Illinois Department of Transportation

Abbreviated Structure Geotechnical Report

Original Report Date: 6/08/2020	**Proposed SN:** 006-0189	**Route:**	FAP 587 (IL 92)
Revised Date:	**Existing SN:** 006-0096	**Section:**	(135 B-1)BRR
Geotechnical Engineer: Mark Jones of McCleary Engineering		**County:**	Bureau
Structural Engineer: Chris Linneman of EFK Moen, LLC		**Contract:**	66H26

Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing): The proposed structure SN006-0189 carries IL 92 over the Hennepin Canal Feeder. The out to out superstructure width is 34.83 ft. and the back to back abutment length is 114.83 ft. The estimated total factored loading at the abutments is 640 kips and 1263 kips at the piers. Bedrock was not encountered in the borings. The proposed structure is a 3 span slab structure with integral abutments supported by friction piles, and either individually concrete encased pile bents, drilled shaft column bents, or precast concrete piles at the pier. The IDNR has requested the piers be concrete or concrete encased for aesthetic reasons. The existing clay liner in the canal (the existence of which has not been verified at the time of this writing) must be maintained and is a construction issue.

Discuss the existing boring data, existing plans foundation information, new subsurface exploration and need for any additional exploration to be provided with SGR Technical Memo (attach all data and subsurface profile plot): The existing structure SN 006-0096 is a three-span concrete slab bridge on concrete piles and open abutments built in 1958.

Two borings were taken in May of 2019, Boring 01 (N.W. Quad.) and Boring 02 (S.E. Quad.) Standard split spoon samplers were used to determine the standard penetration rate at 2.5 ft. intervals down to a depth of 46.5 ft at which it was opened up to 5 ft. intervals for Boring 02. Both borings exhibited a similar stratigraphy, no additional borings are recommended at this time.

Boring 01 has a ground surface elevation of 639.05 ft. and a depth of 46.5 ft. The boring begins with 2.5 ft. black Silty Clay Loam topsoil over 7.5 ft. of stiff Silty Clay Loam fill. At elevation 629.05 ft. there is 4 ft. loose silt and fine sand with free water. From 14.0 ft. to 21.0 ft. below the surface, elevation 618.05 ft., is a medium dense very fine to medium Sand. Below from 21.0 ft. to 32 ft., elevation 607.05 ft. is a medium dense fine to coarse Sand. The boring is terminated at elevation 592.55 ft., with 14.5 ft of dense fine to coarse Sand. Bedrock was not encountered in this boring.

Boring 02 has a ground surface elevation 639.13 ft. and a depth of 56.5 ft. The boring begins with 2.5 ft. black Silty Clay Loam topsoil over 7.0 ft. of stiff Silty Clay Loam fill. At elevation 629.63 ft. there is 2 ft. of very loose silt over 2 ft. of medium fine Sand. From 14.5 ft. to 32.0 ft. below the surface, elevation 607.13 ft., is a medium dense very fine to medium Sand. The boring is terminated at elevation 582.63 ft., with 24.5 ft. of dense fine to medium Sand, some coarse Sand. Bedrock was not encountered in this boring.

Provide the location and maximum height of any new soil fill or magnitude of footing bearing pressure. Estimate the amount and time of the expected settlement. Indicate if further testing, analysis, and/or ground improvement/treatment is necessary: Although not finalized at the time of this writing, the proposed profile will be raised ±5.5 ft. The existing bridge has been in place since 1958 and shows no settlement problems. Future settlement is of minimal concern as there is only a minor increase in loading on the founding soils from the existing abutments. A settlement estimate resulted in 0.56 inches at the west abutment. See attached.

Identify any new cuts or fill slope angles and heights. Estimate the factor of safety against slope failure. Indicate if further testing, analysis or ground improvement/treatment is necessary: After construction, the new west end side slopes will be two 2:1 (H:V) concrete surfaced slopes separated by a multi-use path, one 4 ft. tall and the other 8 ft. tall. The entire east end slope will be 2.5:1 lined with Class A4 stone riprap. A slope stability analysis was completed using Slide for both temporary end slopes. Using the information from boring SB-01 and 02 in an undrained condition the temporary end slopes will have a factor of safety against a slope failure of 3.947 for the west abutment and 3.395 for the east abutment.

Indicate at each substructure, the 100-year and 200-year total scour depths in the Hydraulics report, the non-granular scour depth reduction, the proposed ground surface, and the recommended foundation design scour elevations: Scour is not accounted because of the hydraulic characteristics of the canal. Spill through abutments shall be protected by riprap or slope wall in accordance to the Bridge Manual.

Bridge	Event/Limit State	Design Scour Elevations (ft.)				Item 113
		W. Abut	Pier 1	Pier 2	E. Abut.	
North	Q100	-	-	-	-	8
	Q200	-	-	-	-	
	Design	639.6	625.1	625.1	639.6	
	Check	639.6	625.1	625.1	639.6	

Determining the seismic soil site class, the seismic performance zone, the 0.2 and 1.0 second design spectral accelerations and indicate if that the soils are liquefiable: This site has a seismic site class of "D", the seismic performance zone (SPZ)=1. The S_{DS}= 0.145 g and an S_{D1}=0.09 g. Due to the S_{D1} being is less than 0.15 g, a liquefaction analysis is not required.

Confirm feasibility of the proposed foundation or wall type and provide design parameters. Attach a pile design table indicating feasible pile types, various nominal required bearings, factored resistances available and corresponding estimated lengths at locations where piles will be used. Provide factored bearing resistance and unit sliding resistance at various elevations and confirm no ground improvement/treatment is necessary where spread footings are proposed. Estimated top of rock elevations as well as preliminary factored unit side and tip resistance values shall be indicated when drilled shafts are proposed: Data from the two May and June 2019 borings (Boring 01 (S.E. Quad) and Boring 02 (N.W. Quad)) was used to populate the data fields in the Estimated Pile Length spreadsheets. Boring 01 was used for the east abutment and pier; Boring 02 was used for the west abutment and pier. These borings satisfactorily represent soil layers at the proposed substructure locations. A table providing pile resistance and lengths for various recommended sizes is included in this report. This table was generated using no geotechnical loses associated with scour, liquification or consolidation. A full set of pile length spreadsheets for all the applicable sizes and wall thickness of metal shell piles and precast concrete piles are included in the appendix.

An Integral Abutment Feasibility (BBS 145) spreadsheet is also included. Information from both borings was used to populate the fields in the spreadsheet. This analysis indicates that the abutment soils will allow for the required movement of integral abutments and no remediation is required.

We recommend the use of metal shell piles because of the suitable soils and bedrock was not encountered. Precast piles at the piers are an option.

We recommend the use of metal shell piles, driven to bearing. The fine to medium sands have blow counts that edge near hard driving when bearing is reached; therefore, we recommend the metal shells with a wall thickness of 0.312 inches. Care should be taken not to damage the pile in the denser layers, metal shoes are recommended. Two test piles are recommended, one should be driven at an abutment and the other at a pier. Individual concrete encasement is required at the piers.

Precast concrete piles are an option for the piers. Despite the fragility and spice-ability issues, they could save time with not having to encase them for corrosion protection, they would minimize any repair to the clay liner caused by encasement operations, and would not require a cofferdam for forming. The borings do not indicate any hard driving and the piles would reach bearing at relatively shallow depths. However, they are not the district's preferred choice.

Assumptions used for the pile length analysis include:

- Bottom of abutment elevations = 639.6 ft., and 625.1 ft for the piers
- Bottom of Encasement at pier / bottom of pier cap= 625.1 / 641.0
- The factored loading for the abutments is 640 kips and 1263 kips for the piers.
- The pile cutoff allows for a 2 ft. embedment into the concrete for the abutments, 1 ft. for the piers.
- No geotechnical loses were accounted for in this analysis.

West Abutment, using Boring 01		
Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (Ft.)
MS 14" with 0.312" walls		
169	93	20
230	127	25
298	164	30
570	263	37
MS 16" with 0.312" walls		
209	115	20
285	157	25
368	202	30
654	326	37
MS 16" with 0.375" walls		
209	115	20
285	157	25
368	202	30
782	326	37

East Abutment, using Boring 02		
Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (Ft.)
MS 14" with 0.312" walls		
243	134	25
268	147	30
414	228	35
570	280	40
MS 16" with 0.312" walls		
297	163	25
325	179	30
510	281	35
654	343	40
MS 16" with 0.375" walls		
325	179	30
510	281	35
624	343	40
782	425	45

West Pier, using Boring 01		
Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (Ft.)
MS 14" with 0.312" walls		
176	97	27
243	134	32
284	156	34
570	233	39
MS 16" with 0.312" walls		
223	122	27
305	168	32
410	225	37
654	291	39
MS 16" with 0.375" walls		
223	122	27
305	168	32
410	225	37
782	406	42

East Pier, using Boring 02		
Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (Ft.)
MS 14" with 0.312" walls		
204	112	30
350	192	35
444	244	40
570	313	45
MS 16" with 0.312" walls		
252	138	30
437	240	35
551	303	40
654	357	42
MS 16" with 0.375" walls		
252	138	30
437	240	35
551	303	40
782	385	45

West Pier, using Boring 01			East Pier, using Boring 02		
Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (Ft.)
Precast 14" x 14"			Precast 14" x 14"		
103	57	22	145	80	22
128	71	24	212	116	25
224	123	27	264	145	27
265	135	29	265	143	30

Drilled shaft discussion: Side and base resistances were developed for the sand layers below the pier encasement elevation shown on the TSL. The method is from publication No. FHWA-NHI-10-016 May 2010 for Drilled Shafts: Construction Procedures and LRFD Design Methods. Due to the sands shown in the borings and the water table, some method of shaft support during construction is required. See attached calculations for side and base resistances for drilled shafts at the east and west piers.

Calculate the estimated water surface elevation and determine the need for cofferdams (type 1 or 2), and seal coat: The E.W.S.E. is taken as the D.H.W. which is 634.6 ft, the bottom of the encasement is 625.1 ft, therefore type 2 cofferdams are needed if concrete encasement operations are required. The soils are permeable so a seal coat is required. Calculations show a SF = 1.21 for a seal coat thickness of 4.25 ft.

Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns: At this time, we anticipate the structure to be built under a closed road condition and no temporary soil retention is required. The substructures shall be removed as per Section 501 of the 2016 IDOT Standard Specifications for Road and Bridge Construction. The existing clay liner in the canal (the existence of which has not been verified at the time of this writing) must be maintained and is a construction issue.

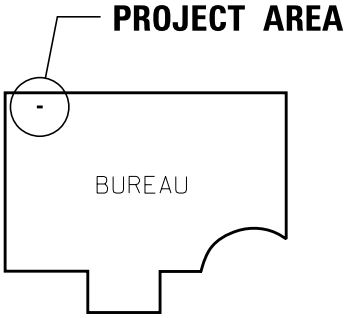
Illinois Professional Engineer
License No. 062.043271 Exp. 11/2021

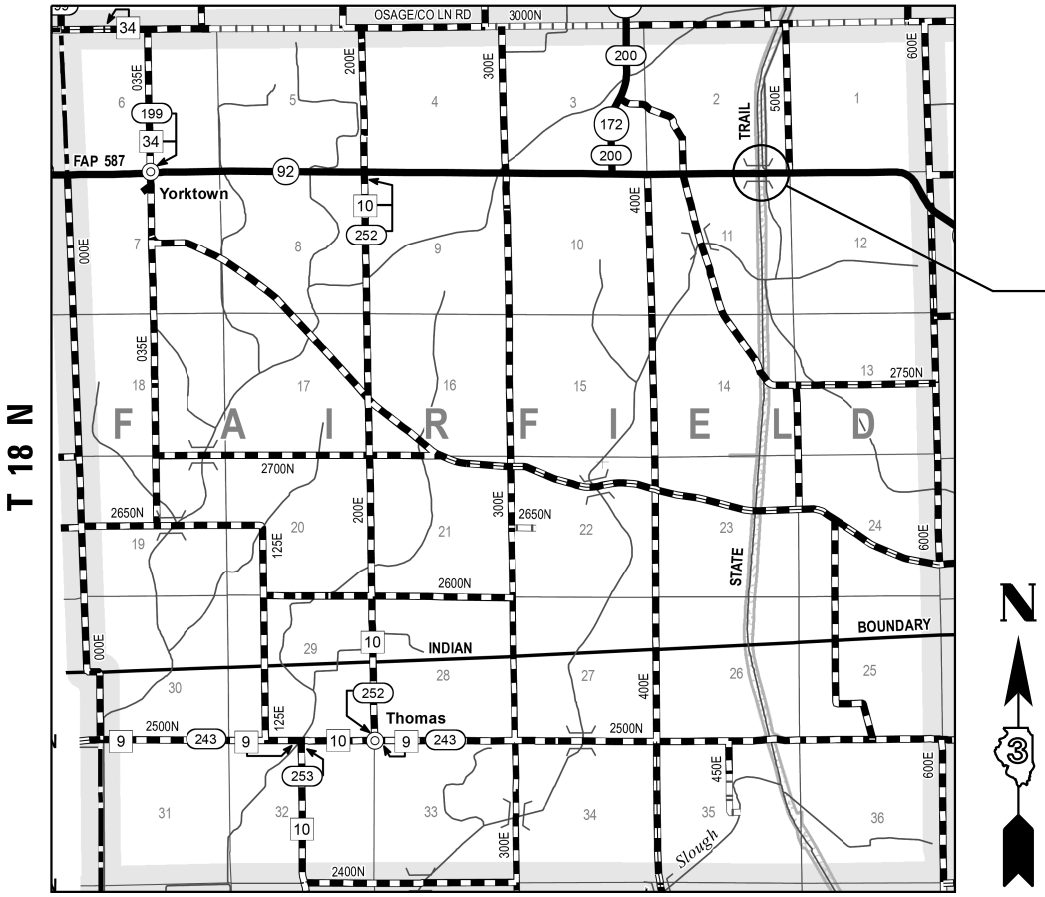
PROJECT LOCATION MAP

F.A.P. ROUTE 587 (IL 92)

BUREAU COUNTY

SECTION (135B–1)BRR





SN 006–0096
F.A.P. ROUTE 587 (IL 92)
OVER HENNEPIN CANAL FEEDER

Benchmark: RR Spike in west side of power pole, west of boat ramp. Sta. 229+60.41, 140.74' left. Elevation 638.647.

Existing Structure: S.N. 006-0096 originally built in 1958 as Section 135B-1. The structure is a 3-span variable depth solid slab bridge on stub abutments and piers founded on concrete piles. The length of the structure is 89'-6" bk. to bk. abutments. The width is 36'-4" out to out. Traffic to be detoured with the bridge closed during construction.

Salvage: None

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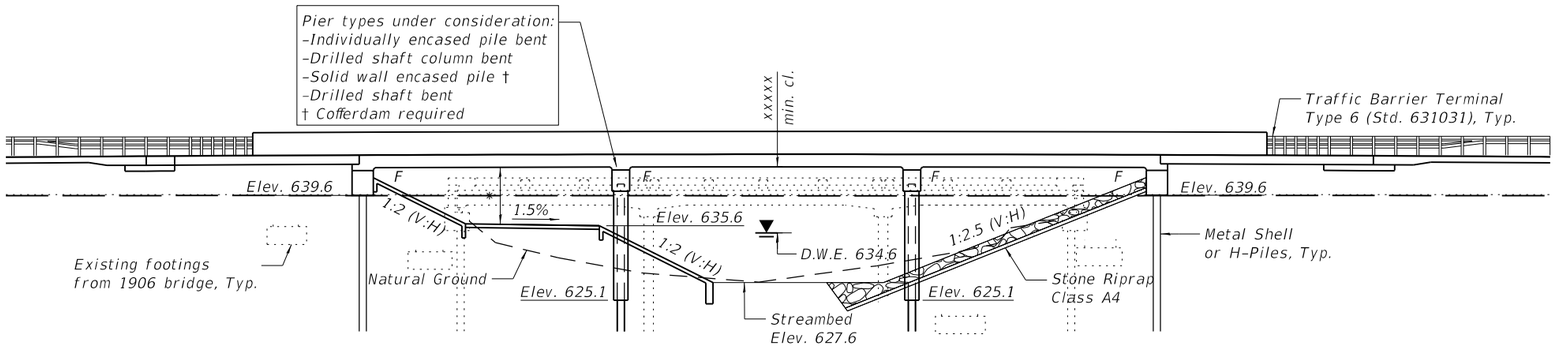
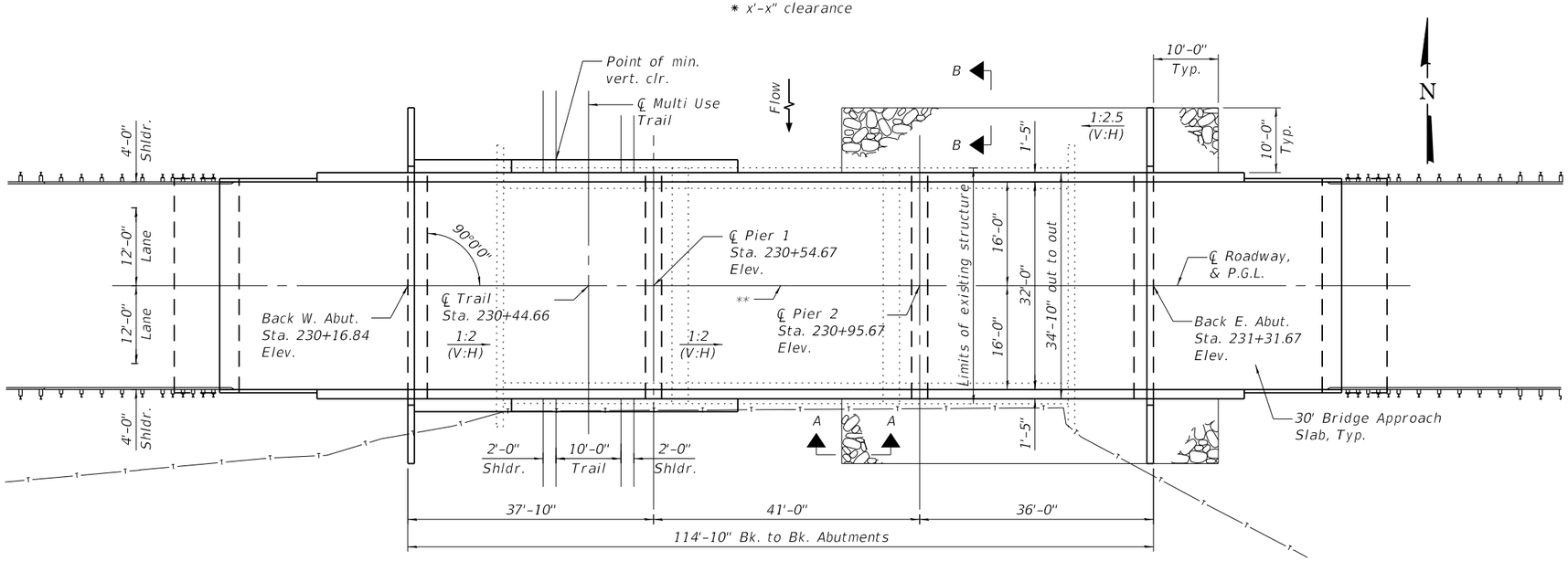


