

# Illinois Department of Transportation

## Memorandum

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To: Derek Verhulst                      Attn: Brenda Pagan-Figuero  
From: Terry Stephenson                By: Scott A. Kassel  
Subject: SN 015-0080 Structural Geotechnical Report  
Date: January 4, 2021

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A handwritten signature in black ink, appearing to read 'Terry Stephenson', written over the signature line of the memorandum header.

Route: FAP 824 (US 45)  
Section: (20XB)B-1  
Structure No.: 01-0022 (Existing), 015-0080 (Proposed)  
County: Coles  
Contract: 74362  
Job No.: P-97-013-09  
Location: US 45 over Flat Branch, West of Humboldt

Attached is one (1) copy of the Structural Geotechnical Report for the above captioned section.

If you have any questions or require any additional information, please contact Scott A. Kassel, P.E., District Geotechnical Engineer, at (217) 342-8233.

SAK

Enclosures

# STRUCTURE GEOTECHNICAL REPORT

**Proposed Structure No. 015-0080**

Existing SN: 015-0022

US 45 over Flat Branch  
FAP Route 824 (US 45)  
Section (20XB) B-1  
Coles County  
Sta. 143+10

P-97-013-09  
Contract No. 74362

**January 4, 2021**

**Prepared By:** Scott A. Kassel, P.E.  
IDOT Region 4 District 7  
Geotechnical Unit  
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(217) 342-8233

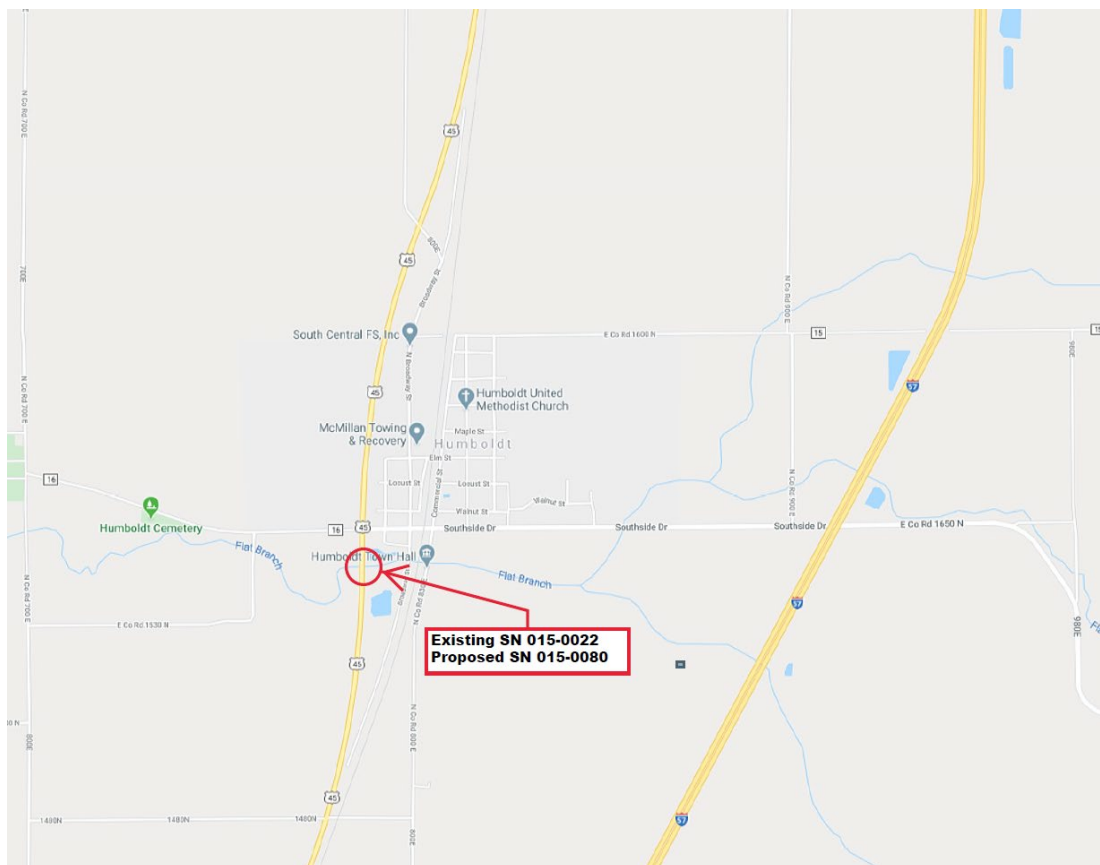
**Approved by:** Bradly Hessing, P.E.  
Bureau of Bridges & Structures  
Foundation & Geotechnical Unit  
[bradly.hessing@illinois.gov](mailto:bradly.hessing@illinois.gov)  
(217) 782-7773

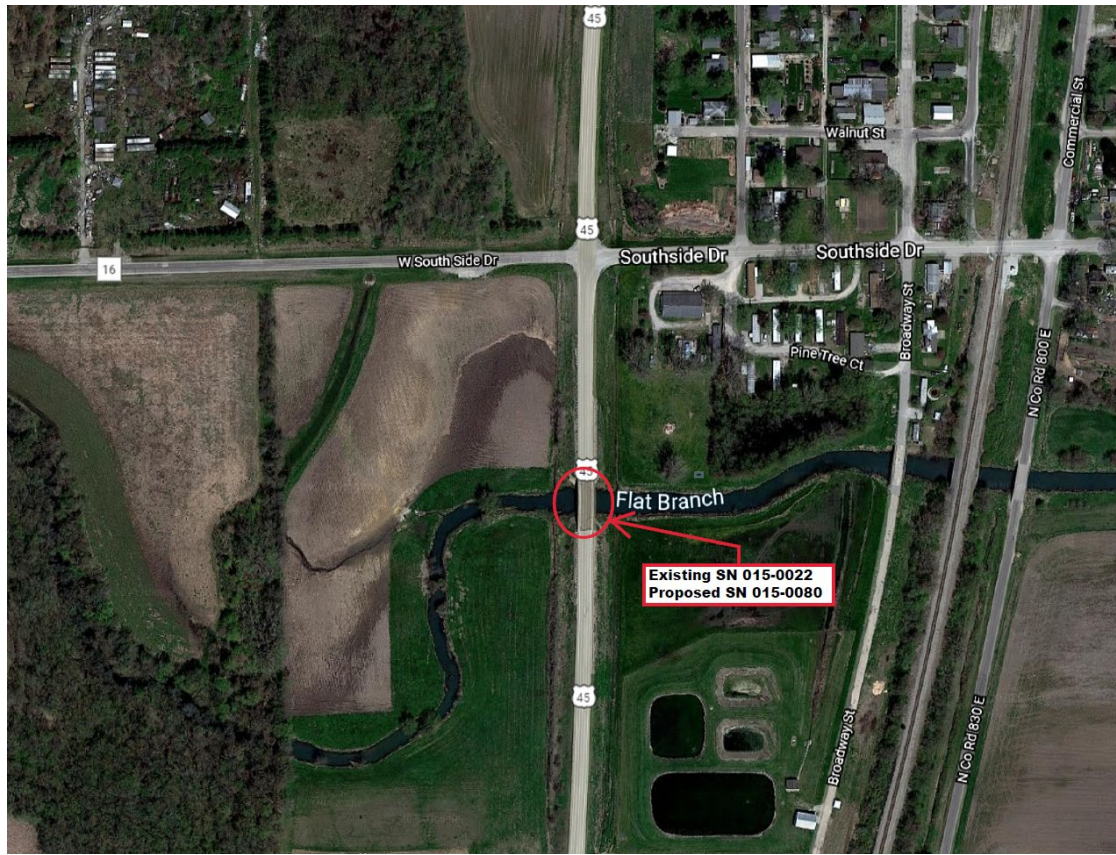
**Prepared For:** Brenda Pagan-Figueroa  
Illinois Department of Transportation  
Bureau of Bridges and Structures  
Bridge Planning Unit and  
Bridge Design Section

