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. 100-0020 (EB)/100-0067 (WB)
Proposed Structure No. 100-0108 (EB)/100-0109 (WB)

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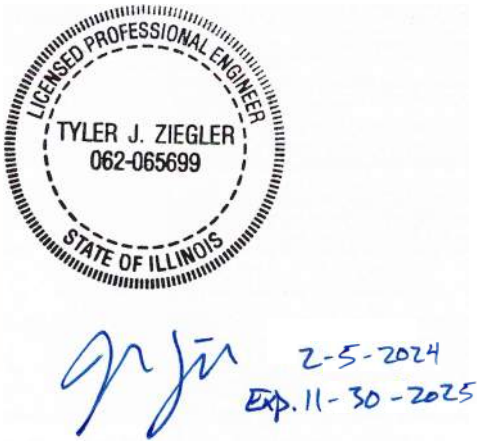

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1.0 Project Description and Scope

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 100-0067 - Originally built in 1939, the west bound structure is a three span continuous wide flange bridge. The 0 degree skew structure is 123'-6" from back to back abutment with approximate span lengths of 38'-3", 47'-0" and 38'-3". 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 W24x55's for spans one and three and W24x62'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 88.4 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 100-0020 - Originally built in 1964, the eastbound structure is a three span continuous wide flange bridge. The 0 degree skew structure is 123'-0" from back to back abutment with approximate span lengths of 35'-9", 46'-11" and 35'-9". 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 100-0020 has a sufficiency rating of 63.0 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 100-0108 to replace SN 100-0020 and proposed SN 100-0109 to replace SN 100-0067. 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 128'-6" with span lengths of 38'-0" – 52'-6" – 38'-0". SN 100-0108 consists of 13 beams with typical spacing at 5'-10" centers and 3'-1" overhangs for an overall width of 76'-2" out to out. SN 100-0109 consists of 10 beams with typical spacing at 6'-2" centers and 2'-4" overhangs for an overall width of 60'-2" out to out. The SN 100-0108 roadway cross sections consist of a 6'-0" shoulder, 45'-6" roadway, 10'-0" shoulder, and a 11'-0" multi use trail. The SN 100-0109 roadway cross sections consist of a 17'-4" shoulder/ramp, 34'-0" 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 August 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 100-0108 (E. Abut.)	1-S	336+71	15' RT - CL EB	414.9	355.9
SN 100-0108 (W. Abut.)	2-S	335+27	15' RT - CL EB	414.9	347.9
SN 100-0109 (E. Abut.)	1-S	336+82	13' LT - CL WB	415.3	348.8
SN 100-0109 (W. Abut.)	2-S	335+21	13' LT - CL WB	415.2	352.2

In addition to the borings discussed above, the existing borings of SN 100-0020 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 348.2 and 348.7 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 100-0108 (E. Abut.)	1-S	403.8	-----	-----
SN 100-0108 (W. Abut.)	2-S	403.9	-----	-----
SN 100-0109 (E. Abut.)	1-S	383.3	-----	-----
SN 100-0109 (W. Abut.)	2-S	385.7	-----	-----

SN 100-0108 - 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 and 7.5 feet in borings 1-S and 2-S, respectively, and has SPT (N) values ranging from 24 to 84. The rock fill extends down 24.5 feet in borings 1-S and 2-S. 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 feet, the boring show soft to stiff, grey, mottled grey, and brown, moist silty clay to silty clay loam with SPT (N) values ranging from WOH to 6 blows per foot, Q_u values of 0.3 to 1.9 tsf, and moisture contents ranging between 21% and 30%. From 34 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 1.9 tsf, and moisture contents ranging between 23% and 48%.

At a depth of 59.1 feet, boring 1-S encounters a very dense grey, dry sandstone layer with SPT (N) of 100/0.5". Boring 2-S encounters a dense grey, dry sandstone with clay shale lenses at a depth of 70 feet with SPT (N) of 100/1".

SN 100-0109 – Both borings, 1-S and 2-S, encountered medium to very stiff brown and grey moist clay to silty clay from the ground surface elevation to an approximate depth of 25 feet and 22 feet respectively. The moist clay has SPT (N) values ranging from WOH to 7 blows per foot with Qu values of 0.6 to 2.3 tsf and moisture contents ranging between 19% and 23%.

Beneath the top moist clay layers, boring 1-S shows a potentially liquefiable layer at depths of 25 to 27 feet. This layer consists of stiff, moist to very moist silty loam to silty clay loam with average soil contents of 10% sand, 71% silt, and 19% clay. Average liquid limit is 32 and plasticity index is 10, both values being estimated based on visual ID and historical database. SPT (N) value is 4 blows per foot with a Qu value of 1.2 tsf and moisture content of 21%. Boring 2-S shows a potentially liquefiable layer at depths of 22 to 27 feet. This layer consists of medium stiff to stiff grey moist to very moist silty loam to silty clay loam with average soil contents of 10% sand, 71% silt, and 19% clay. Average liquid limit is 32 and plasticity index is 10, both values being estimated based on visual ID and historical database. SPT (N) values range from 1 to 2 blows per foot with Qu values of 0.8 to 1.1 tsf and a moisture content of 23%.

From 27 to 37 feet, both borings show soft to stiff grey and mottled brown moist silty clay loam with SPT (N) values ranging from WOH to 4 blows per foot, Q_u values of 0.3 to 1.2 tsf, and moisture

contents ranging between 21% and 30%. From 37 feet down to rock, both borings show soft to stiff, grey to mottled brown moist clays with SPT (N) values ranging from WOH to 2 blows per foot, Q_u values of 0.3 to 1.9 tsf, and moisture contents ranging between 20% and 49%.

At a depth of 66.5 feet, boring 1-S encounters a very dense grey, dry sandstone layer with SPT (N) of 100/1". Rock core logs at 1-S show the top 5 feet of rock with an RQD of 63% and uniaxial compressive strength (UCS) of 350 tsf. The next 5 feet have an RQD of 60% and UCS of 250 tsf. Boring 2-S encounters a very dense grey, dry sandstone at a depth of 63 feet with SPT (N) of 100/1".

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
100-0108	East Abut.	1.65	2.12	1.02
100-0108	West Abut.	1.50	2.06	1.01
100-0109	East Abut.	1.66	1.76	1.03
100-0109	West Abut.	1.67	1.76	1.02

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	386.4	386.4	Note 1	5
Q200	Note 1	386.3	386.3	Note 1	
Design	Note 1	386.4	386.4	Note 1	
Check	Note 1	386.3	386.3	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 100-0109 east abutment soil boring (1-S) between elevations 390.3 to 388.3 as well as the west abutment soil boring (2-S) between elevations 393.2 to 388.2 respectively. 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 for either boring; 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 100-0108 Pier 1 (2-S)

Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		K (pci)	ε50
			c' (ksf)	θ (deg.)		
Medium Silty Clay to Silty Clay Loam	387.9	125	0.6	0	300	0.007
Soft Silty Clay to Silty Clay Loam	386.4	120	0.4	0	100	0.01
Stiff Clay to Silty Clay	382.9	125	1.1	0	300	0.007
Soft Silty Clay	380.4	120	0.3	0	100	0.01
Medium to Stiff Silty Clay to Clay	377.9	125	1.0	0	300	0.007
Soft Silty Clay to Clay	375.4	120	0.4	0	100	0.01
Stiff Clay	365.4	125	1.3	0	300	0.007
Soft Clay	360.4	120	0.4	0	100	0.01
Medium Clay	355.4	125	0.7	0	300	0.007
Soft to Medium Clay	350.4	120	0.5	0	100	0.01
Stiff Clay to Clay Shale	347.9	130	1.5	0	500	0.005
Sandstone	-	150	0	45	-	0.001

Table 3.5 –Soil Parameters for Lateral Load Analysis at SN 100-0108 Pier 2 (1-S)

Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		K (pci)	ε50
			c' (ksf)	θ (deg.)		
Soft to Medium Silty Clay to Silty Clay Loam	385.9	120	0.3	0	100	0.01
Stiff Silty Clay to Clay	383.4	125	1.9	0	300	0.007
Medium Clay Loam to Silty Clay Loam	380.9	125	0.8	0	300	0.007
Stiff Clay	369.9	125	1.9	0	300	0.007
Stiff Clay	355.9	125	1.2	0	300	0.007
Sandstone	-	150	0	45	-	0.001

Table 3.6 –Soil Parameters for Lateral Load Analysis at SN 100-0109 Pier 1 (2-S)

Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		K (pci)	ε50
			c' (ksf)	θ (deg.)		
Stiff Silt Loam to Silty Clay Loam	390.2	125	1.1	0	300	0.007
Medium Silt Loam to Silty Clay Loam	388.2	125	0.8	0	300	0.007
Medium to Soft Silty Clay Loam	385.7	120	0.5	0	100	0.01
Medium to Soft Silty Clay Loam	383.2	125	1.0	0	300	0.007
Soft Clay to Silty Clay	380.7	120	0.3	0	100	0.01
Medium to Stiff Silty Clay to Silty Clay Loam	378.2	125	1.0	0	300	0.007
Soft Clay to Silty Clay	375.7	120	0.3	0	100	0.01
Medium Silty Clay	370.7	125	0.8	0	300	0.007
Stiff Clay	365.7	125	1.5	0	300	0.007
Medium to Stiff Clay	355.7	125	0.8	0	300	0.007
Medium Clay	352.7	125	0.6	0	300	0.007
Sandstone	-	150	0	45	-	0.001

Table 3.7 –Soil Parameters for Lateral Load Analysis at SN 100-0109 Pier 2 (1-S)

Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		K (pci)	ε50
			c' (ksf)	θ (deg.)		
Stiff Silty Loam to Silty Clay Loam	388.3	125	1.2	0	300	0.007
Soft to Med. Stiff Silty Clay Loam	385.8	120	0.5	0	100	0.01
Stiff Silty Clay Loam	383.3	125	1.2	0	300	0.007
Soft Clay	378.3	120	0.3	0	100	0.01
Stiff Clay	365.3	125	1.6	0	300	0.007
Medium to Soft Clay	350.8	120	0.5	0	100	0.01
Stiff Clay to Sandy Clay	348.8	125	1.6	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 100-0108 Abut. Load

Location	Total Factored Reaction (k)
W. Abut.	1,700
E. Abut.	1,700

Table 4.2 – SN 100-0109 Abut. Load

Location	Total Factored Reaction (k)
W. Abut.	1,300
E. Abut.	1,300

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. Pile tip elevations are shown at the maximum nominal required bearing of the pile. Piles shall be evaluated for lateral resistance in final design.

Table 4.3 – H-Pile Capacity at SN 100-0108 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	66	343.7
HP 12x53	418	230	66	343.7
HP 14x73	578	317	67	342.7

Table 4.4 – H-Pile Capacity at SN 100-0108 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	56	353.7
HP 12x53	418	230	56	353.7
HP 14x73	578	317	57	352.7

Table 4.5 – H-Pile Capacity at SN 100-0109 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	60	348.1
HP 12x53	418	230	60	348.1
HP 14x73	578	317	61	349.1

Table 4.6 – H-Pile Capacity at SN 100-0109 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	63	348.1
HP 12x53	418	230	63	348.1
HP 14x73	578	317	63	348.1

The capacities provided above for SN 100-0108 neglect the resistance from the top 10 ft below the cap. Due to no blow counts provided by the boring logs for the crushed aggregate and rockfill layers, precoring holes extending 10 ft below the caps and backfilling with bentonite is recommended at SN 100-0108.

One test pile is recommended at each abutment location. Due to the presence of the rockfill 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 100-0108 Pier Load

Location	Total Factored Reaction (k)
Pier 1	3,200
Pier 2	3,200

Table 4.8 – SN 100-0109 Pier Load

Location	Total Factored Reaction (k)
Pier 1	2,600
Pier 2	2,600

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. 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 100-0108 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	65	344.0
HP 12x74	589	312	68	341.0
HP 14x73	578	310	66	343.0

Table 4.10 – H-Pile Capacity at SN 100-0108 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	226	55	354.0
HP 12x74	589	320	56	353.0
HP 14x73	578	312	56	353.0

Table 4.11 – H-Pile Capacity at SN 100-0109 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	221	60	349.0
HP 12x74	589	314	61	348.0
HP 14x73	578	306	61	348.0

Table 4.12 – H-Pile Capacity at SN 100-0109 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	220	62	347.0
HP 12x74	589	313	63	346.0
HP 14x73	578	305	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 100-0109. The use of a temporary soil retention system is advised at SN 100-0108 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 100-0067, 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.

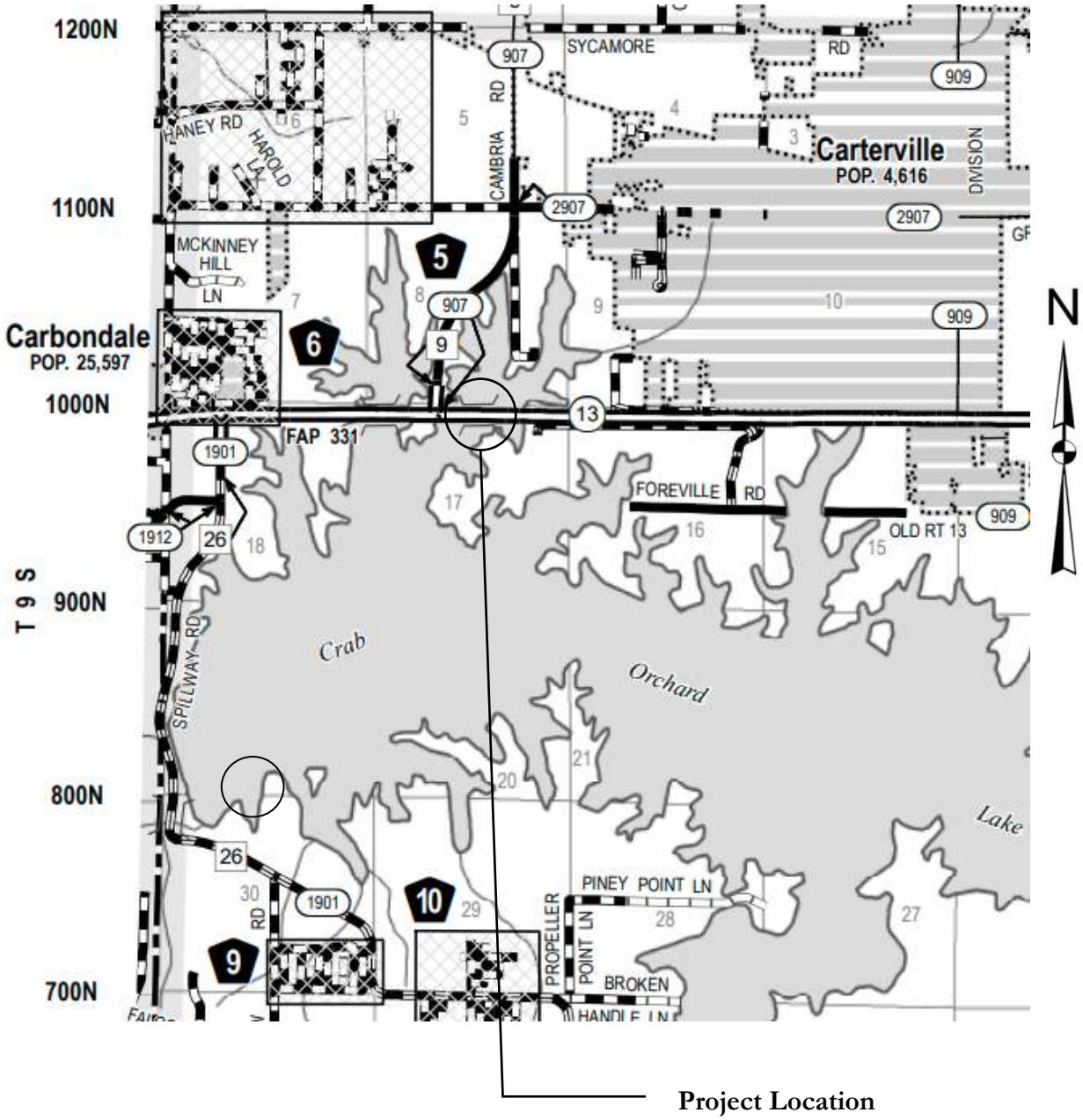
At foundation and structural fill locations, the exposed subgrade shall be proofrolled to aid in locating any unstable and unsuitable materials. Unstable and unsuitable materials shall be removed and replaced with compacted structural fill.

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. 100-0020 (EB)/100-0067 (WB)
Proposed Structure No. 100-0108 (EB)/100-0109 (WB)

Appendix B

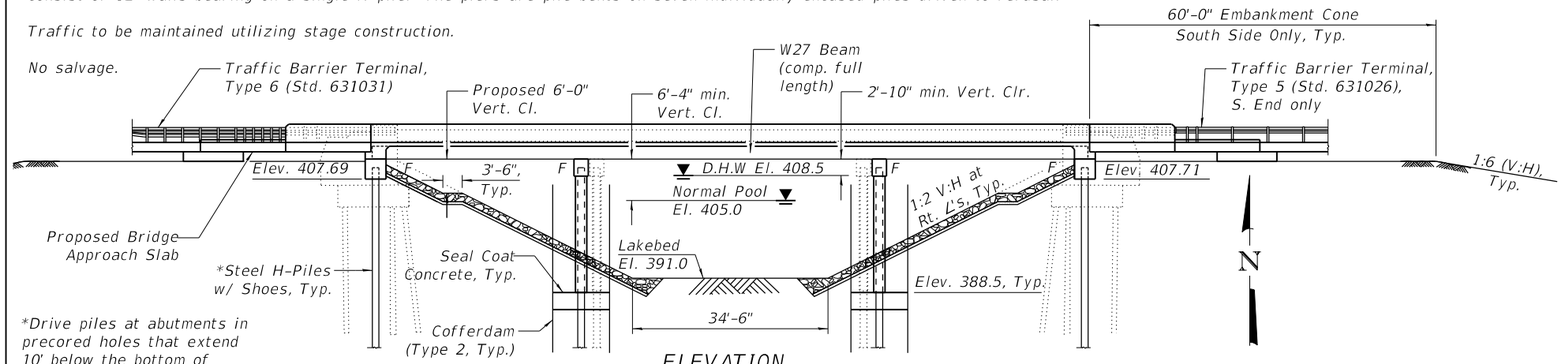
Type, Size, and Location Plan (TS&L)

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

Existing Structure: S.N. 100-0020 was originally constructed in 1964 under F.A. Rte. 14, Section 5-3B-4. The structure is a three span (35'-9", 46'-11", 35'-9") continuous wide flange bridge with seven beam lines on pile bent abutments. The structure is 123'-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.

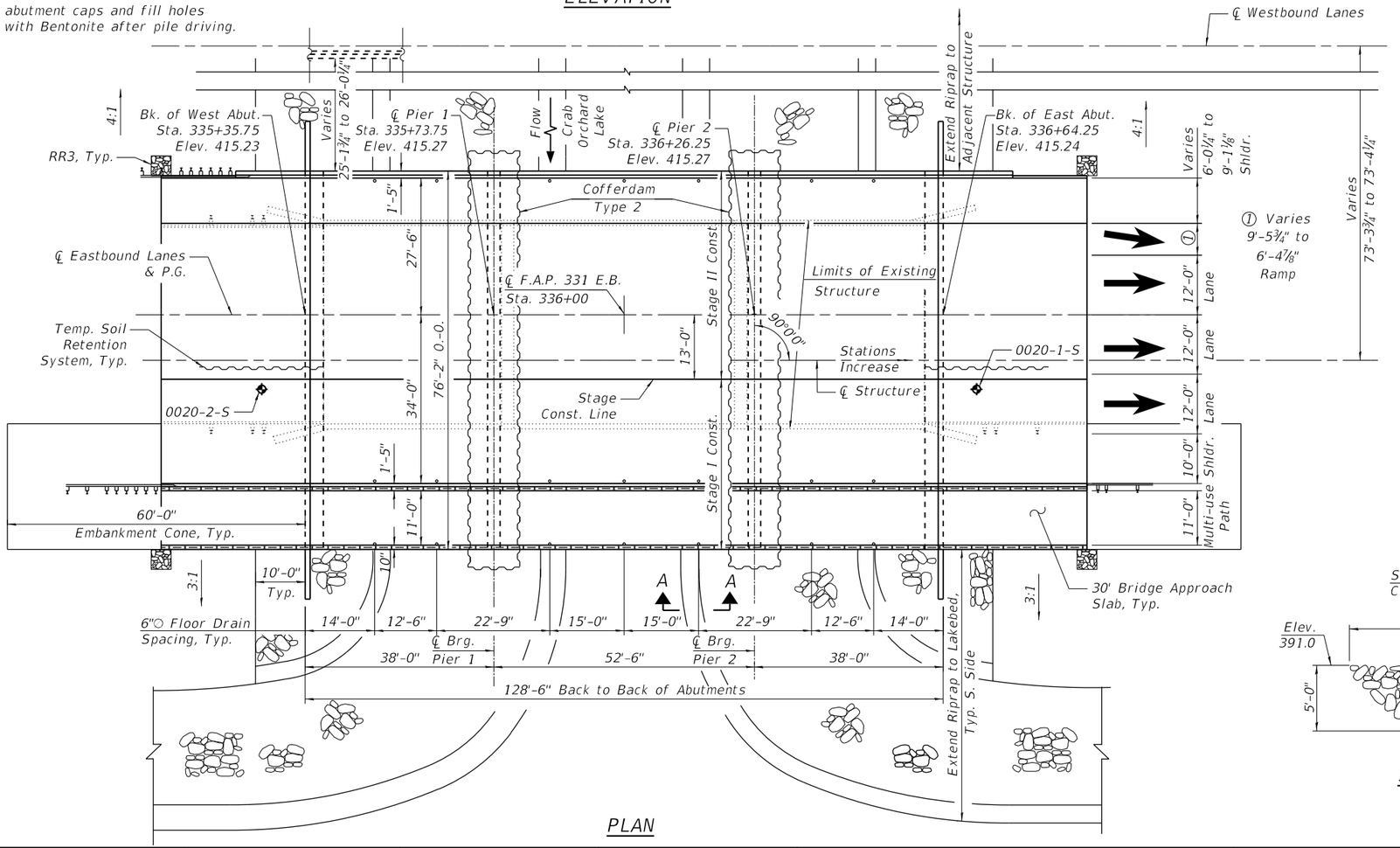
Traffic to be maintained utilizing stage construction.

No salvage.

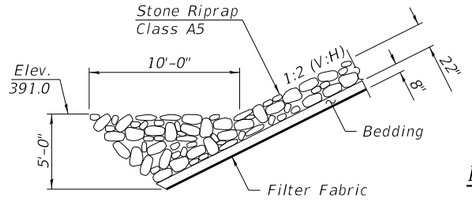


*Drive piles at abutments in precored holes that extend 10' below the bottom of abutment caps and fill holes with Bentonite after pile driving.

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); 760 (2037)
DHV: 2,355
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.

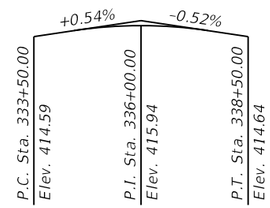
DESIGN STRESSES

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.

