STRUCTURE GEOTECHNICAL REPORT

BRIDGE REPLACEMENT
FAP 331 (IL 13) OVER CRAB ORCHARD LAKE

Section 1-4(B-1)
Williamson County, Illinois
Job No. C-99-045-13
Contract No. 78373
PTB 200-038
Existing Structure No. 100-0018 (EB)/100-0066 (WB)
Proposed Structure No. 100-0106 (EB)/100-0107 (WB)

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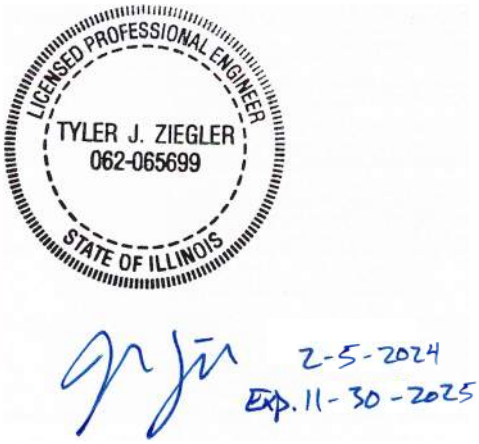

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1.0 Project Description and Scope

1.1 Introduction

The geotechnical investigation summarized herein was performed for the proposed dual bridges at IL 13 over Crab Orchard Lake in Williamson County, Illinois. See Appendix A for Location Map. The purpose of this report is to provide geotechnical design and construction recommendations to aid in the structure planning, final design plans and specification preparation.

1.2 Existing Structure Information

SN 100-0066 - Originally built in 1939, the west bound structure is a three span continuous wide flange bridge. The 0 degree skew structure is 133'-6" from back to back abutment with approximate span lengths of 39'-7", 50'-0" and 39'-7". The abutments are pile bent abutments on H-piles driven to refusal. The pier foundations consist of a single row of precast concrete piles.

The structure was later reconstructed in 1989 including a new superstructure, abutment caps and pier caps. The original piling was incorporated into the reconstruction of the substructure caps. The current, reconstructed superstructure consists of 7 composite steel beam lines of W24x62's for spans one and three and W24x68's for span two. Beams are spaced on 6'-4" centers. The reinforced concrete deck thickness is 7 ½" and is on a normal crown. The clear width between face to face of parapets is 40'-0" and the overall out to out width of the bridge is 43'-2". At the piers, two new H-piles were driven and incorporated into the caps.

SN 100-0066 has a sufficiency rating of 86.4 with a deck rating of 8, very good condition, superstructure rating of 5, fair condition with minor section loss, and a substructure rating of 5, fair condition with minor section loss.

SN 100-0018 - Originally built in 1964, the eastbound structure is a three span continuous wide flange bridge. The 0 degree skew structure is 132'-0" from back to back abutment with approximate span lengths of 38'-3", 50'-11" and 38'-3". The superstructure consists of 7 steel beam lines of 27WF94 on 6'-4" centers with a 7" reinforced concrete deck on normal crown. The clear width between face to face of parapets is 40'-0" and the overall out to out width of the bridge is 42'-0". The abutments are pile bent abutments on H-piles driven to refusal with the front row battered and the back row vertical. The wingwalls consist of 12" walls bearing on a single H-pile. The piers are pile bents on a single row of 7 individually encased H-piles driven to refusal.

Two rehabilitations have been complete since the original construction. In 1997, repairs included abutment joint replacement, new elastomeric bearings and new diaphragms. In 1999, repair included partial and full depth patching of the deck in the driving lanes only, extending and eliminating drains, and installation of a concrete overlay. The overlay work consisted of ½" scarification with a 2 ¼" microsilica concrete overlay for a total deck thickness of 8 ¾".

SN 100-0018 has a sufficiency rating of 69.2 with a deck rating of 5, fair condition with minor section loss, superstructure rating of 4, poor condition with advanced deterioration, and a substructure rating of 6, satisfactory condition with minor deterioration.

1.3 Proposed Structure Information

Proposed SN 100-0106 to replace SN 100-0018 and proposed SN 100-0107 to replace SN 100-0066. The proposed replacement structures are 3 span bridges with continuous, composite steel W27 beams with an 8" reinforced concrete deck on a 0 degree skew. Proposed back to back abutment lengths are 139'-6" with span lengths of 41'-5½" – 56'-7" – 41'-5½". SN 100-0106 consists of 12 beams with typical spacing at 5'-7" centers and 2'-7½" overhangs for an overall width of 66'-8" out to out. SN 100-0107 consists of 10 beams with typical spacing at 6'-4" centers and 3'-0½" overhangs for an overall width of 63'-1" out to out. The SN 100-0106 roadway cross sections consist of a 6'-0" shoulder, 36'-0" roadway, 10'-0" shoulder, and a 11'-0" multi use trail. The SN 100-0107 roadway cross sections consist of a 6'-0" shoulder, 48'-3" roadway, and a 6'-0" shoulder. Staged construction will be utilized to maintain traffic. For further proposed structure information, see Appendix B for Type, Size, and Location Plan (TS&L).

2.0 Field Exploration

2.1 Subsurface Exploration and Testing

The subsurface investigation consisted of four borings drilled by the Illinois Department of Transportation in June and September of 2014. Borings were taken near the west and east abutment locations at each structure. Soil boring exploration was performed by drilling methods using a hollow stem auger and split spoon. Rock coring performed with conventional rotary drilling with water. See Appendix C for Subsurface Data Profile Plot and Appendix D for Soil Boring and Rock Core Logs.

Table 2.1 - Boring Log Summary

Location	Boring No.	Station	Offset	Ground Surface Elevation	Top of Rock Elevation
SN 100-0106 (E. Abut.)	1-S	310+40	13' RT - CL EB	414.8	352.3
SN 100-0106 (W. Abut.)	2-S	308+53	14' RT - CL EB	414.9	348.4
SN 100-0107 (E. Abut.)	1-S	310+32	14' LT - CL WB	415.2	350.7
SN 100-0107 (W. Abut.)	2-S	308+65	14' LT - CL WB	415.2	350.2

In addition to the borings discussed above, the existing borings of SN 100-0018 from 1964 are included in Appendix D to provide the designer with further soils information. In particular, the recent drillings do not include borings at the piers. The existing borings indicate the top of rock elevations of 346.2 and 348.0 at the existing west and east piers, respectively.

2.2 Subsurface Conditions

The groundwater conditions at each soil boring varies. See Table 2.2 below. Temperature, seasonal variations, and recent rainfall conditions may influence the levels of groundwater table. Without extended periods of observation, the measurement of groundwater conditions may not give a true indication of typical groundwater levels. Volume of water depends on the permeability of the soils.

Table 2.2 – Groundwater Conditions Summary

Location	Boring No.	First Encounter	Upon Completion	After 24 Hours
SN 100-0106 (E. Abut.)	1-S	404.8	404.8	-----
SN 100-0106 (W. Abut.)	2-S	403.9	-----	-----
SN 100-0107 (E. Abut.)	1-S	380.2	-----	-----
SN 100-0107 (W. Abut.)	2-S	380.7	-----	-----

SN 100-0106 - Built 25 years after the adjacent westbound structure, crushed aggregate (CA-6) and rock fill embankment layers are encountered below the groundline and appear to have been used to build up the surrounding elevation to construct this bridge. The crushed aggregate extends down 8 to 9.5 feet in borings 1-S and 2-S, respectively, and has SPT (N) values ranging from 24 to 84. The rock fill extends down 24 to 26 feet in borings 1-S and 2-S, respectively. Riprap and crusher run make up the rock fill with primarily boulder sized with some gravel and sand recovered in the sample tube. Rock fill SPT (N) values range from 1 to 30.

Below the rockfill down to a depth of 34.5 feet, the boring show soft to medium, grey and mottle brown, moist silty clay with SPT (N) values ranging from WOH to 2 blows per foot, Q_u values of 0.2 to 0.7 tsf, and moisture contents ranging between 28% and 34%. From 34.5 feet to down to rock, both borings show soft to stiff, grey to mottled brown moist clays with SPT (N) values ranging from WOH to 10 blows per foot, Q_u values of 0.4 to 2.9 tsf, and moisture contents ranging between 20% and 37%.

At a depth of 62.5 feet, boring 1-S encounters a dense grey, dry sandstone layer with clay shale seams with SPT (N) of 100/5". Boring 2-S encounters a dense grey, dry sandstone with clay shale lenses at a depth of 66.5 feet with SPT (N) of 100/2".

SN 100-0107 - Both borings, 1-S and 2-S, encountered stiff brown and grey moist clay from the ground surface elevation to an approximate depth of 29.5 feet. The moist clay has SPT (N) values ranging from 3 to 8 blows per foot with Qu values of 1.2 to 2.7 tsf and moisture contents ranging between 16% and 25%.

Beneath the top moist clay layers, boring 1-S shows a potentially liquefiable layer at depths of 29.5 to 34.5 feet. This layer consists of stiff, moist silty clay loam with average soil contents of 9% sand, 72% silt, and 19% clay. Average liquid limit is 30 and plasticity index is 10, both values being estimated based on visual ID and historical database. SPT (N) values range from 3 to 5 blows per foot with Qu values of 1.1 to 1.7 tsf and moisture contents ranging between 21% and 25%. Boring 2-S shows soft to medium grey moist silty clay to silty clay loam within this same depth range. SPT (N) values range from WOH to 2 blows per foot with Qu values of 0.3 to 0.6 tsf and moisture contents ranging between 25% and 29%.

From 34.5 to 39.5 feet, both borings show soft to medium grey and mottled brown moist silty clay loam with SPT (N) values ranging from 1 to 4 blows per foot, Q_u values of 0.1 to 1.0 tsf, and moisture contents ranging between 24% and 30%. From 39.5 feet down to rock, both borings show soft to stiff, grey to mottled brown moist clays with SPT (N) values ranging from WOH to 7 blows

per foot, Q_u values of 0.3 to 2.9 tsf, and moisture contents ranging between 22% and 48%.

At a depth of 64.5 feet, boring 1-S encounters a dense grey, dry sandstone layer with some clay shale with SPT (N) of 100/8". Rock core logs at 1-S show the top 5 feet of rock with an RQD of 16% and uniaxial compressive strength (UCS) of 350 tsf. The next 5 feet have an RQD of 37% and UCS of 250 tsf. Boring 2-S encounters a hard grey, dry clay shale at a depth of 64 feet with SPT (N) of 100/3".

3.0 Geotechnical Evaluations and Recommendations

3.1 Settlement

Existing Embankment - Based on the provided preliminary plan and profile, the anticipated difference between the existing and proposed elevations at the abutments is minimal. Thus, settlement of the existing embankment is not anticipated due to minimal changes in loading and existing soil conditions. By inspection, the proposed structure should result in less than 0.4 inches of settlement. Per IDOT Geotechnical Manual Section 6.9.2, driven pile capacity need not account for downdrag if total settlement of soil around the piling is less than 0.4 inches.

Regarding settlement of approach slabs, one end of the slab is supported by the pile supported abutment. The other end of the slab is supported by the existing embankment subgrades. Provided proper compaction according to IDOT Standard Specifications is performed during construction, settlement of the approach slab is not a concern.

Proposed Widening Embankment – Due to the widening of the bridges, proposed embankment outside of the limits of the existing embankment is necessary. Potential settlement due to the proposed widened embankment was investigated using the IDOT Cohesive Soil Settlement Estimate spreadsheet. This simplified procedure estimates the primary settlement anticipated. The results from the settlement analysis shows settlement of less than 0.1". See Appendix E. In addition, secondary settlement is considered negligible with no organic layers are present.

3.2 Slope Stability

Slope stability analyses of the end slopes at both abutments of each structure were performed due to the high seismic region, unique high water conditions and proposed embankment required for widening. Engineering soil properties taken from the subsurface exploration descriptions were input and slope stability was evaluated using the software program StablPro. The Bishop's method analysis was used to search for the critical circular failure surface to calculate the factor of safety for the slope.

A critical factor of safety was calculated for three modeled conditions: short term static, long term static, and seismic. Short term conditions capture full cohesive values, while long term conditions assume drained soil properties. A live load surcharge of 250 psf was considered at both abutments. For seismic analysis, a horizontal acceleration coefficient of 0.422g was calculated according to guidance in the FHWA-NHI-11-032, LFRD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations.

See Table 3.1 below for slope stability factors of safety at each abutment. Each abutment location achieved the minimum factor of safety of 1.5 for static conditions and 1.0 for seismic conditions. See Appendix F for soil parameters and individual output of the analyses presented in the table.

Table 3.1 - Summary of Slope Stability Calculated Factors of Safety

Structure No.	Location	Short Term Static	Long Term Static	Seismic
100-0106	East Abut.	1.50	1.95	1.03
100-0106	West Abut.	1.81	2.23	1.02
100-0107	East Abut.	1.94	1.57	1.02
100-0107	West Abut.	1.92	1.56	1.03

As validation of the results, no known issues or concerns are present or have been present at the existing embankment slopes which have been in place for over 55 plus years. In addition, the existing piles supporting the abutments and piers will remain in place and increase the nominal slope stability FOS by intersecting the circular failure planes.

3.3 Seismic Considerations

LRFD Seismic Soil Site Class Definition was determined based on the methodology described in IDOT AGMU 9.1 and the IDOT BBS 149 form for Seismic Site Class Determination. See Appendix G for determination.

Further seismic parameters were determined using the figures and tables provided in AASHTO LRFD Bridge Design Specifications, Article 3.10 for Earthquake Effects, EQ. These parameters are based on a 1000 Year Return Period with a Probability of Exceedance of 7% in 75 years. See table below for a summary of seismic parameters.

Table 3.2 - Summary of Seismic Parameters

Parameter	Value
Seismic Soil Site Class	D
Spectral Acceleration Coefficient at period of 0.2 sec., Ss	0.682g
Spectral Acceleration Coefficient at period of 1.0 sec., S1	0.171g
Site Factor, Short Period, Fa	1.24
Site Factor, Long Period, Fv	2.10
Design Spectral Acceleration at 0.2 sec. (SDS)	0.864g

Design Spectral Acceleration at 1.0 sec. (SD1)	0.359g
Seismic Performance Zone	SPZ 3

The Spectral Acceleration Coefficient at T=1.0 sec. (SD1) and Seismic Performance Zone were confirmed using Bridge Manual Planning Section 2.3.10.3.

Abutment foundations shall be designed for the full elastic base shear (R=1.0) and the solid wall encased pile bent piers shall be designed with an R of 2.0 for the longitudinal and transverse directions per BM 3.15.4.3.

3.4 Scour

Design scour elevations for the proposed structures were provided by Crawford, Murphy & Tilly. See table below. Stone Riprap, Class A4 is proposed to protect the bridge embankment side slopes from each abutment down to the toe of the lake bed.

Table 3.3 – Design Scour Elevation Table

Event/Limit State	Design Scour Elevations (ft.)				Item 113
	W. Abut.	Pier 1	Pier 2	E. Abut.	
Q100	Note 1	385.3	385.3	Note 1	5
Q200	Note 1	385.2	385.2	Note 1	
Design	Note 1	385.3	385.3	Note 1	
Check	Note 1	385.2	385.2	Note 1	

Note 1: Bottom of Abutment Cap Elevation

Scour loss shall be accounted for in the pier pile capacity design calculations. The design event shall be considered for the Strength Limit State and the check event shall be considered for the Extreme Event II Limit State. Though by inspection of the minimal difference between design and check scour elevations, the design event controls over the check event due to larger factored loads and smaller factored geotechnical resistance required for the Strength Limit State.

3.5 Mining Activity

Reviewing the Illinois State Geological Survey (ISGS) "Directory of Coal Mines in Illinois" for Williamson County, no mining activity is present at the bridge location. The nearest underground mine proximity region is located near Cambia, 2 miles northeast of the project location.

3.6 Liquefaction

The subsurface exploration indicated a potential liquefiable soil layer in the SN 100-0107 east abutment soil boring (1-S) between elevations 385.7 to 380.7. By inspection, no liquefiable layers are present at the other subject boring locations.

A liquefaction analysis was performed using the IDOT Liquefaction Analysis spreadsheet. The results from the liquefaction analysis show no liquefaction concern within the first 60 ft of the soil profile; thus, liquefaction was not considered for the pile capacity tables below. See Appendix H for Liquefaction Analysis.

3.7 Lateral Load Analysis

The tables below provide soil parameters to structural engineer for lateral or displacement analysis of the foundations. The values were estimated based on the descriptions given in the soil boring logs. Short term conditions are recommended for lateral load analysis. Full cohesion was assumed with a friction angle of 0 degrees for cohesive soils. No specific analyses were performed on the soil to determine the estimated parameters.

Table 3.4 –Soil Parameters for Lateral Load Analysis at SN 100-0106 Pier 1 (2-S)

Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		K (pci)	ε50
			c' (ksf)	θ (deg.)		
Medium Clay to Silty Clay	385.4	125	0.7	0	300	0.007
Medium Silt Loam to Silty Clay Loam	382.9	120	0.7	0	300	0.007
Medium Clay to Silty Clay	380.4	125	0.7	0	300	0.007
Medium Silty Clay to Silty Clay Loam	377.9	120	0.8	0	300	0.007
Medium Clay	375.4	125	0.8	0	300	0.007
Stiff Clay	360.4	125	1.1	0	300	0.007
Medium Clay to Silty Clay	355.4	125	0.6	0	300	0.007
Soft Clay to Silty Clay	350.4	120	0.4	0	100	0.01
Stiff Sandy Clay	348.4	125	1.8	0	300	0.007
Sandstone	-	150	0	45	-	0.001

Table 3.5 –Soil Parameters for Lateral Load Analysis at SN 100-0106 Pier 2 (1-S)

Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		K (pci)	ε50
			c' (ksf)	θ (deg.)		
Very Stiff Silty Clay Loam	387.8	125	2.5	0	500	0.005
Very Soft Silty Clay	385.3	120	0.2	0	100	0.01
Soft Clay to Silty Clay	380.3	120	0.4	0	100	0.01
Very Stiff Clay	377.8	125	2.1	0	500	0.005
Stiff Clay	370.3	125	1.5	0	300	0.007
Medium Clay	364.8	125	0.8	0	300	0.007
Stiff Clay	360.3	125	1.6	0	300	0.007
Very Stiff Clay	352.3	125	2.3	0	500	0.005
Sandstone	-	150	0	45	-	0.001

Table 3.6 –Soil Parameters for Lateral Load Analysis at SN 100-0107 Pier 1 (2-S)

Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		K (pci)	ε50
			c' (ksf)	θ (deg.)		
Very Stiff Clay	388.2	125	2.5	0	500	0.005
Stiff Clay	385.7	125	1.2	0	300	0.007
Medium Silty Clay to Silty Clay Loam	383.2	125	0.6	0	300	0.007
Soft Clay	378.2	120	0.3	0	100	0.01
Medium Silty Clay Loam	375.7	125	1.0	0	500	0.005
Stiff Clay	370.7	125	2.3	0	300	0.007
Stiff Silty Clay to Clay	360.7	125	1.6	0	300	0.007
Medium Clay	351.2	125	0.6	0	300	0.007
Sandstone	-	150	0	45	-	0.001

Table 3.7 –Soil Parameters for Lateral Load Analysis at SN 100-0107 Pier 2 (1-S)

Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		K (pci)	ε50
			c' (ksf)	θ (deg.)		
Stiff Clay	385.7	125	1.3	0	300	0.007
Stiff Silt Loam	383.2	125	1.7	0	300	0.007
Stiff Silty Clay to Silty Clay Loam	380.7	125	1.1	0	300	0.007
Medium to Stiff Silty Clay Loam	378.2	125	1.0	0	300	0.007
Very Soft Silty Clay Loam	375.7	120	0.1	0	100	0.01
Very Stiff Clay	370.7	125	2.9	0	500	0.005
Stiff Clay	365.2	125	1.8	0	300	0.007
Medium to Stiff Clay	360.7	125	1.0	0	300	0.007
Soft Clay	355.7	120	0.3	0	100	0.01
Medium Clay	350.7	125	0.6	0	300	0.007
Sandstone	-	150	0	45	-	0.001

4.0 Foundation Recommendations

4.1 Abutments

Preliminary superstructure loads for the proposed structure configuration discussed above were provided by Civil Design, Inc. See tables below for total factored loads at each substructure. These loads include the approach slab and abutment self-weight.

Table 4.1 – SN 100-0106 Abut. Load

Location	Total Factored Reaction (k)
W. Abut.	1,500
E. Abut.	1,500

Table 4.2 – SN 100-0107 Abut. Load

Location	Total Factored Reaction (k)
W. Abut.	1,400
E. Abut.	1,400

Integral abutments are preferred to eliminate joints in the bridge decks, decreasing maintenance costs and increasing service life. See results of preliminary Integral Abutment Feasibility Analysis in Appendix I. The designer shall verify integral abutment feasibility analysis with final configuration. In addition, see IDOT ABD Memo 19.8 for further integral abutment design guidance.

Foundation type for integral abutments shall be pile supported with a pile placed under each girder. Due to the presence of sandstone at the subject site and H-piles being most effective in point bearing applications, H-piles are recommended over metal shell piles.

The tables below summarize the nominal required bearing (R_N), factored resistance available (R_F), estimated pile length and estimated pile tip elevation for the strength limit state. R_N indicates the resistance of the pile during driving, which assists the Contractor from causing damage to the pile. R_F represents the net long term axial geotechnical resistance available to support the factored structure loads. The estimated pile lengths include a 2 foot embedment into the abutment. Analyses have been performed using the IDOT Static Method of Estimating Pile Length. See Appendix J.

The factored resistance available values shown in the tables are intended to provide the designer with a range of feasible options for the anticipated vertical loading. Piles shall be evaluated for lateral resistance in final design.

Table 4.3 – H-Pile Capacity at SN 100-0106 West Abutment (2-S) – Strength Limit State

Pile Size	Max. Nominal Required Bearing, R_N (kips)	Max. Factored Resistance Available, R_F (kips)	Estimated Pile Length (ft.)	Estimated Pile Tip Elevation (ft.)
HP 10x42	335	184	65	344.6
HP 12x53	418	230	65	344.6
HP 14x73	578	317	65	344.6

Table 4.4 – H-Pile Capacity at SN 100-0106 East Abutment (1-S) – Strength Limit State

Pile Size	Max. Nominal Required Bearing, R_N (kips)	Max. Factored Resistance Available, R_F (kips)	Estimated Pile Length (ft.)	Estimated Pile Tip Elevation (ft.)
HP 10x42	335	184	60	347.5
HP 12x53	418	230	61	346.5
HP 14x73	578	317	61	346.5

Table 4.5 – H-Pile Capacity at SN 100-0107 West Abutment (2-S) – Strength Limit State

Pile Size	Max. Nominal Required Bearing, R_N (kips)	Max. Factored Resistance Available, R_F (kips)	Estimated Pile Length (ft.)	Estimated Pile Tip Elevation (ft.)
HP 10x42	335	184	61	348.9
HP 12x53	418	230	61	348.9
HP 14x73	578	317	62	347.9

Table 4.6 – H-Pile Capacity at SN 100-0107 East Abutment (1-S) – Strength Limit State

Pile Size	Max. Nominal Required Bearing, R_N (kips)	Max. Factored Resistance Available, R_F (kips)	Estimated Pile Length (ft.)	Estimated Pile Tip Elevation (ft.)
HP 10x42	335	184	61	349.0
HP 12x53	418	230	61	349.0
HP 14x73	578	317	62	348.0

One test pile is recommended at each abutment location. Due to the presence of the rock fill riprap layer and hard sandstone, pile shoes are recommended.

4.2 Piers

Preliminary superstructure loads for the proposed structure configuration discussed above were provided by Civil Design, Inc. See tables below for total factored loads at each substructure.

Table 4.7 – SN 100-0106 Pier Load

Location	Total Factored Reaction (k)
Pier 1	2,900
Pier 2	2,900

Table 4.8 – SN 100-0107 Pier Load

Location	Total Factored Reaction (k)
Pier 1	2,700
Pier 2	2,700

A pile-supported bent matches the existing substructure foundations. In addition, driven piles are recommended at the abutments so pile driving equipment will already be mobilized. Driven piles appear to be the most efficient pier foundation type. Similar to the abutments, H-piles are recommended over metal shell piles due to the presence of sandstone.

The tables below summarizes the nominal required bearing (R_N), factored resistance available (R_F), estimated pile length and estimated pile tip elevation. R_N indicates the resistance of the pile during driving, which assists the Contractor from causing damage to the pile. R_F represents the net long term axial geotechnical resistance available to support the factored structure loads. Geotechnical scour loss to the elevations shown in the design scour elevation tables herein were applied at each pier. The estimated pile lengths include a 1 foot embedment into the pier cap. Analysis has been performed using the IDOT Static Method of Estimating Pile Length. See Appendix J.

The factored resistance available values shown in the tables are intended to provide the designer with a range of feasible options for the anticipated vertical loading. Piles shall be evaluated for lateral resistance in final design.

Table 4.9 – H-Pile Capacity at SN 100-0106 Pier 1 (2-S) – Strength Limit State

Pile Size	Max. Nominal Required Bearing, R_N (kips)	Max. Factored Resistance Available, R_F (kips)	Estimated Pile Length (ft.)	Estimated Pile Tip Elevation (ft.)
HP 12x53	418	224	63	346.0
HP 12x74	589	317	64	347.0
HP 14x73	578	311	63	346.0

Table 4.10 – H-Pile Capacity at SN 100-0106 Pier 2 (1-S) – Strength Limit State

Pile Size	Max. Nominal Required Bearing, R_N (kips)	Max. Factored Resistance Available, R_F (kips)	Estimated Pile Length (ft.)	Estimated Pile Tip Elevation (ft.)
HP 12x53	418	219	59	350.0
HP 12x74	589	312	61	351.0
HP 14x73	578	304	60	349.0

Table 4.11 – H-Pile Capacity at SN 100-0107 Pier 1 (2-S) – Strength Limit State

Pile Size	Max. Nominal Required Bearing, R_N (kips)	Max. Factored Resistance Available, R_F (kips)	Estimated Pile Length (ft.)	Estimated Pile Tip Elevation (ft.)
HP 12x53	418	215	61	348.0
HP 12x74	589	308	64	345.0
HP 14x73	578	300	62	347.0

Table 4.12 – H-Pile Capacity at SN 100-0107 Pier 2 (1-S) – Strength Limit State

Pile Size	Max. Nominal Required Bearing, R_N (kips)	Max. Factored Resistance Available, R_F (kips)	Estimated Pile Length (ft.)	Estimated Pile Tip Elevation (ft.)
HP 12x53	418	218	62	347.0
HP 12x74	589	306	65	344.0
HP 14x73	578	303	63	346.0

One test pile is recommended at each pier location. Pile shoes are recommended when driving into hard sandstone.

5.0 Construction Considerations

5.1 Construction Activities

All construction activities shall be performed in accordance with the current IDOT Standard Specifications for Road and Bridge Construction and any pertinent Special Provisions or Policies.

The bridge cone embankment necessary for widening the existing roadway shall satisfy the requirements of Section 205 of the Standard Specifications.

5.2 Temporary Shoring

Temporary shoring will be required at the abutments during staged construction. From the preliminary TS&L, the distance from the proposed profile grade to the bottom of proposed abutment is approximately 8 feet, which represents the maximum soil retention anticipated. Investigating the subsurface conditions below the excavation line, the use of IDOT temporary sheet piling design charts appears feasible at the abutments for SN 100-0107. The use of a temporary soil retention system is advised at SN 100-0106 due to drivability concerns with the encountered crushed aggregate and rockfill. In addition, Type 2 Cofferdams will be required at both piers during staged construction due to more than 6 feet of water anticipated above the bottom of the pier. Seal coat is recommended at each cofferdam.

5.3 Foundation Construction

Conventional pile driving equipment and methodologies shall be assumed.

5.4 Excavation

Excavation shall be performed in accordance with IDOT Standard Specifications Section 202. Substructure construction shall occur after removal of the existing structure is complete.

A Joint Utility Locating Information for Excavators (J.U.L.I.E.) locate shall be performed prior to commencing construction activities to determine underground utilities within the project limits. On SN 100-0066, fiber optics utility runs through the existing abutment backwalls and spans the entire length of the bridge on hangers. In addition, IDOT shall be contacted to locate private utilities.