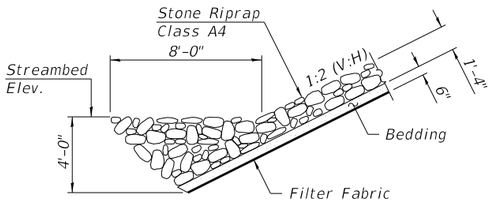
ELEVATION

* x'-x" clearance

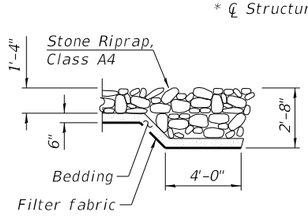


PLAN

* ℄ Structure Sta. 230+74.26



SECTION A-A



SECTION B-B

WATERWAY INFORMATION

Exist. Overtopping Elev. 639.8 @ Sta. 230+75
Drainage Area = 0.32 sq. mi. Prop. Overtopping Elev. 647.8 @ Sta. 230+75

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.
	--	--	--	--	--	--	--	--	--
Design	N/A	N/A	348	279	634.6	--	--	634.6	634.6
Base	--	--	--	--	--	--	--	--	--
Scour Check	--	--	--	--	--	--	--	--	--
Max. Calc.	--	--	--	--	--	--	--	--	--

Est. 100' wide canal, 17 miles long to US Lock 33
Maximum HWE based on Locks 33 (US) and 22 (DS)

LOADING HL-93

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

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications, 8th Edition

DESIGN STRESSES

FIELD UNITS

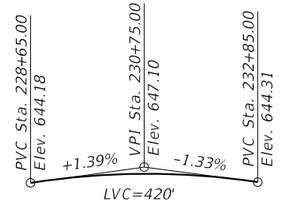
f'c = 3,500 psi
f'c = 4,000 psi (Superstructure Concrete)
fy = 60,000 psi (Reinforcement)

SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (SD1) = xxxxxx
Design Spectral Acceleration at 0.2 sec. (SDS) = xxxxx
Soil Site Class = xxxx

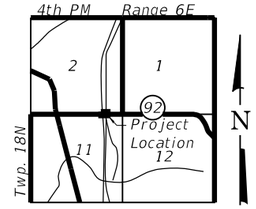
HIGHWAY CLASSIFICATION

F.A.P. Rte. 587 (IL 92)
Functional Class: Major Collector
ADT: 450 (2017); 656 (2032)
ADTT: 50 (2017); 72 (2032)
DHV: 45 (2032)
Design Speed: 60 m.p.h.
Posted Speed: 55 m.p.h.
2-Way Traffic
Directional Distribution: 50:50



PROFILE GRADE

Along ℄ Roadway



LOCATION SKETCH

GENERAL PLAN & ELEVATION
F.A.P. ROUTE 587 (IL 92)
OVER HENNEPIN CANAL FEEDER
SEC. (135B-1)BRR
BUREAU COUNTY
STATION 230+74.26
STRUCTURE NO. 006-0189

EFK•Moen Civil Engineering Design

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	CHECKED - ACB	REVISED -	
PLOT SCALE = $SCALE$	DRAWN - CDL	REVISED -	
PLOT DATE = 5/23/2020	CHECKED - ACB	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 1 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
587	(135B-1)BRR	BUREAU		
		CONTRACT NO. 66H26		
	ILLINOIS	FED. AID PROJECT		

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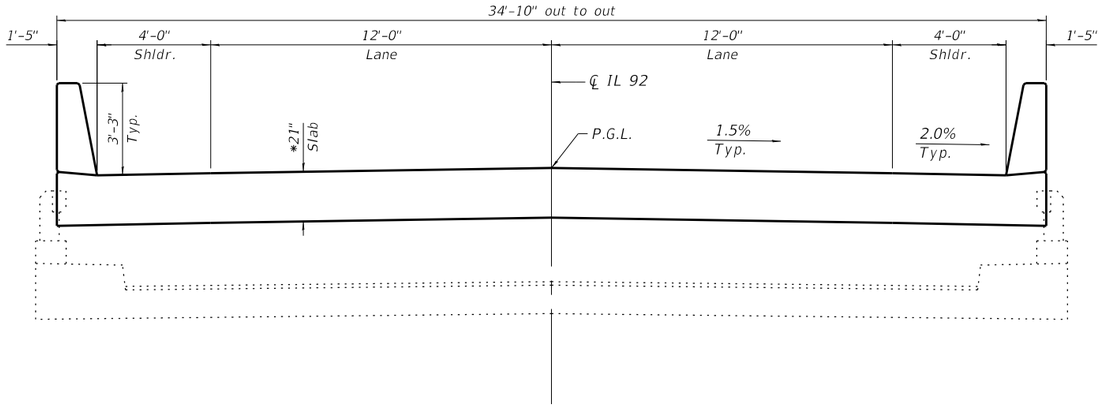
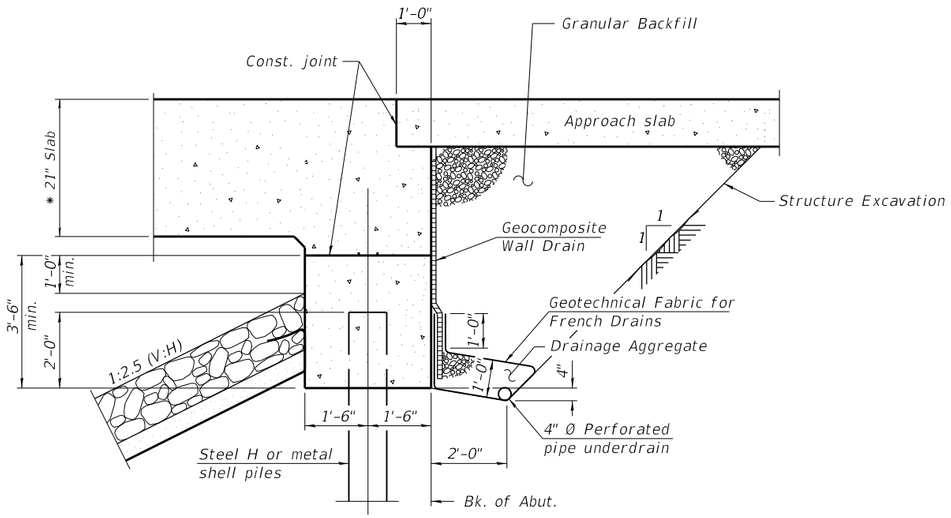


CROSS SECTION

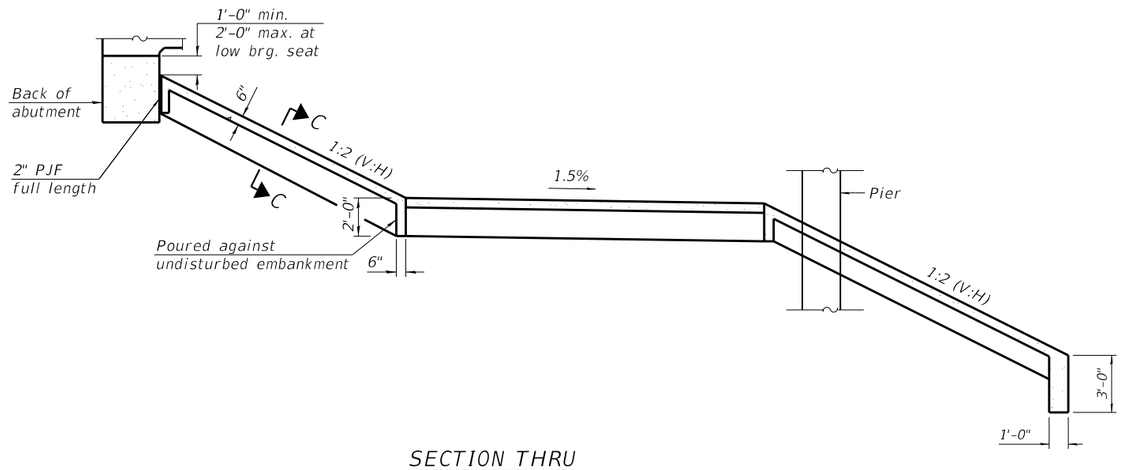
(Looking East)

* Subjuect to refinement during final design

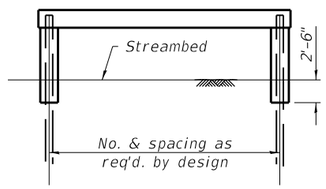


SECTION THRU INTEGRAL ABUTMENT

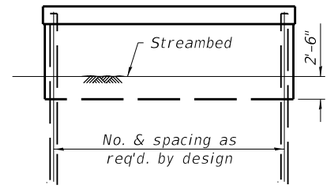
* Subject to refinement during final design



SECTION THRU CONCRETE SLOPEWALL AND MULTI-USE TRAIL



PIER SKETCH

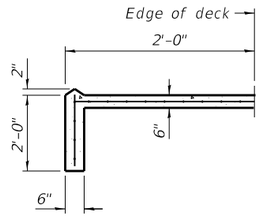


PIER SKETCH

Pier types under consideration:

-Individually encased pile bent
-Drilled shaft column bent
-Solid wall encased pile †
-Drilled shaft bent

† Cofferdam required



SECTION C-C

GENERAL PLAN & ELEVATION
F.A.P. ROUTE 587 (IL 92)
OVER HENNEPIN CANAL FEEDER
SEC. (135B-1)BRR
BUREAU COUNTY
STATION 230+74.26
STRUCTURE NO. 006-0189

MODEL: Default
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EFK♦Moen
Civil Engineering Design

USER NAME = $USER$	DESIGNED - CDL	REVISED -	
	CHECKED - ACB	REVISED -	
PLOT SCALE = $SCALE$	DRAWN - CDL	REVISED -	
PLOT DATE = 5/23/2020	CHECKED - ACB	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 1 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
587	(135B-1)BRR	BUREAU		
		CONTRACT NO. 66H26		
	ILLINOIS	FED. AID PROJECT		

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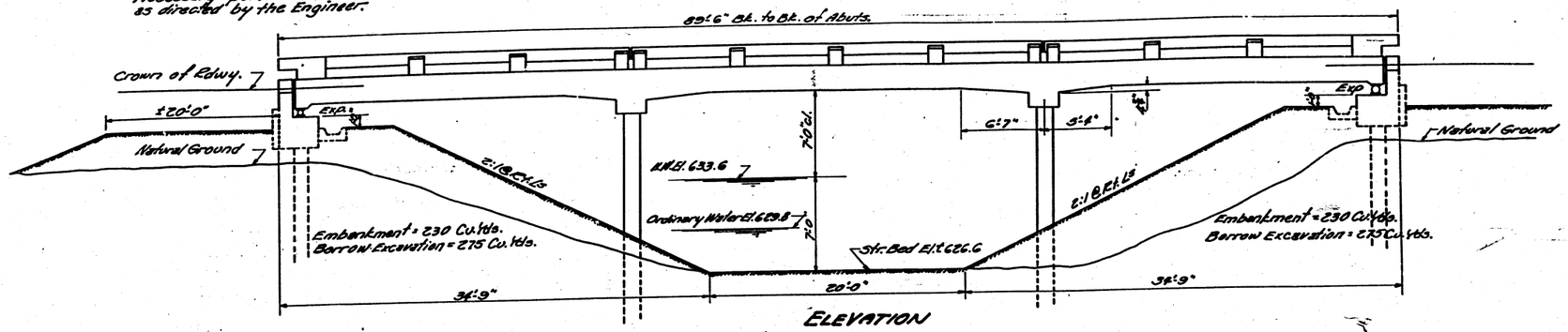
C.M.-S.E. Corner W. Pier @ 230+30 ; El. 645.68 U.S.G.S.
Existing Structure: Pony Truss 75' span; 16'-6" Rdwy; To be removed by contractor. No Salvage.
Necessary portions of substructure to be removed as directed by the Engineer.

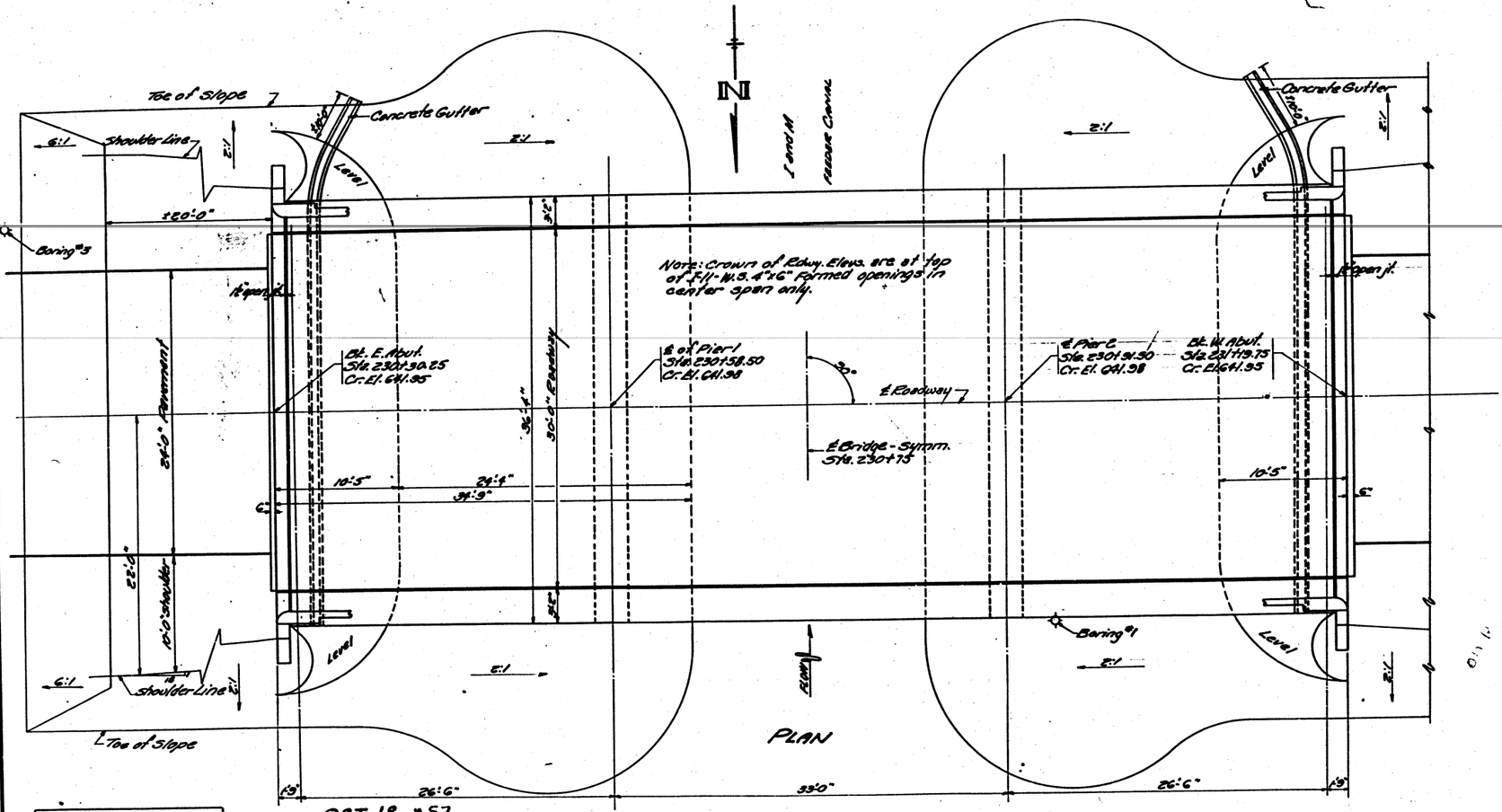
STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS & BUILDINGS
DIVISION OF HIGHWAYS

ROUTE NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
I.B.I. 92	135B-1	Bureau	27	4
FED. ROAD DIST. NO. 7				

SHEET NO. 1
5 SHEETS



ELEVATION



PLAN

OCT. 18 1957

DESIGNED	M. Tamaschis
CHECKED	T. Tanaka
DRAWN	M.T. E.Rush
CHECKED	T. T.

EXAMINED M.W. Ramirez, Engineer of Bridges and Traffic Structures
PASSED E.H. Finney, Engineer of Design
APPROVED R.K. Bartelmay, Chief Highway Engineer

Station 230+75
Built 1955 By
State of Illinois
S.B.I. Rt. 92 Sec. 135B-1
Project F-191(15)
Loading H20-S16.

LETTERING FOR NAME PLATE
See Sht. 2113

WATERWAY INFORMATION

Drainage Area ---------- Feeder Canal
Character ---------- Level, rolling, cultivated
Present Opening ------ 3378 Sq. Ft.
Proposed Opening ---- 228 Sq. Ft.

DESIGN STRESSES

f_c = 1400 p.s.i. Super.Str.
f_c = 800 p.s.i. Substr.
f_s = 20,000 p.s.i. Reinf.
f_s = 18,000 p.s.i. Struct. Steel
n = 10

Loading H20-S16-44

GENERAL NOTES

Class X concrete shall be used throughout except in handrail.

Handrail concrete shall be used in handrails.
The concrete floor slab shall be finished in accordance with Article 51.18(c) of the Standard Specifications.
The handrail concrete in the rail posts and railings shall be poured in separate operations.
All rollers, bearing plates, lead plates and anchor bolts shall be fabricated and set in accordance with Article 51.14 of the Standard Specifications and are included in quantity of: Structural Steel, Est. Wt. 2219 Lbs.
The following surfaces of expansion guards shall be given two coats of red lead paint; outside faces of vertical leg and top faces of horizontal legs of 4"x4"x½".
Expansion guards are included in quantity of Structural Steel, Est. Wt. 1839 Lbs.
Expansion guards shall be fabricated and erected in accordance with Article 51.12(d) of the Standard Specifications.
Except as otherwise provided, all structural steel shall receive one shop coat of red lead paint and two field coats of aluminum paint. See Article 57.1 to 57.5 inclusive of the Standard Specifications.
All paint shall be furnished and applied by the contr.
The contractor shall drive 2 test piles (in permanent locations) as directed by the Engineer before ordering (casting) remainder of piles. One test pile at Pier 2 North End and one at West Abutment South End.