**Attachments:** Boring Logs  
Subsurface Data Profile Plot  
Preliminary TSL  
IDOT Static Method of  
Estimating Pile Lengths

## 1. Project Description and Scope

This project consists of complete replacement of existing structure 015-0022 with proposed structure 015-0080. The existing structure consists of a three-span, reinforced concrete haunch T-beam bridge. It measures 120 ft-3 in total length (back to back abutments) and a clear width of 35 ft-8 in (out to out deck) and is set at a zero-degree skew. The proposed structure will consist of a three-span concrete deck on steel beams supported on integral abutments and will also be set at a zero-degree skew. The planned length is 142 ft-8 in (back to back abutments) and planned width of 34 ft-10 in (out to out deck). According to the BCR, replacement has been recommended due to age, deterioration of abutment backwalls/superstructure and scour mitigation at the piers. The location of the existing and proposed structure is at FAP 824 (US 45) over Flat Branch in Coles County. Specifically, this is in the Northeast  $\frac{1}{4}$  of the Southeast  $\frac{1}{4}$ , Section 5, Township 13N, Range 8E. The maps below show the location of the structure just south of County Highway 16 in Humboldt.





## 2. Subsurface Conditions

Six (6) boring logs are located on the original 1953 plans for this structure. The data obtained from these borings included elevations and soil descriptions along with the corresponding N values and unconfined compressive strength data. The data from borings located at Station 142+87 and Station 143+33 were used in the analysis of Piers 1 and 2.

Two new borings, one at the South Abutment (Sta. 142+25) and one at the North Abutment (Sta. 144+00), were advanced to depths of 67.5 feet and 78 feet respectively.

**Abutments:** As presented on the Soil Boring Logs, fill material at the abutments mainly consists of Clay from ground surface to a depth of 18 to 20 feet. Generalized native subsurface soils underlying the fill at the embankments consist of Silty/Loam material from depths 20 to 37 feet. Clay Till was encountered between depths of 37 feet to 65 feet. The materials underlying the soils at a depth of 65 feet and extending to the maximum depth of exploration consisted of shale. The south abutment boring indicated a sand layer at a depth between 55 and 60 feet below ground surface. The hard glacial (Till) unconfined compressive strengths ( $Q_u$ ) range from 2.0 – 8.2 tsf with SPT (N Value) ranging from 11 to 100 blows per 12” of penetration. The South

Abutment boring was advanced to elevation 586.91 feet. Grain size distribution analyses (% passing the No. 200 Sieve) was performed on the sand layer of the South abutment.

Rock coring was performed at the North Abutment boring from Elevation 585 feet to Elevation 575 feet. The rock obtained from the coring operation consists of a weathered silty clay shale with thin sandstone partings. RQD values ranged from 28% to 63%, and unconfined compressive strength values ranged from 3.6 to 13.5 tsf.

**Piers:** The 1953 borings indicate Clay material at both piers to a depth of 12 feet below ground surface. The South pier boring indicates a Clay till material from 12 feet to 19 feet below ground surface. A silt material underlies the till layer and overlays another Clay till material. The clay till underlying the silt begins at a depth of 24 feet and continues to the extent of the boring to 35 feet.

The North pier boring reveals a 2-½ foot silt layer overlaying a 2-½ foot sand layer overlaying another 3-foot silt layer between the depths of 12 feet and 20 feet below ground surface. A Clay till material begins at a depth of 20 feet and extends to the depth of exploration of 38 feet.

The cohesive soils unconfined compressive strengths ( $Q_u$ ) at the pier borings range from 1.5 – 4.1 tsf with SPT (N Value) ranging from 10 to 80 blows per 12" of penetration.

**Groundwater:** Groundwater was first encountered at an elevation of 634.2 feet in boring B-1 and boring B-2 was dry at the time of field exploration. Upon completion of drilling, the groundwater was measured at an of elevation 637.7 feet in boring B-1 and 639.2 in boring B-2. When checked 24 hours after drilling, groundwater was measured at elevation 637.7 feet in boring B-1 and at an elevation of 640.2 feet in B-2. These observations represent groundwater conditions at the time of the field exploration, and may not be indicative of other times, or at other locations. Groundwater levels can be expected to fluctuate with varying seasonal and weather conditions.

### **3. Settlement**

The proposed profile grades will be within six inches of the existing grade. The small additional load at each abutment by the new embankment should result in less than 0.4 inches of total settlement. Therefore, downdrag forces do not need to be evaluated and remedial methods used to accelerate, or limit settlement should not be necessary.

### **4. Slope Stability**

Due to lengthening of the structure, soil will be excavated to a distance approximately 12 feet behind the existing south abutment and 10-½ feet behind the existing north abutment, to the proposed north and south abutment locations. A 1:2 (V:H) cut slope will be constructed in front of the proposed north and south abutments.