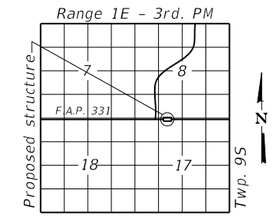
SEISMIC DATA

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-3)
WILLIAMSON COUNTY
STATION 336+00.00
STRUCTURE NO. 100-0108

CIVIL DESIGN, INC.
WBE | DBE
EFFINGHAM, IL
LICENSE #184.003322

USER NAME =	DESIGNED - K. STREICHER	REVISED -	
	CHECKED - R TIWARI	REVISED -	
PLOT SCALE =	DRAWN - K. STREICHER	REVISED -	
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	

MODEL: Default
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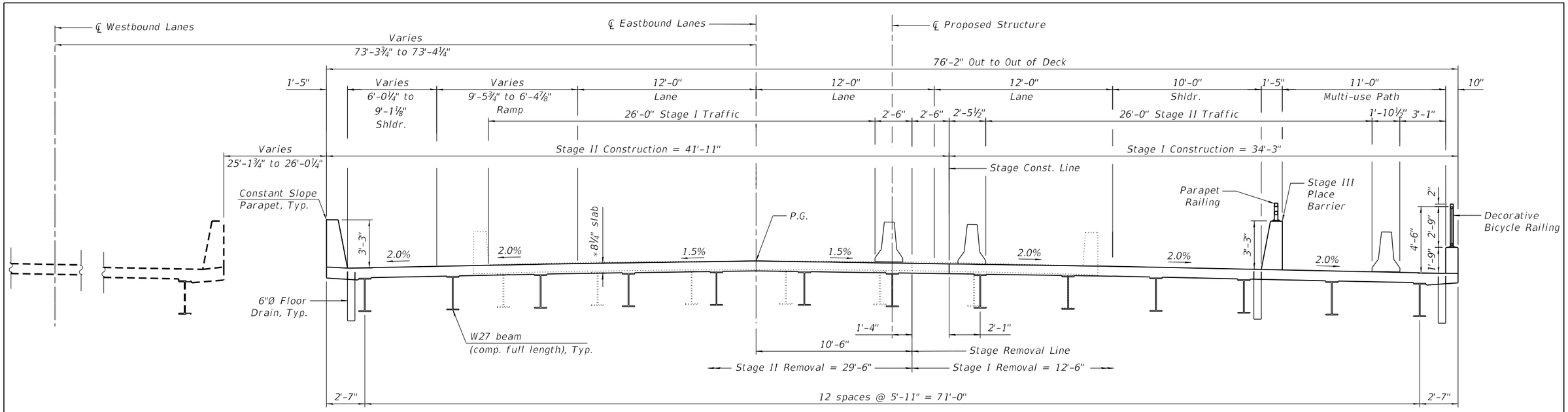
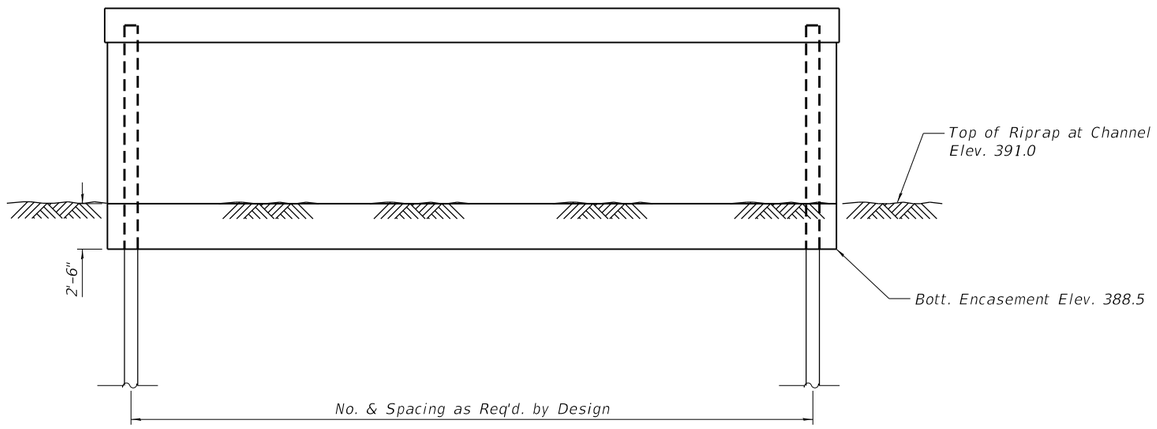


CROSS SECTION

(Looking East)
* Prior to grinding



PIER SKETCH

*Drive piles at abutments (S.N. 100-0108 only) in precored holes that extend 10' below the bottom of abutment caps and fill holes with Bentonite after pile driving.

SECTION THRU INTEGRAL ABUTMENT

(Horiz. dim. @ Rt. ℄'s)

WATERWAY INFORMATION

Drainage Area = 3.2 Sq. mi. Low Grade Elev. 414.6 @ Sta. 333+50

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	731	968	1,075	407.5	0.0	0.0	407.5	407.5
Design	50	1,164	1,065	1,182	408.5	0.0	0.0	408.5	408.5
Base	100	1,356	1,106	1,227	408.9	0.0	0.0	408.9	408.9
Scour Check	200	1,541	1,147	1,271	409.3	0.0	0.0	409.3	409.3
Max. Calc.	500	1,853	1,221	1,351	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	407.7	386.4	386.4	407.7	5
Q200	407.7	386.3	386.3	407.7	
Design	407.7	386.4	386.4	407.7	
Check	407.7	386.3	386.3	407.7	

DETAILS
IL 13 E.B. OVER CRAB ORCHARD LAKE
F.A.P. RT. 331 - SEC. 1-4(B-3)
WILLIAMSON COUNTY
STATION 336+00.00
STRUCTURE NO. 100-0108

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PLOT DATE =	CHECKED - R TIWARI	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 2 OF 2 SHEETS

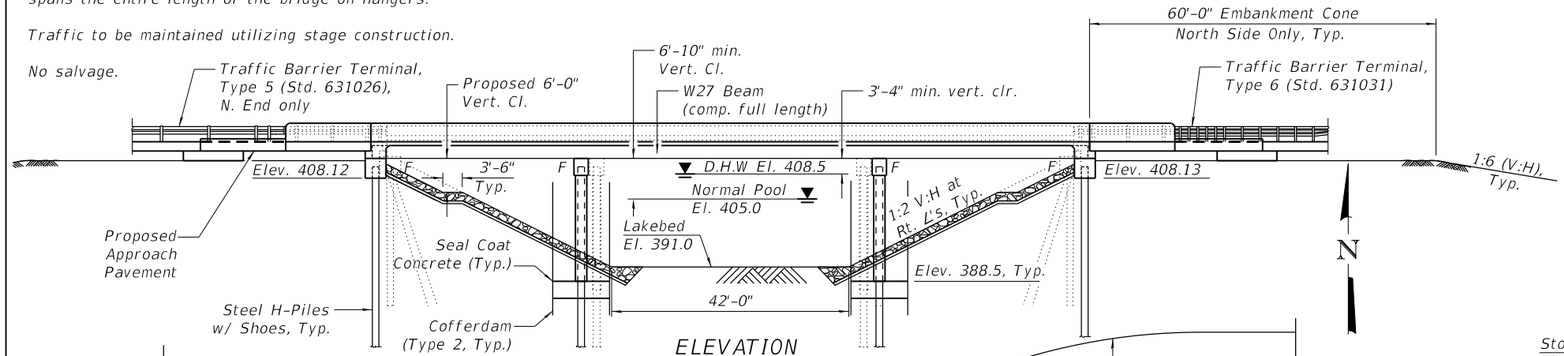
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
331	1-4 (B-1)	WILLIAMSON		
		CONTRACT NO. 78373		
	ILLINOIS FED. AID PROJECT			

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

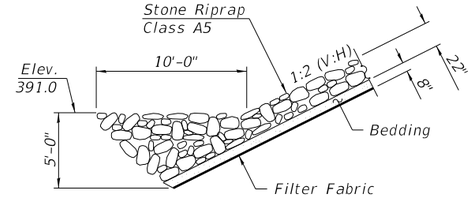
Existing Structure: S.N. 100-0067 was originally constructed in 1939 under F.A. Proj. 15, Section 5-B1 and 5-A1. An extensive reconstruction was built in 1989 under F.A. Route 410, Section (5B-1)DR-1. This reconstruction included an entirely new superstructure, abutments, and pier caps. The structure is a three span (36'-1", 47'-0", 36'-1") continuous wide flange bridge with seven beam lines on pile bent abutments. The structure is 123'-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 W24x55 for spans one and three, and W24x62 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.

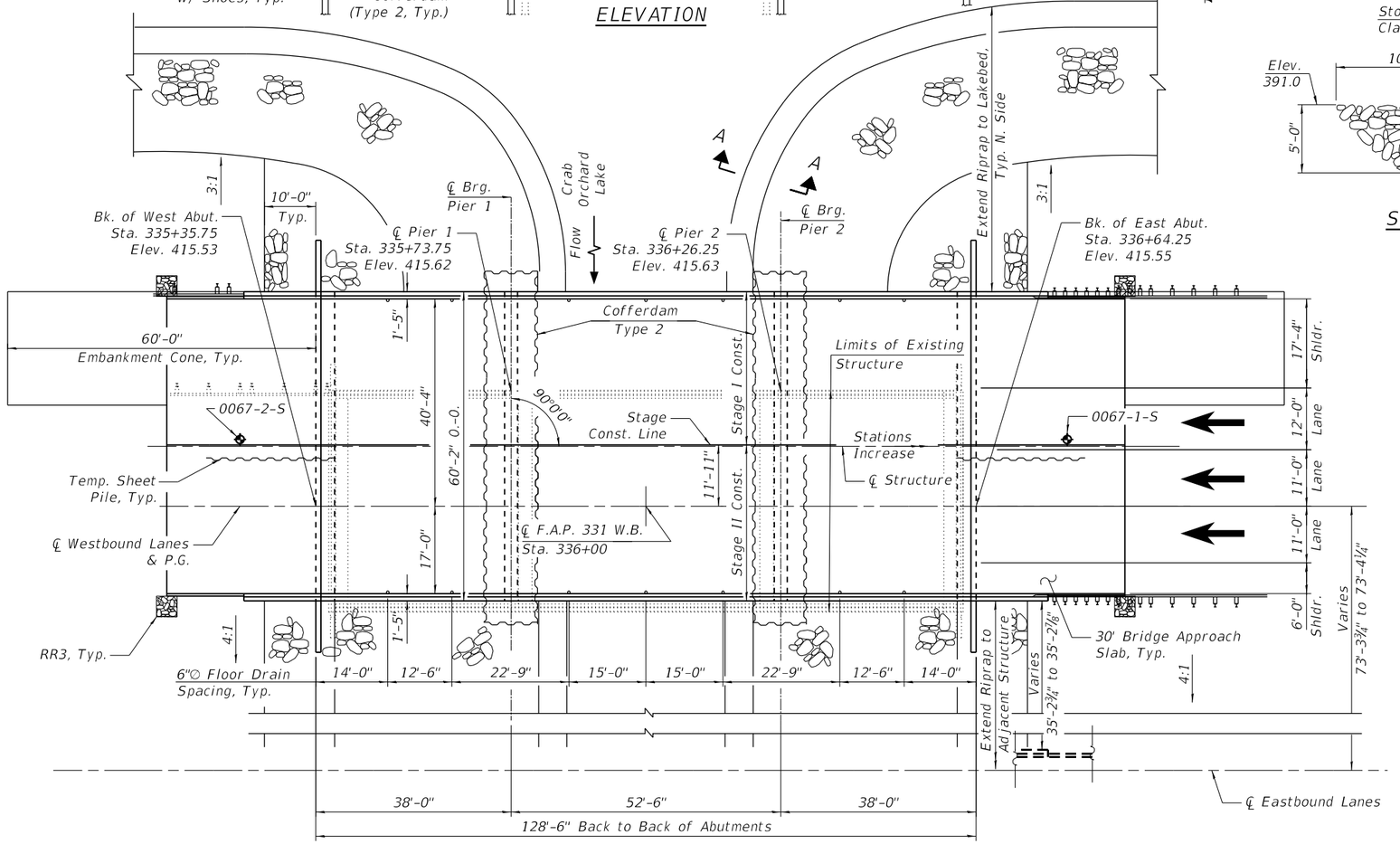
No salvage.



ELEVATION



SECTION A-A



PLAN

HIGHWAY CLASSIFICATION

F.A.P. Rte. 331 - IL Rte. 13 W.B.
Functional Class: Other Principal Arterial
ADT: 15,000 (2011); 22,090 (2037)
ADTT: 725 (2011); 1070 (2037)
DHV: 2,210
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.

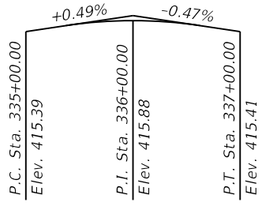
DESIGN STRESSES

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

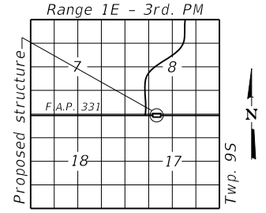
Seismic Performance Zone (SPZ) = 3
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.359 g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.864 g
Soil Site Class = D



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-4)
WILLIAMSON COUNTY
STATION 336+00.00
STRUCTURE NO. 100-0109

CIVIL DESIGN, INC. WBE | DBE
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LICENSE #184.003322

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		CHECKED -	R TIWARI	REVISED -
PLOT SCALE =		DRAWN -	K. STREICHER	REVISED -
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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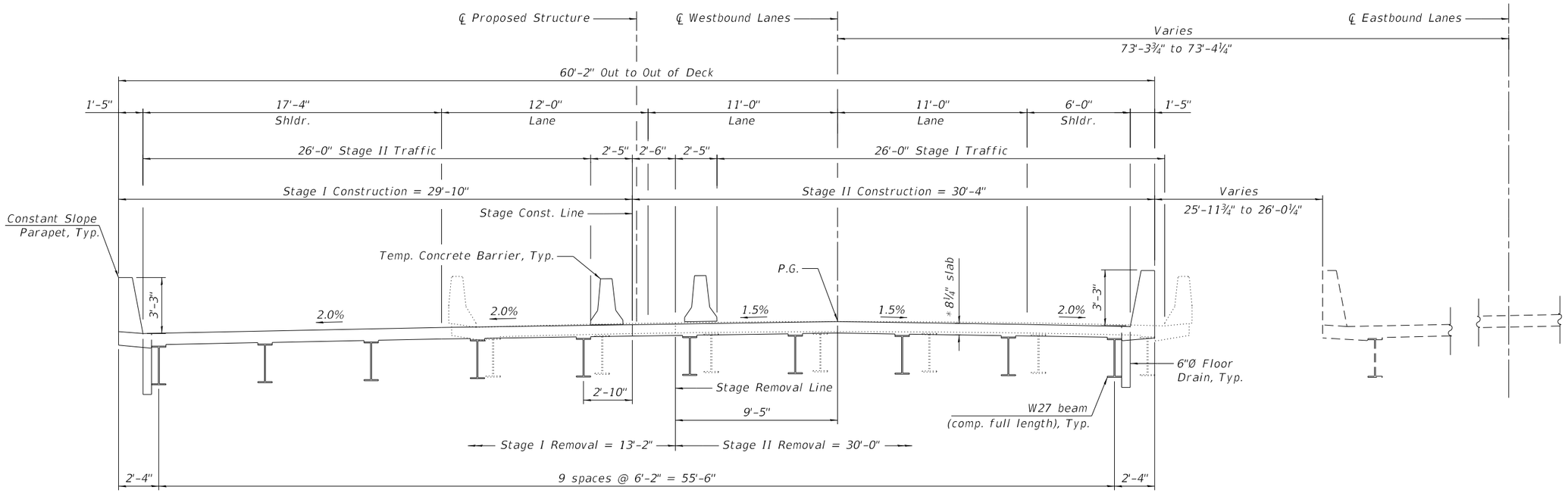
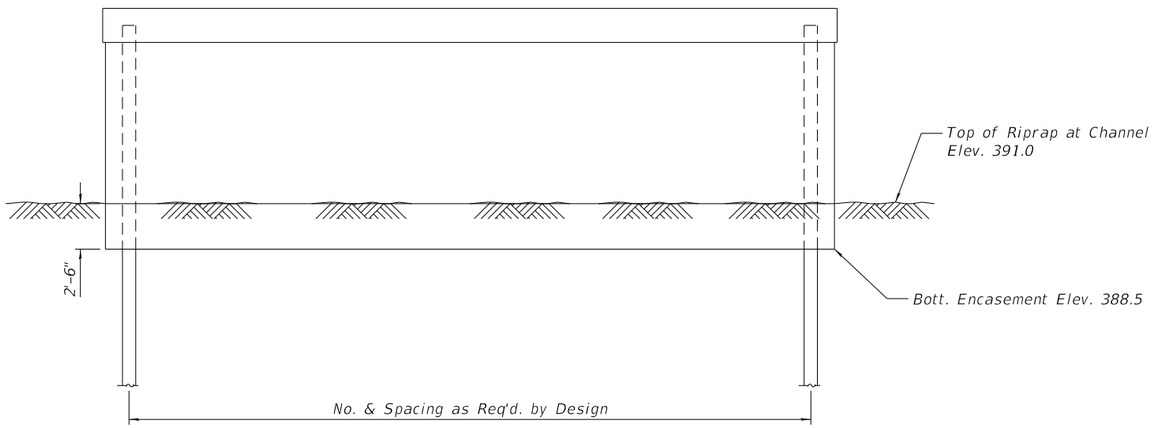
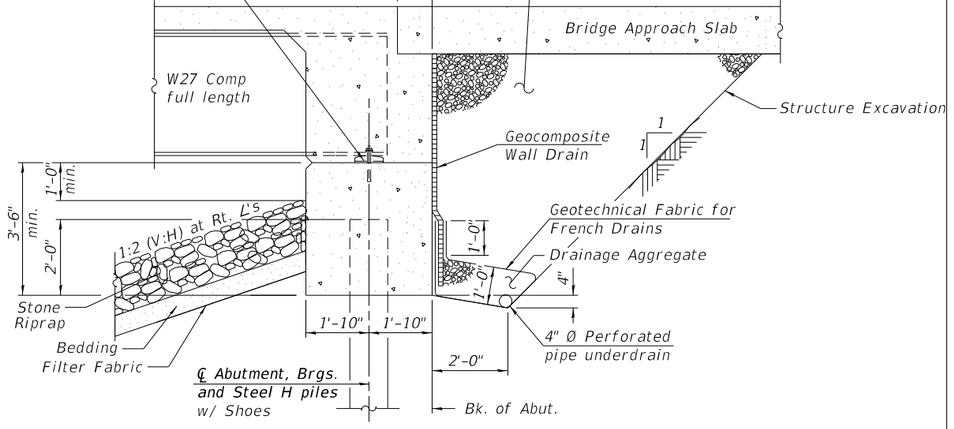


CROSS SECTION

(Looking East)
* Prior to grinding



PIER SKETCH



SECTION THRU INTEGRAL ABUTMENT

(Horiz. dim. @ Rt. ∠'s)

WATERWAY INFORMATION

Drainage Area = 3.2 Sq. mi. Low Grade Elev. 414.6 @ Sta. 333+50

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	731	968	1,075	407.5	0.0	0.0	407.5	407.5
Design	50	1,164	1,065	1,182	408.5	0.0	0.0	408.5	408.5
Base	100	1,356	1,106	1,227	408.9	0.0	0.0	408.9	408.9
Scour Check	200	1,541	1,147	1,271	409.3	0.0	0.0	409.3	409.3
Max. Calc.	500	1,853	1,221	1,351	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	408.1	386.4	386.4	408.1	
Q200	408.1	386.3	386.3	408.1	5
Design	408.1	386.4	386.4	408.1	
Check	408.1	386.3	386.3	408.1	

DETAILS
IL 13 W.B. OVER CRAB ORCHARD LAKE
F.A.P. RT. 331 - SEC. 1-4(B-4)
WILLIAMSON COUNTY
STATION 336+00.00
STRUCTURE NO. 100-0109

MODEL: Default
FILE NAME: P:\SXXX\50XXX-51YXX\5000 - IDOT PTB 200-038 D9 IL 13 Crab Orchard Bridges\24-Structures\CAD-MS\TSL1100-0109 - R1.dgn

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LICENSE #184.003222

USER NAME =	DESIGNED - K. STREICHER	REVISED -	
	CHECKED - R TIWARI	REVISED -	
PLOT SCALE =	DRAWN - K. STREICHER	REVISED -	
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 335+27
OFFSET 15 FT RT CL EBL
EL 414.9 FT
8/5/2014

PR ℄ PROFILE

	D	N	Qu	W%
Asphalt over crushed aggregate				
407.4				
Rock Fill				
389.9				
Medium, very moist, grey, Silty Clay to Silty Clay Loam A-6		1	0.6 B	26
387.9				
Soft, very moist, grey, Silty Clay to Silty Clay Loam A-6		2	0.4 B	28
386.4				
Stiff, moist to very moist, brown mottled grey, Clay to Silty Clay A7-6		8	1.1 B	26
382.9				
Soft, very moist, grey and brown, Silty Clay A-6		WH	0.3 B	30
380.4				
Medium to stiff, moist to very moist, grey mottled brown, Silty Clay to Clay A7-6		2	1.0 B	26
377.9				
Soft, very moist, grey mottled brown, Silty Clay to Clay A7-6		WH	0.4 B	27
375.4				
Stiff, moist, grey mottled brown, Clay A7-6		6	1.9 B	26
365.4				
Soft, very moist, grey, Clay A7-6		1	1.3 B	28
360.4				
Medium, very moist, grey, Clay A7-6		WH	0.4 B	31
355.4				
Soft to medium, very moist, grey, Clay A7-6		WH	0.7 B	33
350.4				
Stiff, moist, grey and black, Clay to weathered Clay Shale with Coal and some gravel		WH	0.5 B	25
347.9				
Hard, dry, grey, Clay Shale		16	1.5 E	21
345.3				
Very dense, dry, grey, Sandstone with Clay seams		100/8"		
340.3		100/1"		
Very dense, dry, grey, Sandstone				
335.3				
End of Boring				

Boring 1-S
STA 336+71
OFFSET 15 FT RT CL EBL
EL 414.9 FT
8/6/2014

EL	D	N	Qu	W%
Asphalt over crushed aggregate				
406.9				
Rock fill (crusher run or rip-rap)				
390.4				
Soft to medium, very moist, grey, Silty Clay to Silty Clay Loam A-6		WH	0.5 B	28
385.9				
Stiff, moist, brown mottled grey, Silty Clay to Clay A7-6		WH	0.3 B	28
383.4				
Medium, very moist, brown, Clay Loam to Silty Clay Loam A-4		5	1.9 B	23
380.9				
Stiff, moist, brown mottled grey, Clay A7-6		5	0.8 S	21
378.4				
Stiff, moist, grey mottled brown, Clay A7-6		6	1.9 B	26
		6	1.9 S	41
		5	1.9 B	39
		3	1.2 B	48
		3	1.1 B	25
360.4				
Stiff, moist, grey mottled brown, Clay A7-6		8	1.2 B	23
355.9				
V. Dense, dry, grey, Sandstone		100/½"		
354.4				
End of Boring				

LEGEND

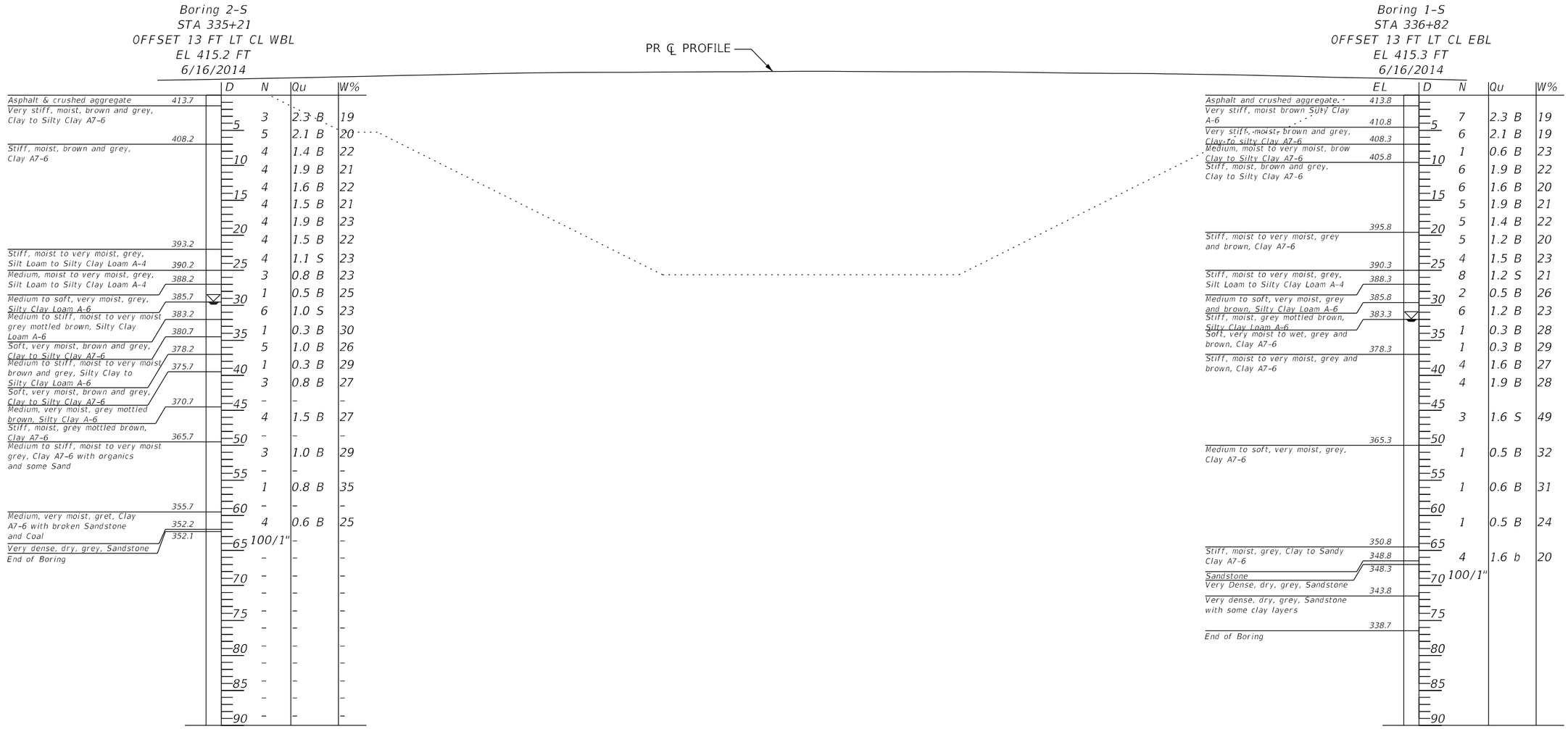
EL = Elevation (FT)
D = Depth Below Existing Ground Surface (FT)
N = SPT N-VALUE (AASHTO T206)
Qu = Unconfined Compressive Strength in tons per sq. ft. (tsf)
Failure Mode (B=bulge, S=shear, P=penetrometer)
W% = Moisture Content Percentage