GRADE PROFILE

LOCATION SKETCH

TOTAL BILL OF MATERIAL

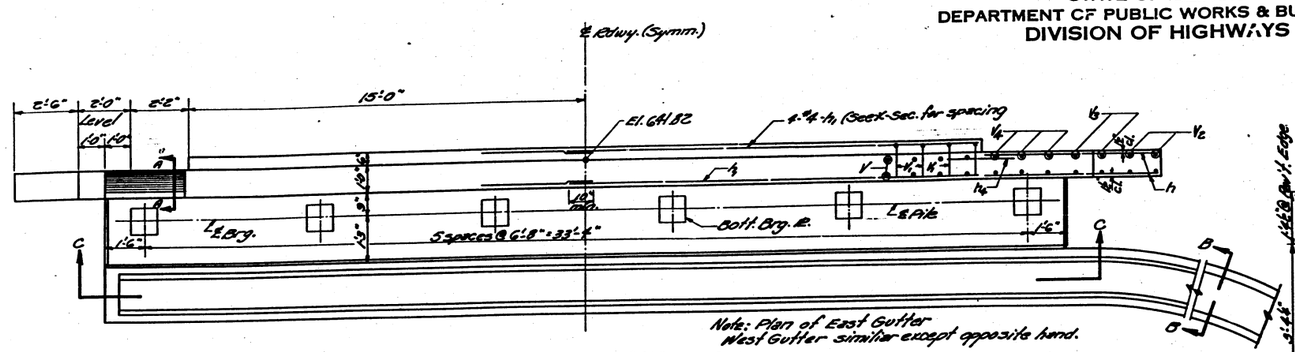
Item	Unit	Superstr.	Substr.	Total
Class X Concrete	Cu. Yds.	154.3	39.0	193.3
Reinforcement Bars	Lbs.	34,470	4490	38,960
Handrail Concrete	Cu. Yds.	4.2	0	4.2
Structural Steel	Lbs.	4880		4880
12" R.C. Piles (Abuts.)	Lin. Ft.		220	220
14" R.C. Piles (Piers)	Lin. Ft.		275	275
Test Piles - 12"	Each		1	1
Name Plate	Each	1		1
Borrow Excavation	Cu. Yds.		550	550
Removal of Exist. Struct.	Each			1
Test Piles - 14"	Each		1	1

GENERAL PLAN & ELEVATION
PROJECT F-191( )
S.B.I. RT. 92 SEC. 135B-1
BUREAU COUNTY
STA. 230+75

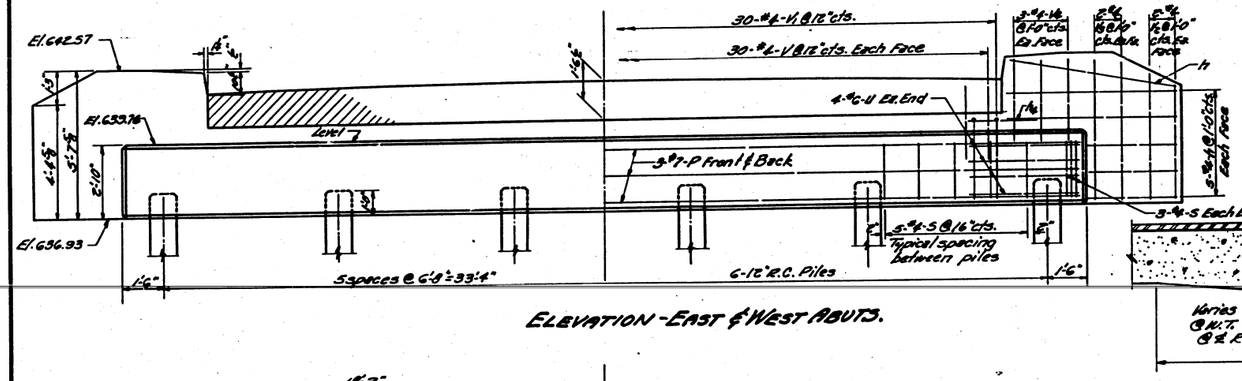
STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS & BUILDINGS
DIVISION OF HIGHWAYS

ROUTE NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
I.B.I. 92	135B-1	Bureau	27	6
FED. ROAD DIST. NO. 7	ILLINOIS	FED. AID PROJECT		

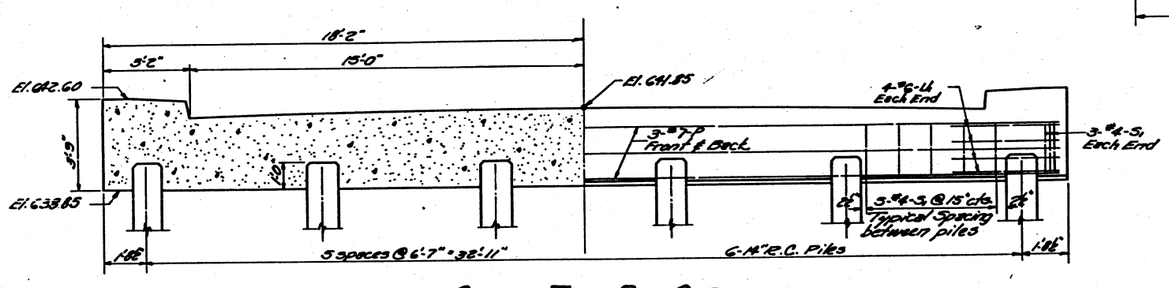
SHEET NO. 3
5 SHEETS



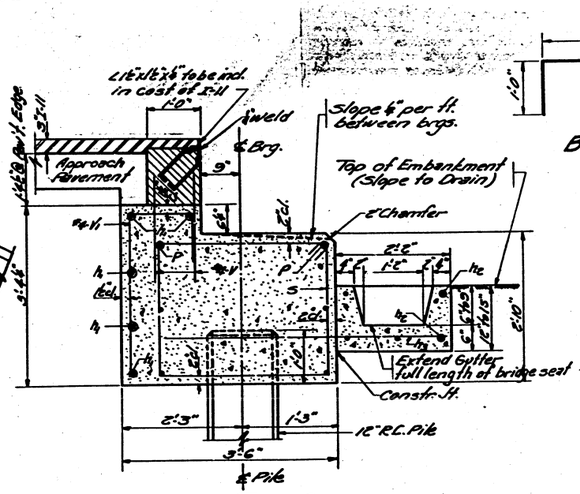
PLAN - EAST & WEST ABUTS.



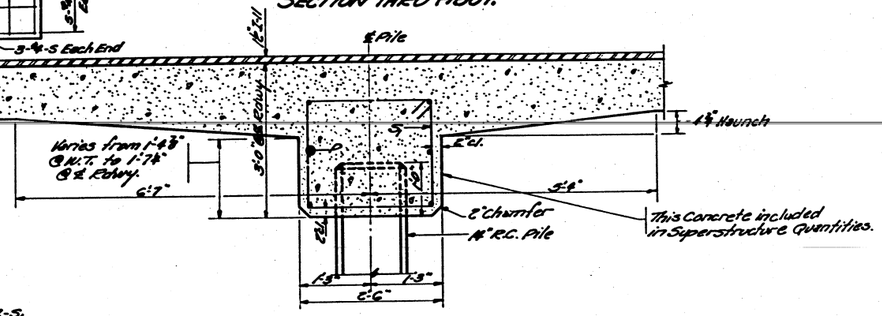
ELEVATION - EAST & WEST ABUTS.



SECTION THRU PIER CAP

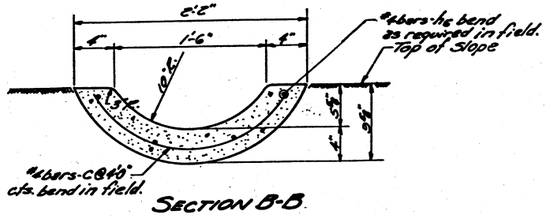


SECTION THRU ABUT.

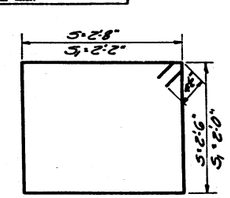


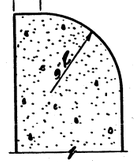
SECTION THRU PIER PILE CAP

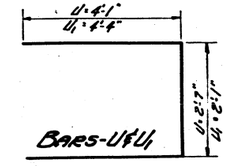
SECTION C-C



SECTION B-B







BILL OF MATERIAL

Bar	No.	Size	Length	Shape
h	48	#4	6'-3"	
h1	20	#4	15'-3"	
h2	20	#4	20'-0"	
h3	76	#4	3'-0"	
h4	4	#4	3'-0"	
P	24	#7	36'-0"	
U	16	#6	10'-9"	
U1	16	#6	12'-10"	
V	120	#4	2'-3"	
V1	60	#4	5'-3"	
V2	16	#4	4'-0"	
V3	16	#4	5'-0"	
V4	24	#4	5'-3"	
C	20	#4	2'-6"	
S	62	#4	11'-1"	
S1	62	#4	9'-1"	
h5	8	#4	10'-9"	
* Class X Concrete				Cu. Yds. 99.0
Reinforcement Bars				Lbs. 4490
12" R.C. Piles				Lin. Ft. 220
14" R.C. Piles				Lin. Ft. 275
Test Piles - 12"				Each 1
Test Piles - 14"				Each 1

* This quantity includes 86' of gutter section, as detailed in section through abutment and 120' of flume as detailed in Section B-B

PILE DATA @ PIER

14" R.C. Pile
11 Req'd + 1 Test Pile
Est. Length = 25'-0"
Test Pile - 1 @ Pier ℄ N. End

Capacity = 28 Tons.

PILE DATA @ ABUT.

12" R.C. Pile
11 Req'd + 1 Test Pile
Est. Length E. Abut. = 20'-0"
Est. Length W. Abut. = 20'-0"
Test Pile @ W. Abut. = 1 @ S. End

Capacity = 24 Tons.

DESIGNED	M. Tamashiro	
CHECKED	T. Tanaka	
DRAWN	M.T.	E. Rosh
CHECKED	T. T.	

OCT. 18 1957

EXAMINED — Bridge Engineer of Bridges and Traffic Structures
PASSED — Engineer of Bridges
APPROVED R.K. Bartelsmeyer — Chief Highway Engineer

SUBSTRUCTURE
S.B.I. Rt. 92 Sec. 135B-1
BUREAU COUNTY
STA. 230+75

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 5/28/19

ROUTE FAP 587 (IL 92) **DESCRIPTION** IL 92 over I&M Feeder Canal (Hennepin Canal Feeder), 1.0 miles East of IL 172 **LOGGED BY** Larry Myers

SECTION (135 B-1)ES **LOCATION** SE 1/4, **SEC.** 2, **TWP.** 18N, **RNG.** 6E, 4th **PM**, **Latitude** 41.569205, **Longitude** -89.767603

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

STRUCT. NO. 006-0096 (Exist.)
Station 230+75

BORING NO. 01 (N.W. Quad.)
Station 230+16
Offset 29.0 ft Lt.
Ground Surface Elev. 639.05 ft

Surface Water Elev. 633.08 ft
Stream Bed Elev. 628.51 ft

Groundwater Elev.:
First Encounter 626.6 ft ▼
Upon Completion 627.1 ft ▽
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Augered Black Silty Clay Loam Topsoil, Gray & Brown Silt / Silty Loam Fill
636.55				
	3			Stiff Gray & Brown Silt & Silty Loam Fill & Brown Silty Clay Loam Fill
	3	1.0	21	
	3	P		
-5				
	1			
	2	1.0	27	
	3	P		
	1			
	3	1.5	23	
	2	P		
629.05 -10				
	2			Stiff Brown & Gray Fine Sand, Silt, Silty Loam - Bedded
	2	1.0	27	
	2	P		
627.05 ▽				
	2			Loose Brown Very Fine Silty Sand - Free Water
	3		20	
625.05	6			
-15				Medium Brown Very Fine to Medium Sand - Minor Silty Layers
	6			
	7		19	
	9			
	5			
	6		19	
	8			
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	2			Medium Brown Very Fine to Medium Sand - Minor Silty Layers *(continued)*
618.05	4		19	
	8			
				Medium Gray Fine to Coarse Sand - Clean
	4			* Washed Sample 22.5' to 24.0'
	8		23	
	12	*		
-25				
	4			* Washed Sample 25.0' to 26.5'
	7		19	
	13	*		
	7			* Washed Sample 27.5' to 29.0'
	10		21	
	15	*		
-30				
	9			* Washed Sample 30.0' to 31.5'
	11		22	
	17	*		
607.05				
	10			Dense Gray Fine to Coarse Sand - Clean
	14		21	* Washed Sample 32.5' to 34.0'
	17	*		
-35				
	11			* Washed Sample 35.0' to 36.5'
	18		21	
	23	*		
	12			* Washed Sample 37.5' to 39.0'
	24		20	
	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)

BBS, form 137 (Rev. 8-99)

SOIL BORING 006-0096.GPJ IL_DOT.GDT 6/4/20

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 5/28/19

ROUTE FAP 587 (IL 92) **DESCRIPTION** IL 92 over I&M Feeder Canal (Hennepin Canal Feeder), 1.0 miles East of IL 172 **LOGGED BY** Larry Myers

SECTION (135 B-1)ES **LOCATION** SE 1/4, **SEC.** 2, **TWP.** 18N, **RNG.** 6E, 4th **PM**, **Latitude** 41.569205, **Longitude** -89.767603

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

STRUCT. NO. 006-0096 (Exist.)
Station 230+75

BORING NO. 01 (N.W. Quad.)
Station 230+16
Offset 29.0 ft Lt.
Ground Surface Elev. 639.05 ft

Surface Water Elev. 633.08 ft
Stream Bed Elev. 628.51 ft

Groundwater Elev.:
First Encounter 626.6 ft ▼
Upon Completion 627.1 ft ▽
After ____ **Hrs.** ____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Dense Gray Fine to Coarse Sand - Clean *(continued)*		15		
		23		21
* Washed Sample 40.0' to 41.5'		36	*	
* Washed Sample 42.5' to 44.0'		16		
		25		21
		39	*	
	-45			
* Washed Sample 45.0' to 46.5'		21		
		24		21
592.55		41	*	
End of Boring				
	-50			
	-55			
	-60			

SOIL BORING 006-0096.GPJ IL_DOT.GDT 6/4/20

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Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 6/11/19

ROUTE FAP 587 (IL 92) **DESCRIPTION** IL 92 over I&M Feeder Canal (Hennepin Canal Feeder), 1.0 miles East of IL 172 **LOGGED BY** Larry Myers

SECTION (135 B-1)ES **LOCATION** NE 1/4, **SEC.** 11, **TWP.** 18N, **RNG.** 6E, 4th **PM**,
Latitude 41.569059, **Longitude** -89.767187

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

STRUCT. NO. 006-0096 (Exist.)
Station 230+75

BORING NO. 02 (S.E. Quad.)
Station 231+37
Offset 23.0 ft Rt.
Ground Surface Elev. 639.13 ft

Surface Water Elev. 633.08 ft
Stream Bed Elev. 627.90 ft

Groundwater Elev.:
First Encounter 627.1 ft ▼
Upon Completion 627.1 ft ▽
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Notes
				Augered Black / Brown Silty Clay Loam Fill
636.63				
	3			Stiff Brown Silty Clay Loam Fill with Fine Sand Layers - Fill
	2 3	1.5 P	15	
-5				
	3			
	3 2	2.0 P	22	
	WH			WH = Weight of Hammer
	1 1	1.0 P	26	
629.63				
-10				Very Loose Brown & Gray Fine Sand & Silt - Interbedded
	2			
	2 1		24	
627.13 ▼				
	3			Medium Brown Fine Sand
	5 6		20	
624.63				
-15				Medium Gray Fine to Medium Sand
	7			
	10 15		19	
	8			* Washed Sample 17.5' to 19.0'
	12 14	 *	19	
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Notes
	6			Medium Gray Fine to Medium Sand *(continued)*
	7 8	 *	23	* Washed Sample 20.0' to 21.5'
	6			* Washed Sample 22.5' to 24.0'
	8 10	 *	22	
-25				
	7			* Washed Sample 25.0' to 26.5'
	9 11	 *	20	
	6			* Washed Sample 27.5' to 29.0'
	8 9	 *	21	
-30				
	6			* Washed Sample 30.0' to 31.5'
	9 11	 *	22	
607.13				
	10			Dense Gray Fine to Medium Sand with some Coarse Sand
	18 16	 *	20	* Washed Sample 32.5' to 34.0'
-35				
	12			* Washed Sample 35.0' to 36.5'
	15 17	 *	19	
	16			* Washed Sample 37.5' to 39.0'
	18 21	 *	21	
-40				

SOIL BORING 006-0096.GPJ IL_DOT.GDT 6/4/20

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 Transportation

SOIL BORING LOG

Date 6/11/19

ROUTE FAP 587 (IL 92) **DESCRIPTION** IL 92 over I&M Feeder Canal (Hennepin Canal Feeder), 1.0 miles East of IL 172 **LOGGED BY** Larry Myers

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Latitude 41.569059, **Longitude** -89.767187

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

STRUCT. NO. 006-0096 (Exist.)
Station 230+75

BORING NO. 02 (S.E. Quad.)
Station 231+37
Offset 23.0 ft Rt.
Ground Surface Elev. 639.13 ft

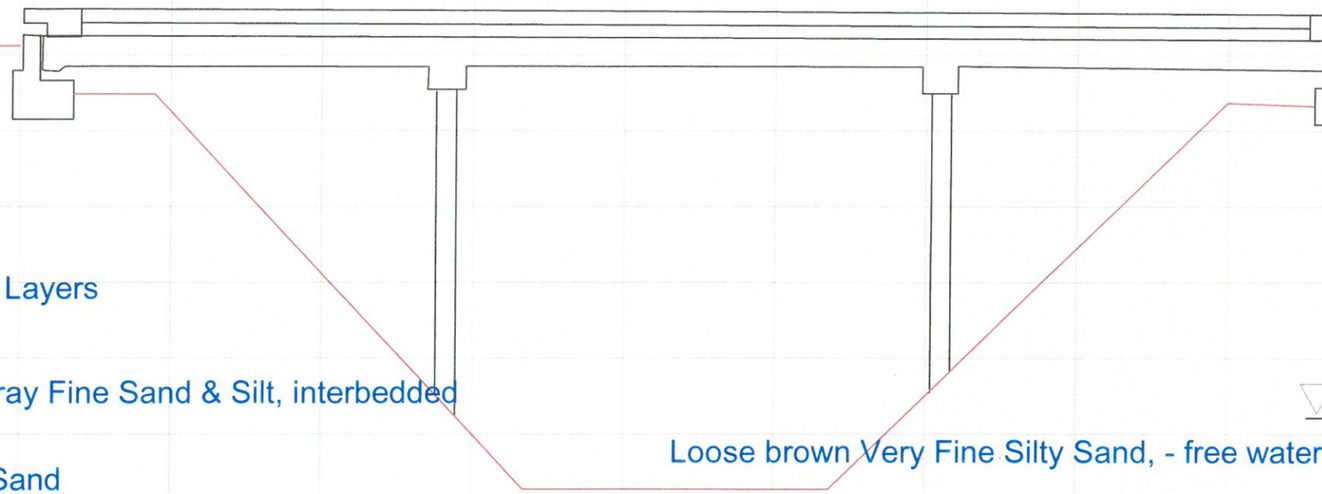
Surface Water Elev. 633.08 ft
Stream Bed Elev. 627.90 ft

