Structure Geotechnical Report

Larry Powers Road over I-57
Section 46-2(1)HBR-2
Kankakee County
SN 046-0087 (Existing)
SN 046-0151 (Proposed)
PTB Item 136/16
Contract No. 66961
P-93-030-06

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Attachments:
Aerial
Subsurface Profile
Preliminary TSL
Existing Pier Plan Sheet
Boring Logs
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Slope Stability Results
Seismic Soil Site Class

Contact the author if there are any questions regarding this report or if there are modifications to structure location, size, geometry or vertical alignment.

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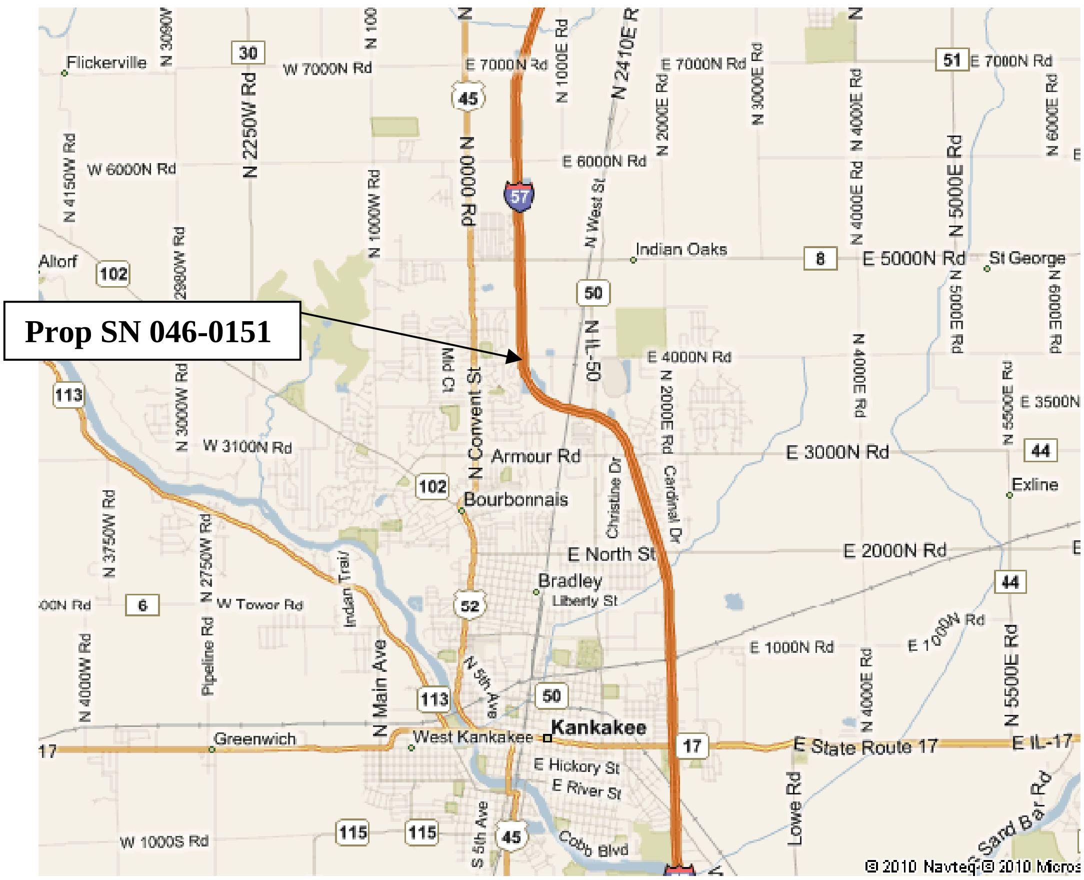
Project Description

The original structure, built in 1963, has a current sufficiency rating of 62.1 with an inventory and operating ratings of 17.2 and 28.3 respectively. The existing four span, 226 ft long structure has a bare reinforced concrete deck over continuous reinforced concrete T-beams. The superstructure is supported by pile bent abutments and hammerhead piers founded on pile supported footings. This structure is located 1.2 miles north of Kankakee, Illinois in Kankakee County on I-57.

The project includes removing the existing four span structure (SN 046-0087) and replacing it with a two span structure (SN 046-0151) with steel beams, a concrete deck on integral abutments and multi-column piers. The new abutments will be placed just in front of the existing abutments. The east and west piers are being eliminated while the center pier will be placed in the same location as the existing center pier. The structural engineer estimates the factored substructure loadings to be as high as 1900 kips at the abutment and 2750 kips at the pier.



<u>Subsurface Conditions</u>

Geology

Physiographically, the project location lies in the Kankakee outwash area, southwest of the Valparaiso Moraine, created by the Wisconsin glacial episode.

Bedrock was encountered in the boring logs drilled at this specific structure location. The top of rock elevation varies between 676.80 ft and 678.30 ft. The logs describe the surface to be weathered Dolostone. This depth is approximately 19 ft below the existing natural ground surface. The overburden and fill materials found in the embankment have relatively high unconfined compressive strengths, up to 7.8 tsf, Even with these high strength soils the rock may play a significant role in the design of the new structure.

Subsurface Profile

Three borings were taken for this structure, one near each proposed abutment and one near the proposed pier. One boring was taken through the roadway behind each abutment. One boring was taken on the south side of the proposed pier.

Boring #1 (NW Quadrant 1366+16, 6 ft Lt) with a ground surface elevation of 718.46 ft, encountered 2.5 ft of brown sand & gravel fill over 5.0 ft of very stiff brown and gray silty clay loam till with layers of black topsoil. Below this is approximately 15 ft of hard silty clay loam till fill with strengths between 4.0 and 4.9 tsf as determined by the Rimac soil classifier. Below the fill material is a 2 ft layer of very stiff black silty clay loam topsoil and 17ft of very stiff to hard silty clay loam till with unconfined compressive strengths between 2.5 and 7.8 tsf. At an elevation of 676.96 ft weathered Dolostone was encountered with an N-value of 50 blows/inch.

Boring #2 (S.E. Quadrant, 1368+87, 6 ft Rt) with a ground surface elevation of 718.30 ft, encountered similar soils with similar strengths as that found in boring B #1. The top of rock, white to tan Dolostone was encountered at 676.80 ft. The N-value at 1.5 ft into the rock was recorded as 100 blows/inch.

Boring #3 (Center Pier 1367+61, 24 ft Lt) with a ground surface elevation of 697.30 ft, encountered 2.5 ft of black silty clay loam fill material over 2 ft of very stiff silty clay (Loess) over 14.5 ft of hard silty clay loam till with unconfined compressive strengths between 4.0 and 9.9 tsf. At an elevation of 678.30 ft, weathered Dolostone was encountered with an N-value of 100 blows/inch.

For a more detailed description of the soils encountered, please refer to the attached profile and boring logs.

Groundwater

The groundwater was not encountered in any of the three borings.

Scour Potential

This structure does not cross a waterway; therefore, scour is not a concern.

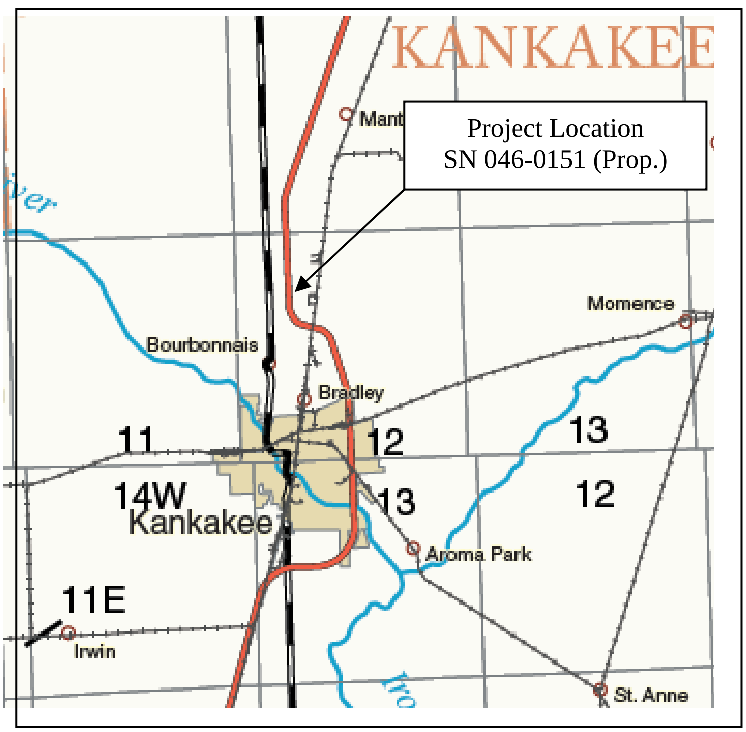
Abandoned Coal Mines

There are no records that indicate any mining activity at this specific project location. However, due to the shallowness and the quality of the rock, surface mining for limestone aggregate is prevalent in the area and is as close as 1 mile to the east of the structure.

The map below was taken from the website;

www.isgs.uiuc.edu/maps-data-pub/coal-maps/mines-series/mines-quads/pdf-files/quadstudies-bureau.pdf .

A more detailed map is not available for this exact location, alluding to the lack of mining activity at the bridge location.



Geotechnical Evaluation

Slope Stability

The soil profile at the east abutment was used for the slope stability evaluation since that boring had the weakest soils and provided the worst scenario of the two abutment/embankment borings. The cohesion values used in the slope stability analyses were estimated from the unconfined compressive strengths recorded on the boring logs. In addition, for the proposed embankment a cohesion value of 1000 psf was used to model the newly constructed embankment at the end of construction.

A factor of safety (FOS) of 7.0 was obtained using the SLIDE 5.0 slope stability software with the Simplified Bishop method for total stress (undrained) conditions. To check the long term stability of the embankment, effective stress or drained conditions were modeled. For an embankment made of a cohesive material under drained conditions, the cohesion is reduced and the internal angle of friction typically increases. Without having actual test data this reduction is done empirically from past experience. Some have argued that with the lack of actual test data for drained conditions the cohesion should be set to zero and the friction angle be raised up to between 20 and 30˚. By doing so, the resulting FOS is 1.50 using the Bishop method. This FOS was achieved by limiting the angle to which the slope can start to between -45° and -30°. This limits the search to more deep seated failures and not the surficial slides. The addition of some small amount of cohesion will raise the resulting factor of safety without limiting the angle to which the failure circle can begin. No load was applied to the slope during either stress condition.

A FOS of 1.5 is desired for undrained conditions at the end of construction, because of the lack of test data. This could be lowered to 1.3 if laboratory testing on shelby tube samples was performed. At this location it would be very difficult, if even possible, to obtain shelby tube samples in soils of these high strengths. The Illinois Department of Transportation has looked at short term undrained conditions as the most critical and therefore they have not published a FOS for drained conditions. The moisture contents from the borings taken at this site would suggest the embankment that has been in place for nearly 46 years is not in a drained condition.

Settlement

The new profile grade line shows an appreciable increase in elevation from the existing profile grade, especially in the areas being widened to accommodate additional lanes. At the abutments there appears to be less than 2 ft of new embankment above the existing embankment. To the north of the existing embankment approximately 23 ft. of fill is expected to widen the roadway. Due to the high unconfined compressive strengths and relatively low moisture contents of the founding soils, the additional embankment is expected to cause very little settlement in the embankment at the abutments. Elastic settlement is estimated to be less than 0.5 inches.

Seismic Considerations

The probability of a seismic event, large enough to cause damage to the structure or embankment, is not high enough to warrant any undo concern. Therefore, seismic effects were not considered in the foundation design of this project. This bridge is considered to have an Importance Category of “Other Bridge”. Please use the following seismic information for TSL and plan development.

Seismic Performance Zone (SPZ) = 1
Soil Site Class = C
Design Spectral Acceleration at 0.0 sec (As) = 0.056g
Design Spectral Acceleration at 0.2 sec (S_{DS}) = 0.120g
Design Spectral Acceleration at 1.0 sec (S_{D1}) = 0.065g

Per AGMU 10.1, a liquefaction analysis is not required for SPZ=1, therefore a liquefaction analysis was not completed.

Foundation Recommendations

The proposed bridge is approximately 215.0 ft long from back to back of the abutments. The following foundation options were explored for this structure;

- Spread footing for the pier
- Piling at the abutments and pier
- Drilled Shafts at the pier

The spread footing is an option for the pier due to the relatively high soil strengths and low moisture contents. This option may be the most economical of the three foundation types analyzed. As seen in the boring B-3, hard silty clay loam till with a Qu of 4.0 tsf and a moisture content of 19.7% was encountered at 4.5 ft. Using a resistance factor of 0.45 the factored bearing capacity of the founding soils for a foundation at this depth is 13.1 ksf. The proposed design load on the pier is estimated to be 2750k. For a 6ft wide and 56 ft long foundation the pier load translates to 8.2 ksf. The elastic settlement likely to result from a foundation at Elev. 692.80 ft is less than 0.50 inch with differential settlement less than 0.25 inches. The existing piling should be removed to at least 1 ft below the proposed footing elevation.