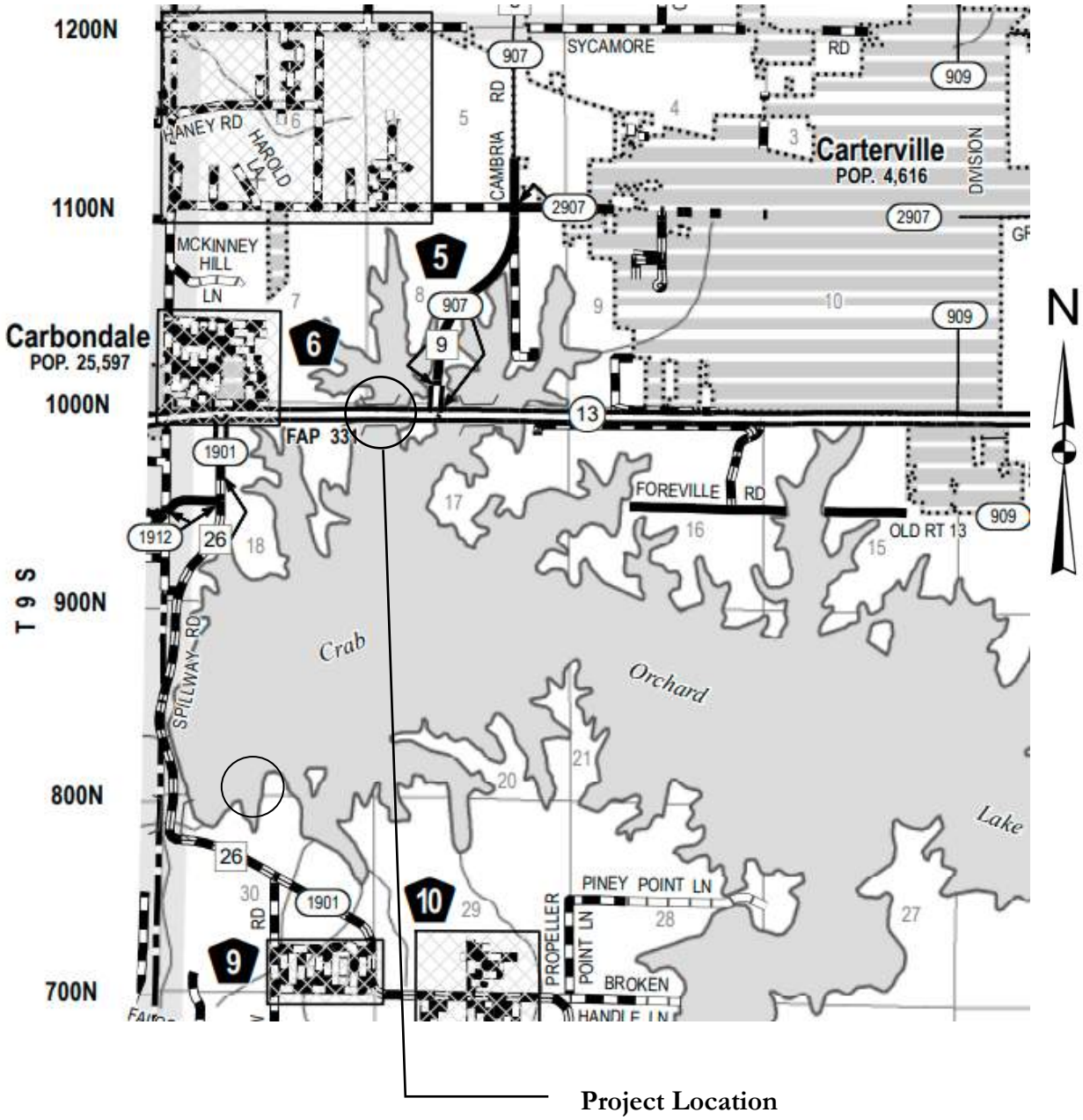
At foundation and structural fill locations, the exposed subgrade shall be proofrolled to aid in locating any unstable and unsuitable materials. Unstable and unsuitable materials shall be removed and replaced with compacted structural fill.

6.0 Limitations

The analysis and discussion provided herein are for the exclusive use of IDOT District 9. They are based upon the subsurface data obtained at boring locations within the bridge area and are specific to the project described, our understanding of the project as described herein, and geotechnical engineering practice consistent with the standard of care.

Appendix A

Location Map



Location Map

IL 13 over Crab Orchard Lake
Williamson County, Illinois
Existing Structure No. 100-0018 (EB)/100-0066 (WB)
Proposed Structure No. 100-0106 (EB)/100-0107 (WB)

Appendix B

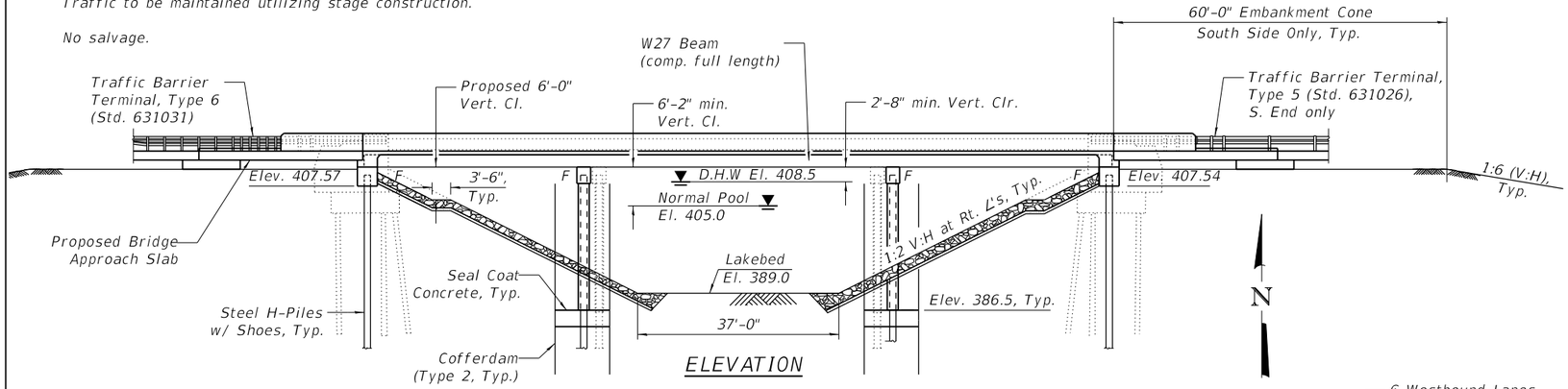
Type, Size, and Location Plan (TS&L)

Bench Mark: Sq. cut in N.W. corner W. wall of S.N. 100-0020.

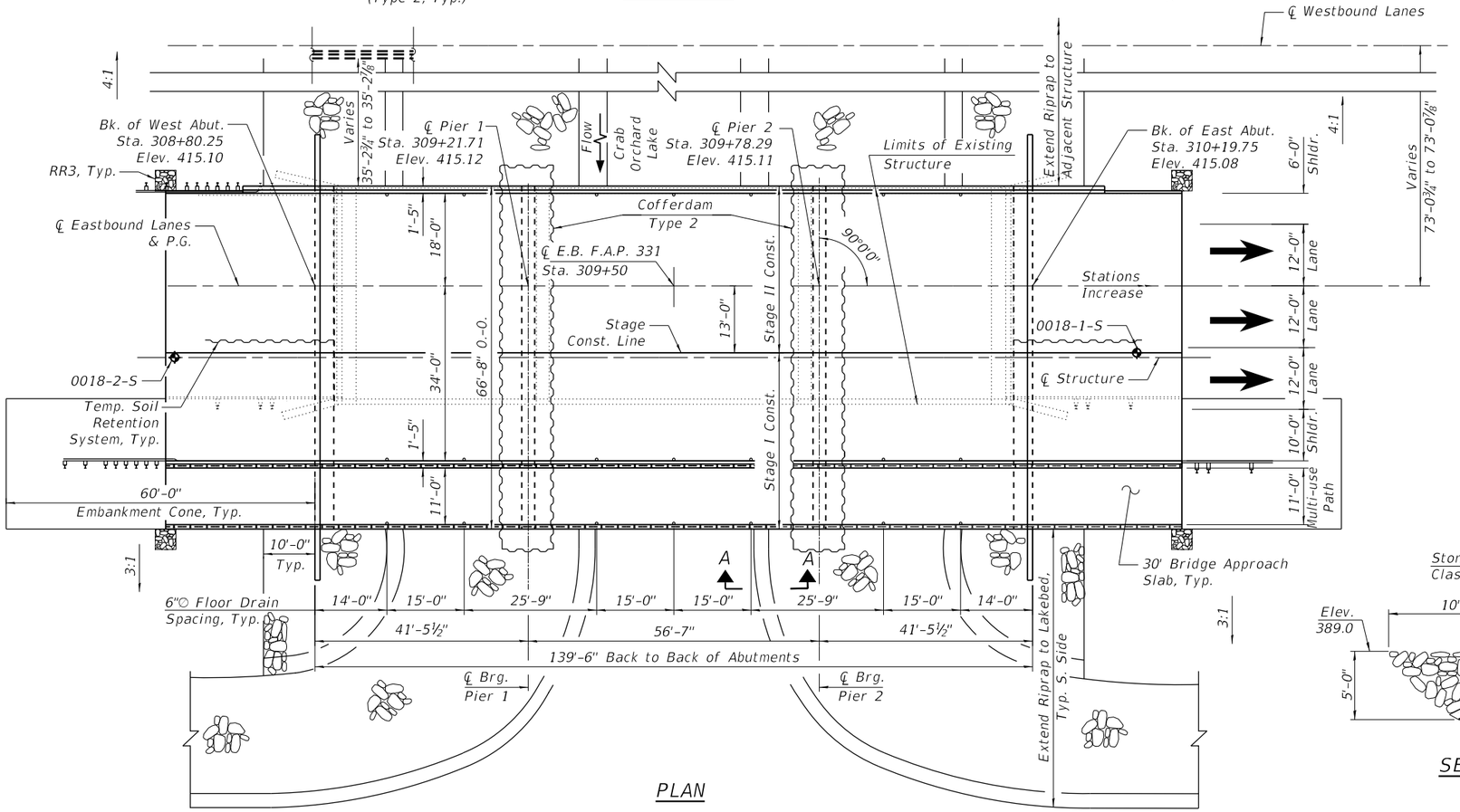
Existing Structure: S.N. 100-0018 was originally constructed in 1964 under F.A. Rte. 14, Section 5-3B-3. The structure is a three span (38'-3", 50'-11", 38'-3") continuous wide flange bridge with seven beam lines on pile bent abutments. The structure is 132'-0" from bk. to bk. abutments on a zero degree skew. The clear width is 40'-0" between face to face of parapets and the overall out to out width of the bridge is 42'-0". The superstructure consists of seven beam lines of 27WF94 on 6'-4" centers. The original reinforced concrete deck thickness was 7", but was later scarified 1/2" (1999) and a 2 1/4" Microsilica concrete overlay was installed for a total thickness of +/- 8 3/4". The bridge deck is on a normal crown. The abutments are pile bent abutments on H-piles driven to refusal. The wingwalls consist of 12" walls bearing on a single H-pile. The piers are pile bents on seven individually encased piles driven to refusal.

Traffic to be maintained utilizing stage construction.

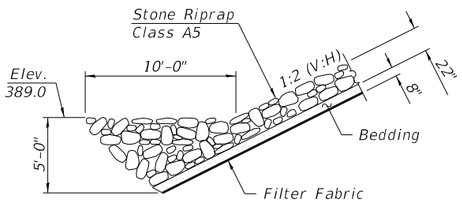
No salvage.



ELEVATION



PLAN



SECTION A-A

HIGHWAY CLASSIFICATION

F.A.P. Rte. 331 - IL Rte. 13 E.B.
Functional Class: Other Principal Arterial
ADT: 16,000 (2011); 23,560 (2037)
ADTT: 600 (2011); 885 (2037)
DHV: 2355
Design Speed: 65 m.p.h.
Posted Speed: 55 m.p.h.
One-Way Traffic
Directional Dist.: 100

LOADING HL-93

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

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design
Specifications, 9th Edition.

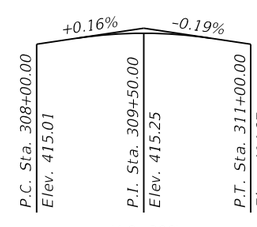
DESIGN STRESSES

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 new structural steel to be galvanized.

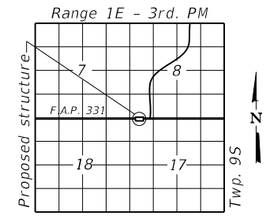
SEISMIC DATA

Seismic Performance Zone (SPZ) = 3
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.359g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.864g
Soil Site Class = D



PROFILE GRADE

Along ℄ Eastbound Lanes



LOCATION SKETCH

GENERAL PLAN AND ELEVATION
IL 13 E.B. OVER CRAB ORCHARD LAKE
F.A.P. RT. 331 - SEC. 1-4(B-1)
WILLIAMSON COUNTY
STATION 309+50.00
STRUCTURE NO. 100-0106

MODEL: Default
FILE NAME: P:\5XXX\50XX-51XX\5000 - IDOT PTB 200-038 D9 IL 13 Crab Orchard Bridges\24-Structures\CAD-MS\TSL\100-0106 - R1.dgn

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WBE / DBE
EFFINGHAM, IL
LICENSE #184.003222

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PLOT SCALE =	DRAWN - K. STREICHER	REVISED -	
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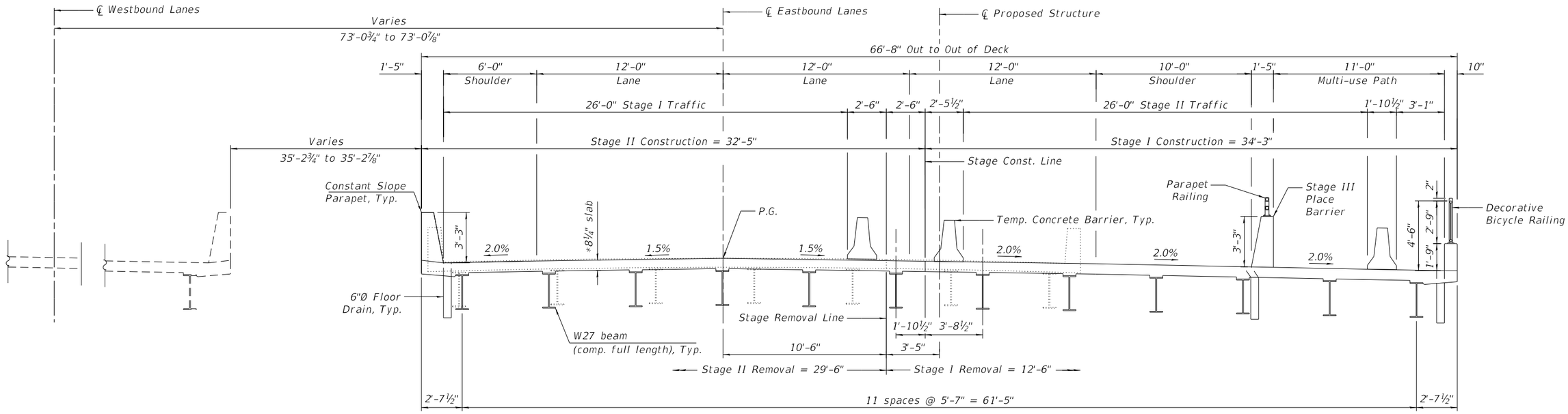
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 2 SHEETS

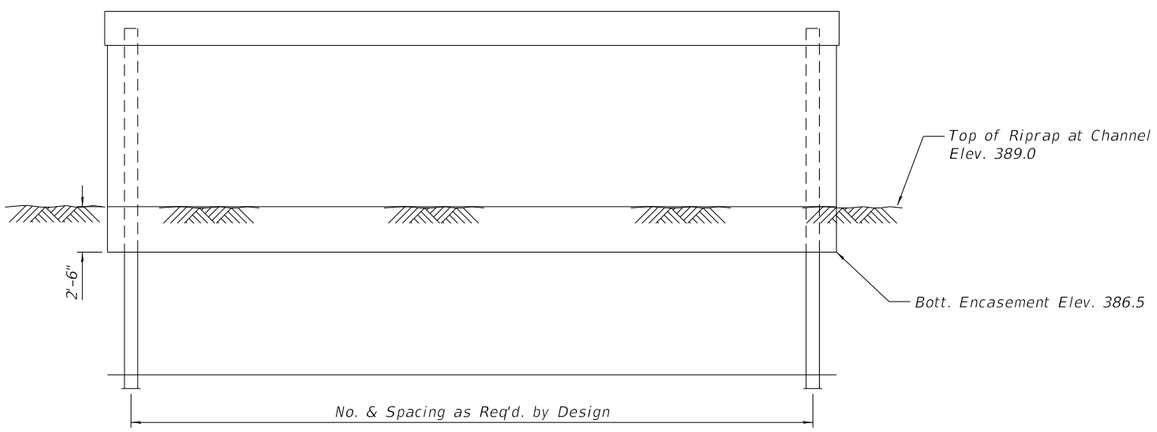
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
331	1-4(B-1)	WILLIAMSON		
		CONTRACT NO. 78383		
		ILLINOIS FED. AID PROJECT		



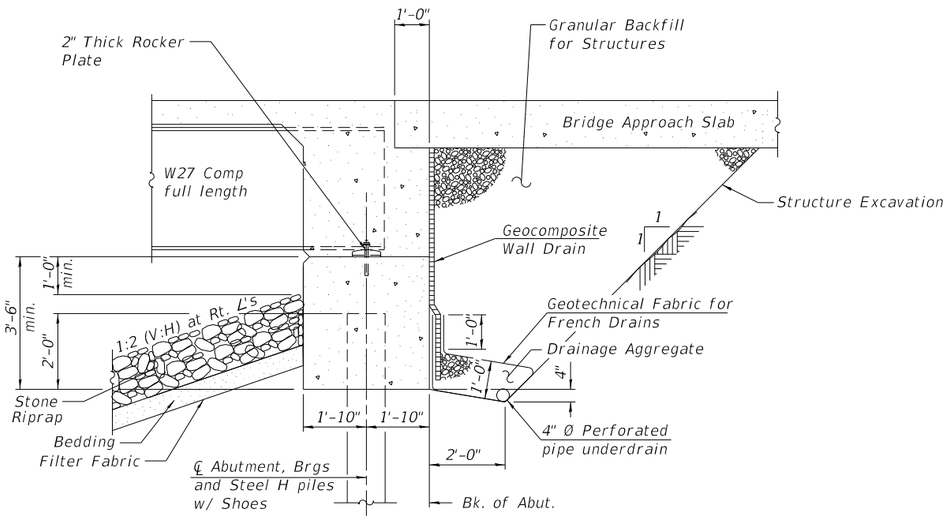
CROSS SECTION

(Looking East)

* Prior to grinding



PIER SKETCH



SECTION THRU INTEGRAL ABUTMENT

(Horiz. dim. @ Rt. ℄'s)

WATERWAY INFORMATION

Drainage Area = 1.3 Sq. mi. Low Grade Elev. 415.0 @ Sta. 311+00

Flood	Freq. Yr.	Q C.F.S.	Opening Ft²		Nat. H.W.E.	Head - Ft.		Headwater El.	
			Exist.	Prop.		Exist.	Prop.	Exist.	Prop.
Ten-Year	10	586	1,314	1,347	407.5	0.0	0.0	407.5	407.5
Design	50	962	1,424	1,466	408.5	0.0	0.0	408.5	408.5
Base	100	1,131	1,470	1,515	408.9	0.0	0.0	408.9	408.9
Scour Check	200	1,295	1,517	1,565	409.3	0.0	0.0	409.3	409.3
Max. Calc.	500	1,570	1,602	1,653	410.0	0.0	0.0	410.0	410.0

DESIGN SCOUR ELEVATION TABLE

Event / Limit State	Design Scour Elevations (ft.)				
	W. Abut.	Pier 1	Pier 2	E. Abut.	Item 113
Q100	407.5	385.3	385.3	407.5	5
Q200	407.5	385.2	385.2	407.5	
Design	407.5	385.3	385.3	407.5	
Check	407.5	385.2	385.2	407.5	

DETAILS
IL 13 E.B. OVER CRAB ORCHARD LAKE
F.A.P. RT. 331 - SEC. 1-4(B-1)
WILLIAMSON COUNTY
STATION 309+50.00
STRUCTURE NO. 100-0106

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STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 2 OF 2 SHEETS

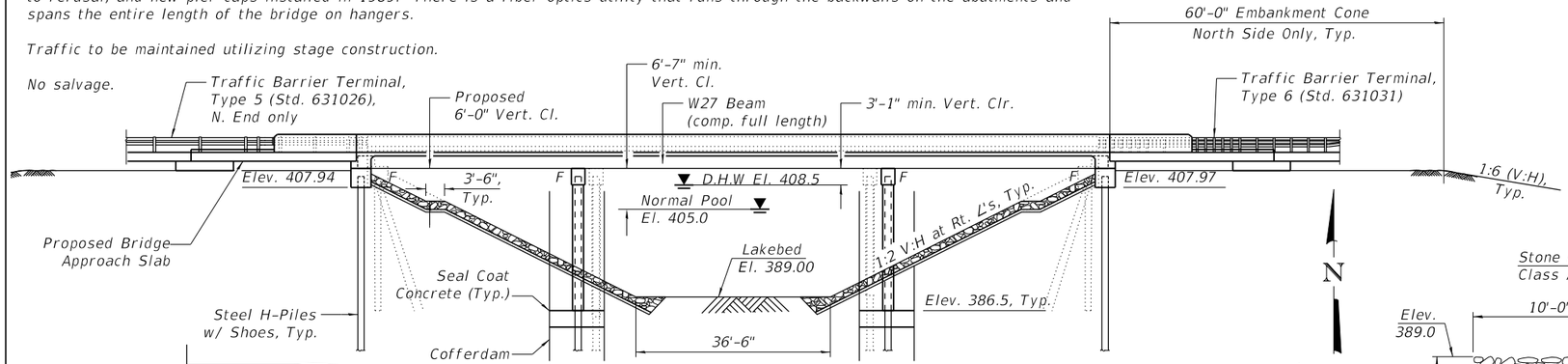
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
331	1-4(B-1)	WILLIAMSON		
		CONTRACT NO. 78383		
	ILLINOIS	FED. AID PROJECT		

Bench Mark: Sq. cut in N.W. corner W. wall of S.N. 100-0020.

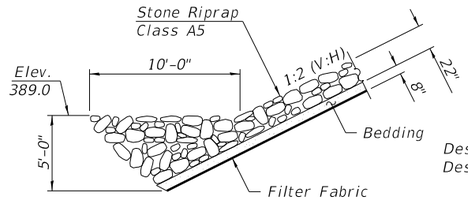
Existing Structure: S.N. 100-0066 was originally constructed in 1939 under F.A. Proj. 15, Section 5-B1 and 5-A1. An extensive reconstruction was built in 1989 under F.A. Route 410, Section (5B-1)DR. This reconstruction included an entirely new superstructure, abutments, and pier caps. The structure is a three span (39'-7", 50'-0", 39'-7") continuous wide flange bridge with seven beam lines on pile bent abutments. The structure is 133'-6" from bk. to bk. abutments on a zero degree skew. The clear width is 40'-0" between face to face of parapets and the overall out to out width of the bridge is 43'-2". The composite superstructure consists of seven beam lines of W24x62 for spans one and three, and W24x68 for span two, on 6'-4" centers. The reinforced concrete deck thickness is 7 1/2". The bridge deck is on a normal crown. The abutments are pile bent abutments on H-piles driven to refusal. The wingwalls are typical 12" thick dog ear wing walls. Each pier is comprised of 6 original precast concrete piles, two new H-piles encased in concrete driven to refusal, and new pier caps installed in 1989. There is a fiber optics utility that runs through the backwalls on the abutments and spans the entire length of the bridge on hangers.

Traffic to be maintained utilizing stage construction.

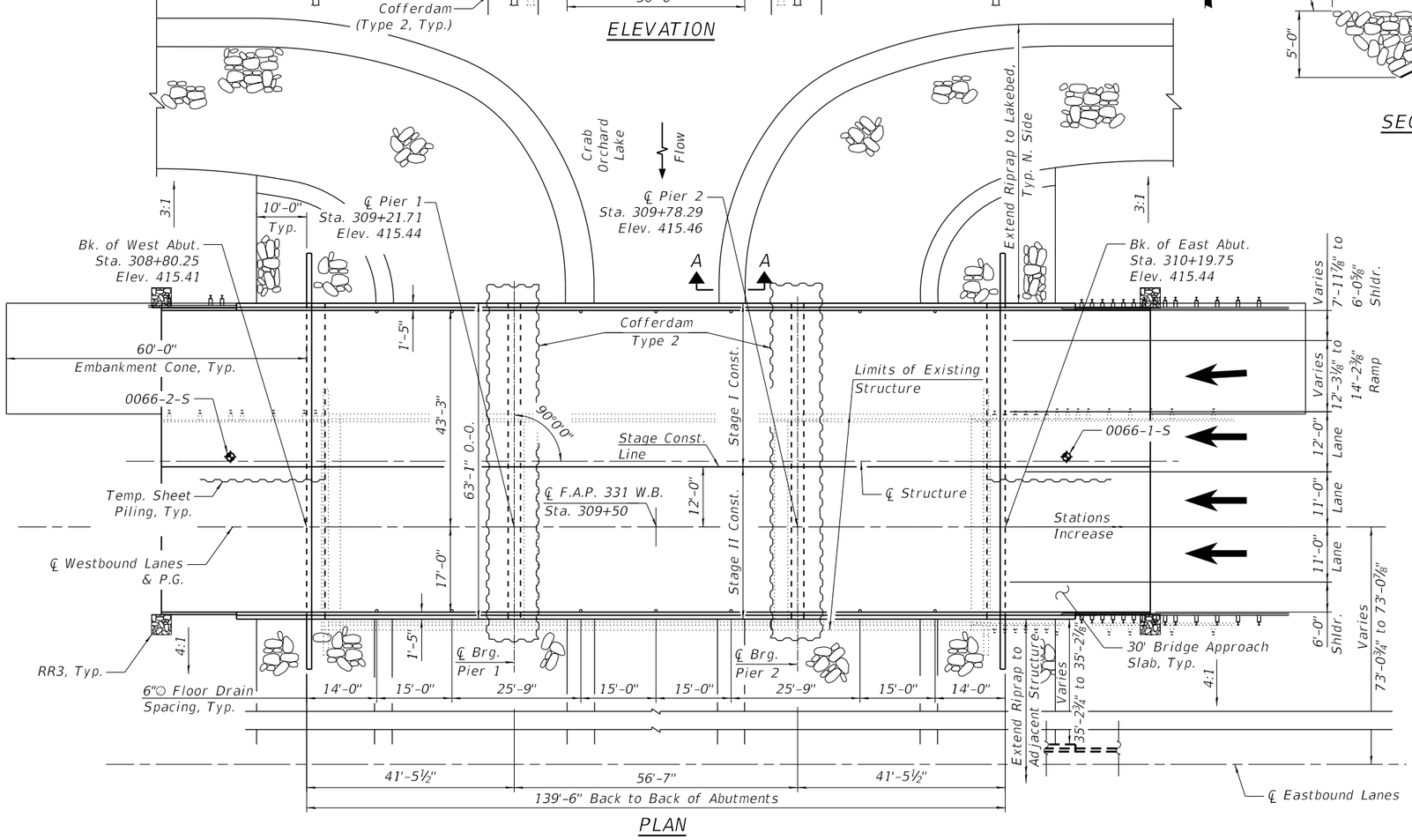
No salvage.



ELEVATION



SECTION A-A



PLAN

HIGHWAY CLASSIFICATION

F.A.P. Rte. 331 - IL Rte. 13 W.B.
Functional Class: Other Principal Arterial
ADT: 16,200 (2011); 23,860 (2037)
ADTT: 650 (2011); 955 (2037)
DHV: 2385
Design Speed: 65 m.p.h.
Posted Speed: 55 m.p.h.
One-Way Traffic
Directional Dist.: 100

LOADING HL-93

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

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition.

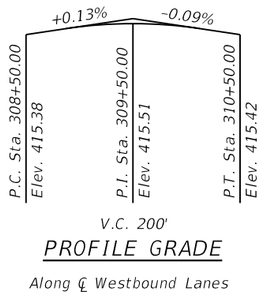
DESIGN STRESSES

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 new structural steel to be galvanized.

