Illinois Department of Transportation

# Abbreviated Structure Geotechnical Report

| | | | |
|---|---|---|---|
| **Original Report Date:** 6/9/2025 | **Proposed SN:** 015-0081 | **Route:** | F.A.S. 674 (C.H. 31) |
| **Revised Date:** 6/26/2025 | **Existing SN:** 015-0034 | **Section:** | (32Q-MFT)BR |
| **Geotechnical Engineer:** | | **County:** | Coles |
| **Structural Engineer:** Chad Hodel, P.E., S.E. (WHKS & Co.) | | **Contract:** | 74653 |

**Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing):**

The proposed structure is a three-span 184'-7" back-to-back abutment bridge with concrete deck on steel beams. Span lengths are 54'-9.5" (back of abutment to centerline of pier), 75'-0" (centerline to centerline of piers), and 54'-9.5" (centerline of pier to back of abutment). The substructure units consist of reinforced concrete integral abutments and solid wall encased pile bent piers with driven piles at all units. See draft TSL in Attachment A for further details.

**Discuss the existing boring data, existing plans foundation information, new subsurface exploration and need for any additional exploration to be provided with SGR Technical Memo (attach all data and subsurface profile plot):**

Two boring logs have been completed for the project. Boring 1 (B-1) is located at the southern end of the project while Boring 2 (B-2) is located at the northern end. The subsurface data for B-1 indicates a mixture of stiff to very stiff and hard cohesive soils and medium dense to very dense granular soils until encountering shale at a depth of approximately 60 feet (elevation 598.21). Rock cores were also obtained for B-1 for a depth of 10 ft with unconfined compressive strengths ranging from 46 to 72 tsf. Except as noted, B-2 consists of a similar mix of cohesive and granular soils with shale encountered at a depth of approximately 45 feet (elevation 611.98). B-2 also reflects a 5 ft layer of soft cohesive soils approximately 15 ft below the surface. No further subsurface exploration is recommended at this time if a driven pile foundation is used at each substructure. See boring logs in Attachment B for further details.

**Provide the location and maximum height of any new soil fill or magnitude of footing bearing pressure. Estimate the amount and time of the expected settlement. Indicate if further testing, analysis, and/or ground improvement/treatment is necessary:** Minimal to no change in the profile grade occurs beyond the limits of the abutments. Settlement should not be an issue.

**Identify any new cuts or fill slope angles and heights. Estimate the factor of safety against slope failure. Indicate if further testing, analysis or ground improvement/treatment is necessary:**

Channel excavation associated with the lengthened structure results in a revised embankment configuration in front of the abutments. The embankment configurations use slopes of 1:2 (V:H) or flatter with a bench located approximately at mid-height. A slope stability analysis using the soils data in Boring 2 indicates a factor of safety of 1.8 for undrained conditions. See Attachment C for additional information.

**Indicate at each substructure, the 100-year and 200-year total scour depths in the Hydraulics report, the non-granular scour depth reduction, the proposed ground surface, and the recommended foundation design scour elevations:** The draft TSL in Attachment A reports Q100 and Q200 design scour elevations at the base of the abutment caps and solid wall pier encasements. Since the abutments are protected with riprap, abutment scour depths reported on the draft TSL are in accordance with IDOT Bridge Manual Section 2.3.6.3.2. Pier scour depths for the 100-year and 200-year design flows are documented in the Hydraulic Report as 6.4 feet and 6.6 feet, respectively. The proposed top of riprap elevations are 646.25 at Pier 1 and 645.39 at Pier 2. By inspection, the scour elevations at the piers, without applying reduction factors, remain above the bottom of the solid wall pier encasements. Therefore, the design scour elevations for the piers reported on the draft TSL (at the bottom of pier encasements, elevation 634.17 at both piers) are also in accordance with IDOT Bridge Manual Section 2.3.6.3.2. The Design Scour Elevation Table is shown below:

*DESIGN SCOUR ELEVATION TABLE*

| *Event / Limit State* | *Design Scour Elevations (ft.)* | | | | *Item 113* |
|---|---|---|---|---|---|
| | *S. Abut.* | *Pier 1* | *Pier 2* | *N. Abut.* | |
| *Q100* | *650.76* | *634.17* | *634.17* | *649.41* | *5* |
| *Q200* | *650.76* | *634.17* | *634.17* | *649.41* | |
| *Design* | *650.76* | *634.17* | *634.17* | *649.41* | |
| *Check* | *650.76* | *634.17* | *634.17* | *649.41* | |

**Determining the seismic soil site class, the seismic performance zone, the 0.2 and 1.0 second design spectral accelerations and indicate if that the soils are liquefiable:**

Seismic soil site class and seismic design category were determined using the draft 2024 IDOT Seismic Manual. The average seismic soil site class was determined to be C. The seismic design category was determined to be A with a 1.0 second design spectral acceleration of 0.116g. Since the seismic design category is A, no liquefaction analysis is needed. See Attachment D for seismic data to be shown on the TSL.

**Confirm feasibility of the proposed foundation or wall type and provide design parameters. Attach a pile design table indicating feasible pile types, various nominal required bearings, factored resistances available and corresponding estimated lengths at locations where piles will be used. Provide factored bearing resistance and unit sliding resistance at various elevations and confirm no ground improvement/treatment is necessary where spread footings are proposed. Estimated top of rock elevations as well as preliminary factored unit side and tip resistance values shall be indicated when drilled shafts are proposed:**

Form BBS 145 was completed to assess the feasibility of various pile types for an integral abutment. The results indicate that most pile types and sizes are suitable. However, given the proximity of shale, it is recommended that the pile selection be limited to HPs and driven to refusal in shale.

Form BBS 147 was completed to estimate pile lengths, nominal required bearing, and factored pile resistance available at each substructure unit. Tables summarizing the pile design data and estimated lengths are included with the input provided for Form BBS 147 at each substructure unit. It is recommended that the designer specify a pile length corresponding to the maximum nominal required bearing indicated in IDOT Bridge Manual Table 3.10.1.2.1-1 for the HP pile selected by the designer. Results of Forms BBS 145 and 147 are provided in Attachment E.

The estimated top of rock elevation at the South Abutment and Pier 1 is 598.2 as determined from Boring 1. The estimated top of rock elevation at the North Abutment is 612.0 as determined from Boring 2. For Pier 2, the estimated top of rock elevation is taken as the average between the south and north abutments, approximately 605.0.

Due to the variation in rock elevations and lack of boring data near the piers, test piles are recommended at each substructure unit.

**Calculate the estimated water surface elevation and determine the need for cofferdams (type 1 or 2), and seal coat:**

The EWSE is 644.35. Given the required amount of channel excavation, it may be feasible for the contractor to sequence construction such that the ground elevation remains above the EWSE during the pier construction. However, the base elevation of 634.17 for the solid wall pier encasements occurs near the top of a permeable granular soil layer. Due to this condition, it is recommended that a Type 2 cofferdam with seal coat be specified for the proposed pier type. Calculations included in Attachment F suggest that a 5 ft thick seal coat is required. IDOT Bridge Manual General Note 30 should be added to the final plans. The size of the cofferdam and seal coat relative to the pier may add considerable load to the pier piles. It is therefore recommened that the seal coat located outside of the pier limits be specified to be fractured once it is no longer needed. It is recommended that this be detailed in the final plans along with the following note: "Contractor shall fracture seal coat (full depth) approximately 6" from each side of stem wall prior to backfilling. Care shall be taken to avoid damage to new construction. Cost included with Cofferdam (Type 2)." An example pier detail indicating the seal coat fracturing is provided in Attachment F.

Alternatively, the need for cofferdams may be eliminated by using column-web wall drilled shaft bent piers. It is anticipated that the drilled shafts would extend to the shale layer. If this option is considered more cost-effective, design parameters for the drilled shafts can be provided in an SGR Technical Memo. Additional exploration is recommended to confirm the shale properties at the pier locations if this alternative is pursued.

**Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns:**

The road will be fully closed during construction. No additional sheeting, soil retention, or temporary construction slope requirements have been identified for the project.

# Attachment A – Draft TSL

Benchmark: BM 506 - Chiseled square on southwest wingwall of bridge 015-0034
Station 131+90, 15ft. left of ℄, Elevation = 658.856

Existing Structure: Structure 015-0034 was originally built in 1961 under S.A. 7, Section 32Q-MFT at Sta. 132+65. The existing structure consists of a 3 span concrete deck on non composite steel WF beams supported by stub abutments on concrete piles and solid wall piers on spread footings, 40° right ahead skew. Length is 127'-10" back to back abutments, out-to-out deck width is 32'-4". Structure to be removed and replaced.

Traffic will be detoured during construction.

No salvage.

## DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition

## LOADING HL-93

Allow 50#/sq. ft. for future wearing surface.

## DESIGN STRESSES

FIELD UNITS

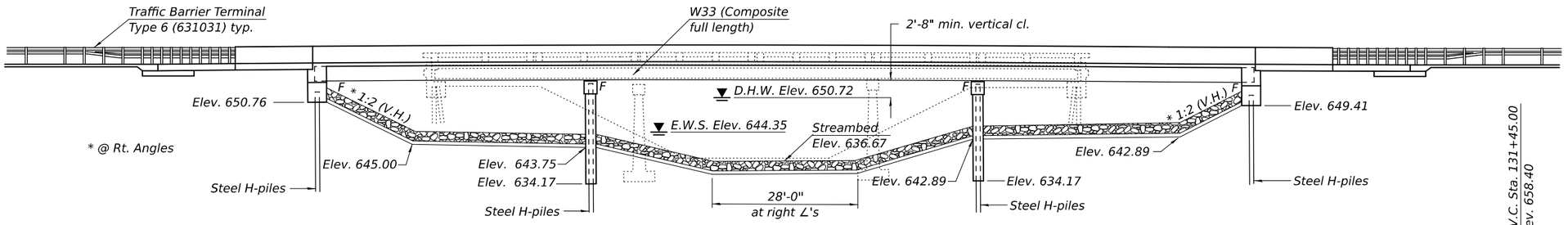
f 'c = 3,500 psi (Substructure)
f 'c = 4,000 psi (Superstructure)
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (M270 Grade 50)
All structural steel shall be galvanized.

## SEISMIC DATA

Seismic Performance Zone (SPZ) =
Design Spectral Acceleration at 1.0 sec. (SD1) =
Design Spectral Acceleration at 0.2 sec. (SDS) =
Soil Site Class =

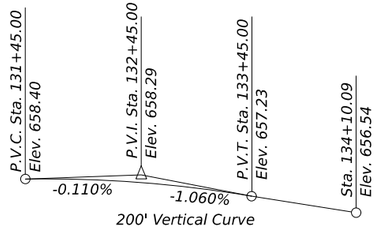
## HIGHWAY CLASSIFICATION

F.A.S. Rte. 674 - (C.H. 31)
Functional Class: Major Collector
ADT: 1,300 (2025); 1,600 (2045)
ADTT: 100 (2025); 123 (2045)
DHV: 156
Design Speed: 60 m.p.h.
Posted Speed: 55 m.p.h.
Two-Way Traffic
Directional Distribution: 50:50



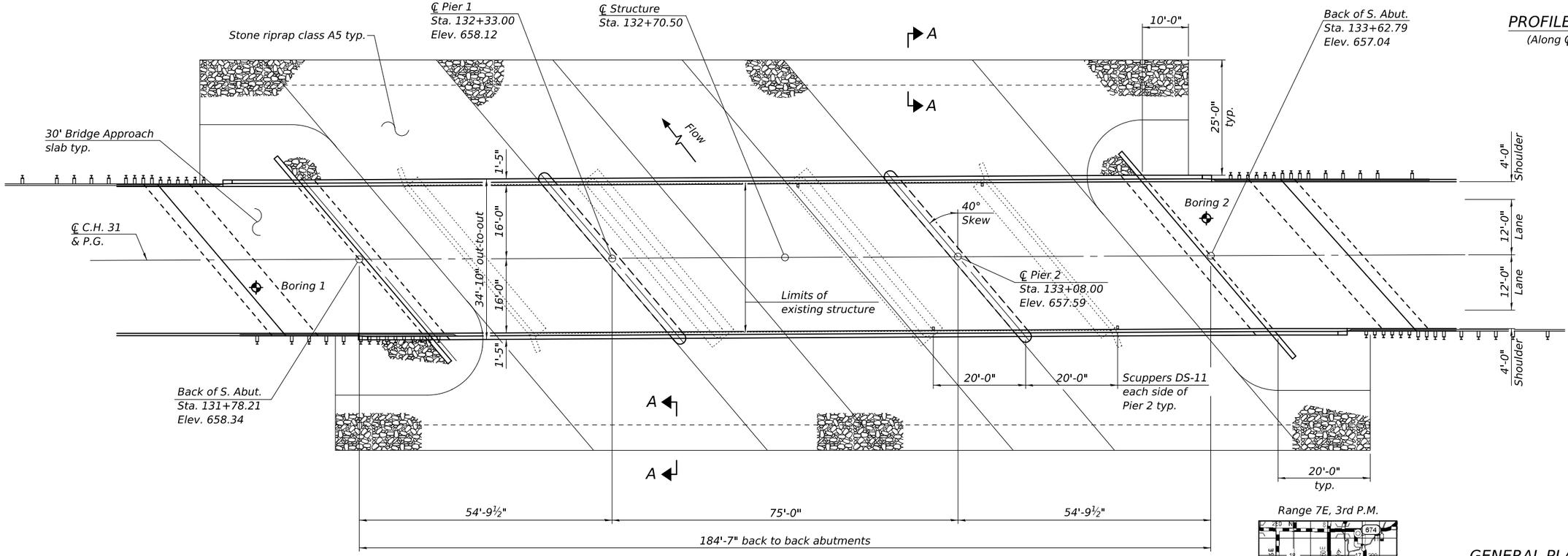

## ELEVATION

(Looking downstream)

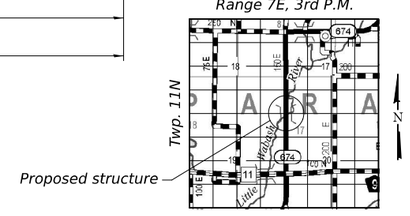



## PROFILE GRADE

(Along ℄ C.H. 31)




## PLAN




## LOCATION SKETCH

# GENERAL PLAN & ELEVATION
# C.H. 31 OVER LITTLE WABASH RIVER
# F.A.S. ROUTE 674 - SEC. (32Q-MFT)BR
# COLES COUNTY
# STATION 132+70.50
# STRUCTURE NO. 015-0081

| | |
|---|---|
| DESIGNED - | ANDREW M. DIORIO |
| CHECKED - | _____ |
| DRAWN - | GLENN W. STOVER |
| CHECKED - | _____ |

**STATE OF ILLINOIS**
**DEPARTMENT OF TRANSPORTATION**

8/9/2024 - 8:35:50 AM

SHEET 1 OF 2 SHEETS

| F.A.S. RTE. | SECTION | COUNTY | TOTAL SHEETS | SHEET NO. |
|---|---|---|---|---|
| 674 | (32Q-MFT)BR | COLES | __ | ___ |
| | | CONTRACT NO.74653 | | |
| | ILLINOIS FED. AID PROJECT | | | |