Driven piling is a viable option for both the pier and the abutments. A driven pile foundation is the preferred substructure treatment for the abutments at this structure. Because the local contractors have the in-house ability to drive pile this typically results in a lower cost option when compared to drilled shafts. However, spread footing is the lower cost option for the pier. Because of the relatively large Qu’s, H-pile would perform well at each of the substructure locations. Due to the length of structure, the following tables show only the H-pile for the driven pile option. The use of pile shoes is also recommended to help ensure the design bearing and estimated pile depths are attained especially at the pier where bedrock was encountered only 19 ft below the surface. The piling will need to be spaced as to miss the existing piling in both the pier and abutments. This is primarily a concern in the pier but the battered piling of the existing abutments may be an issue as well.

The pile tables, Tables 1 through 3, were generated using the modified IDOT formulas and factored loadings as recommended by the Bureau of Bridges and Structures, AGMU 10.2.

The pile lengths in the pier foundation should encounter rock near elevation 678 ft. When rock is encountered with a pile the Nominal Required Bearing can be increased to equal the Maximum Nominal Required Bearing of each pile section. The pile lengths shown in table 2 are based on 2 ft of the pile being embedded in the abutment foundation with a 3 ft encapsulation below the abutment and the bottom of the foundation elevations remaining at or near elevation 712.08 ft for the east abutment and 711.79 ft for the west abutment.

The proposed structure is being widened to the north. Using the bottom of abutment elevations of 711.79 ft and 712.08 ft for the west and east abutments respectively, there will be less than 2 ft of fill between the bottom of the 3 ft encasement and the existing fill material at the north pile. Therefore, depending on the nominal required bearing to which the pile is driven, the far north pile in each abutment may drive longer than the rest of the piling. This increase in depth is expected to be less than 2 ft in the lower required bearings. If the piles are driven into the bedrock there will likely be no change in pile length in the piles driven in the fill areas.

The pile lengths for the pier are based on a 1 ft embedment into the pier foundation with no encapsulation below the foundation with a bottom elevation of 692.10 ft.

The soil strengths and type and depth to bedrock may work well with drilled shafts. There were no rock cores taken for this structure. The drilled shaft option was investigated with the thought the shaft would terminate in the soil and at its deepest, be resting on the rock surface. Side friction and soil end bearing above the rock were used in the calculating the resistance of the individual shafts.

Table 3 shows a sample of resistance values, for depths of 10, 15 and 20 ft, capable of drilled shafts at this structure. Additional depths can be provided should the designer want to pursue this option. The top of shaft elevations used in the analysis for the pier was 695.00 ft. As mentioned previously in the report, rock cores were not taken for this structure. The 20 ft depth would be approximately 3 ft into the weathered bedrock. Table 3 is made up of values derived from a frictional component and end bearing component of the soil. The end bearing component of the bedrock was estimated on an unconfined compressive strength of 20 ksf and assumes there will be enough downward movement of the shaft for the skin friction in the soil to develop. There

appears to be enough resistance in the soil above the rock that it is likely a drilled shaft would terminate above the surface of the rock.
Rock cores should be taken by the District should drilled shafts into bedrock be selected for the foundation of choice. Drilled shafts were not considered for the abutments due to the depth needed to gain sufficient resistance.

Table 1, Estimated Pile Length for Pier Foundation

Piling Driven at Pier Utilizing Boring B-3		
Nominal Required Bearing (kips)	**Factored Resistance Available (kips)**	**Estimated Pile Length (ft)**
HP 10 X 42		
155	85	14
276	152	15
HP 12 x 53		
136	75	12
186	103	14
331	182	15
HP 12 X 63		
194	107	14
341	187	15
487	268	16
HP 14 X 73		
164	90	12
229	126	14
403	222	15
577	317	16
HP 14 X 89		
167	92	12
239	131	14
414	228	15
590	324	16

With the bedrock so close and with the possible effects from driving between the existing piling, driving the pile to rock is recommended. When rock is encountered with a pile the Nominal Required Bearing can be increased to equal the Maximum Nominal Required Bearing of each pile section.

Table 2, Estimated Pile Length for Abutment Foundations

Piling Driven for West Abutment Utilizing Boring B-1			Piling Driven for East Abutment Utilizing Boring B-2		
Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft)
HP 10 X 42			**HP 10 X 42**		
207	114	34	190	104	34
316	174	36	290	160	36
335	184	37	335	184	37
HP 12 X 53			**HP 12 X 53**		
252	139	34	232	127	34
378	208	36	348	191	36
418	230	37	418	230	37
HP 12 X 63			**HP 12 X 63**		
255	140	34	234	129	34
388	213	36	357	196	36
497	273	37	497	273	37
HP 14 X 73			**HP 14 X 73**		
270	149	26	279	154	34
293	161	31	423	233	36
304	167	34	578	318	37
459	253	36			
578	318	38			
HP 14 X 89			**HP 14 X 89**		
274	151	26	283	156	34
297	163	31	434	239	36
308	169	34	705	388	38
471	259	36			
705	388	38			

Table 3, Drilled Shaft in Soil Axial Capacity, Pier

Shaft Diameter (ft)	Depth (ft)	Total Factored Resistance (kips)
3	10	331
3	15	697
3	20	1030
4	10	551
4	15	1147
4	20	1656
5	10	825
5	15	1706
5	20	2424

Based on the preliminary TSL drawing, a single row of vertical piles is planned for the abutments and two rows in the pier substructure. Due to the possibility of vehicle collision with the pier it the pier foundation should withstand a 400 kip static load. A range of lateral loads from 1.0 kips/pile to 35.0 kips/pile were used for analysis at the pier. For comparison reasons the same lateral loads were used to analyze the east abutment. Due to the stiff soils at the abutments, pre-coring the upper portion of the pile and backfilling with loose pea gravel may be needed to allow for lateral movement from expansion and contraction.

A 6 ft wide by 56 ft long footing, under a load of 2750 kip will easily withstand this 400 kip static load. Using a resistance factor of $\varphi_T = 0.85$, $\delta = 18°$ the resistance force from the design load of 2750 kip and ignoring the passive pressure from the soil in front of the footing results in a resistance force of 893.5 kip.

These loads were evaluated for a single unit with the packaged software, L-pile. The attached graphs summarize our findings for the range of lateral loads that may become evident as the actual design of the structure begins. The graphs illustrate the effect of lateral load on pile head deflection and maximum bending moment. As can be seen in the graphs in the supporting documents portion of this report, the deflection is very minimal. As expected with the drilled shafts, the deflection is negligible and was not included in the graph set.

The pile length results, in general, showed very similar piling lengths and resistances at both abutments. Therefore, only the pier and east abutment were analyzed. Tables 5 through 6 are a compilation of the lateral load analysis. An HP 12 x 63 and HP 14 x 73 piling were examined for the pier and east abutment. This table does not give the depth of fixity rather it gives the depth to which a particular pile should be driven to achieve fixity.

Table 5, Driven Pile Depths to Achieve Fixity for East Abutment

East Abutment, 046-0151		
Lateral Load/Pile (lbs)	**Embedment Depth to Achieve Fixity (ft)**	
	HP 12	HP 14
100	8	11
500	12	12
1000	14	15
2000	17	18
4000	18	20

Table 6, Driven Pile Depths to Achieve Fixity for Pier

Pier, 046-0151		
Lateral Load/Pile (lbs)	**Embedment Depth to Achieve Fixity (ft)**	
	HP 12	HP 14
1000	11	13
5000	12	14
10000	13	15
20000	14	15
35000	14	15

This structure is currently being designed as a reinforced concrete deck with steel beams on integral abutments. The top of pile was analyzed as a fixed connection for both the pier and the abutment substructures. The pile sizes 12 x 63 and 14 x 73 were modeled for the pier with axial loadings of 250k. Drilled shafts with diameters of 3 ft 4 ft and 5 ft were modeled for the pier. The depth needed to achieve fixity for the above diameter shafts are 17 ft, 22 ft and 27 ft respectively. This is using a top of shaft elevation of 695.0 ft. Keep in mind because we are not expecting any settlement, the piles were not designed to accommodate negative skin friction. The effects of group interaction should be taken into account for lateral loads applied to the pier. The lateral resistance calculated above should be reduced by P-multipliers provided in the AASHTO LRFD Bridge Design Specifications when determining the lateral resistance of a pile group.

The soil parameters are based on empirical correlations with N-values from the SPT and unconfined compressive strength results shown in the boring logs as well as an assumed moist unit weight of 120 pcf.

Table 9, Soil Parameters at East Abutment

Soil Parameters For Static Lateral Load Analysis						
Soil Type From Boring #3	Angle of Internal Friction (degrees)	Undrained Shear Strength (psi)	Static Soil Modulus, k (pci)	Soil Strain Parameter E50	Effective Unit Wt. (pci)	Moist Unit Wt. (pci)
Very Stiff Silty Clay Loam	n/a	26.0	1000	0.005	0.0333	0.0694
Hard Silty Clay Loam	n/a	30.4	1000	0.005	0.0362	0.0723
Limestone	n/a	400	n/a	n/a	0.081	0.081

Table 10, Soil Parameters at Pier

Soil Parameters For Static Lateral Load Analysis						
Soil Type From Boring #2	Angle of Internal Friction (degrees)	Undrained Shear Strength (psi)	Static Soil Modulus, k (pci)	Soil Strain Parameter E50	Effective Unit Wt. (pci)	Moist Unit Wt. (pci)
Very Stiff to Hard Silty Clay	n/a	30.6	1000	0.005	0.033	0.0694
Limestone	n/a	400	n/a	n/a	0.081	0.081

Construction Considerations

At this time, the structure is planned to be built under closed road conditions with traffic being detoured around the location. The borings show very similar soil types and strengths from the east abutment to the west abutment however there will be a large amount of fill on the north side of the existing embankment. Test piles are useful for determining actual pile lengths during construction and suggest one be placed near centerline and in the widening area of embankments. One test pile at each abutment should suffice.

If a spread footing is used in the pier, the soil strengths suggest the excavation may go unsupported if the bottom of the excavation is above the water table. The water table was not encountered at the time of subsurface investigation. If sheet piling is used to brace the excavation, the N values and Qu's at the pier shown in the boring logs suggest the sheets should be driven without difficulty if the foundation is near 692.10. The piling in the existing pier should be removed to a minimum of 1 ft below the bottom of the proposed pier.

Should drilled shafts be used, temporary casing is not expected due to the cohesive nature of the soils and the fact that the groundwater table was not encountered in any of the borings. If pilings are chosen as the foundation type, An HP 12 or HP 14 is recommended for this structure because of their large range of available resistances. If the spacing of the piling is large, near 8 ft, a pile larger than the HP12x63 is recommended for the pier. The abutment loadings are less than that of the pier but the abutment is expected to have only one row of piling. For this reason the smallest recommended pile here is the HP 12x63 if the spacing is near 8 ft, making the individual pile load near 250 kip. Care will need to be taken to place the pile so as to miss the existing piling in both abutments and the pier. The existing piling, 10x42, in the pier as can be seen in the attached plan sheet are approximately 3.83 ft center to center.

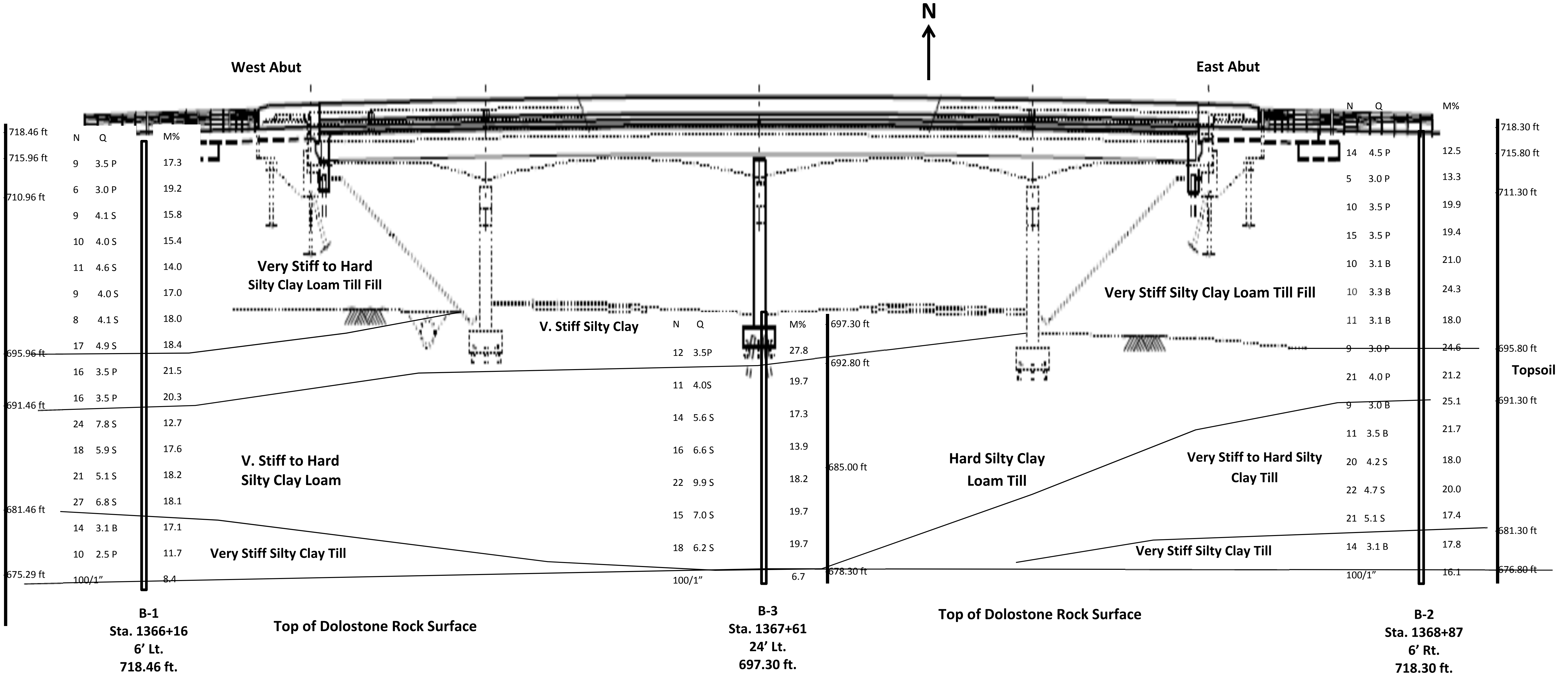
Because of the lack of settlement expected, it is possible to construct the embankment and drive the piling through the embankment without pre-coring. The amount of fill to which the piling would need to be driven through is estimated at 2 ft at the north end of the abutments. No borings were taken at the toe of the slope. This area is typically where water sits and the soil here can soften over time. During construction, topsoil and any weak and/or wet material should be removed.

