.	H FT. IN.	K FT. IN.	NOMINAL LENGTH FT. IN.	ACTUAL LENGTH FT. IN.	WEIGHT LBS.
5	6	F4	DIAPHRAGM		21	S				2 9.875	4 5.000				2 9.000	7.500	7 3	7 0	53
15	6	H1	BEAM & DIAPH		20					41 5.000							41 5	41 5	933
20	6	H2	DIAPHRAGM		20					6 7.000							6 7	6 7	198
10	6	H3	DIAPHRAGM		20					21.000							0 21	0 21	26
5	5	H4	STRAND TIE		23	S				15.000	2 0.000	15.000	3.250	14.625	3.250	14.625	4 6	4 6	23
38	5	H5	APP. SLAB	E	20					2 6.000							2 6	2 6	99
12	8	H6	WING		20					21 10.000							21 10	21 10	700
6	8	H7	WING	E	20					21 10.000							21 10	21 10	350
52	6	H8	WING		20					20 10.000							20 10	20 10	1627
4	6	H9	DIAPHRAGM	E	20					41 5.000							41 5	41 5	249
12	6	H10	BEAM		20					3 3.000							3 3	3 3	59
8	6	H11	BEAM		20					4 1.000							4 1	4 1	49
20	5	U1	BEAM		10	S					4 10.500	2 9.875					12 7	12 4	257
23	4	U2	BEAM		13	S				2 9.875	2 9.000	2 9.875	2 9.000				11 11	11 8	179
32	5	U3	DIAPHRAGM	E	10	S					5 2.000	2 2.500					12 7	12 4	412
32	6	U4	DIAPHRAGM		19	S				4 2.000	2 9.875						7 0	6 10	328
53	6	U5	DIAPH./SLAB	E	19	S				3 0.000	4 10.500						7 11	7 9	617
35	4	U6	BEAM		10	S					12.000	2 9.875					4 10	4 8	109
12	5	V1	BEAM		20					4 9.000							4 9	4 9	59
40	6	V2	WING		20			V	2	8 9.000							8 9	8 9	
			INCREMENT = 0.250 INCH							8 5.000							8 5	8 5	516
2	6	V3	WING		20					8 9.000							8 9	8 9	26
40	6	V4	WING		20			V	2	8 9.000							8 9	8 9	
			INCREMENT = 0.125 INCH							8 7.000							8 7	8 7	521
2	6	V5	WING		20					8 9.000							8 9	8 9	26
15	6	V6	DIAPHRAGM		20					4 3.000							4 3	4 3	96
1 617																			
			END BEAM																
			NO. 4																
12	6	F40	WING BRACE		23	S				14.000	6 1.000	14.000	8.375	11.250	8.375	11.250	8 5	8 4	150
5	6	F41	DIAPHRAGM		21	S				2 10.500	5 2.500				2 9.000	10.250	8 1	7 10	59
12	6	F42	WING BRACE		23	S				14.000	4 6.625	14.000	11.250	8.250	11.250	8.250	6 11	6 9	122
5	6	F43	DIAPHRAGM		23	S				2 10.500	4 5.875				2 9.000	10.125	7 4	7 3	54
15	6	H40	BEAM & DIAPH		20					42 4.000							42 4	42 4	954
20	6	H41	DIAPHRAGM		20					6 8.000							6 8	6 8	200
10	6	H42	DIAPHRAGM		20					22.000							0 22	0 22	28
5	5	H43	STRAND TIE		23	S				15.000	2 0.000	15.000	3.250	14.625	3.250	14.625	4 6	4 6	23
38	5	H44	APP. SLAB	E	20					2 6.000							2 6	2 6	99
12	8	H45	WING		20					21 10.000							21 10	21 10	700
4	8	H46	WING	E	20					21 10.000							21 10	21 10	233
48	6	H47	WING		20					20 10.000							20 10	20 10	1502
4	6	H48	DIAPHRAGM	E	20					42 4.000							42 4	42 4	254
12	6	H49	BEAM		20					4 0.000							4 0	4 0	72
8	6	H50	BEAM		20					3 3.000							3 3	3 3	39
24	5	U40	BEAM		10	S					4 10.500	2 9.875					12 7	12 4	309
20	4	U41	BEAM		13	S				2 9.875	2 9.000	2 9.875	2 9.000				11 11	11 8	156
5	4	U42	BEAM		10	S					2 9.875	2 9.000					8 5	8 3	28
34	5	U43	DIAPHRAGM	E	10	S					5 2.000	2 2.500					12 7	12 4	437
34	6	U44	DIAPHRAGM		19	S				4 2.000	2 9.875						7 0	6 10	349
53	6	U45	DIAPH./SLAB	E	19	S				3 0.000	4 10.500						7 11	7 9	617
35	4	U46	BEAM		10	S					12.000	2 9.875					4 10	4 8	109

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B52

SHAPE 6 SHAPE 7 SHAPE 8

SHAPE 9 SHAPE 10 SHAPE 11

SHAPE 12 SHAPE 13 SHAPE 14

SHAPE 15 SHAPE 16 SHAPE 17 SHAPE 18 SHAPE 20

SHAPE 19 SHAPE 21

SPOT WELD AASHTO M32 SIZE W5 WIRE (TYP.)

SHAPE 23 SHAPE 24 SHAPE 22

SHAPE 25 SHAPE 26 SHAPE 27

SHAPE 28 SHAPE 29 SHAPE 31

SHAPE 30 SHAPE 32

SHAPE 36 SHAPE 35 SHAPE 33 SHAPE 34

(SHAPE 35 SHALL BE A DEFORMED OR PLAIN SPIRAL BAR OR WIRE.)

BENDING DIAGRAMS

6d FOR #4 AND #5, 12d FOR #6

90° STIRRUP 135° STIRRUP

Detailed July 2003
Checked July 2003

STIRRUP HOOK DIMENSIONS				
GRADES 40 - 50 - 60 KSI				
BAR SIZE	D (IN.)	90° HOOK A OR G	135° HOOK A OR G	135° HOOK APPROX. H
#4	2"	4-1/2"	4-1/2"	3"
#5	2-1/2"	6"	5-1/2"	3-3/4"
#6	4-1/2"	12"	8"	4-1/2"

NOTE: UNLESS OTHERWISE NOTED DIAMETER "D" IS THE SAME FOR ALL BENDS AND HOOKS ON A BAR.

DETAILING DIMENSION — 90° — A OR G — 12d — HOOK

DETAILING DIMENSION — 180° — 4d OR 2-1/2" MIN.

END HOOK DIMENSIONS				
BAR SIZE	D (IN.)	ALL GRADES 180° HOOKS A OR G	180° HOOKS J	90° HOOKS A OR G
#3	2-1/4"	5"	3"	6"
#4	3"	6"	4"	8"
#5	3-3/4"	7"	5"	10"
#6	4-1/2"	8"	6"	12"
#7	5-1/4"	10"	7"	14"
#8	6"	11"	8"	16"
#9	9-1/2"	15"	11-3/4"	19"
#10	10-3/4"	17"	13-1/4"	22"
#11	12"	19"	14-3/4"	2'-0"
#14	18-1/4"	2'-3"	21-3/4"	2'-7"

TWO ADDITIONAL #8-H7 ARE INCLUDED IN THE BAR BILL FOR TESTING.

NOTE:
ALL STANDARD HOOKS AND BENDS OTHER THAN 180 DEG. TO BE BENT WITH THE SAME PROCEDURE AS FOR 90 DEG. STD. HOOKS.
HOOKS AND BENDS SHALL BE IN ACCORDANCE WITH THE PROCEDURES AS SHOWN ON THIS SHEET.
E = EPOXY COATED REINFORCEMENT.
S = STIRRUP.
X = BAR IS INCLUDED IN SUBSTRUCTURE QUANTITIES.
V = BAR DIMENSIONS VARY IN EQUAL INCREMENTS BETWEEN DIMENSIONS SHOWN ON THIS LINE AND THE FOLLOWING LINE.
NO. EA. = NUMBER OF BARS OF EACH LENGTH.
NOMINAL LENGTHS ARE BASED ON OUT TO OUT DIMENSIONS SHOWN IN BENDING DIAGRAMS AND ARE LISTED FOR FABRICATOR'S USE (NEAREST INCH).
ACTUAL LENGTHS ARE MEASURED ALONG CENTERLINE BAR TO THE NEAREST INCH.
PAYWEIGHTS ARE BASED ON ACTUAL LENGTHS.
FOUR ANGLE OR CHANNEL SPACERS ARE REQUIRED FOR EACH COLUMN SPIRAL. SPACERS ARE TO BE PLACED ON INSIDE OF SPIRALS. LENGTH AND WEIGHT OF COLUMN SPIRALS DO NOT INCLUDE SPLICES OR SPACERS.
REINFORCING STEEL (GRADE 60) = FY 60,000 PSI.

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 35 of 38

1 REVISED 03-29-2004

BOONE COUNTY A6951

barbill_i May 2003

BILL OF REINFORCING STEEL

NO. REQ'D.	MARK NO. SIZE MARK	LOCATION	EPOXY (E)	SHAPE NO.	STIRRUP (S)	SUBSTR. (X)	VARIES (V)	NO. EACH	DIMENSIONS B FT. IN.	C FT. IN.	D FT. IN.	E FT. IN.	F FT. IN.	H FT. IN.	K FT. IN.	NOMINAL LENGTH FT. IN.	ACTUAL LENGTH FT. IN.	WEIGHT LBS.
10	5 V40	BEAM		20					4 9.000							4 9	4 9	50
40	6 V41	WING		20			V	2	8 4.000							8 4	8 4	
		INCREMENT =							8 7.000							8 7	8 7	508
		0.125 INCH																
2	6 V42	WING		20					8 3.000							8 3	8 3	25
40	6 V43	WING		20			V	2	8 3.000							8 3	8 3	
		INCREMENT =							8 4.000							8 4	8 4	498
2	6 V44	WING		20					8 3.000							8 3	8 3	25
15	6 V45	DIAPHRAGM		20					4 3.000							4 3	4 3	96
		DIAPHRAGM																
		BENTS NO.																
		2 & 3																
32	6 H201	DIAPHRAGM		20					6 7.000							6 7	6 7	316
32	4 H202	DIAPHRAGM		20					7 4.000							7 4	7 4	157
16	5 H203	STRAND TIE		20					3 5.000							3 5	3 5	57
24	5 H204	STRAND TIE		20					4 6.000							4 6	4 6	113
32	5 H205	DIAPHRAGM		19	S				3 2.000	12.000						4 2	4 1	136
32	6 U201	DIAPHRAGM	E	28	S					2 6.000	4 10.250	14.000				8 6	8 3	397
80	4 U202	DIAPHRAGM	E	28	S					2 6.000	5 0.625	12.000				8 7	8 5	450
16	5 V201	DIAPHRAGM	E	20					4 9.000							4 9	4 9	79
		SLAB																
132	6 S1	SLAB	E	20					52 0.000							52 0	52 0	10310
130	7 S2	SLAB	E	20					40 6.000							40 6	40 6	10762
450	6 S3	SLAB	E	20					40 5.000							40 5	40 5	27318
22	6 S4	SLAB	E	20			V	2	40 2.000							40 2	40 2	
		INCREMENT =							2 0.000							2 0	2 0	697
		45.750 INCH																
392	5 S5	SLAB	E	20					3 2.000							3 2	3 2	1295
32	5 S6	SLAB	E	20					51 9.000							51 9	51 9	1727
28	6 S7	SLAB	E	20			V	2	40 0.000							40 0	40 0	
		INCREMENT =							2 0.000							2 0	2 0	883
		35.125 INCH																
		BAR. CURB																
40	5 C1	SLIP FORM	E	20					10 0.000							10 0	10 0	417
6	5 C2	SLIP FORM	E	20					18 0.000							18 0	18 0	113
2	5 C3	SLIP FORM	E	20					22 5.000							22 5	22 5	47
2	5 C4	SLIP FORM	E	20					5 9.000							5 9	5 9	12
83	5 K1	BARRIER CURB	E	19	S				2 5.500	5.125						2 11	2 9	238
83	5 K2	BARRIER CURB	E	14	S				5.125	11.625	18.000			2.000	17.875	2 11	2 9	238
119	5 K3	BARRIER CURB	E	27	S				2 5.875	5.125	12.000	20.000		9.875	6.875	5 7	5 5	672
33	5 K4	BARRIER CURB	E	7					2 5.875	6.000						5 2	5 2	178
3	5 K5	BARRIER CURB	E	25	S				20.000	6.750	4.375			5.500	4.000	2 7	2 6	8
3	5 K6	BARRIER CURB	E	25	S				20.000	7.875	4.375			6.500	4.500	2 8	2 8	8
3	5 K7	BARRIER CURB	E	25	S				20.000	9.625	4.375			7.875	5.500	2 10	2 9	9
3	5 K8	BARRIER CURB	E	25	S				20.000	11.250	4.375			9.250	6.500	3 0	2 11	9
36	5 K9	BARRIER CURB	E	20					5 7.000							5 7	5 7	210

BILL OF REINFORCING STEEL

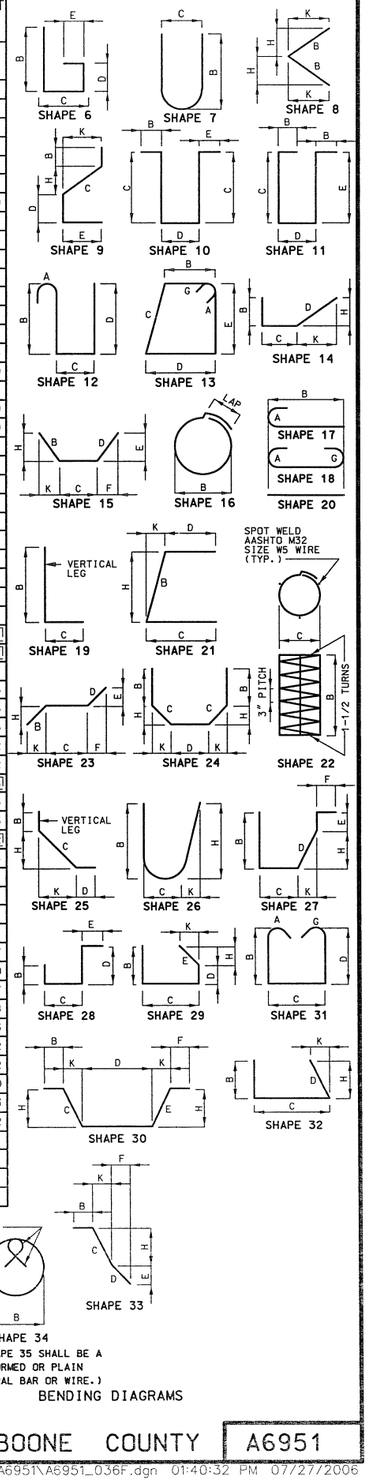
FINAL PLANS

NO. REQ'D.	MARK NO. SIZE MARK	LOCATION	EPOXY (E)	SHAPE NO.	STIRRUP (S)	SUBSTR. (X)	VARIES (V)	NO. EACH	DIMENSIONS B FT. IN.	C FT. IN.	D FT. IN.	E FT. IN.	F FT. IN.	H FT. IN.	K FT. IN.	NOMINAL LENGTH FT. IN.	ACTUAL LENGTH FT. IN.	WEIGHT LBS.
20	4 K10	BARRIER CURB	E	20					19 3.000							19 3	19 3	257
3	5 K11	BARRIER CURB	E	8					2 2.125					2 2.000	2.375	4 4	4 4	14
4	5 K12	BARRIER CURB	E	27	S				17.000	5.125	12.000	7.125	12.000	9.875	6.875	4 5	4 2	17
12	4 K13	BARRIER CURB		20					18 10.000							18 10	18 10	151
10	4 K14	BARRIER CURB	E	20					22 4.000							22 4	22 4	149
10	4 K15	BARRIER CURB	E	20					5 3.000							5 3	5 3	35
8	5 K16	BARRIER CURB	E	27	S				20.500	5.125	12.000	10.625	12.000	9.875	6.875	5 0	4 9	40
81	5 K17	BARRIER CURB	E	19	S				2 4.000	5.125						2 9	2 8	225
81	5 K18	BARRIER CURB	E	14	S				5.125	10.125	18.000			2.000	17.875	2 9	2 8	225
197	5 R1	BARRIER CURB	E	19	S				2 6.000	3.500						2 10	2 8	548
197	5 R2	BARRIER CURB	E	15	S				2 6.125	3.500				2 6.000	3.000	2 10	2 9	565
394	5 R3	BARRIER CURB	E	19	S				17.000	6.000						0 23	0 22	753
394	5 R4	BARRIER CURB	E	27	S					6.000	11.250	7.000	12.000	9.250	6.375	3 0	2 10	1164
14	5 R5	BARRIER CURB	E	20					27 10.000							27 10	27 10	406
58	5 R6	BARRIER CURB	E	20					9 9.000							9 9	9 9	590
7	5 R7	BARRIER CURB	E	20					33 3.000							33 3	33 3	243
14	5 R8	BARRIER CURB	E	20					33 7.000							33 7	33 7	490
14	5 R9	BARRIER CURB	E	20					28 1.000							28 1	28 1	410
7	5 R10	BARRIER CURB	E	20					33 3.000							33 3	33 3	243
14	5 R11	BARRIER CURB	E	20					33 4.000							33 4	33 4	487
197	5 R12	BARRIER CURB	E	19	S				2 4.875	3.500						2 8	2 7	531
197	5 R13	BARRIER CURB	E	15	S				2 5.375	3.500				2 5.250	2.875	2 9	2 8	548
		TOTALS																
	9																	3114
	4																1 2240	→ 1927
	4		E															891
	5																	1856
	5		E															13806
	6																	12706
	6		E															41342
	7		E															10762
	8																1 10639	→ 10718
	8		E															583
	10																	6025
		TOTAL															1 36580	→ 33232
		TOTAL	E															67384
		Slab on Girder																

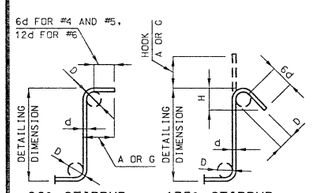
1 ADDED

TWO ADDITIONAL #7-S2, #6-S3, #4-K13, & #5-R6 ARE INCLUDED IN THE BAR BILL FOR TESTING.

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B53

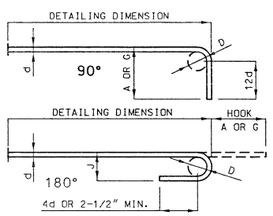


BENDING DIAGRAMS



STIRRUP HOOK DIMENSIONS			
GRADES 40 - 50 - 60 KSI			
BAR SIZE	D (IN.)	90° HOOK A OR G	135° HOOK A OR G	135° HOOK APPROX. H
#4	2"	4-1/2"	4-1/2"	3"
#5	2-1/2"	6"	5-1/2"	3-3/4"
#6	4-1/2"	12"	8"	4-1/2"

NOTE: UNLESS OTHERWISE NOTED DIAMETER "D" IS THE SAME FOR ALL BENDS AND HOOKS ON A BAR.



END HOOK DIMENSIONS				
BAR SIZE	D (IN.)	ALL GRADES 180° HOOKS A OR G	180° HOOKS J	90° HOOKS A OR G
#3	2-1/4"	5"	3"	6"
#4	3"	6"	4"	8"
#5	3-3/4"	7"	5"	10"
#6	4-1/2"	8"	6"	12"
#7	5-1/4"	10"	7"	14"
#8	6"	11"	8"	16"
#9	9-1/2"	15"	11-3/4"	19"
#10	10-3/4"	17"	13-1/4"	22"
#11	12"	19"	14-3/4"	2'-0"
#14	18-1/4"	2'-3"	21-3/4"	2'-7"

NOTE:
ALL STANDARD HOOKS AND BENDS OTHER THAN 180 DEG. TO BE BENT WITH THE SAME PROCEDURE AS FOR 90 DEG. STD. HOOKS.
HOOKS AND BENDS SHALL BE IN ACCORDANCE WITH THE PROCEDURES AS SHOWN ON THIS SHEET.
E = EPOXY COATED REINFORCEMENT.
S = STIRRUP.
X = BAR IS INCLUDED IN SUBSTRUCTURE QUANTITIES.
V = BAR DIMENSIONS VARY IN EQUAL INCREMENTS BETWEEN DIMENSIONS SHOWN ON THIS LINE AND THE FOLLOWING LINE.
NO. EA. = NUMBER OF BARS OF EACH LENGTH.
NOMINAL LENGTHS ARE BASED ON OUT TO OUT DIMENSIONS SHOWN IN BENDING DIAGRAMS AND ARE LISTED FOR FABRICATOR'S USE (NEAREST INCH).
ACTUAL LENGTHS ARE MEASURED ALONG CENTERLINE BAR TO THE NEAREST INCH.
PAYWEIGHTS ARE BASED ON ACTUAL LENGTHS.
FOUR ANGLE OR CHANNEL SPACERS ARE REQUIRED FOR EACH COLUMN SPIRAL. SPACERS ARE TO BE PLACED ON INSIDE OF SPIRALS. LENGTH AND WEIGHT OF COLUMN SPIRALS DO NOT INCLUDE SPLICES OR SPACERS.
REINFORCING STEEL (GRADE 60) = FY 60,000 PSI.

Detailed July 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 36 of 38

1 REVISED 03-29-2004

BOONE COUNTY A6951

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BILL OF REINFORCING STEEL

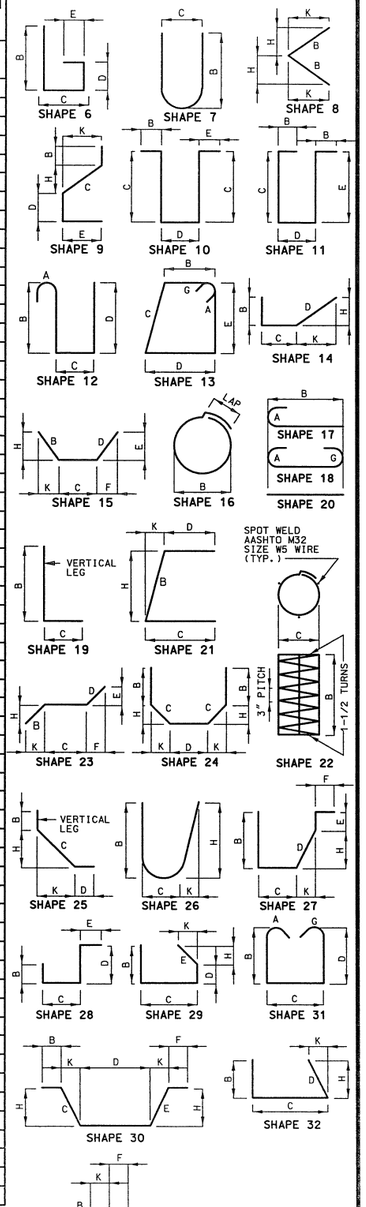
NO. REQ'D.	MARK NO. SIZE MARK	LOCATION	EPOXY (E)	SHAPE NO.	STIRRUP (S)	SUBSTR. (X)	VARIES (V)	NO. EACH	DIMENSIONS B FT. IN.	C FT. IN.	D FT. IN.	E FT. IN.	F FT. IN.	H FT. IN.	K FT. IN.	NOMINAL LENGTH FT. IN.	ACTUAL LENGTH FT. IN.	WEIGHT LBS.
		(Bridges)																
	4																1 1202	889
	5																	829
	6																	2923
	8																1 9239	9316
	10												1 ADDED					6025
		TOTAL															1 23332	19984
	9																	3114
		Safety																
		Barrier																
		Curb																
	4																	151
	4		E															441
	5		E															9069
		TOTAL																9661
		Slip Form																
		Option																
	5		E															589
		TOTAL																589

BILL OF REINFORCING STEEL

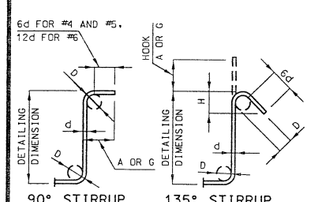
FINAL PLANS

NO. REQ'D.	MARK NO. SIZE MARK	LOCATION	EPOXY (E)	SHAPE NO.	STIRRUP (S)	SUBSTR. (X)	VARIES (V)	NO. EACH	DIMENSIONS B FT. IN.	C FT. IN.	D FT. IN.	E FT. IN.	F FT. IN.	H FT. IN.	K FT. IN.	NOMINAL LENGTH FT. IN.	ACTUAL LENGTH FT. IN.	WEIGHT LBS.

State	Proj. No.	Sheet No.
MO	I-70-3(200)	B54



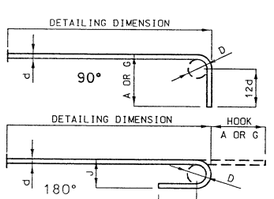
BENDING DIAGRAMS



Detailed July 2003
Checked July 2003

STIRRUP HOOK DIMENSIONS				
GRADES 40 - 50 - 60 KSI				
BAR SIZE	D (IN.)	90° HOOK HOOK A OR G	135° HOOK HOOK A OR G	135° HOOK APPROX. H
#4	2"	4-1/2"	4-1/2"	3"
#5	2-1/2"	6"	5-1/2"	3-3/4"
#6	4-1/2"	12"	8"	4-1/2"

NOTE: UNLESS OTHERWISE NOTED DIAMETER "D" IS THE SAME FOR ALL BENDS AND HOOKS ON A BAR.



END HOOK DIMENSIONS				
		ALL GRADES		
BAR SIZE	D (IN.)	180° HOOKS		90° HOOKS
		A OR G	J	A OR G
#3	2-1/4"	5"	3"	6"
#4	3"	6"	4"	8"
#5	3-3/4"	7"	5"	10"
#6	4-1/2"	8"	6"	12"
#7	5-1/4"	10"	7"	14"
#8	6"	11"	8"	16"
#9	9-1/2"	15"	11-3/4"	19"
#10	10-3/4"	17"	13-1/4"	22"
#11	12"	19"	14-3/4"	2'-0"
#14	18-1/4"	2'-3"	21-3/4"	2'-7"

Note: This drawing is not to scale. Follow dimensions.

TWO ADDITIONAL ARE INCLUDED IN THE BAR BILL FOR TESTING.

NOTE:
ALL STANDARD HOOKS AND BENDS OTHER THAN 180 DEG. TO BE BENT WITH THE SAME PROCEDURE AS FOR 90 DEG. STD. HOOKS.
HOOKS AND BENDS SHALL BE IN ACCORDANCE WITH THE PROCEDURES AS SHOWN ON THIS SHEET.
E = EPOXY COATED REINFORCEMENT.
S = STIRRUP.
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V = BAR DIMENSIONS VARY IN EQUAL INCREMENTS BETWEEN DIMENSIONS SHOWN ON THIS LINE AND THE FOLLOWING LINE.
NO. EA. = NUMBER OF BARS OF EACH LENGTH.
NOMINAL LENGTHS ARE BASED ON OUT TO OUT DIMENSIONS SHOWN IN BENDING DIAGRAMS AND ARE LISTED FOR FABRICATOR'S USE (NEAREST INCH).
ACTUAL LENGTHS ARE MEASURED ALONG CENTERLINE BAR TO THE NEAREST INCH.
PAYWEIGHTS ARE BASED ON ACTUAL LENGTHS.
FOUR ANGLE OR CHANNEL SPACERS ARE REQUIRED FOR EACH COLUMN SPIRAL. SPACERS ARE TO BE PLACED ON INSIDE OF SPIRALS. LENGTH AND WEIGHT OF COLUMN SPIRALS DO NOT INCLUDE SPLICES OR SPACERS.
REINFORCING STEEL (GRADE 60) = FY 60,000 PSI.

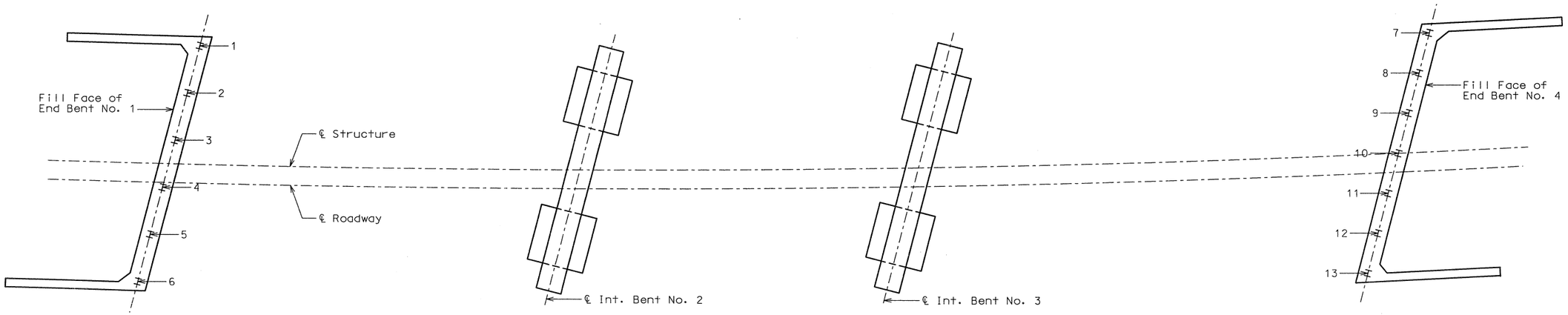
Sheet No. 37 of 38

1 REVISED 03-29-2004

BOONE COUNTY A6951

State	Proj. No.	Sheet No.
MO.	I-70-3(200)	B55

FINAL PLANS



PART PLAN SHOWING PILE NUMBERING FOR RECORDING "AS BUILT PILE" DATA

"AS BUILT PILE" DATA			
PILE NO.	LENGTH IN PLACE (FT.)	COMPUTED BEARING (TONS)	REMARKS
			END BENT NO. 1
1	13	145.7	HP 12 x 53
2	14	145.7	HP 12 x 53
3	13	145.7	HP 12 x 53
4	15	145.7	HP 12 x 53
5	15	145.7	HP 12 x 53
6	18	145.7	HP 12 x 53

"AS BUILT PILE" DATA			
PILE NO.	LENGTH IN PLACE (FT.)	COMPUTED BEARING (TONS)	REMARKS
			END BENT NO. 4
7	34	145.7	HP 12 x 53
8	45	145.7	HP 12 x 53
9	44	145.7	HP 12 x 53
10	42	145.7	HP 12 x 53
11	45	145.7	HP 12 x 53
12	41	145.7	HP 12 x 53
13	40	145.7	HP 12 x 53

NOTE: INDICATE IN REMARKS COLUMN:
A.) IF PILING WERE DRIVEN TO PRACTICAL REFUSAL.
B.) PILE BATTER IF OTHER THAN SHOWN ON BENT DETAIL SHEET.
C.) TYPE OF PILING USED.

NOTE: THIS SHEET TO BE COMPLETED BY MoDOT CONSTRUCTION PERSONNEL.

Detailed June 2003
Checked July 2003

Note: This drawing is not to scale. Follow dimensions.

BOONE COUNTY A6951

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SEC/SUR 8 TWP 48N RGE 12W

U.I.P. AND REHABILITATE EXISTING (66′- 54′- 77′) PRESTRESSED CONCRETE I-GIRDER SPANS

General Notes:

Design Specifications:

2002-AASHTO LFD (17th Ed.) Standard Specifications
Bridge Deck Rating = 8

Design Loading:

HS20-44 Modified 24,000 lb Tandem Axle
with 15 psf FWS (AASHTO 1977 and interims thru 1982)

Traffic Handling:

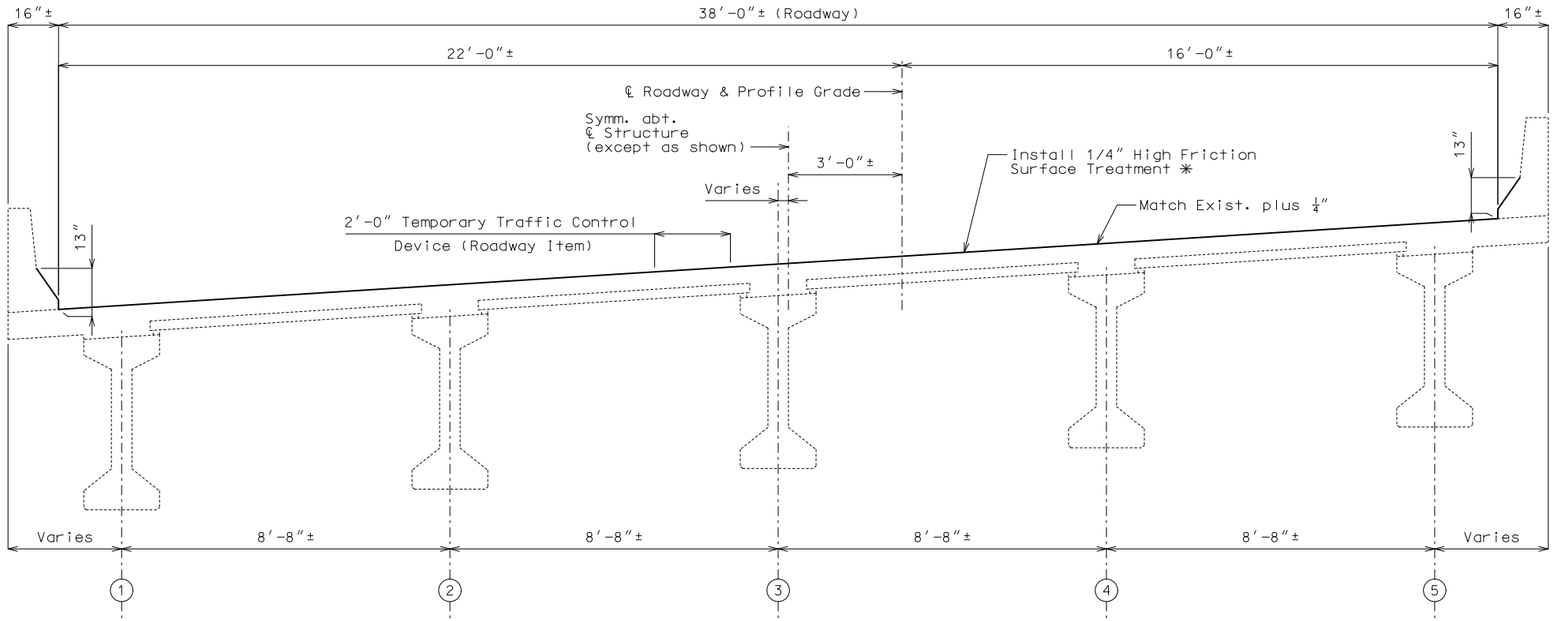
Maintain traffic on structure during construction
(See Roadway Traffic Control Plans).

Miscellaneous:

Roadway surfacing adjacent to bridge ends shall match bridge overlay (Roadway Item).

Outline of old work is indicated by light dashed lines. Heavy lines indicate new work.

Polymer shall also be applied on the traffic faces of all safety barrier curbs for a distance of 13″ vertically up the faces from the deck surface, and for the full length of the bridge. Plan quantity includes barrier surface area and the bridge approach slabs to meet this requirement.



SECTION THRU SLAB

✳ In accordance with Rdwy Job Special Provisions.

Estimated Quantities		
✳✳ High Friction Surface Treatment	sq. yard	1093

✳✳ Includes approach slabs and curb faces.

The contractor shall exercise care to ensure spillage over joint edges is prevented and that a neat line is obtained along any terminating edge of the polymer.

The contractor shall use only one type of overlay on the bridge.

REPAIRS TO BRIDGE: ROUTE I-70 WB OVER HINKSON CREEK

ROUTE I-70 AT RTE. 63 CONNECTOR
IN COLUMBIA
BEG. TIE STA. 816+33.96 (MATCH EXISTING)

STD.
STD.

Detailed Nov. 2018
Checked Nov. 2018

Note: This drawing is not to scale. Follow dimensions.

STATE OF MISSOURI
WILLIAM J. DUNN
NUMBER PE-2006019647
PROFESSIONAL ENGINEER
THIS SHEET HAS BEEN SIGNED, SEALED AND DATED ELECTRONICALLY.

DATE PREPARED 11/29/2018
ROUTE I-70 | STATE MO
DISTRICT BR | SHEET NO. 1
COUNTY BOONE
JOB NO. J5M0285
CONTRACT ID.
PROJECT NO.
BRIDGE NO. A69511

DESCRIPTION | DATE

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

Appendix C. I-70 and US-63 Interchange Geotechnical Data Report

GEOTECHNOLOGY
A Universal Engineering Sciences Company

October 4, 2023

Buddy Desai
Hg Consult, Inc.
11809 N. Harrison St.
Kansas City, Missouri 64155

Re: Geotechnical Drilling and Testing Report
I-70 Improvements
I-70 and US-63 Interchange
MoDOT Job No. J5S3411, J5T0017, J5T0021
Boone County, Missouri
Geotechnology Project No. J036741.01

Dear Mr. Desai:

Presented in this report are the results of geotechnical drilling and laboratory testing services performed for the referenced project. The site location and general topography of the area as per 2021 U.S.G.S. map of the vicinity is shown on Figure 1 included in Appendix A.

SUBSURFACE EXPLORATION

The field exploration consisted of drilling ten borings at the locations shown on Figure 2 in Appendix A. The borings were located in the field by Geotechnology using a sub-meter GPS. Surface elevations at the boring locations were provided by others. Subsurface profiles for Borings B-7, B-8 and B-10; B-9 and B-11; B-7, B-10, B-13, B-15 and B-16; and B-9 and B-14 are presented on Figures 3, 4, 5 and 6 respectively, in Appendix A.

The borings were drilled using CME 55HTX, CME 55LC and Diedrich D50 rotary drill rigs and hollow stem augers. Standard Penetration Tests (SPTs) were performed using an automatic hammer. Split-spoon and Shelby tube samples were obtained at the depths indicated on the boring logs presented in Appendix B. Coring was performed using double-tube NQ2 wireline methods. A legend of the terms and symbols used on the boring logs and rock core descriptions is included in Appendix C. Photographs of the recovered rock core are included in Appendix D.

An engineer and geologist from Geotechnology provided direction during field exploration, observed drilling and sampling, assisted in obtaining samples and prepared logs of the material encountered. The boring logs represent conditions observed at the time of exploration, and have been edited to incorporate results of the laboratory tests. Unless noted on the boring logs, the lines designating the changes between various

strata represent approximate boundaries. The transition between materials could be gradual or could occur between recovered samples.

The boring logs and related information depict subsurface conditions only at the specific locations and times where the borings were performed. The stratification given on the boring logs should not be used as the basis of design or construction cost estimates without realizing that there can be variation from that shown or described.

LABORATORY TESTING

Laboratory testing was performed on the soil samples to estimate engineering and index properties. Moisture contents and Atterberg limits tests were performed on select split-spoon and Shelby tube samples. Unconsolidated-undrained triaxial compression (UU) tests were performed on select undisturbed Shelby tube samples, the results of which are presented in Appendix E. Laboratory index test results are presented on the boring logs.

Unconfined compression tests were performed on select core samples to determine the peak strength. Compressive strength results are presented in Appendix F. Pocket penetrometers were performed on the recovered shale samples using a modified shale tip, the results of which are presented in Appendix G.

LIMITATIONS

The drilling, sampling and laboratory test data presented in this report were performed for design-build procurement. The locations and details of the proposed structures were unknown and therefore the number and locations of borings might not meet MoDOT's subsurface investigation requirements. Therefore, additional borings and laboratory testing could be required for the design of new structures.

This report has been prepared on behalf of and for the exclusive use of the client for specific application to the named project as described herein. Geotechnology has attempted to perform the services reported herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions.

The field data collection methods used indicate conditions only at the specific locations where data were obtained, only at the time they were obtained, and only to the depths specified. Geotechnology will not be responsible for any claims, damages, or liability associated with any other party's interpretations or use of the test data.

* * * * *

If we can provide further information or services, please contact the undersigned.

Very truly yours,

GEOTECHNOLOGY, LLC

Alexander D. Phegley, E.I.
Project Engineer

Craig K. Kaibel, P.E.
Principal Engineer

ADP/CKK/JAW:adp/ckk

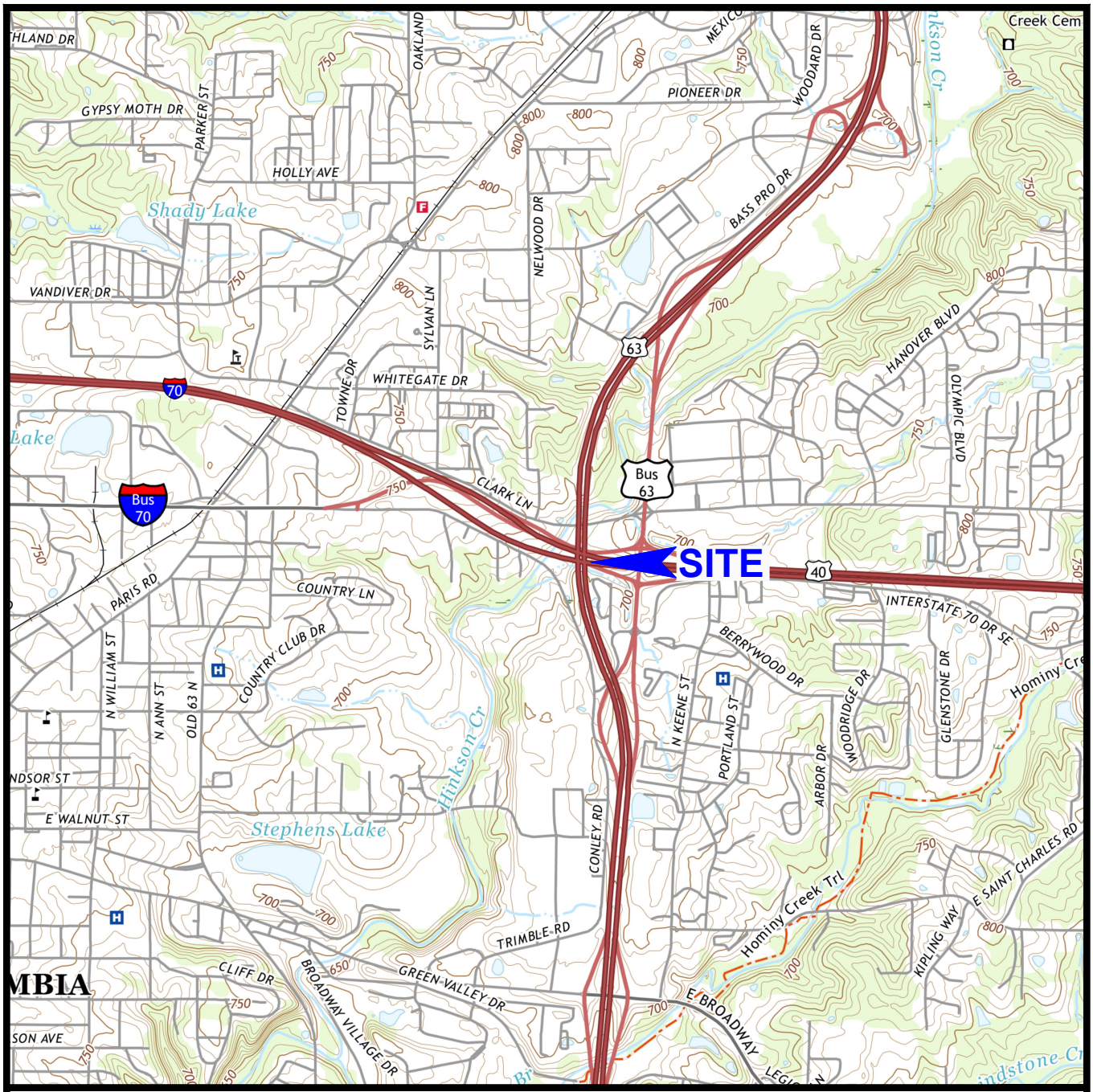
Attachments:

Appendix A – Figures
Appendix B – Boring Logs
Appendix C – Boring Log Terms and Symbols and Rock Core Descriptions Sheets
Appendix D – Rock Core Photographs
Appendix E – Laboratory Test Results
Appendix F – Rock Core Unconfined Compressive Strength Results
Appendix G – Shale Pocket Penetrometer Results



APPENDIX A

FIGURES



NOTES

1. Plan adapted from a 7.5 minute U.S.G.S. map for Columbia, Missouri quadrangle, last revised in 2021.

0 2,000 4,000

SCALE IN FEET

N

Drawn By: WAH	Ck'd By: ADP	App'vd By: CKK
Date: 6-22-23	Date: 9-26-23	Date: 9-27-23

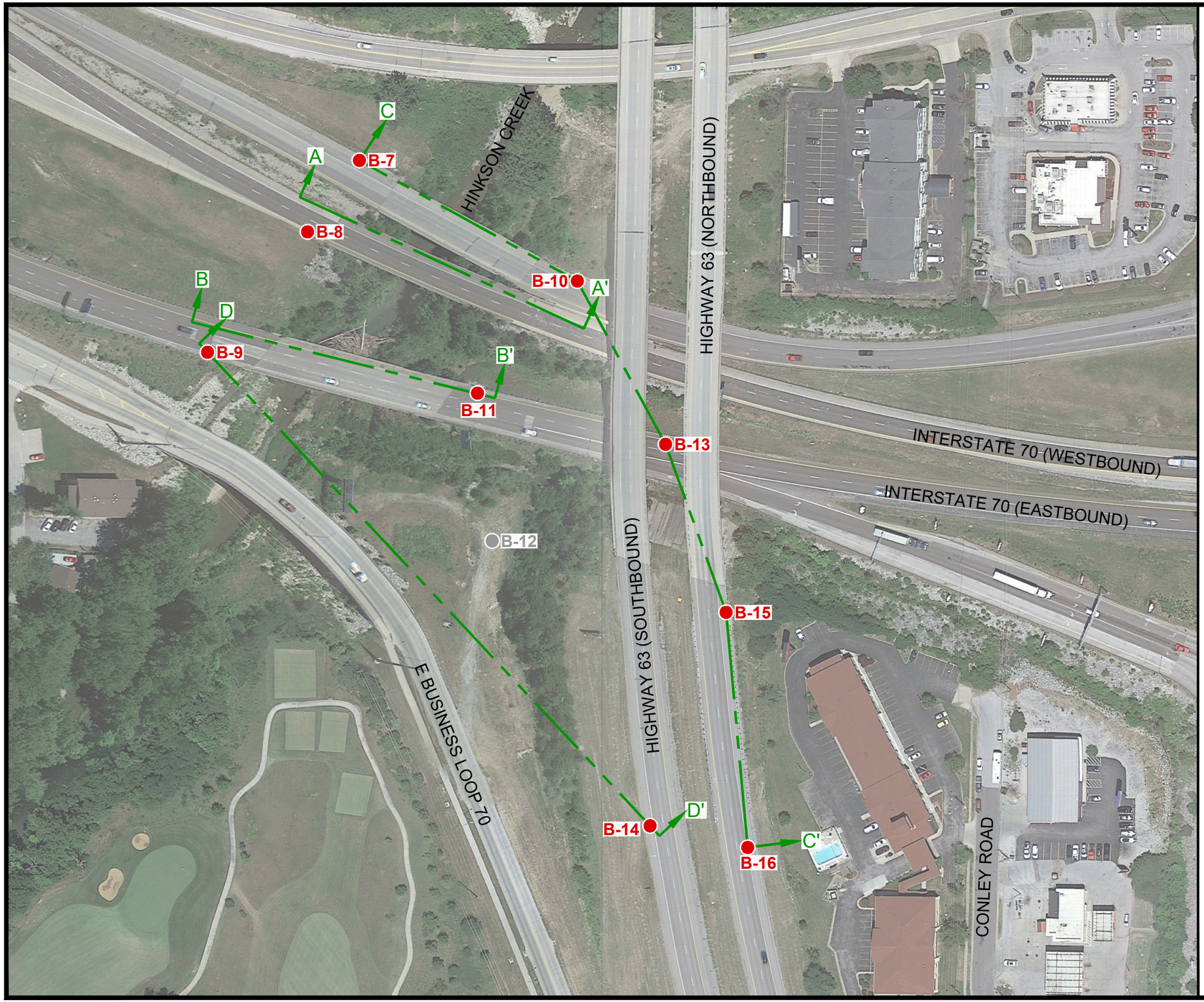
GEOTECHNOLOGY
A UES Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

SITE LOCATION AND TOPOGRAPHY

Project Number J036741.01

FIGURE 1



NOTES

1. Plan adapted from a June 29, 2022 aerial photograph courtesy of Google Earth.
2. Borings were located in the field using GPS and are shown approximate only.

LEGEND

- Boring Location
- Planned Boring Not Completed
- Subsurface Profile A-A' Through D-D' (See Figure 3 through 6, Respectively)

N

0 120 240

SCALE IN FEET

Drawn By: WAH	Ck'd By: ADP	App'vd By: CKK
Date: 5-25-23	Date: 9-26-23	Date: 9-27-23

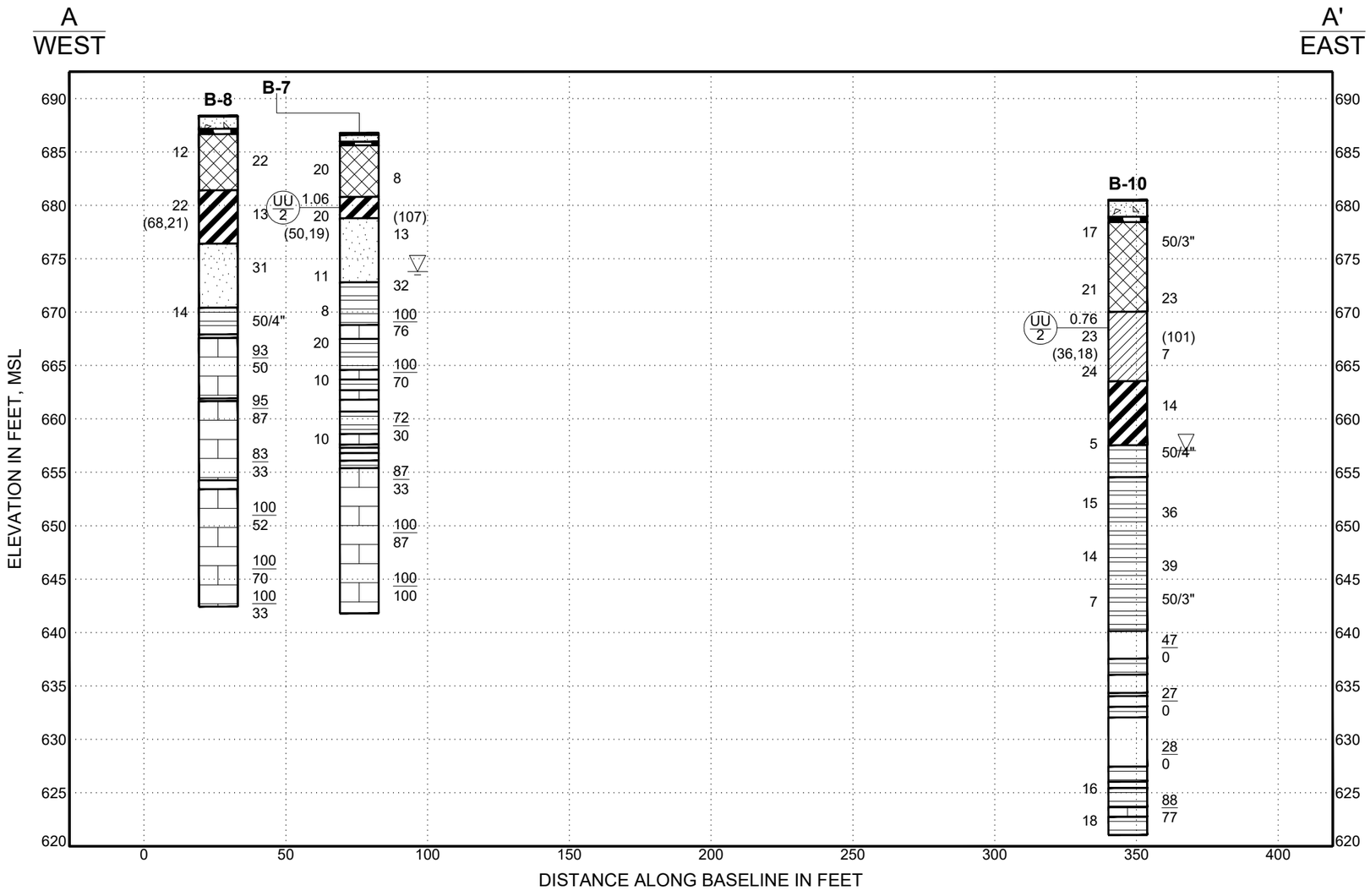
GEOTECHNOLOGY
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I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

AERIAL PHOTOGRAPH OF SITE AND BORING LOCATIONS

Project Number
J036741.01

FIGURE 2



NOTES

1. See Figure 2 for location of Subsurface Profile A-A'.
2. Data concerning subsurface conditions were obtained at boring locations only. Actual conditions at locations between borings could differ from the generalized profile shown here.

KEY TO TEST DATA

Natural Water Content in Percent — 21
Liquid and Plastic Limits — (58,31)

Shear Strength in TSF from Unconsolidated, Undrained Compression — UU 2 — 0.73

9 — Standard Penetration Test Resistance (No. of Blows of a 140-lb. Hammer Dropping 30-in. Required to Drive a 2-in. O.D. Split Spoon One Foot or Indicated Depth - "S" Denotes Seating)

(97) — Dry Unit Weight in Pounds per Cubic Foot

Groundwater Elevation Observed at Time of Drilling

100/83 — Percent Core Recovery
R.Q.D.*

*R.Q.D. Denotes Modified Core Recovery Percentage in Which Only Pieces of Sound Core Over 4 Inches Long are Counted as Recovery

KEY TO BOREHOLE SYMBOLS

Pavement
Fill
Lean Clay
Fat Clay
Sand
Coal
Shale
Core Loss
Limestone

Drawn By: WAH	Ck'd By: ADP	App'vd By: CKK
Date: 7-17-23	Date: 9-26-23	Date: 9-27-23

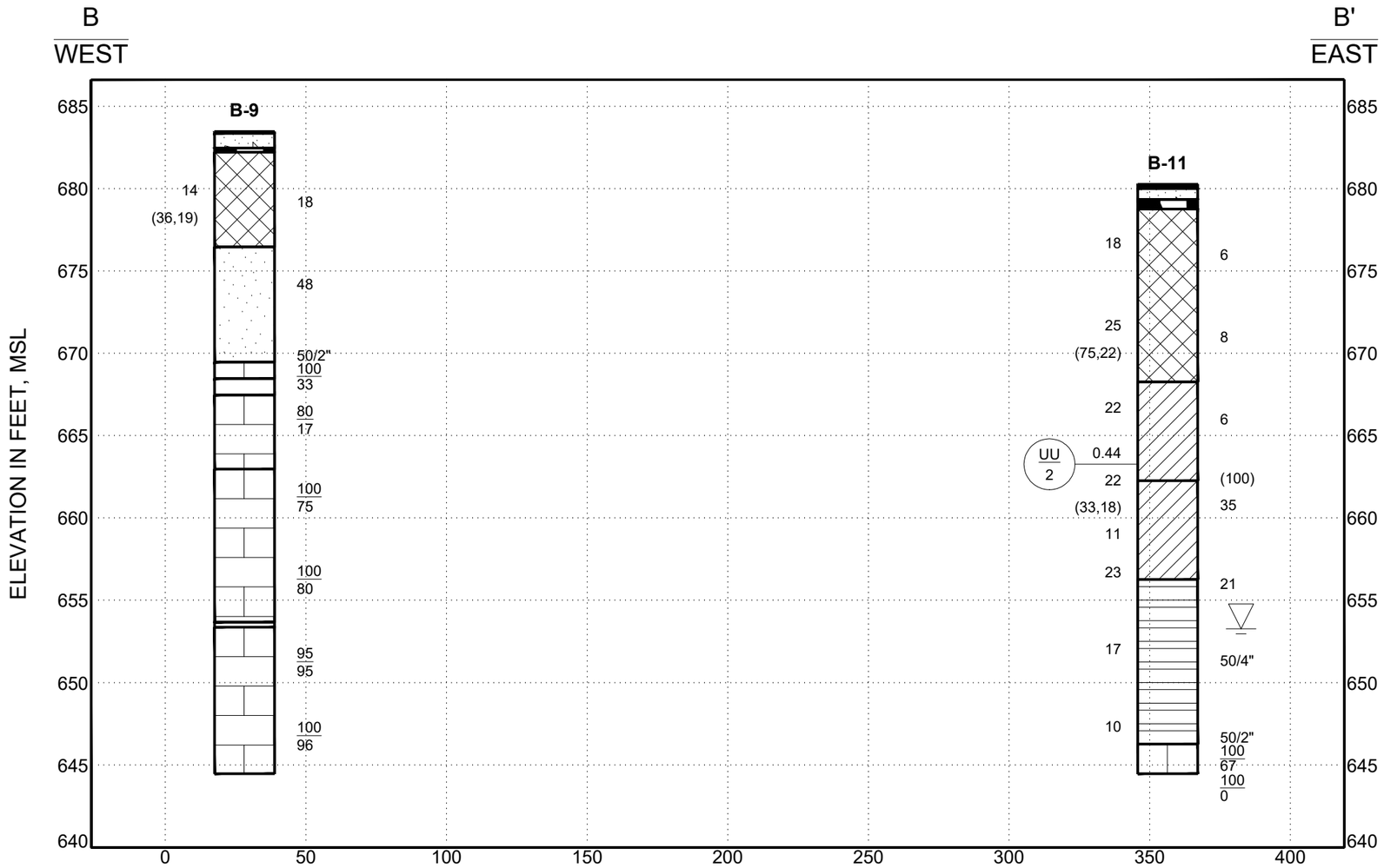
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GENERALIZED SUBSURFACE PROFILE A-A'

Project Number
J036741.01

FIGURE 3



NOTES

1. See Figure 2 for location of Subsurface Profile B-B'.
2. Data concerning subsurface conditions were obtained at boring locations only. Actual conditions at locations between borings could differ from the generalized profile shown here.

KEY TO TEST DATA

Natural Water Content in Percent: 21
Liquid and Plastic Limits: (58,31)

Shear Strength in TSF from Unconsolidated, Undrained Compression: UU / 2 — 0.73

9 — Standard Penetration Test Resistance (No. of Blows of a 140-lb. Hammer Dropping 30-in. Required to Drive a 2-in. O.D. Split Spoon One Foot or Indicated Depth - "S" Denotes Seating)

(97) — Dry Unit Weight in Pounds per Cubic Foot

▽ — Groundwater Elevation Observed at Time of Drilling

100 / 83 — Percent Core Recovery R.Q.D.*

*R.Q.D. Denotes Modified Core Recovery Percentage in Which Only Pieces of Sound Core Over 4 Inches Long are Counted as Recovery

KEY TO BOREHOLE SYMBOLS

Pavement
Fill
Lean Clay
Fat Clay
Sand
Coal
Shale
Core Loss
Limestone

Drawn By: WAH	Ck'd By: ADP	App'vd By: CKK
Date: 7-17-23	Date: 9-26-23	Date: 9-27-23

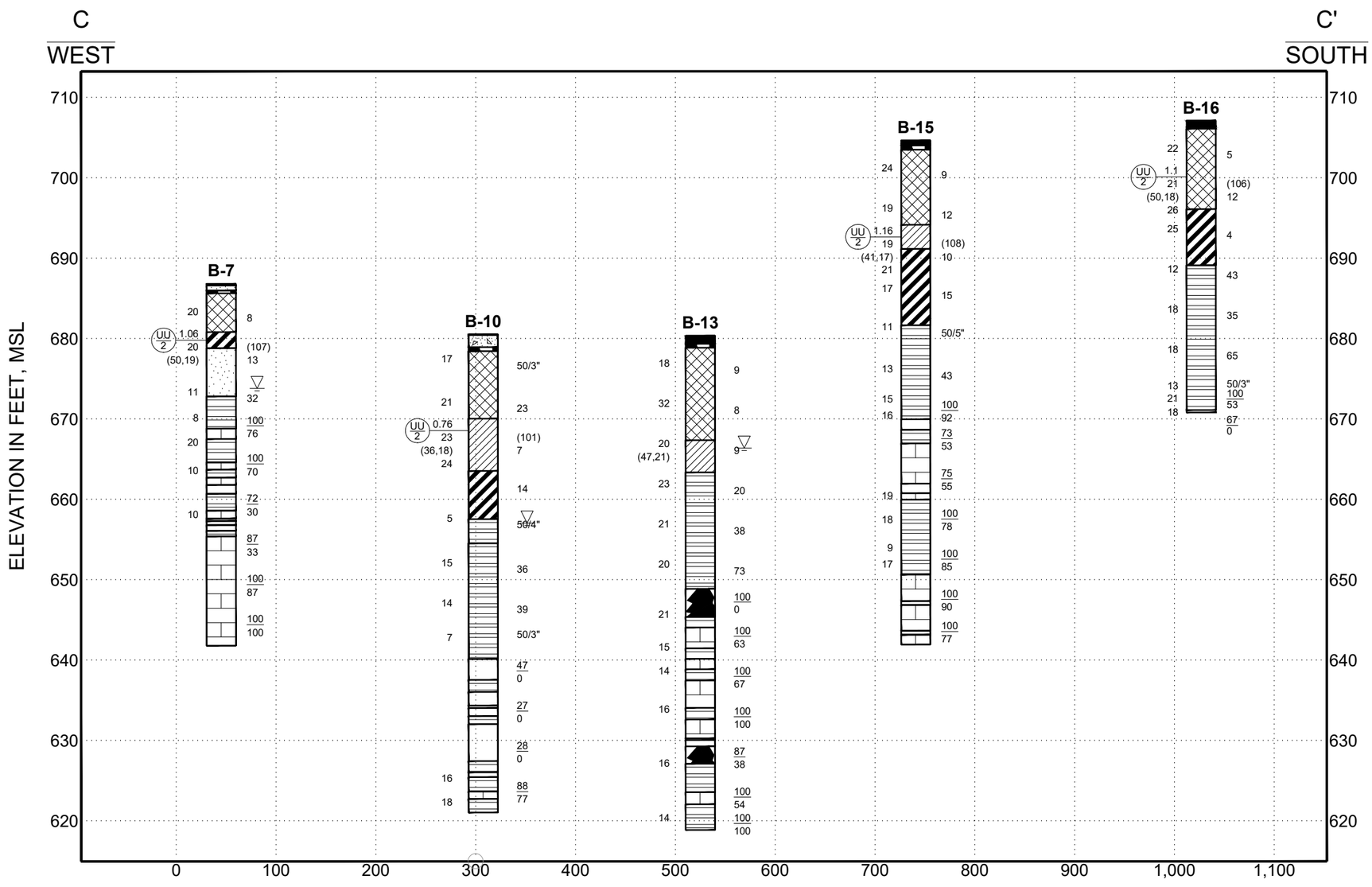
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GENERALIZED SUBSURFACE PROFILE B-B'

Project Number
J036741.01

FIGURE 4



DISTANCE ALONG BASELINE IN FEET

NOTES

1. See Figure 2 for location of Subsurface Profile C-C'.
2. Data concerning subsurface conditions were obtained at boring locations only. Actual conditions at locations between borings could differ from the generalized profile shown here.

KEY TO TEST DATA

Natural Water Content in Percent Liquid and Plastic Limits	21 (58,31)
Shear Strength in TSF from Unconsolidated, Undrained Compression	UU/2 0.73
9	Standard Penetration Test Resistance (No. of Blows of a 140-lb. Hammer Dropping 30-in. Required to Drive a 2-in. O.D. Split Spoon One Foot or Indicated Depth - "S" Denotes Seating)
(97)	Dry Unit Weight in Pounds per Cubic Foot
▽	Groundwater Elevation Observed at Time of Drilling
100/83	Percent Core Recovery R.Q.D.*

*R.Q.D. Denotes Modified Core Recovery Percentage in Which Only Pieces of Sound Core Over 4 Inches Long are Counted as Recovery

KEY TO BOREHOLE SYMBOLS

Pavement, Fill, Lean Clay, Fat Clay, Sand, Coal, Shale, Core Loss, Limestone

Drawn By: WAH	Ck'd By: ADP	App'vd By: CKK
Date: 7-17-23	Date: 9-26-23	Date: 9-27-23

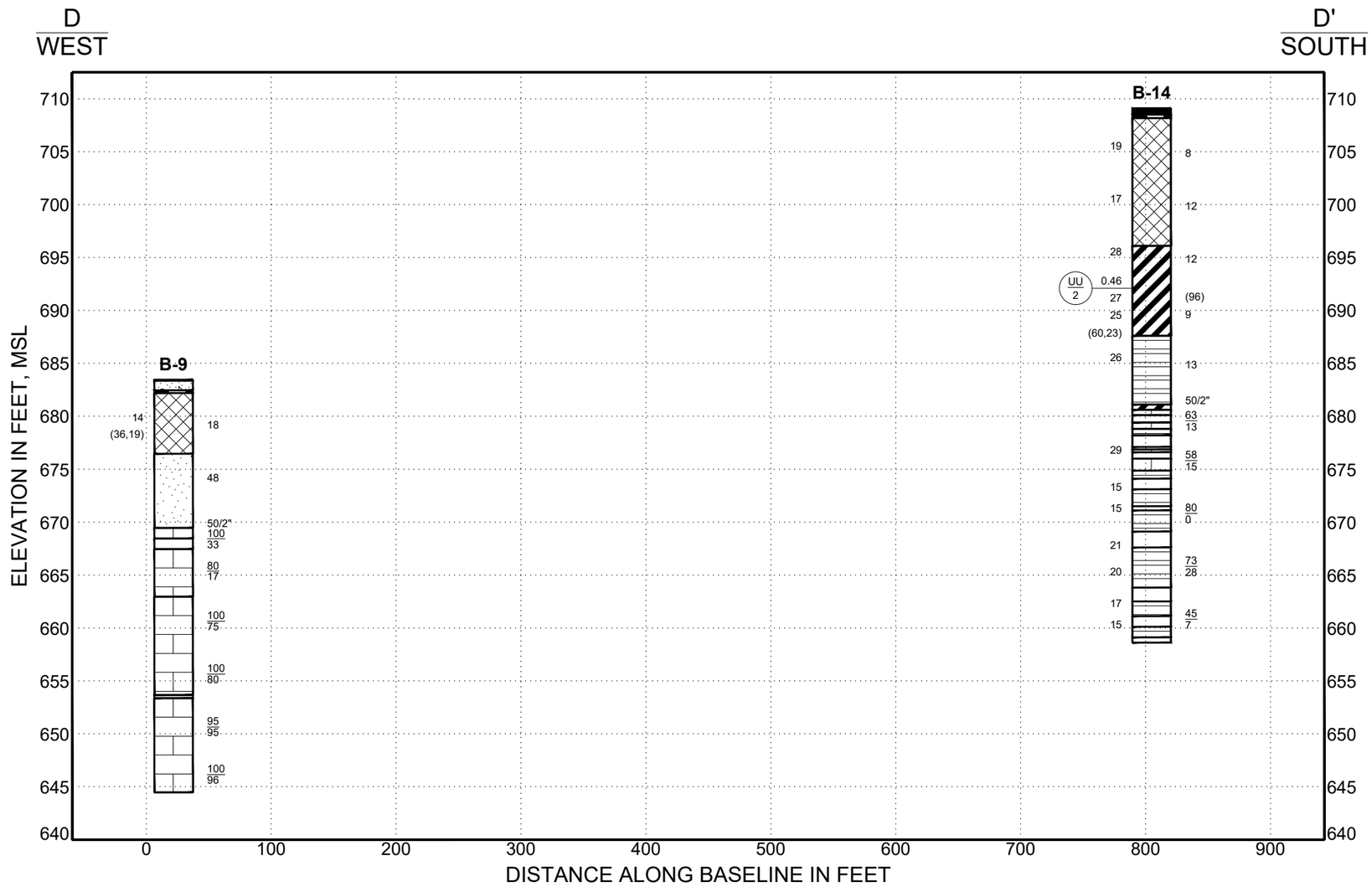
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GENERALIZED SUBSURFACE PROFILE C-C'

Project Number J036741.01

FIGURE 5



NOTES

1. See Figure 2 for location of Subsurface Profile D-D'.
2. Data concerning subsurface conditions were obtained at boring locations only. Actual conditions at locations between borings could differ from the generalized profile shown here.

KEY TO TEST DATA

Natural Water Content in Percent	21	9 Standard Penetration Test Resistance (No. of Blows of a 140-lb. Hammer Dropping 30-in. Required to Drive a 2-in. O.D. Split Spoon One Foot or Indicated Depth - "S" Denotes Seating)
Liquid and Plastic Limits	(58,31)	
Shear Strength in TSF from Unconsolidated, Undrained Compression	UU 2 — 0.73	(97) Dry Unit Weight in Pounds per Cubic Foot
		▽ Groundwater Elevation Observed at Time of Drilling
		100 / 83 Percent Core Recovery R.Q.D.*

*R.Q.D. Denotes Modified Core Recovery Percentage in Which Only Pieces of Sound Core Over 4 Inches Long are Counted as Recovery

KEY TO BOREHOLE SYMBOLS

Pavement, Fill, Lean Clay, Fat Clay, Sand, Coal, Shale, Core Loss, Limestone

Drawn By: WAH	Ck'd By: ADP	App'vd By: CKK
Date: 7-17-23	Date: 9-26-23	Date: 9-27-23

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GENERALIZED SUBSURFACE PROFILE D-D'

Project Number J036741.01

FIGURE 6

APPENDIX B

BORING LOGS

Surface Elevation: 686.8
Datum: NAVD88
Completion Date: 4/20/23
Northing: 1139542.22
Easting: 1698409.32

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		Asphalt - 2 inches		
		Concrete - 8 inches		
		Granular Base - 4 inches		
		(1.2 to 6.0 ft) Fill: medium stiff, brown and gray, fat clay, trace gravel	3-3-5 (11)	SS1
5	681.8			
		(2.5 to 6.0 ft) Medium stiff to stiff, brown, FAT CLAY, trace sand - (CH)	107	ST2
		(8.0 to 14.0 ft) Medium dense, brown, clayey SAND, little chert gravel - SP	3-7-6 (19)	SS3
10	676.8			
		(14.0 to 18.0 ft) Extremely weak to very weak, gray, very finely grained, thin to medium bedded, moderately weathered to slightly weathered SHALE	10-13-19 (46)	SS4
15	671.8	unconfined compressive strength = 38 psi (5 ksf)	100% 76%	NQ1
		(18.0 to 19.3 ft) Strong, gray, very finely crystalline, medium bedded, unweathered LIMESTONE unconfined compressive strength = 11,863 psi (1,708 ksf)		
20	666.8	(19.3 to 22.2 ft) Extremely weak to very weak, gray, very finely grained, thin to medium bedded, unweathered SHALE		

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 13 FEET ▽

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
DT DRILLER EER LOGGER
Diedrich D-50 DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 86 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/26/23	Date: 10/2/23	Date: 10/2/23

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Boone County, Missouri

LOG OF BORING: B-7

Page 1 of 3

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE.ME.GPJ 9/29/23

Surface Elevation: 686.8
Datum: NAVD88
Completion Date: 4/20/23
Northing: 1139542.22
Easting: 1698409.32

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		(22.2 to 23.1 ft) Medium strong, gray, very finely crystalline, thin to medium bedded, unweathered LIMESTONE, some chert nodules	100% / 70%	NQ2
		(23.1 to 24.1 ft) Extremely weak, gray and green, very finely grained, thin bedded, slightly weathered SHALE		
25	661.8	(24.1 to 25.0 ft) limestone cont.		
		(25.0 to 26.1 ft) Core Loss - 14 inches (rock core not recovered)		
		(26.1 to 28.2 ft) Extremely weak to very weak, gray, very finely grained, thin to medium bedded, unweathered SHALE	72% / 30%	NQ3
		(28.2 to 29.2 ft) Strong, gray, very finely crystalline, thin bedded, slightly weathered LIMESTONE, some chert seams/nodules		
		unconfined compressive strength = 13,086 psi (1,884 ksf)		
30	656.8	(29.2 to 29.5 ft) Core Loss - 3 inches (rock core not recovered)		
		(29.5 to 30.0 ft) shale cont.		
		(30.0 to 30.7 ft) Core Loss - 8 inches (rock core not recovered)	87% / 33%	NQ4
		(30.7 to 31.4 ft) shale cont.		
		(31.4 to 45.0 ft) Strong, gray, very finely crystalline, thin to medium bedded, unweathered LIMESTONE		
		unconfined compressive strength = 11,997 psi (1,728 ksf)		
35	651.8			
			100% / 87%	NQ5
		unconfined compressive strength = 9,917 psi (1,428 ksf)		
40	646.8			
			100% / 100%	NQ6
		unconfined compressive strength = 11,506 psi (1,657 ksf)		

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 13 FEET ▽

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
DT DRILLER EER LOGGER
Diedrich D-50 DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 86 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/26/23	Date: 10/2/23	Date: 10/2/23

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Boone County, Missouri

LOG OF BORING: B-7

Page 2 of 3

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE.ME.GPJ 9/29/23

Surface Elevation: 686.8
Datum: NAVD88
Completion Date: 4/20/23
Northing: 1139542.22
Easting: 1698409.32

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL
45	641.8	(31.4 to 45.0 ft) Strong, gray, very finely crystalline, thin to medium bedded, unweathered LIMESTONE *(continued)*
		Boring terminated at 45 feet.
50	636.8	
55	631.8	
60	626.8	
65	621.8	

GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD | SAMPLES

SHEAR STRENGTH, tsf
Δ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 13 FEET ▽

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
DT DRILLER EER LOGGER
Diedrich D-50 DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 86 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/26/23	Date: 10/2/23	Date: 10/2/23

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LOG OF BORING: B-7

Page 3 of 3

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE ME.GPJ 9/29/23

Surface Elevation: 688.4
Datum: NAVD88
Completion Date: 4/26/23
Northing: 1139455.89
Easting: 1698346.64

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		Asphalt - 1 inch Concrete - 14 inches			
		Granular Base - 6 inches			
		(1.8 to 7.0 ft) Fill: medium stiff, brown and gray, fat clay, trace gravel			
				3-10-12 (29)	SS1
5	683.4				
		(7.0 to 12.0 ft) Stiff, brown, FAT CLAY - (CH)			
				3-5-8 (17)	SS2
10	678.4				
		(12.0 to 18.0 ft) Dense, brown, poorly-graded SAND, some chert gravel - SP			
				9-15-16 (41)	SS3
15	673.4				
		(18.0 to 20.5 ft) Extremely weak, gray SHALE			
				12-16 -50/4" ()	SS4
20	668.4				
		(20.5 to 20.8 ft) Core Loss - 4 inches (clay and gravel)			
		unconfined compressive strength = 15,582 psi			

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

68 >>

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE.ME.GPJ 9/29/23

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 5/5/23	Date: 10/2/23	Date: 10/2/23

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Boone County, Missouri

LOG OF BORING: B-8

Page 1 of 3

Project No. J036741.01

Surface Elevation: 688.4
Datum: NAVD88
Completion Date: 4/26/23
Northing: 1139455.89
Easting: 1698346.64

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		(2,244 ksf) (20.8 to 26.5 ft) Strong to very strong, gray, very finely crystalline, thin to medium bedded, unweathered LIMESTONE, some chert seams/nodules *(continued)*		93% 50%	NQ1
25	663.4				
		(26.5 to 26.8 ft) Core Loss - 3 inches (rock core not recovered) (26.8 to 34.2 ft) limestone cont. unconfined compressive strength = 13,509 psi (1,945 ksf)		95% 87%	NQ2
30	658.4			83% 33%	NQ3
		unconfined compressive strength = 17,593 psi (2,533 ksf)			
35	653.4	(34.2 to 35.0 ft) Core Loss - 10 inches (rock core not recovered) (35.0 to 46.0 ft) Medium strong to strong, gray, very finely crystalline, thin to medium bedded, unweathered LIMESTONE, some chert seams and shale seams		100% 52%	NQ4
		unconfined compressive strength = 6,654 psi (958 ksf)			
40	648.4			100% 70%	NQ5

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00 CLONE ME.GPJ 9/29/23

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 5/5/23	Date: 10/2/23	Date: 10/2/23

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LOG OF BORING: B-8

Project No. J036741.01

Surface Elevation: 688.4
Datum: NAVD88
Completion Date: 4/26/23
Northing: 1139455.89
Easting: 1698346.64

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
45	643.4	(35.0 to 46.0 ft) Medium strong to strong, gray, very finely crystalline, thin to medium bedded, unweathered LIMESTONE, some chert seams and shale seams *(continued)*			
		unconfined compressive strength = 13,871 psi (1,997 ksf)		100% / 33%	NQ6
		Boring terminated at 46 feet.			
50	638.4				
55	633.4				
60	628.4				
65	623.4				

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 5/5/23	Date: 10/2/23	Date: 10/2/23

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LOG OF BORING: B-8

Page 3 of 3

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE ME.GPJ 9/29/23

Surface Elevation: 683.5
Datum: NAVD88
Completion Date: 4/28/23
Northing: 1139310.47
Easting: 1698225.85

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		Asphalt - 1 inch Concrete - 11 inches			
		Granular Base - 5 inches			
		(1.3 to 7.0 ft) Fill: medium stiff, brown and gray, lean clay, trace gravel			
				3-5-13 (24)	SS1
5	678.5				
		(7.0 to 14.0 ft) Dense, brown, poorly-graded SAND, some chert gravel - SP			
				8-18-30 (64)	SS2
10	673.5				
				50/2"	SS3
		(14.0 to 15.0 ft) Medium strong to strong, gray, very finely crystalline, thin to medium bedded, slightly weathered to unweathered LIMESTONE, some nodules, some shale seams		100% 33%	NQ1
15	668.5	(15.0 to 16.0 ft) Core Loss - 12 inches (rock core not recovered)			
		(16.0 to 20.5 ft) limestone cont.		80% 17%	NQ2
		Clay seam - 1 inch Clay seam - 1 inch unconfined compressive strength = 12,848 psi (1,850 ksf)			
20	663.5				
		(20.5 to 39.0 ft) Medium strong to very strong, gray, very finely crystalline, thin to medium bedded, unweathered LIMESTONE, little chert seams/nodules			

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE ME.GPJ 9/29/23

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 5/5/23	Date: 10/2/23	Date: 10/2/23

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LOG OF BORING: B-9

Page 1 of 2

Project No. J036741.01

Surface Elevation: 683.5
Datum: NAVD88
Completion Date: 4/28/23
Northing: 1139310.47
Easting: 1698225.85

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		(20.5 to 39.0 ft) Medium strong to very strong, gray, very finely crystalline, thin to medium bedded, unweathered LIMESTONE, little chert seams/nodules *(continued)*		100% / 75%	NQ3
		unconfined compressive strength = 14,634 psi (2,107 ksf)			
25	658.5				
		unconfined compressive strength = 13,640 psi (1,964 ksf)		100% / 80%	NQ4
30	653.5	(29.8 to 30.1 ft) Core loss - 3 inches (rock core not recovered)			
		(30.1 to 39.0 ft) limestone cont.		95% / 95%	NQ5
		unconfined compressive strength = 15,175 psi (2,185 ksf)			
35	648.5			100% / 96%	NQ6
		unconfined compressive strength = 12,207 psi (1,758 ksf)			
		Boring terminated at 39 feet.			
40	643.5				

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 5/5/23	Date: 10/2/23	Date: 10/2/23

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-9

Page 2 of 2

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE ME.GPJ 9/29/23

Surface Elevation: 680.6
Datum: NAVD88
Completion Date: 4/20/23
Northing: 1139396.48
Easting: 1698672.61

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		Asphalt - 1 inches Concrete - 18 inches			
		Granular Base - 6 inches			
		(2.1 to 10.5 ft) Fill: soft, brown and gray, fat clay, trace to little gravel		2-50/3"	SS1
5	675.6				
				3-16-7 (31)	SS2
10	670.6				
		(10.5 to 17.0 ft) Medium stiff, gray, LEAN CLAY - (CL)		101	ST3
				3-3-4 (9)	SS4
15	665.6				
		(17.0 to 23.0 ft) Medium stiff, gray, FAT CLAY, some gravel - CH		3-5-9 (19)	SS5
20	660.6				

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 23.5 FEET ▽

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/26/23	Date: 10/2/23	Date: 10/2/23

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-10

Page 1 of 3

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE ME.GPJ 9/29/23

Surface Elevation: 680.6
Datum: NAVD88
Completion Date: 4/20/23
Northing: 1139396.48
Easting: 1698672.61

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		(17.0 to 23.0 ft) Medium stiff, gray, FAT CLAY, some gravel - CH *(continued)*			
		(23.0 to 26.0 ft) Very weak, gray, very finely grained, thin bedded, moderately weathered, calcareous SHALE ▽		50/4"	SS6
25	655.6				
		(26.0 to 40.4 ft) Extremely weak, green and gray, very finely grained, thin bedded, moderately weathered SHALE, some chert layers/nodules		8-14-22 (48)	SS7
30	650.6				
				9-15-24 (52)	SS8
35	645.6				
				24-50/3"	SS9
40	640.6				
		(40.4 to 43.0 ft) Core Loss - 32 inches (rapid bit advance with pressure spikes, likely clay or soft shale)		47% 0%	NQ1
		(43.0 to 44.5 ft) shale cont.			

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE.ME.GPJ 9/29/23

GROUNDWATER DATA

ENCOUNTERED AT 23.5 FEET ▽

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/26/23	Date: 10/2/23	Date: 10/2/23

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-10

Project No. J036741.01

Surface Elevation: 680.6
Datum: NAVD88
Completion Date: 4/20/23
Northing: 1139396.48
Easting: 1698672.61

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		(43.0 to 44.5 ft) shale cont. *(continued)*		
45	635.6	(44.5 to 46.2 ft) Core Loss - 20 inches (rapid bit advance with pressure spikes, likely clay or soft shale)		
		(46.2 to 46.5 ft) shale cont.		
		(46.5 to 47.5 ft) Core Loss - 12 inches (rapid bit advance with pressure spikes, likely clay or soft shale)	27% / 0%	NQ2
		(47.5 to 48.5 ft) shale cont.		
		(48.5 to 53.1 ft) Core Loss - 55 inches (rapid bit advance with pressure spikes, likely clay or soft shale)		
50	630.6		28% / 0%	NQ3
		(53.1 to 54.5 ft) Extremely weak, green and gray, very finely grained, thin bedded, moderately weathered SHALE, some limestone and chert layers and nodules		
55	625.6	(54.5 ro 55.1 ft) Core Loss - 7 inches (rock core not recovered)		
		(55.1 to 56.9 ft) shale cont.		
		(56.9 to 57.8 ft) Medium strong, gray, very finely crystalline, thin bedded, slightly weathered LIMESTONE, trace chert seams and nodules	88% / 77%	NQ4
		(57.8 to 59.5 ft) shale cont. unconfined compressive strength = 29 psi (4 ksf)		
60	620.6	Boring terminated at 59.5 feet.		
65	615.6			

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00 CLONE ME.GPJ 9/29/23

GROUNDWATER DATA

ENCOUNTERED AT 23.5 FEET ▽

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/26/23	Date: 10/2/23	Date: 10/2/23

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I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-10

Page 3 of 3

Project No. J036741.01

Surface Elevation: 680.3
Datum: NAVD88
Completion Date: 4/21/23
Northing: 1139248.90
Easting: 1698549.64

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		Asphalt - 3 inches			
		Concrete - 8 inches			
		Granular Base - 6 inches			
		(1.5 to 12.0 ft) Fill: medium stiff, brown, fat clay, trace to little gravel			
				2-3-3 (8)	SS1
5	675.3				
				2-3-5 (11)	SS2
10	670.3				
		(12.0 to 18.0 ft) Medium stiff to soft, gray, LEAN CLAY, trace sand - (CL)			
				2-3-3 (8)	SS3
15	665.3				
				100	ST4
		(18.0 to 24.0 ft) Medium stiff, gray, LEAN CLAY, some sand, little chert gravel - CL			
				1-17-18 (47)	SS5
20	660.3				

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

75 >>

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 27 FEET ▽

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/27/23	Date: 10/2/23	Date: 10/2/23

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-11

Page 1 of 2

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE ME.GPJ 9/29/23

Surface Elevation: 680.3
Datum: NAVD88
Completion Date: 4/21/23
Northing: 1139248.90
Easting: 1698549.64

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		(18.0 to 24.0 ft) Medium stiff, gray, LEAN CLAY, some sand, little chert gravel - CL *(continued)*			
				11-9-12 (28)	SS6
25	655.3	(24.0 to 34.0 ft) Extremely weak, gray, very finely grained, moderately weathered to unweathered SHALE			
				13-50/4"	SS7
30	650.3				
				50/2"	SS8
		(34.0 to 35.8 ft) Strong, gray, very finely crystalline, medium to thin bedded, unweathered LIMESTONE, some shale seams		100% 67%	NQ1
35	645.3	unconfined compressive strength = 4,554 psi (656 ksf)		100% 0%	NQ2
		Boring terminated at 35.8 feet.			
40	640.3				

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 27 FEET ▽

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/27/23	Date: 10/2/23	Date: 10/2/23

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-11

Page 2 of 2

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00 CLONE ME.GPJ 9/29/23

Surface Elevation: 680.4
Datum: NAVD88
Completion Date: 4/21/23
Northing: 1139199.29
Easting: 1698779.18

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		Asphalt - 12 inches		
		Granular Base - 6 inches		
		(1.5 to 13.0 ft) Fill: medium stiff, brown, lean clay, trace sand, trace to little gravel		
			3-4-5 (13)	SS1
5	675.4			
			3-3-5 (11)	SS2
10	670.4			
		(13.0 to 17.0 ft) Stiff, gray, LEAN CLAY, trace gravel - (CL) ▽	2-3-6 (13)	SS3
15	665.4			
		(17.0 to 31.5 ft) Extremely weak, brown to gray, very finely grained, moderately weathered to slightly weathered SHALE	3-8-12 (29)	SS4
20	660.4			

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 14 FEET ▽

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
DT DRILLER EER LOGGER
Diedrich D-50 DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 86 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/27/23	Date: 10/2/23	Date: 10/2/23

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-13

Page 1 of 3

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE.ME.GPJ 9/29/23

Surface Elevation: 680.4
Datum: NAVD88
Completion Date: 4/21/23
Northing: 1139199.29
Easting: 1698779.18

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		(17.0 to 31.5 ft) Extremely weak, brown to gray, very finely grained, moderately weathered to slightly weathered SHALE *(continued)*			
				7-14-24 (54)	SS5
25	655.4				
				10-28-45 (105)	SS6
30	650.4				
		(31.5 to 35.0 ft) Weak, black, very fine grained, thin bedded, slightly weathered COAL		100% 0%	NQ1
35	645.4	(35.0 to 36.3 ft) Extremely weak to very weak, gray, very finely grained, thin bedded, slightly weathered SHALE		100% 63%	NQ2
		(36.3 to 38.9 ft) Weak to Strong, gray, very finely crystalline, thin to medium bedded, slightly weathered LIMESTONE, interbedded with shale layers unconfined compressive strength = 8,137 psi (1,172 ksf)			
		(38.9 to 40.2 ft) shale cont.			
40	640.4	(40.2 to 41.5 ft) Strong, gray, very finely crystalline, medium bedded, slightly weathered LIMESTONE		100% 67%	NQ3
		(41.5 to 42.9 ft) Very weak, gray, very finely grained, thin bedded, unweathered SHALE			
		(42.9 to 46.3 ft) Strong, gray, very finely crystalline, medium bedded, slightly weathered LIMESTONE, some chert layers			

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL
73

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 14 FEET ▽

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
DT DRILLER EER LOGGER
Diedrich D-50 DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 86 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/27/23	Date: 10/2/23	Date: 10/2/23

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-13

Page 2 of 3

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE ME.GPJ 9/29/23

Surface Elevation: 680.4
Datum: NAVD88
Completion Date: 4/21/23
Northing: 1139199.29
Easting: 1698779.18

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		unconfined compressive strength = 8,923 psi (1,285 ksf)		
45	635.4	(42.9 to 46.3 ft) Strong, gray, very finely crystalline, medium bedded, slightly weathered LIMESTONE, some chert layers *(continued)*		
		(46.3 to 47.8 ft) Very weak, gray, very finely grained, medium bedded, unweathered SHALE	100% / 100%	NQ4
		(47.8 to 50.1 ft) Strong, gray, very finely crystalline, medium bedded, slightly weathered LIMESTONE, some chert seams		
50	630.4	unconfined compressive strength = 9,505 psi (1,369 ksf)		
		(50.1 to 50.3 ft) Very weak, gray, SHALE		
		(50.3 to 51.1 ft) Core Loss - 8 inches (rock core not recovered)		
		(51.1 to 53.3 ft) Weak, black, very fine grained, thin bedded, unweathered COAL	87% / 38%	NQ5
		(53.3 to 56.8 ft) Extremely weak to very weak, gray, very finely grained, thin to medium bedded, unweathered SHALE		
55	625.4			
		(56.8 to 58.3 ft) Strong, gray, very finely crystalline, medium bedded, unweathered LIMESTONE, some chert nodules and shale seams	100% / 54%	NQ6
		unconfined compressive strength = 9,365 psi (1,349 ksf)		
		(58.3 to 61.5 ft) shale cont.		
60	620.4			
		unconfined compressive strength = 12 psi (2 ksf)	100% / 100%	NQ7
		Boring terminated at 61.5 feet.		
65	615.4			

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00 CLONE ME.GPJ 9/29/23

GROUNDWATER DATA

ENCOUNTERED AT 14 FEET ▽

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
DT DRILLER EER LOGGER
Diedrich D-50 DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 86 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/27/23	Date: 10/2/23	Date: 10/2/23

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-13

Page 3 of 3

Project No. J036741.01

Surface Elevation: 709.1
Datum: NAVD88
Completion Date: 4/27/23
Northing: 1138738.34
Easting: 1698760.51

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		Asphalt - 7 inches			
		Granular Base - 4 inches			
		(0.9 to 13.0 ft) Fill: medium stiff, brown, lean clay, trace sand, trace gravel			
				4-4-4 (11)	SS1
5	704.1				
				3-7-5 (16)	SS2
10	699.1				
		(13.0 to 21.5 ft) Stiff to soft, gray, FAT CLAY - (CH)		3-5-7 (16)	SS3
15	694.1				
				96	ST4
				2-3-6 (12)	SS5
20	689.1				

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

60

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 5/5/23	Date: 10/2/23	Date: 10/2/23

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-14

Page 1 of 3

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE ME.GPJ 9/29/23

Surface Elevation: 709.1
Datum: NAVD88
Completion Date: 4/27/23
Northing: 1138738.34
Easting: 1698760.51

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		(21.5 to 28.0 ft) Extremely weak, gray, very finely grained, moderately weathered SHALE, trace sand *(continued)*		
			3-5-8 (17)	SS6
25	684.1			
			50/2"	SS7
		(28.0 to 28.5 ft) Brown CLAY		
		(28.5 to 29.0 ft) Medium strong, gray, very finely crystalline, thin to medium bedded, slightly weathered LIMESTONE	63% 13%	NQ1
30	679.1	(29.0 to 29.7 ft) Core Loss - 7 inches (rock core not recovered)		
		(29.7 to 30.3 ft) limestone cont.		
		(30.3 to 30.9 ft) Extremely weak, tan to gray, very finely grained, thin bedded, slightly weathered SHALE		
		(30.9 to 32.0 ft) Core Loss - 13 inches (rock core not recovered)	58% 15%	NQ2
		(32.0 to 32.25 ft) shale cont.		
		(32.3 to 32.5 ft) Very strong, gray, very finely crystalline, thin to medium bedded,unweathered LIMESTONE		
35	674.1	(32.5 to 33.1 ft) Core Loss - 7 inches (rock core not recovered)		
		(33.1 to 34.3 ft) limestone cont. unconfined compressive strength = 27,222 psi (3,920 ksf)		
		(34.3 to 35.0 ft) Extremely weak to very weak, gray, very finely grained, thin bedded, unweathered SHALE	80% 0%	NQ3
		(35.0 to 36.0 ft) Core Loss - 12 inches (rock core not recovered)		
		(36.0 to 37.6 ft) shale cont.		
40	669.1	(37.6 to 38.0 ft) Core Loss - 5 inches (rock core not recovered)		
		(38.0 to 40.0 ft) shale cont.		
		(40.0 to 41.5 ft) Core Loss - 18 inches (rock core not recovered)		
		(41.5 to 45.3 ft) Extremely weak to very weak, gray, very finely grained, thin bedded, unweathered SHALE	73% 28%	NQ4

GRAPHIC LOG

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 5/5/23	Date: 10/2/23	Date: 10/2/23

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I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-14

Page 2 of 3

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE ME.GPJ 9/29/23

Surface Elevation: 709.1
Datum: NAVD88
Completion Date: 4/27/23
Northing: 1138738.34
Easting: 1698760.51

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
45	664.1	(41.5 to 45.3 ft) Extremely weak to very weak, gray, very finely grained, thin bedded, unweathered SHALE *(continued)*			
		(45.3 to 46.6 ft) Core Loss - 15 inches (rock core not recovered)			
		(46.6 to 48.0 ft) shale cont.		45% 7%	NQ5
		(48.0 to 49.0 ft) Core Loss - 12 inches (rock core not recovered)			
		(19.0 to 50.0 ft) shale cont.			
50	659.1	(50.0 to 50.5 ft) Core Loss - 6 inches (rock core not recovered)			
		Boring terminated at 50.5 feet.			
55	654.1				
60	649.1				
65	644.1				

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 5/5/23	Date: 10/2/23	Date: 10/2/23

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Boone County, Missouri

LOG OF BORING: B-14

Page 3 of 3

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE ME.GPJ 9/29/23

Surface Elevation: 704.7
Datum: NAVD88
Completion Date: 4/19/23
Northing: 1138996.26
Easting: 1698852.33

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		Asphalt - 7.5 inches			
		Granular Base - 6.5 inches			
		(1.2 to 10.5 ft) Fill: medium stiff, brown, lean clay, trace sand, trace gravel			
				3-4-5 (13)	SS1
5	699.7				
				3-4-8 (17)	SS2
10	694.7				
		(10.5 to 13.5 ft) Stiff, gray, LEAN CLAY - (CL)			
				108	ST3
		(13.5 to 23.0 ft) Stiff, brown, FAT CLAY, trace gravel - CH			
				3-4-6 (14)	SS4
15	689.7				
				3-5-10 (22)	SS5
20	684.7				

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
DT DRILLER EER LOGGER
Diedrich D-50 DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 86 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/27/23	Date: 10/2/23	Date: 10/2/23

GEOTECHNOLOGY
A Universal Engineering Sciences Company

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I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-15

Page 1 of 3

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE ME.GPJ 9/29/23

Surface Elevation: 704.7
Datum: NAVD88
Completion Date: 4/19/23
Northing: 1138996.26
Easting: 1698852.33

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		(13.5 to 23.0 ft) Stiff, brown, FAT CLAY, trace gravel - CH *(continued)*		
		(23.0 to 34.7 ft) Extremely weak to very weak, tan to gray, very finely grained, thin to medium bedded, moderately weathered to unweathered SHALE	14-50/5"	SS6
25	679.7			
			9-14-29 (62)	SS7
30	674.7			
			100% 92%	NQ1
		unconfined compressive strength = 24 psi (3 ksf)		
35	669.7	(34.7 to 36.0 ft) Core Loss - 16 inches (rock core not recovered)		
		(36.0 to 37.7 ft) shale cont. Limestone layer with pyrite pockets - 3 inches	73% 53%	NQ2
		(37.7 to 42.7 ft) Medium strong, gray, very finely crystalline, thin to medium bedded, uweathered LIMESTONE, some shale partings and seams		
40	664.7			
		unconfined compressive strength = 6,032 psi (869 ksf)	75% 55%	NQ3
		Shale layer - 3 inches		
		(42.7 to 43.9 ft) Core Loss - 15 inches (rock core not recovered)		

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
DT DRILLER EER LOGGER
Diedrich D-50 DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 86 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/27/23	Date: 10/2/23	Date: 10/2/23

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A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-15

Page 2 of 3

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE ME.GPJ 9/29/23

Surface Elevation: 704.7
Datum: NAVD88
Completion Date: 4/19/23
Northing: 1138996.26
Easting: 1698852.33

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		(43.9 to 44.7 ft) limestone cont. *(continued)*		
45	659.7	(44.7 to 54.0 ft) Very weak, gray, very finely grained, thin to medium bedded, unweathered SHALE	100% 78%	NQ4
50	654.7	Limestone seam - 2 inches turns calcareous to 54.0 unconfined compressive strength = 423 psi (61 ksf) Limestone seam - 3 inches Limestone seam - 3 inches	100% 85%	NQ5
55	649.7	(54.0 to 57.3 ft) Very strong, gray, very finely crystalline, thin medium bedded, uweathered LIMESTONE, some shale partings and seams unconfined compressive strength = 27,612 psi (3,976 ksf) (57.3 to 57.8 ft) Very weak, gray, SHALE (57.8 to 61.0 ft) limestone cont.	100% 90%	NQ6
60	644.7	Shale seam - 1.5 inches (61.0 to 61.5 ft) Very weak, gray, SHALE (61.5 to 62.7 ft) limestone cont. unconfined compressive strength = 26,029 psi (3,748 ksf) Shale seam - 1 inch Boring terminated at 62.7 feet.	100% 77%	NQ7
65	639.7			

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
DT DRILLER EER LOGGER
Diedrich D-50 DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 86 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/27/23	Date: 10/2/23	Date: 10/2/23

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-15

Page 3 of 3

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE ME.GPJ 9/29/23

Surface Elevation: 707.1
Datum: NAVD88
Completion Date: 4/19/23
Northing: 1138712.60
Easting: 1698888.48

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		Asphalt - 10 inches			
		Granular Base - 2 inches			
		(1.0 to 11.0 ft) Fill: medium stiff, brown, fat clay, trace sand, trace gravel			
				3-2-3 (7)	SS1
5	702.1				
				106	ST2
				2-6-6 (16)	SS3
10	697.1				
		(11.0 to 18.0 ft) Stiff to soft, gray, FAT CLAY - CH			
				1-2-2 (5)	SS4
15	692.1				
		(18.0 to 36.3 ft) Extremely weak to very weak, gray, very finely grained, thin to medium bedded, moderately weathered to unweathered SHALE			
				6-20-23 (57)	SS5
20	687.1				

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/27/23	Date: 10/2/23	Date: 10/2/23

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I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-16

Page 1 of 2

Project No. J036741.01

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00.CLONE ME.GPJ 9/29/23

Surface Elevation: 707.1
Datum: NAVD88
Completion Date: 4/19/23
Northing: 1138712.60
Easting: 1698888.48

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS (N60) CORE RECOVERY/RQD	SAMPLES
		(18.0 to 36.3 ft) Extremely weak to very weak, gray, very finely grained, thin to medium bedded, moderately weathered to unweathered SHALE *(continued)*		
			6-13-22 (47)	SS6
25	682.1			
			12-26-39 (87)	SS7
30	677.1			
			35-50/3"	SS8
		unconfined compressive strength = 29 psi (4 ksf)	100% 53%	NQ1
35	672.1	coal seam - 2 inches	67% 0%	NQ2
		(36.0 to 36.3 ft) Core loss - 4 inches (rock core not recovered)		
		Boring terminated at 36.3 feet.		
40	667.1			

GRAPHIC LOG

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 □ - PP/2
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
▲ N-VALUE (BLOWS PER FOOT)
(ASTM D 1586)

WATER CONTENT, %
PL 10 20 30 40 50 LL

65

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

N60 BORING LOG (WITH PAGE #) B-7 THROUGH B-16.GPJ 00 CLONE ME.GPJ 9/29/23

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
RR DRILLER VTZ LOGGER
CME 55HTX DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 80 %

REMARKS:

Drawn by: ADP	Checked by: CKK	App'vd. by: CKK
Date: 4/27/23	Date: 10/2/23	Date: 10/2/23

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I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

LOG OF BORING: B-16

Page 2 of 2

Project No. J036741.01

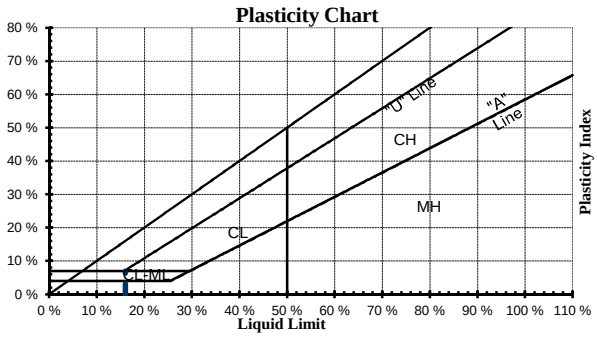
APPENDIX C

BORING LOGS TERMS AND SYMBOLS AND ROCK CORE DESCRIPTIONS SHEETS

BORING LOG: TERMS AND SYMBOLS

LEGEND

CS	Continuous Sampler
GB	Grab Sample
NQ	NQ Rock Core
PST	Three-Inch Diameter Piston Tube Sample
SS	Split-Spoon Sample (Standard Penetration Test)
ST	Three-Inch Diameter Shelby Tube Sample
*	Sample Not Recovered
PL	Plastic Limit (ASTM D4318)
LL	Liquid Limit (ASTM D4318)
SV	Shear Strength from Field Vane (ASTM D2573)
UU	Shear Strength from Unconsolidated-Undrained Triaxial Compression Test (ASTM D2850)
QU	Shear Strength from Unconfined Compression Test (ASTM D2166)



SOIL GRAIN SIZE

US STANDARD SIEVE

12"	3"	3/4"	4	10	40	200

BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		

300	76.2	19.1	4.76	2.00	0.42	0.074	0.005

SOIL GRAIN SIZE IN MILLIMETERS

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions			Symbol	Description
Coarse-Grained Soils (More than 50% Larger than No. 200 Sieve Size)	Gravel and Gravelly Soil	Clean Gravels Little or no Fines	GW	Well-Graded Gravel, Gravel- Sand Mixture
			GP	Poorly-Graded Gravel, Gravel-Sand Mixture
		Gravels with Appreciable Fines	GM	Silty Gravel, Gravel-Sand-Silt Mixture
			GC	Clayey-Gravel, Gravel-Sand-Clay Mixture
	Sand and Sandy Soils	Clean Sands Little or no Fines	SW	Well-Graded Sand, Gravelly Sand
			SP	Poorly-Graded Sand, Gravelly Sand
		Sands with Appreciable Fines	SM	Silty Sand, Sand-Silt Mixture
			SC	Clayey-Sand, Sand-Clay Mixture
Fine-Grained Soils (More than 50% Smaller than No. 200 Sieve Size)	Silts and Clays	Liquid Limit Less Than 50	ML	Silt, Sandy Silt, Clayey Silt, Slight Plasticity
			CL	Lean Clay, Sandy Clay, Silty Clay, Low to Medium Plasticity
			OL	Organic Silts or Lean Clays, Low Plasticity
	Silts and Clays	Liquid Limit Greater Than 50	MH	Silt, High Plasticity
			CH	Fat Clay, High Plasticity
			OH	Organic Clay, Medium to High Plasticity
	Highly Organic Soils		PT	Peat, Humus, Swamp Soil

STRENGTH OF COHESIVE SOILS

Consistency	Undrained Shear Strength (tsf)	Unconfined Comp. Strength (tsf)
Very Soft	less than 0.125	less then 0.25
Soft	0.125 to 0.25	0.25 to 0.5
Medium Stiff	0.25 to 0.5	0.5 to 1.0
Stiff	0.5 to 1.0	1.0 to 2.0
Very Stiff	1.0 to 2.0	2.0 to 3.0
Hard	greater than 2.0	greater than 4.0

DENSITY OF GRANULAR SOILS

Descriptive Term	Approximate N_{60}-Value Range
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	>50

N-Value (Blow Count) is the last two, 6-inch drive increments (i.e. 4/7/9, N = 7 + 9 = 16). Values are shown as a summation on the grid plot and shown in the Unit Dry Weight/SPT column.

RELATIVE COMPOSITION

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

OTHER TERMS

Layer - Inclusion greater than 3 inches thick.

Seam - Inclusion 1/8-inch to 3 inches thick

Parting - Inclusion less than 1/8-inch thick

Pocket - Inclusion of material that is smaller than sample diameter

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Relative composition and Unified Soil Classification System (USCS) designations are based on visual descriptions and are approximate only. If laboratory tests were performed to classify the soil, the USCS designation is shown in parenthesis.

ROCK CORE DESCRIPTIONS

TERM

Strength
Color
Crystallinity
Grain Size
Mass Bedding
Weathering
Voids
Quality

SEDIMENTARY ROCK TYPE

Sandstone - Predominantly quartz grains cemented by silica, iron, clay or carbonate material. Color depends on cementing agent; porous and pervious; hard and generally thickly bedded.

Siltstone - Composition similar to sandstone but at least 50% grains 0.002 to 0.02 millimeters in size. Rarely forms thick beds, but often hard.

Shale - Predominant particles are less than 0.002 millimeters with a well defined fissile fabric. Commonly interbedded with sandstone or limestone and relatively soft.

Limestone - Contains more than 50% calcium carbonate. The calcite can be precipitated chemically, organically, or it may be detrital in origin. Reacts with dilute HCL.

Dolomite - Harder and heavier than limestone. Forms by alteration of limestone or by direct precipitation from sea water. Reacts with dilute HCL only when powdered.

Coal - Composed of highly altered plant remains and varying amounts of clay, generally black in color.

Chert - Formed by silica deposited from solution in water. May occur as nodules or relatively thick beds.

GEOLOGIC DEFINITIONS

Stylolite - A term applied to parts of certain limestones which have a column like development that is grooved, sutured or striated and irregular in cross-section.

Fissility - A property of splitting along closely spaced parallel planes.

Argillaceous - A term applied to rock or substances having a notable portion, greater then 30%, clay in composition.

Oolitic - A spherical or ellipsoidal texture, 0.25 to 2.0 mm in diameter, with concentric or radial structure.

Brecciated - A rock texture which is composed of angular fragments which correspond in size to gravel and/or pebbles.

Slickenside - A polished or striated surface on or within a rock.

REFERENCE

STRENGTH

Description	***Uniaxial Compressive Strength (psi)***
Extremely Weak	less than 150
Very Weak	150 to 700
Weak	700 to 4,000
Medium Strong	4,000 to 7,000
Strong	7,000 to 15,000
Very Strong	15,000 to 36,000
Extremely Strong	greater than 36,000

COLOR

Common colors are gray, brown, black and white. Exotic colors such as green, blue, maroon can be used when necessary.

CRYSTALLINITY

Description	***Criteria***
Aphanitic	Crystals cannot be seen with the naked eye
Very Finely Crystalline	Crystals are barely visible with the naked eye
Finely Crystalline	Crystals are easily visible with the naked eye
Medium Crystalline	Crystals are medium size; up to 1/8-inch diameter
Coarsely Crystalline	Crystals are 1/8- to 1/4-inch in diameter
Very Coarsely Crystalline	Crystals are larger than 1/4-inch in diameter

GRAIN SIZE

Description	***Criteria***
Very Finely Grained	Grains cannot be seen with the naked eye
Fine Grained	Grains are barely visible with the naked eye
Medium Grained	Grains up to 2 mm in diameter
Coarse Grained	Grains are larger than 2 mm in diameter

BEDDING

Description	***Criteria***
Thin	less than 2 inches
Medium	2 to 24 inches
Thick	24 to 48 inches
Massive	greater than 48 inches

WEATHERING

Description	***Criteria***
Unweathered	No visible alteration of rock mass
Slightly Weathered	Slight discoloration inward from fractures
Moderately Weathered	Discoloration throughout, slight loss of strength, texture intact
Highly Weathered	Entire rock mass appears discolored and dull, texture indistinct, fabric intact
Severely Weathered	Majority of rock mass reduced to soil-like state with relic rock structure

VOIDS

Description	***Criteria***
Dense	Usually not visible with the naked eye
Pitted	Visible to 1/4-inch
Vuggy	1/4-inch to diameter of the core
Cavity	Larger than 6 inches in diameter

QUALITY

Percent RQD	***Description***
90 to 100	Excellent
75 to 90	Good
50 to 75	Fair
25 to 50	Poor
0 to 25	Very Poor

APPENDIX D

ROCK CORE PHOTOGRAPHS

J036741.01 I-70 Improvements Box 1 of 3
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-7

RUN	DEPTH, FT	RECOVERY, %	RQD, %
1	15.5 – 20.0	100	76
2	20.0 – 25.0	100	70
3	25.0 – cont.	72	30

J036741.01 I-70 Improvements Box 2 of 3
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-7

RUN	DEPTH, FT	RECOVERY, %	RQD, %
3	cont. – 30.0	72	30
4	30.0 – 35.0	87	33
5	35.0 – cont.	100	87

J036741.01 I-70 Improvements Box 3 of 3

I-70 and US-63 Interchange

Boone County, Missouri



BORING B-7

RUN	DEPTH, FT	RECOVERY, %	RQD, %
5	cont. – 40.0	100	87
6	40.0 – 45.0	100	100

J036741.01 I-70 Improvements Box 1 of 3
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-8

RUN	DEPTH, FT	RECOVERY, %	RQD, %
1	20.5 – 25.0	93	50
2	25.0 – 30.0	95	87
3	30.0 – cont.	83	33

J036741.01 I-70 Improvements Box 2 of 3
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-8

RUN	DEPTH, FT	RECOVERY, %	RQD, %
3	cont. – 35.0	83	33
4	35.0 – 40.0	100	52
5	40.0 – cont.	100	70



BORING B-8

RUN	DEPTH, FT	RECOVERY, %	RQD, %
5	cont. – 45.0	100	70
6	45.0 – 46.0	100	33

J036741.01 I-70 Improvements Box 1 of 3
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-9

RUN	DEPTH, FT	RECOVERY, %	RQD, %
1	14.0 – 15.0	100	33
2	15.0 – 20.0	80	17
3	20.0 – cont.	100	75

J036741.01 I-70 Improvements Box 2 of 3
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-9

RUN	DEPTH, FT	RECOVERY, %	RQD, %
3	cont. – 25.0	100	75
4	25.0 – 30.0	100	80
5	30.0 – cont.	95	95

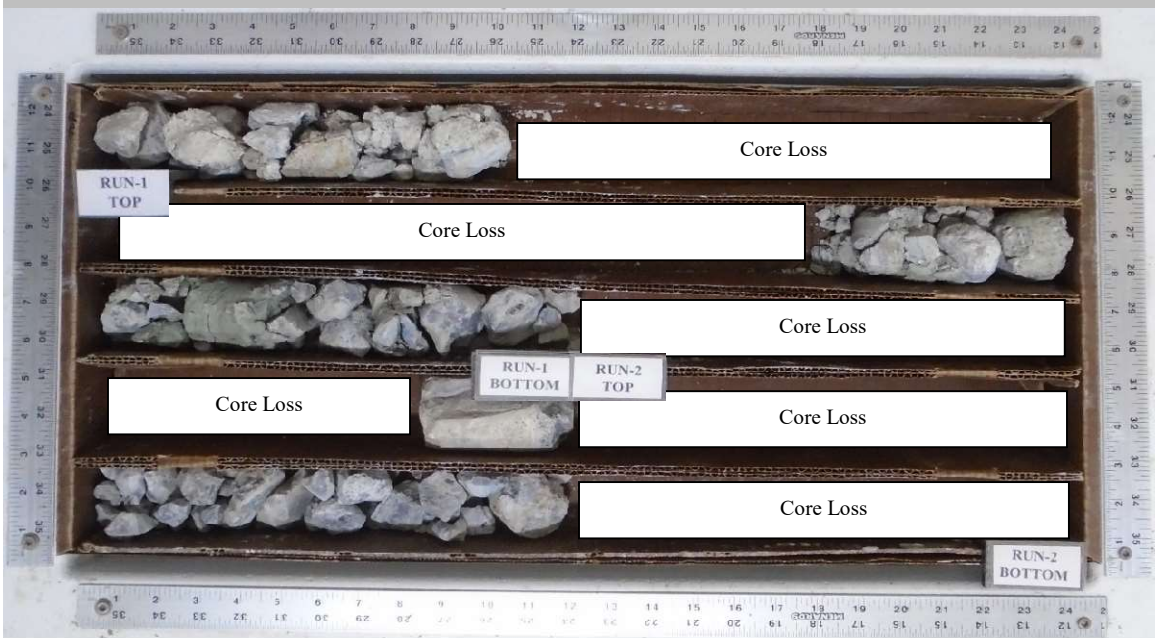
J036741.01 I-70 Improvements Box 3 of 3
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-9

RUN	DEPTH, FT	RECOVERY, %	RQD, %
5	cont. – 35.0	95	95
6	35.0 – 39.0	100	96

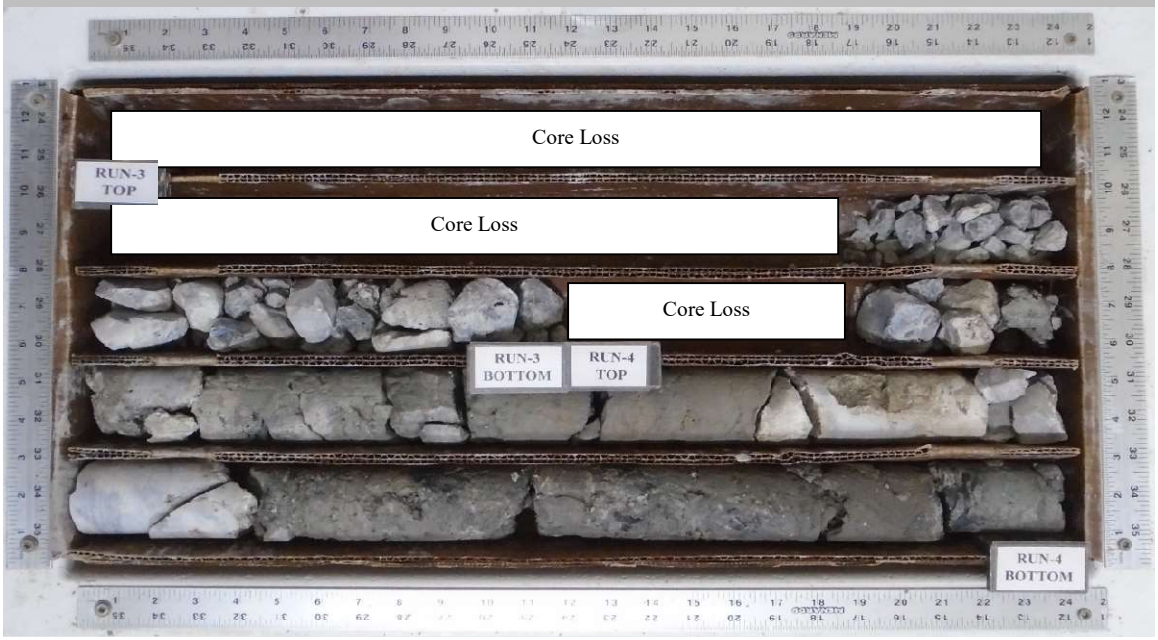
J036741.01 I-70 Improvements Box 1 of 2
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-10

RUN	DEPTH, FT	RECOVERY, %	RQD, %
1	39.5 – 44.5	47	0
2	44.5 – 49.5	27	0

J036741.01 I-70 Improvements Box 2 of 2
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-10

RUN	DEPTH, FT	RECOVERY, %	RQD, %
3	49.5 – 54.5	28	0
4	54.5 – 59.5	88	77



BORING B-11

RUN	DEPTH, FT	RECOVERY, %	RQD, %
1	34.0 – 35.0	100	67
2	35.0 – 35.8	100	0

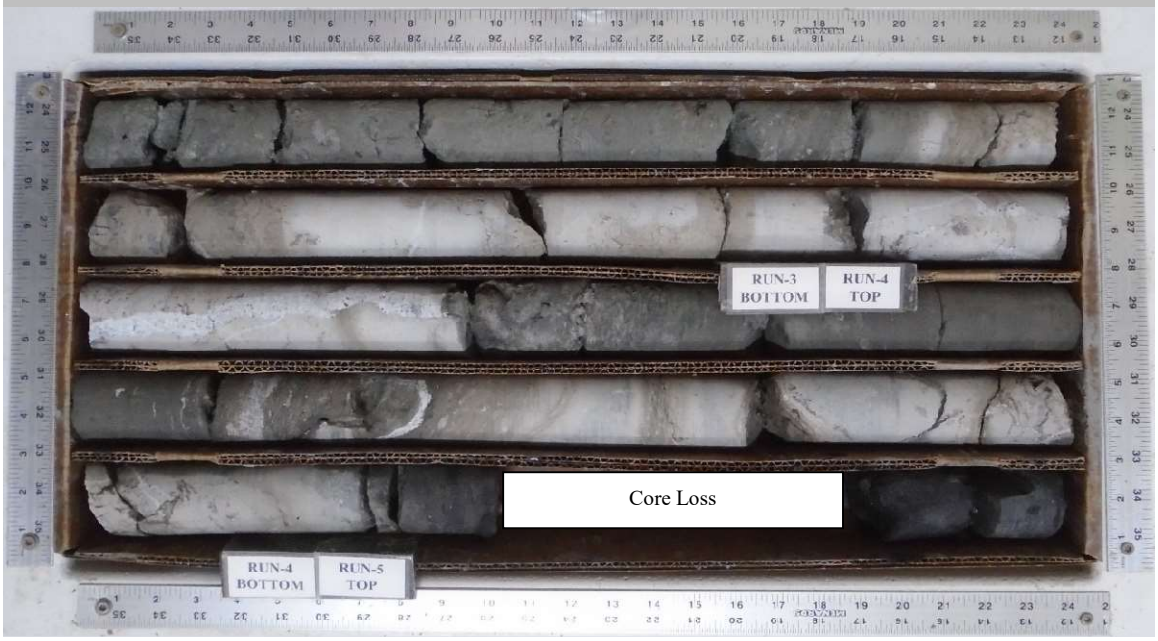
J036741.01 I-70 Improvements Box 1 of 3
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-13

RUN	DEPTH, FT	RECOVERY, %	RQD, %
1	31.5 – 35.0	100	0
2	35.0 – 40.0	100	63
3	40.0 – cont.	100	67

J036741.01 I-70 Improvements Box 2 of 3
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-13

RUN	DEPTH, FT	RECOVERY, %	RQD, %
3	cont. – 45.0	100	67
4	45.0 – 50.0	100	100
5	50.0 – cont.	87	38



BORING B-13

RUN	DEPTH, FT	RECOVERY, %	RQD, %
5	cont. – 55.0	87	38
6	55.0 – 60.0	100	54
7	60.0 – 61.5	100	100

J036741.01 I-70 Improvements Box 1 of 3
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-14

RUN	DEPTH, FT	RECOVERY, %	RQD, %
1	28.0 – 30.5	63	13
2	30.5 – 35.5	58	15
3	35.5 – cont.	80	0

J036741.01 I-70 Improvements Box 2 of 3
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-14

RUN	DEPTH, FT	RECOVERY, %	RQD, %
3	cont. – 40.5	80	0
4	40.5 – 45.5	73	28
5	45.5 – cont.	45	7



BORING B-14

RUN	DEPTH, FT	RECOVERY, %	RQD, %
5	cont. – 50.5	45	7

J036741.01 I-70 Improvements Box 1 of 3
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-15

RUN	DEPTH, FT	RECOVERY, %	RQD, %
1	32.7 – 34.7	100	92
2	34.7 – 39.7	73	53
3	39.7 – cont.	75	55

J036741.01 I-70 Improvements Box 2 of 3
I-70 and US-63 Interchange
Boone County, Missouri



BORING B-15

RUN	DEPTH, FT	RECOVERY, %	RQD, %
3	cont. – 44.7	75	55
4	44.7 – 49.7	100	78
5	49.7 – cont.	100	85

J036741.01 I-70 Improvements Box 3 of 3

I-70 and US-63 Interchange

Boone County, Missouri



BORING B-15

RUN	DEPTH, FT	RECOVERY, %	RQD, %
5	cont. – 54.7	100	85
6	54.7 – 59.7	100	90
7	59.7 – 62.7	100	77

J036741.01 | I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri | Box 1 of 1

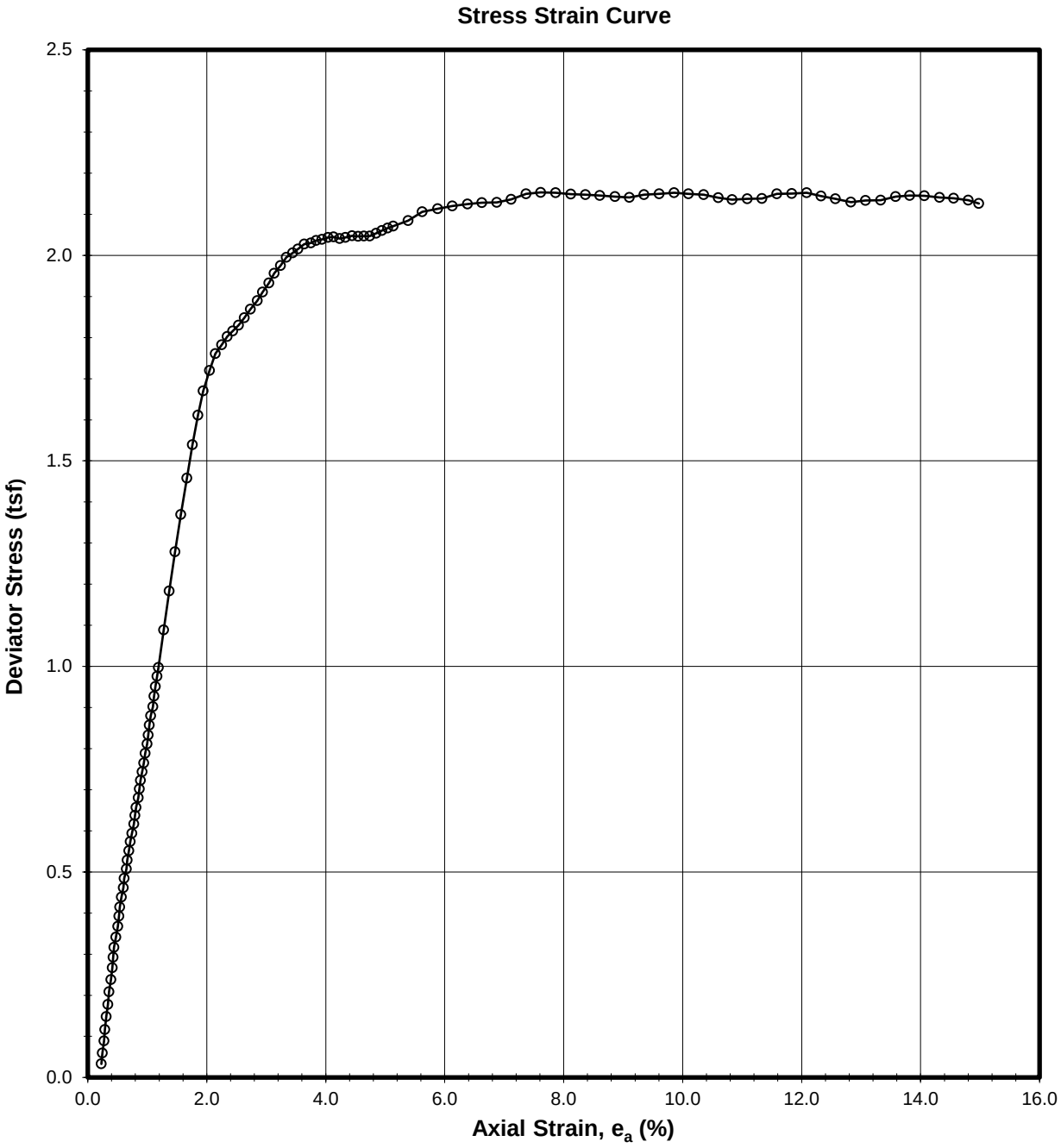


BORING B-16

RUN	DEPTH, FT	RECOVERY, %	RQD, %
1	34.0 – 35.5	100	53
2	35.5 – 36.3	67	0

APPENDIX E

LABORATORY TEST RESULTS



SAMPLE INFORMATION		
Boring: B-7	Sample: ST-2	Depth: 6-8 feet

SAMPLE DATA	
Moisture Content (%):	19.6
Dry Unit Weight (pcf):	107.3

RESULTS	
Undrained Shear Strength (tsf):	1.08
Failure Strain (%):	14.3
Confining Pressure (psi):	3.2

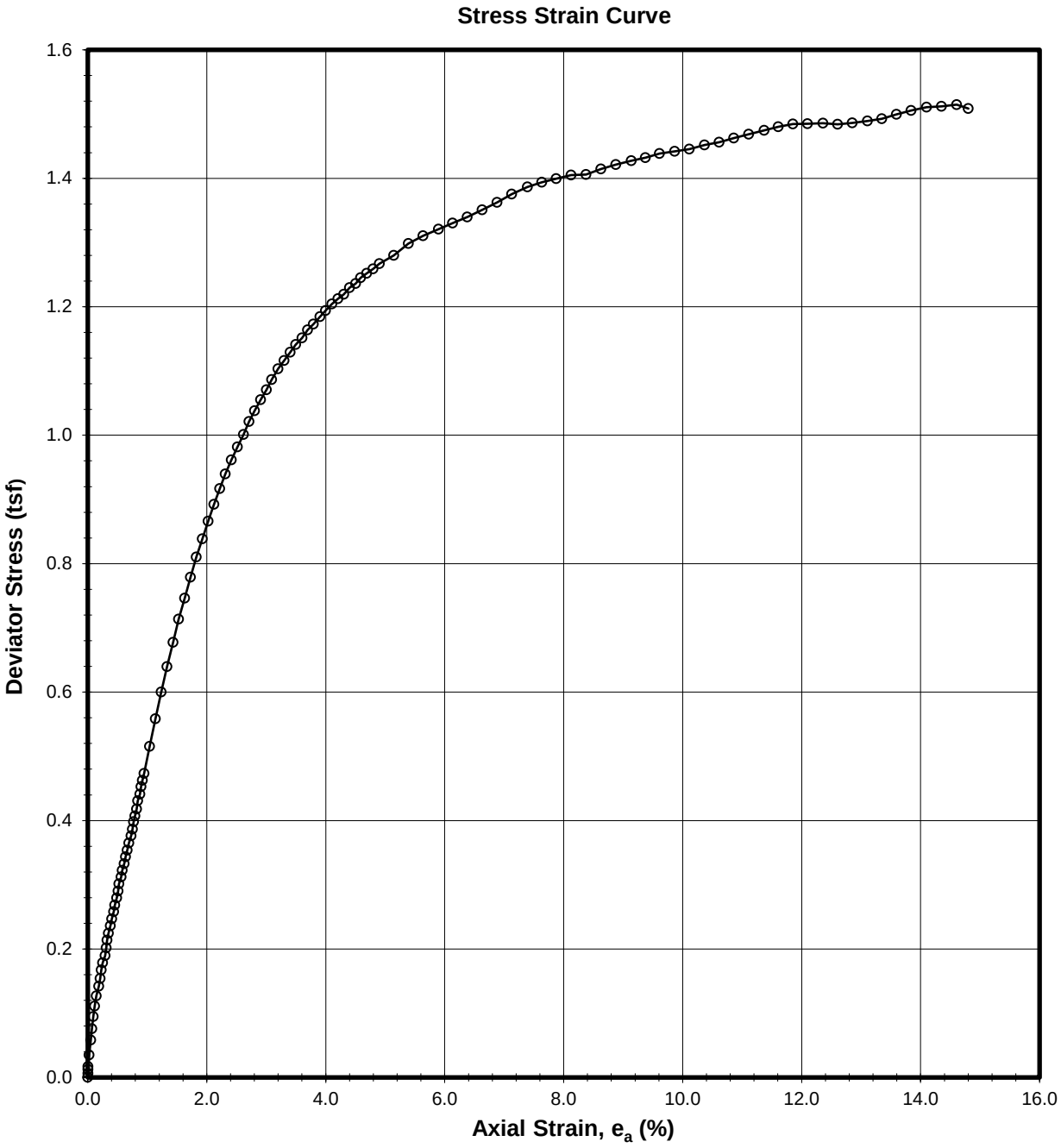
Tested By: AMT	Calc'd By: ADP	Check'd By: EKG
Date: 5/2/2023	Date: 5/25/2023	Date: 5/25/2023

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ASTM D2850

Project Number: J036741.01



SAMPLE INFORMATION

Boring: B-10 Sample: ST-3 Depth: 11-13 feet

SAMPLE DATA

Moisture Content (%):	23.1
Dry Unit Weight (pcf):	100.9

RESULTS

Undrained Shear Strength (tsf):	0.76
Failure Strain (%):	14.3
Confining Pressure (psi):	5.4

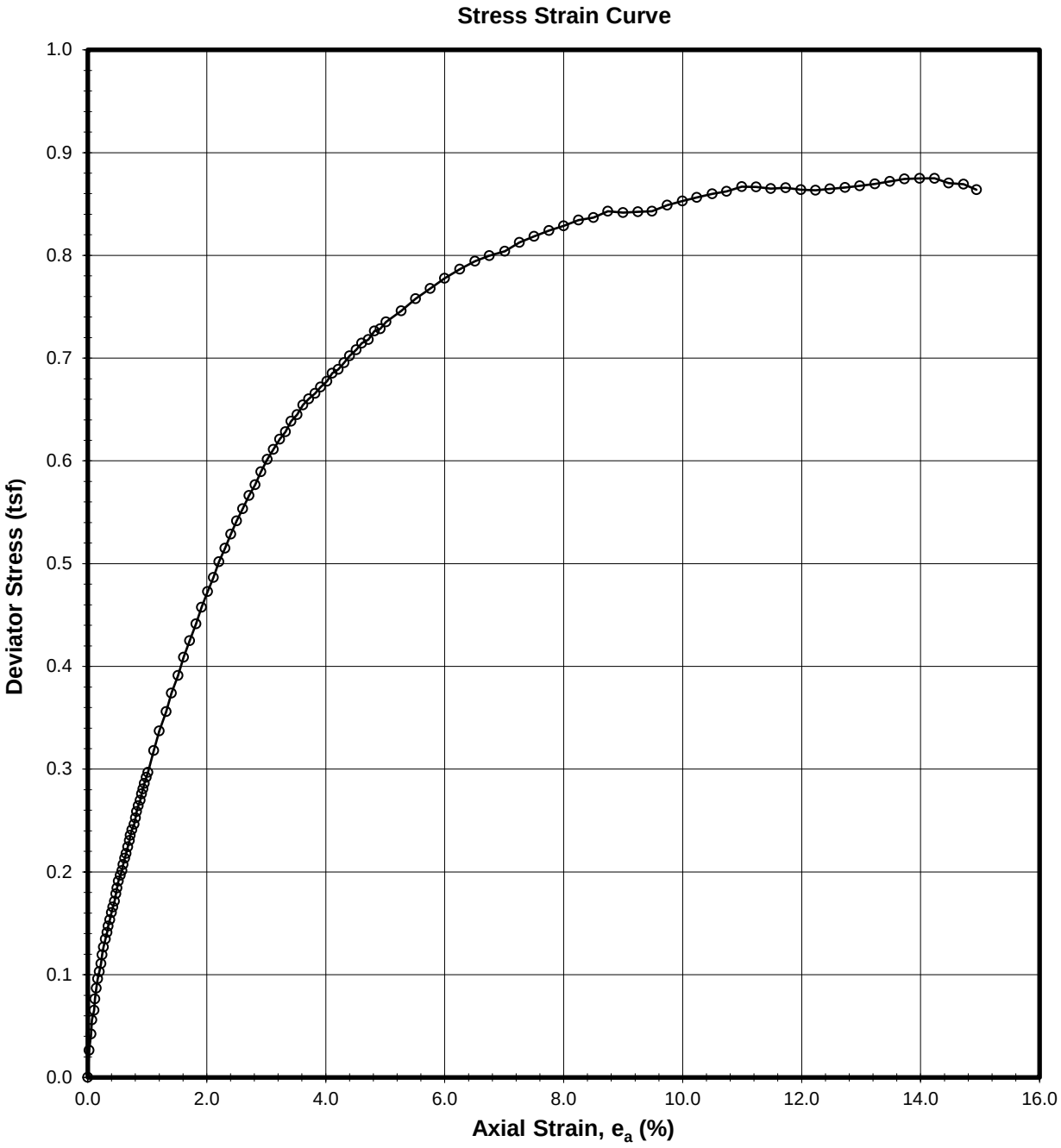
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Date: 5/2/2023	Date: 5/25/2023	Date: 5/25/2023

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ASTM D2850

Project Number: J036741.01



SAMPLE INFORMATION

Boring: B-11 Sample: ST-4 Depth: 16-18 feet

SAMPLE DATA

Moisture Content (%):	22.4
Dry Unit Weight (pcf):	100.3

RESULTS

Undrained Shear Strength (tsf):	0.44
Failure Strain (%):	14.3
Confining Pressure (psi):	7.7

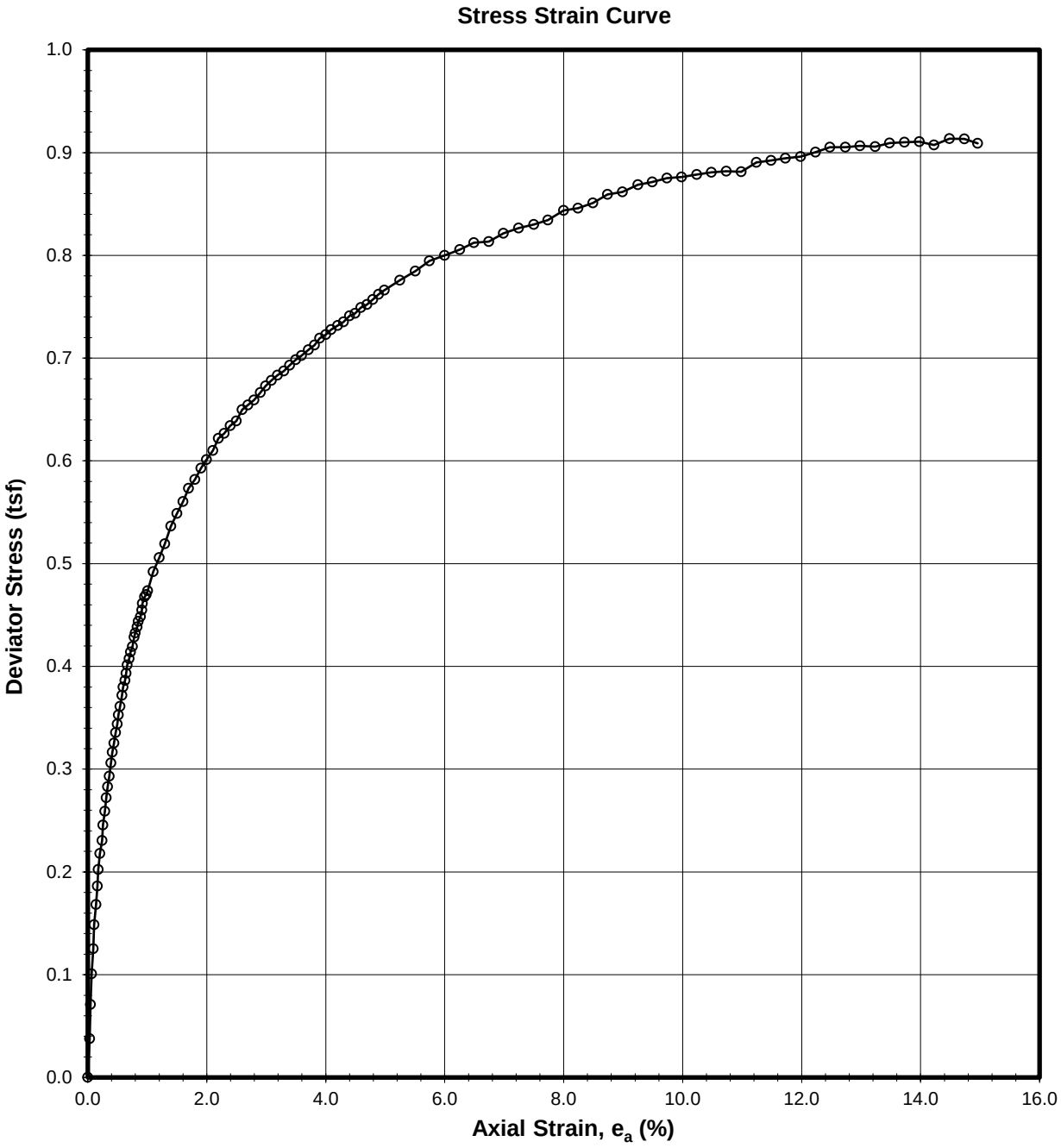
Tested By: AMT	Calc'd By: ADP	Check'd By: EKG
Date: 5/2/2023	Date: 5/25/2023	Date: 5/25/2023

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ASTM D2850

Project Number: J036741.01



SAMPLE INFORMATION

Boring: B-14 Sample: ST-4 Depth: 16-18 feet

SAMPLE DATA

Moisture Content (%):	26.7
Dry Unit Weight (pcf):	96.0

RESULTS

Undrained Shear Strength (tsf):	0.46
Failure Strain (%):	14.2
Confining Pressure (psi):	7.7

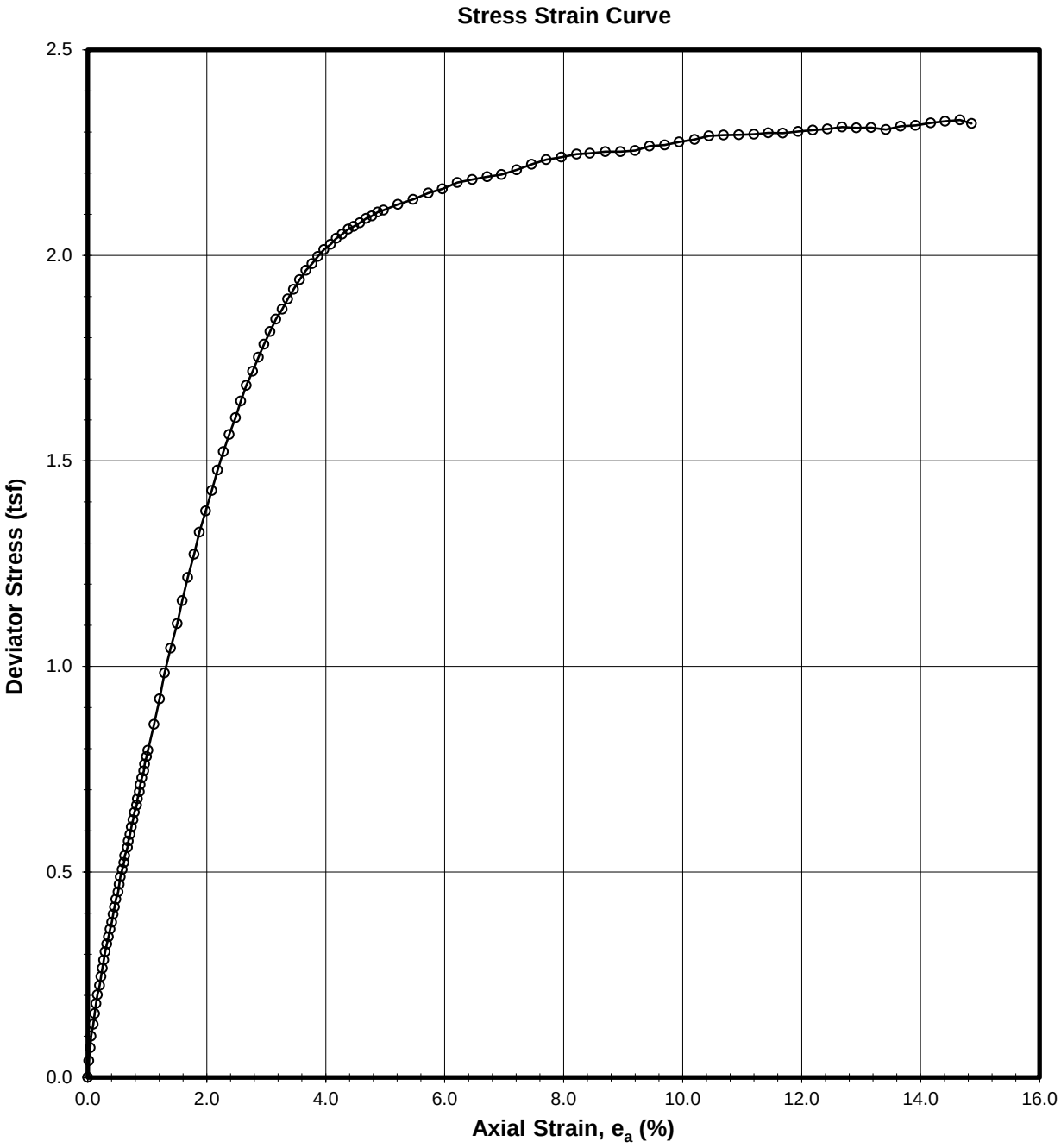
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GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ASTM D2850

Project Number: J036741.01



SAMPLE INFORMATION

Boring: B-15 Sample: ST-3 Depth: 11-13 feet

SAMPLE DATA

Moisture Content (%):	18.9
Dry Unit Weight (pcf):	108.1

RESULTS

Undrained Shear Strength (tsf):	1.16
Failure Strain (%):	14.3
Confining Pressure (psi):	5.4

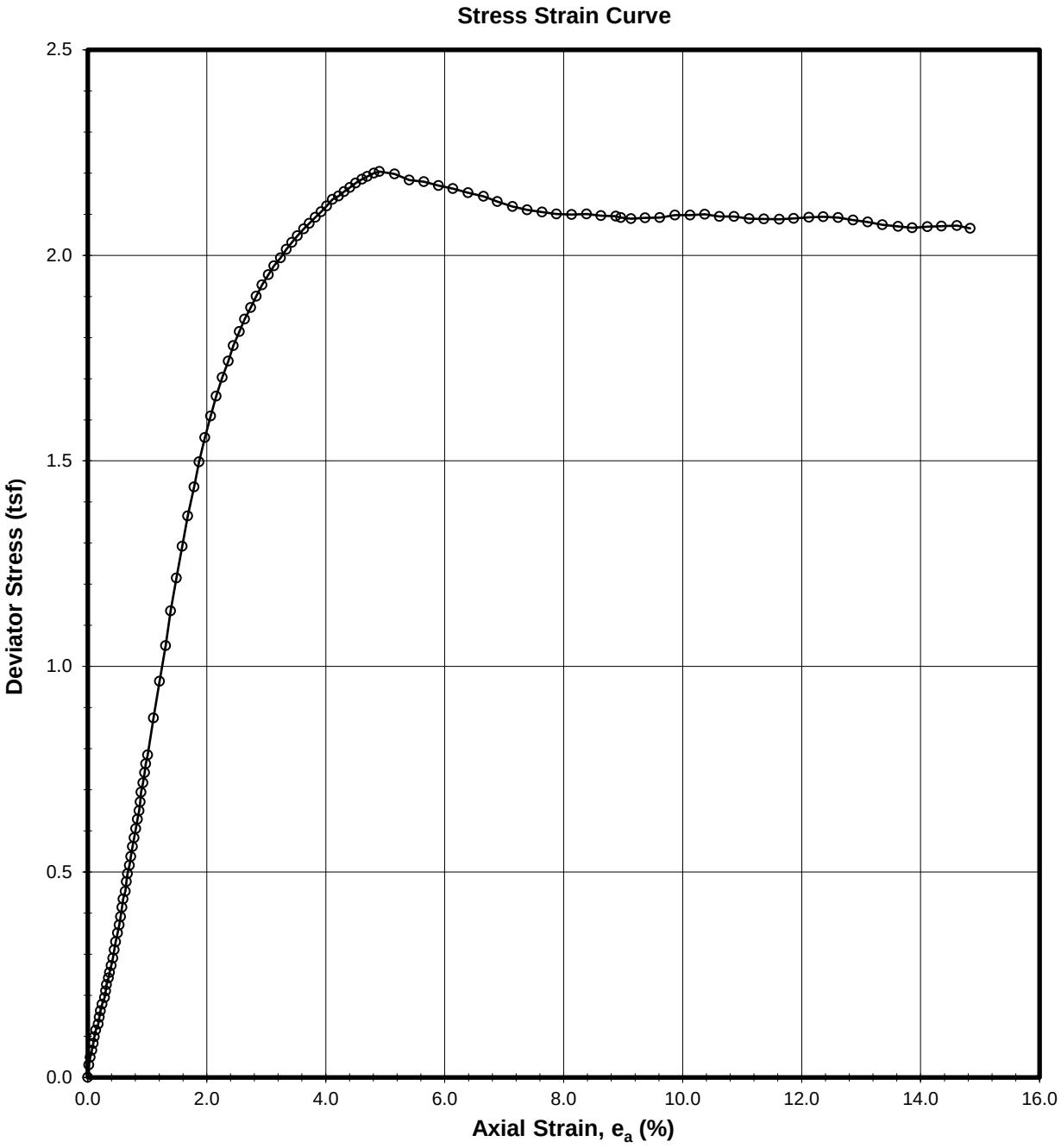
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Date: 5/2/2023	Date: 5/25/2023	Date: 5/25/2023

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ASTM D2850

Project Number: J036741.01



SAMPLE INFORMATION

Boring: B-16 Sample: ST-2 Depth: 6-8 feet

SAMPLE DATA

Moisture Content (%):	21.2
Dry Unit Weight (pcf):	105.6

RESULTS

Undrained Shear Strength (tsf):	1.10
Failure Strain (%):	14.3
Confining Pressure (psi):	3.2

Tested By: AMT	Calc'd By: ADP	Check'd By: EKG
Date: 5/2/2023	Date: 5/25/2023	Date: 5/25/2023

GEOTECHNOLOGY
A Universal Engineering Sciences Company

I-70 Improvements
I-70 and US-63 Interchange
Boone County, Missouri

UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ASTM D2850

Project Number: J036741.01

APPENDIX F

ROCK CORE UNCONFINED COMPRESSIVE STRENGTH TEST RESULTS

GEOTECHNOLOGY
A Universal Engineering Sciences Company

Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens

ASTM D7012

Job Name: I-70 Improvements
Location: I-70 and US-63 Interchange
Job Number: J036741.01
Client: HG Consult, Inc.
Moisture Condition: As Received
Test Temperature: Lab Conditions
Date Tested: 5/18/2023 and 5/23/2023

Boring Location	Depth (ft)	Diameter (in)	Length (in)	Area (in^2)	L/D Ratio	Load (lbs)	Strength (lbs/in^2)	Strength ($kips/ft^2$)	Mass (gm)	Unit Weight (lbs/ft^3)
B-7	16.3	2.03	4.07	3.23	2.00	123	38	5	474.9	137.7
	18.5	1.94	4.22	2.95	2.18	34,996	11,863	1,708	545.0	166.8
	28.5	1.93	4.23	2.92	2.19	38,212	13,086	1,884	512.0	157.9
	32.0	1.93	4.20	2.92	2.18	35,032	11,997	1,728	544.5	169.1
	38.3	1.95	4.18	2.98	2.14	29,554	9,917	1,428	541.8	165.7
	43.0	1.95	4.15	2.98	2.13	34,289	11,506	1,657	542.7	167.2
B-8	21.5	1.96	4.11	3.02	2.10	47,058	15,582	2,244	542.0	166.4
	27.0	1.98	4.01	3.08	2.03	41,607	13,509	1,945	530.6	163.7
	34.0	1.98	4.12	3.08	2.08	54,186	17,593	2,533	566.6	170.1
	39.2	1.98	4.10	3.08	2.07	20,493	6,654	958	525.0	158.4
	44.3	1.98	4.10	3.08	2.07	42,723	13,871	1,997	547.9	165.3
B-9	19.5	1.99	4.17	3.11	2.10	39,956	12,848	1,850	533.6	156.7
	22.7	1.97	4.06	3.05	2.06	44,634	14,634	2,107	548.0	168.6
	27.5	1.99	4.12	3.11	2.07	42,419	13,640	1,964	552.5	164.3
	32.3	1.99	4.05	3.11	2.04	47,193	15,175	2,185	545.9	165.1
	37.5	1.99	4.02	3.11	2.02	37,965	12,207	1,758	541.5	165.0

GEOTECHNOLOGY
A Universal Engineering Sciences Company

Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens

ASTM D7012

Job Name: I-70 Improvements
Location: I-70 and US-63 Interchange
Job Number: J036741.01
Client: HG Consult, Inc.
Moisture Condition: As Received
Test Temperature: Lab Conditions
Date Tested: 5/18/2023 and 5/23/2023

Boring Location	Depth (ft)	Diameter (in)	Length (in)	Area (in^2)	L/D Ratio	Load (lbs)	Strength (lbs/in^2)	Strength ($kips/ft^2$)	Mass (gm)	Unit Weight (lbs/ft^3)
B-10	58.0	1.98	4.26	3.08	2.15	90	29	4	432.9	125.7
B-11	34.5	1.94	4.22	2.95	2.18	13,435	4,554	656	521.1	159.5
B-13	37.7	1.99	4.24	3.11	2.13	25,305	8,137	1,172	556.8	160.9
	43.7	1.99	4.00	3.11	2.01	27,750	8,923	1,285	526.6	161.3
	49.7	1.99	4.23	3.11	2.13	29,559	9,505	1,369	578.3	167.5
	58.0	1.99	4.20	3.11	2.11	29,126	9,365	1,349	572.2	166.9
	60.7	2.02	4.35	3.21	2.15	38	12	2	500.2	136.3
B-14	33.5	1.98	4.09	3.08	2.07	83,844	27,222	3,920	562.8	170.2
B-15	34.2	2.02	4.16	3.20	2.06	77	24	3	484.3	138.6
	41.0	1.97	4.12	3.05	2.09	18,397	6,032	869	534.5	162.0
	51.3	1.98	4.07	3.08	2.05	1,302	423	61	508.0	154.6
	56.5	1.98	4.13	3.08	2.09	85,046	27,612	3,976	557.2	166.9
	61.7	1.98	4.12	3.08	2.08	80,169	26,029	3,748	561.0	168.4
B-16	34.5	1.92	3.95	2.91	2.05	85	29	4	396.4	131.3

APPENDIX G

SHALE POCKET PENETROMETER RESULTS

GEOTECHNOLOGY
A Universal Engineering Sciences Company

Job Name: I-70 Improvements
Location: I-70 and US-63 Interchange
Job Number: J036741.01
Client: HG Consult, Inc.
Moisture Condition: As Received

Boring Location	Depth (ft)	Pocket Penetrometer (tsf)
B-7	14.0	5.0
	17.0	7.5
	17.5	>9.0
	19.5	3.5
	20.5	4.0
	21.5	>9.0
	24.0	7.0
	26.3	2.0
	27.5	>9.0
	28.0	>9.0
	29.5	>9.0
B-8	19.0	>9.0
B-10	56.0	6.0
	59.0	7.0
B-11	29.0	8.0
B-13	18.5	7.0
	23.5	5.5
	28.5	7.0
	35.5	5.0
	39.0	5.0
	39.5	>9.0
	42.5	>9.0
	47.3	>9.0
	54.0	6.0
	55.0	>9.0
	60.0	>9.0
	61.5	9.0

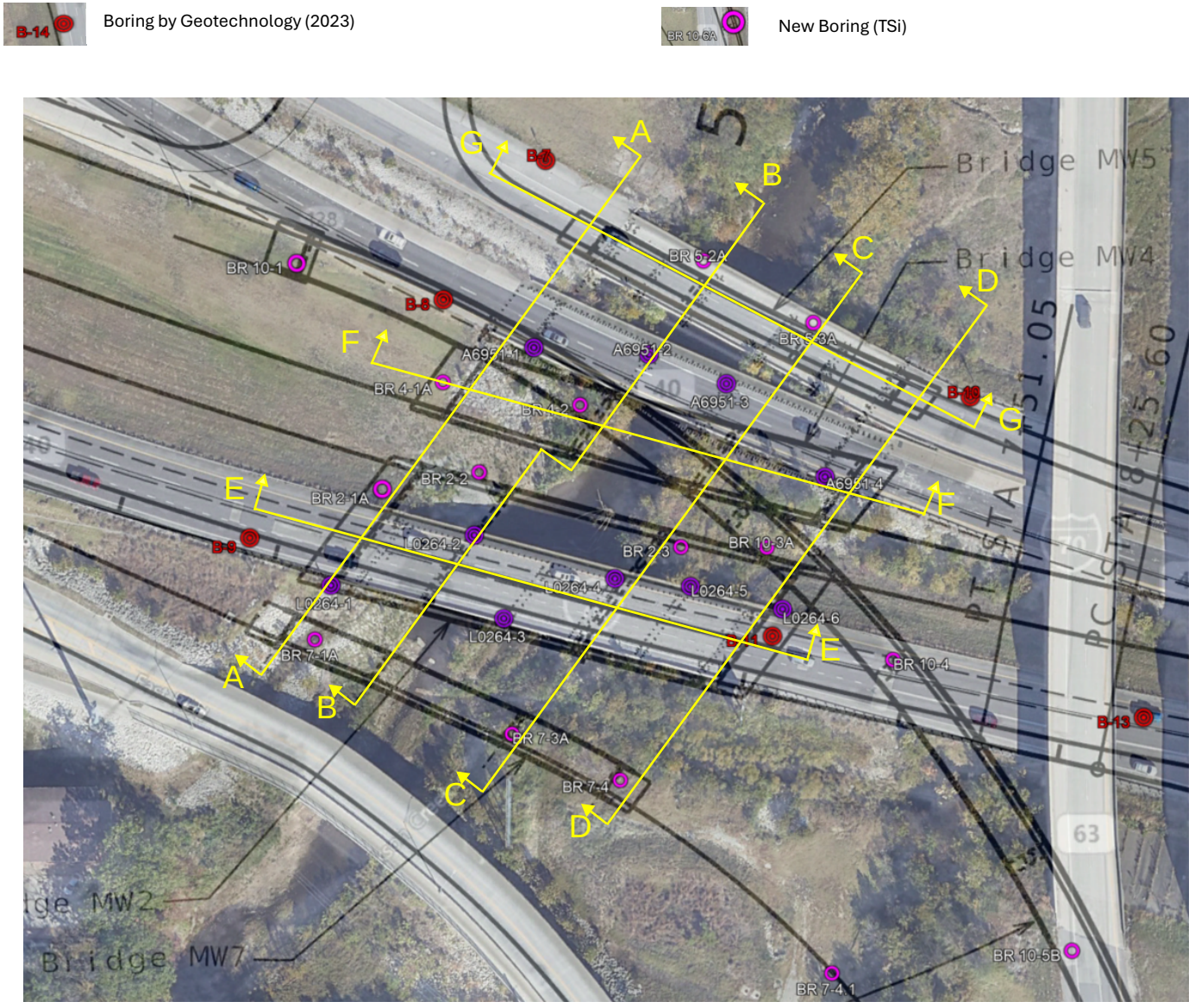
Boring Location	Depth (ft)	Pocket Penetrometer (tsf)
B-14	23.5	3.0
	30.5	4.0
	36.5	9.0
	37.5	>9.0
	38.5	>9.0
	39.5	8.0
	42.0	7.0
	44.5	8.0
	47.5	7.0
	49.5	8.0
B-15	28.5	7.0
	33.0	>9.0
	35.0	>9.0
	42.5	3.0
	43.9	3.0
	45.0	8.0
	48.0	>9.0
	50.0	7.0
	52.0	9.0
	53.5	>9.0
B-16	23.5	>9.0
	28.5	>9.0
	33.5	>9.0
	34.0	3.5
	35.0	<9.0
	36.0	4.0

Appendix D. New Subsurface Investigation Data

D.1 Boring Location Plan at I-70/US-63 Interchange

D.2 Subsurface Soil Profiles at Bridges A9542 and A9543

D.3 Geotechnical Data Report by TSi



Boring Location Plan

SUBSURFACE DIAGRAM

PROJECT NAME I-70 3rd Lane

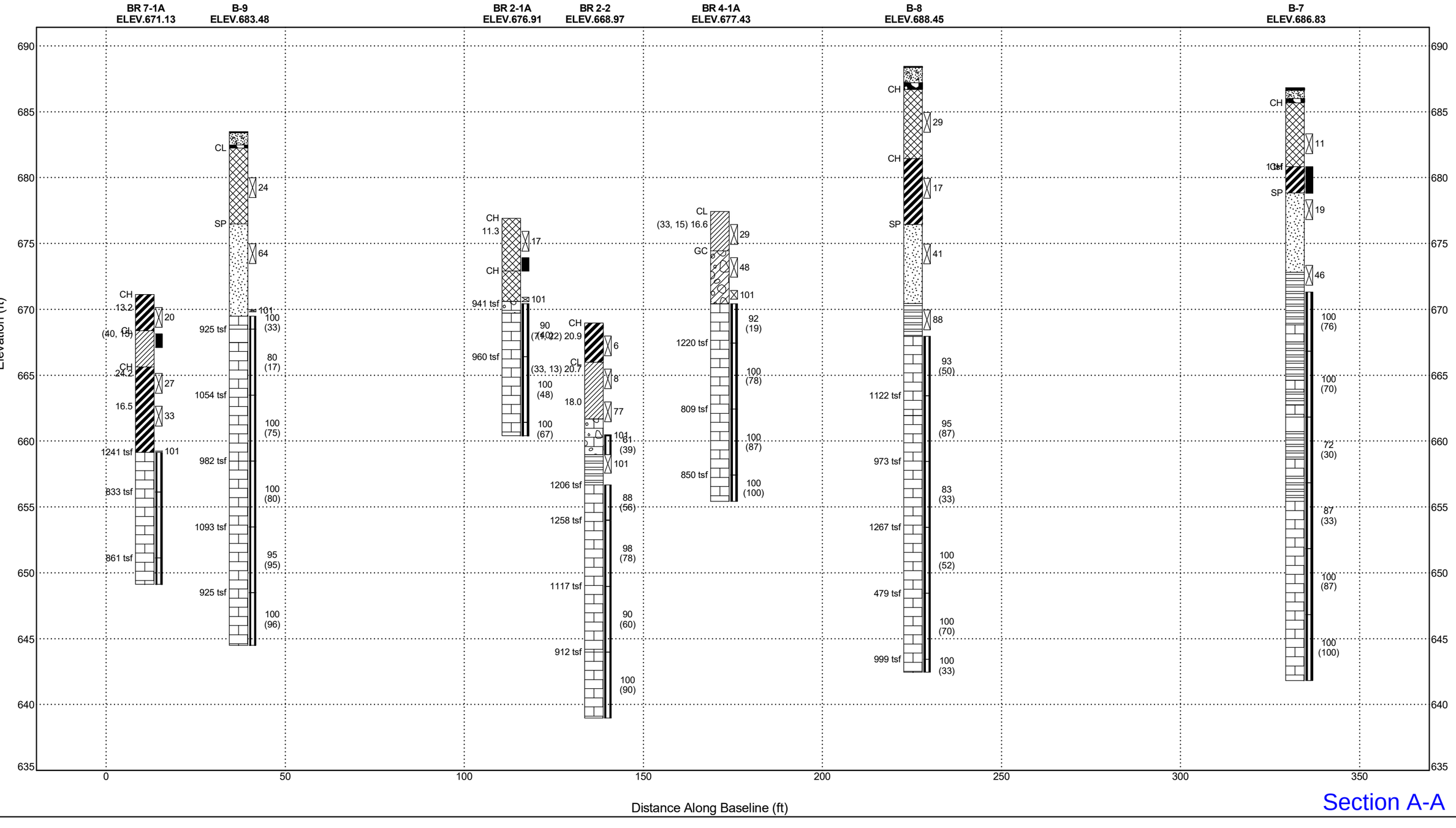
PROJECT LOCATION Columbia, Missouri

Asphalt
Fill (made ground)
Shale
USCS Low Plasticity Clay
Concrete
USCS High Plasticity Clay
Limestone
USCS Clayey Gravel
Boulders and cobbles
USCS Poorly-graded Sand
Highly Weathered Limestone

Sampler Type
Split-Spoon
Shelby Tube
Coring
Continuous
Grab

Key
(LL,PL) MC N_{60}
USCS
UC
REC (RQD)

LL = Liquid Limit
PL = Plastic Limit
MC = In-situ Moisture Content
USCS = Unified Soil Classification System
UC = Unconfined Compression Test
N_{60} = Energy Corrected SPT Blow Count
REC = Recovery (%)
RQD = Rock Quality Designation (%)



MODOT FENCE - JACOBS UPDATE - - 8/20/24 14:59 - G:\TPW\GEOTECH\F3X03000 - I-70 3RD LANE COLUMBIA TO KINGDOM CITY\SITE INVESTIGATION\MODOT I-70 3RD LANE COMBINED EXIST AND NEW BORINGS_NOTCOMPLETE 08142024.GPJ

SUBSURFACE DIAGRAM

PROJECT NAME I-70 3rd Lane

PROJECT LOCATION Columbia, Missouri

- USCS Poorly-graded Sand
- USCS High Plasticity Clay
- USCS Sandy Silt
- No reading
- Highly Weathered Limestone
- USCS Low Plasticity Clay
- Concrete
- USCS Poorly-graded Gravel
- Limestone
- Shale
- Air
- USCS High Plasticity Gravelly Clay

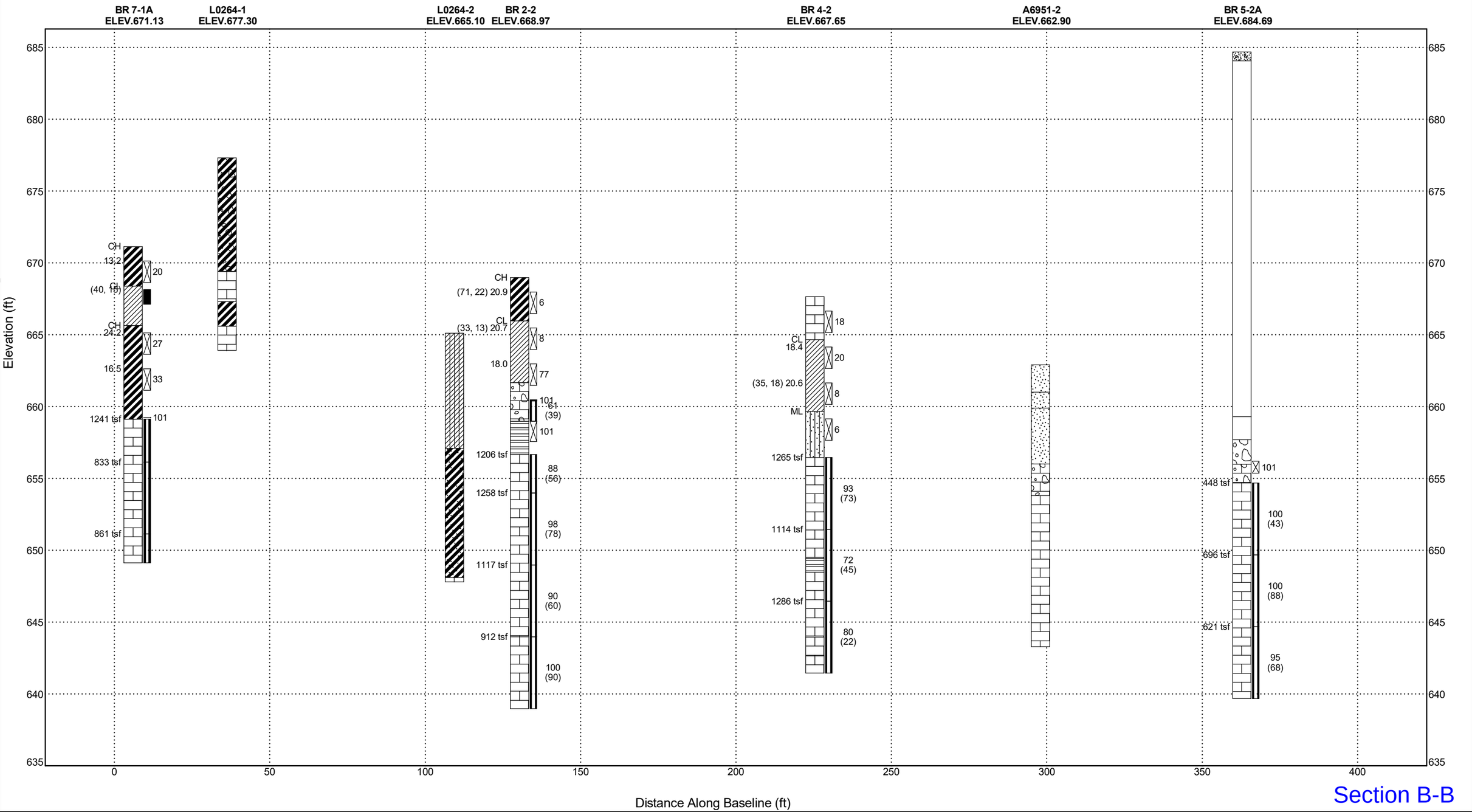
Sampler Type

- Split-Spoon
- Continuous
- Shelby Tube
- Grab
- Coring

Key

(LL,PL) MC — N_{60} — USCS — REC (RQD) — UC

- **LL** = Liquid Limit
- **PL** = Plastic Limit
- **MC** = In-situ Moisture Content
- **USCS** = Unified Soil Classification System
- **UC** = Unconfined Compression Test
- **N_{60}** = Energy Corrected SPT Blow Count
- **REC** = Recovery (%)
- **RQD** = Rock Quality Designation (%)



Section B-B

MODOT FENCE - JACOBS UPDATE - - 8/20/24 14:07 - G:\TPW\GEOTECH\F3X03000 - I-70 3RD LANE COLUMBIA TO KINGDOM CITY\SITE INVESTIGATION\MODOT I-70 3RD LANE COMBINED EXIST AND NEW BORINGS_NOTCOMPLETE 08142024.GPJ

SUBSURFACE DIAGRAM

PROJECT NAME I-70 3rd Lane

PROJECT LOCATION Columbia, Missouri

- USCS Poorly-graded Sand
- Limestone
- USCS Clayey Gravel
- Concrete
- USCS High Plasticity Sandy Clay
- USCS Low Plasticity Clay
- Shale
- Air
- Boulders and cobbles
- USCS Low Plasticity Sandy Clay
- Highly Weathered Limestone
- USCS Poorly-graded Gravel

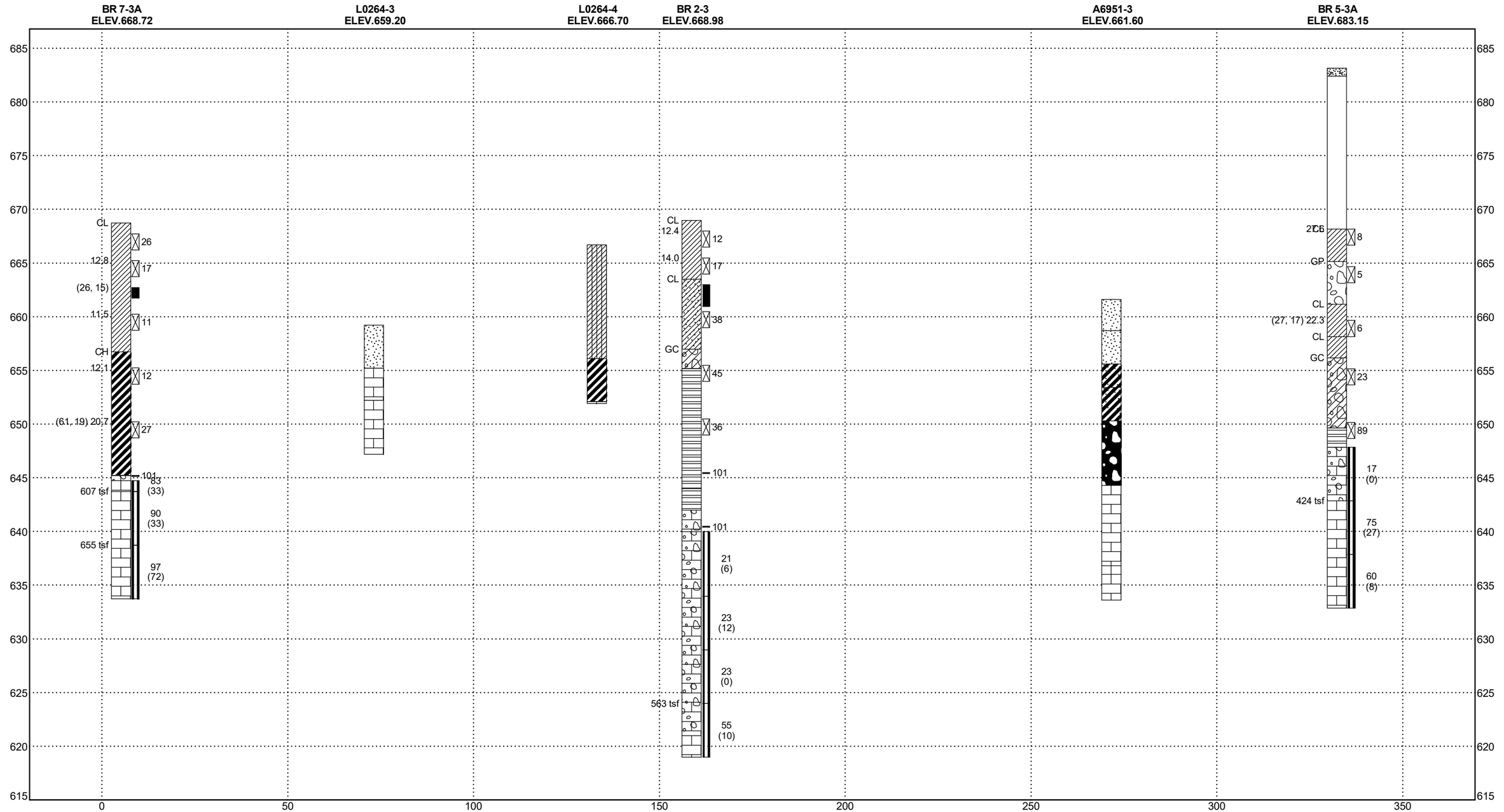
Sampler Type

- Split-Spoon
- Shelby Tube
- Coring
- Continuous
- Grab

Key

(LL,PL) MC N_{60} | USCS | UC | REC (RQD)

- **LL** = Liquid Limit
- **PL** = Plastic Limit
- **MC** = In-situ Moisture Content
- **USCS** = Unified Soil Classification System
- **UC** = Unconfined Compression Test
- **N_{60}** = Energy Corrected SPT Blow Count
- **REC** = Recovery (%)
- **RQD** = Rock Quality Designation (%)



Section C-C

MODOT FENCE - JACOBS UPDATE - - 8/20/24 15:30 - G:\TPW\GEOTECH\F3X03000 - I-70 3RD LANE COLUMBIA TO KINGDOM CITY\SITE INVESTIGATION\MODOT I-70 3RD LANE COMBINED EXIST AND NEW BORINGS_NOTCOMPLETE 08142024.GPJ

SUBSURFACE DIAGRAM

PROJECT NAME I-70 3rd Lane

PROJECT LOCATION Columbia, Missouri

- USCS Low Plasticity Clay
- Asphalt
- Fill (made ground)
- USCS Clayey Sand
- Shale
- Concrete
- USCS High Plasticity Clay
- Highly Weathered Limestone
- Limestone
- Boulders and cobbles
- USCS Sandy Silt
- Coal

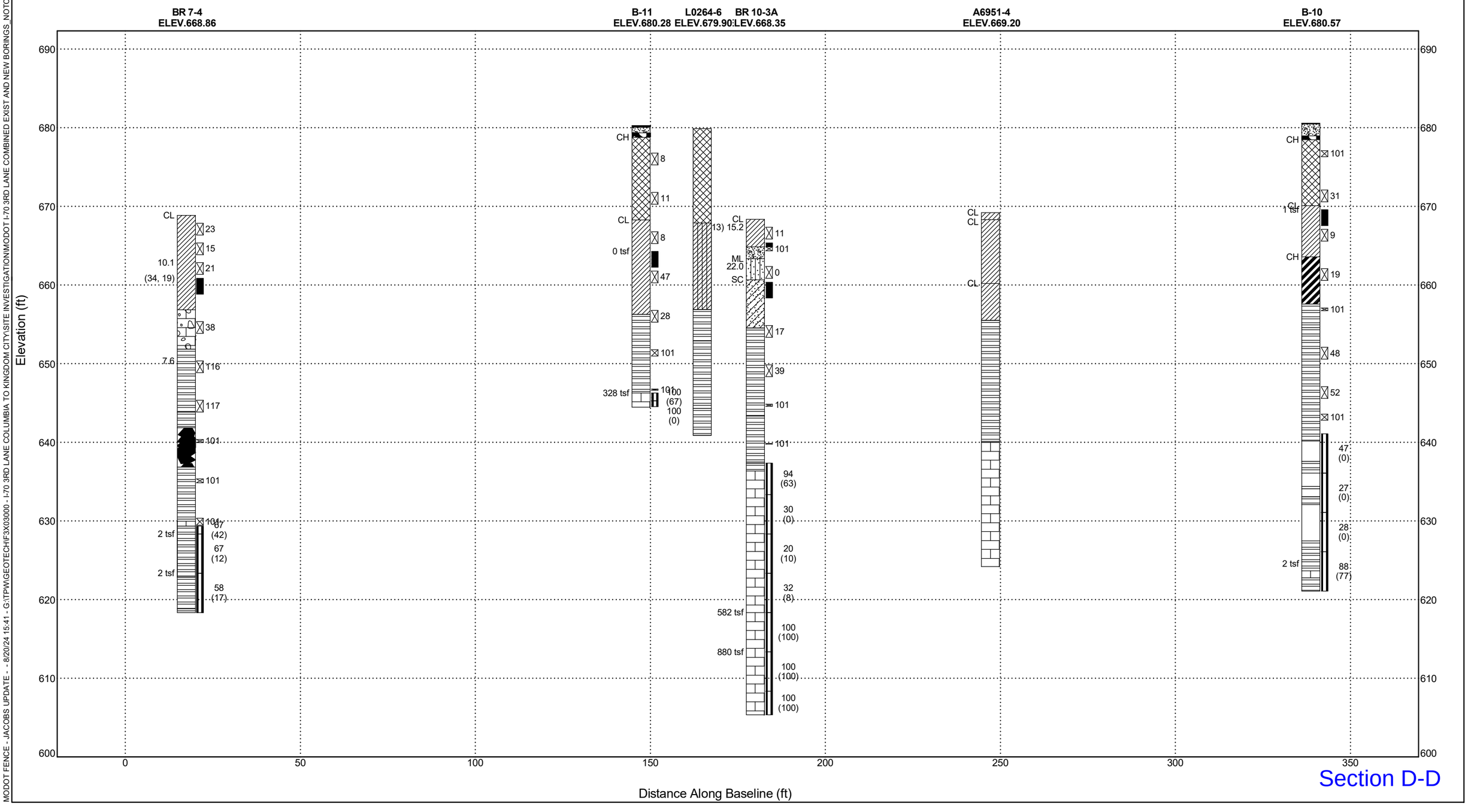
Sampler Type

- Split-Spoon
- Shelby Tube
- Coring
- Continuous
- Grab

Key

(LL,PL) MC | N_{60} | USCS | REC (RQD) | UC

- **LL** = Liquid Limit
- **PL** = Plastic Limit
- **MC** = In-situ Moisture Content
- **USCS** = Unified Soil Classification System
- **UC** = Unconfined Compression Test
- **N_{60}** = Energy Corrected SPT Blow Count
- **REC** = Recovery (%)
- **RQD** = Rock Quality Designation (%)



Section D-D

MODOT FENCE - JACOBS UPDATE - - 8/20/24 15:41 - G:\TPW\GEOTECH\F3X03000 - I-70 3RD LANE COLUMBIA TO KINGDOM CITY\SITE INVESTIGATION\MODOT I-70 3RD LANE COMBINED EXIST AND NEW BORINGS_NOTCOMPLETE 08142024.GPJ

SUBSURFACE DIAGRAM

PROJECT NAME I-70 3rd Lane

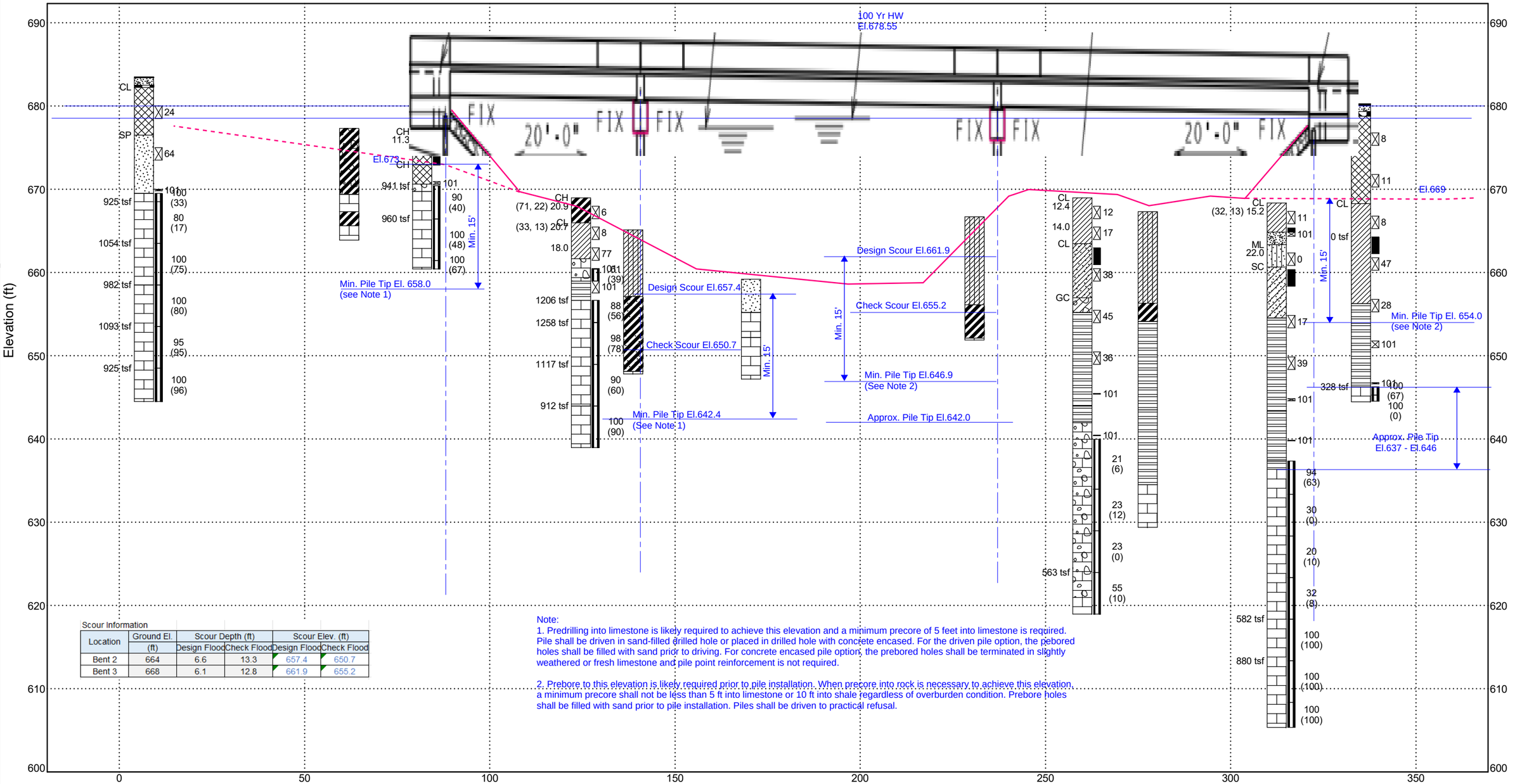
PROJECT LOCATION Columbia, Missouri

Asphalt
Concrete
Boulders and cobbles
Fill (made ground)
USCS Low Plasticity Clay
Shale
Limestone
USCS Poorly-graded Sand
USCS Sandy Silt
USCS Clayey Sand
Highly Weathered Limestone
USCS High Plasticity Clay

Sampler Type
Split-Spoon
Continuous
Shelby Tube
Grab
Coring

Key
(LL,PL) MC N_{60}
USCS
UC
REC (RQD)

LL = Liquid Limit
PL = Plastic Limit
MC = In-situ Moisture Content
USCS = Unified Soil Classification System
UC = Unconfined Compression Test
N_{60} = Energy Corrected SPT Blow Count
REC = Recovery (%)
RQD = Rock Quality Designation (%)



Scour Information

Location	Ground El. (ft)	Scour Depth (ft)		Scour Elev. (ft)	
		Design Flood	Check Flood	Design Flood	Check Flood
Bent 2	664	6.6	13.3	657.4	650.7
Bent 3	668	6.1	12.8	661.9	655.2

Note:
1. Predrilling into limestone is likely required to achieve this elevation and a minimum precore of 5 feet into limestone is required. Pile shall be driven in sand-filled drilled hole or placed in drilled hole with concrete encased. For the driven pile option, the prebored holes shall be filled with sand prior to driving. For concrete encased pile option, the prebored holes shall be terminated in slightly weathered or fresh limestone and pile point reinforcement is not required.

2. Prebore to this elevation is likely required prior to pile installation. When precore into rock is necessary to achieve this elevation, a minimum precore shall not be less than 5 ft into limestone or 10 ft into shale regardless of overburden condition. Prebore holes shall be filled with sand prior to pile installation. Piles shall be driven to practical refusal.

Section E-E

MODOT FENCE - JACOBS UPDATE - - 8/20/24 15:53 - G:\TPW\GEOTECH\F3X03000 - I-70 3RD LANE COLUMBIA TO KINGDOM CITY\SITE INVESTIGATION\MODOT I-70 3RD LANE COMBINED EXIST AND NEW BORINGS_NOTCOMPLETE 08142024.GPJ

SUBSURFACE DIAGRAM

PROJECT NAME I-70 3rd Lane

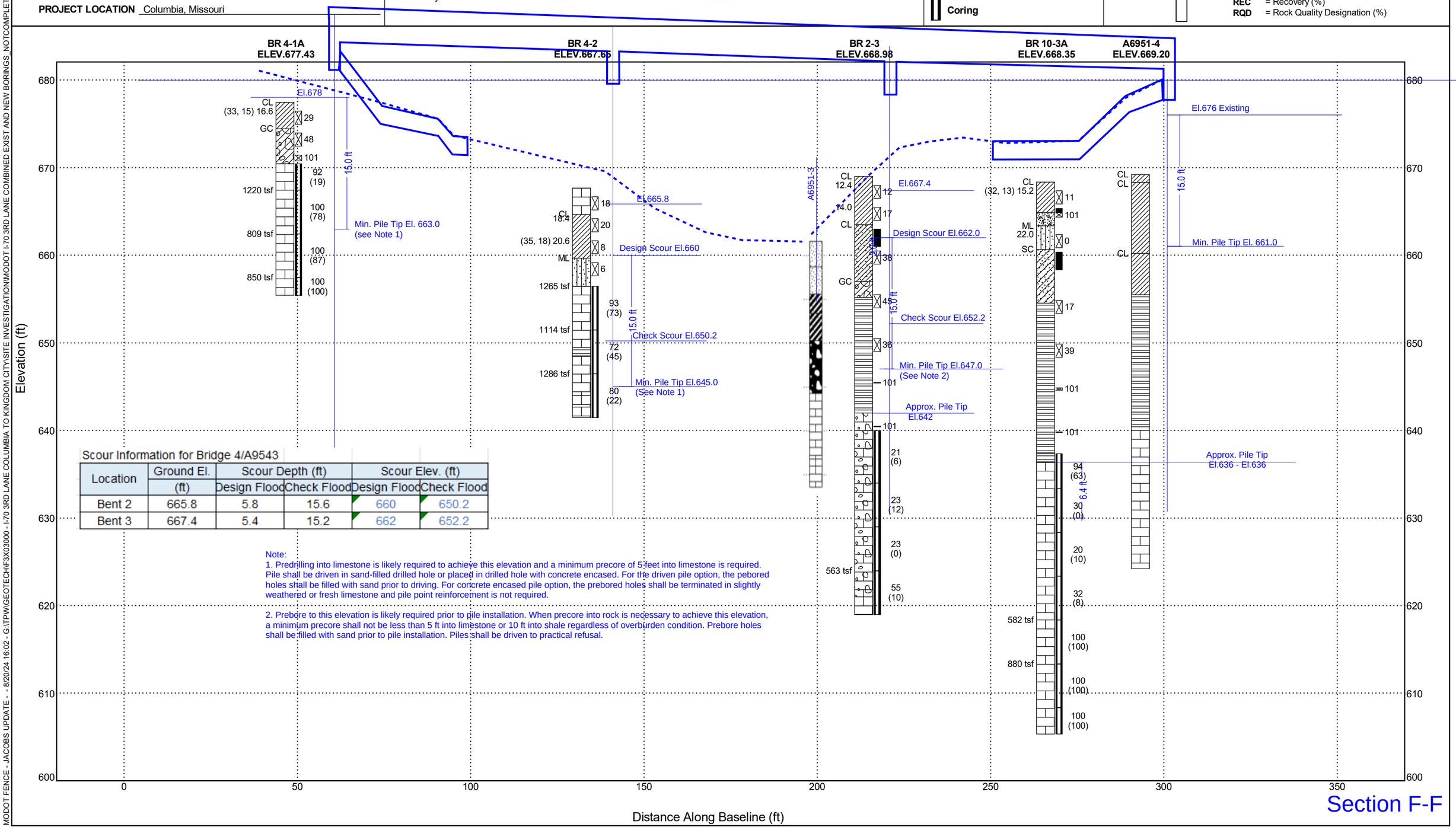
PROJECT LOCATION Columbia, Missouri

USCS Low Plasticity Clay
Concrete
USCS Low Plasticity Sandy Clay
Shale
USCS Sandy Silt
USCS Clayey Gravel
Limestone
USCS Clayey Sand
Highly Weathered Limestone

Sampler Type
Split-Spoon
Shelby Tube
Coring
Continuous
Grab

Key
(LL,PL) MC
USCS
UC
N_{60}
REC (RQD)

LL = Liquid Limit
PL = Plastic Limit
MC = In-situ Moisture Content
USCS = Unified Soil Classification System
UC = Unconfined Compression Test
N_{60} = Energy Corrected SPT Blow Count
REC = Recovery (%)
RQD = Rock Quality Designation (%)



Scour Information for Bridge 4/A9543

Location	Ground El. (ft)	Scour Depth (ft)		Scour Elev. (ft)	
		Design Flood	Check Flood	Design Flood	Check Flood
Bent 2	665.8	5.8	15.6	660	650.2
Bent 3	667.4	5.4	15.2	662	652.2

Note:
1. Predrilling into limestone is likely required to achieve this elevation and a minimum precore of 5 feet into limestone is required. Pile shall be driven in sand-filled drilled hole or placed in drilled hole with concrete encased. For the driven pile option, the pebored holes shall be filled with sand prior to driving. For concrete encased pile option, the prebored holes shall be terminated in slightly weathered or fresh limestone and pile point reinforcement is not required.

2. Prebore to this elevation is likely required prior to pile installation. When precore into rock is necessary to achieve this elevation, a minimum precore shall not be less than 5 ft into limestone or 10 ft into shale regardless of overburden condition. Prebore holes shall be filled with sand prior to pile installation. Piles shall be driven to practical refusal.

Section F-F

MODOT FENCE - JACOBS UPDATE - - 8/20/24 16:02 - G:\TPW\GEOTECH\F3X03000 - I-70 3RD LANE COLUMBIA TO KINGDOM CITY\SITE INVESTIGATION\MODOT I-70 3RD LANE COMBINED EXIST AND NEW BORINGS_NOTCOMPLETE 08142024.GPJ

GEOTECHNICAL DATA REPORT

I-70 3RD LANE PROJECT
COLUMBIA TO KINGDOM CITY, MISSOURI
TSI PROJECT NO. 20241040.00

JACOBS ENGINEERING GROUP, INC.
1001 Highlands Plaza Drive – Suite 400
St. Louis, Missouri 63110

TSi geotechnical, inc.

1340 North Price Road
St. Louis, Missouri 63132

October 22, 2024

October 22, 2024

Mr. Shane Rasch, PE
JACOBS ENGINEERING GROUP, INC.
1001 Highlands Plaza Drive – Suite 400
St. Louis, Missouri 63110

Re: Geotechnical Data Report
I-70 3rd Lane Project
Columbia to Kingdom City, Missouri
TSi Project No. 20241040.00

Dear Mr. Rasch:

TSi Geotechnical, Inc. (TSi) has completed the authorized Subsurface Exploration and Geotechnical Data Report for the I-70 3rd Lane Project and is pleased to submit this report of our findings to Jacobs Engineering Group, Inc. (Jacobs). The purpose of our work was to perform a geotechnical exploration of subsurface conditions at the project site, and to provide boring logs and requested laboratory results for the project.

We appreciate the opportunity to assist you with this project. If you have any questions or if we may be of further service to you, please call us.

Respectfully submitted,
TSI GEOTECHNICAL, INC.

Fred H. Held III
Project Manager

Andrew Declue, PE
Director of Operations

STATE OF MISSOURI
ANDREW DECLUE
10-22-24
NUMBER PE-2022001621
PROFESSIONAL ENGINEER

Denise B. Hervey, PE
Principal

CONTENTS

1.0 SCOPE OF WORK 1

2.0 SITE AND PROJECT DESCRIPTIONS 1

3.0 FIELD EXPLORATION AND LABORATORY TESTING 2
3.1 Field Exploration 2
3.2 Laboratory Testing 3

4.0 SUBSURFACE CONDITIONS 4
4.1 General Geology 4
4.2 Generalized Subsurface Profile 4
4.3 Groundwater 5

5.0 REPORT LIMITATIONS 6

Appendix A – Site Vicinity Maps, Figure 1.1 and 1.2
Site and Boring Location Plans, Figure 2.1 through 2.7

Appendix B – Logs of Boring
General Notes

Appendix C – Laboratory Test Results
UC, UU-Triaxial, and Atterberg Limits

Appendix D – Consolidation Test Results

Appendix E – Rock Core Photos and Compressive Strength Tests

Appendix F – Corrosivity Test Results

GEOTECHNICAL DATA REPORT
I-70 3RD LANE PROJECT
COLUMBIA TO KINGDOM CITY, MISSOURI

1.0 SCOPE OF WORK

This report summarizes the results of a subsurface exploration and laboratory testing performed for the I-70 3rd Lane Project for Jacobs. The study was performed in general accordance with the TSi proposal dated March 19, 2024, and Limited Notice to Proceed signed April 4, 2024.

Based on TSi's understanding of the project, the following items have been identified for inclusion in this report:

- Subsurface conditions, including material types present at the boring locations;
- Groundwater conditions during drilling;
- Field and requested laboratory test results for materials encountered in the borings; and
- Boring location plans and boring logs.

2.0 SITE AND PROJECT DESCRIPTIONS

The following understanding of the project is based on information received from Jacobs. The proposed project includes the addition of a third lane between US 63 interchange in Columbia Missouri and US 54 interchange in Kingdom City. In addition to the new lanes in each direction, new bridges and retaining walls will be required. The general project areas where the borings were drilled are shown on the Vicinity Maps, Figures 1.1 and 1.2, in Appendix A.

3.0 Field Exploration and Laboratory Testing

3.1 Field Exploration

From April 11 to June 10, 2024, TSi conducted a subsurface exploration within the project site consisting of thirty-eight (38) test borings, designated as Bridge Borings BR 2, 4, 5, 7, 10, 12, 13, 14, 16, 17, 36, and 37 with multiple borings at each bridge, and Ramp Borings 5-1A, 5-2A, and C-D-1. The boring locations were selected by Jacobs and marked in the field by TSi using the provided coordinates. Some borings were offset as required to avoid existing utilities. Ground surface elevations and coordinates were surveyed and provided to TSi by Jacobs. These elevations and coordinates are shown on the boring logs. The approximate location of the borings are shown on the Site and Boring Location Plans, Figure 2.1 through 2.7, in Appendix A.

The borings were drilled with a CME-550 using hollow stem auger (HSA) drilling methods. Split-spoon and Shelby tube samples were recovered from each boring. Split-spoon samples were recovered using a 2-inch outside-diameter, split-barrel sampler, driven by an automatic hammer, in accordance with ASTM D 1586. Shelby tube samples were obtained in general accordance with ASTM D 1587. The split-spoon samples were placed in plastic bags for later testing in the laboratory. Shelby tube samples were preserved by sealing the entire sample in the tube. Hand penetrometer readings were taken in the field to correlate soil undrained shear strengths and give an index of the soils stiffness. The sampling sequence for each boring is summarized on the Logs of Boring in Appendix B.

Many of the borings were extending into bedrock using N-series, diamond bit rock coring methods based on the requested boring depths. The core samples recovered were measured in the field for percent recovery and rock quality designation (RQD) value. Each core sample was placed in a box for transportation to the laboratory.

The results of the geotechnical field tests and measurements were recorded on the field logs and appropriate data sheets. Those data sheets and logs contain information concerning the exploration methods, samples attempted and recovered, indications of the presence of various subsurface materials, and the observation of groundwater. The field logs and data sheets contain the geotechnical specialist's interpretations of the conditions between samples, based on the performance of the exploration equipment and the cuttings brought to the surface by the drilling tools.

3.2 LABORATORY TESTING

A laboratory testing program was conducted by TSi as requested by Jacobs to determine selected engineering properties of the obtained soil and rock samples. Some of the requested testing was not performed due to disturbed samples such as crushed Shelby tubes for soil and broken rock cores. The following laboratory tests were performed on the samples in general accordance with the applicable ASTM standards:

- Visual descriptions by color and texture;
- Natural moisture content;
- Hand penetrometer test;
- Atterberg limits;
- Dry unit weight;
- Unconfined compressive strength of selected soil and rock samples;
- Unconsolidated-undrained triaxial test;
- #200 wash sieve;
- Hydrometer test;
- Consolidation test; and
- Corrosivity suite of tests.

Data and observations from laboratory tests were recorded on laboratory data sheets during the course of the testing program. The results of the tests are summarized on the Logs of Boring in Appendix B and shown in Appendix C. Consolidation test results are shown in Appendix D. Rock core photographs and strength test results are shown in Appendix E. Corrosivity test results are shown in Appendix F. The boring logs are an interpretation of the subsurface conditions based on the field and laboratory data. Only data pertinent to the objectives of this report have been included on the logs; therefore, these logs should not be used for other purposes.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions encountered at the boring locations are shown on the Logs of Boring in Appendix B. Rock core photographs are included in Appendix E of this report. The general subsurface conditions encountered and their pertinent engineering characteristics are described in the following paragraphs. Conditions represented by the borings should be considered applicable only at those locations on the dates shown; the reported conditions may be different at other locations or at other times.

4.1 GENERAL GEOLOGY

Based on the United States Geological Survey (USGS) and Missouri Department of Natural Resources (GeoSTRAT) database, the site lies in the geological formations that include Burlington-Keokuk Limestone of the Mississippian Subsystem, and the Cabaniss and Krebs Subgroups of the Cherokee Group of the Pennsylvanian Subsystem in Columbia, Missouri. The underlying Burlington-Keokuk Limestone is generally crystalline limestone with zones of chert and cherty limestone and ranges from about 75 to 100 feet thick in Central Missouri. The overlying Cherokee Group generally consists of sandstone, siltstone, shale, underclay, limestone, and coal beds. The thickness of the Cabaniss and Krebs Subgroups vary and can be over 100 feet thick in Central Missouri. The native surface soil deposits near Columbia consist of windblown loessial soils overlying residual soils that have been formed by weathering of the underlying bedrock. These soils are generally relatively shallow near a depth of about 25 feet or less. The loess typically consists of silts and lean clays, whereas the residual soils are usually composed of lean and fat clays, frequently with remnant particles of weathered bedrock.

The geologic formation of the Fort Scott Subgroup of Marmaton Group of the Pennsylvanian Subsystem is in Kingdom City Missouri. This subgroup is the lower part of the Marmaton Group that is underlain by the Cherokee Group and generally consists of limestone, shale, sandstone, and a thin coal bed. The soils near Kingdom City include glacial tills to depths of about 75 to 100 feet. These generally consist of lean and fat clays with various quantities of sand and gravel. Some till layers may be predominantly sand or gravel with silt and clay as secondary constituents.

4.2 GENERALIZED SUBSURFACE PROFILE

The surface material across the site generally consists of pavement materials and gravel base rock in the roadways. Fill materials were encountered in some of the borings consisting of primarily of lean clays, fat clays, clayey gravels, or poorly graded gravels (CL, CH, GC and GP, respectively, in accordance with the Unified Soil Classification System), with secondary materials such as sand, gravel, silt, and clay. The fill materials extend to depths of approximately 5 to 12 feet below the existing ground surface in isolated areas.

Below the fill materials, native lean clay and fat clay (CL and CH) materials were encountered, with variable amounts of secondary materials such as sand, gravel, and rock fragments. Highly weathered shale and limestone bedrock layers were drilled through prior to encountering auger refusal. Shale

and limestone bedrock of varying degrees of weathering with some coal layers were generally encountered in the rock cores performed.

4.3 GROUNDWATER

Groundwater was generally encountered in the borings during drilling and prior to backfill at depths of about 3 to 48.5 feet in 27 of the 38 borings drilled for this project. Some delayed groundwater readings encountered water at depths ranging from 0.5 to 22 feet. Groundwater was not encountered in 11 of these 38 borings during drilling prior to performing rock coring procedures. After the introduction of water into the borings during rock coring, groundwater readings are not reliable. The presence or absence of groundwater at a particular location does not necessarily mean that groundwater will be present or absent at that location at other times. Seasonal variations and other unknown considerations could cause fluctuations in water levels.

5.0 REPORT LIMITATIONS

This report has been prepared for the exclusive use of **JACOBS ENGINEERING GROUP, INC.** for the specific application to the subject project. The drilling data and laboratory testing results contained in this report have been made in accordance with generally accepted soil and foundation engineering practices; no other warranties are implied or expressed.

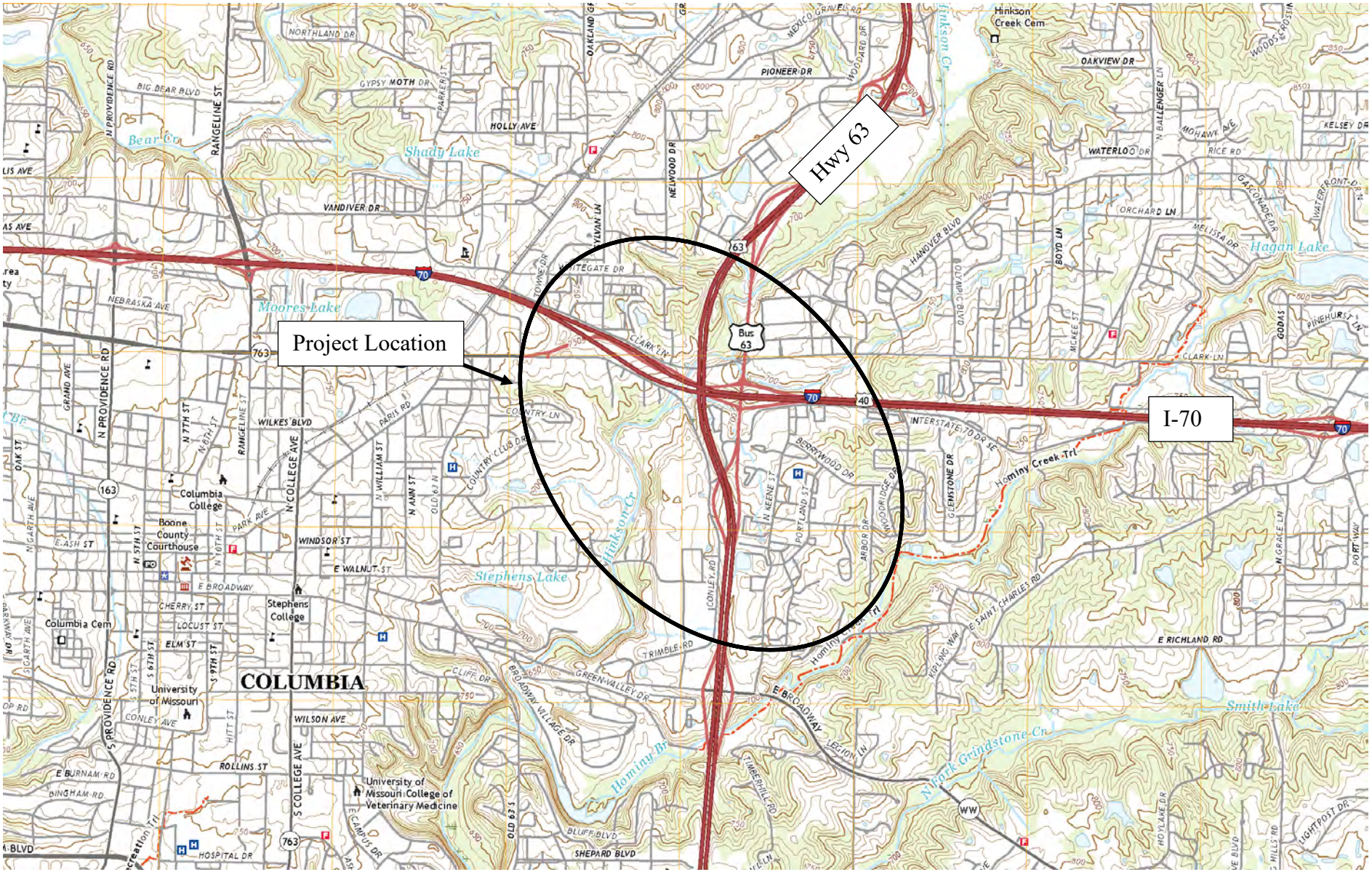
The boring logs and laboratory testing results submitted in this report are based in part upon the data obtained from the test borings. The nature and extent of variations away from the borings may not become evident until construction. If variations then appear evident, it may be necessary to re-evaluate the data of this report.

We emphasize that this report was prepared for design purposes only and may not be sufficient to prepare an accurate construction bid. Contractors reviewing this report should acknowledge that the information and recommendations contained herein are for design purposes.

If conditions at the site have changed due to natural causes or construction operations, this report should be reviewed by TSi to determine the applicability of the data considering the changed conditions. The report should also be reviewed by TSi if changes occur in the structure locations, sizes, and types, or in the planned loads, elevations, or project concepts.

TSi requests the opportunity to review the final plans and specifications for the project prior to construction to verify that the data in this report are properly interpreted and incorporated in the design and construction documents. If TSi is not accorded the opportunity to make this recommended review, we can assume no responsibility for the misinterpretation of our boring logs and laboratory test results.

APPENDIX A

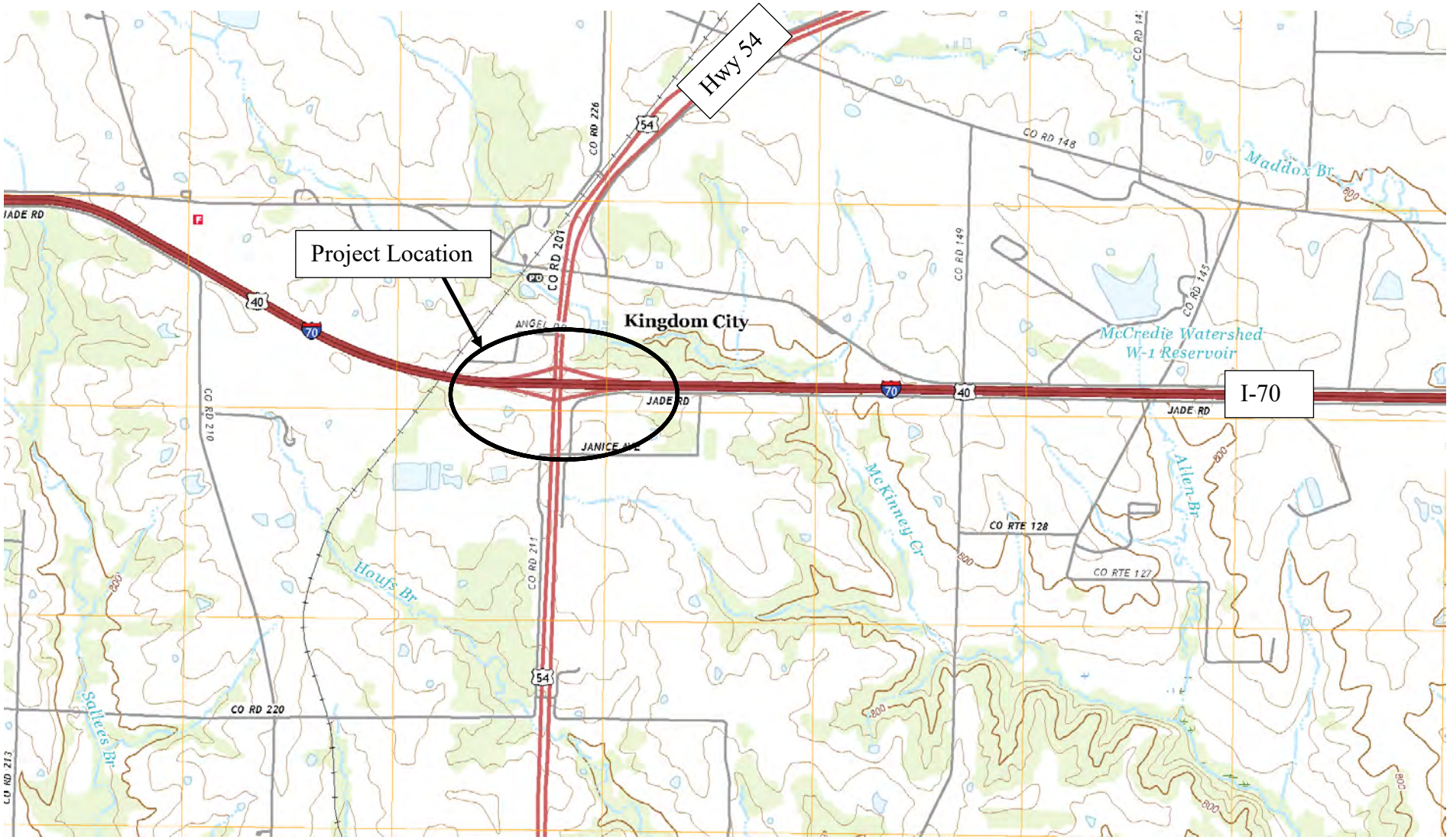


N
W E
S

Figure 1.1, Vicinity Map	Project No. 20241040.00
I-70 Third Lane (Columbia to Kingdom City) Columbia, Missouri	
Not to Scale	Approved by: JPE

This plan was prepared from an image retrieved from USGS Topoview on 5/21/2024.

TSI geotechnical, inc.



N
W E
S

Figure 1.2, Vicinity Map	Project No. 20241040.00
I-70 Third Lane (Columbia to Kingdom City) Kingdom City, Missouri	
Not to Scale	Approved by: JPE

TSi geotechnical, inc.

This plan was prepared from an image retrieved from USGS Topoview on 5/21/2024.



Legend

B-01 Approximate Boring Location and Number

This figure was prepared from an image taken from Google Earth on 07/02/24.

N
W E
S

Figure 2.1, Site and Boring Location Plan	Project No. 20241040.00
I-70 Third Lane (Columbia to Kingdom City) Columbia, Missouri	
Not to Scale	Approved by: JPE

TSI geotechnical, inc.



Legend

B-01 Approximate Boring Location and Number

This figure was prepared from an image taken from Google Earth on 07/02/24.

N
W E
S

Figure 2.2, Site and Boring Location Plan	Project No. 20241040.00
I-70 Third Lane (Columbia to Kingdom City) Columbia, Missouri	
Not to Scale	Approved by: JPE

TSI geotechnical, inc.



Legend

B-01 Approximate Boring Location and Number

This figure was prepared from an image taken from Google Earth on 07/02/24.

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W E
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Figure 2.3, Site and Boring Location Plan	Project No. 20241040.00
I-70 Third Lane (Columbia to Kingdom City) Columbia, Missouri	
Not to Scale	Approved by: JPE

TSI geotechnical, inc.



Legend

B-01 Approximate Boring Location and Number

This figure was prepared from an image taken from Google Earth on 07/02/24.

N
W E
S

Figure 2.4, Site and Boring Location Plan		Project No. 20241040.00
I-70 Third Lane (Columbia to Kingdom City) Columbia, Missouri		TSI geotechnical, inc.
Not to Scale	Approved by: JPE	



Legend

B-01 Approximate Boring Location and Number

This figure was prepared from an image taken from Google Earth on 07/01/24.

N
W E
S

Figure 2.5, Site and Boring Location Plan		Project No. 20241040.00
I-70 Third Lane (Columbia to Kingdom City) Columbia, Missouri		TSI geotechnical, inc.
Not to Scale	Approved by: JPE	



Legend

B-01 Approximate Boring Location and Number

This figure was prepared from an image taken from Google Earth on 07/01/24.

N
W E
S

Figure 2.6, Site and Boring Location Plan		Project No. 20241040.00
I-70 Third Lane (Columbia to Kingdom City) Columbia, Missouri		TSI geotechnical, inc.
Not to Scale	Approved by: JPE	



Legend

B-01 Approximate Boring Location and Number

This figure was prepared from an image taken from Google Earth on 07/01/24.

N
W E
S

Figure 2.7, Site and Boring Location Plan		Project No. 20241040.00
I-70 Third Lane (Columbia to Kingdom City) Kingdom City, Missouri		TSI geotechnical, inc.
Not to Scale	Approved by: JPE	

APPENDIX B

Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681535.813 **Date of Work:** 04/16/24-04/16/24
Offset: **Easting:** 756723.586 **Depth to Water:**
Elevation: 676.9 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9623550°, -92.2964048°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-4.0' (CH) FILL: Brown, fat CLAY, trace sand, gravel, and concrete cobble	675		50	4-5-6 (17)		PP = 2.25 tsf	MC = 11.3%
					0				
5		4.0-6.3' (CH) FILL: Brown, fat CLAY, with gravel 4.0' -rough drilling below 4.0 ft.							
		6.3-7.2' LIMESTONE, highly weathered	670		75	50/0.3'		PP = 1.75 tsf	
		7.2-16.5' LIMESTONE, gray, hard to very hard, moderately to slightly weathered, finely crystalline to aphanitic, thin to thick bedded, dense, with chert nodules and seams			90 (40)		Qu Test Results UCS = 1880 ksf		
10			665						
		12.7' -highly weathered chert seam from 12.7 to 13.2 ft.			100 (48)		Qu Test Results UCS = 1920 ksf		
15					100 (67)				
		Refusal at 6.5 feet. Bottom of borehole at 16.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

* Persons using this information are cautioned that the materials shown are determined by the equipment noted and accuracy of the "log of materials" is limited thereby and by judgement of the operator. THIS INFORMATION IS FOR DESIGN PURPOSES ONLY.

LETTER BOREHOLE - MODOT 20150728.GDT - 8/15/24 11:50 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\2024 1040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040 - PRELIMINARY.GPJ

Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681533.576 **Date of Work:** 06/10/24-06/10/24
Offset: **Easting:** 756767.524 **Depth to Water:**
Elevation: 669.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9623850, -92.2961972)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0	0.0-3.0' (CH) Brown and gray, fat CLAY, trace sand and gravel							
				39	3-2-2 (6)		PP = 2.00 tsf	LL = 71 PL = 22 MC = 20.9%
	3.0-7.3' (CL) Brown and gray, sandy lean CLAY	665						
				100	3-2-3 (8)		PP = 1.50 tsf	LL = 33 PL = 13 MC = 20.7% Sieve Analysis Sieve # % Passing #200 65.3
5	6.0' -with gravel below 6.0 ft.			100	3-3-48 (77)		PP = 1.50 tsf	MC = 18.0%
	7.3-10.0' LIMESTONE, highly weathered 7.5' -rough drilling from 7.5 to 8.5 ft.	660		0	50/0.1'			
10	9.5' -10 " rod drop at 9.5 ft.			61 (39)				
	10.0-12.3' Gray and brown, completely weathered clayey SHALE, with limestone fragments 10.0' -rotary wash from 10.0 to 12.3 ft.			71	15-13-50/0.4'			
	12.3-25.0' LIMESTONE, gray, moderately hard to very hard, slightly weathered, finely to medium crystalline, thin to medium bedded, dense, with occasional chert nodules or bands	655		88 (56)		Qu Test Results UCS = 2410 ksf		
15	15.0' -fine to coarse crystalline below 15.0 ft.							
				98 (78)		Qu Test Results UCS = 2520 ksf		
20		650						
				90 (60)		Qu Test Results UCS = 2230 ksf		
25		645						

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

* Persons using this information are cautioned that the materials shown are determined by the equipment noted and accuracy of the "log of materials" is limited thereby and by judgement of the operator. THIS INFORMATION IS FOR DESIGN PURPOSES ONLY.

LETTER BOREHOLE - MODOT 20150728.GDT - 8/15/24 11:51 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\20241040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040 - PRELIMINARY.GPJ

Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681533.576 **Date of Work:** 06/10/24-06/10/24
Offset: **Easting:** 756767.524 **Depth to Water:**
Elevation: 669.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9623850, -92.2961972)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-30.0' LIMESTONE, gray, moderately hard to hard, slightly weathered, finely to coarse crystalline, thin to thick bedded, dense	640		100 (90)		Qu Test Results UCS = 1820 ksf		
30		Refusal at 8.5 feet. Bottom of borehole at 30.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681486.399 **Date of Work:** 06/07/24-06/07/24
Offset: **Easting:** 756894.83 **Depth to Water:** 13.0
Elevation: 669.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9622544, -92.2957516)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-5.5' (CL) Brown, lean CLAY, with gravel, trace sand							
				X	11	4-4-4 (12)		PP = 2.00 tsf	MC = 12.4%
		3.5' -sandy below 3.5 ft.	665	X		4-6-5 (17)		PP = 3.50 tsf	MC = 14.0%
5									
		5.5-12.0' (CL) Brown, sandy lean CLAY		■	100		Qu Test Results MC = 20.8%	PP = 1.75 tsf	Sieve Analysis Sieve # % Passing #200 64.3
		8.5' -with gravel below 8.5 ft.	660	X	44	7-15-10 (38)		PP = 0.50 tsf	
10									
		12.0-13.8' (GC) Gray, clayey GRAVEL, with sand							
		13.8-25.0' Gray, highly weathered SHALE, with gravel	655	X	33	18-11-19 (45)			
15									
			650	X	56	7-9-15 (36)		PP >4.50 tsf	
20									
		23.5' -trace gravel below 23.5 ft.	645		100	50/0.1'			
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681486.399 **Date of Work:** 06/07/24-06/07/24
Offset: **Easting:** 756894.83 **Depth to Water:** 13.0
Elevation: 669.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9622544, -92.2957516)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-27.0' Gray, highly weathered SHALE, trace gravel							
		27.0-29.0' Highly weathered LIMESTONE	640		100	50/0.1'			
30		29.0-48.0' Cherty LIMESTONE, highly weathered, with shale			21 (6)				
			635						
35					23 (12)		Qu Test Results UCS = 3.28 ksf		
			630						
40					23 (0)				
			625						
45					55 (10)		Qu Test Results UCS = 1130 ksf		
		48.0-50.0' Cherty LIMESTONE, gray, moderately hard, slightly weathered, finely to medium crystalline, thin bedded, dense to pitted	620						
50		Refusal at 29.0 feet. Bottom of borehole at 50.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

BORING NO. BR 4-1A

Job No.: 20241040.00	**County:** Boone	**Route:** I-70
Design:	**Skew:**	**Location:** Columbia, Missouri
Bent:	**Logged By:** SO	**Operator:** LRK
Station:	**Northing:** 1681588.356	**Date of Work:** 04/16/24-04/16/24
Offset:	**Easting:** 756749.989	**Depth to Water:** 3.5
Elevation: 677.4	**Requested Northing:**	**Depth Hole Open:**
Requested Station:	**Requested Easting:**	**Time Change:**
Requested Offset:	**Equipment:** CME 550X,Split-Spoon Sampler	
Requested Elevation:	**Location Note:** (38.9625098°, -92.2962804°)	
Drill No.:	**Hammer Efficiency:** 90%	**Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-3.0' (CL) Brown, lean CLAY, with gravel							
			675		39	3-10-9 (29)		PP = 4.25 tsf	LL = 33 PL = 15 MC = 16.6%
		▽ 3.0-7.0' (GC) Brown, clayey GRAVEL, with sand			33	10-14-18 (48)			
5					13	5-50/0.2'			
		7.0-22.0' LIMESTONE, gray and tan, hard to very hard, highly to moderately weathered, finely to medium crystalline, thin to thick bedded, dense, with chert nodules and seams	670		92 (19)		Qu Test Results		
10		10.0' -slightly weathered, thin to thick bedded below 10.0 ft.							
			665		100 (78)		Qu Test Results UCS = 2440 ksf		
15									
			660		100 (87)		Qu Test Results UCS = 1620 ksf		
20					100 (100)		Qu Test Results UCS = 1700 ksf		
		Refusal at 7.0 feet. Bottom of borehole at 22.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681563.583 **Date of Work:** 06/10/24-06/10/24
Offset: **Easting:** 756831.888 **Depth to Water:** 8.5
Elevation: 667.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9624989, -92.2959726)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-3.0' LIMESTONE rip rap							
			665		11	31-6-6 (18)			
		3.0-8.0' (CL) Brown and gray, lean CLAY, with sand, silty 3.5' -with gravel from 3.5 to 5.0 ft.			44	5-6-7 (20)		PP = 1.50 tsf	MC = 18.4%
5									
			660		56	1-2-3 (8)		PP = 1.00 tsf	LL = 35 PL = 18 MC = 20.6%
		▽ 8.0-11.2' (ML) Gray and brown, sandy SILT			67	1-2-2 (6)		PP = 0.50 tsf	Sieve Analysis Sieve # % Passing #200 60.5
10									
		11.2-18.2' LIMESTONE, gray, moderately hard to very hard, slightly weathered, fine to medium crystalline, thin to medium bedded, dense, with chert	655		93 (73)		Qu Test Results UCS = 2530 ksf		
15									
		16.2' -6" calcereous shale layer at 16.2 ft. 16.7' -6" chert layer at 16.7 ft. 17.2' -3" calcereous shale layer at 17.2 ft.	650		72 (45)		Qu Test Results UCS = 2230 ksf		
		18.2-19.2' Calcereous SHALE, gray							
20		19.2-23.7' LIMESTONE, gray, moderately hard to very hard, slightly weathered, finely to medium crystalline, thin to medium bedded, dense, with chert 21.4' -4" calcereous shale with coal band at 21.4 ft. 21.7' -moderately to slightly weathered below 21.7 ft.	645		80 (22)		Qu Test Results UCS = 2570 ksf		
		23.7-25.0' CHERT, moderately weathered							
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681563.583 **Date of Work:** 06/10/24-06/10/24
Offset: **Easting:** 756831.888 **Depth to Water:** 8.5
Elevation: 667.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9624989, -92.2959726)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-26.2' CHERT, moderately weathered 25.7' -6" limestone layer at 25.7 ft. Refusal at 11.2 feet. Bottom of borehole at 26.2 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681667.505 **Date of Work:** 05/01/24-05/01/24
Offset: **Easting:** 756923.27 **Depth to Water:**
Elevation: 684.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9627403°, -92.2957010°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-0.6' Portland cement concrete (7.5") (Bridge deck) 0.6-25.4' Air gap between bridge deck and ground							
5			680						
10			675						
15			670						
20			665						
25			660						

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681667.505 **Date of Work:** 05/01/24-05/01/24
Offset: **Easting:** 756923.27 **Depth to Water:**
Elevation: 684.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9627403°, -92.2957010°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.4-27.0' Surface soil							
		27.0-28.7' Gray, GRAVEL							
		28.7-30.0' Gray, highly weathered LIMESTONE	655	X	40	11-50/0.3'			
30		30.0-45.0' LIMESTONE, gray and tan, hard to very hard, slightly weathered, finely to coarse crystalline, thin bedded, dense 30.0' -with chert from 30.0 to 35.0 ft. 31.6' -2" chert seam at 31.6 ft. 33.5' -5" chert seam at 33.5 ft.			100 (43)		Qu Test Results UCS = 896 ksf		
35			650						
		35.0' -hard, thin to medium bedded below 35.0 ft.			100 (88)		Qu Test Results UCS = 1390 ksf		
40			645						
		43.3' -cherty, pitted to vuggy from 43.3 to 44.6 ft.			95 (68)		Qu Test Results UCS = 1240 ksf		
45			640						
		Refusal at 30.0 feet. Bottom of borehole at 45.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681631.451 **Date of Work:** 04/30/24-05/01/24
Offset: **Easting:** 756990.246 **Depth to Water:**
Elevation: 683.2 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9626360°, -92.2954596°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-0.8' Portland cement concrete (9.0") (Bridge deck) 0.8-15.0' Air gap between bridge deck and ground	680						
5			675						
10			670						
15		15.0-18.0' (CL) Brown, silty lean CLAY, with gravel	665	X	28	2-4-1 (8)		PP = 0.25 tsf	MC = 27.6%
20		18.0-22.0' (GP) Gray, GRAVEL		X	11	3-2-1 (5)			
25		22.0-25.0' (CL) Gray, silty lean CLAY, with sand	660	X	28	4-2-2 (6)		PP = 0.50 tsf	LL = 27 PL = 17 MC = 22.3%

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681631.451 **Date of Work:** 04/30/24-05/01/24
Offset: **Easting:** 756990.246 **Depth to Water:**
Elevation: 683.2 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9626360°, -92.2954596°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-27.0' (CL) Gray, silty lean CLAY, with sand							
		27.0-33.5' (GC) Gray, clayey GRAVEL	655		39	7-6-9 (23)			
30									
			650		44	27-39-20 (89)		PP >4.50 tsf	
		33.5-35.3' Gray, highly weathered calcareous SHALE							
35		35.3-40.3' LIMESTONE, gray and tan, hard to very hard, highly weathered with chert	645		17 (0)				
40		40.3-50.3' LIMESTONE, gray and tan, moderately hard to very hard, moderately to slightly weathered, medium crystalline to aphanitic, pitted to dense, with chert	640		75 (27)		Qu Test Results UCS = 848 ksf		
45		45.3' -tan, moderately to highly weathered, medium crystalline, thin bedded, pitted below 45.3 ft.	635		60 (8)				
50		48.5' -6" shale seam at 48.5 ft.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681631.451 **Date of Work:** 04/30/24-05/01/24
Offset: **Easting:** 756990.246 **Depth to Water:**
Elevation: 683.2 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9626360°, -92.2954596°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		Refusal at 35.3 feet. Bottom of borehole at 50.3 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

BORING NO. BR 7-1A

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681442.097 **Date of Work:** 04/15/24-04/15/24
Offset: **Easting:** 756679.256 **Depth to Water:**
Elevation: 671.1 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9621144°, -92.2965312°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-2.8' (CH) Brown and gray, fat CLAY, with sand and gravel	670						
					67	3-7-6 (20)		PP = 3.75 tsf	MC = 13.2%
		2.8-5.5' (CL) Brown, lean CLAY, with sand and gravel 3.0' (sample disturbed)			83		Qu Test Results MC = 13.1%	PP = 2.25 tsf	LL = 40 PL = 15
5		5.5-12.0' (CH) Brown and gray, fat CLAY 6.0' -gravelly below 6.0 ft.	665						
					56	9-11-7 (27)		PP = 2.75 tsf	MC = 24.2%
					22	9-9-13 (33)			MC = 16.5%
10		10.0' -rough drilling below 10.0 ft.	660						
		12.0-22.0' LIMESTONE, gray, hard to very hard, slightly weathered, finely crystalline to aphanitic, medium to thick bedded, dense, with chert nodules and seams			0	50/0.0'			
					100 (100)		Qu Test Results UCS = 2480 ksf MC = 0.0% γ_{moist} = 167.4 pcf		
15		15.0' -thin to thick bedded below 15.0 ft.	655						
					98 (90)		Qu Test Results UCS = 1670 ksf		
20			650		100 (92)		Qu Test Results UCS = 1720 ksf MC = 0.0% γ_{moist} = 166.2 pcf		
		Refusal at 12.0 feet. Bottom of borehole at 22.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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LETTER BOREHOLE - MODOT 20150728.GDT - 8/15/24 11:51 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\2024 1040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040 - PRELIMINARY.GPJ

Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681366.454 **Date of Work:** 04/11/24-04/11/24
Offset: **Easting:** 756798.332 **Depth to Water:** 18.5
Elevation: 668.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9619321, -92.2961325)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-12.0' (CL) Brown, lean CLAY, with gravel							
		1.0' -sandy from 1.0 to 2.5 ft.			11	9-10-7 (26)			
			665						
		3.5' -brown and gray below 3.5 ft.			39	15-6-5 (17)		PP = 2.25 tsf	MC = 12.8%
5		3.5' -with sand from 3.5 to 7.0 ft.							
					92		Qu Test Results MC = 13.2%	PP = 1.75 tsf	LL = 26 PL = 15
			660						
		8.5' -sandy below 8.5 ft.			39	11-4-3 (11)			MC = 11.5%
10									
		12.0-23.5' (CH) Gray, fat CLAY, with sand and gravel							
			655						
					39	3-3-5 (12)		PP = 3.50 tsf	MC = 12.1%
15									
		15.5' -rough drilling from 15.5 to 17.0 ft.							
		▽	650						
					44	7-8-10 (27)		PP = 0.75 tsf	LL = 61 PL = 19 MC = 20.7%
20									
			645		100	50/0.1'			
		23.5-24.0' Gray, highly weath. LIMESTONE							
		24.0-25.0' Cherty LIMESTONE, gray, hard			83 (33)				
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681366.454 **Date of Work:** 04/11/24-04/11/24
Offset: **Easting:** 756798.332 **Depth to Water:** 18.5
Elevation: 668.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9619321, -92.2961325)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-35.0' Cherty LIMESTONE, gray and tan, hard to very hard, moderately to highly weathered, finely crystalline to aphanitic, dense to pitted			90 (33)		Qu Test Results UCS = 1210 ksf		
			640						
30		30.0' -gray, moderately weathered, coarse to finely crystalline below 30.0 ft.							
		32.0' -highly weathered from 32.0 to 33.0 ft.			97 (72)		Qu Test Results UCS = 1310 ksf		
			635						
35		Bottom of borehole at 35.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681349.112 **Date of Work:** 04/11/24-04/11/24
Offset: **Easting:** 756866.562 **Depth to Water:**
Elevation: 668.9 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9618677, -92.2959357)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-12.0' (CL) Brown, lean CLAY, with gravel							
		1.5' -rough drilling from 1.5 to 3.5 ft.		X	22	7-9-6 (23)		PP = 1.00 tsf	
			665	X	0	6-5-5 (15)			
5		6.0' -gray below 6.0 ft. 6.0' -sandy from 6.0 to 7.5 ft.		X	6	7-8-6 (21)			MC = 10.1%
		8.0' (sample disturbed)	660	■	63		Qu Test Results MC = 17.4% γ_{moist} = 130.2 pcf	PP = 0.75 tsf	LL = 34 PL = 19
10									
		12.0-17.0' Gray, highly weathered LIMESTONE	655	X	33	6-12-13 (38)		PP >4.50 tsf	
15									
		17.0-25.0' Gray, weathered SHALE	650	X	39	20-37-40 (116)			MC = 7.6%
20									
			645	X	44	24-32-46 (117)			
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681349.112 **Date of Work:** 04/11/24-04/11/24
Offset: **Easting:** 756866.562 **Depth to Water:**
Elevation: 668.9 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9618677, -92.2959357)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-27.0' Gray, weathered SHALE							
		27.0-32.0' Black, COAL	640		60	50/0.4'			
30		32.0-38.9' Gray, weathered SHALE	635		67	50/0.5'			
35			630		55	28-50/0.4'			
40		38.9-39.5' Gray, Calcareous SHALE with limestone band 38.9-46.0'			67 (42)				
		39.5-46.0' Calcareous SHALE, gray, soft to very soft, slightly to highly weathered, thin to thick bedded	625		67 (12)		Qu Test Results UCS = 3.96 ksf		
45		46.0-50.0' SHALE, gray and black, soft to very soft, slightly to highly weathered, thin to thick bedded	620		58 (17)		Qu Test Results UCS = 4.08 ksf		
50									

$N_{60} = (Em/60)Nm$ N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681349.112 **Date of Work:** 04/11/24-04/11/24
Offset: **Easting:** 756866.562 **Depth to Water:**
Elevation: 668.9 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9618677, -92.2959357)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		50.0-50.5' SHALE, gray and black, soft to very soft, highly to completely weathered, thin to thick bedded							
		Bottom of borehole at 50.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

BORING NO. BR 7-4.1

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681227.525 **Date of Work:** 04/11/24-04/11/24
Offset: **Easting:** 756998.155 **Depth to Water:** 9.5
Elevation: 671.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9615015, -92.2954744)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-12.0' (CL) Brown, lean CLAY							
		1.0' -with gravel from 1.0 to 2.5 ft.	670		39	4-5-5 (15)		PP = 2.00 tsf	
		3.0' -gray below 3.0 ft.			100		Qu Test Results UCS = 3.17 ksf MC = 18.1% γ_{moist} = 150.8 pcf	PP = 4.50 tsf	LL = 39 PL = 17
5			665		78	2-2-2 (6)		PP = 1.00 tsf	MC = 23.1%
					100	2-3-3 (9)		PP = 2.00 tsf	MC = 24.4%
10			660						
		12.0-17.0' (CH) Gray, gravelly fat CLAY			75		Qu Test Results MC = 18.4%		LL = 56 PL = 20
		13.0' -gravelly below 13.0 ft.			11	10-10-9 (29)			
15			655						
		17.0-24.3' Gray, weathered SHALE			100	12-18-33 (77)		PP >4.50 tsf	MC = 20.9%
20			650						
					100	28-50/0.3'		PP >4.50 tsf	
		Bottom of borehole at 24.3 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681663.503 **Date of Work:** 04/16/24-04/16/24
Offset: **Easting:** 756660.752 **Depth to Water:**
Elevation: 690.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9627325°, -92.2965781°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0	0.0-13.5' (CL) Brown, lean CLAY	690						
	1.0' -with gravel from 1.0 to 2.5 ft.			33	29-8-4 (18)		PP = 2.00 tsf	MC = 10.8%
	3.5' -brown and gray from 3.5 to 7.5 ft.			83		Qu Test Results UCS = 5.60 ksf MC = 17.2% γ_{moist} = 133.8 pcf	PP = 4.50 tsf	LL = 29 PL = 16
5		685						
	6.0' -with gravel from 6.0 to 7.5 ft.			44	7-19-41 (90)		PP = 1.75 tsf	MC = 10.6%
	8.5' -gravelly below 8.5 ft.			44	6-17-17 (51)		PP = 2.00 tsf	MC = 20.4%
10		680						
				100			PP = 3.75 tsf	
	13.5-19.5' Gray, highly weathered LIMESTONE 13.5' -rough drilling from 13.5 to 16.5 and below 18.5 ft.			50	50/0.2'			
15		675						
	18.5' -cherty below 18.5 ft.			75	50/0.3'			
20	19.5-25.0' LIMESTONE, gray, hard to very hard, slightly weathered, finely crystalline to aphanitic, thin to thick bedded, dense, with chert nodules and seams	670		98 (82)		Qu Test Results UCS = 2160 ksf		
25								

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681663.503 **Date of Work:** 04/16/24-04/16/24
Offset: **Easting:** 756660.752 **Depth to Water:**
Elevation: 690.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9627325°, -92.2965781°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-29.5' LIMESTONE, gray, hard to very hard, slightly weathered, finely crystalline to aphanitic, thin to thick bedded, dense, with chert nodules and seams	665		98 (68)		Qu Test Results UCS = 1080 ksf		
		Refusal at 19.5 feet. Bottom of borehole at 29.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681489.012 **Date of Work:** 06/06/24-06/06/24
Offset: **Easting:** 756950.055 **Depth to Water:** 8.0
Elevation: 668.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:**
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-3.5' (CL) Brown, lean CLAY, with sand, gravel, and coal			44	3-3-4 (11)		PP = 3.00 tsf	LL = 32 PL = 13 MC = 15.2%
		3.0' -with concrete below 3.0 ft.	665		100		Qu Test Results MC = 14.1%		
		3.5-5.0' CONCRETE			17	50/0.5'			
5		5.0-7.7' (ML) Brown and gray, sandy SILT			67	0-0-0 (0)		PP = 0.50 tsf	MC = 22.0% Sieve Analysis Sieve # % Passing #200 56.2
		7.7-13.8' (SC) Coarse clayey SAND	660		79				Sieve Analysis Sieve # % Passing #200 31.7
10									
			655						
		13.8-25.0' Gray, SHALE, highly weathered			28	7-5-6 (17)		PP = 4.50 tsf	
15									
			650						
		18.5' -with crystalline lenses from 18.5 to 20.0 ft.			44	21-11-15 (39)		PP >4.50 tsf	
20									
			645						
		23.5' -slightly weathered below 23.5 ft.			100	50/0.3'		PP >4.50 tsf	
		24.0' -rough drilling from 24.0 to 25.0 ft.							
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681489.012 **Date of Work:** 06/06/24-06/06/24
Offset: **Easting:** 756950.055 **Depth to Water:** 8.0
Elevation: 668.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:**
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-31.0' Gray, SHALE, slightly weathered							
			640						
		28.5' -calcareous below 28.5 ft.			100	50/0.1'			
30		30.0' -rough drilling from 30.0 to 31.0 ft.							
		31.0-32.0' SHALE, gray, very soft							
		32.0-50.0' Cherty LIMESTONE, gray, moderately hard to very hard, slightly weathered, finely to medium crystalline, thin bedded, dense to pitted	635		94 (63)				
35		35.0' -highly weathered, interbedded shale below 35.0 ft.							
			630		30 (0)				
40									
			625		20 (10)				
45									
			620		32 (8)				
50									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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LETTER BOREHOLE - MODOT 20150728.GDT - 8/15/24 11:50 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\2024 1040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040 - PRELIMINARY.GPJ

Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681489.012 **Date of Work:** 06/06/24-06/06/24
Offset: **Easting:** 756950.055 **Depth to Water:** 8.0
Elevation: 668.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:**
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		50.0-63.0' LIMESTONE, gray, moderately hard, slightly weathered, finely to coarse crystalline, medium to thick bedded, dense to pitted	615		100 (100)		Qu Test Results UCS = 1160 ksf		
55			610		100 (100)		Qu Test Results UCS = 1760 ksf		
60		60.0' -fine to medium crystalline, thin to medium bedded below 60.0 ft. 61.6' -7" chert seam at 61.6 ft.			100 (100)				
		Refusal at 31.0 feet. Bottom of borehole at 63.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681429.848 **Date of Work:** 04/29/24-04/30/24
Offset: **Easting:** 757037.888 **Depth to Water:** 23.5
Elevation: 680.2 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.962078°, -92.295292)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-0.4' Asphaltic concrete (5")	680						
		0.4-1.1' Portland cement concrete (8")							
		1.1-12.0' (CH) Brown and gray, fat CLAY, with gravel		X	44	3-2-5 (11)		PP = 1.75 tsf	MC = 18.3%
				X	22	6-5-4 (14)		PP = 1.75 tsf	MC = 16.1%
5			675						
		6.0' -trace sand and gravel below 6.0 ft.		X	67	2-3-4 (11)		PP = 1.75 tsf	
				■	92		Qu Test Results UCS = 3.98 ksf MC = 23.5%	PP = 2.75 tsf	LL = 58 PL = 15
10			670						
		12.0-17.0' (CL) Brown, lean CLAY, silty		X	89	4-6-7 (20)		PP = 2.00 tsf	MC = 19.0%
15			665						
		17.0-22.0' (SC) Brown, clayey SAND, with gravel		■	58		Qu Test Results MC = 10.4%		Sieve Analysis Sieve # % Passing 1.5" 100.0 3/4" 95.1 3/8" 93.5 No. 4 91.0 No. 8 87.7 No. 16 80.5 No. 30 59.6 No. 50 43.6 No. 100 37.6 No. 200 36.8 Pan 36.7
20			660						
		22.0-25.0' Gray, highly weathered SHALE ▽		X	56	10-14-19 (50)		PP >4.50 tsf	
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681429.848 **Date of Work:** 04/29/24-04/30/24
Offset: **Easting:** 757037.888 **Depth to Water:** 23.5
Elevation: 680.2 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.962078°, -92.295292)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-32.0' Gray, highly weathered SHALE	655						
		28.5' -black, moderately to highly weathered, with coal below 28.5 ft.			44	35-50/0.3'			
30			650						
		32.0-34.0' Gray, highly weathered LIMESTONE			25	50/0.2'			
		34.0-37.7' LIMESTONE, gray and tan, hard, slightly weathered, finely crystalline to aphanitic, thin to medium bedded, dense			94 (83)		Qu Test Results UCS = 1060 ksf		
35			645						
		36.0' -6" shale layer at 36.0 ft.							
		37.7-39.2' SHALE			98 (85)		Qu Test Results UCS = 4.03 ksf		
40		39.2-42.0' LIMESTONE, gray, hard, slightly weathered, finely crystalline to aphanitic, thin to medium bedded, dense	640						
		42.0-44.5' SHALE, gray, soft to very soft, highly to slightly weathered			100 (77)		Qu Test Results UCS = 1170 ksf		
45		44.5-46.6' LIMESTONE, gray, hard, slightly weathered, finely crystalline to aphanitic, thin to medium bedded, dense	635						
		46.6-50.0' SHALE, black, very soft to hard, highly to slightly weathered			100 (63)		Qu Test Results UCS = 305 ksf		
50		49.5' -gray below 49.5 ft.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00	**County:** Boone	**Route:** I-70
Design:	**Skew:**	**Location:** Columbia, Missouri
Bent:	**Logged By:** SO	**Operator:** LRK
Station:	**Northing:** 1681429.848	**Date of Work:** 04/29/24-04/30/24
Offset:	**Easting:** 757037.888	**Depth to Water:** 23.5
Elevation: 680.2	**Requested Northing:**	**Depth Hole Open:**
Requested Station:	**Requested Easting:**	**Time Change:**
Requested Offset:	**Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube	
Requested Elevation:	**Location Note:** (38.962078°, -92.295292)	
Drill No.:	**Hammer Efficiency:** 90%	**Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		50.0-54.5' SHALE, gray, very soft to soft, moderately weathered	630		100 (70)		Qu Test Results UCS = 9.35 ksf		
55		54.5-55.5' LIMESTONE, gray, moderately hard to hard, highly weathered, thin bedded, pitted to vuggy, interbedded shale	625						
		55.5-70.5' SHALE, gray, soft to very soft, completely to highly weathered			100 (47)		Qu Test Results UCS = 4.19 ksf		
60			620		100 (100)		Qu Test Results UCS = 2.92 ksf		
65			615		92 (58)		Qu Test Results UCS = 7.14 ksf		
70			610						
		Refusal at 34.0 feet. Bottom of borehole at 70.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681313.156 **Date of Work:** 06/05/24-06/05/24
Offset: **Easting:** 757037.454 **Depth to Water:** 8.5
Elevation: 668.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:**
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-12.0' (CH) Brown and gray, fat CLAY, with gravel							
					33	2-5-8 (20)		PP = 1.75 tsf	MC = 15.9%
			665						
5					0	3-3-4 (11)			
					67		Qu Test Results UCS = 1.63 ksf MC = 25.9% γ_{moist} = 122.1 pcf	PP = 2.00 tsf	LL = 54 PL = 17
		▽	660						
10					33	12-8-8 (24)		PP = 0.75 tsf	MC = 27.6%
		12.0-25.0' Gray, SHALE, clayey, highly weathered							
			655		83		Qu Test Results UCS = 5.29 ksf	PP >4.50 tsf	
15									
			650						
					89	11-20-25 (68)		PP >4.50 tsf	
20									
		23.0' (sample disturbed)	645		100			PP >4.50 tsf	
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681313.156 **Date of Work:** 06/05/24-06/05/24
Offset: **Easting:** 757037.454 **Depth to Water:** 8.5
Elevation: 668.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:**
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-27.0' Gray, clayey SHALE, highly weathered							
		27.0-32.0' Black, COAL	640		100	50/0.2'			
30		32.0-36.4' LIMESTONE, gray, moderately hard, moderately to highly weathered, finely crystalline to aphanitic, thin bedded, dense to pitted	635		75 (0)				
35		34.7' -shale, gray from 34.7 to 35.2 ft. 35.2' -slightly weathered, thin to medium bedded below 35.2 ft. 36.4-38.0' SHALE, gray			87 (75)		Qu Test Results UCS = 1500 ksf		
		38.0-41.7' LIMESTONE, gray, moderately hard, slightly weathered, finely crystalline to aphanitic, thin to medium bedded, dense to pitted	630						
40		41.7-43.4' SHALE, gray			100 (77)		Qu Test Results UCS = 1190 ksf		
		43.4-45.6' LIMESTONE, gray, moderately hard, slightly weathered, finely crystalline to aphanitic, thin to thick bedded, dense to pitted	625						
45		45.6-50.0' COAL, black, very soft to moderately hard			92 (40)				
			620						
50									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681313.156 **Date of Work:** 06/05/24-06/05/24
Offset: **Easting:** 757037.454 **Depth to Water:** 8.5
Elevation: 668.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:**
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		50.0-50.2' COAL, black, very soft to moderately hard 50.2-65.0' SHALE, gray, soft, highly weathered, clayey			100 (90)		Qu Test Results UCS = 13.4 ksf		
			615						
55		55.0' -calcareous, with limestone fragments from 55.0 to 60.0 ft.			75 (40)		Qu Test Results UCS = 3.04 ksf		
			610						
60					100 (83)		Qu Test Results UCS = 8.52 ksf		
			605						
65		Refusal at 32.0 feet. Bottom of borehole at 65.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681133.662 **Date of Work:** 05/07/24-05/08/24
Offset: **Easting:** 757205.251 **Depth to Water:** 33.5
Elevation: 703.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9613205, -92.2946935)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-16.0' (CH) Brown and gray, fat CLAY, trace sand and gravel							
				X	44	2-3-3		PP = 1.50 tsf	MC = 25.2%
			700						
				■	71		Qu Test Results UCS = 1.82 ksf MC = 27.8% γ_{moist} = 124.4 pcf	PP = 2.75 tsf	LL = 78 PL = 22
5									
				X	89	3-4-6		PP = 2.25 tsf	MC = 23.5%
			695						
				X	61	3-2-3		PP = 1.75 tsf	MC = 18.9%
10		11.0' -rough drilling from 11.0 to 12.0 ft.							
			690						
				■	100		Qu Test Results UCS = 4.22 ksf MC = 24.2% γ_{moist} = 123.2 pcf	PP = 3.75 tsf	LL = 74 PL = 21
15									
		16.0-17.0' (CL) Gray lean CLAY							
		17.0-22.0' (CL) Brown and gray, sandy lean CLAY, trace gravel	685						
				X	89	5-8-11		PP = 3.75 tsf	MC = 16.9%
20									
		22.0-25.0' (CH) Gray and tan, shaley fat CLAY	680						
				X	44	7-10-11		PP >4.50 tsf	MC = 21.0%
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681133.662 **Date of Work:** 05/07/24-05/08/24
Offset: **Easting:** 757205.251 **Depth to Water:** 33.5
Elevation: 703.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9613205, -92.2946935)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-27.0' (CH) Gray and tan, shaley fat CLAY							
		27.0-30.0' Gray, highly weathered LIMESTONE	675						
				X	18	16-50/0.4'			
30		30.0-42.5' Gray, highly weathered SHALE							
			670						
		▽ 33.5' -with gravel from 33.5 to 34.3 ft.		X	67	25-50/0.3'		PP >4.50 tsf	
35									
			665						
				X	100	50/0.4'		PP = 3.75 tsf	
40									
		42.5-46.6' LIMESTONE, gray and tan, hard, slightly weathered, thin to thick bedded, finely crystalline, dense	660		100 (47)	50/0.0'	Qu Test Results UCS = 2220 ksf		
45		45.3' -4" highly weathered shale layer at 45.3 ft. 45.7' -pitted to dense bewlow 45.7 ft.							
		46.6-50.0' SHALE, gray, very soft to soft, highly weathered, with limestone fragments	655		100 (27)				
50									

$N_{60} = (Em/60)Nm$ N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681133.662 **Date of Work:** 05/07/24-05/08/24
Offset: **Easting:** 757205.251 **Depth to Water:** 33.5
Elevation: 703.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9613205, -92.2946935)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		50.0-56.0' LIMESTONE, gray and tan, moderately hard, slightly weathered, thin to thick bedded, aphanitic to finely crystalline, dense	650		92 (52)		Qu Test Results UCS = 2630 ksf		
55		53.5' -6" shale layer at 53.5 ft.							
		56.0-57.0' SHALE, gray, soft							
		57.0-65.0' LIMESTONE, gray and tan, moderately hard, slightly weathered, thin to thick bedded, aphanitic to finely crystalline, dense	645		92 (65)		Qu Test Results UCS = 910 ksf		
60			640		82 (43)		Qu Test Results UCS = 2130 ksf		
65		65.0-72.5' SHALE, gray, very soft to soft, moderately to highly weathered	635		73 (52)		Qu Test Results UCS = 6.28 ksf		
70									
		72.5-75.0' LIMESTONE, gray, moderately hard, slightly weathered, thin to medium bedded, aphanitic to finely crystalline, dense	630		100 (48)		Qu Test Results UCS = 1.10 ksf		
75		Refusal at 42.5 feet. Bottom of borehole at 75.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** **Date of Work:** 05/30/24-05/30/24
Offset: **Easting:** **Depth to Water:**
Elevation: 728.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9578062, -92.2934185)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-0.8' Asphaltic concrete (10")							
		0.8-2.7' (CH) Gray and brown, fat CLAY, trace coal			22	2-2-3 (8)		PP = 1.50 tsf	LL = 60 PL = 16 MC = 20.0%
		2.7-16.0' Gray, SHALE	725						
		3.0' -completely weathered from 3.0 to 4.5 ft.			100		Qu Test Results MC = 7.7%	PP >4.50 tsf	
5									
					56	15-33-38 (107)		PP >4.50 tsf	
			720						
					73	30-50/0.4'		PP >4.50 tsf	
10									
			715						
					60	50/0.4'			
15									
		16.0-19.0' LIMESTONE, gray, highly weathered							
			710		67	50/0.3'			
		19.0-25.0' Cherty LIMESTONE, gray, highly weathered, interbedded with SHALE			42 (0)				
20									
			705		31 (10)				
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** **Date of Work:** 05/30/24-05/30/24
Offset: **Easting:** **Depth to Water:**
Elevation: 728.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9578062, -92.2934185)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-50.0' LIMESTONE, gray, moderately hard to very hard, slightly weathered, finely to medium crystalline, thin to medium bedded, dense to pitted, with chert	700		97 (82)		Qu Test Results UCS = 2270 ksf		
30		32.9' -cherty from 32.9 to 34.4 ft.	695		100 (90)		Qu Test Results UCS = 1860 ksf		
35		37.0' -12" chert layer at 37.0 ft. 38.3' -2" chert seam at 38.3 ft. 38.8' -2" chert seam at 38.8 ft.	690		100 (80)				
40		41.3' -4" chert seam at 41.3 ft.	685		100 (82)		Qu Test Results UCS = 2470 ksf		
45		44.6' -6" chert seam at 44.6 ft.	680		100 (90)				
50		Refusal at 19.0 feet Bottom of borehole at 50.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** **Date of Work:** 05/29/24-05/29/24
Offset: **Easting:** **Depth to Water:**
Elevation: 728.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9577228, -92.2933769)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-0.8' Portland cement concrete (10.0")							
		0.8-3.0' (CL) Brown and gray, lean CLAY, with sand and gravel		X	28	2-11-5 (24)		PP = 1.50 tsf	LL = 44 PL = 15 MC = 16.2%
			725						
		3.0-17.0' Gray, SHALE 3.5' -completely weathered from 3.5 to 5.0 ft.		X	44	6-16-16 (48)		PP >4.50 tsf	MC = 9.5%
5									
		6.0' -highly weathered from 6.0 to 6.8 ft.		■	100			PP >4.50 tsf	
			720						
				X	67	20-44-50/0.5'		PP >4.50 tsf	MC = 6.8%
10									
			715						
				X	67	30-50/0.5'		PP >4.50 tsf	
15									
		17.0-18.6' Gray, LIMESTONE, highly weathered	710						
		18.6-25.0' LIMESTONE, gray and tan, moderately hard to very hard, moderately weathered, with chert		▮	50	50/0.1'			
20		18.6-20.2'		▮	32 (0)				
		20.2' -moderately to slightly weathered, finely to medium crystalline, thin to medium bedded, dense to pitted below 20.2 ft.	705	▮	75 (55)		Qu Test Results UCS = 1640 ksf		
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** **Date of Work:** 05/29/24-05/29/24
Offset: **Easting:** **Depth to Water:**
Elevation: 728.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9577228, -92.2933769)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-50.0' LIMESTONE, gray, moderately hard to very hard, slightly weathered, finely to medium crystalline, thin to medium bedded, dense to pitted, trace chert	700		100 (78)				
30		31.8' -5" chert seam at 31.8 ft.	695		100 (72)				
35		37.0' -6" chert seam at 37.0 ft.	690		100 (87)		Qu Test Results UCS = 1710 ksf		
40		38.6' -2" chert seam at 38.6 ft. 40.2' -moderately hard below 40.2 ft.	685		100 (100)				
45			680		100 (95)		Qu Test Results UCS = 1860 ksf		
50									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** **Date of Work:** 05/29/24-05/29/24
Offset: **Easting:** **Depth to Water:**
Elevation: 728.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9577228, -92.2933769)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		50.0-50.2' LIMESTONE, gray, moderately hard to very hard, slightly weathered, finely to medium crystalline, thin to medium bedded, dense to pitted, trace chert Refusal at 18.6 feet. Bottom of borehole at 50.2 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1679808.427 **Date of Work:** 06/03/24-06/04/24
Offset: **Easting:** 757612.181 **Depth to Water:**
Elevation: 720.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9575903, -92.2933159)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-0.1' Aspahltic concrete (1.0")	720						
		0.1-0.8' Portland cement concrete (8.0")							
		0.8-3.0' (CH) Brown and gray, fat CLAY, with gravel		X	33	2-2-2 (6)		PP = 1.25 tsf	MC = 23.5%
		3.0-5.0' LIMESTONE, highly weathered		X	50	50/0.2'			
5		5.0-19.5' Gray, SHALE	715	X	56	13-25-36 (92)		PP >4.50 tsf	
				X	67	12-24-32 (84)		PP >4.50 tsf	
10			710						
				X	100	50/0.5'			
15			705						
				X	100	36-50/0.3'			
20		19.5-25.0' SHALE, gray, very soft to soft, fresh to highly weathered	700		68 (0)				
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1679808.427 **Date of Work:** 06/03/24-06/04/24
Offset: **Easting:** 757612.181 **Depth to Water:**
Elevation: 720.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9575903, -92.2933159)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-29.5' SHALE, gray, soft to moderately hard, slightly to highly weathered	695		60 (12)				
30		29.5-33.4' LIMESTONE, gray, moderately hard, slightly to moderately weathered, finely to medium crystalline, thin to medium bedded, dense to pitted 31.4' -6" shale layer at 31.4 ft.	690		83 (50)		Qu Test Results UCS = 1770 ksf		
35		33.4-38.8' Calcereous SHALE, gray, soft to moderately hard, slightly to moderately weathered	685		65 (25)				
40		38.8-41.5' LIMESTONE, gray, moderately hard, slightly weathered, medium crystalline, thin bedded, dense to pitted 39.7' -2" shale seam at 39.7 ft.	680		92 (35)		Qu Test Results UCS = 1240 ksf		
		41.5-42.5' Calcareous SHALE							
45		42.5-50.0' LIMESTONE, gray, moderately hard to very hard, slightly weathered, finely to medium crystalline, thin to medium bedded, dense to pitted, with chert 44.3' -2" calcereous shale seam at 44.3 ft. 44.5' -cherty, gray and white, aphanitic from 44.5 to 46.0 ft.	675		90 (48)		Qu Test Results UCS = 1970 ksf		
50									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1679808.427 **Date of Work:** 06/03/24-06/04/24
Offset: **Easting:** 757612.181 **Depth to Water:**
Elevation: 720.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9575903, -92.2933159)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		50.0-51.5' LIMESTONE, gray, moderately hard, slightly weathered, finely to medium crystalline, thin to medium bedded, dense to pitted	670		100 (83)		Qu Test Results UCS = 1450 ksf		
		Refusal at 19.5 feet. Bottom of borehole at 51.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

BORING NO. BR 13-1A

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** JM **Operator:** LRK
Station: **Northing:** 1677351.298 **Date of Work:** 04/17/24-04/17/24
Offset: **Easting:** 757594.209 **Depth to Water:** 23.0
Elevation: 755.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9508333°, -92.2933333°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-0.9' Portland cement concrete (11")							
		0.9-2.7' (CL) FILL: Brown and gray, lean CLAY, trace sand, gravel, and wood		X	22	4-2-3 (8)			
		2.7-5.5' (GC) FILL:Gray, clayey GRAVEL							
5			750		27		Qu Test Results MC = 8.2%	PP >4.50 tsf	
		5.5-8.0' (CL) FILL: Gray, lean CLAY, trace sand and gravel		X	39	7-6-4 (15)		PP >4.50 tsf	LL = 46 PL = 17 MC = 11.7%
		8.0-12.0' (GP) FILL: Gray, crushed limestone GRAVEL		X	3	23-10-7 (26)			
10		8.0' -rough drilling below 8.0 ft.	745						
		12.0-25.0' (CH) Brown, fat CLAY, trace sand and gravel							
					88		Qu Test Results UCS = 3.77 ksf MC = 29.1% γ_{moist} = 125.1 pcf	PP = 3.00 tsf	LL = 78 PL = 22
15			740						
		18.5' -brown and gray below 18.5 ft.		X	100	5-5-7 (18)		PP = 3.00 tsf	MC = 20.9%
20			735						
		▽							
		23.5' -shaley below 23.5 ft.		X	75	12-10-50/0.3'		PP >4.50 tsf	MC = 19.0%
25			730						

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** JM **Operator:** LRK
Station: **Northing:** 1677351.298 **Date of Work:** 04/17/24-04/17/24
Offset: **Easting:** 757594.209 **Depth to Water:** 23.0
Elevation: 755.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9508333°, -92.2933333°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-27.0' LIMESTONE, gray, very hard, slightly weathered, finely crystalline, thin bedded			67 (67)				
		27.0-28.5' SHALE, black, very soft, highly weathered, aphanitic			92 (38)				
		28.5-29.2' COAL, black							
30		29.2-33.4' SHALE, gray, very soft, highly weathered, aphanitic	725						
		32.6' -moderately hard below 32.6 ft.			100 (63)				
		33.4-35.0' LIMESTONE, gray, very hard, slightly weathered, finely crystalline, thin bedded							
35			720						
		Refusal at 25.0 feet. Bottom of borehole at 35.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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LETTER BOREHOLE - MODOT 20150728.GDT - 8/15/24 11:50 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\20241040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040 - PRELIMINARY.GPJ

Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** JM **Operator:** LRK
Station: **Northing:** 1677251.076 **Date of Work:** 04/19/24-04/19/24
Offset: **Easting:** 757660.91 **Depth to Water:**
Elevation: 750.1 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.950628°, -92.293179°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-12.0' (CL) FILL: Brown and gray, lean CLAY, trace sand	750						
		0.0' -trace roots from 1.0 to 2.5 ft.			61	5-6-5 (17)		PP = 4.00 tsf	MC = 16.8%
		3.5' -trace cinders from 3.5 to 5.0 ft.			28	6-4-5 (14)		PP = 2.00 tsf	MC = 19.9%
5			745						
		6.0' -trace limestone fragments from 6.0 to 7.5 ft.			22	6-8-13 (32)		PP = 2.50 tsf	
					100		Qu Test Results MC = 19.8%	PP = 1.50 tsf	LL = 40 PL = 19
		8.5' (Sample disturbed) -trace gravel below 8.5 ft.			89	6-3-6 (14)		PP = 2.00 tsf	
10			740						
		12.0-16.0' (CL) Dark gray, lean CLAY, trace sand and roots							
					28	6-4-5 (14)		PP = 3.50 tsf	LL = 39 PL = 18 MC = 23.9%
15			735						
		16.0-17.5' Gray, highly weathered LIMESTONE							
					0	50/0.0'			
		17.5-22.5' LIMESTONE, gray, hard, slightly weathered, finely crystalline, thin bedded			83 (83)		Qu Test Results UCS = 2870 ksf		
20		19.5' -4" rod drop and core loss at 19.5 ft.	730						
					83 (67)		Qu Test Results UCS = 2670 ksf		
		22.5-23.4' SHALE, dark gray, soft							
		23.4-24.3' Core loss (rod drop)			58 (0)				
25		24.3-25.0' SHALE, black, moderately hard							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** JM **Operator:** LRK
Station: **Northing:** 1677251.076 **Date of Work:** 04/19/24-04/19/24
Offset: **Easting:** 757660.91 **Depth to Water:**
Elevation: 750.1 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.950628°, -92.293179°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-25.5' SHALE, black, moderately hard	725						
		25.5-26.8' COAL, black, slightly weathered							
		26.8-28.8' Core loss			60 (8)				
30		28.8-30.5' SHALE, gray, very soft, completely weathered	720						
		Refusal at 17.5 feet. Bottom of borehole at 30.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1677354.508 **Date of Work:** 05/03/24-05/03/24
Offset: **Easting:** 757670.63 **Depth to Water:**
Elevation: 752.9 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9509275°, -92.2931254°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-1.2' (SC) Brown, clayey SAND, with gravel							
		1.2-18.0' (CH) Gray, fat CLAY 1.2' -shaley from 1.2 to 2.5 ft.	750		44	5-7-9 (24)		PP = 2.00 tsf	MC = 21.3%
5					33	3-4-5 (14)		PP = 2.50 tsf	LL = 50 PL = 18 MC = 11.8%
		6.0' -gray and brown, trace sand and gravel below 6.0 ft. 7.5' -rough drilling from 7.5 to 10.0 ft.	745		33	5-5-4 (14)		PP = 2.25 tsf	MC = 25.1%
					40	50/0.4'			MC = 21.4%
10			740						
		13.0' -gray, with gravel below 13.0 ft. 13.0' (Sample disturbed)			100		Qu Test Results MC = 34.2%		LL = 67 PL = 19
15			735						
		18.0-19.0' Gray, weathered LIMESTONE			40	50/0.4'			
20		19.0-21.5' LIMESTONE, gray and tan, hard, slightly weathered, finely crystalline to aphanitic, thin to medium bedded, dense			100 (83)		Qu Test Results UCS = 3580 ksf		
		21.5-23.3' SHALE, gray and tan, highly to moderately weathered	730		100 (77)				
25		23.3-25.0' LIMESTONE, gray and tan, hard, slightly weathered, finely crystalline to aphanitic, thin to medium bedded, dense							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1677354.508 **Date of Work:** 05/03/24-05/03/24
Offset: **Easting:** 757670.63 **Depth to Water:**
Elevation: 752.9 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9509275°, -92.2931254°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-25.5' LIMESTONE, gray and tan, hard, slightly weathered, finely crystalline to aphanitic, thin to medium bedded, dense							
		25.5-30.5' SHALE, black, soft to hard, slightly weathered	725		60 (33)				
30		29.4' -gray, very soft, completely to highly weathered below 29.4 ft.							
		Refusal at 19.0 feet. Bottom of borehole at 30.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** JM **Operator:** LRK
Station: **Northing:** 1677268.569 **Date of Work:** 04/18/24-04/18/24
Offset: **Easting:** 757742.38 **Depth to Water:**
Elevation: 751.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.950648°, -92.292874°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-7.8' (CL) Brown and gray, lean CLAY, trace sand 1.0' -trace gravel from 1.0 to 2.5 ft.	750		33	3-2-3		PP = 2.00 tsf	MC = 22.5%
					11	3-4-5		PP = 3.50 tsf	
5			745		28	4-7-6		PP = 3.50 tsf	MC = 17.4%
		7.8-15.5' (CH) Brown, fat CLAY , trace sand			42		Qu Test Results UCS = 4.43 ksf MC = 15.4% γ_{moist} = 122.0 pcf	PP = 4.50 tsf	LL = 51 PL = 19
10			740						
		13.5' -brown and gray below 13.5 ft.			67	4-4-6		PP = 3.50 tsf	MC = 22.2%
15		15.5-18.3' LIMESTONE, gray, very hard, slightly weathered, finely crystalline, thin bedded	735		0	50/0.0'			
					100 (62)		Qu Test Results UCS = 2740 ksf		
		18.3-20.0' SHALE, tan, very soft							
20		19.5' -calcareous below 19.5 ft.							
		20.0-22.1' LIMESTONE, gray, hard, slightly weathered, finely crystalline, thin bedded	730		100 (53)				
		22.1-22.5' SHALE, dark gray, very soft, completely weathered							
		22.5-25.0' Shaley COAL, black, moderately hard, highly weathered, aphanitic, thin bedded			67 (0)				
25		24.5' -3" limestone seam							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** JM **Operator:** LRK
Station: **Northing:** 1677268.569 **Date of Work:** 04/18/24-04/18/24
Offset: **Easting:** 757742.38 **Depth to Water:**
Elevation: 751.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.950648°, -92.292874°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-25.5' COAL, black 25.5-29.5' SHALE, gray, very soft, completely weathered	725		98 (0)				
					100	24-25-28			
		Refusal at 16.0 feet. Bottom of borehole at 29.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681285.672 **Date of Work:** 05/23/24-05/24/24
Offset: **Easting:** 760921.16 **Depth to Water:** 18.5
Elevation: 759.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9614876, -92.2816536)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-2.7' (CH) Brown, fat CLAY, with gravel							
				X	17	17-4-6 (15)		PP >4.50 tsf	MC = 12.7%
		2.7-5.5' (CL) Brown, lean CLAY, with sand and gravel							
				■	92		Qu Test Results UCS = 2.51 ksf MC = 15.4% γ_{moist} = 134.8 pcf	PP = 1.00 tsf	LL = 32 PL = 14
5			755						
		5.5-16.8' (CH) Gray, fat CLAY							
				X	83	3-3-4 (11)		PP = 1.75 tsf	MC = 25.5%
		8.5' -brown and gray, trace sand and gravel from 8.5 to 10.0 ft.		X	89	3-6-7 (20)		PP = 3.25 tsf	MC = 22.1%
10			750						
		13.0' -brown and gray, gravelly from 13.0 to 14.5 ft.		■	100		Qu Test Results UCS = 3.36 ksf MC = 18.9% γ_{moist} = 127.6 pcf		LL = 64 PL = 14
15			745						
		16.8-24.0' (CL) Brown, lean CLAY, trace sand and gravel							
		▽		X	100	10-6-7 (20)		PP = 3.25 tsf	LL = 44 PL = 12 MC = 17.8%
20			740						
				■	100		Qu Test Results MC = 24.1%	PP >4.50 tsf	
		24.0-25.0' LIMESTONE, tan and gray, moderately hard, dense to pitted	735	▯	92 (33)				
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681285.672 **Date of Work:** 05/23/24-05/24/24
Offset: **Easting:** 760921.16 **Depth to Water:** 18.5
Elevation: 759.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9614876, -92.2816536)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-29.5' LIMESTONE, tan and gray, moderately hard, moderately to highly weathered, aphanitic to finely crystalline, thin bedded, pitted to vuggy 25.5' -5" clay seam at 25.5 ft.			60 (40)		Qu Test Results UCS = 1230 ksf		
30		29.5-33.5' COAL, black, very soft to moderately hard, slightly to highly weathered 29.5' -subbituminous and wet from 29.5 to 31.0 ft.	730		87 (17)				
35		33.5-35.0' SHALE, gray, soft, moderately to highly weathered	725						
		Refusal at 24.0 feet. Bottom of borehole at 35.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

BORING NO. BR 16-1.1A

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681285.672 **Date of Work:** 04/15/24-04/15/24
Offset: **Easting:** 760921.16 **Depth to Water:** 13.0
Elevation: 759.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9616501°, -92.2816000°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-22.0' (CH) Brown and gray, fat CLAY, trace sand							
					44	3-3-4 (11)		PP = 2.25 tsf	MC = 29.3%
			755		89	4-4-6 (15)		PP = 3.00 tsf	
5		6.0' -trace gravel below 6.0 ft.			83	4-5-7 (18)		PP = 4.00 tsf	MC = 24.6%
			750		100		Qu Test Results UCS = 4.63 ksf MC = 18.6% γ_{moist} = 128.7 pcf	PP = 3.50 tsf	LL = 54 PL = 15
10									
		13.5' -brown below 13.5 ft.	745		100	8-7-8 (23)		PP = 4.50 tsf	MC = 19.7%
15									
			740		100		Qu Test Results MC = 22.4% γ_{moist} = 125.5 pcf	PP = 3.75 tsf	LL = 67 PL = 17
20									
		21.3' -rough drilling below 21.3 ft.							
		22.0-24.0' Gray and brown, weathered SHALE			100	50/0.5'		PP >4.50 tsf	
		Bottom of borehole at 24.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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LETTER BOREHOLE - MODOT 20150728.GDT - 8/15/24 11:50 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\2024 1040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040 - PRELIMINARY.GPJ

Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681194.498 **Date of Work:** 04/24/24-04/24/24
Offset: **Easting:** 761002.639 **Depth to Water:**
Elevation: 765.1 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9613894°, -92.2814347°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-0.8' Asphaltic concrete (9")	765						
		0.8-1.1' Crushed limestone (4")							
		1.1-5.5' FILL: Possible CLAY			22	18-7-3 (15)			
					0	4-4-4 (12)			
5			760						
		5.5-25.0' (CL) Brown, lean CLAY, with sand and gravel			96		Qu Test Results UCS = 3.33 ksf MC = 16.8% γ_{moist} = 132.7 pcf	PP = 3.00 tsf	LL = 25 PL = 13
		8.5' -brown and gray, trace sand and gravel below 8.5 ft.			89	2-3-4 (11)		PP = 2.00 tsf	MC = 25.4%
10			755						
					100	3-4-5 (14)		PP = 3.00 tsf	MC = 24.0%
15			750						
					96		Qu Test Results UCS = 3.04 ksf MC = 23.3% γ_{moist} = 126.4 pcf	PP = 3.00 tsf	LL = 46 PL = 16
20			745						
					100		Qu Test Results MC = 19.5%	PP = 3.00 tsf	
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681194.498 **Date of Work:** 04/24/24-04/24/24
Offset: **Easting:** 761002.639 **Depth to Water:**
Elevation: 765.1 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9613894°, -92.2814347°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-27.8' (CH) Brown and gray, fat CLAY, trace sand and gravel	740						
		27.5' -rough drilling below 27.5 ft.			0	50/0.0'			
		27.8-33.7' LIMESTONE, gray and tan, moderately hard, slightly weathered, finely crystalline to aphanitic, thin bedded, dense			87 (32)				
30		29.8' -4" rod drop at 29.8 ft. 30.2' -6" shale seam 30.8' -shale seams below 30.8 ft.	735						
					47 (28)				
		33.7-35.2' Core loss 33.7' -3" rod drop at 33.7 ft.							
35			730						
		35.2-36.6' SHALE, black, moderately hard, slightly weathered, thin bedded, with interbedded coal							
		36.6-40.4' SHALE, gray, very soft to soft, highly weathered			100 (78)				
40			725						
		Refusal at 27.8 feet. Bottom of borehole at 40.4 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681283.069 **Date of Work:** 04/15/24-04/15/24
Offset: **Easting:** 761077.078 **Depth to Water:** 8.0
Elevation: 752.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9616537°, -92.2810873°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-5.5' (CL) Brown and gray, lean CLAY, silty, trace sand and gravel							
					67	5-3-3 (9)		PP = 0.50 tsf	MC = 23.1%
			750						
		3.0' -gravelly below 3.0 ft.			96		Qu Test Results UCS = 1.03 ksf MC = 24.2% γ_{moist} = 118.3 pcf		LL = 41 PL = 19
5									
		5.5-12.0' (CH) Brown and gray, fat CLAY, trace sand and gravel			78	4-4-8 (18)		PP = 2.50 tsf	MC = 28.1%
			745						
					78	6-5-7 (18)		PP = 4.25 tsf	LL = 54 PL = 16 MC = 21.9%
10									
		12.0-13.6' Gray, weathered LIMESTONE	740						
		Refusal at 13.6 feet. Bottom of borehole at 13.6 feet.			50	50/0.1'			

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681163.13 **Date of Work:** 04/23/24-04/23/24
Offset: **Easting:** 760921.309 **Depth to Water:** 23.0
Elevation: 762.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9613007°, -92.2816006°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-0.7' Asphaltic concrete (8")							
		0.7-25.0' (CH) Gray and brown, fat CLAY 0.7' -with gravel from 1.0 to 7.5 ft.	760	X	17	5-4-4 (12)		PP = 3.00 tsf	
5				X	33	5-4-5 (14)		PP = 2.25 tsf	LL = 51 PL = 15 MC = 19.0%
			755	X	67	3-3-5 (12)		PP = 1.75 tsf	MC = 31.2%
10				■	67		Qu Test Results UCS = 3.54 ksf MC = 20.0%	PP >4.50 tsf	LL = 52 PL = 15
			750						
15				■	100		Qu Test Results MC = 25.8%	PP = 2.00 tsf	LL = 66 PL = 16
			745						
20		18.5' -sandy, trace gravel from 18.5 to 20.0 ft.		X	83	6-5-5 (15)		PP = 1.50 tsf	MC = 17.1%
			740						
25		▽		■	96		Qu Test Results UCS = 2.36 ksf MC = 25.2% γ_{moist} = 122.7	PP = 3.50 tsf	LL = 68 PL = 18

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1681163.13 **Date of Work:** 04/23/24-04/23/24
Offset: **Easting:** 760921.309 **Depth to Water:** 23.0
Elevation: 762.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9613007°, -92.2816006°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-27.0' (CH) Gray and brown, fat CLAY					pcf		
		27.0-28.2' Gray, weathered LIMESTONE 27.0' -rough drilling below 27.0 ft.	735						
		28.2-30.2' LIMESTONE, gray and tan, hard, slightly weathered, finely crystalline to aphanitic, thin to medium bedded, dense			25 92 (27)	50/0.2'			
30		30.2-31.2' (CH) Gray and red, fat CLAY							
		31.2-32.5' SHALE, gray and tan, moderately to highly weathered	730						
		32.5-33.9' LIMESTONE, gray and tan, hard, slightly weathered, finely crystalline to aphanitic, thin to medium bedded, dense			100 (37)				
35		33.9-36.2' SHALE, black, soft to moderately hard, slightly to moderately weathered							
		36.2-37.2' COAL, black	725						
		37.2-40.2' SHALE, gray, soft, moderately to highly weathered			65 (37)				
40		Refusal at 28.0 feet. Bottom of borehole at 40.2 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** EV **Operator:** LRK
Station: **Northing:** 1681126.886 **Date of Work:** 04/22/24-04/22/24
Offset: **Easting:** 761007.373 **Depth to Water:**
Elevation: 765.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9611855°, -92.2814290°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-1.0' Asphaltic concrete (12")	765						
		1.0-1.2' Crushed limestone (2")							
		1.2-5.5' (CL) FILL: Brown and gray, lean CLAY, with sand, trace gravel			56	5-4-6 (15)		PP = 4.00 tsf	MC = 15.1%
5			760		86		Qu Test Results MC = 18.9%	PP = 1.00 tsf	
		5.5-17.0' (CH) Brown and gray, fat CLAY, trace sand and gravel			89	3-3-5 (12)		PP = 1.75 tsf	MC = 30.3%
10			755		94	8-5-4 (14)		PP = 1.00 tsf	LL = 71 PL = 20 MC = 7.7%
15			750		100	3-4-4 (12)		PP = 1.50 tsf	MC = 21.8%
		17.0-25.0' (CL) Brown and gray, lean CLAY, trace sand and gravel			71		Qu Test Results UCS = 4.03 ksf MC = 21.7% γ_{moist} = 130.3 pcf	PP = 0.75 tsf	LL = 49 PL = 15
20			745						
25		23.5' -trace wood chips below 23.5 ft.			100	2-3-3 (9)		PP = 0.75 tsf	MC = 27.3%

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** EV **Operator:** LRK
Station: **Northing:** 1681126.886 **Date of Work:** 04/22/24-04/22/24
Offset: **Easting:** 761007.373 **Depth to Water:**
Elevation: 765.0 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9611855°, -92.2814290°)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-32.5' (CH) Brown and gray, fat CLAY, trace sand and gravel	740						
		28.0' -gravelly and sandy below 28.0 ft.			100		Qu Test Results MC = 27.5%	PP = 1.25 tsf	LL = 69 PL = 19
30			735						
		32.5-33.9' LIMESTONE, gray, hard, slightly weathered, finely crystalline, fossiliferous			0	50/0.0'			
		33.7' -highly weathered below 33.7 ft.			73 (37)				
35		33.9-36.7' SHALE, black, soft, highly weathered, fissile	730						
		34.3' -8" core loss at 34.3 ft.							
		35.0' -gray, very soft below 35.0 ft.							
		36.7-38.0' Core loss (possible washout)			74 (60)				
		38.0-42.0' SHALE, black, moderately hard, highly weathered, fissile							
40			725						
		40.0' -gray, very soft below 40.0 ft.							
		42.0-45.0' LIMESTONE, gray, hard, moderately to highly weathered, finely crystalline			100 (80)				
45		44.8' -2" shale seam at 44.8 ft.							
		Refusal at 32.5 feet. Bottom of borehole at 45.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

BORING NO. Ramp 5-1A

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1682630.825 **Date of Work:** 06/04/24-06/04/24
Offset: **Easting:** 754554.285 **Depth to Water:** 3.5
Elevation: 723.9 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler
Requested Elevation: **Location Note:** (38.9653970, -92.3039837)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-5.5' (CH) Brown and gray, fat CLAY, with sand and gravel							
					56	2-3-3 (9)		PP = 1.50 tsf	MC = 17.6%
		▽	720						
					78	2-2-2 (6)		PP = 1.50 tsf	LL = 72 PL = 21 MC = 27.4%
5		5.5-7.5' Gray, SHALE							
					100	50/0.5'		PP >4.50 tsf	
		Refusal at 7.5 feet. Bottom of borehole at 7.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

BORING NO. Ramp 5-2A

Job No.: 20241040.00 **County:** Boone **Route:** I-70
Design: **Skew:** **Location:** Columbia, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1682507.395 **Date of Work:** 06/04/24-06/04/24
Offset: **Easting:** 754653.015 **Depth to Water:** 4.0
Elevation: 720.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9650837, -92.3036414)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-4.0' (CL) Brown and gray, lean CLAY, with sand	720						
					50	2-3-2 (8)		PP = 1.25 tsf	MC = 20.6%
		3.0' -trace sand below 3.0 ft.			83		Qu Test Results UCS = 0.812 ksf MC = 50.9%	PP = 1.50 tsf	
		Refusal at 4.0 feet. Bottom of borehole at 4.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

BORING NO. Ramp C-D-1

Job No.: 20241040.00	**County:** Boone	**Route:** I-70
Design:	**Skew:**	**Location:** Columbia, Missouri
Bent:	**Logged By:** SO	**Operator:** LRK
Station:	**Northing:** 1681794.145	**Date of Work:** 04/12/24-04/12/24
Offset:	**Easting:** 755880.903	**Depth to Water:** 18.0
Elevation: 710.8	**Requested Northing:**	**Depth Hole Open:**
Requested Station:	**Requested Easting:**	**Time Change:**
Requested Offset:	**Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube	
Requested Elevation:	**Location Note:** (38.9631034, -92.2993807)	
Drill No.:	**Hammer Efficiency:** 90%	**Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-2.7' (CH) Brown, fat CLAY, with gravel	710						
					33	3-3-6 (14)		PP = 2.50 tsf	LL = 55 PL = 17 MC = 18.3%
		2.7-5.5' (GP) GRAVEL			0				
5			705						
		5.5-17.0' (CH) Brown and gray, fat CLAY, trace gravel			56	3-4-4 (12)		PP = 2.00 tsf	MC = 19.9%
					83	3-3-4 (11)		PP = 2.00 tsf	MC = 21.9%
10			700						
					100		Qu Test Results MC = 28.5% γ_{moist} = 120.8 pcf	PP = 2.50 tsf	LL = 65 PL = 19
15			695						
		17.0-24.2' (SC) Brown, clayey SAND (SC), with gravel ▽			92		Qu Test Results MC = 13.2%		
					100	12-16-17 (50)			MC = 12.6%
20			690						
					56	7-4-4 (12)		PP = 0.50 tsf	
25		24.2-25.0' Gray and brown, weathered SHALE							
		Bottom of borehole at 25.0 feet							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**

Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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LETTER BOREHOLE - MODOT 20150728.GDT - 8/15/24 11:51 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\20241040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040 - PRELIMINARY.GPJ

Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675603.137 **Date of Work:** 05/21/24-05/22/24
Offset: **Easting:** 857708.988 **Depth to Water:** 48.5
Elevation: 830.8 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9444108, -91.9414268)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-21.8' (CH) Brown and gray, fat CLAY, trace sand and gravel	830						
				X	56	2-2-2 (6)		PP = 1.75 tsf	MC = 26.4%
				■	58		Qu Test Results UCS = 2.76 ksf MC = 22.8%	PP = 2.00 tsf	LL = 50 PL = 13
5			825						
				X	72	3-5-5 (15)		PP = 3.50 tsf	MC = 13.7%
				■	83		Qu Test Results MC = 19.3% γ_{moist} = 135.1 pcf	PP = 3.75 tsf	LL = 70 PL = 16
10			820						
				X	22	4-5-7 (18)		PP = 2.25 tsf	LL = 52 PL = 13 MC = 20.4%
15			815						
				X	17	7-7-10 (26)			MC = 17.2%
20			810						
		21.8-25.0' (CL) Brown and gray, lean CLAY, trace sand and gravel		X	100	4-4-5 (14)		PP = 3.00 tsf	LL = 47 PL = 15 MC = 20.3%
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675603.137 **Date of Work:** 05/21/24-05/22/24
Offset: **Easting:** 857708.988 **Depth to Water:** 48.5
Elevation: 830.8 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9444108, -91.9414268)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-26.8' (CL) Brown and gray, lean CLAY, trace sand and gravel	805						
		26.8-50.0' (CH) Brown and gray, fat CLAY, trace sand and gravel		X	100	5-11-10 (32)		PP = 3.00 tsf	MC = 15.0%
30			800						
				X	100	7-6-10 (24)		PP >4.50 tsf	MC = 14.3%
35			795						
		38.5' -auto hammer broke down at 38.5 ft. 38.5' -with silt lenses from 38.5 to 39.0 ft.		X	83	9/0.5', 10/0'		PP >4.50 tsf	MC = 13.9%
40			790						
		43.5' -gravelly, with sand below 43.5 ft.		X	100	6-11-14 (38)		PP >4.50 tsf	MC = 15.4%
45			785						
	▽			X	6	4-6-8 (21)			
50									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675603.137 **Date of Work:** 05/21/24-05/22/24
Offset: **Easting:** 857708.988 **Depth to Water:** 48.5
Elevation: 830.8 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9444108, -91.9414268)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		50.0-61.8' (CH) Brown and gray, fat CLAY, trace sand and gravel	780						
				X	100	5-5-6 (17)		PP = 2.75 tsf	MC = 19.5%
55			775						
		58.5' -with sand and gravel below 58.5 ft.		X	100	7-9-11 (30)		PP >4.50 tsf	MC = 18.6%
60			770						
		61.8-66.8' (CL) Brown and gray, lean CLAY, trace sand and gravel		X	100	6-8-10 (27)		PP >4.50 tsf	LL = 48 PL = 15 MC = 18.1%
65			765						
		66.8-75.0' (CH) Brown and gray, fat CLAY, trace sand and gravel		X	100	8-10-21 (47)		PP >4.50 tsf	MC = 17.7%
70			760						
				X	100	7-9-12 (32)		PP >4.50 tsf	MC = 16.8%
75									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675603.137 **Date of Work:** 05/21/24-05/22/24
Offset: **Easting:** 857708.988 **Depth to Water:** 48.5
Elevation: 830.8 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9444108, -91.9414268)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
75		75.0-97.0' (CH) Brown and gray, fat CLAY, with sand and gravel	755						
				X	100	7-12-24 (54)		PP = 3.75 tsf	MC = 16.4%
80			750						
				X	100	8-7-9 (24)		PP = 4.50 tsf	MC = 18.5%
85			745						
		88.5' -trace sand and gravel below 88.5 ft.		X	100	5-6-7 (20)		PP = 3.25 tsf	LL = 63 PL = 14 MC = 22.7%
90			740						
				X	100	10-13-19 (48)		PP >4.50 tsf	MC = 16.3%
95			735						
		97.0-99.2' Gray, SHALE		X	100	30-50/0.2'		PP >4.50 tsf	MC = 9.4%
100		99.2-100.0' SHALE, gray, soft to very soft			67				

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675603.137 **Date of Work:** 05/21/24-05/22/24
Offset: **Easting:** 857708.988 **Depth to Water:** 48.5
Elevation: 830.8 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9444108, -91.9414268)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
100		100.0-109.3' SHALE, gray, soft to very soft, highly weathered	730		(0)				
					60 (37)		Qu Test Results UCS = 3.96 ksf		
105		105.0' -completely weathered below 105.0 ft.	725		33 (0)				
110		109.3-115.0' LIMESTONE, moderately hard to hard, slightly to moderately weathered, aphanitic, thin to thick bedded, dense to pitted 109.3' -cherty from 109.3 to 110.0 ft.	720		100 (77)		Qu Test Results UCS = 2320 ksf		
115		Refusal at 99.2 feet. Bottom of borehole at 115.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675553.73 **Date of Work:** 05/22/24-05/23/24
Offset: **Easting:** 857700.349 **Depth to Water:** 8.0
Elevation: 830.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9442819, -91.9414030)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-7.7' (CH) Brown and gray, fat CLAY, with gravel and sand	830						
				X	44	2-4-4 (12)		PP = 1.75 tsf	MC = 19.3%
		3.5' -sandy from 3.5 to 4.0 ft. 4.0' -trace sand and gravel from 4.0 to 5.0 ft.		X	72	1-2-2 (6)		PP = 1.00 tsf	MC = 20.5%
5			825						
		6.0' -with sand seams from 6.0 to 7.5 ft.		X	83	5-8-14 (33)		PP >4.50 tsf	MC = 15.4%
		7.7-12.0' (CL-ML) Brown and gray, SILTY CLAY, with gravel and sand		■	100		Qu Test Results UCS = 4.51 ksf MC = 19.3% γ_{moist} = 127.3 pcf	PP = 3.25 tsf	LL = 23 PL = 17
10			820						
		12.0-25.0' (CH) Brown and gray, fat CLAY, with gravel and sand							
		13.5' -trace sand and gravel from 13.5 to 15.0 ft.		X	67	5-9-11 (30)		PP >4.50 tsf	MC = 17.1%
15			815						
		18.5' -gray from 18.5 to 20.0 ft.		X	72	8-10-11 (32)		PP = 2.50 tsf	MC = 18.9%
20			810						
		23.5' -with sand seams from 23.5 to 25.0 ft.		X	100	13-9-7 (24)		PP = 3.00 tsf	MC = 20.7%
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675553.73 **Date of Work:** 05/22/24-05/23/24
Offset: **Easting:** 857700.349 **Depth to Water:** 8.0
Elevation: 830.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9442819, -91.9414030)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-50.0' (CH) Gray, fat CLAY, with gravel and sand	805						
				X	100	5-10-11 (32)		PP = 3.50 tsf	MC = 18.1%
30			800						
		33.5' -trace sand and gravel from 33.5 to 35.0 ft.		X	100	5-7-11 (27)		PP >4.50 tsf	MC = 16.1%
35			795						
				X	100	6-9-11 (30)		PP >4.50 tsf	MC = 17.8%
40			790						
		43.5' -with sand lenses from 43.5 to 45.0 ft.		X	100	11-27-25 (78)		PP = 3.00 tsf	MC = 17.1%
45			785						
				X	100	4-7-8 (23)		PP = 3.00 tsf	MC = 17.8%
50									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675553.73 **Date of Work:** 05/22/24-05/23/24
Offset: **Easting:** 857700.349 **Depth to Water:** 8.0
Elevation: 830.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9442819, -91.9414030)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		50.0-67.0' (CH) Brown and gray, fat CLAY, with gravel and sand	780						
		53.5' -trace sand and gravel from 53.5 to 55.0 ft.		X	100	6-8-8 (24)		PP = 3.00 tsf	MC = 16.8%
55			775						
				X	100	5-12-13 (38)		PP = 4.00 tsf	MC = 22.0%
60			770						
		63.5' -with sand seams below 63.5 ft.		X	100	5-6-7 (20)		PP >4.50 tsf	MC = 18.0%
65			765						
		67.0-69.3' (CL) Gray, lean CLAY, silty		X	100	5-6-7 (20)		PP = 4.50 tsf	LL = 31 PL = 14 MC = 20.1%
70		69.3-93.5' (CH) Brown and gray, fat CLAY, with gravel and sand	760						
				X	100	6-7-10 (26)		PP = 4.25 tsf	MC = 18.3%
75									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675553.73 **Date of Work:** 05/22/24-05/23/24
Offset: **Easting:** 857700.349 **Depth to Water:** 8.0
Elevation: 830.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9442819, -91.9414030)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
75		69.3-93.5' (CH) Brown and gray, fat CLAY, with gravel and sand *(continued)*	755						
				X	56	11-36-22 (87)		PP = 3.75 tsf	MC = 17.7%
80			750						
				X	100	5-5-11 (24)		PP = 2.00 tsf	MC = 19.7%
85			745						
				X	100	8-13-13 (39)		PP = 4.00 tsf	MC = 20.5%
90			740						
		93.5-100.0' No recovery			0	50/0.1'			
		93.5' (Run 1 = 5.3 min/ft)			0 (0)				
95			735						
		97.0' (Run 2 = 5, 4, 3, 4, 8 min/ft)			0 (0)				
100									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675553.73 **Date of Work:** 05/22/24-05/23/24
Offset: **Easting:** 857700.349 **Depth to Water:** 8.0
Elevation: 830.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9442819, -91.9414030)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
100		100.0-120.0' SHALE, gray, soft to very soft 100.0' -with limestone fragments from 100.0 to 105.0 ft.	730						
		102.0' (Run 3 = 7, 5, 8, 6, 6 min/ft)			17 (10)				
105		105.0' -rotary wash from 105.0 to 106.0 ft.	725		100	50/0.3'		PP >4.50 tsf	
		108.0' (Run 4 = 3, 3, 3, 9 min/ft)			92 (54)		Qu Test Results UCS = 7.98 ksf MC = 11.6%		
110			720						
		112.0' (Run 5 = 4, 4, 4, 7, 10 min/ft)			68 (45)		Qu Test Results UCS = 2.08 ksf MC = 12.6%		
115			715						
		117.0' (Run 6 = 6, 5, 5, 7, 7 min/ft)			47 (23)				
120		Refusal at 93.5 feet. Bottom of borehole at 120.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675503.187 **Date of Work:** 05/14/24-05/15/24
Offset: **Easting:** 857701.073 **Depth to Water:** 13.5
Elevation: 831.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9441375, -91.9414315)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-0.6' Asphaltic concrete (7.0")							
		0.6-1.2' Aggregate base (7.0")	830						
		1.2-7.7' (CH) Brown and gray, fat CLAY			44	8-3-3 (9)		PP = 1.75 tsf	MC = 15.7%
					92		Qu Test Results UCS = 2.82 ksf MC = 23.3% γ_{moist} = 129.4 pcf	PP = 4.25 tsf	LL = 64 PL = 17
5									
		6.0' -trace sand and gravel below 6.0 ft.	825		100	6-5-6 (17)		PP = 2.75 tsf	MC = 14.9%
		7.7-25.0' (CL) Brown and gray, lean CLAY							
		8.0' -sandy from 8.0 to 15.0 ft.			92		Qu Test Results UCS = 4.46 ksf MC = 11.2% γ_{moist} = 136.4 pcf	PP = 4.00 tsf	LL = 44 PL = 14
10			820						
		13.5' -trace gravel from 13.5 to 15.0 ft.			67	4-5-16 (32)		PP = 2.00 tsf	MC = 11.8%
15			815						
		18.5' -with sand and gravel below 18.5 ft.			44	7-8-7 (23)		PP = 2.50 tsf	MC = 12.1%
20			810						
					17	11-9-11 (30)			MC = 16.9%
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675503.187 **Date of Work:** 05/14/24-05/15/24
Offset: **Easting:** 857701.073 **Depth to Water:** 13.5
Elevation: 831.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9441375, -91.9414315)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-27.0' (CL) Brown and gray, lean CLAY, with sand and gravel	805						
		27.0-42.0' (CH) Gray, fat CLAY, trace sand and gravel		X	100	3-4-6 (15)		PP = 3.00 tsf	LL = 57 PL = 17 MC = 17.0%
30			800						
				X	100	4-14-21 (53)		PP >4.50 tsf	MC = 11.1%
35			795						
				X	100	13-32-19 (77)		PP = 4.50 tsf	MC = 13.4%
40			790						
		42.0-50.0' (CL) Gray, lean CLAY, trace sand and gravel		X	100	6-10-14 (36)		PP = 4.00 tsf	LL = 45 PL = 14 MC = 13.0%
45			785						
				X	100	6-8-14 (33)		PP = 3.50 tsf	MC = 14.1%
50									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675503.187 **Date of Work:** 05/14/24-05/15/24
Offset: **Easting:** 857701.073 **Depth to Water:** 13.5
Elevation: 831.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9441375, -91.9414315)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		50.0-75.0' (CH) Gray, fat CLAY	780						
				X	100	12-6-5 (17)		PP = 2.50 tsf	MC = 18.5%
55			775						
		58.5' -gray and brown, with gravel below 58.5 ft.		X	100	8-8-10 (27)		PP = 4.25 tsf	LL = 56 PL = 17 MC = 14.6%
60			770						
				X	100	10-14-13 (41)		PP >4.50 tsf	MC = 14.7%
65			765						
				X	39	9-12-16 (42)		PP = 4.50 tsf	MC = 20.3%
70			760						
		73.5' -trace sand below 73.5 ft.		X	100	12-9-10 (29)		PP >4.50 tsf	LL = 53 PL = 15 MC = 14.1%
75									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675503.187 **Date of Work:** 05/14/24-05/15/24
Offset: **Easting:** 857701.073 **Depth to Water:** 13.5
Elevation: 831.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9441375, -91.9414315)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
75		75.0-99.2' (CH) Gray and brown, fat CLAY, with gravel 75.0' -trace sand from 75.0 to 85.0 ft.	755						
				X	17	25-16-17 (50)		PP = 2.50 tsf	MC = 15.3%
80			750						
		83.5' -trace gravel from 83.5 to 90.0 ft.		X	100	5-5-8 (20)		PP = 3.00 tsf	MC = 18.5%
85			745						
				X	100	6-7-10 (26)		PP = 3.50 tsf	LL = 66 PL = 15 MC = 17.8%
90			740						
		93.5' -gravelly below 93.5 ft.		X	100	20-18-17 (53)		PP >4.50 tsf	MC = 11.9%
95			735						
				X	100	15-50/0.5'		PP = 4.50 tsf	
100		99.2-100.0' Gray, SHALE, soft							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675503.187 **Date of Work:** 05/14/24-05/15/24
Offset: **Easting:** 857701.073 **Depth to Water:** 13.5
Elevation: 831.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9441375, -91.9414315)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
100		100.0-104.8' SHALE, gray, very soft to soft, highly weathered	730		100 (90)		Qu Test Results UCS = 7.98 ksf		
105		104.8-110.0' LIMESTONE, with interbedded shale, tan and gray, soft to moderately hard, moderately to slightly weathered, aphanitic, thin bedded, dense	725		77 (33)		Qu Test Results UCS = 78.0 ksf		
110		Refusal at 100.0 feet. Bottom of borehole at 110.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675626.041 **Date of Work:** 05/16/24-05/16/24
Offset: **Easting:** 857942.937 **Depth to Water:** 3.0
Elevation: 828.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9444720, -91.900566)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-2.7' (CL) Brown and gray, lean CLAY, silty, trace sand		X	94	3-3-5 (12)		PP = 2.50 tsf	MC = 18.4%
		2.7-5.0' (SC) Brown, clayey SAND, with gravel	825	■	100			PP = 0.50 tsf	Sieve Analysis Sieve # % Passing #200 17.6
5		5.0-12.0' (CL) Brown and gray, lean CLAY, with sand and gravel		X	78	13-19-12 (47)		PP = 4.50 tsf	MC = 13.1%
			820	■	94		Qu Test Results UCS = 11.0 ksf MC = 15.5% γ_{moist} = 136.2 pcf	PP >4.50 tsf	LL = 44 PL = 13
10		12.0-22.0' (CH) Brown and gray, fat CLAY, with sand and gravel	815	X	100	7-7-7 (21)		PP = 4.25 tsf	LL = 56 PL = 16 MC = 18.7%
15			810	X	44	7-7-10 (26)		PP = 4.50 tsf	MC = 18.6%
20		22.0-25.0' (CL) Brown and gray, lean CLAY, with sand and gravel	805	X	100	4-6-9 (23)		PP = 3.00 tsf	LL = 44 PL = 15 MC = 17.8%
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00	**County:** Callaway	**Route:** I-70
Design:	**Skew:**	**Location:** Kingdom City, Missouri
Bent:	**Logged By:** SO	**Operator:** LRK
Station:	**Northing:** 1675626.041	**Date of Work:** 05/16/24-05/16/24
Offset:	**Easting:** 857942.937	**Depth to Water:** 3.0
Elevation: 828.6	**Requested Northing:**	**Depth Hole Open:**
Requested Station:	**Requested Easting:**	**Time Change:**
Requested Offset:	**Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube	
Requested Elevation:	**Location Note:** (38.9444720, -91.900566)	
Drill No.:	**Hammer Efficiency:** 90%	**Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-37.0' (CH) Gray, fat CLAY, with sand and gravel							
			800						
				X	17	8-11-12 (35)		PP = 3.25 tsf	MC = 17.0%
30									
			795						
		33.5' -with chert gravel from 33.5 to 35.0 ft.		X	11	31-31-37 (102)			MC = 14.0%
35									
		37.0-42.0' (CL) Gray, lean CLAY, with sand and gravel	790						
				X	22	13-9-10 (29)		PP = 3.25 tsf	LL = 46 PL = 15 MC = 17.8%
40									
		42.0-50.0' (CH) Gray, fat CLAY, with sand and gravel	785						
				X	22	12-17-8 (38)			MC = 17.6%
45									
			780						
				X	100	8-7-8 (23)		PP = 3.25 tsf	LL = 68 PL = 18 MC = 22.0%
50									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Coordinate System: _____ **Coordinate Zone:** _____ **Coordinate Proj. Factor:** _____

Coordinate Datum: _____ **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675626.041 **Date of Work:** 05/16/24-05/16/24
Offset: **Easting:** 857942.937 **Depth to Water:** 3.0
Elevation: 828.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9444720, -91.900566)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		50.0-54.3' (CH) Gray, fat CLAY, with gravel	775						
				X	100	10-12-14 (39)		PP = 4.00 tsf	MC = 16.2%
55		54.3-59.5' (CL) Gray, lean CLAY, silty	770						
				X	100	5-7-9 (24)		PP = 3.00 tsf	MC = 19.1%
60		59.5-72.0' (CH) Gray and brown, fat CLAY, with gravel	765						
		63.5' -with sand below 63.5 ft.		X	100	6-8-9 (26)		PP = 4.00 tsf	LL = 52 PL = 15 MC = 18.1%
65									
			760						
				X	100	4-8-8 (24)		PP = 4.00 tsf	MC = 16.8%
70									
		72.0-75.0' (CL) Gray and brown, lean CLAY, with sand and gravel	755						
				X	100	6-7-10 (26)		PP = 3.25 tsf	LL = 49 PL = 16 MC = 18.3%
75									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675626.041 **Date of Work:** 05/16/24-05/16/24
Offset: **Easting:** 857942.937 **Depth to Water:** 3.0
Elevation: 828.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9444720, -91.900566)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
75		75.0-86.0' (CH) Brown and gray, fat CLAY 75.0' -with sand and gravel from 75.0 to 80.0 ft							
			750	X	100	5-8-50/0.5'		PP = 2.50 tsf	MC = 19.5%
80		80.0' -rough drilling from 80.0 to 81.0 ft.							
			745	X	100	4-6-11 (26)		PP = 3.00 tsf	MC = 20.6%
85		83.5' -trace gravel below 83.5 ft.							
		86.0-89.5' Gray, highly weathered LIMESTONE 86.0' -rough drilling below 86.0 ft.	740	X	100	50/0.3'			
90		89.5-99.7' LIMESTONE, cherty, white and gray, moderately hard to very hard, slightly to moderately weathered, aphanitic, thin bedded, dense to pitted 90.7' -highly weathered below 90.7 ft.			93 (43)				
			735		97 (20)				
95									
			730		83 (40)				
		99.2' -3" clay seam at 99.2 ft.							
		Refusal at 89.5 feet Bottom of borehole at 99.7 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675553.612 **Date of Work:** 05/28/24-05/29/24
Offset: **Easting:** 857935.644 **Depth to Water:** 38.5
Elevation: 831.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9442600, -91.9406107)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-3.0' (CH) Gray and brown, fat CLAY, with sand and gravel	830	X	83	3-3-4 (11)		PP = 1.25 tsf	MC = 11.7%
		3.0-5.5' (CL) Gray and brown, lean CLAY, with sand and gravel		X	100	4-6-11 (26)		PP = 4.50 tsf	MC = 15.6%
5		5.5-8.0' (SC) Brown, fine clayey SAND	825	X	83	15-22-20 (63)			MC = 16.2% Sieve Analysis Sieve # % Passing #200 20.2
		8.0-12.0' (CH) Brown and gray, fat CLAY, with sand and gravel		X	100	6-10-10 (30)		PP = 4.00 tsf	MC = 17.8%
10			820						
		12.0-17.0' (SC) Gray, clayey SAND		X	11	6-10-11 (32)			MC = 16.1% Sieve Analysis Sieve # % Passing #200 30.5
15			815						
		17.0-25.0' (CL) Gray, lean CLAY, with sand and gravel		X	100	8-9-12 (32)		PP = 2.50 tsf	MC = 15.6%
20			810						
				X	100	12-20-50/0.3'		PP = 3.50 tsf	LL = 48 PL = 13 MC = 19.9%
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: **Coordinate Zone:** **Coordinate Proj. Factor:**
Coordinate Datum: **Coordinate Units:** U.S. Survey Feet

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LETTER BOREHOLE - MODOT 20150728.GDT - 8/15/24 11:52 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\20241040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040 - PRELIMINARY.GPJ

Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675553.612 **Date of Work:** 05/28/24-05/29/24
Offset: **Easting:** 857935.644 **Depth to Water:** 38.5
Elevation: 831.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9442600, -91.9406107)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-31.8' (CH) Gray, fat CLAY, with sand and gravel	805						
					31		Qu Test Results MC = 15.1%		
30			800						
		31.8-36.8' (CL) Gray, lean CLAY, with sand and gravel							
					100	6-16-20 (54)		PP >4.50 tsf	LL = 40 PL = 13 MC = 17.1%
35			795						
		36.8-50.0' (CH) Gray, fat CLAY, with sand and gravel ▽							
					100	35-43-31 (111)		PP = 3.25 tsf	MC = 19.3%
40			790						
					100	14-26-17 (65)		PP = 2.50 tsf	MC = 26.0%
45			785						
					33	50/0.3'			MC = 18.3%
50									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675553.612 **Date of Work:** 05/28/24-05/29/24
Offset: **Easting:** 857935.644 **Depth to Water:** 38.5
Elevation: 831.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9442600, -91.9406107)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		50.0-64.2' (CH) Gray, fat CLAY, with sand and gravel	780						
					75		Qu Test Results MC = 24.0% γ_{moist} = 100.7 pcf	PP = 3.00 tsf	LL = 63 PL = 16
55			775						
		58.5' -gray and brown below 58.5 ft.			100	7-12-16 (42)		PP >4.50 tsf	MC = 14.3%
60			770						
		64.2-67.0' (CL) Gray, silty lean CLAY			100	21-39-24 (95)		PP = 4.25 tsf	LL = 31 PL = 15 MC = 19.9%
65			765						
		67.0-72.0' (SC) Gray, clayey SAND, with gravel			83	10-8-10 (27)		PP = 1.75 tsf	MC = 19.4%
70			760						
		72.0-75.0' (CL) Gray, lean CLAY, with sand and gravel			100	7-7-13 (30)			LL = 49 PL = 14 MC = 19.4%
75									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00	**County:** Callaway	**Route:** I-70
Design:	**Skew:**	**Location:** Kingdom City, Missouri
Bent:	**Logged By:** SO	**Operator:** LRK
Station:	**Northing:** 1675553.612	**Date of Work:** 05/28/24-05/29/24
Offset:	**Easting:** 857935.644	**Depth to Water:** 38.5
Elevation: 831.6	**Requested Northing:**	**Depth Hole Open:**
Requested Station:	**Requested Easting:**	**Time Change:**
Requested Offset:	**Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube	
Requested Elevation:	**Location Note:** (38.9442600, -91.9406107)	
Drill No.:	**Hammer Efficiency:** 90%	**Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
75		75.0-87.0' (CL) Gray, lean CLAY, with sand and gravel	755						
				X	100	9-10-44 (81)		PP = 1.50 tsf	MC = 18.2%
80			750						
		83.5' -trace sand and gravel below 83.5 ft.		X	100	7-8-10 (27)		PP = 1.50 tsf	MC = 19.9%
85			745						
		87.0-94.0' (CH) Gray, fat CLAY, trace sand and gravel							
					100		Qu Test Results UCS = 4.99 ksf MC = 21.1% γ_{moist} = 127.1 pcf	PP = 2.50 tsf	LL = 50 PL = 14
90			740						
		94.0-94.5' Gray, fat CLAY and LIMESTONE		X	100	37-50/0.0'		PP = 1.50 tsf	MC = 20.8%
95		94.5-95.5' No recovery			0 (0)				
		95.5-100.0' LIMESTONE, gray and tan, slightly to highly weathered, moderately hard to hard, aphanitic, thin bedded, dense to pitted	735		38 (9)				
100									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675553.612 **Date of Work:** 05/28/24-05/29/24
Offset: **Easting:** 857935.644 **Depth to Water:** 38.5
Elevation: 831.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9442600, -91.9406107)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
100		100.0-110.5' LIMESTONE, gray and tan, hard to very hard, moderately to highly weathered, thin bedded, pitted 100.0-105.5' 100.5' -cherty from 100.5 to 105.5 ft.	730		45 (8)				
105		105.5' -slightly to moderately weathered, moderately hard, aphanitic, dense to pitted below 105.5 ft.	725		75 (37)		Qu Test Results UCS = 1720 ksf		
110		Refusal at 94.5 feet. Bottom of borehole at 110.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675466.664 **Date of Work:** 05/15/24-05/16/24
Offset: **Easting:** 857925.743 **Depth to Water:** 8.5
Elevation: 834.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9440491, -91.9406617)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-2.7' (CL) Brown, sandy lean CLAY							
				X	67	2-3-5 (12)		PP = 2.50 tsf	MC = 16.7%
		2.7-8.0' (CH) Brown and gray, fat CLAY							
			830	■	92		Qu Test Results UCS = 6.95 ksf MC = 15.3% γ_{moist} = 131.7 pcf	PP = 4.00 tsf	LL = 63 PL = 16
5									
		6.0' -with gravel below 6.0 ft.		X	56	7-35-28 (95)		PP = 3.50 tsf	MC = 20.6%
		▽ 8.0-17.0' (CL) Brown, lean CLAY, with sand and gravel							
			825	X	56	12-29-12 (62)		PP = 4.25 tsf	MC = 16.5%
10									
				■	100		Qu Test Results MC = 16.5% γ_{moist} = 139.2 pcf	PP >4.50 tsf	LL = 43 PL = 15
			820						
15									
		17.0-25.0' (CH) Gray, fat CLAY, with sand and gravel							
			815	X	67	9-11-11 (33)		PP = 3.25 tsf	MC = 18.6%
20									
		23.5' -gray and brown below 23.5 ft.	810	X	83	25-24-16 (60)		PP >4.50 tsf	LL = 51 PL = 16 MC = 16.3%
25									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675466.664 **Date of Work:** 05/15/24-05/16/24
Offset: **Easting:** 857925.743 **Depth to Water:** 8.5
Elevation: 834.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9440491, -91.9406617)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
25		25.0-50.0' (CL) Gray, lean CLAY, with sand and gravel							
			805	X	100	6-7-8 (23)		PP = 3.50 tsf	MC = 18.8%
30									
			800	X	100	4-7-8 (23)		PP = 3.00 tsf	LL = 41 PL = 15 MC = 16.7%
35									
			795	X	100	23-13-18 (47)		PP >4.50 tsf	MC = 16.2%
40									
			790	X	100	6-7-9 (24)		PP = 2.75 tsf	MC = 18.9%
45									
			785	X	100	8-7-8 (23)		PP = 2.75 tsf	LL = 48 PL = 15 MC = 19.9%
50									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675466.664 **Date of Work:** 05/15/24-05/16/24
Offset: **Easting:** 857925.743 **Depth to Water:** 8.5
Elevation: 834.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9440491, -91.9406617)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
50		50.0-67.0' (CH) Gray, fat CLAY, with sand and gravel							
			780	X	100	6-9-10 (29)		PP = 2.75 tsf	MC = 19.2%
55									
			775	X	100	6-8-18 (39)		PP = 3.25 tsf	MC = 22.2%
60									
		63.5' -gray and brown below 63.5 ft.	770	X	100	12-17-20 (56)		PP >4.50 tsf	LL = 55 PL = 15 MC = 16.7%
65									
		67.0-72.0' (CL) Gray, lean CLAY, silty	765	X	100	7-8-12 (30)		PP = 3.50 tsf	LL = 28 PL = 17 MC = 19.6%
70									
		72.0-75.0' (ML) Gray, sandy SILT	760	X	100	3-4-7 (17)			MC = 25.8%
75									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675466.664 **Date of Work:** 05/15/24-05/16/24
Offset: **Easting:** 857925.743 **Depth to Water:** 8.5
Elevation: 834.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9440491, -91.9406617)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
75		75.0-77.0' (ML) Gray, sandy SILT							
		77.0-79.5' (CH) Gray and brown, fat CLAY, with sand and gravel	755	X	100	8-50/0.5'		PP = 2.50 tsf	
80		79.5-87.0' Gray, highly weathered LIMESTONE, with shale 79.5' -rough drilling from 79.5 to 82.0 ft.	750	X	22	25-30-30 (90)			
85		87.0-96.0' (CL) Gray, lean CLAY, with gravel	745	X	100	9-9-8 (26)		PP = 2.50 tsf	LL = 45 PL = 14 MC = 20.8%
90			740	X	100	10-28-50/0.4'		PP = 3.00 tsf	MC = 23.7%
95		95.0' -rough drilling below 95.0 ft.							
		96.0-100.0' LIMESTONE, gray, moderately hard, slightly weathered, aphanitic, thin to medium beddded, dense	735		100 (71)		Qu Test Results UCS = 2510 ksf		
100									

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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Missouri Department of Transportation
Construction and Materials

Job No.: 20241040.00 **County:** Callaway **Route:** I-70
Design: **Skew:** **Location:** Kingdom City, Missouri
Bent: **Logged By:** SO **Operator:** LRK
Station: **Northing:** 1675466.664 **Date of Work:** 05/15/24-05/16/24
Offset: **Easting:** 857925.743 **Depth to Water:** 8.5
Elevation: 834.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550X,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:** (38.9440491, -91.9406617)
Drill No.: **Hammer Efficiency:** 90% **Drilling Method:** HSA

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
100		100.0-106.3' LIMESTONE, gray, moderately hard, slightly weathered, aphanitic, thin to medium beddded, dense							
					100 (68)		Qu Test Results UCS = 1540 ksf		
			730						
105					100 (83)				
		Refusal at 96.0 feet. Bottom of borehole at 106.3 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
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GENERAL NOTES

The number of borings is based on: topographic and geologic factors; the magnitude of structure loading; the size, shape, and value of the structure; consequences of failure; and other factors. The type and sequence of sampling are selected to reduce the possibility of undiscovered anomalies and maintain drilling efficiency. Attempts are made to detect and/or identify occurrences during drilling and sampling such as the presence of water, boulders, gas, zones of lost circulation, relative ease or resistance to drilling progress, unusual sample recovery, variation in resistance to driving split-spoon samplers, unusual odors, etc. However, lack of notation regarding these occurrences does not preclude their presence.