MODEL: 0150081-74653-TSL-001
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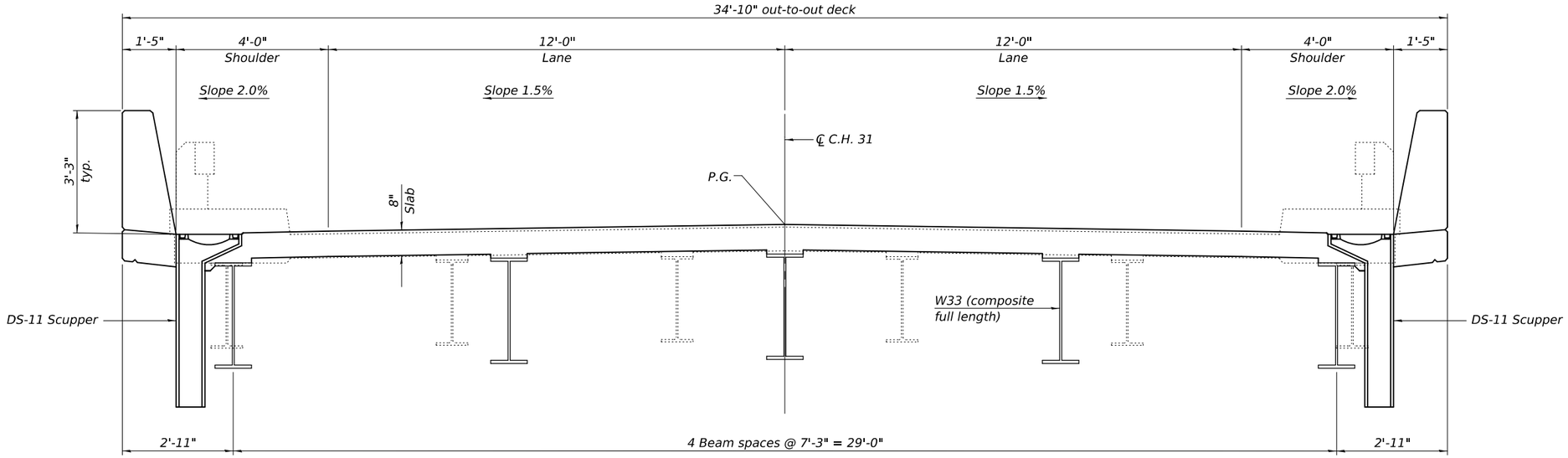
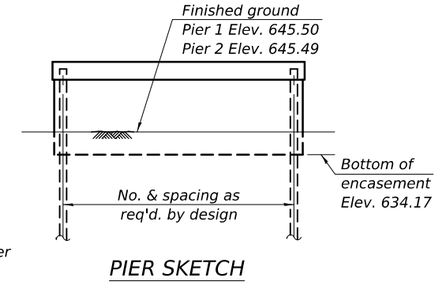
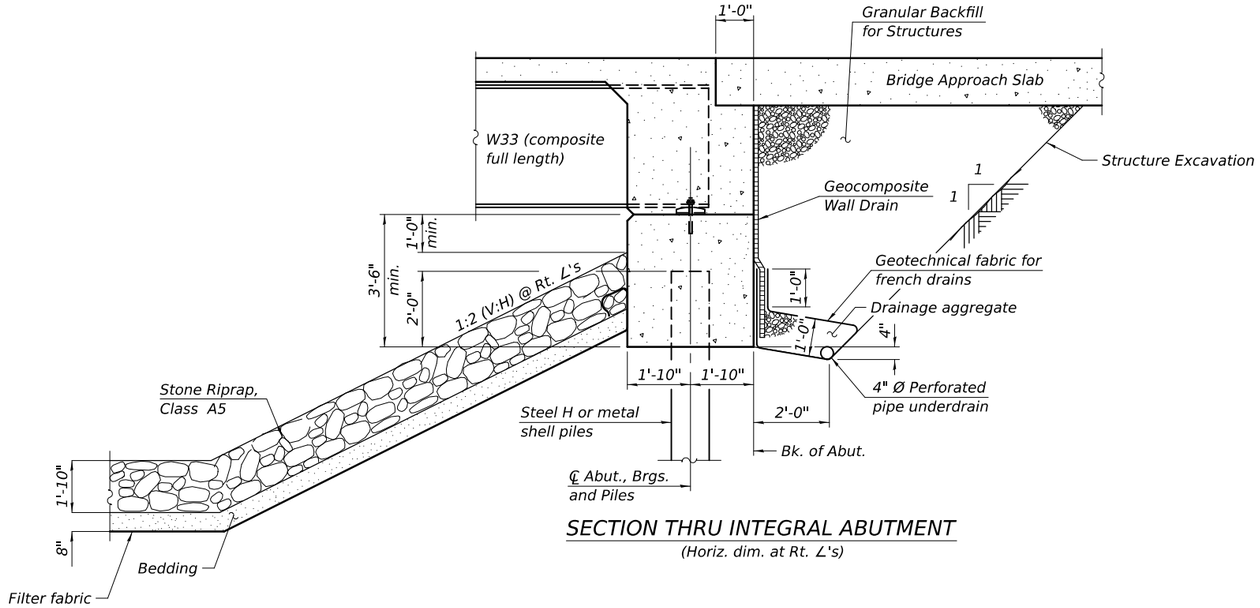


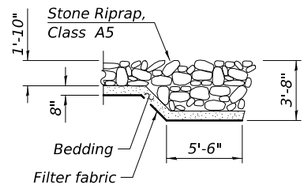




PIER SKETCH




SECTION THRU INTEGRAL ABUTMENT

(Horiz. dim. at Rt. ∠'s)




SECTION A-A

## WATERWAY INFORMATION

| Drainage Area = 19.7 sq. miles | | Existing Overtopping Elev. 654.4 @ Sta. 138+02.00 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Proposed Overtopping Elev. 654.4 @ Sta. 138+02.00 | | | | | | |
| Flood | Freq. Yr. | Q C.F.S. | Opening Ft² Exist. | Opening Ft² Prop. | Nat. H.W.E. | Head - Ft. Exist. | Head - Ft. Prop. | Headwater El. Exist. | Headwater El. Prop. |
| | 10 | 2,960 | 596 | 750 | 649.41 | 0.79 | 0.67 | 650.20 | 650.08 |
| Design | 50 | 4,640 | 705 | 958 | 650.72 | 1.33 | 0.93 | 652.05 | 651.65 |
| Base | 100 | 5,380 | 751 | 1,043 | 651.24 | 1.64 | 1.05 | 652.88 | 652.29 |
| Scour Design Check | 200 | 6,173 | 799 | 1,130 | 651.77 | 1.94 | 1.19 | 653.71 | 652.96 |
| Max. Calc. | 500 | 7,230 | 862 | 1,241 | 652.43 | 2.37 | 1.40 | 654.80 | 653.83 |

## DESIGN SCOUR ELEVATION TABLE

| Event / Limit State | Design Scour Elevations (ft.) S. Abut. | Pier 1 | Pier 2 | N. Abut. | Item 113 |
|---|---|---|---|---|---|
| Q100 | 650.76 | 634.17 | 634.17 | 649.41 | 5 |
| Q200 | 650.76 | 634.17 | 634.17 | 649.41 | |
| Design | 650.76 | 634.17 | 634.17 | 649.41 | |
| Check | 650.76 | 634.17 | 634.17 | 649.41 | |

GENERAL DATA

C.H. 31 OVER LITTLE WABASH RIVER

F.A.S. ROUTE 674 - SEC. (32Q-MFT)BR

COLES COUNTY

STATION 132+70.50

STRUCTURE NO. 015-0081

| | |
|---|---|
| DESIGNED - | ANDREW M. DIORIO |
| CHECKED - | _____ |
| DRAWN - | GLENN W. STOVER |
| CHECKED - | _____ |

**STATE OF ILLINOIS**
**DEPARTMENT OF TRANSPORTATION**

8/9/2024 - 8:35:51 AM

SHEET 2 OF 2 SHEETS

| F.A.S. RTE. | SECTION | COUNTY | TOTAL SHEETS | SHEET NO. |
|---|---|---|---|---|
| 674 | (32Q-MFT)BR | COLES | __ | ___ |
| | | CONTRACT NO. 74653 | | |
| | ILLINOIS | FED. AID PROJECT | | |

MODEL: 015008I-74653-TSL-002
FILE NAME: pw://idot-pw.bentley.com:PWIDOT/Documents/IDOT O ces/Bureau of Bridges and Structures/OBM Projects/015008I/CADData/Bridge/015008I-74653-TSL

# Attachment B – Boring Logs

**Illinois Department of Transportation**
Division of Highways
Illinois Department of Transportation

B-1

# SOIL BORING LOG



Date 7/25/22

**ROUTE** FAS 674 (CH 31) **DESCRIPTION** CH 31 over Little Wabash River **LOGGED BY** E. Sandschafer

**SECTION** (32Q-MFT)BR **LOCATION** Southwest 1/4 of Northeast 1/4, **SEC.** 17, **TWP.** 7E, **RNG.** 11N, 3rd **PM**,
**Latitude** N 39.397017, **Longitude** W 88.443693

**COUNTY** Coles **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER** Auto ETR = 91.8% @ 57.4 bpm

**STRUCT. NO.** 015-0034 (Existing) 015-0081 (Proposed)
**Station** 132+65

**BORING NO.** 1 South Abutment
**Station** 131+57
**Offset** 6.0 ft RT
**Ground Surface Elev.** 658.21 ft

**Surface Water Elev.** 640.61 ft
**Stream Bed Elev.** 636.38 ft

**Groundwater Elev.:**
**First Encounter** 633.7 ft ▼
**Upon Completion** 650.2 ft ▽
**After** 24 **Hrs.** Dry ft

| DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) |
|---|---|---|---|
| 1-3/8" Oil and Chip over 12" of Concrete | | | |
| 657.11 | | | |
| Grey, CLAY | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| -5 | WH | | |
| | 2 | 2.1 | 18 |
| *Very stiff, moist* | 3 | BS | |
| Bottom S. Abutment 650.76 | | | |
| | 2 | | |
| *Stiff, with sand* ▽ | 2 | 1.3 | 19 |
| | 4 | S | |
| | | | |
| | | | |
| -10 | 1 | | |
| | 3 | 1.4 | 19 |
| | 6 | B | |
| | | | |
| | 1 | | |
| | 3 | 1.2 | 20 |
| | 3 | B | |
| | | | |
| | | | |
| -15 | WH | | |
| *Gravelly* | 3 | 1.2 | 15 |
| | 1 | B | |
| 641.21 | | | |
| Stiff, moist, grey, SANDY CLAY | WH | | |
| | 1 | 1.3 | 17 |
| | 2 | S | |
| | | | |
| 638.21 -20 | 2 | | |

| DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) |
|---|---|---|---|
| Soft, moist, grey, SANDY LOAM | 6 | 0.4 | 17 |
| | 9 | BS | |
| 636.21 | | | |
| Very stiff, moist, grey, CLAY LOAM Till | 3 | | |
| | 12 | 2.5 | 9 |
| 634.91 | 15 | B | |
| Medium dense, wet, grey, coarse grained, SAND | | | |
| Bottom Pier 1 634.17 ▼ | | | |
| -25 | 5 | | |
| *Medium grained* | 12 | NT | 10 |
| *18.7% passing #200 Sieve* | 17 | NT | |
| | | | |
| | 15 | | |
| | 32 | NT | 22 |
| *Very dense, fine grained* | 35 | NT | |
| *18.7% passing #200 Sieve* | | | |
| 628.71 | | | |
| -30 | 5 | | |
| Hard, moist, grey, CLAY LOAM Till | 16 | 8.9 | 10 |
| | 16 | BS | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 623.71 | | | |
| -35 | 7 | | |
| Very dense, moist, grey, fine grained, SAND | 35 | NT | 20 |
| | 33 | NT | |
| | | | |
| | | | |
| | | | |
| | | | |
| 618.21 -40 | 18 | | |

SOIL BORING 015-0081 (OLD 0034) SOIL ROCK 2022.GPJ IL_DOT.GDT 11/18/22

**The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)**
**The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206), WH-Weight of Hammer, NT-Not Tested.**

# Illinois Department of Transportation

Division of Highways
Illinois Department of Transportation

# SOIL BORING LOG

Date 7/25/22

**ROUTE** FAS 674 (CH 31) **DESCRIPTION** CH 31 over Little Wabash River **LOGGED BY** E. Sandschafer

**SECTION** (32Q-MFT)BR **LOCATION** Southwest 1/4 of Northeast 1/4, **SEC.** 17, **TWP.** 7E, **RNG.** 11N, 3rd **PM**,
**Latitude** N 39.397017, **Longitude** W 88.443693

**COUNTY** Coles **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER** Auto ETR = 91.8% @ 57.4 bpm

**STRUCT. NO.** 015-0034 (Existing) 015-0081 (Proposed)
**Station** 132+65

**BORING NO.** 1 South Abutment
**Station** 131+57
**Offset** 6.0 ft RT
**Ground Surface Elev.** 658.21 ft

**Surface Water Elev.** 640.61 ft
**Stream Bed Elev.** 636.38 ft

**Groundwater Elev.:**
**First Encounter** 633.7 ft ▼
**Upon Completion** 650.2 ft ▽
**After** 24 **Hrs.** Dry ft

| DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) | Description |
|---|---|---|---|---|
| | 31<br>41 | 7.8<br>BS | 9 | Hard, moist, grey, CLAY LOAM Till |
| 613.71 | | | | |
| -45 | 2 | | | Medium, moist, grey, SILT |
| | 13<br>15 | 3.0<br>S | 16 | |
| 608.71 | | | | |
| -50 | 7 | | | Hard, moist, brown, SILTY CLAY Till |
| | 8<br>12 | 5.2<br>B | 15 | |
| -55 | 23 | | | |
| | 50/5" | NT | 17 | *Hard, grey* |
| | 50/4-1/8" | NT | | |
| 598.21 -60 | 45 | | | |

| DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) | Description |
|---|---|---|---|---|
| | 50/5-1/8" | NT | 13 | Hard, moist, grey, SILTY CLAY SHALE |
| 597.21 | 50/3/4" | NT | | |
| -65 | | | | Borehole continued with rock coring. |
| -70 | | | | |
| -75 | | | | |
| -80 | | | | |

SOIL BORING 015-0081 (OLD 0034) SOIL ROCK 2022.GPJ IL_DOT.GDT 11/18/22

**The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)**
**The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206), WH-Weight of Hammer, NT-Not Tested.**

**Illinois Department of Transportation**
Division of Highways
Illinois Department of Transportation

B-1

# ROCK CORE LOG



Date 7/25/22

**ROUTE** FAS 674 (CH 31) **DESCRIPTION** CH 31 over Little Wabash River **LOGGED BY** E. Sandschafer

**SECTION** (32Q-MFT)BR **LOCATION** Southwest 1/4 of Northeast 1/4, **SEC.** 17, **TWP.** 7E, **RNG.** 11N, 3rd **PM**,
**Latitude** N 39.397017, **Longitude** W 88.443693

**COUNTY** Coles **CORING METHOD** Rotary, surf set diamond bit

**STRUCT. NO.** 015-0034 (Existing) 015-0081 (Proposed)
**Station** 132+65

**CORING BARREL TYPE & SIZE** NW, conv dbl bbl, split inner

**Core Diameter** 2.1 in
**Top of Rock Elev.** 598.21 ft
**Begin Core Elev.** 597.21 ft

**BORING NO.** 1 South Abutment
**Station** 131+57
**Offset** 6.0 ft RT
**Ground Surface Elev.** 658.21 ft

| | | DEPTH (ft) | CORE (#) | RECOVERY (%) | R.Q.D. (%) | CORE TIME (min/ft) | STRENGTH (tsf) |
|---|---|---|---|---|---|---|---|
| Grey, SHALE | 597.21 | | C1 | 61 | 53 | 1.1 | |
| Depth 62.5', Moisture Content: 7.5%, Dry Density: 140.4 pcf | | -65 | | | | | 72.7 |
| | 592.21 | | | | | | |
| Grey, SHALE | | | C2 | 100 | 83 | 3.2 | |
| Depth 69.4', Moisture Content: 8.0%, Dry Density: 134.3 pcf. | | -70 | | | | | 46.1 |
| | 587.21 | | | | | | |
| Benchmak: BM 507 - Cut Square on Northeast Corner of Headwall of Bridge over Little Wabash River, SN 015-0034, Sta. 133+00, 15 Feet RT. Elevation = 657.835 Feet. | | | | | | | |
| End of Boring | | -75 | | | | | |
| | | -80 | | | | | |

ROCK CORE 015-0081 (OLD 0034) SOIL ROCK 2022.GPJ IL_DOT.GDT 11/18/22

**Color pictures of the cores** Available on request
**Cores will be stored for examination until** Construction Complete
**The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)**

**Illinois Department of Transportation**
Division of Highways
Illinois Department of Transportation

B-2

# SOIL BORING LOG



Date 8/12/22

**ROUTE** FAS 674 (CH 31) **DESCRIPTION** CH 31 over Little Wabash River **LOGGED BY** E. Sandschafer

**SECTION** (32Q-MFT)BR **LOCATION** Southwest 1/4 of Northeast 1/4, **SEC.** 17, **TWP.** 7E, **RNG.** 11N, 3rd **PM**,
**Latitude** N 39.397546, **Longitude** W 88.443742

**COUNTY** Coles **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER** Auto ETR = 91.8% @ 57.4 bpm

**STRUCT. NO.** 015-0034 (Existing) 015-0081 (Proposed)
**Station** 132+65

**BORING NO.** 2 North Abutment
**Station** 133+60
**Offset** 8.0 ft LT
**Ground Surface Elev.** 656.98 ft

**Surface Water Elev.** 640.61 ft
**Stream Bed Elev.** 636.38 ft

**Groundwater Elev.:**
**First Encounter** 640.0 ft ▼
**Upon Completion** 642.0 ft ▽
**After** 24 **Hrs.** 642.0 ft ▽

| Material Description | Elev. | DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) |
|---|---|---|---|---|---|
| 1-3/8" Oil & Chip over 12" of Concrete | 655.88 | | | | |
| Grey, CLAY | | | 2 | | |
| *Stiff, moist* | | | 3<br>4 | 1.8<br>B | 22 |
| | | -5 | 5 | | |
| | | | 5<br>6 | 1.8<br>B | 20 |
| | 649.98 | | | | |
| Stiff, moist, grey, SILTY CLAY | | | 2 | | |
| Bottom N. Abutment 649.41 | | | 3<br>4 | 1.4<br>B | 18 |
| | 647.48 | | | | |
| Very stiff, moist, grey, CLAY | | -10 | 1 | | |
| | | | 4<br>5 | 2.3<br>B | 17 |
| | 644.98 | | | | |
| Stiff, moist, brown, CLAY LOAM | | | WH | | |
| | | | 1<br>1 | 1.0<br>B | 23 |
| | 642.48 | | | | |
| Soft, moist, grey, SANDY LOAM ▽▼ | | -15 | 1 | | |
| | | | 1<br>2 | 0.3<br>S | 16 |
| | | | WH | | |
| | | | 1<br>1 | 0.3<br>S | 18 |
| | 636.98 | -20 | 1 | | |
| Stiff, moist, grey, SANDY CLAY | | | 1<br>1 | 1.3<br>B | 16 |
| | 634.98 | | | | |
| Medium dense, wet, grey, fine grain, SAND | | | 2 | | |
| *15.* Bottom N. Pier 634.17 | | | 4<br>9 | NT<br>NT | 23 |
| | | -25 | 2 | | |
| | | | 17<br>28 | NT<br>NT | 18 |
| *Dense*<br>*37.8% passing #200 Sieve* | 629.98 | | | | |
| Dense, moist, grey, fine grain, SANDY LOAM | | | 11 | | |
| | | | 18<br>21 | NT<br>NT | 18 |
| | | -30 | 3 | | |
| | | | 16<br>24 | NT<br>NT | 18 |
| | | -35 | 6 | | |
| | 621.38 | | 14<br>16 | 7.0<br>B | 11 |
| Hard, moist, grey, CLAY LOAM Till | | | | | |
| | 616.98 | -40 | 3 | | |