Should the pile be driven into the limestone below cutting shoes for the H-pile would aid in the driving of the pile. All excavations should meet the applicable OSHA standards.

Supporting Documents

Aerial Photo of Structure Location

Subsurface Profile



Mc Cleary Engineering

SOIL PROFILE
Proposed SN 046-0151
Larry Powers Road
Over FAI-57 Sec. 46-2(I) HBR-1

Preliminary TSL

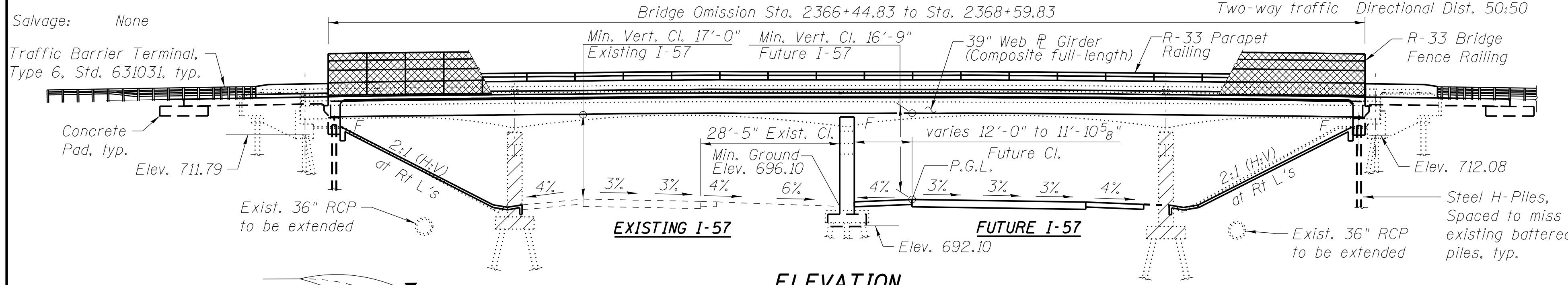
Benchmark: B.M. # 702 - Spike in power pole, Sta. 2375+73, 33' Rt, Elev. 698.32

Existing Structure: S.N. 046-0087, originally built under FAI-57, Section 46-2(I)HB-2 in 1963. Bridge consists of a four span continuous haunched R.C. deck girder superstructure supported by three hammerhead piers founded on footings supported by steel H-piles bearing on rock and two pile bent abutments. 226'-6" bk. to bk. abutments, 29'-8" out-to-out. Entire structure to be removed and replaced. Larry Power Road will be closed and traffic detoured during construction. Temporary shoulder closures, lane shifts and intermittent total closures will be required on I-57.

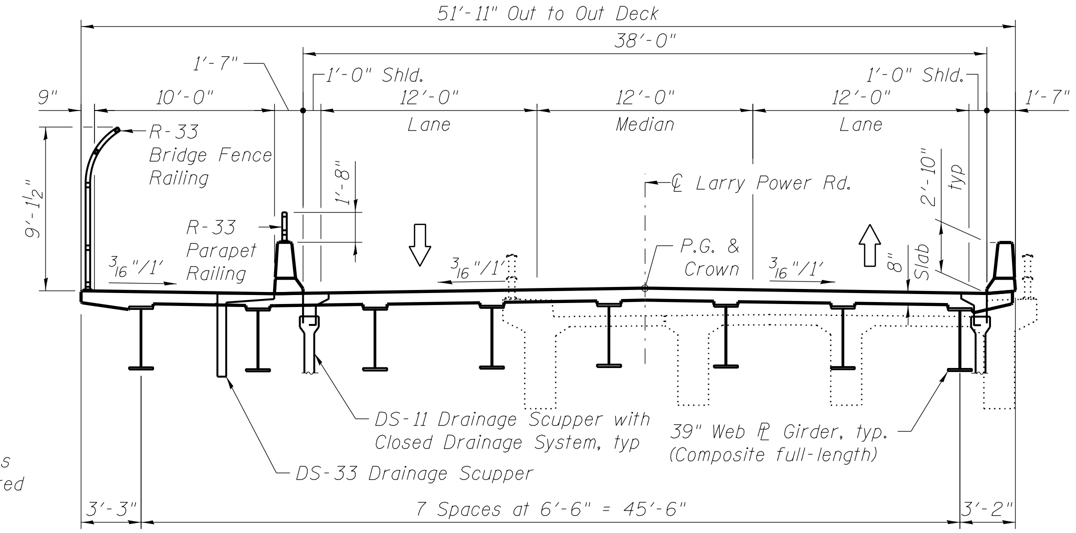
Salvage: None

HIGHWAY CLASSIFICATION

FAU 6214 - Larry Power Road	F.A.I. Rte. 57
Functional Class: Minor Arterial (Urban)	Functional Class: Interstate
ADT: 8,200 (2011); 13,100 (2031)	ADT: 33,400 (2009); 58,500 (2029)
ADTT: 12%	ADTT: 22%
DHV: 1,310 (2031)	DHV: 5,265 (2029)
Speed: 35 m.p.h.(Design); 35 m.p.h.(Posted)	Speed: 70 m.p.h.(Design) 65 m.p.h.(Posted)
Two-way traffic Directional Dist. 50:50	Two-way traffic Directional Dist. 50:50



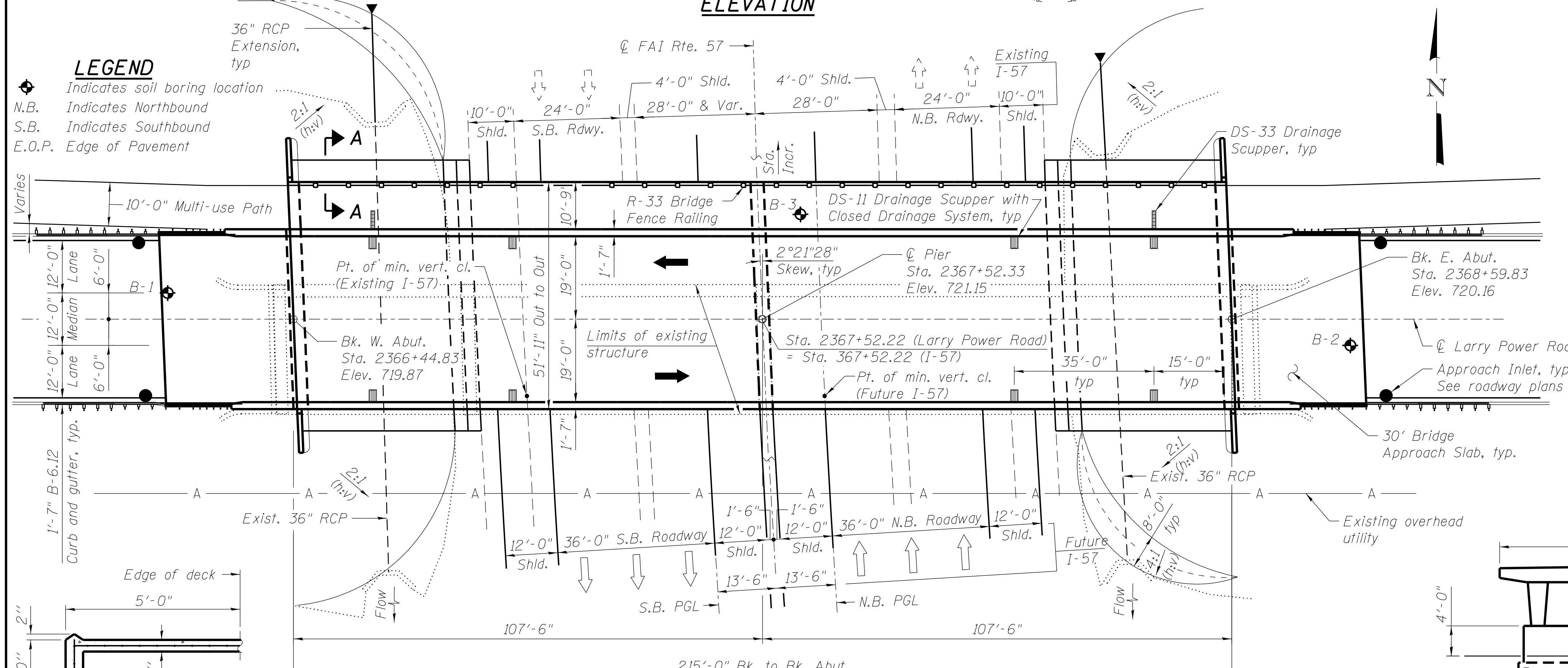
ELEVATION



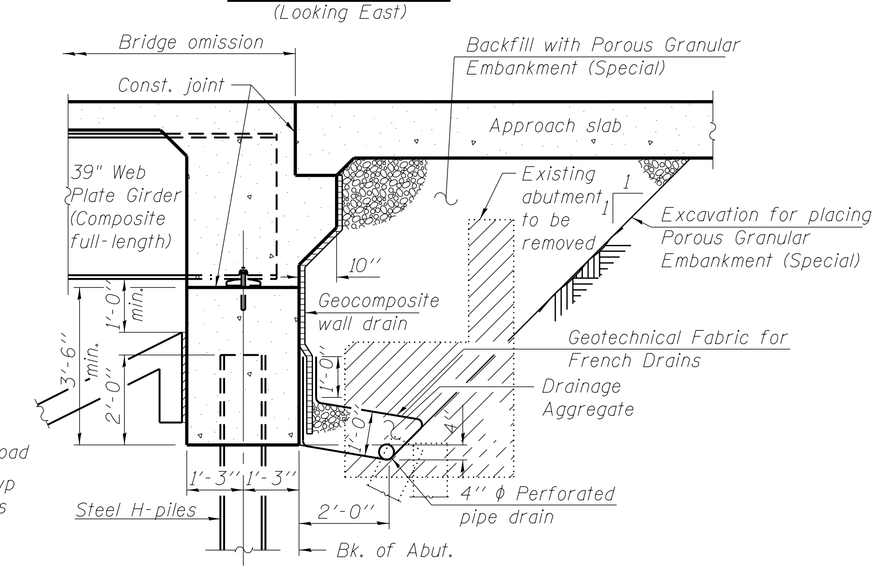
CROSS-SECTION
(Looking East)

LEGEND

⊕ Indicates soil boring location
N.B. Indicates Northbound
S.B. Indicates Southbound
E.O.P. Edge of Pavement



PLAN



SECTION THRU INTEGRAL ABUTMENT
(Horiz. dim. @ Rt. L's)

DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (M270 Grade 50)

SEISMIC DATA

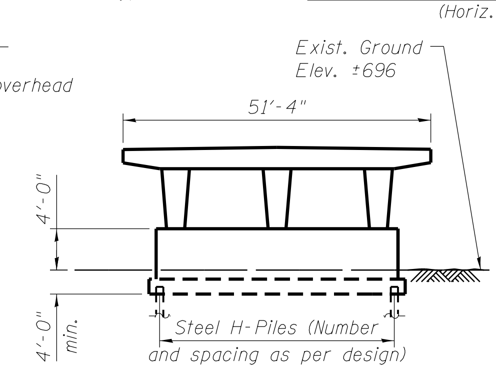
Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.065g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.120g
Soil Site Class = C

DESIGN SPECIFICATIONS

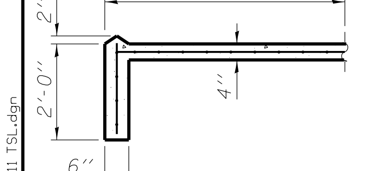
2010 AASHTO LRFD Bridge Design Specifications with 2010 Interims

LOADING HL-93

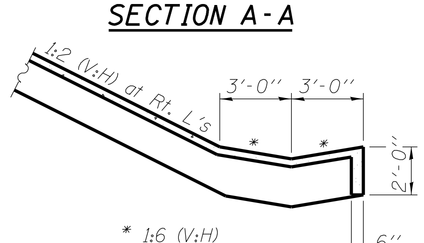
Allow 50#/sq. ft. for future wearing surface.