SEISMIC DATA

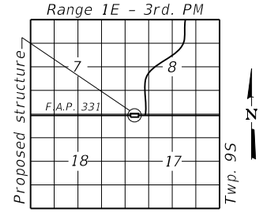
Seismic Performance Zone (SPZ) = 3
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.359g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.864g
Soil Site Class = D



V.C. 200'

PROFILE GRADE

Along ℄ Westbound Lanes



LOCATION SKETCH

GENERAL PLAN AND ELEVATION
IL 13 W.B. OVER CRAB ORCHARD LAKE
F.A.P. RT. 331 - SEC. 1-4(B-2)
WILLIAMSON COUNTY
STATION 309+50.00
STRUCTURE NO. 100-0107

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PLOT DATE =	CHECKED - R. TIWARI	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
331		WILLIAMSON		
		CONTRACT NO. 78373		
		ILLINOIS FED. AID PROJECT		

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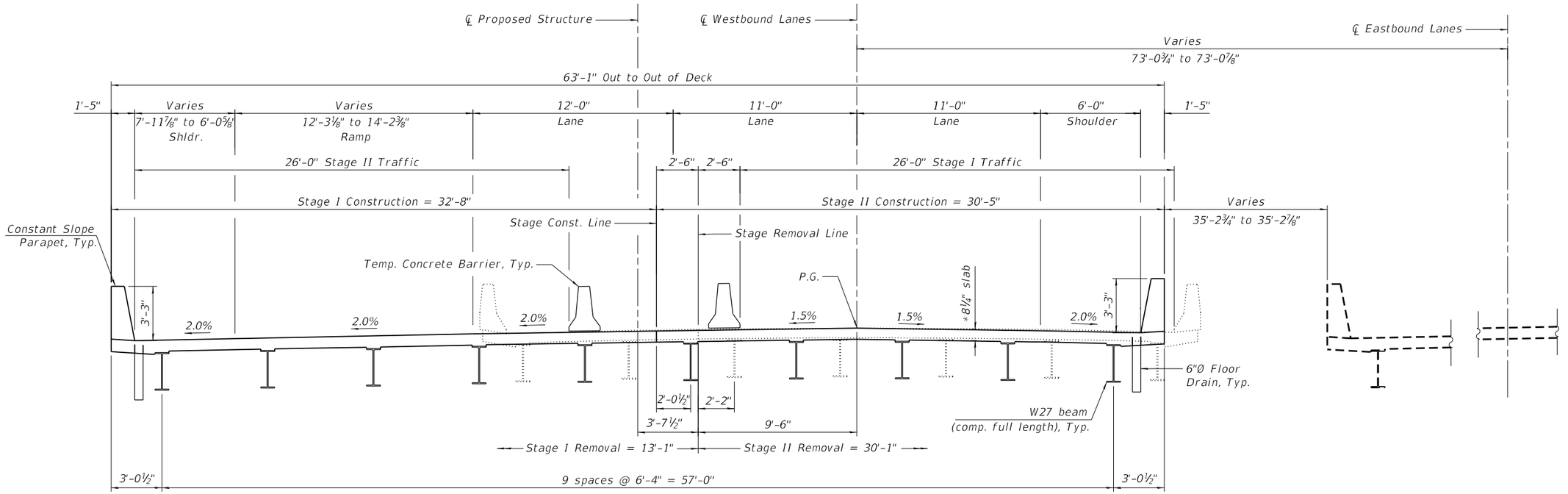
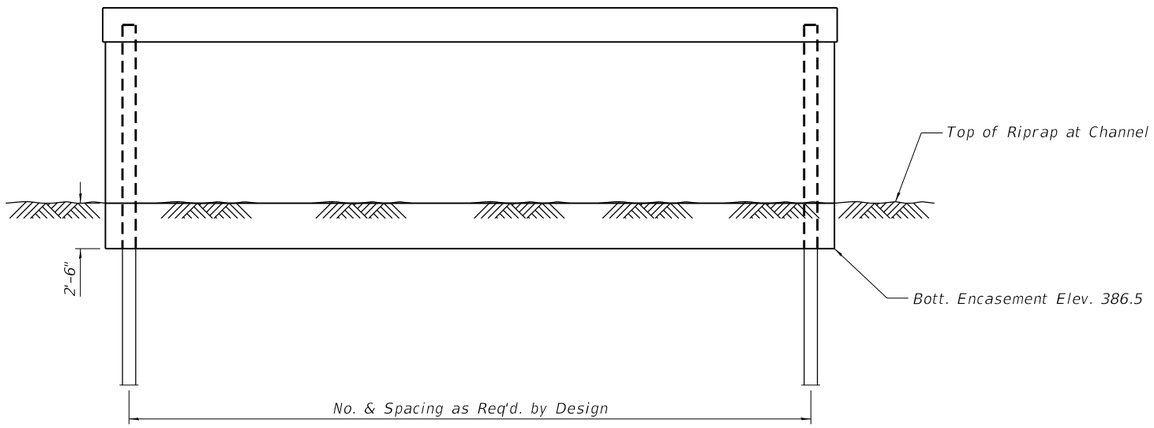


CROSS SECTION

(Looking East)

* Prior to grinding



PIER SKETCH

SECTION THRU INTEGRAL ABUTMENT

(Horiz. dim. @ Rt. ℒ's)

WATERWAY INFORMATION

Drainage Area = 1.3 Sq. mi. Low Grade Elev. 411.65 @ Sta. 310+17

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.
Ten-Year	10	586	1,314	1,316	407.5	0.0	0.0	407.5	407.5
Design	50	962	1,424	1,435	408.5	0.0	0.0	408.5	408.5
Base	100	1,131	1,470	1,483	408.9	0.0	0.0	408.9	408.9
Scour Check	200	1,295	1,517	1,532	409.3	0.0	0.0	409.3	409.3
Max. Calc.	500	1,570	1,602	1,620	410.0	0.0	0.0	410.0	410.0

DESIGN SCOUR ELEVATION TABLE

Event / Limit State	Design Scour Elevations (ft.) W. Abut.	Pier 1	Pier 2	E. Abut.	Item 113
Q100	407.9	385.3	385.3	407.9	5
Q200	407.9	385.2	385.2	407.9	
Design	407.9	385.3	385.3	407.9	
Check	407.9	385.2	385.2	407.9	

DETAILS
IL 13 W.B. OVER CRAB ORCHARD LAKE
F.A.P. RT. 331 - SEC. 1-4(B-2)
WILLIAMSON COUNTY
STATION 309+50.00
STRUCTURE NO. 100-0107

MODEL: Default
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PLOT DATE =	CHECKED - R. TIWARI	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
331	1-4 (B-1)	WILLIAMSON		
		CONTRACT NO. 78373		
		ILLINOIS FED. AID PROJECT		

Appendix C

Subsurface Data Profile Plot

Boring 2-S
STA 308+53
OFFSET 14 FT RT CL BLE
EL 414.9 FT
6/18/2014

PR ℄ PROFILE

D	EL	N	Qu	W%
	413.9			
		44	–	–
5		84	–	–
	405.4	22	–	–
10		30	–	–
		9	–	–
15		7	–	–
		2	–	–
20		6	–	–
		6	–	–
25		1	–	–
	388.9	1	0.7 B	32
30	385.4	1	0.7 B	29
	382.9	2	0.7 B	28
35	380.4	4	0.8 B	26
	377.9	2	0.8 B	27
40	375.4	2	1.1 B	27
		–	–	–
45		6	1.2 B	27
		–	–	–
50		4	1.4 B	37
	360.4	–	–	–
55		1	0.6 B	24
	355.4	–	–	–
60		WH	0.4 B	24
	350.4	–	–	–
65		13	1.8 B	19
	348.4	100/1"	–	–
70	345.2	100/2"	–	–
		–	–	–
75		–	–	–
		–	–	–
80		–	–	–
		–	–	–
85		–	–	–
		–	–	–
90		–	–	–

Asphalt
crushed aggregate (CA-6)

Rock fill (rip-rap or crusher run)
(free water in rock at 11.0 feet)

Medium, very moist, grey, Clay to Silty Clay A7-6

Medium, very moist, grey mottled brown, Silt Loam to Silty Clay Loam A-4

Medium, very moist, grey mottled brown, Clay to Silty Clay A7-6

Medium, very moist, brown, mottled grey, Silty Clay to Silty Clay Loam A-6

Medium, very moist, grey, Clay A7-6

Stiff, moist to very moist, grey mottled brown, Clay A7-6

Medium, very moist, grey, Clay to Silty Clay A7-6

Soft, very moist, grey, Clay to Silty Clay A7-6

Stiff, moist, grey, Sandy Clay A7-6 with broken Sandstone

Very dense, dry, grey Sandstone with black Clay Shale lenses

End of Boring

Boring 1-S
STA 310+40
OFFSET 13 FT RT CL EBL
EL 414.8 FT
6/23/2014

D	EL	N	Qu	W%
	413.8			
		–	–	–
5		–	–	–
	406.8	–	–	–
10		–	–	–
		–	–	–
15		–	–	–
		–	–	–
20		–	–	–
		–	–	–
25	390.8	4	2.5 S	21
	389.3	1	0.2 B	34
30	387.8	WH	0.4 B	30
	385.3	1	0.4 B	33
35	380.3	5	2.1 B	27
	377.8	4	1.5 B	35
40		5	1.8 B	31
		–	–	–
45	370.3	3	0.8 B	28
		–	–	–
50	364.8	4	1.6 B	23
		–	–	–
55	360.3	8	2.9 B	20
		–	–	–
60		10	2.3 B	21
	352.3	–	–	–
65	349.9	100/5"		
		–	–	–
70		–	–	–
		–	–	–
75		–	–	–
		–	–	–
80		–	–	–
		–	–	–
85		–	–	–
		–	–	–
90		–	–	–

Asphalt
Crushed aggregate (CA-6)

Rock fill (rip-rap or crusher run)
(free water in rock at 10.0 feet)

Soft, very moist, grey, Clay A7-6

Very stiff, moist, grey, Silty Clay Loam A-4

Very soft, wet, grey, Silty Clay A7-6

Soft, very moist, grey mottled brown, Clay to Silty Clay A7-6

Very stiff, moist, grey mottled brown, Clay A7-6

Stiff, moist, grey mottled brown, Clay A7-6

Medium, very moist, grey mottled brown, Clay A7-6

Stiff, moist, brown mottled grey, Clay A7-6

Very stiff, moist, brown mottled grey, Clay A7-6

Very Dense, dry, grey, Sandstone with Clay Shale seams

End of Boring

LEGEND

EL = Elevation (FT)
D = Depth Below Existing Ground Surface (FT)
N = SPT N-VALUE (AASHTO T206)
Qu = Unconfined Compressive Strength in tons per sq. ft. (tsf)
Failure Mode (B=bulge, S=shear, P=penetrometer)
W% = Moisture Content Percentage

▽ = Groundwater Level First Encountered

Soil profile is for illustrative purposes only. Actual conditions will vary.

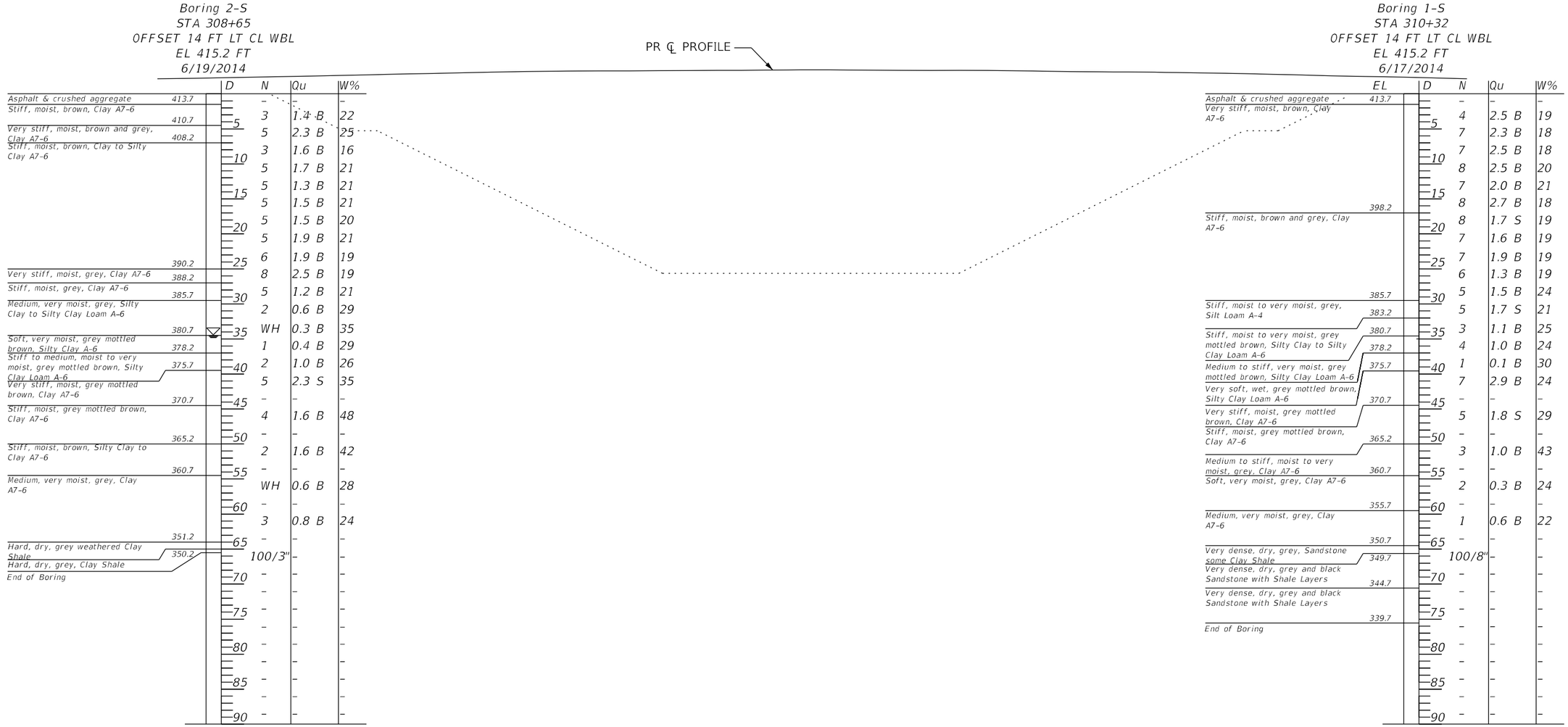
SUBSURFACE DATA PROFILE
ILL 13 EB OVER CRAB ORCHARD LAKE
F.A.P. RT. 331 - SECTION 1-4(B-1)
WILLIAMSON COUNTY
STATION 309+50.00
SN 100-0106

FILE NAME =	USER NAME = $USER$	DESIGNED - TAW	REVISED -
$FILEL$		DRAWN - TAW	REVISED -
$MODELNAME$	PLOT SCALE = $SCALE$	CHECKED - TJZ	REVISED -
	PLOT DATE = $DATE$	DATE - 10/25/22	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 1 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
57		WILLIAMSON	1	1
	ILLINOIS	FED. AID PROJECT		



LEGEND

EL = Elevation (FT)
D = Depth Below Existing Ground Surface (FT)
N = SPT N-VALUE (AASHTO T206)
Qu = Unconfined Compressive Strength in tons per sq. ft. (tsf)
Failure Mode (B=bulge, S=shear, P=penetrometer)
W% = Moisture Content Percentage

▽ = Groundwater Level First Encountered

Soil profile is for illustrative purposes only. Actual conditions will vary.

SUBSURFACE DATA PROFILE
ILL 13 WB OVER CRAB ORCHARD LAKE
F.A.P. RT. 331 - SECTION 1-4(B-1)
WILLIAMSON COUNTY
STATION 309+50.00
SN 100-0107

FILE NAME = $FILEL$ $MODELNAMES	USER NAME = $USER$	DESIGNED - TAW	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION		F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS / SHEET NO.
		DRAWN - TAW	REVISED -			57		WILLIAMSON	1 / 1
	PLOT SCALE = $SCALE$	CHECKED - TJZ	REVISED -						
	PLOT DATE = $DATE$	DATE - 10/25/22	REVISED -		SHEET 1 OF 1 SHEETS		ILLINOIS	FED. AID PROJECT	

Appendix D

Soil Boring and Rock Core Logs

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 6/23/14

ROUTE FAP 331 (IL 13) **DESCRIPTION** IL 13 EB Lanes over Crab Orchard Lake **LOGGED BY** L. Estel

SECTION 5-3B-3 **LOCATION** 1.1 mi. E of Jackson Co. (near E Abut.), **SEC.** 17, **TWP.** 9S, **RNG.** 1E, **PM**

COUNTY Williamson **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lb

STRUCT. NO. 100-0018
Station 309+50

BORING NO. 1-S
Station 310+40
Offset 13.0ft Rt EB CL
Ground Surface Elev. 414.8 ft

Surface Water Elev. 405.5 ft
Stream Bed Elev. ft

Groundwater Elev.:
▽ **First Encounter** 404.8 ft
▽ **Upon Completion** 404.8 ft
▼ **After** Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Cored HMA Pavment			
413.80			
Crushed Aggregate (CA-6)			
-5			
406.80			
Rock Fill (Rip Rap or Crusher Run)			
▽▼ -10			
-15			
-20			
Rock Fill (Rip Rap or Crusher Run) *(continued)*			
390.80			
Soft Grey, V. Moist CLAY			
-25	WOH		
389.30	1 3	2.5 S	21
V. Stiff Grey, Moist SILTY CLAY LOAM			
387.80			
V. Soft Grey, Wet SILTY CLAY	1		
	WOH 1	0.2 B	34
385.30			
-30 Soft Grey and mottled Brown, V. Moist CLAY to SILTY CLAY	WOH		
	WOH WOH	0.4 B	30
	WOH		
	1 WOH	0.4 B	33
380.30			
-35 V. Stiff Grey and mottled Brown, Moist CLAY	1		
	2 3	2.1 B	27
377.80			
Stiff Grey and mottled Brown, Moist CLAY	1		
	2 2	1.5 B	35
-40	1		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 6/23/14

ROUTE FAP 331 (IL 13) **DESCRIPTION** IL 13 EB Lanes over Crab Orchard Lake **LOGGED BY** L. Estel

SECTION 5-3B-3 **LOCATION** 1.1 mi. E of Jackson Co. (near E Abut.), **SEC.** 17, **TWP.** 9S, **RNG.** 1E, **PM**

COUNTY Williamson **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lb

STRUCT. NO. 100-0018
Station 309+50

BORING NO. 1-S
Station 310+40
Offset 13.0ft Rt EB CL
Ground Surface Elev. 414.8 ft

Surface Water Elev. 405.5 ft
Stream Bed Elev. ft

Groundwater Elev.:
▽ **First Encounter** 404.8 ft
▽ **Upon Completion** 404.8 ft
▼ **After** Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	Description
	2 3	1.8 B	31	Stiff Grey and mottled Brown, Moist CLAY *(continued)*
370.30				
-45	WOH			Medium Grey and mottled Brown, V. Moist CLAY
	1 2	0.8 B	28	
364.80				
-50	1			
	2 2	1.6 B	23	Stiff Brown and mottled Grey, Moist CLAY
360.30				
-55	1			V. Stiff Brown and mottled Grey, Moist CLAY
	3 5	2.9 B	20	
-60	1			
	4 6	2.3 B	21	V. Stiff Brown and mottled Grey, Moist CLAY *(continued)*
352.30				
				V. Dense Grey, Dry SANDSTONE with CLAY SHALE seams
349.90				
-65	100/5"			
				(end of boring)
				Bottom of hole @ 64.9 feet
				Free water observed at 10.0 feet
				Ground Surface Elevation referenced to BM at NW corner of SN 100-0018; Elev. 416.6
-70				
				SPT Hammer Efficiency: 75% (To convert "N" values to "N60", multiply by 1.25)
-75				
-80				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 6/18/14

ROUTE FAP 331 (IL 13) **DESCRIPTION** IL 13 EB Lanes over Crab Orchard Lake **LOGGED BY** L. Estel

SECTION 5-3B-3 **LOCATION** 1.1 mi. E of Jackson Co. (near W Abut.), **SEC.** 17, **TWP.** 9S, **RNG.** 1E, **PM**

COUNTY Williamson **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lb

STRUCT. NO. 100-0018
Station 309+50

BORING NO. 2-S
Station 308+53
Offset 14.0ft Rt EB CL
Ground Surface Elev. 414.9 ft

Surface Water Elev. 405.5 ft
Stream Bed Elev. ft

Groundwater Elev.:
▽ **First Encounter** 403.9 ft
▽ **Upon Completion** ft
▼ **After** Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Cored HMA Pavement			
413.90			
Crushed Aggregate (CA-6)			
	14		
	25		
	19		
-5	28		
	45		
	39		
	9		
	13		
	9		
405.40			
Rock Fill (Rip Rap or Crusher Run)			
-10	8		
	20		
▽	10		
Note: despite low blow counts the material encountered from 9.5 to 26.0 ft was primarily boulder sized with some gravel and sand recovered in the sample tube.	6		
	6		
	3		
-15	3		
	4		
	3		
	5		
	1		
	1		
-20	1		

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Rock Fill (Rip Rap or Crusher Run)	5		
	1		
Note: despite low blow counts the material encountered from 9.5 to 26.0 ft was primarily boulder sized with some gravel and sand recovered in the sample tube. *(continued)*	1		
	5		
	1		
-25	1		
	WOH		
388.90	1		
Medium Grey, V. Moist CLAY to SILTY CLAY			
	WOH		
	WOH	0.7	32
	1	B	
385.40			
-30 Medium Grey and mottled Brown, V. Moist SILT LOAM to SILTY CLAY LOAM	WOH		
	WOH	0.7	29
	1	B	
382.90			
Medium Grey and mottled Brown, V. Moist CLAY to SILTY CLAY	1		
	1	0.7	28
	1	B	
380.40			
-35 Medium Brown and mottled Grey, V. Moist SILTY CLAY to SILTY CLAY LOAM	1		
	2	0.8	26
	2	B	
377.90			
Medium Grey, V. Moist CLAY	WOH		
	1	0.8	27
	1	B	
375.40			
-40	WOH		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 6/18/14

ROUTE FAP 331 (IL 13) **DESCRIPTION** IL 13 EB Lanes over Crab Orchard Lake **LOGGED BY** L. Estel

SECTION 5-3B-3 **LOCATION** 1.1 mi. E of Jackson Co. (near W Abut.), **SEC.** 17, **TWP.** 9S, **RNG.** 1E, **PM**

COUNTY Williamson **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lb

STRUCT. NO. 100-0018
Station 309+50

BORING NO. 2-S
Station 308+53
Offset 14.0ft Rt EB CL
Ground Surface Elev. 414.9 ft

Surface Water Elev. 405.5 ft
Stream Bed Elev. ft

Groundwater Elev.:
▽ **First Encounter** 403.9 ft
▽ **Upon Completion** ft
▼ **After** Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
	Stiff Grey and mottled Brown, Moist to V. Moist CLAY *(continued)*		
	1	1.1	27
	1	B	
-45	1		
	2	1.2	27
	5	B	
-50	1		
	2	1.4	37
	2	B	
360.40			
-55	Medium Grey, V. Moist CLAY to SILTY CLAY		
	WOH		
	1	0.6	24
	WOH	B	
355.40			
-60	WOH		

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
	Soft Grey, V. Moist CLAY to SILTY CLAY *(continued)*		
	WOH	0.4	24
	WOH	B	
350.40			
-65	Stiff Grey, Moist SANDY CLAY with broken SANDSTONE		
	2		
	3	1.8	19
	10	B	
348.40			
	Very Dense Grey, Dry SANDSTONE with Black CLAY SHALE LENSES		
	100/1"		
345.20			
-70	100/2"		
-75	(end of boring)		
	Bottom of hole @ 69.7 feet		
	Ground Surface Elevation referenced to benchmark at NW corner of SN 100-0018; Elev. 416.6		
	SPT Hammer Efficiency: 75% (To convert "N" values to "N60", multiply by 1.25)		
	Note: During drilling in the rock fill from 9.5 to 26.0 feet, the augers were "kicked out" of plumb such that coring was not possible		
-80			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

Borings for SN 100-0018 from 1964

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS & BUILDINGS
DIVISION OF HIGHWAYS

ROUTE NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
FED. ROAD DIST. NO. 7	ILLINOIS	FED. AID PROJECT		
14	5-38.3	WILLIAMSON	18	13

SHEET NO. 8
SHEETS 8

COUNTY Williamson
Boring No. 1
Station 308+88
Offset 10 Ft. Rt.
Surface Water El. 405.0
Groundwater El. at Completion —
After — Hours —

Elevation	N	Qu t/s.f.	w (%)
Ground Surface 390.1 0			
Soft wet gray clay A-6(12-13)			
387.7			
	2	—	27
		0.8P	22
Medium wet gray clay A-7-6(15)			
	1	1.0P	20
-5			
384.2			
	6	0.8B	24
Medium moist gray mottled brown silty clay Loam A-6(9-10)			
-10			
	6	Lost Sample	
	6	1.0B	24
376.7			
Medium moist gray mottled brown silty clay A-6(10-11) 375.7	7	0.8B	25
-15			
Very stiff moist gray mottled brown and black clay A-7-6(14-15) 373.2	12	3.0B	21
See next column			
	11	1.4B	22
-20			
	10	1.6B	24

Elevation	N	Qu t/s.f.	w (%)
Medium to stiff moist gray mottled brown to dark gray clay A7-6(15+)			
	8	0.7B	40
-25			
	7	0.7B	37
360.7			
	5	0.8B	40
-30			
Medium moist gray silty clay loam A-6(8-9)			
358.2	6	0.7B	29
Medium very moist gray silty clay A-6(10-11)			
	5	0.6B	23
-35			
353.2	6	0.5B	22
Medium to stiff moist to very moist gray clay loam A-4(8)			
	4	0.6B	20
-40			
	15	1.0B	16
346.7			
Dense moist gray mottled brown sandy gravel with clay binder	100	Blows in 8"	12
-45			

COUNTY Williamson
Boring No. 1
Station 308+88
Offset 10 Ft. Rt.

Elevation	N	Qu t/s.f.	w (%)
40			
See previous sheet			
	15	1.0B	16
346.7			
Dense moist gray mottled brown sandy gravel with clay binder 346.0	100	Blows 3"	12
45			
Hard gray fine grained sandstone with thin laminations of black sandy shale		Cored 80% Recovery	
341.0			
Bottom of Hole 49.1 feet			
-50			
Washing procedure used in drilling entire hole.			
Location: Near the N.W. corner of the NW¼, NW¼ Sec. 17, R1E, T9S,3 P.M.			
-55			

N – Standard Penetration Test – Blows per foot to drive 2" O.D. Split Spoon Sampler 12" with 140# hammer falling 30".

Qu – Unconfined Compressive Strength – t/sf

w – Water Content – percentage of oven dry weight – %

Type failure
B – Bulge Failure
S – Shear Failure
E – Estimated Value
P – Penetrometer Value

COUNTY Williamson
Boring No. 2
Station 309+24.5
Offset 144 Lt.
Surface Water El. 402.7
Groundwater El. at Completion •
After 9 Hours •

Elevation	N	Qu t/s.f.	w (%)
Ground Surface 388.9 0			
Medium moist gray mottled brown silty clay loam A-4(8)			
-5			
	9	0.8S	24
379.9			
Medium moist brown mottled black silty clay loam A-6(9-10)			
-10			
	7	0.8B	25
377.4			
Stiff moist gray mottled brown silty clay to clay A-6(11-13)			
	7	1.4B	26
-15			
	9	1.4B	25
	9	1.4B	26
-20			
	7	Lost Sample	
367.4			
See next column			

Elevation	N	Qu t/s.f.	w (%)
Medium moist dark gray mottled brown silty clay loam A-6(9-10)			
	7	0.9B	30
363.4 -25			
Medium to stiff moist dark gray clay A7-6(15-17)	9	1.2B	31
		—	—
	5	Lost Sample	
359.4			
Medium moist dark gray clay A7-6(13-14) -30	5	0.6P	27
357.4			
Medium moist to very moist dark gray silty clay to clay A-6(11-12)			
	6	0.5P	47
-35			
	6	Lost Sample	
350.9			
Medium fine to coarse very moist light brown sandy gravel with clay loam binder	8	0.8P	24
-40			
	49	—	35
346.2	100	—	16
Rotten gray sandstone 346.0	blows	—	—
Bottom of Hole = 42.9 ft. *Boring taken in Lake through 18.8 feet of water.	9"		
Washing procedure used in drilling entire hole -45			

COUNTY Williamson
Boring No. 3
Station 309+75.5
Offset 6 Ft. Rt.
Surface Water El. 401.1
Groundwater El. at Completion •
After — Hours —

Elevation	N	Qu t/s.f.	w (%)
Ground Surface 391.0 0			
Stiff to medium moist gray mottled brown silty clay loam A-4(8)			
	19	1.5S	28
-5			
384.5	9	0.6B	27
Stiff to medium moist gray mottled brown and black silty clay loam A-6(9-10)			
-10			
	6	1.0S	26
	12	Lost Sample	
	5	0.7B	29
376.0 -15			
Stiff moist gray mottled brown and black clay A7-6(15-17)			
	11	1.1B	24
366.5 -25			
	9	2.0B	27
372.0 -20			
See next column			

Elevation	N	Qu t/s.f.	w (%)
Stiff moist gray mottled brown clay A7-6(17+)			
	10	1.1P	40
366.0 -25			
Medium moist gray mottled brown clay A7-6(14-15) 364.5	6	0.7B	43
Medium moist to very moist gray mottled brown silty clay to clay A-6(11-12) with some vegetation	6	1.0P	25
-30			
	5	0.6B	29
	7	0.8P	30
-35			
	6	0.8B	26
	5	0.6B	20
350.5 -40			
Medium moist bluish gray mottled brown sandy gravel with clay loam binder	40	—	13
348.0			
Rotten moist brown sandstone 347.8	100	Blows in 3"	18
Bottom of Hole = 43.2 ft. *Boring taken in Lake through 13.1 feet of water. -45			
Washing procedure used in drilling entire hole.			