There is no significant increase in the roadway profile grade for slopes which have been stable for over 65 years; therefore, no stability problems are expected for the new side embankment slopes considering a proposed inclination equal to the existing standard inclination of 2 horizontal to 1 vertical (2H:1V). Therefore, there is no stability concern at either slope wall or end slopes and remedial measures are not necessary.

## 5. Scour

The proposed bridge opening will be widened, and the abutments will be protected by a 1:2 (V:H) riprap slope. Based upon no predicted contraction scour depth, the Q100, the Q200, Design and the Check scour elevations for both abutments are to be set at the bottom of abutment elevation.

The design scour elevations at the piers are based upon the theoretical Q100 and Q200 scour depths of 4.9 feet and 5.0 feet, respectively. Based upon a ground surface elevation of 633.9 feet, the Q100 design scour elevations are less than 6 feet below the ground surface elevation. Therefore, no Q200 flood event scour countermeasures will be needed.

The following table shows the recommended design scour elevations at each substructure to be presented on the Type, Size and Location plan sheets. Based upon data presented in the historical borings near the proposed pier locations, it is assumed the soil within the scour depth is non-cohesive. Therefore, no reductions were applied to the theoretical scour elevations at the piers and the pier design scour elevations shown in the table below are the adjusted theoretical values.

Event/Limit State	Design Scour Elevations (ft.)				Item 113
	South Abutment	Pier 1	Pier 2	North Abutment	
Q100	646.97	629.00	629.00	646.20	8
Q200	646.97	628.90	628.90	646.20	
Design	646.97	629.00	629.00	646.20	
Check	646.97	628.90	628.90	646.20	

## 6. Seismic Considerations

Based on the proposed structure location and boring data, we recommend that the seismic data to be shown on the Type, Size and Location plan sheets as follows:

Seismic Performance Zone (SPZ) = 1  
 Design Spectral Acceleration at 1.0 sec. (SD1) = 0.119  
 Design Spectral Acceleration at 0.2 sec. (SDS) = 0.248  
 Soil Site Class = C

Based upon an SPZ =1, the liquefaction potential is low at this site. In accordance with AGMU 10.1, a liquefaction analysis is not required for a SPZ =1 and the design of this structure will not likely be impacted by seismic considerations.

## 7. Foundation Recommendations

The total preliminary maximum factored loads, provided by the structure designer, are estimated to be approximately 600 kips vertical at the abutments, and 1052 kips at pier 1 and 1047 kips at pier 2. The draft TS&L proposes an integral abutment substructure system for this structure. Driven piling is the preferred foundation for integral abutments, therefore drilled shafts and spread footings were not evaluated as alternatives to driven pile foundations.

**Piles:** Based on the “*Integral Abutment Feasibility Analysis*”, it appears that H-piles or metal shell piles are feasible. The analysis included steel H-piles and 14” metal shell piles. The Pile Design Tables (below) list Metal Shell piles for a range of design capacities with the corresponding required bearings and estimated lengths for each substructure and steel H-piles driven to Maximum Nominal Required Bearing. Bedrock was encountered in the boring logs at an approximate depth of 65 feet. Steel H-piles driven to their Maximum Nominal Required Bearing are at a lessor risk than metal shell piles at this location due to the hard glacial till material and the presence of cobbles. A conical tip for metal shell piles or pile shoes for H-type piles, should be used to prevent damage during driving. A minimum of 2 test piles should be driven, one at Pier 1 (South Pier) and one at the North abutment to verify the estimated lengths determined in design. Pile capacities on the pile data sheets were calculated assuming no pre-coring thorough the existing embankment material. Since settlement at the embankments under the weight of new fill should be minimal, we do not feel that pre-coring is necessary. Lateral loading to the piles should not be a concern in this situation. A structure with pile configurations as shown on the TSL should not require a lateral load pile analysis. However, if a lateral load analysis becomes necessary, the designer should contact the District Geotechnical Engineer.

<b>Pile Design Table for South Abutment – Boring 1 SN: 015-0080</b>			
<b>Pile Type and Size</b>	<b>Nominal Required Bearing (kips)</b>	<b>Factored Resistance Available (kips)</b>	<b>Estimated Pile Length* (Ft)</b>
MS 14” w/0.312” walls	257	141	29
	306	169	34
	570	314	39
HP 12x63	497	273	60
HP 12x74	589	324	62
*Estimated pile length is based on an assumed pile cut off elevation of 648.97 feet. (accounting for the embedment depth of 2.0 feet inside the substructure), a bottom of substructure elevation of 646.97 ft., and a ground surface elevation during driving of 646.97 ft.			

<b>Pile Design Table for Pier 1 – 1953 Boring Sta. 142+87, 32 Ft LT. SN: 015-0080</b>			
<b>Pile Type and Size</b>	<b>Nominal Required Bearing (kips)</b>	<b>Factored Resistance Available (kips)</b>	<b>Estimated Pile Length* (Ft)</b>
MS 14" w/0.312" walls	167	92	37
	550	303	39
	570	314	43
HP 12x63	497	273	63
HP 12x74	589	324	64
*Estimated pile length is based on an assumed pile cut off elevation of 651.00 feet. (accounting for the embedment depth of 19.6 feet inside the substructure), a bottom of substructure elevation of 631.40 ft., and a ground surface elevation during driving of 631.40 ft.			

<b>Pile Design Table for Pier 2 – 1953 Boring Sta. 143+33, 32 ft LT. SN: 015-0080</b>			
<b>Pile Type and Size</b>	<b>Nominal Required Bearing (kips)</b>	<b>Factored Resistance Available (kips)</b>	<b>Estimated Pile Length* (Ft)</b>
MS 14" w/0.312" walls	444	244	39
	510	280	42
	570	314	43
HP 12x63	497	273	69
HP 12x74	589	324	70
*Estimated pile length is based on an assumed pile cut off elevation of 651.00 feet. (accounting for the embedment depth of 19.6 feet inside the substructure), a bottom of substructure elevation of 631.40 ft., and a ground surface elevation during driving of 631.40 ft.			



<b>Pile Design Table for North Abutment – Boring 2 SN: 015-0080</b>			
<b>Pile Type and Size</b>	<b>Nominal Required Bearing (kips)</b>	<b>Factored Resistance Available (kips)</b>	<b>Estimated Pile Length* (Ft)</b>
MS 14" w/0.312" walls	157	86	30
	399	219	35
	570	314	40
HP 12x63	497	273	65
HP 12x74	589	324	67
*Estimated pile length is based on an assumed pile cut off elevation of 648.20 feet. (accounting for the embedment depth of 2.0 feet inside the substructure), a bottom of substructure elevation of 646.20 ft., and a ground surface elevation during driving of 646.20 ft.			