Although attempts are made to obtain stabilized groundwater levels, the levels shown on the Logs of Boring may not have stabilized, particularly in more impermeable cohesive soils. Consequently, the indicated groundwater levels may not represent present or future levels. Groundwater levels may vary significantly over time due to the effects of precipitation, infiltration, or other factors not evident at the time indicated.

Unless otherwise noted, soil classifications indicated on the Logs of Boring are based on visual observations and are not the result of classification tests. Although visual classifications are performed by experienced technicians or engineers, classifications so made may not be conclusive.

Generally, variations in texture less than one foot in thickness are described as layers within a stratum, while thicker zones are logged as individual strata. However, minor anomalies and changes of questionable lateral extent may appear only in the verbal description. The lines indicating changes in strata on the Logs of Boring are approximate boundaries only, as the actual material change may be between samples or may be a gradual transition.

Samples chosen for laboratory testing are selected in such a manner as to measure selected physical characteristics of each material encountered. However, as samples are recovered only intermittently and not all samples undergo a complete series of tests, the results of such tests may not conclusively represent the characteristics of all subsurface materials present.

NOTATION USED ON BORING LOGS

APPROXIMATE PROPORTIONS

TRACE	<15%
WITH	15-30%
MODIFIER	>30%

Clay or clayey may be used as major material or modifier, regardless of relative proportions, if the clay content is sufficient to dominate the soil properties.

PARTICLE SIZE

BOULDERS		>12 Inches
COBBLES		12 Inches – 3 Inches
GRAVEL		
	Coarse	3 Inches – ¾ Inch
	Fine	¾ Inch – No. 4 Sieve (4.750 mm)
SAND		
	Coarse	No. 4 – No. 10 Sieve (2.000 mm)
	Medium	No. 10 – No. 40 Sieve (0.420 mm)
	Fine	No. 40 – No. 200 Sieve (0.074 mm)
SILT		No. 200 Sieve - 0.002 mm
CLAY		< 0.002 mm

PENETRATION – BLOWS

Number of impacts of a 140-pound hammer falling a distance of 30 inches to cause a standard split-barrel sampler, 1 3/8 inches I.D., to penetrate a distance of 6 inches. The number of impacts for the first 6 inches of penetration is known as the seating drive. The sum of the impacts for the last 12 inches of penetration is the Standard Penetration Test Resistance or "N" value, blows per foot. For example, if blows = 6-8-9, "N" = 8+9 or 17.

OTHER NOTATIONS

Recovery % – length of recovered soil divided by length of sample attempted.

50/2"	Impacts of hammer to cause sampler to penetrate the indicated number of inches
WR	Sampler penetrated under the static loading of the weight of the drill rods
WH	Sampler penetrated under the static loading the weight of the hammer and drill rods
HSA	Hollow stem auger drilling method
FA	Flight auger drilling method
RW	Rotary wash drilling methods with drilling mud
AH	Automatic hammer used for Standard Penetration Test sample
SH	Safety hammer with rope and cathead used for Standard Penetration Test sample

GRAPHIC SYMBOLS


Depth at which groundwater was encountered during drilling


Depth at which groundwater was measured after drilling


Standard Penetration Test Sample, ASTM D1586


3-inch diameter Shelby Tube Sample, ASTM D1587

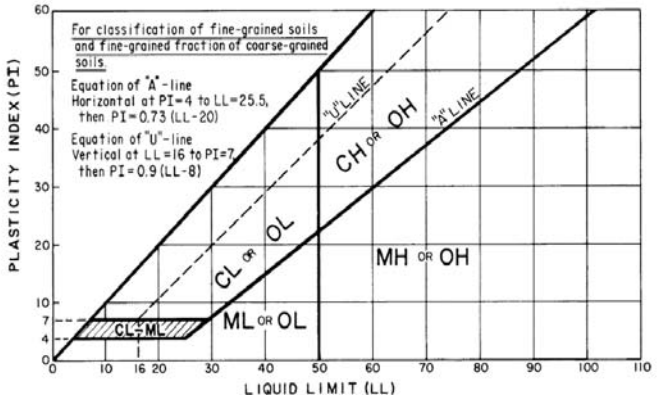


Sample grabbed from auger


NX Size rock core sample

UNIFIED SOIL CLASSIFICATION SYSTEM, (ASTM D-2487)

Major Divisions			*Group Symbols*		*Typical Names*	*Laboratory Classification Criteria*	
Coarse-grained soils (More than half of materials is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-Grained soils are classified as follows: Less than 5 per cent GW, GP, SW, SP; More than 12 per cent GM, GC, SM, SC; 5 to 12 per cent Borderline cases requiring dual symbols[b]	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			GP		Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW
		Gravels with fines (Appreciable amount of fines)	GM[a]	d	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.1. less than 4	Above "A" line with P.1. between 4 and 7 are *borderline* cases requiring use of dual symbols
				u			
			GC		Clayey gravels, gravel-sand-clay mixtures	Atterberg limits below "A" line with P.1. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW
		Sands with fines (Appreciable amount of fines)	SM[a]	d	Silty sands, sand-mix mixtures	Atterberg limits about "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
				u			
			SC		Clayey sands, sand-clay mixtures	Atterberg limits about "A" line with P.I. greater than 7	
Fine-grained soils (More than half of materials is smaller than No. 200 sieve size)	Silts and clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity		
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL		Organic silts and organic silty clays of low plasticity		
	Silts and clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
			CH		Inorganic clays of medium to high plasticity, organic silts		
			OH		Organic clays of medium to high plasticity, organic silts		
	Highly organic soils		Pt		Peat and other highly organic soils		



[a]Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 26 or less and the P.1. is 6 or less; the suffix u used when L.L. is greater than 28.

[b]Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

ROCK CORE DESCRIPTIONS AND CRITERIA

Hardness

Very Soft	- Easily indented with the thumb
Soft	- Able to be scratched with a fingernail
Moderately Hard	- Easily scratched with a knife; cannot be scratched with the fingernail
Hard	- Difficult to scratch with a knife
Very Hard	- Cannot be scratched with a knife

Crystallinity (Soluble Rock Only)

Aphanitic	- Crystals cannot be distinguished with the naked eye
Very Finely Crystalline	- Crystals are barely discernable with the naked eye
Finely Crystalline	- Crystals are easily discernable with the naked eye
Medium Crystalline	- Crystals are medium size; up to 1/8" in diameter
Coarsely Crystalline	- Crystals are 1/8" to 1/4" in diameter
Very Coarsely Crystalline	- Crystals are larger than 1/4" in diameter

Grain Size

Very Fine Grained	- Less than or equal to 0.0029" (#200 Sieve)
Fine Grained	- 0.0029" to 0.0165" (#200 to #40 Sieve)
Medium Grained	- 0.0165" to 0.07087" (#40 to #10 Sieve)
Coarse Grained	- Greater than 0.0787" (#10 Sieve)

Mass Bedding

Parting	- Less than 0.02 foot
Band	- 0.02 to 0.2 foot
Thin Bed	- 0.2 to 0.5 foot
Medium Bed	- 0.5 to 1.0 foot
Thick Bed	- 1.0 to 2.0 feet
Massive	- Greater than 2.0 feet

Weathering

Fresh	- No visible signs of decomposition or discoloration
Slightly Weathered	- Slight discoloration inward from open fractures
Moderately Weathered	- Discoloration throughout, slight loss of strength, texture intact
Highly Weathered	- Specimen can be broken by hand, texture indistinct, fabric intact
Completely Weathered	- Specimen easily crumbled, minerals decomposed to soil

Voids

Dense	- Usually not discernable with the naked eye
Pitted	- Discernable to ¼"
Vuggy	- ¼" to diameter of the core
Cavity	- Larger than 6" in diameter

APPENDIX C

PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 7-4.1**
SAMPLE NO.	**ST-2-3**
SAMPLE DEPTH (ft)	**4-4.5**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CL**

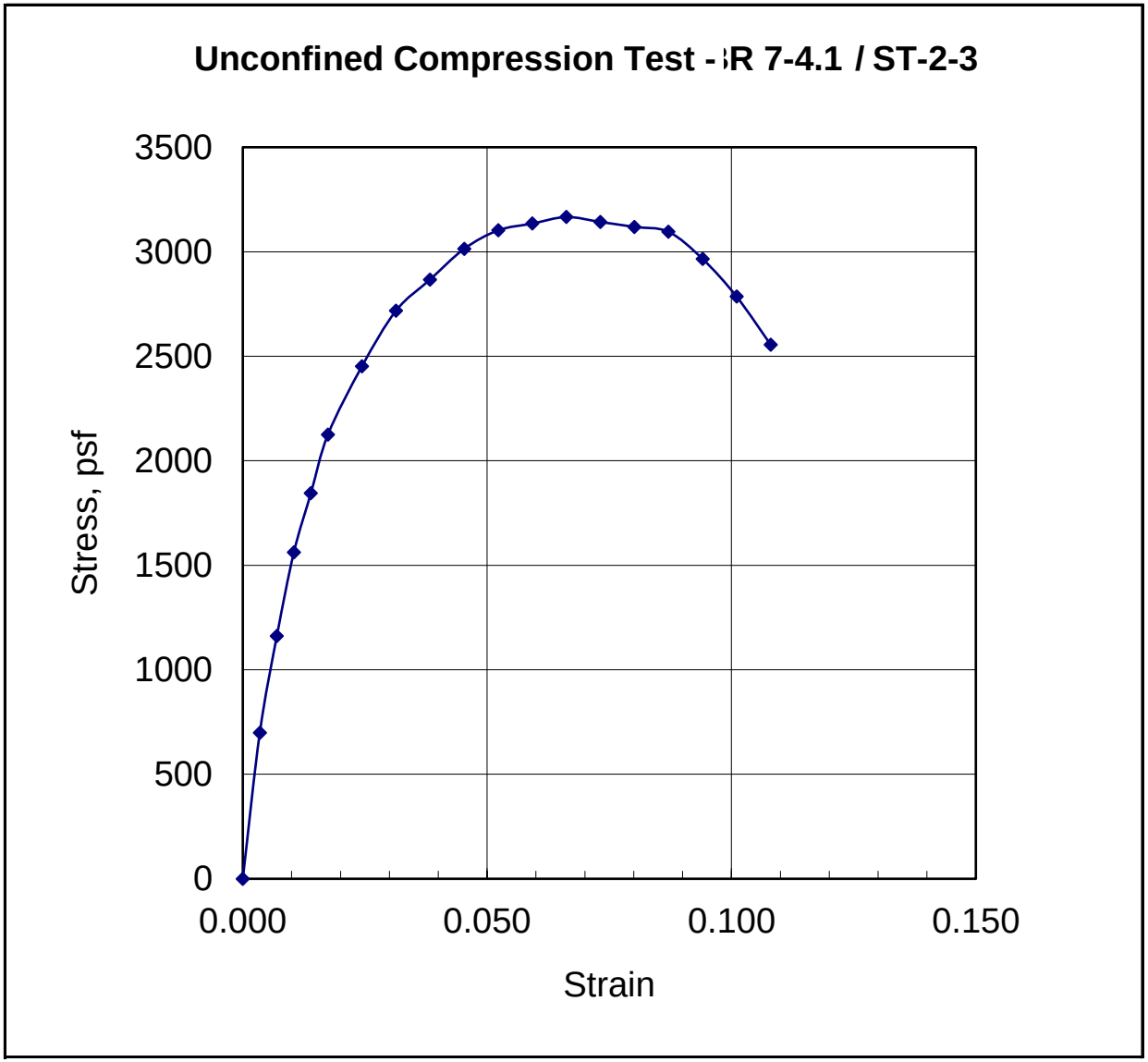
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	39
Plastic Limit	17
Plasticity Index	22
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**150.8**
Moisture content (%)	**18.1**
Dry unit weight (pcf)	**127.7**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**0.79**
% Strain at q_u	**6.6%**

Tested by: SLY	5/15/2024
Calculated by: AK	5/16/2024
Checked by: JPE	



PROJECT NAME:

PROJECT No.:

BORING NO.	**BR 10-1**
SAMPLE NO.	**ST-2**
SAMPLE DEPTH (ft)	**3.5**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CL**

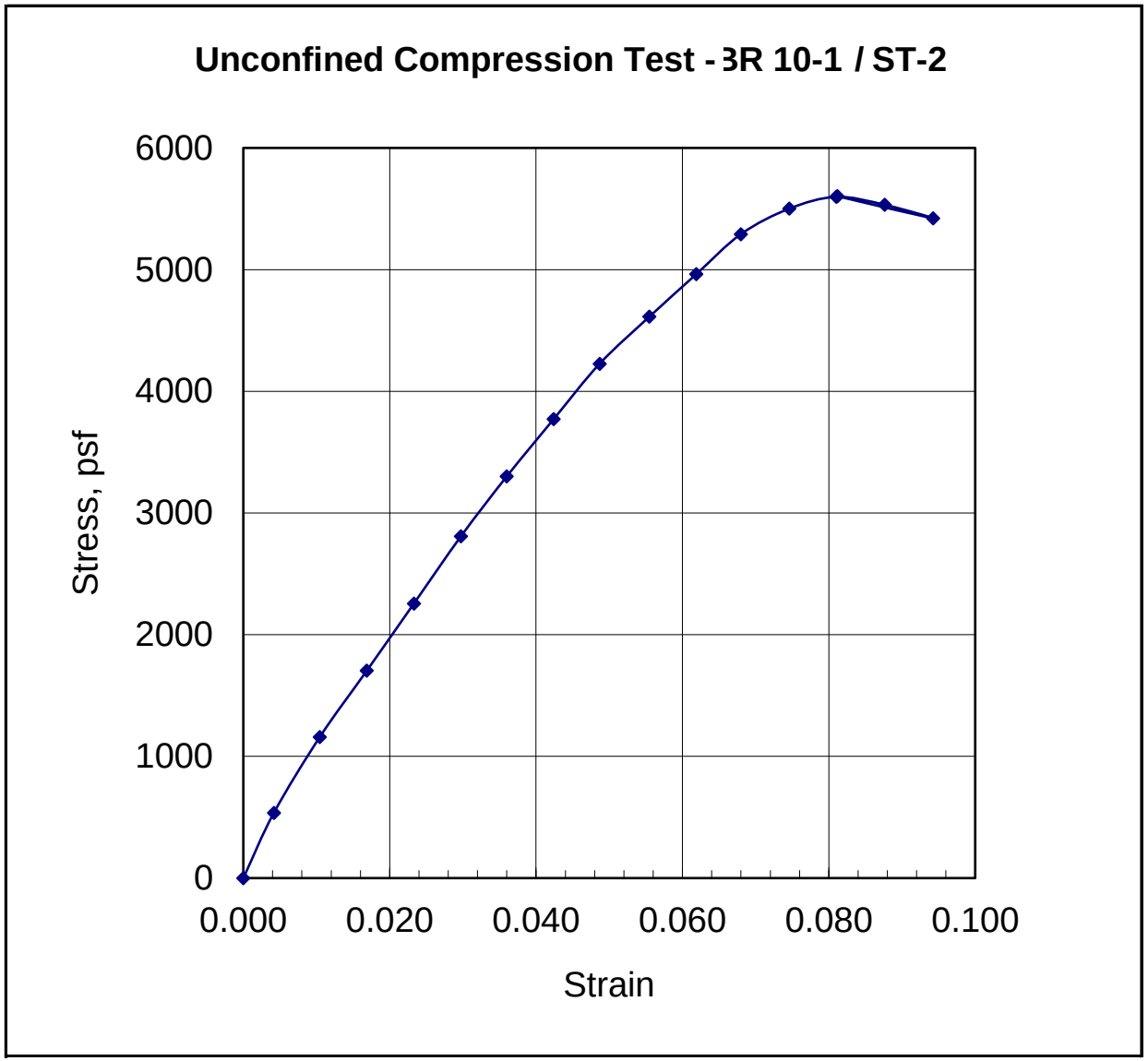
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	29
Plastic Limit	16
Plasticity Index	13
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**133.8**
Moisture content (%)	**17.2**
Dry unit weight (pcf)	**114.2**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**1.40**
% Strain at q_u	**8.1%**

Tested by: ML	5/24/2024
Calculated by: AK	6/7/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 10-4**
SAMPLE NO.	**ST-4-3**
SAMPLE DEPTH (ft)	**9-9.5**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

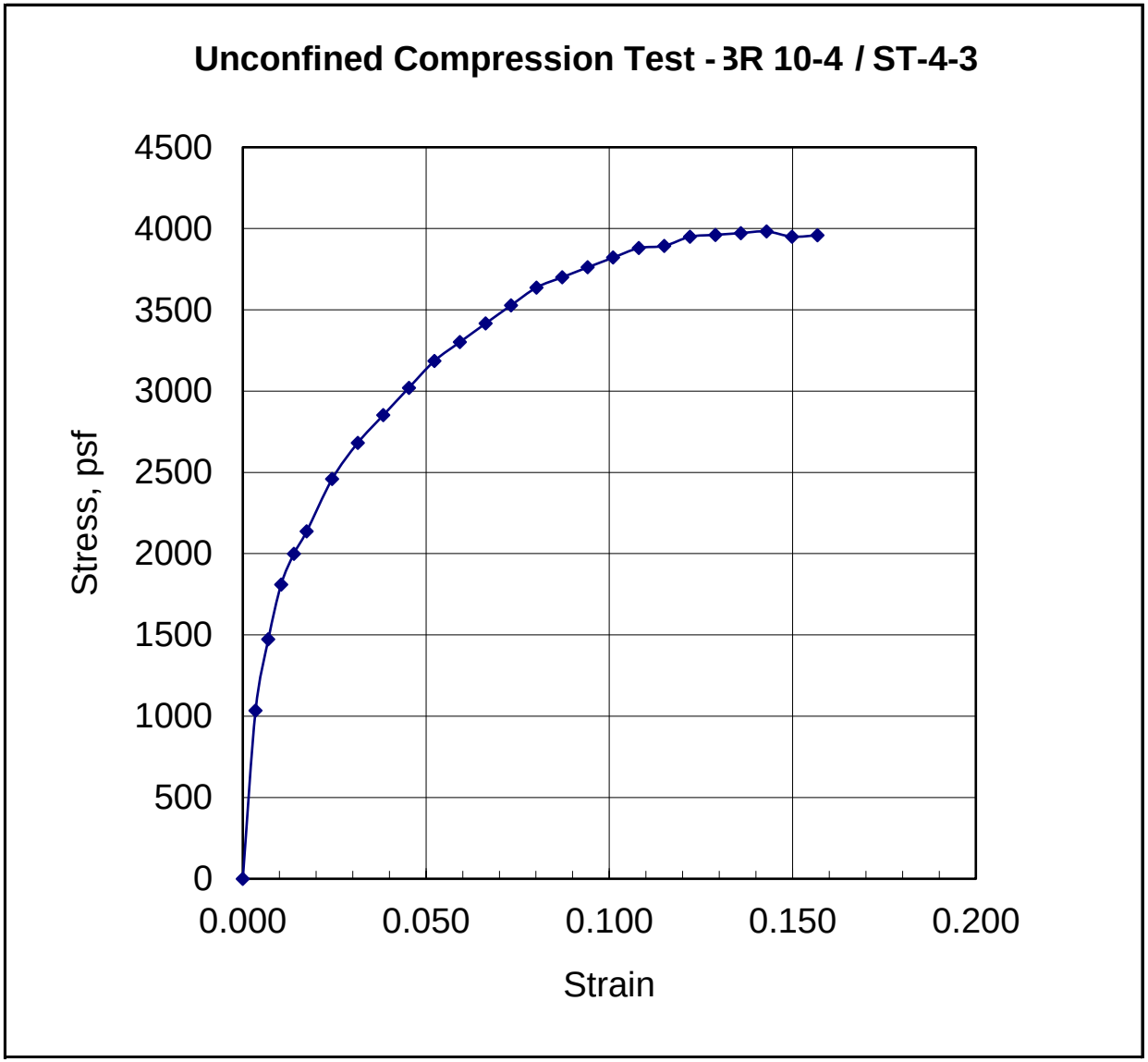
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	58
Plastic Limit	15
Plasticity Index	43
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**128.0**
Moisture content (%)	**23.5**
Dry unit weight (pcf)	**103.7**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**1.00**
% Strain at q_u	**14.3%**

Tested by: SLY	5/9/2024
Calculated by: AK	5/9/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 10-5B**
SAMPLE NO.	**ST-3-3**
SAMPLE DEPTH (ft)	**7-7.5**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

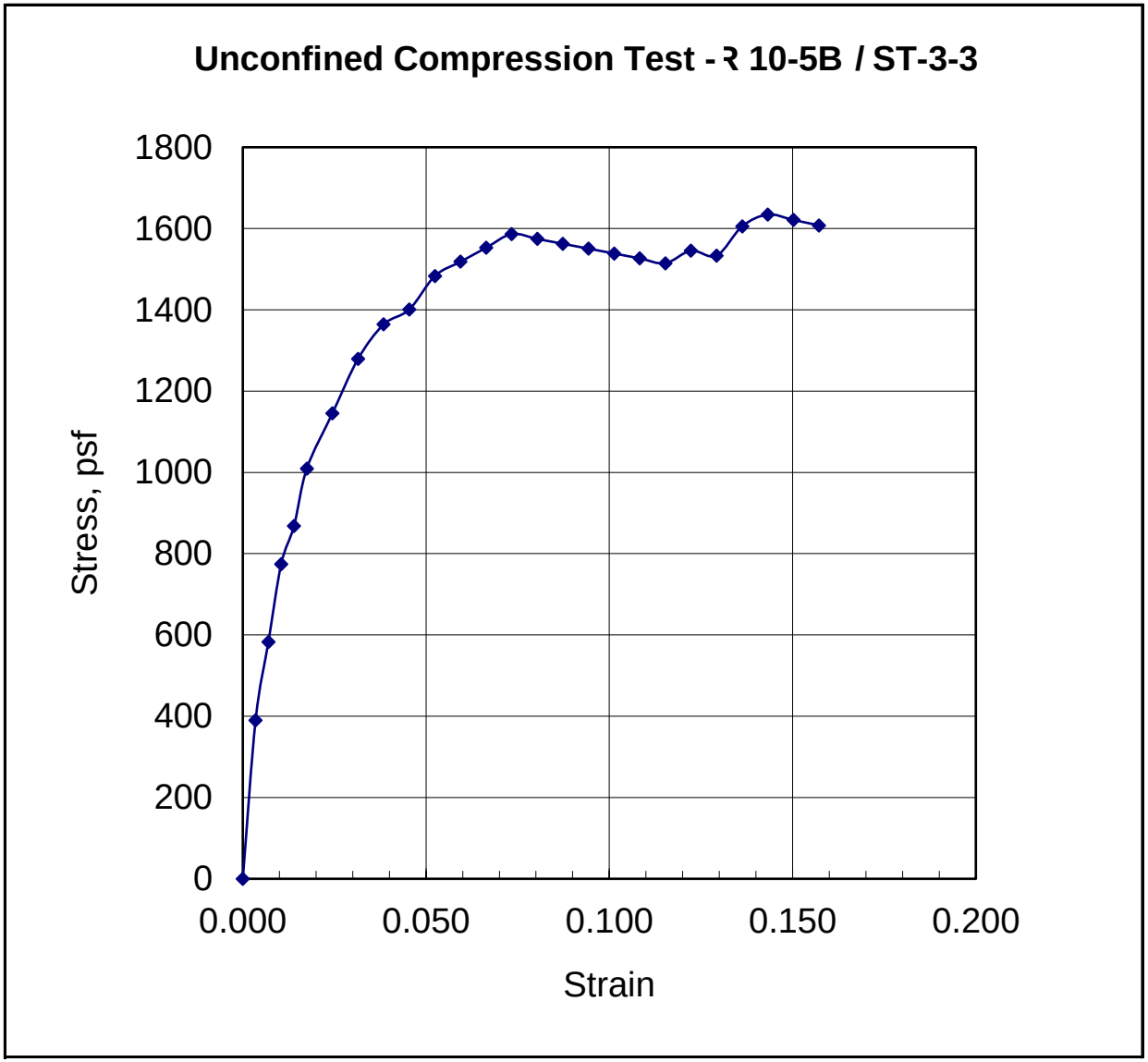
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	54
Plastic Limit	17
Plasticity Index	37
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**122.1**
Moisture content (%)	**18.2**
Dry unit weight (pcf)	**103.4**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**0.41**
% Strain at q_u	**14.3%**

Tested by: SLY	7/10/2024
Calculated by: JPE	7/11/2024
Checked by: JPY	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 10-5B**
SAMPLE NO.	**ST-5-2**
SAMPLE DEPTH (ft)	**13-13.5**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

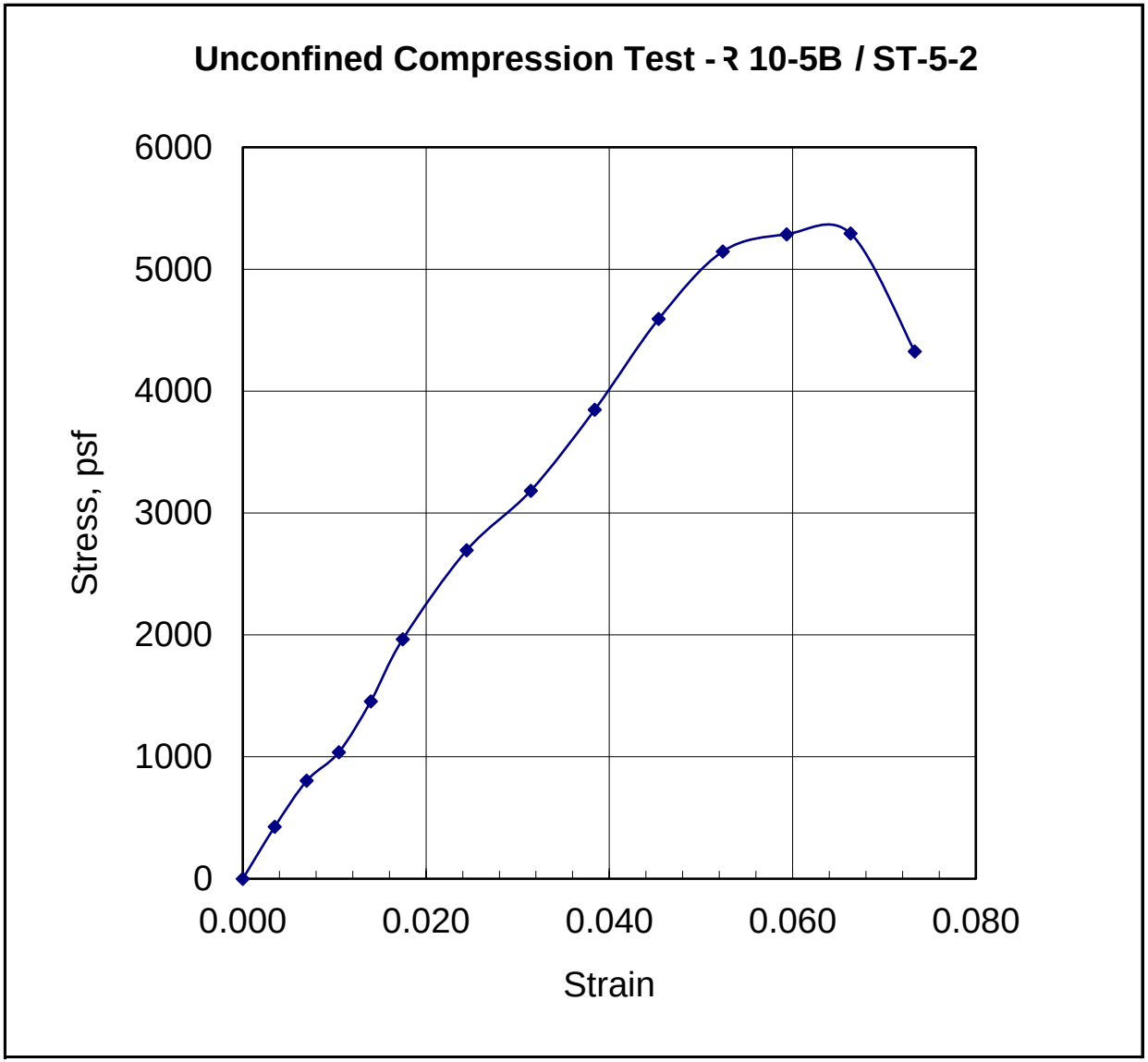
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	
Plastic Limit	
Plasticity Index	
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**129.2**
Moisture content (%)	**18.2**
Dry unit weight (pcf)	**109.3**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**1.32**
% Strain at q_u	**6.6%**

Tested by: SLY	7/10/2024
Calculated by: JPE	7/11/2024
Checked by: JPY	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 10-6A**
SAMPLE NO.	**ST-2-3**
SAMPLE DEPTH (ft)	**4.5-5**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

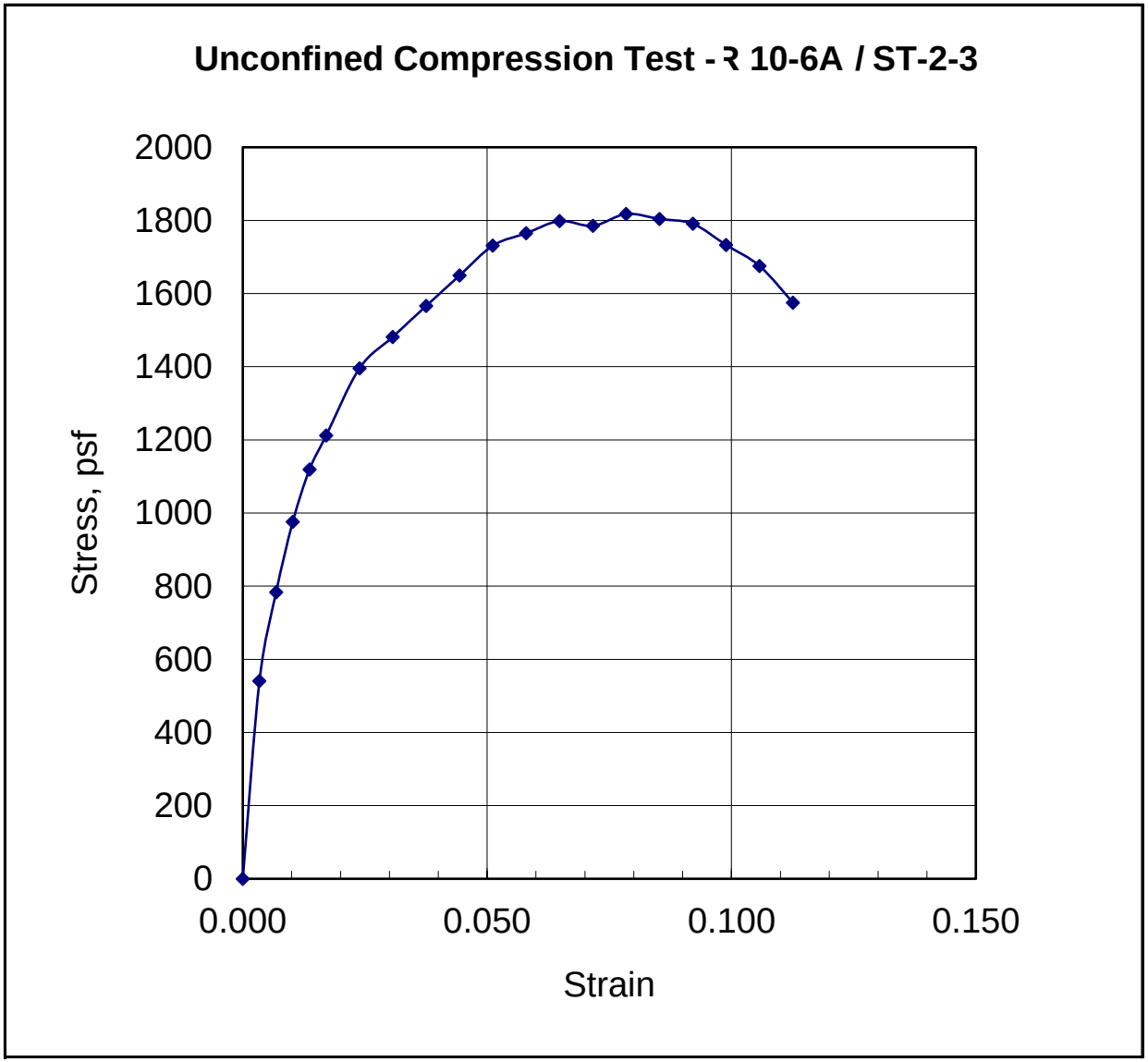
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	78
Plastic Limit	22
Plasticity Index	56
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**124.5**
Moisture content (%)	**27.8**
Dry unit weight (pcf)	**97.4**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**0.45**
% Strain at q_u	**7.8%**

Tested by: SLY	5/17/2024
Calculated by: AK	5/21/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 10-6A**
SAMPLE NO.	**ST-5-4**
SAMPLE DEPTH (ft)	**13-15.0**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

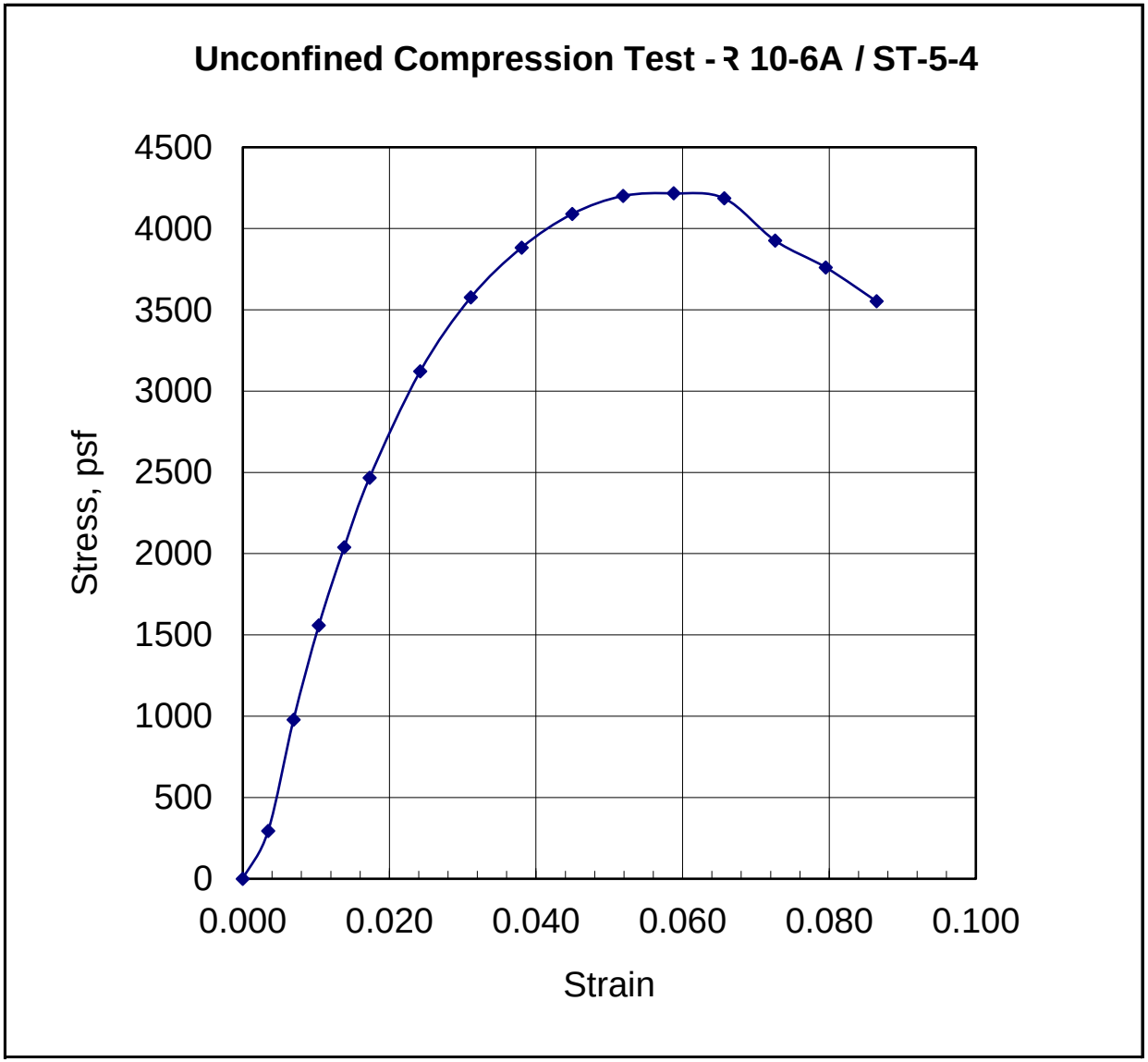
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	74
Plastic Limit	21
Plasticity Index	53
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**123.2**
Moisture content (%)	**24.2**
Dry unit weight (pcf)	**99.2**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**1.05**
% Strain at q_u	**5.9%**

Tested by: SLY	5/17/2024
Calculated by: AK	5/21/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 13-1A**
SAMPLE NO.	**ST-5-3**
SAMPLE DEPTH (ft)	**14.0-14.5**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

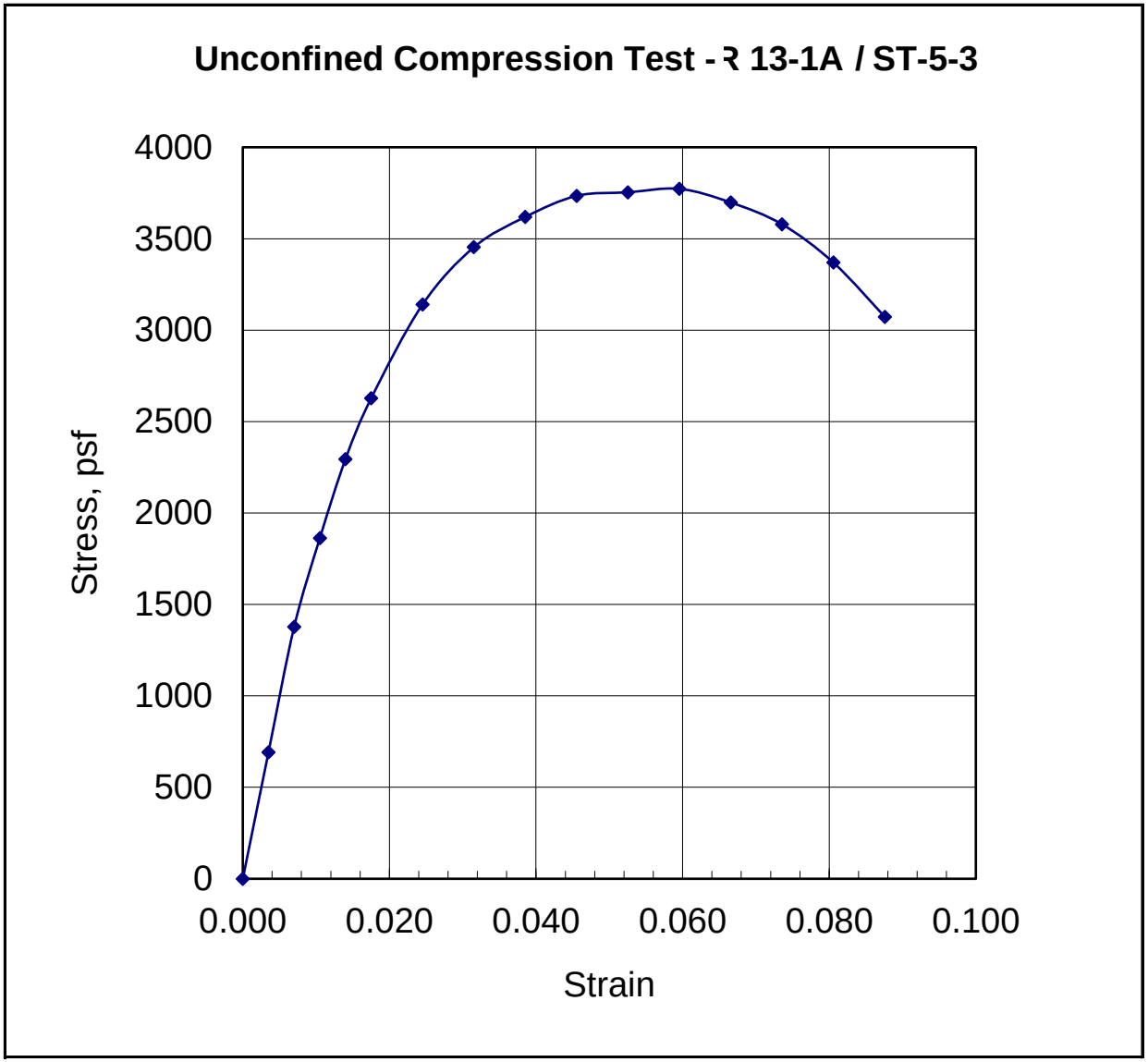
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	78
Plastic Limit	22
Plasticity Index	56
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**125.2**
Moisture content (%)	**29.1**
Dry unit weight (pcf)	**97.0**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**0.94**
% Strain at q_u	**6.0%**

Tested by: SLY	5/8/2024
Calculated by: AK	5/8/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 16-1.1A**
SAMPLE NO.	**ST-4-3**
SAMPLE DEPTH (ft)	**9.0-9.5**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

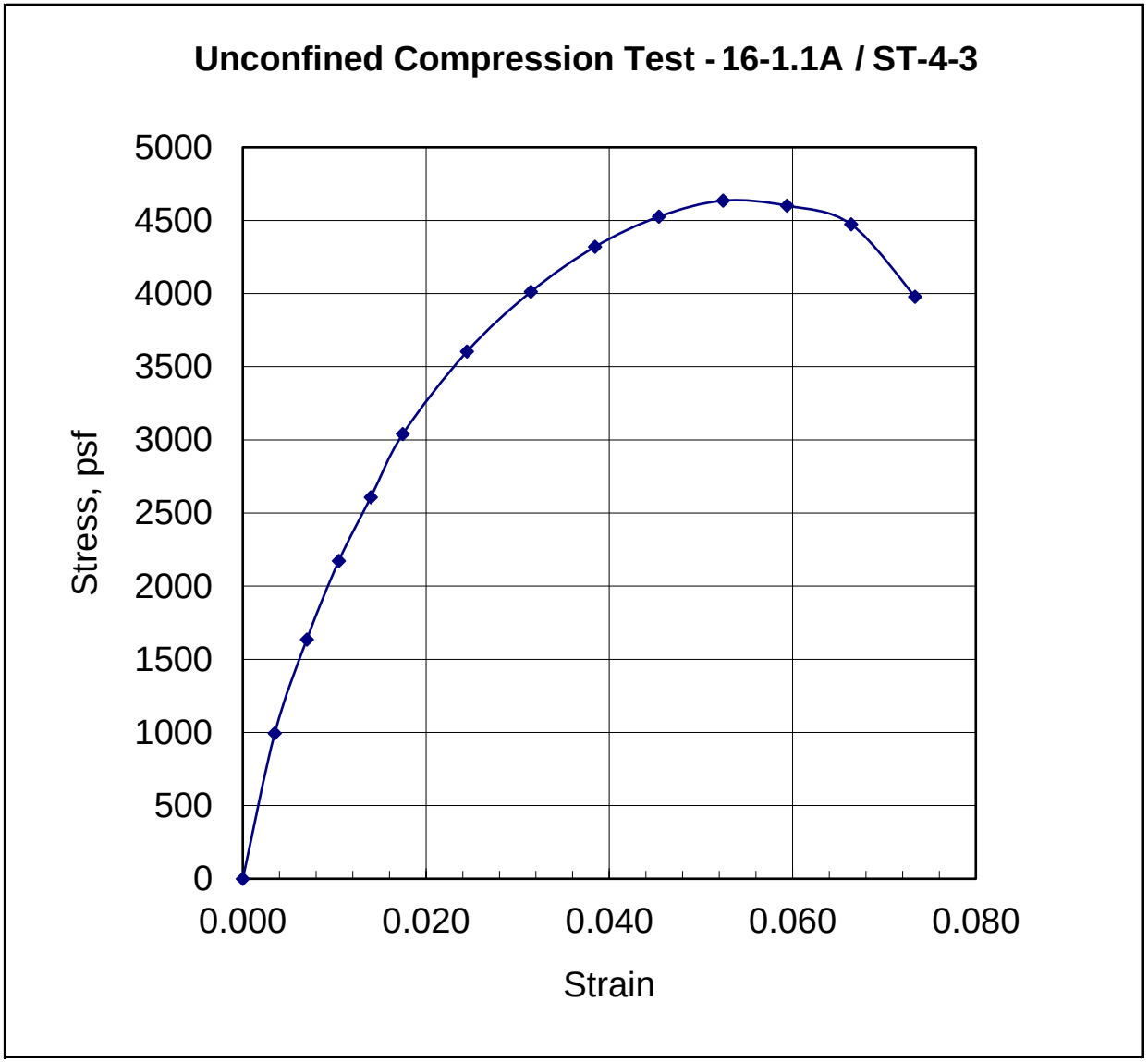
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	54
Plastic Limit	15
Plasticity Index	39
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**128.7**
Moisture content (%)	**18.6**
Dry unit weight (pcf)	**108.5**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**1.16**
% Strain at q_u	**5.2%**

Tested by: SLY	5/8/2024
Calculated by: AK	5/8/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 16-1.1A**
SAMPLE NO.	**ST-6-2**
SAMPLE DEPTH (ft)	**18.5-19.0**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

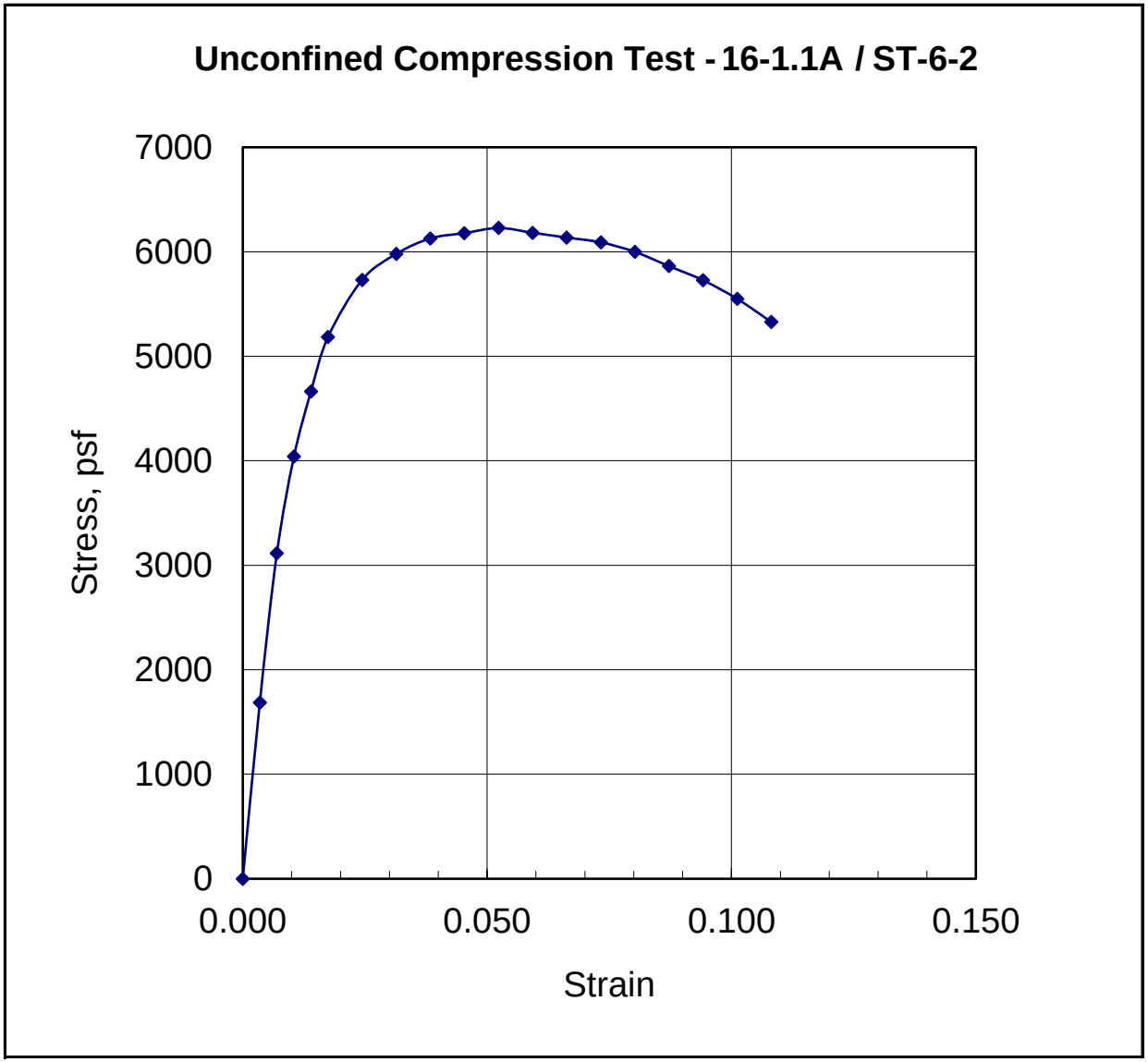
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	67
Plastic Limit	17
Plasticity Index	50
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**125.6**
Moisture content (%)	**22.4**
Dry unit weight (pcf)	**102.6**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**1.56**
% Strain at q_u	**5.2%**

Tested by: SLY	5/8/2024
Calculated by: AK	5/8/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 16-1**
SAMPLE NO.	**ST-2-2**
SAMPLE DEPTH (ft)	**3-5.0**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CL**

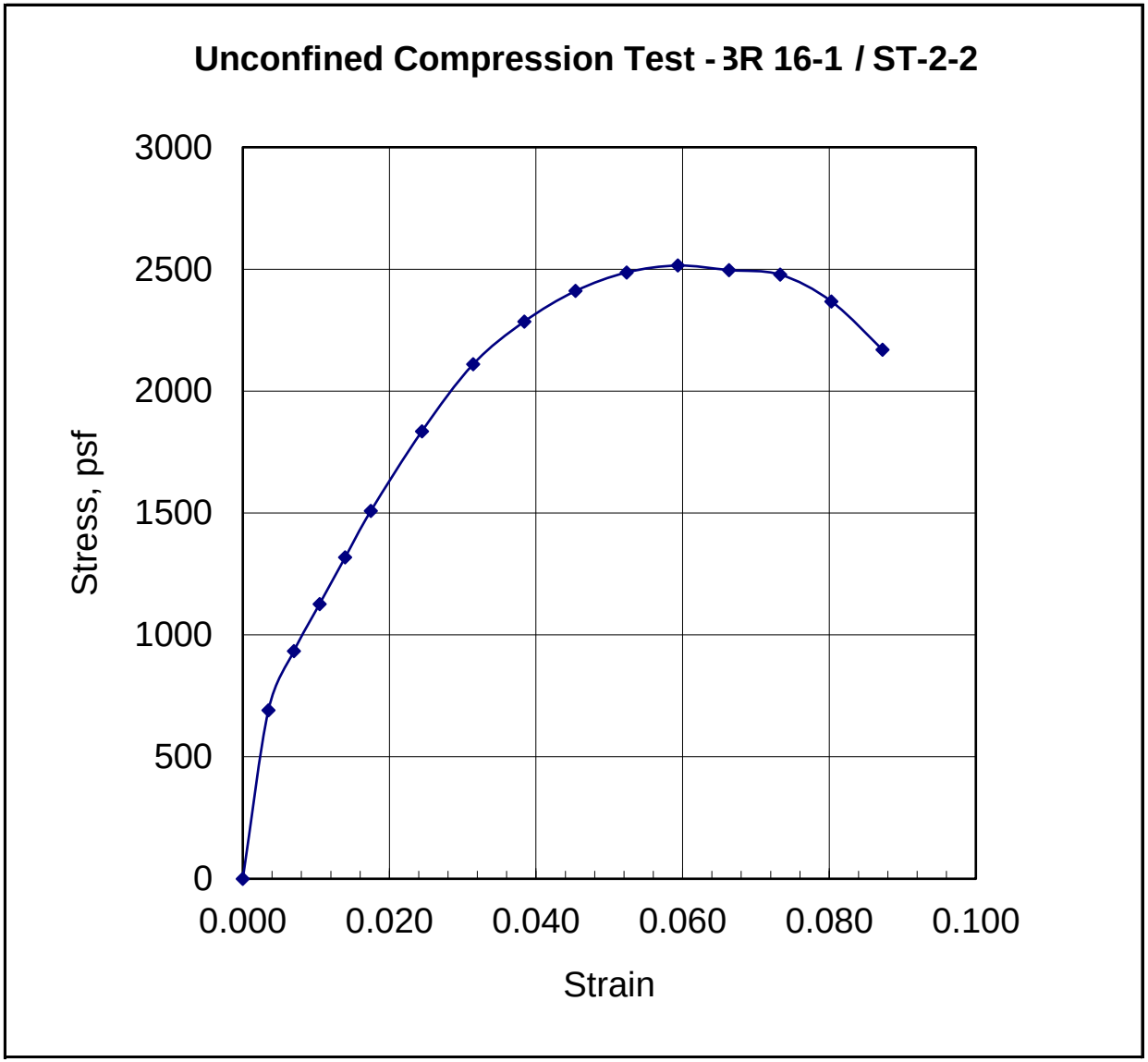
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	32
Plastic Limit	14
Plasticity Index	18
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**134.9**
Moisture content (%)	**15.4**
Dry unit weight (pcf)	**116.9**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**0.63**
% Strain at q_u	**5.9%**

Tested by: SLY	7/10/2024
Calculated by: JPE	7/11/2024
Checked by: JPY	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 16-1**
SAMPLE NO.	**ST-5-2**
SAMPLE DEPTH (ft)	**13.5-14**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

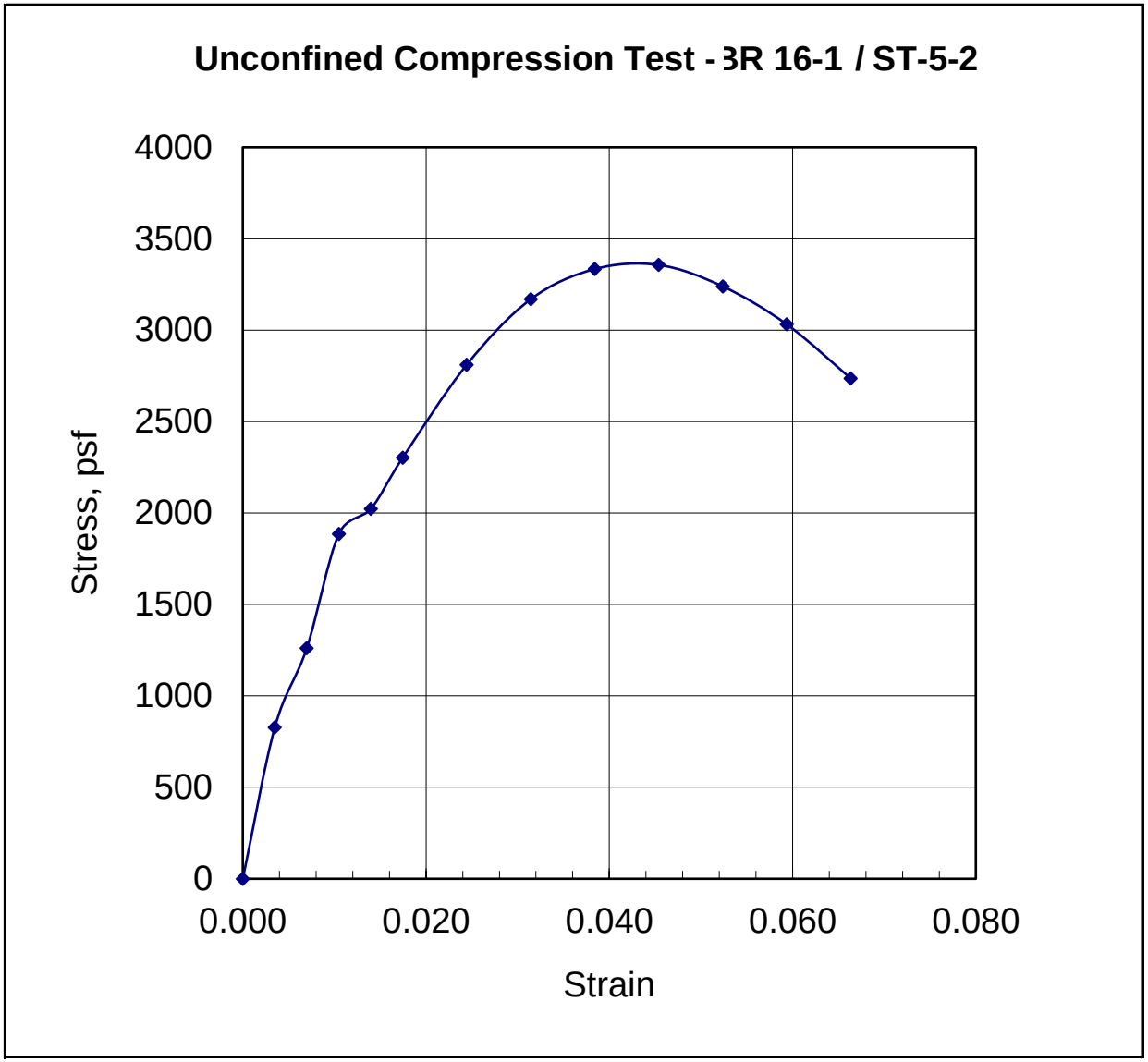
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	64
Plastic Limit	14
Plasticity Index	50
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**127.6**
Moisture content (%)	**18.9**
Dry unit weight (pcf)	**107.3**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**0.84**
% Strain at q_u	**4.5%**

Tested by: SLY	6/27/2024
Calculated by: AK	6/28/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 16-1**
SAMPLE NO.	**ST-7-3**
SAMPLE DEPTH (ft)	**23-23.5**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

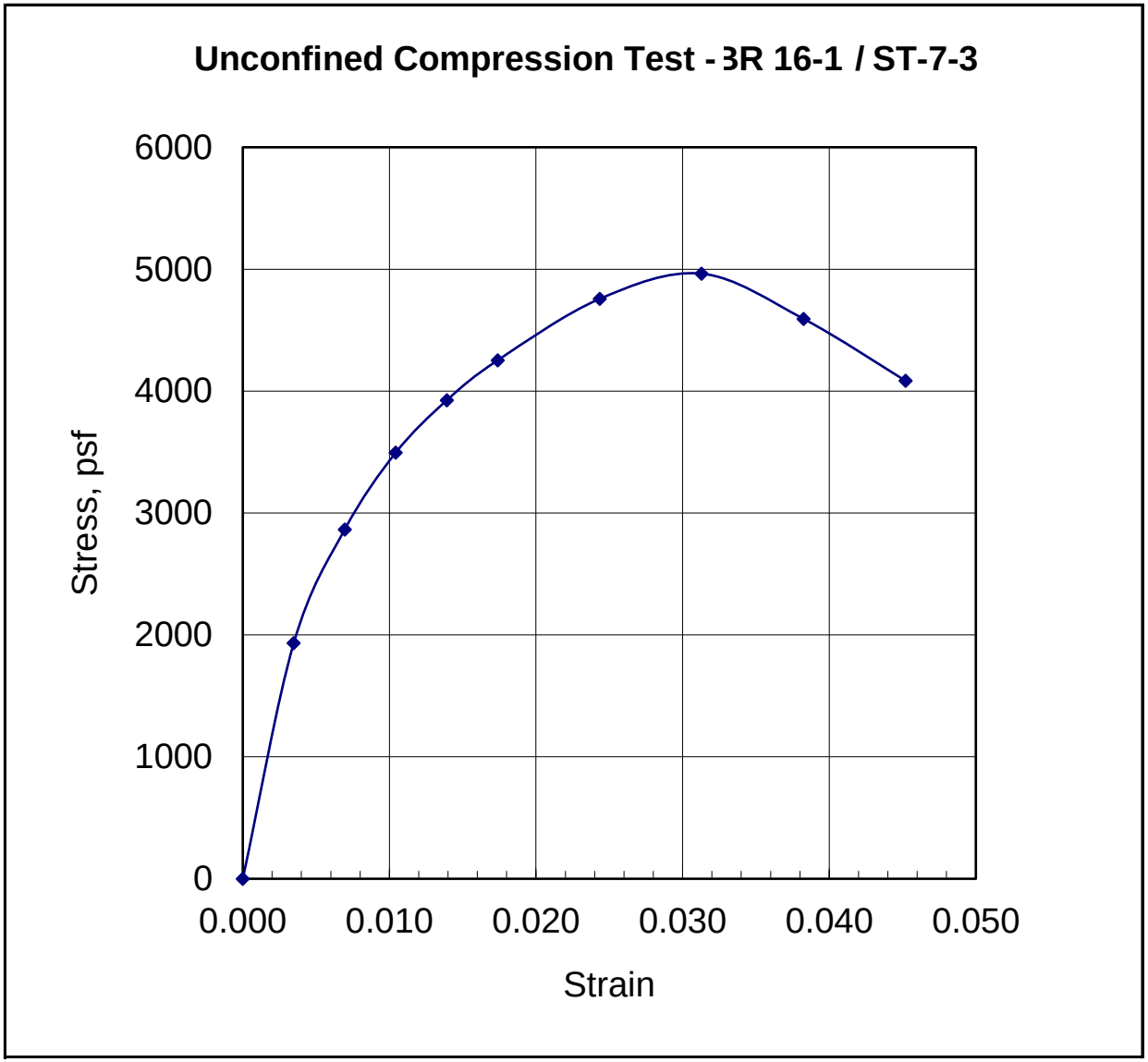
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	
Plastic Limit	
Plasticity Index	
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**128.7**
Moisture content (%)	**24.1**
Dry unit weight (pcf)	**103.8**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**1.24**
% Strain at q_u	**3.1%**

Tested by: SLY	6/27/2024
Calculated by: AK	6/28/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 16-2**
SAMPLE NO.	**ST-3-4**
SAMPLE DEPTH (ft)	**7.5-8**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CL**

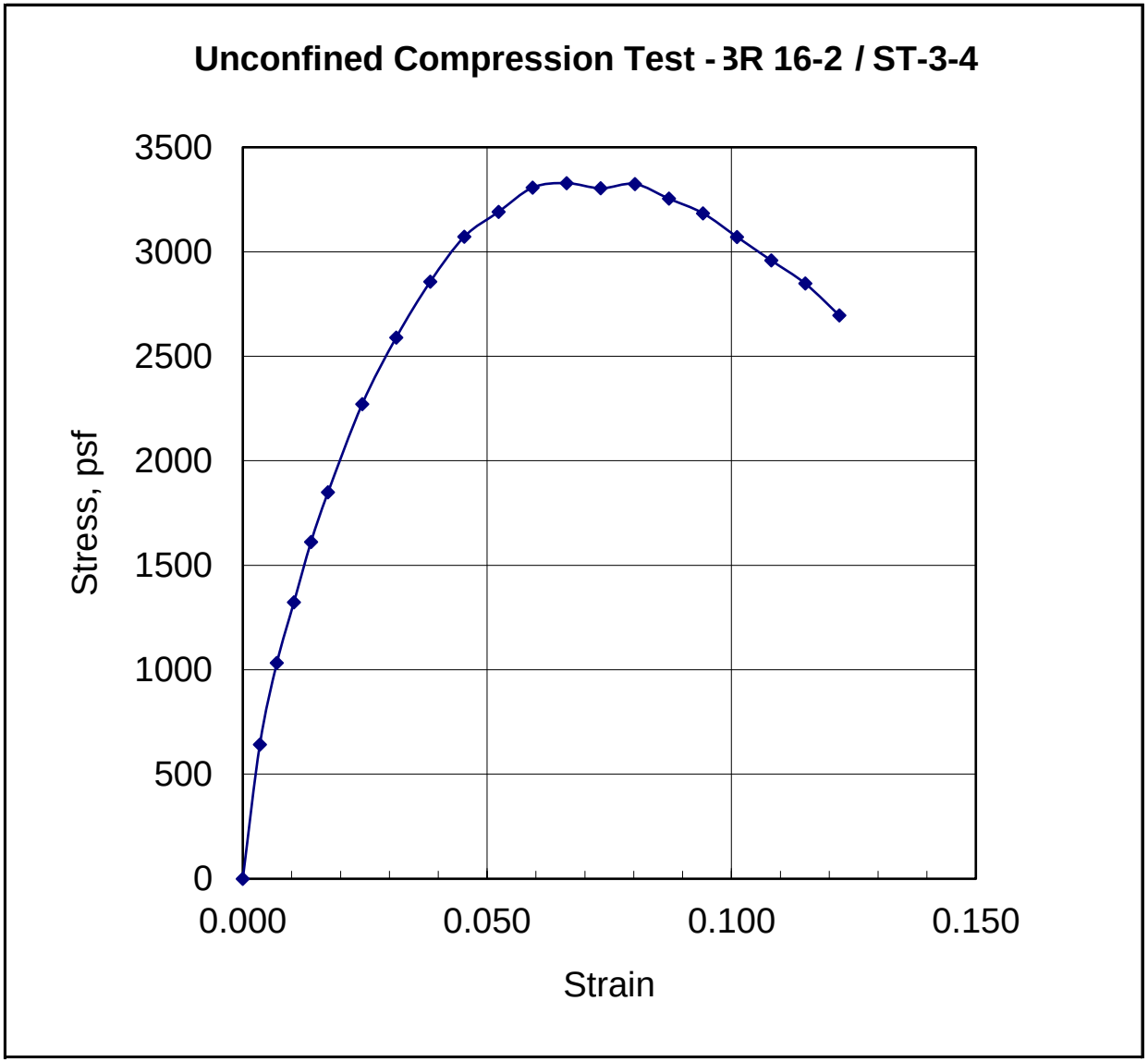
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	25
Plastic Limit	13
Plasticity Index	12
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**132.7**
Moisture content (%)	**16.8**
Dry unit weight (pcf)	**113.6**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**0.83**
% Strain at q_u	**6.6%**

Tested by: SLY	5/9/2024
Calculated by: AK	5/9/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 16-2**
SAMPLE NO.	**ST-6-3**
SAMPLE DEPTH (ft)	**17.5-18**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CL**

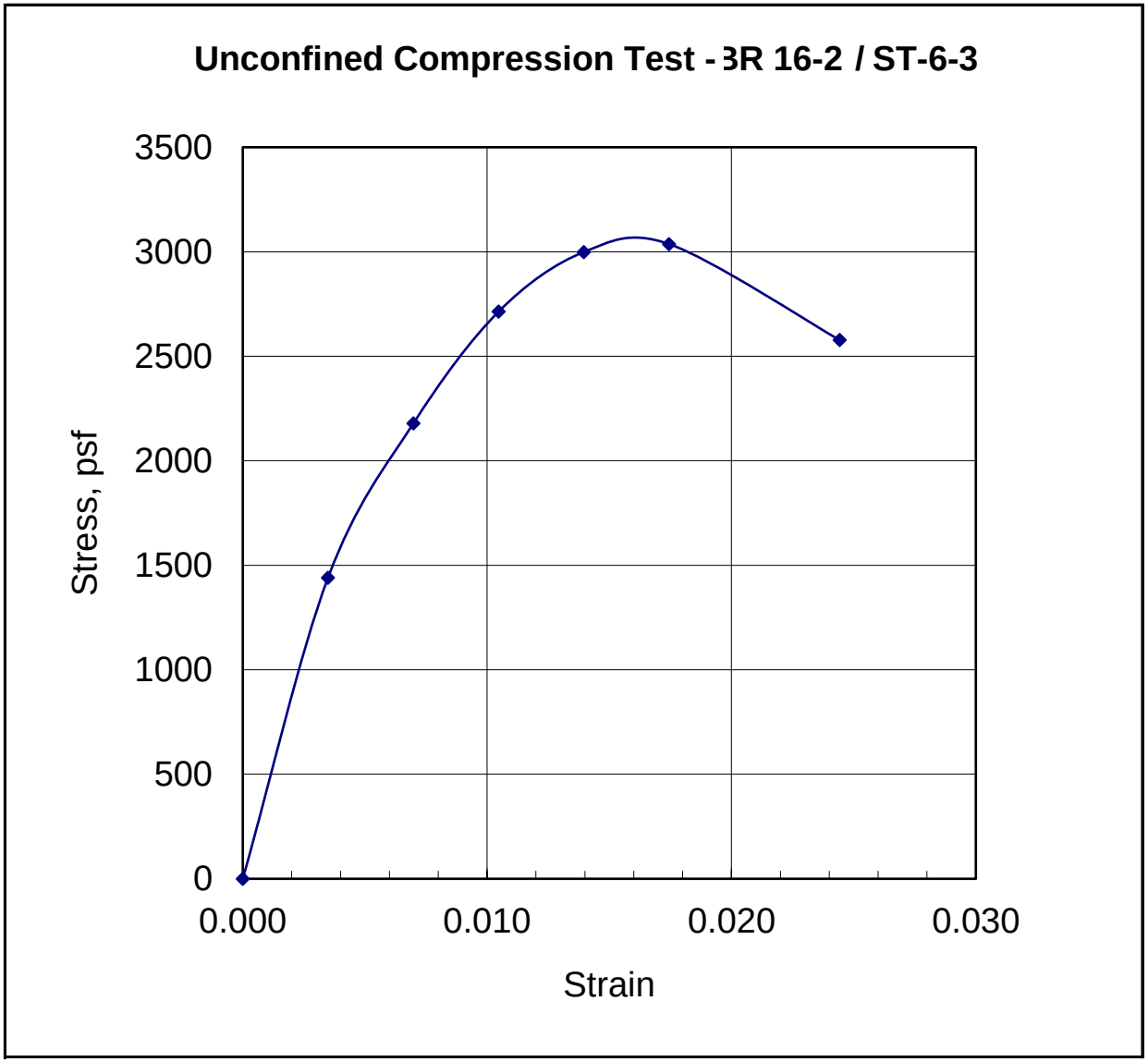
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	46
Plastic Limit	16
Plasticity Index	30
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**126.7**
Moisture content (%)	**23.3**
Dry unit weight (pcf)	**102.8**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**0.76**
% Strain at q_u	**1.7%**

Tested by: SLY	8/9/2024
Calculated by: jpe	8/12/2024
Checked by: AK	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 17-1**
SAMPLE NO.	**ST-4-2**
SAMPLE DEPTH (ft)	**8.5-9**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

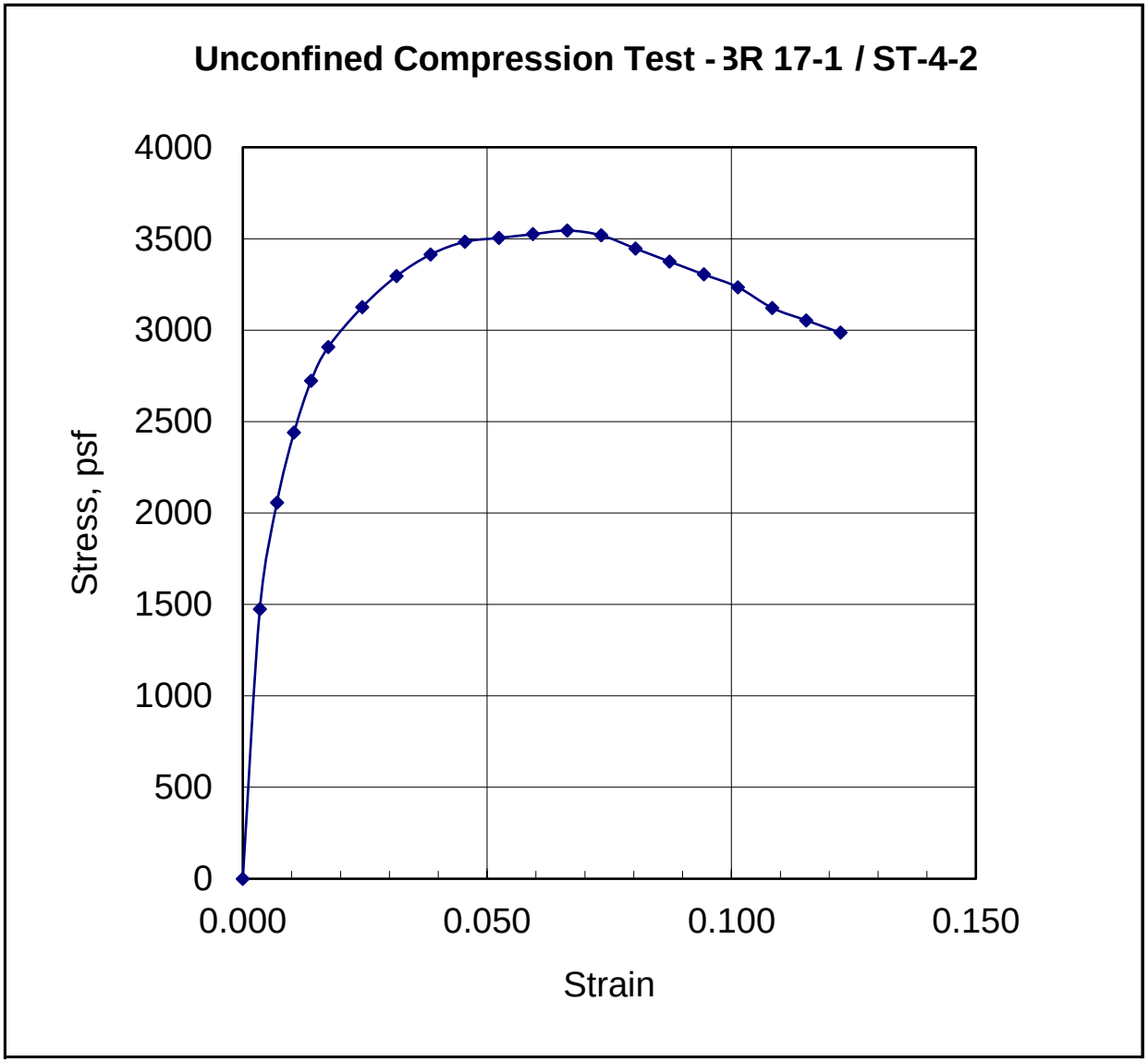
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	**52**
Plastic Limit	**15**
Plasticity Index	**37**
CLASSIFICATION. (USCS)	**CH**

DENSITY & MOISTURE	
Wet unit weight (pcf)	**126.8**
Moisture content (%)	**20.0**
Dry unit weight (pcf)	**105.7**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**0.89**
% Strain at q_u	**6.6%**

Tested by: SLY	5/15/2024
Calculated by: AK	5/16/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 17-1**
SAMPLE NO.	**ST-5-2**
SAMPLE DEPTH (ft)	**13-15**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

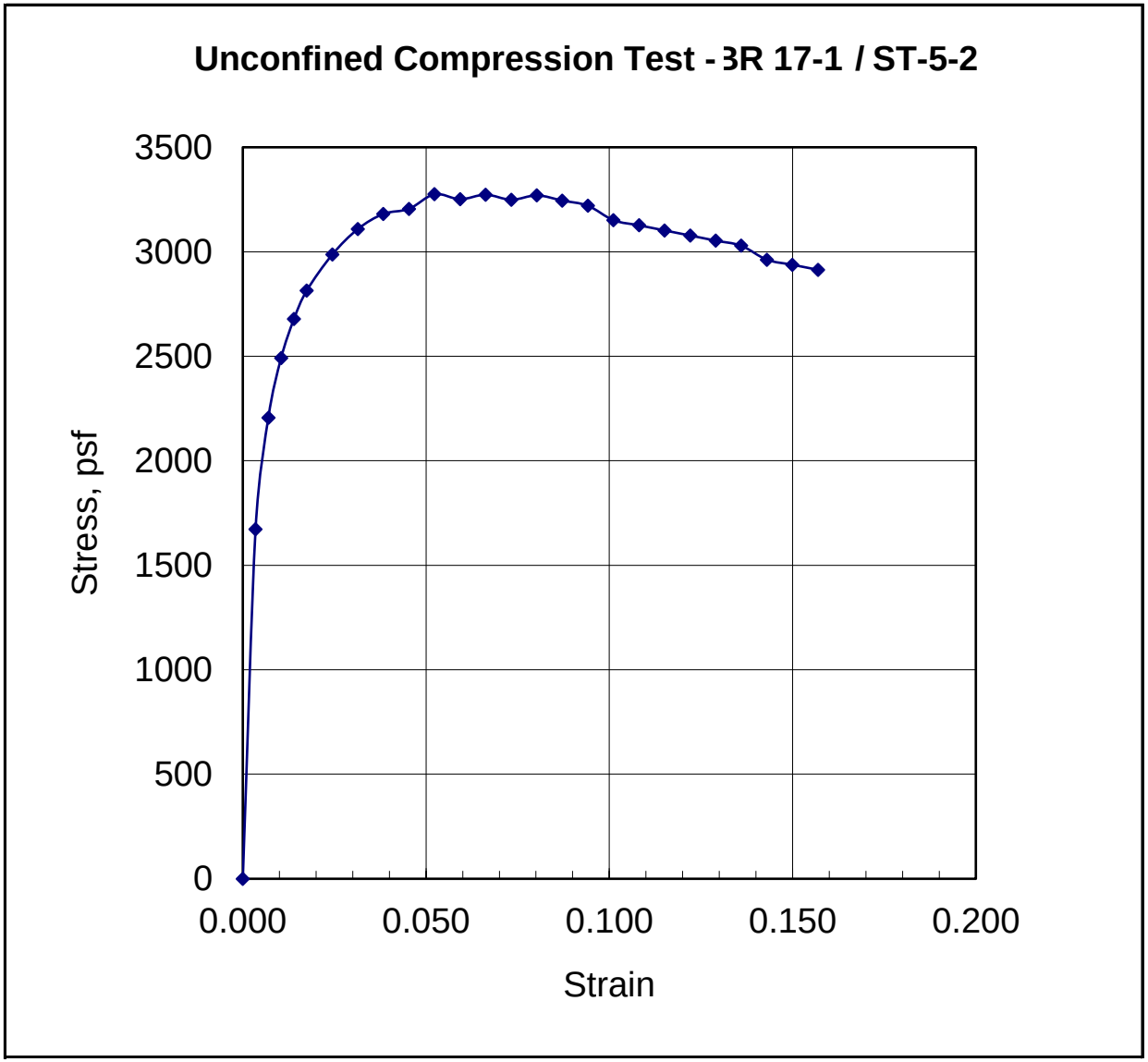
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	66
Plastic Limit	16
Plasticity Index	50
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**124.0**
Moisture content (%)	**25.8**
Dry unit weight (pcf)	**98.6**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**0.82**
% Strain at q_u	**5.2%**

Tested by: SLY	5/15/2024
Calculated by: AK	5/16/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 17-1**
SAMPLE NO.	**ST-7-4**
SAMPLE DEPTH (ft)	**23-25**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

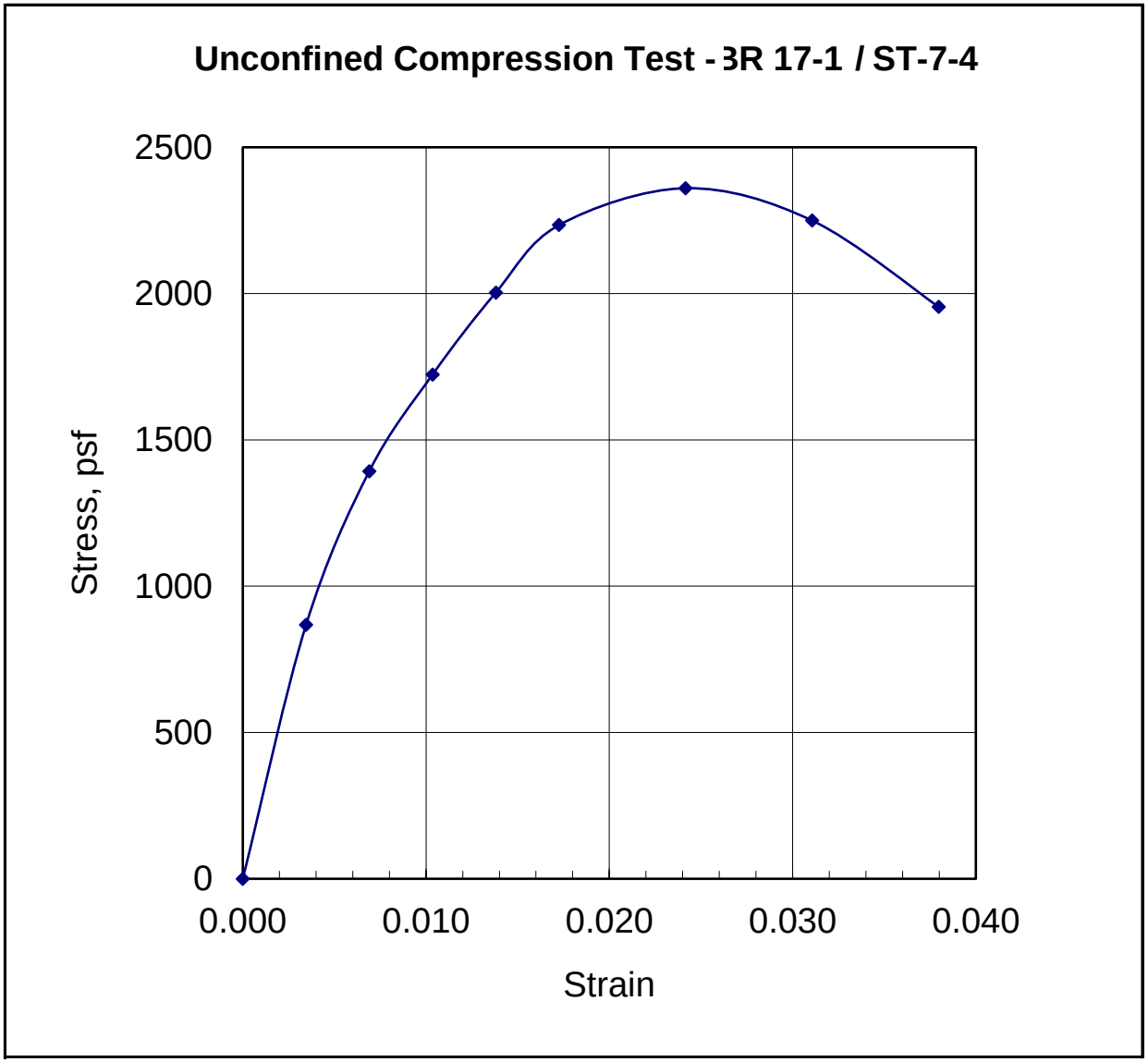
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	68
Plastic Limit	18
Plasticity Index	50
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**122.7**
Moisture content (%)	**25.2**
Dry unit weight (pcf)	**98.0**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**0.59**
% Strain at q_u	**2.4%**

Tested by: SLY	5/15/2024
Calculated by: AK	5/16/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 36-1A**
SAMPLE NO.	**ST-2-2**
SAMPLE DEPTH (ft)	**3.5-4**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

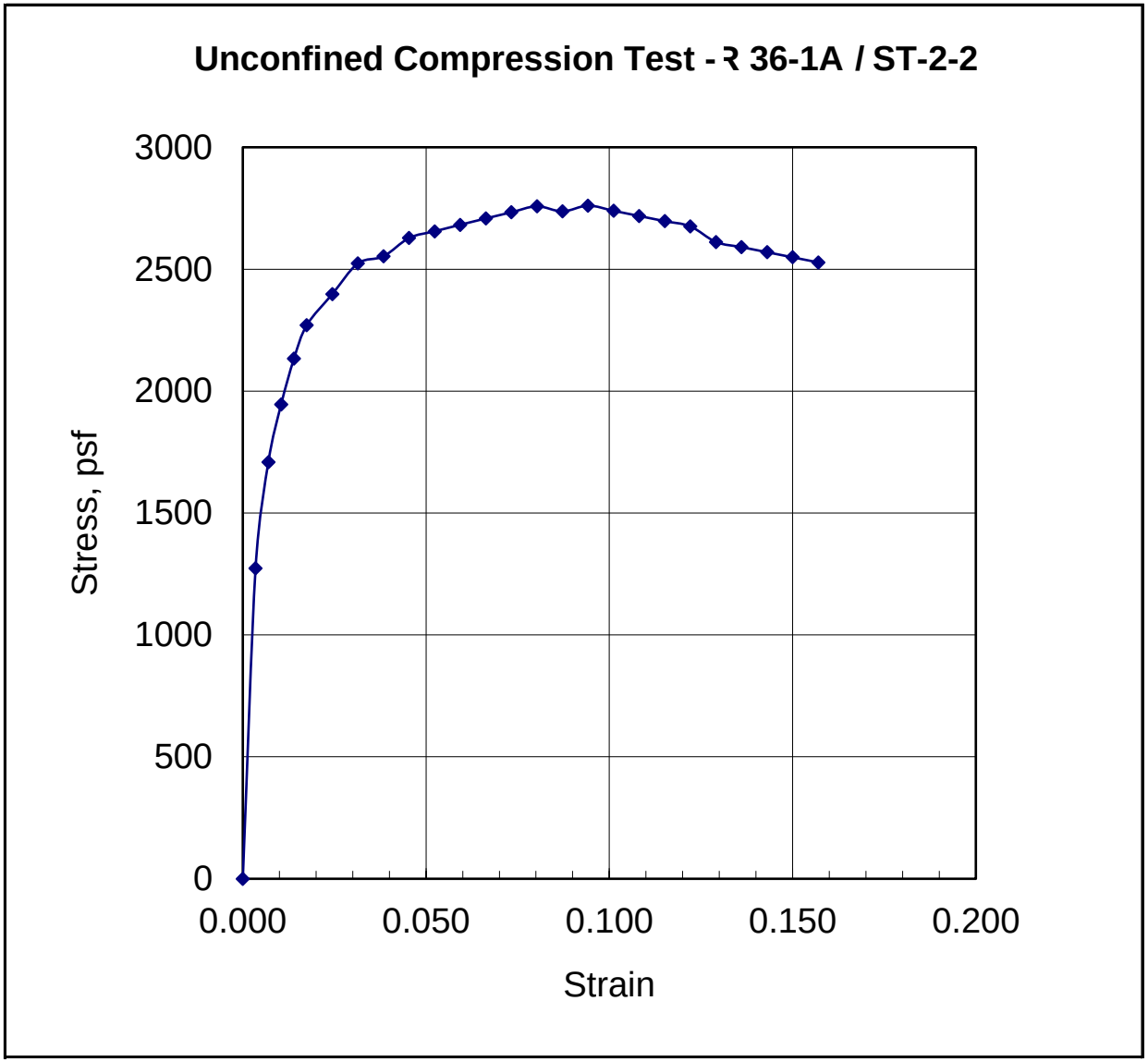
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	50
Plastic Limit	13
Plasticity Index	37
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**129.4**
Moisture content (%)	**22.8**
Dry unit weight (pcf)	**105.4**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**0.69**
% Strain at q_u	**9.4%**

Tested by: SLY	6/27/2024
Calculated by: AK	6/28/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 36-1A**
SAMPLE NO.	**ST-4-3**
SAMPLE DEPTH (ft)	**9.0-9.5**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

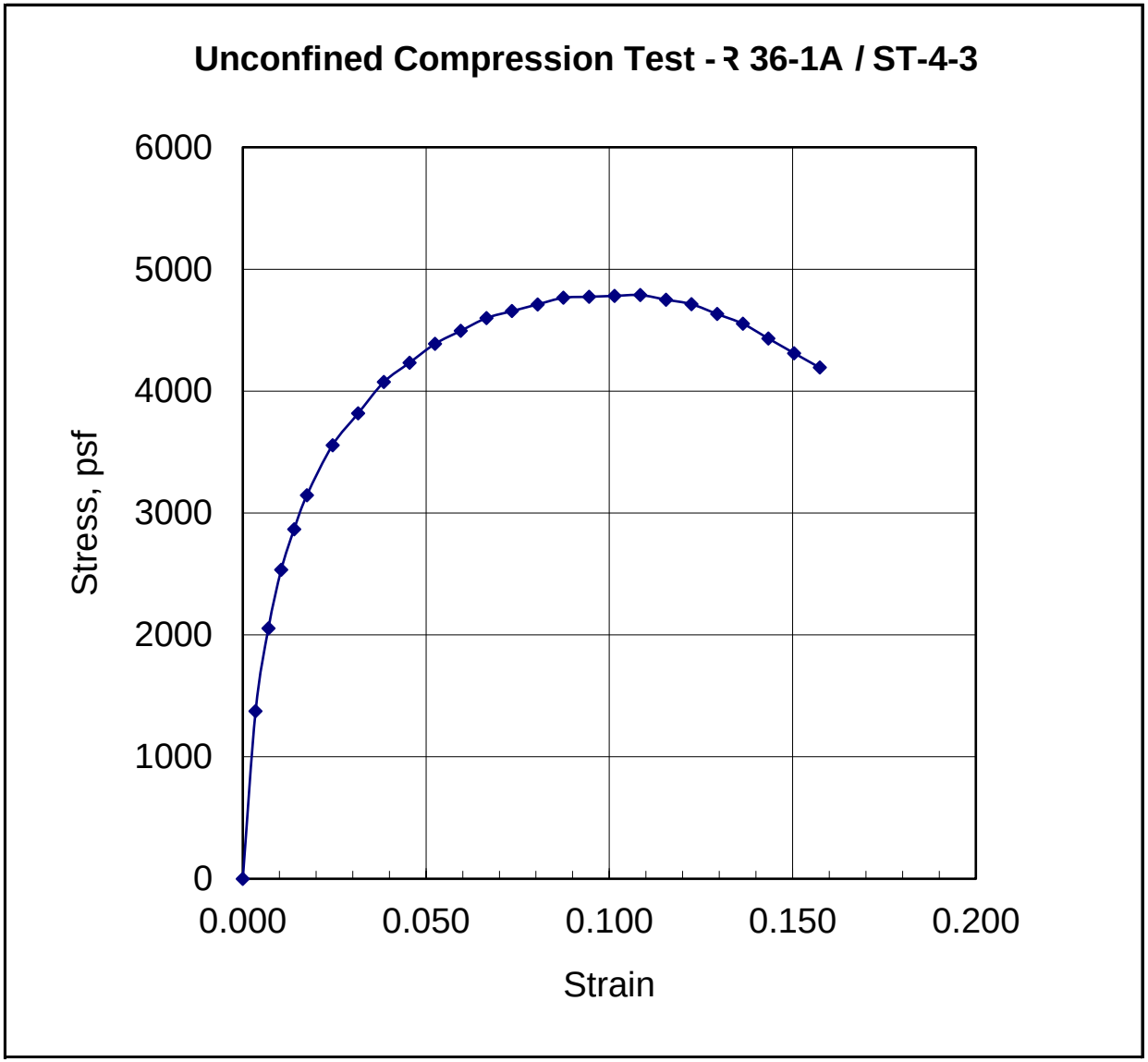
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	**70**
Plastic Limit	**16**
Plasticity Index	**54**
CLASSIFICATION. (USCS)	**CH**

DENSITY & MOISTURE	
Wet unit weight (pcf)	**135.1**
Moisture content (%)	**19.3**
Dry unit weight (pcf)	**113.2**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**1.20**
% Strain at q_u	**10.8%**

Tested by: SLY	6/27/2024
Calculated by: AK	6/28/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 36-3A**
SAMPLE NO.	**ST-2-3**
SAMPLE DEPTH (ft)	**4-4.5**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

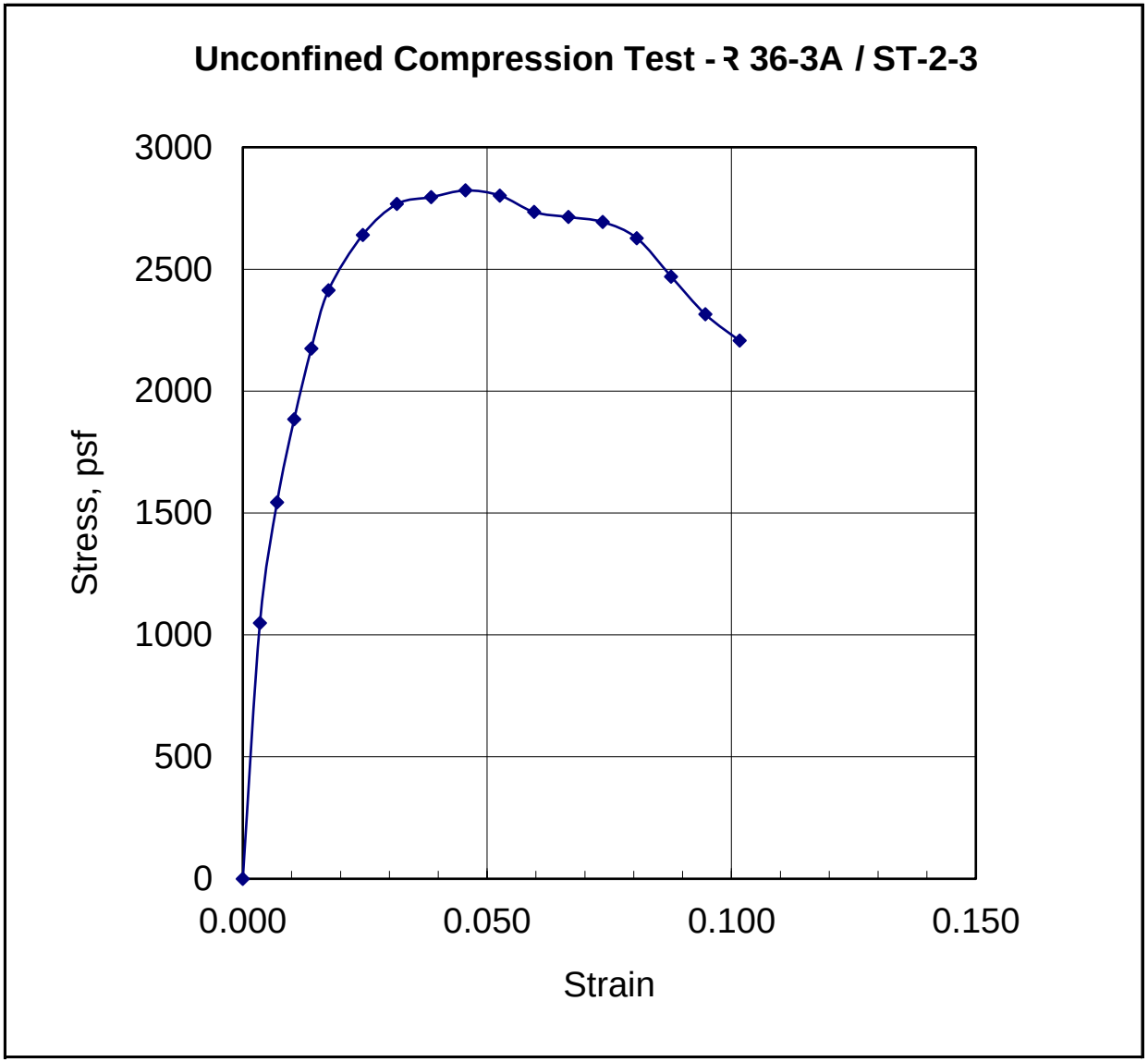
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	64
Plastic Limit	17
Plasticity Index	47
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**129.4**
Moisture content (%)	**23.3**
Dry unit weight (pcf)	**104.9**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**0.71**
% Strain at q_u	**4.6%**

Tested by: SLY	5/30/2024
Calculated by: AK	6/3/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 37-1**
SAMPLE NO.	**ST-4-3**
SAMPLE DEPTH (ft)	**9.0-9.5**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CL**

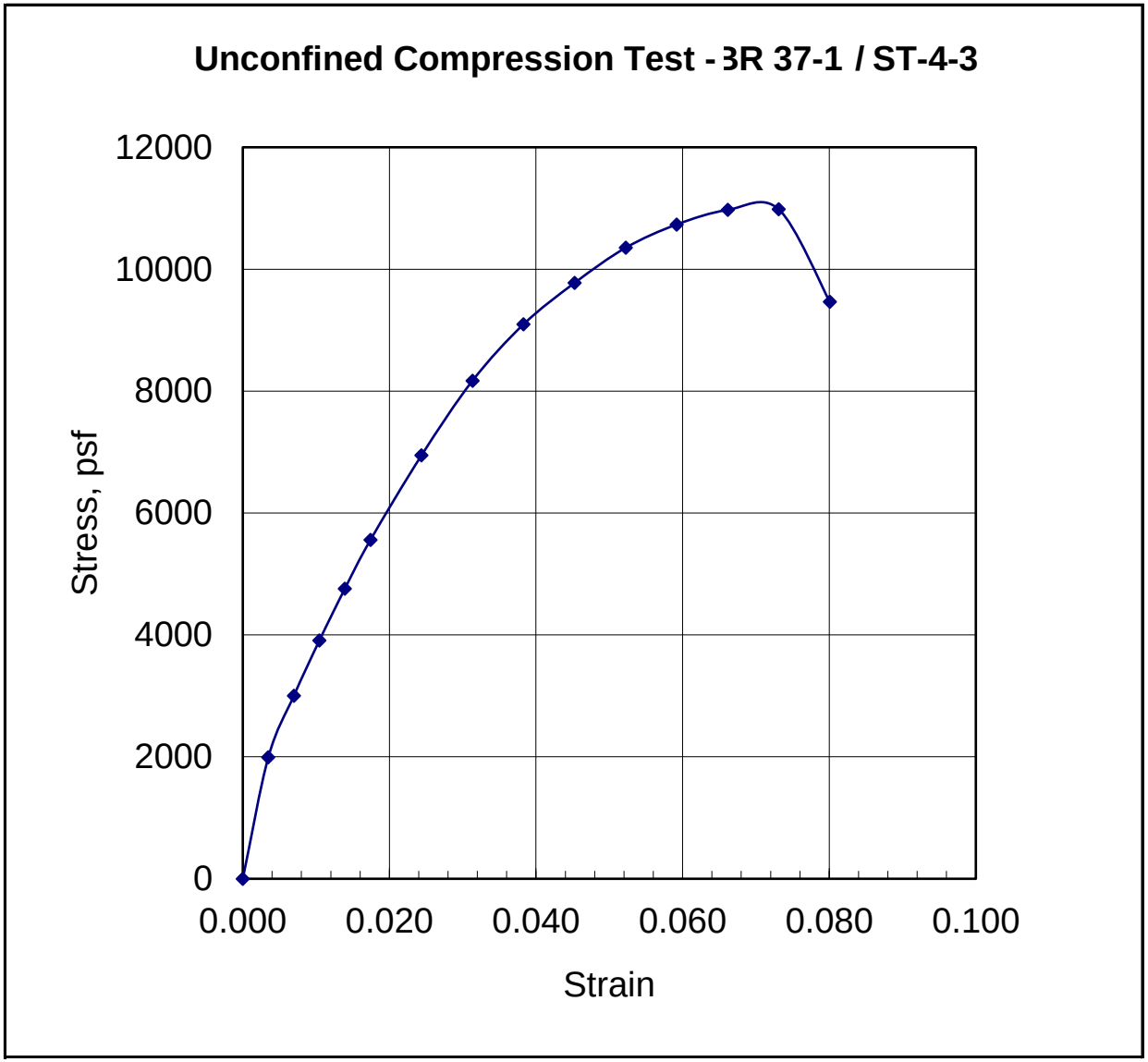
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	44
Plastic Limit	13
Plasticity Index	31
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**136.2**
Moisture content (%)	**15.5**
Dry unit weight (pcf)	**117.9**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**2.75**
% Strain at q_u	**7.3%**

Tested by: SLY	5/30/2024
Calculated by: AK	6/3/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 37-2**
SAMPLE NO.	**ST-20-2**
SAMPLE DEPTH (ft)	**88.5-89**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

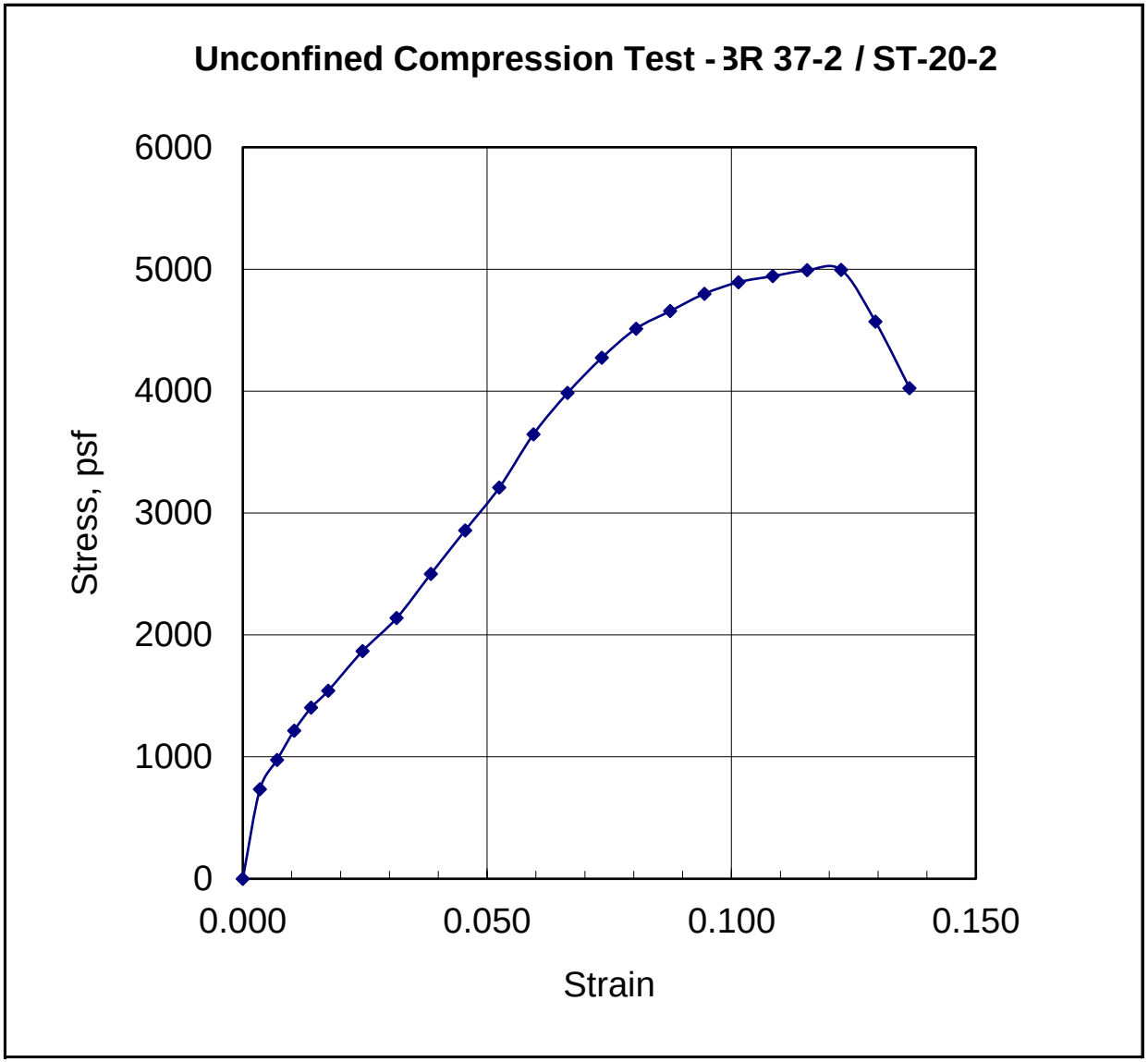
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	50
Plastic Limit	14
Plasticity Index	36
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**127.1**
Moisture content (%)	**21.1**
Dry unit weight (pcf)	**105.0**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**1.25**
% Strain at q_u	**12.2%**

Tested by: SLY	6/18/2024
Calculated by: AK	6/24/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 37-3**
SAMPLE NO.	**ST-2-3**
SAMPLE DEPTH (ft)	**4-4.5**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CH**

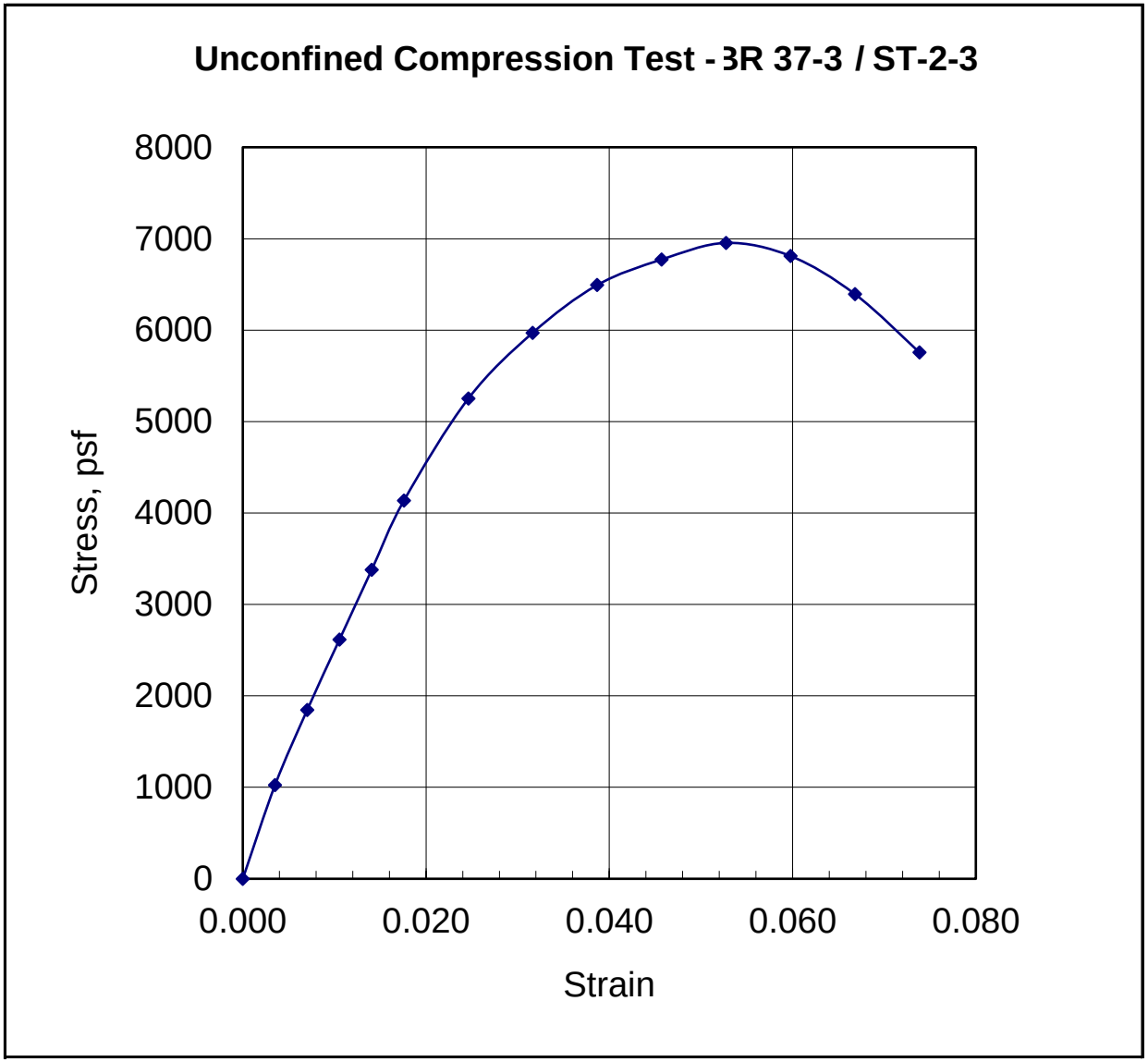
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	63
Plastic Limit	16
Plasticity Index	47
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**131.7**
Moisture content (%)	**15.3**
Dry unit weight (pcf)	**114.2**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**1.74**
% Strain at q_u	**5.3%**

Tested by: SLY	5/30/2024
Calculated by: AK	6/3/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**BR 37-3**
SAMPLE NO.	**ST-5-3**
SAMPLE DEPTH (ft)	**14-14.5**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CL**

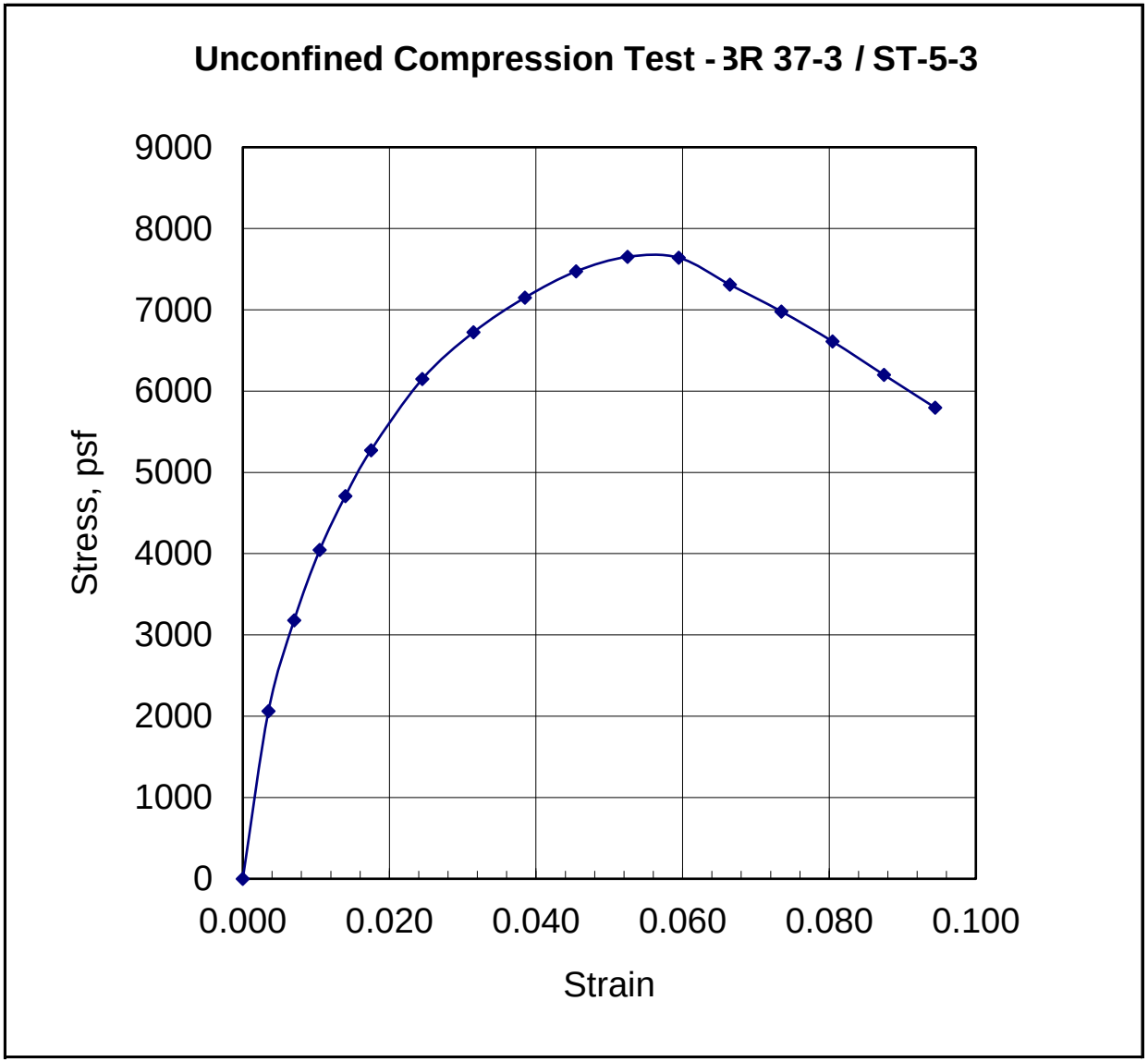
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	43
Plastic Limit	15
Plasticity Index	28
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**139.3**
Moisture content (%)	**16.5**
Dry unit weight (pcf)	**119.5**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**1.91**
% Strain at q_u	**5.2%**

Tested by: SLY	5/30/2024
Calculated by: AK	6/3/2024
Checked by: JPE	



PROJECT NAME: I-70 Third Lane

PROJECT No.: 20241040.00

BORING NO.	**Ramp 5-2A**
SAMPLE NO.	**ST-2**
SAMPLE DEPTH (ft)	**3.5-4**
RECOVERY (%)	
VISUAL CLASS. (USCS)	**CL**

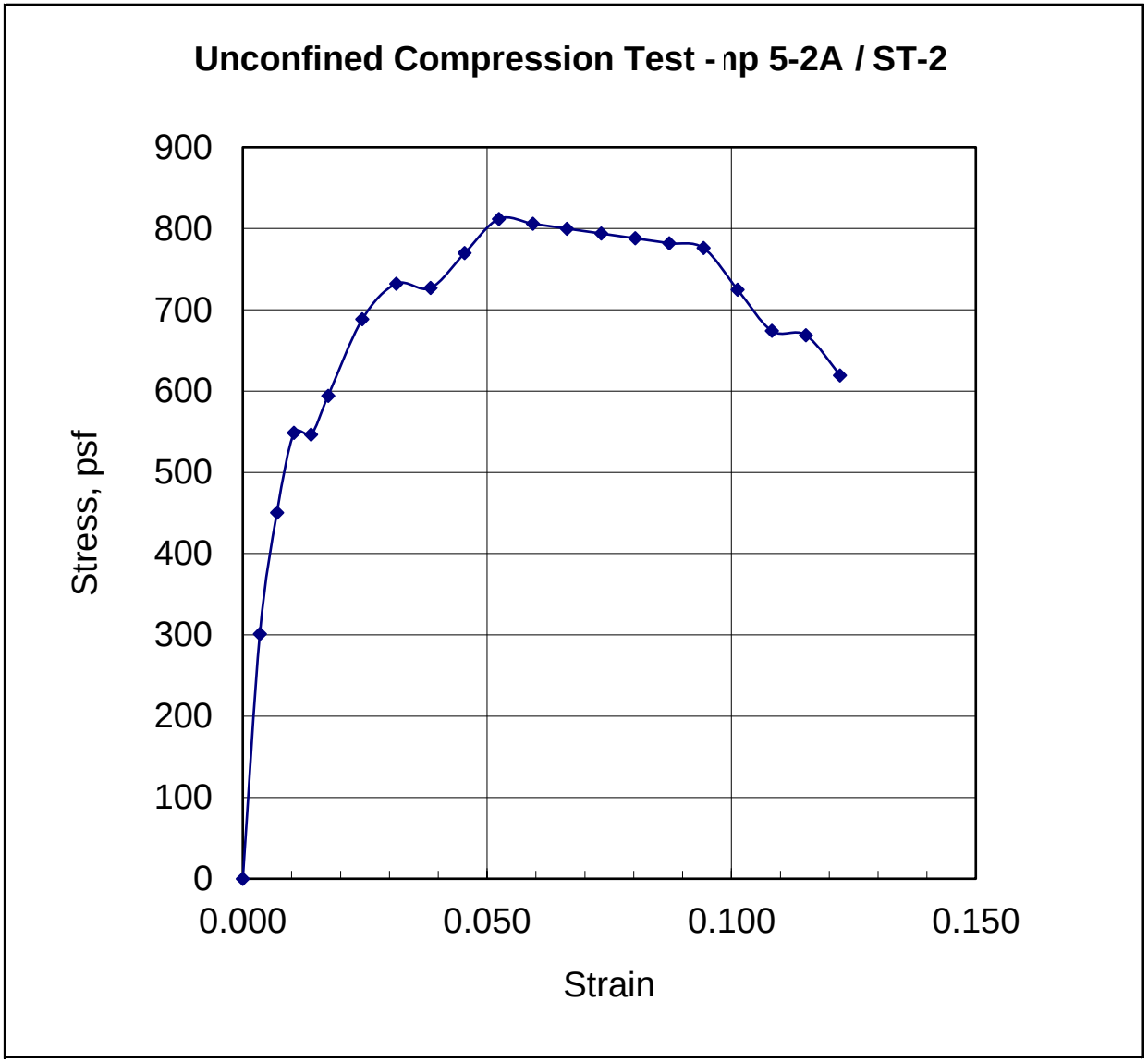
SPECIFICATIONS	
Unconfined Compression	**ASTM D2166**
Atterberg Limits	**ASTM D4318**
VISUAL CLASS. (USCS)	**ASTM D2488**

ATTERBERG LIMITS	
Liquid Limit	
Plastic Limit	
Plasticity Index	
CLASSIFICATION. (USCS)	

DENSITY & MOISTURE	
Wet unit weight (pcf)	**116.0**
Moisture content (%)	**50.9**
Dry unit weight (pcf)	**76.9**

STRENGTH	
Undrained Shear Strength S_u (tsf)	**0.20**
% Strain at q_u	**5.2%**

Tested by: SLY	6/18/2024
Calculated by: AK	6/24/2024
Checked by: JPE	



Unconsolidated-Undrained Triaxial Compression Test - Q-test

Project Name	I-70 Third Lane	Tested By	SLY 6/24/2024
Project No.	20241040.00	Checked By	JPE
Boring No.	BR 2-3	Sample No.	ST-3-3
Depth	7-7.5		
Soil Description	**Brown, lean CLAY (CL), with sand**		

Liquid Limit		%
Plastic Limit		%
Plasticity Index		%
USCS		
Specific Gravity	2.70	*

*assumed

Water Content Data:

Wet & Tare	63.00	gm
Dry & Tare	52.59	gm
Tare	2.56	gm
Water Content	20.8	%

Moisture content sample taken from: Trimmings

Specimen Data:

Diameter	72.88	mm
Height	145.15	mm
Wet Weight	1141.57	gm
Volume	605.51	cc
L:D Ratio	1.99	
Wet Density	117.64	pcf
Dry Density	97.38	pcf
Water Content	20.8	%
Saturation	77	%
Void Ratio	0.73	

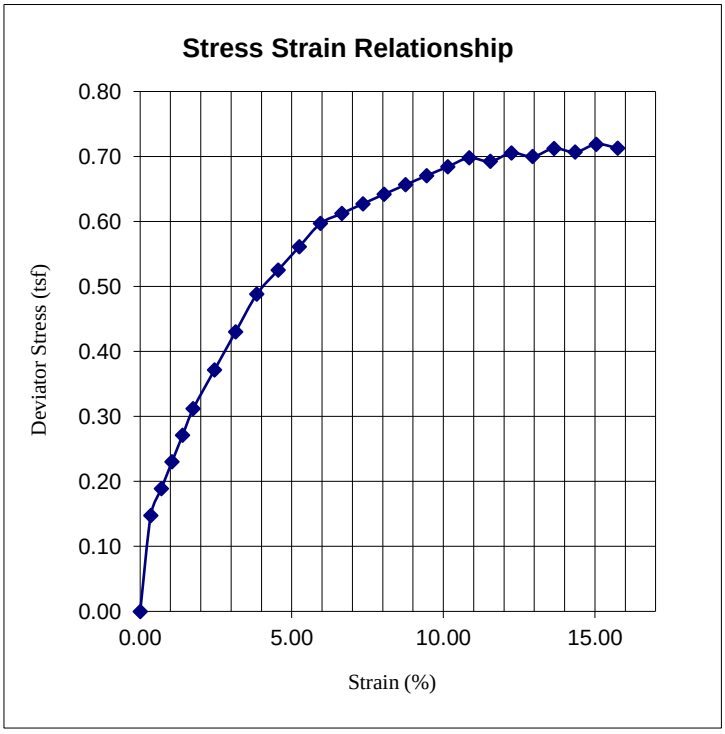
Instrument Constants

Deformation	0.0001	in/div
Load	1.9	lbs/div
Strain Rate	0.039	in/min
	0.05	%/min

Failure Mode: Bulge

Undrained Shear Strength (tsf)	0.36
Axial Strain (%)	15.0

Confining Pressure (psi): 5.8



TSi Geotechnical, Inc.

Unconsolidated-Undrained Triaxial Compression Test - Q-test

Project Name	I-70 Third Lane		Tested By	SLY	5/8/2024
Project No.	20241040.00		Checked By	JPE	5/22/2024
Boring No.	BR 13-1A	Sample No. ST-5-3		Depth	14.0-14.5'

Soil Description **Brown and gray, fat CLAY (CH), trace gravel and sand**

Liquid Limit		%
Plastic Limit		%
Plasticity Index		%
USCS		
Specific Gravity	2.70	*

*assumed

Water Content Data:

Wet & Tare	89.54	gm
Dry & Tare	69.96	gm
Tare	2.59	gm
Water Content	29.1	%

Moisture content sample taken from: Trimmings

Specimen Data:

Diameter	72.49	mm
Height	145.02	mm
Wet Weight	1199.8	gm
Volume	598.51	cc
L:D Ratio	2.00	
Wet Density	125.09	pcf
Dry Density	96.92	pcf
Water Content	29.1	%
Saturation	106	%
Void Ratio	0.74	

Instrument Constants

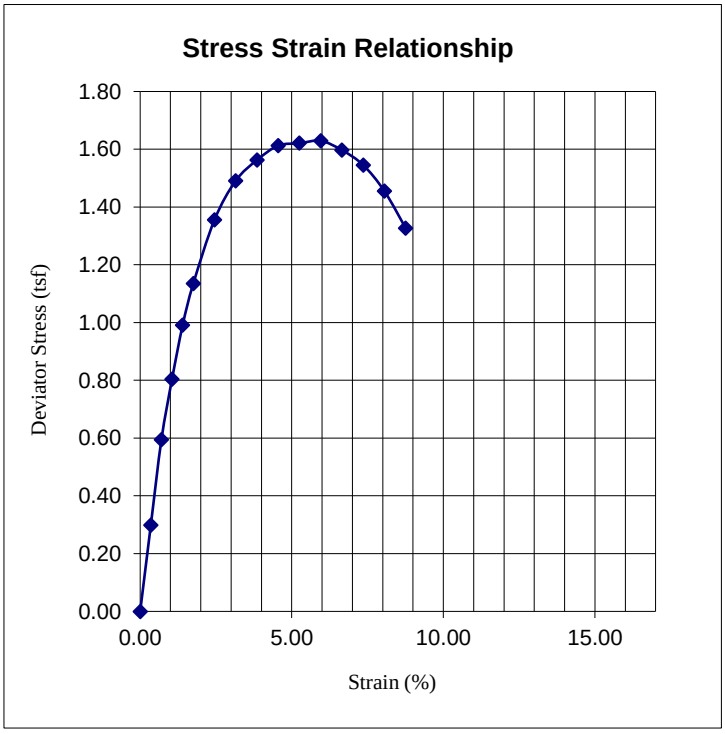
Deformation	0.0001	in/div
Load	1.9	lbs/div
Strain Rate	0.039	in/min
	0.05	%/min

Failure Mode: Bulge

Undrained Shear Strength (tsf): 0.81

Confining Pressure (psi): 10.4

Axial Strain (%): 6.0



Unconsolidated-Undrained Triaxial Compression Test - Q-test

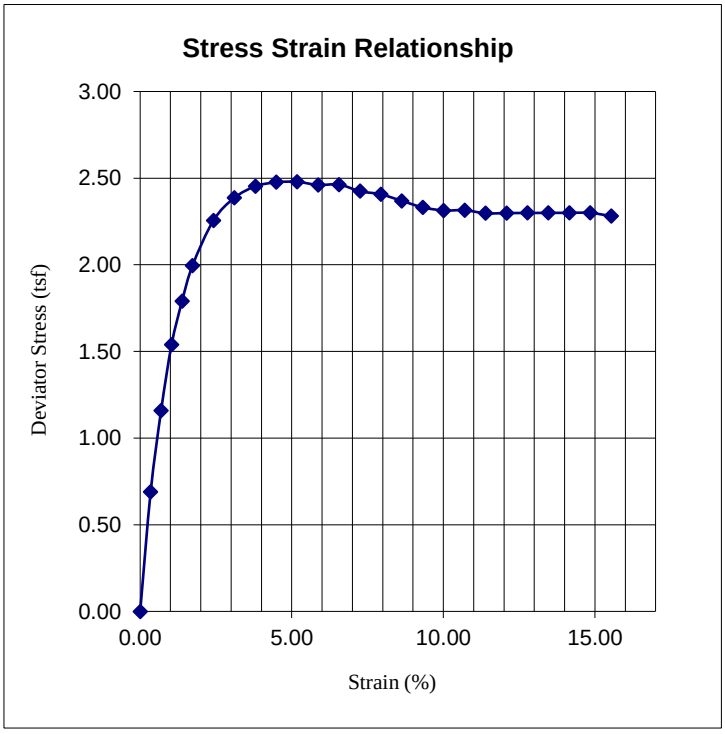
Project Name	I-70 Third Lane		Tested By	SLY	5/8/2024
Project No.	20241040.00		Checked By	JPE	5/22/2024
Boring No.	BR 14-2	Sample No. ST-4-2		Depth	8.5-9

Soil Description **Brown and gray, fat CLAY (CH), with gravel and sand**

			Specimen Data:			Instrument Constants		
Liquid Limit	51	%	Diameter	72.12	mm	Deformation	0.0001	in/div
Plastic Limit	19	%	Height	147.13	mm	Load	1.9	lbs/div
Plasticity Index	32	%	Wet Weight	1174.11	gm	Strain Rate	0.039	in/min
USCS			Volume	601.04	cc		0.05	%/min
Specific Gravity	2.70	*	L:D Ratio	2.04				
*assumed			Wet Density	121.90	pcf	Failure Mode		
Water Content Data:			Dry Density	105.62	pcf			
Wet & Tare	76.56	gm	Water Content	15.4	%			
Dry & Tare	66.68	gm	Saturation	70	%	Bulge		
Tare	2.56	gm	Void Ratio	0.60				
Water Content	15.4	%						

Moisture content sample taken from: Trimmings

Undrained Shear Strength (tsf)	1.24	Confining Pressure (psi)	10.4
Axial Strain (%)	5.2		



TSi Geotechnical, Inc.

Unconsolidated-Undrained Triaxial Compression Test - Q-test

Project Name	I-70 Third Lane		Tested By	SLY	5/8/2024
Project No.	20241040.00		Checked By	JPE	5/8/2024
Boring No.	BR 16-1.1A	Sample No. ST-6-2		Depth	18.5-19

Soil Description **Brown and gray, fat CLAY (CH), with sand, trace gravel**

Liquid Limit	67	%
Plastic Limit	17	%
Plasticity Index	50	%
USCS		
Specific Gravity	2.70	*

*assumed

Water Content Data:

Wet & Tare	74.60	gm
Dry & Tare	61.41	gm
Tare	2.60	gm
Water Content	22.4	%

Moisture content sample taken from: Trimmings

Specimen Data:

Diameter	72.30	mm
Height	145.61	mm
Wet Weight	1202.22	gm
Volume	597.80	cc
L:D Ratio	2.01	
Wet Density	125.49	pcf
Dry Density	102.50	pcf
Water Content	22.4	%
Saturation	94	%
Void Ratio	0.64	

Instrument Constants

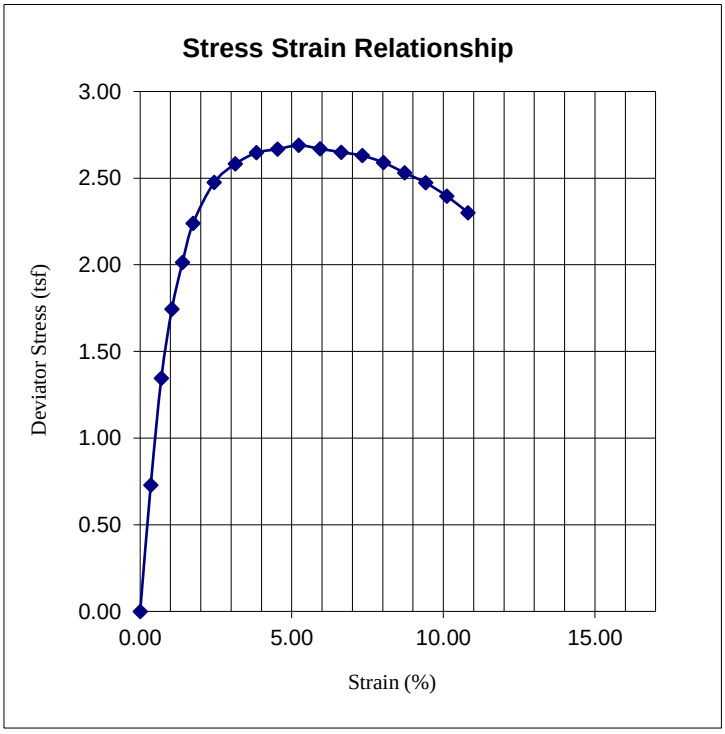
Deformation	0.0001	in/div
Load	1.9	lbs/div
Strain Rate	0.039	in/min
	0.05	%/min

Failure Mode: Bulge

Confining Pressure (psi): 6.9

Undrained Shear Strength (tsf): 1.34

Axial Strain (%): 5.2



TSi Geotechnical, Inc.

Unconsolidated-Undrained Triaxial Compression Test - Q-test

Project Name	I-70 Third Lane		Tested By	SLY	8/7/2024
Project No.	20241040.00		Checked By	JPE	8/16/2024
Boring No.	BR 16-2.1	Sample No. ST-2-3		Depth	4.0-4.5

Soil Description **Brown and gray, lean CLAY (CL), trace sand**

Liquid Limit	41	%
Plastic Limit	19	%
Plasticity Index	22	%
USCS		
Specific Gravity	2.70	*

*assumed

Water Content Data:

Wet & Tare	83.60	gm
Dry & Tare	72.56	gm
Tare	2.58	gm
Water Content	15.8	%

Moisture content sample taken from: Trimmings

Specimen Data:

Diameter	72.38	mm
Height	144.97	mm
Wet Weight	1217.2	gm
Volume	596.49	cc
L:D Ratio	2.00	
Wet Density	127.33	pcf
Dry Density	109.98	pcf
Water Content	15.8	%
Saturation	80	%
Void Ratio	0.53	

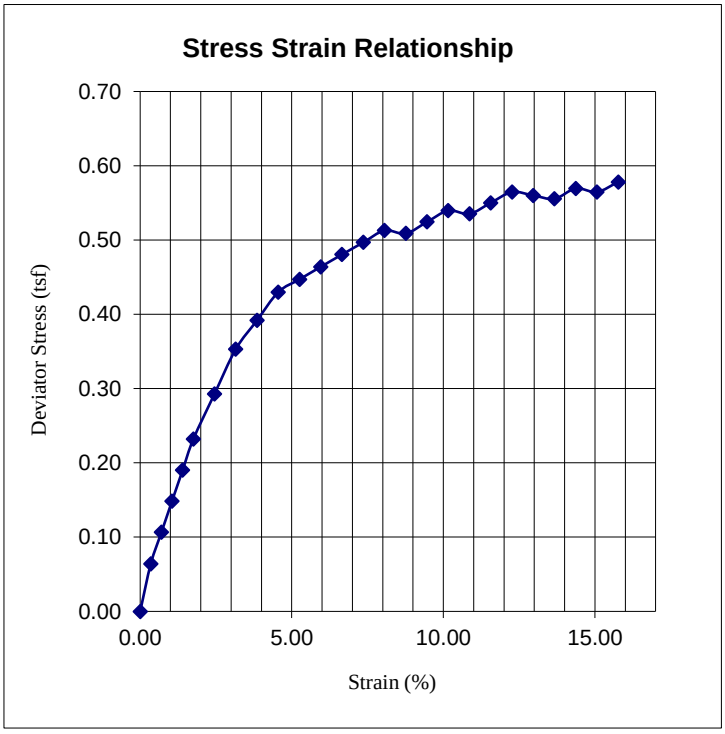
Instrument Constants

Deformation	0.0001	in/div
Load	1.9	lbs/div
Strain Rate	0.039	in/min
	0.05	%/min

Failure Mode: Bulge

Undrained Shear Strength (tsf)	0.29
Axial Strain (%)	15.0

Confining Pressure (psi) 3.5



TSi Geotechnical, Inc.

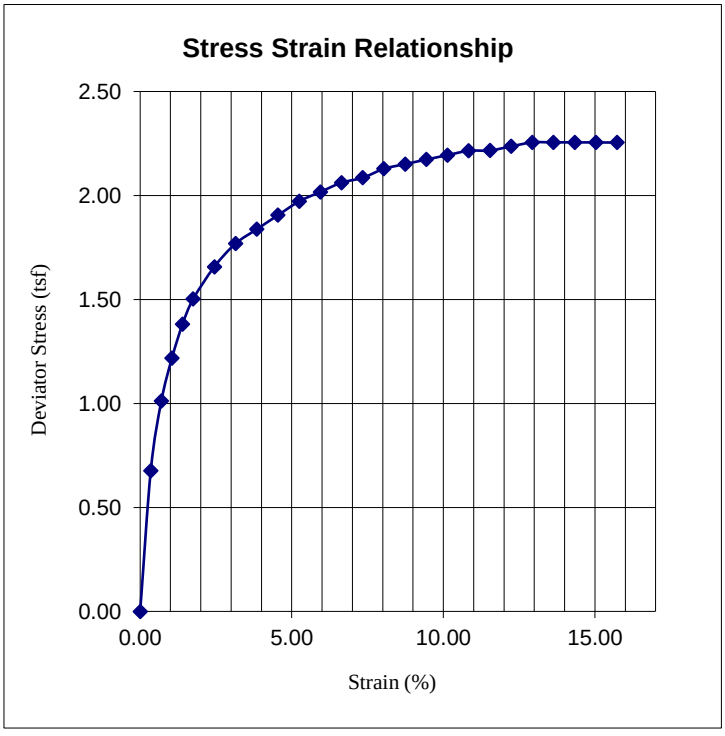
Unconsolidated-Undrained Triaxial Compression Test - Q-test

Project Name	I-70 Third Lane		Tested By	SLY	5/21/2024
Project No.	20241040.00		Checked By	JPE	5/22/2024
Boring No.	BR 17-2	Sample No. ST-6-3		Depth	
Soil Description	**Brown and gray, lean CLAY (CL), trace gravel**				

Liquid Limit	49	%	Specimen Data:			Instrument Constants		
Plastic Limit	15	%	Diameter	72.75	mm	Deformation	0.0001	in/div
Plasticity Index	34	%	Height	145.31	mm	Load	1.9	lbs/div
USCS			Wet Weight	1260.52	gm	Strain Rate	0.039	in/min
Specific Gravity	2.70	*	Volume	604.02	cc		0.05	%/min
*assumed			L:D Ratio	2.00				
Water Content Data:			Wet Density	130.22	pcf	Failure Mode		
Wet & Tare	28.55	gm	Dry Density	107.03	pcf	Bulge		
Dry & Tare	23.92	gm	Water Content	21.7	%			
Tare	2.55	gm	Saturation	102	%			
Water Content	21.7	%	Void Ratio	0.57				

Moisture content sample taken from: Trimmings

Undrained Shear Strength (tsf)	1.13		
Confining Pressure (psi)	13.9	Axial Strain (%)	13.6



Unconsolidated-Undrained Triaxial Compression Test - Q-test

Project Name	I-70 Third Lane	Tested By	SLY	6/26/2024
Project No.	20241040.00	Checked By	AK	6/27/2024
Boring No.	BR 36-2	Sample No.	ST-4-3	Depth 9.0-9.5

Soil Description **Brown and gray, SILTY CLAY (CL-ML), with sand, trace gravel**

Liquid Limit	23	%
Plastic Limit	17	%
Plasticity Index	6	%
USCS		
Specific Gravity	2.70	*

*assumed

Water Content Data:

Wet & Tare	96.94	gm
Dry & Tare	81.64	gm
Tare	2.57	gm
Water Content	19.3	%

Moisture content sample taken from: Trimmings

Specimen Data:

Diameter	71.22	mm
Height	146.28	mm
Wet Weight	1187.88	gm
Volume	582.75	cc
L:D Ratio	2.05	
Wet Density	127.20	pcf
Dry Density	106.57	pcf
Water Content	19.3	%
Saturation	90	%
Void Ratio	0.58	

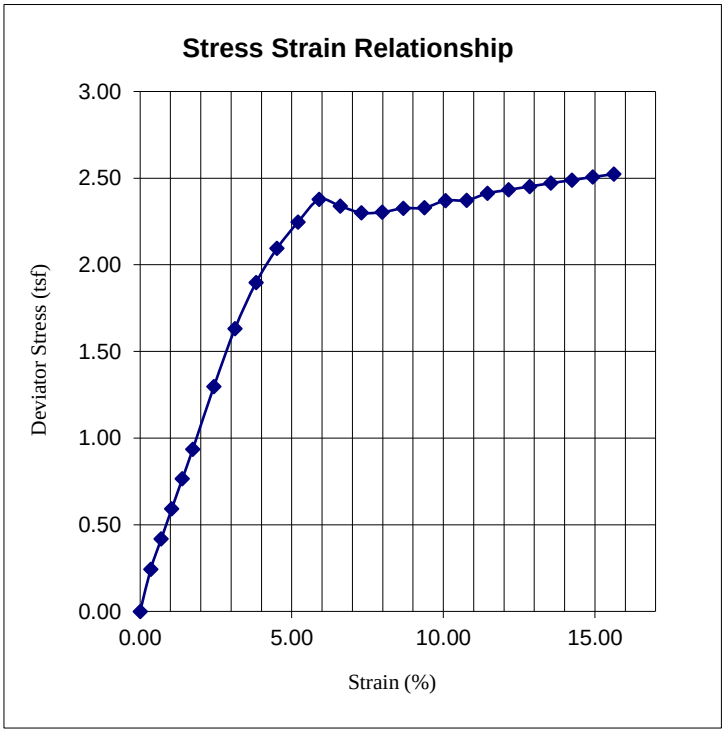
Instrument Constants

Deformation	0.0001	in/div
Load	1.9	lbs/div
Strain Rate	0.039	in/min
	0.05	%/min

Failure Mode: Bulge

Undrained Shear Strength (tsf)	1.26
Axial Strain (%)	15.0

Confining Pressure (psi) 6.9



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Unconsolidated-Undrained Triaxial Compression Test - Q-test

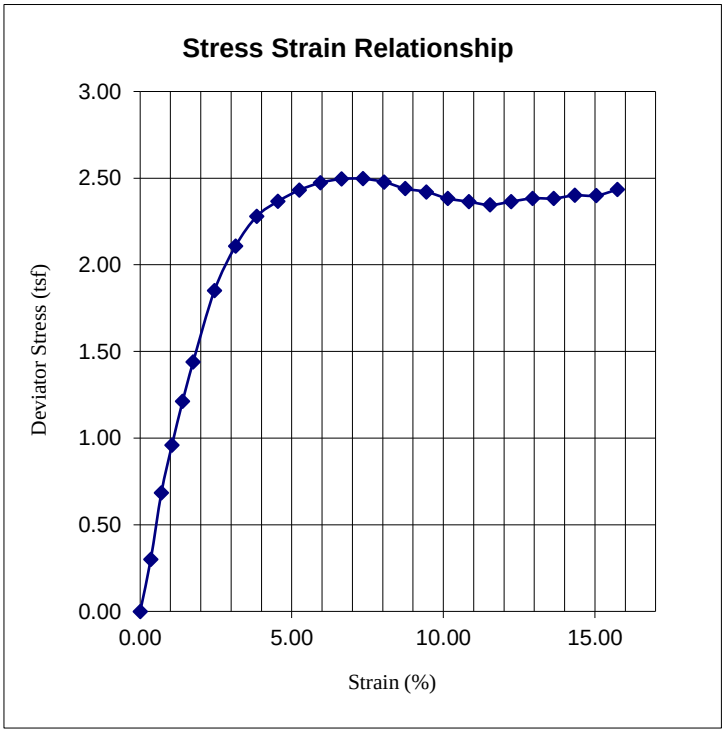
Project Name	I-70 Third Lane		Tested By	SLY	5/8/2024
Project No.	20241040.00		Checked By	JPE	5/22/2024
Boring No.	BR 36-3A	Sample No. ST-4-3		Depth	9.0-9.5

Soil Description **Brown and gray, lean CLAY (CL), with sand, trace gravel**

Liquid Limit	44	%	Specimen Data:			Instrument Constants		
Plastic Limit	14	%	Diameter	72.20	mm	Deformation	0.0001	in/div
Plasticity Index	30	%	Height	145.24	mm	Load	1.9	lbs/div
USCS			Wet Weight	1299.04	gm	Strain Rate	0.039	in/min
Specific Gravity	2.70	*	Volume	594.64	cc		0.05	%/min
*assumed			L:D Ratio	2.01				
Water Content Data:			Wet Density	136.32	pcf	Failure Mode		
Wet & Tare	85.32	gm	Dry Density	122.63	pcf			
Dry & Tare	77.01	gm	Water Content	11.2	%			
Tare	2.55	gm	Saturation	81	%	Bulge		
Water Content	11.2	%	Void Ratio	0.37				

Moisture content sample taken from: Trimmings

Undrained Shear Strength (tsf)		1.25	
Confining Pressure (psi)	6.9	Axial Strain (%)	7.3



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ATTERBERG LIMITS' RESULTS

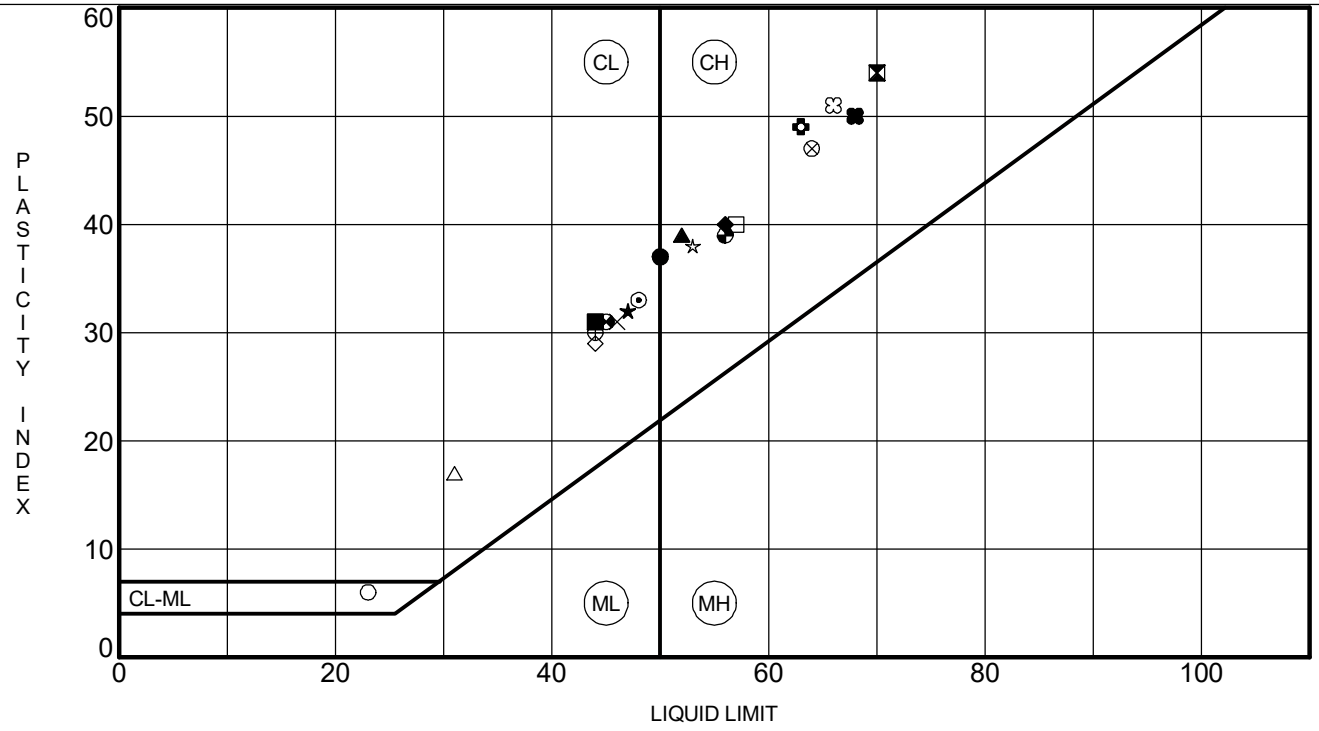
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1340 North Price Road
Saint Louis, Missouri 63132

CLIENT Jacobs

PROJECT NAME I-70 3rd Lane (Kingdom City to Columbia)

PROJECT NUMBER 20241040.00

PROJECT LOCATION Kingdom City and Columbia, Missouri



	Specimen Identification		LL	PL	PI	Fines	Classification
●	BR 36-1A	3.0	50	13	37		
⊠	BR 36-1A	8.0	70	16	54		
▲	BR 36-1A	13.5	52	13	39		
★	BR 36-1A	23.5	47	15	32		
⊙	BR 36-1A	63.5	48	15	33		
✿	BR 36-1A	88.5	63	14	49		
○	BR 36-2	8.0	23	17	6		
△	BR 36-2	68.5	31	14	17		
⊗	BR 36-3A	3.0	64	17	47		
⊕	BR 36-3A	8.0	44	14	30		
□	BR 36-3A	28.5	57	17	40		
⊛	BR 36-3A	43.5	45	14	31		
◕	BR 36-3A	58.5	56	17	39		
☆	BR 36-3A	73.5	53	15	38		
⊠	BR 36-3A	88.5	66	15	51		
■	BR 37-1	8.0	44	13	31		
◆	BR 37-1	13.5	56	16	40		
◇	BR 37-1	23.5	44	15	29		
×	BR 37-1	38.5	46	15	31		
✖	BR 37-1	48.5	68	18	50		

ATTERBERG LIMITS - MODOT 20150728.GDT - 8/15/24 13:23 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\20241040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040 - PRELIMINARY.GPJ

ATTERBERG LIMITS' RESULTS

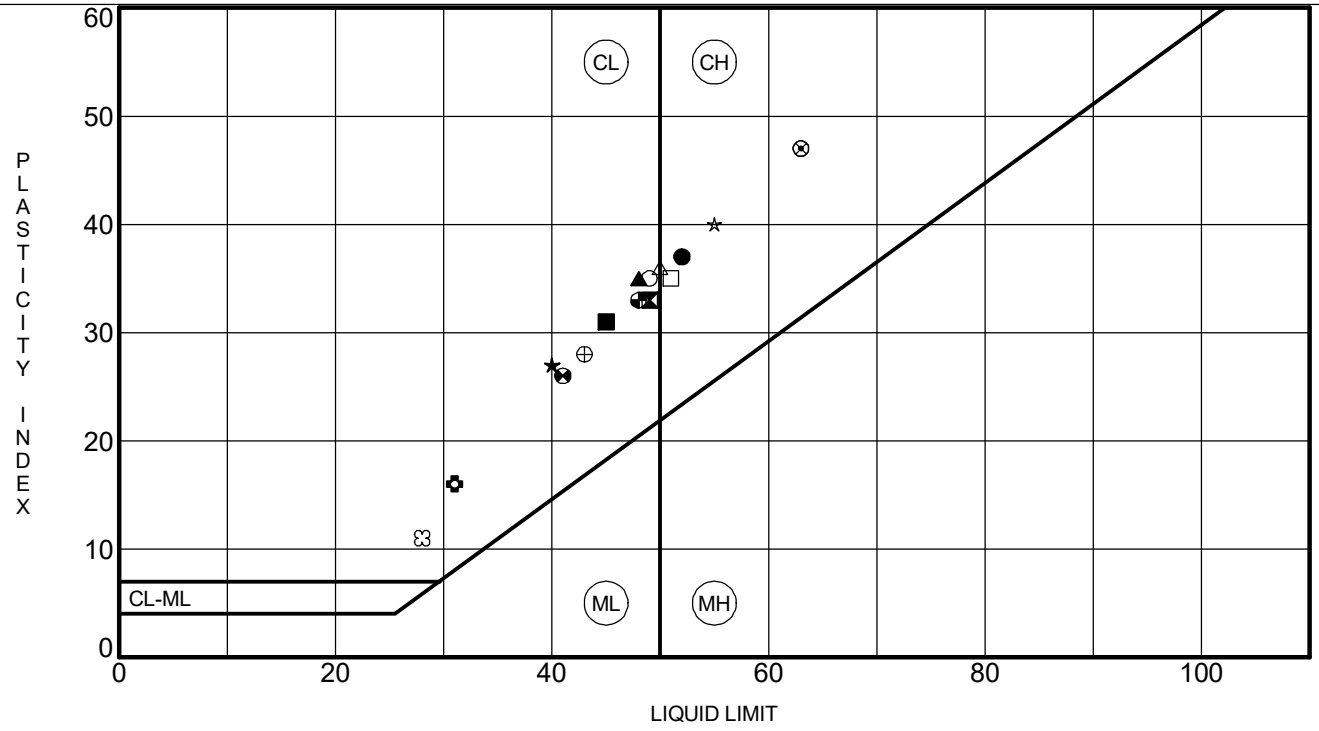
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Saint Louis, Missouri 63132

CLIENT Jacobs

PROJECT NAME I-70 3rd Lane (Kingdom City to Columbia)

PROJECT NUMBER 20241040.00

PROJECT LOCATION Kingdom City and Columbia, Missouri



	Specimen Identification		LL	PL	PI	Fines	Classification
●	BR 37-1	63.5	52	15	37		
⊠	BR 37-1	73.5	49	16	33		
▲	BR 37-2	23.5	48	13	35		
★	BR 37-2	33.5	40	13	27		
⊙	BR 37-2	53.0	63	16	47		
✿	BR 37-2	63.5	31	15	16		
○	BR 37-2	73.5	49	14	35		
△	BR 37-2	88.0	50	14	36		
⊗	BR 37-3	3.0	63	16	47		
⊕	BR 37-3	13.0	43	15	28		
□	BR 37-3	23.5	51	16	35		
⊛	BR 37-3	33.5	41	15	26		
◕	BR 37-3	48.5	48	15	33		
☆	BR 37-3	63.5	55	15	40		
⊠	BR 37-3	68.5	28	17	11		
■	BR 37-3	88.5	45	14	31		

ATTERBERG LIMITS - MODOT 20150728.GDT - 8/15/24 13:23 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\20241040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040 - PRELIMINARY.GPJ

ATTERBERG LIMITS' RESULTS

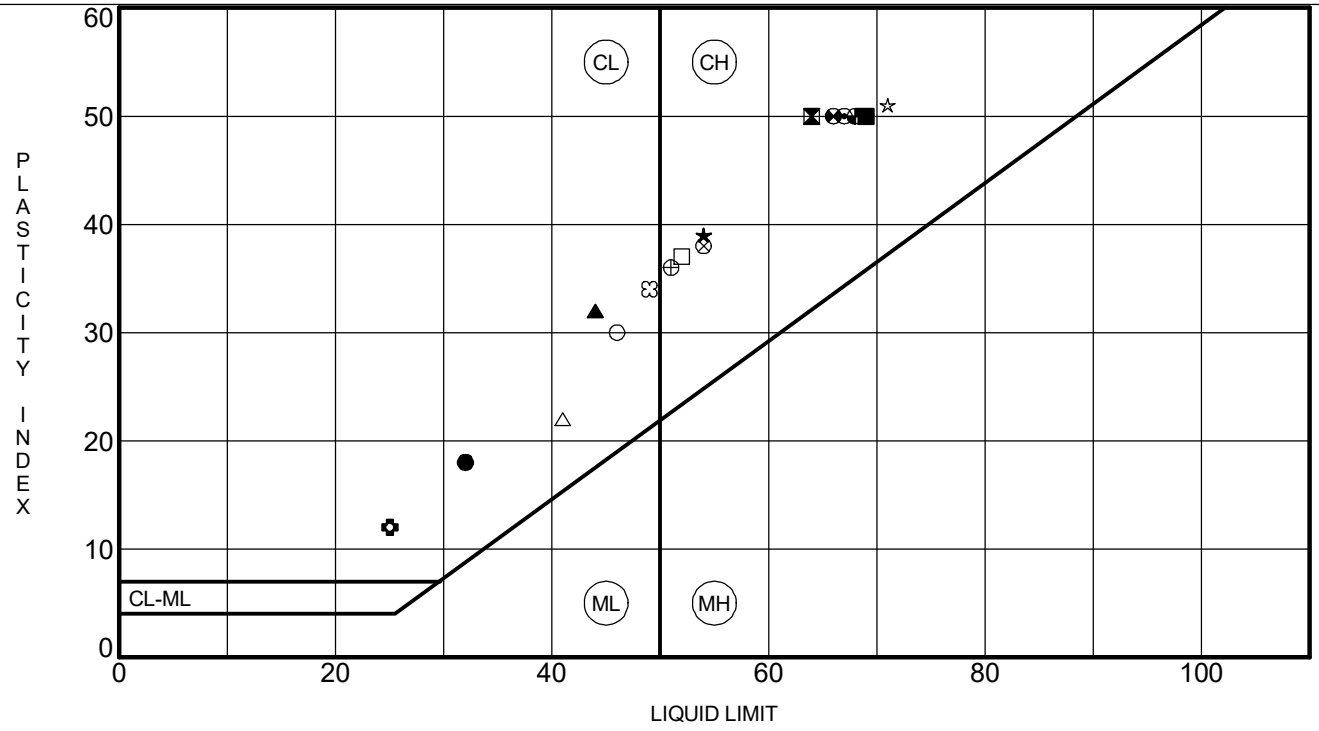
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Saint Louis, Missouri 63132

CLIENT Jacobs

PROJECT NAME I-70 3rd Lane (Kingdom City to Columbia)

PROJECT NUMBER 20241040.00

PROJECT LOCATION Kingdom City and Columbia, Missouri



	Specimen Identification		LL	PL	PI	Fines	Classification
●	BR 16-1	3.0	32	14	18		
⊠	BR 16-1	13.0	64	14	50		
▲	BR 16-1	18.5	44	12	32		
★	BR 16-1.1A	8.0	54	15	39		
⊙	BR 16-1.1A	18.0	67	17	50		
✿	BR 16-2	6.0	25	13	12		
○	BR 16-2	16.0	46	16	30		
△	BR 16-2.1	3.0	41	19	22		
⊗	BR 16-2.1	8.5	54	16	38		
⊕	BR 17-1	3.5	51	15	36		
□	BR 17-1	8.0	52	15	37		
⊠	BR 17-1	13.0	66	16	50		
◕	BR 17-1	23.0	68	18	50		
☆	BR 17-2	8.5	71	20	51		
⊠	BR 17-2	18.0	49	15	34		
■	BR 17-2	28.0	69	19	50		

ATTERBERG LIMITS - MODOT 20150728.GDT - 8/15/24 13:15 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\20241040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040 - PRELIMINARY.GPJ

ATTERBERG LIMITS' RESULTS

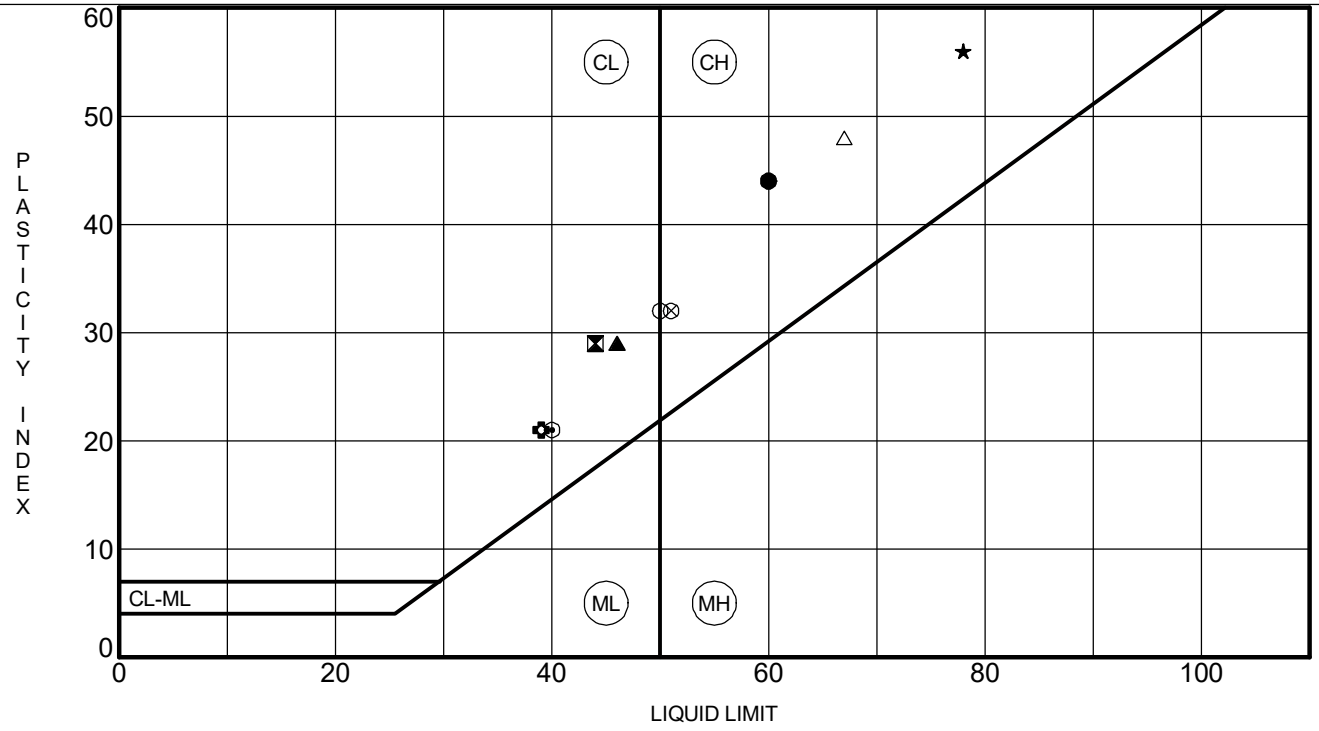
TSi Geotechnical Inc.
1340 North Price Road
Saint Louis, Missouri 63132

CLIENT Jacobs

PROJECT NAME I-70 3rd Lane (Kingdom City to Columbia)

PROJECT NUMBER 20241040.00

PROJECT LOCATION Kingdom City and Columbia, Missouri



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BR 12-2B**	**1.0**	**60**	**16**	**44**		
⊠	**BR 12-3B**	**1.0**	**44**	**15**	**29**		
▲	**BR 13-1A**	**6.0**	**46**	**17**	**29**		
★	**BR 13-1A**	**13.0**	**78**	**22**	**56**		
⊙	**BR 13-2A**	**8.0**	**40**	**19**	**21**		
✿	**BR 13-2A**	**13.5**	**39**	**18**	**21**		
○	**BR 14-1**	**3.5**	**50**	**18**	**32**		
△	**BR 14-1**	**13.0**	**67**	**19**	**48**		
⊗	**BR 14-2A**	**8.0**	**51**	**19**	**32**		

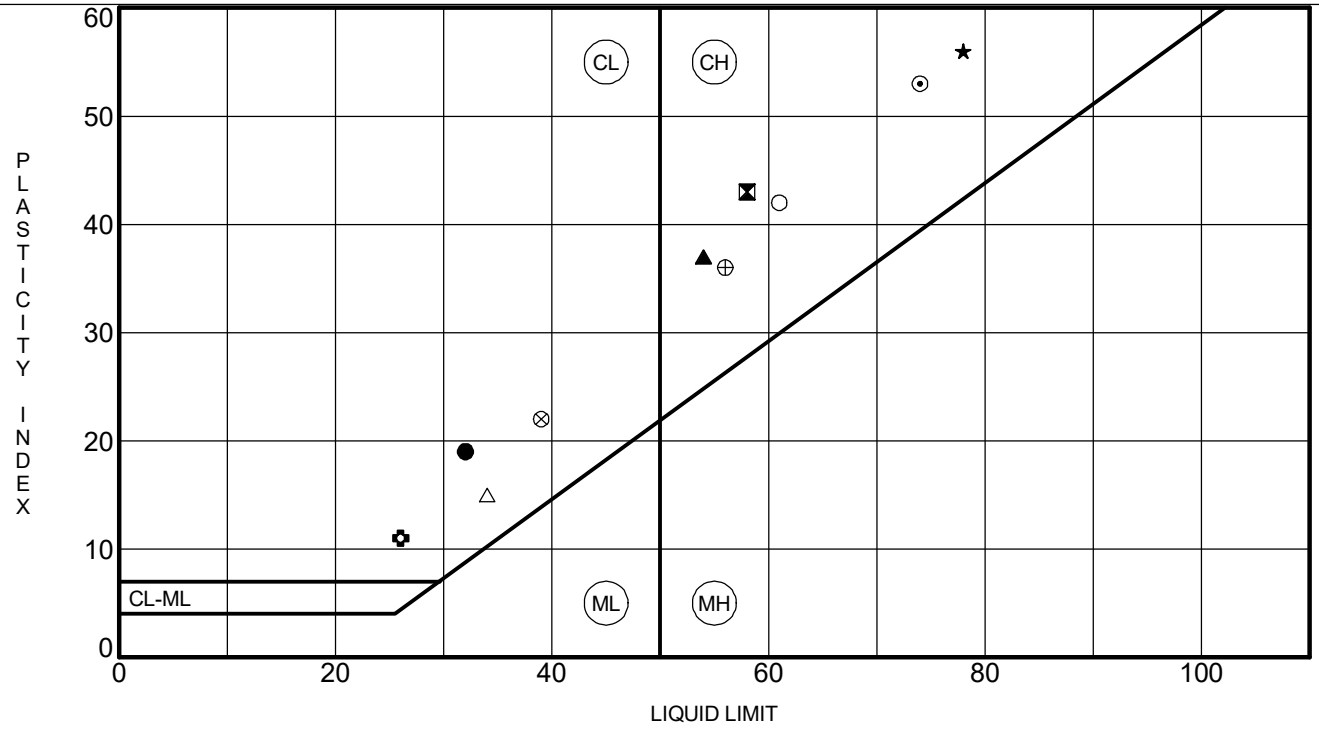
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ATTERBERG LIMITS' RESULTS

TSi Geotechnical Inc.
1340 North Price Road
Saint Louis, Missouri 63132

CLIENT Jacobs **PROJECT NAME** I-70 3rd Lane (Kingdom City to Columbia)

PROJECT NUMBER 20241040.00 **PROJECT LOCATION** Kingdom City and Columbia, Missouri



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BR 10-3A**	**1.0**	**32**	**13**	**19**		
⊠	**BR 10-4**	**8.0**	**58**	**15**	**43**		
▲	**BR 10-5B**	**6.0**	**54**	**17**	**37**		
★	**BR 10-6A**	**3.0**	**78**	**22**	**56**		
⊙	**BR 10-6A**	**13.0**	**74**	**21**	**53**		
✿	**BR 7-3A**	**6.0**	**26**	**15**	**11**		
○	**BR 7-3A**	**18.5**	**61**	**19**	**42**		
△	**BR 7-4**	**8.0**	**34**	**19**	**15**		
⊗	**BR 7-4.1**	**3.0**	**39**	**17**	**22**		
⊕	**BR 7-4.1**	**13.0**	**56**	**20**	**36**		

ATTERBERG LIMITS - MODOT 20150728.GDT - 8/15/24 13:12 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\20241040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040 - PRELIMINARY.GPJ

ATTERBERG LIMITS' RESULTS

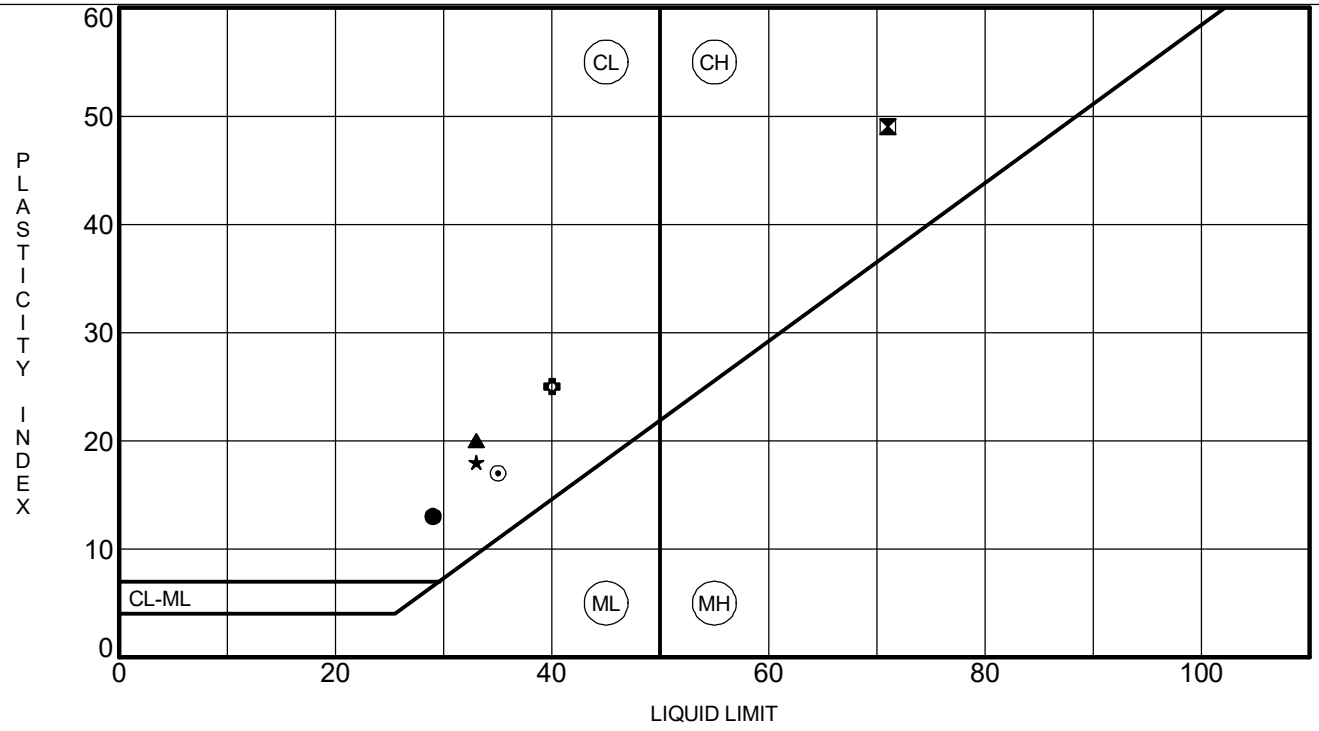
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1340 North Price Road
Saint Louis, Missouri 63132

CLIENT Jacobs

PROJECT NAME I-70 3rd Lane (Kingdom City to Columbia)

PROJECT NUMBER 20241040.00

PROJECT LOCATION Kingdom City and Columbia, Missouri



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BR 10-1**	**3.5**	**29**	**16**	**13**		
⊠	**BR 2-2**	**1.0**	**71**	**22**	**49**		
▲	**BR 2-2**	**3.5**	**33**	**13**	**20**	**65**	**SANDY LEAN CLAY(CL)**
★	**BR 4-1A**	**1.0**	**33**	**15**	**18**		
⊙	**BR 4-2**	**6.0**	**35**	**18**	**17**		
✿	**BR 7-1A**	**3.0**	**40**	**15**	**25**		

ATTERBERG LIMITS - MODOT 20150728.GDT - 8/15/24 13:06 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\20241040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040 - PRELIMINARY.GPJ

ATTERBERG LIMITS' RESULTS

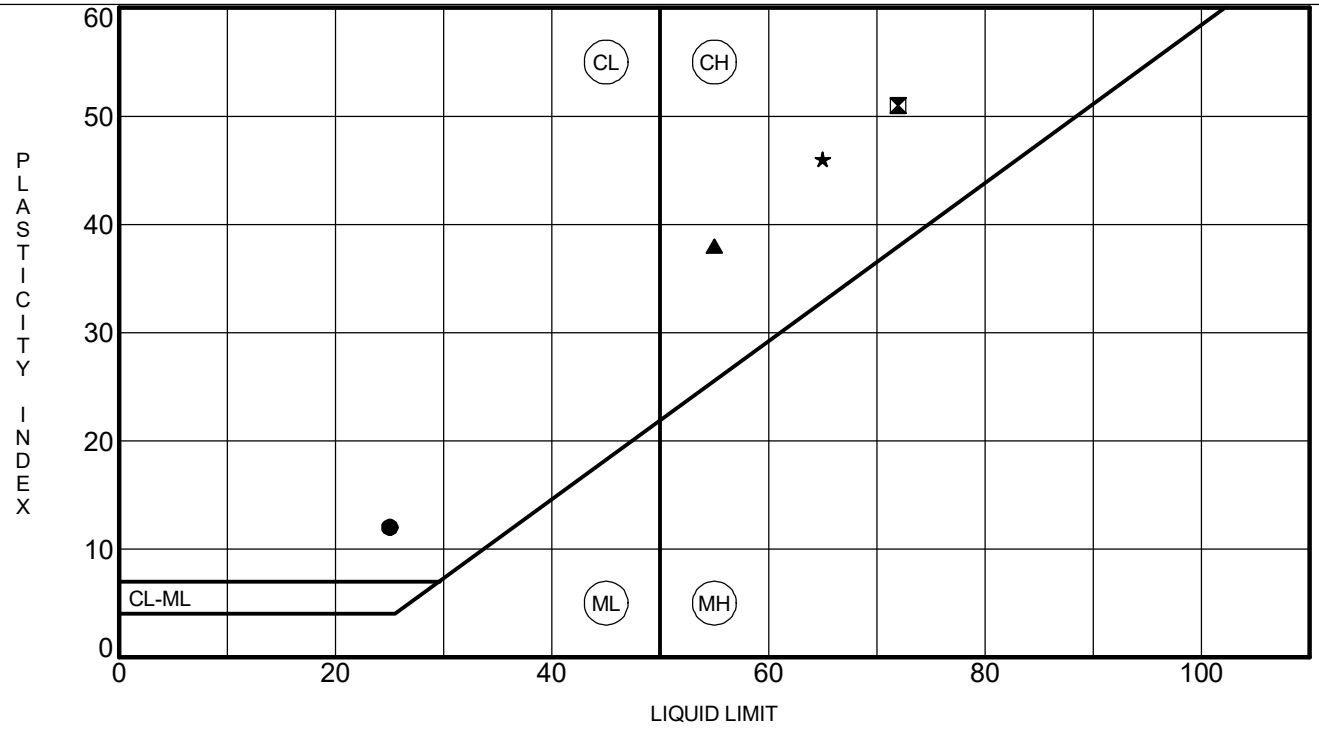
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1340 North Price Road
Saint Louis, Missouri 63132

CLIENT Jacobs

PROJECT NAME I-70 3rd Lane (Kingdom City to Columbia)

PROJECT NUMBER 20241040.00

PROJECT LOCATION Kingdom City and Columbia, Missouri



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BR 16-2**	**6.0**	**25**	**13**	**12**		
⊠	**Ramp 5-1A**	**3.5**	**72**	**21**	**51**		
▲	**Ramp C-D-1**	**1.0**	**55**	**17**	**38**		
★	**Ramp C-D-1**	**13.0**	**65**	**19**	**46**		

ATTERBERG LIMITS - MODOT 20150728.GDT - 8/15/24 13:14 - \\TSI\PROJECTS\STL\GEOTECH\2024 PROJECTS\20241040.00 I-70 THIRD LANE (KINGDOM CITY TO COLUMBIA)\WORKING FILES\MODOT I-70 3RD LANE 20241040 - PRELIMINARY.GPJ

GRAIN SIZE ANALYSIS

Project: I-70 Job No. 20241040.00

Boring BR 10-4 Sample ST-6-1 Depth 18-18.5

Visual: Tested by SLY

Checked by AK

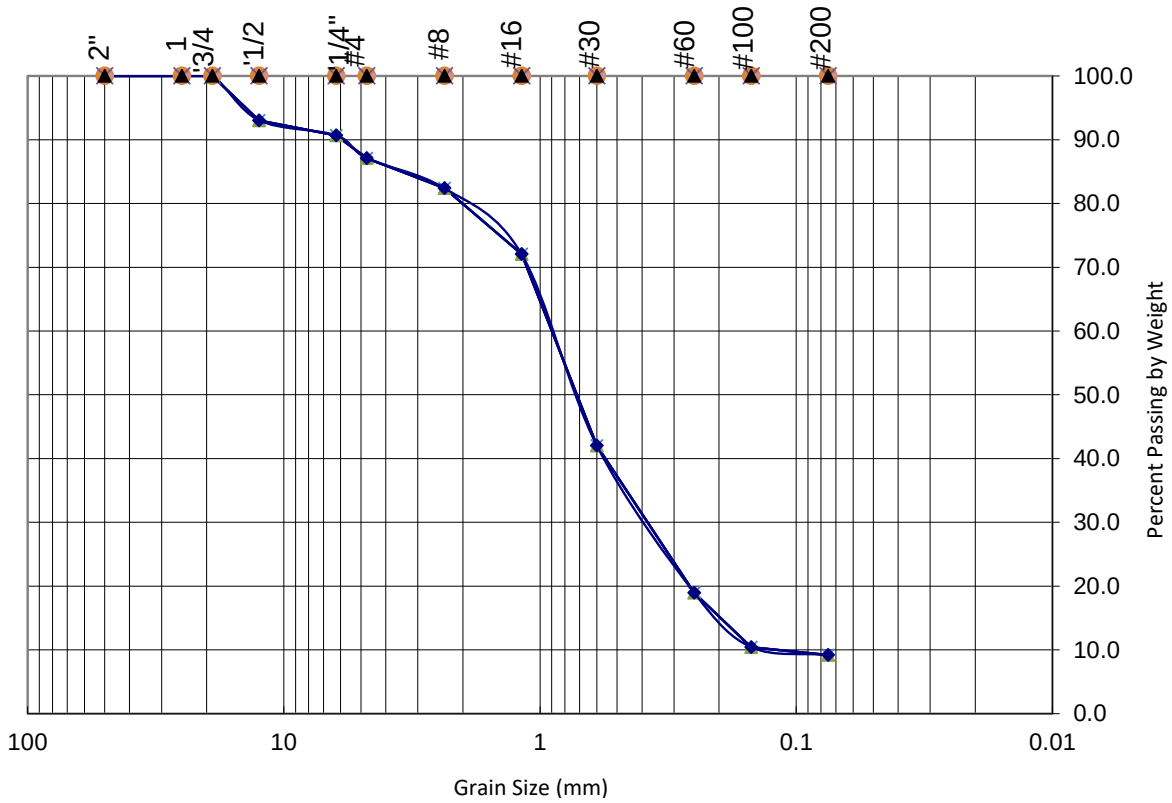
Sieve	Sieve and Sample Weight, g	Sieve Weight, g	Sample Weight, g	Cumul-ative Weight, g	% Passing by Wt.
2	0.00	0.00	**0.00**	**0.00**	**100.0**
1.0	0.00	0.00	**0.00**	**0.00**	**100.0**
3/4	0.00	0.00	**0.00**	**0.00**	**100.0**
1/2	0.00	0.00	**42.65**	**42.65**	**93.0**
1/4	0.00	0.00	**14.40**	**57.05**	**90.7**
4	0.00	0.00	**21.97**	**79.02**	**87.1**
8	0.00	0.00	**28.80**	**107.82**	**82.4**
16	0.00	0.00	**63.36**	**171.18**	**72.1**
30	0.00	0.00	**183.86**	**355.04**	**42.0**
60	0.00	0.00	**141.33**	**496.37**	**19.0**
100	0.00	0.00	**52.21**	**548.58**	**10.4**
200	0.00	0.00	**7.55**	**556.13**	**9.2**
PAN	0.00	0.00	**0.45**	**556.58**	

Moisture Content

Tare No.	
Wet Wt.	879.34
Dry Wt.	842.50
Tare Wt.	230.02
%	6.0

No. 200 Sieve Washing Data

	before-wet	after-dry
Sample & Tare	879.34	786.60
Tare	230.02	230.02
Sample Wt.	**649.32**	**556.58**
Minus 200 Wt		**55.90**
Dry Weight	**612.48**	



TSi Geotechnical, Inc.
HYDROMETER ANALYSIS (ASTM D422)

Project Name:	I-70 Third Lane	**Project Number:**	20241040.00
Boring Number:	BR 5-3A	**Tested by:**	SLY 7/24/24
Sample Number:	SS-1	**Calculated by:**	AK 7/31/24
Sample Depth:	1.0-2.5	**Checked by:**	JPE 8/15/24
Visual Description:	FILL: Brown and gray, GRAVEL (GP) and Sa		

Coarse Analysis

Initial Air Dry Mass: 179.1 grams

Sieve	Particle Size, mm	Cummulative Mass Retained, grams	Percent Retained	Percent Passing
1"	25.40	0	0.00	100
1/2"	12.70	63.02	35.19	65
3/8"	9.53	75.51	6.97	58
No.4	4.75	95.1	10.94	47
No.10	2.00	107.68	7.02	40
Pan			-60.12	**100**

Fine Analysis

Initial Air Dry Mass: 69.32 grams

Sieve	Particle Size, mm	Cummulative Mass Retained, grams	Percent Retained	Percent Passing
No.20	0.85	10.19	14.70	34
No.40	0.43	19.45	13.36	29
No.60	0.25	25.22	8.32	25
No.100	0.15	30.49	7.60	22
No.200	0.08	35.95	7.88	19
Pan		69.32		**0**

Hydrometer analysis

Specific Gravity	2.70	**Hydrometer Reading**		**Combined Correction:**			
Constant, a	0.99			**Hygroscopic Corrected Mass, g.**		69.32	
Elapsed Time minutes	**Temperature °C**	**Uncorrected, Ra**	**Corrected, Rc**	**Effective Depth, L cm**	**Constant K**	**Particle Size mm**	**Percent Passing**
2	23.0	30.0	24.7	12.4	0.01297	0.0323	14
6.5	23.0	26.0	20.7	13.0	0.01297	0.0183	12
15	23.0	22.0	16.7	13.7	0.01297	0.0124	10
34	23.1	20.0	14.8	14.0	0.01296	0.0083	8
81	23.1	19.0	13.8	14.2	0.01296	0.0054	8
150	23.1	16.8	11.5	14.5	0.01296	0.0040	7
240	23.2	16.0	10.8	14.7	0.01294	0.0032	6
420	23.2	15.0	9.8	14.8	0.01294	0.0024	6
1440	22.5	13.3	7.8	15.2	0.01305	0.0013	4

Hygroscopic Moisture Correction	
Air Dry Mass + Tare:	15
Oven Dry Mass + Tare:	15
Tare:	0.75
Correction Factor:	1

TSi Geotechnical, Inc.
HYDROMETER ANALYSIS (ASTM D422)

Project Name:	I-70 Third Lane	**Project Number:**	20241040.00
Boring Number:	BR 5-3A	**Tested by:**	SLY 7/24/24
Sample Number:	SS-1	**Calculated by:**	AK 7/31/24
Sample Depth:	1.0-2.5	**Checked by:**	JPE 8/15/24
Visual Description:	FILL: Brown and gray, GRAVEL (GP) and Sandy CH		

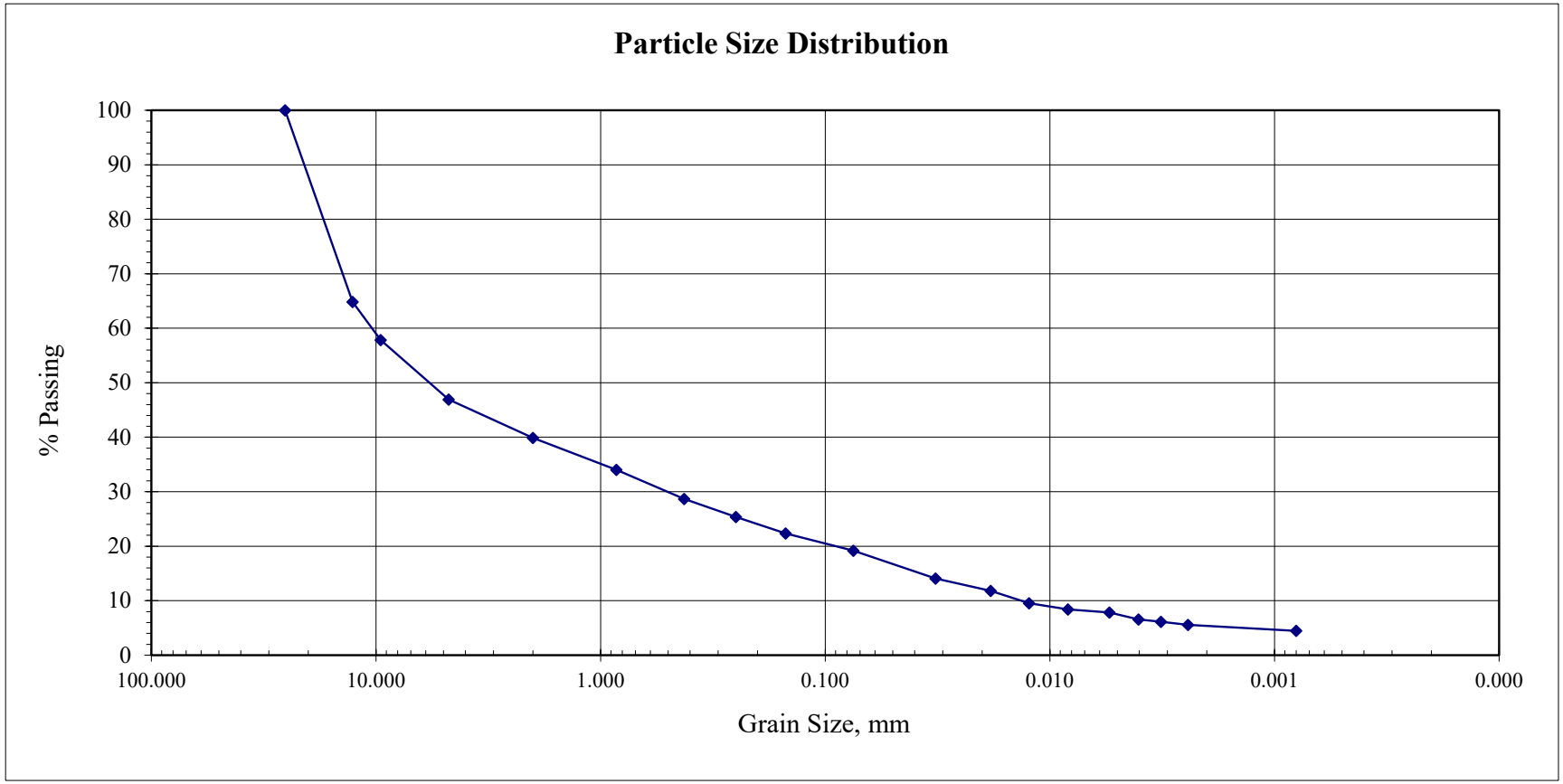
Sieve	Particle Size, mm	Percent Finer
1"	25.40	100
1/2"	12.70	65
3/8"	9.53	58
No.4	4.75	47
No.10	2.00	40
No.20	0.85	34
No.40	0.425	29
No.60	0.250	25
No.100	0.150	22
No.200	0.075	19
Hydrometer Analysis	0.0323	14
	0.0183	12
	0.0124	10
	0.0083	8
	0.0054	8
	0.0040	7
	0.0032	6
	0.0024	6
	0.0013	4

Particle Size Description
Soil Classification System

Particle	Size Range, mm	Percent of Specimen
Gravel	4.75 to 76.4	53
Coarse Sand	2.00 to 4.75	7
Medium Sand	0.43 to 2.00	11
Fine Sand	0.075 to 0.43	9
Silt	0.005 to 0.075	12
Clay	<0.005	7

TSi Geotechnical, Inc.
HYDROMETER ANALYSIS (ASTM D422)

Project Name:	I-70 Third Lane	**Project Number:**	20241040.00
Boring Number:	BR 5-3A	**Tested by:**	SLY 7/24/24
Sample Number:	SS-1	**Calculated by:**	AK 7/31/24
Sample Depth:	1.0-2.5	**Checked by:**	JPE 8/15/24
Visual Description:	FILL: Brown and gray, GRAVEL (GP) and Sandy		



TSi Geotechnical, Inc.
HYDROMETER ANALYSIS (ASTM D422)

Project Name:	I-70 Third Lane (Kingdom City to Columbia)	**Project Number:**	20241040.00
Boring Number:	BR-7-4	**Tested by:**	SLY 5/28/2024
Sample Number:	ST-4-2	**Calculated by:**	SLY 5/29/2024
Sample Depth:	8.5-9.0	**Checked by:**	
Visual Description:	Brown and gray, sandy lean CLAY (CL), with gravel		

Initial Air Dry Mass, Total: 291.00 grams

Sieve	Particle Size, mm	Cummulative Mass Retained, grams	Percent Retained	Percent Passing
1"	25.40	0.00	0.00	100.0
1/2"	12.70	39.29	13.50	86.5
3/8"	9.53	46.64	2.53	84.0
No.4	4.75	55.20	2.94	81.0
No.10	2.00	61.03	2.00	79.0
Pan		291.00		

Fine Analysis

Initial Air Dry Mass, Fine: 64.20 grams

Sieve	Particle Size, mm	Cummulative Mass Retained, grams	Percent Retained	Percent Passing
No.20	0.85	2.17	3.38	76.4
No.40	0.43	5.51	5.20	72.2
No.60	0.25	10.48	7.74	66.1
No.100	0.15	17.92	11.59	57.0
No.200	0.08	24.89	10.86	48.4
Pan		64.20		**0.0**

Hydrometer analysis

Specific Gravity 2.65		**Hydrometer Reading**		**Combined Correction:**			
Constant, a 1				**Hygroscopic Corrected Mass, g.** 63.45			
Elapsed Time minutes	**Temperature °C**	**Uncorrected, Ra**	**Corrected, Rc**	**Effective Depth, L cm**	**Constant K**	**Particle Size mm**	**Percent Passing**
2	22.8	32.0	26.4	12.0	0.01320	0.0323	32.8
5	22.8	27.5	21.9	12.9	0.01320	0.0212	27.2
15	22.8	22.0	16.4	13.7	0.01320	0.0126	20.4
30	22.8	20.3	14.6	14.0	0.01320	0.0090	18.2
60	22.8	19.0	13.4	14.2	0.01320	0.0064	16.7
120	22.8	18.0	12.4	14.3	0.01320	0.0046	15.4
240	22.9	17.0	11.4	14.5	0.01319	0.0032	14.2
420	22.8	16.0	10.4	14.7	0.01320	0.0025	12.9
1440	22.6	14.5	8.8	15.0	0.01323	0.0014	11.0

Hygroscopic Moisture Correction	
Air Dry Mass + Tare:	15.25
Oven Dry Mass + Tare:	15.08
Tare:	0.78
Correction Factor:	0.988251555

TSi Geotechnical, Inc.
HYDROMETER ANALYSIS (ASTM D422)

Project Name:	I-70 Third Lane (Kingdom City to Columbia)	**Project Number:**	20241040.00
Boring Number:	BR-7-4	**Tested by:**	SLY 5/28/2024
Sample Number:	ST-4-2	**Calculated by:**	SLY 5/29/2024
Sample Depth:	8.5-9.0	**Checked by:**	
Visual Description:	Brown and gray, sandy lean CLAY (CL), with gravel		

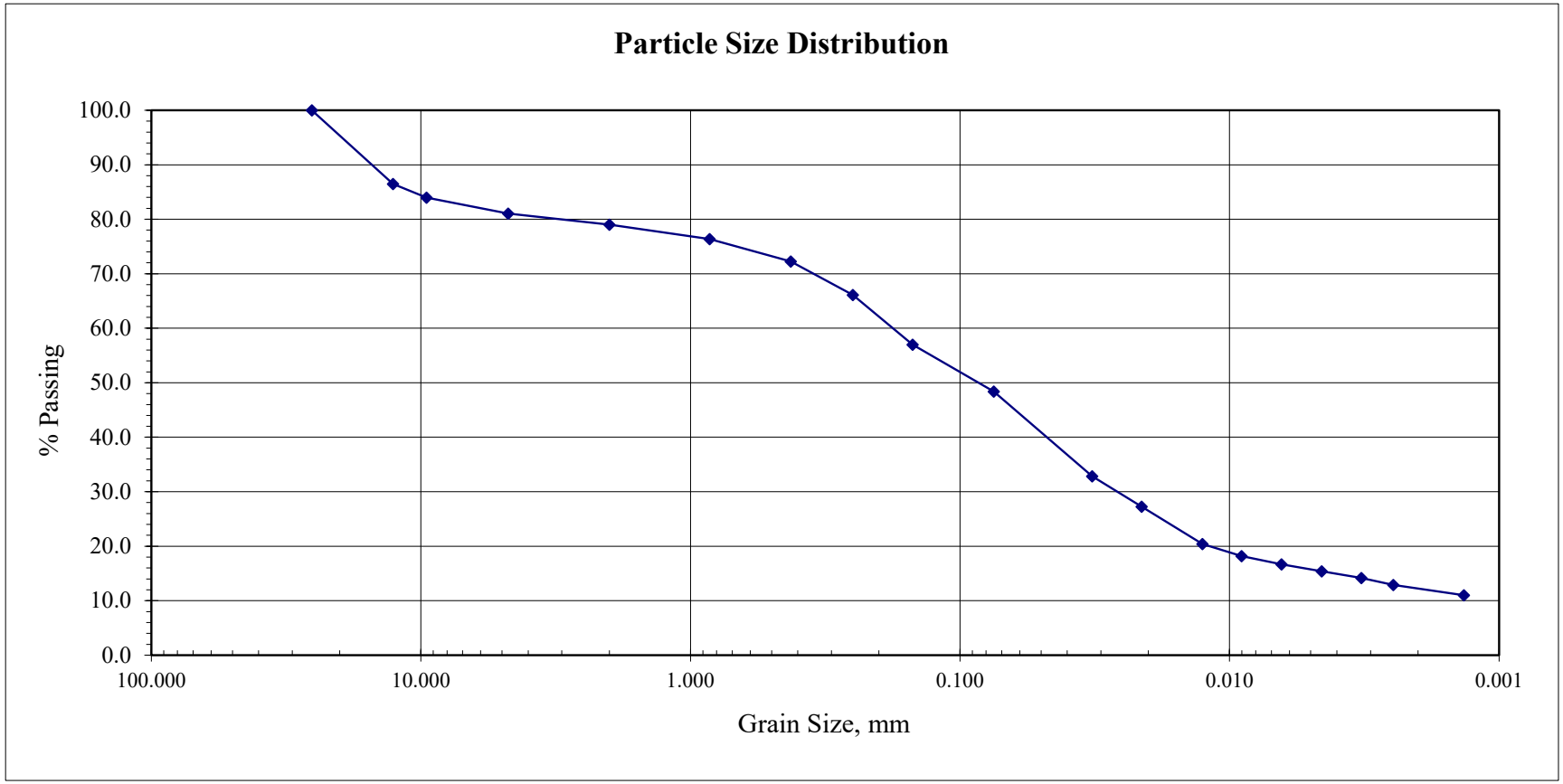
Sieve	Particle Size, mm	Percent Finer
1"	25.40	100
1/2"	12.70	86
3/8"	9.53	84
No.4	4.75	81
No.10	2.00	79
No.20	0.85	76
No.40	0.425	72
No.60	0.250	66
No.100	0.150	57
No.200	0.075	48
Hydrometer Analysis	0.0323	33
	0.0212	27
	0.0126	20
	0.0090	18
	0.0064	17
	0.0046	15
	0.0032	14
	0.0025	13
	0.0014	11

Particle Size Description
Soil Classification System

Particle	Size Range, mm	Percent of Specimen
Gravel	4.75 to 76.4	19
Coarse Sand	2.00 to 4.75	2
Medium Sand	0.43 to 2.00	7
Fine Sand	0.075 to 0.43	24
Silt	0.005 to 0.075	33
Clay	<0.005	16

TSi Geotechnical, Inc.
HYDROMETER ANALYSIS (ASTM D422)

Project Name:	I-70 Third Lane (Kingdom City to Columbia)	**Project Number:**	20241040.00
Location:	BR-7-4	**Tested by:**	SLY 5/28/2024
Sample Number:	ST-4-2	**Calculated by:**	SLY 5/29/2024
Sample Depth:	8.5-9.0	**Checked by:**	
Visual Description:	Brown and gray, sandy lean CLAY (CL), with gravel		



TSi Geotechnical, Inc.
HYDROMETER ANALYSIS (ASTM D422)

Project Name:	I-70 Third Lane (Kingdom City to Columbia)	**Project Number:**	20241040.00
Boring Number:	BR-7-4.1	**Tested by:**	SLY 5/28/2024
Sample Number:	ST-2-4	**Calculated by:**	SLY 5/29/2024
Sample Depth:	4.5-5.0	**Checked by:**	
Visual Description:	Brown and gray, lean CLAY (CL), with sand, trace gravel		

Initial Air Dry Mass, Total: 346.15 grams

Sieve	Particle Size, mm	Cummulative Mass Retained, grams	Percent Retained	Percent Passing
1"	25.40	0.00	0.00	100.0
1/2"	12.70	3.59	1.04	99.0
3/8"	9.53	5.41	0.53	98.4
No.4	4.75	8.88	1.00	97.4
No.10	2.00	12.78	1.13	96.3
Pan		346.15		

Fine Analysis

Initial Air Dry Mass, Fine: 66.35 grams

Sieve	Particle Size, mm	Cummulative Mass Retained, grams	Percent Retained	Percent Passing
No.20	0.85	1.38	2.08	94.3
No.40	0.43	2.89	2.28	92.1
No.60	0.25	4.89	3.01	89.2
No.100	0.15	7.67	4.19	85.2
No.200	0.08	11.33	5.52	79.9
Pan		66.35		**0.0**

Hydrometer analysis

Specific Gravity 2.65		**Hydrometer Reading**		**Combined Correction:**			
Constant, a 1				**Hygroscopic Corrected Mass, g.** 65.81			
Elapsed Time minutes	**Temperature °C**	**Uncorrected, Ra**	**Corrected, Rc**	**Effective Depth, L cm**	**Constant K**	**Particle Size mm**	**Percent Passing**
2	22.8	45.5	39.9	9.9	0.01320	0.0294	58.3
5	22.8	37.0	31.4	11.2	0.01320	0.0198	45.9
15	22.8	29.0	23.4	12.5	0.01320	0.0120	34.2
30	22.7	27.0	21.4	12.9	0.01322	0.0087	31.2
60	22.8	25.0	19.4	13.2	0.01320	0.0062	28.3
120	22.8	23.0	17.4	13.5	0.01320	0.0044	25.4
240	23.0	22.0	16.4	13.7	0.01317	0.0031	24.0
420	22.8	21.0	15.4	13.8	0.01320	0.0024	22.5
1440	22.6	19.8	14.1	14.0	0.01323	0.0013	20.6

Hygroscopic Moisture Correction	
Air Dry Mass + Tare:	15.51
Oven Dry Mass + Tare:	15.39
Tare:	0.81
Correction Factor:	0.991836735

TSi Geotechnical, Inc.
HYDROMETER ANALYSIS (ASTM D422)

Project Name:	I-70 Third Lane (Kingdom City to Columbia)	**Project Number:**	20241040.00
Boring Number:	BR-7-4.1	**Tested by:**	SLY 5/28/2024
Sample Number:	ST-2-4	**Calculated by:**	SLY 5/29/2024
Sample Depth:	4.5-5.0	**Checked by:**	
Visual Description:	Brown and gray, lean CLAY (CL), with sand, trace gravel		

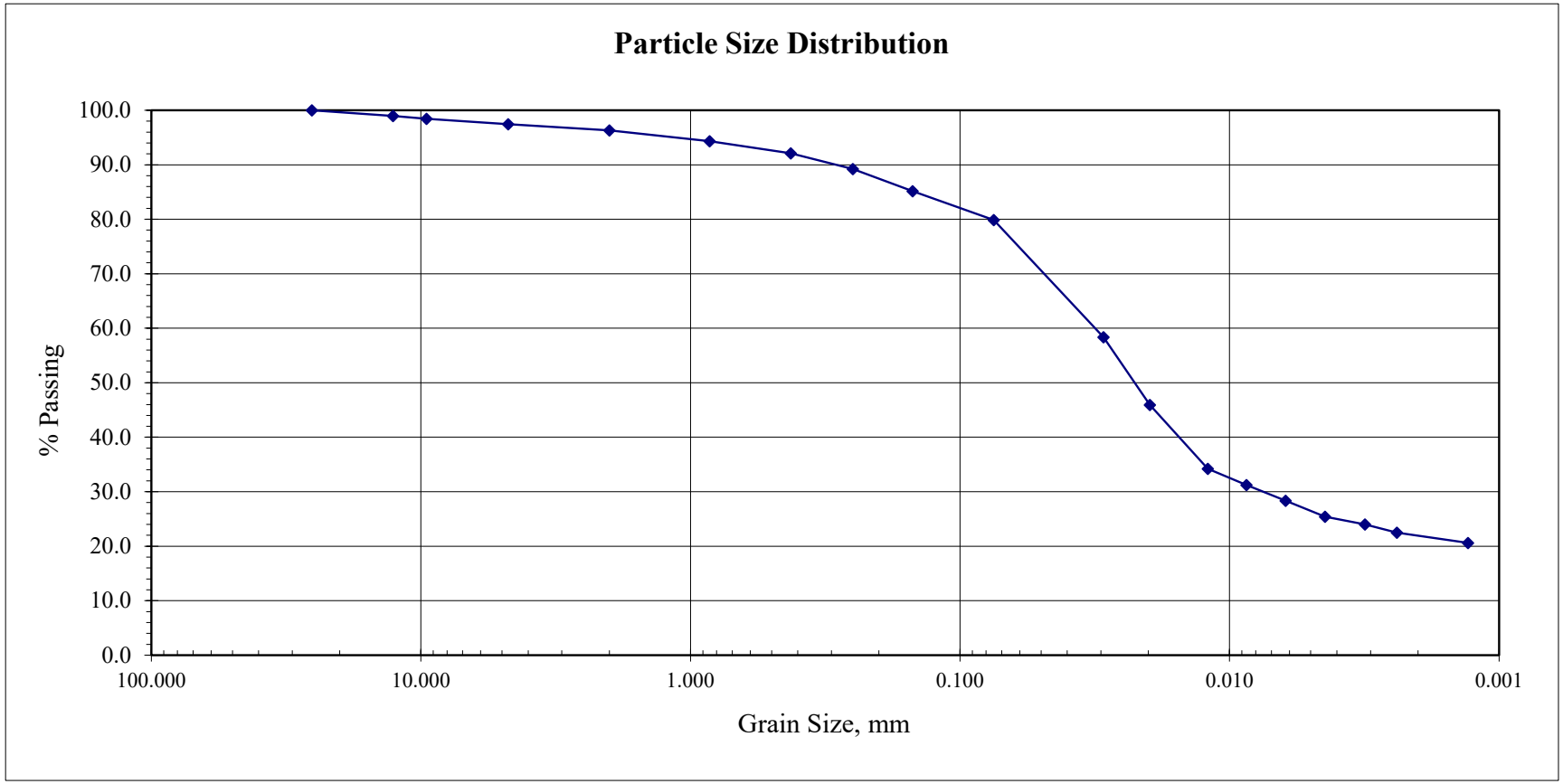
Sieve	Particle Size, mm	Percent Finer
1"	25.40	100
1/2"	12.70	99
3/8"	9.53	98
No.4	4.75	97
No.10	2.00	96
No.20	0.85	94
No.40	0.425	92
No.60	0.250	89
No.100	0.150	85
No.200	0.075	80
Hydrometer Analysis	0.0294	58
	0.0198	46
	0.0120	34
	0.0087	31
	0.0062	28
	0.0044	25
	0.0031	24
	0.0024	22
	0.0013	21

Particle Size Description
Soil Classification System

Particle	Size Range, mm	Percent of Specimen
Gravel	4.75 to 76.4	3
Coarse Sand	2.00 to 4.75	1
Medium Sand	0.43 to 2.00	4
Fine Sand	0.075 to 0.43	12
Silt	0.005 to 0.075	53
Clay	<0.005	26

TSi Geotechnical, Inc.
HYDROMETER ANALYSIS (ASTM D422)

Project Name:	I-70 Third Lane (Kingdom City to Columbia)	**Project Number:**	20241040.00
Location:	BR-7-4.1	**Tested by:**	SLY 5/28/2024
Sample Number:	ST-2-4	**Calculated by:**	SLY 5/29/2024
Sample Depth:	4.5-5.0	**Checked by:**	
Visual Description:	Brown and gray, lean CLAY (CL), with sand, trace gravel		



TSi Geotechnical, Inc.
HYDROMETER ANALYSIS (ASTM D422)

Project Name:	I-70 Third Lane (Kingdom City to Columbia)	**Project Number:**	20241040.00
Boring Number:	C-D-1	**Tested by:**	SLY 5/28/2024
Sample Number:	ST-5-3	**Calculated by:**	SLY 5/29/2024
Sample Depth:	14.0-14.5	**Checked by:**	
Visual Description:	Brown and gray, fat CLAY (CH)		

Initial Air Dry Mass, Total: 128.18 grams

Sieve	Particle Size, mm	Cummulative Mass Retained, grams	Percent Retained	Percent Passing
1"	25.40	0.00	0.00	100.0
1/2"	12.70	0.00	0.00	100.0
3/8"	9.53	0.00	0.00	100.0
No.4	4.75	0.00	0.00	100.0
No.10	2.00	0.00	0.00	100.0
Pan		128.18		

Fine Analysis

Initial Air Dry Mass, Fine: 65.61 grams

Sieve	Particle Size, mm	Cummulative Mass Retained, grams	Percent Retained	Percent Passing
No.20	0.85	0.01	0.02	100.0
No.40	0.43	0.03	0.03	100.0
No.60	0.25	0.09	0.09	99.9
No.100	0.15	0.13	0.06	99.8
No.200	0.08	0.26	0.20	99.6
Pan		65.61		**0.0**

Hydrometer analysis

Specific Gravity 2.65		**Hydrometer Reading**		**Combined Correction:**			
Constant, a 1				**Hygroscopic Corrected Mass, g.** 65.02			
Elapsed Time minutes	**Temperature °C**	**Uncorrected, Ra**	**Corrected, Rc**	**Effective Depth, L cm**	**Constant K**	**Particle Size mm**	**Percent Passing**
2	22.8	60.0	54.4	7.4	0.01320	0.0254	83.6
5	22.8	53.0	47.4	8.6	0.01320	0.0173	72.9
15	22.8	46.0	40.4	9.7	0.01320	0.0106	62.1
30	22.8	42.0	36.4	10.4	0.01320	0.0078	55.9
60	22.8	39.5	33.9	10.9	0.01320	0.0056	52.1
120	22.9	37.0	31.4	11.2	0.01319	0.0040	48.3
240	23.0	35.0	29.4	11.5	0.01317	0.0029	45.2
420	22.9	33.5	27.9	11.9	0.01319	0.0022	42.9
1440	22.7	31.5	25.9	12.2	0.01322	0.0012	39.8

Hygroscopic Moisture Correction	
Air Dry Mass + Tare:	15.18
Oven Dry Mass + Tare:	15.05
Tare:	0.78
Correction Factor:	0.990972222

TSi Geotechnical, Inc.
HYDROMETER ANALYSIS (ASTM D422)

Project Name:	I-70 Third Lane (Kingdom City to Columbia)	**Project Number:**	20241040.00
Boring Number:	C-D-1	**Tested by:**	SLY 5/28/2024
Sample Number:	ST-5-3	**Calculated by:**	SLY 5/29/2024
Sample Depth:	14.0-14.5	**Checked by:**	
Visual Description:	Brown and gray, fat CLAY (CH)		

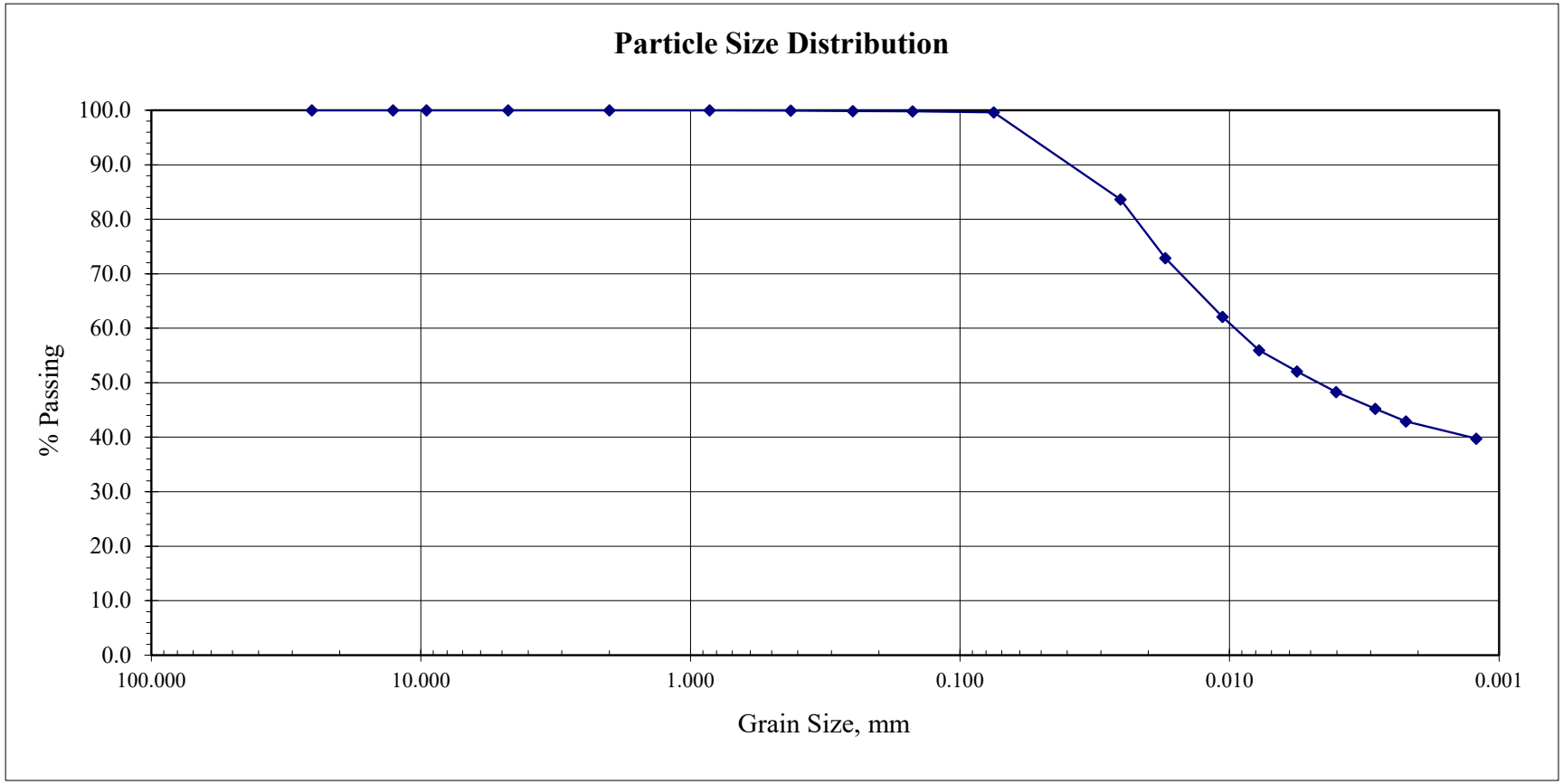
Sieve	Particle Size, mm	Percent Finer
1"	25.40	100
1/2"	12.70	100
3/8"	9.53	100
No.4	4.75	100
No.10	2.00	100
No.20	0.85	100
No.40	0.425	100
No.60	0.250	100
No.100	0.150	100
No.200	0.075	100
Hydrometer Analysis	0.0254	84
	0.0173	73
	0.0106	62
	0.0078	56
	0.0056	52
	0.0040	48
	0.0029	45
	0.0022	43
	0.0012	40

Particle Size Description
Soil Classification System

Particle	Size Range, mm	Percent of Specimen
Gravel	4.75 to 76.4	0
Coarse Sand	2.00 to 4.75	0
Medium Sand	0.43 to 2.00	0
Fine Sand	0.075 to 0.43	0
Silt	0.005 to 0.075	49
Clay	<0.005	51

TSi Geotechnical, Inc.
HYDROMETER ANALYSIS (ASTM D422)

Project Name:	I-70 Third Lane (Kingdom City to Columbia)	**Project Number:**	20241040.00
Location:	C-D-1	**Tested by:**	SLY 5/28/2024
Sample Number:	ST-5-3	**Calculated by:**	SLY 5/29/2024
Sample Depth:	14.0-14.5	**Checked by:**	
Visual Description:	Brown and gray, fat CLAY (CH)		



APPENDIX D

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project Number: 20241040.00

Boring Number: C-D-1

Sample Number: ST-5-3

Depth (ft): 14.0-14.5

Wet Unit Weight (pcf): 120.79

Dry Unit Weight (pcf): 95.70

Initial Moisture		Final Moisture	
Wet Wt Sample+Ring (g):	371.00	Wet Wt Sample+Ring (g):	371.82
Dry Wt Sample+Ring (g):	338.67	Dry Wt Sample+Ring (g):	337.51
Wt of Ring (g):	215.36	Wt of Ring (g):	215.36
Dry Wt of Sample (g):	123.31	Dry Wt of Sample (g):	122.15
Wt of Water (g):	32.33	Wt of Water (g):	34.31
Moisture Content (%):	26.2	Moisture Content (%):	28.1

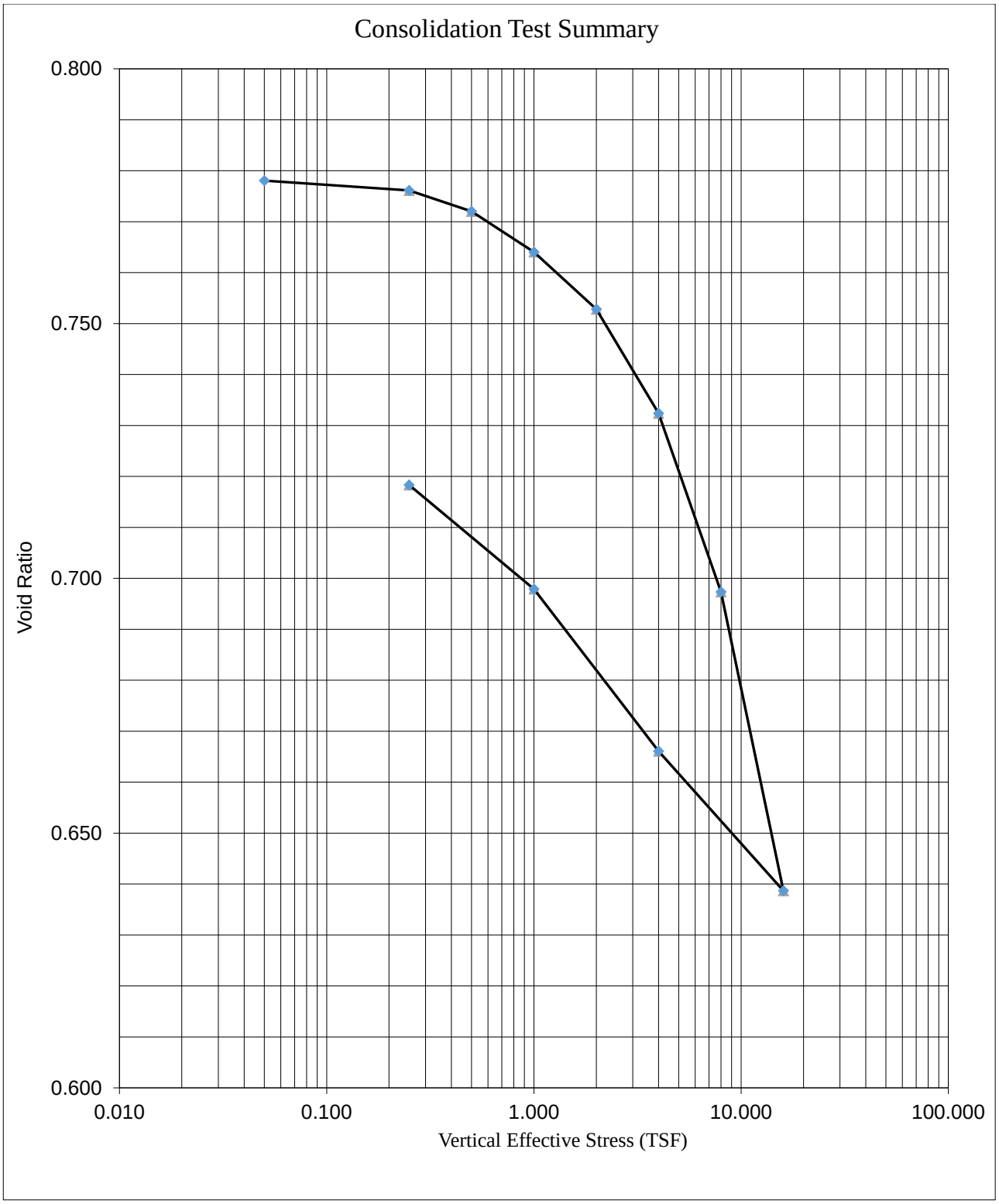
Visual Classification:

Initial Data

Sample Height (in):	1.000
Sample Diameter (in):	2.500
Volume (in^3):	4.909
Specific Gravity:	2.7
Height of Solids (in):	0.562
Initial Void Ratio:	0.778

1

Load (tsf)	D_{100} (0.0001")	Machine Deflection (0.0001")	Correction Factor	Corrected D_{100} (0.0001")	% Strain	Void Ratio Change	Void Ratio	D_{50} Uncorrected (0.0001")	H_{50} Corrected	t_{50} (min)	Cv (IN^2/MIN)
0.050	0.0	0.1		-0.1	0.00	0.0000	0.778	0.0	1.0000	480.00	0.0001
0.250	11.0	0.1		10.9	0.11	0.0019	0.776	5.1	0.9995	4.00	0.0123
0.500	34.0	0.1		33.9	0.34	0.0060	0.772	27.2	0.9973	80.00	0.0006
1.000	79.0	0.1		78.9	0.79	0.0140	0.764	65.6	0.9935	24.00	0.0020
2.000	142.0	0.1		141.9	1.42	0.0252	0.753	127.3	0.9873	3.50	0.0137
4.000	257.0	0.1		256.9	2.57	0.0457	0.732	231.0	0.9769	36.00	0.0013
8.000	454.0	0.1		453.9	4.54	0.0807	0.697	397.7	0.9602	14.00	0.0032
16.000	784.0	0.1		783.9	7.84	0.1394	0.639	667.5	0.9333	18.00	0.0024
4.000	630.0	0.1		629.9	6.30	0.1120	0.666	669.3	0.9331	19.50	0.0022
1.000	451.0	0.1		450.9	4.51	0.0802	0.698	522.3	0.9478	45.00	0.0010
0.250	336.0	0.1		335.9	3.36	0.0597	0.718	377.3	0.9623	80.50	0.0006



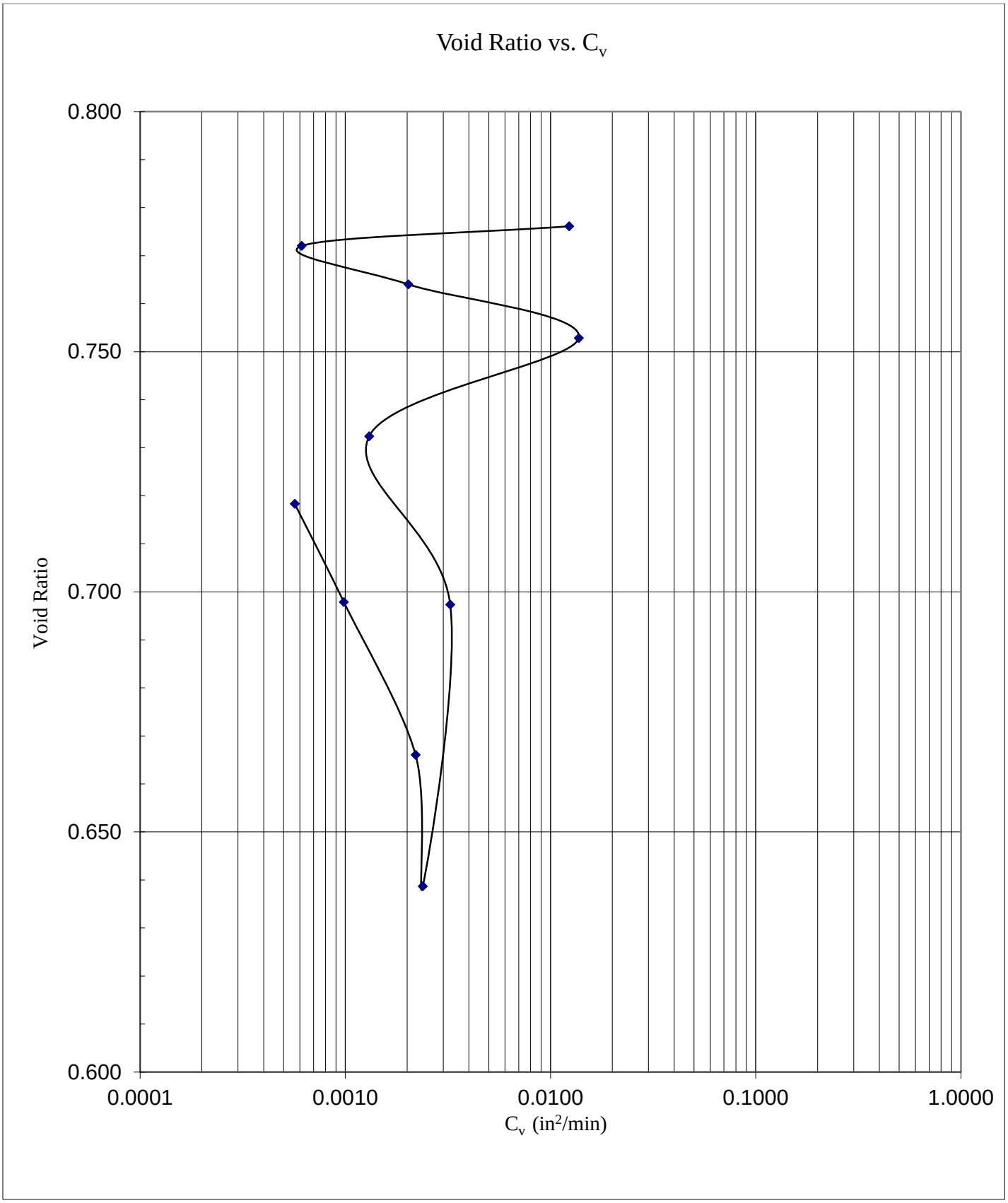
Boring No. C-D-1 Sample ST-5-3 Depth 14.0-14.5

Soil Description : Brown, fat CLAY (CH), with sand and gravel

Initial Moisture Content (%): 26.2 Specific Gravity: 2.7 (assumed)

Initial Dry Density(pcf): 95.7 Project Name: I-70 Third Lane (Kingdom City to Columb

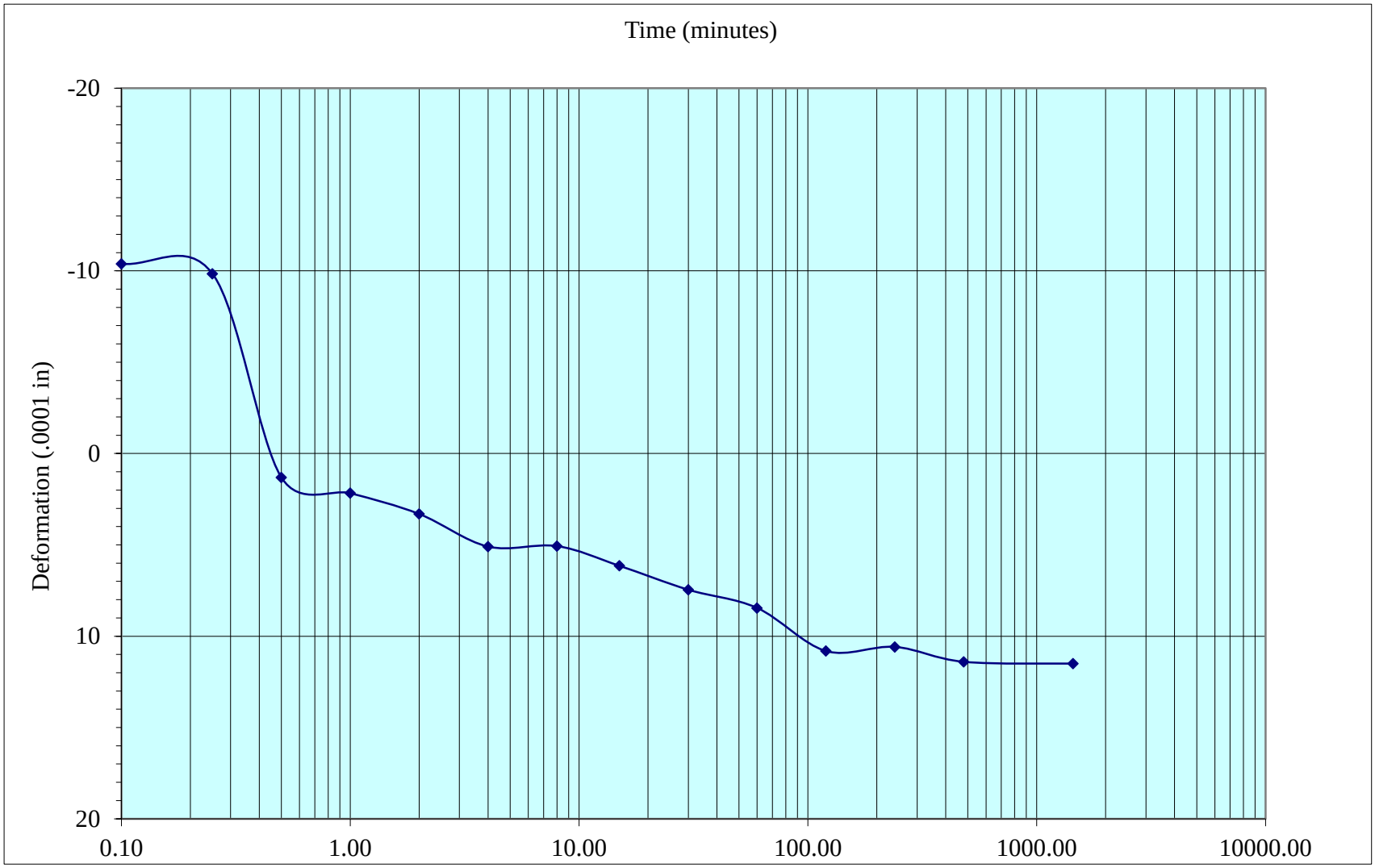
Project Number: 20241040.00


Void Ratio vs. C_v
0.800
0.750
0.700
0.650
0.600
Void Ratio
0.0001
0.0010
0.0100
0.1000
1.0000
C_v (in²/min)

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. C-D-1 Sample No. ST-5-3 Load No. 1 TSF 0.25



D-0= _____

D-50= _____

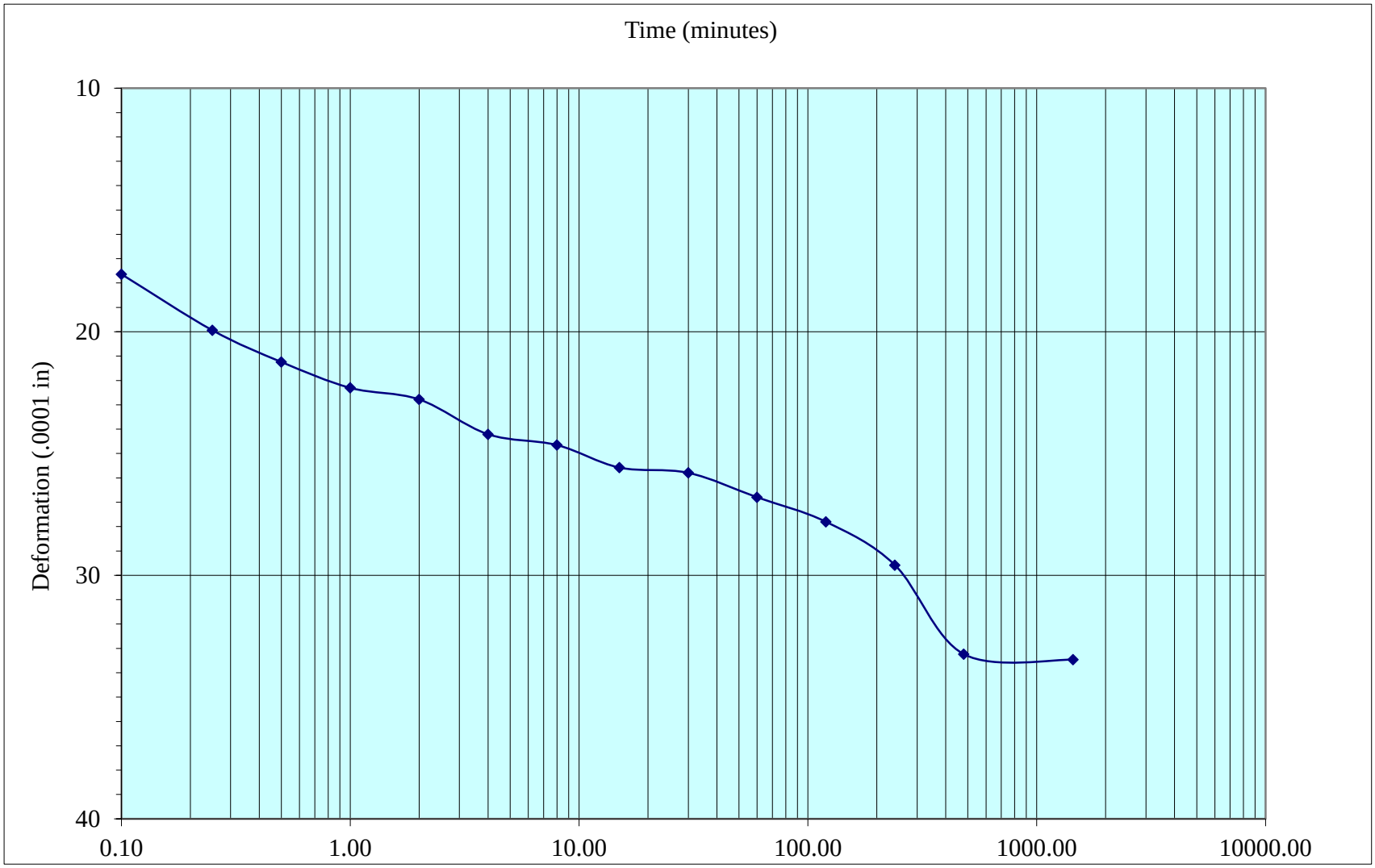
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. C-D-1 Sample No. ST-5-3 Load No. 2 TSF 0.5



D-0= _____

D-50= _____

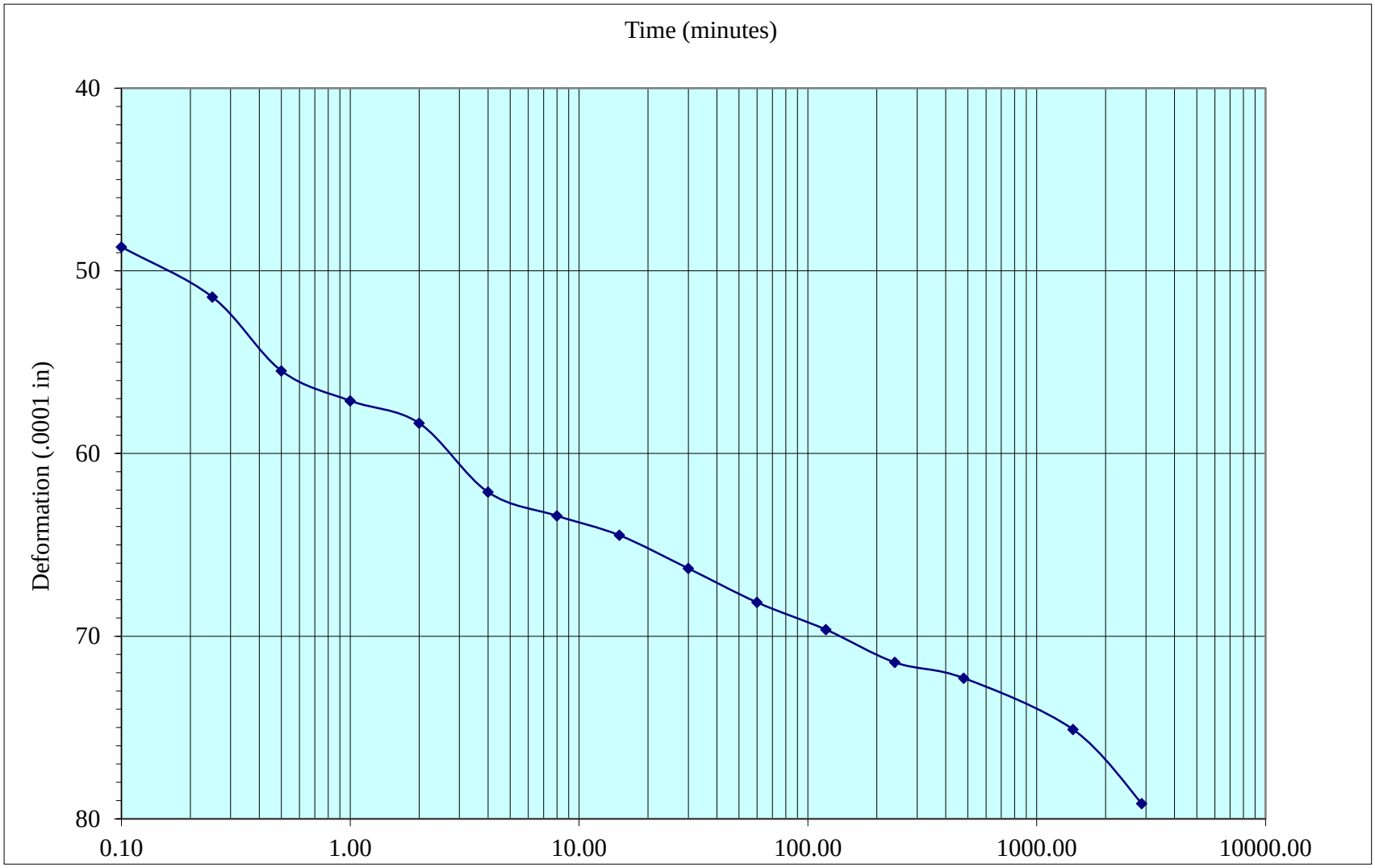
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. C-D-1 Sample No. ST-5-3 Load No. 3 TSF 1



D-0=

D-50=

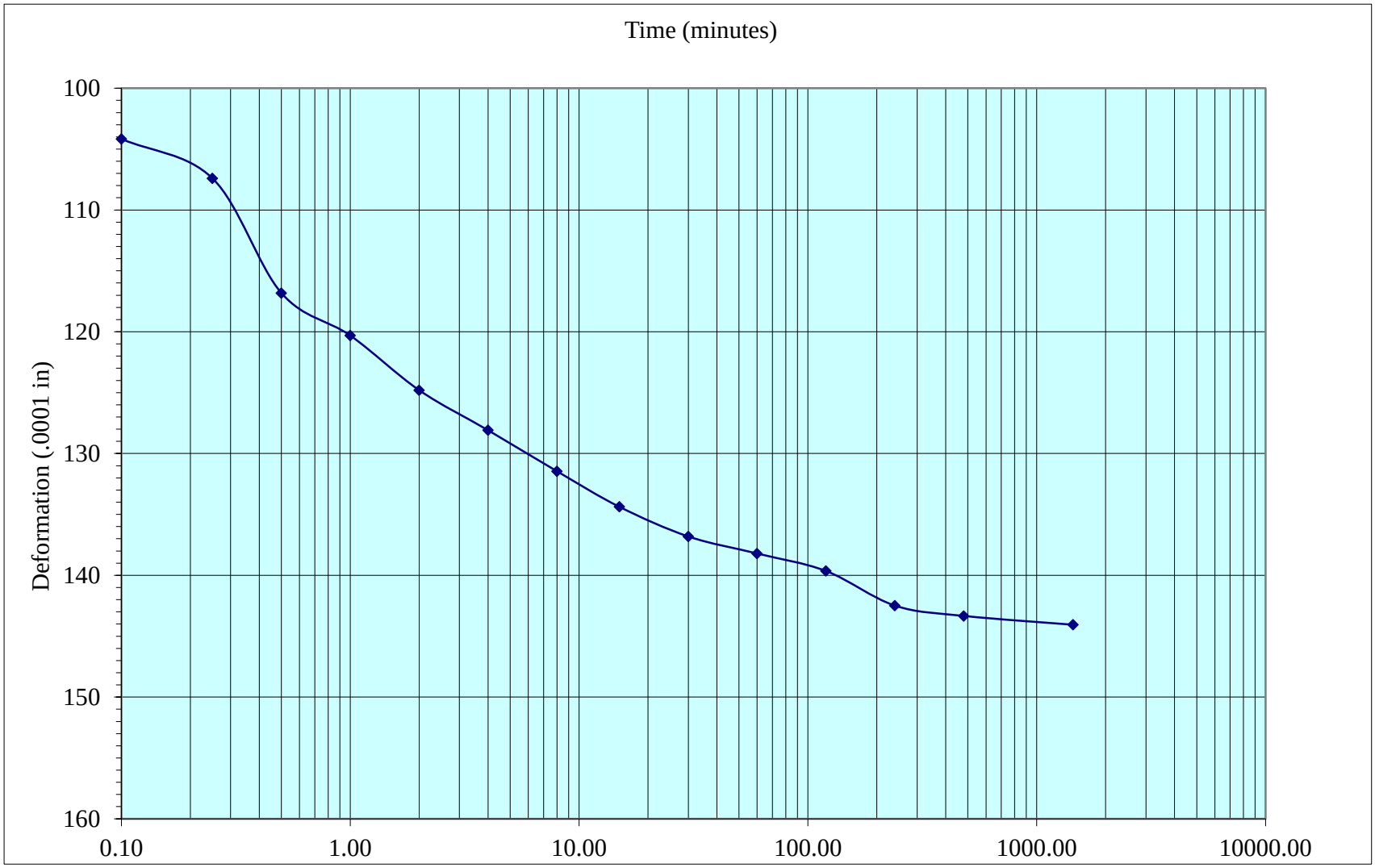
D-100=

t-50=

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. C-D-1 Sample No. ST-5-3 Load No. 4 TSF 2



D-0= _____

D-50= _____

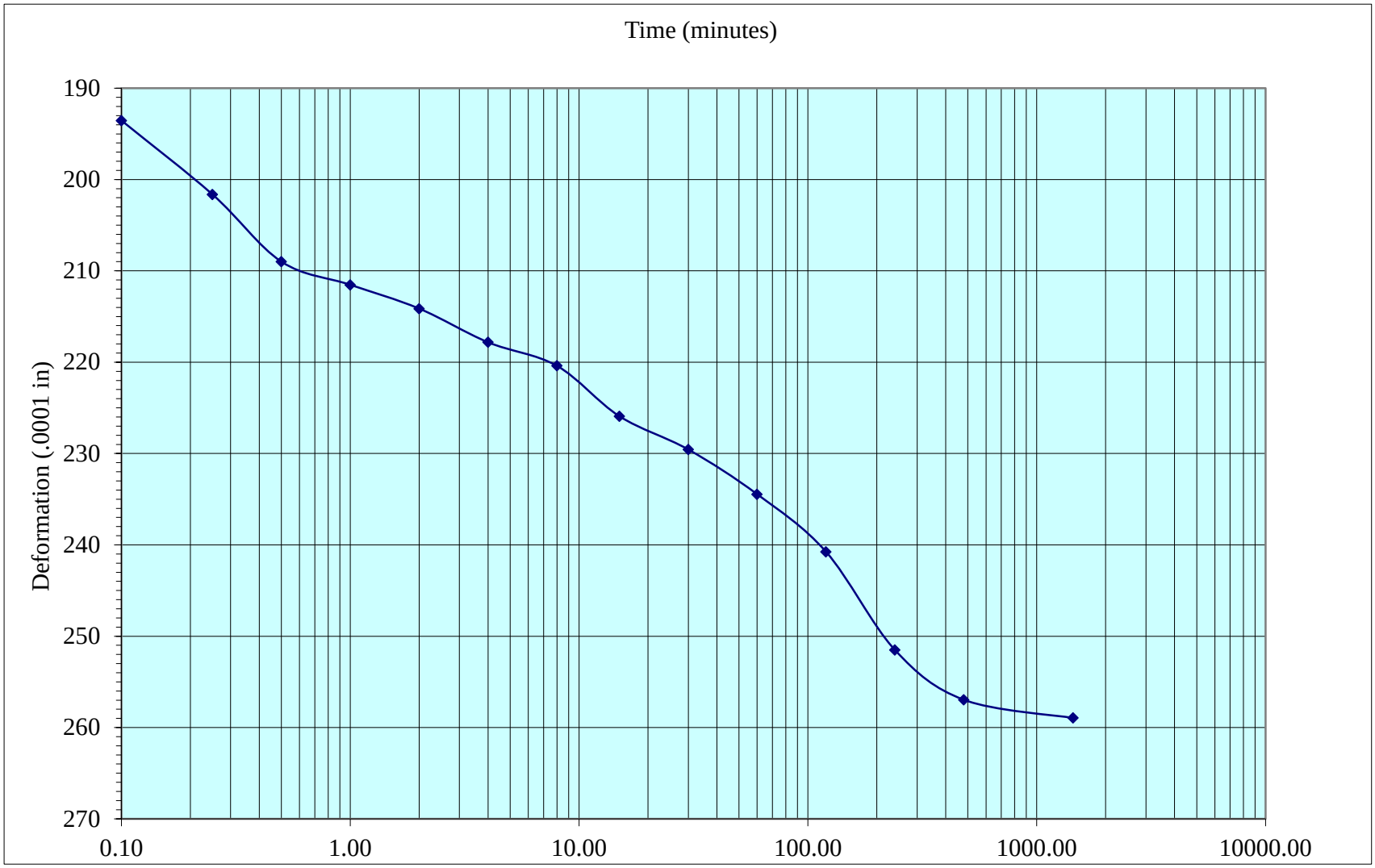
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. C-D-1 Sample No. ST-5-3 Load No. 5 TSF 4



D-0= _____

D-50= _____

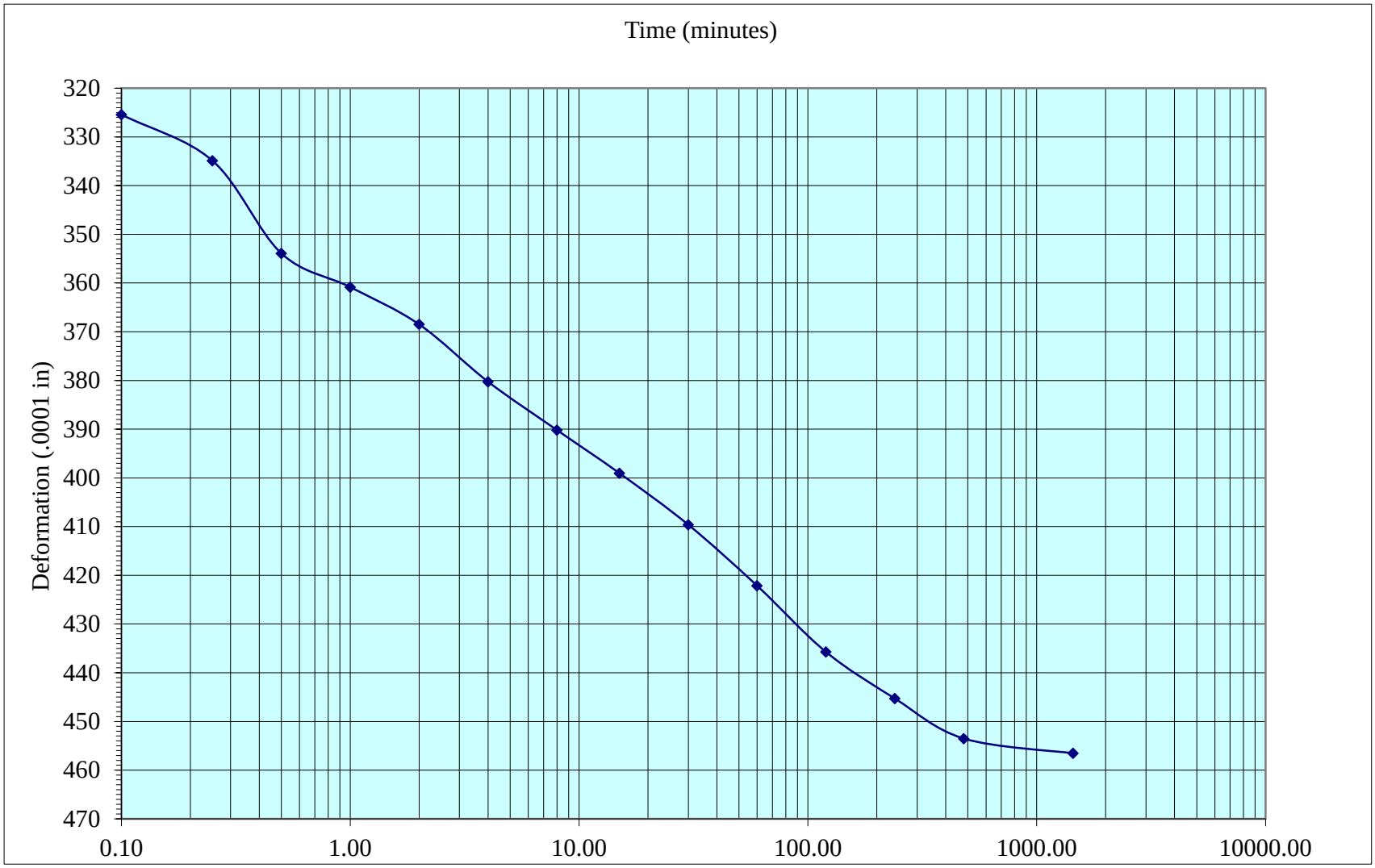
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. C-D-1 Sample No. ST-5-3 Load No. 6 TSF 8