COUNTY Williamson
Boring No. 4
Station 309+96
Offset 19 Ft. Rt.
Surface Water El. 403.2
Groundwater El. at Completion •
After 8 Hours •

Elevation	N	Qu t/s.f.	w (%)
Ground Surface 391.0 0			
Medium moist light brown mottled gray and black clay A7-6(14-15)			
386.5			
	5	0.8B	33
-5	5	0.3P	31
Soft very moist gray mottled black silt loam A-4(8) with rotten vegetation 385.0			
Stiff moist gray mottled brown silty clay loam A-6(9)			
	6	1.1B	26
381.0 -10			
	7	1.0B	23
Medium moist light brown mottled black silty clay loam A-6(9-10)			
	9	0.8B	24
377.0			
Stiff moist gray mottled brown and black clay A7-6(17+) -15	13	3.0B	30
	9	1.6B	34
372.5			
Medium moist gray mottled brown and black clay A7-6(17+) -20	8	0.8B	43
	6	1.0B	45
-45			

Elevation	N	Qu t/s.f.	w (%)
See previous column			
-25	11	Lost Sample	
365.0			
Medium moist dark gray clay A7-6(15)			
	7	1.0B	30
362.5			
Medium very moist dark gray silty clay A-6(11-12) with some rotten vegetation -30	6	0.6B	27
	6	0.8B	32
357.0			
Soft very moist dark gray silty clay loam A-6(9-10) with some rotten vegetation -35	9	0.4B	29
354.5			
Medium to soft very moist dark gray silty clay A7-6(12-13) with some rotten vegetation	6	0.8P	24
351.5	19	0.3P	29
Soft gray mottled brown sandy shale with silt seams -40	—	—	—
350.0			
Soft light brown sandstone 349.5	100	Blows in -2"	
		Cored 40% Recovery	
-45			

COUNTY Williamson
Boring No. 4
Station 309+96
Offset 19 Ft. Rt.

Elevation	N	Qu t/s.f.	w (%)
40			
See previous sheet			
350.0			
Soft light brown sandstone 349.5	100	Blows in 6"	
Medium hard light brown to gray sandstone with thin laminations of black sandy shale		Cored 40% Recovery	
45			
344.5			
Bottom of Hole = 46.5 ft.			
*Boring taken in Lake through 12.2 feet of water.			
Washing procedure used in drilling entire hole. -50			

DESIGNED	T.O. Williams
CHECKED	Emily J. Stuber
DRAWN	T.O.W.
CHECKED	E.S.

FEB 18 1964

EXAMINED W.C. Baumann — ENGINEER OF BRIDGES AND TRAFFIC REGULATIONS
PASSED E.J. Stuber — ENGINEER OF SOILS
APPROVED O.E. Leigh — CHIEF ENGINEER

BORINGS
F.A. RTE. 14 SEC. 5-38.3
WILLIAMSON COUNTY
STA. 305+50

(5-38.3) WILLIAMSON Co. D.H. 9

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 6/17/14

ROUTE FAP 331 (IL 13) **DESCRIPTION** IL 13 WB over Crab Orchard Lake **LOGGED BY** L. Estel

SECTION 5-B1 **LOCATION** 0.2 miles W of Cambria Road (near E Abut.), **SEC.** 17, **TWP.** 9S, **RNG.** 1E, **PM**

COUNTY Williamson **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lbs

STRUCT. NO. 100-0066
Station 309+50

BORING NO. 1-S
Station 310+32
Offset 14.0ft Lt CL WB
Ground Surface Elev. 415.2 ft

Surface Water Elev. 405.5 ft
Stream Bed Elev. ft

Groundwater Elev.:
▽ **First Encounter** 380.2 ft
▽ **Upon Completion** ft
▼ **After** Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	Description
				Cored Pavement, HMA over Crushed AGGREGATE
				413.70
				V. Stiff Brown, Moist CLAY
	1			
	2 2	2.5 B	19	
-5	1			
	3 4	2.3 B	18	
	1			
	3 4	2.5 B	18	
-10	1			
	4 4	2.5 B	20	
	1			
	3 4	2.0 B	21	
-15	1			
	3 5	2.7 B	18	
				398.20
	1			Stiff Brown and Grey, Moist CLAY
	3 5	1.7 S	19	
-20	1			
	3 4	1.6 B	19	Stiff Brown and Grey, Moist CLAY *(continued)*
	1			
-25	1			
	3 4	1.9 B	19	
	1			
	2 4	1.3 B	19	
	1			
	2 3	1.5 B	24	
				385.70
-30	1			Stiff Grey, Moist to V. Moist SILT LOAM SAND 9%, SILT 74%, CLAY 17%, LL 28, PI 9 (estimated based on visual ID and historical database)
	1 4	1.7 S	21	
				383.20
	1			Stiff Grey and mottled Brown, Moist to V. Moist SILTY CLAY to SILTY CLAY LOAM SAND 9%, SILT 70%, CLAY 21%, LL 31, PI 11 (estimated based on visual ID and historical database)
	1 2	1.1 B	25	
				380.70
-35	1			Medium Grey and mottled Brown, ▽ V. Moist SILTY CLAY LOAM
	2 2	1.0 B	24	
				378.20
	WOH			V. Soft Grey and mottled Brown, Wet SILTY CLAY LOAM
	WOH 1	0.1 B	30	
				375.70
-40	1			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 6/17/14

ROUTE FAP 331 (IL 13) **DESCRIPTION** IL 13 WB over Crab Orchard Lake **LOGGED BY** L. Estel

SECTION 5-B1 **LOCATION** 0.2 miles W of Cambria Road (near E Abut.), **SEC.** 17, **TWP.** 9S, **RNG.** 1E, **PM**

COUNTY Williamson **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lbs

STRUCT. NO. 100-0066
Station 309+50

BORING NO. 1-S
Station 310+32
Offset 14.0ft Lt CL WB
Ground Surface Elev. 415.2 ft

Surface Water Elev. 405.5 ft
Stream Bed Elev. ft

Groundwater Elev.:
▽ **First Encounter** 380.2 ft
▽ **Upon Completion** ft
▼ **After** Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	Description
	3 4	2.9 B	24	V. Stiff Grey and mottled Brown, Moist CLAY *(continued)*
370.70				
-45	1			Stiff Grey and mottled Brown, Moist CLAY
	2 3	1.8 S	29	
365.20				
-50	1			Medium Grey, Moist to V. Moist CLAY
	1 2	1.0 B	43	
360.70				
-55	WOH			Soft Grey, V. Moist CLAY
	1 1	0.3 B	24	
355.70				
-60	WOH			Medium Grey, V. Moist CLAY
	WOH 1	0.6 B	22	Medium Grey, V. Moist CLAY *(continued)*
350.70				
-65	100/8"			V. Dense Grey, Dry SANDSTONE with some CLAY SHALE
				(Borehole continued with rock coring.)
				Bottom of hole @ 75.5 feet
				Ground Surface Elevation Referenced to BM at NW corner of SN 100-0018; Elev. 416.6
-70				
				Hammer Efficiency = 75% (To convert "N" values to "N60", multiply by 1.25)
-75				
-80				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

File Name S:\MATERIALS GEOTECHNICAL UNIT\GINT\PROJECTS\PROJECTS FILE\WILLIAMSON\STRUCTURES\100-0066 IL 13 WB OVER CRAB ORCHARD LAKE\100-0066 IL 13 WB OVER CRAB ORCHARD LAKE.GPJ Data Template D6TEMPLT.GDT Date Printed 4/14/21
Latitude Longitude Datum NAD83 Job Number

Illinois Department of Transportation
Division of Highways
District 9

ROCK CORE LOG

Date 6/17/14

ROUTE FAP 331 (IL 13) **DESCRIPTION** IL 13 WB over Crab Orchard Lake **LOGGED BY** L. Estel

SECTION 5-B1 **LOCATION** 0.2 miles W of Cambria Road (near E Abut.), **SEC.** 17, **TWP.** 9S, **RNG.** 1E, **PM**

COUNTY Williamson **CORING METHOD** Conventional rotary with water

STRUCT. NO. 100-0066
Station 309+50

BORING NO. 1-S
Station 310+32
Offset 14.0ft Lt CL WB
Ground Surface Elev. 415.2 **ft**

CORING BARREL TYPE & SIZE NV3 5FT NWJ
Core Diameter 1.78 **in**
Top of Rock Elev. 350.70 **ft**
Begin Core Elev. 349.70 **ft**

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
V. Dense Grey and Black, Dry SANDSTONE with SHALE layers		1	97	16		
						356.7
						344.5
	-70					
	344.70					
V. Dense Grey and Black, Dry SANDSTONE with SHALE layers		2	100	37		
	-75					248.8
	339.70					
	-80					
	-85					

Color pictures of the cores Yes, attached
Cores will be stored for examination until 5 Years after Construction
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)
RQD is the ratio of the total length of sound core specimens >4" to total length of core run

BBS, form 138 (Rev. 8-99)

ROCK CORE 100-0066 IL 13 WB OVER CRAB ORCHARD LAKE.GPJ D6TEMPLT.GDT 4/14/21

Illinois Department of Transportation
District Nine Materials
Unconfined Compressive Strength

FAP 331 (IL 13)
Structure 100-0066 (Boring 1-S)
Williamson County

Boring #	Specimen#	Depth	Unconfined Compression
1-S	1	66’ 8”	4,954 psi
1-S	2	67’ 8”	4,785 psi
1-S	3	74’ 6”	3,456 psi

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 9/19/14

ROUTE FAP 331 (IL 13) **DESCRIPTION** IL 13 WB over Crab Orchard Lake **LOGGED BY** L. Estel

SECTION 5-B1 **LOCATION** 0.2 miles W of Cambria Road (near W Abut.), **SEC.** 17, **TWP.** 9S, **RNG.** 1E, **PM**

COUNTY Williamson **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lbs

STRUCT. NO. 100-0066
Station 309+50

BORING NO. 2-S
Station 308+65
Offset 14.0ft Lt CL WB
Ground Surface Elev. 415.2 ft

Surface Water Elev. 405.5 ft
Stream Bed Elev. ft

Groundwater Elev.:
▽ **First Encounter** 380.7 ft
▽ **Upon Completion** ft
▼ **After** Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	Description
				Cored Pavement, HMA over Crushed AGGREGATE
				413.70
				Stiff Brown, Moist CLAY
	1			
	1	1.4	22	
	2	B		
				410.70
-5	1			V. Stiff Brown and Grey, Moist CLAY
	2	2.3	25	
	3	B		
				408.20
	1			Stiff Brown, Moist CLAY to SILTY CLAY
	1	1.6	16	
	2	B		
-10	1			
	2	1.7	21	
	3	B		
	1			
	2	1.3	21	
	3	B		
-15	1			
	2	1.5	21	
	3	B		
	1			
	2	1.5	20	
	3	B		
-20	1			
				Stiff Brown, Moist CLAY to SILTY CLAY *(continued)*
	2	1.9	21	
	3	B		
	1			
	2	1.9	19	
	4	B		
-25	1			390.20
	3	2.5	19	V. Stiff Grey, Moist CLAY
	5	B		
	1			388.20
	2	1.2	21	Stiff Grey, Moist CLAY
	3	B		
-30	1			385.70
	1	0.6	29	Medium Grey, V. Moist SILTY CLAY to SILTY CLAY LOAM
	1	B		
	WOH			383.20
	WOH	0.3	25	Soft Grey, V. Moist CLAY
	WOH	B		
-35	1			▽ 380.70
	WOH	0.4	29	Soft Grey and mottled Brown, V. Moist SILTY CLAY
	1	B		
	1			378.20
	1	1.0	26	Medium Grey and mottled Brown, Moist to V. Moist SILTY CLAY LOAM
	1	B		
-40	1			375.70

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 9/19/14

ROUTE FAP 331 (IL 13) **DESCRIPTION** IL 13 WB over Crab Orchard Lake **LOGGED BY** L. Estel

SECTION 5-B1 **LOCATION** 0.2 miles W of Cambria Road (near W Abut.), **SEC.** 17, **TWP.** 9S, **RNG.** 1E, **PM**

COUNTY Williamson **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lbs

STRUCT. NO. 100-0066
Station 309+50

BORING NO. 2-S
Station 308+65
Offset 14.0ft Lt CL WB
Ground Surface Elev. 415.2 ft

Surface Water Elev. 405.5 ft
Stream Bed Elev. ft

Groundwater Elev.:
▽ **First Encounter** 380.7 ft
▽ **Upon Completion** ft
▼ **After** Hrs. ft

	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
V. Stiff Grey and mottled Brown, Moist CLAY *(continued)*		2 3	2.3 S	35
370.70				
Stiff Grey and mottled Brown, Moist CLAY	-45	1		
		2 2	1.6 B	48
365.20	-50	WOH		
Stiff Brown, Moist SILTY CLAY to CLAY		1 1	1.6 B	42
360.70				
Medium Grey, V. Moist CLAY	-55	WOH		
		WOH WOH	0.6 B	28
	-60	WOH		
Medium Grey, V. Moist CLAY *(continued)*		1 2	0.8 B	24
351.20				
Hard Grey, Dry Weathered CLAY SHALE				
350.20	-65	18		
Hard Grey, Dry CLAY SHALE		100/3"		
	-70			
Bottom of hole @ 65.3 feet				
Ground Surface Elevation referenced to BM at NW corner of SN 100-0018; Elev. 416.6				
Hammer Efficiency = 75% (To convert "N" values to "N60", multiply by 1.25)				
	-75			
	-80			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

Appendix E

Settlement Analysis

COHESIVE SOIL SETTLEMENT ESTIMATE

LOCATION AND BORING USED ====: East Abutment / Boring 1-S (0106)
TYPE OF SURCHARGE ==========: 1 (1=2:1 bridge cone, 2=continuous embank., 3=rectangular surch.)
DEPTH TO WATER TABLE (below top of existing embankment) ==: 27 FT

NEW EMBANKMENT:
- NEW EMBANKMENT FILL UNIT WEIGHT ==========: 120 PCF
- NEW EMBANKMENT FILL HEIGHT ==========: 27 FT
- PROPOSED WIDTH AT TOP ==========: 90 FT
- PROPOSED WIDTH AT BOTTOM ==========: 198 FT (which is a 2.0:1 slope)

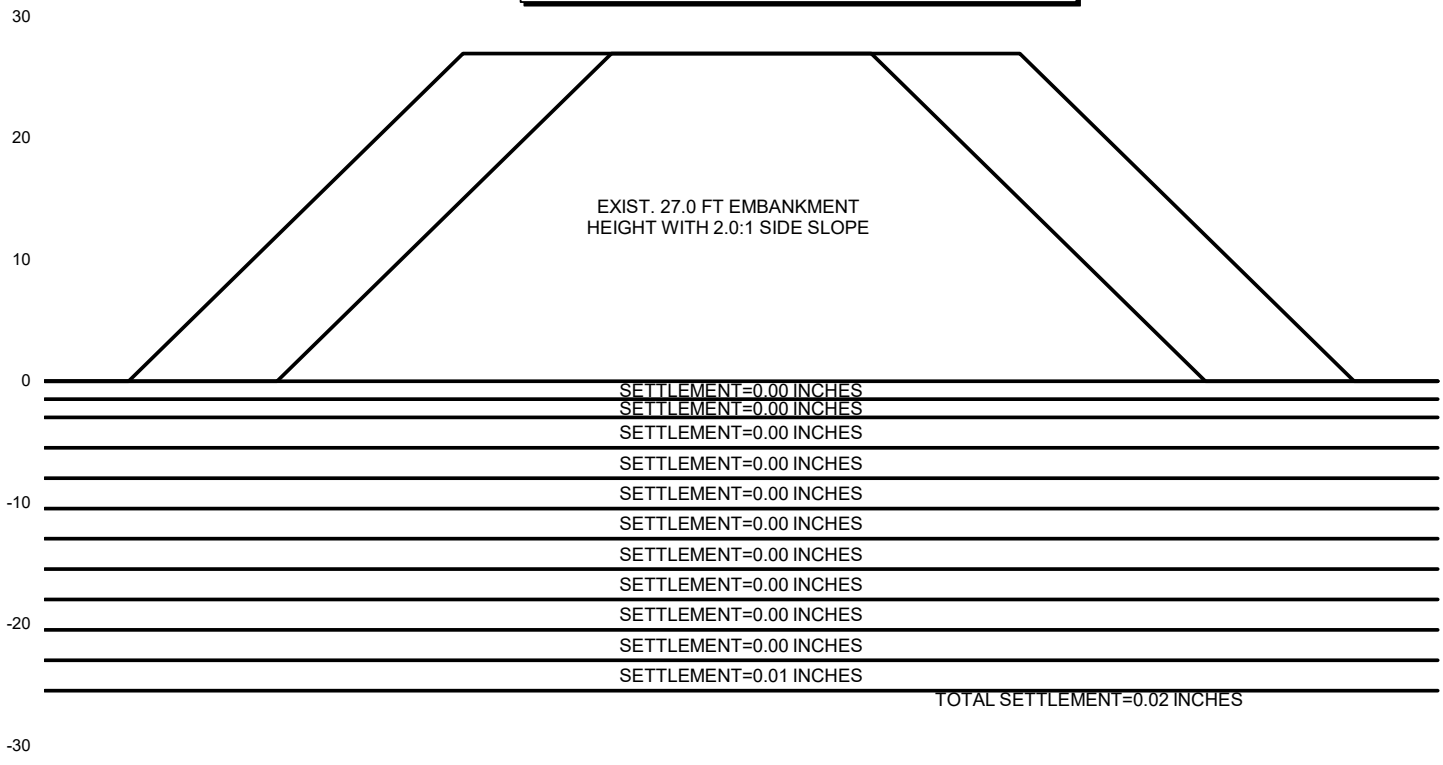
EXISTING EMBANKMENT (IF ANY):
- EXISTING EMBANKMENT UNIT WEIGHT ==========: 120 PCF
- EXISTING EMBANKMENT HEIGHT ==========: 27 FT
- EXISTING WIDTH AT TOP ==========: 42 FT
- EXISTING WIDTH AT BASE ==========: 150 FT (which is a 2.0:1 slope)

ASSUMPTIONS:
Soil Deposit is Normally Consolidated
Cohesive Layers are Saturated
Soils have a Low Sensitivity
Liquid Limit (LL)=Moist. Content (MC%)
Initial Void Ratio (Eo)=2.7*(MC%)/100
Comp. Index (Cc)=0.009*(LL-10)
Neglecting Granular & Secondary Settlem't

LAYER THICK (FT)	*TOTAL UNIT WT. (PCF)*	*UNCONF. COMP. STRENGTH (Qu) (TSF)*	*MOIST. CONTENT (%)*	*EXISTING PRESSURE (KSF)*	*PRESSURE INCREASE (KSF)*	*INITIAL VOID RATIO*	*COMPRESSION INDEX (Cc)*	*Qu CORRECTION FACTOR*	*LAYER SETTLEMENT (IN.)*
1.5	120	2.50	21	3.269	0.000	0.567	0.099	0.100	**0.00**
1.5	120	2.50	21	3.327	0.000	0.567	0.099	0.100	**0.00**
2.5	120	0.20	34	3.403	0.001	0.918	0.216	0.700	**0.00**
2.5	120	0.40	30	3.497	0.003	0.810	0.180	0.436	**0.00**
2.5	120	0.40	33	3.588	0.007	0.891	0.207	0.436	**0.00**
2.5	120	2.10	27	3.678	0.014	0.729	0.153	0.106	**0.00**
2.5	120	1.50	35	3.765	0.023	0.945	0.225	0.142	**0.00**
2.5	120	1.80	31	3.850	0.034	0.837	0.189	0.121	**0.00**
2.5	120	1.80	31	3.933	0.047	0.837	0.189	0.121	**0.00**
2.5	120	0.80	28	4.016	0.060	0.756	0.162	0.242	**0.00**
2.5	120	0.80	28	4.097	0.075	0.756	0.162	0.242	**0.01**

TOTAL SETTLEMENT UNDER CENTER OF BRIDGE CONE = 0.02 IN.

EMBANKMENT AND SOIL PROFILE



COHESIVE SOIL SETTLEMENT ESTIMATE

LOCATION AND BORING USED ====: West Abutment / Boring 2-S (0106)
TYPE OF SURCHARGE ================================ 1 (1=2:1 bridge cone, 2=continuous embank., 3=rectangular surch.)
DEPTH TO WATER TABLE (below top of existing embankment) == 27 FT

NEW EMBANKMENT:
- NEW EMBANKMENT FILL UNIT WEIGHT ========== 120 PCF
- NEW EMBANKMENT FILL HEIGHT ========== 27 FT
- PROPOSED WIDTH AT TOP ========== 90 FT
- PROPOSED WIDTH AT BOTTOM ========== 198 FT (which is a 2.0:1 slope)

EXISTING EMBANKMENT (IF ANY):
- EXISTING EMBANKMENT UNIT WEIGHT ========== 120 PCF
- EXISTING EMBANKMENT HEIGHT ========== 27 FT
- EXISTING WIDTH AT TOP ========== 42 FT
- EXISTING WIDTH AT BASE ========== 150 FT (which is a 2.0:1 slope)

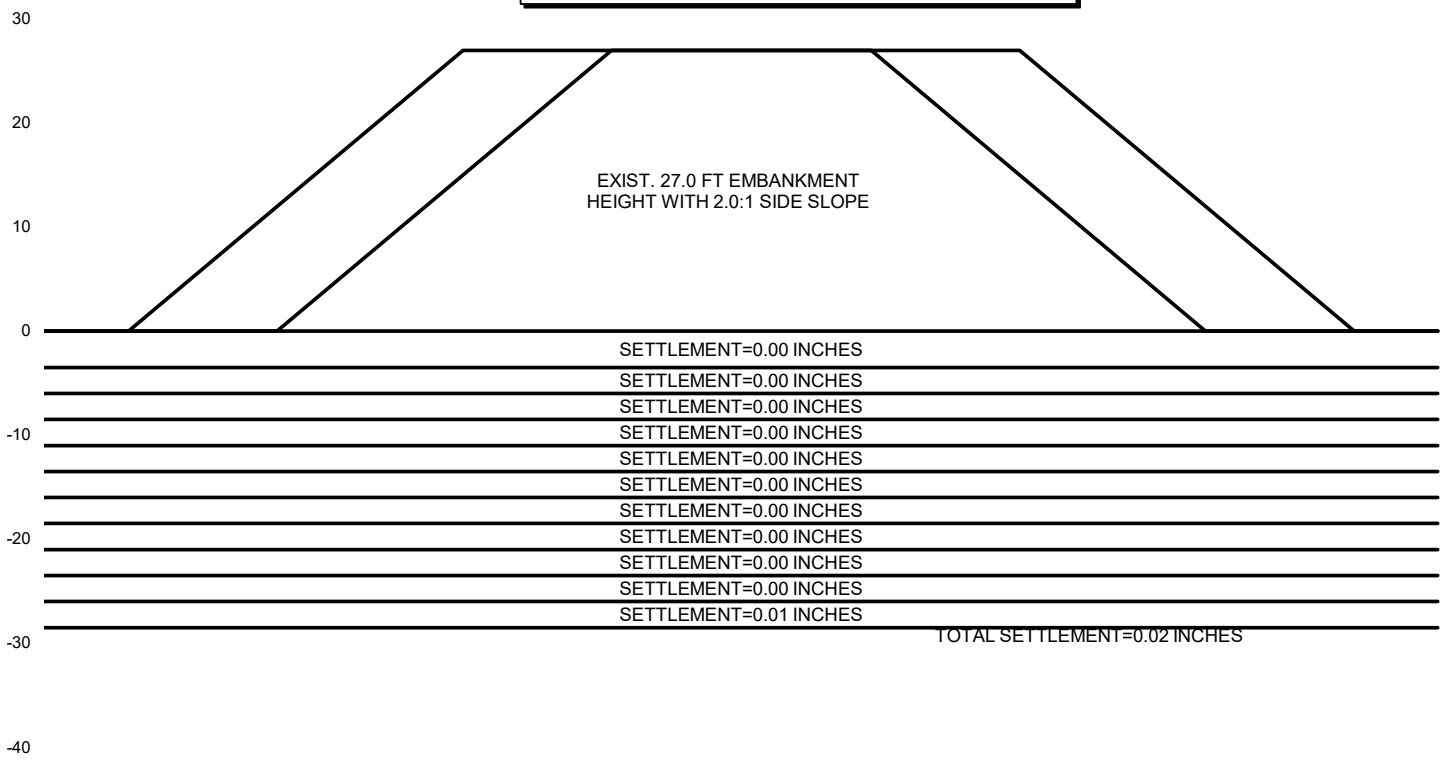
ASSUMPTIONS:

Soil Deposit is Normally Consolidated
Cohesive Layers are Saturated
Soils have a Low Sensitivity
Liquid Limit (LL)=Moist. Content (MC%)
Initial Void Ratio (Eo)=2.7*(MC%)/100
Comp. Index (Cc)=0.009*(LL-10)
Neglecting Granular & Secondary Settlem't

LAYER THICK (FT)	*TOTAL UNIT WT. (PCF)*	*UNCONF. COMP. STRENGTH (Qu) (TSF)*	*MOIST. CONTENT (%)*	*EXISTING PRESSURE (KSF)*	*PRESSURE INCREASE (KSF)*	*INITIAL VOID RATIO*	*COMPRESSION INDEX (Cc)*	*Qu CORRECTION FACTOR*	*LAYER SETTLEMENT (IN.)*
3.5	120	0.70	32	3.307	0.000	0.864	0.198	0.271	**0.00**
2.5	120	0.70	29	3.422	0.001	0.783	0.171	0.271	**0.00**
2.5	120	0.70	28	3.515	0.004	0.756	0.162	0.271	**0.00**
2.5	120	0.80	26	3.607	0.009	0.702	0.144	0.242	**0.00**
2.5	120	0.80	27	3.695	0.016	0.729	0.153	0.242	**0.00**
2.5	120	1.10	27	3.782	0.025	0.729	0.153	0.184	**0.00**
2.5	120	1.10	27	3.867	0.036	0.729	0.153	0.184	**0.00**
2.5	120	1.20	27	3.950	0.049	0.729	0.153	0.171	**0.00**
2.5	120	1.20	27	4.032	0.063	0.729	0.153	0.171	**0.00**
2.5	120	1.40	37	4.114	0.078	0.999	0.243	0.150	**0.00**
2.5	120	1.40	37	4.195	0.093	0.999	0.243	0.150	**0.01**

TOTAL SETTLEMENT UNDER CENTER OF BRIDGE CONE = 0.02 IN.