Groundwater Elev.:
First Encounter 627.1 ft ▼
Upon Completion 627.1 ft ▽
After _____ **Hrs.** _____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Dense Gray Fine to Medium Sand with some Coarse Sand *(continued)*		18		
		21		20
		24	*	
* Washed Sample 40.0' to 41.5'				
* Washed Sample 42.5' to 44.0'		14		
		20		20
		22	*	
	-45			
* Washed Sample 45.0' to 46.5'		16		
		23		21
		24	*	
	-50			
* Washed Sample 50.0' to 51.5'		18		
		24		21
		25	*	
	-55			
* Washed Sample 55.0' to 56.5'		16		
		22		23
	582.63	24	*	
End of Boring				
	-60			

SOIL BORING 006-0096.GPJ IL_DOT.GDT 6/4/20

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)



B-02 (2019) SE Quad
Elev. 639.13
Sta. ~~230+13~~ 231+37 ~~23' Lt~~ 23' Rt

N - Qu- M%

- 5-1.5P-15 — Augered black Silty Clay Loam fill
- 5-2.0P-22 — Stiff brown Silty Clay Loam fill w/Fine Sand Layers
- 2-1.0P-26
- 3-24 — Very loose brown & gray Fine Sand & Silt, interbedded
- 11-20 — Medium brown Fine Sand
- 25-19
- 26-19
- 15-23
- 18-22 — Medium gray Fine to Medium Sand
- 20-20
- 17-21
- 20-22
- 34-20
- 32-19
- 39-21
- 45-20

- 42-20
- 47-21 — Dense gray Fine to Medium Sand w/some Coarse Sand
- 49-21
- 46-23 — End of Boring

230+50

B-01 (2019) NW Quad
Elev. 639.05
Sta. ~~231+34~~ 230+16 ~~29' Rt~~ 29' Lt

N - Qu- M%

- 6-1.0P-21 — Augered black Silty Clay Loam topsoil, gray & brown Silt/Silty Loam fill
- 5-1.0P-27 — Stiff gray & brown Silt & Silty Loam fill, brown Silty Clay Loam fill
- 5-1.5P-23
- 4-1.0P-27 — Stiff brown & gray Fine Sand, Silt & Silty Loam - bedded
- 9-20 — Loose brown Very Fine Silty Sand, - free water
- 16-19 — Medium brown Very Fine to Medium Sand - minor Silty layers
- 14-19
- 12-19
- 20-23
- 20-19 — Medium gray Fine to Coarse Sand - clean
- 25-21
- 28-22
- 31-21 — Dense gray Fine to Coarse Sand - clean
- 41-21
- 59-20
- 59-21
- 64-21
- 65-21 — End of Boring

231+00

McCleary Engineering	Designed by:	Date:	Illinois Rte. 92 over Hennepin Canal Feeder			Route	Section	County
	Drawn by: MLL	Date: 6-2-20				FAP 567	(135 B-1)ES	Bureau
	Checked by:	Date:	Scale = NA	Sheet 1 of 1	Sta. _____ to Sta. _____	Bridge Number: 006-0096		

Illinois Department of Transportation

COHESIVE SOIL SETTLEMENT ESTIMATE

LOCATION AND BORING USED ====: west Abutment / Boring 01 NW Quad
TYPE OF SURCHARGE ================================ 1 (1=2:1 bridge cone, 2=continuous embank., 3=rectangular surch.)
DEPTH TO WATER TABLE (below top of existing embankment) == 12 FT

NEW EMBANKMENT:
- NEW EMBANKMENT FILL UNIT WEIGHT ========== 120 PCF
- NEW EMBANKMENT FILL HEIGHT ========== 5.5 FT
- PROPOSED WIDTH AT TOP ========== 36 FT
- PROPOSED WIDTH AT BOTTOM ========== 58 FT (which is a 2.0:1 slope)

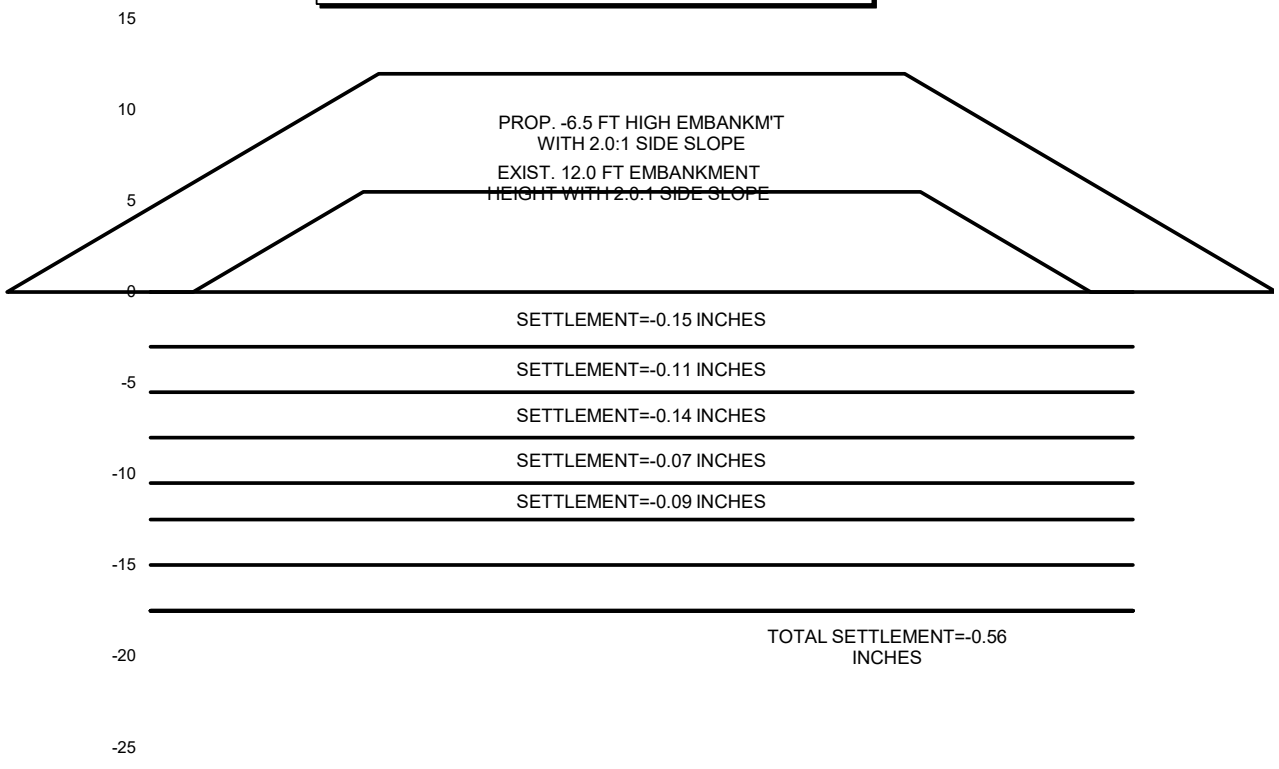
EXISTING EMBANKMENT (IF ANY):
- EXISTING EMBANKMENT UNIT WEIGHT ========== 120 PCF
- EXISTING EMBANKMENT HEIGHT ========== 12 FT
- EXISTING WIDTH AT TOP ========== 34 FT
- EXISTING WIDTH AT BASE ========== 82 FT (which is a 2.0:1 slope)

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.)*
3.0	120	1.00	21	1.498	-0.780	0.567	0.099	0.200	**-0.15**
2.5	120	1.00	21	1.603	-0.777	0.567	0.099	0.200	**-0.11**
2.5	120	1.00	27	1.698	-0.768	0.729	0.153	0.200	**-0.14**
2.5	120	1.50	23	1.792	-0.754	0.621	0.117	0.142	**-0.07**
2.0	120	1.00	27	1.877	-0.737	0.729	0.153	0.200	**-0.09**
2.5	120	0.00	33	1.961	-0.718	0.891	0.207	1.000	**Granular**
2.5	120	0.00	25	2.055	-0.695	0.675	0.135	1.000	**Granular**

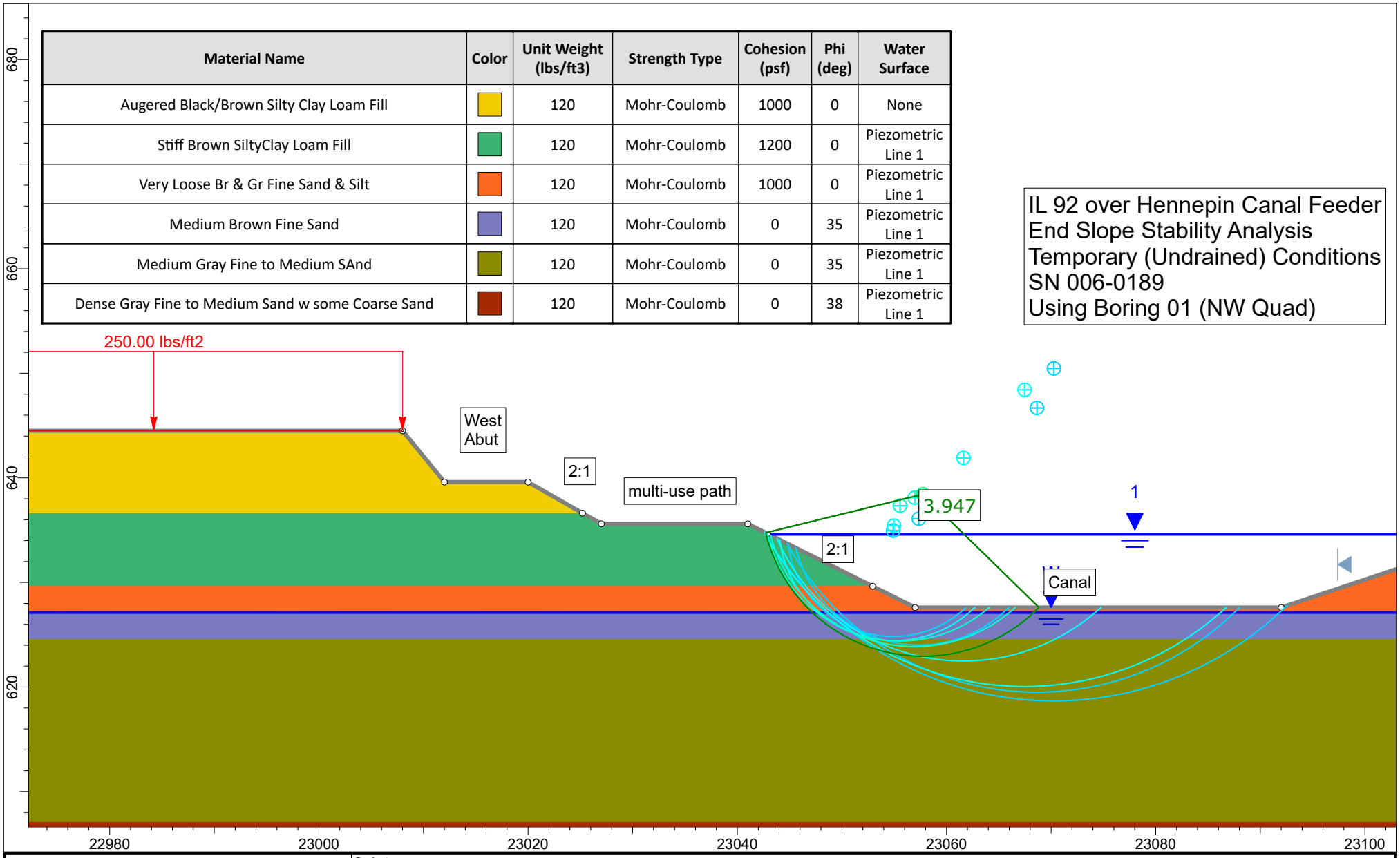
TOTAL SETTLEMENT UNDER CENTER OF BRIDGE CONE = -0.56 IN.

EMBANKMENT AND SOIL PROFILE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Augered Black/Brown Silty Clay Loam Fill		120	Mohr-Coulomb	1000	0	None
Stiff Brown SiltyClay Loam Fill		120	Mohr-Coulomb	1200	0	Piezometric Line 1
Very Loose Br & Gr Fine Sand & Silt		120	Mohr-Coulomb	1000	0	Piezometric Line 1
Medium Brown Fine Sand		120	Mohr-Coulomb	0	35	Piezometric Line 1
Medium Gray Fine to Medium SAnd		120	Mohr-Coulomb	0	35	Piezometric Line 1
Dense Gray Fine to Medium Sand w some Coarse Sand		120	Mohr-Coulomb	0	38	Piezometric Line 1

IL 92 over Hennepin Canal Feeder
End Slope Stability Analysis
Temporary (Undrained) Conditions
SN 006-0189
Using Boring 01 (NW Quad)



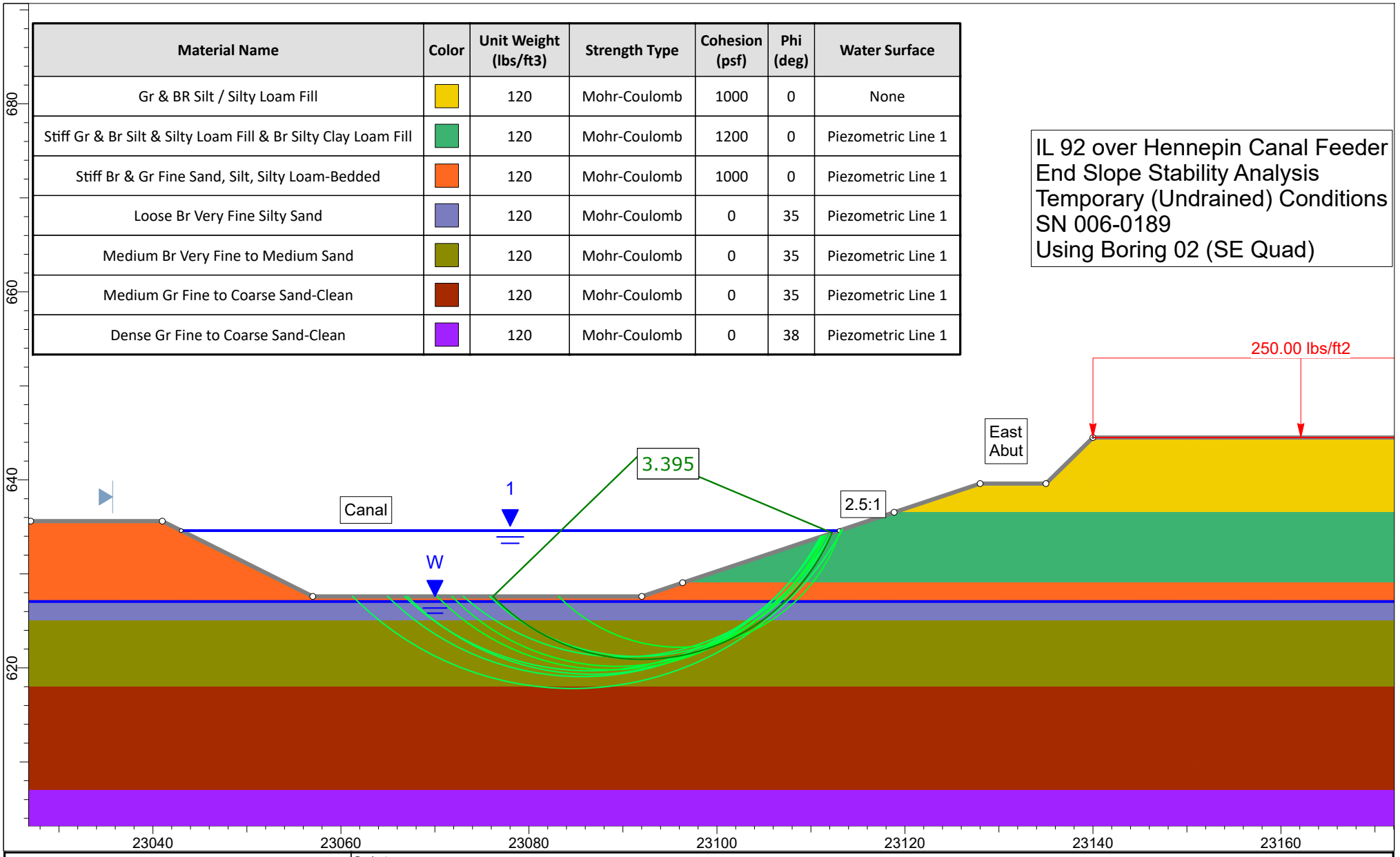
McCleary Engineering

SLIDEINTERPRET 8.032

Project	IL 92 over Hennepin Canal Feeder SN 006-0189		
Analysis Description	Short Term (Undrained) Analysis		
Drawn By	MJ	Scale 1:152	Company McCleary Engineering
Date	5/31/2020, 2:07:38 PM		File Name West Abut Boring 01.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Gr & BR Silt / Silty Loam Fill		120	Mohr-Coulomb	1000	0	None
Stiff Gr & Br Silt & Silty Loam Fill & Br Silty Clay Loam Fill		120	Mohr-Coulomb	1200	0	Piezometric Line 1
Stiff Br & Gr Fine Sand, Silt, Silty Loam-Bedded		120	Mohr-Coulomb	1000	0	Piezometric Line 1
Loose Br Very Fine Silty Sand		120	Mohr-Coulomb	0	35	Piezometric Line 1
Medium Br Very Fine to Medium Sand		120	Mohr-Coulomb	0	35	Piezometric Line 1
Medium Gr Fine to Coarse Sand-Clean		120	Mohr-Coulomb	0	35	Piezometric Line 1
Dense Gr Fine to Coarse Sand-Clean		120	Mohr-Coulomb	0	38	Piezometric Line 1

IL 92 over Hennepin Canal Feeder
End Slope Stability Analysis
Temporary (Undrained) Conditions
SN 006-0189
Using Boring 02 (SE Quad)



Project	IL 92 over Hennepin Canal Feeder SN 006-0189		
Analysis Description	Short Term (Undrained) Analysis		
Drawn By	MJ	Scale 1:169	Company McCleary Engineering
Date	5/31/2020, 2:07:38 PM		File Name East Abut Boring 02.slmd

SLIDEINTERPRET 8.032

Illinois Department of Transportation

SEISMIC SITE CLASS DETERMINATION

PROJECT TITLE=====

Substructure 1

Base of Substruct. Elev. (or ground surf for bents	635	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-1	
Top of Boring Elev.	639.05	ft.
Approximate Fixity Elev.	629	ft.