D-0= _____

D-50= _____

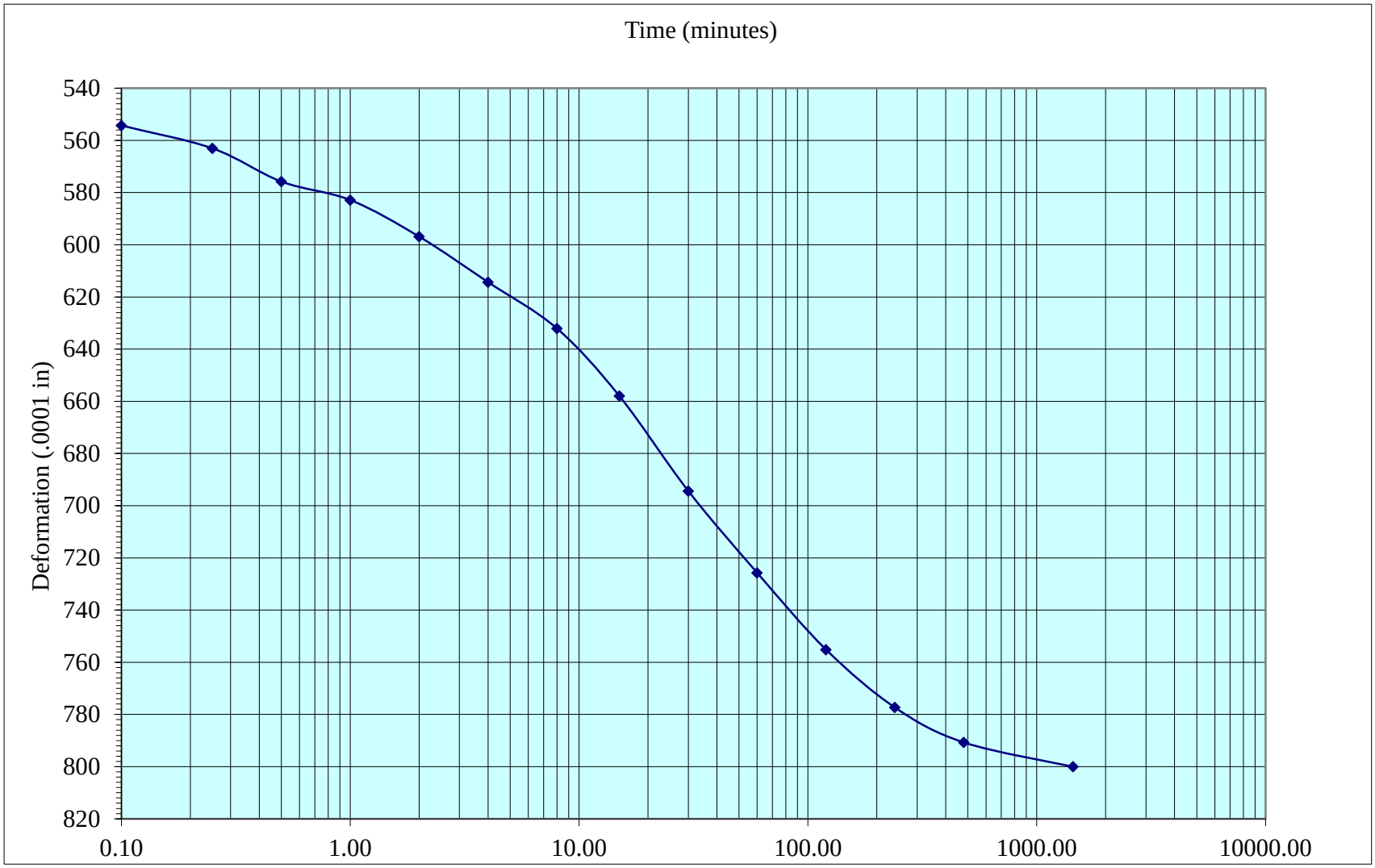
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. C-D-1 Sample No. ST-5-3 Load No. 7 TSF 16



D-0= _____

D-50= _____

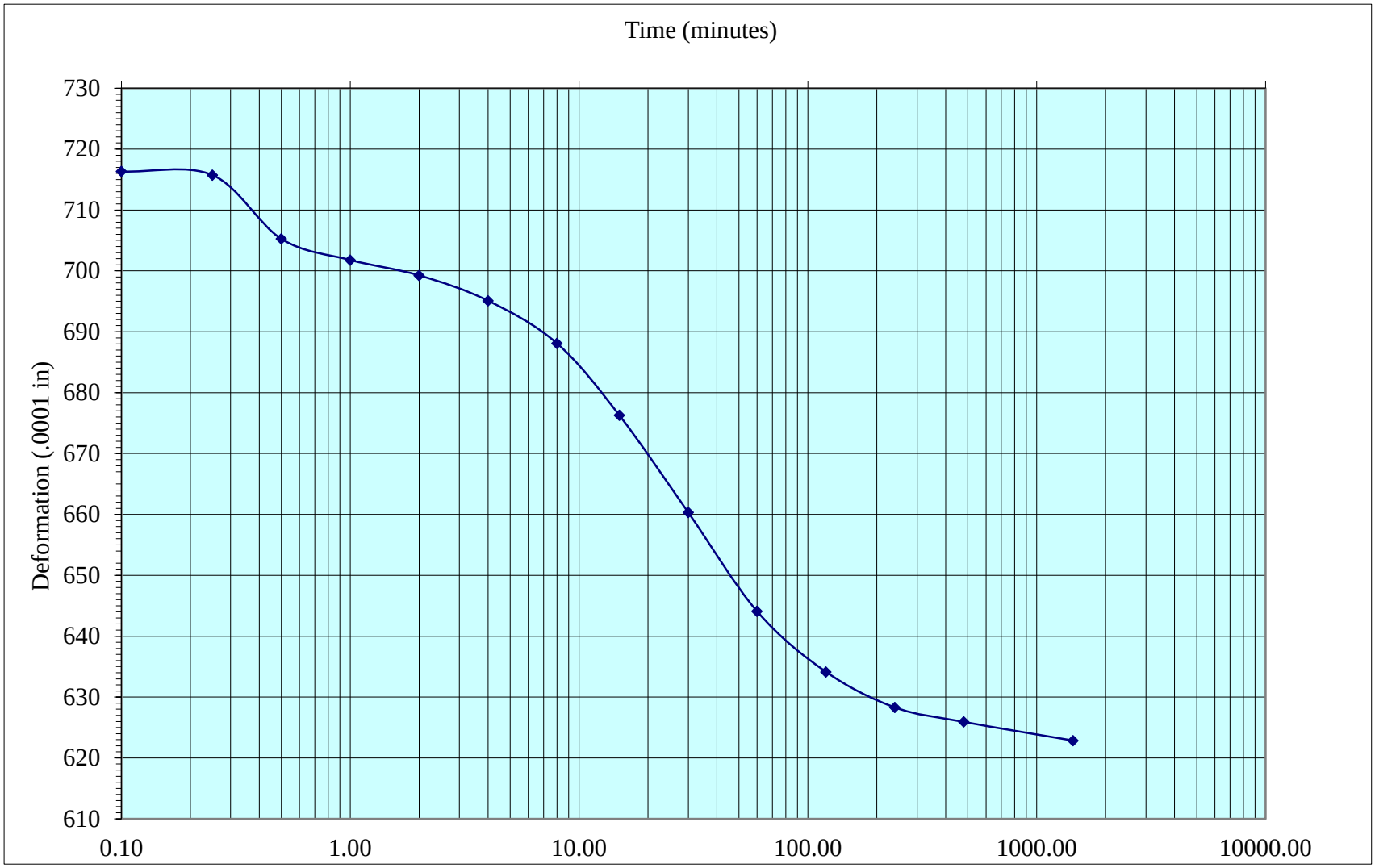
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. C-D-1 Sample No. ST-5-3 Load No. 8 TSF 4



D-0= _____

D-50= _____

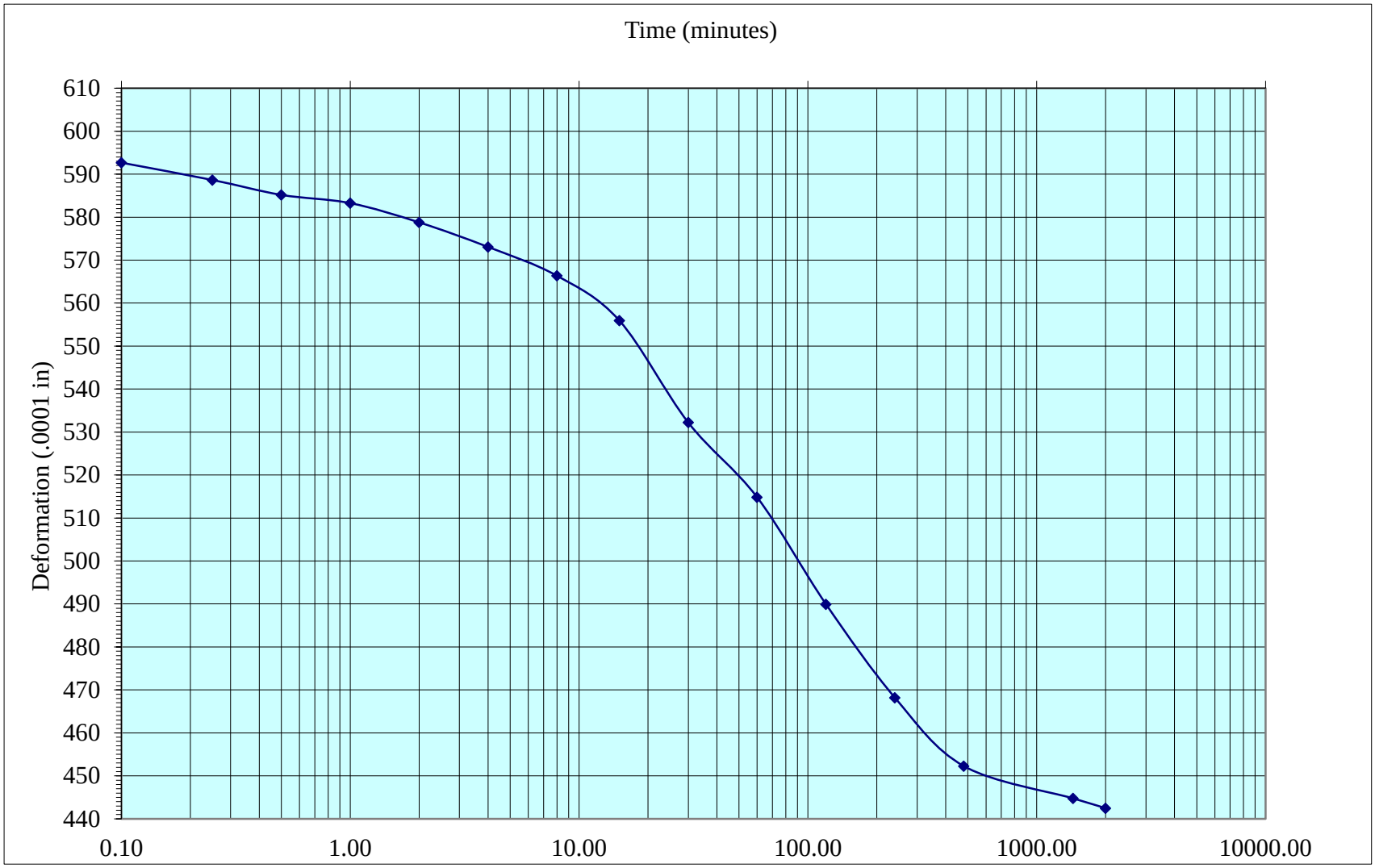
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. C-D-1 Sample No. ST-5-3 Load No. 9 TSF 1



D-0= _____

D-50= _____

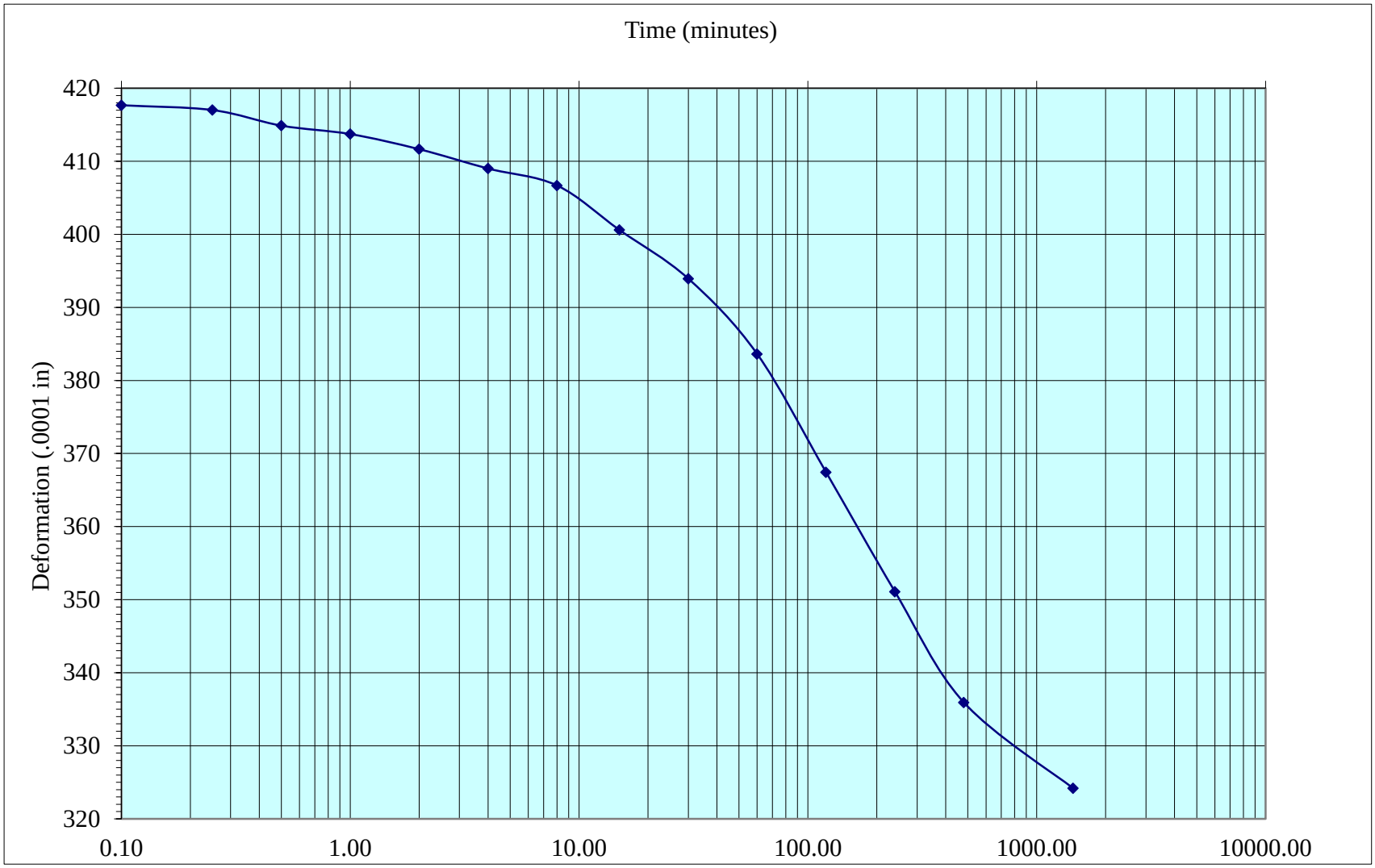
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. C-D-1 Sample No. ST-5-3 Load No. 10 TSF 0.25



D-0= _____

D-50= _____

D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project Number: 20241040.00

Boring Number: BR-7-4

Sample Number: ST-4-2

Depth (ft): 8.5-9.0

Wet Unit Weight (pcf): 130.22

Dry Unit Weight (pcf): 110.94

Initial Moisture		Final Moisture	
Wet Wt Sample+Ring (g):	313.32	Wet Wt Sample+Ring (g):	307.30
Dry Wt Sample+Ring (g):	288.47	Dry Wt Sample+Ring (g):	286.04
Wt of Ring (g):	145.52	Wt of Ring (g):	145.52
Dry Wt of Sample (g):	142.95	Dry Wt of Sample (g):	140.52
Wt of Water (g):	24.85	Wt of Water (g):	21.26
Moisture Content (%):	17.4	Moisture Content (%):	15.1

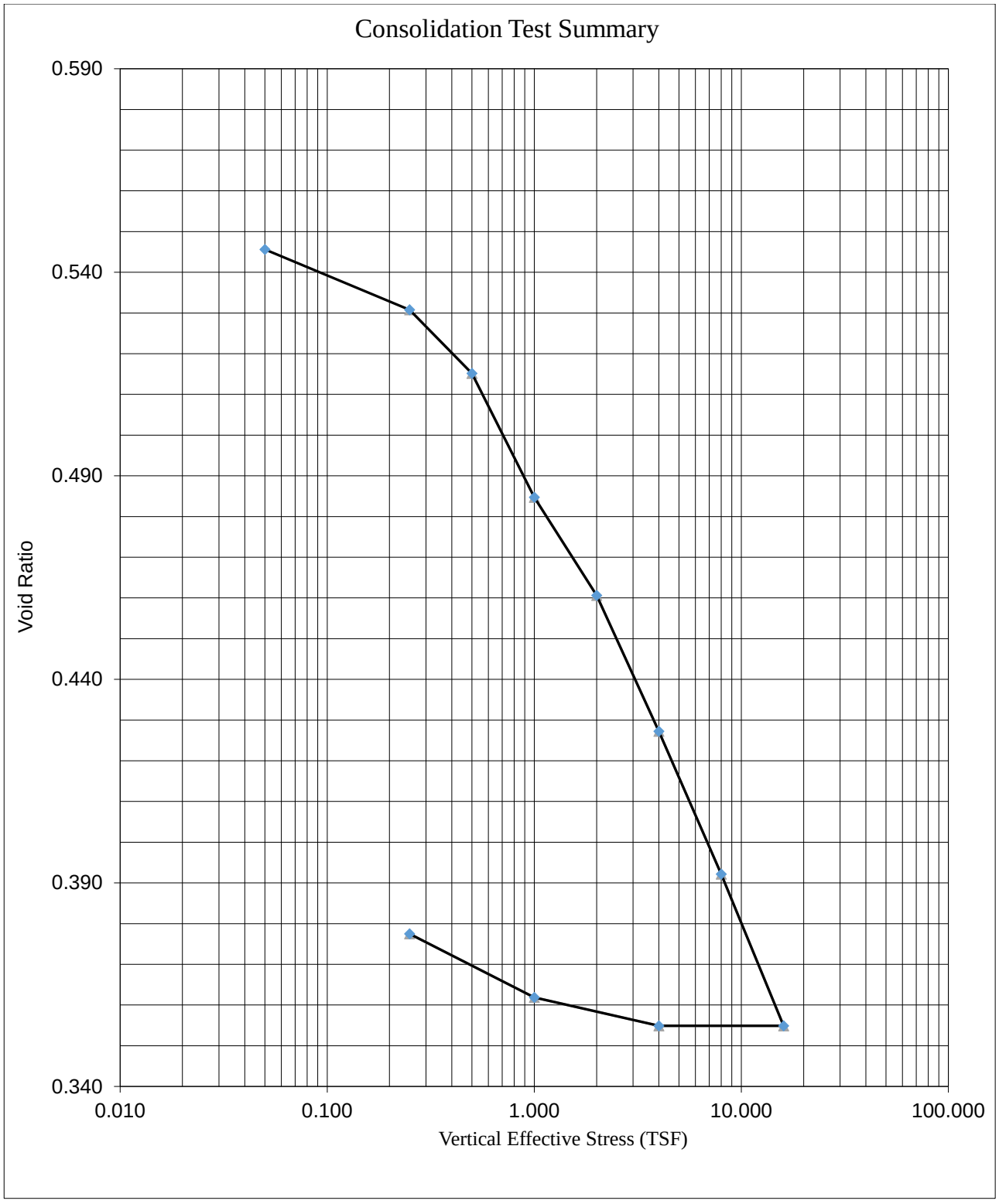
Visual Classification:

Initial Data

Sample Height (in):	1.000
Sample Diameter (in):	2.500
Volume (in^3):	4.909
Specific Gravity:	2.7
Height of Solids (in):	0.647
Initial Void Ratio:	0.546

1

Load (tsf)	D_{100} (0.0001")	Machine Deflection (0.0001")	Correction Factor	Corrected D_{100} (0.0001")	% Strain	Void Ratio Change	Void Ratio	D_{50} Uncorrected (0.0001")	H_{50} Corrected	t_{50} (min)	Cv (IN^2/MIN)
0.050	-46.0	0.1		-46.1	-0.46	0.0000	0.546	-23.0	1.0000	480.00	0.0001
0.250	96.0	0.1		95.9	0.96	0.0148	0.531	56.0	0.9944	20.00	0.0024
0.500	197.0	0.1		196.9	1.97	0.0304	0.515	166.5	0.9834	10.70	0.0045
1.000	394.0	0.1		393.9	3.94	0.0609	0.485	327.0	0.9673	24.00	0.0019
2.000	550.0	0.1		549.9	5.50	0.0850	0.461	502.5	0.9498	6.70	0.0066
4.000	766.0	0.1		765.9	7.66	0.1184	0.427	710.5	0.9290	11.00	0.0039
8.000	993.0	0.1		992.9	9.93	0.1535	0.392	939.5	0.9061	3.80	0.0106
16.000	1234.0	0.1		1233.9	12.34	0.1907	0.355	1182.0	0.8818	3.25	0.0118
4.000	1234.0	0.1		1233.9	12.34	0.1907	0.355	1236.5	0.8764	5.40	0.0070
1.000	1189.0	0.1		1188.9	11.89	0.1838	0.362	1203.0	0.8797	4.00	0.0095
0.250	1088.0	0.1		1087.9	10.88	0.1681	0.377	1131.5	0.8869	31.00	0.0012



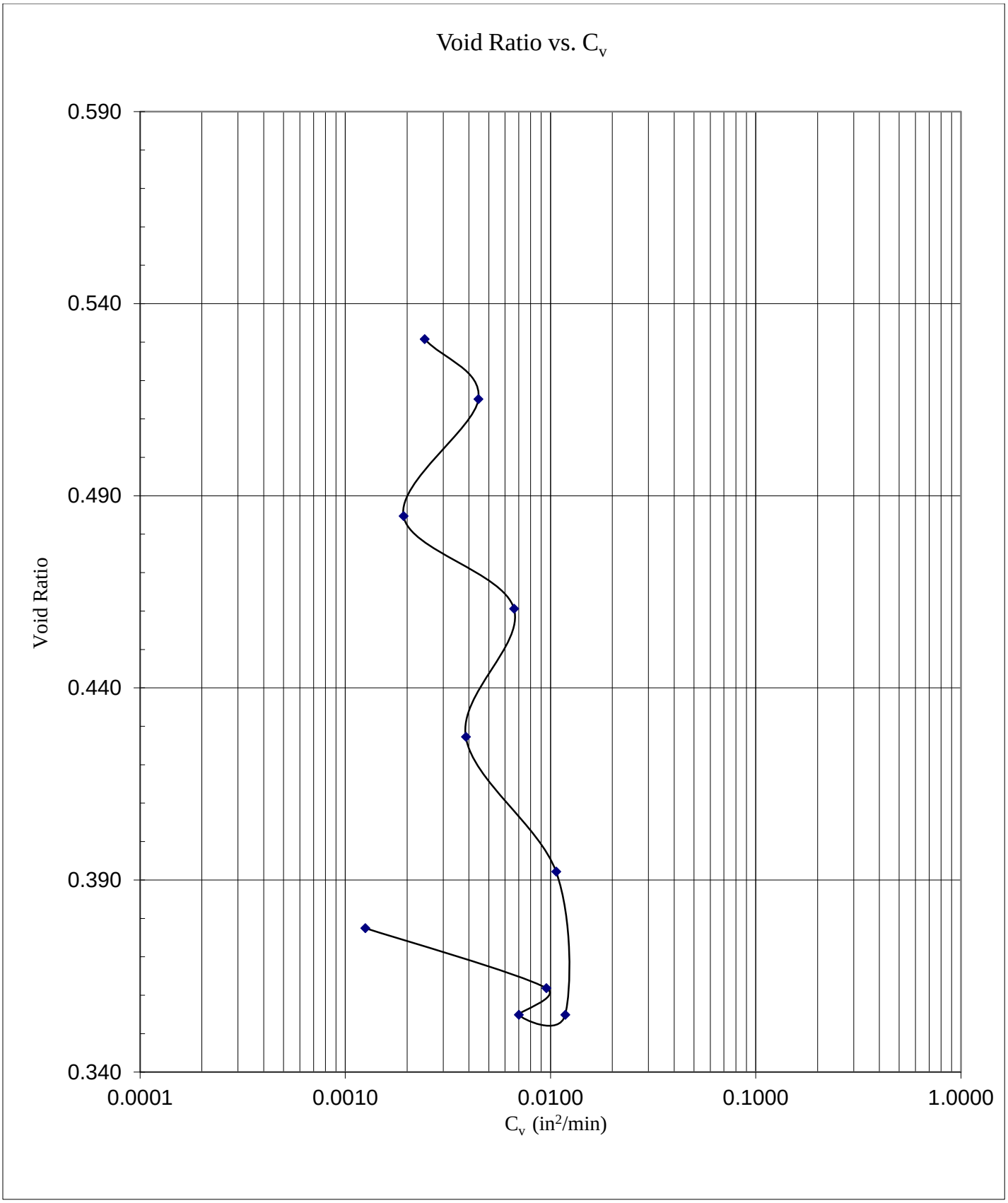
Boring No. BR-7-4 Sample ST-4-2 Depth 8.5-9.0

Soil Description : Brown, fat CLAY (CH), with sand and gravel

Initial Moisture Content (%): 17.4 Specific Gravity: 2.7 (assumed)

Initial Dry Density(pcf): 110.9 Project Name: I-70 Third Lane (Kingdom City to Columb

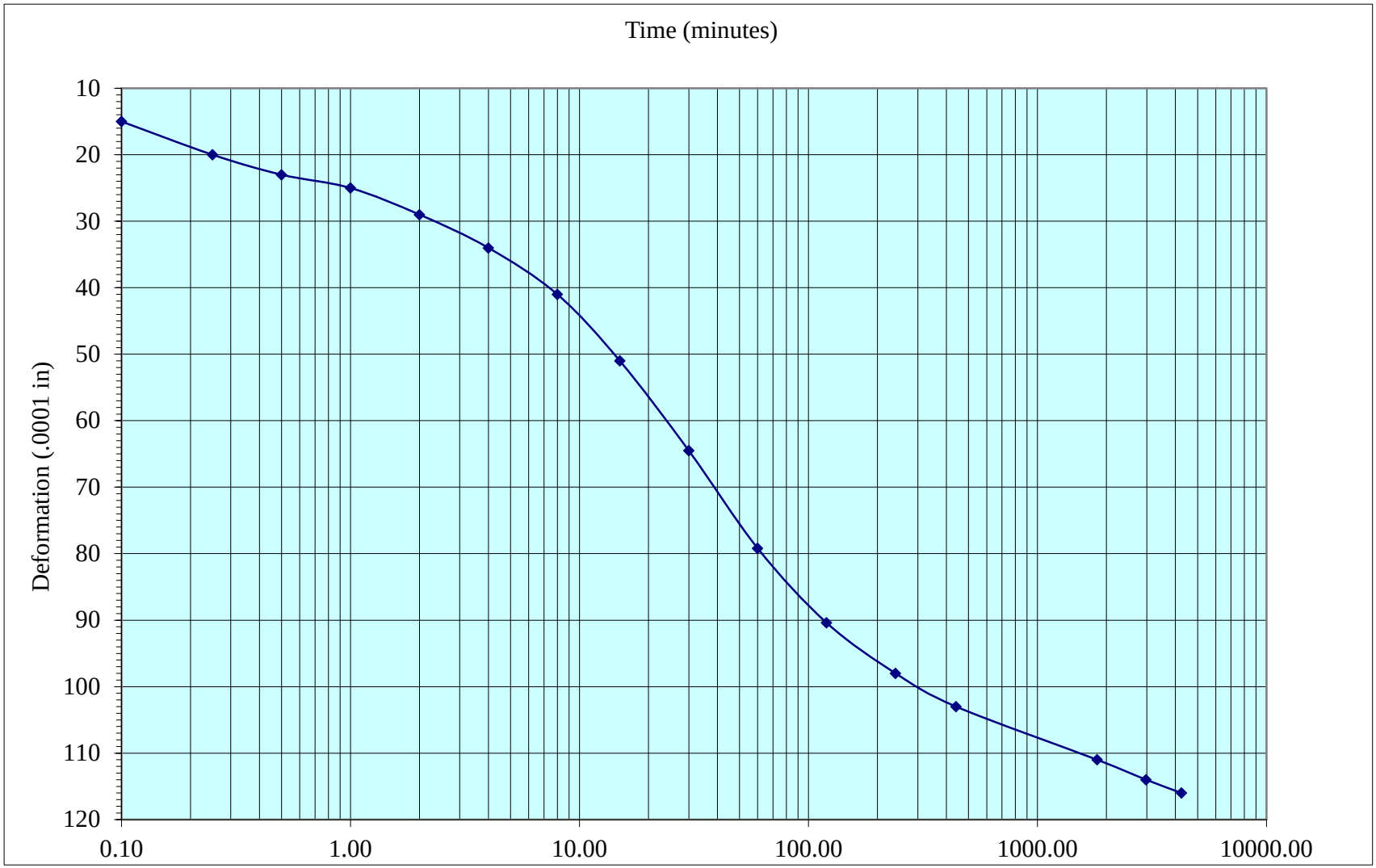
Project Number: 20241040.00


Void Ratio vs. C_v
0.590
0.540
0.490
0.440
0.390
0.340
Void Ratio
0.0001
0.0010
0.0100
0.1000
1.0000
C_v (in^2/min)

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4 Sample No. ST-4-2 Load No. 1 TSF 0.25



D-0= _____

D-50= _____

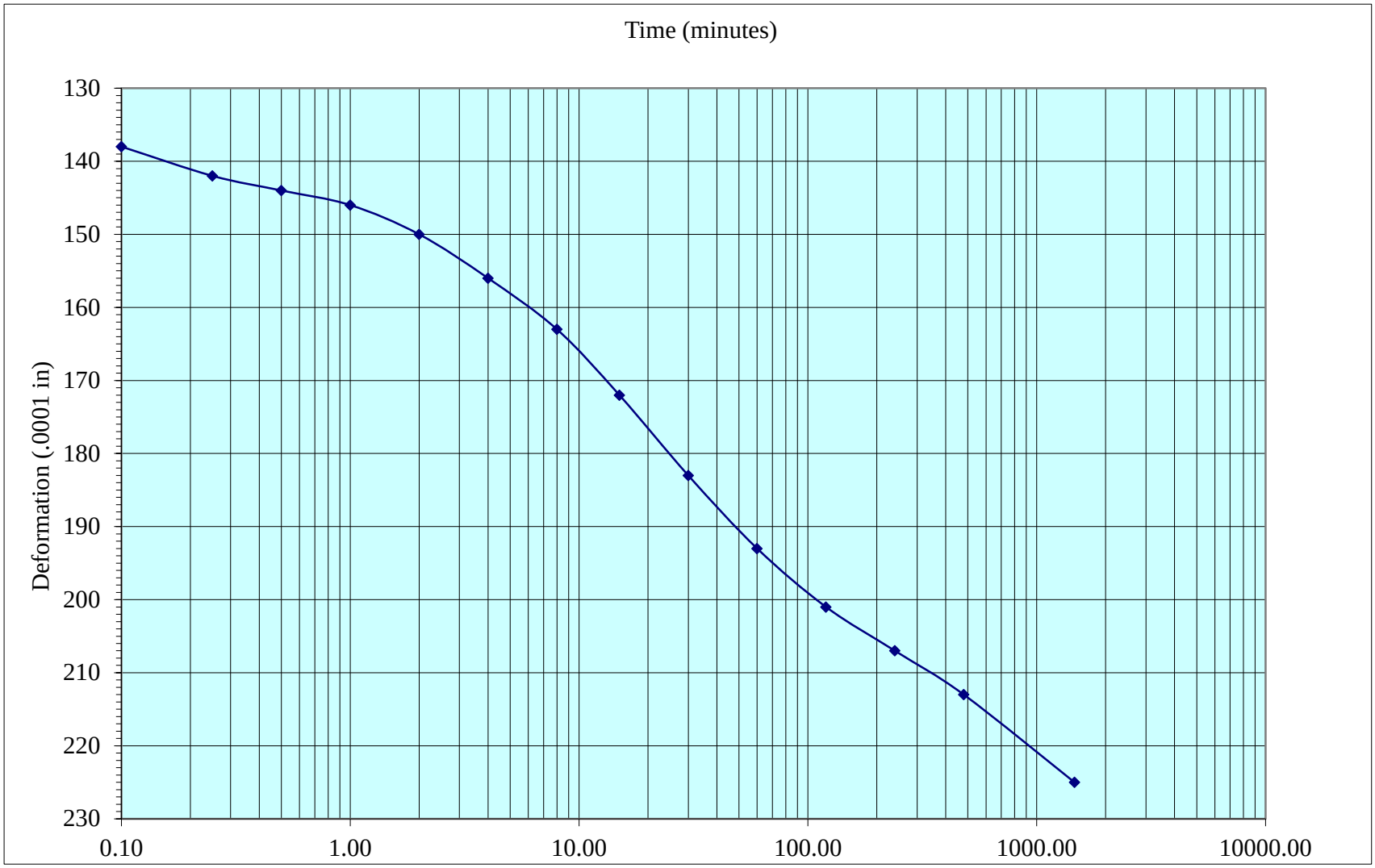
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4 Sample No. ST-4-2 Load No. 2 TSF 0.5



D-0= _____

D-50= _____

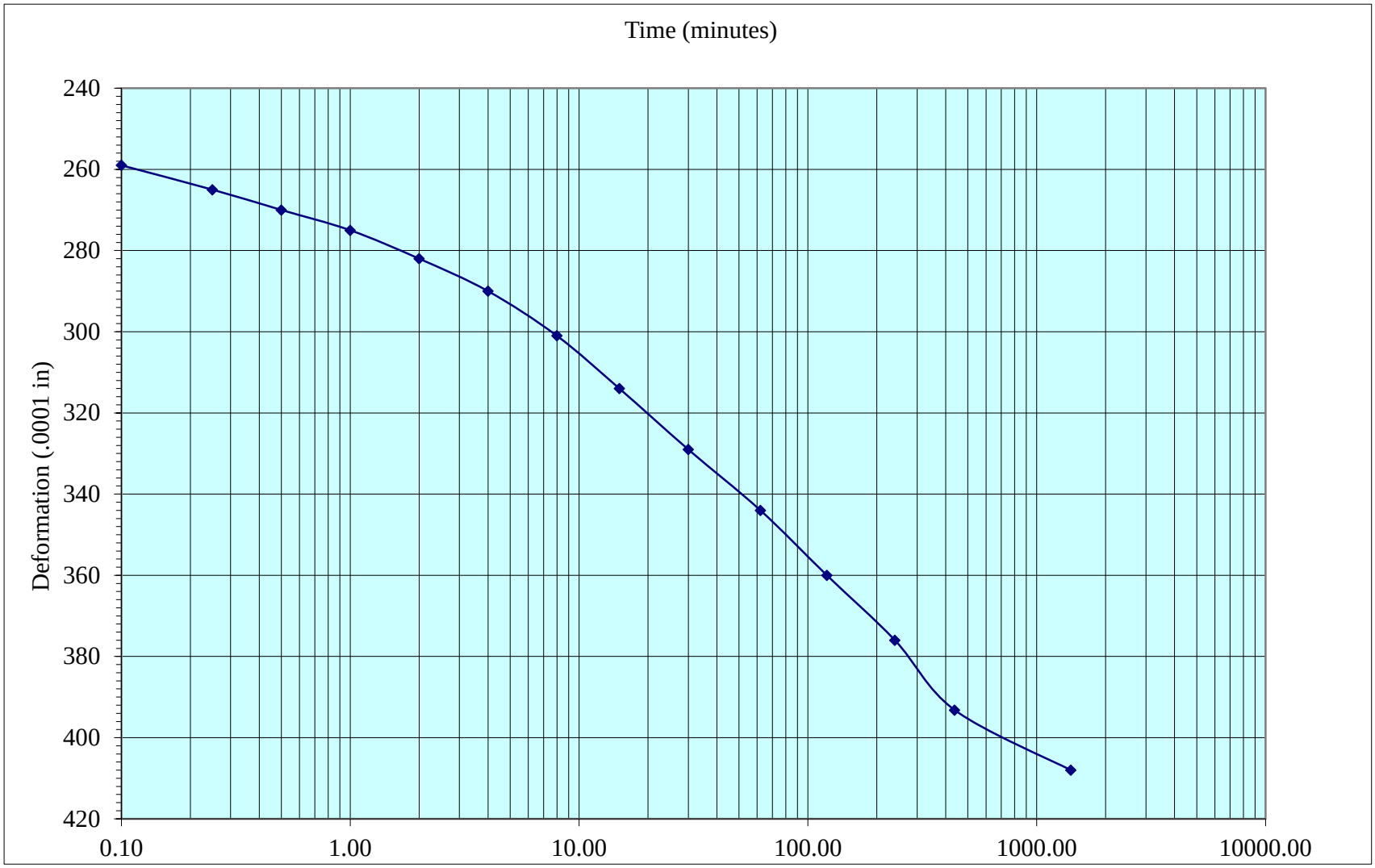
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4 Sample No. ST-4-2 Load No. 3 TSF 1



D-0= _____

D-50= _____

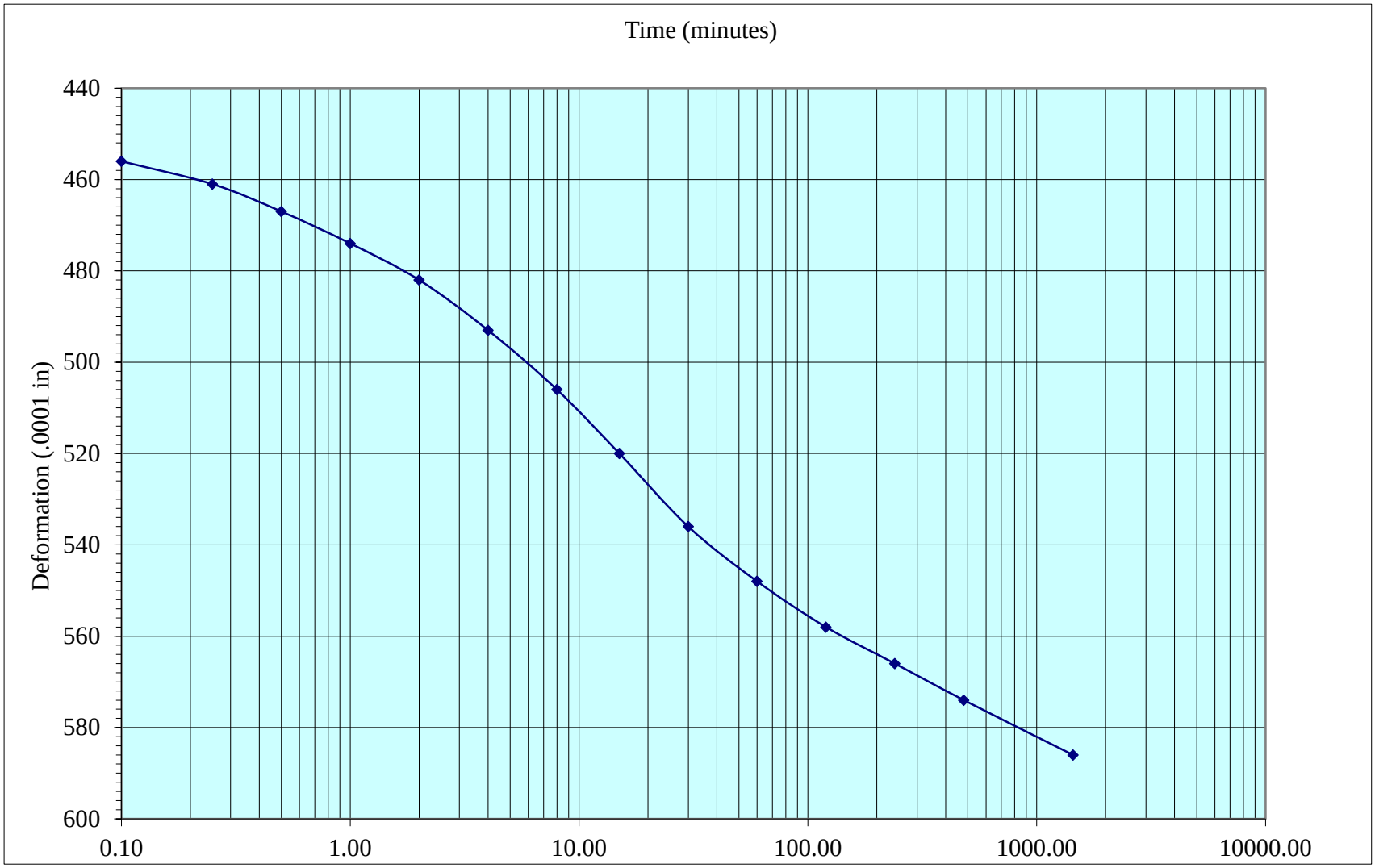
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4 Sample No. ST-4-2 Load No. 4 TSF 2



D-0= _____

D-50= _____

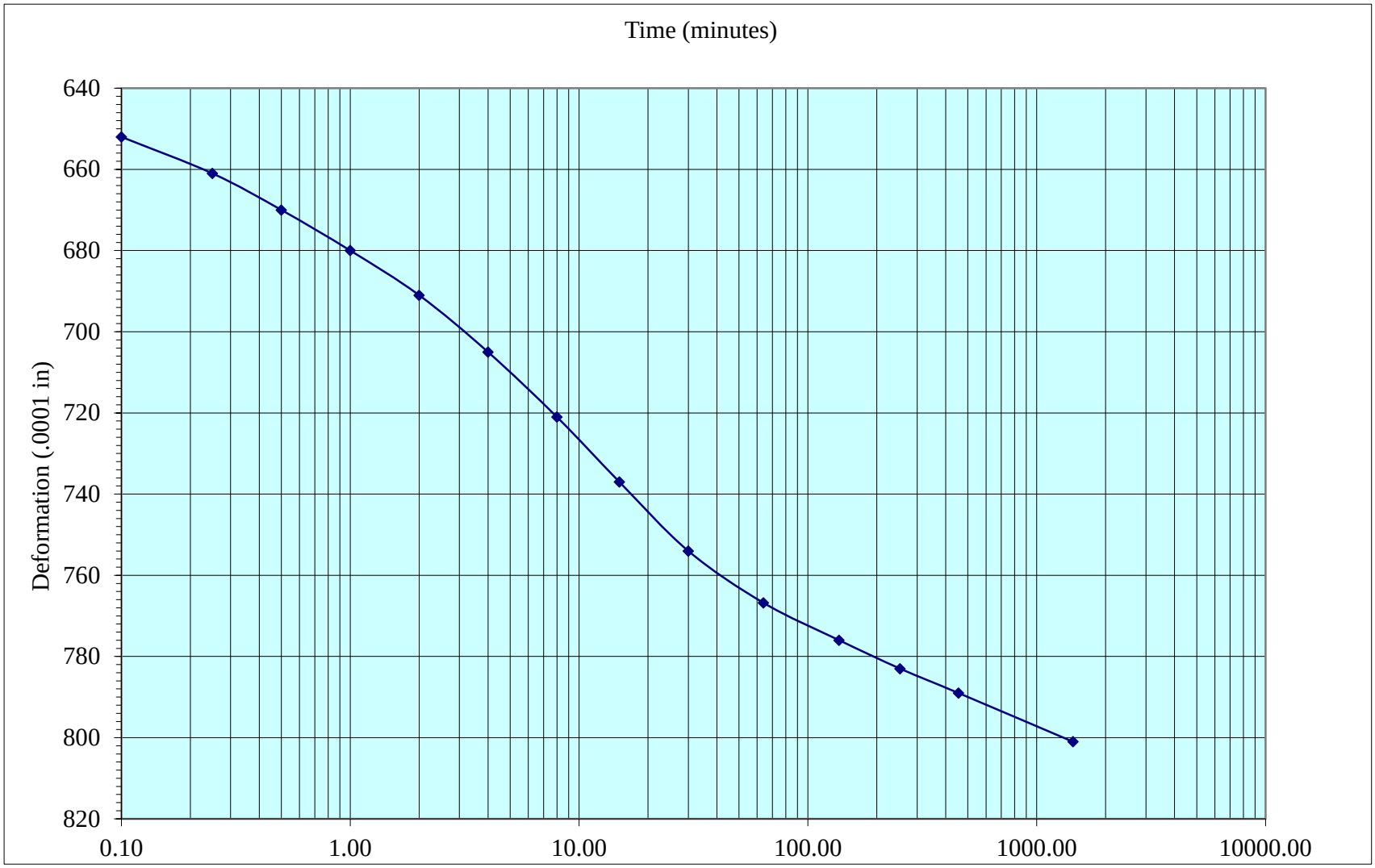
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4 Sample No. ST-4-2 Load No. 5 TSF 4



D-0= _____

D-50= _____

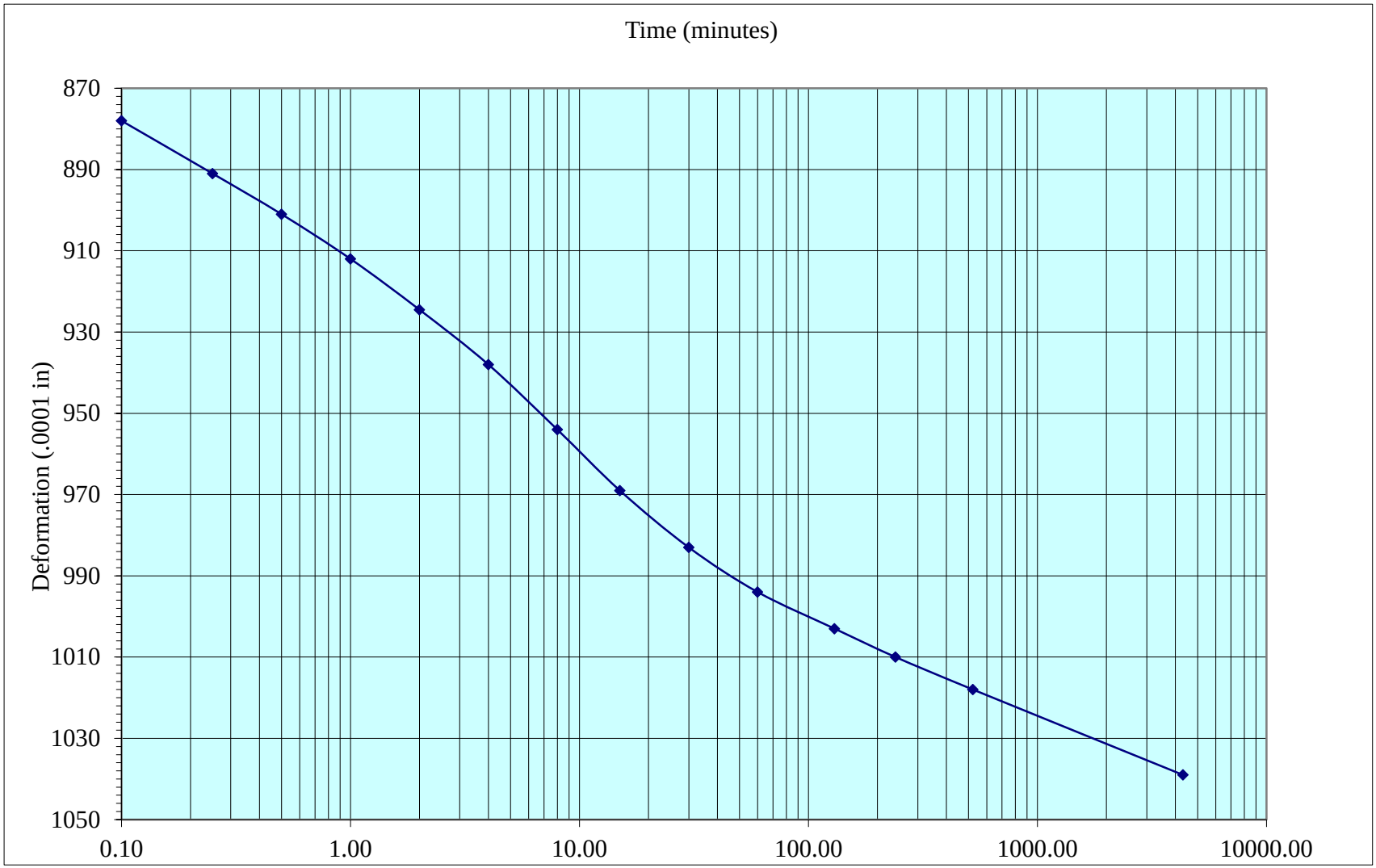
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4 Sample No. ST-4-2 Load No. 6 TSF 8



D-0=

D-50=

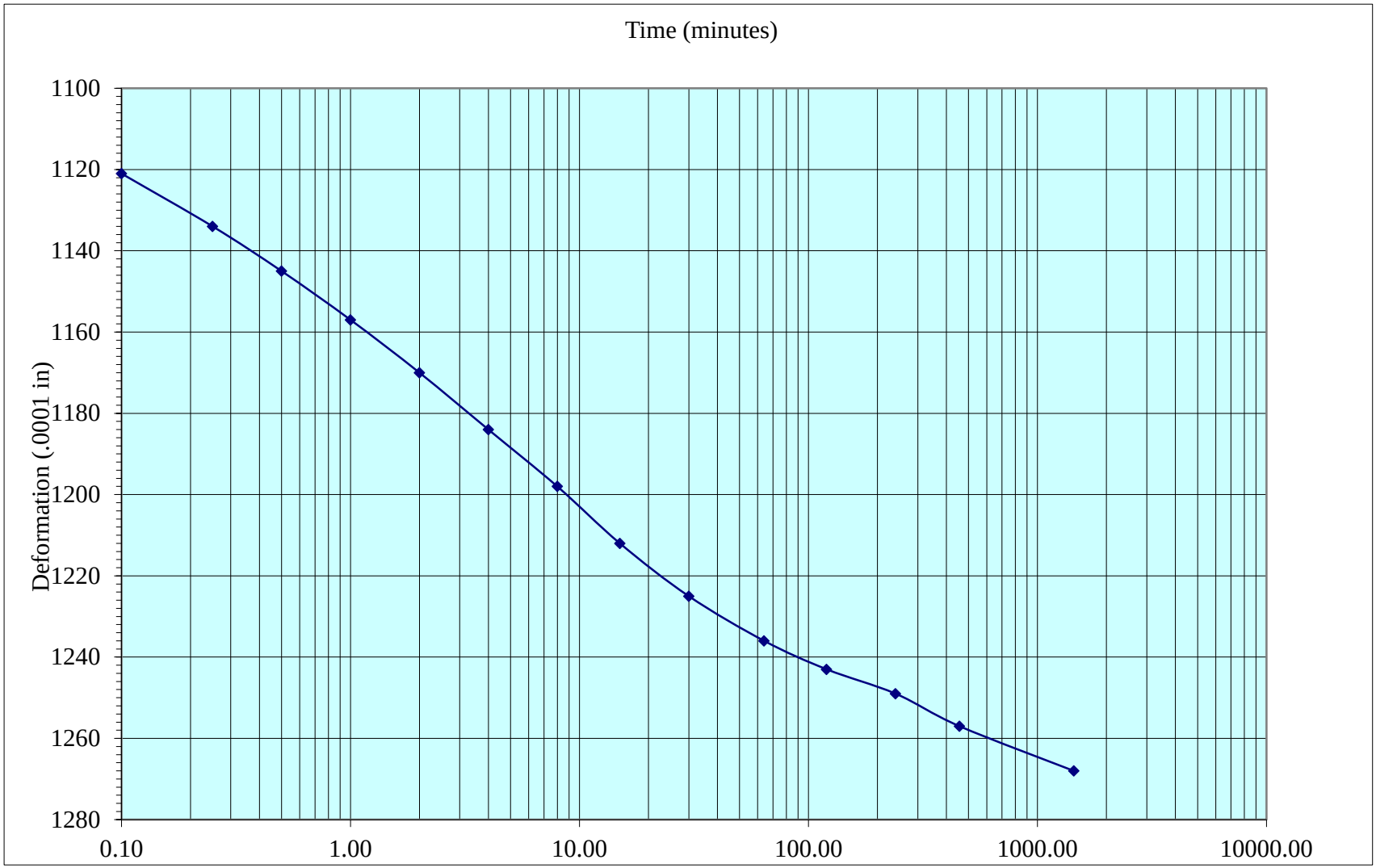
D-100=

t-50=

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4 Sample No. ST-4-2 Load No. 7 TSF 16



D-0= _____

D-50= _____

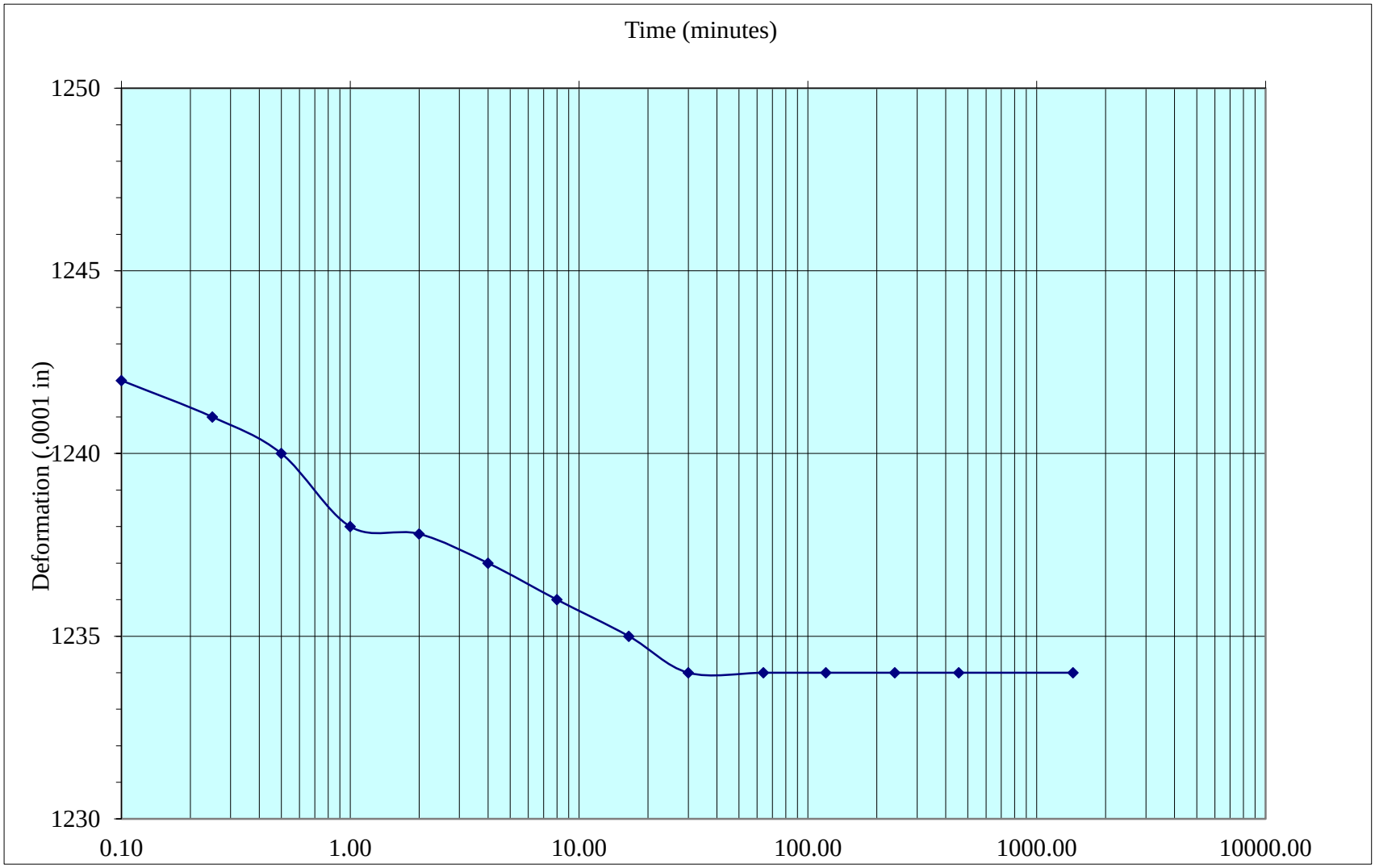
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4 Sample No. ST-4-2 Load No. 8 TSF 4



D-0= _____

D-50= _____

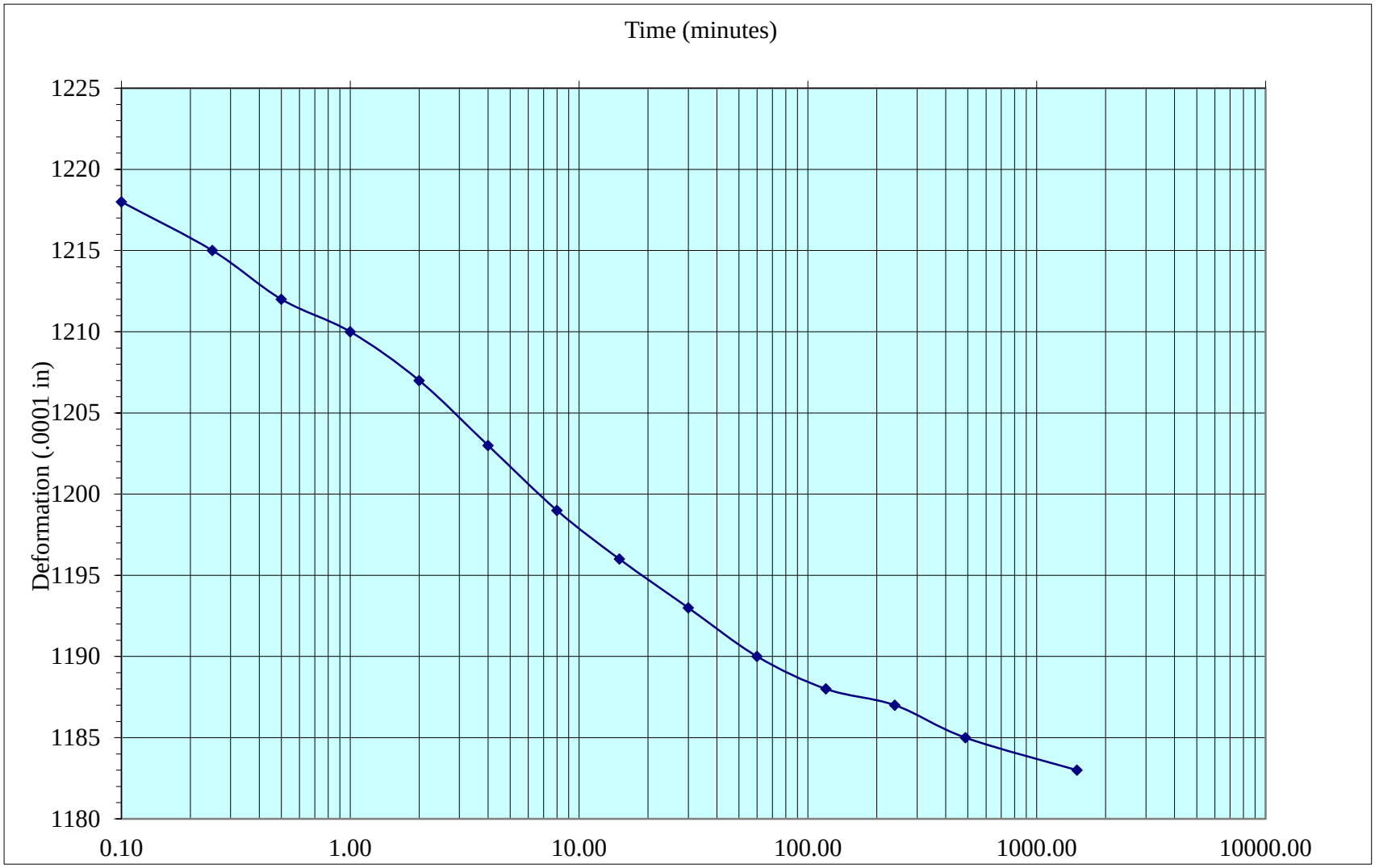
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4 Sample No. ST-4-2 Load No. 9 TSF 1



D-0= _____

D-50= _____

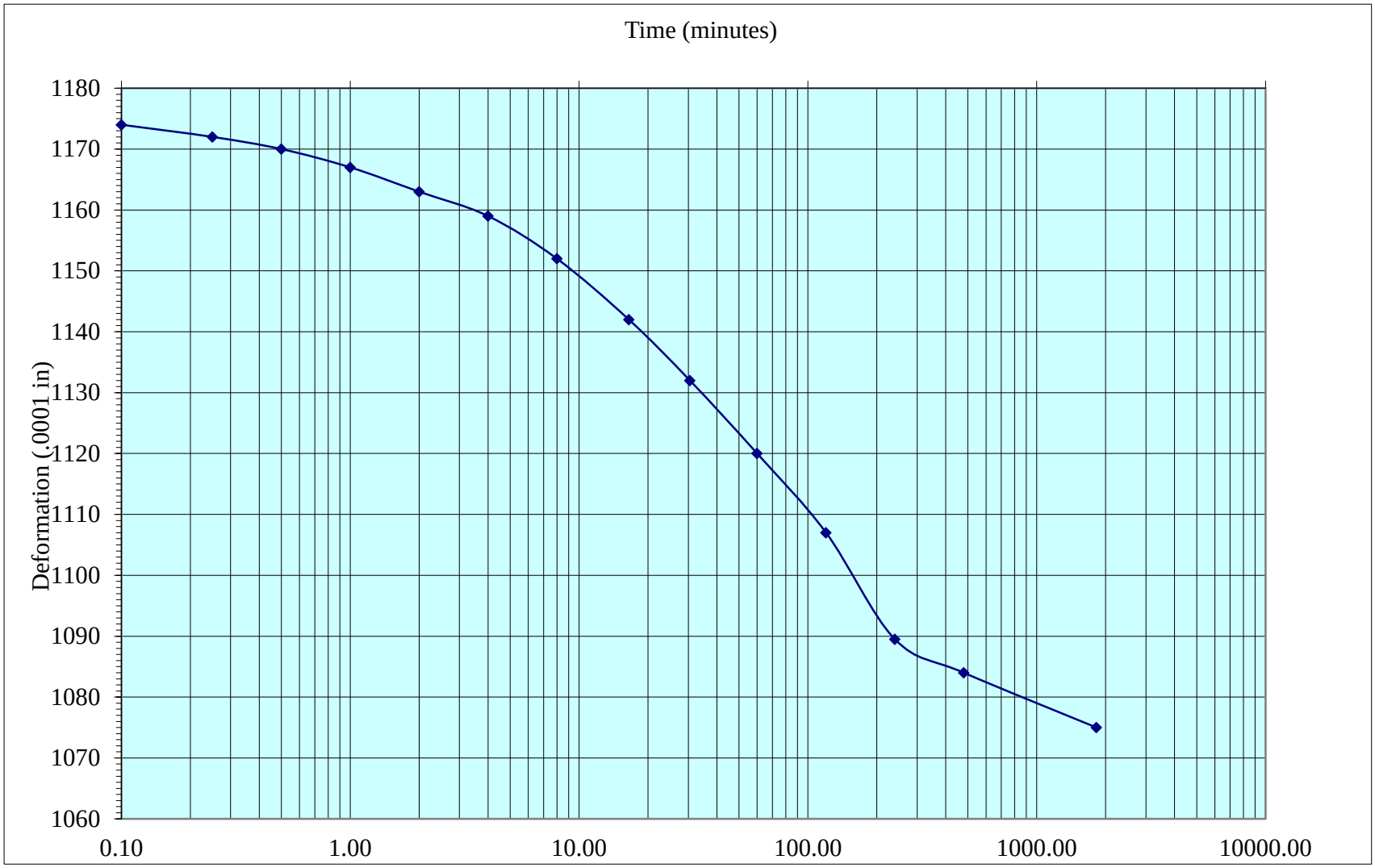
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4 Sample No. ST-4-2 Load No. 10 TSF 0.25



D-0=

D-50=

D-100=

t-50=

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project Number: 20241040.00

Boring Number: BR-7-4.1

Sample Number: ST-2-4

Depth (ft): 4.5-5.0

Wet Unit Weight (pcf): 129.19

Dry Unit Weight (pcf): 110.30

Initial Moisture		Final Moisture	
Wet Wt Sample+Ring (g):	312.83	Wet Wt Sample+Ring (g):	312.44
Dry Wt Sample+Ring (g):	288.52	Dry Wt Sample+Ring (g):	285.31
Wt of Ring (g):	146.56	Wt of Ring (g):	146.56
Dry Wt of Sample (g):	141.96	Dry Wt of Sample (g):	138.75
Wt of Water (g):	24.31	Wt of Water (g):	27.13
Moisture Content (%):	17.1	Moisture Content (%):	19.6

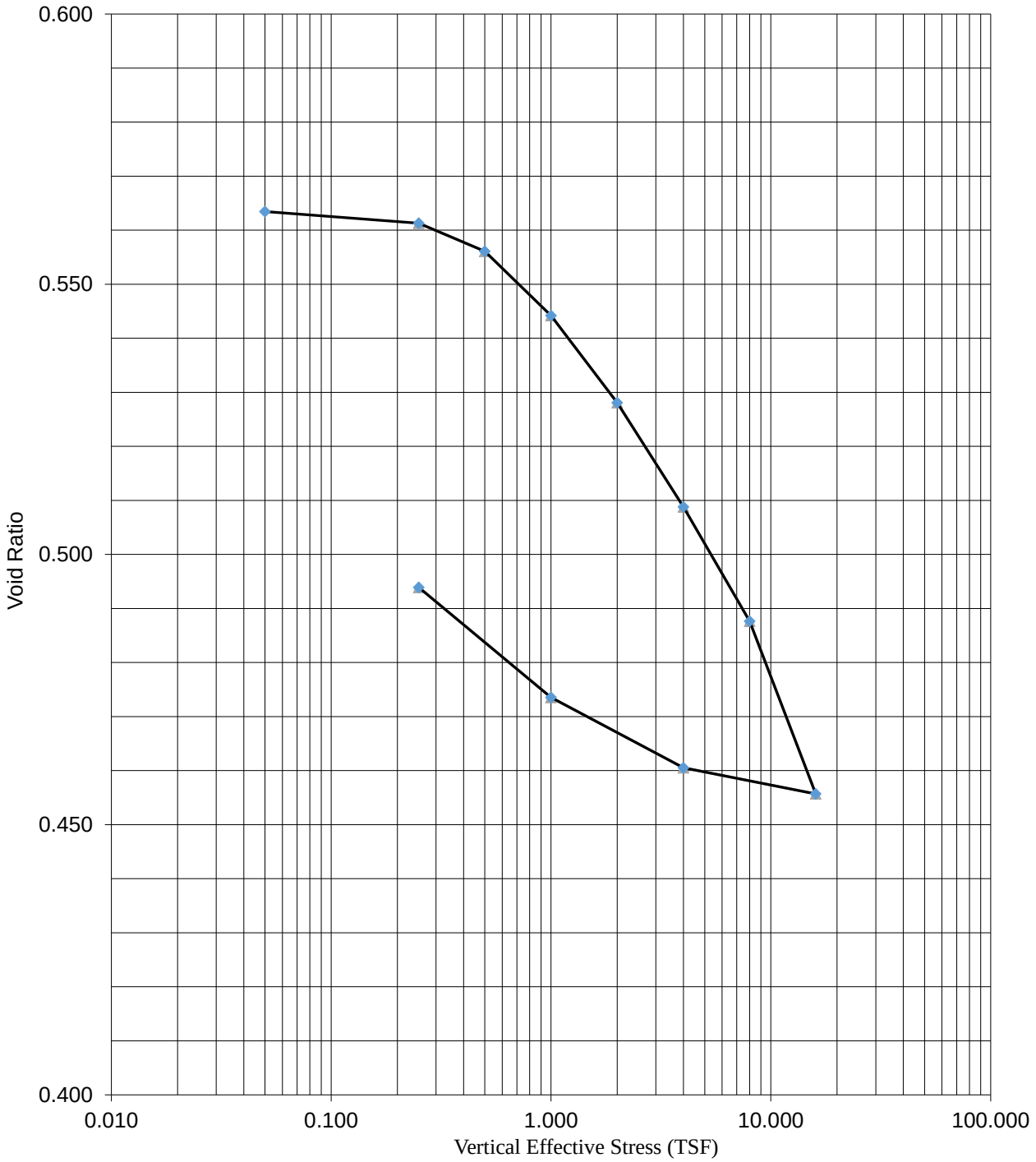
Visual Classification:

Initial Data	
Sample Height (in):	0.998
Sample Diameter (in):	2.501
Volume (in^3):	4.903
Specific Gravity:	2.7
Height of Solids (in):	0.638
Initial Void Ratio:	0.563

1

Load (tsf)	D_{100} (0.0001")	Machine Deflection (0.0001")	Correction Factor	Corrected D_{100} (0.0001")	% Strain	Void Ratio Change	Void Ratio	D_{50} Uncorrected (0.0001")	H_{50} Corrected	t_{50} (min)	Cv (IN^2/MIN)
0.050	27.0	0.1		26.9	0.27	0.0000	0.563	13.5	0.9980	480.00	0.0001
0.250	14.0	0.1		13.9	0.14	0.0022	0.561	10.0	0.9970	24.00	0.0020
0.500	47.0	0.1		46.9	0.47	0.0073	0.556	35.5	0.9945	34.00	0.0014
1.000	123.0	0.1		122.9	1.23	0.0193	0.544	97.5	0.9883	12.00	0.0040
2.000	226.0	0.1		225.9	2.26	0.0354	0.528	191.5	0.9789	10.40	0.0045
4.000	349.0	0.1		348.9	3.50	0.0547	0.509	302.0	0.9678	8.00	0.0058
8.000	484.0	0.1		483.9	4.85	0.0758	0.488	435.0	0.9545	7.50	0.0060
16.000	688.0	0.1		687.9	6.89	0.1078	0.456	615.5	0.9365	10.00	0.0043
4.000	657.0	0.1		656.9	6.58	0.1029	0.461	671.5	0.9309	3.70	0.0115
1.000	574.0	0.1		573.9	5.75	0.0899	0.474	607.0	0.9373	17.00	0.0025
0.250	444.0	0.1		443.9	4.45	0.0695	0.494	501.0	0.9479	115.00	0.0004

Consolidation Test Summary



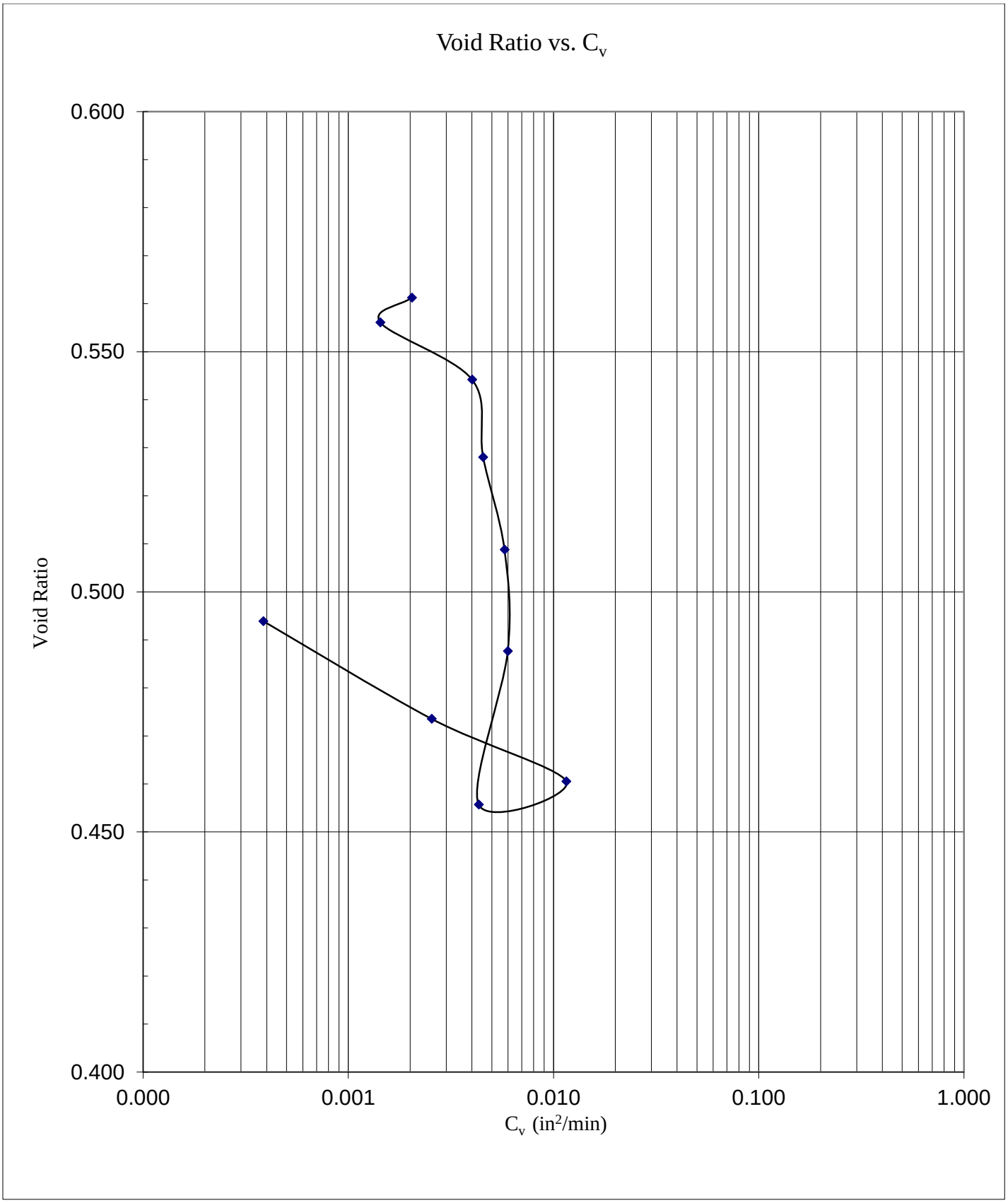
Boring No. BR-7-4.1 Sample ST-2-4 Depth 4.5-5.0

Soil Description : Brown and gray, silty lean CLAY (CL), trace gravel

Initial Moisture Content (%): 17.1 Specific Gravity: 2.7 (assumed)

Initial Dry Density(pcf): 110.3 Project Name: I-70 Third Lane (Kingdom City to Columbia)

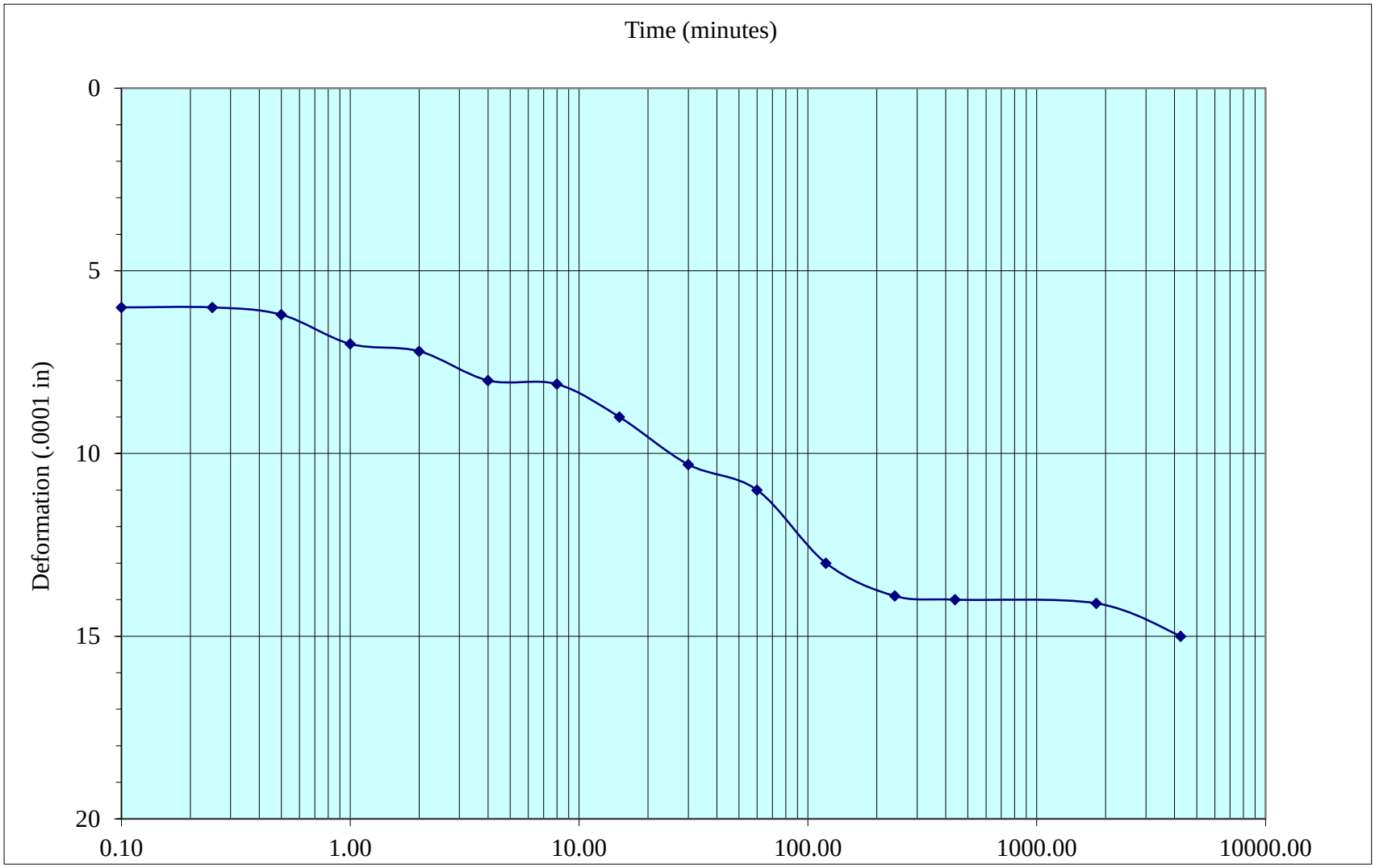
Project Number: 20241040.00


Void Ratio vs. C_v
0.600
0.550
0.500
0.450
0.400
Void Ratio
0.000
0.001
0.010
0.100
1.000
C_v (in^2/min)

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4.1 Sample No. ST-2-4 Load No. 1 TSF 0.25



D-0=

D-50=

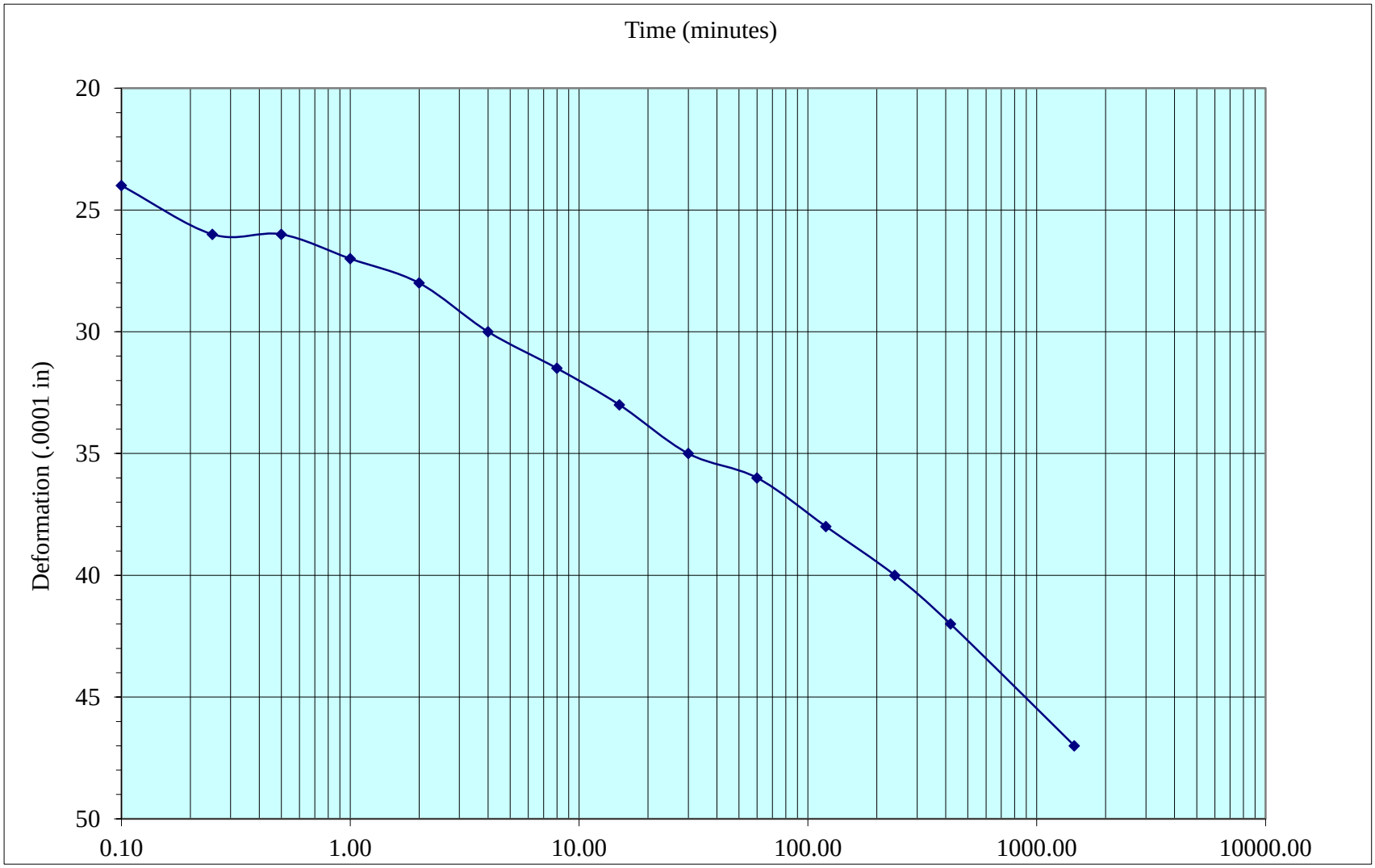
D-100=

t-50=

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4.1 Sample No. ST-2-4 Load No. 2 TSF 0.5



D-0= _____

D-50= _____

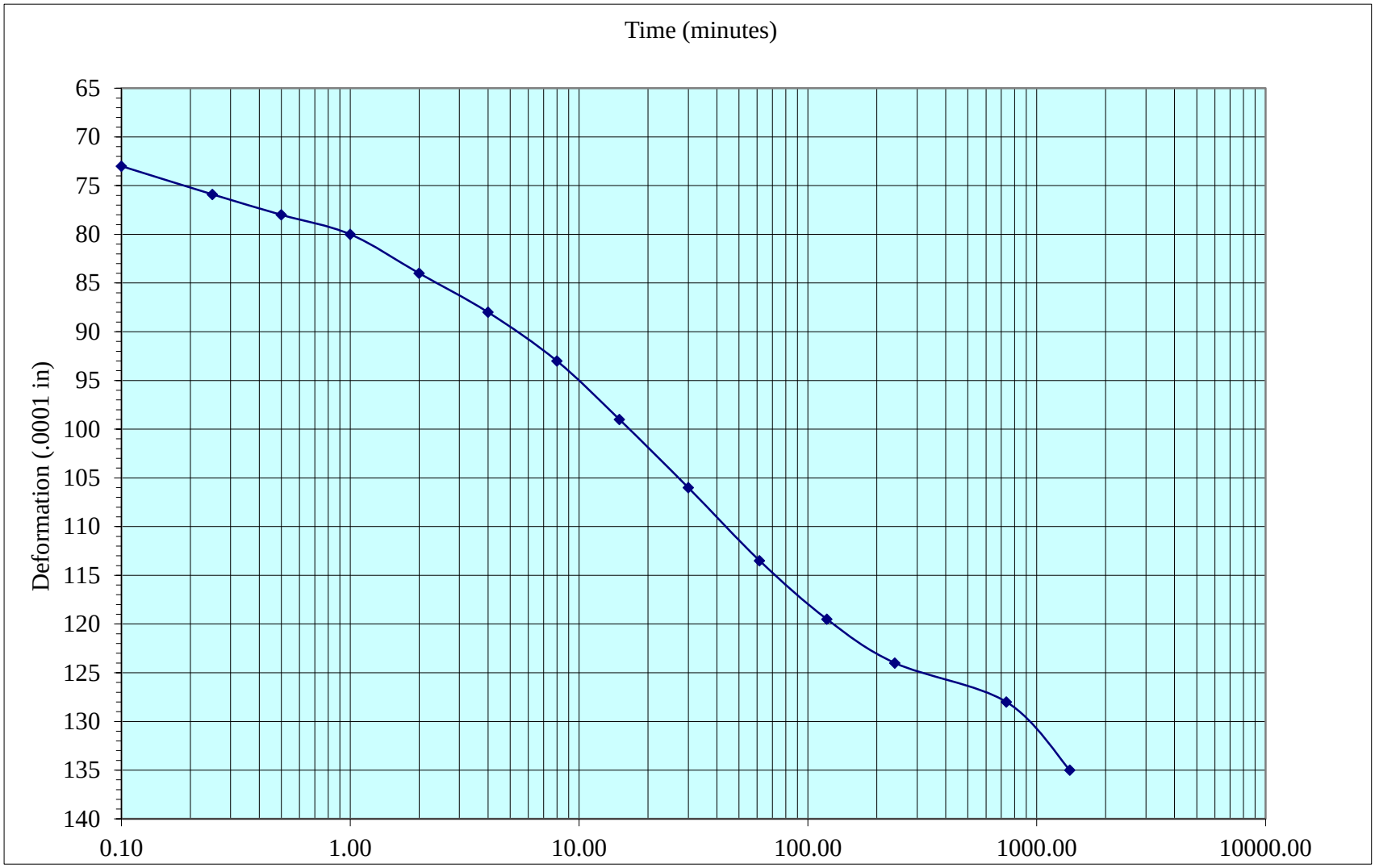
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4.1 Sample No. ST-2-4 Load No. 3 TSF 1



D-0= _____

D-50= _____

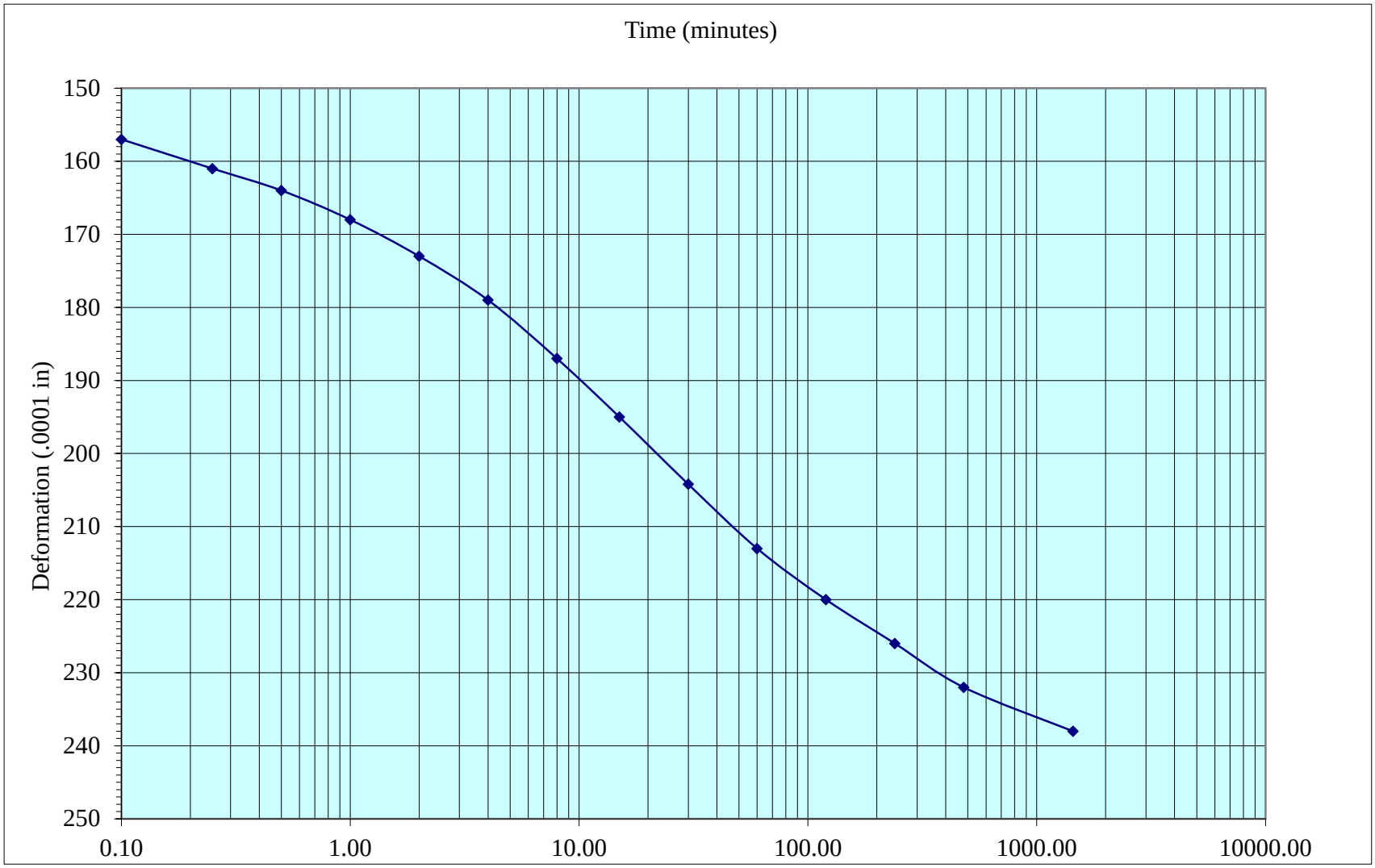
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4.1 Sample No. ST-2-4 Load No. 4 TSF 2



D-0= _____

D-50= _____

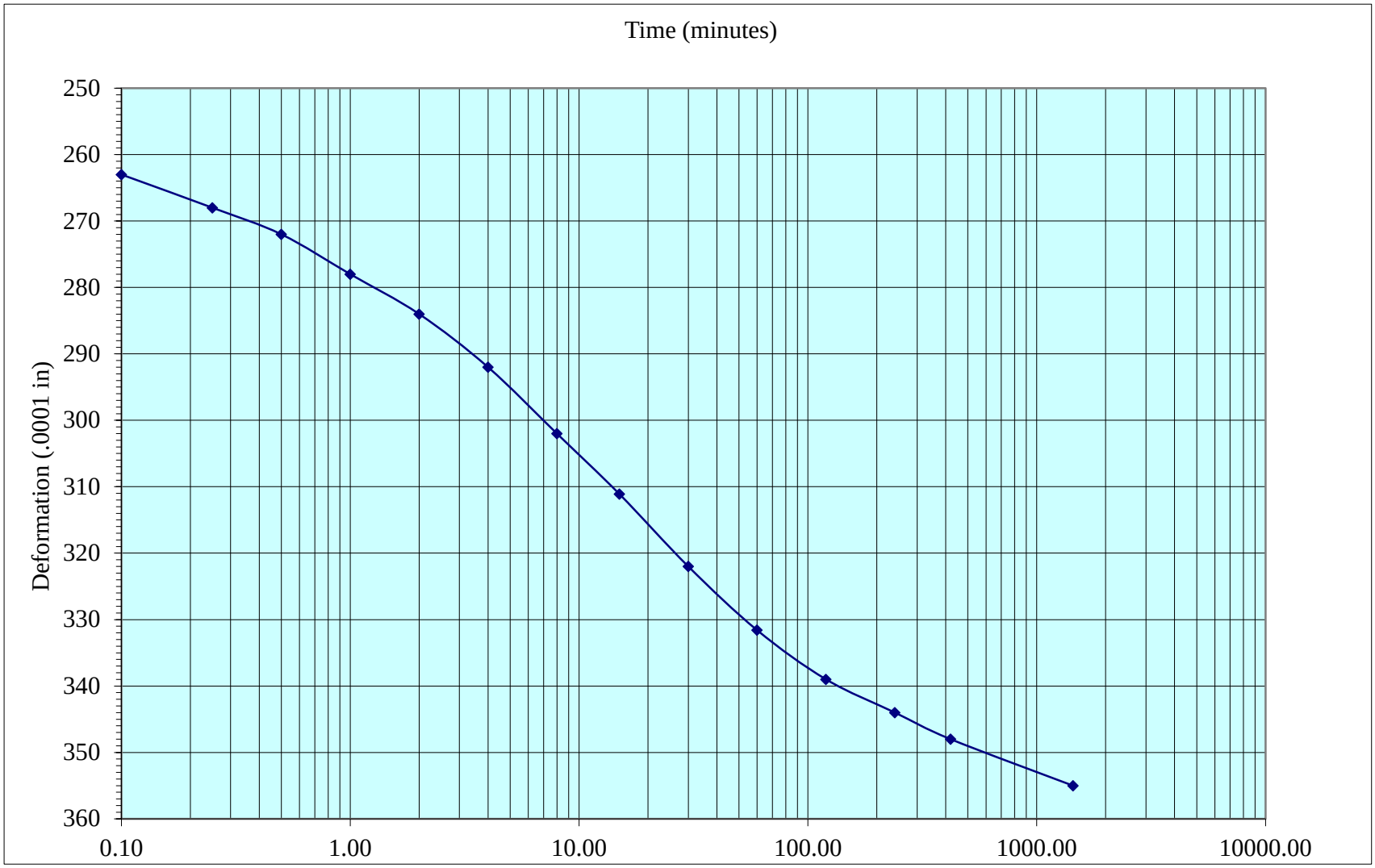
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4.1 Sample No. ST-2-4 Load No. 5 TSF 4



D-0= _____

D-50= _____

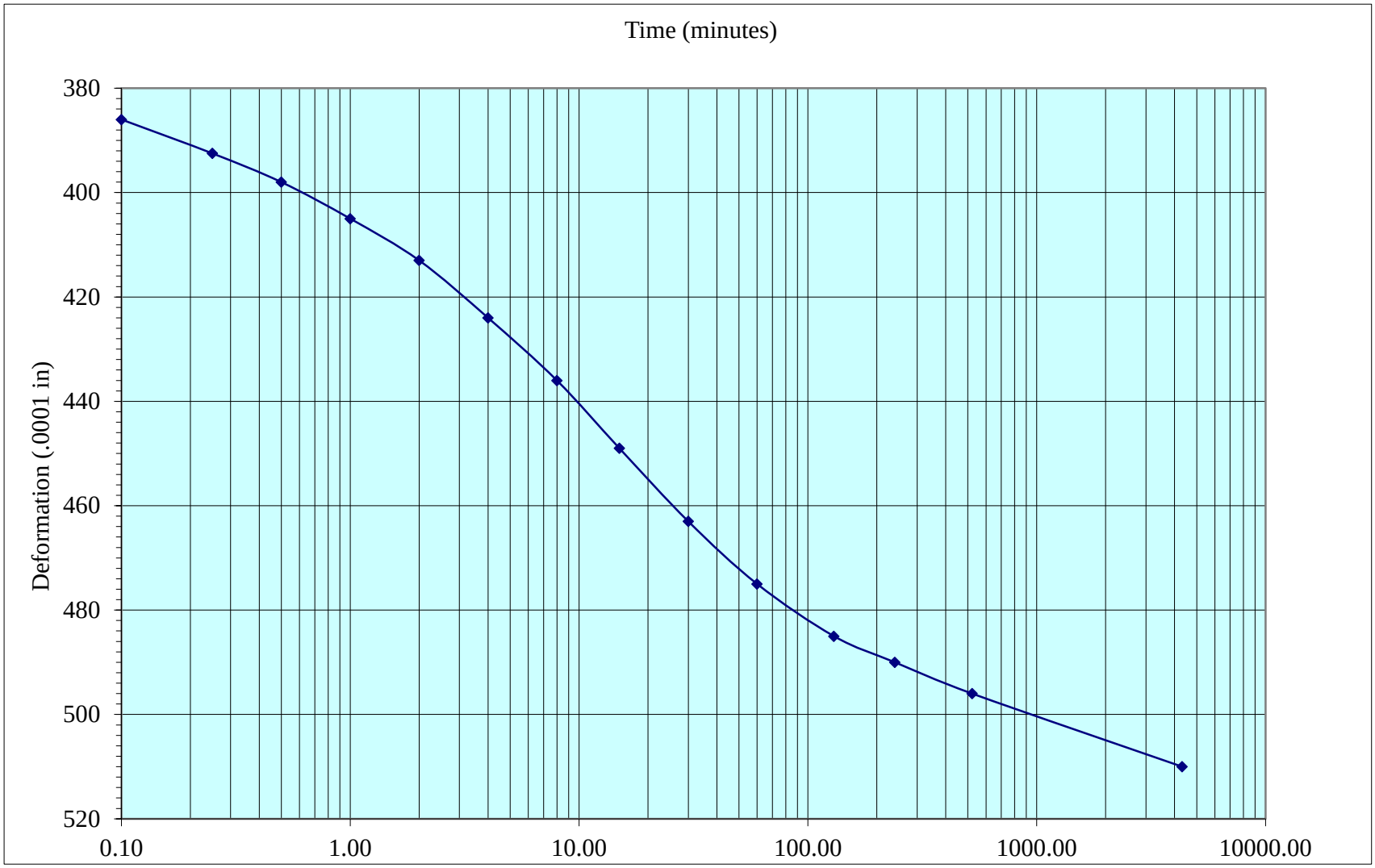
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4.1 Sample No. ST-2-4 Load No. 6 TSF 8



D-0= _____

D-50= _____

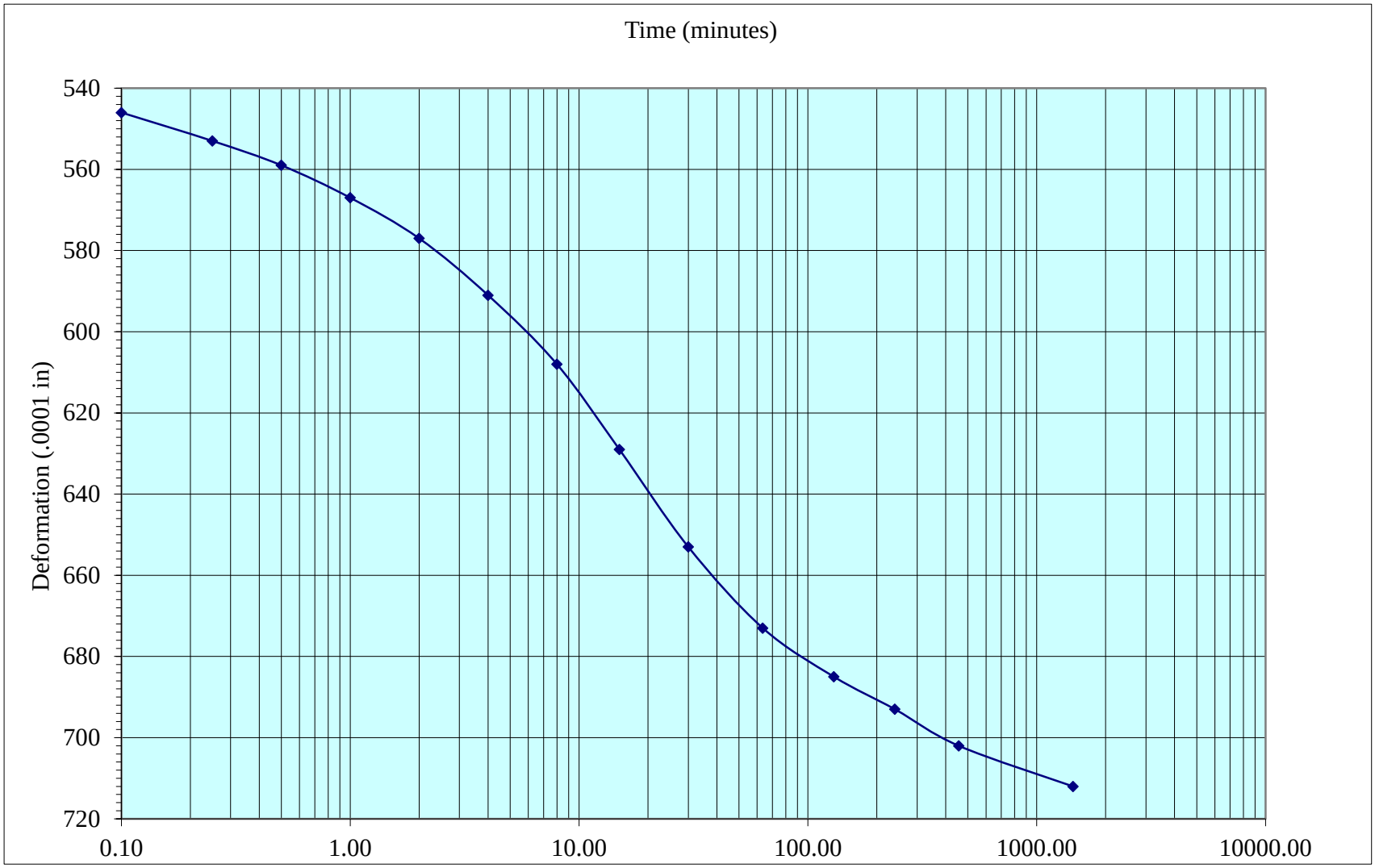
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4.1 Sample No. ST-2-4 Load No. 7 TSF 16



D-0= _____

D-50= _____

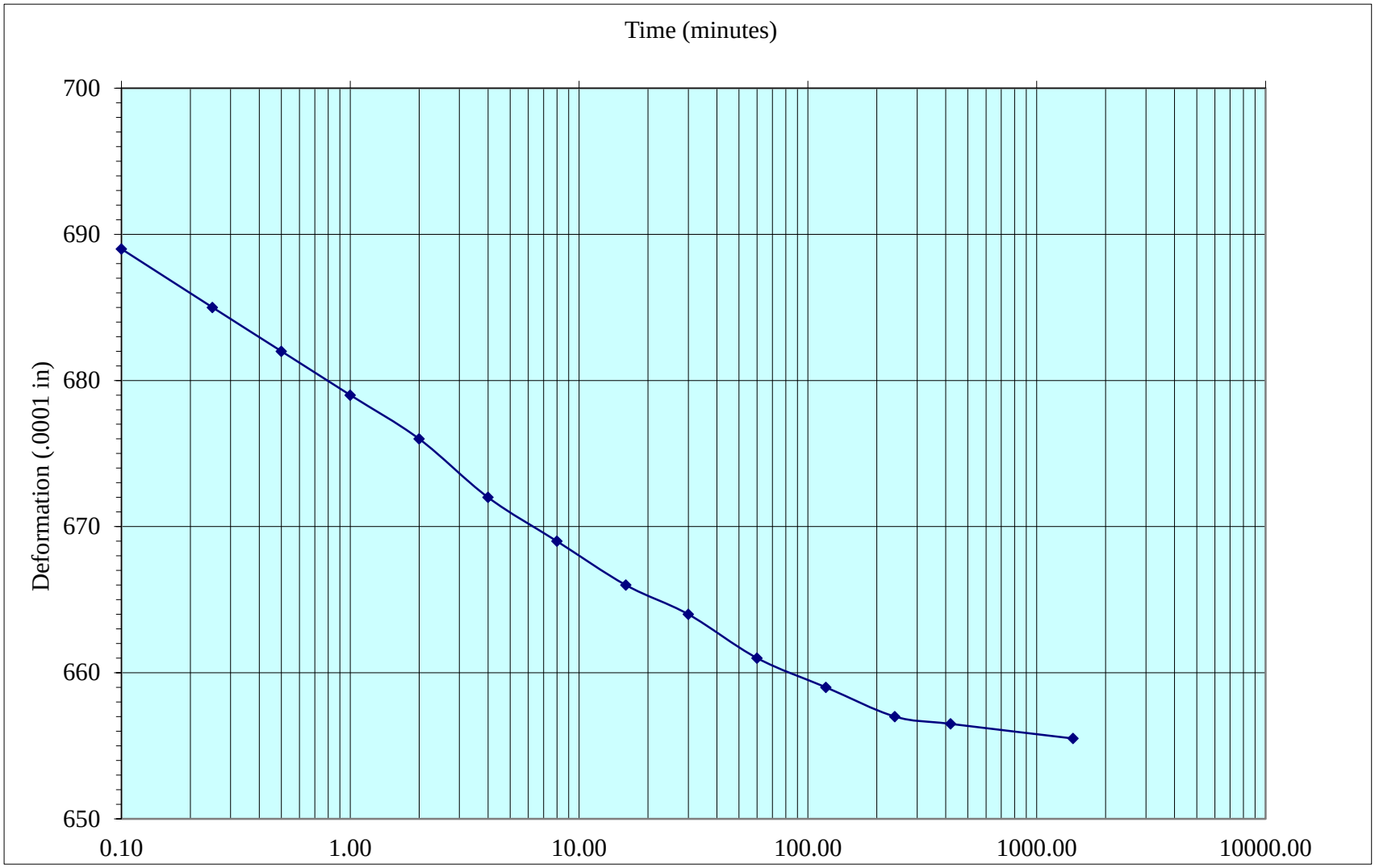
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4.1 Sample No. ST-2-4 Load No. 8 TSF 4



D-0= _____

D-50= _____

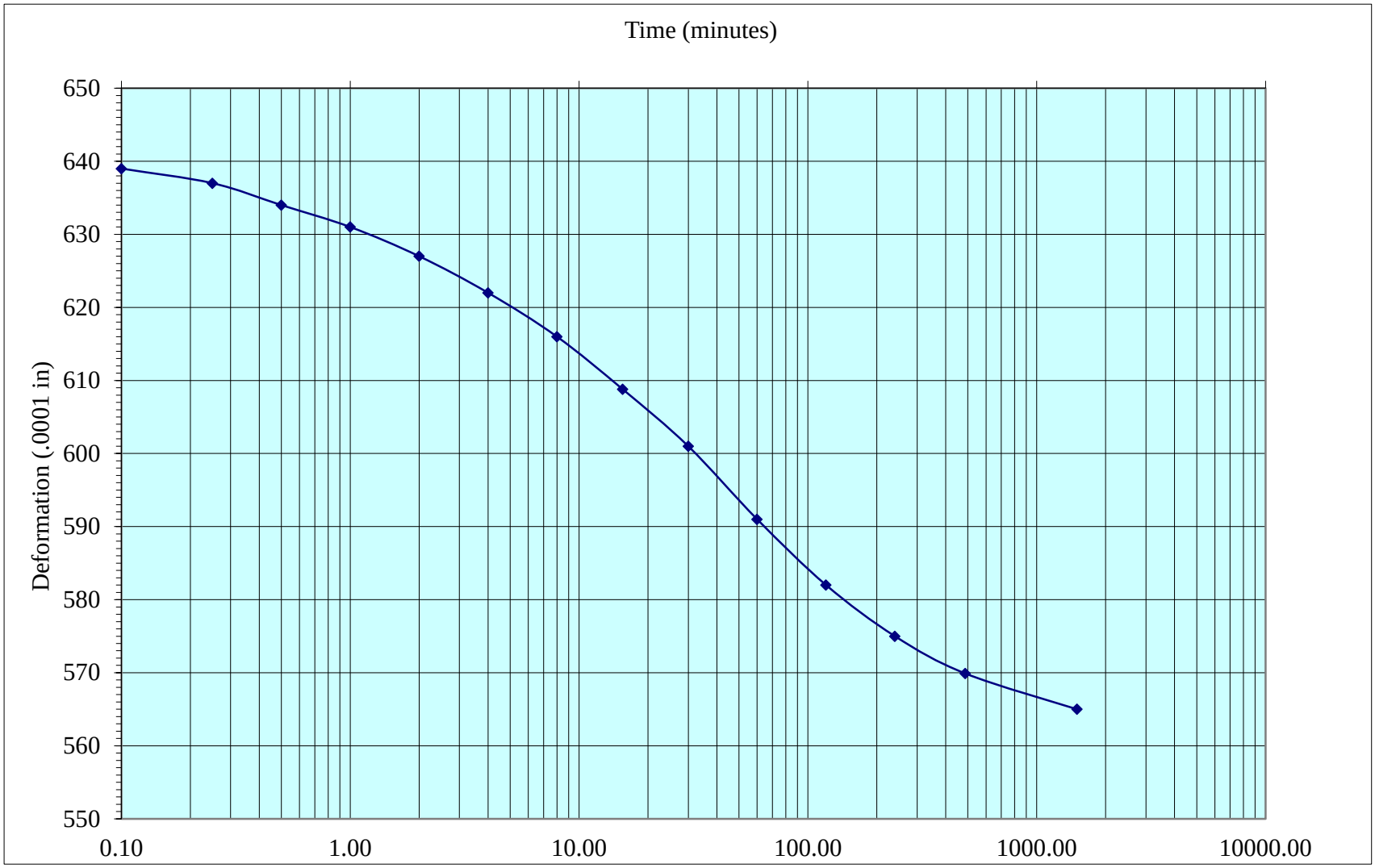
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4.1 Sample No. ST-2-4 Load No. 9 TSF 1



D-0= _____

D-50= _____

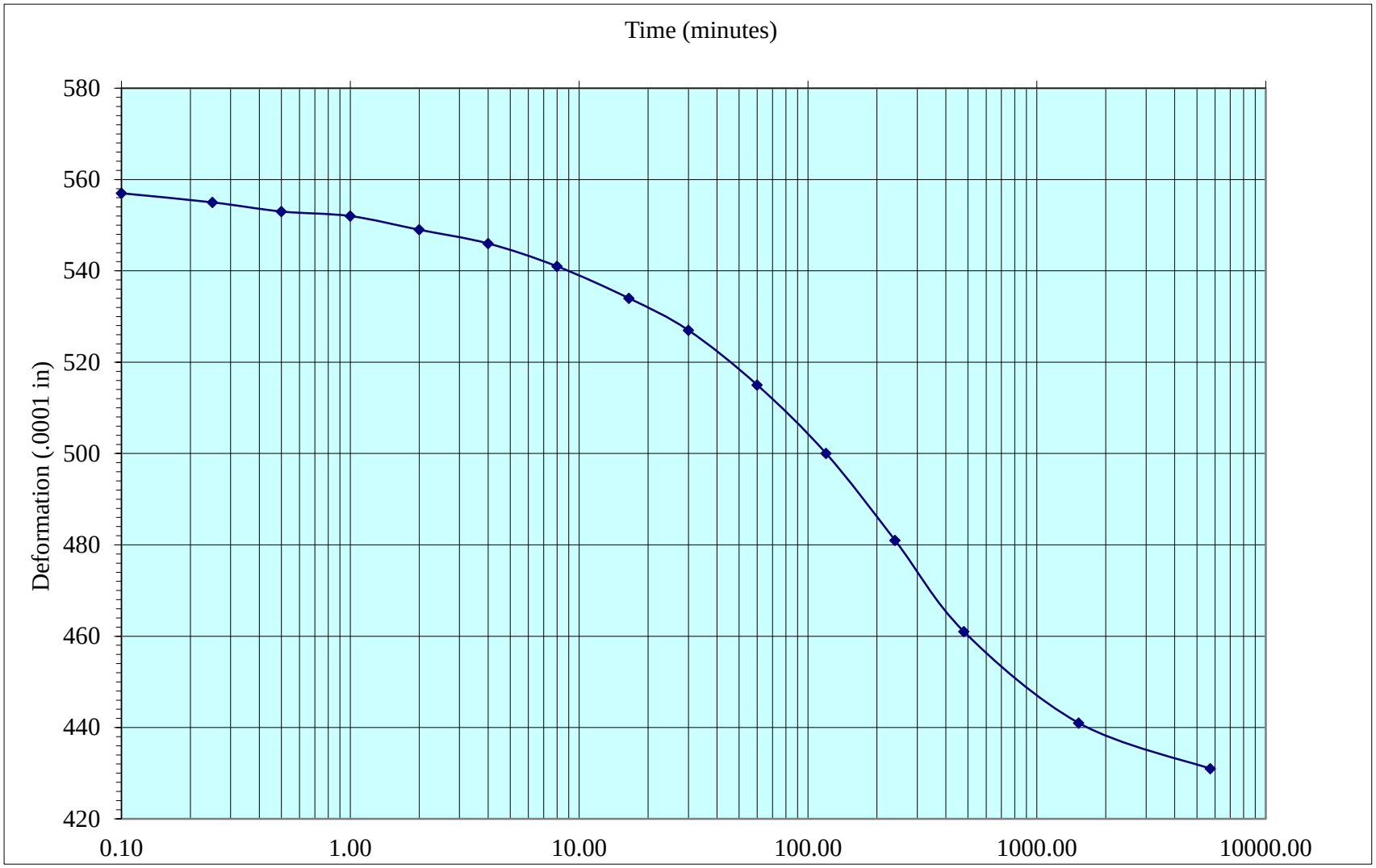
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-7-4.1 Sample No. ST-2-4 Load No. 10 TSF 0.25



D-0=

D-50=

D-100=

t-50=

CONSOLIDATION TEST

Project	I-70 3rd Lane			Client	TSi Geotechnical, Inc.	
Location	Columbia, Missouri			Tested By / Date	CMB	07/26/24
Job Number	113722-002			Calculated By / Date	CMB	08/08/24
Boring	BR-36-3A			Checked By / Date	DPM	8/8/2024
Sample	ST-2-2			File	113722-002 BR-36-3A ST-2-2 D2435	
Depth (ft)	3.5 - 4.0			Procedure	ASTM D2435	

	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.013	2.502	0.899	inches	Tare No.	C-1	
Measured Reading 2	1.009	2.500	0.896	inches	Tare Weight	2.39	
Measured Reading 3	1.010	2.501	0.910	inches	Wet Weight	105.03	
Measured Reading 4	1.013	2.498	0.908	inches	Dry Weight	84.46	
Average Reading	1.011	2.500	0.903	inches	M.C. %	25.1%	
Wet Weight + Ring	304.15		381.84	grams	*Trimmings #2*		
Weight of Ring	144.82	Dry Weight	356.82	grams	Tare No.	C-2	
Specific Gravity	2.75	Tare Weight	85.13	grams	Tare Weight	2.40	
Sample Volume	81.36		71.15	cm^3	Wet Weight	104.98	
Height of Solids	0.573		0.573	inches	Dry Weight	84.33	
Void Ratio	0.76		0.54		M.C. %	25.2%	
Saturation	92.1		100.0	percent	Ring Number	550	
Weight of Water	32.46		25.02	grams	Inundated @	0.25	tsf
Moisture Content	25.6		19.7	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	122.3		133.3	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	97.4		111.3	pcf	Method Used	(A) or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.884	inches

Load 1		Load 2		Load 3		Load 4	
Air Press.	1.6	Air Press.	2.2	Air Press.	3.7	Air Press.	6.8
Load, tsf	0.25	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	29	0.1	82	0.1	137	0.1	262
0.25	48	0.25	86	0.25	142	0.25	269
0.5	52	0.5	88	0.5	146	0.5	275
1	58	1	90	1	151	1	281
2	61	2	91	2	156	2	288
4	62	4	93	4	161	4	296
8	62	8	95	8	167	8	307
15	62	15	96	15	172	15	319
30	62	30	97	30	179	30	335
60	63	60	97	60	186	60	354
120	63	120	99	120	194	120	373
180	58	240	100	240	200	240	390
480		480	100	480	204	480	404
1440		1200	101	1440	210	1440	417

Load 5		Load 6		Load 7		Load 8	
Air Press.	3.7	Air Press.	2.2	Air Press.	3.7	Air Press.	6.8
Load, tsf	1.0	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	411	0.1	370	0.1	310	0.1	348
0.25	409	0.25	368	0.25	311	0.25	351
0.5	408	0.5	367	0.5	312	0.5	353
1	407	1	365	1	313	1	356
2	405	2	363	2	315	2	360
4	403	4	360	4	316	4	365
8	401	8	357	8	318	8	370
15	397	15	353	15	320	15	376
30	394	30	347	30	323	30	386
60	389	60	339	60	326	60	396
120	383	120	329	120	329	120	408
180	380	240	318	240	331	240	417
255	379	480	309	480		480	
1440		1185	302	1440		1440	

CONSOLIDATION TEST

Project	I-70 3rd Lane			Client		TSi Geotechnical, Inc.	
Location	Columbia, Missouri			Tested By / Date		CMB	07/26/24
Job Number	113722-002			Calculated By / Date		CMB	08/08/24
Boring	BR-36-3A			Checked By / Date		DPM	8/8/2024
Sample	ST-2-2			File		113722-002 BR-36-3A ST-2-2 D2435	
Depth (ft)	3.5 - 4.0			Procedure		ASTM D2435	
	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.013	2.502	0.899	inches	Tare No.	C-1	
Measured Reading 2	1.009	2.500	0.896	inches	Tare Weight	2.39	
Measured Reading 3	1.010	2.501	0.910	inches	Wet Weight	105.03	
Measured Reading 4	1.013	2.498	0.908	inches	Dry Weight	84.46	
Average Reading	1.011	2.500	0.903	inches	M.C. %	25.1%	
Wet Weight + Ring	304.15		381.84	grams	*Trimmings #2*		
Weight of Ring	144.82	Dry Weight	356.82	grams	Tare No.	C-2	
Specific Gravity	2.75	Tare Weight	85.13	grams	Tare Weight	2.40	
Sample Volume	81.36		71.15	cm^3	Wet Weight	104.98	
Height of Solids	0.573		0.573	inches	Dry Weight	84.33	
Void Ratio	0.76		0.54		M.C. %	25.2%	
Saturation	92.1		100.0	percent	Ring Number	550	
Weight of Water	32.46		25.02	grams	Inundated @	0.25	tsf
Moisture Content	25.6		19.7	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	122.3		133.3	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	97.4		111.3	pcf	Method Used	(A) or B	

Load 9		Load 10		Load 11	
Air Press.	12.8	Air Press.	25.2	Air Press.	50.2
Load, tsf	4.0	Load, tsf	8.0	Load, tsf	16.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	457	0.1	748	0.1	1063
0.25	463	0.25	754	0.25	1069
0.5	469	0.5	759	0.5	1074
1	475	1	764	1	1079
2	483	2	770	2	1087
4	491	4	779	4	1096
8	503	8	791	8	1109
15	516	15	804	15	1125
30	538	30	824	30	1149
60	564	60	852	60	1183
120	599	120	890	120	1228
240	638	240	938	240	1287
480	675	480	988	480	1354
1440	706	1440	1037	1440	1425

CONSOLIDATION TEST

Project	I-70 3rd Lane			Client	TSi Geotechnical, Inc.	
Location	Columbia, Missouri			Tested By / Date	CMB	07/26/24
Job Number	113722-002			Calculated By / Date	CMB	08/08/24
Boring	BR-36-3A			Checked By / Date	DCm	8/8/2024
Sample	ST-2-2			File	113722-002 BR-36-3A ST-2-2 D2435	
Depth (ft)	3.5 - 4.0			Procedure	ASTM D2435	
	Initial Data		*Final Data*			
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*	
Measured Reading 1	1.013	2.502	0.899	inches	Tare No.	C-1
Measured Reading 2	1.009	2.500	0.896	inches	Tare Weight	2.39
Measured Reading 3	1.010	2.501	0.910	inches	Wet Weight	105.03
Measured Reading 4	1.013	2.498	0.908	inches	Dry Weight	84.46
Average Reading	1.011	2.500	0.903	inches	M.C. %	25.1%
Wet Weight + Ring	304.15		381.84	grams	*Trimmings #2*	
Weight of Ring	144.82	Dry Weight	356.82	grams	Tare No.	C-2
Specific Gravity	2.75	Tare Weight	85.13	grams	Tare Weight	2.40
Sample Volume	81.36		71.15	cm^3	Wet Weight	104.98
Height of Solids	0.573		0.573	inches	Dry Weight	84.33
Void Ratio	0.76		0.54		M.C. %	25.2%
Saturation	92.1		100.0	percent	Ring Number	550
Weight of Water	32.46		25.02	grams	Inundated @	0.25 tsf
Moisture Content	25.6		19.7	percent	Trimming Method	Cutting Shoe
Wet Unit Weight	122.3		133.3	pcf	[Cutting Shoe / Turntable / None (Ring)]	
Dry Unit Weight	97.4		111.3	pcf	Method Used	(A) or B

CALIBRATION OF CONSOLIDATION DEFORMATION

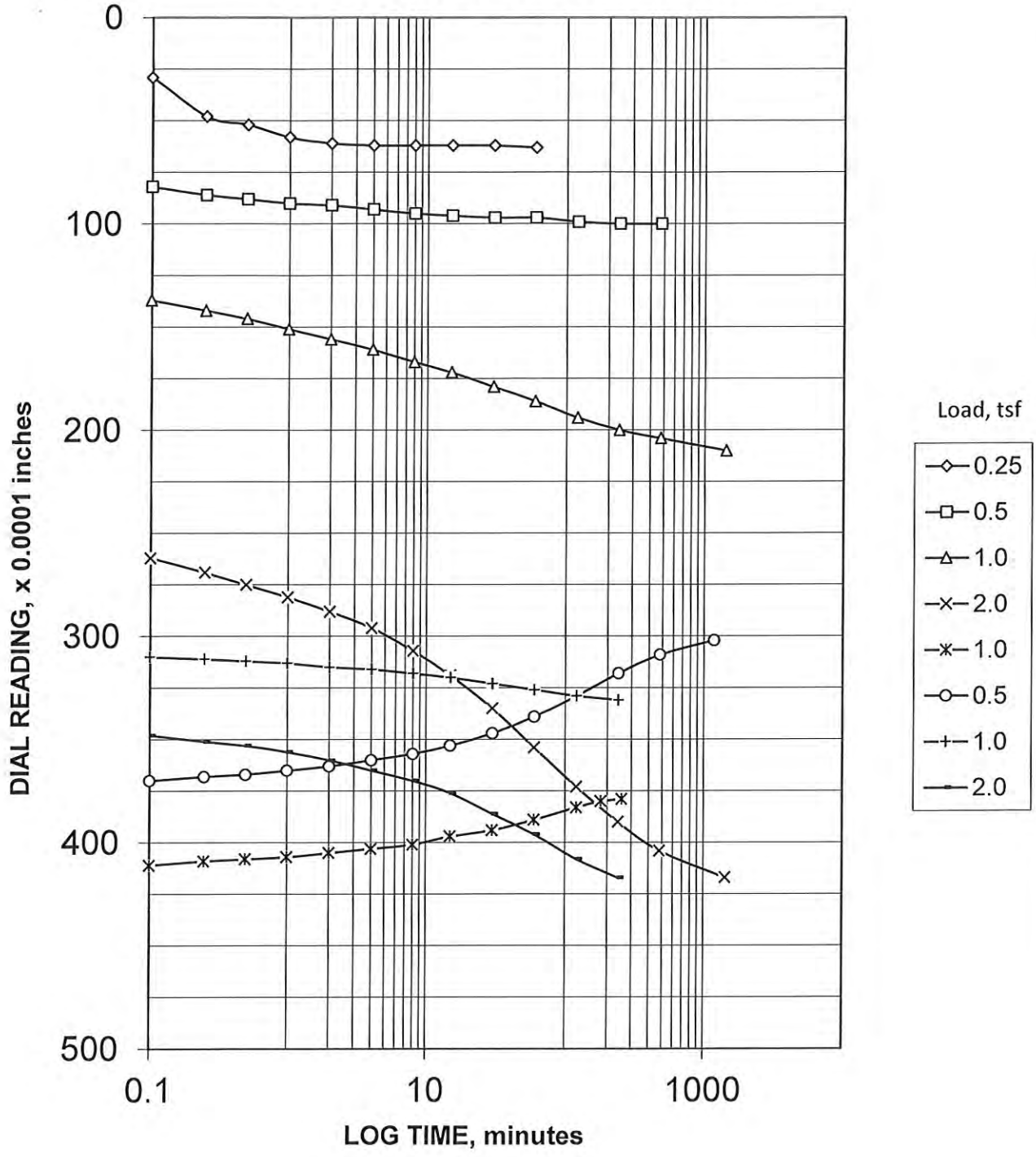
Procedure SWCP-15 (Reference ASTM D2435 AASHTO T216)

Equipment Calibrated:	Consolidation Deformation	Date Calibrated:	08/07/24
Reason for Calibration:	Test Completion	Next Calibration Due:	Next Test
Equipment Used:	Consolidation Appartus	Calibrated By:	CMB
	Steel Calibration Disk	Checked By:	CMB

Machine Number: 550

Load tsf	Machine Def x 10^{-4}	Correction Factor x 10^{-4}	U-100 x 10^{-4}	Corr. U-100 x 10^{-4}	Compression, Percent	C_v	Void Ratio
0.01	0	0	0	0	0.00%	0	0.76
0.25	16	0	62.0	46	0.46%	1.5E+00	0.76
0.5	26	0	89.0	63	0.63%	2.4E+00	0.75
1.0	45	0	200.0	155	1.55%	6.9E-02	0.74
2.0	75	0	398.0	323	3.23%	2.3E-02	0.71
1.0	69	19	380.0	292	2.92%	NA	0.71
0.5	63	19	311.0	229	2.29%	NA	0.72
1.0	65	19	329.0	245	2.45%	NA	0.72
2.0	77	19	408.0	312	3.12%	NA	0.71
4.0	102	0	675.0	573	5.73%	8.3E-03	0.66
8.0	132	0	988.0	856	8.56%	5.8E-03	0.61
16.0	156	0	1354.0	1198	11.98%	4.9E-03	0.55

CONSOLIDATION TEST



I-70 3rd Lane
Columbia, Missouri

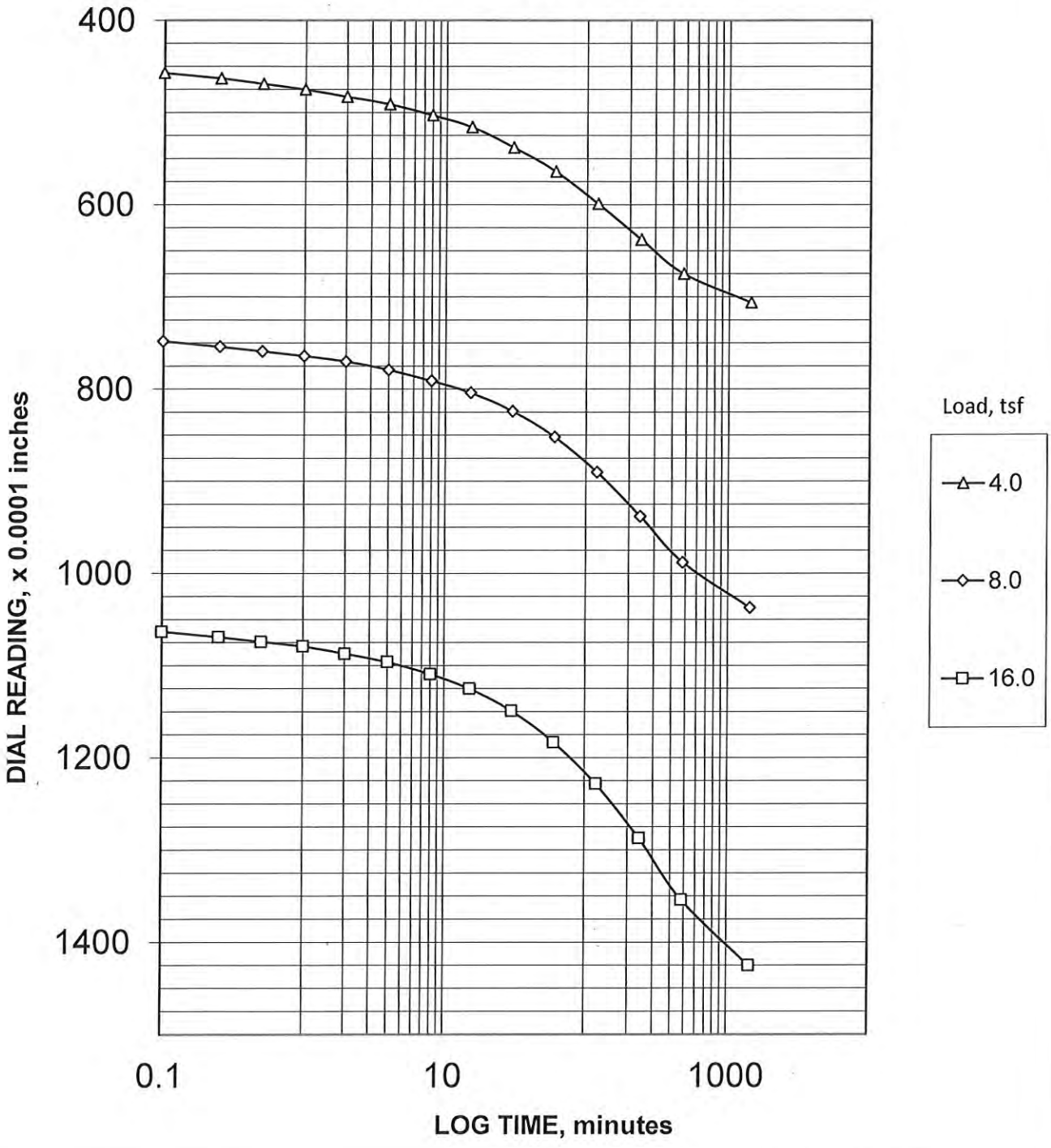
TIME PLOTS
BR-36-3A
ST-2-2

July 2024 113722-002

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FIG.

CONSOLIDATION TEST



I-70 3rd Lane
Columbia, Missouri

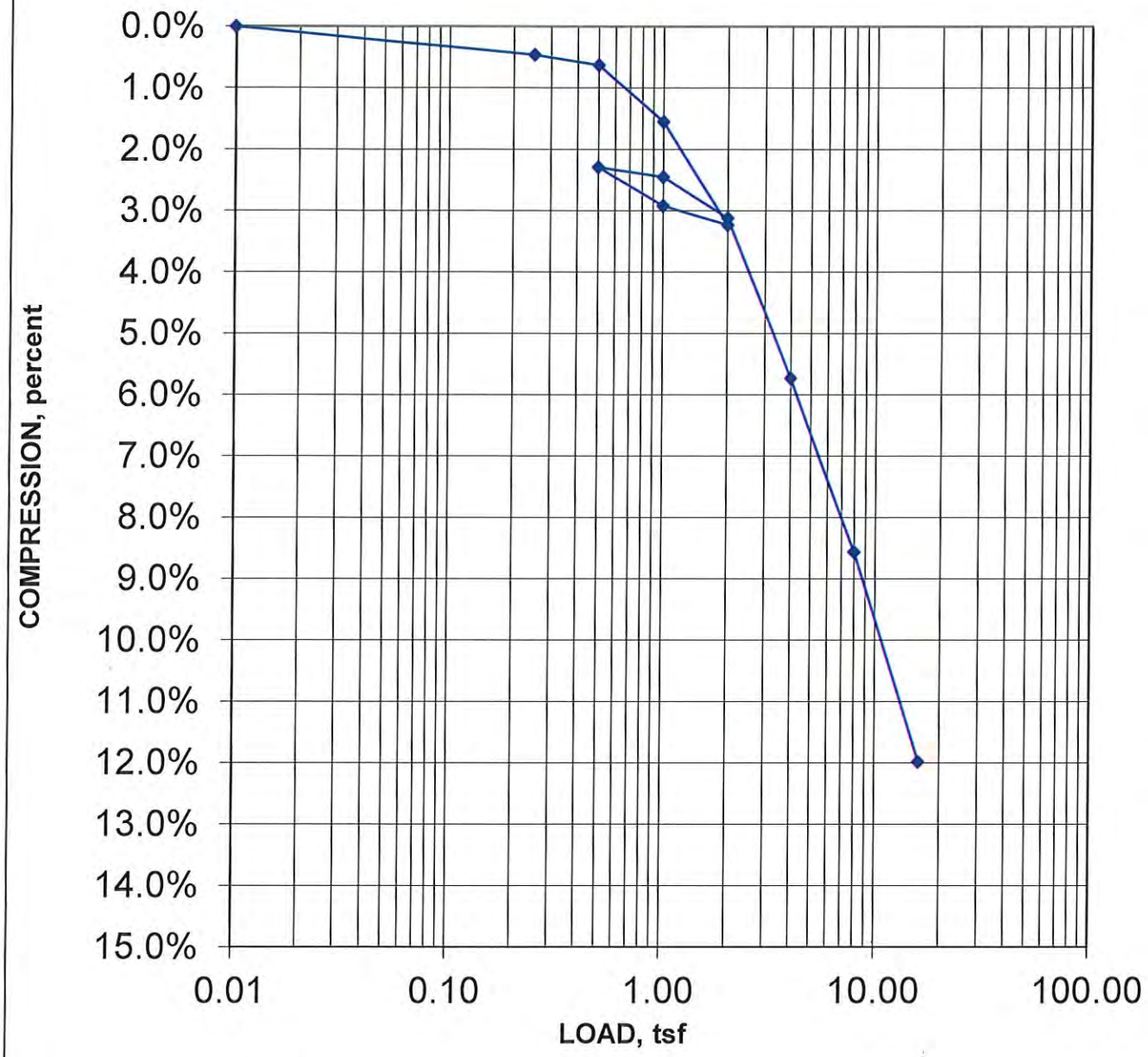
TIME PLOTS
BR-36-3A
ST-2-2

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FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.25	1.5E+00	2.0	NA
0.5	2.4E+00	4.0	8.3E-03
1.0	6.9E-02	8.0	5.8E-03
2.0	2.3E-02	16.0	4.9E-03
1.0	NA		
0.5	NA		
1.0	NA		

I-70 3rd Lane
Columbia, Missouri

SETTLEMENT PLOTS

BR-36-3A

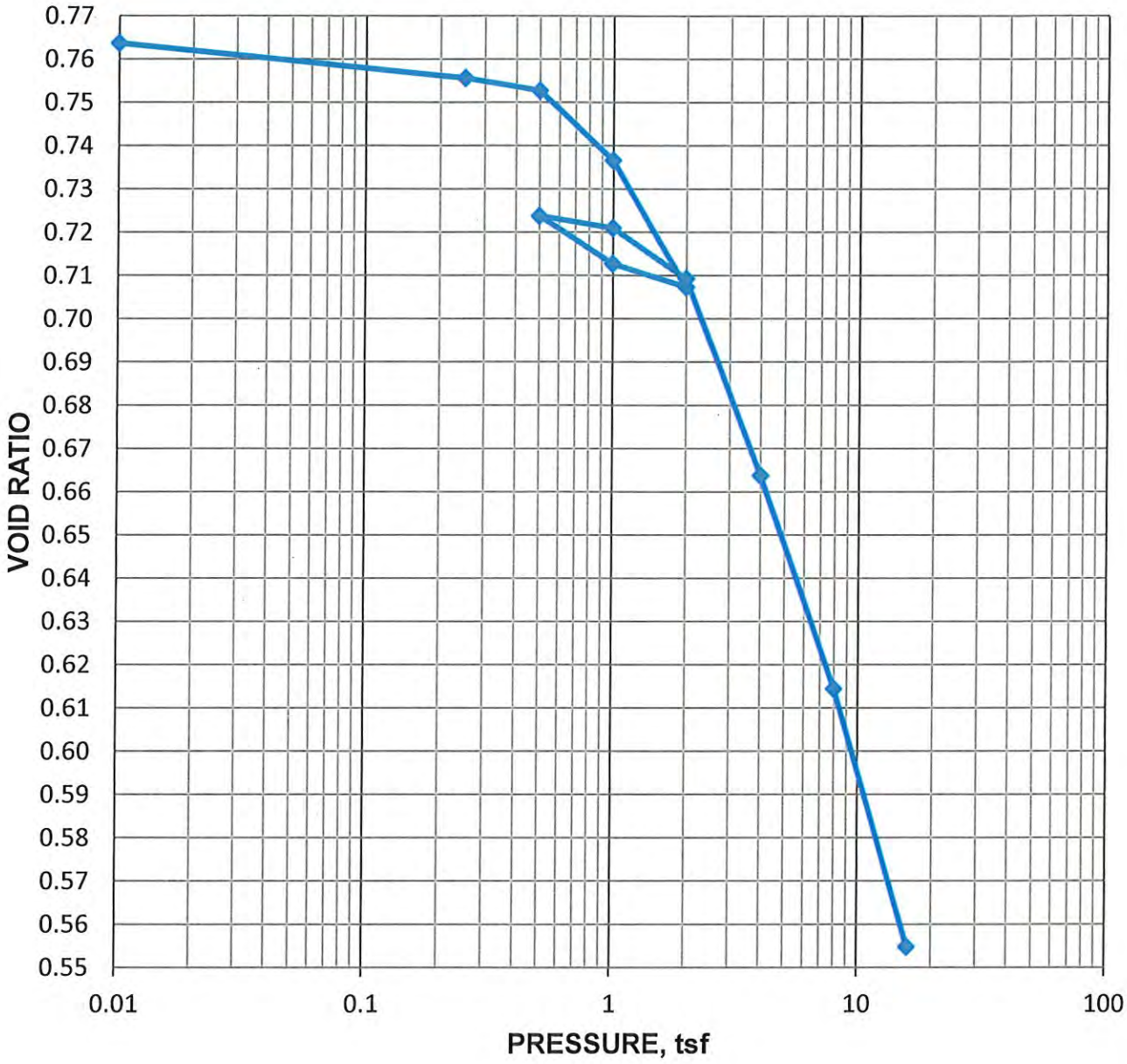
ST-2-2

July 2024 113722-002

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FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.25	1.5E+00	2.0	NA
0.5	2.4E+00	4.0	8.3E-03
1.0	6.9E-02	8.0	5.8E-03
2.0	2.3E-02	16.0	4.9E-03
1.0	NA		
0.5	NA		
1.0	NA		

I-70 3rd Lane
Columbia, Missouri

VOID RATIO PLOT

BR-36-3A

ST-2-2

July 2024 113722-002

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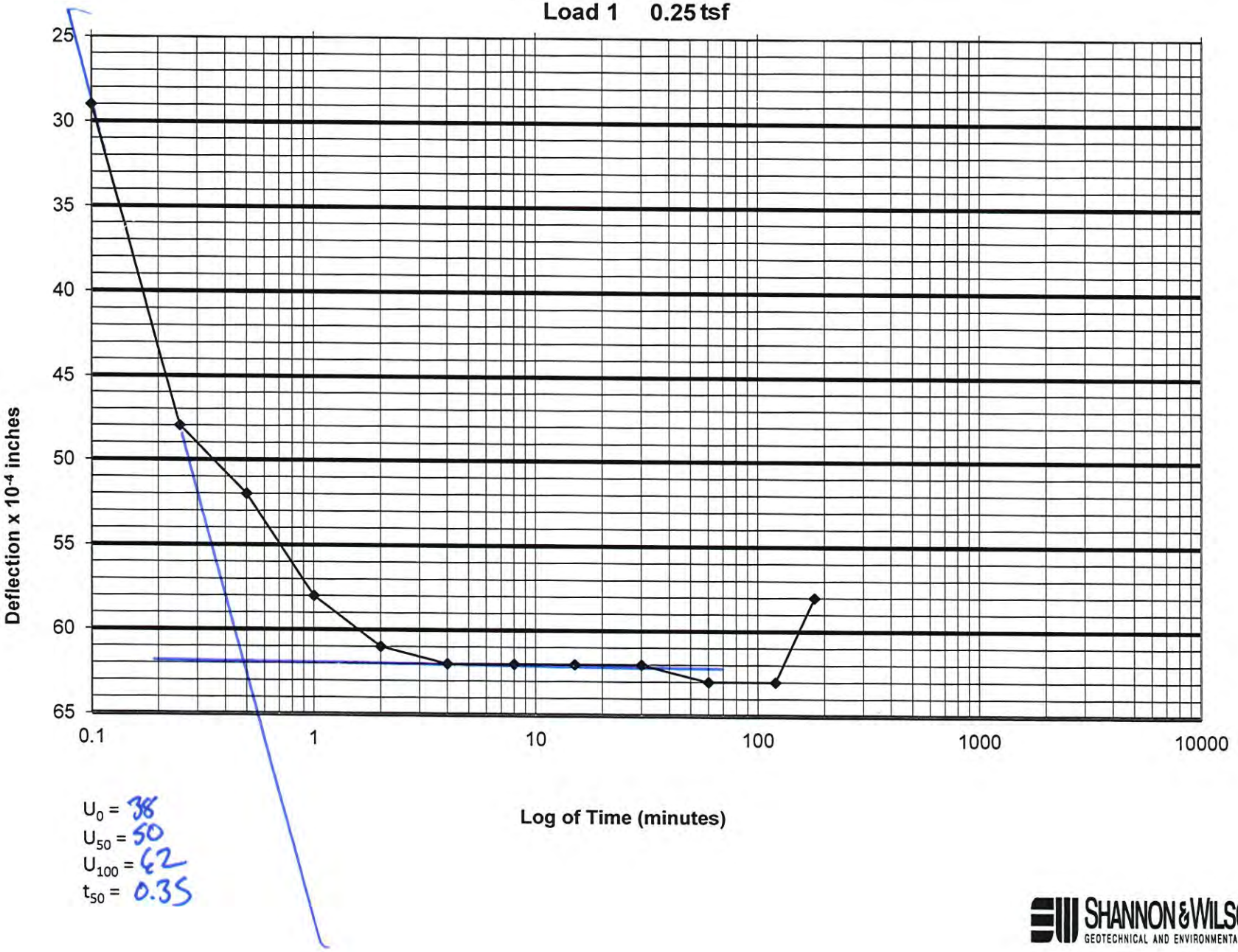
FIG.

I-70 3rd Lane

113722-002

BR-36-3A ST-2-2

Load 1 0.25 tsf



U_0 = 38
U_{50} = 50
U_{100} = 62
t_{50} = 0.35

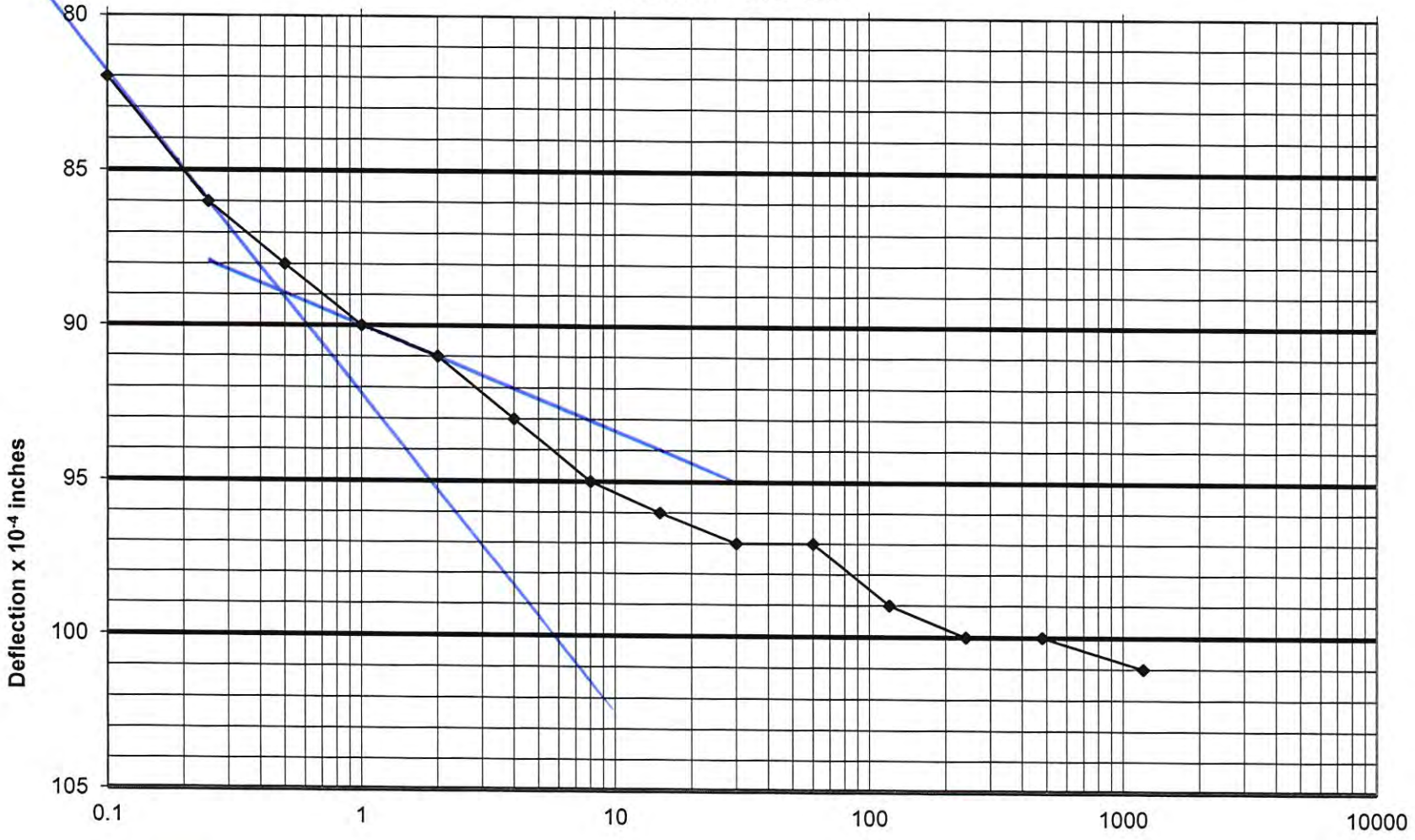
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I-70 3rd Lane

113722-002

BR-36-3A ST-2-2

Load 2 0.5 tsf



U_0 = 82

U_{50} = 86

U_{100} = 89

t_{50} = 0.22

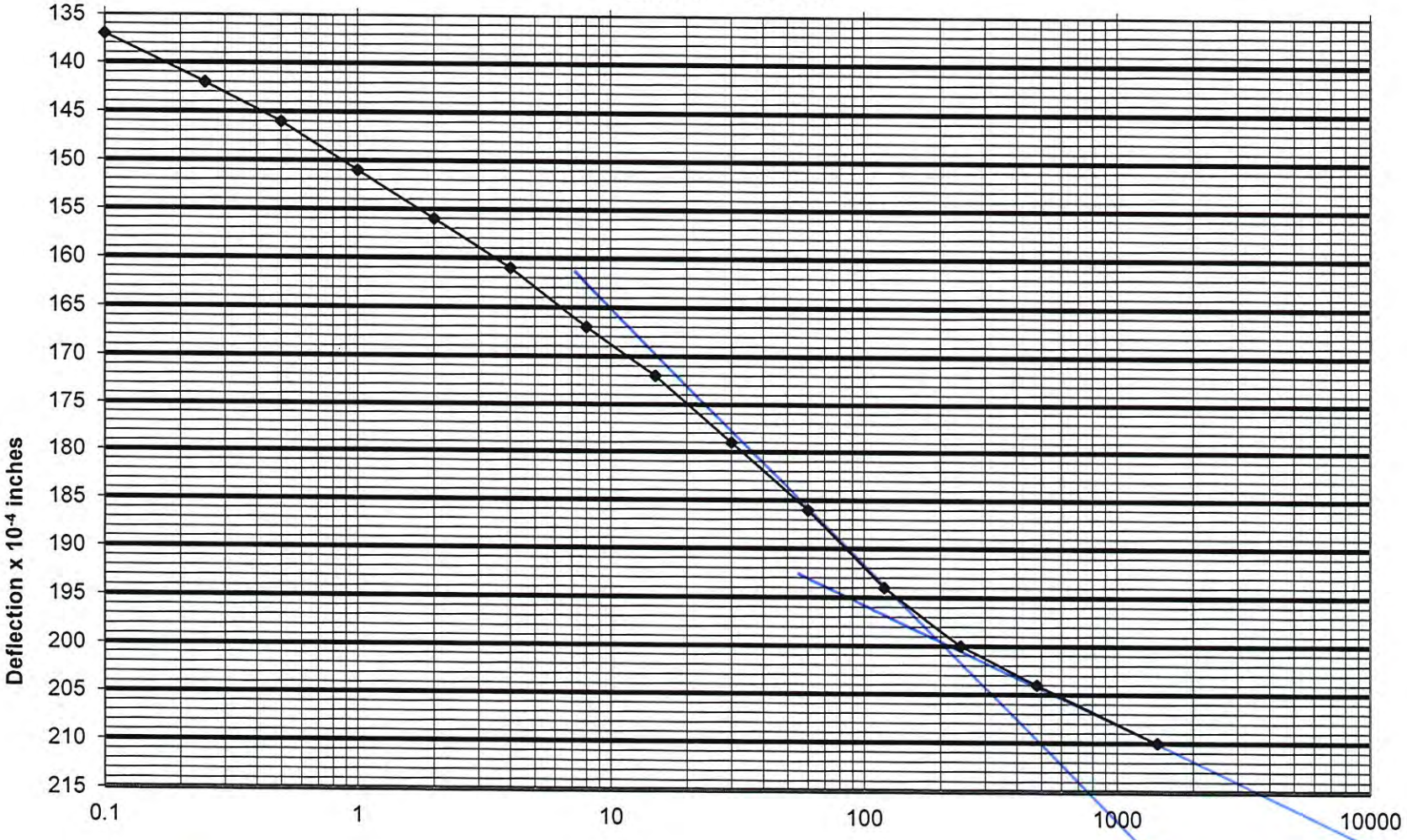
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I-70 3rd Lane

113722-002

BR-36-3A ST-2-2

Load 3 1.0 tsf



U_0 = 133

U_{50} = 167

U_{100} = 200

t_{50} = 7.55

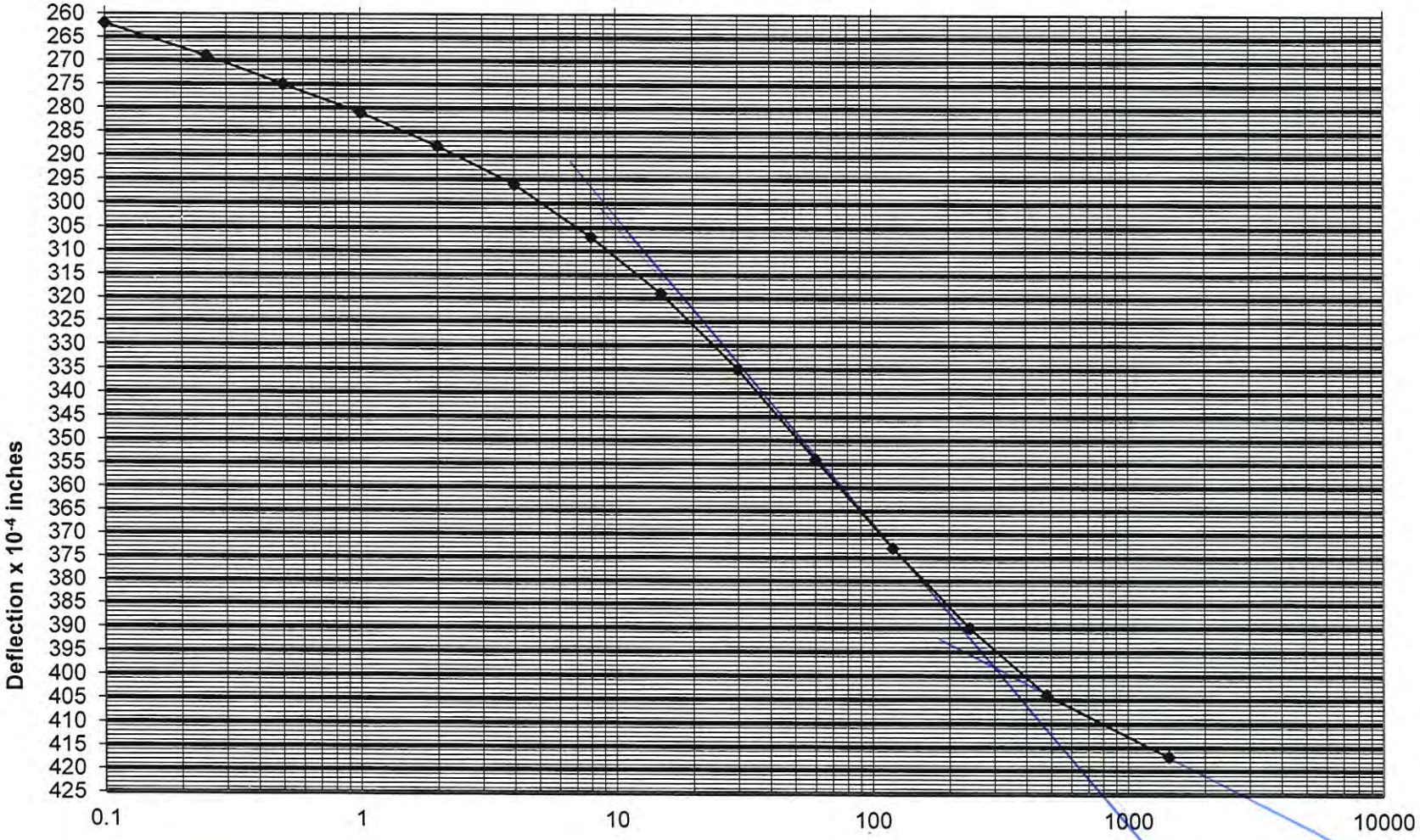
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I-70 3rd Lane

113722-002

BR-36-3A ST-2-2

Load 4 2.0 tsf



U_0 = 257

U_{50} = 328

U_{100} = 398

t_{50} = 21.68

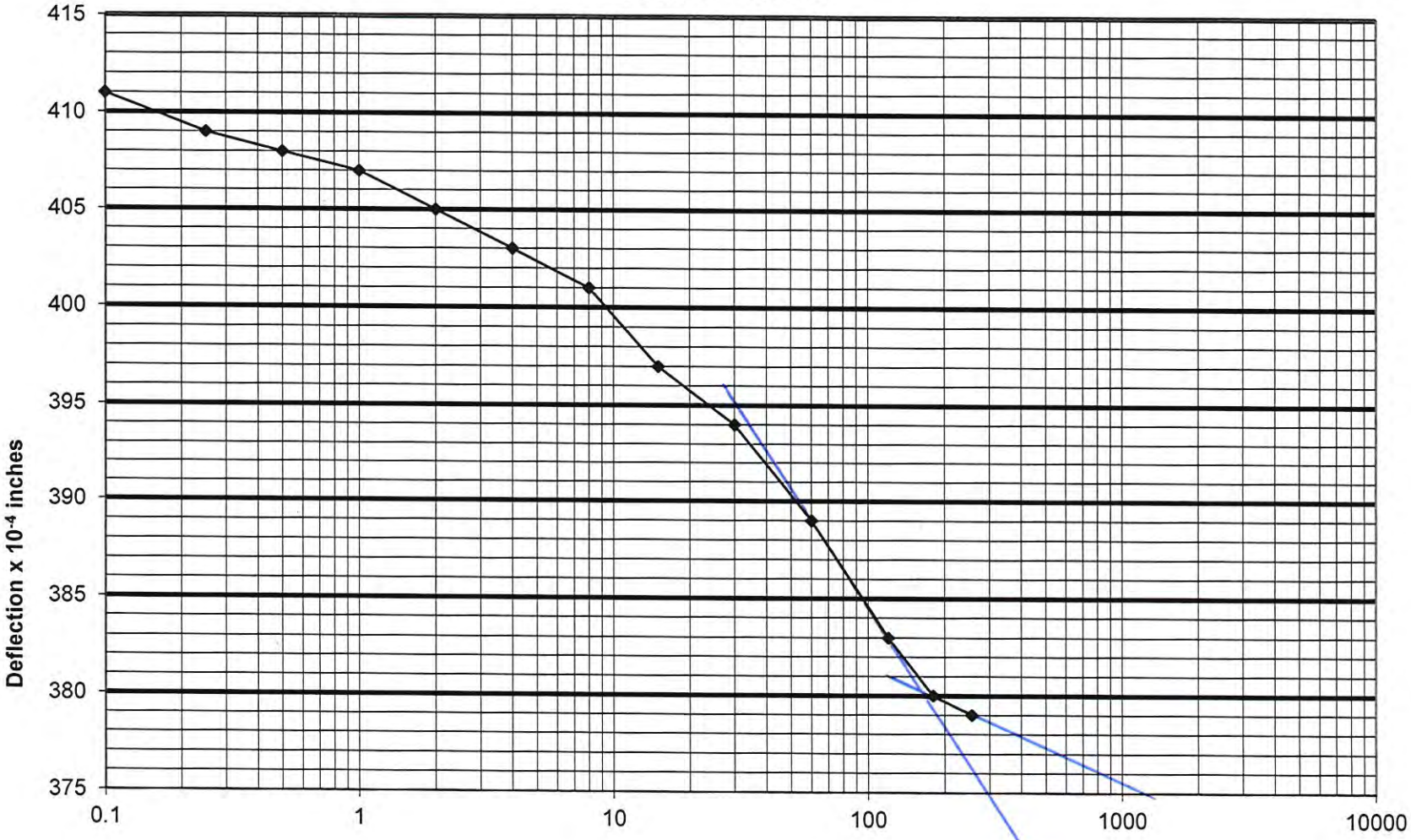
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I-70 3rd Lane

113722-002

BR-36-3A ST-2-2

Load 5 1.0 tsf



U_0 = —

U_{50} = —

U_{100} = 380

t_{50} = —

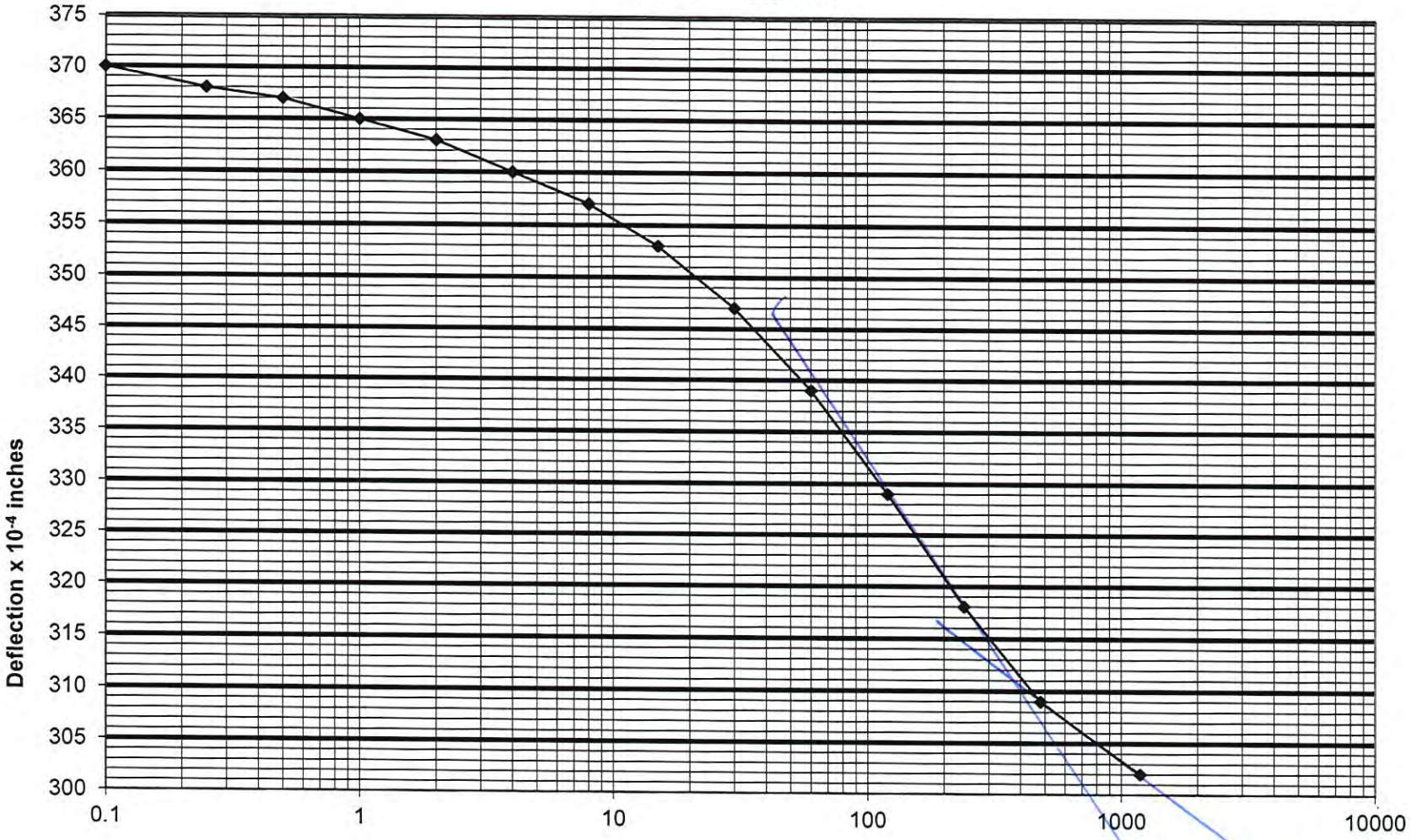
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I-70 3rd Lane

113722-002

BR-36-3A ST-2-2

Load 6 0.5 tsf



U_0 = —

U_{50} = —

U_{100} = 311

t_{50} = —

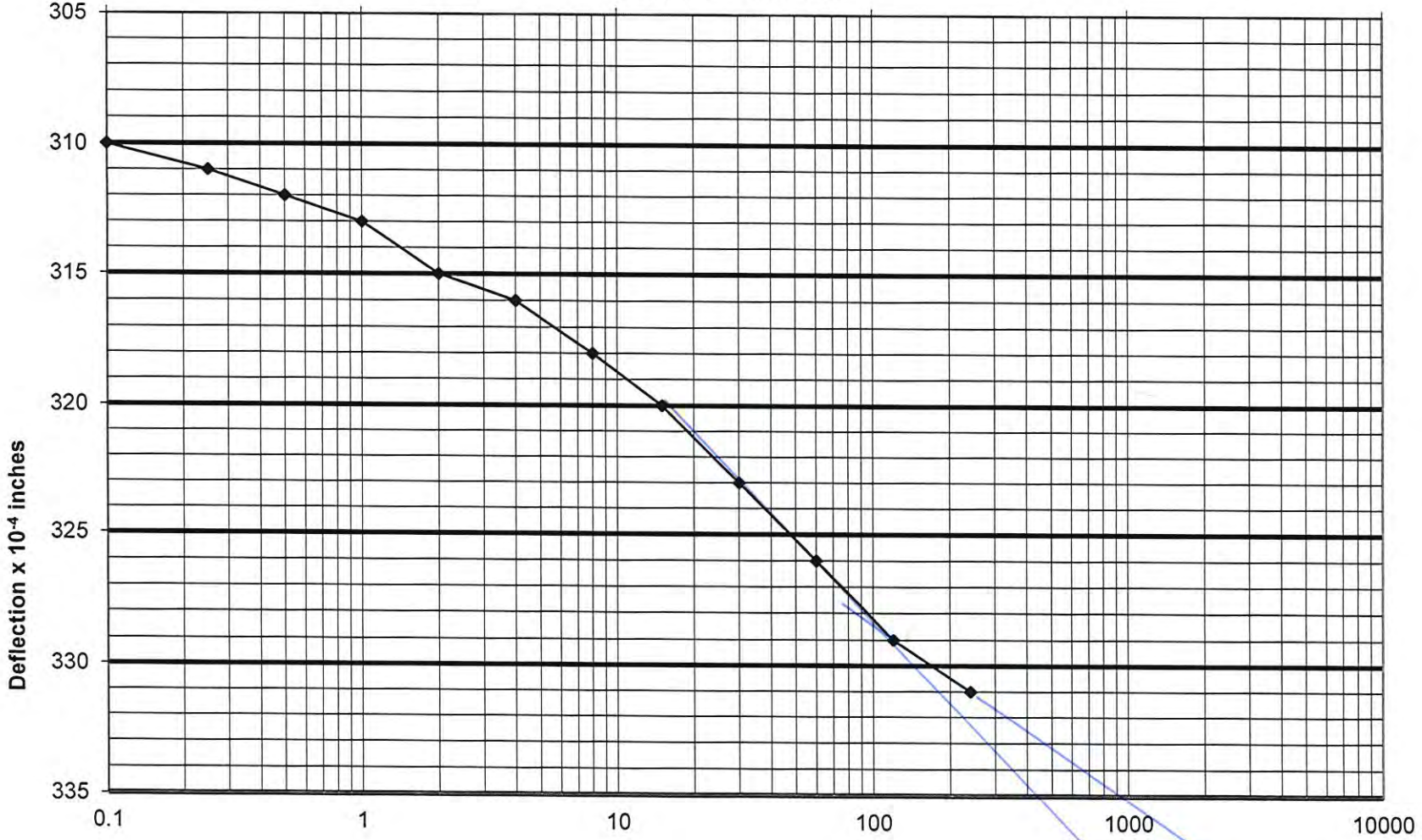
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I-70 3rd Lane

113722-002

BR-36-3A ST-2-2

Load 7 1.0 tsf



U_0 = —

U_{50} = —

U_{100} = 329

t_{50} =

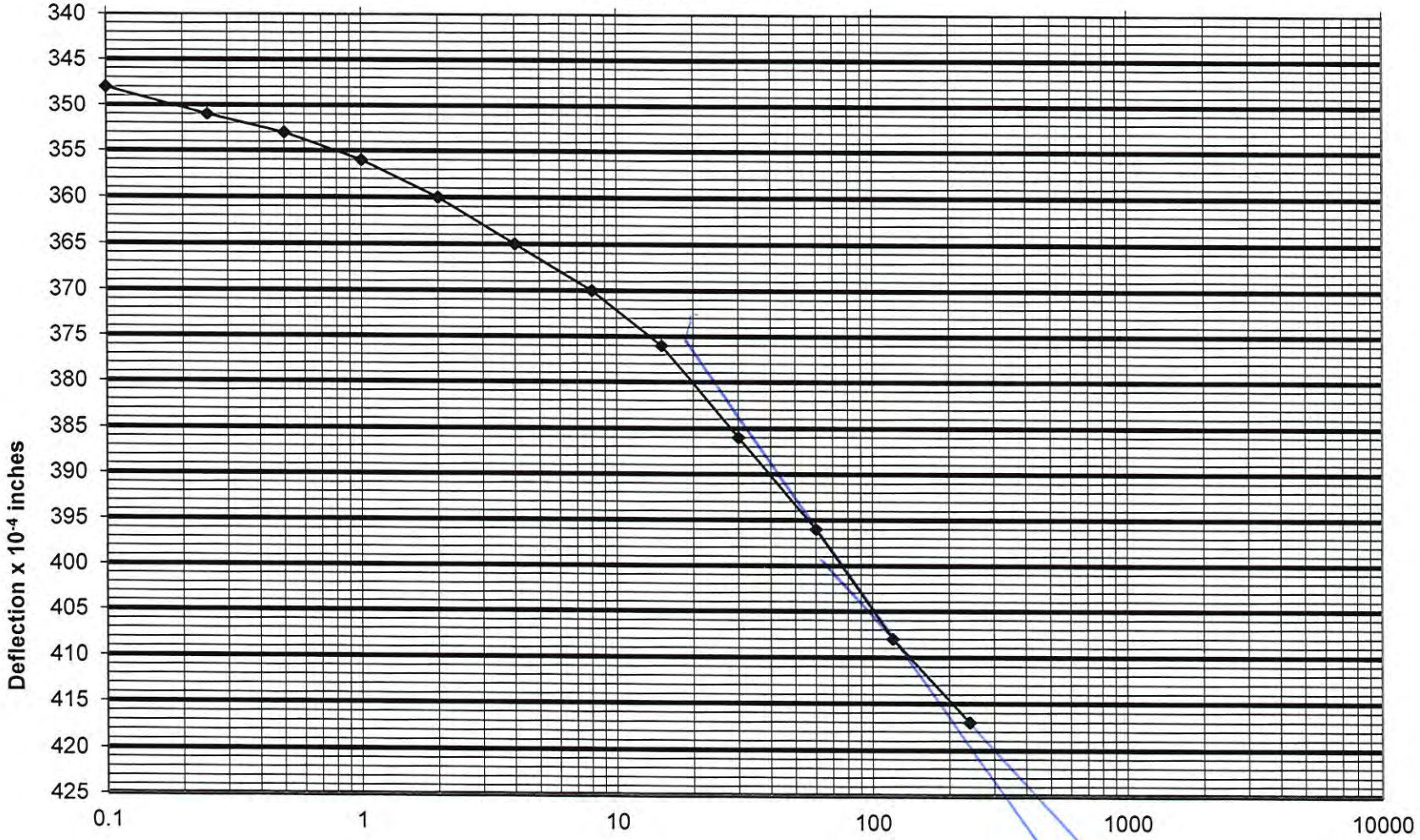
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I-70 3rd Lane

113722-002

BR-36-3A ST-2-2

Load 8 2.0 tsf



U_0 = —

U_{50} = —

U_{100} = 408

t_{50} = —

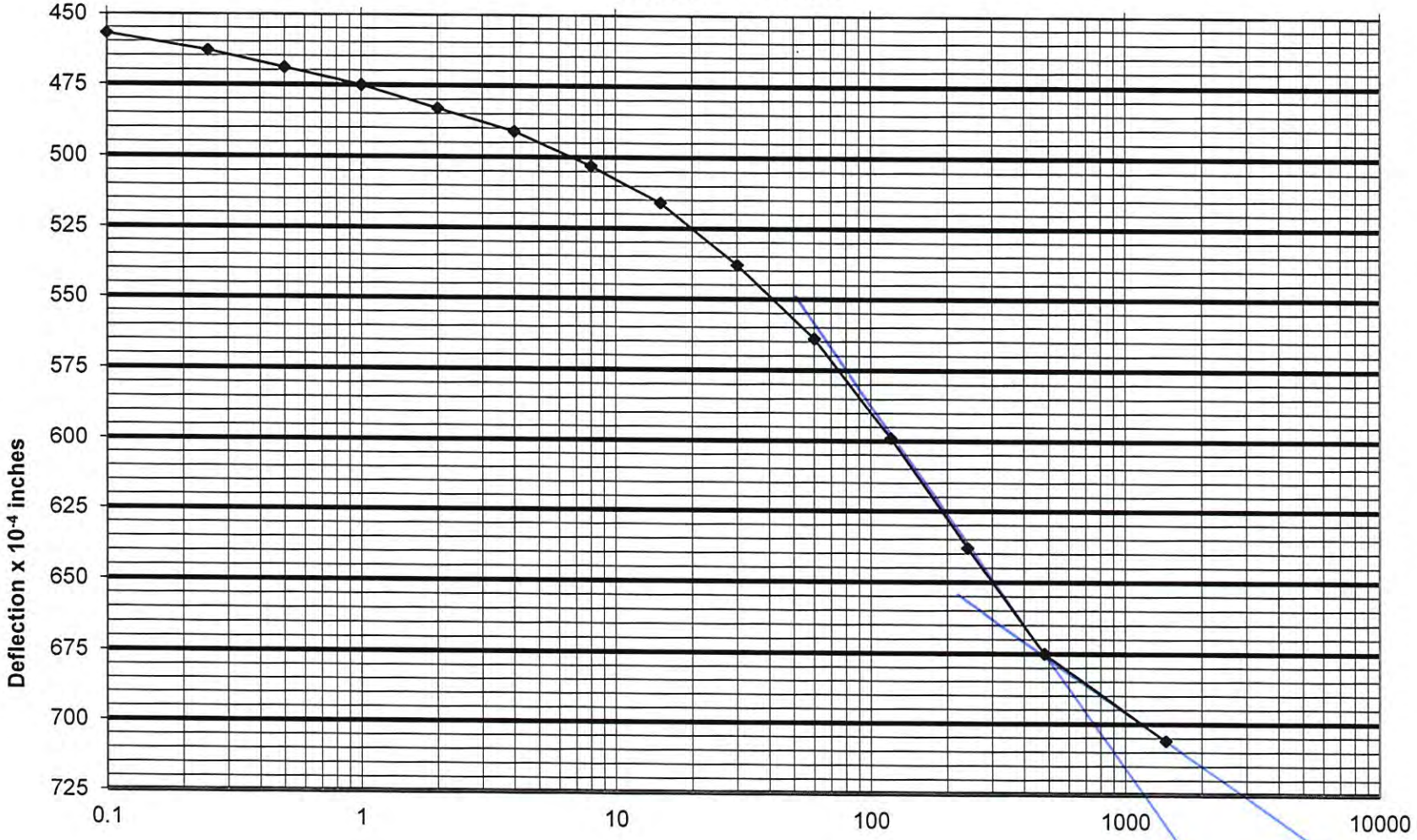
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I-70 3rd Lane

113722-002

BR-36-3A ST-2-2

Load 9 4.0 tsf



U_0 = 451
U_{50} = 563
U_{100} = 675
t_{50} = 58.42

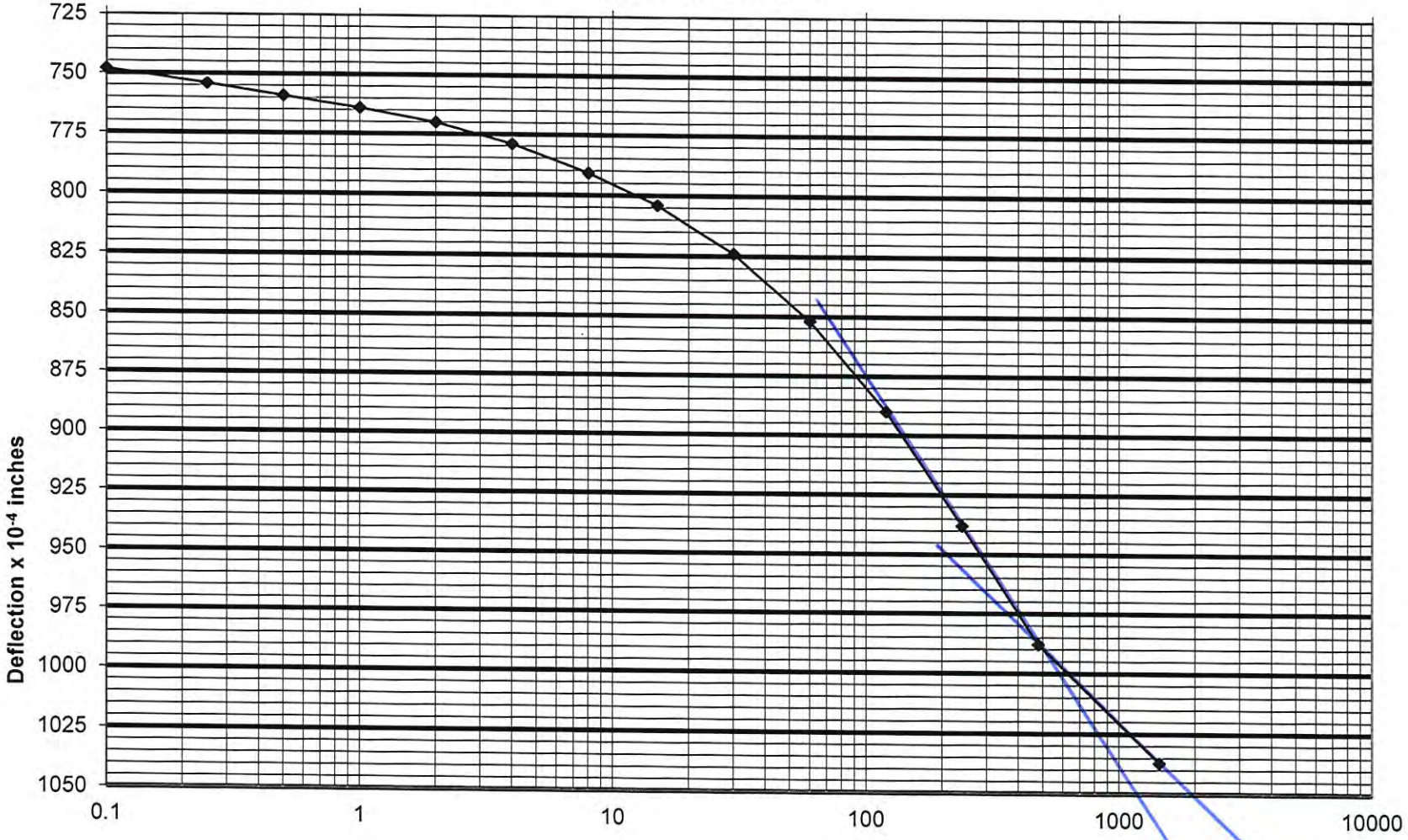
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I-70 3rd Lane

113722-002

BR-36-3A ST-2-2

Load 10 8.0 tsf



U_0 = 744

U_{50} = 866

U_{100} = 988

t_{50} = 77.46

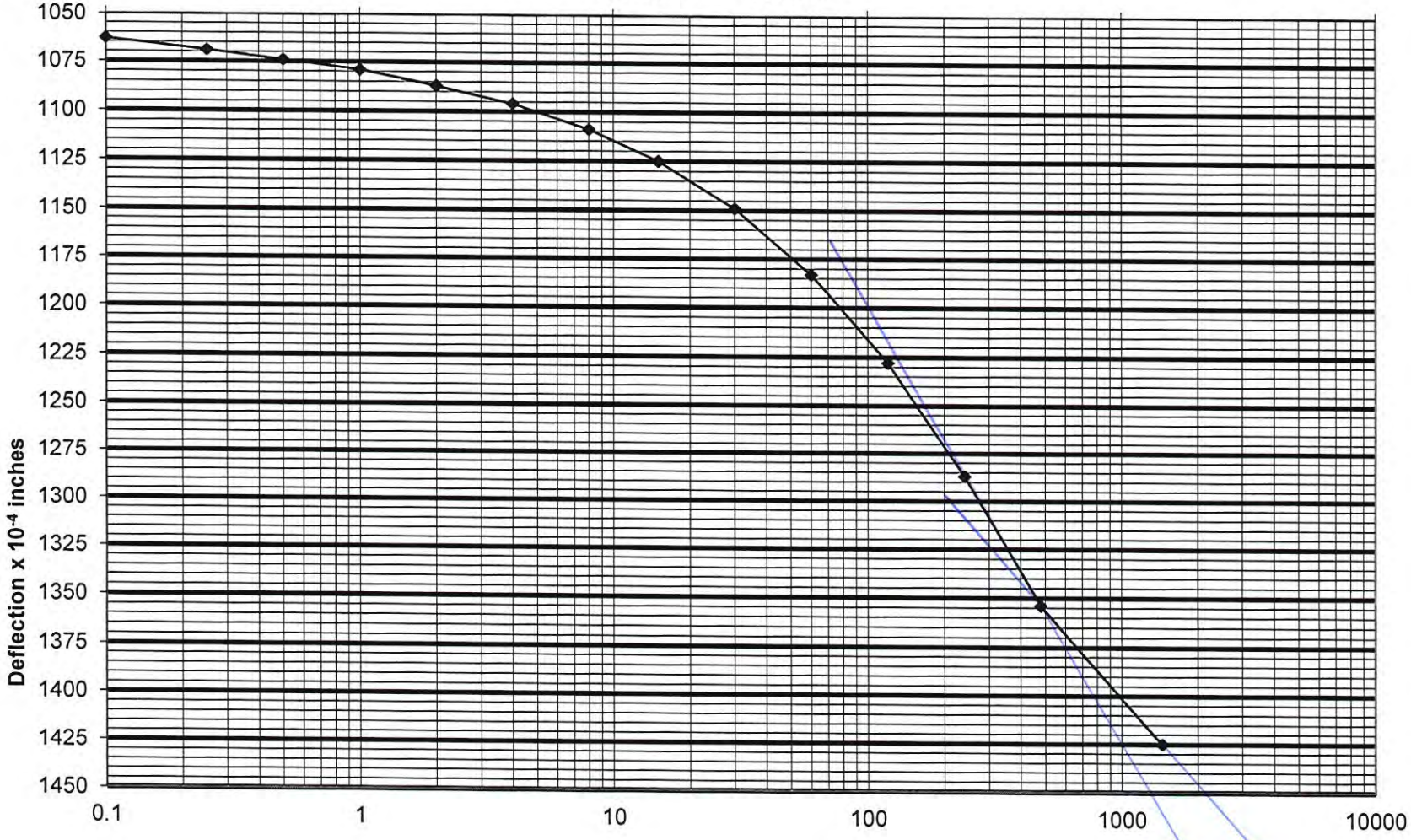
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I-70 3rd Lane

113722-002

BR-36-3A ST-2-2

Load 11 16.0 tsf



U_0 = 1059
U_{50} = 1207
U_{100} = 1354
t_{50} = 86.17

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

CONSOLIDATION TEST

Project	I-70 3rd Lane			Client		TSi Geotechnical, Inc.	
Location	Columbia, Missouri			Tested By / Date		CMB	07/26/24
Job Number	113722-002			Calculated By / Date		CMB	08/08/24
Boring	BR-36-3A			Checked By / Date		DRM	8/8/2024
Sample	ST-4-2			File		113722-002 BR-36-3A ST-4-2 D2435	
Depth (ft)	8.5 - 9.0			Procedure		ASTM D2435	
	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.007	2.499	0.954	inches	Tare No.	C-3	
Measured Reading 2	1.008	2.502	0.954	inches	Tare Weight	2.42	
Measured Reading 3	1.003	2.500	0.955	inches	Wet Weight	103.48	
Measured Reading 4	1.004	2.500	0.956	inches	Dry Weight	88.06	
Average Reading	1.006	2.500	0.955	inches	M.C. %	18.0%	
Wet Weight + Ring	312.36		393.87	grams	*Trimmings #2*		
Weight of Ring	144.76	Dry Weight	371.52	grams	Tare No.	C-4	
Specific Gravity	2.79	Tare Weight	83.51	grams	Tare Weight	2.42	
Sample Volume	80.90		73.67	cm^3	Wet Weight	107.94	
Height of Solids	0.638		0.638	inches	Dry Weight	91.43	
Void Ratio	0.58		0.44		M.C. %	18.5%	
Saturation	82.3		100.0	percent	Ring Number	551	
Weight of Water	24.35		22.35	grams	Inundated @	0.25	tsf
Moisture Content	17.0		15.6	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	129.3		140.4	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	110.6		121.4	pcf	Method Used	(A) or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.916	inches

Load 1		Load 2		Load 3		Load 4	
Air Press.	1.5	Air Press.	2.2	Air Press.	3.8	Air Press.	6.8
Load, tsf	0.25	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	6	0.1	54	0.1	117	0.1	232
0.25	21	0.25	56	0.25	123	0.25	240
0.5	35	0.5	57	0.5	127	0.5	246
1	42	1	58	1	132	1	253
2	47	2	60	2	136	2	261
4	47	4	61	4	141	4	270
8	47	8	62	8	147	8	279
15	46	15	63	15	152	15	289
30	45	30	65	30	158	30	298
60		60	66	60	163	60	306
120		120	67	120	166	120	312
240		240	69	240	170	240	316
480		480	70	480	173	480	319
1440		1350	71	1440	177	1440	324

Load 5		Load 6		Load 7		Load 8	
Air Press.	3.8	Air Press.	2.2	Air Press.	3.8	Air Press.	6.8
Load, tsf	1.0	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	317	0.1	295	0.1	270	0.1	300
0.25	316	0.25	293	0.25	271	0.25	304
0.5	315	0.5	291	0.5	271	0.5	306
1	313	1	289	1	272	1	309
2	313	2	287	2	273	2	312
4	311	4	284	4	274	4	316
8	310	8	280	8	275	8	320
15	309	15	277	15	276	15	323
30	308	30	273	30	278	30	326
60	306	60	270	60	278	60	328
120	306	120	268	120	279	120	330
240		240	266	240	279	240	332
480		480	265	480		480	
1440		1185	263	1440		1440	

CONSOLIDATION TEST

Project	I-70 3rd Lane			Client		TSi Geotechnical, Inc.	
Location	Columbia, Missouri			Tested By / Date		CMB	07/26/24
Job Number	113722-002			Calculated By / Date		CMB	08/08/24
Boring	BR-36-3A			Checked By / Date		DPM	8/8/2024
Sample	ST-4-2			File		113722-002 BR-36-3A ST-4-2 D2435	
Depth (ft)	8.5 - 9.0			Procedure		ASTM D2435	
	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.007	2.499	0.954	inches	Tare No.	C-3	
Measured Reading 2	1.008	2.502	0.954	inches	Tare Weight	2.42	
Measured Reading 3	1.003	2.500	0.955	inches	Wet Weight	103.48	
Measured Reading 4	1.004	2.500	0.956	inches	Dry Weight	88.06	
Average Reading	1.006	2.500	0.955	inches	M.C. %	18.0%	
Wet Weight + Ring	312.36		393.87	grams	*Trimmings #2*		
Weight of Ring	144.76	Dry Weight	371.52	grams	Tare No.	C-4	
Specific Gravity	2.79	Tare Weight	83.51	grams	Tare Weight	2.42	
Sample Volume	80.90		73.67	cm^3	Wet Weight	107.94	
Height of Solids	0.638		0.638	inches	Dry Weight	91.43	
Void Ratio	0.58		0.44		M.C. %	18.5%	
Saturation	82.3		100.0	percent	Ring Number	551	
Weight of Water	24.35		22.35	grams	Inundated @	0.25	tsf
Moisture Content	17.0		15.6	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	129.3		140.4	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	110.6		121.4	pcf	Method Used	(A) or B	

Load 9		Load 10		Load 11	
Air Press.	12.9	Air Press.	25.2	Air Press.	50.1
Load, tsf	4.0	Load, tsf	8.0	Load, tsf	16.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	407	0.1	599	0.1	822
0.25	416	0.25	609	0.25	834
0.5	424	0.5	618	0.5	843
1	434	1	628	1	856
2	444	2	639	2	871
4	455	4	654	4	891
8	467	8	669	8	915
15	479	15	686	15	939
30	490	30	703	30	966
60	499	60	718	60	987
120	506	120	728	120	1001
240	510	240	735	240	1010
480	515	480	741	480	1018
1440	520	1440	748	1440	1026

CONSOLIDATION TEST

Project	I-70 3rd Lane			Client		TSi Geotechnical, Inc.	
Location	Columbia, Missouri			Tested By / Date		CMB	07/26/24
Job Number	113722-002			Calculated By / Date		CMB	08/08/24
Boring	BR-36-3A			Checked By / Date		DPm	8/8/2024
Sample	ST-4-2			File		113722-002 BR-36-3A ST-4-2 D2435	
Depth (ft)	8.5 - 9.0			Procedure		ASTM D2435	
	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.007	2.499	0.954	inches	Tare No.	C-3	
Measured Reading 2	1.008	2.502	0.954	inches	Tare Weight	2.42	
Measured Reading 3	1.003	2.500	0.955	inches	Wet Weight	103.48	
Measured Reading 4	1.004	2.500	0.956	inches	Dry Weight	88.06	
Average Reading	1.006	2.500	0.955	inches	M.C. %	18.0%	
Wet Weight + Ring	312.36		393.87	grams	*Trimmings #2*		
Weight of Ring	144.76	Dry Weight	371.52	grams	Tare No.	C-4	
Specific Gravity	2.79	Tare Weight	83.51	grams	Tare Weight	2.42	
Sample Volume	80.90		73.67	cm^3	Wet Weight	107.94	
Height of Solids	0.638		0.638	inches	Dry Weight	91.43	
Void Ratio	0.58		0.44		M.C. %	18.5%	
Saturation	82.3		100.0	percent	Ring Number	551	
Weight of Water	24.35		22.35	grams	Inundated @	0.25	tsf
Moisture Content	17.0		15.6	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	129.3		140.4	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	110.6		121.4	pcf	Method Used	(A) or B	

CALIBRATION OF CONSOLIDATION DEFORMATION

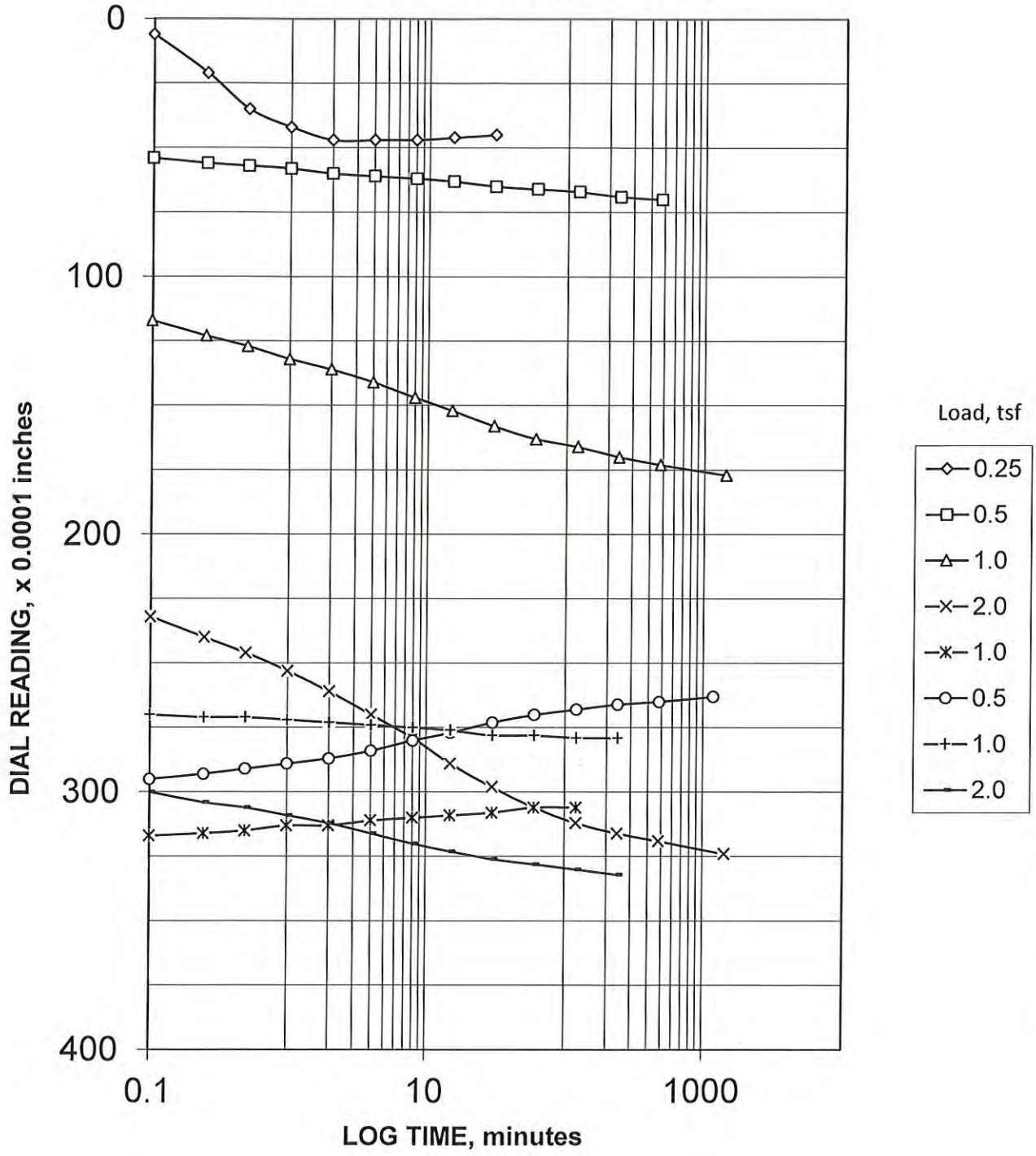
Procedure SWCP-15 (Reference ASTM D2435 AASHTO T216)

Equipment Calibrated:	Consolidation Deformation	Date Calibrated:	08/07/24
Reason for Calibration:	Test Completion	Next Calibration Due:	Next Test
Equipment Used:	Consolidation Appartus	Calibrated By:	CMB
	Steel Calibration Disk	Checked By:	CMB

Machine Number: 551

Load tsf	Machine Def x 10^{-4}	Correction Factor x 10^{-4}	U-100 x 10^{-4}	Corr. U-100 x 10^{-4}	Compression, Percent	C_v	Void Ratio
0.01	0	0	0	0	0.00%	0	0.58
0.3	31	0	47.0	16	0.16%	1.9E+00	0.57
0.5	53	0	69.5	17	0.17%	7.9E-02	0.57
1.0	73	0	162.0	89	0.89%	2.0E-01	0.56
2.0	96	0	310.0	214	2.14%	1.4E-01	0.54
1.0	88	14	313.0	211	2.11%	NA	0.54
0.5	78	14	268.0	176	1.76%	NA	0.55
1.0	86	14	278.0	178	1.78%	NA	0.55
2.0	98	14	324.0	212	2.12%	NA	0.54
4.0	122	0	506.0	384	3.84%	1.5E-01	0.52
8.0	144	0	730.0	586	5.86%	8.8E-02	0.48
16.0	127	0	1005.0	878	8.78%	6.7E-02	0.44

CONSOLIDATION TEST



I-70 3rd Lane
Columbia, Missouri

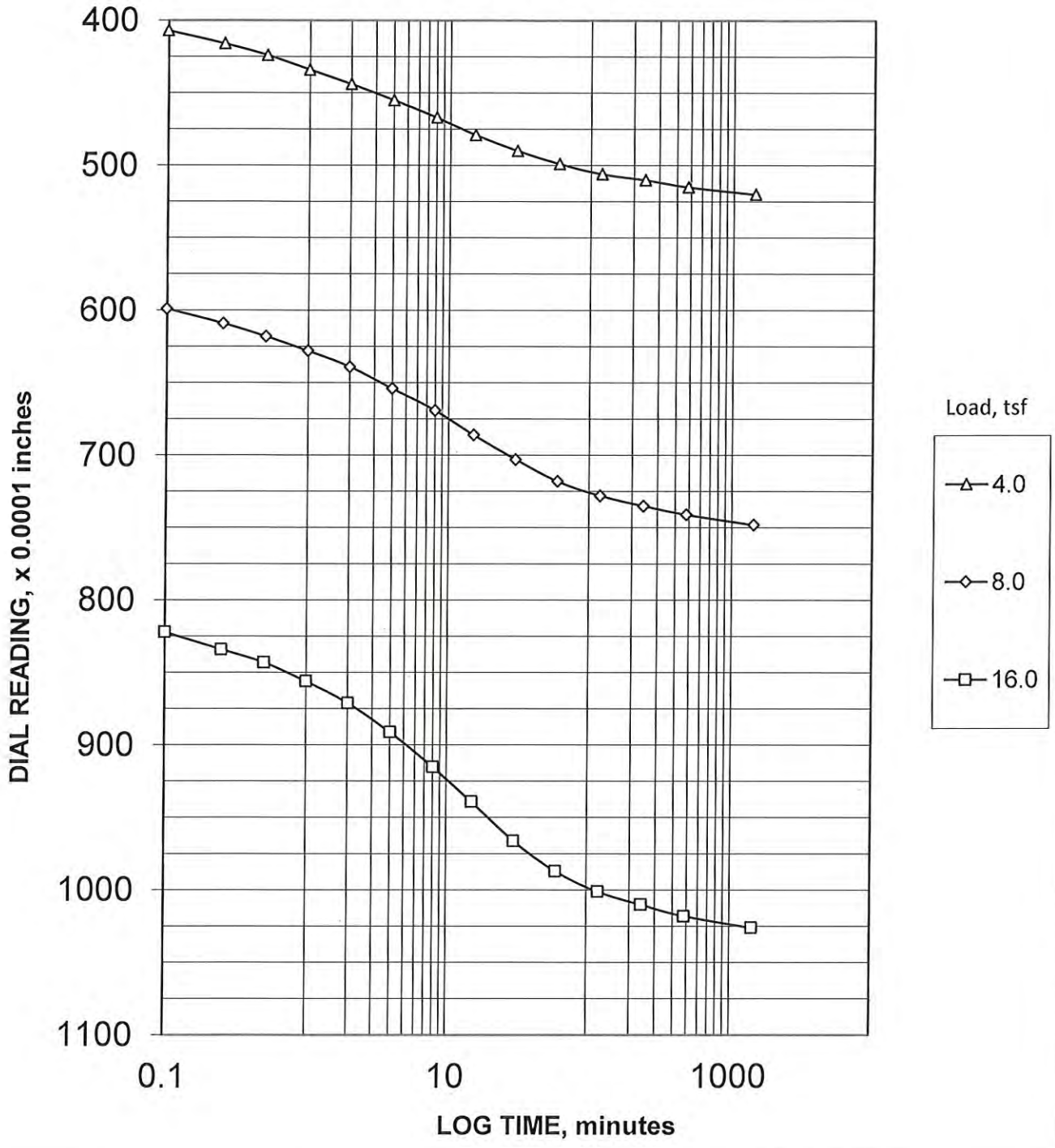
TIME PLOTS
BR-36-3A
ST-4-2

July 2024 113722-002

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FIG.

CONSOLIDATION TEST



I-70 3rd Lane
Columbia, Missouri

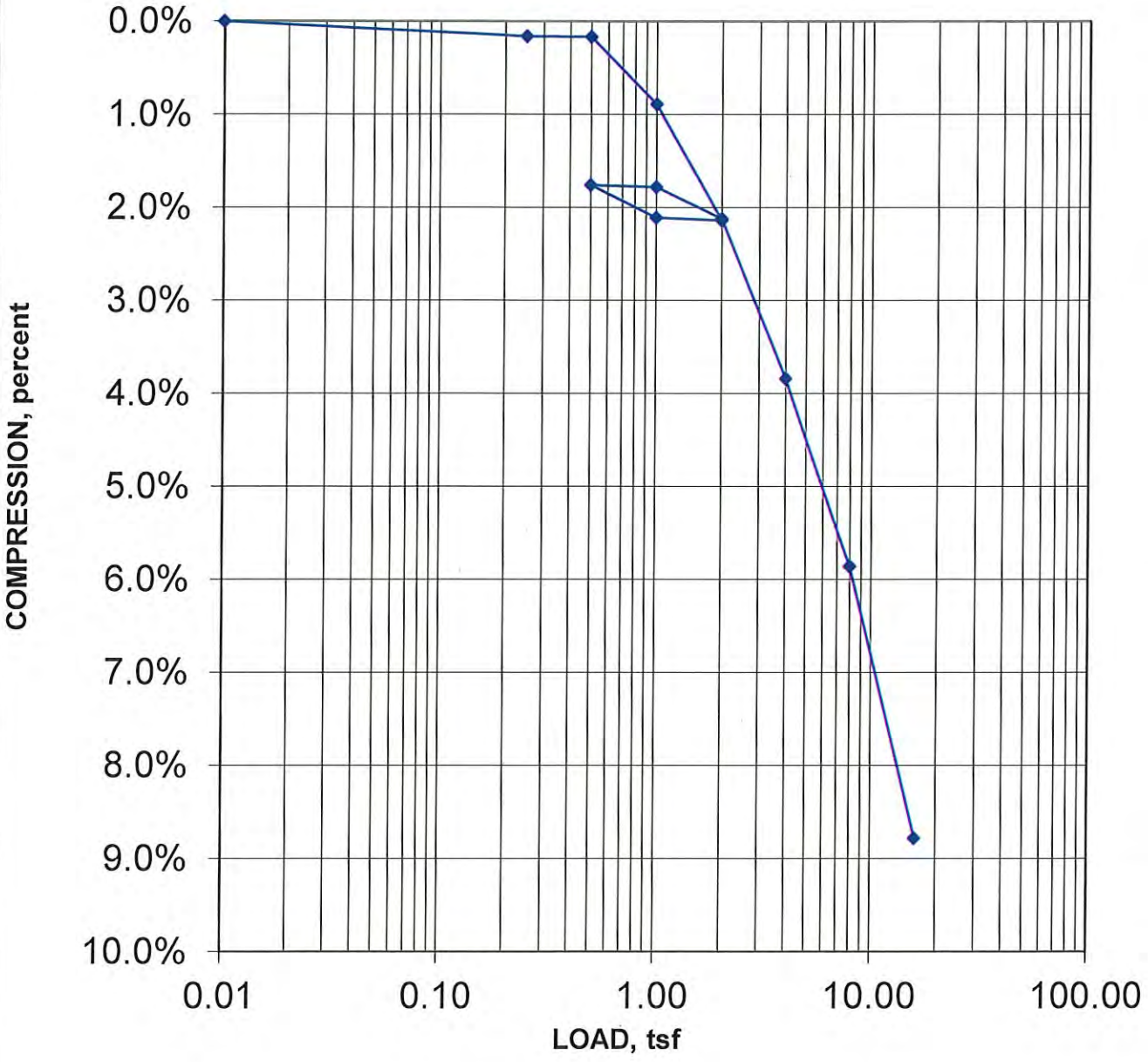
TIME PLOTS
BR-36-3A
ST-4-2

July 2024 113722-002

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FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.25	1.9E+00	2.0	NA
0.5	7.9E-02	4.0	1.5E-01
1.0	2.0E-01	8.0	8.8E-02
2.0	1.4E-01	16.0	6.7E-02
1.0	NA		
0.5	NA		
1.0	NA		

I-70 3rd Lane
Columbia, Missouri

SETTLEMENT PLOTS

BR-36-3A

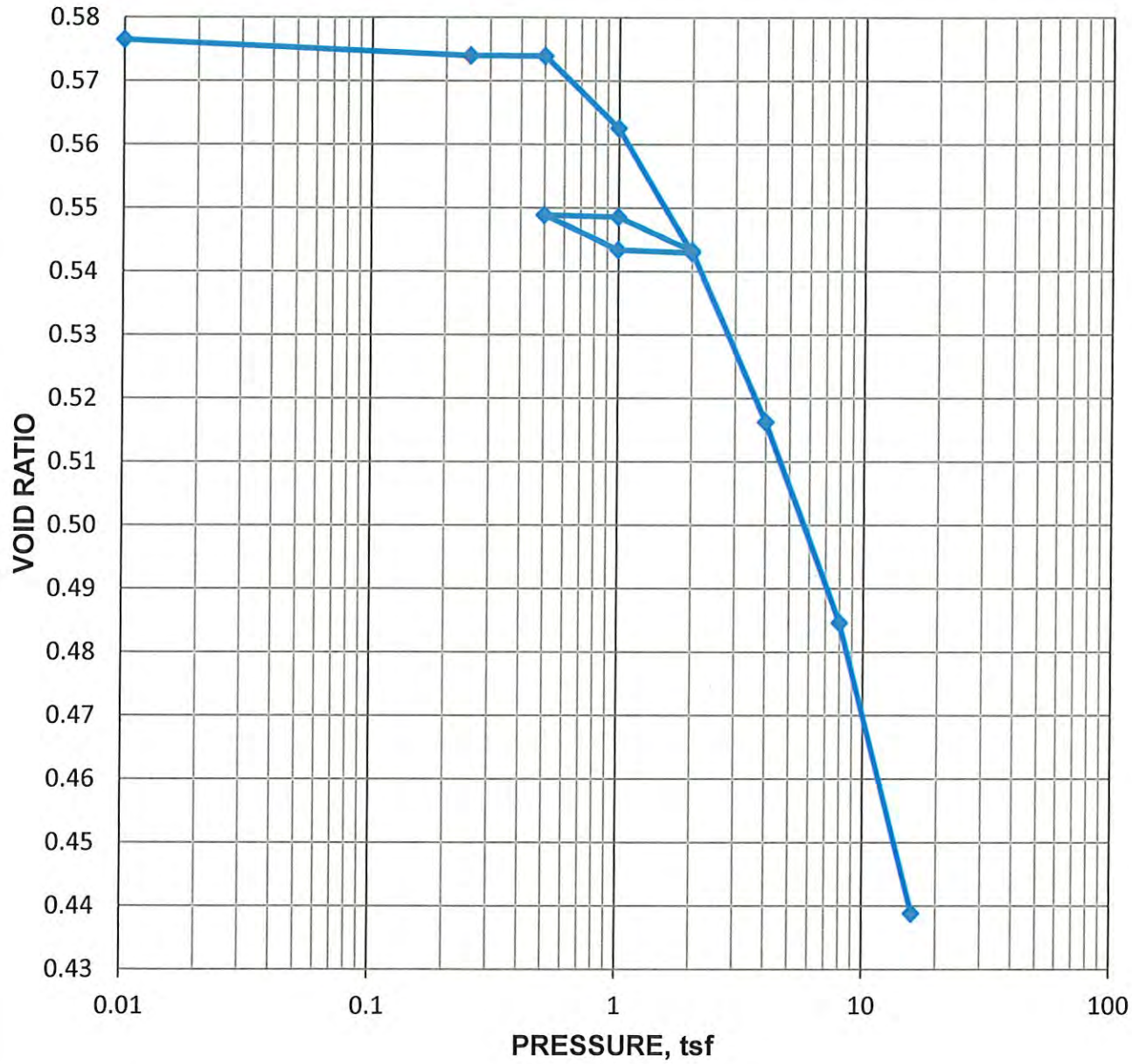
ST-4-2

July 2024 113722-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.25	1.9E+00	2.0	NA
0.5	7.9E-02	4.0	1.5E-01
1.0	2.0E-01	8.0	8.8E-02
2.0	1.4E-01	16.0	6.7E-02
1.0	NA		
0.5	NA		
1.0	NA		

I-70 3rd Lane
Columbia, Missouri

VOID RATIO PLOT

BR-36-3A

ST-4-2

July 2024 113722-002

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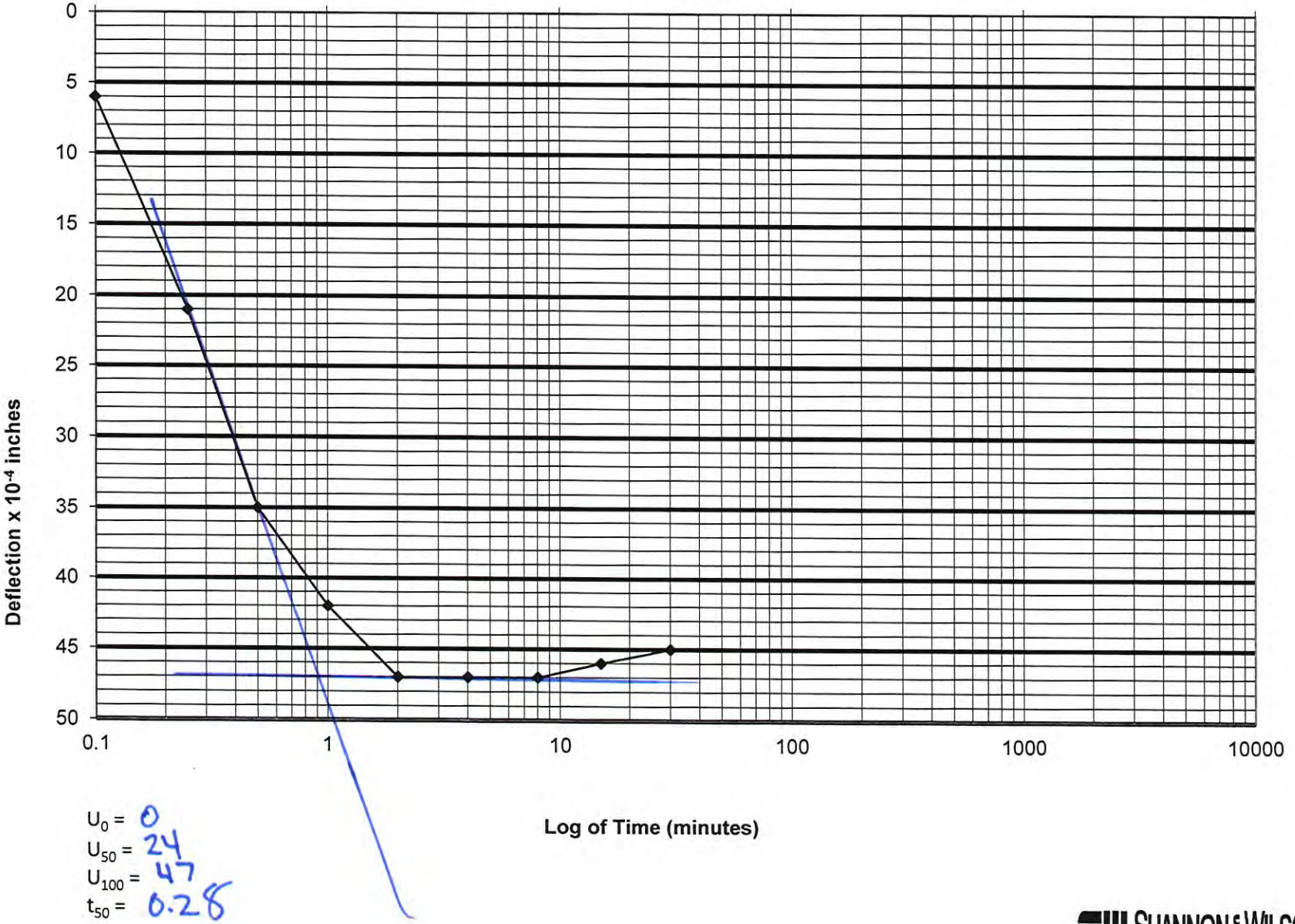
FIG.

I-70 3rd Lane

113722-002

BR-36-3A ST-4-2

Load 1 0.25 tsf



U_0 = 0
U_{50} = 24
U_{100} = 47
t_{50} = 0.28

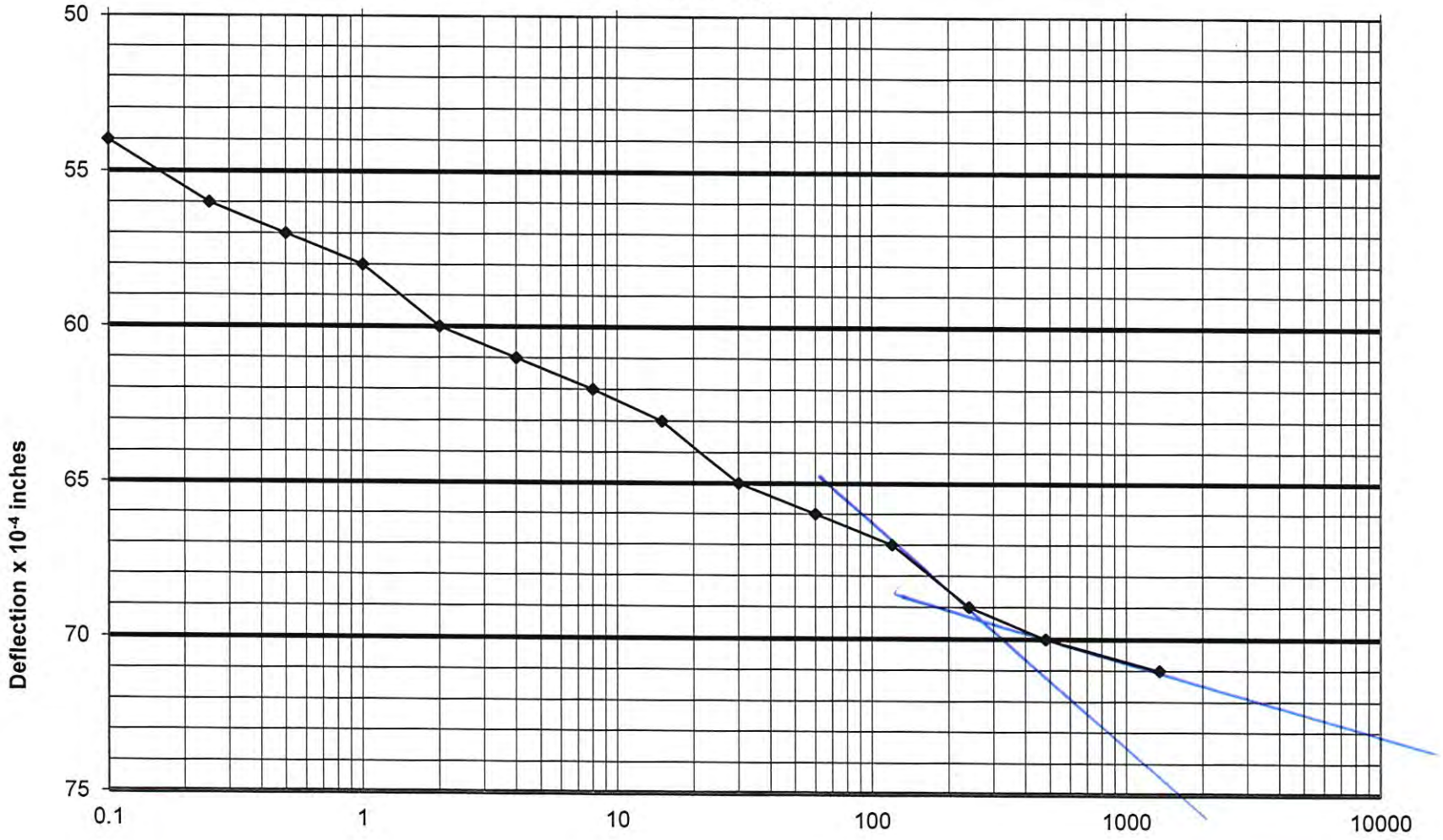
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I-70 3rd Lane

113722-002

BR-36-3A ST-4-2

Load 2 0.5 tsf



U_0 = 54
U_{50} = 62
U_{100} = 70
t_{50} = 6.73

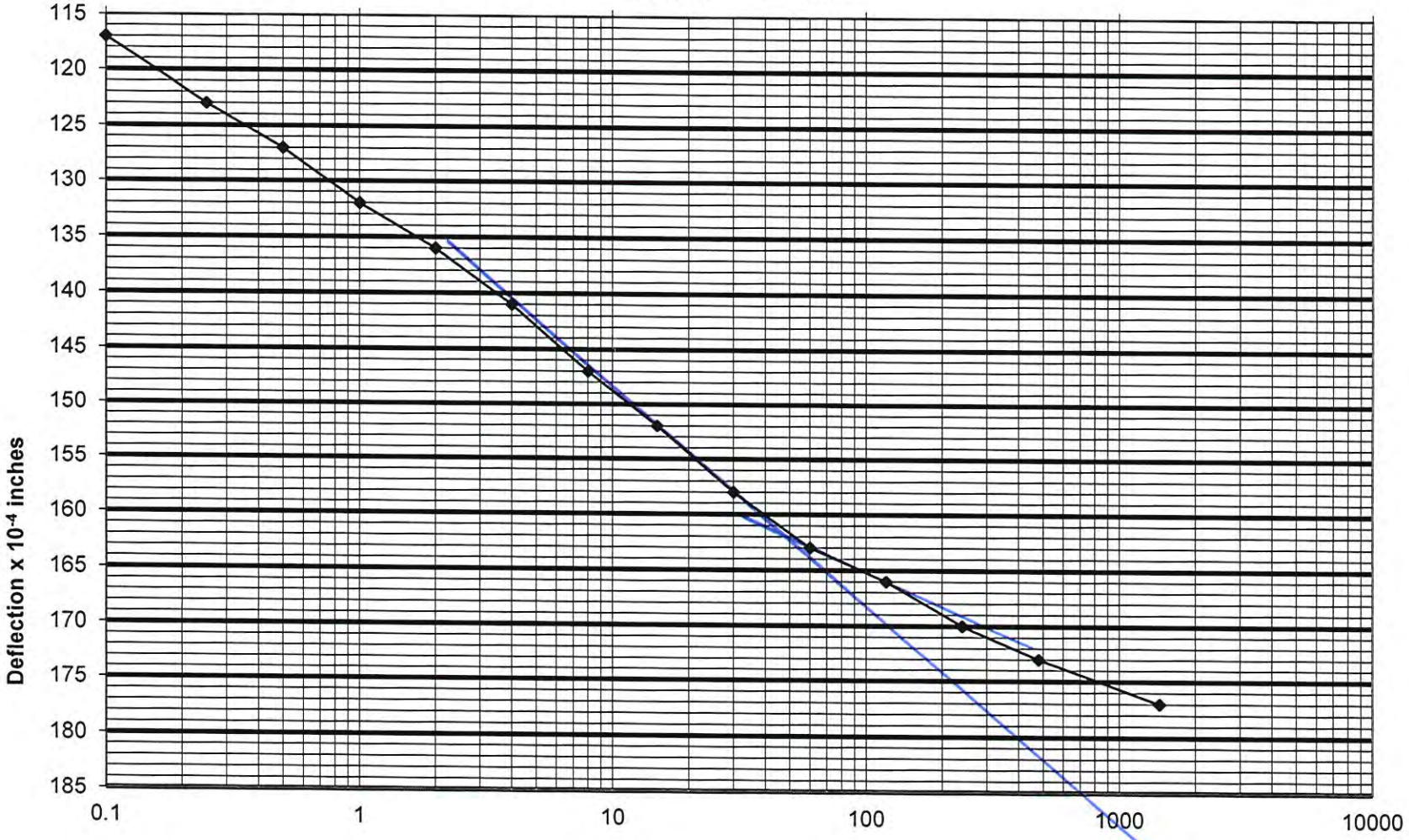
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I-70 3rd Lane

113722-002

BR-36-3A ST-4-2

Load 3 1.0 tsf



U_0 = 114
U_{50} = 138
U_{100} = 162
t_{50} = 2.64

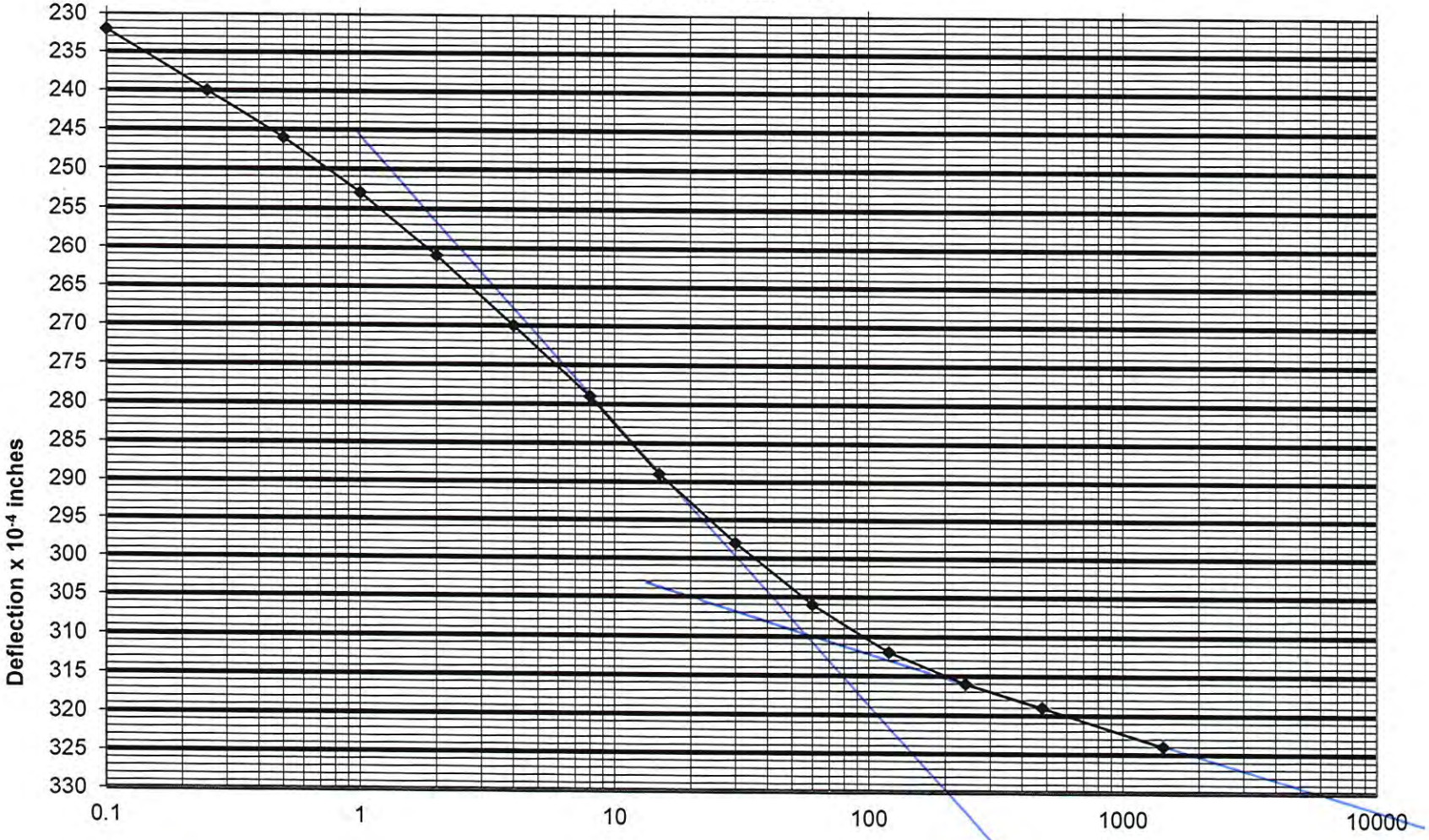
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I-70 3rd Lane

113722-002

BR-36-3A ST-4-2

Load 4 2.0 tsf



U_0 = 227

U_{50} = 269

U_{100} = 310

t_{50} = 3.56

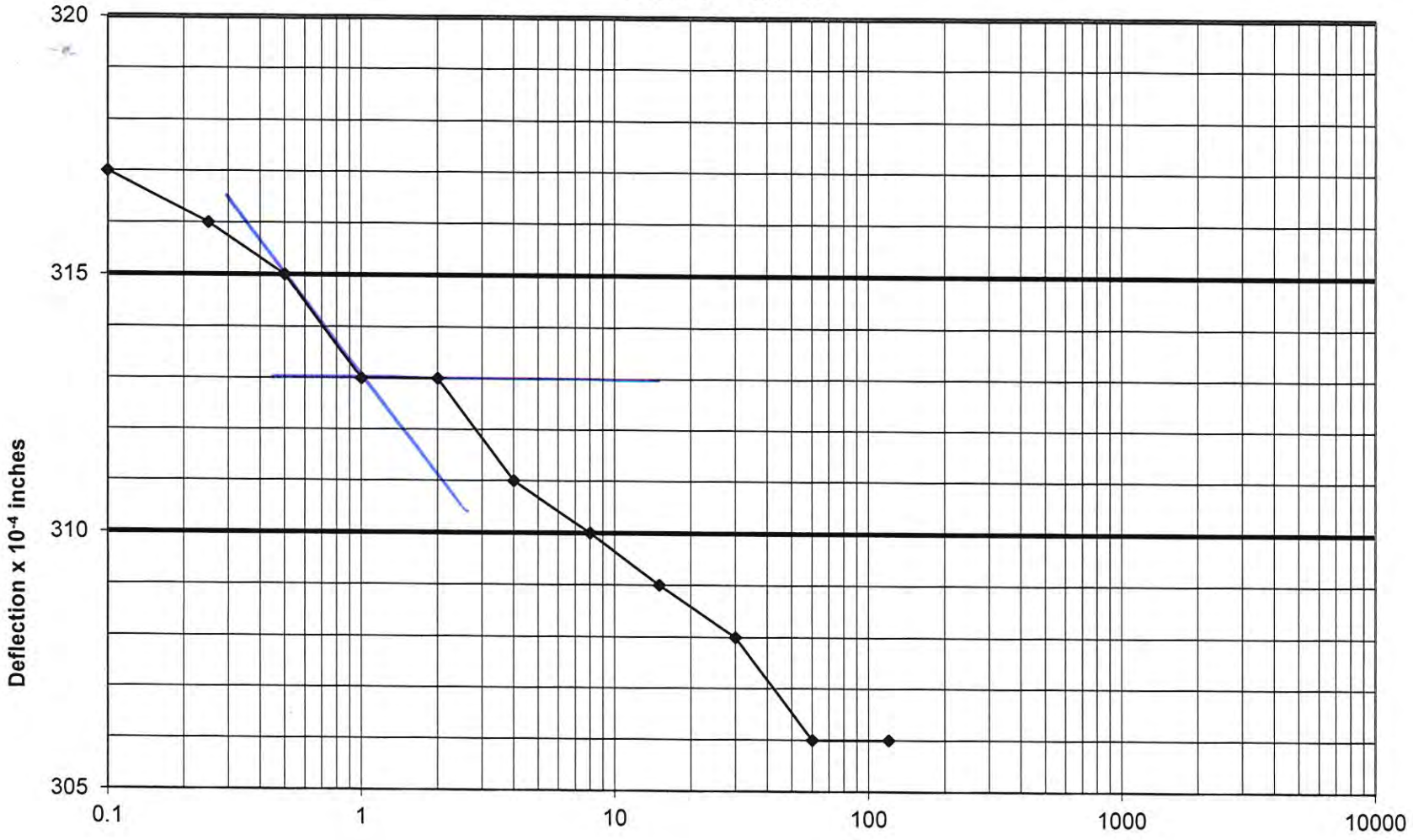
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I-70 3rd Lane

113722-002

BR-36-3A ST-4-2

Load 5 1.0 tsf



U_0 = —

U_{50} = —

U_{100} = 313

t_{50} = —

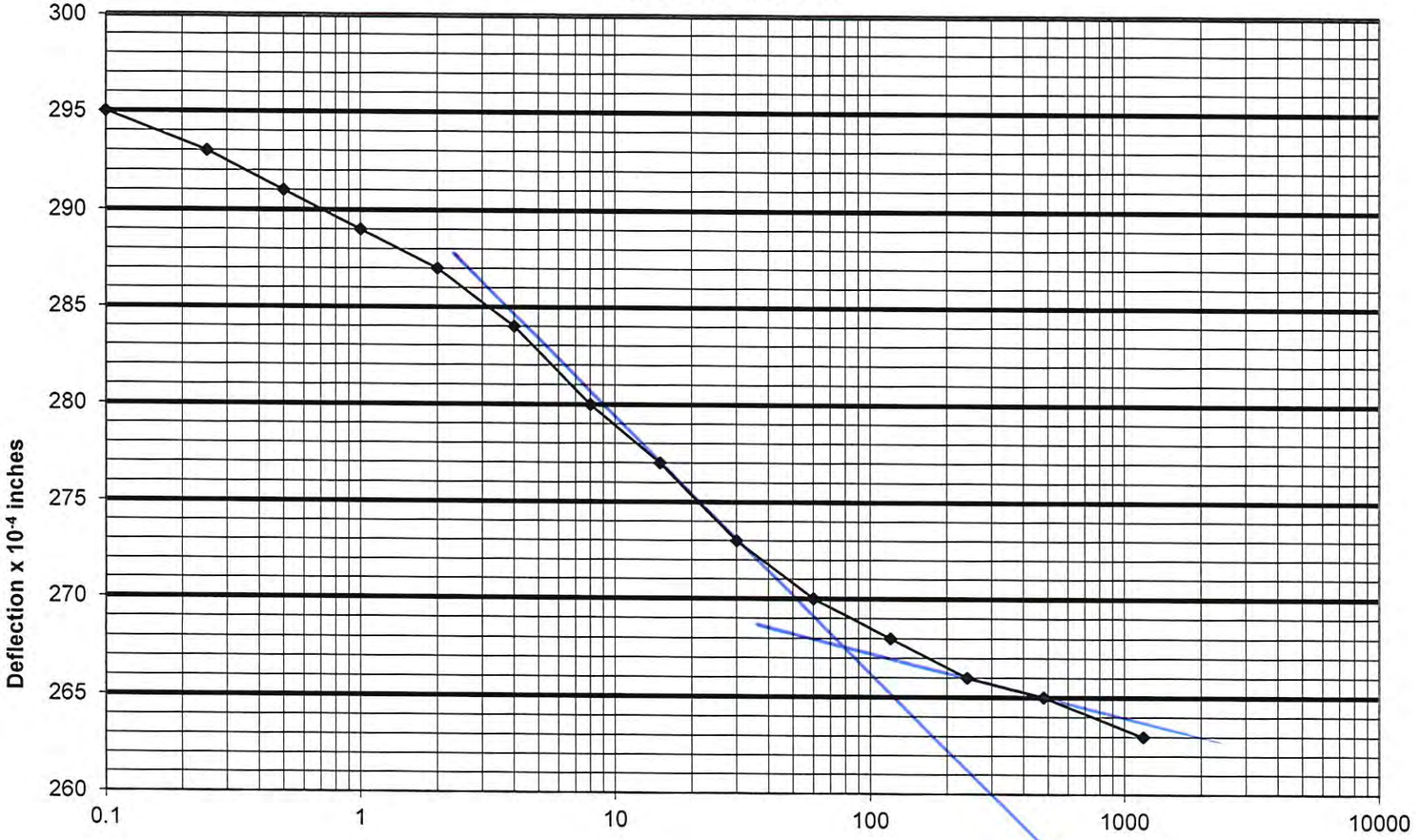
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I-70 3rd Lane

113722-002

BR-36-3A ST-4-2

Load 6 0.5 tsf



U_0 =

U_{50} =

U_{100} = 268

t_{50} =

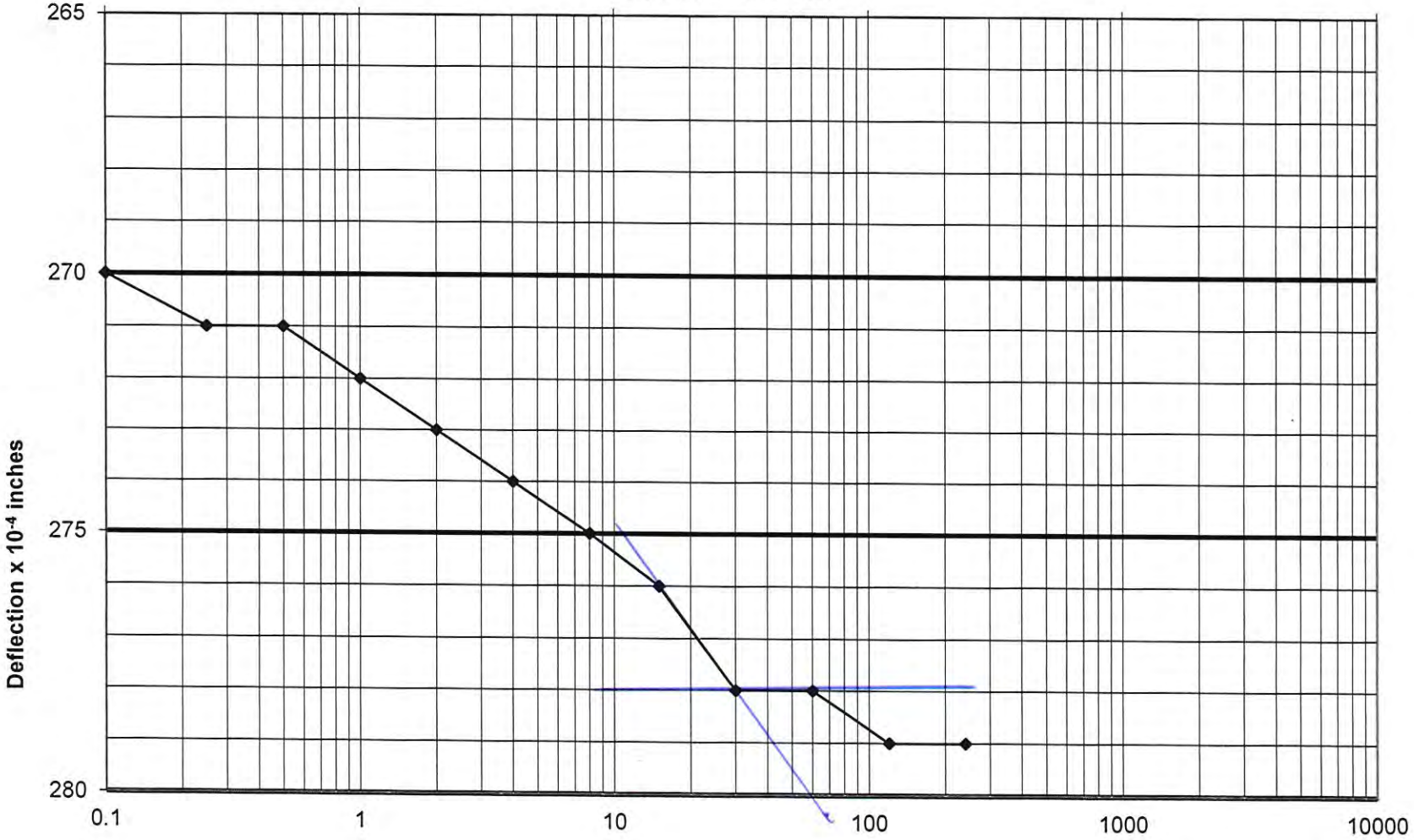
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I-70 3rd Lane

113722-002

BR-36-3A ST-4-2

Load 7 1.0 tsf



U_0 = —

U_{50} = —

U_{100} = 278

t_{50} = —

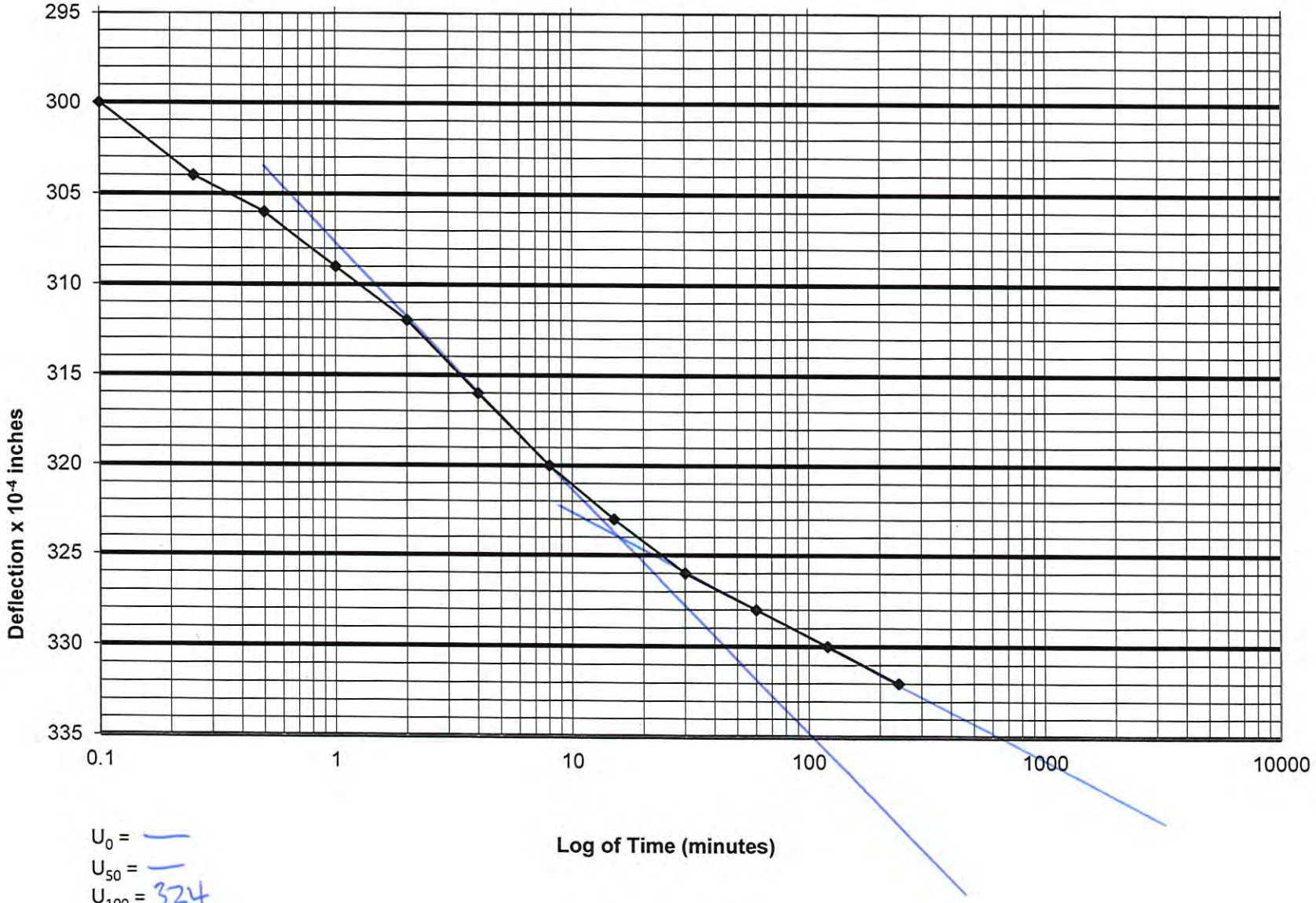
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I-70 3rd Lane

113722-002

BR-36-3A ST-4-2

Load 8 2.0 tsf



U_0 = —

U_{50} = —

U_{100} = 324

t_{50} = —

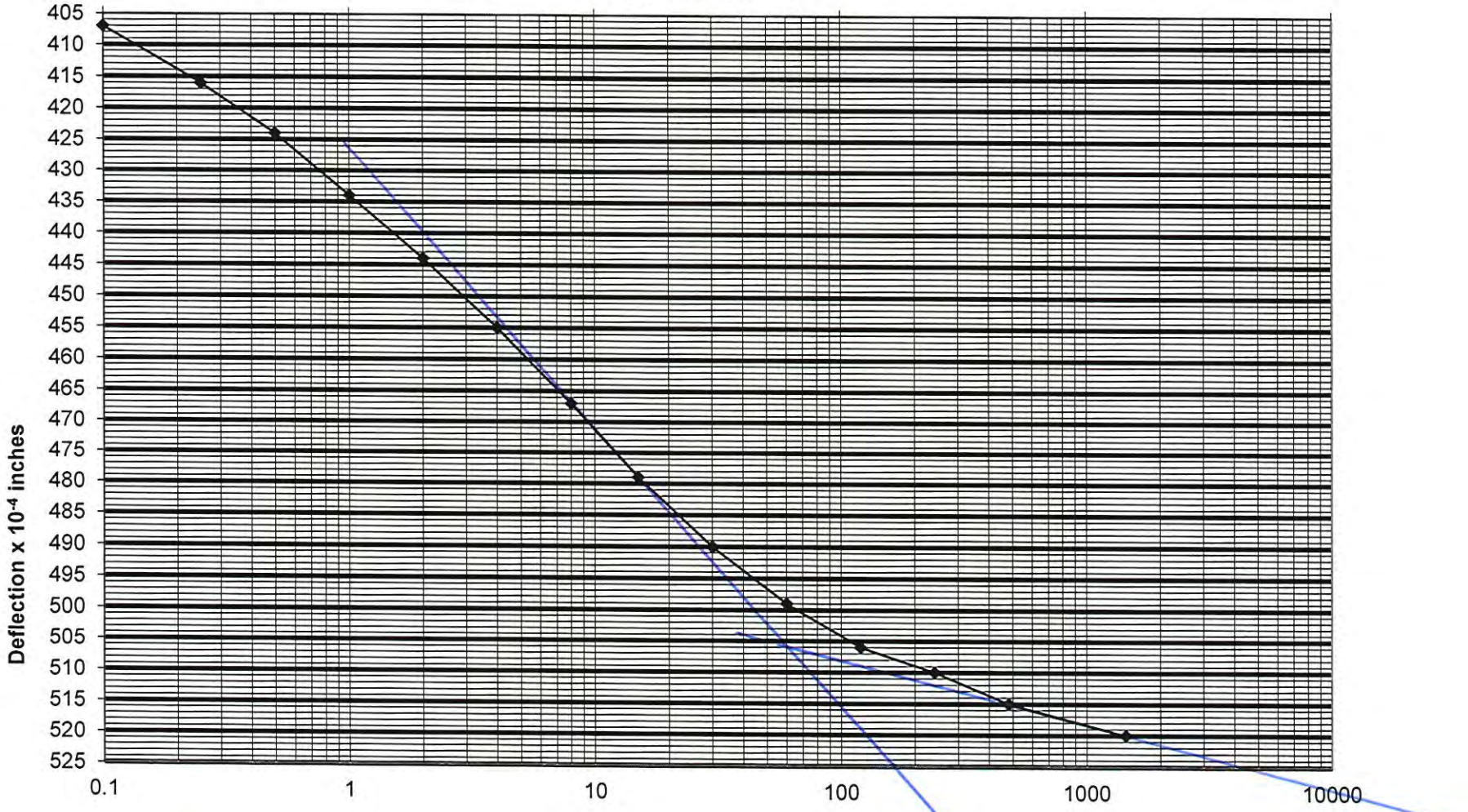
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I-70 3rd Lane

113722-002

BR-36-3A ST-4-2

Load 9 4.0 tsf



U_0 = 398

U_{50} = 452

U_{100} = 506

t_{50} = 3.31

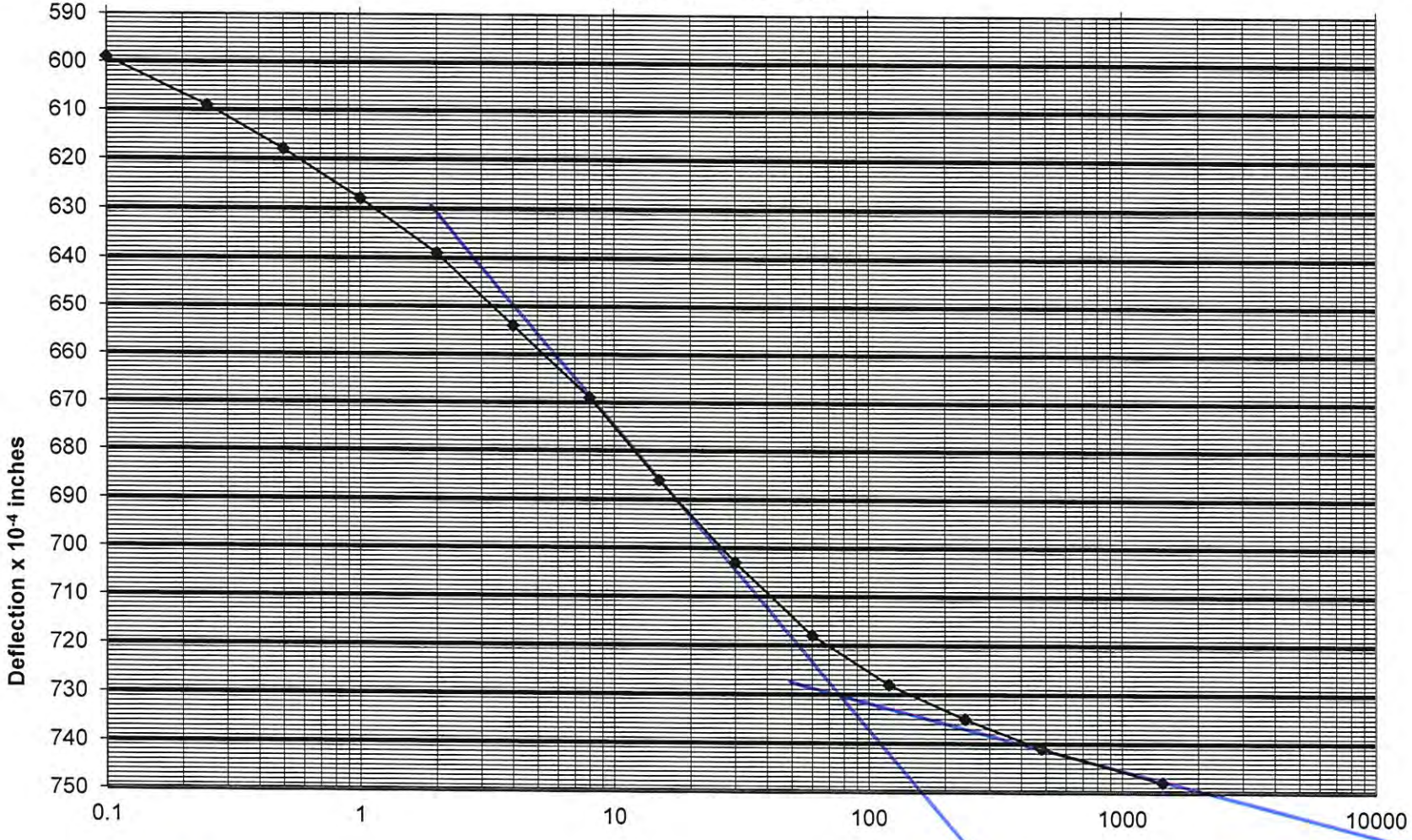
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I-70 3rd Lane

113722-002

BR-36-3A ST-4-2

Load 10 8.0 tsf



U_0 = 590
U_{50} = 660
U_{100} = 730
t_{50} = 5.28

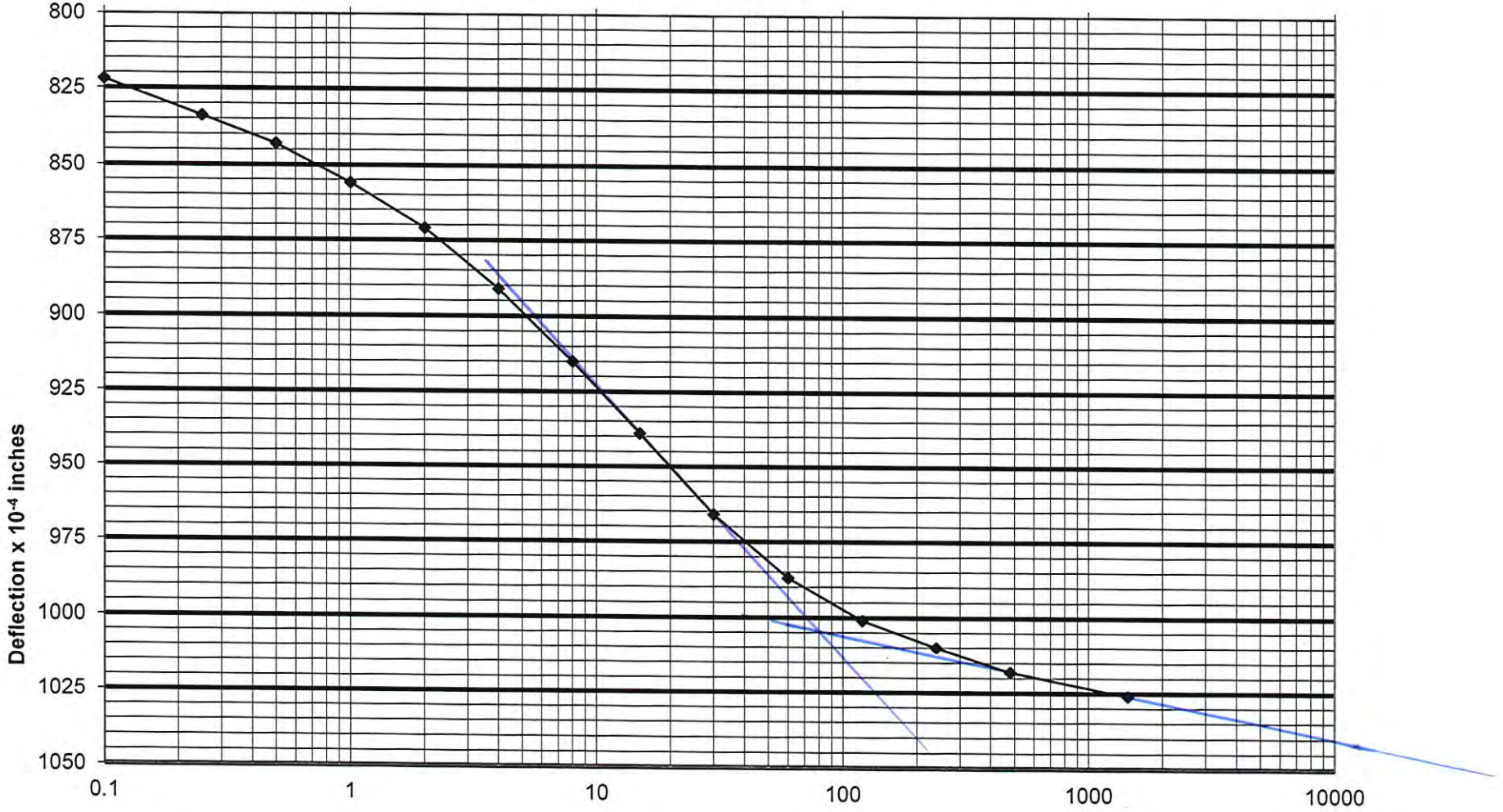
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I-70 3rd Lane

113722-002

BR-36-3A ST-4-2

Load 11 16.0 tsf



U_0 = 812

U_{50} = 909

U_{100} = 1005

t_{50} = 6.63

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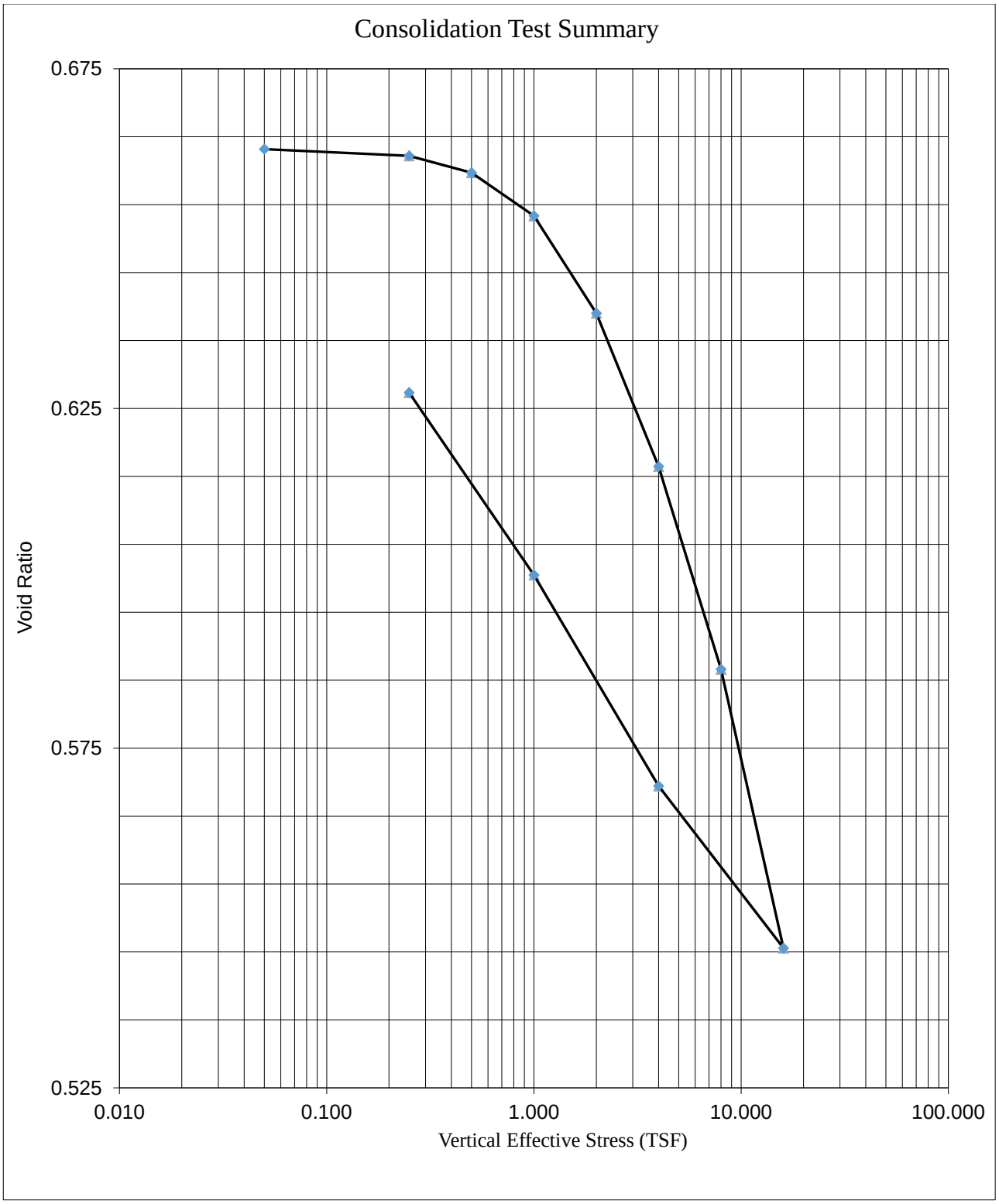
Project Name: I-70 Third Lane (Kingdom City to Columbia)

Visual Classification:

Project Number:	20241040.00	**Initial Moisture**		**Final Moisture**		**Initial Data**	
Boring Number:	BR-16-1.1A	Wet Wt Sample+Ring (g):	307.48	Wet Wt Sample+Ring (g):	308.89	Sample Height (in):	0.997
Sample Number:	ST-6-2	Dry Wt Sample+Ring (g):	276.73	Dry Wt Sample+Ring (g):	*276.73*	Sample Diameter (in):	2.500
Depth (ft):	18.5-19.0	Wt of Ring (g):	146.53	Wt of Ring (g):	146.53	Volume (in^3):	4.894
		Dry Wt of Sample (g):	130.20	Dry Wt of Sample (g):	130.19547	Specific Gravity:	2.7
Wet Unit Weight (pcf):	125.28	Wt of Water (g):	30.75	Wt of Water (g):	32.164531	Height of Solids (in):	0.599
Dry Unit Weight (pcf):	101.34	Moisture Content (%):	23.6	Moisture Content (%):	24.7	Initial Void Ratio:	0.663

1

Load (tsf)	D_{100} (0.0001")	Machine Deflection (0.0001")	Correction Factor	Corrected D_{100} (0.0001")	% Strain	Void Ratio Change	Void Ratio	D_{50} Uncorrected (0.0001")	H_{50} Corrected	t_{50} (min)	Cv (IN^2/MIN)
0.050	-6.0	0.1		-6.1	-0.06	0.0000	0.663	-3.0	0.9970	480.00	0.0001
0.250	6.0	0.1		5.9	0.06	0.0010	0.662	5.0	0.9965	15.00	0.0033
0.500	21.0	0.1		20.9	0.21	0.0035	0.660	15.9	0.9954	14.80	0.0033
1.000	59.0	0.1		58.9	0.59	0.0098	0.653	46.5	0.9924	14.00	0.0035
2.000	145.0	0.1		144.9	1.45	0.0242	0.639	114.0	0.9856	17.00	0.0028
4.000	280.0	0.1		279.9	2.81	0.0467	0.616	230.5	0.9740	24.00	0.0019
8.000	459.0	0.1		458.9	4.60	0.0766	0.587	390.0	0.9580	46.00	0.0010
16.000	705.0	0.1		704.9	7.07	0.1176	0.546	605.5	0.9365	36.00	0.0012
4.000	562.0	0.1		561.9	5.64	0.0937	0.569	630.5	0.9340	44.00	0.0010
1.000	376.0	0.1		375.9	3.77	0.0627	0.600	457.0	0.9513	110.00	0.0004
0.250	215.0	0.1		214.9	2.16	0.0358	0.627	285.5	0.9685	239.00	0.0002



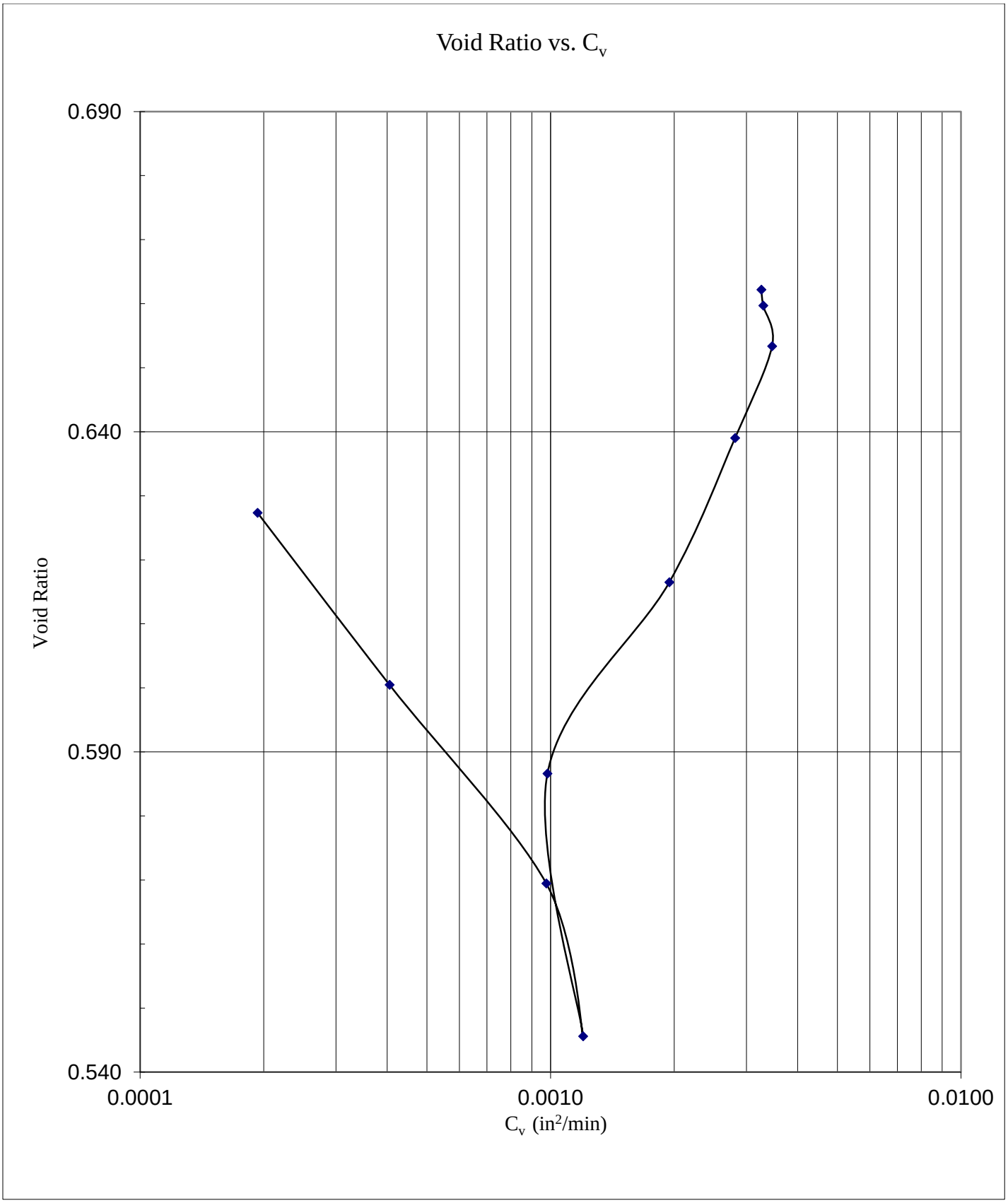
Boring No. BR-16-1.1A Sample ST-6-2 Depth 18.5-19.0

Soil Description : Brown, fat CLAY (CH)

Initial Moisture Content (%): 23.6 Specific Gravity: 2.7 (assumed)

Initial Dry Density(pcf): 101.3 Project Name: I-70 Third Lane (Kingdom City to Columb

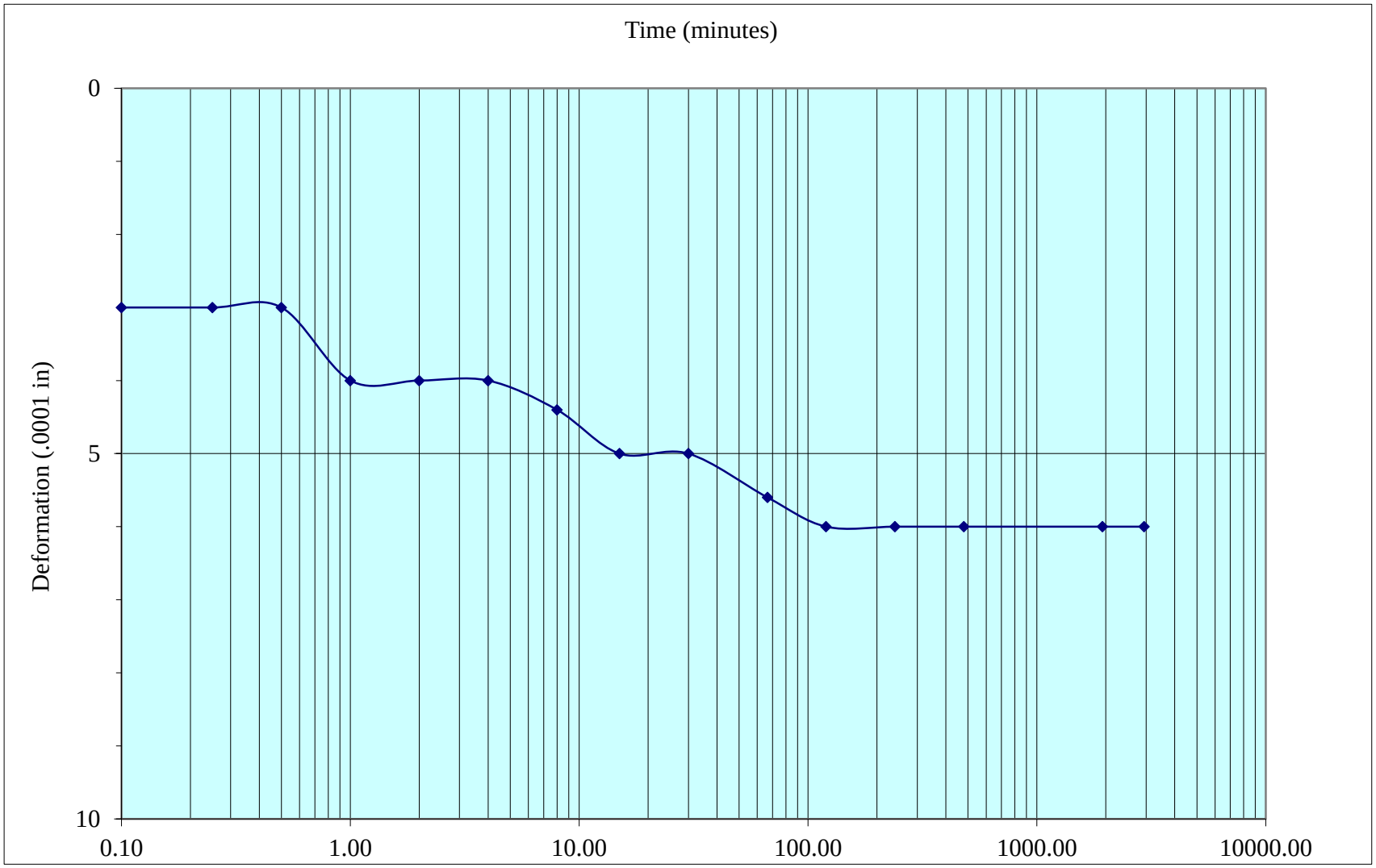
Project Number: 20241040.00


Void Ratio vs. C_v
0.690
0.640
0.590
0.540
Void Ratio
0.0001
0.0010
0.0100
C_v (in^2/min)

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-16-1.1A Sample No. ST-6-2 Load No. 1 TSF 0.25



D-0=

D-50=

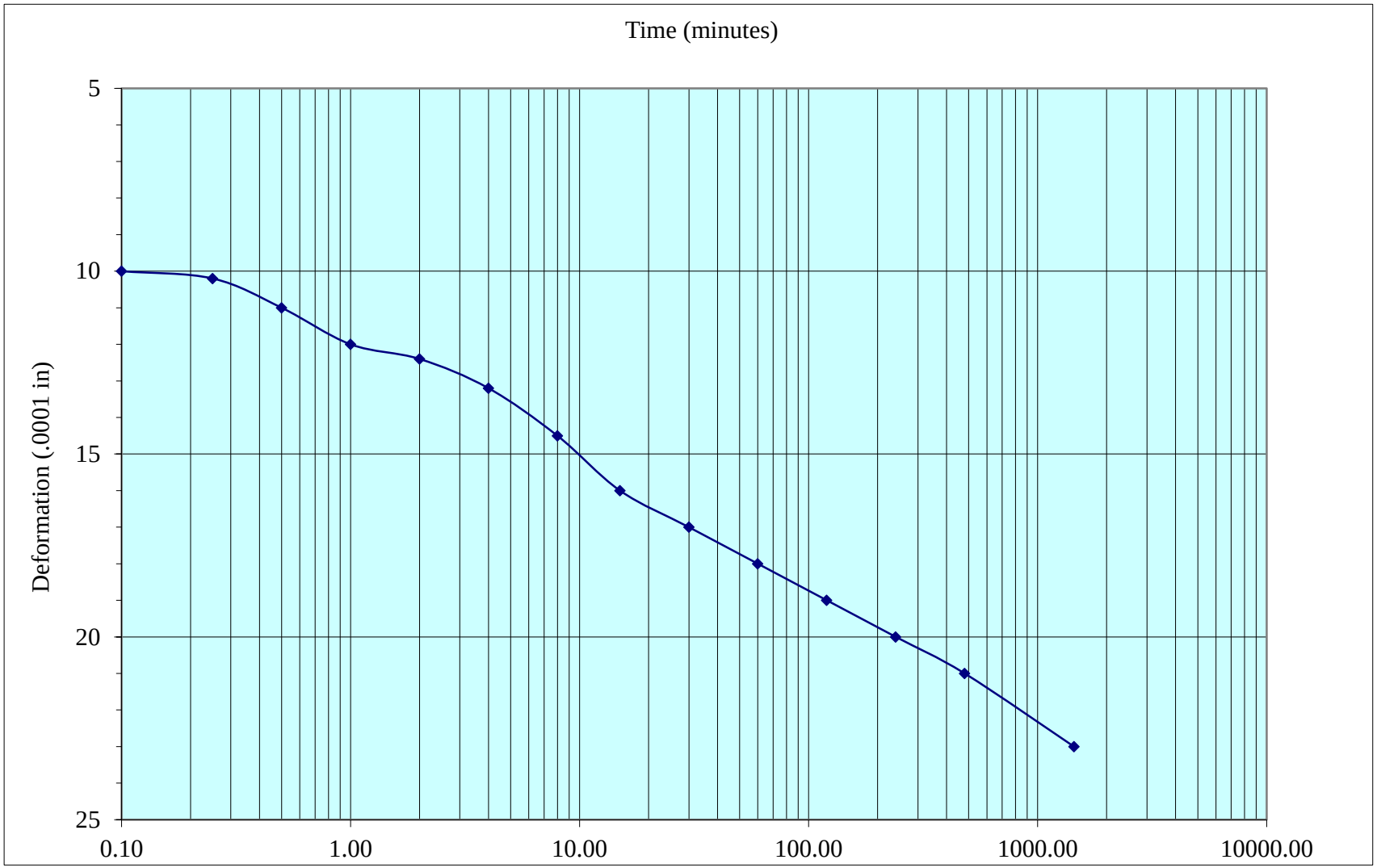
D-100=

t-50=

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-16-1.1A Sample No. ST-6-2 Load No. 2 TSF 0.5



D-0= _____

D-50= _____

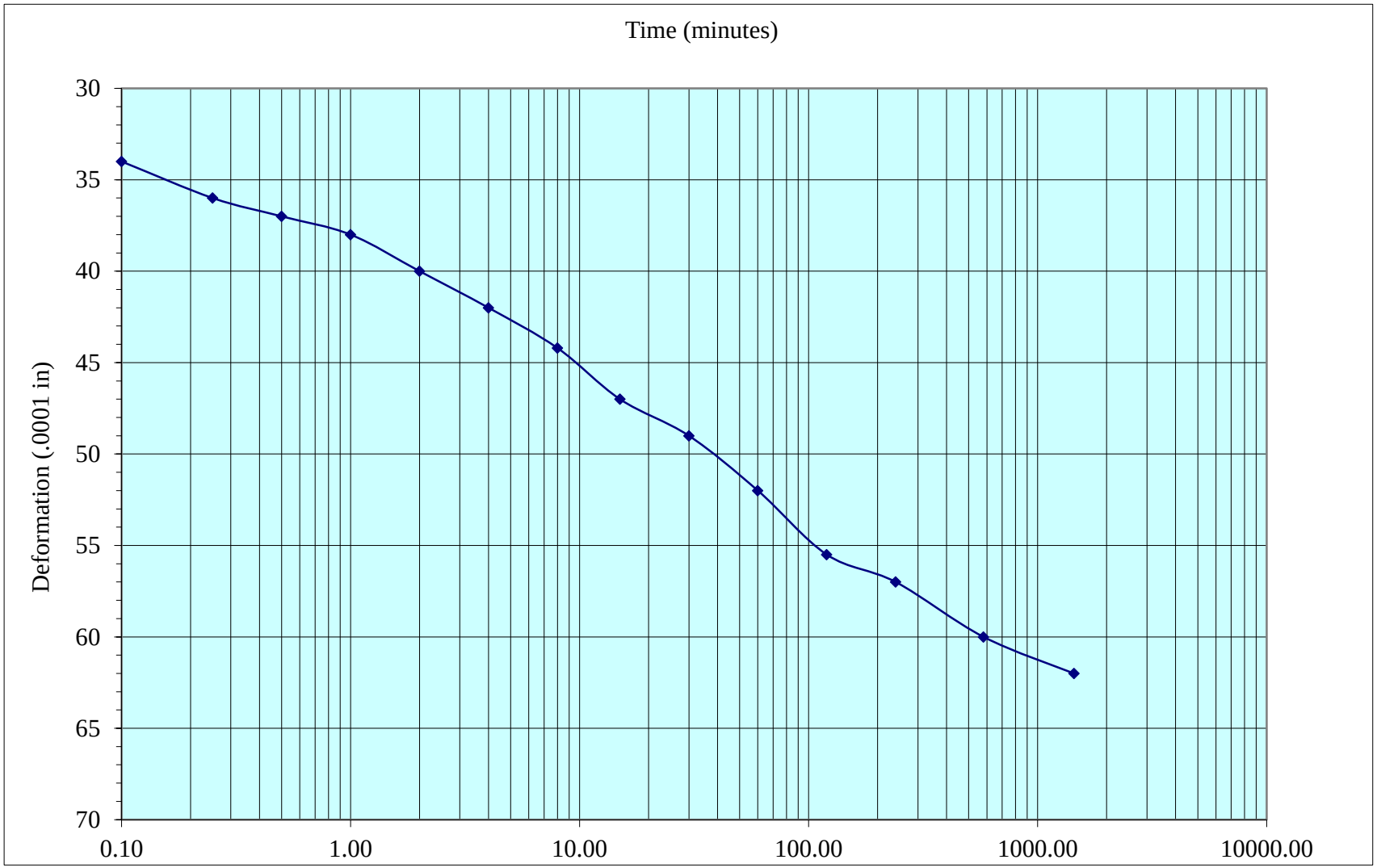
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-16-1.1A Sample No. ST-6-2 Load No. 3 TSF 1



D-0= _____

D-50= _____

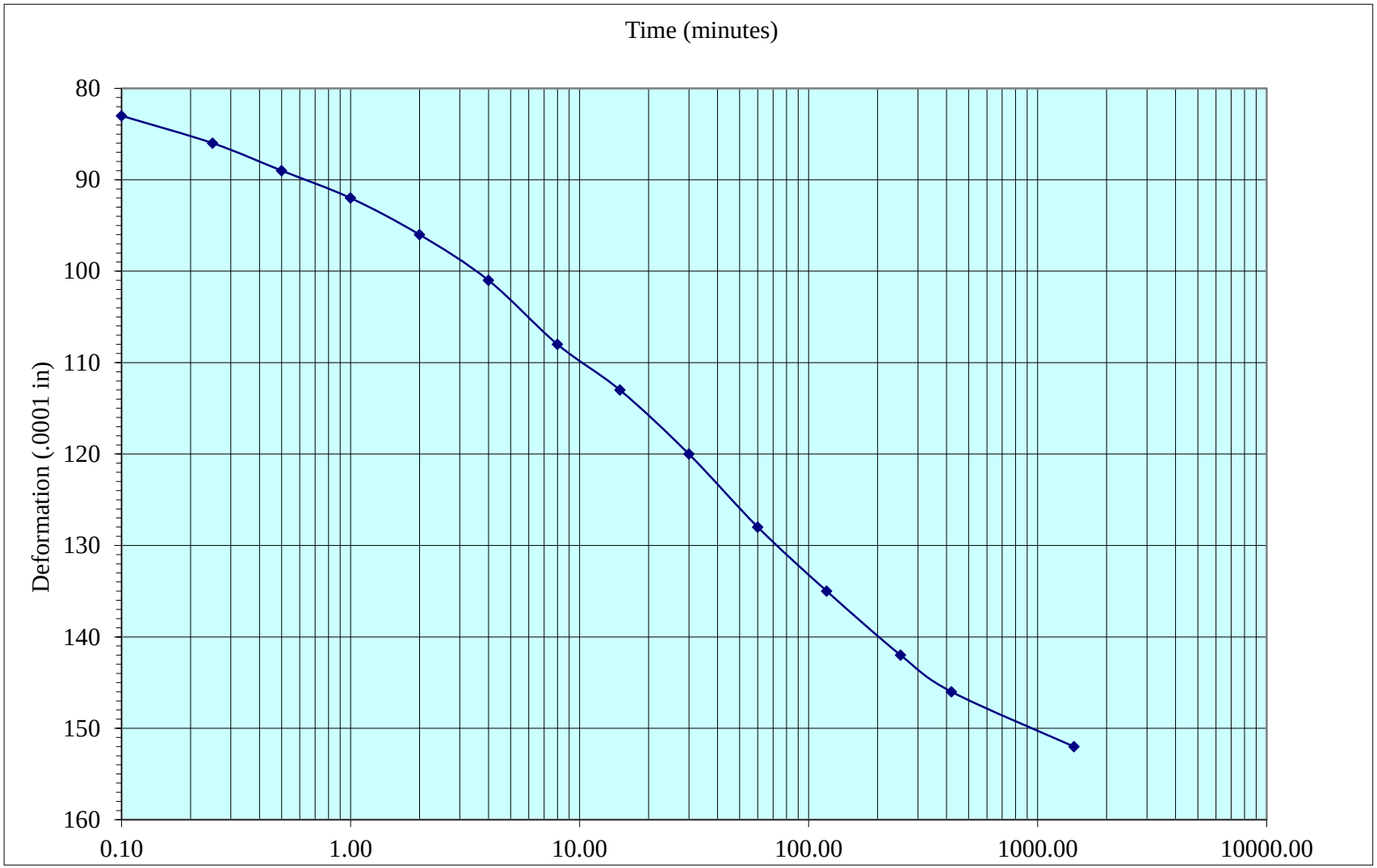
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-16-1.1A Sample No. ST-6-2 Load No. 4 TSF 2