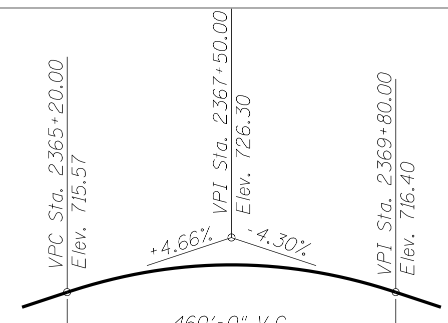
PIER SKETCH



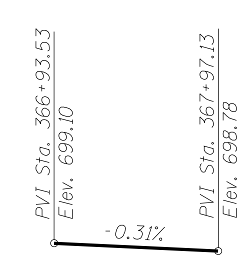
SECTION A-A



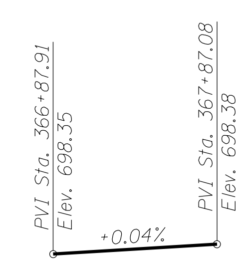
SECTION THRU CONCRETE SLOPEWALL



PROFILE GRADE
LARRY POWER ROAD
Along ℄ Roadway



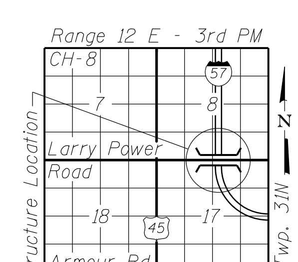
SURVEYED WEST E.O.P
N.B. I-57



SURVEYED EAST E.O.P.
S.B. I-57

I-57 CURVE DATA

Δ = 74°47'29.21" (RT)
D = 1°59'58.50"
T = 2,190.41'
L = 3,740.35'
E = 741.32'
R = 2,865.38'
S.E. = 0.04 '/' and varies
P.C. = Sta. 330+48.47
P.T. = Sta. 367+88.81
P.I. = Sta. 352+38.88



LOCATION SKETCH

GENERAL PLAN
LARRY POWER ROAD OVER F.A.I. 57
SECTION 46-2(I)HBR-2
KANKAKEE COUNTY
STATION 2367+52.33
STRUCTURE NO. 046-0151

N:\PROJ\0003291.00\0003291.11\Design\Structural\CAD\3291_11 TSL.dgn

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue Suite 402 Chicago, Illinois 60656
Tel 773.775.4009 Fax 773.775.4014 Email chicago@ciorba.com

USER NAME = akhan	DESIGNED - AMK	REVISED -
	CHECKED - BWS	REVISED -
PLOT SCALE = 32.000000 ' / in.	DRAWN - RD	REVISED -
PLOT DATE = 10/20/2011	CHECKED - DL	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. OF SHEETS

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
6214	46-2 (I) HBR-2	KANKAKEE	1	1

CONTRACT NO. 66961

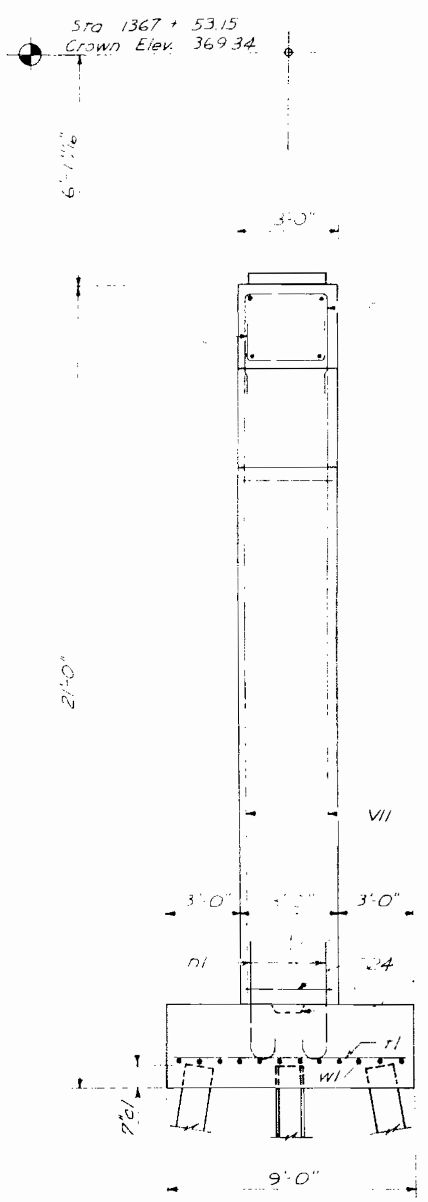
ILLINOIS FED. AID PROJECT

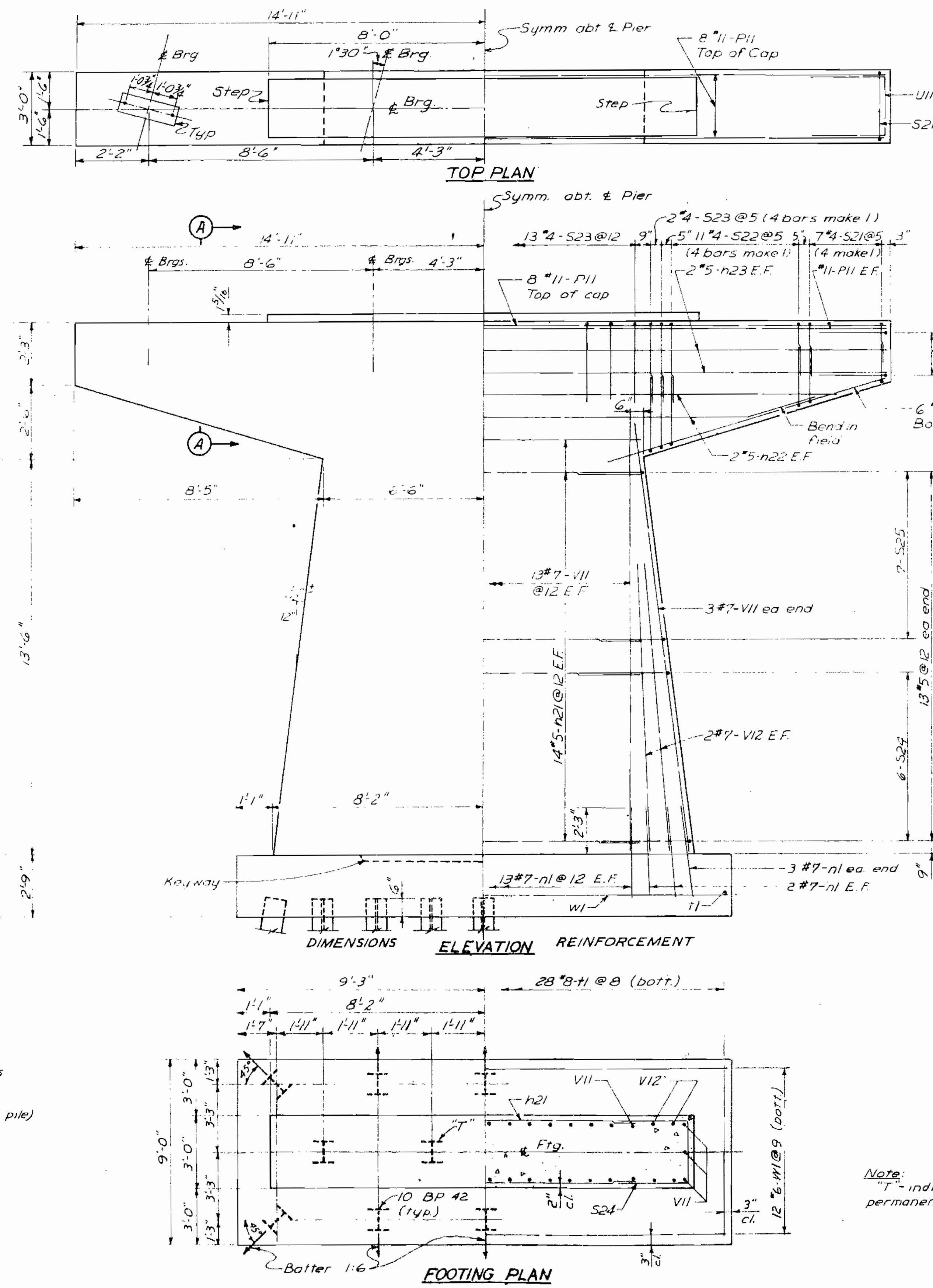
Existing Pier Plan Sheet

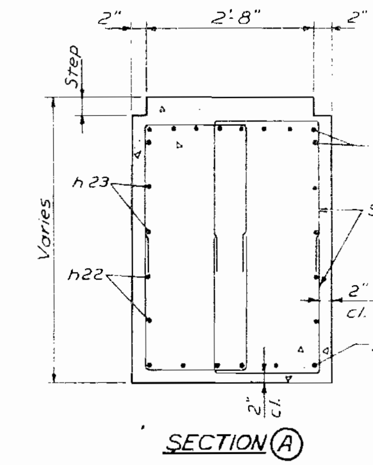
ROUTE NO.	SEC	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I. 57	46-2(I)HB-2	KANKAKEE	22	13
STA		TO STA		
FED ROAD DIST No 7	ILLINOIS	FED AID PROJECT		

SHT 8 OF 10

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



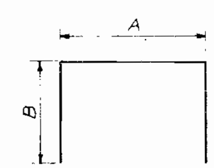




Note: All edges shall have standard 3/4" chamfers except footings

PILE DATA

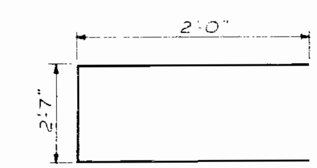
Type - 10 BP 42
Capacity - 35 tons
Est. length - 15'
No. reqd - 14
(includes 1 test pile)



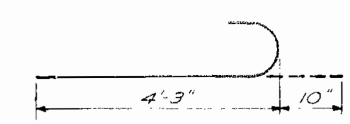
A ¢ B DIMENSIONS

Bar	A	B
S21	1'-8"	2'-0"
S22	1'-8"	2'-8"
S23	1'-8"	3'-0"
S24	2'-8"	2'-9"
S25	2'-8"	2'-0"

S BARS



U11 BAR



n1 BAR

Note:
"T" - indicates location of permanent test pile

PIER 2
BILL OF MATERIAL

Bar	No.	Size	Length	Shape
h21	28	#5	12'-10"	——
h22	4	#5	26'-0"	——
h23	4	#5	29'-6"	——
n1	40	#7	5'-1"	——⊃
P11	10	#[illegible]	29'-6"	——
P12	12	#[illegible]	10'-0"	——
S21	56	#4	5'-8"	⊓
S22	88	#4	7'-0"	⊓
S23	42	#4	7'-8"	⊓
S24	12	#5	8'-2"	⊓
S25	14	#5	6'-8"	⊓
t1	28	#8	8'-6"	——
U11	6	#[illegible]	6'-7"	⊏
V11	32	#[illegible]	15'-6"	——
V12	8	#7	8'-3"	——
W1	12	#6	18'-0"	——
Class X Concrete			Cu. Yds.	52.5
Reinforcement Bars			Lbs.	5,875
Steel Piles (10BP42)			Lin. Ft.	195
Test Pile (Steel)			Each	1
Cl. A Excav. for Struct.			Cu. Yds.	34

DESIGNED RJH
CHECKED RD
DRAWN BDD LCH
CHECKED RD

EXAMINED ______ 19__
ENGINEER OF BRIDGE AND TRAFFIC STRUCTURES
PASSED
ENGINEER OF DESIGN
APPROVED
CHIEF HIGHWAY ENGINEER

ILLINOIS DIVISION OF HIGHWAYS

PIER NO. 2
(FIXED)
F.A.I. RT. 57 SEC. 46-2(I)HB-2
KANKAKEE COUNTY
STRUCTURE NO. 8
STATION 367+45.50

Boring Logs

Illinois Department of Transportation
Division of Highways
ILLINOIS DEPARTMENT OF TRASPORTATION

SOIL BORING LOG

Date 10/21/10

ROUTE I-57 (FAI 57) **DESCRIPTION** Larry Power Road over I-57, 1.2 Miles North of IL 50 **LOGGED BY** Larry Myers

SECTION 46-2 (1) HBR-2 **LOCATION** South 1/2, **SEC.** 8, **TWP.** 31N, **RNG.** 12E

COUNTY Kankakee **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. 046-0087 (Exist.)
Station 367+45.5 (I-57 Exist.)