EMBANKMENT AND SOIL PROFILE



COHESIVE SOIL SETTLEMENT ESTIMATE

LOCATION AND BORING USED ====: East Abutment / Boring 1-S (0107)
TYPE OF SURCHARGE ==========: 1 (1=2:1 bridge cone, 2=continuous embank., 3=rectangular surch.)
DEPTH TO WATER TABLE (below top of existing embankment) ==: 27 FT

NEW EMBANKMENT:
- NEW EMBANKMENT FILL UNIT WEIGHT ==========: 120 PCF
- NEW EMBANKMENT FILL HEIGHT ==========: 27 FT
- PROPOSED WIDTH AT TOP ==========: 90 FT
- PROPOSED WIDTH AT BOTTOM ==========: 198 FT (which is a 2.0:1 slope)

EXISTING EMBANKMENT (IF ANY):
- EXISTING EMBANKMENT UNIT WEIGHT ==========: 120 PCF
- EXISTING EMBANKMENT HEIGHT ==========: 27 FT
- EXISTING WIDTH AT TOP ==========: 42 FT
- EXISTING WIDTH AT BASE ==========: 150 FT (which is a 2.0:1 slope)

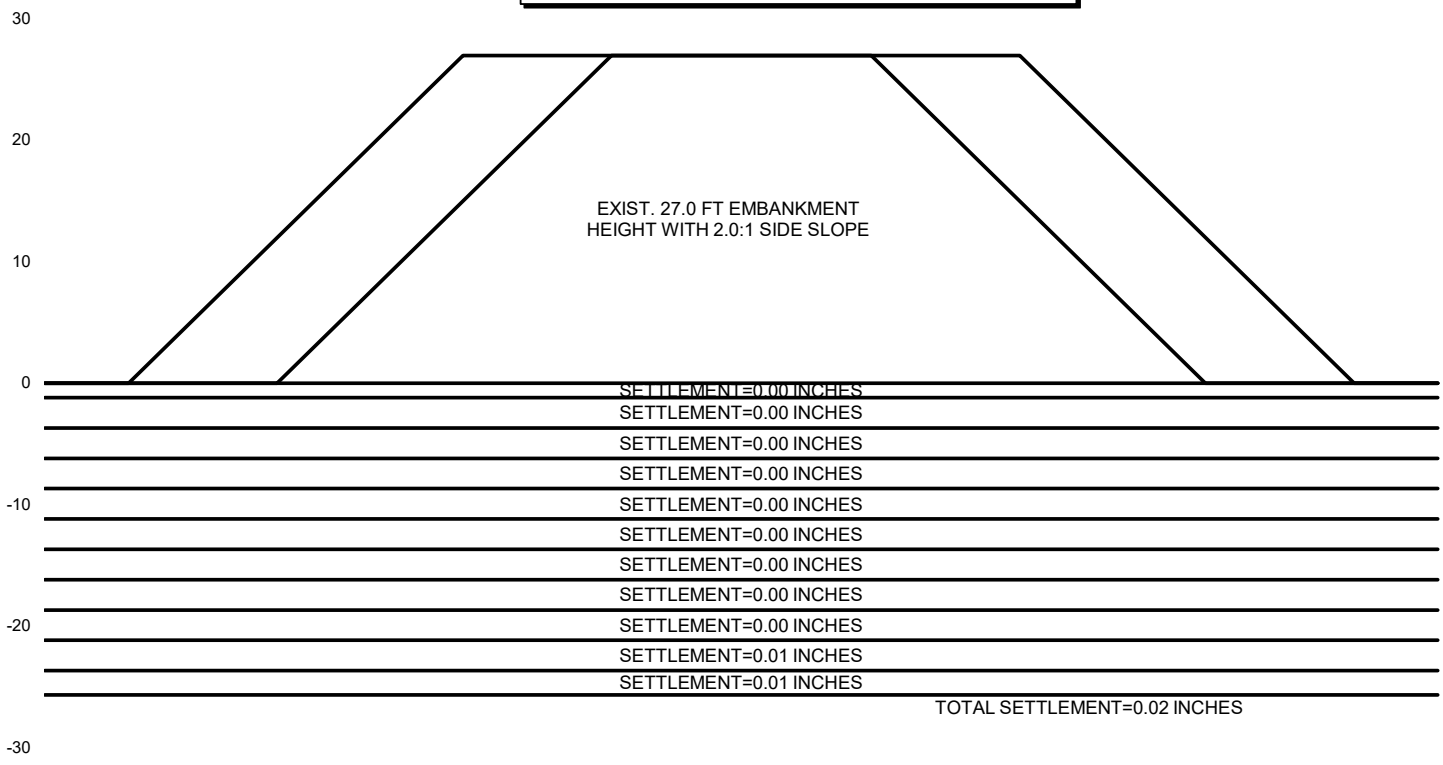
ASSUMPTIONS:

Soil Deposit is Normally Consolidated
Cohesive Layers are Saturated
Soils have a Low Sensitivity
Liquid Limit (LL)=Moist. Content (MC%)
Initial Void Ratio (Eo)=2.7*(MC%)/100
Comp. Index (Cc)=0.009*(LL-10)
Neglecting Granular & Secondary Settlem't

LAYER THICK (FT)	*TOTAL UNIT WT. (PCF)*	*UNCONF. COMP. STRENGTH (Qu) (TSF)*	*MOIST. CONTENT (%)*	*EXISTING PRESSURE (KSF)*	*PRESSURE INCREASE (KSF)*	*INITIAL VOID RATIO*	*COMPRESSION INDEX (Cc)*	*Qu CORRECTION FACTOR*	*LAYER SETTLEMENT (IN.)*
1.2	120	1.50	24	3.263	0.000	0.648	0.126	0.142	**0.00**
2.5	120	1.70	21	3.334	0.000	0.567	0.099	0.127	**0.00**
2.5	120	1.10	25	3.429	0.001	0.675	0.135	0.184	**0.00**
2.5	120	1.00	24	3.523	0.004	0.648	0.126	0.200	**0.00**
2.5	120	0.10	30	3.614	0.009	0.810	0.180	0.850	**0.00**
2.5	120	2.90	24	3.702	0.016	0.648	0.126	0.100	**0.00**
2.5	120	2.90	24	3.789	0.026	0.648	0.126	0.100	**0.00**
2.5	120	1.80	29	3.873	0.037	0.783	0.171	0.121	**0.00**
2.5	120	1.80	29	3.956	0.050	0.783	0.171	0.121	**0.00**
2.5	120	1.00	43	4.039	0.064	1.161	0.297	0.200	**0.01**
2.0	120	1.00	43	4.112	0.077	1.161	0.297	0.200	**0.01**

TOTAL SETTLEMENT UNDER CENTER OF BRIDGE CONE = 0.02 IN.

EMBANKMENT AND SOIL PROFILE



COHESIVE SOIL SETTLEMENT ESTIMATE

LOCATION AND BORING USED ====: West Abutment / Boring 2-S (0107)
TYPE OF SURCHARGE ==========: 1 (1=2:1 bridge cone, 2=continuous embank., 3=rectangular surch.)
DEPTH TO WATER TABLE (below top of existing embankment) ==: 27 FT

NEW EMBANKMENT:
- NEW EMBANKMENT FILL UNIT WEIGHT ==========: 120 PCF
- NEW EMBANKMENT FILL HEIGHT ==========: 27 FT
- PROPOSED WIDTH AT TOP ==========: 90 FT
- PROPOSED WIDTH AT BOTTOM ==========: 198 FT (which is a 2.0:1 slope)

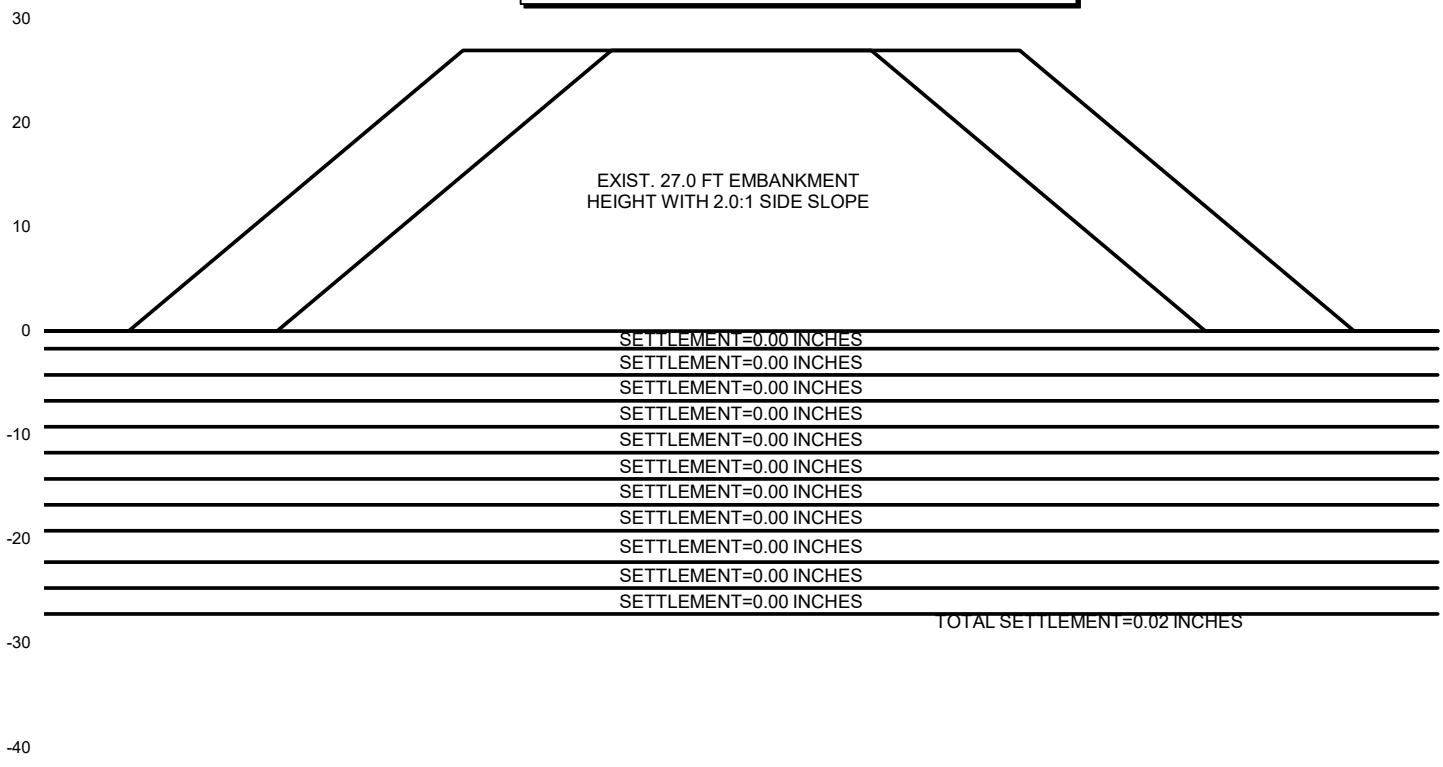
EXISTING EMBANKMENT (IF ANY):
- EXISTING EMBANKMENT UNIT WEIGHT ==========: 120 PCF
- EXISTING EMBANKMENT HEIGHT ==========: 27 FT
- EXISTING WIDTH AT TOP ==========: 42 FT
- EXISTING WIDTH AT BASE ==========: 150 FT (which is a 2.0:1 slope)

ASSUMPTIONS:
Soil Deposit is Normally Consolidated
Cohesive Layers are Saturated
Soils have a Low Sensitivity
Liquid Limit (LL)=Moist. Content (MC%)
Initial Void Ratio (Eo)=2.7*(MC%)/100
Comp. Index (Cc)=0.009*(LL-10)
Neglecting Granular & Secondary Settlem't

LAYER THICK (FT)	*TOTAL UNIT WT. (PCF)*	*UNCONF. COMP. STRENGTH (Qu) (TSF)*	*MOIST. CONTENT (%)*	*EXISTING PRESSURE (KSF)*	*PRESSURE INCREASE (KSF)*	*INITIAL VOID RATIO*	*COMPRESSION INDEX (Cc)*	*Qu CORRECTION FACTOR*	*LAYER SETTLEMENT (IN.)*
1.7	120	2.50	19	3.273	0.000	0.513	0.081	0.100	**0.00**
2.5	120	1.20	21	3.353	0.000	0.567	0.099	0.171	**0.00**
2.5	120	0.60	29	3.448	0.002	0.783	0.171	0.309	**0.00**
2.5	120	0.30	35	3.541	0.005	0.945	0.225	0.550	**0.00**
2.5	120	0.40	29	3.632	0.010	0.783	0.171	0.436	**0.00**
2.5	120	1.00	26	3.720	0.018	0.702	0.144	0.200	**0.00**
2.5	120	2.30	35	3.806	0.028	0.945	0.225	0.100	**0.00**
2.5	120	2.30	35	3.890	0.040	0.945	0.225	0.100	**0.00**
3.0	120	1.60	48	3.981	0.054	1.296	0.342	0.134	**0.00**
2.5	120	1.60	48	4.071	0.070	1.296	0.342	0.134	**0.00**
2.5	120	1.60	42	4.153	0.085	1.134	0.288	0.134	**0.00**

TOTAL SETTLEMENT UNDER CENTER OF BRIDGE CONE = 0.02 IN.

EMBANKMENT AND SOIL PROFILE



Appendix F

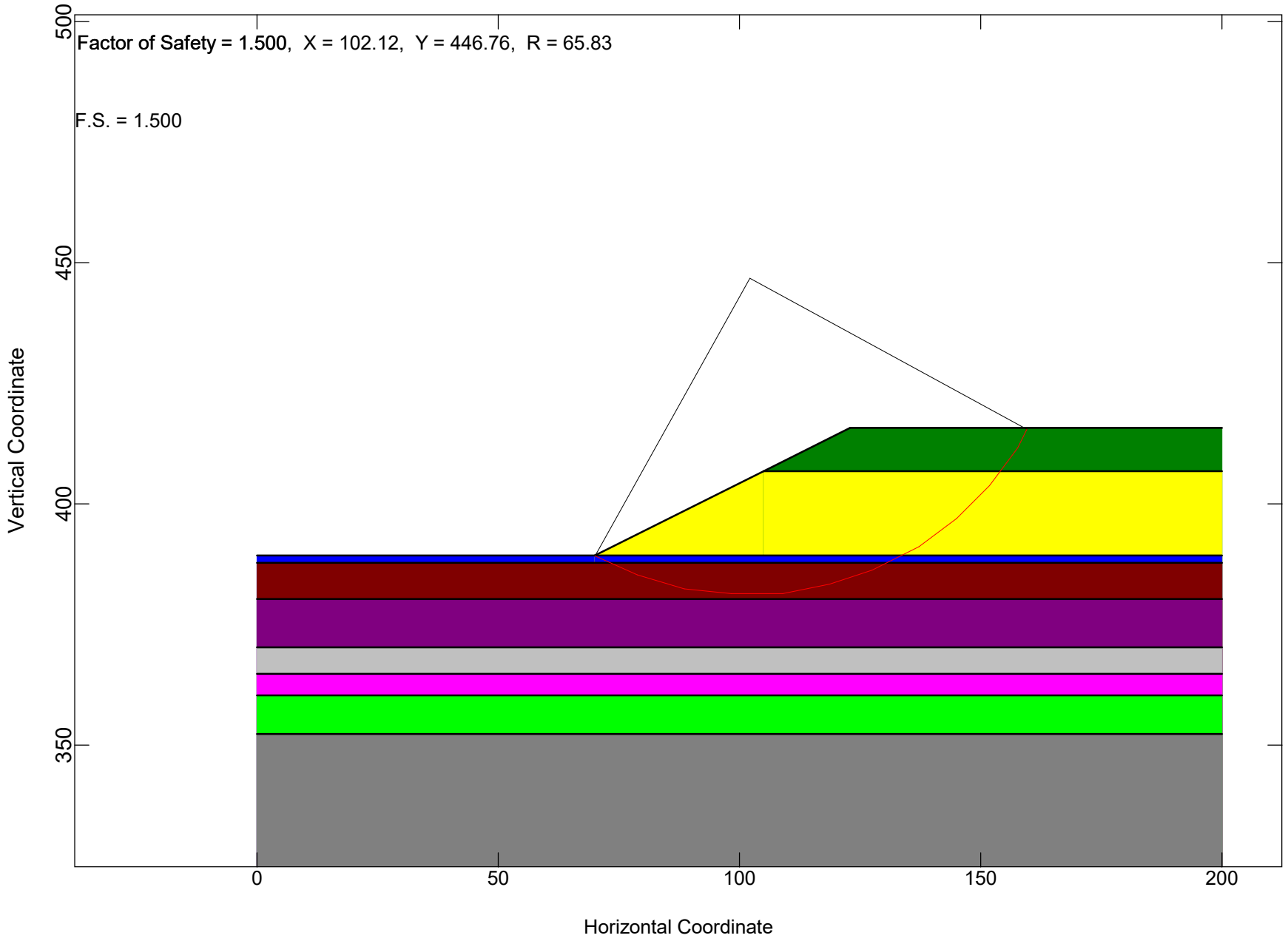
Slope Stability Analysis

Soil Parameters for Slope Stability Analysis

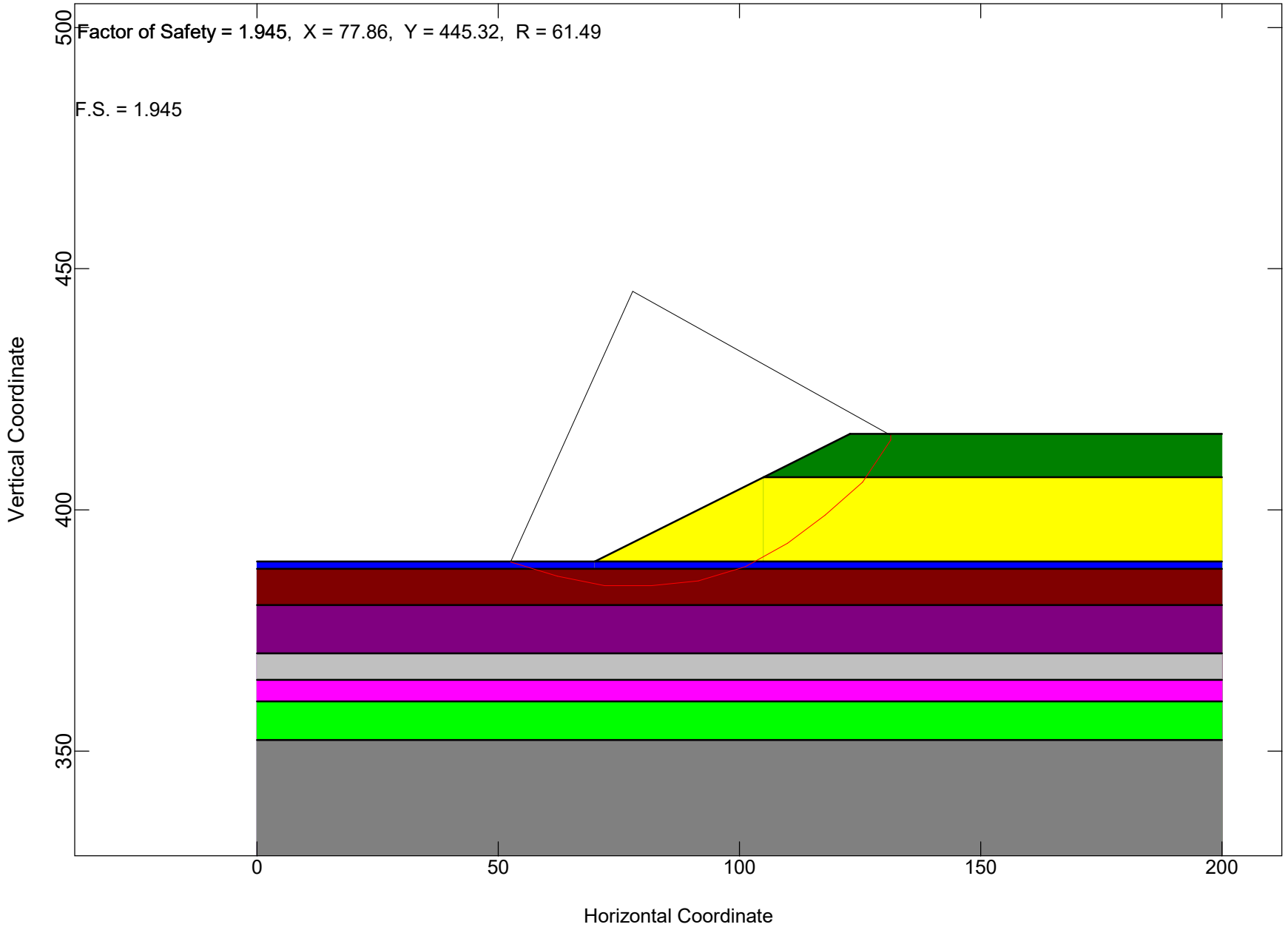
SN 100-0106 - East Abutment

Layer #	Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term	
				c' (ksf)	θ (deg.)	c' (ksf)	θ (deg.)
1	Crushed Aggregate	406.8	125	0	40	0	40
2	Rock Fill	389.3	125	0	40	0	40
3	Stiff Silty Clay Loam	387.8	125	2.5	0	0.1	28
4	Soft Silty Clay	380.3	120	0.4	0	0.1	26
5	Stiff Moist Clay	370.3	125	1.8	0	0.1	28
6	Medium Moist Clay	364.8	125	0.8	0	0.1	28
7	Stiff Moist Clay	360.3	125	1.6	0	0.1	28
8	Stiff Moist Clay	352.3	125	2.6	0	0.1	28
9	Sandstone	-	150	0	45	0	45

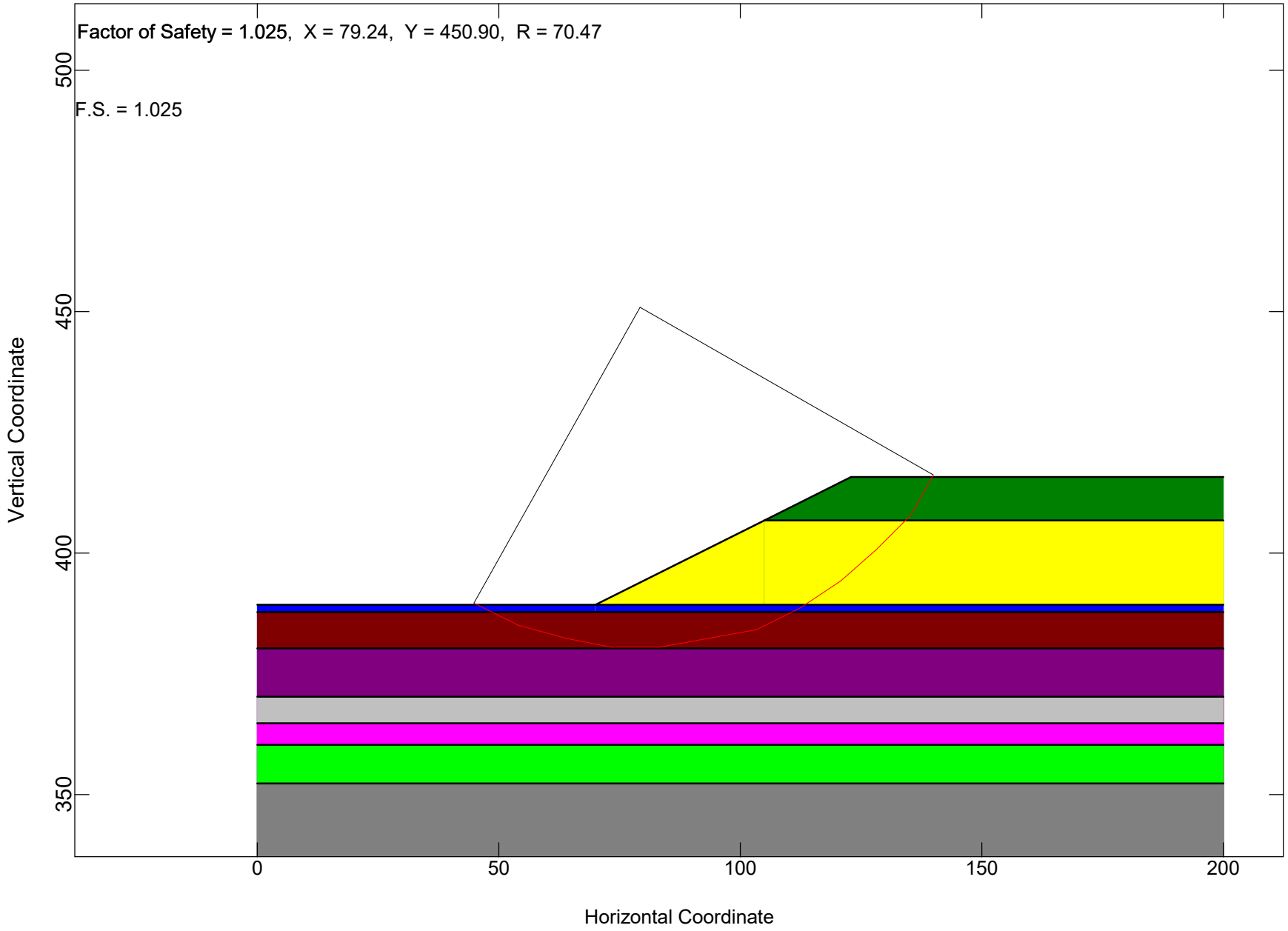
SN 100-0106 East Abutment
Short Term Strength