D-0=

D-50=

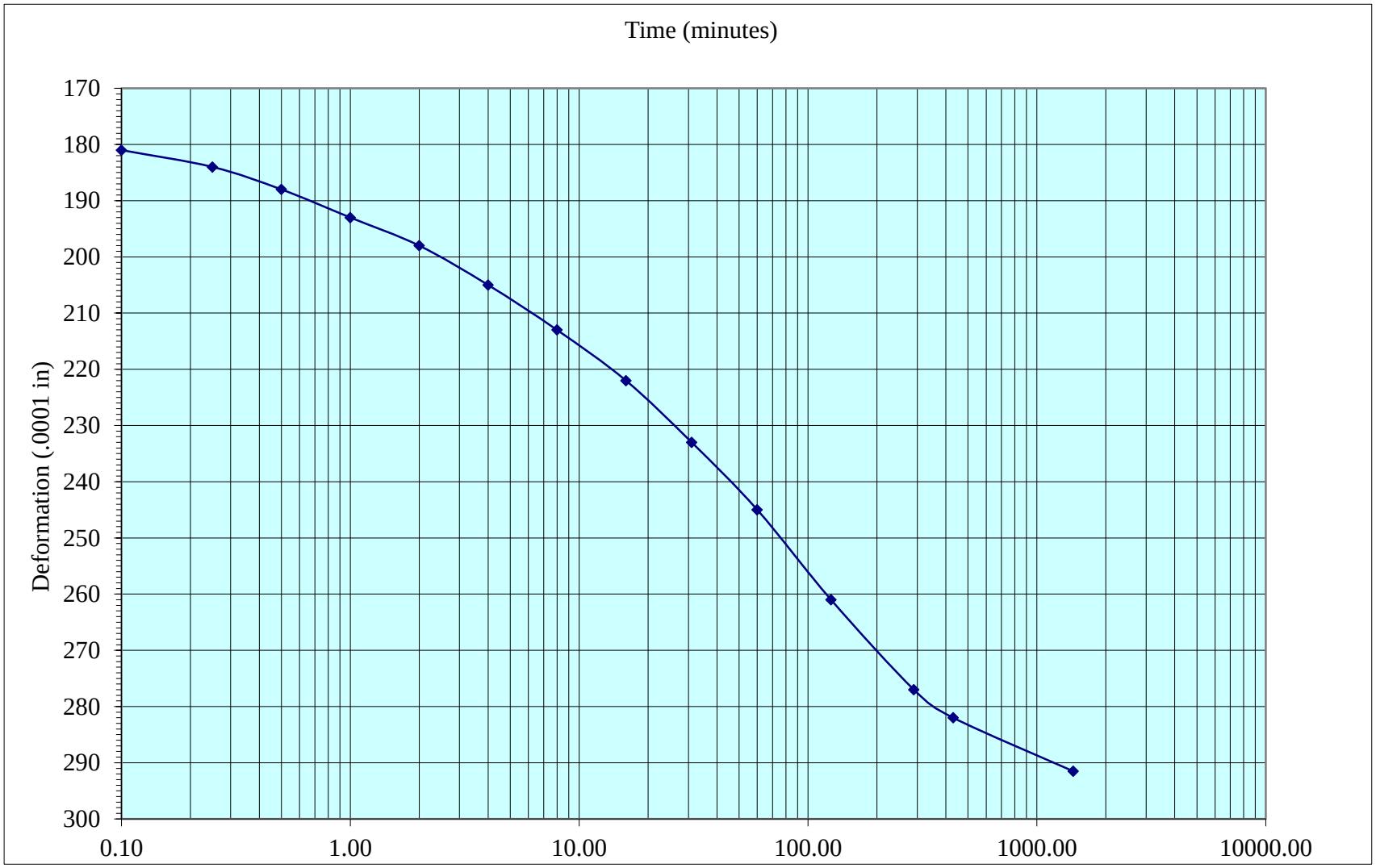
D-100=

t-50=

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-16-1.1A Sample No. ST-6-2 Load No. 5 TSF 4



D-0= _____

D-50= _____

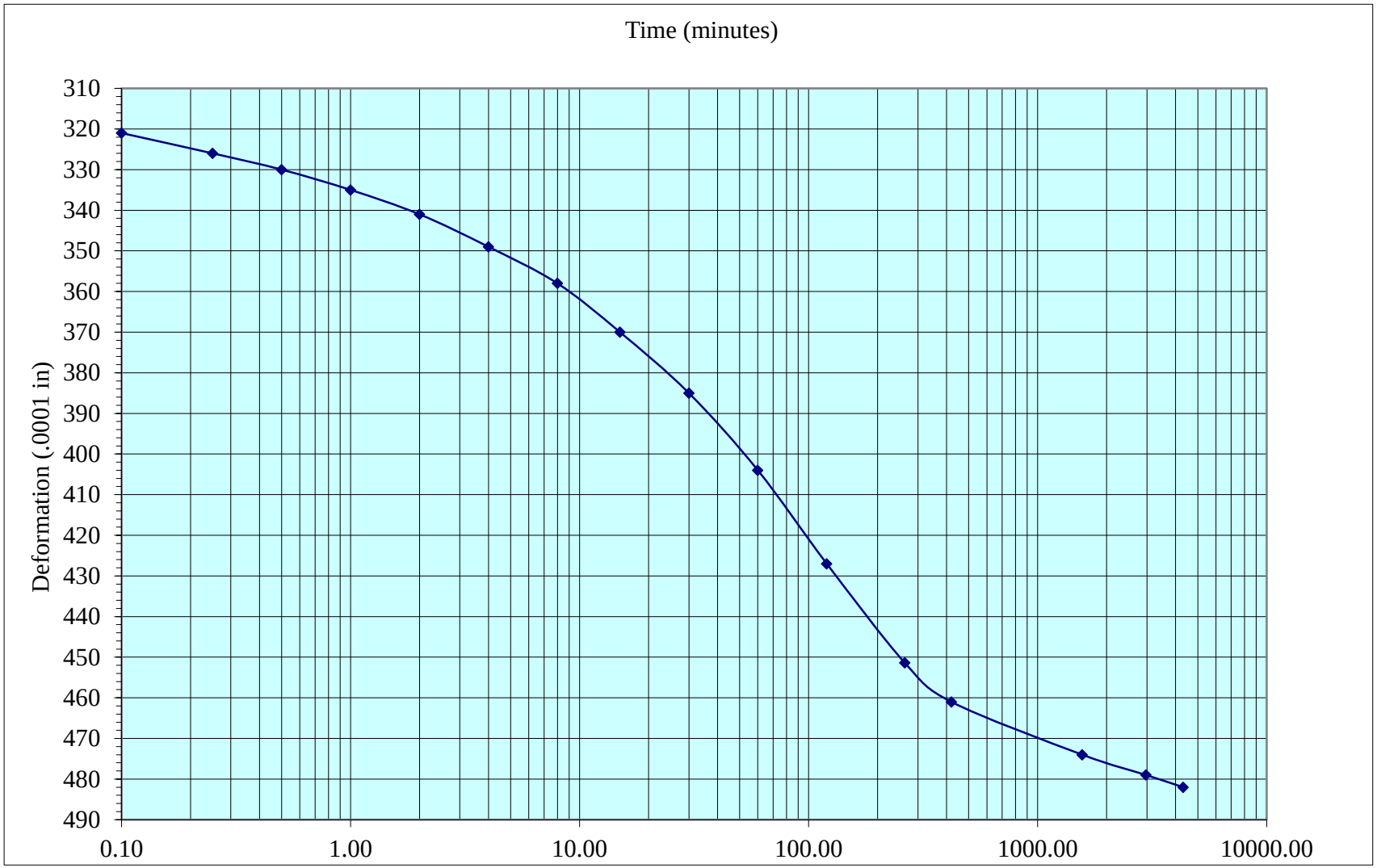
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-16-1.1A Sample No. ST-6-2 Load No. 6 TSF 8



D-0= _____

D-50= _____

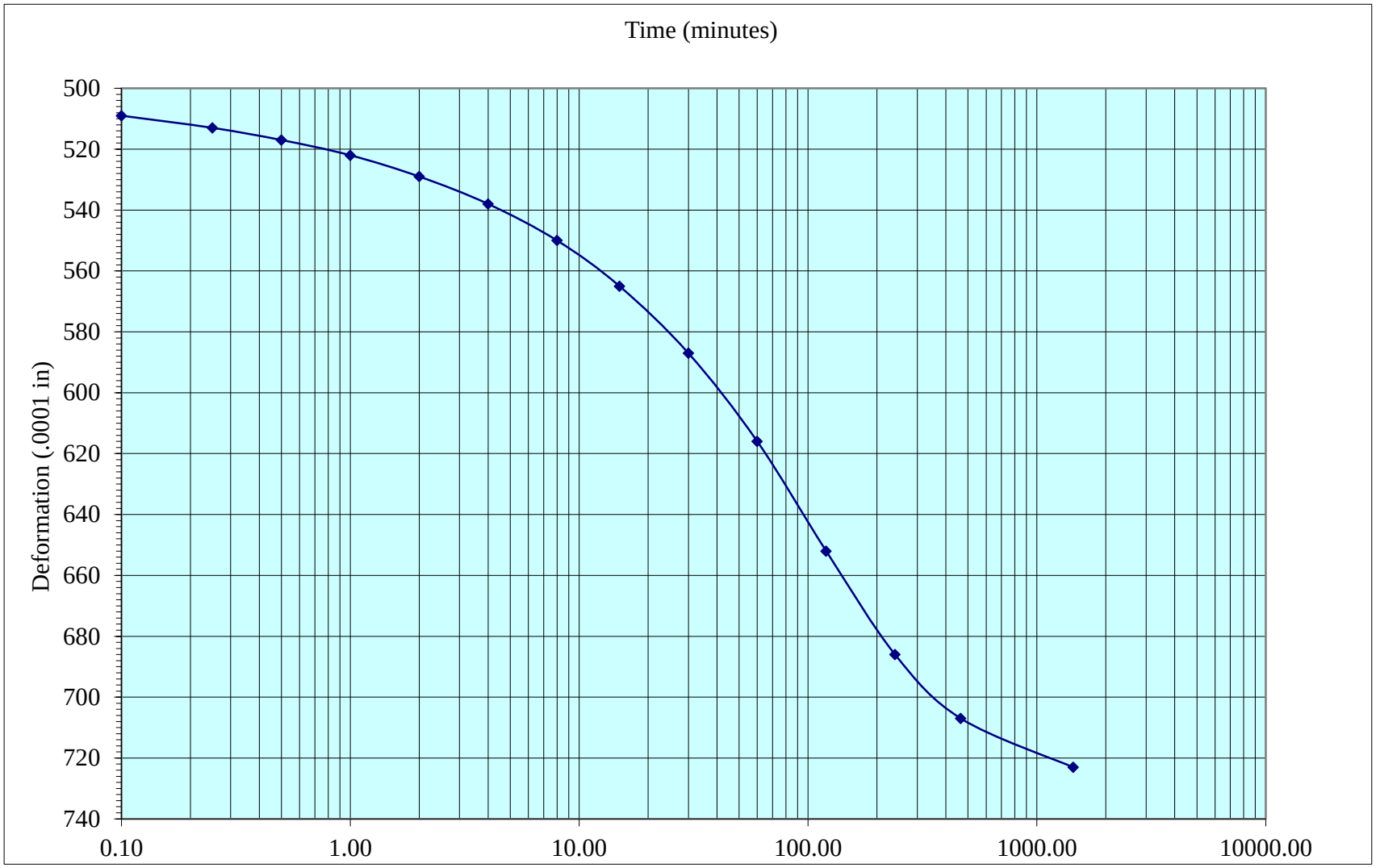
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-16-1.1A Sample No. ST-6-2 Load No. 7 TSF 16



D-0= _____

D-50= _____

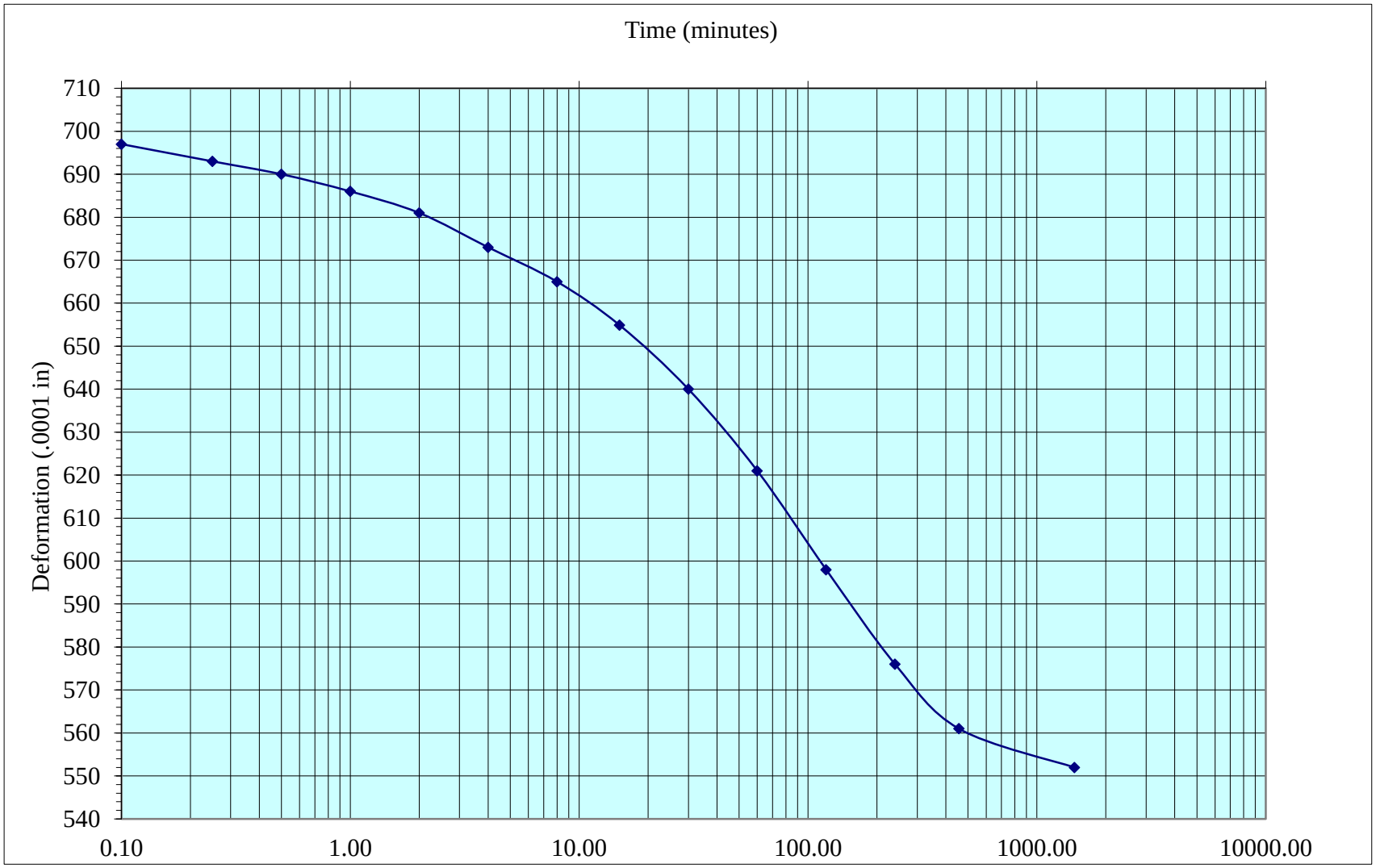
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-16-1.1A Sample No. ST-6-2 Load No. 8 TSF 4



D-0= _____

D-50= _____

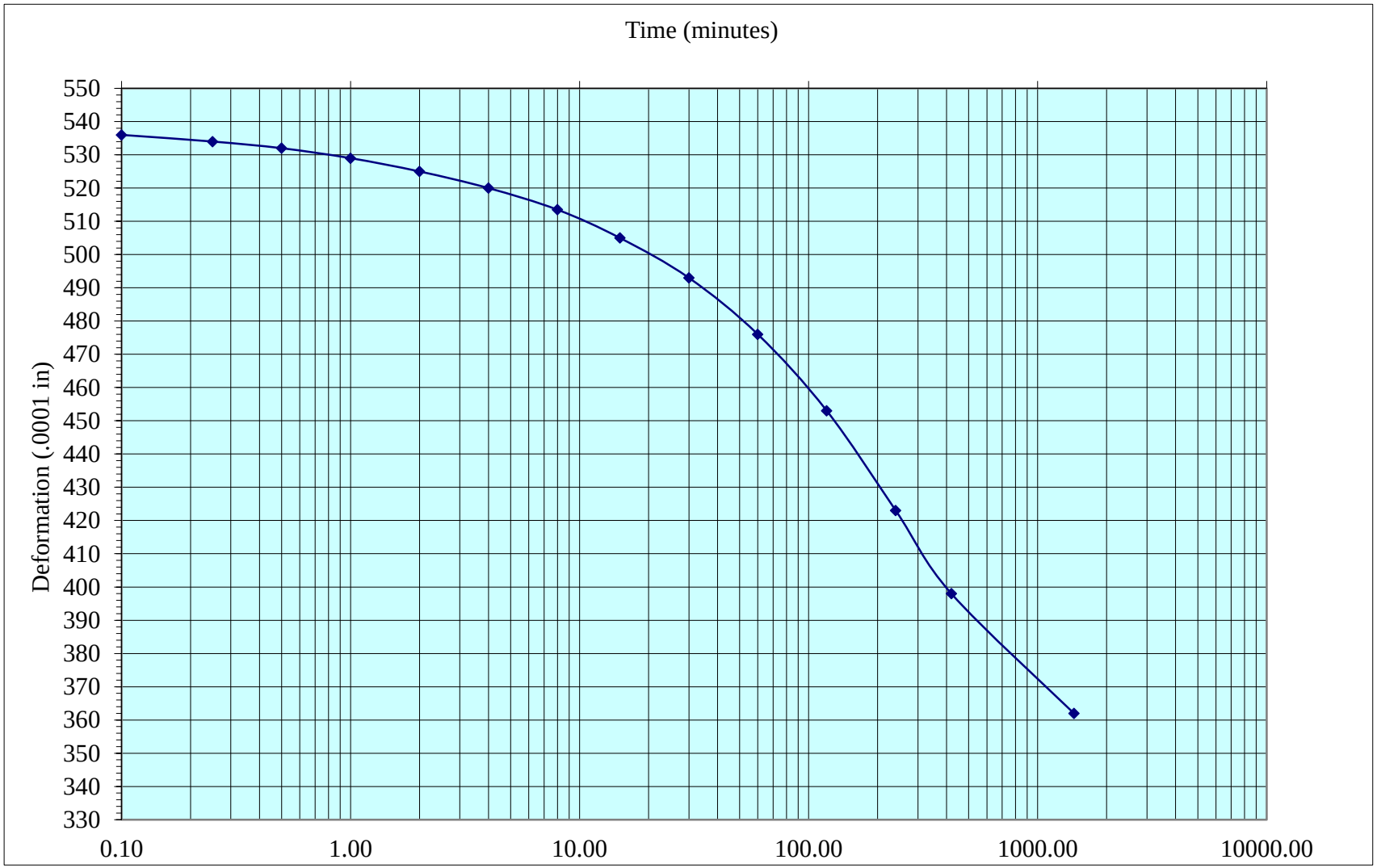
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-16-1.1A Sample No. ST-6-2 Load No. 9 TSF 1



D-0= _____

D-50= _____

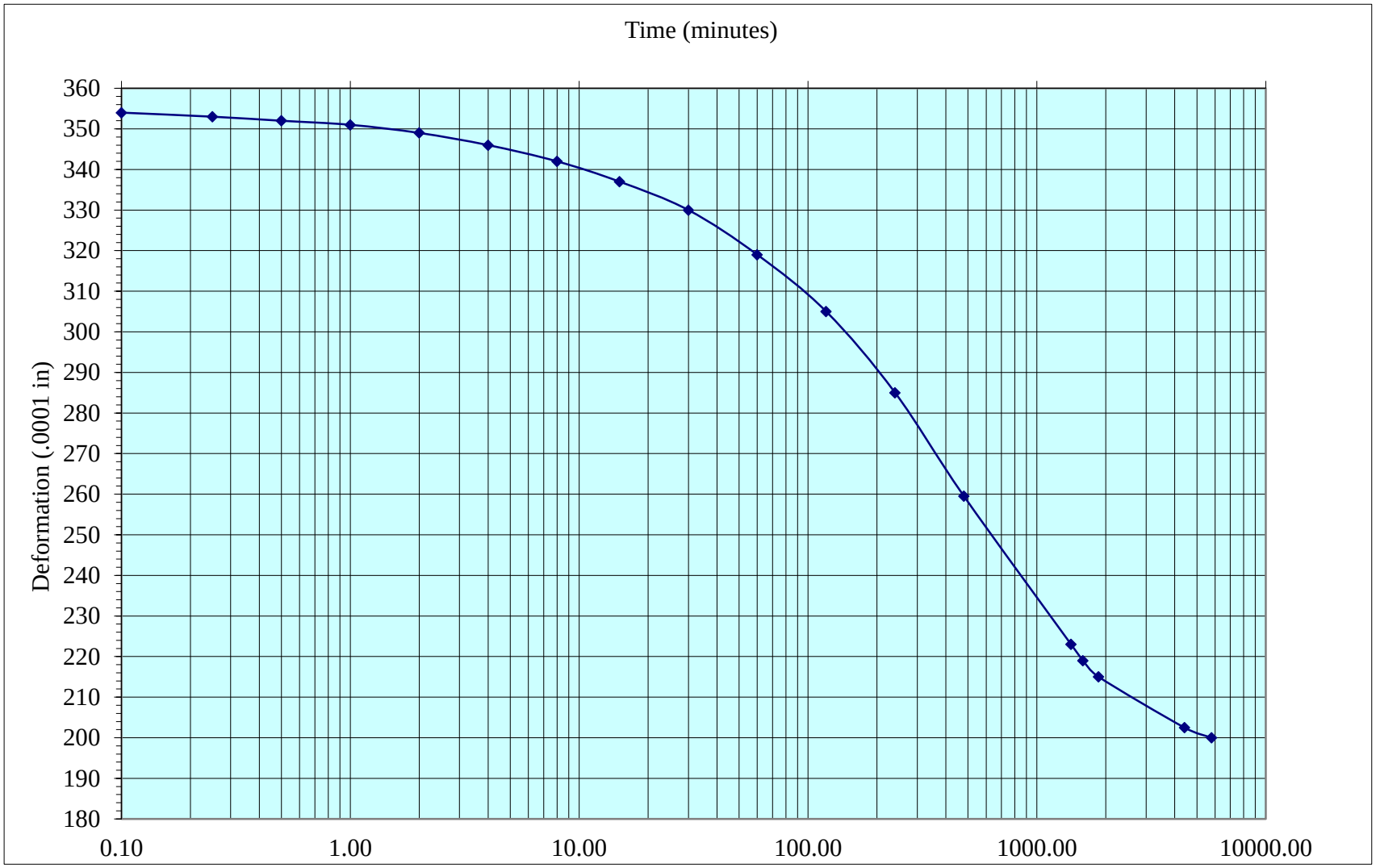
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-16-1.1A Sample No. ST-6-2 Load No. 10 TSF 0.25



D-0= _____

D-50= _____

D-100= _____

t-50= _____

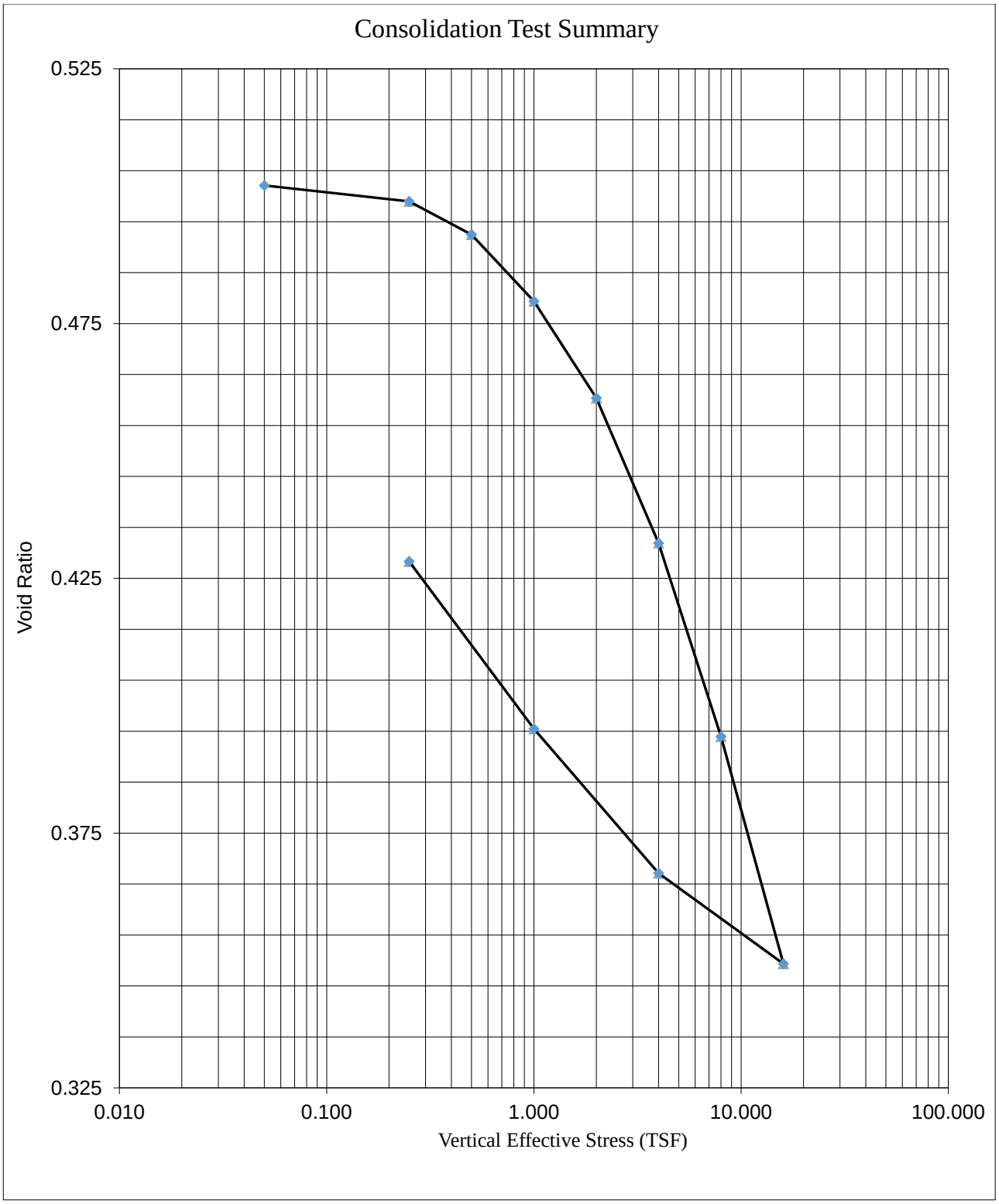
Project Name: I-70 Third Lane (Kingdom City to Columbia)

Visual Classification:

Project Number:	20241040.00	**Initial Moisture**		**Final Moisture**		**Initial Data**	
Boring Number:	BR-36-1A	Wet Wt Sample+Ring (g):	314.91	Wet Wt Sample+Ring (g):	314.82	Sample Height (in):	0.997
Sample Number:	ST-4-2	Dry Wt Sample+Ring (g):	289.79	Dry Wt Sample+Ring (g):	*289.79*	Sample Diameter (in):	2.501
Depth (ft):	8.5-9.0	Wt of Ring (g):	145.52	Wt of Ring (g):	145.52	Volume (in^3):	4.898
		Dry Wt of Sample (g):	144.27	Dry Wt of Sample (g):	144.27106	Specific Gravity:	2.7
Wet Unit Weight (pcf):	131.75	Wt of Water (g):	25.12	Wt of Water (g):	25.028944	Height of Solids (in):	0.664
Dry Unit Weight (pcf):	112.21	Moisture Content (%):	17.4	Moisture Content (%):	17.3	Initial Void Ratio:	0.502

1

Load (tsf)	D_{100} (0.0001")	Machine Deflection (0.0001")	Correction Factor	Corrected D_{100} (0.0001")	% Strain	Void Ratio Change	Void Ratio	D_{50} Uncorrected (0.0001")	H_{50} Corrected	t_{50} (min)	Cv (IN^2/MIN)
0.050	105.0	0.1		104.9	1.05	0.0000	0.502	57.5	0.9970	480.00	0.0001
0.250	21.0	0.1		20.9	0.21	0.0031	0.499	14.0	0.9956	30.00	0.0016
0.500	64.0	0.1		63.9	0.64	0.0096	0.492	49.0	0.9921	30.00	0.0016
1.000	151.0	0.1		150.9	1.51	0.0227	0.479	120.0	0.9850	14.00	0.0034
2.000	277.0	0.1		276.9	2.78	0.0417	0.460	233.5	0.9737	12.00	0.0039
4.000	466.0	0.1		465.9	4.67	0.0702	0.432	402.0	0.9568	20.00	0.0023
8.000	718.0	0.1		717.9	7.20	0.1082	0.394	626.0	0.9344	31.00	0.0014
16.000	1014.0	0.1		1013.9	10.17	0.1528	0.349	902.0	0.9068	47.00	0.0009
4.000	896.0	0.1		895.9	8.99	0.1350	0.367	952.5	0.9018	34.00	0.0012
1.000	708.0	0.1		707.9	7.10	0.1067	0.395	788.5	0.9182	64.00	0.0006
0.250	490.0	0.1		489.9	4.91	0.0738	0.428	576.5	0.9394	198.00	0.0002



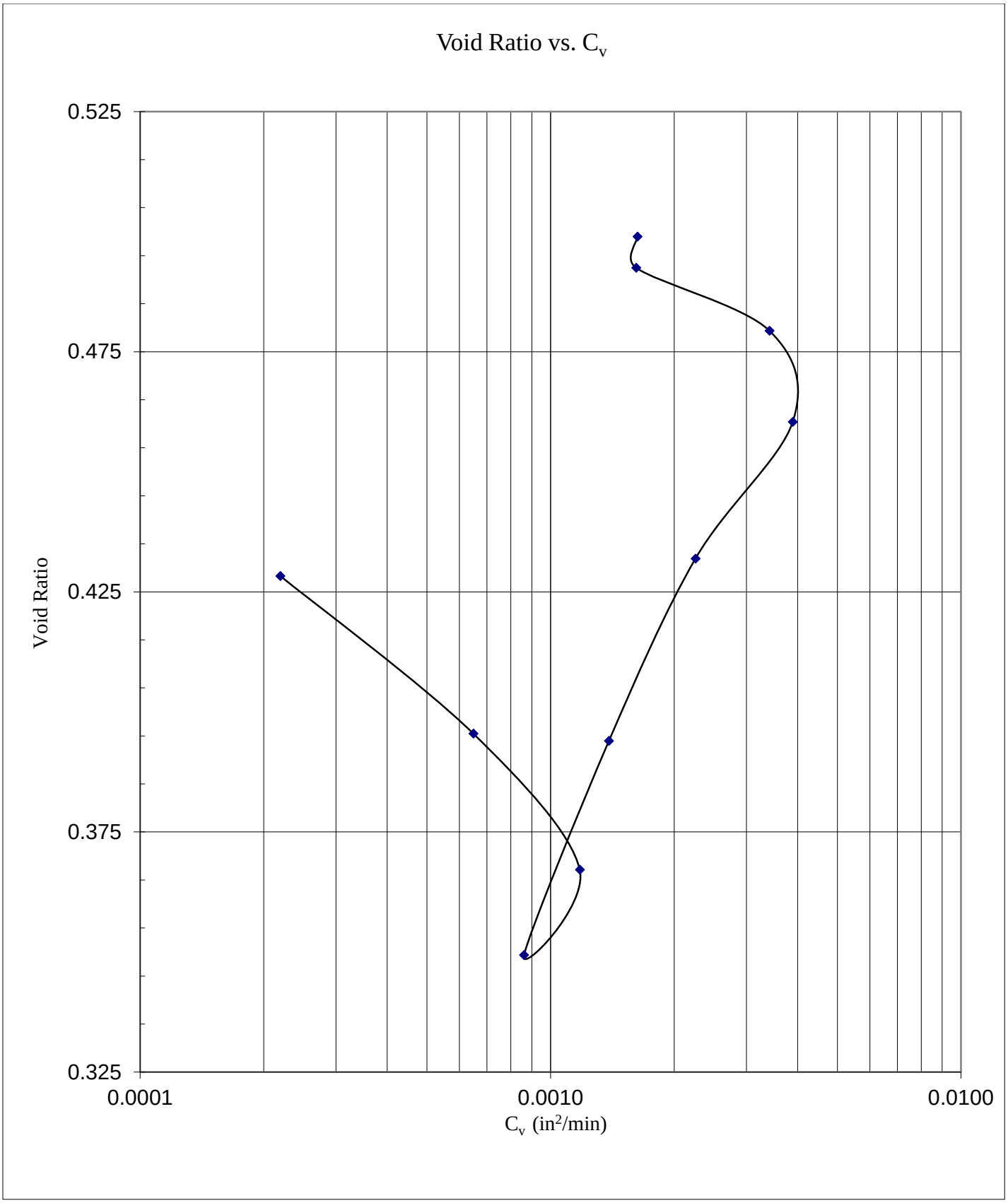
Boring No. BR-36-1A Sample ST-4-2 Depth 8.5-9.0

Soil Description : Brown and gray, fat CLAY (CH), trace sand and gravel

Initial Moisture Content (%): 17.4 Specific Gravity: 2.7 (assumed)

Initial Dry Density(pcf): 112.2 Project Name: I-70 Third Lane (Kingdom City to Columb

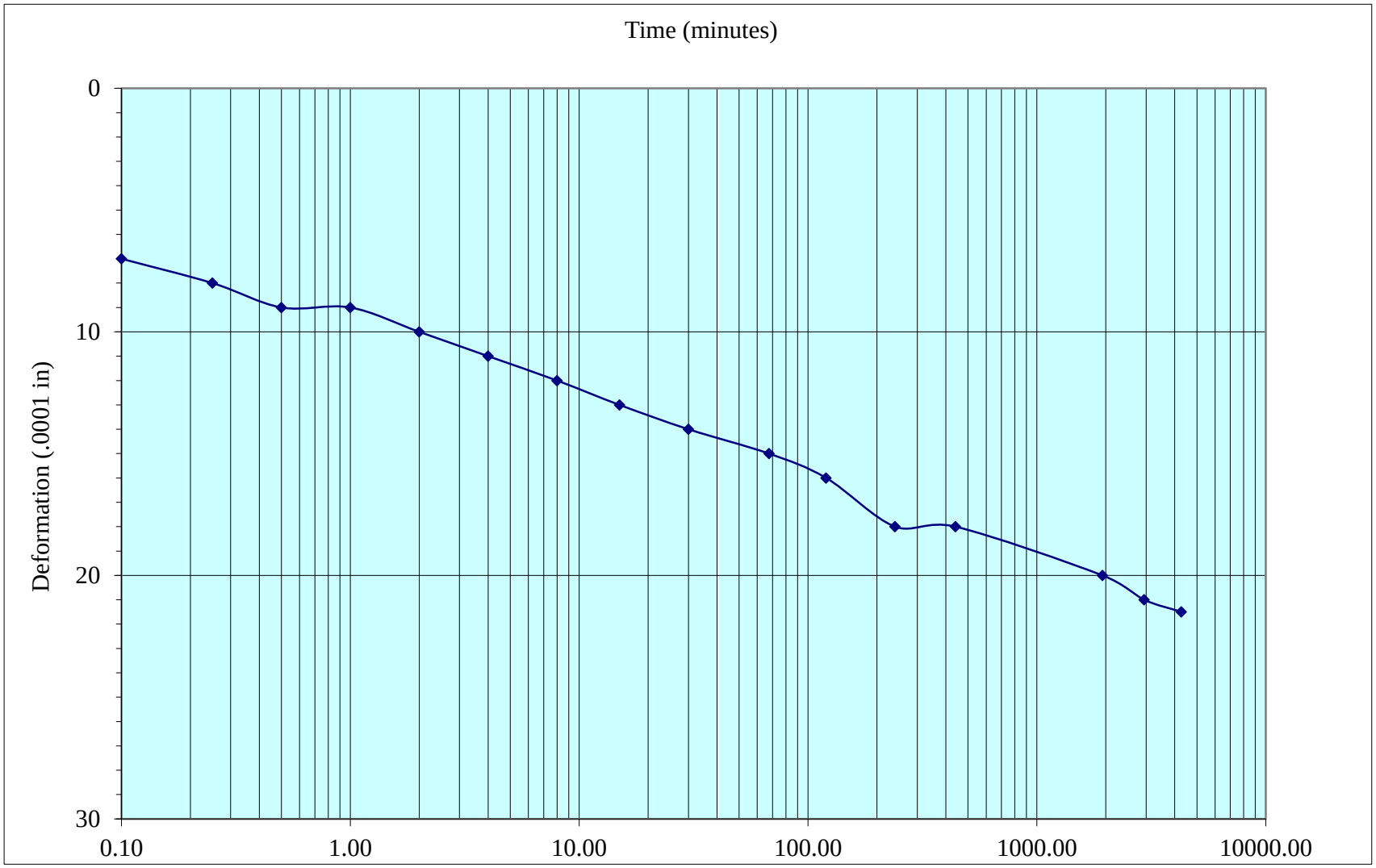
Project Number: 20241040.00


Void Ratio vs. C_v
0.525
0.475
0.425
0.375
0.325
Void Ratio
0.0001
0.0010
0.0100
C_v (in^2/min)

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-36-1A Sample No. ST-4-2 Load No. 1 TSF 0.25



D-0=

D-50=

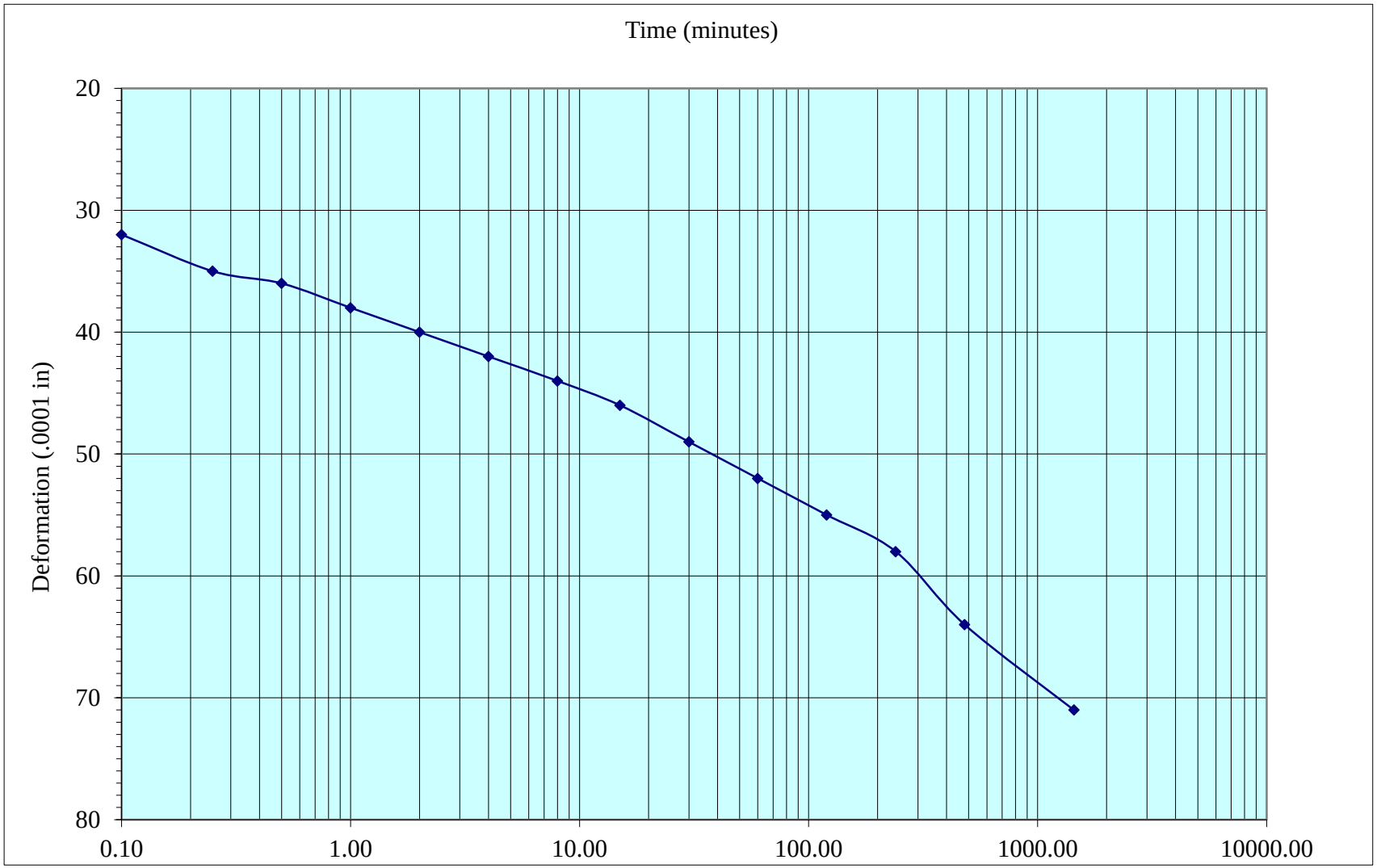
D-100=

t-50=

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-36-1A Sample No. ST-4-2 Load No. 2 TSF 0.5



D-0= _____

D-50= _____

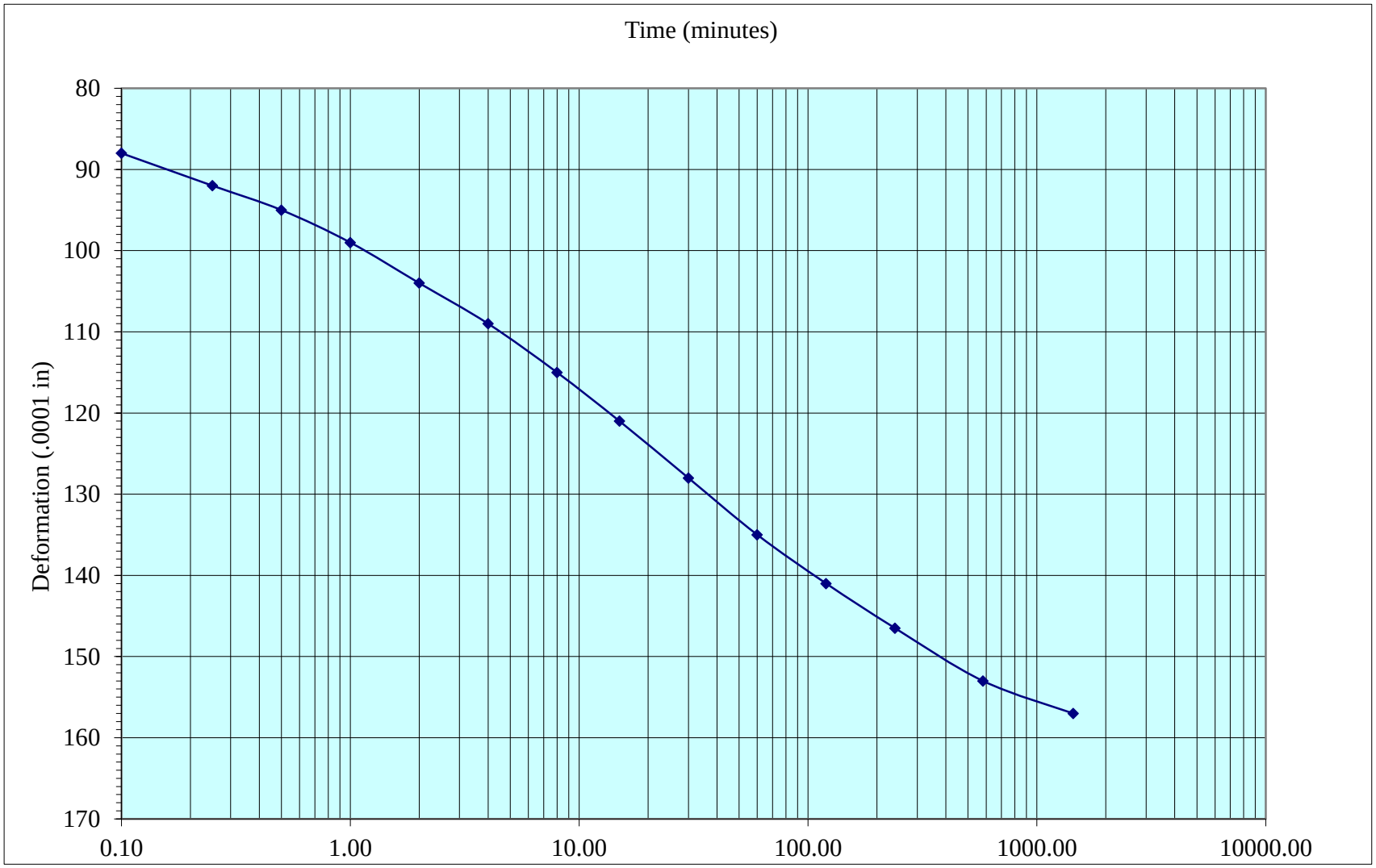
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-36-1A Sample No. ST-4-2 Load No. 3 TSF 1



D-0= _____

D-50= _____

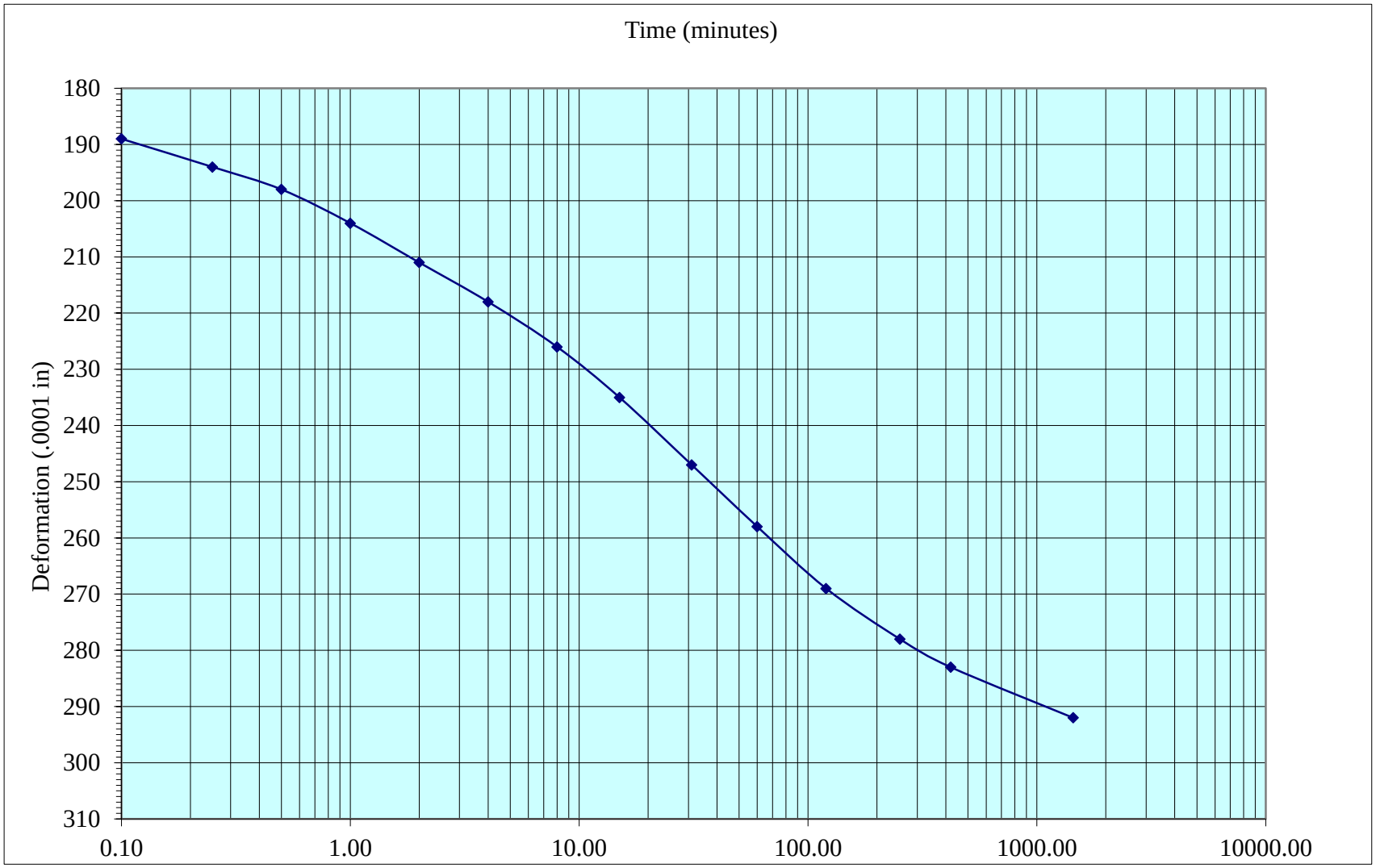
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-36-1A Sample No. ST-4-2 Load No. 4 TSF 2



D-0=

D-50=

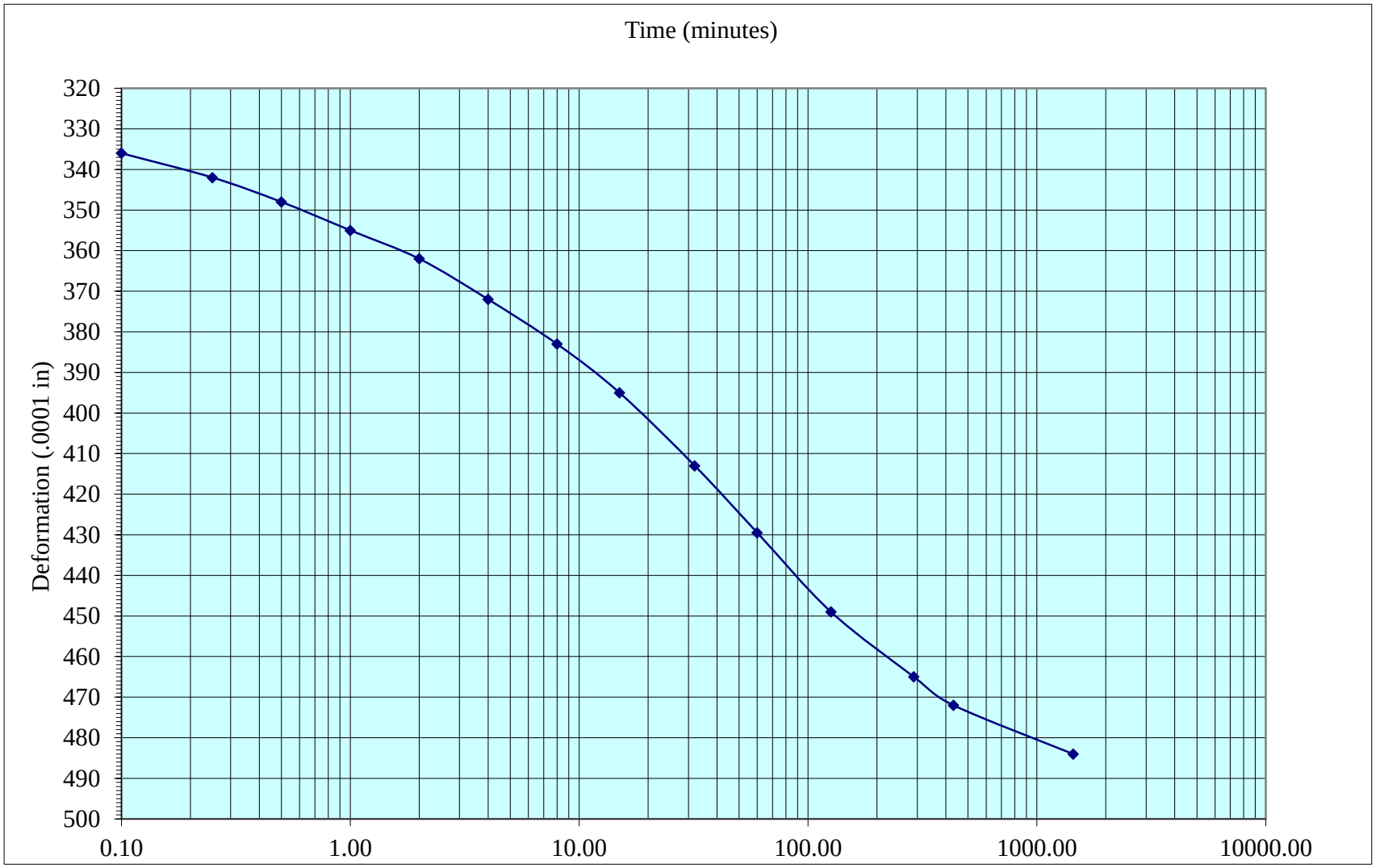
D-100=

t-50=

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-36-1A Sample No. ST-4-2 Load No. 5 TSF 4



D-0= _____

D-50= _____

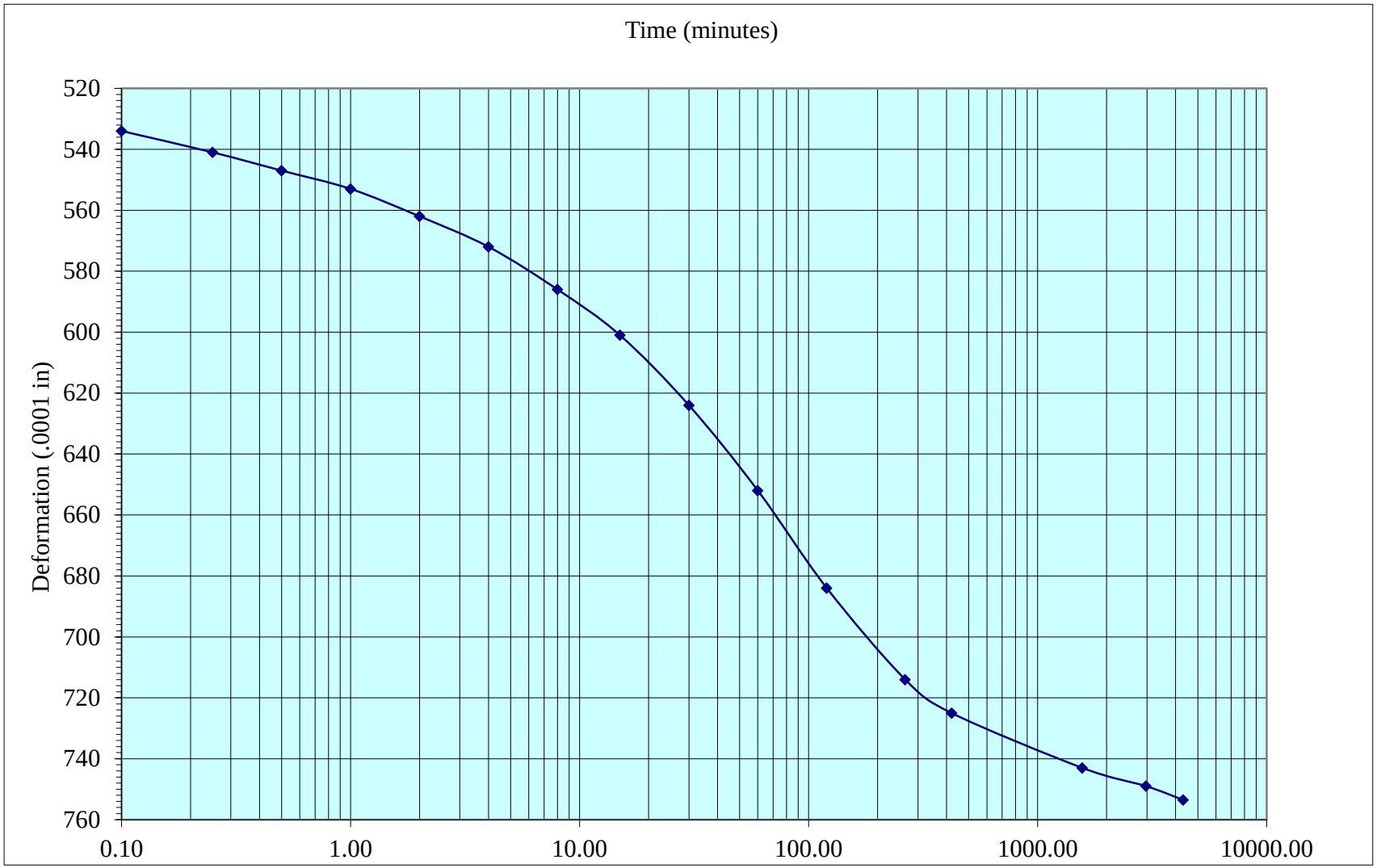
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-36-1A Sample No. ST-4-2 Load No. 6 TSF 8



D-0= _____

D-50= _____

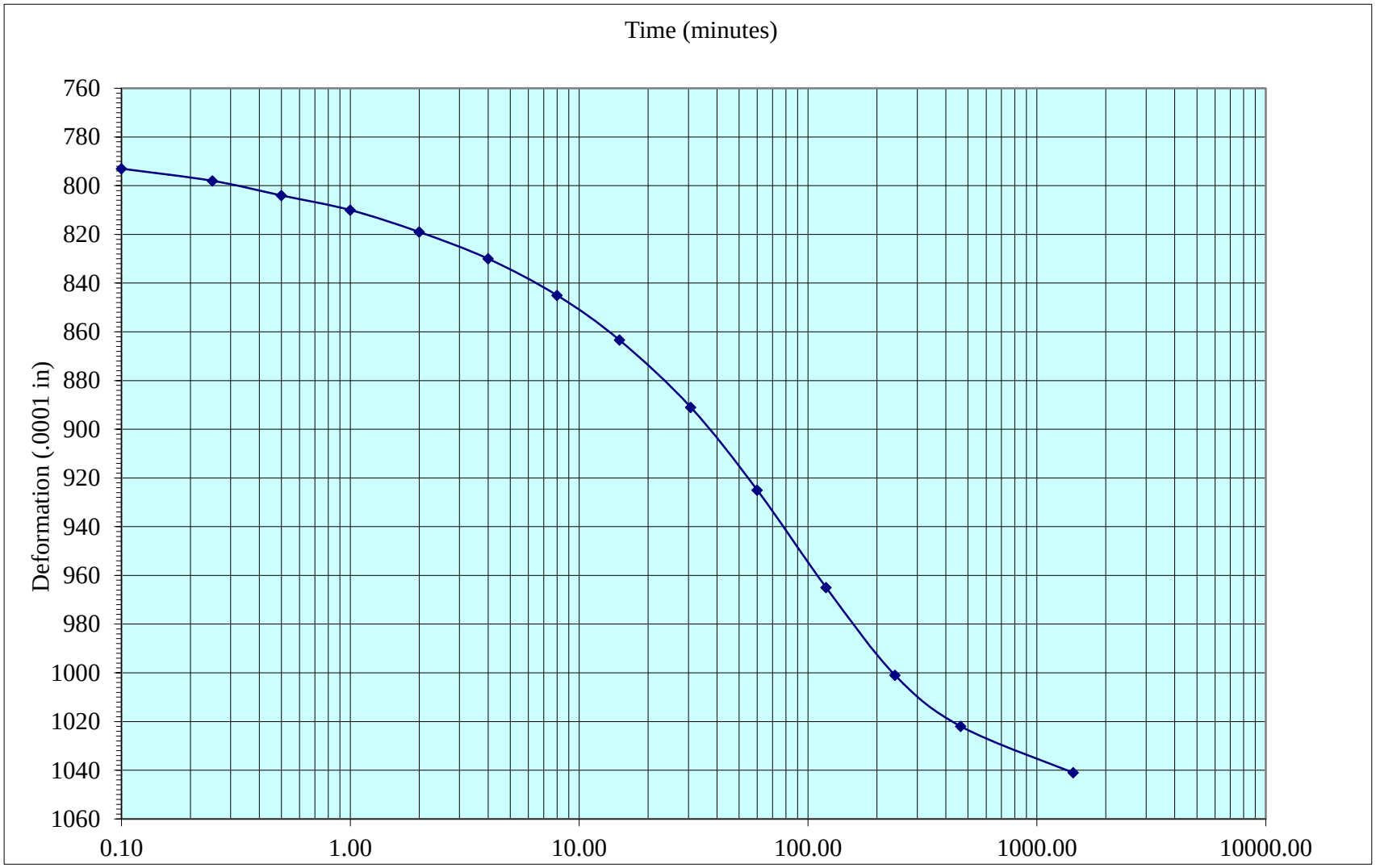
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-36-1A Sample No. ST-4-2 Load No. 7 TSF 16



D-0=

D-50=

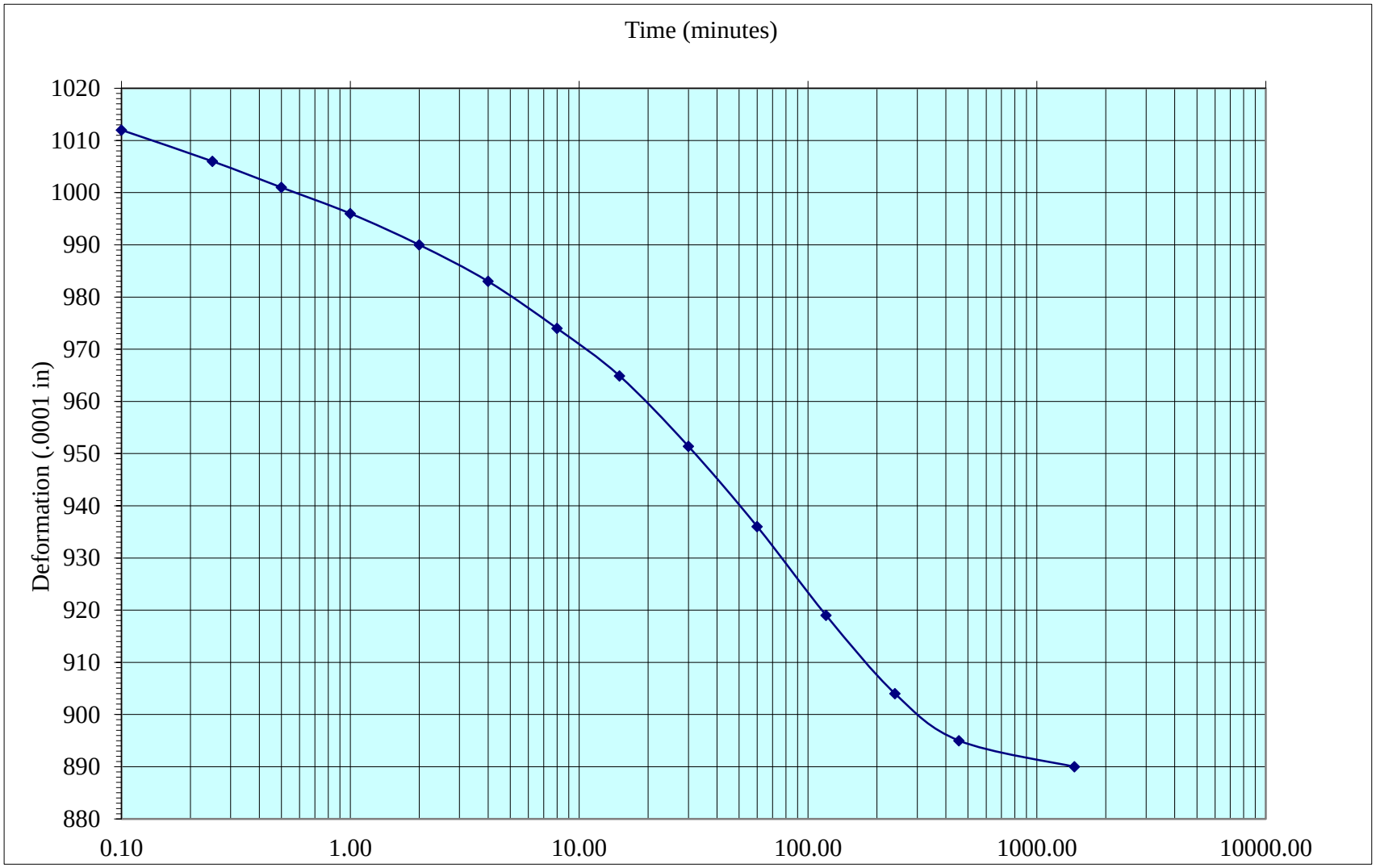
D-100=

t-50=

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-36-1A Sample No. ST-4-2 Load No. 8 TSF 4



D-0= _____

D-50= _____

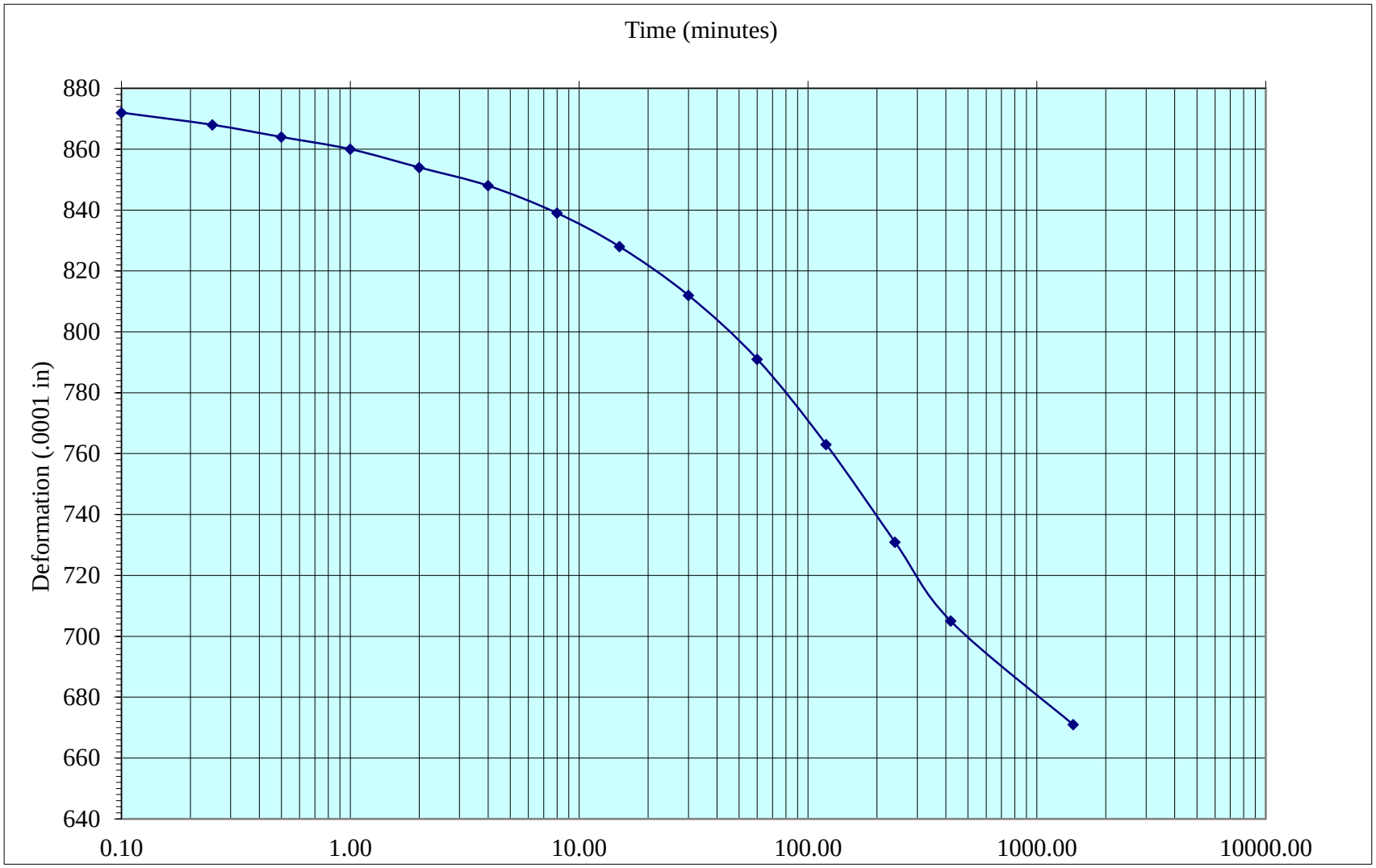
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-36-1A Sample No. ST-4-2 Load No. 9 TSF 1



D-0= _____

D-50= _____

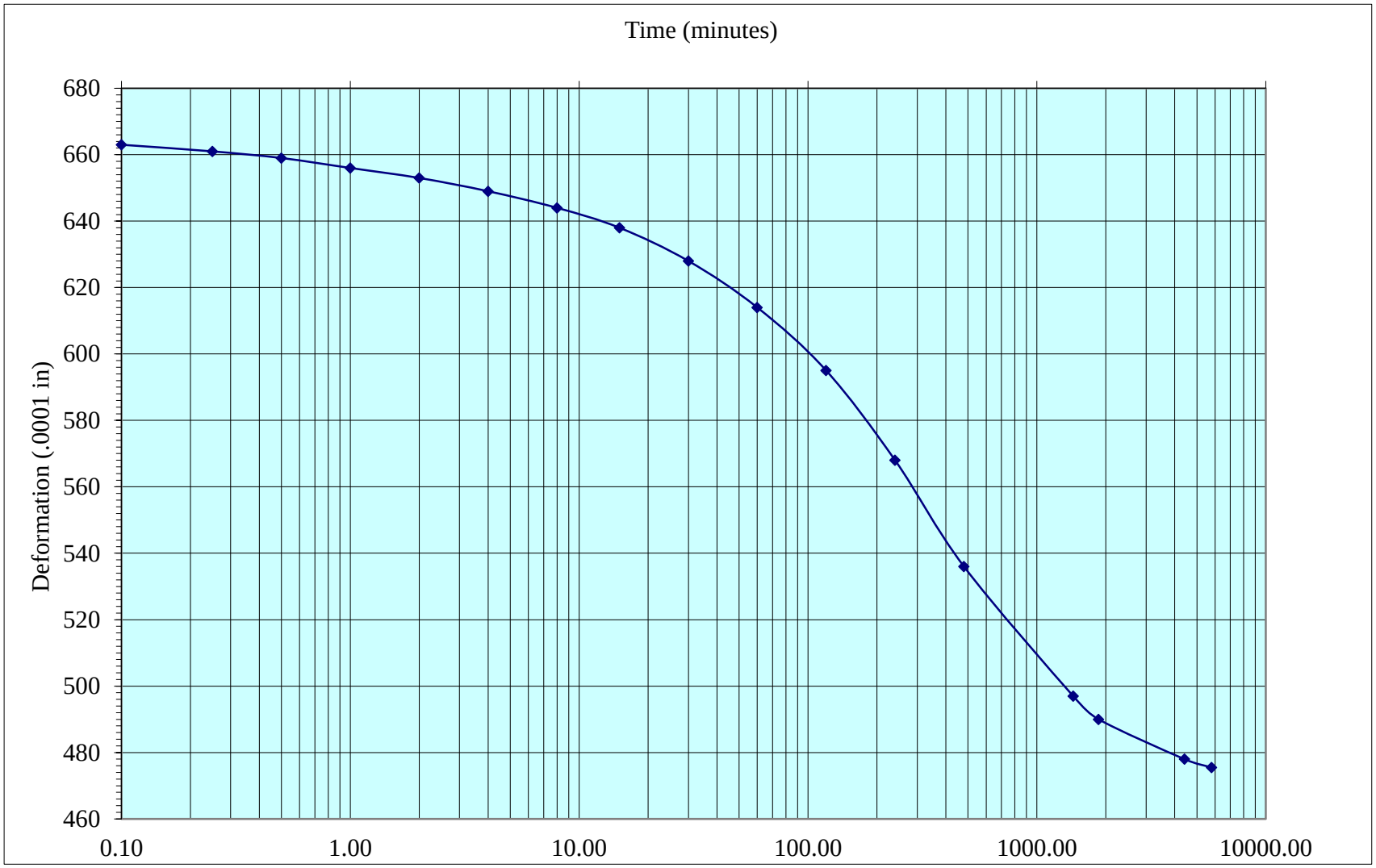
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-36-1A Sample No. ST-4-2 Load No. 10 TSF 0.25



D-0=

D-50=

D-100=

t-50=

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project Number: 20241040.00

Boring Number: BR-37-2

Sample Number: ST-13-3

Depth (ft): 54.0-54.5

Wet Unit Weight (pcf): 126.25

Dry Unit Weight (pcf): 103.20

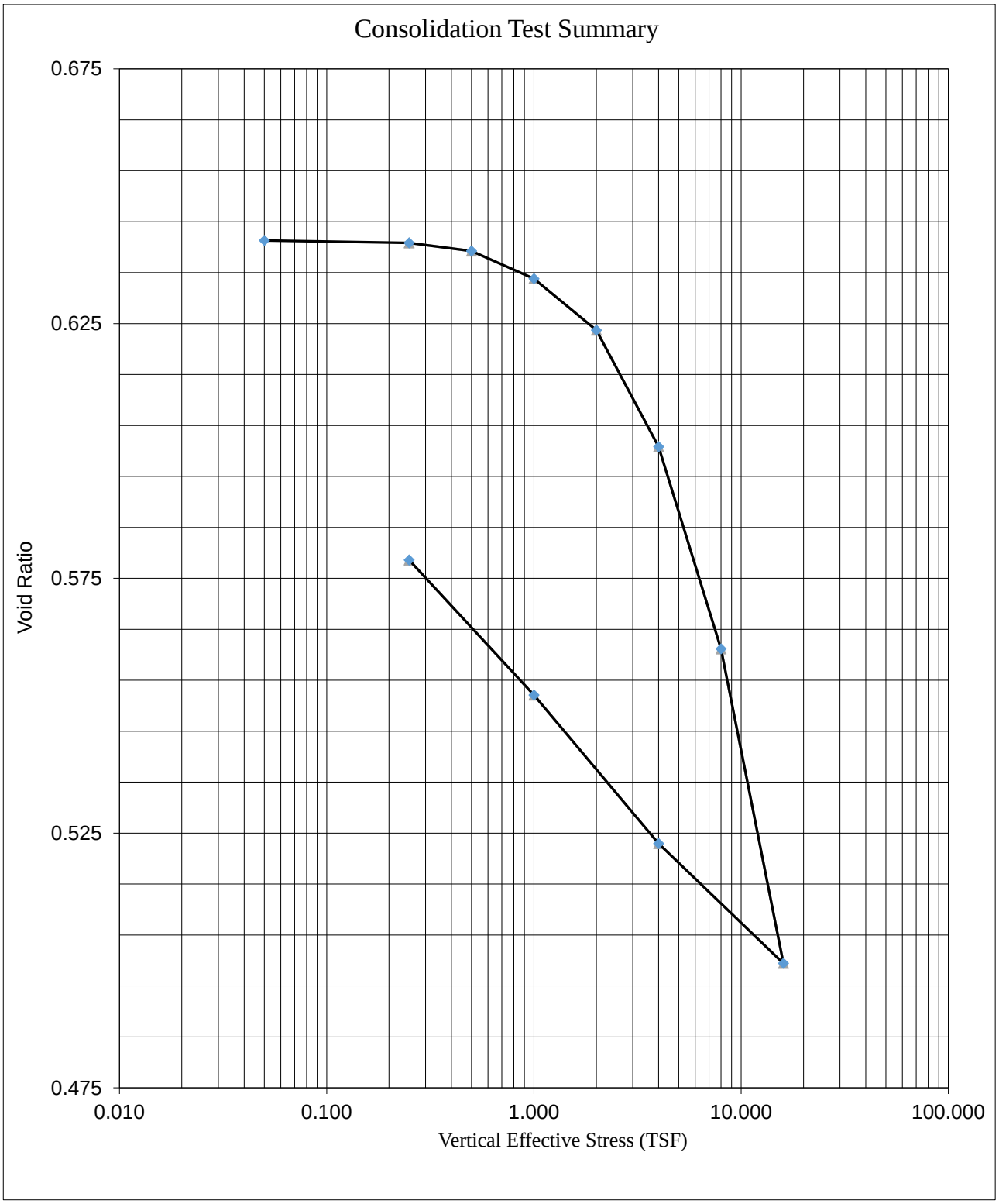
	Initial Moisture	Final Moisture
Wet Wt Sample+Ring (g):	377.53	377.33
Dry Wt Sample+Ring (g):	347.27	347.27
Wt of Ring (g):	215.34	215.34
Dry Wt of Sample (g):	131.93	131.93
Wt of Water (g):	30.26	30.06
Moisture Content (%):	22.3	22.8

Visual Classification:

Initial Data

Sample Height (in):	0.997
Sample Diameter (in):	2.500
Volume (in^3):	4.894
Specific Gravity:	2.7
Height of Solids (in):	0.607
Initial Void Ratio:	0.641

Load (tsf)	D_{100} (0.0001")	Machine Deflection (0.0001")	Correction Factor	Corrected D_{100} (0.0001")	% Strain	Void Ratio Change	Void Ratio	D_{50} Uncorrected (0.0001")	H_{50} Corrected	t_{50} (min)	Cv (IN^2/MIN)
0.050	0.0	0.1		-0.1	0.00	0.0000	0.641	0.0	0.9970	480.00	0.0001
0.250	3.0	0.1		2.9	0.03	0.0005	0.641	3.0	0.9967	7.00	0.0070
0.500	12.8	0.1		12.7	0.13	0.0021	0.639	8.9	0.9961	540.00	0.0001
1.000	45.6	0.1		45.5	0.46	0.0075	0.634	35.3	0.9935	20.00	0.0024
2.000	107.0	0.1		106.9	1.07	0.0176	0.624	86.0	0.9884	11.00	0.0044
4.000	246.0	0.1		245.9	2.47	0.0405	0.601	199.0	0.9771	13.00	0.0036
8.000	487.0	0.1		486.9	4.88	0.0802	0.561	403.5	0.9567	11.00	0.0041
16.000	862.0	0.1		861.9	8.64	0.1419	0.499	727.0	0.9243	41.00	0.0010
4.000	719.0	0.1		718.9	7.21	0.1183	0.523	763.5	0.9207	17.00	0.0025
1.000	542.0	0.1		541.9	5.44	0.0892	0.552	620.0	0.9350	90.00	0.0005
0.250	381.0	0.1		380.9	3.82	0.0627	0.579	443.0	0.9527	270.00	0.0002



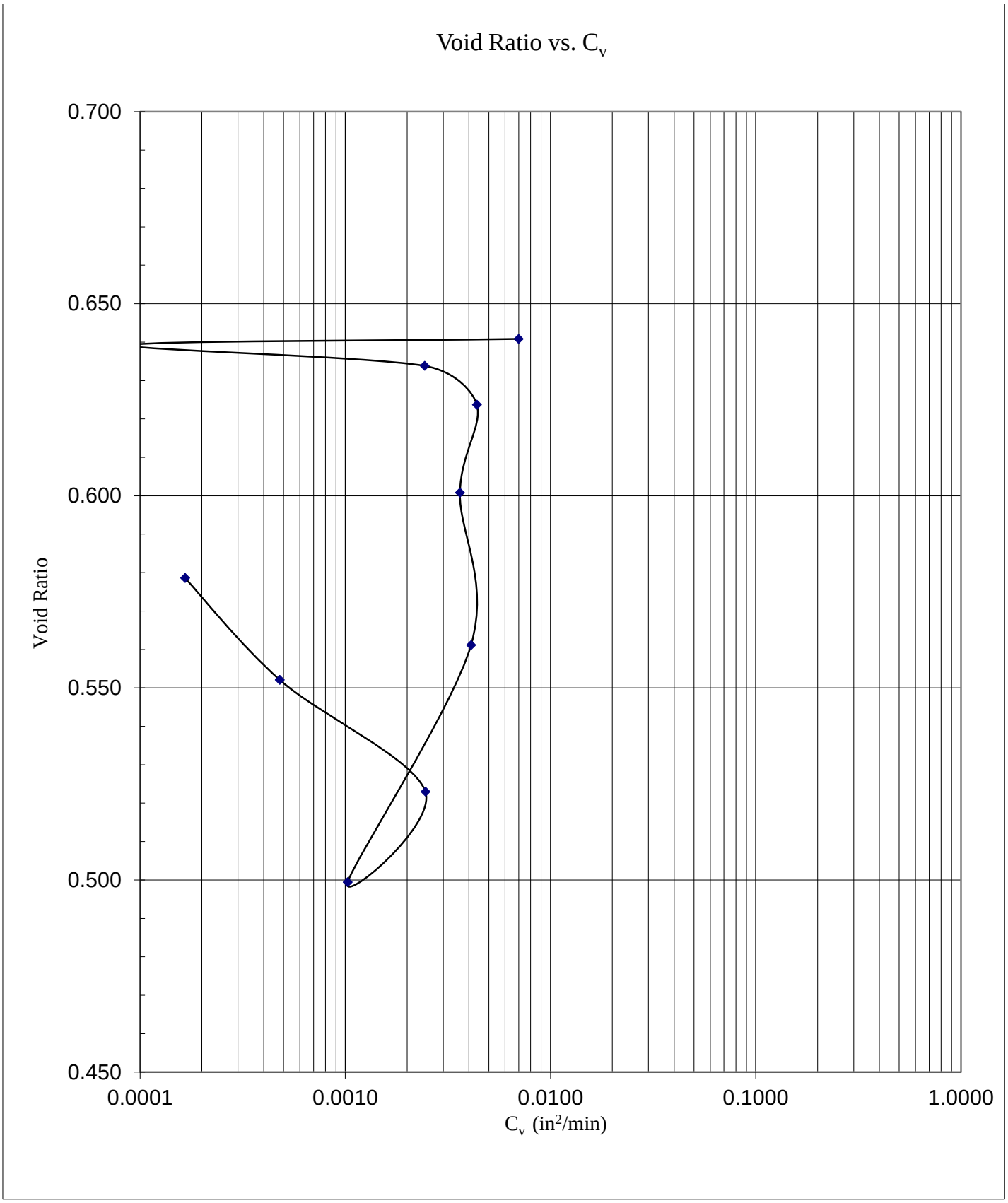
Boring No. BR-37-2 Sample ST-13-3 Depth 54.0-54.5

Soil Description : Brown, fat CLAY (CH), with sand and gravel

Initial Moisture Content (%): 22.3 Specific Gravity: 2.7 (assumed)

Initial Dry Density(pcf): 103.2 Project Name: I-70 Third Lane (Kingdom City to Columb

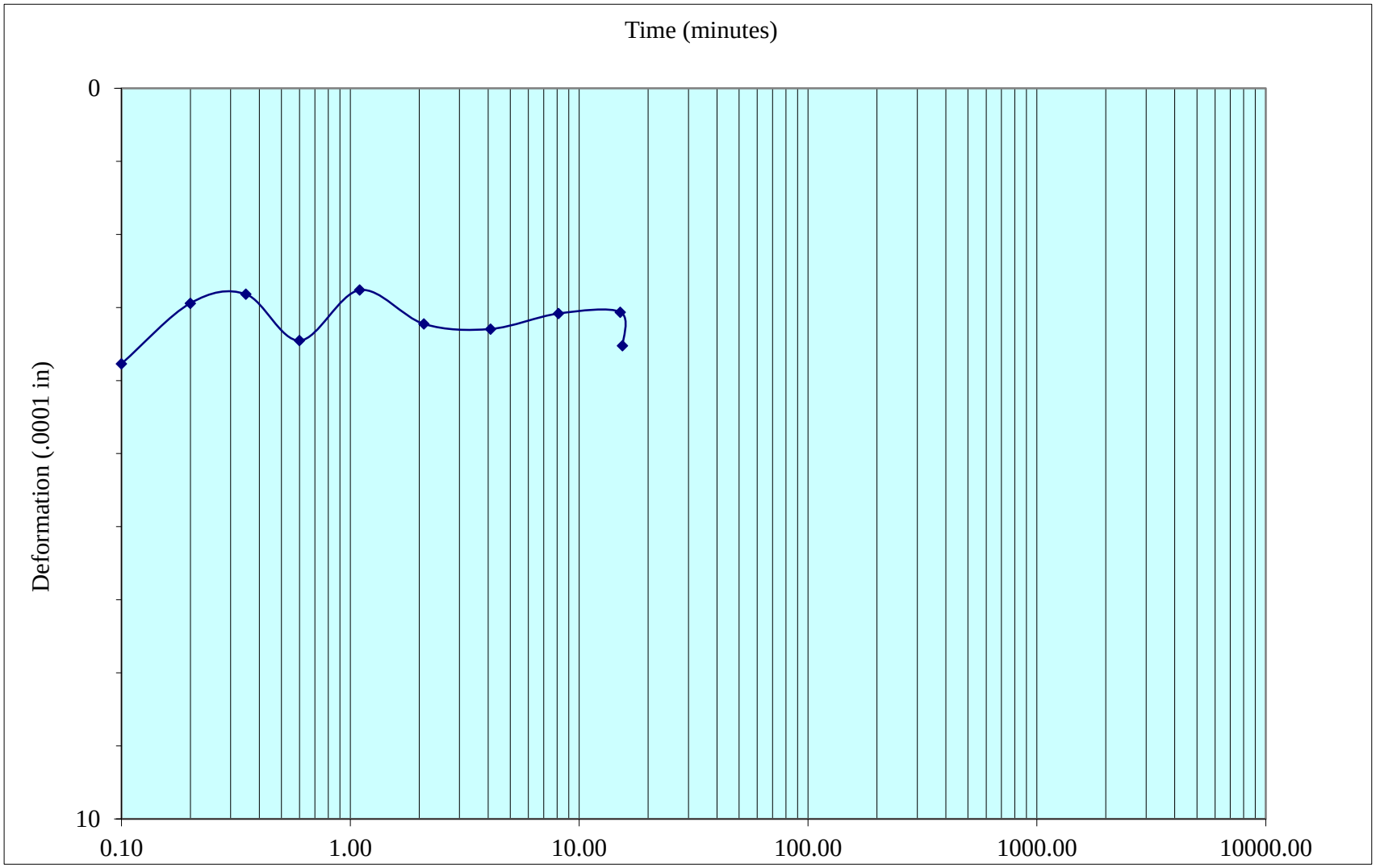
Project Number: 20241040.00


Void Ratio vs. C_v
0.700
0.650
0.600
0.550
0.500
0.450
Void Ratio
0.0001
0.0010
0.0100
0.1000
1.0000
C_v (in²/min)

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-37-2 Sample No. ST-13-3 Load No. 1 TSF 0.25



D-0=

D-50=

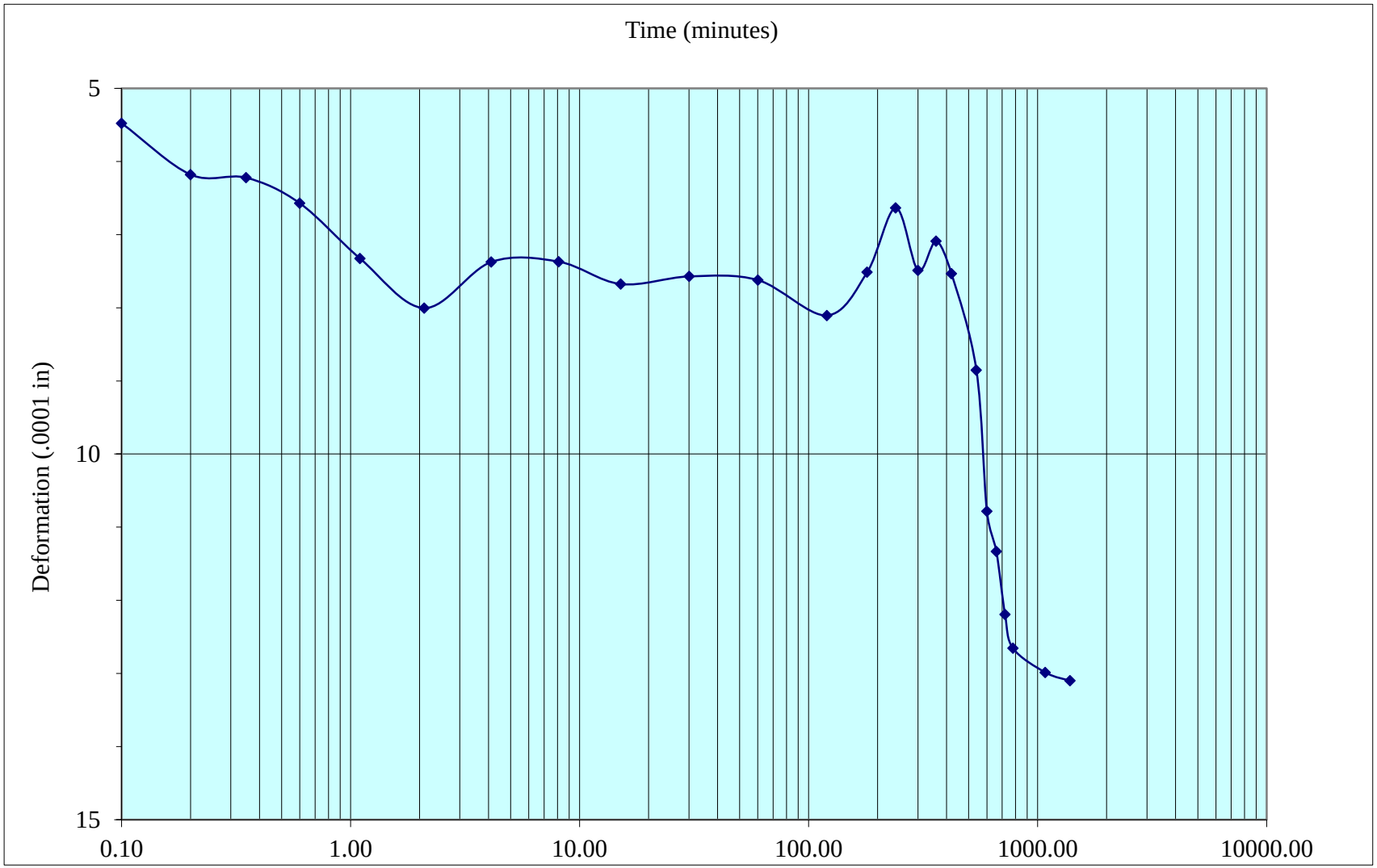
D-100=

t-50=

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-37-2 Sample No. ST-13-3 Load No. 2 TSF 0.5



D-0=

D-50=

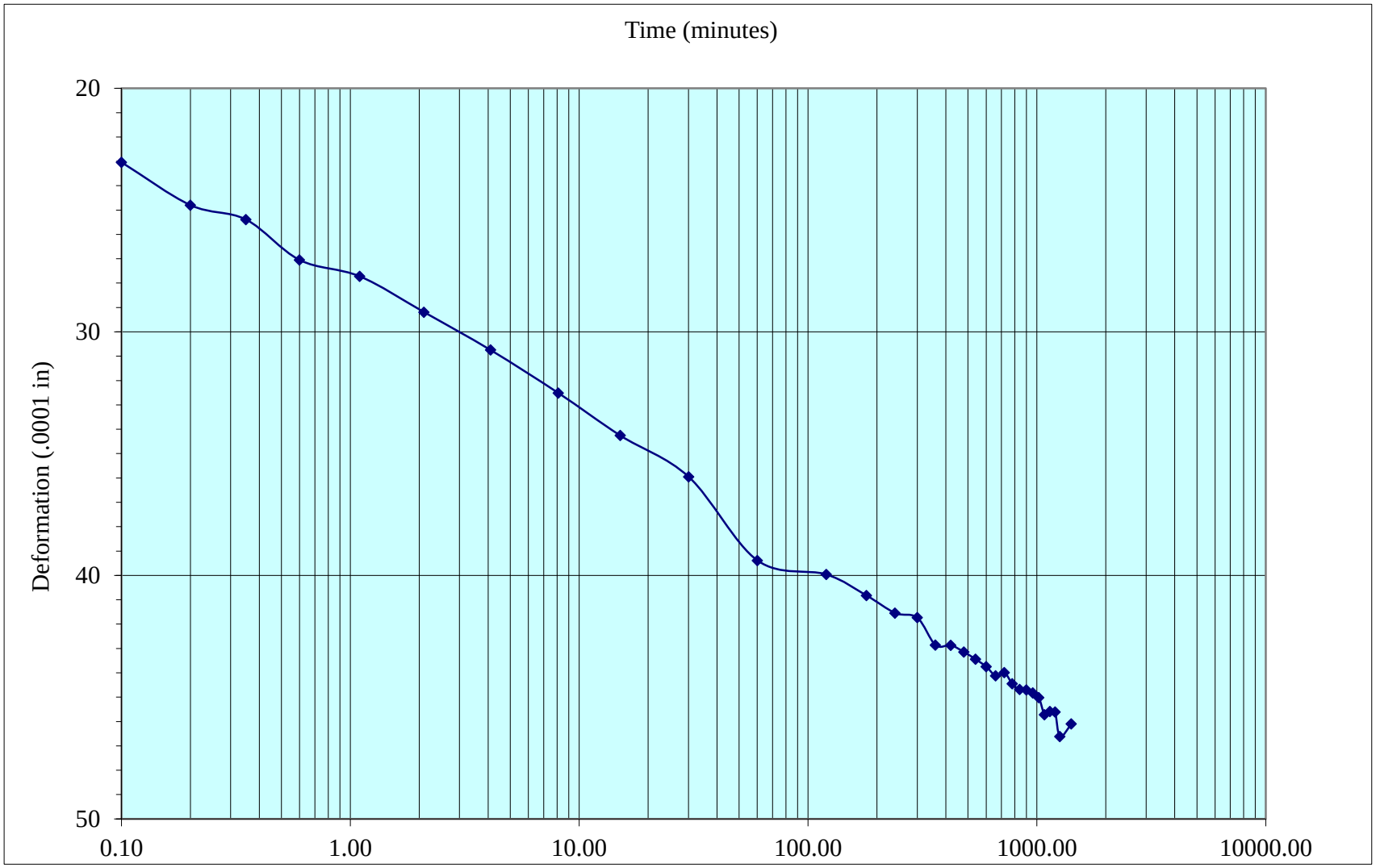
D-100=

t-50=

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-37-2 Sample No. ST-13-3 Load No. 3 TSF 1



D-0= _____

D-50= _____

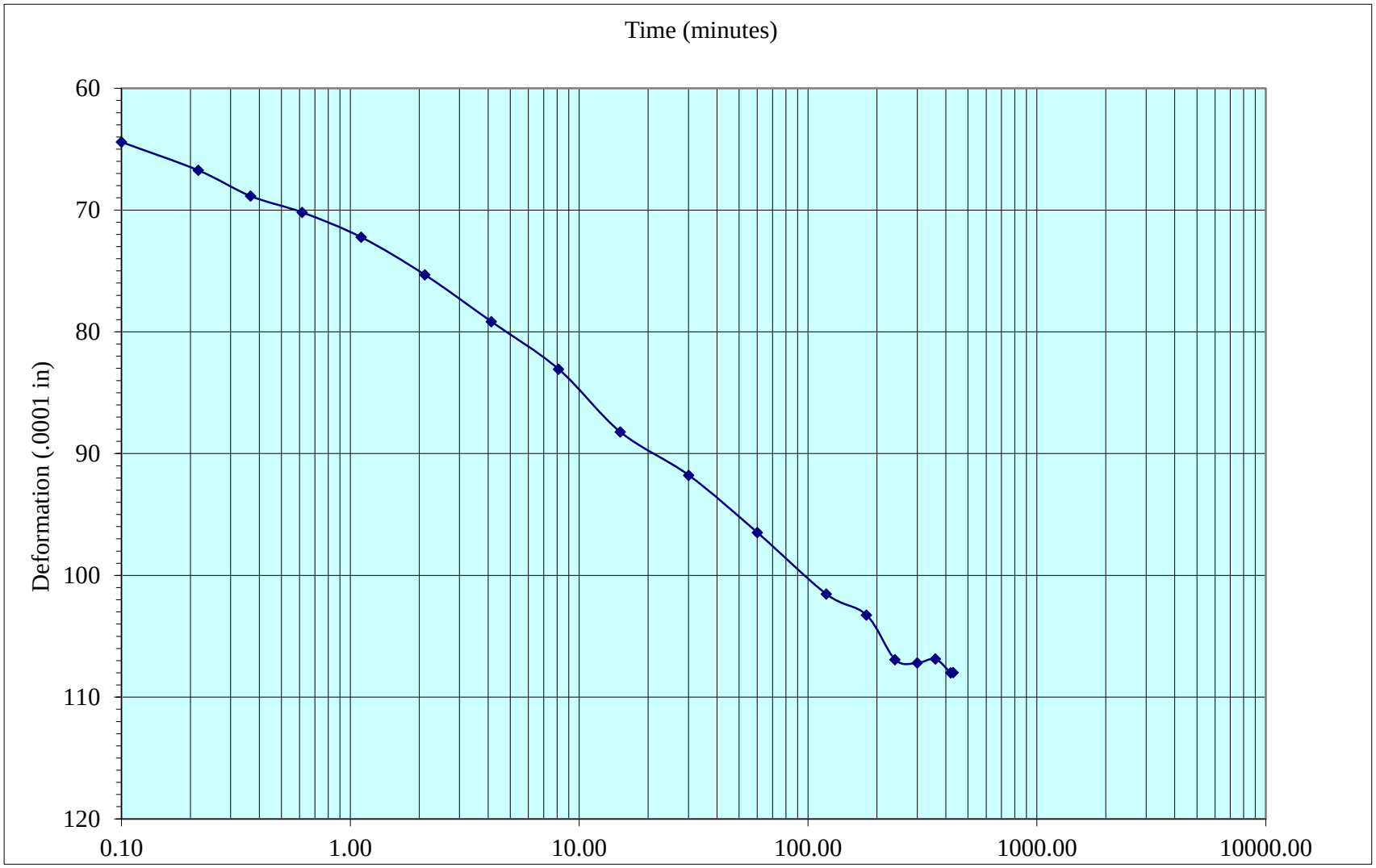
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-37-2 Sample No. ST-13-3 Load No. 4 TSF 2



D-0= _____

D-50= _____

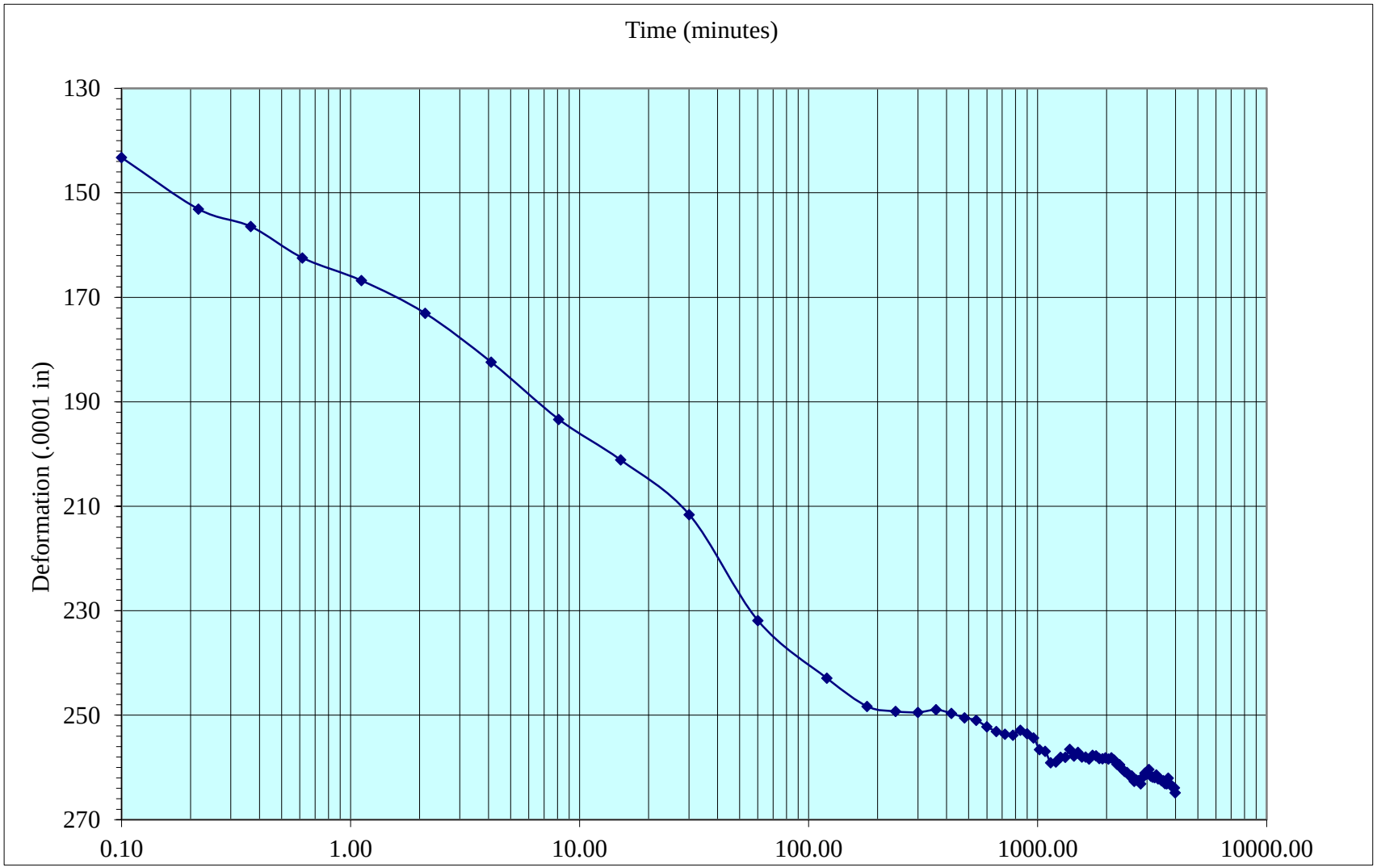
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-37-2 Sample No. ST-13-3 Load No. 5 TSF 4



D-0=

D-50=

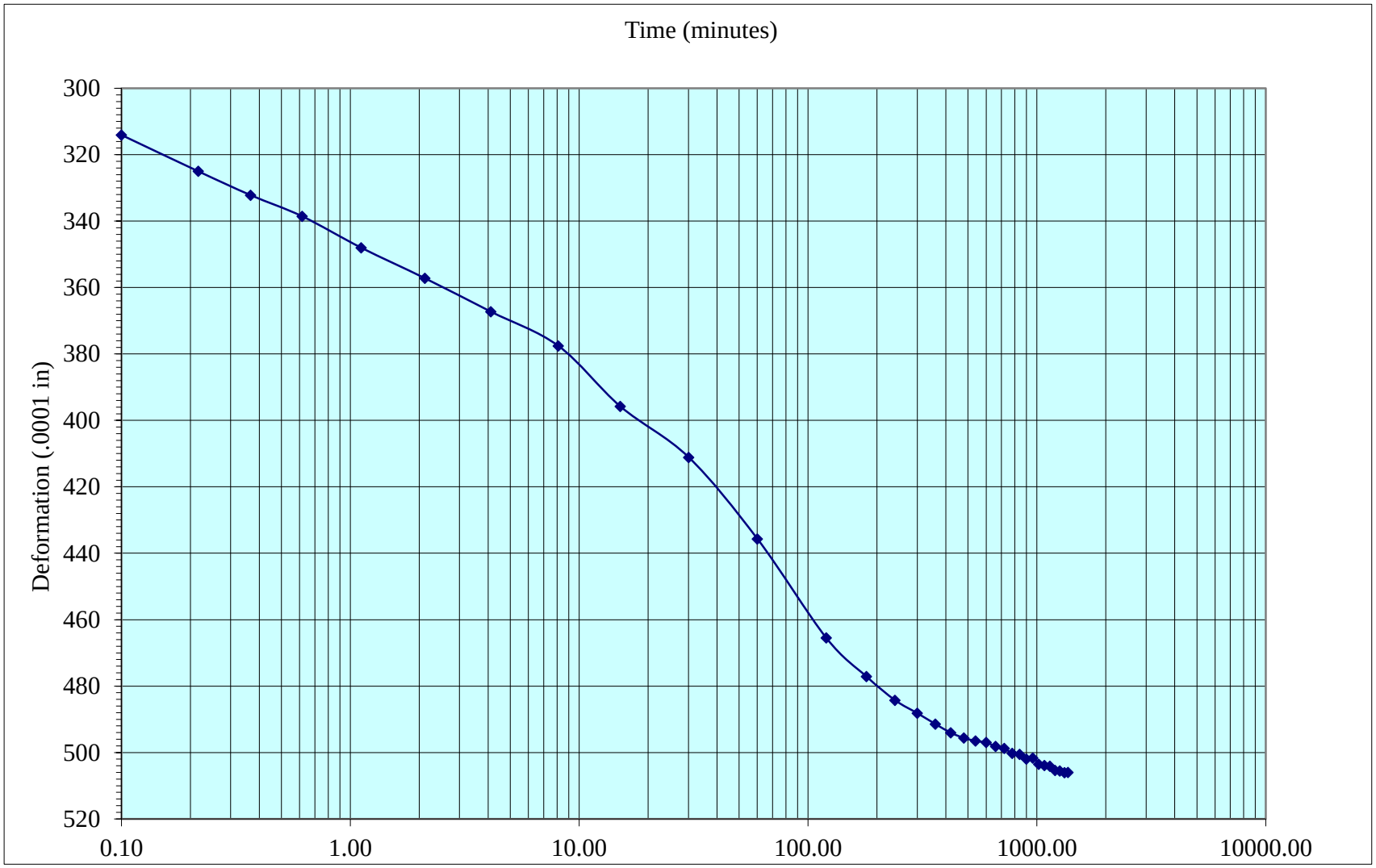
D-100=

t-50=

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-37-2 Sample No. ST-13-3 Load No. 6 TSF 8



D-0= _____

D-50= _____

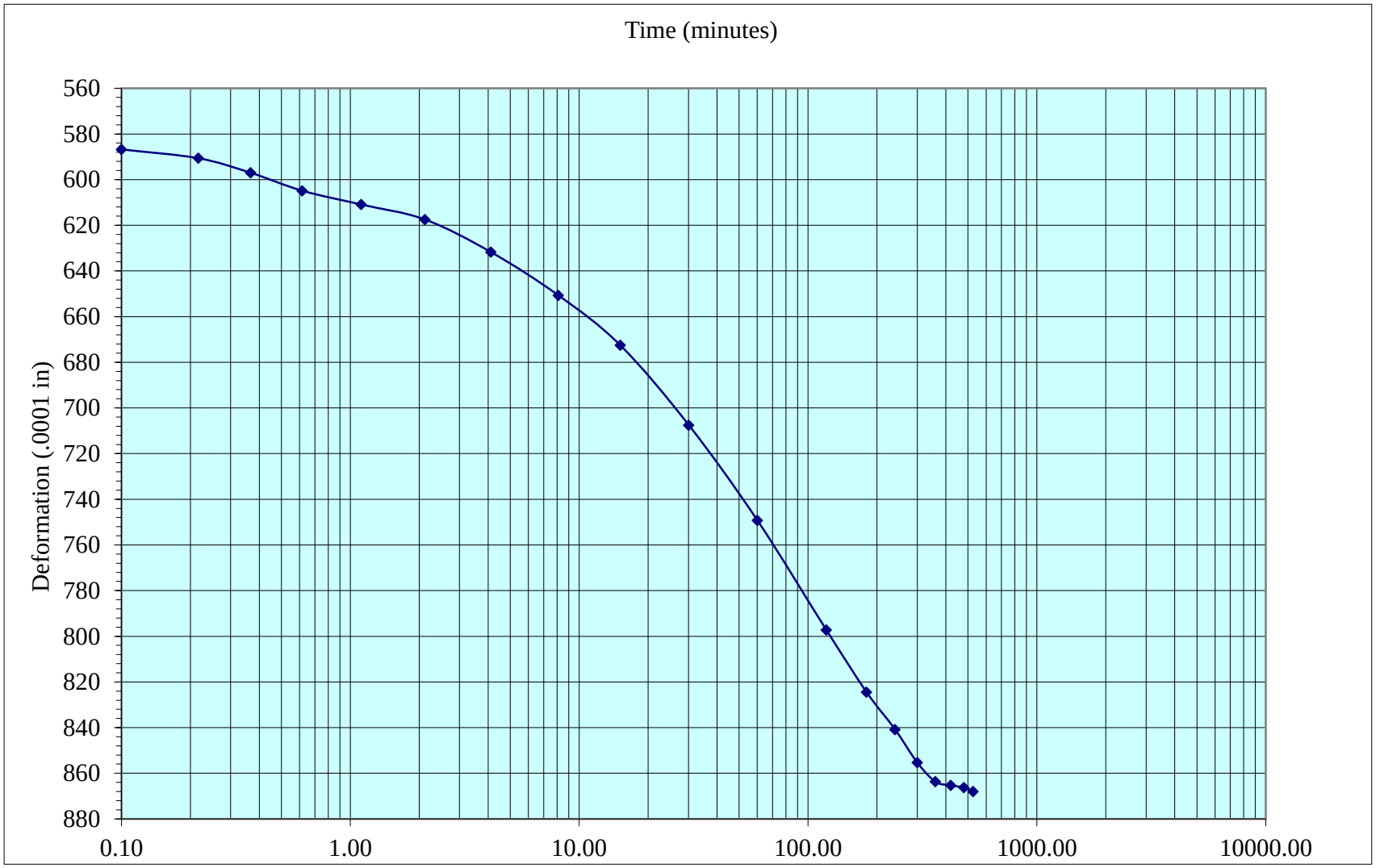
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-37-2 Sample No. ST-13-3 Load No. 7 TSF 16



D-0= _____

D-50= _____

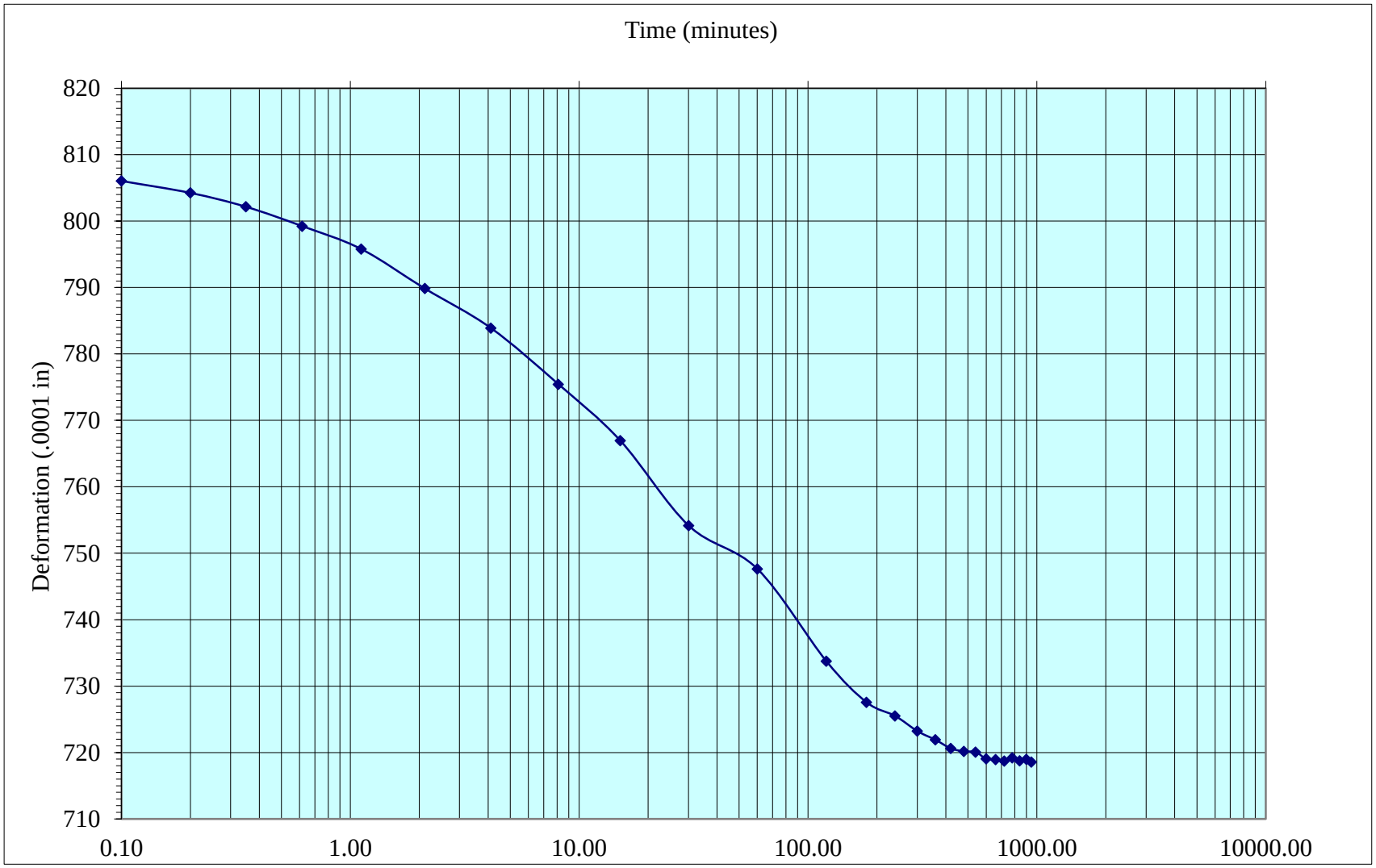
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-37-2 Sample No. ST-13-3 Load No. 8 TSF 4



D-0= _____

D-50= _____

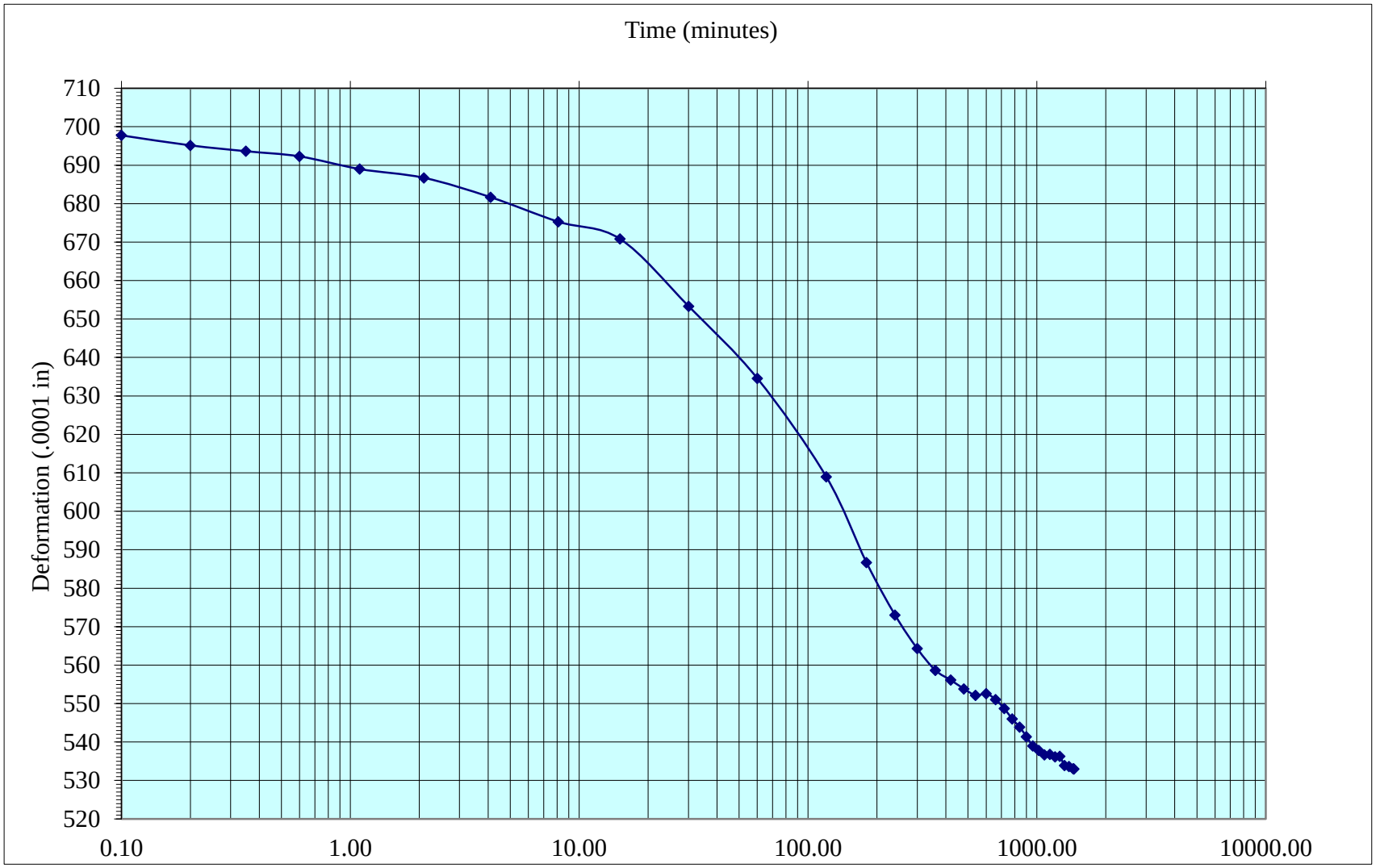
D-100= _____

t-50= _____

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-37-2 Sample No. ST-13-3 Load No. 9 TSF 1



D-0=

D-50=

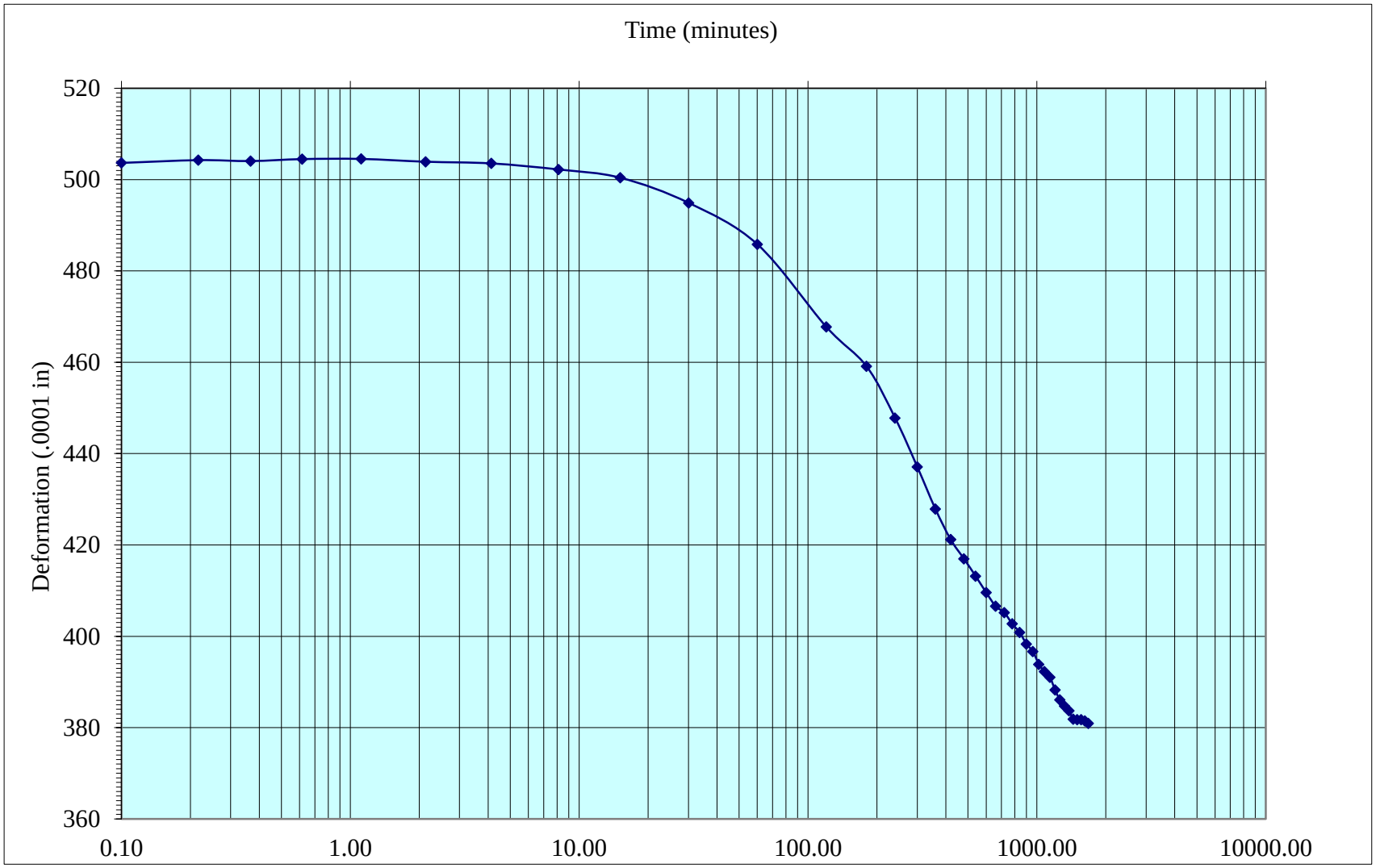
D-100=

t-50=

Project Name: I-70 Third Lane (Kingdom City to Columbia)

Project No.: 20241040

Boring No. BR-37-2 Sample No. ST-13-3 Load No. 10 TSF 0.25



D-0= _____

D-50= _____

D-100= _____

t-50= _____

APPENDIX E



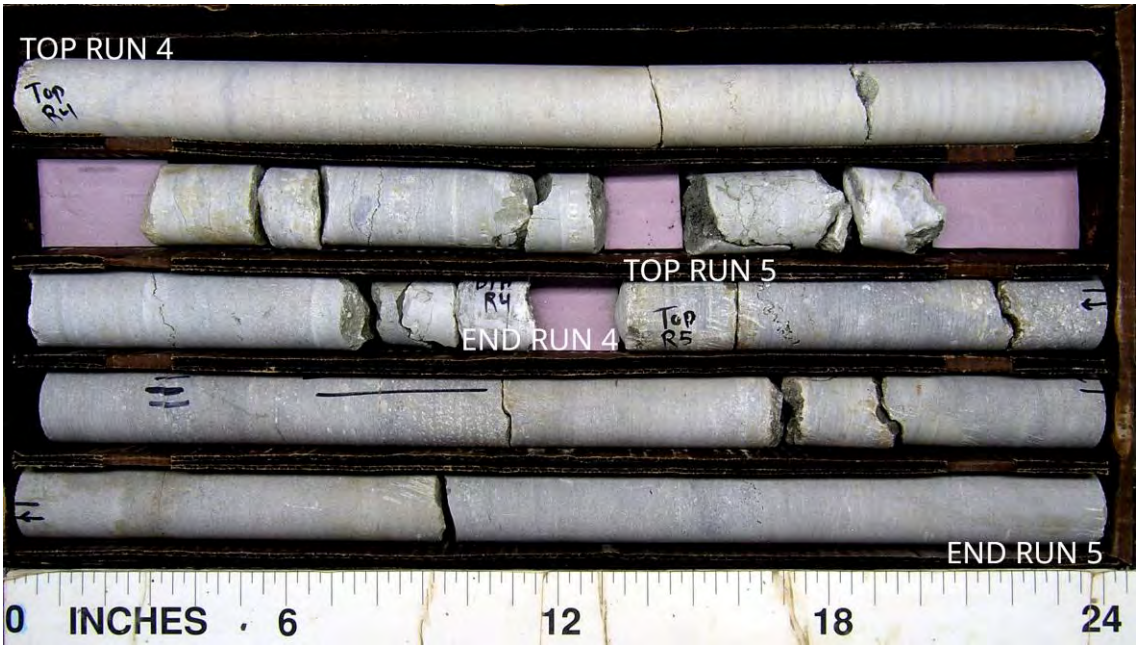
BORING BR 2-1A

Run	Depth, Ft.	Recovery, %	RQD, %
1	6.5-10.5	90	40
2	10.5-15.5	100	48
3	15.5-16.5	100	67



BORING BR 2-2

Run	Depth, Ft.	Recovery, %	RQD, %
1	8.5-10.0	61	39
2	12.3-15.0	88	56
3	15.0-20.0	98	78



BORING BR 2-2

Run	Depth, Ft.	Recovery, %	RQD, %
4	15.0-20.0	90	60
5	20.0-25.0	100	90



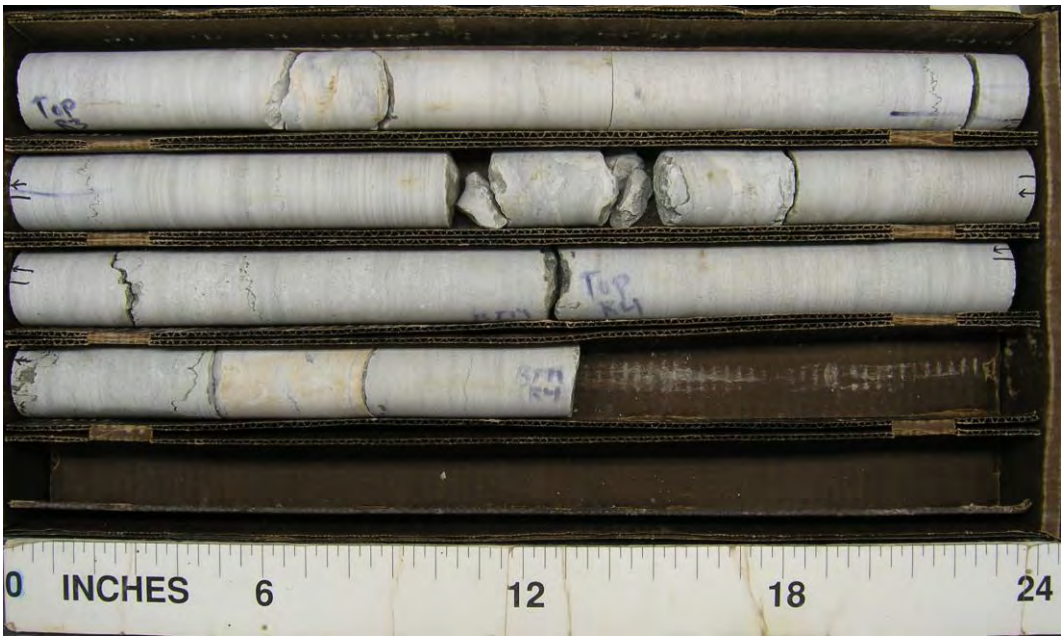
BORING BR 2-3

Run	Depth, Ft.	Recovery, %	RQD, %
1	29.0-35.0	21	6
2	35.0-40.0	23	12
3	40.0-45.0	23	0
4	45.0-50.0	55	10



BORING BR 4-1A

Run	Depth, Ft.	Recovery, %	RQD, %
1	7.0-10.0	92	19
2	10.0-15.0	100	78



BORING BR 4-1A

Run	Depth, Ft.	Recovery, %	RQD, %
3	15.0-20.0	100	87
4	20.0-22.0	100	100



BORING BR 4-2

Run	Depth, Ft.	Recovery, %	RQD, %
1	11.2-16.2	93	73
2	16.2-21.2	72	45



BORING BR 4-2

Run	Depth, Ft.	Recovery, %	RQD, %
3	21.2-25.2	80	22



BORING BR 5-2A

Run	Depth, Ft.	Recovery, %	RQD, %
1	30.0-35.0	100	43
2	35.0-40.0	100	88



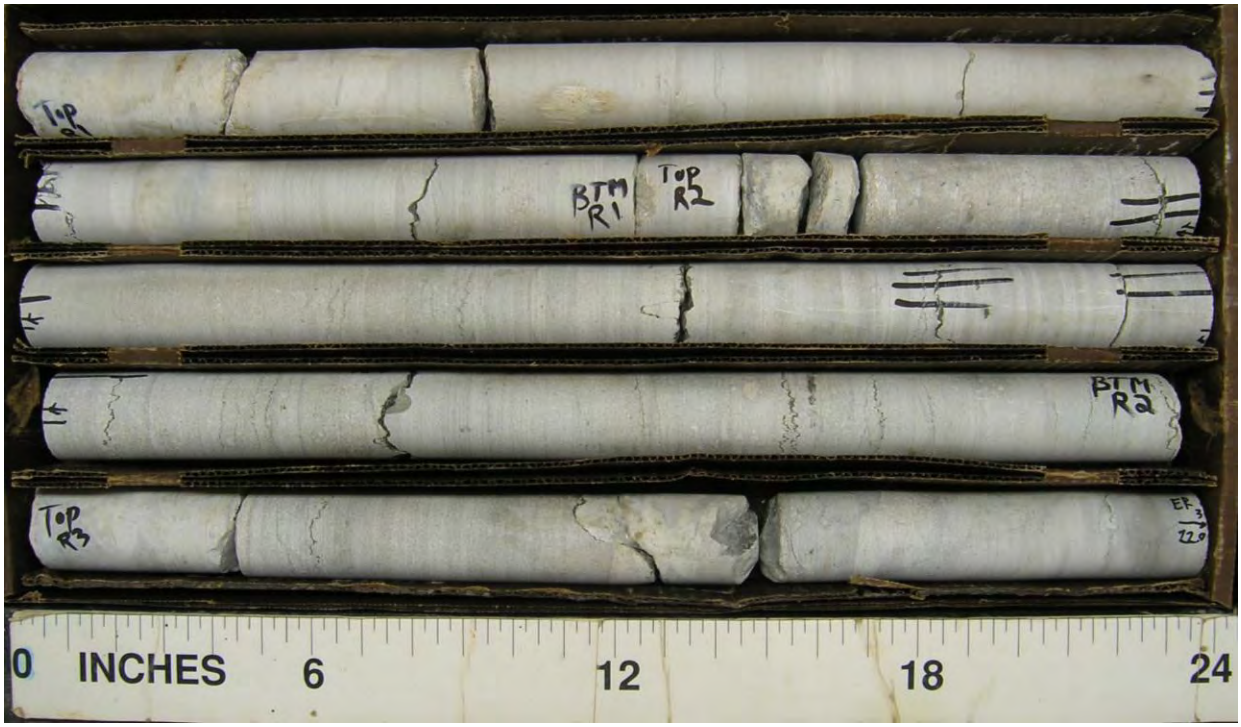
BORING BR 5-2A

Run	Depth, Ft.	Recovery, %	RQD, %
3	40.0-45.0	100	68



BORING BR 5-3A

Run	Depth, Ft.	Recovery, %	RQD, %
1	35.3-40.3	17	0
2	40.3-45.3	75	27
3	45.3-50.3	60	8



BORING BR 7-1A

Run	Depth, Ft.	Recovery, %	RQD, %
1	12.0-15.0	100	100
2	15.0-20.0	98	90
3	20.0-22.0	100	92



BORING BR 7-3A

Run	Depth, Ft.	Recovery, %	RQD, %
1	24.0-25.0	83	33
2	25.0-30.0	93	33
3	30.0-35.0	97	72



BORING BR 7-4

Run	Depth, Ft.	Recovery, %	RQD, %
1	39.5-40.5	67	42
2	40.5-45.5	67	12
3	45.5-50.5	58	17



BORING BR 10-1

Run	Depth, Ft.	Recovery, %	RQD, %
1	19.5-24.5	98	82
2	24.5-29.5	98	68



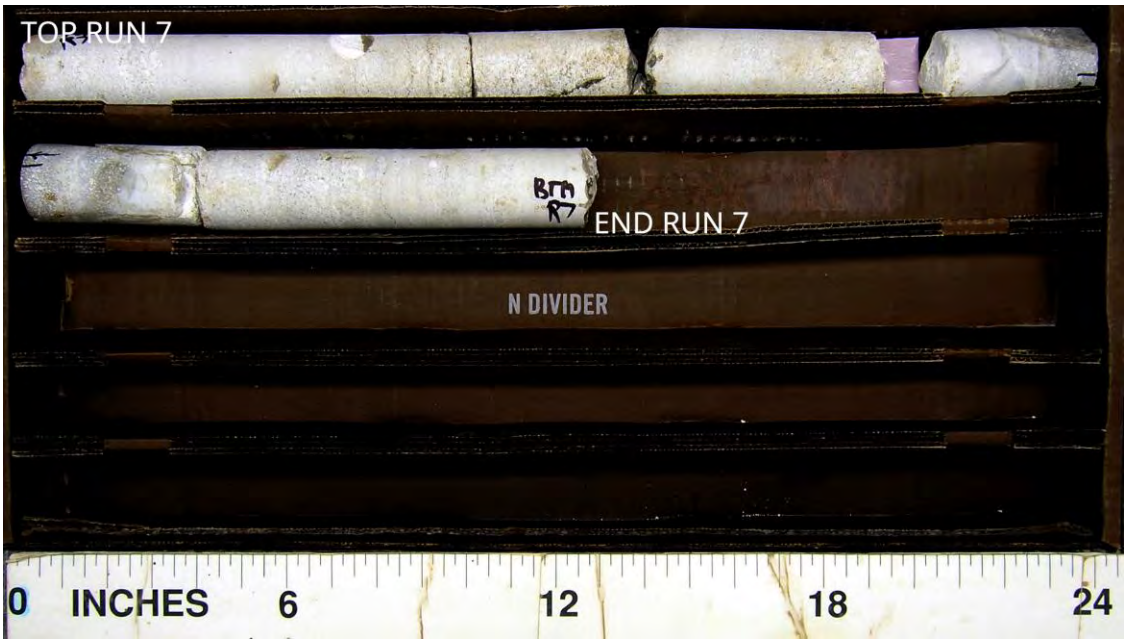
BORING BR 10-3A

Run	Depth, Ft.	Recovery, %	RQD, %
1	31.0-35.0	94	63
2	35.0-40.0	30	0
3	40.0-45.0	20	10
4	45.0-50.0	32	8



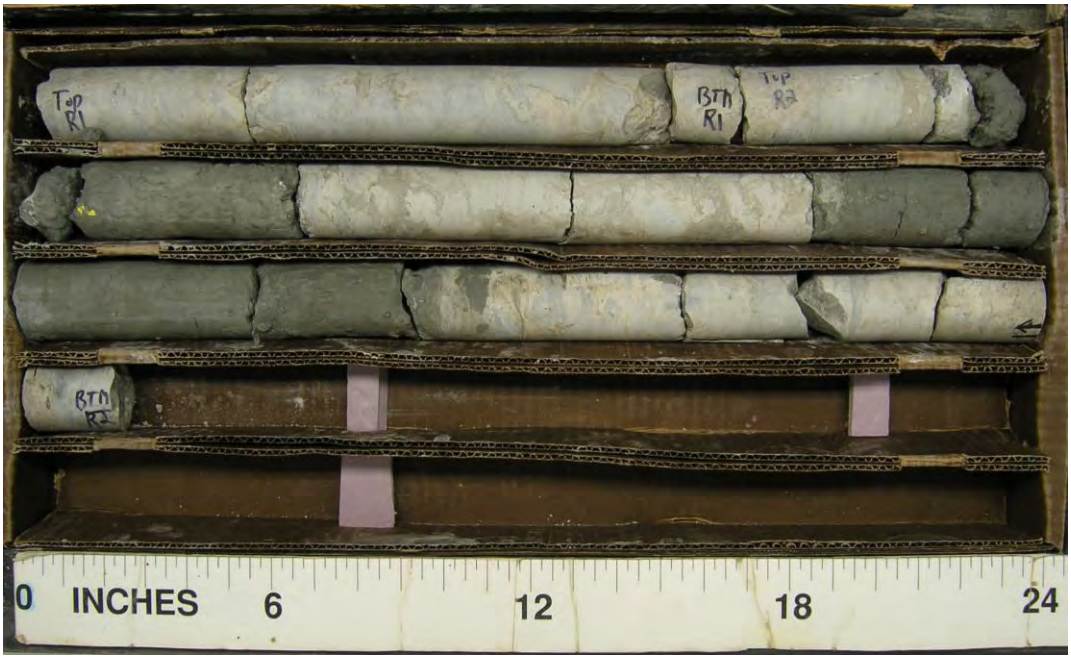
BORING BR 10-3A

Run	Depth, Ft.	Recovery, %	RQD, %
5	50.0-55.0	100	100
6	55.0-60.0	100	100



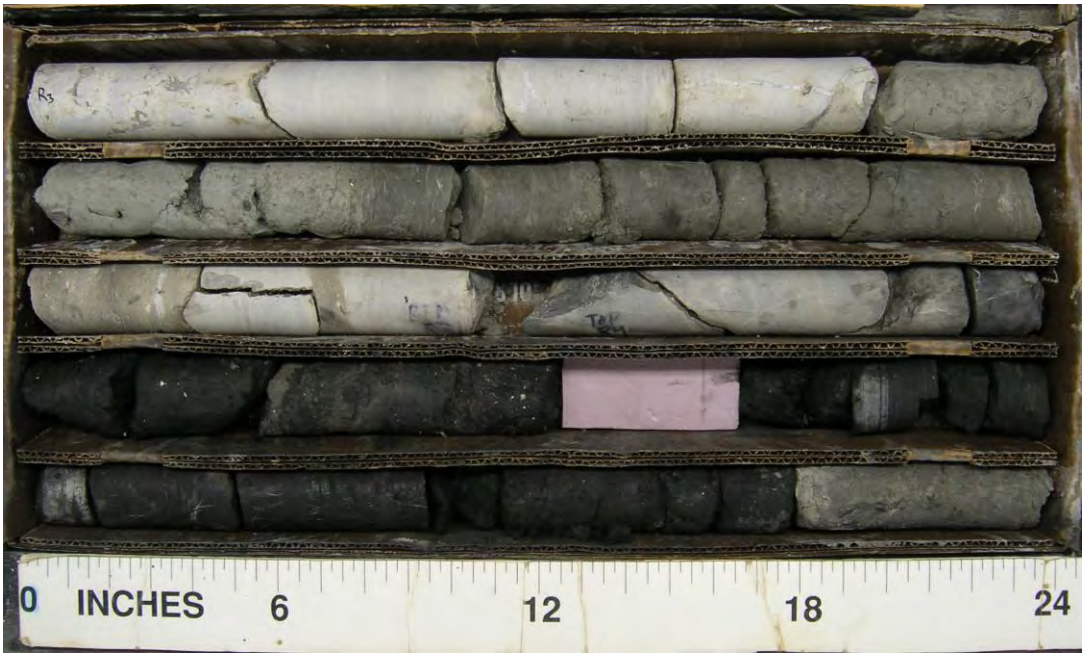
BORING BR 10-3A

Run	Depth, Ft.	Recovery, %	RQD, %
7	60.0-65.0	100	100



BORING BR 10-4

Run	Depth, Ft.	Recovery, %	RQD, %
1	34.0-35.5	94	83
2	35.5-40.5	98	85



BORING BR 10-4

Run	Depth, Ft.	Recovery, %	RQD, %
3	40.5-45.5	100	77
4	45.5-50.5	100	63



BORING BR 10-4

Run	Depth, Ft.	Recovery, %	RQD, %
5	50.5-55.5	100	70
6	55.5-60.5	100	47



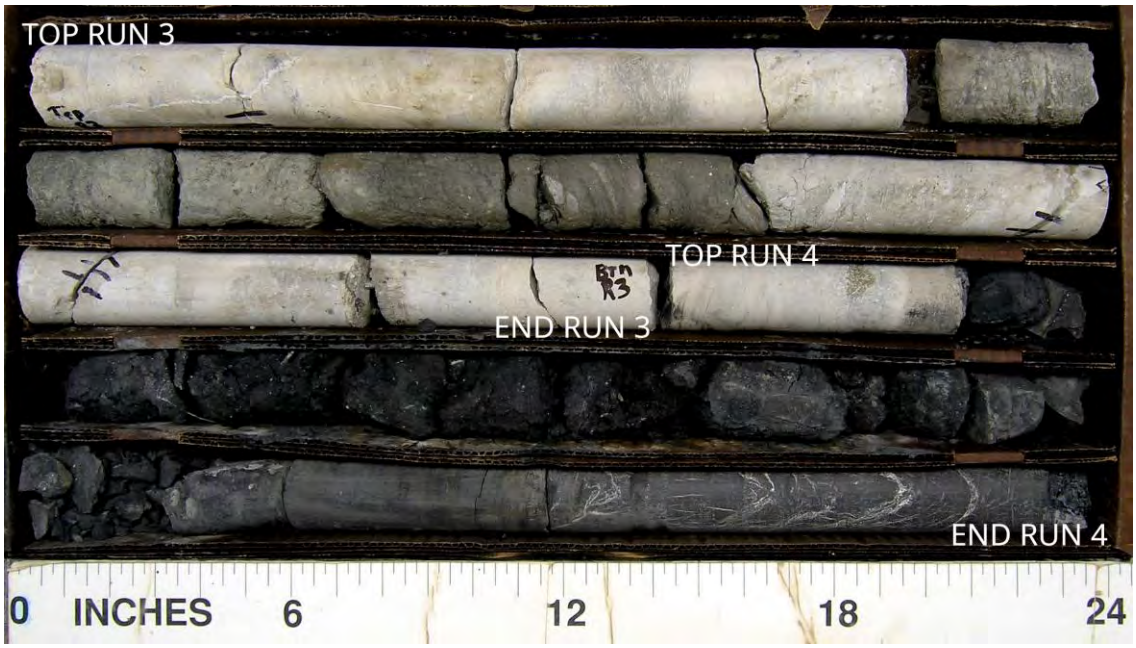
BORING BR 10-4

Run	Depth, Ft.	Recovery, %	RQD, %
7	60.5-65.5	100	100
8	65.5-70.5	92	58



BORING BR 10-5B

Run	Depth, Ft.	Recovery, %	RQD, %
1	32.0-35.0	75	0
2	35.0-40.0	87	75



BORING BR 10-5B

Run	Depth, Ft.	Recovery, %	RQD, %
3	40.0-45.0	100	77
4	45.0-50.0	92	40



BORING BR 10-5B

Run	Depth, Ft.	Recovery, %	RQD, %
5	50.0-55.0	100	90
6	55.0-60.0	75	40



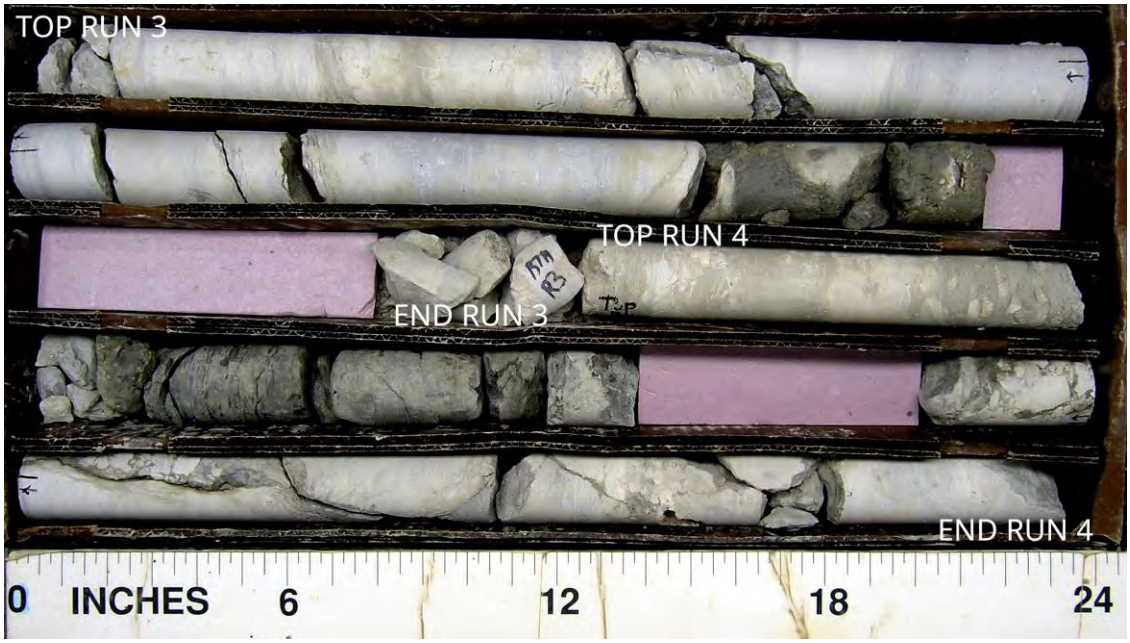
BORING BR 10-5B

Run	Depth, Ft.	Recovery, %	RQD, %
7	60.0-65.0	100	83



BORING BR 10-6A

Run	Depth, Ft.	Recovery, %	RQD, %
1	42.5-45.0	100	47
2	45.0-50.0	100	27



BORING BR 10-6A

Run	Depth, Ft.	Recovery, %	RQD, %
3	50.0-55.0	92	52
4	55.0-60.0	92	65



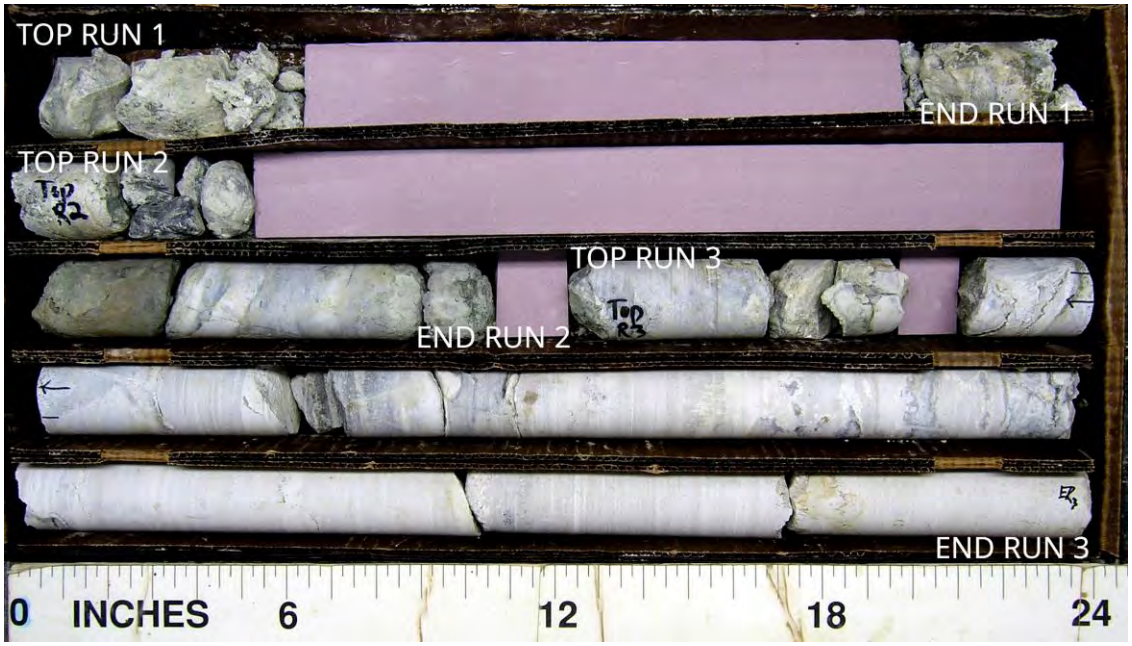
BORING BR 10-6A

Run	Depth, Ft.	Recovery, %	RQD, %
5	60.0-65.0	82	43
6	65.0-70.0	73	52



BORING BR 10-6A

Run	Depth, Ft.	Recovery, %	RQD, %
7	70.0-75.0	100	48



BORING BR 12-2B

Run	Depth, Ft.	Recovery, %	RQD, %
1	19.0-21.0	42	0
2	21.0-25.0	31	10
3	25.0-30.0	97	82



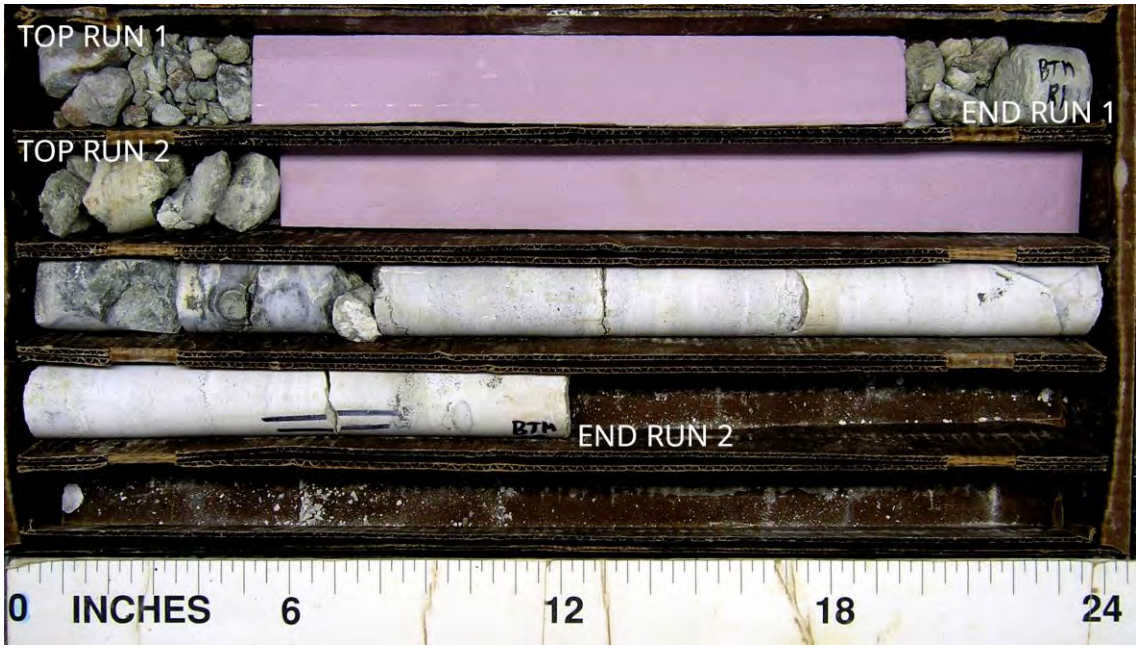
BORING BR 12-2B

Run	Depth, Ft.	Recovery, %	RQD, %
4	30.0-35.0	97	90
5	35.0-40.0	97	80



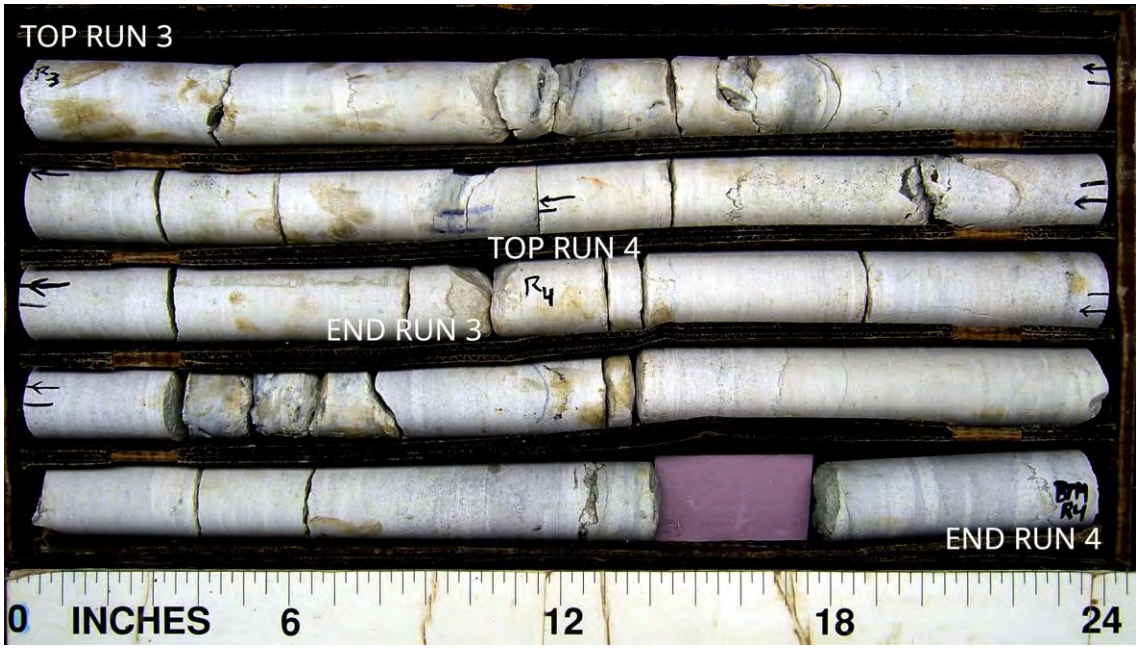
BORING BR 12-2B

Run	Depth, Ft.	Recovery, %	RQD, %
6	40.0-45.0	100	82
7	45.0-50.0	100	90



BORING BR 12-3B

Run	Depth, Ft.	Recovery, %	RQD, %
1	18.6-20.2	32	0
2	20.2-25.2	75	55



BORING BR 12-3B

Run	Depth, Ft.	Recovery, %	RQD, %
3	25.2-30.2	100	78
4	30.2-35.2	100	8



BORING BR 12-3B

Run	Depth, Ft.	Recovery, %	RQD, %
5	35.2-40.2	100	87
6	40.2-45.2	100	100



BORING BR 12-3B

Run	Depth, Ft.	Recovery, %	RQD, %
7	45.2-50.2	100	95



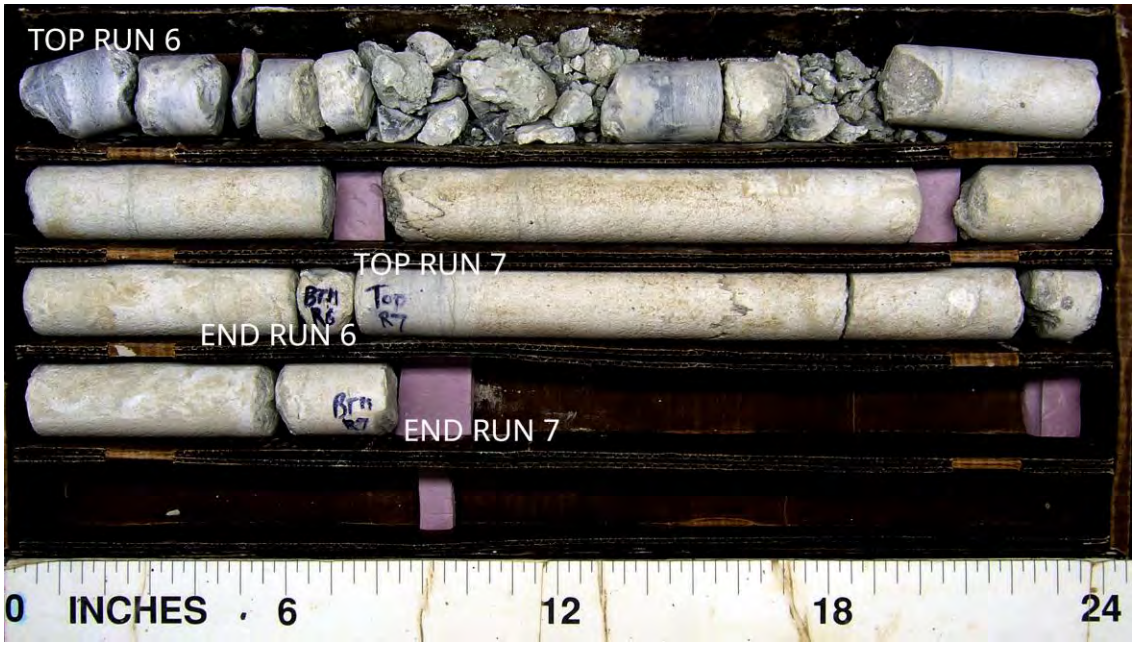
BORING BR 12-4A

Run	Depth, Ft.	Recovery, %	RQD, %
1	19.5-24.5	68	0
2	24.5-29.5	60	12
3	29.5-34.5	83	50



BORING BR 12-4A

Run	Depth, Ft.	Recovery, %	RQD, %
3	34.5-39.5	65	25
4	39.5-44.5	92	35



BORING BR 12-4A

Run	Depth, Ft.	Recovery, %	RQD, %
6	44.5-49.5	90	48
7	49.5-51.5	100	83



BORING BR 13-1A

Run	Depth, Ft.	Recovery, %	RQD, %
1	25.0-26.0	67	67
2	26.0-30.0	92	38
3	30.0-35.0	100	63



BORING BR 13-2A

Run	Depth, Ft.	Recovery, %	RQD, %
1	17.5-20.5	83	83
2	20.5-23.5	83	67



BORING BR 13-2A

Run	Depth, Ft.	Recovery, %	RQD, %
3	23.5-25.5	58	0
4	25.5-30.5	60	8



BORING BR 14-1

Run	Depth, Ft.	Recovery, %	RQD, %
1	19.0-20.5	100	83
2	20.5-25.5	100	77
3	25.5-30.5	60	33



BORING BR 14-2A

Run	Depth, Ft.	Recovery, %	RQD, %
1	15.5-19.5	100	62
2	19.5-22.5	100	53
3	22.5-24.5	67	0



BORING BR 14-2A

Run	Depth, Ft.	Recovery, %	RQD, %
4	24.5-28.0	98	0



BORING BR 16-1

Run	Depth, Ft.	Recovery, %	RQD, %
1	24.0-25.0	92	33
2	25.0-30.0	60	40
3	30.0-35.0	87	17



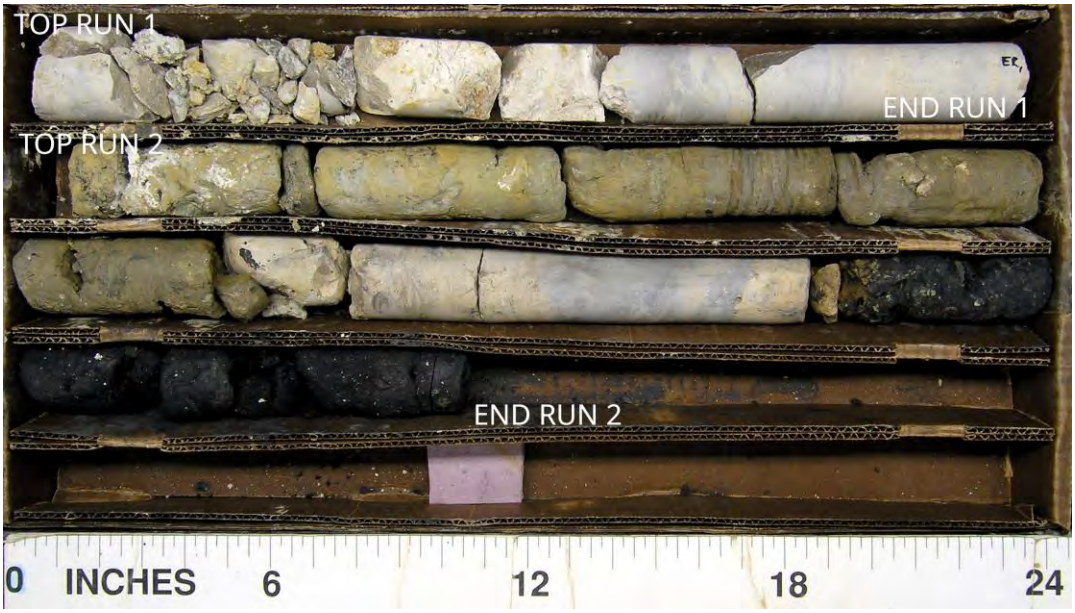
BORING BR 16-2

Run	Depth, Ft.	Recovery, %	RQD, %
1	27.8-30.4	87	32
2	30.4-35.4	47	28



BORING BR 16-2

Run	Depth, Ft.	Recovery, %	RQD, %
3	35.4-40.4	100	78



BORING BR 17-1

Run	Depth, Ft.	Recovery, %	RQD, %
1	28.2-30.2	92	27
2	30.2-35.2	100	37



BORING BR 17-1

Run	Depth, Ft.	Recovery, %	RQD, %
3	35.2-40.2	65	37



BORING BR 17-2

Run	Depth, Ft.	Recovery, %	RQD, %
1	32.5-35.0	73	37
2	35.0-40.0	74	60



BORING BR 17-2

Run	Depth, Ft.	Recovery, %	RQD, %
3	40.0-45.0	100	80



BORING BR 36-1A

Run	Depth, Ft.	Recovery, %	RQD, %
1	99.2-100.0	67	0
2	100.0-105.0	60	37



BORING BR 36-1A

Run	Depth, Ft.	Recovery, %	RQD, %
3	105.0-110.0	33	0
4	110.0-115.0	100	77



BORING BR 36-2

Run	Depth, Ft.	Recovery, %	RQD, %
1	93.5-95.0	0	0
2	95.0-100.0	0	0
3	100.0-105.0	17	10
4	106.0-110.0	92	54
5	110.0-115.0	68	45



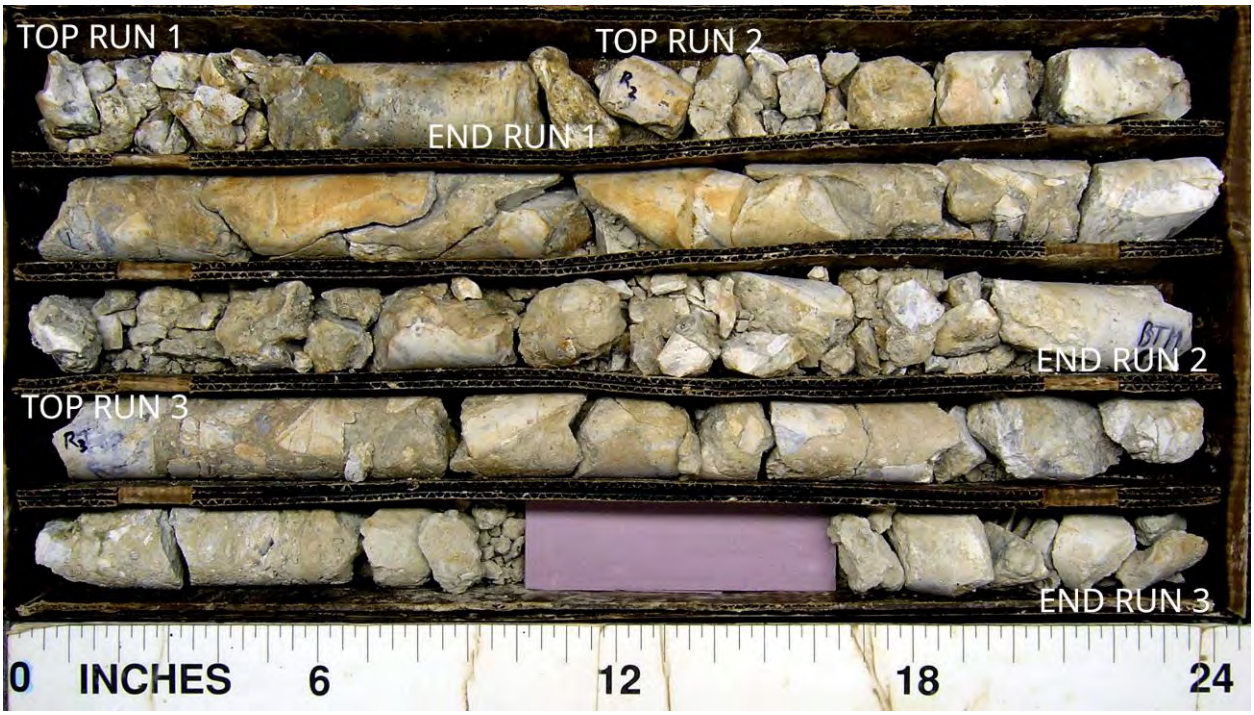
BORING BR 36-2

Run	Depth, Ft.	Recovery, %	RQD, %
6	115.0-120.0	47	23



BORING BR 36-3A

Run	Depth, Ft.	Recovery, %	RQD, %
1	100.0-105.0	100	90
2	105.0-110.0	77	33



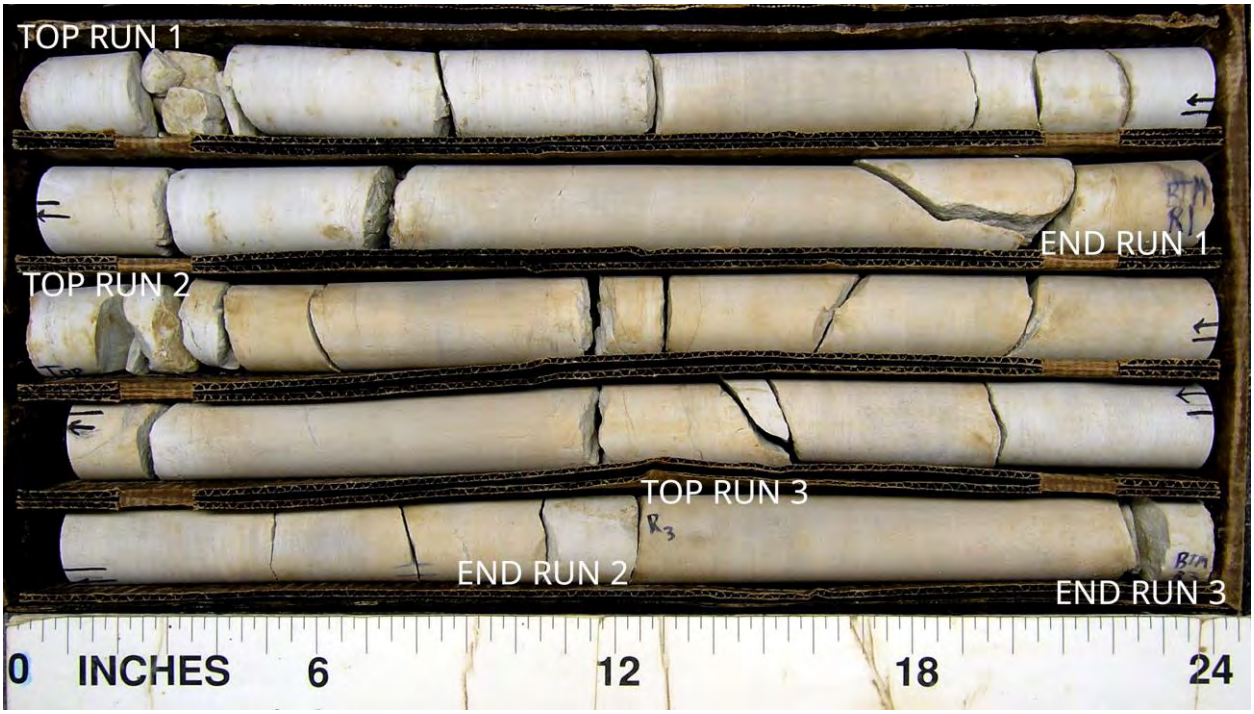
BORING BR 37-1

Run	Depth, Ft.	Recovery, %	RQD, %
1	89.5-90.7	93	43
2	90.7-95.7	97	20
3	95.7-99.7	83	40



BORING BR 37-2

Run	Depth, Ft.	Recovery, %	RQD, %
1	94.5-95.5	0	0
2	95.5-100.5	38	9
3	100.5-105.5	45	8
4	105.5-110.5	75	37



BORING BR 37-3

Run	Depth, Ft.	Recovery, %	RQD, %
1	96.0-100.3	100	71
2	100.3-105.3	100	68
3	105.3-106.3	100	83

TSi
geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-2-1A Date: 6/20/2024
Project Number: 20241040 Sample Number: R-1 Depth: 10.2-10.5

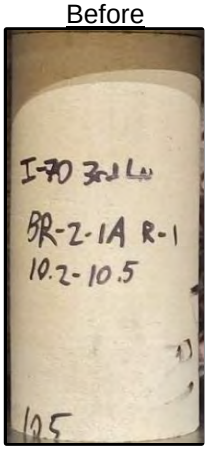
Visual Description: LIMESTONE

Specimen Weight	460.22	g
Diameter	1.860	inches
Length	4.035	inches
Volume	**0.0063**	ft^3

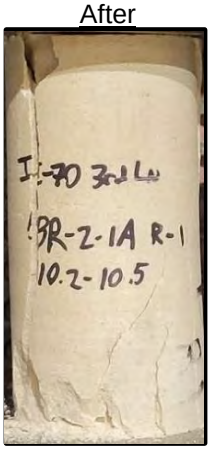
Wet unit weight	**159.9**	pcf
Length:Diameter Ratio	**2.17**	

Specimen Area (metric)	**1753.004**	mm^2
Specimen Area	**2.717**	in^2
Total Load on Specimen	**35510**	lbs
Unconfined Strength (qu)	**13069**	**psi**
Unconfined Strength (qu)	**941**	**tsf**
Unconfined Strength (qu)	**90**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-2-1A Date: 6/14/2024
Project Number: 20241040 Sample Number: R-2 Depth: 14.0-14.3

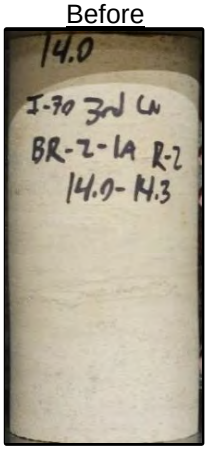
Visual Description: LIMESTONE

Specimen Weight	465.73	g
Diameter	1.860	inches
Length	4.076	inches
Volume	**0.0064**	ft^3

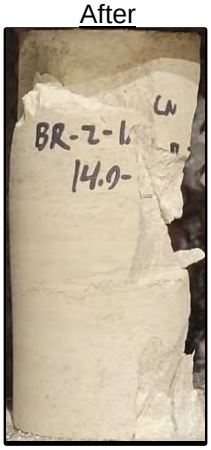
Wet unit weight	**160.2**	pcf
Length:Diameter Ratio	**2.19**	

Specimen Area (metric)	**1753.004**	mm^2
Specimen Area	**2.717**	in^2
Total Load on Specimen	**36240**	lbs
Unconfined Strength (qu)	**13338**	**psi**
Unconfined Strength (qu)	**960**	**tsf**
Unconfined Strength (qu)	**92**	**MPa**

Before



After



Tested by: SLY Date: 6/14/2024
Calculated by: SLY Date: 6/25/2024
Checked by: AK Date: 6/28/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-2-2 Date: 7/23/2024
Project Number: 20241040 Sample Number: R-2 Depth: 13.2-13.5

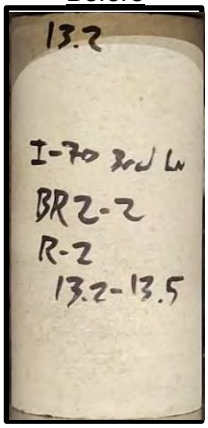
Visual Description: LIMESTONE

Specimen Weight	451.00	g
Diameter	1.869	inches
Length	3.774	inches
Volume	**0.0060**	ft^3

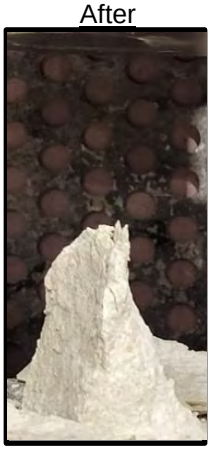
Wet unit weight	**165.9**	pcf
Length:Diameter Ratio	**2.02**	

Specimen Area (metric)	**1770.009**	mm^2
Specimen Area	**2.743**	in^2
Total Load on Specimen	**45960**	lbs
Unconfined Strength (qu)	**16753**	**psi**
Unconfined Strength (qu)	**1206**	**tsf**
Unconfined Strength (qu)	**116**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/31/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-2-2 Date: 7/23/2024
Project Number: 20241040 Sample Number: R-3 Depth: 15.7-16.0

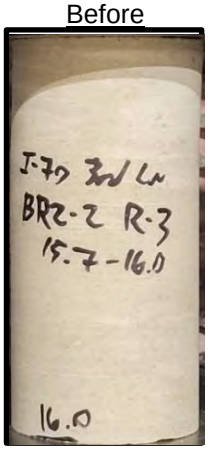
Visual Description: LIMESTONE

Specimen Weight	509.28	g
Diameter	1.873	inches
Length	4.204	inches
Volume	**0.0067**	ft^3

Wet unit weight	**167.5**	pcf
Length:Diameter Ratio	**2.24**	

Specimen Area (metric)	**1777.594**	mm^2
Specimen Area	**2.755**	in^2
Total Load on Specimen	**48130**	lbs
Unconfined Strength (qu)	**17469**	**psi**
Unconfined Strength (qu)	**1258**	**tsf**
Unconfined Strength (qu)	**120**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/31/2024

geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-2-2 Date: 7/23/2024
Project Number: 20241040 Sample Number: R-4 Depth: 21.7-22.0

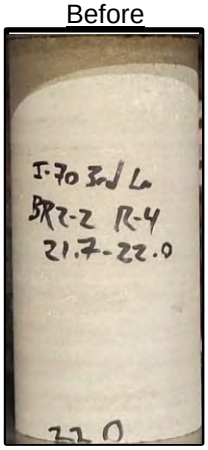
Visual Description: LIMESTONE

Specimen Weight	481.46	g
Diameter	1.874	inches
Length	4.004	inches
Volume	**0.0064**	ft^3

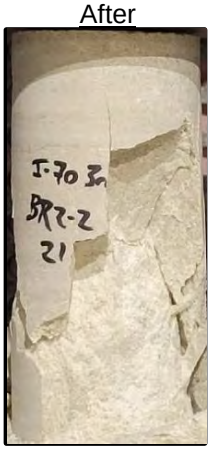
Wet unit weight	**166.1**	pcf
Length:Diameter Ratio	**2.14**	

Specimen Area (metric)	**1779.492**	mm^2
Specimen Area	**2.758**	in^2
Total Load on Specimen	**42780**	lbs
Unconfined Strength (qu)	**15510**	**psi**
Unconfined Strength (qu)	**1117**	**tsf**
Unconfined Strength (qu)	**107**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/31/2024

geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-2-2 Date: 7/23/2024
Project Number: 20241040 Sample Number: R-5 Depth: 27.9-28.2

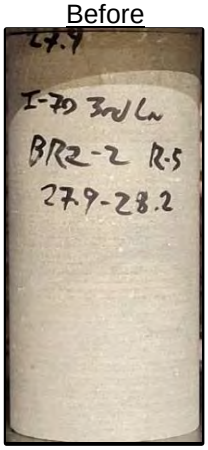
Visual Description: LIMESTONE

Specimen Weight	499.82	g
Diameter	1.873	inches
Length	4.172	inches
Volume	**0.0067**	ft^3

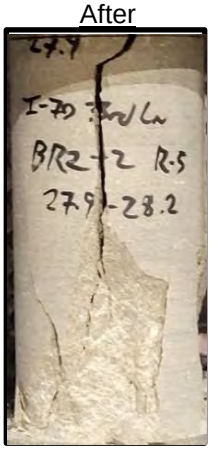
Wet unit weight	**165.6**	pcf
Length:Diameter Ratio	**2.23**	

Specimen Area (metric)	**1777.594**	mm^2
Specimen Area	**2.755**	in^2
Total Load on Specimen	**34900**	lbs
Unconfined Strength (qu)	**12667**	**psi**
Unconfined Strength (qu)	**912**	**tsf**
Unconfined Strength (qu)	**87**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/31/2024

PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)

PROJECT No.: 20241040

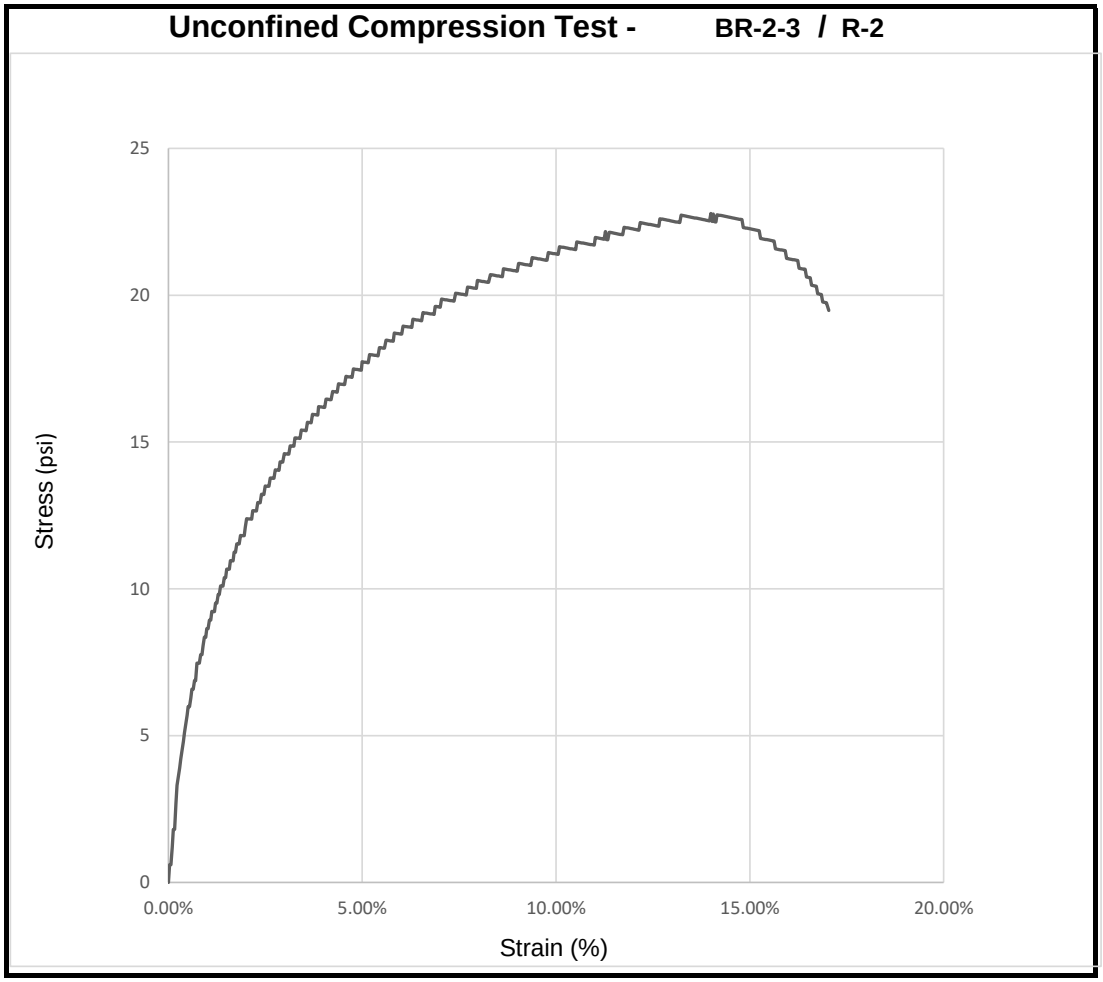
BORING NO.	**BR-2-3**
SAMPLE NO.	**R-2**
SAMPLE DEPTH (ft)	**35.4-35.7**
RECOVERY (%)	**23**
VISUAL CLASS. (USCS)	**SHALE**

SPECIFICATIONS	
Unconfined Compression	**ASTM D7012**
VISUAL CLASS. (USCS)	**SHALE**

DENSITY & MOISTURE	
Wet unit weight (pcf)	**129.9**
Moisture Content (%)	**22.1%**
Dry unit weight (pcf)	**106.5**

STRENGTH	
Unconfined Strength qu (psi)	**22.8**
% Strain at qu	**13.99**

Tested by: SLY	7/24/2024
Calculated by: SLY	7/25/2024
Checked by: AK	7/31/2024



Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-2-3 Date: 7/23/2024
Project Number: 20241040 Sample Number: R-4 Depth: 48.9-49.2

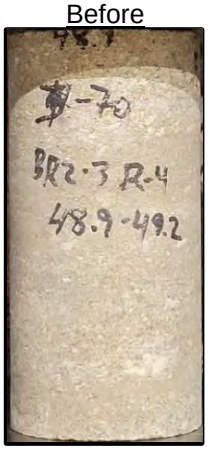
Visual Description: FOSSILIFEROUS LIMESTONE

Specimen Weight	457.13	g
Diameter	1.871	inches
Length	3.983	inches
Volume	**0.0063**	ft^3

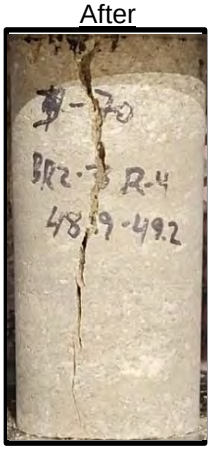
Wet unit weight	**159.0**	pcf
Length:Diameter Ratio	**2.13**	

Specimen Area (metric)	**1773.799**	mm^2
Specimen Area	**2.749**	in^2
Total Load on Specimen	**21500**	lbs
Unconfined Strength (qu)	**7820**	**psi**
Unconfined Strength (qu)	**563**	**tsf**
Unconfined Strength (qu)	**54**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/31/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-4-1A Date: 6/20/2024
Project Number: 20241040 Sample Number: R-2 Depth: 10.7-11.0

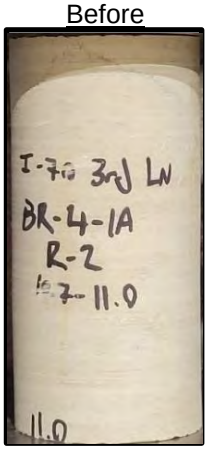
Visual Description: LIMESTONE

Specimen Weight	483.18	g
Diameter	1.863	inches
Length	4.035	inches
Volume	**0.0064**	ft^3

Wet unit weight	**167.3**	pcf
Length:Diameter Ratio	**2.17**	

Specimen Area (metric)	**1758.663**	mm^2
Specimen Area	**2.726**	in^2
Total Load on Specimen	**46180**	lbs
Unconfined Strength (qu)	**16941**	**psi**
Unconfined Strength (qu)	**1220**	**tsf**
Unconfined Strength (qu)	**117**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

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Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-4-1A Date: 6/20/2024
Project Number: 20241040 Sample Number: R-3 Depth: 16.3-16.6

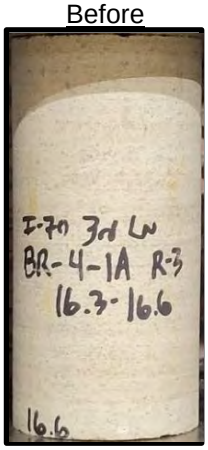
Visual Description: LIMESTONE

Specimen Weight	476.47	g
Diameter	1.863	inches
Length	4.008	inches
Volume	**0.0063**	ft^3

Wet unit weight	**166.1**	pcf
Length:Diameter Ratio	**2.15**	

Specimen Area (metric)	**1758.663**	mm^2
Specimen Area	**2.726**	in^2
Total Load on Specimen	**30640**	lbs
Unconfined Strength (qu)	**11241**	**psi**
Unconfined Strength (qu)	**809**	**tsf**
Unconfined Strength (qu)	**78**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-4-1A Date: 6/20/2024
Project Number: 20241040 Sample Number: R-4 Depth: 20.5-20.8

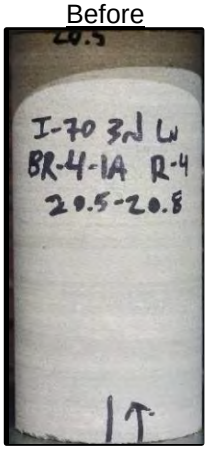
Visual Description: LIMESTONE

Specimen Weight	493.48	g
Diameter	1.862	inches
Length	4.156	inches
Volume	**0.0065**	ft^3

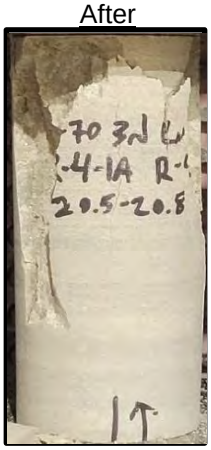
Wet unit weight	**166.1**	pcf
Length:Diameter Ratio	**2.23**	

Specimen Area (metric)	**1756.776**	mm^2
Specimen Area	**2.723**	in^2
Total Load on Specimen	**32150**	lbs
Unconfined Strength (qu)	**11807**	**psi**
Unconfined Strength (qu)	**850**	**tsf**
Unconfined Strength (qu)	**81**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-4-2 Date: 7/23/2024
Project Number: 20241040 Sample Number: R-1 Depth: 15.6-15.9

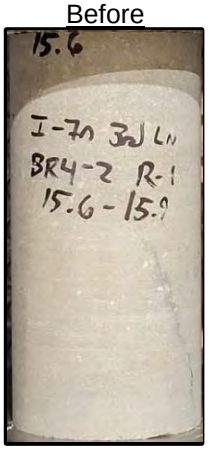
Visual Description: LIMESTONE

Specimen Weight	497.38	g
Diameter	1.873	inches
Length	4.068	inches
Volume	**0.0065**	ft^3

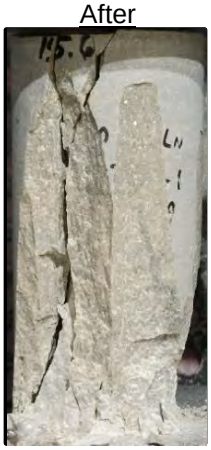
Wet unit weight	**169.0**	pcf
Length:Diameter Ratio	**2.17**	

Specimen Area (metric)	**1777.594**	mm^2
Specimen Area	**2.755**	in^2
Total Load on Specimen	**48410**	lbs
Unconfined Strength (qu)	**17570**	**psi**
Unconfined Strength (qu)	**1265**	**tsf**
Unconfined Strength (qu)	**121**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/31/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-4-2 Date: 7/23/2024
Project Number: 20241040 Sample Number: R-2 Depth: 18.8-19.1

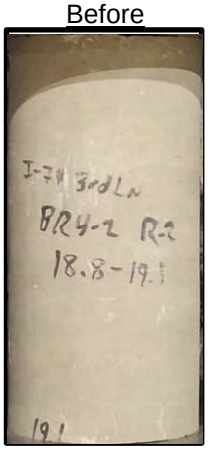
Visual Description: DOLOMITIC LIMESTONE

Specimen Weight	482.60	g
Diameter	1.872	inches
Length	4.102	inches
Volume	**0.0065**	ft^3

Wet unit weight	**162.8**	pcf
Length:Diameter Ratio	**2.19**	

Specimen Area (metric)	**1775.696**	mm^2
Specimen Area	**2.752**	in^2
Total Load on Specimen	**42570**	lbs
Unconfined Strength (qu)	**15467**	**psi**
Unconfined Strength (qu)	**1114**	**tsf**
Unconfined Strength (qu)	**107**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/25/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-4-2 Date: 7/23/2024
Project Number: 20241040 Sample Number: R-3 Depth: 23.9-24.2

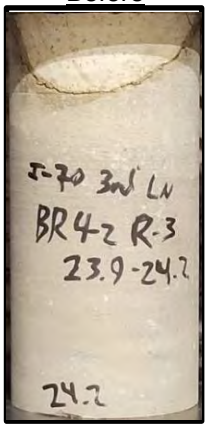
Visual Description: LIMESTONE AND CHERT

Specimen Weight	472.06	g
Diameter	1.875	inches
Length	3.931	inches
Volume	**0.0063**	ft^3

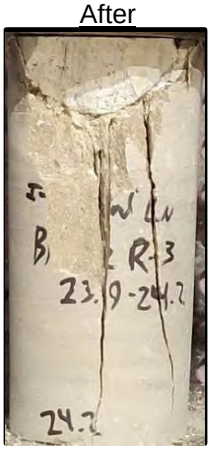
Wet unit weight	**165.7**	pcf
Length:Diameter Ratio	**2.10**	

Specimen Area (metric)	**1781.392**	mm^2
Specimen Area	**2.761**	in^2
Total Load on Specimen	**49320**	lbs
Unconfined Strength (qu)	**17863**	**psi**
Unconfined Strength (qu)	**1286**	**tsf**
Unconfined Strength (qu)	**123**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/31/2024

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Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-5-2A Date: 6/20/2024
Project Number: 20241040 Sample Number: R-1 Depth: 32.6-32.9

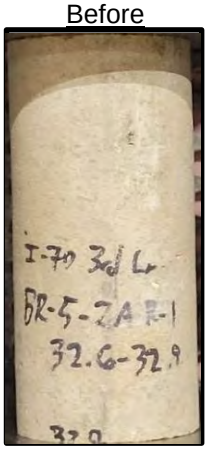
Visual Description: LIMESTONE, crystalline

Specimen Weight	461.11	g
Diameter	1.864	inches
Length	4.113	inches
Volume	**0.0065**	ft^3

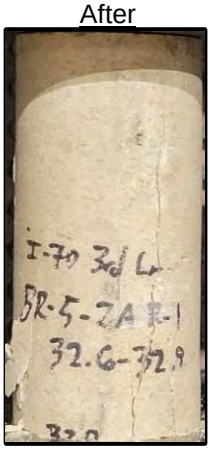
Wet unit weight	**156.5**	pcf
Length:Diameter Ratio	**2.21**	

Specimen Area (metric)	**1760.552**	mm^2
Specimen Area	**2.729**	in^2
Total Load on Specimen	**16990**	lbs
Unconfined Strength (qu)	**6226**	**psi**
Unconfined Strength (qu)	**448**	**tsf**
Unconfined Strength (qu)	**43**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

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Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-5-2A Date: 6/20/2024
Project Number: 20241040 Sample Number: R-2 Depth: 37.3-37.6

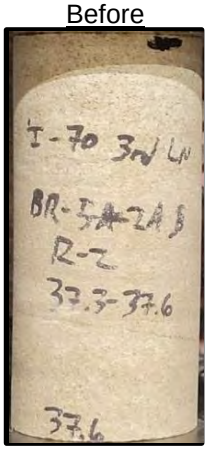
Visual Description: LIMESTONE

Specimen Weight	463.25	g
Diameter	1.864	inches
Length	4.000	inches
Volume	**0.0063**	ft^3

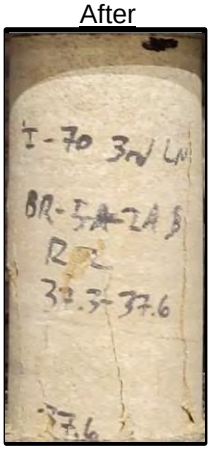
Wet unit weight	**161.7**	pcf
Length:Diameter Ratio	**2.15**	

Specimen Area (metric)	**1760.552**	mm^2
Specimen Area	**2.729**	in^2
Total Load on Specimen	**26370**	lbs
Unconfined Strength (qu)	**9664**	**psi**
Unconfined Strength (qu)	**696**	**tsf**
Unconfined Strength (qu)	**67**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

TSi
geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-5-2A Date: 6/20/2024
Project Number: 20241040 Sample Number: R-3 Depth: 42.3-42.6

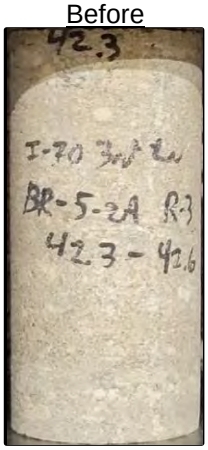
Visual Description: LIMESTONE, fossiliferous

Specimen Weight	482.08	g
Diameter	1.866	inches
Length	4.105	inches
Volume	**0.0065**	ft^3

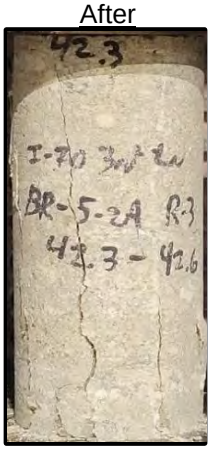
Wet unit weight	**163.6**	pcf
Length:Diameter Ratio	**2.20**	

Specimen Area (metric)	**1764.332**	mm^2
Specimen Area	**2.735**	in^2
Total Load on Specimen	**23580**	lbs
Unconfined Strength (qu)	**8623**	**psi**
Unconfined Strength (qu)	**621**	**tsf**
Unconfined Strength (qu)	**59**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-5-3A Date: 6/20/2024
Project Number: 20241040 Sample Number: R-2 Depth: 41.6-41.9

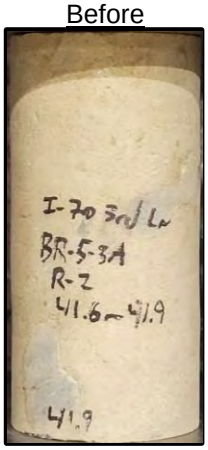
Visual Description: LIMESTONE

Specimen Weight	464.50	g
Diameter	1.863	inches
Length	4.176	inches
Volume	**0.0066**	ft^3

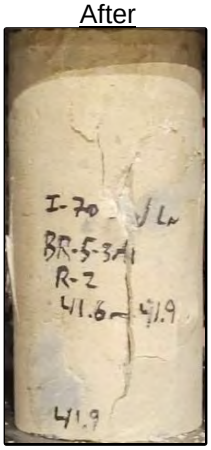
Wet unit weight	**155.4**	pcf
Length:Diameter Ratio	**2.24**	

Specimen Area (metric)	**1758.663**	mm^2
Specimen Area	**2.726**	in^2
Total Load on Specimen	**16060**	lbs
Unconfined Strength (qu)	**5892**	**psi**
Unconfined Strength (qu)	**424**	**tsf**
Unconfined Strength (qu)	**41**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-7-1A Date: 6/14/2024
Project Number: 20241040 Sample Number: R-1 Depth: 13.2-13.5

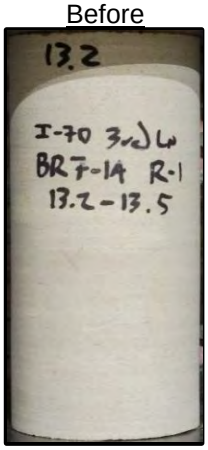
Visual Description: LIMESTONE

Specimen Weight	512.04	g
Diameter	1.857	inches
Length	4.303	inches
Volume	**0.0067**	ft^3

Wet unit weight	**167.4**	pcf
Length:Diameter Ratio	**2.32**	

Specimen Area (metric)	**1747.353**	mm^2
Specimen Area	**2.708**	in^2
Total Load on Specimen	**46690**	lbs
Unconfined Strength (qu)	**17239**	**psi**
Unconfined Strength (qu)	**1241**	**tsf**
Unconfined Strength (qu)	**119**	**MPa**

Before



After



Tested by: SLY Date: 6/14/2024
Calculated by: SLY Date: 6/25/2024
Checked by: AK Date: 6/28/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-7-1A Date: 6/20/2024
Project Number: 20241040 Sample Number: R-2 Depth: 16.0-16.3

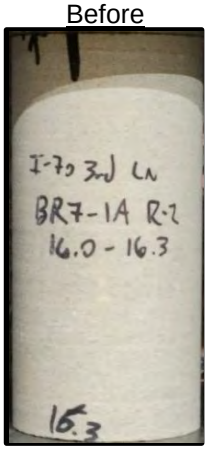
Visual Description: LIMESTONE

Specimen Weight	468.16	g
Diameter	1.857	inches
Length	3.987	inches
Volume	**0.0062**	ft^3

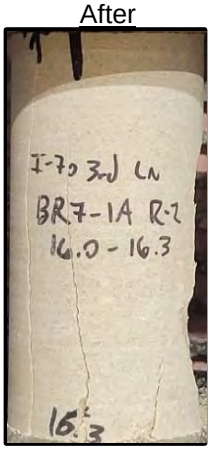
Wet unit weight	**165.2**	pcf
Length:Diameter Ratio	**2.15**	

Specimen Area (metric)	**1747.353**	mm^2
Specimen Area	**2.708**	in^2
Total Load on Specimen	**31320**	lbs
Unconfined Strength (qu)	**11564**	**psi**
Unconfined Strength (qu)	**833**	**tsf**
Unconfined Strength (qu)	**80**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-7-1A Date: 6/20/2024
Project Number: 20241040 Sample Number: R-3 Depth: 20.6-20.9

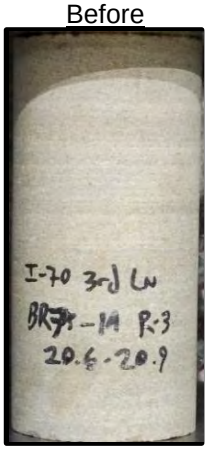
Visual Description: LIMESTONE

Specimen Weight	474.16	g
Diameter	1.856	inches
Length	4.016	inches
Volume	**0.0063**	ft^3

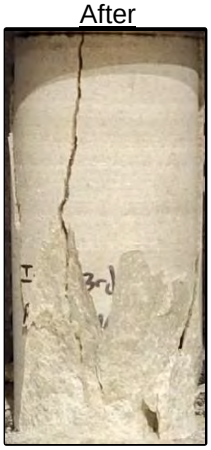
Wet unit weight	**166.2**	pcf
Length:Diameter Ratio	**2.16**	

Specimen Area (metric)	**1745.472**	mm^2
Specimen Area	**2.705**	in^2
Total Load on Specimen	**32340**	lbs
Unconfined Strength (qu)	**11954**	**psi**
Unconfined Strength (qu)	**861**	**tsf**
Unconfined Strength (qu)	**82**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

TSi geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-7-3A Date: 6/20/2024
Project Number: 20241040 Sample Number: R-2 Depth: 27.9-28.2

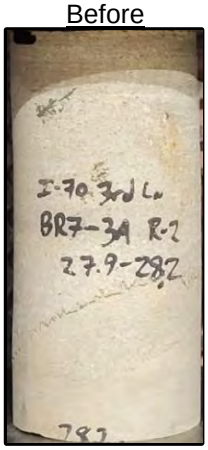
Visual Description: LIMESTONE

Specimen Weight	460.06	g
Diameter	1.843	inches
Length	3.985	inches
Volume	**0.0062**	ft^3

Wet unit weight	**164.9**	pcf
Length:Diameter Ratio	**2.16**	

Specimen Area (metric)	**1721.106**	mm^2
Specimen Area	**2.668**	in^2
Total Load on Specimen	**22490**	lbs
Unconfined Strength (qu)	**8431**	**psi**
Unconfined Strength (qu)	**607**	**tsf**
Unconfined Strength (qu)	**58**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

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Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-7-3A Date: 6/20/2024
Project Number: 20241040 Sample Number: R-3 Depth: 33.9-34.2

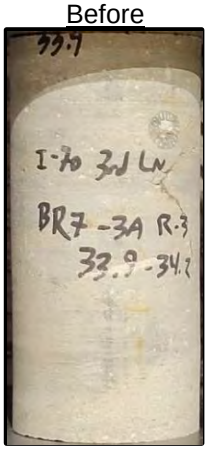
Visual Description: LIMESTONE, with conglomorate-healed fractures

Specimen Weight	456.84	g
Diameter	1.865	inches
Length	3.843	inches
Volume	**0.0061**	ft^3

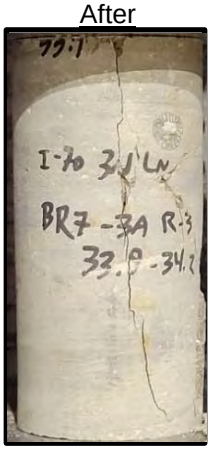
Wet unit weight	**165.8**	pcf
Length:Diameter Ratio	**2.06**	

Specimen Area (metric)	**1762.441**	mm^2
Specimen Area	**2.732**	in^2
Total Load on Specimen	**24850**	lbs
Unconfined Strength (qu)	**9097**	**psi**
Unconfined Strength (qu)	**655**	**tsf**
Unconfined Strength (qu)	**63**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)

PROJECT No.: 20241040

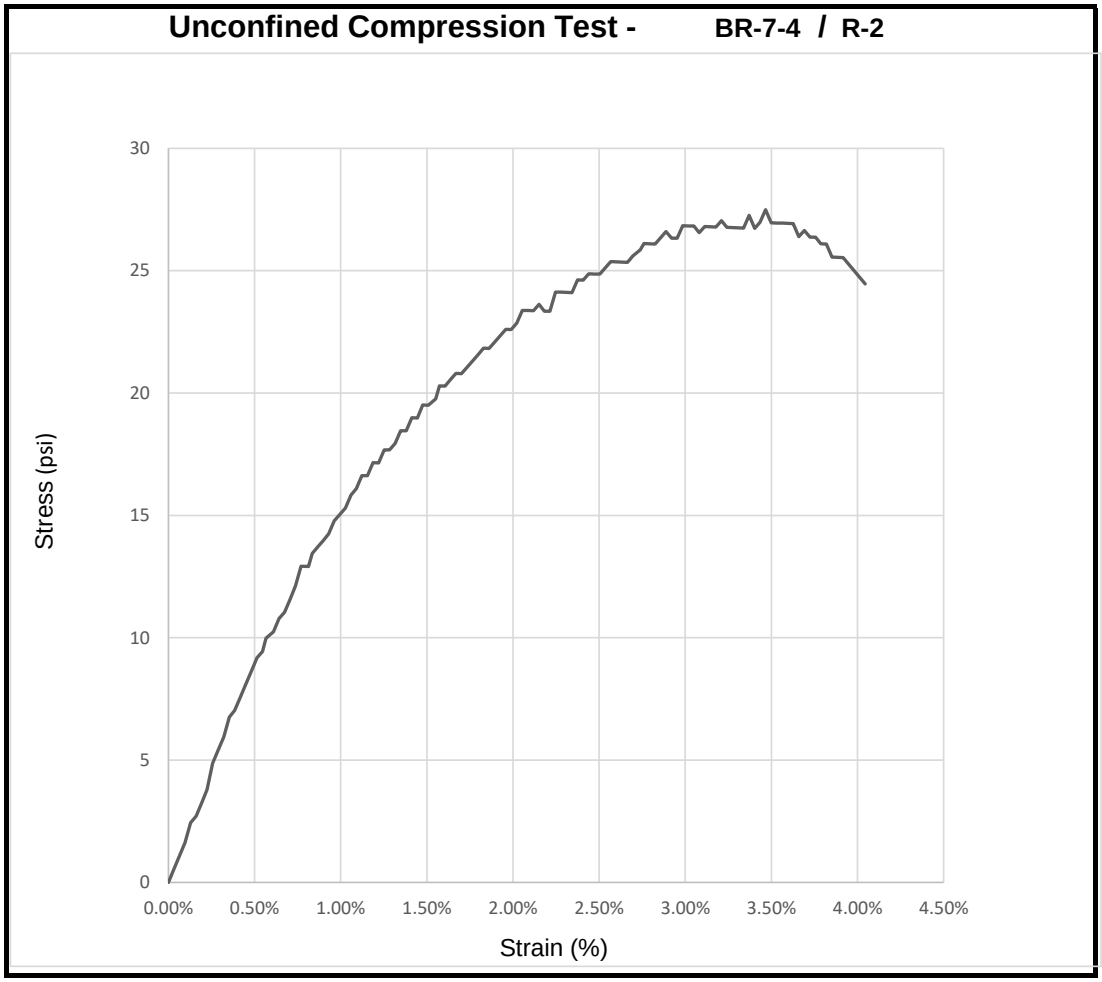
BORING NO.	**BR-7-4**
SAMPLE NO.	**R-2**
SAMPLE DEPTH (ft)	**41.0-41.3**
RECOVERY (%)	**67**
VISUAL CLASS. (USCS)	**SHALE**

SPECIFICATIONS	
Unconfined Compression	**ASTM D7012**
VISUAL CLASS. (USCS)	**SHALE**

DENSITY & MOISTURE	
Wet unit weight (pcf)	**135.3**
Moisture Content (%)	**16.3%**
Dry unit weight (pcf)	**116.4**

STRENGTH	
Unconfined Strength qu (psi)	**27.5**
% Strain at qu	**3.47**

Tested by: SLY	5/28/2024
Calculated by: SLY	5/29/2024
Checked by: AK	6/28/2024



PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)

PROJECT No.: 20241040

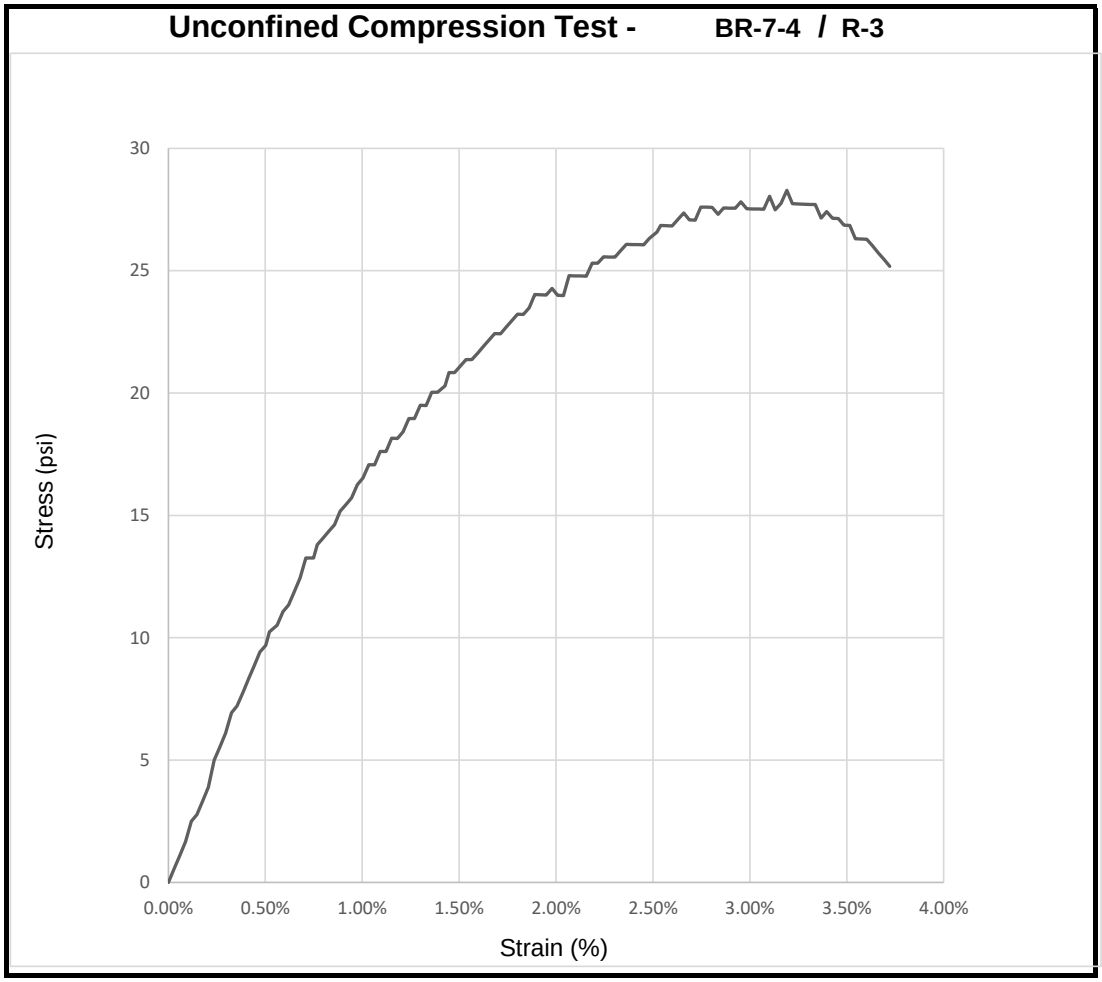
BORING NO.	BR-7-4
SAMPLE NO.	R-3
SAMPLE DEPTH (ft)	48.2-48.5
RECOVERY (%)	58
VISUAL CLASS. (USCS)	SHALE, w/ coal

SPECIFICATIONS	
Unconfined Compression	ASTM D7012
VISUAL CLASS. (USCS)	SHALE

DENSITY & MOISTURE	
Wet unit weight (pcf)	124.0
Moisture Content (%)	18.8%
Dry unit weight (pcf)	104.4

STRENGTH	
Unconfined Strength qu (psi)	28.3
% Strain at qu	3.19

Tested by: SLY	5/28/2024
Calculated by: SLY	5/29/2024
Checked by: AK	6/28/2024



TSi geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-10-1 Date: 6/20/2024
Project Number: 20241040 Sample Number: R-1 Depth: 21.1-21.4

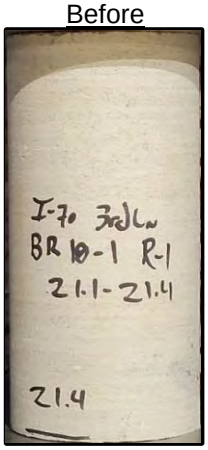
Visual Description: LIMESTONE

Specimen Weight	520.01	g
Diameter	1.860	inches
Length	4.358	inches
Volume	**0.0069**	ft^3

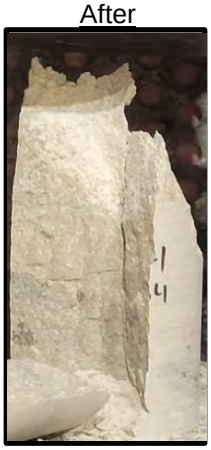
Wet unit weight	**167.3**	pcf
Length:Diameter Ratio	**2.34**	

Specimen Area (metric)	**1753.004**	mm^2
Specimen Area	**2.717**	in^2
Total Load on Specimen	**40680**	lbs
Unconfined Strength (qu)	**14972**	**psi**
Unconfined Strength (qu)	**1078**	**tsf**
Unconfined Strength (qu)	**103**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-10-1 Date: 6/20/2024
Project Number: 20241040 Sample Number: R-2 Depth: 26.7-27.0

Visual Description: LIMESTONE

Specimen Weight	449.22	g
Diameter	1.862	inches
Length	3.888	inches
Volume	**0.0061**	ft^3

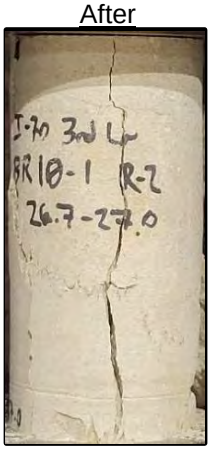
Wet unit weight	**161.6**	pcf
Length:Diameter Ratio	**2.09**	

Specimen Area (metric)	**1756.776**	mm^2
Specimen Area	**2.723**	in^2
Total Load on Specimen	**20380**	lbs
Unconfined Strength (qu)	**7485**	**psi**
Unconfined Strength (qu)	**539**	**tsf**
Unconfined Strength (qu)	**52**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

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Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-10-3A Date: 7/23/2024
Project Number: 20241040 Sample Number: R-5 Depth: 52.0-52.3

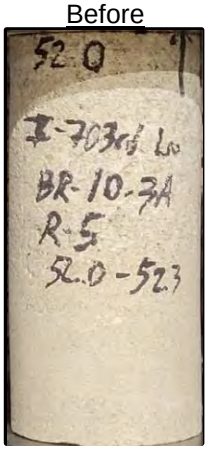
Visual Description: LIMESTONE

Specimen Weight	445.86	g
Diameter	1.858	inches
Length	3.880	inches
Volume	**0.0061**	ft^3

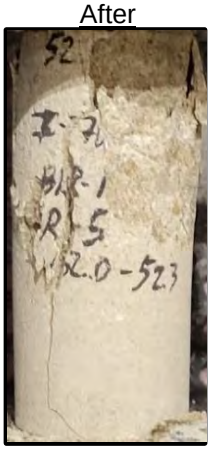
Wet unit weight	**161.5**	pcf
Length:Diameter Ratio	**2.09**	

Specimen Area (metric)	**1749.236**	mm^2
Specimen Area	**2.711**	in^2
Total Load on Specimen	**21920**	lbs
Unconfined Strength (qu)	**8085**	**psi**
Unconfined Strength (qu)	**582**	**tsf**
Unconfined Strength (qu)	**56**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/31/2024

TSi geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-10-3A Date: 7/23/2024
Project Number: 20241040 Sample Number: R-6 Depth: 57.2-57.5

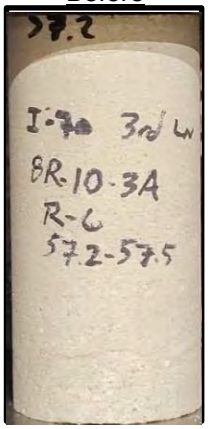
Visual Description: LIMESTONE

Specimen Weight	468.80	g
Diameter	1.859	inches
Length	4.045	inches
Volume	**0.0064**	ft^3

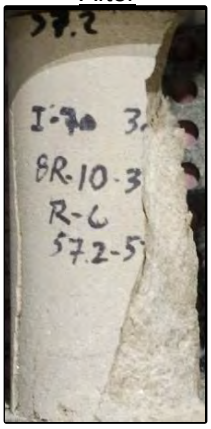
Wet unit weight	**162.7**	pcf
Length:Diameter Ratio	**2.18**	

Specimen Area (metric)	**1751.119**	mm^2
Specimen Area	**2.714**	in^2
Total Load on Specimen	**33170**	lbs
Unconfined Strength (qu)	**12221**	**psi**
Unconfined Strength (qu)	**880**	**tsf**
Unconfined Strength (qu)	**84**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/31/2024

geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-10-4 Date: 6/20/2024
Project Number: 20241040 Sample Number: R-1 Depth: 34.8-35.1

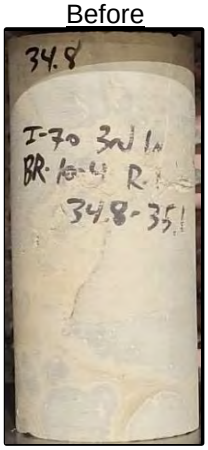
Visual Description: LIMESTONE

Specimen Weight	485.70	g
Diameter	1.863	inches
Length	4.167	inches
Volume	**0.0066**	ft^3

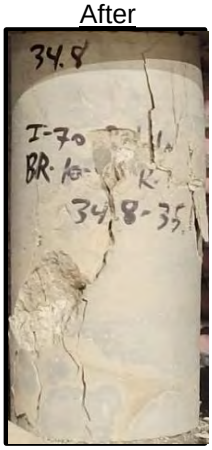
Wet unit weight	**162.9**	pcf
Length:Diameter Ratio	**2.24**	

Specimen Area (metric)	**1758.663**	mm^2
Specimen Area	**2.726**	in^2
Total Load on Specimen	**20070**	lbs
Unconfined Strength (qu)	**7363**	**psi**
Unconfined Strength (qu)	**530**	**tsf**
Unconfined Strength (qu)	**51**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)
PROJECT No.: 20241040

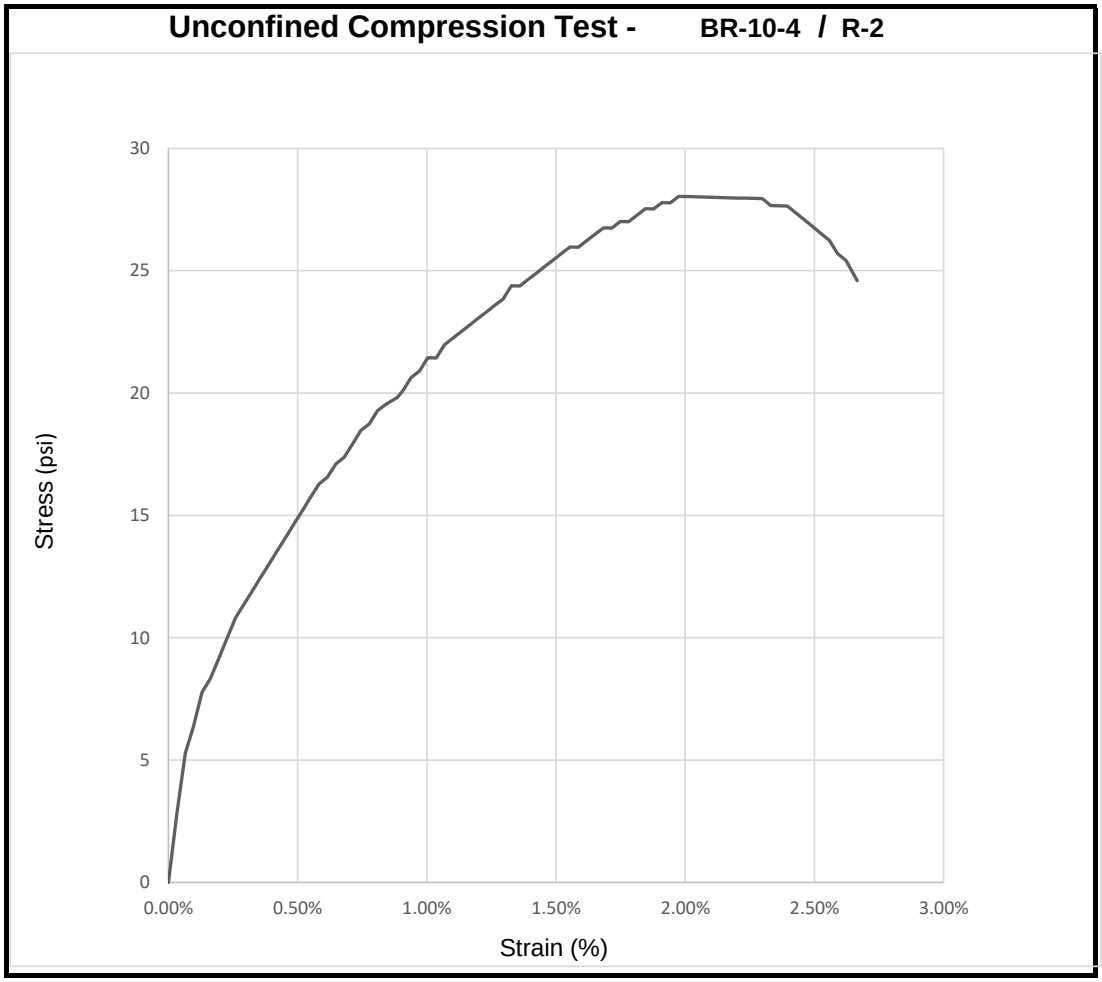
BORING NO.	BR-10-4
SAMPLE NO.	R-2
SAMPLE DEPTH (ft)	38.3-38.6
RECOVERY (%)	98
VISUAL CLASS. (USCS)	SHALE

SPECIFICATIONS	
Unconfined Compression	ASTM D7012
VISUAL CLASS. (USCS)	SHALE

DENSITY & MOISTURE	
Wet unit weight (pcf)	135.4
Moisture Content (%)	18.5%
Dry unit weight (pcf)	114.3

STRENGTH	
Unconfined Strength qu (psi)	28.0
% Strain at qu	1.97

Tested by: SLY	5/28/2024
Calculated by: SLY	5/29/2024
Checked by: AK	6/28/2024



Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-10-4 Date: 6/20/2024
Project Number: 20241040 Sample Number: R-3 Depth: 41.8-42.1

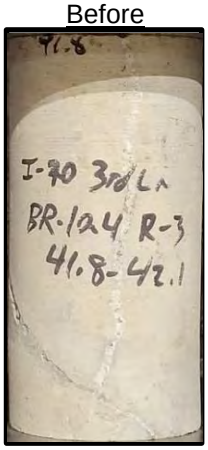
Visual Description: LIMESTONE, with vertical healed calcite fracture

Specimen Weight	426.05	g
Diameter	1.863	inches
Length	3.779	inches
Volume	**0.0060**	ft^3

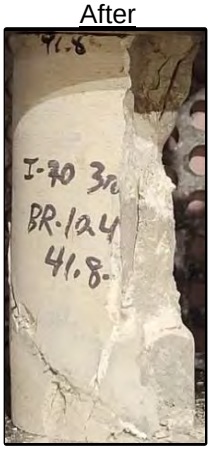
Wet unit weight	**157.6**	pcf
Length:Diameter Ratio	**2.03**	

Specimen Area (metric)	**1758.663**	mm^2
Specimen Area	**2.726**	in^2
Total Load on Specimen	**22060**	lbs
Unconfined Strength (qu)	**8093**	**psi**
Unconfined Strength (qu)	**583**	**tsf**
Unconfined Strength (qu)	**56**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)
PROJECT No.: 20241040

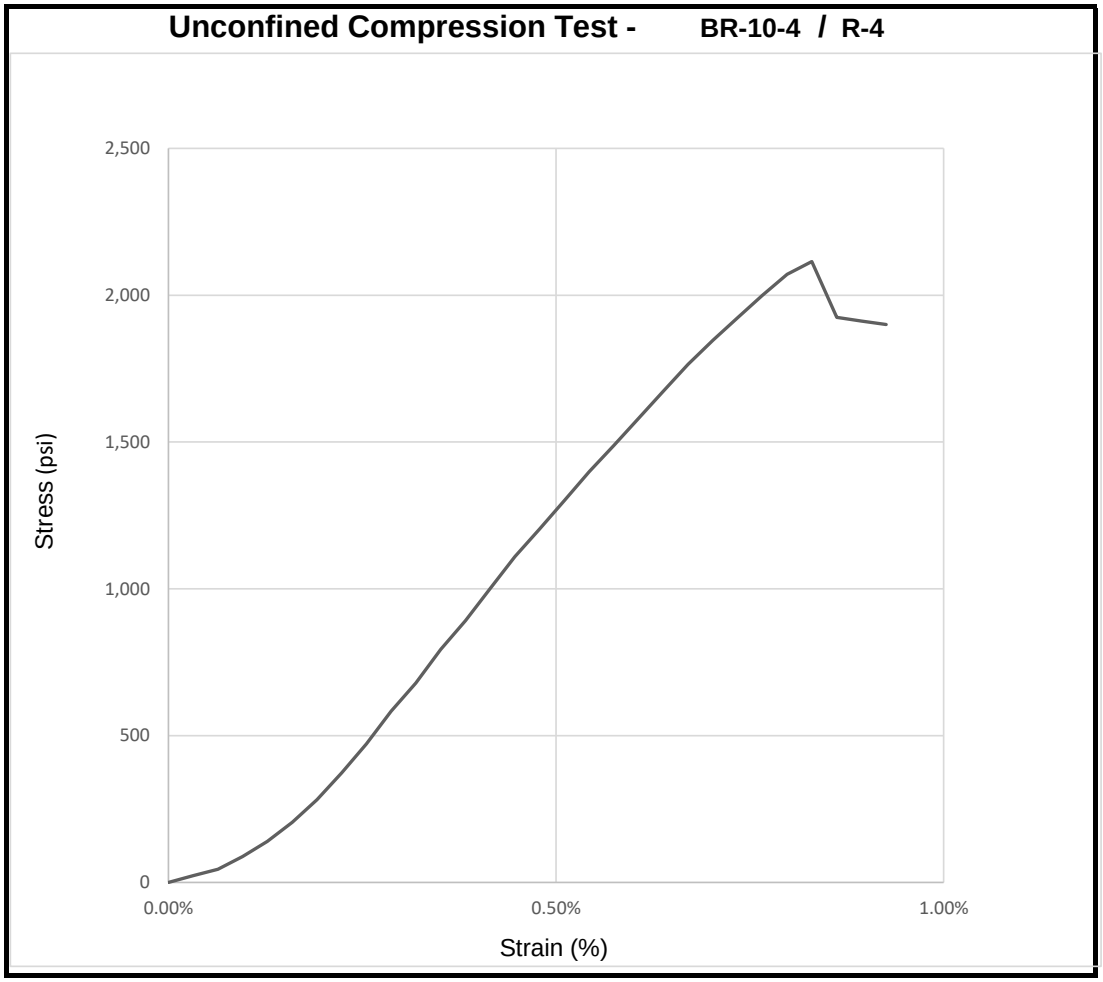
BORING NO.	BR-10-4
SAMPLE NO.	R-4
SAMPLE DEPTH (ft)	48.9-49.2
RECOVERY (%)	100
VISUAL CLASS. (USCS)	COAL

SPECIFICATIONS	
Unconfined Compression	ASTM D7012
VISUAL CLASS. (USCS)	COAL

DENSITY & MOISTURE	
Wet unit weight (pcf)	90.7
Moisture Content (%)	6.7%
Dry unit weight (pcf)	85.0

STRENGTH	
Unconfined Strength qu (psi)	2114.6
% Strain at qu	0.83

Tested by: SLY	5/28/2024
Calculated by: SLY	5/29/2024
Checked by: AK	6/28/2024



PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)
PROJECT No.: 20241040

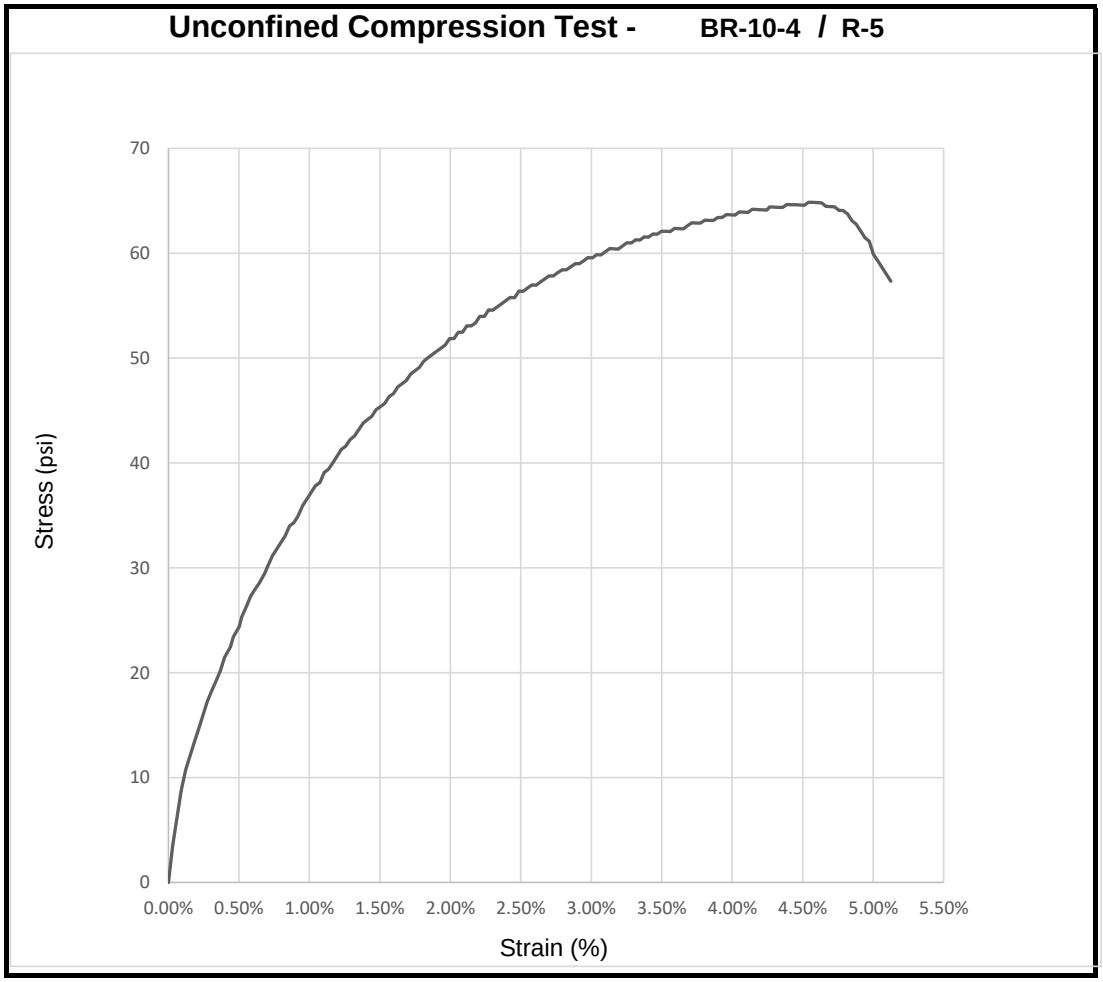
BORING NO.	**BR-10-4**
SAMPLE NO.	**R-5**
SAMPLE DEPTH (ft)	**51.7-52.0**
RECOVERY (%)	**100**
VISUAL CLASS. (USCS)	**SHALE**

SPECIFICATIONS	
Unconfined Compression	**ASTM D7012**
VISUAL CLASS. (USCS)	**SHALE**

DENSITY & MOISTURE	
Wet unit weight (pcf)	**137.1**
Moisture Content (%)	**16.6%**
Dry unit weight (pcf)	**117.5**

STRENGTH	
Unconfined Strength qu (psi)	**64.9**
% Strain at qu	**4.54**

Tested by: SLY	5/28/2024
Calculated by: SLY	5/29/2024
Checked by: AK	6/28/2024



PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)
PROJECT No.: 20241040

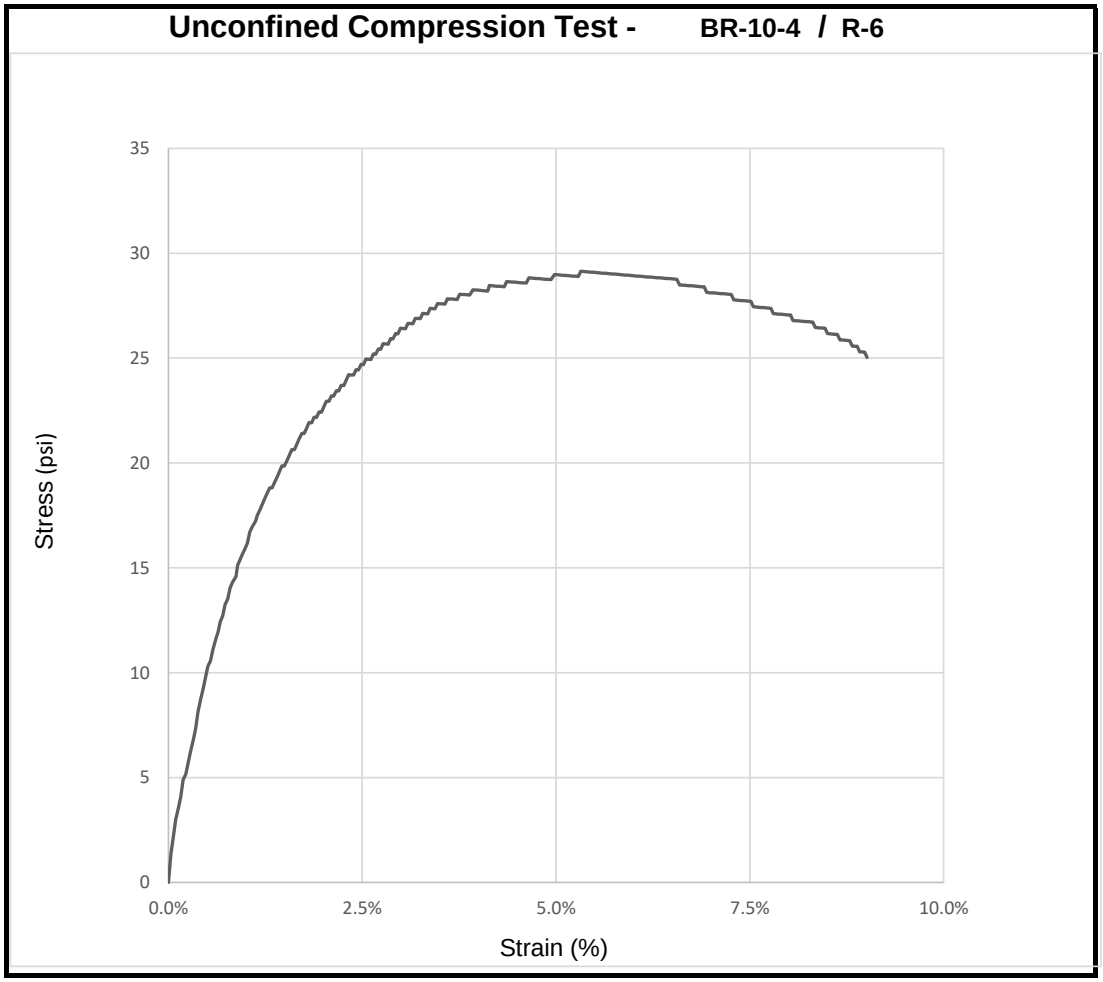
BORING NO.	BR-10-4
SAMPLE NO.	R-6
SAMPLE DEPTH (ft)	57.0-57.3
RECOVERY (%)	100
VISUAL CLASS. (USCS)	SHALE

SPECIFICATIONS	
Unconfined Compression	ASTM D7012
VISUAL CLASS. (USCS)	SHALE

DENSITY & MOISTURE	
Wet unit weight (pcf)	138.0
Moisture Content (%)	17.6%
Dry unit weight (pcf)	117.4

STRENGTH	
Unconfined Strength qu (psi)	29.1
% Strain at qu	5.32

Tested by: SLY	5/28/2024
Calculated by: SLY	5/29/2024
Checked by: AK	6/28/2024



PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)

PROJECT No.: 20241040

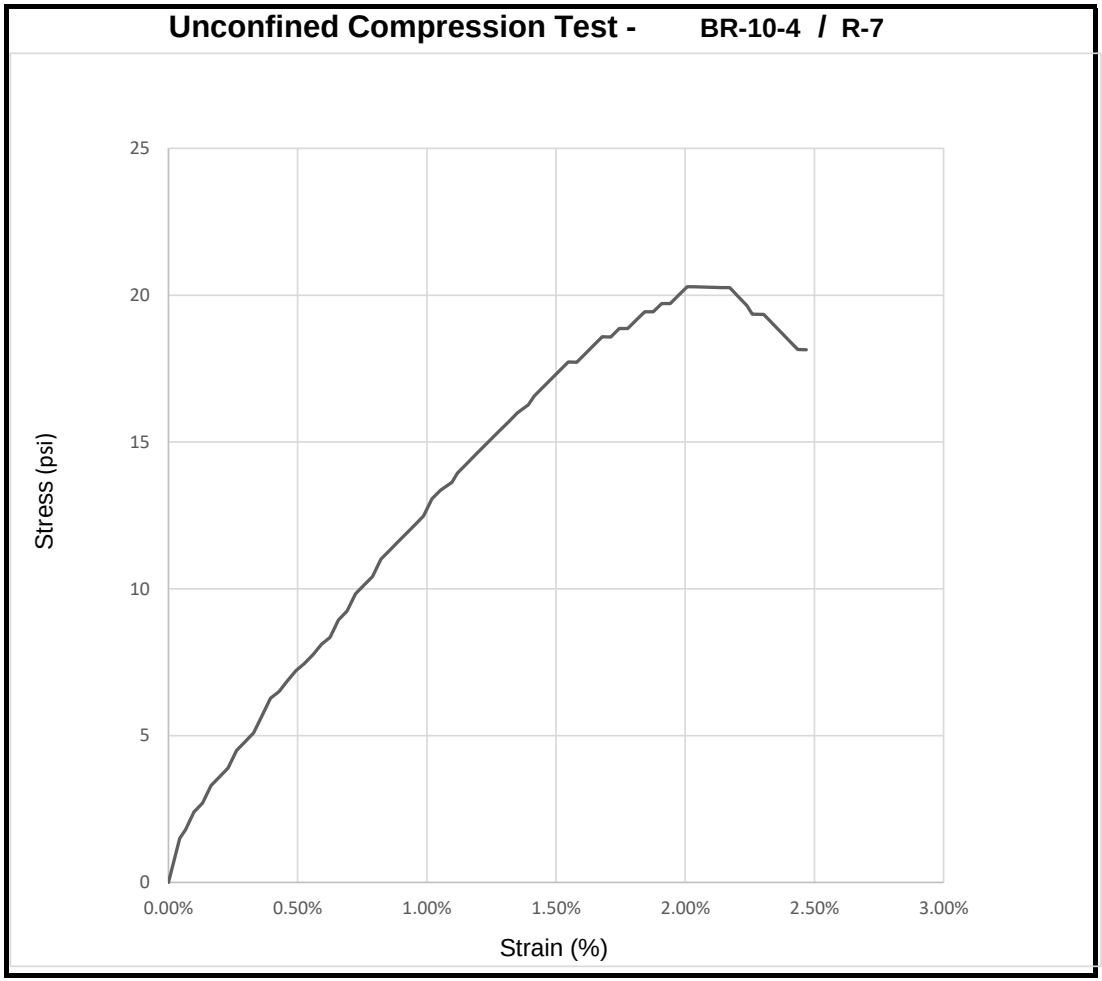
BORING NO.	BR-10-4
SAMPLE NO.	R-7
SAMPLE DEPTH (ft)	62.2-62.5
RECOVERY (%)	100
VISUAL CLASS. (USCS)	SHALE

SPECIFICATIONS	
Unconfined Compression	ASTM D7012
VISUAL CLASS. (USCS)	SHALE

DENSITY & MOISTURE	
Wet unit weight (pcf)	137.1
Moisture Content (%)	12.2%
Dry unit weight (pcf)	122.2

STRENGTH	
Unconfined Strength qu (psi)	20.3
% Strain at qu	2.01

Tested by: SLY	5/28/2024
Calculated by: SLY	5/29/2024
Checked by: AK	6/28/2024



PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)

PROJECT No.: 20241040

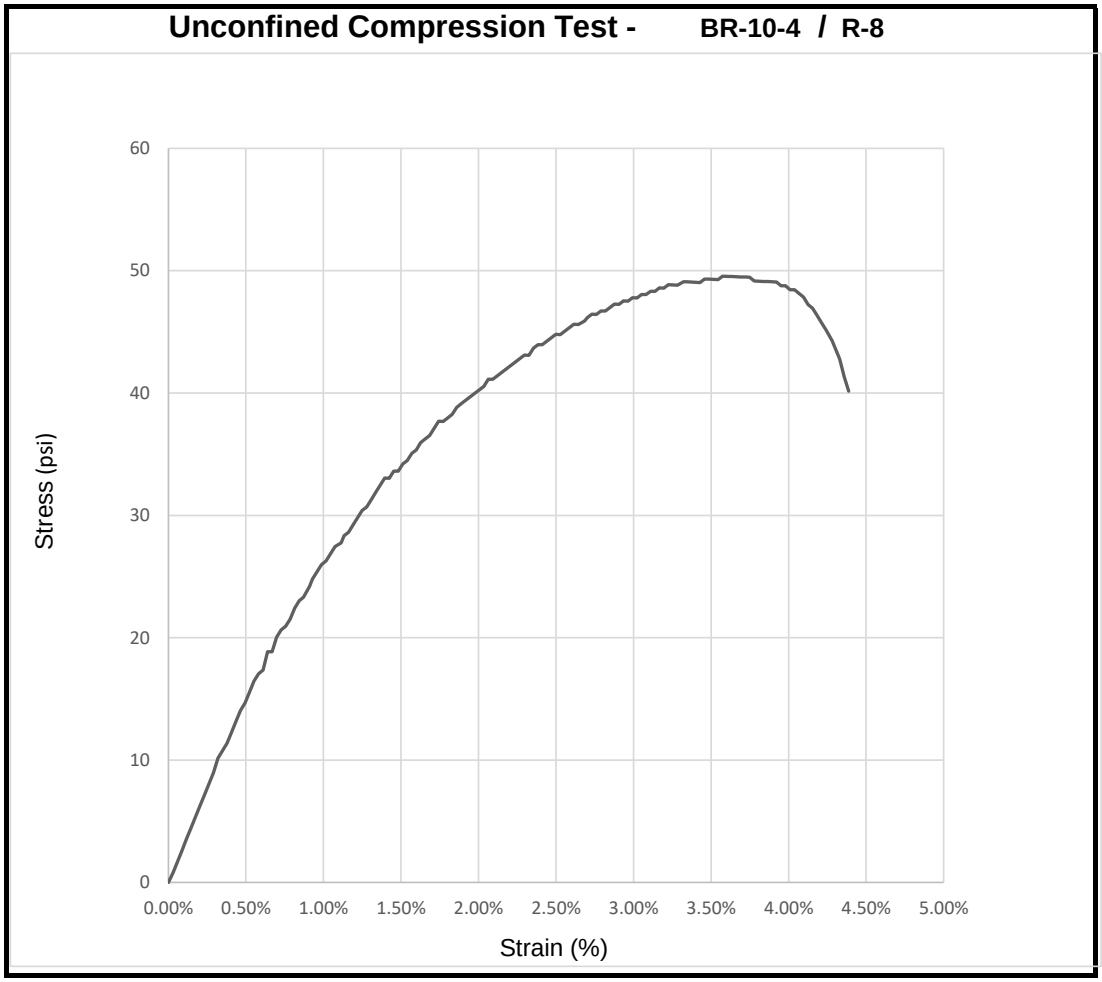
BORING NO.	**BR-10-4**
SAMPLE NO.	**R-8**
SAMPLE DEPTH (ft)	**65.5-65.8**
RECOVERY (%)	**92**
VISUAL CLASS. (USCS)	**SHALE**

SPECIFICATIONS	
Unconfined Compression	**ASTM D7012**
VISUAL CLASS. (USCS)	**SHALE**

DENSITY & MOISTURE	
Wet unit weight (pcf)	**133.8**
Moisture Content (%)	**16.2%**
Dry unit weight (pcf)	**115.2**

STRENGTH	
Unconfined Strength qu (psi)	**49.6**
% Strain at qu	**3.57**

Tested by: SLY	5/28/2024
Calculated by: SLY	5/29/2024
Checked by: AK	6/28/2024



TSi
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Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-10-5B Date: 7/23/2024
Project Number: 20241040 Sample Number: R-2 Depth: 39.6-39.9

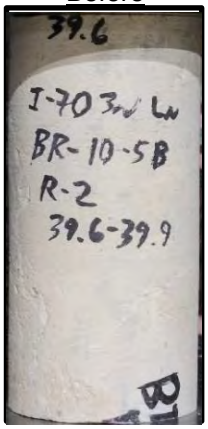
Visual Description: LIMESTONE , WITH HEALED FRACTURE

Specimen Weight	475.71	g
Diameter	1.869	inches
Length	4.116	inches
Volume	**0.0065**	ft^3

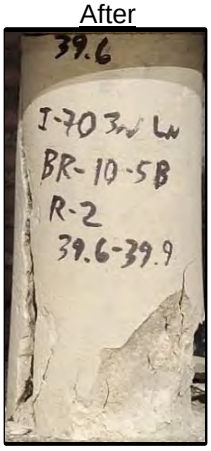
Wet unit weight	**160.5**	pcf
Length:Diameter Ratio	**2.20**	

Specimen Area (metric)	**1770.009**	mm^2
Specimen Area	**2.743**	in^2
Total Load on Specimen	**28570**	lbs
Unconfined Strength (qu)	**10414**	**psi**
Unconfined Strength (qu)	**750**	**tsf**
Unconfined Strength (qu)	**72**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/31/2024

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Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-10-5B Date: 7/23/2024
Project Number: 20241040 Sample Number: R-3 Depth: 44.1-44.4

Visual Description: LIMESTONE & DOLOMITE, WITH PYRITE

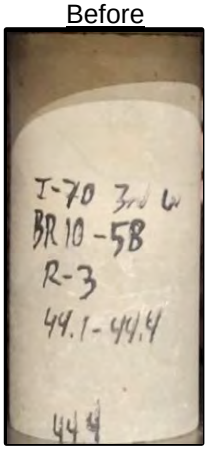
(Sample below 2:1 L:D ratio)

Specimen Weight	409.87	g
Diameter	1.869	inches
Length	3.469	inches
Volume	**0.0055**	ft^3

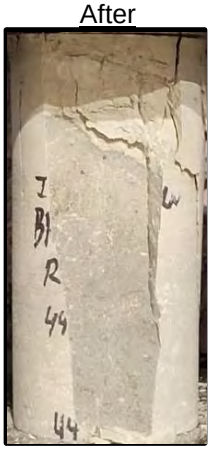
Wet unit weight	**164.1**	pcf
Length:Diameter Ratio	**1.86**	

Specimen Area (metric)	**1770.009**	mm^2
Specimen Area	**2.743**	in^2
Total Load on Specimen	**22610**	lbs
Unconfined Strength (qu)	**8241**	**psi**
Unconfined Strength (qu)	**593**	**tsf**
Unconfined Strength (qu)	**57**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/31/2024

PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)
PROJECT No.: 20241040

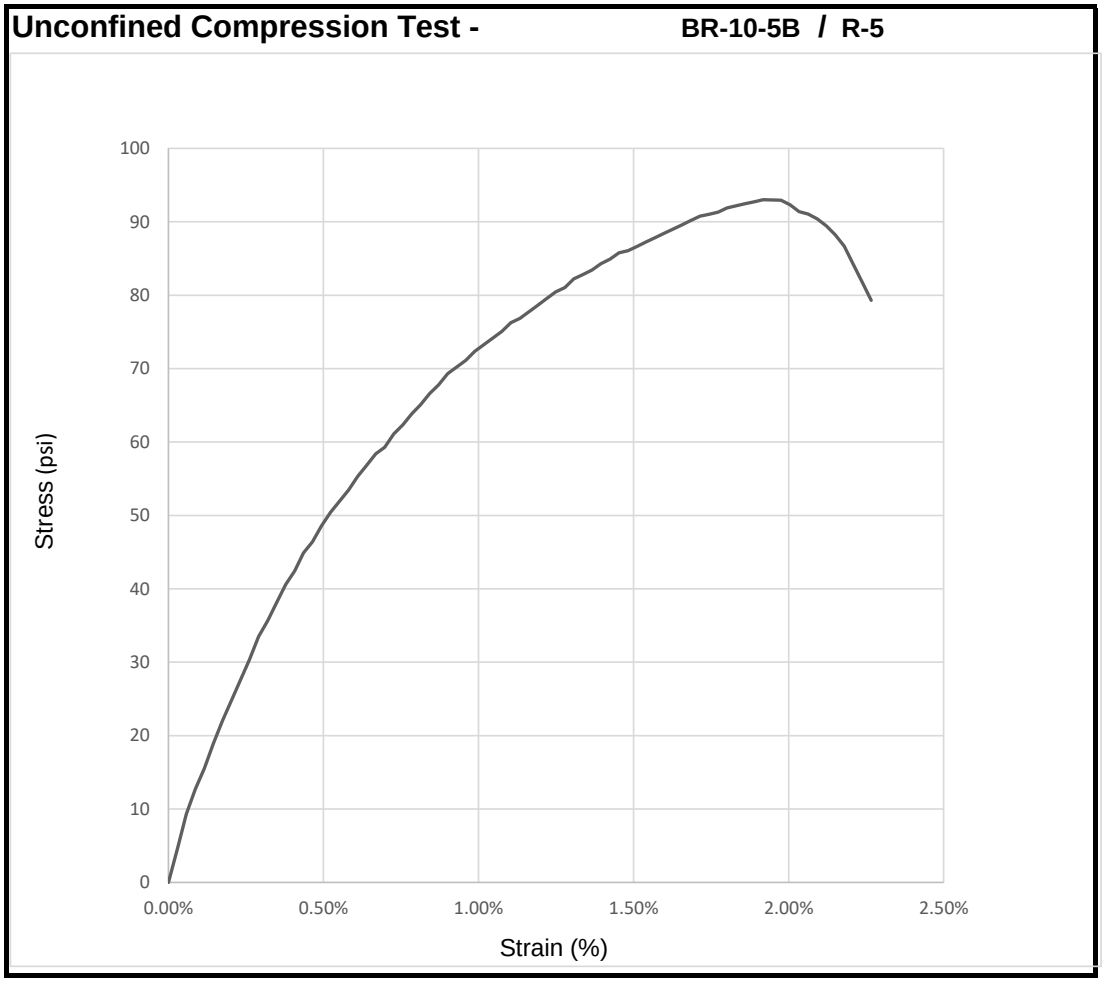
BORING NO.	BR-10-5B
SAMPLE NO.	R-5
SAMPLE DEPTH (ft)	53.4-53.7
RECOVERY (%)	100
VISUAL CLASS. (USCS)	SHALE

SPECIFICATIONS	
Unconfined Compression	ASTM D7012
VISUAL CLASS. (USCS)	SHALE

DENSITY & MOISTURE	
Wet unit weight (pcf)	134.6
Moisture Content (%)	14.2%
Dry unit weight (pcf)	117.8

STRENGTH	
Unconfined Strength qu (psi)	93.0
% Strain at qu	1.92

Tested by: SLY	7/24/2024
Calculated by: SLY	7/25/2024
Checked by: AK	7/31/2024



PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)

PROJECT No.: 20241040

BORING NO.	**BR-10-5B**
SAMPLE NO.	**R-6**
SAMPLE DEPTH (ft)	**55.3-55.6**
RECOVERY (%)	**75**
VISUAL CLASS. (USCS)	**SHALE**

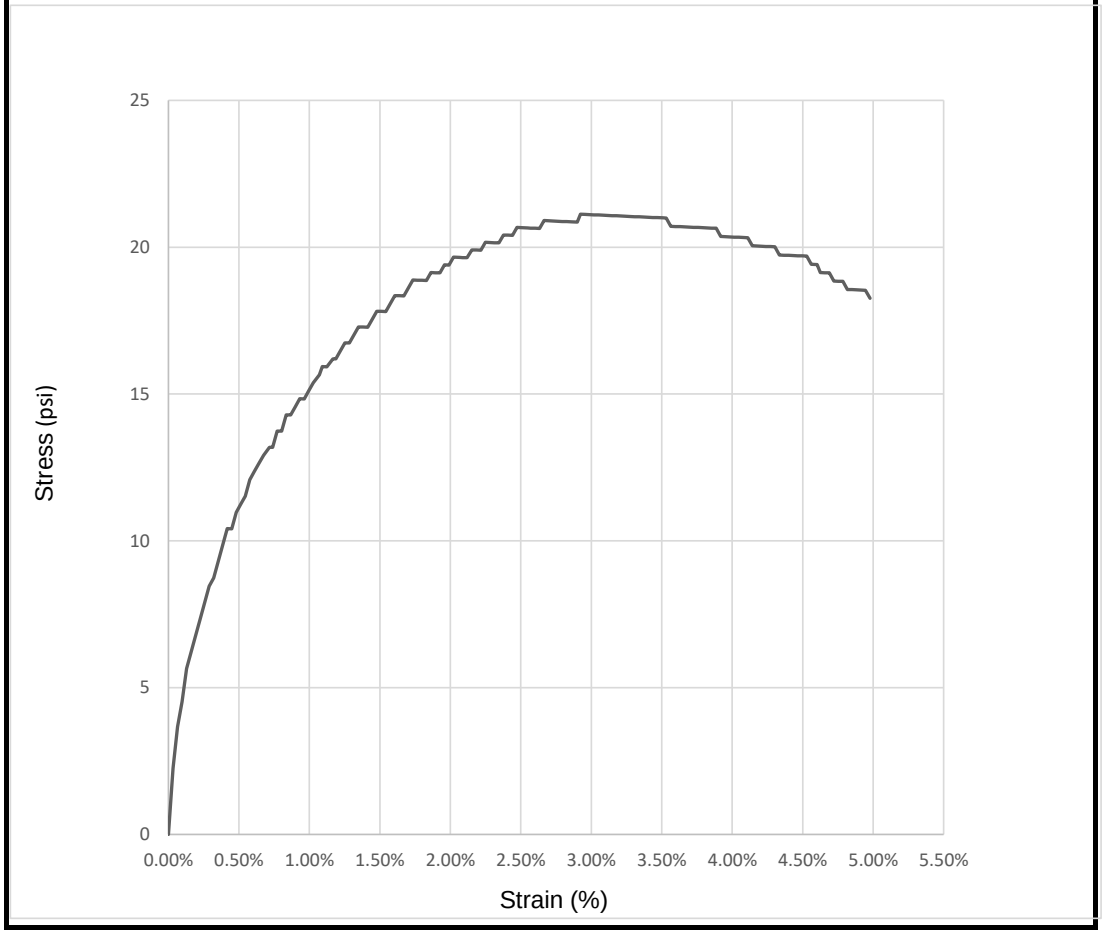
SPECIFICATIONS	
Unconfined Compression	**ASTM D7012**
VISUAL CLASS. (USCS)	**SHALE**

DENSITY & MOISTURE	
Wet unit weight (pcf)	**135.4**
Moisture Content (%)	**18.9%**
Dry unit weight (pcf)	**113.9**

STRENGTH	
Unconfined Strength qu (psi)	**21.1**
% Strain at qu	**2.92**

Tested by: SLY	7/24/2024
Calculated by: SLY	7/25/2024
Checked by: AK	7/31/2024

Unconfined Compression Test - BR-10-5B / R-6



PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)
PROJECT No.: 20241040

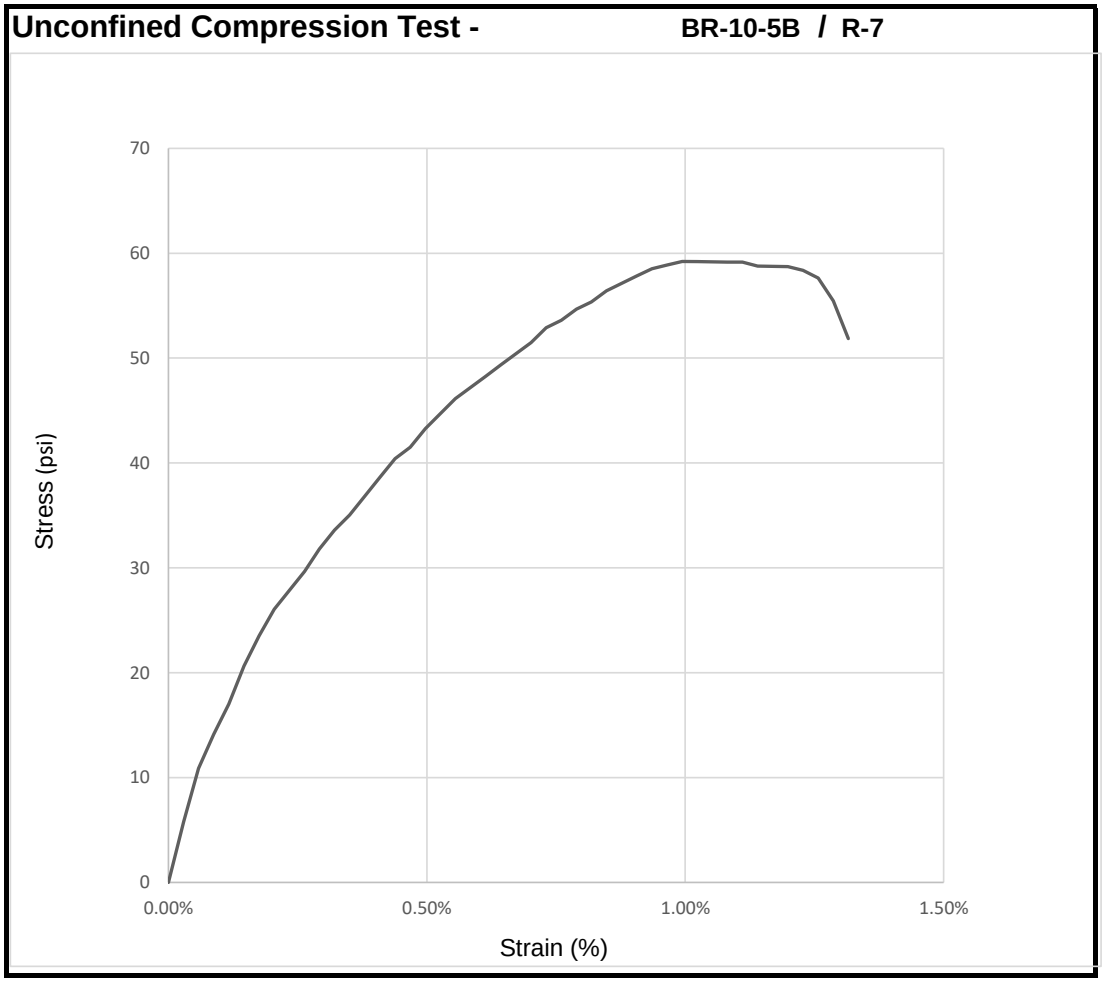
BORING NO.	BR-10-5B
SAMPLE NO.	R-7
SAMPLE DEPTH (ft)	60.3-60.6
RECOVERY (%)	100
VISUAL CLASS. (USCS)	SHALE

SPECIFICATIONS	
Unconfined Compression	ASTM D7012
VISUAL CLASS. (USCS)	SHALE

DENSITY & MOISTURE	
Wet unit weight (pcf)	137.1
Moisture Content (%)	16.4%
Dry unit weight (pcf)	117.8

STRENGTH	
Unconfined Strength qu (psi)	59.2
% Strain at qu	0.99

Tested by: SLY	7/24/2024
Calculated by: SLY	7/25/2024
Checked by: AK	7/31/2024



Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-10-6A Date: 7/3/2024
Project Number: 20241040 Sample Number: R-1 Depth: 43.8-44.1

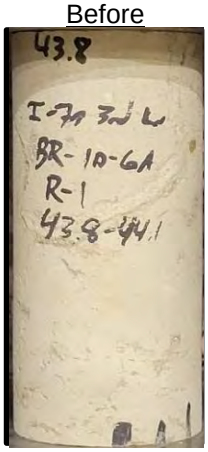
Visual Description: LIMESTONE

Specimen Weight	513.16	g
Diameter	1.863	inches
Length	4.234	inches
Volume	**0.0067**	ft^3

Wet unit weight	**169.4**	pcf
Length:Diameter Ratio	**2.27**	

Specimen Area (metric)	**1758.663**	mm^2
Specimen Area	**2.726**	in^2
Total Load on Specimen	**42080**	lbs
Unconfined Strength (qu)	**15437**	**psi**
Unconfined Strength (qu)	**1111**	**tsf**
Unconfined Strength (qu)	**106**	**MPa**

Before



After



Tested by: SLY Date: 7/3/2024
Calculated by: SLY Date: 7/8/2024
Checked by: JPE Date: 7/8/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-10-6A Date: 7/3/2024
Project Number: 20241040 Sample Number: R-3 Depth: 51.7-52.0

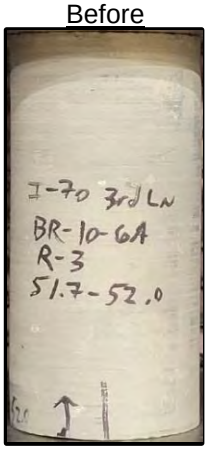
Visual Description: LIMESTONE

Specimen Weight	498.16	g
Diameter	1.848	inches
Length	4.198	inches
Volume	**0.0065**	ft^3

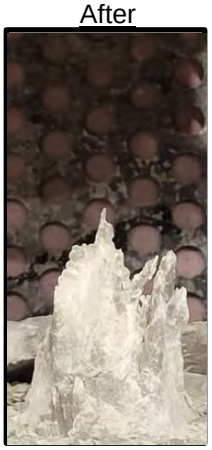
Wet unit weight	**168.5**	pcf
Length:Diameter Ratio	**2.27**	

Specimen Area (metric)	**1730.457**	mm^2
Specimen Area	**2.682**	in^2
Total Load on Specimen	**49010**	lbs
Unconfined Strength (qu)	**18273**	**psi**
Unconfined Strength (qu)	**1316**	**tsf**
Unconfined Strength (qu)	**126**	**MPa**

Before



After



Tested by: SLY Date: 7/3/2024
Calculated by: SLY Date: 7/8/2024
Checked by: JPE Date: 7/8/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-10-6A Date: 7/3/2024
Project Number: 20241040 Sample Number: R-4 Depth: 55.1-55.4

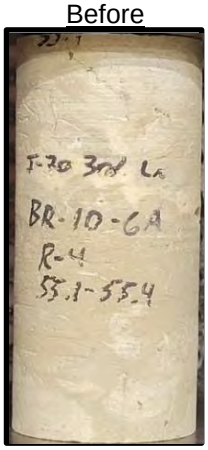
Visual Description: LIMESTONE

Specimen Weight	473.29	g
Diameter	1.846	inches
Length	4.152	inches
Volume	**0.0064**	ft^3

Wet unit weight	**162.3**	pcf
Length:Diameter Ratio	**2.25**	

Specimen Area (metric)	**1726.714**	mm^2
Specimen Area	**2.676**	in^2
Total Load on Specimen	**16910**	lbs
Unconfined Strength (qu)	**6318**	**psi**
Unconfined Strength (qu)	**455**	**tsf**
Unconfined Strength (qu)	**44**	**MPa**

Before



After



Tested by: SLY Date: 7/3/2024
Calculated by: SLY Date: 7/8/2024
Checked by: jpe Date: 7/8/2024

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Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-10-6A Date: 7/3/2024
Project Number: 20241040 Sample Number: R-5 Depth: 63.9-64.2

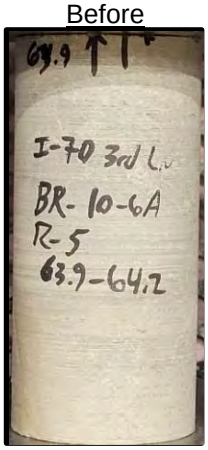
Visual Description: LIMESTONE

Specimen Weight	494.54	g
Diameter	1.857	inches
Length	4.161	inches
Volume	**0.0065**	ft^3

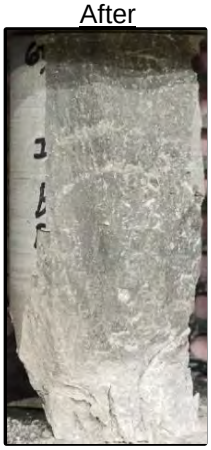
Wet unit weight	**167.2**	pcf
Length:Diameter Ratio	**2.24**	

Specimen Area (metric)	**1747.353**	mm^2
Specimen Area	**2.708**	in^2
Total Load on Specimen	**40000**	lbs
Unconfined Strength (qu)	**14769**	**psi**
Unconfined Strength (qu)	**1063**	**tsf**
Unconfined Strength (qu)	**102**	**MPa**

Before



After



Tested by: SLY Date: 7/3/2024
Calculated by: SLY Date: 7/8/2024
Checked by: JPE Date: 7/8/2024

PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)

PROJECT No.: 20241040

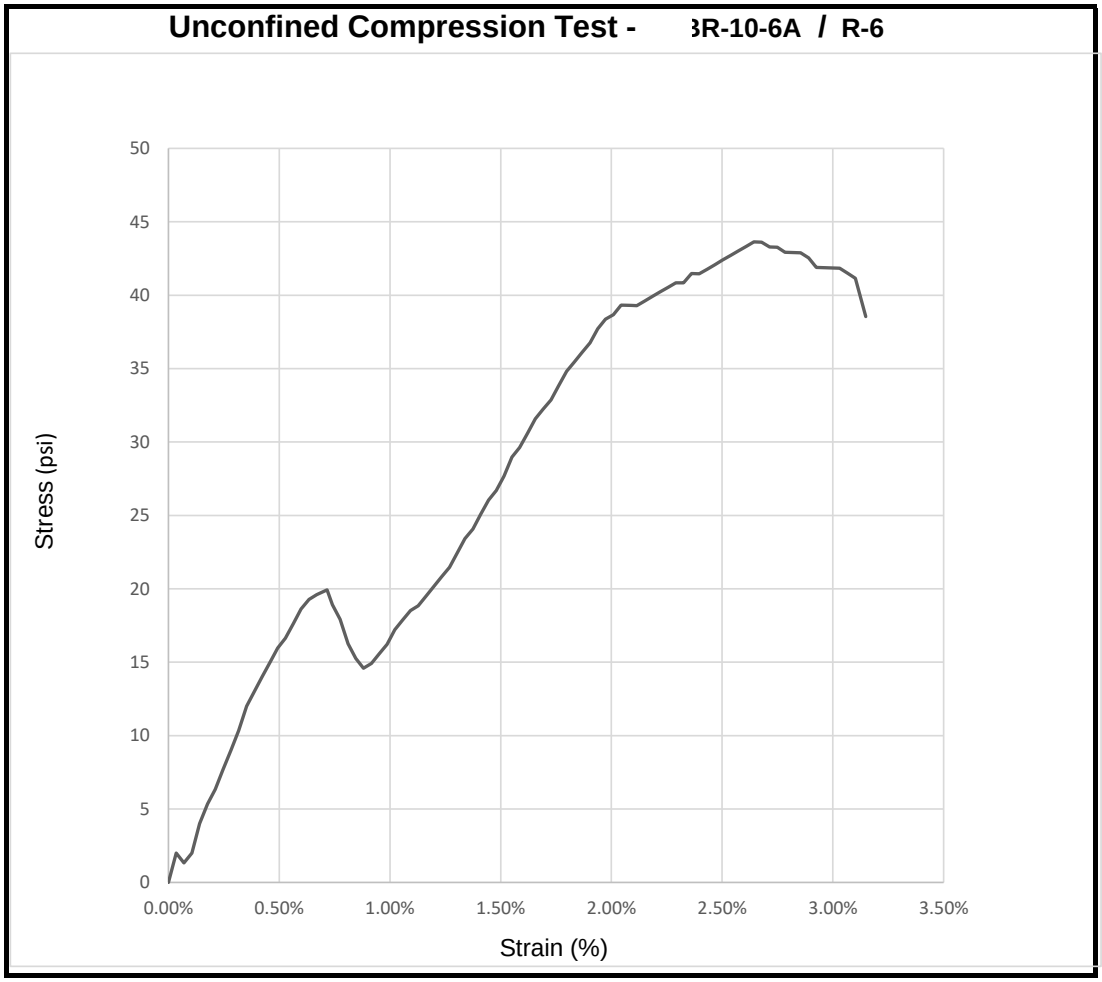
BORING NO.	BR-10-6A
SAMPLE NO.	R-6
SAMPLE DEPTH (ft)	67.3-67.6
RECOVERY (%)	73
VISUAL CLASS. (USCS)	SHALE

SPECIFICATIONS	
Unconfined Compression	ASTM D7012
VISUAL CLASS. (USCS)	SHALE

DENSITY & MOISTURE	
Wet unit weight (pcf)	126.0
Moisture Content (%)	16.0%
Dry unit weight (pcf)	108.7

STRENGTH	
Unconfined Strength qu (psi)	43.6
% Strain at qu	2.64

Tested by: SLY	6/28/2024
Calculated by: SLY	7/1/2024
Checked by: AK	7/1/2024



PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)
PROJECT No.: 20241040

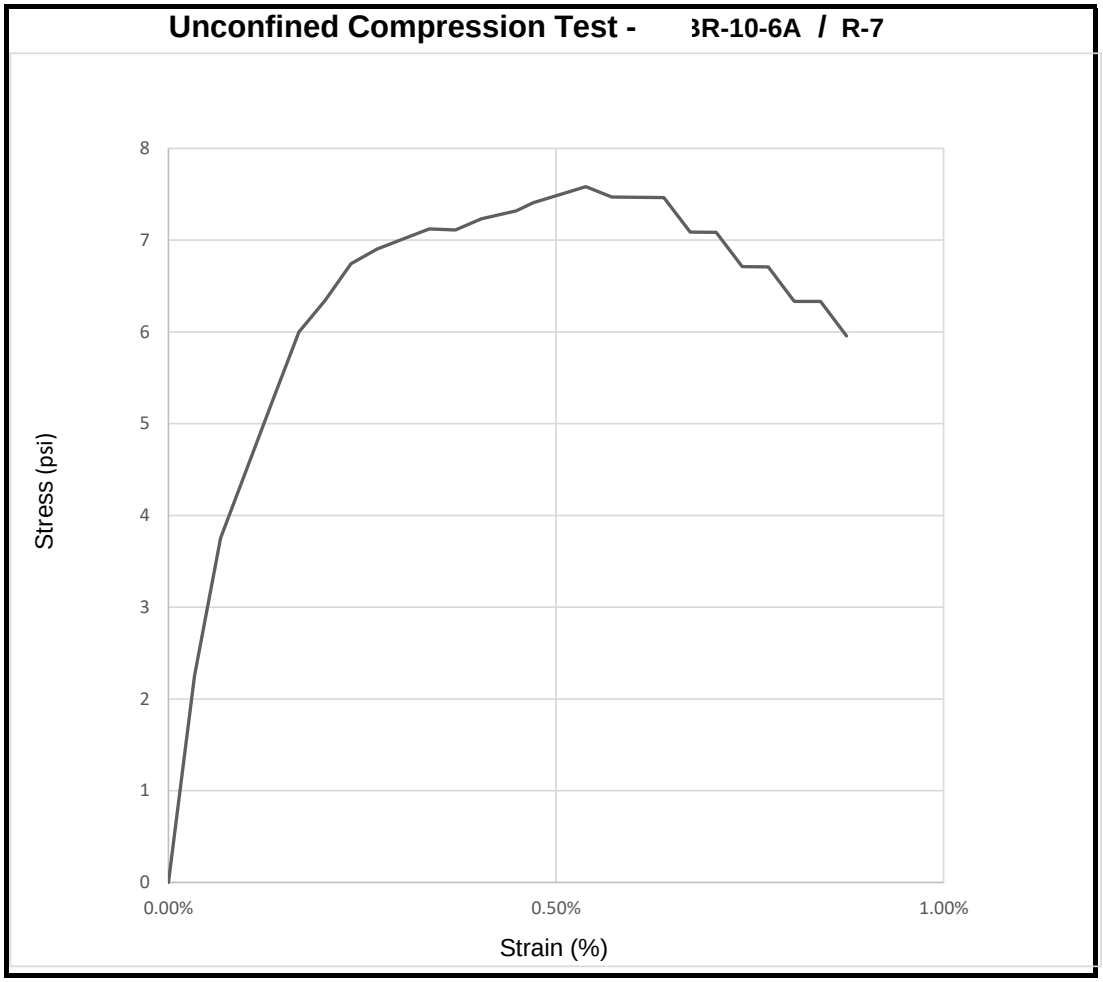
BORING NO.	**BR-10-6A**
SAMPLE NO.	**R-7**
SAMPLE DEPTH (ft)	**70.1-70.4**
RECOVERY (%)	**100**
VISUAL CLASS. (USCS)	**SHALE**

SPECIFICATIONS	
Unconfined Compression	**ASTM D7012**
VISUAL CLASS. (USCS)	**SHALE**

DENSITY & MOISTURE	
Wet unit weight (pcf)	**121.3**
Moisture Content (%)	**18.8%**
Dry unit weight (pcf)	**102.1**

STRENGTH	
Unconfined Strength qu (psi)	**7.6**
% Strain at qu	**0.54**

Tested by: SLY	6/28/2024
Calculated by: SLY	7/1/2024
Checked by: AK	7/1/2024



Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-12-2B Date: 7/3/2024
Project Number: 20241040 Sample Number: R-3 Depth: 28.2-28.5

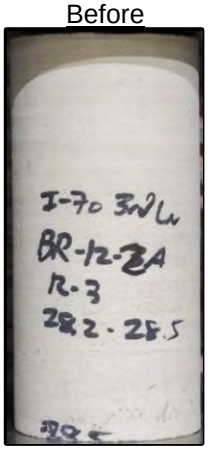
Visual Description: LIMESTONE

Specimen Weight	488.84	g
Diameter	1.868	inches
Length	4.077	inches
Volume	**0.0065**	ft^3

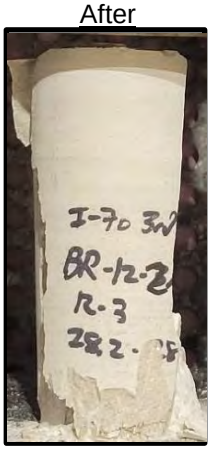
Wet unit weight	**166.7**	pcf
Length:Diameter Ratio	**2.18**	

Specimen Area (metric)	**1768.116**	mm^2
Specimen Area	**2.741**	in^2
Total Load on Specimen	**43150**	lbs
Unconfined Strength (qu)	**15745**	**psi**
Unconfined Strength (qu)	**1134**	**tsf**
Unconfined Strength (qu)	**109**	**MPa**

Before



After



Tested by: SLY Date: 7/3/2024
Calculated by: SLY Date: 7/8/2024
Checked by: JPE Date: 7/8/2024

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Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-12-2B Date: 7/3/2024
Project Number: 20241040 Sample Number: R-4 Depth: 32.0-32.3

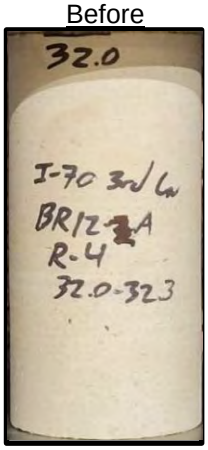
Visual Description: LIMESTONE

Specimen Weight	510.00	g
Diameter	1.869	inches
Length	4.278	inches
Volume	**0.0068**	ft^3

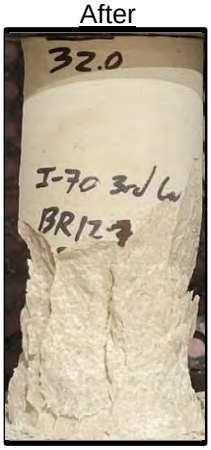
Wet unit weight	**165.5**	pcf
Length:Diameter Ratio	**2.29**	

Specimen Area (metric)	**1770.009**	mm^2
Specimen Area	**2.743**	in^2
Total Load on Specimen	**35520**	lbs
Unconfined Strength (qu)	**12947**	**psi**
Unconfined Strength (qu)	**932**	**tsf**
Unconfined Strength (qu)	**89**	**MPa**

Before



After



Tested by: SLY Date: 7/3/2024
Calculated by: SLY Date: 7/8/2024
Checked by: JPE Date: 7/8/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-12-2B Date: 7/3/2024
Project Number: 20241040 Sample Number: R-6 Depth: 40.7-41.0

Visual Description: LIMESTONE

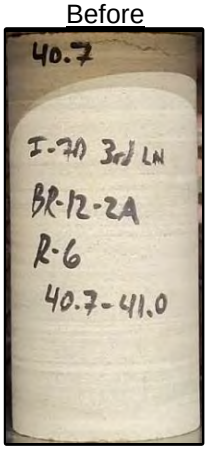
(sample below 2:1 length:diameter ratio)

Specimen Weight	427.95	g
Diameter	1.869	inches
Length	3.548	inches
Volume	**0.0056**	ft^3

Wet unit weight	**167.5**	pcf
Length:Diameter Ratio	**1.90**	

Specimen Area (metric)	**1770.009**	mm^2
Specimen Area	**2.743**	in^2
Total Load on Specimen	**47060**	lbs
Unconfined Strength (qu)	**17154**	**psi**
Unconfined Strength (qu)	**1235**	**tsf**
Unconfined Strength (qu)	**118**	**MPa**

Before



After



Tested by: SLY Date: 7/3/2024
Calculated by: SLY Date: 7/8/2024
Checked by: JPE Date: 7/8/2024

geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-12-3B Date: 7/3/2024
Project Number: 20241040 Sample Number: R-2 Depth: 22.9-23.2

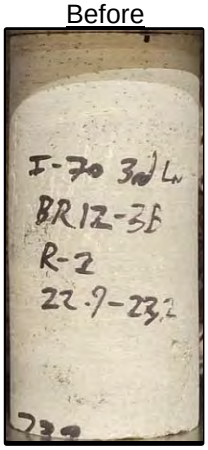
Visual Description: LIMESTONE, with pyrite

Specimen Weight	501.08	g
Diameter	1.866	inches
Length	4.140	inches
Volume	**0.0066**	ft^3

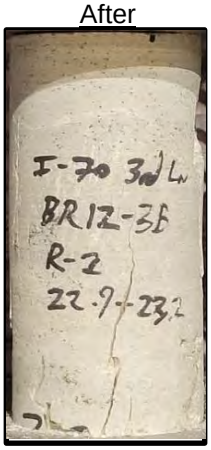
Wet unit weight	**168.6**	pcf
Length:Diameter Ratio	**2.22**	

Specimen Area (metric)	**1764.332**	mm^2
Specimen Area	**2.735**	in^2
Total Load on Specimen	**31050**	lbs
Unconfined Strength (qu)	**11354**	**psi**
Unconfined Strength (qu)	**818**	**tsf**
Unconfined Strength (qu)	**78**	**MPa**

Before



After



Tested by: SLY Date: 7/3/2024
Calculated by: SLY Date: 7/8/2024
Checked by: JPE Date: 7/8/2024

TSi geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-12-3B Date: 7/3/2024
Project Number: 20241040 Sample Number: R-5 Depth: 39.6-39.9

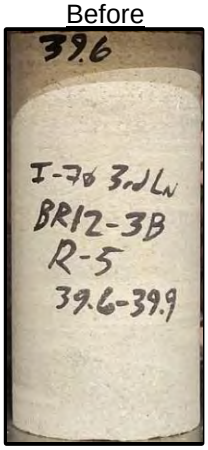
Visual Description: LIMESTONE

Specimen Weight	489.12	g
Diameter	1.866	inches
Length	4.150	inches
Volume	**0.0066**	ft^3

Wet unit weight	**164.2**	pcf
Length:Diameter Ratio	**2.22**	

Specimen Area (metric)	**1764.332**	mm^2
Specimen Area	**2.735**	in^2
Total Load on Specimen	**32480**	lbs
Unconfined Strength (qu)	**11877**	**psi**
Unconfined Strength (qu)	**855**	**tsf**
Unconfined Strength (qu)	**82**	**MPa**

Before



After



Tested by: SLY Date: 7/3/2024
Calculated by: SLY Date: 7/8/2024
Checked by: JPE Date: 7/8/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-12-3B Date: 7/3/2024
Project Number: 20241040 Sample Number: R-7 Depth: 45.9-46.2

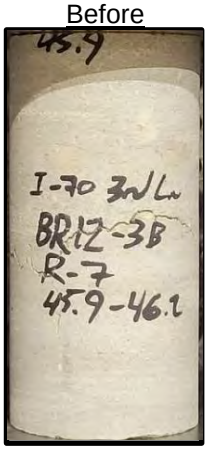
Visual Description: LIMESTONE

Specimen Weight	466.37	g
Diameter	1.861	inches
Length	3.904	inches
Volume	**0.0061**	ft^3

Wet unit weight	**167.3**	pcf
Length:Diameter Ratio	**2.10**	

Specimen Area (metric)	**1754.889**	mm^2
Specimen Area	**2.720**	in^2
Total Load on Specimen	**35120**	lbs
Unconfined Strength (qu)	**12912**	**psi**
Unconfined Strength (qu)	**930**	**tsf**
Unconfined Strength (qu)	**89**	**MPa**

Before



After



Tested by: SLY Date: 7/3/2024
Calculated by: SLY Date: 7/8/2024
Checked by: JPE Date: 7/8/2024

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Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-12-4A Date: 7/23/2024
Project Number: 20241040 Sample Number: R-3 Depth: 29.5-29.8

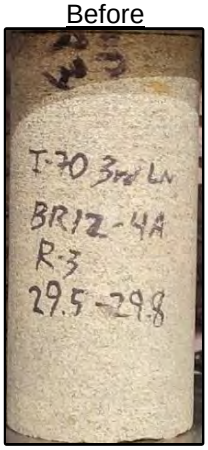
Visual Description: LIMESTONE, with hematite

Specimen Weight	492.80	g
Diameter	1.868	inches
Length	4.047	inches
Volume	**0.0064**	ft^3

Wet unit weight	**169.3**	pcf
Length:Diameter Ratio	**2.17**	

Specimen Area (metric)	**1768.116**	mm^2
Specimen Area	**2.741**	in^2
Total Load on Specimen	**33680**	lbs
Unconfined Strength (qu)	**12290**	**psi**
Unconfined Strength (qu)	**885**	**tsf**
Unconfined Strength (qu)	**85**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/31/2024

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Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-12-4A Date: 7/23/2024
Project Number: 20241040 Sample Number: R-5 Depth: 43.8-44.1

Visual Description: LIMESTONE AND CHERTY DOLOMITE

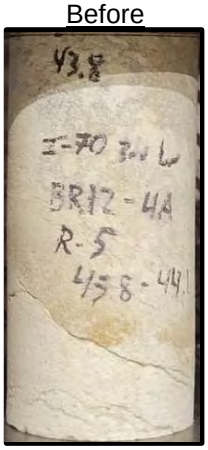
(sample below 2:1 L:D ratio)

Specimen Weight	401.71	g
Diameter	1.867	inches
Length	3.694	inches
Volume	**0.0059**	ft^3

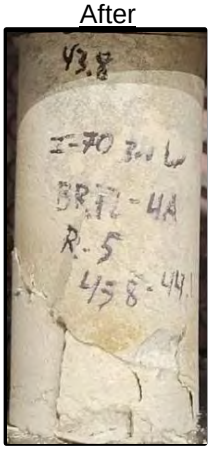
Wet unit weight	**151.3**	pcf
Length:Diameter Ratio	**1.98**	

Specimen Area (metric)	**1766.223**	mm^2
Specimen Area	**2.738**	in^2
Total Load on Specimen	**23570**	lbs
Unconfined Strength (qu)	**8610**	**psi**
Unconfined Strength (qu)	**620**	**tsf**
Unconfined Strength (qu)	**59**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/31/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-12-4A Date: 7/23/2024
Project Number: 20241040 Sample Number: R-6 Depth: 48.2-48.5

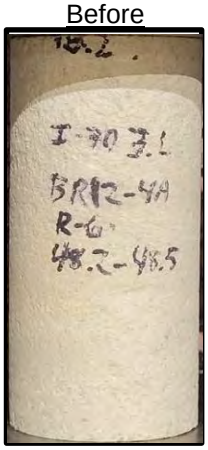
Visual Description: LIMESTONE , CHALKY, WITH PYRITE AND FOSSIL

Specimen Weight	469.70	g
Diameter	1.831	inches
Length	4.141	inches
Volume	**0.0063**	ft^3

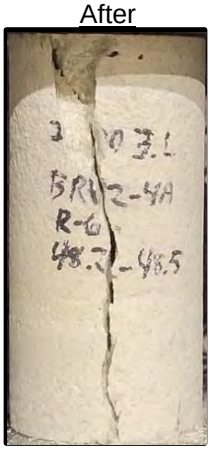
Wet unit weight	**164.1**	pcf
Length:Diameter Ratio	**2.26**	

Specimen Area (metric)	**1698.766**	mm^2
Specimen Area	**2.633**	in^2
Total Load on Specimen	**36040**	lbs
Unconfined Strength (qu)	**13688**	**psi**
Unconfined Strength (qu)	**986**	**tsf**
Unconfined Strength (qu)	**94**	**MPa**

Before



After



Tested by: SLY Date: 7/23/2024
Calculated by: JPE Date: 7/24/2024
Checked by: AK Date: 7/31/2024

geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-12-4A Date: 8/12/2024
Project Number: 20241040 Sample Number: R-7 Depth: 50.8-51.1

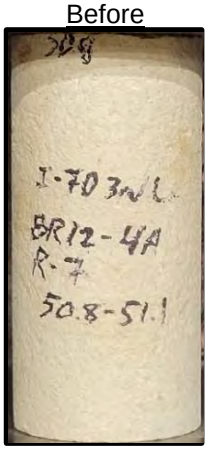
Visual Description: LIMESTONE, pitted and chalky

Specimen Weight	459.86	g
Diameter	1.830	inches
Length	4.042	inches
Volume	**0.0062**	ft^3

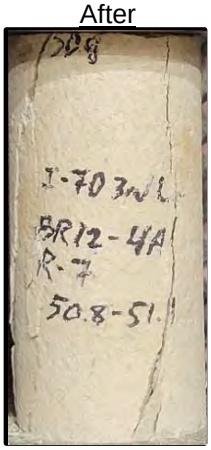
Wet unit weight	**164.8**	pcf
Length:Diameter Ratio	**2.21**	

Specimen Area (metric)	**1696.911**	mm^2
Specimen Area	**2.630**	in^2
Total Load on Specimen	**26540**	lbs
Unconfined Strength (qu)	**10091**	**psi**
Unconfined Strength (qu)	**727**	**tsf**
Unconfined Strength (qu)	**70**	**MPa**

Before



After



Tested by: SLY Date: 8/12/2024
Calculated by: SLY Date: 8/12/2024
Checked by: JPE Date: 8/12/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-13-2A Date: 6/20/2024
Project Number: 20241040 Sample Number: R-1 Depth: 18.5-18.8

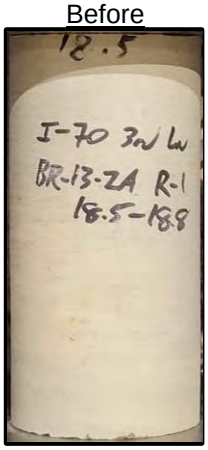
Visual Description: LIMESTONE

Specimen Weight	480.29	g
Diameter	1.862	inches
Length	4.039	inches
Volume	**0.0064**	ft^3

Wet unit weight	**166.4**	pcf
Length:Diameter Ratio	**2.17**	

Specimen Area (metric)	**1756.776**	mm^2
Specimen Area	**2.723**	in^2
Total Load on Specimen	**54330**	lbs
Unconfined Strength (qu)	**19953**	**psi**
Unconfined Strength (qu)	**1437**	**tsf**
Unconfined Strength (qu)	**138**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

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Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-13-2A Date: 6/20/2024
Project Number: 20241040 Sample Number: R-2 Depth: 21.6-21.9

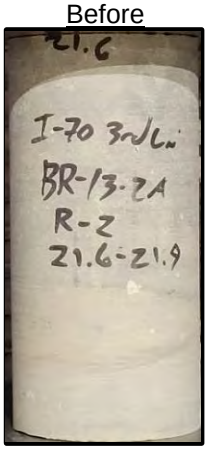
Visual Description: LIMESTONE

Specimen Weight	518.64	g
Diameter	1.862	inches
Length	4.303	inches
Volume	**0.0068**	ft^3

Wet unit weight	**168.6**	pcf
Length:Diameter Ratio	**2.31**	

Specimen Area (metric)	**1756.776**	mm^2
Specimen Area	**2.723**	in^2
Total Load on Specimen	**50560**	lbs
Unconfined Strength (qu)	**18568**	**psi**
Unconfined Strength (qu)	**1337**	**tsf**
Unconfined Strength (qu)	**128**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

TSi geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-14-1 Date: 6/20/2024
Project Number: 20241040 Sample Number: R-1 Depth: 19.0-19.3

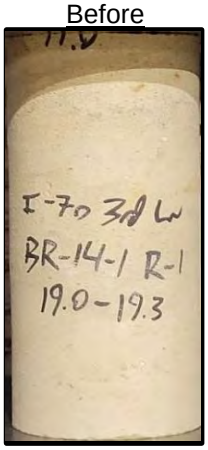
Visual Description: LIMESTONE

Specimen Weight	459.58	g
Diameter	1.864	inches
Length	4.046	inches
Volume	**0.0064**	ft^3

Wet unit weight	**158.6**	pcf
Length:Diameter Ratio	**2.17**	

Specimen Area (metric)	**1760.552**	mm^2
Specimen Area	**2.729**	in^2
Total Load on Specimen	**67790**	lbs
Unconfined Strength (qu)	**24843**	**psi**
Unconfined Strength (qu)	**1789**	**tsf**
Unconfined Strength (qu)	**171**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-14-2 Date: 6/20/2024
Project Number: 20241040 Sample Number: R-1 Depth: 17.7-18.0

Visual Description: LIMESTONE

Specimen Weight	449.19	g
Diameter	1.863	inches
Length	3.991	inches
Volume	**0.0063**	ft^3

Wet unit weight	**157.3**	pcf
Length:Diameter Ratio	**2.14**	

Specimen Area (metric)	**1758.663**	mm^2
Specimen Area	**2.726**	in^2
Total Load on Specimen	**51840**	lbs
Unconfined Strength (qu)	**19018**	**psi**
Unconfined Strength (qu)	**1369**	**tsf**
Unconfined Strength (qu)	**131**	**MPa**

Before



After



Tested by: SLY Date: 6/20/2024
Calculated by: SLY Date: 6/21/2024
Checked by: AK Date: 6/28/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-16-1 Date: 8/12/2024
Project Number: 20241040 Sample Number: R-2 Depth: 29.0-29.3

Visual Description: LIMESTONE and DOLOMITIC CHERT

Specimen Weight	445.65	g
Diameter	1.841	inches
Length	4.126	inches
Volume	**0.0064**	ft^3

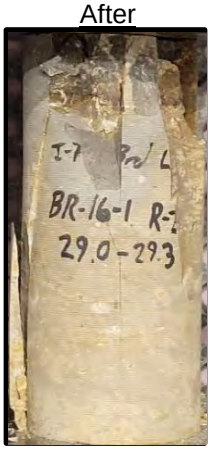
Wet unit weight	**154.6**	pcf
Length:Diameter Ratio	**2.24**	

Specimen Area (metric)	**1717.373**	mm^2
Specimen Area	**2.662**	in^2
Total Load on Specimen	**22790**	lbs
Unconfined Strength (qu)	**8562**	**psi**
Unconfined Strength (qu)	**616**	**tsf**
Unconfined Strength (qu)	**59**	**MPa**

Before



After



Tested by: SLY Date: 8/12/2024
Calculated by: SLY Date: 8/12/2024
Checked by: JPE Date: 8/12/2024

PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)
PROJECT No.: 20241040

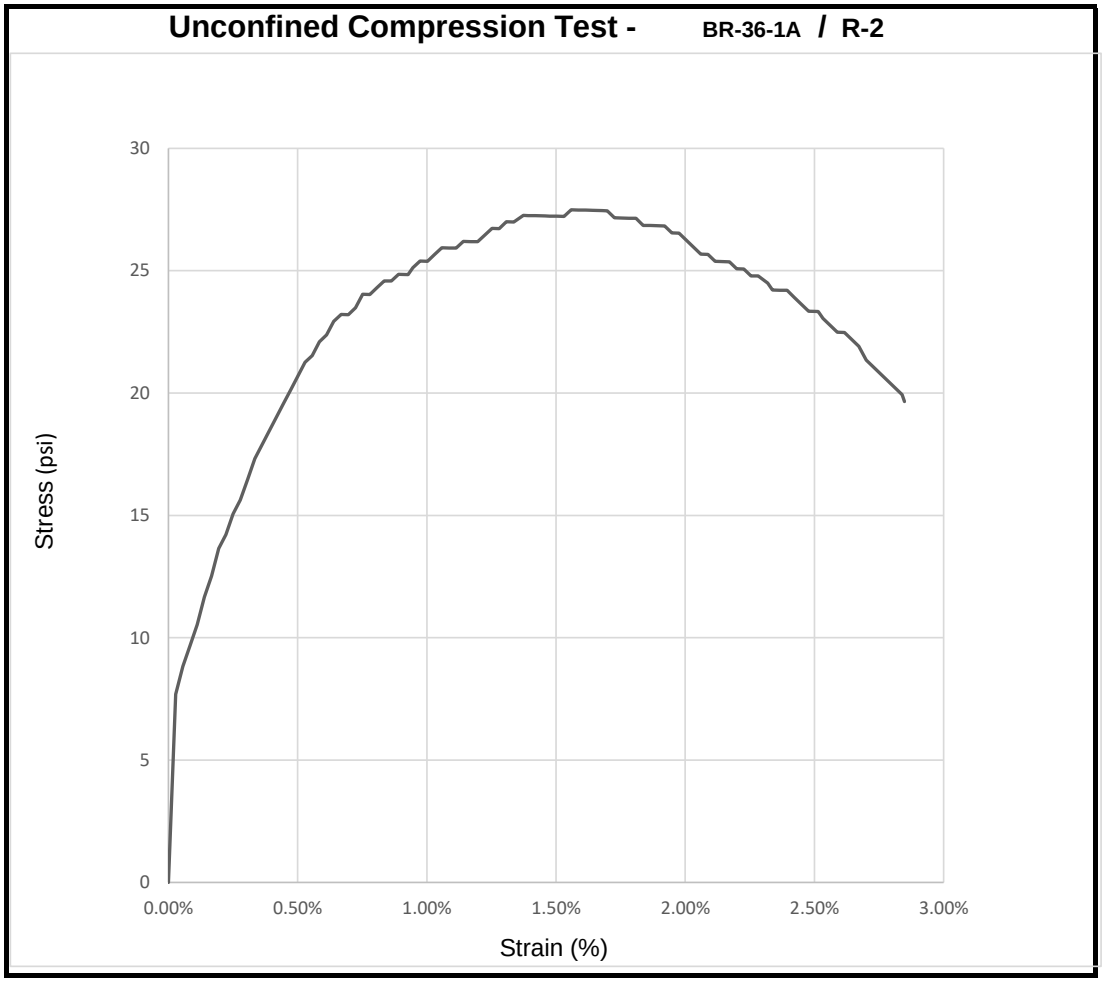
BORING NO.	BR-36-1A
SAMPLE NO.	R-2
SAMPLE DEPTH (ft)	103.4-103.7
RECOVERY (%)	60
VISUAL CLASS. (USCS)	SHALE

SPECIFICATIONS	
Unconfined Compression	ASTM D7012
VISUAL CLASS. (USCS)	SHALE

DENSITY & MOISTURE	
Wet unit weight (pcf)	141.7
Moisture Content (%)	12.7%
Dry unit weight (pcf)	125.7

STRENGTH	
Unconfined Strength qu (psi)	27.5
% Strain at qu	1.56

Tested by: SLY	8/9/2024
Calculated by: SLY	8/9/2024
Checked by: JPE	8/12/2024



Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-36-1A Date: 8/9/2024
Project Number: 20241040 Sample Number: R-4 Depth: 110.8-111.1

Visual Description: LIMESTONE

Specimen Weight	469.70	g
Diameter	1.831	inches
Length	4.141	inches
Volume	**0.0063**	ft^3

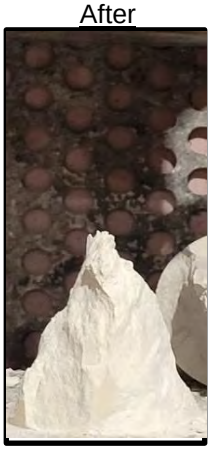
Wet unit weight	**164.1**	pcf
Length:Diameter Ratio	**2.26**	

Specimen Area (metric)	**1698.766**	mm^2
Specimen Area	**2.633**	in^2
Total Load on Specimen	**42340**	lbs
Unconfined Strength (qu)	**16080**	**psi**
Unconfined Strength (qu)	**1158**	**tsf**
Unconfined Strength (qu)	**111**	**MPa**

Before



After



Tested by: SLY Date: 8/9/2024
Calculated by: SLY Date: 8/9/2024
Checked by: JPE Date: 8/12/2024

PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)

PROJECT No.: 20241040

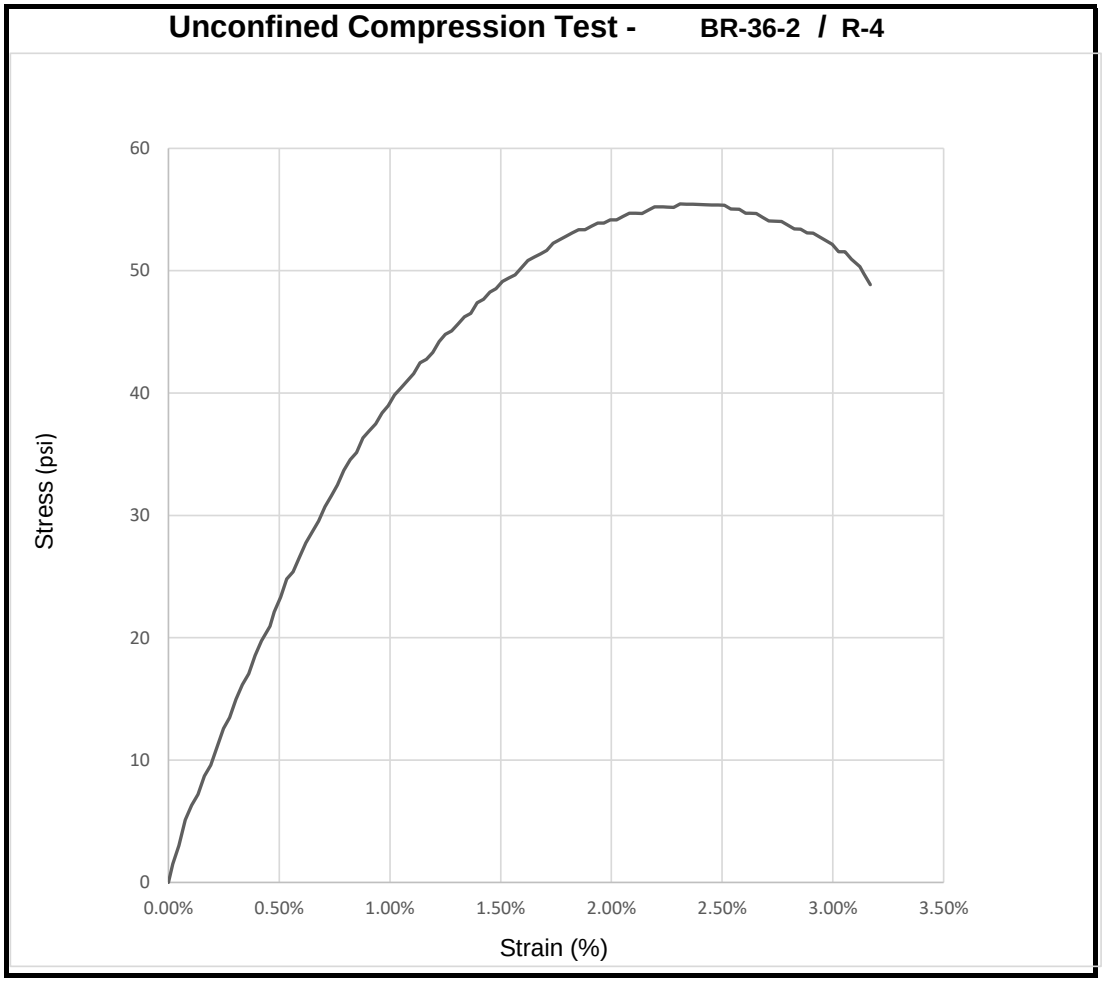
BORING NO.	**BR-36-2**
SAMPLE NO.	**R-4**
SAMPLE DEPTH (ft)	**106.9-107.2**
RECOVERY (%)	**92**
VISUAL CLASS. (USCS)	**SHALE**

SPECIFICATIONS	
Unconfined Compression	**ASTM D7012**
VISUAL CLASS. (USCS)	**SHALE**

DENSITY & MOISTURE	
Wet unit weight (pcf)	**145.2**
Moisture Content (%)	**11.6%**
Dry unit weight (pcf)	**130.1**

STRENGTH	
Unconfined Strength qu (psi)	**55.5**
% Strain at qu	**2.31**

Tested by: SLY	8/9/2024
Calculated by: SLY	8/9/2024
Checked by: JPE	8/12/2024



PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)
PROJECT No.: 20241040

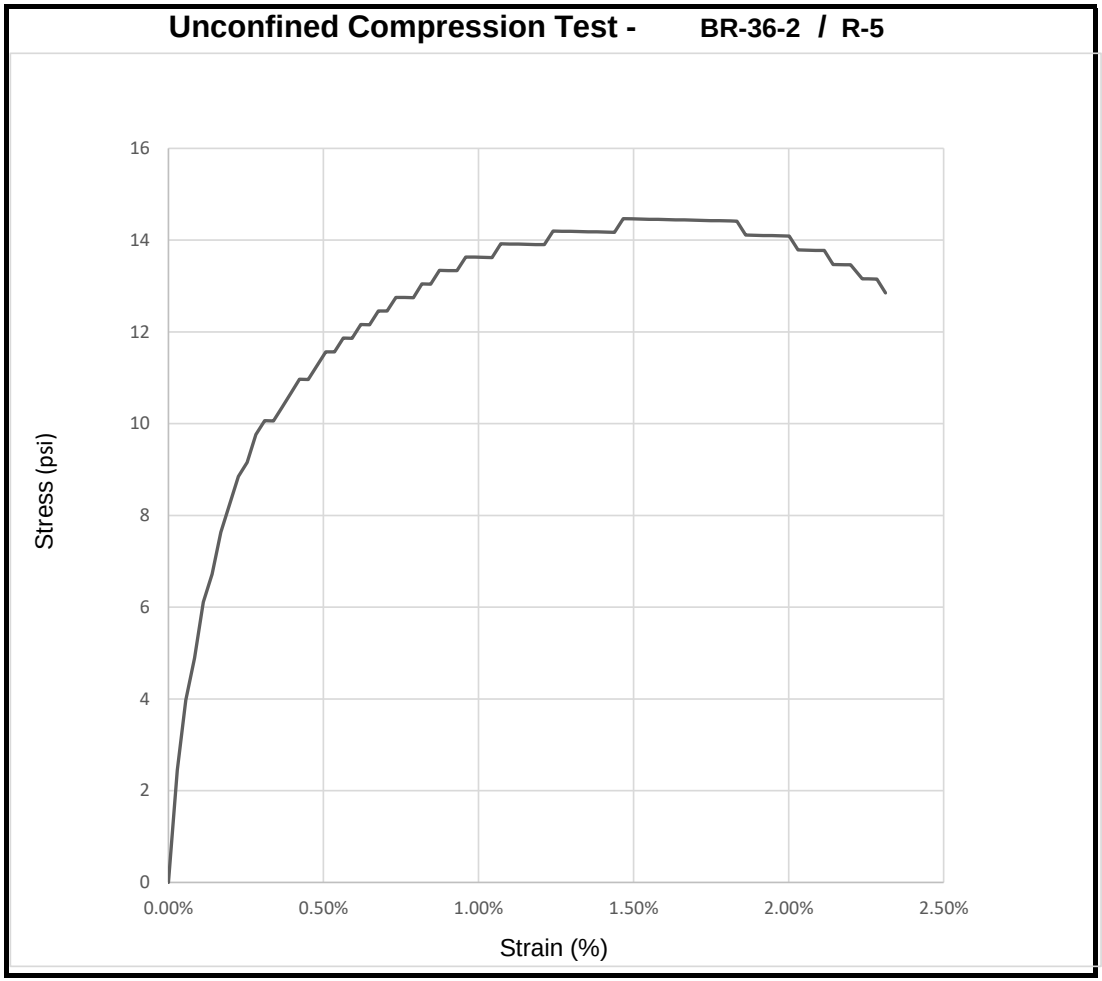
BORING NO.	BR-36-2
SAMPLE NO.	R-5
SAMPLE DEPTH (ft)	110.9-111.2
RECOVERY (%)	68
VISUAL CLASS. (USCS)	SHALE

SPECIFICATIONS	
Unconfined Compression	ASTM D7012
VISUAL CLASS. (USCS)	SHALE

DENSITY & MOISTURE	
Wet unit weight (pcf)	140.1
Moisture Content (%)	12.6%
Dry unit weight (pcf)	124.4

STRENGTH	
Unconfined Strength qu (psi)	14.5
% Strain at qu	1.47

Tested by: SLY	8/9/2024
Calculated by: SLY	8/9/2024
Checked by: JPE	8/12/2024



PROJECT NAME: I-70 Third Lane (Kingdom City to Columbia)
PROJECT No.: 20241040

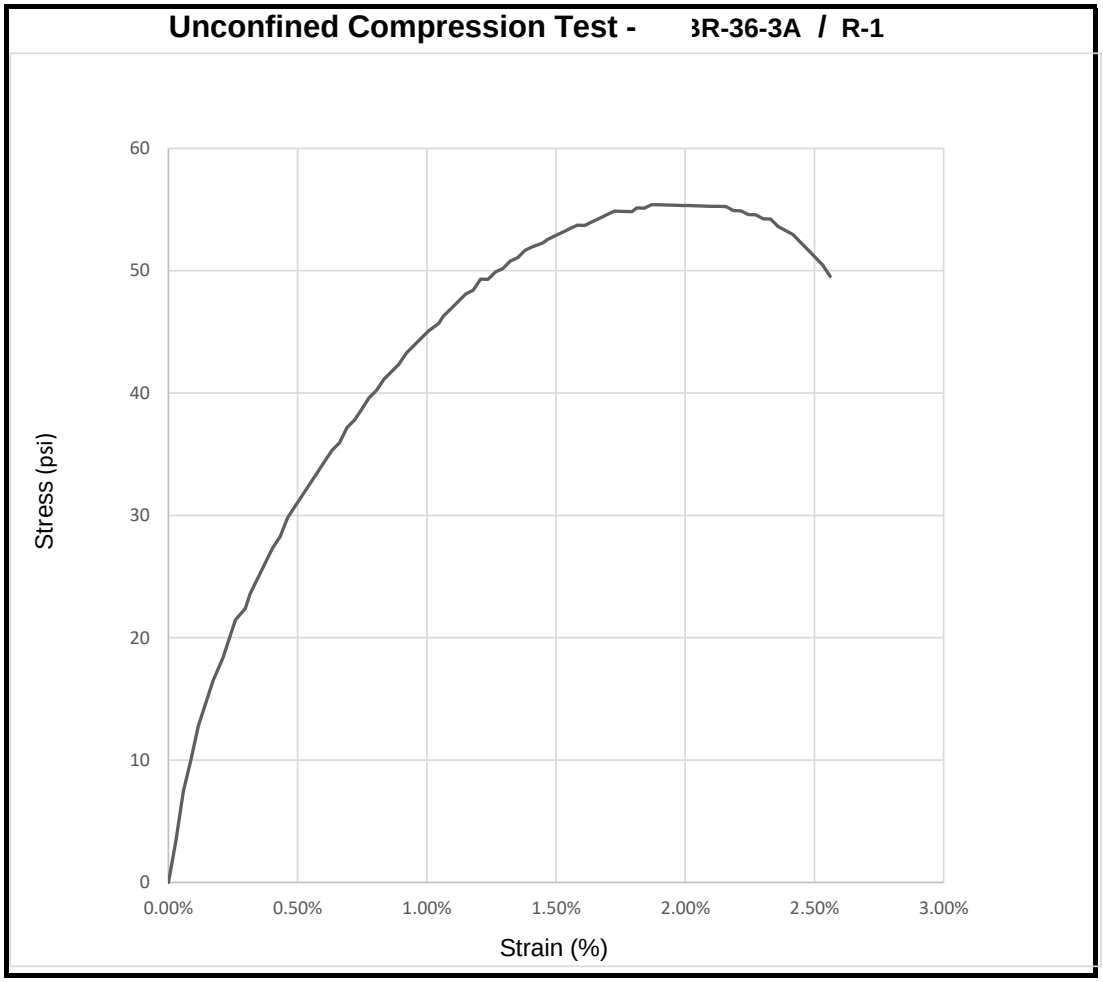
BORING NO.	BR-36-3A
SAMPLE NO.	R-1
SAMPLE DEPTH (ft)	104.2-104.5
RECOVERY (%)	100
VISUAL CLASS. (USCS)	SHALE

SPECIFICATIONS	
Unconfined Compression	ASTM D7012
VISUAL CLASS. (USCS)	SHALE

DENSITY & MOISTURE	
Wet unit weight (pcf)	138.1
Moisture Content (%)	11.5%
Dry unit weight (pcf)	123.8

STRENGTH	
Unconfined Strength qu (psi)	55.4
% Strain at qu	1.87

Tested by: SLY	6/28/2024
Calculated by: SLY	7/1/2024
Checked by: AK	7/1/2024



Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-36-3A Date: 7/3/2024
Project Number: 20241040 Sample Number: R-2 Depth: 109.2-109.5

Visual Description: LIMESTONE, weathered and pitted

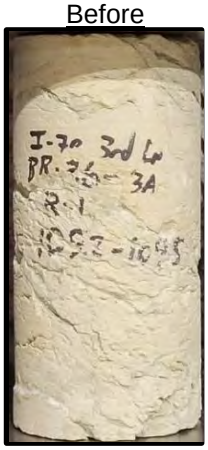
(sample below 2:1 length:diameter ratio)

Specimen Weight	385.44	g
Diameter	1.856	inches
Length	3.695	inches
Volume	**0.0058**	ft^3

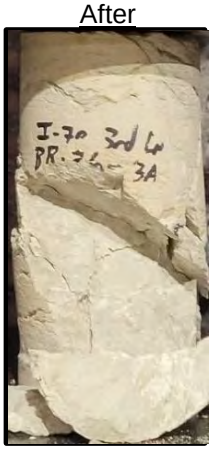
Wet unit weight	**146.9**	pcf
Length:Diameter Ratio	**1.99**	

Specimen Area (metric)	**1745.472**	mm^2
Specimen Area	**2.705**	in^2
Total Load on Specimen	**1450**	lbs
Unconfined Strength (qu)	**536**	**psi**
Unconfined Strength (qu)	**39**	**tsf**
Unconfined Strength (qu)	**4**	**MPa**

Before



After



Tested by: SLY Date: 7/3/2024
Calculated by: SLY Date: 7/8/2024
Checked by: JPE Date: 7/8/2024

TSi geotechnical, inc.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-37-2 Date: 7/3/2024
Project Number: 20241040 Sample Number: R-4 Depth: 109.7-110.0

Visual Description: LIMESTONE

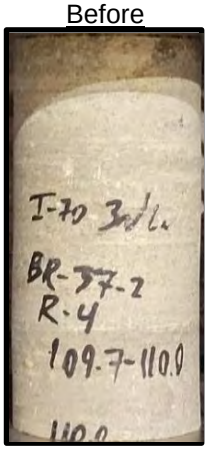
(sample below 2:1 length:diameter ratio)

Specimen Weight	418.74	g
Diameter	1.856	inches
Length	3.552	inches
Volume	**0.0056**	ft^3

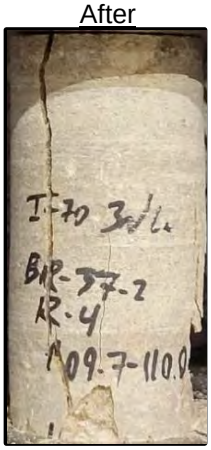
Wet unit weight	**166.0**	pcf
Length:Diameter Ratio	**1.91**	

Specimen Area (metric)	**1745.472**	mm^2
Specimen Area	**2.705**	in^2
Total Load on Specimen	**32330**	lbs
Unconfined Strength (qu)	**11950**	**psi**
Unconfined Strength (qu)	**860**	**tsf**
Unconfined Strength (qu)	**82**	**MPa**

Before



After



Tested by: SLY Date: 7/3/2024
Calculated by: SLY Date: 7/8/2024
Checked by: JPE Date: 7/8/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-37-3 Date: 7/3/2024
Project Number: 20241040 Sample Number: R-1 Depth: 97.6-97.9

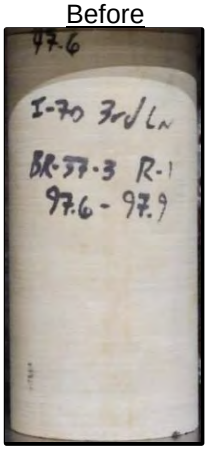
Visual Description: Dolomitic LIMESTONE

Specimen Weight	407.29	g
Diameter	1.861	inches
Length	3.961	inches
Volume	**0.0062**	ft^3

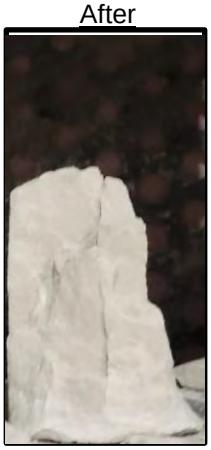
Wet unit weight	**144.0**	pcf
Length:Diameter Ratio	**2.13**	

Specimen Area (metric)	**1754.889**	mm^2
Specimen Area	**2.720**	in^2
Total Load on Specimen	**47430**	lbs
Unconfined Strength (qu)	**17437**	**psi**
Unconfined Strength (qu)	**1255**	**tsf**
Unconfined Strength (qu)	**120**	**MPa**

Before



After



Tested by: SLY Date: 7/3/2024
Calculated by: SLY Date: 7/8/2024
Checked by: JPE Date: 7/8/2024

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: I-70 Third Lane (Kingdom City to Columbia) Boring Number: BR-37-3 Date: 7/3/2024
Project Number: 20241040 Sample Number: R-2 Depth: 102.9-103.2

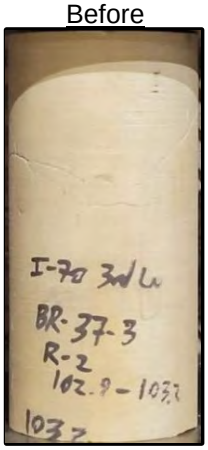
Visual Description: Dolomitic LIMESTONE

Specimen Weight	422.70	g
Diameter	1.862	inches
Length	4.125	inches
Volume	**0.0065**	ft^3

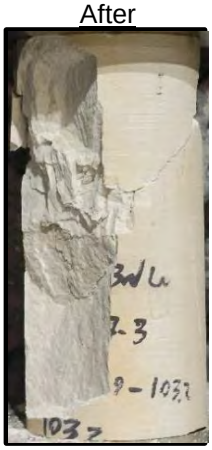
Wet unit weight	**143.4**	pcf
Length:Diameter Ratio	**2.22**	

Specimen Area (metric)	**1756.776**	mm^2
Specimen Area	**2.723**	in^2
Total Load on Specimen	**29040**	lbs
Unconfined Strength (qu)	**10665**	**psi**
Unconfined Strength (qu)	**768**	**tsf**
Unconfined Strength (qu)	**74**	**MPa**

Before



After



Tested by: SLY Date: 7/3/2024
Calculated by: SLY Date: 7/8/2024
Checked by: JPE Date: 7/8/2024

APPENDIX F

May 06, 2024

Ally Kamp
TSI Geotechnical Inc.
1340 North Price Rd.
Olivette, MO 63132
TEL: (314) 373-4060
FAX:

Illinois	100226
Illinois	1004652024-2
Kansas	E-10374
Louisiana	05002
Louisiana	05003
Oklahoma	9978

RE: I-70 3rd Lane **WorkOrder:** 24042113

Dear Ally Kamp:

TEKLAB, INC received 1 sample on 4/25/2024 12:17:00 PM for the analysis presented in the following report.