▽ = 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 100-0108

FILE NAME =	USER NAME = $USER$	DESIGNED - TAW	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION		F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS / SHEET NO.
$FILE$		DRAWN - TAW	REVISED -			57		WILLIAMSON	1 / 1
$MODELNAME$	PLOT SCALE = $SCALE$	CHECKED - TJZ	REVISED -						
	PLOT DATE = $DATE$	DATE - 10/25/22	REVISED -		SHEET 1 OF 1 SHEETS			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 100-0109

FILE NAME = $FILEL$	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
$MODELNAME$	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 8/6/14

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

SECTION 5-3B-4 **LOCATION** 1.6 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 lbs

STRUCT. NO. 100-0020
Station 336+00

BORING NO. 1-S
Station 336+71
Offset 15.0ft Rt of EB CL
Ground Surface Elev. 414.9 ft

Surface Water Elev. 405.2 ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 403.8 ft
Upon Completion ft
After Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
HMA Pavement over Crushed Aggregate			
-5			
406.90			
ROCK FILL (Crusher Run or Rip-Rap)			
-10			
▽			
-15			
-20			
ROCK FILL (Crusher Run or Rip-Rap) *(continued)*			
390.40			
-25	WOH		
Soft to M. Stiff Grey, V. Moist SILTY CLAY to SILTY CLAY LOAM	WOH	0.5	28
	WOH	B	
93% Fines <#200, LL 36, PI 18 (Estimated based on visual ID and historical database)	WOH		
	WOH	0.3	28
	WOH	B	
385.90			
Stiff Brown and mottled Grey, Moist SILTY CLAY to CLAY			
-30	1		
	2	1.9	23
	3	B	
383.40			
M. Stiff Brown, V. Moist CLAY LOAM to SILTY CLAY LOAM	1		
	2	0.8	21
	3	S	
380.90			
Stiff Brown and mottled Grey, Moist CLAY	1		
-35	2	1.9	26
	4	B	
378.40			
Stiff Grey and mottled Brown, Moist CLAY	1		
	2	1.9	41
	4	S	
-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 8/6/14

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

SECTION 5-3B-4 **LOCATION** 1.6 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 lbs

STRUCT. NO. 100-0020
Station 336+00

BORING NO. 1-S
Station 336+71
Offset 15.0ft Rt of EB CL
Ground Surface Elev. 414.9 ft

Surface Water Elev. 405.2 ft
Stream Bed Elev. ft

Groundwater Elev.:
▽ **First Encounter** 403.8 ft
▽ **Upon Completion** ft
▼ **After** Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Stiff Grey and mottled Brown, Moist CLAY *(continued)*	2 3	1.9 B	39				
-45	1			-65			
	1 2	1.2 B	48	Bottom of hole at 59.1 feet Ground Surface Elevation referenced to BM at NW corner SN 100-0020; Elev. 416.70 Hammer Efficiency: 75% To convert "N" values to "N60", multiply by 1.25 Note: Augers kicked out of plumb preventing use of the core barrel. Sandstone too hard to auger without overtightening drill rods, therefore unable to confirm solid formation of sandstone. Drilled by: R. Moberly			
-50	1			-70			
	1 2	1.1 B	25				
360.40							
Stiff Grey and mottled Brown, Moist CLAY with broken SANDSTONE GRAVEL							
-55	1			-75			
	3 5	1.2 B	23				
355.90							
V. Dense Grey, Dry SANDSTONE	100/0.5"						
-60				-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 8/5/14

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

SECTION 5-3B-4 **LOCATION** 1.6 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 lbs

STRUCT. NO. 100-0020
Station 336+00

BORING NO. 2-S
Station 335+27
Offset 15.0ft Rt of EB CL
Ground Surface Elev. 414.9 ft

Surface Water Elev. 405.2 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 (%)
HMA Pavement over Crushed Aggregate			
-5			
407.40			
ROCK FILL (Crusher Run or Rip-Rap)			
-10			
▽			
-15			
-20			
ROCK FILL (Crusher Run or Rip-Rap) *(continued)*			
390.40			
-25	WOH		
M. Stiff Grey, V. Moist SILTY CLAY to SILTY CLAY LOAM	WOH	0.6	26
	1	B	
93% Fines <#200, LL 36, PI 18 (Estimated based on visual ID and historical database)			
387.90			
Soft Grey, V. Moist SILTY CLAY to SILTY CLAY LOAM	WOH		
	WOH	0.4	28
	2	B	
386.40			
93% Fines <#200, LL 36, PI 18 (Estimated based on visual ID and historical database)			
-30	3		
Stiff Brown and mottled Grey, Moist to V. Moist CLAY to SILTY CLAY	4	1.1	26
	4	B	
382.90			
Soft Grey and Brown, V. Moist SILTY CLAY	WOH		
	WOH	0.3	30
	WOH	B	
96% Fines <#200, LL 44, PI 23 (Estimated based on visual ID and historical database)			
380.40			
-35	WOH		
M. Stiff Grey and mottled Brown, Moist to V. Moist SILTY CLAY to SILTY CLAY LOAM	1	1.0	26
	1	B	
377.90			
Soft Grey and mottled Brown, V. Moist SILTY CLAY to CLAY	WOH		
	WOH	0.4	27
	WOH	B	
93% Fines <#200, LL 48, PI 26 (Estimated based on visual ID and historical database)			
375.40			
-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 8/5/14

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

SECTION 5-3B-4 **LOCATION** 1.6 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 lbs

STRUCT. NO. 100-0020
Station 336+00

BORING NO. 2-S
Station 335+27
Offset 15.0ft Rt of EB CL
Ground Surface Elev. 414.9 ft

Surface Water Elev. 405.2 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 (%)	Description
	2 4	1.9 B	26	Stiff Grey and mottled Brown, Moist CLAY *(continued)*
-45	WOH			
	WOH 1	1.3 B	28	
365.40				
-50	WOH			Soft Grey, V. Moist CLAY
	WOH WOH	0.4 B	31	
360.40				
-55	WOH			M. Sfiff Grey, V. Moist CLAY
	WOH WOH	0.7 B	33	
355.40				
-60	WOH			
	WOH WOH	0.5 B	25	Soft to M. Stiff Grey, V. Moist CLAY *(continued)*
350.40				
-65	2			Stiff Grey and Black, Moist CLAY to Weathered CLAY SHALE with COAL and some GRAVEL
	6 10	1.5 E	21	
347.90				
	100/8"			Hard Grey, Dry CLAY SHALE
345.30				
-70	100/1"			Hard Grey, Dry CLAY SHALE
				Borehole continued with rock coring.
				Bottom of hole at 79.6 feet
				Ground Surface Elevation referenced to BM at NW corner SN 100-0020; Elev. 416.70
-75				Hammer Efficiency: 75% To convert "N" values to "N60", multiply by 1.25
				Drilled by: R. Moberly
-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

ROCK CORE LOG

Date 8/5/14

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

SECTION 5-3B-4 **LOCATION** 1.6 mi E. of Jackson Co. (near W. Abut.), **SEC.** 17, **TWP.** 9S, **RNG.** 1E, **PM**

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

STRUCT. NO. 100-0020
Station 336+00

BORING NO. 2-S
Station 335+27
Offset 15.0ft Rt of EB CL
Ground Surface Elev. 414.9 **ft**

CORING BARREL TYPE & SIZE NV3 5FT NWJ
Core Diameter 1.78 **in**
Top of Rock Elev. 347.90 **ft**
Begin Core Elev. 345.30 **ft**

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
V. Dense Grey, Dry SANDSTONE with CLAY seams	345.30	-70	1	89	17		
	340.30						
V. Dense Grey, Dry SANDSTONE		-75	2	100	72		382 269.2 291
	335.30						316.2
		-80					
Bottom of hole @ 79.6 ft		-85					
Ground Surface Elevation referenced to BM at NW corner SN 100-0020; Elev. 416.70							
Drilled by: R. Moberly							

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

Illinois Department of Transportation
District Nine Materials
Unconfined Compressive Strength

FAP 331 (IL 13)
Structure 100-0020 (Boring 2-S)
Williamson County

Boring #	Specimen#	Depth	Unconfined Compression
2-S	1	76'5"	5,306 psi
2-S	2	77'3"	3,739 psi
2-S	3	77'9"	4,041 psi
2-S	4	78'10"	4,391 psi

1963 Borings for SN 100-0020

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

ROUTE NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A. 14	5-3B-4	WILLIAMSON	18	13
FED. ROAD DIST. NO. 7	ILLINOIS	FED. AID PROJECT		

SHEET NO. 8
8 SHEETS

COUNTY Williamson
Boring No. 1
Station 335+38
Offset 7 ft. Rt.
Surface Water El. 405.0
Groundwater El. at Completion —
After — Hours —

Elevation	Depth	Description	N	Qu t/s.f.	w (%)
Ground Surface 391.2	0	Stiff moist gray Silt Loam A-4(8)			
387.7			3	2.0P	23
	-5	Stiff moist gray mottled brown to brown silty clay loam A-4(8) to A-6(9)	12	3.0P	23
			9	1.8B	34
382.2	-10	Medium moist brown mottled gray and black silty clay A-6(10-11)	4	0.5B	26
			4	0.5B	27
377.2	-15	Stiff moist gray mottled brown and black clay A7-6(15)	7	2.0B	27
374.7		Medium to stiff moist to very moist gray to gray mottled brown clay A-6(12)	8	0.4B	34
	-20		7	1.4B	25
		See previous column	9	1.3B	31
366.2	-25		—	—	—
		Medium moist gray clay A7-6(15-18)	8	1.0B	39
364.7		Medium moist gray clay A-6(11-12)	6	0.4B	30
361.7	-30	Stiff wet gray clay A7-6(14-15)	6	0.5B	32
			8	1.0P	36
358.2		Medium wet gray clay loam A-4(6)		—	22
356.2	-35	Soft very moist gray clay A7-6(13-14)	6	[illegible]	30
354.7		Medium moist gray silty clay A-6(9-10)	7	0.6B	25
352.2	-40	Hard moist gray mottled brown clay loam A-4(8)	32	4.0P	20
348.7		Soft to medium dry gray clay shale.	—	—	—
			56	—	—
346.0	-45				

COUNTY Williamson
Boring No. 1
Station 335+38
Offset 7 ft. Rt.

Elevation	Depth	Description	N	Qu t/s.f.	w (%)
	40	See previous sheet	32	4.0P	20
348.7		Soft to medium dry gray clay shale	—	—	—
			56	—	—
				Cored 81% Recovery	
346.0	45				
345.5		Medium gray medium grained sandstone with thin shale seams			
		Bottom of hole = 45.7 feet			
	-50	Washing procedure was used in drilling entire hole.			
		Location: N.W Cor. NE¼, NW¼, Sec 17 T9S, R1E, 3rd P.M.			

COUNTY Williamson
Boring No. 2
Station 335+77
Offset 1 ft. Rt.
Surface Water El. 405.0
Groundwater El. at Completion —
After — Hours —

Elevation	Depth	Description	N	Qu t/s.f.	w (%)
Ground Surface 390.0	0	Stiff wet to moist gray mottled brown silty clay loam A-6(9)			
385.7			10	2.0P	24
	-5	Medium moist gray mottled brown silty clay A-6(11)			
383.2			6	0.6B	23
		Medium moist gray mottled brown silty clay loam A-6(9)	9	0.6B	23
379.7	-10	Stiff to very stiff moist gray mottled brown and black clay A7-6(17)+			
			8	1.3B	24
	-15		12	1.9B	27
			10	1.2S	36
			9	0.8S	40
	-20		7	1.2B	43
		See previous column			
365.7	-25		8	No Recovery	
		Soft to medium moist to very moist gray mottled brown to gray clay A-6(12) to A7-6(13)	5	0.6B	36
	-30		5	0.6B	28
			7	0.3B	33
356.7	-35	Medium very moist gray clay A7-6(14-15)	8	0.5P	28
353.7		Medium very moist gray clay loam A-4(7)	5	0.7P	17
351.7	-40	Soft very moist gray silty clay A-6(10-11)	6	0.3B	32
349.7		Hard very moist gray poorly graded coarse gravel with clay binder.	100	Blows 5"*	22
348.2		Bottom of hole = 41.8 feet			
		Washing procedure used in drilling entire hole.			
	-45	*Refusal of chopping bit at 41.8 feet			

COUNTY Williamson
Boring No. 3
Station 336+21
Offset 9 ft. Lt.
Surface Water El. 405.0
Groundwater El. at Completion —
After — Hours —

Elevation	Depth	Description	N	Qu t/s.f.	w (%)
Ground Surface 393.0	0	Soft wet brown to gray silty clay A-6(9-10)			
387.7	-5		3	No Recovery	
		Stiff moist gray mottled brown silty clay loam A-6(8-9)			
385.2			5	2.0P	—
	-10	Medium to stiff moist gray mottled brown silty clay A-6(9-10)	11	0.8B	22
380.2			7	1.1B	23
	-15	Very stiff gray mottled brown and black clay A7-6(17+)	9	2.0B	22
			12	2.0B	22
	-20		12	1.0S	41
370.2		see previous column	8	1.4B	36
	-25	Stiff moist brown to gray to dark gray clay A7-6(15)	9	1.2B	41
			8	1.0B	37
	-30		7	No Recovery	
360.2			8	1.0B	34
	-35	Medium gray mottled brown clay A7-6(12-13)	5	0.7B	35
355.2		Medium moist gray clay A7-6(15)	11	0.9B	36
352.7	-40	Medium moist gray silty clay A-6(12)	7	0.8B	25
			15	1.0B	23
348.7	-45	see next sheet			

COUNTY Williamson
Boring No. 3
Station 336+21
Offset 9 ft. Lt.

Elevation	Depth	Description	N	Qu t/s.f.	w (%)
	40				
352.7		see previous sheet	7	0.8B	25
		Medium moist gray silty clay A-6(12)	15	1.0B	23
348.7	45	Soft gray clay shale	100 Blows	in 8"	
347.7		Medium gray fine grained sandstone	100	Blows in 2"	
347.5		Bottom of hole = 45.5 feet			
	-50	Washing procedure was used in drilling entire hole.			

COUNTY Williamson
Boring No. 4
Station 336+62
Offset 7 ft. Rt.
Surface Water El. 405.0
Groundwater El. at Completion —
After — Hours —

Elevation	Depth	Description	N	Qu t/s.f.	w (%)
Ground Surface 390.9	0	Medium wet gr. Silt Loam A-4(8)			
			2	1.0P	31
386.9	-5	Stiff to medium moist gr. mot. br. Silty Clay Loam, A-4(8)	9	1.1B	21
			8	0.8B	24
381.9	-10	Medium moist gr. mot. br. Silty Clay A-6(9-10)	7	0.4B	28
380.4		Very stiff moist gr. mot. br. and bk. clay, A-7-6(17+)	13	1.8B	34
	-15		9	1.8B	38
372.9			8	1.5S	43
	-20	Stiff moist gr. mot. br. and bk. to dark gr. clay, A-7-6(15+)	8	1.1S	38
		see previous column	9	1.4B	47
	-25		10	1.1B	34
362.9		Medium moist gr. clay, A-6(12-13)	7	0.8B	28
	-30		4	0.5B	30
			5	0.8B	28
	-35		6	0.8B	27
			5	0.7B	29
351.2	-40	Soft gr. Sandy Shale	100 Blows in 8 inches		
350.0		Medium gr. fine grained sandstone with thin laminations of black sandy shale		Cored 89% Recovery	
	-45				

COUNTY Williamson
Boring No. 4
Station 336+62
Offset 7 ft. Rt.

Elevation	Depth	Description	N	Qu t/s.f.	w (%)
	40	see previous sheet			
350.0		Medium gr. fine grained sandstone with thin laminations of black sandy shale		Cored 89% Recovery	
345.5	45	Bottom of hole = 45.4 feet			
		Washing procedure used in drilling the entire hole.			

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

DESIGNED	Emery J. Stikan
CHECKED	T. C. [illegible]
DRAWN	E.S.
CHECKED	[illegible]

FEB 18 1964
EXAMINED W. E. Baumann — ENGINEER OF BRIDGE AND TRAFFIC STRUCTURES
PASSED [illegible] — ENGINEER OF DESIGN
APPROVED [illegible] — CHIEF HIGHWAY ENGINEER

BORINGS
F.A. Rt. 14 SEC. 5-3B-4
WILLIAMSON CO.
STA. 336+00

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 6/16/14

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

SECTION (5B-1)DR-1 **LOCATION** 1.6 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 lbs

STRUCT. NO. 100-0067
Station 336+00
BORING NO. 1-S
Station 336+82
Offset 13.0ft Lt of WB CL
Ground Surface Elev. 415.3 ft

Surface Water Elev. 405.2 ft
Stream Bed Elev. ft
Groundwater Elev.:
First Encounter 383.3 ft
Upon Completion ft
After Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	Description
				HMA Pavement over crushed Aggregate
				413.80
				V. Stiff Brown, Moist SILTY CLAY
	1			
	3 4	2.3 B	19	
				410.80
-5	1			V. Stiff Brown and Grey, Moist CLAY to SILTY CLAY
	2 4	2.1 B	19	
				408.30
	WOH			M. Stiff Brown, Moist to V. Moist CLAY to SILTY CLAY
	1 WOH	0.6 B	23	
				405.80
-10	1			Stiff Brown and Grey, Moist CLAY to SILTY CLAY
	2 4	1.9 B	22	
	1			
	3 3	1.6 B	20	
-15	1			
	2 3	1.9 B	21	
	1			
	2 3	1.4 B	22	
				395.80
-20	1			
	2 3	1.2 B	20	Stiff Brown and Grey, Moist to V. Moist CLAY to SILTY CLAY *(continued)*
	1			
	2 2	1.5 B	23	
				390.30
-25	1			
	4 4	1.2 S	21	Stiff Grey, Moist to V. Moist SILTY LOAM to SILTY CLAY LOAM
				90% Fines <#200, LL 32, PI 10 (Estimated based on visual ID and historical database) 388.30
	WOH			
	WOH 2	0.5 B	26	Soft to M. Stiff Grey and Brown, V. Moist SILTY CLAY LOAM
				91% Fines <#200, LL 37, PI 14 (Estimated based on visual ID and historical database) 385.80
-30	1			
	3 3	1.2 B	23	Stiff Grey and mottled Brown, Moist SILTY CLAY LOAM
				91% Fines <#200, LL 37, PI 14 (Estimated based on visual ID and historical database) ▽ 383.30
	WOH			
	1 WOH	0.3 B	28	Soft Grey and Brown, V. Moist to Wet CLAY
				92% Fines <#200, LL 50, PI 29 (Estimated based on visual ID and historical database)
-35	WOH			
	1 WOH	0.3 B	29	
				378.30
	1			Stiff Grey and Brown, Moist to V. Moist CLAY
	2 2	1.6 B	27	
-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 6/16/14

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

SECTION (5B-1)DR-1 **LOCATION** 1.6 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 lbs

STRUCT. NO. 100-0067
Station 336+00

BORING NO. 1-S
Station 336+82
Offset 13.0ft Lt of WB CL
Ground Surface Elev. 415.3 ft

Surface Water Elev. 405.2 ft
Stream Bed Elev. ft

Groundwater Elev.:
▽ **First Encounter** 383.3 ft
▽ **Upon Completion** ft
▼ **After** Hrs. ft

	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Stiff Grey and Brown, Moist to V. Moist CLAY *(continued)*		2 2	1.9 B	28
	-45	WOH		
		1 2	1.6 S	49
	-50	1		
365.30 Soft to M. Stiff Grey, V. Moist CLAY		WOH 1	0.5 B	32
	-55	WOH		
		1 WOH	0.6 B	31
	-60	WOH		
Soft to M. Stiff Grey, V. Moist CLAY *(continued)*		1 WOH	0.5 B	24
350.80 Stiff Grey, Moist CLAY to SANDY CLAY	-65	1		
		2 2	1.6 B	20
348.80 V. Dense Grey, Dry SANDSTONE		100/1"		
(Borehole continued with rock coring.)				
Bottom of hole @ 76.6 ft	-70			
Ground surface elevation referenced to benchmark at NW corner of SN 100-0020; Elev. 416.70				
Hammer efficiency: 75% To convert "N" values to "N60", multiply by 1.25	-75			
Drilled by: R. Moberly				
	-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

ROCK CORE LOG

Date 6/16/14

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

SECTION (5B-1)DR-1 **LOCATION** 1.6 mi. E. of Jackson Co. (near E. Abut.), **SEC.** 17, **TWP.** 9S, **RNG.** 1E, **PM**

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

STRUCT. NO. 100-0067
Station 336+00

BORING NO. 1-S
Station 336+82
Offset 13.0ft Lt of WB CL
Ground Surface Elev. 415.3 **ft**

CORING BARREL TYPE & SIZE NV3 5FT NWJ
Core Diameter 1.78 **in**
Top of Rock Elev. 348.80 **ft**
Begin Core Elev. 348.70 **ft**

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
V. Dense Grey, Dry SANDSTONE		1	88	63		299.1
	-70					355.7
V. Dense Grey, Dry SANDSTONE with some CLAY layers		2	100	60		301.7
	-75					291.2
	338.70					240.1
	-80					
Bottom of hole @ 76.6 ft						
Ground Surface Elevation referenced to BM at NW corner of SN 100-0020; Elev. 416.7						
Drilled by: R. Moberly	-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 100-0067 IL 13 WB OVER CRAB ORCHARD LAKE.GPJ D6TEMPLT.GDT 5/11/21

Illinois Department of Transportation
District Nine Materials
Unconfined Compressive Strength

FAP 331 (IL 13)
Structure 100-0067 (Boring 1-S)
Williamson County

Boring #	Specimen#	Depth	Unconfined Compression
1-S	1	67’ 4”	4,154 psi
1-S	2	69’ 0”	4,940 psi
1-S	3	72’ 2”	4,190 psi
1-S	4	73’ 6”	4,045 psi
1-S	5	75’ 10”	3,335 psi

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 6/16/14

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

SECTION (5B-1)DR-1 **LOCATION** 1.6 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 lbs

STRUCT. NO. 100-0067
Station 336+00
BORING NO. 2-S
Station 335+21
Offset 13.0ft Lt of WB CL
Ground Surface Elev. 415.2 ft

Surface Water Elev. 405.2 ft
Stream Bed Elev. ft
Groundwater Elev.:
▽ **First Encounter** 385.7 ft
▽ **Upon Completion** ft
▼ **After** Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	
				HMA Pavement over crushed Aggregate
413.70				
				V. Stiff Brown and Grey, Moist CLAY to SILTY CLAY
	1			
	1	2.3	19	
	2	B		
-5	1			
	2	2.1	20	
	3	B		
408.20				
	1			Stiff Brown and Grey, Moist CLAY
	2	1.4	22	
	2	B		
-10	1			
	2	1.9	21	
	2	B		
	1			
	2	1.6	22	
	2	B		
-15	1			
	2	1.5	21	
	2	B		
	1			
	2	1.9	23	
	2	B		
-20	1			