SN 100-0106 East Abutment
Long Term Strength



SN 100-0106 East Abutment
Seismic

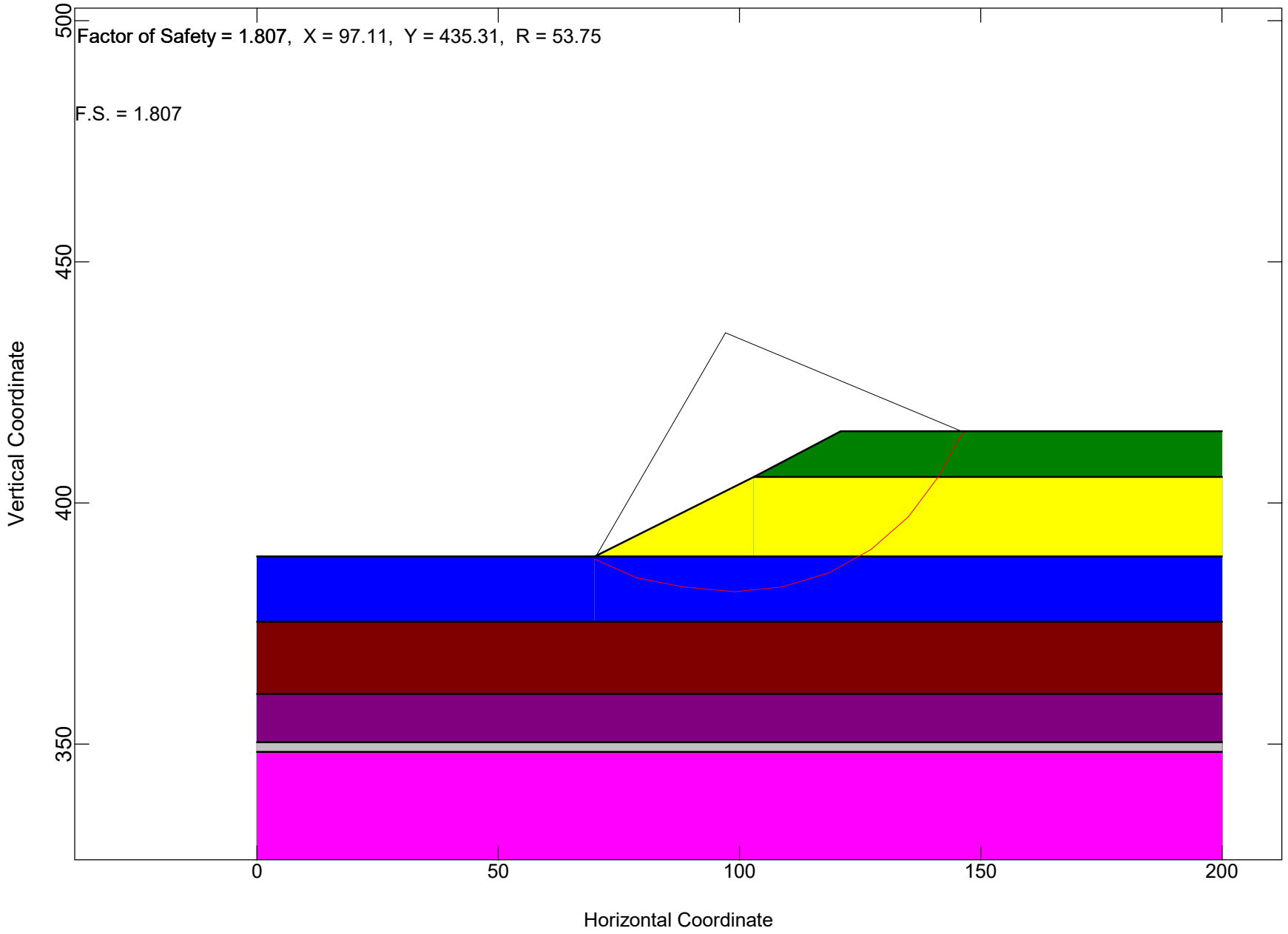


Soil Parameters for Slope Stability Analysis

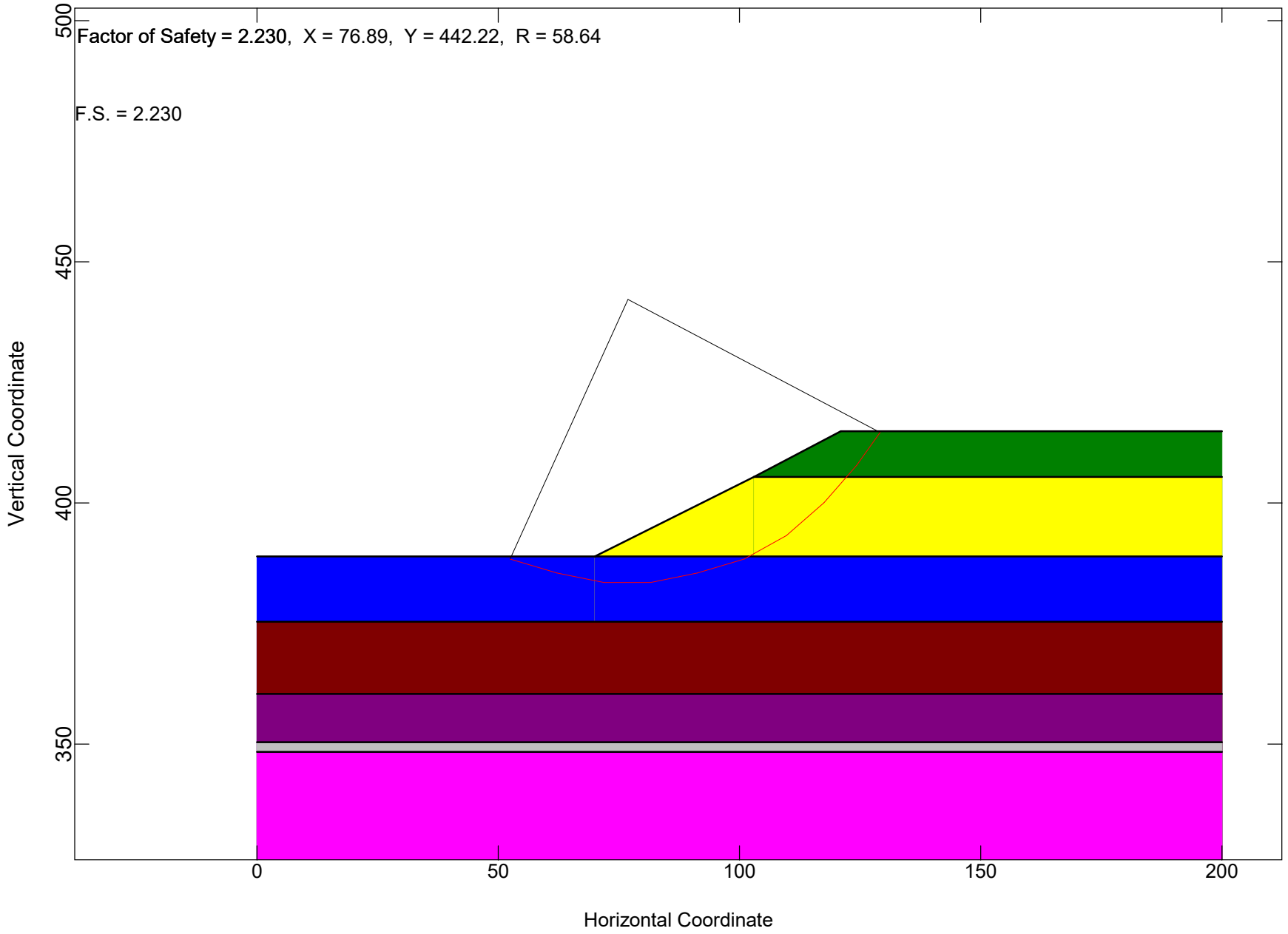
SN 100-0106 - West Abutment

Layer #	Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term	
				c' (ksf)	θ (deg.)	c' (ksf)	θ (deg.)
1	Crushed Aggregate	405.4	125	0	40	0	40
2	Rock Fill	388.9	125	0	40	0	40
3	Medium Moist Clay/ Silty Clay	375.4	120	0.7	0	0.1	26
4	Stiff Moist Clay	360.4	125	1.2	0	0.1	28
5	Soft to Medium Moist Clay/Silty Clay	350.4	120	0.4	0	0.1	26
6	Stiff Moist Sandy Clay	348.4	125	1.8	0	0.1	28
7	Sandstone	-	150	0	45	0	45

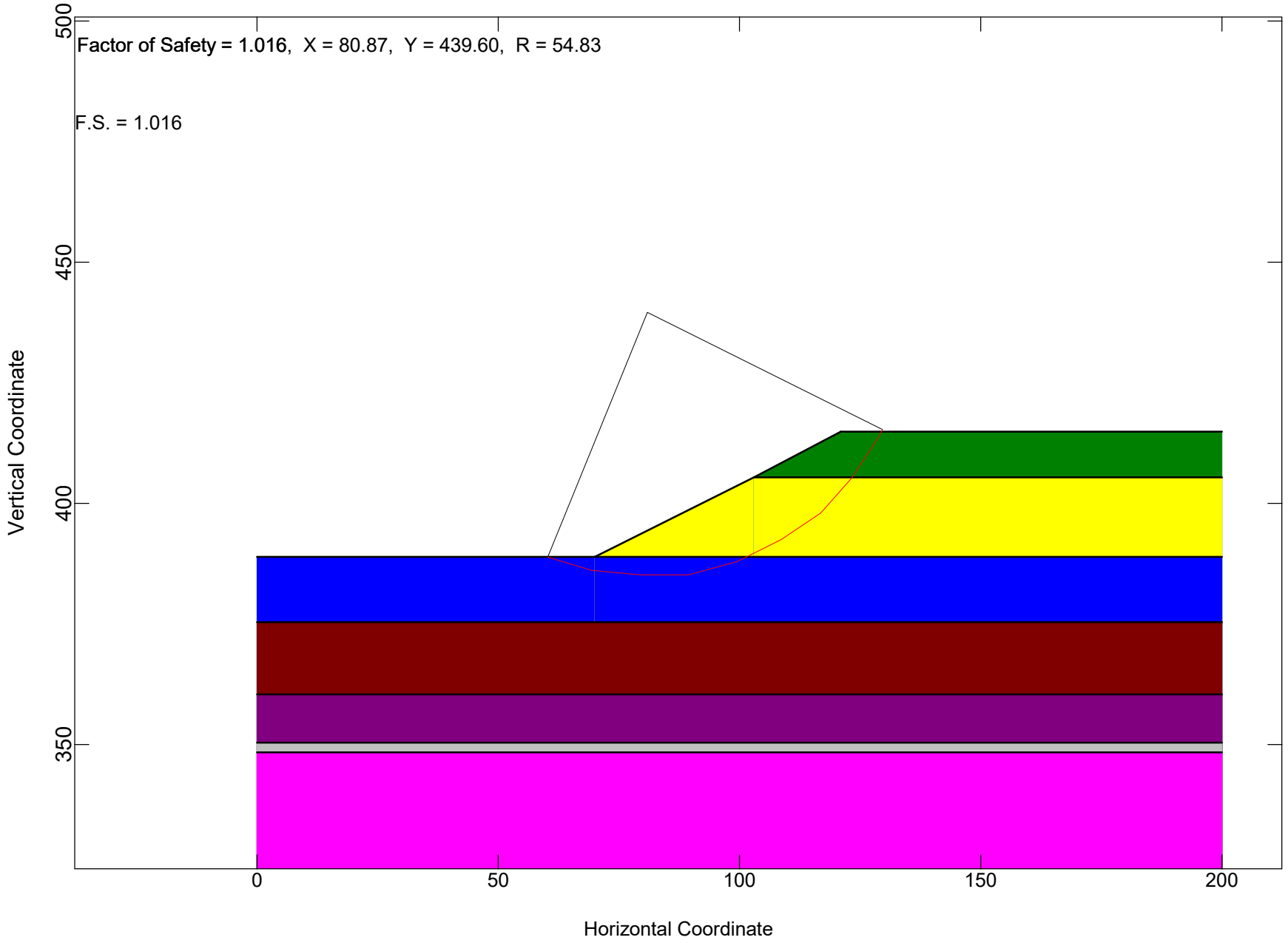
SN 100-0106 West Abutment
Short Term Strength



SN 100-0106 West Abutment
Long Term Strength



SN 100-0106 West Abutment
Seismic

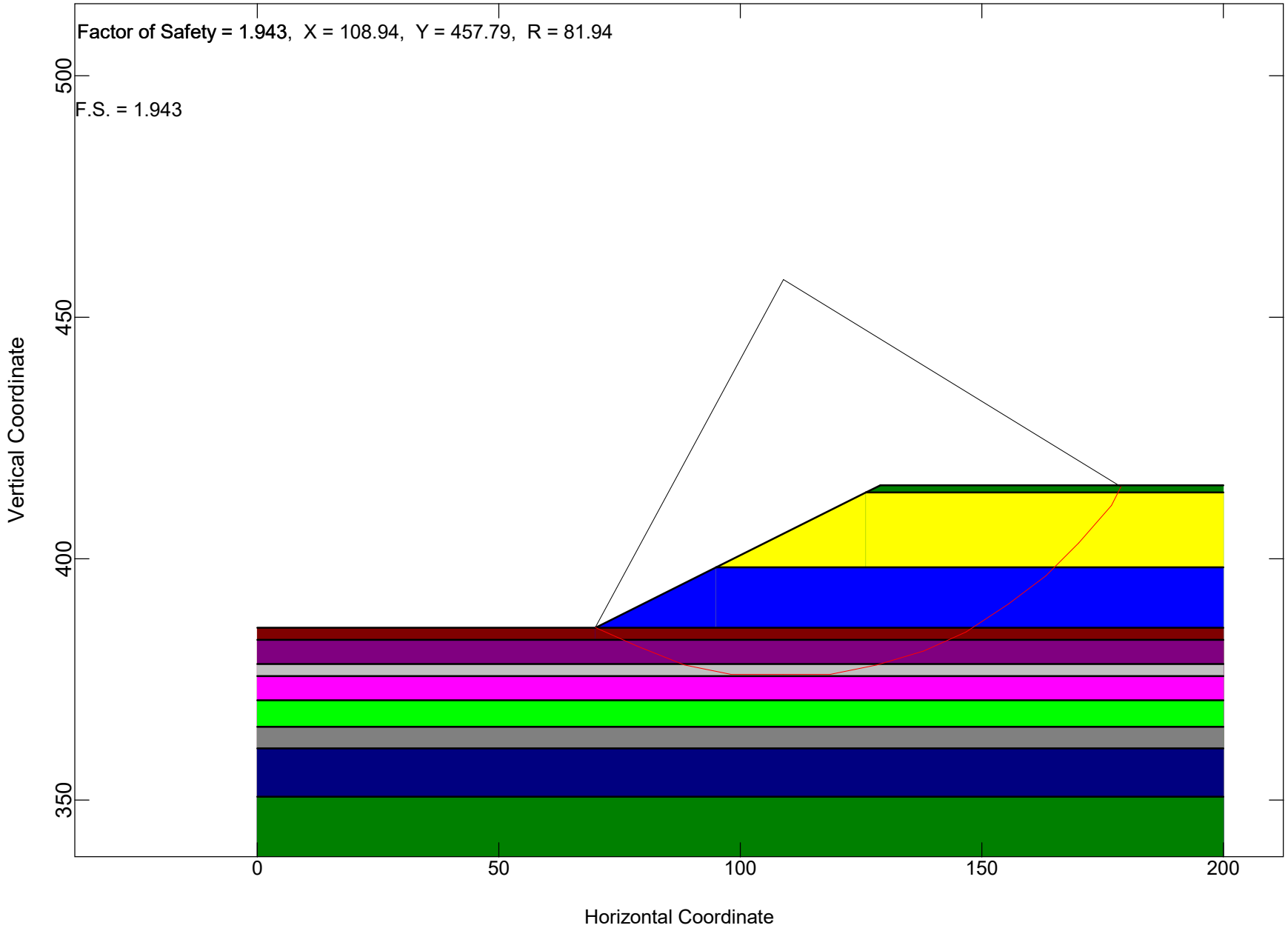


Soil Parameters for Slope Stability Analysis

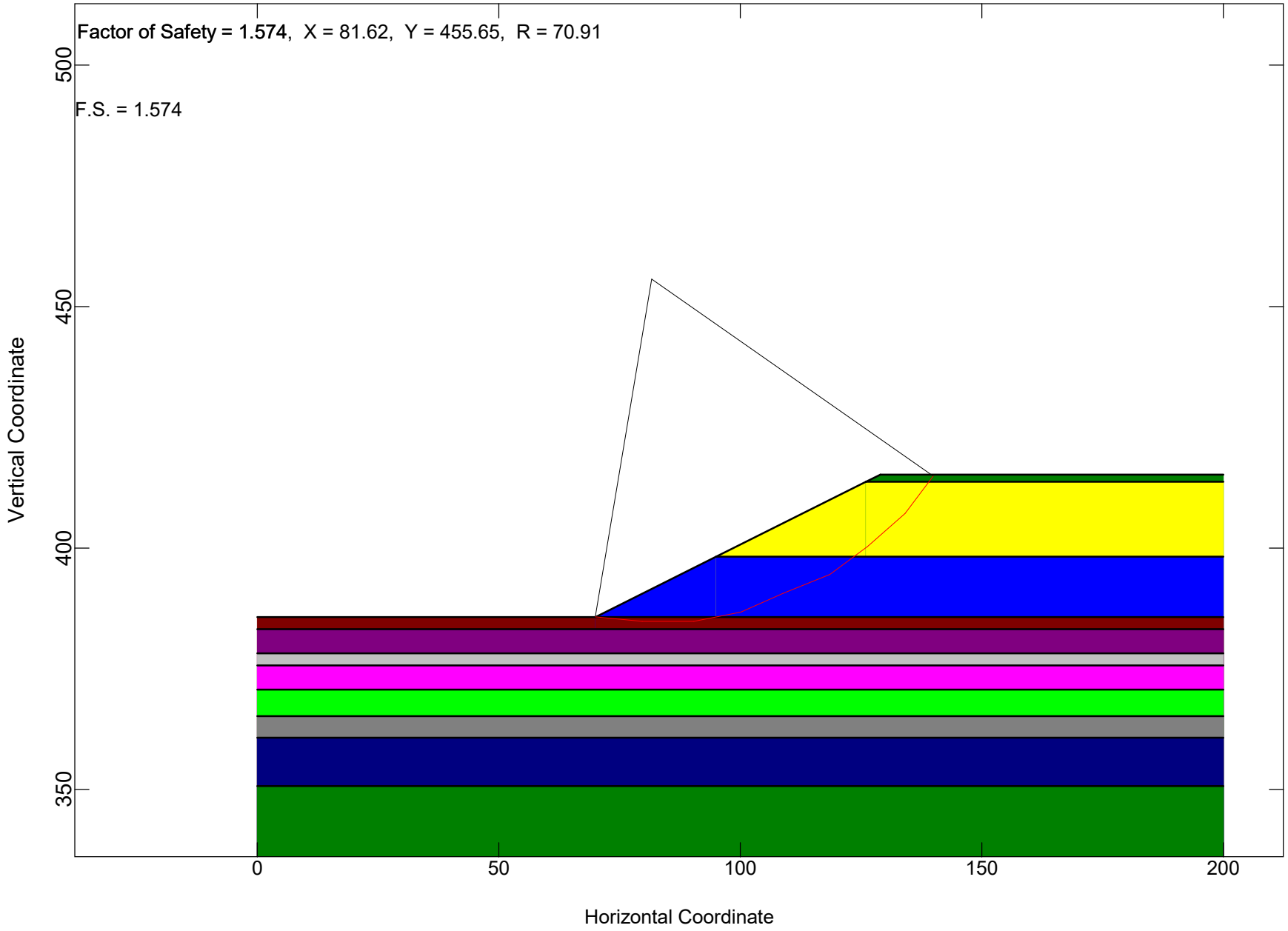
SN 100-0107 - East Abutment

Layer #	Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term	
				c' (ksf)	θ (deg.)	c' (ksf)	θ (deg.)
1	Stiff Moist Clay	398.2	125	2.4	0	0.1	28
2	Stiff Moist Clay	385.7	125	1.6	0	0.1	28
3	Stiff Moist Silt Loam	383.2	125	1.7	0	0.1	28
4	Stiff Moist Silty Clay Loam	378.2	125	1.0	0	0.1	28
5	Soft Silty Clay Loam	375.7	120	0.1	0	0.1	26
6	Stiff Moist Clay	370.7	125	2.9	0	0.1	28
7	Stiff Moist Clay	365.2	125	1.6	0	0.1	28
8	Medium Moist Clay	360.7	125	1.0	0	0.1	28
9	Soft/Medium Moist Clay	350.7	120	0.3	0	0.1	26
10	Sandstone	-	150	0	45	0	45

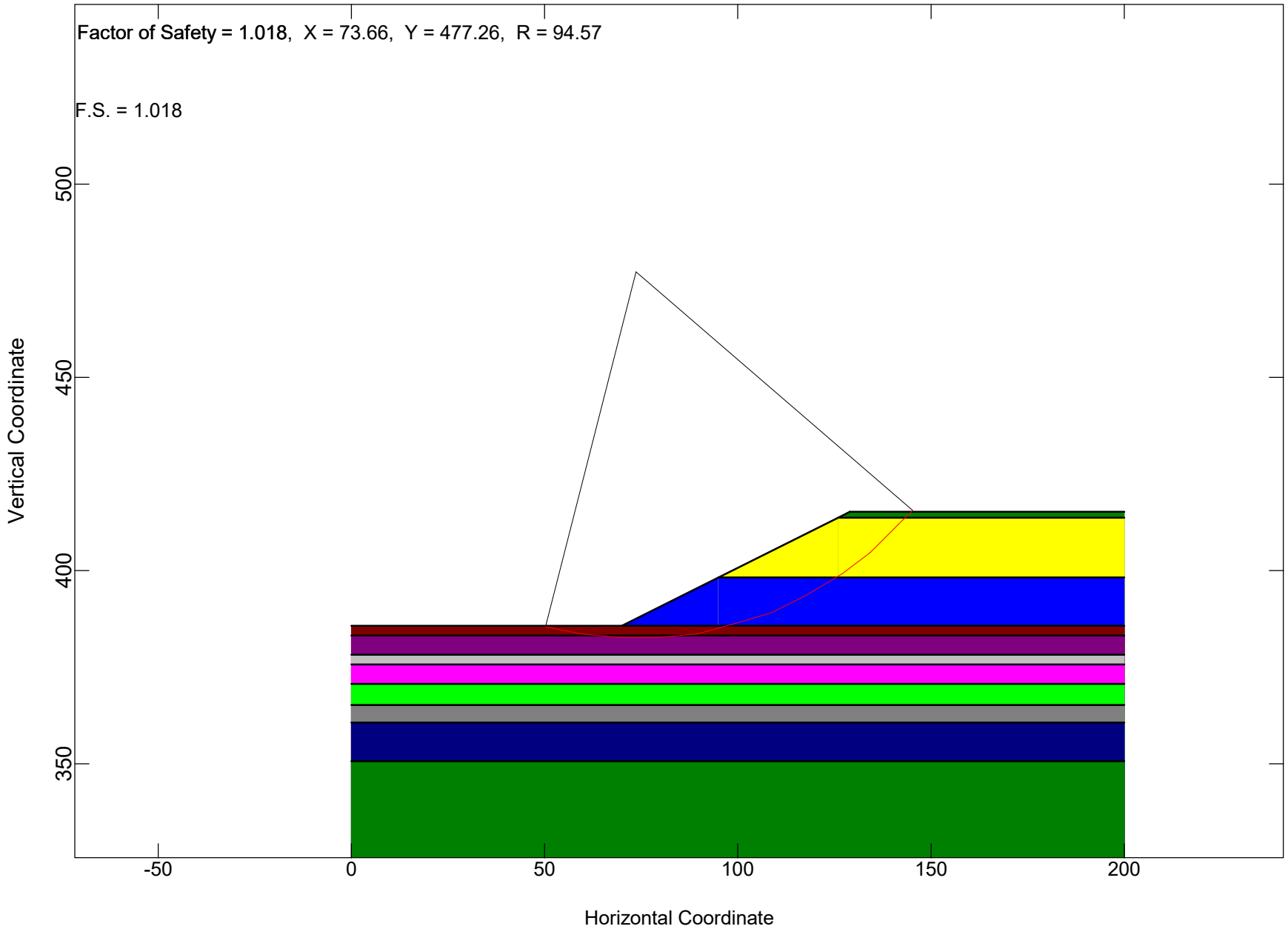
SN 100-0107 East Abutment
Short Term Strength



SN 100-0107 East Abutment
Long Term Strength



SN 100-0107 East Abutment
Seismic

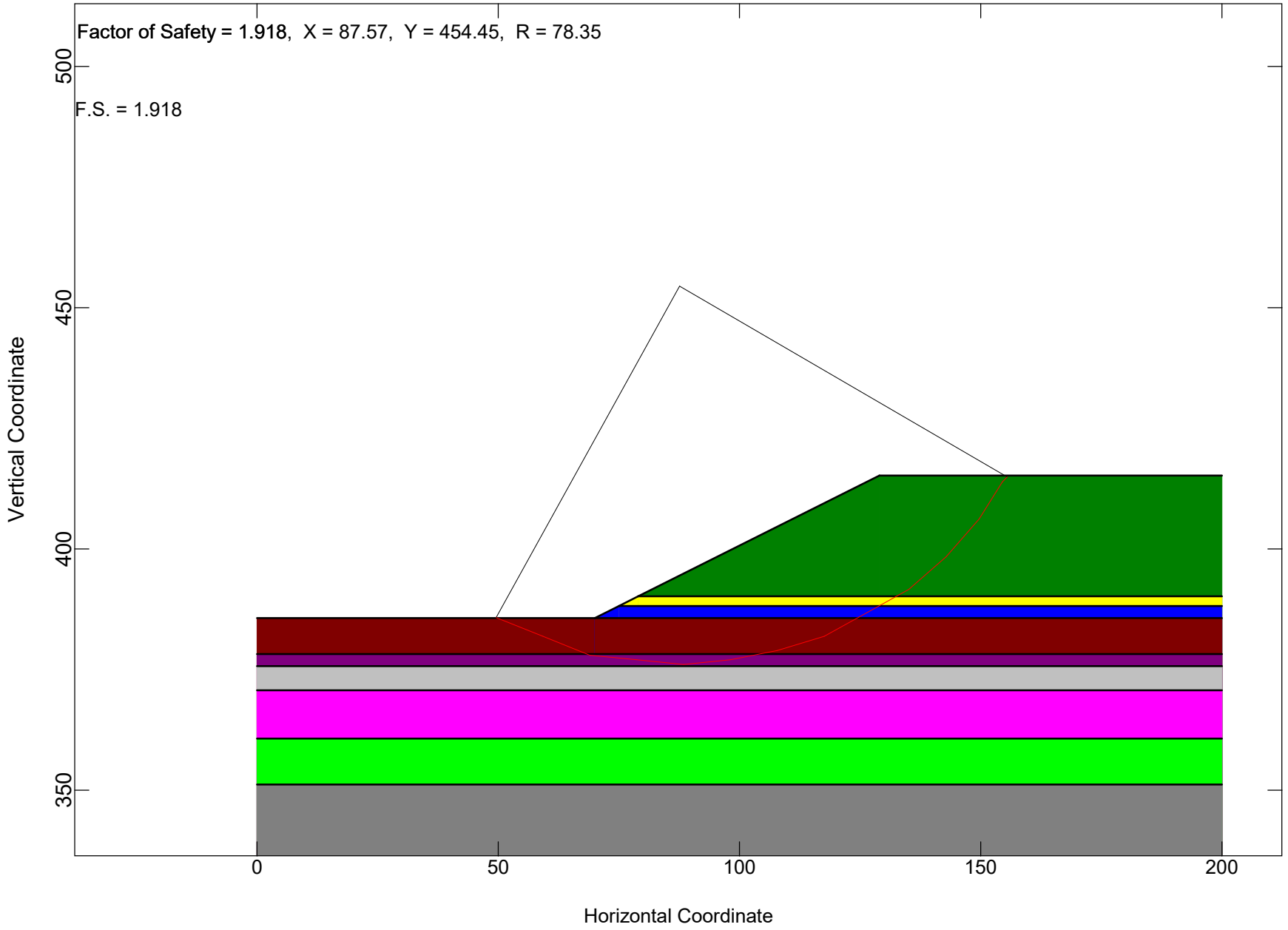


Soil Parameters for Slope Stability Analysis

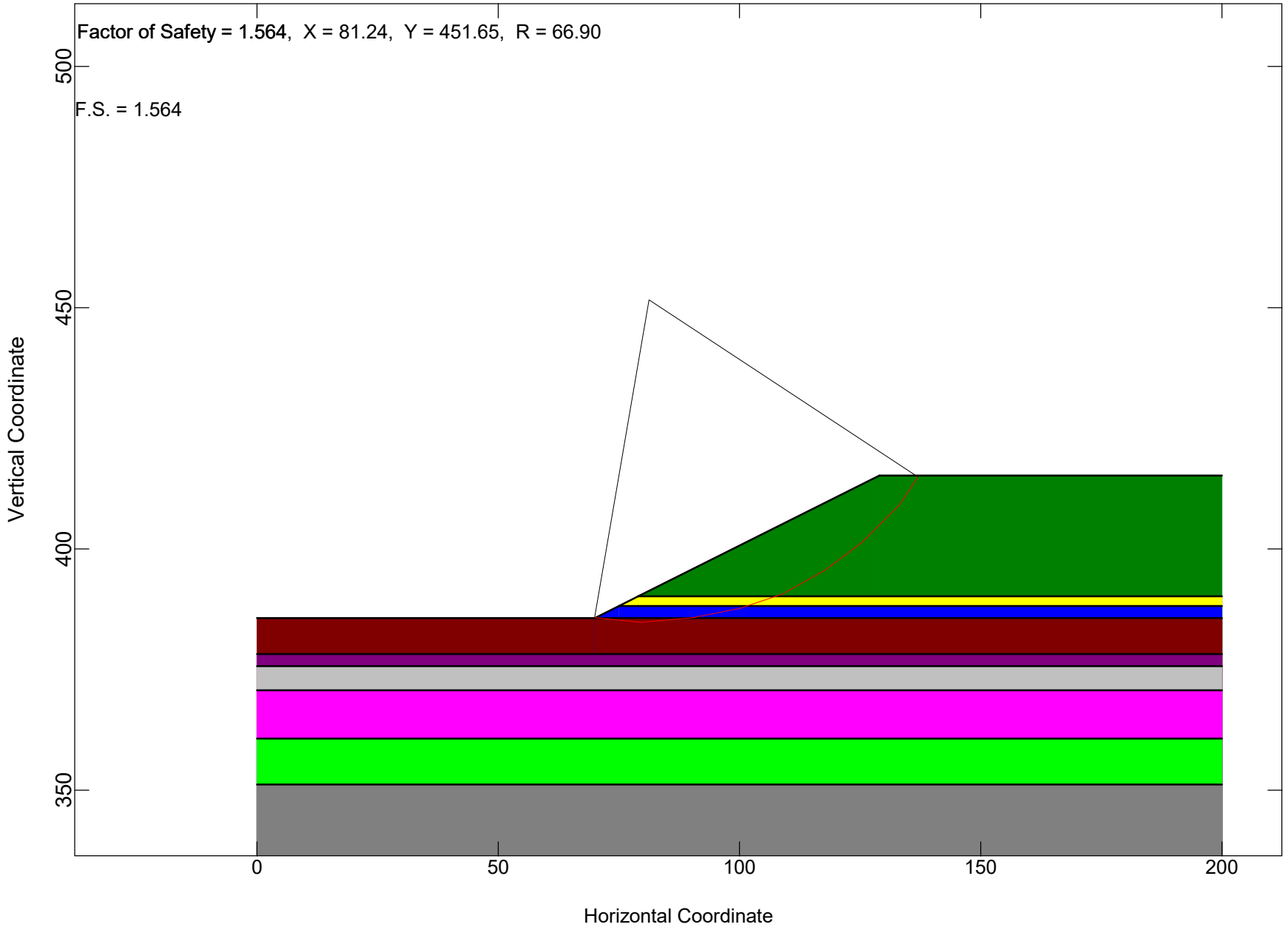
SN 100-0107 - West Abutment

Layer #	Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term	
				c' (ksf)	θ (deg.)	c' (ksf)	θ (deg.)
1	Stiff Moist Clay	390.2	125	1.5	0	0.1	26
2	Stiff Moist Clay	388.2	125	2.5	0	0.1	28
3	Stiff Moist Clay	385.7	125	1.2	0	0.1	28
4	Soft/Medium Moist Clay	378.2	120	0.4	0	0.1	26
5	Medium Silty Clay Loam	375.7	125	1.0	0	0.1	28
6	Stiff Moist Clay	370.7	125	2.3	0	0.1	28
7	Stiff Moist Clay	360.7	125	1.6	0	0.1	28
8	Medium Moist Clay	360.7	125	0.7	0	0.1	28
9	Sandstone	-	150	0	45	0	45