Samples are analyzed on an as received basis unless otherwise requested and documented. The sample results contained in this report relate only to the requested analytes of interest as directed on the chain of custody. NELAP accredited fields of testing are indicated by the letters NELAP under the Certification column. Unless otherwise documented within this report, Teklab Inc. analyzes samples utilizing the most current methods in compliance with 40CFR. All tests are performed in the Collinsville, IL laboratory unless otherwise noted in the Case Narrative.

All quality control criteria applicable to the test methods employed for this project have been satisfactorily met and are in accordance with NELAP except where noted. The following report shall not be reproduced, except in full, without the written approval of Teklab, Inc.

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

Patrick Riley

Patrick Riley
Project Manager
(618)344-1004 ex 44
patrickriley@teklabinc.com

Report Contents

Client: TSI Geotechnical Inc.

Work Order: 24042113

Client Project: I-70 3rd Lane

Report Date: 06-May-24

This reporting package includes the following:

Cover Letter	1
Report Contents	2
Definitions	3
Case Narrative	5
Accreditations	6
Laboratory Results	7
Receiving Check List	8
Chain of Custody	Appended

Client: TSI Geotechnical Inc. **Work Order:** 24042113

Client Project: I-70 3rd Lane **Report Date:** 06-May-24

Abbr	Definition
*	Analytes on report marked with an asterisk are not NELAP accredited
CCV	Continuing calibration verification is a check of a standard to determine the state of calibration of an instrument between recalibration.
CRQL	A Client Requested Quantitation Limit is a reporting limit that varies according to customer request. The CRQL may not be less than the MDL.
DF	Dilution factor is the dilution performed during analysis only and does not take into account any dilutions made during sample preparation. The reported result is final and includes all dilution factors.
DNI	Did not ignite
DUP	Laboratory duplicate is a replicate aliquot prepared under the same laboratory conditions and independently analyzed to obtain a measure of precision.
ICV	Initial calibration verification is a check of a standard to determine the state of calibration of an instrument before sample analysis is initiated.
IDPH	IL Dept. of Public Health
LCS	Laboratory control sample is a sample matrix, free from the analytes of interest,spiked with verified known amounts of analytes and analyzed exactly like a sample to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.
LCSD	Laboratory control sample duplicate is a replicate laboratory control sample that is prepared and analyzed in order to determine the precision of the approved test method. The acceptable recovery range is listed in the QC Package (provided upon request).
MBLK	Method blank is a sample of a matrix similar to the batch of associated sample (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences should present at concentrations that impact the analytical results for sample analyses.
MDL	"The method detection limit is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results."
MS	Matrix spike is an aliquot of matrix fortified (spiked) with known quantities of specific analytes that is subjected to the entire analytical procedures in order to determine the effect of the matrix on an approved test method's recovery system. The acceptable recovery range is listed in the QC Package (provided upon request).
MSD	Matrix spike duplicate means a replicate matrix spike that is prepared and analyzed in order to determine the precision of the approved test method. The acceptable recovery range is listed in the QC Package (provided upon request).
MW	Molecular weight
NC	Data is not acceptable for compliance purposes
ND	Not Detected at the Reporting Limit
NELAP	NELAP Accredited
PQL	Practical quantitation limit means the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operation conditions.
RL	The reporting limit the lowest level that the data is displayed in the final report. The reporting limit may vary according to customer request or sample dilution. The reporting limit may not be less than the MDL.
RPD	Relative percent difference is a calculated difference between two recoveries (ie. MS/MSD). The acceptable recovery limit is listed in the QC Package (provided upon request).
SPK	The spike is a known mass of target analyte added to a blank sample or sub-sample; used to determine recovery deficiency or for other quality control purposes.
Surr	Surrogates are compounds which are similar to the analytes of interest in chemical composition and behavior in the analytical process, but which are not normally found in environmental samples.
TIC	Tentatively identified compound: Analytes tentatively identified in the sample by using a library search. Only results not in the calibration standard will be reported as tentatively identified compounds. Results for tentatively identified compounds that are not present in the calibration standard, but are assigned a specific chemical name based upon the library search, are calculated using total peak areas from reconstructed ion chromatograms and a response factor of one. The nearest Internal Standard is used for the calculation. The results of any TICs must be considered estimated, and are flagged with a "T". If the estimated result is above the calibration range it is flagged "ET"
TNTC	Too numerous to count (> 200 CFU)

Definitions

Client: TSI Geotechnical Inc.

Work Order: 24042113

Client Project: I-70 3rd Lane

Report Date: 06-May-24

Qualifiers

- # - Unknown hydrocarbon
- B - Analyte detected in associated Method Blank
- C - RL shown is a Client Requested Quantitation Limit
- E - Value above quantitation range
- H - Holding times exceeded
- I - Associated internal standard was outside method criteria
- J - Analyte detected below quantitation limits
- M - Manual Integration used to determine area response
- ND - Not Detected at the Reporting Limit
- R - RPD outside accepted recovery limits
- S - Spike Recovery outside recovery limits
- T - TIC(Tentatively identified compound)
- X - Value exceeds Maximum Contaminant Level

Case Narrative

http://www.teklabinc.com/

Client: TSI Geotechnical Inc.

Client Project: I-70 3rd Lane

Work Order: 24042113

Report Date: 06-May-24

Cooler Receipt Temp: 5.1 °C

Locations

Collinsville

Address 5445 Horseshoe Lake Road
Collinsville, IL 62234-7425
Phone (618) 344-1004
Fax (618) 344-1005
Email jhriley@teklabinc.com

Springfield

Address 3920 Pintail Dr
Springfield, IL 62711-9415
Phone (217) 698-1004
Fax (217) 698-1005
Email KKlostermann@teklabinc.com

Kansas City

Address 8421 Nieman Road
Lenexa, KS 66214
Phone (913) 541-1998
Fax (913) 541-1998
Email jhriley@teklabinc.com

Collinsville Air

Address 5445 Horseshoe Lake Road
Collinsville, IL 62234-7425
Phone (618) 344-1004
Fax (618) 344-1005
Email EHurley@teklabinc.com

Chicago

Address 1319 Butterfield Rd.
Downers Grove, IL 60515
Phone (630) 324-6855
Fax
Email arenner@teklabinc.com

Client: TSI Geotechnical Inc.

Work Order: 24042113

Client Project: I-70 3rd Lane

Report Date: 06-May-24

State	Dept	Cert #	NELAP	Exp Date	Lab
Illinois	IEPA	100226	NELAP	1/31/2025	Collinsville
Illinois	IEPA	1004652024-2	NELAP	4/30/2025	Collinsville
Kansas	KDHE	E-10374	NELAP	4/30/2025	Collinsville
Louisiana	LDEQ	05002	NELAP	6/30/2024	Collinsville
Louisiana	LDEQ	05003	NELAP	6/30/2024	Collinsville
Oklahoma	ODEQ	9978	NELAP	8/31/2024	Collinsville
Arkansas	ADEQ	88-0966		3/14/2025	Collinsville
Illinois	IDPH	17584		5/31/2025	Collinsville
Iowa	IDNR	430		6/1/2024	Collinsville
Kentucky	UST	0073		1/31/2025	Collinsville
Missouri	MDNR	00930		10/31/2026	Collinsville
Missouri	MDNR	930		1/31/2025	Collinsville

Client: TSI Geotechnical Inc. **Work Order:** 24042113

Client Project: I-70 3rd Lane **Report Date:** 06-May-24

Lab ID: 24042113-001 **Client Sample ID:** BR 7-3A ST-3-1

Matrix: SOLID **Collection Date:** 04/11/2024 12:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
ASTM D2974								
% Dry Ash, Soil	*	0.10	H	**96.9**	%	1	04/29/2024 13:28	R346429
Sample analysis did not meet hold time requirements.								
ASTM G200-09								
Oxidation-Reduction Potential	*	-2000		**352**	mV	1	04/29/2024 10:06	R346426
Sample was analyzed at 18C with saturated Ag/AgCl electrode.								
EPA SW846 3550B, 5035A, ASTM D2974								
Percent Moisture	*	0.1		**11.2**	%	1	04/29/2024 13:28	R346429
STANDARD METHODS 4500-CL E (TOTAL) 1997, 2011								
Chloride	*	448		**< 448**	mg/Kg-dry	10	05/02/2024 15:41	222446
Elevated reporting limit due to sample composition.								
SW-846 9030B, 9034								
Sulfide, Total	NELAP	34	H	**< 34**	mg/Kg-dry	1	04/26/2024 15:05	222047
Sulfide, as Hydrogen Sulfide	*	36	H	**< 36**	mg/Kg-dry	1	04/26/2024 15:05	222047
Sample analysis did not meet hold time requirements.								
SW-846 9036 (TOTAL)								
Sulfate	NELAP	1120		**< 1120**	mg/Kg-dry	10	05/02/2024 15:42	222445
Elevated reporting limit due to sample composition.								
SW-846 9045C								
pH (1:1)	NELAP	1.00	H	**7.80**		1	04/29/2024 13:29	R346449
Sample analysis did not meet hold time requirements.								

Receiving Check List

http://www.teklabinc.com/

Client: TSI Geotechnical Inc.

Client Project: I-70 3rd Lane

Work Order: 24042113

Report Date: 06-May-24

Carrier: Employee

Received By: LM

Completed by: Paul Schultz
On: 25-Apr-24

Reviewed by: Ellie Hopkins
On: 25-Apr-24

Pages to follow: Chain of custody 1 Extra pages included 0

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐	Temp °C 5.1
Type of thermal preservation?	None ☐	Ice ☑	Blue Ice ☐	Dry Ice ☐
Chain of custody present?	Yes ☑	No ☐		
Chain of custody signed when relinquished and received?	Yes ☑	No ☐		
Chain of custody agrees with sample labels?	Yes ☑	No ☐		
Samples in proper container/bottle?	Yes ☑	No ☐		
Sample containers intact?	Yes ☑	No ☐		
Sufficient sample volume for indicated test?	Yes ☑	No ☐		
All samples received within holding time?	Yes ☑	No ☐		
Reported field parameters measured:	Field ☐	Lab ☐	NA ☑	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐		
When thermal preservation is required, samples are compliant with a temperature between 0.1°C - 6.0°C, or when samples are received on ice the same day as collected.				
Water – at least one vial per sample has zero headspace?	Yes ☐	No ☐	No VOA vials ☑	
Water - TOX containers have zero headspace?	Yes ☐	No ☐	No TOX containers ☑	
Water - pH acceptable upon receipt?	Yes ☐	No ☐	NA ☑	
NPDES/CWA TCN interferences checked/treated in the field?	Yes ☐	No ☐	NA ☑	

Any No responses must be detailed below or on the COC.

Samples requiring pH should be analyzed as soon as possible after collection. Samples submitted for pH analysis are analyzed as soon as practicable upon arrival at the laboratory. - pschultz - 4/25/2024 3:27:43 PM

Per Patrick Riley, For Loss of Ignition Analysis, run Ash. Not anlayzing total salts. PS 4/25/2024

Print PDF

CHAIN OF CUSTODY

Pg 1 of 1 Workorder # 24042113

TEKLAB INC, 5445 Horseshoe Lake Road, Collinsville, IL 62234 Phone (618) 344-1004 Fax (618) 344-1005

Client: TSi Geotechnical
Address: 1340 North Price Road
City/State/Zip: St. Louis, MO 63132
Contact: Ally Kamp Phone: (618)-818-4616
Email: AKamp@tsigeotech.com Fax:

Samples on: [X] ICE [ ] BLUE ICE [ ] NO ICE 5.1 °C #3
Preserved in: [ ] LAB [ ] FIELD FOR LAB USE ONLY
LAB NOTES: For loss of Ignition, analyze Ash. per PR
Not analyzing total Salts, per Patrick Riley. PS 4/25/24

Client Comments: Need cooler back

Are these samples known to be involved in litigation? If yes, a surcharge will apply: [ ] Yes [✓] No
Are these samples known to be hazardous? [ ] Yes [✓] No
Are there any required reporting limits to be met on the requested analysis?. If yes, please provide limits in the comment section: [ ] Yes [✓] No

Loss on Ignition ASTM D7348
Water Soluble Sulfate ASTM C1580
Oxidation-Reduction Potential (Redox) AWWA 2580
Chlorides ASTM D512
pH AWWA 4500 H
Sulfide AWWA 4500-SD
Total Salts AWWA 2520B

PROJECT NAME/NUMBER	SAMPLE COLLECTOR'S NAME
I-70 3rd Lane/ BR 7-3A ST-3-1	

RESULTS REQUESTED
[✓] Standard [ ] 1-2 Day (100% Surcharge)
[ ] Other _____ [ ] 3 Day (50% Surcharge)

BILLING INSTRUCTIONS

Lab Use Only	Sample ID	Date/Time Sampled	Matrix	# and Type of Containers: UNP	HNO3	NaOH	H2SO4	HCL	MeOH	NaHSO4	TSP	Other	INDICATE ANALYSIS REQUESTED: Loss of Ignition	pH	Water Soluble Sulfate	Sulfide	Oxidation-Reduction P	Chlorides	Total Salts
24042113-601	BR 7-3A ST-3-1	4-11-24/noon	Soil									1	✓	✓	✓	✓	✓	✓	✓
			Wastewater																
			Wastewater																
			Wastewater																
			Wastewater																
			Aqueous																
			Aqueous																
			Aqueous																
			Aqueous																
			Aqueous																

Relinquished By	Date/Time	Received By	Date/Time
Ally Kamp	4/25 12:17 pm		4/25/24 12:17

*The individual signing this agreement on behalf of the client, acknowledges that he/she has read and understands the terms and conditions of this agreement, and that he/she has the authority to sign on behalf of the client. See www.teklabinc.com for terms and conditions

VM 4/25

May 20, 2024

Ally Kamp
TSI Geotechnical Inc.
1340 North Price Rd.
Olivette, MO 63132
TEL: (314) 373-4052
FAX:

Illinois	100226
Illinois	1004652024-2
Kansas	E-10374
Louisiana	05002
Louisiana	05003
Oklahoma	9978

RE: I-70 3rd Lane **WorkOrder:** 24050540

Dear Ally Kamp:

TEKLAB, INC received 1 sample on 4/25/2024 12:17:00 PM for the analysis presented in the following report.

Samples are analyzed on an as received basis unless otherwise requested and documented. The sample results contained in this report relate only to the requested analytes of interest as directed on the chain of custody. NELAP accredited fields of testing are indicated by the letters NELAP under the Certification column. Unless otherwise documented within this report, Teklab Inc. analyzes samples utilizing the most current methods in compliance with 40CFR. All tests are performed in the Collinsville, IL laboratory unless otherwise noted in the Case Narrative.

All quality control criteria applicable to the test methods employed for this project have been satisfactorily met and are in accordance with NELAP except where noted. The following report shall not be reproduced, except in full, without the written approval of Teklab, Inc.

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

Elizabeth A. Hurley
Director of Customer Service
(618)344-1004 ex 33
ehurley@teklabinc.com

Report Contents

Client: TSI Geotechnical Inc.
Work Order: 24050540
Client Project: I-70 3rd Lane
Report Date: 20-May-24

This reporting package includes the following:

Cover Letter	1
Report Contents	2
Definitions	3
Case Narrative	5
Accreditations	6
Laboratory Results	7
Chain of Custody	Appended

Client: TSI Geotechnical Inc. **Work Order:** 24050540

Client Project: I-70 3rd Lane **Report Date:** 20-May-24

Abbr Definition

*	Analytes on report marked with an asterisk are not NELAP accredited
CCV	Continuing calibration verification is a check of a standard to determine the state of calibration of an instrument between recalibration.
CRQL	A Client Requested Quantitation Limit is a reporting limit that varies according to customer request. The CRQL may not be less than the MDL.
DF	Dilution factor is the dilution performed during analysis only and does not take into account any dilutions made during sample preparation. The reported result is final and includes all dilution factors.
DNI	Did not ignite
DUP	Laboratory duplicate is a replicate aliquot prepared under the same laboratory conditions and independently analyzed to obtain a measure of precision.
ICV	Initial calibration verification is a check of a standard to determine the state of calibration of an instrument before sample analysis is initiated.
IDPH	IL Dept. of Public Health
LCS	Laboratory control sample is a sample matrix, free from the analytes of interest,spiked with verified known amounts of analytes and analyzed exactly like a sample to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.
LCSD	Laboratory control sample duplicate is a replicate laboratory control sample that is prepared and analyzed in order to determine the precision of the approved test method. The acceptable recovery range is listed in the QC Package (provided upon request).
MBLK	Method blank is a sample of a matrix similar to the batch of associated sample (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences should present at concentrations that impact the analytical results for sample analyses.
MDL	"The method detection limit is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results."
MS	Matrix spike is an aliquot of matrix fortified (spiked) with known quantities of specific analytes that is subjected to the entire analytical procedures in order to determine the effect of the matrix on an approved test method's recovery system. The acceptable recovery range is listed in the QC Package (provided upon request).
MSD	Matrix spike duplicate means a replicate matrix spike that is prepared and analyzed in order to determine the precision of the approved test method. The acceptable recovery range is listed in the QC Package (provided upon request).
MW	Molecular weight
NC	Data is not acceptable for compliance purposes
ND	Not Detected at the Reporting Limit
NELAP	NELAP Accredited
PQL	Practical quantitation limit means the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operation conditions.
RL	The reporting limit the lowest level that the data is displayed in the final report. The reporting limit may vary according to customer request or sample dilution. The reporting limit may not be less than the MDL.
RPD	Relative percent difference is a calculated difference between two recoveries (ie. MS/MSD). The acceptable recovery limit is listed in the QC Package (provided upon request).
SPK	The spike is a known mass of target analyte added to a blank sample or sub-sample; used to determine recovery deficiency or for other quality control purposes.
Surr	Surrogates are compounds which are similar to the analytes of interest in chemical composition and behavior in the analytical process, but which are not normally found in environmental samples.
TIC	Tentatively identified compound: Analytes tentatively identified in the sample by using a library search. Only results not in the calibration standard will be reported as tentatively identified compounds. Results for tentatively identified compounds that are not present in the calibration standard, but are assigned a specific chemical name based upon the library search, are calculated using total peak areas from reconstructed ion chromatograms and a response factor of one. The nearest Internal Standard is used for the calculation. The results of any TICs must be considered estimated, and are flagged with a "T". If the estimated result is above the calibration range it is flagged "ET"
TNTC	Too numerous to count (> 200 CFU)

Definitions

Client: TSI Geotechnical Inc.

Work Order: 24050540

Client Project: I-70 3rd Lane

Report Date: 20-May-24

Qualifiers

- # - Unknown hydrocarbon
- B - Analyte detected in associated Method Blank
- C - RL shown is a Client Requested Quantitation Limit
- E - Value above quantitation range
- H - Holding times exceeded
- I - Associated internal standard was outside method criteria
- J - Analyte detected below quantitation limits
- M - Manual Integration used to determine area response
- ND - Not Detected at the Reporting Limit
- R - RPD outside accepted recovery limits
- S - Spike Recovery outside recovery limits
- T - TIC(Tentatively identified compound)
- X - Value exceeds Maximum Contaminant Level

Case Narrative

http://www.teklabinc.com/

Client: TSI Geotechnical Inc.

Client Project: I-70 3rd Lane

Work Order: 24050540

Report Date: 20-May-24

Cooler Receipt Temp: °C

Additional analysis to WO# 24042113.

Locations

Collinsville

Address 5445 Horseshoe Lake Road
Collinsville, IL 62234-7425
Phone (618) 344-1004
Fax (618) 344-1005
Email jhriley@teklabinc.com

Springfield

Address 3920 Pintail Dr
Springfield, IL 62711-9415
Phone (217) 698-1004
Fax (217) 698-1005
Email KKlostermann@teklabinc.com

Kansas City

Address 8421 Nieman Road
Lenexa, KS 66214
Phone (913) 541-1998
Fax (913) 541-1998
Email jhriley@teklabinc.com

Collinsville Air

Address 5445 Horseshoe Lake Road
Collinsville, IL 62234-7425
Phone (618) 344-1004
Fax (618) 344-1005
Email EHurley@teklabinc.com

Chicago

Address 1319 Butterfield Rd.
Downers Grove, IL 60515
Phone (630) 324-6855
Fax
Email arenner@teklabinc.com

Client: TSI Geotechnical Inc.

Work Order: 24050540

Client Project: I-70 3rd Lane

Report Date: 20-May-24

State	Dept	Cert #	NELAP	Exp Date	Lab
Illinois	IEPA	100226	NELAP	1/31/2025	Collinsville
Illinois	IEPA	1004652024-2	NELAP	4/30/2025	Collinsville
Kansas	KDHE	E-10374	NELAP	4/30/2025	Collinsville
Louisiana	LDEQ	05002	NELAP	6/30/2024	Collinsville
Louisiana	LDEQ	05003	NELAP	6/30/2024	Collinsville
Oklahoma	ODEQ	9978	NELAP	8/31/2024	Collinsville
Arkansas	ADEQ	88-0966		3/14/2025	Collinsville
Illinois	IDPH	17584		5/31/2025	Collinsville
Iowa	IDNR	430		6/1/2024	Collinsville
Kentucky	UST	0073		1/31/2025	Collinsville
Mississippi	MSDH			4/30/2025	Collinsville
Missouri	MDNR	930		1/31/2025	Collinsville
Missouri	MDNR	00930		10/31/2026	Collinsville

Client: TSI Geotechnical Inc. **Work Order:** 24050540

Client Project: I-70 3rd Lane **Report Date:** 20-May-24

Lab ID: 24050540-001 **Client Sample ID:** BR 7-3A ST-3-1

Matrix: SOLID **Collection Date:** 04/11/2024 12:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid	*	150	H	**1560**	Ohms/cm	1	05/17/2024 17:00	R347490

Sample analysis did not meet hold time requirements.

TEKLAB, INC
5445 Horseshoe Lake Road
Collinsville, IL 62234-7425
TEL: (618) 344-1004
FAX: (618) 344-1005

CHAIN-OF-CUSTODY RECORD

24050540

WorkOrder: 24050540

Client:
TSI Geotechnical Inc.
1340 North Price Rd.
Olivette, MO 63132

TEL: (314) 373-4060
FAX:
Project: I-70 3rd Lane/BR 7-3A ST-3-

07-May-24

					Requested Tests						
Sample ID	ClientSampID	Matrix	Date Collected	Bottle	EPA2-78-054 (R)						
24050540-001	BR 7-3A ST-3-1	Solid	4/11/2024 12:00:00 PM		A						

	Date/Time		Date/Time
Relinquished by:		**Received by:** Spencer Dillard	5/7/24 1305
Relinquished by:		**Received by:**	
Relinquished by:		**Received by:**	

June 10, 2024

Ally Kamp
TSI Geotechnical Inc.
1340 North Price Rd.
Olivette, MO 63132
TEL: (314) 373-4052
FAX:

Illinois	100226
Illinois	1004652024-2
Kansas	E-10374
Louisiana	05002
Louisiana	05003
Oklahoma	9978

RE: I-70 3rd Lane **WorkOrder:** 24060118

Dear Ally Kamp:

TEKLAB, INC received 2 samples on 6/3/2024 4:45:00 PM for the analysis presented in the following report.

Samples are analyzed on an as received basis unless otherwise requested and documented. The sample results contained in this report relate only to the requested analytes of interest as directed on the chain of custody. NELAP accredited fields of testing are indicated by the letters NELAP under the Certification column. Unless otherwise documented within this report, Teklab Inc. analyzes samples utilizing the most current methods in compliance with 40CFR. All tests are performed in the Collinsville, IL laboratory unless otherwise noted in the Case Narrative.

All quality control criteria applicable to the test methods employed for this project have been satisfactorily met and are in accordance with NELAP except where noted. The following report shall not be reproduced, except in full, without the written approval of Teklab, Inc.

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

Patrick Riley
Project Manager
(618)344-1004 ex 44
patrickriley@teklabinc.com

Report Contents

Client: TSI Geotechnical Inc.
Work Order: 24060118
Client Project: I-70 3rd Lane
Report Date: 10-Jun-24

This reporting package includes the following:

Cover Letter	1
Report Contents	2
Definitions	3
Case Narrative	5
Accreditations	6
Laboratory Results	7
Receiving Check List	9
Chain of Custody	Appended

Client: TSI Geotechnical Inc. **Work Order:** 24060118

Client Project: I-70 3rd Lane **Report Date:** 10-Jun-24

Abbr Definition

*	Analytes on report marked with an asterisk are not NELAP accredited
CCV	Continuing calibration verification is a check of a standard to determine the state of calibration of an instrument between recalibration.
CRQL	A Client Requested Quantitation Limit is a reporting limit that varies according to customer request. The CRQL may not be less than the MDL.
DF	Dilution factor is the dilution performed during analysis only and does not take into account any dilutions made during sample preparation. The reported result is final and includes all dilution factors.
DNI	Did not ignite
DUP	Laboratory duplicate is a replicate aliquot prepared under the same laboratory conditions and independently analyzed to obtain a measure of precision.
ICV	Initial calibration verification is a check of a standard to determine the state of calibration of an instrument before sample analysis is initiated.
IDPH	IL Dept. of Public Health
LCS	Laboratory control sample is a sample matrix, free from the analytes of interest,spiked with verified known amounts of analytes and analyzed exactly like a sample to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.
LCSD	Laboratory control sample duplicate is a replicate laboratory control sample that is prepared and analyzed in order to determine the precision of the approved test method. The acceptable recovery range is listed in the QC Package (provided upon request).
MBLK	Method blank is a sample of a matrix similar to the batch of associated sample (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences should present at concentrations that impact the analytical results for sample analyses.
MDL	"The method detection limit is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results."
MS	Matrix spike is an aliquot of matrix fortified (spiked) with known quantities of specific analytes that is subjected to the entire analytical procedures in order to determine the effect of the matrix on an approved test method's recovery system. The acceptable recovery range is listed in the QC Package (provided upon request).
MSD	Matrix spike duplicate means a replicate matrix spike that is prepared and analyzed in order to determine the precision of the approved test method. The acceptable recovery range is listed in the QC Package (provided upon request).
MW	Molecular weight
NC	Data is not acceptable for compliance purposes
ND	Not Detected at the Reporting Limit
NELAP	NELAP Accredited
PQL	Practical quantitation limit means the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operation conditions.
RL	The reporting limit the lowest level that the data is displayed in the final report. The reporting limit may vary according to customer request or sample dilution. The reporting limit may not be less than the MDL.
RPD	Relative percent difference is a calculated difference between two recoveries (ie. MS/MSD). The acceptable recovery limit is listed in the QC Package (provided upon request).
SPK	The spike is a known mass of target analyte added to a blank sample or sub-sample; used to determine recovery deficiency or for other quality control purposes.
Surr	Surrogates are compounds which are similar to the analytes of interest in chemical composition and behavior in the analytical process, but which are not normally found in environmental samples.
TIC	Tentatively identified compound: Analytes tentatively identified in the sample by using a library search. Only results not in the calibration standard will be reported as tentatively identified compounds. Results for tentatively identified compounds that are not present in the calibration standard, but are assigned a specific chemical name based upon the library search, are calculated using total peak areas from reconstructed ion chromatograms and a response factor of one. The nearest Internal Standard is used for the calculation. The results of any TICs must be considered estimated, and are flagged with a "T". If the estimated result is above the calibration range it is flagged "ET"
TNTC	Too numerous to count (> 200 CFU)

Definitions

Client: TSI Geotechnical Inc.

Work Order: 24060118

Client Project: I-70 3rd Lane

Report Date: 10-Jun-24

Qualifiers

- # - Unknown hydrocarbon
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- S - Spike Recovery outside recovery limits
- T - TIC(Tentatively identified compound)
- X - Value exceeds Maximum Contaminant Level

Case Narrative

http://www.teklabinc.com/

Client: TSI Geotechnical Inc.

Client Project: I-70 3rd Lane

Work Order: 24060118

Report Date: 10-Jun-24

Cooler Receipt Temp: 5.9 °C

Locations

Collinsville

Address 5445 Horseshoe Lake Road
Collinsville, IL 62234-7425
Phone (618) 344-1004
Fax (618) 344-1005
Email jhriley@teklabinc.com

Springfield

Address 3920 Pintail Dr
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Collinsville, IL 62234-7425
Phone (618) 344-1004
Fax (618) 344-1005
Email EHurley@teklabinc.com

Chicago

Address 1319 Butterfield Rd.
Downers Grove, IL 60515
Phone (630) 324-6855
Fax
Email arenner@teklabinc.com

Client: TSI Geotechnical Inc.

Work Order: 24060118

Client Project: I-70 3rd Lane

Report Date: 10-Jun-24

State	Dept	Cert #	NELAP	Exp Date	Lab
Illinois	IEPA	100226	NELAP	1/31/2025	Collinsville
Illinois	IEPA	1004652024-2	NELAP	4/30/2025	Collinsville
Kansas	KDHE	E-10374	NELAP	4/30/2025	Collinsville
Louisiana	LDEQ	05002	NELAP	6/30/2024	Collinsville
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Kentucky	UST	0073		1/31/2025	Collinsville
Mississippi	MSDH			4/30/2025	Collinsville
Missouri	MDNR	930		1/31/2025	Collinsville
Missouri	MDNR	00930		10/31/2026	Collinsville

Client: TSI Geotechnical Inc. **Work Order:** 24060118

Client Project: I-70 3rd Lane **Report Date:** 10-Jun-24

Lab ID: 24060118-001 **Client Sample ID:** BR 13-1 ST-5-3

Matrix: SOLID **Collection Date:** 04/17/2024 12:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
ASTM D2974								
% Dry Ash, Soil	*	0.10	H	**92.9**	%	1	06/05/2024 14:46	R348335
Sample analysis did not meet hold time requirements.								
ASTM G200-09								
Oxidation-Reduction Potential	*	-2000		**241**	mV	1	06/04/2024 12:50	R348228
Sample was analyzed at 19C with saturated Ag/AgCl electrode.								
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid	*	150	H	**2950**	Ohms/cm	1	06/04/2024 15:35	R348252
EPA SW846 3550B, 5035A, ASTM D2974								
Percent Moisture	*	0.1		**22.6**	%	1	06/05/2024 14:46	R348335
STANDARD METHODS 4500-CL E (TOTAL) 1997, 2011								
Chloride	*	515	H	**< 515**	mg/Kg-dry	10	06/05/2024 13:59	223852
Elevated reporting limit due to sample composition.								
SW-846 9030B, 9034								
Sulfide, Total	NELAP	39	H	**< 39**	mg/Kg-dry	1	06/07/2024 14:58	224104
Sulfide, as Hydrogen Sulfide	*	41	H	**< 41**	mg/Kg-dry	1	06/07/2024 14:58	224104
SW-846 9036 (TOTAL)								
Sulfate	NELAP	1290	H	**< 1290**	mg/Kg-dry	10	06/05/2024 13:58	223851
Elevated reporting limit due to sample composition.								
SW-846 9045C								
pH (1:1)	NELAP	1.00	H	**8.10**		1	06/04/2024 12:51	R348219
Sample analysis did not meet hold time requirements.								

Client: TSI Geotechnical Inc. **Work Order:** 24060118

Client Project: I-70 3rd Lane **Report Date:** 10-Jun-24

Lab ID: 24060118-002 **Client Sample ID:** BR 37-1 ST-4-3

Matrix: SOLID **Collection Date:** 05/16/2024 10:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
ASTM D2974								
% Dry Ash, Soil	*	0.10	H	**93.1**	%	1	06/05/2024 14:47	R348335
Sample analysis did not meet hold time requirements.								
ASTM G200-09								
Oxidation-Reduction Potential	*	-2000		**314**	mV	1	06/04/2024 12:50	R348228
Sample was analyzed at 19C with saturated Ag/AgCl electrode.								
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid	*	150		**2870**	Ohms/cm	1	06/04/2024 15:36	R348252
EPA SW846 3550B, 5035A, ASTM D2974								
Percent Moisture	*	0.1		**11.5**	%	1	06/05/2024 14:47	R348335
STANDARD METHODS 4500-CL E (TOTAL) 1997, 2011								
Chloride	*	437		**< 437**	mg/Kg-dry	10	06/05/2024 14:02	223852
Elevated reporting limit due to sample composition.								
SW-846 9030B, 9034								
Sulfide, Total	NELAP	33	H	**< 33**	mg/Kg-dry	1	06/07/2024 14:59	224104
Sulfide, as Hydrogen Sulfide	*	36	H	**< 36**	mg/Kg-dry	1	06/07/2024 14:59	224104
SW-846 9036 (TOTAL)								
Sulfate	NELAP	1090		**< 1090**	mg/Kg-dry	10	06/05/2024 14:01	223851
Elevated reporting limit due to sample composition.								
SW-846 9045C								
pH (1:1)	NELAP	1.00	H	**8.33**		1	06/04/2024 12:53	R348219
Sample analysis did not meet hold time requirements.								

Receiving Check List

http://www.teklabinc.com/

Client: TSI Geotechnical Inc.

Client Project: I-70 3rd Lane

Work Order: 24060118

Report Date: 10-Jun-24

Carrier: Employee

Received By: LEH

Completed by: Whitney Olinger
On: 04-Jun-24

Reviewed by: Ellie Hopkins
On: 04-Jun-24

Pages to follow: Chain of custody 1 Extra pages included 0

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐	Temp °C 5.9
Type of thermal preservation?	None ☐	Ice ☑	Blue Ice ☐	Dry Ice ☐
Chain of custody present?	Yes ☑	No ☐		
Chain of custody signed when relinquished and received?	Yes ☑	No ☐		
Chain of custody agrees with sample labels?	Yes ☑	No ☐		
Samples in proper container/bottle?	Yes ☑	No ☐		
Sample containers intact?	Yes ☑	No ☐		
Sufficient sample volume for indicated test?	Yes ☑	No ☐		
All samples received within holding time?	Yes ☐	No ☑		
Reported field parameters measured:	Field ☐	Lab ☐	NA ☑	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐		
When thermal preservation is required, samples are compliant with a temperature between 0.1°C - 6.0°C, or when samples are received on ice the same day as collected.				
Water – at least one vial per sample has zero headspace?	Yes ☐	No ☐	No VOA vials ☑	
Water - TOX containers have zero headspace?	Yes ☐	No ☐	No TOX containers ☑	
Water - pH acceptable upon receipt?	Yes ☐	No ☐	NA ☑	
NPDES/CWA TCN interferences checked/treated in the field?	Yes ☐	No ☐	NA ☑	

Any No responses must be detailed below or on the COC.

Samples requiring pH should be analyzed as soon as possible after collection. Samples submitted for pH analysis are analyzed as soon as practicable upon arrival at the laboratory. - wolinger - 6/4/2024 8:23:45 AM

Cancel total salts analysis per Patrick Riley and work order history; cannot analyze for total salts. - ERH 6/4/24

Print PDF

CHAIN OF CUSTODY

Pg 1 of 1 Workorder # 24060118

TEKLAB INC, 5445 Horseshoe Lake Road, Collinsville, IL 62234 Phone (618) 344-1004 Fax (618) 344-1005

Client: TSi Geotechnical
Address: 1340 North Price Road
City/State/Zip: St. Louis, MO 63132
Contact: Ally Kamp Phone: (618)-818-4616
Email: AKamp@tsigeotech.com Fax:

Are these samples known to be involved in litigation? If yes, a surcharge will apply: ☐ Yes ☑ No
Are these samples known to be hazardous? ☐ Yes ☑ No
Are there any required reporting limits to be met on the requested analysis?. If yes, please provide limits in the comment section: ☐ Yes ☑ No

Samples on: ☑ ICE ☐ BLUE ICE ☐ NO ICE 5.9 °C 3
Preserved in: ☐ LAB ☐ FIELD FOR LAB USE ONLY

LAB NOTES:
Cancel total salts analysis per Patrick Riley's history ERH 6/4/24

Client Comments:
Loss on Ignition ASTM D7348
Water Soluble Sulfate ASTM C1580
Oxidation-Reduction Potential (Redox) AWWA 2580
Chlorides ASTM D512
pH AWWA 4500 H
Sulfide AWWA 4500-SD
Total Salts AWWA 2520B

PROJECT NAME/NUMBER	SAMPLE COLLECTOR'S NAME
I-70 3rd Lane/ BR 7-3A ST-3-1	McQueeny

RESULTS REQUESTED
☑ Standard ☐ 1-2 Day (100% Surcharge)
☐ Other _____ ☐ 3 Day (50% Surcharge)

BILLING INSTRUCTIONS

Lab Use Only	Sample ID	Date/Time Sampled	Matrix	# and Type of Containers: UNP	HNO3	NaOH	H2SO4	HCL	MeOH	NaHSO4	TSP	Other	INDICATE ANALYSIS REQUESTED: Loss of Ignition (Ash)	pH	Water Soluble Sulfate	Sulfide	Oxidation-Reduction P	Chlorides	Total Salts	Resistivity
24060118-001	BR 13-1 ST-5-3	4-17-24/noon	Soil									1	✓	✓	✓	✓	✓	✓	✓	✓
-002	BR 37-1 ST-4-3	5-16-24/10am	Soil									1	✓	✓	✓	✓	✓	✓	✓	✓
			Wastewater																	
			Wastewater																	
			Wastewater																	
			Aqueous																	
			Aqueous																	
			Aqueous																	
			Aqueous																	
			Aqueous																	
			Aqueous																	

Relinquished By	Date/Time	Received By	Date/Time
Ally Kamp 6/3/24	6/3/24 16:45		6/3/24 1645

*The individual signing this agreement on behalf of the client, acknowledges that he/she has read and understands the terms and conditions of this agreement, and that he/she has the authority to sign on behalf of the client. See www.teklabinc.com for terms and conditions

Appendix E. Geotechnical Analysis

E.0 Foundation Recommendation Summary

E.1 Seismic Site Class Determination and Design Parameters

E.2 Liquefaction Evaluation

E.3 Passive Resistance behind Backwall

E.4 Preliminary Scour and Load Information for Substructure Design

E.5 Pile Lateral Analysis

E.6 Pile Drivability Analysis

E.7 Global Stability Analysis

E.8 Settlement Analysis

Foundation Recommendations for Bridges A9542

SUBSURFACE DIAGRAM

PROJECT NAME I-70 3rd Lane

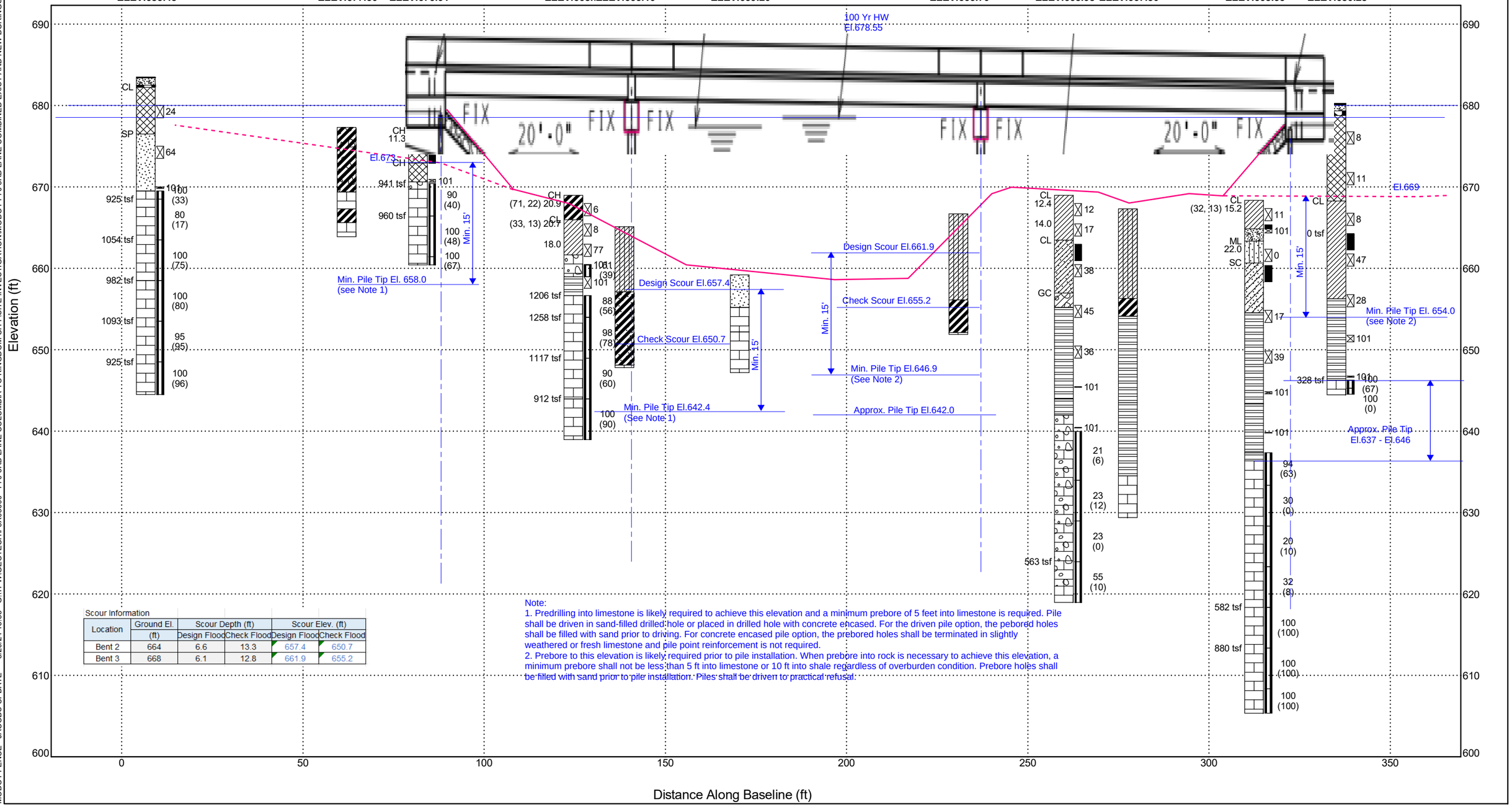
PROJECT LOCATION Columbia, Missouri

Asphalt
Concrete
Boulders and cobbles
Fill (made ground)
USCS Low Plasticity Clay
Shale
Limestone
USCS Poorly-graded Sand
USCS Sandy Silt
USCS Clayey Sand
Highly Weathered Limestone
USCS High Plasticity Clay

Sampler Type
Split-Spoon
Continuous
Shelby Tube
Grab
Coring

Key
(LL,PL) MC N_{60}
USCS
UC
REC (RQD)

LL = Liquid Limit
PL = Plastic Limit
MC = In-situ Moisture Content
USCS = Unified Soil Classification System
UC = Unconfined Compression Test
N_{60} = Energy Corrected SPT Blow Count
REC = Recovery (%)
RQD = Rock Quality Designation (%)



Scour Information

Location	Ground El. (ft)	Scour Depth (ft)		Scour Elev. (ft)	
		Design Flood	Check Flood	Design Flood	Check Flood
Bent 2	664	6.6	13.3	657.4	650.7
Bent 3	668	6.1	12.8	661.9	655.2

Note:
1. Predrilling into limestone is likely required to achieve this elevation and a minimum prebore of 5 feet into limestone is required. Pile shall be driven in sand-filled drilled hole or placed in drilled hole with concrete encased. For the driven pile option, the pebored holes shall be filled with sand prior to driving. For concrete encased pile option, the prebored holes shall be terminated in slightly weathered or fresh limestone and pile point reinforcement is not required.
2. Prebore to this elevation is likely required prior to pile installation. When prebore into rock is necessary to achieve this elevation, a minimum prebore shall not be less than 5 ft into limestone or 10 ft into shale regardless of overburden condition. Prebore holes shall be filled with sand prior to pile installation. Piles shall be driven to practical refusal.

MODOT FENCE - JACOBS UPDATE - - 8/20/24 15:53 - G:\TPW\GEOTECH\F3X03000 - I-70 3RD LANE COLUMBIA TO KINGDOM CITY\SITE INVESTIGATION\MODOT I-70 3RD LANE COMBINED EXIST AND NEW BORINGS_NOTCOMPLETE 08142024.GPJ

Foundation Recommendations for Bridges A9543

SUBSURFACE DIAGRAM

PROJECT NAME I-70 3rd Lane

PROJECT LOCATION Columbia, Missouri

- USCS Low Plasticity Clay
- Concrete
- USCS Low Plasticity Sandy Clay
- Shale
- USCS Sandy Silt
- USCS Clayey Gravel
- Limestone
- USCS Clayey Sand
- Highly Weathered Limestone

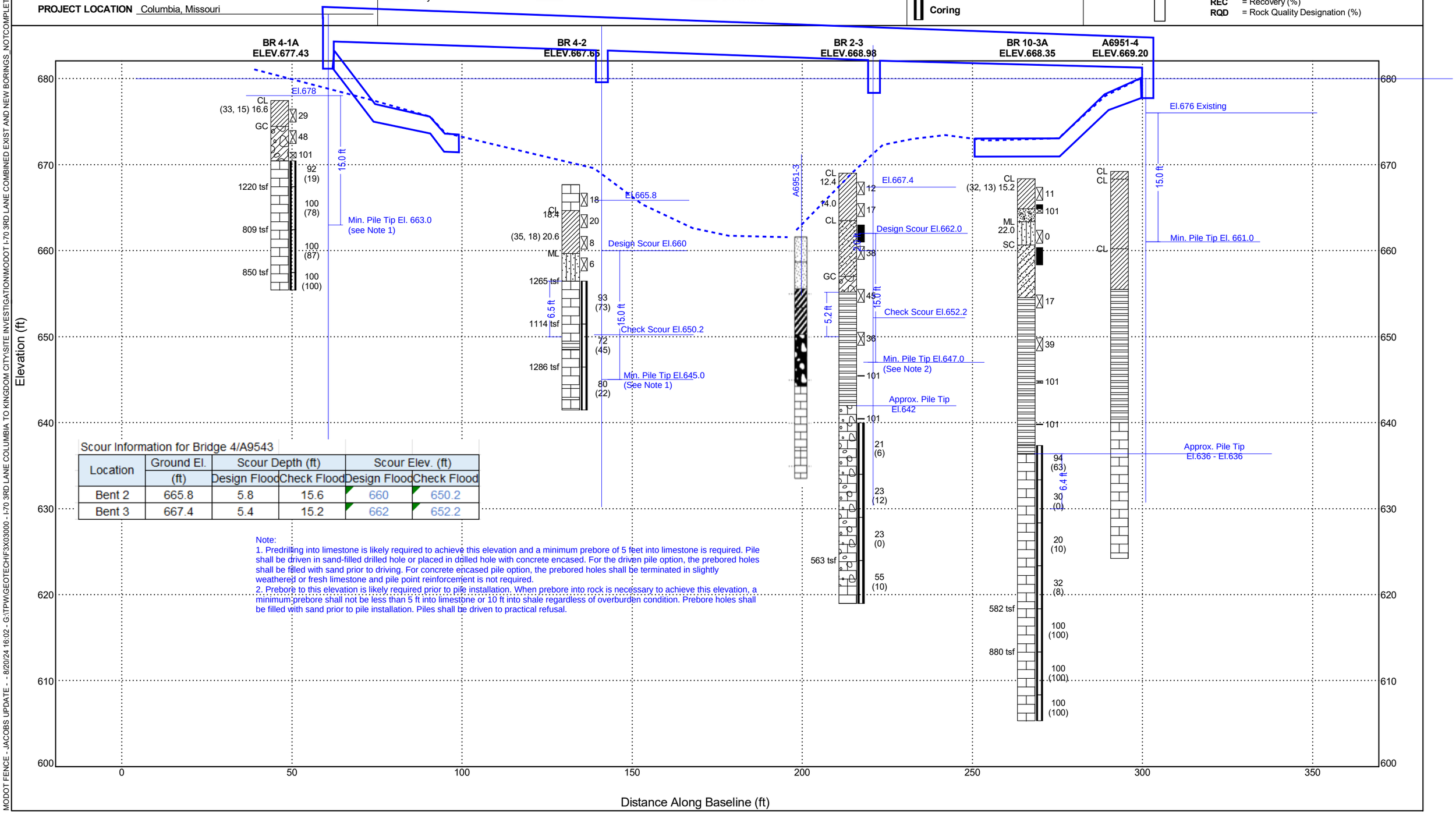
Sampler Type

- Split-Spoon
- Shelby Tube
- Coring
- Continuous
- Grab

Key

(LL,PL) MC — N_{60} — USCS — REC (RQD) — UC

- **LL** = Liquid Limit
- **PL** = Plastic Limit
- **MC** = In-situ Moisture Content
- **USCS** = Unified Soil Classification System
- **UC** = Unconfined Compression Test
- **N_{60}** = Energy Corrected SPT Blow Count
- **REC** = Recovery (%)
- **RQD** = Rock Quality Designation (%)



Scour Information for Bridge 4/A9543

Location	Ground El. (ft)	Scour Depth (ft)		Scour Elev. (ft)	
		Design Flood	Check Flood	Design Flood	Check Flood
Bent 2	665.8	5.8	15.6	660	650.2
Bent 3	667.4	5.4	15.2	662	652.2

Note:
1. Predrilling into limestone is likely required to achieve this elevation and a minimum prebore of 5 feet into limestone is required. Pile shall be driven in sand-filled drilled hole or placed in drilled hole with concrete encased. For the driven pile option, the prebored holes shall be filled with sand prior to driving. For concrete encased pile option, the prebored holes shall be terminated in slightly weathered or fresh limestone and pile point reinforcement is not required.
2. Prebore to this elevation is likely required prior to pile installation. When prebore into rock is necessary to achieve this elevation, a minimum prebore shall not be less than 5 ft into limestone or 10 ft into shale regardless of overburden condition. Prebore holes shall be filled with sand prior to pile installation. Piles shall be driven to practical refusal.

MODOT FENCE - JACOBS UPDATE - - 8/20/24 16:02 - G:\TPW\GEOTECH\F3X03000 - I-70 3RD LANE COLUMBIA TO KINGDOM CITY\SITE INVESTIGATION\MODOT I-70 3RD LANE COMBINED EXIST AND NEW BORINGS_NOTCOMPLETE 08142024.GPJ

SEISMIC SITE CLASS DETERMINATION

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified on 12/10/10

PROJECT TITLE=====MoDOT Improve I-70 Columbia to Kingdom City DB - Bridge MW 2&4

Substructure 1

Base of Substruct. Elev. (or ground surf for bents)	672	ft.
Pile or Shaft Dia.	12	inches
Boring Number	BR 2-1A	
Top of Boring Elev.	677	ft.
Approximate Fixity Elev.	666	ft.

Individual Site Class Definition:

N (bar): 100 (Blows/ft.) Soil Site Class C <----Controls
N_{ch} (bar): NA (Blows/ft.) NA
s_u (bar): 5 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	674.5	2.50	17	2.25	B
	672.0	2.50	17	2.25	B
	670.7	1.30	17	1.75	B
	669.8	0.90	100		B
1.2	664.8	5.00	100	99.00	B
100.0	566.0	98.80	100	99.00	R

Substructure 2

Base of Substruct. Elev. (or ground surf for bents)	663.5	ft.
Pile or Shaft Dia.	24	inches
Boring Number	BR 2-2	
Top of Boring Elev.	669	ft.
Approximate Fixity Elev.	651.5	ft.

Individual Site Class Definition:

N (bar): 100 (Blows/ft.) Soil Site Class C <----Controls
N_{ch} (bar): NA (Blows/ft.) NA
s_u (bar): 5 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	666.0	3.00	6	2.00	B
	664.0	2.00	8	1.50	B
	661.7	2.30	8	1.50	B
	659.0	2.70	100		B
2.5	649.0	10.00	100	99.00	B
100.0	551.5	97.50	100	99.00	R

Substructure 3

Base of Substruct. Elev. (or ground surf for bents)	667.8	ft.
Pile or Shaft Dia.	24	inches
Boring Number	BR 2-3	
Top of Boring Elev.	669	ft.
Approximate Fixity Elev.	655.8	ft.

Individual Site Class Definition:

N (bar): 90 (Blows/ft.) Soil Site Class C <----Controls
N_{ch} (bar): 88 (Blows/ft.) Soil Site Class C
s_u (bar): 5 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	666.5	2.50	12	2.00	B
	663.5	3.00	17	3.50	B
	661.0	2.50		1.75	B
	657.0	4.00	38	0.50	B
0.6	655.2	1.80	45		B
1.8	654.0	1.20	45		B
6.8	649.0	5.00	36		B
11.8	644.0	5.00	100		B
13.8	642.0	2.00	100		B
34.8	621.0	21.00	100	99.00	B
100.0	555.8	65.20	100	99.00	R

Substructure 4

Base of Substruct. Elev. (or ground surf for bents)	672	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-11	
Top of Boring Elev.	680.3	ft.
Approximate Fixity Elev.	666	ft.

Individual Site Class Definition:

N (bar): 68 (Blows/ft.) Soil Site Class C
N_{ch} (bar): 100 (Blows/ft.) Soil Site Class C
s_u (bar): 4.24 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	675.3	5.00	8	2.50	B
	670.3	5.00	11	3.00	B
	668.3	2.00	11	3.00	B
0.7	665.3	3.00	8	1.25	B
3.2	662.8	2.50	8	1.00	B
5.7	660.3	2.50	47	3.00	B
9.7	656.3	4.00	47	3.00	B
10.7	655.3	1.00	28	5.00	B
15.7	650.3	5.00	100		B
19.7	646.3	4.00	100		B
100.0	566.0	80.30	100	99.00	R

Global Site Class Definition: Substructures 1 through 8

N (bar): 87 (Blows/ft.) Soil Site Class C
N_{ch} (bar): 96 (Blows/ft.) Soil Site Class C
s_u (bar): 4.64 (ksf) Soil Site Class C <----Controls

SEISMIC SITE CLASS DETERMINATION

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified on 12/10/10

PROJECT TITLE=====

Substructure 5

Base of Substruct. Elev. (or ground surf for bents)	676.5	ft.
Pile or Shaft Dia.	12	inches
Boring Number	BR 4-1A	
Top of Boring Elev.	677.4	ft.
Approximate Fixity Elev.	670.5	ft.

Individual Site Class Definition:

N (bar): 100 (Blows/ft.) Soil Site Class C <----Controls

N_{ch} (bar): NA (Blows/ft.) NA

s_u (bar): 5 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	674.4	3.00	29	4.25	B
	672.4	2.00	48		B
0.1	670.4	2.00	100		B
5.1	665.4	5.00	100	99.00	B
100.0	570.5	94.90	100	99.00	R

Substructure 6

Base of Substruct. Elev. (or ground surf for bents)	665.8	ft.
Pile or Shaft Dia.	24	inches
Boring Number	BR 4-2	
Top of Boring Elev.	667.7	ft.
Approximate Fixity Elev.	653.8	ft.

Individual Site Class Definition:

N (bar): 100 (Blows/ft.) Soil Site Class C <----Controls

N_{ch} (bar): NA (Blows/ft.) NA

s_u (bar): 5 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	665.2	2.50	18		B
	662.7	2.50	20	1.50	B
	659.7	3.00	8	1.00	B
	656.5	3.20	6	0.50	B
7.3	646.5	10.00	100	99.00	B
100.0	553.8	92.70	100	99.00	R

Substructure 7

Base of Substruct. Elev. (or ground surf for bents)	668.3	ft.
Pile or Shaft Dia.	24	inches
Boring Number	BR 10-3A	
Top of Boring Elev.	668.3	ft.
Approximate Fixity Elev.	656.3	ft.

Individual Site Class Definition:

N (bar): 78 (Blows/ft.) Soil Site Class C

N_{ch} (bar): 90 (Blows/ft.) Soil Site Class C <----Controls

s_u (bar): 4.93 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	665.8	2.50	11	3.00	B
	663.3	2.50	11	3.00	B
	660.6	2.70	1	0.50	B
	658.3	2.30	15		B
1.8	654.5	3.80	15		B
4.3	652.0	2.50	17	4.50	B
8.0	648.3	3.70	39	4.50	B
13.0	643.3	5.00	100	4.50	B
18.0	638.3	5.00	100		B
20.0	636.3	2.00	100		B
100.0	556.3	80.00	100	99.00	R

Substructure 8

Base of Substruct. Elev. (or ground surf for bents)	676.5	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-10	
Top of Boring Elev.	680.6	ft.
Approximate Fixity Elev.	670.5	ft.

Individual Site Class Definition:

N (bar): 58 (Blows/ft.) Soil Site Class C

N_{ch} (bar): 91 (Blows/ft.) Soil Site Class C

s_u (bar): 2.66 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	675.6	5.00	31	0.50	B
0.4	670.1	5.50	31	0.50	B
2.9	667.6	2.50		1.50	B
6.9	663.6	4.00	9	1.50	B
9.9	660.6	3.00	19	0.50	B
12.9	657.6	3.00	19	0.50	B
15.9	654.6	3.00	100		B
19.9	650.6	4.00	48		B
24.9	645.6	5.00	52		B
29.9	640.6	5.00	100		B
100.0	570.5	70.10	100	99.00	R

Pretty-print ☑


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U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new USGS Earthquake Hazard Toolbox for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

Input

Edition

Dynamic: Conterminous U.S. 2014 (u…

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

38.962353

Time Horizon

Return period in years

975

Longitude

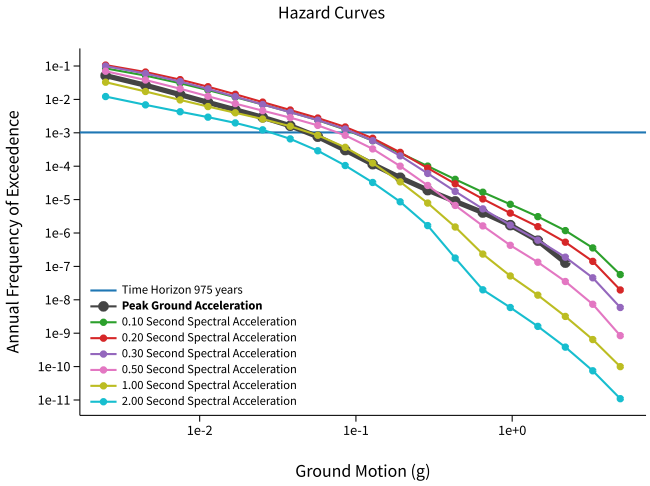
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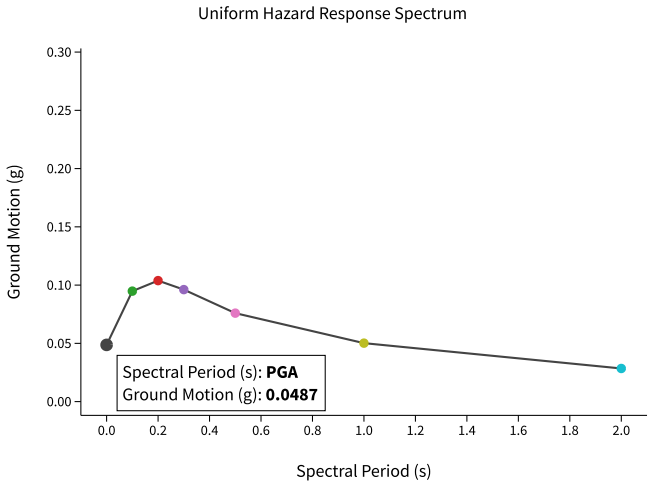
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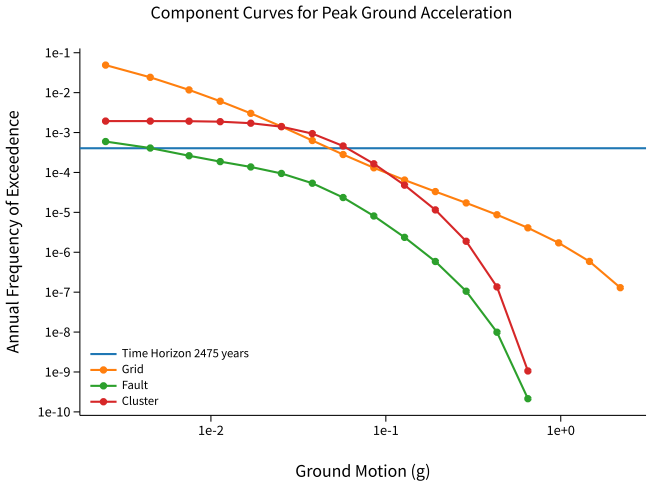
Site Class

760 m/s (B/C boundary)

Hazard Curve





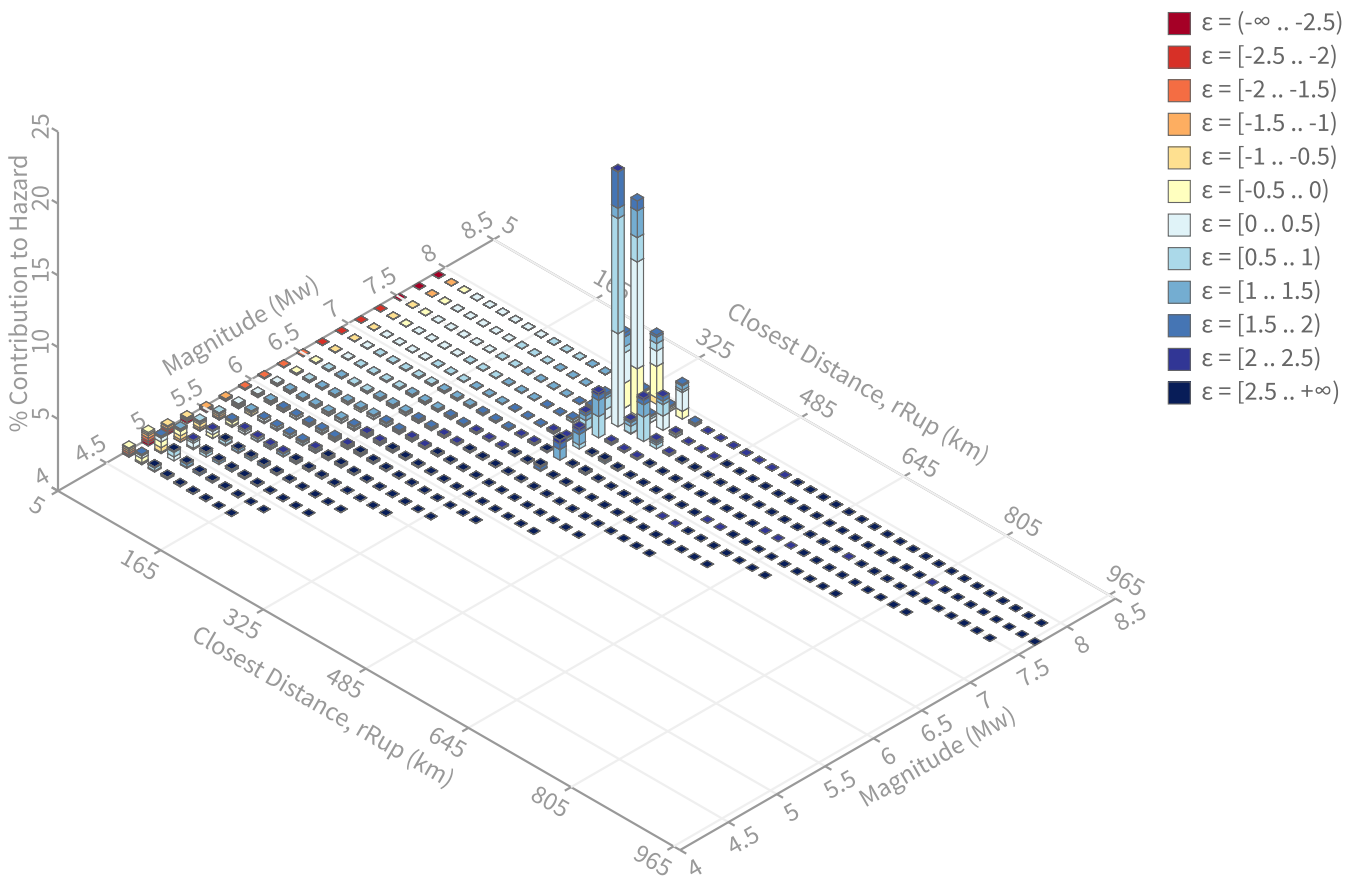


View Raw Data

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 975 yrs
Exceedance rate: 0.001025641 yr^{-1}
PGA ground motion: 0.048681851 g

Recovered targets

Return period: 982.7102 yrs
Exceedance rate: 0.001017594 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 2.11 %

Mean (over all sources)

m: 6.99
r: 273.57 km
ε_0: 0.53 σ

Mode (largest m-r bin)

m: 7.53
r: 345.33 km
ε_0: 0.74 σ
Contribution: 17.76 %

Mode (largest m-r-ε_0 bin)

m: 7.52
r: 345.49 km
ε_0: 0.74 σ
Contribution: 8.02 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
SSCn New Madrid	Cluster							38.05
NMFS RLME 1		352.11	7.63	0.62	89.288°W	36.995°N	128.76	11.31
NMFS RLME 5		359.90	7.63	0.68	89.288°W	36.995°N	128.76	6.98
NMFS RLME 2		345.39	7.63	0.57	89.898°W	36.569°N	140.88	5.14
NMFS RLME 4		351.98	7.63	0.62	89.288°W	36.995°N	128.76	4.85
NMFS RLME 6		351.98	7.63	0.62	89.898°W	36.569°N	140.88	3.20
NMFS RLME 7		359.74	7.63	0.68	89.288°W	36.995°N	128.76	3.00
NMFS RLME 3		345.27	7.63	0.57	89.898°W	36.569°N	140.88	2.20
NMFS RLME 8		351.84	7.63	0.62	89.898°W	36.569°N	140.88	1.37
USGS Fixed Smoothing Zone 1 (opt)	Grid							11.33
SSCn Fixed Smoothing Zone 1 (opt)	Grid							10.79
USGS New Madrid 500-year	Cluster							10.52
NMSZ: Center Model		355.29	7.60	0.69	89.070°W	37.165°N	124.28	7.39
NMSZ: Mid-West Model		345.19	7.59	0.63	89.193°W	37.218°N	124.57	1.16
USGS New Madrid 750-year	Cluster							7.02
NMSZ: Center Model		355.29	7.60	0.69	89.070°W	37.165°N	124.28	4.93
USGS Adaptive Smoothing Zone 1 (opt)	Grid							5.43
SSCn Adaptive Smoothing Zone 1 (opt)	Grid							5.13
USGS New Madrid 500-year	Fault							2.98
New Madrid central		345.05	7.64	0.51	89.070°W	37.165°N	124.28	2.08
USGS New Madrid 1500-year	Cluster							2.77
NMSZ: Center Model		359.41	7.65	0.62	89.583°W	36.687°N	135.88	1.95
Commerce Lineament	Grid							1.23

Critical

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== BR 2-1A
ELEVATION OF BORING GROUND SURFACE ========== 676.90 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 7.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.060
EARTHQUAKE MOMENT MAGNITUDE ========== 7.6
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 60 %
BOREHOLE DIAMETER========== 2.5 to 4.5 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.968**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **729** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.63
Source-To-Site Distance, R (km) = 345.39
Ground Motion Prediction Equations = NMSZ
PGA = **0.036**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
674.4	2.5	17	2.25				11.3	0.131	0.328	26.427	26.427	0.323	0.069	0.173	0.329	1.500	**0.469**	0.999	**0.074**	**N.L. (3)**
670.6	6.3	17	1.75		22	50	11.3	0.128	0.814	21.891	21.891	0.240	0.066	0.423	0.816	1.500	**0.349**	0.997	**0.075**	**N.L. (2)**

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== BR 2-2
ELEVATION OF BORING GROUND SURFACE ========== 669.00 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 7.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.060
EARTHQUAKE MOMENT MAGNITUDE ========== 7.6
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 60 %
BOREHOLE DIAMETER========== 2.5 to 4.5 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.968**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **582** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.63
Source-To-Site Distance, R (km) = 345.39
Ground Motion Prediction Equations = NMSZ
PGA = **0.036**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
666	3	6	2		49	71	20.9	0.130	0.390	7.869	7.869	0.095	0.068	0.204	0.391	1.500	**0.138**	0.993	**0.074**	**N.L. (2)**
664	5	8	1.5	65.3	20	33	20.7	0.126	0.642	9.812	16.774	0.178	0.064	0.332	0.644	1.500	**0.259**	0.988	**0.075**	**N.L. (2)**
661.7	7.3	77	1.5	65.3	20	33	18	0.064	0.789	######	131.059	0.956	0.064	0.479	0.935	1.500	**1.387**	0.980	**0.075**	**N.L. (2)**

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== BR 2-3
ELEVATION OF BORING GROUND SURFACE ========== 669.00 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 13.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.060
EARTHQUAKE MOMENT MAGNITUDE ========== 7.6
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 60 %
BOREHOLE DIAMETER========== 2.5 to 4.5 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.968**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **823** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.63
Source-To-Site Distance, R (km) = 345.39
Ground Motion Prediction Equations = NMSZ
PGA = **0.036**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
666.5	2.5	12	2		20	33	12.4	0.130	0.325	17.485	17.485	0.186	0.068	0.170	0.326	1.500	**0.270**	1.000	**0.075**	**N.L. (2)**
663.5	5.5	17	3.5		20	33	14	0.137	0.736	22.512	22.512	0.249	0.075	0.395	0.738	1.500	**0.362**	0.999	**0.073**	**N.L. (2)**
661	8	17		64.3			20.8	0.124	1.046	20.716	29.859	0.458	0.062	0.550	1.049	1.500	**0.665**	0.999	**0.074**	**8.986 (D)**
657	12	38	0.5	64.3				0.114	1.502	48.517	63.220	0.429	0.052	0.758	1.507	1.500	**0.623**	0.997	**0.077**	**N.L. (3)**
655.2	13.8	45						0.075	1.637	57.327	57.327	0.377	0.075	0.893	1.754	1.413	**0.515**	0.997	**0.076**	**N.L. (3)**

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== BR 4-1A
ELEVATION OF BORING GROUND SURFACE ========== 677.40 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 3.50 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.060
EARTHQUAKE MOMENT MAGNITUDE ========== 7.6
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 60 %
BOREHOLE DIAMETER========== 2.5 to 4.5 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.968**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **1201** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.63
Source-To-Site Distance, R (km) = 345.39
Ground Motion Prediction Equations = NMSZ
PGA = **0.036**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
674.4	3	29	4.25		18	33	16.6	0.139	0.417	44.537	44.537	0.230	0.077	0.231	0.418	1.500	**0.334**	1.000	**0.071**	**N.L. (2)**
672.4	5	48						0.075	0.567	70.162	70.162	0.487	0.075	0.381	0.693	1.500	**0.707**	1.000	**0.071**	**N.L. (3)**
670.4	7	100						0.083	0.733	######	138.767	1.013	0.083	0.547	0.984	1.500	**1.471**	1.000	**0.070**	**N.L. (3)**

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== BR 4-2
ELEVATION OF BORING GROUND SURFACE ========== 667.70 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 8.50 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.060
EARTHQUAKE MOMENT MAGNITUDE ========== 7.6
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 60 %
BOREHOLE DIAMETER========== 2.5 to 4.5 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.968**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **557** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.63
Source-To-Site Distance, R (km) = 345.39
Ground Motion Prediction Equations = NMSZ
PGA = **0.036**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
664.7	3	18						0.125	0.375	27.774	27.774	0.362	0.063	0.189	0.376	1.500	**0.525**	0.991	**0.077**	**N.L. (3)**
662.7	5	20	1.5				18.4	0.126	0.627	28.552	28.552	0.391	0.064	0.317	0.629	1.500	**0.567**	0.984	**0.076**	**N.L. (3)**
659.7	8	8	1		17	35	20.6	0.122	0.993	8.960	8.960	0.104	0.060	0.497	0.996	1.386	**0.140**	0.971	**0.076**	**N.L. (2)**
656.5	11.2	6		60.5				0.057	1.175	6.937	13.325	0.144	0.057	0.679	1.378	1.333	**0.185**	0.954	**0.075**	**2.467 (C)**

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== BR 10-3A
ELEVATION OF BORING GROUND SURFACE ========== 668.30 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 8.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.060
EARTHQUAKE MOMENT MAGNITUDE ========== 7.6
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 60 %
BOREHOLE DIAMETER========== 2.5 to 4.5 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.968**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **314** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.63
Source-To-Site Distance, R (km) = 345.39
Ground Motion Prediction Equations = NMSZ
PGA = **0.036**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
665.3	3	11	3		19	32	15.2	0.135	0.405	15.318	15.318	0.163	0.073	0.219	0.406	1.500	**0.237**	0.942	**0.068**	**N.L. (2)**
660.6	7.7	1	0.5	56.2	4	25.5	22	0.114	0.941	1.119	6.343	0.082	0.052	0.463	0.944	1.373	**0.110**	0.843	**0.067**	**1.642 (C)**
654.5	13.8	10		31.7				0.061	1.313	11.908	18.725	0.200	0.061	0.836	1.697	1.305	**0.253**	0.719	**0.057**	**4.439 (D)**

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== B-8
ELEVATION OF BORING GROUND SURFACE ========== 688.40 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 18.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 11.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.060
EARTHQUAKE MOMENT MAGNITUDE ========== 7.6
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 60 %
BOREHOLE DIAMETER========== 2.5 to 4.5 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.968**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **899** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.63
Source-To-Site Distance, R (km) = 345.39
Ground Motion Prediction Equations = NMSZ
PGA = **0.036**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
683.4	5	29						0.131	0.655	41.224	41.224	0.162	0.131	0.655	0.655	1.500	**0.235**	1.000	**0.039**	**N.L. (1)**
677.4	11	17						0.124	1.399	20.157	20.157	0.217	0.124	1.399	1.399	1.130	**0.238**	0.999	**0.039**	**N.L. (1)**
676.4	12	17			47	68	22	0.124	1.523	19.848	19.848	0.214	0.062	1.461	1.523	1.115	**0.230**	0.999	**0.041**	**N.L. (2)**
673.4	15	41						0.135	1.928	49.646	49.646	0.299	0.073	1.680	1.930	1.098	**0.318**	0.999	**0.045**	**N.L. (3)**
670.4	18	41						0.135	2.333	46.954	46.954	0.266	0.197	2.271	2.708	0.973	**0.250**	0.998	**0.046**	**N.L. (3)**

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ==========: B-9
ELEVATION OF BORING GROUND SURFACE ==========: 683.50 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ==========: 16.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==========: 6.10 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) =====: 0.060
EARTHQUAKE MOMENT MAGNITUDE ==========: 7.6
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ==========: 0.00 FT.
HAMMER EFFICIENCY==========: 60 %
BOREHOLE DIAMETER==========: 2.5 to 4.5 IN.
SAMPLING METHOD==========: Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.968**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **1087** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.63
Source-To-Site Distance, R (km) = 345.39
Ground Motion Prediction Equations = NMSZ
PGA = **0.036**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
678.5	5	24	1.25		17	36	16	0.124	0.620	34.494	34.494	-1.775	0.124	0.620	0.620	1.500	**-2.577**	1.000	**0.039**	**N.L. (1)**
676.5	7	24	1.25		17	36	16	0.124	0.868	31.986	31.986	0.729	0.062	0.744	0.800	1.472	**1.038**	1.000	**0.042**	**N.L. (2)**
673.5	10	64						0.141	1.291	82.464	82.464	0.585	0.079	0.981	1.224	1.361	**0.771**	1.000	**0.049**	**N.L. (3)**
669.5	14	64						0.141	1.855	77.720	77.720	0.548	0.079	1.297	1.790	1.217	**0.645**	1.000	**0.054**	**N.L. (3)**

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ==========: B-11
ELEVATION OF BORING GROUND SURFACE ==========: 680.30 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ==========: 27.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==========: 2.90 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) =====: 0.060
EARTHQUAKE MOMENT MAGNITUDE ==========: 7.6
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ==========: 0.00 FT.
HAMMER EFFICIENCY==========: 60 %
BOREHOLE DIAMETER==========: 2.5 to 4.5 IN.
SAMPLING METHOD==========: Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.968**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **607** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.63
Source-To-Site Distance, R (km) = 345.39
Ground Motion Prediction Equations = NMSZ
PGA = **0.036**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
675.3	5	8	2.5		53	75	18	0.133	0.665	9.734	9.734	0.111	0.071	0.355	0.486	1.500	**0.161**	0.990	**0.053**	**N.L. (2)**
670.3	10	11	3		53	75	25	0.135	1.340	12.187	12.187	0.133	0.073	0.720	1.163	1.303	**0.168**	0.975	**0.061**	**N.L. (2)**
668.3	12	11	3		53	75	25	0.135	1.610	11.822	11.822	0.130	0.073	0.866	1.434	1.243	**0.156**	0.967	**0.062**	**N.L. (2)**
665.3	15	8	1.25		15	33	22	0.124	1.982	8.099	8.099	0.097	0.062	1.052	1.807	1.166	**0.109**	0.953	**0.064**	**N.L. (2)**
662.3	18	8	0.9		15	33	11	0.120	2.342	7.738	7.738	0.094	0.058	1.226	2.168	1.126	**0.102**	0.935	**0.065**	**N.L. (2)**
660.3	20	47	0.5					0.114	2.570	52.079	52.079	0.326	0.052	1.330	2.397	1.205	**0.380**	0.922	**0.065**	**N.L. (3)**
655.3	25	28	5					0.142	3.280	26.242	26.242	0.319	0.080	1.730	3.109	1.070	**0.330**	0.881	**0.062**	**N.L. (3)**

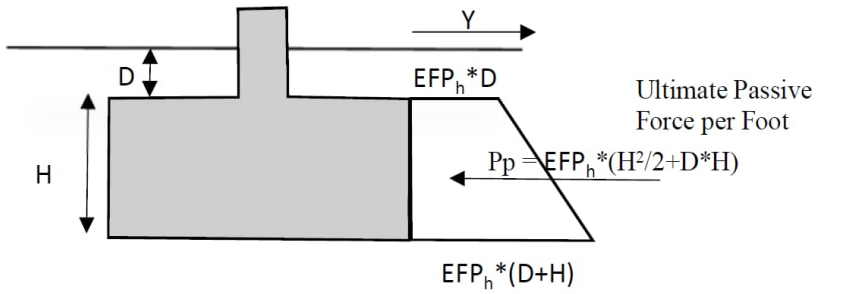
* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Passive Lateral Resistance on an Embedded Footing

Input Soil/Pile Cap Parameters

Soil Type	Sand	
Density	Medium Dense Sand	
Unit Weight, γ	120	pcf
Friction Angle, ϕ	32	deg
Interface Friction Angle, δ	21	deg
Kp for δ/ϕ = -1	7.5	



Calculated Soil/Pile Cap Parameters

δ/ϕ	0.66	
Reduction Factor for δ/ϕ	0.84	
K_p	6.33	
K_p*cos(δ)	5.91	
Displacement for Full Passive Pressure, (Y/H)	0.02	
Horizontal Passive Equivalent Fluid Unit	709	pcf

Plot Data

Y/H	EFP (pcf)
0.00%	0
0.50%	355
2.00%	709
5.00%	709

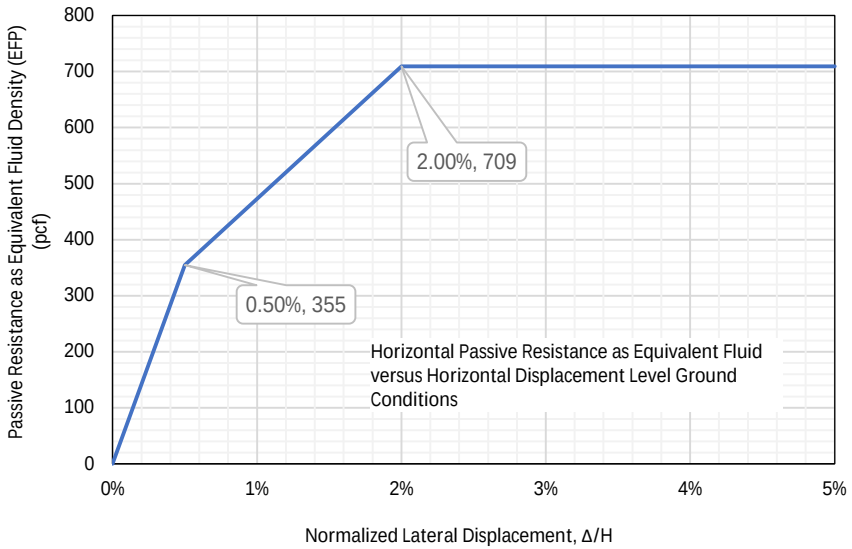


Table C2.11.1-1 - Approximate Values of Relative Movements Required to Reach Active or Passive Earth Pressure Conditions (Clough and Duncan, 1991)

Type of Backfill	Values of Δ/H	
	Active	Passive
Dense Sand	0.001	0.01
Medium Dense Sand	0.002	0.02
Loose Sand	0.004	0.04

Wei, Zhongxin

From: Rasch, Shane
Sent: Monday, August 12, 2024 2:48 PM
To: Rasch, Shane; Wei, Zhongxin
Subject: FW: Hinkson Cr Brdg-2 (I-70-EB) Scour Design Flood results

Rod, Shane,

Here are scour depths for the intermediate bents (2 and 3). These results are for the "Scour Design Flood", per MoDOT that is the 200-yr flood for Interstate Routes

Bent 2: Estim ground elevation: 664 Total scour depth: 6.6' Estimated scour elevation: 657.4

Bent 3: Estim ground elevation: 668 Total scour depth: 6.1' Estimated scour elevation: ~~657.3~~ 661.9

Here are scour depths for the intermediate bents (2 and 3). These results are for the "Scour Check Flood", per MoDOT that is the 500-yr flood for Interstate Routes

Bent 2: Estim ground elevation: 664 Total scour depth: 13.3' Estimated scour elevation: 650.7

Bent 3: Estim ground elevation: 668 Total scour depth: 12.8' Estimated scour elevation: 655.2

The Check Flood includes a pressure flow scour component (vertical contraction) since the bridge deck low chord is fully submerged for this event. The vertical contraction replaces the horizintal (lateral) contraction scour used for unsubmerged conditions.

Wei, Zhongxin

From: Juen, Thomas
Sent: Tuesday, October 15, 2024 2:15 PM
To: Wei, Zhongxin
Subject: RE: Hinkson Cr Brdg-4 (I-70-EB) Scour Design Flood results

Hi Zhongxin,

Sorry it took so long to get this data over to you.

Here are scour depths for the intermediate bents (2 and 3). These results are for the "Scour Design Flood", per MoDOT that is the 200-yr flood for Interstate Routes

Bent 2: Estimated ground elevation: 665.8 Total scour depth: 5.8' Estimated scour elevation: 660.0

Bent 3: Estimated ground elevation: 667.4 Total scour depth: 5.4' Estimated scour elevation: 662.0

Below are scour depths for the intermediate bents (2 and 3). These results are for the "Scour Check Flood", per MoDOT that is the 500-yr flood for Interstate Routes

Bent 2: Estimated ground elevation: 665.8 Total scour depth: 15.6' Estimated scour elevation: 650.2

Bent 3: Estimated ground elevation: 667.4 Total scour depth: 15.2' Estimated scour elevation: 652.2

The Check Flood includes a pressure flow scour component (vertical contraction) since the bridge deck low chord, on the upstream side of the bridge, is fully submerged for this event. The vertical contraction replaces the horizontal (lateral) contraction scour used for unsubmerged conditions.

Also, these results assume any channel migration at this site would be minimal. If the channel migrates, the scour depths at either of the bents for the design flood (200-yr) could be appreciably lower.

Let me know if you have any questions or would like to discuss the results, in particular for the check flood results; there is a fair amount of judgement in the application of the methods presented in HEC-18

Regards,
Tom

From: Wei, Zhongxin <Zhongxin.Wei@jacobs.com>
Sent: Monday, October 14, 2024 10:44 AM
To: Juen, Thomas <Thomas.Juen@jacobs.com>
Subject: RE: Hinkson Cr Brdg-4 (I-70-EB) Scour Design Flood results

Understood. I had the same occurrence before with my laptop.
Zhongxin

Wei, Zhongxin

From: Muenks, Matthew
Sent: Wednesday, June 26, 2024 11:01 AM
To: Wei, Zhongxin
Cc: Rasch, Shane; Riley, Rod; Schroeder, Jay
Subject: Bridge 2 Substructure Pile Loads
Attachments: Bridge 2 Pile Intermediate Bent 2 Design.pdf; Bridge 2 Pile Intermediate Bent 3 Design.pdf

Zhongxin, the loads for the piles at Bridge 2 are shown below. Note that the End Bent Pile Loads are final at this point but the pile loads at the intermediate bents are currently being checked. We anticipate sloping the bent caps so the pile cutoff elevations vary.

End Bents General
HP12x53 ASTM A709 Grade 50S Spaced at 8.5' = 12 Piles
Required thermal movement over 120 degrees = 1.07" Based on past emails from Rod, full temperature range used due to unknown setting temp.
Required thermal movement over 70 degrees max differential per EPG = 0.622"

End Bent 1
Pile Cutoff varies from 679.96' to 682.38'
The Maximum Strength Pile Reaction = 177.31k/pile

End Bent 4
Pile Cutoff varies from 677.44' to 679.87'
The Maximum Strength Pile Reaction = 228.47k/pile

Intermediate Bents General
CECIP 24"x (variable thickness depending on geotech results)
ASTM A252 Grade 3 Spaced at 8.9' = 11 Piles
Class B-1 Concrete Filled Full Length
The Maximum Pile Reaction and Loads – See attached.
Required thermal movements – See attached.

Intermediate Bent 2
Pile Cutoff varies from 679.13' to 681.5'

Intermediate Bent 3
Pile Cutoff varies from 678.06' to 680.43'

Let me know if you need anything else, or have any questions regarding what I have provided.

Thanks,

Matthew Muenks, PE (MO)
Jacobs
Structural Engineering Professional Associate
Buildings & Infrastructure
1.314.335.4462 direct
matthew.muenks@jacobs.com

1001 Highlands Plaza Drive, Suite 400
St. Louis, Missouri 63110, USA
www.jacobs.com

Bridge 2/A9542 - Intermediate Bent 2 Design - CIP Concrete Pipe Pile Loads

Summary of Pile Loads for Geotechnical Analysis

- ALL LOADS ARE FACTORED FOR THE APPROPRIATE LOAD COMBINATION AND INCLUDE OPERATIONAL IMPORTANCE FACTOR=1.05 IF APPLICABLE!

Total Vertical Loads on Piles (Fy):

(kips)	Ext. Pile	Int. Pile	Max/Pile
Ser I =	370.1	367.9	370.1
Str I =	574.2	570.3	574.2
Str III =	283.5	286.2	286.2
Str V =	508.6	505.3	508.6

Service	Strength	
Max/Pile	Max/Pile	
370.1	574.2	(k)

Summary/Load Combinations for Transverse Forces/Moments (IGNORE COLUMN LOADS) (Fx):

- Note Longitudinal Forces from Superstructure have been distributed to the end bent fill. NO Fz REACTIONS EXIST.

(kips)	Max/Pile
Ser I =	4.1
Str I =	5.3
Str III =	1.4
Str V =	5.5

Service	Strength	
Max/Pile	Max/Pile	
4.1	5.5	(k)

Summary of additional Pile Loads for exposed length of pile:

- *TU*

A forced deflection should be modelled to verify the pile is able to flex enough to allow thermal movements to occur.
CG of force is located at the CG of the Superstructure. If needed is acceptable (conservative) to model at the top of pile. => 0.345in modelled at 0ft to 5.04ft above bottom of cap/top of pile.

	Ser	Str	
Δ =	0.414	0.435	in

- *WA (100 year Design Flood)*

Stream pressures on each pile are as follows:

	Ser 1	Str I	Str III	Str V	
Stream Pressure =	0.082	0.086	0.086	0.086	klf
Top Elevation =	678.55	ft			

Bottom Elevation => Top of Ground or Bottom of Scour (if applicable) as determined by Geotech

Service	Strength	
Max/Pile	Max/Pile	
0.082	0.086	(klf)

- *WS, column*

Wind on Structure on column/pile pressures on each pile are as follows. Note = 0 for Str I Cases:

	Ser 1	Str I	Str III	Str V	
WS, column Pressure =	0.040	0	0.114	0.055	klf
Top Elevation =	Varies	ft			

Bottom Elevation => Top of Ground or Bottom of Scour (if applicable) as determined by Geotech

Service	Strength	
Max/Pile	Max/Pile	
0.040	0.114	(klf)

Bridge 2/A9542 - Intermediate Bent 3 Design - CIP Concrete Pipe Pile Loads

Summary of Pile Loads for Geotechnical Analysis

- ALL LOADS ARE FACTORED FOR THE APPROPRIATE LOAD COMBINATION AND INCLUDE OPERATIONAL IMPORTANCE FACTOR=1.05 IF APPLICABLE!

Total Vertical Loads on Piles (Fy):

(kips)	Ext. Pile	Int. Pile	Max/Pile
Ser I =	425.7	423.4	425.7
Str I =	658.5	654.5	658.5
Str III =	333.0	336.4	336.4
Str V =	585.0	581.8	585.0

Service	Strength	
Max/Pile	Max/Pile	
425.7	658.5	(k)

Summary/Load Combinations for Transverse Forces/Moments (IGNORE COLUMN LOADS) (Fx):

- Note Longitudinal Forces from Superstructure have been distributed to the end bent fill. NO Fz REACTIONS EXIST.

(kips)	Max/Pile
Ser I =	4.6
Str I =	5.8
Str III =	1.7
Str V =	6.2

Service	Strength	
Max/Pile	Max/Pile	
4.6	6.2	(k)

Summary of additional Pile Loads for exposed length of pile:

- *TU*

A forced deflection should be modelled to verify the pile is able to flex enough to allow thermal movements to occur.
CG of force is located at the CG of the Superstructure. If needed is acceptable (conservative) to model at the top of pile. => 0.176in modelled at 0ft to 5.04ft above bottom of cap/top of pile.

	Ser	Str	
Δ =	0.212	0.222	in

- *WA (100 year Design Flood)*

Stream pressures on each pile are as follows:

	Ser 1	Str I	Str III	Str V	
Stream Pressure =	0.082	0.086	0.086	0.086	klf
Top Elevation =	678.55	ft			

Bottom Elevation => Top of Ground or Bottom of Scour (if applicable) as determined by Geotech

Service	Strength	
Max/Pile	Max/Pile	
0.082	0.086	(klf)

- *WS, column*

Wind on Structure on column/pile pressures on each pile are as follows. Note = 0 for Str I Cases:

	Ser 1	Str I	Str III	Str V	
WS, column Pressure =	0.040	0	0.114	0.055	klf
Top Elevation =	Varies	ft			

Bottom Elevation => Top of Ground or Bottom of Scour (if applicable) as determined by Geotech

Service	Strength	
Max/Pile	Max/Pile	
0.040	0.114	(klf)

Wei, Zhongxin

From: Faress Hraib <fhraib@abnacorp.com>
Sent: Monday, September 30, 2024 12:33 PM
To: Riley, Rod; Stephen Alsbury
Cc: Rasch, Shane; Wei, Zhongxin
Subject: [EXTERNAL] RE: Bridge 4 information for Geotech

Rod,

Below are the loads information required for the Geotechnical report.

Please note the following:

- The loads are for a single pile
- The results are summarized similar to you sent it to us previously.
- All loads for intermediate and end bents are in this email (no attachments)
- End bent 1 & 4 loads are identical
- Intermediate bent 2 & 3 loads are identical

Ends Bents (1 & 4) Summary:

- HP12x53 ASTM A709 Grade 50S Spaced at 8.5' = 6 Piles
- Required thermal movement over 120 degrees = 1.04", full temperature range used due to unknown setting temp.
- Required thermal movement over 70 degrees max differential per EPG = 0.607"
- The Maximum Strength Pile Reaction = 240 kips/pile (Service 162.8 kips/ pile)

Intermediate Bents (2 & 3) Summary:

- CECIP 24"x (variable thickness depending on Geotech results)
- ASTM A252 Grade 3 Spaced at 8.5' = 6 Piles
- Class B-1 Concrete Filled Full Length
- The Maximum Pile Vertical Reaction – See Table below.

Load Case	Maximum pile reaction (Kips)
Service I	320.75
Strength I	502.9
Strength III	237.4
Strength V	442.2

- The Maximum Pile transverse loads – See Table below. (wind and centrifugal forces results)

Load Case	Maximum Transverse Force (Kips)
Service I	4.2
Strength I	4.8
Strength III	4.47
Strength V	5.86

- Loads applied to the substructure columns – See Table below.

- TU: deflection force should be modeled to verify piles capability of flexing enough to allow for thermal movement. The CG of the force is the CG of the superstructure. Approximately 5 feet above top of piles.

Load Case	Maximum deflection (inches)
Service	0.35
Strength	0.3675

- WA: Stream pressure force applied along the pile length from bottom of the cap to the top of the ground or bottom of the scour (if applicable).

Load Case	Maximum Force (kip/ft)
Service I	0.0706
Strength I	0.0735
Strength III	0.0735
Strength V	0.0735

- WS: Wind on substructure (columns/piles), force applied along the pile length from bottom of the cap to the top of the ground or bottom of the scour (if applicable).

Load Case	Maximum Force (kip/ft)
Service I	0.040
Strength I	0
Strength III	0.114
Strength V	0.055

If you have any questions or needed anything please just let us know.

Thanks,
Faress

Faress Hraib, PhD, PE
ABNA | Structural Project Manager
Office: (314) 454-0222, ext. 1139

From: Faress Hraib
Sent: Monday, September 30, 2024 10:26 AM
To: 'Riley, Rod' <Rod.Riley@jacobs.com>; Stephen Alsbury <SAlsbury@abnacorp.com>
Cc: Rasch, Shane <Shane.Rasch@jacobs.com>; Wei, Zhongxin <Zhongxin.Wei@jacobs.com>
Subject: RE: Bridge 4 information for Geotech

Rod,

I will send you the Geotech loads in the next couple of hours. Sorry for the delay!

We should be on track to submit bridge 4 preliminary plans on 10/2/2024.

We only need the hydrologic table to add it to our plans.

Thank you,
Faress

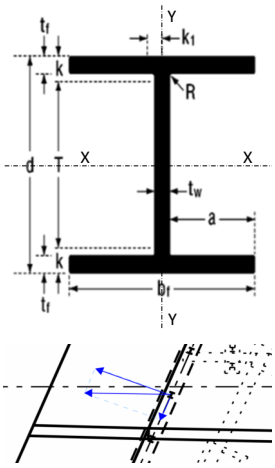
Jacobs

Project: MoDOT Improve I-70 Columbia to Kingdom City DB
Job No.: F3X03001
Subject: Bridge 2/A9542 - Lateral Analysis at Bent 1

By: ZW 7/2/24 8/22/2024
Ckd: SR 7/12/2024 11/5/2024

Foundation Design Data

Support No.:	*Abutment 1*		Pile Size:	HP12X53		F_y =	50	ksi
Assumed Grade Elev.:	*680.00*	ft	b_f =	12.000	in	Ix =	393	in^4
Top of Pile Elev.:	*680.00*	ft	d=	11.800	in	Iy =	127	in^4
Depth:	0.00	ft	t_f=	0.435	in	J =	1.12	in^4
Design GW El.	678.60	ft	t_w =	0.435	in	Sx =	66.7	in^3
Depth below Pile Top:	1.40	ft	A =	15.5	in^2	Sy =	21.1	in^3
Approx. Pile Tip El.:	664	ft	E =	29,000	ksi	GJ =	12,638	k-in
Approx. Pile Length:	16.00	ft	G =	11,284	ksi			



Load Information:

Thermal movement in the bridge longitudinal direction was provided by Structure engineer:

1.07 in

Thermal movement in the HP pile weak axis direction was calculated based on the bent skew angle:

Bent	Skewed Angle (°)	Displ. in Weak Axis in)
Bent 1	20.71556	1.00
Bent 4	23.28444	0.98

1-inch displacement in the HP weak axis was used for both abutments in the lateral analysis.

P-Multipliers

D = 1 ft

Loading Direction	Number of Rows	Pile Spacing S (ft)	S/D	P-Multiplier* (AASHTO LRFD Table 10.7.2.4-1) Row Number 1	2	3	After 3	Aver.
Longitudinal	1	-	-	1.00	-	-	-	1.00
Transverse	12	8.50	8.50	1.00	0.85	0.70	0.70	0.74

Note: Group reduction factor of 1.0 was used within fresh rock.

Design Soil/Rock Profile and Parameters:

Since higher pile lateral stiffness will induce higher pile internal forces (moment and shear) due to the thermal movement, the boring log where rock was observed at higher elevation was selected to generate the design soil/rock profile.

Design Ground Water El.: 678.6 ft

Reference Borings: BR 2-1A

Depth From (ft)	Depth To (ft)	Soil/Rock	Elevation From (ft)	Elevation To (ft)	Eff. Unit Weight (pcf)	Su (psf)	ϕ' (deg.)	qu (psi)	Modulus , k or E (psi)	RQD	ε_{50}
0.0	1.4	Stiff Clay w/o Free Water	680.0	678.6	120.0	1,200	0	-	-	-	0.007
1.4	10.0	Stiff Clay w/o Free Water	678.6	670.0	57.6	1,200	0	-	-	-	0.007
10.0	30.0	Strong Rock	670.0	650.0	101.6	-	-	7,500	-	-	-

Lateral Analysis

Software: LPILE 2022 developed by ENSOFT, Inc.

Lateral Analysis Results:

Deflection, Moment, and Shear vs Depth figures are attached.

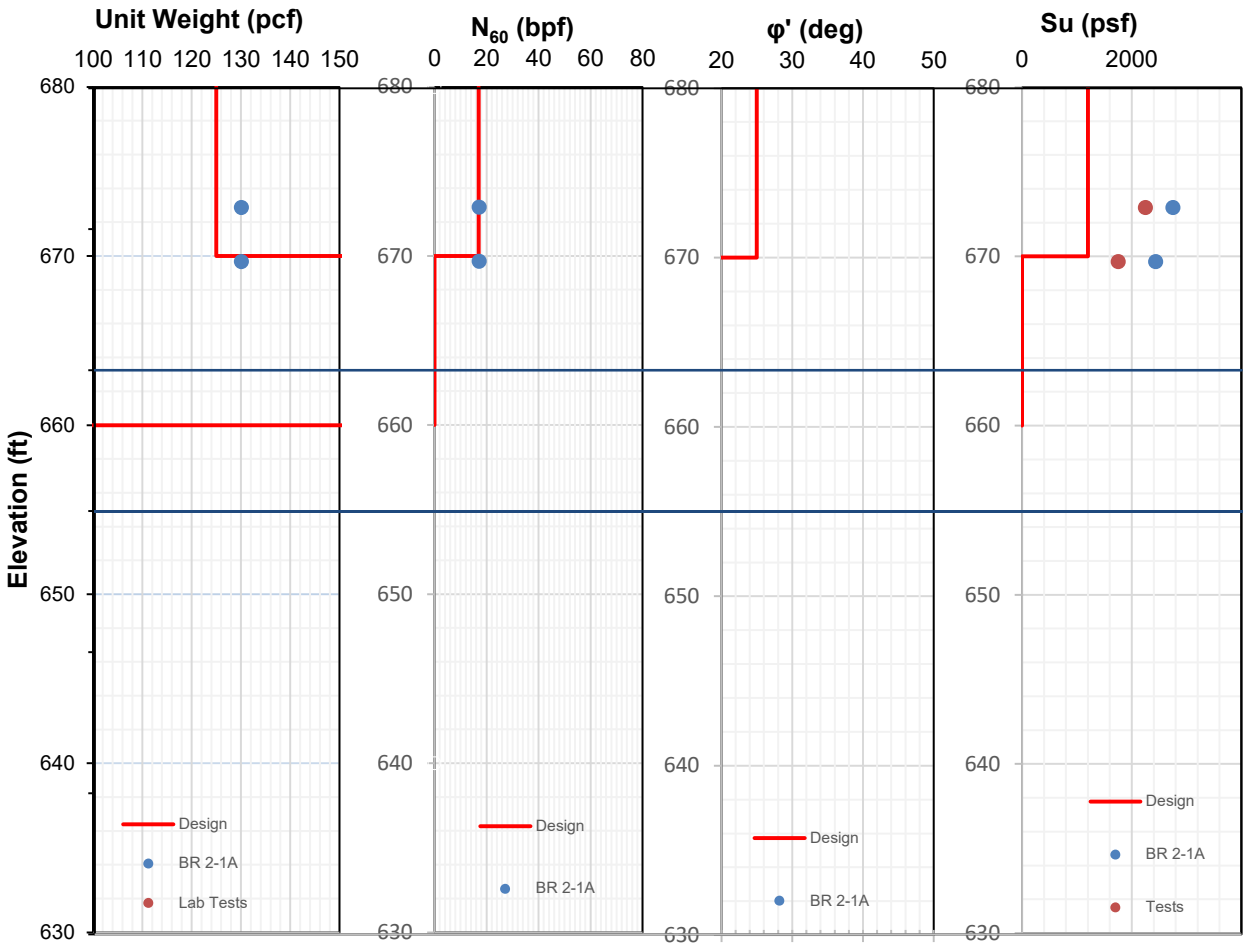
Structure Engineer should check the pile structural acceptability under the assumed thermal movement.

LPile Analysis Summary at Bent 1 of Bridge 2 (A9542)

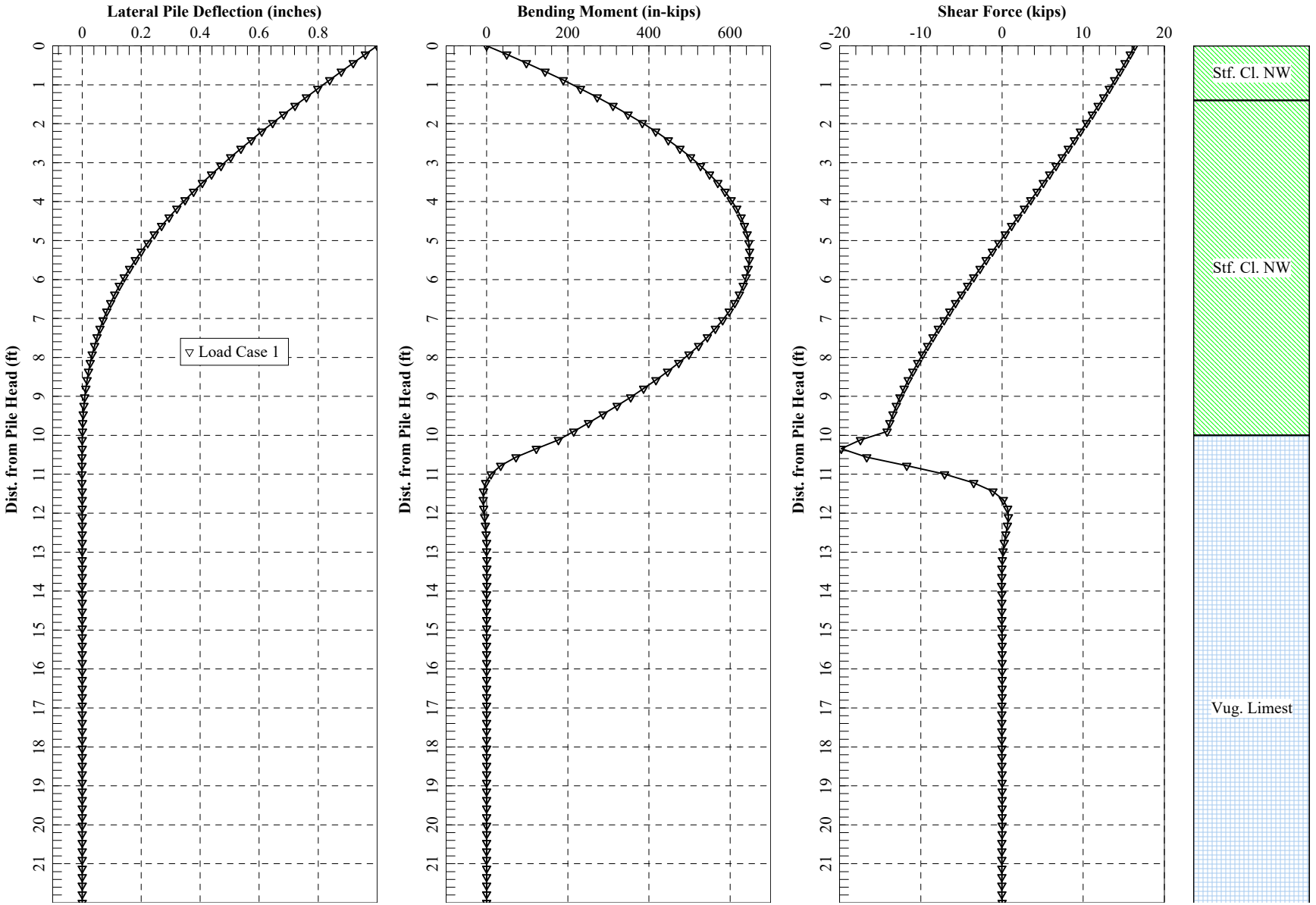
Loading Condition No.	Load Case	Axial Load (lb)	P-Mult.	Pile Head Deflect. δ (in)	Max Moment (in-lbs)	Max Shear (lbs)	Pile Head Rotation (rad.)
1	1" Displ. in Weak Axis	177,310	1	1	647,787	-19,797	-0.0154

Design Soil Profile and Parameters

Soil	Elevation		Unit Weight	N_{60}	Undrained		Drained		ε_{50}	k
	From	To			C	ϕ	C'	ϕ'		
	(ft)	(ft)	(pcf)	(bpf)	(psf)	(deg.)	(psf)	(deg.)		(pci)
CH	669.0	670.0	125	17	1,200	0	100	25	0.007	-
Rock	670.0	660.0	164						-	-
	(Strong Rock Qu =1,078 ksf =7.5 ksi)									



MoDOT Improve I-70 C2KC- Bridge 2/A9542- Bent 1 - HP Pile Weak Axis - Thermal Movement



```
================================================================================

                    LPile for Windows, Version 2022-12.004

                Analysis of Individual Piles and Drilled Shafts
               Subjected to Lateral Loading Using the p-y Method
                          © 1985-2022 by Ensoft, Inc.
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================================================================================

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--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\TPW\GEOTECH\F3X03000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A6951)\LPile\

Name of input data file:
Bent 1 Thermal Movement 1inch HP12X53 Weak Axis.lp12d

Name of output report file:
Bent 1 Thermal Movement 1inch HP12X53 Weak Axis.lp12o

Name of plot output file:
Bent 1 Thermal Movement 1inch HP12X53 Weak Axis.lp12p

Name of runtime message file:
Bent 1 Thermal Movement 1inch HP12X53 Weak Axis.lp12r



--------------------------------------------------------------------------------
                            Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  August 22, 2024            Time:  10:22:03



--------------------------------------------------------------------------------
                                 Problem Title
--------------------------------------------------------------------------------

Project Name: MoDOT Improve I-70  Columbia to Kingdom City DB

Job Number: F3X03001

Client: MoDOT

Engineer:

Description: Bridge 2 (A9542) Bent 1 Lateral Analysis - HP12X53 Weak Axis




--------------------------------------------------------------------------------
                          Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed               =          500
 - Deflection tolerance for convergence               =   1.0000E-05 in
 - Maximum allowable deflection                       =     100.0000 in
 - Number of pile increments                          =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified
```

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 22.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	12.0000
2	22.000	12.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

   Section 1 is a H weak axis steel pile
   Length of section = 22.000000 ft
   Pile width = 11.800000 in

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is stiff clay without free water

   Distance from top of pile to top of layer = 0.0000 ft
   Distance from top of pile to bottom of layer = 1.400000 ft
   Effective unit weight at top of layer = 120.000000 pcf
   Effective unit weight at bottom of layer = 120.000000 pcf
   Undrained cohesion at top of layer = 1200. psf
   Undrained cohesion at bottom of layer = 1200. psf
   Epsilon-50 at top of layer = 0.007000
   Epsilon-50 at bottom of layer = 0.007000

Layer 2 is stiff clay without free water

   Distance from top of pile to top of layer = 1.400000 ft
   Distance from top of pile to bottom of layer = 10.000000 ft
   Effective unit weight at top of layer = 57.600000 pcf
   Effective unit weight at bottom of layer = 57.600000 pcf
   Undrained cohesion at top of layer = 1200. psf
   Undrained cohesion at bottom of layer = 1200. psf
   Epsilon-50 at top of layer = 0.007000
   Epsilon-50 at bottom of layer = 0.007000

Layer 3 is strong rock (vuggy limestone)

   Distance from top of pile to top of layer = 10.000000 ft
   Distance from top of pile to bottom of layer = 30.000000 ft
   Effective unit weight at top of layer = 101.600000 pcf
   Effective unit weight at bottom of layer = 101.600000 pcf
   Uniaxial compressive strength at top of layer = 7500. psi
   Uniaxial compressive strength at bottom of layer = 7500. psi

(Depth of the lowest soil layer extends 8.000 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Cohesion psf	Uniaxial qu psi	E50 or krm
1	Stiff Clay	0.00	120.0000	1200.	--	0.00700
	w/o Free Water	1.4000	120.0000	1200.	--	0.00700
2	Stiff Clay	1.4000	57.6000	1200.	--	0.00700
	w/o Free Water	10.0000	57.6000	1200.	--	0.00700
3	Strong Rock	10.0000	101.6000	--	7500.	--
	(Vuggy Limestone)	30.0000	101.6000	--	7500.	--

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	4	y = 1.000000 in	M = 0.0000 in-lbs	177310.	N.A.	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel H Weak Axis:

Length of Section	=	22.000000 ft
Flange Width	=	12.000000 in
Section Depth	=	11.800000 in
Flange Thickness	=	0.435000 in
Web Thickness	=	0.435000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	15.194550 sq. in.
Moment of Inertia	=	125.354973 in^4
Elastic Bending Stiffness	=	3635294. kip-in^2
Plastic Modulus, Z	=	31.837057in^3
Plastic Moment Capacity = Fy Z	=	1592.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	759.727 kips
Nominal Axial Tensile Capacity	=	-759.727 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force

	kips
1	177.310

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 177.310 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000536	19.4739531	3635033.	81.1106720	12.5921636	
0.00001071	38.9479062	3635033.	43.5553360	13.5150116	
0.00001607	58.4218592	3635033.	31.0368907	14.4378596	
0.00002143	77.8958123	3635033.	24.7776680	15.3607079	
0.00002679	97.3697654	3635033.	21.0221344	16.2835557	
0.00003214	116.8437185	3635033.	18.5184453	17.2064037	
0.00003750	136.3176716	3635033.	16.7300960	18.1292519	
0.00004286	155.7916246	3635033.	15.3888340	19.0520999	
0.00004822	175.2655777	3635033.	14.3456302	19.9749479	
0.00005357	194.7395308	3635033.	13.5110672	20.8977960	
0.00005893	214.2134839	3635033.	12.8282429	21.8206440	
0.00006429	233.6874370	3635033.	12.2592227	22.7434920	
0.00006964	253.1613900	3635033.	11.7777440	23.6663400	
0.00007500	272.6353431	3635033.	11.3650480	24.5891881	
0.00008036	292.1092962	3635033.	11.0073781	25.5120361	
0.00008572	311.5832493	3635033.	10.6944170	26.4348842	
0.00009107	331.0572024	3635033.	10.4182748	27.3577322	
0.00009643	350.5311554	3635033.	10.1728151	28.2805802	
0.0001018	370.0051085	3635033.	9.9531933	29.2034283	
0.0001071	389.4790616	3635033.	9.7555336	30.1262763	
0.0001125	408.9530147	3635033.	9.5766987	31.0491243	
0.0001179	428.4269678	3635033.	9.4141215	31.9719724	
0.0001232	447.9009208	3635033.	9.2656814	32.8948204	
0.0001286	467.3748739	3635033.	9.1296113	33.8176685	
0.0001339	486.8488270	3635033.	9.0044269	34.7405165	
0.0001393	506.3227801	3635033.	8.8888720	35.6633645	
0.0001446	525.7967332	3635033.	8.7818767	36.5862126	
0.0001500	545.2706862	3635033.	8.6825240	37.5090606	
0.0001554	564.7446393	3635033.	8.5900232	38.4319086	
0.0001607	584.2185924	3635033.	8.5036891	39.3547567	
0.0001661	603.6925455	3635033.	8.4229249	40.2776047	
0.0001714	623.1664986	3635033.	8.3472085	41.2004527	
0.0001768	642.6404517	3635033.	8.2760810	42.1233008	
0.0001821	662.1144047	3635033.	8.2091374	43.0461488	
0.0001875	681.5883578	3635033.	8.1460192	43.9689968	
0.0001929	701.0623109	3635033.	8.0864076	44.8918449	
0.0001982	720.5362640	3635033.	8.0300182	45.8146929	
0.0002036	740.0102171	3635033.	7.9765966	46.7375409	
0.0002089	759.4841701	3635033.	7.9259147	47.6603890	
0.0002196	798.4320763	3635033.	7.8319676	49.5060850	
0.0002304	836.1911726	3629873.	7.7487432	50.0000000	Y
0.0002411	871.4793873	3614921.	7.6769641	50.0000000	Y
0.0002518	904.5725129	3592525.	7.6148968	50.0000000	Y
0.0002625	935.7340628	3564598.	7.5610756	50.0000000	Y
0.0002732	965.2149168	3532711.	7.5142488	50.0000000	Y
0.0002839	993.2529346	3498149.	7.4733377	50.0000000	Y
0.0002947	1020.	3461460.	7.4376604	50.0000000	Y
0.0003054	1045.	3423581.	7.4063918	50.0000000	Y
0.0003161	1070.	3384772.	7.3790754	50.0000000	Y
0.0003268	1093.	3345771.	7.3550350	50.0000000	Y
0.0003375	1116.	3306701.	7.3339462	50.0000000	Y
0.0003482	1138.	3267632.	7.3155468	50.0000000	Y
0.0003589	1159.	3228985.	7.2993897	50.0000000	Y
0.0003697	1180.	3190871.	7.2852223	50.0000000	Y
0.0003804	1199.	3151065.	7.2715849	50.0000000	Y
0.0003911	1216.	3109665.	7.2581954	50.0000000	Y
0.0004018	1232.	3067277.	7.2450833	50.0000000	Y
0.0004125	1248.	3024215.	7.2322688	50.0000000	Y
0.0004232	1262.	2980695.	7.2198206	50.0000000	Y
0.0004339	1275.	2937173.	7.2075802	50.0000000	Y
0.0004447	1287.	2893901.	7.1955110	50.0000000	Y
0.0004554	1298.	2850867.	7.1837868	50.0000000	Y
0.0004661	1309.	2808131.	7.1722734	50.0000000	Y
0.0004768	1319.	2766009.	7.1607468	50.0000000	Y
0.0004875	1328.	2724331.	7.1497205	50.0000000	Y
0.0004982	1337.	2683596.	7.1388086	50.0000000	Y
0.0005089	1345.	2643404.	7.1281746	50.0000000	Y
0.0005197	1353.	2603943.	7.1175411	50.0000000	Y
0.0005304	1361.	2565324.	7.1073456	50.0000000	Y
0.0005411	1368.	2527535.	7.0971271	50.0000000	Y
0.0005518	1374.	2490339.	7.0872402	50.0000000	Y
0.0005625	1381.	2454308.	7.0774976	50.0000000	Y
0.0005732	1386.	2418618.	7.0678705	50.0000000	Y
0.0005839	1392.	2384062.	7.0585543	50.0000000	Y
0.0005947	1398.	2350115.	7.0491096	50.0000000	Y
0.0006054	1403.	2317010.	7.0402246	50.0000000	Y

0.0006161	1408.	2284578.	7.0311431	50.0000000	Y
0.0006268	1412.	2253106.	7.0224245	50.0000000	Y
0.0006375	1417.	2222037.	7.0137610	50.0000000	Y
0.0006804	1433.	2105498.	6.9806890	50.0000000	Y
0.0007232	1446.	1999253.	6.9496308	50.0000000	Y
0.0007661	1457.	1902396.	6.9205934	50.0000000	Y
0.0008090	1467.	1813726.	6.8930251	50.0000000	Y
0.0008518	1476.	1732481.	6.8671659	50.0000000	Y
0.0008947	1483.	1657798.	6.8428982	50.0000000	Y
0.0009375	1490.	1589093.	6.8196888	50.0000000	Y
0.0009804	1496.	1525538.	6.7981310	50.0000000	Y
0.0010232	1501.	1466811.	6.7774116	50.0000000	Y
0.0010661	1505.	1412102.	6.7577613	50.0000000	Y
0.0011090	1510.	1361296.	6.7390588	50.0000000	Y
0.0011518	1514.	1314042.	6.7213326	50.0000000	Y
0.0011947	1517.	1269667.	6.7043695	50.0000000	Y
0.0012375	1520.	1228262.	6.6883154	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	177.3100000000	1520.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	5746.
2	1.4000	1.4000	Yes	No	5746.	187787.
3	10.0000	10.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 1.000000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 177310.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	0.00	16368.	-0.01537	11669.	3.64E+09	-221.583	292.4896	0.00
0.2200	0.9594	49634.	15774.	-0.01535	14045.	3.64E+09	-228.950	629.9888	0.00
0.4400	0.9189	97656.	15160.	-0.01530	16344.	3.64E+09	-236.041	678.1138	0.00
0.6600	0.8787	144000.	14528.	-0.01521	18562.	3.64E+09	-242.850	729.6671	0.00
0.8800	0.8386	188602.	13878.	-0.01509	20697.	3.64E+09	-249.366	784.9983	0.00
1.1000	0.7990	231402.	13211.	-0.01494	22745.	3.64E+09	-255.582	844.4993	0.00
1.3200	0.7598	272341.	12529.	-0.01475	24705.	3.64E+09	-261.490	908.6105	0.00
1.5400	0.7211	311366.	11832.	-0.01454	26573.	3.64E+09	-266.584	976.0110	0.00
1.7600	0.6830	348427.	11122.	-0.01430	28346.	3.64E+09	-271.086	1048.	0.00
1.9800	0.6456	383480.	10401.	-0.01404	30024.	3.64E+09	-275.276	1126.	0.00

2.2000	0.6089	416485.	9669.	-0.01375	31604.	3.64E+09	-279.145	1210.	0.00
2.4200	0.5730	447402.	8927.	-0.01343	33084.	3.64E+09	-282.685	1302.	0.00
2.6400	0.5380	476197.	8177.	-0.01310	34462.	3.64E+09	-285.887	1403.	0.00
2.8600	0.5038	502837.	7418.	-0.01274	35737.	3.64E+09	-288.745	1513.	0.00
3.0800	0.4707	527294.	6653.	-0.01237	36908.	3.64E+09	-291.248	1634.	0.00
3.3000	0.4385	549542.	5881.	-0.01198	37973.	3.64E+09	-293.390	1766.	0.00
3.5200	0.4074	569558.	5104.	-0.01157	38931.	3.64E+09	-295.160	1912.	0.00
3.7400	0.3774	587324.	4323.	-0.01115	39781.	3.64E+09	-296.550	2074.	0.00
3.9600	0.3486	602823.	3539.	-0.01072	40523.	3.64E+09	-297.551	2254.	0.00
4.1800	0.3209	616043.	2753.	-0.01028	41156.	3.64E+09	-298.154	2453.	0.00
4.4000	0.2943	626976.	1965.	-0.00982	41679.	3.64E+09	-298.347	2676.	0.00
4.6200	0.2690	635616.	1178.	-0.00937	42092.	3.64E+09	-298.122	2926.	0.00
4.8400	0.2449	641963.	391.6536	-0.00890	42396.	3.64E+09	-297.468	3207.	0.00
5.0600	0.2220	646017.	-392.217	-0.00843	42590.	3.64E+09	-296.373	3525.	0.00
5.2800	0.2003	647787.	-1173.	-0.00796	42675.	3.64E+09	-294.826	3885.	0.00
5.5000	0.1799	647282.	-1948.	-0.00749	42651.	3.64E+09	-292.815	4296.	0.00
5.7200	0.1608	644516.	-2718.	-0.00702	42518.	3.64E+09	-290.327	4767.	0.00
5.9400	0.1428	639507.	-3481.	-0.00656	42279.	3.64E+09	-287.347	5311.	0.00
6.1600	0.1261	632278.	-4235.	-0.00610	41933.	3.64E+09	-283.860	5941.	0.00
6.3800	0.1107	622856.	-4979.	-0.00564	41482.	3.64E+09	-279.852	6677.	0.00
6.6000	0.09636	611271.	-5711.	-0.00519	40927.	3.64E+09	-275.303	7542.	0.00
6.8200	0.08324	597560.	-6432.	-0.00475	40271.	3.64E+09	-270.195	8569.	0.00
7.0400	0.07126	581763.	-7137.	-0.00433	39515.	3.64E+09	-264.505	9799.	0.00
7.2600	0.06040	563924.	-7827.	-0.00391	38661.	3.64E+09	-258.211	11285.	0.00
7.4800	0.05062	544095.	-8500.	-0.00351	37712.	3.64E+09	-251.283	13104.	0.00
7.7000	0.04189	522328.	-9153.	-0.00312	36670.	3.64E+09	-243.691	15359.	0.00
7.9200	0.03415	498686.	-9786.	-0.00275	35538.	3.64E+09	-235.396	18196.	0.00
8.1400	0.02737	473234.	-10395.	-0.00240	34320.	3.64E+09	-226.354	21829.	0.00
8.3600	0.02150	446043.	-10980.	-0.00206	33019.	3.64E+09	-216.510	26581.	0.00
8.5800	0.01649	417191.	-11537.	-0.00175	31638.	3.64E+09	-205.793	32952.	0.00
8.8000	0.01227	386764.	-12065.	-0.00146	30181.	3.64E+09	-194.113	41761.	0.00
9.0200	0.00880	354852.	-12561.	-0.00119	28654.	3.64E+09	-181.343	54424.	0.00
9.2400	0.00600	321555.	-13021.	-9.42E-04	27060.	3.64E+09	-167.299	73583.	0.00
9.4600	0.00382	286983.	-13442.	-7.21E-04	25406.	3.64E+09	-151.692	104707.	0.00
9.6800	0.00220	251257.	-13819.	-5.25E-04	23695.	3.64E+09	-133.996	161002.	0.00
9.9000	0.00105	214511.	-14145.	-3.56E-04	21937.	3.64E+09	-113.060	283871.	0.00
10.1200	3.17E-04	176904.	-17433.	-2.14E-04	20137.	3.64E+09	-2378.	1.98E+07	0.00
10.3400	-7.82E-05	122665.	-19797.	-1.05E-04	17541.	3.64E+09	586.5597	1.98E+07	0.00
10.5600	-2.38E-04	72473.	-16664.	-3.43E-05	15138.	3.64E+09	1787.	1.98E+07	0.00
10.7800	-2.59E-04	34710.	-11738.	4.61E-06	13331.	3.64E+09	1945.	1.98E+07	0.00
11.0000	-2.14E-04	10492.	-7053.	2.10E-05	12171.	3.64E+09	1604.	1.98E+07	0.00
11.2200	-1.48E-04	-2550.	-3467.	2.39E-05	11791.	3.64E+09	1112.	1.98E+07	0.00
11.4400	-8.76E-05	-7837.	-1131.	2.01E-05	12044.	3.64E+09	657.2400	1.98E+07	0.00
11.6600	-4.20E-05	-8541.	151.8995	1.42E-05	12078.	3.64E+09	314.7952	1.98E+07	0.00
11.8800	-1.27E-05	-7048.	693.0549	8.53E-06	12007.	3.64E+09	95.1710	1.98E+07	0.00
12.1000	3.08E-06	-4890.	788.1890	4.20E-06	11903.	3.64E+09	-23.100	1.98E+07	0.00
12.3200	9.47E-06	-2890.	663.9033	1.37E-06	11808.	3.64E+09	-71.056	1.98E+07	0.00
12.5400	1.03E-05	-1386.	467.8787	-1.80E-07	11736.	3.64E+09	-77.447	1.98E+07	0.00
12.7600	8.52E-06	-419.931	281.2821	-8.36E-07	11689.	3.64E+09	-63.914	1.98E+07	0.00
12.9800	5.91E-06	100.3897	138.3847	-9.52E-07	11674.	3.64E+09	-44.342	1.98E+07	0.00
13.2000	3.50E-06	311.6316	45.2519	-8.02E-07	11684.	3.64E+09	-26.213	1.98E+07	0.00
13.4200	1.68E-06	340.0712	-5.937	-5.66E-07	11686.	3.64E+09	-12.566	1.98E+07	0.00
13.6400	5.08E-07	280.8141	-27.552	-3.40E-07	11683.	3.64E+09	-3.809	1.98E+07	0.00
13.8600	-1.21E-07	194.9127	-31.380	-1.68E-07	11679.	3.64E+09	0.9096	1.98E+07	0.00
14.0800	-3.77E-07	115.2843	-26.450	-5.49E-08	11675.	3.64E+09	2.8255	1.98E+07	0.00
14.3000	-4.11E-07	55.3094	-18.650	7.05E-09	11672.	3.64E+09	3.0837	1.98E+07	0.00
14.5200	-3.40E-07	16.8075	-11.218	3.32E-08	11670.	3.64E+09	2.5464	1.98E+07	0.00
14.7400	-2.36E-07	-3.952	-5.523	3.79E-08	11670.	3.64E+09	1.7676	1.98E+07	0.00
14.9600	-1.39E-07	-12.392	-1.810	3.20E-08	11670.	3.64E+09	1.0455	1.98E+07	0.00
15.1800	-6.69E-08	-13.540	0.2320	2.26E-08	11670.	3.64E+09	0.5016	1.98E+07	0.00
15.4000	-2.03E-08	-11.188	1.0953	1.36E-08	11670.	3.64E+09	0.1525	1.98E+07	0.00
15.6200	4.77E-09	-7.770	1.2493	6.69E-09	11670.	3.64E+09	-0.03581	1.98E+07	0.00
15.8400	1.50E-08	-4.598	1.0538	2.20E-09	11670.	3.64E+09	-0.112	1.98E+07	0.00
16.0600	1.64E-08	-2.208	0.7434	-2.75E-10	11669.	3.64E+09	-0.123	1.98E+07	0.00
16.2800	1.35E-08	-0.673	0.4474	-1.32E-09	11669.	3.64E+09	-0.101	1.98E+07	0.00
16.5000	9.39E-09	0.1556	0.2205	-1.51E-09	11669.	3.64E+09	-0.07046	1.98E+07	0.00
16.7200	5.56E-09	0.4927	0.07241	-1.27E-09	11669.	3.64E+09	-0.04170	1.98E+07	0.00
16.9400	2.67E-09	0.5391	-0.00906	-8.99E-10	11669.	3.64E+09	-0.02002	1.98E+07	0.00
17.1600	8.14E-10	0.4458	-0.04354	-5.41E-10	11669.	3.64E+09	-0.00610	1.98E+07	0.00
17.3800	-1.88E-10	0.3097	-0.04974	-2.67E-10	11669.	3.64E+09	0.00141	1.98E+07	0.00
17.6000	-5.96E-10	0.1834	-0.04198	-8.79E-11	11669.	3.64E+09	0.00447	1.98E+07	0.00
17.8200	-6.52E-10	0.08813	-0.02963	1.07E-11	11669.	3.64E+09	0.00489	1.98E+07	0.00
18.0400	-5.39E-10	0.02692	-0.01784	5.25E-11	11669.	3.64E+09	0.00404	1.98E+07	0.00
18.2600	-3.74E-10	-0.00612	-0.00880	6.01E-11	11669.	3.64E+09	0.00281	1.98E+07	0.00
18.4800	-2.22E-10	-0.01959	-0.00290	5.07E-11	11669.	3.64E+09	0.00166	1.98E+07	0.00
18.7000	-1.07E-10	-0.02147	3.54E-04	3.58E-11	11669.	3.64E+09	7.99E-04	1.98E+07	0.00
18.9200	-3.26E-11	-0.01776	0.00173	2.16E-11	11669.	3.64E+09	2.44E-04	1.98E+07	0.00
19.1400	7.40E-12	-0.01235	0.00198	1.07E-11	11669.	3.64E+09	-5.55E-05	1.98E+07	0.00
19.3600	2.37E-11	-0.00731	0.00167	3.51E-12	11669.	3.64E+09	-1.78E-04	1.98E+07	0.00
19.5800	2.60E-11	-0.00352	0.00118	0.00	11669.	3.64E+09	-1.95E-04	1.98E+07	0.00
19.8000	2.15E-11	-0.00108	7.11E-04	-2.09E-12	11669.	3.64E+09	-1.61E-04	1.98E+07	0.00
20.0200	1.49E-11	2.40E-04	3.51E-04	-2.39E-12	11669.	3.64E+09	-1.12E-04	1.98E+07	0.00
20.2400	8.84E-12	7.78E-04	1.16E-04	-2.02E-12	11669.	3.64E+09	-6.63E-05	1.98E+07	0.00
20.4600	4.25E-12	8.53E-04	-1.39E-05	-1.43E-12	11669.	3.64E+09	-3.19E-05	1.98E+07	0.00
20.6800	1.29E-12	7.06E-04	-6.88E-05	0.00	11669.	3.64E+09	-9.69E-06	1.98E+07	0.00
20.9000	0.00	4.90E-04	-7.85E-05	0.00	11669.	3.64E+09	2.35E-06	1.98E+07	0.00
21.1200	0.00	2.92E-04	-6.57E-05	0.00	11669.	3.64E+09	7.34E-06	1.98E+07	0.00
21.3400	-1.09E-12	1.44E-04	-4.52E-05	0.00	11669.	3.64E+09	8.14E-06	1.98E+07	0.00
21.5600	0.00	5.26E-05	-2.54E-05	0.00	11669.	3.64E+09	6.87E-06	1.98E+07	0.00
21.7800	0.00	9.42E-06	-9.95E-06	0.00	11669.	3.64E+09	4.85E-06	1.98E+07	0.00
22.0000	0.00	0.00	0.00	0.00	11669.	3.64E+09	2.69E-06	9900000.	0.00

* This analysis computed pile response using nonlinear moment-curvature rela-
  tionships. Values of total stress due to combined axial and bending stresses
  are computed only for elastic sections only and do not equal the actual
  stresses in concrete and steel. Stresses in concrete and steel may be inter-
  polated from the output for nonlinear bending properties relative to the
  magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection   =   1.00000000 inches
Computed slope at pile head   =   -0.0153694 radians
Maximum bending moment   =   647787. inch-lbs
Maximum shear force   =   -19797. lbs
Depth of maximum bending moment =   5.28000000 feet below pile head
Depth of maximum shear force   =   10.34000000 feet below pile head
Number of iterations   =   13
Number of zero deflection points =   7

            Summary of Pile-head Responses for Conventional Analyses
---

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	y, in	1.0000	M, in-lb	0.00	177310.	1.0000	-0.01537	-19797.	647787.

Maximum pile-head deflection = 1.0000000000 inches
Maximum pile-head rotation   = -0.0153694330 radians = -0.880604 deg.

                            Summary of Warning Messages

The following warning was reported 770 times

**** Warning ****

This warning is for an input value for uniaxial compressive strength that
has been specified for a soil defined using the vuggy limestone criteria.
The input value is outside of the range of 1,000 to 2,500 psi
(6,895 to 17,237 kPa) which were used in actual field tests
on which this theory is based. Higher or lower values may be applicable
but the user is warned about the theoretical and testing limitations.

The analysis ended normally.

Jacobs

Project: MoDOT Improve I-70 Columbia to Kingdom City DB
Job No.: F3X03001
Subject: Bridge 2/A9542 - Lateral Analysis at Bent 2

By: ZW 8/22/24
Ckd: SR 8/28/24

Foundation Design Data

Support No.: **Bent 2** - High Rock Elevation Case

General Information:

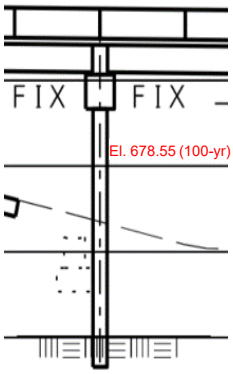
	North	South	Average	
Bottom of Pile Cap El.:	677.26	680.04	678.65	ft
Assumed Grade Elev.:	*664.00*	*664.00*	664.00	ft
Design Scour Depth:	*6.60*	*6.60*	6.60	ft
El.:	*657.40*	*657.40*	657.40	ft
Min. Pile Length below Scour Depth:	*15.00*	*15.00*	15.00	ft
El.:	642.40	642.40	642.40	ft
Top of Rock El.:	648.00	648.00	648.00	ft
Rock Type:	Limestone	Limestone	Limestone	
Min. Embd. into Rock:	5	5	5	ft
Min. Pile Tip El by Rock Embd.:	643.00	643.00	643.00	ft
Min Design Pile Tip El:	**642.40**	**642.40**	**642.40**	
Min. Pile Length:	34.86	37.64	36.25	ft
Design GW El.:	678.55	678.55	678.55	ft
Depth below Top of Pile:	-1.29	1.49	0.10	ft
Exposed Pile Length to Scour Depth:	19.86	22.64	21.25	ft

Scour Information

Location	Ground El.	Scour Depth (ft)		Scour Elev. (ft)	
	(ft)	Design Flood	Check Flood	Design Flood	Check Flood
Bent 2	664	6.6	13.3	657.4	650.7
Bent 3	668	6.1	12.8	661.9	655.2

Section 751.1.2.22 MoDOT EPG

100-year Flood Level



Pile Data:

Pile:	24X0.500		Class B-1 Concrete,	fc'=	4,000	psi
F_y =	45	ksi	Pile Structural Axial Resistance Factor:	ϕ_c =	0.6	
E =	29,000	ksi	Max Nominal Driving Resistance:	R_{ndr} =	1,305	k
OD =	24	in	Preli. Structural Nominal Axial Design Capacity:	PNDC = F_yA_s =	1,450	k
Wall Thick. =	0.500	in	Preli. Factored Axial Design Capacity:	PFDC = ϕc xPNDC =	870	k
ID =	23.00	in				
As (No Corrosion) =	32.21	in^2				

Load Information:

Load Case	At Top of Pile		Stream Pressure, WA				Wind on Structure, WS				Max (WA+WS)
	Axial	Lateral Load	Load	Load	From	To	Load	Load	From	To	
	(k)	(k)	(klf)	(lbs/in)	(ft	(ft)	(klf)	(lbs/in)	(ft	(ft)	(lbs/in)
Ser I	370.1	4.1	0.082	6.83	0.10	21.25	0.040	3.33	0	21.25	10.17
Str I	574.2	5.3	0.086	7.17	0.10	21.25	0.000	0.00	0	21.25	7.17
Str III	286.2	1.4	0.086	7.17	0.10	21.25	0.114	9.50	0	21.25	16.67
Str V	508.6	5.5	0.086	7.17	0.10	21.25	0.055	4.58	0	21.25	11.75

P-Multipliers D = 2 ft

Loading Direction	Number of Rows	Pile Spacing S	S/D	P-Multiplier* (AASHTO LRFD Table 10.7.2.4-1)				
				Row Number				Aver.
		(ft)		1	2	3	After 3	
Longitudinal	1	-	-	0.95	-	-	-	0.95
Transverse	11	8.90	4.45	0.95	0.73	0.59	0.59	0.63

Note: Group reduction factor of 1.0 was used within fresh rock.

Lateral Analysis

Software: LPILE 2022 developed by ENSOFT, Inc.

Pile Geometry for Analysis:

Top of Pile El.:	678.65 ft	Design Scour El.:	657.40 ft	(Design Flood for Strength Limit)
Min. Pile Tip El.:	642.40 ft	Min. Pile Length:	36.25 ft	

Design Soil Profile and Parameters:

Reference Borings: BR 2-2 and L0264-2 High Rock Elevation Case Design Ground Water El.: 678.55 ft

Depth		Soil/Rock	Elevation		Eff. Unit Weight	Su	ϕ'	qu	Modulus , k or E	RQD	ε_{50}
From	To		From	To							
(ft)	(ft)		(ft)	(ft)	(pcf)	(psf)	(deg.)	(psi)	(psi)		
21.3	30.7	Strong Rock	657.4	648.0	101.6	-	-	7,500	-	-	-
30.7	48.7	Strong Rock	648.0	630.0	101.6	-	-	7,500	-	-	-

Lateral Analysis Results:

LPile Analysis Summary at Bent 2 of Bridge 2 (A9542)

Load Comb.	Case in LPile	Lat.	Moment	Axial	Pmult.	Head Fixity	Pile Head	Max Moment	Max Shear	Pile Head Rotation
		(lbs)	(lbs-in)	(lbs)			δ (in)	(in-lbs)	(lbs)	(rad.)
Ser I	1	4,100	-	370,100	0.63	Fixed	0.074	714,300	-24,859	0.00E+00
Str I	2	5,300	-	574,200	0.63	Fixed	0.087	-835,438	-28,297	0.00E+00
Str III	3	1,400	-	286,200	0.63	Fixed	0.049	516,513	-17,901	0.00E+00
Str V	4	5,500	-	508,600	0.63	Fixed	0.098	926,289	-32,356	0.00E+00

Deflection, Moment, and Shear vs Depth figures are attached.

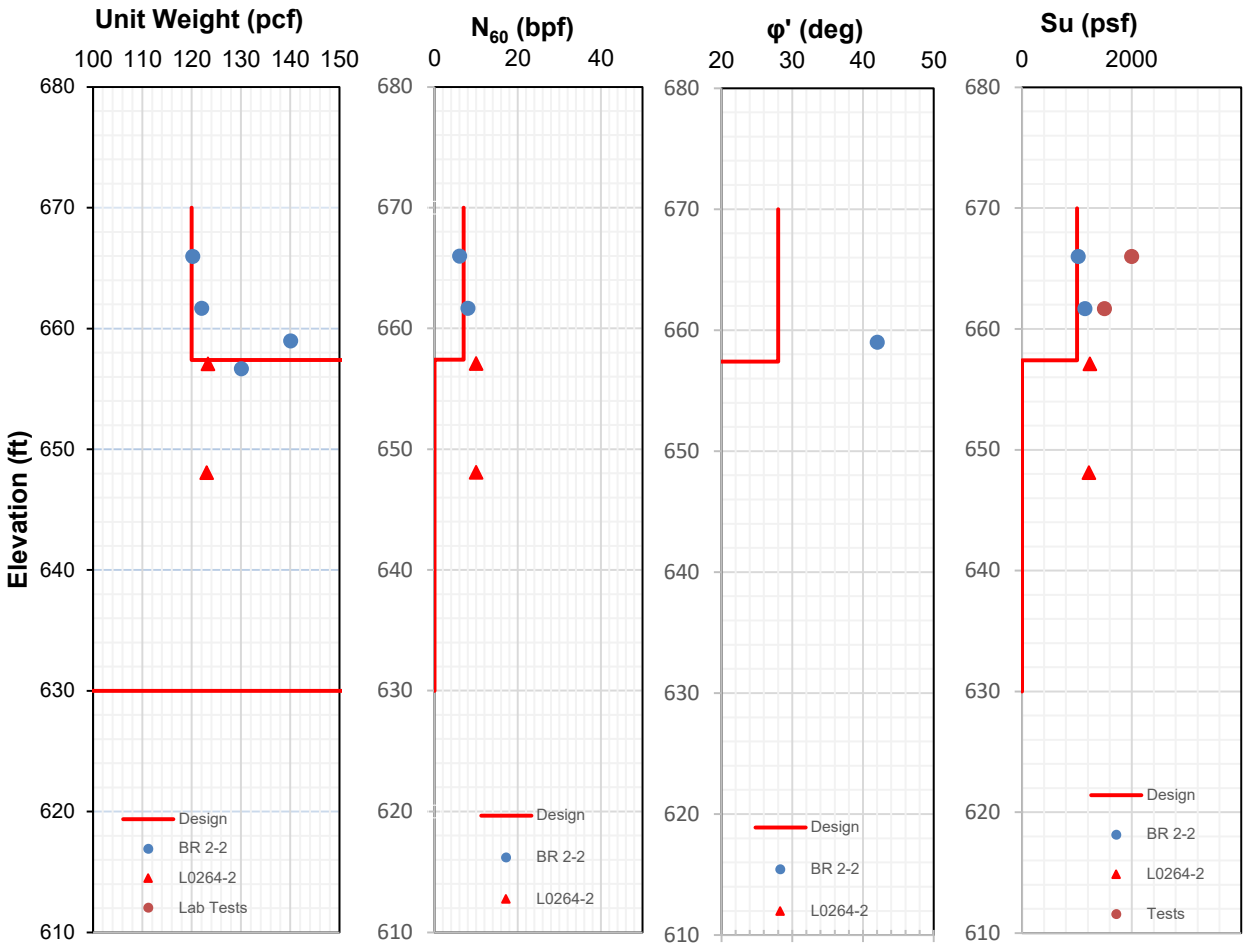
Structure Engineer should check the pile structural acceptability for the analyzed load combinations.

Jacobs

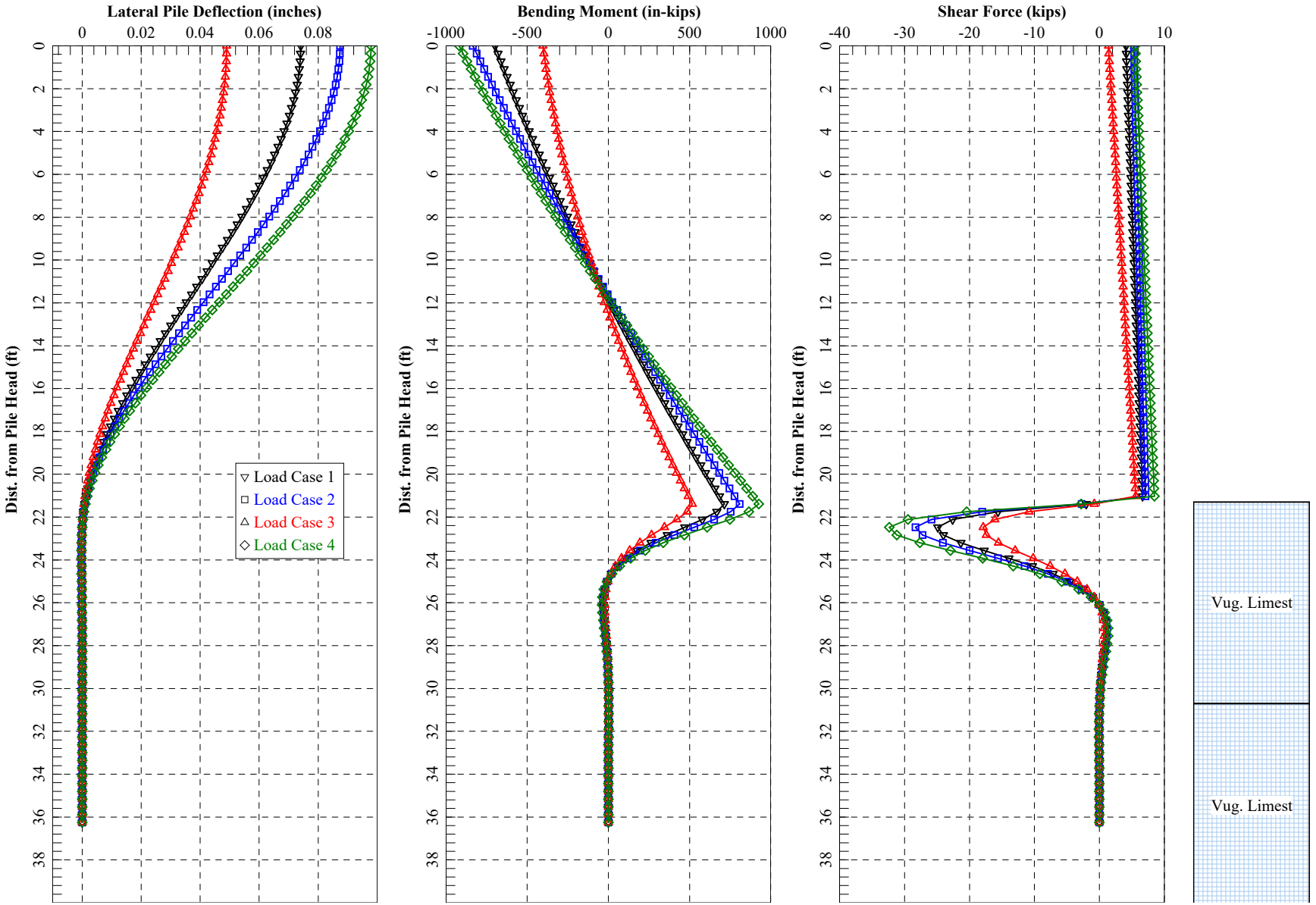
Project:	MoDOT Improve I-70 Columbia to Kingdom City DB	By:ZW	8/21/24
Job No.:	F3X03001	Ckd:SR	8/28/24
Subject:	Bridge 2/A9542 - Bent 2 - High Rock El.	BkCkd:	

Design Soil Profile and Parameters

Soil	Elevation		Unit Weight	N_{60}	Undrained		Drained		ε_{50}	k
	From	To			C	ϕ	C'	ϕ'		
	(ft)	(ft)	(pcf)	(bpf)	(psf)	(deg.)	(psf)	(deg.)		(pci)
CL	669.0	657.4	120	7	1,000	0	0	28	0.01	-
Rock	657.4	630.0	164							
	(Strong Rock Qu =1,078 ksf =7.5 ksi)									



MoDOT Improve I-70 C2KC- Bridge 2/A9542- Bent 2 - OECIP24X0.5in - High Rock El.



```
================================================================================

                    LPile for Windows, Version 2022-12.004

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\TPW\GEOTECH\F3X03000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A6951)\LPile\

Name of input data file:
Bridge 2 Bent 2 24in OECIP_Higher Rock El.lp12d

Name of output report file:
Bridge 2 Bent 2 24in OECIP_Higher Rock El.lp12o

Name of plot output file:
Bridge 2 Bent 2 24in OECIP_Higher Rock El.lp12p

Name of runtime message file:
Bridge 2 Bent 2 24in OECIP_Higher Rock El.lp12r



--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  August 28, 2024            Time:  14:10:23



--------------------------------------------------------------------------------
                                  Problem Title
--------------------------------------------------------------------------------

Project Name: MoDOT Improve I-70  Columbia to Kingdom City DB

Job Number: F3X03001

Client: MoDOT

Engineer:

Description: Bridge 2 (A9542) Bent 2 Lateral Analysis - OECIP 24X0.5_High




--------------------------------------------------------------------------------
                          Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed               =          500
 - Deflection tolerance for convergence               =   1.0000E-05 in
 - Maximum allowable deflection                       =     100.0000 in
 - Number of pile increments                          =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified
```

- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- Analysis includes loading by multiple distributed lateral loads acting on pile
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 36.250 ft
Depth of ground surface below top of pile = 21.3000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	24.0000
2	36.250	24.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a drilled shaft with permanent casing
Length of section = 36.250000 ft
Casing outside diameter = 24.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is strong rock (vuggy limestone)

Distance from top of pile to top of layer = 21.300000 ft
Distance from top of pile to bottom of layer = 30.700000 ft
Effective unit weight at top of layer = 101.600000 pcf
Effective unit weight at bottom of layer = 101.600000 pcf
Uniaxial compressive strength at top of layer = 7500. psi
Uniaxial compressive strength at bottom of layer = 7500. psi

Layer 2 is strong rock (vuggy limestone)

Distance from top of pile to top of layer = 30.700000 ft
Distance from top of pile to bottom of layer = 50.000000 ft
Effective unit weight at top of layer = 101.600000 pcf
Effective unit weight at bottom of layer = 101.600000 pcf
Uniaxial compressive strength at top of layer = 7500. psi
Uniaxial compressive strength at bottom of layer = 7500. psi

(Depth of the lowest soil layer extends 13.750 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Uniaxial qu psi

1	Strong Rock	21.3000	101.6000	7500.
	(Vuggy Limestone)	30.7000	101.6000	7500.
2	Strong Rock	30.7000	101.6000	7500.
	(Vuggy Limestone)	50.0000	101.6000	7500.

Modification Factors for p-y Curves

Distribution of p-y modifiers with depth defined using 4 points

Point No.	Depth X ft	p-mult	y-mult
1	21.300	0.6300	1.0000
2	30.700	0.6300	1.0000
3	30.700	1.0000	1.0000
4	50.000	1.0000	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading for Individual Load Cases

Distributed lateral load intensity for Load Case 1 defined using 4 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	3.330
2	0.100	3.330
3	0.100	10.170
4	21.250	10.170

Distributed lateral load intensity for Load Case 2 defined using 4 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	0.000
2	0.100	0.000
3	0.100	7.170
4	21.250	7.170

Distributed lateral load intensity for Load Case 3 defined using 4 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	9.500
2	0.100	9.500
3	0.100	16.670
4	21.250	16.670

Distributed lateral load intensity for Load Case 4 defined using 4 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	4.580
2	0.100	4.580
3	0.100	11.750
4	21.250	11.750

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis

1	2	V =	4100. lbs	S =	0.0000 in/in	370100.	Yes	Yes
2	2	V =	5300. lbs	S =	0.0000 in/in	574200.	Yes	Yes
3	2	V =	1400. lbs	S =	0.0000 in/in	286200.	Yes	Yes
4	2	V =	5500. lbs	S =	0.0000 in/in	508600.	Yes	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile) with Permanent Casing:

Length of Section	=	36.250000 ft
Outer Diameter of Casing	=	24.000000 in
Casing Wall Thickness	=	0.500000 in
Moment of Inertia of Steel Casing	=	2549. in^4
Yield Stress of Casing	=	45000. psi
Elastic Modulus of Casing	=	29000000. psi
Number of Reinforcing Bars	=	0 bars
Area of Single Reinforcing Bar	=	0.0000 sq. in.
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in
Yield Stress of Reinforcing Bars	=	0.0000 psi
Modulus of Elasticity of Reinforcing Bars	=	0.0000 psi
Gross Area of Pile	=	452.389342 sq. in.
Area of Concrete	=	415.475628 sq. in.
Cross-sectional Area of Steel Casing	=	36.913714 sq. in.
Area of All Steel (Casing and Bars)	=	36.913714 sq. in.
Area Ratio of All Steel to Gross Area of Pile	=	8.16 percent

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	3073.734 kips
Tensile Load for Cracking of Concrete	=	-296.304 kips
Nominal Axial Tensile Capacity	=	-1661.117 kips

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.34165 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 4

Number	Axial Thrust Force kips
1	286.200
2	370.100
3	508.600
4	574.200

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.

Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 286.200 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	161.2791649	129023332.	94.2308790	0.0001178	0.00008779	0.4833677	0.00000	3.4115194	
0.00000250	322.5562868	129022515.	53.1260220	0.0001328	0.00007282	0.5422776	0.00000	3.8429366	
0.00000375	483.8293222	129021153.	39.4291066	0.0001479	0.00005786	0.6007589	0.00000	4.2748654	
0.00000500	645.0962281	129019246.	32.5841766	0.0001629	0.00004292	0.6588098	0.00000	4.7073056	
0.00000625	806.3549608	129016794.	28.4800410	0.0001780	0.00002800	0.7164285	0.00000	5.1402575	
0.00000750	967.6034766	129013797.	25.7463029	0.0001931	0.00001310	0.7736133	0.00000	5.5737209	
0.00000875	1129.	129010255.	23.7956491	0.0002082	-0.00000179	0.8303623	0.00000	6.0076960	
0.00001000	1290.	129005546.	22.3344026	0.0002233	-0.00001666	0.8866731	0.00000	6.4421768	
0.00001125	1451.	128994382.	21.1992367	0.0002385	-0.00003151	0.9425358	0.00000	6.8771010	
0.00001250	1612.	128971879.	20.2920743	0.0002537	-0.00004635	0.9979375	0.00000	7.3123770	
0.00001375	1773.	128936617.	19.5505463	0.0002688	-0.00006118	1.0528674	0.00000	7.7479304	
0.00001500	1933.	128888982.	18.9331162	0.0002840	-0.00007600	1.1073177	0.00000	8.1837056	
0.00001625	2093.	128830078.	18.4110586	0.0002992	-0.00009082	1.1612825	0.00000	8.6196614	
0.00001750	2253.	128761204.	17.9638759	0.0003144	-0.000106	1.2147575	0.00000	9.0557671	
0.00001875	2253.	120177124.	17.2118094	0.0003227	-0.000127	1.2437149	0.00000	9.2936714	C
0.00002000	2376.	118804696.	16.8150407	0.0003363	-0.000144	1.2907917	0.00000	9.6831236	C
0.00002125	2500.	117628479.	16.4605877	0.0003498	-0.000160	1.3371423	0.00000	10.0698872	C
0.00002250	2622.	116520173.	16.1414184	0.0003632	-0.000177	1.3827765	0.00000	10.4539756	C
0.00002375	2743.	115481780.	15.8527218	0.0003765	-0.000193	1.4277639	0.00000	10.8359122	C
0.00002500	2863.	114509742.	15.5903262	0.0003898	-0.000210	1.4721449	0.00000	11.2159865	C
0.00002625	2982.	113598947.	15.3507142	0.0004030	-0.000227	1.5159460	0.00000	11.5943812	C
0.00002750	3100.	112745016.	15.1310264	0.0004161	-0.000244	1.5591950	0.00000	11.9712936	C
0.00002875	3218.	111944122.	14.9289183	0.0004292	-0.000261	1.6019204	0.00000	12.3469357	C
0.00003000	3336.	111192846.	14.7424534	0.0004423	-0.000278	1.6441514	0.00000	12.7215345	C
0.00003125	3453.	110483396.	14.5694757	0.0004553	-0.000295	1.6858630	0.00000	13.0948374	C
0.00003250	3569.	109815294.	14.4088326	0.0004683	-0.000312	1.7271012	0.00000	13.4672248	C
0.00003375	3685.	109187822.	14.2595881	0.0004813	-0.000329	1.7679151	0.00000	13.8391220	C
0.00003500	3801.	108591776.	14.1198830	0.0004942	-0.000346	1.8082361	0.00000	14.2098813	C
0.00003625	3916.	108030039.	13.9894541	0.0005071	-0.000363	1.8481491	0.00000	14.5802638	C
0.00003750	4031.	107496944.	13.8670731	0.0005200	-0.000380	1.8876205	0.00000	14.9499421	C
0.00003875	4146.	106992072.	13.7522357	0.0005329	-0.000397	1.9266849	0.00000	15.3192249	C
0.00004000	4260.	106511400.	13.6440347	0.0005458	-0.000414	1.9653192	0.00000	15.6878803	C
0.00004125	4375.	106056345.	13.5423684	0.0005586	-0.000431	2.0035874	0.00000	16.0565083	C
0.00004250	4489.	105619901.	13.4459263	0.0005715	-0.000449	2.0413969	0.00000	16.4242042	C
0.00004375	4603.	105206352.	13.3551661	0.0005843	-0.000466	2.0788669	0.00000	16.7921172	C
0.00004500	4716.	104810177.	13.2690097	0.0005971	-0.000483	2.1159176	0.00000	17.1594578	C
0.00004625	4830.	104431108.	13.1872723	0.0006099	-0.000500	2.1525758	0.00000	17.5264791	C
0.00004750	4943.	104070114.	13.1099940	0.0006227	-0.000517	2.1888952	0.00000	17.8937168	C
0.00004875	5056.	103722923.	13.0363046	0.0006355	-0.000534	2.2248024	0.00000	18.2604258	C
0.00005125	5282.	103070451.	12.8994671	0.0006611	-0.000569	2.2955040	0.00000	18.9934832	C
0.00005375	5508.	102468107.	12.7751176	0.0006867	-0.000603	2.3647336	0.00000	19.7261632	C
0.00005625	5732.	101909675.	12.6616804	0.0007122	-0.000638	2.4325071	0.00000	20.4586154	C
0.00005875	5957.	101390374.	12.5578818	0.0007378	-0.000672	2.4988439	0.00000	21.1910408	C
0.00006125	6180.	100904498.	12.4623326	0.0007633	-0.000707	2.5637116	0.00000	21.9230682	C
0.00006375	6404.	100451136.	12.3747514	0.0007889	-0.000741	2.6272218	0.00000	22.6559717	C
0.00006625	6627.	100023279.	12.2933897	0.0008144	-0.000776	2.6892330	0.00000	23.3881250	C
0.00006875	6849.	99620659.	12.2182127	0.0008400	-0.000810	2.7498547	0.00000	24.1208117	C
0.00007125	7071.	99241255.	12.1487418	0.0008656	-0.000844	2.8091122	0.00000	24.8543879	C
0.00007375	7292.	98881104.	12.0839307	0.0008912	-0.000879	2.8669226	0.00000	25.5878571	C
0.00007625	7514.	98538662.	12.0234245	0.0009168	-0.000913	2.9233039	0.00000	26.3214477	C
0.00007875	7734.	98213371.	11.9671567	0.0009424	-0.000948	2.9783134	0.00000	-27.205956	C
0.00008125	7955.	97903623.	11.9147383	0.0009681	-0.000982	3.0319461	0.00000	-28.193148	C
0.00008375	8175.	97607462.	11.8656364	0.0009937	-0.001016	3.0841648	0.00000	-29.179885	C
0.00008625	8394.	97322994.	11.8193127	0.0010194	-0.001051	3.1349241	0.00000	-30.166794	C
0.00008875	8613.	97050420.	11.7759606	0.0010451	-0.001085	3.1842979	0.00000	-31.152771	C
0.00009125	8832.	96788739.	11.7353381	0.0010708	-0.001119	3.2322810	0.00000	-32.137811	C
0.00009375	9050.	96537056.	11.6972292	0.0010966	-0.001153	3.2788683	0.00000	-33.121908	C
0.00009625	9268.	96294569.	11.6614403	0.0011224	-0.001188	3.3240546	0.00000	-34.105055	C
0.00009875	9486.	96060180.	11.6276288	0.0011482	-0.001222	3.3678066	0.00000	-35.087728	C
0.0001013	9703.	95833029.	11.5955362	0.0011740	-0.001256	3.4101030	0.00000	-36.070257	C
0.0001038	9920.	95613188.	11.5653139	0.0011999	-0.001290	3.4509878	0.00000	-37.051812	C
0.0001063	10136.	95400122.	11.5368322	0.0012258	-0.001324	3.4904557	0.00000	-38.032386	C
0.0001088	10352.	95193341.	11.5099730	0.0012517	-0.001358	3.5285010	0.00000	-39.011973	C
0.0001113	10568.	94992400.	11.4846292	0.0012777	-0.001392	3.5651184	0.00000	-39.990565	C
0.0001138	10783.	94796893.	11.4607030	0.0013037	-0.001426	3.6003021	0.00000	-40.968156	C
0.0001163	10998.	94606449.	11.4381049	0.0013297	-0.001460	3.6340465	0.00000	-41.944739	C
0.0001188	11212.	94420728.	11.4167532	0.0013557	-0.001494	3.6663459	0.00000	-42.920307	C
0.0001213	11427.	94239340.	11.3965238	0.0013818	-0.001528	3.6971875	0.00000	-43.895023	C
0.0001238	11640.	94061726.	11.3771725	0.0014079	-0.001562	3.7265420	0.00000	-44.869523	C
0.0001263	11845.	93818449.	11.3556936	0.0014337	-0.001596	3.7540162	0.00000	-45.000000	CY
0.0001288	12028.	93422368.	11.3278808	0.0014585	-0.001632	3.7791174	0.00000	-45.000000	CY
0.0001313	12195.	92915110.	11.2954569	0.0014825	-0.001667	3.8021666	0.00000	-45.000000	CY
0.0001338	12351.	92343512.	11.2604978	0.0015061	-0.001704	3.8234999	0.00000	-45.000000	CY
0.0001363	12498.	91726304.	11.2237959	0.0015292	-0.001741	3.8432704	0.00000	-45.000000	CY
0.0001388	12637.	91075522.	11.1858501	0.0015520	-0.001778	3.8615861	0.00000	-45.000000	CY
0.0001413	12768.	90391013.	11.1474591	0.0015746	-0.001815	3.8785776	0.00000	45.0000000	CY
0.0001438	12889.	89665429.	11.1097924	0.0015970	-0.001853	3.8943962	0.00000	45.0000000	CY
0.0001463	13001.	88892895.	11.0747568	0.0016197	-0.001890	3.9092368	0.00000	45.0000000	CY
0.0001488	13105.	88098113.	11.0408954	0.0016423	-0.001928	3.9229539	0.00000	45.0000000	CY
0.0001588	13449.	84715788.	10.9225786	0.0017340	-0.002076	3.9669875	0.00000	45.0000000	CY
0.0001688	13721.	81312112.	10.8168451	0.0018253	-0.002225	3.9925915	0.00000	45.0000000	CY

0.0001788	13944.	78009203.	10.7218890	0.0019165	-0.002373	3.9986940	0.00000	45.0000000 CY
0.0001888	14129.	74855553.	10.6364474	0.0020076	-0.002522	3.9984450	0.00000	45.0000000 CY
0.0001988	14285.	71873644.	10.5578451	0.0020984	-0.002672	3.9999927	0.00000	45.0000000 CY
0.0002088	14416.	69060214.	10.4873906	0.0021892	-0.002821	3.9994218	0.00000	45.0000000 CY
0.0002188	14529.	66417140.	10.4232884	0.0022801	-0.002970	3.9999770	0.00000	45.0000000 CY
0.0002288	14626.	63937585.	10.3644587	0.0023709	-0.003119	3.9984650	0.00000	45.0000000 CY
0.0002388	14709.	61608545.	10.3106482	0.0024617	-0.003268	3.9992251	0.00000	45.0000000 CY
0.0002488	14782.	59424910.	10.2620518	0.0025527	-0.003417	3.9995442	0.00000	45.0000000 CY
0.0002588	14846.	57375264.	10.2178699	0.0026439	-0.003566	3.9996091	0.00000	45.0000000 CY
0.0002688	14901.	55446793.	10.1770264	0.0027351	-0.003715	3.9994586	0.00000	45.0000000 CY
0.0002788	14950.	53631620.	10.1392499	0.0028263	-0.003864	3.9989879	0.00000	45.0000000 CY
0.0002888	14993.	51923440.	10.1044879	0.0029177	-0.004012	3.9979454	0.00000	45.0000000 CY
0.0002988	15031.	50311798.	10.0725567	0.0030092	-0.004161	3.9963771	0.00000	45.0000000 CY
0.0003088	15064.	48789755.	10.0435025	0.0031009	-0.004309	3.9999282	0.00000	45.0000000 CY
0.0003188	15094.	47352511.	10.0165019	0.0031928	-0.004457	3.9988300	0.00000	45.0000000 CY
0.0003288	15120.	45991588.	9.9926173	0.0032851	-0.004605	3.9958376	0.00000	45.0000000 CY
0.0003388	15143.	44703517.	9.9699322	0.0033773	-0.004753	3.9998098	0.00000	45.0000000 CY
0.0003488	15163.	43479045.	9.9491529	0.0034698	-0.004900	3.9973388	0.00000	45.0000000 CY
0.0003588	15182.	42318701.	9.9294223	0.0035622	-0.005048	3.9999896	0.00000	45.0000000 CY
0.0003688	15197.	41213423.	9.9113103	0.0036548	-0.005195	3.9976495	0.00000	45.0000000 CY
0.0003788	15212.	40162666.	9.8947934	0.0037477	-0.005342	3.9999952	0.00000	45.0000000 CY
0.0003888	15224.	39161565.	9.8791082	0.0038405	-0.005489	3.9969930	0.00000	45.0000000 CY

Axial Thrust Force = 370.100 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	160.0890747	128071260.	118.8875599	0.0001486	0.0001186	0.6048640	0.00000	4.3053241	
0.00000250	320.1760846	128070434.	65.4544750	0.0001636	0.0001036	0.6627442	0.00000	4.7367494	
0.00000375	480.2589647	128069057.	47.6482003	0.0001787	0.00008868	0.7201951	0.00000	5.1686918	
0.00000500	640.3356500	128067130.	38.7486282	0.0001937	0.00007374	0.7772151	0.00000	5.6011511	
0.00000625	800.4040752	128064652.	33.4117373	0.0002088	0.00005882	0.8338024	0.00000	6.0341274	
0.00000750	960.4621749	128061623.	29.8561873	0.0002239	0.00004392	0.8899551	0.00000	6.4676208	
0.00000875	1121.	128058044.	27.3185466	0.0002390	0.00002904	0.9456715	0.00000	6.9016312	
0.00001000	1281.	128053914.	25.4170993	0.0002542	0.00001417	1.0009498	0.00000	7.3361586	
0.00001125	1441.	128049232.	23.9397813	0.0002693	-6.77460E-07	1.0557882	0.00000	7.7712035	
0.00001250	1601.	128043835.	22.7593485	0.0002845	-0.00001551	1.1101846	0.00000	8.2067637	
0.00001375	1760.	128035078.	21.7947398	0.0002997	-0.00003032	1.1641328	0.00000	8.6428024	
0.00001500	1920.	128019142.	20.9918333	0.0003149	-0.00004512	1.2176222	0.00000	9.0792475	
0.00001625	2080.	127994005.	20.3131701	0.0003301	-0.00005991	1.2706433	0.00000	9.5160314	
0.00001750	2239.	127959068.	19.7320181	0.0003453	-0.00007469	1.3231883	0.00000	9.9530992	
0.00001875	2398.	127914511.	19.2287941	0.0003605	-0.00008946	1.3752510	0.00000	10.3904069	
0.00002000	2557.	127860913.	18.7888267	0.0003758	-0.000104	1.4268265	0.00000	10.8279195	
0.00002125	2587.	121752208.	18.1527189	0.0003857	-0.000124	1.4601181	0.00000	11.1126631	C
0.00002250	2716.	120693725.	17.7617273	0.0003996	-0.000140	1.5063533	0.00000	11.5112270	C
0.00002375	2842.	119674175.	17.4080155	0.0004134	-0.000157	1.5518583	0.00000	11.9071207	C
0.00002500	2967.	118687053.	17.0856901	0.0004271	-0.000173	1.5966167	0.00000	12.3001253	C
0.00002625	3091.	117743710.	16.7911484	0.0004408	-0.000189	1.6407131	0.00000	12.6909118	C
0.00002750	3213.	116843601.	16.5208393	0.0004543	-0.000206	1.6841755	0.00000	13.0796694	C
0.00002875	3335.	115985309.	16.2717878	0.0004678	-0.000222	1.7270272	0.00000	13.4665531	C
0.00003000	3455.	115167539.	16.0415312	0.0004812	-0.000239	1.7692925	0.00000	13.8517323	C
0.00003125	3575.	114389066.	15.8280174	0.0004946	-0.000255	1.8109968	0.00000	14.2353909	C
0.00003250	3694.	113648699.	15.6295255	0.0005080	-0.000272	1.8521658	0.00000	14.6177279	C
0.00003375	3812.	112945249.	15.4446045	0.0005213	-0.000289	1.8928264	0.00000	14.9989568	C
0.00003500	3930.	112274181.	15.2716885	0.0005345	-0.000305	1.9329701	0.00000	15.3789639	C
0.00003625	4047.	111633161.	15.1095584	0.0005477	-0.000322	1.9726029	0.00000	15.7577734	C
0.00003750	4163.	111024969.	14.9576936	0.0005609	-0.000339	2.0117912	0.00000	16.1359919	C
0.00003875	4280.	110443177.	14.8147312	0.0005741	-0.000356	2.0504943	0.00000	16.5132043	C
0.00004000	4396.	109887669.	14.6800379	0.0005872	-0.000373	2.0887389	0.00000	16.8896441	C
0.00004125	4511.	109358526.	14.5531393	0.0006003	-0.000390	2.1265605	0.00000	17.2656430	C
0.00004250	4626.	108850263.	14.4329296	0.0006134	-0.000407	2.1639093	0.00000	17.6406858	C
0.00004375	4741.	108365973.	14.3194228	0.0006265	-0.000424	2.2008615	0.00000	18.0155178	C
0.00004500	4856.	107900491.	14.2116280	0.0006395	-0.000440	2.2373628	0.00000	18.3895747	C
0.00004625	4970.	107454827.	14.1094066	0.0006526	-0.000457	2.2734574	0.00000	18.7632917	C
0.00004750	5084.	107028336.	14.0124163	0.0006656	-0.000474	2.3091590	0.00000	19.1368036	C
0.00004875	5198.	106616258.	13.9197971	0.0006786	-0.000491	2.3444075	0.00000	19.5094632	C
0.00005125	5424.	105842810.	13.7479671	0.0007046	-0.000525	2.4137707	0.00000	20.2545663	C
0.00005375	5651.	105125715.	13.5914233	0.0007305	-0.000559	2.4815515	0.00000	20.9985813	C
0.00005625	5876.	104457439.	13.4480189	0.0007565	-0.000594	2.5477409	0.00000	21.7413309	C
0.00005875	6100.	103837308.	13.3169706	0.0007824	-0.000628	2.6124776	0.00000	22.4843389	C
0.00006125	6324.	103253545.	13.1956938	0.0008082	-0.000662	2.6755999	0.00000	23.2257012	C
0.00006375	6548.	102709685.	13.0844220	0.0008341	-0.000696	2.7373277	0.00000	23.9679754	C
0.00006625	6770.	102194916.	12.9807968	0.0008600	-0.000730	2.7974667	0.00000	24.7088060	C
0.00006875	6993.	101711867.	12.8851158	0.0008859	-0.000764	2.8562019	0.00000	25.4504498	C
0.00007125	7214.	101254883.	12.7960409	0.0009117	-0.000798	2.9134496	0.00000	26.1918698	C
0.00007375	7436.	100821322.	12.7129011	0.0009376	-0.000832	2.9692110	0.00000	26.9330657	C
0.00007625	7656.	100411246.	12.6356320	0.0009635	-0.000867	3.0235707	0.00000	27.6751904	C
0.00007875	7877.	100020470.	12.5632042	0.0009894	-0.000901	3.0764476	0.00000	28.4171671	C
0.00008125	8096.	99647322.	12.4951965	0.0010152	-0.000935	3.1278467	0.00000	29.1590565	C
0.00008375	8316.	99291915.	12.4316363	0.0010411	-0.000969	3.1778366	0.00000	29.9018866	C
0.00008625	8535.	98952680.	12.3721391	0.0010671	-0.001003	3.2264121	0.00000	30.6456631	C
0.00008875	8753.	98626192.	12.3157830	0.0010930	-0.001037	3.2734748	0.00000	31.3888966	C
0.00009125	8971.	98312861.	12.2627246	0.0011190	-0.001071	3.3190941	0.00000	32.1326852	C
0.00009375	9189.	98012132.	12.2128507	0.0011450	-0.001105	3.3632907	0.00000	32.8774380	C
0.00009625	9406.	97723000.	12.1659153	0.0011710	-0.001139	3.4060590	0.00000	33.6231612	C
0.00009875	9623.	97444559.	12.1216974	0.0011970	-0.001173	3.4473937	0.00000	34.3698612	C
0.0001013	9839.	97174397.	12.0794520	0.0012230	-0.001207	3.4872052	0.00000	35.1159411	C
0.0001038	10055.	96913421.	12.0395502	0.0012491	-0.001241	3.5255752	0.00000	35.8629469	C

0.0001063	10270.	96661024.	12.0018502	0.0012752	-0.001275	3.5625016	0.00000	36.6109511 C
0.0001088	10485.	96416591.	11.9662024	0.0013013	-0.001309	3.5979788	0.00000	-37.573139 C
0.0001113	10700.	96179563.	11.9324705	0.0013275	-0.001343	3.6320010	0.00000	-38.545717 C
0.0001138	10914.	95949430.	11.9005304	0.0013537	-0.001376	3.6645624	0.00000	-39.517275 C
0.0001163	11128.	95725407.	11.8701320	0.0013799	-0.001410	3.6956386	0.00000	-40.488267 C
0.0001188	11341.	95506775.	11.8410404	0.0014061	-0.001444	3.7252080	0.00000	-41.459167 C
0.0001213	11554.	95293816.	11.8134460	0.0014324	-0.001478	3.7533047	0.00000	-42.429020 C
0.0001238	11767.	95086165.	11.7872603	0.0014587	-0.001511	3.7799227	0.00000	-43.397819 C
0.0001263	11979.	94883487.	11.7624015	0.0014850	-0.001545	3.8050559	0.00000	-44.365557 C
0.0001288	12187.	94658781.	11.7375808	0.0015112	-0.001579	3.8285607	0.00000	-45.000000 CY
0.0001313	12381.	94331646.	11.7090123	0.0015368	-0.001613	3.8500507	0.00000	-45.000000 CY
0.0001338	12557.	93880952.	11.6755220	0.0015616	-0.001648	3.8694891	0.00000	-45.000000 CY
0.0001363	12715.	93319321.	11.6407485	0.0015861	-0.001684	3.8873352	0.00000	45.0000000 CY
0.0001388	12858.	92673589.	11.6058653	0.0016103	-0.001720	3.9037454	0.00000	45.0000000 CY
0.0001413	12989.	91956002.	11.5725361	0.0016346	-0.001755	3.9188918	0.00000	45.0000000 CY
0.0001438	13106.	91174100.	11.5416702	0.0016591	-0.001791	3.9328455	0.00000	45.0000000 CY
0.0001463	13216.	90364760.	11.5113360	0.0016835	-0.001826	3.9454451	0.00000	45.0000000 CY
0.0001488	13318.	89531849.	11.4819528	0.0017079	-0.001862	3.9567324	0.00000	45.0000000 CY
0.0001588	13664.	86074563.	11.3716740	0.0018053	-0.002005	3.9887426	0.00000	45.0000000 CY
0.0001688	13940.	82608674.	11.2706743	0.0019019	-0.002148	3.9999763	0.00000	45.0000000 CY
0.0001788	14166.	79248171.	11.1791158	0.0019983	-0.002292	3.9985120	0.00000	45.0000000 CY
0.0001888	14352.	76038516.	11.0954676	0.0020943	-0.002436	3.9986993	0.00000	45.0000000 CY
0.0001988	14509.	72999726.	11.0190443	0.0021900	-0.002580	3.9999556	0.00000	45.0000000 CY
0.0002088	14641.	70135284.	10.9504065	0.0022859	-0.002724	3.9992269	0.00000	45.0000000 CY
0.0002188	14753.	67441498.	10.8875412	0.0023816	-0.002868	3.9999872	0.00000	45.0000000 CY
0.0002288	14849.	64915016.	10.8302352	0.0024774	-0.003013	3.9981828	0.00000	45.0000000 CY
0.0002388	14932.	62542721.	10.7779558	0.0025732	-0.003157	3.9990359	0.00000	45.0000000 CY
0.0002488	15004.	60318512.	10.7307833	0.0026693	-0.003301	3.9994085	0.00000	45.0000000 CY
0.0002588	15067.	58230784.	10.6879463	0.0027655	-0.003444	3.9994940	0.00000	45.0000000 CY
0.0002688	15121.	56265577.	10.6480737	0.0028617	-0.003588	3.9993334	0.00000	45.0000000 CY
0.0002788	15169.	54417057.	10.6115368	0.0029580	-0.003732	3.9988376	0.00000	45.0000000 CY
0.0002888	15211.	52677488.	10.5779993	0.0030544	-0.003876	3.9977614	0.00000	45.0000000 CY
0.0002988	15247.	51036344.	10.5474061	0.0031510	-0.004019	3.9968595	0.00000	45.0000000 CY
0.0003088	15279.	49486419.	10.5195192	0.0032479	-0.004162	3.9999044	0.00000	45.0000000 CY
0.0003188	15307.	48022760.	10.4937410	0.0033449	-0.004305	3.9987652	0.00000	45.0000000 CY
0.0003288	15332.	46637052.	10.4710085	0.0034423	-0.004448	3.9957649	0.00000	45.0000000 CY
0.0003388	15354.	45325483.	10.4495311	0.0035398	-0.004590	3.9998058	0.00000	45.0000000 CY
0.0003488	15372.	44078783.	10.4299447	0.0036374	-0.004733	3.9973689	0.00000	45.0000000 CY
0.0003588	15389.	42897425.	10.4114397	0.0037351	-0.004875	3.9999940	0.00000	45.0000000 CY
0.0003688	15403.	41772033.	10.3945558	0.0038330	-0.005017	3.9977709	0.00000	45.0000000 CY

Axial Thrust Force = 508.600 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	158.0963191	126477055.	160.1741270	0.0002002	0.0001702	0.8035221	0.00000	5.8019621	
0.00000250	316.1905360	126476214.	86.0979525	0.0002152	0.0001552	0.8596778	0.00000	6.2334016	
0.00000375	474.2805482	126474813.	61.4107340	0.0002303	0.0001403	0.9154034	0.00000	6.6653673	
0.00000500	632.3642532	126472851.	49.0707547	0.0002454	0.0001254	0.9706971	0.00000	7.0978594	
0.00000625	790.4395485	126470328.	41.6696712	0.0002604	0.0001104	1.0255571	0.00000	7.5308779	
0.00000750	948.5043309	126467244.	36.7380359	0.0002755	0.00009554	1.0799816	0.00000	7.9644228	
0.00000875	1107.	126463600.	33.2175141	0.0002907	0.00008065	1.1339688	0.00000	8.3984942	
0.00001000	1265.	126459394.	30.5789384	0.0003058	0.00006579	1.1875168	0.00000	8.8330922	
0.00001125	1423.	126454628.	28.5283270	0.0003209	0.00005094	1.2406238	0.00000	9.2682167	
0.00001250	1581.	126449301.	26.8892908	0.0003361	0.00003612	1.2932879	0.00000	9.7038680	
0.00001375	1739.	126443412.	25.5495824	0.0003513	0.00002131	1.3455074	0.00000	10.1400460	
0.00001500	1897.	126436963.	24.4343699	0.0003665	0.00000652	1.3972805	0.00000	10.5767510	
0.00001625	2054.	126429952.	23.4918470	0.0003817	-0.00000826	1.4486052	0.00000	11.0139829	
0.00001750	2212.	126422062.	22.6849981	0.0003970	-0.00002301	1.4994791	0.00000	11.4517361	
0.00001875	2370.	126411418.	21.9866203	0.0004122	-0.00003775	1.5498961	0.00000	11.8899745	
0.00002000	2528.	126395962.	21.3762832	0.0004275	-0.00005247	1.5998486	0.00000	12.3286441	
0.00002125	2685.	126374373.	20.8383672	0.0004428	-0.00006718	1.6493292	0.00000	12.7676937	
0.00002250	2843.	126345984.	20.3607333	0.0004581	-0.00008188	1.6983316	0.00000	13.2070784	
0.00002375	3000.	126310572.	19.9338073	0.0004734	-0.00009657	1.7468505	0.00000	13.6467598	
0.00002500	3157.	126268202.	19.5499382	0.0004887	-0.000111	1.7948811	0.00000	14.0867052	
0.00002625	3208.	122217040.	19.0411078	0.0004998	-0.000130	1.8291673	0.00000	14.4036934 C	
0.00002750	3340.	121440292.	18.6933846	0.0005141	-0.000146	1.8729640	0.00000	14.8122738 C	
0.00002875	3469.	120670475.	18.3730574	0.0005282	-0.000162	1.9160645	0.00000	15.2184865 C	
0.00003000	3597.	119904762.	18.0764266	0.0005423	-0.000178	1.9584512	0.00000	15.6220908 C	
0.00003125	3724.	119153019.	17.8011323	0.0005563	-0.000194	2.0001782	0.00000	16.0235261 C	
0.00003250	3849.	118418959.	17.5449385	0.0005702	-0.000210	2.0412741	0.00000	16.4230044 C	
0.00003375	3973.	117704184.	17.3058634	0.0005841	-0.000226	2.0817591	0.00000	16.8206637 C	
0.00003500	4095.	117010017.	17.0822231	0.0005979	-0.000242	2.1216543	0.00000	17.2166565 C	
0.00003625	4217.	116337527.	16.8725801	0.0006116	-0.000258	2.1609816	0.00000	17.6111499 C	
0.00003750	4338.	115687543.	16.6757024	0.0006253	-0.000275	2.1997637	0.00000	18.0043265 C	
0.00003875	4458.	115054661.	16.4900335	0.0006390	-0.000291	2.2379696	0.00000	18.3958253 C	
0.00004000	4578.	114443876.	16.3149859	0.0006526	-0.000307	2.2756562	0.00000	18.7861836 C	
0.00004125	4697.	113856151.	16.1498128	0.0006662	-0.000324	2.3128520	0.00000	19.1756636 C	
0.00004250	4815.	113287917.	15.9934849	0.0006797	-0.000340	2.3495414	0.00000	19.5640702 C	
0.00004375	4932.	112736871.	15.8451307	0.0006932	-0.000357	2.3857143	0.00000	19.9512597 C	
0.00004500	5049.	112208896.	15.7047406	0.0007067	-0.000373	2.4214532	0.00000	20.3380866 C	
0.00004625	5166.	111694210.	15.5708923	0.0007202	-0.000390	2.4566645	0.00000	20.7235094 C	
0.00004750	5282.	111200648.	15.4438982	0.0007336	-0.000406	2.4914551	0.00000	21.1086700 C	
0.00004875	5398.	110721121.	15.3226768	0.0007470	-0.000423	2.5257561	0.00000	21.4927844 C	
0.00005125	5628.	109811716.	15.0969495	0.0007737	-0.000456	2.5930429	0.00000	22.2594913 C	
0.00005375	5857.	108960963.	14.8908558	0.0008004	-0.000490	2.6585779	0.00000	23.0240717 C	
0.00005625	6084.	108164472.	14.7020705	0.0008270	-0.000523	2.7224137	0.00000	23.7870027 C	
0.00005875	6311.	107417550.	14.5285854	0.0008536	-0.000556	2.7845881	0.00000	24.5486276 C	

0.00006125	6536.	106711430.	14.3680847	0.0008800	-0.000590	2.8450472	0.00000	25.3081606	C
0.00006375	6761.	106048521.	14.2199196	0.0009065	-0.000623	2.9039282	0.00000	26.0672265	C
0.00006625	6984.	105422568.	14.0824935	0.0009330	-0.000657	2.9612053	0.00000	26.8254407	C
0.00006875	7207.	104829408.	13.9545428	0.0009594	-0.000691	3.0168704	0.00000	27.5826198	C
0.00007125	7429.	104268989.	13.8355750	0.0009858	-0.000724	3.0710033	0.00000	28.3398071	C
0.00007375	7650.	103735373.	13.7242169	0.0010122	-0.000758	3.1235365	0.00000	29.0960190	C
0.00007625	7871.	103228905.	13.6202009	0.0010385	-0.000791	3.1745468	0.00000	29.8523196	C
0.00007875	8091.	102746814.	13.5227639	0.0010649	-0.000825	3.2240241	0.00000	30.6085624	C
0.00008125	8311.	102285404.	13.4310386	0.0010913	-0.000859	3.2719306	0.00000	31.3641348	C
0.00008375	8530.	101846652.	13.3452002	0.0011177	-0.000892	3.3183711	0.00000	32.1207051	C
0.00008625	8748.	101424981.	13.2640311	0.0011440	-0.000926	3.3632364	0.00000	32.8765081	C
0.00008875	8966.	101020906.	13.1875212	0.0011704	-0.000960	3.4065870	0.00000	33.6325328	C
0.00009125	9183.	100634454.	13.1155848	0.0011968	-0.000993	3.4484643	0.00000	34.3895667	C
0.00009375	9400.	100262289.	13.0474381	0.0012232	-0.001027	3.4888027	0.00000	35.1464725	C
0.00009625	9616.	99903172.	12.9827560	0.0012496	-0.001060	3.5275989	0.00000	35.9031680	C
0.00009875	9831.	99558032.	12.9217064	0.0012760	-0.001094	3.5649135	0.00000	36.6608870	C
0.0001013	10047.	99225807.	12.8640225	0.0013025	-0.001128	3.6007408	0.00000	37.4196362	C
0.0001038	10261.	98903924.	12.8090539	0.0013289	-0.001161	3.6350204	0.00000	38.1781913	C
0.0001063	10475.	98592029.	12.7567046	0.0013554	-0.001195	3.6677657	0.00000	38.9368434	C
0.0001088	10689.	98290603.	12.7070945	0.0013819	-0.001228	3.6990144	0.00000	39.6965475	C
0.0001113	10902.	97998912.	12.6600413	0.0014084	-0.001262	3.7287603	0.00000	40.4573069	C
0.0001138	11115.	97716289.	12.6153785	0.0014350	-0.001295	3.7569972	0.00000	41.2191290	C
0.0001163	11328.	97440875.	12.5725820	0.0014616	-0.001328	3.7836761	0.00000	41.9807667	C
0.0001188	11539.	97172768.	12.5316987	0.0014881	-0.001362	3.8088164	0.00000	42.7427871	C
0.0001213	11751.	96912164.	12.4928100	0.0015148	-0.001395	3.8324368	0.00000	43.5058930	C
0.0001238	11961.	96658585.	12.4557972	0.0015414	-0.001429	3.8545307	0.00000	44.2700922	C
0.0001263	12172.	96409293.	12.4206801	0.0015681	-0.001462	3.8751040	0.00000	45.0000000	CY
0.0001288	12375.	96119654.	12.3898454	0.0015952	-0.001495	3.8943686	0.00000	45.0000000	CY
0.0001313	12569.	95760133.	12.3649493	0.0016229	-0.001527	3.9124134	0.00000	45.0000000	CY
0.0001338	12753.	95350619.	12.3445694	0.0016511	-0.001559	3.9290404	0.00000	45.0000000	CY
0.0001363	12925.	94862711.	12.3254709	0.0016793	-0.001591	3.9439554	0.00000	45.0000000	CY
0.0001388	13079.	94264454.	12.3043394	0.0017072	-0.001623	3.9569467	0.00000	45.0000000	CY
0.0001413	13216.	93567048.	12.2810823	0.0017347	-0.001655	3.9680740	0.00000	45.0000000	CY
0.0001438	13340.	92802049.	12.2569167	0.0017619	-0.001688	3.9774622	0.00000	45.0000000	CY
0.0001463	13455.	92000277.	12.2320715	0.0017889	-0.001721	3.9851631	0.00000	45.0000000	CY
0.0001488	13562.	91171362.	12.2071226	0.0018158	-0.001754	3.9912323	0.00000	45.0000000	CY
0.0001588	13922.	87699542.	12.1088852	0.0019223	-0.001888	3.9994978	0.00000	45.0000000	CY
0.0001688	14208.	84194242.	12.0149819	0.0020275	-0.002022	3.9999997	0.00000	45.0000000	CY
0.0001788	14439.	80776057.	11.9283022	0.0021322	-0.002158	3.9987804	0.00000	45.0000000	CY
0.0001888	14629.	77502012.	11.8496200	0.0022366	-0.002293	3.9986459	0.00000	45.0000000	CY
0.0001988	14787.	74398158.	11.7767933	0.0023406	-0.002429	3.9996185	0.00000	45.0000000	CY
0.0002088	14919.	71466880.	11.7113641	0.0024447	-0.002565	3.9996488	0.00000	45.0000000	CY
0.0002188	15031.	68712769.	11.6521945	0.0025489	-0.002701	3.9979945	0.00000	45.0000000	CY
0.0002288	15127.	66127339.	11.5978323	0.0026530	-0.002837	3.9990338	0.00000	45.0000000	CY
0.0002388	15208.	63698772.	11.5479825	0.0027571	-0.002973	3.9996620	0.00000	45.0000000	CY
0.0002488	15278.	61420234.	11.5029720	0.0028614	-0.003109	3.9998886	0.00000	45.0000000	CY
0.0002588	15339.	59281360.	11.4622926	0.0029659	-0.003244	3.9999425	0.00000	45.0000000	CY
0.0002688	15392.	57271545.	11.4253162	0.0030706	-0.003379	3.9999096	0.00000	45.0000000	CY
0.0002788	15437.	55378940.	11.3918991	0.0031755	-0.003515	3.9997358	0.00000	45.0000000	CY
0.0002888	15476.	53596052.	11.3606123	0.0032804	-0.003650	3.9992079	0.00000	45.0000000	CY
0.0002988	15510.	51916030.	11.3317850	0.0033854	-0.003785	3.9979741	0.00000	45.0000000	CY
0.0003088	15539.	50328991.	11.3061632	0.0034908	-0.003919	3.9964393	0.00000	45.0000000	CY
0.0003188	15565.	48830233.	11.2828071	0.0035964	-0.004054	3.9998608	0.00000	45.0000000	CY
0.0003288	15587.	47411507.	11.2617976	0.0037023	-0.004188	3.9983676	0.00000	45.0000000	CY
0.0003388	15605.	46066479.	11.2423206	0.0038083	-0.004322	3.9963897	0.00000	45.0000000	CY

Axial Thrust Force = 574.200 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	157.1397413	125711793.	179.9928224	0.0002250	0.0001950	0.8967562	0.00000	6.5203898	
0.00000250	314.2773618	125710945.	96.0073958	0.0002400	0.0001800	0.9520841	0.00000	6.9518362	
0.00000375	471.4107407	125709531.	68.0171357	0.0002551	0.0001651	1.0069815	0.00000	7.3838135	
0.00000500	628.5377572	125707551.	54.0256675	0.0002701	0.0001501	1.0614465	0.00000	7.8163218	
0.00000625	785.6562900	125705006.	45.6337162	0.0002852	0.0001352	1.1154773	0.00000	8.2493611	
0.00000750	942.7642177	125701896.	40.0415236	0.0003003	0.0001203	1.1690722	0.00000	8.6829314	
0.00000875	1100.	125698219.	36.0491933	0.0003154	0.0001054	1.2222292	0.00000	9.1170328	
0.00001000	1257.	125693977.	33.0567772	0.0003306	0.00009057	1.2749464	0.00000	9.5516654	
0.00001125	1414.	125689169.	30.7309709	0.0003457	0.00007572	1.3272222	0.00000	9.9868293	
0.00001250	1571.	125683795.	28.8717915	0.0003609	0.00006090	1.3790546	0.00000	10.4225245	
0.00001375	1728.	125677855.	27.3519775	0.0003761	0.00004609	1.4304417	0.00000	10.8587511	
0.00001500	1885.	125671348.	26.0866877	0.0003913	0.00003130	1.4813818	0.00000	11.2955092	
0.00001625	2042.	125664276.	25.0171862	0.0004065	0.00001653	1.5318730	0.00000	11.7327990	
0.00001750	2199.	125656637.	24.1015184	0.0004218	0.00000178	1.5819133	0.00000	12.1706206	
0.00001875	2356.	125648428.	23.3089178	0.0004370	-0.00001296	1.6315011	0.00000	12.6089741	
0.00002000	2513.	125639183.	22.6162934	0.0004523	-0.00002767	1.6806333	0.00000	13.0478502	
0.00002125	2670.	125627261.	22.0059409	0.0004676	-0.00004237	1.7293040	0.00000	13.4872106	
0.00002250	2826.	125611102.	21.4640759	0.0004829	-0.00005706	1.7775063	0.00000	13.9270092	
0.00002375	2983.	125589649.	20.9798185	0.0004983	-0.00007173	1.8252337	0.00000	14.3671998	
0.00002500	3139.	125562309.	20.5444715	0.0005136	-0.00008639	1.8724806	0.00000	14.8077417	
0.00002625	3295.	125528834.	20.1510012	0.0005290	-0.000101	1.9192420	0.00000	15.2485996	
0.00002750	3374.	122677918.	19.6819435	0.0005413	-0.000119	1.9562105	0.00000	15.6006500	C
0.00002875	3508.	122018450.	19.3292736	0.0005557	-0.000134	1.9993722	0.00000	16.0157319	C
0.00003000	3640.	121339823.	19.0026635	0.0005701	-0.000150	2.0417768	0.00000	16.4279171	C
0.00003125	3771.	120659431.	18.6996465	0.0005844	-0.000166	2.0834946	0.00000	16.8378042	C
0.00003250	3899.	119982179.	18.4176477	0.0005986	-0.000181	2.1245471	0.00000	17.2455328	C
0.00003375	4027.	119311211.	18.1544307	0.0006127	-0.000197	2.1649509	0.00000	17.6511989	C
0.00003500	4153.	118649265.	17.9080942	0.0006268	-0.000213	2.2047236	0.00000	18.0549153	C

0.00003625	4277.	117998711.	17.6770134	0.0006408	-0.000229	2.2438841	0.00000	18.4568104 C
0.00003750	4401.	117361583.	17.4597944	0.0006547	-0.000245	2.2824519	0.00000	18.8570265 C
0.00003875	4524.	116739607.	17.2552367	0.0006686	-0.000261	2.3204474	0.00000	19.2557223 C
0.00004000	4645.	116134225.	17.0623028	0.0006825	-0.000278	2.3578917	0.00000	19.6530714 C
0.00004125	4766.	115546619.	16.8800938	0.0006963	-0.000294	2.3948066	0.00000	20.0492623 C
0.00004250	4886.	114974355.	16.7075572	0.0007101	-0.000310	2.4311838	0.00000	20.4441643 C
0.00004375	5006.	114415881.	16.5437852	0.0007238	-0.000326	2.4670184	0.00000	20.8376774 C
0.00004500	5124.	113876832.	16.3885683	0.0007375	-0.000343	2.5023754	0.00000	21.2304817 C
0.00004625	5243.	113352938.	16.2409704	0.0007511	-0.000359	2.5372285	0.00000	21.6222517 C
0.00004750	5360.	112842941.	16.1003359	0.0007648	-0.000375	2.5715744	0.00000	22.0129128 C
0.00004875	5477.	112352418.	15.9667147	0.0007784	-0.000392	2.6054880	0.00000	22.4032931 C
0.00005125	5710.	111409536.	15.7170381	0.0008055	-0.000425	2.6718438	0.00000	23.1810980 C
0.00005375	5941.	110521448.	15.4888426	0.0008325	-0.000457	2.7363586	0.00000	23.9561836 C
0.00005625	6170.	109683874.	15.2794315	0.0008595	-0.000491	2.7990712	0.00000	24.7288228 C
0.00005875	6398.	108894162.	15.0866970	0.0008863	-0.000524	2.8600355	0.00000	25.4995102 C
0.00006125	6624.	108149591.	14.9088696	0.0009132	-0.000557	2.9193002	0.00000	26.2687297 C
0.00006375	6850.	107447615.	14.7444766	0.0009400	-0.000590	2.9769128	0.00000	27.0370013 C
0.00006625	7074.	106779501.	14.5914473	0.0009667	-0.000623	3.0328033	0.00000	27.8032683 C
0.00006875	7298.	106147650.	14.4492451	0.0009934	-0.000657	3.0870818	0.00000	28.5689326 C
0.00007125	7520.	105548362.	14.3167410	0.0010201	-0.000690	3.1397537	0.00000	29.3340163 C
0.00007375	7742.	104976751.	14.1926661	0.0010467	-0.000723	3.1907826	0.00000	30.0979148 C
0.00007625	7963.	104434219.	14.0767810	0.0010734	-0.000757	3.2402590	0.00000	30.8619323 C
0.00007875	8183.	103915142.	13.9678313	0.0011000	-0.000790	3.2881152	0.00000	31.6249849 C
0.00008125	8403.	103420093.	13.8656005	0.0011266	-0.000823	3.3344168	0.00000	32.3880714 C
0.00008375	8622.	102947312.	13.7695223	0.0011532	-0.000857	3.3791685	0.00000	33.1512775 C
0.00008625	8840.	102492489.	13.6786553	0.0011798	-0.000890	3.4223131	0.00000	33.9135868 C
0.00008875	9058.	102058495.	13.5933105	0.0012064	-0.000924	3.4639595	0.00000	34.6769331 C
0.00009125	9275.	101640395.	13.5124350	0.0012330	-0.000957	3.5040199	0.00000	35.4397314 C
0.00009375	9491.	101237901.	13.4358538	0.0012596	-0.000990	3.5425221	0.00000	36.2024779 C
0.00009625	9707.	100851863.	13.3636263	0.0012862	-0.001024	3.5795186	0.00000	36.9662722 C
0.00009875	9922.	100479469.	13.2951027	0.0013129	-0.001057	3.6149614	0.00000	37.7302005 C
0.0001013	10137.	100118633.	13.2297820	0.0013395	-0.001090	3.6488210	0.00000	38.4935977 C
0.0001038	10351.	99771024.	13.1679623	0.0013662	-0.001124	3.6811664	0.00000	39.2580570 C
0.0001063	10565.	99435680.	13.1093988	0.0013929	-0.001157	3.7119913	0.00000	40.0235854 C
0.0001088	10778.	99110261.	13.0535189	0.0014196	-0.001190	3.7412484	0.00000	40.7890855 C
0.0001113	10991.	98793967.	13.0001103	0.0014463	-0.001224	3.7689342	0.00000	41.5544563 C
0.0001138	11203.	98487722.	12.9493790	0.0014730	-0.001257	3.7950900	0.00000	42.3209144 C
0.0001163	11415.	98190853.	12.9011545	0.0014998	-0.001290	3.8197091	0.00000	43.0884673 C
0.0001188	11626.	97902743.	12.8552805	0.0015266	-0.001323	3.8427851	0.00000	43.8571225 C
0.0001213	11837.	97621415.	12.8112231	0.0015534	-0.001357	3.8642744	0.00000	44.6255134 C
0.0001238	12043.	97320888.	12.7705160	0.0015804	-0.001390	3.8843253	0.00000	45.0000000 CY
0.0001263	12242.	96968251.	12.7351453	0.0016078	-0.001422	3.9030852	0.00000	45.0000000 CY
0.0001288	12431.	96552668.	12.7056572	0.0016359	-0.001454	3.9205338	0.00000	45.0000000 CY
0.0001313	12612.	96090735.	12.6810459	0.0016644	-0.001486	3.9365155	0.00000	45.0000000 CY
0.0001338	12786.	95597268.	12.6603896	0.0016933	-0.001517	3.9508958	0.00000	45.0000000 CY
0.0001363	12955.	95082134.	12.6430428	0.0017226	-0.001547	3.9635727	0.00000	45.0000000 CY
0.0001388	13117.	94536152.	12.6273575	0.0017520	-0.001578	3.9744090	0.00000	45.0000000 CY
0.0001413	13267.	93922898.	12.6106614	0.0017813	-0.001609	3.9832767	0.00000	45.0000000 CY
0.0001438	13401.	93222717.	12.5910047	0.0018100	-0.001640	3.9901583	0.00000	45.0000000 CY
0.0001463	13520.	92444868.	12.5693058	0.0018383	-0.001672	3.9951680	0.00000	45.0000000 CY
0.0001488	13630.	91630479.	12.5463913	0.0018663	-0.001704	3.9983898	0.00000	45.0000000 CY
0.0001588	14002.	88202016.	12.4540737	0.0019771	-0.001833	3.9999779	0.00000	45.0000000 CY
0.0001688	14293.	84699715.	12.3649697	0.0020866	-0.001963	3.9994343	0.00000	45.0000000 CY
0.0001788	14527.	81271415.	12.2811705	0.0021953	-0.002095	3.9998169	0.00000	45.0000000 CY
0.0001888	14719.	77980637.	12.2041111	0.0023035	-0.002226	3.9998072	0.00000	45.0000000 CY
0.0001988	14877.	74855243.	12.1347606	0.0024118	-0.002358	3.9994034	0.00000	45.0000000 CY
0.0002088	15011.	71906803.	12.0706051	0.0025197	-0.002490	3.9979327	0.00000	45.0000000 CY
0.0002188	15123.	69132875.	12.0122808	0.0026277	-0.002622	3.9995577	0.00000	45.0000000 CY
0.0002288	15218.	66524894.	11.9595221	0.0027357	-0.002754	3.9999975	0.00000	45.0000000 CY
0.0002388	15299.	64078653.	11.9121418	0.0028440	-0.002886	3.9977238	0.00000	45.0000000 CY
0.0002488	15368.	61782459.	11.8690986	0.0029524	-0.003018	3.9983524	0.00000	45.0000000 CY
0.0002588	15427.	59622872.	11.8291126	0.0030608	-0.003149	3.9985073	0.00000	45.0000000 CY
0.0002688	15478.	57593856.	11.7930070	0.0031694	-0.003281	3.9982769	0.00000	45.0000000 CY
0.0002788	15522.	55685689.	11.7602440	0.0032782	-0.003412	3.9975741	0.00000	45.0000000 CY
0.0002888	15561.	53889415.	11.7304008	0.0033872	-0.003543	3.9965725	0.00000	45.0000000 CY
0.0002988	15593.	52194216.	11.7041521	0.0034966	-0.003673	3.9999905	0.00000	45.0000000 CY
0.0003088	15621.	50594132.	11.6799835	0.0036062	-0.003804	3.9994839	0.00000	45.0000000 CY
0.0003188	15645.	49080979.	11.6580501	0.0037160	-0.003934	3.9977720	0.00000	45.0000000 CY
0.0003288	15665.	47649636.	11.6384925	0.0038262	-0.004064	3.9978575	0.00000	45.0000000 CY

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	286.200	15026.863	0.00300000	-0.00414593
2	370.100	15187.006	0.00300000	-0.00379462
3	508.600	15356.226	0.00300000	-0.00328825
4	574.200	15394.301	0.00300000	-0.00307536

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	286.200000	15027.	186.030000	9767.	95767751.
2	0.65	370.100000	15187.	240.565000	9872.	97134928.
3	0.65	508.600000	15356.	330.590000	9982.	99326229.
4	0.65	574.200000	15394.	373.230000	10006.	100338358.
1	0.75	286.200000	15027.	214.650000	11270.	94371846.
2	0.75	370.100000	15187.	277.575000	11390.	95457947.
3	0.75	508.600000	15356.	381.450000	11517.	97200744.
4	0.75	574.200000	15394.	430.650000	11546.	98012149.
1	0.90	286.200000	15027.	257.580000	13524.	83773176.
2	0.90	370.100000	15187.	333.090000	13668.	86024711.
3	0.90	508.600000	15356.	457.740000	13821.	88678789.
4	0.90	574.200000	15394.	516.780000	13855.	89558518.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	21.3000	0.00	N.A.	Yes	N.A.	N.A.
2	30.7000	9.4000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 4100.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 370100.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.07409	-697912.	4100.	0.00	0.00	1.28E+11	0.00	0.00	6.3962
0.3625	0.07404	-679997.	4136.	-2.34E-05	0.00	1.28E+11	0.00	0.00	10.1700
0.7250	0.07389	-661853.	4180.	-4.62E-05	0.00	1.28E+11	0.00	0.00	10.1700
1.0875	0.07364	-643480.	4225.	-6.84E-05	0.00	1.28E+11	0.00	0.00	10.1700
1.4500	0.07329	-624879.	4269.	-8.99E-05	0.00	1.28E+11	0.00	0.00	10.1700
1.8125	0.07286	-606052.	4313.	-1.11E-04	0.00	1.28E+11	0.00	0.00	10.1700
2.1750	0.07233	-587000.	4357.	-1.31E-04	0.00	1.28E+11	0.00	0.00	10.1700
2.5375	0.07172	-567722.	4401.	-1.51E-04	0.00	1.28E+11	0.00	0.00	10.1700
2.9000	0.07102	-548222.	4446.	-1.70E-04	0.00	1.28E+11	0.00	0.00	10.1700
3.2625	0.07024	-528499.	4490.	-1.88E-04	0.00	1.28E+11	0.00	0.00	10.1700
3.6250	0.06938	-508554.	4534.	-2.06E-04	0.00	1.28E+11	0.00	0.00	10.1700
3.9875	0.06845	-488389.	4578.	-2.22E-04	0.00	1.28E+11	0.00	0.00	10.1700
4.3500	0.06745	-468005.	4623.	-2.39E-04	0.00	1.28E+11	0.00	0.00	10.1700
4.7125	0.06638	-447404.	4667.	-2.54E-04	0.00	1.28E+11	0.00	0.00	10.1700
5.0750	0.06524	-426585.	4711.	-2.69E-04	0.00	1.28E+11	0.00	0.00	10.1700
5.4375	0.06403	-405550.	4755.	-2.83E-04	0.00	1.28E+11	0.00	0.00	10.1700
5.8000	0.06277	-384301.	4800.	-2.97E-04	0.00	1.28E+11	0.00	0.00	10.1700
6.1625	0.06145	-362838.	4844.	-3.09E-04	0.00	1.28E+11	0.00	0.00	10.1700
6.5250	0.06008	-341163.	4888.	-3.21E-04	0.00	1.28E+11	0.00	0.00	10.1700
6.8875	0.05866	-319277.	4932.	-3.32E-04	0.00	1.28E+11	0.00	0.00	10.1700
7.2500	0.05719	-297181.	4977.	-3.43E-04	0.00	1.28E+11	0.00	0.00	10.1700
7.6125	0.05567	-274877.	5021.	-3.53E-04	0.00	1.28E+11	0.00	0.00	10.1700

7.9750	0.05412	-252365.	5065.	-3.62E-04	0.00	1.28E+11	0.00	0.00	10.1700
8.3375	0.05253	-229646.	5109.	-3.70E-04	0.00	1.28E+11	0.00	0.00	10.1700
8.7000	0.05090	-206723.	5154.	-3.77E-04	0.00	1.28E+11	0.00	0.00	10.1700
9.0625	0.04925	-183596.	5198.	-3.84E-04	0.00	1.28E+11	0.00	0.00	10.1700
9.4250	0.04756	-160266.	5242.	-3.90E-04	0.00	1.28E+11	0.00	0.00	10.1700
9.7875	0.04586	-136735.	5286.	-3.95E-04	0.00	1.28E+11	0.00	0.00	10.1700
10.1500	0.04413	-113005.	5330.	-3.99E-04	0.00	1.28E+11	0.00	0.00	10.1700
10.5125	0.04238	-89075.	5375.	-4.02E-04	0.00	1.28E+11	0.00	0.00	10.1700
10.8750	0.04063	-64949.	5419.	-4.05E-04	0.00	1.28E+11	0.00	0.00	10.1700
11.2375	0.03886	-40626.	5463.	-4.07E-04	0.00	1.28E+11	0.00	0.00	10.1700
11.6000	0.03709	-16109.	5507.	-4.08E-04	0.00	1.28E+11	0.00	0.00	10.1700
11.9625	0.03531	8602.	5552.	-4.08E-04	0.00	1.28E+11	0.00	0.00	10.1700
12.3250	0.03354	33504.	5596.	-4.07E-04	0.00	1.28E+11	0.00	0.00	10.1700
12.6875	0.03177	58598.	5640.	-4.06E-04	0.00	1.28E+11	0.00	0.00	10.1700
13.0500	0.03001	83880.	5684.	-4.03E-04	0.00	1.28E+11	0.00	0.00	10.1700
13.4125	0.02826	109350.	5729.	-4.00E-04	0.00	1.28E+11	0.00	0.00	10.1700
13.7750	0.02653	135007.	5773.	-3.96E-04	0.00	1.28E+11	0.00	0.00	10.1700
14.1375	0.02482	160849.	5817.	-3.91E-04	0.00	1.28E+11	0.00	0.00	10.1700
14.5000	0.02313	186874.	5861.	-3.85E-04	0.00	1.28E+11	0.00	0.00	10.1700
14.8625	0.02147	213082.	5906.	-3.78E-04	0.00	1.28E+11	0.00	0.00	10.1700
15.2250	0.01984	239470.	5950.	-3.70E-04	0.00	1.28E+11	0.00	0.00	10.1700
15.5875	0.01825	266038.	5994.	-3.62E-04	0.00	1.28E+11	0.00	0.00	10.1700
15.9500	0.01669	292784.	6038.	-3.52E-04	0.00	1.28E+11	0.00	0.00	10.1700
16.3125	0.01518	319706.	6083.	-3.42E-04	0.00	1.28E+11	0.00	0.00	10.1700
16.6750	0.01372	346803.	6127.	-3.31E-04	0.00	1.28E+11	0.00	0.00	10.1700
17.0375	0.01231	374074.	6171.	-3.18E-04	0.00	1.28E+11	0.00	0.00	10.1700
17.4000	0.01095	401516.	6215.	-3.05E-04	0.00	1.28E+11	0.00	0.00	10.1700
17.7625	0.00965	429129.	6260.	-2.91E-04	0.00	1.28E+11	0.00	0.00	10.1700
18.1250	0.00842	456911.	6304.	-2.76E-04	0.00	1.28E+11	0.00	0.00	10.1700
18.4875	0.00725	484861.	6348.	-2.60E-04	0.00	1.28E+11	0.00	0.00	10.1700
18.8500	0.00616	512976.	6392.	-2.43E-04	0.00	1.28E+11	0.00	0.00	10.1700
19.2125	0.00514	541256.	6436.	-2.25E-04	0.00	1.28E+11	0.00	0.00	10.1700
19.5750	0.00420	569699.	6481.	-2.06E-04	0.00	1.28E+11	0.00	0.00	10.1700
19.9375	0.00334	598303.	6525.	-1.86E-04	0.00	1.28E+11	0.00	0.00	10.1700
20.3000	0.00257	627066.	6569.	-1.66E-04	0.00	1.28E+11	0.00	0.00	10.1700
20.6625	0.00190	655988.	6613.	-1.44E-04	0.00	1.28E+11	0.00	0.00	10.1700
21.0250	0.00132	685066.	6658.	-1.21E-04	0.00	1.28E+11	0.00	0.00	10.1700
21.3875	8.46E-04	714300.	-2015.	-9.73E-05	0.00	1.28E+11	-3999.	2.06E+07	1.2274
21.7500	4.76E-04	667846.	-15600.	-7.39E-05	0.00	1.28E+11	-2248.	2.06E+07	0.00
22.1125	2.04E-04	578817.	-22584.	-5.27E-05	0.00	1.28E+11	-963.204	2.06E+07	0.00
22.4750	1.75E-05	471531.	-24859.	-3.48E-05	0.00	1.28E+11	-82.506	2.06E+07	0.00
22.8375	-9.93E-05	362657.	-24018.	-2.07E-05	0.00	1.28E+11	469.0028	2.06E+07	0.00
23.2000	-1.62E-04	262639.	-21329.	-1.01E-05	0.00	1.28E+11	767.3311	2.06E+07	0.00
23.5625	-1.87E-04	177126.	-17741.	-2.59E-06	0.00	1.28E+11	882.3056	2.06E+07	0.00
23.9250	-1.85E-04	108299.	-13922.	2.26E-06	0.00	1.28E+11	873.6253	2.06E+07	0.00
24.2875	-1.67E-04	55997.	-10305.	5.05E-06	0.00	1.28E+11	789.3398	2.06E+07	0.00
24.6500	-1.41E-04	18628.	-7140.	6.32E-06	0.00	1.28E+11	665.9620	2.06E+07	0.00
25.0125	-1.12E-04	-6140.	-4540.	6.53E-06	0.00	1.28E+11	529.5799	2.06E+07	0.00
25.3750	-8.41E-05	-20887.	-2523.	6.07E-06	0.00	1.28E+11	397.4844	2.06E+07	0.00
25.7375	-5.93E-05	-28112.	-1050.	5.24E-06	0.00	1.28E+11	279.9707	2.06E+07	0.00
26.1000	-3.85E-05	-30037.	-44.742	4.25E-06	0.00	1.28E+11	182.0822	2.06E+07	0.00
26.4625	-2.23E-05	-28514.	580.0159	3.26E-06	0.00	1.28E+11	105.1626	2.06E+07	0.00
26.8250	-1.02E-05	-25001.	913.4699	2.35E-06	0.00	1.28E+11	48.1496	2.06E+07	0.00
27.1875	-1.82E-06	-20575.	1037.	1.58E-06	0.00	1.28E+11	8.5900	2.06E+07	0.00
27.5500	3.51E-06	-15985.	1019.	9.54E-07	0.00	1.28E+11	-16.606	2.06E+07	0.00
27.9125	6.49E-06	-11709.	916.6794	4.84E-07	0.00	1.28E+11	-30.642	2.06E+07	0.00
28.2750	7.73E-06	-8012.	770.6350	1.49E-07	0.00	1.28E+11	-36.505	2.06E+07	0.00
28.6375	7.78E-06	-5005.	611.2544	-7.19E-08	0.00	1.28E+11	-36.774	2.06E+07	0.00
29.0000	7.10E-06	-2693.	458.3014	-2.03E-07	0.00	1.28E+11	-33.549	2.06E+07	0.00
29.3625	6.02E-06	-1017.	323.4650	-2.66E-07	0.00	1.28E+11	-28.444	2.06E+07	0.00
29.7250	4.79E-06	121.5888	212.3788	-2.81E-07	0.00	1.28E+11	-22.630	2.06E+07	0.00
30.0875	3.58E-06	831.7799	126.4020	-2.65E-07	0.00	1.28E+11	-16.900	2.06E+07	0.00
30.4500	2.49E-06	1222.	64.0871	-2.30E-07	0.00	1.28E+11	-11.751	2.06E+07	0.00
30.8125	1.58E-06	1390.	12.7929	-1.85E-07	0.00	1.28E+11	-11.833	3.26E+07	0.00
31.1750	8.74E-07	1334.	-27.199	-1.39E-07	0.00	1.28E+11	-6.554	3.26E+07	0.00
31.5375	3.67E-07	1154.	-47.444	-9.69E-08	0.00	1.28E+11	-2.754	3.26E+07	0.00
31.9000	3.10E-08	921.5824	-53.939	-6.16E-08	0.00	1.28E+11	-0.232	3.26E+07	0.00
32.2625	-1.69E-07	684.8272	-51.685	-3.44E-08	0.00	1.28E+11	1.2683	3.26E+07	0.00
32.6250	-2.68E-07	472.0343	-44.555	-1.47E-08	0.00	1.28E+11	2.0099	3.26E+07	0.00
32.9875	-2.97E-07	297.2485	-35.336	-1.65E-09	0.00	1.28E+11	2.2285	3.26E+07	0.00
33.3500	-2.82E-07	164.6146	-25.884	6.19E-09	0.00	1.28E+11	2.1176	3.26E+07	0.00
33.7125	-2.43E-07	72.0420	-17.310	1.02E-08	0.00	1.28E+11	1.8243	3.26E+07	0.00
34.0750	-1.93E-07	13.9864	-10.185	1.17E-08	0.00	1.28E+11	1.4512	3.26E+07	0.00
34.4375	-1.42E-07	-16.609	-4.718	1.16E-08	0.00	1.28E+11	1.0626	3.26E+07	0.00
34.8000	-9.23E-08	-27.096	-0.900	1.09E-08	0.00	1.28E+11	0.6924	3.26E+07	0.00
35.1625	-4.70E-08	-24.478	1.3718	1.00E-08	0.00	1.28E+11	0.3523	3.26E+07	0.00
35.5250	-5.23E-09	-15.193	2.2233	9.34E-09	0.00	1.28E+11	0.03923	3.26E+07	0.00
35.8875	3.43E-08	-5.165	1.7497	8.99E-09	0.00	1.28E+11	-0.257	3.26E+07	0.00
36.2500	7.30E-08	0.00	0.00	8.90E-09	0.00	1.28E+11	-0.547	1.63E+07	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.07409146 inches

```
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =        714300. inch-lbs
Maximum shear force              =        -24859. lbs
Depth of maximum bending moment  =    21.38750000 feet below pile head
Depth of maximum shear force     =    22.47500000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              4
Pile deflection at ground        =     0.00096129 inches
```

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 2, Shear and Slope

```
Shear      =           4100. lbs
Slope      =        0.00000
Axial Load =         370100. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
36.25000	0.07409146	714300.	-24859.
34.43750	0.07377705	712363.	-24704.
32.62500	0.07580754	720566.	-24976.
30.81250	0.07628080	722007.	-25238.
29.00000	0.07517837	716683.	-25144.
27.18750	0.07548477	717165.	-25058.
25.37500	0.07384234	709194.	-25050.
23.56250	0.08188392	-726150.	-39135.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

```
Shear force at pile head                          =       5300.0 lbs
Rotation of pile head                             =    0.000E+00 radians
Axial load at pile head                           =     574200.0 lbs
```

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.08740	-835438.	5300.	0.00	0.00	1.26E+11	0.00	0.00	3.2141
0.3625	0.08734	-812316.	5323.	-2.85E-05	0.00	1.26E+11	0.00	0.00	7.1700
0.7250	0.08716	-788989.	5354.	-5.62E-05	0.00	1.26E+11	0.00	0.00	7.1700
1.0875	0.08685	-765457.	5385.	-8.31E-05	0.00	1.26E+11	0.00	0.00	7.1700
1.4500	0.08643	-741724.	5416.	-1.09E-04	0.00	1.26E+11	0.00	0.00	7.1700
1.8125	0.08590	-717791.	5447.	-1.34E-04	0.00	1.26E+11	0.00	0.00	7.1700
2.1750	0.08526	-693661.	5479.	-1.59E-04	0.00	1.26E+11	0.00	0.00	7.1700
2.5375	0.08452	-669335.	5510.	-1.82E-04	0.00	1.26E+11	0.00	0.00	7.1700
2.9000	0.08368	-644815.	5541.	-2.05E-04	0.00	1.26E+11	0.00	0.00	7.1700
3.2625	0.08273	-620104.	5572.	-2.27E-04	0.00	1.26E+11	0.00	0.00	7.1700
3.6250	0.08170	-595203.	5603.	-2.48E-04	0.00	1.26E+11	0.00	0.00	7.1700
3.9875	0.08058	-570116.	5634.	-2.68E-04	0.00	1.26E+11	0.00	0.00	7.1700
4.3500	0.07937	-544843.	5666.	-2.88E-04	0.00	1.26E+11	0.00	0.00	7.1700
4.7125	0.07807	-519388.	5697.	-3.06E-04	0.00	1.26E+11	0.00	0.00	7.1700
5.0750	0.07670	-493752.	5728.	-3.23E-04	0.00	1.26E+11	0.00	0.00	7.1700
5.4375	0.07526	-467938.	5759.	-3.40E-04	0.00	1.26E+11	0.00	0.00	7.1700
5.8000	0.07374	-441947.	5790.	-3.56E-04	0.00	1.26E+11	0.00	0.00	7.1700
6.1625	0.07216	-415783.	5822.	-3.71E-04	0.00	1.26E+11	0.00	0.00	7.1700
6.5250	0.07052	-389447.	5853.	-3.85E-04	0.00	1.26E+11	0.00	0.00	7.1700
6.8875	0.06882	-362942.	5884.	-3.98E-04	0.00	1.26E+11	0.00	0.00	7.1700
7.2500	0.06706	-336270.	5915.	-4.10E-04	0.00	1.26E+11	0.00	0.00	7.1700
7.6125	0.06525	-309433.	5946.	-4.21E-04	0.00	1.26E+11	0.00	0.00	7.1700
7.9750	0.06340	-282434.	5978.	-4.31E-04	0.00	1.26E+11	0.00	0.00	7.1700
8.3375	0.06150	-255274.	6009.	-4.40E-04	0.00	1.26E+11	0.00	0.00	7.1700
8.7000	0.05957	-227957.	6040.	-4.49E-04	0.00	1.26E+11	0.00	0.00	7.1700
9.0625	0.05760	-200485.	6071.	-4.56E-04	0.00	1.26E+11	0.00	0.00	7.1700
9.4250	0.05560	-172859.	6102.	-4.63E-04	0.00	1.26E+11	0.00	0.00	7.1700
9.7875	0.05357	-145083.	6134.	-4.68E-04	0.00	1.26E+11	0.00	0.00	7.1700
10.1500	0.05152	-117159.	6165.	-4.73E-04	0.00	1.26E+11	0.00	0.00	7.1700
10.5125	0.04946	-89088.	6196.	-4.76E-04	0.00	1.26E+11	0.00	0.00	7.1700
10.8750	0.04738	-60875.	6227.	-4.79E-04	0.00	1.26E+11	0.00	0.00	7.1700
11.2375	0.04529	-32520.	6258.	-4.81E-04	0.00	1.26E+11	0.00	0.00	7.1700
11.6000	0.04320	-4027.	6289.	-4.81E-04	0.00	1.26E+11	0.00	0.00	7.1700
11.9625	0.04110	24602.	6321.	-4.81E-04	0.00	1.26E+11	0.00	0.00	7.1700
12.3250	0.03902	53364.	6352.	-4.79E-04	0.00	1.26E+11	0.00	0.00	7.1700
12.6875	0.03693	82258.	6383.	-4.77E-04	0.00	1.26E+11	0.00	0.00	7.1700
13.0500	0.03486	111280.	6414.	-4.74E-04	0.00	1.26E+11	0.00	0.00	7.1700
13.4125	0.03281	140428.	6445.	-4.69E-04	0.00	1.26E+11	0.00	0.00	7.1700

13.7750	0.03078	169700.	6477.	-4.64E-04	0.00	1.26E+11	0.00	0.00	7.1700
14.1375	0.02877	199093.	6508.	-4.58E-04	0.00	1.26E+11	0.00	0.00	7.1700
14.5000	0.02680	228604.	6539.	-4.50E-04	0.00	1.26E+11	0.00	0.00	7.1700
14.8625	0.02486	258231.	6570.	-4.42E-04	0.00	1.26E+11	0.00	0.00	7.1700
15.2250	0.02296	287971.	6601.	-4.32E-04	0.00	1.26E+11	0.00	0.00	7.1700
15.5875	0.02110	317823.	6633.	-4.22E-04	0.00	1.26E+11	0.00	0.00	7.1700
15.9500	0.01928	347782.	6664.	-4.10E-04	0.00	1.26E+11	0.00	0.00	7.1700
16.3125	0.01753	377847.	6695.	-3.98E-04	0.00	1.26E+11	0.00	0.00	7.1700
16.6750	0.01582	408015.	6726.	-3.84E-04	0.00	1.26E+11	0.00	0.00	7.1700
17.0375	0.01418	438284.	6757.	-3.70E-04	0.00	1.26E+11	0.00	0.00	7.1700
17.4000	0.01261	468650.	6788.	-3.54E-04	0.00	1.26E+11	0.00	0.00	7.1700
17.7625	0.01110	499112.	6820.	-3.37E-04	0.00	1.26E+11	0.00	0.00	7.1700
18.1250	0.00967	529666.	6851.	-3.19E-04	0.00	1.26E+11	0.00	0.00	7.1700
18.4875	0.00833	560310.	6882.	-3.01E-04	0.00	1.26E+11	0.00	0.00	7.1700
18.8500	0.00706	591041.	6913.	-2.81E-04	0.00	1.26E+11	0.00	0.00	7.1700
19.2125	0.00588	621857.	6944.	-2.60E-04	0.00	1.26E+11	0.00	0.00	7.1700
19.5750	0.00480	652754.	6976.	-2.38E-04	0.00	1.26E+11	0.00	0.00	7.1700
19.9375	0.00382	683731.	7007.	-2.14E-04	0.00	1.26E+11	0.00	0.00	7.1700
20.3000	0.00294	714785.	7038.	-1.90E-04	0.00	1.26E+11	0.00	0.00	7.1700
20.6625	0.00216	745912.	7069.	-1.65E-04	0.00	1.26E+11	0.00	0.00	7.1700
21.0250	0.00150	777111.	7100.	-1.39E-04	0.00	1.26E+11	0.00	0.00	7.1700
21.3875	9.57E-04	808378.	-2716.	-1.11E-04	0.00	1.26E+11	-4521.	2.06E+07	0.8653
21.7500	5.34E-04	754034.	-18039.	-8.41E-05	0.00	1.26E+11	-2524.	2.06E+07	0.00
22.1125	2.25E-04	651861.	-25841.	-5.98E-05	0.00	1.26E+11	-1063.	2.06E+07	0.00
22.4750	1.39E-05	529512.	-28297.	-3.94E-05	0.00	1.26E+11	-65.858	2.06E+07	0.00
22.8375	-1.17E-04	405872.	-27233.	-2.32E-05	0.00	1.26E+11	554.8812	2.06E+07	0.00
23.2000	-1.88E-04	292697.	-24097.	-1.11E-05	0.00	1.26E+11	886.9513	2.06E+07	0.00
23.5625	-2.14E-04	196280.	-19970.	-2.63E-06	0.00	1.26E+11	1011.	2.06E+07	0.00
23.9250	-2.11E-04	118973.	-15607.	2.82E-06	0.00	1.26E+11	995.1462	2.06E+07	0.00
24.2875	-1.89E-04	60487.	-11496.	5.93E-06	0.00	1.26E+11	894.8284	2.06E+07	0.00
24.6500	-1.59E-04	18928.	-7915.	7.30E-06	0.00	1.26E+11	751.4912	2.06E+07	0.00
25.0125	-1.26E-04	-8413.	-4987.	7.48E-06	0.00	1.26E+11	594.6923	2.06E+07	0.00
25.3750	-9.39E-05	-24500.	-2728.	6.91E-06	0.00	1.26E+11	443.8768	2.06E+07	0.00
25.7375	-6.57E-05	-32185.	-1088.	5.93E-06	0.00	1.26E+11	310.4861	2.06E+07	0.00
26.1000	-4.23E-05	-33993.	22.5462	4.79E-06	0.00	1.26E+11	199.9860	2.06E+07	0.00
26.4625	-2.41E-05	-32013.	704.7311	3.65E-06	0.00	1.26E+11	113.6622	2.06E+07	0.00
26.8250	-1.06E-05	-27880.	1061.	2.61E-06	0.00	1.26E+11	50.1067	2.06E+07	0.00
27.1875	-1.35E-06	-22796.	1184.	1.73E-06	0.00	1.26E+11	6.3797	2.06E+07	0.00
27.5500	4.47E-06	-17589.	1152.	1.03E-06	0.00	1.26E+11	-21.134	2.06E+07	0.00
27.9125	7.65E-06	-12781.	1027.	5.09E-07	0.00	1.26E+11	-36.138	2.06E+07	0.00
28.2750	8.90E-06	-8656.	857.0617	1.38E-07	0.00	1.26E+11	-42.052	2.06E+07	0.00
28.6375	8.85E-06	-5326.	674.6615	-1.04E-07	0.00	1.26E+11	-41.810	2.06E+07	0.00
29.0000	8.00E-06	-2786.	501.5540	-2.44E-07	0.00	1.26E+11	-37.780	2.06E+07	0.00
29.3625	6.72E-06	-960.801	350.2869	-3.09E-07	0.00	1.26E+11	-31.768	2.06E+07	0.00
29.7250	5.31E-06	263.1922	226.6557	-3.21E-07	0.00	1.26E+11	-25.074	2.06E+07	0.00
30.0875	3.93E-06	1013.	131.7397	-2.99E-07	0.00	1.26E+11	-18.566	2.06E+07	0.00
30.4500	2.70E-06	1411.	63.5651	-2.57E-07	0.00	1.26E+11	-12.779	2.06E+07	0.00
30.8125	1.69E-06	1567.	8.1707	-2.06E-07	0.00	1.26E+11	-12.690	3.26E+07	0.00
31.1750	9.15E-07	1483.	-34.363	-1.53E-07	0.00	1.26E+11	-6.866	3.26E+07	0.00
31.5375	3.62E-07	1269.	-55.201	-1.05E-07	0.00	1.26E+11	-2.715	3.26E+07	0.00
31.9000	-3.77E-10	1003.	-61.100	-6.60E-08	0.00	1.26E+11	0.00283	3.26E+07	0.00
32.2625	-2.12E-07	737.5747	-57.640	-3.58E-08	0.00	1.26E+11	1.5883	3.26E+07	0.00
32.6250	-3.12E-07	501.9275	-49.093	-1.44E-08	0.00	1.26E+11	2.3410	3.26E+07	0.00
32.9875	-3.37E-07	310.5354	-38.505	-3.33E-10	0.00	1.26E+11	2.5272	3.26E+07	0.00
33.3500	-3.15E-07	166.9372	-27.869	7.93E-09	0.00	1.26E+11	2.3628	3.26E+07	0.00
33.7125	-2.68E-07	68.0340	-18.359	1.20E-08	0.00	1.26E+11	2.0099	3.26E+07	0.00
34.0750	-2.11E-07	7.1567	-10.550	1.33E-08	0.00	1.26E+11	1.5802	3.26E+07	0.00
34.4375	-1.52E-07	-23.820	-4.629	1.30E-08	0.00	1.26E+11	1.1424	3.26E+07	0.00
34.8000	-9.75E-08	-33.178	-0.553	1.20E-08	0.00	1.26E+11	0.7315	3.26E+07	0.00
35.1625	-4.77E-08	-28.690	1.8171	1.09E-08	0.00	1.26E+11	0.3581	3.26E+07	0.00
35.5250	-2.28E-09	-17.424	2.6331	1.02E-08	0.00	1.26E+11	0.01707	3.26E+07	0.00
35.8875	4.06E-08	-5.833	2.0083	9.75E-09	0.00	1.26E+11	-0.304	3.26E+07	0.00
36.2500	8.25E-08	0.00	0.00	9.65E-09	0.00	1.26E+11	-0.619	1.63E+07	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     0.08740342 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =       -835438. inch-lbs
Maximum shear force              =        -28297. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =    22.47500000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              4
Pile deflection at ground        =     0.00108833 inches
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 2, Shear and Slope

Shear = 5300. lbs
Slope = 0.00000
Axial Load = 574200. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
36.25000	0.08740342	-835438.	-28297.
34.43750	0.08703978	-834179.	-28145.
32.62500	0.08938545	-842293.	-28349.
30.81250	0.08993179	-844169.	-28665.
29.00000	0.08865774	-839803.	-28595.
27.18750	0.08901106	-841037.	-28524.
25.37500	0.08711114	-834468.	-28433.
23.56250	0.09624930	-867226.	-44347.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 1400.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 286200.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.04897	-403445.	1400.	0.00	0.00	1.29E+11	0.00	0.00	12.7141
0.3625	0.04894	-397226.	1464.	-1.35E-05	0.00	1.29E+11	0.00	0.00	16.6700
0.7250	0.04885	-390675.	1536.	-2.68E-05	0.00	1.29E+11	0.00	0.00	16.6700
1.0875	0.04871	-383793.	1609.	-3.98E-05	0.00	1.29E+11	0.00	0.00	16.6700
1.4500	0.04851	-376578.	1681.	-5.27E-05	0.00	1.29E+11	0.00	0.00	16.6700
1.8125	0.04825	-369033.	1754.	-6.52E-05	0.00	1.29E+11	0.00	0.00	16.6700
2.1750	0.04794	-361156.	1826.	-7.75E-05	0.00	1.29E+11	0.00	0.00	16.6700
2.5375	0.04757	-352949.	1899.	-8.96E-05	0.00	1.29E+11	0.00	0.00	16.6700
2.9000	0.04716	-344412.	1972.	-1.01E-04	0.00	1.29E+11	0.00	0.00	16.6700
3.2625	0.04669	-335545.	2044.	-1.13E-04	0.00	1.29E+11	0.00	0.00	16.6700
3.6250	0.04618	-326348.	2117.	-1.24E-04	0.00	1.29E+11	0.00	0.00	16.6700
3.9875	0.04561	-316822.	2189.	-1.35E-04	0.00	1.29E+11	0.00	0.00	16.6700
4.3500	0.04500	-306968.	2262.	-1.45E-04	0.00	1.29E+11	0.00	0.00	16.6700
4.7125	0.04435	-296785.	2334.	-1.55E-04	0.00	1.29E+11	0.00	0.00	16.6700
5.0750	0.04365	-286274.	2407.	-1.65E-04	0.00	1.29E+11	0.00	0.00	16.6700
5.4375	0.04291	-275436.	2479.	-1.75E-04	0.00	1.29E+11	0.00	0.00	16.6700
5.8000	0.04213	-264271.	2552.	-1.84E-04	0.00	1.29E+11	0.00	0.00	16.6700
6.1625	0.04131	-252779.	2624.	-1.93E-04	0.00	1.29E+11	0.00	0.00	16.6700
6.5250	0.04046	-240961.	2697.	-2.01E-04	0.00	1.29E+11	0.00	0.00	16.6700
6.8875	0.03956	-228818.	2769.	-2.09E-04	0.00	1.29E+11	0.00	0.00	16.6700
7.2500	0.03864	-216349.	2842.	-2.16E-04	0.00	1.29E+11	0.00	0.00	16.6700
7.6125	0.03768	-203556.	2914.	-2.23E-04	0.00	1.29E+11	0.00	0.00	16.6700
7.9750	0.03670	-190440.	2987.	-2.30E-04	0.00	1.29E+11	0.00	0.00	16.6700
8.3375	0.03568	-176999.	3059.	-2.36E-04	0.00	1.29E+11	0.00	0.00	16.6700
8.7000	0.03464	-163236.	3132.	-2.42E-04	0.00	1.29E+11	0.00	0.00	16.6700
9.0625	0.03358	-149150.	3204.	-2.47E-04	0.00	1.29E+11	0.00	0.00	16.6700
9.4250	0.03249	-134743.	3277.	-2.52E-04	0.00	1.29E+11	0.00	0.00	16.6700
9.7875	0.03138	-120015.	3349.	-2.56E-04	0.00	1.29E+11	0.00	0.00	16.6700
10.1500	0.03026	-104966.	3422.	-2.60E-04	0.00	1.29E+11	0.00	0.00	16.6700
10.5125	0.02912	-89598.	3494.	-2.63E-04	0.00	1.29E+11	0.00	0.00	16.6700
10.8750	0.02797	-73910.	3567.	-2.66E-04	0.00	1.29E+11	0.00	0.00	16.6700
11.2375	0.02680	-57903.	3639.	-2.68E-04	0.00	1.29E+11	0.00	0.00	16.6700
11.6000	0.02563	-41579.	3712.	-2.70E-04	0.00	1.29E+11	0.00	0.00	16.6700
11.9625	0.02445	-24938.	3784.	-2.71E-04	0.00	1.29E+11	0.00	0.00	16.6700
12.3250	0.02327	-7980.	3857.	-2.72E-04	0.00	1.29E+11	0.00	0.00	16.6700
12.6875	0.02209	9294.	3929.	-2.72E-04	0.00	1.29E+11	0.00	0.00	16.6700
13.0500	0.02091	26882.	4002.	-2.71E-04	0.00	1.29E+11	0.00	0.00	16.6700
13.4125	0.01973	44785.	4074.	-2.70E-04	0.00	1.29E+11	0.00	0.00	16.6700
13.7750	0.01856	63002.	4147.	-2.68E-04	0.00	1.29E+11	0.00	0.00	16.6700
14.1375	0.01740	81531.	4219.	-2.66E-04	0.00	1.29E+11	0.00	0.00	16.6700
14.5000	0.01625	100373.	4292.	-2.63E-04	0.00	1.29E+11	0.00	0.00	16.6700
14.8625	0.01511	119525.	4364.	-2.59E-04	0.00	1.29E+11	0.00	0.00	16.6700
15.2250	0.01400	138988.	4437.	-2.55E-04	0.00	1.29E+11	0.00	0.00	16.6700
15.5875	0.01290	158761.	4510.	-2.49E-04	0.00	1.29E+11	0.00	0.00	16.6700
15.9500	0.01183	178843.	4582.	-2.44E-04	0.00	1.29E+11	0.00	0.00	16.6700
16.3125	0.01078	199232.	4655.	-2.37E-04	0.00	1.29E+11	0.00	0.00	16.6700
16.6750	0.00976	219928.	4727.	-2.30E-04	0.00	1.29E+11	0.00	0.00	16.6700
17.0375	0.00878	240931.	4800.	-2.23E-04	0.00	1.29E+11	0.00	0.00	16.6700
17.4000	0.00782	262239.	4872.	-2.14E-04	0.00	1.29E+11	0.00	0.00	16.6700
17.7625	0.00691	283851.	4945.	-2.05E-04	0.00	1.29E+11	0.00	0.00	16.6700
18.1250	0.00604	305767.	5017.	-1.95E-04	0.00	1.29E+11	0.00	0.00	16.6700
18.4875	0.00522	327986.	5090.	-1.84E-04	0.00	1.29E+11	0.00	0.00	16.6700
18.8500	0.00444	350506.	5162.	-1.73E-04	0.00	1.29E+11	0.00	0.00	16.6700
19.2125	0.00371	373327.	5235.	-1.61E-04	0.00	1.29E+11	0.00	0.00	16.6700

19.5750	0.00304	396447.	5307.	-1.48E-04	0.00	1.29E+11	0.00	0.00	16.6700
19.9375	0.00243	419867.	5380.	-1.34E-04	0.00	1.29E+11	0.00	0.00	16.6700
20.3000	0.00188	443584.	5452.	-1.19E-04	0.00	1.29E+11	0.00	0.00	16.6700
20.6625	0.00139	467598.	5525.	-1.04E-04	0.00	1.29E+11	0.00	0.00	16.6700
21.0250	9.71E-04	491908.	5597.	-8.78E-05	0.00	1.29E+11	0.00	0.00	16.6700
21.3875	6.25E-04	516513.	-786.556	-7.08E-05	0.00	1.29E+11	-2954.	2.06E+07	2.0119
21.7500	3.55E-04	485241.	-10854.	-5.39E-05	0.00	1.29E+11	-1677.	2.06E+07	0.00
22.1125	1.56E-04	422214.	-16105.	-3.86E-05	0.00	1.29E+11	-736.801	2.06E+07	0.00
22.4750	1.88E-05	345226.	-17901.	-2.57E-05	0.00	1.29E+11	-89.036	2.06E+07	0.00
22.8375	-6.76E-05	266540.	-17400.	-1.54E-05	0.00	1.29E+11	319.4959	2.06E+07	0.00
23.2000	-1.15E-04	193887.	-15523.	-7.62E-06	0.00	1.29E+11	543.3243	2.06E+07	0.00
23.5625	-1.34E-04	131508.	-12965.	-2.14E-06	0.00	1.29E+11	632.7949	2.06E+07	0.00
23.9250	-1.34E-04	81097.	-10216.	1.45E-06	0.00	1.29E+11	631.1350	2.06E+07	0.00
24.2875	-1.21E-04	42626.	-7596.	3.53E-06	0.00	1.29E+11	573.2774	2.06E+07	0.00
24.6500	-1.03E-04	15000.	-5293.	4.50E-06	0.00	1.29E+11	485.8818	2.06E+07	0.00
25.0125	-8.21E-05	-3432.	-3392.	4.70E-06	0.00	1.29E+11	388.0916	2.06E+07	0.00
25.3750	-6.19E-05	-14520.	-1911.	4.40E-06	0.00	1.29E+11	292.6796	2.06E+07	0.00
25.7375	-4.39E-05	-20070.	-823.595	3.81E-06	0.00	1.29E+11	207.3297	2.06E+07	0.00
26.1000	-2.88E-05	-21695.	-77.098	3.11E-06	0.00	1.29E+11	135.8873	2.06E+07	0.00
26.4625	-1.68E-05	-20748.	391.3230	2.39E-06	0.00	1.29E+11	79.4788	2.06E+07	0.00
26.8250	-7.93E-06	-18296.	645.6390	1.74E-06	0.00	1.29E+11	37.4481	2.06E+07	0.00
27.1875	-1.71E-06	-15135.	744.6977	1.17E-06	0.00	1.29E+11	8.0962	2.06E+07	0.00
27.5500	2.28E-06	-11820.	738.8876	7.19E-07	0.00	1.29E+11	-10.767	2.06E+07	0.00
27.9125	4.54E-06	-8709.	668.8368	3.72E-07	0.00	1.29E+11	-21.440	2.06E+07	0.00
28.2750	5.52E-06	-6003.	565.4870	1.24E-07	0.00	1.29E+11	-26.077	2.06E+07	0.00
28.6375	5.62E-06	-3789.	451.0114	-4.06E-08	0.00	1.29E+11	-26.555	2.06E+07	0.00
29.0000	5.17E-06	-2079.	340.1682	-1.40E-07	0.00	1.29E+11	-24.407	2.06E+07	0.00
29.3625	4.41E-06	-829.614	241.8020	-1.89E-07	0.00	1.29E+11	-20.819	2.06E+07	0.00
29.7250	3.52E-06	25.5065	160.2961	-2.02E-07	0.00	1.29E+11	-16.655	2.06E+07	0.00
30.0875	2.65E-06	565.4655	96.8623	-1.92E-07	0.00	1.29E+11	-12.510	2.06E+07	0.00
30.4500	1.85E-06	868.6872	50.6100	-1.68E-07	0.00	1.29E+11	-8.756	2.06E+07	0.00
30.8125	1.19E-06	1006.	12.2194	-1.36E-07	0.00	1.29E+11	-8.895	3.26E+07	0.00
31.1750	6.67E-07	975.3352	-18.000	-1.03E-07	0.00	1.29E+11	-4.999	3.26E+07	0.00
31.5375	2.90E-07	849.8468	-33.604	-7.22E-08	0.00	1.29E+11	-2.175	3.26E+07	0.00
31.9000	3.83E-08	683.1569	-38.960	-4.64E-08	0.00	1.29E+11	-0.287	3.26E+07	0.00
32.2625	-1.13E-07	511.0098	-37.735	-2.62E-08	0.00	1.29E+11	0.8503	3.26E+07	0.00
32.6250	-1.90E-07	354.9309	-32.785	-1.16E-08	0.00	1.29E+11	1.4254	3.26E+07	0.00
32.9875	-2.15E-07	225.8089	-26.183	-1.85E-09	0.00	1.29E+11	1.6101	3.26E+07	0.00
33.3500	-2.06E-07	127.1439	-19.318	4.10E-09	0.00	1.29E+11	1.5464	3.26E+07	0.00
33.7125	-1.79E-07	57.7349	-13.034	7.21E-09	0.00	1.29E+11	1.3428	3.26E+07	0.00
34.0750	-1.43E-07	13.7333	-7.773	8.42E-09	0.00	1.29E+11	1.0758	3.26E+07	0.00
34.4375	-1.06E-07	-9.912	-3.707	8.48E-09	0.00	1.29E+11	0.7936	3.26E+07	0.00
34.8000	-6.97E-08	-18.540	-0.845	8.00E-09	0.00	1.29E+11	0.5224	3.26E+07	0.00
35.1625	-3.62E-08	-17.282	0.8819	7.40E-09	0.00	1.29E+11	0.2715	3.26E+07	0.00
35.5250	-5.29E-09	-10.886	1.5588	6.92E-09	0.00	1.29E+11	0.03968	3.26E+07	0.00
35.8875	2.40E-08	-3.738	1.2531	6.68E-09	0.00	1.29E+11	-0.180	3.26E+07	0.00
36.2500	5.28E-08	0.00	0.00	6.61E-09	0.00	1.29E+11	-0.396	1.63E+07	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 3:

```
Pile-head deflection             =     0.04896945 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =        516513. inch-lbs
Maximum shear force              =        -17901. lbs
Depth of maximum bending moment  =    21.38750000 feet below pile head
Depth of maximum shear force     =    22.47500000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              4
Pile deflection at ground        =     0.00070864 inches
```

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 2, Shear and Slope

```
Shear      =           1400. lbs
Slope      =        0.00000
Axial Load =         286200. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
36.25000	0.04896945	516513.	-17901.
34.43750	0.04874016	514786.	-17757.
32.62500	0.05022540	522279.	-18098.
30.81250	0.05057243	523626.	-18277.
29.00000	0.04976592	518833.	-18154.
27.18750	0.04999025	519327.	-18070.