SOIL BORING 015-0081 (OLD 0034) SOIL ROCK 2022.GPJ IL_DOT.GDT 11/18/22

**The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated) The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206), WH-Weight of Hammer, NT-Not Tested.**

B-2

# Illinois Department of Transportation

Division of Highways
Illinois Department of Transportation

# SOIL BORING LOG



Date 8/12/22

**ROUTE** FAS 674 (CH 31) **DESCRIPTION** CH 31 over Little Wabash River **LOGGED BY** E. Sandschafer

**SECTION** (32Q-MFT)BR **LOCATION** Southwest 1/4 of Northeast 1/4, **SEC.** 17, **TWP.** 7E, **RNG.** 11N, 3rd **PM**,
**Latitude** N 39.397546, **Longitude** W 88.443742

**COUNTY** Coles **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER** Auto ETR = 91.8% @ 57.4 bpm

**STRUCT. NO.** 015-0034 (Existing) 015-0081 (Proposed)
**Station** 132+65

**BORING NO.** 2 North Abutment
**Station** 133+60
**Offset** 8.0 ft LT
**Ground Surface Elev.** 656.98 ft

**Surface Water Elev.** 640.61 ft
**Stream Bed Elev.** 636.38 ft

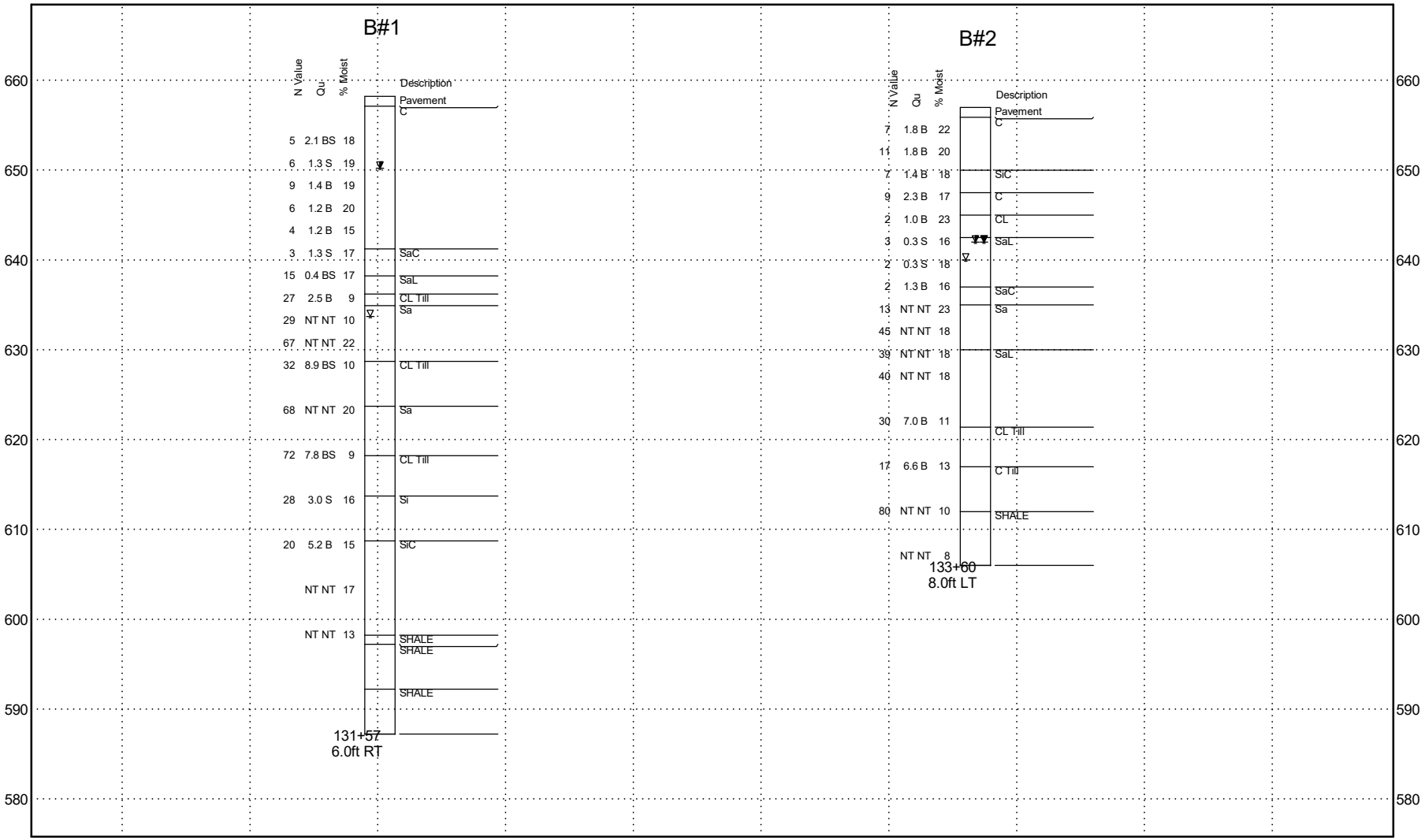
**Groundwater Elev.:**
**First Encounter** 640.0 ft ▼
**Upon Completion** 642.0 ft ▽
**After** 24 **Hrs.** 642.0 ft ▼

| | DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) |
|---|---|---|---|---|
| Hard, moist, brown, CLAY Till | | 7<br>10 | 6.6<br>B | 13 |
| 611.98 | -45 | 8 | | |
| Hard, moist, grey, SHALE | | 31<br>49 | NT<br>NT | 10 |
| | -50 | 15 | | |
| 605.98 | | 50/4-1/2"<br>50/1-1/2" | NT<br>NT | 8 |
| Benchmak: BM 507 - Cut Square on Northeast Corner of Headwall of Bridge over Little Wabash River, SN 015-0034, Sta. 133+00, 15 Feet RT. Elevation = 657.835 Feet.<br>End of Boring | -55 | | | |
| | -60 | | | |

SOIL BORING 015-0081 (OLD 0034) SOIL ROCK 2022.GPJ IL_DOT.GDT 11/18/22

**The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)**
**The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206), WH-Weight of Hammer, NT-Not Tested.**

Structure Number 015-0034 (Existing) 015-0081 (Proposed) CH 31 over Little Wabash River
Located in the Southwest 1/4 of Northeast 1/4 of Section 17, Township 7E, Range 11N of the 3 P.M.




**NOT TO HORIZONTAL SCALE**

**Illinois Department of Transportation**
Division of Highways
Illinois Department of Transportation

**VARIATIONS IN SUBSURFACE CONDITIONS MAY EXIST BETWEEN BORINGS**

**Groundwater**
First Encounter
Completion
after (refer to log) hours

**Abbreviations**
WH - Sampler Advanced by Weight of Hammer, WOP - Weight of Pipe
B.S. - Before Seating
NT- Not Tested

## SUBSURFACE DATA PROFILE

Route: FAS 674 (CH 31)

Section: (32Q-MFT)BR

County: Coles

TEST FENCE 2 015-0081 (OLD 0034) SOIL ROCK 2022.GPJ D7.GDT 11/18/22

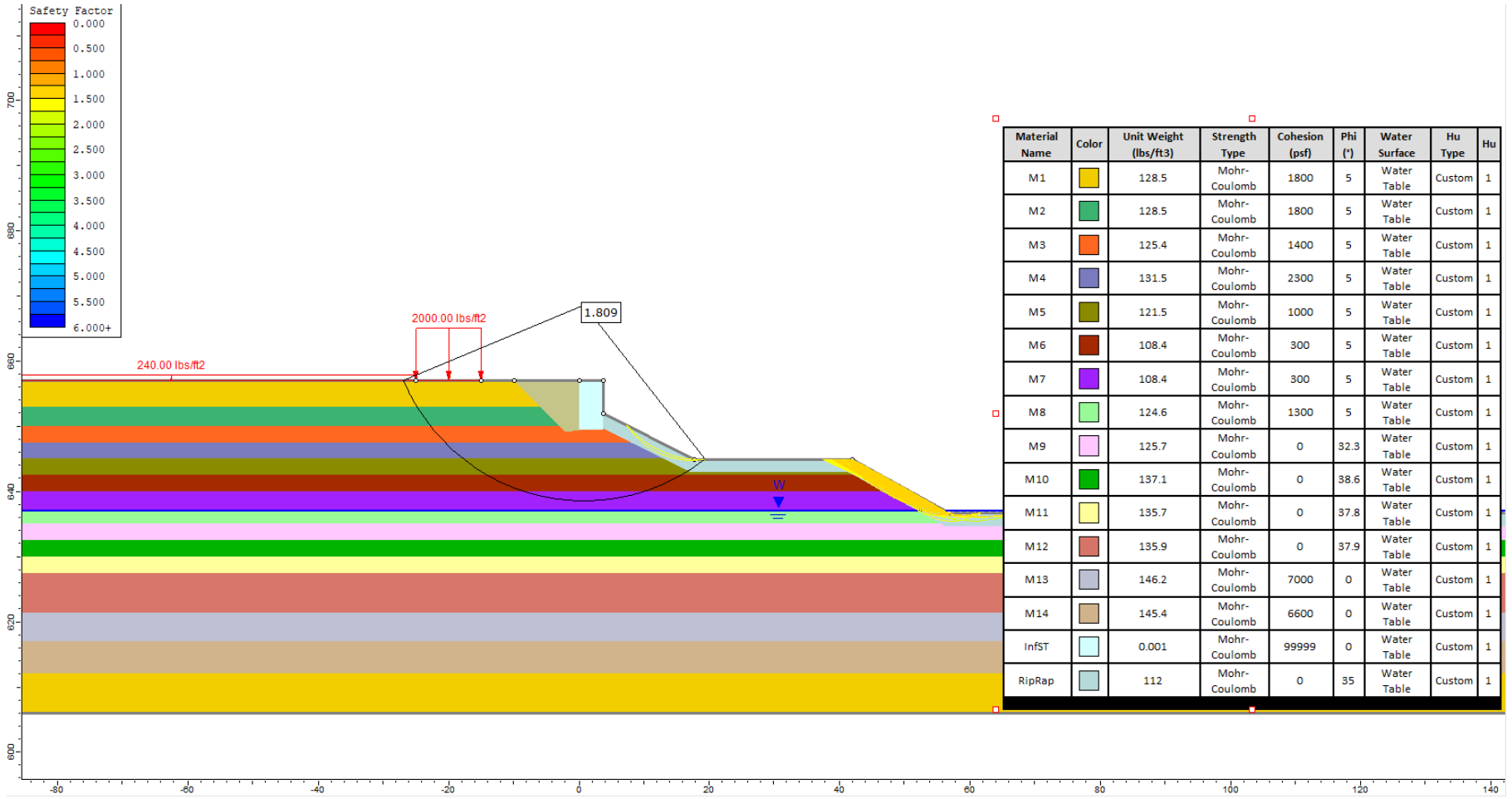
TEST FENCE 2 015-0081 (OLD 0034) SOIL ROCK 2022.GPJ D7.GDT 11/18/22

# Attachment C – Slope Stability Analysis

Slope stability analysis was conducted using the Rocscience Slide2 software. Analysis results for the short-term (undrained) and long-term (drained) conditions are presented in the attached pages. The analysis was performed considering soil data shown in Boring 2.

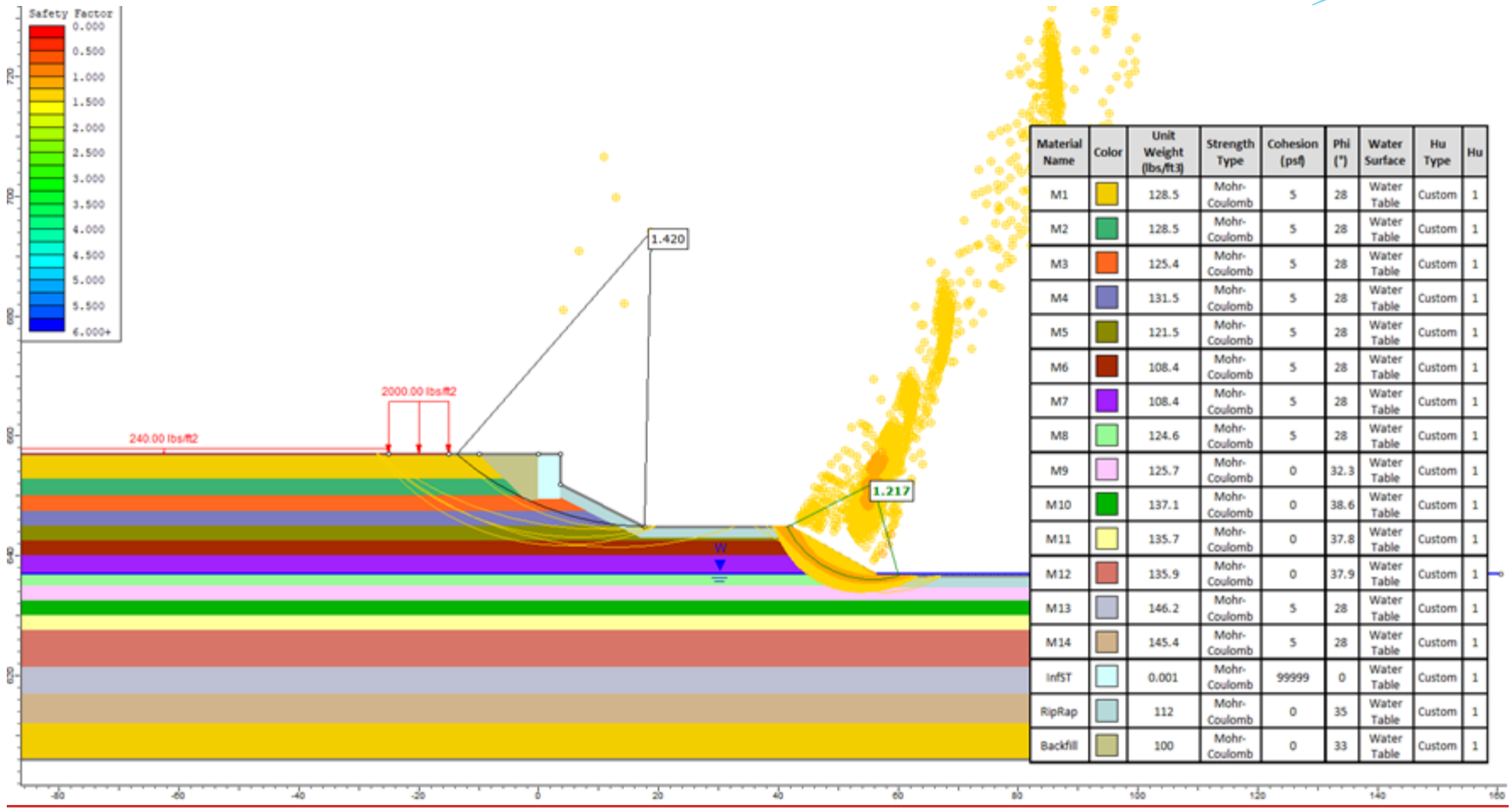
The analysis for the short-term condition indicates a slope stability factor of safety (FOS) of 1.8 for the simplified Bishop method with circular failure surface. This exceeds the minimum required FOS of 1.7 indicated in Section 6.5.1 of the IDOT Geotechnical Manual. A small friction angle of 5 degrees was used in the analysis for the cohesive soil layers.

Cohesive soil properties were approximated for the drained condition and long-term analysis. The slope stability FOS for the proposed embankment configuration is indicated to be 1.4 for a failure surface that extends behind the abutment. As this is less than the minimum desired FOS, a comparative analysis was also performed for the existing embankment configuration using the same soil properties. The slope stability FOS for the existing embankment configuration for a similar failure surface is also indicated to be 1.4. It is anticipated that additional soil testing may improve the drained soil properties used for the long-term analysis and subsequently the slope stability FOS. Notably, the analysis suggests that the proposed embankment configuration offers a similar slope stability FOS as the existing configuration. Furthermore, no known slope stability issues have been reported with the current embankment, and since the proposed design does not increase embankment height, the existing soils are expected to be adequate for long-term performance under the proposed configuration.