BORING NO. 1 (W. Abut.)
Station 1366+16 (Larry Power)
Offset 6.00ft Lt.
Ground Surface Elev. 718.46 ft

Surface Water Elev. ______ ft
Stream Bed Elev. ______ ft

Groundwater Elev.:
First Encounter ______ ft
Upon Completion Dry ft
After ____ **Hrs.** ______ ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Augered Bituminous, Brown Sand/Gravel Fill				
715.96				
Very Stiff Brown & Gray SIlty Clay Loam Till Fill with Layers of Black Topsoil		4		
		5	3.5	17.3
		4	P	
	-5	3		
		3	3.0	19.2
		3	P	
710.96				
Hard Brown & Gray Silty Clay Loam Till Fill		4		
		3	4.1	15.8
		6	S	
	-10	4		
		4	4.0	15.4
		6	S	
		5		
		5	4.6	14.0
		6	S	
	-15	3		
		4	4.0	17.0
		5	S	
		5		
		4	4.1	18.0
		4	S	
	-20			
Hard Brown & Gray Silty Clay Loam Till Fill *(continued)*		5		
		7	4.9	18.4
		10	S	
695.96				
Very Stiff Black Silty Clay Loam Topsoil		11		
		9	3.5	21.5
		7	P	
693.96				
Very Stiff Grayish Brown Silty Clay Loam/Silty Loam Till	-25	4		
		6	3.5	20.3
		10	P	
691.46				
Hard Brown & Gray Silty Clay Loam Till		7		
		9	7.8	12.7
		15	S	
	-30	6		
		8	5.9	17.6
		10	S	
		6		
		9	5.1	18.2
		12	S	
	-35	8		
		12	6.8	18.1
		15	S	
681.46				
Very Stiff Gray Silty Clay Till		5		
		6	3.1	17.1
		8	B	
678.46	-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
ILLINOIS DEPARTMENT OF TRASPORTATION

SOIL BORING LOG

Date 10/21/10

ROUTE I-57 (FAI 57) DESCRIPTION Larry Power Road over I-57, 1.2 Miles North of IL 50 LOGGED BY Larry Myers

SECTION 46-2 (1) HBR-2 LOCATION South 1/2, SEC. 8, TWP. 31N, RNG. 12E

COUNTY Kankakee DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME Automatic

STRUCT. NO. 046-0087 (Exist.)
Station 367+45.5 (I-57 Exist.)

BORING NO. 1 (W. Abut.)
Station 1366+16 (Larry Power)
Offset 6.00ft Lt.
Ground Surface Elev. 718.46 ft

Surface Water Elev. ft
Stream Bed Elev. ft

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

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Stiff Brown Loam with Dolostone Fragments		3		
		5	2.5	11.7
676.96		5	P	
White to Tan Dolostone Weathered and Reworked in Top 12"		61		
675.29		100/2"		8.4
End of Boring				
	-45			
	-50			
	-55			
	-60			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
ILLINOIS DEPARTMENT OF TRASPORTATION

SOIL BORING LOG

Date 10/21/10

ROUTE I-57 (FAI 57) **DESCRIPTION** Larry Power Road over I-57, 1.2 Miles North of IL 50 **LOGGED BY** Larry Myers

SECTION 46-2 (1) HBR-2 **LOCATION** North 1/2, **SEC.** 17, **TWP.** 31N, **RNG.** 12E

COUNTY Kankakee **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. 046-0087 (Exist.)
Station 367+45.5 (I-57 Exist.)

BORING NO. 2 (E. Abut.)
Station 1368+87 (Larry Power)
Offset 6.00ft Rt.
Ground Surface Elev. 718.30 ft

Surface Water Elev. ______ ft
Stream Bed Elev. ______ ft

Groundwater Elev.:
First Encounter ______ ft
Upon Completion Dry ft
After ____ **Hrs.** ______ ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Augered Bituminous, Brown Sand/Gravel Fill				
715.80				
Hard and Very Stiff Gray Silty Clay Loam Till Fill		4		
		6	4.5	12.5
		8	P	
	-5	3		
		1	3.0	13.3
712.08		4	P	
711.30				
Very Stiff Brown & Gray Silty Clay Loam Till Fill with Topsoil mixed in at 20'		3		
		4	3.5	19.9
		6	P	
	-10	3		
		6	3.5	19.4
		9	P	
		3		
		4	3.1	21.0
		6	B	
	-15	4		
		4	3.3	24.3
		6	B	
		4		
		5	3.1	18.0
		6	B	
	-20			

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Stiff Brown & Gray Silty Clay Loam Till Fill with Topsoil mixed in at 20' *(continued)*		4		
		4	3.0	24.6
		5	P	
695.80				
Hard Black Silty Clay Loam Topsoil		6		
		8	4.0	21.2
		13	P	
693.80				
Very Stiff Gray & Brown Silty Clay Loess	-25	3		
		4	3.0	25.1
		5	B	
691.30				
Very Stiff to Hard Brown & Gray Silty Clay Loam Till		4		
		5	3.5	21.7
		6	B	
	-30	6		
		8	4.2	18.0
		12	S	
		6		
		9	4.7	20.0
		13	S	
	-35	6		
		8	5.1	17.4
		13	S	
681.30				
Very Stiff Gray Silty Clay Till		5		
		6	3.1	17.8
		8	B	
678.80	-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
ILLINOIS DEPARTMENT OF TRASPORTATION

SOIL BORING LOG

Date 10/21/10

ROUTE I-57 (FAI 57) DESCRIPTION Larry Power Road over I-57, 1.2 Miles North of IL 50 LOGGED BY Larry Myers

SECTION 46-2 (1) HBR-2 LOCATION North 1/2, **SEC.** 17, **TWP.** 31N, **RNG.** 12E

COUNTY Kankakee DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME Automatic

STRUCT. NO. 046-0087 (Exist.)
Station 367+45.5 (I-57 Exist.)

BORING NO. 2 (E. Abut.)
Station 1368+87 (Larry Power)
Offset 6.00ft Rt.
Ground Surface Elev. 718.30 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter ____ ft
Upon Completion Dry ft
After ____ Hrs. ____ ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Stiff Brown Loam with Dolostone Fragments *(continued)*		3		
		4	2.5	16.1
676.80		5	P	
White to Tan Dolostone Weathered & Reworked in Top 12"				
675.22		41		
End of Boring		100/1"		14.4
	-45			
	-50			
	-55			
	-60			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation

Division of Highways
ILLINOIS DEPARTMENT OF TRASPORTATION

SOIL BORING LOG

Date 10/22/10

ROUTE I-57 (FAI 57) **DESCRIPTION** Larry Power Road over I-57, 1.2 Miles North of IL 50 **LOGGED BY** Larry Myers

SECTION 46-2 (1) HBR-2 **LOCATION** South 1/2, **SEC.** 8, **TWP.** 31N, **RNG.** 12E

COUNTY Kankakee **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. 046-0087 (Exist.)
Station 367+45.5 (I-57 Exist.)

BORING NO. 3 (Center Pier)
Station 1367+61 (Larry Power)
Offset 24.00ft Lt.
Ground Surface Elev. 697.30 ft

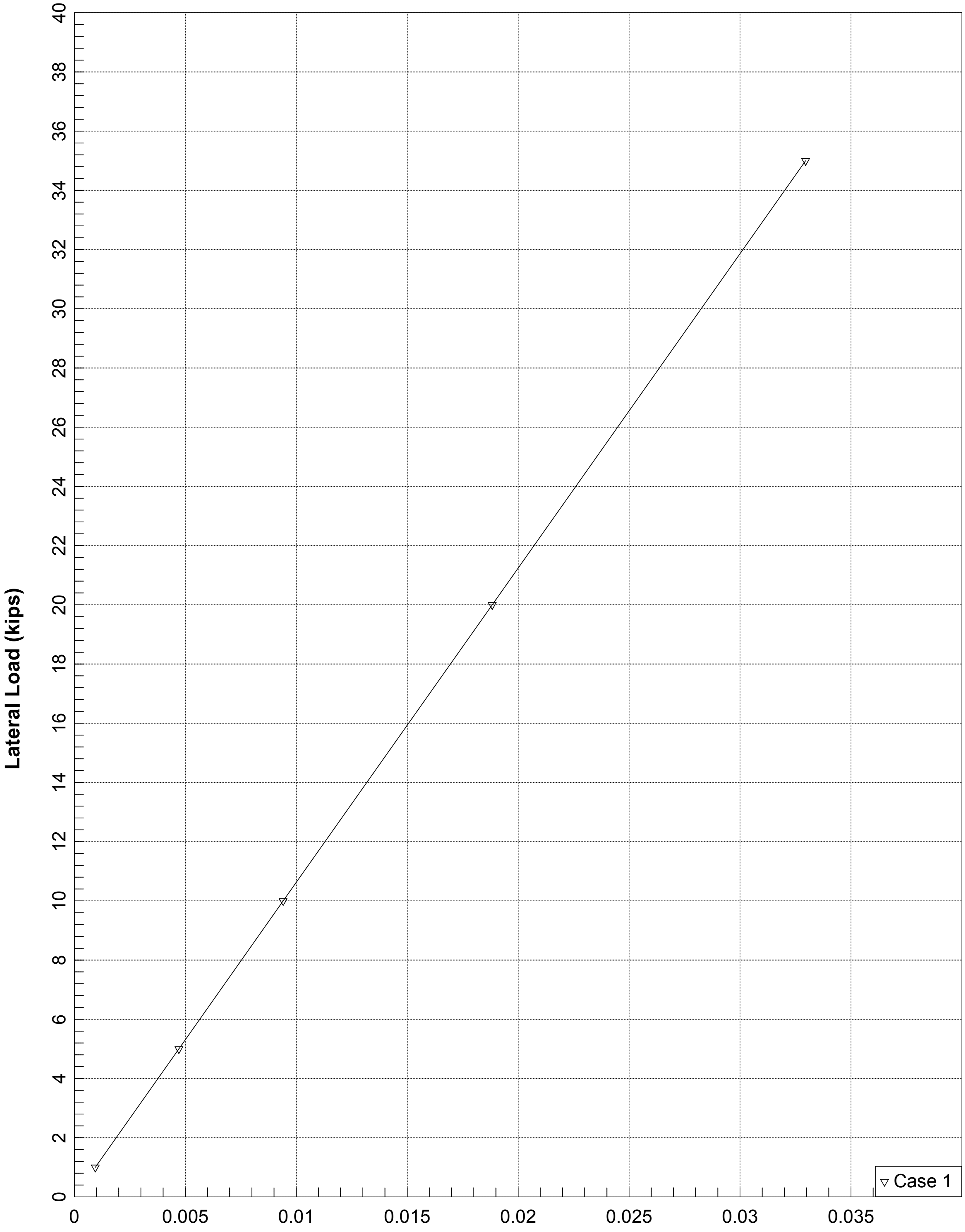
Surface Water Elev. ______ ft
Stream Bed Elev. ______ ft

Groundwater Elev.:
First Encounter ______ ft
Upon Completion Dry ft
After ____ **Hrs.** ______ ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Augered Black Silty Clay Loam Fill					
	694.80				
Very Stiff Brown & Gray Silty Clay Loess			4		
			5	3.5	27.8
			7	P	
	692.80				
Hard Brown & Gray Silty Clay Loam Till		-5			
	691.3		3		
			5	4.0	19.7
	690.3		6	S	
	689.3		5		
	688.3		6	5.6	17.3
			8	S	
	687.3	-10			
	686.3		5		
			6	6.6	13.9
	685.3		10	S	
	684.3		6		
			8	9.9	18.2
			14	S	
		-15	4		
			6	7.0	19.7
			9	S	
			5		
			8	6.2	19.7
	678.30		10	S	
		-20			
White to Tan Dolostone Weathered & Reworked in Top 12" *(continued)*	676.72		72		
			100/1"		6.7
End of Boring					
		-25			
		-30			
		-35			
		-40			