25.37500	0.04879031	512137.	-18104.
23.56250	0.05467897	500945.	-28390.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 4

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 5500.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 508600.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.09792	-919303.	5500.	0.00	0.00	1.26E+11	0.00	0.00	7.7941
0.3625	0.09785	-895269.	5543.	-3.12E-05	0.00	1.26E+11	0.00	0.00	11.7500
0.7250	0.09765	-870945.	5594.	-6.16E-05	0.00	1.26E+11	0.00	0.00	11.7500
1.0875	0.09732	-846332.	5645.	-9.11E-05	0.00	1.26E+11	0.00	0.00	11.7500
1.4500	0.09686	-821432.	5696.	-1.20E-04	0.00	1.26E+11	0.00	0.00	11.7500
1.8125	0.09627	-796248.	5747.	-1.48E-04	0.00	1.26E+11	0.00	0.00	11.7500
2.1750	0.09557	-770781.	5798.	-1.75E-04	0.00	1.26E+11	0.00	0.00	11.7500
2.5375	0.09476	-745032.	5849.	-2.01E-04	0.00	1.26E+11	0.00	0.00	11.7500
2.9000	0.09383	-719005.	5900.	-2.26E-04	0.00	1.26E+11	0.00	0.00	11.7500
3.2625	0.09279	-692701.	5951.	-2.50E-04	0.00	1.26E+11	0.00	0.00	11.7500
3.6250	0.09165	-666121.	6003.	-2.73E-04	0.00	1.26E+11	0.00	0.00	11.7500
3.9875	0.09041	-639269.	6054.	-2.96E-04	0.00	1.26E+11	0.00	0.00	11.7500
4.3500	0.08908	-612145.	6105.	-3.17E-04	0.00	1.26E+11	0.00	0.00	11.7500
4.7125	0.08765	-584753.	6156.	-3.38E-04	0.00	1.26E+11	0.00	0.00	11.7500
5.0750	0.08614	-557094.	6207.	-3.58E-04	0.00	1.26E+11	0.00	0.00	11.7500
5.4375	0.08454	-529170.	6258.	-3.76E-04	0.00	1.26E+11	0.00	0.00	11.7500
5.8000	0.08286	-500983.	6309.	-3.94E-04	0.00	1.26E+11	0.00	0.00	11.7500
6.1625	0.08111	-472536.	6360.	-4.11E-04	0.00	1.26E+11	0.00	0.00	11.7500
6.5250	0.07929	-443831.	6411.	-4.27E-04	0.00	1.26E+11	0.00	0.00	11.7500
6.8875	0.07740	-414869.	6463.	-4.41E-04	0.00	1.26E+11	0.00	0.00	11.7500
7.2500	0.07545	-385654.	6514.	-4.55E-04	0.00	1.26E+11	0.00	0.00	11.7500
7.6125	0.07344	-356187.	6565.	-4.68E-04	0.00	1.26E+11	0.00	0.00	11.7500
7.9750	0.07138	-326470.	6616.	-4.80E-04	0.00	1.26E+11	0.00	0.00	11.7500
8.3375	0.06927	-296507.	6667.	-4.90E-04	0.00	1.26E+11	0.00	0.00	11.7500
8.7000	0.06711	-266298.	6718.	-5.00E-04	0.00	1.26E+11	0.00	0.00	11.7500
9.0625	0.06492	-235847.	6769.	-5.09E-04	0.00	1.26E+11	0.00	0.00	11.7500
9.4250	0.06269	-205156.	6820.	-5.16E-04	0.00	1.26E+11	0.00	0.00	11.7500
9.7875	0.06043	-174226.	6871.	-5.23E-04	0.00	1.26E+11	0.00	0.00	11.7500
10.1500	0.05814	-143061.	6923.	-5.28E-04	0.00	1.26E+11	0.00	0.00	11.7500
10.5125	0.05583	-111663.	6974.	-5.33E-04	0.00	1.26E+11	0.00	0.00	11.7500
10.8750	0.05351	-80034.	7025.	-5.36E-04	0.00	1.26E+11	0.00	0.00	11.7500
11.2375	0.05117	-48176.	7076.	-5.38E-04	0.00	1.26E+11	0.00	0.00	11.7500
11.6000	0.04883	-16093.	7127.	-5.39E-04	0.00	1.26E+11	0.00	0.00	11.7500
11.9625	0.04648	16214.	7178.	-5.39E-04	0.00	1.26E+11	0.00	0.00	11.7500
12.3250	0.04414	48742.	7229.	-5.38E-04	0.00	1.26E+11	0.00	0.00	11.7500
12.6875	0.04180	81489.	7280.	-5.36E-04	0.00	1.26E+11	0.00	0.00	11.7500
13.0500	0.03947	114452.	7331.	-5.32E-04	0.00	1.26E+11	0.00	0.00	11.7500
13.4125	0.03717	147629.	7383.	-5.28E-04	0.00	1.26E+11	0.00	0.00	11.7500
13.7750	0.03488	181016.	7434.	-5.22E-04	0.00	1.26E+11	0.00	0.00	11.7500
14.1375	0.03262	214612.	7485.	-5.15E-04	0.00	1.26E+11	0.00	0.00	11.7500
14.5000	0.03040	248415.	7536.	-5.08E-04	0.00	1.26E+11	0.00	0.00	11.7500
14.8625	0.02821	282420.	7587.	-4.98E-04	0.00	1.26E+11	0.00	0.00	11.7500
15.2250	0.02606	316627.	7638.	-4.88E-04	0.00	1.26E+11	0.00	0.00	11.7500
15.5875	0.02396	351032.	7689.	-4.77E-04	0.00	1.26E+11	0.00	0.00	11.7500
15.9500	0.02191	385632.	7740.	-4.64E-04	0.00	1.26E+11	0.00	0.00	11.7500
16.3125	0.01993	420425.	7791.	-4.50E-04	0.00	1.26E+11	0.00	0.00	11.7500
16.6750	0.01800	455409.	7843.	-4.35E-04	0.00	1.26E+11	0.00	0.00	11.7500
17.0375	0.01614	490581.	7894.	-4.19E-04	0.00	1.26E+11	0.00	0.00	11.7500
17.4000	0.01436	525937.	7945.	-4.01E-04	0.00	1.26E+11	0.00	0.00	11.7500
17.7625	0.01265	561476.	7996.	-3.83E-04	0.00	1.26E+11	0.00	0.00	11.7500
18.1250	0.01103	597194.	8047.	-3.63E-04	0.00	1.26E+11	0.00	0.00	11.7500
18.4875	0.00950	633089.	8098.	-3.41E-04	0.00	1.26E+11	0.00	0.00	11.7500
18.8500	0.00806	669159.	8149.	-3.19E-04	0.00	1.26E+11	0.00	0.00	11.7500
19.2125	0.00672	705400.	8200.	-2.95E-04	0.00	1.26E+11	0.00	0.00	11.7500
19.5750	0.00549	741809.	8251.	-2.71E-04	0.00	1.26E+11	0.00	0.00	11.7500
19.9375	0.00437	778385.	8303.	-2.44E-04	0.00	1.26E+11	0.00	0.00	11.7500
20.3000	0.00336	815123.	8354.	-2.17E-04	0.00	1.26E+11	0.00	0.00	11.7500
20.6625	0.00248	852022.	8405.	-1.88E-04	0.00	1.26E+11	0.00	0.00	11.7500
21.0250	0.00172	889078.	8456.	-1.58E-04	0.00	1.26E+11	0.00	0.00	11.7500
21.3875	0.00110	926289.	-2819.	-1.27E-04	0.00	1.26E+11	-5197.	2.06E+07	1.4181
21.7500	6.16E-04	865117.	-20450.	-9.64E-05	0.00	1.26E+11	-2911.	2.06E+07	0.00
22.1125	2.62E-04	748800.	-29470.	-6.86E-05	0.00	1.26E+11	-1236.	2.06E+07	0.00
22.4750	1.93E-05	609035.	-32356.	-4.52E-05	0.00	1.26E+11	-90.989	2.06E+07	0.00
22.8375	-1.32E-04	467501.	-31198.	-2.67E-05	0.00	1.26E+11	623.6678	2.06E+07	0.00
23.2000	-2.13E-04	337733.	-27649.	-1.29E-05	0.00	1.26E+11	1008.	2.06E+07	0.00
23.5625	-2.44E-04	227010.	-22949.	-3.17E-06	0.00	1.26E+11	1153.	2.06E+07	0.00
23.9250	-2.41E-04	138092.	-17965.	3.11E-06	0.00	1.26E+11	1138.	2.06E+07	0.00
24.2875	-2.17E-04	70701.	-13259.	6.70E-06	0.00	1.26E+11	1026.	2.06E+07	0.00
24.6500	-1.83E-04	22710.	-9152.	8.30E-06	0.00	1.26E+11	862.8398	2.06E+07	0.00
25.0125	-1.45E-04	-8956.	-5787.	8.54E-06	0.00	1.26E+11	684.1230	2.06E+07	0.00

25.3750	-1.08E-04	-27676.	-3186.	7.91E-06	0.00	1.26E+11	511.7375	2.06E+07	0.00
25.7375	-7.60E-05	-36711.	-1292.	6.80E-06	0.00	1.26E+11	358.9167	2.06E+07	0.00
26.1000	-4.91E-05	-38951.	-7.135	5.50E-06	0.00	1.26E+11	232.0474	2.06E+07	0.00
26.4625	-2.81E-05	-36797.	786.2193	4.20E-06	0.00	1.26E+11	132.7131	2.06E+07	0.00
26.8250	-1.26E-05	-32129.	1204.	3.01E-06	0.00	1.26E+11	59.3913	2.06E+07	0.00
27.1875	-1.86E-06	-26335.	1352.	2.01E-06	0.00	1.26E+11	8.7824	2.06E+07	0.00
27.5500	4.91E-06	-20373.	1321.	1.21E-06	0.00	1.26E+11	-23.210	2.06E+07	0.00
27.9125	8.63E-06	-14848.	1182.	6.00E-07	0.00	1.26E+11	-40.800	2.06E+07	0.00
28.2750	1.01E-05	-10095.	988.8164	1.72E-07	0.00	1.26E+11	-47.893	2.06E+07	0.00
28.6375	1.01E-05	-6246.	780.5735	-1.09E-07	0.00	1.26E+11	-47.851	2.06E+07	0.00
29.0000	9.18E-06	-3303.	582.1202	-2.74E-07	0.00	1.26E+11	-43.392	2.06E+07	0.00
29.3625	7.75E-06	-1181.	408.1397	-3.51E-07	0.00	1.26E+11	-36.599	2.06E+07	0.00
29.7250	6.13E-06	249.1601	265.5262	-3.67E-07	0.00	1.26E+11	-28.971	2.06E+07	0.00
30.0875	4.55E-06	1131.	155.7123	-3.43E-07	0.00	1.26E+11	-21.519	2.06E+07	0.00
30.4500	3.15E-06	1605.	76.5759	-2.96E-07	0.00	1.26E+11	-14.866	2.06E+07	0.00
30.8125	1.98E-06	1798.	11.9688	-2.38E-07	0.00	1.26E+11	-14.838	3.26E+07	0.00
31.1750	1.08E-06	1711.	-37.918	-1.77E-07	0.00	1.26E+11	-8.098	3.26E+07	0.00
31.5375	4.37E-07	1469.	-62.660	-1.22E-07	0.00	1.26E+11	-3.277	3.26E+07	0.00
31.9000	1.40E-08	1166.	-70.017	-7.72E-08	0.00	1.26E+11	-0.105	3.26E+07	0.00
32.2625	-2.35E-07	860.5153	-66.420	-4.23E-08	0.00	1.26E+11	1.7588	3.26E+07	0.00
32.6250	-3.54E-07	588.2918	-56.815	-1.74E-08	0.00	1.26E+11	2.6571	3.26E+07	0.00
32.9875	-3.86E-07	366.3033	-44.738	-1.00E-09	0.00	1.26E+11	2.8953	3.26E+07	0.00
33.3500	-3.63E-07	199.0740	-32.519	8.72E-09	0.00	1.26E+11	2.7225	3.26E+07	0.00
33.7125	-3.10E-07	83.3464	-21.538	1.36E-08	0.00	1.26E+11	2.3263	3.26E+07	0.00
34.0750	-2.45E-07	11.6320	-12.484	1.52E-08	0.00	1.26E+11	1.8366	3.26E+07	0.00
34.4375	-1.78E-07	-25.331	-5.588	1.50E-08	0.00	1.26E+11	1.3338	3.26E+07	0.00
34.8000	-1.15E-07	-37.052	-0.818	1.39E-08	0.00	1.26E+11	0.8594	3.26E+07	0.00
35.1625	-5.69E-08	-32.509	1.9793	1.27E-08	0.00	1.26E+11	0.4267	3.26E+07	0.00
35.5250	-4.05E-09	-19.889	2.9733	1.18E-08	0.00	1.26E+11	0.03035	3.26E+07	0.00
35.8875	4.58E-08	-6.694	2.2919	1.13E-08	0.00	1.26E+11	-0.344	3.26E+07	0.00
36.2500	9.47E-08	0.00	0.00	1.12E-08	0.00	1.26E+11	-0.710	1.63E+07	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 4:

```
Pile-head deflection             =     0.09792132 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =        926289. inch-lbs
Maximum shear force              =        -32356. lbs
Depth of maximum bending moment  =    21.38750000 feet below pile head
Depth of maximum shear force     =    22.47500000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              4
Pile deflection at ground        =     0.00125013 inches
```

Pile-head Deflection vs. Pile Length for Load Case 4

Boundary Condition Type 2, Shear and Slope

```
Shear      =           5500. lbs
Slope      =         0.00000
Axial Load =         508600. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
36.25000	0.09792132	926289.	-32356.
34.43750	0.09750665	923813.	-32167.
32.62500	0.10018348	934334.	-32467.
30.81250	0.10080728	936188.	-32821.
29.00000	0.09935348	929368.	-32716.
27.18750	0.09975694	929996.	-32622.
25.37500	0.09758988	919788.	-32552.
23.56250	0.10806678	-955857.	-50820.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

```
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians
```

Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	4100.	S, rad	0.00	370100.	0.07409	0.00	-24859.	714300.
2	V, lb	5300.	S, rad	0.00	574200.	0.08740	0.00	-28297.	-835438.
3	V, lb	1400.	S, rad	0.00	286200.	0.04897	0.00	-17901.	516513.
4	V, lb	5500.	S, rad	0.00	508600.	0.09792	0.00	-32356.	926289.

Maximum pile-head deflection = 0.0979213233 inches
Maximum pile-head rotation = 0.0000000000 radians = 0.000000 deg.

Summary of Warning Messages

The following warning was reported 10000 times

**** Warning ****

This warning is for an input value for uniaxial compressive strength that
has been specified for a soil defined using the vuggy limestone criteria.
The input value is outside of the range of 1,000 to 2,500 psi
(6,895 to 17,237 kPa) which were used in actual field tests
on which this theory is based. Higher or lower values may be applicable
but the user is warned about the theoretical and testing limitations.

The analysis ended normally.

Jacobs

Project: MoDOT Improve I-70 Columbia to Kingdom City DB
Job No.: F3X03001
Subject: Bridge 2/A9542 - Lateral Analysis at Bent 2

By: ZW 8/22/24
Ckd: SR 8/28/24

Foundation Design Data

Support No.: **Bent 2** - Low Rock Elevation Case

General Information:

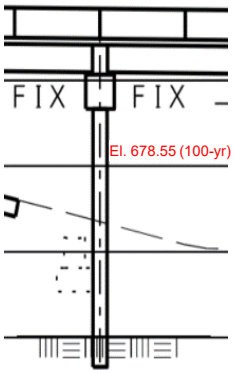
	North	South	Average	
Bottom of Pile Cap El.:	677.26	680.04	678.65	ft
Assumed Grade Elev.:	*664.00*	*664.00*	664.00	ft
Design Scour Depth:	*6.60*	*6.60*	6.60	ft
El.:	*657.40*	*657.40*	657.40	ft
Min. Pile Length below Scour Depth:	*15.00*	*15.00*	15.00	ft
El.:	642.40	642.40	642.40	ft
Top of Rock El.:	648.00	648.00	648.00	ft
Rock Type:	Limestone	Limestone	Limestone	
Min. Embd. into Rock:	5	5	5	ft
Min. Pile Tip El by Rock Embd.:	643.00	643.00	643.00	ft
Min Design Pile Tip El:	**642.40**	**642.40**	**642.40**	
Min. Pile Length:	34.86	37.64	36.25	ft
Design GW El.:	678.55	678.55	678.55	ft
Depth below Top of Pile:	-1.29	1.49	0.10	ft
Exposed Pile Length to Scour Depth:	19.86	22.64	21.25	ft

Scour Information

Location	Ground El.	Scour Depth (ft)		Scour Elev. (ft)	
	(ft)	Design Flood	Check Flood	Design Flood	Check Flood
Bent 2	664	6.6	13.3	657.4	650.7
Bent 3	668	6.1	12.8	661.9	655.2

Section 751.1.2.22 MoDOT EPG

100-year Flood Level



Pile Data:

Pile:	24X0.500		Class B-1 Concrete,	fc'=	4,000	psi
F_y =	45	ksi	Pile Structural Axial Resistance Factor:	ϕ_c =	0.6	
E =	29,000	ksi	Max Nominal Driving Resistance:	R_{ndr} =	1,305	k
OD =	24	in	Preli. Structural Nominal Axial Design Capacity:	PNDC = F_yA_s =	1,450	k
Wall Thick. =	0.500	in	Preli. Factored Axial Design Capacity:	PFDC = ϕc xPNDC =	870	k
ID =	23.00	in				
As (No Corrosion) =	32.21	in^2				

Load Information:

Load Case	At Top of Pile		Stream Pressure, WA				Wind on Structure, WS				Max (WA+WS)
	Axial	Lateral Load	Load	Load	From	To	Load	Load	From	To	
	(k)	(k)	(klf)	(lbs/in)	(ft	(ft)	(klf)	(lbs/in)	(ft	(ft)	(lbs/in)
Ser I	370.1	4.1	0.082	6.83	0.10	21.25	0.040	3.33	0	21.25	10.17
Str I	574.2	5.3	0.086	7.17	0.10	21.25	0.000	0.00	0	21.25	7.17
Str III	286.2	1.4	0.086	7.17	0.10	21.25	0.114	9.50	0	21.25	16.67
Str V	508.6	5.5	0.086	7.17	0.10	21.25	0.055	4.58	0	21.25	11.75

P-Multipliers D = 2 ft

Loading Direction	Number of Rows	Pile Spacing S	S/D	P-Multiplier* (AASHTO LRFD Table 10.7.2.4-1)				
				Row Number				Aver.
		(ft)		1	2	3	After 3	
Longitudinal	1	-	-	0.95	-	-	-	0.95
Transverse	11	8.90	4.45	0.95	0.73	0.59	0.59	0.63

Note: Group reduction factor of 1.0 was used within fresh rock.

Lateral Analysis

Software: LPILE 2022 developed by ENSOFT, Inc.

Pile Geometry for Analysis:

Top of Pile El.:	678.65 ft	Design Scour El.:	657.40 ft	(Design Flood for Strength Limit)
Min. Pile Tip El.:	642.40 ft	Min. Pile Length:	36.25 ft	

Design Soil Profile and Parameters:

Reference Borings: BR 2-2 and L0264-2 Low Rock Elevation Case Design Ground Water El.: 678.55 ft

Depth		Soil/Rock	Elevation		Eff. Unit Weight	Su	ϕ'	qu	Modulus , k or E	RQD	ε_{50}
From	To		From	To							
(ft)	(ft)		(ft)	(ft)	(pcf)	(psf)	(deg.)	(psi)	(psi)		
21.3	21.7	Stiff Clay w/ Free Water	657.4	657.0	57.6	1,000	-	-	-	-	0.01
21.7	30.7	Stiff Clay w/ Free Water	657.0	648.0	57.6	1,000	-	-	-	-	0.01
30.7	48.7	Strong Rock	648.0	630.0	101.6	-	-	7,500	-	-	-

Lateral Analysis Results:

LPile Analysis Summary at Bent 2 of Bridge 2 (A9542)

Load Comb.	Case in LPile	Lat.	Moment	Axial	Pmult.	Head Fixity	Pile Head	Max Moment	Max Shear	Pile Head Rotation
		(lbs)	(lbs-in)	(lbs)			δ (in)	(in-lbs)	(lbs)	(rad.)
Ser I	1	4,100	-	370,100	0.63	Fixed	0.189	-985,154	-26,105	0.00E+00
Str I	2	5,300	-	574,200	0.63	Fixed	0.221	-1,168,216	-29,792	0.00E+00
Str III	3	1,400	-	286,200	0.63	Fixed	0.134	-614,945	-19,162	0.00E+00
Str V	4	5,500	-	508,600	0.63	Fixed	0.255	-1,307,988	-36,006	0.00E+00

Deflection, Moment, and Shear vs Depth figures are attached.

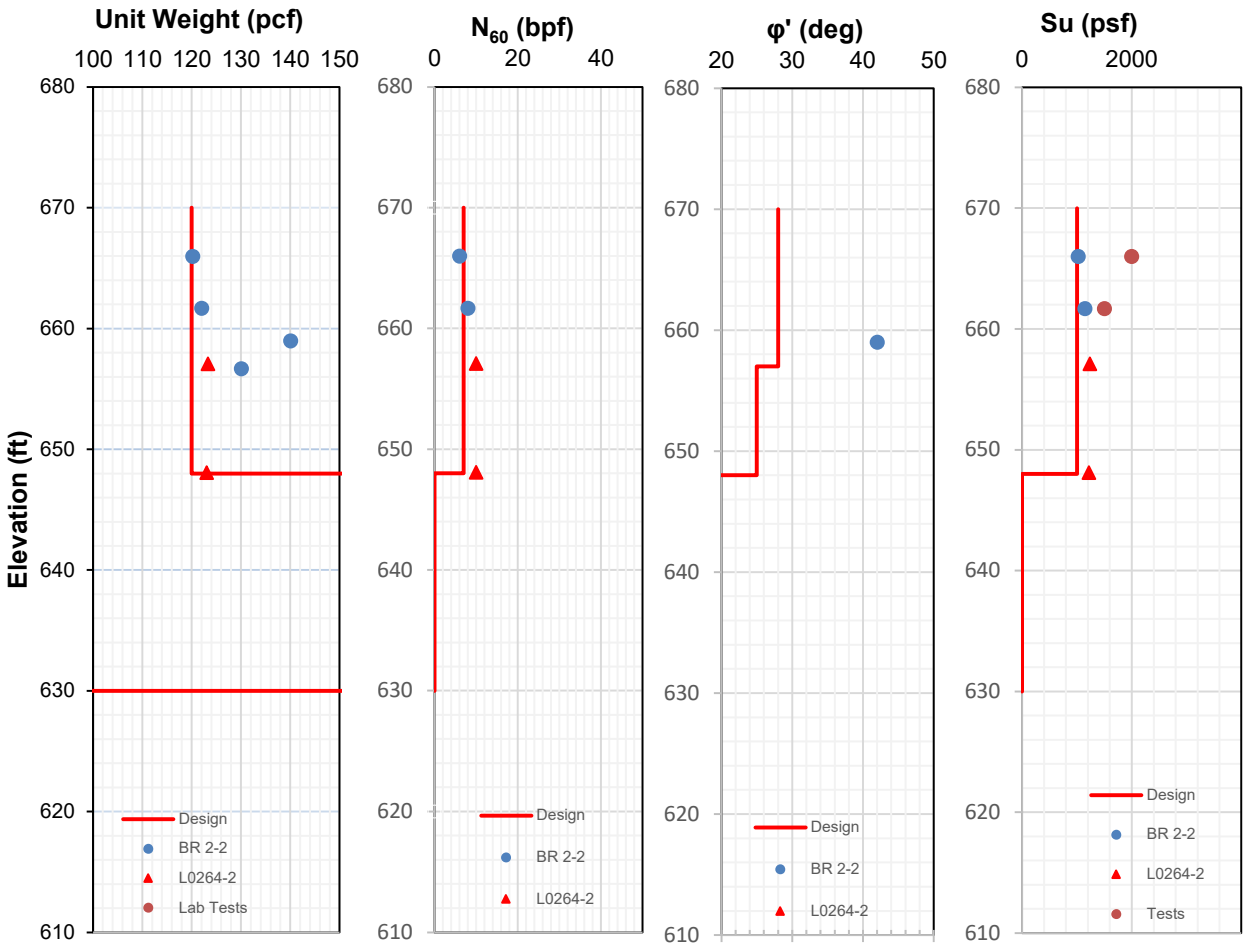
Structure Engineer should check the pile structural acceptability for the analyzed load combinations.

Jacobs

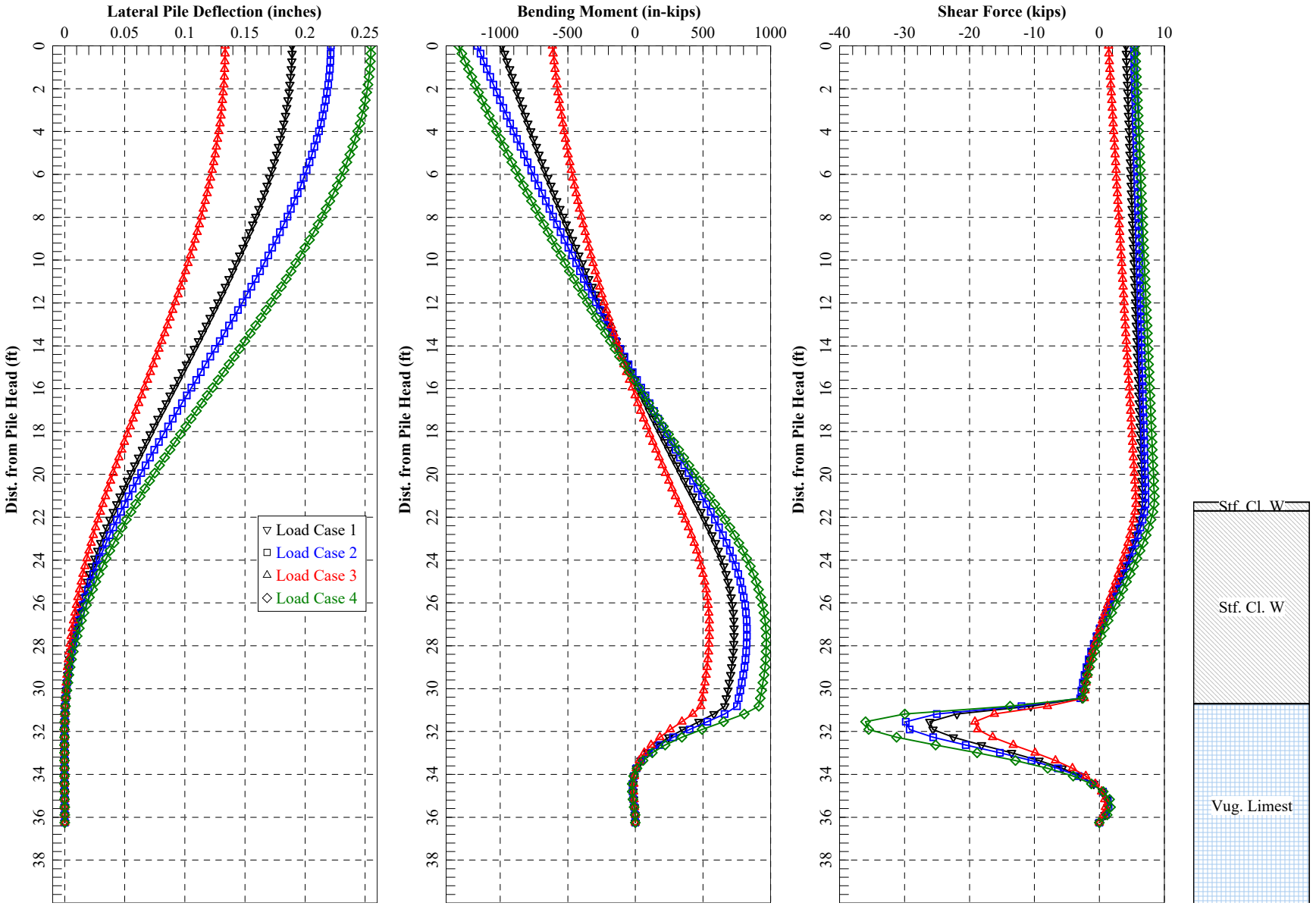
Project:	MoDOT Improve I-70 Columbia to Kingdom City DB	By:ZW	8/21/24
Job No.:	F3X03001	Ckd:SR	8/28/24
Subject:	Bridge 2/A9542 - Bent 2 - Low Rock El.	BkCkd:	

Design Soil Profile and Parameters

Soil	Elevation		Unit Weight	N_{60}	Undrained		Drained		ε_{50}	k
	From	To			C	ϕ	C'	ϕ'		
	(ft)	(ft)	(pcf)	(bpf)	(psf)	(deg.)	(psf)	(deg.)		(pci)
CL	669.0	657.0	120	7	1,000	0	0	28	0.01	-
CH	657.0	648.0	120	7	1,000	40	0	25	0.01	-
Rock	648.0	630.0	164							
	(Strong Rock Qu =1,078 ksf =7.5 ksi)									



MoDOT Improve I-70 C2KC- Bridge 2/A9542- Bent 2 - OECIP24X0.5in - Low Rock El.



```
================================================================================

                    LPile for Windows, Version 2022-12.004

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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================================================================================

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--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\TPW\GEOTECH\F3X03000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A6951)\LPile\

Name of input data file:
Bridge 2 Bent 2 24in OECIP_Low Rock El.lp12d

Name of output report file:
Bridge 2 Bent 2 24in OECIP_Low Rock El.lp12o

Name of plot output file:
Bridge 2 Bent 2 24in OECIP_Low Rock El.lp12p

Name of runtime message file:
Bridge 2 Bent 2 24in OECIP_Low Rock El.lp12r



--------------------------------------------------------------------------------
                            Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  August 28, 2024            Time:  13:51:18



--------------------------------------------------------------------------------
                                  Problem Title
--------------------------------------------------------------------------------

Project Name: MoDOT Improve I-70  Columbia to Kingdom City DB

Job Number: F3X03001

Client: MoDOT

Engineer:

Description: Bridge 2 (A9542) Bent 2 Lateral Analysis - OECIP 24X0.5_Low



--------------------------------------------------------------------------------
                          Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed               =          500
 - Deflection tolerance for convergence               =   1.0000E-05 in
 - Maximum allowable deflection                       =     100.0000 in
 - Number of pile increments                          =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified
```

```
 - Analysis uses p-y modification factors for p-y curves
 - Analysis uses layering correction (Method of Georgiadis)
 - Analysis includes loading by multiple distributed lateral loads acting on pile
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using wide report formats



--------------------------------------------------------------------------------
                     Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Number of pile sections defined                      =            1
Total length of pile                                 =       36.250 ft
Depth of ground surface below top of pile            =      21.3000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

            Depth Below           Pile
Point        Pile Head          Diameter
 No.            feet             inches
-----      -------------     -------------
  1             0.000           24.0000
  2            36.250           24.0000


Input Structural Properties for Pile Sections:
----------------------------------------------

Pile Section No. 1:

   Section 1 is a drilled shaft with permanent casing
   Length of section                                 =    36.250000 ft
   Casing outside diameter                           =    24.000000 in



--------------------------------------------------------------------------------
                       Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using 3 layers

Layer 1 is stiff clay with water-induced erosion

   Distance from top of pile to top of layer         =    21.300000 ft
   Distance from top of pile to bottom of layer      =    21.700000 ft
   Effective unit weight at top of layer             =    57.600000 pcf
   Effective unit weight at bottom of layer          =    57.600000 pcf
   Undrained cohesion at top of layer                =  1000.000000 psf
   Undrained cohesion at bottom of layer             =  1000.000000 psf
   Epsilon-50 at top of layer                        =     0.010000
   Epsilon-50 at bottom of layer                     =     0.010000
   Subgrade k at top of layer                        =       0.0000 pci
   Subgrade k at bottom of layer                     =       0.0000 pci

   NOTE: Default values for subgrade k will be computed for this layer.

Layer 2 is stiff clay with water-induced erosion

   Distance from top of pile to top of layer         =    21.700000 ft
   Distance from top of pile to bottom of layer      =    30.700000 ft
   Effective unit weight at top of layer             =    57.600000 pcf
   Effective unit weight at bottom of layer          =    57.600000 pcf
   Undrained cohesion at top of layer                =  1000.000000 psf
   Undrained cohesion at bottom of layer             =  1000.000000 psf
   Epsilon-50 at top of layer                        =     0.010000
   Epsilon-50 at bottom of layer                     =     0.010000
   Subgrade k at top of layer                        =       0.0000 pci
   Subgrade k at bottom of layer                     =       0.0000 pci

   NOTE: Default values for subgrade k will be computed for this layer.

Layer 3 is strong rock (vuggy limestone)
```

```
   Distance from top of pile to top of layer           =    30.700000 ft
   Distance from top of pile to bottom of layer        =    50.000000 ft
   Effective unit weight at top of layer               =   101.600000 pcf
   Effective unit weight at bottom of layer            =   101.600000 pcf
   Uniaxial compressive strength at top of layer       =        7500. psi
   Uniaxial compressive strength at bottom of layer    =        7500. psi


 (Depth of the lowest soil layer extends 13.750 ft below the pile tip)
```

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Cohesion psf	Uniaxial qu psi	E50 or krm	kpy pci
1	Stiff Clay with Free Water	21.3000 21.7000	57.6000 57.6000	1000.0000 1000.0000	-- --	0.01000 0.01000	default default
2	Stiff Clay with Free Water	21.7000 30.7000	57.6000 57.6000	1000.0000 1000.0000	-- --	0.01000 0.01000	default default
3	Strong Rock (Vuggy Limestone)	30.7000 50.0000	101.6000 101.6000	-- --	7500. 7500.	-- --	-- --

---

Modification Factors for p-y Curves

Distribution of p-y modifiers with depth defined using 4 points

Point No.	Depth X ft	p-mult	y-mult
1	21.300	0.6300	1.0000
2	30.700	0.6300	1.0000
3	30.700	1.0000	1.0000
4	50.000	1.0000	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading for Individual Load Cases

Distributed lateral load intensity for Load Case 1 defined using 4 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	3.330
2	0.100	3.330
3	0.100	10.170
4	21.250	10.170

Distributed lateral load intensity for Load Case 2 defined using 4 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	0.000
2	0.100	0.000
3	0.100	7.170
4	21.250	7.170

Distributed lateral load intensity for Load Case 3 defined using 4 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	9.500
2	0.100	9.500
3	0.100	16.670
4	21.250	16.670

Distributed lateral load intensity for Load Case 4 defined using 4 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	4.580
2	0.100	4.580
3	0.100	11.750
4	21.250	11.750

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	2	V = 4100. lbs	S = 0.0000 in/in	370100.	Yes	Yes
2	2	V = 5300. lbs	S = 0.0000 in/in	574200.	Yes	Yes
3	2	V = 1400. lbs	S = 0.0000 in/in	286200.	Yes	Yes
4	2	V = 5500. lbs	S = 0.0000 in/in	508600.	Yes	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile) with Permanent Casing:

Length of Section	=	36.250000 ft
Outer Diameter of Casing	=	24.000000 in
Casing Wall Thickness	=	0.500000 in
Moment of Inertia of Steel Casing	=	2549. in^4
Yield Stress of Casing	=	45000. psi
Elastic Modulus of Casing	=	29000000. psi
Number of Reinforcing Bars	=	0 bars
Area of Single Reinforcing Bar	=	0.0000 sq. in.
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in
Yield Stress of Reinforcing Bars	=	0.0000 psi
Modulus of Elasticity of Reinforcing Bars	=	0.0000 psi
Gross Area of Pile	=	452.389342 sq. in.
Area of Concrete	=	415.475628 sq. in.
Cross-sectional Area of Steel Casing	=	36.913714 sq. in.
Area of All Steel (Casing and Bars)	=	36.913714 sq. in.
Area Ratio of All Steel to Gross Area of Pile	=	8.16 percent

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	3073.734 kips
Tensile Load for Cracking of Concrete	=	-296.304 kips
Nominal Axial Tensile Capacity	=	-1661.117 kips

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.34165 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 4

Number	Axial Thrust Force kips
1	286.200
2	370.100
3	508.600
4	574.200

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 286.200 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	161.2791649	129023332.	94.2308790	0.0001178	0.00008779	0.4833677	0.00000	3.4115194	
0.00000250	322.5562868	129022515.	53.1260220	0.0001328	0.00007282	0.5422776	0.00000	3.8429366	
0.00000375	483.8293222	129021153.	39.4291066	0.0001479	0.00005786	0.6007589	0.00000	4.2748654	
0.00000500	645.0962281	129019246.	32.5841766	0.0001629	0.00004292	0.6588098	0.00000	4.7073056	
0.00000625	806.3549608	129016794.	28.4800410	0.0001780	0.00002800	0.7164285	0.00000	5.1402575	
0.00000750	967.6034766	129013797.	25.7463029	0.0001931	0.00001310	0.7736133	0.00000	5.5737209	
0.00000875	1129.	129010255.	23.7956491	0.0002082	-0.00000179	0.8303623	0.00000	6.0076960	
0.00001000	1290.	129005546.	22.3344026	0.0002233	-0.00001666	0.8866731	0.00000	6.4421768	
0.00001125	1451.	128994382.	21.1992367	0.0002385	-0.00003151	0.9425358	0.00000	6.8771010	
0.00001250	1612.	128971879.	20.2920743	0.0002537	-0.00004635	0.9979375	0.00000	7.3123770	
0.00001375	1773.	128936617.	19.5505463	0.0002688	-0.00006118	1.0528674	0.00000	7.7479304	
0.00001500	1933.	128888982.	18.9331162	0.0002840	-0.00007600	1.1073177	0.00000	8.1837056	
0.00001625	2093.	128830078.	18.4110586	0.0002992	-0.00009082	1.1612825	0.00000	8.6196614	
0.00001750	2253.	128761204.	17.9638759	0.0003144	-0.000106	1.2147575	0.00000	9.0557671	
0.00001875	2253.	120177124.	17.2118094	0.0003227	-0.000127	1.2437149	0.00000	9.2936714	C
0.00002000	2376.	118804696.	16.8150407	0.0003363	-0.000144	1.2907917	0.00000	9.6831236	C
0.00002125	2500.	117628479.	16.4605877	0.0003498	-0.000160	1.3371423	0.00000	10.0698872	C
0.00002250	2622.	116520173.	16.1414184	0.0003632	-0.000177	1.3827765	0.00000	10.4539756	C
0.00002375	2743.	115481780.	15.8527218	0.0003765	-0.000193	1.4277639	0.00000	10.8359122	C
0.00002500	2863.	114509742.	15.5903262	0.0003898	-0.000210	1.4721449	0.00000	11.2159865	C
0.00002625	2982.	113598947.	15.3507142	0.0004030	-0.000227	1.5159460	0.00000	11.5943812	C
0.00002750	3100.	112745016.	15.1310264	0.0004161	-0.000244	1.5591950	0.00000	11.9712936	C
0.00002875	3218.	111944122.	14.9289183	0.0004292	-0.000261	1.6019204	0.00000	12.3469357	C
0.00003000	3336.	111192846.	14.7424534	0.0004423	-0.000278	1.6441514	0.00000	12.7215345	C
0.00003125	3453.	110483396.	14.5694757	0.0004553	-0.000295	1.6858630	0.00000	13.0948374	C
0.00003250	3569.	109815294.	14.4088326	0.0004683	-0.000312	1.7271012	0.00000	13.4672248	C
0.00003375	3685.	109187822.	14.2595881	0.0004813	-0.000329	1.7679151	0.00000	13.8391220	C
0.00003500	3801.	108591776.	14.1198830	0.0004942	-0.000346	1.8082361	0.00000	14.2098813	C
0.00003625	3916.	108030039.	13.9894541	0.0005071	-0.000363	1.8481491	0.00000	14.5802638	C
0.00003750	4031.	107496944.	13.8670731	0.0005200	-0.000380	1.8876205	0.00000	14.9499421	C
0.00003875	4146.	106992072.	13.7522357	0.0005329	-0.000397	1.9266849	0.00000	15.3192249	C
0.00004000	4260.	106511400.	13.6440347	0.0005458	-0.000414	1.9653192	0.00000	15.6878803	C
0.00004125	4375.	106056345.	13.5423684	0.0005586	-0.000431	2.0035874	0.00000	16.0565083	C
0.00004250	4489.	105619901.	13.4459263	0.0005715	-0.000449	2.0413969	0.00000	16.4242042	C
0.00004375	4603.	105206352.	13.3551661	0.0005843	-0.000466	2.0788669	0.00000	16.7921172	C
0.00004500	4716.	104810177.	13.2690097	0.0005971	-0.000483	2.1159176	0.00000	17.1594578	C
0.00004625	4830.	104431108.	13.1872723	0.0006099	-0.000500	2.1525758	0.00000	17.5264791	C
0.00004750	4943.	104070114.	13.1099940	0.0006227	-0.000517	2.1888952	0.00000	17.8937168	C
0.00004875	5056.	103722923.	13.0363046	0.0006355	-0.000534	2.2248024	0.00000	18.2604258	C
0.00005125	5282.	103070451.	12.8994671	0.0006611	-0.000569	2.2955040	0.00000	18.9934832	C
0.00005375	5508.	102468107.	12.7751176	0.0006867	-0.000603	2.3647336	0.00000	19.7261632	C
0.00005625	5732.	101909675.	12.6616804	0.0007122	-0.000638	2.4325071	0.00000	20.4586154	C
0.00005875	5957.	101390374.	12.5578818	0.0007378	-0.000672	2.4988439	0.00000	21.1910408	C
0.00006125	6180.	100904498.	12.4623326	0.0007633	-0.000707	2.5637116	0.00000	21.9230682	C
0.00006375	6404.	100451136.	12.3747514	0.0007889	-0.000741	2.6272218	0.00000	22.6559717	C
0.00006625	6627.	100023279.	12.2933897	0.0008144	-0.000776	2.6892330	0.00000	23.3881250	C
0.00006875	6849.	99620659.	12.2182127	0.0008400	-0.000810	2.7498547	0.00000	24.1208117	C
0.00007125	7071.	99241255.	12.1487418	0.0008656	-0.000844	2.8091122	0.00000	24.8543879	C
0.00007375	7292.	98881104.	12.0839307	0.0008912	-0.000879	2.8669226	0.00000	25.5878571	C
0.00007625	7514.	98538662.	12.0234245	0.0009168	-0.000913	2.9233039	0.00000	26.3214477	C
0.00007875	7734.	98213371.	11.9671567	0.0009424	-0.000948	2.9783134	0.00000	-27.205956	C
0.00008125	7955.	97903623.	11.9147383	0.0009681	-0.000982	3.0319461	0.00000	-28.193148	C
0.00008375	8175.	97607462.	11.8656364	0.0009937	-0.001016	3.0841648	0.00000	-29.179885	C
0.00008625	8394.	97322994.	11.8193127	0.0010194	-0.001051	3.1349241	0.00000	-30.166794	C
0.00008875	8613.	97050420.	11.7759606	0.0010451	-0.001085	3.1842979	0.00000	-31.152771	C
0.00009125	8832.	96788739.	11.7353381	0.0010708	-0.001119	3.2322810	0.00000	-32.137811	C
0.00009375	9050.	96537056.	11.6972292	0.0010966	-0.001153	3.2788683	0.00000	-33.121908	C
0.00009625	9268.	96294569.	11.6614403	0.0011224	-0.001188	3.3240546	0.00000	-34.105055	C
0.00009875	9486.	96060180.	11.6276288	0.0011482	-0.001222	3.3678066	0.00000	-35.087728	C

0.0001013	9703.	95833029.	11.5955362	0.0011740	-0.001256	3.4101030	0.00000	-36.070257 C
0.0001038	9920.	95613188.	11.5653139	0.0011999	-0.001290	3.4509878	0.00000	-37.051812 C
0.0001063	10136.	95400122.	11.5368322	0.0012258	-0.001324	3.4904557	0.00000	-38.032386 C
0.0001088	10352.	95193341.	11.5099730	0.0012517	-0.001358	3.5285010	0.00000	-39.011973 C
0.0001113	10568.	94992400.	11.4846292	0.0012777	-0.001392	3.5651184	0.00000	-39.990565 C
0.0001138	10783.	94796893.	11.4607030	0.0013037	-0.001426	3.6003021	0.00000	-40.968156 C
0.0001163	10998.	94606449.	11.4381049	0.0013297	-0.001460	3.6340465	0.00000	-41.944739 C
0.0001188	11212.	94420728.	11.4167532	0.0013557	-0.001494	3.6663459	0.00000	-42.920307 C
0.0001213	11427.	94239340.	11.3965238	0.0013818	-0.001528	3.6971875	0.00000	-43.895023 C
0.0001238	11640.	94061726.	11.3771725	0.0014079	-0.001562	3.7265420	0.00000	-44.869523 C
0.0001263	11845.	93818449.	11.3556936	0.0014337	-0.001596	3.7540162	0.00000	-45.000000 CY
0.0001288	12028.	93422368.	11.3278808	0.0014585	-0.001632	3.7791174	0.00000	-45.000000 CY
0.0001313	12195.	92915110.	11.2954569	0.0014825	-0.001667	3.8021666	0.00000	-45.000000 CY
0.0001338	12351.	92343512.	11.2604978	0.0015061	-0.001704	3.8234999	0.00000	-45.000000 CY
0.0001363	12498.	91726304.	11.2237959	0.0015292	-0.001741	3.8432704	0.00000	-45.000000 CY
0.0001388	12637.	91075522.	11.1858501	0.0015520	-0.001778	3.8615861	0.00000	-45.000000 CY
0.0001413	12768.	90391013.	11.1474591	0.0015746	-0.001815	3.8785776	0.00000	45.0000000 CY
0.0001438	12889.	89665429.	11.1097924	0.0015970	-0.001853	3.8943962	0.00000	45.0000000 CY
0.0001463	13001.	88892895.	11.0747568	0.0016197	-0.001890	3.9092368	0.00000	45.0000000 CY
0.0001488	13105.	88098113.	11.0408954	0.0016423	-0.001928	3.9229539	0.00000	45.0000000 CY
0.0001588	13449.	84715788.	10.9225786	0.0017340	-0.002076	3.9669875	0.00000	45.0000000 CY
0.0001688	13721.	81312112.	10.8168451	0.0018253	-0.002225	3.9925915	0.00000	45.0000000 CY
0.0001788	13944.	78009203.	10.7218890	0.0019165	-0.002373	3.9986940	0.00000	45.0000000 CY
0.0001888	14129.	74855553.	10.6364474	0.0020076	-0.002522	3.9984450	0.00000	45.0000000 CY
0.0001988	14285.	71873644.	10.5578451	0.0020984	-0.002672	3.9999927	0.00000	45.0000000 CY
0.0002088	14416.	69060214.	10.4873906	0.0021892	-0.002821	3.9994218	0.00000	45.0000000 CY
0.0002188	14529.	66417140.	10.4232884	0.0022801	-0.002970	3.9999770	0.00000	45.0000000 CY
0.0002288	14626.	63937585.	10.3644587	0.0023709	-0.003119	3.9984650	0.00000	45.0000000 CY
0.0002388	14709.	61608545.	10.3106482	0.0024617	-0.003268	3.9992251	0.00000	45.0000000 CY
0.0002488	14782.	59424910.	10.2620518	0.0025527	-0.003417	3.9995442	0.00000	45.0000000 CY
0.0002588	14846.	57375264.	10.2178699	0.0026439	-0.003566	3.9996091	0.00000	45.0000000 CY
0.0002688	14901.	55446793.	10.1770264	0.0027351	-0.003715	3.9994586	0.00000	45.0000000 CY
0.0002788	14950.	53631620.	10.1392499	0.0028263	-0.003864	3.9989879	0.00000	45.0000000 CY
0.0002888	14993.	51923440.	10.1044879	0.0029177	-0.004012	3.9979454	0.00000	45.0000000 CY
0.0002988	15031.	50311798.	10.0725567	0.0030092	-0.004161	3.9963771	0.00000	45.0000000 CY
0.0003088	15064.	48789755.	10.0435025	0.0031009	-0.004309	3.9999282	0.00000	45.0000000 CY
0.0003188	15094.	47352511.	10.0165019	0.0031928	-0.004457	3.9988300	0.00000	45.0000000 CY
0.0003288	15120.	45991588.	9.9926173	0.0032851	-0.004605	3.9958376	0.00000	45.0000000 CY
0.0003388	15143.	44703517.	9.9699322	0.0033773	-0.004753	3.9998098	0.00000	45.0000000 CY
0.0003488	15163.	43479045.	9.9491529	0.0034698	-0.004900	3.9973388	0.00000	45.0000000 CY
0.0003588	15182.	42318701.	9.9294223	0.0035622	-0.005048	3.9999896	0.00000	45.0000000 CY
0.0003688	15197.	41213423.	9.9113103	0.0036548	-0.005195	3.9976495	0.00000	45.0000000 CY
0.0003788	15212.	40162666.	9.8947934	0.0037477	-0.005342	3.9999952	0.00000	45.0000000 CY
0.0003888	15224.	39161565.	9.8791082	0.0038405	-0.005489	3.9969930	0.00000	45.0000000 CY

Axial Thrust Force = 370.100 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	160.0890747	128071260.	118.8875599	0.0001486	0.0001186	0.6048640	0.00000	4.3053241	
0.00000250	320.1760846	128070434.	65.4544750	0.0001636	0.0001036	0.6627442	0.00000	4.7367494	
0.00000375	480.2589647	128069057.	47.6482003	0.0001787	0.00008868	0.7201951	0.00000	5.1686918	
0.00000500	640.3356500	128067130.	38.7486282	0.0001937	0.00007374	0.7772151	0.00000	5.6011511	
0.00000625	800.4040752	128064652.	33.4117373	0.0002088	0.00005882	0.8338024	0.00000	6.0341274	
0.00000750	960.4621749	128061623.	29.8561873	0.0002239	0.00004392	0.8899551	0.00000	6.4676208	
0.00000875	1121.	128058044.	27.3185466	0.0002390	0.00002904	0.9456715	0.00000	6.9016312	
0.00001000	1281.	128053914.	25.4170993	0.0002542	0.00001417	1.0009498	0.00000	7.3361586	
0.00001125	1441.	128049232.	23.9397813	0.0002693	-6.77460E-07	1.0557882	0.00000	7.7712035	
0.00001250	1601.	128043835.	22.7593485	0.0002845	-0.00001551	1.1101846	0.00000	8.2067637	
0.00001375	1760.	128035078.	21.7947398	0.0002997	-0.00003032	1.1641328	0.00000	8.6428024	
0.00001500	1920.	128019142.	20.9918333	0.0003149	-0.00004512	1.2176222	0.00000	9.0792475	
0.00001625	2080.	127994005.	20.3131701	0.0003301	-0.00005991	1.2706433	0.00000	9.5160314	
0.00001750	2239.	127959068.	19.7320181	0.0003453	-0.00007469	1.3231883	0.00000	9.9530992	
0.00001875	2398.	127914511.	19.2287941	0.0003605	-0.00008946	1.3752510	0.00000	10.3904069	
0.00002000	2557.	127860913.	18.7888267	0.0003758	-0.000104	1.4268265	0.00000	10.8279195	
0.00002125	2587.	121752208.	18.1527189	0.0003857	-0.000124	1.4601181	0.00000	11.1126631 C	
0.00002250	2716.	120693725.	17.7617273	0.0003996	-0.000140	1.5063533	0.00000	11.5112270 C	
0.00002375	2842.	119674175.	17.4080155	0.0004134	-0.000157	1.5518583	0.00000	11.9071207 C	
0.00002500	2967.	118687053.	17.0856901	0.0004271	-0.000173	1.5966167	0.00000	12.3001253 C	
0.00002625	3091.	117743710.	16.7911484	0.0004408	-0.000189	1.6407131	0.00000	12.6909118 C	
0.00002750	3213.	116843601.	16.5208393	0.0004543	-0.000206	1.6841755	0.00000	13.0796694 C	
0.00002875	3335.	115985309.	16.2717878	0.0004678	-0.000222	1.7270272	0.00000	13.4665531 C	
0.00003000	3455.	115167539.	16.0415312	0.0004812	-0.000239	1.7692925	0.00000	13.8517323 C	
0.00003125	3575.	114389066.	15.8280174	0.0004946	-0.000255	1.8109968	0.00000	14.2353909 C	
0.00003250	3694.	113648699.	15.6295255	0.0005080	-0.000272	1.8521658	0.00000	14.6177279 C	
0.00003375	3812.	112945249.	15.4446045	0.0005213	-0.000289	1.8928264	0.00000	14.9989568 C	
0.00003500	3930.	112274181.	15.2716885	0.0005345	-0.000305	1.9329701	0.00000	15.3789639 C	
0.00003625	4047.	111633161.	15.1095584	0.0005477	-0.000322	1.9726029	0.00000	15.7577734 C	
0.00003750	4163.	111024969.	14.9576936	0.0005609	-0.000339	2.0117912	0.00000	16.1359919 C	
0.00003875	4280.	110443177.	14.8147312	0.0005741	-0.000356	2.0504943	0.00000	16.5132043 C	
0.00004000	4396.	109887669.	14.6800379	0.0005872	-0.000373	2.0887389	0.00000	16.8896441 C	
0.00004125	4511.	109358526.	14.5531393	0.0006003	-0.000390	2.1265605	0.00000	17.2656430 C	
0.00004250	4626.	108850263.	14.4329296	0.0006134	-0.000407	2.1639093	0.00000	17.6406858 C	
0.00004375	4741.	108365973.	14.3194228	0.0006265	-0.000424	2.2008615	0.00000	18.0155178 C	
0.00004500	4856.	107900491.	14.2116280	0.0006395	-0.000440	2.2373628	0.00000	18.3895747 C	
0.00004625	4970.	107454827.	14.1094066	0.0006526	-0.000457	2.2734574	0.00000	18.7632917 C	
0.00004750	5084.	107028336.	14.0124163	0.0006656	-0.000474	2.3091590	0.00000	19.1368036 C	
0.00004875	5198.	106616258.	13.9197971	0.0006786	-0.000491	2.3444075	0.00000	19.5094632 C	

0.00005125	5424.	105842810.	13.7479671	0.0007046	-0.000525	2.4137707	0.00000	20.2545663	C
0.00005375	5651.	105125715.	13.5914233	0.0007305	-0.000559	2.4815515	0.00000	20.9985813	C
0.00005625	5876.	104457439.	13.4480189	0.0007565	-0.000594	2.5477409	0.00000	21.7413309	C
0.00005875	6100.	103837308.	13.3169706	0.0007824	-0.000628	2.6124776	0.00000	22.4843389	C
0.00006125	6324.	103253545.	13.1956938	0.0008082	-0.000662	2.6755999	0.00000	23.2257012	C
0.00006375	6548.	102709685.	13.0844220	0.0008341	-0.000696	2.7373277	0.00000	23.9679754	C
0.00006625	6770.	102194916.	12.9807968	0.0008600	-0.000730	2.7974667	0.00000	24.7088060	C
0.00006875	6993.	101711867.	12.8851158	0.0008859	-0.000764	2.8562019	0.00000	25.4504498	C
0.00007125	7214.	101254883.	12.7960409	0.0009117	-0.000798	2.9134496	0.00000	26.1918698	C
0.00007375	7436.	100821322.	12.7129011	0.0009376	-0.000832	2.9692110	0.00000	26.9330657	C
0.00007625	7656.	100411246.	12.6356320	0.0009635	-0.000867	3.0235707	0.00000	27.6751904	C
0.00007875	7877.	100020470.	12.5632042	0.0009894	-0.000901	3.0764476	0.00000	28.4171671	C
0.00008125	8096.	99647322.	12.4951965	0.0010152	-0.000935	3.1278467	0.00000	29.1590565	C
0.00008375	8316.	99291915.	12.4316363	0.0010411	-0.000969	3.1778366	0.00000	29.9018866	C
0.00008625	8535.	98952680.	12.3721391	0.0010671	-0.001003	3.2264121	0.00000	30.6456631	C
0.00008875	8753.	98626192.	12.3157830	0.0010930	-0.001037	3.2734748	0.00000	31.3888966	C
0.00009125	8971.	98312861.	12.2627246	0.0011190	-0.001071	3.3190941	0.00000	32.1326852	C
0.00009375	9189.	98012132.	12.2128507	0.0011450	-0.001105	3.3632907	0.00000	32.8774380	C
0.00009625	9406.	97723000.	12.1659153	0.0011710	-0.001139	3.4060590	0.00000	33.6231612	C
0.00009875	9623.	97444559.	12.1216974	0.0011970	-0.001173	3.4473937	0.00000	34.3698612	C
0.0001013	9839.	97174397.	12.0794520	0.0012230	-0.001207	3.4872052	0.00000	35.1159411	C
0.0001038	10055.	96913421.	12.0395502	0.0012491	-0.001241	3.5255752	0.00000	35.8629469	C
0.0001063	10270.	96661024.	12.0018502	0.0012752	-0.001275	3.5625016	0.00000	36.6109511	C
0.0001088	10485.	96416591.	11.9662024	0.0013013	-0.001309	3.5979788	0.00000	-37.573139	C
0.0001113	10700.	96179563.	11.9324705	0.0013275	-0.001343	3.6320010	0.00000	-38.545717	C
0.0001138	10914.	95949430.	11.9005304	0.0013537	-0.001376	3.6645624	0.00000	-39.517275	C
0.0001163	11128.	95725407.	11.8701320	0.0013799	-0.001410	3.6956386	0.00000	-40.488267	C
0.0001188	11341.	95506775.	11.8410404	0.0014061	-0.001444	3.7252080	0.00000	-41.459167	C
0.0001213	11554.	95293816.	11.8134460	0.0014324	-0.001478	3.7533047	0.00000	-42.429020	C
0.0001238	11767.	95086165.	11.7872603	0.0014587	-0.001511	3.7799227	0.00000	-43.397819	C
0.0001263	11979.	94883487.	11.7624015	0.0014850	-0.001545	3.8050559	0.00000	-44.365557	C
0.0001288	12187.	94658781.	11.7375808	0.0015112	-0.001579	3.8285607	0.00000	-45.000000	CY
0.0001313	12381.	94331646.	11.7090123	0.0015368	-0.001613	3.8500507	0.00000	-45.000000	CY
0.0001338	12557.	93880952.	11.6755220	0.0015616	-0.001648	3.8694891	0.00000	-45.000000	CY
0.0001363	12715.	93319321.	11.6407485	0.0015861	-0.001684	3.8873352	0.00000	45.0000000	CY
0.0001388	12858.	92673589.	11.6058653	0.0016103	-0.001720	3.9037454	0.00000	45.0000000	CY
0.0001413	12989.	91956002.	11.5725361	0.0016346	-0.001755	3.9188918	0.00000	45.0000000	CY
0.0001438	13106.	91174100.	11.5416702	0.0016591	-0.001791	3.9328455	0.00000	45.0000000	CY
0.0001463	13216.	90364760.	11.5113360	0.0016835	-0.001826	3.9454451	0.00000	45.0000000	CY
0.0001488	13318.	89531849.	11.4819528	0.0017079	-0.001862	3.9567324	0.00000	45.0000000	CY
0.0001588	13664.	86074563.	11.3716740	0.0018053	-0.002005	3.9887426	0.00000	45.0000000	CY
0.0001688	13940.	82608674.	11.2706743	0.0019019	-0.002148	3.9999763	0.00000	45.0000000	CY
0.0001788	14166.	79248171.	11.1791158	0.0019983	-0.002292	3.9985120	0.00000	45.0000000	CY
0.0001888	14352.	76038516.	11.0954676	0.0020943	-0.002436	3.9986993	0.00000	45.0000000	CY
0.0001988	14509.	72999726.	11.0190443	0.0021900	-0.002580	3.9999556	0.00000	45.0000000	CY
0.0002088	14641.	70135284.	10.9504065	0.0022859	-0.002724	3.9992269	0.00000	45.0000000	CY
0.0002188	14753.	67441498.	10.8875412	0.0023816	-0.002868	3.9999872	0.00000	45.0000000	CY
0.0002288	14849.	64915016.	10.8302352	0.0024774	-0.003013	3.9981828	0.00000	45.0000000	CY
0.0002388	14932.	62542721.	10.7779558	0.0025732	-0.003157	3.9990359	0.00000	45.0000000	CY
0.0002488	15004.	60318512.	10.7307833	0.0026693	-0.003301	3.9994085	0.00000	45.0000000	CY
0.0002588	15067.	58230784.	10.6879463	0.0027655	-0.003444	3.9994940	0.00000	45.0000000	CY
0.0002688	15121.	56265577.	10.6480737	0.0028617	-0.003588	3.9993334	0.00000	45.0000000	CY
0.0002788	15169.	54417057.	10.6115368	0.0029580	-0.003732	3.9988376	0.00000	45.0000000	CY
0.0002888	15211.	52677488.	10.5779993	0.0030544	-0.003876	3.9977614	0.00000	45.0000000	CY
0.0002988	15247.	51036344.	10.5474061	0.0031510	-0.004019	3.9968595	0.00000	45.0000000	CY
0.0003088	15279.	49486419.	10.5195192	0.0032479	-0.004162	3.9999044	0.00000	45.0000000	CY
0.0003188	15307.	48022760.	10.4937410	0.0033449	-0.004305	3.9987652	0.00000	45.0000000	CY
0.0003288	15332.	46637052.	10.4710085	0.0034423	-0.004448	3.9957649	0.00000	45.0000000	CY
0.0003388	15354.	45325483.	10.4495311	0.0035398	-0.004590	3.9998058	0.00000	45.0000000	CY
0.0003488	15372.	44078783.	10.4299447	0.0036374	-0.004733	3.9973689	0.00000	45.0000000	CY
0.0003588	15389.	42897425.	10.4114397	0.0037351	-0.004875	3.9999940	0.00000	45.0000000	CY
0.0003688	15403.	41772033.	10.3945558	0.0038330	-0.005017	3.9977709	0.00000	45.0000000	CY

Axial Thrust Force = 508.600 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	158.0963191	126477055.	160.1741270	0.0002002	0.0001702	0.8035221	0.00000	5.8019621	
0.00000250	316.1905360	126476214.	86.0979525	0.0002152	0.0001552	0.8596778	0.00000	6.2334016	
0.00000375	474.2805482	126474813.	61.4107340	0.0002303	0.0001403	0.9154034	0.00000	6.6653673	
0.00000500	632.3642532	126472851.	49.0707547	0.0002454	0.0001254	0.9706971	0.00000	7.0978594	
0.00000625	790.4395485	126470328.	41.6696712	0.0002604	0.0001104	1.0255571	0.00000	7.5308779	
0.00000750	948.5043309	126467244.	36.7380359	0.0002755	0.00009554	1.0799816	0.00000	7.9644228	
0.00000875	1107.	126463600.	33.2175141	0.0002907	0.00008065	1.1339688	0.00000	8.3984942	
0.00001000	1265.	126459394.	30.5789384	0.0003058	0.00006579	1.1875168	0.00000	8.8330922	
0.00001125	1423.	126454628.	28.5283270	0.0003209	0.00005094	1.2406238	0.00000	9.2682167	
0.00001250	1581.	126449301.	26.8892908	0.0003361	0.00003612	1.2932879	0.00000	9.7038680	
0.00001375	1739.	126443412.	25.5495824	0.0003513	0.00002131	1.3455074	0.00000	10.1400460	
0.00001500	1897.	126436963.	24.4343699	0.0003665	0.00000652	1.3972805	0.00000	10.5767510	
0.00001625	2054.	126429952.	23.4918470	0.0003817	-0.00000826	1.4486052	0.00000	11.0139829	
0.00001750	2212.	126422062.	22.6849981	0.0003970	-0.00002301	1.4994791	0.00000	11.4517361	
0.00001875	2370.	126411418.	21.9866203	0.0004122	-0.00003775	1.5498961	0.00000	11.8899745	
0.00002000	2528.	126395962.	21.3762832	0.0004275	-0.00005247	1.5998486	0.00000	12.3286441	
0.00002125	2685.	126374373.	20.8383672	0.0004428	-0.00006718	1.6493292	0.00000	12.7676937	
0.00002250	2843.	126345984.	20.3607333	0.0004581	-0.00008188	1.6983316	0.00000	13.2070784	
0.00002375	3000.	126310572.	19.9338073	0.0004734	-0.00009657	1.7468505	0.00000	13.6467598	
0.00002500	3157.	126268202.	19.5499382	0.0004887	-0.000111	1.7948811	0.00000	14.0867052	
0.00002625	3208.	122217040.	19.0411078	0.0004998	-0.000130	1.8291673	0.00000	14.4036934	C

0.00002750	3340.	121440292.	18.6933846	0.0005141	-0.000146	1.8729640	0.00000	14.8122738	C
0.00002875	3469.	120670475.	18.3730574	0.0005282	-0.000162	1.9160645	0.00000	15.2184865	C
0.00003000	3597.	119904762.	18.0764266	0.0005423	-0.000178	1.9584512	0.00000	15.6220908	C
0.00003125	3724.	119153019.	17.8011323	0.0005563	-0.000194	2.0001782	0.00000	16.0235261	C
0.00003250	3849.	118418959.	17.5449385	0.0005702	-0.000210	2.0412741	0.00000	16.4230044	C
0.00003375	3973.	117704184.	17.3058634	0.0005841	-0.000226	2.0817591	0.00000	16.8206637	C
0.00003500	4095.	117010017.	17.0822231	0.0005979	-0.000242	2.1216543	0.00000	17.2166565	C
0.00003625	4217.	116337527.	16.8725801	0.0006116	-0.000258	2.1609816	0.00000	17.6111499	C
0.00003750	4338.	115687543.	16.6757024	0.0006253	-0.000275	2.1997637	0.00000	18.0043265	C
0.00003875	4458.	115054661.	16.4900335	0.0006390	-0.000291	2.2379696	0.00000	18.3958253	C
0.00004000	4578.	114443876.	16.3149859	0.0006526	-0.000307	2.2756562	0.00000	18.7861836	C
0.00004125	4697.	113856151.	16.1498128	0.0006662	-0.000324	2.3128520	0.00000	19.1756636	C
0.00004250	4815.	113287917.	15.9934849	0.0006797	-0.000340	2.3495414	0.00000	19.5640702	C
0.00004375	4932.	112736871.	15.8451307	0.0006932	-0.000357	2.3857143	0.00000	19.9512597	C
0.00004500	5049.	112208896.	15.7047406	0.0007067	-0.000373	2.4214532	0.00000	20.3380866	C
0.00004625	5166.	111694210.	15.5708923	0.0007202	-0.000390	2.4566645	0.00000	20.7235094	C
0.00004750	5282.	111200648.	15.4438982	0.0007336	-0.000406	2.4914551	0.00000	21.1086700	C
0.00004875	5398.	110721121.	15.3226768	0.0007470	-0.000423	2.5257561	0.00000	21.4927844	C
0.00005125	5628.	109811716.	15.0969495	0.0007737	-0.000456	2.5930429	0.00000	22.2594913	C
0.00005375	5857.	108960963.	14.8908558	0.0008004	-0.000490	2.6585779	0.00000	23.0240717	C
0.00005625	6084.	108164472.	14.7020705	0.0008270	-0.000523	2.7224137	0.00000	23.7870027	C
0.00005875	6311.	107417550.	14.5285854	0.0008536	-0.000556	2.7845881	0.00000	24.5486276	C
0.00006125	6536.	106711430.	14.3680847	0.0008800	-0.000590	2.8450472	0.00000	25.3081606	C
0.00006375	6761.	106048521.	14.2199196	0.0009065	-0.000623	2.9039282	0.00000	26.0672265	C
0.00006625	6984.	105422568.	14.0824935	0.0009330	-0.000657	2.9612053	0.00000	26.8254407	C
0.00006875	7207.	104829408.	13.9545428	0.0009594	-0.000691	3.0168704	0.00000	27.5826198	C
0.00007125	7429.	104268989.	13.8355750	0.0009858	-0.000724	3.0710033	0.00000	28.3398071	C
0.00007375	7650.	103735373.	13.7242169	0.0010122	-0.000758	3.1235365	0.00000	29.0960190	C
0.00007625	7871.	103228905.	13.6202009	0.0010385	-0.000791	3.1745468	0.00000	29.8523196	C
0.00007875	8091.	102746814.	13.5227639	0.0010649	-0.000825	3.2240241	0.00000	30.6085624	C
0.00008125	8311.	102285404.	13.4310386	0.0010913	-0.000859	3.2719306	0.00000	31.3641348	C
0.00008375	8530.	101846652.	13.3452002	0.0011177	-0.000892	3.3183711	0.00000	32.1207051	C
0.00008625	8748.	101424981.	13.2640311	0.0011440	-0.000926	3.3632364	0.00000	32.8765081	C
0.00008875	8966.	101020906.	13.1875212	0.0011704	-0.000960	3.4065870	0.00000	33.6325328	C
0.00009125	9183.	100634454.	13.1155848	0.0011968	-0.000993	3.4484643	0.00000	34.3895667	C
0.00009375	9400.	100262289.	13.0474381	0.0012232	-0.001027	3.4888027	0.00000	35.1464725	C
0.00009625	9616.	99903172.	12.9827560	0.0012496	-0.001060	3.5275989	0.00000	35.9031680	C
0.00009875	9831.	99558032.	12.9217064	0.0012760	-0.001094	3.5649135	0.00000	36.6608870	C
0.0001013	10047.	99225807.	12.8640225	0.0013025	-0.001128	3.6007408	0.00000	37.4196362	C
0.0001038	10261.	98903924.	12.8090539	0.0013289	-0.001161	3.6350204	0.00000	38.1781913	C
0.0001063	10475.	98592029.	12.7567046	0.0013554	-0.001195	3.6677657	0.00000	38.9368434	C
0.0001088	10689.	98290603.	12.7070945	0.0013819	-0.001228	3.6990144	0.00000	39.6965475	C
0.0001113	10902.	97998912.	12.6600413	0.0014084	-0.001262	3.7287603	0.00000	40.4573069	C
0.0001138	11115.	97716289.	12.6153785	0.0014350	-0.001295	3.7569972	0.00000	41.2191290	C
0.0001163	11328.	97440875.	12.5725820	0.0014616	-0.001328	3.7836761	0.00000	41.9807667	C
0.0001188	11539.	97172768.	12.5316987	0.0014881	-0.001362	3.8088164	0.00000	42.7427871	C
0.0001213	11751.	96912164.	12.4928100	0.0015148	-0.001395	3.8324368	0.00000	43.5058930	C
0.0001238	11961.	96658585.	12.4557972	0.0015414	-0.001429	3.8545307	0.00000	44.2700922	C
0.0001263	12172.	96409293.	12.4206801	0.0015681	-0.001462	3.8751040	0.00000	45.0000000	CY
0.0001288	12375.	96119654.	12.3898454	0.0015952	-0.001495	3.8943686	0.00000	45.0000000	CY
0.0001313	12569.	95760133.	12.3649493	0.0016229	-0.001527	3.9124134	0.00000	45.0000000	CY
0.0001338	12753.	95350619.	12.3445694	0.0016511	-0.001559	3.9290404	0.00000	45.0000000	CY
0.0001363	12925.	94862711.	12.3254709	0.0016793	-0.001591	3.9439554	0.00000	45.0000000	CY
0.0001388	13079.	94264454.	12.3043394	0.0017072	-0.001623	3.9569467	0.00000	45.0000000	CY
0.0001413	13216.	93567048.	12.2810823	0.0017347	-0.001655	3.9680740	0.00000	45.0000000	CY
0.0001438	13340.	92802049.	12.2569167	0.0017619	-0.001688	3.9774622	0.00000	45.0000000	CY
0.0001463	13455.	92000277.	12.2320715	0.0017889	-0.001721	3.9851631	0.00000	45.0000000	CY
0.0001488	13562.	91171362.	12.2071226	0.0018158	-0.001754	3.9912323	0.00000	45.0000000	CY
0.0001588	13922.	87699542.	12.1088852	0.0019223	-0.001888	3.9994978	0.00000	45.0000000	CY
0.0001688	14208.	84194242.	12.0149819	0.0020275	-0.002022	3.9999997	0.00000	45.0000000	CY
0.0001788	14439.	80776057.	11.9283022	0.0021322	-0.002158	3.9987804	0.00000	45.0000000	CY
0.0001888	14629.	77502012.	11.8496200	0.0022366	-0.002293	3.9986459	0.00000	45.0000000	CY
0.0001988	14787.	74398158.	11.7767933	0.0023406	-0.002429	3.9996185	0.00000	45.0000000	CY
0.0002088	14919.	71466880.	11.7113641	0.0024447	-0.002565	3.9996488	0.00000	45.0000000	CY
0.0002188	15031.	68712769.	11.6521945	0.0025489	-0.002701	3.9979945	0.00000	45.0000000	CY
0.0002288	15127.	66127339.	11.5978323	0.0026530	-0.002837	3.9990338	0.00000	45.0000000	CY
0.0002388	15208.	63698772.	11.5479825	0.0027571	-0.002973	3.9996620	0.00000	45.0000000	CY
0.0002488	15278.	61420234.	11.5029720	0.0028614	-0.003109	3.9998886	0.00000	45.0000000	CY
0.0002588	15339.	59281360.	11.4622926	0.0029659	-0.003244	3.9999425	0.00000	45.0000000	CY
0.0002688	15392.	57271545.	11.4253162	0.0030706	-0.003379	3.9999096	0.00000	45.0000000	CY
0.0002788	15437.	55378940.	11.3918991	0.0031755	-0.003515	3.9997358	0.00000	45.0000000	CY
0.0002888	15476.	53596052.	11.3606123	0.0032804	-0.003650	3.9992079	0.00000	45.0000000	CY
0.0002988	15510.	51916030.	11.3317850	0.0033854	-0.003785	3.9979741	0.00000	45.0000000	CY
0.0003088	15539.	50328991.	11.3061632	0.0034908	-0.003919	3.9964393	0.00000	45.0000000	CY
0.0003188	15565.	48830233.	11.2828071	0.0035964	-0.004054	3.9998608	0.00000	45.0000000	CY
0.0003288	15587.	47411507.	11.2617976	0.0037023	-0.004188	3.9983676	0.00000	45.0000000	CY
0.0003388	15605.	46066479.	11.2423206	0.0038083	-0.004322	3.9963897	0.00000	45.0000000	CY

Axial Thrust Force = 574.200 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	157.1397413	125711793.	179.9928224	0.0002250	0.0001950	0.8967562	0.00000	6.5203898	
0.00000250	314.2773618	125710945.	96.0073958	0.0002400	0.0001800	0.9520841	0.00000	6.9518362	
0.00000375	471.4107407	125709531.	68.0171357	0.0002551	0.0001651	1.0069815	0.00000	7.3838135	
0.00000500	628.5377572	125707551.	54.0256675	0.0002701	0.0001501	1.0614465	0.00000	7.8163218	
0.00000625	785.6562900	125705006.	45.6337162	0.0002852	0.0001352	1.1154773	0.00000	8.2493611	
0.00000750	942.7642177	125701896.	40.0415236	0.0003003	0.0001203	1.1690722	0.00000	8.6829314	

0.00000875	1100.	125698219.	36.0491933	0.0003154	0.0001054	1.2222292	0.00000	9.1170328
0.00001000	1257.	125693977.	33.0567772	0.0003306	0.00009057	1.2749464	0.00000	9.5516654
0.00001125	1414.	125689169.	30.7309709	0.0003457	0.00007572	1.3272222	0.00000	9.9868293
0.00001250	1571.	125683795.	28.8717915	0.0003609	0.00006090	1.3790546	0.00000	10.4225245
0.00001375	1728.	125677855.	27.3519775	0.0003761	0.00004609	1.4304417	0.00000	10.8587511
0.00001500	1885.	125671348.	26.0866877	0.0003913	0.00003130	1.4813818	0.00000	11.2955092
0.00001625	2042.	125664276.	25.0171862	0.0004065	0.00001653	1.5318730	0.00000	11.7327990
0.00001750	2199.	125656637.	24.1015184	0.0004218	0.00000178	1.5819133	0.00000	12.1706206
0.00001875	2356.	125648428.	23.3089178	0.0004370	-0.00001296	1.6315011	0.00000	12.6089741
0.00002000	2513.	125639183.	22.6162934	0.0004523	-0.00002767	1.6806333	0.00000	13.0478502
0.00002125	2670.	125627261.	22.0059409	0.0004676	-0.00004237	1.7293040	0.00000	13.4872106
0.00002250	2826.	125611102.	21.4640759	0.0004829	-0.00005706	1.7775063	0.00000	13.9270092
0.00002375	2983.	125589649.	20.9798185	0.0004983	-0.00007173	1.8252337	0.00000	14.3671998
0.00002500	3139.	125562309.	20.5444715	0.0005136	-0.00008639	1.8724806	0.00000	14.8077417
0.00002625	3295.	125528834.	20.1510012	0.0005290	-0.000101	1.9192420	0.00000	15.2485996
0.00002750	3374.	122677918.	19.6819435	0.0005413	-0.000119	1.9562105	0.00000	15.6006500 C
0.00002875	3508.	122018450.	19.3292736	0.0005557	-0.000134	1.9993722	0.00000	16.0157319 C
0.00003000	3640.	121339823.	19.0026635	0.0005701	-0.000150	2.0417768	0.00000	16.4279171 C
0.00003125	3771.	120659431.	18.6996465	0.0005844	-0.000166	2.0834946	0.00000	16.8378042 C
0.00003250	3899.	119982179.	18.4176477	0.0005986	-0.000181	2.1245471	0.00000	17.2455328 C
0.00003375	4027.	119311211.	18.1544307	0.0006127	-0.000197	2.1649509	0.00000	17.6511989 C
0.00003500	4153.	118649265.	17.9080942	0.0006268	-0.000213	2.2047236	0.00000	18.0549153 C
0.00003625	4277.	117998711.	17.6770134	0.0006408	-0.000229	2.2438841	0.00000	18.4568104 C
0.00003750	4401.	117361583.	17.4597944	0.0006547	-0.000245	2.2824519	0.00000	18.8570265 C
0.00003875	4524.	116739607.	17.2552367	0.0006686	-0.000261	2.3204474	0.00000	19.2557223 C
0.00004000	4645.	116134225.	17.0623028	0.0006825	-0.000278	2.3578917	0.00000	19.6530714 C
0.00004125	4766.	115546619.	16.8800938	0.0006963	-0.000294	2.3948066	0.00000	20.0492623 C
0.00004250	4886.	114974355.	16.7075572	0.0007101	-0.000310	2.4311838	0.00000	20.4441643 C
0.00004375	5006.	114415881.	16.5437852	0.0007238	-0.000326	2.4670184	0.00000	20.8376774 C
0.00004500	5124.	113876832.	16.3885683	0.0007375	-0.000343	2.5023754	0.00000	21.2304817 C
0.00004625	5243.	113352938.	16.2409704	0.0007511	-0.000359	2.5372285	0.00000	21.6222517 C
0.00004750	5360.	112842941.	16.1003359	0.0007648	-0.000375	2.5715744	0.00000	22.0129128 C
0.00004875	5477.	112352418.	15.9667147	0.0007784	-0.000392	2.6054880	0.00000	22.4032931 C
0.00005125	5710.	111409536.	15.7170381	0.0008055	-0.000425	2.6718438	0.00000	23.1810980 C
0.00005375	5941.	110521448.	15.4888426	0.0008325	-0.000457	2.7363586	0.00000	23.9561836 C
0.00005625	6170.	109683874.	15.2794315	0.0008595	-0.000491	2.7990712	0.00000	24.7288228 C
0.00005875	6398.	108894162.	15.0866970	0.0008863	-0.000524	2.8600355	0.00000	25.4995102 C
0.00006125	6624.	108149591.	14.9088696	0.0009132	-0.000557	2.9193002	0.00000	26.2687297 C
0.00006375	6850.	107447615.	14.7444766	0.0009400	-0.000590	2.9769128	0.00000	27.0370013 C
0.00006625	7074.	106779501.	14.5914473	0.0009667	-0.000623	3.0328033	0.00000	27.8032683 C
0.00006875	7298.	106147650.	14.4492451	0.0009934	-0.000657	3.0870818	0.00000	28.5689326 C
0.00007125	7520.	105548362.	14.3167410	0.0010201	-0.000690	3.1397537	0.00000	29.3340163 C
0.00007375	7742.	104976751.	14.1926661	0.0010467	-0.000723	3.1907826	0.00000	30.0979148 C
0.00007625	7963.	104434219.	14.0767810	0.0010734	-0.000757	3.2402590	0.00000	30.8619323 C
0.00007875	8183.	103915142.	13.9678313	0.0011000	-0.000790	3.2881152	0.00000	31.6249849 C
0.00008125	8403.	103420093.	13.8656005	0.0011266	-0.000823	3.3344168	0.00000	32.3880714 C
0.00008375	8622.	102947312.	13.7695223	0.0011532	-0.000857	3.3791685	0.00000	33.1512775 C
0.00008625	8840.	102492489.	13.6786553	0.0011798	-0.000890	3.4223131	0.00000	33.9135868 C
0.00008875	9058.	102058495.	13.5933105	0.0012064	-0.000924	3.4639595	0.00000	34.6769331 C
0.00009125	9275.	101640395.	13.5124350	0.0012330	-0.000957	3.5040199	0.00000	35.4397314 C
0.00009375	9491.	101237901.	13.4358538	0.0012596	-0.000990	3.5425221	0.00000	36.2024779 C
0.00009625	9707.	100851863.	13.3636263	0.0012862	-0.001024	3.5795186	0.00000	36.9662722 C
0.00009875	9922.	100479469.	13.2951027	0.0013129	-0.001057	3.6149614	0.00000	37.7302005 C
0.0001013	10137.	100118633.	13.2297820	0.0013395	-0.001090	3.6488210	0.00000	38.4935977 C
0.0001038	10351.	99771024.	13.1679623	0.0013662	-0.001124	3.6811664	0.00000	39.2580570 C
0.0001063	10565.	99435680.	13.1093988	0.0013929	-0.001157	3.7119913	0.00000	40.0235854 C
0.0001088	10778.	99110261.	13.0535189	0.0014196	-0.001190	3.7412484	0.00000	40.7890855 C
0.0001113	10991.	98793967.	13.0001103	0.0014463	-0.001224	3.7689342	0.00000	41.5544563 C
0.0001138	11203.	98487722.	12.9493790	0.0014730	-0.001257	3.7950900	0.00000	42.3209144 C
0.0001163	11415.	98190853.	12.9011545	0.0014998	-0.001290	3.8197091	0.00000	43.0884673 C
0.0001188	11626.	97902743.	12.8552805	0.0015266	-0.001323	3.8427851	0.00000	43.8571225 C
0.0001213	11837.	97621415.	12.8112231	0.0015534	-0.001357	3.8642744	0.00000	44.6255134 C
0.0001238	12043.	97320888.	12.7705160	0.0015804	-0.001390	3.8843253	0.00000	45.0000000 CY
0.0001263	12242.	96968251.	12.7351453	0.0016078	-0.001422	3.9030852	0.00000	45.0000000 CY
0.0001288	12431.	96552668.	12.7056572	0.0016359	-0.001454	3.9205338	0.00000	45.0000000 CY
0.0001313	12612.	96090735.	12.6810459	0.0016644	-0.001486	3.9365155	0.00000	45.0000000 CY
0.0001338	12786.	95597268.	12.6603896	0.0016933	-0.001517	3.9508958	0.00000	45.0000000 CY
0.0001363	12955.	95082134.	12.6430428	0.0017226	-0.001547	3.9635727	0.00000	45.0000000 CY
0.0001388	13117.	94536152.	12.6273575	0.0017520	-0.001578	3.9744090	0.00000	45.0000000 CY
0.0001413	13267.	93922898.	12.6106614	0.0017813	-0.001609	3.9832767	0.00000	45.0000000 CY
0.0001438	13401.	93222717.	12.5910047	0.0018100	-0.001640	3.9901583	0.00000	45.0000000 CY
0.0001463	13520.	92444868.	12.5693058	0.0018383	-0.001672	3.9951680	0.00000	45.0000000 CY
0.0001488	13630.	91630479.	12.5463913	0.0018663	-0.001704	3.9983898	0.00000	45.0000000 CY
0.0001588	14002.	88202016.	12.4540737	0.0019771	-0.001833	3.9999779	0.00000	45.0000000 CY
0.0001688	14293.	84699715.	12.3649697	0.0020866	-0.001963	3.9994343	0.00000	45.0000000 CY
0.0001788	14527.	81271415.	12.2811705	0.0021953	-0.002095	3.9998169	0.00000	45.0000000 CY
0.0001888	14719.	77980637.	12.2041111	0.0023035	-0.002226	3.9998072	0.00000	45.0000000 CY
0.0001988	14877.	74855243.	12.1347606	0.0024118	-0.002358	3.9994034	0.00000	45.0000000 CY
0.0002088	15011.	71906803.	12.0706051	0.0025197	-0.002490	3.9979327	0.00000	45.0000000 CY
0.0002188	15123.	69132875.	12.0122808	0.0026277	-0.002622	3.9995577	0.00000	45.0000000 CY
0.0002288	15218.	66524894.	11.9595221	0.0027357	-0.002754	3.9999975	0.00000	45.0000000 CY
0.0002388	15299.	64078653.	11.9121418	0.0028440	-0.002886	3.9977238	0.00000	45.0000000 CY
0.0002488	15368.	61782459.	11.8690986	0.0029524	-0.003018	3.9983524	0.00000	45.0000000 CY
0.0002588	15427.	59622872.	11.8291126	0.0030608	-0.003149	3.9985073	0.00000	45.0000000 CY
0.0002688	15478.	57593856.	11.7930070	0.0031694	-0.003281	3.9982769	0.00000	45.0000000 CY
0.0002788	15522.	55685689.	11.7602440	0.0032782	-0.003412	3.9975741	0.00000	45.0000000 CY
0.0002888	15561.	53889415.	11.7304008	0.0033872	-0.003543	3.9965725	0.00000	45.0000000 CY
0.0002988	15593.	52194216.	11.7041521	0.0034966	-0.003673	3.9999905	0.00000	45.0000000 CY
0.0003088	15621.	50594132.	11.6799835	0.0036062	-0.003804	3.9994839	0.00000	45.0000000 CY
0.0003188	15645.	49080979.	11.6580501	0.0037160	-0.003934	3.9977720	0.00000	45.0000000 CY
0.0003288	15665.	47649636.	11.6384925	0.0038262	-0.004064	3.9978575	0.00000	45.0000000 CY

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	286.200	15026.863	0.00300000	-0.00414593
2	370.100	15187.006	0.00300000	-0.00379462
3	508.600	15356.226	0.00300000	-0.00328825
4	574.200	15394.301	0.00300000	-0.00307536

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	286.200000	15027.	186.030000	9767.	95767751.
2	0.65	370.100000	15187.	240.565000	9872.	97134928.
3	0.65	508.600000	15356.	330.590000	9982.	99326229.
4	0.65	574.200000	15394.	373.230000	10006.	100338358.
1	0.75	286.200000	15027.	214.650000	11270.	94371846.
2	0.75	370.100000	15187.	277.575000	11390.	95457947.
3	0.75	508.600000	15356.	381.450000	11517.	97200744.
4	0.75	574.200000	15394.	430.650000	11546.	98012149.
1	0.90	286.200000	15027.	257.580000	13524.	83773176.
2	0.90	370.100000	15187.	333.090000	13668.	86024711.
3	0.90	508.600000	15356.	457.740000	13821.	88678789.
4	0.90	574.200000	15394.	516.780000	13855.	89558518.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	21.3000	0.00	N.A.	No	0.00	36.8998
2	21.7000	0.3998	Yes	No	36.8998	43907.
3	30.7000	9.4000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only
for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 4100.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 370100.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch

0.00	0.1892	-985154.	4100.	0.00	0.00	1.28E+11	0.00	0.00	6.3962
0.3625	0.1891	-967231.	4136.	-3.32E-05	0.00	1.28E+11	0.00	0.00	10.1700
0.7250	0.1889	-949063.	4180.	-6.57E-05	0.00	1.28E+11	0.00	0.00	10.1700
1.0875	0.1885	-930651.	4225.	-9.76E-05	0.00	1.28E+11	0.00	0.00	10.1700
1.4500	0.1881	-911996.	4269.	-1.29E-04	0.00	1.28E+11	0.00	0.00	10.1700
1.8125	0.1874	-893098.	4313.	-1.60E-04	0.00	1.28E+11	0.00	0.00	10.1700
2.1750	0.1867	-873959.	4357.	-1.90E-04	0.00	1.28E+11	0.00	0.00	10.1700
2.5375	0.1858	-854580.	4401.	-2.19E-04	0.00	1.28E+11	0.00	0.00	10.1700
2.9000	0.1848	-834961.	4446.	-2.48E-04	0.00	1.28E+11	0.00	0.00	10.1700
3.2625	0.1836	-815105.	4490.	-2.76E-04	0.00	1.28E+11	0.00	0.00	10.1700
3.6250	0.1824	-795011.	4534.	-3.03E-04	0.00	1.28E+11	0.00	0.00	10.1700
3.9875	0.1810	-774681.	4578.	-3.30E-04	0.00	1.28E+11	0.00	0.00	10.1700
4.3500	0.1795	-754117.	4623.	-3.56E-04	0.00	1.28E+11	0.00	0.00	10.1700
4.7125	0.1779	-733319.	4667.	-3.81E-04	0.00	1.28E+11	0.00	0.00	10.1700
5.0750	0.1762	-712289.	4711.	-4.05E-04	0.00	1.28E+11	0.00	0.00	10.1700
5.4375	0.1744	-691027.	4755.	-4.29E-04	0.00	1.28E+11	0.00	0.00	10.1700
5.8000	0.1724	-669535.	4800.	-4.52E-04	0.00	1.28E+11	0.00	0.00	10.1700
6.1625	0.1704	-647813.	4844.	-4.75E-04	0.00	1.28E+11	0.00	0.00	10.1700
6.5250	0.1683	-625864.	4888.	-4.96E-04	0.00	1.28E+11	0.00	0.00	10.1700
6.8875	0.1661	-603688.	4932.	-5.17E-04	0.00	1.28E+11	0.00	0.00	10.1700
7.2500	0.1638	-581287.	4977.	-5.37E-04	0.00	1.28E+11	0.00	0.00	10.1700
7.6125	0.1614	-558662.	5021.	-5.57E-04	0.00	1.28E+11	0.00	0.00	10.1700
7.9750	0.1590	-535813.	5065.	-5.75E-04	0.00	1.28E+11	0.00	0.00	10.1700
8.3375	0.1564	-512743.	5109.	-5.93E-04	0.00	1.28E+11	0.00	0.00	10.1700
8.7000	0.1538	-489453.	5154.	-6.10E-04	0.00	1.28E+11	0.00	0.00	10.1700
9.0625	0.1511	-465943.	5198.	-6.26E-04	0.00	1.28E+11	0.00	0.00	10.1700
9.4250	0.1484	-442215.	5242.	-6.42E-04	0.00	1.28E+11	0.00	0.00	10.1700
9.7875	0.1455	-418271.	5286.	-6.56E-04	0.00	1.28E+11	0.00	0.00	10.1700
10.1500	0.1426	-394111.	5330.	-6.70E-04	0.00	1.28E+11	0.00	0.00	10.1700
10.5125	0.1397	-369737.	5375.	-6.83E-04	0.00	1.28E+11	0.00	0.00	10.1700
10.8750	0.1367	-345151.	5419.	-6.95E-04	0.00	1.28E+11	0.00	0.00	10.1700
11.2375	0.1337	-320353.	5463.	-7.07E-04	0.00	1.28E+11	0.00	0.00	10.1700
11.6000	0.1306	-295345.	5507.	-7.17E-04	0.00	1.28E+11	0.00	0.00	10.1700
11.9625	0.1274	-270129.	5552.	-7.27E-04	0.00	1.28E+11	0.00	0.00	10.1700
12.3250	0.1242	-244706.	5596.	-7.35E-04	0.00	1.28E+11	0.00	0.00	10.1700
12.6875	0.1210	-219077.	5640.	-7.43E-04	0.00	1.28E+11	0.00	0.00	10.1700
13.0500	0.1178	-193243.	5684.	-7.50E-04	0.00	1.28E+11	0.00	0.00	10.1700
13.4125	0.1145	-167206.	5729.	-7.56E-04	0.00	1.28E+11	0.00	0.00	10.1700
13.7750	0.1112	-140968.	5773.	-7.62E-04	0.00	1.28E+11	0.00	0.00	10.1700
14.1375	0.1079	-114529.	5817.	-7.66E-04	0.00	1.28E+11	0.00	0.00	10.1700
14.5000	0.1045	-87892.	5861.	-7.69E-04	0.00	1.28E+11	0.00	0.00	10.1700
14.8625	0.1012	-61058.	5906.	-7.72E-04	0.00	1.28E+11	0.00	0.00	10.1700
15.2250	0.09781	-34028.	5950.	-7.74E-04	0.00	1.28E+11	0.00	0.00	10.1700
15.5875	0.09444	-6803.	5994.	-7.74E-04	0.00	1.28E+11	0.00	0.00	10.1700
15.9500	0.09107	20614.	6038.	-7.74E-04	0.00	1.28E+11	0.00	0.00	10.1700
16.3125	0.08770	48223.	6083.	-7.73E-04	0.00	1.28E+11	0.00	0.00	10.1700
16.6750	0.08435	76021.	6127.	-7.71E-04	0.00	1.28E+11	0.00	0.00	10.1700
17.0375	0.08100	104008.	6171.	-7.68E-04	0.00	1.28E+11	0.00	0.00	10.1700
17.4000	0.07767	132181.	6215.	-7.64E-04	0.00	1.28E+11	0.00	0.00	10.1700
17.7625	0.07435	160540.	6260.	-7.59E-04	0.00	1.28E+11	0.00	0.00	10.1700
18.1250	0.07107	189082.	6304.	-7.53E-04	0.00	1.28E+11	0.00	0.00	10.1700
18.4875	0.06780	217807.	6348.	-7.46E-04	0.00	1.28E+11	0.00	0.00	10.1700
18.8500	0.06458	246711.	6392.	-7.38E-04	0.00	1.28E+11	0.00	0.00	10.1700
19.2125	0.06138	275795.	6436.	-7.29E-04	0.00	1.28E+11	0.00	0.00	10.1700
19.5750	0.05823	305057.	6481.	-7.19E-04	0.00	1.28E+11	0.00	0.00	10.1700
19.9375	0.05513	334494.	6525.	-7.08E-04	0.00	1.28E+11	0.00	0.00	10.1700
20.3000	0.05207	364105.	6569.	-6.97E-04	0.00	1.28E+11	0.00	0.00	10.1700
20.6625	0.04907	393889.	6613.	-6.84E-04	0.00	1.28E+11	0.00	0.00	10.1700
21.0250	0.04612	423843.	6658.	-6.70E-04	0.00	1.28E+11	0.00	0.00	10.1700
21.3875	0.04324	453967.	6651.	-6.55E-04	0.00	1.28E+11	-14.301	1439.	1.2274
21.7500	0.04042	483819.	6498.	-6.39E-04	0.00	1.28E+11	-57.366	6173.	0.00
22.1125	0.03768	512558.	6229.	-6.22E-04	0.00	1.28E+11	-66.490	7676.	0.00
22.4750	0.03501	540012.	5921.	-6.04E-04	0.00	1.28E+11	-74.798	9293.	0.00
22.8375	0.03242	566020.	5580.	-5.85E-04	0.00	1.28E+11	-82.282	11039.	0.00
23.2000	0.02992	590441.	5207.	-5.66E-04	0.00	1.28E+11	-88.936	12930.	0.00
23.5625	0.02750	613147.	4808.	-5.45E-04	0.00	1.28E+11	-94.755	14987.	0.00
23.9250	0.02518	634026.	4385.	-5.24E-04	0.00	1.28E+11	-99.735	17233.	0.00
24.2875	0.02294	652983.	3942.	-5.02E-04	0.00	1.28E+11	-103.875	19695.	0.00
24.6500	0.02081	669938.	3483.	-4.80E-04	0.00	1.28E+11	-107.172	22407.	0.00
25.0125	0.01877	684830.	3011.	-4.57E-04	0.00	1.28E+11	-109.626	25409.	0.00
25.3750	0.01683	697609.	2531.	-4.33E-04	0.00	1.28E+11	-111.239	28749.	0.00
25.7375	0.01500	708245.	2046.	-4.09E-04	0.00	1.28E+11	-112.013	32487.	0.00
26.1000	0.01327	716723.	1558.	-3.85E-04	0.00	1.28E+11	-111.951	36699.	0.00
26.4625	0.01165	723044.	1073.	-3.61E-04	0.00	1.28E+11	-111.057	41479.	0.00
26.8250	0.01013	727223.	593.9949	-3.36E-04	0.00	1.28E+11	-109.336	46946.	0.00
27.1875	0.00872	729294.	123.9120	-3.11E-04	0.00	1.28E+11	-106.794	53260.	0.00
27.5500	0.00742	729304.	-329.260	-2.87E-04	0.00	1.28E+11	-101.561	59527.	0.00
27.9125	0.00623	727352.	-752.518	-2.62E-04	0.00	1.28E+11	-93.041	64978.	0.00
28.2750	0.00514	723600.	-1139.	-2.37E-04	0.00	1.28E+11	-84.546	71507.	0.00
28.6375	0.00416	718209.	-1488.	-2.13E-04	0.00	1.28E+11	-76.079	79465.	0.00
29.0000	0.00329	711338.	-1801.	-1.88E-04	0.00	1.28E+11	-67.642	89377.	0.00
29.3625	0.00252	703149.	-2077.	-1.64E-04	0.00	1.28E+11	-59.237	102060.	0.00
29.7250	0.00186	693801.	-2316.	-1.41E-04	0.00	1.28E+11	-50.862	118866.	0.00
30.0875	0.00130	683452.	-2519.	-1.17E-04	0.00	1.28E+11	-42.513	142211.	0.00
30.4500	8.40E-04	672261.	-2675.	-9.43E-05	0.00	1.28E+11	-29.068	150453.	0.00
30.8125	4.80E-04	660484.	-10565.	-7.17E-05	0.00	1.28E+11	-3598.	3.26E+07	0.00
31.1750	2.17E-04	580581.	-21926.	-5.06E-05	0.00	1.28E+11	-1625.	3.26E+07	0.00
31.5375	3.95E-05	469888.	-26105.	-3.28E-05	0.00	1.28E+11	-295.951	3.26E+07	0.00
31.9000	-6.84E-05	353569.	-25634.	-1.88E-05	0.00	1.28E+11	512.8562	3.26E+07	0.00
32.2625	-1.24E-04	246936.	-22496.	-8.59E-06	0.00	1.28E+11	929.8609	3.26E+07	0.00

32.6250	-1.43E-04	157884.	-18139.	-1.71E-06	0.00	1.28E+11	1073.	3.26E+07	0.00
32.9875	-1.39E-04	89132.	-13539.	2.48E-06	0.00	1.28E+11	1042.	3.26E+07	0.00
33.3500	-1.22E-04	40086.	-9292.	4.68E-06	0.00	1.28E+11	911.2844	3.26E+07	0.00
33.7125	-9.82E-05	8281.	-5708.	5.50E-06	0.00	1.28E+11	736.5073	3.26E+07	0.00
34.0750	-7.37E-05	-9588.	-2904.	5.48E-06	0.00	1.28E+11	552.5538	3.26E+07	0.00
34.4375	-5.06E-05	-17000.	-877.250	5.02E-06	0.00	1.28E+11	379.2246	3.26E+07	0.00
34.8000	-3.00E-05	-17236.	436.3594	4.44E-06	0.00	1.28E+11	224.7338	3.26E+07	0.00
35.1625	-1.19E-05	-13218.	1119.	3.93E-06	0.00	1.28E+11	89.3426	3.26E+07	0.00
35.5250	4.19E-06	-7509.	1245.	3.57E-06	0.00	1.28E+11	-31.401	3.26E+07	0.00
35.8875	1.92E-05	-2394.	864.3836	3.41E-06	0.00	1.28E+11	-143.824	3.26E+07	0.00
36.2500	3.38E-05	0.00	0.00	3.36E-06	0.00	1.28E+11	-253.594	1.63E+07	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     0.18919208 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =       -985154. inch-lbs
Maximum shear force              =        -26105. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =    31.53750000 feet below pile head
Number of iterations             =              7
Number of zero deflection points =              2
Pile deflection at ground        =     0.04393474 inches
```

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 2, Shear and Slope

```
Shear      =           4100. lbs
Slope      =         0.00000
Axial Load =         370100. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
36.25000	0.18919208	-985154.	-26105.
34.43750	0.19067192	-987606.	-25361.
32.62500	0.19775049	-999953.	-39078.
30.81250	0.31518716	-1225626.	-11387.
29.00000	0.44684186	-1640380.	6671.
27.18750	0.46127249	-1728252.	6674.
25.37500	0.46408983	-1722186.	6670.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

```
Shear force at pile head                          =       5300.0 lbs
Rotation of pile head                             =    0.000E+00 radians
Axial load at pile head                           =     574200.0 lbs
```

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.2214	-1168216.	5300.	0.00	0.00	1.26E+11	0.00	0.00	3.2141
0.3625	0.2213	-1145081.	5323.	-4.00E-05	0.00	1.26E+11	0.00	0.00	7.1700
0.7250	0.2210	-1121710.	5354.	-7.93E-05	0.00	1.26E+11	0.00	0.00	7.1700
1.0875	0.2206	-1098107.	5385.	-1.18E-04	0.00	1.26E+11	0.00	0.00	7.1700
1.4500	0.2200	-1074273.	5416.	-1.55E-04	0.00	1.26E+11	0.00	0.00	7.1700
1.8125	0.2192	-1050211.	5447.	-1.92E-04	0.00	1.26E+11	0.00	0.00	7.1700
2.1750	0.2183	-1025922.	5479.	-2.28E-04	0.00	1.26E+11	0.00	0.00	7.1700
2.5375	0.2173	-1001409.	5510.	-2.63E-04	0.00	1.26E+11	0.00	0.00	7.1700
2.9000	0.2160	-976673.	5541.	-2.97E-04	0.00	1.26E+11	0.00	0.00	7.1700
3.2625	0.2147	-951718.	5572.	-3.31E-04	0.00	1.26E+11	0.00	0.00	7.1700
3.6250	0.2132	-926545.	5603.	-3.63E-04	0.00	1.26E+11	0.00	0.00	7.1700
3.9875	0.2115	-901155.	5634.	-3.95E-04	0.00	1.26E+11	0.00	0.00	7.1700
4.3500	0.2097	-875553.	5666.	-4.25E-04	0.00	1.26E+11	0.00	0.00	7.1700
4.7125	0.2078	-849739.	5697.	-4.55E-04	0.00	1.26E+11	0.00	0.00	7.1700
5.0750	0.2058	-823715.	5728.	-4.84E-04	0.00	1.26E+11	0.00	0.00	7.1700
5.4375	0.2036	-797485.	5759.	-5.12E-04	0.00	1.26E+11	0.00	0.00	7.1700

5.8000	0.2013	-771051.	5790.	-5.39E-04	0.00	1.26E+11	0.00	0.00	7.1700
6.1625	0.1989	-744414.	5822.	-5.66E-04	0.00	1.26E+11	0.00	0.00	7.1700
6.5250	0.1964	-717577.	5853.	-5.91E-04	0.00	1.26E+11	0.00	0.00	7.1700
6.8875	0.1938	-690542.	5884.	-6.15E-04	0.00	1.26E+11	0.00	0.00	7.1700
7.2500	0.1910	-663312.	5915.	-6.39E-04	0.00	1.26E+11	0.00	0.00	7.1700
7.6125	0.1882	-635889.	5946.	-6.61E-04	0.00	1.26E+11	0.00	0.00	7.1700
7.9750	0.1853	-608275.	5978.	-6.83E-04	0.00	1.26E+11	0.00	0.00	7.1700
8.3375	0.1823	-580473.	6009.	-7.03E-04	0.00	1.26E+11	0.00	0.00	7.1700
8.7000	0.1792	-552485.	6040.	-7.23E-04	0.00	1.26E+11	0.00	0.00	7.1700
9.0625	0.1760	-524314.	6071.	-7.42E-04	0.00	1.26E+11	0.00	0.00	7.1700
9.4250	0.1727	-495962.	6102.	-7.59E-04	0.00	1.26E+11	0.00	0.00	7.1700
9.7875	0.1694	-467431.	6134.	-7.76E-04	0.00	1.26E+11	0.00	0.00	7.1700
10.1500	0.1660	-438724.	6165.	-7.92E-04	0.00	1.26E+11	0.00	0.00	7.1700
10.5125	0.1625	-409844.	6196.	-8.06E-04	0.00	1.26E+11	0.00	0.00	7.1700
10.8750	0.1589	-380792.	6227.	-8.20E-04	0.00	1.26E+11	0.00	0.00	7.1700
11.2375	0.1554	-351572.	6258.	-8.33E-04	0.00	1.26E+11	0.00	0.00	7.1700
11.6000	0.1517	-322186.	6289.	-8.44E-04	0.00	1.26E+11	0.00	0.00	7.1700
11.9625	0.1480	-292636.	6321.	-8.55E-04	0.00	1.26E+11	0.00	0.00	7.1700
12.3250	0.1443	-262926.	6352.	-8.65E-04	0.00	1.26E+11	0.00	0.00	7.1700
12.6875	0.1405	-233057.	6383.	-8.73E-04	0.00	1.26E+11	0.00	0.00	7.1700
13.0500	0.1367	-203032.	6414.	-8.81E-04	0.00	1.26E+11	0.00	0.00	7.1700
13.4125	0.1328	-172854.	6445.	-8.87E-04	0.00	1.26E+11	0.00	0.00	7.1700
13.7750	0.1290	-142525.	6477.	-8.93E-04	0.00	1.26E+11	0.00	0.00	7.1700
14.1375	0.1251	-112048.	6508.	-8.97E-04	0.00	1.26E+11	0.00	0.00	7.1700
14.5000	0.1211	-81426.	6539.	-9.00E-04	0.00	1.26E+11	0.00	0.00	7.1700
14.8625	0.1172	-50661.	6570.	-9.03E-04	0.00	1.26E+11	0.00	0.00	7.1700
15.2250	0.1133	-19756.	6601.	-9.04E-04	0.00	1.26E+11	0.00	0.00	7.1700
15.5875	0.1094	11286.	6633.	-9.04E-04	0.00	1.26E+11	0.00	0.00	7.1700
15.9500	0.1054	42463.	6664.	-9.03E-04	0.00	1.26E+11	0.00	0.00	7.1700
16.3125	0.1015	73772.	6695.	-9.01E-04	0.00	1.26E+11	0.00	0.00	7.1700
16.6750	0.09759	105210.	6726.	-8.98E-04	0.00	1.26E+11	0.00	0.00	7.1700
17.0375	0.09369	136775.	6757.	-8.94E-04	0.00	1.26E+11	0.00	0.00	7.1700
17.4000	0.08982	168463.	6788.	-8.89E-04	0.00	1.26E+11	0.00	0.00	7.1700
17.7625	0.08596	200273.	6820.	-8.82E-04	0.00	1.26E+11	0.00	0.00	7.1700
18.1250	0.08214	232201.	6851.	-8.75E-04	0.00	1.26E+11	0.00	0.00	7.1700
18.4875	0.07835	264245.	6882.	-8.66E-04	0.00	1.26E+11	0.00	0.00	7.1700
18.8500	0.07461	296402.	6913.	-8.56E-04	0.00	1.26E+11	0.00	0.00	7.1700
19.2125	0.07090	328668.	6944.	-8.46E-04	0.00	1.26E+11	0.00	0.00	7.1700
19.5750	0.06725	361042.	6976.	-8.34E-04	0.00	1.26E+11	0.00	0.00	7.1700
19.9375	0.06365	393521.	7007.	-8.21E-04	0.00	1.26E+11	0.00	0.00	7.1700
20.3000	0.06011	426101.	7038.	-8.06E-04	0.00	1.26E+11	0.00	0.00	7.1700
20.6625	0.05664	458779.	7069.	-7.91E-04	0.00	1.26E+11	0.00	0.00	7.1700
21.0250	0.05323	491554.	7100.	-7.75E-04	0.00	1.26E+11	0.00	0.00	7.1700
21.3875	0.04990	524422.	7082.	-7.57E-04	0.00	1.26E+11	-16.503	1439.	0.8653
21.7500	0.04664	556949.	6914.	-7.38E-04	0.00	1.26E+11	-61.621	5747.	0.00
22.1125	0.04347	588262.	6625.	-7.19E-04	0.00	1.26E+11	-71.419	7146.	0.00
22.4750	0.04039	618172.	6294.	-6.98E-04	0.00	1.26E+11	-80.339	8652.	0.00
22.8375	0.03740	646509.	5928.	-6.76E-04	0.00	1.26E+11	-88.374	10278.	0.00
23.2000	0.03451	673118.	5528.	-6.53E-04	0.00	1.26E+11	-95.519	12039.	0.00
23.5625	0.03172	697861.	5098.	-6.29E-04	0.00	1.26E+11	-101.767	13955.	0.00
23.9250	0.02904	720618.	4644.	-6.05E-04	0.00	1.26E+11	-107.115	16046.	0.00
24.2875	0.02646	741286.	4169.	-5.79E-04	0.00	1.26E+11	-111.560	18338.	0.00
24.6500	0.02400	759778.	3676.	-5.53E-04	0.00	1.26E+11	-115.101	20864.	0.00
25.0125	0.02165	776028.	3169.	-5.27E-04	0.00	1.26E+11	-117.737	23658.	0.00
25.3750	0.01941	789982.	2653.	-5.00E-04	0.00	1.26E+11	-119.471	26768.	0.00
25.7375	0.01730	801607.	2132.	-4.72E-04	0.00	1.26E+11	-120.303	30249.	0.00
26.1000	0.01531	810886.	1609.	-4.44E-04	0.00	1.26E+11	-120.237	34170.	0.00
26.4625	0.01344	817820.	1088.	-4.16E-04	0.00	1.26E+11	-119.278	38619.	0.00
26.8250	0.01169	822427.	572.7418	-3.88E-04	0.00	1.26E+11	-117.431	43710.	0.00
27.1875	0.01006	824740.	67.8546	-3.59E-04	0.00	1.26E+11	-114.701	49588.	0.00
27.5500	0.00856	824812.	-418.869	-3.31E-04	0.00	1.26E+11	-109.080	55423.	0.00
27.9125	0.00718	822748.	-873.460	-3.02E-04	0.00	1.26E+11	-99.928	60499.	0.00
28.2750	0.00593	818722.	-1288.	-2.74E-04	0.00	1.26E+11	-90.801	66580.	0.00
28.6375	0.00480	812908.	-1663.	-2.46E-04	0.00	1.26E+11	-81.703	73995.	0.00
29.0000	0.00380	805477.	-1999.	-2.18E-04	0.00	1.26E+11	-72.636	83232.	0.00
29.3625	0.00291	796601.	-2295.	-1.90E-04	0.00	1.26E+11	-63.600	95057.	0.00
29.7250	0.00214	786454.	-2553.	-1.62E-04	0.00	1.26E+11	-54.596	110734.	0.00
30.0875	0.00150	775206.	-2771.	-1.35E-04	0.00	1.26E+11	-45.618	132529.	0.00
30.4500	9.67E-04	763027.	-2942.	-1.09E-04	0.00	1.26E+11	-33.433	150453.	0.00
30.8125	5.51E-04	750150.	-12000.	-8.26E-05	0.00	1.26E+11	-4131.	3.26E+07	0.00
31.1750	2.48E-04	659039.	-25028.	-5.82E-05	0.00	1.26E+11	-1859.	3.26E+07	0.00
31.5375	4.42E-05	532694.	-29792.	-3.76E-05	0.00	1.26E+11	-331.217	3.26E+07	0.00
31.9000	-7.94E-05	400035.	-29218.	-2.15E-05	0.00	1.26E+11	595.2548	3.26E+07	0.00
32.2625	-1.43E-04	278605.	-25596.	-9.73E-06	0.00	1.26E+11	1070.	3.26E+07	0.00
32.6250	-1.64E-04	177400.	-20592.	-1.85E-06	0.00	1.26E+11	1230.	3.26E+07	0.00
32.9875	-1.59E-04	99463.	-15326.	2.95E-06	0.00	1.26E+11	1191.	3.26E+07	0.00
33.3500	-1.38E-04	44045.	-10479.	5.43E-06	0.00	1.26E+11	1038.	3.26E+07	0.00
33.7125	-1.12E-04	8270.	-6402.	6.33E-06	0.00	1.26E+11	836.3339	3.26E+07	0.00
34.0750	-8.33E-05	-11681.	-3223.	6.27E-06	0.00	1.26E+11	625.0503	3.26E+07	0.00
34.4375	-5.69E-05	-19802.	-934.978	5.73E-06	0.00	1.26E+11	426.9532	3.26E+07	0.00
34.8000	-3.35E-05	-19844.	540.0306	5.04E-06	0.00	1.26E+11	251.2116	3.26E+07	0.00
35.1625	-1.30E-05	-15129.	1299.	4.44E-06	0.00	1.26E+11	97.8718	3.26E+07	0.00
35.5250	5.12E-06	-8562.	1429.	4.03E-06	0.00	1.26E+11	-38.388	3.26E+07	0.00
35.8875	2.20E-05	-2720.	986.3348	3.83E-06	0.00	1.26E+11	-164.982	3.26E+07	0.00
36.2500	3.85E-05	0.00	0.00	3.79E-06	0.00	1.26E+11	-288.505	1.63E+07	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the

magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     0.22137170 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -1168216. inch-lbs
Maximum shear force              =        -29792. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =    31.53750000 feet below pile head
Number of iterations             =              7
Number of zero deflection points =              2
Pile deflection at ground        =     0.05070098 inches
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 2, Shear and Slope

```
Shear      =           5300. lbs
Slope      =        0.00000
Axial Load =         574200. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
36.25000	0.22137170	-1168216.	-29792.
34.43750	0.22317498	-1171243.	-28962.
32.62500	0.23146507	-1185737.	-44692.
30.81250	0.38435941	-1480004.	-12931.
29.00000	0.55408462	-2010386.	7110.
27.18750	0.56651645	-2105963.	7112.
25.37500	0.56233102	-2086368.	7104.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

```
Shear force at pile head                          =       1400.0 lbs
Rotation of pile head                             =    0.000E+00 radians
Axial load at pile head                           =     286200.0 lbs
```

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1335	-614945.	1400.	0.00	0.00	1.29E+11	0.00	0.00	12.7141
0.3625	0.1335	-608721.	1464.	-2.06E-05	0.00	1.29E+11	0.00	0.00	16.6700
0.7250	0.1333	-602157.	1536.	-4.10E-05	0.00	1.29E+11	0.00	0.00	16.6700
1.0875	0.1331	-595252.	1609.	-6.12E-05	0.00	1.29E+11	0.00	0.00	16.6700
1.4500	0.1328	-588007.	1681.	-8.12E-05	0.00	1.29E+11	0.00	0.00	16.6700
1.8125	0.1324	-580422.	1754.	-1.01E-04	0.00	1.29E+11	0.00	0.00	16.6700
2.1750	0.1319	-572496.	1826.	-1.20E-04	0.00	1.29E+11	0.00	0.00	16.6700
2.5375	0.1313	-564232.	1899.	-1.39E-04	0.00	1.29E+11	0.00	0.00	16.6700
2.9000	0.1307	-555628.	1972.	-1.58E-04	0.00	1.29E+11	0.00	0.00	16.6700
3.2625	0.1300	-546685.	2044.	-1.77E-04	0.00	1.29E+11	0.00	0.00	16.6700
3.6250	0.1292	-537404.	2117.	-1.95E-04	0.00	1.29E+11	0.00	0.00	16.6700
3.9875	0.1283	-527785.	2189.	-2.13E-04	0.00	1.29E+11	0.00	0.00	16.6700
4.3500	0.1273	-517829.	2262.	-2.31E-04	0.00	1.29E+11	0.00	0.00	16.6700
4.7125	0.1263	-507535.	2334.	-2.48E-04	0.00	1.29E+11	0.00	0.00	16.6700
5.0750	0.1251	-496904.	2407.	-2.65E-04	0.00	1.29E+11	0.00	0.00	16.6700
5.4375	0.1240	-485938.	2479.	-2.82E-04	0.00	1.29E+11	0.00	0.00	16.6700
5.8000	0.1227	-474635.	2552.	-2.98E-04	0.00	1.29E+11	0.00	0.00	16.6700
6.1625	0.1214	-462997.	2624.	-3.14E-04	0.00	1.29E+11	0.00	0.00	16.6700
6.5250	0.1200	-451024.	2697.	-3.29E-04	0.00	1.29E+11	0.00	0.00	16.6700
6.8875	0.1185	-438717.	2769.	-3.44E-04	0.00	1.29E+11	0.00	0.00	16.6700
7.2500	0.1170	-426076.	2842.	-3.59E-04	0.00	1.29E+11	0.00	0.00	16.6700
7.6125	0.1154	-413102.	2914.	-3.73E-04	0.00	1.29E+11	0.00	0.00	16.6700
7.9750	0.1137	-399794.	2987.	-3.86E-04	0.00	1.29E+11	0.00	0.00	16.6700
8.3375	0.1120	-386155.	3059.	-4.00E-04	0.00	1.29E+11	0.00	0.00	16.6700
8.7000	0.1103	-372184.	3132.	-4.12E-04	0.00	1.29E+11	0.00	0.00	16.6700
9.0625	0.1084	-357882.	3204.	-4.25E-04	0.00	1.29E+11	0.00	0.00	16.6700
9.4250	0.1066	-343249.	3277.	-4.37E-04	0.00	1.29E+11	0.00	0.00	16.6700
9.7875	0.1046	-328287.	3349.	-4.48E-04	0.00	1.29E+11	0.00	0.00	16.6700
10.1500	0.1027	-312995.	3422.	-4.59E-04	0.00	1.29E+11	0.00	0.00	16.6700
10.5125	0.1006	-297375.	3494.	-4.69E-04	0.00	1.29E+11	0.00	0.00	16.6700
10.8750	0.09858	-281427.	3567.	-4.79E-04	0.00	1.29E+11	0.00	0.00	16.6700
11.2375	0.09648	-265152.	3639.	-4.88E-04	0.00	1.29E+11	0.00	0.00	16.6700
11.6000	0.09434	-248550.	3712.	-4.97E-04	0.00	1.29E+11	0.00	0.00	16.6700

11.9625	0.09216	-231622.	3784.	-5.05E-04	0.00	1.29E+11	0.00	0.00	16.6700
12.3250	0.08994	-214369.	3857.	-5.12E-04	0.00	1.29E+11	0.00	0.00	16.6700
12.6875	0.08770	-196792.	3929.	-5.19E-04	0.00	1.29E+11	0.00	0.00	16.6700
13.0500	0.08543	-178890.	4002.	-5.25E-04	0.00	1.29E+11	0.00	0.00	16.6700
13.4125	0.08313	-160666.	4074.	-5.31E-04	0.00	1.29E+11	0.00	0.00	16.6700
13.7750	0.08081	-142120.	4147.	-5.36E-04	0.00	1.29E+11	0.00	0.00	16.6700
14.1375	0.07846	-123253.	4219.	-5.41E-04	0.00	1.29E+11	0.00	0.00	16.6700
14.5000	0.07610	-104064.	4292.	-5.45E-04	0.00	1.29E+11	0.00	0.00	16.6700
14.8625	0.07372	-84556.	4364.	-5.48E-04	0.00	1.29E+11	0.00	0.00	16.6700
15.2250	0.07133	-64729.	4437.	-5.50E-04	0.00	1.29E+11	0.00	0.00	16.6700
15.5875	0.06894	-44584.	4510.	-5.52E-04	0.00	1.29E+11	0.00	0.00	16.6700
15.9500	0.06653	-24121.	4582.	-5.53E-04	0.00	1.29E+11	0.00	0.00	16.6700
16.3125	0.06412	-3343.	4655.	-5.54E-04	0.00	1.29E+11	0.00	0.00	16.6700
16.6750	0.06171	17752.	4727.	-5.54E-04	0.00	1.29E+11	0.00	0.00	16.6700
17.0375	0.05931	39161.	4800.	-5.53E-04	0.00	1.29E+11	0.00	0.00	16.6700
17.4000	0.05691	60884.	4872.	-5.51E-04	0.00	1.29E+11	0.00	0.00	16.6700
17.7625	0.05451	82920.	4945.	-5.48E-04	0.00	1.29E+11	0.00	0.00	16.6700
18.1250	0.05213	105268.	5017.	-5.45E-04	0.00	1.29E+11	0.00	0.00	16.6700
18.4875	0.04977	127927.	5090.	-5.41E-04	0.00	1.29E+11	0.00	0.00	16.6700
18.8500	0.04742	150896.	5162.	-5.37E-04	0.00	1.29E+11	0.00	0.00	16.6700
19.2125	0.04510	174174.	5235.	-5.31E-04	0.00	1.29E+11	0.00	0.00	16.6700
19.5750	0.04280	197760.	5307.	-5.25E-04	0.00	1.29E+11	0.00	0.00	16.6700
19.9375	0.04053	221653.	5380.	-5.18E-04	0.00	1.29E+11	0.00	0.00	16.6700
20.3000	0.03830	245853.	5452.	-5.10E-04	0.00	1.29E+11	0.00	0.00	16.6700
20.6625	0.03610	270357.	5525.	-5.01E-04	0.00	1.29E+11	0.00	0.00	16.6700
21.0250	0.03394	295166.	5597.	-4.92E-04	0.00	1.29E+11	0.00	0.00	16.6700
21.3875	0.03182	320278.	5615.	-4.81E-04	0.00	1.29E+11	-10.524	1439.	2.0119
21.7500	0.02975	345215.	5489.	-4.70E-04	0.00	1.29E+11	-49.212	7196.	0.00
22.1125	0.02773	369206.	5258.	-4.58E-04	0.00	1.29E+11	-57.038	8948.	0.00
22.4750	0.02576	392103.	4995.	-4.45E-04	0.00	1.29E+11	-64.162	10834.	0.00
22.8375	0.02385	413769.	4702.	-4.32E-04	0.00	1.29E+11	-70.576	12870.	0.00
23.2000	0.02201	434083.	4382.	-4.17E-04	0.00	1.29E+11	-76.275	15077.	0.00
23.5625	0.02022	452934.	4040.	-4.02E-04	0.00	1.29E+11	-81.254	17478.	0.00
23.9250	0.01851	470229.	3677.	-3.87E-04	0.00	1.29E+11	-85.510	20100.	0.00
24.2875	0.01686	485887.	3297.	-3.71E-04	0.00	1.29E+11	-89.041	22977.	0.00
24.6500	0.01528	499839.	2904.	-3.54E-04	0.00	1.29E+11	-91.845	26147.	0.00
25.0125	0.01378	512032.	2500.	-3.37E-04	0.00	1.29E+11	-93.923	29658.	0.00
25.3750	0.01235	522427.	2088.	-3.20E-04	0.00	1.29E+11	-95.277	33566.	0.00
25.7375	0.01100	530996.	1672.	-3.02E-04	0.00	1.29E+11	-95.908	37944.	0.00
26.1000	0.00972	537729.	1255.	-2.84E-04	0.00	1.29E+11	-95.820	42878.	0.00
26.4625	0.00853	542626.	840.3845	-2.66E-04	0.00	1.29E+11	-95.018	48481.	0.00
26.8250	0.00741	545702.	430.3411	-2.47E-04	0.00	1.29E+11	-93.507	54895.	0.00
27.1875	0.00637	546985.	28.3988	-2.29E-04	0.00	1.29E+11	-91.294	62304.	0.00
27.5500	0.00542	546519.	-358.910	-2.10E-04	0.00	1.29E+11	-86.779	69668.	0.00
27.9125	0.00454	544387.	-720.482	-1.92E-04	0.00	1.29E+11	-79.461	76085.	0.00
28.2750	0.00375	540729.	-1050.	-1.74E-04	0.00	1.29E+11	-72.169	83773.	0.00
28.6375	0.00303	535682.	-1348.	-1.56E-04	0.00	1.29E+11	-64.907	93146.	0.00
29.0000	0.00239	529385.	-1615.	-1.38E-04	0.00	1.29E+11	-57.677	104823.	0.00
29.3625	0.00183	521974.	-1850.	-1.20E-04	0.00	1.29E+11	-50.480	119768.	0.00
29.7250	0.00135	513586.	-2054.	-1.02E-04	0.00	1.29E+11	-42.991	138532.	0.00
30.0875	9.42E-04	504363.	-2215.	-8.53E-05	0.00	1.29E+11	-31.282	144493.	0.00
30.4500	6.08E-04	494527.	-2329.	-6.85E-05	0.00	1.29E+11	-21.014	150453.	0.00
30.8125	3.46E-04	484273.	-8017.	-5.20E-05	0.00	1.29E+11	-2594.	3.26E+07	0.00
31.1750	1.55E-04	424910.	-16191.	-3.67E-05	0.00	1.29E+11	-1164.	3.26E+07	0.00
31.5375	2.69E-05	343499.	-19162.	-2.37E-05	0.00	1.29E+11	-201.734	3.26E+07	0.00
31.9000	-5.11E-05	258257.	-18768.	-1.36E-05	0.00	1.29E+11	382.9430	3.26E+07	0.00
32.2625	-9.11E-05	180250.	-16449.	-6.18E-06	0.00	1.29E+11	683.5503	3.26E+07	0.00
32.6250	-1.05E-04	115170.	-13253.	-1.20E-06	0.00	1.29E+11	785.8921	3.26E+07	0.00
32.9875	-1.02E-04	64956.	-9887.	1.84E-06	0.00	1.29E+11	761.5535	3.26E+07	0.00
33.3500	-8.88E-05	29150.	-6782.	3.43E-06	0.00	1.29E+11	665.7671	3.26E+07	0.00
33.7125	-7.17E-05	5940.	-4164.	4.02E-06	0.00	1.29E+11	537.9179	3.26E+07	0.00
34.0750	-5.38E-05	-7091.	-2117.	4.00E-06	0.00	1.29E+11	403.5348	3.26E+07	0.00
34.4375	-3.69E-05	-12486.	-636.689	3.67E-06	0.00	1.29E+11	276.9513	3.26E+07	0.00
34.8000	-2.19E-05	-12639.	322.6001	3.25E-06	0.00	1.29E+11	164.1012	3.26E+07	0.00
35.1625	-8.69E-06	-9687.	821.2290	2.87E-06	0.00	1.29E+11	65.1535	3.26E+07	0.00
35.5250	3.09E-06	-5502.	912.6105	2.61E-06	0.00	1.29E+11	-23.139	3.26E+07	0.00
35.8875	1.41E-05	-1754.	633.0816	2.49E-06	0.00	1.29E+11	-105.380	3.26E+07	0.00
36.2500	2.48E-05	0.00	0.00	2.46E-06	0.00	1.29E+11	-185.692	1.63E+07	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 3:

```
Pile-head deflection             =     0.13349797 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =       -614945. inch-lbs
Maximum shear force              =        -19162. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =    31.53750000 feet below pile head
Number of iterations             =              7
Number of zero deflection points =              2
Pile deflection at ground        =     0.03232953 inches
```

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 2, Shear and Slope

Shear = 1400. lbs
Slope = 0.00000
Axial Load = 286200. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
36.25000	0.13349797	-614945.	-19162.
34.43750	0.13454505	-616686.	-18581.
32.62500	0.13936687	-625024.	-28319.
30.81250	0.21135731	-762943.	-9016.
29.00000	0.31020999	-1065945.	5620.
27.18750	0.32503964	-1140439.	5624.
25.37500	0.32774448	-1141442.	5628.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 4

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 5500.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 508600.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.2548	-1307988.	5500.	0.00	0.00	1.26E+11	0.00	0.00	7.7941
0.3625	0.2547	-1283940.	5543.	-4.46E-05	0.00	1.26E+11	0.00	0.00	11.7500
0.7250	0.2544	-1259571.	5594.	-8.83E-05	0.00	1.26E+11	0.00	0.00	11.7500
1.0875	0.2539	-1234884.	5645.	-1.31E-04	0.00	1.26E+11	0.00	0.00	11.7500
1.4500	0.2532	-1209881.	5696.	-1.73E-04	0.00	1.26E+11	0.00	0.00	11.7500
1.8125	0.2524	-1184564.	5747.	-2.14E-04	0.00	1.26E+11	0.00	0.00	11.7500
2.1750	0.2514	-1158934.	5798.	-2.55E-04	0.00	1.26E+11	0.00	0.00	11.7500
2.5375	0.2502	-1132993.	5849.	-2.94E-04	0.00	1.26E+11	0.00	0.00	11.7500
2.9000	0.2488	-1106744.	5900.	-3.33E-04	0.00	1.26E+11	0.00	0.00	11.7500
3.2625	0.2473	-1080189.	5951.	-3.70E-04	0.00	1.26E+11	0.00	0.00	11.7500
3.6250	0.2456	-1053328.	6003.	-4.07E-04	0.00	1.26E+11	0.00	0.00	11.7500
3.9875	0.2437	-1026166.	6054.	-4.43E-04	0.00	1.26E+11	0.00	0.00	11.7500
4.3500	0.2417	-998703.	6105.	-4.78E-04	0.00	1.26E+11	0.00	0.00	11.7500
4.7125	0.2396	-970941.	6156.	-5.11E-04	0.00	1.26E+11	0.00	0.00	11.7500
5.0750	0.2373	-942884.	6207.	-5.44E-04	0.00	1.26E+11	0.00	0.00	11.7500
5.4375	0.2348	-914532.	6258.	-5.76E-04	0.00	1.26E+11	0.00	0.00	11.7500
5.8000	0.2323	-885888.	6309.	-6.07E-04	0.00	1.26E+11	0.00	0.00	11.7500
6.1625	0.2296	-856955.	6360.	-6.37E-04	0.00	1.26E+11	0.00	0.00	11.7500
6.5250	0.2267	-827734.	6411.	-6.66E-04	0.00	1.26E+11	0.00	0.00	11.7500
6.8875	0.2238	-798227.	6463.	-6.94E-04	0.00	1.26E+11	0.00	0.00	11.7500
7.2500	0.2207	-768438.	6514.	-7.21E-04	0.00	1.26E+11	0.00	0.00	11.7500
7.6125	0.2175	-738368.	6565.	-7.47E-04	0.00	1.26E+11	0.00	0.00	11.7500
7.9750	0.2142	-708019.	6616.	-7.72E-04	0.00	1.26E+11	0.00	0.00	11.7500
8.3375	0.2108	-677394.	6667.	-7.96E-04	0.00	1.26E+11	0.00	0.00	11.7500
8.7000	0.2073	-646495.	6718.	-8.19E-04	0.00	1.26E+11	0.00	0.00	11.7500
9.0625	0.2037	-615325.	6769.	-8.40E-04	0.00	1.26E+11	0.00	0.00	11.7500
9.4250	0.2000	-583885.	6820.	-8.61E-04	0.00	1.26E+11	0.00	0.00	11.7500
9.7875	0.1962	-552179.	6871.	-8.80E-04	0.00	1.26E+11	0.00	0.00	11.7500
10.1500	0.1923	-520208.	6923.	-8.99E-04	0.00	1.26E+11	0.00	0.00	11.7500
10.5125	0.1883	-487975.	6974.	-9.16E-04	0.00	1.26E+11	0.00	0.00	11.7500
10.8750	0.1843	-455483.	7025.	-9.32E-04	0.00	1.26E+11	0.00	0.00	11.7500
11.2375	0.1802	-422734.	7076.	-9.47E-04	0.00	1.26E+11	0.00	0.00	11.7500
11.6000	0.1761	-389731.	7127.	-9.61E-04	0.00	1.26E+11	0.00	0.00	11.7500
11.9625	0.1719	-356475.	7178.	-9.74E-04	0.00	1.26E+11	0.00	0.00	11.7500
12.3250	0.1676	-322970.	7229.	-9.86E-04	0.00	1.26E+11	0.00	0.00	11.7500
12.6875	0.1633	-289218.	7280.	-9.97E-04	0.00	1.26E+11	0.00	0.00	11.7500
13.0500	0.1589	-255222.	7331.	-0.00101	0.00	1.26E+11	0.00	0.00	11.7500
13.4125	0.1545	-220984.	7383.	-0.00101	0.00	1.26E+11	0.00	0.00	11.7500
13.7750	0.1501	-186506.	7434.	-0.00102	0.00	1.26E+11	0.00	0.00	11.7500
14.1375	0.1457	-151793.	7485.	-0.00103	0.00	1.26E+11	0.00	0.00	11.7500
14.5000	0.1412	-116845.	7536.	-0.00103	0.00	1.26E+11	0.00	0.00	11.7500
14.8625	0.1367	-81666.	7587.	-0.00103	0.00	1.26E+11	0.00	0.00	11.7500
15.2250	0.1322	-46259.	7638.	-0.00104	0.00	1.26E+11	0.00	0.00	11.7500
15.5875	0.1277	-10625.	7689.	-0.00104	0.00	1.26E+11	0.00	0.00	11.7500
15.9500	0.1231	25231.	7740.	-0.00104	0.00	1.26E+11	0.00	0.00	11.7500
16.3125	0.1186	61308.	7791.	-0.00104	0.00	1.26E+11	0.00	0.00	11.7500
16.6750	0.1141	97602.	7843.	-0.00103	0.00	1.26E+11	0.00	0.00	11.7500
17.0375	0.1096	134112.	7894.	-0.00103	0.00	1.26E+11	0.00	0.00	11.7500
17.4000	0.1052	170834.	7945.	-0.00102	0.00	1.26E+11	0.00	0.00	11.7500
17.7625	0.1007	207764.	7996.	-0.00102	0.00	1.26E+11	0.00	0.00	11.7500

18.1250	0.09631	244902.	8047.	-0.00101	0.00	1.26E+11	0.00	0.00	11.7500
18.4875	0.09194	282243.	8098.	-0.00100	0.00	1.26E+11	0.00	0.00	11.7500
18.8500	0.08760	319785.	8149.	-9.91E-04	0.00	1.26E+11	0.00	0.00	11.7500
19.2125	0.08332	357525.	8200.	-9.79E-04	0.00	1.26E+11	0.00	0.00	11.7500
19.5750	0.07908	395460.	8251.	-9.66E-04	0.00	1.26E+11	0.00	0.00	11.7500
19.9375	0.07491	433588.	8303.	-9.52E-04	0.00	1.26E+11	0.00	0.00	11.7500
20.3000	0.07080	471904.	8354.	-9.36E-04	0.00	1.26E+11	0.00	0.00	11.7500
20.6625	0.06677	510408.	8405.	-9.19E-04	0.00	1.26E+11	0.00	0.00	11.7500
21.0250	0.06281	549094.	8456.	-9.01E-04	0.00	1.26E+11	0.00	0.00	11.7500
21.3875	0.05893	587962.	8442.	-8.82E-04	0.00	1.26E+11	-19.490	1439.	1.4181
21.7500	0.05514	626442.	8257.	-8.61E-04	0.00	1.26E+11	-66.996	5286.	0.00
22.1125	0.05144	663607.	7942.	-8.39E-04	0.00	1.26E+11	-77.686	6570.	0.00
22.4750	0.04784	699252.	7583.	-8.15E-04	0.00	1.26E+11	-87.433	7950.	0.00
22.8375	0.04435	733189.	7184.	-7.90E-04	0.00	1.26E+11	-96.227	9439.	0.00
23.2000	0.04096	765249.	6748.	-7.65E-04	0.00	1.26E+11	-104.062	11051.	0.00
23.5625	0.03769	795282.	6281.	-7.38E-04	0.00	1.26E+11	-110.931	12802.	0.00
23.9250	0.03454	823155.	5785.	-7.10E-04	0.00	1.26E+11	-116.827	14712.	0.00
24.2875	0.03152	848755.	5266.	-6.81E-04	0.00	1.26E+11	-121.748	16804.	0.00
24.6500	0.02862	871987.	4728.	-6.52E-04	0.00	1.26E+11	-125.689	19106.	0.00
25.0125	0.02585	892774.	4175.	-6.21E-04	0.00	1.26E+11	-128.651	21651.	0.00
25.3750	0.02321	911059.	3611.	-5.90E-04	0.00	1.26E+11	-130.631	24481.	0.00
25.7375	0.02071	926802.	3041.	-5.59E-04	0.00	1.26E+11	-131.630	27645.	0.00
26.1000	0.01835	939984.	2468.	-5.27E-04	0.00	1.26E+11	-131.651	31207.	0.00
26.4625	0.01613	950604.	1897.	-4.94E-04	0.00	1.26E+11	-130.697	35244.	0.00
26.8250	0.01405	958678.	1333.	-4.61E-04	0.00	1.26E+11	-128.770	39860.	0.00
27.1875	0.01212	964242.	779.1973	-4.28E-04	0.00	1.26E+11	-125.876	45184.	0.00
27.5500	0.01033	967351.	244.8400	-3.95E-04	0.00	1.26E+11	-119.805	50460.	0.00
27.9125	0.00868	968120.	-254.653	-3.62E-04	0.00	1.26E+11	-109.847	55034.	0.00
28.2750	0.00718	966736.	-710.860	-3.28E-04	0.00	1.26E+11	-99.904	60512.	0.00
28.6375	0.00583	963388.	-1124.	-2.95E-04	0.00	1.26E+11	-89.978	67187.	0.00
29.0000	0.00461	958265.	-1494.	-2.62E-04	0.00	1.26E+11	-80.074	75498.	0.00
29.3625	0.00355	951553.	-1821.	-2.29E-04	0.00	1.26E+11	-70.191	86128.	0.00
29.7250	0.00262	943441.	-2104.	-1.97E-04	0.00	1.26E+11	-60.329	100208.	0.00
30.0875	0.00183	934115.	-2345.	-1.64E-04	0.00	1.26E+11	-50.484	119751.	0.00
30.4500	0.00119	923763.	-2544.	-1.32E-04	0.00	1.26E+11	-40.643	148748.	0.00
30.8125	6.82E-04	912571.	-13749.	-1.01E-04	0.00	1.26E+11	-5111.	3.26E+07	0.00
31.1750	3.11E-04	804590.	-29940.	-7.13E-05	0.00	1.26E+11	-2333.	3.26E+07	0.00
31.5375	6.09E-05	652411.	-36006.	-4.63E-05	0.00	1.26E+11	-456.538	3.26E+07	0.00
31.9000	-9.16E-05	491544.	-35504.	-2.66E-05	0.00	1.26E+11	687.3471	3.26E+07	0.00
32.2625	-1.71E-04	343645.	-31226.	-1.22E-05	0.00	1.26E+11	1280.	3.26E+07	0.00
32.6250	-1.98E-04	219935.	-25209.	-2.55E-06	0.00	1.26E+11	1486.	3.26E+07	0.00
32.9875	-1.93E-04	124334.	-18831.	3.37E-06	0.00	1.26E+11	1446.	3.26E+07	0.00
33.3500	-1.69E-04	56091.	-12930.	6.47E-06	0.00	1.26E+11	1267.	3.26E+07	0.00
33.7125	-1.37E-04	11813.	-7947.	7.64E-06	0.00	1.26E+11	1024.	3.26E+07	0.00
34.0750	-1.02E-04	-13085.	-4049.	7.62E-06	0.00	1.26E+11	768.3990	3.26E+07	0.00
34.4375	-7.03E-05	-23443.	-1230.	6.99E-06	0.00	1.26E+11	527.2973	3.26E+07	0.00
34.8000	-4.17E-05	-23821.	596.1524	6.17E-06	0.00	1.26E+11	312.5003	3.26E+07	0.00
35.1625	-1.66E-05	-18283.	1546.	5.45E-06	0.00	1.26E+11	124.4322	3.26E+07	0.00
35.5250	5.75E-06	-10390.	1723.	4.96E-06	0.00	1.26E+11	-43.120	3.26E+07	0.00
35.8875	2.65E-05	-3312.	1197.	4.72E-06	0.00	1.26E+11	-199.014	3.26E+07	0.00
36.2500	4.68E-05	0.00	0.00	4.66E-06	0.00	1.26E+11	-351.190	1.63E+07	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 4:

```
Pile-head deflection             =     0.25476075 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -1307988. inch-lbs
Maximum shear force              =        -36006. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =    31.53750000 feet below pile head
Number of iterations             =              7
Number of zero deflection points =              2
Pile deflection at ground        =     0.05986271 inches
```

Pile-head Deflection vs. Pile Length for Load Case 4

Boundary Condition Type 2, Shear and Slope

```
Shear      =           5500. lbs
Slope      =         0.00000
Axial Load =         508600. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
36.25000	0.25476075	-1307988.	-36006.
34.43750	0.25706781	-1311896.	-35235.

```
   32.62500    0.26748007     -1330125.       -54704.
   30.81250    0.46979457     -1720173.       -14113.
   29.00000    0.64413420     -2286298.         8472.
   27.18750    0.65142427     -2373728.         8475.
   25.37500    0.66176431     -2333065.         8465.

--------------------------------------------------------------------------------
            Summary of Pile-head Responses for Conventional Analyses
--------------------------------------------------------------------------------

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians


Load Load                Load                  Axial    Pile-head  Pile-head  Max Shear Max Moment
Case Type   Pile-head    Type     Pile-head   Loading  Deflection  Rotation    in Pile    in Pile
 No.  1      Load 1       2        Load 2       lbs      inches     radians      lbs      in-lbs
---- ----- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
  1  V, lb      4100.   S, rad         0.00    370100.     0.1892       0.00    -26105.   -985154.
  2  V, lb      5300.   S, rad         0.00    574200.     0.2214       0.00    -29792.  -1168216.
  3  V, lb      1400.   S, rad         0.00    286200.     0.1335       0.00    -19162.   -614945.
  4  V, lb      5500.   S, rad         0.00    508600.     0.2548       0.00    -36006.  -1307988.


Maximum pile-head deflection = 0.2547607513 inches
Maximum pile-head rotation   = 0.0000000000 radians = 0.000000 deg.

--------------------------------------------------------------------------------
                          Summary of Warning Messages
--------------------------------------------------------------------------------

The following warning was reported 5429 times


**** Warning ****

This warning is for an input value for uniaxial compressive strength that
has been specified for a soil defined using the vuggy limestone criteria.
The input value is outside of the range of 1,000 to 2,500 psi
(6,895 to 17,237 kPa) which were used in actual field tests
on which this theory is based. Higher or lower values may be applicable
but the user is warned about the theoretical and testing limitations.


The analysis ended normally.
```

Jacobs

Project: MoDOT Improve I-70 Columbia to Kingdom City DB
Job No.: F3X03001
Subject: Bridge 2/A9542 - Lateral Analysis at Bent 3

By: ZW 8/22/24
Ckd: SR 8/28/2024

Foundation Design Data

Support No.: **Bent 3**

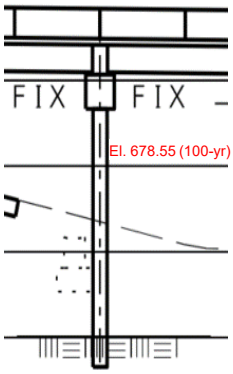
General Information:

	North	South	Average	
Bottom of Pile Cap El.:	679.19	678.97	679.08	ft
Assumed Grade Elev.:	*668.00*	*668.00*	668.00	ft
Design Scour Depth:	*6.10*	*6.10*	6.10	ft
El.:	*661.90*	*661.90*	661.90	ft
Min. Pile Length below Scour Depth:	*15.00*	*15.00*	15.00	ft
El.:	646.90	646.90	646.90	ft
Top of Rock El.:	652.00	652.00	652.00	ft
Rock Type:	Shale	Shale	Shale	
Min. Embd. into Rock:	10	10	10	ft
Min. Pile Tip El by Rock Embd.:	642.00	642.00	642.00	ft
Min Design Pile Tip El:	642.00	642.00	642.00	
Min. Pile Length:	37.19	36.97	37.08	ft
Design GW El.:	678.55	678.55	678.55	ft
Depth below Top of Pile:	0.64	0.42	0.53	ft
Exposed Pile Length to Scour Depth:	17.29	17.07	17.18	ft

Scour Information

Location	Ground El.	Scour Depth (ft)		Scour Elev. (ft)	
	(ft)	Design Flood	Check Flood	Design Flood	Check Flood
Bent 2	664	6.6	13.3	657.4	650.7
Bent 3	668	6.1	12.8	661.9	655.2

Section 751.1.2.22 MoDOT EPG



100-year Flood Level

Pile Data:

Pile:	24X0.500		Class B-1 Concrete,	fc'=	4,000	psi
F_y =	45	ksi	Pile Structural Axial Resistance Factor:	ϕ_c =	0.6	
E =	29,000	ksi	Max Nominal Driving Resistance:	R_{ndr} =	1,305	k
OD =	24	in	Preli. Structural Nominal Axial Design Capacity:	PNDC = F_yA_s =	1,450	k
Wall Thick. =	0.500	in	Preli. Factored Axial Design Capacity:	PFDC = ϕc xPNDC =	870	k
ID =	23.00	in				
As (No Corrosion) =	32.21	in^2				

Load Information:

Load Case	At Top of Pile		Stream Pressure, WA				Wind on Structure, WS				Max (WA+WS)
	Axial	Lateral Load	Load	Load	From	To	Load	Load	From	To	
	(k)	(k)	(klf)	(lbs/in)	(ft	(ft)	(klf)	(lbs/in)	(ft	(ft)	(lbs/in)
Ser I	425.7	4.6	0.082	6.83	0.53	17.18	0.040	3.33	0	17.18	10.17
Str I	658.5	5.8	0.086	7.17	0.53	17.18	0.000	0.00	0	17.18	7.17
Str III	336.4	1.7	0.086	7.17	0.53	17.18	0.114	9.50	0	17.18	16.67
Str V	585	6.2	0.086	7.17	0.53	17.18	0.055	4.58	0	17.18	11.75

P-Multipliers D = 2 ft

Loading Direction	Number of Rows	Pile Spacing S	S/D	P-Multiplier* (AASHTO LRFD Table 10.7.2.4-1)				
				Row Number				Aver.
		(ft)		1	2	3	After 3	
Longitudinal	1	-	-	0.95	-	-	-	0.95
Transverse	11	8.90	4.45	0.95	0.73	0.59	0.59	0.63

Note: Group reduction factor of 1.0 was used within fresh rock.

Lateral Analysis

Software: LPILE 2022 developed by ENSOFT, Inc.

Pile Geometry for Analysis:

Top of Pile El.: 679.08 ft
Min. Pile Tip El.: 642.00 ft
Design Scour El.: 661.90 ft
Min. Pile Length: 37.08 ft
(Design Flood for Strength Limit)

Design Soil Profile and Parameters:

Reference Borings: BR 2-3, L0264-3, L0264-4, L0264-5
Design Ground Water El.: 678.55 ft

Depth		Soil/Rock	Elevation		Eff. Unit Weight	Su	ϕ'	qu	Modulus , k or E	RQD	ε_{50}
From	To		From	To							
(ft)	(ft)		(ft)	(ft)	(pcf)	(psf)	(deg.)	(psi)	(psi)		
17.2	23.1	Stiff Clay w/ Free Water	661.9	656.0	57.6	1,200	-	-	-	-	0.007
23.1	27.1	Stiff Clay w/ Free Water	656.0	652.0	57.6	1,200	-	-	-	-	0.007
27.1	36.1	Stiff Clay w/ Free Water	652.0	643.0	70.6	3,000	-	-	-	-	0.005
36.1	57.1	Sand (Reese)	643.0	622.0	72.6	0	42	-	-	-	-
57.1	69.1	Strong Rock	622.0	610.0	101.6						
			(Strong Rock Qu =1,078 ksf =7.5 ksi)								

Lateral Analysis Results:

LPile Analysis Summary at Bent 3 of Bridge 2 (A9542)

Load Comb.	Case in LPile	Lat.	Moment	Axial	Pmult.	Head Fixity	Pile Head	Max Moment	Max Shear	Pile Head Rotation
		(lbs)	(lbs-in)	(lbs)			δ (in)	(in-lbs)	(lbs)	(rad.)
Ser I	1	4,600	-	425,700	0.63	Fixed	0.122	-874,676	6,634	0.00E+00
Str I	2	5,800	-	658,500	0.63	Fixed	0.144	-1,036,966	7,219	0.00E+00
Str III	3	1,700	-	336,400	0.63	Fixed	0.078	-508,592	5,060	0.00E+00
Str V	4	6,200	-	585,000	0.63	Fixed	0.169	-1,178,794	8,555	0.00E+00

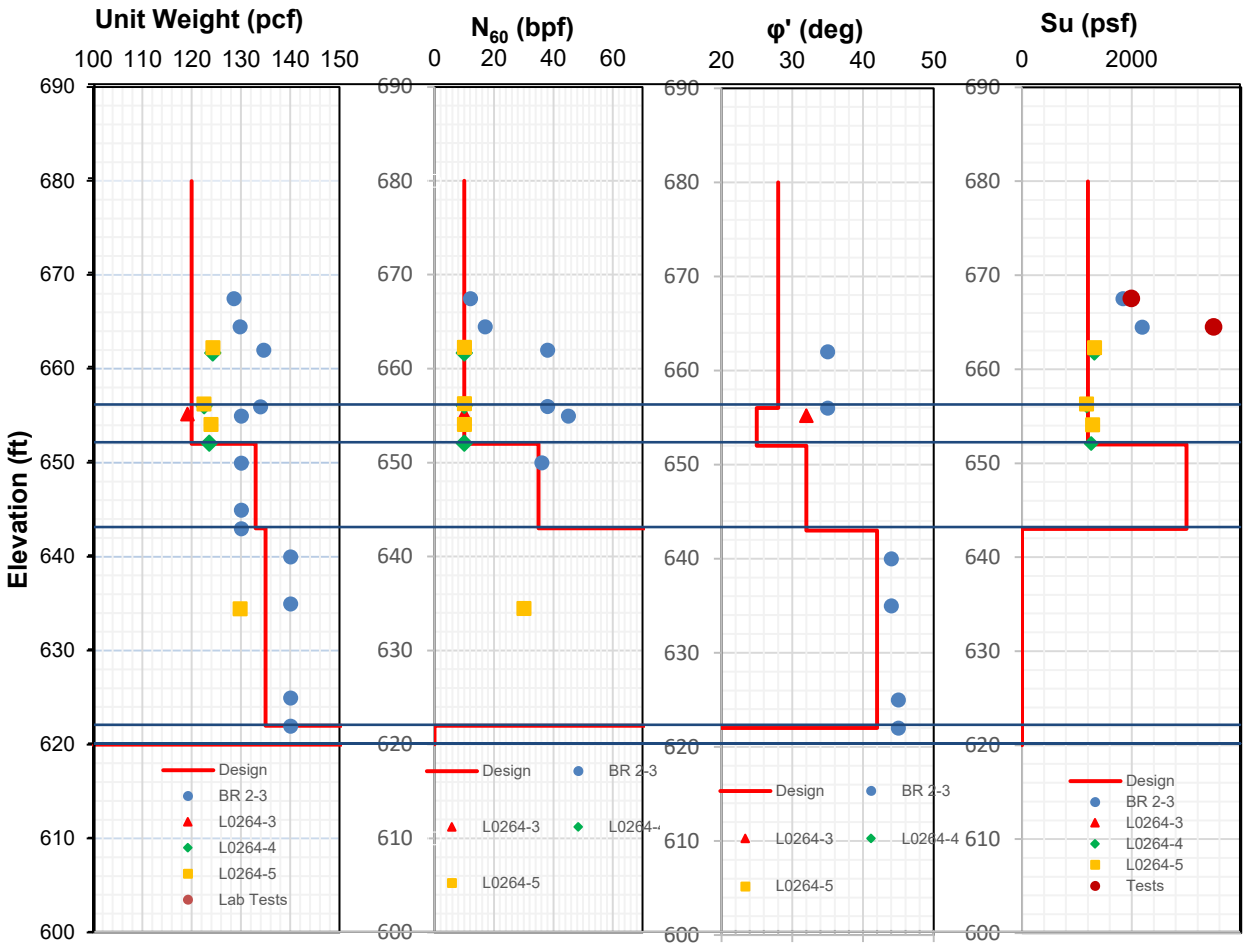
Deflection, Moment, and Shear vs Depth figures are attached.

Structure Engineer should check the pile structural acceptability for the analyzed load combinations.

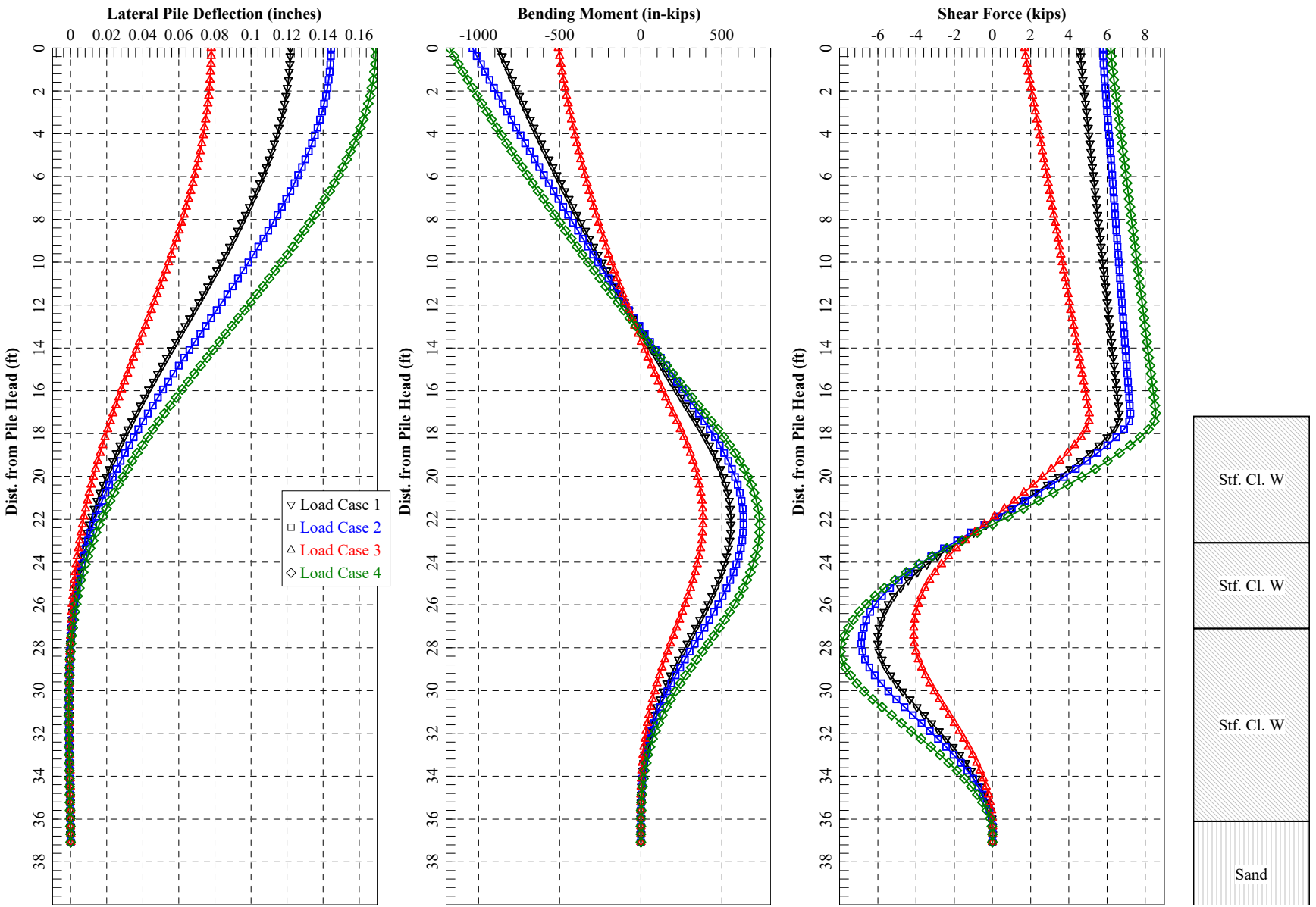
Jacobs	Project:	MoDOT Improve I-70 Columbia to Kingdom City DB	By: ZW	8/22/24
	Job No.:	F3X03001	Ckd:SR	8/28/24
	Subject:	Bridge 2/A9542 - Bent 3	BkCkd:	

Design Soil Profile and Parameters

Soil	Elevation		Unit Weight	N_{60}	Undrained		Drained		ε_{50}	k
	From	To			C	ϕ	C'	ϕ'		
	(ft)	(ft)	(pcf)	(bpf)	(psf)	(deg.)	(psf)	(deg.)		(pci)
CL	680.0	656.0	120	10	1,200	0	0	28	0.007	-
CH	656.0	652.0	120	10	1,200	0	100	25	0.007	-
Shale	652.0	643.0	133	35	3,000	0	0	32	0.005	
GP	643.0	622.0	135	100	0	42	0	42	-	-
Rock	622.0	620.0	164							
		(Strong Rock Qu =1,078 ksf =7.5 ksi)								



MoDOT Improve I-70 C2KC- Bridge 2/A9542- Bent 3 - CECIP24X0.5in



```
================================================================================

                    LPile for Windows, Version 2022-12.004

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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================================================================================

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--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\TPW\GEOTECH\F3X03000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A6951)\LPile\

Name of input data file:
Bridge 2 Bent 3 24in CECIP.lp12d

Name of output report file:
Bridge 2 Bent 3 24in CECIP.lp12o

Name of plot output file:
Bridge 2 Bent 3 24in CECIP.lp12p

Name of runtime message file:
Bridge 2 Bent 3 24in CECIP.lp12r



--------------------------------------------------------------------------------
                            Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  August 28, 2024            Time:  14:22:34



--------------------------------------------------------------------------------
                                 Problem Title
--------------------------------------------------------------------------------

Project Name: MoDOT Improve I-70  Columbia to Kingdom City DB

Job Number: F3X03001

Client: MoDOT

Engineer:

Description: Bridge 2 (A9542) Bent 3 Lateral Analysis - CECIP 24X0.5




--------------------------------------------------------------------------------
                        Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed               =          500
 - Deflection tolerance for convergence               =   1.0000E-05 in
 - Maximum allowable deflection                       =     100.0000 in
 - Number of pile increments                          =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified
```

 - Analysis uses p-y modification factors for p-y curves
 - Analysis uses layering correction (Method of Georgiadis)
 - Analysis includes loading by multiple distributed lateral loads acting on pile
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 37.080 ft
Depth of ground surface below top of pile = 17.2000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	24.0000
2	37.080	24.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

   Section 1 is a drilled shaft with permanent casing
   Length of section = 37.080000 ft
   Casing outside diameter = 24.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is stiff clay with water-induced erosion

   Distance from top of pile to top of layer = 17.200000 ft
   Distance from top of pile to bottom of layer = 23.100000 ft
   Effective unit weight at top of layer = 57.600000 pcf
   Effective unit weight at bottom of layer = 57.600000 pcf
   Undrained cohesion at top of layer = 1200. psf
   Undrained cohesion at bottom of layer = 1200. psf
   Epsilon-50 at top of layer = 0.007000
   Epsilon-50 at bottom of layer = 0.007000
   Subgrade k at top of layer = 0.0000 pci
   Subgrade k at bottom of layer = 0.0000 pci

   NOTE: Default values for subgrade k will be computed for this layer.

Layer 2 is stiff clay with water-induced erosion

   Distance from top of pile to top of layer = 23.100000 ft
   Distance from top of pile to bottom of layer = 27.100000 ft
   Effective unit weight at top of layer = 57.600000 pcf
   Effective unit weight at bottom of layer = 57.600000 pcf
   Undrained cohesion at top of layer = 1200. psf
   Undrained cohesion at bottom of layer = 1200. psf
   Epsilon-50 at top of layer = 0.007000
   Epsilon-50 at bottom of layer = 0.007000
   Subgrade k at top of layer = 0.0000 pci
   Subgrade k at bottom of layer = 0.0000 pci

   NOTE: Default values for subgrade k will be computed for this layer.

Layer 3 is stiff clay with water-induced erosion

```
   Distance from top of pile to top of layer           =    27.100000 ft
   Distance from top of pile to bottom of layer        =    36.100000 ft
   Effective unit weight at top of layer               =    70.600000 pcf
   Effective unit weight at bottom of layer            =    70.600000 pcf
   Undrained cohesion at top of layer                  =        3000. psf
   Undrained cohesion at bottom of layer               =        3000. psf
   Epsilon-50 at top of layer                          =     0.005000
   Epsilon-50 at bottom of layer                       =     0.005000
   Subgrade k at top of layer                          =       0.0000 pci
   Subgrade k at bottom of layer                       =       0.0000 pci

   NOTE: Default values for subgrade k will be computed for this layer.

Layer 4 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer           =    36.100000 ft
   Distance from top of pile to bottom of layer        =    57.100000 ft
   Effective unit weight at top of layer               =    72.600000 pcf
   Effective unit weight at bottom of layer            =    72.600000 pcf
   Friction angle at top of layer                      =    42.000000 deg.
   Friction angle at bottom of layer                   =    42.000000 deg.
   Subgrade k at top of layer                          =       0.0000 pci
   Subgrade k at bottom of layer                       =       0.0000 pci

   NOTE: Default values for subgrade k will be computed for this layer.

Layer 5 is strong rock (vuggy limestone)

   Distance from top of pile to top of layer           =    57.100000 ft
   Distance from top of pile to bottom of layer        =    69.000000 ft
   Effective unit weight at top of layer               =   101.600000 pcf
   Effective unit weight at bottom of layer            =   101.600000 pcf
   Uniaxial compressive strength at top of layer       =        7500. psi
   Uniaxial compressive strength at bottom of layer    =        7500. psi


 (Depth of the lowest soil layer extends 31.920 ft below the pile tip)
```

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Cohesion psf	Angle of Friction deg.	Uniaxial qu psi	E50 or krm	kpy pci
1	Stiff Clay	17.2000	57.6000	1200.	--	--	0.00700	default
	with Free Water	23.1000	57.6000	1200.	--	--	0.00700	default
2	Stiff Clay	23.1000	57.6000	1200.	--	--	0.00700	default
	with Free Water	27.1000	57.6000	1200.	--	--	0.00700	default
3	Stiff Clay	27.1000	70.6000	3000.	--	--	0.00500	default
	with Free Water	36.1000	70.6000	3000.	--	--	0.00500	default
4	Sand	36.1000	72.6000	--	42.0000	--	--	default
	(Reese, et al.)	57.1000	72.6000	--	42.0000	--	--	default
5	Strong Rock	57.1000	101.6000	--	--	7500.	--	--
	(Vuggy Limestone)	69.0000	101.6000	--	--	7500.	--	--

Modification Factors for p-y Curves

Distribution of p-y modifiers with depth defined using 4 points

Point No.	Depth X ft	p-mult	y-mult
1	17.200	0.6300	1.0000
2	36.100	0.6300	1.0000
3	36.100	1.0000	1.0000
4	60.000	1.0000	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading for Individual Load Cases

Distributed lateral load intensity for Load Case 1 defined using 4 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	3.330
2	0.530	3.330
3	0.530	10.170
4	17.180	10.170

Distributed lateral load intensity for Load Case 2 defined using 4 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	0.000
2	0.530	0.000
3	0.530	7.170
4	17.180	7.170

Distributed lateral load intensity for Load Case 3 defined using 4 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	9.500
2	0.530	9.500
3	0.530	16.670
4	17.180	16.670

Distributed lateral load intensity for Load Case 4 defined using 4 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	4.580
2	0.530	4.580
3	0.530	11.750
4	17.180	11.750

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	2	V = 4600. lbs	S = 0.0000 in/in	425700.	Yes	Yes
2	2	V = 5800. lbs	S = 0.0000 in/in	658500.	Yes	Yes
3	2	V = 1700. lbs	S = 0.0000 in/in	336400.	Yes	Yes
4	2	V = 6200. lbs	S = 0.0000 in/in	585000.	Yes	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile) with Permanent Casing:

Length of Section	=	37.080000 ft
Outer Diameter of Casing	=	24.000000 in
Casing Wall Thickness	=	0.500000 in
Moment of Inertia of Steel Casing	=	2549. in^4
Yield Stress of Casing	=	45000. psi
Elastic Modulus of Casing	=	29000000. psi
Number of Reinforcing Bars	=	0 bars

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Area of Single Reinforcing Bar                        =       0.0000 sq. in.
Offset of Center of Rebar Cage from Center of Pile    =       0.0000 in
Yield Stress of Reinforcing Bars                      =       0.0000 psi
Modulus of Elasticity of Reinforcing Bars             =       0.0000 psi
Gross Area of Pile                                    =   452.389342 sq. in.
Area of Concrete                                      =   415.475628 sq. in.
Cross-sectional Area of Steel Casing                  =    36.913714 sq. in.
Area of All Steel (Casing and Bars)                   =    36.913714 sq. in.
Area Ratio of All Steel to Gross Area of Pile         =         8.16 percent

Axial Structural Capacities:
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Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As   =     3073.734 kips
Tensile Load for Cracking of Concrete                 =     -296.304 kips
Nominal Axial Tensile Capacity                        =    -1661.117 kips



Concrete Properties:
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Compressive Strength of Concrete                      =        4000. psi
Modulus of Elasticity of Concrete                     =     3604997. psi
Modulus of Rupture of Concrete                        =   -474.34165 psi
Compression Strain at Peak Stress                     =     0.001886
Tensile Strain at Fracture of Concrete                =   -0.0001154
Maximum Coarse Aggregate Size                         =     0.750000 in


Number of Axial Thrust Force Values Determined from Pile-head Loadings = 4

   Number     Axial Thrust Force
                      kips
   ------     ------------------
      1              336.400
      2              425.700
      3              585.000
      4              658.500


Definitions of Run Messages and Notes:
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  C = concrete in section has cracked in tension.
  Y = stress in reinforcing steel has reached yield stress.
  T = ACI 318 criteria for tension-controlled section met, tensile strain in
      reinforcement exceeds 0.005 while simultaneously compressive strain in
      concrete more than 0.003. See ACI 318-14, Section 21.2.3.
  Z = depth of tensile zone in concrete section is less than 10 percent of
      section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.


Axial Thrust Force =    336.400 kips

    Bending       Bending       Bending      Depth to      Max Comp      Max Tens      Max Conc      Max Steel    Max Casing  Run
   Curvature      Moment       Stiffness      N Axis        Strain        Strain        Stress        Stress       Stress    Msg
    rad/in.       in-kip        kip-in2         in          in/in         in/in          ksi           ksi          ksi
------------- ------------- ------------- ------------- ------------- ------------- ------------- ------------- ------------- ---
   0.00000125   160.5686108    128454889.   108.9523738     0.0001362     0.0001062     0.5561651       0.00000     3.9451736
   0.00000250   321.1351656    128454066.    60.4868364     0.0001512     0.00009122    0.6144602       0.00000     4.3765956
   0.00000375   481.6976081    128452696.    44.3363904     0.0001663     0.00007626    0.6723263       0.00000     4.8085325
   0.00000500   642.2538823    128450776.    36.2647176     0.0001813     0.00006132    0.7297617       0.00000     5.2409841
   0.00000625   802.8019317    128448309.    31.4245541     0.0001964     0.00004640    0.7867646       0.00000     5.6739504
   0.00000750   963.3396996    128445293.    28.2001455     0.0002115     0.00003150    0.8433331       0.00000     6.1074317
   0.00000875         1124.    128441729.    25.8990257     0.0002266     0.00001662    0.8994657       0.00000     6.5414278
   0.00001000         1284.    128437616.    24.1749615     0.0002417     0.00000175    0.9551603       0.00000     6.9759387
   0.00001125         1445.    128432853.    22.8355979     0.0002569    -0.00001310    1.0104152       0.00000     7.4109638
   0.00001250         1605.    128424717.    21.7654308     0.0002721    -0.00002793    1.0652242       0.00000     7.8464686
   0.00001375         1766.    128408615.    20.8908474     0.0002872    -0.00004275    1.1195760       0.00000     8.2823754
   0.00001500         1926.    128382220.    20.1627834     0.0003024    -0.00005756    1.1734602       0.00000     8.7186108
   0.00001625         2086.    128344994.    19.5473023     0.0003176    -0.00007236    1.2268685       0.00000     9.1551163
   0.00001750         2245.    128297322.    19.0201897     0.0003329    -0.00008715    1.2797945       0.00000     9.5918463
   0.00001875         2404.    128239996.    18.5637068     0.0003481     -0.000102     1.3322332       0.00000    10.0287656
   0.00002000         2429.    121434897.    17.8862690     0.0003577     -0.000122     1.3650564       0.00000    10.3044361 C
   0.00002125         2556.    120288737.    17.4832704     0.0003715     -0.000138     1.4118134       0.00000    10.7001153 C
   0.00002250         2682.    119193432.    17.1207600     0.0003852     -0.000155     1.4578256       0.00000    11.0929958 C
   0.00002375         2806.    118145340.    16.7923727     0.0003988     -0.000171     1.5031040       0.00000    11.4830967 C
   0.00002500         2929.    117151870.    16.4937975     0.0004123     -0.000188     1.5477242       0.00000    11.8710032 C
   0.00002625         3051.    116209957.    16.2209653     0.0004258     -0.000204     1.5917096       0.00000    12.2568599 C
   0.00002750         3171.    115316983.    15.9705649     0.0004392     -0.000221     1.6350842       0.00000    12.6408256 C
   0.00002875         3291.    114470651.    15.7398785     0.0004525     -0.000237     1.6778733       0.00000    13.0230738 C
   0.00003000         3410.    113668895.    15.5266580     0.0004658     -0.000254     1.7201029       0.00000    13.4037925 C
   0.00003125         3528.    112909803.    15.3290312     0.0004790     -0.000271     1.7617999       0.00000    13.7831846 C
   0.00003250         3646.    112191573.    15.1454298     0.0004922     -0.000288     1.8029918       0.00000    14.1614677 C
   0.00003375         3764.    111512462.    14.9745332     0.0005054     -0.000305     1.8437071       0.00000    14.5388745 C
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0.00003500	3880.	110865419.	14.8146259	0.0005185	-0.000321	1.8839101	0.00000	14.9150454	C
0.00003625	3997.	110251203.	14.6649413	0.0005316	-0.000338	1.9236455	0.00000	15.2903697	C
0.00003750	4113.	109670447.	14.5248926	0.0005447	-0.000355	1.9629655	0.00000	15.6653208	C
0.00003875	4228.	109112949.	14.3926810	0.0005577	-0.000372	2.0017703	0.00000	16.0389254	C
0.00004000	4343.	108586537.	14.2687545	0.0005708	-0.000389	2.0402046	0.00000	16.4125553	C
0.00004125	4458.	108080330.	14.1513301	0.0005837	-0.000406	2.0781433	0.00000	16.7849787	C
0.00004250	4573.	107601712.	14.0409981	0.0005967	-0.000423	2.1157342	0.00000	17.1576303	C
0.00004375	4687.	107139598.	13.9359616	0.0006097	-0.000440	2.1528265	0.00000	17.5290014	C
0.00004500	4802.	106701020.	13.8369226	0.0006227	-0.000457	2.1895709	0.00000	17.9005842	C
0.00004625	4915.	106279610.	13.7427405	0.0006356	-0.000474	2.2258813	0.00000	18.2715008	C
0.00004750	5029.	105875640.	13.6532674	0.0006485	-0.000491	2.2617909	0.00000	18.6420759	C
0.00004875	5143.	105490492.	13.5685413	0.0006615	-0.000509	2.2973548	0.00000	19.0128755	C
0.00005125	5369.	104760003.	13.4101674	0.0006873	-0.000543	2.3671965	0.00000	19.7525115	C
0.00005375	5595.	104086309.	13.2663617	0.0007131	-0.000577	2.4355521	0.00000	20.4918915	C
0.00005625	5820.	103460207.	13.1348878	0.0007388	-0.000611	2.5023803	0.00000	21.2305359	C
0.00005875	6044.	102876902.	13.0143237	0.0007646	-0.000645	2.5677082	0.00000	21.9687041	C
0.00006125	6268.	102331948.	12.9034811	0.0007903	-0.000680	2.6315610	0.00000	22.7066584	C
0.00006375	6491.	101821679.	12.8013354	0.0008161	-0.000714	2.6939583	0.00000	23.4446190	C
0.00006625	6714.	101340878.	12.7066277	0.0008418	-0.000748	2.7548571	0.00000	24.1820572	C
0.00006875	6936.	100889688.	12.6192602	0.0008676	-0.000782	2.8143739	0.00000	24.9203994	C
0.00007125	7158.	100461639.	12.5376703	0.0008933	-0.000817	2.8723766	0.00000	25.6580110	C
0.00007375	7379.	100056639.	12.4618067	0.0009191	-0.000851	2.9289561	0.00000	26.3960389	C
0.00007625	7600.	99673334.	12.3913314	0.0009448	-0.000885	2.9841469	0.00000	27.1349816	C
0.00007875	7821.	99307983.	12.3252837	0.0009706	-0.000919	3.0378701	0.00000	27.8738168	C
0.00008125	8040.	98959124.	12.2633081	0.0009964	-0.000954	3.0901351	0.00000	28.6126700	C
0.00008375	8260.	98626634.	12.2054157	0.0010222	-0.000988	3.1410037	0.00000	29.3524536	C
0.00008625	8479.	98309066.	12.1512537	0.0010480	-0.001022	3.1904707	0.00000	30.0931736	C
0.00008875	8698.	98004315.	12.1002476	0.0010739	-0.001056	3.2384880	0.00000	30.8341624	C
0.00009125	8916.	97710895.	12.0519999	0.0010997	-0.001090	3.2850314	0.00000	31.5750550	C
0.00009375	9134.	97429083.	12.0066769	0.0011256	-0.001124	3.3301643	0.00000	32.3169016	C
0.00009625	9351.	97157956.	11.9640529	0.0011515	-0.001158	3.3738817	0.00000	-33.260387	C
0.00009875	9569.	96896674.	11.9239252	0.0011775	-0.001193	3.4161780	0.00000	-34.239209	C
0.0001013	9785.	96644487.	11.8861110	0.0012035	-0.001227	3.4570477	0.00000	-35.217056	C
0.0001038	10001.	96399685.	11.8500377	0.0012294	-0.001261	3.4964219	0.00000	-36.195149	C
0.0001063	10217.	96162556.	11.8159037	0.0012554	-0.001295	3.5343512	0.00000	-37.172497	C
0.0001088	10433.	95932748.	11.7836556	0.0012815	-0.001329	3.5708436	0.00000	-38.148846	C
0.0001113	10648.	95709747.	11.7531686	0.0013075	-0.001362	3.6058932	0.00000	-39.124190	C
0.0001138	10862.	95493083.	11.7243285	0.0013336	-0.001396	3.6394944	0.00000	-40.098521	C
0.0001163	11077.	95282323.	11.6970313	0.0013598	-0.001430	3.6716414	0.00000	-41.071833	C
0.0001188	11290.	95077076.	11.6711816	0.0013860	-0.001464	3.7023283	0.00000	-42.044118	C
0.0001213	11504.	94876979.	11.6466919	0.0014122	-0.001498	3.7315493	0.00000	-43.015369	C
0.0001238	11717.	94681253.	11.6232466	0.0014384	-0.001532	3.7592681	0.00000	-43.986423	C
0.0001263	11929.	94489902.	11.6009271	0.0014646	-0.001565	3.7855013	0.00000	-44.956755	C
0.0001288	12131.	94221920.	11.5760534	0.0014904	-0.001600	3.8098143	0.00000	-45.000000	CY
0.0001313	12313.	93810329.	11.5453334	0.0015153	-0.001635	3.8318910	0.00000	-45.000000	CY
0.0001338	12479.	93298049.	11.5105667	0.0015395	-0.001670	3.8520398	0.00000	-45.000000	CY
0.0001363	12634.	92725281.	11.4735217	0.0015633	-0.001707	3.8705337	0.00000	-45.000000	CY
0.0001388	12776.	92082670.	11.4369541	0.0015869	-0.001743	3.8877088	0.00000	45.0000000	CY
0.0001413	12908.	91383875.	11.4013598	0.0016104	-0.001780	3.9036324	0.00000	45.0000000	CY
0.0001438	13028.	90627014.	11.3673595	0.0016341	-0.001816	3.9183700	0.00000	45.0000000	CY
0.0001463	13137.	89823015.	11.3357646	0.0016579	-0.001852	3.9319858	0.00000	45.0000000	CY
0.0001488	13238.	88998039.	11.3047257	0.0016816	-0.001888	3.9443225	0.00000	45.0000000	CY
0.0001588	13583.	85563187.	11.1915463	0.0017767	-0.002033	3.9813895	0.00000	45.0000000	CY
0.0001688	13858.	82119228.	11.0889706	0.0018713	-0.002179	3.9986025	0.00000	45.0000000	CY
0.0001788	14081.	78776919.	10.9954405	0.0019654	-0.002325	3.9991132	0.00000	45.0000000	CY
0.0001888	14268.	75589535.	10.9114943	0.0020595	-0.002470	3.9989490	0.00000	45.0000000	CY
0.0001988	14424.	72571647.	10.8339202	0.0021532	-0.002617	3.9985513	0.00000	45.0000000	CY
0.0002088	14555.	69725562.	10.7642463	0.0022470	-0.002763	3.9997476	0.00000	45.0000000	CY
0.0002188	14668.	67052886.	10.7013048	0.0023409	-0.002909	3.9978126	0.00000	45.0000000	CY
0.0002288	14765.	64544465.	10.6435796	0.0024347	-0.003055	3.9991185	0.00000	45.0000000	CY
0.0002388	14848.	62188860.	10.5904461	0.0025285	-0.003202	3.9996845	0.00000	45.0000000	CY
0.0002488	14920.	59978919.	10.5422955	0.0026224	-0.003348	3.9998847	0.00000	45.0000000	CY
0.0002588	14983.	57904772.	10.4986095	0.0027165	-0.003493	3.9999261	0.00000	45.0000000	CY
0.0002688	15038.	55956018.	10.4587110	0.0028108	-0.003639	3.9998703	0.00000	45.0000000	CY
0.0002788	15086.	54120310.	10.4222484	0.0029052	-0.003785	3.9996350	0.00000	45.0000000	CY
0.0002888	15128.	52391489.	10.3880797	0.0029996	-0.003930	3.9989772	0.00000	45.0000000	CY
0.0002988	15165.	50762546.	10.3563370	0.0030940	-0.004076	3.9975097	0.00000	45.0000000	CY
0.0003088	15198.	49223061.	10.3280670	0.0031888	-0.004221	3.9981911	0.00000	45.0000000	CY
0.0003188	15227.	47769715.	10.3018042	0.0032837	-0.004366	3.9996430	0.00000	45.0000000	CY
0.0003288	15252.	46394210.	10.2784348	0.0033790	-0.004511	3.9976433	0.00000	45.0000000	CY
0.0003388	15274.	45090141.	10.2559723	0.0034742	-0.004656	3.9991881	0.00000	45.0000000	CY
0.0003488	15294.	43853001.	10.2362544	0.0035699	-0.004800	3.9988324	0.00000	45.0000000	CY
0.0003588	15311.	42679968.	10.2177899	0.0036656	-0.004944	3.9955131	0.00000	45.0000000	CY
0.0003688	15326.	41562085.	10.2012215	0.0037617	-0.005088	3.9991609	0.00000	45.0000000	CY
0.0003788	15340.	40500748.	10.1853979	0.0038577	-0.005232	3.9946392	0.00000	45.0000000	CY

Axial Thrust Force = 425.700 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	159.2933882	127434711.	135.3728561	0.0001692	0.0001392	0.6849043	0.00000	4.9029160	
0.00000250	318.5846967	127433879.	73.6971997	0.0001842	0.0001242	0.7420959	0.00000	5.3343470	
0.00000375	477.8718459	127432492.	53.1434351	0.0001993	0.0001093	0.7988580	0.00000	5.7662986	
0.00000500	637.1527559	127430551.	42.8701437	0.0002144	0.00009435	0.8551887	0.00000	6.1987708	
0.00000625	796.4253467	127428055.	36.7090417	0.0002294	0.00007943	0.9110863	0.00000	6.6317638	
0.00000750	955.6875380	127425005.	32.6040346	0.0002445	0.00006453	0.9665490	0.00000	7.0652775	
0.00000875	1115.	127421400.	29.6739390	0.0002596	0.00004965	1.0215749	0.00000	7.4993121	
0.00001000	1274.	127417240.	27.4781635	0.0002748	0.00003478	1.0761624	0.00000	7.9338674	

0.00001125	1433.	127412525.	25.7719348	0.0002899	0.00001993	1.1303095	0.00000	8.3689438
0.00001250	1593.	127407256.	24.4083892	0.0003051	0.00000510	1.1840144	0.00000	8.8045408
0.00001375	1752.	127401428.	23.2940677	0.0003203	-0.00000971	1.2372754	0.00000	9.2406593
0.00001500	1911.	127394208.	22.3666363	0.0003355	-0.00002450	1.2900892	0.00000	9.6772866
0.00001625	2070.	127382597.	21.5828533	0.0003507	-0.00003928	1.3424475	0.00000	10.1143696
0.00001750	2229.	127364137.	20.9118120	0.0003660	-0.00005404	1.3943414	0.00000	10.5518446
0.00001875	2388.	127337586.	20.3308601	0.0003812	-0.00006880	1.4457629	0.00000	10.9896552
0.00002000	2546.	127302565.	19.8230250	0.0003965	-0.00008354	1.4967053	0.00000	11.4277545
0.00002125	2704.	127259190.	19.3753411	0.0004117	-0.00009827	1.5471632	0.00000	11.8661040
0.00002250	2862.	127207860.	18.9777350	0.0004270	-0.000113	1.5971322	0.00000	12.3046722
0.00002375	2891.	121725616.	18.3997795	0.0004370	-0.000133	1.6293876	0.00000	12.5901982 C
0.00002500	3020.	120799516.	18.0400171	0.0004510	-0.000149	1.6744109	0.00000	12.9920124 C
0.00002625	3147.	119895205.	17.7110837	0.0004649	-0.000165	1.7187137	0.00000	13.3912124 C
0.00002750	3273.	119019039.	17.4091839	0.0004788	-0.000181	1.7623402	0.00000	13.7881242 C
0.00002875	3397.	118167919.	17.1306631	0.0004925	-0.000197	1.8052860	0.00000	14.1826403 C
0.00003000	3520.	117347792.	16.8730816	0.0005062	-0.000214	1.8476038	0.00000	14.5751810 C
0.00003125	3642.	116559830.	16.6341716	0.0005198	-0.000230	1.8893233	0.00000	14.9659681 C
0.00003250	3764.	115803895.	16.4119601	0.0005334	-0.000247	1.9304681	0.00000	15.3551725 C
0.00003375	3884.	115079191.	16.2047342	0.0005469	-0.000263	1.9710575	0.00000	15.7429337 C
0.00003500	4003.	114381219.	16.0107066	0.0005604	-0.000280	2.0110771	0.00000	16.1290673 C
0.00003625	4122.	113713193.	15.8289504	0.0005738	-0.000296	2.0505790	0.00000	16.5140342 C
0.00003750	4240.	113074816.	15.6584405	0.0005872	-0.000313	2.0895889	0.00000	16.8980541 C
0.00003875	4358.	112463705.	15.4981058	0.0006006	-0.000329	2.1281118	0.00000	17.2811465 C
0.00004000	4475.	111874061.	15.3466179	0.0006139	-0.000346	2.1661075	0.00000	17.6628769 C
0.00004125	4592.	111312211.	15.2039600	0.0006272	-0.000363	2.2036724	0.00000	18.0441873 C
0.00004250	4708.	110770650.	15.0688178	0.0006404	-0.000380	2.2407438	0.00000	18.4244180 C
0.00004375	4824.	110251933.	14.9409541	0.0006537	-0.000396	2.2773747	0.00000	18.8040857 C
0.00004500	4939.	109753346.	14.8196707	0.0006669	-0.000413	2.3135554	0.00000	19.1830704 C
0.00004625	5054.	109274315.	14.7045135	0.0006801	-0.000430	2.3492979	0.00000	19.5614789 C
0.00004750	5169.	108813011.	14.5949629	0.0006933	-0.000447	2.3845994	0.00000	19.9392616 C
0.00004875	5283.	108370712.	14.4908747	0.0007064	-0.000464	2.4194992	0.00000	20.3168243 C
0.00005125	5511.	107532392.	14.2968374	0.0007327	-0.000497	2.4880092	0.00000	21.0703247 C
0.00005375	5738.	106750946.	14.1196258	0.0007589	-0.000531	2.5548335	0.00000	21.8219169 C
0.00005625	5964.	106023969.	13.9576114	0.0007851	-0.000565	2.6200699	0.00000	22.5726037 C
0.00005875	6189.	105346240.	13.8090828	0.0008113	-0.000599	2.6837563	0.00000	23.3227750 C
0.00006125	6413.	104707613.	13.6716860	0.0008374	-0.000633	2.7457938	0.00000	24.0711824 C
0.00006375	6637.	104111279.	13.5452972	0.0008635	-0.000666	2.8063680	0.00000	24.8200185 C
0.00006625	6860.	103546595.	13.4276773	0.0008896	-0.000700	2.8653278	0.00000	25.5673752 C
0.00006875	7082.	103017272.	13.3190733	0.0009157	-0.000734	2.9228641	0.00000	26.3156527 C
0.00007125	7304.	102512891.	13.2173030	0.0009417	-0.000768	2.9787833	0.00000	27.0623025 C
0.00007375	7525.	102037441.	13.1228747	0.0009678	-0.000802	3.0332800	0.00000	27.8098984 C
0.00007625	7746.	101585256.	13.0344966	0.0009939	-0.000836	3.0862606	0.00000	28.5571808 C
0.00007875	7966.	101154347.	12.9516369	0.0010199	-0.000870	3.1377337	0.00000	29.3042510 C
0.00008125	8186.	100745147.	12.8742823	0.0010460	-0.000904	3.1877778	0.00000	30.0522779 C
0.00008375	8405.	100353537.	12.8014475	0.0010721	-0.000938	3.2363107	0.00000	30.8000660 C
0.00008625	8623.	99978264.	12.7328025	0.0010982	-0.000972	3.2833433	0.00000	31.5477702 C
0.00008875	8841.	99619704.	12.6684017	0.0011243	-0.001006	3.3289396	0.00000	32.2964477 C
0.00009125	9059.	99276453.	12.6078988	0.0011505	-0.001040	3.3730939	0.00000	33.0461015 C
0.00009375	9276.	98944796.	12.5503321	0.0011766	-0.001073	3.4157015	0.00000	33.7949649 C
0.00009625	9493.	98625871.	12.4960103	0.0012027	-0.001107	3.4568481	0.00000	34.5445386 C
0.00009875	9709.	98319056.	12.4447860	0.0012289	-0.001141	3.4965440	0.00000	35.2951059 C
0.0001013	9925.	98023428.	12.3964319	0.0012551	-0.001175	3.5347838	0.00000	36.0466734 C
0.0001038	10140.	97737748.	12.3506169	0.0012814	-0.001209	3.5715434	0.00000	36.7988689 C
0.0001063	10355.	97460190.	12.3068167	0.0013076	-0.001242	3.6067704	0.00000	37.5506291 C
0.0001088	10570.	97191670.	12.2653540	0.0013339	-0.001276	3.6405312	0.00000	38.3034106 C
0.0001113	10784.	96931556.	12.2260737	0.0013602	-0.001310	3.6728200	0.00000	39.0572205 C
0.0001138	10997.	96679272.	12.1888338	0.0013865	-0.001344	3.7036308	0.00000	39.8120659 C
0.0001163	11210.	96434289.	12.1535049	0.0014128	-0.001377	3.7329577	0.00000	40.5679539 C
0.0001188	11423.	96196122.	12.1199680	0.0014392	-0.001411	3.7607945	0.00000	41.3248902 C
0.0001213	11636.	95963167.	12.0876683	0.0014656	-0.001444	3.7870822	0.00000	42.0813139 C
0.0001238	11847.	95736254.	12.0569714	0.0014921	-0.001478	3.8118741	0.00000	42.8388065 C
0.0001263	12059.	95515004.	12.0277844	0.0015185	-0.001511	3.8351639	0.00000	43.5973759 C
0.0001288	12270.	95299064.	12.0000213	0.0015450	-0.001545	3.8569453	0.00000	44.3570299 C
0.0001313	12476.	95056196.	11.9728746	0.0015714	-0.001579	3.8771407	0.00000	45.0000000 CY
0.0001338	12664.	94682431.	11.9446730	0.0015976	-0.001612	3.8956106	0.00000	45.0000000 CY
0.0001363	12825.	94130417.	11.9162363	0.0016236	-0.001646	3.9124683	0.00000	45.0000000 CY
0.0001388	12969.	93468494.	11.8873494	0.0016494	-0.001681	3.9277258	0.00000	45.0000000 CY
0.0001413	13099.	92737520.	11.8582846	0.0016750	-0.001715	3.9414363	0.00000	45.0000000 CY
0.0001438	13218.	91953933.	11.8298714	0.0017005	-0.001749	3.9536825	0.00000	45.0000000 CY
0.0001463	13329.	91136681.	11.8019988	0.0017260	-0.001784	3.9644687	0.00000	45.0000000 CY
0.0001488	13432.	90300290.	11.7741778	0.0017514	-0.001819	3.9737821	0.00000	45.0000000 CY
0.0001588	13783.	86818909.	11.6688377	0.0018524	-0.001958	3.9968548	0.00000	45.0000000 CY
0.0001688	14062.	83329099.	11.5707723	0.0019526	-0.002097	3.9986265	0.00000	45.0000000 CY
0.0001788	14289.	79937709.	11.4803590	0.0020521	-0.002238	3.9991678	0.00000	45.0000000 CY
0.0001888	14477.	76698926.	11.3990911	0.0021516	-0.002378	3.9990452	0.00000	45.0000000 CY
0.0001988	14634.	73629269.	11.3238107	0.0022506	-0.002519	3.9980997	0.00000	45.0000000 CY
0.0002088	14766.	70734114.	11.2560354	0.0023497	-0.002660	3.9998237	0.00000	45.0000000 CY
0.0002188	14878.	68014822.	11.1948373	0.0024489	-0.002801	3.9980963	0.00000	45.0000000 CY
0.0002288	14974.	65462081.	11.1390328	0.0025481	-0.002942	3.9993270	0.00000	45.0000000 CY
0.0002388	15057.	63065415.	11.0875009	0.0026471	-0.003083	3.9998192	0.00000	45.0000000 CY
0.0002488	15128.	60815966.	11.0407334	0.0027464	-0.003224	3.9999655	0.00000	45.0000000 CY
0.0002588	15190.	58704722.	10.9984044	0.0028458	-0.003364	3.9999900	0.00000	45.0000000 CY
0.0002688	15244.	56721118.	10.9598583	0.0029455	-0.003505	3.9999712	0.00000	45.0000000 CY
0.0002788	15291.	54853983.	10.9250735	0.0030454	-0.003645	3.9998472	0.00000	45.0000000 CY
0.0002888	15331.	53094548.	10.8925132	0.0031452	-0.003785	3.9993997	0.00000	45.0000000 CY
0.0002988	15367.	51436651.	10.8622445	0.0032451	-0.003925	3.9982614	0.00000	45.0000000 CY
0.0003088	15398.	49870845.	10.8350870	0.0033453	-0.004065	3.9959544	0.00000	45.0000000 CY
0.0003188	15425.	48391940.	10.8103145	0.0034458	-0.004204	3.9999143	0.00000	45.0000000 CY
0.0003288	15449.	46991957.	10.7877313	0.0035465	-0.004344	3.9985305	0.00000	45.0000000 CY
0.0003388	15469.	45664786.	10.7668837	0.0036473	-0.004483	3.9959051	0.00000	45.0000000 CY
0.0003488	15487.	44407004.	10.7482901	0.0037485	-0.004622	3.9995016	0.00000	45.0000000 CY

0.0003588	15502.	43212065.	10.7311293	0.0038498	-0.004760	3.9959759	0.00000	45.0000000	CY

Axial Thrust Force = 585.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	156.9814497	125585160.	183.2723589	0.0002291	0.0001991	0.9120513	0.00000	6.6392730	
0.00000250	313.9607756	125584310.	97.6471800	0.0002441	0.0001841	0.9672421	0.00000	7.0707206	
0.00000375	470.9358538	125582894.	69.1103429	0.0002592	0.0001692	1.0220025	0.00000	7.5026998	
0.00000500	627.9045602	125580912.	54.8455915	0.0002742	0.0001542	1.0763303	0.00000	7.9352108	
0.00000625	784.8647706	125578363.	46.2896746	0.0002893	0.0001393	1.1302240	0.00000	8.3682535	
0.00000750	941.8143605	125575248.	40.5881752	0.0003044	0.0001244	1.1836815	0.00000	8.8018281	
0.00000875	1099.	125571566.	36.5177716	0.0003195	0.0001095	1.2367011	0.00000	9.2359346	
0.00001000	1256.	125567318.	33.4668032	0.0003347	0.00009467	1.2892809	0.00000	9.6705730	
0.00001125	1413.	125562503.	31.0954585	0.0003498	0.00007982	1.3414191	0.00000	10.1057434	
0.00001250	1569.	125557121.	29.1998506	0.0003650	0.00006500	1.3931139	0.00000	10.5414459	
0.00001375	1726.	125551172.	27.6502334	0.0003802	0.00005019	1.4443633	0.00000	10.9776806	
0.00001500	1883.	125544656.	26.3601095	0.0003954	0.00003540	1.4951655	0.00000	11.4144477	
0.00001625	2040.	125537573.	25.2695960	0.0004106	0.00002063	1.5455187	0.00000	11.8517471	
0.00001750	2197.	125529923.	24.3359195	0.0004259	0.00000588	1.5954211	0.00000	12.2895792	
0.00001875	2354.	125521705.	23.5277129	0.0004411	-0.00000886	1.6448707	0.00000	12.7279440	
0.00002000	2510.	125512727.	22.8214442	0.0004564	-0.00002357	1.6938653	0.00000	13.1668377	
0.00002125	2667.	125501665.	22.1990766	0.0004717	-0.00003827	1.7423997	0.00000	13.6062310	
0.00002250	2823.	125486890.	21.6465566	0.0004870	-0.00005295	1.7904674	0.00000	14.0460778	
0.00002375	2980.	125467223.	21.1527894	0.0005024	-0.00006762	1.8380617	0.00000	14.4863334	
0.00002500	3136.	125441954.	20.7089046	0.0005177	-0.00008228	1.8851768	0.00000	14.9269557	
0.00002625	3292.	125410727.	20.3077278	0.0005331	-0.00009692	1.9318075	0.00000	15.3679077	
0.00002750	3448.	125373452.	19.9433957	0.0005484	-0.000112	1.9779495	0.00000	15.8091580	
0.00002875	3513.	122184871.	19.4845936	0.0005602	-0.000130	2.0127436	0.00000	16.1452300	C
0.00003000	3646.	121527324.	19.1532783	0.0005746	-0.000145	2.0551623	0.00000	16.5589522	C
0.00003125	3777.	120865294.	18.8459461	0.0005889	-0.000161	2.0968928	0.00000	16.9703886	C
0.00003250	3906.	120197191.	18.5595752	0.0006032	-0.000177	2.1379187	0.00000	17.3792994	C
0.00003375	4034.	119533994.	18.2923089	0.0006174	-0.000193	2.1782940	0.00000	17.7861469	C
0.00003500	4161.	118879296.	18.0422540	0.0006315	-0.000209	2.2180406	0.00000	18.1910878	C
0.00003625	4286.	118235483.	17.8077522	0.0006455	-0.000224	2.2571771	0.00000	18.5942494	C
0.00003750	4410.	117604607.	17.5873804	0.0006595	-0.000240	2.2957229	0.00000	18.9957761	C
0.00003875	4533.	116988407.	17.3799126	0.0006735	-0.000257	2.3336984	0.00000	19.3958268	C
0.00004000	4655.	116385271.	17.1840619	0.0006874	-0.000273	2.3710999	0.00000	19.7943118	C
0.00004125	4777.	115795753.	16.9988311	0.0007012	-0.000289	2.4079389	0.00000	20.1913017	C
0.00004250	4897.	115223607.	16.8236082	0.0007150	-0.000305	2.4442567	0.00000	20.5871971	C
0.00004375	5017.	114669756.	16.6577000	0.0007288	-0.000321	2.4800757	0.00000	20.9822070	C
0.00004500	5136.	114127770.	16.4998987	0.0007425	-0.000338	2.5153484	0.00000	21.3757680	C
0.00004625	5254.	113602166.	16.3499476	0.0007562	-0.000354	2.5501268	0.00000	21.7684173	C
0.00004750	5372.	113095235.	16.2075273	0.0007699	-0.000370	2.5844497	0.00000	22.1605690	C
0.00004875	5489.	112597358.	16.0713020	0.0007835	-0.000387	2.6182267	0.00000	22.5511533	C
0.00005125	5722.	111650783.	15.8177350	0.0008107	-0.000419	2.6844260	0.00000	23.3307588	C
0.00005375	5953.	110758570.	15.5859906	0.0008377	-0.000452	2.7487754	0.00000	24.1076130	C
0.00005625	6183.	109917341.	15.3734129	0.0008648	-0.000485	2.8113249	0.00000	24.8821299	C
0.00005875	6411.	109124078.	15.1778188	0.0008917	-0.000518	2.8721241	0.00000	25.6547590	C
0.00006125	6638.	108376019.	14.9974021	0.0009186	-0.000551	2.9312212	0.00000	26.4259856	C
0.00006375	6864.	107664124.	14.8298519	0.0009454	-0.000585	2.9885536	0.00000	27.1948389	C
0.00006625	7088.	106991714.	14.6745165	0.0009722	-0.000618	3.0442465	0.00000	27.9628651	C
0.00006875	7312.	106356044.	14.5302540	0.0009990	-0.000651	3.0983313	0.00000	28.7304441	C
0.00007125	7535.	105748146.	14.3951610	0.0010257	-0.000684	3.1507081	0.00000	29.4960517	C
0.00007375	7757.	105173991.	14.2694754	0.0010524	-0.000718	3.2015525	0.00000	30.2621906	C
0.00007625	7978.	104622972.	14.1512072	0.0010790	-0.000751	3.2507123	0.00000	31.0265072	C
0.00007875	8198.	104101532.	14.0409028	0.0011057	-0.000784	3.2983738	0.00000	31.7918620	C
0.00008125	8417.	103598922.	13.9365687	0.0011323	-0.000818	3.3443552	0.00000	32.5552902	C
0.00008375	8636.	103121163.	13.8388804	0.0011590	-0.000851	3.3888362	0.00000	33.3197310	C
0.00008625	8855.	102662276.	13.7466095	0.0011856	-0.000884	3.4317211	0.00000	34.0835573	C
0.00008875	9072.	102221751.	13.6594816	0.0012123	-0.000918	3.4730386	0.00000	34.8472411	C
0.00009125	9289.	101800659.	13.5775232	0.0012389	-0.000951	3.5128503	0.00000	35.6119711	C
0.00009375	9506.	101393384.	13.4995559	0.0012656	-0.000984	3.5510478	0.00000	36.3756679	C
0.00009625	9721.	101001678.	13.4258027	0.0012922	-0.001018	3.5877075	0.00000	37.1398221	C
0.00009875	9937.	100625424.	13.3561532	0.0013189	-0.001051	3.6228535	0.00000	37.9050341	C
0.0001013	10151.	100261614.	13.2899158	0.0013456	-0.001084	3.6564306	0.00000	38.6701656	C
0.0001038	10366.	99909027.	13.2267746	0.0013723	-0.001118	3.6884307	0.00000	39.4350084	C
0.0001063	10579.	99568930.	13.1669529	0.0013990	-0.001151	3.7189085	0.00000	40.2009239	C
0.0001088	10792.	99240435.	13.1102240	0.0014257	-0.001184	3.7478576	0.00000	40.9679191	C
0.0001113	11005.	98921417.	13.0560638	0.0014525	-0.001218	3.7752360	0.00000	41.7349761	C
0.0001138	11217.	98610940.	13.0042277	0.0014792	-0.001251	3.8010352	0.00000	42.5018466	C
0.0001163	11429.	98310011.	12.9549471	0.0015060	-0.001284	3.8252958	0.00000	43.2698158	C
0.0001188	11640.	98018001.	12.9080627	0.0015328	-0.001317	3.8480111	0.00000	44.0388913	C
0.0001213	11850.	97734335.	12.8634285	0.0015597	-0.001350	3.8691746	0.00000	44.8090809	C
0.0001238	12056.	97418968.	12.8227962	0.0015868	-0.001383	3.8889444	0.00000	45.0000000	CY
0.0001263	12251.	97040530.	12.7878048	0.0016145	-0.001416	3.9074245	0.00000	45.0000000	CY
0.0001288	12438.	96603532.	12.7585212	0.0016427	-0.001447	3.9245504	0.00000	45.0000000	CY
0.0001313	12617.	96126153.	12.7338301	0.0016713	-0.001479	3.9401631	0.00000	45.0000000	CY
0.0001338	12790.	95624010.	12.7127411	0.0017003	-0.001510	3.9541310	0.00000	45.0000000	CY
0.0001363	12958.	95102288.	12.6948738	0.0017297	-0.001540	3.9663748	0.00000	45.0000000	CY
0.0001388	13120.	94558974.	12.6797787	0.0017593	-0.001571	3.9768170	0.00000	45.0000000	CY
0.0001413	13271.	93956215.	12.6640841	0.0017888	-0.001601	3.9852820	0.00000	45.0000000	CY
0.0001438	13406.	93257357.	12.6449404	0.0018177	-0.001632	3.9917218	0.00000	45.0000000	CY
0.0001463	13527.	92492812.	12.6238571	0.0018462	-0.001664	3.9962725	0.00000	45.0000000	CY
0.0001488	13638.	91684773.	12.6020909	0.0018746	-0.001695	3.9990177	0.00000	45.0000000	CY
0.0001588	14012.	88267019.	12.5103561	0.0019860	-0.001824	3.9987307	0.00000	45.0000000	CY
0.0001688	14305.	84768334.	12.4216754	0.0020962	-0.001954	3.9998140	0.00000	45.0000000	CY
0.0001788	14540.	81340815.	12.3394301	0.0022057	-0.002084	3.9999938	0.00000	45.0000000	CY

0.0001888	14731.	78046592.	12.2626864	0.0023146	-0.002215	3.9999953	0.00000	45.0000000	CY
0.0001988	14890.	74919433.	12.1930320	0.0024234	-0.002347	3.9998525	0.00000	45.0000000	CY
0.0002088	15024.	71969499.	12.1301536	0.0025322	-0.002478	3.9989575	0.00000	45.0000000	CY
0.0002188	15135.	69188493.	12.0719450	0.0026407	-0.002609	3.9999483	0.00000	45.0000000	CY
0.0002288	15230.	66579256.	12.0194243	0.0027494	-0.002741	3.9979524	0.00000	45.0000000	CY
0.0002388	15311.	64128488.	11.9716846	0.0028582	-0.002872	3.9989348	0.00000	45.0000000	CY
0.0002488	15380.	61829667.	11.9287804	0.0029673	-0.003003	3.9993825	0.00000	45.0000000	CY
0.0002588	15440.	59671137.	11.8900168	0.0030765	-0.003133	3.9995193	0.00000	45.0000000	CY
0.0002688	15491.	57639675.	11.8542368	0.0031858	-0.003264	3.9994210	0.00000	45.0000000	CY
0.0002788	15534.	55728215.	11.8216443	0.0032953	-0.003395	3.9990324	0.00000	45.0000000	CY
0.0002888	15572.	53928771.	11.7919671	0.0034049	-0.003525	3.9981477	0.00000	45.0000000	CY
0.0002988	15604.	52231334.	11.7648997	0.0035148	-0.003655	3.9964166	0.00000	45.0000000	CY
0.0003088	15631.	50628139.	11.7407906	0.0036250	-0.003785	3.9999921	0.00000	45.0000000	CY
0.0003188	15655.	49114297.	11.7187286	0.0037353	-0.003915	3.9992874	0.00000	45.0000000	CY
0.0003288	15675.	47681021.	11.6997699	0.0038463	-0.004044	3.9969693	0.00000	45.0000000	CY

Axial Thrust Force = 658.500 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	155.8980106	124718408.	205.7194079	0.0002571	0.0002271	1.0157249	0.00000	7.4529785	
0.00000250	311.7938760	124717550.	108.8708151	0.0002722	0.0002122	1.0699782	0.00000	7.8844341	
0.00000375	467.6854509	124716120.	76.5928893	0.0002872	0.0001972	1.1238004	0.00000	8.3164267	
0.00000500	623.5705900	124714118.	60.4576304	0.0003023	0.0001823	1.1771896	0.00000	8.7489564	
0.00000625	779.4471476	124711544.	50.7794385	0.0003174	0.0001674	1.2301441	0.00000	9.1820232	
0.00000750	935.3129779	124708397.	44.3297803	0.0003325	0.0001525	1.2826618	0.00000	9.6156272	
0.00000875	1091.	124704678.	39.7249987	0.0003476	0.0001376	1.3347411	0.00000	10.0497685	
0.00001000	1247.	124700387.	36.2732653	0.0003627	0.0001227	1.3863800	0.00000	10.4844470	
0.00001125	1403.	124695524.	33.5902309	0.0003779	0.0001079	1.4375766	0.00000	10.9196629	
0.00001250	1559.	124690088.	31.4452860	0.0003931	0.00009307	1.4883291	0.00000	11.3554162	
0.00001375	1714.	124684079.	29.6916793	0.0004083	0.00007826	1.5386356	0.00000	11.7917072	
0.00001500	1870.	124677497.	28.2315764	0.0004235	0.00006347	1.5884943	0.00000	12.2285358	
0.00001625	2026.	124670343.	26.9972459	0.0004387	0.00004871	1.6379033	0.00000	12.6659022	
0.00001750	2182.	124662616.	25.9403084	0.0004540	0.00003396	1.6868606	0.00000	13.1038066	
0.00001875	2337.	124654315.	25.0252854	0.0004692	0.00001922	1.7353645	0.00000	13.5422490	
0.00002000	2493.	124645442.	24.2255683	0.0004845	0.00000451	1.7834131	0.00000	13.9812297	
0.00002125	2649.	124635994.	23.5208093	0.0004998	-0.00001018	1.8310044	0.00000	14.4207488	
0.00002250	2804.	124625827.	22.8951771	0.0005151	-0.00002486	1.8781363	0.00000	14.8608032	
0.00002375	2960.	124613932.	22.3361416	0.0005305	-0.00003952	1.9248042	0.00000	15.3013676	
0.00002500	3115.	124599007.	21.8336583	0.0005458	-0.00005416	1.9710022	0.00000	15.7424024	
0.00002625	3270.	124580045.	21.3795948	0.0005612	-0.00006879	2.0167243	0.00000	16.1838660	
0.00002750	3425.	124556367.	20.9673003	0.0005766	-0.00008340	2.0619652	0.00000	16.6257216	
0.00002875	3580.	124527576.	20.5912851	0.0005920	-0.00009800	2.1067201	0.00000	17.0679337	
0.00003000	3735.	124493499.	20.2469796	0.0006074	-0.000113	2.1509845	0.00000	17.5104722	
0.00003125	3809.	121902543.	19.8280978	0.0006196	-0.000130	2.1856213	0.00000	17.8604637	C
0.00003250	3943.	121337652.	19.5134610	0.0006342	-0.000146	2.2265471	0.00000	18.2783371	C
0.00003375	4076.	120759280.	19.2197616	0.0006487	-0.000161	2.2667827	0.00000	18.6938915	C
0.00003500	4206.	120175467.	18.9450040	0.0006631	-0.000177	2.3063600	0.00000	19.1073787	C
0.00003625	4335.	119589864.	18.6873110	0.0006774	-0.000193	2.3452938	0.00000	19.5188851	C
0.00003750	4463.	119005715.	18.4450705	0.0006917	-0.000208	2.3836004	0.00000	19.9285140	C
0.00003875	4589.	118425881.	18.2168925	0.0007059	-0.000224	2.4212967	0.00000	20.3363828	C
0.00004000	4714.	117852878.	18.0015747	0.0007201	-0.000240	2.4584006	0.00000	20.7426265	C
0.00004125	4838.	117288897.	17.7980732	0.0007342	-0.000256	2.4949310	0.00000	21.1473950	C
0.00004250	4961.	116735828.	17.6054797	0.0007482	-0.000272	2.5309073	0.00000	21.5508537	C
0.00004375	5083.	116192344.	17.4227882	0.0007622	-0.000288	2.5663259	0.00000	21.9529125	C
0.00004500	5205.	115657348.	17.2490937	0.0007762	-0.000304	2.6011821	0.00000	22.3534673	C
0.00004625	5325.	115136624.	17.0841044	0.0007901	-0.000320	2.6355311	0.00000	22.7531052	C
0.00004750	5445.	114630334.	16.9272192	0.0008040	-0.000336	2.6693858	0.00000	23.1519446	C
0.00004875	5564.	114130247.	16.7772132	0.0008179	-0.000352	2.7026779	0.00000	23.5491351	C
0.00005125	5800.	113173349.	16.4978332	0.0008455	-0.000384	2.7678374	0.00000	24.3415547	C
0.00005375	6034.	112263552.	16.2423282	0.0008730	-0.000417	2.8310577	0.00000	25.1306793	C
0.00005625	6266.	111398773.	16.0077299	0.0009004	-0.000450	2.8923865	0.00000	25.9168596	C
0.00005875	6496.	110577133.	15.7915958	0.0009278	-0.000482	2.9518714	0.00000	26.7004815	C
0.00006125	6725.	109796881.	15.5919022	0.0009550	-0.000515	3.0095591	0.00000	27.4819664	C
0.00006375	6952.	109056342.	15.4069622	0.0009822	-0.000548	3.0654952	0.00000	28.2617716	C
0.00006625	7178.	108353879.	15.2353627	0.0010093	-0.000581	3.1197242	0.00000	29.0403907	C
0.00006875	7403.	107680722.	15.0750487	0.0010364	-0.000614	3.1721739	0.00000	29.8166286	C
0.00007125	7627.	107041600.	14.9256685	0.0010635	-0.000647	3.2229706	0.00000	30.5922127	C
0.00007375	7849.	106433169.	14.7861196	0.0010905	-0.000680	3.2721196	0.00000	31.3671634	C
0.00007625	8071.	105849407.	14.6549896	0.0011174	-0.000713	3.3195654	0.00000	32.1404960	C
0.00007875	8292.	105294872.	14.5323730	0.0011444	-0.000746	3.3654372	0.00000	32.9142571	C
0.00008125	8512.	104760199.	14.4165305	0.0011713	-0.000779	3.4096062	0.00000	33.6862002	C
0.00008375	8731.	104251153.	14.3079101	0.0011983	-0.000812	3.4522224	0.00000	34.4588869	C
0.00008625	8949.	103760449.	14.2051103	0.0012252	-0.000845	3.4931803	0.00000	35.2303825	C
0.00008875	9167.	103290251.	14.1081995	0.0012521	-0.000878	3.5325594	0.00000	36.0021288	C
0.00009125	9384.	102839173.	14.0167216	0.0012790	-0.000911	3.5703618	0.00000	36.7741997	C
0.00009375	9600.	102402498.	13.9297134	0.0013059	-0.000944	3.6065195	0.00000	37.5451586	C
0.00009625	9816.	101983858.	13.8476160	0.0013328	-0.000977	3.6411359	0.00000	38.3172085	C
0.00009875	10031.	101579741.	13.7696739	0.0013598	-0.001010	3.6741585	0.00000	39.0892540	C
0.0001013	10245.	101187955.	13.6953745	0.0013867	-0.001043	3.7055635	0.00000	39.8606936	C
0.0001038	10459.	100810703.	13.6250222	0.0014136	-0.001076	3.7354189	0.00000	40.6332359	C
0.0001063	10672.	100446821.	13.5583190	0.0014406	-0.001109	3.7637157	0.00000	41.4068207	C
0.0001088	10885.	100091478.	13.4942229	0.0014675	-0.001143	3.7903641	0.00000	42.1789558	C
0.0001113	11097.	99748018.	13.4333539	0.0014945	-0.001176	3.8154536	0.00000	42.9522085	C
0.0001138	11309.	99415631.	13.3755016	0.0015215	-0.001209	3.8389776	0.00000	43.7265864	C
0.0001163	11520.	99093574.	13.3204736	0.0015485	-0.001241	3.8609293	0.00000	44.5020970	C
0.0001188	11728.	98758839.	13.2684397	0.0015756	-0.001274	3.8813318	0.00000	45.0000000	CY
0.0001213	11928.	98372187.	13.2222720	0.0016032	-0.001307	3.9004188	0.00000	45.0000000	CY

0.0001238	12117.	97914607.	13.1829268	0.0016314	-0.001339	3.9182059	0.00000	45.0000000 CY
0.0001263	12297.	97405619.	13.1492300	0.0016601	-0.001370	3.9345248	0.00000	45.0000000 CY
0.0001288	12471.	96864775.	13.1199762	0.0016892	-0.001401	3.9492229	0.00000	45.0000000 CY
0.0001313	12639.	96300646.	13.0945796	0.0017187	-0.001431	3.9622038	0.00000	45.0000000 CY
0.0001338	12803.	95723115.	13.0722269	0.0017484	-0.001462	3.9733689	0.00000	45.0000000 CY
0.0001363	12962.	95136335.	13.0524979	0.0017784	-0.001492	3.9826531	0.00000	45.0000000 CY
0.0001388	13118.	94543889.	13.0353199	0.0018087	-0.001521	3.9900092	0.00000	45.0000000 CY
0.0001413	13270.	93947532.	13.0204895	0.0018391	-0.001551	3.9953841	0.00000	45.0000000 CY
0.0001438	13415.	93322844.	13.0070226	0.0018698	-0.001580	3.9987186	0.00000	45.0000000 CY
0.0001463	13550.	92651665.	12.9924876	0.0019002	-0.001610	3.9999849	0.00000	45.0000000 CY
0.0001488	13672.	91913634.	12.9751046	0.0019300	-0.001640	3.9998926	0.00000	45.0000000 CY
0.0001588	14063.	88587944.	12.8937948	0.0020469	-0.001763	3.9998681	0.00000	45.0000000 CY
0.0001688	14363.	85115430.	12.8107268	0.0021618	-0.001888	3.9991053	0.00000	45.0000000 CY
0.0001788	14602.	81690034.	12.7315081	0.0022758	-0.002014	3.9996332	0.00000	45.0000000 CY
0.0001888	14797.	78392630.	12.6583585	0.0023893	-0.002141	3.9996375	0.00000	45.0000000 CY
0.0001988	14956.	75252710.	12.5921400	0.0025027	-0.002267	3.9991478	0.00000	45.0000000 CY
0.0002088	15090.	72286475.	12.5305121	0.0026157	-0.002394	3.9990520	0.00000	45.0000000 CY
0.0002188	15202.	69495023.	12.4749510	0.0027289	-0.002521	3.9993725	0.00000	45.0000000 CY
0.0002288	15296.	66868342.	12.4243027	0.0028421	-0.002648	3.9999723	0.00000	45.0000000 CY
0.0002388	15376.	64403789.	12.3791699	0.0029555	-0.002774	3.9973996	0.00000	45.0000000 CY
0.0002488	15444.	62088016.	12.3378633	0.0030690	-0.002901	3.9981030	0.00000	45.0000000 CY
0.0002588	15502.	59911004.	12.2998916	0.0031826	-0.003027	3.9983055	0.00000	45.0000000 CY
0.0002688	15551.	57865114.	12.2657130	0.0032964	-0.003154	3.9981000	0.00000	45.0000000 CY
0.0002788	15593.	55940687.	12.2348177	0.0034105	-0.003280	3.9974135	0.00000	45.0000000 CY
0.0002888	15630.	54128670.	12.2068515	0.0035247	-0.003405	3.9968938	0.00000	45.0000000 CY
0.0002988	15660.	52418585.	12.1823814	0.0036395	-0.003531	3.9999867	0.00000	45.0000000 CY
0.0003088	15686.	50804242.	12.1599857	0.0037544	-0.003656	3.9994839	0.00000	45.0000000 CY
0.0003188	15707.	49277432.	12.1397791	0.0038696	-0.003780	3.9978268	0.00000	45.0000000 CY

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	336.400	15128.217	0.00300000	-0.00393112
2	425.700	15269.320	0.00300000	-0.00358102
3	585.000	15398.029	0.00300000	-0.00304187
4	658.500	15403.041	0.00300000	-0.00282403

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	336.400000	15128.	218.660000	9833.	96590042.
2	0.65	425.700000	15269.	276.705000	9925.	98023181.
3	0.65	585.000000	15398.	380.250000	10009.	100503506.
4	0.65	658.500000	15403.	428.025000	10012.	101615487.
1	0.75	336.400000	15128.	252.300000	11346.	95024800.
2	0.75	425.700000	15269.	319.275000	11452.	96164621.
3	0.75	585.000000	15398.	438.750000	11549.	98144040.
4	0.75	658.500000	15403.	493.875000	11552.	99041021.
1	0.90	336.400000	15128.	302.760000	13615.	85158649.
2	0.90	425.700000	15269.	383.130000	13742.	87217528.
3	0.90	585.000000	15398.	526.500000	13858.	89674768.
4	0.90	658.500000	15403.	592.650000	13863.	90293361.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	17.2000	0.00	N.A.	No	0.00	7105.

2	23.1000	5.9000	Yes	No	7105.	9273.
3	27.1000	9.2653	Yes	No	16378.	52032.
4	36.1000	6.9015	No	No	68410.	21244.
5	57.1000	39.9000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only
for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 4600.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 425700.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1218	-874676.	4600.	0.00	0.00	1.27E+11	0.00	0.00	3.3300
0.3708	0.1217	-854146.	4616.	-3.02E-05	0.00	1.27E+11	0.00	0.00	3.8133
0.7416	0.1215	-833484.	4647.	-5.96E-05	0.00	1.27E+11	0.00	0.00	10.1700
1.1124	0.1212	-812566.	4692.	-8.84E-05	0.00	1.27E+11	0.00	0.00	10.1700
1.4832	0.1207	-791392.	4738.	-1.16E-04	0.00	1.27E+11	0.00	0.00	10.1700
1.8540	0.1201	-769965.	4783.	-1.44E-04	0.00	1.27E+11	0.00	0.00	10.1700
2.2248	0.1195	-748285.	4828.	-1.70E-04	0.00	1.27E+11	0.00	0.00	10.1700
2.5956	0.1186	-726355.	4873.	-1.96E-04	0.00	1.27E+11	0.00	0.00	10.1700
2.9664	0.1177	-704175.	4919.	-2.21E-04	0.00	1.27E+11	0.00	0.00	10.1700
3.3372	0.1167	-681747.	4964.	-2.45E-04	0.00	1.27E+11	0.00	0.00	10.1700
3.7080	0.1155	-659073.	5009.	-2.68E-04	0.00	1.27E+11	0.00	0.00	10.1700
4.0788	0.1143	-636153.	5054.	-2.91E-04	0.00	1.27E+11	0.00	0.00	10.1700
4.4496	0.1129	-612991.	5100.	-3.13E-04	0.00	1.27E+11	0.00	0.00	10.1700
4.8204	0.1115	-589586.	5145.	-3.34E-04	0.00	1.27E+11	0.00	0.00	10.1700
5.1912	0.1100	-565941.	5190.	-3.54E-04	0.00	1.27E+11	0.00	0.00	10.1700
5.5620	0.1083	-542058.	5235.	-3.73E-04	0.00	1.27E+11	0.00	0.00	10.1700
5.9328	0.1066	-517937.	5281.	-3.92E-04	0.00	1.27E+11	0.00	0.00	10.1700
6.3036	0.1049	-493580.	5326.	-4.10E-04	0.00	1.27E+11	0.00	0.00	10.1700
6.6744	0.1030	-468990.	5371.	-4.26E-04	0.00	1.27E+11	0.00	0.00	10.1700
7.0452	0.1011	-444167.	5416.	-4.42E-04	0.00	1.27E+11	0.00	0.00	10.1700
7.4160	0.09906	-419114.	5462.	-4.57E-04	0.00	1.27E+11	0.00	0.00	10.1700
7.7868	0.09699	-393831.	5507.	-4.72E-04	0.00	1.27E+11	0.00	0.00	10.1700
8.1576	0.09486	-368321.	5552.	-4.85E-04	0.00	1.27E+11	0.00	0.00	10.1700
8.5284	0.09268	-342585.	5597.	-4.97E-04	0.00	1.27E+11	0.00	0.00	10.1700
8.8992	0.09044	-316625.	5643.	-5.09E-04	0.00	1.27E+11	0.00	0.00	10.1700
9.2700	0.08815	-290443.	5688.	-5.19E-04	0.00	1.27E+11	0.00	0.00	10.1700
9.6408	0.08581	-264041.	5733.	-5.29E-04	0.00	1.27E+11	0.00	0.00	10.1700
10.0116	0.08344	-237419.	5778.	-5.38E-04	0.00	1.27E+11	0.00	0.00	10.1700
10.3824	0.08103	-210581.	5824.	-5.46E-04	0.00	1.27E+11	0.00	0.00	10.1700
10.7532	0.07858	-183527.	5869.	-5.53E-04	0.00	1.27E+11	0.00	0.00	10.1700
11.1240	0.07611	-156259.	5914.	-5.58E-04	0.00	1.27E+11	0.00	0.00	10.1700
11.4948	0.07361	-128780.	5959.	-5.63E-04	0.00	1.27E+11	0.00	0.00	10.1700
11.8656	0.07110	-101092.	6005.	-5.67E-04	0.00	1.27E+11	0.00	0.00	10.1700
12.2364	0.06856	-73195.	6050.	-5.71E-04	0.00	1.27E+11	0.00	0.00	10.1700
12.6072	0.06602	-45092.	6095.	-5.73E-04	0.00	1.27E+11	0.00	0.00	10.1700
12.9780	0.06347	-16784.	6140.	-5.74E-04	0.00	1.27E+11	0.00	0.00	10.1700
13.3488	0.06091	11726.	6186.	-5.74E-04	0.00	1.27E+11	0.00	0.00	10.1700
13.7196	0.05836	40436.	6231.	-5.73E-04	0.00	1.27E+11	0.00	0.00	10.1700
14.0904	0.05582	69345.	6276.	-5.71E-04	0.00	1.27E+11	0.00	0.00	10.1700
14.4612	0.05328	98451.	6321.	-5.68E-04	0.00	1.27E+11	0.00	0.00	10.1700
14.8320	0.05076	127752.	6367.	-5.64E-04	0.00	1.27E+11	0.00	0.00	10.1700
15.2028	0.04826	157246.	6412.	-5.59E-04	0.00	1.27E+11	0.00	0.00	10.1700
15.5736	0.04579	186930.	6457.	-5.53E-04	0.00	1.27E+11	0.00	0.00	10.1700
15.9444	0.04334	216804.	6502.	-5.46E-04	0.00	1.27E+11	0.00	0.00	10.1700
16.3152	0.04093	246865.	6548.	-5.38E-04	0.00	1.27E+11	0.00	0.00	10.1700
16.6860	0.03855	277110.	6593.	-5.29E-04	0.00	1.27E+11	0.00	0.00	10.1700
17.0568	0.03622	307539.	6634.	-5.19E-04	0.00	1.27E+11	0.00	0.00	8.4640
17.4276	0.03394	338115.	6588.	-5.07E-04	0.00	1.27E+11	-29.197	3828.	0.00
17.7984	0.03171	368091.	6364.	-4.95E-04	0.00	1.27E+11	-71.717	10065.	0.00
18.1692	0.02953	396622.	6003.	-4.82E-04	0.00	1.27E+11	-90.284	13603.	0.00
18.5400	0.02742	423339.	5578.	-4.67E-04	0.00	1.27E+11	-100.803	16358.	0.00
18.9108	0.02537	448033.	5109.	-4.52E-04	0.00	1.27E+11	-110.251	19334.	0.00
19.2816	0.02340	470514.	4599.	-4.36E-04	0.00	1.27E+11	-118.624	22560.	0.00
19.6524	0.02149	490616.	4055.	-4.19E-04	0.00	1.27E+11	-125.920	26069.	0.00
20.0232	0.01967	508192.	3481.	-4.02E-04	0.00	1.27E+11	-132.142	29899.	0.00
20.3940	0.01792	523118.	2882.	-3.84E-04	0.00	1.27E+11	-137.292	34096.	0.00
20.7648	0.01625	535291.	2262.	-3.65E-04	0.00	1.27E+11	-141.378	38714.	0.00
21.1356	0.01467	544629.	1626.	-3.47E-04	0.00	1.27E+11	-144.409	43815.	0.00
21.5064	0.01317	551073.	978.9469	-3.27E-04	0.00	1.27E+11	-146.395	49477.	0.00
21.8772	0.01175	554581.	325.4188	-3.08E-04	0.00	1.27E+11	-147.352	55791.	0.00

22.2480	0.01042	555136.	-330.107	-2.89E-04	0.00	1.27E+11	-147.293	62872.	0.00
22.6188	0.00918	552737.	-983.149	-2.69E-04	0.00	1.27E+11	-146.236	70859.	0.00
22.9896	0.00803	547407.	-1629.	-2.50E-04	0.00	1.27E+11	-144.197	79930.	0.00
23.3604	0.00696	539186.	-2264.	-2.31E-04	0.00	1.27E+11	-141.032	90205.	0.00
23.7312	0.00597	528136.	-2868.	-2.13E-04	0.00	1.27E+11	-130.648	97375.	0.00
24.1020	0.00507	514465.	-3427.	-1.94E-04	0.00	1.27E+11	-120.344	105715.	0.00
24.4728	0.00424	498377.	-3939.	-1.77E-04	0.00	1.27E+11	-110.112	115540.	0.00
24.8436	0.00349	480076.	-4407.	-1.60E-04	0.00	1.27E+11	-99.941	127301.	0.00
25.2144	0.00282	459765.	-4819.	-1.43E-04	0.00	1.27E+11	-85.447	134798.	0.00
25.5852	0.00222	437732.	-5166.	-1.27E-04	0.00	1.27E+11	-70.341	141035.	0.00
25.9560	0.00169	414276.	-5446.	-1.13E-04	0.00	1.27E+11	-55.801	147271.	0.00
26.3268	0.00122	389689.	-5664.	-9.86E-05	0.00	1.27E+11	-41.986	153508.	0.00
26.6976	8.09E-04	364245.	-5822.	-8.54E-05	0.00	1.27E+11	-29.031	159745.	0.00
27.0684	4.57E-04	338201.	-5925.	-7.32E-05	0.00	1.27E+11	-17.042	165981.	0.00
27.4392	1.58E-04	311798.	-5990.	-6.18E-05	0.00	1.27E+11	-12.200	344436.	0.00
27.8100	-9.32E-05	285133.	-6000.	-5.14E-05	0.00	1.27E+11	7.4750	356910.	0.00
28.1808	-3.00E-04	258597.	-5928.	-4.19E-05	0.00	1.27E+11	24.8789	369383.	0.00
28.5516	-4.66E-04	232536.	-5784.	-3.33E-05	0.00	1.27E+11	39.9926	381856.	0.00
28.9224	-5.96E-04	207252.	-5577.	-2.56E-05	0.00	1.27E+11	52.8370	394330.	0.00
29.2932	-6.94E-04	183000.	-5319.	-1.88E-05	0.00	1.27E+11	63.4675	406803.	0.00
29.6640	-7.64E-04	159993.	-5017.	-1.28E-05	0.00	1.27E+11	71.9683	419276.	0.00
30.0348	-8.08E-04	138400.	-4683.	-7.63E-06	0.00	1.27E+11	78.4472	431750.	0.00
30.4056	-8.32E-04	118351.	-4323.	-3.15E-06	0.00	1.27E+11	83.0301	444223.	0.00
30.7764	-8.36E-04	99938.	-3948.	6.62E-07	0.00	1.27E+11	85.8558	456696.	0.00
31.1472	-8.26E-04	83219.	-3563.	3.86E-06	0.00	1.27E+11	87.0713	469170.	0.00
31.5180	-8.02E-04	68217.	-3176.	6.50E-06	0.00	1.27E+11	86.8272	481643.	0.00
31.8888	-7.68E-04	54931.	-2793.	8.65E-06	0.00	1.27E+11	85.2736	494116.	0.00
32.2596	-7.25E-04	43329.	-2420.	1.04E-05	0.00	1.27E+11	82.5565	506590.	0.00
32.6304	-6.76E-04	33359.	-2061.	1.17E-05	0.00	1.27E+11	78.8142	519063.	0.00
33.0012	-6.21E-04	24946.	-1720.	1.27E-05	0.00	1.27E+11	74.1753	531536.	0.00
33.3720	-5.62E-04	18001.	-1402.	1.35E-05	0.00	1.27E+11	68.7559	544010.	0.00
33.7428	-5.01E-04	12416.	-1110.	1.40E-05	0.00	1.27E+11	62.6584	556483.	0.00
34.1136	-4.38E-04	8071.	-845.974	1.44E-05	0.00	1.27E+11	55.9702	568956.	0.00
34.4844	-3.73E-04	4833.	-612.963	1.46E-05	0.00	1.27E+11	48.7633	581430.	0.00
34.8552	-3.08E-04	2561.	-413.048	1.47E-05	0.00	1.27E+11	41.0943	593903.	0.00
35.2260	-2.42E-04	1102.	-248.192	1.48E-05	0.00	1.27E+11	33.0050	606376.	0.00
35.5968	-1.76E-04	296.2462	-120.202	1.48E-05	0.00	1.27E+11	24.5236	618850.	0.00
35.9676	-1.10E-04	-23.892	-30.787	1.48E-05	0.00	1.27E+11	15.6664	631323.	0.00
36.3384	-4.45E-05	-33.851	8.0677	1.48E-05	0.00	1.27E+11	1.7981	179749.	0.00
36.7092	2.14E-05	-8.206	10.1086	1.48E-05	0.00	1.27E+11	-0.881	183231.	0.00
37.0800	8.73E-05	0.00	0.00	1.48E-05	0.00	1.27E+11	-3.663	93357.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     0.12178397 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =       -874676. inch-lbs
Maximum shear force              =          6634. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =    17.05680000 feet below pile head
Number of iterations             =              9
Number of zero deflection points =              2
Pile deflection at ground        =     0.03533844 inches
```

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 2, Shear and Slope

```
Shear      =           4600. lbs
Slope      =        0.00000
Axial Load =         425700. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
37.08000	0.12178397	-874676.	6634.
35.22600	0.12185833	-874877.	6630.
33.37200	0.12237862	-875655.	6633.
31.51800	0.12563823	-882793.	-7406.
29.66400	0.13746639	-913733.	-8382.
27.81000	0.16959381	-1017985.	-7721.
25.95600	0.22435567	-1228886.	6642.
24.10200	0.25226224	-1367873.	6642.
22.24800	0.25883638	-1442506.	6643.
20.39400	0.28067802	-1403410.	6644.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 5800.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 658500.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1444	-1036966.	5800.	0.00	0.00	1.25E+11	0.00	0.00	0.00
0.3708	0.1443	-1011104.	5801.	-3.65E-05	0.00	1.25E+11	0.00	0.00	0.5066
0.7416	0.1441	-985126.	5818.	-7.22E-05	0.00	1.25E+11	0.00	0.00	7.1700
1.1124	0.1437	-958904.	5850.	-1.07E-04	0.00	1.25E+11	0.00	0.00	7.1700
1.4832	0.1431	-932439.	5882.	-1.41E-04	0.00	1.25E+11	0.00	0.00	7.1700
1.8540	0.1424	-905735.	5914.	-1.73E-04	0.00	1.25E+11	0.00	0.00	7.1700
2.2248	0.1416	-878794.	5946.	-2.05E-04	0.00	1.25E+11	0.00	0.00	7.1700
2.5956	0.1406	-851619.	5978.	-2.36E-04	0.00	1.25E+11	0.00	0.00	7.1700
2.9664	0.1395	-824213.	6010.	-2.66E-04	0.00	1.25E+11	0.00	0.00	7.1700
3.3372	0.1382	-796580.	6042.	-2.95E-04	0.00	1.25E+11	0.00	0.00	7.1700
3.7080	0.1369	-768721.	6073.	-3.23E-04	0.00	1.25E+11	0.00	0.00	7.1700
4.0788	0.1354	-740639.	6105.	-3.50E-04	0.00	1.25E+11	0.00	0.00	7.1700
4.4496	0.1337	-712338.	6137.	-3.76E-04	0.00	1.25E+11	0.00	0.00	7.1700
4.8204	0.1320	-683821.	6169.	-4.01E-04	0.00	1.25E+11	0.00	0.00	7.1700
5.1912	0.1302	-655091.	6201.	-4.24E-04	0.00	1.25E+11	0.00	0.00	7.1700
5.5620	0.1282	-626150.	6233.	-4.47E-04	0.00	1.25E+11	0.00	0.00	7.1700
5.9328	0.1262	-597001.	6265.	-4.69E-04	0.00	1.25E+11	0.00	0.00	7.1700
6.3036	0.1241	-567648.	6297.	-4.90E-04	0.00	1.25E+11	0.00	0.00	7.1700
6.6744	0.1218	-538094.	6329.	-5.10E-04	0.00	1.25E+11	0.00	0.00	7.1700
7.0452	0.1195	-508342.	6361.	-5.28E-04	0.00	1.25E+11	0.00	0.00	7.1700
7.4160	0.1171	-478394.	6392.	-5.46E-04	0.00	1.25E+11	0.00	0.00	7.1700
7.7868	0.1147	-448255.	6424.	-5.62E-04	0.00	1.25E+11	0.00	0.00	7.1700
8.1576	0.1121	-417926.	6456.	-5.78E-04	0.00	1.25E+11	0.00	0.00	7.1700
8.5284	0.1095	-387413.	6488.	-5.92E-04	0.00	1.25E+11	0.00	0.00	7.1700
8.8992	0.1069	-356716.	6520.	-6.06E-04	0.00	1.25E+11	0.00	0.00	7.1700
9.2700	0.1041	-325841.	6552.	-6.18E-04	0.00	1.25E+11	0.00	0.00	7.1700
9.6408	0.1014	-294789.	6584.	-6.29E-04	0.00	1.25E+11	0.00	0.00	7.1700
10.0116	0.09855	-263565.	6616.	-6.39E-04	0.00	1.25E+11	0.00	0.00	7.1700
10.3824	0.09568	-232171.	6648.	-6.48E-04	0.00	1.25E+11	0.00	0.00	7.1700
10.7532	0.09278	-200611.	6680.	-6.55E-04	0.00	1.25E+11	0.00	0.00	7.1700
11.1240	0.08985	-168887.	6712.	-6.62E-04	0.00	1.25E+11	0.00	0.00	7.1700
11.4948	0.08689	-137005.	6743.	-6.67E-04	0.00	1.25E+11	0.00	0.00	7.1700
11.8656	0.08391	-104966.	6775.	-6.72E-04	0.00	1.25E+11	0.00	0.00	7.1700
12.2364	0.08092	-72774.	6807.	-6.75E-04	0.00	1.25E+11	0.00	0.00	7.1700
12.6072	0.07791	-40432.	6839.	-6.77E-04	0.00	1.25E+11	0.00	0.00	7.1700
12.9780	0.07489	-7945.	6871.	-6.78E-04	0.00	1.25E+11	0.00	0.00	7.1700
13.3488	0.07188	24686.	6903.	-6.77E-04	0.00	1.25E+11	0.00	0.00	7.1700
13.7196	0.06886	57455.	6935.	-6.76E-04	0.00	1.25E+11	0.00	0.00	7.1700
14.0904	0.06586	90361.	6967.	-6.73E-04	0.00	1.25E+11	0.00	0.00	7.1700
14.4612	0.06287	123399.	6999.	-6.69E-04	0.00	1.25E+11	0.00	0.00	7.1700
14.8320	0.05990	156567.	7031.	-6.64E-04	0.00	1.25E+11	0.00	0.00	7.1700
15.2028	0.05696	189860.	7062.	-6.58E-04	0.00	1.25E+11	0.00	0.00	7.1700
15.5736	0.05404	223275.	7094.	-6.51E-04	0.00	1.25E+11	0.00	0.00	7.1700
15.9444	0.05117	256808.	7126.	-6.42E-04	0.00	1.25E+11	0.00	0.00	7.1700
16.3152	0.04833	290457.	7158.	-6.33E-04	0.00	1.25E+11	0.00	0.00	7.1700
16.6860	0.04554	324218.	7190.	-6.22E-04	0.00	1.25E+11	0.00	0.00	7.1700
17.0568	0.04280	358086.	7219.	-6.09E-04	0.00	1.25E+11	0.00	0.00	5.9673
17.4276	0.04011	392035.	7156.	-5.96E-04	0.00	1.25E+11	-34.510	3828.	0.00
17.7984	0.03749	425260.	6890.	-5.82E-04	0.00	1.25E+11	-84.803	10065.	0.00
18.1692	0.03494	456761.	6483.	-5.66E-04	0.00	1.25E+11	-98.201	12507.	0.00
18.5400	0.03246	486271.	6021.	-5.49E-04	0.00	1.25E+11	-109.672	15036.	0.00
18.9108	0.03005	513558.	5510.	-5.31E-04	0.00	1.25E+11	-119.988	17766.	0.00
19.2816	0.02773	538416.	4956.	-5.12E-04	0.00	1.25E+11	-129.144	20723.	0.00
19.6524	0.02549	560661.	4363.	-4.93E-04	0.00	1.25E+11	-137.139	23937.	0.00
20.0232	0.02334	580131.	3738.	-4.72E-04	0.00	1.25E+11	-143.975	27443.	0.00
20.3940	0.02129	596691.	3084.	-4.51E-04	0.00	1.25E+11	-149.656	31281.	0.00
20.7648	0.01933	610225.	2408.	-4.30E-04	0.00	1.25E+11	-154.188	35499.	0.00
21.1356	0.01746	620643.	1715.	-4.08E-04	0.00	1.25E+11	-157.583	40154.	0.00
21.5064	0.01570	627876.	1009.	-3.86E-04	0.00	1.25E+11	-159.851	45314.	0.00
21.8772	0.01403	631878.	294.6951	-3.63E-04	0.00	1.25E+11	-161.007	51062.	0.00
22.2480	0.01246	632627.	-421.856	-3.41E-04	0.00	1.25E+11	-161.067	57498.	0.00
22.6188	0.01100	630120.	-1136.	-3.18E-04	0.00	1.25E+11	-160.050	64747.	0.00
22.9896	0.00963	624379.	-1844.	-2.96E-04	0.00	1.25E+11	-157.973	72964.	0.00
23.3604	0.00837	615445.	-2539.	-2.74E-04	0.00	1.25E+11	-154.676	82253.	0.00
23.7312	0.00720	603384.	-3203.	-2.52E-04	0.00	1.25E+11	-143.471	88679.	0.00
24.1020	0.00613	588419.	-3816.	-2.31E-04	0.00	1.25E+11	-132.351	96131.	0.00
24.4728	0.00515	570772.	-4381.	-2.10E-04	0.00	1.25E+11	-121.313	104881.	0.00
24.8436	0.00426	550664.	-4896.	-1.90E-04	0.00	1.25E+11	-110.344	115310.	0.00
25.2144	0.00346	528314.	-5363.	-1.71E-04	0.00	1.25E+11	-99.422	127982.	0.00
25.5852	0.00274	503940.	-5777.	-1.52E-04	0.00	1.25E+11	-86.822	141035.	0.00
25.9560	0.00210	477794.	-6125.	-1.35E-04	0.00	1.25E+11	-69.563	147271.	0.00
26.3268	0.00154	450221.	-6398.	-1.18E-04	0.00	1.25E+11	-53.134	153508.	0.00
26.6976	0.00105	421549.	-6600.	-1.03E-04	0.00	1.25E+11	-37.697	159745.	0.00
27.0684	6.27E-04	392087.	-6736.	-8.81E-05	0.00	1.25E+11	-23.382	165981.	0.00

27.4392	2.66E-04	362120.	-6834.	-7.47E-05	0.00	1.25E+11	-20.579	344436.	0.00
27.8100	-3.76E-05	331709.	-6873.	-6.23E-05	0.00	1.25E+11	3.0177	356910.	0.00
28.1808	-2.88E-04	301322.	-6813.	-5.10E-05	0.00	1.25E+11	23.9447	369383.	0.00
28.5516	-4.91E-04	271378.	-6666.	-4.08E-05	0.00	1.25E+11	42.1728	381856.	0.00
28.9224	-6.51E-04	242240.	-6444.	-3.16E-05	0.00	1.25E+11	57.7210	394330.	0.00
29.2932	-7.73E-04	214221.	-6158.	-2.35E-05	0.00	1.25E+11	70.6500	406803.	0.00
29.6640	-8.60E-04	187577.	-5820.	-1.63E-05	0.00	1.25E+11	81.0553	419276.	0.00
30.0348	-9.18E-04	162519.	-5442.	-1.01E-05	0.00	1.25E+11	89.0615	431750.	0.00
30.4056	-9.50E-04	139207.	-5033.	-4.68E-06	0.00	1.25E+11	94.8153	444223.	0.00
30.7764	-9.59E-04	117757.	-4603.	-9.32E-08	0.00	1.25E+11	98.4795	456696.	0.00
31.1472	-9.51E-04	98245.	-4161.	3.76E-06	0.00	1.25E+11	100.2274	469170.	0.00
31.5180	-9.26E-04	80708.	-3715.	6.95E-06	0.00	1.25E+11	100.2370	481643.	0.00
31.8888	-8.89E-04	65146.	-3272.	9.55E-06	0.00	1.25E+11	98.6862	494116.	0.00
32.2596	-8.41E-04	51532.	-2840.	1.16E-05	0.00	1.25E+11	95.7487	506590.	0.00
32.6304	-7.85E-04	39808.	-2423.	1.33E-05	0.00	1.25E+11	91.5896	519063.	0.00
33.0012	-7.23E-04	29893.	-2027.	1.45E-05	0.00	1.25E+11	86.3623	531536.	0.00
33.3720	-6.56E-04	21684.	-1656.	1.54E-05	0.00	1.25E+11	80.2063	544010.	0.00
33.7428	-5.86E-04	15062.	-1315.	1.61E-05	0.00	1.25E+11	73.2445	556483.	0.00
34.1136	-5.13E-04	9888.	-1006.	1.65E-05	0.00	1.25E+11	65.5824	568956.	0.00
34.4844	-4.39E-04	6012.	-732.688	1.68E-05	0.00	1.25E+11	57.3073	581430.	0.00
34.8552	-3.63E-04	3269.	-497.315	1.70E-05	0.00	1.25E+11	48.4880	593903.	0.00
35.2260	-2.87E-04	1487.	-302.280	1.71E-05	0.00	1.25E+11	39.1760	606376.	0.00
35.5968	-2.11E-04	479.2540	-149.699	1.71E-05	0.00	1.25E+11	29.4061	618850.	0.00
35.9676	-1.35E-04	54.1359	-41.562	1.71E-05	0.00	1.25E+11	19.1991	631323.	0.00
36.3384	-5.92E-05	9.1336	6.4718	1.71E-05	0.00	1.25E+11	2.3911	179749.	0.00
36.7092	1.69E-05	11.4715	10.2399	1.71E-05	0.00	1.25E+11	-0.697	183231.	0.00
37.0800	9.31E-05	0.00	0.00	1.71E-05	0.00	1.25E+11	-3.905	93357.	0.00

* This analysis computed pile response using nonlinear moment-curvature rela-
  tionships. Values of total stress due to combined axial and bending stresses
  are computed only for elastic sections only and do not equal the actual
  stresses in concrete and steel. Stresses in concrete and steel may be inter-
  polated from the output for nonlinear bending properties relative to the
  magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.14440280 inches
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -1036966. inch-lbs
Maximum shear force = 7219. lbs
Depth of maximum bending moment = 0.000000 feet below pile head
Depth of maximum shear force = 17.05680000 feet below pile head
Number of iterations = 9
Number of zero deflection points = 2
Pile deflection at ground = 0.04175942 inches

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 2, Shear and Slope

Shear = 5800. lbs
Slope = 0.00000
Axial Load = 658500. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
37.08000	0.14440280	-1036966.	7219.
35.22600	0.14462066	-1037576.	7209.
33.37200	0.14527493	-1038514.	-7368.
31.51800	0.14989212	-1048644.	-8581.
29.66400	0.16579493	-1090110.	-9628.
27.81000	0.20773159	-1225566.	-8803.
25.95600	0.27832502	-1494538.	7225.
24.10200	0.31154138	-1661071.	7224.
22.24800	0.31651179	-1740876.	7226.
20.39400	0.34264269	-1685995.	7226.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 1700.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 336400.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth	Deflect.	Bending	Shear	Slope	Total	Bending	Soil Res.	Soil Spr.	Distrib.

X feet	y inches	Moment in-lbs	Force lbs	S radians	Stress psi*	Stiffness lb-in^2	p lb/inch	Es*H lb/inch	Lat. Load lb/inch
0.00	0.07796	-508592.	1700.	0.00	0.00	1.28E+11	0.00	0.00	9.5000
0.3708	0.07792	-500920.	1743.	-1.75E-05	0.00	1.28E+11	0.00	0.00	10.0066
0.7416	0.07781	-493024.	1803.	-3.47E-05	0.00	1.28E+11	0.00	0.00	16.6700
1.1124	0.07761	-484773.	1877.	-5.16E-05	0.00	1.28E+11	0.00	0.00	16.6700
1.4832	0.07735	-476167.	1951.	-6.83E-05	0.00	1.28E+11	0.00	0.00	16.6700
1.8540	0.07701	-467205.	2025.	-8.46E-05	0.00	1.28E+11	0.00	0.00	16.6700
2.2248	0.07659	-457890.	2099.	-1.01E-04	0.00	1.28E+11	0.00	0.00	16.6700
2.5956	0.07611	-448221.	2174.	-1.16E-04	0.00	1.28E+11	0.00	0.00	16.6700
2.9664	0.07556	-438198.	2248.	-1.32E-04	0.00	1.28E+11	0.00	0.00	16.6700
3.3372	0.07494	-427823.	2322.	-1.47E-04	0.00	1.28E+11	0.00	0.00	16.6700
3.7080	0.07425	-417095.	2396.	-1.61E-04	0.00	1.28E+11	0.00	0.00	16.6700
4.0788	0.07350	-406016.	2470.	-1.76E-04	0.00	1.28E+11	0.00	0.00	16.6700
4.4496	0.07269	-394586.	2544.	-1.89E-04	0.00	1.28E+11	0.00	0.00	16.6700
4.8204	0.07182	-382805.	2619.	-2.03E-04	0.00	1.28E+11	0.00	0.00	16.6700
5.1912	0.07088	-370674.	2693.	-2.16E-04	0.00	1.28E+11	0.00	0.00	16.6700
5.5620	0.06990	-358194.	2767.	-2.29E-04	0.00	1.28E+11	0.00	0.00	16.6700
5.9328	0.06885	-345366.	2841.	-2.41E-04	0.00	1.28E+11	0.00	0.00	16.6700
6.3036	0.06775	-332189.	2915.	-2.53E-04	0.00	1.28E+11	0.00	0.00	16.6700
6.6744	0.06660	-318665.	2990.	-2.64E-04	0.00	1.28E+11	0.00	0.00	16.6700
7.0452	0.06541	-304795.	3064.	-2.75E-04	0.00	1.28E+11	0.00	0.00	16.6700
7.4160	0.06416	-290579.	3138.	-2.85E-04	0.00	1.28E+11	0.00	0.00	16.6700
7.7868	0.06287	-276017.	3212.	-2.95E-04	0.00	1.28E+11	0.00	0.00	16.6700
8.1576	0.06154	-261112.	3286.	-3.04E-04	0.00	1.28E+11	0.00	0.00	16.6700
8.5284	0.06016	-245862.	3360.	-3.13E-04	0.00	1.28E+11	0.00	0.00	16.6700
8.8992	0.05875	-230270.	3435.	-3.21E-04	0.00	1.28E+11	0.00	0.00	16.6700
9.2700	0.05731	-214336.	3509.	-3.29E-04	0.00	1.28E+11	0.00	0.00	16.6700
9.6408	0.05583	-198061.	3583.	-3.36E-04	0.00	1.28E+11	0.00	0.00	16.6700
10.0116	0.05432	-181445.	3657.	-3.42E-04	0.00	1.28E+11	0.00	0.00	16.6700
10.3824	0.05278	-164490.	3731.	-3.48E-04	0.00	1.28E+11	0.00	0.00	16.6700
10.7532	0.05122	-147197.	3805.	-3.54E-04	0.00	1.28E+11	0.00	0.00	16.6700
11.1240	0.04963	-129565.	3880.	-3.59E-04	0.00	1.28E+11	0.00	0.00	16.6700
11.4948	0.04803	-111597.	3954.	-3.63E-04	0.00	1.28E+11	0.00	0.00	16.6700
11.8656	0.04640	-93293.	4028.	-3.66E-04	0.00	1.28E+11	0.00	0.00	16.6700
12.2364	0.04477	-74655.	4102.	-3.69E-04	0.00	1.28E+11	0.00	0.00	16.6700
12.6072	0.04312	-55682.	4176.	-3.72E-04	0.00	1.28E+11	0.00	0.00	16.6700
12.9780	0.04146	-36376.	4251.	-3.73E-04	0.00	1.28E+11	0.00	0.00	16.6700
13.3488	0.03980	-16739.	4325.	-3.74E-04	0.00	1.28E+11	0.00	0.00	16.6700
13.7196	0.03813	3230.	4399.	-3.74E-04	0.00	1.28E+11	0.00	0.00	16.6700
14.0904	0.03647	23528.	4473.	-3.74E-04	0.00	1.28E+11	0.00	0.00	16.6700
14.4612	0.03480	44155.	4547.	-3.73E-04	0.00	1.28E+11	0.00	0.00	16.6700
14.8320	0.03315	65110.	4621.	-3.71E-04	0.00	1.28E+11	0.00	0.00	16.6700
15.2028	0.03151	86392.	4696.	-3.68E-04	0.00	1.28E+11	0.00	0.00	16.6700
15.5736	0.02987	107999.	4770.	-3.65E-04	0.00	1.28E+11	0.00	0.00	16.6700
15.9444	0.02826	129931.	4844.	-3.61E-04	0.00	1.28E+11	0.00	0.00	16.6700
16.3152	0.02666	152186.	4918.	-3.56E-04	0.00	1.28E+11	0.00	0.00	16.6700
16.6860	0.02509	174763.	4992.	-3.50E-04	0.00	1.28E+11	0.00	0.00	16.6700
17.0568	0.02355	197661.	5060.	-3.44E-04	0.00	1.28E+11	0.00	0.00	13.8737
17.4276	0.02204	220823.	5049.	-3.36E-04	0.00	1.28E+11	-18.958	3828.	0.00
17.7984	0.02056	243599.	4903.	-3.28E-04	0.00	1.28E+11	-46.496	10065.	0.00
18.1692	0.01911	265442.	4644.	-3.20E-04	0.00	1.28E+11	-70.024	16301.	0.00
18.5400	0.01771	285884.	4308.	-3.10E-04	0.00	1.28E+11	-81.021	20354.	0.00
18.9108	0.01636	304707.	3931.	-3.00E-04	0.00	1.28E+11	-88.519	24083.	0.00
19.2816	0.01504	321762.	3522.	-2.89E-04	0.00	1.28E+11	-95.128	28135.	0.00
19.6524	0.01378	336917.	3086.	-2.77E-04	0.00	1.28E+11	-100.846	32553.	0.00
20.0232	0.01258	350058.	2627.	-2.66E-04	0.00	1.28E+11	-105.674	37391.	0.00
20.3940	0.01142	361089.	2148.	-2.53E-04	0.00	1.28E+11	-109.618	42708.	0.00
20.7648	0.01032	369930.	1653.	-2.41E-04	0.00	1.28E+11	-112.682	48577.	0.00
21.1356	0.00928	376521.	1147.	-2.28E-04	0.00	1.28E+11	-114.876	55084.	0.00
21.5064	0.00830	380819.	632.8300	-2.15E-04	0.00	1.28E+11	-116.209	62334.	0.00
21.8772	0.00737	382795.	114.6628	-2.01E-04	0.00	1.28E+11	-116.696	70454.	0.00
22.2480	0.00650	382442.	-403.813	-1.88E-04	0.00	1.28E+11	-116.348	79602.	0.00
22.6188	0.00570	379765.	-918.920	-1.75E-04	0.00	1.28E+11	-115.181	89973.	0.00
22.9896	0.00495	374788.	-1416.	-1.62E-04	0.00	1.28E+11	-108.272	97378.	0.00
23.3604	0.00426	367647.	-1877.	-1.49E-04	0.00	1.28E+11	-99.112	103615.	0.00
23.7312	0.00362	358526.	-2297.	-1.36E-04	0.00	1.28E+11	-89.415	109851.	0.00
24.1020	0.00304	347615.	-2672.	-1.24E-04	0.00	1.28E+11	-79.380	116088.	0.00
24.4728	0.00252	335115.	-3003.	-1.12E-04	0.00	1.28E+11	-69.195	122325.	0.00
24.8436	0.00204	321227.	-3288.	-1.01E-04	0.00	1.28E+11	-59.029	128561.	0.00
25.2144	0.00162	306155.	-3529.	-9.01E-05	0.00	1.28E+11	-49.034	134798.	0.00
25.5852	0.00124	290095.	-3725.	-7.98E-05	0.00	1.28E+11	-39.345	141035.	0.00
25.9560	9.09E-04	273241.	-3880.	-7.00E-05	0.00	1.28E+11	-30.078	147271.	0.00
26.3268	6.18E-04	255778.	-3994.	-6.08E-05	0.00	1.28E+11	-21.333	153508.	0.00
26.6976	3.67E-04	237879.	-4071.	-5.23E-05	0.00	1.28E+11	-13.188	159745.	0.00
27.0684	1.53E-04	219706.	-4113.	-4.44E-05	0.00	1.28E+11	-5.707	165981.	0.00
27.4392	-2.75E-05	201410.	-4121.	-3.71E-05	0.00	1.28E+11	2.1277	344436.	0.00
27.8100	-1.77E-04	183145.	-4085.	-3.04E-05	0.00	1.28E+11	14.1913	356910.	0.00
28.1808	-2.98E-04	165151.	-3998.	-2.44E-05	0.00	1.28E+11	24.7493	369383.	0.00
28.5516	-3.94E-04	147639.	-3868.	-1.90E-05	0.00	1.28E+11	33.8024	381856.	0.00
28.9224	-4.67E-04	130788.	-3700.	-1.41E-05	0.00	1.28E+11	41.3757	394330.	0.00
29.2932	-5.20E-04	114750.	-3503.	-9.89E-06	0.00	1.28E+11	47.5153	406803.	0.00
29.6640	-5.55E-04	99647.	-3281.	-6.17E-06	0.00	1.28E+11	52.2845	419276.	0.00
30.0348	-5.75E-04	85573.	-3040.	-2.97E-06	0.00	1.28E+11	55.7605	431750.	0.00
30.4056	-5.81E-04	72599.	-2787.	-2.27E-07	0.00	1.28E+11	58.0308	444223.	0.00
30.7764	-5.77E-04	60771.	-2526.	2.08E-06	0.00	1.28E+11	59.1895	456696.	0.00
31.1472	-5.63E-04	50111.	-2263.	4.00E-06	0.00	1.28E+11	59.3350	469170.	0.00
31.5180	-5.41E-04	40623.	-2000.	5.58E-06	0.00	1.28E+11	58.5661	481643.	0.00
31.8888	-5.13E-04	32293.	-1743.	6.84E-06	0.00	1.28E+11	56.9804	494116.	0.00
32.2596	-4.80E-04	25089.	-1495.	7.83E-06	0.00	1.28E+11	54.6715	506590.	0.00

32.6304	-4.43E-04	18967.	-1258.	8.59E-06	0.00	1.28E+11	51.7268	519063.	0.00
33.0012	-4.04E-04	13867.	-1036.	9.16E-06	0.00	1.28E+11	48.2268	531536.	0.00
33.3720	-3.62E-04	9722.	-830.035	9.57E-06	0.00	1.28E+11	44.2428	544010.	0.00
33.7428	-3.19E-04	6452.	-642.974	9.85E-06	0.00	1.28E+11	39.8369	556483.	0.00
34.1136	-2.74E-04	3970.	-476.342	1.00E-05	0.00	1.28E+11	35.0608	568956.	0.00
34.4844	-2.29E-04	2183.	-331.693	1.01E-05	0.00	1.28E+11	29.9561	581430.	0.00
34.8552	-1.84E-04	988.0420	-210.417	1.02E-05	0.00	1.28E+11	24.5546	593903.	0.00
35.2260	-1.39E-04	279.5633	-113.787	1.02E-05	0.00	1.28E+11	18.8784	606376.	0.00
35.5968	-9.31E-05	-55.157	-42.994	1.02E-05	0.00	1.28E+11	12.9415	618850.	0.00
35.9676	-4.76E-05	-133.645	0.8176	1.02E-05	0.00	1.28E+11	6.7509	631323.	0.00
36.3384	-2.13E-06	-78.466	16.0285	1.02E-05	0.00	1.28E+11	0.08607	179749.	0.00
36.7092	4.33E-05	-21.579	12.2523	1.02E-05	0.00	1.28E+11	-1.783	183231.	0.00
37.0800	8.87E-05	0.00	0.00	1.02E-05	0.00	1.28E+11	-3.724	93357.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 3:

Pile-head deflection = 0.07796165 inches
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -508592. inch-lbs
Maximum shear force = 5060. lbs
Depth of maximum bending moment = 0.000000 feet below pile head
Depth of maximum shear force = 17.05680000 feet below pile head
Number of iterations = 7
Number of zero deflection points = 2
Pile deflection at ground = 0.02296473 inches

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 2, Shear and Slope

Shear = 1700. lbs
Slope = 0.00000
Axial Load = 336400. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
37.08000	0.07796165	-508592.	5060.
35.22600	0.07800473	-508710.	5071.
33.37200	0.07819318	-508925.	5065.
31.51800	0.07954843	-511885.	5068.
29.66400	0.08485759	-525935.	-5730.
27.81000	0.10221441	-581501.	-5622.
25.95600	0.13779517	-716320.	5073.
24.10200	0.15942457	-818604.	5072.
22.24800	0.16733207	-882083.	5075.
20.39400	0.17651690	-859561.	5076.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 4

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 6200.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 585000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1693	-1178794.	6200.	0.00	0.00	1.26E+11	0.00	0.00	4.5800
0.3708	0.1692	-1151107.	6222.	-4.13E-05	0.00	1.26E+11	0.00	0.00	5.0866
0.7416	0.1689	-1123213.	6259.	-8.16E-05	0.00	1.26E+11	0.00	0.00	11.7500
1.1124	0.1685	-1094982.	6311.	-1.21E-04	0.00	1.26E+11	0.00	0.00	11.7500
1.4832	0.1679	-1066418.	6364.	-1.59E-04	0.00	1.26E+11	0.00	0.00	11.7500
1.8540	0.1671	-1037523.	6416.	-1.96E-04	0.00	1.26E+11	0.00	0.00	11.7500
2.2248	0.1661	-1008300.	6468.	-2.33E-04	0.00	1.26E+11	0.00	0.00	11.7500
2.5956	0.1650	-978751.	6520.	-2.68E-04	0.00	1.26E+11	0.00	0.00	11.7500
2.9664	0.1637	-948879.	6573.	-3.02E-04	0.00	1.26E+11	0.00	0.00	11.7500
3.3372	0.1623	-918687.	6625.	-3.35E-04	0.00	1.26E+11	0.00	0.00	11.7500
3.7080	0.1607	-888178.	6677.	-3.67E-04	0.00	1.26E+11	0.00	0.00	11.7500

4.0788	0.1590	-857354.	6730.	-3.98E-04	0.00	1.26E+11	0.00	0.00	11.7500
4.4496	0.1572	-826218.	6782.	-4.28E-04	0.00	1.26E+11	0.00	0.00	11.7500
4.8204	0.1552	-794773.	6834.	-4.57E-04	0.00	1.26E+11	0.00	0.00	11.7500
5.1912	0.1531	-763023.	6886.	-4.84E-04	0.00	1.26E+11	0.00	0.00	11.7500
5.5620	0.1509	-730970.	6939.	-5.11E-04	0.00	1.26E+11	0.00	0.00	11.7500
5.9328	0.1486	-698616.	6991.	-5.36E-04	0.00	1.26E+11	0.00	0.00	11.7500
6.3036	0.1462	-665965.	7043.	-5.60E-04	0.00	1.26E+11	0.00	0.00	11.7500
6.6744	0.1436	-633021.	7095.	-5.83E-04	0.00	1.26E+11	0.00	0.00	11.7500
7.0452	0.1410	-599785.	7148.	-6.05E-04	0.00	1.26E+11	0.00	0.00	11.7500
7.4160	0.1382	-566261.	7200.	-6.26E-04	0.00	1.26E+11	0.00	0.00	11.7500
7.7868	0.1354	-532453.	7252.	-6.45E-04	0.00	1.26E+11	0.00	0.00	11.7500
8.1576	0.1325	-498363.	7305.	-6.63E-04	0.00	1.26E+11	0.00	0.00	11.7500
8.5284	0.1295	-463994.	7357.	-6.80E-04	0.00	1.26E+11	0.00	0.00	11.7500
8.8992	0.1264	-429350.	7409.	-6.96E-04	0.00	1.26E+11	0.00	0.00	11.7500
9.2700	0.1233	-394433.	7461.	-7.11E-04	0.00	1.26E+11	0.00	0.00	11.7500
9.6408	0.1201	-359248.	7514.	-7.24E-04	0.00	1.26E+11	0.00	0.00	11.7500
10.0116	0.1168	-323796.	7566.	-7.36E-04	0.00	1.26E+11	0.00	0.00	11.7500
10.3824	0.1135	-288082.	7618.	-7.47E-04	0.00	1.26E+11	0.00	0.00	11.7500
10.7532	0.1102	-252109.	7671.	-7.57E-04	0.00	1.26E+11	0.00	0.00	11.7500
11.1240	0.1068	-215881.	7723.	-7.65E-04	0.00	1.26E+11	0.00	0.00	11.7500
11.4948	0.1034	-179399.	7775.	-7.72E-04	0.00	1.26E+11	0.00	0.00	11.7500
11.8656	0.09994	-142668.	7827.	-7.78E-04	0.00	1.26E+11	0.00	0.00	11.7500
12.2364	0.09647	-105692.	7880.	-7.82E-04	0.00	1.26E+11	0.00	0.00	11.7500
12.6072	0.09298	-68473.	7932.	-7.85E-04	0.00	1.26E+11	0.00	0.00	11.7500
12.9780	0.08948	-31015.	7984.	-7.87E-04	0.00	1.26E+11	0.00	0.00	11.7500
13.3488	0.08598	6678.	8037.	-7.87E-04	0.00	1.26E+11	0.00	0.00	11.7500
13.7196	0.08247	44603.	8089.	-7.87E-04	0.00	1.26E+11	0.00	0.00	11.7500
14.0904	0.07898	82757.	8141.	-7.84E-04	0.00	1.26E+11	0.00	0.00	11.7500
14.4612	0.07550	121136.	8193.	-7.81E-04	0.00	1.26E+11	0.00	0.00	11.7500
14.8320	0.07203	159736.	8246.	-7.76E-04	0.00	1.26E+11	0.00	0.00	11.7500
15.2028	0.06859	198554.	8298.	-7.69E-04	0.00	1.26E+11	0.00	0.00	11.7500
15.5736	0.06518	237587.	8350.	-7.62E-04	0.00	1.26E+11	0.00	0.00	11.7500
15.9444	0.06181	276830.	8403.	-7.52E-04	0.00	1.26E+11	0.00	0.00	11.7500
16.3152	0.05849	316280.	8455.	-7.42E-04	0.00	1.26E+11	0.00	0.00	11.7500
16.6860	0.05521	355934.	8507.	-7.30E-04	0.00	1.26E+11	0.00	0.00	11.7500
17.0568	0.05199	395788.	8555.	-7.17E-04	0.00	1.26E+11	0.00	0.00	9.7790
17.4276	0.04883	435798.	8483.	-7.02E-04	0.00	1.26E+11	-42.013	3828.	0.00
17.7984	0.04574	474937.	8180.	-6.86E-04	0.00	1.26E+11	-94.530	9195.	0.00
18.1692	0.04273	512160.	7728.	-6.68E-04	0.00	1.26E+11	-108.599	11309.	0.00
18.5400	0.03980	547186.	7216.	-6.50E-04	0.00	1.26E+11	-121.439	13578.	0.00
18.9108	0.03695	579757.	6650.	-6.30E-04	0.00	1.26E+11	-133.042	16022.	0.00
19.2816	0.03419	609641.	6035.	-6.09E-04	0.00	1.26E+11	-143.402	18662.	0.00
19.6524	0.03153	636629.	5376.	-5.87E-04	0.00	1.26E+11	-152.518	21523.	0.00
20.0232	0.02897	660539.	4680.	-5.64E-04	0.00	1.26E+11	-160.390	24633.	0.00
20.3940	0.02652	681212.	3952.	-5.40E-04	0.00	1.26E+11	-167.022	28027.	0.00
20.7648	0.02417	698516.	3196.	-5.15E-04	0.00	1.26E+11	-172.419	31743.	0.00
21.1356	0.02193	712341.	2420.	-4.90E-04	0.00	1.26E+11	-176.591	35829.	0.00
21.5064	0.01981	722604.	1628.	-4.65E-04	0.00	1.26E+11	-179.550	40340.	0.00
21.8772	0.01779	729246.	824.8176	-4.39E-04	0.00	1.26E+11	-181.311	45340.	0.00
22.2480	0.01590	732231.	16.7722	-4.13E-04	0.00	1.26E+11	-181.889	50912.	0.00
22.6188	0.01412	731547.	-791.255	-3.87E-04	0.00	1.26E+11	-181.303	57152.	0.00
22.9896	0.01245	727206.	-1594.	-3.62E-04	0.00	1.26E+11	-179.572	64182.	0.00
23.3604	0.01090	719243.	-2386.	-3.36E-04	0.00	1.26E+11	-176.514	72070.	0.00
23.7312	0.00946	707718.	-3145.	-3.11E-04	0.00	1.26E+11	-164.459	77354.	0.00
24.1020	0.00813	692872.	-3850.	-2.86E-04	0.00	1.26E+11	-152.495	83423.	0.00
24.4728	0.00692	674943.	-4502.	-2.62E-04	0.00	1.26E+11	-140.625	90466.	0.00
24.8436	0.00581	654168.	-5102.	-2.38E-04	0.00	1.26E+11	-128.841	98741.	0.00
25.2144	0.00480	630781.	-5649.	-2.15E-04	0.00	1.26E+11	-117.131	108615.	0.00
25.5852	0.00389	605017.	-6144.	-1.93E-04	0.00	1.26E+11	-105.468	120629.	0.00
25.9560	0.00308	577109.	-6588.	-1.72E-04	0.00	1.26E+11	-93.808	135626.	0.00
26.3268	0.00236	547290.	-6977.	-1.53E-04	0.00	1.26E+11	-81.278	153508.	0.00
26.6976	0.00172	515812.	-7295.	-1.34E-04	0.00	1.26E+11	-61.767	159745.	0.00
27.0684	0.00117	483063.	-7530.	-1.16E-04	0.00	1.26E+11	-43.508	165981.	0.00
27.4392	6.88E-04	449409.	-7745.	-9.95E-05	0.00	1.26E+11	-53.287	344436.	0.00
27.8100	2.81E-04	414658.	-7914.	-8.41E-05	0.00	1.26E+11	-22.562	356910.	0.00
28.1808	-6.05E-05	379422.	-7953.	-7.01E-05	0.00	1.26E+11	5.0187	369383.	0.00
28.5516	-3.42E-04	344250.	-7876.	-5.73E-05	0.00	1.26E+11	29.3821	381856.	0.00
28.9224	-5.70E-04	309628.	-7698.	-4.57E-05	0.00	1.26E+11	50.5163	394330.	0.00
29.2932	-7.49E-04	275978.	-7434.	-3.53E-05	0.00	1.26E+11	68.4640	406803.	0.00
29.6640	-8.84E-04	243658.	-7096.	-2.61E-05	0.00	1.26E+11	83.3146	419276.	0.00
30.0348	-9.81E-04	212965.	-6699.	-1.80E-05	0.00	1.26E+11	95.1965	431750.	0.00
30.4056	-0.00104	184137.	-6255.	-1.10E-05	0.00	1.26E+11	104.2699	444223.	0.00
30.7764	-0.00108	157356.	-5777.	-4.92E-06	0.00	1.26E+11	110.7188	456696.	0.00
31.1472	-0.00109	132754.	-5275.	2.17E-07	0.00	1.26E+11	114.7442	469170.	0.00
31.5180	-0.00108	110410.	-4761.	4.52E-06	0.00	1.26E+11	116.5575	481643.	0.00
31.8888	-0.00105	90365.	-4242.	8.08E-06	0.00	1.26E+11	116.3737	494116.	0.00
32.2596	-0.00100	72615.	-3729.	1.10E-05	0.00	1.26E+11	114.4064	506590.	0.00
32.6304	-9.50E-04	57123.	-3228.	1.33E-05	0.00	1.26E+11	110.8620	519063.	0.00
33.0012	-8.87E-04	43821.	-2745.	1.51E-05	0.00	1.26E+11	105.9361	531536.	0.00
33.3720	-8.16E-04	32613.	-2288.	1.64E-05	0.00	1.26E+11	99.8093	544010.	0.00
33.7428	-7.41E-04	23378.	-1859.	1.74E-05	0.00	1.26E+11	92.6445	556483.	0.00
34.1136	-6.62E-04	15974.	-1465.	1.81E-05	0.00	1.26E+11	84.5847	568956.	0.00
34.4844	-5.80E-04	10244.	-1108.	1.86E-05	0.00	1.26E+11	75.7514	581430.	0.00
34.8552	-4.96E-04	6013.	-792.571	1.89E-05	0.00	1.26E+11	66.2440	593903.	0.00
35.2260	-4.12E-04	3093.	-520.292	1.90E-05	0.00	1.26E+11	56.1397	606376.	0.00
35.5968	-3.27E-04	1284.	-294.175	1.91E-05	0.00	1.26E+11	45.4947	618850.	0.00
35.9676	-2.42E-04	375.4989	-116.547	1.91E-05	0.00	1.26E+11	34.3453	631323.	0.00
36.3384	-1.57E-04	147.1255	-26.029	1.91E-05	0.00	1.26E+11	6.3408	179749.	0.00
36.7092	-7.18E-05	44.2800	-5.340	1.91E-05	0.00	1.26E+11	2.9582	183231.	0.00
37.0800	1.33E-05	0.00	0.00	1.91E-05	0.00	1.26E+11	-0.558	93357.	0.00

* This analysis computed pile response using nonlinear moment-curvature rela-
  tionships. Values of total stress due to combined axial and bending stresses
  are computed only for elastic sections only and do not equal the actual
  stresses in concrete and steel. Stresses in concrete and steel may be inter-
  polated from the output for nonlinear bending properties relative to the
  magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 4:

Pile-head deflection   =   0.16930221 inches
Computed slope at pile head   =   0.000000 radians
Maximum bending moment   =   -1178794. inch-lbs
Maximum shear force   =   8555. lbs
Depth of maximum bending moment =   0.000000 feet below pile head
Depth of maximum shear force   =   17.05680000 feet below pile head
Number of iterations   =   10
Number of zero deflection points =   2
Pile deflection at ground   =   0.05077162 inches

            Pile-head Deflection vs. Pile Length for Load Case 4

Boundary Condition Type 2, Shear and Slope

Shear   =   6200. lbs
Slope   =   0.00000
Axial Load =   585000. lbs

    Pile   Pile Head   Maximum   Maximum
   Length   Deflection   Moment   Shear
    feet   inches   ln-lbs   lbs
------------ ------------ ------------ ------------
   37.08000   0.16930221   -1178794.   8555.
   35.22600   0.16946628   -1179237.   8546.
   33.37200   0.17057801   -1180874.   -8716.
   31.51800   0.17795063   -1197322.   -10170.
   29.66400   0.19993791   -1255135.   -11087.
   27.81000   0.25215314   -1425661.   -9733.
   25.95600   0.33107303   -1731184.   8564.
   24.10200   0.36407722   -1905027.   8564.
   22.24800   0.36605417   -1978891.   8565.
   20.39400   0.45584720   -1906335.   8566.

            Summary of Pile-head Responses for Conventional Analyses
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Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Load   Load   Axial   Pile-head Pile-head Max Shear Max Moment
Case Type   Pile-head   Type   Pile-head   Loading Deflection Rotation   in Pile   in Pile
 No. 1   Load 1   2   Load 2   lbs   inches   radians   lbs   in-lbs
---- ----- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
  1 V, lb   4600.   S, rad   0.00   425700.   0.1218   0.00   6634.   -874676.
  2 V, lb   5800.   S, rad   0.00   658500.   0.1444   0.00   7219. -1036966.
  3 V, lb   1700.   S, rad   0.00   336400.   0.07796   0.00   5060.   -508592.
  4 V, lb   6200.   S, rad   0.00   585000.   0.1693   0.00   8555. -1178794.

Maximum pile-head deflection = 0.1693022122 inches
Maximum pile-head rotation   = 0.0000000000 radians = 0.000000 deg.

                          Summary of Warning Messages

The following warning was reported 63 times

**** Warning ****

The input value for friction angle is either smaller than 29 degrees or
higher than 41 degrees and no value of k has been specified for a soil layer
defined using the sand criteria. Program will assume an internal default value,
for k, but the friction angle is outside the range of data available.
Please check your input data for correctness.

The analysis ended normally.

Jacobs

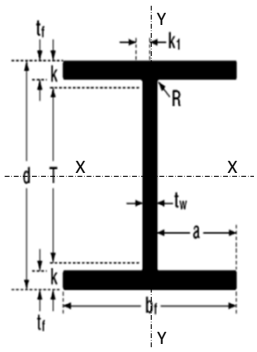
Project: MoDOT Improve I-70 Columbia to Kingdom City DB
Job No.: F3X03001
Subject: Bridge 2/A9542 - Lateral Analysis at Bent 4

By: ZW 7/2/24 8/22/24
Ckd: SR 7/12/24 11/5/24

Foundation Design Data

Pile Size: HP12X53

Support No.:	*Abutment 4*		b_f =	12.000	in	F_y =	50	ksi
Assumed Grade Elev.:	*677.40*	ft	d=	11.800	in	Ix =	393	in^4
Top of Pile Elev.:	*677.40*	ft	t_f=	0.435	in	Iy =	127	in^4
Depth:	0.00	ft	t_w =	0.435	in	J =	1.12	in^4
Design GW El.	678.60	ft	A =	15.5	in^2	Sx =	66.7	in^3
Depth below Pile Top:	-1.20	ft	E =	29,000	ksi	Sy =	21.1	in^3
Approx. Pile Tip El.:	637	ft	G =	11,284	ksi	GJ =	12,638	k-in
Approx. Pile Length:	40.40	ft						



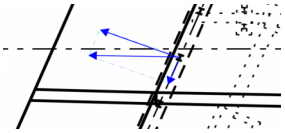
Load Information:

Thermal movement in the bridge longitudinal direction was provided by Structure engineer:

1.07 in

Thermal movement in the HP pile weak axis direction was calculated based on the bent skew angle:

Bent	Skewed Angle (°)	Displ. in Weak Axis in)
Bent 1	20.71556	1.00
Bent 4	23.28444	0.98



1-inch displacement in the HP weak axis was used for both abutments in the lateral analysis.

P-Multipliers

D = 1 ft

Loading Direction	Number of Rows	Pile Spacing S	S/D	P-Multiplier* (AASHTO LRFD Table 10.7.2.4-1)				
				Row Number				Aver.
		(ft)		1	2	3	After 3	
Longitudinal	1	-	-	1.00	-	-	-	1.00
Transverse	12	8.50	8.50	1.00	0.85	0.70	0.70	0.74

Note: Group reduction factor of 1.0 was used within fresh rock.

Design Soil/Rock Profile and Parameters:

Since higher pile lateral stiffness will induce higher pile internal forces (moment and shear) due to the thermal movement, the boring log where rock was observed at higher elevation was selected to generate the design soil/rock profile.

Design Ground Water El.: 678.6 ft

Reference Borings: B-11, BR 10-3A, L0264-6

Depth		Soil/Rock	Elevation		Eff. Unit Weight	Su	ϕ'	qu	Modulus, k or E	RQD	ε_{50}
From	To		From	To							
(ft)	(ft)		(ft)	(ft)	(pcf)	(psf)	(deg.)	(psi)	(psi)		
0.0	9.4	Stiff Clay w/o Free Water	677.4	668.0	57.6	1,200	0	-	-	-	0.007
9.4	24.4	Stiff Clay w/o Free Water	668.0	653.0	57.6	1,000	0	-	-	-	0.01
24.4	40.4	Shale	653.0	637.0	70.6	3,000	0	-	-	-	0.005
40.4	57.4	Strong Rock	637.0	620.0	101.6	-	-	7,500	-	-	-

Lateral Analysis

Software: LPILE 2022 developed by ENSOFT, Inc.

Lateral Analysis Results:

Deflection, Moment, and Shear vs Depth figures are attached.

Structure Engineer should check the pile structural acceptability under the assumed thermal movement.

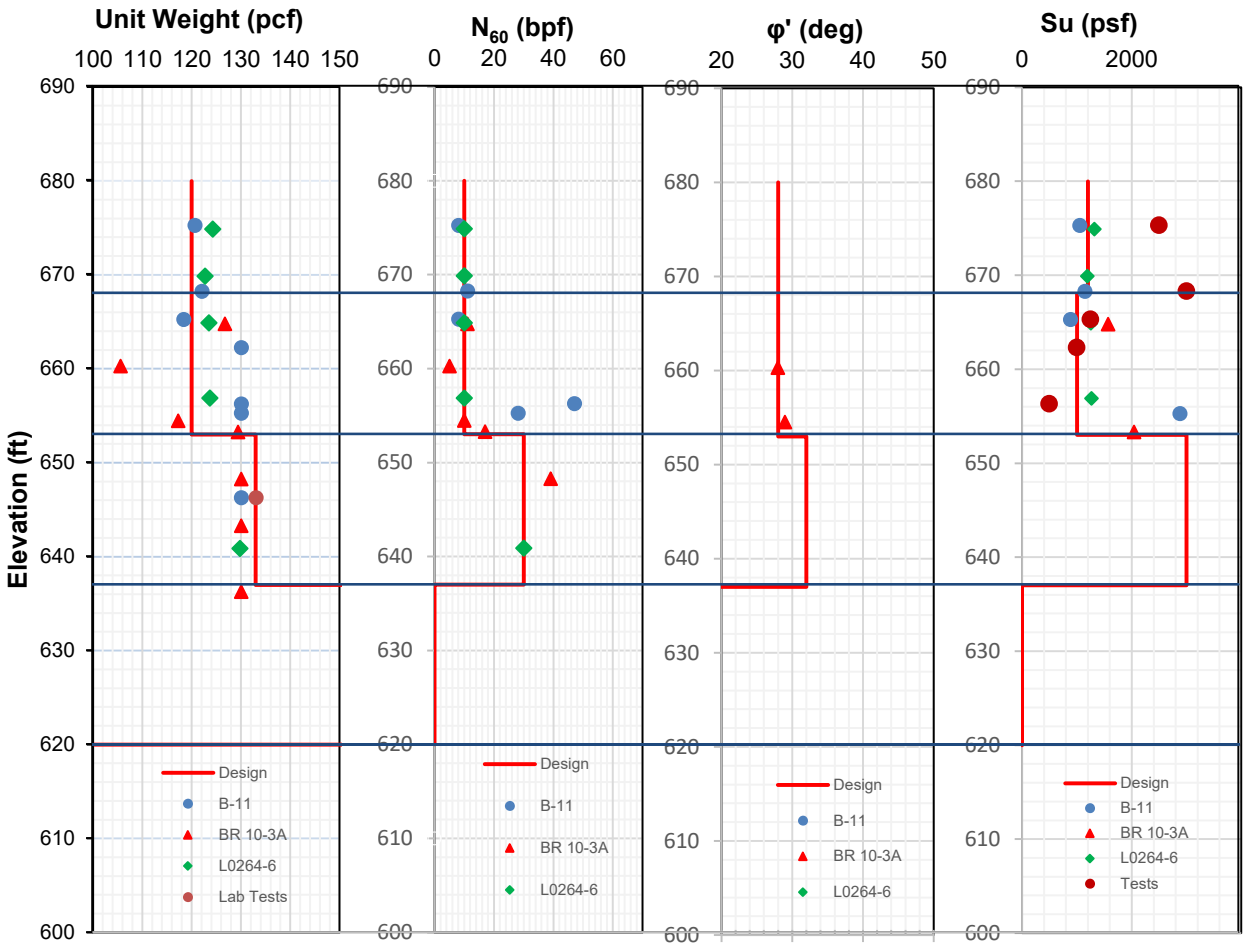
LPile Analysis Summary at Bent 4 of Bridge 2 (A9542)

Loading Condition		Axial Load	P-Mult.	Pile Head Deflect.	Max Moment	Max Shear	Pile Head Rotation
No.	Load Case						
		(lb)		δ (in)	(in-lbs)	(lbs)	(rad.)
1	1" Displ. in Weak Axis	228,470	1	1	641,119	15,476	-0.0154

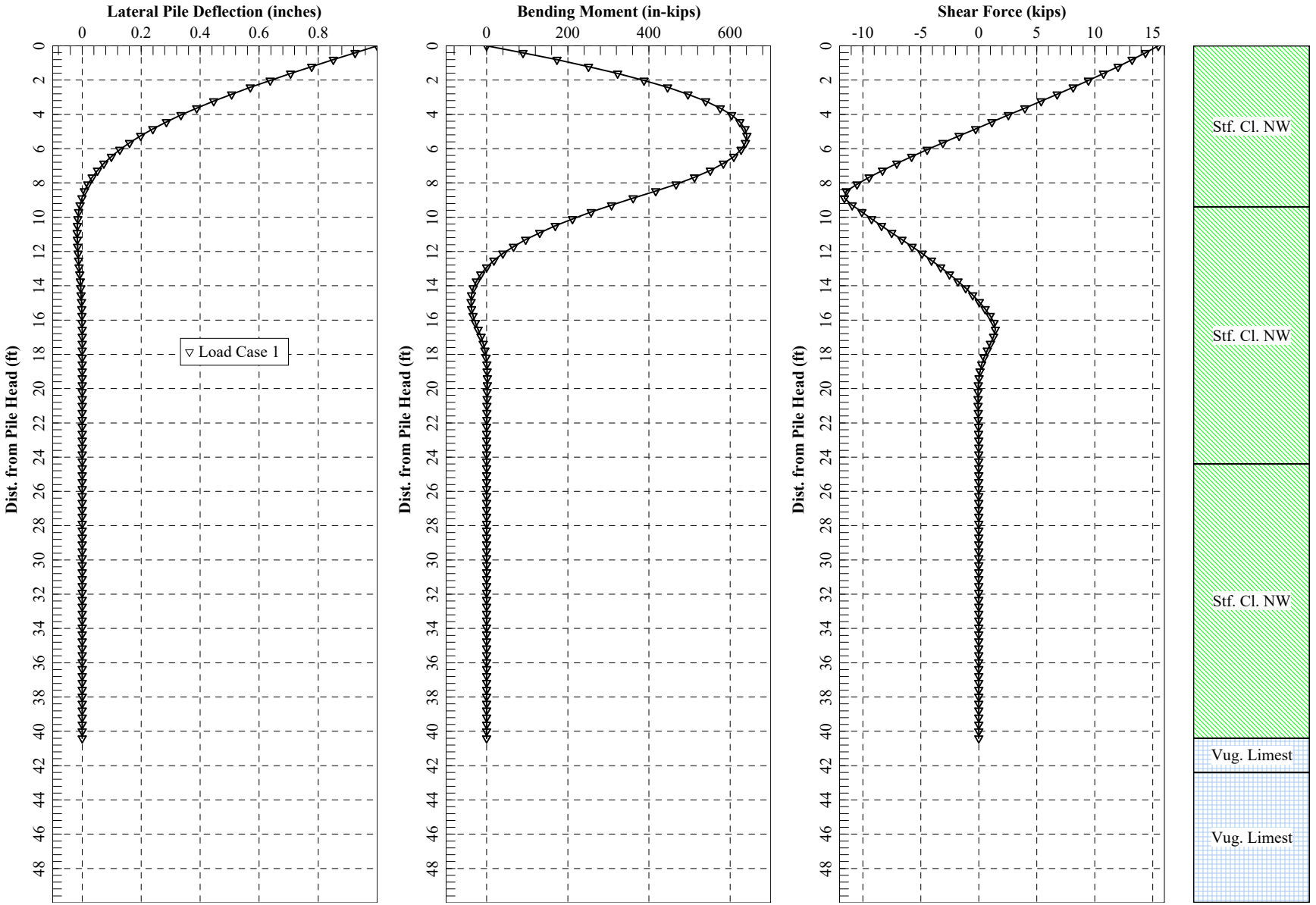
Jacobs	Project:	MoDOT Improve I-70 Columbia to Kingdom City DB	By: ZW	8/22/24
	Job No.:	F3X03001	Ckd:SR	8/28/24
	Subject:	Bridge 2/A9542 - Bent 4	BkCkd:	

Design Soil Profile and Parameters

Soil	Elevation		Unit Weight	N_{60}	Undrained		Drained		ε_{50}	k
	From	To			C	ϕ	C'	ϕ'		
	(ft)	(ft)	(pcf)	(bpf)	(psf)	(deg.)	(psf)	(deg.)		(pci)
CL	680.0	668.0	120	10	1,200	0	0	28	0.007	-
CL	668.0	653.0	120	10	1,000	0	0	28	0.01	-
Shale	653.0	637.0	133	30	3,000	0	0	32	0.005	
Rock	637.0	620.0	164							
(Strong Rock Qu =1,078 ksf =7.5 ksi)										



MoDOT Improve I-70 C2KC- Bridge 2/A9542- Bent 4 - HP Pile Weak Axis - Thermal Movement



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================================================================================

                    LPile for Windows, Version 2022-12.004

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\TPW\GEOTECH\F3X03000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A6951)\LPile\

Name of input data file:
Bent 4 Thermal Movement 1inch HP12X53 Weak Axis.lp12d

Name of output report file:
Bent 4 Thermal Movement 1inch HP12X53 Weak Axis.lp12o

Name of plot output file:
Bent 4 Thermal Movement 1inch HP12X53 Weak Axis.lp12p

Name of runtime message file:
Bent 4 Thermal Movement 1inch HP12X53 Weak Axis.lp12r



--------------------------------------------------------------------------------
                            Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  August 22, 2024            Time:  10:30:11



--------------------------------------------------------------------------------
                                 Problem Title
--------------------------------------------------------------------------------

Project Name: MoDOT Improve I-70  Columbia to Kingdom City DB

Job Number: F3X03001

Client: MoDOT

Engineer:

Description: Bridge 2(A9542) Bent 4 Lateral Analysis - HP12X53 Weak Axis




--------------------------------------------------------------------------------
                          Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed               =          500
 - Deflection tolerance for convergence               =   1.0000E-05 in
 - Maximum allowable deflection                       =     100.0000 in
 - Number of pile increments                          =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified
```