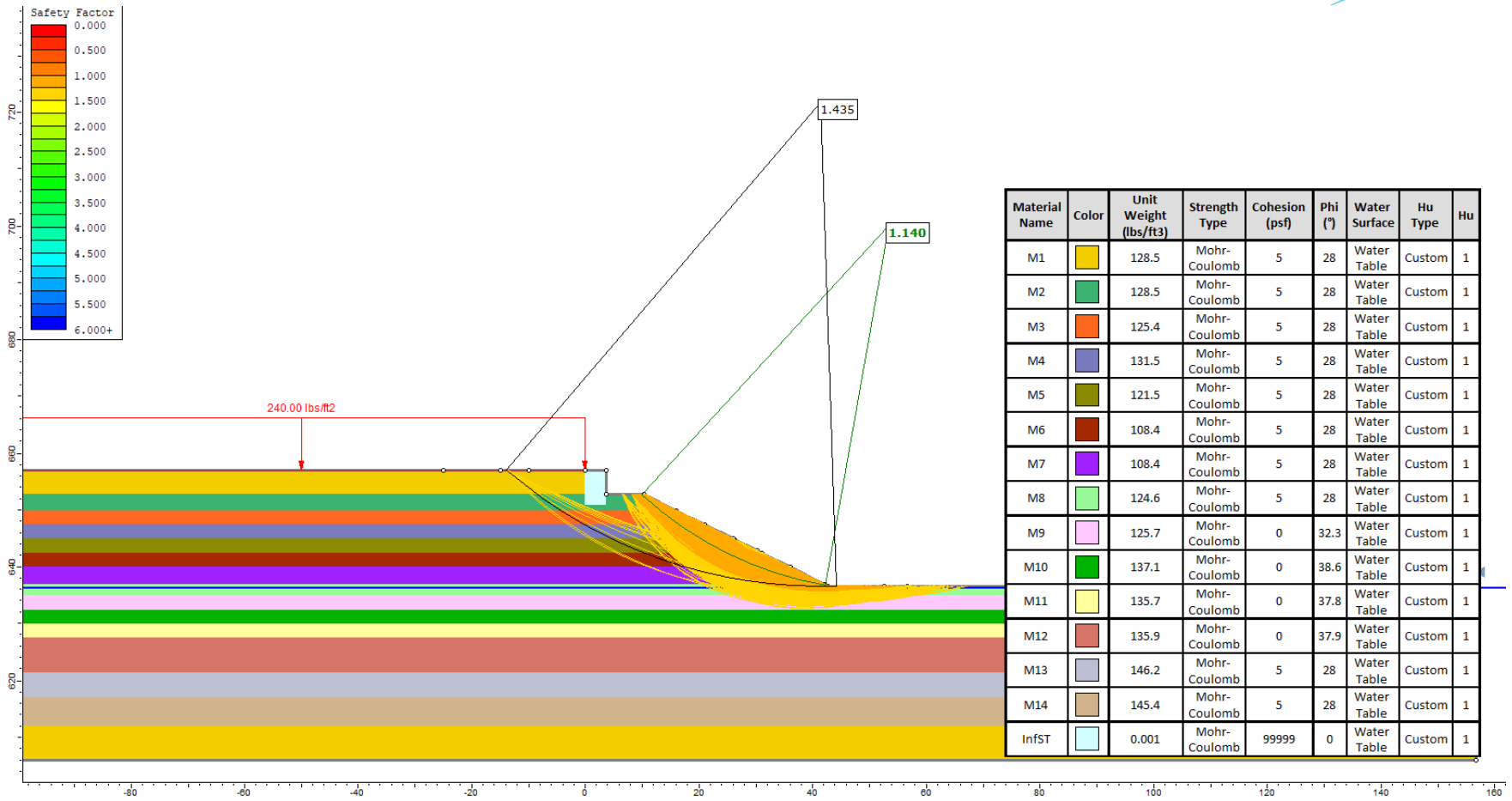

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (°) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| M1 | | 128.5 | Mohr-Coulomb | 1800 | 5 | Water Table | Custom | 1 |
| M2 | | 128.5 | Mohr-Coulomb | 1800 | 5 | Water Table | Custom | 1 |
| M3 | | 125.4 | Mohr-Coulomb | 1400 | 5 | Water Table | Custom | 1 |
| M4 | | 131.5 | Mohr-Coulomb | 2300 | 5 | Water Table | Custom | 1 |
| M5 | | 121.5 | Mohr-Coulomb | 1000 | 5 | Water Table | Custom | 1 |
| M6 | | 108.4 | Mohr-Coulomb | 300 | 5 | Water Table | Custom | 1 |
| M7 | | 108.4 | Mohr-Coulomb | 300 | 5 | Water Table | Custom | 1 |
| M8 | | 124.6 | Mohr-Coulomb | 1300 | 5 | Water Table | Custom | 1 |
| M9 | | 125.7 | Mohr-Coulomb | 0 | 32.3 | Water Table | Custom | 1 |
| M10 | | 137.1 | Mohr-Coulomb | 0 | 38.6 | Water Table | Custom | 1 |
| M11 | | 135.7 | Mohr-Coulomb | 0 | 37.8 | Water Table | Custom | 1 |
| M12 | | 135.9 | Mohr-Coulomb | 0 | 37.9 | Water Table | Custom | 1 |
| M13 | | 146.2 | Mohr-Coulomb | 7000 | 0 | Water Table | Custom | 1 |
| M14 | | 145.4 | Mohr-Coulomb | 6600 | 0 | Water Table | Custom | 1 |
| InfST | | 0.001 | Mohr-Coulomb | 99999 | 0 | Water Table | Custom | 1 |
| RipRap | | 112 | Mohr-Coulomb | 0 | 35 | Water Table | Custom | 1 |

**Slope Stability Analysis for Short-Term Condition**




| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (°) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| M1 | | 128.5 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M2 | | 128.5 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M3 | | 125.4 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M4 | | 131.5 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M5 | | 121.5 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M6 | | 108.4 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M7 | | 108.4 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M8 | | 124.6 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M9 | | 125.7 | Mohr-Coulomb | 0 | 32.3 | Water Table | Custom | 1 |
| M10 | | 137.1 | Mohr-Coulomb | 0 | 38.6 | Water Table | Custom | 1 |
| M11 | | 135.7 | Mohr-Coulomb | 0 | 37.8 | Water Table | Custom | 1 |
| M12 | | 135.9 | Mohr-Coulomb | 0 | 37.9 | Water Table | Custom | 1 |
| M13 | | 146.2 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M14 | | 145.4 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| InfST | | 0.001 | Mohr-Coulomb | 99999 | 0 | Water Table | Custom | 1 |
| RipRap | | 112 | Mohr-Coulomb | 0 | 35 | Water Table | Custom | 1 |
| Backfill | | 100 | Mohr-Coulomb | 0 | 33 | Water Table | Custom | 1 |

**Slope Stability Analysis for Long-Term Condition – Proposed Embankment Configuration**




| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (°) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| M1 | | 128.5 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M2 | | 128.5 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M3 | | 125.4 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M4 | | 131.5 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M5 | | 121.5 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M6 | | 108.4 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M7 | | 108.4 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M8 | | 124.6 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M9 | | 125.7 | Mohr-Coulomb | 0 | 32.3 | Water Table | Custom | 1 |
| M10 | | 137.1 | Mohr-Coulomb | 0 | 38.6 | Water Table | Custom | 1 |
| M11 | | 135.7 | Mohr-Coulomb | 0 | 37.8 | Water Table | Custom | 1 |
| M12 | | 135.9 | Mohr-Coulomb | 0 | 37.9 | Water Table | Custom | 1 |
| M13 | | 146.2 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| M14 | | 145.4 | Mohr-Coulomb | 5 | 28 | Water Table | Custom | 1 |
| InfST | | 0.001 | Mohr-Coulomb | 99999 | 0 | Water Table | Custom | 1 |

**Slope Stability Analysis for Long-Term Condition – Existing Embankment Configuration**

# Attachment D – Seismic Data

3501 Constitution Drive,
Suite B Springfield, IL 62711
(217) 483-WHKS (9457)
(217) 483-9458 (Fax)
www.whks.com

| | | | |
|---|---|---|---|
| **PROJECT NUMBER:** | 9855.00 PTB 207-051 | | |
| **DESCRIPTION:** | SN 015-0081 SGR | | |
| **CALCULATED BY:** | JLM | **DATE:** | 4/1/2025 |
| **CHECKED BY:** | CEH | **DATE:** | 4/3/2025 |
| **SHEET:** | 1 | OF | 5 |

| Unit | Average Velocity (ft/s) | Site class A-E |
|---|---|---|
| **Boring B-1 (S. Abut.)** | **1,288.6** | **CD** |
| **Boring B-1 (Pier 1)** | **1,634.6** | **C** |
| **Boring B-2 (Pier 2)** | **1,673.3** | **C** |
| **Boring B-2 (N. Abut.)** | **1,338.4** | **CD** |

| | | |
|---|---|---|
| **Average for Project Site:** | **1,483.7** | **C** |

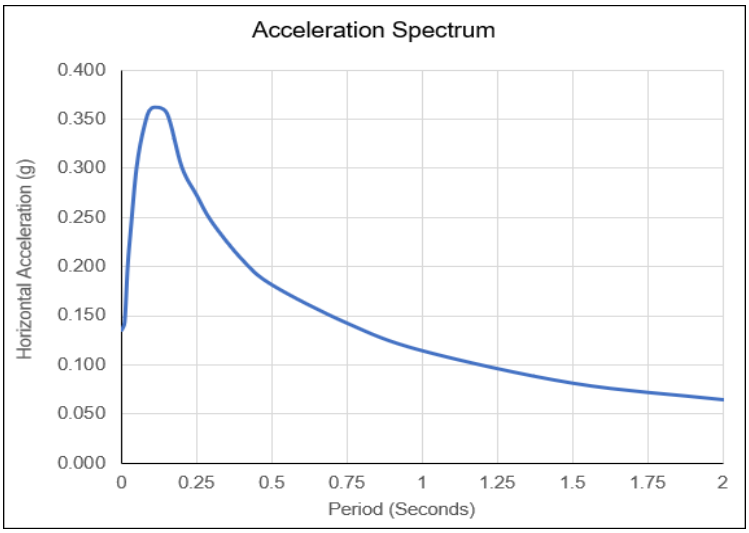
## ***SEISMIC DATA***

2023 AASHTO Seismic Hazard
Site Class C
Latitude 39.40° N, Longitude 88.44° W
Performance Level: Life Safety
SD1 = 0.116g
SDC A

AASHTO-2023 Web Services

| | | | | | |
|---|---|---|---|---|---|
| Longitude | -88.44 | Latitude | 39.397 | SiteClass | C |

| Period (s) | 0 | 0.01 | 0.02 | 0.03 | 0.05 | 0.08 | 0.10 | 0.15 | 0.20 | 0.25 | 0.30 | 0.40 | 0.50 | 0.75 | 1.0 | 1.5 | 2.0 | 3.0 | 4.0 | 5.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spectral Acceleration (g) | 0.135 | 0.143 | 0.199 | 0.236 | 0.301 | 0.342 | 0.361 | 0.356 | 0.301 | 0.272 | 0.245 | 0.207 | 0.181 | 0.142 | 0.114 | 0.081 | 0.064 | 0.041 | 0.029 | 0.022 |
| $0.9*T*S_a$ | | | | | | | | | | | | | | | 0.103 | 0.109 | 0.116 | 0.111 | 0.103 | 0.099 |



# SN 015-0081

**Boring B-1 (S. Abut.)**

Ground Surface Elev. = 658.34 | 644.76 = Est. Fixity Elevation | Assumed Epoch= Quaternary | Average Shear Wave Velocity = 1288.6 ft/s

Ground Water Elev. = 633.7 | Hammer Efficiency (%) = 91.8 | **Site Class CD**

| Soil Description | Top Elev. | N | $Q_u$ (tsf) | Comments | $d_i$ (ft) | $\Sigma d_{is}$ (ft) | $\gamma'$ (kcf) | $\sigma'_v$ (ksf) | N60 | $\sigma'_v$ (kPa) | $v_{si}$ (m/s) | $v_{si}$ (ft/s) | $d_i/v_{si}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Clay | 658.34 | 5 | 2.1 | | 6.13 | 0 | 0.130 | 0.00 | 7.7 | 0.00 | | | |
| Clay with Sand | 652.21 | 6 | 1.3 | | 2.5 | 0 | 0.125 | 0.80 | 9.2 | 38.27 | | | |
| Clay with Sand | 649.71 | 9 | 1.4 | | 2.5 | 0 | 0.125 | 1.11 | 13.8 | 53.18 | | | |
| Clay with Sand | 647.21 | 6 | 1.2 | **Est. Fixity Layer** | 2.5 | 0.05 | 0.124 | 1.42 | 9.2 | 68.19 | 151.3 | 496.3 | 0.0001 |
| Gravelly Clay | 644.71 | 4 | 1.2 | | 2.5 | 2.55 | 0.124 | 1.73 | 6.1 | 82.99 | 149.5 | 490.5 | 0.0051 |
| Sandy Clay | 642.21 | 3 | 1.3 | | 2.5 | 5.05 | 0.125 | 2.04 | 4.6 | 97.79 | 149.5 | 490.4 | 0.0051 |
| Sandy Loam | 639.71 | 15 | 0.4 | | 2.5 | 7.55 | 0.111 | 2.35 | 23.0 | 112.70 | 204.6 | 671.3 | 0.00372 |
| Clay Loam | 637.21 | 27 | 2.5 | | 2.5 | 10.05 | 0.133 | 2.63 | 41.3 | 126.03 | 234.6 | 769.7 | 0.00325 |
| Sand | 634.71 | 29 | | | 2.5 | 12.55 | 0.095 | 2.96 | 44.4 | 141.89 | 226.4 | 742.7 | 0.00337 |
| Sand | 632.21 | 67 | | | 3.5 | 16.05 | 0.079 | 3.20 | 100.0 | 153.25 | 277.9 | 911.9 | 0.00384 |
| Clay Loam | 628.71 | 32 | 8.9 | | 5 | 21.05 | 0.087 | 3.48 | 49.0 | 166.41 | 263.9 | 865.9 | 0.00577 |
| Sand | 623.71 | 68 | | | 5.5 | 26.55 | 0.079 | 3.91 | 100.0 | 187.27 | 291.9 | 957.6 | 0.00574 |
| Clay Loam | 618.21 | 72 | 7.8 | | 4.5 | 31.05 | 0.085 | 4.34 | 100.0 | 207.99 | 318.2 | 1044.1 | 0.00431 |
| Silt | 613.71 | 28 | 3 | | 5 | 36.05 | 0.072 | 4.73 | 42.8 | 226.37 | 282.6 | 927.2 | 0.00539 |
| Silty Clay | 608.71 | 20 | 5.2 | | 5 | 41.05 | 0.080 | 5.09 | 30.6 | 243.72 | 273.3 | 896.8 | 0.00558 |
| Silty Clay | 603.71 | 100 | 5.2 | | 5.5 | 46.55 | 0.080 | 5.49 | 100.0 | 262.80 | 338.3 | 1109.8 | 0.00496 |
| Shale | 598.21 | | | Rock, manually input 2500 ft/s | 1 | 47.55 | | | | | | 2500.0 | 0.0004 |
| Shale | 597.21 | | | Rock, manually input 2500 ft/s | 5 | 52.55 | | | | | | 2500.0 | 0.002 |
| Shale | 592.21 | | | Rock, manually input 2500 ft/s | 47.45 | 100 | | | | | | 2500.0 | 0.01898 |
| 100' Below Est. Fixity | 544.76 | | | | | | | | | | | | |

# SN 015-0081

**Boring B-1 (Pier 1)**

Ground Surface Elev. = 646.25 | 623.17 = Est. Fixity Elevation | Assumed Epoch= Quaternary | Average Shear Wave Velocity = 1634.6 ft/s