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	
	2	1.5	22	Stiff Brown and Grey, Moist CLAY *(continued)*
	2	B		
393.20				
	1			Stiff Grey, Moist to V. Moist SILTY LOAM to SILTY CLAY LOAM
	2	1.1	23	
	2	S		90% Fines<#200, LL 32, PI 10 (Estimated based on visual ID and historical database)
390.20 -25	1			
	1	0.8	23	M. Stiff Grey, Moist to V. Moist SILTY LOAM to SILTY CLAY LOAM
	2	B		
388.20				
	WOH			90% Fines<#200, LL 32, PI 10 (Estimated based on visual ID and historical database)
	1	0.5	25	Soft to M. Stiff Grey, V. Moist SILTY CLAY LOAM
	WOH	B		
385.70				
-30	1			91% Fines<#200, LL 37, PI 14 ▽ (Estimated based on visual ID and historical database)
	3	1.0	23	
	3	S		M. Stiff Grey and mottled Brown, Moist to V. Moist SILTY CLAY LOAM
383.20				
	WOH			91% Fines<#200, LL 37, PI 14 (Estimated based on visual ID and historical database)
	1	0.3	30	
	WOH	B		
				Soft Brown and Grey, V. Moist CLAY to SILTY CLAY
380.70				
-35	1			95% Fines<#200, LL 44, PI 24 (Estimated based on visual ID and historical database)
	2	1.0	26	
	3	B		
				M. Stiff Brown and Grey, Moist to V. Moist SILTY CLAY to SILTY CLAY LOAM
378.20				
	WOH			94% Fines<#200, LL 39, PI 18 (Estimated based on visual ID and historical database)
	1	0.3	29	
	WOH	B		
375.70				
-40	WOH			Soft Grey and mottled Brown, V. Moist CLAY

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 6/16/14

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

SECTION (5B-1)DR-1 **LOCATION** 1.6 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 lbs

STRUCT. NO. 100-0067
Station 336+00

BORING NO. 2-S
Station 335+21
Offset 13.0ft Lt of WB CL
Ground Surface Elev. 415.2 ft

Surface Water Elev. 405.2 ft
Stream Bed Elev. ft

Groundwater Elev.:
▽ **First Encounter** 385.7 ft
▽ **Upon Completion** ft
▼ **After** Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	Description
	1 2	0.8 B	27	91% Fines<#200, LL 50, PI 29 (Estimated based on visual ID and historical database)
				M. Stiff Grey and mottled Brown, V. Moist SILTY CLAY
				96% Fines<#200, LL 44, PI 23 (Estimated based on visual ID and historical database) *(continued)*
370.70				
-45	1			Stiff Grey and mottled Brown, Moist CLAY
	2 2	1.5 B	27	
365.70				
-50	1			M. Stiff Grey, Moist to V. Moist CLAY with ORGANICS and some SAND
	1 2	1.0 B	29	
-55	WOH			
	1 WOH	0.8 B	35	
355.70				
-60	1			

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	Description
	2 2	0.6 B	25	M. Stiff Grey, V. Moist CLAY with broken SANDSTONE and COAL *(continued)*
352.20				
	100/1"			V. Dense Grey, Dry SANDSTONE
-65				
-70				Bottom of hole @ 63.1 ft
				Ground Surface Elevation referenced to BM at NW corner of SN 100-0020; Elev. 416.7
				Hammer Efficiency 75% To convert "N" values to "N60", multiply by 1.25
				Drilled by: R. Moberly
-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 (0108)
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)

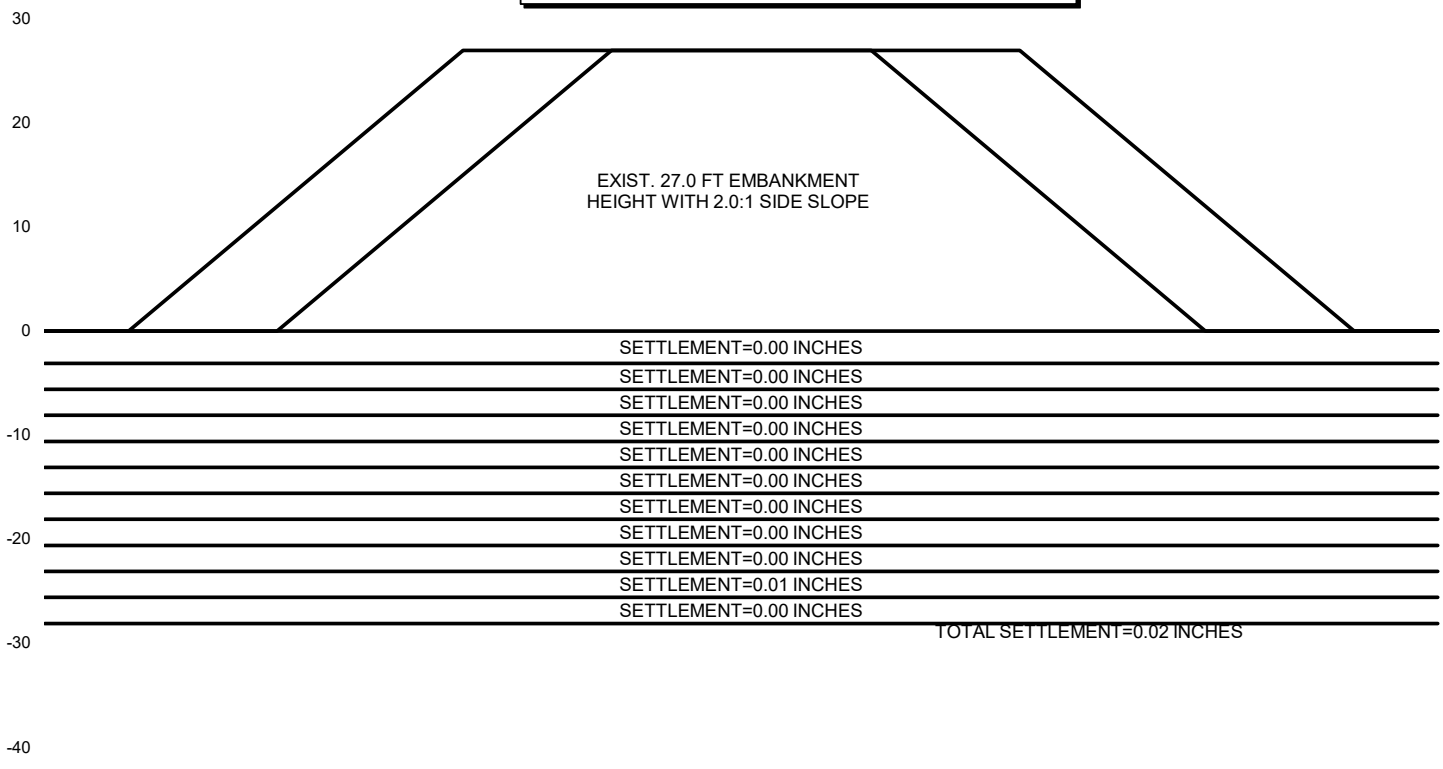
ASSUMPTIONS:

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.)*
3.1	120	0.50	28	3.300	0.000	0.756	0.162	0.361	**0.00**
2.5	120	0.30	28	3.407	0.001	0.756	0.162	0.550	**0.00**
2.5	120	1.90	23	3.500	0.003	0.621	0.117	0.116	**0.00**
2.5	120	0.80	21	3.592	0.008	0.567	0.099	0.242	**0.00**
2.5	120	1.90	26	3.681	0.014	0.702	0.144	0.116	**0.00**
2.5	120	1.90	41	3.768	0.024	1.107	0.279	0.116	**0.00**
2.5	120	1.90	39	3.853	0.035	1.053	0.261	0.116	**0.00**
2.5	120	1.90	39	3.937	0.047	1.053	0.261	0.116	**0.00**
2.5	120	1.20	48	4.019	0.061	1.296	0.342	0.171	**0.00**
2.5	120	1.20	48	4.101	0.075	1.296	0.342	0.171	**0.01**
2.5	120	1.10	25	4.182	0.090	0.675	0.135	0.184	**0.00**

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 (0108)
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)

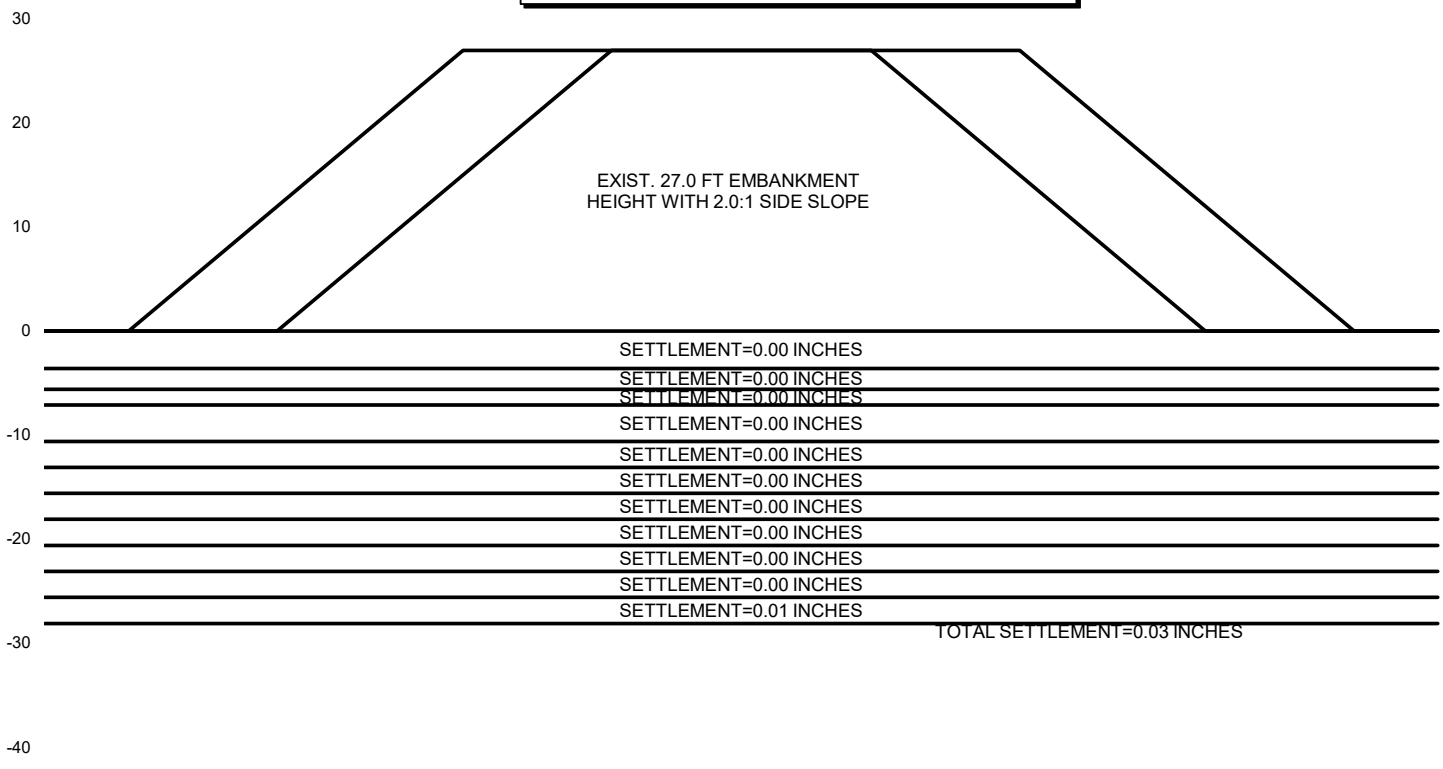
ASSUMPTIONS:

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.)*
3.6	120	0.60	26	3.309	0.000	0.702	0.144	0.309	**0.00**
2.0	120	0.40	28	3.416	0.001	0.756	0.162	0.436	**0.00**
1.5	120	1.10	26	3.482	0.003	0.702	0.144	0.184	**0.00**
3.5	120	0.30	30	3.574	0.007	0.810	0.180	0.550	**0.00**
2.5	120	1.00	26	3.681	0.014	0.702	0.144	0.200	**0.00**
2.5	120	0.40	27	3.768	0.024	0.729	0.153	0.436	**0.00**
2.5	120	1.90	26	3.853	0.035	0.702	0.144	0.116	**0.00**
2.5	120	1.90	26	3.937	0.047	0.702	0.144	0.116	**0.00**
2.5	120	1.30	28	4.019	0.061	0.756	0.162	0.160	**0.00**
2.5	120	1.30	28	4.101	0.075	0.756	0.162	0.160	**0.00**
2.5	120	0.40	31	4.182	0.090	0.837	0.189	0.436	**0.01**

TOTAL SETTLEMENT UNDER CENTER OF BRIDGE CONE = 0.03 IN.

EMBANKMENT AND SOIL PROFILE



COHESIVE SOIL SETTLEMENT ESTIMATE

LOCATION AND BORING USED ====: East Abutment / Boring 1-S (0109)
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)

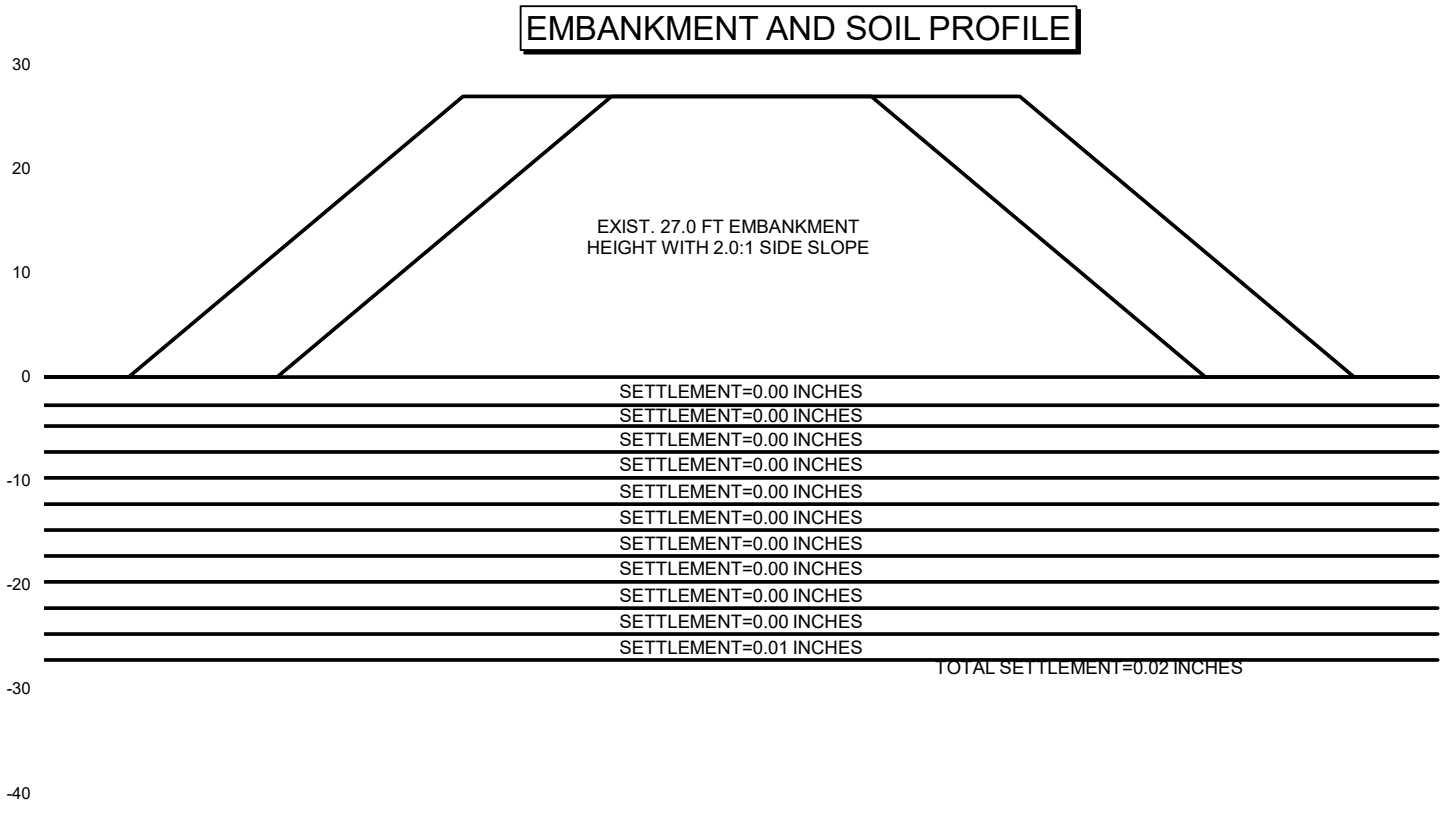
EXISTING EMBANKMENT (IF ANY):
- EXISTING EMBANKMENT UNIT WEIGHT ========== 120 PCF
- EXISTING EMBANKMENT HEIGHT ========== 27 FT
- EXISTING WIDTH AT TOP ========== 42 FT
- EXISTING WIDTH AT BASE ========== 150 FT (which is a 2.0:1 slope)

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.)*
2.7	120	1.50	23	3.292	0.000	0.621	0.117	0.142	**0.00**
2.0	120	1.20	21	3.382	0.001	0.567	0.099	0.171	**0.00**
2.5	120	0.50	26	3.467	0.002	0.702	0.144	0.361	**0.00**
2.5	120	1.20	23	3.559	0.006	0.621	0.117	0.171	**0.00**
2.5	120	0.30	28	3.649	0.012	0.756	0.162	0.550	**0.00**
2.5	120	0.30	29	3.737	0.020	0.783	0.171	0.550	**0.00**
2.5	120	1.60	27	3.823	0.030	0.729	0.153	0.134	**0.00**
2.5	120	1.90	28	3.907	0.042	0.756	0.162	0.116	**0.00**
2.5	120	1.90	28	3.989	0.056	0.756	0.162	0.116	**0.00**
2.5	120	1.60	49	4.071	0.070	1.323	0.351	0.134	**0.00**
2.5	120	1.60	49	4.153	0.085	1.323	0.351	0.134	**0.01**

TOTAL SETTLEMENT UNDER CENTER OF BRIDGE CONE = 0.02 IN.



COHESIVE SOIL SETTLEMENT ESTIMATE

LOCATION AND BORING USED ====: West Abutment / Boring 2-S (0109)
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)

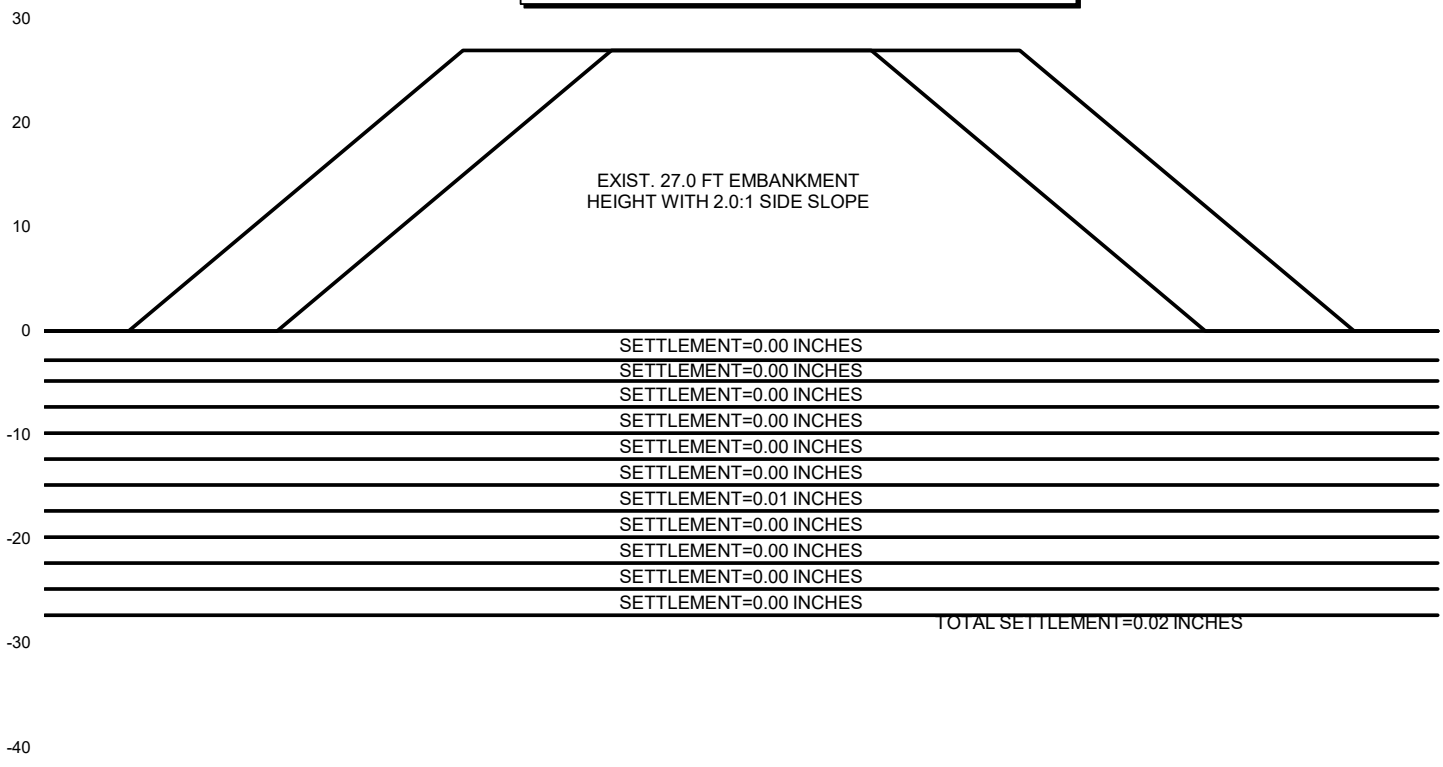
EXISTING EMBANKMENT (IF ANY):
- EXISTING EMBANKMENT UNIT WEIGHT ==========: 120 PCF
- EXISTING EMBANKMENT HEIGHT ==========: 27 FT
- EXISTING WIDTH AT TOP ==========: 42 FT
- EXISTING WIDTH AT BASE ==========: 150 FT (which is a 2.0:1 slope)

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.)*
2.8	120	1.10	23	3.294	0.000	0.621	0.117	0.184	**0.00**
2.0	120	0.80	23	3.386	0.001	0.621	0.117	0.242	**0.00**
2.5	120	0.50	25	3.471	0.002	0.675	0.135	0.361	**0.00**
2.5	120	1.00	23	3.563	0.006	0.621	0.117	0.200	**0.00**
2.5	120	0.30	30	3.653	0.012	0.810	0.180	0.550	**0.00**
2.5	120	1.00	26	3.741	0.020	0.702	0.144	0.200	**0.00**
2.5	120	0.30	29	3.826	0.031	0.783	0.171	0.550	**0.01**
2.5	120	0.80	27	3.910	0.043	0.729	0.153	0.242	**0.00**
2.5	120	0.80	27	3.993	0.056	0.729	0.153	0.242	**0.00**
2.5	120	1.50	27	4.074	0.071	0.729	0.153	0.142	**0.00**
2.5	120	1.50	27	4.156	0.085	0.729	0.153	0.142	**0.00**

TOTAL SETTLEMENT UNDER CENTER OF BRIDGE CONE = 0.02 IN.