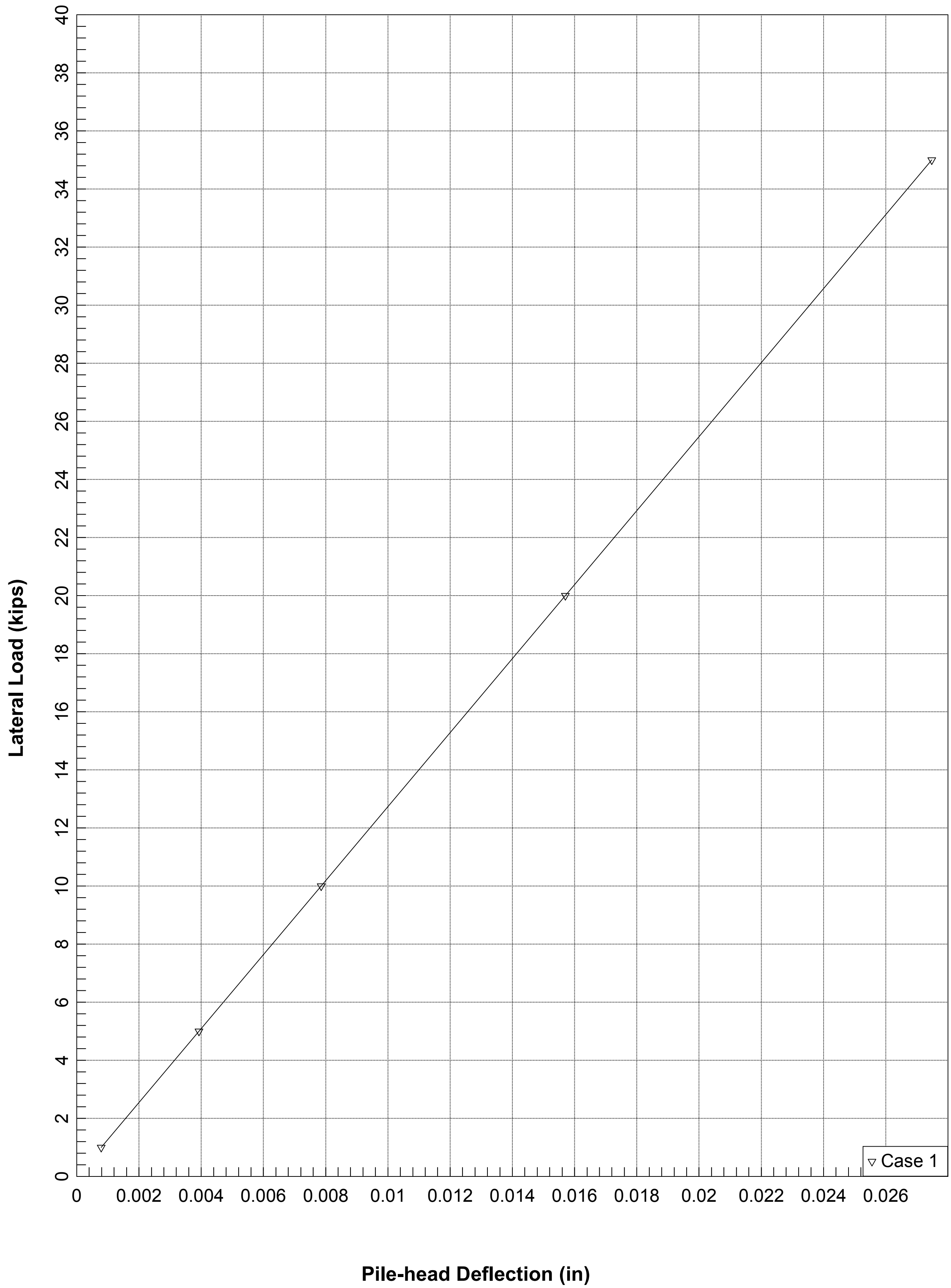
The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Lateral Load Analysis Results

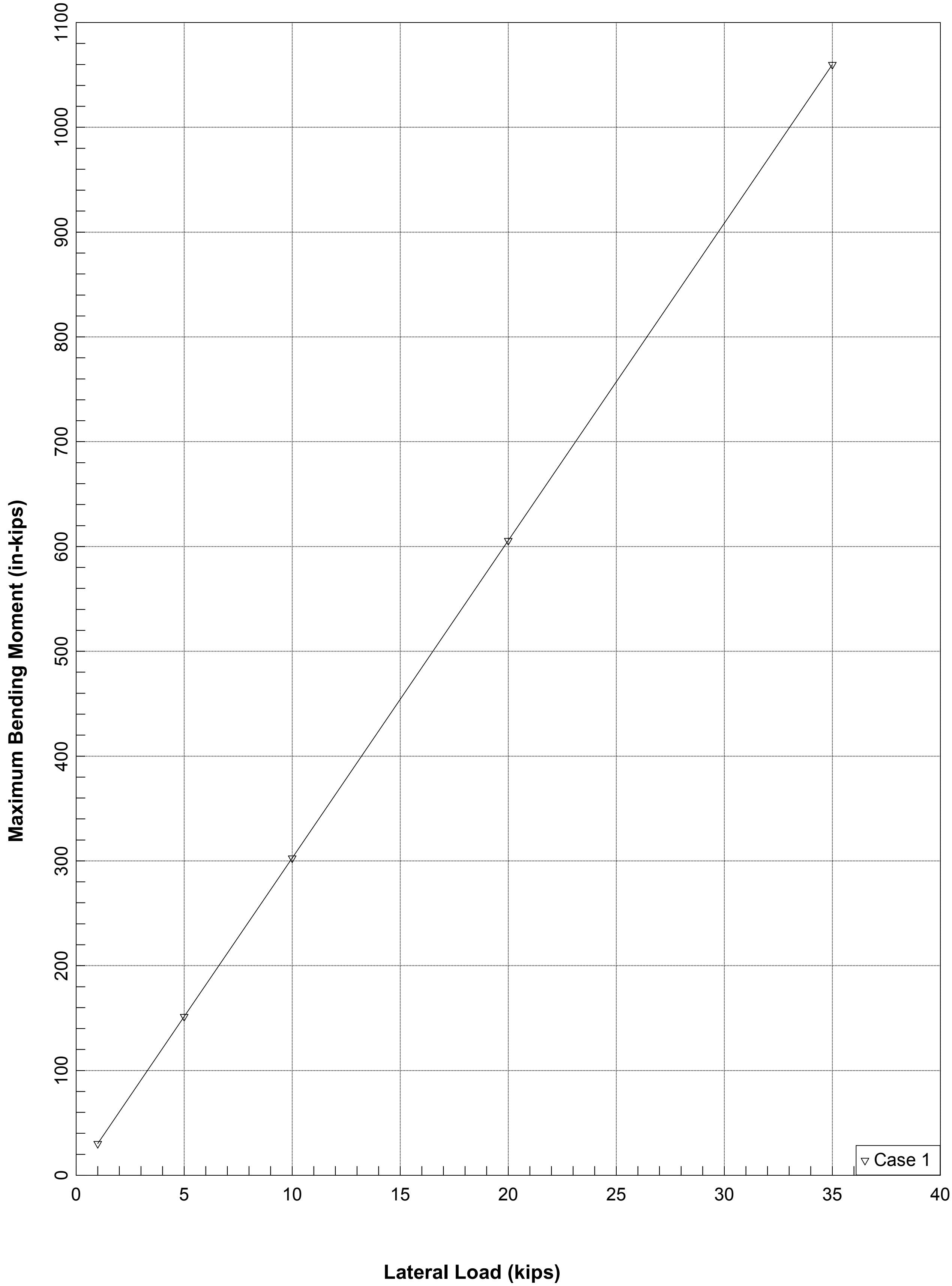


Pile-head Deflection (in)