**8. WSE/Cofferdams:**

The estimated water surface elevation (EWSE) is approximately 638.1 feet. Based upon the encased bottom of pier elevation at 631.4 feet, the pier foundations will be constructed in water. Since the EWSE is more than six feet above the bottom of the footing, a Type 2 Cofferdam will be required at the pier foundations. The soil profile at the pier locations exhibits a low permeability, cohesive material. Therefore, a seal coat should not be needed to construct the pier foundations.

**9. Construction Considerations:**

**Road Closure Construction:** Temporary excavation support/sheeting should not be required at the abutments since U.S. 45 will be closed and staged construction will not be utilized.







# SOIL BORING LOG

ROUTE FAP 824 (US 45) DESCRIPTION US 45 over Flat Branch Creek LOGGED BY Unknown

SECTION (20XB)B-1 LOCATION SE 1/4, SEC. 5, TWP. 13N, RNG. 8E, 3 PM

COUNTY Coles DRILLING METHOD Unknown HAMMER TYPE Unknown

STRUCT. NO. <u>015-0022 (E)</u>	D E P T H  H	B L O W S	U C S  Qu	M O I S T	Surface Water Elev. _____ ft	D E P T H  H	B L O W S	U C S  Qu	M O I S T
Station <u>015-0080 (P)</u> <u>143+10.76</u>					Stream Bed Elev. _____ ft				
BORING NO. <u>1953 -South Pier S. Pier</u>					Groundwater Elev.:				
Station <u>142+87</u>					▽ First Encounter _____ ft				
Offset <u>32.0ft West</u>					▽ Upon Completion <u>639.0</u> ft				
Ground Surface Elev. <u>642.5</u> ft					▽ After _____ Hrs. _____ ft				

Stiff, black, SILTY CLAY					Dark brown, medium, highly organic, CLAYEY SILT				
640.50							0		
Stiff, dark brown, CLAY							12		
▽							0		
-5					617.50	-25	12	1.5	
636.50					Hard, greenish gray, stoney CLAY Till				
Stiff, mottled SANDY GRAVELLY CLAY							0		
							33	4.1	
							0		
632.50 -10						-30	30	4.1	
Stiff, grey, fine, SANDY SILTY CLAY							0		
630.50							80	4.1	
Hard, gray, SANDY SILTY CLAY Till									
		0							
-15		33	1.2			-35			
						606.50			
		0					0		
		30	4.1				60	4.1	
		0							
622.50 -20		10	4.1			-40			

File Name S:\NEW GEOTECHNICAL\GINT\DATA\PROJECTS\COLES CO (015)\015-0080 SOIL ROCK 2019.GPJ Data Template D6TEMPLT.GDT Date Printed 12/29/20  
Latitude Longitude Datum Job Number

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



# SOIL BORING LOG

ROUTE FAP 824 (US 45) DESCRIPTION US 45 over Flat Branch Creek LOGGED BY Unknown

SECTION (20XB)B-1 LOCATION SE 1/4, SEC. 5, TWP. 13N, RNG. 8E, 3 PM

COUNTY Coles DRILLING METHOD Unknown HAMMER TYPE Unknown

STRUCT. NO. <u>015-0022 (E)</u>	D E P T H  H	B L O W S	U C S  Qu	M O I S T	Surface Water Elev. _____ ft	D E P T H  H	B L O W S	U C S  Qu	M O I S T
Station <u>015-0080 (P)</u> <u>143+10.76</u>					Stream Bed Elev. _____ ft				
BORING NO. <u>1953-North Pier N. Pier</u>					Groundwater Elev.:				
Station <u>143+33</u>					▽ First Encounter _____ ft				
Offset <u>32.0ft West</u>					▽ Upon Completion <u>639.5</u> ft				
Ground Surface Elev. <u>643</u> ft					▽ After _____ Hrs. _____ ft				

Soil Description	Depth (ft)	Blow Count (/6")	UCS (tsf)	Moisture (%)	Soil Description	Depth (ft)	Blow Count (/6")	UCS (tsf)	Moisture (%)
Stiff, black SILTY CLAY	641.00				Hard, gray, stoney, CLAY till	0		4.1	
Stiff, dark brown, CLAY	638.00					10		3.9	
Stiff, mottled SANDY GRAVELLY CLAY	634.00					0		4.1	
Stiff, gray, fine, SANDY SILTY CLAY	631.00					12		4.1	
Medium, gray, fine, SANDY CLAYEY SILT	628.50	0				80		4.1	
Medium, gray, fine, SILTY SAND	626.00	15				0			
Medium, dark brown, highly organic, CLAYEY SILT	623.00	26				30	1.5		
		0				604.50		0	
		30	1.5				80	4.1	
		0					0		

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



# SOIL BORING LOG

ROUTE FAP 824 (US 45) DESCRIPTION US 45 over Flat Branch Creek LOGGED BY E. Sandschafer

SECTION (20XB)B-1 LOCATION SE 1/4, SEC. 5, TWP. 13N, RNG. 8E, 3<sup>rd</sup> PM,

Latitude N 39.599848, Longitude W 88.324494

COUNTY Coles DRILLING METHOD Hollow stem auger & split spoon HAMMER Auto SPT 140#

STRUCT. NO. 015-0022 (E)  
015-0080 (P)  
Station 143+10.76

BORING NO. 2 N. Abutment  
Station 144+00  
Offset 8.0 ft West  
Ground Surface Elev. 653.16 ft

DEPTH (ft)	BLOW COUNTS (/6")	UCS (tsf)	MOISTURE (%)	Soil Description	DEPTH (ft)	BLOW COUNTS (/6")	UCS (tsf)	MOISTURE (%)
652.06				3-1/8" Asphalt over 9-1/2" Concrete				
				Very stiff, moist, dark grey, CLAY	5	8	2.9	12
	1				630.66	5		
	2	2.1	20	Medium, moist, grey, CLAY LOAM	3	3	0.8	22
	4	B						
	2				-25	2		
	4	2.5	16			3	0.6	15
	5	B				3	B	
					626.16			
	3			Stiff, moist, grey, SANDY LOAM		11		
	5	2.3	17			16	1.0	19
	6	B				25	S	
643.66								
				Very stiff, moist, dark grey, CLAY LOAM	623.16	-30	14	
	3					7	0.8	17
	6	2.1	14	Medium, moist, grey, SANDY CLAY LOAM		7	B	
	7	B						
	3							
	5	1.7	20					
	7	B						
638.66					618.66			
				Stiff, moist, grey, CLAY	-35	3		
	3					4	2.0	9
	3	1.0	18	Stiff, moist, grey, CLAY Till		7	B	
	4	B						
636.16				Medium, moist, grey, CLAY LOAM				
	2							
	2	0.8	13					
	3	B						
633.16					613.16	-40	4	