Individual Site Class Definition:

N (bar): 33 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 39 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): (ksf) NA, H < 0.1*H (Soil)

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	636.6	2.50	6	1.00	B
	634.1	2.50	6	1.00	
	631.6	2.50	5	1.00	
	629.1	2.50	5	1.50	B
2.0	627.1	2.00	4	1.00	B
4.0	625.1	2.00	9		B
6.5	622.6	2.50	16		
9.0	620.1	2.50	14		
11.0	618.1	2.00	8		B
13.0	616.1	2.00	12		
15.0	614.1	2.00	20		
17.0	612.1	2.00	20		
19.0	610.1	2.00	25		
21.0	608.1	2.00	27		
22.0	607.1	1.00	28		B
24.0	605.1	2.00	41		
26.0	603.1	2.00	58		
28.0	601.1	2.00	59		
30.0	599.1	2.00	64		
32.0	597.1	2.00	65		B
34.0	595.1	2.00	62		
36.0	593.1	2.00	62		
38.0	591.1	2.00	62		
40.0	589.1	2.00	62		
42.0	587.1	2.00	62		
44.0	585.1	2.00	62		
46.0	583.1	2.00	62		
48.0	581.1	2.00	62		
50.0	579.1	2.00	62		
52.0	577.1	2.00	62		
54.0	575.1	2.00	62		
56.0	573.1	2.00	62		
58.0	571.1	2.00	62		
60.0	569.1	2.00	62		
62.0	567.1	2.00	62		
64.0	565.1	2.00	62		
100.0	529.1	36.00	62		B

Substructure 2

Base of Substruct. Elev. (or ground surf for bents	635	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-2	
Top of Boring Elev.	639.13	ft.
Approximate Fixity Elev.	629	ft.

Individual Site Class Definition:

N (bar): 29 (Blows/ft.) Soil Site Class D <----Controls
N_{ch} (bar): 29 (Blows/ft.) Soil Site Class D
s_u (bar): (ksf) NA

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	636.6	2.50	5	1.00	B
	634.1	2.50	5	1.50	
	631.6	2.50	5	2.00	
	629.6	2.00	2	1.00	B
1.9	627.1	2.50	3		B
4.4	624.6	2.50	11		B
6.4	622.6	2.00	25		
8.4	620.6	2.00	26		
10.4	618.6	2.00	15		
12.4	616.6	2.00	18		
14.4	614.6	2.00	19		
16.4	612.6	2.00	18		
18.4	610.6	2.00	17		
20.4	608.6	2.00	20		
21.9	607.1	1.50	20		B
23.9	605.1	2.00	34		
25.9	603.1	2.00	32		
27.9	601.1	2.00	39		
29.9	599.1	2.00	42		
31.9	597.1	2.00	45		
33.9	595.1	2.00	44		
35.9	593.1	2.00	47		
37.9	591.1	2.00	48		
39.9	589.1	2.00	49		
41.9	587.1	2.00	48		
43.9	585.1	2.00	47		
46.4	582.6	2.50	46		B
48.4	580.6	2.00	48		
50.4	578.6	2.00	48		
52.4	576.6	2.00	48		
54.4	574.6	2.00	48		
56.4	572.6	2.00	48		
58.4	570.6	2.00	48		
60.4	568.6	2.00	48		
62.4	566.6	2.00	48		
64.4	564.6	2.00	48		
100.0	529.0	35.60	48		B

Substructure 3

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

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 2

N (bar): 31 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 34 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): (ksf) NA, H < 0.1*H (Total)

JSON Raw Data Headers

Save Copy Collapse All Expand All Filter JSON

request:
- date: "2020-05-29T18:36:35.485Z"
- referenceDocument: "AASHTO-2009"
- status: "success"
- url: "https://earthquake.usgs.gov/ws/designmaps/aashto-2009.json?latitude=41.569205&longitude=-89.767603&siteClass=D&title=IL 92 over Hennepin Feeder Canal"
- parameters:
  - latitude: 41.569205
  - longitude: -89.767603
  - siteClass: "D"
  - title: "IL 92 over Hennepin Feeder Canal"

response:
- data:
  - pga: 0.041
  - fpga: 1.6
  - as: 0.065
  - ss: 0.09
  - fa: 1.6
  - sds: 0.145
  - s1: 0.038
  - fv: 2.4
  - sd1: 0.09
  - sdc: "A"
  - ts: 0.622
  - t0: 0.124
  - twoPeriodDesignSpectrum:
    - 0:
      - 0: 0
      - 1: 0.065
    - 1:
      - 0: 0.025
      - 1: 0.081
    - 2:
      - 0: 0.05
      - 1: 0.097
    - 3:
      - 0: 0.1
      - 1: 0.129
    - 4:
      - 0: 0.124
      - 1: 0.145
    - 5:
      - 0: 0.15
      - 1: 0.145
    - 6:
      - 0: 0.2

EFK♦Moen, LLC	By:	CDL	Date:	4/23/2020	Job No.
Civil Engineering Design	Chkd By:	ACB	Date:	4/28/2020	20027.01
For: IL92 over Hennepin Canal	Bckchk By:		Date:		Sht. No.

\\server18\PROJECTSSS4\20027.01 IDOT D1 PTB 194-027 WO1 IL92 TSL\Structural\Substructure\[Prelim Loads and Elevations.xlsx]Summary-WF

Abutments

Summary of Loads		Strength I		Extreme I		Service I	
	(k)	Factor	Factored Load	Factor	Factored Load	Factor	Factored Load
DC	325	1.25	406	1.25	406	1.00	325
DW	22	1.50	33	1.50	33	1.00	22
LL+I	114	1.75	200	0.00	0	1.00	114
EQ (T)	45	0.00	0	1.00	45	0.00	0
EQ (L)	45	0.00	0	1.00	45	0.00	0
WS (T)	5	0.00	0	0.00	0	0.30	1
WS (L)	0	0.00	0	0.00	0	0.30	0
WL (T)	2	0.00	0	0.00	0	1.00	2
WL (L)	1	0.00	0	0.00	0	1.00	1
	Total Vertical		**640**		**440**		**462**
	Total Transverse		**0**		**45**		**3**
	Total Longitudinal		**0**		**45**		**1**

Piers

Summary of Loads		Strength I		Extreme I		Service I	
	(k)	Factor	Factored Load	Factor	Factored Load	Factor	Factored Load
DC	669	1.25	837	1.25	837	1.00	669
DW	69	1.50	103	1.50	103	1.00	69
LL+I	185	1.75	324	0.00	0	1.00	185
EQ (T)	119	0.00	0	1.00	119	0.00	0
EQ (L)	119	0.00	0	1.00	119	0.00	0
WS (T)	10	0.00	0	0.00	0	0.30	3
WS (L)	0	0.00	0	0.00	0	0.30	0
WL (T)	4	0.00	0	0.00	0	1.00	4
WL (L)	2	0.00	0	0.00	0	1.00	2
	Total Vertical		**1263**		**940**		**923**
	Total Transverse		**0**		**119**		**7**
	Total Longitudinal		**0**		**119**		**2**

All loads are preliminary and subject to refinement during the TSL and final design.

Illinois Department of Transportation

INTEGRAL ABUTMENT FEASIBILITY ANALYSIS

Modified 10/30/17

GENERAL DATA

STRUCTURE NUMBER	006-0189		TOTAL STRUCTURE LENGTH	114.83	FT
STRUCTURE TYPE	MULTI-SPAN		NUMBER OF SPANS	3	
STRUCTURE SKEW	0	DEGREES	END SPAN LENGTH	36.00	FT
SUPER. DATA IN REFERENCE TO SUB. DATA	ABUT 1		ADJACENT INTERIOR SPAN LENGTH	41.00	FT

SUPERSTRUCTURE DATA (END OR MAIN SPAN)

BEAM TYPE	SLAB BRIDGE	
SLAB THICKNESS	21.00	IN
SLAB F'C	4.00	KSI

SUPERSTRUCTURE DATA (ADJACENT SPAN)

SLAB THICKNESS	21.00	IN
SLAB F'C	4.00	KSI

ABUTMENT #1 DATA

ABUTMENT NAME	West	
ABUTMENT REFERENCE BORING	Boring 02 NW Quad	
BOTTOM OF ABUTMENT ELEVATION	639.6	FT
ESTIMATED NUMBER OF PILES AT ABUT.	6	
PILE SPACING PERP. TO CL	9	FT

ABUTMENT #2 DATA

ABUTMENT NAME	East	
ABUTMENT REFERENCE BORING	Boring 01 SE Quad	
BOTTOM OF ABUTMENT ELEVATION	639.6	FT
ESTIMATED NUMBER OF PILES AT ABUT.	6	
PILE SPACING PERP. TO CL	9	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)*
636.60	3.00	1.5		
634.60	2.00	1.5		
632.10	2.50	2.0		
629.60	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)*
636.60	3.00	1.0		
634.60	2.00	1.0		
632.10	2.50	1.0		
629.60	2.50	1.50		

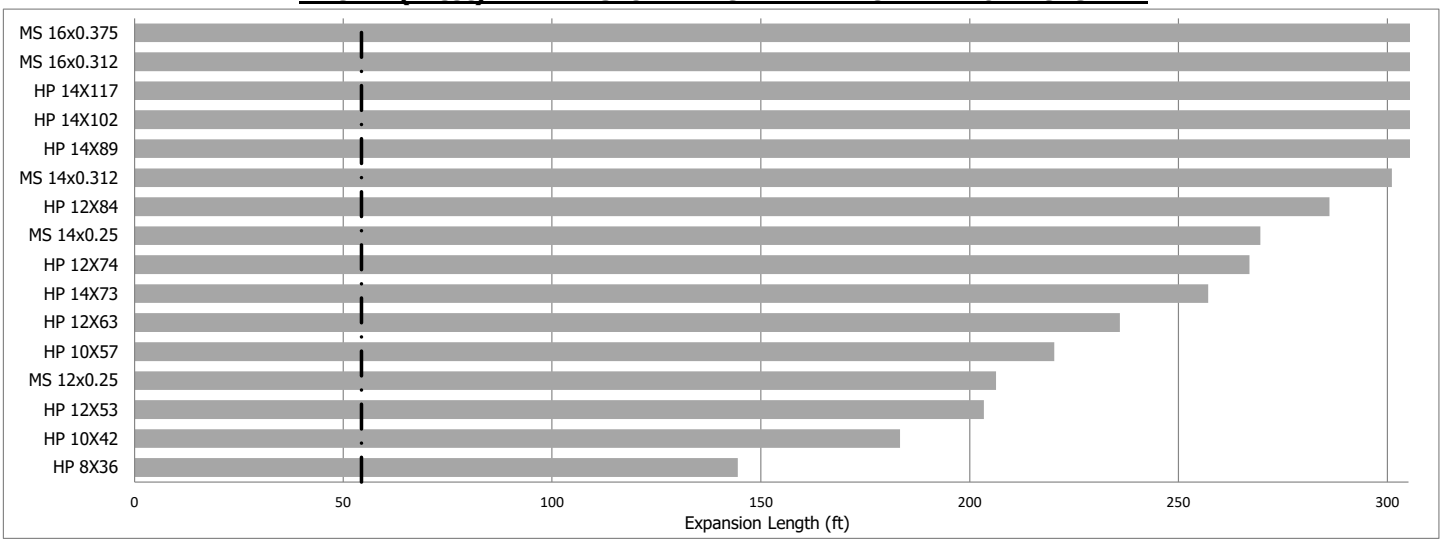
10.00 FT = TOTAL DEPTH ENTERED

WEIGHTED AVERAGE Qu FOR ABUTMENT #1	1.50	TSF	WEIGHTED AVERAGE Qu FOR ABUTMENT #2	1.13	TSF
PILE STIFFNESS MODIFIER FOR ABUTMENT #1 = 1/(1.45-[0.3*1.5])	1.00		PILE STIFFNESS MODIFIER FOR ABUTMENT #2 = 1/(1.45-[0.3*1.13])	0.90	

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #1 = [1*6*0+0.9*6*114.83]/[1*6+0.9*6] = 54.36 FT

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #2 = [0.9*6*0+1*6*114.83]/[0.9*6+1*6] = 60.47 FT

ABUT 1 (West) - 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.)

Pile Design Table for West Abutment utilizing Boring #Boring 01 NW (Quad)

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls		
80	44	15
130	72	17
133	73	22
181	100	25
195	108	27
235	129	30
268	147	32
303	167	35
376	207	37
Metal Shell 14"Φ w/.25" walls		
100	55	15
167	92	22
230	127	25
247	136	27
298	164	30
339	186	32
383	211	35
Metal Shell 14"Φ w/.312" walls		
100	55	15
167	92	22
230	127	25
247	136	27
298	164	30
339	186	32
383	211	35
478	263	37
Metal Shell 16"Φ w/.312" walls		
69	38	13
122	67	15
204	112	22
285	157	25
305	168	27
368	202	30
418	230	32
472	260	35
592	326	37
Metal Shell 16"Φ w/.375" walls		
69	38	13
122	67	15
204	112	22
285	157	25
305	168	27
368	202	30
418	230	32
472	260	35
592	326	37
Steel HP 8 X 36		
88	49	40
109	60	42
131	72	45
155	85	47

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42		
94	52	37
109	60	40
135	74	42
163	89	45
193	106	47
Steel HP 10 X 57		
97	54	37
114	63	40
141	77	42
168	93	45
199	109	47
Steel HP 12 X 53		
93	51	32
101	56	35
113	62	37
131	72	40
162	89	42
195	107	45
231	127	47
Steel HP 12 X 63		
96	53	32
104	57	35
116	64	37
136	75	40
167	92	42
201	110	45
237	130	47
Steel HP 12 X 74		
98	54	32
106	59	35
119	65	37
140	77	40
172	94	42
205	113	45
242	133	47

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84		
99	55	32
108	60	35
122	67	37
143	79	40
175	96	42
209	115	45
246	135	47
Steel HP 14 X 73		
96	53	27
104	57	30
113	62	32
123	68	35
137	76	37
161	88	40
198	109	42
237	131	45
281	154	47
Steel HP 14 X 89		
98	54	27
107	59	30
116	64	32
127	70	35
142	78	37
167	92	40
204	112	42
244	134	45
288	158	47
Steel HP 14 X 102		
100	55	27
109	60	30
118	65	32
129	71	35
145	80	37
171	94	40
209	115	42
250	137	45
293	161	47
Steel HP 14 X 117		
96	53	25
102	56	27
112	61	30
121	67	32
132	73	35
149	82	37
177	97	40
215	118	42
256	141	45
301	165	47
Precast 14"x 14"		
74	41	13
128	70	15
213	117	22

Pile Design Table for West Pier utilizing Boring #Boring 01 (NW Quad)

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls		
188	103	32
221	121	34
256	141	37
329	181	39
Metal Shell 14"Φ w/.25" walls		
192	106	29
243	134	32
284	156	34
329	181	37
424	233	39
Metal Shell 14"Φ w/.312" walls		
192	106	29
243	134	32
284	156	34
329	181	37
424	233	39
Metal Shell 16"Φ w/.312" walls		
126	70	24
223	122	27
242	133	29
305	168	32
356	196	34
410	225	37
529	291	39
Metal Shell 16"Φ w/.375" walls		
126	70	24
223	122	27
242	133	29
305	168	32
356	196	34
410	225	37
529	291	39
737	406	42
Steel HP 8 X 36		
118	65	49

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42		
146	80	49
Steel HP 10 X 57		
152	84	49
Steel HP 12 X 53		
175	97	49
Steel HP 12 X 63		
181	100	49
Steel HP 12 X 74		
186	102	49

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84		
190	104	49
Steel HP 14 X 73		
171	94	47
214	118	49
Steel HP 14 X 89		
177	98	47
221	122	49
Steel HP 14 X 102		
182	100	47
226	124	49
Steel HP 14 X 117		
188	104	47
233	128	49
Precast 14"x 14"		
128	71	24
224	123	27
245	135	29

Pile Design Table for East Pier utilizing Boring #Boring 02 SE (Quad)

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls		
188	103	32
272	149	35
289	159	37
349	192	40
Metal Shell 14"Φ w/.25" walls		
166	91	25
204	112	30
238	131	32
350	192	35
368	202	37
444	244	40
Metal Shell 14"Φ w/.312" walls		
166	91	25
204	112	30
238	131	32
350	192	35
368	202	37
444	244	40
525	289	42
570	313	45
Metal Shell 16"Φ w/.312" walls		
141	78	22
208	114	25
252	138	30
294	162	32
437	240	35
456	251	37
551	303	40
649	357	42
Metal Shell 16"Φ w/.375" walls		
141	78	22
208	114	25
252	138	30
294	162	32
437	240	35
456	251	37
551	303	40
649	357	42
699	385	45
Steel HP 8 X 36		
125	69	57

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42		
155	85	57
Steel HP 10 X 57		
160	88	57
Steel HP 12 X 53		
186	102	57
Steel HP 12 X 63		
191	105	57
Steel HP 12 X 74		
194	107	57

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84		
197	109	57
Steel HP 14 X 73		
183	101	52
205	113	55
226	124	57
Steel HP 14 X 89		
188	104	52
210	116	55
231	127	57
Steel HP 14 X 102		
192	106	52
214	118	55
235	129	57
Steel HP 14 X 117		
197	109	52
219	121	55
240	132	57
Precast 14"x 14"		
145	80	22
212	116	25
260	143	30

Pile Design Table for East Abutment utilizing Boring #Boring 02 (SE Quad)