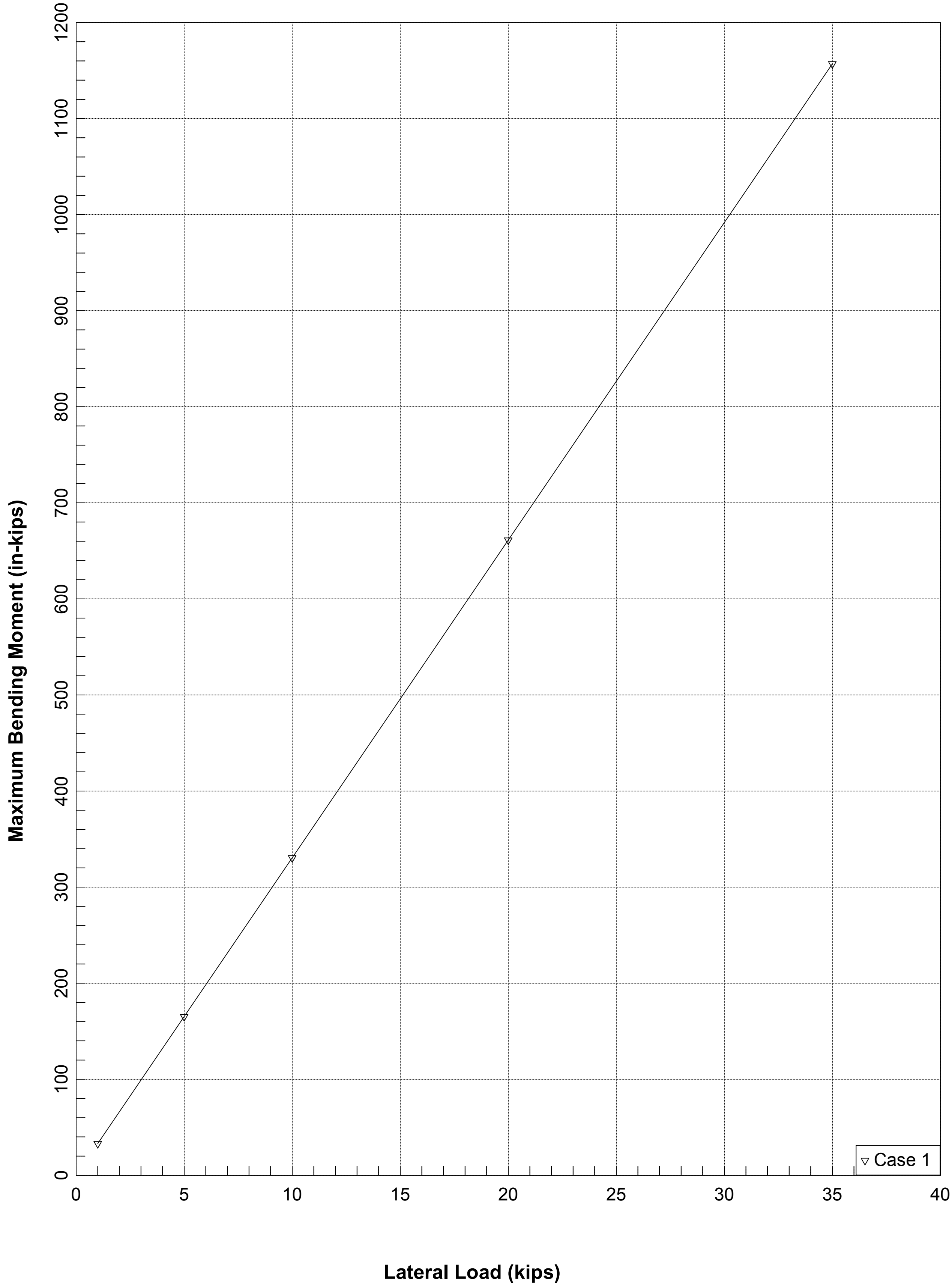
PIER HP12X53



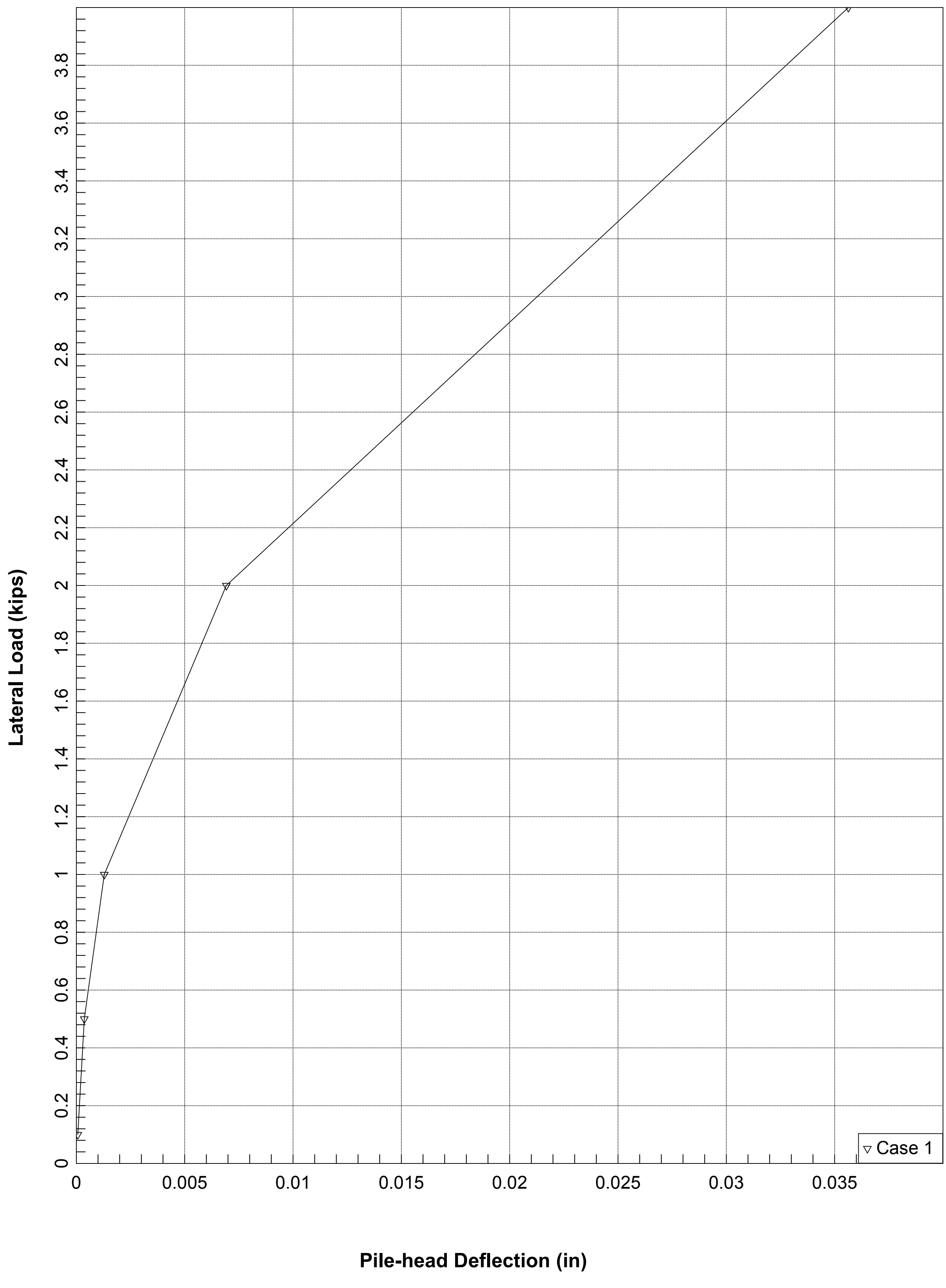
PIER HP14X73



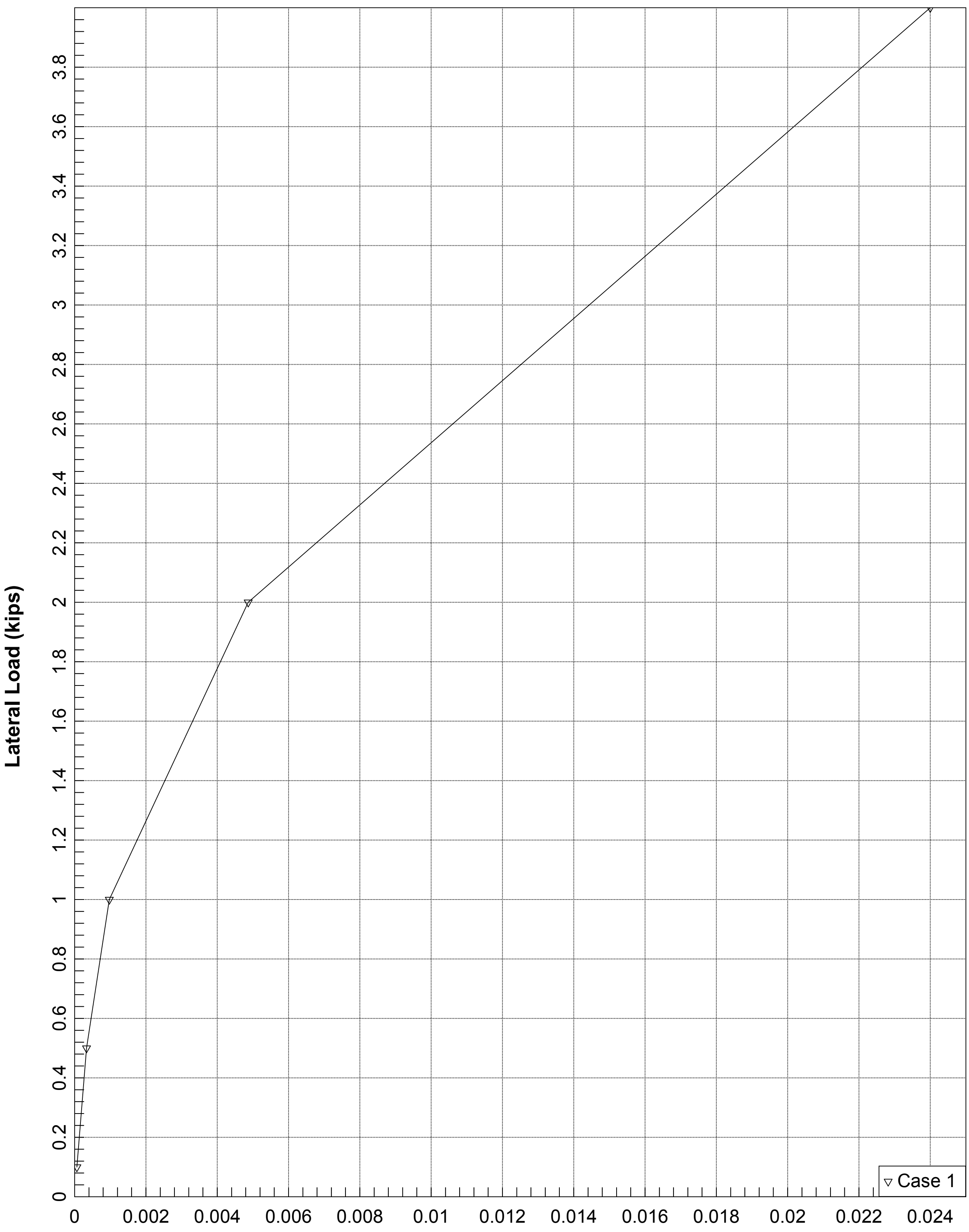
PIER HP12X53



PIER HP14X73

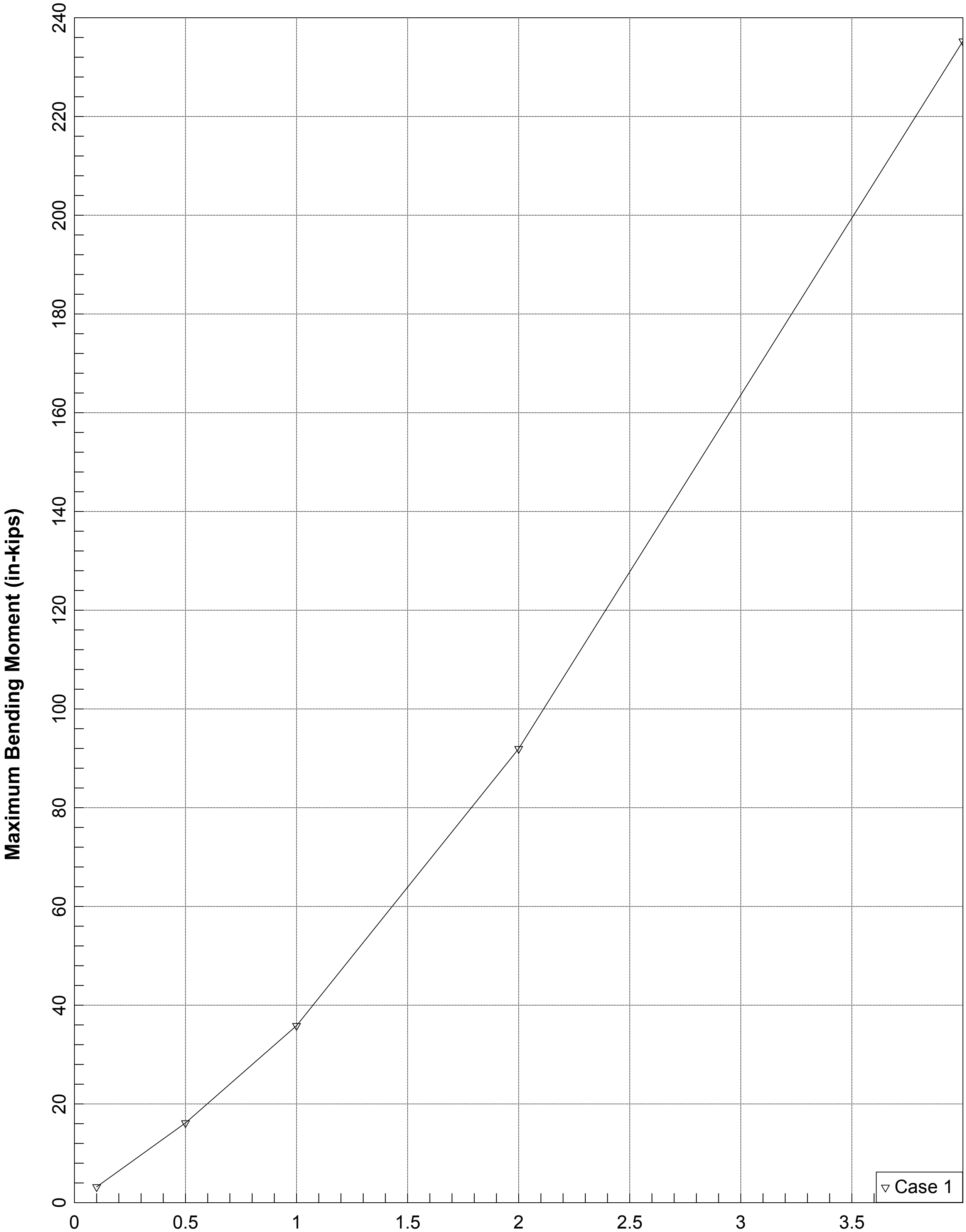


EAST ABUTMENT HP12X53



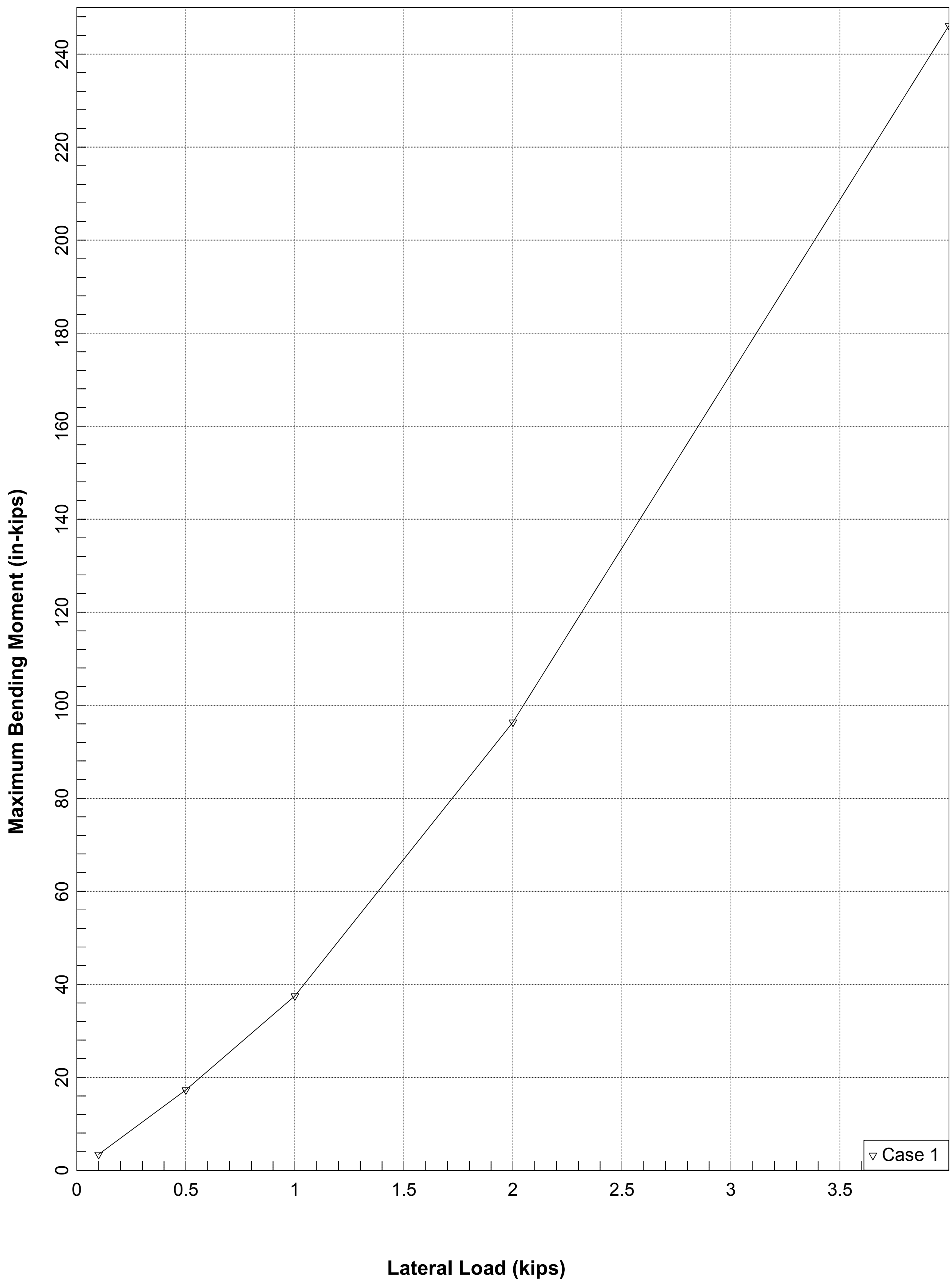
Pile-head Deflection (in)