SOIL BORING 015-0080 SOIL ROCK 2019.GPJ IL\_DOT.GDT 12/28/20

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





# ROCK CORE LOG

ROUTE FAP 824 (US 45) DESCRIPTION US 45 over Flat Branch Creek LOGGED BY E. Sandschafer

SECTION (20XB)B-1 LOCATION SE 1/4, SEC. 5, TWP. 13N, RNG. 8E, 3<sup>rd</sup> PM,  
Latitude N 39.599848, Longitude W 88.324494

COUNTY Coles CORING METHOD Rotary, surf set diamond bit

STRUCT. NO. 015-0022 (E) CORING BARREL TYPE & SIZE NW, conv dbl bbl, split inner

Station 143+10.76

BORING NO. 2 N. Abutment

Station 144+00

Offset 8.0 ft West

Ground Surface Elev. 653.16 ft

DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
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585.16	B2C1	77	28	15	
Gray, weathered, silty clay SHALE with 1/4" sandstone partings					
No recovery at bottom 1.13' of core run.					
580.16					

580.16	B2C2	100	62	15.53	
Gray, weathered, silty clay SHALE with thin sandstone partings					
Depth 74.1', Moisture Content: 5.6%, Dry Density: 143.2 pcf					
Depth 76.2', Moisture Content: 7.7%, Dry Density: 135.2 pcf					
575.16					

575.16					
Benchmark: TBM 1 - Chiseled square on top of southeast wingwall of Structure No. 015-0022.					
End of Boring					

ROCK CORE 015-0080 SOIL ROCK 2019.GPJ IL\_DOT.GDT 12/28/20

Color pictures of the cores Available on Request

Cores will be stored for examination until 07/10/24

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)