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 40.400 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	12.0000
2	40.400	12.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a H weak axis steel pile
Length of section = 40.400000 ft
Pile width = 11.800000 in

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer = 0.0000 ft
Distance from top of pile to bottom of layer = 9.400000 ft
Effective unit weight at top of layer = 57.600000 pcf
Effective unit weight at bottom of layer = 57.600000 pcf
Undrained cohesion at top of layer = 1200. psf
Undrained cohesion at bottom of layer = 1200. psf
Epsilon-50 at top of layer = 0.007000
Epsilon-50 at bottom of layer = 0.007000

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer = 9.400000 ft
Distance from top of pile to bottom of layer = 24.400000 ft
Effective unit weight at top of layer = 52.600000 pcf
Effective unit weight at bottom of layer = 52.600000 pcf
Undrained cohesion at top of layer = 1000.000000 psf
Undrained cohesion at bottom of layer = 1000.000000 psf
Epsilon-50 at top of layer = 0.010000
Epsilon-50 at bottom of layer = 0.010000

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer = 24.400000 ft
Distance from top of pile to bottom of layer = 40.400000 ft
Effective unit weight at top of layer = 70.600000 pcf
Effective unit weight at bottom of layer = 70.600000 pcf
Undrained cohesion at top of layer = 3000. psf
Undrained cohesion at bottom of layer = 3000. psf

```
   Epsilon-50 at top of layer                          =     0.005000
   Epsilon-50 at bottom of layer                       =     0.005000


Layer 4 is strong rock (vuggy limestone)

   Distance from top of pile to top of layer           =    40.400000 ft
   Distance from top of pile to bottom of layer        =    50.000000 ft
   Effective unit weight at top of layer               =   101.600000 pcf
   Effective unit weight at bottom of layer            =   101.600000 pcf
   Uniaxial compressive strength at top of layer       =        7500. psi
   Uniaxial compressive strength at bottom of layer    =        7500. psi


 (Depth of the lowest soil layer extends 9.600 ft below the pile tip)



--------------------------------------------------------------------------------
                        Summary of Input Soil Properties
--------------------------------------------------------------------------------

Layer         Soil Type          Layer      Effective    Cohesion     Uniaxial        E50
 Num.           Name             Depth       Unit Wt.                    qu           or
          (p-y Curve Type)        ft           pcf          psf         psi          krm
-----   -------------------   ----------   ----------   ----------   ----------   ----------
  1         Stiff Clay              0.00      57.6000        1200.       --         0.00700
          w/o Free Water           9.4000     57.6000        1200.       --         0.00700
  2         Stiff Clay             9.4000      52.6000    1000.0000       --         0.01000
          w/o Free Water          24.4000      52.6000    1000.0000       --         0.01000
  3         Stiff Clay            24.4000      70.6000        3000.       --         0.00500
          w/o Free Water          40.4000      70.6000        3000.       --         0.00500
  4         Strong Rock           40.4000     101.6000        --           7500.       --
         (Vuggy Limestone)        50.0000     101.6000        --           7500.       --


--------------------------------------------------------------------------------
                              Static Loading Type
--------------------------------------------------------------------------------

Static loading criteria were used when computing p-y curves for all analyses.



--------------------------------------------------------------------------------
                Pile-head Loading and Pile-head Fixity Conditions
--------------------------------------------------------------------------------

Number of loads specified = 1

Load    Load         Condition              Condition            Axial Thrust      Compute Top y     Run Analysis
 No.    Type             1                      2                Force, lbs      vs. Pile Length
-----   ----   -------------------   ----------------------   ----------------   ---------------   ------------
   1     4     y =     1.000000 in    M =       0.0000 in-lbs          228470.          N.A.              Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.



--------------------------------------------------------------------------------
     Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
--------------------------------------------------------------------------------

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:
-------------------

Dimensions and Properties of Steel H Weak Axis:
-----------------------------------------------

Length of Section                                  =    40.400000 ft
Flange Width                                       =    12.000000 in
Section Depth                                      =    11.800000 in
Flange Thickness                                   =     0.435000 in
Web Thickness                                      =     0.435000 in
Yield Stress of Pipe                               =    50.000000 ksi
Elastic Modulus                                    =       29000. ksi
Cross-sectional Area                               =    15.194550 sq. in.
Moment of Inertia                                  =   125.354973 in^4
Elastic Bending Stiffness                          =     3635294. kip-in^2
Plastic Modulus, Z                                 =    31.837057in^3
```

Plastic Moment Capacity = Fy Z = 1592.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As = 759.727 kips
Nominal Axial Tensile Capacity = -759.727 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	228.470

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 228.470 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000511	18.5798017	3635033.	107.4403282	15.9167876	
0.00001022	37.1596033	3635033.	56.7201641	16.7972626	
0.00001533	55.7394050	3635033.	39.8134427	17.6777380	
0.00002045	74.3192066	3635033.	31.3600820	18.5582133	
0.00002556	92.8990083	3635033.	26.2880656	19.4386884	
0.00003067	111.4788099	3635033.	22.9067214	20.3191637	
0.00003578	130.0586116	3635033.	20.4914755	21.1996390	
0.00004089	148.6384132	3635033.	18.6800410	22.0801142	
0.00004600	167.2182149	3635033.	17.2711476	22.9605894	
0.00005111	185.7980165	3635033.	16.1440328	23.8410647	
0.00005622	204.3778182	3635033.	15.2218480	24.7215399	
0.00006134	222.9576198	3635033.	14.4533607	25.6020152	
0.00006645	241.5374215	3635033.	13.8031022	26.4824904	
0.00007156	260.1172231	3635033.	13.2457377	27.3629656	
0.00007667	278.6970248	3635033.	12.7626885	28.2434409	
0.00008178	297.2768264	3635033.	12.3400205	29.1239161	
0.00008689	315.8566281	3635033.	11.9670781	30.0043913	
0.00009200	334.4364297	3635033.	11.6355738	30.8848666	
0.00009711	353.0162314	3635033.	11.3389646	31.7653418	
0.0001022	371.5960330	3635033.	11.0720164	32.6458171	
0.0001073	390.1758347	3635033.	10.8304918	33.5262923	
0.0001124	408.7556364	3635033.	10.6109240	34.4067675	
0.0001176	427.3354380	3635033.	10.4104491	35.2872428	
0.0001227	445.9152397	3635033.	10.2266803	36.1677180	
0.0001278	464.4950413	3635033.	10.0576131	37.0481932	
0.0001329	483.0748430	3635033.	9.9015511	37.9286685	
0.0001380	501.6546446	3635033.	9.7570492	38.8091437	
0.0001431	520.2344463	3635033.	9.6228689	39.6896190	
0.0001482	538.8142479	3635033.	9.4979424	40.5700942	
0.0001533	557.3940496	3635033.	9.3813443	41.4505694	
0.0001585	575.9738512	3635033.	9.2722687	42.3310447	
0.0001636	594.5536529	3635033.	9.1700103	43.2115199	
0.0001687	613.1334545	3635033.	9.0739493	44.0919951	
0.0001738	631.7132562	3635033.	8.9835391	44.9724704	
0.0001789	650.2930578	3635033.	8.8982951	45.8529456	
0.0001840	668.8728595	3635033.	8.8177869	46.7334208	
0.0001891	687.4526611	3635033.	8.7416305	47.6138961	
0.0001942	706.0324628	3635033.	8.6694823	48.4943713	
0.0001993	724.6122644	3635033.	8.6010341	49.3748465	
0.0002096	760.8073259	3630431.	8.4759223	50.0000000	Y
0.0002198	794.5565252	3615128.	8.3668342	50.0000000	Y
0.0002300	826.1264736	3591711.	8.2713546	50.0000000	Y
0.0002402	855.7721658	3562276.	8.1874643	50.0000000	Y
0.0002505	883.7366493	3528532.	8.1134575	50.0000000	Y
0.0002607	910.2506632	3491871.	8.0478797	50.0000000	Y
0.0002709	935.5322449	3453426.	7.9894786	50.0000000	Y
0.0002811	959.5615069	3413323.	7.9375948	50.0000000	Y
0.0002913	982.6618358	3372846.	7.8910381	50.0000000	Y
0.0003016	1005.	3331787.	7.8494605	50.0000000	Y
0.0003118	1026.	3290838.	7.8120767	50.0000000	Y
0.0003220	1047.	3250248.	7.7783810	50.0000000	Y
0.0003322	1067.	3210147.	7.7479748	50.0000000	Y
0.0003425	1086.	3170644.	7.7205050	50.0000000	Y
0.0003527	1105.	3131830.	7.6956580	50.0000000	Y
0.0003629	1123.	3093784.	7.6731533	50.0000000	Y
0.0003731	1140.	3056568.	7.6527393	50.0000000	Y
0.0003833	1158.	3020234.	7.6341895	50.0000000	Y
0.0003936	1175.	2984825.	7.6172989	50.0000000	Y
0.0004038	1191.	2949351.	7.6012954	50.0000000	Y
0.0004140	1206.	2913091.	7.5855347	50.0000000	Y
0.0004242	1220.	2876017.	7.5702712	50.0000000	Y
0.0004345	1233.	2838729.	7.5552226	50.0000000	Y

0.0004447	1246.	2801480.	7.5403377	50.0000000	Y
0.0004549	1257.	2764058.	7.5259866	50.0000000	Y
0.0004651	1268.	2727025.	7.5118007	50.0000000	Y
0.0004754	1279.	2689978.	7.4977581	50.0000000	Y
0.0004856	1288.	2653354.	7.4840065	50.0000000	Y
0.0004958	1298.	2617284.	7.4705576	50.0000000	Y
0.0005060	1306.	2581752.	7.4574365	50.0000000	Y
0.0005162	1315.	2546483.	7.4443475	50.0000000	Y
0.0005265	1322.	2511993.	7.4315561	50.0000000	Y
0.0005367	1330.	2478037.	7.4191680	50.0000000	Y
0.0005469	1337.	2444642.	7.4066315	50.0000000	Y
0.0005571	1344.	2411919.	7.3947397	50.0000000	Y
0.0005674	1350.	2379681.	7.3827446	50.0000000	Y
0.0005776	1356.	2348279.	7.3709874	50.0000000	Y
0.0005878	1362.	2317276.	7.3595831	50.0000000	Y
0.0005980	1368.	2287026.	7.3482654	50.0000000	Y
0.0006082	1373.	2257433.	7.3370152	50.0000000	Y
0.0006491	1392.	2144737.	7.2943397	50.0000000	Y
0.0006900	1409.	2041308.	7.2543065	50.0000000	Y
0.0007309	1423.	1946254.	7.2165533	50.0000000	Y
0.0007718	1435.	1858875.	7.1813368	50.0000000	Y
0.0008127	1445.	1778281.	7.1477988	50.0000000	Y
0.0008536	1455.	1704031.	7.1159980	50.0000000	Y
0.0008945	1463.	1635295.	7.0862417	50.0000000	Y
0.0009354	1470.	1571713.	7.0577368	50.0000000	Y
0.0009763	1477.	1512610.	7.0310247	50.0000000	Y
0.0010172	1483.	1457694.	7.0055292	50.0000000	Y
0.0010580	1488.	1406363.	6.9809569	50.0000000	Y
0.0010989	1493.	1358407.	6.9578486	50.0000000	Y
0.0011398	1497.	1313627.	6.9358414	50.0000000	Y
0.0011807	1501.	1271546.	6.9144776	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	228.4700000000	1501.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	62869.
2	9.4000	10.5711	Yes	No	62869.	135482.
3	24.4000	11.2019	Yes	No	198350.	431429.
4	40.4000	40.4000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 1.000000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 228470.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	0.00	15476.	-0.01542	15036.	3.64E+09	-221.583	537.1172	0.00
0.4040	0.9253	89500.	14373.	-0.01536	19320.	3.64E+09	-233.359	1223.	0.00
0.8080	0.8511	173383.	13215.	-0.01518	23335.	3.64E+09	-244.241	1391.	0.00
1.2120	0.7780	251270.	12007.	-0.01490	27063.	3.64E+09	-254.180	1584.	0.00
1.6160	0.7066	322811.	10753.	-0.01452	30487.	3.64E+09	-263.127	1805.	0.00
2.0200	0.6373	387691.	9458.	-0.01404	33593.	3.64E+09	-271.031	2062.	0.00
2.4240	0.5704	445629.	8128.	-0.01349	36366.	3.64E+09	-277.838	2361.	0.00
2.8280	0.5065	496378.	6767.	-0.01286	38795.	3.64E+09	-283.497	2714.	0.00
3.2320	0.4458	539731.	5382.	-0.01217	40870.	3.64E+09	-287.948	3132.	0.00
3.6360	0.3885	575518.	3978.	-0.01143	42583.	3.64E+09	-291.131	3633.	0.00
4.0400	0.3350	603614.	2562.	-0.01064	43928.	3.64E+09	-292.980	4240.	0.00
4.4440	0.2853	623931.	1141.	-0.00982	44900.	3.64E+09	-293.420	4985.	0.00
4.8480	0.2398	636431.	-278.990	-0.00898	45498.	3.64E+09	-292.368	5912.	0.00
5.2520	0.1983	641119.	-1690.	-0.00813	45723.	3.64E+09	-289.722	7084.	0.00
5.6560	0.1609	638050.	-3084.	-0.00727	45576.	3.64E+09	-285.360	8596.	0.00
6.0600	0.1277	627332.	-4452.	-0.00643	45063.	3.64E+09	-279.121	10593.	0.00
6.4640	0.09859	609127.	-5785.	-0.00561	44192.	3.64E+09	-270.786	13315.	0.00
6.8680	0.07338	583658.	-7072.	-0.00481	42973.	3.64E+09	-260.030	17180.	0.00
7.2720	0.05194	551216.	-8299.	-0.00405	41420.	3.64E+09	-246.326	22991.	0.00
7.6760	0.03407	512169.	-9451.	-0.00335	39551.	3.64E+09	-228.715	32548.	0.00
8.0800	0.01950	466991.	-10502.	-0.00269	37388.	3.64E+09	-205.089	50976.	0.00
8.4840	0.00796	416302.	-11409.	-0.00210	34962.	3.64E+09	-168.889	102835.	0.00
8.8880	-8.89E-04	361029.	-11576.	-0.00158	32317.	3.64E+09	99.7575	543940.	0.00
9.2920	-0.00741	307568.	-10910.	-0.00114	29758.	3.64E+09	175.2060	114692.	0.00
9.6960	-0.01193	257770.	-10080.	-7.62E-04	27374.	3.64E+09	167.4012	68004.	0.00
10.1000	-0.01480	211525.	-9245.	-4.49E-04	25161.	3.64E+09	176.6600	57886.	0.00
10.5040	-0.01629	169120.	-8379.	-1.95E-04	23131.	3.64E+09	180.9683	53860.	0.00
10.9080	-0.01669	130719.	-7499.	4.60E-06	21293.	3.64E+09	182.0748	52889.	0.00
11.3120	-0.01624	96404.	-6619.	1.56E-04	19651.	3.64E+09	180.8516	53972.	0.00
11.7160	-0.01518	66197.	-5749.	2.64E-04	18205.	3.64E+09	177.8035	56798.	0.00
12.1200	-0.01368	40071.	-4899.	3.35E-04	16954.	3.64E+09	173.2493	61396.	0.00
12.5240	-0.01193	17958.	-4073.	3.74E-04	15896.	3.64E+09	167.4021	68055.	0.00
12.9280	-0.01005	-247.486	-3278.	3.86E-04	15048.	3.64E+09	160.4070	77350.	0.00
13.3320	-0.00818	-14682.	-2520.	3.76E-04	15739.	3.64E+09	152.3620	90257.	0.00
13.7360	-0.00641	-25514.	-1803.	3.49E-04	16258.	3.64E+09	143.3268	108418.	0.00
14.1400	-0.00480	-32940.	-1133.	3.10E-04	16613.	3.64E+09	133.3245	134683.	0.00
14.5440	-0.00340	-37184.	-512.959	2.63E-04	16816.	3.64E+09	122.3336	174322.	0.00
14.9480	-0.00225	-38497.	50.8521	2.13E-04	16879.	3.64E+09	110.2616	238034.	0.00
15.3520	-0.00134	-37162.	552.9340	1.62E-04	16815.	3.64E+09	96.8679	350957.	0.00
15.7560	-6.71E-04	-33496.	985.2943	1.15E-04	16640.	3.64E+09	81.4986	589008.	0.00
16.1600	-2.20E-04	-27864.	1323.	7.44E-05	16370.	3.64E+09	57.8294	1273958.	0.00
16.5640	5.05E-05	-20832.	1431.	4.19E-05	16033.	3.64E+09	-13.270	1273958.	0.00
16.9680	1.86E-04	-14082.	1280.	1.86E-05	15710.	3.64E+09	-48.974	1273958.	0.00
17.3720	2.31E-04	-8461.	1014.	3.60E-06	15441.	3.64E+09	-60.752	1273958.	0.00
17.7760	2.21E-04	-4256.	725.9522	-4.88E-06	15240.	3.64E+09	-58.154	1273958.	0.00
18.1800	1.84E-04	-1412.	467.8501	-8.66E-06	15104.	3.64E+09	-48.324	1273958.	0.00
18.5840	1.37E-04	299.1748	263.2179	-9.40E-06	15051.	3.64E+09	-36.095	1273958.	0.00
18.9880	9.28E-05	1161.	116.6376	-8.43E-06	15092.	3.64E+09	-24.375	1273958.	0.00
19.3920	5.57E-05	1449.	22.0943	-6.69E-06	15106.	3.64E+09	-14.628	1273958.	0.00
19.7960	2.79E-05	1390.	-31.161	-4.79E-06	15103.	3.64E+09	-7.342	1273958.	0.00
20.2000	9.20E-06	1157.	-54.822	-3.09E-06	15092.	3.64E+09	-2.419	1273958.	0.00
20.6040	-2.05E-06	865.5989	-59.380	-1.74E-06	15078.	3.64E+09	0.5384	1273958.	0.00
21.0080	-7.71E-06	585.3420	-53.167	-7.77E-07	15064.	3.64E+09	2.0249	1273958.	0.00
21.4120	-9.58E-06	351.8123	-42.158	-1.52E-07	15053.	3.64E+09	2.5169	1273958.	0.00
21.8160	-9.18E-06	176.9182	-30.212	2.01E-07	15045.	3.64E+09	2.4111	1273958.	0.00
22.2200	-7.63E-06	58.4321	-19.508	3.58E-07	15039.	3.64E+09	2.0048	1273958.	0.00
22.6240	-5.70E-06	-13.022	-11.014	3.88E-07	15037.	3.64E+09	1.4992	1273958.	0.00
23.0280	-3.86E-06	-49.221	-4.918	3.47E-07	15039.	3.64E+09	1.0156	1273958.	0.00
23.4320	-2.34E-06	-61.478	-0.964	2.73E-07	15039.	3.64E+09	0.6158	1273958.	0.00
23.8360	-1.22E-06	-59.171	1.3052	1.92E-07	15039.	3.64E+09	0.3203	1273958.	0.00
24.2400	-4.77E-07	-49.248	2.3857	1.20E-07	15039.	3.64E+09	0.1254	1273958.	0.00
24.6440	-5.41E-08	-36.305	2.8118	6.31E-08	15038.	3.64E+09	0.05032	4510453.	0.00
25.0480	1.34E-07	-22.125	2.6283	2.41E-08	15037.	3.64E+09	-0.126	4545000.	0.00
25.4520	1.80E-07	-10.875	1.9141	2.12E-09	15037.	3.64E+09	-0.169	4545000.	0.00
25.8560	1.55E-07	-3.571	1.1531	-7.51E-09	15036.	3.64E+09	-0.145	4545000.	0.00
26.2600	1.07E-07	0.3225	0.5577	-9.68E-09	15036.	3.64E+09	-0.100	4545000.	0.00
26.6640	6.12E-08	1.8574	0.1755	-8.22E-09	15036.	3.64E+09	-0.05733	4545000.	0.00
27.0680	2.73E-08	2.0421	-0.02551	-5.62E-09	15036.	3.64E+09	-0.02558	4545000.	0.00
27.4720	6.63E-09	1.6225	-0.103	-3.18E-09	15036.	3.64E+09	-0.00621	4545000.	0.00
27.8760	-3.54E-09	1.0544	-0.110	-1.39E-09	15036.	3.64E+09	0.00332	4545000.	0.00
28.2800	-6.90E-09	0.5629	-0.08588	-3.16E-10	15036.	3.64E+09	0.00647	4545000.	0.00
28.6840	-6.61E-09	0.2225	-0.05518	2.07E-10	15036.	3.64E+09	0.00620	4545000.	0.00
29.0880	-4.89E-09	0.02737	-0.02906	3.74E-10	15036.	3.64E+09	0.00458	4545000.	0.00
29.4920	-2.98E-09	-0.06011	-0.01117	3.52E-10	15036.	3.64E+09	0.00280	4545000.	0.00
29.8960	-1.47E-09	-0.08176	-0.00105	2.58E-10	15036.	3.64E+09	0.00138	4545000.	0.00
30.3000	-4.87E-10	-0.07086	0.00340	1.56E-10	15036.	3.64E+09	4.57E-04	4545000.	0.00
30.7040	3.92E-11	-0.04913	0.00442	7.58E-11	15036.	3.64E+09	-3.67E-05	4545000.	0.00
31.1080	2.48E-10	-0.02819	0.00377	2.42E-11	15036.	3.64E+09	-2.32E-04	4545000.	0.00
31.5120	2.74E-10	-0.01266	0.00258	-3.04E-12	15036.	3.64E+09	-2.57E-04	4545000.	0.00
31.9160	2.18E-10	-0.00316	0.00146	-1.36E-11	15036.	3.64E+09	-2.05E-04	4545000.	0.00
32.3200	1.42E-10	0.00155	6.44E-04	-1.47E-11	15036.	3.64E+09	-1.33E-04	4545000.	0.00
32.7240	7.61E-11	0.00312	1.49E-04	-1.15E-11	15036.	3.64E+09	-7.13E-05	4545000.	0.00
33.1280	3.02E-11	0.00302	-9.30E-05	-7.44E-12	15036.	3.64E+09	-2.83E-05	4545000.	0.00
33.5320	3.88E-12	0.00224	-1.70E-04	-3.94E-12	15036.	3.64E+09	-3.64E-06	4545000.	0.00
33.9360	-7.97E-12	0.00137	-1.61E-04	-1.53E-12	15036.	3.64E+09	7.48E-06	4545000.	0.00
34.3400	-1.09E-11	6.81E-04	-1.18E-04	0.00	15036.	3.64E+09	1.03E-05	4545000.	0.00

34.7440	-9.52E-12	2.28E-04	-7.16E-05	0.00	15036.	3.64E+09	8.93E-06	4545000.	0.00
35.1480	-6.62E-12	-1.45E-05	-3.49E-05	0.00	15036.	3.64E+09	6.20E-06	4545000.	0.00
35.5520	-3.81E-12	-1.12E-04	-1.13E-05	0.00	15036.	3.64E+09	3.57E-06	4545000.	0.00
35.9560	-1.72E-12	-1.25E-04	1.29E-06	0.00	15036.	3.64E+09	1.61E-06	4545000.	0.00
36.3600	0.00	-9.99E-05	6.18E-06	0.00	15036.	3.64E+09	4.06E-07	4545000.	0.00
36.7640	0.00	-6.53E-05	6.70E-06	0.00	15036.	3.64E+09	-1.90E-07	4545000.	0.00
37.1680	0.00	-3.51E-05	5.29E-06	0.00	15036.	3.64E+09	-3.92E-07	4545000.	0.00
37.5720	0.00	-1.40E-05	3.42E-06	0.00	15036.	3.64E+09	-3.80E-07	4545000.	0.00
37.9760	0.00	-1.91E-06	1.81E-06	0.00	15036.	3.64E+09	-2.84E-07	4545000.	0.00
38.3800	0.00	3.56E-06	6.98E-07	0.00	15036.	3.64E+09	-1.75E-07	4545000.	0.00
38.7840	0.00	4.90E-06	5.78E-08	0.00	15036.	3.64E+09	-8.87E-08	4545000.	0.00
39.1880	0.00	4.16E-06	-2.34E-07	0.00	15036.	3.64E+09	-3.18E-08	4545000.	0.00
39.5920	0.00	2.65E-06	-3.12E-07	0.00	15036.	3.64E+09	-8.91E-11	4545000.	0.00
39.9960	0.00	1.14E-06	-2.74E-07	0.00	15036.	3.64E+09	1.56E-08	4545000.	0.00
40.4000	0.00	0.00	0.00	0.00	15036.	3.64E+09	9.76E-08	9140500.	0.00

* This analysis computed pile response using nonlinear moment-curvature rela-
  tionships. Values of total stress due to combined axial and bending stresses
  are computed only for elastic sections only and do not equal the actual
  stresses in concrete and steel. Stresses in concrete and steel may be inter-
  polated from the output for nonlinear bending properties relative to the
  magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection = 1.00000000 inches
Computed slope at pile head = -0.0154185 radians
Maximum bending moment = 641119. inch-lbs
Maximum shear force = 15476. lbs
Depth of maximum bending moment = 5.25200000 feet below pile head
Depth of maximum shear force = 0.000000 feet below pile head
Number of iterations = 21
Number of zero deflection points = 9

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	y, in	1.0000	M, in-lb	0.00	228470.	1.0000	-0.01542	15476.	641119.

Maximum pile-head deflection = 1.0000000000 inches
Maximum pile-head rotation = -0.0154184698 radians = -0.883413 deg.

The analysis ended normally.

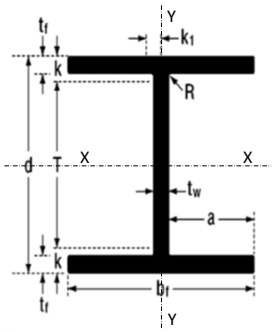
Jacobs

Project: MoDOT Improve I-70 Columbia to Kingdom City DB
Job No.: F3X03001
Subject: Bridge 4/A9543 - Lateral Analysis at Bent 1

By: ZW 10/9/24
Ckd: SR 11/5/2024

Foundation Design Data

Support No.:	*Abutment 1*		Pile Size:	HP12X53		F_y =	50	ksi
Assumed Grade Elev.:	*678.00*	ft	b_f =	12.000	in	Ix =	393	in^4
Top of Pile Elev.:	*678.00*	ft	d=	11.800	in	Iy =	127	in^4
Depth:	0.00	ft	t_f =	0.435	in	J =	1.12	in^4
Design GW El.	678.60	ft	t_w =	0.435	in	Sx =	66.7	in^3
Depth below Pile Top:	-0.60	ft	A =	15.5	in^2	Sy =	21.1	in^3
Approx. Pile Tip El.:	678.6	ft	E =	29,000	ksi	GJ =	12,638	k-in
Approx. Pile Length:	-0.60	ft	G =	11,284	ksi			



Load Information:

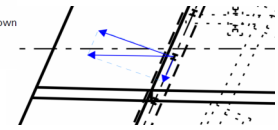
Thermal movement in the bridge longitudinal direction was provided by Structure engineer:

1.04 in

Thermal movement in the HP pile weak axis direction was calculated based on the bent skew angle:

Bent	Skewed Angle (°)	Displ. in Weak Axis in)
Bent 1	22.416944	0.96
Bent 4	22.416944	0.96

Ends Bents (1 & 4) Summary:
- HP12x53 ASTM A709 Grade 50S Spaced at 8.5' = 6 Piles
- Required thermal movement over 120 degrees = 1.04", full temperature range used due to unknown setting temp.
- Required thermal movement over 70 degrees max differential per EPG = 0.607"
- The Maximum Strength Pile Reaction = 240 kips/pile (Service 162.8 kips/ pile)



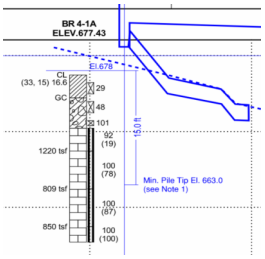
1-inch displacement in the HP weak axis was used for both abutments in the lateral analysis.

P-Multipliers

D = 1 ft

Loading Direction	Number of Rows	Pile Spacing S (ft)	S/D	P-Multiplier* (AASHTO LRFD Table 10.7.2.4-1) Row Number 1	2	3	After 3	Aver.
Longitudinal	1	-	-	1.00	-	-	-	1.00
Transverse	6	8.50	8.50	1.00	0.85	0.70	0.70	0.78

Note: Group reduction factor of 1.0 was used within fresh rock.



Design Soil/Rock Profile and Parameters:

Since higher pile lateral stiffness will induce higher pile internal forces (moment and shear) due to the thermal movement, the boring log where rock was observed at higher elevation was selected to generate the design soil/rock profile.

Design Ground Water El.: 678.6 ft

Reference Borings: BR 2-1A

Depth From (ft)	Depth To (ft)	Soil/Rock	Elevation From (ft)	Elevation To (ft)	Eff. Unit Weight (pcf)	Su (psf)	ϕ' (deg.)	qu (psi)	Modulus , k or E (psi)	RQD	ε_{50}
0.0	3.6	Stiff Clay w/o Free Water	678.0	674.4	57.6	1,200	0	-	-	-	0.007
3.6	7.6	Sand	674.4	670.4	62.6	0	36	-	-	-	-
7.6	28.0	Strong Rock	670.4	650.0	101.6	-	-	7,500	-	-	-

Lateral Analysis

Software: LPILE 2022 developed by ENSOFT, Inc.

Lateral Analysis Results:

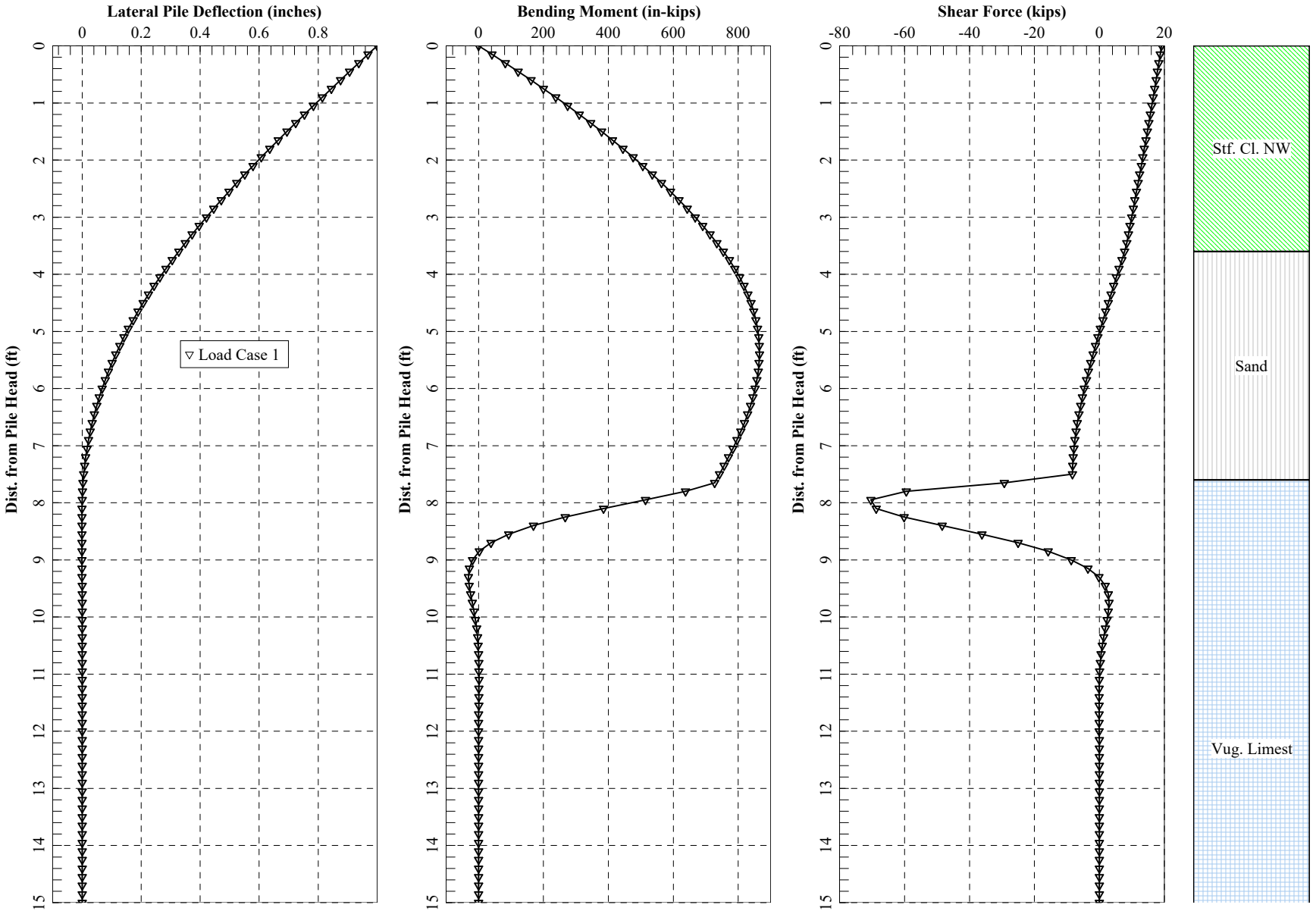
Deflection, Moment, and Shear vs Depth figures are attached.

Structure Engineer should check the pile structural acceptability under the assumed thermal movement.

LPile Analysis Summary at Bent 1 of Bridge 4 (A9543)

Loading Condition No.	Load Case	Axial Load (lb)	P-Mult.	Pile Head Deflect. δ (in)	Max Moment (in-lbs)	Max Shear (lbs)	Pile Head Rotation (rad.)
1	1" Displ. in Weak Axis	240,000	1	1	865,373	-70,333	-0.01733

MoDOT Improve I-70 C2KC- Bridge 4/A9543- Bent 1 - HP12X53 Weak Axis - Thermal Movement



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================================================================================

                    LPile for Windows, Version 2022-12.004

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\TPW\GEOTECH\F3X03000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A6951)\LPile- Bridge 2_A9543\

Name of input data file:
Bent 1 Thermal Movement 1inch HP12X53 Weak Axis.lp12d

Name of output report file:
Bent 1 Thermal Movement 1inch HP12X53 Weak Axis.lp12o

Name of plot output file:
Bent 1 Thermal Movement 1inch HP12X53 Weak Axis.lp12p

Name of runtime message file:
Bent 1 Thermal Movement 1inch HP12X53 Weak Axis.lp12r



--------------------------------------------------------------------------------
                            Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  October 9, 2024             Time:   8:30:04



--------------------------------------------------------------------------------
                                 Problem Title
--------------------------------------------------------------------------------

Project Name: MoDOT Improve I-70  Columbia to Kingdom City DB

Job Number: F3X03001

Client: MoDOT

Engineer:

Description: Bridge 4 (A9543) Bent 1 Lateral Analysis - HP12X53 Weak Axis




--------------------------------------------------------------------------------
                          Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed               =          500
 - Deflection tolerance for convergence               =   1.0000E-05 in
 - Maximum allowable deflection                       =     100.0000 in
 - Number of pile increments                          =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified
```

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 15.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	12.0000
2	15.000	12.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a H weak axis steel pile
Length of section = 15.000000 ft
Pile width = 11.800000 in

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer = 0.0000 ft
Distance from top of pile to bottom of layer = 3.600000 ft
Effective unit weight at top of layer = 57.600000 pcf
Effective unit weight at bottom of layer = 57.600000 pcf
Undrained cohesion at top of layer = 1200. psf
Undrained cohesion at bottom of layer = 1200. psf
Epsilon-50 at top of layer = 0.007000
Epsilon-50 at bottom of layer = 0.007000

Layer 2 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 3.600000 ft
Distance from top of pile to bottom of layer = 7.600000 ft
Effective unit weight at top of layer = 62.600000 pcf
Effective unit weight at bottom of layer = 62.600000 pcf
Friction angle at top of layer = 36.000000 deg.
Friction angle at bottom of layer = 36.000000 deg.
Subgrade k at top of layer = 0.0000 pci
Subgrade k at bottom of layer = 0.0000 pci

NOTE: Default values for subgrade k will be computed for this layer.

Layer 3 is strong rock (vuggy limestone)

Distance from top of pile to top of layer = 7.600000 ft
Distance from top of pile to bottom of layer = 20.000000 ft
Effective unit weight at top of layer = 101.600000 pcf
Effective unit weight at bottom of layer = 101.600000 pcf
Uniaxial compressive strength at top of layer = 7500. psi

Uniaxial compressive strength at bottom of layer = 7500. psi

(Depth of the lowest soil layer extends 5.000 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Cohesion psf	Angle of Friction deg.	Uniaxial qu psi	E50 or krm	kpy pci
1	Stiff Clay w/o Free Water	0.00 3.6000	57.6000 57.6000	1200. 1200.	-- --	-- --	0.00700 0.00700	-- --
2	Sand (Reese, et al.)	3.6000 7.6000	62.6000 62.6000	-- --	36.0000 36.0000	-- --	-- --	default default
3	Strong Rock (Vuggy Limestone)	7.6000 20.0000	101.6000 101.6000	-- --	-- --	7500. 7500.	-- --	-- --

---

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	4	y = 1.000000 in	M = 0.0000 in-lbs	240000.	N.A.	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel H Weak Axis:

Length of Section	=	15.000000 ft
Flange Width	=	12.000000 in
Section Depth	=	11.800000 in
Flange Thickness	=	0.435000 in
Web Thickness	=	0.435000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	15.194550 sq. in.
Moment of Inertia	=	125.354973 in^4
Elastic Bending Stiffness	=	3635294. kip-in^2
Plastic Modulus, Z	=	31.837057in^3
Plastic Moment Capacity = Fy Z	=	1592.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	759.727 kips
Nominal Axial Tensile Capacity	=	-759.727 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	240.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 240.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000506	18.3782855	3635033.	113.7280466	16.6660627	
0.00001011	36.7565710	3635033.	59.8640233	17.5369885	
0.00001517	55.1348565	3635033.	41.9093489	18.4079140	
0.00002022	73.5131420	3635033.	32.9320116	19.2788395	
0.00002528	91.8914275	3635033.	27.5456093	20.1497653	
0.00003034	110.2697130	3635033.	23.9546744	21.0206908	
0.00003539	128.6479986	3635033.	21.3897209	21.8916164	
0.00004045	147.0262841	3635033.	19.4660058	22.7625420	
0.00004550	165.4045696	3635033.	17.9697830	23.6334677	
0.00005056	183.7828551	3635033.	16.7728047	24.5043933	
0.00005561	202.1611406	3635033.	15.7934588	25.3753188	
0.00006067	220.5394261	3635033.	14.9773372	26.2462445	
0.00006573	238.9177116	3635033.	14.2867728	27.1171701	
0.00007078	257.2959971	3635033.	13.6948605	27.9880957	
0.00007584	275.6742826	3635033.	13.1818698	28.8590213	
0.00008089	294.0525681	3635033.	12.7330029	29.7299469	
0.00008595	312.4308536	3635033.	12.3369439	30.6008726	
0.00009101	330.8091391	3635033.	11.9848915	31.4717982	
0.00009606	349.1874246	3635033.	11.6698972	32.3427238	
0.0001011	367.5657102	3635033.	11.3864023	33.2136494	
0.0001062	385.9439957	3635033.	11.1299070	34.0845750	
0.0001112	404.3222812	3635033.	10.8967294	34.9555007	
0.0001163	422.7005667	3635033.	10.6838281	35.8264263	
0.0001213	441.0788522	3635033.	10.4886686	36.6973519	
0.0001264	459.4571377	3635033.	10.3091219	37.5682775	
0.0001315	477.8354232	3635033.	10.1433864	38.4392032	
0.0001365	496.2137087	3635033.	9.9899277	39.3101288	
0.0001416	514.5919942	3635033.	9.8474302	40.1810544	
0.0001466	532.9702797	3635033.	9.7147602	41.0519800	
0.0001517	551.3485652	3635033.	9.5909349	41.9229056	
0.0001567	569.7268507	3635033.	9.4750983	42.7938312	
0.0001618	588.1051362	3635033.	9.3665015	43.6647569	
0.0001668	606.4834218	3635033.	9.2644863	44.5356825	
0.0001719	624.8617073	3635033.	9.1684720	45.4066081	
0.0001770	643.2399928	3635033.	9.0779442	46.2775337	
0.0001820	661.6182783	3635033.	8.9924457	47.1484593	
0.0001871	679.9965638	3635033.	8.9115688	48.0193850	
0.0001921	698.3748493	3635033.	8.8349486	48.8903106	
0.0001972	716.7531348	3635033.	8.7622576	49.7612362	
0.0002073	752.0367129	3627927.	8.6302502	50.0000000	Y
0.0002174	784.8353303	3610052.	8.5150759	50.0000000	Y
0.0002275	815.5575365	3584639.	8.4139555	50.0000000	Y
0.0002376	844.4511734	3553694.	8.3248068	50.0000000	Y
0.0002477	871.7521259	3518846.	8.2458710	50.0000000	Y
0.0002578	897.6414295	3481257.	8.1757301	50.0000000	Y
0.0002680	922.2178179	3441605.	8.1133140	50.0000000	Y
0.0002781	945.7739651	3401168.	8.0573260	50.0000000	Y
0.0002882	968.2328306	3359761.	8.0073031	50.0000000	Y
0.0002983	989.8565340	3318361.	7.9622251	50.0000000	Y
0.0003084	1011.	3277191.	7.9215269	50.0000000	Y
0.0003185	1031.	3236246.	7.8848276	50.0000000	Y
0.0003286	1050.	3195797.	7.8516277	50.0000000	Y
0.0003387	1069.	3156056.	7.8214895	50.0000000	Y
0.0003489	1087.	3117103.	7.7940867	50.0000000	Y
0.0003590	1105.	3079003.	7.7691279	50.0000000	Y
0.0003691	1123.	3041808.	7.7463517	50.0000000	Y
0.0003792	1140.	3005545.	7.7255340	50.0000000	Y
0.0003893	1156.	2970044.	7.7066161	50.0000000	Y
0.0003994	1172.	2935514.	7.6892795	50.0000000	Y
0.0004095	1188.	2901135.	7.6728568	50.0000000	Y
0.0004196	1203.	2866106.	7.6566688	50.0000000	Y
0.0004297	1216.	2830410.	7.6409477	50.0000000	Y
0.0004399	1229.	2794518.	7.6254935	50.0000000	Y
0.0004500	1241.	2758720.	7.6102077	50.0000000	Y
0.0004601	1253.	2722730.	7.5954712	50.0000000	Y
0.0004702	1263.	2686914.	7.5806562	50.0000000	Y
0.0004803	1273.	2651281.	7.5663049	50.0000000	Y
0.0004904	1283.	2616218.	7.5521467	50.0000000	Y
0.0005005	1292.	2581524.	7.5384438	50.0000000	Y
0.0005106	1301.	2547155.	7.5245998	50.0000000	Y
0.0005208	1309.	2513260.	7.5113289	50.0000000	Y
0.0005309	1317.	2480174.	7.4981713	50.0000000	Y
0.0005410	1324.	2447226.	7.4852114	50.0000000	Y
0.0005511	1331.	2415129.	7.4725717	50.0000000	Y
0.0005612	1338.	2383546.	7.4599500	50.0000000	Y

0.0005713	1344.	2352441.	7.4477790	50.0000000	Y
0.0005814	1350.	2322066.	7.4357063	50.0000000	Y
0.0005915	1356.	2292210.	7.4237052	50.0000000	Y
0.0006016	1361.	2262940.	7.4121962	50.0000000	Y
0.0006421	1382.	2151564.	7.3672950	50.0000000	Y
0.0006825	1399.	2049015.	7.3251642	50.0000000	Y
0.0007230	1413.	1954746.	7.2856742	50.0000000	Y
0.0007634	1426.	1867809.	7.2481910	50.0000000	Y
0.0008039	1437.	1787598.	7.2130534	50.0000000	Y
0.0008443	1447.	1713568.	7.1798275	50.0000000	Y
0.0008848	1456.	1645069.	7.1482972	50.0000000	Y
0.0009252	1463.	1581503.	7.1184898	50.0000000	Y
0.0009657	1470.	1522442.	7.0901388	50.0000000	Y
0.0010061	1476.	1467493.	7.0631093	50.0000000	Y
0.0010466	1482.	1416208.	7.0377124	50.0000000	Y
0.0010870	1487.	1368240.	7.0132261	50.0000000	Y
0.0011275	1492.	1323306.	6.9896602	50.0000000	Y
0.0011679	1496.	1281178.	6.9676777	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	240.0000000000	1496.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	17221.
2	3.6000	6.0752	No	No	17221.	51218.
3	7.6000	7.6000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 1.000000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 240000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	0.00	19096.	-0.01733	15795.	3.64E+09	-221.583	199.4247	0.00
0.1500	0.9688	41501.	18694.	-0.01732	17782.	3.64E+09	-225.858	419.6345	0.00
0.3000	0.9376	82262.	18283.	-0.01729	19733.	3.64E+09	-229.994	441.5191	0.00
0.4500	0.9066	122260.	17866.	-0.01724	21647.	3.64E+09	-233.988	464.5881	0.00
0.6000	0.8756	161474.	17441.	-0.01717	23524.	3.64E+09	-237.836	488.9347	0.00
0.7500	0.8448	199882.	17010.	-0.01708	25362.	3.64E+09	-241.535	514.6609	0.00
0.9000	0.8141	237466.	16572.	-0.01697	27161.	3.64E+09	-245.080	541.8787	0.00
1.0500	0.7837	274204.	16128.	-0.01684	28920.	3.64E+09	-248.469	570.7114	0.00
1.2000	0.7535	310079.	15678.	-0.01670	30637.	3.64E+09	-251.697	601.2950	0.00

1.3500	0.7235	345072.	15222.	-0.01654	32312.	3.64E+09	-254.759	633.7799	0.00
1.5000	0.6939	379165.	14761.	-0.01636	33944.	3.64E+09	-257.653	668.3324	0.00
1.6500	0.6647	412343.	14294.	-0.01616	35532.	3.64E+09	-260.373	705.1373	0.00
1.8000	0.6357	444589.	13823.	-0.01595	37075.	3.64E+09	-262.916	744.4003	0.00
1.9500	0.6072	475888.	13348.	-0.01572	38573.	3.64E+09	-265.277	786.3506	0.00
2.1000	0.5791	506225.	12869.	-0.01548	40025.	3.64E+09	-267.451	831.2445	0.00
2.2500	0.5515	535588.	12385.	-0.01522	41431.	3.64E+09	-269.434	879.3697	0.00
2.4000	0.5244	563963.	11899.	-0.01495	42789.	3.64E+09	-271.221	931.0491	0.00
2.5500	0.4977	591339.	11409.	-0.01466	44099.	3.64E+09	-272.805	986.6474	0.00
2.7000	0.4716	617705.	10917.	-0.01436	45361.	3.64E+09	-274.183	1047.	0.00
2.8500	0.4460	643050.	10422.	-0.01405	46574.	3.64E+09	-275.349	1111.	0.00
3.0000	0.4210	667365.	9926.	-0.01373	47738.	3.64E+09	-276.296	1181.	0.00
3.1500	0.3966	690642.	9428.	-0.01339	48852.	3.64E+09	-277.019	1257.	0.00
3.3000	0.3728	712874.	8929.	-0.01304	49916.	3.64E+09	-277.511	1340.	0.00
3.4500	0.3496	734055.	8429.	-0.01268	50930.	3.63E+09	-277.765	1430.	0.00
3.6000	0.3271	754178.	7755.	-0.01232	51893.	3.63E+09	-470.974	2592.	0.00
3.7500	0.3053	772614.	6908.	-0.01194	52776.	3.62E+09	-470.727	2775.	0.00
3.9000	0.2841	789358.	6061.	-0.01155	53577.	3.61E+09	-469.478	2974.	0.00
4.0500	0.2637	804411.	5218.	-0.01115	54298.	3.59E+09	-467.290	3190.	0.00
4.2000	0.2440	817776.	4380.	-0.01074	54937.	3.58E+09	-464.231	3425.	0.00
4.3500	0.2250	829459.	3548.	-0.01033	55496.	3.57E+09	-460.374	3682.	0.00
4.5000	0.2068	839470.	2723.	-0.00991	55976.	3.56E+09	-455.799	3967.	0.00
4.6500	0.1894	847821.	1908.	-0.00948	56375.	3.55E+09	-450.429	4281.	0.00
4.8000	0.1727	854527.	1103.	-0.00905	56696.	3.54E+09	-443.686	4624.	0.00
4.9500	0.1568	859607.	311.6515	-0.00861	56939.	3.53E+09	-435.505	4999.	0.00
5.1000	0.1417	863087.	-463.601	-0.00817	57106.	3.53E+09	-425.887	5409.	0.00
5.2500	0.1274	864998.	-1220.	-0.00773	57197.	3.53E+09	-414.840	5861.	0.00
5.4000	0.1139	865373.	-1956.	-0.00729	57215.	3.53E+09	-402.376	6359.	0.00
5.5500	0.1012	864254.	-2668.	-0.00685	57162.	3.53E+09	-388.511	6912.	0.00
5.7000	0.08924	861686.	-3353.	-0.00641	57039.	3.53E+09	-373.267	7529.	0.00
5.8500	0.07810	857718.	-4010.	-0.00597	56849.	3.54E+09	-356.674	8220.	0.00
6.0000	0.06775	852406.	-4636.	-0.00553	56595.	3.54E+09	-338.764	9000.	0.00
6.1500	0.05818	845810.	-5228.	-0.00510	56279.	3.55E+09	-319.579	9887.	0.00
6.3000	0.04938	837993.	-5785.	-0.00468	55905.	3.56E+09	-299.165	10905.	0.00
6.4500	0.04134	829024.	-6304.	-0.00426	55476.	3.57E+09	-277.579	12085.	0.00
6.6000	0.03406	818975.	-6784.	-0.00384	54995.	3.58E+09	-254.886	13471.	0.00
6.7500	0.02751	807922.	-7207.	-0.00343	54466.	3.59E+09	-215.227	14081.	0.00
6.9000	0.02170	795997.	-7557.	-0.00303	53895.	3.60E+09	-173.509	14393.	0.00
7.0500	0.01660	783338.	-7835.	-0.00264	53289.	3.61E+09	-135.621	14706.	0.00
7.2000	0.01220	770070.	-8049.	-0.00225	52654.	3.62E+09	-101.825	15019.	0.00
7.3500	0.00850	756307.	-8205.	-0.00187	51995.	3.63E+09	-72.375	15332.	0.00
7.5000	0.00547	742148.	-8313.	-0.00150	51317.	3.63E+09	-47.510	15645.	0.00
7.6500	0.00310	727676.	-29268.	-0.00114	50625.	3.63E+09	-23235.	1.35E+07	0.00
7.8000	0.00138	637766.	-59486.	-7.97E-04	46321.	3.64E+09	-10341.	1.35E+07	0.00
7.9500	2.28E-04	514213.	-70333.	-5.12E-04	40407.	3.64E+09	-1711.	1.35E+07	0.00
8.1000	-4.64E-04	385008.	-68739.	-2.89E-04	34223.	3.64E+09	3482.	1.35E+07	0.00
8.2500	-8.13E-04	267001.	-60115.	-1.28E-04	28575.	3.64E+09	6101.	1.35E+07	0.00
8.4000	-9.25E-04	168705.	-48382.	-2.00E-05	23870.	3.64E+09	6935.	1.35E+07	0.00
8.5500	-8.86E-04	92843.	-36163.	4.47E-05	20239.	3.64E+09	6642.	1.35E+07	0.00
8.7000	-7.64E-04	38480.	-25030.	7.72E-05	17637.	3.64E+09	5728.	1.35E+07	0.00
8.8500	-6.07E-04	2667.	-15775.	8.74E-05	15923.	3.64E+09	4556.	1.35E+07	0.00
9.0000	-4.49E-04	-18385.	-8644.	8.35E-05	16675.	3.64E+09	3367.	1.35E+07	0.00
9.1500	-3.07E-04	-28525.	-3544.	7.19E-05	17160.	3.64E+09	2300.	1.35E+07	0.00
9.3000	-1.90E-04	-31205.	-191.084	5.71E-05	17289.	3.64E+09	1425.	1.35E+07	0.00
9.4500	-1.01E-04	-29262.	1773.	4.22E-05	17196.	3.64E+09	757.7397	1.35E+07	0.00
9.6000	-3.82E-05	-24858.	2713.	2.88E-05	16985.	3.64E+09	286.2908	1.35E+07	0.00
9.7500	2.53E-06	-19521.	2953.	1.78E-05	16729.	3.64E+09	-18.982	1.35E+07	0.00
9.9000	2.58E-05	-14241.	2762.	9.42E-06	16477.	3.64E+09	-193.758	1.35E+07	0.00
10.0500	3.64E-05	-9586.	2342.	3.52E-06	16254.	3.64E+09	-273.331	1.35E+07	0.00
10.2000	3.85E-05	-5815.	1836.	-2.92E-07	16073.	3.64E+09	-288.821	1.35E+07	0.00
10.3500	3.54E-05	-2978.	1337.	-2.47E-06	15938.	3.64E+09	-265.440	1.35E+07	0.00
10.5000	2.96E-05	-1000.	897.9618	-3.45E-06	15843.	3.64E+09	-222.153	1.35E+07	0.00
10.6500	2.30E-05	257.9365	543.0620	-3.64E-06	15807.	3.64E+09	-172.180	1.35E+07	0.00
10.8000	1.65E-05	958.0601	276.5611	-3.34E-06	15841.	3.64E+09	-123.932	1.35E+07	0.00
10.9500	1.09E-05	1256.	91.1431	-2.79E-06	15855.	3.64E+09	-82.088	1.35E+07	0.00
11.1000	6.49E-06	1289.	-26.515	-2.16E-06	15857.	3.64E+09	-48.644	1.35E+07	0.00
11.2500	3.18E-06	1163.	-91.727	-1.55E-06	15851.	3.64E+09	-23.813	1.35E+07	0.00
11.4000	9.01E-07	959.7090	-119.239	-1.03E-06	15841.	3.64E+09	-6.756	1.35E+07	0.00
11.5500	-5.18E-07	734.4737	-121.823	-6.06E-07	15830.	3.64E+09	3.8849	1.35E+07	0.00
11.7000	-1.28E-06	521.6683	-109.673	-2.95E-07	15820.	3.64E+09	9.6162	1.35E+07	0.00
11.8500	-1.58E-06	339.9079	-90.344	-8.21E-08	15811.	3.64E+09	11.8602	1.35E+07	0.00
12.0000	-1.58E-06	196.5017	-69.021	5.07E-08	15805.	3.64E+09	11.8319	1.35E+07	0.00
12.1500	-1.40E-06	91.3889	-48.931	1.22E-07	15800.	3.64E+09	10.4900	1.35E+07	0.00
12.3000	-1.14E-06	20.2443	-31.807	1.50E-07	15796.	3.64E+09	8.5372	1.35E+07	0.00
12.4500	-8.60E-07	-23.244	-18.319	1.49E-07	15796.	3.64E+09	6.4491	1.35E+07	0.00
12.6000	-6.02E-07	-45.832	-8.450	1.32E-07	15797.	3.64E+09	4.5163	1.35E+07	0.00
12.7500	-3.85E-07	-53.778	-1.784	1.07E-07	15798.	3.64E+09	2.8900	1.35E+07	0.00
12.9000	-2.16E-07	-52.349	2.2775	8.09E-08	15798.	3.64E+09	1.6231	1.35E+07	0.00
13.0500	-9.42E-08	-45.649	4.3738	5.66E-08	15797.	3.64E+09	0.7062	1.35E+07	0.00
13.2000	-1.26E-08	-36.652	5.0944	3.62E-08	15797.	3.64E+09	0.09443	1.35E+07	0.00
13.3500	3.63E-08	-27.341	4.9343	2.04E-08	15796.	3.64E+09	-0.272	1.35E+07	0.00
13.5000	6.08E-08	-18.906	4.2786	8.95E-09	15796.	3.64E+09	-0.456	1.35E+07	0.00
13.6500	6.85E-08	-11.945	3.4054	1.31E-09	15796.	3.64E+09	-0.514	1.35E+07	0.00
13.8000	6.55E-08	-6.647	2.5005	-3.30E-09	15795.	3.64E+09	-0.492	1.35E+07	0.00
13.9500	5.67E-08	-2.941	1.6757	-5.67E-09	15795.	3.64E+09	-0.425	1.35E+07	0.00
14.1000	4.51E-08	-0.610	0.9886	-6.55E-09	15795.	3.64E+09	-0.339	1.35E+07	0.00
14.2500	3.31E-08	0.6238	0.4606	-6.55E-09	15795.	3.64E+09	-0.248	1.35E+07	0.00
14.4000	2.16E-08	1.0538	0.09171	-6.13E-09	15795.	3.64E+09	-0.162	1.35E+07	0.00
14.5500	1.10E-08	0.9592	-0.128	-5.63E-09	15795.	3.64E+09	-0.08259	1.35E+07	0.00
14.7000	1.30E-09	0.5969	-0.211	-5.25E-09	15795.	3.64E+09	-0.00977	1.35E+07	0.00
14.8500	-7.87E-09	0.2028	-0.167	-5.05E-09	15795.	3.64E+09	0.05905	1.35E+07	0.00

```
   15.0000  -1.69E-08       0.00       0.00  -5.00E-09     15795.   3.64E+09     0.1265   6750000.       0.00

* This analysis computed pile response using nonlinear moment-curvature rela-
  tionships. Values of total stress due to combined axial and bending stresses
  are computed only for elastic sections only and do not equal the actual
  stresses in concrete and steel. Stresses in concrete and steel may be inter-
  polated from the output for nonlinear bending properties relative to the
  magnitude of bending moment developed in the pile.


Output Summary for Load Case No. 1:

Pile-head deflection             =     1.00000000 inches
Computed slope at pile head      =     -0.0173304 radians
Maximum bending moment           =        865373. inch-lbs
Maximum shear force              =        -70333. lbs
Depth of maximum bending moment  =     5.40000000 feet below pile head
Depth of maximum shear force     =     7.95000000 feet below pile head
Number of iterations             =              9
Number of zero deflection points =              5


--------------------------------------------------------------------------------
            Summary of Pile-head Responses for Conventional Analyses
--------------------------------------------------------------------------------

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians


Load Load                Load                  Axial    Pile-head  Pile-head  Max Shear Max Moment
Case Type   Pile-head    Type     Pile-head   Loading  Deflection  Rotation    in Pile    in Pile
 No.  1      Load 1       2        Load 2       lbs      inches     radians      lbs      in-lbs
---- ----- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
  1  y, in     1.0000  M, in-lb        0.00    240000.     1.0000   -0.01733    -70333.    865373.


Maximum pile-head deflection = 1.0000000000 inches
Maximum pile-head rotation   = -0.0173304315 radians = -0.992961 deg.

--------------------------------------------------------------------------------
                           Summary of Warning Messages
--------------------------------------------------------------------------------

The following warning was reported 500 times


**** Warning ****

This warning is for an input value for uniaxial compressive strength that
has been specified for a soil defined using the vuggy limestone criteria.
The input value is outside of the range of 1,000 to 2,500 psi
(6,895 to 17,237 kPa) which were used in actual field tests
on which this theory is based. Higher or lower values may be applicable
but the user is warned about the theoretical and testing limitations.


The analysis ended normally.
```

Foundation Design Data

Support No.: **Bent 2**

General Information:

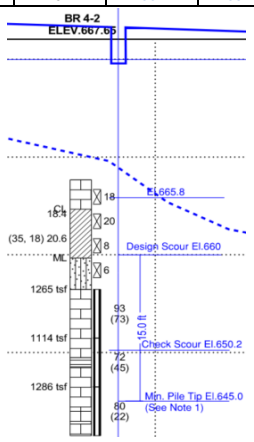
	North	South	Average	
Bottom of Pile Cap El.:			677.20	ft
Assumed Grade Elev.:			665.80	ft
Design Scour Depth:			5.80	ft
El.:			660.00	ft
Min. Pile Length below Scour Depth:			15.00	ft
El.:			645.00	ft
Top of Rock El.:			656.50	ft
Rock Type:			Limestone	
Min. Embd. into Rock:			5	ft
Min. Pile Tip El by Rock Embd.:			651.50	ft
Min Design Pile Tip El:			**645.00**	
Min. Pile Length:			32.20	ft
Design GW El.:			678.60	ft
Depth below Top of Pile:			-1.40	ft
Exposed Pile Length to Scour Depth:			17.20	ft

Scour Information for Bridge 4/A9543

Location	Ground El.	Scour Depth (ft)		Scour Elev. (ft)	
	(ft)	Design Flood	Check Flood	Design Flood	Check Flood
Bent 2	665.8	5.8	15.6	660	650.2
Bent 3	667.4	5.4	15.2	662	652.2

Section 751.1.2.22 MoDOT EPG

100-year Flood Level



Pile Data:

Pile:	24X0.500		Class B-1 Concrete,	fc'=	4,000	psi
F_y =	45	ksi	Pile Structural Axial Resistance Factor:	ϕ_c =	0.6	
E =	29,000	ksi	Max Nominal Driving Resistance:	R_{ndr} =	1,305	k
OD =	24	in	Preli. Structural Nominal Axial Design Capacity:	PNDC = F_yA_s =	1,450	k
Wall Thick. =	0.500	in	Preli. Factored Axial Design Capacity:	PFDC = ϕc xPNDC =	870	k
ID =	23.00	in				
As (No Corrosion) =	32.21	in^2				

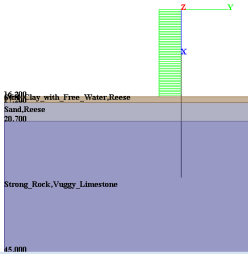
Load Information:

Load Case	At Top of Pile		Stream Pressure, WA				Wind on substructure, WS				Max (WA+WS)
	Axial	Lateral Load	Load	Load	From	To	Load	Load	From	To	
	(k)	(k)	(klf)	(lbs/in)	(ft	(ft)	(klf)	(lbs/in)	(ft	(ft)	(lbs/in)
Ser I	320.75	4.2	0.071	5.88	0.00	17.20	0.040	3.33	0	17.20	9.22
Str I	502.9	4.8	0.074	6.13	0.00	17.20	0.000	0.00	0	17.20	6.13
Str III	237.4	4.47	0.074	6.13	0.00	17.20	0.114	9.50	0	17.20	15.63
Str V	442.2	5.86	0.074	6.13	0.00	17.20	0.055	4.58	0	17.20	10.71

P-Multipliers D = 2 ft

Loading Direction	Number of Rows	Pile Spacing S	S/D	P-Multiplier* (AASHTO LRFD Table 10.7.2.4-1)				
				Row Number				Aver.
		(ft)		1	2	3	After 3	
Longitudinal	1	-	-	0.93	-	-	-	0.93
Transverse	6	8.50	4.25	0.93	0.68	0.55	0.55	0.63

Note: Group reduction factor of 1.0 was used within fresh rock.



Lateral Analysis

Software: LPILE 2022 developed by ENSOFT, Inc.

Pile Geometry for Analysis:

Top of Pile El.: 677.20 ft
Min. Pile Tip El.: 645.00 ft
Design Scour El.: 660.00 ft
Min. Pile Length: 32.20 ft
(Design Flood for Strength Limit)

Design Soil Profile and Parameters:

Reference Borings: BR 4-2
Design Ground Water El.: 678.60 ft

Depth		Soil/Rock	Elevation		Eff. Unit Weight	Su	ϕ'	qu	Modulus , k or E	RQD	ε_{50}
From	To		From	To							
(ft)	(ft)		(ft)	(ft)	(pcf)	(psf)	(deg.)	(psi)	(psi)		
17.2	17.2	Stiff Clay w/ Free Water	660.0	660.0	62.6	1,200	0	-	-	-	0.007
17.2	20.7	Sand (Reese)	660.0	656.5	47.6	0	28	-	-	-	-
20.7	37.2	Strong Rock	656.5	640.0	101.6	-	-	7,500	-	-	-
			(Strong Rock Qu =1,078 ksf =7.5 ksi, use 2,000 psi per LPile's limit)								

Lateral Analysis Results:

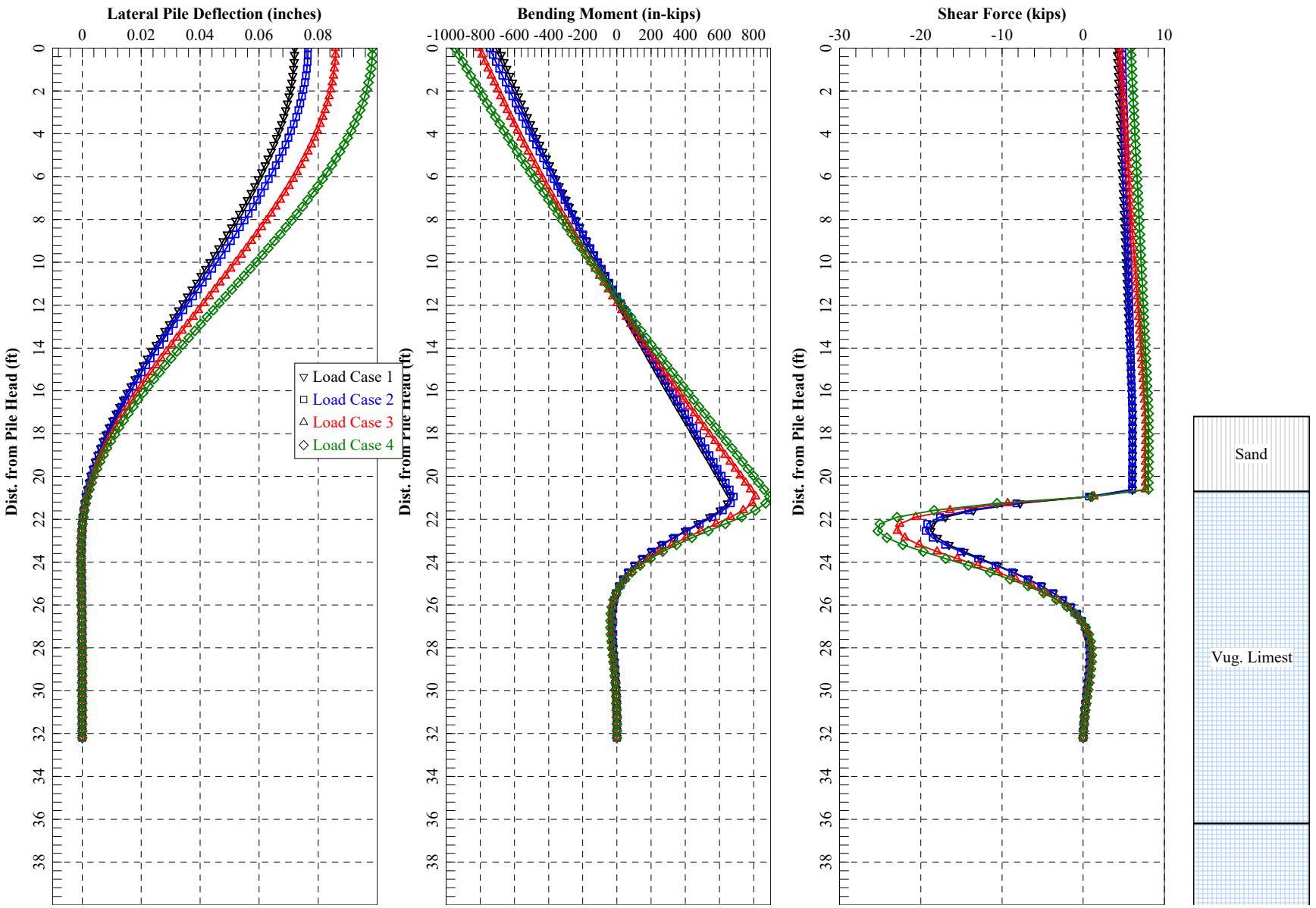
LPile Analysis Summary at Bent 2 of Bridge 4 (A9543)

Load Comb.	Case in LPile	Lat.	Moment	Axial	Pmult.	Head Fixity	Pile Head	Max Moment	Max Shear	Pile Head Rotation
		(lbs)	(lbs-in)	(lbs)			δ (in)	(in-lbs)	(lbs)	(rad.)
Ser I	1	4,200	-	320,750	0.63	Fixed	0.072	-694,283	-18,756	0.00E+00
Str I	2	4,800	-	502,900	0.63	Fixed	0.077	-745,722	-19,389	0.00E+00
Str III	3	4,470	-	237,400	0.63	Fixed	0.086	811,509	-22,887	0.00E+00
Str V	4	5,860	-	442,200	0.63	Fixed	0.098	-947,893	-25,274	0.00E+00

Deflection, Moment, and Shear vs Depth figures are attached.

Structure Engineer should check the pile structural acceptability for the analyzed load combinations.

MoDOT Improve I-70 C2KC- Bridge 4/A9543- Bent 2 - CIP24X0.5in



==

LPile for Windows, Version 2022-12.004

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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Files Used for Analysis

Path to file locations:
\TPW\GEOTECH\F3X03000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A6951)\LPile- Bridge 2_A9543\

Name of input data file:
Bridge 4 Bent 2 24X0.5in CIP.lp12d

Name of output report file:
Bridge 4 Bent 2 24X0.5in CIP.lp12o

Name of plot output file:
Bridge 4 Bent 2 24X0.5in CIP.lp12p

Name of runtime message file:
Bridge 4 Bent 2 24X0.5in CIP.lp12r

Date and Time of Analysis

Date: October 16, 2024 Time: 16:15:37

Problem Title

Project Name: MoDOT Improve I-70 Columbia to Kingdom City DB

Job Number: F3X03001

Client: MoDOT

Engineer:

Description: Bridge 4 (A9543) Bent 2 Lateral Analysis - CECIP 24X0.5

Program Options and Settings

Computational Options:
- Conventional Analysis

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	100

Loading Type and Number of Cycles of Loading:
- Static loading specified

 - Analysis uses p-y modification factors for p-y curves
 - Analysis uses layering correction (Method of Georgiadis)
 - Analysis includes loading by multiple distributed lateral loads acting on pile
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 32.200 ft
Depth of ground surface below top of pile = 17.2000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	24.0000
2	32.200	24.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

   Section 1 is a drilled shaft with permanent casing
   Length of section = 32.200000 ft
   Casing outside diameter = 24.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer = 17.200000 ft
   Distance from top of pile to bottom of layer = 20.700000 ft
   Effective unit weight at top of layer = 47.600000 pcf
   Effective unit weight at bottom of layer = 47.600000 pcf
   Friction angle at top of layer = 28.000000 deg.
   Friction angle at bottom of layer = 28.000000 deg.
   Subgrade k at top of layer = 15.000000 pci
   Subgrade k at bottom of layer = 15.000000 pci

Layer 2 is strong rock (vuggy limestone)

   Distance from top of pile to top of layer = 20.700000 ft
   Distance from top of pile to bottom of layer = 45.000000 ft
   Effective unit weight at top of layer = 101.600000 pcf
   Effective unit weight at bottom of layer = 101.600000 pcf
   Uniaxial compressive strength at top of layer = 2000. psi
   Uniaxial compressive strength at bottom of layer = 2000. psi

 (Depth of the lowest soil layer extends 12.800 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Name	Layer Depth	Effective Unit Wt.	Angle of Friction	Uniaxial qu	kpy

	(p-y Curve Type)	ft	pcf	deg.	psi	pci
1	Sand	17.2000	47.6000	28.0000	--	15.0000
	(Reese, et al.)	20.7000	47.6000	28.0000	--	15.0000
2	Strong Rock	20.7000	101.6000	--	2000.	--
	(Vuggy Limestone)	45.0000	101.6000	--	2000.	--

Modification Factors for p-y Curves

Distribution of p-y modifiers with depth defined using 4 points

Point No.	Depth X ft	p-mult	y-mult
1	17.200	0.6300	1.0000
2	20.700	0.6300	1.0000
3	20.700	1.0000	1.0000
4	45.000	1.0000	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading for Individual Load Cases

Distributed lateral load intensity for Load Case 1 defined using 2 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	9.220
2	17.200	9.220

Distributed lateral load intensity for Load Case 2 defined using 2 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	6.130
2	17.200	6.130

Distributed lateral load intensity for Load Case 3 defined using 2 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	15.630
2	17.200	15.630

Distributed lateral load intensity for Load Case 4 defined using 2 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	10.710
2	17.200	10.710

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	2	V = 4200. lbs	S = 0.0000 in/in	320750.	Yes	Yes
2	2	V = 4800. lbs	S = 0.0000 in/in	502900.	Yes	Yes
3	2	V = 4470. lbs	S = 0.0000 in/in	237400.	Yes	Yes
4	2	V = 5860. lbs	S = 0.0000 in/in	442200.	Yes	Yes

V = shear force applied normal to pile axis

M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile) with Permanent Casing:

Length of Section	=	32.200000 ft
Outer Diameter of Casing	=	24.000000 in
Casing Wall Thickness	=	0.500000 in
Moment of Inertia of Steel Casing	=	2549. in^4
Yield Stress of Casing	=	45000. psi
Elastic Modulus of Casing	=	29000000. psi
Number of Reinforcing Bars	=	0 bars
Area of Single Reinforcing Bar	=	0.0000 sq. in.
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in
Yield Stress of Reinforcing Bars	=	0.0000 psi
Modulus of Elasticity of Reinforcing Bars	=	0.0000 psi
Gross Area of Pile	=	452.389342 sq. in.
Area of Concrete	=	415.475628 sq. in.
Cross-sectional Area of Steel Casing	=	36.913714 sq. in.
Area of All Steel (Casing and Bars)	=	36.913714 sq. in.
Area Ratio of All Steel to Gross Area of Pile	=	8.16 percent

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	3073.734 kips
Tensile Load for Cracking of Concrete	=	-296.304 kips
Nominal Axial Tensile Capacity	=	-1661.117 kips

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.34165 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 4

Number	Axial Thrust Force kips
1	237.400
2	320.750
3	442.200
4	502.900

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 237.400 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	161.9656502	129572520.	80.0080517	0.0001000	0.00007001	0.4123130	0.00000	2.8959419	
0.00000250	323.9292696	129571708.	46.0145446	0.0001150	0.00005504	0.4718170	0.00000	3.3273545	
0.00000375	485.8888273	129570354.	34.6880506	0.0001301	0.00004008	0.5308926	0.00000	3.7592755	
0.00000500	647.8422923	129568458.	29.0283102	0.0001451	0.00002514	0.5895381	0.00000	4.1917050	
0.00000625	809.7876335	129566021.	25.6352713	0.0001602	0.00001022	0.6477518	0.00000	4.6246429	
0.00000750	971.7228189	129563043.	23.3755833	0.0001753	-0.00000468	0.7055318	0.00000	5.0580894	
0.00000875	1134.	129557386.	21.7634531	0.0001904	-0.00001957	0.7628741	0.00000	5.4920262	
0.00001000	1295.	129540756.	20.5557219	0.0002056	-0.00003444	0.8197646	0.00000	5.9263594	
0.00001125	1457.	129508983.	19.6172837	0.0002207	-0.00004931	0.8761891	0.00000	6.3609888	
0.00001250	1618.	129462110.	18.8671513	0.0002358	-0.00006416	0.9321372	0.00000	6.7958424	
0.00001375	1779.	129401704.	18.2538420	0.0002510	-0.00007901	0.9876018	0.00000	7.2308695	
0.00001500	1940.	129329657.	17.7430683	0.0002661	-0.00009385	1.0425778	0.00000	7.6660348	
0.00001625	2100.	129247756.	17.3111144	0.0002813	-0.000109	1.0970616	0.00000	8.1013127	
0.00001750	2100.	120015773.	16.4649856	0.0002881	-0.000132	1.1211525	0.00000	8.2950802	C
0.00001875	2191.	116866660.	16.0791628	0.0003015	-0.000149	1.1684402	0.00000	8.6777948	C
0.00002000	2313.	115631903.	15.7373894	0.0003147	-0.000165	1.2150405	0.00000	9.0580859	C
0.00002125	2433.	114487763.	15.4318477	0.0003279	-0.000182	1.2609576	0.00000	9.4359262	C
0.00002250	2552.	113430721.	15.1572830	0.0003410	-0.000199	1.3062603	0.00000	9.8118272	C
0.00002375	2671.	112453393.	14.9092295	0.0003541	-0.000216	1.3509892	0.00000	10.1860819	C
0.00002500	2789.	111548035.	14.6839953	0.0003671	-0.000233	1.3951738	0.00000	10.5588967	C
0.00002625	2906.	110708123.	14.4786113	0.0003801	-0.000250	1.4388441	0.00000	10.9304929	C
0.00002750	3023.	109927081.	14.2905497	0.0003930	-0.000267	1.4820205	0.00000	11.3010135	C
0.00002875	3139.	109196161.	14.1173166	0.0004059	-0.000284	1.5246836	0.00000	11.6702628	C
0.00003000	3255.	108515242.	13.9577438	0.0004187	-0.000301	1.5669052	0.00000	12.0388372	C
0.00003125	3371.	107879793.	13.8103721	0.0004316	-0.000318	1.6087057	0.00000	12.4068998	C
0.00003250	3487.	107280176.	13.6731235	0.0004444	-0.000336	1.6500159	0.00000	12.7738189	C
0.00003375	3602.	106720509.	13.5459875	0.0004572	-0.000353	1.6909603	0.00000	13.1406854	C
0.00003500	3717.	106190165.	13.4269173	0.0004699	-0.000370	1.7314313	0.00000	13.5065212	C
0.00003625	3831.	105693718.	13.3162157	0.0004827	-0.000387	1.7715625	0.00000	13.8725219	C
0.00003750	3946.	105220779.	13.2119061	0.0004954	-0.000405	1.8112193	0.00000	14.2374480	C
0.00003875	4060.	104776115.	13.1145131	0.0005082	-0.000422	1.8505426	0.00000	14.6025843	C
0.00004000	4174.	104353223.	13.0227060	0.0005209	-0.000439	1.8894477	0.00000	14.9671391	C
0.00004125	4288.	103951666.	12.9362474	0.0005336	-0.000456	1.9279704	0.00000	15.3314361	C
0.00004250	4402.	103571697.	12.8550448	0.0005463	-0.000474	1.9661601	0.00000	15.6959428	C
0.00004375	4515.	103207603.	12.7778956	0.0005590	-0.000491	2.0039176	0.00000	16.0597041	C
0.00004500	4629.	102860937.	12.7050188	0.0005717	-0.000508	2.0413196	0.00000	16.4234489	C
0.00004625	4742.	102531146.	12.6362377	0.0005844	-0.000526	2.0783891	0.00000	16.7874034	C
0.00004750	4855.	102215238.	12.5708708	0.0005971	-0.000543	2.1150761	0.00000	17.1510743	C
0.00004875	4968.	101911790.	12.5085767	0.0006098	-0.000560	2.1513701	0.00000	17.5143502	C
0.00005125	5194.	101344268.	12.3935295	0.0006352	-0.000595	2.2229613	0.00000	18.2415333	C
0.00005375	5419.	100819454.	12.2888347	0.0006605	-0.000629	2.2930867	0.00000	18.9681712	C
0.00005625	5644.	100333585.	12.1935791	0.0006859	-0.000664	2.3618207	0.00000	19.6950261	C
0.00005875	5868.	99882577.	12.1067621	0.0007113	-0.000699	2.4291940	0.00000	20.4224461	C
0.00006125	6092.	99459617.	12.0266452	0.0007366	-0.000733	2.4950911	0.00000	21.1491788	C
0.00006375	6315.	99064404.	11.9532780	0.0007620	-0.000768	2.5596517	0.00000	-22.049527	C
0.00006625	6538.	98693767.	11.8858989	0.0007874	-0.000803	2.6228713	0.00000	-23.043667	C
0.00006875	6761.	98342738.	11.8231169	0.0008128	-0.000837	2.6846215	0.00000	-24.038411	C
0.00007125	6983.	98011228.	11.7650935	0.0008383	-0.000872	2.7450150	0.00000	-25.032425	C
0.00007375	7205.	97697441.	11.7114170	0.0008637	-0.000906	2.8040600	0.00000	-26.025557	C
0.00007625	7427.	97399606.	11.6616624	0.0008892	-0.000941	2.8617517	0.00000	-27.017799	C
0.00007875	7648.	97115349.	11.6151280	0.0009147	-0.000975	2.9180279	0.00000	-28.009901	C
0.00008125	7869.	96843538.	11.5715679	0.0009402	-0.001010	2.9728968	0.00000	-29.001743	C
0.00008375	8089.	96583708.	11.5309829	0.0009657	-0.001044	3.0264036	0.00000	-29.992675	C
0.00008625	8309.	96334792.	11.4931165	0.0009913	-0.001079	3.0785434	0.00000	-30.982693	C
0.00008875	8529.	96095846.	11.4577413	0.0010169	-0.001113	3.1293112	0.00000	-31.971789	C
0.00009125	8748.	95866027.	11.4246549	0.0010425	-0.001148	3.1787020	0.00000	-32.959957	C
0.00009375	8967.	95644412.	11.3935890	0.0010681	-0.001182	3.2266955	0.00000	-33.947430	C
0.00009625	9185.	95429897.	11.3641539	0.0010938	-0.001216	3.2732471	0.00000	-34.934856	C
0.00009875	9403.	95222539.	11.3365416	0.0011195	-0.001251	3.3184112	0.00000	-35.921330	C
0.0001013	9621.	95021786.	11.3106193	0.0011452	-0.001285	3.3621825	0.00000	-36.906846	C
0.0001038	9838.	94827138.	11.2862670	0.0011710	-0.001319	3.4045558	0.00000	-37.891396	C
0.0001063	10055.	94638143.	11.2633761	0.0011967	-0.001353	3.4455257	0.00000	-38.874975	C
0.0001088	10272.	94454392.	11.2418478	0.0012226	-0.001387	3.4850867	0.00000	-39.857575	C
0.0001113	10488.	94275509.	11.2215924	0.0012484	-0.001422	3.5232335	0.00000	-40.839190	C
0.0001138	10704.	94101156.	11.2025281	0.0012743	-0.001456	3.5599606	0.00000	-41.819810	C
0.0001163	10919.	93931015.	11.1845802	0.0013002	-0.001490	3.5952622	0.00000	-42.799434	C
0.0001188	11135.	93764803.	11.1676801	0.0013262	-0.001524	3.6291327	0.00000	-43.778051	C
0.0001213	11349.	93602109.	11.1516469	0.0013521	-0.001558	3.6615489	0.00000	-44.756071	C
0.0001238	11556.	93380731.	11.1336093	0.0013778	-0.001592	3.6920967	0.00000	-45.000000	CY
0.0001263	11743.	93015270.	11.1095754	0.0014026	-0.001627	3.7202506	0.00000	-45.000000	CY
0.0001288	11911.	92516217.	11.0798006	0.0014265	-0.001663	3.7461376	0.00000	-45.000000	CY
0.0001313	12068.	91948166.	11.0471863	0.0014499	-0.001700	3.7702381	0.00000	-45.000000	CY
0.0001338	12216.	91331381.	11.0125976	0.0014729	-0.001737	3.7927246	0.00000	-45.000000	CY
0.0001363	12355.	90678684.	10.9765710	0.0014956	-0.001774	3.8137161	0.00000	-45.000000	CY
0.0001388	12487.	89999237.	10.9394868	0.0015179	-0.001812	3.8333042	0.00000	-45.000000	CY
0.0001413	12613.	89299050.	10.9013229	0.0015398	-0.001850	3.8515284	0.00000	-45.000000	CY
0.0001438	12734.	88583367.	10.8622666	0.0015615	-0.001889	3.8684527	0.00000	-45.000000	CY
0.0001463	12847.	87840109.	10.8243744	0.0015831	-0.001927	3.8843351	0.00000	45.0000000	CY
0.0001488	12953.	87082255.	10.7870605	0.0016046	-0.001965	3.8991263	0.00000	45.0000000	CY
0.0001588	13302.	83791001.	10.6608352	0.0016924	-0.002118	3.9490367	0.00000	45.0000000	CY
0.0001688	13574.	80439806.	10.5519827	0.0017806	-0.002269	3.9821876	0.00000	45.0000000	CY
0.0001788	13796.	77180309.	10.4557944	0.0018690	-0.002421	3.9983121	0.00000	45.0000000	CY
0.0001888	13980.	74065977.	10.3685903	0.0019571	-0.002573	3.9991063	0.00000	45.0000000	CY
0.0001988	14135.	71120180.	10.2892047	0.0020450	-0.002725	3.9999236	0.00000	45.0000000	CY
0.0002088	14267.	68345465.	10.2179456	0.0021330	-0.002877	3.9990659	0.00000	45.0000000	CY
0.0002188	14379.	65733752.	10.1523736	0.0022208	-0.003029	3.9999497	0.00000	45.0000000	CY
0.0002288	14476.	63284382.	10.0928192	0.0023087	-0.003181	3.9978048	0.00000	45.0000000	CY

0.0002388	14560.	60985120.	10.0386061	0.0023967	-0.003333	3.9987077	0.00000	45.0000000 CY
0.0002488	14634.	58829150.	9.9895791	0.0024849	-0.003485	3.9991051	0.00000	45.0000000 CY
0.0002588	14698.	56803314.	9.9443928	0.0025731	-0.003637	3.9991616	0.00000	45.0000000 CY
0.0002688	14753.	54896713.	9.9025119	0.0026613	-0.003789	3.9989042	0.00000	45.0000000 CY
0.0002788	14803.	53104042.	9.8641255	0.0027496	-0.003940	3.9982196	0.00000	45.0000000 CY
0.0002888	14847.	51416919.	9.8286871	0.0028380	-0.004092	3.9968316	0.00000	45.0000000 CY
0.0002988	14885.	49824829.	9.7968879	0.0029268	-0.004243	3.9997180	0.00000	45.0000000 CY
0.0003088	14919.	48321462.	9.7672606	0.0030156	-0.004394	3.9995865	0.00000	45.0000000 CY
0.0003188	14949.	46900336.	9.7399999	0.0031046	-0.004545	3.9978338	0.00000	45.0000000 CY
0.0003288	14976.	45555761.	9.7150230	0.0031938	-0.004696	3.9982151	0.00000	45.0000000 CY
0.0003388	15001.	44282463.	9.6914614	0.0032830	-0.004847	3.9992378	0.00000	45.0000000 CY
0.0003488	15022.	43072755.	9.6692482	0.0033722	-0.004998	3.9955986	0.00000	45.0000000 CY
0.0003588	15041.	41924817.	9.6491304	0.0034616	-0.005148	3.9996559	0.00000	45.0000000 CY
0.0003688	15058.	40834107.	9.6303768	0.0035512	-0.005299	3.9958415	0.00000	45.0000000 CY
0.0003788	15072.	39794407.	9.6133944	0.0036411	-0.005449	3.9996459	0.00000	45.0000000 CY
0.0003888	15086.	38805572.	9.5976010	0.0037311	-0.005599	3.9948240	0.00000	45.0000000 CY
0.0003988	15097.	37861046.	9.5829535	0.0038212	-0.005749	3.9991854	0.00000	45.0000000 CY

Axial Thrust Force = 320.750 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	160.7906091	128632487.	104.3529397	0.0001304	0.0001004	0.5335028	0.00000	3.7784441	
0.00000250	321.5791662	128631666.	58.1870983	0.0001455	0.00008547	0.5919900	0.00000	4.2098646	
0.00000375	482.3636193	128630298.	42.8032084	0.0001605	0.00007051	0.6500483	0.00000	4.6417989	
0.00000500	643.1419161	128628383.	35.1148066	0.0001756	0.00005557	0.7076760	0.00000	5.0742470	
0.00000625	803.9120043	128625921.	30.5046001	0.0001907	0.00004065	0.7648713	0.00000	5.5072088	
0.00000750	964.6718313	128622911.	27.4334915	0.0002058	0.00002575	0.8216324	0.00000	5.9406844	
0.00000875	1125.	128619354.	25.2418677	0.0002209	0.00001087	0.8779575	0.00000	6.3746739	
0.00001000	1286.	128615249.	23.5999220	0.0002360	-0.00000400	0.9338449	0.00000	6.8091773	
0.00001125	1447.	128609877.	22.3244045	0.0002511	-0.00001885	0.9892917	0.00000	7.2441870	
0.00001250	1607.	128598635.	21.3052186	0.0002663	-0.00003368	1.0442887	0.00000	7.6796418	
0.00001375	1768.	128577525.	20.4722484	0.0002815	-0.00004851	1.0988238	0.00000	8.1154591	
0.00001500	1928.	128545131.	19.7787813	0.0002967	-0.00006332	1.1528873	0.00000	8.5515699	
0.00001625	2088.	128501524.	19.1925113	0.0003119	-0.00007812	1.2064717	0.00000	8.9879210	
0.00001750	2248.	128447451.	18.6903871	0.0003271	-0.00009292	1.2595712	0.00000	9.4244715	
0.00001875	2407.	128383907.	18.2555220	0.0003423	-0.000108	1.3121813	0.00000	9.8611901	
0.00002000	2414.	120682655.	17.5558949	0.0003511	-0.000129	1.3422627	0.00000	10.1128191	C
0.00002125	2540.	119524025.	17.1680993	0.0003648	-0.000145	1.3889144	0.00000	10.5058912	C
0.00002250	2664.	118414288.	16.8186322	0.0003784	-0.000162	1.4347894	0.00000	10.8958576	C
0.00002375	2787.	117365762.	16.5025881	0.0003919	-0.000178	1.4799888	0.00000	11.2835076	C
0.00002500	2909.	116375195.	16.2152080	0.0004054	-0.000195	1.5245413	0.00000	11.6690259	C
0.00002625	3030.	115438123.	15.9525253	0.0004188	-0.000211	1.5684645	0.00000	12.0525099	C
0.00002750	3150.	114553110.	15.7115091	0.0004321	-0.000228	1.6117950	0.00000	12.4342286	C
0.00002875	3269.	113717727.	15.4895958	0.0004453	-0.000245	1.6545627	0.00000	12.8144006	C
0.00003000	3388.	112927561.	15.2844539	0.0004585	-0.000261	1.6967779	0.00000	13.1930749	C
0.00003125	3506.	112181343.	15.0943803	0.0004717	-0.000278	1.7384758	0.00000	13.5705322	C
0.00003250	3623.	111476988.	14.9178775	0.0004848	-0.000295	1.7796850	0.00000	13.9469996	C
0.00003375	3740.	110812500.	14.7536851	0.0004979	-0.000312	1.8204345	0.00000	14.3227194	C
0.00003500	3856.	110178437.	14.5998512	0.0005110	-0.000329	1.8606580	0.00000	14.6970491	C
0.00003625	3972.	109579601.	14.4561455	0.0005240	-0.000346	1.9004532	0.00000	15.0708730	C
0.00003750	4088.	109011218.	14.3214034	0.0005371	-0.000363	1.9398045	0.00000	15.4440263	C
0.00003875	4203.	108469544.	14.1946026	0.0005500	-0.000380	1.9786956	0.00000	15.8163348	C
0.00004000	4318.	107955943.	14.0754834	0.0005630	-0.000397	2.0171871	0.00000	16.1883608	C
0.00004125	4433.	107464741.	13.9628952	0.0005760	-0.000414	2.0552246	0.00000	16.5595635	C
0.00004250	4547.	106997432.	13.8567277	0.0005889	-0.000431	2.0928686	0.00000	16.9305170	C
0.00004375	4662.	106551247.	13.7562981	0.0006018	-0.000448	2.1301029	0.00000	17.3010533	C
0.00004500	4776.	106123509.	13.6609918	0.0006147	-0.000465	2.1669112	0.00000	17.6709945	C
0.00004625	4889.	105716913.	13.5710032	0.0006277	-0.000482	2.2033755	0.00000	18.0411581	C
0.00004750	5003.	105324180.	13.4850295	0.0006405	-0.000499	2.2393770	0.00000	18.4103283	C
0.00004875	5116.	104948930.	13.4034969	0.0006534	-0.000517	2.2750186	0.00000	18.7795439	C
0.00005125	5342.	104243248.	13.2519959	0.0006792	-0.000551	2.3451569	0.00000	19.5174290	C
0.00005375	5568.	103591094.	13.1142386	0.0007049	-0.000585	2.4137894	0.00000	20.2547695	C
0.00005625	5793.	102984476.	12.9881488	0.0007306	-0.000619	2.4808834	0.00000	20.9911679	C
0.00005875	6017.	102421250.	12.8729233	0.0007563	-0.000654	2.5465477	0.00000	21.7277932	C
0.00006125	6241.	101893686.	12.7666938	0.0007820	-0.000688	2.6106985	0.00000	22.4636901	C
0.00006375	6464.	101399972.	12.6688964	0.0008076	-0.000722	2.6734169	0.00000	23.1997713	C
0.00006625	6687.	100936860.	12.5786754	0.0008333	-0.000757	2.7347178	0.00000	23.9362297	C
0.00006875	6909.	100498639.	12.4946506	0.0008590	-0.000791	2.7945102	0.00000	24.6719594	C
0.00007125	7131.	100086044.	12.4169578	0.0008847	-0.000825	2.8529259	0.00000	25.4085891	C
0.00007375	7353.	99695704.	12.3447594	0.0009104	-0.000860	2.9099279	0.00000	26.1457043	C
0.00007625	7573.	99323552.	12.2770147	0.0009361	-0.000894	2.9654311	0.00000	26.8821990	C
0.00007875	7794.	98970358.	12.2139719	0.0009619	-0.000928	3.0195504	0.00000	27.6196085	C
0.00008125	8014.	98634346.	12.1551992	0.0009876	-0.000962	3.0722807	0.00000	28.3579384	C
0.00008375	8234.	98313112.	12.1000543	0.0010134	-0.000997	3.1235734	0.00000	29.0965571	C
0.00008625	8453.	98004781.	12.0480385	0.0010391	-0.001031	3.1733962	0.00000	29.8350065	C
0.00008875	8672.	97709619.	11.9993179	0.0010649	-0.001065	3.2218217	0.00000	-30.577905	C
0.00009125	8890.	97426520.	11.9536239	0.0010908	-0.001099	3.2688446	0.00000	-31.560172	C
0.00009375	9108.	97154494.	11.9107167	0.0011166	-0.001133	3.3144598	0.00000	-32.541489	C
0.00009625	9326.	96892311.	11.8702499	0.0011425	-0.001167	3.3586405	0.00000	-33.522215	C
0.00009875	9543.	96638511.	11.8317727	0.0011684	-0.001202	3.4013400	0.00000	-34.503111	C
0.0001013	9760.	96393484.	11.7955271	0.0011943	-0.001236	3.4426219	0.00000	-35.483033	C
0.0001038	9976.	96156571.	11.7613539	0.0012202	-0.001270	3.4824808	0.00000	-36.461976	C
0.0001063	10192.	95927178.	11.7291089	0.0012462	-0.001304	3.5209110	0.00000	-37.439933	C
0.0001088	10408.	95704766.	11.6986615	0.0012722	-0.001338	3.5579070	0.00000	-38.416896	C
0.0001113	10623.	95488840.	11.6698925	0.0012983	-0.001372	3.5934633	0.00000	-39.392859	C
0.0001138	10838.	95278953.	11.6426932	0.0013244	-0.001406	3.6275741	0.00000	-40.367815	C
0.0001163	11052.	95074044.	11.6166398	0.0013504	-0.001440	3.6601870	0.00000	-41.342853	C

0.0001188	11266.	94874365.	11.5919455	0.0013765	-0.001473	3.6913424	0.00000	-42.316988 C
0.0001213	11480.	94679642.	11.5685639	0.0014027	-0.001507	3.7210402	0.00000	-43.290087 C
0.0001238	11693.	94489554.	11.5464176	0.0014289	-0.001541	3.7492742	0.00000	-44.262144 C
0.0001263	11903.	94284620.	11.5245634	0.0014550	-0.001575	3.7759281	0.00000	-45.000000 CY
0.0001288	12100.	93977325.	11.4989100	0.0014805	-0.001610	3.8005182	0.00000	-45.000000 CY
0.0001313	12277.	93537669.	11.4678716	0.0015052	-0.001645	3.8229351	0.00000	-45.000000 CY
0.0001338	12440.	93008066.	11.4332467	0.0015292	-0.001681	3.8434840	0.00000	-45.000000 CY
0.0001363	12593.	92422035.	11.3964454	0.0015528	-0.001717	3.8623968	0.00000	-45.000000 CY
0.0001388	12735.	91782869.	11.3584691	0.0015760	-0.001754	3.8798371	0.00000	45.0000000 CY
0.0001413	12867.	91093108.	11.3210977	0.0015991	-0.001791	3.8960247	0.00000	45.0000000 CY
0.0001438	12986.	90336996.	11.2867591	0.0016225	-0.001828	3.9111992	0.00000	45.0000000 CY
0.0001463	13097.	89549334.	11.2535570	0.0016458	-0.001864	3.9251742	0.00000	45.0000000 CY
0.0001488	13198.	88726809.	11.2225080	0.0016693	-0.001901	3.9380348	0.00000	45.0000000 CY
0.0001588	13543.	85310974.	11.1070867	0.0017633	-0.002047	3.9773086	0.00000	45.0000000 CY
0.0001688	13817.	81877465.	11.0036964	0.0018569	-0.002193	3.9972290	0.00000	45.0000000 CY
0.0001788	14040.	78547816.	10.9109179	0.0019503	-0.002340	3.9999999	0.00000	45.0000000 CY
0.0001888	14226.	75368753.	10.8253392	0.0020433	-0.002487	3.9999973	0.00000	45.0000000 CY
0.0001988	14382.	72360829.	10.7481162	0.0021362	-0.002634	3.9998262	0.00000	45.0000000 CY
0.0002088	14514.	69529481.	10.6785280	0.0022291	-0.002781	3.9987847	0.00000	45.0000000 CY
0.0002188	14626.	66862533.	10.6141449	0.0023218	-0.002928	3.9998718	0.00000	45.0000000 CY
0.0002288	14723.	64361736.	10.5560067	0.0024147	-0.003075	3.9978475	0.00000	45.0000000 CY
0.0002388	14806.	62015313.	10.5032532	0.0025077	-0.003222	3.9984132	0.00000	45.0000000 CY
0.0002488	14879.	59815229.	10.4555765	0.0026008	-0.003369	3.9988705	0.00000	45.0000000 CY
0.0002588	14942.	57746505.	10.4112411	0.0026939	-0.003516	3.9989396	0.00000	45.0000000 CY
0.0002688	14997.	55801491.	10.3705446	0.0027871	-0.003663	3.9986668	0.00000	45.0000000 CY
0.0002788	15045.	53972760.	10.3333063	0.0028804	-0.003810	3.9979395	0.00000	45.0000000 CY
0.0002888	15088.	52251741.	10.2989973	0.0029738	-0.003956	3.9964889	0.00000	45.0000000 CY
0.0002988	15125.	50627492.	10.2684135	0.0030677	-0.004102	3.9999970	0.00000	45.0000000 CY
0.0003088	15158.	49094458.	10.2399566	0.0031616	-0.004248	3.9994835	0.00000	45.0000000 CY
0.0003188	15187.	47644818.	10.2138432	0.0032557	-0.004394	3.9976358	0.00000	45.0000000 CY
0.0003288	15212.	46273495.	10.1896739	0.0033499	-0.004540	3.9987665	0.00000	45.0000000 CY
0.0003388	15235.	44974837.	10.1672861	0.0034442	-0.004686	3.9991527	0.00000	45.0000000 CY
0.0003488	15255.	43741431.	10.1462006	0.0035385	-0.004832	3.9954478	0.00000	45.0000000 CY
0.0003588	15272.	42570803.	10.1272220	0.0036331	-0.004977	3.9996284	0.00000	45.0000000 CY
0.0003688	15288.	41458662.	10.1096092	0.0037279	-0.005122	3.9958027	0.00000	45.0000000 CY
0.0003788	15301.	40398560.	10.0937507	0.0038230	-0.005267	3.9996513	0.00000	45.0000000 CY

Axial Thrust Force = 442.200 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	159.0561596	127244928.	140.2878357	0.0001754	0.0001454	0.7085831	0.00000	5.0810840	
0.00000250	318.1102351	127244094.	76.1547126	0.0001904	0.0001304	0.7655693	0.00000	5.5125167	
0.00000375	477.1601424	127242705.	54.7818026	0.0002054	0.0001154	0.8221260	0.00000	5.9444710	
0.00000500	636.2037971	127240759.	44.0989462	0.0002205	0.0001005	0.8782512	0.00000	6.3769472	
0.00000625	795.2391149	127238258.	37.6921113	0.0002356	0.00008558	0.9339432	0.00000	6.8099452	
0.00000750	954.2640108	127235201.	33.4232875	0.0002507	0.00007067	0.9892001	0.00000	7.2434650	
0.00000875	1113.	127231589.	30.3761844	0.0002658	0.00005579	1.0440203	0.00000	7.6775068	
0.00001000	1272.	127227420.	28.0926570	0.0002809	0.00004093	1.0984017	0.00000	8.1120706	
0.00001125	1431.	127222695.	26.3181803	0.0002961	0.00002608	1.1523427	0.00000	8.5471564	
0.00001250	1590.	127217414.	24.9000393	0.0003113	0.00001125	1.2058414	0.00000	8.9827643	
0.00001375	1749.	127211577.	23.7410518	0.0003264	-0.00000356	1.2588960	0.00000	9.4188941	
0.00001500	1908.	127205001.	22.7764236	0.0003416	-0.00001835	1.3115044	0.00000	9.8555440	
0.00001625	2067.	127195631.	21.9612299	0.0003569	-0.00003313	1.3636607	0.00000	10.2926794	
0.00001750	2226.	127180686.	21.2633290	0.0003721	-0.00004789	1.4153560	0.00000	10.7302394	
0.00001875	2384.	127158477.	20.6591551	0.0003874	-0.00006264	1.4665821	0.00000	11.1681656	
0.00002000	2543.	127128256.	20.1310477	0.0004026	-0.00007738	1.5173319	0.00000	11.6064077	
0.00002125	2701.	127089897.	19.6655157	0.0004179	-0.00009211	1.5675994	0.00000	12.0449241	
0.00002250	2858.	127043627.	19.2520773	0.0004332	-0.000107	1.6173800	0.00000	12.4836805	
0.00002375	2903.	122222905.	18.6890144	0.0004439	-0.000126	1.6517631	0.00000	12.7894088 C	
0.00002500	3033.	121326989.	18.3185013	0.0004580	-0.000142	1.6968709	0.00000	13.1939132 C	
0.00002625	3162.	120440768.	17.9794503	0.0004720	-0.000158	1.7412213	0.00000	13.5955065 C	
0.00002750	3288.	119578200.	17.6683011	0.0004859	-0.000174	1.7848870	0.00000	13.9947702 C	
0.00002875	3414.	118738086.	17.3813752	0.0004997	-0.000190	1.8278719	0.00000	14.3916716 C	
0.00003000	3538.	117923101.	17.1158593	0.0005135	-0.000207	1.8702035	0.00000	14.7863975 C	
0.00003125	3661.	117137434.	16.8695657	0.0005272	-0.000223	1.9119252	0.00000	15.1792940 C	
0.00003250	3782.	116381334.	16.6404478	0.0005408	-0.000239	1.9530597	0.00000	15.5705222 C	
0.00003375	3903.	115654915.	16.4267771	0.0005544	-0.000256	1.9936305	0.00000	15.9602582 C	
0.00003500	4023.	114954978.	16.2268181	0.0005679	-0.000272	2.0336338	0.00000	16.3484205 C	
0.00003625	4143.	114281757.	16.0393170	0.0005814	-0.000289	2.0730920	0.00000	16.7351821 C	
0.00003750	4261.	113636811.	15.8633366	0.0005949	-0.000305	2.1120434	0.00000	17.1208787 C	
0.00003875	4380.	113019957.	15.6979625	0.0006083	-0.000322	2.1505135	0.00000	17.5057354 C	
0.00004000	4497.	112424217.	15.5417529	0.0006217	-0.000338	2.1884539	0.00000	17.8892335 C	
0.00004125	4614.	111853037.	15.3943285	0.0006350	-0.000355	2.2259217	0.00000	18.2719155 C	
0.00004250	4731.	111306862.	15.2551679	0.0006483	-0.000372	2.2629494	0.00000	18.6540946 C	
0.00004375	4847.	110777591.	15.1229075	0.0006616	-0.000388	2.2994594	0.00000	19.0349390 C	
0.00004500	4962.	110273836.	14.9980114	0.0006749	-0.000405	2.3355836	0.00000	19.4158051 C	
0.00004625	5077.	109783571.	14.8787743	0.0006881	-0.000422	2.3711833	0.00000	19.7952062 C	
0.00004750	5193.	109317026.	14.7659929	0.0007014	-0.000439	2.4064211	0.00000	20.1748554 C	
0.00004875	5307.	108862725.	14.6580387	0.0007146	-0.000455	2.4411501	0.00000	20.5531524 C	
0.00005125	5535.	108008129.	14.4575931	0.0007410	-0.000489	2.5094157	0.00000	21.3092479 C	
0.00005375	5763.	107213844.	14.2749309	0.0007673	-0.000523	2.5760356	0.00000	22.0639987 C	
0.00005625	5989.	106469143.	14.1072189	0.0007935	-0.000556	2.6409536	0.00000	22.8166510 C	
0.00005875	6214.	105774087.	13.9533285	0.0008198	-0.000590	2.7042930	0.00000	23.5685336 C	
0.00006125	6439.	105124303.	13.8118079	0.0008460	-0.000624	2.7660932	0.00000	24.3200739 C	
0.00006375	6663.	104510181.	13.6804763	0.0008721	-0.000658	2.8262500	0.00000	25.0699308 C	
0.00006625	6886.	103935610.	13.5594134	0.0008983	-0.000692	2.8849565	0.00000	25.8204732 C	
0.00006875	7108.	103389065.	13.4462632	0.0009244	-0.000726	2.9420231	0.00000	26.5692375 C	

0.00007125	7330.	102875375.	13.3415145	0.0009506	-0.000759	2.9976606	0.00000	27.3189546 C
0.00007375	7551.	102386099.	13.2433648	0.0009767	-0.000793	3.0517189	0.00000	28.0675967 C
0.00007625	7772.	101922418.	13.1518318	0.0010028	-0.000827	3.1043063	0.00000	28.8166383 C
0.00007875	7992.	101482340.	13.0663592	0.0010290	-0.000861	3.1554319	0.00000	29.5662481 C
0.00008125	8211.	101060354.	12.9856960	0.0010551	-0.000895	3.2049861	0.00000	30.3147963 C
0.00008375	8430.	100658852.	12.9102465	0.0010812	-0.000929	3.2531032	0.00000	31.0643115 C
0.00008625	8649.	100275999.	12.8395542	0.0011074	-0.000963	3.2997771	0.00000	31.8147852 C
0.00008875	8867.	99906549.	12.7723618	0.0011335	-0.000996	3.3448717	0.00000	32.5640164 C
0.00009125	9084.	99552987.	12.7092219	0.0011597	-0.001030	3.3885216	0.00000	33.3142268 C
0.00009375	9301.	99214022.	12.6498128	0.0011859	-0.001064	3.4307213	0.00000	34.0654273 C
0.00009625	9518.	98888181.	12.5937636	0.0012121	-0.001098	3.4714530	0.00000	34.8173921 C
0.00009875	9734.	98572421.	12.5402721	0.0012384	-0.001132	3.5106318	0.00000	35.5685539 C
0.0001013	9950.	98268276.	12.4897646	0.0012646	-0.001165	3.5483516	0.00000	36.3207210 C
0.0001038	10165.	97974881.	12.4420275	0.0012909	-0.001199	3.5846064	0.00000	37.0739003 C
0.0001063	10380.	97691454.	12.3968676	0.0013172	-0.001233	3.6193906	0.00000	37.8280984 C
0.0001088	10594.	97417029.	12.3540285	0.0013435	-0.001266	3.6526873	0.00000	38.5830676 C
0.0001113	10808.	97149735.	12.3129547	0.0013698	-0.001300	3.6844389	0.00000	39.3375204 C
0.0001138	11021.	96890570.	12.2740020	0.0013962	-0.001334	3.7147094	0.00000	40.0930144 C
0.0001163	11234.	96638989.	12.2370357	0.0014226	-0.001367	3.7434928	0.00000	40.8495570 C
0.0001188	11447.	96394489.	12.2019325	0.0014490	-0.001401	3.7707829	0.00000	41.6071554 C
0.0001213	11659.	96156611.	12.1685792	0.0014754	-0.001435	3.7965736	0.00000	42.3658171 C
0.0001238	11871.	95924929.	12.1368720	0.0015019	-0.001468	3.8208586	0.00000	43.1255498 C
0.0001263	12082.	95698582.	12.1065274	0.0015284	-0.001502	3.8436119	0.00000	43.8856737 C
0.0001288	12293.	95477148.	12.0774251	0.0015550	-0.001535	3.8648267	0.00000	44.6460362 C
0.0001313	12499.	95233749.	12.0510961	0.0015817	-0.001568	3.8846533	0.00000	45.0000000 CY
0.0001338	12689.	94870898.	12.0252593	0.0016084	-0.001602	3.9028648	0.00000	45.0000000 CY
0.0001363	12854.	94338293.	11.9979665	0.0016347	-0.001635	3.9193154	0.00000	45.0000000 CY
0.0001388	12997.	93671669.	11.9707613	0.0016609	-0.001669	3.9341732	0.00000	45.0000000 CY
0.0001413	13127.	92935954.	11.9431847	0.0016870	-0.001703	3.9474288	0.00000	45.0000000 CY
0.0001438	13247.	92154561.	11.9153760	0.0017128	-0.001737	3.9591222	0.00000	45.0000000 CY
0.0001463	13358.	91336620.	11.8880964	0.0017386	-0.001771	3.9693237	0.00000	45.0000000 CY
0.0001488	13461.	90493189.	11.8610148	0.0017643	-0.001806	3.9780298	0.00000	45.0000000 CY
0.0001588	13814.	87015424.	11.7562436	0.0018663	-0.001944	3.9982885	0.00000	45.0000000 CY
0.0001688	14094.	83519508.	11.6594791	0.0019675	-0.002082	3.9995510	0.00000	45.0000000 CY
0.0001788	14322.	80123651.	11.5700406	0.0020681	-0.002222	3.9998596	0.00000	45.0000000 CY
0.0001888	14510.	76875608.	11.4881148	0.0021684	-0.002362	3.9998288	0.00000	45.0000000 CY
0.0001988	14667.	73797417.	11.4146970	0.0022687	-0.002501	3.9994027	0.00000	45.0000000 CY
0.0002088	14800.	70896958.	11.3469026	0.0023687	-0.002641	3.9979793	0.00000	45.0000000 CY
0.0002188	14912.	68170746.	11.2853823	0.0024687	-0.002781	3.9994879	0.00000	45.0000000 CY
0.0002288	15008.	65609013.	11.2295625	0.0025688	-0.002921	3.9999841	0.00000	45.0000000 CY
0.0002388	15091.	63207421.	11.1794467	0.0026691	-0.003061	3.9974068	0.00000	45.0000000 CY
0.0002488	15162.	60951752.	11.1333493	0.0027694	-0.003201	3.9979979	0.00000	45.0000000 CY
0.0002588	15223.	58832337.	11.0908139	0.0028697	-0.003340	3.9980942	0.00000	45.0000000 CY
0.0002688	15276.	56841431.	11.0522059	0.0029703	-0.003480	3.9977496	0.00000	45.0000000 CY
0.0002788	15323.	54969391.	11.0169516	0.0030710	-0.003619	3.9968485	0.00000	45.0000000 CY
0.0002888	15363.	53206402.	10.9849427	0.0031719	-0.003758	3.9988772	0.00000	45.0000000 CY
0.0002988	15399.	51543342.	10.9562793	0.0032732	-0.003897	3.9998582	0.00000	45.0000000 CY
0.0003088	15430.	49975057.	10.9299087	0.0033746	-0.004035	3.9989396	0.00000	45.0000000 CY
0.0003188	15456.	48489910.	10.9053350	0.0034761	-0.004174	3.9966060	0.00000	45.0000000 CY
0.0003288	15479.	47085753.	10.8822654	0.0035775	-0.004312	3.9999710	0.00000	45.0000000 CY
0.0003388	15500.	45755425.	10.8619676	0.0036795	-0.004451	3.9985406	0.00000	45.0000000 CY
0.0003488	15517.	44493738.	10.8428449	0.0037814	-0.004589	3.9962625	0.00000	45.0000000 CY
0.0003588	15532.	43294557.	10.8258991	0.0038838	-0.004726	3.9992499	0.00000	45.0000000 CY

Axial Thrust Force = 502.900 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	158.1790437	126543235.	158.4602130	0.0001981	0.0001681	0.7953945	0.00000	5.7398327	
0.00000250	316.3559866	126542395.	85.2409872	0.0002131	0.0001531	0.8516217	0.00000	6.1712716	
0.00000375	474.5287281	126540994.	60.8394147	0.0002281	0.0001381	0.9074189	0.00000	6.6032364	
0.00000500	632.6951672	126539033.	48.6422557	0.0002432	0.0001232	0.9627843	0.00000	7.0357271	
0.00000625	790.8532027	126536512.	41.3268622	0.0002583	0.0001083	1.0177160	0.00000	7.4687438	
0.00000750	949.0007335	126533431.	36.4523517	0.0002734	0.00009339	1.0722123	0.00000	7.9022865	
0.00000875	1107.	126529789.	32.9726318	0.0002885	0.00007851	1.1262712	0.00000	8.3363553	
0.00001000	1265.	126525587.	30.3646561	0.0003036	0.00006365	1.1798911	0.00000	8.7709503	
0.00001125	1423.	126520825.	28.3378435	0.0003188	0.00004880	1.2330699	0.00000	9.2060715	
0.00001250	1581.	126515501.	26.7178453	0.0003340	0.00003397	1.2858060	0.00000	9.6417190	
0.00001375	1740.	126509617.	25.3937124	0.0003492	0.00001916	1.3380975	0.00000	10.0778929	
0.00001500	1898.	126503173.	24.2914787	0.0003644	0.00000437	1.3899426	0.00000	10.5145933	
0.00001625	2056.	126496166.	23.3599368	0.0003796	-0.00001040	1.4413393	0.00000	10.9518203	
0.00001750	2214.	126488088.	22.5624928	0.0003948	-0.00002516	1.4922850	0.00000	11.3895648	
0.00001875	2371.	126476845.	21.8722495	0.0004101	-0.00003990	1.5427729	0.00000	11.8277854	
0.00002000	2529.	126460441.	21.2690130	0.0004254	-0.00005462	1.5927951	0.00000	12.2664274	
0.00002125	2687.	126437668.	20.7373471	0.0004407	-0.00006933	1.6423446	0.00000	12.7054401	
0.00002250	2844.	126407933.	20.2652554	0.0004560	-0.00008403	1.6914151	0.00000	13.1447791	
0.00002375	3001.	126371083.	19.8432767	0.0004713	-0.00009872	1.7400013	0.00000	13.5844068	
0.00002500	3158.	126327237.	19.4638506	0.0004866	-0.000113	1.7880987	0.00000	14.0242918	
0.00002625	3205.	122089154.	18.9509549	0.0004975	-0.000133	1.8217670	0.00000	14.3350645 C	
0.00002750	3336.	121308168.	18.6066203	0.0005117	-0.000148	1.8655783	0.00000	14.7430796 C	
0.00002875	3465.	120524610.	18.2887748	0.0005258	-0.000164	1.9086401	0.00000	15.1482157 C	
0.00003000	3593.	119753924.	17.9948293	0.0005398	-0.000180	1.9510275	0.00000	15.5511014 C	
0.00003125	3719.	118999265.	17.7220809	0.0005538	-0.000196	1.9927632	0.00000	15.9518856 C	
0.00003250	3844.	118262531.	17.4682133	0.0005677	-0.000212	2.0338666	0.00000	16.3506910 C	
0.00003375	3967.	117545313.	17.2312688	0.0005816	-0.000228	2.0743578	0.00000	16.7476543 C	
0.00003500	4090.	116848930.	17.0095841	0.0005953	-0.000245	2.1142581	0.00000	17.1429278 C	
0.00003625	4211.	116174444.	16.8017394	0.0006091	-0.000261	2.1535894	0.00000	17.5366786 C	
0.00003750	4332.	115522681.	16.6065182	0.0006227	-0.000277	2.1923744	0.00000	17.9290886 C	

0.00003875	4452.	114894249.	16.4228741	0.0006364	-0.000294	2.2306364	0.00000	18.3203549 C
0.00004000	4571.	114283760.	16.2494045	0.0006500	-0.000310	2.2683436	0.00000	18.7101094 C
0.00004125	4690.	113694503.	16.0855348	0.0006635	-0.000326	2.3055408	0.00000	19.0987711 C
0.00004250	4808.	113128755.	15.9307592	0.0006771	-0.000343	2.3422708	0.00000	19.4867608 C
0.00004375	4925.	112579534.	15.7838210	0.0006905	-0.000359	2.3784793	0.00000	19.8734731 C
0.00004500	5042.	112050301.	15.6444659	0.0007040	-0.000376	2.4142184	0.00000	20.2594282 C
0.00004625	5159.	111540809.	15.5122068	0.0007174	-0.000393	2.4495058	0.00000	20.6447975 C
0.00004750	5275.	111046072.	15.3861032	0.0007308	-0.000409	2.4842964	0.00000	21.0290573 C
0.00004875	5390.	110571355.	15.2663238	0.0007442	-0.000426	2.5186742	0.00000	21.4131154 C
0.00005125	5620.	109665344.	15.0426795	0.0007709	-0.000459	2.5860382	0.00000	22.1788326 C
0.00005375	5849.	108817796.	14.8384537	0.0007976	-0.000492	2.6516512	0.00000	22.9423899 C
0.00005625	6076.	108024359.	14.6513492	0.0008241	-0.000526	2.7155660	0.00000	23.7042635 C
0.00005875	6303.	107281147.	14.4794809	0.0008507	-0.000559	2.7778342	0.00000	24.4649657 C
0.00006125	6528.	106581136.	14.3208110	0.0008771	-0.000593	2.8384390	0.00000	25.2241907 C
0.00006375	6752.	105920686.	14.1738859	0.0009036	-0.000626	2.8974033	0.00000	25.9821217 C
0.00006625	6976.	105300585.	14.0380979	0.0009300	-0.000660	2.9548387	0.00000	26.7401457 C
0.00006875	7199.	104709692.	13.9111921	0.0009564	-0.000694	3.0105939	0.00000	27.4961895 C
0.00007125	7421.	104154089.	13.7935928	0.0009828	-0.000727	3.0648794	0.00000	28.2530612 C
0.00007375	7642.	103622824.	13.6831604	0.0010091	-0.000761	3.1175150	0.00000	29.0082095 C
0.00007625	7863.	103121068.	13.5804164	0.0010355	-0.000794	3.1686918	0.00000	29.7643459 C
0.00007875	8083.	102640677.	13.4836860	0.0010618	-0.000828	3.2182649	0.00000	30.5193182 C
0.00008125	8302.	102183496.	13.3930894	0.0010882	-0.000862	3.2663408	0.00000	31.2747172 C
0.00008375	8521.	101747965.	13.3081627	0.0011146	-0.000895	3.3129296	0.00000	32.0307503 C
0.00008625	8740.	101328476.	13.2276817	0.0011409	-0.000929	3.3579202	0.00000	32.7855891 C
0.00008875	8957.	100928010.	13.1521239	0.0011673	-0.000963	3.4014441	0.00000	33.5414291 C
0.00009125	9175.	100544974.	13.0810870	0.0011936	-0.000996	3.4434956	0.00000	34.2982766 C
0.00009375	9391.	100174056.	13.0133508	0.0012200	-0.001030	3.4839460	0.00000	35.0537978 C
0.00009625	9607.	99818063.	12.9494837	0.0012464	-0.001064	3.5229197	0.00000	35.8102967 C
0.00009875	9823.	99475895.	12.8892072	0.0012728	-0.001097	3.5604129	0.00000	36.5678174 C
0.0001013	10039.	99146088.	12.8321542	0.0012993	-0.001131	3.5964056	0.00000	37.3260630 C
0.0001038	10253.	98825665.	12.7775711	0.0013257	-0.001164	3.6308238	0.00000	38.0834674 C
0.0001063	10467.	98516385.	12.7258940	0.0013521	-0.001198	3.6637523	0.00000	38.8419089 C
0.0001088	10681.	98217457.	12.6769247	0.0013786	-0.001231	3.6951852	0.00000	39.6013999 C
0.0001113	10895.	97928157.	12.6304829	0.0014051	-0.001265	3.7251164	0.00000	40.3619444 C
0.0001138	11107.	97647192.	12.5862176	0.0014317	-0.001298	3.7535173	0.00000	41.1229348 C
0.0001163	11320.	97373289.	12.5437749	0.0014582	-0.001332	3.7803606	0.00000	41.8836506 C
0.0001188	11531.	97107321.	12.5034316	0.0014848	-0.001365	3.8056913	0.00000	42.6454422 C
0.0001213	11743.	96848772.	12.4650600	0.0015114	-0.001399	3.8295033	0.00000	43.4083173 C
0.0001238	11954.	96597169.	12.4285429	0.0015380	-0.001432	3.8517901	0.00000	44.1722835 C
0.0001263	12164.	96352079.	12.3937722	0.0015647	-0.001465	3.8725451	0.00000	44.9373486 C
0.0001288	12369.	96068257.	12.3631680	0.0015918	-0.001498	3.8919881	0.00000	45.0000000 CY
0.0001313	12563.	95721212.	12.3377288	0.0016193	-0.001531	3.9101569	0.00000	45.0000000 CY
0.0001338	12749.	95322608.	12.3171347	0.0016474	-0.001563	3.9269524	0.00000	45.0000000 CY
0.0001363	12921.	94835037.	12.2976448	0.0016756	-0.001594	3.9420359	0.00000	45.0000000 CY
0.0001388	13074.	94229558.	12.2757965	0.0017033	-0.001627	3.9551865	0.00000	45.0000000 CY
0.0001413	13210.	93521971.	12.2522956	0.0017306	-0.001659	3.9665147	0.00000	45.0000000 CY
0.0001438	13334.	92755038.	12.2277124	0.0017577	-0.001692	3.9761059	0.00000	45.0000000 CY
0.0001463	13448.	91952188.	12.2025265	0.0017846	-0.001725	3.9840260	0.00000	45.0000000 CY
0.0001488	13554.	91118939.	12.1776042	0.0018114	-0.001759	3.9903388	0.00000	45.0000000 CY
0.0001588	13914.	87647832.	12.0783634	0.0019174	-0.001893	3.9992412	0.00000	45.0000000 CY
0.0001688	14199.	84142351.	11.9843260	0.0020224	-0.002028	3.9999639	0.00000	45.0000000 CY
0.0001788	14430.	80726501.	11.8979519	0.0021268	-0.002163	3.9985772	0.00000	45.0000000 CY
0.0001888	14620.	77454711.	11.8186042	0.0022308	-0.002299	3.9985137	0.00000	45.0000000 CY
0.0001988	14778.	74352271.	11.7458273	0.0023345	-0.002436	3.9999726	0.00000	45.0000000 CY
0.0002088	14910.	71424217.	11.6803485	0.0024383	-0.002572	3.9993444	0.00000	45.0000000 CY
0.0002188	15022.	68670886.	11.6206602	0.0025420	-0.002708	3.9999997	0.00000	45.0000000 CY
0.0002288	15118.	66087534.	11.5661097	0.0026457	-0.002844	3.9984962	0.00000	45.0000000 CY
0.0002388	15199.	63660449.	11.5162366	0.0027495	-0.002980	3.9993019	0.00000	45.0000000 CY
0.0002488	15269.	61384518.	11.4713648	0.0028535	-0.003116	3.9996430	0.00000	45.0000000 CY
0.0002588	15330.	59247999.	11.4307637	0.0029577	-0.003252	3.9997365	0.00000	45.0000000 CY
0.0002688	15383.	57239381.	11.3938398	0.0030621	-0.003388	3.9996586	0.00000	45.0000000 CY
0.0002788	15428.	55347785.	11.3595919	0.0031665	-0.003524	3.9993343	0.00000	45.0000000 CY
0.0002888	15467.	53566754.	11.3281696	0.0032710	-0.003659	3.9985501	0.00000	45.0000000 CY
0.0002988	15502.	51887917.	11.2993474	0.0033757	-0.003794	3.9969436	0.00000	45.0000000 CY
0.0003088	15531.	50301902.	11.2737150	0.0034808	-0.003929	3.9995803	0.00000	45.0000000 CY
0.0003188	15556.	48804415.	11.2501336	0.0035860	-0.004064	3.9994784	0.00000	45.0000000 CY
0.0003288	15578.	47386959.	11.2295393	0.0036917	-0.004198	3.9973326	0.00000	45.0000000 CY
0.0003388	15597.	46043663.	11.2097998	0.0037973	-0.004333	3.9998436	0.00000	45.0000000 CY
0.0003488	15613.	44768809.	11.1927991	0.0039035	-0.004467	3.9987434	0.00000	45.0000000 CY

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	237.400	14913.249	0.00300000	-0.00436774
2	320.750	15098.081	0.00300000	-0.00399691
3	442.200	15289.883	0.00300000	-0.00352083
4	502.900	15351.756	0.00300000	-0.00330723

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	237.400000	14913.	154.310000	9694.	94956721.
2	0.65	320.750000	15098.	208.487500	9814.	96334462.
3	0.65	442.200000	15290.	287.430000	9938.	98284127.
4	0.65	502.900000	15352.	326.885000	9979.	99237847.
1	0.75	237.400000	14913.	178.050000	11185.	93726634.
2	0.75	320.750000	15098.	240.562500	11324.	94822186.
3	0.75	442.200000	15290.	331.650000	11467.	96371427.
4	0.75	502.900000	15352.	377.175000	11514.	97129514.
1	0.90	237.400000	14913.	213.660000	13422.	82313416.
2	0.90	320.750000	15098.	288.675000	13588.	84744511.
3	0.90	442.200000	15290.	397.980000	13761.	87535887.
4	0.90	502.900000	15352.	452.610000	13817.	88587656.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	17.2000	0.00	N.A.	No	0.00	4809.
2	20.7000	3.5000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only
for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 4200.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 320750.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.07202	-694283.	4200.	0.00	0.00	1.29E+11	0.00	0.00	9.2200
0.3220	0.07198	-677972.	4236.	-2.06E-05	0.00	1.29E+11	0.00	0.00	9.2200
0.6440	0.07186	-661499.	4271.	-4.07E-05	0.00	1.29E+11	0.00	0.00	9.2200
0.9660	0.07167	-644863.	4307.	-6.04E-05	0.00	1.29E+11	0.00	0.00	9.2200
1.2880	0.07140	-628066.	4343.	-7.95E-05	0.00	1.29E+11	0.00	0.00	9.2200
1.6100	0.07105	-611107.	4378.	-9.81E-05	0.00	1.29E+11	0.00	0.00	9.2200
1.9320	0.07064	-593988.	4414.	-1.16E-04	0.00	1.29E+11	0.00	0.00	9.2200
2.2540	0.07016	-576710.	4449.	-1.34E-04	0.00	1.29E+11	0.00	0.00	9.2200
2.5760	0.06960	-559272.	4485.	-1.51E-04	0.00	1.29E+11	0.00	0.00	9.2200
2.8980	0.06899	-541676.	4521.	-1.67E-04	0.00	1.29E+11	0.00	0.00	9.2200
3.2200	0.06831	-523922.	4556.	-1.83E-04	0.00	1.29E+11	0.00	0.00	9.2200
3.5420	0.06757	-506010.	4592.	-1.99E-04	0.00	1.29E+11	0.00	0.00	9.2200
3.8640	0.06677	-487943.	4628.	-2.14E-04	0.00	1.29E+11	0.00	0.00	9.2200
4.1860	0.06592	-469719.	4663.	-2.28E-04	0.00	1.29E+11	0.00	0.00	9.2200
4.5080	0.06501	-451340.	4699.	-2.42E-04	0.00	1.29E+11	0.00	0.00	9.2200
4.8300	0.06405	-432807.	4734.	-2.55E-04	0.00	1.29E+11	0.00	0.00	9.2200
5.1520	0.06304	-414120.	4770.	-2.68E-04	0.00	1.29E+11	0.00	0.00	9.2200
5.4740	0.06198	-395280.	4806.	-2.80E-04	0.00	1.29E+11	0.00	0.00	9.2200
5.7960	0.06087	-376288.	4841.	-2.92E-04	0.00	1.29E+11	0.00	0.00	9.2200
6.1180	0.05972	-357144.	4877.	-3.03E-04	0.00	1.29E+11	0.00	0.00	9.2200
6.4400	0.05853	-337849.	4913.	-3.13E-04	0.00	1.29E+11	0.00	0.00	9.2200
6.7620	0.05730	-318403.	4948.	-3.23E-04	0.00	1.29E+11	0.00	0.00	9.2200

7.0840	0.05604	-298809.	4984.	-3.32E-04	0.00	1.29E+11	0.00	0.00	9.2200
7.4060	0.05474	-279065.	5019.	-3.41E-04	0.00	1.29E+11	0.00	0.00	9.2200
7.7280	0.05340	-259173.	5055.	-3.49E-04	0.00	1.29E+11	0.00	0.00	9.2200
8.0500	0.05204	-239135.	5091.	-3.57E-04	0.00	1.29E+11	0.00	0.00	9.2200
8.3720	0.05065	-218949.	5126.	-3.63E-04	0.00	1.29E+11	0.00	0.00	9.2200
8.6940	0.04923	-198618.	5162.	-3.70E-04	0.00	1.29E+11	0.00	0.00	9.2200
9.0160	0.04779	-178141.	5198.	-3.75E-04	0.00	1.29E+11	0.00	0.00	9.2200
9.3380	0.04633	-157521.	5233.	-3.80E-04	0.00	1.29E+11	0.00	0.00	9.2200
9.6600	0.04485	-136757.	5269.	-3.85E-04	0.00	1.29E+11	0.00	0.00	9.2200
9.9820	0.04336	-115850.	5304.	-3.89E-04	0.00	1.29E+11	0.00	0.00	9.2200
10.3040	0.04185	-94801.	5340.	-3.92E-04	0.00	1.29E+11	0.00	0.00	9.2200
10.6260	0.04033	-73611.	5376.	-3.94E-04	0.00	1.29E+11	0.00	0.00	9.2200
10.9480	0.03880	-52280.	5411.	-3.96E-04	0.00	1.29E+11	0.00	0.00	9.2200
11.2700	0.03727	-30810.	5447.	-3.97E-04	0.00	1.29E+11	0.00	0.00	9.2200
11.5920	0.03573	-9201.	5483.	-3.98E-04	0.00	1.29E+11	0.00	0.00	9.2200
11.9140	0.03419	12546.	5518.	-3.98E-04	0.00	1.29E+11	0.00	0.00	9.2200
12.2360	0.03265	34430.	5554.	-3.97E-04	0.00	1.29E+11	0.00	0.00	9.2200
12.5580	0.03112	56450.	5589.	-3.96E-04	0.00	1.29E+11	0.00	0.00	9.2200
12.8800	0.02959	78606.	5625.	-3.94E-04	0.00	1.29E+11	0.00	0.00	9.2200
13.2020	0.02807	100897.	5661.	-3.91E-04	0.00	1.29E+11	0.00	0.00	9.2200
13.5240	0.02657	123321.	5696.	-3.88E-04	0.00	1.29E+11	0.00	0.00	9.2200
13.8460	0.02508	145879.	5732.	-3.84E-04	0.00	1.29E+11	0.00	0.00	9.2200
14.1680	0.02360	168569.	5768.	-3.79E-04	0.00	1.29E+11	0.00	0.00	9.2200
14.4900	0.02215	191390.	5803.	-3.74E-04	0.00	1.29E+11	0.00	0.00	9.2200
14.8120	0.02071	214342.	5839.	-3.68E-04	0.00	1.29E+11	0.00	0.00	9.2200
15.1340	0.01931	237424.	5874.	-3.61E-04	0.00	1.29E+11	0.00	0.00	9.2200
15.4560	0.01793	260634.	5910.	-3.53E-04	0.00	1.29E+11	0.00	0.00	9.2200
15.7780	0.01658	283972.	5946.	-3.45E-04	0.00	1.29E+11	0.00	0.00	9.2200
16.1000	0.01526	307438.	5981.	-3.36E-04	0.00	1.29E+11	0.00	0.00	9.2200
16.4220	0.01398	331029.	6017.	-3.27E-04	0.00	1.29E+11	0.00	0.00	9.2200
16.7440	0.01273	354746.	6053.	-3.16E-04	0.00	1.29E+11	0.00	0.00	9.2200
17.0660	0.01153	378588.	6087.	-3.05E-04	0.00	1.29E+11	0.00	0.00	8.4469
17.3880	0.01038	402541.	6103.	-2.94E-04	0.00	1.29E+11	-0.221	82.3774	0.00
17.7100	0.00926	426476.	6101.	-2.81E-04	0.00	1.29E+11	-0.536	223.4706	0.00
18.0320	0.00820	450388.	6099.	-2.68E-04	0.00	1.29E+11	-0.774	364.5638	0.00
18.3540	0.00719	474271.	6095.	-2.54E-04	0.00	1.29E+11	-0.941	505.6570	0.00
18.6760	0.00624	498122.	6091.	-2.40E-04	0.00	1.29E+11	-1.044	646.7501	0.00
18.9980	0.00534	521939.	6087.	-2.24E-04	0.00	1.29E+11	-1.089	787.8433	0.00
19.3200	0.00451	545720.	6083.	-2.08E-04	0.00	1.29E+11	-1.083	928.9365	0.00
19.6420	0.00373	569465.	6079.	-1.91E-04	0.00	1.29E+11	-1.034	1070.	0.00
19.9640	0.00303	593173.	6075.	-1.74E-04	0.00	1.29E+11	-0.949	1211.	0.00
20.2860	0.00239	616845.	6072.	-1.56E-04	0.00	1.29E+11	-0.836	1352.	0.00
20.6080	0.00182	640482.	6069.	-1.37E-04	0.00	1.29E+11	-0.705	1493.	0.00
20.9300	0.00133	664084.	921.9697	-1.17E-04	0.00	1.29E+11	-2663.	7728000.	0.00
21.2520	9.17E-04	647898.	-7767.	-9.76E-05	0.00	1.29E+11	-1834.	7728000.	0.00
21.5740	5.78E-04	604304.	-13542.	-7.88E-05	0.00	1.29E+11	-1155.	7728000.	0.00
21.8960	3.08E-04	543441.	-16965.	-6.15E-05	0.00	1.29E+11	-616.635	7728000.	0.00
22.2180	1.02E-04	473350.	-18551.	-4.63E-05	0.00	1.29E+11	-204.243	7728000.	0.00
22.5400	-4.91E-05	400193.	-18756.	-3.31E-05	0.00	1.29E+11	98.2632	7728000.	0.00
22.8620	-1.54E-04	328488.	-17971.	-2.22E-05	0.00	1.29E+11	307.8664	7728000.	0.00
23.1840	-2.21E-04	261367.	-16524.	-1.33E-05	0.00	1.29E+11	441.2132	7728000.	0.00
23.5060	-2.57E-04	200824.	-14679.	-6.39E-06	0.00	1.29E+11	513.8857	7728000.	0.00
23.8280	-2.70E-04	147946.	-12643.	-1.15E-06	0.00	1.29E+11	539.9384	7728000.	0.00
24.1500	-2.66E-04	103124.	-10572.	2.62E-06	0.00	1.29E+11	531.6467	7728000.	0.00
24.4720	-2.50E-04	66236.	-8580.	5.17E-06	0.00	1.29E+11	499.4157	7728000.	0.00
24.7940	-2.26E-04	36802.	-6743.	6.71E-06	0.00	1.29E+11	451.8087	7728000.	0.00
25.1160	-1.98E-04	14112.	-5105.	7.48E-06	0.00	1.29E+11	395.6584	7728000.	0.00
25.4380	-1.68E-04	-2671.	-3691.	7.65E-06	0.00	1.29E+11	336.2321	7728000.	0.00
25.7600	-1.39E-04	-14433.	-2506.	7.39E-06	0.00	1.29E+11	277.4258	7728000.	0.00
26.0820	-1.11E-04	-22053.	-1541.	6.84E-06	0.00	1.29E+11	221.9701	7728000.	0.00
26.4040	-8.58E-05	-26358.	-780.436	6.12E-06	0.00	1.29E+11	171.6338	7728000.	0.00
26.7260	-6.37E-05	-28100.	-202.671	5.30E-06	0.00	1.29E+11	127.4164	7728000.	0.00
27.0480	-4.49E-05	-27938.	216.8406	4.46E-06	0.00	1.29E+11	89.7220	7728000.	0.00
27.3700	-2.93E-05	-26435.	503.2309	3.64E-06	0.00	1.29E+11	58.5131	7728000.	0.00
27.6920	-1.67E-05	-24058.	680.8861	2.88E-06	0.00	1.29E+11	33.4409	7728000.	0.00
28.0140	-6.98E-06	-21180.	772.4518	2.20E-06	0.00	1.29E+11	13.9534	7728000.	0.00
28.3360	3.09E-07	-18094.	798.2171	1.61E-06	0.00	1.29E+11	-0.617	7728000.	0.00
28.6580	5.49E-06	-15015.	775.7961	1.12E-06	0.00	1.29E+11	-10.988	7728000.	0.00
28.9800	8.94E-06	-12101.	720.0382	7.09E-07	0.00	1.29E+11	-17.872	7728000.	0.00
29.3020	1.10E-05	-9453.	643.1050	3.85E-07	0.00	1.29E+11	-21.948	7728000.	0.00
29.6240	1.19E-05	-7132.	554.6633	1.36E-07	0.00	1.29E+11	-23.829	7728000.	0.00
29.9460	1.20E-05	-5167.	462.1513	-4.84E-08	0.00	1.29E+11	-24.055	7728000.	0.00
30.2680	1.15E-05	-3560.	371.0851	-1.79E-07	0.00	1.29E+11	-23.081	7728000.	0.00
30.5900	1.06E-05	-2298.	285.3785	-2.67E-07	0.00	1.29E+11	-21.281	7728000.	0.00
30.9120	9.47E-06	-1354.	207.6594	-3.22E-07	0.00	1.29E+11	-18.947	7728000.	0.00
31.2340	8.15E-06	-692.901	139.5659	-3.53E-07	0.00	1.29E+11	-16.298	7728000.	0.00
31.5560	6.74E-06	-274.839	82.0163	-3.68E-07	0.00	1.29E+11	-13.489	7728000.	0.00
31.8780	5.31E-06	-58.168	35.4446	-3.73E-07	0.00	1.29E+11	-10.616	7728000.	0.00
32.2000	3.86E-06	0.00	0.00	-3.74E-07	0.00	1.29E+11	-7.730	3864000.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.07202223 inches

```
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =       -694283. inch-lbs
Maximum shear force              =        -18756. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =    22.54000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              2
Pile deflection at ground        =     0.01105128 inches
```

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 2, Shear and Slope

```
Shear      =           4200. lbs
Slope      =        0.00000
Axial Load =         320750. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
32.20000	0.07202223	-694283.	-18756.
30.59000	0.07078892	-689907.	-18689.
28.98000	0.07152096	-692521.	-18759.
27.37000	0.07096921	-690583.	-18534.
25.76000	0.07174557	-693324.	-19114.
24.15000	0.07293160	-697811.	-23980.
22.54000	0.09932980	-802288.	-36369.
20.93000	0.23585056	-1383341.	6102.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

```
Shear force at pile head                          =       4800.0 lbs
Rotation of pile head                             =    0.000E+00 radians
Axial load at pile head                           =     502900.0 lbs
```

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.07655	-745722.	4800.	0.00	0.00	1.27E+11	0.00	0.00	6.1300
0.3220	0.07651	-727107.	4824.	-2.25E-05	0.00	1.27E+11	0.00	0.00	6.1300
0.6440	0.07638	-708357.	4847.	-4.44E-05	0.00	1.27E+11	0.00	0.00	6.1300
0.9660	0.07616	-689474.	4871.	-6.57E-05	0.00	1.27E+11	0.00	0.00	6.1300
1.2880	0.07587	-670458.	4895.	-8.65E-05	0.00	1.27E+11	0.00	0.00	6.1300
1.6100	0.07549	-651311.	4918.	-1.07E-04	0.00	1.27E+11	0.00	0.00	6.1300
1.9320	0.07504	-632034.	4942.	-1.26E-04	0.00	1.27E+11	0.00	0.00	6.1300
2.2540	0.07452	-612627.	4966.	-1.45E-04	0.00	1.27E+11	0.00	0.00	6.1300
2.5760	0.07392	-593093.	4989.	-1.64E-04	0.00	1.27E+11	0.00	0.00	6.1300
2.8980	0.07325	-573432.	5013.	-1.82E-04	0.00	1.27E+11	0.00	0.00	6.1300
3.2200	0.07252	-553646.	5037.	-1.99E-04	0.00	1.27E+11	0.00	0.00	6.1300
3.5420	0.07172	-533735.	5061.	-2.15E-04	0.00	1.27E+11	0.00	0.00	6.1300
3.8640	0.07085	-513701.	5084.	-2.31E-04	0.00	1.27E+11	0.00	0.00	6.1300
4.1860	0.06993	-493545.	5108.	-2.47E-04	0.00	1.27E+11	0.00	0.00	6.1300
4.5080	0.06895	-473268.	5132.	-2.61E-04	0.00	1.27E+11	0.00	0.00	6.1300
4.8300	0.06791	-452872.	5155.	-2.76E-04	0.00	1.27E+11	0.00	0.00	6.1300
5.1520	0.06682	-432357.	5179.	-2.89E-04	0.00	1.27E+11	0.00	0.00	6.1300
5.4740	0.06567	-411725.	5203.	-3.02E-04	0.00	1.27E+11	0.00	0.00	6.1300
5.7960	0.06448	-390977.	5226.	-3.14E-04	0.00	1.27E+11	0.00	0.00	6.1300
6.1180	0.06325	-370115.	5250.	-3.26E-04	0.00	1.27E+11	0.00	0.00	6.1300
6.4400	0.06197	-349139.	5274.	-3.37E-04	0.00	1.27E+11	0.00	0.00	6.1300
6.7620	0.06064	-328050.	5297.	-3.47E-04	0.00	1.27E+11	0.00	0.00	6.1300
7.0840	0.05928	-306851.	5321.	-3.57E-04	0.00	1.27E+11	0.00	0.00	6.1300
7.4060	0.05788	-285542.	5345.	-3.66E-04	0.00	1.27E+11	0.00	0.00	6.1300
7.7280	0.05645	-264124.	5368.	-3.74E-04	0.00	1.27E+11	0.00	0.00	6.1300
8.0500	0.05499	-242600.	5392.	-3.82E-04	0.00	1.27E+11	0.00	0.00	6.1300
8.3720	0.05350	-220969.	5416.	-3.89E-04	0.00	1.27E+11	0.00	0.00	6.1300
8.6940	0.05198	-199234.	5440.	-3.96E-04	0.00	1.27E+11	0.00	0.00	6.1300
9.0160	0.05044	-177395.	5463.	-4.01E-04	0.00	1.27E+11	0.00	0.00	6.1300
9.3380	0.04888	-155454.	5487.	-4.06E-04	0.00	1.27E+11	0.00	0.00	6.1300
9.6600	0.04730	-133413.	5511.	-4.11E-04	0.00	1.27E+11	0.00	0.00	6.1300
9.9820	0.04571	-111272.	5534.	-4.15E-04	0.00	1.27E+11	0.00	0.00	6.1300
10.3040	0.04410	-89033.	5558.	-4.18E-04	0.00	1.27E+11	0.00	0.00	6.1300
10.6260	0.04248	-66697.	5582.	-4.20E-04	0.00	1.27E+11	0.00	0.00	6.1300
10.9480	0.04086	-44266.	5605.	-4.22E-04	0.00	1.27E+11	0.00	0.00	6.1300
11.2700	0.03922	-21740.	5629.	-4.23E-04	0.00	1.27E+11	0.00	0.00	6.1300
11.5920	0.03759	877.9966	5653.	-4.23E-04	0.00	1.27E+11	0.00	0.00	6.1300
11.9140	0.03595	23588.	5676.	-4.23E-04	0.00	1.27E+11	0.00	0.00	6.1300

12.2360	0.03432	46388.	5700.	-4.22E-04	0.00	1.27E+11	0.00	0.00	6.1300
12.5580	0.03270	69276.	5724.	-4.20E-04	0.00	1.27E+11	0.00	0.00	6.1300
12.8800	0.03108	92252.	5747.	-4.17E-04	0.00	1.27E+11	0.00	0.00	6.1300
13.2020	0.02947	115314.	5771.	-4.14E-04	0.00	1.27E+11	0.00	0.00	6.1300
13.5240	0.02788	138461.	5795.	-4.10E-04	0.00	1.27E+11	0.00	0.00	6.1300
13.8460	0.02630	161691.	5819.	-4.06E-04	0.00	1.27E+11	0.00	0.00	6.1300
14.1680	0.02474	185003.	5842.	-4.00E-04	0.00	1.27E+11	0.00	0.00	6.1300
14.4900	0.02321	208396.	5866.	-3.94E-04	0.00	1.27E+11	0.00	0.00	6.1300
14.8120	0.02170	231868.	5890.	-3.88E-04	0.00	1.27E+11	0.00	0.00	6.1300
15.1340	0.02021	255417.	5913.	-3.80E-04	0.00	1.27E+11	0.00	0.00	6.1300
15.4560	0.01876	279043.	5937.	-3.72E-04	0.00	1.27E+11	0.00	0.00	6.1300
15.7780	0.01734	302744.	5961.	-3.63E-04	0.00	1.27E+11	0.00	0.00	6.1300
16.1000	0.01595	326518.	5984.	-3.54E-04	0.00	1.27E+11	0.00	0.00	6.1300
16.4220	0.01460	350365.	6008.	-3.43E-04	0.00	1.27E+11	0.00	0.00	6.1300
16.7440	0.01330	374282.	6032.	-3.32E-04	0.00	1.27E+11	0.00	0.00	6.1300
17.0660	0.01204	398269.	6054.	-3.20E-04	0.00	1.27E+11	0.00	0.00	5.6160
17.3880	0.01082	422315.	6065.	-3.08E-04	0.00	1.27E+11	-0.231	82.3774	0.00
17.7100	0.00966	446334.	6063.	-2.95E-04	0.00	1.27E+11	-0.559	223.4706	0.00
18.0320	0.00855	470317.	6061.	-2.81E-04	0.00	1.27E+11	-0.806	364.5638	0.00
18.3540	0.00749	494261.	6057.	-2.66E-04	0.00	1.27E+11	-0.980	505.6570	0.00
18.6760	0.00649	518160.	6053.	-2.50E-04	0.00	1.27E+11	-1.086	646.7501	0.00
18.9980	0.00555	542013.	6049.	-2.34E-04	0.00	1.27E+11	-1.132	787.8433	0.00
19.3200	0.00468	565816.	6045.	-2.17E-04	0.00	1.27E+11	-1.125	928.9365	0.00
19.6420	0.00387	589569.	6040.	-2.00E-04	0.00	1.27E+11	-1.073	1070.	0.00
19.9640	0.00314	613272.	6036.	-1.81E-04	0.00	1.27E+11	-0.984	1211.	0.00
20.2860	0.00247	636923.	6033.	-1.62E-04	0.00	1.27E+11	-0.866	1352.	0.00
20.6080	0.00188	660523.	6030.	-1.42E-04	0.00	1.27E+11	-0.728	1493.	0.00
20.9300	0.00137	684073.	722.5915	-1.22E-04	0.00	1.27E+11	-2746.	7728000.	0.00
21.2520	9.43E-04	666581.	-8225.	-1.01E-04	0.00	1.27E+11	-1885.	7728000.	0.00
21.5740	5.91E-04	620904.	-14149.	-8.16E-05	0.00	1.27E+11	-1181.	7728000.	0.00
21.8960	3.12E-04	557554.	-17637.	-6.36E-05	0.00	1.27E+11	-623.918	7728000.	0.00
22.2180	9.91E-05	484855.	-19225.	-4.77E-05	0.00	1.27E+11	-198.178	7728000.	0.00
22.5400	-5.66E-05	409169.	-19389.	-3.40E-05	0.00	1.27E+11	113.1464	7728000.	0.00
22.8620	-1.64E-04	335148.	-18537.	-2.27E-05	0.00	1.27E+11	327.9159	7728000.	0.00
23.1840	-2.32E-04	266002.	-17008.	-1.35E-05	0.00	1.27E+11	463.5984	7728000.	0.00
23.5060	-2.68E-04	203763.	-15076.	-6.32E-06	0.00	1.27E+11	536.5107	7728000.	0.00
23.8280	-2.81E-04	149522.	-12955.	-9.30E-07	0.00	1.27E+11	561.3400	7728000.	0.00
24.1500	-2.75E-04	103654.	-10806.	2.94E-06	0.00	1.27E+11	550.8858	7728000.	0.00
24.4720	-2.58E-04	66004.	-8745.	5.53E-06	0.00	1.27E+11	515.9720	7728000.	0.00
24.7940	-2.33E-04	36054.	-6848.	7.08E-06	0.00	1.27E+11	465.4830	7728000.	0.00
25.1160	-2.03E-04	13051.	-5164.	7.83E-06	0.00	1.27E+11	406.4863	7728000.	0.00
25.4380	-1.72E-04	-3883.	-3713.	7.97E-06	0.00	1.27E+11	344.4098	7728000.	0.00
25.7600	-1.42E-04	-15674.	-2500.	7.67E-06	0.00	1.27E+11	283.2495	7728000.	0.00
26.0820	-1.13E-04	-23236.	-1517.	7.08E-06	0.00	1.27E+11	225.7880	7728000.	0.00
26.4040	-8.69E-05	-27425.	-744.960	6.31E-06	0.00	1.27E+11	173.8096	7728000.	0.00
26.7260	-6.42E-05	-29018.	-161.278	5.45E-06	0.00	1.27E+11	128.3028	7728000.	0.00
27.0480	-4.48E-05	-28693.	259.7939	4.56E-06	0.00	1.27E+11	89.6435	7728000.	0.00
27.3700	-2.89E-05	-27028.	544.5675	3.71E-06	0.00	1.27E+11	57.7549	7728000.	0.00
27.6920	-1.61E-05	-24499.	718.4455	2.93E-06	0.00	1.27E+11	32.2441	7728000.	0.00
28.0140	-6.26E-06	-21487.	804.9190	2.22E-06	0.00	1.27E+11	12.5144	7728000.	0.00
28.3360	1.07E-06	-18287.	824.9528	1.62E-06	0.00	1.27E+11	-2.145	7728000.	0.00
28.6580	6.24E-06	-15118.	796.6799	1.11E-06	0.00	1.27E+11	-12.489	7728000.	0.00
28.9800	9.63E-06	-12134.	735.3297	6.92E-07	0.00	1.27E+11	-19.266	7728000.	0.00
29.3020	1.16E-05	-9438.	653.3267	3.62E-07	0.00	1.27E+11	-23.179	7728000.	0.00
29.6240	1.24E-05	-7087.	560.5058	1.10E-07	0.00	1.27E+11	-24.865	7728000.	0.00
29.9460	1.24E-05	-5107.	464.4008	-7.62E-08	0.00	1.27E+11	-24.879	7728000.	0.00
30.2680	1.18E-05	-3498.	370.5708	-2.08E-07	0.00	1.27E+11	-23.687	7728000.	0.00
30.5900	1.08E-05	-2242.	282.9388	-2.95E-07	0.00	1.27E+11	-21.671	7728000.	0.00
30.9120	9.56E-06	-1310.	204.1216	-3.49E-07	0.00	1.27E+11	-19.125	7728000.	0.00
31.2340	8.13E-06	-663.426	135.7387	-3.80E-07	0.00	1.27E+11	-16.270	7728000.	0.00
31.5560	6.63E-06	-259.633	78.6899	-3.94E-07	0.00	1.27E+11	-13.258	7728000.	0.00
31.8780	5.09E-06	-53.780	33.3961	-3.98E-07	0.00	1.27E+11	-10.186	7728000.	0.00
32.2000	3.55E-06	0.00	0.00	-3.99E-07	0.00	1.27E+11	-7.100	3864000.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     0.07654920 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =       -745722. inch-lbs
Maximum shear force              =        -19389. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =    22.54000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              2
Pile deflection at ground        =     0.01153131 inches
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 2, Shear and Slope

Shear = 4800. lbs
Slope = 0.00000
Axial Load = 502900. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
32.20000	0.07654920	-745722.	-19389.
30.59000	0.07525381	-741156.	-19336.
28.98000	0.07602191	-743881.	-19420.
27.37000	0.07544283	-741861.	-19177.
25.76000	0.07625387	-744708.	-19744.
24.15000	0.07744128	-749166.	-24717.
22.54000	0.10507456	-857617.	-37809.
20.93000	0.25540484	-1491418.	6064.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 4470.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 237400.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.08589	-807597.	4470.	0.00	0.00	1.30E+11	0.00	0.00	15.6300
0.3220	0.08584	-790197.	4530.	-2.38E-05	0.00	1.30E+11	0.00	0.00	15.6300
0.6440	0.08570	-772542.	4591.	-4.71E-05	0.00	1.30E+11	0.00	0.00	15.6300
0.9660	0.08548	-754633.	4651.	-6.99E-05	0.00	1.30E+11	0.00	0.00	15.6300
1.2880	0.08516	-736470.	4712.	-9.21E-05	0.00	1.30E+11	0.00	0.00	15.6300
1.6100	0.08476	-718053.	4772.	-1.14E-04	0.00	1.30E+11	0.00	0.00	15.6300
1.9320	0.08428	-699383.	4832.	-1.35E-04	0.00	1.30E+11	0.00	0.00	15.6300
2.2540	0.08372	-680461.	4893.	-1.56E-04	0.00	1.30E+11	0.00	0.00	15.6300
2.5760	0.08308	-661287.	4953.	-1.76E-04	0.00	1.30E+11	0.00	0.00	15.6300
2.8980	0.08236	-641861.	5014.	-1.95E-04	0.00	1.30E+11	0.00	0.00	15.6300
3.2200	0.08157	-622184.	5074.	-2.14E-04	0.00	1.30E+11	0.00	0.00	15.6300
3.5420	0.08071	-602257.	5134.	-2.32E-04	0.00	1.30E+11	0.00	0.00	15.6300
3.8640	0.07978	-582080.	5195.	-2.50E-04	0.00	1.30E+11	0.00	0.00	15.6300
4.1860	0.07878	-561654.	5255.	-2.67E-04	0.00	1.30E+11	0.00	0.00	15.6300
4.5080	0.07772	-540979.	5316.	-2.83E-04	0.00	1.30E+11	0.00	0.00	15.6300
4.8300	0.07659	-520056.	5376.	-2.99E-04	0.00	1.30E+11	0.00	0.00	15.6300
5.1520	0.07541	-498886.	5436.	-3.14E-04	0.00	1.30E+11	0.00	0.00	15.6300
5.4740	0.07417	-477468.	5497.	-3.29E-04	0.00	1.30E+11	0.00	0.00	15.6300
5.7960	0.07287	-455804.	5557.	-3.43E-04	0.00	1.30E+11	0.00	0.00	15.6300
6.1180	0.07152	-433894.	5617.	-3.56E-04	0.00	1.30E+11	0.00	0.00	15.6300
6.4400	0.07012	-411739.	5678.	-3.69E-04	0.00	1.30E+11	0.00	0.00	15.6300
6.7620	0.06867	-389339.	5738.	-3.81E-04	0.00	1.30E+11	0.00	0.00	15.6300
7.0840	0.06718	-366695.	5799.	-3.92E-04	0.00	1.30E+11	0.00	0.00	15.6300
7.4060	0.06564	-343808.	5859.	-4.02E-04	0.00	1.30E+11	0.00	0.00	15.6300
7.7280	0.06407	-320678.	5919.	-4.12E-04	0.00	1.30E+11	0.00	0.00	15.6300
8.0500	0.06245	-297306.	5980.	-4.22E-04	0.00	1.30E+11	0.00	0.00	15.6300
8.3720	0.06081	-273692.	6040.	-4.30E-04	0.00	1.30E+11	0.00	0.00	15.6300
8.6940	0.05913	-249838.	6101.	-4.38E-04	0.00	1.30E+11	0.00	0.00	15.6300
9.0160	0.05742	-225743.	6161.	-4.45E-04	0.00	1.30E+11	0.00	0.00	15.6300
9.3380	0.05569	-201409.	6221.	-4.51E-04	0.00	1.30E+11	0.00	0.00	15.6300
9.6600	0.05394	-176836.	6282.	-4.57E-04	0.00	1.30E+11	0.00	0.00	15.6300
9.9820	0.05216	-152025.	6342.	-4.62E-04	0.00	1.30E+11	0.00	0.00	15.6300
10.3040	0.05037	-126976.	6403.	-4.66E-04	0.00	1.30E+11	0.00	0.00	15.6300
10.6260	0.04856	-101690.	6463.	-4.69E-04	0.00	1.30E+11	0.00	0.00	15.6300
10.9480	0.04674	-76169.	6523.	-4.72E-04	0.00	1.30E+11	0.00	0.00	15.6300
11.2700	0.04491	-50411.	6584.	-4.74E-04	0.00	1.30E+11	0.00	0.00	15.6300
11.5920	0.04308	-24419.	6644.	-4.75E-04	0.00	1.30E+11	0.00	0.00	15.6300
11.9140	0.04124	1807.	6705.	-4.75E-04	0.00	1.30E+11	0.00	0.00	15.6300
12.2360	0.03940	28266.	6765.	-4.75E-04	0.00	1.30E+11	0.00	0.00	15.6300
12.5580	0.03757	54958.	6825.	-4.74E-04	0.00	1.30E+11	0.00	0.00	15.6300
12.8800	0.03574	81882.	6886.	-4.72E-04	0.00	1.30E+11	0.00	0.00	15.6300
13.2020	0.03392	109036.	6946.	-4.69E-04	0.00	1.30E+11	0.00	0.00	15.6300
13.5240	0.03212	136422.	7007.	-4.65E-04	0.00	1.30E+11	0.00	0.00	15.6300
13.8460	0.03033	164037.	7067.	-4.61E-04	0.00	1.30E+11	0.00	0.00	15.6300
14.1680	0.02856	191880.	7127.	-4.55E-04	0.00	1.30E+11	0.00	0.00	15.6300
14.4900	0.02681	219952.	7188.	-4.49E-04	0.00	1.30E+11	0.00	0.00	15.6300
14.8120	0.02509	248251.	7248.	-4.42E-04	0.00	1.30E+11	0.00	0.00	15.6300
15.1340	0.02339	276777.	7309.	-4.34E-04	0.00	1.30E+11	0.00	0.00	15.6300
15.4560	0.02173	305529.	7369.	-4.26E-04	0.00	1.30E+11	0.00	0.00	15.6300
15.7780	0.02010	334505.	7429.	-4.16E-04	0.00	1.30E+11	0.00	0.00	15.6300
16.1000	0.01851	363706.	7490.	-4.06E-04	0.00	1.30E+11	0.00	0.00	15.6300
16.4220	0.01697	393130.	7550.	-3.95E-04	0.00	1.30E+11	0.00	0.00	15.6300
16.7440	0.01546	422777.	7611.	-3.82E-04	0.00	1.30E+11	0.00	0.00	15.6300
17.0660	0.01401	452646.	7668.	-3.69E-04	0.00	1.30E+11	0.00	0.00	14.3194

17.3880	0.01261	482716.	7696.	-3.55E-04	0.00	1.30E+11	-0.269	82.3774	0.00
17.7100	0.01126	512769.	7694.	-3.41E-04	0.00	1.30E+11	-0.651	223.4706	0.00
18.0320	0.00998	542798.	7691.	-3.25E-04	0.00	1.30E+11	-0.941	364.5638	0.00
18.3540	0.00875	572798.	7687.	-3.08E-04	0.00	1.30E+11	-1.146	505.6570	0.00
18.6760	0.00760	602765.	7682.	-2.91E-04	0.00	1.30E+11	-1.272	646.7501	0.00
18.9980	0.00651	632697.	7677.	-2.72E-04	0.00	1.30E+11	-1.327	787.8433	0.00
19.3200	0.00549	662592.	7672.	-2.53E-04	0.00	1.30E+11	-1.321	928.9365	0.00
19.6420	0.00455	692449.	7667.	-2.33E-04	0.00	1.30E+11	-1.261	1070.	0.00
19.9640	0.00370	722268.	7662.	-2.12E-04	0.00	1.30E+11	-1.158	1211.	0.00
20.2860	0.00292	752050.	7658.	-1.90E-04	0.00	1.30E+11	-1.022	1352.	0.00
20.6080	0.00223	781797.	7654.	-1.67E-04	0.00	1.30E+11	-0.862	1493.	0.00
20.9300	0.00163	811509.	1350.	-1.43E-04	0.00	1.30E+11	-3262.	7728000.	0.00
21.2520	0.00113	792492.	-9301.	-1.19E-04	0.00	1.30E+11	-2251.	7728000.	0.00
21.5740	7.11E-04	739847.	-16398.	-9.62E-05	0.00	1.30E+11	-1422.	7728000.	0.00
21.8960	3.82E-04	665946.	-20622.	-7.52E-05	0.00	1.30E+11	-764.188	7728000.	0.00
22.2180	1.30E-04	580617.	-22600.	-5.66E-05	0.00	1.30E+11	-259.555	7728000.	0.00
22.5400	-5.56E-05	491397.	-22887.	-4.07E-05	0.00	1.30E+11	111.2673	7728000.	0.00
22.8620	-1.84E-04	403824.	-21959.	-2.73E-05	0.00	1.30E+11	368.8412	7728000.	0.00
23.1840	-2.67E-04	321748.	-20216.	-1.65E-05	0.00	1.30E+11	533.3495	7728000.	0.00
23.5060	-3.12E-04	247626.	-17981.	-8.00E-06	0.00	1.30E+11	623.7080	7728000.	0.00
23.8280	-3.28E-04	182809.	-15506.	-1.58E-06	0.00	1.30E+11	656.9991	7728000.	0.00
24.1500	-3.24E-04	127797.	-12985.	3.05E-06	0.00	1.30E+11	648.1603	7728000.	0.00
24.4720	-3.05E-04	82458.	-10554.	6.18E-06	0.00	1.30E+11	609.8697	7728000.	0.00
24.7940	-2.76E-04	46223.	-8308.	8.10E-06	0.00	1.30E+11	552.5759	7728000.	0.00
25.1160	-2.42E-04	18237.	-6304.	9.06E-06	0.00	1.30E+11	484.6296	7728000.	0.00
25.4380	-2.06E-04	-2513.	-4571.	9.30E-06	0.00	1.30E+11	412.4803	7728000.	0.00
25.7600	-1.70E-04	-17106.	-3116.	9.01E-06	0.00	1.30E+11	340.9102	7728000.	0.00
26.0820	-1.37E-04	-26607.	-1929.	8.35E-06	0.00	1.30E+11	273.2823	7728000.	0.00
26.4040	-1.06E-04	-32028.	-991.835	7.48E-06	0.00	1.30E+11	211.7862	7728000.	0.00
26.7260	-7.88E-05	-34286.	-278.043	6.49E-06	0.00	1.30E+11	157.6713	7728000.	0.00
27.0480	-5.57E-05	-34189.	241.9139	5.47E-06	0.00	1.30E+11	111.4578	7728000.	0.00
27.3700	-3.66E-05	-32426.	598.5246	4.48E-06	0.00	1.30E+11	73.1233	7728000.	0.00
27.6920	-2.11E-05	-29572.	821.4488	3.55E-06	0.00	1.30E+11	42.2618	7728000.	0.00
28.0140	-9.11E-06	-26085.	938.2908	2.72E-06	0.00	1.30E+11	18.2153	7728000.	0.00
28.3360	-9.02E-08	-22325.	973.8312	2.00E-06	0.00	1.30E+11	0.1803	7728000.	0.00
28.6580	6.35E-06	-18563.	949.6244	1.39E-06	0.00	1.30E+11	-12.710	7728000.	0.00
28.9800	1.07E-05	-14989.	883.8758	8.91E-07	0.00	1.30E+11	-21.322	7728000.	0.00
29.3020	1.32E-05	-11734.	791.5240	4.92E-07	0.00	1.30E+11	-26.479	7728000.	0.00
29.6240	1.45E-05	-8873.	684.4675	1.85E-07	0.00	1.30E+11	-28.933	7728000.	0.00
29.9460	1.47E-05	-6445.	571.8815	-4.32E-08	0.00	1.30E+11	-29.341	7728000.	0.00
30.2680	1.41E-05	-4454.	460.5860	-2.06E-07	0.00	1.30E+11	-28.265	7728000.	0.00
30.5900	1.31E-05	-2885.	355.4336	-3.15E-07	0.00	1.30E+11	-26.162	7728000.	0.00
30.9120	1.17E-05	-1706.	259.6916	-3.84E-07	0.00	1.30E+11	-23.394	7728000.	0.00
31.2340	1.01E-05	-877.170	175.4043	-4.22E-07	0.00	1.30E+11	-20.233	7728000.	0.00
31.5560	8.43E-06	-350.053	103.7218	-4.40E-07	0.00	1.30E+11	-16.870	7728000.	0.00
31.8780	6.71E-06	-74.800	45.1907	-4.47E-07	0.00	1.30E+11	-13.426	7728000.	0.00
32.2000	4.98E-06	0.00	0.00	-4.48E-07	0.00	1.30E+11	-9.965	3864000.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 3:

```
Pile-head deflection             =     0.08588699 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =        811509. inch-lbs
Maximum shear force              =        -22887. lbs
Depth of maximum bending moment  =    20.93000000 feet below pile head
Depth of maximum shear force     =    22.54000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              2
Pile deflection at ground        =     0.01342755 inches
```

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 2, Shear and Slope

```
Shear      =           4470. lbs
Slope      =        0.00000
Axial Load =         237400. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
32.20000	0.08588699	811509.	-22887.
30.59000	0.08438901	804700.	-22789.
28.98000	0.08527861	807607.	-22868.
27.37000	0.08460813	803913.	-22611.
25.76000	0.08555365	806661.	-23332.
24.15000	0.08702307	-812012.	-29303.

22.54000	0.11907722	-939344.	-44256.
20.93000	0.28110636	-1631488.	7694.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 4

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 5860.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 442200.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.09841	-947893.	5860.	0.00	0.00	1.27E+11	0.00	0.00	10.7100
0.3220	0.09835	-925145.	5901.	-2.84E-05	0.00	1.27E+11	0.00	0.00	10.7100
0.6440	0.09819	-902190.	5943.	-5.62E-05	0.00	1.27E+11	0.00	0.00	10.7100
0.9660	0.09792	-879027.	5984.	-8.32E-05	0.00	1.27E+11	0.00	0.00	10.7100
1.2880	0.09754	-855660.	6026.	-1.10E-04	0.00	1.27E+11	0.00	0.00	10.7100
1.6100	0.09707	-832088.	6067.	-1.35E-04	0.00	1.27E+11	0.00	0.00	10.7100
1.9320	0.09650	-808313.	6108.	-1.60E-04	0.00	1.27E+11	0.00	0.00	10.7100
2.2540	0.09583	-784336.	6150.	-1.84E-04	0.00	1.27E+11	0.00	0.00	10.7100
2.5760	0.09507	-760158.	6191.	-2.08E-04	0.00	1.27E+11	0.00	0.00	10.7100
2.8980	0.09423	-735781.	6232.	-2.30E-04	0.00	1.27E+11	0.00	0.00	10.7100
3.2200	0.09329	-711206.	6274.	-2.52E-04	0.00	1.27E+11	0.00	0.00	10.7100
3.5420	0.09228	-686434.	6315.	-2.74E-04	0.00	1.27E+11	0.00	0.00	10.7100
3.8640	0.09118	-661467.	6357.	-2.94E-04	0.00	1.27E+11	0.00	0.00	10.7100
4.1860	0.09000	-636305.	6398.	-3.14E-04	0.00	1.27E+11	0.00	0.00	10.7100
4.5080	0.08875	-610951.	6439.	-3.33E-04	0.00	1.27E+11	0.00	0.00	10.7100
4.8300	0.08743	-585405.	6481.	-3.51E-04	0.00	1.27E+11	0.00	0.00	10.7100
5.1520	0.08604	-559668.	6522.	-3.68E-04	0.00	1.27E+11	0.00	0.00	10.7100
5.4740	0.08459	-533743.	6564.	-3.85E-04	0.00	1.27E+11	0.00	0.00	10.7100
5.7960	0.08307	-507630.	6605.	-4.01E-04	0.00	1.27E+11	0.00	0.00	10.7100
6.1180	0.08149	-481331.	6646.	-4.16E-04	0.00	1.27E+11	0.00	0.00	10.7100
6.4400	0.07985	-454847.	6688.	-4.30E-04	0.00	1.27E+11	0.00	0.00	10.7100
6.7620	0.07817	-428179.	6729.	-4.43E-04	0.00	1.27E+11	0.00	0.00	10.7100
7.0840	0.07643	-401330.	6770.	-4.56E-04	0.00	1.27E+11	0.00	0.00	10.7100
7.4060	0.07464	-374299.	6812.	-4.68E-04	0.00	1.27E+11	0.00	0.00	10.7100
7.7280	0.07281	-347090.	6853.	-4.79E-04	0.00	1.27E+11	0.00	0.00	10.7100
8.0500	0.07094	-319702.	6895.	-4.89E-04	0.00	1.27E+11	0.00	0.00	10.7100
8.3720	0.06904	-292138.	6936.	-4.98E-04	0.00	1.27E+11	0.00	0.00	10.7100
8.6940	0.06709	-264399.	6977.	-5.07E-04	0.00	1.27E+11	0.00	0.00	10.7100
9.0160	0.06512	-236486.	7019.	-5.14E-04	0.00	1.27E+11	0.00	0.00	10.7100
9.3380	0.06312	-208401.	7060.	-5.21E-04	0.00	1.27E+11	0.00	0.00	10.7100
9.6600	0.06109	-180145.	7102.	-5.27E-04	0.00	1.27E+11	0.00	0.00	10.7100
9.9820	0.05905	-151720.	7143.	-5.32E-04	0.00	1.27E+11	0.00	0.00	10.7100
10.3040	0.05698	-123127.	7184.	-5.36E-04	0.00	1.27E+11	0.00	0.00	10.7100
10.6260	0.05491	-94368.	7226.	-5.39E-04	0.00	1.27E+11	0.00	0.00	10.7100
10.9480	0.05282	-65444.	7267.	-5.42E-04	0.00	1.27E+11	0.00	0.00	10.7100
11.2700	0.05072	-36357.	7308.	-5.43E-04	0.00	1.27E+11	0.00	0.00	10.7100
11.5920	0.04862	-7108.	7350.	-5.44E-04	0.00	1.27E+11	0.00	0.00	10.7100
11.9140	0.04652	22301.	7391.	-5.44E-04	0.00	1.27E+11	0.00	0.00	10.7100
12.2360	0.04442	51869.	7433.	-5.43E-04	0.00	1.27E+11	0.00	0.00	10.7100
12.5580	0.04232	81594.	7474.	-5.41E-04	0.00	1.27E+11	0.00	0.00	10.7100
12.8800	0.04024	111475.	7515.	-5.38E-04	0.00	1.27E+11	0.00	0.00	10.7100
13.2020	0.03817	141510.	7557.	-5.34E-04	0.00	1.27E+11	0.00	0.00	10.7100
13.5240	0.03611	171698.	7598.	-5.29E-04	0.00	1.27E+11	0.00	0.00	10.7100
13.8460	0.03408	202036.	7639.	-5.23E-04	0.00	1.27E+11	0.00	0.00	10.7100
14.1680	0.03207	232524.	7681.	-5.17E-04	0.00	1.27E+11	0.00	0.00	10.7100
14.4900	0.03009	263160.	7722.	-5.09E-04	0.00	1.27E+11	0.00	0.00	10.7100
14.8120	0.02813	293942.	7764.	-5.01E-04	0.00	1.27E+11	0.00	0.00	10.7100
15.1340	0.02622	324869.	7805.	-4.91E-04	0.00	1.27E+11	0.00	0.00	10.7100
15.4560	0.02434	355938.	7846.	-4.81E-04	0.00	1.27E+11	0.00	0.00	10.7100
15.7780	0.02250	387150.	7888.	-4.70E-04	0.00	1.27E+11	0.00	0.00	10.7100
16.1000	0.02071	418501.	7929.	-4.58E-04	0.00	1.27E+11	0.00	0.00	10.7100
16.4220	0.01896	449990.	7971.	-4.44E-04	0.00	1.27E+11	0.00	0.00	10.7100
16.7440	0.01727	481616.	8012.	-4.30E-04	0.00	1.27E+11	0.00	0.00	10.7100
17.0660	0.01564	513376.	8052.	-4.15E-04	0.00	1.27E+11	0.00	0.00	9.8120
17.3880	0.01406	545257.	8070.	-3.99E-04	0.00	1.27E+11	-0.300	82.3774	0.00
17.7100	0.01255	577104.	8068.	-3.82E-04	0.00	1.27E+11	-0.726	223.4706	0.00
18.0320	0.01111	608911.	8065.	-3.64E-04	0.00	1.27E+11	-1.048	364.5638	0.00
18.3540	0.00974	640671.	8060.	-3.45E-04	0.00	1.27E+11	-1.275	505.6570	0.00
18.6760	0.00845	672379.	8055.	-3.25E-04	0.00	1.27E+11	-1.414	646.7501	0.00
18.9980	0.00723	704030.	8049.	-3.04E-04	0.00	1.27E+11	-1.474	787.8433	0.00
19.3200	0.00609	735623.	8044.	-2.82E-04	0.00	1.27E+11	-1.465	928.9365	0.00
19.6420	0.00505	767156.	8038.	-2.59E-04	0.00	1.27E+11	-1.398	1070.	0.00
19.9640	0.00409	798628.	8033.	-2.36E-04	0.00	1.27E+11	-1.282	1211.	0.00
20.2860	0.00323	830040.	8028.	-2.11E-04	0.00	1.27E+11	-1.129	1352.	0.00
20.6080	0.00246	861391.	8024.	-1.85E-04	0.00	1.27E+11	-0.950	1493.	0.00
20.9300	0.00179	892684.	1093.	-1.59E-04	0.00	1.27E+11	-3587.	7728000.	0.00
21.2520	0.00123	870377.	-10600.	-1.32E-04	0.00	1.27E+11	-2465.	7728000.	0.00
21.5740	7.74E-04	811215.	-18355.	-1.06E-04	0.00	1.27E+11	-1548.	7728000.	0.00
21.8960	4.11E-04	728895.	-22933.	-8.30E-05	0.00	1.27E+11	-821.436	7728000.	0.00
22.2180	1.33E-04	634273.	-25033.	-6.23E-05	0.00	1.27E+11	-265.699	7728000.	0.00

22.5400	-7.06E-05	535651.	-25274.	-4.45E-05	0.00	1.27E+11	141.1869	7728000.	0.00
22.8620	-2.11E-04	439109.	-24185.	-2.97E-05	0.00	1.27E+11	422.3665	7728000.	0.00
23.1840	-3.00E-04	348850.	-22209.	-1.78E-05	0.00	1.27E+11	600.4974	7728000.	0.00
23.5060	-3.48E-04	267539.	-19703.	-8.39E-06	0.00	1.27E+11	696.7618	7728000.	0.00
23.8280	-3.65E-04	196617.	-16946.	-1.35E-06	0.00	1.27E+11	730.2415	7728000.	0.00
24.1500	-3.59E-04	136588.	-14148.	3.71E-06	0.00	1.27E+11	717.5805	7728000.	0.00
24.4720	-3.36E-04	87265.	-11462.	7.11E-06	0.00	1.27E+11	672.8659	7728000.	0.00
24.7940	-3.04E-04	47984.	-8988.	9.16E-06	0.00	1.27E+11	607.6725	7728000.	0.00
25.1160	-2.66E-04	17774.	-6788.	1.02E-05	0.00	1.27E+11	531.2185	7728000.	0.00
25.4380	-2.25E-04	-4506.	-4891.	1.04E-05	0.00	1.27E+11	450.5934	7728000.	0.00
25.7600	-1.86E-04	-20058.	-3304.	9.99E-06	0.00	1.27E+11	371.0259	7728000.	0.00
26.0820	-1.48E-04	-30070.	-2015.	9.23E-06	0.00	1.27E+11	296.1654	7728000.	0.00
26.4040	-1.14E-04	-35658.	-1001.	8.23E-06	0.00	1.27E+11	228.3616	7728000.	0.00
26.7260	-8.45E-05	-37835.	-233.566	7.12E-06	0.00	1.27E+11	168.9258	7728000.	0.00
27.0480	-5.92E-05	-37487.	321.4878	5.97E-06	0.00	1.27E+11	118.3689	7728000.	0.00
27.3700	-3.83E-05	-35371.	698.1854	4.87E-06	0.00	1.27E+11	76.6092	7728000.	0.00
27.6920	-2.16E-05	-32108.	929.5602	3.84E-06	0.00	1.27E+11	43.1500	7728000.	0.00
28.0140	-8.61E-06	-28200.	1046.	2.93E-06	0.00	1.27E+11	17.2259	7728000.	0.00
28.3360	1.04E-06	-24033.	1075.	2.13E-06	0.00	1.27E+11	-2.080	7728000.	0.00
28.6580	7.87E-06	-19896.	1041.	1.47E-06	0.00	1.27E+11	-15.747	7728000.	0.00
28.9800	1.24E-05	-15993.	962.7979	9.21E-07	0.00	1.27E+11	-24.744	7728000.	0.00
29.3020	1.50E-05	-12459.	857.0563	4.89E-07	0.00	1.27E+11	-29.988	7728000.	0.00
29.6240	1.62E-05	-9372.	736.7007	1.58E-07	0.00	1.27E+11	-32.308	7728000.	0.00
29.9460	1.62E-05	-6766.	611.6289	-8.71E-08	0.00	1.27E+11	-32.429	7728000.	0.00
30.2680	1.55E-05	-4645.	489.1577	-2.60E-07	0.00	1.27E+11	-30.962	7728000.	0.00
30.5900	1.42E-05	-2985.	374.4606	-3.76E-07	0.00	1.27E+11	-28.405	7728000.	0.00
30.9120	1.26E-05	-1750.	270.9970	-4.48E-07	0.00	1.27E+11	-25.148	7728000.	0.00
31.2340	1.07E-05	-889.367	180.9135	-4.88E-07	0.00	1.27E+11	-21.479	7728000.	0.00
31.5560	8.80E-06	-349.810	105.4067	-5.07E-07	0.00	1.27E+11	-17.603	7728000.	0.00
31.8780	6.82E-06	-73.052	45.0383	-5.13E-07	0.00	1.27E+11	-13.644	7728000.	0.00
32.2000	4.83E-06	0.00	0.00	-5.14E-07	0.00	1.27E+11	-9.668	3864000.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 4:

Pile-head deflection = 0.09840635 inches
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -947893. inch-lbs
Maximum shear force = -25274. lbs
Depth of maximum bending moment = 0.000000 feet below pile head
Depth of maximum shear force = 22.54000000 feet below pile head
Number of iterations = 6
Number of zero deflection points = 2
Pile deflection at ground = 0.01498249 inches

Pile-head Deflection vs. Pile Length for Load Case 4

Boundary Condition Type 2, Shear and Slope

Shear = 5860. lbs
Slope = 0.00000
Axial Load = 442200. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
32.20000	0.09840635	-947893.	-25274.
30.59000	0.09672509	-941953.	-25194.
28.98000	0.09772236	-945499.	-25298.
27.37000	0.09697056	-942870.	-24977.
25.76000	0.09802515	-946579.	-25743.
24.15000	0.09959096	-952472.	-32252.
22.54000	0.13547045	-1093681.	-49187.
20.93000	0.32724156	-1904674.	8069.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	4200.	S, rad	0.00	320750.	0.07202	0.00	-18756.	-694283.
2	V, lb	4800.	S, rad	0.00	502900.	0.07655	0.00	-19389.	-745722.
3	V, lb	4470.	S, rad	0.00	237400.	0.08589	0.00	-22887.	811509.
4	V, lb	5860.	S, rad	0.00	442200.	0.09841	0.00	-25274.	-947893.

Maximum pile-head deflection = 0.0984063525 inches
Maximum pile-head rotation = 0.0000000000 radians = 0.000000 deg.

The analysis ended normally.

Foundation Design Data

Support No.: **Bent 3**

General Information:

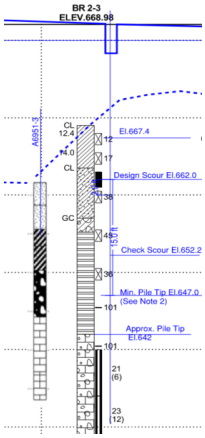
	North	South	Average	
Bottom of Pile Cap El.:			676.70	ft
Assumed Grade Elev.:			667.40	ft
Design Scour Depth:			5.40	ft
El.:			662.00	ft
Min. Pile Length below Scour Depth:			15.00	ft
El.:			647.00	ft
Top of Rock El.:			655.00	ft
Rock Type:			Shale	
Min. Embd. into Rock:			10	ft
Min. Pile Tip El by Rock Embd.:			645.00	ft
Min Design Pile Tip El:			**645.00**	
Min. Pile Length:			31.70	ft
Design GW El.:			678.60	ft
Depth below Top of Pile:			-1.90	ft
Exposed Pile Length to Scour Depth:			14.70	ft

Scour Information for Bridge 4/A9543

Location	Ground El. (ft)	Scour Depth (ft)		Scour Elev. (ft)	
		Design Flood	Check Flood	Design Flood	Check Flood
Bent 2	665.8	5.8	15.6	660	650.2
Bent 3	667.4	5.4	15.2	662	652.2

Section 751.1.2.22 MoDOT EPG

100-year Flood Level



Pile Data:

Pile:	24X0.500		Class B-1 Concrete,	fc'=	4,000	psi
F_y =	45	ksi	Pile Structural Axial Resistance Factor:	ϕ_c =	0.6	
E =	29,000	ksi	Max Nominal Driving Resistance:	R_{ndr} =	1,305	k
OD =	24	in	Preli. Structural Nominal Axial Design Capacity:	PNDC = F_yA_s =	1,450	k
Wall Thick. =	0.500	in	Preli. Factored Axial Design Capacity:	PFDC = ϕc xPNDC =	870	k
ID =	23.00	in				
As (No Corrosion) =	32.21	in^2				

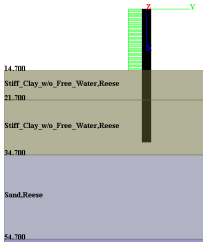
Load Information:

Load Case	At Top of Pile		Stream Pressure, WA				Wind on substructure, WS				Max (WA+WS)
	Axial (k)	Lateral Load (k)	Load (klf)	Load (lbs/in)	From (ft)	To (ft)	Load (klf)	Load (lbs/in)	From (ft)	To (ft)	(lbs/in)
Ser I	320.75	4.2	0.071	5.88	0.00	14.70	0.040	3.33	0	14.70	9.22
Str I	502.9	4.8	0.074	6.13	0.00	14.70	0.000	0.00	0	14.70	6.13
Str III	237.4	4.47	0.074	6.13	0.00	14.70	0.114	9.50	0	14.70	15.63
Str V	442.2	5.86	0.074	6.13	0.00	14.70	0.055	4.58	0	14.70	10.71

P-Multipliers D = 2 ft

Loading Direction	Number of Rows	Pile Spacing S (ft)	S/D	P-Multiplier* (AASHTO LRFD Table 10.7.2.4-1) Row Number 1	2	3	After 3	Aver.
Longitudinal	1	-	-	0.93	-	-	-	0.93
Transverse	6	8.50	4.25	0.93	0.68	0.55	0.55	0.63

Note: Group reduction factor of 1.0 was used within fresh rock.



Lateral Analysis

Software: LPILE 2022 developed by ENSOFT, Inc.

Pile Geometry for Analysis:

Top of Pile El.: 676.70 ft Design Scour El.: 662.00 ft (Design Flood for Strength Limit)
Min. Pile Tip El.: 645.00 ft Min. Pile Length: 31.70 ft

Design Soil Profile and Parameters:

Reference Borings: BR 2-3 and A6951-3 Design Ground Water El.: 678.60 ft

Depth From (ft)	Depth To (ft)	Soil/Rock	Elevation From (ft)	Elevation To (ft)	Eff. Unit Weight (pcf)	Su (psf)	ϕ' (deg.)	qu (psi)	Modulus , k or E (psi)	RQD	ε_{50}
14.7	21.7	Stiff Clay w/ Free Water	662.0	655.0	62.6	2,000	0	-	-	-	0.007
21.7	34.7	Stiff Clay w/ Free Water	655.0	642.0	70.6	3,000	0	-	-	-	0.005
34.7	54.7	Sand (Reese)	642.0	622.0	72.6	0	42	-	-	-	-
54.7	56.7	Strong Rock	622.0	620.0	101.6	-	-	7,500	-	-	-
			(Strong Rock Qu =1,078 ksf =7.5 ksi, use 2,000 psi per LPile's limit)								

Lateral Analysis Results:

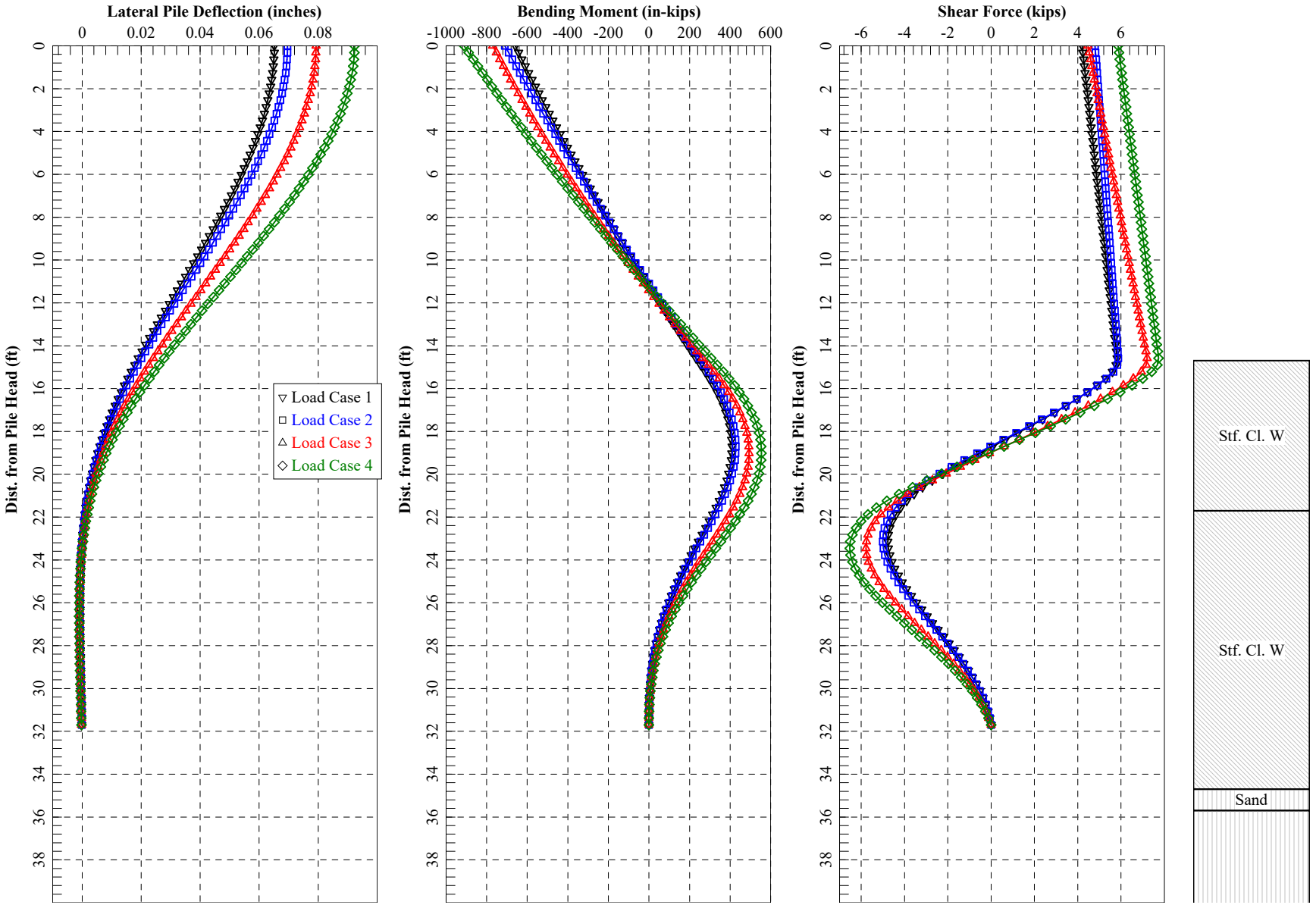
LPile Analysis Summary at Bent 3 of Bridge 4 (A9543)

Load Comb.	Case in LPile	Lat. (lbs)	Moment (lbs-in)	Axial (lbs)	Pmult.	Head Fixity	Pile Head δ (in)	Max Moment (in-lbs)	Max Shear (lbs)	Pile Head Rotation (rad.)
Ser I	1	4,200	-	320,750	0.63	Fixed	0.065	-658,901	5,811	0.00E+00
Str I	2	4,800	-	502,900	0.63	Fixed	0.070	-710,088	5,871	0.00E+00
Str III	3	4,470	-	237,400	0.63	Fixed	0.079	-770,025	7,201	0.00E+00
Str V	4	5,860	-	442,200	0.63	Fixed	0.092	-911,212	7,731	0.00E+00

Deflection, Moment, and Shear vs Depth figures are attached.

Structure Engineer should check the pile structural acceptability for the analyzed load combinations.

MoDOT Improve I-70 C2KC- Bridge 4/A9543- Bent 3 - CIP24X0.5in



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================================================================================

                    LPile for Windows, Version 2022-12.004

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\TPW\GEOTECH\F3X03000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A6951)\LPile- Bridge 4_A9543\

Name of input data file:
Bridge 4 Bent 3 24X0.5in CIP.lp12d

Name of output report file:
Bridge 4 Bent 3 24X0.5in CIP.lp12o

Name of plot output file:
Bridge 4 Bent 3 24X0.5in CIP.lp12p

Name of runtime message file:
Bridge 4 Bent 3 24X0.5in CIP.lp12r



--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  November 7, 2024           Time:  14:22:38



--------------------------------------------------------------------------------
                                  Problem Title
--------------------------------------------------------------------------------

Project Name: MoDOT Improve I-70  Columbia to Kingdom City DB

Job Number: F3X03001

Client: MoDOT

Engineer:

Description: Bridge 4 (A9543) Bent 3 Lateral Analysis - CECIP 24X0.5




--------------------------------------------------------------------------------
                          Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed               =          500
 - Deflection tolerance for convergence               =   1.0000E-05 in
 - Maximum allowable deflection                       =     100.0000 in
 - Number of pile increments                          =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified
```

- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- Analysis includes loading by multiple distributed lateral loads acting on pile
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 31.700 ft
Depth of ground surface below top of pile = 14.7000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	24.0000
2	31.700	24.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a drilled shaft with permanent casing
Length of section = 31.700000 ft
Casing outside diameter = 24.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is stiff clay with water-induced erosion

Distance from top of pile to top of layer = 14.700000 ft
Distance from top of pile to bottom of layer = 21.700000 ft
Effective unit weight at top of layer = 62.600000 pcf
Effective unit weight at bottom of layer = 62.600000 pcf
Undrained cohesion at top of layer = 2000. psf
Undrained cohesion at bottom of layer = 2000. psf
Epsilon-50 at top of layer = 0.007000
Epsilon-50 at bottom of layer = 0.007000
Subgrade k at top of layer = 0.0000 pci
Subgrade k at bottom of layer = 0.0000 pci

NOTE: Default values for subgrade k will be computed for this layer.

Layer 2 is stiff clay with water-induced erosion

Distance from top of pile to top of layer = 21.700000 ft
Distance from top of pile to bottom of layer = 34.700000 ft
Effective unit weight at top of layer = 70.600000 pcf
Effective unit weight at bottom of layer = 70.600000 pcf
Undrained cohesion at top of layer = 3000. psf
Undrained cohesion at bottom of layer = 3000. psf
Epsilon-50 at top of layer = 0.005000
Epsilon-50 at bottom of layer = 0.005000
Subgrade k at top of layer = 0.0000 pci
Subgrade k at bottom of layer = 0.0000 pci

NOTE: Default values for subgrade k will be computed for this layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

```
   Distance from top of pile to top of layer           =    34.700000 ft
   Distance from top of pile to bottom of layer        =    54.700000 ft
   Effective unit weight at top of layer               =    72.600000 pcf
   Effective unit weight at bottom of layer            =    72.600000 pcf
   Friction angle at top of layer                      =    42.000000 deg.
   Friction angle at bottom of layer                   =    42.000000 deg.
   Subgrade k at top of layer                          =       0.0000 pci
   Subgrade k at bottom of layer                       =       0.0000 pci

   NOTE: Default values for subgrade k will be computed for this layer.

Layer 4 is strong rock (vuggy limestone)

   Distance from top of pile to top of layer           =    54.700000 ft
   Distance from top of pile to bottom of layer        =    60.000000 ft
   Effective unit weight at top of layer               =   101.600000 pcf
   Effective unit weight at bottom of layer            =   101.600000 pcf
   Uniaxial compressive strength at top of layer       =        2000. psi
   Uniaxial compressive strength at bottom of layer    =        2000. psi


 (Depth of the lowest soil layer extends 28.300 ft below the pile tip)
```

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Cohesion psf	Angle of Friction deg.	Uniaxial qu psi	E50 or krm	kpy pci
1	Stiff Clay with Free Water	14.7000 21.7000	62.6000 62.6000	2000. 2000.	--	--	0.00700 0.00700	default default
2	Stiff Clay with Free Water	21.7000 34.7000	70.6000 70.6000	3000. 3000.	--	--	0.00500 0.00500	default default
3	Sand (Reese, et al.)	34.7000 54.7000	72.6000 72.6000	-- --	42.0000 42.0000	-- --	-- --	default default
4	Strong Rock (Vuggy Limestone)	54.7000 60.0000	101.6000 101.6000	-- --	-- --	2000. 2000.	-- --	-- --

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Modification Factors for p-y Curves

Distribution of p-y modifiers with depth defined using 4 points

Point No.	Depth X ft	p-mult	y-mult
1	14.700	0.6300	1.0000
2	54.700	0.6300	1.0000
3	54.700	1.0000	1.0000
4	60.000	1.0000	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading for Individual Load Cases

Distributed lateral load intensity for Load Case 1 defined using 2 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	9.220
2	14.700	9.220

Distributed lateral load intensity for Load Case 2 defined using 2 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	6.130
2	14.700	6.130

Distributed lateral load intensity for Load Case 3 defined using 2 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	15.630
2	14.700	15.630

Distributed lateral load intensity for Load Case 4 defined using 2 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	10.710
2	14.700	10.710

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	2	V = 4200. lbs	S = 0.0000 in/in	320750.	Yes	Yes
2	2	V = 4800. lbs	S = 0.0000 in/in	502900.	Yes	Yes
3	2	V = 4470. lbs	S = 0.0000 in/in	237400.	Yes	Yes
4	2	V = 5860. lbs	S = 0.0000 in/in	442200.	Yes	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile) with Permanent Casing:

Length of Section	=	31.700000 ft
Outer Diameter of Casing	=	24.000000 in
Casing Wall Thickness	=	0.500000 in
Moment of Inertia of Steel Casing	=	2549. in^4
Yield Stress of Casing	=	45000. psi
Elastic Modulus of Casing	=	29000000. psi
Number of Reinforcing Bars	=	0 bars
Area of Single Reinforcing Bar	=	0.0000 sq. in.
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in
Yield Stress of Reinforcing Bars	=	0.0000 psi
Modulus of Elasticity of Reinforcing Bars	=	0.0000 psi
Gross Area of Pile	=	452.389342 sq. in.
Area of Concrete	=	415.475628 sq. in.
Cross-sectional Area of Steel Casing	=	36.913714 sq. in.
Area of All Steel (Casing and Bars)	=	36.913714 sq. in.
Area Ratio of All Steel to Gross Area of Pile	=	8.16 percent

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	3073.734 kips
Tensile Load for Cracking of Concrete	=	-296.304 kips
Nominal Axial Tensile Capacity	=	-1661.117 kips

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.34165 psi

Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 4

Number	Axial Thrust Force kips
1	237.400
2	320.750
3	442.200
4	502.900

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 237.400 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	161.9656502	129572520.	80.0080517	0.0001000	0.00007001	0.4123130	0.00000	2.8959419	
0.00000250	323.9292696	129571708.	46.0145446	0.0001150	0.00005504	0.4718170	0.00000	3.3273545	
0.00000375	485.8888273	129570354.	34.6880506	0.0001301	0.00004008	0.5308926	0.00000	3.7592755	
0.00000500	647.8422923	129568458.	29.0283102	0.0001451	0.00002514	0.5895381	0.00000	4.1917050	
0.00000625	809.7876335	129566021.	25.6352713	0.0001602	0.00001022	0.6477518	0.00000	4.6246429	
0.00000750	971.7228189	129563043.	23.3755833	0.0001753	-0.00000468	0.7055318	0.00000	5.0580894	
0.00000875	1134.	129557386.	21.7634531	0.0001904	-0.00001957	0.7628741	0.00000	5.4920262	
0.00001000	1295.	129540756.	20.5557219	0.0002056	-0.00003444	0.8197646	0.00000	5.9263594	
0.00001125	1457.	129508983.	19.6172837	0.0002207	-0.00004931	0.8761891	0.00000	6.3609888	
0.00001250	1618.	129462110.	18.8671513	0.0002358	-0.00006416	0.9321372	0.00000	6.7958424	
0.00001375	1779.	129401704.	18.2538420	0.0002510	-0.00007901	0.9876018	0.00000	7.2308695	
0.00001500	1940.	129329657.	17.7430683	0.0002661	-0.00009385	1.0425778	0.00000	7.6660348	
0.00001625	2100.	129247756.	17.3111144	0.0002813	-0.000109	1.0970616	0.00000	8.1013127	
0.00001750	2100.	120015773.	16.4649856	0.0002881	-0.000132	1.1211525	0.00000	8.2950802	C
0.00001875	2191.	116866660.	16.0791628	0.0003015	-0.000149	1.1684402	0.00000	8.6777948	C
0.00002000	2313.	115631903.	15.7373894	0.0003147	-0.000165	1.2150405	0.00000	9.0580859	C
0.00002125	2433.	114487763.	15.4318477	0.0003279	-0.000182	1.2609576	0.00000	9.4359262	C
0.00002250	2552.	113430721.	15.1572830	0.0003410	-0.000199	1.3062603	0.00000	9.8118272	C
0.00002375	2671.	112453393.	14.9092295	0.0003541	-0.000216	1.3509892	0.00000	10.1860819	C
0.00002500	2789.	111548035.	14.6839953	0.0003671	-0.000233	1.3951738	0.00000	10.5588967	C
0.00002625	2906.	110708123.	14.4786113	0.0003801	-0.000250	1.4388441	0.00000	10.9304929	C
0.00002750	3023.	109927081.	14.2905497	0.0003930	-0.000267	1.4820205	0.00000	11.3010135	C
0.00002875	3139.	109196161.	14.1173166	0.0004059	-0.000284	1.5246836	0.00000	11.6702628	C
0.00003000	3255.	108515242.	13.9577438	0.0004187	-0.000301	1.5669052	0.00000	12.0388372	C
0.00003125	3371.	107879793.	13.8103721	0.0004316	-0.000318	1.6087057	0.00000	12.4068998	C
0.00003250	3487.	107280176.	13.6731235	0.0004444	-0.000336	1.6500159	0.00000	12.7738189	C
0.00003375	3602.	106720509.	13.5459875	0.0004572	-0.000353	1.6909603	0.00000	13.1406854	C
0.00003500	3717.	106190165.	13.4269173	0.0004699	-0.000370	1.7314313	0.00000	13.5065212	C
0.00003625	3831.	105693718.	13.3162157	0.0004827	-0.000387	1.7715625	0.00000	13.8725219	C
0.00003750	3946.	105220779.	13.2119061	0.0004954	-0.000405	1.8112193	0.00000	14.2374480	C
0.00003875	4060.	104776115.	13.1145131	0.0005082	-0.000422	1.8505426	0.00000	14.6025843	C
0.00004000	4174.	104353223.	13.0227060	0.0005209	-0.000439	1.8894477	0.00000	14.9671391	C
0.00004125	4288.	103951666.	12.9362474	0.0005336	-0.000456	1.9279704	0.00000	15.3314361	C
0.00004250	4402.	103571697.	12.8550448	0.0005463	-0.000474	1.9661601	0.00000	15.6959428	C
0.00004375	4515.	103207603.	12.7778956	0.0005590	-0.000491	2.0039176	0.00000	16.0597041	C
0.00004500	4629.	102860937.	12.7050188	0.0005717	-0.000508	2.0413196	0.00000	16.4234489	C
0.00004625	4742.	102531146.	12.6362377	0.0005844	-0.000526	2.0783891	0.00000	16.7874034	C
0.00004750	4855.	102215238.	12.5708708	0.0005971	-0.000543	2.1150761	0.00000	17.1510743	C
0.00004875	4968.	101911790.	12.5085767	0.0006098	-0.000560	2.1513701	0.00000	17.5143502	C
0.00005125	5194.	101344268.	12.3935295	0.0006352	-0.000595	2.2229613	0.00000	18.2415333	C
0.00005375	5419.	100819454.	12.2888347	0.0006605	-0.000629	2.2930867	0.00000	18.9681712	C
0.00005625	5644.	100333585.	12.1935791	0.0006859	-0.000664	2.3618207	0.00000	19.6950261	C
0.00005875	5868.	99882577.	12.1067621	0.0007113	-0.000699	2.4291940	0.00000	20.4224461	C
0.00006125	6092.	99459617.	12.0266452	0.0007366	-0.000733	2.4950911	0.00000	21.1491788	C
0.00006375	6315.	99064404.	11.9532780	0.0007620	-0.000768	2.5596517	0.00000	-22.049527	C
0.00006625	6538.	98693767.	11.8858989	0.0007874	-0.000803	2.6228713	0.00000	-23.043667	C
0.00006875	6761.	98342738.	11.8231169	0.0008128	-0.000837	2.6846215	0.00000	-24.038411	C
0.00007125	6983.	98011228.	11.7650935	0.0008383	-0.000872	2.7450150	0.00000	-25.032425	C
0.00007375	7205.	97697441.	11.7114170	0.0008637	-0.000906	2.8040600	0.00000	-26.025557	C
0.00007625	7427.	97399606.	11.6616624	0.0008892	-0.000941	2.8617517	0.00000	-27.017799	C
0.00007875	7648.	97115349.	11.6151280	0.0009147	-0.000975	2.9180279	0.00000	-28.009901	C
0.00008125	7869.	96843538.	11.5715679	0.0009402	-0.001010	2.9728968	0.00000	-29.001743	C

0.00008375	8089.	96583708.	11.5309829	0.0009657	-0.001044	3.0264036	0.00000	-29.992675 C
0.00008625	8309.	96334792.	11.4931165	0.0009913	-0.001079	3.0785434	0.00000	-30.982693 C
0.00008875	8529.	96095846.	11.4577413	0.0010169	-0.001113	3.1293112	0.00000	-31.971789 C
0.00009125	8748.	95866027.	11.4246549	0.0010425	-0.001148	3.1787020	0.00000	-32.959957 C
0.00009375	8967.	95644412.	11.3935890	0.0010681	-0.001182	3.2266955	0.00000	-33.947430 C
0.00009625	9185.	95429897.	11.3641539	0.0010938	-0.001216	3.2732471	0.00000	-34.934856 C
0.00009875	9403.	95222539.	11.3365416	0.0011195	-0.001251	3.3184112	0.00000	-35.921330 C
0.0001013	9621.	95021786.	11.3106193	0.0011452	-0.001285	3.3621825	0.00000	-36.906846 C
0.0001038	9838.	94827138.	11.2862670	0.0011710	-0.001319	3.4045558	0.00000	-37.891396 C
0.0001063	10055.	94638143.	11.2633761	0.0011967	-0.001353	3.4455257	0.00000	-38.874975 C
0.0001088	10272.	94454392.	11.2418478	0.0012226	-0.001387	3.4850867	0.00000	-39.857575 C
0.0001113	10488.	94275509.	11.2215924	0.0012484	-0.001422	3.5232335	0.00000	-40.839190 C
0.0001138	10704.	94101156.	11.2025281	0.0012743	-0.001456	3.5599606	0.00000	-41.819810 C
0.0001163	10919.	93931015.	11.1845802	0.0013002	-0.001490	3.5952622	0.00000	-42.799434 C
0.0001188	11135.	93764803.	11.1676801	0.0013262	-0.001524	3.6291327	0.00000	-43.778051 C
0.0001213	11349.	93602109.	11.1516469	0.0013521	-0.001558	3.6615489	0.00000	-44.756071 C
0.0001238	11556.	93380731.	11.1336093	0.0013778	-0.001592	3.6920967	0.00000	-45.000000 CY
0.0001263	11743.	93015270.	11.1095754	0.0014026	-0.001627	3.7202506	0.00000	-45.000000 CY
0.0001288	11911.	92516217.	11.0798006	0.0014265	-0.001663	3.7461376	0.00000	-45.000000 CY
0.0001313	12068.	91948166.	11.0471863	0.0014499	-0.001700	3.7702381	0.00000	-45.000000 CY
0.0001338	12216.	91331381.	11.0125976	0.0014729	-0.001737	3.7927246	0.00000	-45.000000 CY
0.0001363	12355.	90678684.	10.9765710	0.0014956	-0.001774	3.8137161	0.00000	-45.000000 CY
0.0001388	12487.	89999237.	10.9394868	0.0015179	-0.001812	3.8333042	0.00000	-45.000000 CY
0.0001413	12613.	89299050.	10.9013229	0.0015398	-0.001850	3.8515284	0.00000	-45.000000 CY
0.0001438	12734.	88583367.	10.8622666	0.0015615	-0.001889	3.8684527	0.00000	-45.000000 CY
0.0001463	12847.	87840109.	10.8243744	0.0015831	-0.001927	3.8843351	0.00000	45.0000000 CY
0.0001488	12953.	87082255.	10.7870605	0.0016046	-0.001965	3.8991263	0.00000	45.0000000 CY
0.0001588	13302.	83791001.	10.6608352	0.0016924	-0.002118	3.9490367	0.00000	45.0000000 CY
0.0001688	13574.	80439806.	10.5519827	0.0017806	-0.002269	3.9821876	0.00000	45.0000000 CY
0.0001788	13796.	77180309.	10.4557944	0.0018690	-0.002421	3.9983121	0.00000	45.0000000 CY
0.0001888	13980.	74065977.	10.3685903	0.0019571	-0.002573	3.9991063	0.00000	45.0000000 CY
0.0001988	14135.	71120180.	10.2892047	0.0020450	-0.002725	3.9999236	0.00000	45.0000000 CY
0.0002088	14267.	68345465.	10.2179456	0.0021330	-0.002877	3.9990659	0.00000	45.0000000 CY
0.0002188	14379.	65733752.	10.1523736	0.0022208	-0.003029	3.9999497	0.00000	45.0000000 CY
0.0002288	14476.	63284382.	10.0928192	0.0023087	-0.003181	3.9978048	0.00000	45.0000000 CY
0.0002388	14560.	60985120.	10.0386061	0.0023967	-0.003333	3.9987077	0.00000	45.0000000 CY
0.0002488	14634.	58829150.	9.9895791	0.0024849	-0.003485	3.9991051	0.00000	45.0000000 CY
0.0002588	14698.	56803314.	9.9443928	0.0025731	-0.003637	3.9991616	0.00000	45.0000000 CY
0.0002688	14753.	54896713.	9.9025119	0.0026613	-0.003789	3.9989042	0.00000	45.0000000 CY
0.0002788	14803.	53104042.	9.8641255	0.0027496	-0.003940	3.9982196	0.00000	45.0000000 CY
0.0002888	14847.	51416919.	9.8286871	0.0028380	-0.004092	3.9968316	0.00000	45.0000000 CY
0.0002988	14885.	49824829.	9.7968879	0.0029268	-0.004243	3.9997180	0.00000	45.0000000 CY
0.0003088	14919.	48321462.	9.7672606	0.0030156	-0.004394	3.9995865	0.00000	45.0000000 CY
0.0003188	14949.	46900336.	9.7399999	0.0031046	-0.004545	3.9978338	0.00000	45.0000000 CY
0.0003288	14976.	45555761.	9.7150230	0.0031938	-0.004696	3.9982151	0.00000	45.0000000 CY
0.0003388	15001.	44282463.	9.6914614	0.0032830	-0.004847	3.9992378	0.00000	45.0000000 CY
0.0003488	15022.	43072755.	9.6692482	0.0033722	-0.004998	3.9955986	0.00000	45.0000000 CY
0.0003588	15041.	41924817.	9.6491304	0.0034616	-0.005148	3.9996559	0.00000	45.0000000 CY
0.0003688	15058.	40834107.	9.6303768	0.0035512	-0.005299	3.9958415	0.00000	45.0000000 CY
0.0003788	15072.	39794407.	9.6133944	0.0036411	-0.005449	3.9996459	0.00000	45.0000000 CY
0.0003888	15086.	38805572.	9.5976010	0.0037311	-0.005599	3.9948240	0.00000	45.0000000 CY
0.0003988	15097.	37861046.	9.5829535	0.0038212	-0.005749	3.9991854	0.00000	45.0000000 CY

Axial Thrust Force = 320.750 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	160.7906091	128632487.	104.3529397	0.0001304	0.0001004	0.5335028	0.00000	3.7784441	
0.00000250	321.5791662	128631666.	58.1870983	0.0001455	0.00008547	0.5919900	0.00000	4.2098646	
0.00000375	482.3636193	128630298.	42.8032084	0.0001605	0.00007051	0.6500483	0.00000	4.6417989	
0.00000500	643.1419161	128628383.	35.1148066	0.0001756	0.00005557	0.7076760	0.00000	5.0742470	
0.00000625	803.9120043	128625921.	30.5046001	0.0001907	0.00004065	0.7648713	0.00000	5.5072088	
0.00000750	964.6718313	128622911.	27.4334915	0.0002058	0.00002575	0.8216324	0.00000	5.9406844	
0.00000875	1125.	128619354.	25.2418677	0.0002209	0.00001087	0.8779575	0.00000	6.3746739	
0.00001000	1286.	128615249.	23.5999220	0.0002360	-0.00000400	0.9338449	0.00000	6.8091773	
0.00001125	1447.	128609877.	22.3244045	0.0002511	-0.00001885	0.9892917	0.00000	7.2441870	
0.00001250	1607.	128598635.	21.3052186	0.0002663	-0.00003368	1.0442887	0.00000	7.6796418	
0.00001375	1768.	128577525.	20.4722484	0.0002815	-0.00004851	1.0988238	0.00000	8.1154591	
0.00001500	1928.	128545131.	19.7787813	0.0002967	-0.00006332	1.1528873	0.00000	8.5515699	
0.00001625	2088.	128501524.	19.1925113	0.0003119	-0.00007812	1.2064717	0.00000	8.9879210	
0.00001750	2248.	128447451.	18.6903871	0.0003271	-0.00009292	1.2595712	0.00000	9.4244715	
0.00001875	2407.	128383907.	18.2555220	0.0003423	-0.000108	1.3121813	0.00000	9.8611901	
0.00002000	2414.	120682655.	17.5558949	0.0003511	-0.000129	1.3422627	0.00000	10.1128191 C
0.00002125	2540.	119524025.	17.1680993	0.0003648	-0.000145	1.3889144	0.00000	10.5058912 C
0.00002250	2664.	118414288.	16.8186322	0.0003784	-0.000162	1.4347894	0.00000	10.8958576 C
0.00002375	2787.	117365762.	16.5025881	0.0003919	-0.000178	1.4799888	0.00000	11.2835076 C
0.00002500	2909.	116375195.	16.2152080	0.0004054	-0.000195	1.5245413	0.00000	11.6690259 C
0.00002625	3030.	115438123.	15.9525253	0.0004188	-0.000211	1.5684645	0.00000	12.0525099 C
0.00002750	3150.	114553110.	15.7115091	0.0004321	-0.000228	1.6117950	0.00000	12.4342286 C
0.00002875	3269.	113717727.	15.4895958	0.0004453	-0.000245	1.6545627	0.00000	12.8144006 C
0.00003000	3388.	112927561.	15.2844539	0.0004585	-0.000261	1.6967779	0.00000	13.1930749 C
0.00003125	3506.	112181343.	15.0943803	0.0004717	-0.000278	1.7384758	0.00000	13.5705322 C
0.00003250	3623.	111476988.	14.9178775	0.0004848	-0.000295	1.7796850	0.00000	13.9469996 C
0.00003375	3740.	110812500.	14.7536851	0.0004979	-0.000312	1.8204345	0.00000	14.3227194 C
0.00003500	3856.	110178437.	14.5998512	0.0005110	-0.000329	1.8606580	0.00000	14.6970491 C
0.00003625	3972.	109579601.	14.4561455	0.0005240	-0.000346	1.9004532	0.00000	15.0708730 C
0.00003750	4088.	109011218.	14.3214034	0.0005371	-0.000363	1.9398045	0.00000	15.4440263 C
0.00003875	4203.	108469544.	14.1946026	0.0005500	-0.000380	1.9786956	0.00000	15.8163348 C

0.00004000	4318.	107955943.	14.0754834	0.0005630	-0.000397	2.0171871	0.00000	16.1883608 C
0.00004125	4433.	107464741.	13.9628952	0.0005760	-0.000414	2.0552246	0.00000	16.5595635 C
0.00004250	4547.	106997432.	13.8567277	0.0005889	-0.000431	2.0928686	0.00000	16.9305170 C
0.00004375	4662.	106551247.	13.7562981	0.0006018	-0.000448	2.1301029	0.00000	17.3010533 C
0.00004500	4776.	106123509.	13.6609918	0.0006147	-0.000465	2.1669112	0.00000	17.6709945 C
0.00004625	4889.	105716913.	13.5710032	0.0006277	-0.000482	2.2033755	0.00000	18.0411581 C
0.00004750	5003.	105324180.	13.4850295	0.0006405	-0.000499	2.2393770	0.00000	18.4103283 C
0.00004875	5116.	104948930.	13.4034969	0.0006534	-0.000517	2.2750186	0.00000	18.7795439 C
0.00005125	5342.	104243248.	13.2519959	0.0006792	-0.000551	2.3451569	0.00000	19.5174290 C
0.00005375	5568.	103591094.	13.1142386	0.0007049	-0.000585	2.4137894	0.00000	20.2547695 C
0.00005625	5793.	102984476.	12.9881488	0.0007306	-0.000619	2.4808834	0.00000	20.9911679 C
0.00005875	6017.	102421250.	12.8729233	0.0007563	-0.000654	2.5465477	0.00000	21.7277932 C
0.00006125	6241.	101893686.	12.7666938	0.0007820	-0.000688	2.6106985	0.00000	22.4636901 C
0.00006375	6464.	101399972.	12.6688964	0.0008076	-0.000722	2.6734169	0.00000	23.1997713 C
0.00006625	6687.	100936860.	12.5786754	0.0008333	-0.000757	2.7347178	0.00000	23.9362297 C
0.00006875	6909.	100498639.	12.4946506	0.0008590	-0.000791	2.7945102	0.00000	24.6719594 C
0.00007125	7131.	100086044.	12.4169578	0.0008847	-0.000825	2.8529259	0.00000	25.4085891 C
0.00007375	7353.	99695704.	12.3447594	0.0009104	-0.000860	2.9099279	0.00000	26.1457043 C
0.00007625	7573.	99323552.	12.2770147	0.0009361	-0.000894	2.9654311	0.00000	26.8821990 C
0.00007875	7794.	98970358.	12.2139719	0.0009619	-0.000928	3.0195504	0.00000	27.6196085 C
0.00008125	8014.	98634346.	12.1551992	0.0009876	-0.000962	3.0722807	0.00000	28.3579384 C
0.00008375	8234.	98313112.	12.1000543	0.0010134	-0.000997	3.1235734	0.00000	29.0965571 C
0.00008625	8453.	98004781.	12.0480385	0.0010391	-0.001031	3.1733962	0.00000	29.8350065 C
0.00008875	8672.	97709619.	11.9993179	0.0010649	-0.001065	3.2218217	0.00000	-30.577905 C
0.00009125	8890.	97426520.	11.9536239	0.0010908	-0.001099	3.2688446	0.00000	-31.560172 C
0.00009375	9108.	97154494.	11.9107167	0.0011166	-0.001133	3.3144598	0.00000	-32.541489 C
0.00009625	9326.	96892311.	11.8702499	0.0011425	-0.001167	3.3586405	0.00000	-33.522215 C
0.00009875	9543.	96638511.	11.8317727	0.0011684	-0.001202	3.4013400	0.00000	-34.503111 C
0.0001013	9760.	96393484.	11.7955271	0.0011943	-0.001236	3.4426219	0.00000	-35.483033 C
0.0001038	9976.	96156571.	11.7613539	0.0012202	-0.001270	3.4824808	0.00000	-36.461976 C
0.0001063	10192.	95927178.	11.7291089	0.0012462	-0.001304	3.5209110	0.00000	-37.439933 C
0.0001088	10408.	95704766.	11.6986615	0.0012722	-0.001338	3.5579070	0.00000	-38.416896 C
0.0001113	10623.	95488840.	11.6698925	0.0012983	-0.001372	3.5934633	0.00000	-39.392859 C
0.0001138	10838.	95278953.	11.6426932	0.0013244	-0.001406	3.6275741	0.00000	-40.367815 C
0.0001163	11052.	95074044.	11.6166398	0.0013504	-0.001440	3.6601870	0.00000	-41.342853 C
0.0001188	11266.	94874365.	11.5919455	0.0013765	-0.001473	3.6913424	0.00000	-42.316988 C
0.0001213	11480.	94679642.	11.5685639	0.0014027	-0.001507	3.7210402	0.00000	-43.290087 C
0.0001238	11693.	94489554.	11.5464176	0.0014289	-0.001541	3.7492742	0.00000	-44.262144 C
0.0001263	11903.	94284620.	11.5245634	0.0014550	-0.001575	3.7759281	0.00000	-45.000000 CY
0.0001288	12100.	93977325.	11.4989100	0.0014805	-0.001610	3.8005182	0.00000	-45.000000 CY
0.0001313	12277.	93537669.	11.4678716	0.0015052	-0.001645	3.8229351	0.00000	-45.000000 CY
0.0001338	12440.	93008066.	11.4332467	0.0015292	-0.001681	3.8434840	0.00000	-45.000000 CY
0.0001363	12593.	92422035.	11.3964454	0.0015528	-0.001717	3.8623968	0.00000	-45.000000 CY
0.0001388	12735.	91782869.	11.3584691	0.0015760	-0.001754	3.8798371	0.00000	45.0000000 CY
0.0001413	12867.	91093108.	11.3210977	0.0015991	-0.001791	3.8960247	0.00000	45.0000000 CY
0.0001438	12986.	90336996.	11.2867591	0.0016225	-0.001828	3.9111992	0.00000	45.0000000 CY
0.0001463	13097.	89549334.	11.2535570	0.0016458	-0.001864	3.9251742	0.00000	45.0000000 CY
0.0001488	13198.	88726809.	11.2225080	0.0016693	-0.001901	3.9380348	0.00000	45.0000000 CY
0.0001588	13543.	85310974.	11.1070867	0.0017633	-0.002047	3.9773086	0.00000	45.0000000 CY
0.0001688	13817.	81877465.	11.0036964	0.0018569	-0.002193	3.9972290	0.00000	45.0000000 CY
0.0001788	14040.	78547816.	10.9109179	0.0019503	-0.002340	3.9999999	0.00000	45.0000000 CY
0.0001888	14226.	75368753.	10.8253392	0.0020433	-0.002487	3.9999973	0.00000	45.0000000 CY
0.0001988	14382.	72360829.	10.7481162	0.0021362	-0.002634	3.9998262	0.00000	45.0000000 CY
0.0002088	14514.	69529481.	10.6785280	0.0022291	-0.002781	3.9987847	0.00000	45.0000000 CY
0.0002188	14626.	66862533.	10.6141449	0.0023218	-0.002928	3.9998718	0.00000	45.0000000 CY
0.0002288	14723.	64361736.	10.5560067	0.0024147	-0.003075	3.9978475	0.00000	45.0000000 CY
0.0002388	14806.	62015313.	10.5032532	0.0025077	-0.003222	3.9984132	0.00000	45.0000000 CY
0.0002488	14879.	59815229.	10.4555765	0.0026008	-0.003369	3.9988705	0.00000	45.0000000 CY
0.0002588	14942.	57746505.	10.4112411	0.0026939	-0.003516	3.9989396	0.00000	45.0000000 CY
0.0002688	14997.	55801491.	10.3705446	0.0027871	-0.003663	3.9986668	0.00000	45.0000000 CY
0.0002788	15045.	53972760.	10.3333063	0.0028804	-0.003810	3.9979395	0.00000	45.0000000 CY
0.0002888	15088.	52251741.	10.2989973	0.0029738	-0.003956	3.9964889	0.00000	45.0000000 CY
0.0002988	15125.	50627492.	10.2684135	0.0030677	-0.004102	3.9999970	0.00000	45.0000000 CY
0.0003088	15158.	49094458.	10.2399566	0.0031616	-0.004248	3.9994835	0.00000	45.0000000 CY
0.0003188	15187.	47644818.	10.2138432	0.0032557	-0.004394	3.9976358	0.00000	45.0000000 CY
0.0003288	15212.	46273495.	10.1896739	0.0033499	-0.004540	3.9987665	0.00000	45.0000000 CY
0.0003388	15235.	44974837.	10.1672861	0.0034442	-0.004686	3.9991527	0.00000	45.0000000 CY
0.0003488	15255.	43741431.	10.1462006	0.0035385	-0.004832	3.9954478	0.00000	45.0000000 CY
0.0003588	15272.	42570803.	10.1272220	0.0036331	-0.004977	3.9996284	0.00000	45.0000000 CY
0.0003688	15288.	41458662.	10.1096092	0.0037279	-0.005122	3.9958027	0.00000	45.0000000 CY
0.0003788	15301.	40398560.	10.0937507	0.0038230	-0.005267	3.9996513	0.00000	45.0000000 CY

Axial Thrust Force = 442.200 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	159.0561596	127244928.	140.2878357	0.0001754	0.0001454	0.7085831	0.00000	5.0810840	
0.00000250	318.1102351	127244094.	76.1547126	0.0001904	0.0001304	0.7655693	0.00000	5.5125167	
0.00000375	477.1601424	127242705.	54.7818026	0.0002054	0.0001154	0.8221260	0.00000	5.9444710	
0.00000500	636.2037971	127240759.	44.0989462	0.0002205	0.0001005	0.8782512	0.00000	6.3769472	
0.00000625	795.2391149	127238258.	37.6921113	0.0002356	0.00008558	0.9339432	0.00000	6.8099452	
0.00000750	954.2640108	127235201.	33.4232875	0.0002507	0.00007067	0.9892001	0.00000	7.2434650	
0.00000875	1113.	127231589.	30.3761844	0.0002658	0.00005579	1.0440203	0.00000	7.6775068	
0.00001000	1272.	127227420.	28.0926570	0.0002809	0.00004093	1.0984017	0.00000	8.1120706	
0.00001125	1431.	127222695.	26.3181803	0.0002961	0.00002608	1.1523427	0.00000	8.5471564	
0.00001250	1590.	127217414.	24.9000393	0.0003113	0.00001125	1.2058414	0.00000	8.9827643	
0.00001375	1749.	127211577.	23.7410518	0.0003264	-0.00000356	1.2588960	0.00000	9.4188941	
0.00001500	1908.	127205001.	22.7764236	0.0003416	-0.00001835	1.3115044	0.00000	9.8555440	

0.00001625	2067.	127195631.	21.9612299	0.0003569	-0.00003313	1.3636607	0.00000	10.2926794
0.00001750	2226.	127180686.	21.2633290	0.0003721	-0.00004789	1.4153560	0.00000	10.7302394
0.00001875	2384.	127158477.	20.6591551	0.0003874	-0.00006264	1.4665821	0.00000	11.1681656
0.00002000	2543.	127128256.	20.1310477	0.0004026	-0.00007738	1.5173319	0.00000	11.6064077
0.00002125	2701.	127089897.	19.6655157	0.0004179	-0.00009211	1.5675994	0.00000	12.0449241
0.00002250	2858.	127043627.	19.2520773	0.0004332	-0.000107	1.6173800	0.00000	12.4836805
0.00002375	2903.	122222905.	18.6890144	0.0004439	-0.000126	1.6517631	0.00000	12.7894088 C
0.00002500	3033.	121326989.	18.3185013	0.0004580	-0.000142	1.6968709	0.00000	13.1939132 C
0.00002625	3162.	120440768.	17.9794503	0.0004720	-0.000158	1.7412213	0.00000	13.5955065 C
0.00002750	3288.	119578200.	17.6683011	0.0004859	-0.000174	1.7848870	0.00000	13.9947702 C
0.00002875	3414.	118738086.	17.3813752	0.0004997	-0.000190	1.8278719	0.00000	14.3916716 C
0.00003000	3538.	117923101.	17.1158593	0.0005135	-0.000207	1.8702035	0.00000	14.7863975 C
0.00003125	3661.	117137434.	16.8695657	0.0005272	-0.000223	1.9119252	0.00000	15.1792940 C
0.00003250	3782.	116381334.	16.6404478	0.0005408	-0.000239	1.9530597	0.00000	15.5705222 C
0.00003375	3903.	115654915.	16.4267771	0.0005544	-0.000256	1.9936305	0.00000	15.9602582 C
0.00003500	4023.	114954978.	16.2268181	0.0005679	-0.000272	2.0336338	0.00000	16.3484205 C
0.00003625	4143.	114281757.	16.0393170	0.0005814	-0.000289	2.0730920	0.00000	16.7351821 C
0.00003750	4261.	113636811.	15.8633366	0.0005949	-0.000305	2.1120434	0.00000	17.1208787 C
0.00003875	4380.	113019957.	15.6979625	0.0006083	-0.000322	2.1505135	0.00000	17.5057354 C
0.00004000	4497.	112424217.	15.5417529	0.0006217	-0.000338	2.1884539	0.00000	17.8892335 C
0.00004125	4614.	111853037.	15.3943285	0.0006350	-0.000355	2.2259217	0.00000	18.2719155 C
0.00004250	4731.	111306862.	15.2551679	0.0006483	-0.000372	2.2629494	0.00000	18.6540946 C
0.00004375	4847.	110777591.	15.1229075	0.0006616	-0.000388	2.2994594	0.00000	19.0349390 C
0.00004500	4962.	110273836.	14.9980114	0.0006749	-0.000405	2.3355836	0.00000	19.4158051 C
0.00004625	5077.	109783571.	14.8787743	0.0006881	-0.000422	2.3711833	0.00000	19.7952062 C
0.00004750	5193.	109317026.	14.7659929	0.0007014	-0.000439	2.4064211	0.00000	20.1748554 C
0.00004875	5307.	108862725.	14.6580387	0.0007146	-0.000455	2.4411501	0.00000	20.5531524 C
0.00005125	5535.	108008129.	14.4575931	0.0007410	-0.000489	2.5094157	0.00000	21.3092479 C
0.00005375	5763.	107213844.	14.2749309	0.0007673	-0.000523	2.5760356	0.00000	22.0639987 C
0.00005625	5989.	106469143.	14.1072189	0.0007935	-0.000556	2.6409536	0.00000	22.8166510 C
0.00005875	6214.	105774087.	13.9533285	0.0008198	-0.000590	2.7042930	0.00000	23.5685336 C
0.00006125	6439.	105124303.	13.8118079	0.0008460	-0.000624	2.7660932	0.00000	24.3200739 C
0.00006375	6663.	104510181.	13.6804763	0.0008721	-0.000658	2.8262500	0.00000	25.0699308 C
0.00006625	6886.	103935610.	13.5594134	0.0008983	-0.000692	2.8849565	0.00000	25.8204732 C
0.00006875	7108.	103389065.	13.4462632	0.0009244	-0.000726	2.9420231	0.00000	26.5692375 C
0.00007125	7330.	102875375.	13.3415145	0.0009506	-0.000759	2.9976606	0.00000	27.3189546 C
0.00007375	7551.	102386099.	13.2433648	0.0009767	-0.000793	3.0517189	0.00000	28.0675967 C
0.00007625	7772.	101922418.	13.1518318	0.0010028	-0.000827	3.1043063	0.00000	28.8166383 C
0.00007875	7992.	101482340.	13.0663592	0.0010290	-0.000861	3.1554319	0.00000	29.5662481 C
0.00008125	8211.	101060354.	12.9856960	0.0010551	-0.000895	3.2049861	0.00000	30.3147963 C
0.00008375	8430.	100658852.	12.9102465	0.0010812	-0.000929	3.2531032	0.00000	31.0643115 C
0.00008625	8649.	100275999.	12.8395542	0.0011074	-0.000963	3.2997771	0.00000	31.8147852 C
0.00008875	8867.	99906549.	12.7723618	0.0011335	-0.000996	3.3448717	0.00000	32.5640164 C
0.00009125	9084.	99552987.	12.7092219	0.0011597	-0.001030	3.3885216	0.00000	33.3142268 C
0.00009375	9301.	99214022.	12.6498128	0.0011859	-0.001064	3.4307213	0.00000	34.0654273 C
0.00009625	9518.	98888181.	12.5937636	0.0012121	-0.001098	3.4714530	0.00000	34.8173921 C
0.00009875	9734.	98572421.	12.5402721	0.0012384	-0.001132	3.5106318	0.00000	35.5685539 C
0.0001013	9950.	98268276.	12.4897646	0.0012646	-0.001165	3.5483516	0.00000	36.3207210 C
0.0001038	10165.	97974881.	12.4420275	0.0012909	-0.001199	3.5846064	0.00000	37.0739003 C
0.0001063	10380.	97691454.	12.3968676	0.0013172	-0.001233	3.6193906	0.00000	37.8280984 C
0.0001088	10594.	97417029.	12.3540285	0.0013435	-0.001266	3.6526873	0.00000	38.5830676 C
0.0001113	10808.	97149735.	12.3129547	0.0013698	-0.001300	3.6844389	0.00000	39.3375204 C
0.0001138	11021.	96890570.	12.2740020	0.0013962	-0.001334	3.7147094	0.00000	40.0930144 C
0.0001163	11234.	96638989.	12.2370357	0.0014226	-0.001367	3.7434928	0.00000	40.8495570 C
0.0001188	11447.	96394489.	12.2019325	0.0014490	-0.001401	3.7707829	0.00000	41.6071554 C
0.0001213	11659.	96156611.	12.1685792	0.0014754	-0.001435	3.7965736	0.00000	42.3658171 C
0.0001238	11871.	95924929.	12.1368720	0.0015019	-0.001468	3.8208586	0.00000	43.1255498 C
0.0001263	12082.	95698582.	12.1065274	0.0015284	-0.001502	3.8436119	0.00000	43.8856737 C
0.0001288	12293.	95477148.	12.0774251	0.0015550	-0.001535	3.8648267	0.00000	44.6460362 C
0.0001313	12499.	95233749.	12.0510961	0.0015817	-0.001568	3.8846533	0.00000	45.0000000 CY
0.0001338	12689.	94870898.	12.0252593	0.0016084	-0.001602	3.9028648	0.00000	45.0000000 CY
0.0001363	12854.	94338293.	11.9979665	0.0016347	-0.001635	3.9193154	0.00000	45.0000000 CY
0.0001388	12997.	93671669.	11.9707613	0.0016609	-0.001669	3.9341732	0.00000	45.0000000 CY
0.0001413	13127.	92935954.	11.9431847	0.0016870	-0.001703	3.9474288	0.00000	45.0000000 CY
0.0001438	13247.	92154561.	11.9153760	0.0017128	-0.001737	3.9591222	0.00000	45.0000000 CY
0.0001463	13358.	91336620.	11.8880964	0.0017386	-0.001771	3.9693237	0.00000	45.0000000 CY
0.0001488	13461.	90493189.	11.8610148	0.0017643	-0.001806	3.9780298	0.00000	45.0000000 CY
0.0001588	13814.	87015424.	11.7562436	0.0018663	-0.001944	3.9982885	0.00000	45.0000000 CY
0.0001688	14094.	83519508.	11.6594791	0.0019675	-0.002082	3.9995510	0.00000	45.0000000 CY
0.0001788	14322.	80123651.	11.5700406	0.0020681	-0.002222	3.9998596	0.00000	45.0000000 CY
0.0001888	14510.	76875608.	11.4881148	0.0021684	-0.002362	3.9998288	0.00000	45.0000000 CY
0.0001988	14667.	73797417.	11.4146970	0.0022687	-0.002501	3.9994027	0.00000	45.0000000 CY
0.0002088	14800.	70896958.	11.3469026	0.0023687	-0.002641	3.9979793	0.00000	45.0000000 CY
0.0002188	14912.	68170746.	11.2853823	0.0024687	-0.002781	3.9994879	0.00000	45.0000000 CY
0.0002288	15008.	65609013.	11.2295625	0.0025688	-0.002921	3.9999841	0.00000	45.0000000 CY
0.0002388	15091.	63207421.	11.1794467	0.0026691	-0.003061	3.9974068	0.00000	45.0000000 CY
0.0002488	15162.	60951752.	11.1333493	0.0027694	-0.003201	3.9979979	0.00000	45.0000000 CY
0.0002588	15223.	58832337.	11.0908139	0.0028697	-0.003340	3.9980942	0.00000	45.0000000 CY
0.0002688	15276.	56841431.	11.0522059	0.0029703	-0.003480	3.9977496	0.00000	45.0000000 CY
0.0002788	15323.	54969391.	11.0169516	0.0030710	-0.003619	3.9968485	0.00000	45.0000000 CY
0.0002888	15363.	53206402.	10.9849427	0.0031719	-0.003758	3.9988772	0.00000	45.0000000 CY
0.0002988	15399.	51543342.	10.9562793	0.0032732	-0.003897	3.9998582	0.00000	45.0000000 CY
0.0003088	15430.	49975057.	10.9299087	0.0033746	-0.004035	3.9989396	0.00000	45.0000000 CY
0.0003188	15456.	48489910.	10.9053350	0.0034761	-0.004174	3.9966060	0.00000	45.0000000 CY
0.0003288	15479.	47085753.	10.8822654	0.0035775	-0.004312	3.9999710	0.00000	45.0000000 CY
0.0003388	15500.	45755425.	10.8619676	0.0036795	-0.004451	3.9985406	0.00000	45.0000000 CY
0.0003488	15517.	44493738.	10.8428449	0.0037814	-0.004589	3.9962625	0.00000	45.0000000 CY
0.0003588	15532.	43294557.	10.8258991	0.0038838	-0.004726	3.9992499	0.00000	45.0000000 CY

Axial Thrust Force = 502.900 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Max Casing Stress ksi	Run Msg
0.00000125	158.1790437	126543235.	158.4602130	0.0001981	0.0001681	0.7953945	0.00000	5.7398327	
0.00000250	316.3559866	126542395.	85.2409872	0.0002131	0.0001531	0.8516217	0.00000	6.1712716	
0.00000375	474.5287281	126540994.	60.8394147	0.0002281	0.0001381	0.9074189	0.00000	6.6032364	
0.00000500	632.6951672	126539033.	48.6422557	0.0002432	0.0001232	0.9627843	0.00000	7.0357271	
0.00000625	790.8532027	126536512.	41.3268622	0.0002583	0.0001083	1.0177160	0.00000	7.4687438	
0.00000750	949.0007335	126533431.	36.4523517	0.0002734	0.00009339	1.0722123	0.00000	7.9022865	
0.00000875	1107.	126529789.	32.9726318	0.0002885	0.00007851	1.1262712	0.00000	8.3363553	
0.00001000	1265.	126525587.	30.3646561	0.0003036	0.00006365	1.1798911	0.00000	8.7709503	
0.00001125	1423.	126520825.	28.3378435	0.0003188	0.00004880	1.2330699	0.00000	9.2060715	
0.00001250	1581.	126515501.	26.7178453	0.0003340	0.00003397	1.2858060	0.00000	9.6417190	
0.00001375	1740.	126509617.	25.3937124	0.0003492	0.00001916	1.3380975	0.00000	10.0778929	
0.00001500	1898.	126503173.	24.2914787	0.0003644	0.00000437	1.3899426	0.00000	10.5145933	
0.00001625	2056.	126496166.	23.3599368	0.0003796	-0.00001040	1.4413393	0.00000	10.9518203	
0.00001750	2214.	126488088.	22.5624928	0.0003948	-0.00002516	1.4922850	0.00000	11.3895648	
0.00001875	2371.	126476845.	21.8722495	0.0004101	-0.00003990	1.5427729	0.00000	11.8277854	
0.00002000	2529.	126460441.	21.2690130	0.0004254	-0.00005462	1.5927951	0.00000	12.2664274	
0.00002125	2687.	126437668.	20.7373471	0.0004407	-0.00006933	1.6423446	0.00000	12.7054401	
0.00002250	2844.	126407933.	20.2652554	0.0004560	-0.00008403	1.6914151	0.00000	13.1447791	
0.00002375	3001.	126371083.	19.8432767	0.0004713	-0.00009872	1.7400013	0.00000	13.5844068	
0.00002500	3158.	126327237.	19.4638506	0.0004866	-0.000113	1.7880987	0.00000	14.0242918	
0.00002625	3205.	122089154.	18.9509549	0.0004975	-0.000133	1.8217670	0.00000	14.3350645	C
0.00002750	3336.	121308168.	18.6066203	0.0005117	-0.000148	1.8655783	0.00000	14.7430796	C
0.00002875	3465.	120524610.	18.2887748	0.0005258	-0.000164	1.9086401	0.00000	15.1482157	C
0.00003000	3593.	119753924.	17.9948293	0.0005398	-0.000180	1.9510275	0.00000	15.5511014	C
0.00003125	3719.	118999265.	17.7220809	0.0005538	-0.000196	1.9927632	0.00000	15.9518856	C
0.00003250	3844.	118262531.	17.4682133	0.0005677	-0.000212	2.0338666	0.00000	16.3506910	C
0.00003375	3967.	117545313.	17.2312688	0.0005816	-0.000228	2.0743578	0.00000	16.7476543	C
0.00003500	4090.	116848930.	17.0095841	0.0005953	-0.000245	2.1142581	0.00000	17.1429278	C
0.00003625	4211.	116174444.	16.8017394	0.0006091	-0.000261	2.1535894	0.00000	17.5366786	C
0.00003750	4332.	115522681.	16.6065182	0.0006227	-0.000277	2.1923744	0.00000	17.9290886	C
0.00003875	4452.	114894249.	16.4228741	0.0006364	-0.000294	2.2306364	0.00000	18.3203549	C
0.00004000	4571.	114283760.	16.2494045	0.0006500	-0.000310	2.2683436	0.00000	18.7101094	C
0.00004125	4690.	113694503.	16.0855348	0.0006635	-0.000326	2.3055408	0.00000	19.0987711	C
0.00004250	4808.	113128755.	15.9307592	0.0006771	-0.000343	2.3422708	0.00000	19.4867608	C
0.00004375	4925.	112579534.	15.7838210	0.0006905	-0.000359	2.3784793	0.00000	19.8734731	C
0.00004500	5042.	112050301.	15.6444659	0.0007040	-0.000376	2.4142184	0.00000	20.2594282	C
0.00004625	5159.	111540809.	15.5122068	0.0007174	-0.000393	2.4495058	0.00000	20.6447975	C
0.00004750	5275.	111046072.	15.3861032	0.0007308	-0.000409	2.4842964	0.00000	21.0290573	C
0.00004875	5390.	110571355.	15.2663238	0.0007442	-0.000426	2.5186742	0.00000	21.4131154	C
0.00005125	5620.	109665344.	15.0426795	0.0007709	-0.000459	2.5860382	0.00000	22.1788326	C
0.00005375	5849.	108817796.	14.8384537	0.0007976	-0.000492	2.6516512	0.00000	22.9423899	C
0.00005625	6076.	108024359.	14.6513492	0.0008241	-0.000526	2.7155660	0.00000	23.7042635	C
0.00005875	6303.	107281147.	14.4794809	0.0008507	-0.000559	2.7778342	0.00000	24.4649657	C
0.00006125	6528.	106581136.	14.3208110	0.0008771	-0.000593	2.8384390	0.00000	25.2241907	C
0.00006375	6752.	105920686.	14.1738859	0.0009036	-0.000626	2.8974033	0.00000	25.9821217	C
0.00006625	6976.	105300585.	14.0380979	0.0009300	-0.000660	2.9548387	0.00000	26.7401457	C
0.00006875	7199.	104709692.	13.9111921	0.0009564	-0.000694	3.0105939	0.00000	27.4961895	C
0.00007125	7421.	104154089.	13.7935928	0.0009828	-0.000727	3.0648794	0.00000	28.2530612	C
0.00007375	7642.	103622824.	13.6831604	0.0010091	-0.000761	3.1175150	0.00000	29.0082095	C
0.00007625	7863.	103121068.	13.5804164	0.0010355	-0.000794	3.1686918	0.00000	29.7643459	C
0.00007875	8083.	102640677.	13.4836860	0.0010618	-0.000828	3.2182649	0.00000	30.5193182	C
0.00008125	8302.	102183496.	13.3930894	0.0010882	-0.000862	3.2663408	0.00000	31.2747172	C
0.00008375	8521.	101747965.	13.3081627	0.0011146	-0.000895	3.3129296	0.00000	32.0307503	C
0.00008625	8740.	101328476.	13.2276817	0.0011409	-0.000929	3.3579202	0.00000	32.7855891	C
0.00008875	8957.	100928010.	13.1521239	0.0011673	-0.000963	3.4014441	0.00000	33.5414291	C
0.00009125	9175.	100544974.	13.0810870	0.0011936	-0.000996	3.4434956	0.00000	34.2982766	C
0.00009375	9391.	100174056.	13.0133508	0.0012200	-0.001030	3.4839460	0.00000	35.0537978	C
0.00009625	9607.	99818063.	12.9494837	0.0012464	-0.001064	3.5229197	0.00000	35.8102967	C
0.00009875	9823.	99475895.	12.8892072	0.0012728	-0.001097	3.5604129	0.00000	36.5678174	C
0.0001013	10039.	99146088.	12.8321542	0.0012993	-0.001131	3.5964056	0.00000	37.3260630	C
0.0001038	10253.	98825665.	12.7775711	0.0013257	-0.001164	3.6308238	0.00000	38.0834674	C
0.0001063	10467.	98516385.	12.7258940	0.0013521	-0.001198	3.6637523	0.00000	38.8419089	C
0.0001088	10681.	98217457.	12.6769247	0.0013786	-0.001231	3.6951852	0.00000	39.6013999	C
0.0001113	10895.	97928157.	12.6304829	0.0014051	-0.001265	3.7251164	0.00000	40.3619444	C
0.0001138	11107.	97647192.	12.5862176	0.0014317	-0.001298	3.7535173	0.00000	41.1229348	C
0.0001163	11320.	97373289.	12.5437749	0.0014582	-0.001332	3.7803606	0.00000	41.8836506	C
0.0001188	11531.	97107321.	12.5034316	0.0014848	-0.001365	3.8056913	0.00000	42.6454422	C
0.0001213	11743.	96848772.	12.4650600	0.0015114	-0.001399	3.8295033	0.00000	43.4083173	C
0.0001238	11954.	96597169.	12.4285429	0.0015380	-0.001432	3.8517901	0.00000	44.1722835	C
0.0001263	12164.	96352079.	12.3937722	0.0015647	-0.001465	3.8725451	0.00000	44.9373486	C
0.0001288	12369.	96068257.	12.3631680	0.0015918	-0.001498	3.8919881	0.00000	45.0000000	CY
0.0001313	12563.	95721212.	12.3377288	0.0016193	-0.001531	3.9101569	0.00000	45.0000000	CY
0.0001338	12749.	95322608.	12.3171347	0.0016474	-0.001563	3.9269524	0.00000	45.0000000	CY
0.0001363	12921.	94835037.	12.2976448	0.0016756	-0.001594	3.9420359	0.00000	45.0000000	CY
0.0001388	13074.	94229558.	12.2757965	0.0017033	-0.001627	3.9551865	0.00000	45.0000000	CY
0.0001413	13210.	93521971.	12.2522956	0.0017306	-0.001659	3.9665147	0.00000	45.0000000	CY
0.0001438	13334.	92755038.	12.2277124	0.0017577	-0.001692	3.9761059	0.00000	45.0000000	CY
0.0001463	13448.	91952188.	12.2025265	0.0017846	-0.001725	3.9840260	0.00000	45.0000000	CY
0.0001488	13554.	91118939.	12.1776042	0.0018114	-0.001759	3.9903388	0.00000	45.0000000	CY
0.0001588	13914.	87647832.	12.0783634	0.0019174	-0.001893	3.9992412	0.00000	45.0000000	CY
0.0001688	14199.	84142351.	11.9843260	0.0020224	-0.002028	3.9999639	0.00000	45.0000000	CY
0.0001788	14430.	80726501.	11.8979519	0.0021268	-0.002163	3.9985772	0.00000	45.0000000	CY
0.0001888	14620.	77454711.	11.8186042	0.0022308	-0.002299	3.9985137	0.00000	45.0000000	CY
0.0001988	14778.	74352271.	11.7458273	0.0023345	-0.002436	3.9999726	0.00000	45.0000000	CY
0.0002088	14910.	71424217.	11.6803485	0.0024383	-0.002572	3.9993444	0.00000	45.0000000	CY
0.0002188	15022.	68670886.	11.6206602	0.0025420	-0.002708	3.9999997	0.00000	45.0000000	CY

0.0002288	15118.	66087534.	11.5661097	0.0026457	-0.002844	3.9984962	0.00000	45.0000000 CY
0.0002388	15199.	63660449.	11.5162366	0.0027495	-0.002980	3.9993019	0.00000	45.0000000 CY
0.0002488	15269.	61384518.	11.4713648	0.0028535	-0.003116	3.9996430	0.00000	45.0000000 CY
0.0002588	15330.	59247999.	11.4307637	0.0029577	-0.003252	3.9997365	0.00000	45.0000000 CY
0.0002688	15383.	57239381.	11.3938398	0.0030621	-0.003388	3.9996586	0.00000	45.0000000 CY
0.0002788	15428.	55347785.	11.3595919	0.0031665	-0.003524	3.9993343	0.00000	45.0000000 CY
0.0002888	15467.	53566754.	11.3281696	0.0032710	-0.003659	3.9985501	0.00000	45.0000000 CY
0.0002988	15502.	51887917.	11.2993474	0.0033757	-0.003794	3.9969436	0.00000	45.0000000 CY
0.0003088	15531.	50301902.	11.2737150	0.0034808	-0.003929	3.9995803	0.00000	45.0000000 CY
0.0003188	15556.	48804415.	11.2501336	0.0035860	-0.004064	3.9994784	0.00000	45.0000000 CY
0.0003288	15578.	47386959.	11.2295393	0.0036917	-0.004198	3.9973326	0.00000	45.0000000 CY
0.0003388	15597.	46043663.	11.2097998	0.0037973	-0.004333	3.9998436	0.00000	45.0000000 CY
0.0003488	15613.	44768809.	11.1927991	0.0039035	-0.004467	3.9987434	0.00000	45.0000000 CY

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	237.400	14913.249	0.00300000	-0.00436774
2	320.750	15098.081	0.00300000	-0.00399691
3	442.200	15289.883	0.00300000	-0.00352083
4	502.900	15351.756	0.00300000	-0.00330723

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	237.400000	14913.	154.310000	9694.	94956721.
2	0.65	320.750000	15098.	208.487500	9814.	96334462.
3	0.65	442.200000	15290.	287.430000	9938.	98284127.
4	0.65	502.900000	15352.	326.885000	9979.	99237847.
1	0.75	237.400000	14913.	178.050000	11185.	93726634.
2	0.75	320.750000	15098.	240.562500	11324.	94822186.
3	0.75	442.200000	15290.	331.650000	11467.	96371427.
4	0.75	502.900000	15352.	377.175000	11514.	97129514.
1	0.90	237.400000	14913.	213.660000	13422.	82313416.
2	0.90	320.750000	15098.	288.675000	13588.	84744511.
3	0.90	442.200000	15290.	397.980000	13761.	87535887.
4	0.90	502.900000	15352.	452.610000	13817.	88587656.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	14.7000	0.00	N.A.	No	0.00	15986.
2	21.7000	6.9693	Yes	No	15986.	57839.
3	34.7000	20.0000	No	No	73825.	0.00
4	54.7000	40.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only
for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection

for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 4200.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 320750.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.06516	-658901.	4200.	0.00	0.00	1.29E+11	0.00	0.00	9.2200
0.3170	0.06513	-642846.	4235.	-1.92E-05	0.00	1.29E+11	0.00	0.00	9.2200
0.6340	0.06502	-626634.	4270.	-3.80E-05	0.00	1.29E+11	0.00	0.00	9.2200
0.9510	0.06484	-610266.	4305.	-5.63E-05	0.00	1.29E+11	0.00	0.00	9.2200
1.2680	0.06459	-593742.	4340.	-7.41E-05	0.00	1.29E+11	0.00	0.00	9.2200
1.5850	0.06427	-577064.	4375.	-9.14E-05	0.00	1.29E+11	0.00	0.00	9.2200
1.9020	0.06389	-560231.	4410.	-1.08E-04	0.00	1.29E+11	0.00	0.00	9.2200
2.2190	0.06345	-543245.	4446.	-1.25E-04	0.00	1.29E+11	0.00	0.00	9.2200
2.5360	0.06294	-526106.	4481.	-1.40E-04	0.00	1.29E+11	0.00	0.00	9.2200
2.8530	0.06238	-508814.	4516.	-1.56E-04	0.00	1.29E+11	0.00	0.00	9.2200
3.1700	0.06176	-491371.	4551.	-1.70E-04	0.00	1.29E+11	0.00	0.00	9.2200
3.4870	0.06108	-473776.	4586.	-1.85E-04	0.00	1.29E+11	0.00	0.00	9.2200
3.8040	0.06035	-456031.	4621.	-1.98E-04	0.00	1.29E+11	0.00	0.00	9.2200
4.1210	0.05957	-438136.	4656.	-2.12E-04	0.00	1.29E+11	0.00	0.00	9.2200
4.4380	0.05874	-420092.	4691.	-2.24E-04	0.00	1.29E+11	0.00	0.00	9.2200
4.7550	0.05787	-401899.	4726.	-2.37E-04	0.00	1.29E+11	0.00	0.00	9.2200
5.0720	0.05694	-383559.	4761.	-2.48E-04	0.00	1.29E+11	0.00	0.00	9.2200
5.3890	0.05598	-365071.	4796.	-2.59E-04	0.00	1.29E+11	0.00	0.00	9.2200
5.7060	0.05497	-346436.	4831.	-2.70E-04	0.00	1.29E+11	0.00	0.00	9.2200
6.0230	0.05393	-327656.	4866.	-2.80E-04	0.00	1.29E+11	0.00	0.00	9.2200
6.3400	0.05284	-308730.	4901.	-2.89E-04	0.00	1.29E+11	0.00	0.00	9.2200
6.6570	0.05173	-289660.	4937.	-2.98E-04	0.00	1.29E+11	0.00	0.00	9.2200
6.9740	0.05058	-270446.	4972.	-3.06E-04	0.00	1.29E+11	0.00	0.00	9.2200
7.2910	0.04940	-251089.	5007.	-3.14E-04	0.00	1.29E+11	0.00	0.00	9.2200
7.6080	0.04819	-231589.	5042.	-3.21E-04	0.00	1.29E+11	0.00	0.00	9.2200
7.9250	0.04695	-211948.	5077.	-3.28E-04	0.00	1.29E+11	0.00	0.00	9.2200
8.2420	0.04570	-192165.	5112.	-3.34E-04	0.00	1.29E+11	0.00	0.00	9.2200
8.5590	0.04442	-172242.	5147.	-3.39E-04	0.00	1.29E+11	0.00	0.00	9.2200
8.8760	0.04312	-152180.	5182.	-3.44E-04	0.00	1.29E+11	0.00	0.00	9.2200
9.1930	0.04180	-131978.	5217.	-3.48E-04	0.00	1.29E+11	0.00	0.00	9.2200
9.5100	0.04047	-111639.	5252.	-3.52E-04	0.00	1.29E+11	0.00	0.00	9.2200
9.8270	0.03912	-91161.	5287.	-3.55E-04	0.00	1.29E+11	0.00	0.00	9.2200
10.1440	0.03777	-70548.	5322.	-3.57E-04	0.00	1.29E+11	0.00	0.00	9.2200
10.4610	0.03641	-49798.	5357.	-3.59E-04	0.00	1.29E+11	0.00	0.00	9.2200
10.7780	0.03504	-28913.	5392.	-3.60E-04	0.00	1.29E+11	0.00	0.00	9.2200
11.0950	0.03367	-7894.	5428.	-3.61E-04	0.00	1.29E+11	0.00	0.00	9.2200
11.4120	0.03230	13260.	5463.	-3.60E-04	0.00	1.29E+11	0.00	0.00	9.2200
11.7290	0.03093	34546.	5498.	-3.60E-04	0.00	1.29E+11	0.00	0.00	9.2200
12.0460	0.02956	55964.	5533.	-3.58E-04	0.00	1.29E+11	0.00	0.00	9.2200
12.3630	0.02820	77513.	5568.	-3.56E-04	0.00	1.29E+11	0.00	0.00	9.2200
12.6800	0.02685	99194.	5603.	-3.54E-04	0.00	1.29E+11	0.00	0.00	9.2200
12.9970	0.02551	121004.	5638.	-3.51E-04	0.00	1.29E+11	0.00	0.00	9.2200
13.3140	0.02418	142943.	5673.	-3.47E-04	0.00	1.29E+11	0.00	0.00	9.2200
13.6310	0.02287	165010.	5708.	-3.42E-04	0.00	1.29E+11	0.00	0.00	9.2200
13.9480	0.02158	187205.	5743.	-3.37E-04	0.00	1.29E+11	0.00	0.00	9.2200
14.2650	0.02031	209527.	5778.	-3.31E-04	0.00	1.29E+11	0.00	0.00	9.2200
14.5820	0.01906	231974.	5811.	-3.24E-04	0.00	1.29E+11	0.00	0.00	8.0421
14.8990	0.01784	254530.	5775.	-3.17E-04	0.00	1.29E+11	-26.840	5723.	0.00
15.2160	0.01665	276687.	5601.	-3.09E-04	0.00	1.29E+11	-64.942	14839.	0.00
15.5330	0.01549	297895.	5292.	-3.01E-04	0.00	1.29E+11	-97.524	23956.	0.00
15.8500	0.01436	317682.	4892.	-2.92E-04	0.00	1.29E+11	-112.458	29794.	0.00
16.1670	0.01327	335829.	4447.	-2.82E-04	0.00	1.29E+11	-121.625	34876.	0.00
16.4840	0.01221	352204.	3969.	-2.72E-04	0.00	1.29E+11	-129.672	40395.	0.00
16.8010	0.01120	366690.	3463.	-2.61E-04	0.00	1.29E+11	-136.596	46409.	0.00
17.1180	0.01022	379187.	2932.	-2.50E-04	0.00	1.29E+11	-142.399	52988.	0.00
17.4350	0.00929	389609.	2382.	-2.39E-04	0.00	1.29E+11	-147.084	60215.	0.00
17.7520	0.00840	397888.	1815.	-2.27E-04	0.00	1.29E+11	-150.656	68188.	0.00
18.0690	0.00756	403974.	1237.	-2.15E-04	0.00	1.29E+11	-153.123	77024.	0.00
18.3860	0.00677	407829.	652.3403	-2.03E-04	0.00	1.29E+11	-154.493	86868.	0.00
18.7030	0.00601	409433.	64.1106	-1.91E-04	0.00	1.29E+11	-154.776	97895.	0.00
19.0200	0.00531	408783.	-523.149	-1.79E-04	0.00	1.29E+11	-153.983	110325.	0.00
19.3370	0.00465	405891.	-1105.	-1.67E-04	0.00	1.29E+11	-152.122	124438.	0.00
19.6540	0.00404	400782.	-1678.	-1.55E-04	0.00	1.29E+11	-149.201	140592.	0.00
19.9710	0.00347	393500.	-2225.	-1.44E-04	0.00	1.29E+11	-138.222	151585.	0.00
20.2880	0.00294	384203.	-2725.	-1.32E-04	0.00	1.29E+11	-124.398	160701.	0.00
20.6050	0.00246	373093.	-3170.	-1.21E-04	0.00	1.29E+11	-109.992	169817.	0.00
20.9220	0.00203	360377.	-3561.	-1.10E-04	0.00	1.29E+11	-95.256	178934.	0.00
21.2390	0.00163	346270.	-3895.	-9.96E-05	0.00	1.29E+11	-80.421	188050.	0.00
21.5560	0.00127	330987.	-4173.	-8.96E-05	0.00	1.29E+11	-65.696	197166.	0.00
21.8730	9.45E-04	314742.	-4395.	-8.00E-05	0.00	1.29E+11	-51.268	206283.	0.00
22.1900	6.59E-04	297743.	-4564.	-7.10E-05	0.00	1.29E+11	-37.301	215399.	0.00
22.5070	4.06E-04	280193.	-4680.	-6.24E-05	0.00	1.29E+11	-23.937	224516.	0.00
22.8240	1.84E-04	262287.	-4747.	-5.44E-05	0.00	1.29E+11	-11.295	233632.	0.00
23.1410	-8.25E-06	244209.	-4768.	-4.69E-05	0.00	1.29E+11	0.5264	242748.	0.00
23.4580	-1.73E-04	226129.	-4745.	-3.99E-05	0.00	1.29E+11	11.4497	251865.	0.00
23.7750	-3.12E-04	208206.	-4682.	-3.35E-05	0.00	1.29E+11	21.4170	260981.	0.00