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls		
58	32	12
103	57	15
168	92	22
193	106	25
216	119	30
243	134	32
327	180	35
344	189	37
Metal Shell 14"Φ w/.25" walls		
70	38	12
131	72	15
210	115	22
243	134	25
268	147	30
303	166	32
414	228	35
432	238	37
Metal Shell 14"Φ w/.312" walls		
70	38	12
131	72	15
210	115	22
243	134	25
268	147	30
303	166	32
414	228	35
432	238	37
508	280	40
Metal Shell 16"Φ w/.312" walls		
82	45	12
161	89	15
256	141	22
297	163	25
325	179	30
368	202	32
510	281	35
529	291	37
624	343	40
Metal Shell 16"Φ w/.375" walls		
82	45	12
161	89	15
256	141	22
297	163	25
325	179	30
368	202	32
510	281	35
529	291	37
624	343	40
722	397	42
773	425	45
Steel HP 8 X 36		
94	52	42
105	57	45
116	64	47
127	70	50
140	77	52
152	84	55
160	88	57

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42		
96	53	37
105	58	40
117	64	42
130	71	45
144	79	47
158	87	50
174	96	52
189	104	55
204	112	57
Steel HP 10 X 57		
98	54	37
108	60	40
121	66	42
134	74	45
148	81	47
163	90	50
179	98	52
194	107	55
208	115	57
Steel HP 12 X 53		
96	53	32
105	58	35
115	63	37
125	69	40
140	77	42
156	86	45
172	95	47
190	104	50
208	115	52
227	125	55
244	134	57
Steel HP 12 X 63		
98	54	32
108	59	35
118	65	37
129	71	40
144	79	42
160	88	45
177	97	47
195	107	50
214	117	52
232	128	55
250	137	57
Steel HP 12 X 74		
100	55	32
111	61	35
120	66	37
132	73	40
147	81	42
163	90	45
180	99	47
198	109	50
217	120	52
236	130	55
253	139	57

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84		
95	53	30
101	56	32
113	62	35
122	67	37
134	74	40
150	82	42
166	91	45
183	101	47
202	111	50
221	121	52
239	132	55
257	141	57
Steel HP 14 X 73		
98	54	25
105	58	27
110	60	30
116	64	32
128	70	35
139	77	37
153	84	40
170	94	42
189	104	45
209	115	47
230	127	50
253	139	52
275	151	55
296	163	57
Steel HP 14 X 89		
94	52	22
100	55	25
107	59	27
112	62	30
119	65	32
132	72	35
143	79	37
157	86	40
175	96	42
194	107	45
214	118	47
236	130	50
259	142	52
281	155	55
302	166	57
Steel HP 14 X 102		
96	53	22
102	56	25
109	60	27
114	63	30
121	66	32
134	74	35
146	80	37
160	88	40
179	98	42
198	109	45
218	120	47
240	132	50
263	145	52
285	157	55
306	168	57
Steel HP 14 X 117		
97	54	22
104	57	25
111	61	27
116	64	30
123	68	32
138	76	35
149	82	37
164	90	40
183	101	42
203	111	45
223	123	47
246	135	50
269	148	52
291	160	55
312	171	57
Precast 14"x 14"		
89	49	12
166	92	15

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== West Abutment
REFERENCE BORING ========== Boring 01 NW (Quad)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 641.60 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 639.60 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== None ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== None ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 640 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 147.00 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 55.12 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.312" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
570 KIPS	**478** KIPS	**263** KIPS	**37** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
636.55	3.05	1.00	6		12.4		***24.2***				24	0	0	13	5
634.05	2.50	1.00	6		10.2	11.7	***34.3***				34	0	0	19	8
631.55	2.50	1.00	5		10.2	11.7	***50.4***				50	0	0	28	10
629.05	2.50	1.50	5		13.8	17.6	***58.3***				58	0	0	32	13
627.05	2.00	1.00	4		8.2	11.7	***100.2***				100	0	0	55	15
625.05	2.00		9	Very Fine Silty Sand	5.2	45.4	***167.6***				168	0	0	92	17
622.05	3.00		16	Fine Sand	15.2	107.7	***169.4***				169	0	0	93	20
619.55	2.50		14	Fine Sand	11.1	94.2	***167.0***				167	0	0	92	22
617.05	2.50		12	Fine Sand	9.5	80.8	***230.4***				230	0	0	127	25
614.55	2.50		20	Medium Sand	16.9	134.6	***247.3***				247	0	0	136	27
612.05	2.50		20	Medium Sand	16.9	134.6	***297.8***				298	0	0	164	30
609.55	2.50		25	Medium Sand	21.1	168.2	***339.1***				339	0	0	186	32
607.05	2.50		28	Medium Sand	24.1	188.4	***383.4***				383	0	0	211	35
604.55	2.50		31	Medium Sand	27.8	208.6	***478.4***				478	0	0	263	37
602.05	2.50		41	Medium Sand	43.7	275.9	***643.3***				~~643~~	~~0~~	~~0~~	~~354~~	~~40~~
599.55	2.50		59	Clean Coarse Sand	99.7	397.0	***743.0***				~~743~~	~~0~~	~~0~~	~~409~~	~~42~~
597.05	2.50		59	Clean Coarse Sand	99.7	397.0	***876.3***				~~876~~	~~0~~	~~0~~	~~482~~	~~45~~
594.55	2.50		64	Clean Coarse Sand	113.9	430.7	***996.9***				~~997~~	~~0~~	~~0~~	~~548~~	~~47~~
592.55	2.00		65	Clean Coarse Sand		437.4									

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== West Abutment
REFERENCE BORING ========== Boring 01 NW (Quad)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 641.60 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 639.60 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== None ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== None ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 640 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 147.00 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 55.12 KIPS

PILE TYPE AND SIZE ========== Metal Shell 16"Φ w/.312" walls
Pile Perimeter========== 4.189 FT.
Pile End Bearing Area========== 1.396 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
654 KIPS	**592** KIPS	**326** KIPS	**37** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
636.55	3.05	1.00	6		14.2		***29.5***	30	0	0	16	5
634.05	2.50	1.00	6		11.6	15.3	***41.2***	41	0	0	23	8
631.55	2.50	1.00	5		11.6	15.3	***60.5***	60	0	0	33	10
629.05	2.50	1.50	5		15.8	23.0	***68.6***	69	0	0	38	13
627.05	2.00	1.00	4		9.3	15.3	***121.9***	122	0	0	67	15
625.05	2.00		9	Very Fine Silty Sand	5.9	59.3	***209.2***	209	0	0	115	17
622.05	3.00		16	Fine Sand	17.4	140.6	***209.0***	209	0	0	115	20
619.55	2.50		14	Fine Sand	12.7	123.1	***204.1***	204	0	0	112	22
617.05	2.50		12	Fine Sand	10.9	105.5	***285.3***	285	0	0	157	25
614.55	2.50		20	Medium Sand	19.3	175.8	***304.6***	305	0	0	168	27
612.05	2.50		20	Medium Sand	19.3	175.8	***367.8***	368	0	0	202	30
609.55	2.50		25	Medium Sand	24.1	219.7	***418.3***	418	0	0	230	32
607.05	2.50		28	Medium Sand	27.6	246.1	***472.2***	472	0	0	260	35
604.55	2.50		31	Medium Sand	31.7	272.5	***591.8***	592	0	0	326	37
602.05	2.50		41	Medium Sand	50.0	360.4	***800.0***	~~800~~	~~0~~	~~0~~	~~440~~	~~40~~
599.55	2.50		59	Clean Coarse Sand	113.9	518.6	***913.9***	~~914~~	~~0~~	~~0~~	~~503~~	~~42~~
597.05	2.50		59	Clean Coarse Sand	113.9	518.6	***1071.8***	~~1072~~	~~0~~	~~0~~	~~589~~	~~45~~
594.55	2.50		64	Clean Coarse Sand	130.2	562.5	***1210.8***	~~1211~~	~~0~~	~~0~~	~~666~~	~~47~~
592.55	2.00		65	Clean Coarse Sand		571.3						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== West Abutment
REFERENCE BORING ========== Boring 01 NW (Quad)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 641.60 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 639.60 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== None ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== None ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 640 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 147.00 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 55.12 KIPS

PILE TYPE AND SIZE ========== Metal Shell 16"Φ w/.375" walls
Plugged Pile Perimeter========== 4.189 FT.
Plugged Pile End Bearing Area========== 1.396 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
782 KIPS	**592** KIPS	**326** KIPS	**37** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)				NOMINAL 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.)
636.55	3.05	1.00	6		14.2		***29.5***				30	0	0	16	5
634.05	2.50	1.00	6		11.6	15.3	***41.2***				41	0	0	23	8
631.55	2.50	1.00	5		11.6	15.3	***60.5***				60	0	0	33	10
629.05	2.50	1.50	5		15.8	23.0	***68.6***				69	0	0	38	13
627.05	2.00	1.00	4		9.3	15.3	***121.9***				122	0	0	67	15
625.05	2.00		9	Very Fine Silty Sand	5.9	59.3	***209.2***				209	0	0	115	17
622.05	3.00		16	Fine Sand	17.4	140.6	***209.0***				209	0	0	115	20
619.55	2.50		14	Fine Sand	12.7	123.1	***204.1***				204	0	0	112	22
617.05	2.50		12	Fine Sand	10.9	105.5	***285.3***				285	0	0	157	25
614.55	2.50		20	Medium Sand	19.3	175.8	***304.6***				305	0	0	168	27
612.05	2.50		20	Medium Sand	19.3	175.8	***367.8***				368	0	0	202	30
609.55	2.50		25	Medium Sand	24.1	219.7	***418.3***				418	0	0	230	32
607.05	2.50		28	Medium Sand	27.6	246.1	***472.2***				472	0	0	260	35
604.55	2.50		31	Medium Sand	31.7	272.5	***591.8***				592	0	0	326	37
602.05	2.50		41	Medium Sand	50.0	360.4	***800.0***				~~800~~	~~0~~	~~0~~	~~440~~	~~40~~
599.55	2.50		59	Clean Coarse Sand	113.9	518.6	***913.9***				~~914~~	~~0~~	~~0~~	~~503~~	~~42~~
597.05	2.50		59	Clean Coarse Sand	113.9	518.6	***1071.8***				~~1072~~	~~0~~	~~0~~	~~589~~	~~45~~
594.55	2.50		64	Clean Coarse Sand	130.2	562.5	***1210.8***				~~1211~~	~~0~~	~~0~~	~~666~~	~~47~~
592.55	2.00		65	Clean Coarse Sand		571.3									

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== West Pier
REFERENCE BORING ========== Boring 01 (NW Quad)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 642.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 625.10 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== None ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== None ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1263 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 290.09 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 108.79 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.312" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
570 KIPS	**424** KIPS	**233** KIPS	**39** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
623.10	2.00		9	Very Fine Silty Sand	5.2		***51.3***				51	0	0	28	19
620.10	3.00		16	Fine Sand	15.2	46.1	***81.0***				81	0	0	45	22
617.60	2.50		14	Fine Sand	11.1	60.6	***100.7***				101	0	0	55	24
615.10	2.50		12	Fine Sand	9.5	69.2	***175.6***				176	0	0	97	27
612.60	2.50		20	Medium Sand	16.9	134.6	***192.5***				192	0	0	106	29
610.10	2.50		20	Medium Sand	16.9	134.6	***243.0***				243	0	0	134	32
607.60	2.50		25	Medium Sand	21.1	168.2	***284.3***				284	0	0	156	34
605.10	2.50		28	Medium Sand	24.1	188.4	***328.6***				329	0	0	181	37
602.60	2.50		31	Medium Sand	27.8	208.6	***423.7***				424	0	0	233	39
600.10	2.50		41	Medium Sand	43.7	275.9	***588.5***				~~589~~	~~0~~	~~0~~	~~324~~	~~42~~
597.60	2.50		59	Clean Coarse Sand	99.7	397.0	***688.2***				~~688~~	~~0~~	~~0~~	~~379~~	~~44~~
595.10	2.50		59	Clean Coarse Sand	99.7	397.0	***821.5***				~~822~~	~~0~~	~~0~~	~~452~~	~~47~~
592.60	2.50		64	Clean Coarse Sand	113.9	430.7	***942.2***				~~942~~	~~0~~	~~0~~	~~518~~	~~49~~
590.60	2.00		65	Clean Coarse Sand		437.4									

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== West Pier
REFERENCE BORING ========== Boring 01 (NW Quad)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 642.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 625.10 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== None ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== None ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1263 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 290.09 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 108.79 KIPS

PILE TYPE AND SIZE ========== Metal Shell 16"Φ w/.312" walls
Pile Perimeter========== 4.189 FT.
Pile End Bearing Area========== 1.396 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
654 KIPS	**529** KIPS	**291** KIPS	**39** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
623.10	2.00		9	Very Fine Silty Sand	5.9		***66.2***				66	0	0	36	19
620.10	3.00		16	Fine Sand	17.4	60.3	***102.4***				102	0	0	56	22
617.60	2.50		14	Fine Sand	12.7	79.1	***126.4***				126	0	0	70	24
615.10	2.50		12	Fine Sand	10.9	90.4	***222.7***				223	0	0	122	27
612.60	2.50		20	Medium Sand	19.3	175.8	***242.0***				242	0	0	133	29
610.10	2.50		20	Medium Sand	19.3	175.8	***305.2***				305	0	0	168	32
607.60	2.50		25	Medium Sand	24.1	219.7	***355.7***				356	0	0	196	34
605.10	2.50		28	Medium Sand	27.6	246.1	***409.6***				410	0	0	225	37
602.60	2.50		31	Medium Sand	31.7	272.5	***529.2***				529	0	0	291	39
600.10	2.50		41	Medium Sand	50.0	360.4	***737.4***				~~737~~	~~0~~	~~0~~	~~406~~	~~42~~
597.60	2.50		59	Clean Coarse Sand	113.9	518.6	***851.4***				~~851~~	~~0~~	~~0~~	~~468~~	~~44~~
595.10	2.50		59	Clean Coarse Sand	113.9	518.6	***1009.2***				~~1009~~	~~0~~	~~0~~	~~555~~	~~47~~
592.60	2.50		64	Clean Coarse Sand	130.2	562.5	***1148.2***				~~1148~~	~~0~~	~~0~~	~~631~~	~~49~~
590.60	2.00		65	Clean Coarse Sand		571.3									

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== West Pier
REFERENCE BORING ========== Boring 01 (NW Quad)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 642.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 625.10 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== None ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== None ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1263 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 290.09 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 108.79 KIPS

PILE TYPE AND SIZE ========== Metal Shell 16"Φ w/.375" walls
Plugged Pile Perimeter========== 4.189 FT.
Plugged Pile End Bearing Area========== 1.396 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
782 KIPS	**737** KIPS	**406** KIPS	**42** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)				NOMINAL 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.)
623.10	2.00		9	Very Fine Silty Sand	5.9		***66.2***				66	0	0	36	19
620.10	3.00		16	Fine Sand	17.4	60.3	***102.4***				102	0	0	56	22
617.60	2.50		14	Fine Sand	12.7	79.1	***126.4***				126	0	0	70	24
615.10	2.50		12	Fine Sand	10.9	90.4	***222.7***				223	0	0	122	27
612.60	2.50		20	Medium Sand	19.3	175.8	***242.0***				242	0	0	133	29
610.10	2.50		20	Medium Sand	19.3	175.8	***305.2***				305	0	0	168	32
607.60	2.50		25	Medium Sand	24.1	219.7	***355.7***				356	0	0	196	34
605.10	2.50		28	Medium Sand	27.6	246.1	***409.6***				410	0	0	225	37
602.60	2.50		31	Medium Sand	31.7	272.5	***529.2***				529	0	0	291	39
600.10	2.50		41	Medium Sand	50.0	360.4	***737.4***				737	0	0	406	42
597.60	2.50		59	Clean Coarse Sand	113.9	518.6	***851.4***				~~851~~	~~0~~	~~0~~	~~468~~	~~44~~
595.10	2.50		59	Clean Coarse Sand	113.9	518.6	***1009.2***				~~1009~~	~~0~~	~~0~~	~~555~~	~~47~~
592.60	2.50		64	Clean Coarse Sand	130.2	562.5	***1148.2***				~~1148~~	~~0~~	~~0~~	~~631~~	~~49~~
590.60	2.00		65	Clean Coarse Sand		571.3									

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== East Pier
REFERENCE BORING ========== Boring 02 SE (Quad)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 642.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 625.10 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== None ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== None ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1263 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 290.09 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 108.79 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.312" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
570 KIPS	**570** KIPS	**313** KIPS	**45** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
624.63	0.47		11	Medium Sand	1.7		***44.6***				45	0	0	25	17
622.13	2.50		25	Medium Sand	21.1	42.8	***104.9***				105	0	0	58	20
619.63	2.50		26	Medium Sand	22.0	82.0	***113.8***				114	0	0	63	22
617.13	2.50		15	Medium Sand	12.7	69.0	***166.2***				166	0	0	91	25
614.63	2.50		18	Medium Sand	15.2	108.7	***207.2***				207	0	0	114	27
612.13	2.50		20	Medium Sand	16.9	134.6	***203.9***				204	0	0	112	30
609.63	2.50		17	Medium Sand	14.3	114.4	***238.5***				238	0	0	131	32
607.13	2.50		20	Medium Sand	16.9	134.6	***349.5***				350	0	0	192	35
604.63	2.50		34	Medium Sand	31.9	228.8	***368.0***				368	0	0	202	37
602.13	2.50		32	Medium Sand	29.1	215.3	***444.2***				444	0	0	244	40
599.63	2.50		39	Medium Sand	40.1	262.4	***524.7***				525	0	0	289	42
597.13	2.50		45	Medium Sand	51.7	302.8	***569.7***				570	0	0	313	45
594.63	2.50		44	Medium Sand	49.6	296.1	***639.5***				~~639~~	~~0~~	~~0~~	~~352~~	~~47~~
592.13	2.50		47	Medium Sand	56.1	316.3	***702.3***				~~702~~	~~0~~	~~0~~	~~386~~	~~50~~
589.63	2.50		48	Medium Sand	58.3	323.0	***767.4***				~~767~~	~~0~~	~~0~~	~~422~~	~~52~~
587.13	2.50		49	Medium Sand	60.7	329.7	***814.6***				~~815~~	~~0~~	~~0~~	~~448~~	~~55~~
584.63	2.50		47	Medium Sand	56.1	316.3	***864.0***				~~864~~	~~0~~	~~0~~	~~475~~	~~57~~
582.63	2.00		46	Medium Sand		309.6									

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== East Pier
REFERENCE BORING ========== Boring 02 SE (Quad)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 642.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 625.10 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== None ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== None ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1263 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 290.09 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 108.79 KIPS