EAST ABUTMENT HP14X73



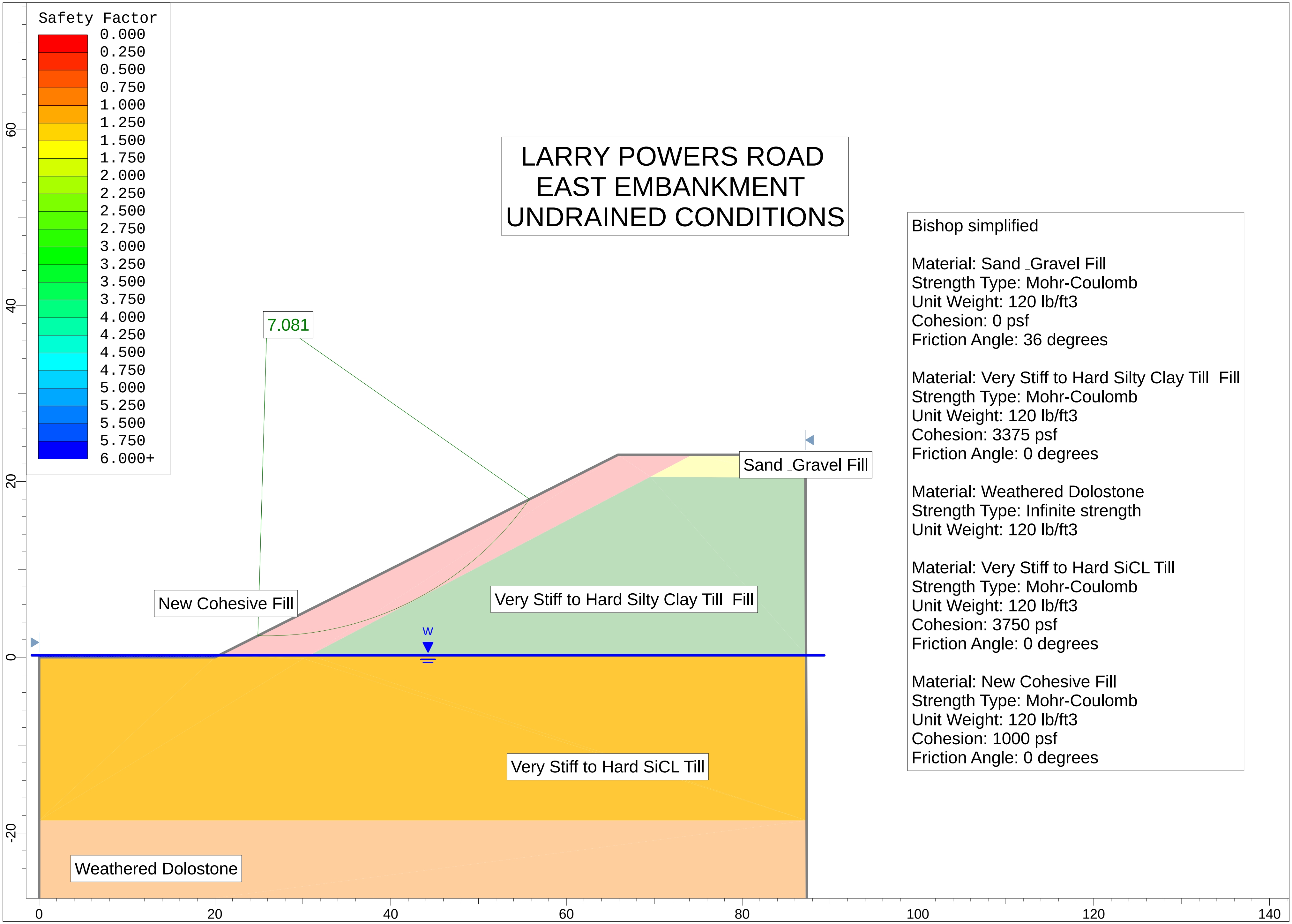
Lateral Load (kips)

EAST ABUTMENT HP12X53

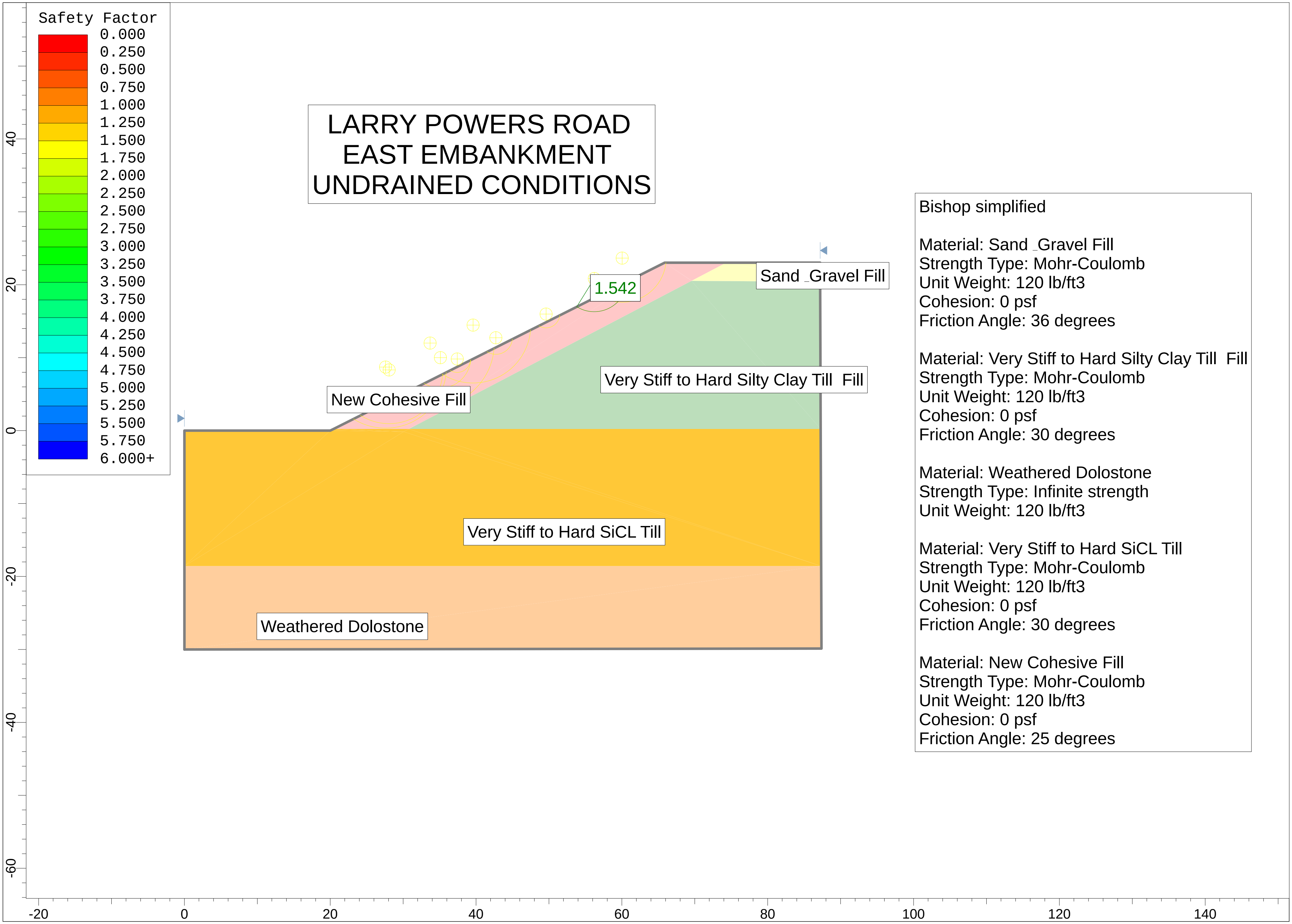


EAST ABUTMENT HP14X73

Slope Stability Analysis Results



Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
LARRY POWERS ROAD
EAST EMBANKMENT
UNDRAINED CONDITIONS
7.081
New Cohesive Fill
Very Stiff to Hard Silty Clay Till Fill
Sand _Gravel Fill
Very Stiff to Hard SiCL Till
Weathered Dolostone
W
Bishop simplified
Material: Sand _Gravel Fill
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 36 degrees
Material: Very Stiff to Hard Silty Clay Till Fill
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 3375 psf
Friction Angle: 0 degrees
Material: Weathered Dolostone
Strength Type: Infinite strength
Unit Weight: 120 lb/ft3
Material: Very Stiff to Hard SiCL Till
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 3750 psf
Friction Angle: 0 degrees
Material: New Cohesive Fill
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 1000 psf
Friction Angle: 0 degrees
0
20
40
60
80
100
120
140
-20


Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
LARRY POWERS ROAD
EAST EMBANKMENT
UNDRAINED CONDITIONS
1.542
Sand _Gravel Fill
Very Stiff to Hard Silty Clay Till Fill
New Cohesive Fill
Very Stiff to Hard SiCL Till
Weathered Dolostone
Bishop simplified
Material: Sand _Gravel Fill
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 36 degrees
Material: Very Stiff to Hard Silty Clay Till Fill
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Material: Weathered Dolostone
Strength Type: Infinite strength
Unit Weight: 120 lb/ft3
Material: Very Stiff to Hard SiCL Till
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Material: New Cohesive Fill
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 25 degrees
40
20
0
-20
-40
-60
-20
0
20
40
60
80
100
120
140

Seismic Determination Worksheet

SEISMIC SITE CLASS DETERMINATION

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified on 12/10/10

PROJECT TITLE=====046-0087 LARRY POWER ROAD OVER I-57

Substructure 1

Base of Substruct. Elev. (or ground surf for bents)	712.5	ft.
Pile or Shaft Dia.	12	inches
Boring Number	1	
Top of Boring Elev.	718.46	ft.

Approximate Fixity Elev. 706.5 ft.

Individual Site Class Definition:

N (bar):	43	(Blows/ft.)	Soil Site Class D
N_{ch} (bar):	NA	(Blows/ft.)	NA
s_u (bar):	4.76	(ksf)	Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	716.0	2.50	1	1.00	B
	713.5	2.50	9	3.50	
	711.0	2.50	6	3.00	B
	708.5	2.50	9	4.10	
0.5	706.0	2.50	10	4.00	
3.0	703.5	2.50	11	4.60	
5.5	701.0	2.50	9	4.00	
8.0	698.5	2.50	8	4.10	
10.5	696.0	2.50	17	4.90	B
12.5	694.0	2.00	16	3.50	B
15.0	691.5	2.50	16	3.50	
17.5	689.0	2.50	24	7.80	
20.0	686.5	2.50	18	5.90	
22.5	684.0	2.50	21	5.10	
25.0	681.5	2.50	27	6.80	B
28.0	678.5	3.00	14	3.10	B
29.5	677.0	1.50	10	2.50	B
129.5	577.0	100.00	100	99.00	R

Substructure 2

Base of Substruct. Elev. (or ground surf for bents)	693.3	ft.
Pile or Shaft Dia.	12	inches
Boring Number	3	
Top of Boring Elev.	697.3	ft.

Approximate Fixity Elev. 687.3 ft.

Individual Site Class Definition:

N (bar):	73	(Blows/ft.)	Soil Site Class C
N_{ch} (bar):	NA	(Blows/ft.)	NA
s_u (bar):	5	(ksf)	Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	694.8	2.50	1	1.00	B
	692.8	2.00	12	3.50	B
	690.3	2.50	11	4.00	
	687.8	2.50	14	5.60	
2.0	685.3	2.50	16	6.60	
4.5	682.8	2.50	22	9.90	
7.0	680.3	2.50	15	7.00	
9.0	678.3	2.00	18	6.20	B
109.0	578.3	100.00	100	99.00	R

Substructure 3

Base of Substruct. Elev. (or ground surf for bents)	713	ft.
Pile or Shaft Dia.	12	inches
Boring Number	2	
Top of Boring Elev.	718.3	ft.

Approximate Fixity Elev. 707 ft.

Individual Site Class Definition:

N (bar):	39	(Blows/ft.)	Soil Site Class D
N_{ch} (bar):	NA	(Blows/ft.)	NA
s_u (bar):	4.53	(ksf)	Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	715.8	2.50	1	1.00	B
	713.3	2.50	14	4.50	
	710.8	2.50	5	3.00	b
	708.3	2.50	10	3.50	
1.2	705.8	2.50	15	3.50	
3.7	703.3	2.50	10	3.10	
6.2	700.8	2.50	10	3.30	
8.7	698.3	2.50	11	3.10	
11.2	695.8	2.50	9	3.00	B
13.2	693.8	2.00	21	4.00	B
15.7	691.3	2.50	9	3.00	B
18.2	688.8	2.50	11	3.50	
20.7	686.3	2.50	20	4.20	
23.2	683.8	2.50	22	4.70	
25.7	681.3	2.50	21	5.10	B
28.2	678.8	2.50	14	3.10	B
30.2	676.8	2.00	9	2.50	B
130.2	576.8	100.00	100	99.00	R

Substructure 4

Base of Substruct. Elev. (or ground surf for bents)		ft.
Pile or Shaft Dia.		inches
Boring Number		
Top of Boring Elev.		ft.

Approximate Fixity Elev. ft.

Individual Site Class Definition:

N (bar):		(Blows/ft.)	NA
N_{ch} (bar):		(Blows/ft.)	NA
s_u (bar):		(ksf)	NA

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary

Global Site Class Definition: Substructures 1 through 3

N (bar):	52	(Blows/ft.)	Soil Site Class C
N_{ch} (bar):		(Blows/ft.)	NA
s_u (bar):	4.75	(ksf)	Soil Site Class C <----Controls