Ground Water Elev. = 644.35 | Hammer Efficiency (%) = 91.8 | **Site Class C**

| Soil Description | Top Elev. | N | $Q_u$ (tsf) | Comments | $d_i$ (ft) | $\Sigma d_{is}$ (ft) | $\gamma'$ (kcf) | $\sigma'_v$ (ksf) | N60 | $\sigma'_v$ (kPa) | $v_{si}$ (m/s) | $v_{si}$ (ft/s) | $d_i/v_{si}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Riprap | 646.25 | | | | 2.5 | 0 | 0.110 | 0.00 | | 0.00 | | | |
| Gravelly Clay | 643.75 | 4 | 1.2 | | 1.54 | 0 | 0.061 | 0.28 | 6.1 | 13.17 | | | |
| Sandy Clay | 642.21 | 3 | 1.3 | | 2.5 | 0 | 0.062 | 0.37 | 4.6 | 17.68 | | | |
| Sandy Loam | 639.71 | 15 | 0.4 | | 2.5 | 0 | 0.049 | 0.52 | 23.0 | 25.13 | | | |
| Clay Loam | 637.21 | 27 | 2.5 | | 2.5 | 0 | 0.070 | 0.65 | 41.3 | 30.99 | | | |
| Sand | 634.71 | 29 | | | 2.5 | 0 | 0.071 | 0.82 | 44.4 | 39.38 | | | |
| Sand | 632.21 | 67 | | | 3.5 | 0 | 0.079 | 1.00 | 100.0 | 47.82 | | | |
| Clay Loam | 628.71 | 32 | 8.9 | | 5 | 0 | 0.087 | 1.27 | 49.0 | 60.98 | | | |
| Sand | 623.71 | 68 | | **Est. Fixity Layer** | 5.5 | 5.5 | 0.079 | 1.71 | 100.0 | 81.85 | 244.9 | 803.6 | 0.00684 |
| Clay Loam | 618.21 | 72 | 7.8 | | 4.5 | 10 | 0.085 | 2.14 | 100.0 | 102.57 | 257.3 | 844.2 | 0.00533 |
| Silt | 613.71 | 28 | 3 | | 5 | 15 | 0.072 | 2.53 | 42.8 | 120.94 | 233.6 | 766.4 | 0.00652 |
| Silty Clay | 608.71 | 20 | 5.2 | | 5 | 20 | 0.080 | 2.89 | 30.6 | 138.29 | 230.1 | 754.9 | 0.00662 |
| Silty Clay | 603.71 | 100 | 5.2 | | 5.5 | 25.5 | 0.080 | 3.29 | 100.0 | 157.37 | 287.1 | 941.9 | 0.00584 |
| Shale | 598.21 | | Rock, manually input 2500 ft/s | | 1 | 26.5 | | | | | | 2500.0 | 0.0004 |
| Shale | 597.21 | | Rock, manually input 2500 ft/s | | 5 | 31.5 | | | | | | 2500.0 | 0.002 |
| Shale | 592.21 | | Rock, manually input 2500 ft/s | | 69.04 | 100.54 | | | | | | 2500.0 | 0.02762 |
| 100' Below Est. Fixity | 523.17 | | | | | | | | | | | | |

# SN 015-0081

**Boring B-2 (Pier 2)**

Ground Surface Elev. = 645.39 | 623.17 = Est. Fixity Elevation | Assumed Epoch= Quaternary | Average Shear Wave Velocity = 1673.3 ft/s

Ground Water Elev. = 644.35 | Hammer Efficiency (%) = 91.8 | **Site Class C**

| Soil Description | Top Elev. | N | $Q_u$ (tsf) | Comments | $d_i$ (ft) | $\Sigma d_i$ (ft) | $\gamma'$ (kcf) | $\sigma'_v$ (ksf) | N60 | $\sigma'_v$ (kPa) | $v_{si}$ (m/s) | $v_{si}$ (ft/s) | $d_i/v_{si}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Riprap | 645.39 | 3 | 0.3 | | 2.5 | 0 | 0.089 | 0.00 | 4.6 | 0.00 | | | |
| Sandy Loam | 642.89 | 3 | 0.3 | | 1.91 | 0 | 0.046 | 0.22 | 4.6 | 10.60 | | | |
| Sandy Loam | 640.98 | 2 | 0.3 | | 2.5 | 0 | 0.046 | 0.31 | 3.1 | 14.80 | | | |
| Sandy Clay | 638.48 | 2 | 1.3 | | 2.5 | 0 | 0.062 | 0.42 | 3.1 | 20.31 | | | |
| Sand | 635.98 | 13 | | | 2.5 | 0 | 0.063 | 0.58 | 19.9 | 27.75 | | | |
| Sand | 633.48 | 45 | | | 3.5 | 0 | 0.075 | 0.74 | 68.9 | 35.32 | | | |
| Sandy Loam | 629.98 | 39 | | | 1.5 | 0 | 0.073 | 1.00 | 59.7 | 47.83 | | | |
| Sandy Loam | 628.48 | 40 | | **Est. Fixity Layer** | 7 | 1.69 | 0.074 | 1.11 | 61.2 | 53.09 | 202.2 | 663.3 | 0.00255 |
| Clay Loam | 621.48 | 30 | 7 | | 4.5 | 6.19 | 0.084 | 1.62 | 45.9 | 77.74 | 207.9 | 682.0 | 0.0066 |
| Clay Till | 616.98 | 17 | 6.6 | | 5 | 11.19 | 0.083 | 2.00 | 26.0 | 95.79 | 201.0 | 659.6 | 0.00758 |
| Clay Till | 611.98 | 17 | 6.6 | | 7 | 18.19 | 0.083 | 2.42 | 26.0 | 115.65 | 206.9 | 678.8 | 0.01031 |
| Shale | 604.98 | | Rock, manually input 2500 ft/s | | 81.81 | 100 | | | | | | 2500.0 | 0.03272 |
| 100' Below Top Level | 523.17 | | | | | | | | | | | | |

# SN 015-0081

**Boring B-2 (N. Abut.)**

Ground Surface Elev. = 657.04 | 643.41 = Est. Fixity Elevation | Assumed Epoch= Quaternary | Average Shear Wave Velocity = 1338.4 ft/s

Ground Water Elev. = 640 | Hammer Efficiency (%) = 91.8 | **Site Class CD**

| Soil Description | Top Elev. | N | $Q_u$ (tsf) | Comments | $d_i$ (ft) | $\Sigma d_{is}$ (ft) | $\gamma'$ (kcf) | $\sigma'_v$ (ksf) | N60 | $\sigma'_v$ (kPa) | $v_{si}$ (m/s) | $v_{si}$ (ft/s) | $d_i/v_{si}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Clay | 657.04 | 7 | 1.8 | | 3.56 | 0 | 0.128 | 0.00 | 10.7 | 0.00 | | | |
| Clay | 653.48 | 11 | 1.8 | | 2.5 | 0 | 0.128 | 0.46 | 16.8 | 21.90 | | | |
| Silty Clay | 650.98 | 7 | 1.4 | | 2.5 | 0 | 0.125 | 0.78 | 10.7 | 37.28 | | | |
| Clay | 648.48 | 9 | 2.3 | | 2.5 | 0 | 0.132 | 1.09 | 13.8 | 52.29 | | | |
| Clay Loam | 645.98 | 2 | 1 | | 2.5 | 0 | 0.122 | 1.42 | 3.1 | 68.04 | | | |
| Sandy Loam | 643.48 | 3 | 0.3 | **Est. Fixity Layer** | 2.5 | 2.43 | 0.108 | 1.72 | 4.6 | 82.58 | 141.7 | 464.9 | 0.00523 |
| Sandy Loam | 640.98 | 2 | 0.3 | | 2.5 | 4.93 | 0.070 | 2.00 | 3.1 | 95.55 | 137.2 | 450.0 | 0.00556 |
| Sandy Clay | 638.48 | 2 | 1.3 | | 2.5 | 7.43 | 0.062 | 2.17 | 3.1 | 103.98 | 140.6 | 461.2 | 0.00542 |
| Sand | 635.98 | 13 | | | 2.5 | 9.93 | 0.063 | 2.33 | 19.9 | 111.42 | 177.8 | 583.4 | 0.00429 |
| Sand | 633.48 | 45 | | | 3.5 | 13.43 | 0.075 | 2.49 | 68.9 | 118.99 | 241.2 | 791.3 | 0.00442 |
| Sandy Loam | 629.98 | 39 | | | 1.5 | 14.93 | 0.073 | 2.75 | 59.7 | 131.50 | 237.1 | 777.8 | 0.00193 |
| Sandy Loam | 628.48 | 40 | | | 7 | 21.93 | 0.074 | 2.86 | 61.2 | 136.77 | 244.3 | 801.6 | 0.00873 |
| Clay Loam | 621.48 | 30 | 7 | | 4.5 | 26.43 | 0.084 | 3.37 | 45.9 | 161.42 | 258.0 | 846.4 | 0.00532 |
| Clay Till | 616.98 | 17 | 6.6 | | 5 | 31.43 | 0.083 | 3.75 | 26.0 | 179.46 | 238.1 | 781.3 | 0.0064 |
| Shale | 611.98 | | Rock, manually input 2500 ft/s | | 68.57 | 100 | | | | | | 2500.0 | 0.02743 |
| 100' Below Top Level | 543.41 | | | | | | | | | | | | |

# Attachment E – Pile Data

Illinois Department of Transportation

# INTEGRAL ABUTMENT FEASIBILITY ANALYSIS

Modified 10/30/17

**GENERAL DATA**

| | | | | | |
|---|---|---|---|---|---|
| STRUCTURE NUMBER | 015-0081 | | TOTAL STRUCTURE LENGTH | 184.58 | FT |
| STRUCTURE TYPE | MULTI-SPAN | | NUMBER OF SPANS | 3 | |
| STRUCTURE SKEW | 40 | DEGREES | END SPAN LENGTH | 53.00 | FT |
| SUPER. DATA IN REFERENCE TO SUB. DATA | ABUT 1 | | ADJACENT INTERIOR SPAN LENGTH | 75.00 | FT |

**SUPERSTRUCTURE POSITIVE MOMENT REGION DATA (END OR MAIN SPAN)**

| | | |
|---|---|---|
| BEAM TYPE | WIDE FLANGE | |
| WIDE FLANGE | W33X152 (Assumed Weight) | |
| BEAM SPACING PERP. TO CL | 7.25 | FT |
| SLAB THICKNESS | 8.00 | IN |
| SLAB F'C | 4.00 | KSI |

**SUPERSTRUCTURE POSITIVE MOMENT REGION DATA (ADJACENT SPAN)**

| | | |
|---|---|---|
| WIDE FLANGE | W33X152 (Assumed Weight) | |
| BEAM SPACING PERP. TO CL | 7.25 | FT |
| SLAB THICKNESS | 8.00 | IN |
| SLAB F'C | 4.00 | KSI |

**ABUTMENT #1 DATA**

| | | |
|---|---|---|
| ABUTMENT NAME | South | |
| ABUTMENT REFERENCE BORING | B-1 | |
| BOTTOM OF ABUTMENT ELEVATION | 650.76 | FT |
| ESTIMATED NUMBER OF PILES AT ABUT. | 5 | |
| PILE SPACING PERP. TO CL | 7.25 | FT |

**ABUTMENT #2 DATA**

| | | |
|---|---|---|
| ABUTMENT NAME | North | |
| ABUTMENT REFERENCE BORING | B-2 | |
| BOTTOM OF ABUTMENT ELEVATION | 649.41 | FT |
| ESTIMATED NUMBER OF PILES AT ABUT. | 5 | |
| PILE SPACING PERP. TO CL | 7.25 | FT |

**SOIL DATA FOR 10 FT BENEATH BOTTOM OF ABUTMENT #1**

| *BOT. OF LAYER ELEV. (FT)* | *LAYER THICKNESS (FT)* | *UNCONFINED COMPRESSIVE STRENGTH (TSF)* | *N S.P.T. VALUE (BLOWS/12 IN.)* | *Qu EQUIV. FOR N VALUE (TSF)* |
|---|---|---|---|---|
| 649.71 | 1.05 | 1.3 | | |
| 647.21 | 2.50 | 1.4 | | |
| 644.71 | 2.50 | 1.2 | | |
| 642.21 | 2.50 | 1.2 | | |
| 640.76 | 1.45 | 1.3 | | |
| | | | | |
| | | | | |

10.00 FT = TOTAL DEPTH ENTERED

**SOIL DATA FOR 10 FT BENEATH BOTTOM OF ABUTMENT #2**

| *BOT. OF LAYER ELEV. (FT)* | *LAYER THICKNESS (FT)* | *UNCONFINED COMPRESSIVE STRENGTH (TSF)* | *N S.P.T. VALUE (BLOWS/12 IN.)* | *Qu EQUIV. FOR N VALUE (TSF)* |
|---|---|---|---|---|
| 648.48 | 0.93 | 1.4 | | |
| 645.98 | 2.50 | 2.3 | | |
| 643.48 | 2.50 | 1.0 | | |
| 640.98 | 2.50 | 0.30 | | |
| 639.41 | 1.57 | 0.30 | | |
| | | | | |
| | | | | |

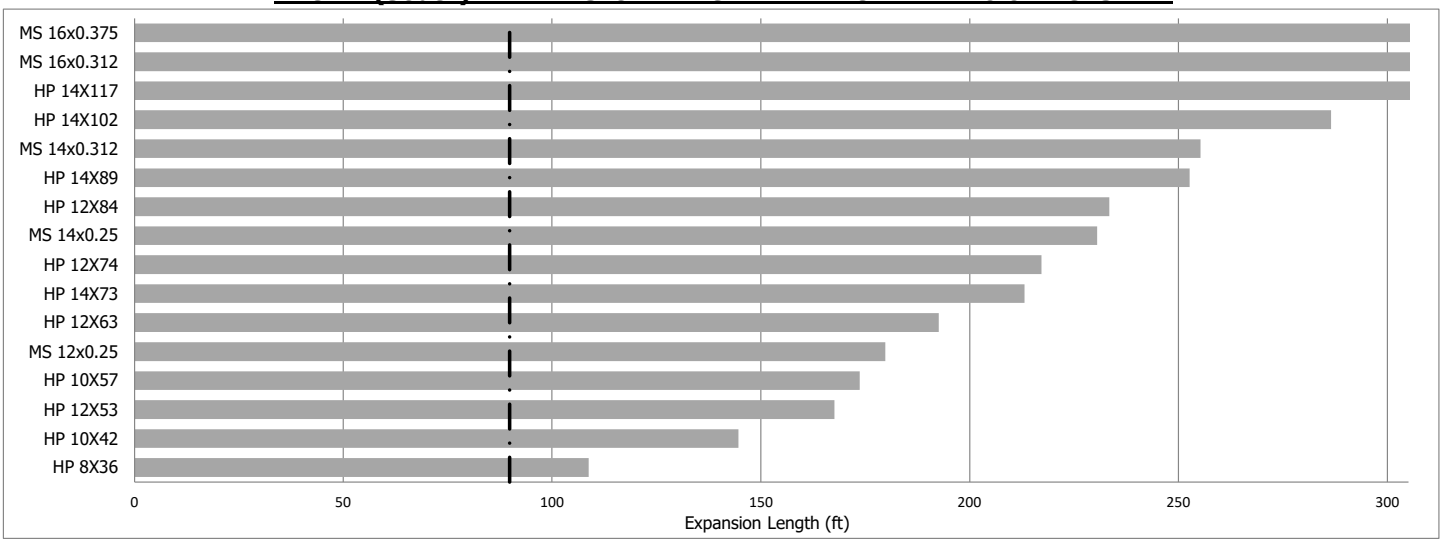
10.00 FT = TOTAL DEPTH ENTERED

| | | | | | |
|---|---|---|---|---|---|
| WEIGHTED AVERAGE Qu FOR ABUTMENT #1 | 1.28 | TSF | WEIGHTED AVERAGE Qu FOR ABUTMENT #2 | 1.08 | TSF |
| PILE STIFFNESS MODIFIER FOR ABUTMENT #1 = 1/(1.45-[0.3*1.28]) | 0.94 | | PILE STIFFNESS MODIFIER FOR ABUTMENT #2 = 1/(1.45-[0.3*1.08]) | 0.89 | |

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #1 = [0.94*5*0+0.89*5*184.583333333333]/[0.94*5+0.89*5] = 89.80 FT

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #2 = [0.89*5*0+0.94*5*184.583333333333]/[0.89*5+0.94*5] = 94.79 FT

## ABUT 1 (South) - EXPANSION LENGTH LIMIT CHART - 40.0 DEG. SKEW




*= Estimated expansion length for the indicated abutment. Piles with an expansion length greater than this are suitable for consideration.*
*(Note: The same size pile should be used at both abutments.)*

Illinois Department of Transportation

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== S Abutment
REFERENCE BORING ========== B-01
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 652.76 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 650.76 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 749 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 46.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 130.30 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 48.86 KIPS

PILE TYPE AND SIZE ========== Steel HP 12 X 84
Plugged Pile Perimeter========== 4.100 FT. Unplugged Pile Perimeter========== 5.942 FT.
Plugged Pile End Bearing Area========== 1.051 SQFT. Unplugged Pile End Bearing Area========= 0.171 SQFT.

***MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses***

| Maximum Nominal Req'd Bearing of Pile | Maximum Nominal Req.d Bearing of Boring | Maximum Factored Resistance Available in Boring | Maximum Pile Driveable Length in Boring |
|---|---|---|---|
| **664** KIPS | **664** KIPS | **365** KIPS | **62** FT. |

| BOT. OF LAYER ELEV. (FT.) | LAYER THICK. (FT.) | UNCONF. COMPR. STRENGTH (TSF.) | S.P.T. N VALUE (BLOWS) | GRANULAR OR ROCK LAYER DESCRIPTION | NOMINAL PLUGGED SIDE RESIST. (KIPS) | NOMINAL PLUGGED END BRG. RESIST. (KIPS) | NOMINAL PLUGGED TOTAL RESIST. (KIPS) | NOMINAL UNPLUG'D SIDE RESIST. (KIPS) | NOMINAL UNPLUG'D END BRG. RESIST. (KIPS) | NOMINAL UNPLUG'D TOTAL RESIST. (KIPS) | NOMINAL REQ'D BEARING (KIPS) | FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS) | FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS) | FACTORED RESISTANCE AVAILABLE (KIPS) | ESTIMATED PILE LENGTH (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 649.71 | 1.05 | 1.30 | | | 3.7 | | 24.4 | 5.4 | | ***8.8*** | 9 | 0 | 0 | 5 | 3 |
| 647.21 | 2.50 | 1.40 | | | 9.4 | 20.6 | 30.8 | 13.6 | 3.4 | ***21.9*** | 22 | 0 | 0 | 12 | 6 |
| 644.71 | 2.50 | 1.20 | | | 8.4 | 17.7 | 39.2 | 12.2 | 2.9 | ***34.1*** | 34 | 0 | 0 | 19 | 8 |
| 642.21 | 2.50 | 1.20 | | | 8.4 | 17.7 | 49.1 | 12.2 | 2.9 | ***46.5*** | 47 | 0 | 0 | 26 | 11 |
| 639.71 | 2.50 | 1.30 | | | 8.9 | 19.1 | ***44.7*** | 12.9 | 3.1 | 57.3 | 45 | 0 | 0 | 25 | 13 |
| 637.21 | 2.50 | 0.40 | | | 3.3 | 5.9 | 78.9 | 4.7 | 1.0 | ***67.0*** | 67 | 0 | 0 | 37 | 16 |
| 634.71 | 2.50 | 2.50 | | | 13.8 | 36.8 | 131.8 | 20.0 | 6.0 | ***93.4*** | 93 | 0 | 0 | 51 | 18 |
| 632.21 | 2.50 | | 29 | Medium Sand | 5.6 | 75.9 | 236.9 | 8.1 | 12.3 | ***117.7*** | 118 | 0 | 0 | 65 | 21 |
| 628.71 | 3.50 | | 67 | Fine Sand | 27.1 | 175.4 | 151.4 | 39.3 | 28.5 | ***138.6*** | 139 | 0 | 0 | 76 | 24 |
| 627.21 | 1.50 | | 32 | Hard Till | 2.1 | 62.8 | 153.6 | 3.1 | 10.2 | ***141.8*** | 142 | 0 | 0 | 78 | 26 |
| 623.71 | 3.50 | | 32 | Hard Till | 5.0 | 62.8 | 273.8 | 7.2 | 10.2 | ***167.7*** | 168 | 0 | 0 | 92 | 29 |
| 618.71 | 5.00 | | 68 | Fine Sand | 39.8 | 178.0 | 276.9 | 57.6 | 28.9 | ***219.4*** | 219 | 0 | 0 | 121 | 34 |
| 613.71 | 5.00 | | 72 | Hard Till | 24.1 | 141.3 | ***203.8*** | 34.9 | 23.0 | 238.5 | 204 | 0 | 0 | 112 | 39 |
| 608.71 | 5.00 | 3.00 | | | 31.4 | 44.2 | ***230.2*** | 45.5 | 7.2 | 283.2 | 230 | 0 | 0 | 127 | 44 |
| 603.71 | 5.00 | | 20 | Hard Till | 4.5 | 39.3 | 332.9 | 6.5 | 6.4 | ***305.6*** | 306 | 0 | 0 | 168 | 49 |
| 598.21 | 5.50 | | 70 | Hard Till | 25.2 | 137.4 | 351.5 | 36.5 | 22.3 | ***341.0*** | 341 | 0 | 0 | 188 | 55 |
| 597.21 | 1.00 | | | Shale | 51.1 | 130.9 | ***402.6*** | 74.0 | 21.3 | 415.0 | 403 | 0 | 0 | 221 | 55.6 |
| 596.21 | 1.00 | | | Shale | 51.1 | 130.9 | ***453.7*** | 74.0 | 21.3 | 489.1 | 454 | 0 | 0 | 250 | 56.6 |
| 595.21 | 1.00 | | | Shale | 51.1 | 130.9 | ***504.7*** | 74.0 | 21.3 | 563.1 | 505 | 0 | 0 | 278 | 57.6 |
| 594.21 | 1.00 | | | Shale | 51.1 | 130.9 | ***555.8*** | 74.0 | 21.3 | 637.1 | 556 | 0 | 0 | 306 | 58.6 |
| 593.21 | 1.00 | | | Shale | 51.1 | 130.9 | ***606.9*** | 74.0 | 21.3 | 711.1 | 607 | 0 | 0 | 334 | 59.6 |
| 592.21 | 1.00 | | | Shale | 51.1 | 130.9 | ***658.0*** | 74.0 | 21.3 | 785.1 | 658 | 0 | 0 | 362 | 60.6 |
| 591.21 | 1.00 | | | Shale | 51.1 | 130.9 | ***709.0*** | 74.0 | 21.3 | 859.1 | ~~709~~ | ~~0~~ | ~~0~~ | ~~390~~ | ~~61.6~~ |
| 590.21 | 1.00 | | | Shale | 51.1 | 130.9 | ***760.1*** | 74.0 | 21.3 | 933.2 | ~~760~~ | ~~0~~ | ~~0~~ | ~~418~~ | ~~62.6~~ |
| 589.21 | 1.00 | | | Shale | 51.1 | 130.9 | ***811.2*** | 74.0 | 21.3 | 1007.2 | ~~811~~ | ~~0~~ | ~~0~~ | ~~446~~ | ~~63.6~~ |
| 588.21 | 1.00 | | | Shale | 51.1 | 130.9 | ***862.3*** | 74.0 | 21.3 | 1081.2 | ~~862~~ | ~~0~~ | ~~0~~ | ~~474~~ | ~~64.6~~ |
| 587.21 | 1.00 | | | Shale | | 130.9 | | | 21.3 | | | | | | |

**Pile Design Table for S Abutment utilizing Boring #B-01**

| Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|
| **Metal Shell 12"Φ w/.25" walls** | | |
| 72 | 40 | 16 |
| 210 | 116 | 18 |
| **Metal Shell 14"Φ w/.25" walls** | | |
| 88 | 49 | 16 |
| 273 | 150 | 18 |
| **Metal Shell 14"Φ w/.312" walls** | | |
| 88 | 49 | 16 |
| 273 | 150 | 18 |
| 388 | 213 | 24 |
| 397 | 218 | 26 |
| **Metal Shell 16"Φ w/.312" walls** | | |
| 68 | 38 | 13 |
| 106 | 58 | 16 |
| 344 | 189 | 18 |
| **Metal Shell 16"Φ w/.375" walls** | | |
| 68 | 38 | 13 |
| 106 | 58 | 16 |
| 344 | 189 | 18 |
| 469 | 258 | 24 |
| 480 | 264 | 26 |
| **Steel HP 8 X 36** | | |
| 87 | 48 | 26 |
| 103 | 57 | 29 |
| 124 | 68 | 39 |
| 142 | 78 | 44 |
| 188 | 103 | 49 |
| 202 | 111 | 55 |
| 286 | 157 | 58 |

| Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|
| **Steel HP 10 X 42** | | |
| 87 | 48 | 21 |
| 110 | 61 | 24 |
| 113 | 62 | 26 |
| 128 | 70 | 29 |
| 157 | 86 | 39 |
| 179 | 99 | 44 |
| 243 | 134 | 49 |
| 262 | 144 | 55 |
| 335 | 184 | 57 |
| **Steel HP 10 X 57** | | |
| 75 | 41 | 18 |
| 93 | 51 | 21 |
| 113 | 62 | 24 |
| 115 | 63 | 26 |
| 134 | 74 | 29 |
| 161 | 88 | 39 |
| 183 | 101 | 44 |
| 248 | 136 | 49 |
| 269 | 148 | 55 |
| 454 | 250 | 60 |
| **Steel HP 12 X 53** | | |
| 87 | 48 | 18 |
| 105 | 58 | 21 |
| 132 | 72 | 24 |
| 135 | 74 | 26 |
| 154 | 85 | 29 |
| 196 | 108 | 39 |
| 222 | 122 | 44 |
| 291 | 160 | 49 |
| 326 | 179 | 55 |
| 418 | 230 | 57 |
| **Steel HP 12 X 63** | | |
| 65 | 36 | 16 |
| 89 | 49 | 18 |
| 110 | 60 | 21 |
| 135 | 74 | 24 |
| 138 | 76 | 26 |
| 159 | 87 | 29 |
| 198 | 109 | 39 |
| 224 | 123 | 44 |
| 297 | 163 | 49 |
| 333 | 183 | 55 |
| 497 | 273 | 59 |
| **Steel HP 12 X 74** | | |
| 66 | 36 | 16 |
| 92 | 50 | 18 |
| 114 | 63 | 21 |
| 137 | 75 | 24 |
| 140 | 77 | 26 |
| 164 | 90 | 29 |
| 201 | 110 | 39 |
| 227 | 125 | 44 |
| 301 | 166 | 49 |
| 337 | 185 | 55 |
| 589 | 324 | 60 |

| Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|
| **Steel HP 12 X 84** | | |
| 67 | 37 | 16 |
| 93 | 51 | 18 |
| 118 | 65 | 21 |
| 139 | 76 | 24 |
| 142 | 78 | 26 |
| 168 | 92 | 29 |
| 204 | 112 | 39 |
| 230 | 127 | 44 |
| 306 | 168 | 49 |
| 341 | 188 | 55 |
| 664 | 365 | 62 |
| **Steel HP 14 X 73** | | |
| 77 | 42 | 16 |
| 106 | 58 | 18 |
| 129 | 71 | 21 |
| 160 | 88 | 24 |
| 163 | 90 | 26 |
| 188 | 103 | 29 |
| 241 | 133 | 39 |
| 270 | 149 | 44 |
| 352 | 194 | 49 |
| 394 | 217 | 55 |
| 578 | 318 | 58 |
| **Steel HP 14 X 89** | | |
| 79 | 43 | 16 |
| 109 | 60 | 18 |
| 136 | 75 | 21 |
| 163 | 90 | 24 |
| 167 | 92 | 26 |
| 195 | 107 | 29 |
| 244 | 134 | 39 |
| 274 | 151 | 44 |
| 359 | 197 | 49 |
| 401 | 221 | 55 |
| 705 | 388 | 60 |
| **Steel HP 14 X 102** | | |
| 80 | 44 | 16 |
| 111 | 61 | 18 |
| 141 | 77 | 21 |
| 165 | 91 | 24 |
| 169 | 93 | 26 |
| 200 | 110 | 29 |
| 247 | 136 | 39 |
| 277 | 153 | 44 |
| 364 | 200 | 49 |
| 406 | 223 | 55 |
| 810 | 445 | 62 |
| **Steel HP 14 X 117** | | |
| 81 | 45 | 16 |
| 114 | 63 | 18 |
| 147 | 81 | 21 |
| 168 | 92 | 24 |
| 172 | 95 | 26 |
| 207 | 114 | 29 |
| 251 | 138 | 39 |
| 281 | 154 | 44 |
| 371 | 204 | 49 |
| 413 | 227 | 55 |
| 929 | 511 | 64 |
| **Precast 14"x 14"** | | |
| 75 | 41 | 13 |
| 112 | 62 | 16 |

Illinois Department of Transportation

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 1
REFERENCE BORING ========== B-01
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 652.30 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 629.17 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1430 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 46.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 248.66 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 93.25 KIPS

***MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses***

| Maximum Nominal Req'd Bearing of Pile | Maximum Nominal Req.d Bearing of Boring | Maximum Factored Resistance Available in Boring | Maximum Pile Driveable Length in Boring |
|---|---|---|---|
| **418** KIPS | **418** KIPS | **230** KIPS | **58** FT. |

PILE TYPE AND SIZE ========== Steel HP 12 X 53
Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area========= 0.108 SQFT.

| BOT. OF LAYER ELEV. (FT.) | LAYER THICK. (FT.) | UNCONF. COMPR. STRENGTH (TSF.) | S.P.T. N VALUE (BLOWS) | GRANULAR OR ROCK LAYER DESCRIPTION | NOMINAL PLUGGED SIDE RESIST. (KIPS) | NOMINAL PLUGGED END BRG. RESIST. (KIPS) | NOMINAL PLUGGED TOTAL RESIST. (KIPS) | NOMINAL UNPLUG'D SIDE RESIST. (KIPS) | NOMINAL UNPLUG'D END BRG. RESIST. (KIPS) | NOMINAL UNPLUG'D TOTAL RESIST. (KIPS) | NOMINAL REQ'D BEARING (KIPS) | FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS) | FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS) | FACTORED RESISTANCE AVAILABLE (KIPS) | ESTIMATED PILE LENGTH (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 628.71 | 0.46 | | 67 | Fine Sand | 3.4 | | 46.3 | 5.0 | | ***9.7*** | 10 | 0 | 0 | 5 | 24 |
| 623.71 | 5.00 | | 32 | Hard Till | 6.9 | 42.8 | 177.0 | 10.1 | 4.7 | ***33.4*** | 33 | 0 | 0 | 18 | 29 |
| 618.71 | 5.00 | | 68 | Fine Sand | 38.5 | 166.6 | 181.1 | 56.3 | 18.2 | ***85.9*** | 86 | 0 | 0 | 47 | 34 |
| 613.71 | 5.00 | | 72 | Hard Till | 23.3 | 132.3 | 113.5 | 34.1 | 14.5 | ***110.0*** | 110 | 0 | 0 | 61 | 39 |
| 608.71 | 5.00 | 3.00 | | | 30.3 | 41.3 | ***139.2*** | 44.4 | 4.5 | 153.9 | 139 | 0 | 0 | 77 | 44 |
| 603.71 | 5.00 | | 20 | Hard Till | 4.3 | 36.7 | 235.4 | 6.3 | 4.0 | ***170.2*** | 170 | 0 | 0 | 94 | 49 |
| 598.21 | 5.50 | | 70 | Hard Till | 24.4 | 128.6 | 253.7 | 35.6 | 14.1 | ***205.2*** | 205 | 0 | 0 | 113 | 54 |
| 597.21 | 1.00 | | | Shale | 49.4 | 122.5 | 303.1 | 72.3 | 13.4 | ***277.4*** | 277 | 0 | 0 | 153 | 55.1 |
| 596.21 | 1.00 | | | Shale | 49.4 | 122.5 | 352.5 | 72.3 | 13.4 | ***349.7*** | 350 | 0 | 0 | 192 | 56.1 |
| 595.21 | 1.00 | | | Shale | 49.4 | 122.5 | ***401.9*** | 72.3 | 13.4 | 422.0 | 402 | 0 | 0 | 221 | 57.1 |
| 594.21 | 1.00 | | | Shale | 49.4 | 122.5 | ***451.3*** | 72.3 | 13.4 | 494.2 | ~~451~~ | ~~0~~ | ~~0~~ | ~~248~~ | ~~58.1~~ |
| 593.21 | 1.00 | | | Shale | 49.4 | 122.5 | ***500.7*** | 72.3 | 13.4 | 566.5 | ~~501~~ | ~~0~~ | ~~0~~ | ~~275~~ | ~~59.1~~ |
| 592.21 | 1.00 | | | Shale | 49.4 | 122.5 | ***550.1*** | 72.3 | 13.4 | 638.7 | ~~550~~ | ~~0~~ | ~~0~~ | ~~303~~ | ~~60.1~~ |
| 591.21 | 1.00 | | | Shale | 49.4 | 122.5 | ***599.6*** | 72.3 | 13.4 | 711.0 | ~~600~~ | ~~0~~ | ~~0~~ | ~~330~~ | ~~61.1~~ |
| 590.21 | 1.00 | | | Shale | 49.4 | 122.5 | ***649.0*** | 72.3 | 13.4 | 783.2 | ~~649~~ | ~~0~~ | ~~0~~ | ~~357~~ | ~~62.1~~ |
| 589.21 | 1.00 | | | Shale | 49.4 | 122.5 | ***698.4*** | 72.3 | 13.4 | 855.5 | ~~698~~ | ~~0~~ | ~~0~~ | ~~384~~ | ~~63.1~~ |
| 588.21 | 1.00 | | | Shale | 49.4 | 122.5 | ***747.8*** | 72.3 | 13.4 | 927.7 | ~~748~~ | ~~0~~ | ~~0~~ | ~~411~~ | ~~64.1~~ |
| 587.21 | 1.00 | | | Shale | | 122.5 | | | 13.4 | | | | | | |