24.0920	-4.28E-04	190586.	-4584.	-2.76E-05	0.00	1.29E+11	30.3887	270097.	0.00
24.4090	-5.22E-04	173399.	-4453.	-2.22E-05	0.00	1.29E+11	38.3418	279214.	0.00
24.7260	-5.97E-04	156760.	-4294.	-1.74E-05	0.00	1.29E+11	45.2687	288330.	0.00
25.0430	-6.54E-04	140771.	-4111.	-1.30E-05	0.00	1.29E+11	51.1757	297446.	0.00
25.3600	-6.96E-04	125517.	-3907.	-9.03E-06	0.00	1.29E+11	56.0807	306563.	0.00
25.6770	-7.23E-04	111070.	-3686.	-5.53E-06	0.00	1.29E+11	60.0125	315679.	0.00
25.9940	-7.38E-04	97488.	-3452.	-2.45E-06	0.00	1.29E+11	63.0081	324796.	0.00
26.3110	-7.42E-04	84814.	-3208.	2.50E-07	0.00	1.29E+11	65.1120	333912.	0.00
26.6280	-7.36E-04	73078.	-2958.	2.58E-06	0.00	1.29E+11	66.3739	343028.	0.00
26.9450	-7.22E-04	62301.	-2705.	4.59E-06	0.00	1.29E+11	66.8473	352145.	0.00
27.2620	-7.01E-04	52489.	-2451.	6.28E-06	0.00	1.29E+11	66.5882	361261.	0.00
27.5790	-6.74E-04	43639.	-2199.	7.70E-06	0.00	1.29E+11	65.6539	370377.	0.00
27.8960	-6.43E-04	35737.	-1953.	8.88E-06	0.00	1.29E+11	64.1011	379494.	0.00
28.2130	-6.07E-04	28761.	-1713.	9.83E-06	0.00	1.29E+11	61.9853	388610.	0.00
28.5300	-5.68E-04	22681.	-1482.	1.06E-05	0.00	1.29E+11	59.3598	397726.	0.00
28.8470	-5.26E-04	17459.	-1262.	1.12E-05	0.00	1.29E+11	56.2744	406843.	0.00
29.1640	-4.83E-04	13051.	-1055.	1.16E-05	0.00	1.29E+11	52.7749	415959.	0.00
29.4810	-4.38E-04	9406.	-861.347	1.20E-05	0.00	1.29E+11	48.9028	425076.	0.00
29.7980	-3.92E-04	6469.	-683.325	1.22E-05	0.00	1.29E+11	44.6941	434192.	0.00
30.1150	-3.45E-04	4178.	-521.895	1.24E-05	0.00	1.29E+11	40.1799	443308.	0.00
30.4320	-2.98E-04	2468.	-378.170	1.25E-05	0.00	1.29E+11	35.3855	452425.	0.00
30.7490	-2.50E-04	1270.	-253.177	1.25E-05	0.00	1.29E+11	30.3309	461541.	0.00
31.0660	-2.02E-04	511.3846	-147.879	1.25E-05	0.00	1.29E+11	25.0308	470657.	0.00
31.3830	-1.55E-04	114.6446	-63.191	1.26E-05	0.00	1.29E+11	19.4949	479774.	0.00
31.7000	-1.07E-04	0.00	0.00	1.26E-05	0.00	1.29E+11	13.7286	244445.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     0.06516282 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =       -658901. inch-lbs
Maximum shear force              =          5811. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =    14.58200000 feet below pile head
Number of iterations             =              7
Number of zero deflection points =              1
Pile deflection at ground        =     0.01860699 inches
```

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 2, Shear and Slope

```
Shear      =           4200. lbs
Slope      =        0.00000
Axial Load =         320750. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
31.70000	0.06516282	-658901.	5811.
30.11500	0.06527021	-659138.	5807.
28.53000	0.06582028	-660662.	5810.
26.94500	0.06796136	-667977.	-6013.
25.36000	0.07423054	-692319.	-6748.
23.77500	0.08769141	-751342.	-6822.
22.19000	0.10868538	-859093.	5817.
20.60500	0.12851489	-988719.	5817.
19.02000	0.13371632	-1051919.	5818.
17.43500	0.14108478	-1032530.	5819.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

```
Shear force at pile head                          =       4800.0 lbs
Rotation of pile head                             =    0.000E+00 radians
Axial load at pile head                           =     502900.0 lbs
```

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch

0.00	0.06960	-710088.	4800.	0.00	0.00	1.27E+11	0.00	0.00	6.1300
0.3170	0.06956	-691764.	4823.	-2.11E-05	0.00	1.27E+11	0.00	0.00	6.1300
0.6340	0.06944	-673312.	4847.	-4.16E-05	0.00	1.27E+11	0.00	0.00	6.1300
0.9510	0.06925	-654732.	4870.	-6.16E-05	0.00	1.27E+11	0.00	0.00	6.1300
1.2680	0.06898	-636026.	4893.	-8.10E-05	0.00	1.27E+11	0.00	0.00	6.1300
1.5850	0.06863	-617194.	4917.	-9.98E-05	0.00	1.27E+11	0.00	0.00	6.1300
1.9020	0.06822	-598238.	4940.	-1.18E-04	0.00	1.27E+11	0.00	0.00	6.1300
2.2190	0.06773	-579160.	4963.	-1.36E-04	0.00	1.27E+11	0.00	0.00	6.1300
2.5360	0.06718	-559959.	4987.	-1.53E-04	0.00	1.27E+11	0.00	0.00	6.1300
2.8530	0.06657	-540637.	5010.	-1.69E-04	0.00	1.27E+11	0.00	0.00	6.1300
3.1700	0.06590	-521196.	5033.	-1.85E-04	0.00	1.27E+11	0.00	0.00	6.1300
3.4870	0.06516	-501635.	5057.	-2.01E-04	0.00	1.27E+11	0.00	0.00	6.1300
3.8040	0.06437	-481958.	5080.	-2.16E-04	0.00	1.27E+11	0.00	0.00	6.1300
4.1210	0.06352	-462163.	5103.	-2.30E-04	0.00	1.27E+11	0.00	0.00	6.1300
4.4380	0.06262	-442254.	5126.	-2.43E-04	0.00	1.27E+11	0.00	0.00	6.1300
4.7550	0.06167	-422230.	5150.	-2.56E-04	0.00	1.27E+11	0.00	0.00	6.1300
5.0720	0.06067	-402094.	5173.	-2.69E-04	0.00	1.27E+11	0.00	0.00	6.1300
5.3890	0.05962	-381845.	5196.	-2.80E-04	0.00	1.27E+11	0.00	0.00	6.1300
5.7060	0.05854	-361486.	5220.	-2.92E-04	0.00	1.27E+11	0.00	0.00	6.1300
6.0230	0.05741	-341018.	5243.	-3.02E-04	0.00	1.27E+11	0.00	0.00	6.1300
6.3400	0.05624	-320441.	5266.	-3.12E-04	0.00	1.27E+11	0.00	0.00	6.1300
6.6570	0.05503	-299757.	5290.	-3.21E-04	0.00	1.27E+11	0.00	0.00	6.1300
6.9740	0.05379	-278967.	5313.	-3.30E-04	0.00	1.27E+11	0.00	0.00	6.1300
7.2910	0.05252	-258072.	5336.	-3.38E-04	0.00	1.27E+11	0.00	0.00	6.1300
7.6080	0.05122	-237074.	5360.	-3.46E-04	0.00	1.27E+11	0.00	0.00	6.1300
7.9250	0.04989	-215973.	5383.	-3.53E-04	0.00	1.27E+11	0.00	0.00	6.1300
8.2420	0.04854	-194771.	5406.	-3.59E-04	0.00	1.27E+11	0.00	0.00	6.1300
8.5590	0.04716	-173470.	5430.	-3.64E-04	0.00	1.27E+11	0.00	0.00	6.1300
8.8760	0.04576	-152070.	5453.	-3.69E-04	0.00	1.27E+11	0.00	0.00	6.1300
9.1930	0.04435	-130572.	5476.	-3.73E-04	0.00	1.27E+11	0.00	0.00	6.1300
9.5100	0.04292	-108978.	5500.	-3.77E-04	0.00	1.27E+11	0.00	0.00	6.1300
9.8270	0.04148	-87289.	5523.	-3.80E-04	0.00	1.27E+11	0.00	0.00	6.1300
10.1440	0.04003	-65506.	5546.	-3.82E-04	0.00	1.27E+11	0.00	0.00	6.1300
10.4610	0.03858	-43631.	5570.	-3.84E-04	0.00	1.27E+11	0.00	0.00	6.1300
10.7780	0.03711	-21665.	5593.	-3.85E-04	0.00	1.27E+11	0.00	0.00	6.1300
11.0950	0.03565	391.4906	5616.	-3.85E-04	0.00	1.27E+11	0.00	0.00	6.1300
11.4120	0.03418	22536.	5639.	-3.85E-04	0.00	1.27E+11	0.00	0.00	6.1300
11.7290	0.03272	44769.	5663.	-3.84E-04	0.00	1.27E+11	0.00	0.00	6.1300
12.0460	0.03126	67087.	5686.	-3.82E-04	0.00	1.27E+11	0.00	0.00	6.1300
12.3630	0.02981	89491.	5709.	-3.80E-04	0.00	1.27E+11	0.00	0.00	6.1300
12.6800	0.02837	111978.	5733.	-3.77E-04	0.00	1.27E+11	0.00	0.00	6.1300
12.9970	0.02695	134547.	5756.	-3.73E-04	0.00	1.27E+11	0.00	0.00	6.1300
13.3140	0.02554	157197.	5779.	-3.69E-04	0.00	1.27E+11	0.00	0.00	6.1300
13.6310	0.02414	179927.	5803.	-3.64E-04	0.00	1.27E+11	0.00	0.00	6.1300
13.9480	0.02277	202735.	5826.	-3.58E-04	0.00	1.27E+11	0.00	0.00	6.1300
14.2650	0.02142	225620.	5849.	-3.51E-04	0.00	1.27E+11	0.00	0.00	6.1300
14.5820	0.02010	248581.	5871.	-3.44E-04	0.00	1.27E+11	0.00	0.00	5.3468
14.8990	0.01880	271605.	5828.	-3.36E-04	0.00	1.27E+11	-28.286	5723.	0.00
15.2160	0.01754	294204.	5644.	-3.28E-04	0.00	1.27E+11	-68.412	14839.	0.00
15.5330	0.01631	315796.	5318.	-3.19E-04	0.00	1.27E+11	-102.691	23956.	0.00
15.8500	0.01511	335884.	4903.	-3.09E-04	0.00	1.27E+11	-115.374	29042.	0.00
16.1670	0.01396	354284.	4447.	-2.99E-04	0.00	1.27E+11	-124.750	34003.	0.00
16.4840	0.01284	370857.	3957.	-2.88E-04	0.00	1.27E+11	-132.971	39393.	0.00
16.8010	0.01177	385486.	3437.	-2.76E-04	0.00	1.27E+11	-140.036	45270.	0.00
17.1180	0.01074	398065.	2893.	-2.65E-04	0.00	1.27E+11	-145.946	51701.	0.00
17.4350	0.00975	408510.	2329.	-2.52E-04	0.00	1.27E+11	-150.703	58770.	0.00
17.7520	0.00882	416751.	1749.	-2.40E-04	0.00	1.27E+11	-154.315	66572.	0.00
18.0690	0.00793	422734.	1157.	-2.27E-04	0.00	1.27E+11	-156.788	75225.	0.00
18.3860	0.00709	426425.	558.2507	-2.15E-04	0.00	1.27E+11	-158.131	84871.	0.00
18.7030	0.00630	427803.	-43.707	-2.02E-04	0.00	1.27E+11	-158.355	95685.	0.00
19.0200	0.00555	426865.	-644.405	-1.89E-04	0.00	1.27E+11	-157.469	107886.	0.00
19.3370	0.00486	423623.	-1240.	-1.76E-04	0.00	1.27E+11	-155.483	121751.	0.00
19.6540	0.00421	418107.	-1825.	-1.64E-04	0.00	1.27E+11	-152.404	137641.	0.00
19.9710	0.00361	410362.	-2389.	-1.51E-04	0.00	1.27E+11	-144.009	151585.	0.00
20.2880	0.00306	400510.	-2909.	-1.39E-04	0.00	1.27E+11	-129.384	160701.	0.00
20.6050	0.00256	388762.	-3372.	-1.27E-04	0.00	1.27E+11	-114.162	169817.	0.00
20.9220	0.00210	375340.	-3777.	-1.16E-04	0.00	1.27E+11	-98.609	178934.	0.00
21.2390	0.00168	360469.	-4122.	-1.04E-04	0.00	1.27E+11	-82.969	188050.	0.00
21.5560	0.00130	344377.	-4408.	-9.39E-05	0.00	1.27E+11	-67.461	197166.	0.00
21.8730	9.64E-04	327289.	-4636.	-8.38E-05	0.00	1.27E+11	-52.283	206283.	0.00
22.1900	6.64E-04	309426.	-4807.	-7.42E-05	0.00	1.27E+11	-37.607	215399.	0.00
22.5070	4.00E-04	291000.	-4924.	-6.52E-05	0.00	1.27E+11	-23.581	224516.	0.00
22.8240	1.68E-04	272217.	-4988.	-5.67E-05	0.00	1.27E+11	-10.331	233632.	0.00
23.1410	-3.20E-05	253268.	-5004.	-4.88E-05	0.00	1.27E+11	2.0412	242748.	0.00
23.4580	-2.03E-04	234335.	-4974.	-4.15E-05	0.00	1.27E+11	13.4556	251865.	0.00
23.7750	-3.48E-04	215583.	-4903.	-3.47E-05	0.00	1.27E+11	23.8522	260981.	0.00
24.0920	-4.67E-04	197163.	-4795.	-2.85E-05	0.00	1.27E+11	33.1909	270097.	0.00
24.4090	-5.65E-04	179213.	-4653.	-2.29E-05	0.00	1.27E+11	41.4487	279214.	0.00
24.7260	-6.41E-04	161852.	-4482.	-1.77E-05	0.00	1.27E+11	48.6194	288330.	0.00
25.0430	-7.00E-04	145185.	-4285.	-1.31E-05	0.00	1.27E+11	54.7107	297446.	0.00
25.3600	-7.41E-04	129301.	-4067.	-9.00E-06	0.00	1.27E+11	59.7432	306563.	0.00
25.6770	-7.68E-04	114275.	-3832.	-5.34E-06	0.00	1.27E+11	63.7483	315679.	0.00
25.9940	-7.82E-04	100164.	-3584.	-2.12E-06	0.00	1.27E+11	66.7663	324796.	0.00
26.3110	-7.84E-04	87014.	-3326.	6.95E-07	0.00	1.27E+11	68.8451	333912.	0.00
26.6280	-7.77E-04	74855.	-3062.	3.13E-06	0.00	1.27E+11	70.0377	343028.	0.00
26.9450	-7.61E-04	63705.	-2795.	5.21E-06	0.00	1.27E+11	70.4014	352145.	0.00
27.2620	-7.37E-04	53571.	-2528.	6.97E-06	0.00	1.27E+11	69.9957	361261.	0.00
27.5790	-7.07E-04	44446.	-2264.	8.45E-06	0.00	1.27E+11	68.8812	370377.	0.00
27.8960	-6.73E-04	36315.	-2005.	9.66E-06	0.00	1.27E+11	67.1178	379494.	0.00
28.2130	-6.34E-04	29153.	-1754.	1.06E-05	0.00	1.27E+11	64.7640	388610.	0.00

28.5300	-5.92E-04	22927.	-1513.	1.14E-05	0.00	1.27E+11	61.8755	397726.	0.00
28.8470	-5.47E-04	17595.	-1285.	1.20E-05	0.00	1.27E+11	58.5046	406843.	0.00
29.1640	-5.00E-04	13108.	-1069.	1.25E-05	0.00	1.27E+11	54.6990	415959.	0.00
29.4810	-4.52E-04	9413.	-869.104	1.28E-05	0.00	1.27E+11	50.5017	425076.	0.00
29.7980	-4.03E-04	6447.	-685.653	1.31E-05	0.00	1.27E+11	45.9501	434192.	0.00
30.1150	-3.52E-04	4146.	-520.129	1.32E-05	0.00	1.27E+11	41.0759	443308.	0.00
30.4320	-3.02E-04	2439.	-373.711	1.33E-05	0.00	1.27E+11	35.9052	452425.	0.00
30.7490	-2.51E-04	1252.	-247.488	1.34E-05	0.00	1.27E+11	30.4582	461541.	0.00
31.0660	-2.00E-04	505.3346	-142.482	1.34E-05	0.00	1.27E+11	24.7498	470657.	0.00
31.3830	-1.49E-04	116.7240	-59.671	1.34E-05	0.00	1.27E+11	18.7896	479774.	0.00
31.7000	-9.79E-05	0.00	0.00	1.34E-05	0.00	1.27E+11	12.5830	244445.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     0.06960493 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =       -710088. inch-lbs
Maximum shear force              =          5871. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =    14.58200000 feet below pile head
Number of iterations             =              7
Number of zero deflection points =              1
Pile deflection at ground        =     0.01961468 inches
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 2, Shear and Slope

```
Shear      =           4800. lbs
Slope      =         0.00000
Axial Load =         502900. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
31.70000	0.06960493	-710088.	5871.
30.11500	0.06973162	-710403.	5863.
28.53000	0.07030575	-711971.	5870.
26.94500	0.07259415	-719703.	-6302.
25.36000	0.07945438	-746044.	-7102.
23.77500	0.09417463	-809865.	-7218.
22.19000	0.11751246	-928295.	5875.
20.60500	0.13951025	-1070494.	5875.
19.02000	0.14499584	-1138328.	5876.
17.43500	0.15125358	-1117796.	5876.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 3

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

```
Shear force at pile head                          =       4470.0 lbs
Rotation of pile head                             =    0.000E+00 radians
Axial load at pile head                           =     237400.0 lbs
```

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.07928	-770025.	4470.	0.00	0.00	1.30E+11	0.00	0.00	15.6300
0.3170	0.07924	-752898.	4529.	-2.24E-05	0.00	1.30E+11	0.00	0.00	15.6300
0.6340	0.07911	-735524.	4589.	-4.42E-05	0.00	1.30E+11	0.00	0.00	15.6300
0.9510	0.07890	-717905.	4648.	-6.55E-05	0.00	1.30E+11	0.00	0.00	15.6300
1.2680	0.07861	-700041.	4708.	-8.64E-05	0.00	1.30E+11	0.00	0.00	15.6300
1.5850	0.07824	-681932.	4767.	-1.07E-04	0.00	1.30E+11	0.00	0.00	15.6300
1.9020	0.07780	-663579.	4827.	-1.26E-04	0.00	1.30E+11	0.00	0.00	15.6300
2.2190	0.07728	-644982.	4886.	-1.46E-04	0.00	1.30E+11	0.00	0.00	15.6300
2.5360	0.07669	-626142.	4946.	-1.64E-04	0.00	1.30E+11	0.00	0.00	15.6300
2.8530	0.07603	-607059.	5005.	-1.82E-04	0.00	1.30E+11	0.00	0.00	15.6300
3.1700	0.07530	-587734.	5065.	-2.00E-04	0.00	1.30E+11	0.00	0.00	15.6300
3.4870	0.07451	-568167.	5124.	-2.17E-04	0.00	1.30E+11	0.00	0.00	15.6300
3.8040	0.07365	-548359.	5183.	-2.33E-04	0.00	1.30E+11	0.00	0.00	15.6300

4.1210	0.07274	-528310.	5243.	-2.49E-04	0.00	1.30E+11	0.00	0.00	15.6300
4.4380	0.07176	-508020.	5302.	-2.64E-04	0.00	1.30E+11	0.00	0.00	15.6300
4.7550	0.07073	-487492.	5362.	-2.79E-04	0.00	1.30E+11	0.00	0.00	15.6300
5.0720	0.06964	-466724.	5421.	-2.93E-04	0.00	1.30E+11	0.00	0.00	15.6300
5.3890	0.06850	-445717.	5481.	-3.06E-04	0.00	1.30E+11	0.00	0.00	15.6300
5.7060	0.06731	-424473.	5540.	-3.19E-04	0.00	1.30E+11	0.00	0.00	15.6300
6.0230	0.06607	-402991.	5600.	-3.31E-04	0.00	1.30E+11	0.00	0.00	15.6300
6.3400	0.06479	-381272.	5659.	-3.43E-04	0.00	1.30E+11	0.00	0.00	15.6300
6.6570	0.06346	-359317.	5719.	-3.54E-04	0.00	1.30E+11	0.00	0.00	15.6300
6.9740	0.06210	-337127.	5778.	-3.64E-04	0.00	1.30E+11	0.00	0.00	15.6300
7.2910	0.06069	-314701.	5837.	-3.73E-04	0.00	1.30E+11	0.00	0.00	15.6300
7.6080	0.05926	-292041.	5897.	-3.82E-04	0.00	1.30E+11	0.00	0.00	15.6300
7.9250	0.05779	-269146.	5956.	-3.91E-04	0.00	1.30E+11	0.00	0.00	15.6300
8.2420	0.05629	-246019.	6016.	-3.98E-04	0.00	1.30E+11	0.00	0.00	15.6300
8.5590	0.05476	-222659.	6075.	-4.05E-04	0.00	1.30E+11	0.00	0.00	15.6300
8.8760	0.05320	-199066.	6135.	-4.11E-04	0.00	1.30E+11	0.00	0.00	15.6300
9.1930	0.05163	-175243.	6194.	-4.17E-04	0.00	1.30E+11	0.00	0.00	15.6300
9.5100	0.05003	-151188.	6254.	-4.21E-04	0.00	1.30E+11	0.00	0.00	15.6300
9.8270	0.04842	-126903.	6313.	-4.26E-04	0.00	1.30E+11	0.00	0.00	15.6300
10.1440	0.04680	-102389.	6373.	-4.29E-04	0.00	1.30E+11	0.00	0.00	15.6300
10.4610	0.04516	-77646.	6432.	-4.32E-04	0.00	1.30E+11	0.00	0.00	15.6300
10.7780	0.04351	-52674.	6492.	-4.33E-04	0.00	1.30E+11	0.00	0.00	15.6300
11.0950	0.04186	-27475.	6551.	-4.35E-04	0.00	1.30E+11	0.00	0.00	15.6300
11.4120	0.04021	-2050.	6610.	-4.35E-04	0.00	1.30E+11	0.00	0.00	15.6300
11.7290	0.03855	23603.	6670.	-4.35E-04	0.00	1.30E+11	0.00	0.00	15.6300
12.0460	0.03690	49480.	6729.	-4.34E-04	0.00	1.30E+11	0.00	0.00	15.6300
12.3630	0.03525	75583.	6789.	-4.32E-04	0.00	1.30E+11	0.00	0.00	15.6300
12.6800	0.03361	101909.	6848.	-4.29E-04	0.00	1.30E+11	0.00	0.00	15.6300
12.9970	0.03199	128460.	6908.	-4.26E-04	0.00	1.30E+11	0.00	0.00	15.6300
13.3140	0.03037	155232.	6967.	-4.22E-04	0.00	1.30E+11	0.00	0.00	15.6300
13.6310	0.02878	182227.	7027.	-4.17E-04	0.00	1.30E+11	0.00	0.00	15.6300
13.9480	0.02720	209444.	7086.	-4.11E-04	0.00	1.30E+11	0.00	0.00	15.6300
14.2650	0.02565	236881.	7146.	-4.04E-04	0.00	1.30E+11	0.00	0.00	15.6300
14.5820	0.02413	264537.	7201.	-3.97E-04	0.00	1.30E+11	0.00	0.00	13.6331
14.8990	0.02263	292385.	7162.	-3.89E-04	0.00	1.30E+11	-34.046	5723.	0.00
15.2160	0.02117	319731.	6941.	-3.80E-04	0.00	1.30E+11	-82.574	14839.	0.00
15.5330	0.01974	345875.	6564.	-3.70E-04	0.00	1.30E+11	-115.354	22229.	0.00
15.8500	0.01835	370339.	6103.	-3.60E-04	0.00	1.30E+11	-127.135	26353.	0.00
16.1670	0.01700	392955.	5599.	-3.48E-04	0.00	1.30E+11	-137.695	30804.	0.00
16.4840	0.01570	413567.	5058.	-3.37E-04	0.00	1.30E+11	-147.031	35623.	0.00
16.8010	0.01444	432041.	4483.	-3.24E-04	0.00	1.30E+11	-155.138	40859.	0.00
17.1180	0.01323	448259.	3880.	-3.11E-04	0.00	1.30E+11	-162.016	46569.	0.00
17.4350	0.01208	462120.	3253.	-2.98E-04	0.00	1.30E+11	-167.667	52819.	0.00
17.7520	0.01097	473543.	2606.	-2.84E-04	0.00	1.30E+11	-172.096	59688.	0.00
18.0690	0.00991	482463.	1946.	-2.70E-04	0.00	1.30E+11	-175.310	67270.	0.00
18.3860	0.00891	488833.	1275.	-2.56E-04	0.00	1.30E+11	-177.318	75678.	0.00
18.7030	0.00797	492625.	598.8740	-2.41E-04	0.00	1.30E+11	-178.129	85052.	0.00
19.0200	0.00708	493825.	-78.018	-2.27E-04	0.00	1.30E+11	-177.755	95560.	0.00
19.3370	0.00624	492441.	-751.253	-2.12E-04	0.00	1.30E+11	-176.207	107417.	0.00
19.6540	0.00546	488494.	-1416.	-1.98E-04	0.00	1.30E+11	-173.494	120890.	0.00
19.9710	0.00473	482023.	-2069.	-1.84E-04	0.00	1.30E+11	-169.624	136331.	0.00
20.2880	0.00406	473085.	-2705.	-1.70E-04	0.00	1.30E+11	-164.600	154201.	0.00
20.6050	0.00344	461752.	-3310.	-1.56E-04	0.00	1.30E+11	-153.608	169817.	0.00
20.9220	0.00287	448185.	-3859.	-1.43E-04	0.00	1.30E+11	-135.134	178934.	0.00
21.2390	0.00235	432650.	-4338.	-1.30E-04	0.00	1.30E+11	-116.412	188050.	0.00
21.5560	0.00189	415419.	-4745.	-1.17E-04	0.00	1.30E+11	-97.711	197166.	0.00
21.8730	0.00146	396764.	-5081.	-1.05E-04	0.00	1.30E+11	-79.275	206283.	0.00
22.1900	0.00108	376950.	-5349.	-9.41E-05	0.00	1.30E+11	-61.320	215399.	0.00
22.5070	7.46E-04	356239.	-5549.	-8.33E-05	0.00	1.30E+11	-44.032	224516.	0.00
22.8240	4.49E-04	334882.	-5685.	-7.32E-05	0.00	1.30E+11	-27.573	233632.	0.00
23.1410	1.89E-04	313117.	-5761.	-6.37E-05	0.00	1.30E+11	-12.077	242748.	0.00
23.4580	-3.55E-05	291169.	-5779.	-5.48E-05	0.00	1.30E+11	2.3485	251865.	0.00
23.7750	-2.28E-04	269247.	-5745.	-4.66E-05	0.00	1.30E+11	15.6203	260981.	0.00
24.0920	-3.90E-04	247544.	-5663.	-3.90E-05	0.00	1.30E+11	27.6783	270097.	0.00
24.4090	-5.24E-04	226234.	-5537.	-3.20E-05	0.00	1.30E+11	38.4843	279214.	0.00
24.7260	-6.34E-04	205476.	-5372.	-2.57E-05	0.00	1.30E+11	48.0200	288330.	0.00
25.0430	-7.20E-04	185407.	-5174.	-2.00E-05	0.00	1.30E+11	56.2848	297446.	0.00
25.3600	-7.85E-04	166148.	-4947.	-1.48E-05	0.00	1.30E+11	63.2945	306563.	0.00
25.6770	-8.32E-04	147800.	-4695.	-1.02E-05	0.00	1.30E+11	69.0787	315679.	0.00
25.9940	-8.63E-04	130448.	-4423.	-6.11E-06	0.00	1.30E+11	73.6789	324796.	0.00
26.3110	-8.79E-04	114159.	-4136.	-2.52E-06	0.00	1.30E+11	77.1465	333912.	0.00
26.6280	-8.82E-04	98982.	-3838.	6.13E-07	0.00	1.30E+11	79.5410	343028.	0.00
26.9450	-8.74E-04	84955.	-3533.	3.31E-06	0.00	1.30E+11	80.9275	352145.	0.00
27.2620	-8.57E-04	72096.	-3225.	5.62E-06	0.00	1.30E+11	81.3753	361261.	0.00
27.5790	-8.31E-04	60412.	-2916.	7.56E-06	0.00	1.30E+11	80.9560	370377.	0.00
27.8960	-7.99E-04	49899.	-2610.	9.18E-06	0.00	1.30E+11	79.7419	379494.	0.00
28.2130	-7.62E-04	40538.	-2310.	1.05E-05	0.00	1.30E+11	77.8044	388610.	0.00
28.5300	-7.19E-04	32302.	-2019.	1.16E-05	0.00	1.30E+11	75.2129	397726.	0.00
28.8470	-6.74E-04	25153.	-1739.	1.24E-05	0.00	1.30E+11	72.0330	406843.	0.00
29.1640	-6.25E-04	19046.	-1472.	1.31E-05	0.00	1.30E+11	68.3262	415959.	0.00
29.4810	-5.74E-04	13928.	-1220.	1.36E-05	0.00	1.30E+11	64.1485	425076.	0.00
29.7980	-5.22E-04	9737.	-985.157	1.39E-05	0.00	1.30E+11	59.5498	434192.	0.00
30.1150	-4.68E-04	6408.	-768.095	1.41E-05	0.00	1.30E+11	54.5735	443308.	0.00
30.4320	-4.14E-04	3868.	-570.611	1.43E-05	0.00	1.30E+11	49.2561	452425.	0.00
30.7490	-3.60E-04	2041.	-393.948	1.44E-05	0.00	1.30E+11	43.6267	461541.	0.00
31.0660	-3.05E-04	844.6295	-239.250	1.44E-05	0.00	1.30E+11	37.7075	470657.	0.00
31.3830	-2.50E-04	194.3092	-107.592	1.44E-05	0.00	1.30E+11	31.5137	479774.	0.00
31.7000	-1.95E-04	0.00	0.00	1.44E-05	0.00	1.30E+11	25.0540	244445.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses

are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 3:

```
Pile-head deflection             =     0.07927931 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =       -770025. inch-lbs
Maximum shear force              =          7201. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =    14.58200000 feet below pile head
Number of iterations             =              8
Number of zero deflection points =              1
Pile deflection at ground        =     0.02356953 inches
```

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 2, Shear and Slope

```
Shear      =           4470. lbs
Slope      =         0.00000
Axial Load =         237400. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
31.70000	0.07927931	-770025.	7201.
30.11500	0.07945527	-770412.	7200.
28.53000	0.08029197	-772722.	7199.
26.94500	0.08359878	-783954.	-7436.
25.36000	0.09291060	-820001.	-8177.
23.77500	0.11069245	-898425.	-7957.
22.19000	0.13589458	-1030411.	7212.
20.60500	0.15699834	-1174147.	7211.
19.02000	0.16139441	-1237526.	7213.
17.43500	0.17685928	-1202015.	7214.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 4

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

```
Shear force at pile head                          =       5860.0 lbs
Rotation of pile head                             =    0.000E+00 radians
Axial load at pile head                           =     442200.0 lbs
```

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.09232	-911212.	5860.	0.00	0.00	1.27E+11	0.00	0.00	10.7100
0.3170	0.09227	-888820.	5901.	-2.69E-05	0.00	1.27E+11	0.00	0.00	10.7100
0.6340	0.09212	-866229.	5941.	-5.31E-05	0.00	1.27E+11	0.00	0.00	10.7100
0.9510	0.09186	-843439.	5982.	-7.87E-05	0.00	1.27E+11	0.00	0.00	10.7100
1.2680	0.09152	-820451.	6023.	-1.04E-04	0.00	1.27E+11	0.00	0.00	10.7100
1.5850	0.09108	-797268.	6064.	-1.28E-04	0.00	1.27E+11	0.00	0.00	10.7100
1.9020	0.09055	-773889.	6104.	-1.51E-04	0.00	1.27E+11	0.00	0.00	10.7100
2.2190	0.08993	-750316.	6145.	-1.74E-04	0.00	1.27E+11	0.00	0.00	10.7100
2.5360	0.08922	-726551.	6186.	-1.96E-04	0.00	1.27E+11	0.00	0.00	10.7100
2.8530	0.08843	-702594.	6227.	-2.17E-04	0.00	1.27E+11	0.00	0.00	10.7100
3.1700	0.08757	-678447.	6267.	-2.38E-04	0.00	1.27E+11	0.00	0.00	10.7100
3.4870	0.08662	-654110.	6308.	-2.58E-04	0.00	1.27E+11	0.00	0.00	10.7100
3.8040	0.08560	-629586.	6349.	-2.77E-04	0.00	1.27E+11	0.00	0.00	10.7100
4.1210	0.08451	-604875.	6390.	-2.96E-04	0.00	1.27E+11	0.00	0.00	10.7100
4.4380	0.08335	-579979.	6430.	-3.13E-04	0.00	1.27E+11	0.00	0.00	10.7100
4.7550	0.08213	-554899.	6471.	-3.30E-04	0.00	1.27E+11	0.00	0.00	10.7100
5.0720	0.08084	-529636.	6512.	-3.47E-04	0.00	1.27E+11	0.00	0.00	10.7100
5.3890	0.07949	-504191.	6553.	-3.62E-04	0.00	1.27E+11	0.00	0.00	10.7100
5.7060	0.07809	-478566.	6593.	-3.77E-04	0.00	1.27E+11	0.00	0.00	10.7100
6.0230	0.07663	-452761.	6634.	-3.91E-04	0.00	1.27E+11	0.00	0.00	10.7100
6.3400	0.07512	-426779.	6675.	-4.04E-04	0.00	1.27E+11	0.00	0.00	10.7100
6.6570	0.07356	-400621.	6716.	-4.16E-04	0.00	1.27E+11	0.00	0.00	10.7100
6.9740	0.07195	-374287.	6756.	-4.28E-04	0.00	1.27E+11	0.00	0.00	10.7100
7.2910	0.07030	-347780.	6797.	-4.39E-04	0.00	1.27E+11	0.00	0.00	10.7100
7.6080	0.06861	-321100.	6838.	-4.49E-04	0.00	1.27E+11	0.00	0.00	10.7100
7.9250	0.06689	-294249.	6879.	-4.58E-04	0.00	1.27E+11	0.00	0.00	10.7100
8.2420	0.06513	-267229.	6919.	-4.66E-04	0.00	1.27E+11	0.00	0.00	10.7100

8.5590	0.06334	-240040.	6960.	-4.74E-04	0.00	1.27E+11	0.00	0.00	10.7100
8.8760	0.06153	-212683.	7001.	-4.80E-04	0.00	1.27E+11	0.00	0.00	10.7100
9.1930	0.05969	-185162.	7041.	-4.86E-04	0.00	1.27E+11	0.00	0.00	10.7100
9.5100	0.05783	-157475.	7082.	-4.92E-04	0.00	1.27E+11	0.00	0.00	10.7100
9.8270	0.05595	-129626.	7123.	-4.96E-04	0.00	1.27E+11	0.00	0.00	10.7100
10.1440	0.05405	-101616.	7164.	-4.99E-04	0.00	1.27E+11	0.00	0.00	10.7100
10.4610	0.05215	-73445.	7204.	-5.02E-04	0.00	1.27E+11	0.00	0.00	10.7100
10.7780	0.05024	-45116.	7245.	-5.04E-04	0.00	1.27E+11	0.00	0.00	10.7100
11.0950	0.04832	-16629.	7286.	-5.05E-04	0.00	1.27E+11	0.00	0.00	10.7100
11.4120	0.04640	12013.	7327.	-5.05E-04	0.00	1.27E+11	0.00	0.00	10.7100
11.7290	0.04448	40810.	7367.	-5.04E-04	0.00	1.27E+11	0.00	0.00	10.7100
12.0460	0.04256	69759.	7408.	-5.02E-04	0.00	1.27E+11	0.00	0.00	10.7100
12.3630	0.04066	98860.	7449.	-5.00E-04	0.00	1.27E+11	0.00	0.00	10.7100
12.6800	0.03876	128112.	7490.	-4.96E-04	0.00	1.27E+11	0.00	0.00	10.7100
12.9970	0.03688	157511.	7530.	-4.92E-04	0.00	1.27E+11	0.00	0.00	10.7100
13.3140	0.03502	187058.	7571.	-4.87E-04	0.00	1.27E+11	0.00	0.00	10.7100
13.6310	0.03318	216750.	7612.	-4.81E-04	0.00	1.27E+11	0.00	0.00	10.7100
13.9480	0.03136	246587.	7653.	-4.74E-04	0.00	1.27E+11	0.00	0.00	10.7100
14.2650	0.02957	276566.	7693.	-4.66E-04	0.00	1.27E+11	0.00	0.00	10.7100
14.5820	0.02781	306686.	7731.	-4.57E-04	0.00	1.27E+11	0.00	0.00	9.3417
14.8990	0.02609	336925.	7675.	-4.48E-04	0.00	1.27E+11	-39.254	5723.	0.00
15.2160	0.02441	366580.	7419.	-4.37E-04	0.00	1.27E+11	-95.215	14839.	0.00
15.5330	0.02277	394839.	7002.	-4.26E-04	0.00	1.27E+11	-123.882	20700.	0.00
15.8500	0.02117	421285.	6507.	-4.14E-04	0.00	1.27E+11	-136.547	24538.	0.00
16.1670	0.01962	445734.	5966.	-4.01E-04	0.00	1.27E+11	-147.907	28679.	0.00
16.4840	0.01812	468020.	5384.	-3.87E-04	0.00	1.27E+11	-157.956	33161.	0.00
16.8010	0.01667	487997.	4767.	-3.73E-04	0.00	1.27E+11	-166.692	38029.	0.00
17.1180	0.01528	505538.	4118.	-3.58E-04	0.00	1.27E+11	-174.114	43335.	0.00
17.4350	0.01395	520533.	3444.	-3.43E-04	0.00	1.27E+11	-180.225	49141.	0.00
17.7520	0.01268	532895.	2750.	-3.27E-04	0.00	1.27E+11	-185.029	55519.	0.00
18.0690	0.01146	542552.	2039.	-3.11E-04	0.00	1.27E+11	-188.534	62555.	0.00
18.3860	0.01031	549454.	1318.	-2.94E-04	0.00	1.27E+11	-190.749	70355.	0.00
18.7030	0.00922	553567.	590.3168	-2.78E-04	0.00	1.27E+11	-191.684	79043.	0.00
19.0200	0.00820	554880.	-138.216	-2.61E-04	0.00	1.27E+11	-191.351	88778.	0.00
19.3370	0.00724	553395.	-863.092	-2.45E-04	0.00	1.27E+11	-189.762	99752.	0.00
19.6540	0.00634	549137.	-1580.	-2.28E-04	0.00	1.27E+11	-186.927	112213.	0.00
19.9710	0.00550	542146.	-2283.	-2.12E-04	0.00	1.27E+11	-182.854	126480.	0.00
20.2880	0.00472	532482.	-2968.	-1.96E-04	0.00	1.27E+11	-177.546	142973.	0.00
20.6050	0.00401	520222.	-3631.	-1.80E-04	0.00	1.27E+11	-170.998	162261.	0.00
20.9220	0.00335	505461.	-4257.	-1.65E-04	0.00	1.27E+11	-157.716	178934.	0.00
21.2390	0.00275	488393.	-4815.	-1.50E-04	0.00	1.27E+11	-136.169	188050.	0.00
21.5560	0.00221	469330.	-5293.	-1.36E-04	0.00	1.27E+11	-114.633	197166.	0.00
21.8730	0.00172	448584.	-5688.	-1.22E-04	0.00	1.27E+11	-93.389	206283.	0.00
22.1900	0.00128	426465.	-6004.	-1.09E-04	0.00	1.27E+11	-72.688	215399.	0.00
22.5070	8.94E-04	403272.	-6243.	-9.65E-05	0.00	1.27E+11	-52.747	224516.	0.00
22.8240	5.50E-04	379296.	-6407.	-8.48E-05	0.00	1.27E+11	-33.753	233632.	0.00
23.1410	2.49E-04	354812.	-6502.	-7.38E-05	0.00	1.27E+11	-15.863	242748.	0.00
23.4580	-1.20E-05	330080.	-6530.	-6.36E-05	0.00	1.27E+11	0.7978	251865.	0.00
23.7750	-2.35E-04	305344.	-6498.	-5.41E-05	0.00	1.27E+11	16.1329	260981.	0.00
24.0920	-4.24E-04	280826.	-6410.	-4.53E-05	0.00	1.27E+11	30.0717	270097.	0.00
24.4090	-5.80E-04	256729.	-6272.	-3.73E-05	0.00	1.27E+11	42.5694	279214.	0.00
24.7260	-7.07E-04	233235.	-6089.	-3.00E-05	0.00	1.27E+11	53.6039	288330.	0.00
25.0430	-8.08E-04	210504.	-5867.	-2.33E-05	0.00	1.27E+11	63.1744	297446.	0.00
25.3600	-8.85E-04	188678.	-5611.	-1.74E-05	0.00	1.27E+11	71.2984	306563.	0.00
25.6770	-9.40E-04	167873.	-5327.	-1.20E-05	0.00	1.27E+11	78.0098	315679.	0.00
25.9940	-9.76E-04	148190.	-5020.	-7.31E-06	0.00	1.27E+11	83.3564	324796.	0.00
26.3110	-9.96E-04	129704.	-4695.	-3.16E-06	0.00	1.27E+11	87.3973	333912.	0.00
26.6280	-0.00100	112477.	-4358.	4.64E-07	0.00	1.27E+11	90.2011	343028.	0.00
26.9450	-9.92E-04	96550.	-4011.	3.59E-06	0.00	1.27E+11	91.8429	352145.	0.00
27.2620	-9.73E-04	81946.	-3661.	6.26E-06	0.00	1.27E+11	92.4029	361261.	0.00
27.5790	-9.45E-04	68676.	-3310.	8.51E-06	0.00	1.27E+11	91.9639	370377.	0.00
27.8960	-9.08E-04	56733.	-2963.	1.04E-05	0.00	1.27E+11	90.6093	379494.	0.00
28.2130	-8.66E-04	46098.	-2623.	1.19E-05	0.00	1.27E+11	88.4217	388610.	0.00
28.5300	-8.18E-04	36741.	-2292.	1.32E-05	0.00	1.27E+11	85.4813	397726.	0.00
28.8470	-7.65E-04	28618.	-1973.	1.41E-05	0.00	1.27E+11	81.8642	406843.	0.00
29.1640	-7.10E-04	21679.	-1670.	1.49E-05	0.00	1.27E+11	77.6412	415959.	0.00
29.4810	-6.52E-04	15862.	-1384.	1.54E-05	0.00	1.27E+11	72.8773	425076.	0.00
29.7980	-5.93E-04	11099.	-1117.	1.59E-05	0.00	1.27E+11	67.6301	434192.	0.00
30.1150	-5.32E-04	7314.	-870.099	1.61E-05	0.00	1.27E+11	61.9499	443308.	0.00
30.4320	-4.70E-04	4425.	-645.989	1.63E-05	0.00	1.27E+11	55.8787	452425.	0.00
30.7490	-4.08E-04	2345.	-445.653	1.64E-05	0.00	1.27E+11	49.4505	461541.	0.00
31.0660	-3.45E-04	979.4600	-270.400	1.65E-05	0.00	1.27E+11	42.6909	470657.	0.00
31.3830	-2.82E-04	232.0362	-121.458	1.65E-05	0.00	1.27E+11	35.6175	479774.	0.00
31.7000	-2.20E-04	0.00	0.00	1.65E-05	0.00	1.27E+11	28.2404	244445.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 4:

Pile-head deflection = 0.09232098 inches
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -911212. inch-lbs
Maximum shear force = 7731. lbs
Depth of maximum bending moment = 0.000000 feet below pile head
Depth of maximum shear force = 14.58200000 feet below pile head

```
Number of iterations             =              8
Number of zero deflection points =              1
Pile deflection at ground        =     0.02717350 inches
```

Pile-head Deflection vs. Pile Length for Load Case 4

Boundary Condition Type 2, Shear and Slope

```
Shear      =           5860. lbs
Slope      =         0.00000
Axial Load =         442200. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
31.70000	0.09232098	-911212.	7731.
30.11500	0.09250523	-911571.	7722.
28.53000	0.09360406	-914658.	7730.
26.94500	0.09790379	-929057.	-8445.
25.36000	0.10950320	-973497.	-9247.
23.77500	0.13137903	-1069002.	-8976.
22.19000	0.16177268	-1227299.	7739.
20.60500	0.18600537	-1393024.	7738.
19.02000	0.19022518	-1462655.	7740.
17.43500	0.20777424	-1420547.	7740.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

```
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians
```

Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	4200.	S, rad	0.00	320750.	0.06516	0.00	5811.	-658901.
2	V, lb	4800.	S, rad	0.00	502900.	0.06960	0.00	5871.	-710088.
3	V, lb	4470.	S, rad	0.00	237400.	0.07928	0.00	7201.	-770025.
4	V, lb	5860.	S, rad	0.00	442200.	0.09232	0.00	7731.	-911212.

```
Maximum pile-head deflection = 0.0923209753 inches
Maximum pile-head rotation   = -0.0000000000 radians = -0.000000 deg.

The analysis ended normally.
```

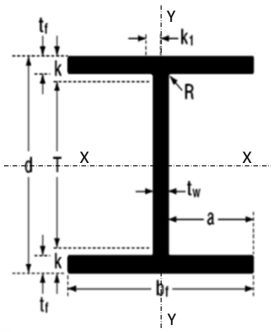
Jacobs

Project: MoDOT Improve I-70 Columbia to Kingdom City DB
Job No.: F3X03001
Subject: Bridge 4/A9543 - Lateral Analysis at Bent 4

By: ZW 10/9/24
Ckd: SR 11/5/2024

Foundation Design Data

Support No.:	*Abutment 4*		Pile Size:	HP12X53		F_y =	50	ksi
Assumed Grade Elev.:	*676.40*	ft	b_f =	12.000	in	Ix =	393	in^4
Top of Pile Elev.:	*676.40*	ft	d=	11.800	in	Iy =	127	in^4
Depth:	0.00	ft	t_f =	0.435	in	J =	1.12	in^4
Design GW El.	678.60	ft	t_w =	0.435	in	Sx =	66.7	in^3
Depth below Pile Top:	-2.20	ft	A =	15.5	in^2	Sy =	21.1	in^3
Approx. Pile Tip El.:	678.6	ft	E =	29,000	ksi	GJ =	12,638	k-in
Approx. Pile Length:	-2.20	ft	G =	11,284	ksi			



Load Information:

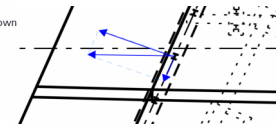
Thermal movement in the bridge longitudinal direction was provided by Structure engineer:

1.04 in

Thermal movement in the HP pile weak axis direction was calculated based on the bent skew angle:

Bent	Skewed Angle (°)	Displ. in Weak Axis in)
Bent 1	22.416944	0.96
Bent 4	22.416944	0.96

Ends Bents (1 & 4) Summary:
- HP12x53 ASTM A709 Grade 50S Spaced at 8.5' = 6 Piles
- Required thermal movement over 120 degrees = 1.04", full temperature range used due to unknown setting temp.
- Required thermal movement over 70 degrees max differential per EPG = 0.607"
- The Maximum Strength Pile Reaction = 240 kips/pile (Service 162.8 kips/ pile)



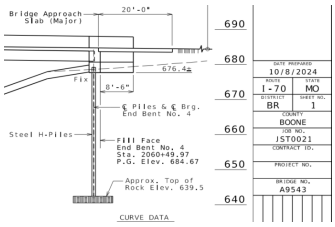
1-inch displacement in the HP weak axis was used for both abutments in the lateral analysis.

P-Multipliers

D = 1 ft

Loading Direction	Number of Rows	Pile Spacing S (ft)	S/D	P-Multiplier* (AASHTO LRFD Table 10.7.2.4-1) Row Number 1	2	3	After 3	Aver.
Longitudinal	1	-	-	1.00	-	-	-	1.00
Transverse	6	8.50	8.50	1.00	0.85	0.70	0.70	0.78

Note: Group reduction factor of 1.0 was used within fresh rock.



Design Soil/Rock Profile and Parameters:

Since higher pile lateral stiffness will induce higher pile internal forces (moment and shear) due to the thermal movement, the boring log where rock was observed at higher elevation was selected to generate the design soil/rock profile.

Design Ground Water El.: 678.6 ft

Reference Borings: BR 2-1A

Depth From (ft)	Depth To (ft)	Soil/Rock	Elevation From (ft)	Elevation To (ft)	Eff. Unit Weight (pcf)	Su (psf)	ϕ' (deg.)	qu (psi)	Modulus , k or E (psi)	RQD	ε_{50}
0.0	22.4	Stiff Clay w/o Free Water	676.4	654.0	52.6	800	0	-	-	-	0.015
22.4	40.4	Stiff Clay w/o Free Water	654.0	636.0	70.6	3,000	0	-	-	-	0.005
40.4	26.4	Strong Rock	636.0	650.0	101.6	-	-	7,500	-	-	-

Lateral Analysis

Software: LPILE 2022 developed by ENSOFT, Inc.

Lateral Analysis Results:

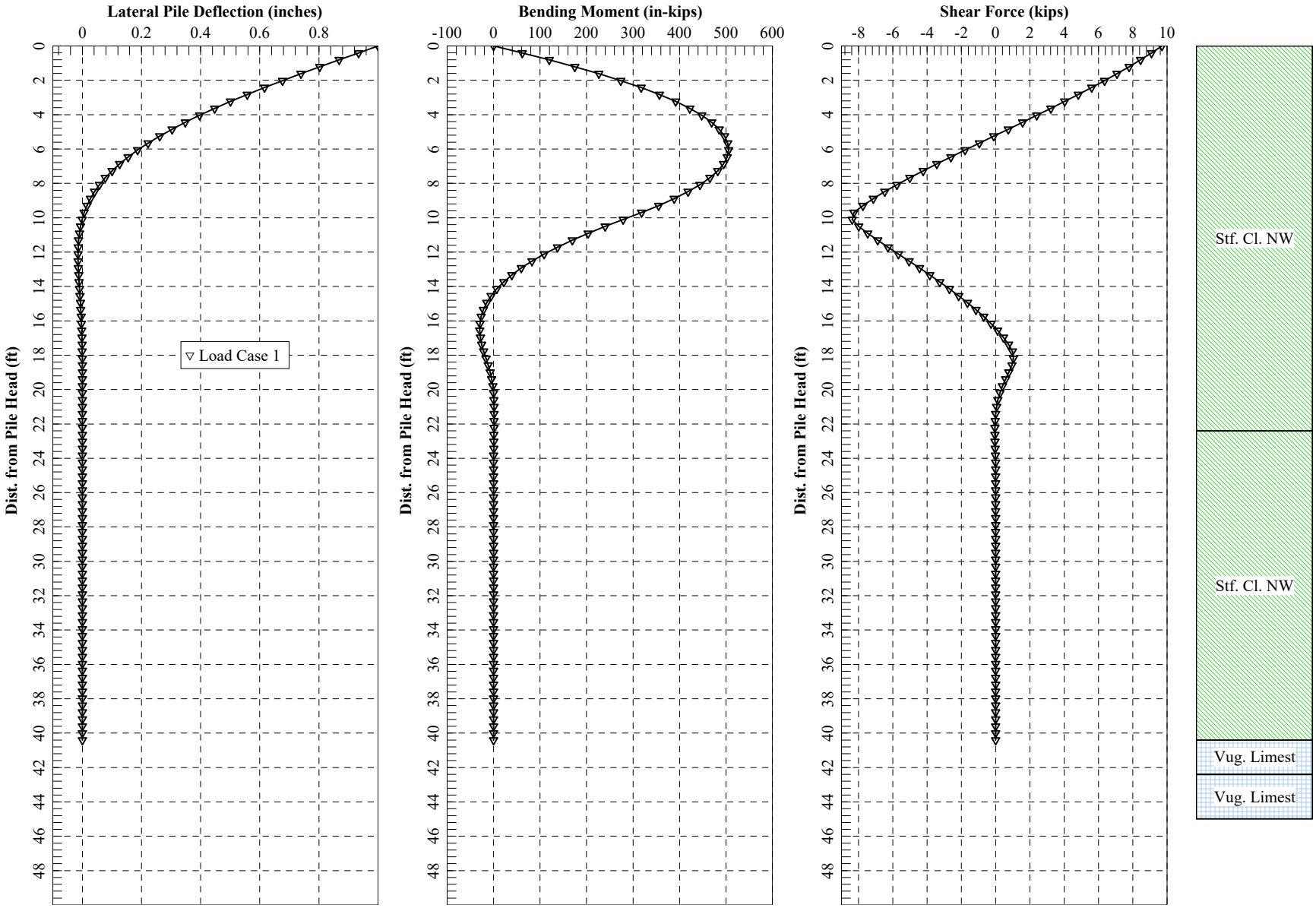
Deflection, Moment, and Shear vs Depth figures are attached.

Structure Engineer should check the pile structural acceptability under the assumed thermal movement.

LPile Analysis Summary at Bent 4 of Bridge 4 (A9543)

Loading Condition No.	Load Case	Axial Load (lb)	P-Mult.	Pile Head Deflect. δ (in)	Max Moment (in-lbs)	Max Shear (lbs)	Pile Head Rotation (rad.)
1	1" Displ. in Weak Axis	240,000	1	1	505,699	9,705	-0.01365

MoDOT Improve I-70 C2KC- Bridge 4/A9543- Bent 4 - HP12X53 Weak Axis - Thermal Movement



```
================================================================================

                    LPile for Windows, Version 2022-12.004

                Analysis of Individual Piles and Drilled Shafts
               Subjected to Lateral Loading Using the p-y Method
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================================================================================

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--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\TPW\GEOTECH\F3X03000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A6951)\LPile- Bridge 2_A9543\

Name of input data file:
Bent 4 Thermal Movement 1inch HP12X53 Weak Axis.lp12d

Name of output report file:
Bent 4 Thermal Movement 1inch HP12X53 Weak Axis.lp12o

Name of plot output file:
Bent 4 Thermal Movement 1inch HP12X53 Weak Axis.lp12p

Name of runtime message file:
Bent 4 Thermal Movement 1inch HP12X53 Weak Axis.lp12r



--------------------------------------------------------------------------------
                            Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  October 9, 2024            Time:   8:56:03



--------------------------------------------------------------------------------
                                 Problem Title
--------------------------------------------------------------------------------

Project Name: MoDOT Improve I-70  Columbia to Kingdom City DB

Job Number: F3X03001

Client: MoDOT

Engineer:

Description: Bridge 4 (A9543) Bent 4 Lateral Analysis - HP12X53 Weak Axis




--------------------------------------------------------------------------------
                         Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed               =          500
 - Deflection tolerance for convergence               =   1.0000E-05 in
 - Maximum allowable deflection                       =     100.0000 in
 - Number of pile increments                          =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified
```

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 40.400 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	12.0000
2	40.400	12.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

   Section 1 is a H weak axis steel pile
   Length of section = 40.400000 ft
   Pile width = 11.800000 in

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is stiff clay without free water

   Distance from top of pile to top of layer = 0.0000 ft
   Distance from top of pile to bottom of layer = 22.400000 ft
   Effective unit weight at top of layer = 52.600000 pcf
   Effective unit weight at bottom of layer = 52.600000 pcf
   Undrained cohesion at top of layer = 800.000000 psf
   Undrained cohesion at bottom of layer = 800.000000 psf
   Epsilon-50 at top of layer = 0.015000
   Epsilon-50 at bottom of layer = 0.015000

Layer 2 is stiff clay without free water

   Distance from top of pile to top of layer = 22.400000 ft
   Distance from top of pile to bottom of layer = 40.400000 ft
   Effective unit weight at top of layer = 70.600000 pcf
   Effective unit weight at bottom of layer = 70.600000 pcf
   Undrained cohesion at top of layer = 3000. psf
   Undrained cohesion at bottom of layer = 3000. psf
   Epsilon-50 at top of layer = 0.005000
   Epsilon-50 at bottom of layer = 0.005000

Layer 3 is strong rock (vuggy limestone)

   Distance from top of pile to top of layer = 40.400000 ft
   Distance from top of pile to bottom of layer = 45.000000 ft
   Effective unit weight at top of layer = 101.600000 pcf
   Effective unit weight at bottom of layer = 101.600000 pcf
   Uniaxial compressive strength at top of layer = 7500. psi
   Uniaxial compressive strength at bottom of layer = 7500. psi

(Depth of the lowest soil layer extends 4.600 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Cohesion psf	Uniaxial qu psi	E50 or krm
1	Stiff Clay w/o Free Water	0.00 22.4000	52.6000 52.6000	800.0000 800.0000	-- --	0.01500 0.01500
2	Stiff Clay w/o Free Water	22.4000 40.4000	70.6000 70.6000	3000. 3000.	-- --	0.00500 0.00500
3	Strong Rock (Vuggy Limestone)	40.4000 45.0000	101.6000 101.6000	-- --	7500. 7500.	-- --

---

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	4	y = 1.000000 in	M = 0.0000 in-lbs	240000.	N.A.	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel H Weak Axis:

Length of Section	=	40.400000 ft
Flange Width	=	12.000000 in
Section Depth	=	11.800000 in
Flange Thickness	=	0.435000 in
Web Thickness	=	0.435000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	15.194550 sq. in.
Moment of Inertia	=	125.354973 in^4
Elastic Bending Stiffness	=	3635294. kip-in^2
Plastic Modulus, Z	=	31.837057in^3
Plastic Moment Capacity = Fy Z	=	1592.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	759.727 kips
Nominal Axial Tensile Capacity	=	-759.727 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force

	kips
1	240.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 240.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000506	18.3782855	3635033.	113.7280466	16.6660627	
0.00001011	36.7565710	3635033.	59.8640233	17.5369885	
0.00001517	55.1348565	3635033.	41.9093489	18.4079140	
0.00002022	73.5131420	3635033.	32.9320116	19.2788395	
0.00002528	91.8914275	3635033.	27.5456093	20.1497653	
0.00003034	110.2697130	3635033.	23.9546744	21.0206908	
0.00003539	128.6479986	3635033.	21.3897209	21.8916164	
0.00004045	147.0262841	3635033.	19.4660058	22.7625420	
0.00004550	165.4045696	3635033.	17.9697830	23.6334677	
0.00005056	183.7828551	3635033.	16.7728047	24.5043933	
0.00005561	202.1611406	3635033.	15.7934588	25.3753188	
0.00006067	220.5394261	3635033.	14.9773372	26.2462445	
0.00006573	238.9177116	3635033.	14.2867728	27.1171701	
0.00007078	257.2959971	3635033.	13.6948605	27.9880957	
0.00007584	275.6742826	3635033.	13.1818698	28.8590213	
0.00008089	294.0525681	3635033.	12.7330029	29.7299469	
0.00008595	312.4308536	3635033.	12.3369439	30.6008726	
0.00009101	330.8091391	3635033.	11.9848915	31.4717982	
0.00009606	349.1874246	3635033.	11.6698972	32.3427238	
0.0001011	367.5657102	3635033.	11.3864023	33.2136494	
0.0001062	385.9439957	3635033.	11.1299070	34.0845750	
0.0001112	404.3222812	3635033.	10.8967294	34.9555007	
0.0001163	422.7005667	3635033.	10.6838281	35.8264263	
0.0001213	441.0788522	3635033.	10.4886686	36.6973519	
0.0001264	459.4571377	3635033.	10.3091219	37.5682775	
0.0001315	477.8354232	3635033.	10.1433864	38.4392032	
0.0001365	496.2137087	3635033.	9.9899277	39.3101288	
0.0001416	514.5919942	3635033.	9.8474302	40.1810544	
0.0001466	532.9702797	3635033.	9.7147602	41.0519800	
0.0001517	551.3485652	3635033.	9.5909349	41.9229056	
0.0001567	569.7268507	3635033.	9.4750983	42.7938312	
0.0001618	588.1051362	3635033.	9.3665015	43.6647569	
0.0001668	606.4834218	3635033.	9.2644863	44.5356825	
0.0001719	624.8617073	3635033.	9.1684720	45.4066081	
0.0001770	643.2399928	3635033.	9.0779442	46.2775337	
0.0001820	661.6182783	3635033.	8.9924457	47.1484593	
0.0001871	679.9965638	3635033.	8.9115688	48.0193850	
0.0001921	698.3748493	3635033.	8.8349486	48.8903106	
0.0001972	716.7531348	3635033.	8.7622576	49.7612362	
0.0002073	752.0367129	3627927.	8.6302502	50.0000000	Y
0.0002174	784.8353303	3610052.	8.5150759	50.0000000	Y
0.0002275	815.5575365	3584639.	8.4139555	50.0000000	Y
0.0002376	844.4511734	3553694.	8.3248068	50.0000000	Y
0.0002477	871.7521259	3518846.	8.2458710	50.0000000	Y
0.0002578	897.6414295	3481257.	8.1757301	50.0000000	Y
0.0002680	922.2178179	3441605.	8.1133140	50.0000000	Y
0.0002781	945.7739651	3401168.	8.0573260	50.0000000	Y
0.0002882	968.2328306	3359761.	8.0073031	50.0000000	Y
0.0002983	989.8565340	3318361.	7.9622251	50.0000000	Y
0.0003084	1011.	3277191.	7.9215269	50.0000000	Y
0.0003185	1031.	3236246.	7.8848276	50.0000000	Y
0.0003286	1050.	3195797.	7.8516277	50.0000000	Y
0.0003387	1069.	3156056.	7.8214895	50.0000000	Y
0.0003489	1087.	3117103.	7.7940867	50.0000000	Y
0.0003590	1105.	3079003.	7.7691279	50.0000000	Y
0.0003691	1123.	3041808.	7.7463517	50.0000000	Y
0.0003792	1140.	3005545.	7.7255340	50.0000000	Y
0.0003893	1156.	2970044.	7.7066161	50.0000000	Y
0.0003994	1172.	2935514.	7.6892795	50.0000000	Y
0.0004095	1188.	2901135.	7.6728568	50.0000000	Y
0.0004196	1203.	2866106.	7.6566688	50.0000000	Y
0.0004297	1216.	2830410.	7.6409477	50.0000000	Y
0.0004399	1229.	2794518.	7.6254935	50.0000000	Y
0.0004500	1241.	2758720.	7.6102077	50.0000000	Y
0.0004601	1253.	2722730.	7.5954712	50.0000000	Y
0.0004702	1263.	2686914.	7.5806562	50.0000000	Y
0.0004803	1273.	2651281.	7.5663049	50.0000000	Y
0.0004904	1283.	2616218.	7.5521467	50.0000000	Y
0.0005005	1292.	2581524.	7.5384438	50.0000000	Y
0.0005106	1301.	2547155.	7.5245998	50.0000000	Y
0.0005208	1309.	2513260.	7.5113289	50.0000000	Y
0.0005309	1317.	2480174.	7.4981713	50.0000000	Y
0.0005410	1324.	2447226.	7.4852114	50.0000000	Y
0.0005511	1331.	2415129.	7.4725717	50.0000000	Y
0.0005612	1338.	2383546.	7.4599500	50.0000000	Y
0.0005713	1344.	2352441.	7.4477790	50.0000000	Y

0.0005814	1350.	2322066.	7.4357063	50.0000000	Y
0.0005915	1356.	2292210.	7.4237052	50.0000000	Y
0.0006016	1361.	2262940.	7.4121962	50.0000000	Y
0.0006421	1382.	2151564.	7.3672950	50.0000000	Y
0.0006825	1399.	2049015.	7.3251642	50.0000000	Y
0.0007230	1413.	1954746.	7.2856742	50.0000000	Y
0.0007634	1426.	1867809.	7.2481910	50.0000000	Y
0.0008039	1437.	1787598.	7.2130534	50.0000000	Y
0.0008443	1447.	1713568.	7.1798275	50.0000000	Y
0.0008848	1456.	1645069.	7.1482972	50.0000000	Y
0.0009252	1463.	1581503.	7.1184898	50.0000000	Y
0.0009657	1470.	1522442.	7.0901388	50.0000000	Y
0.0010061	1476.	1467493.	7.0631093	50.0000000	Y
0.0010466	1482.	1416208.	7.0377124	50.0000000	Y
0.0010870	1487.	1368240.	7.0132261	50.0000000	Y
0.0011275	1492.	1323306.	6.9896602	50.0000000	Y
0.0011679	1496.	1281178.	6.9676777	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	240.0000000000	1496.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	136566.
2	22.4000	8.6781	Yes	No	136566.	478949.
3	40.4000	40.4000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 1.000000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 240000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	0.00	9705.	-0.01365	15795.	3.64E+09	-122.095	295.9576	0.00
0.4040	0.9338	61497.	9096.	-0.01361	18739.	3.64E+09	-129.167	670.5750	0.00
0.8080	0.8681	119863.	8454.	-0.01349	21532.	3.64E+09	-135.809	758.4790	0.00
1.2120	0.8031	174851.	7780.	-0.01329	24164.	3.64E+09	-141.998	857.2320	0.00
1.6160	0.7392	226230.	7078.	-0.01302	26623.	3.64E+09	-147.711	968.7732	0.00
2.0200	0.6768	273787.	6349.	-0.01269	28900.	3.64E+09	-152.927	1095.	0.00
2.4240	0.6161	317324.	5597.	-0.01230	30984.	3.64E+09	-157.622	1240.	0.00
2.8280	0.5576	356665.	4822.	-0.01185	32867.	3.64E+09	-161.772	1407.	0.00
3.2320	0.5013	391649.	4029.	-0.01135	34541.	3.64E+09	-165.353	1599.	0.00
3.6360	0.4475	422140.	3221.	-0.01080	36000.	3.64E+09	-168.340	1824.	0.00

4.0400	0.3965	448019.	2399.	-0.01022	37239.	3.64E+09	-170.704	2087.	0.00
4.4440	0.3484	469191.	1567.	-0.00961	38253.	3.64E+09	-172.419	2399.	0.00
4.8480	0.3033	485582.	728.6624	-0.00898	39037.	3.64E+09	-173.452	2772.	0.00
5.2520	0.2614	497144.	-112.999	-0.00832	39590.	3.64E+09	-173.768	3223.	0.00
5.6560	0.2226	503849.	-954.364	-0.00765	39911.	3.64E+09	-173.329	3774.	0.00
6.0600	0.1872	505699.	-1792.	-0.00698	40000.	3.64E+09	-172.089	4457.	0.00
6.4640	0.1550	502720.	-2621.	-0.00631	39857.	3.64E+09	-169.993	5318.	0.00
6.8680	0.1260	494965.	-3438.	-0.00564	39486.	3.64E+09	-166.971	6424.	0.00
7.2720	0.1003	482518.	-4237.	-0.00499	38890.	3.64E+09	-162.932	7879.	0.00
7.6760	0.07763	465492.	-5015.	-0.00436	38076.	3.64E+09	-157.750	9852.	0.00
8.0800	0.05800	444037.	-5764.	-0.00375	37049.	3.64E+09	-151.236	12641.	0.00
8.4840	0.04125	418338.	-6477.	-0.00318	35819.	3.64E+09	-143.082	16816.	0.00
8.8880	0.02720	388627.	-7146.	-0.00264	34396.	3.64E+09	-132.728	23655.	0.00
9.2920	0.01567	355194.	-7756.	-0.00214	32796.	3.64E+09	-118.940	36804.	0.00
9.6960	0.00643	318413.	-8281.	-0.00169	31036.	3.64E+09	-97.888	73816.	0.00
10.1000	-7.51E-04	278839.	-8377.	-0.00129	29141.	3.64E+09	58.2063	375959.	0.00
10.5040	-0.00613	240199.	-7990.	-9.49E-04	27292.	3.64E+09	101.7225	80485.	0.00
10.9080	-0.00995	203577.	-7463.	-6.53E-04	25539.	3.64E+09	115.6168	56328.	0.00
11.3120	-0.01246	169357.	-6886.	-4.04E-04	23901.	3.64E+09	122.3154	47598.	0.00
11.7160	-0.01387	137749.	-6285.	-1.99E-04	22388.	3.64E+09	125.6520	43918.	0.00
12.1200	-0.01439	108881.	-5673.	-3.50E-05	21007.	3.64E+09	126.8217	42720.	0.00
12.5240	-0.01421	82824.	-5059.	9.28E-05	19759.	3.64E+09	126.4205	43131.	0.00
12.9280	-0.01349	59609.	-4450.	1.88E-04	18648.	3.64E+09	124.7938	44841.	0.00
13.3320	-0.01239	39236.	-3852.	2.54E-04	17673.	3.64E+09	122.1606	47804.	0.00
13.7360	-0.01103	21673.	-3268.	2.94E-04	16832.	3.64E+09	118.6680	52149.	0.00
14.1400	-0.00953	6865.	-2703.	3.13E-04	16124.	3.64E+09	114.4179	58176.	0.00
14.5440	-0.00799	-5265.	-2160.	3.14E-04	16047.	3.64E+09	109.4814	66401.	0.00
14.9480	-0.00649	-14813.	-1643.	3.01E-04	16504.	3.64E+09	103.9060	77667.	0.00
15.3520	-0.00507	-21896.	-1154.	2.77E-04	16843.	3.64E+09	97.7186	93362.	0.00
15.7560	-0.00380	-26648.	-696.983	2.44E-04	17071.	3.64E+09	90.9245	115873.	0.00
16.1600	-0.00271	-29222.	-274.177	2.07E-04	17194.	3.64E+09	83.5004	149574.	0.00
16.5640	-0.00180	-29788.	110.9362	1.68E-04	17221.	3.64E+09	75.3748	203282.	0.00
16.9680	-0.00108	-28536.	454.5325	1.29E-04	17161.	3.64E+09	66.3728	297565.	0.00
17.3720	-5.50E-04	-25680.	751.2340	9.26E-05	17024.	3.64E+09	56.0288	494186.	0.00
17.7760	-1.84E-04	-21468.	971.7597	6.11E-05	16823.	3.64E+09	34.9472	920921.	0.00
18.1800	4.29E-05	-16400.	1037.	3.59E-05	16580.	3.64E+09	-8.149	920921.	0.00
18.5840	1.64E-04	-11499.	941.5780	1.73E-05	16346.	3.64E+09	-31.101	920921.	0.00
18.9880	2.10E-04	-7311.	769.3990	4.71E-06	16145.	3.64E+09	-39.930	920921.	0.00
19.3920	2.09E-04	-4050.	576.1845	-2.86E-06	15989.	3.64E+09	-39.779	920921.	0.00
19.7960	1.82E-04	-1718.	395.7590	-6.71E-06	15877.	3.64E+09	-34.654	920921.	0.00
20.2000	1.44E-04	-197.192	245.2945	-7.99E-06	15805.	3.64E+09	-27.419	920921.	0.00
20.6040	1.05E-04	679.2282	130.4923	-7.67E-06	15828.	3.64E+09	-19.942	920921.	0.00
21.0080	7.00E-05	1086.	49.9171	-6.49E-06	15847.	3.64E+09	-13.299	920921.	0.00
21.4120	4.21E-05	1178.	-1.686	-4.98E-06	15852.	3.64E+09	-7.990	920921.	0.00
21.8160	2.17E-05	1081.	-31.059	-3.47E-06	15847.	3.64E+09	-4.128	920921.	0.00
22.2200	8.39E-06	885.2607	-44.927	-2.16E-06	15838.	3.64E+09	-1.594	920921.	0.00
22.6240	7.73E-07	650.5537	-50.275	-1.14E-06	15826.	3.64E+09	-0.613	3841874.	0.00
23.0280	-2.64E-06	400.4373	-46.555	-4.36E-07	15814.	3.64E+09	2.1473	3947963.	0.00
23.4320	-3.46E-06	200.1673	-34.342	-3.58E-08	15805.	3.64E+09	2.8914	4054077.	0.00
23.8360	-2.98E-06	67.5437	-21.125	1.43E-07	15798.	3.64E+09	2.5609	4160214.	0.00
24.2400	-2.07E-06	-4.996	-10.493	1.84E-07	15795.	3.64E+09	1.8253	4266374.	0.00
24.6440	-1.20E-06	-34.629	-3.453	1.58E-07	15797.	3.64E+09	1.0790	4372556.	0.00
25.0480	-5.42E-07	-38.848	0.3767	1.09E-07	15797.	3.64E+09	0.5011	4478758.	0.00
25.4520	-1.40E-07	-31.230	1.9088	6.22E-08	15797.	3.64E+09	0.1309	4545000.	0.00
25.8560	6.11E-08	-20.486	2.0873	2.78E-08	15796.	3.64E+09	-0.05731	4545000.	0.00
26.2600	1.29E-07	-11.057	1.6541	6.73E-09	15796.	3.64E+09	-0.121	4545000.	0.00
26.6640	1.26E-07	-4.463	1.0727	-3.62E-09	15795.	3.64E+09	-0.118	4545000.	0.00
27.0680	9.43E-08	-0.647	0.5712	-7.03E-09	15795.	3.64E+09	-0.08845	4545000.	0.00
27.4720	5.82E-08	1.0915	0.2246	-6.74E-09	15795.	3.64E+09	-0.05453	4545000.	0.00
27.8760	2.90E-08	1.5466	0.02644	-4.98E-09	15795.	3.64E+09	-0.02723	4545000.	0.00
28.2800	9.92E-09	1.3594	-0.06210	-3.04E-09	15795.	3.64E+09	-0.00930	4545000.	0.00
28.6840	-4.15E-10	0.9516	-0.08370	-1.50E-09	15795.	3.64E+09	3.89E-04	4545000.	0.00
29.0880	-4.60E-09	0.5514	-0.07231	-4.95E-10	15795.	3.64E+09	0.00431	4545000.	0.00
29.4920	-5.21E-09	0.2516	-0.05002	4.08E-11	15795.	3.64E+09	0.00489	4545000.	0.00
29.8960	-4.20E-09	0.06626	-0.02864	2.53E-10	15795.	3.64E+09	0.00394	4545000.	0.00
30.3000	-2.76E-09	-0.02663	-0.01282	2.79E-10	15795.	3.64E+09	0.00259	4545000.	0.00
30.7040	-1.49E-09	-0.05865	-0.00315	2.22E-10	15795.	3.64E+09	0.00140	4545000.	0.00
31.1080	-6.06E-10	-0.05767	0.00162	1.45E-10	15795.	3.64E+09	5.68E-04	4545000.	0.00
31.5120	-9.06E-11	-0.04325	0.00321	7.74E-11	15795.	3.64E+09	8.50E-05	4545000.	0.00
31.9160	1.45E-10	-0.02677	0.00308	3.07E-11	15795.	3.64E+09	-1.36E-04	4545000.	0.00
32.3200	2.07E-10	-0.01344	0.00228	3.91E-12	15795.	3.64E+09	-1.94E-04	4545000.	0.00
32.7240	1.83E-10	-0.00465	0.00140	-8.15E-12	15795.	3.64E+09	-1.71E-04	4545000.	0.00
33.1280	1.28E-10	1.24E-04	6.90E-04	-1.12E-11	15795.	3.64E+09	-1.20E-04	4545000.	0.00
33.5320	7.44E-11	0.00207	2.30E-04	-9.70E-12	15795.	3.64E+09	-6.98E-05	4545000.	0.00
33.9360	3.41E-11	0.00237	-1.69E-05	-6.74E-12	15795.	3.64E+09	-3.19E-05	4545000.	0.00
34.3400	9.08E-12	0.00192	-1.15E-04	-3.87E-12	15795.	3.64E+09	-8.51E-06	4545000.	0.00
34.7440	-3.48E-12	0.00127	-1.28E-04	-1.75E-12	15795.	3.64E+09	3.27E-06	4545000.	0.00
35.1480	-7.84E-12	6.90E-04	-1.02E-04	0.00	15795.	3.64E+09	7.35E-06	4545000.	0.00
35.5520	-7.74E-12	2.82E-04	-6.65E-05	0.00	15795.	3.64E+09	7.26E-06	4545000.	0.00
35.9560	-5.82E-12	4.46E-05	-3.56E-05	0.00	15795.	3.64E+09	5.46E-06	4545000.	0.00
36.3600	-3.61E-12	-6.46E-05	-1.42E-05	0.00	15795.	3.64E+09	3.38E-06	4545000.	0.00
36.7640	-1.82E-12	-9.41E-05	-1.87E-06	0.00	15795.	3.64E+09	1.70E-06	4545000.	0.00
37.1680	0.00	-8.34E-05	3.69E-06	0.00	15795.	3.64E+09	5.92E-07	4545000.	0.00
37.5720	0.00	-5.87E-05	5.10E-06	0.00	15795.	3.64E+09	-1.31E-08	4545000.	0.00
37.9760	0.00	-3.42E-05	4.43E-06	0.00	15795.	3.64E+09	-2.63E-07	4545000.	0.00
38.3800	0.00	-1.58E-05	3.05E-06	0.00	15795.	3.64E+09	-3.05E-07	4545000.	0.00
38.7840	0.00	-4.61E-06	1.71E-06	0.00	15795.	3.64E+09	-2.51E-07	4545000.	0.00
39.1880	0.00	7.45E-07	6.92E-07	0.00	15795.	3.64E+09	-1.69E-07	4545000.	0.00
39.5920	0.00	2.14E-06	6.20E-08	0.00	15795.	3.64E+09	-9.11E-08	4545000.	0.00
39.9960	0.00	1.38E-06	-2.23E-07	0.00	15795.	3.64E+09	-2.66E-08	4545000.	0.00
40.4000	0.00	0.00	0.00	0.00	15795.	3.64E+09	1.19E-07	9140500.	0.00

* This analysis computed pile response using nonlinear moment-curvature rela-
  tionships. Values of total stress due to combined axial and bending stresses
  are computed only for elastic sections only and do not equal the actual
  stresses in concrete and steel. Stresses in concrete and steel may be inter-
  polated from the output for nonlinear bending properties relative to the
  magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     1.00000000 inches
Computed slope at pile head      =     -0.0136492 radians
Maximum bending moment           =        505699. inch-lbs
Maximum shear force              =          9705. lbs
Depth of maximum bending moment  =     6.06000000 feet below pile head
Depth of maximum shear force     =       0.000000 feet below pile head
Number of iterations             =             23
Number of zero deflection points =              9
```

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

```
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians
```

Load Case No.	Load Type	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	y, in	1.0000	M, in-lb	0.00	240000.	1.0000	-0.01365	9705.	505699.

Maximum pile-head deflection = 1.0000000000 inches
Maximum pile-head rotation   = -0.0136492282 radians = -0.782043 deg.

The analysis ended normally.

Jacobs

Project: MoDOT Improve I-70 Columbia to Kingdom City DB | By: ZW | 8/5/24 | 8/22/24
Job No. F3X03001 | Ckd: SR | 8/28/24
Subject: Bridge 2 (A9542)- Drivability Analysis at Bent 3

Axial Capacity:

Factored Load under Strength Limit:	658.5 k		See Table 4 of the GEDR.
Pile Structural Axial Resistance Factor:	ϕ_c = 0.6	(Seated on or into hard rock)	
Field Verification Method:	Dynamic Testing		
Driving Resistance Factor:	$\phi_{dynamic}$= 0.65		
Required Min. Nominal Driving Resistance:	R_{ndr} = 1,013 k		

Piles are to be seated on or into the hard rock.

Assumptions:

Pile Data:

	24X0.500		24X0.625				
F_y =	45	ksi	45	ksi	Pile Cutoff El.	678	ft
E =	29,000	ksi	29,000	ksi	Min. Pile Tip El.	646.9	ft
OD =	24	in	24	in	Approx. Pile Tip El.	642	ft
Wall Thick. =	0.500	in	0.625	in			
ID =	23.00	in	22.75	in			
As (No Corrosion) =	32.21	in^2	40.03	in^2			

	Pile: 24X0.500		
Max Nominal Driving Resistance:	R_{ndr} = 1,305	k	**OK**
Preliminary Structural Nominal Axial Design Capacity:	PNDC = F_yA_s = 1,450	k	
Preliminary Factored Axial Design Capacity:	PFDC =ϕc xPNDC = 870	k	

Drivability Analysis

Reference: MoDOT EPG Section 751.36.5.11
Software: GRLWEAP 2010, Pile Dynamics, Inc.
APIle Version 2018.8.2, Ensoft, Inc.

Boring Information: BR 2-3
Ground El. 669 ft
Min Pile Depth: 22.1 ft below Boring Ground Surface EL.

Max Allowable Driving Stress: $0.9F_y$ = 40.5 ksi

Pile side resistance and tip resistance were calculated using Apile. Pile drivability analysis was performed using GRLWEAP.

Drivability Analysis Results

Hammer	Pile Size	Depth	R_{ndr}	Blow Count	Max Comp. Stress	Max Tension Stress	Note
	(ft)	(ft)	(k)	(blows/ft)	(ksi)	(ksi)	
D19-42	24X0.5	25.5	820	1,235	27.9	4.8	Reach min. design pile tip El. without overstressing but required R_{ndr} is not achived
D30-32	24X0.5	26.5	1,025	244	37.9	5.3	Reach min. design pile tip El. without overstressing
D30-32	24X0.625	26.5	1,025	202	31.8	5.3	Reach min. design pile tip El. without overstressing

See the attached outputs.

Conclusions:

1. The hammer DELMAG D30-32 or equivalent can be used to drive piles to minimum design pile tip elevation and achieve the required minimum driving resistance within the allowable pile driving stress limit.

2. Piles shall be driven to practical refusal. When indication of hard rock occurs, in no case shall the pile be driven more than 3 blows when the hammer is operating at maximum rated energy and the penetration per blow is equivalent to or less than 10 blows per 0.5 inch. Driving should be terminated immediately once 30 blows/inch is encountered.

Jacobs

Project: MoDOT Improve I-70 Columbia to Kingdom City DB | By: ZW | 8/5/24 | 8/22/24 | 9/6/24
Job No. F3X03001 | Ckd: SR | 8/28/24
Subject: Bridge 2 (A9542)- Drivability Analysis at Bent 3

Axial Capacity:

Prebore to Min Pile Tip Elev. 646.9', Filled with Sand, and then driving to practical refusal)

Factored Load under Strength Limit:	658.5 k		See Table 4 of the GEDR.
Pile Structural Axial Resistance Factor:	ϕ_c = 0.6	(Seated on or into hard rock)	
Field Verification Method:	Dynamic Testing		
Driving Resistance Factor:	$\phi_{dynamic}$= 0.65		
Required Min. Nominal Driving Resistance:	R_{ndr} = 1,013 k		

Piles are to be seated on or into the hard rock.

Assumptions:

Pile Data:

	24X0.500		24X0.625				
F_y =	45	ksi	45	ksi	Pile Cutoff El.	678	ft
E =	29,000	ksi	29,000	ksi	Min. Pile Tip El.	646.9	ft
OD =	24	in	24	in	Approx. Pile Tip El.	642	ft
Wall Thick. =	0.500	in	0.625	in			
ID =	23.00	in	22.75	in			
As (No Corrosion) =	32.21	in^2	40.03	in^2			

	Pile: 24X0.625		
Max Nominal Driving Resistance:	R_{ndr} =	1,621 k	**OK**
Preliminary Structural Nominal Axial Design Capacity:	PNDC = F_yA_s =	1,801 k	
Preliminary Factored Axial Design Capacity:	PFDC =ϕc xPNDC =	1,081 k	

Drivability Analysis

Reference: MoDOT EPG Section 751.36.5.11
Software: GRLWEAP 2010, Pile Dynamics, Inc.
APIle Version 2018.8.2, Ensoft, Inc.

Boring Information: BR 2-3
Ground El. 669 ft
Min Pile Depth: 22.1 ft below Boring Ground Surface EL.

Max Allowable Driving Stress: 0.9F_y = 40.5 ksi

Pile side resistance and tip resistance were calculated using Apile. Pile drivability analysis was performed using GRLWEAP.

Drivability Analysis Results with Prebore

Hammer	Pile Size	Depth	R_{ndr}	Blow Count	Max Comp. Stress	Max Tension Stress	Note
	(ft)	(ft)	(k)	(blows/ft)	(ksi)	(ksi)	
D19-42	24X0.625	25	1,116	767	33.5	5.8	Reach min. design pile tip El. without overstressing

See the attached outputs.

Conclusions:

1. The hammer DELMAG D19-42 or equivalent can be used to drive piles to minimum design pile tip elevation and achieve the required minimum driving resistance within the allowable pile driving stress limit.

2. Piles shall be driven to practical refusal. When indication of hard rock occurs, in no case shall the pile be driven more than 3 blows when the hammer is operating at maximum rated energy and the penetration per blow is equivalent to or less than 10 blows per 0.5 inch. Driving should be terminated immediately once 30 blows/inch is encountered.

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

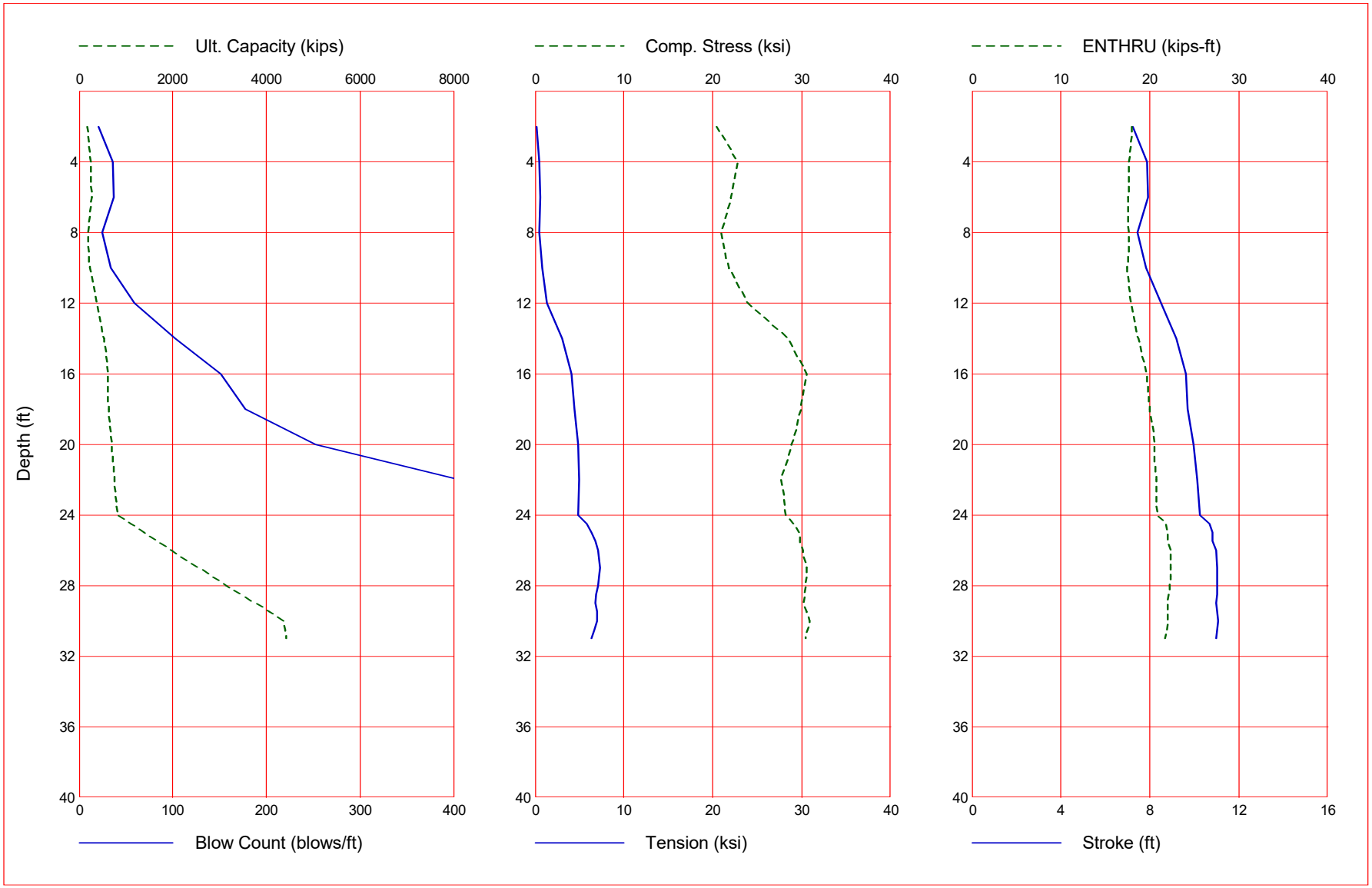
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	167.1	4.3	162.7	20.4	20.426	-0.126	7.24	18.0
4.0	260.7	20.0	240.6	35.9	22.812	-0.463	7.89	17.6
6.0	263.9	30.8	233.1	36.9	22.028	-0.595	7.91	17.5
8.0	190.2	46.0	144.2	24.9	20.954	-0.523	7.46	17.7
10.0	241.4	60.1	181.3	34.2	21.793	-0.826	7.81	17.4
12.0	383.6	66.3	317.3	59.7	23.929	-1.377	8.50	17.9
14.0	529.1	79.9	449.2	102.4	28.532	-3.029	9.19	18.7
16.0	614.9	131.1	483.8	151.8	30.559	-4.115	9.62	19.7
18.0	636.8	193.9	443.0	177.3	29.958	-4.405	9.71	20.0
20.0	698.8	255.9	443.0	252.8	28.812	-4.863	9.96	20.5
22.0	757.9	315.0	443.0	407.0	27.688	-4.914	10.13	20.7
24.0	816.8	373.9	443.0	869.6	28.210	-4.865	10.28	20.9
24.5	1103.3	388.6	714.7	9999.0	29.051	-5.840	10.69	21.8
25.0	1389.8	403.3	986.5	9999.0	29.683	-6.342	10.81	22.0
25.5	1679.4	418.1	1261.3	9999.0	29.837	-6.769	10.81	22.0
26.0	1969.0	432.8	1536.2	9999.0	30.083	-7.111	10.97	22.3
27.0	2553.2	460.9	2092.3	9999.0	30.597	-7.269	11.03	22.3
27.5	2849.1	474.1	2375.0	9999.0	30.571	-7.191	11.03	22.3
28.0	3144.9	487.1	2657.8	9999.0	30.448	-7.061	11.02	22.2
28.5	3446.9	500.1	2946.8	9999.0	30.330	-6.932	11.01	22.1
29.0	3749.1	513.3	3235.9	9999.0	30.214	-6.785	11.00	22.0
29.5	4061.0	526.7	3534.3	9999.0	30.563	-6.958	11.03	22.0
30.0	4373.1	540.4	3832.8	9999.0	30.900	-7.010	11.06	22.0
30.5	4402.9	554.4	3848.5	9999.0	30.674	-6.672	11.03	21.9
31.0	4432.9	568.8	3864.2	9999.0	30.456	-6.356	10.99	21.7

Refusal occurred; no driving time output possible

CH2M HILL
Br2_Bent3_BR2-3_CECIP24X0.5_D19-42

Sep 06 2024
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

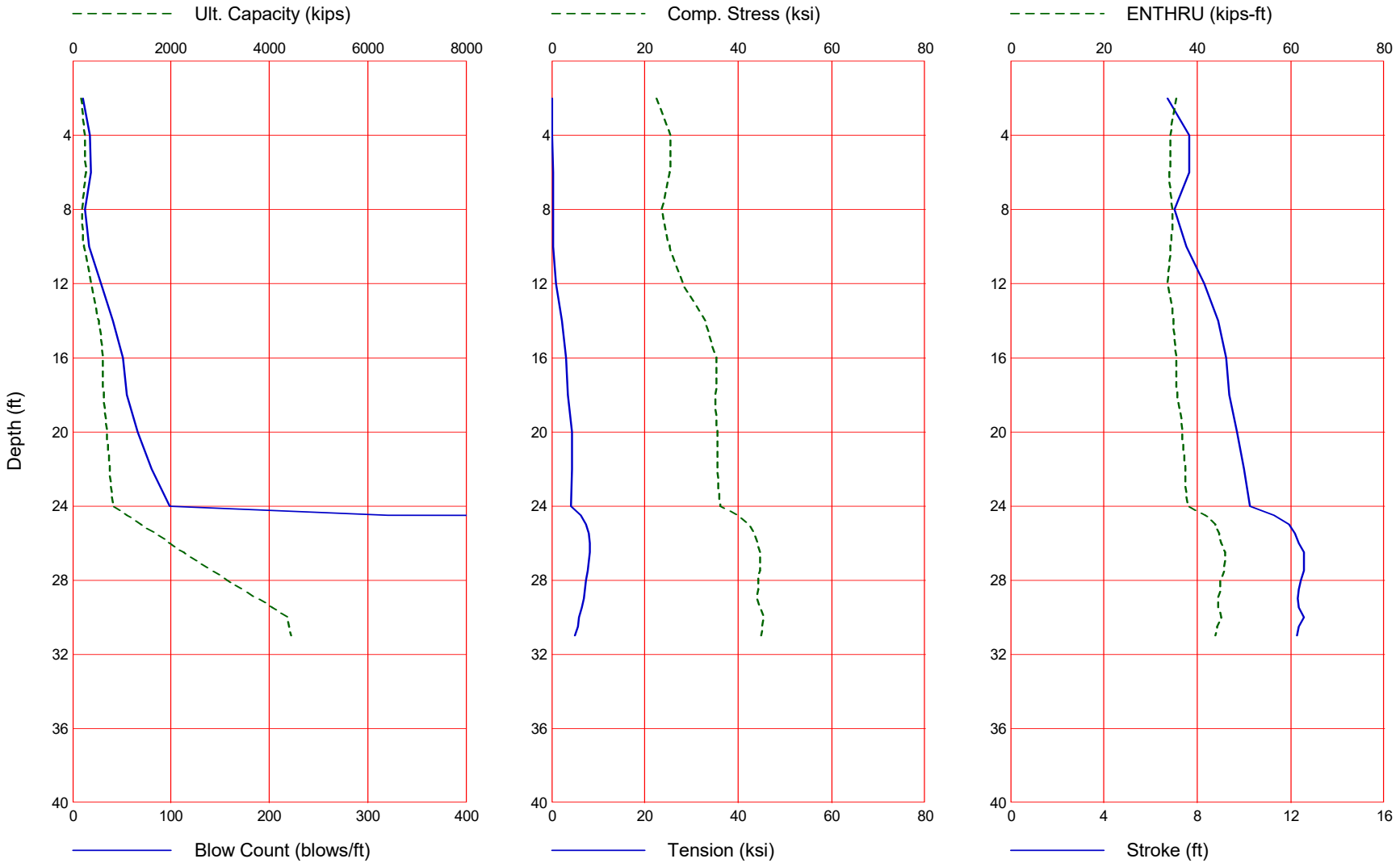
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	167.4	4.3	163.1	10.5	22.582	-0.099	6.72	35.6
4.0	261.2	20.0	241.2	18.1	25.567	-0.162	7.64	34.2
6.0	264.4	30.8	233.6	18.6	25.292	-0.214	7.67	34.1
8.0	190.5	46.0	144.5	12.8	23.501	-0.366	7.03	34.7
10.0	241.8	60.1	181.7	17.1	25.247	-0.255	7.55	34.3
12.0	384.3	66.3	318.0	28.6	28.127	-0.924	8.31	33.7
14.0	530.1	79.9	450.2	40.9	32.914	-2.239	8.91	34.9
16.0	615.9	131.1	484.9	51.2	35.311	-3.076	9.22	35.6
18.0	637.8	193.9	443.9	55.5	34.992	-3.476	9.36	35.8
20.0	699.8	255.9	443.9	66.2	35.474	-4.294	9.71	36.7
22.0	758.9	315.0	443.9	80.0	35.502	-4.332	9.99	37.4
24.0	817.8	373.9	443.9	99.2	36.136	-4.234	10.25	37.9
24.5	1104.9	388.6	716.3	320.7	40.030	-6.241	11.30	41.7
25.0	1392.0	403.3	988.6	9999.0	42.254	-7.440	11.94	43.8
25.5	1682.2	418.1	1264.1	9999.0	43.371	-7.997	12.20	44.6
26.0	1972.4	432.8	1539.6	9999.0	44.034	-8.157	12.37	45.1
26.5	2265.5	447.2	1818.3	9999.0	44.601	-8.142	12.58	45.9
27.5	2854.4	474.1	2380.3	9999.0	44.607	-7.687	12.58	45.7
28.0	3150.8	487.1	2663.7	9999.0	44.349	-7.461	12.42	45.0
28.5	3453.4	500.1	2953.3	9999.0	44.268	-7.210	12.37	44.8
29.0	3756.3	513.3	3243.0	9999.0	44.134	-6.903	12.32	44.5
29.5	4068.8	526.7	3542.1	9999.0	44.750	-6.449	12.35	44.5
30.0	4381.6	540.4	3841.2	9999.0	45.653	-5.795	12.55	45.2
30.5	4411.4	554.4	3857.0	9999.0	45.095	-5.583	12.34	44.3
31.0	4441.5	568.8	3872.7	9999.0	44.831	-5.022	12.25	43.9

Refusal occurred; no driving time output possible

CH2M HILL
Br2_Bent3_BR2-3_CECIP24X0.5_D30-32

Sep 06 2024
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

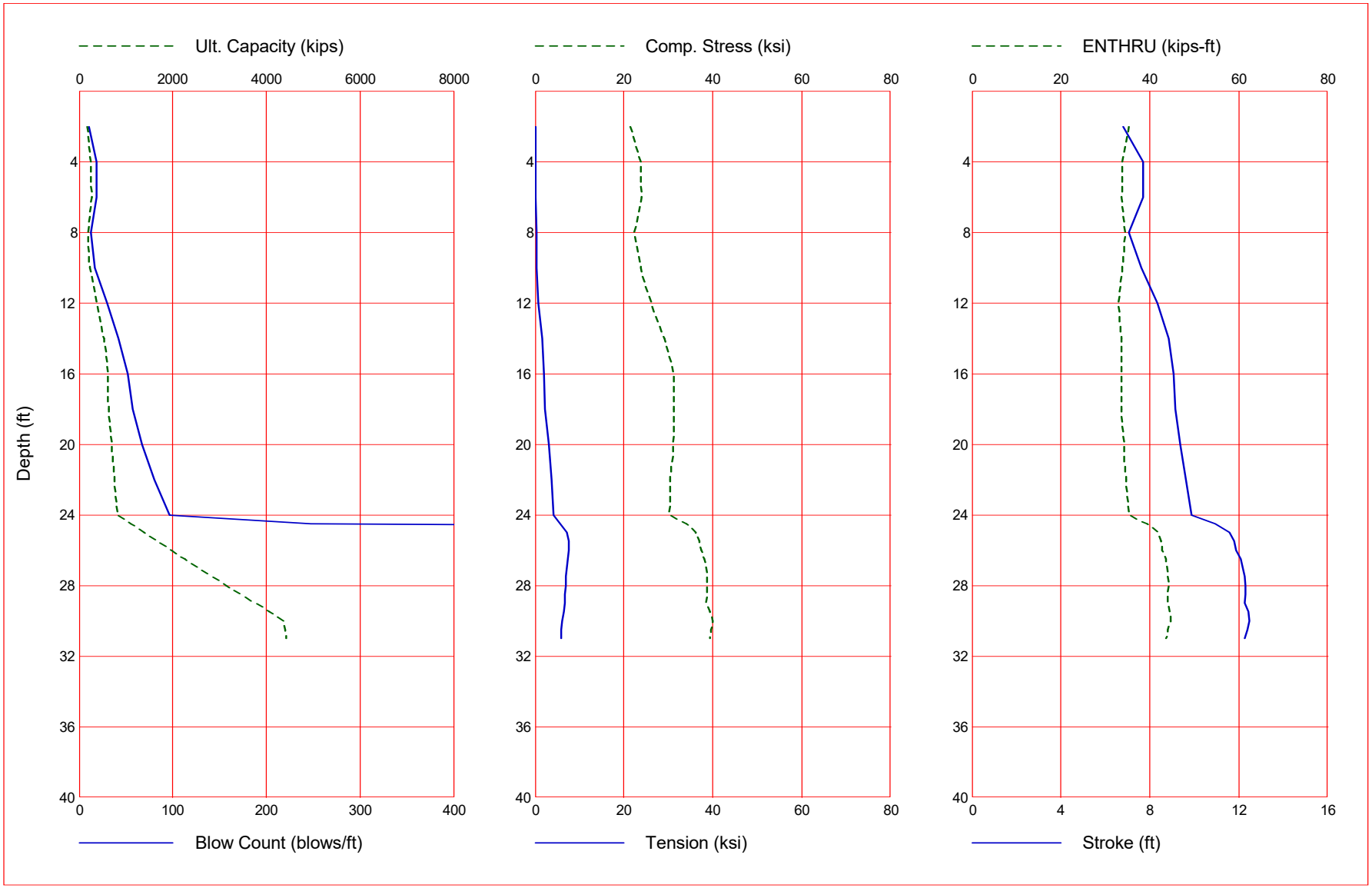
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	167.1	4.3	162.7	10.4	21.427	-0.081	6.79	35.3
4.0	260.7	20.0	240.6	18.3	23.867	-0.153	7.68	33.8
6.0	263.9	30.8	233.1	18.7	23.973	-0.200	7.71	33.7
8.0	190.2	46.0	144.2	12.8	22.288	-0.307	7.08	34.5
10.0	241.4	60.1	181.3	17.2	23.777	-0.316	7.60	33.9
12.0	383.6	66.3	317.3	29.8	26.129	-0.658	8.34	32.9
14.0	529.1	79.9	449.2	42.3	29.019	-1.543	8.86	33.6
16.0	614.9	131.1	483.8	52.4	31.286	-2.084	9.07	33.7
18.0	636.8	193.9	443.0	56.8	31.150	-2.247	9.16	33.7
20.0	698.8	255.9	443.0	67.4	31.075	-3.166	9.38	34.2
22.0	757.9	315.0	443.0	80.3	30.334	-3.734	9.63	34.6
24.0	816.8	373.9	443.0	96.8	30.254	-4.214	9.86	35.3
24.5	1103.3	388.6	714.7	247.9	34.073	-5.617	10.93	39.4
25.0	1389.8	403.3	986.5	1923.7	36.223	-7.066	11.57	41.9
25.5	1679.4	418.1	1261.3	9999.0	37.086	-7.501	11.78	42.6
26.0	1969.0	432.8	1536.2	9999.0	37.445	-7.511	11.87	42.8
26.5	2261.4	447.2	1814.3	9999.0	38.092	-7.432	12.08	43.6
27.5	2849.1	474.1	2375.0	9999.0	38.614	-7.023	12.27	44.1
28.0	3144.9	487.1	2657.8	9999.0	38.664	-6.948	12.29	44.2
28.5	3446.9	500.1	2946.8	9999.0	38.626	-6.814	12.29	44.1
29.0	3749.1	513.3	3235.9	9999.0	38.535	-6.677	12.28	44.0
29.5	4061.0	526.7	3534.3	9999.0	39.373	-6.531	12.42	44.4
30.0	4373.1	540.4	3832.8	9999.0	40.039	-6.162	12.48	44.6
30.5	4402.9	554.4	3848.5	9999.0	39.632	-5.921	12.39	44.1
31.0	4432.9	568.8	3864.2	9999.0	39.288	-5.826	12.27	43.6

Refusal occurred; no driving time output possible

CH2M HILL
Br2_Bent3_BR2-3_CECIP24X0.625_D30-32

Sep 06 2024
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

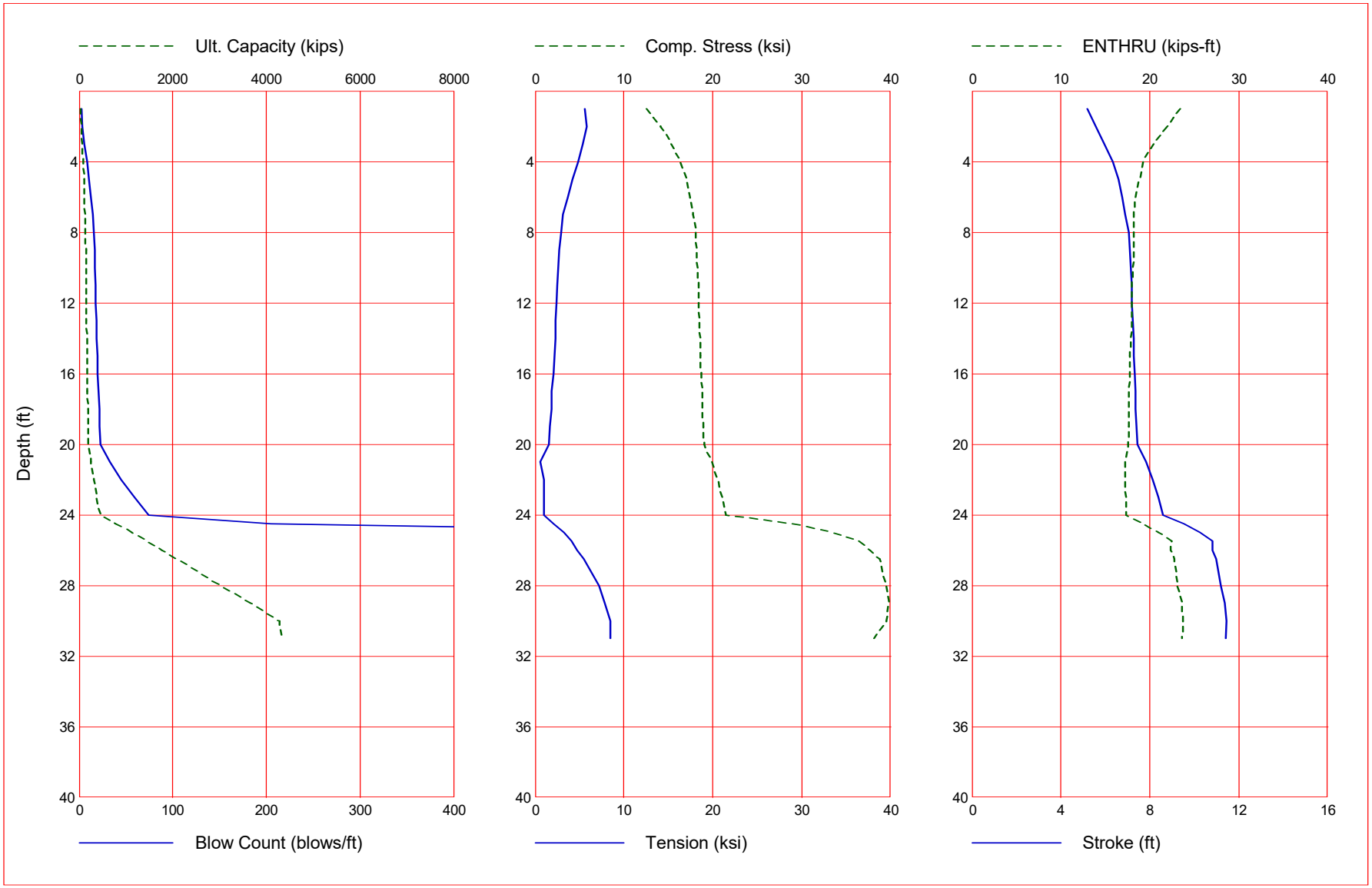
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.0	25.9	0.2	25.8	2.2	12.584	-5.573	5.19	23.4
2.0	41.9	0.7	41.2	3.5	14.125	-5.792	5.58	21.9
3.0	61.6	1.6	60.0	5.7	15.309	-5.435	5.97	20.4
4.0	84.2	2.8	81.4	8.4	16.328	-4.827	6.34	19.3
5.0	102.4	4.4	98.0	10.8	16.991	-4.214	6.60	18.8
6.0	117.8	6.3	111.5	12.9	17.439	-3.639	6.78	18.4
7.0	129.9	8.6	121.3	14.5	17.753	-3.154	6.91	18.2
8.0	139.1	11.2	127.9	15.7	18.107	-2.897	7.07	18.2
9.0	144.9	14.2	130.7	16.5	18.234	-2.700	7.12	18.2
10.0	148.9	17.5	131.3	17.0	18.289	-2.615	7.15	18.1
11.0	152.6	21.2	131.3	17.5	18.354	-2.553	7.17	18.0
12.0	156.6	25.3	131.3	18.0	18.431	-2.438	7.20	18.0
13.0	161.0	29.6	131.3	18.6	18.502	-2.340	7.23	18.0
14.0	165.6	34.3	131.3	19.1	18.567	-2.268	7.26	17.9
15.0	170.5	39.2	131.3	19.6	18.640	-2.176	7.29	17.8
16.0	175.8	44.5	131.3	20.1	18.705	-2.029	7.31	17.8
17.0	181.4	50.1	131.3	20.7	18.790	-1.913	7.35	17.7
18.0	187.3	56.0	131.3	21.4	18.868	-1.831	7.38	17.6
19.0	193.6	62.3	131.3	22.1	18.954	-1.692	7.42	17.6
20.0	200.3	69.0	131.3	22.8	19.042	-1.548	7.45	17.5
21.0	259.5	76.0	183.5	33.0	19.848	-0.543	7.82	17.2
22.0	318.9	83.3	235.6	45.2	20.507	-1.043	8.13	17.2
23.0	378.8	91.1	287.8	58.8	21.039	-1.043	8.39	17.3
24.0	450.0	110.7	339.3	74.2	21.454	-1.017	8.61	17.3
24.5	783.0	126.4	656.6	205.0	28.983	-2.055	9.54	19.3
25.0	1116.0	142.1	973.9	766.8	33.447	-3.304	10.24	21.0
25.5	1449.0	157.8	1291.2	9999.0	36.562	-4.055	10.81	22.4
26.0	1782.0	173.6	1608.5	9999.0	37.678	-4.757	10.81	22.3
26.5	2091.5	189.3	1902.2	9999.0	38.808	-5.469	10.99	22.8
28.0	3025.3	235.6	2789.7	9999.0	39.509	-7.150	11.18	23.1
29.0	3658.6	265.8	3392.9	9999.0	39.808	-7.893	11.37	23.6
30.0	4286.7	297.0	3989.7	9999.0	39.515	-8.451	11.44	23.7
31.0	4319.1	329.3	3989.7	9999.0	38.104	-8.431	11.40	23.6

Refusal occurred; no driving time output possible

CH2M HILL
Br2_Bent3_BR2-3_CECIP24X0.625D19-42_Preb

Sep 06 2024
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



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=========================================================================

                 APILE for Windows, Version 2018.8.2

                  Serial Number :  419704647

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                (c) Copyright ENSOFT, Inc., 1987-2015
                      All Rights Reserved

=========================================================================


This program is licensed to :

Jacobs/CH2M Hill
APILE Global, Global License

Path to file locations      : G:\TPW\GEOTECH\F3X03000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A6951)\APile\
Name of input data file     : A9542 Bent 3_BR 2-3.ap8d
Name of output file         : A9542 Bent 3_BR 2-3.ap8o
Name of plot output file    : A9542 Bent 3_BR 2-3.ap8p

-------------------------------------------------------------------------
                     Time and Date of Analysis
-------------------------------------------------------------------------

          Date:  August 02, 2024     Time:  16:11:09



1
      *********************
      * INPUT INFORMATION *
      *********************



      MoDOT I-70 Improve C2KC Bridge 2 (A9542) Bent 3 BR 2-3

      DESIGNER   : Zhongxin Wei

      JOB NUMBER : F3X03001


      METHOD FOR UNIT LOAD TRANSFERS :

      - FHWA (Federal Highway Administration)
        Unfactored Unit Side Friction and Unit Side Resistance are used.



      COMPUTATION METHOD(S) FOR PILE CAPACITY :

      - FHWA (Federal Highway Administration)
      - API RP 2A (American Petroleum Institute)


      TYPE OF LOADING :
      - COMPRESSION


      PILE TYPE :

      Steel pipe pile or non-tapered portion of monotube pile
      - Close-Ended Pile


      DATA FOR AXIAL STIFFNESS :

      - MODULUS OF ELASTICITY     = 0.290E+08 PSI
      - CROSS SECTION AREA        =     36.91 IN2


      CIRCULAR PILE PROPERTIES :

      - OUTSIDE DIAMETER, OD      =     24.00 IN.
      - INTERNAL DIAMETER, ID     =     23.00 IN.
      - TOTAL PILE LENGTH, TL     =     40.00 FT.
      - BATTER ANGLE              =      0.00 DEG
      - PILE STICKUP LENGTH, PSL  =      0.00 FT.
      - ZERO FRICTION LENGTH, ZFL =      0.00 FT.
      - INCREMENT OF PILE LENGTH
        USED IN COMPUTATION       =      1.00 FT.
      - LENGTH OF ENHANCED
        END SECTION               =     40.00 FT.
      - INTERNAL DIAMETER OF
        ENHANCED END SECTION      =     23.00 IN.
```

PLUGGED/UNPLUGGED CONDITIONS :
Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	CLAY	0.00	120.00	0.00	0.00
2.50	CLAY	0.00	120.00	0.00	0.00
2.50	CLAY	0.00	120.00	0.00	0.00
5.50	CLAY	0.00	120.00	0.00	0.00
5.50	CLAY	0.00	120.00	0.00	0.00
8.50	CLAY	0.00	120.00	0.00	0.00
8.50	CLAY	0.00	120.00	0.00	0.00
12.00	CLAY	0.00	120.00	0.00	0.00
12.00	SAND	0.00	120.00	35.00	0.00
13.00	SAND	0.00	120.00	35.00	0.00
13.00	SAND	0.00	57.60	35.00	0.00
14.00	SAND	0.00	57.60	35.00	0.00
14.00	CLAY	0.00	72.60	0.00	0.00
20.00	CLAY	0.00	72.60	0.00	0.00
20.00	CLAY	0.00	72.60	0.00	0.00
27.00	CLAY	0.00	72.60	0.00	0.00
27.00	SAND	0.00	72.60	0.00	0.00
29.00	SAND	0.00	72.60	0.00	0.00
29.00	SAND	0.00	135.00	0.00	0.00
48.00	SAND	0.00	72.60	0.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	2.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.75	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.75	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	100.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	100.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	100.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	100.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
2.50	1.000	1.000
2.50	1.000	1.000
5.50	1.000	1.000
5.50	1.000	1.000
8.50	1.000	1.000
8.50	1.000	1.000
12.00	1.000	1.000
12.00	1.000	1.000
13.00	1.000	1.000
13.00	1.000	1.000
14.00	1.000	1.000
14.00	1.000	1.000
20.00	1.000	1.000
20.00	1.000	1.000
27.00	1.000	1.000
27.00	1.000	1.000
29.00	1.000	1.000
29.00	1.000	1.000

48.00 1.000 1.000

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	28.3	28.3
1.00	0.0	35.3	35.3
2.00	4.3	51.8	56.2
3.00	13.0	68.3	81.3
4.00	20.0	76.6	96.6
5.00	25.4	75.4	100.8
6.00	30.8	74.2	105.0
7.00	37.6	60.1	97.7
8.00	46.0	45.9	91.9
9.00	54.3	31.8	86.1
10.00	60.0	57.7	117.8
11.00	63.1	85.7	148.8
12.00	66.2	101.0	167.2
13.00	71.7	122.2	193.9
14.00	79.8	143.4	223.2
15.00	99.6	164.6	264.3
16.00	131.0	154.0	285.1
17.00	162.5	141.4	303.8
18.00	193.9	141.4	335.2
19.00	225.3	141.4	366.7
20.00	255.9	141.4	397.3
21.00	285.6	141.4	426.9
22.00	315.0	141.4	456.4
23.00	344.5	141.4	485.8
24.00	373.9	141.4	515.3
25.00	403.4	313.8	717.2
26.00	432.8	488.7	921.6
27.00	460.9	665.6	1126.5
28.00	487.2	846.1	1333.3
29.00	513.3	1029.8	1543.1
30.00	540.5	1216.0	1756.5
31.00	568.9	1231.9	1800.8
32.00	598.5	1246.9	1845.4
33.00	629.2	1260.5	1889.8
34.00	661.1	1267.0	1928.1
35.00	694.2	1266.5	1960.7
36.00	728.1	1259.7	1987.8
37.00	762.8	1247.2	2010.0
38.00	798.2	1229.6	2027.8
39.00	834.2	1208.2	2042.4
40.00	870.9	1186.9	2057.8

****
* API RP-2A (2010) *
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PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	28.3	28.3
1.00	3.1	35.3	38.5
2.00	6.5	51.8	58.3
3.00	10.4	68.3	78.7
4.00	15.8	76.6	92.4
5.00	22.7	75.4	98.1
6.00	29.9	74.2	104.1
7.00	35.9	60.1	96.0
8.00	40.6	45.9	86.5
9.00	45.4	31.8	77.2
10.00	49.0	55.0	104.0
11.00	51.5	80.0	131.5
12.00	54.1	95.3	149.4
13.00	55.5	116.5	172.0
14.00	55.5	137.7	193.2
15.00	61.4	158.9	220.4
16.00	73.5	151.1	224.6
17.00	85.7	141.4	227.0
18.00	97.9	141.4	239.3
19.00	110.3	141.4	251.7
20.00	122.9	141.4	264.2
21.00	135.5	141.4	276.9

22.00	148.2	141.4	289.6
23.00	161.1	141.4	302.4
24.00	174.0	141.4	315.4
25.00	187.1	185.8	372.9
26.00	200.2	232.2	432.4
27.00	213.5	281.2	494.7
28.00	220.1	333.7	553.8
29.00	220.1	389.5	609.6
30.00	220.1	448.7	668.8
31.00	220.1	466.6	686.6
32.00	220.1	485.6	705.7
33.00	220.1	504.7	724.8
34.00	220.1	522.8	742.9
35.00	220.1	540.0	760.1
36.00	220.1	556.4	776.5
37.00	220.1	571.8	791.9
38.00	220.1	586.3	806.4
39.00	220.1	600.2	820.3
40.00	220.1	613.6	833.7

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

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=========================================================================

                 APILE for Windows, Version 2018.8.2

                  Serial Number :  419704647

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
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=========================================================================


This program is licensed to :

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Path to file locations      : G:\TPW\GEOTECH\F3X03000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A6951)\APile\
Name of input data file     : A9542 Bent 3_BR 2-3_PreBore.ap8d
Name of output file         : A9542 Bent 3_BR 2-3_PreBore.ap8o
Name of plot output file    : A9542 Bent 3_BR 2-3_PreBore.ap8p

-------------------------------------------------------------------------
                     Time and Date of Analysis
-------------------------------------------------------------------------

          Date:  September 06, 2024     Time:  07:53:55



1
      *********************
      * INPUT INFORMATION *
      *********************



      MoDOT I-70 Improve C2KC Bridge 2 (A9542) Bent 3 BR 2-3, Prebore to Min

      DESIGNER   : Zhongxin Wei

      JOB NUMBER : F3X03001


      METHOD FOR UNIT LOAD TRANSFERS :

      - FHWA (Federal Highway Administration)
        Unfactored Unit Side Friction and Unit Side Resistance are used.



      COMPUTATION METHOD(S) FOR PILE CAPACITY :

      - FHWA (Federal Highway Administration)
      - API RP 2A (American Petroleum Institute)


      TYPE OF LOADING :
      - COMPRESSION


      PILE TYPE :

      Steel pipe pile or non-tapered portion of monotube pile
      - Close-Ended Pile


      DATA FOR AXIAL STIFFNESS :

      - MODULUS OF ELASTICITY     = 0.290E+08 PSI
      - CROSS SECTION AREA        =     36.91 IN2


      CIRCULAR PILE PROPERTIES :

      - OUTSIDE DIAMETER, OD      =     24.00 IN.
      - INTERNAL DIAMETER, ID     =     23.00 IN.
      - TOTAL PILE LENGTH, TL     =     40.00 FT.
      - BATTER ANGLE              =      0.00 DEG
      - PILE STICKUP LENGTH, PSL  =      0.00 FT.
      - ZERO FRICTION LENGTH, ZFL =      0.00 FT.
      - INCREMENT OF PILE LENGTH
        USED IN COMPUTATION       =      1.00 FT.
      - LENGTH OF ENHANCED
        END SECTION               =     40.00 FT.
      - INTERNAL DIAMETER OF
        ENHANCED END SECTION      =     23.00 IN.
```

PLUGGED/UNPLUGGED CONDITIONS :
Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	120.00	30.00	0.00
2.50	SAND	0.00	120.00	30.00	0.00
2.50	SAND	0.00	120.00	30.00	0.00
5.50	SAND	0.00	120.00	30.00	0.00
5.50	SAND	0.00	120.00	30.00	0.00
8.50	SAND	0.00	120.00	30.00	0.00
8.50	SAND	0.00	120.00	30.00	0.00
12.00	SAND	0.00	120.00	30.00	0.00
12.00	SAND	0.00	120.00	30.00	0.00
13.00	SAND	0.00	120.00	30.00	0.00
13.00	SAND	0.00	57.60	30.00	0.00
14.00	SAND	0.00	57.60	30.00	0.00
14.00	SAND	0.00	120.00	30.00	0.00
22.10	SAND	0.00	120.00	30.00	0.00
22.10	CLAY	0.00	72.60	0.00	0.00
27.00	CLAY	0.00	72.60	0.00	0.00
27.00	SAND	0.00	72.60	0.00	0.00
29.00	SAND	0.00	72.60	0.00	0.00
29.00	SAND	0.00	135.00	0.00	0.00
48.00	SAND	0.00	72.60	0.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	100.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	100.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	100.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	100.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
2.50	1.000	1.000
2.50	1.000	1.000
5.50	1.000	1.000
5.50	1.000	1.000
8.50	1.000	1.000
8.50	1.000	1.000
12.00	1.000	1.000
12.00	1.000	1.000
13.00	1.000	1.000
13.00	1.000	1.000
14.00	1.000	1.000
14.00	1.000	1.000
22.10	1.000	1.000
22.10	1.000	1.000
27.00	1.000	1.000
27.00	1.000	1.000
29.00	1.000	1.000
29.00	1.000	1.000

48.00 1.000 1.000

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****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	4.9	4.9
1.00	0.2	8.2	8.4
2.00	0.7	13.1	13.8
3.00	1.6	19.1	20.7
4.00	2.8	25.9	28.7
5.00	4.4	31.2	35.6
6.00	6.3	35.5	41.8
7.00	8.6	38.6	47.2
8.00	11.2	40.7	51.9
9.00	14.2	41.6	55.8
10.00	17.5	41.8	59.4
11.00	21.2	41.8	63.1
12.00	25.3	41.8	67.1
13.00	29.6	41.8	71.5
14.00	34.3	41.8	76.1
15.00	39.2	41.8	81.0
16.00	44.4	41.8	86.3
17.00	50.1	41.8	91.9
18.00	56.0	41.8	97.9
19.00	62.3	41.8	104.2
20.00	69.0	41.8	110.8
21.00	76.0	58.4	134.4
22.00	83.3	75.0	158.4
23.00	91.1	91.6	182.7
24.00	110.7	108.2	218.9
25.00	142.1	309.5	451.6
26.00	173.5	512.4	685.9
27.00	205.0	699.1	904.0
28.00	235.6	887.9	1123.4
29.00	265.8	1078.0	1343.8
30.00	296.9	1266.3	1563.2
31.00	329.3	1265.5	1594.8
32.00	362.8	1259.0	1621.8
33.00	397.3	1247.9	1645.2
34.00	432.5	1230.9	1663.3
35.00	468.4	1208.6	1677.0
36.00	505.1	1184.5	1689.5
37.00	542.4	1161.1	1703.5
38.00	580.4	1138.4	1718.8
39.00	618.9	1116.4	1735.3
40.00	658.0	1095.2	1753.2

****
* API RP-2A (2010) *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	5.7	5.7
1.00	0.0	9.4	9.4
2.00	0.0	15.1	15.1
3.00	0.0	22.0	22.0
4.00	0.0	30.2	30.2
5.00	0.0	37.7	37.7
6.00	0.0	45.2	45.2
7.00	0.0	52.8	52.8
8.00	0.0	60.3	60.3
9.00	0.0	67.9	67.9
10.00	0.0	75.4	75.4
11.00	0.0	82.6	82.6
12.00	0.0	89.5	89.5
13.00	0.0	96.4	96.4
14.00	0.0	103.3	103.3
15.00	0.0	110.2	110.2
16.00	0.0	117.0	117.0
17.00	0.0	124.3	124.3
18.00	0.0	131.8	131.8
19.00	0.0	139.3	139.3
20.00	0.0	146.9	146.9
21.00	0.0	149.1	149.1

22.00	0.0	150.1	150.1
23.00	0.0	149.8	149.8
24.00	6.8	148.2	155.0
25.00	20.4	201.0	221.4
26.00	34.1	254.5	288.6
27.00	47.8	314.7	362.5
28.00	54.7	378.4	433.1
29.00	54.7	445.2	499.9
30.00	54.7	514.9	569.6
31.00	54.7	531.7	586.4
32.00	54.7	549.3	604.0
33.00	54.7	566.7	621.5
34.00	54.7	583.2	637.9
35.00	54.7	598.9	653.6
36.00	54.7	614.0	668.8
37.00	54.7	628.6	683.3
38.00	54.7	642.6	697.3
39.00	54.7	656.1	710.8
40.00	54.7	669.0	723.7

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.5816E-01	0.1000E-01
			0.1163E+00	0.2000E-01
			0.2326E+00	0.4000E-01
			0.3490E+00	0.6000E-01
			0.4653E+00	0.8000E-01
			0.5234E+00	0.9000E-01
			0.5816E+00	0.1000E+00
			0.5816E+00	0.5000E+00
			0.5816E+00	0.2000E+01
2	10	0.1275E+01		
			0.0000E+00	0.0000E+00
			0.7755E-01	0.1000E-01
			0.1551E+00	0.2000E-01
			0.3102E+00	0.4000E-01
			0.4653E+00	0.6000E-01
			0.6204E+00	0.8000E-01
			0.6979E+00	0.9000E-01
			0.7755E+00	0.1000E+00
			0.7755E+00	0.5000E+00
			0.7755E+00	0.2000E+01
3	10	0.2458E+01		
			0.0000E+00	0.0000E+00
			0.1163E+00	0.1000E-01
			0.2326E+00	0.2000E-01
			0.4653E+00	0.4000E-01
			0.6979E+00	0.6000E-01
			0.9306E+00	0.8000E-01
			0.1047E+01	0.9000E-01
			0.1163E+01	0.1000E+00
			0.1163E+01	0.5000E+00
			0.1163E+01	0.2000E+01
4	10	0.2500E+01		
			0.0000E+00	0.0000E+00
			0.1163E+00	0.1000E-01
			0.2326E+00	0.2000E-01
			0.4653E+00	0.4000E-01
			0.6979E+00	0.6000E-01
			0.9306E+00	0.8000E-01
			0.1047E+01	0.9000E-01
			0.1163E+01	0.1000E+00
			0.1163E+01	0.5000E+00
			0.1163E+01	0.2000E+01
5	10	0.4025E+01		
			0.0000E+00	0.0000E+00
			0.1939E+00	0.1000E-01
			0.3877E+00	0.2000E-01
			0.7755E+00	0.4000E-01
			0.1163E+01	0.6000E-01
			0.1551E+01	0.8000E-01
			0.1745E+01	0.9000E-01
			0.1939E+01	0.1000E+00
			0.1939E+01	0.5000E+00

```
                                0.1939E+01      0.2000E+01
 6          10      0.5458E+01
                                0.0000E+00      0.0000E+00
                                0.2326E+00      0.1000E-01
                                0.4653E+00      0.2000E-01
                                0.9306E+00      0.4000E-01
                                0.1396E+01      0.6000E-01
                                0.1861E+01      0.8000E-01
                                0.2094E+01      0.9000E-01
                                0.2326E+01      0.1000E+00
                                0.2326E+01      0.5000E+00
                                0.2326E+01      0.2000E+01
 7          10      0.5500E+01
                                0.0000E+00      0.0000E+00
                                0.2326E+00      0.1000E-01
                                0.4653E+00      0.2000E-01
                                0.9306E+00      0.4000E-01
                                0.1396E+01      0.6000E-01
                                0.1861E+01      0.8000E-01
                                0.2094E+01      0.9000E-01
                                0.2326E+01      0.1000E+00
                                0.2326E+01      0.5000E+00
                                0.2326E+01      0.2000E+01
 8          10      0.7025E+01
                                0.0000E+00      0.0000E+00
                                0.3102E+00      0.1000E-01
                                0.6204E+00      0.2000E-01
                                0.1241E+01      0.4000E-01
                                0.1861E+01      0.6000E-01
                                0.2481E+01      0.8000E-01
                                0.2792E+01      0.9000E-01
                                0.3102E+01      0.1000E+00
                                0.3102E+01      0.5000E+00
                                0.3102E+01      0.2000E+01
 9          10      0.8458E+01
                                0.0000E+00      0.0000E+00
                                0.3490E+00      0.1000E-01
                                0.6979E+00      0.2000E-01
                                0.1396E+01      0.4000E-01
                                0.2094E+01      0.6000E-01
                                0.2792E+01      0.8000E-01
                                0.3141E+01      0.9000E-01
                                0.3490E+01      0.1000E+00
                                0.3490E+01      0.5000E+00
                                0.3490E+01      0.2000E+01
10          10      0.8500E+01
                                0.0000E+00      0.0000E+00
                                0.3490E+00      0.1000E-01
                                0.6979E+00      0.2000E-01
                                0.1396E+01      0.4000E-01
                                0.2094E+01      0.6000E-01
                                0.2792E+01      0.8000E-01
                                0.3141E+01      0.9000E-01
                                0.3490E+01      0.1000E+00
                                0.3490E+01      0.5000E+00
                                0.3490E+01      0.2000E+01
11          10      0.1028E+02
                                0.0000E+00      0.0000E+00
                                0.4265E+00      0.1000E-01
                                0.8530E+00      0.2000E-01
                                0.1706E+01      0.4000E-01
                                0.2559E+01      0.6000E-01
                                0.3412E+01      0.8000E-01
                                0.3839E+01      0.9000E-01
                                0.4265E+01      0.1000E+00
                                0.4265E+01      0.5000E+00
                                0.4265E+01      0.2000E+01
12          10      0.1196E+02
                                0.0000E+00      0.0000E+00
                                0.4653E+00      0.1000E-01
                                0.9306E+00      0.2000E-01
                                0.1861E+01      0.4000E-01
                                0.2792E+01      0.6000E-01
                                0.3722E+01      0.8000E-01
                                0.4188E+01      0.9000E-01
                                0.4653E+01      0.1000E+00
                                0.4653E+01      0.5000E+00
                                0.4653E+01      0.2000E+01
13          10      0.1200E+02
                                0.0000E+00      0.0000E+00
                                0.4990E+00      0.1000E-01
                                0.9980E+00      0.2000E-01
                                0.1996E+01      0.4000E-01
                                0.2994E+01      0.6000E-01
                                0.3992E+01      0.8000E-01
                                0.4491E+01      0.9000E-01
                                0.4990E+01      0.1000E+00
                                0.4990E+01      0.5000E+00
                                0.4990E+01      0.2000E+01
14          10      0.1253E+02
                                0.0000E+00      0.0000E+00
```

```
                                0.4990E+00      0.1000E-01
                                0.9980E+00      0.2000E-01
                                0.1996E+01      0.4000E-01
                                0.2994E+01      0.6000E-01
                                0.3992E+01      0.8000E-01
                                0.4491E+01      0.9000E-01
                                0.4990E+01      0.1000E+00
                                0.4990E+01      0.5000E+00
                                0.4990E+01      0.2000E+01
15          10      0.1296E+02
                                0.0000E+00      0.0000E+00
                                0.4990E+00      0.1000E-01
                                0.9980E+00      0.2000E-01
                                0.1996E+01      0.4000E-01
                                0.2994E+01      0.6000E-01
                                0.3992E+01      0.8000E-01
                                0.4491E+01      0.9000E-01
                                0.4990E+01      0.1000E+00
                                0.4990E+01      0.5000E+00
                                0.4990E+01      0.2000E+01
16          10      0.1300E+02
                                0.0000E+00      0.0000E+00
                                0.5277E+00      0.1000E-01
                                0.1055E+01      0.2000E-01
                                0.2111E+01      0.4000E-01
                                0.3166E+01      0.6000E-01
                                0.4222E+01      0.8000E-01
                                0.4749E+01      0.9000E-01
                                0.5277E+01      0.1000E+00
                                0.5277E+01      0.5000E+00
                                0.5277E+01      0.2000E+01
17          10      0.1353E+02
                                0.0000E+00      0.0000E+00
                                0.5277E+00      0.1000E-01
                                0.1055E+01      0.2000E-01
                                0.2111E+01      0.4000E-01
                                0.3166E+01      0.6000E-01
                                0.4222E+01      0.8000E-01
                                0.4749E+01      0.9000E-01
                                0.5277E+01      0.1000E+00
                                0.5277E+01      0.5000E+00
                                0.5277E+01      0.2000E+01
18          10      0.1396E+02
                                0.0000E+00      0.0000E+00
                                0.5277E+00      0.1000E-01
                                0.1055E+01      0.2000E-01
                                0.2111E+01      0.4000E-01
                                0.3166E+01      0.6000E-01
                                0.4222E+01      0.8000E-01
                                0.4749E+01      0.9000E-01
                                0.5277E+01      0.1000E+00
                                0.5277E+01      0.5000E+00
                                0.5277E+01      0.2000E+01
19          10      0.1400E+02
                                0.0000E+00      0.0000E+00
                                0.5614E+00      0.1000E-01
                                0.1123E+01      0.2000E-01
                                0.2246E+01      0.4000E-01
                                0.3369E+01      0.6000E-01
                                0.4492E+01      0.8000E-01
                                0.5053E+01      0.9000E-01
                                0.5614E+01      0.1000E+00
                                0.5614E+01      0.5000E+00
                                0.5614E+01      0.2000E+01
20          10      0.1808E+02
                                0.0000E+00      0.0000E+00
                                0.7165E+00      0.1000E-01
                                0.1433E+01      0.2000E-01
                                0.2866E+01      0.4000E-01
                                0.4299E+01      0.6000E-01
                                0.5732E+01      0.8000E-01
                                0.6449E+01      0.9000E-01
                                0.7165E+01      0.1000E+00
                                0.7165E+01      0.5000E+00
                                0.7165E+01      0.2000E+01
21          10      0.2206E+02
                                0.0000E+00      0.0000E+00
                                0.1512E+01      0.1000E-01
                                0.3024E+01      0.2000E-01
                                0.6048E+01      0.4000E-01
                                0.9072E+01      0.6000E-01
                                0.1210E+02      0.8000E-01
                                0.1361E+02      0.9000E-01
                                0.1512E+02      0.1000E+00
                                0.1512E+02      0.5000E+00
                                0.1512E+02      0.2000E+01
22          10      0.2210E+02
                                0.0000E+00      0.0000E+00
                                0.4536E+01      0.3840E-01
                                0.7560E+01      0.7440E-01
                                0.1134E+02      0.1368E+00
```

```
                                0.1361E+02      0.1920E+00
                                0.1512E+02      0.2400E+00
                                0.1361E+02      0.4800E+00
                                0.1361E+02      0.7200E+00
                                0.1361E+02      0.1200E+01
                                0.1361E+02      0.4800E+01
23          10      0.2458E+02
                                0.0000E+00      0.0000E+00
                                0.1042E+02      0.3840E-01
                                0.1736E+02      0.7440E-01
                                0.2604E+02      0.1368E+00
                                0.3125E+02      0.1920E+00
                                0.3472E+02      0.2400E+00
                                0.3125E+02      0.4800E+00
                                0.3125E+02      0.7200E+00
                                0.3125E+02      0.1200E+01
                                0.3125E+02      0.4800E+01
24          10      0.2696E+02
                                0.0000E+00      0.0000E+00
                                0.1029E+02      0.3840E-01
                                0.1715E+02      0.7440E-01
                                0.2572E+02      0.1368E+00
                                0.3086E+02      0.1920E+00
                                0.3429E+02      0.2400E+00
                                0.3086E+02      0.4800E+00
                                0.3086E+02      0.7200E+00
                                0.3086E+02      0.1200E+01
                                0.3086E+02      0.4800E+01
25          10      0.2700E+02
                                0.0000E+00      0.0000E+00
                                0.3361E+01      0.1000E-01
                                0.6723E+01      0.2000E-01
                                0.1345E+02      0.4000E-01
                                0.2017E+02      0.6000E-01
                                0.2689E+02      0.8000E-01
                                0.3025E+02      0.9000E-01
                                0.3361E+02      0.1000E+00
                                0.3361E+02      0.5000E+00
                                0.3361E+02      0.2000E+01
26          10      0.2803E+02
                                0.0000E+00      0.0000E+00
                                0.3391E+01      0.1000E-01
                                0.6781E+01      0.2000E-01
                                0.1356E+02      0.4000E-01
                                0.2034E+02      0.6000E-01
                                0.2712E+02      0.8000E-01
                                0.3051E+02      0.9000E-01
                                0.3391E+02      0.1000E+00
                                0.3391E+02      0.5000E+00
                                0.3391E+02      0.2000E+01
27          10      0.2896E+02
                                0.0000E+00      0.0000E+00
                                0.3391E+01      0.1000E-01
                                0.6781E+01      0.2000E-01
                                0.1356E+02      0.4000E-01
                                0.2034E+02      0.6000E-01
                                0.2712E+02      0.8000E-01
                                0.3051E+02      0.9000E-01
                                0.3391E+02      0.1000E+00
                                0.3391E+02      0.5000E+00
                                0.3391E+02      0.2000E+01
28          10      0.2900E+02
                                0.0000E+00      0.0000E+00
                                0.3512E+01      0.1000E-01
                                0.7024E+01      0.2000E-01
                                0.1405E+02      0.4000E-01
                                0.2107E+02      0.6000E-01
                                0.2810E+02      0.8000E-01
                                0.3161E+02      0.9000E-01
                                0.3512E+02      0.1000E+00
                                0.3512E+02      0.5000E+00
                                0.3512E+02      0.2000E+01
29          10      0.3853E+02
                                0.0000E+00      0.0000E+00
                                0.4291E+01      0.1000E-01
                                0.8581E+01      0.2000E-01
                                0.1716E+02      0.4000E-01
                                0.2574E+02      0.6000E-01
                                0.3433E+02      0.8000E-01
                                0.3862E+02      0.9000E-01
                                0.4291E+02      0.1000E+00
                                0.4291E+02      0.5000E+00
                                0.4291E+02      0.2000E+01
30          10      0.4796E+02
                                0.0000E+00      0.0000E+00
                                0.4321E+01      0.1000E-01
                                0.8643E+01      0.2000E-01
                                0.1729E+02      0.4000E-01
                                0.2593E+02      0.6000E-01
                                0.3457E+02      0.8000E-01
                                0.3889E+02      0.9000E-01
```

0.4321E+02	0.1000E+00
0.4321E+02	0.5000E+00
0.4321E+02	0.2000E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.6845E+02	0.1200E-01
0.1369E+03	0.2400E-01
0.2738E+03	0.4800E-01
0.5476E+03	0.3120E+00
0.8214E+03	0.1008E+01
0.9856E+03	0.1752E+01
0.1095E+04	0.2400E+01
0.1095E+04	0.3600E+01
0.1095E+04	0.4800E+01

LOAD VERSUS SETTLEMENT CURVE
****

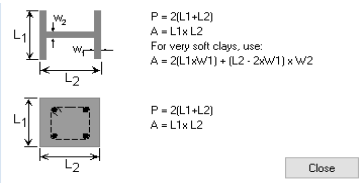
TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.2004E+01	0.7621E-03	0.5704E+00	0.1000E-03
0.2007E+02	0.7623E-02	0.5704E+01	0.1000E-02
0.1028E+03	0.3883E-01	0.2852E+02	0.5000E-02
0.2056E+03	0.7766E-01	0.5704E+02	0.1000E-01
0.8477E+03	0.3537E+00	0.2759E+03	0.5000E-01
0.1023E+04	0.4758E+00	0.3277E+03	0.1000E+00
0.1314E+04	0.1007E+01	0.6215E+03	0.5000E+00
0.1510E+04	0.1595E+01	0.8182E+03	0.1000E+01
0.1720E+04	0.2689E+01	0.1028E+04	0.2000E+01

Jacobs

Project: MoDOT Improve I-70 Columbia to Kingdom City DB — By: ZW 8/5/24
Job No. F3X03001 — Ckd: SR 8/28/24
Subject: Bridge 2 (A9542)- Drivability Analysis at Bent 4

Axial Capacity:

Factored Load under Strength Limit: 228.5 k — See Table 4 of the GEDR.
Pile Structural Axial Resistance Factor: ϕ_c = 0.5 (Seated on or into hard rock)
Field Verification Method: FHWA-modified Gates Formula
Driving Resistance Factor: $\phi_{dynamic}$ = 0.4
Required Min. Nominal Driving Resistance: R_{ndr} = 572 k
Piles are to be seated on or into the hard rock.



Assumptions:

Pile Data:

Pile:	HP12X53	
F_y =	50	ksi
E =	29,000	ksi
Net A_s=	15.50	in^2
d (L2) =	11.80	in
b_f (L1)=	12.00	in
t_w (w2) =	0.435	in
t_f (w1) =	0.435	in

Preliminary Structural Nominal Axial Design Capacity: PNDC = F_yA_s = 775 k
Preliminary Factored Axial Design Capacity: PFDC = ϕc x PNDC = 388 k
Max Nominal Driving Resistance: R_{ndr} = 698 k
OK

Drivability Analysis Cases

Case	Area	Perimeter		Note
	in^2	in	ft	
Box Shape	141.6	47.60	3.97	-
Net Shape	15.50	68.99	5.75	For Soft Clay

Drivability Analysis

Reference: MoDOT EPG Section 751.36.5.11
Software: GRLWEAP 2010, Pile Dynamics, Inc.
APIle Version 2018.8.2, Ensoft, Inc.

Boring Information: B-11

Ground El.	680.3	ft
Pile Top El.	675.3	ft
Min. Design Pile Tip EL.	654	ft
Min Pile Depth:	21.3	ft

Assumed Ground surface at driving.

Max Allowable Driving Stress: $0.9F_y$ = 45 ksi

Drivability Analysis:

Per EPG 751.36.5.11, drivability analysis shall be performed for two cases:

1. Box Shape
2. Perimeter

Pile side resistance and tip resistance were calculated using Apile. Pile drivability analysis was performed using GRLWEAP.

Drivability Analysis Results

Case	Hammer	Depth	R_{ndr}	Blow Count	Max Comp. Stress	Max Tension Stress	Note
		(ft)	(k)	(blows/ft)	(ksi)	(ksi)	
Box Shape	D19-42	29.5	596	433	43.8	0.7	Reach Min. R_{ndr} and min pile tip El. without overstressing.
Perimeter	D19-42	29.2	584	>464	40.6	0.7	Reach Min. R_{ndr} and min pile tip El. without overstressing.

See the attached outputs.

Conclusions:

1. The hammer DELMAG D19-42 can be used to drive piles to minimum design pile tip elevation and achieve the required minimum driving resistance within the allowable pile driving stress limit.

2. Piles shall be driven to practical refusal. When indication of hard rock occurs, in no case shall the pile be driven more than 3 blows when the hammer is operating at maximum rated energy and the penetration per blow is equivalent to or less than 10 blows per 0.5 inch. Driving should be terminated immediately once 30 blows/inch is encountered.

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

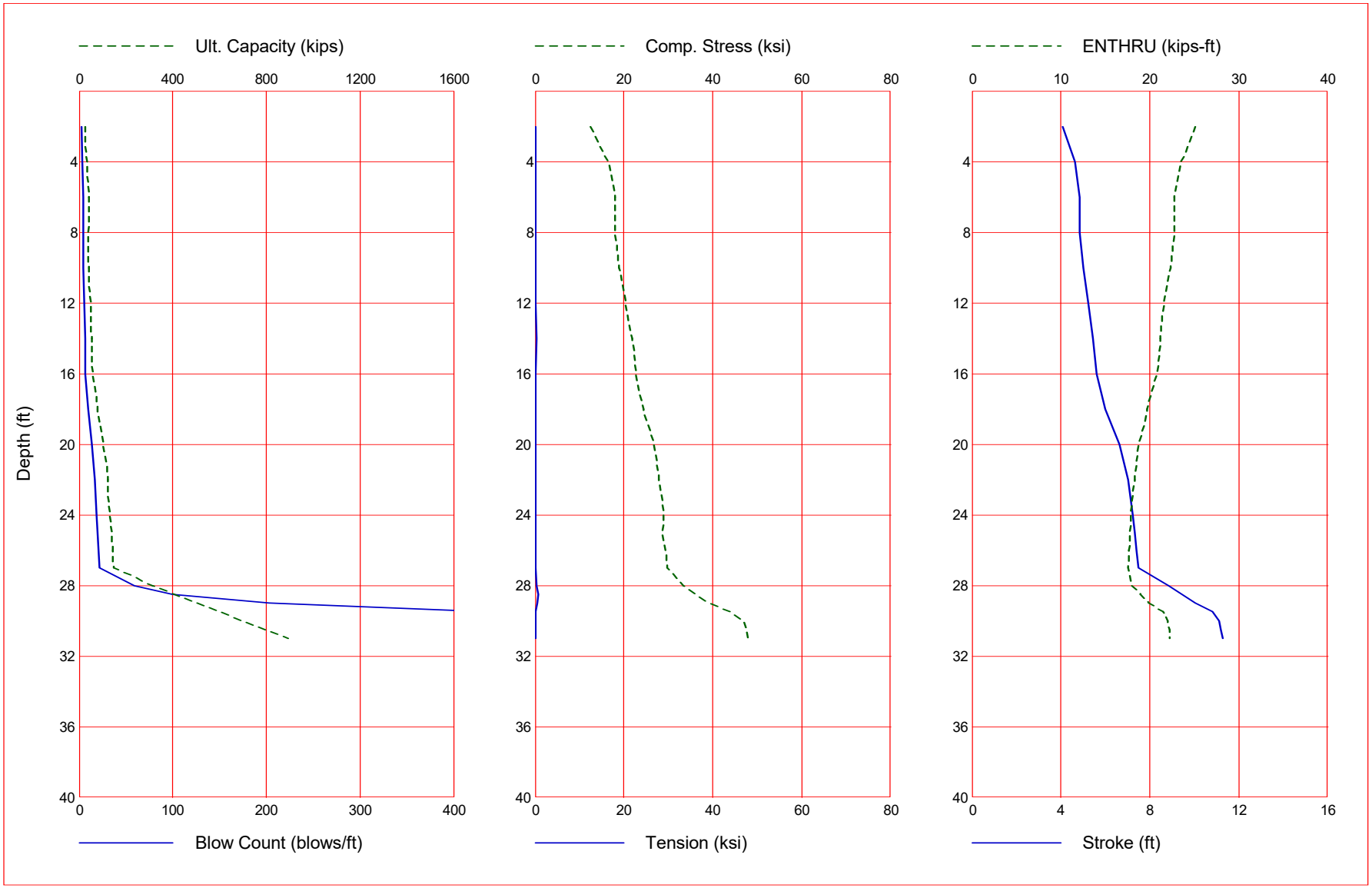
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	25.4	2.2	23.2	2.2	12.551	-0.018	4.06	25.1
4.0	36.1	10.6	25.5	3.5	16.572	0.000	4.61	23.5
6.0	40.6	17.8	22.8	4.1	17.967	0.000	4.83	22.8
8.0	39.8	25.4	14.4	4.1	17.994	0.000	4.84	22.8
10.0	43.5	33.8	9.7	4.7	18.873	0.000	5.01	22.3
12.0	49.2	41.4	7.8	5.5	20.363	0.000	5.23	21.6
14.0	54.4	47.9	6.5	6.2	21.763	-0.231	5.42	21.2
16.0	60.5	52.7	7.8	7.0	22.729	-0.204	5.61	20.8
18.0	77.3	60.1	17.2	9.4	24.481	-0.140	6.01	19.7
20.0	104.1	68.2	35.9	13.4	26.862	0.000	6.62	18.7
22.0	122.7	78.4	44.3	16.6	27.821	0.000	7.03	18.3
24.0	132.9	88.6	44.3	18.7	28.911	-0.041	7.22	17.9
25.0	138.1	93.8	44.3	19.7	28.652	-0.129	7.30	17.8
26.0	143.3	99.0	44.3	20.9	29.309	-0.116	7.40	17.7
27.0	148.6	104.3	44.3	22.1	29.848	-0.086	7.48	17.5
28.0	314.5	109.5	205.0	58.9	33.341	-0.317	8.85	18.0
28.5	407.1	112.1	295.0	100.1	36.076	-0.700	9.47	18.9
29.0	499.8	114.8	385.0	202.8	39.250	-0.600	10.04	19.9
29.5	596.0	121.0	475.0	432.6	43.758	-0.170	10.81	21.5
30.0	699.1	134.1	565.0	5642.6	47.003	-0.079	11.12	22.0
30.5	795.7	150.7	645.0	9999.0	47.601	-0.003	11.21	22.2
31.0	892.5	167.5	725.0	9999.0	47.827	0.000	11.30	22.2

Refusal occurred; no driving time output possible

CH2M HILL
Br2_Bent4_B-11_HP12X53_D19-42_Box Shape

Aug 02 2024
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

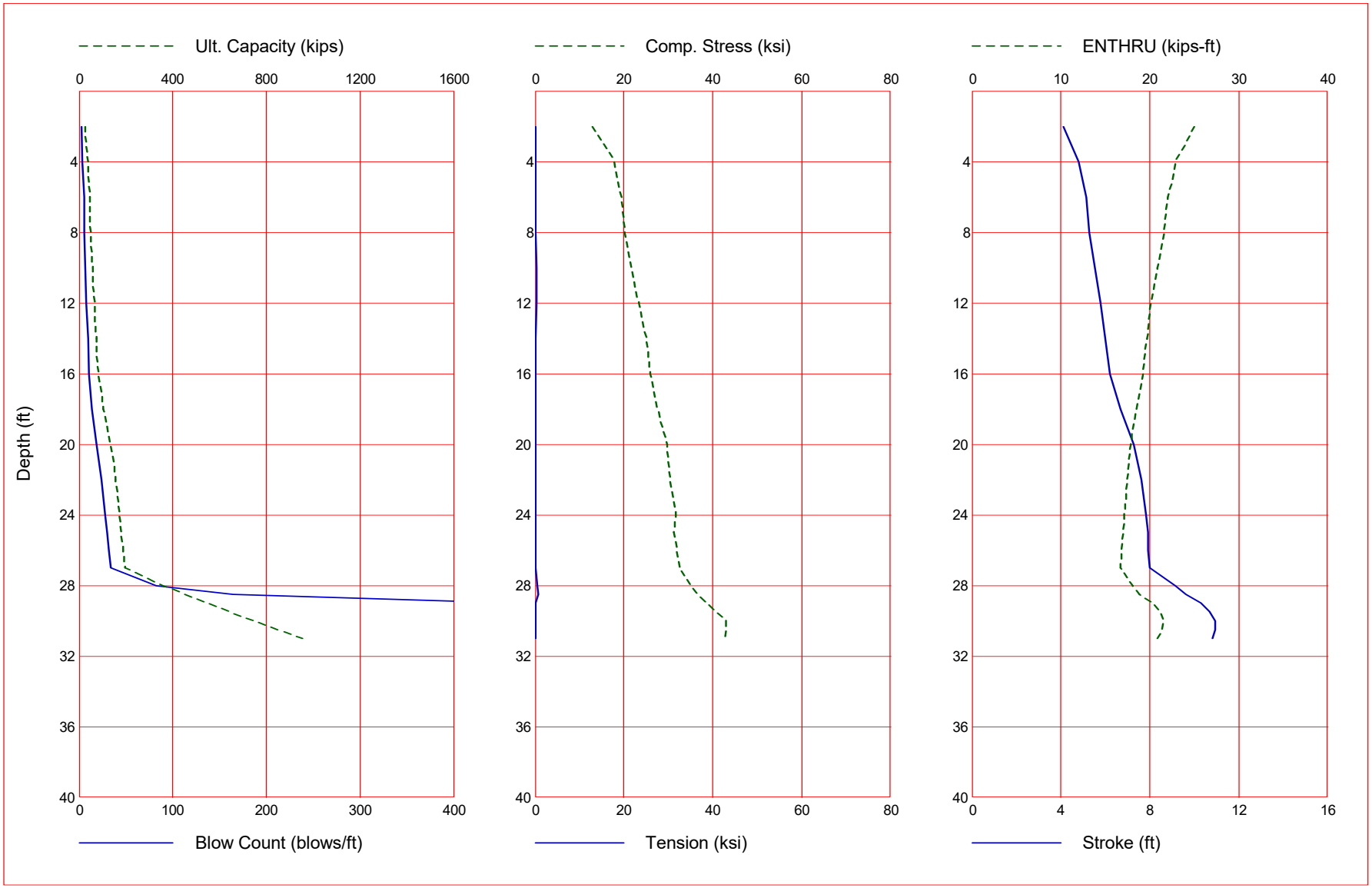
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	26.0	3.2	22.8	2.3	12.869	-0.031	4.11	25.0
4.0	40.4	15.4	25.1	4.0	17.845	0.000	4.81	22.9
6.0	48.3	25.8	22.4	5.1	19.450	0.000	5.13	22.0
8.0	50.9	36.7	14.2	5.6	20.099	0.000	5.26	21.6
10.0	58.4	48.9	9.5	6.7	21.706	-0.324	5.52	20.9
12.0	67.6	59.9	7.7	8.1	23.318	-0.226	5.76	20.1
14.0	75.7	69.3	6.4	9.3	24.975	-0.192	6.00	19.7
16.0	84.0	76.3	7.7	10.6	25.814	-0.068	6.22	19.3
18.0	104.0	87.1	16.9	13.8	27.585	0.000	6.68	18.5
20.0	134.1	98.8	35.3	19.1	29.789	-0.088	7.26	17.9
22.0	157.0	113.5	43.6	24.1	30.322	-0.144	7.61	17.4
24.0	171.9	128.3	43.6	27.8	31.664	-0.022	7.81	17.1
25.0	179.4	135.8	43.6	29.8	31.189	0.000	7.90	17.0
26.0	187.0	143.4	43.6	31.7	31.828	0.000	7.92	16.8
27.0	194.6	151.0	43.6	33.6	32.520	0.000	8.01	16.7
28.0	360.2	158.6	201.6	82.1	35.195	-0.459	9.16	18.1
28.5	452.5	162.4	290.1	164.9	36.543	-0.691	9.61	18.8
29.0	544.9	166.3	378.6	464.4	38.763	-0.180	10.30	20.3
29.5	642.3	175.2	467.1	9999.0	40.609	-0.045	10.70	21.2
30.0	749.7	194.2	555.6	9999.0	43.104	0.000	10.95	21.6
30.5	852.5	218.2	634.3	9999.0	43.002	0.000	10.94	21.4
31.0	955.5	242.6	712.9	9999.0	42.526	0.000	10.81	20.9

Refusal occurred; no driving time output possible

CH2M HILL
Br2_Bent4_B-11_HP12X53_D19-42_Perimeter

Aug 02 2024
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



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=========================================================================

                 APILE for Windows, Version 2018.8.2

                  Serial Number :  419704647

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                (c) Copyright ENSOFT, Inc., 1987-2015
                     All Rights Reserved

=========================================================================


This program is licensed to :

Jacobs/CH2M Hill
APILE Global, Global License

Path to file locations      : G:\TPW\GEOTECH\F3X03000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A6951)\APile\
Name of input data file     : A9542 Bent 4_B-11_Box.ap8d
Name of output file         : A9542 Bent 4_B-11_Box.ap8o
Name of plot output file    : A9542 Bent 4_B-11_Box.ap8p

-------------------------------------------------------------------------
                     Time and Date of Analysis
-------------------------------------------------------------------------

          Date:  August 02, 2024     Time:  16:24:11



1
      *********************
      * INPUT INFORMATION *
      *********************



      MoDOT I-70 Improve C2KC Bridge 2 (A9542) Bent 4_B-11_Box_HP12X53

      DESIGNER   : Zhongxin Wei

      JOB NUMBER : F3X03001


      METHOD FOR UNIT LOAD TRANSFERS :

      - FHWA (Federal Highway Administration)
        Unfactored Unit Side Friction and Unit Side Resistance are used.



      COMPUTATION METHOD(S) FOR PILE CAPACITY :

      - FHWA (Federal Highway Administration)
      - API RP 2A (American Petroleum Institute)


      TYPE OF LOADING :
      - COMPRESSION


      PILE TYPE :

      H-Pile/Steel Pile


      DATA FOR AXIAL STIFFNESS :

      - MODULUS OF ELASTICITY     = 0.290E+08 PSI
      - CROSS SECTION AREA        =     15.50 IN2


      NONCIRCULAR PILE PROPERTIES :

      - TOTAL PILE LENGTH, TL     =     32.00 FT.
      - BATTER ANGLE              =      0.00 DEG
      - PILE STICKUP LENGTH, PSL  =      0.00 FT.
      - ZERO FRICTION LENGTH, ZFL =      0.00 FT.
      - PERIMETER OF PILE         =     47.60 IN.
      - TIP AREA OF PILE          =    141.60 IN2
      - INCREMENT OF PILE LENGTH
        USED IN COMPUTATION       =      1.00 FT.



      SOIL INFORMATIONS :
```

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	CLAY	0.00	120.00	0.00	0.00
3.00	CLAY	0.00	120.00	0.00	0.00
3.00	CLAY	0.00	120.00	0.00	0.00
7.00	CLAY	0.00	120.00	0.00	0.00
7.00	CLAY	0.00	120.00	0.00	0.00
10.00	CLAY	0.00	120.00	0.00	0.00
10.00	CLAY	0.00	120.00	0.00	0.00
13.00	CLAY	0.00	120.00	0.00	0.00
13.00	CLAY	0.00	120.00	0.00	0.00
15.00	CLAY	0.00	120.00	0.00	0.00
15.00	CLAY	0.00	135.00	0.00	0.00
19.00	CLAY	0.00	135.00	0.00	0.00
19.00	CLAY	0.00	135.00	0.00	0.00
22.00	CLAY	0.00	135.00	0.00	0.00
22.00	CLAY	0.00	72.60	0.00	0.00
24.00	CLAY	0.00	72.60	0.00	0.00
24.00	CLAY	0.00	72.60	0.00	0.00
29.00	CLAY	0.00	72.60	0.00	0.00
29.00	SAND	0.00	72.60	60.00	0.00
48.00	SAND	0.00	82.60	60.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	2.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.20	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.20	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
3.00	1.000	1.000
3.00	1.000	1.000
7.00	1.000	1.000
7.00	1.000	1.000
10.00	1.000	1.000
10.00	1.000	1.000
13.00	1.000	1.000
13.00	1.000	1.000
15.00	1.000	1.000
15.00	1.000	1.000
19.00	1.000	1.000
19.00	1.000	1.000
22.00	1.000	1.000
22.00	1.000	1.000
24.00	1.000	1.000
24.00	1.000	1.000
29.00	1.000	1.000
29.00	1.000	1.000
48.00	1.000	1.000

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	11.1	11.1
1.00	0.0	11.1	11.1
2.00	2.2	23.2	25.4
3.00	6.6	24.3	30.9
4.00	10.6	25.5	36.1
5.00	14.2	26.5	40.7
6.00	17.8	22.8	40.6
7.00	21.4	18.6	40.0
8.00	25.3	14.4	39.7
9.00	29.5	10.2	39.7
10.00	33.7	9.7	43.5
11.00	37.7	9.3	47.0
12.00	41.4	7.8	49.2
13.00	45.0	6.6	51.7
14.00	47.9	6.5	54.4
15.00	49.8	6.6	56.4
16.00	52.6	7.8	60.4
17.00	56.4	8.9	65.2
18.00	60.1	17.2	77.3
19.00	63.8	26.6	90.3
20.00	68.2	35.9	104.1
21.00	73.2	44.3	117.4
22.00	78.3	44.3	122.5
23.00	83.4	44.3	127.6
24.00	88.5	44.3	132.7
25.00	93.7	44.3	137.9
26.00	98.9	44.3	143.2
27.00	104.2	44.3	148.4
28.00	109.4	205.0	314.4
29.00	114.7	384.8	499.5
30.00	134.0	564.6	698.5
31.00	167.4	725.3	892.7
32.00	201.5	725.3	926.8

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* API RP-2A (2010) *
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PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	11.1	11.1
1.00	2.3	11.1	13.4
2.00	4.9	23.2	28.0
3.00	7.8	24.3	32.1
4.00	11.2	25.5	36.7
5.00	15.0	26.5	41.6
6.00	19.1	22.8	41.9
7.00	23.4	18.6	42.0
8.00	26.7	14.4	41.0
9.00	28.9	10.2	39.1
10.00	31.3	9.7	41.0
11.00	33.6	9.3	42.9
12.00	35.9	7.8	43.8
13.00	38.4	6.6	45.0
14.00	40.5	6.5	47.0
15.00	42.4	6.6	49.0
16.00	44.7	7.8	52.5
17.00	47.5	8.9	56.4
18.00	50.4	17.2	67.6
19.00	53.4	26.6	79.9
20.00	59.1	35.9	95.0
21.00	67.4	44.3	111.7
22.00	75.9	44.3	120.2
23.00	84.5	44.3	128.7
24.00	93.1	44.3	137.4
25.00	101.8	44.3	146.0
26.00	110.5	44.3	154.8
27.00	119.3	44.3	163.5
28.00	128.1	71.9	200.0
29.00	137.0	103.8	240.8
30.00	141.4	136.6	278.1
31.00	141.4	167.2	308.6
32.00	141.4	170.8	312.2

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface	Effective Cohesion Fn
	CH	Spatial Mohr-Coulomb	120		0	1	CH
	CL	Spatial Mohr-Coulomb	120		0	1	CL
	CL-4	Mohr-Coulomb	120	1,200	0	1	
	Exist. Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Limestone	Bedrock (Impenetrable)				1	
	New Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Rock Blanket	Mohr-Coulomb	125	0	40	1	
	Shale (IGMs)	Mohr-Coulomb	133	3,000	0	1	
	Weatherd LS	Mohr-Coulomb	135	0	42	1	

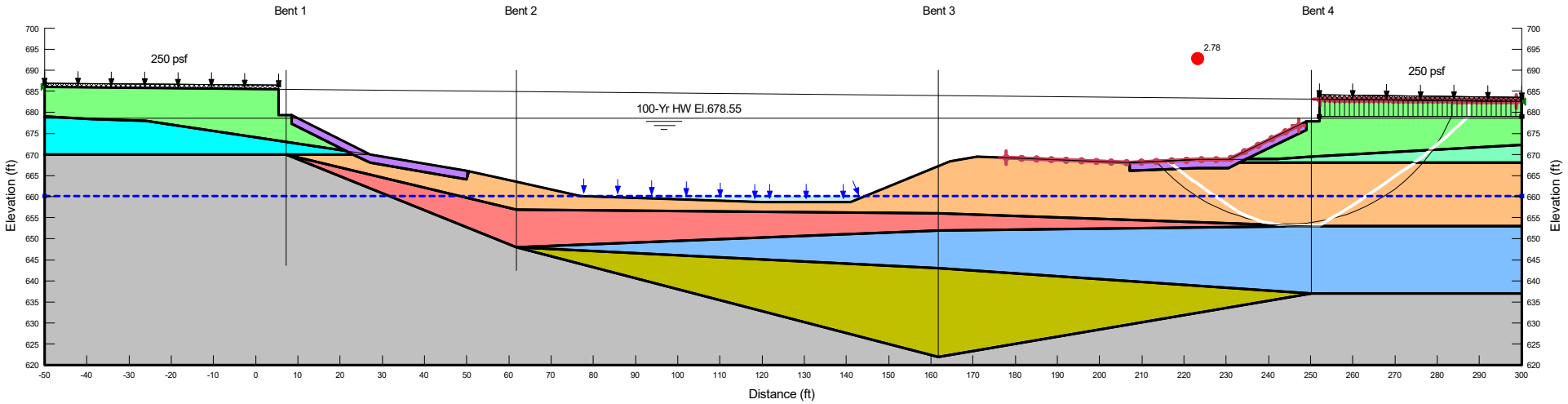
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

East Abutment

Circular Search
Short Term



Directory: G:\TPW\GEOTECH\P3\63000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A9551)\Global Stability\MW Br 2\ File Name: Bridge A9542 Short Term.gpz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface	Effective Cohesion Fn
	CH	Spatial Mohr-Coulomb	120		25	1	CH
	CL	Mohr-Coulomb	120	0	28	1	
	CL-4	Mohr-Coulomb	120	0	28	1	
	Exist. Embk Fill	Mohr-Coulomb	125	100	28	1	
	Limestone	Bedrock (Impenetrable)				1	
	New Embk Fill	Mohr-Coulomb	125	100	28	1	
	Rock Blanket	Mohr-Coulomb	125	0	40	1	
	Shale (IGMs)	Mohr-Coulomb	133	0	32	1	
	Weatherd LS	Mohr-Coulomb	135	0	42	1	

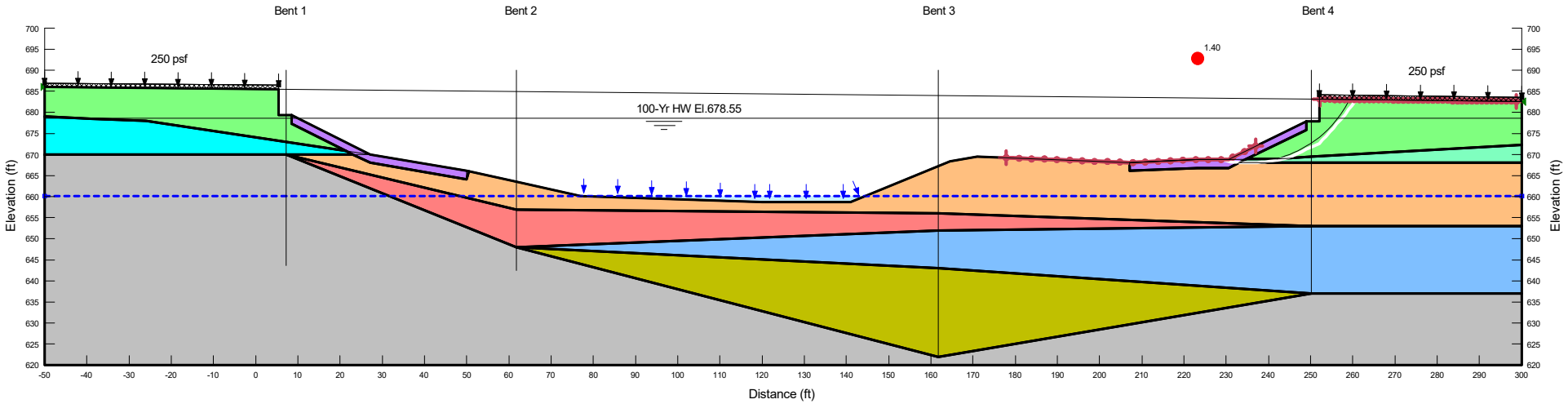
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

East Abutment

Circular Search
Long Term



Directory: G:\TPW\GEOTECH\P3\063000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A9551)\Global Stability\MW Br 2\ File Name: Bridge A9542 Long Term.gpz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface	Effective Cohesion Fn
	CH	Spatial Mohr-Coulomb	120		0	1	CH
	CL	Spatial Mohr-Coulomb	120		0	1	CL
	CL-4	Mohr-Coulomb	120	1,200	0	1	
	Exist. Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Limestone	Bedrock (Impenetrable)				1	
	New Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Rock Blanket	Mohr-Coulomb	125	0	40	1	
	Shale (IGMs)	Mohr-Coulomb	133	3,000	0	1	
	Weatherd LS	Mohr-Coulomb	135	0	42	1	

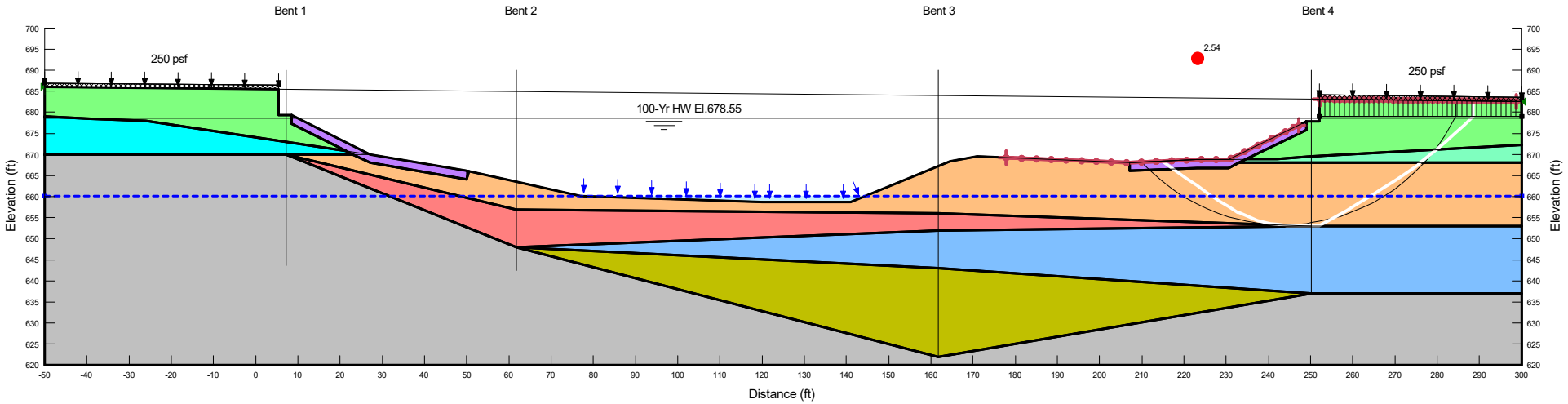
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

East Abutment

Circular Search
Seismic kh=0.03g



Directory: G:\TPW\GEOTECH\P3\063000 - I-70 3rd lane Columbia to Kingdom City\GEDRs\for Structures\MW 2 & 4 (L0264 & A9551)\Global Stability\MW Br 2\ File Name: Bridge A9542 Short Term.gpz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Cohesion R (psf)	Phi R (°)	Piezometric Surface	Piezometric Surface After Drawdown
	CH	Spatial Mohr-Coulomb	120	0	25	1,000	0	1	2
	CL	Spatial Mohr-Coulomb	120	0	28	1,000	0	1	2
	CL-4	Mohr-Coulomb	120	0	28	1,200	0	1	2
	Exist. Embk Fill	Mohr-Coulomb	125	100	28	1,200	0	1	2
	Limestone	Bedrock (Impenetrable)						1	2
	New Embk Fill	Mohr-Coulomb	125	100	28	1,200	0	1	2
	Rock Blanket	Mohr-Coulomb	125	0	40	0	0	1	2
	Shale (IGMs)	Mohr-Coulomb	133	0	32	3,000	0	1	2
	Weatherd LS	Mohr-Coulomb	135	0	42	0	0	1	2

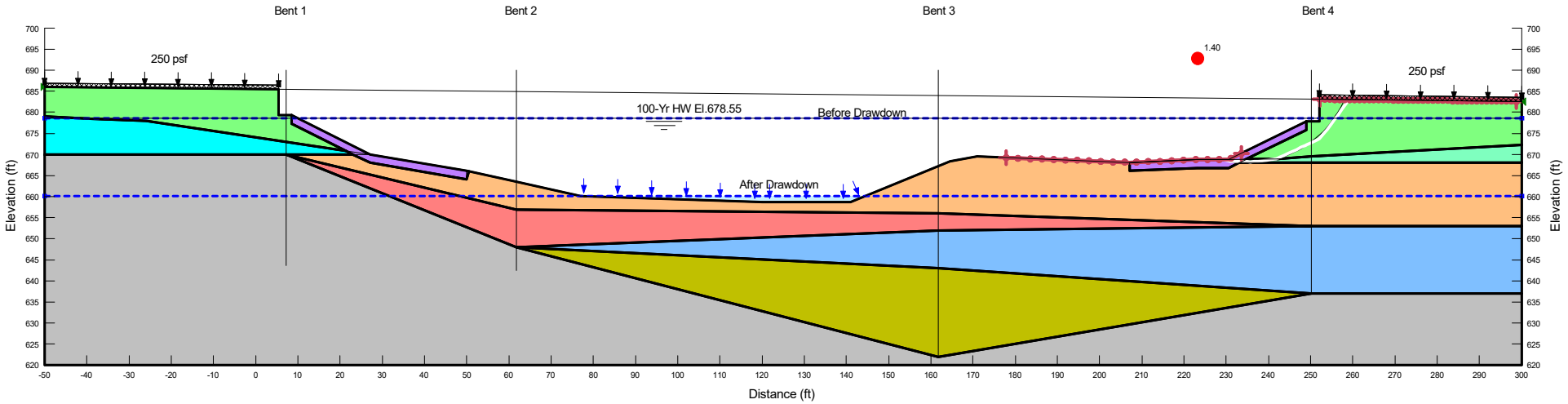
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

East Abutment

Circular Search
Rapid Drawdown



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Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface	Effective Cohesion Fn
	CH	Spatial Mohr-Coulomb	120		0	1	CH
	CL	Spatial Mohr-Coulomb	120		0	1	CL
	CL-4	Mohr-Coulomb	120	1,200	0	1	
	Exist. Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Limestone	Bedrock (Impenetrable)				1	
	New Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Rock Blanket	Mohr-Coulomb	125	0	40	1	
	Shale (IGMs)	Mohr-Coulomb	133	3,000	0	1	
	Weatherd LS	Mohr-Coulomb	135	0	42	1	

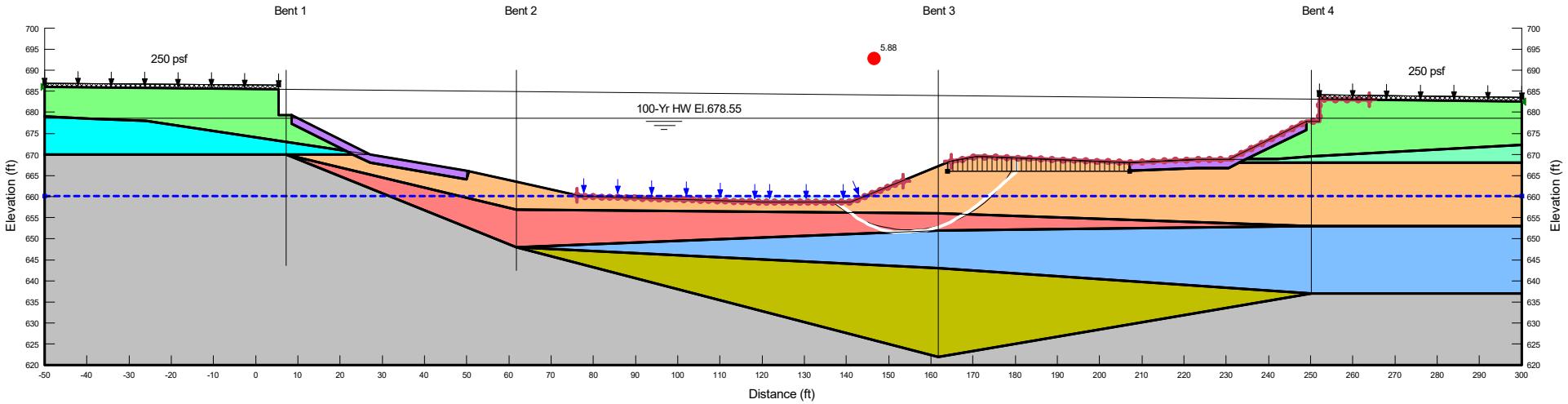
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

Hinkson Creek East Slope

Circular Search
Short Term



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Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface	Effective Cohesion Fn
	CH	Spatial Mohr-Coulomb	120		25	1	CH
	CL	Mohr-Coulomb	120	0	28	1	
	CL-4	Mohr-Coulomb	120	0	28	1	
	Exist. Embk Fill	Mohr-Coulomb	125	100	28	1	
	Limestone	Bedrock (Impenetrable)				1	
	New Embk Fill	Mohr-Coulomb	125	100	28	1	
	Rock Blanket	Mohr-Coulomb	125	0	40	1	
	Shale (IGMs)	Mohr-Coulomb	133	0	32	1	
	Weatherd LS	Mohr-Coulomb	135	0	42	1	

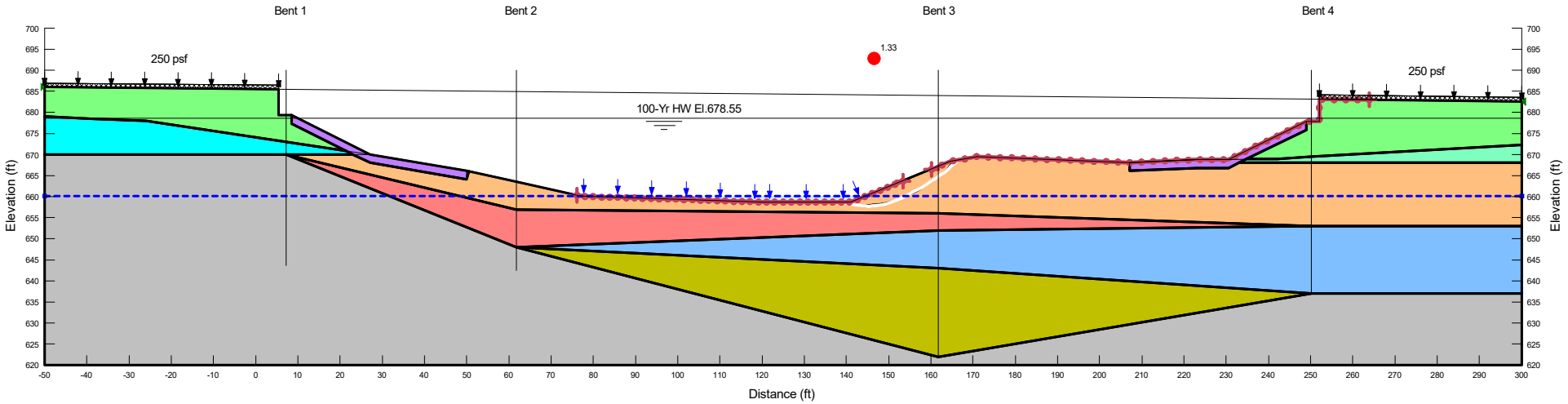
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

Hinkson Creek East Slope

Circular Search
Long Term



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Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface	Effective Cohesion Fn
	CH	Spatial Mohr-Coulomb	120		0	1	CH
	CL	Spatial Mohr-Coulomb	120		0	1	CL
	CL-4	Mohr-Coulomb	120	1,200	0	1	
	Exist. Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Limestone	Bedrock (Impenetrable)				1	
	New Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Rock Blanket	Mohr-Coulomb	125	0	40	1	
	Shale (IGMs)	Mohr-Coulomb	133	3,000	0	1	
	Weatherd LS	Mohr-Coulomb	135	0	42	1	

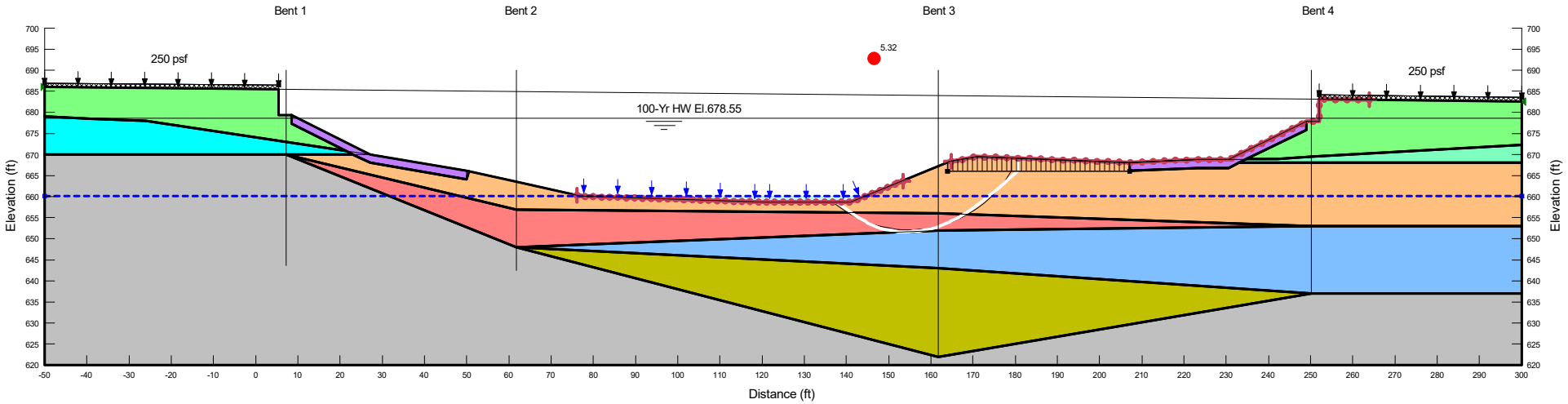
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

Hinkson Creek East Slope

Circular Search
Seismic kh=0.03g



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Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Cohesion R (psf)	Phi R (°)	Piezometric Surface	Piezometric Surface After Drawdown
	CH	Spatial Mohr-Coulomb	120	0	25	1,000	0	1	2
	CL	Spatial Mohr-Coulomb	120	0	28	1,000	0	1	2
	CL-4	Mohr-Coulomb	120	0	28	1,200	0	1	2
	Exist. Embk Fill	Mohr-Coulomb	125	100	28	1,200	0	1	2
	Limestone	Bedrock (Impenetrable)						1	2
	New Embk Fill	Mohr-Coulomb	125	100	28	1,200	0	1	2
	Rock Blanket	Mohr-Coulomb	125	0	40	0	0	1	2
	Shale (IGMs)	Mohr-Coulomb	133	0	32	3,000	0	1	2
	Weatherd LS	Mohr-Coulomb	135	0	42	0	0	1	2

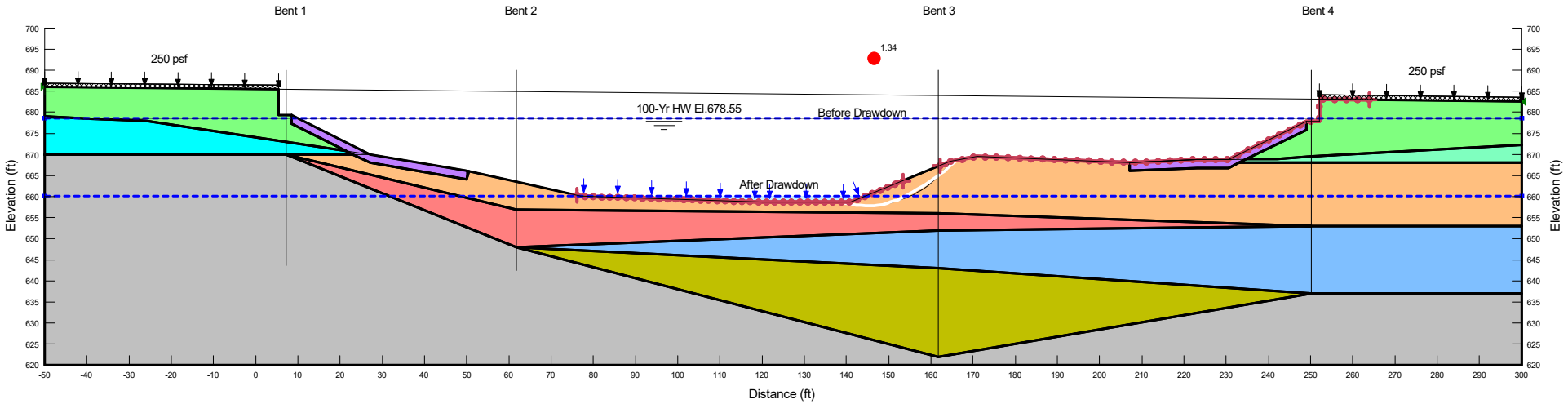
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

Hinkson Creek East Slope

Circular Search
Rapid Drawdown



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Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface	Effective Cohesion Fn
	CH	Spatial Mohr-Coulomb	120		0	1	CH
	CL	Spatial Mohr-Coulomb	120		0	1	CL
	CL-4	Mohr-Coulomb	120	1,200	0	1	
	Exist. Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Limestone	Bedrock (Impenetrable)				1	
	New Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Rock Blanket	Mohr-Coulomb	125	0	40	1	
	Shale (IGMs)	Mohr-Coulomb	133	3,000	0	1	
	Weatherd LS	Mohr-Coulomb	135	0	42	1	

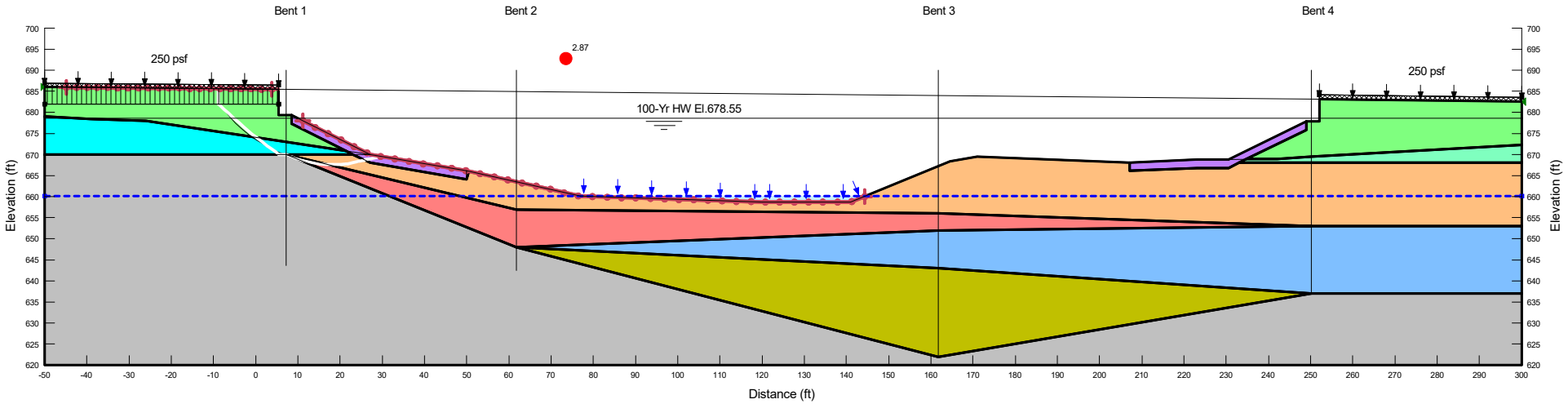
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

West Abutment

Circular Search
Short Term



Directory: G:\TPW\GEOTECH\P3\63000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A9551)\Global Stability\MW Br 2\ File Name: Bridge A9542 Short Term.gsz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface	Effective Cohesion Fn
	CH	Spatial Mohr-Coulomb	120		25	1	CH
	CL	Mohr-Coulomb	120	0	28	1	
	CL-4	Mohr-Coulomb	120	0	28	1	
	Exist. Embk Fill	Mohr-Coulomb	125	100	28	1	
	Limestone	Bedrock (Impenetrable)				1	
	New Embk Fill	Mohr-Coulomb	125	100	28	1	
	Rock Blanket	Mohr-Coulomb	125	0	40	1	
	Shale (IGMs)	Mohr-Coulomb	133	0	32	1	
	Weatherd LS	Mohr-Coulomb	135	0	42	1	

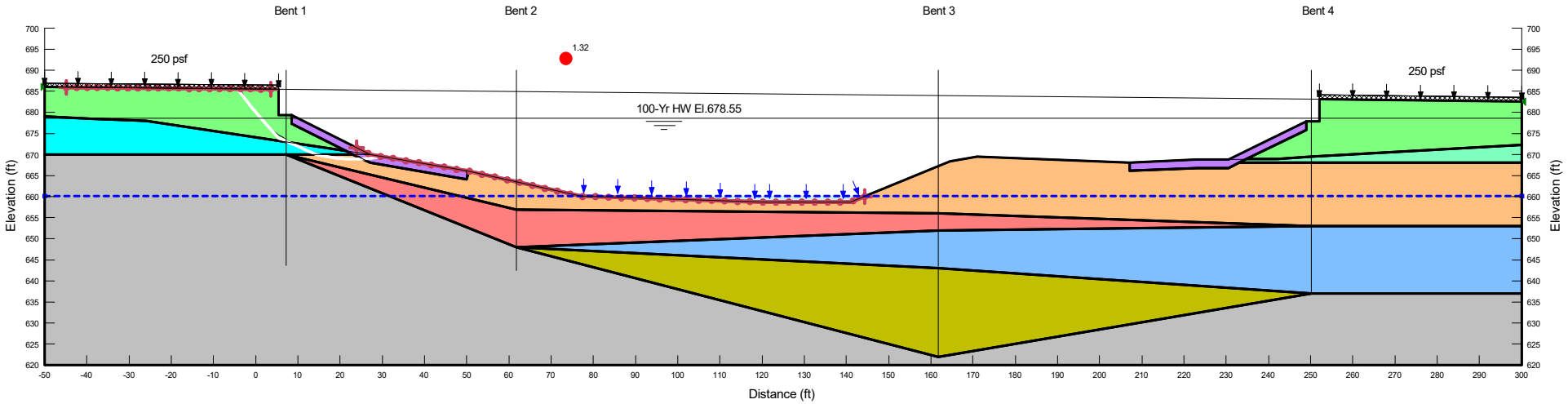
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

West Abutment

Circular Search
Long Term



Directory: G:\TPW\GEOTECH\P3\065000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A9551)\Global Stability\MW Br 2\ File Name: Bridge A9542 Long Term.gpz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface	Effective Cohesion Fn
	CH	Spatial Mohr-Coulomb	120		0	1	CH
	CL	Spatial Mohr-Coulomb	120		0	1	CL
	CL-4	Mohr-Coulomb	120	1,200	0	1	
	Exist. Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Limestone	Bedrock (Impenetrable)				1	
	New Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Rock Blanket	Mohr-Coulomb	125	0	40	1	
	Shale (IGMs)	Mohr-Coulomb	133	3,000	0	1	
	Weatherd LS	Mohr-Coulomb	135	0	42	1	

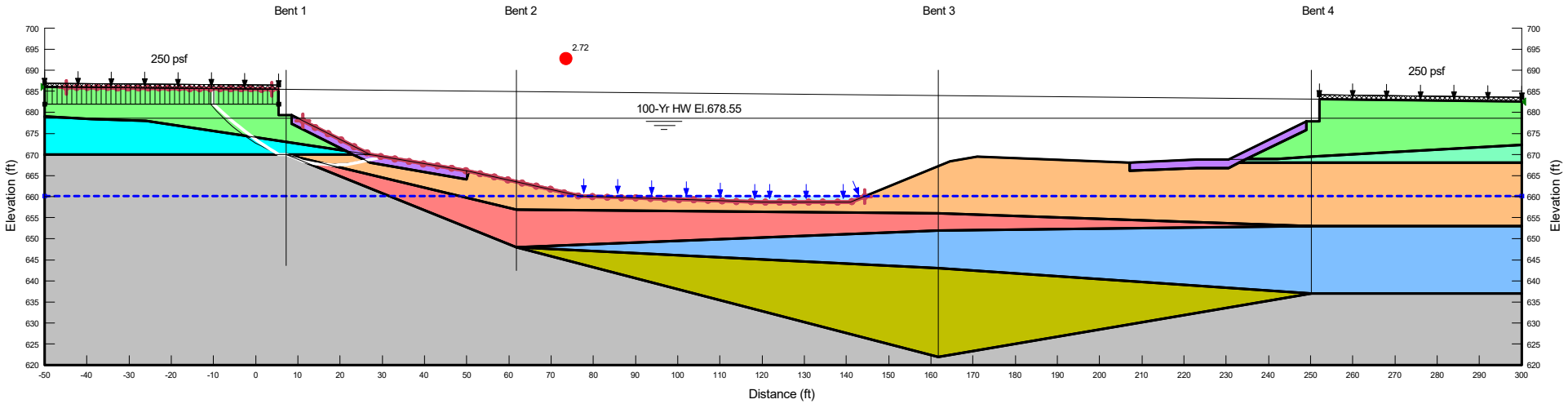
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

West Abutment

Circular Search
Seismic kh=0.03g



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Cohesion R (psf)	Phi R (°)	Piezometric Surface	Piezometric Surface After Drawdown
	CH	Spatial Mohr-Coulomb	120	0	25	1,000	0	1	2
	CL	Spatial Mohr-Coulomb	120	0	28	1,000	0	1	2
	CL-4	Mohr-Coulomb	120	0	28	1,200	0	1	2
	Exist. Embk Fill	Mohr-Coulomb	125	100	28	1,200	0	1	2
	Limestone	Bedrock (Impenetrable)						1	2
	New Embk Fill	Mohr-Coulomb	125	100	28	1,200	0	1	2
	Rock Blanket	Mohr-Coulomb	125	0	40	0	0	1	2
	Shale (IGMs)	Mohr-Coulomb	133	0	32	3,000	0	1	2
	Weatherd LS	Mohr-Coulomb	135	0	42	0	0	1	2

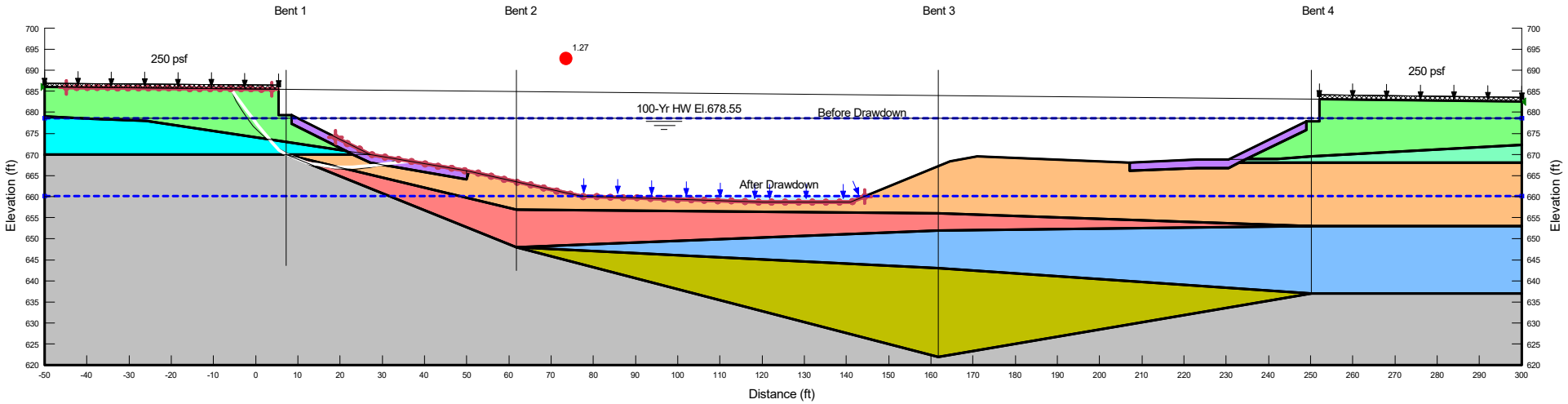
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

West Abutment

Circular Search
Rapid Drawdown



Directory: G:\TPW\GEOTECH\P3\063000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A9551)\Global Stability\MW Br 2\File Name: Brdge A9542 rpd.gsz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface	Effective Cohesion Fn
	CH	Spatial Mohr-Coulomb	120		0	1	CH
	CL	Spatial Mohr-Coulomb	120		0	1	CL
	CL-4	Mohr-Coulomb	120	1,200	0	1	
	Exist. Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Limestone	Bedrock (Impenetrable)				1	
	New Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Rock Blanket	Mohr-Coulomb	125	0	40	1	
	Shale (IGMs)	Mohr-Coulomb	133	3,000	0	1	
	Weatherd LS	Mohr-Coulomb	135	0	42	1	

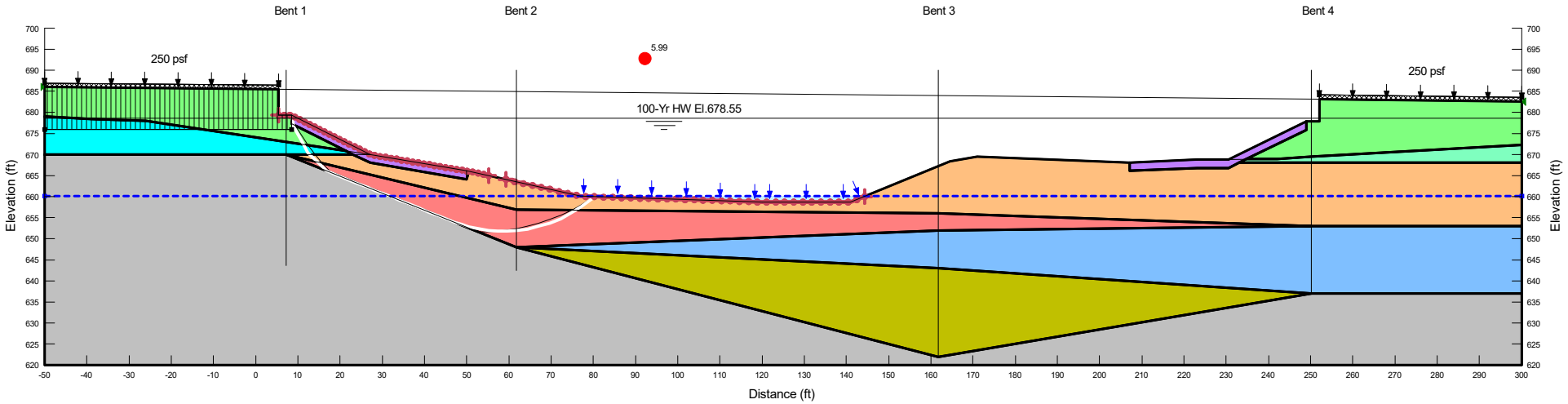
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

Hinkson Creek West Slope

Circular Search
Short Term



Directory: G:\TPW\GEOTECH\P3\063000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A9551)\Global Stability\MW Br 2\ File Name: Bridge A9542 Short Term.gpz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface	Effective Cohesion Fn
	CH	Spatial Mohr-Coulomb	120		25	1	CH
	CL	Mohr-Coulomb	120	0	28	1	
	CL-4	Mohr-Coulomb	120	0	28	1	
	Exist. Embk Fill	Mohr-Coulomb	125	100	28	1	
	Limestone	Bedrock (Impenetrable)				1	
	New Embk Fill	Mohr-Coulomb	125	100	28	1	
	Rock Blanket	Mohr-Coulomb	125	0	40	1	
	Shale (IGMs)	Mohr-Coulomb	133	0	32	1	
	Weatherd LS	Mohr-Coulomb	135	0	42	1	

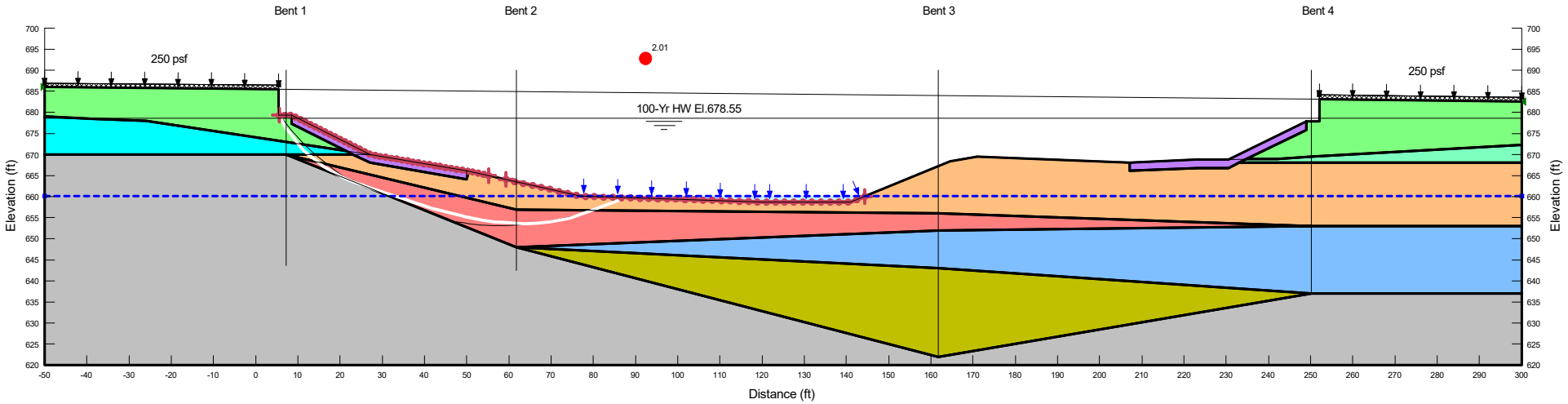
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

Hinkson Creek West Slope

Circular Search
Long Term



Directory: G:\TPW\GEOTECH\P3\065000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A9551)\Global Stability\MW Br 2\ File Name: Bridge A9542 Long Term.gpz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface	Effective Cohesion Fn
	CH	Spatial Mohr-Coulomb	120		0	1	CH
	CL	Spatial Mohr-Coulomb	120		0	1	CL
	CL-4	Mohr-Coulomb	120	1,200	0	1	
	Exist. Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Limestone	Bedrock (Impenetrable)				1	
	New Embk Fill	Mohr-Coulomb	125	1,200	0	1	
	Rock Blanket	Mohr-Coulomb	125	0	40	1	
	Shale (IGMs)	Mohr-Coulomb	133	3,000	0	1	
	Weatherd LS	Mohr-Coulomb	135	0	42	1	

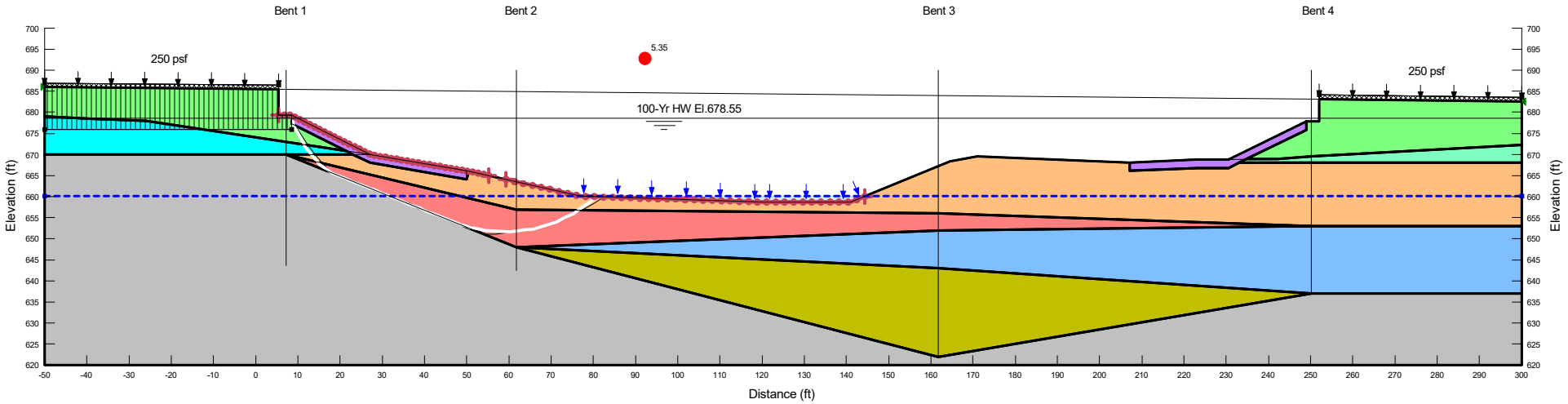
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

Hinkson Creek West Slope

Circular Search
Seismic kh=0.03g



Directory: G:\TPW\GEOTECH\P3\K5000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A9551)\Global Stability\MW Br 2\ File Name: Bridge A9542 Short Term.gsz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Cohesion R (psf)	Phi R (°)	Piezometric Surface	Piezometric Surface After Drawdown
	CH	Spatial Mohr-Coulomb	120	0	25	1,000	0	1	2
	CL	Spatial Mohr-Coulomb	120	0	28	1,000	0	1	2
	CL-4	Mohr-Coulomb	120	0	28	1,200	0	1	2
	Exist. Embk Fill	Mohr-Coulomb	125	100	28	1,200	0	1	2
	Limestone	Bedrock (Impenetrable)						1	2
	New Embk Fill	Mohr-Coulomb	125	100	28	1,200	0	1	2
	Rock Blanket	Mohr-Coulomb	125	0	40	0	0	1	2
	Shale (IGMs)	Mohr-Coulomb	133	0	32	3,000	0	1	2
	Weatherd LS	Mohr-Coulomb	135	0	42	0	0	1	2

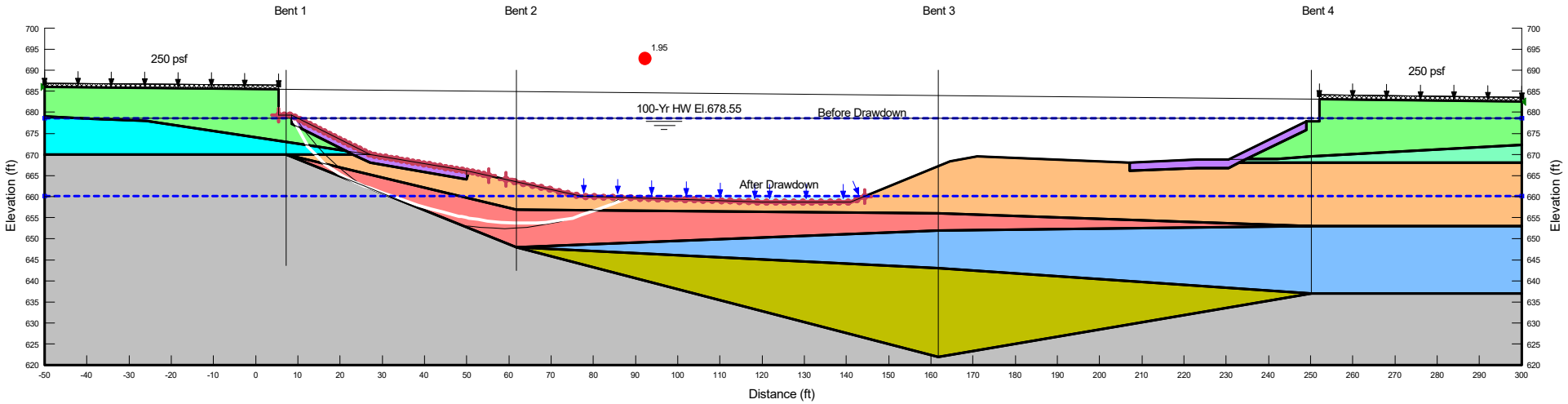
MoDot Improve I-70 Columbia to Kingdom City DB

Global Stability Analysis
Spencer's Method

Bridge 2/A9542 and Bridge 4/A9543

Hinkson Creek West Slope

Circular Search
Rapid Drawdown



Directory: G:\TPW\GEOTECH\P3\63000 - I-70 3rd lane Columbia to Kingdom City\GEDRs for Structures\MW 2 & 4 (L0264 & A9551)\Global Stability\MW Br 2\File Name: Brdge A9542 rpd.gsz

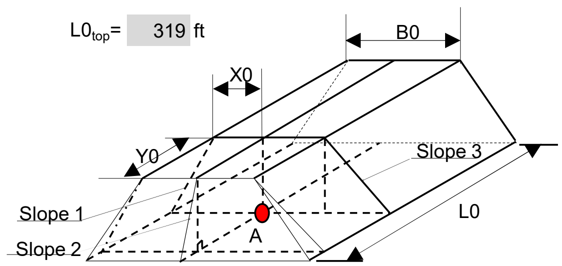
Jacobs

Project:	MoDOT Improve I-70 Columbia to Kingdom City DB	Authored by: ZW	9/3/2024
Subject:	F3X03001	Checked by: SR	11/5/2024
Job No.:	Bridge 2 Approach Embankment to Bent 1		

Boring:		BR 2-1A	
Ground Surface El.		680	ft
GW EL.		670	ft
Fill	γ =	125	pcf
Water	γw =	62.4	pcf
Fill Height:	H0 =	6.3	ft
Width:	B0 =	98	ft
Length	L0 =	344	ft
Slope 1 =	1V:	2.5	H
Slope 2 =	1V:	2	H
Slope 3 =	1V:	2.5	H

Settlement Point A: X0 = 49 ft, Y0 = 4 ft

$L0_{top}$= 319 ft

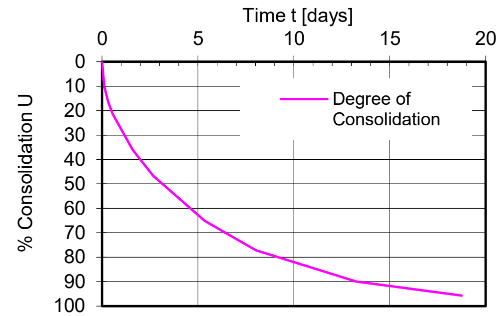


Consolidation Time Rate in Cohesive Soil

Drain Length H: 1 ft

Coefficient of Consol. 0.064 (ft^2/day) Assumed

U_v (%)	T_v	t (day)
0.00	0.0000	0
10.00	0.0079	0
16.29	0.0208	0
21.32	0.0357	1
36.06	0.1021	2
46.67	0.1711	3
65.15	0.3422	5
77.16	0.5133	8
90.00	0.8480	13
95.81	1.2000	19



SPT Hammer Efficiency 60 %

Consolidation Reference Boring: C-D-1

El.	Soil	Field SPT	Thick. ΔH_i	Unit Wt.	Qu	Moist. Cont.	LL	PL	PI	LI	Used $\sigma_{p'}$	C_c	C_r	e_o	Corr. SPT	Bearing Capacity Index, C'	Effect. Overb. σ_o'	$\Delta\sigma_z$	$\sigma_f' = \sigma_0' + \Delta\sigma_z$	CL/CH	Granular
ft		bpf	ft	pcf	tsf	%	%	%	%		psf				BPF		psf	psf	psf	Inches	Inches
680.0																					
674.4	CH	17	5.6	120	2.25	11.30	65.00	19.00	46.0	-0.2	8,030	0.195	0.044	0.778	23.2	N/A	336	781	1,117	0.87	
670.6	CH	17	3.8	120	1.75	11.30	65.00	19.00	46.0	-0.2	6,246	0.195	0.044	0.778	20.3	N/A	900	733	1,633	0.29	
			9																SubTotal	1.2	0.0
																			Total	1.2	

Note:
- Time factor: $T_v = c_v t / H_e^2$
- The average degree of consolidation for single drainage is derived from the formula (Craig (2004)):
  For U<0.60, $T_v = \frac{\pi}{4}\overline{U}_v^2$ For U>0.60, $T_v = -0.933 \log\left(1-\overline{U}_v\right) - 0.085$
- Preconsolidation pressure can be estimated using the formula (NAFAC DM-7.01): $\sigma_p' = \frac{Q_u}{0.11 + 0.0037PI}$

Jacobs

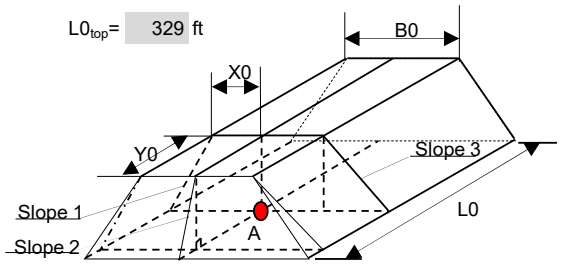
Project: MoDOT Improve I-70 Columbia to Kingdom City DB
Subject: F3X03001
Job No.: Bridge 2 Approach Embankment to Bent 4

Authored by: ZW 9/3/2024
Checked by: SR 11/5/2024

Boring:		B-11	
Ground Surface El.		682.6	ft
GW EL.		670	ft
Fill	γ =	125	pcf
Water	γw =	62.4	pcf
Fill Height:	H0 =	10.3	ft
Width:	B0 =	98	ft
Length	L0 =	370	ft
Slope 1 =	1V:	2.5	H
Slope 2 =	1V:	2	H
Slope 3 =	1V:	2.5	H

Settlement Point A: X0 = 49 ft
Y0 = 4 ft

$L0_{top}$ = 329 ft

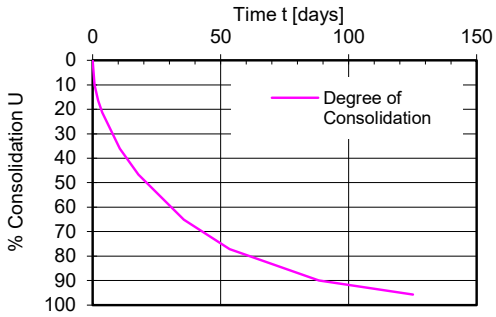


Consolidation Time Rate in Cohesive Soil

Drain Length H: 6.85 ft

Coefficient of Consol. 0.45 (ft^2/day) Assumed

U_v (%)	T_v	t (day)
0.00	0.0000	0
10.00	0.0079	1
16.29	0.0208	2
21.32	0.0357	4
36.06	0.1021	11
46.67	0.1711	18
65.15	0.3422	36
77.16	0.5133	54
90.00	0.8480	88
95.81	1.2000	125



SPT Hammer Efficiency 60 %

Consolidation Reference Boring: C-D-1 BR 7-4

El.	Soil	Field SPT	Thick. ΔH_i	Unit Wt.	Qu	Moist. Cont.	LL	PL	PI	LI	Used $\sigma_{p'}$	C_c	C_r	e_o	Corr. SPT	Bearing Capacity Index, C'	Effect. Overb. σ_o'	$\Delta\sigma_z$	$\sigma_f' = \sigma_0' + \Delta\sigma_z$	CL/CH	Granular
ft		bpf	ft	pcf	tsf	%	%	%	%		psf				BPF		psf	psf	psf	Inches	Inches
682.6																					
675.3	CH	8	7.3	120	2.50	18.00	75.00	22.00	53.0	-0.1	8,167	0.195	0.044	0.778	10.2	N/A	438	1,275	1,713	1.28	
668.3	CH	11	7.0	120	3.00	25.00	75.00	22.00	53.0	0.1	9,801	0.195	0.044	0.778	11.8	N/A	1,296	1,180	2,476	0.58	
662.3	CL	8	6.0	120	1.00	22.00	33.00	18.00	15.0	0.3	6,042	0.117	0.011	0.545	8.1	N/A	1,783	1,088	2,870	0.11	
656.3	CL	47	6.0	120	1.00	11.00	33.00	18.00	15.0	-0.5	6,042	0.117	0.011	0.545	44.9	N/A	2,128	1,012	3,140	0.09	
			26																	SubTotal	2.1	0.0
																				Total	2.1	

Note:
- Time factor: $T_v = c_v t / H_e^2$
- The average degree of consolidation for single drainage is derived from the formula (Craig (2004)):
  For U<0.60, $T_v = \frac{\pi}{4}\overline{U_v}^2$ For U>0.60, $T_v = -0.933 \log\left(1 - \overline{U_v}\right) - 0.085$
- Preconsolidation pressure can be estimated using the formula (NAFAC DM-7.01): $\sigma_p' = \frac{Q_u}{0.11 + 0.0037PI}$

Jacobs

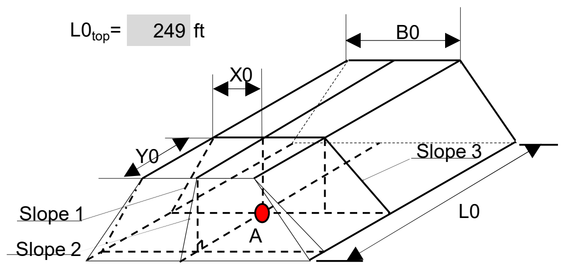
Project:	MoDOT Improve I-70 Columbia to Kingdom City DB	Authored by:	ZW	9/3/24
Subject:	F3X03001	Checked by:	SR	11/5/24
Job No.:	Bridge 4 Approach Embankment to Bent 1			

Boring:		BR 4-1A	
Ground Surface El.		679.5	ft
GW EL.		670	ft
Fill	γ =	125	pcf
Water	γw =	62.4	pcf
Fill Height:	H0 =	7.1	ft
Width:	B0 =	25	ft
Length	L0 =	277	ft
Slope 1 =	1V:	2.5	H
Slope 2 =	1V:	2	H
Slope 3 =	1V:	2.5	H

Settlement Point A: X0 = 25 ft

Y0 = 4 ft

$L0_{top}$= 249 ft



SPT Hammer Efficiency 60 %

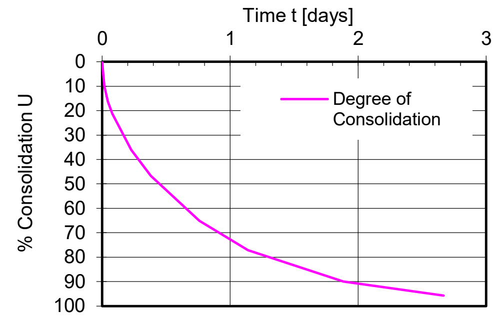
Consolidation Reference Boring: BR 7-4

Consolidation Time Rate in Cohesive Soil

Drain Length H: 1 ft

Coefficient of Consol. 0.45 (ft^2/day) Assumed

U_v (%)	T_v	t (day)
0.00	0.0000	0
10.00	0.0079	0
16.29	0.0208	0
21.32	0.0357	0
36.06	0.1021	0
46.67	0.1711	0
65.15	0.3422	1
77.16	0.5133	1
90.00	0.8480	2
95.81	1.2000	3



El.	Soil	Field SPT	Thick. ΔH_i	Unit Wt.	Qu	Moist. Cont.	LL	PL	PI	LI	Used $\sigma_{p'}$	C_c	C_r	e_o	Corr. SPT	Bearing Capacity Index, C'	Effect. Overb. σ_o'	$\Delta\sigma_z$	$\sigma_f' = \sigma_0' + \Delta\sigma_z$	CL/CH	Granular
ft		bpf	ft	pcf	tsf	%	%	%	%		psf				BPF		psf	psf	psf	Inches	Inches
679.5																					
674.4	CL	29	5.1	120	4.25	16.60	33.00	15.00	18.0	0.1	24,066	0.117	0.011	0.545	40.5	N/A	306	845	1,151	0.25	
670.4	SP	48	4.0	120											57.8	326	852	745	1,597		0.04
			9																SubTotal	0.25	0.04
																			Total	0.29	

Note: - Time factor: $T_v = c_v t / H_e^2$

- The average degree of consolidation for single drainage is derived from the formula (Craig (2004)):
For U<0.60, $T_v = \frac{\pi}{4}\overline{U}_v^2$ For U>0.60, $T_v = -0.933 \log(1 - \overline{U}_v) - 0.085$
- Preconsolidation pressure can be estimated using the formula (NAFAC DM-7.01): $\sigma_p' = \frac{Q_u}{0.11 + 0.0037PI}$

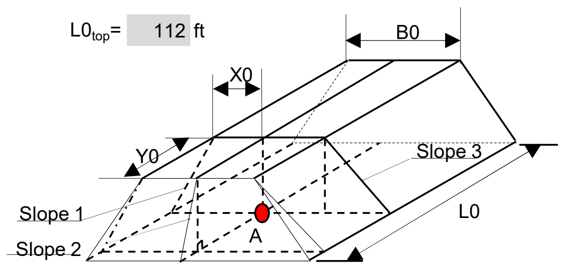
Jacobs

Project:	MoDOT Improve I-70 Columbia to Kingdom City DB	Authored by: ZW	9/3/2024
Subject:	F3X03001	Checked by: SR	11/5/2024
Job No.:	Bridge 4 Approach Embankment to Bent 4		

Boring:		BR 10-3A	
Ground Surface El.		678.6	ft
GW EL.		660.3	ft
Fill	γ =	125	pcf
Water	γw =	62.4	pcf
Fill Height:	H0 =	5.8	ft
Width:	B0 =	25	ft
Length	L0 =	135	ft
Slope 1 =	1V:	2.5	H
Slope 2 =	1V:	2	H
Slope 3 =	1V:	2.5	H

Settlement Point A: X0 = 25 ft, Y0 = 4 ft

$L0_{top}$= 112 ft



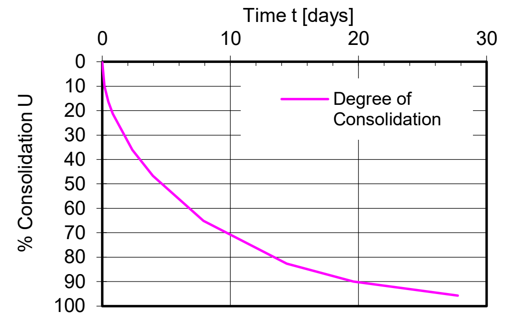
SPT Hammer Efficiency 60 %

Consolidation Time Rate in Cohesive Soil

Drain Length H: 3.4 ft

Coefficient of Consol. 0.5 (ft^2/day) Assumed

U_v (%)	T_v	t (day)
0.00	0.0000	0
10.00	0.0079	0
16.29	0.0208	0
21.32	0.0357	1
36.06	0.1021	2
46.67	0.1711	4
65.15	0.3422	8
82.57	0.6228	14
90.00	0.8480	20
95.81	1.2000	28



Consolidation Reference Boring: BR 7-4

El.	Soil	Field SPT	Thick. ΔH_i	Unit Wt.	Qu	Moist. Cont.	LL	PL	PI	LI	Used $\sigma_{p'}$	C_c	C_r	e_o	Corr. SPT	Bearing Capacity Index, C'	Effect. Overb. σ_o'	$\Delta\sigma_z$	$\sigma_f' = \sigma_0' + \Delta\sigma_z$	CL/CH	Granular
ft		bpf	ft	pcf	tsf	%	%	%	%		psf				BPF		psf	psf	psf	Inches	Inches
678.6																					
668.3	CL	10.3	10.3	120	4.25	15.20	32.00	13.00	19.0	0.1	23,572	0.117	0.011	0.545	12.0	N/A	618	628	1,246	0.27	
663.3	CL	11	5.0	120	3.00	15.20	32.00	13.00	19.0	0.1	16,639	0.117	0.011	0.545	11.3	N/A	1,536	478	2,014	0.05	
660.6	ML	1	2.7	120											1.0	18	1,998	421	2,419		0.15
654.5	SC	17	6.1	120											15.7	44	2,354	368	2,723		0.11
			24																**SubTotal**	**0.32**	**0.26**
																			Total	**0.58**	

Note:
- Time factor: $T_v = c_v t / H_e^2$
- The average degree of consolidation for single drainage is derived from the formula (Craig (2004)):
  For U<0.60, $T_v = \frac{\pi}{4}\overline{U}_v^2$ For U>0.60, $T_v = -0.933\log(1-\overline{U}_v) - 0.085$
- Preconsolidation pressure can be estimated using the formula (NAFAC DM-7.01): $\sigma_p' = \frac{Q_u}{0.11 + 0.0037PI}$

END CONSTRUCTION - SEGMENT 1
STA. 20+38.84 ℄ RAMP 9

END CONSTRUCTION - SEGMENT 1
STA. 1+00.14 ℄ RAMP 2

BRIDGE (A4273) (UIP)

BRIDGE 8 (A40921)(UIP)

BRIDGE 9 (A40912)(UIP)

LAMBETH DRIVE

SECTION LINE

CLARK LANE

SEE CLARK LANE ROUNDABOUT DETAILS

MGS TERMINAL

MGS END ANCHOR

TYPE A C&G

TYPE S CURB

TYPE E CURB

TYPE A C&G

8" PCCP

MGS GUARDRAIL (6' POST)

TYPE A CRASHWORTHY END TERMINAL MASH

EXISTING ABANDONED SANITARY SEWER (UIP)

HINKSON CREEK

US 63 SB

US 63 NB

EXISTING ENTRANCE RAMP

EXISTING UG FIBER OPTIC TO BE RELOCATED

BEGIN MEGA BARRIER

BEGIN TYPE D BARRIER

BEGIN TYPE E BARRIER

℄ RAMP 2

℄ RAMP 9

EXISTING I-70 WB

S.L.

EXISTING ABANDONED GAS MAIN (UIP)

BRIDGE 5 (A9544)

TYPE C CRASHWORTHY END TERMINAL MASH

2062+74.25, 48' LT.
8+41.43, 18' LT.

EXIST. R/W

+19.90
14' RT.

END TYPE E BARRIER

END TYPE D BARRIER STA 25+64

RETAINING WALL (A9558)

MGS TERMINAL

EXISTING UG 12" STEEL GAS MAIN (UIP)

Proposed Approximate Settlement Plate Location

BRIDGE 4 (A9543)

TO I-70 WB

TO CLARK LANE

BEGIN TYPE E BARRIER STA 2056+10

℄ I-70 WB

END TYPE E BARRIER STA 2058+13

MGS GUARDRAIL (6' POST)

EXISTING UG FIBER OPTIC TO BE RELOCATED

EXISTING UG MODOT ELECTRIC(TO BE RELOCATED)

+55.37
37.5' LT.

EXISTING UG 6" PE GAS MAIN (UIP)

TYPE C CONCRETE BARRIER

+44.20
13.5' RT.

℄ I-70 EB

MGS TERMINAL

BRIDGE 2 (A9542)

+02.00
1.5' RT.

EXISTING WATER LINE (TO BE ABANDONED)

℄ C-D ROAD

BRIDGE 7 (A9545)

MGS TERMINAL

BRIDGE 10 (A9546)

TO US 63 SB

+53.08
12' LT.

120+04.57
2+55.20

℄ RAMP 3

MGS END ANCHOR

111+58.20
11+00.62

+86.25
14' RT.

℄ RAMP 7

EASTWOOD CIRCLE

MEHL ROAD

EXISTING FIBER OPTIC (TO BE RELOCATED)

EXISTING VARIOUS UG AND OH UTILITY CORRIDOR (UIP)

MGS GUARDRAIL (6' POST)

TYPE A CRASHWORTHY END TERMINAL MASH

MGS GUARDRAIL (6' POST)

EXISTING SANITARY SEWER (UIP)

EXISTING SANITARY SEWER (TO BE RELOCATED)

TYPE C CRASHWORTHY END TERMINAL MASH

END CONSTRUCTION - SEGMENT 1
STA. 9+86.25 ℄ RAMP 7

HINKSON CREEK

BRIDGE
0930044 (UIP)

℄ I-70 BUSINESS LOOP

EXISTING UG COMMUNICATIONS (TO BE RELOCATED)

℄ ACCESS ROAD

MATCH LINE 2052+00 I-70 SHEET S1PL04

MATCH LINE 2065+00 I-70 SHEET S1PL06

MATCH LINE 32+00 RAMP 8 SHEET S1PL11

2055

2060

110

115

120

LEGEND

- 11" PCCP
- 10.5" PCCP
- 5.75" TYPE A2 SHOULDER (CONCRETE)

SCALE
0 50 100 150

SEGMENT 1 - PACKAGE 1
ROADWAY PLAN SHEET
STA 2052+00 TO STA 2065+00
(SHEET 5 OF 12)

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DATE PREPARED
17-JUL-2024

ROUTE	STATE
70	MO
DISTRICT	SHEET NO.
C	S1PL05

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.
X

PROJECT NO.
X

BRIDGE NO.
X

DATE	DESCRIPTION
07/17/24	REV A - PRELIMINARY REVIEW

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER

Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

MATCH LINE STA. 2052+00 S1PR03

MATCH LINE STA. 2065+00 S1PR05

INSIDE EOS

PGL

OUTSIDE EOP

OUTSIDE EOS

R = 5,650.00'

SSD = 602'
K = 145
600.00' V.C.

VPC 2052+25.23
EL 702.48

-4.80%

-4.80%

-0.65%

VPI 2055+25.23
EL 688.08

VPT 2058+25.23
EL 686.13

BRIDGE 4 (A9543)
STA 2058+06.19 TO 2060+49.97

US 63 SB

US 63 NB

VPC 2063+84.31
EL 682.50

VLP 2064+81.33
EL 682.18

248.6 ft

111.7 ft

El. 686.6

7.1 ft

El. 679.5

BR 4-1A

PROFILE GRADE

El. 684.4

-0.65%

El. 678.6

5.8 ft

EXISTING GROUND

A6951-4

BR 10-3A

HINKSON CREEK

SEGMENT 1 - PACKAGE 1
I-70 WB PROFILE
STA 2052+00.00 TO STA 2065+00.00

703.69' 704.23'
699.09' 702.22'
695.15' 698.10'
691.90' 692.30'
689.35' 687.85'
687.49' 684.21'
685.64' 662.54'
684.99' 669.92'
683.69' 682.71'
683.04' 682.43'
682.40' 681.72'
682.19' 681.59'

2052+00 2053+00 2054+00 2055+00 2056+00 2057+00 2058+00 2059+00 2060+00 2062+00 2063+00 2064+00 2065+00

MATCH LINE STA. 5052+00.24 S1PR03

MATCH LINE STA. 5065+09.40 S1PR05

R = 5,420.00'

INSIDE EOS

PGL

OUTSIDE EOP

OUTSIDE EOS

SSD = 590'
K = 140
540.00' V.C.

VPC 5052+54.56
EL 701.04

80%

-4.80%

-0.95%

VPI 5055+24.56
EL 688.08

VPT 5057+94.56
EL 685.51

BRIDGE 2 (A9542)
STA 5058+05.33 TO 5060+52.12

US 63 SB

US 63 NB

VPC 5063+01.81
EL 680.70

VLP 5064+31.94
EL 680.08

319.0 ft

329.4 ft

El. 686.3

6.3 ft

El.680.0

BR 2-1A

PROFILE GRADE

-0.95%

El. 682.6

10.3 ft

El. 672.3

SSD = 586'
K = 137
500.00' V.C.

HINKSON CREEK

EXISTI E

SEGMENT 1 - PACKAGE 1
I-70 EB PROFILE
STA 5052+00.24 TO STA 5065+09.40

703.66' 702.25'
698.93' 698.82'
694.81' 694.72'
691.41' 689.52'
688.71' 686.05'
686.73' 681.97'
685.46' 674.42'
684.51' 659.69'
683.56' 668.45'
682.61'
681.66' 673.58'
680.71' 674.73'
680.11' 678.06'
680.25' 680.98'

5052+00 5053+00 5054+00 5055+00 5056+00 5057+00 5058+00 5059+00 5060+00 5062+00 5063+00 5064+00 5065+00

DATE PREPARED	17-JUL-2024
ROUTE	70
STATE	MO
DISTRICT	C
SHEET NO.	S1PR04
COUNTY	BOONE
JOB NO.	JST0021
CONTRACT ID.	X
PROJECT NO.	X
BRIDGE NO.	X

DATE	DESCRIPTION
07/17/24	REV A - PRELIMINARY REVIEW

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

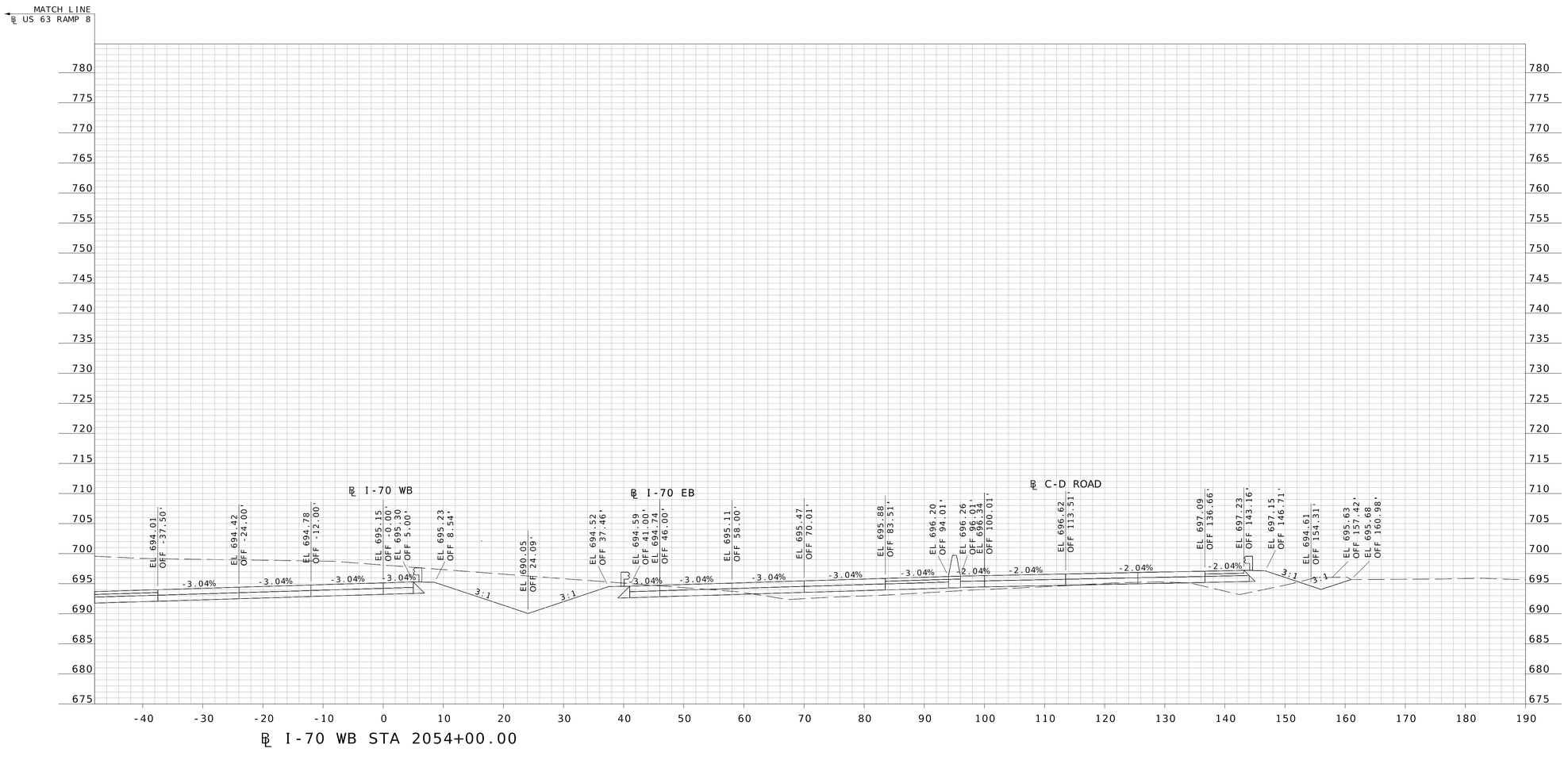
MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER

Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

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DATE PREPARED
28-JUN-2024

ROUTE	STATE
70	MO
DISTRICT	SHEET NO.
C	S1XS021

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.
X

PROJECT NO.
X

BRIDGE NO.
X

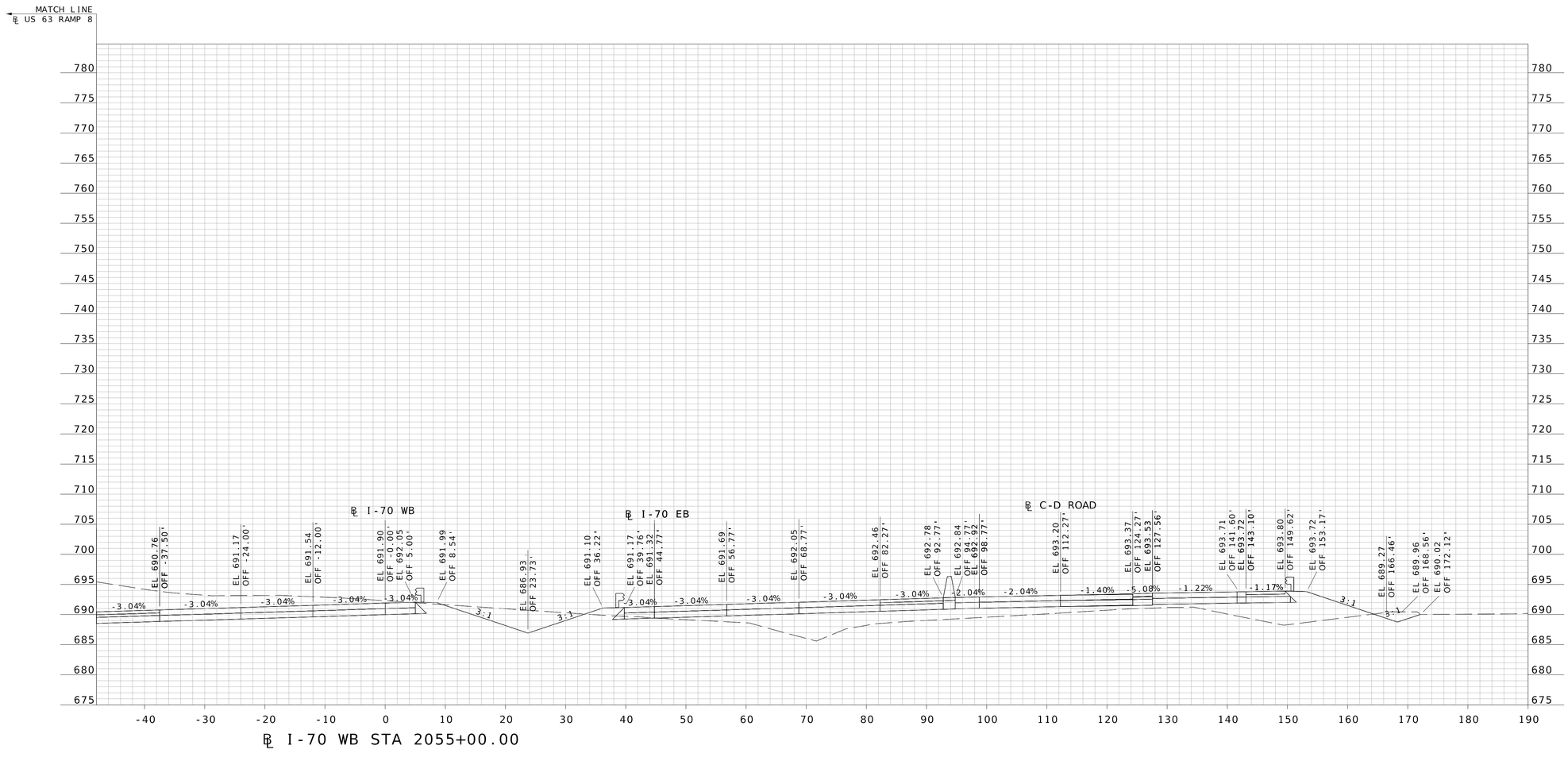
REV.	DESCRIPTION	DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

Jacobs
MILLSTONE WEBER

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING



DATE PREPARED
28-JUN-2024

ROUTE	STATE
70	MO
DISTRICT	SHEET NO.
C	S1XS022

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.
X

PROJECT NO.
X

BRIDGE NO.
X

REV.	DESCRIPTION	DATE

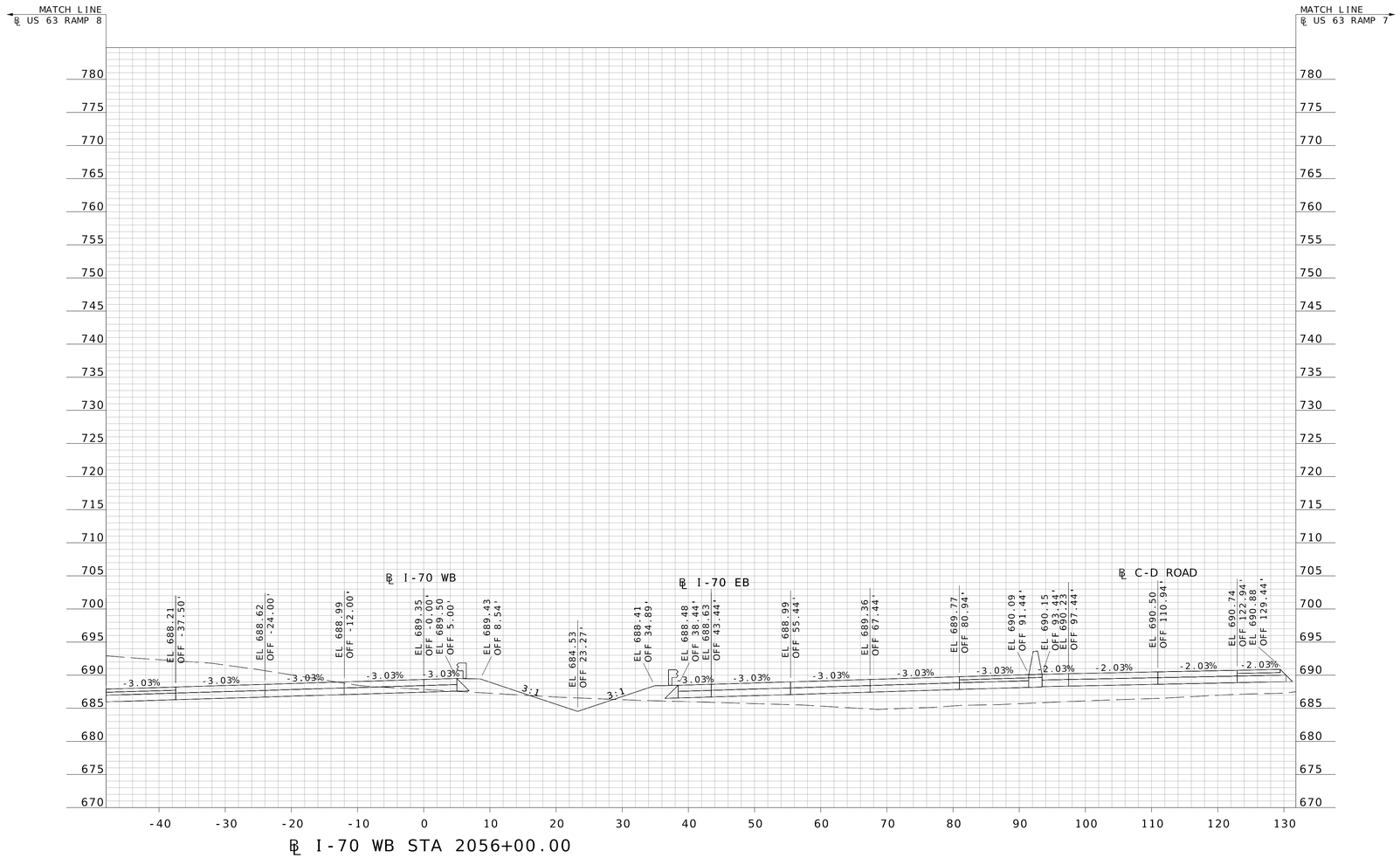
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

Jacobs
MILLSTONE WEBER

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING



DATE PREPARED
28-JUN-2024

ROUTE	STATE
70	MO
DISTRICT	SHEET NO.
C	S1XS023

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.
X

PROJECT NO.
X

BRIDGE NO.
X

DESCRIPTION	DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

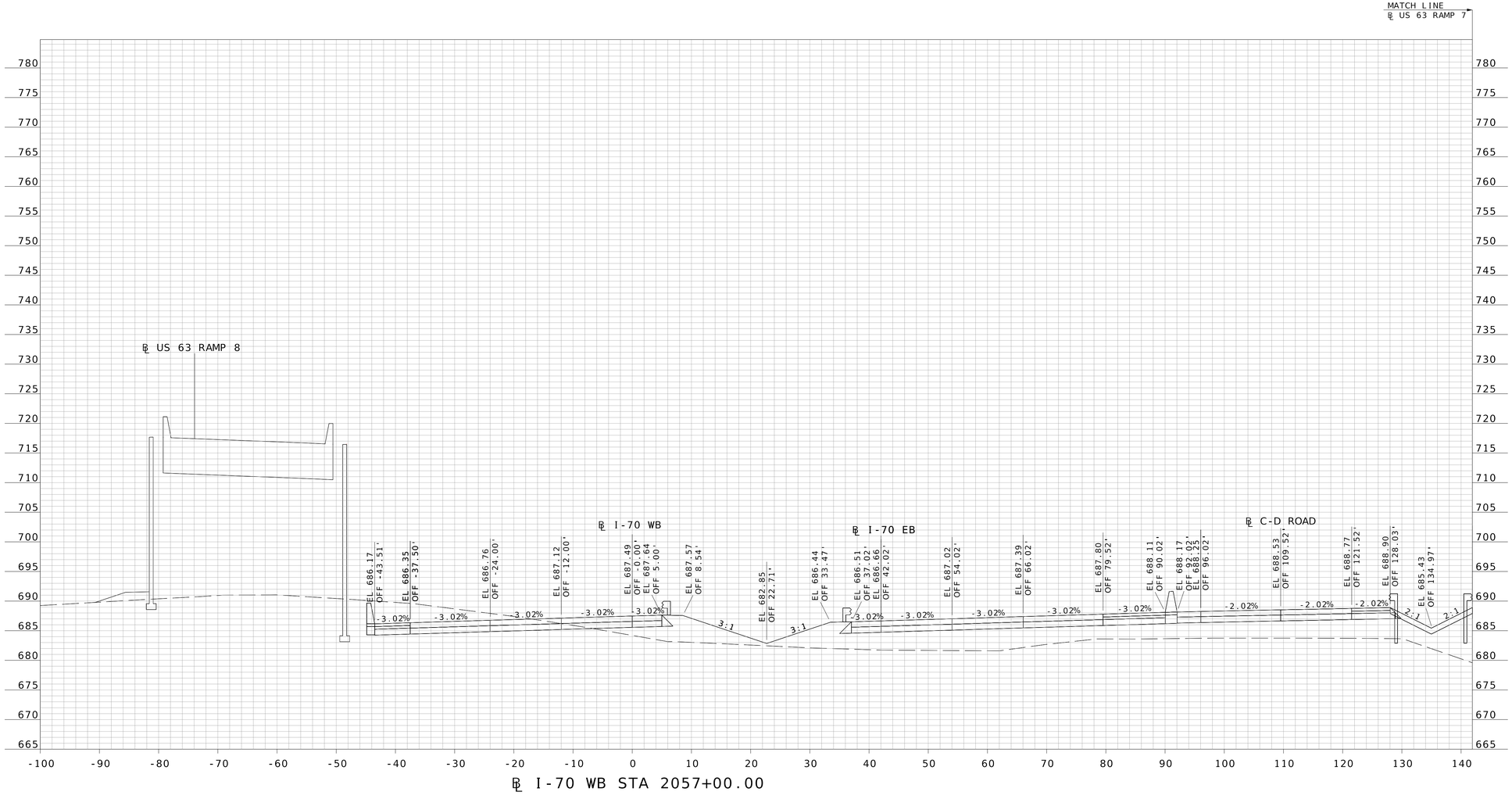
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

Jacobs
MILLSTONE WEBER

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.



℄ I-70 WB STA 2057+00.00

DATE PREPARED
28-JUN-2024

ROUTE	STATE
70	MO
DISTRICT	SHEET NO.
C	S1XS024

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.
X

PROJECT NO.
X

BRIDGE NO.
X

DESCRIPTION	DATE

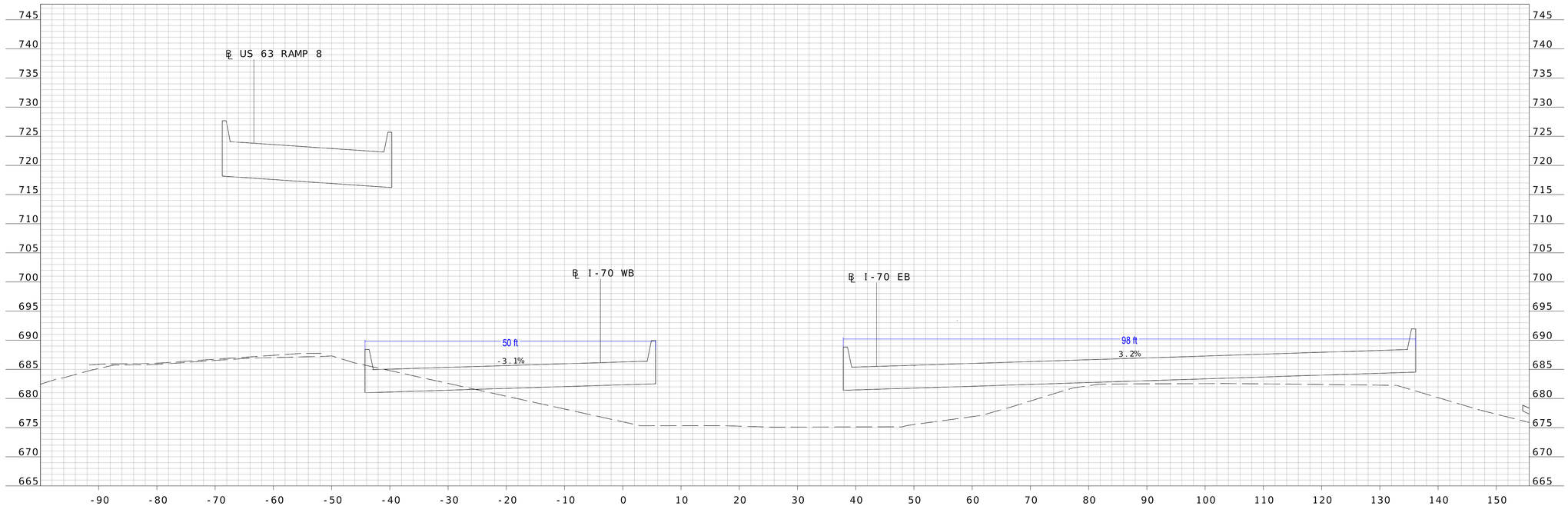
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

Jacobs
MILLSTONE WEBER

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.



℄ I-70 WB STA 2058+06.19
BEGIN BRIDGE 4 SKEW 21°11'30" RT. BACK

DATE PREPARED
17-JUL-2024

ROUTE	STATE
70	MO
DISTRICT	SHEET NO.
C	S1XS025

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.
X

PROJECT NO.
X

BRIDGE NO.
X

DESCRIPTION	DATE
REV A - PRELIMINARY REVIEW	07/17/24

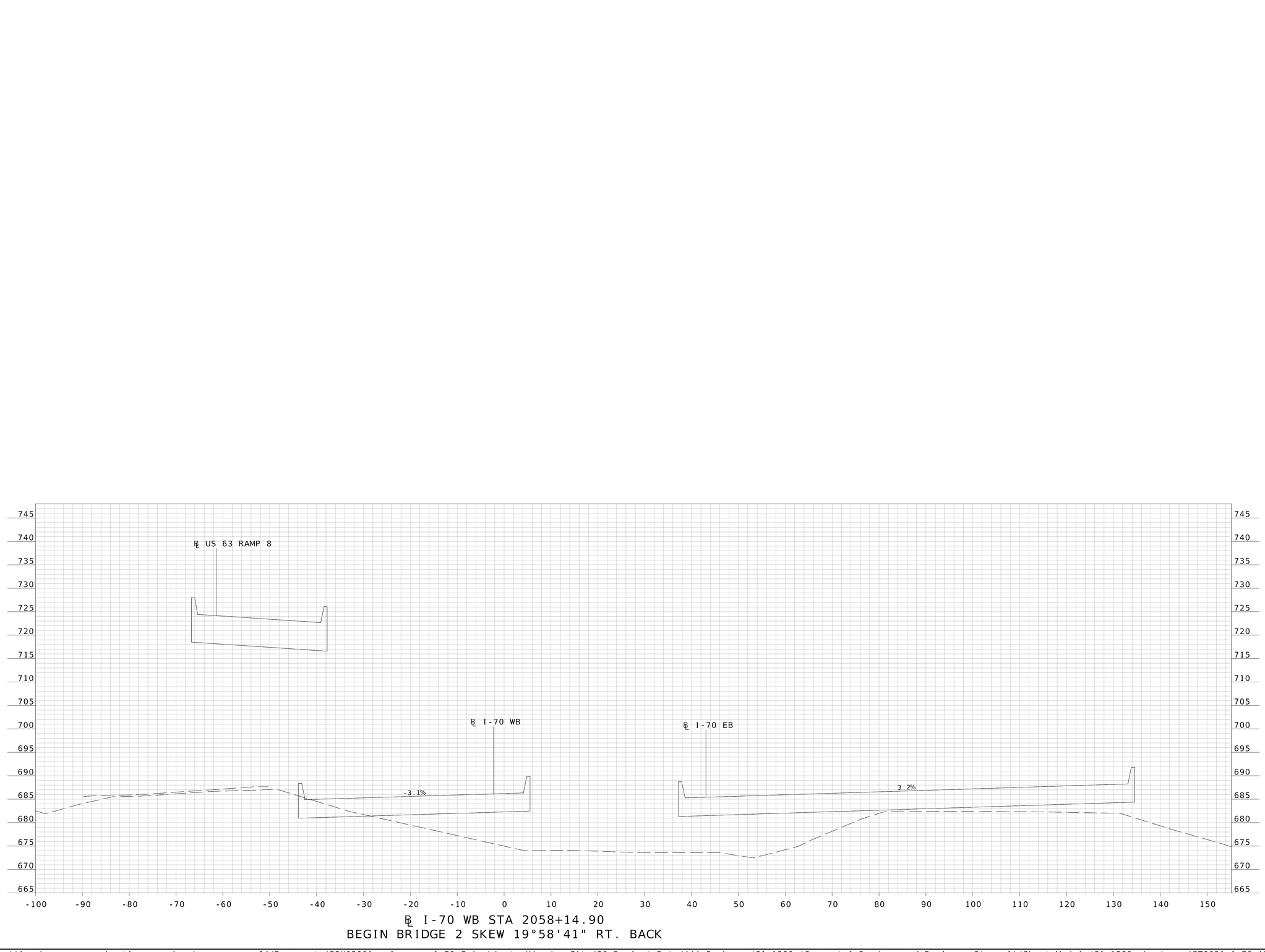
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.



℄ I-70 WB STA 2058+14.90
BEGIN BRIDGE 2 SKEW 19°58'41" RT. BACK

DATE PREPARED
17-JUL-2024

ROUTE	STATE
70	MO
DISTRICT	SHEET NO.
C	S1XS026

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.
X

PROJECT NO.
X

BRIDGE NO.
X

DESCRIPTION	DATE
REV A - PRELIMINARY REVIEW	07/17/24

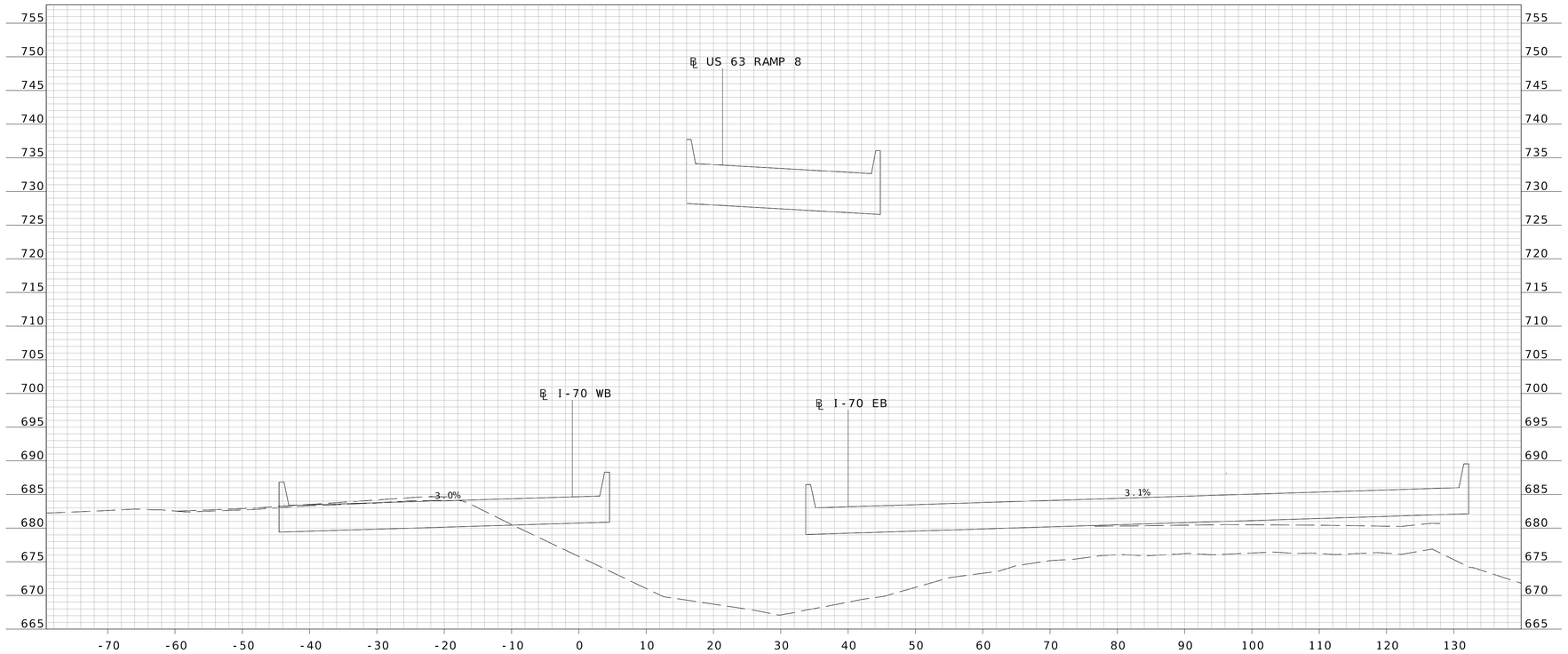
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

Jacobs
MILLSTONE WEBER

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.



℄ I-70 WB STA 2060+49.97
END BRIDGE 4 SKEW 23°50'16" RT. BACK

DATE PREPARED
17-JUL-2024

ROUTE	STATE
70	MO
DISTRICT	SHEET NO.
C	S1XS027

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.
X

PROJECT NO.
X

BRIDGE NO.
X

DESCRIPTION	DATE
REV A - PRELIMINARY REVIEW	07/17/24

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

Jacobs
MILLSTONE WEBER

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING REV.



℄ I-70 WB STA 2060+60.34
END BRIDGE 4 SKEW 22°27'58" RT. BACK

DATE PREPARED
17-JUL-2024

ROUTE	STATE
70	MO
DISTRICT	SHEET NO.
C	S1XS028

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.
X

PROJECT NO.
X

BRIDGE NO.
X

DESCRIPTION	DATE
REV A - PRELIMINARY REVIEW	07/17/24

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

Jacobs
MILLSTONE WEBER

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.

MATCH LINE
℄ US 63 RAMP 2

℄ US 63 RAMP 8

℄ I-70 WB

℄ I-70 EB

℄ C-D ROAD

EL 682.45
OFF -45.40'

EL 683.14
OFF -40.00'

EL 683.22
OFF -37.50'

EL 683.62
OFF -24.00'

EL 683.88
OFF -12.00'

EL 684.34
OFF -0.00'

EL 684.20
OFF 5.00'

EL 684.18
OFF 7.00'

EL 677.91
OFF 19.53'

EL 682.37
OFF 28.45'

EL 682.91
OFF 47.45'

EL 683.27
OFF 59.45'

EL 683.68
OFF 72.96'

EL 683.99
OFF 83.46'

EL 684.05
OFF 85.46'

EL 684.11
OFF 89.46'

EL 684.41
OFF 102.96'

EL 684.65
OFF 114.96'

EL 684.73
OFF 118.95'

EL 663.46
OFF 161.48'

℄ I-70 WB STA 2061+00.00

DATE PREPARED
28-JUN-2024

ROUTE	STATE
70	MO

DISTRICT	SHEET NO.
C	S1XS029

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.
X

PROJECT NO.
X

BRIDGE NO.
X

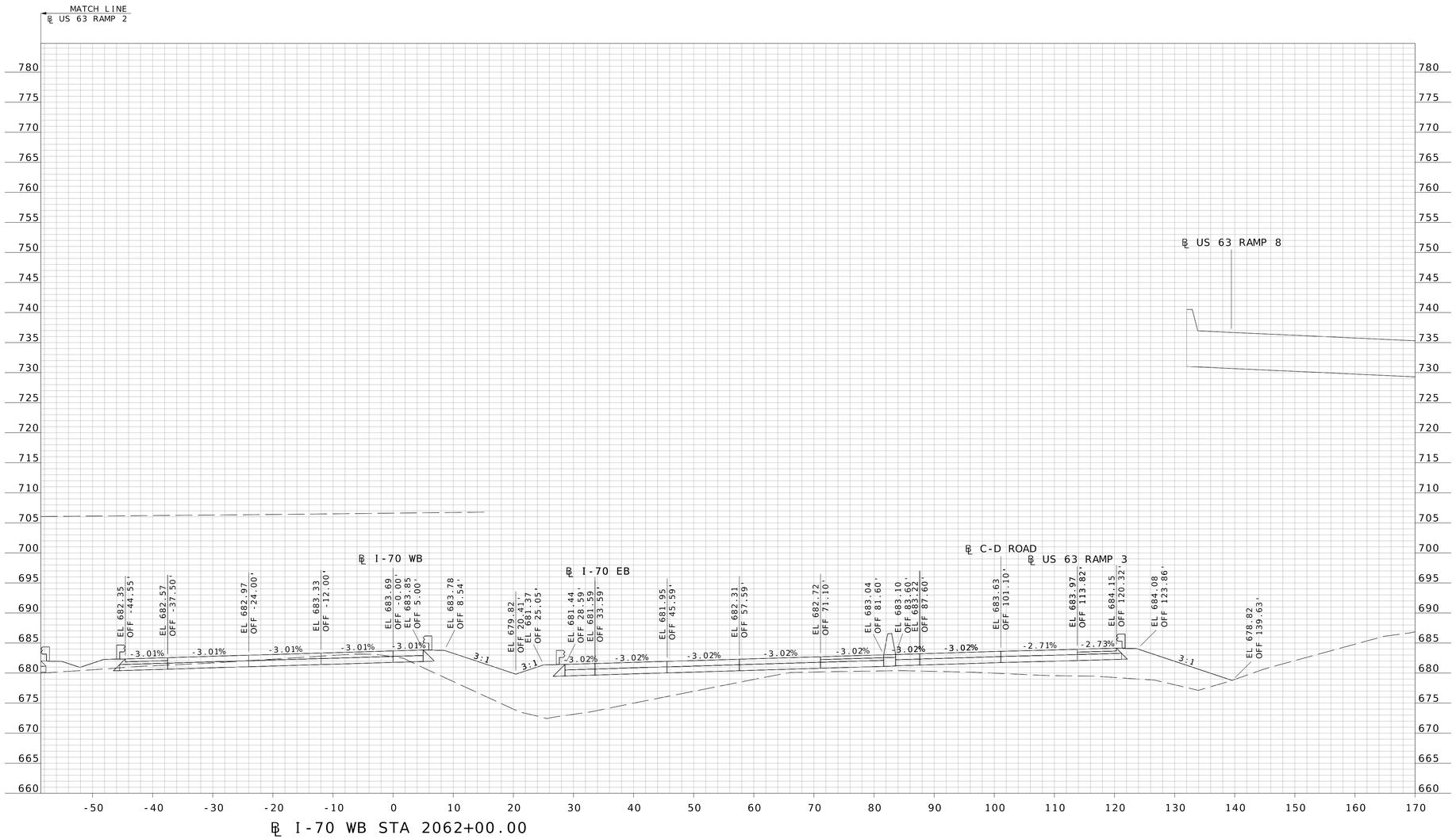
REV.	DESCRIPTION	DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER
Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING



℄ I-70 WB STA 2062+00.00

DATE PREPARED
28-JUN-2024

ROUTE	STATE
70	MO
DISTRICT	SHEET NO.
C	S1XS030

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.
X

PROJECT NO.
X

BRIDGE NO.
X

DESCRIPTION	DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

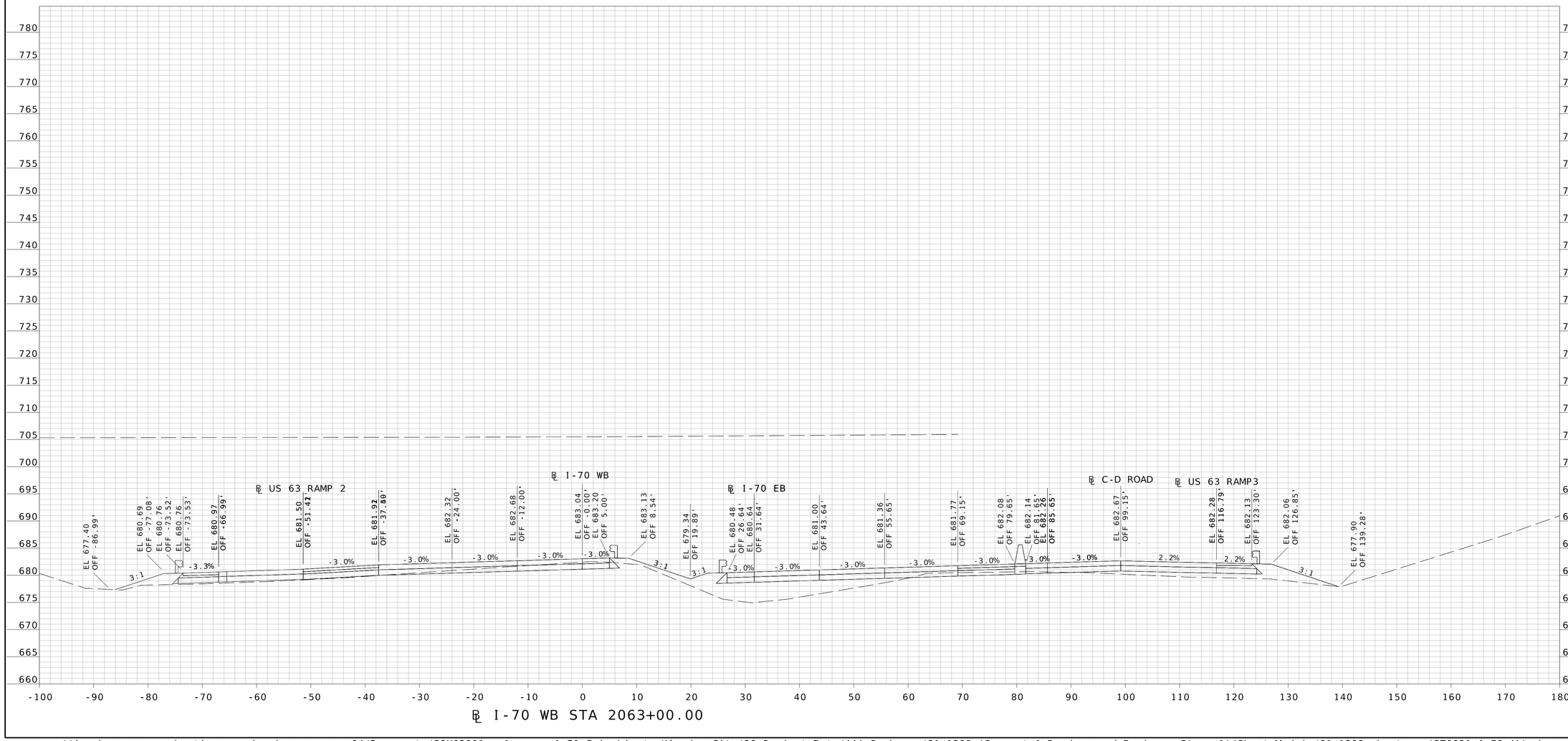
MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER

Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.



DATE PREPARED
28-JUN-2024

ROUTE	STATE
70	MO
DISTRICT	SHEET NO.
C	S1XS031

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.
X

PROJECT NO.
X

BRIDGE NO.
X

DESCRIPTION	DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER

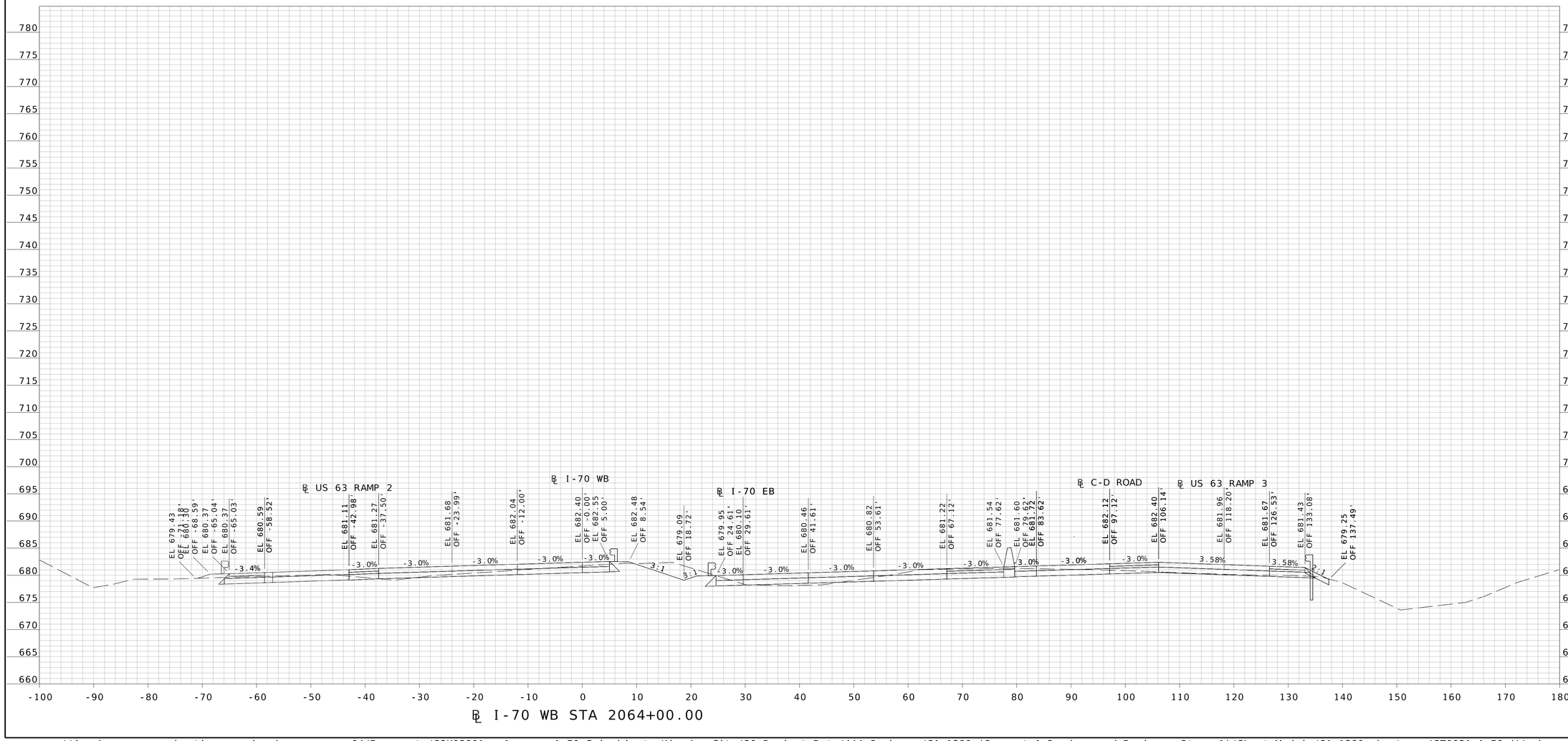
Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.

pw://jacobs-us-va-pw.bentley.com:jacobs-us-va-pw-04/Documents/F3X03001 - Improve I-70 Columbia to Kingdom City/30 Project Data/AAA_Packages/S1-1380 (Segment 1-Roadway and Drainage-Stage 1)/Sheet Models/S1-1380_sheet_xs_JST0021_I-70_ALL.dgn

23:18 18-JUL-2024



DATE PREPARED
28-JUN-2024

ROUTE	STATE
70	MO

DISTRICT	SHEET NO.
C	S1XS032

COUNTY
BOONE

JOB NO.
JST0021

CONTRACT ID.
X

PROJECT NO.
X

BRIDGE NO.
X

DESCRIPTION	DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT IMPROVE I-70 DB PROJECT 1

MILLSTONE WEBER

Jacobs

MO STATE CERTIFICATE OF AUTHORITY #000704 ENGINEERING

REV.