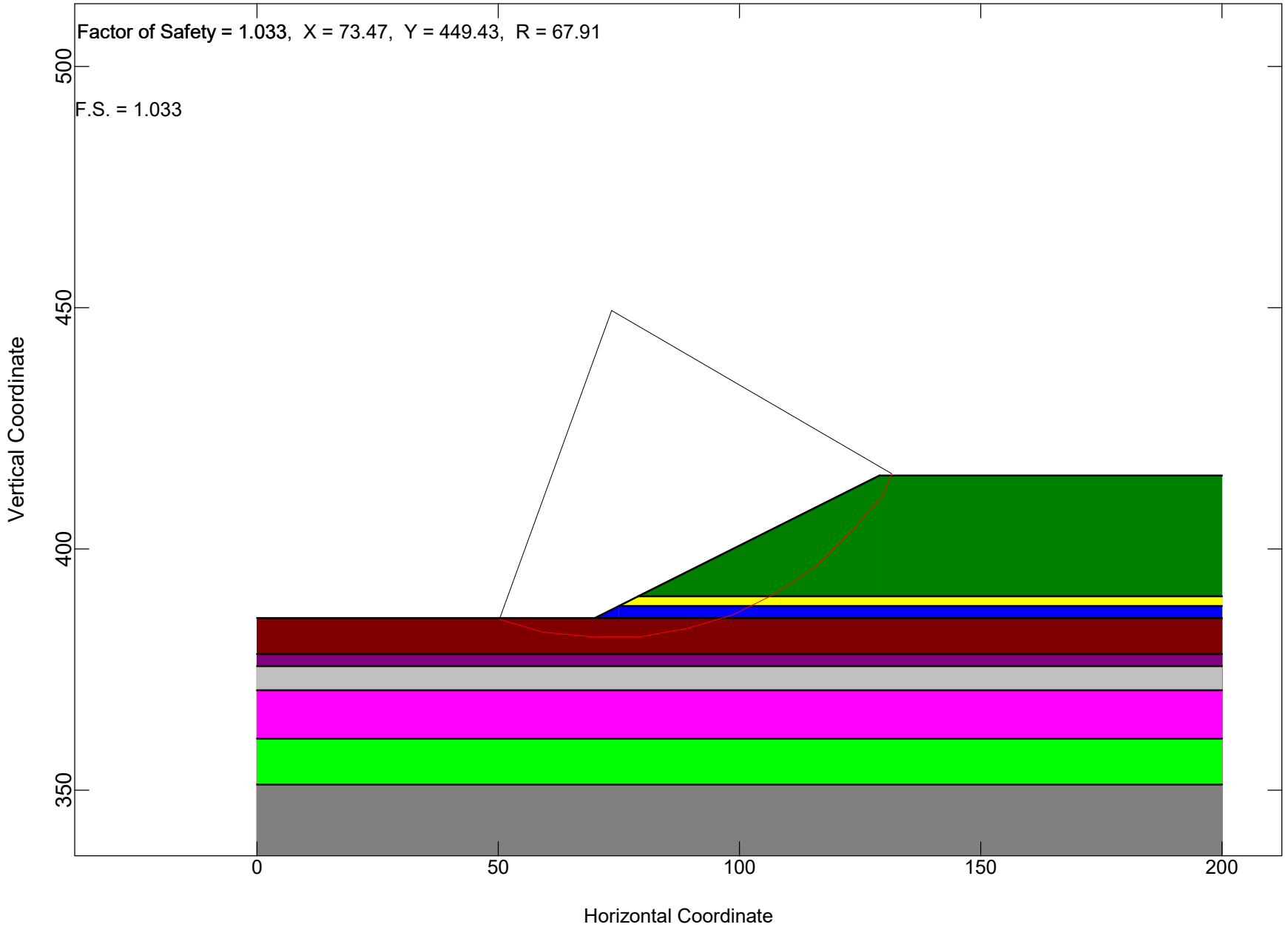
SN 100-0107 West Abutment
Short Term Strength



SN 100-0107 West Abutment
Long Term Strength



SN 100-0107 West Abutment
Seismic



Appendix G

Seismic Site Class Determination

Illinois Department of Transportation

SEISMIC SITE CLASS DETERMINATION

PROJECT TITLE=====IL 13 over Crab Orchard Lake (SN 100-0106 and 100-0107)

Substructure 1

Base of Substruct. Elev. (or ground surf for bents	408	ft.
Pile or Shaft Dia.	12	inches
Boring Number	0018-1-S	
Top of Boring Elev.	414.8	ft.
Approximate Fixity Elev.	402	ft.

Individual Site Class Definition:

N (bar): 6 (Blows/ft.) Soil Site Class E
N_{ch} (bar): 22 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): 1.62 (ksf) Soil Site Class D

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	413.8	1.00	0		B
	410.3	3.50	22		
	406.8	3.50	22		B
	402.8	4.00	5		
3.2	398.8	4.00	5		
7.2	394.8	4.00	5		
11.2	390.8	4.00	5		B
14.2	387.8	3.00	4	2.50	B
16.7	385.3	2.50	1	0.20	B
21.7	380.3	5.00	1	0.40	B
24.2	377.8	2.50	5	2.10	B
27.2	374.8	3.00	4	1.50	
31.7	370.3	4.50	5	1.80	B
37.2	364.8	5.50	3	0.80	B
41.7	360.3	4.50	4	1.60	B
46.7	355.3	5.00	8	2.90	
49.7	352.3	3.00	10	2.30	B
100.0	302.0	50.30	100	10.00	R

Substructure 2

Base of Substruct. Elev. (or ground surf for bents	408	ft.
Pile or Shaft Dia.	12	inches
Boring Number	0018-2-S	
Top of Boring Elev.	414.9	ft.
Approximate Fixity Elev.	402	ft.

Individual Site Class Definition:

N (bar): 5 (Blows/ft.) Soil Site Class E
N_{ch} (bar): 19 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): 1.41 (ksf) Soil Site Class D

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	413.9	1.00	0		B
	409.7	4.25	22		
	405.4	4.25	22		B
0.6	401.4	4.00	5		
4.6	397.4	4.00	5		
8.6	393.4	4.00	5		
13.1	388.9	4.50	5		B
16.6	385.4	3.50	1	0.70	B
19.1	382.9	2.50	1	0.70	B
21.6	380.4	2.50	2	0.70	B
24.1	377.9	2.50	4	0.80	B
26.6	375.4	2.50	2	0.80	B
31.6	370.4	5.00	2	1.10	
36.6	365.4	5.00	7	1.20	
41.6	360.4	5.00	4	1.40	B
46.6	355.4	5.00	1	0.60	B
51.6	350.4	5.00	0	0.40	B
53.6	348.4	2.00	13	1.80	B
100.0	302.0	46.40	100	10.00	R

Substructure 3

Base of Substruct. Elev. (or ground surf for bents	408	ft.
Pile or Shaft Dia.	12	inches
Boring Number	0066-1-S	
Top of Boring Elev.	415.2	ft.
Approximate Fixity Elev.	402	ft.

Individual Site Class Definition:

N (bar): 6 (Blows/ft.) Soil Site Class E
N_{ch} (bar): NA (Blows/ft.) NA
s_u (bar): 1.18 (ksf) Soil Site Class D <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	413.7	1.50	0		B
	411.2	2.50	4	2.50	
	408.7	2.50	7	2.30	
	406.2	2.50	7	2.50	
	403.7	2.50	8	2.50	
0.8	401.2	2.50	7	2.00	
3.8	398.2	3.00	8	2.70	B
6.3	395.7	2.50	8	1.70	
8.8	393.2	2.50	7	1.60	
11.3	390.7	2.50	7	1.90	
13.8	388.2	2.50	6	1.30	
16.3	385.7	2.50	5	1.50	B
18.8	383.2	2.50	5	1.70	B
21.3	380.7	2.50	3	1.10	B
23.8	378.2	2.50	4	1.00	B
26.3	375.7	2.50	1	0.10	B
31.3	370.7	5.00	7	2.90	B
36.8	365.2	5.50	5	1.80	B
41.3	360.7	4.50	3	1.00	B
46.3	355.7	5.00	2	0.30	B
51.3	350.7	5.00	1	0.60	B
100.0	302.0	48.70	100	10.00	R

Substructure 4

Base of Substruct. Elev. (or ground surf for bents	408	ft.
Pile or Shaft Dia.	12	inches
Boring Number	0066-2-S	
Top of Boring Elev.	415.2	ft.
Approximate Fixity Elev.	402	ft.

Individual Site Class Definition:

N (bar): 6 (Blows/ft.) Soil Site Class E
N_{ch} (bar): NA (Blows/ft.) NA
s_u (bar): 1.51 (ksf) Soil Site Class D <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	413.7	1.50	0		B
	410.7	3.00	3	1.40	B
	408.2	2.50	5	2.30	B
	405.7	2.50	3	1.60	
	403.2	2.50	5	1.70	
1.3	400.7	2.50	5	1.30	
3.8	398.2	2.50	5	1.50	
6.3	395.7	2.50	5	1.50	
8.8	393.2	2.50	5	1.90	
11.8	390.2	3.00	6	1.90	B
13.8	388.2	2.00	8	2.50	B
16.3	385.7	2.50	5	1.20	B
18.8	383.2	2.50	2	0.60	B
21.3	380.7	2.50	0	0.30	B
23.8	378.2	2.50	1	0.40	B
26.3	375.7	2.50	2	1.00	B
31.3	370.7	5.00	5	2.30	B
36.8	365.2	5.50	4	1.60	B
41.3	360.7	4.50	2	1.60	B
46.3	355.7	5.00	0	0.60	
50.8	351.2	4.50	3	0.80	B
100.0	302.0	49.20	100	10.00	R

Global Site Class Definition: Substructures 1 through 4

N (bar): 6 (Blows/ft.) Soil Site Class E
N_{ch} (bar): 56 (Blows/ft.) Soil Site Class C
s_u (bar): 1.43 (ksf) Soil Site Class D <----Controls

Appendix H

Liquefaction Analysis

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ==========: 0107 E. Abut.
ELEVATION OF BORING GROUND SURFACE ==========: 415.20 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ==========: 11.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==========: 11.50 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) =====: 0.422
EARTHQUAKE MOMENT MAGNITUDE ==========: 7.6
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ==========: 0.50 FT. (Fill Height)
HAMMER EFFICIENCY==========: 73 %
BOREHOLE DIAMETER==========: 8 IN.
SAMPLING METHOD==========: Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.982**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **364** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.58
Source-To-Site Distance, R (km) = 111.51
Ground Motion Prediction Equations = NMSZ
PGA = **0.143**

	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
413.7	1.5	1						0.095	0.143	1.962	1.962	0.053	0.095	0.203	0.203	1.500	**0.078**	0.968	**0.266**	**N.L. (1)**
410.2	5	4	2.5					0.133	0.608	6.832	6.832	0.086	0.133	0.668	0.668	1.277	**0.108**	0.906	**0.249**	**N.L. (1)**
407.7	7.5	7	2.3					0.132	0.938	10.893	10.893	0.121	0.132	0.998	0.998	1.196	**0.142**	0.857	**0.235**	**N.L. (1)**
405.2	10	7	2.5					0.133	1.271	10.736	10.736	0.120	0.133	1.331	1.331	1.116	**0.131**	0.806	**0.221**	**N.L. (1)**
402.7	12.5	8	2.5		12	30	20	0.070	1.446	12.378	12.378	0.135	0.070	1.506	1.599	1.088	**0.144**	0.754	**0.220**	**N.L. (2)**
400.2	15	7	2		12	30	21	0.067	1.613	10.795	10.795	0.120	0.067	1.673	1.923	1.058	**0.125**	0.704	**0.222**	**N.L. (2)**
398.2	17	8	2.7		12	30	18	0.071	1.755	12.196	12.196	0.133	0.071	1.815	2.189	1.039	**0.136**	0.666	**0.220**	**N.L. (2)**
395.2	20	8	1.7		12	30	19	0.065	1.950	11.943	11.943	0.131	0.065	2.010	2.572	1.013	**0.130**	0.613	**0.215**	**N.L. (2)**
392.7	22.5	7	1.6		12	30	19	0.065	2.113	10.219	10.219	0.115	0.065	2.173	2.890	0.994	**0.112**	0.574	**0.210**	**N.L. (2)**
390.2	25	7	1.9		12	30	19	0.067	2.280	9.958	9.958	0.113	0.067	2.340	3.214	0.977	**0.108**	0.541	**0.204**	**N.L. (2)**
387.7	27.5	6	1.3		12	30	19	0.062	2.435	8.326	8.326	0.099	0.062	2.495	3.525	0.965	**0.093**	0.512	**0.198**	**N.L. (2)**
385.7	29.5	5	1.5		12	30	24	0.064	2.563	6.793	6.793	0.086	0.064	2.623	3.777	0.956	**0.081**	0.493	**0.195**	**N.L. (2)**
383.2	32	5	1.7		9	28	21	0.065	2.726	6.612	6.612	0.085	0.065	2.786	4.096	0.944	**0.078**	0.472	**0.191**	**N.L. (2)**
380.7	34.5	3	1.1		11	31	25	0.060	2.876	3.872	3.872	0.064	0.060	2.936	4.402	0.937	**0.059**	0.456	**0.188**	**N.L. (2)**
378.2	37	4	1		12	30	24	0.059	3.023	5.042	5.042	0.072	0.059	3.083	4.705	0.928	**0.066**	0.443	**0.185**	**N.L. (2)**
375.7	39.5	1	0.1		12	30	30	0.035	3.111	1.245	1.245	0.050	0.035	3.171	4.949	0.923	**0.045**	0.432	**0.185**	**N.L. (2)**
370.7	44.5	7	2.9		12	30	24	0.072	3.471	8.239	8.239	0.098	0.072	3.531	5.621	0.894	**0.086**	0.417	**0.182**	**N.L. (2)**
365.7	49.5	5	1.8		12	30	29	0.066	3.801	5.606	5.606	0.077	0.066	3.861	6.263	0.885	**0.067**	0.408	**0.182**	**N.L. (2)**
360.7	54.5	3	1		12	30	43	0.059	4.096	3.226	3.226	0.060	0.059	4.156	6.870	0.874	**0.051**	0.403	**0.183**	**N.L. (2)**
355.7	59.5	2	0.3		12	30	24	0.046	4.326	2.083	2.083	0.053	0.046	4.386	7.412	0.865	**0.045**	0.399	**0.185**	**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

Appendix I

Integral Abutment Feasibility Analysis

Illinois Department of Transportation

INTEGRAL ABUTMENT FEASIBILITY ANALYSIS

Modified 10/30/17

GENERAL DATA

STRUCTURE NUMBER	100-0106		TOTAL STRUCTURE LENGTH	140.00	FT
STRUCTURE TYPE	MULTI-SPAN		NUMBER OF SPANS	3	
STRUCTURE SKEW	0	DEGREES	END SPAN LENGTH	42.00	FT
SUPER. DATA IN REFERENCE TO SUB. DATA	ABUT 1		ADJACENT INTERIOR SPAN LENGTH	56.00	FT

SUPERSTRUCTURE POSITIVE MOMENT REGION DATA (END OR MAIN SPAN)

BEAM TYPE	WIDE FLANGE	
WIDE FLANGE	W27X102	
BEAM SPACING PERP. TO CL	6.00	FT
SLAB THICKNESS	8.00	IN
SLAB F'C	4.00	KSI

SUPERSTRUCTURE POSITIVE MOMENT REGION DATA (ADJACENT SPAN)

WIDE FLANGE	W27X102	
BEAM SPACING PERP. TO CL	6.00	FT
SLAB THICKNESS	8.00	IN
SLAB F'C	4.00	KSI

ABUTMENT #1 DATA

ABUTMENT NAME	East	
ABUTMENT REFERENCE BORING	B-1	
BOTTOM OF ABUTMENT ELEVATION	408	FT
ESTIMATED NUMBER OF PILES AT ABUT.	12	
PILE SPACING PERP. TO CL	6	FT

ABUTMENT #2 DATA

ABUTMENT NAME	West	
ABUTMENT REFERENCE BORING	B-2	
BOTTOM OF ABUTMENT ELEVATION	408	FT
ESTIMATED NUMBER OF PILES AT ABUT.	12	
PILE SPACING PERP. TO CL	6	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)*
406.80	1.20		84	4.0
404.30	2.50		30	3.3
401.80	2.50		9	2.3
399.30	2.50		7	2.2
398.00	1.30		7	2.2

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)*
405.40	2.60		84	4.0
402.90	2.50		30	3.3
400.40	2.50		9	2.3
398.00	2.40		7	2.2

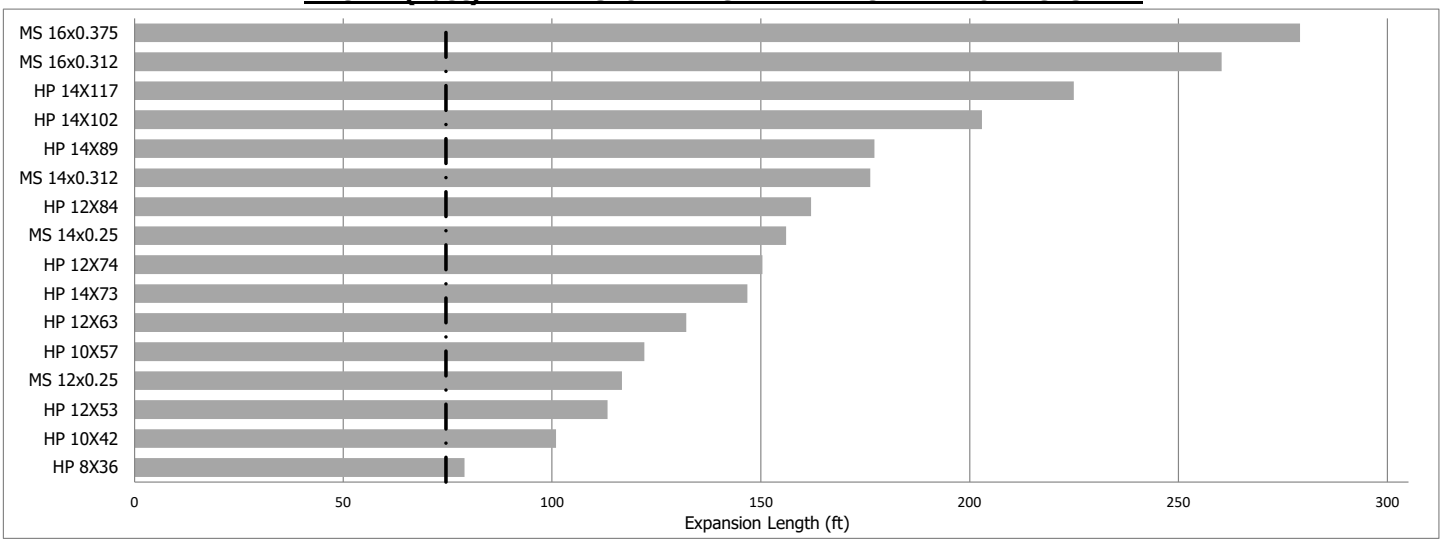
10.00 FT = TOTAL DEPTH ENTERED

WEIGHTED AVERAGE Qu FOR ABUTMENT #1	2.70	TSF	WEIGHTED AVERAGE Qu FOR ABUTMENT #2	2.96	TSF
PILE STIFFNESS MODIFIER FOR ABUTMENT #1 = 1/(1.45-[0.3*2.7])	1.56		PILE STIFFNESS MODIFIER FOR ABUTMENT #2 = 1/(1.45-[0.3*2.96])	1.78	

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #1 = [1.56*12*0+1.78*12*140]/[1.56*12+1.78*12] = 74.57 FT

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #2 = [1.78*12*0+1.56*12*140]/[1.78*12+1.56*12] = 65.43 FT

ABUT 1 (East) - EXPANSION LENGTH LIMIT CHART - 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

INTEGRAL ABUTMENT FEASIBILITY ANALYSIS

Modified 10/30/17

GENERAL DATA

STRUCTURE NUMBER	100-0106 - Widening Embankment		TOTAL STRUCTURE LENGTH	140.00	FT
STRUCTURE TYPE	MULTI-SPAN		NUMBER OF SPANS	3	
STRUCTURE SKEW	0	DEGREES	END SPAN LENGTH	42.00	FT
SUPER. DATA IN REFERENCE TO SUB. DATA	ABUT 1		ADJACENT INTERIOR SPAN LENGTH	56.00	FT

SUPERSTRUCTURE POSITIVE MOMENT REGION DATA (END OR MAIN SPAN)

BEAM TYPE	WIDE FLANGE	
WIDE FLANGE	W27X102	
BEAM SPACING PERP. TO CL	6.00	FT
SLAB THICKNESS	8.00	IN
SLAB F'C	4.00	KSI

SUPERSTRUCTURE POSITIVE MOMENT REGION DATA (ADJACENT SPAN)

WIDE FLANGE	W27X102	
BEAM SPACING PERP. TO CL	6.00	FT
SLAB THICKNESS	8.00	IN
SLAB F'C	4.00	KSI

ABUTMENT #1 DATA

ABUTMENT NAME	East	
ABUTMENT REFERENCE BORING	B-1	
BOTTOM OF ABUTMENT ELEVATION	408	FT
ESTIMATED NUMBER OF PILES AT ABUT.	12	
PILE SPACING PERP. TO CL	6	FT

ABUTMENT #2 DATA

ABUTMENT NAME	West	
ABUTMENT REFERENCE BORING	B-2	
BOTTOM OF ABUTMENT ELEVATION	408	FT
ESTIMATED NUMBER OF PILES AT ABUT.	12	
PILE SPACING PERP. TO CL	6	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)*
405.50	2.50	1.0		
403.00	2.50	1.0		
400.50	2.50	1.0		
398.00	2.50	1.0		

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)*
405.50	2.50	1.0		
403.00	2.50	1.0		
400.50	2.50	1.0		
398.00	2.50	1.00		

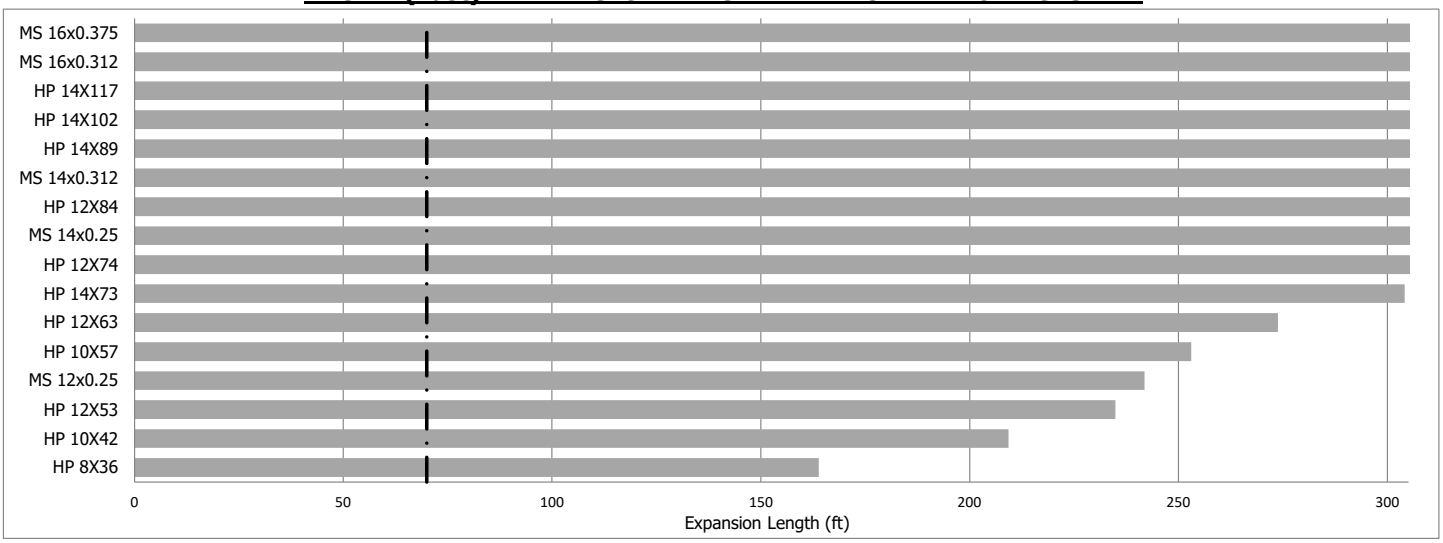
10.00 FT = TOTAL DEPTH ENTERED

WEIGHTED AVERAGE Qu FOR ABUTMENT #1	1.00	TSF	WEIGHTED AVERAGE Qu FOR ABUTMENT #2	1.00	TSF
PILE STIFFNESS MODIFIER FOR ABUTMENT #1 = 1/(1.45-[0.3*1])	0.87		PILE STIFFNESS MODIFIER FOR ABUTMENT #2 = 1/(1.45-[0.3*1])	0.87	

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #1 = [0.87*12*0+0.87*12*140]/[0.87*12+0.87*12] = 70.00 FT

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #2 = [0.87*12*0+0.87*12*140]/[0.87*12+0.87*12] = 70.00 FT

ABUT 1 (East) - EXPANSION LENGTH LIMIT CHART - 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.)