EMBANKMENT AND SOIL PROFILE



Appendix F

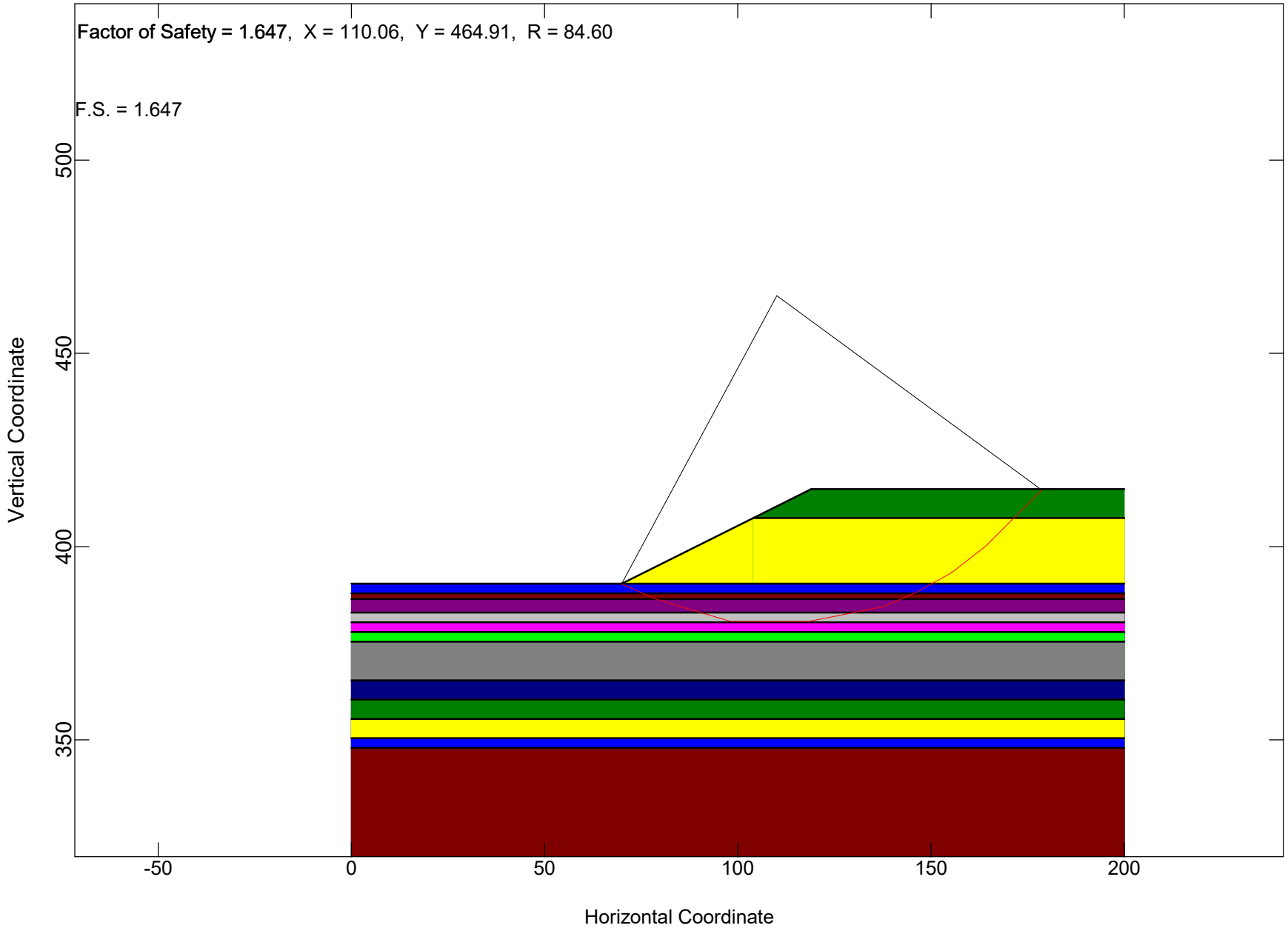
Slope Stability Analysis

Soil Parameters for Slope Stability Analysis

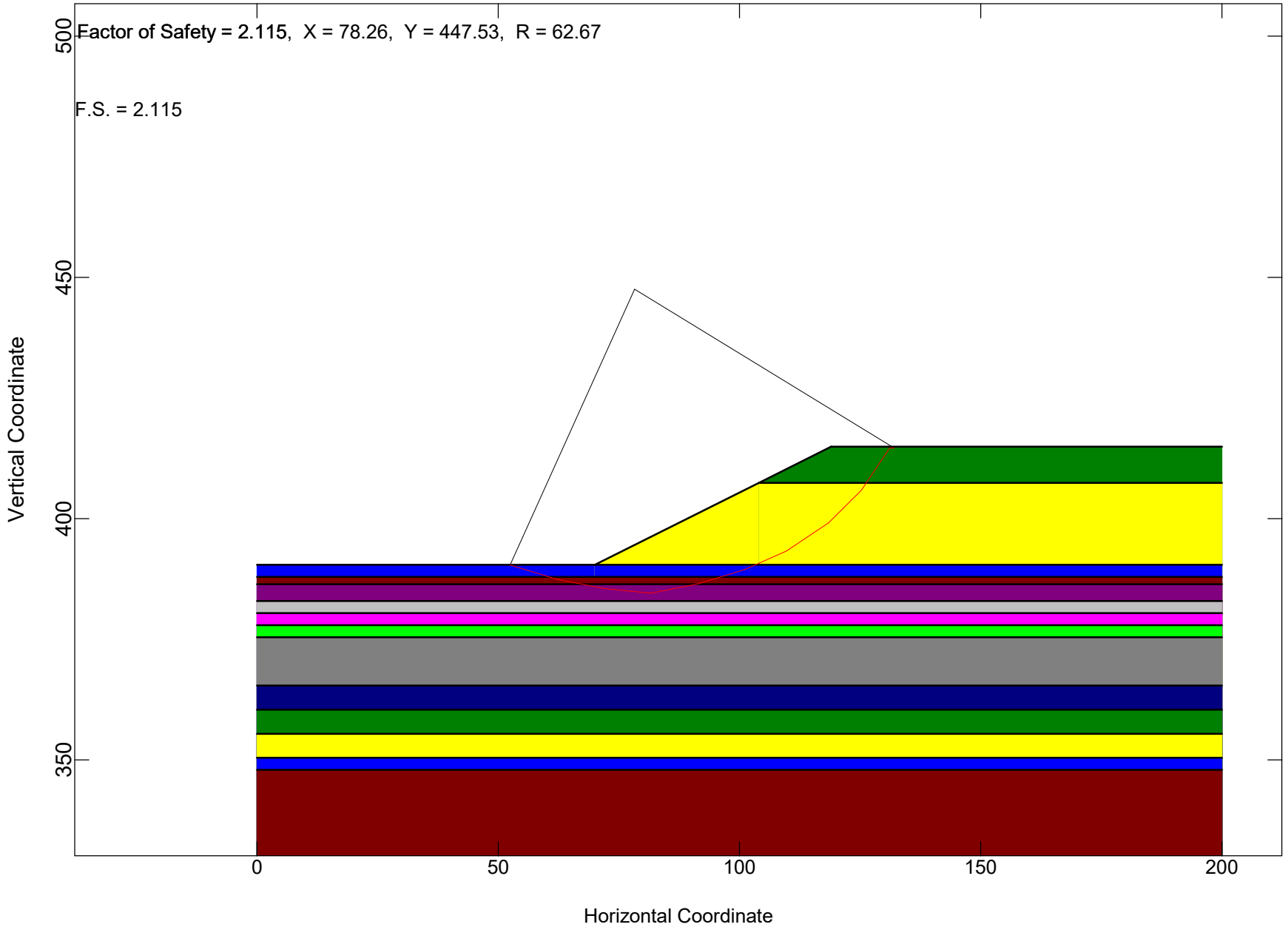
SN 100-0108 - East Abutment

Layer #	Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term	
				c'	θ	c'	θ
				(ksf)	(deg.)	(ksf)	(deg.)
1	Crushed Aggregate	407.4	125	0	40	0	40
2	Rock Fill	390.4	125	0	40	0	40
3	M. Silty Clay/Clay Loam	387.9	125	0.6	0	0.1	28
4	Soft Silty Clay/Clay Loam	386.4	120	0.4	0	0.1	26
5	Stiff Clay/Silty Clay	382.9	125	1.1	0	0.1	28
6	Soft Silty Clay	380.4	120	0.3	0	0.1	26
7	M. Stiff Silty Clay	377.9	125	1	0	0.1	28
8	Soft Silty Clay	375.4	120	0.4	0	0.1	26
9	Stiff Clay	365.4	125	1.3	0	0.1	28
10	Soft Clay	360.4	120	0.4	0	0.1	26
11	Medium Clay	355.4	125	0.7	0	0.1	28
12	Soft Clay	350.4	120	0.5	0	0.1	26
13	Stiff Clay/Clay Shale	347.9	130	1.5	0	0.1	28
14	Sandstone	-	150	0	45	0	45

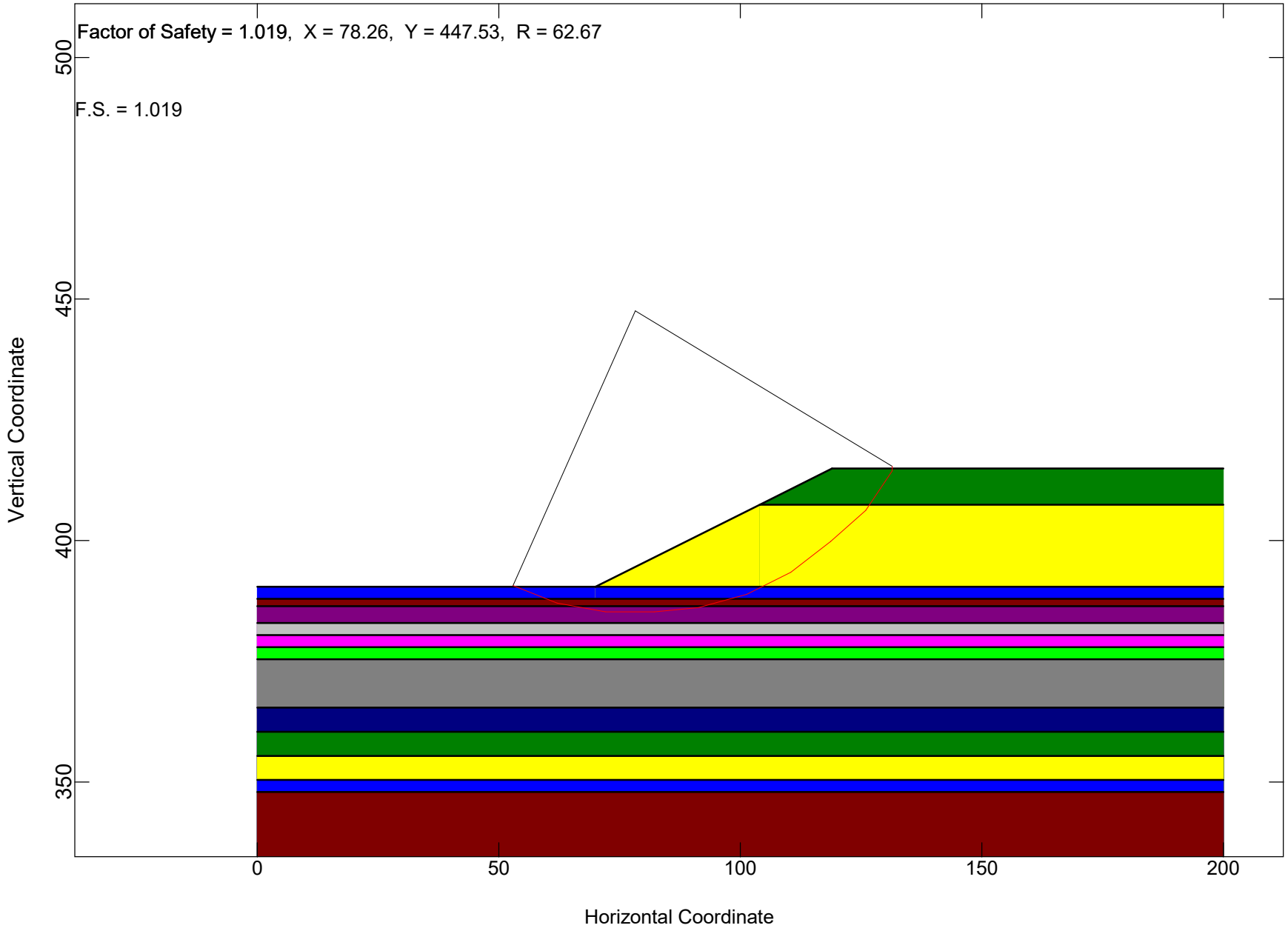
SN 100-0108 East Abutment
Short Term Strength



SN 100-0108 East Abutment
Long Term Strength



SN 100-0108 East Abutment
Seismic

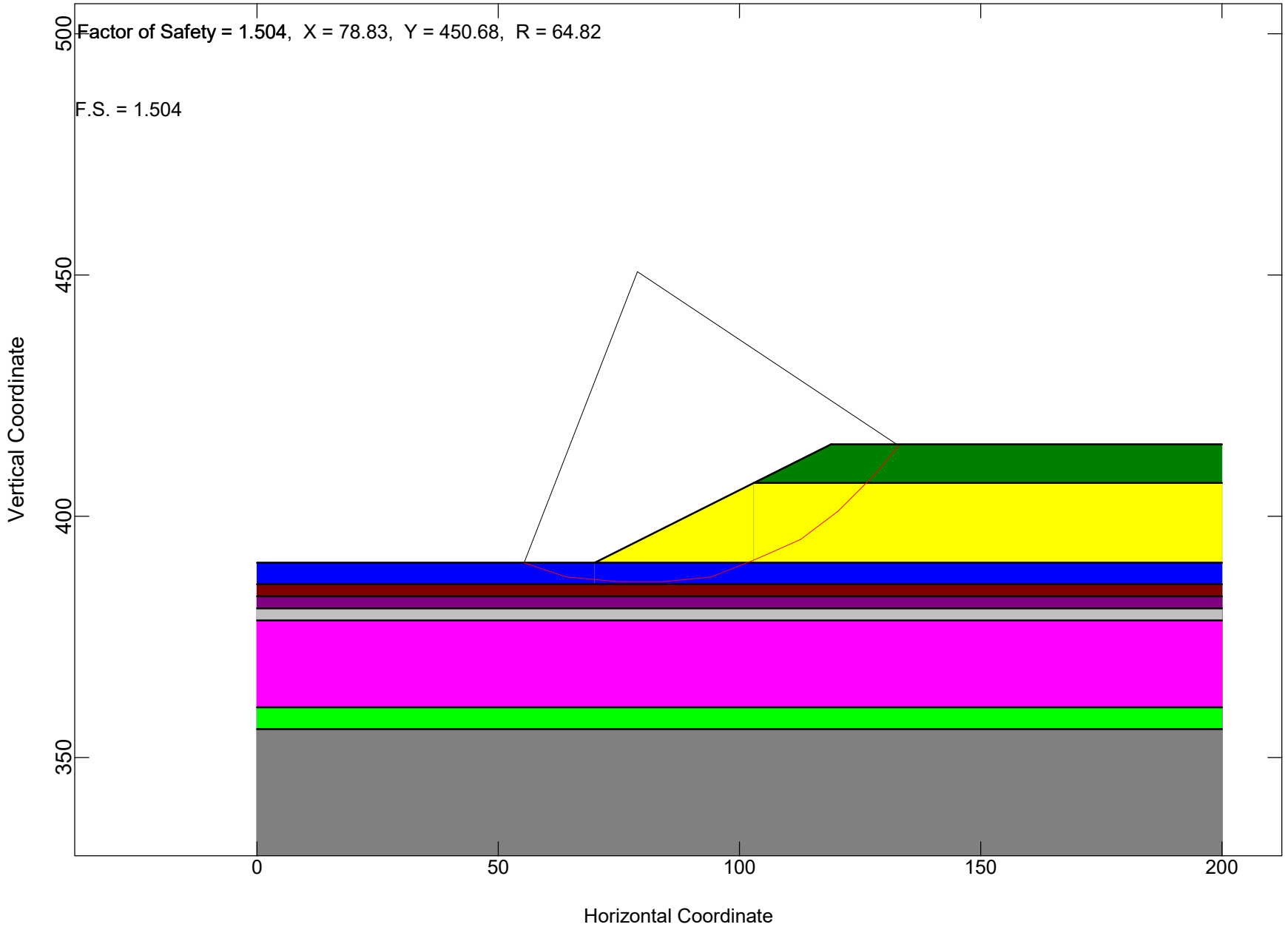


Soil Parameters for Slope Stability Analysis

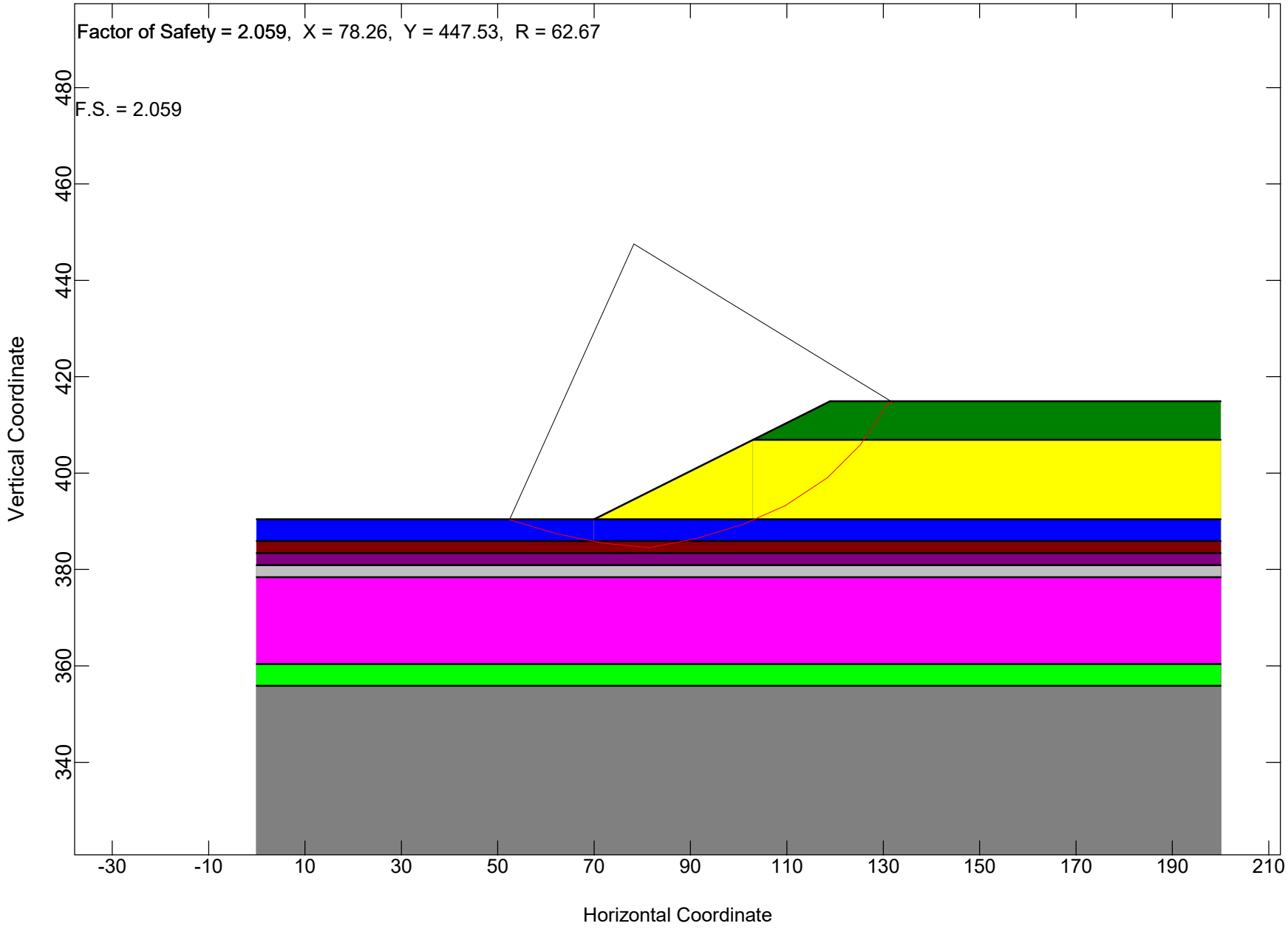
SN 100-0108 - West Abutment

Layer #	Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term	
				c'	θ	c'	θ
				(ksf)	(deg.)	(ksf)	(deg.)
1	Crushed Aggregate	406.9	125	0	40	0	40
2	Rock Fill	390.4	125	0	40	0	40
3	Soft Silty Clay/Clay Loam	385.9	125	0.3	0	0.1	28
4	Stiff Silty Clay/Clay	383.4	120	1.9	0	0.1	26
5	M. Stiff Moist Clay Loam	380.9	125	0.8	0	0.1	28
6	Stiff Moist Clay	378.4	125	1.9	0	0.1	28
7	Stiff Moist Clay	360.4	125	1.1	0	0.1	28
8	Stiff Moist Clay w/ Gravel	355.9	125	1.2	0	0.1	28
9	Sandstone	-	150	0	45	0	45

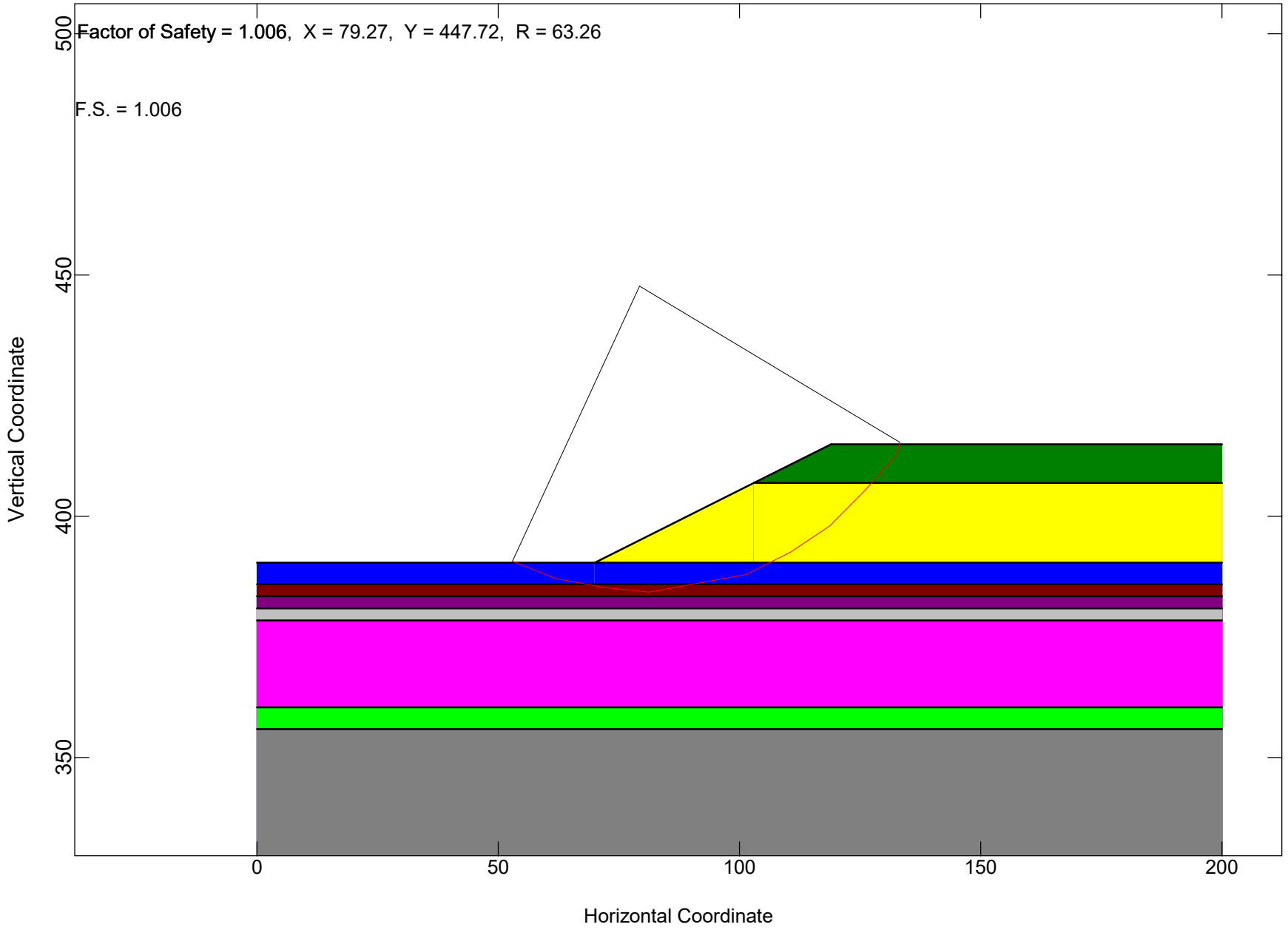
SN 100-0108 West Abutment
Short Term Strength