PILE TYPE AND SIZE ========== Metal Shell 16"Φ w/.312" walls
Pile Perimeter========== 4.189 FT.
Pile End Bearing Area========== 1.396 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring.
654 KIPS	**649** KIPS	**357** KIPS	**42** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
624.63	0.47		11	Medium Sand	2.0		***57.9***				58	0	0	32	17
622.13	2.50		25	Medium Sand	24.1	55.9	***133.2***				133	0	0	73	20
619.63	2.50		26	Medium Sand	25.1	107.1	***141.3***				141	0	0	78	22
617.13	2.50		15	Medium Sand	14.5	90.1	***207.7***				208	0	0	114	25
614.63	2.50		18	Medium Sand	17.4	142.0	***258.8***				259	0	0	142	27
612.13	2.50		20	Medium Sand	19.3	175.8	***251.7***				252	0	0	138	30
609.63	2.50		17	Medium Sand	16.4	149.4	***294.5***				294	0	0	162	32
607.13	2.50		20	Medium Sand	19.3	175.8	***436.8***				437	0	0	240	35
604.63	2.50		34	Medium Sand	36.5	298.8	***455.8***				456	0	0	251	37
602.13	2.50		32	Medium Sand	33.3	281.3	***550.5***				551	0	0	303	40
599.63	2.50		39	Medium Sand	45.8	342.8	***649.1***				649	0	0	357	42
597.13	2.50		45	Medium Sand	59.1	395.5	***699.4***				~~699~~	~~0~~	~~0~~	~~385~~	~~45~~
594.63	2.50		44	Medium Sand	56.7	386.7	***782.5***				~~782~~	~~0~~	~~0~~	~~430~~	~~47~~
592.13	2.50		47	Medium Sand	64.1	413.1	***855.4***				~~855~~	~~0~~	~~0~~	~~470~~	~~50~~
589.63	2.50		48	Medium Sand	66.7	421.9	***930.9***				~~931~~	~~0~~	~~0~~	~~512~~	~~52~~
587.13	2.50		49	Medium Sand	69.3	430.7	***982.6***				~~983~~	~~0~~	~~0~~	~~540~~	~~55~~
584.63	2.50		47	Medium Sand	64.1	413.1	***1037.9***				~~1038~~	~~0~~	~~0~~	~~571~~	~~57~~
582.63	2.00		46	Medium Sand		404.3									

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== East Pier
REFERENCE BORING ========== Boring 02 SE (Quad)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 642.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 625.10 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== None ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== None ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1263 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 290.09 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 108.79 KIPS

PILE TYPE AND SIZE ========== Metal Shell 16"Φ w/.375" walls
Plugged Pile Perimeter========== 4.189 FT.
Plugged Pile End Bearing Area========== 1.396 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
782 KIPS	**699** KIPS	**385** KIPS	**45** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)				NOMINAL 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.)
624.63	0.47		11	Medium Sand	2.0		***57.9***				58	0	0	32	17
622.13	2.50		25	Medium Sand	24.1	55.9	***133.2***				133	0	0	73	20
619.63	2.50		26	Medium Sand	25.1	107.1	***141.3***				141	0	0	78	22
617.13	2.50		15	Medium Sand	14.5	90.1	***207.7***				208	0	0	114	25
614.63	2.50		18	Medium Sand	17.4	142.0	***258.8***				259	0	0	142	27
612.13	2.50		20	Medium Sand	19.3	175.8	***251.7***				252	0	0	138	30
609.63	2.50		17	Medium Sand	16.4	149.4	***294.5***				294	0	0	162	32
607.13	2.50		20	Medium Sand	19.3	175.8	***436.8***				437	0	0	240	35
604.63	2.50		34	Medium Sand	36.5	298.8	***455.8***				456	0	0	251	37
602.13	2.50		32	Medium Sand	33.3	281.3	***550.5***				551	0	0	303	40
599.63	2.50		39	Medium Sand	45.8	342.8	***649.1***				649	0	0	357	42
597.13	2.50		45	Medium Sand	59.1	395.5	***699.4***				699	0	0	385	45
594.63	2.50		44	Medium Sand	56.7	386.7	***782.5***				~~782~~	~~0~~	~~0~~	~~430~~	~~47~~
592.13	2.50		47	Medium Sand	64.1	413.1	***855.4***				~~855~~	~~0~~	~~0~~	~~470~~	~~50~~
589.63	2.50		48	Medium Sand	66.7	421.9	***930.9***				~~931~~	~~0~~	~~0~~	~~512~~	~~52~~
587.13	2.50		49	Medium Sand	69.3	430.7	***982.6***				~~983~~	~~0~~	~~0~~	~~540~~	~~55~~
584.63	2.50		47	Medium Sand	64.1	413.1	***1037.9***				~~1038~~	~~0~~	~~0~~	~~571~~	~~57~~
582.63	2.00		46	Medium Sand		404.3									

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== East Abutment
REFERENCE BORING ========== Boring 02 (SE Quad)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 641.60 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 639.60 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== None ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== None ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 640 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 147.00 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 55.12 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.312" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
570 KIPS	**508** KIPS	**280** KIPS	**40** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
637.10	2.50	1.50	5		13.8		***31.4***				31	0	0	17	5
634.60	2.50	1.50	5		13.8	17.6	***51.0***				51	0	0	28	7
632.10	2.50	2.00	5		16.7	23.5	***56.0***				56	0	0	31	10
629.60	2.50	1.00	2		10.2	11.7	***69.6***				70	0	0	38	12
627.10	2.50		3	Very Fine Silty Sand	2.2	15.1	***130.7***				131	0	0	72	15
624.60	2.50		11	Medium Sand	9.3	74.0	***234.2***				234	0	0	129	17
622.10	2.50		25	Medium Sand	21.1	168.2	***262.0***				262	0	0	144	20
619.60	2.50		26	Medium Sand	22.0	175.0	***209.9***				210	0	0	115	22
617.10	2.50		15	Medium Sand	12.7	100.9	***242.8***				243	0	0	134	25
614.60	2.50		18	Medium Sand	15.2	121.1	***271.4***				271	0	0	149	27
612.10	2.50		20	Medium Sand	16.9	134.6	***268.1***				268	0	0	147	30
609.60	2.50		17	Medium Sand	14.3	114.4	***302.6***				303	0	0	166	32
607.10	2.50		20	Medium Sand	16.9	134.6	***413.7***				414	0	0	228	35
604.60	2.50		34	Medium Sand	31.9	228.8	***432.2***				432	0	0	238	37
602.10	2.50		32	Medium Sand	29.1	215.3	***508.4***				508	0	0	280	40
599.60	2.50		39	Medium Sand	40.1	262.4	***588.8***				~~589~~	~~0~~	~~0~~	~~324~~	~~42~~
597.10	2.50		45	Medium Sand	51.7	302.8	***633.8***				~~634~~	~~0~~	~~0~~	~~349~~	~~45~~
594.60	2.50		44	Medium Sand	49.6	296.1	***703.7***				~~704~~	~~0~~	~~0~~	~~387~~	~~47~~
592.10	2.50		47	Medium Sand	56.1	316.3	***766.5***				~~766~~	~~0~~	~~0~~	~~422~~	~~50~~
589.60	2.50		48	Medium Sand	58.3	323.0	***831.6***				~~832~~	~~0~~	~~0~~	~~457~~	~~52~~
587.10	2.50		49	Medium Sand	60.7	329.7	***878.8***				~~879~~	~~0~~	~~0~~	~~483~~	~~55~~
584.60	2.50		47	Medium Sand	56.1	316.3	***928.1***				~~928~~	~~0~~	~~0~~	~~510~~	~~57~~
582.60	2.00		46	Medium Sand		309.6									

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== East Abutment
REFERENCE BORING ========== Boring 02 (SE Quad)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 641.60 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 639.60 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== None ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== None ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 640 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 147.00 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 55.12 KIPS

PILE TYPE AND SIZE ========== Metal Shell 16"Φ w/.312" walls
Pile Perimeter========== 4.189 FT.
Pile End Bearing Area========== 1.396 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
654 KIPS	**624** KIPS	**343** KIPS	**40** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
637.10	2.50	1.50	5		15.8		***38.7***				39	0	0	21	5
634.60	2.50	1.50	5		15.8	23.0	***62.2***				62	0	0	34	7
632.10	2.50	2.00	5		19.1	30.6	***65.9***				66	0	0	36	10
629.60	2.50	1.00	2		11.6	15.3	***82.0***				82	0	0	45	12
627.10	2.50		3	Very Fine Silty Sand	2.5	19.8	***161.4***				161	0	0	89	15
624.60	2.50		11	Medium Sand	10.6	96.7	***295.1***				295	0	0	162	17
622.10	2.50		25	Medium Sand	24.1	219.7	***328.0***				328	0	0	180	20
619.60	2.50		26	Medium Sand	25.1	228.5	***256.4***				256	0	0	141	22
617.10	2.50		15	Medium Sand	14.5	131.8	***297.2***				297	0	0	163	25
614.60	2.50		18	Medium Sand	17.4	158.2	***332.2***				332	0	0	183	27
612.10	2.50		20	Medium Sand	19.3	175.8	***325.1***				325	0	0	179	30
609.60	2.50		17	Medium Sand	16.4	149.4	***367.8***				368	0	0	202	32
607.10	2.50		20	Medium Sand	19.3	175.8	***510.2***				510	0	0	281	35
604.60	2.50		34	Medium Sand	36.5	298.8	***529.1***				529	0	0	291	37
602.10	2.50		32	Medium Sand	33.3	281.3	***623.9***				624	0	0	343	40
599.60	2.50		39	Medium Sand	45.8	342.8	***722.4***				~~722~~	~~0~~	~~0~~	~~397~~	~~42~~
597.10	2.50		45	Medium Sand	59.1	395.5	***772.7***				~~773~~	~~0~~	~~0~~	~~425~~	~~45~~
594.60	2.50		44	Medium Sand	56.7	386.7	***855.8***				~~856~~	~~0~~	~~0~~	~~471~~	~~47~~
592.10	2.50		47	Medium Sand	64.1	413.1	***928.7***				~~929~~	~~0~~	~~0~~	~~511~~	~~50~~
589.60	2.50		48	Medium Sand	66.7	421.9	***1004.2***				~~1004~~	~~0~~	~~0~~	~~552~~	~~52~~
587.10	2.50		49	Medium Sand	69.3	430.7	***1056.0***				~~1056~~	~~0~~	~~0~~	~~581~~	~~55~~
584.60	2.50		47	Medium Sand	64.1	413.1	***1111.3***				~~1111~~	~~0~~	~~0~~	~~611~~	~~57~~
582.60	2.00		46	Medium Sand		404.3									

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== East Abutment
REFERENCE BORING ========== Boring 02 (SE Quad)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 641.60 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 639.60 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== None ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== None ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 640 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 147.00 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 55.12 KIPS

PILE TYPE AND SIZE ========== Metal Shell 16"Φ w/.375" walls
Plugged Pile Perimeter========== 4.189 FT.
Plugged Pile End Bearing Area========== 1.396 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
782 KIPS	**773** KIPS	**425** KIPS	**45** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)				NOMINAL 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.)
637.10	2.50	1.50	5		15.8		***38.7***				39	0	0	21	5
634.60	2.50	1.50	5		15.8	23.0	***62.2***				62	0	0	34	7
632.10	2.50	2.00	5		19.1	30.6	***65.9***				66	0	0	36	10
629.60	2.50	1.00	2		11.6	15.3	***82.0***				82	0	0	45	12
627.10	2.50		3	Very Fine Silty Sand	2.5	19.8	***161.4***				161	0	0	89	15
624.60	2.50		11	Medium Sand	10.6	96.7	***295.1***				295	0	0	162	17
622.10	2.50		25	Medium Sand	24.1	219.7	***328.0***				328	0	0	180	20
619.60	2.50		26	Medium Sand	25.1	228.5	***256.4***				256	0	0	141	22
617.10	2.50		15	Medium Sand	14.5	131.8	***297.2***				297	0	0	163	25
614.60	2.50		18	Medium Sand	17.4	158.2	***332.2***				332	0	0	183	27
612.10	2.50		20	Medium Sand	19.3	175.8	***325.1***				325	0	0	179	30
609.60	2.50		17	Medium Sand	16.4	149.4	***367.8***				368	0	0	202	32
607.10	2.50		20	Medium Sand	19.3	175.8	***510.2***				510	0	0	281	35
604.60	2.50		34	Medium Sand	36.5	298.8	***529.1***				529	0	0	291	37
602.10	2.50		32	Medium Sand	33.3	281.3	***623.9***				624	0	0	343	40
599.60	2.50		39	Medium Sand	45.8	342.8	***722.4***				722	0	0	397	42
597.10	2.50		45	Medium Sand	59.1	395.5	***772.7***				773	0	0	425	45
594.60	2.50		44	Medium Sand	56.7	386.7	***855.8***				~~856~~	~~0~~	~~0~~	~~471~~	~~47~~
592.10	2.50		47	Medium Sand	64.1	413.1	***928.7***				~~929~~	~~0~~	~~0~~	~~511~~	~~50~~
589.60	2.50		48	Medium Sand	66.7	421.9	***1004.2***				~~1004~~	~~0~~	~~0~~	~~552~~	~~52~~
587.10	2.50		49	Medium Sand	69.3	430.7	***1056.0***				~~1056~~	~~0~~	~~0~~	~~581~~	~~55~~
584.60	2.50		47	Medium Sand	64.1	413.1	***1111.3***				~~1111~~	~~0~~	~~0~~	~~611~~	~~57~~
582.60	2.00		46	Medium Sand		404.3									

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IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== West Pier
REFERENCE BORING ========== Boring 01 (NW Quad)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 642.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 625.10 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== None ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== None ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1263 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 290.09 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 108.79 KIPS

PILE TYPE AND SIZE ========== Precast 14"x 14"
Pile Perimeter========== 4.667 FT.
Pile End Bearing Area========== 1.361 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring.
265 KIPS	**245** KIPS	**135** KIPS	**29** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
623.10	2.00		9	Very Fine Silty Sand	6.6		***65.4***				65	0	0	36	19
620.10	3.00		16	Fine Sand	19.4	58.8	***103.1***				103	0	0	57	22
617.60	2.50		14	Fine Sand	14.1	77.1	***128.3***				128	0	0	71	24
615.10	2.50		12	Fine Sand	12.1	88.1	***223.6***				224	0	0	123	27
612.60	2.50		20	Medium Sand	21.5	171.4	***245.1***				245	0	0	135	29
610.10	2.50		20	Medium Sand	21.5	171.4	***309.4***				~~309~~	~~0~~	~~0~~	~~170~~	~~32~~
607.60	2.50		25	Medium Sand	26.9	214.2	***362.0***				~~362~~	~~0~~	~~0~~	~~199~~	~~34~~
605.10	2.50		28	Medium Sand	30.7	239.9	***418.4***				~~418~~	~~0~~	~~0~~	~~230~~	~~37~~
602.60	2.50		31	Medium Sand	35.4	265.6	***539.4***				~~539~~	~~0~~	~~0~~	~~297~~	~~39~~
600.10	2.50		41	Medium Sand	55.7	351.3	***749.3***				~~749~~	~~0~~	~~0~~	~~412~~	~~42~~
597.60	2.50		59	Clean Coarse Sand	126.9	505.5	***876.3***				~~876~~	~~0~~	~~0~~	~~482~~	~~44~~
595.10	2.50		59	Clean Coarse Sand	126.9	505.5	***1046.0***				~~1046~~	~~0~~	~~0~~	~~575~~	~~47~~
592.60	2.50		64	Clean Coarse Sand	145.0	548.4	***1199.6***				~~1200~~	~~0~~	~~0~~	~~660~~	~~49~~
590.60	2.00		65	Clean Coarse Sand		556.9									

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IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== East Pier
REFERENCE BORING ========== Boring 02 SE (Quad)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 642.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 625.10 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== None ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== None ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1263 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 290.09 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 108.79 KIPS

PILE TYPE AND SIZE ========== Precast 14"x 14"
Pile Perimeter========== 4.667 FT.
Pile End Bearing Area========== 1.361 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
265 KIPS	**260** KIPS	**143** KIPS	**30** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
624.63	0.47		11	Medium Sand	2.2		***56.8***				57	0	0	31	17
622.13	2.50		25	Medium Sand	26.9	54.5	***133.5***				134	0	0	73	20
619.63	2.50		26	Medium Sand	28.0	104.4	***144.9***				145	0	0	80	22
617.13	2.50		15	Medium Sand	16.1	87.8	***211.6***				212	0	0	116	25
614.63	2.50		18	Medium Sand	19.3	138.4	***263.9***				264	0	0	145	27
612.13	2.50		20	Medium Sand	21.5	171.4	***259.6***				260	0	0	143	30
609.63	2.50		17	Medium Sand	18.3	145.7	***303.6***				~~304~~	~~0~~	~~0~~	~~167~~	~~32~~
607.13	2.50		20	Medium Sand	21.5	171.4	***445.0***				~~445~~	~~0~~	~~0~~	~~245~~	~~35~~
604.63	2.50		34	Medium Sand	40.7	291.3	***468.6***				~~469~~	~~0~~	~~0~~	~~258~~	~~37~~
602.13	2.50		32	Medium Sand	37.1	274.2	***565.6***				~~566~~	~~0~~	~~0~~	~~311~~	~~40~~
599.63	2.50		39	Medium Sand	51.0	334.2	***668.0***				~~668~~	~~0~~	~~0~~	~~367~~	~~42~~
597.13	2.50		45	Medium Sand	65.9	385.6	***725.3***				~~725~~	~~0~~	~~0~~	~~399~~	~~45~~
594.63	2.50		44	Medium Sand	63.2	377.0	***814.2***				~~814~~	~~0~~	~~0~~	~~448~~	~~47~~
592.13	2.50		47	Medium Sand	71.4	402.7	***894.2***				~~894~~	~~0~~	~~0~~	~~492~~	~~50~~
589.63	2.50		48	Medium Sand	74.3	411.3	***977.1***				~~977~~	~~0~~	~~0~~	~~537~~	~~52~~
587.13	2.50		49	Medium Sand	77.2	419.8	***1037.2***				~~1037~~	~~0~~	~~0~~	~~570~~	~~55~~
584.63	2.50		47	Medium Sand	71.4	402.7	***1100.0***				~~1100~~	~~0~~	~~0~~	~~605~~	~~57~~
582.63	2.00		46	Medium Sand		394.1									

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Project SN 006-0189 Drilled Shaft

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Calculated By TMR Date 6-7-20

Checked By M Date 6-8-20

West Pier

Depth	N_{60}	γ	ϕ
0-5'	NOT INCLUDED		
5-7'	11	128	33°
7-23'	25	132	38°
23-32.5	56	135	41°

East Pier

Depth	N_{60}	γ	ϕ
0-5'	NOT INCLUDED		
5-18'	16	128	33°
18-26'	33	135	41°
26-42.5	42	137	43°