By inspection, 0107 widening embankment condition OK

Illinois Department of Transportation

INTEGRAL ABUTMENT FEASIBILITY ANALYSIS

Modified 10/30/17

GENERAL DATA

STRUCTURE NUMBER	100-0107		TOTAL STRUCTURE LENGTH	140.00	FT
STRUCTURE TYPE	MULTI-SPAN		NUMBER OF SPANS	3	
STRUCTURE SKEW	0	DEGREES	END SPAN LENGTH	42.00	FT
SUPER. DATA IN REFERENCE TO SUB. DATA	ABUT 1		ADJACENT INTERIOR SPAN LENGTH	56.00	FT

SUPERSTRUCTURE POSITIVE MOMENT REGION DATA (END OR MAIN SPAN)

BEAM TYPE	WIDE FLANGE	
WIDE FLANGE	W27X102	
BEAM SPACING PERP. TO CL	6.33	FT
SLAB THICKNESS	8.00	IN
SLAB F'C	4.00	KSI

SUPERSTRUCTURE POSITIVE MOMENT REGION DATA (ADJACENT SPAN)

WIDE FLANGE	W27X102	
BEAM SPACING PERP. TO CL	6.33	FT
SLAB THICKNESS	8.00	IN
SLAB F'C	4.00	KSI

ABUTMENT #1 DATA

ABUTMENT NAME	East	
ABUTMENT REFERENCE BORING	B-1	
BOTTOM OF ABUTMENT ELEVATION	408	FT
ESTIMATED NUMBER OF PILES AT ABUT.	10	
PILE SPACING PERP. TO CL	6.33	FT

ABUTMENT #2 DATA

ABUTMENT NAME	West	
ABUTMENT REFERENCE BORING	B-2	
BOTTOM OF ABUTMENT ELEVATION	408	FT
ESTIMATED NUMBER OF PILES AT ABUT.	10	
PILE SPACING PERP. TO CL	6.33	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)*
407.70	0.30	2.3		
405.20	2.50	2.5		
402.70	2.50	2.5		
400.20	2.50	2.0		
398.20	2.00	2.7		
398.00	0.20	1.70		

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)*
405.70	2.30	1.6		
403.20	2.50	1.7		
400.70	2.50	1.3		
398.20	2.50	1.50		
398.00	0.20	1.50		

10.00 FT = TOTAL DEPTH ENTERED

WEIGHTED AVERAGE Qu FOR ABUTMENT #1 = 2.39 TSF

PILE STIFFNESS MODIFIER FOR ABUTMENT #1
= 1/(1.45-[0.3*2.39]) = 1.37

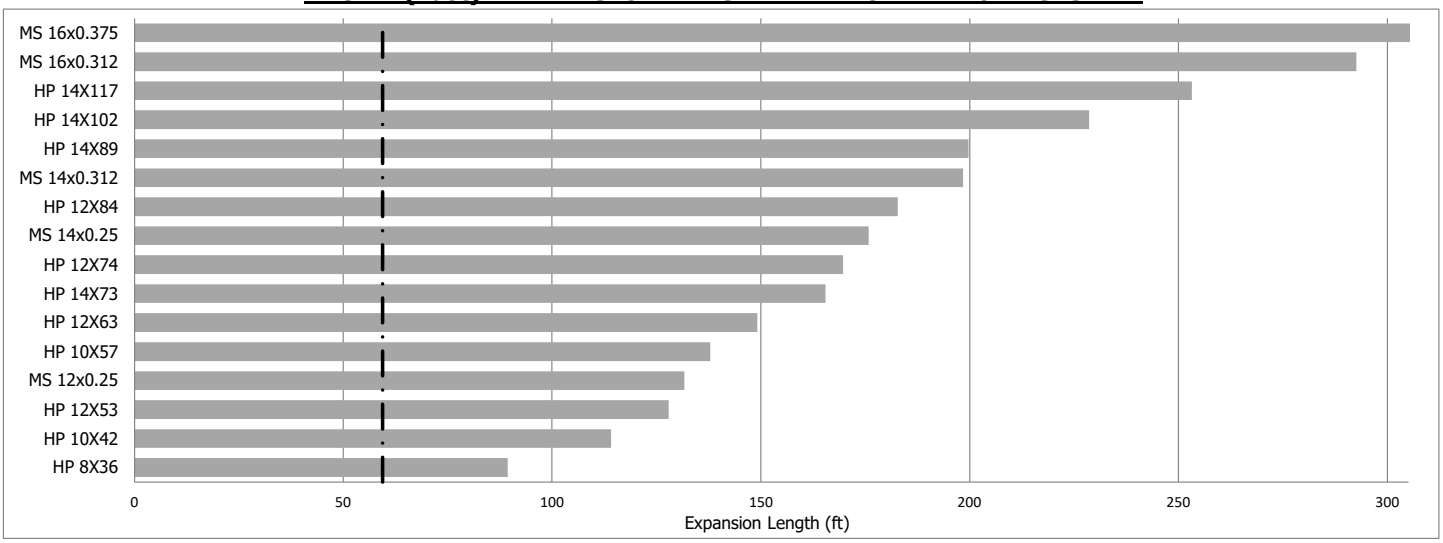
WEIGHTED AVERAGE Qu FOR ABUTMENT #2 = 1.52 TSF

PILE STIFFNESS MODIFIER FOR ABUTMENT #2
= 1/(1.45-[0.3*1.52]) = 1.01

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #1 = [1.37*10*0+1.01*10*140]/[1.37*10+1.01*10] = 59.41 FT

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #2 = [1.01*10*0+1.37*10*140]/[1.01*10+1.37*10] = 80.59 FT

ABUT 1 (East) - EXPANSION LENGTH LIMIT CHART - 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.)

Appendix J

Driven Pile Analysis

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0106 - W. Abut.
REFERENCE BORING ========== 2-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 410.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 408.00 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 ========== 1500 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 66.67 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 179.99 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 67.50 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
578 KIPS	**578** KIPS	**318** KIPS	**66** FT.

PILE TYPE AND SIZE ========== Steel HP 14 X 73
Plugged Pile Perimeter========== 4.700 FT. Unplugged Pile Perimeter========== 6.975 FT.
Plugged Pile End Bearing Area========== 1.379 SQFT. Unplugged Pile End Bearing Area========= 0.149 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.)
405.50	2.50		22	Sandy Gravel	6.0		50.2	9.0		***13.7***	14	0	0	8	5
403.00	2.50		30	Sandy Gravel	9.4	44.2	35.3	14.0	4.8	***25.1***	25	0	0	14	7
400.50	2.50		9	Sandy Gravel	2.5	19.9	38.5	3.7	2.1	***28.8***	29	0	0	16	10
398.00	2.50		7	Sandy Gravel	1.9	20.6	***26.7***	2.9	2.2	30.2	27	0	0	15	12
395.50	2.50		2	Sandy Gravel	0.5	6.9	41.0	0.8	0.7	***32.5***	33	0	0	18	15
393.00	2.50		6	Sandy Gravel	1.6	20.6	42.7	2.4	2.2	***34.9***	35	0	0	19	17
391.00	2.00		6	Sandy Gravel	1.3	20.6	***26.8***	2.0	2.2	35.1	27	0	0	15	19
388.90	2.10		1	Sandy Gravel	0.2	3.4	37.1	0.3	0.4	***36.5***	36	0	0	20	21
385.40	3.50	0.70			8.7	13.5	***45.8***	12.9	1.5	49.3	46	0	0	25	25
382.90	2.50	0.70			6.2	13.5	***52.0***	9.2	1.5	58.5	52	0	0	29	27
380.40	2.50	0.70			6.2	13.5	***60.1***	9.2	1.5	67.9	60	0	0	33	30
377.90	2.50	0.80			6.9	15.5	***67.0***	10.3	1.7	78.2	67	0	0	37	32
375.40	2.50	0.80			6.9	15.5	***79.8***	10.3	1.7	89.1	80	0	0	44	35
370.40	5.00	1.10			18.0	21.3	***99.7***	26.7	2.3	116.1	100	0	0	55	40
365.40	5.00	1.20			19.3	23.2	***122.8***	28.6	2.5	145.0	123	0	0	68	45
360.40	5.00	1.40			21.6	27.1	***128.9***	32.0	2.9	175.4	129	0	0	71	50
355.40	5.00	0.60			10.8	11.6	***135.9***	16.0	1.2	191.0	136	0	0	75	55
350.40	5.00	0.40			7.5	7.7	***170.4***	11.1	0.8	205.0	170	0	0	94	60
348.40	2.00	1.80			10.2	34.8	***145.8***	15.2	3.7	216.4	146	0	0	80	62
347.40	1.00			Sandstone	0.0	0.0	424.9	0.0	0.0	***246.5***	246	0	0	136	62.6
346.40	1.00			Sandstone	97.6	279.1	522.5	144.8	30.1	***391.3***	391	0	0	215	63.6
345.40	1.00			Sandstone	97.6	279.1	620.1	144.8	30.1	***536.1***	536	0	0	295	64.6
344.40	1.00			Sandstone	97.6	279.1	717.7	144.8	30.1	***680.9***	~~681~~	~~0~~	~~0~~	~~374~~	~~65.6~~
343.40	1.00			Sandstone	97.6	279.1	***815.3***	144.8	30.1	825.7	~~815~~	~~0~~	~~0~~	~~448~~	~~66.6~~
342.40	1.00			Sandstone		279.1			30.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0106 - E. Abut.
REFERENCE BORING ========== 1-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 410.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 408.00 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 ========== 1500 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 66.67 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 179.99 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 67.50 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
578 KIPS	**578** KIPS	**318** KIPS	**61** FT.

PILE TYPE AND SIZE ========== Steel HP 14 X 73
Plugged Pile Perimeter========== 4.700 FT. Unplugged Pile Perimeter========== 6.975 FT.
Plugged Pile End Bearing Area========== 1.379 SQFT. Unplugged Pile End Bearing Area========= 0.149 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.)
405.50	2.50		30	Sandy Gravel	9.4		22.7	14.0		***15.4***	15	0	0	8	5
403.00	2.50		9	Sandy Gravel	2.5	13.3	27.4	3.7	1.4	***19.3***	19	0	0	11	7
400.50	2.50		7	Sandy Gravel	1.9	15.5	***19.7***	2.9	1.7	21.1	20	0	0	11	10
398.00	2.50		2	Sandy Gravel	0.5	5.9	35.0	0.8	0.6	***23.5***	24	0	0	13	12
395.50	2.50		6	Sandy Gravel	1.6	20.6	36.6	2.4	2.2	***26.0***	26	0	0	14	15
393.00	2.50		6	Sandy Gravel	1.6	20.6	***21.1***	2.4	2.2	26.6	21	0	0	12	17
390.80	2.20		1	Sandy Gravel	0.2	3.4	***21.8***	0.4	0.4	27.0	22	0	0	12	19
389.30	1.50	0.20			1.2	3.9	67.4	1.7	0.4	***33.5***	33	0	0	18	21
387.80	1.50	2.50			9.5	48.3	***32.4***	14.1	5.2	42.8	32	0	0	18	22
385.30	2.50	0.20			1.9	3.9	***38.2***	2.9	0.4	46.1	38	0	0	21	25
380.30	5.00	0.40			7.5	7.7	78.5	11.1	0.8	***60.7***	61	0	0	33	30
377.80	2.50	2.10			14.1	40.6	81.0	20.9	4.4	***80.4***	80	0	0	44	32
374.80	3.00	1.50			13.6	29.0	***100.4***	20.1	3.1	101.1	100	0	0	55	35
370.30	4.50	1.80			23.0	34.8	***104.1***	34.1	3.7	133.2	104	0	0	57	40
364.80	5.50	0.80			15.3	15.5	***134.8***	22.7	1.7	157.5	135	0	0	74	45
360.30	4.50	1.60			21.3	30.9	***181.2***	31.6	3.3	191.7	181	0	0	100	50
354.80	5.50	2.90			38.6	56.0	***208.2***	57.3	6.0	247.8	208	0	0	115	55
352.30	2.50	2.30			15.0	44.4	***178.7***	22.2	4.8	265.2	179	0	0	98	58
351.30	1.00			Sandstone	0.0	0.0	457.8	0.0	0.0	***295.3***	295	0	0	162	58.7
350.30	1.00			Sandstone	97.6	279.1	555.4	144.8	30.1	***440.1***	440	0	0	242	59.7
349.30	1.00			Sandstone	97.6	279.1	653.0	144.8	30.1	***584.9***	~~585~~	~~0~~	~~0~~	~~322~~	~~60.7~~
349.17	0.13			Sandstone	12.7	279.1	665.7	18.8	30.1	***603.7***	~~604~~	~~0~~	~~0~~	~~332~~	~~60.8~~
348.17	1.00			Sandstone	97.6	279.1	763.3	144.8	30.1	***748.6***	~~749~~	~~0~~	~~0~~	~~412~~	~~61.8~~
347.17	1.00			Sandstone	97.6	279.1	***860.8***	144.8	30.1	893.4	~~861~~	~~0~~	~~0~~	~~473~~	~~62.8~~
346.17	1.00			Sandstone		279.1			30.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0107 - W. Abut.
REFERENCE BORING ========== 2-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 410.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 408.00 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 ========== 1400 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 63.08 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 177.55 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 66.58 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
578 KIPS	**578** KIPS	**318** KIPS	**63** FT.

PILE TYPE AND SIZE ========== Steel HP 14 X 73
Plugged Pile Perimeter========== 4.700 FT. Unplugged Pile Perimeter========== 6.975 FT.
Plugged Pile End Bearing Area========== 1.379 SQFT. Unplugged Pile End Bearing Area========= 0.149 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.)
405.20	2.80	1.60			13.2		46.1	19.6		***23.2***	23	0	0	13	5
402.70	2.50	1.70			12.3	32.9	50.7	18.3	3.5	***40.6***	41	0	0	22	7
400.20	2.50	1.30			10.2	25.1	64.7	15.2	2.7	***56.2***	56	0	0	31	10
397.70	2.50	1.50			11.3	29.0	76.0	16.8	3.1	***73.0***	73	0	0	40	12
395.20	2.50	1.50			11.3	29.0	95.1	16.8	3.1	***90.6***	91	0	0	50	15
392.70	2.50	1.90			13.2	36.7	***108.3***	19.6	4.0	110.2	108	0	0	60	17
390.20	2.50	1.90			13.2	36.7	133.1	19.6	4.0	***131.1***	131	0	0	72	20
388.20	2.00	2.50			12.7	48.3	***120.7***	18.8	5.2	147.2	121	0	0	66	22
385.70	2.50	1.20			9.6	23.2	***118.7***	14.3	2.5	160.2	119	0	0	65	24
383.20	2.50	0.60			5.4	11.6	***118.3***	8.0	1.2	167.6	118	0	0	65	27
380.70	2.50	0.30			2.8	5.8	***123.1***	4.2	0.6	172.0	123	0	0	68	29
378.20	2.50	0.40			3.7	7.7	***138.4***	5.5	0.8	178.8	138	0	0	76	32
375.70	2.50	1.00			8.3	19.3	***171.9***	12.4	2.1	193.9	172	0	0	95	34
370.70	5.00	2.30			29.9	44.4	***188.3***	44.4	4.8	236.9	188	0	0	104	39
365.70	5.00	1.60			23.6	30.9	***211.9***	35.1	3.3	271.9	212	0	0	117	44
360.70	5.00	1.60			23.6	30.9	***216.2***	35.1	3.3	304.9	216	0	0	119	49
355.70	5.00	0.60			10.8	11.6	***230.9***	16.0	1.2	321.4	231	0	0	127	54
351.20	4.50	0.80			12.5	15.5	399.7	18.5	1.7	***356.7***	357	0	0	196	59
350.20	1.00			Shale	58.5	171.8	458.2	86.9	18.5	***443.6***	444	0	0	244	59.8
349.20	1.00			Shale	58.5	171.8	***516.8***	86.9	18.5	530.5	517	0	0	284	60.8
348.20	1.00			Shale	58.5	171.8	***575.3***	86.9	18.5	617.4	575	0	0	316	61.8
347.20	1.00			Shale	58.5	171.8	***633.9***	86.9	18.5	704.3	~~634~~	~~0~~	~~0~~	~~349~~	~~62.8~~
346.20	1.00			Shale	58.5	171.8	***692.4***	86.9	18.5	791.2	~~692~~	~~0~~	~~0~~	~~381~~	~~63.8~~
345.20	1.00			Shale	58.5	171.8	***751.0***	86.9	18.5	878.1	~~751~~	~~0~~	~~0~~	~~413~~	~~64.8~~
344.20	1.00			Shale		171.8			18.5						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0107 - E. Abut.
REFERENCE BORING ========== 1-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 410.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 408.00 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 ========== 1400 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 63.08 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 177.55 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 66.58 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
578 KIPS	**578** KIPS	**318** KIPS	**62** FT.

PILE TYPE AND SIZE ========== Steel HP 14 X 73
Plugged Pile Perimeter========== 4.700 FT. Unplugged Pile Perimeter========== 6.975 FT.
Plugged Pile End Bearing Area========== 1.379 SQFT. Unplugged Pile End Bearing Area========= 0.149 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.)
405.20	2.80	2.50			17.7		66.0	26.3		***31.5***	32	0	0	17	5
402.70	2.50	2.50			15.8	48.3	72.2	23.5	5.2	***54.0***	54	0	0	30	7
400.20	2.50	2.00			13.7	38.6	99.4	20.3	4.2	***75.7***	76	0	0	42	10
398.20	2.00	2.70			13.3	52.2	***93.4***	19.8	5.6	93.4	93	0	0	51	12
395.20	3.00	1.70			14.8	32.9	***106.3***	21.9	3.5	115.1	106	0	0	58	15
392.70	2.50	1.60			11.8	30.9	***123.9***	17.5	3.3	133.3	124	0	0	68	17
390.20	2.50	1.90			13.2	36.7	***125.5***	19.6	4.0	151.7	126	0	0	69	20
387.70	2.50	1.30			10.2	25.1	***139.6***	15.2	2.7	167.3	140	0	0	77	22
385.70	2.00	1.50			9.0	29.0	***152.5***	13.4	3.1	181.1	153	0	0	84	24
383.20	2.50	1.70			12.3	32.9	***153.2***	18.3	3.5	198.1	153	0	0	84	27
380.70	2.50	1.10			9.0	21.3	***160.3***	13.4	2.3	211.3	160	0	0	88	29
378.20	2.50	1.00			8.3	19.3	***151.2***	12.4	2.1	221.8	151	0	0	83	32
375.70	2.50	0.10			1.0	1.9	***206.3***	1.5	0.2	229.1	206	0	0	113	34
370.70	5.00	2.90			35.1	56.0	***220.2***	52.1	6.0	278.9	220	0	0	121	39
365.70	5.00	1.80			25.6	34.8	***230.3***	37.9	3.7	315.1	230	0	0	127	44
360.70	5.00	1.00			16.7	19.3	***233.4***	24.8	2.1	338.4	233	0	0	128	49
355.70	5.00	0.30			5.7	5.8	***244.9***	8.4	0.6	347.5	245	0	0	135	54
350.70	5.00	0.60			10.8	11.6	415.9	16.0	1.2	***380.8***	381	0	0	209	59
349.70	1.00			Shale	58.5	171.8	474.4	86.9	18.5	***467.7***	468	0	0	257	60.3
348.70	1.00			Shale	58.5	171.8	***533.0***	86.9	18.5	554.6	533	0	0	293	61.3
347.70	1.00			Shale	58.5	171.8	***591.5***	86.9	18.5	641.5	~~592~~	~~0~~	~~0~~	~~325~~	~~62.3~~
346.70	1.00			Shale	58.5	171.8	***650.1***	86.9	18.5	728.4	~~650~~	~~0~~	~~0~~	~~358~~	~~63.3~~
345.70	1.00			Shale	58.5	171.8	***708.6***	86.9	18.5	815.2	~~709~~	~~0~~	~~0~~	~~390~~	~~64.3~~
344.70	1.00			Shale	58.5	171.8	***767.2***	86.9	18.5	902.1	~~767~~	~~0~~	~~0~~	~~422~~	~~65.3~~
343.70	1.00			Shale		171.8			18.5						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0106 - Pier 1
REFERENCE BORING ========== 2-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 409.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 391.40 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 385.30 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 2900 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 66.67 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 347.98 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 130.49 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
578 KIPS	**507** KIPS	**272** KIPS	**63** FT.

PILE TYPE AND SIZE ========== Steel HP 14 X 73
Plugged Pile Perimeter========== 4.700 FT. Unplugged Pile Perimeter========== 6.975 FT.
Plugged Pile End Bearing Area========== 1.379 SQFT. Unplugged Pile End Bearing Area========= 0.149 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.)
386.40	5.00	0.70			12.4		25.9	18.4		***19.8***	20	7	0	4	23
383.90	2.50	0.70			6.2	13.5	32.1	9.2	1.5	***29.0***	29	7	0	9	25
381.40	2.50	0.70			6.2	13.5	40.2	9.2	1.5	***38.4***	38	7	0	14	28
378.90	2.50	0.80			6.9	15.5	***47.1***	10.3	1.7	48.7	47	7	0	19	30
376.40	2.50	0.80			6.9	15.5	59.9	10.3	1.7	***59.6***	60	7	0	26	33
371.40	5.00	1.10			18.0	21.3	***79.8***	26.7	2.3	86.5	80	7	0	37	38
366.40	5.00	1.20			19.3	23.2	***102.9***	28.6	2.5	115.5	103	7	0	50	43
361.40	5.00	1.40			21.6	27.1	***109.0***	32.0	2.9	145.9	109	7	0	53	48
356.40	5.00	0.60			10.8	11.6	***116.0***	16.0	1.2	161.5	116	7	0	57	53
351.40	5.00	0.40			7.5	7.7	***150.5***	11.1	0.8	175.4	150	7	0	76	58
349.40	2.00	1.80			10.2	34.8	***125.9***	15.2	3.7	186.9	126	7	0	62	60
348.40	1.00			Sandstone	0.0	0.0	405.0	0.0	0.0	***216.9***	217	7	0	113	60.6
347.40	1.00			Sandstone	97.6	279.1	502.6	144.8	30.1	***361.8***	362	7	0	192	61.6
346.40	1.00			Sandstone	97.6	279.1	600.2	144.8	30.1	***506.6***	507	7	0	272	62.6
345.40	1.00			Sandstone	97.6	279.1	697.8	144.8	30.1	***651.4***	~~651~~	~~7~~	~~0~~	~~351~~	~~63.6~~
344.40	1.00			Sandstone	97.6	279.1	***795.4***	144.8	30.1	796.2	~~795~~	~~7~~	~~0~~	~~431~~	~~64.6~~
343.40	1.00			Sandstone	97.6	279.1	***893.0***	144.8	30.1	941.0	~~893~~	~~7~~	~~0~~	~~484~~	~~65.6~~
342.40	1.00			Sandstone		279.1			30.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0106 - Pier 2
REFERENCE BORING ========== 1-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 409.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 391.40 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 385.30 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 2900 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 66.67 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 347.98 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 130.49 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
578 KIPS	**576** KIPS	**303** KIPS	**60** FT.

PILE TYPE AND SIZE ========== Steel HP 14 X 73
Plugged Pile Perimeter========== 4.700 FT. Unplugged Pile Perimeter========== 6.975 FT.
Plugged Pile End Bearing Area========== 1.379 SQFT. Unplugged Pile End Bearing Area========= 0.149 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.)
387.80	3.60	2.50			22.8		***26.7***	33.8		34.2	27	13	0	2	21
385.30	2.50	0.20			1.9	3.9	***32.4***	2.9	0.4	37.5	32	14	0	4	24
380.30	5.00	0.40			7.5	7.7	72.8	11.1	0.8	***52.1***	52	14	0	15	29
377.80	2.50	2.10			14.1	40.6	75.3	20.9	4.4	***71.8***	72	14	0	26	31
374.80	3.00	1.50			13.6	29.0	94.6	20.1	3.1	***92.6***	93	14	0	37	34
370.30	4.50	1.80			23.0	34.8	***98.3***	34.1	3.7	124.6	98	14	0	40	39
364.80	5.50	0.80			15.3	15.5	***129.0***	22.7	1.7	148.9	129	14	0	57	44
360.30	4.50	1.60			21.3	30.9	***175.4***	31.6	3.3	183.2	175	14	0	83	49
354.80	5.50	2.90			38.6	56.0	***202.4***	57.3	6.0	239.2	202	14	0	98	54
352.30	2.50	2.30			15.0	44.4	***172.9***	22.2	4.8	256.7	173	14	0	82	57
351.30	1.00			Sandstone	0.0	0.0	452.1	0.0	0.0	***286.7***	287	14	0	144	57.7
350.30	1.00			Sandstone	97.6	279.1	549.7	144.8	30.1	***431.6***	432	14	0	224	58.7
349.30	1.00			Sandstone	97.6	279.1	647.2	144.8	30.1	***576.4***	576	14	0	303	59.7
348.30	1.00			Sandstone	97.6	279.1	744.8	144.8	30.1	***721.2***	~~721~~	~~14~~	~~0~~	~~383~~	~~60.7~~
347.30	1.00			Sandstone	97.6	279.1	***842.4***	144.8	30.1	866.0	~~842~~	~~14~~	~~0~~	~~450~~	~~61.7~~
346.30	1.00			Sandstone	97.6	279.1	***940.0***	144.8	30.1	1010.8	~~940~~	~~14~~	~~0~~	~~503~~	~~62.7~~
345.30	1.00			Sandstone		279.1			30.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0107 - Pier 1
REFERENCE BORING ========== 2-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 409.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 391.80 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 385.30 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 2700 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 63.08 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 342.42 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 128.41 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
578 KIPS	**559** KIPS	**290** KIPS	**62** FT.

PILE TYPE AND SIZE ========== Steel HP 14 X 73
Plugged Pile Perimeter========== 4.700 FT. Unplugged Pile Perimeter========== 6.975 FT.
Plugged Pile End Bearing Area========== 1.379 SQFT. Unplugged Pile End Bearing Area========= 0.149 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.)
388.20	3.60	2.50			22.8		46.0	33.8		***36.3***	36	13	0	7	21
385.70	2.50	1.20			9.6	23.2	***44.0***	14.3	2.5	49.4	44	18	0	6	23
383.20	2.50	0.60			5.4	11.6	***43.6***	8.0	1.2	56.7	44	18	0	6	26
380.70	2.50	0.30			2.8	5.8	***48.4***	4.2	0.6	61.2	48	18	0	9	28
378.20	2.50	0.40			3.7	7.7	***63.7***	5.5	0.8	68.0	64	18	0	17	31
375.70	2.50	1.00			8.3	19.3	97.2	12.4	2.1	***83.1***	83	18	0	28	33
370.70	5.00	2.30			29.9	44.4	***113.6***	44.4	4.8	126.0	114	18	0	45	38
365.70	5.00	1.60			23.6	30.9	***137.2***	35.1	3.3	161.1	137	18	0	58	43
360.70	5.00	1.60			23.6	30.9	***141.5***	35.1	3.3	194.1	142	18	0	60	48
355.70	5.00	0.60			10.8	11.6	***156.2***	16.0	1.2	210.5	156	18	0	68	53
351.20	4.50	0.80			12.5	15.5	325.0	18.5	1.7	***245.9***	246	18	0	117	58
350.20	1.00			Shale	58.5	171.8	383.5	86.9	18.5	***332.8***	333	18	0	165	58.8
349.20	1.00			Shale	58.5	171.8	442.1	86.9	18.5	***419.7***	420	18	0	213	59.8
348.20	1.00			Shale	58.5	171.8	***500.6***	86.9	18.5	506.6	501	18	0	258	60.8
347.20	1.00			Shale	58.5	171.8	***559.2***	86.9	18.5	593.4	559	18	0	290	61.8
346.20	1.00			Shale	58.5	171.8	***617.7***	86.9	18.5	680.3	~~618~~	~~18~~	~~0~~	~~322~~	~~62.8~~
345.20	1.00			Shale	58.5	171.8	***676.3***	86.9	18.5	767.2	~~676~~	~~18~~	~~0~~	~~354~~	~~63.8~~
344.20	1.00			Shale		171.8			18.5						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0107 - Pier 2
REFERENCE BORING ========== 1-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 409.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 391.80 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 385.30 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 2700 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 63.08 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 342.42 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 128.41 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
578 KIPS	**556** KIPS	**292** KIPS	**62** FT.

PILE TYPE AND SIZE ========== Steel HP 14 X 73
Plugged Pile Perimeter========== 4.700 FT. Unplugged Pile Perimeter========== 6.975 FT.
Plugged Pile End Bearing Area========== 1.379 SQFT. Unplugged Pile End Bearing Area========= 0.149 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.)
387.70	4.10	1.30			16.8		45.7	24.9		***28.0***	28	9	0	6	21
385.70	2.00	1.50			9.0	29.0	58.7	13.4	3.1	***41.8***	42	14	0	9	23
383.20	2.50	1.70			12.3	32.9	59.4	18.3	3.5	***58.8***	59	14	0	18	26
380.70	2.50	1.10			9.0	21.3	***66.4***	13.4	2.3	72.0	66	14	0	22	28
378.20	2.50	1.00			8.3	19.3	***57.4***	12.4	2.1	82.5	57	14	0	17	31
375.70	2.50	0.10			1.0	1.9	112.5	1.5	0.2	***89.8***	90	14	0	35	33
370.70	5.00	2.90			35.1	56.0	***126.3***	52.1	6.0	139.6	126	14	0	55	38
365.70	5.00	1.80			25.6	34.8	***136.4***	37.9	3.7	175.8	136	14	0	61	43
360.70	5.00	1.00			16.7	19.3	***139.6***	24.8	2.1	199.2	140	14	0	63	48
355.70	5.00	0.30			5.7	5.8	***151.1***	8.4	0.6	208.2	151	14	0	69	53
350.70	5.00	0.60			10.8	11.6	322.0	16.0	1.2	***241.5***	242	14	0	119	58
349.70	1.00			Shale	58.5	171.8	380.6	86.9	18.5	***328.4***	328	14	0	166	59.3
348.70	1.00			Shale	58.5	171.8	439.1	86.9	18.5	***415.3***	415	14	0	214	60.3
347.70	1.00			Shale	58.5	171.8	***497.7***	86.9	18.5	502.2	498	14	0	260	61.3
346.70	1.00			Shale	58.5	171.8	***556.2***	86.9	18.5	589.1	556	14	0	292	62.3
345.70	1.00			Shale	58.5	171.8	***614.8***	86.9	18.5	676.0	~~615~~	~~14~~	~~0~~	~~324~~	~~63.3~~
344.70	1.00			Shale	58.5	171.8	***673.3***	86.9	18.5	762.9	~~673~~	~~14~~	~~0~~	~~356~~	~~64.3~~
343.70	1.00			Shale		171.8			18.5						