SN 100-0108 West Abutment
Long Term Strength



SN 100-0108 West Abutment
Seismic

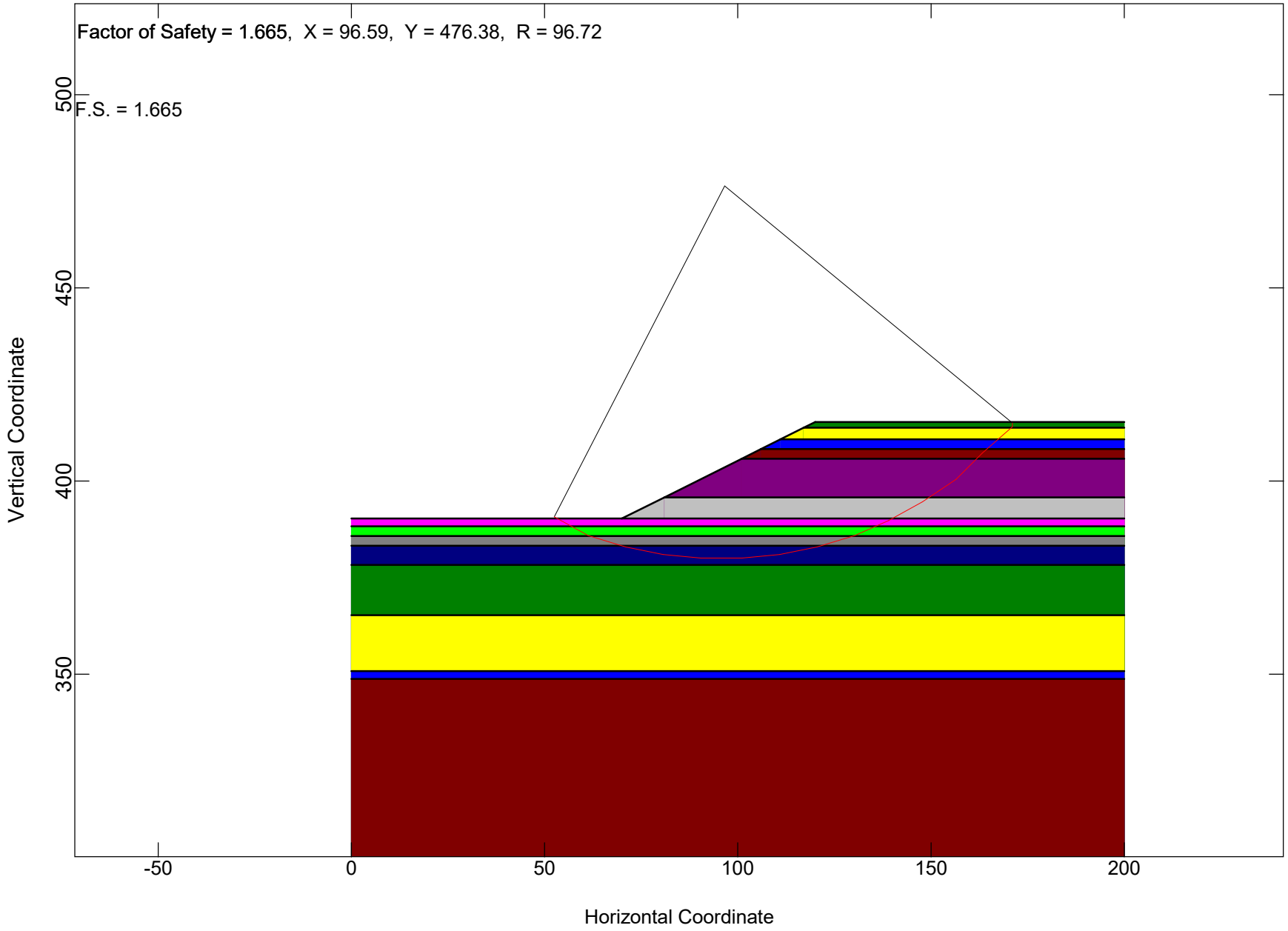


Soil Parameters for Slope Stability Analysis

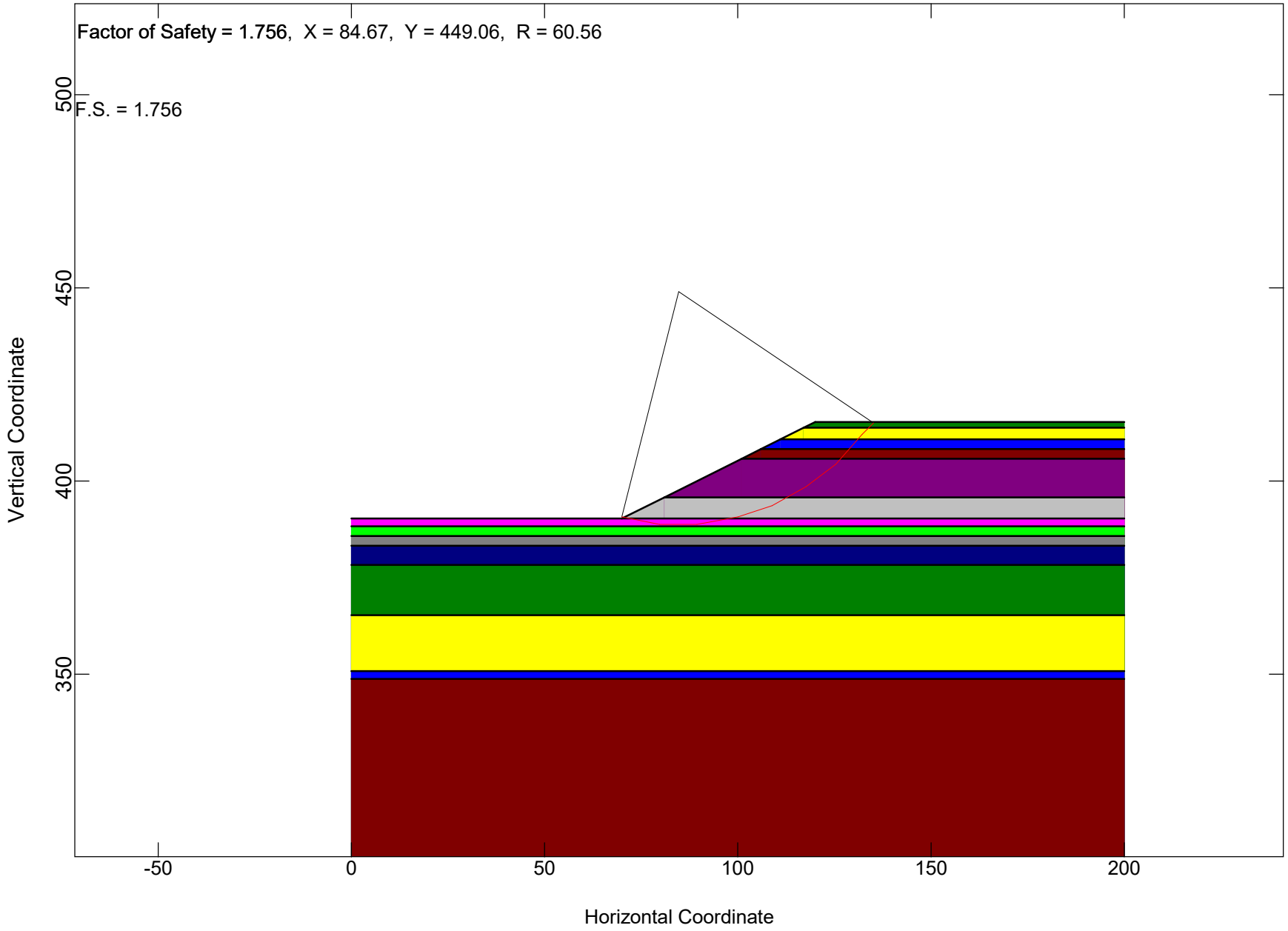
SN 100-0109 - East Abutment

Layer #	Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term	
				c'	θ	c'	θ
				(ksf)	(deg.)	(ksf)	(deg.)
1	Crushed Aggregate	413.8	125	0	40	0	40
2	V. Stiff Silty Clay	410.8	125	2.3	0	0.1	28
3	V. Stiff Clay/Silty Clay	408.3	125	2.1	0	0.1	28
4	M. Clay/Silty Clay	405.8	125	0.6	0	0.1	28
5	Stiff Clay/Silty Clay	395.8	125	1.4	0	0.1	28
6	Stiff Clay/Silty Clay	390.3	125	1.2	0	0.1	28
7	Stiff Silty Loam	388.3	125	1.2	0	0.1	28
8	Soft Silty Clay Loam	385.8	120	0.5	0	0.1	26
9	Stiff Silty Clay Loam	383.3	125	1.2	0	0.1	28
10	Soft Clay	378.3	120	0.3	0	0.1	26
11	Stiff Clay	365.3	125	1.6	0	0.1	28
12	M./ Soft Clay	350.8	120	0.5	0	0.1	26
13	Stiff Sandy Clay	348.8	125	1.6	0	0.1	28
14	Sandstone	-	150	0	45	0	45

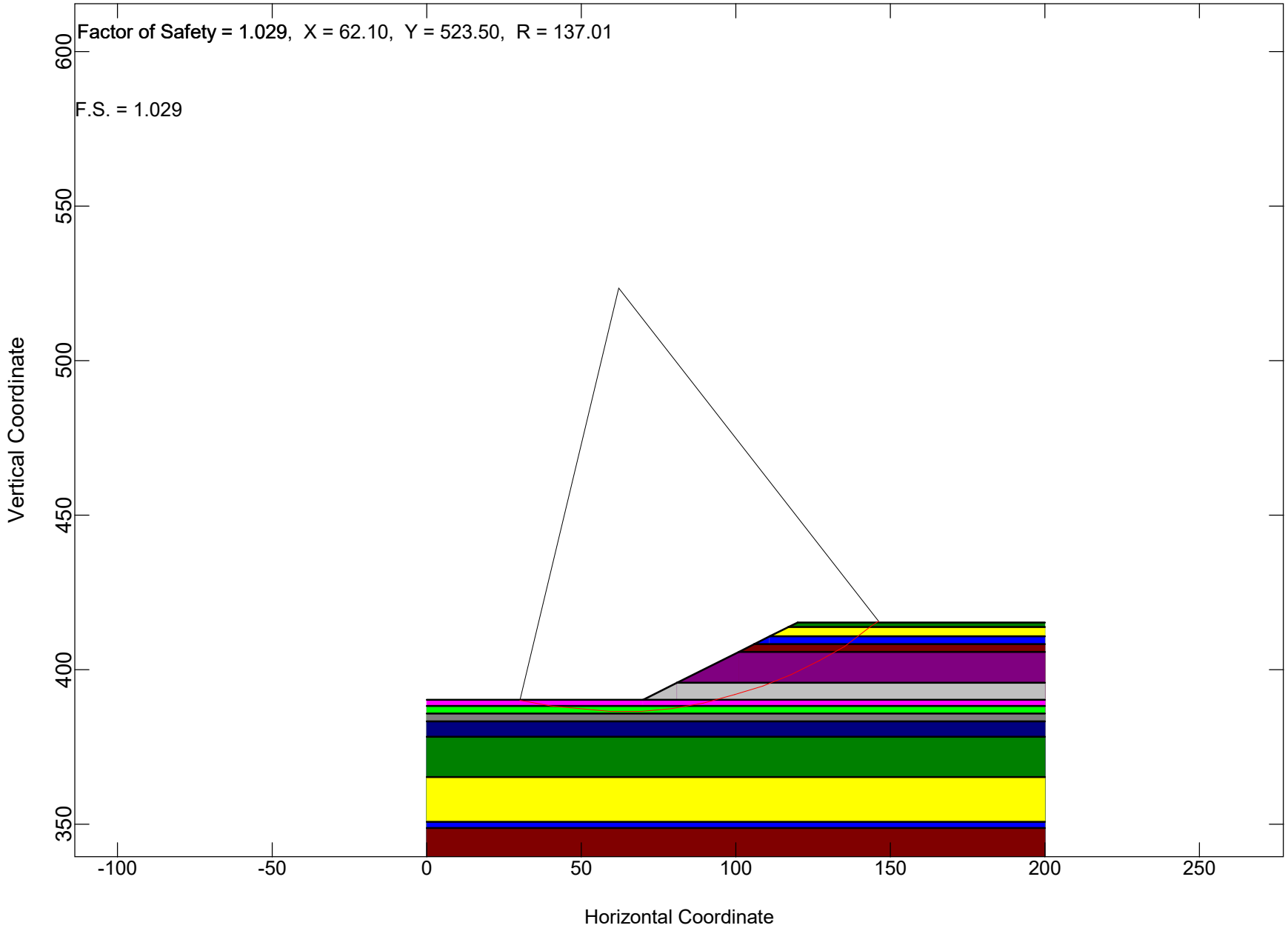
SN 100-0109 East Abutment
Short Term Strength



SN 100-0109 East Abutment
Long Term Strength



SN 100-0109 East Abutment
Seismic

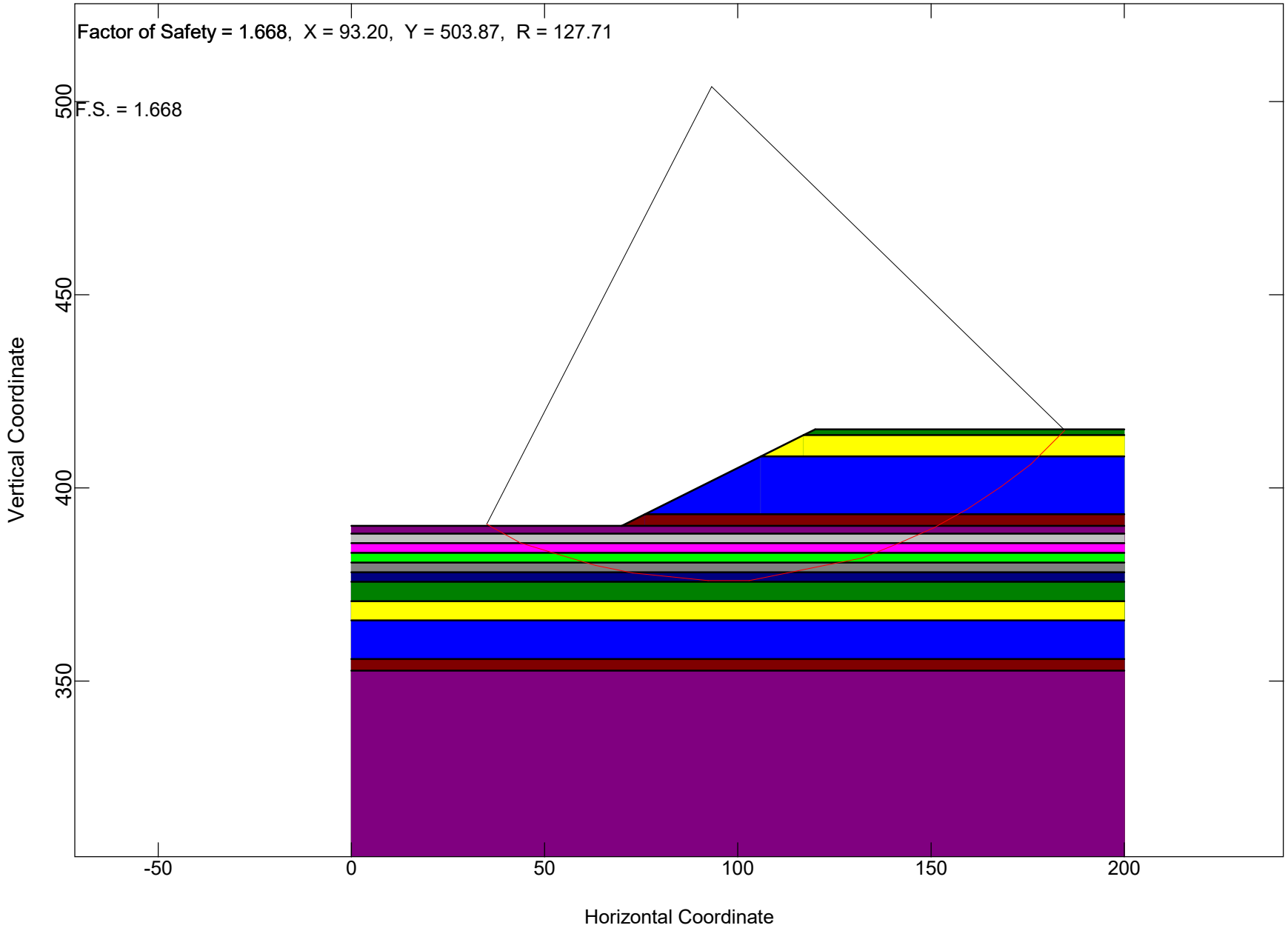


Soil Parameters for Slope Stability Analysis

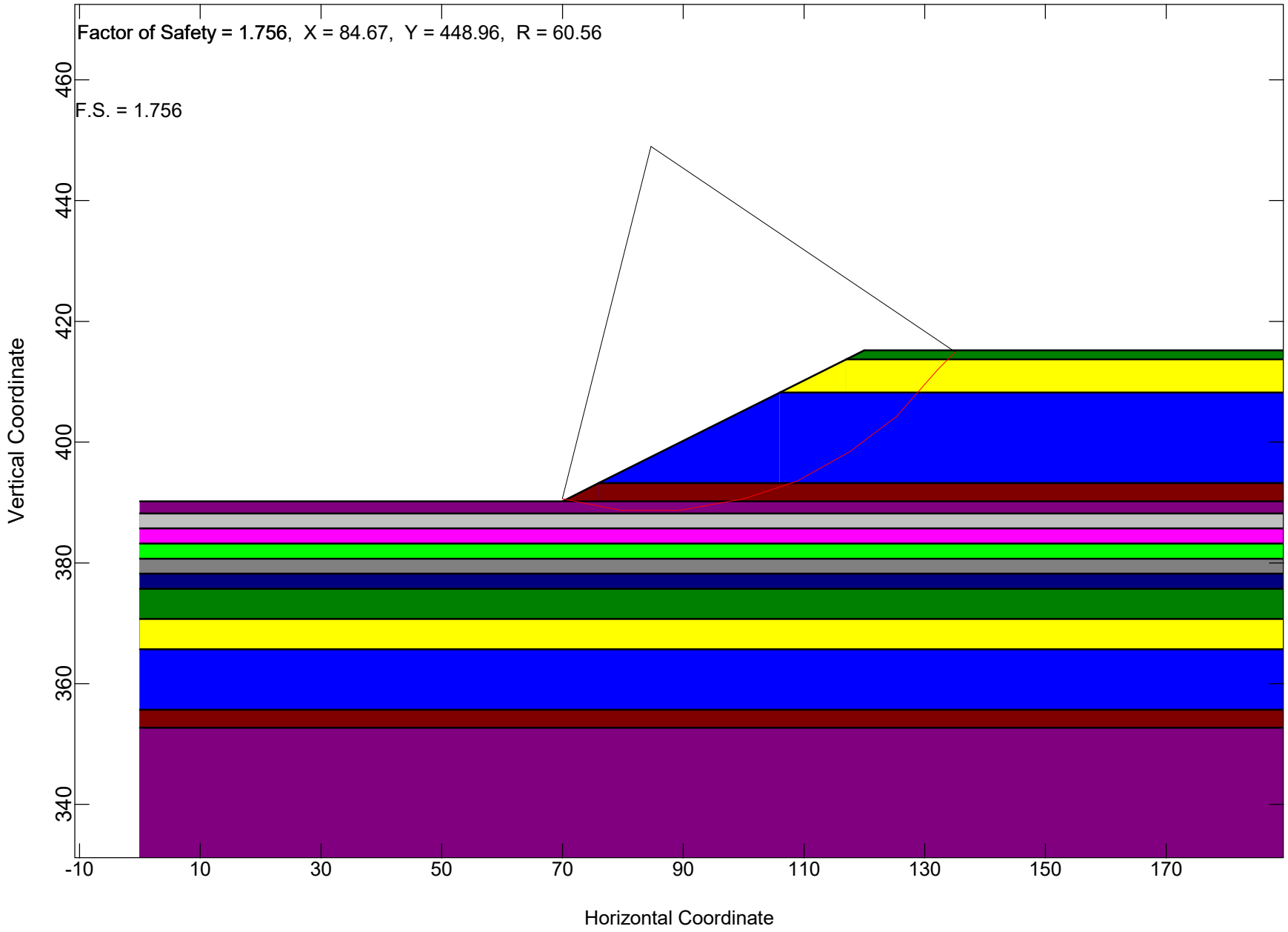
SN 100-0109 - West Abutment

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	413.7	125	0	40	0	40
2	V. Stiff Clay/Silty Clay	408.2	125	2.1	0	0.1	28
3	Stiff Clay	393.2	125	1.4	0	0.1	28
4	Stiff Silt Loam/Silty Clay	390.2	125	1.1	0	0.1	28
5	M. Silty Loam/Silty Clay	388.2	125	0.8	0	0.1	28
6	M./Soft Silty Clay Loam	385.7	125	0.5	0	0.1	28
7	M./Soft Silty Clay Loam	383.2	125	1	0	0.1	28
8	Soft Clay/Silty Clay	380.7	120	0.3	0	0.1	26
9	M. Silty Clay/Silty Loam	378.2	125	1	0	0.1	28
10	Soft Clay/Silty Clay	375.7	120	0.3	0	0.1	26
11	Medium Silty Clay	370.7	125	0.8	0	0.1	28
12	Stiff Clay	365.7	125	1.5	0	0.1	28
13	Medium/Stiff Clay	355.7	125	0.8	0	0.1	28
14	Medium Clay	352.7	125	0.6	0	0.1	28
15	Sandstone	-	150	0	45	0	45

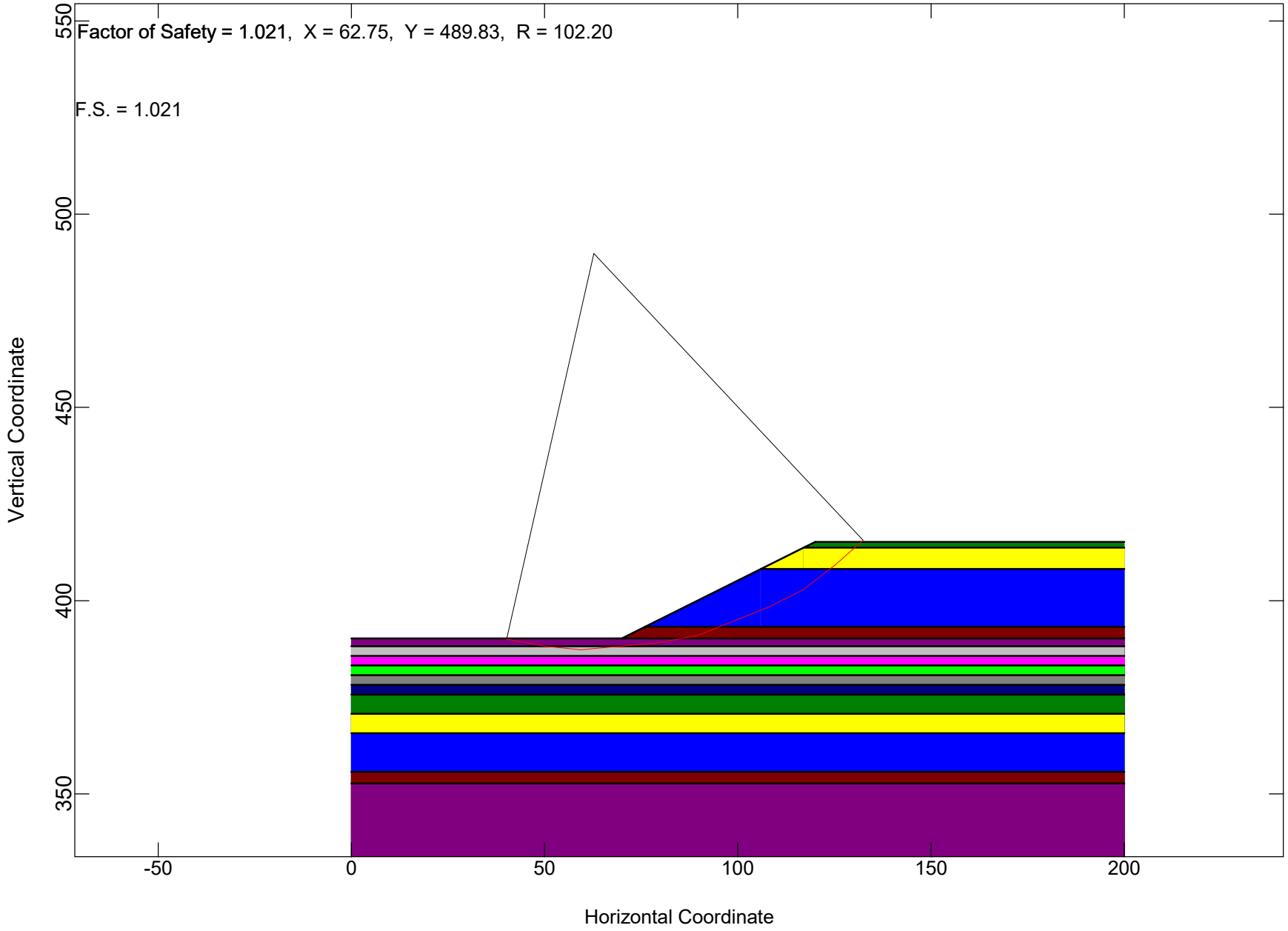
SN 100-0109 West Abutment
Short Term Strength



SN 100-0109 West Abutment
Long Term Strength



SN 100-0109 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 100-0108 and 100-0109)

Substructure 1

Base of Substruct. Elev. (or ground surf for bents	408	ft.
Pile or Shaft Dia.	12	inches
Boring Number	0020-1-S	
Top of Boring Elev.	414.9	ft.
Approximate Fixity Elev.	402	ft.