# Field Rock Core Log

Date: 7-11-19

Structure #: 015-0022

Boring #: R3 NABUT

Rock Core #: C1

Rock Core #: C2

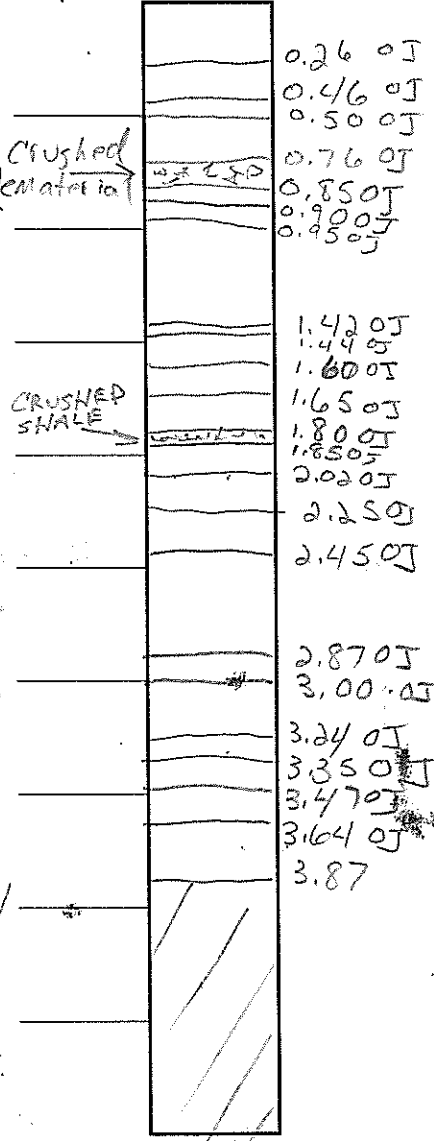
Depth: 68°

Depth: 73°

SILTY CLAY SHALE w/ thin sandstone partings

RQD  
5.5  
5.0  
6.0  
No. 5

ENTIRE SAMPLE SILTY CLAY SHALE w/ some 1/4" sandstone partings



Crushed shale  
CORE TO TEST

0.25 0J  
0.40 0J  
0.60 0J

1.10 0J

1.53 0J

1.80 0J

2.23 0J

3.19 0J

3.40 0J

3.55 0J

4.15 0J

4.30 0J

4.52 0J

4.70 0J

4.72 0J  
4.86 0J

RQD  
6.25  
5.00  
4.75  
16.00  
5.00  
37 ÷ 60  
61.7%

Depth: 73°

Depth: 78°

Core Time: 15:00

Core Time: 15:32

Recovery: 77%

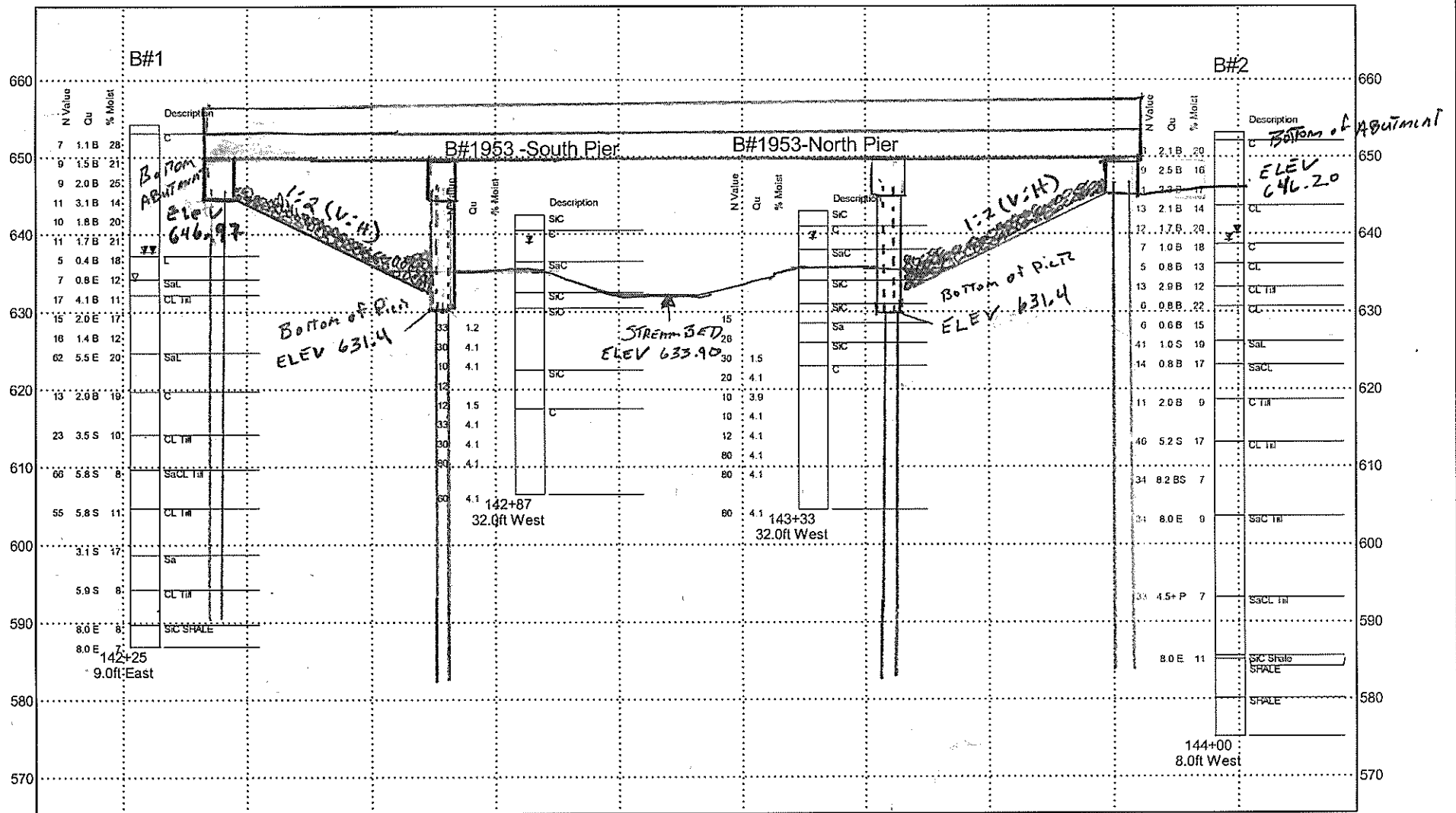
Recovery: 100%

RQD: 27.5%

RQD: 61.7%

Logged By: Eric Sandschafer

Structure Number 015-0022 (E) 015-0080 (P) US 45 over Flat Branch Creek  
 Located in the SE 1/4 of Section 5, Township 13N, Range 8E of the 3 P.M.



NOT TO HORIZONTAL SCALE

VARIATIONS IN SUBSURFACE  
 CONDITIONS MAY EXIST  
 BETWEEN BORINGS

SUBSURFACE DATA PROFILE

Route: FAP 824 (US 45)

Section: (20XB)B-1

County: Coles

Groundwater  
 First Encounter  
 Completion  
 after (refer to log) hours

Abbreviations  
 WH - Sampler Advanced by Weight  
 of Hammer, WOP - Weight of Pipe  
 B.S. - Before Seating



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

Benchmark : Chiseled squared on top of southeast wingwalls of SN 015-0022. Sta. 142 + 46, 15' Rt., Elev. 654.40.

Existing structure: SN 015-0022 was built in 1954 as F.A. RT. 26 (S.B.I. RT. 25) Section 20X-B at Sta. 143 + 10. The existing structure consists of a three-span reinforced concrete haunch T-beam superstructure with a reinforced concrete deck on precast concrete pile supported open abutments and untreated timber pile supported solid concrete piers. The superstructure is composed of 5 concrete T-beams integrated with a 7 inch thick reinforced concrete slab. The bridge deck has a 30'-0" roadway width. The structure is 120'-3" long from back to back of abutments, no skew, and has a 35'-8" out to out bridge width. Road closure and a detour route will be used during construction.

Salvage: None

**DESIGN SPECIFICATIONS**

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition

**LOADING HL-93**

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

**DESIGN STRESSES**

**FIELD UNITS**

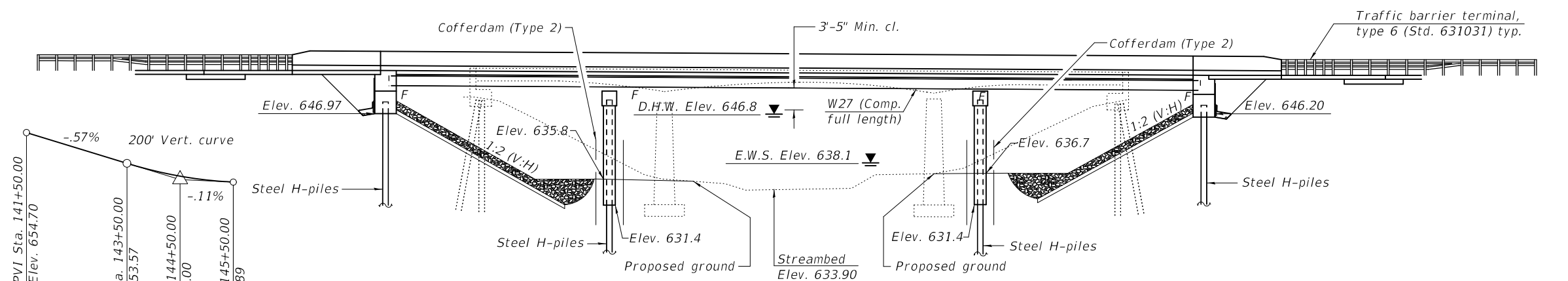
f'c = 3,500 psi  
 f'c = 4,000 psi (Superstructure Concrete)  
 fy = 60,000 psi (Reinforcement)  
 fy = 50,000 psi (M270 Grade 50)  
 All structural steel shall be galvanized