Bottom of Encasement @ Piers = 625.1 ft

$$N_{60} = \frac{E_m C_B C_S C_R N}{0.60} \approx 0.9125\,N$$

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Project SN 006-0189 Drilled Shaft

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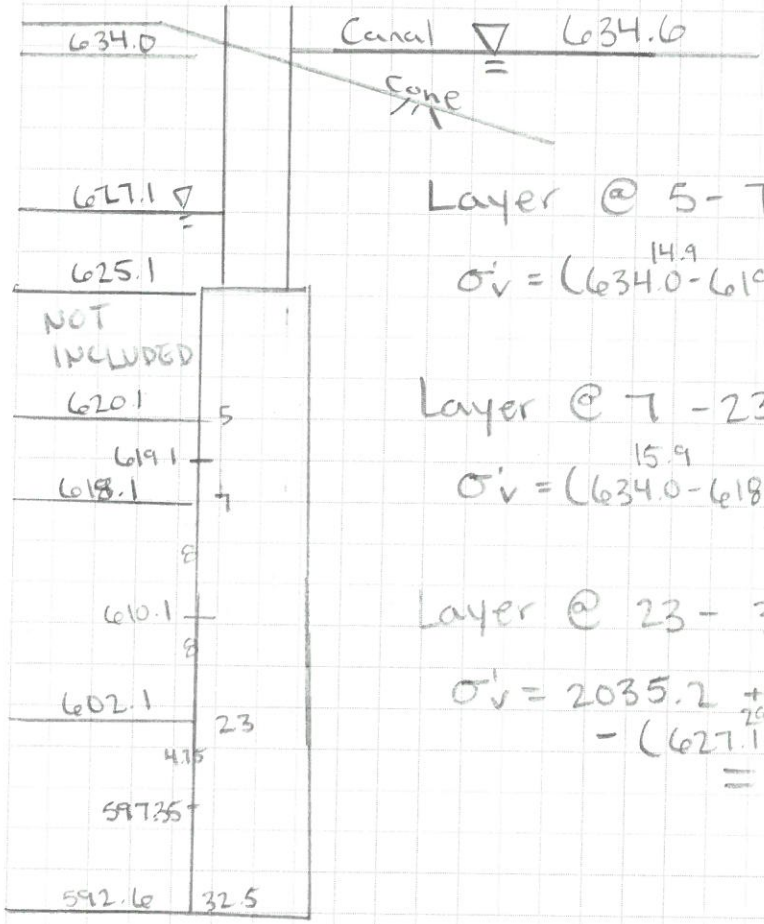
Calculated By TMR Date 6-7-20

Checked By M Date 6.9.20

West Pier



Layer @ 5 - 7'

$\sigma'_v = (634.0 - 619.1)128 - (627.1 - 619.1)62.4$ (14.9, 8.0)

$= 1408.0$ psf

Layer @ 7 - 23'

$\sigma'_v = (634.0 - 618.1)128 + 8' \times 132 - (627.1 - 610.1)62.4$ (15.9, 2035.2, 17.0)

$= 2030.4$ psf

Layer @ 23 - 32.5'

$\sigma'_v = 2035.2 + (16' \times 132) + (4.75 \times 135) - (627.1 - 597.35)62.4$ (29.75)

$= 2932.0$ psf

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Project SN 006 - 0189 Drilled Shaft

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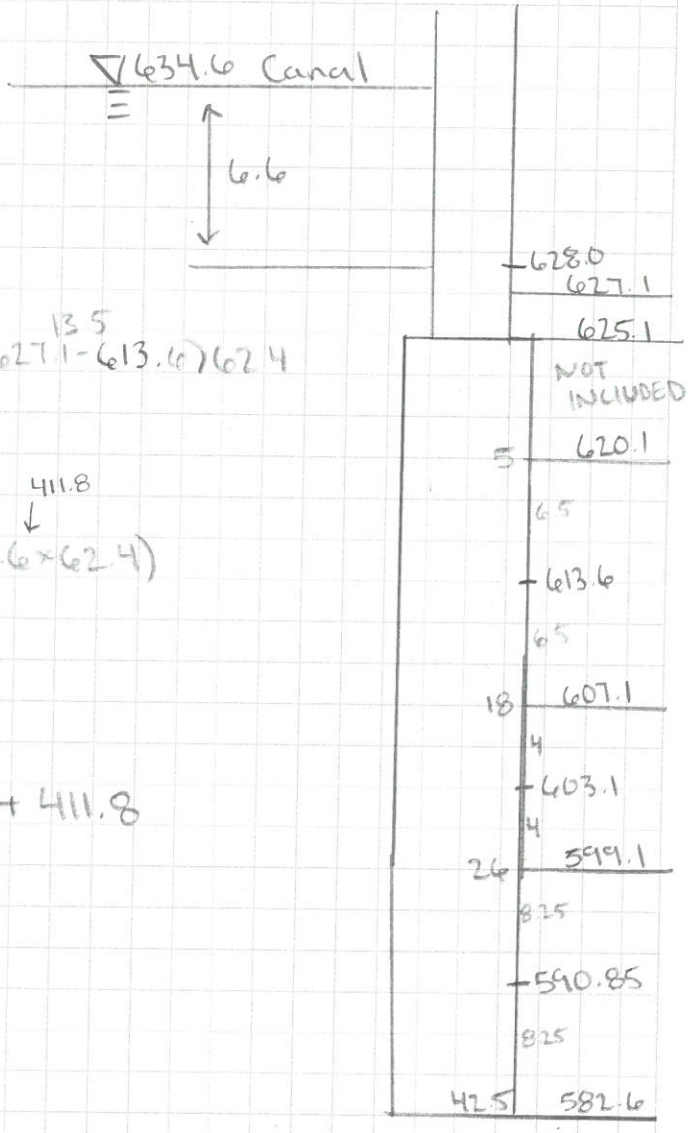
East Pier



Layer @ 5 - 18'

$\sigma'_v = (628.0 - 613.6)\,128 + (6.6 \times 62.4) - (627.1 - 613.6)62.4$

$= 1412.6$ psf

Layer @ 18 - 26'

$\sigma'_v = (628.0 - 607.1)128 + (4 \times 135) + (6.6 \times 62.4) - (627.1 - 603.1)62.4$

$= 2129.4$ psf

Layer @ 26 - 42.5'

$\sigma'_v = 2675.2 + (8.0 \times 135) + (8.25 \times 137) + 411.8 - (627.1 - 590.85)62.4$

$= 3035.3$ psf

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Project SN006-0189 Drilled Shafts

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Calculated By TMR Date 6-7-20

Checked By M Date 6.8.20

West Pier

For Sands 5 to 7' Deep

$\sigma'_v = 1408$ psf

$(N_1)_{60} = N_{60}\sqrt{\frac{Pa}{\sigma'_v}} = 11\sqrt{\frac{2116}{1408}} = 13.5$

$\sigma'_p = Pa \times 0.47 (N_{60})^m \quad m = 0.6$

$2116 \times 0.47 (11)^{0.6} = 4192.3$ psf

$\phi' = 27.5 + 9.2 \log(13.5) = 37.9°$

$OCR = \frac{4192}{1408} = 2.98$

$K_o = (1 - \sin\phi') OCR^{\sin\phi'}$

$(1 - \sin 37.9) \times 2.98^{\sin 37.9} = 0.75$

$K_p = \tan^2(45 + \phi/2)$ $\quad K_o < K_p$ ✓

$\tan^2(45 + 37.9/2) = 4.19$

$\beta = K_o \tan\phi'$

$0.75 \tan(37.9) = 0.58$

Unit Side Resistance $(f_{SN}) = \sigma'_v \beta$

$1408 \times 0.58 = 816.6$ psf

$816.6 \text{ psf} / 1000 \times 0.55 = 0.45$ ksf

Factored F_{SN} - West Pier
Drilled Shaft for Sands @ 5-7' Deep.

$= 0.45$ ksf

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Project SN006 - 0489 Drilled Shaft

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West Pier

For Sands 7 to 23' Deep -

$\sigma'_v = 2030.4$ psf

$(N_1)_{60} = 25\sqrt{\frac{2116}{2030.4}} = 25.5$

$\sigma'_p = 2116.0 \times 0.47 \times 25^{0.6} = 6860.8$ psf

$\phi' = 27.5 + 9.2 \log(25.5) = 40.4°$

$OCR = \frac{6860.8}{2030.4} = 3.38$

$K_o = (1 - \sin 40.4)\, 3.38^{\sin 40.4} = 0.77$

$K_o < K_p$ ✓

$K_p = \tan^2(45 + 40.4/2) = 4.68$

$\beta = 0.77 \tan 40.4 = 0.66$

$f_{SN} = 2030.4 \times 0.66 = 1340.1$ psf

$\frac{1340.1}{1000} \times 0.55 = 0.74$ ksf

factored F_{SN} - West Pier
Drilled Shaft for Sand 7 to 23' Deep.

$= 0.74$ ksf

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Project SN006-0189 Drilled Shaft

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Calculated By TMR Date 6-7-20

Checked By AM Date 6.8.20

West Pier

For Sands 23 to 32.5' Deep

$\sigma'_v = 2932$ psf

$(N_1)_{60} = 56\sqrt{\frac{2116}{2932}} = 47.6$

$\sigma'_p = 2116.0 \times 0.47 \times 56^{0.6} = 11130.8$ psf

$\phi' = 27.5 + 9.2\,\text{Log}(47.6) = 42.9°$

$OCR = \frac{11130.8}{2932} = 3.80$

$K_o = (1-\sin 42.9)\,3.8^{\sin 42.9} = 0.69$ → 0.79

$K_o < K_p$ ✓

$K_p = \tan^2(45° + 42.9/2) = 5.26$

$\beta = 0.69 \tan 42.9 = 0.64$ → 0.73

$f_{SN} = 2932 \times 0.64 = 18765$ psf → $2932 \times 0.73 = 2140.4$ psf

$\frac{18765}{1000} \times 0.55 = 1.03$ ksf → $\frac{2140.4}{1000} \times 0.55 = 1.17$ ksf

factored f_{SN} - West Pier

Drilled Shaft for Sands 23 to 32.5' Deep

$= 1.03$ ksf → 1.17 ksf

Unit Base Resistance - West Pier (Note: units in tsf)

$q_{BN} = 0.60 N_{60} \leq 30$ ksf

$0.6(56) = 33.6$ tsf

factored base resistance

33.6 tsf $\times 0.5 = 16.8$ tsf

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Project SN 006-0189 Drilled Shaft

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Calculated By TMR Date 6-7-20

Checked By M Date 6.9.20

East Pier

For Sands 5 to 18' Deep

$\sigma'_v = 1412.6$ psf

$(N_1)_{60} = 16\sqrt{\frac{2116}{1412.6}} = 19.6$

$\sigma'_p = 2116 \times 0.47 \times (16)^{0.4} = 5249.1$ psf

$\phi' = 27.5 + 9.2 \log(19.6) = 39.4°$

$OCR = \frac{5249.1}{1412.6} = 3.72$

$K_o = (1 - \sin(39.4)) 3.72^{\sin 39.4} = 0.84$ ✓

$K_p = \tan^2(45 + 39.4/2) = 4.48$ ✓

$K_o < K_p$ ✓

$\beta = 0.84 \tan 39.4 = 0.69$ ✓

Unit side resistance (f_{SN})

$f_{SN} = 1412.6 \times 0.69 = 974.7$ psf ✓

$974.7 \text{ psf} / 1000 \times 0.55 = 0.54$ ksf ✓

Factored f_{SN} - East Pier

Drilled Shaft For Sands 5 to 18' Deep

$= 0.54$ ksf ✓

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Project SN006-0189 Drilled Shaft

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Calculated By TMR Date 6-7-20

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East Pier

For Sands 18 to 26' Deep

$\sigma_v = 2129.4$ psf

$(N_1)_{60} = 33\sqrt{\frac{2116}{2129.4}} = 32.9$

$\sigma'_p = 2116 \times 0.47 \times 33^{0.6} = 8104.4$ psf

$\phi' = 27.5 + 9.2 \log 32.9 = 41.5°$

$OCR = \frac{8104.4}{2129.4} = 3.81$

$K_o = (1 - \sin 41.5)3.81^{\sin 41.5} = 0.82$

$K_p = \tan^2(45 + 41.5/2) = 4.93$

$K_o < K_p$ ✓

$\beta = 0.82 \times \tan 41.5 = 0.74$ ~~0.71~~

Unit side resistance (f_{sN})

$f_{sN} = 2129.4$ psf $\times 0.74 = 1575.8$ ~~1544.8~~ psf

$1575.8/1000 \times 0.55 = 0.87$ ksf

Factored Unit side resistance - East Pier

Drilled shaft for Sands 18 to 26' Deep

$= 0.85$ ~~0.87~~ ksf

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Project SN 006-0189

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Calculated By TMR Date 6-7-20

Checked By M Date 6.8.20

East Pier

For Sands 26 to 42.5' Deep

$\bar{\sigma}_v = 3035.3$ psf

$(N_1)_{60} = 42\sqrt{\frac{2116}{3035.3}} = 35.1$

$\bar{\sigma}_p = 2116 \times 0.47 \times 42^{0.6} = 9366.2$ psf

$\phi = 27.5 + 9.2 \log 35.1 = 41.7°$

$OCR = \frac{9366.2}{3035.3} = 3.09$

$K_o = (1-\sin 41.7)\, 3.09^{\sin 41.7} = 0.71$ -

$K_p = \tan^2(45 + 41.7/2) = 4.97$ -

$K_o < K_p$ ✓

$\beta = 0.71 \tan 41.7 = 0.63$ -

Unit Side Resistance (f_{sN})

$f_{sN} = 3035.3 \times 0.63 = 1912.2$ psf -

$1912.2/1000 \times 0.55 = 1.05$ ksf -

Factored Unit side Resistance - East Pier
Drilled Shaft for Sands 26 to 42.5' Deep

$= 1.05$ ksf -

Unit Base Resistance - East Pier (Note: in tsf)

$q_{BN} = 0.6\, N_{60}$

$= 0.6 \times (42) = 25.2$ tsf

Factored Unit Base Resistance

$25.2 \times 0.5 = 12.6$ tsf

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Table 10.5.5.2.4-1—Resistance Factors for Geotechnical Resistance of Drilled Shafts

Method/Soil/Condition			Resistance Factor
Nominal Axial Compressive Resistance of Single-Drilled Shafts, φ_{stat}	Side resistance in clay	α-method (Brown et al., 2010)	0.45
	Tip resistance in clay	Total Stress (Brown et al., 2010)	0.40
	Side resistance in sand	β-method (Brown et al., 2010)	0.55
	Tip resistance in sand	Brown et al. (2010)	0.50
	Side resistance in cohesive IGMs	Brown et al. (2010)	0.60
	Tip resistance in cohesive IGMs	Brown et al. (2010)	0.55
	Side resistance in rock	Kulhawy et al. (2005) Brown et al. (2010)	0.55
	Side resistance in rock	Carter and Kulhawy (1988)	0.50
	Tip resistance in rock	Canadian Geotechnical Society (1985) Pressuremeter Method (Canadian Geotechnical Society, 1985) Brown et al. (2010)	0.50
Block Failure, φ_{bl}	Clay		0.55
Uplift Resistance of Single-Drilled Shafts, φ_{up}	Clay	α-method (Brown et al., 2010)	0.35
	Sand	β-method (Brown et al., 2010)	0.45
	Rock	Kulhawy et al. (2005) Brown et al. (2010)	0.40
Group Uplift Resistance, φ_{ug}	Sand and clay		0.45
Horizontal Geotechnical Resistance of Single Shaft or Shaft Group	All materials		1.0
Static Load Test (compression), φ_{load}	All Materials		0.70
Static Load Test (uplift), φ_{upload}	All Materials		0.60

Illinois Department of Transportation

SEALCOAT ANALYSIS

INPUT DATA:

SEALCOAT THICKNESS	4.25	FT.
COFFERDAM DESIGN WATER ELEVATION	637.6	FT.
STREAMBED ELEVATION	627.6	FT.
BOTTOM OF FOOTING ELEVATION	625.1	FT.
BOTTOM OF SHEETING TIP ELEVATION	616.93	FT.
SHEET PILING WEIGHT	22.00	LBS./SQ.FT.
MISCELLANEOUS WEIGHT (WALES, STRUTS, ETC.)	0.00	LBS.
COFFERDAM WIDTH	12.00	FT.
COFFERDAM LENGTH	42.80	FT.
FOOTING WIDTH	3.00	FT.
FOOTING LENGTH	34.83	FT.
NUMBER OF PILES IN COFFERDAM	6	
PILE LENGTH BELOW TOP OF SEAL	47.00	FT.
EDGE OF FOOTING TO EDGE OF FOUNDATION PILES	1.40	FT.
INPUT H-PILE SECTION, OR PILE DIAMETER	MS 14x0.312	

ASSUMED PARAMETERS:

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

RESULTING FORCES:

I *HYDROSTATIC BUOYANCY FORCE:* ===> ***530.09*** ***KIPS***

II *SEALCOAT CONCRETE WEIGHT:* ===> ***323.32*** ***KIPS***

III *SHEET PILING RESISTANCE (Smallest of a+b+c, or d):* ===> ***225.25*** ***KIPS***

a) WEIGHT OF SHEET PILING	49.84	KIPS
b) MISCELLANEOUS WEIGHT ATTACHED TO SHEET PILING (WALES, STRUTS, BRACING, ETC.)	0.00	KIPS
c) SOIL FRICTION ON SHEET PILING	175.41	KIPS
d) SEALCOAT BOND TO SHEET PILING	469.53	KIPS

IV *FOUNDATION PILING RESISTANCE (Smallest of a+b, or c):* ===> ***94.33*** ***KIPS***

a) WEIGHT OF FOUNDATION PILING	-10.74	KIPS
b) PULLOUT RESISTANCE OF FOUNDATION PILING (SMALLEST OF 1, OR 2 + 3):	141.20	KIPS
1 SOIL FRICTION ON ALL INDIVIDUAL PILES	141.20	KIPS
2 SOIL FRICTION ALONG PERIMETER OF PILE GROUP	413.35	KIPS
3 WEIGHT OF SOIL CONTAINED IN PILE GROUP	-0.05	KIPS
c) SEALCOAT BOND TO FOUNDATION PILING	94.33	KIPS

$$\text{FACTOR OF SAFETY} = \frac{\text{RESISTING FORCES (II + III + IV)}}{\text{BUOYANT FORCE (I)}} = \frac{642.9 \text{ kips}}{530.1 \text{ kips}} = 1.21 \quad \text{OK}$$