Individual Site Class Definition:

N (bar): 11 (Blows/ft.) Soil Site Class E
N_{ch} (bar): 23 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): 2.04 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	413.9	1.00	0		B
	410.4	3.50	22		
	406.9	3.50	22		B
	402.9	4.00	5		
3.1	398.9	4.00	5		
7.1	394.9	4.00	5		
11.6	390.4	4.50	5		B
14.1	387.9	2.50	0	0.50	
16.1	385.9	2.00	0	0.30	B
18.6	383.4	2.50	5	1.90	B
21.1	380.9	2.50	5	0.80	B
23.6	378.4	2.50	6	1.90	B
28.6	373.4	5.00	6	1.90	
33.6	368.4	5.00	5	1.90	
38.6	363.4	5.00	3	1.20	
41.6	360.4	3.00	3	1.10	B
46.1	355.9	4.50	8	1.20	B
100.0	302.0	53.90	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	0020-2-S	
Top of Boring Elev.	414.9	ft.
Approximate Fixity Elev.	402	ft.

Individual Site Class Definition:

N (bar): 10 (Blows/ft.) Soil Site Class E
N_{ch} (bar): 21 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): 1.18 (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
	410.4	3.50	22		
	407.4	3.00	22		B
	403.4	4.00	5		
2.6	399.4	4.00	5		
7.1	394.9	4.50	5		
11.6	390.4	4.50	5		B
14.1	387.9	2.50	1	0.60	B
15.6	386.4	1.50	2	0.40	B
19.1	382.9	3.50	8	1.10	B
21.6	380.4	2.50	0	0.30	B
24.1	377.9	2.50	2	1.00	B
26.6	375.4	2.50	0	0.40	B
31.6	370.4	5.00	6	1.90	
36.6	365.4	5.00	1	1.30	B
41.6	360.4	5.00	0	0.40	B
46.6	355.4	5.00	0	0.70	B
51.6	350.4	5.00	0	0.50	B
54.1	347.9	2.50	16	1.50	B
100.0	302.0	45.90	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	0067-1-S	
Top of Boring Elev.	415.3	ft.
Approximate Fixity Elev.	402	ft.

Individual Site Class Definition:

N (bar): 4 (Blows/ft.) Soil Site Class E
N_{ch} (bar): NA (Blows/ft.) NA
s_u (bar): 1.27 (ksf) Soil Site Class D <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	413.8	1.50	0		B
	410.8	3.00	7	2.30	B
	408.3	2.50	6	2.10	B
	405.8	2.50	1	0.60	B
	403.3	2.50	6	1.90	
1.2	400.8	2.50	6	1.60	
3.7	398.3	2.50	5	1.90	
6.2	395.8	2.50	5	1.40	B
8.7	393.3	2.50	5	1.20	
11.7	390.3	3.00	4	1.50	B
13.7	388.3	2.00	8	1.20	B
16.2	385.8	2.50	2	0.50	B
18.7	383.3	2.50	6	1.20	B
21.2	380.8	2.50	1	0.30	
23.7	378.3	2.50	1	0.30	B
26.7	375.3	3.00	4	1.60	
31.7	370.3	5.00	4	1.90	
36.7	365.3	5.00	3	1.60	B
41.7	360.3	5.00	1	0.50	
46.7	355.3	5.00	1	0.60	
51.2	350.8	4.50	1	0.50	B
53.2	348.8	2.00	4	1.50	B
100.0	302.0	46.80	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	0067-2-S	
Top of Boring Elev.	415.2	ft.
Approximate Fixity Elev.	402	ft.

Individual Site Class Definition:

N (bar): 5 (Blows/ft.) Soil Site Class E
N_{ch} (bar): NA (Blows/ft.) NA
s_u (bar): 1.32 (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	2.30	
	408.2	2.50	5	2.10	B
	405.7	2.50	4	1.40	
	403.2	2.50	4	1.90	
1.3	400.7	2.50	4	1.60	
3.8	398.2	2.50	4	1.50	
6.3	395.7	2.50	4	1.90	
8.8	393.2	2.50	4	1.50	B
11.8	390.2	3.00	4	1.10	B
13.8	388.2	2.00	3	0.80	B
16.3	385.7	2.50	1	0.50	B
18.8	383.2	2.50	6	1.00	B
21.3	380.7	2.50	1	0.30	B
23.8	378.2	2.50	5	1.00	B
26.3	375.7	2.50	1	0.30	B
31.3	370.7	5.00	3	0.80	B
36.3	365.7	5.00	4	1.50	B
41.3	360.7	5.00	3	1.00	
46.3	355.7	5.00	1	0.80	B
49.3	352.7	3.00	4	0.60	B
100.0	302.0	50.70	100	10.00	R

Global Site Class Definition: Substructures 1 through 4

N (bar): 8 (Blows/ft.) Soil Site Class E
N_{ch} (bar): 57 (Blows/ft.) Soil Site Class C
s_u (bar): 1.44 (ksf) Soil Site Class D <----Controls

Appendix H

Liquefaction Analysis

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ==========: 0109 E. Abut.
ELEVATION OF BORING GROUND SURFACE ==========: 415.30 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ==========: 10.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==========: 10.50 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')
$V^{*}_{s,40'}$ = **300** 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
413.8	1.5	1						0.095	0.143	1.962	1.962	0.053	0.095	0.203	0.203	1.500	**0.078**	0.953	**0.261**	**N.L. (1)**
410.8	4.5	7	2.3					0.132	0.539	12.292	12.292	0.134	0.132	0.599	0.599	1.365	**0.179**	0.878	**0.241**	**N.L. (1)**
408.3	7	6	2.1					0.130	0.864	9.480	9.480	0.109	0.130	0.924	0.924	1.209	**0.129**	0.815	**0.223**	**N.L. (1)**
405.8	9.5	1	0.6					0.116	1.154	1.561	1.561	0.051	0.116	1.214	1.214	1.118	**0.056**	0.752	**0.206**	**N.L. (1)**
402.8	12.5	6	1.9		12	30	22	0.067	1.355	9.500	9.500	0.109	0.067	1.415	1.571	1.097	**0.117**	0.682	**0.208**	**N.L. (2)**
400.3	15	6	1.6		12	30	20	0.065	1.517	9.472	9.472	0.108	0.065	1.577	1.889	1.070	**0.114**	0.628	**0.206**	**N.L. (2)**
397.8	17.5	5	1.9		12	30	21	0.067	1.685	7.785	7.785	0.094	0.067	1.745	2.213	1.043	**0.096**	0.581	**0.202**	**N.L. (2)**
395.8	19.5	5	1.4		12	30	22	0.063	1.811	7.678	7.678	0.093	0.063	1.871	2.463	1.028	**0.094**	0.547	**0.198**	**N.L. (2)**
392.8	22.5	5	1.2		12	30	20	0.061	1.994	7.491	7.491	0.092	0.061	2.054	2.834	1.007	**0.091**	0.504	**0.191**	**N.L. (2)**
390.3	25	4	1.5		12	30	23	0.064	2.154	5.843	5.843	0.078	0.064	2.214	3.150	0.991	**0.076**	0.475	**0.185**	**N.L. (2)**
388.3	27	8	1.2	90	10	32	21	0.061	2.276	11.455	18.746	0.200	0.061	2.336	3.396	0.973	**0.191**	0.455	**0.182**	**N.L. (2)**
385.8	29.5	2	0.5	91	14	37	26	0.051	2.403	2.805	8.366	0.099	0.051	2.463	3.680	0.967	**0.094**	0.435	**0.178**	**N.L. (2)**
383.3	32	6	1.2	91	14	37	23	0.061	2.556	8.199	14.839	0.158	0.061	2.616	3.988	0.947	**0.147**	0.419	**0.175**	**N.L. (2)**
380.8	34.5	1	0.3	92	29	50	28	0.046	2.671	1.341	6.610	0.085	0.046	2.731	4.259	0.948	**0.079**	0.406	**0.174**	**N.L. (2)**
378.3	37	1	0.3	92	29	50	29	0.046	2.786	1.317	6.580	0.084	0.046	2.846	4.530	0.940	**0.078**	0.396	**0.173**	**N.L. (2)**
375.3	40	4	1.6		12	30	27	0.065	2.981	5.100	5.100	0.073	0.065	3.041	4.913	0.930	**0.066**	0.386	**0.171**	**N.L. (2)**
370.3	45	4	1.9		12	30	28	0.067	3.316	4.835	4.835	0.071	0.067	3.376	5.560	0.911	**0.063**	0.375	**0.170**	**N.L. (2)**
365.3	50	3	1.6		12	30	49	0.065	3.641	3.452	3.452	0.061	0.065	3.701	6.197	0.895	**0.054**	0.369	**0.169**	**N.L. (2)**
360.3	55	1	0.5		12	30	32	0.051	3.896	1.109	1.109	0.050	0.051	3.956	6.764	0.883	**0.043**	0.365	**0.171**	**N.L. (2)**
355.3	60	1	0.6		12	30	31	0.053	4.161	1.067	1.067	0.049	0.053	4.221	7.341	0.871	**0.042**	0.363	**0.173**	**N.L. (2)**

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== 0109 W. Abut.
ELEVATION OF BORING GROUND SURFACE ========== 415.20 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 10.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 10.50 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')
$\bar{V}_{s,40'}$ = **282** 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**	0.948	**0.260**	**N.L. (1)**
410.7	4.5	3	2.3					0.132	0.539	5.240	5.240	0.074	0.132	0.599	0.599	1.291	**0.094**	0.867	**0.238**	**N.L. (1)**
408.2	7	5	2.1					0.130	0.864	7.900	7.900	0.095	0.130	0.924	0.924	1.199	**0.112**	0.800	**0.219**	**N.L. (1)**
405.7	9.5	4	1.4					0.125	1.176	6.208	6.208	0.081	0.125	1.236	1.236	1.119	**0.089**	0.735	**0.202**	**N.L. (1)**
402.7	12.5	4	1.9		12	30	21	0.067	1.377	6.297	6.297	0.082	0.067	1.437	1.593	1.084	**0.087**	0.663	**0.201**	**N.L. (2)**
400.2	15	4	1.6		12	30	22	0.065	1.540	6.280	6.280	0.082	0.065	1.600	1.912	1.060	**0.085**	0.609	**0.200**	**N.L. (2)**
397.7	17.5	4	1.5		12	30	21	0.064	1.700	6.206	6.206	0.081	0.064	1.760	2.228	1.039	**0.083**	0.562	**0.195**	**N.L. (2)**
395.2	20	4	1.9		12	30	23	0.067	1.867	6.084	6.084	0.080	0.067	1.927	2.551	1.020	**0.080**	0.521	**0.189**	**N.L. (2)**
393.2	22	4	1.5		12	30	22	0.064	1.995	5.977	5.977	0.080	0.064	2.055	2.804	1.006	**0.079**	0.494	**0.185**	**N.L. (2)**
390.2	25	4	1.1	90	10	32	23	0.060	2.175	5.817	11.980	0.131	0.060	2.235	3.171	0.987	**0.127**	0.459	**0.179**	**N.L. (2)**
388.2	27	3	0.8	90	10	32	23	0.057	2.289	4.284	10.140	0.114	0.057	2.349	3.410	0.976	**0.110**	0.441	**0.175**	**N.L. (2)**
385.7	29.5	1	0.5	91	14	37	25	0.051	2.417	1.399	6.679	0.085	0.051	2.477	3.693	0.968	**0.081**	0.421	**0.172**	**N.L. (2)**
383.2	32	6	1	91	14	37	23	0.059	2.564	8.186	14.823	0.158	0.059	2.624	3.997	0.946	**0.147**	0.406	**0.170**	**N.L. (2)**
380.7	34.5	1	0.3	95	24	44	30	0.046	2.679	1.339	6.607	0.084	0.046	2.739	4.268	0.948	**0.079**	0.394	**0.168**	**N.L. (2)**
378.2	37	5	1	94	18	39	26	0.059	2.827	6.533	12.840	0.139	0.059	2.887	4.571	0.926	**0.126**	0.384	**0.167**	**N.L. (2)**
375.7	39.5	1	0.3		12	30	29	0.046	2.942	1.283	1.283	0.050	0.046	3.002	4.842	0.933	**0.046**	0.377	**0.167**	**N.L. (2)**
370.7	44.5	3	0.8		12	30	27	0.057	3.227	3.680	3.680	0.063	0.057	3.287	5.439	0.916	**0.056**	0.366	**0.166**	**N.L. (2)**
365.7	49.5	4	1.5		12	30	27	0.064	3.547	4.672	4.672	0.070	0.064	3.607	6.071	0.899	**0.061**	0.360	**0.166**	**N.L. (2)**
360.7	54.5	3	1		12	30	29	0.059	3.842	3.354	3.354	0.061	0.059	3.902	6.678	0.885	**0.053**	0.356	**0.167**	**N.L. (2)**
355.7	59.5	1	0.8		12	30	35	0.057	4.127	1.072	1.072	0.049	0.057	4.187	7.275	0.873	**0.042**	0.354	**0.169**	**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	100-0108		TOTAL STRUCTURE LENGTH	128.50	FT
STRUCTURE TYPE	MULTI-SPAN		NUMBER OF SPANS	3	
STRUCTURE SKEW	0	DEGREES	END SPAN LENGTH	38.00	FT
SUPER. DATA IN REFERENCE TO SUB. DATA	ABUT 1		ADJACENT INTERIOR SPAN LENGTH	52.50	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.	13	
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.	13	
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)*
406.90	1.10		84	4.0
404.40	2.50		30	3.3
401.90	2.50		9	2.3
399.40	2.50		7	2.2
398.00	1.40		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)*
407.40	0.60		84	4.0
404.90	2.50		30	3.3
402.40	2.50		9	2.3
399.90	2.50		7	2.2
398.00	1.90		7	2.2

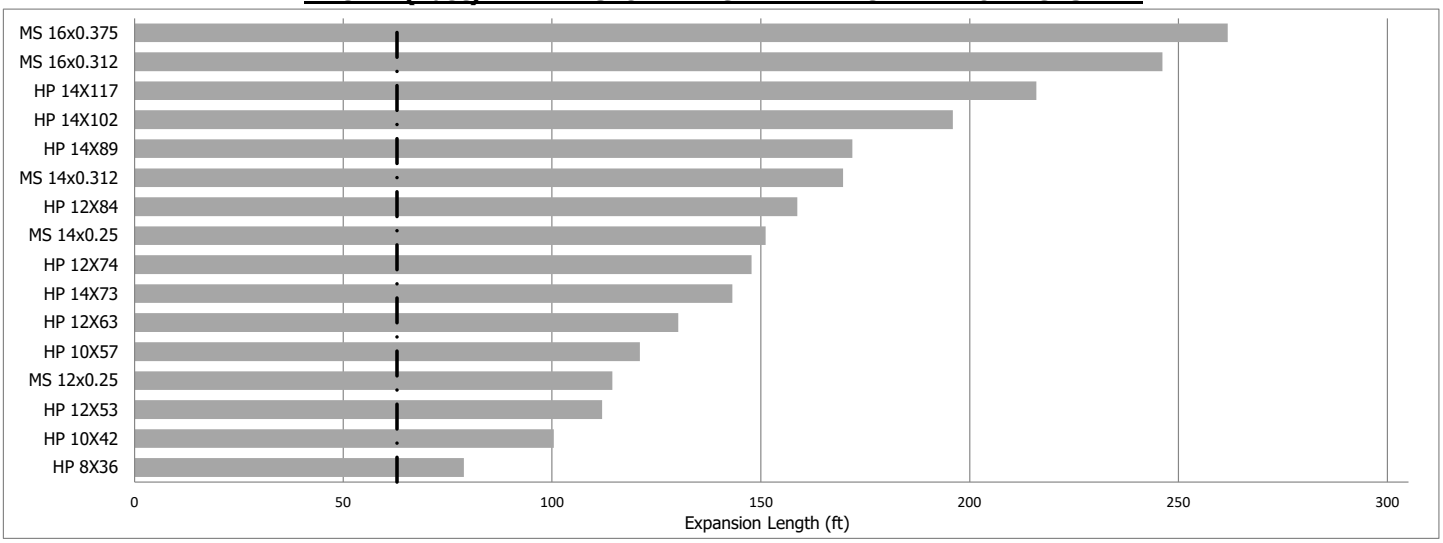
10.00 FT = TOTAL DEPTH ENTERED

WEIGHTED AVERAGE Qu FOR ABUTMENT #1	2.68	TSF	WEIGHTED AVERAGE Qu FOR ABUTMENT #2	2.59	TSF
PILE STIFFNESS MODIFIER FOR ABUTMENT #1 = 1/(1.45-[0.3*2.68])	1.55		PILE STIFFNESS MODIFIER FOR ABUTMENT #2 = 1/(1.45-[0.3*2.59])	1.49	

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #1 = [1.55*13*0+1.49*13*128.5]/[1.55*13+1.49*13] = 62.89 FT

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #2 = [1.49*13*0+1.55*13*128.5]/[1.49*13+1.55*13] = 65.61 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	100-0108 - Widening Embankment		TOTAL STRUCTURE LENGTH	128.50	FT
STRUCTURE TYPE	MULTI-SPAN		NUMBER OF SPANS	3	
STRUCTURE SKEW	0	DEGREES	END SPAN LENGTH	38.00	FT
SUPER. DATA IN REFERENCE TO SUB. DATA	ABUT 1		ADJACENT INTERIOR SPAN LENGTH	52.50	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.	13	
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.	13	
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		

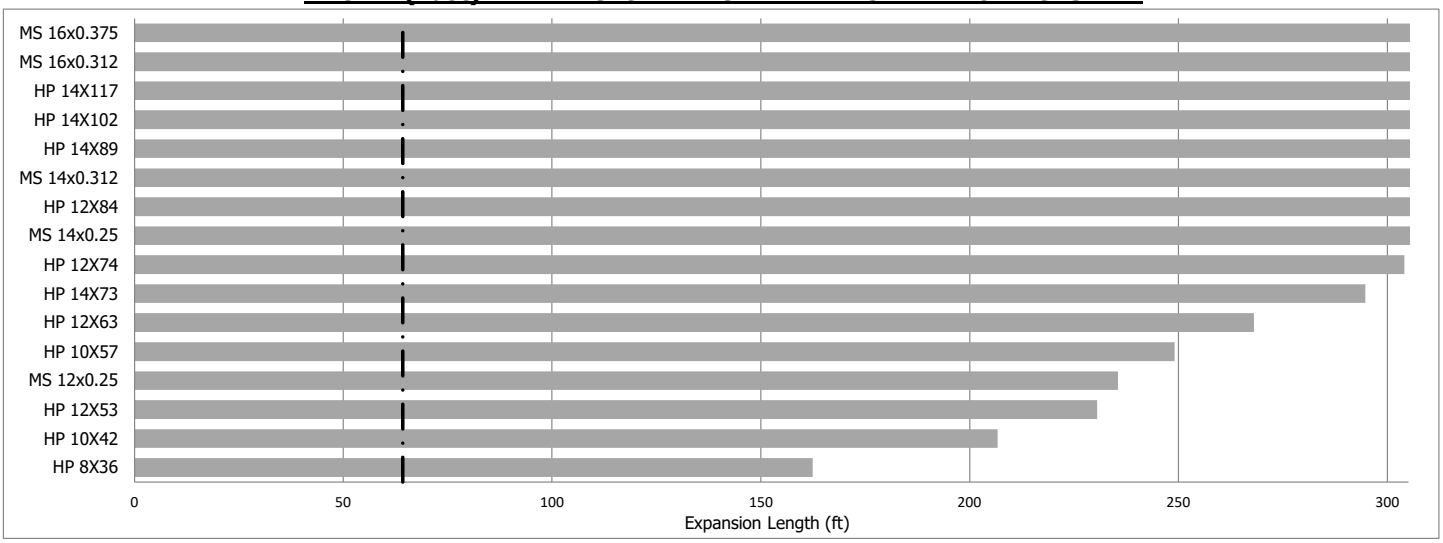
10.00 FT = TOTAL DEPTH ENTERED

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*13*0+0.87*13*128.5]/[0.87*13+0.87*13] = 64.25 FT

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #2 = [0.87*13*0+0.87*13*128.5]/[0.87*13+0.87*13] = 64.25 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, 0109 widening embankment condition OK

Illinois Department of Transportation

INTEGRAL ABUTMENT FEASIBILITY ANALYSIS

Modified 10/30/17

GENERAL DATA

STRUCTURE NUMBER	100-0109		TOTAL STRUCTURE LENGTH	128.50	FT
STRUCTURE TYPE	MULTI-SPAN		NUMBER OF SPANS	3	
STRUCTURE SKEW	0	DEGREES	END SPAN LENGTH	38.00	FT
SUPER. DATA IN REFERENCE TO SUB. DATA	ABUT 1		ADJACENT INTERIOR SPAN LENGTH	52.50	FT

SUPERSTRUCTURE POSITIVE MOMENT REGION DATA (END OR MAIN SPAN)

BEAM TYPE	WIDE FLANGE	
WIDE FLANGE	W27X102	
BEAM SPACING PERP. TO CL	6.17	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	6.17	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	6.17	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	6.17	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)*
405.80	2.20	0.6		
402.80	3.00	1.9		
400.30	2.50	1.6		
398.00	2.30	1.9		

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)*
405.20	2.80	1.4		
402.70	2.50	1.9		
400.20	2.50	1.6		
398.00	2.20	1.50		