## Pile Design Table for Pier 1 utilizing Boring #B-01

| Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|
| **Metal Shell 12"Φ w/.25" walls** | | |
| 146 | 80 | 24 |
| **Metal Shell 14"Φ w/.25" walls** | | |
| 146 | 80 | 24 |
| **Metal Shell 14"Φ w/.312" walls** | | |
| 146 | 80 | 24 |
| **Metal Shell 16"Φ w/.312" walls** | | |
| 146 | 80 | 24 |
| **Metal Shell 16"Φ w/.375" walls** | | |
| 146 | 80 | 24 |
| **Steel HP 8 X 36** | | |
| 286 | 157 | 58 |

| Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|
| **Steel HP 10 X 42** | | |
| 151 | 83 | 49 |
| 181 | 99 | 54 |
| 335 | 184 | 58 |
| **Steel HP 10 X 57** | | |
| 156 | 86 | 49 |
| 185 | 102 | 54 |
| 454 | 250 | 60 |
| **Steel HP 12 X 53** | | |
| 147 | 81 | 44 |
| 181 | 100 | 49 |
| 216 | 119 | 54 |
| 418 | 230 | 58 |
| **Steel HP 12 X 63** | | |
| 148 | 82 | 44 |
| 186 | 102 | 49 |
| 222 | 122 | 54 |
| 497 | 273 | 59 |
| **Steel HP 12 X 74** | | |
| 151 | 83 | 44 |
| 190 | 105 | 49 |
| 225 | 124 | 54 |
| 589 | 324 | 61 |

| Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|
| **Steel HP 12 X 84** | | |
| 153 | 84 | 44 |
| 194 | 106 | 49 |
| 229 | 126 | 54 |
| 664 | 365 | 62 |
| **Steel HP 14 X 73** | | |
| 146 | 80 | 39 |
| 182 | 100 | 44 |
| 220 | 121 | 49 |
| 262 | 144 | 54 |
| 578 | 318 | 59 |
| **Steel HP 14 X 89** | | |
| 149 | 82 | 39 |
| 184 | 101 | 44 |
| 226 | 125 | 49 |
| 268 | 148 | 54 |
| 705 | 388 | 61 |
| **Steel HP 14 X 102** | | |
| 150 | 83 | 39 |
| 187 | 103 | 44 |
| 231 | 127 | 49 |
| 273 | 150 | 54 |
| 810 | 445 | 62 |
| **Steel HP 14 X 117** | | |
| 153 | 84 | 39 |
| 189 | 104 | 44 |
| 236 | 130 | 49 |
| 279 | 153 | 54 |
| 929 | 511 | 64 |
| **Precast 14"x 14"** | | |
| 153 | 84 | 39 |
| 189 | 104 | 44 |
| 236 | 130 | 49 |
| 279 | 153 | 54 |

Illinois Department of Transportation

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 2
REFERENCE BORING ========== B-02 (Interp. w/ B-01)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 651.80 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 629.17 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1430 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 46.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 248.66 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 93.25 KIPS

***MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses***

| Maximum Nominal Req'd Bearing of Pile | Maximum Nominal Req.d Bearing of Boring | Maximum Factored Resistance Available in Boring | Maximum Pile Driveable Length in Boring |
|---|---|---|---|
| **418** KIPS | **398** KIPS | **219** KIPS | **52** FT. |

PILE TYPE AND SIZE ========== Steel HP 12 X 53
Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area========== 0.108 SQFT.

| BOT. OF LAYER ELEV. (FT.) | LAYER THICK. (FT.) | UNCONF. COMPR. STRENGTH (TSF.) | S.P.T. N VALUE (BLOWS) | GRANULAR OR ROCK LAYER DESCRIPTION | NOMINAL PLUGGED SIDE RESIST. (KIPS) | NOMINAL PLUGGED END BRG. RESIST. (KIPS) | NOMINAL PLUGGED TOTAL RESIST. (KIPS) | NOMINAL UNPLUG'D SIDE RESIST. (KIPS) | NOMINAL UNPLUG'D END BRG. RESIST. (KIPS) | NOMINAL UNPLUG'D TOTAL RESIST. (KIPS) | NOMINAL REQ'D BEARING (KIPS) | FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS) | FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS) | FACTORED RESISTANCE AVAILABLE (KIPS) | ESTIMATED PILE LENGTH (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 628.48 | 0.69 | | 39 | Fine Sand | 2.1 | | 33.3 | 3.0 | | ***6.4*** | 6 | 0 | 0 | 4 | 23 |
| 625.98 | 2.50 | | 40 | Fine Sand | 7.8 | 31.3 | 65.0 | 11.4 | 3.4 | ***20.5*** | 20 | 0 | 0 | 11 | 26 |
| 620.98 | 5.00 | | 30 | Hard Till | 6.4 | 55.1 | 47.6 | 9.4 | 6.0 | ***27.3*** | 27 | 0 | 0 | 15 | 31 |
| 615.98 | 5.00 | | 17 | Hard Till | 3.7 | 31.2 | 51.2 | 5.4 | 3.4 | ***32.7*** | 33 | 0 | 0 | 18 | 36 |
| 610.98 | 5.00 | | 17 | Hard Till | 3.7 | 31.2 | 54.9 | 5.4 | 3.4 | ***38.1*** | 38 | 0 | 0 | 21 | 41 |
| 604.98 | 6.00 | | 17 | Hard Till | 4.4 | 31.2 | 150.6 | 6.4 | 3.4 | ***54.5*** | 54 | 0 | 0 | 30 | 47 |
| 603.98 | 1.00 | | | Shale | 49.4 | 122.5 | 200.0 | 72.3 | 13.4 | ***126.7*** | 127 | 0 | 0 | 70 | 47.8 |
| 602.98 | 1.00 | | | Shale | 49.4 | 122.5 | 249.4 | 72.3 | 13.4 | ***199.0*** | 199 | 0 | 0 | 109 | 48.8 |
| 601.98 | 1.00 | | | Shale | 49.4 | 122.5 | 298.8 | 72.3 | 13.4 | ***271.2*** | 271 | 0 | 0 | 149 | 49.8 |
| 600.98 | 1.00 | | | Shale | 49.4 | 122.5 | 348.2 | 72.3 | 13.4 | ***343.5*** | 343 | 0 | 0 | 189 | 50.8 |
| 599.98 | 1.00 | | | Shale | 49.4 | 122.5 | ***397.7*** | 72.3 | 13.4 | 415.7 | 398 | 0 | 0 | 219 | 51.8 |
| 598.98 | 1.00 | | | Shale | 49.4 | 122.5 | ***447.1*** | 72.3 | 13.4 | 488.0 | ~~447~~ | ~~0~~ | ~~0~~ | ~~246~~ | ~~52.8~~ |
| 597.98 | 1.00 | | | Shale | 49.4 | 122.5 | ***496.5*** | 72.3 | 13.4 | 560.2 | ~~496~~ | ~~0~~ | ~~0~~ | ~~273~~ | ~~53.8~~ |
| 596.98 | 1.00 | | | Shale | 49.4 | 122.5 | ***545.9*** | 72.3 | 13.4 | 632.5 | ~~546~~ | ~~0~~ | ~~0~~ | ~~300~~ | ~~54.8~~ |
| 595.98 | 1.00 | | | Shale | 49.4 | 122.5 | ***595.3*** | 72.3 | 13.4 | 704.7 | ~~595~~ | ~~0~~ | ~~0~~ | ~~327~~ | ~~55.8~~ |
| 594.98 | 1.00 | | | Shale | 49.4 | 122.5 | ***644.7*** | 72.3 | 13.4 | 777.0 | ~~645~~ | ~~0~~ | ~~0~~ | ~~355~~ | ~~56.8~~ |
| 593.98 | 1.00 | | | Shale | 49.4 | 122.5 | ***694.1*** | 72.3 | 13.4 | 849.3 | ~~694~~ | ~~0~~ | ~~0~~ | ~~382~~ | ~~57.8~~ |
| 592.98 | 1.00 | | | Shale | 49.4 | 122.5 | ***743.6*** | 72.3 | 13.4 | 921.5 | ~~744~~ | ~~0~~ | ~~0~~ | ~~409~~ | ~~58.8~~ |
| 591.98 | 1.00 | | | Shale | 49.4 | 122.5 | ***793.0*** | 72.3 | 13.4 | 993.8 | ~~793~~ | ~~0~~ | ~~0~~ | ~~436~~ | ~~59.8~~ |
| 590.98 | 1.00 | | | Shale | 49.4 | 122.5 | ***842.4*** | 72.3 | 13.4 | 1066.0 | ~~842~~ | ~~0~~ | ~~0~~ | ~~463~~ | ~~60.8~~ |
| 589.98 | 1.00 | | | Shale | | 122.5 | | | 13.4 | | | | | | |

## Pile Design Table for Pier 2 utilizing Boring #B-02 (Interp. w/ B-01)

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Metal Shell 12"Φ w/.25" walls** | | | |
| | 155 | 85 | 36 |
| | 170 | 93 | 41 |
| | 372 | 204 | 47 |
| **Metal Shell 14"Φ w/.25" walls** | | | |
| | 120 | 66 | 23 |
| | 176 | 97 | 31 |
| | 193 | 106 | 36 |
| | 210 | 116 | 41 |
| **Metal Shell 14"Φ w/.312" walls** | | | |
| | 120 | 66 | 23 |
| | 176 | 97 | 31 |
| | 193 | 106 | 36 |
| | 210 | 116 | 41 |
| | 482 | 265 | 47 |
| **Metal Shell 16"Φ w/.312" walls** | | | |
| | 138 | 76 | 23 |
| | 215 | 118 | 31 |
| | 235 | 129 | 36 |
| | 254 | 140 | 41 |
| | 605 | 333 | 47 |
| **Metal Shell 16"Φ w/.375" walls** | | | |
| | 138 | 76 | 23 |
| | 215 | 118 | 31 |
| | 235 | 129 | 36 |
| | 254 | 140 | 41 |
| | 605 | 333 | 47 |
| **Steel HP 8 X 36** | | | |
| | 286 | 157 | 53 |

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Steel HP 10 X 42** | | | |
| | 335 | 184 | 52 |
| **Steel HP 10 X 57** | | | |
| | 454 | 250 | 55 |
| **Steel HP 12 X 53** | | | |
| | 418 | 230 | 52 |
| **Steel HP 12 X 63** | | | |
| | 497 | 273 | 53 |
| **Steel HP 12 X 74** | | | |
| | 589 | 324 | 55 |

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Steel HP 12 X 84** | | | |
| | 664 | 365 | 56 |
| **Steel HP 14 X 73** | | | |
| | 578 | 318 | 53 |
| **Steel HP 14 X 89** | | | |
| | 705 | 388 | 55 |
| **Steel HP 14 X 102** | | | |
| | 810 | 445 | 56 |
| **Steel HP 14 X 117** | | | |
| | 929 | 511 | 58 |
| **Precast 14"x 14"** | | | |
| | 265 | 84 | 23 |

Illinois Department of Transportation

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== N Abutment
REFERENCE BORING ========== B-02
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 651.41 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 649.41 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 749 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 46.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 130.30 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 48.86 KIPS

PILE TYPE AND SIZE ========== Steel HP 12 X 84
Plugged Pile Perimeter========== 4.100 FT. Unplugged Pile Perimeter========== 5.942 FT.
Plugged Pile End Bearing Area========== 1.051 SQFT. Unplugged Pile End Bearing Area========= 0.171 SQFT.

***MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses***

| Maximum Nominal Req'd Bearing of Pile | Maximum Nominal Req.d Bearing of Boring | Maximum Factored Resistance Available in Boring | Maximum Pile Driveable Length in Boring |
|---|---|---|---|
| **664** KIPS | **664** KIPS | **365** KIPS | **48** FT. |

| BOT. OF LAYER ELEV. (FT.) | LAYER THICK. (FT.) | UNCONF. COMPR. STRENGTH (TSF.) | S.P.T. N VALUE (BLOWS) | GRANULAR OR ROCK LAYER DESCRIPTION | NOMINAL PLUGGED SIDE RESIST. (KIPS) | NOMINAL PLUGGED END BRG. RESIST. (KIPS) | NOMINAL PLUGGED TOTAL RESIST. (KIPS) | NOMINAL UNPLUG'D SIDE RESIST. (KIPS) | NOMINAL UNPLUG'D END BRG. RESIST. (KIPS) | NOMINAL UNPLUG'D TOTAL RESIST. (KIPS) | NOMINAL REQ'D BEARING (KIPS) | FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS) | FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS) | FACTORED RESISTANCE AVAILABLE (KIPS) | ESTIMATED PILE LENGTH (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 648.48 | 0.93 | 1.40 | | | 3.5 | | 37.4 | 5.1 | | ***10.6*** | 11 | 0 | 0 | 6 | 3 |
| 645.98 | 2.50 | 2.30 | | | 13.1 | 33.9 | 31.3 | 18.9 | 5.5 | ***26.4*** | 26 | 0 | 0 | 15 | 5 |
| 643.48 | 2.50 | 1.00 | | | 7.3 | 14.7 | ***28.3*** | 10.6 | 2.4 | 35.3 | 28 | 0 | 0 | 16 | 8 |
| 640.98 | 2.50 | 0.30 | | | 2.5 | 4.4 | ***30.7*** | 3.6 | 0.7 | 38.9 | 31 | 0 | 0 | 17 | 10 |
| 638.48 | 2.50 | 0.30 | | | 2.5 | 4.4 | 47.9 | 3.6 | 0.7 | ***44.8*** | 45 | 0 | 0 | 25 | 13 |
| 635.98 | 2.50 | 1.30 | | | 8.9 | 19.1 | 71.7 | 12.9 | 3.1 | ***60.2*** | 60 | 0 | 0 | 33 | 15 |
| 633.48 | 2.50 | | 13 | Fine Sand | 2.3 | 34.0 | 157.8 | 3.3 | 5.5 | ***77.1*** | 77 | 0 | 0 | 42 | 18 |
| 630.98 | 2.50 | | 45 | Fine Sand | 9.9 | 117.8 | 152.0 | 14.3 | 19.1 | ***88.9*** | 89 | 0 | 0 | 49 | 20 |
| 628.48 | 2.50 | | 39 | Fine Sand | 7.7 | 102.1 | 162.3 | 11.2 | 16.6 | ***100.5*** | 101 | 0 | 0 | 55 | 23 |
| 625.98 | 2.50 | | 40 | Fine Sand | 8.1 | 104.7 | 124.6 | 11.7 | 17.0 | ***104.8*** | 105 | 0 | 0 | 58 | 25 |
| 620.98 | 5.00 | | 30 | Hard Till | 6.7 | 58.9 | ***105.7*** | 9.7 | 9.6 | 110.3 | 106 | 0 | 0 | 58 | 30 |
| 615.98 | 5.00 | | 17 | Hard Till | 3.8 | 33.4 | ***109.5*** | 5.5 | 5.4 | 115.8 | 110 | 0 | 0 | 60 | 35 |
| 611.98 | 4.00 | | 17 | Hard Till | 3.0 | 33.4 | 210.1 | 4.4 | 5.4 | ***136.1*** | 136 | 0 | 0 | 75 | 39 |
| 610.98 | 1.00 | | | Shale | 51.1 | 130.9 | 261.2 | 74.0 | 21.3 | ***210.1*** | 210 | 0 | 0 | 116 | 40.4 |
| 609.98 | 1.00 | | | Shale | 51.1 | 130.9 | 312.2 | 74.0 | 21.3 | ***284.1*** | 284 | 0 | 0 | 156 | 41.4 |
| 608.98 | 1.00 | | | Shale | 51.1 | 130.9 | 363.3 | 74.0 | 21.3 | ***358.1*** | 358 | 0 | 0 | 197 | 42.4 |
| 607.98 | 1.00 | | | Shale | 51.1 | 130.9 | ***414.4*** | 74.0 | 21.3 | 432.1 | 414 | 0 | 0 | 228 | 43.4 |
| 606.98 | 1.00 | | | Shale | 51.1 | 130.9 | ***465.5*** | 74.0 | 21.3 | 506.1 | 465 | 0 | 0 | 256 | 44.4 |
| 605.98 | 1.00 | | | Shale | 51.1 | 130.9 | ***516.5*** | 74.0 | 21.3 | 580.2 | 517 | 0 | 0 | 284 | 45.4 |
| 604.98 | 1.00 | | | Shale | 51.1 | 130.9 | ***567.6*** | 74.0 | 21.3 | 654.2 | 568 | 0 | 0 | 312 | 46.4 |
| 603.98 | 1.00 | | | Shale | 51.1 | 130.9 | ***618.7*** | 74.0 | 21.3 | 728.2 | 619 | 0 | 0 | 340 | 47.4 |
| 602.98 | 1.00 | | | Shale | 51.1 | 130.9 | ***669.8*** | 74.0 | 21.3 | 802.2 | ~~670~~ | ~~0~~ | ~~0~~ | ~~368~~ | ~~48.4~~ |
| 601.98 | 1.00 | | | Shale | 51.1 | 130.9 | ***720.8*** | 74.0 | 21.3 | 876.2 | ~~721~~ | ~~0~~ | ~~0~~ | ~~396~~ | ~~49.4~~ |
| 600.98 | 1.00 | | | Shale | 51.1 | 130.9 | ***771.9*** | 74.0 | 21.3 | 950.2 | ~~772~~ | ~~0~~ | ~~0~~ | ~~425~~ | ~~50.4~~ |
| 599.98 | 1.00 | | | Shale | | 130.9 | | | 21.3 | | | | | | |