**HIGHWAY CLASSIFICATION**

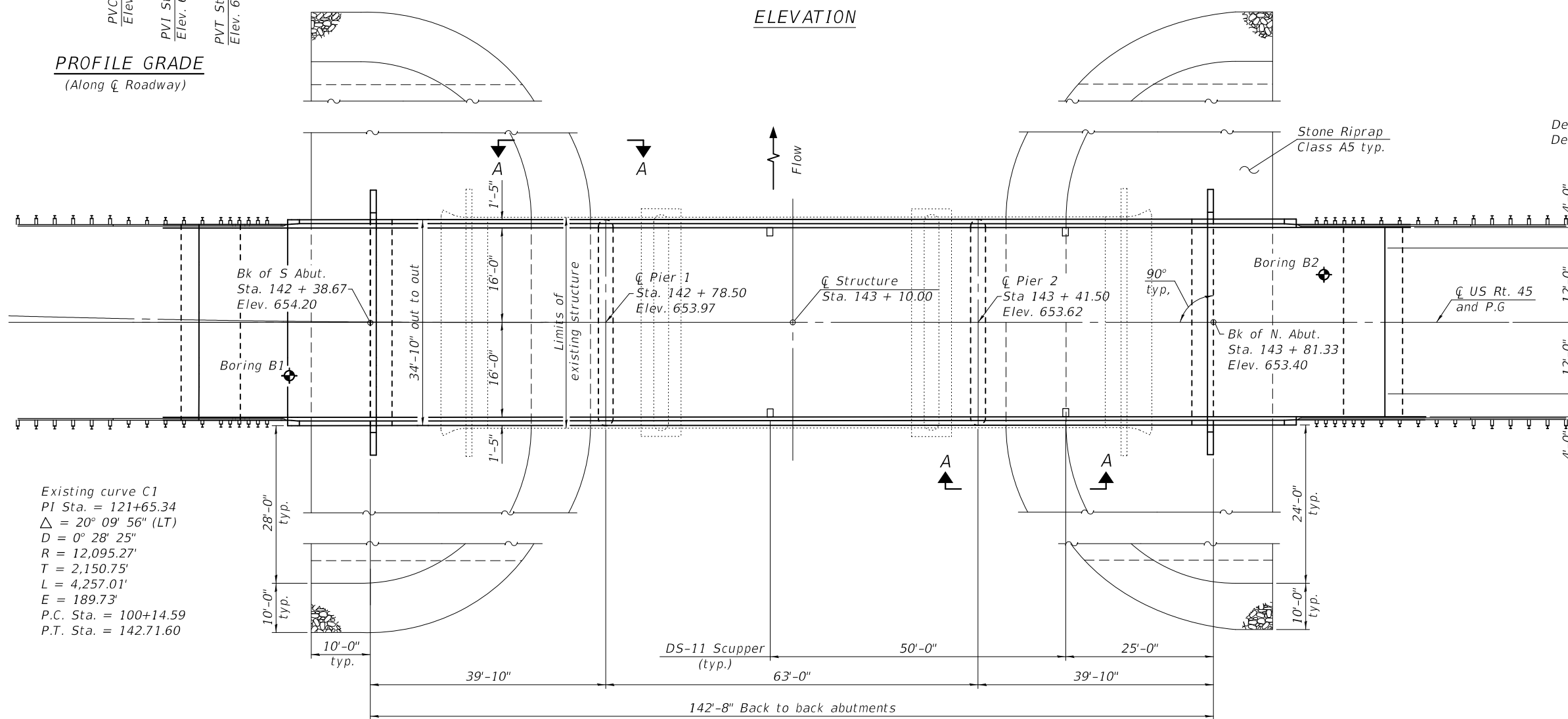
FAP 824 Rte. US 45  
 Functional Class: Minor Arterial  
 ADT: 2850 (2020); 3400 (2040)  
 ADTT: 250 (2020)  
 DHV: 314 (2020)  
 Design Speed: 60 m.p.h.  
 Posted Speed: 55 m.p.h.  
 2-Way Traffic  
 Directional Distribution: 51:49

**SEISMIC DATA**

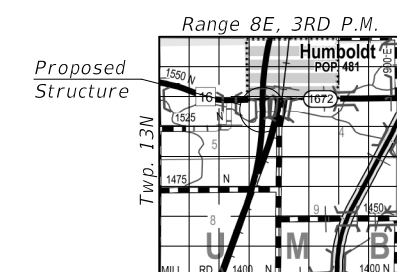
Seismic Performance Zone (SPZ) =  
 Design Spectral Acceleration at 1.0 sec. (SD1) =  
 Design Spectral Acceleration at 0.2 sec. (SDS) =  
 Soil Site Class =



**ELEVATION**



**PLAN**



**LOCATION SKETCH**

**GENERAL PLAN AND ELEVATION**  
**US ROUTE 45 OVER FLAT BRANCH**  
**FAP 824 - SEC. (20XB) B-1**  
**COLES COUNTY**  
**STATION 143 + 10.00**  
**STRUCTURE NO. 015-0080**

STATE OF ILLINOIS  
 DEPARTMENT OF TRANSPORTATION

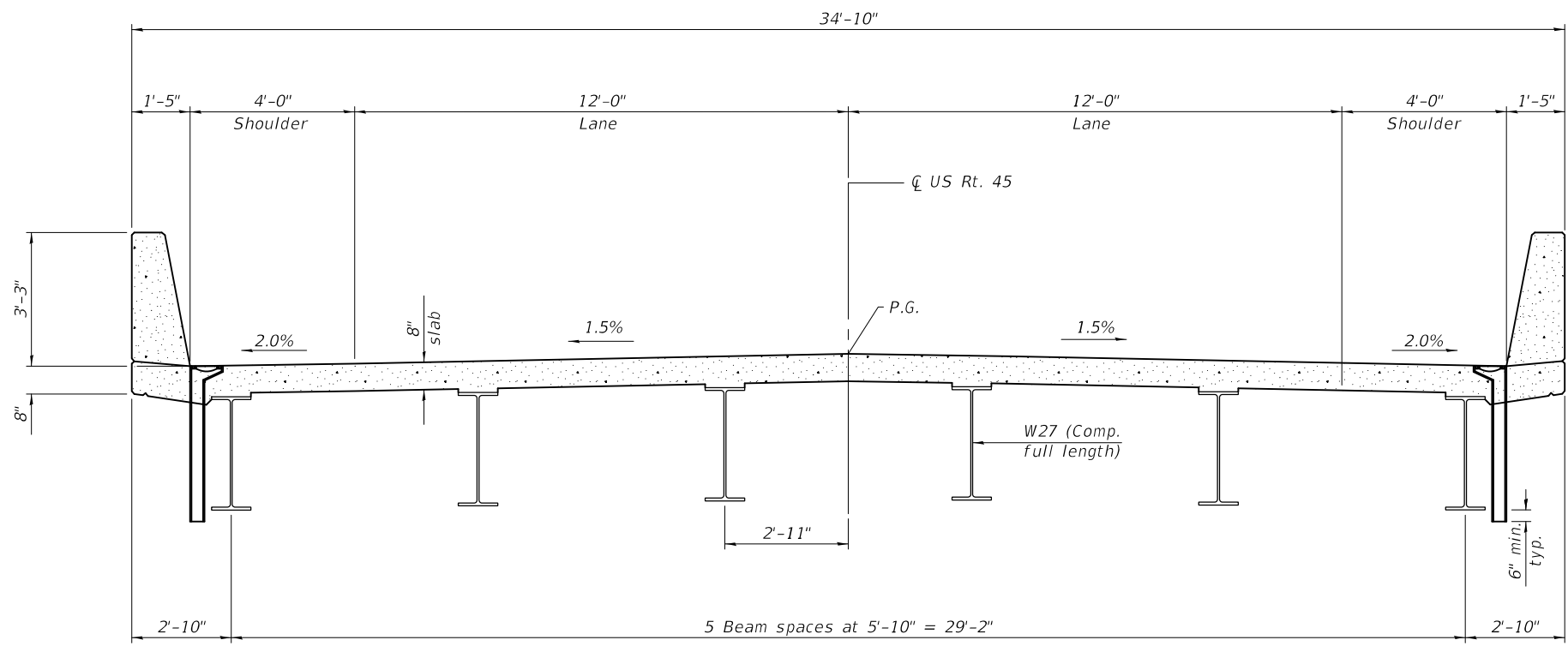
SHEET 1 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
824	(20XB)B-1	COLES	—	—
CONTRACT NO. 74362				