10.00 FT = TOTAL DEPTH ENTERED

WEIGHTED AVERAGE Qu FOR ABUTMENT #1 = 1.54 TSF

PILE STIFFNESS MODIFIER FOR ABUTMENT #1
= 1/(1.45-[0.3*1.54]) = 1.01

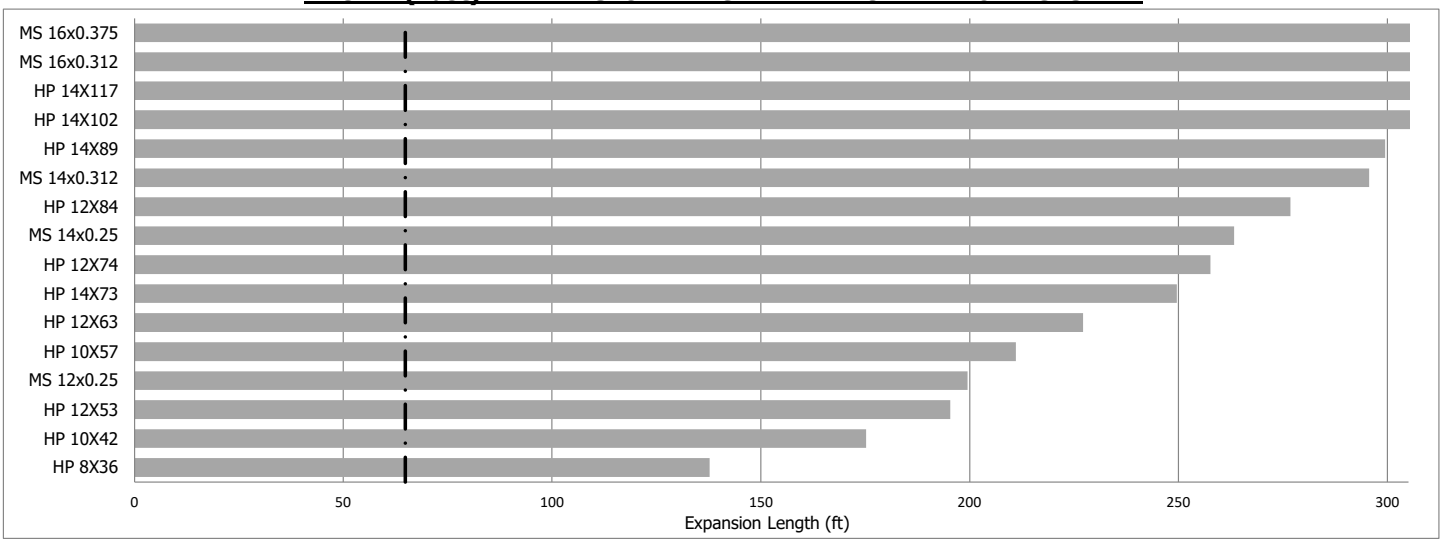
WEIGHTED AVERAGE Qu FOR ABUTMENT #2 = 1.60 TSF

PILE STIFFNESS MODIFIER FOR ABUTMENT #2
= 1/(1.45-[0.3*1.6]) = 1.03

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #1 = [1.01*10*0+1.03*10*128.5]/[1.01*10+1.03*10] = 64.82 FT

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #2 = [1.03*10*0+1.01*10*128.5]/[1.03*10+1.01*10] = 63.68 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========== 100-0108 - 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 ========== 1700 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 76.17 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 178.55 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 66.96 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	**67** 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		0	Sandy Gravel	0.0		0.0	0.0		0.0	0	0	0	0	5
403.00	2.50		0	Sandy Gravel	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	7
400.50	2.50		0	Sandy Gravel	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	10
398.00	2.50		0	Sandy Gravel	0.0	0.0	20.6	0.0	0.0	***2.2***	2	0	0	1	12
395.50	2.50		6	Sandy Gravel	1.6	20.6	22.3	2.4	2.2	***4.7***	5	0	0	3	15
393.00	2.50		6	Sandy Gravel	1.6	20.6	6.7	2.4	2.2	***5.3***	5	0	0	3	17
390.40	2.60		1	Sandy Gravel	0.3	3.4	15.2	0.4	0.4	***6.6***	7	0	0	4	20
387.90	2.50	0.60			5.4	11.6	16.7	8.0	1.2	***14.2***	14	0	0	8	22
386.40	1.50	0.40			2.2	7.7	32.5	3.3	0.8	***18.9***	19	0	0	10	24
382.90	3.50	1.10			12.6	21.3	***29.6***	18.7	2.3	36.0	30	0	0	16	27
380.40	2.50	0.30			2.8	5.8	46.0	4.2	0.6	***41.7***	42	0	0	23	30
377.90	2.50	1.00			8.3	19.3	***42.7***	12.4	2.1	52.8	43	0	0	24	32
375.40	2.50	0.40			3.7	7.7	75.5	5.5	0.8	***61.5***	61	0	0	34	35
370.40	5.00	1.90			26.5	36.7	***90.3***	39.3	4.0	99.5	90	0	0	50	40
365.40	5.00	1.30			20.4	25.1	***93.4***	30.3	2.7	128.0	93	0	0	51	45
360.40	5.00	0.40			7.5	7.7	***106.6***	11.1	0.8	139.6	107	0	0	59	50
355.40	5.00	0.70			12.4	13.5	***115.1***	18.4	1.5	157.6	115	0	0	63	55
350.40	5.00	0.50			9.2	9.7	***143.6***	13.6	1.0	173.3	144	0	0	79	60
347.90	2.50	1.50			11.3	29.0	297.7	16.8	3.1	***205.4***	205	0	0	113	62
346.90	1.00			Shale	58.5	171.8	356.3	86.9	18.5	***292.3***	292	0	0	161	63.1
345.90	1.00			Shale	58.5	171.8	414.8	86.9	18.5	***379.2***	379	0	0	209	64.1
344.90	1.00			Shale	58.5	171.8	473.4	86.9	18.5	***466.1***	466	0	0	256	65.1
343.90	1.00			Shale	58.5	171.8	***531.9***	86.9	18.5	553.0	532	0	0	293	66.1
342.90	1.00			Shale	58.5	171.8	***590.5***	86.9	18.5	639.9	~~590~~	~~0~~	~~0~~	~~325~~	~~67.1~~
341.90	1.00			Shale	58.5	171.8	***649.0***	86.9	18.5	726.8	~~649~~	~~0~~	~~0~~	~~357~~	~~68.1~~
340.90	1.00			Shale		171.8			18.5						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0108 - 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 ========== 1700 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 76.17 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 178.55 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 66.96 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	**57** 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		0	Sandy Gravel	0.0		0.0	0.0		0.0	0	0	0	0	5
403.00	2.50		0	Sandy Gravel	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	7
400.50	2.50		0	Sandy Gravel	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	10
398.00	2.50		0	Sandy Gravel	0.0	0.0	20.6	0.0	0.0	***2.2***	2	0	0	1	12
395.50	2.50		6	Sandy Gravel	1.6	20.6	22.3	2.4	2.2	***4.7***	5	0	0	3	15
393.00	2.50		6	Sandy Gravel	1.6	20.6	6.7	2.4	2.2	***5.3***	5	0	0	3	17
390.40	2.60		1	Sandy Gravel	0.3	3.4	13.2	0.4	0.4	***6.4***	6	0	0	3	20
387.90	2.50	0.50			4.6	9.7	14.0	6.8	1.0	***12.7***	13	0	0	7	22
385.90	2.00	0.30			2.3	5.8	47.2	3.4	0.6	***19.4***	19	0	0	11	24
383.40	2.50	1.90			13.2	36.7	39.1	19.6	4.0	***36.8***	37	0	0	20	27
380.90	2.50	0.80			6.9	15.5	67.3	10.3	1.7	***49.4***	49	0	0	27	29
378.40	2.50	1.90			13.2	36.7	80.6	19.6	4.0	***69.0***	69	0	0	38	32
374.90	3.50	1.90			18.5	36.7	99.1	27.5	4.0	***96.5***	97	0	0	53	35
369.90	5.00	1.90			26.5	36.7	***112.0***	39.3	4.0	134.4	112	0	0	62	40
364.90	5.00	1.20			19.3	23.2	***129.4***	28.6	2.5	162.7	129	0	0	71	45
360.40	4.50	1.10			16.2	21.3	***147.5***	24.1	2.3	187.0	148	0	0	81	50
355.90	4.50	1.20			17.3	23.2	420.8	25.7	2.5	***240.3***	240	0	0	132	54
354.90	1.00			Sandstone	97.6	279.1	518.4	144.8	30.1	***385.1***	385	0	0	212	55.1
353.90	1.00			Sandstone	97.6	279.1	615.9	144.8	30.1	***529.9***	530	0	0	291	56.1
352.90	1.00			Sandstone	97.6	279.1	713.5	144.8	30.1	***674.7***	~~675~~	~~0~~	~~0~~	~~371~~	~~57.1~~
351.90	1.00			Sandstone	97.6	279.1	***811.1***	144.8	30.1	819.6	~~811~~	~~0~~	~~0~~	~~446~~	~~58.1~~
350.90	1.00			Sandstone	97.6	279.1	***908.7***	144.8	30.1	964.4	~~909~~	~~0~~	~~0~~	~~500~~	~~59.1~~
349.90	1.00			Sandstone	97.6	279.1	***1006.3***	144.8	30.1	1109.2	~~1006~~	~~0~~	~~0~~	~~553~~	~~60.1~~
348.90	1.00			Sandstone		279.1			30.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0109 - 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 ========== 1300 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 60.17 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 172.84 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 64.82 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.)
405.20	2.80	1.40			12.1		48.8	17.9		***21.9***	22	0	0	12	5
402.70	2.50	1.90			13.2	36.7	56.2	19.6	4.0	***40.9***	41	0	0	22	7
400.20	2.50	1.60			11.8	30.9	66.1	17.5	3.3	***58.2***	58	0	0	32	10
397.70	2.50	1.50			11.3	29.0	85.1	16.8	3.1	***75.8***	76	0	0	42	12
395.20	2.50	1.90			13.2	36.7	***90.6***	19.6	4.0	94.6	91	0	0	50	15
392.70	2.50	1.50			11.3	29.0	***94.2***	16.8	3.1	110.6	94	0	0	52	17
390.20	2.50	1.10			9.0	21.3	***97.4***	13.4	2.3	123.3	97	0	0	54	20
387.70	2.50	0.80			6.9	15.5	***98.6***	10.3	1.7	133.0	99	0	0	54	22
385.20	2.50	0.50			4.6	9.7	***112.8***	6.8	1.0	140.8	113	0	0	62	25
382.70	2.50	1.00			8.3	19.3	***107.6***	12.4	2.1	151.8	108	0	0	59	27
380.20	2.50	0.30			2.8	5.8	***124.0***	4.2	0.6	157.4	124	0	0	68	30
377.70	2.50	1.00			8.3	19.3	***118.8***	12.4	2.1	168.4	119	0	0	65	32
375.20	2.50	0.30			2.8	5.8	***131.3***	4.2	0.6	173.6	131	0	0	72	35
370.20	5.00	0.80			13.9	15.5	***158.7***	20.6	1.7	195.7	159	0	0	87	40
365.20	5.00	1.50			22.6	29.0	***171.7***	33.5	3.1	228.2	172	0	0	94	45
360.20	5.00	1.00			16.7	19.3	***184.5***	24.8	2.1	252.5	185	0	0	101	50
355.70	4.50	0.80			12.5	15.5	***193.1***	18.5	1.7	270.7	193	0	0	106	54
352.20	3.50	0.60			7.6	11.6	***189.1***	11.2	1.2	280.6	189	0	0	104	58
351.20	1.00			Sandstone	0.0	0.0	468.2	0.0	0.0	***310.7***	311	0	0	171	58.8
350.20	1.00			Sandstone	97.6	279.1	565.8	144.8	30.1	***455.5***	456	0	0	251	59.8
349.20	1.00			Sandstone	97.6	279.1	663.4	144.8	30.1	***600.3***	~~600~~	~~0~~	~~0~~	~~330~~	~~60.8~~
348.20	1.00			Sandstone	97.6	279.1	761.0	144.8	30.1	***745.2***	~~745~~	~~0~~	~~0~~	~~410~~	~~61.8~~
347.20	1.00			Sandstone	97.6	279.1	***858.6***	144.8	30.1	890.0	~~859~~	~~0~~	~~0~~	~~472~~	~~62.8~~
346.20	1.00			Sandstone	97.6	279.1	***956.1***	144.8	30.1	1034.8	~~956~~	~~0~~	~~0~~	~~526~~	~~63.8~~
345.20	1.00			Sandstone		279.1			30.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0109 - 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 ========== 1300 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 60.17 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 172.84 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 64.82 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.)
405.80	2.20	0.60			4.8		41.5	7.1		***11.0***	11	0	0	6	4
402.80	3.00	1.90			15.9	36.7	51.6	23.6	4.0	***34.0***	34	0	0	19	7
400.30	2.50	1.60			11.8	30.9	69.2	17.5	3.3	***52.1***	52	0	0	29	10
397.80	2.50	1.90			13.2	36.7	72.7	19.6	4.0	***70.7***	71	0	0	39	12
395.80	2.00	1.40			8.6	27.1	***77.5***	12.8	2.9	83.1	77	0	0	43	14
392.80	3.00	1.20			11.6	23.2	***94.8***	17.1	2.5	100.9	95	0	0	52	17
390.30	2.50	1.50			11.3	29.0	***100.4***	16.8	3.1	117.0	100	0	0	55	20
388.30	2.00	1.20			7.7	23.2	***94.5***	11.4	2.5	127.0	95	0	0	52	22
385.80	2.50	0.50			4.6	9.7	***112.6***	6.8	1.0	135.2	113	0	0	62	24
383.30	2.50	1.20			9.6	23.2	***104.9***	14.3	2.5	147.7	105	0	0	58	27
380.80	2.50	0.30			2.8	5.8	***107.7***	4.2	0.6	151.9	108	0	0	59	29
378.30	2.50	0.30			2.8	5.8	***135.7***	4.2	0.6	158.8	136	0	0	75	32
375.30	3.00	1.60			14.2	30.9	***155.7***	21.0	3.3	180.5	156	0	0	86	35
370.30	5.00	1.90			26.5	36.7	***176.3***	39.3	4.0	219.1	176	0	0	97	40
365.30	5.00	1.60			23.6	30.9	***178.7***	35.1	3.3	251.9	179	0	0	98	45
360.30	5.00	0.50			9.2	9.7	***189.8***	13.6	1.0	265.7	190	0	0	104	50
355.30	5.00	0.60			10.8	11.6	***198.7***	16.0	1.2	281.5	199	0	0	109	55
350.80	4.50	0.50			8.2	9.7	***228.2***	12.2	1.0	296.1	228	0	0	125	59
348.80	2.00	1.60			9.4	30.9	485.8	14.0	3.3	***336.8***	337	0	0	185	61
347.80	1.00			Sandstone	97.6	279.1	583.4	144.8	30.1	***481.6***	482	0	0	265	62.2
346.80	1.00			Sandstone	97.6	279.1	681.0	144.8	30.1	***626.5***	~~626~~	~~0~~	~~0~~	~~345~~	~~63.2~~
345.80	1.00			Sandstone	97.6	279.1	778.6	144.8	30.1	***771.3***	~~771~~	~~0~~	~~0~~	~~424~~	~~64.2~~
344.80	1.00			Sandstone	97.6	279.1	***876.1***	144.8	30.1	916.1	~~876~~	~~0~~	~~0~~	~~482~~	~~65.2~~
343.80	1.00			Sandstone	97.6	279.1	***973.7***	144.8	30.1	1060.9	~~974~~	~~0~~	~~0~~	~~536~~	~~66.2~~
342.80	1.00			Sandstone		279.1			30.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0108 - 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 = 393.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 386.40 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 3200 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 76.17 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 336.09 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 126.03 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	**534** KIPS	**286** KIPS	**65** 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.)
387.90	5.10	0.60			11.0		18.7	16.3		***17.2***	17	6	0	3	21
386.40	1.50	0.40			2.2	7.7	34.5	3.3	0.8	***22.0***	22	7	0	5	23
382.90	3.50	1.10			12.6	21.3	***31.7***	18.7	2.3	39.0	32	7	0	10	26
380.40	2.50	0.30			2.8	5.8	48.0	4.2	0.6	***44.7***	45	7	0	17	29
377.90	2.50	1.00			8.3	19.3	***44.8***	12.4	2.1	55.8	45	7	0	17	31
375.40	2.50	0.40			3.7	7.7	77.5	5.5	0.8	***64.5***	64	7	0	28	34
370.40	5.00	1.90			26.5	36.7	***92.4***	39.3	4.0	102.5	92	7	0	44	39
365.40	5.00	1.30			20.4	25.1	***95.4***	30.3	2.7	131.0	95	7	0	45	44
360.40	5.00	0.40			7.5	7.7	***108.7***	11.1	0.8	142.7	109	7	0	52	49
355.40	5.00	0.70			12.4	13.5	***117.2***	18.4	1.5	160.6	117	7	0	57	54
350.40	5.00	0.50			9.2	9.7	***145.7***	13.6	1.0	176.3	146	7	0	73	59
347.90	2.50	1.50			11.3	29.0	299.8	16.8	3.1	***208.4***	208	7	0	107	61
346.90	1.00			Shale	58.5	171.8	358.3	86.9	18.5	***295.3***	295	7	0	155	62.1
345.90	1.00			Shale	58.5	171.8	416.9	86.9	18.5	***382.2***	382	7	0	203	63.1
344.90	1.00			Shale	58.5	171.8	475.4	86.9	18.5	***469.1***	469	7	0	251	64.1
343.90	1.00			Shale	58.5	171.8	***534.0***	86.9	18.5	556.0	534	7	0	286	65.1
342.90	1.00			Shale	58.5	171.8	***592.5***	86.9	18.5	642.9	~~592~~	~~7~~	~~0~~	~~319~~	~~66.1~~
341.90	1.00			Shale	58.5	171.8	***651.0***	86.9	18.5	729.8	~~651~~	~~7~~	~~0~~	~~351~~	~~67.1~~
340.90	1.00			Shale		171.8			18.5						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0108 - 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 = 393.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 386.40 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 3200 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 76.17 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 336.09 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 126.03 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	**313** KIPS	**56** 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.)
387.90	5.10	0.50			9.3		15.1	13.9		***14.5***	14	5	0	3	21
385.90	2.00	0.30			2.3	5.8	48.3	3.4	0.6	***21.2***	21	5	0	7	23
383.40	2.50	1.90			13.2	36.7	40.3	19.6	4.0	***38.6***	39	5	0	16	26
380.90	2.50	0.80			6.9	15.5	68.5	10.3	1.7	***51.1***	51	5	0	23	28
378.40	2.50	1.90			13.2	36.7	81.8	19.6	4.0	***70.8***	71	5	0	34	31
374.90	3.50	1.90			18.5	36.7	100.3	27.5	4.0	***98.3***	98	5	0	49	34
369.90	5.00	1.90			26.5	36.7	***113.2***	39.3	4.0	136.1	113	5	0	57	39
364.90	5.00	1.20			19.3	23.2	***130.6***	28.6	2.5	164.5	131	5	0	67	44
360.40	4.50	1.10			16.2	21.3	***148.7***	24.1	2.3	188.8	149	5	0	77	49
355.90	4.50	1.20			17.3	23.2	422.0	25.7	2.5	***242.1***	242	5	0	128	53
354.90	1.00			Sandstone	97.6	279.1	519.5	144.8	30.1	***386.9***	387	5	0	208	54.1
353.90	1.00			Sandstone	97.6	279.1	617.1	144.8	30.1	***531.7***	532	5	0	287	55.1
352.90	1.00			Sandstone	97.6	279.1	714.7	144.8	30.1	***676.5***	~~677~~	~~5~~	~~0~~	~~367~~	~~56.1~~
351.90	1.00			Sandstone	97.6	279.1	***812.3***	144.8	30.1	821.3	~~812~~	~~5~~	~~0~~	~~442~~	~~57.1~~
350.90	1.00			Sandstone	97.6	279.1	***909.9***	144.8	30.1	966.1	~~910~~	~~5~~	~~0~~	~~495~~	~~58.1~~
349.90	1.00			Sandstone	97.6	279.1	***1007.5***	144.8	30.1	1110.9	~~1007~~	~~5~~	~~0~~	~~549~~	~~59.1~~
348.90	1.00			Sandstone		279.1			30.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0109 - 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 = 393.70 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 386.40 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 2600 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 60.17 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 345.69 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 129.63 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	**499** KIPS	**263** 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.)
392.70	1.00	1.50			4.5		25.8	6.7		***9.0***	9	2	0	2	16
390.20	2.50	1.10			9.0	21.3	29.0	13.4	2.3	***21.7***	22	7	0	5	19
387.70	2.50	0.80			6.9	15.5	***30.1***	10.3	1.7	31.4	30	11	0	5	21
385.20	2.50	0.50			4.6	9.7	44.4	6.8	1.0	***39.3***	39	11	0	10	24
382.70	2.50	1.00			8.3	19.3	***39.2***	12.4	2.1	50.2	39	11	0	10	26
380.20	2.50	0.30			2.8	5.8	***55.6***	4.2	0.6	55.9	56	11	0	19	29
377.70	2.50	1.00			8.3	19.3	***50.4***	12.4	2.1	66.8	50	11	0	16	31
375.20	2.50	0.30			2.8	5.8	***62.9***	4.2	0.6	72.1	63	11	0	23	34
370.20	5.00	0.80			13.9	15.5	***90.3***	20.6	1.7	94.1	90	11	0	38	39
365.20	5.00	1.50			22.6	29.0	***103.2***	33.5	3.1	126.6	103	11	0	46	44
360.20	5.00	1.00			16.7	19.3	***116.1***	24.8	2.1	151.0	116	11	0	53	49
355.70	4.50	0.80			12.5	15.5	***124.7***	18.5	1.7	169.1	125	11	0	57	53
352.20	3.50	0.60			7.6	11.6	***120.7***	11.2	1.2	179.1	121	11	0	55	57
351.20	1.00			Sandstone	0.0	0.0	399.8	0.0	0.0	***209.1***	209	11	0	104	57.8
350.20	1.00			Sandstone	97.6	279.1	497.4	144.8	30.1	***354.0***	354	11	0	183	58.8
349.20	1.00			Sandstone	97.6	279.1	595.0	144.8	30.1	***498.8***	499	11	0	263	59.8
348.20	1.00			Sandstone	97.6	279.1	692.5	144.8	30.1	***643.6***	~~644~~	~~11~~	~~0~~	~~343~~	~~60.8~~
347.20	1.00			Sandstone	97.6	279.1	790.1	144.8	30.1	***788.4***	~~788~~	~~11~~	~~0~~	~~422~~	~~61.8~~
346.20	1.00			Sandstone	97.6	279.1	***887.7***	144.8	30.1	933.2	~~888~~	~~11~~	~~0~~	~~477~~	~~62.8~~
345.20	1.00			Sandstone		279.1			30.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 100-0109 - 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 = 393.70 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 386.40 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 2600 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 60.17 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 345.69 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 129.63 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	**534** KIPS	**281** 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.)
392.80	0.90	1.20			3.5		32.5	5.1		***8.3***	8	2	0	3	16
390.30	2.50	1.50			11.3	29.0	38.0	16.8	3.1	***24.4***	24	8	0	5	19
388.30	2.00	1.20			7.7	23.2	***32.1***	11.4	2.5	34.4	32	12	0	5	21
385.80	2.50	0.50			4.6	9.7	50.2	6.8	1.0	***42.6***	43	12	0	11	23
383.30	2.50	1.20			9.6	23.2	***42.5***	14.3	2.5	55.1	42	12	0	11	26
380.80	2.50	0.30			2.8	5.8	***45.3***	4.2	0.6	59.3	45	12	0	13	28
378.30	2.50	0.30			2.8	5.8	73.3	4.2	0.6	***66.2***	66	12	0	24	31
375.30	3.00	1.60			14.2	30.9	93.3	21.0	3.3	***87.9***	88	12	0	36	34
370.30	5.00	1.90			26.5	36.7	***113.9***	39.3	4.0	126.5	114	12	0	50	39
365.30	5.00	1.60			23.6	30.9	***116.3***	35.1	3.3	159.3	116	12	0	52	44
360.30	5.00	0.50			9.2	9.7	***127.4***	13.6	1.0	173.1	127	12	0	58	49
355.30	5.00	0.60			10.8	11.6	***136.3***	16.0	1.2	188.9	136	12	0	63	54
350.80	4.50	0.50			8.2	9.7	***165.8***	12.2	1.0	203.5	166	12	0	79	58
348.80	2.00	1.60			9.4	30.9	423.4	14.0	3.3	***244.2***	244	12	0	122	60
347.80	1.00			Sandstone	97.6	279.1	521.0	144.8	30.1	***389.0***	389	12	0	202	61.2
346.80	1.00			Sandstone	97.6	279.1	618.6	144.8	30.1	***533.9***	534	12	0	281	62.2
345.80	1.00			Sandstone	97.6	279.1	716.2	144.8	30.1	***678.7***	~~679~~	~~12~~	~~0~~	~~361~~	~~63.2~~
344.80	1.00			Sandstone	97.6	279.1	***813.8***	144.8	30.1	823.5	~~814~~	~~12~~	~~0~~	~~435~~	~~64.2~~
343.80	1.00			Sandstone	97.6	279.1	***911.3***	144.8	30.1	968.3	~~911~~	~~12~~	~~0~~	~~489~~	~~65.2~~
342.80	1.00			Sandstone		279.1			30.1						