## Pile Design Table for N Abutment utilizing Boring #B-02

| Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|
| **Metal Shell 12"Φ w/.25" walls** | | |
| 46 | 25 | 13 |
| 110 | 60 | 15 |
| 242 | 133 | 30 |
| 257 | 141 | 35 |
| **Metal Shell 14"Φ w/.25" walls** | | |
| 56 | 31 | 13 |
| 140 | 77 | 15 |
| 295 | 162 | 30 |
| 312 | 172 | 35 |
| **Metal Shell 14"Φ w/.312" walls** | | |
| 56 | 31 | 13 |
| 140 | 77 | 15 |
| 295 | 162 | 30 |
| 312 | 172 | 35 |
| **Metal Shell 16"Φ w/.312" walls** | | |
| 66 | 36 | 13 |
| 175 | 96 | 15 |
| 351 | 193 | 30 |
| 371 | 204 | 35 |
| **Metal Shell 16"Φ w/.375" walls** | | |
| 66 | 36 | 13 |
| 175 | 96 | 15 |
| 351 | 193 | 30 |
| 371 | 204 | 35 |
| 714 | 393 | 39 |
| **Steel HP 8 X 36** | | |
| 286 | 157 | 44 |

| Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|
| **Steel HP 10 X 42** | | |
| 83 | 46 | 35 |
| 105 | 58 | 39 |
| 335 | 184 | 44 |
| **Steel HP 10 X 57** | | |
| 85 | 47 | 35 |
| 109 | 60 | 39 |
| 454 | 250 | 47 |
| **Steel HP 12 X 53** | | |
| 81 | 45 | 20 |
| 92 | 51 | 23 |
| 99 | 54 | 25 |
| 101 | 56 | 30 |
| 105 | 58 | 35 |
| 125 | 69 | 39 |
| 418 | 230 | 44 |
| **Steel HP 12 X 63** | | |
| 84 | 46 | 20 |
| 95 | 52 | 23 |
| 101 | 56 | 25 |
| 102 | 56 | 30 |
| 106 | 58 | 35 |
| 130 | 71 | 39 |
| 497 | 273 | 45 |
| **Steel HP 12 X 74** | | |
| 87 | 48 | 20 |
| 98 | 54 | 23 |
| 103 | 57 | 25 |
| 104 | 57 | 30 |
| 108 | 59 | 35 |
| 133 | 73 | 39 |
| 589 | 324 | 47 |

| Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|
| **Steel HP 12 X 84** | | |
| 77 | 42 | 18 |
| 89 | 49 | 20 |
| 101 | 55 | 23 |
| 105 | 58 | 25 |
| 106 | 58 | 30 |
| 110 | 60 | 35 |
| 136 | 75 | 39 |
| 664 | 365 | 48 |
| **Steel HP 14 X 73** | | |
| 85 | 47 | 18 |
| 99 | 55 | 20 |
| 113 | 62 | 23 |
| 120 | 66 | 25 |
| 127 | 70 | 30 |
| 131 | 72 | 35 |
| 153 | 84 | 39 |
| 578 | 318 | 45 |
| **Steel HP 14 X 89** | | |
| 71 | 39 | 15 |
| 89 | 49 | 18 |
| 103 | 57 | 20 |
| 117 | 64 | 23 |
| 123 | 68 | 25 |
| 129 | 71 | 30 |
| 133 | 73 | 35 |
| 158 | 87 | 39 |
| 705 | 388 | 47 |
| **Steel HP 14 X 102** | | |
| 72 | 39 | 15 |
| 92 | 51 | 18 |
| 106 | 58 | 20 |
| 120 | 66 | 23 |
| 125 | 69 | 25 |
| 130 | 72 | 30 |
| 135 | 74 | 35 |
| 162 | 89 | 39 |
| 810 | 445 | 48 |
| **Steel HP 14 X 117** | | |
| 73 | 40 | 15 |
| 96 | 53 | 18 |
| 110 | 60 | 20 |
| 124 | 68 | 23 |
| 127 | 70 | 25 |
| 132 | 73 | 30 |
| 137 | 75 | 35 |
| 167 | 92 | 39 |
| 929 | 511 | 50 |
| **Precast 14"x 14"** | | |
| 71 | 39 | 13 |
| 179 | 98 | 15 |

# Attachment F – Seal Coat Analysis & Example Pier Detail

Illinois Department of Transportation

# SEALCOAT ANALYSIS

## INPUT DATA:

| | | |
|---|---|---|
| SEALCOAT THICKNESS | 5 | FT. |
| COFFERDAM DESIGN WATER ELEVATION | 647.35 | FT. |
| STREAMBED ELEVATION | 634.2 | FT. |
| BOTTOM OF FOOTING ELEVATION | 634.17 | FT. |
| BOTTOM OF SHEETING TIP ELEVATION | 623.10 | FT. |
| SHEET PILING WEIGHT | 22.00 | LBS./SQ.FT. |
| MISCELLANEOUS WEIGHT (WALES, STRUTS, ETC.) | 10000.00 | LBS. |
| COFFERDAM WIDTH | 10.00 | FT. |
| COFFERDAM LENGTH | 53.47 | FT. |
| FOOTING WIDTH | 2.00 | FT. |
| FOOTING LENGTH | 45.47 | FT. |
| NUMBER OF PILES IN COFFERDAM | 6 | |
| PILE LENGTH BELOW TOP OF SEAL | 20.00 | FT. |
| EDGE OF FOOTING TO EDGE OF FOUNDATION PILES = | 1.00 | FT. |
| INPUT H-PILE SECTION, OR PILE DIAMETER | HP 12X53 | |

## ASSUMED PARAMETERS:

SEALCOAT CONCRETE UNIT WT.:
150 PCF.
BUOYANT SOIL UNIT WT.:
40 PCF.
SEALCOAT BOND TO THE SHEETING:
7 PSI.
SEALCOAT BOND TO THE PILES:
7 PSI.
FRICTION OF SOIL ON SHEETING:
150 PSF.
FRICTION OF SOIL ON FOUNDATION PILES:
150 PSF.

## RESULTING FORCES:

**I** ***HYDROSTATIC BUOYANCY FORCE:*** ===> ***605.86*** ***KIPS***

**II** ***SEALCOAT CONCRETE WEIGHT:*** ===> ***400.55*** ***KIPS***

**III** ***SHEET PILING RESISTANCE (Smallest of a+b+c, or d):*** ===> ***289.08*** ***KIPS***

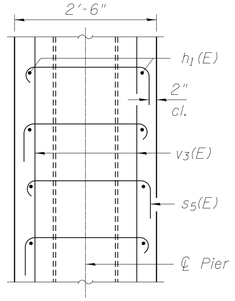
a) WEIGHT OF SHEET PILING ========== 67.72 KIPS
b) MISCELLANEOUS WEIGHT ATTACHED TO SHEET PILING (WALES, STRUTS, BRACING, ETC.) ========== 10.00 KIPS
c) SOIL FRICTION ON SHEET PILING ========== 211.36 KIPS
d) SEALCOAT BOND TO SHEET PILING ========== 639.79 KIPS

**IV** ***FOUNDATION PILING RESISTANCE (Smallest of a+b, or c):*** ===> ***58.60*** ***KIPS***

a) WEIGHT OF FOUNDATION PILING ========== 4.99 KIPS
b) PULLOUT RESISTANCE OF FOUNDATION PILING (SMALLEST OF 1, OR 2 + 3): 53.61 KIPS
1 SOIL FRICTION ON ALL INDIVIDUAL PILES ---------- 53.61 KIPS
2 SOIL FRICTION ALONG PERIMETER OF PILE GROUP ---------- 195.62 KIPS
3 WEIGHT OF SOIL CONTAINED IN PILE GROUP ---------- -0.39 KIPS
c) SEALCOAT BOND TO FOUNDATION PILING ========== 120.08 KIPS

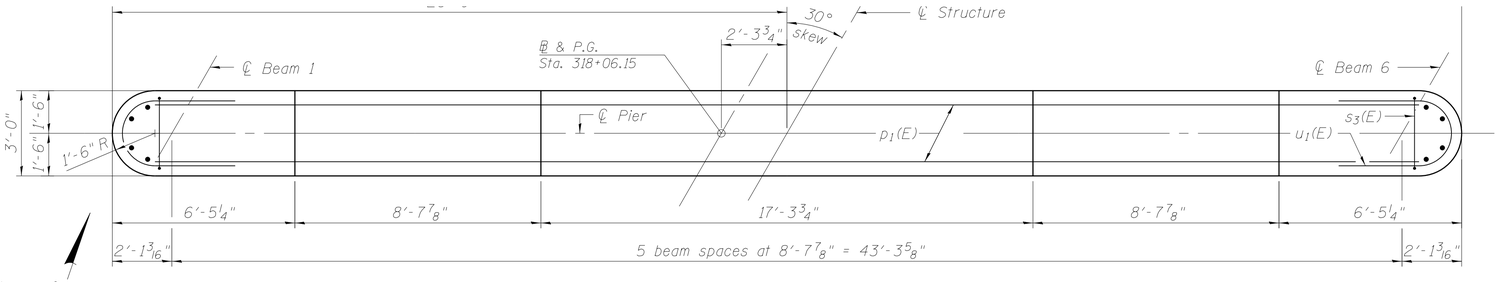
$$\text{FACTOR OF SAFETY} = \frac{\text{RESISTING FORCES (II + III + IV)}}{\text{BUOYANT FORCE (I)}} = \frac{748.2 \text{ kips}}{605.9 \text{ kips}} = 1.23 \quad \text{OK}$$

# EXAMPLE - FOR INFORMATION ONLY

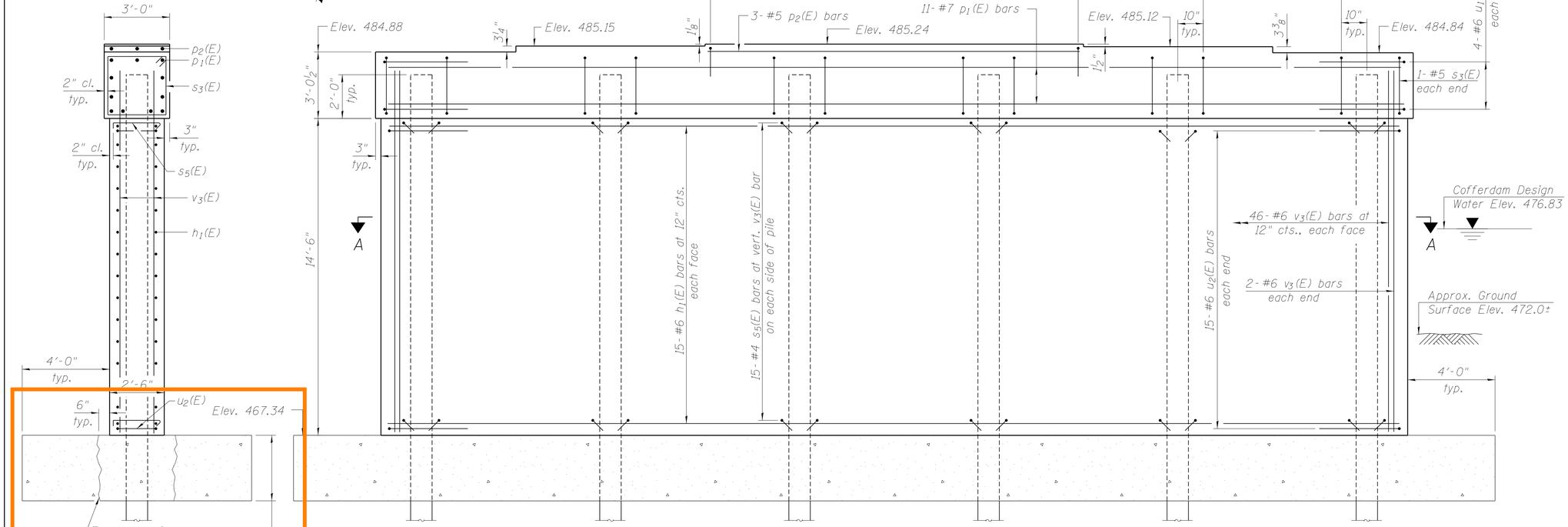



SECTION THRU WALL AT PILE LOCATION

Alternate placement of 90° hooked end of $s_5$(E) tie bars between vertical layers of tie bars.




TOP PLAN



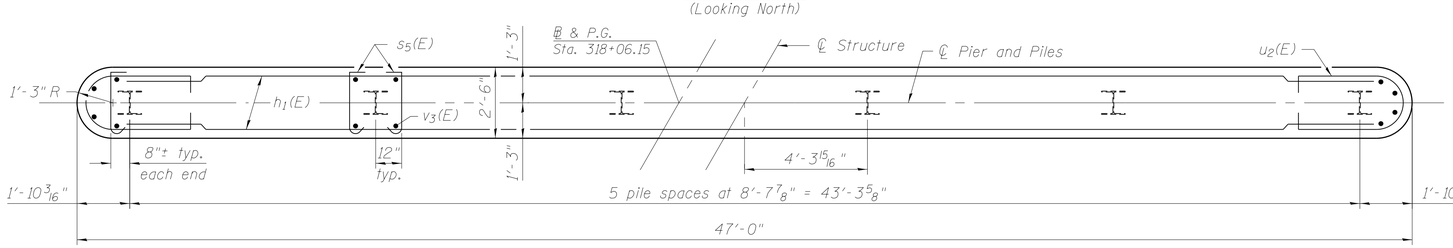




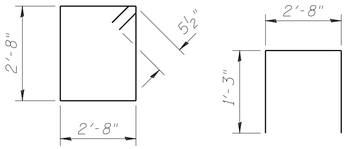
END VIEW

Contractor shall fracture seal coat (full depth) approximatley 6" from each side of stem wall prior to backfilling. Care shall be taken to avoid damage to new construction. Cost included with Cofferdam (Type 2).

ELEVATION
(Looking North)

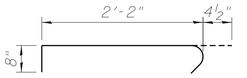



SECTION A-A

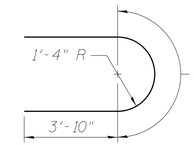



BAR $s_3$(E)

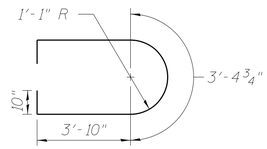
BAR $s_4$(E)




BAR $s_5$(E)




BAR $u_1$(E)




BAR $u_2$(E)

BILL OF MATERIAL

| Bar | No. | Size | Length | Shape |
|---|---|---|---|---|
| $h_1$(E) | 30 | #6 | 44'-6" | —— |
| | | | | |
| $p_1$(E) | 11 | #7 | 44'-6" | —— |
| $p_2$(E) | 3 | #5 | 17'-0" | —— |
| | | | | |
| $s_3$(E) | 42 | #5 | 11'-7" | □ |
| $s_4$(E) | 18 | #5 | 5'-2" | ⊓ |
| $s_5$(E) | 180 | #4 | 3'-3" | ⌙ |
| | | | | |
| $u_1$(E) | 8 | #6 | 11'-11" | ⊃ |
| $u_2$(E) | 30 | #6 | 12'-9" | ⊃ |
| | | | | |
| $v_3$(E) | 96 | #6 | 16'-6" | —— |
| | | | | |
| Cofferdam Excavation | | | Cu. Yd. | 164 |
| Cofferdam (Type 2) (Location 1) | | | Each | 1 |
| Concrete Structures | | | Cu. Yd. | 79.3 |
| Seal Coat Concrete | | | Cu. Yd. | 64.2 |
| Reinforcement Bars, Epoxy Coated | | | Pound | 7,160 |
| Furnishing Steel Piles HP 14x117 | | | Foot | 465 |
| Driving Piles | | | Foot | 465 |
| Test Pile Steel HP 14x117 | | | Each | 1 |

PILE DATA

Type: HP 14x117
Nominal Required Bearing: 929 k
Factored Resistance Available: 511 k
Est. Length: 93'
No. Production Piles: 5
No. Test Piles: 1

Notes:

Pour steps monolithically with cap.
For pile details, see sheet S20 of S22.
Space reinforcement in cap to miss anchor bolts. See sheet S14 of S22 for anchor bolt details.
Seal coat thickness design is based on the Cofferdam Design Water Elevation (CDWE). Cofferdam design details and proposed changes in seal coat thickness shall be submitted to the Engineer for approval with the cofferdam design.

design firm no. 184001036
whks engineers + planners + land surveyors

| | | | |
|---|---|---|---|
| USER NAME = $OPERATOR$ | DESIGNED - RJN | REVISED | |
| FILE NAME = 090-0179-0468671.dgn | CHECKED - CWC | REVISED | |
| PLOT SCALE = 01 '=' / in. | DRAWN - DLH | REVISED | |
| PLOT DATE = 4/30/2013 | CHECKED - CWC | REVISED | |

**STATE OF ILLINOIS**
**DEPARTMENT OF TRANSPORTATION**

**PIER**
**STRUCTURE NO. 090-0179**
SHEET NO. S18 OF S22 SHEETS

| F.A.P RTE. | SECTION | COUNTY | TOTAL SHEETS | SHEET NO. |
|---|---|---|---|---|
| 673 | (102B-1)BR | TAZEWELL | 89 | 61 |
| | | CONTRACT NO. 68671 | | |
| | ILLINOIS FED. AID PROJECT | | | |