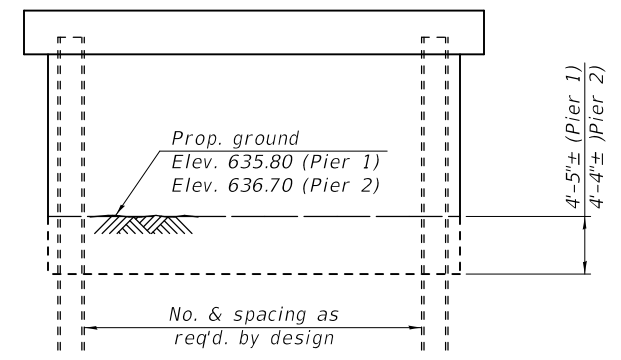
MODEL: 0150080-74362-TSL-001  
 FILE NAME: p:\v\lanroom\d\illinois.gov\PM\DOT\Documents\DOT Offices\Bureau of Bridges and Structures\Projects\0150080\CADD Plans\0150080-74362.dgn

DESIGNED -	BRENDA PAGAN-FIGUEROA
CHECKED -	NEPHITALI RIVERA MARTINEZ
DRAWN -	GLENN W. STOVER
CHECKED -	B.P.F./N.R.M.

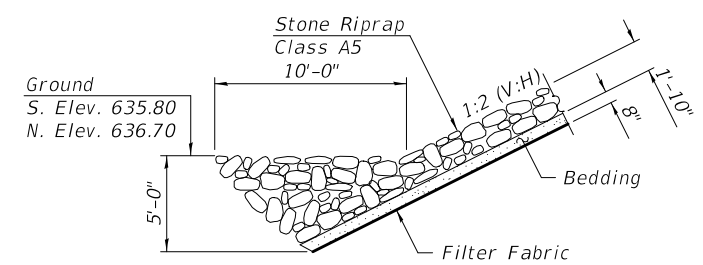
8/6/2020 - 4:14:57 PM



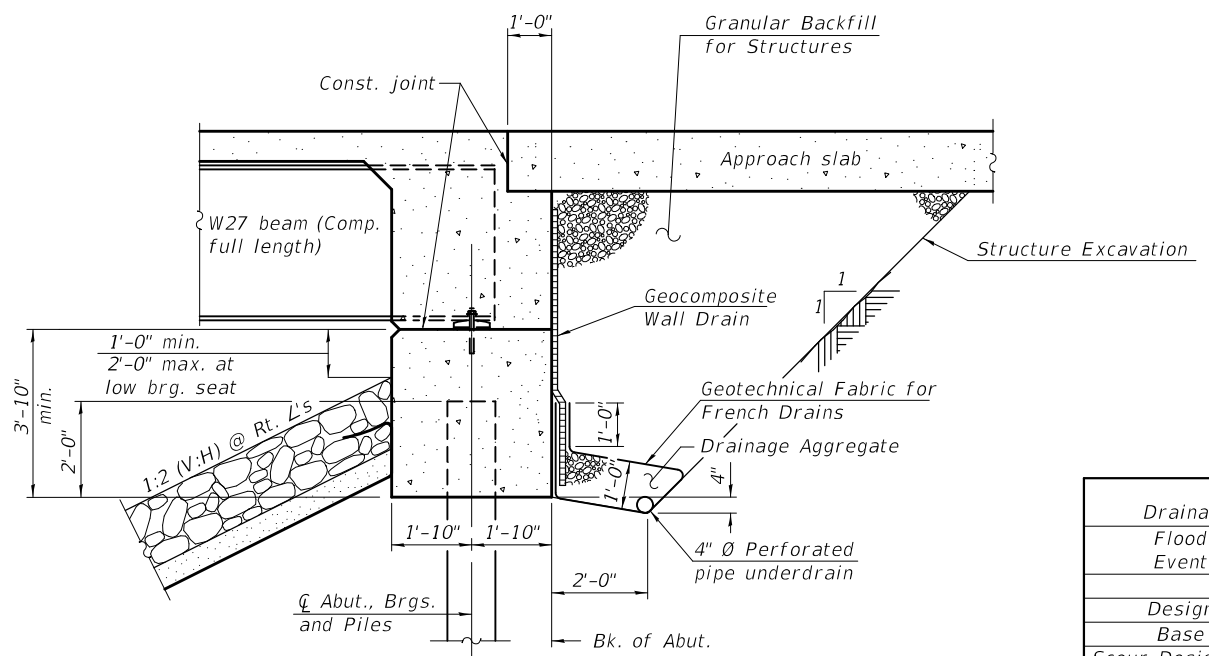
**CROSS SECTION**  
(Looking North)



**PIER SKETCH**



**SECTION A-A**



**SECTION THRU INTEGRAL ABUTMENT**

**DESIGN SCOUR ELEVATION TABLE**

Event / Limit	Design Scour Elevations (ft.)				Item 113
	S. Abut.	Pier 1	Pier 2	N. Abut.	
Q100					
Q200					
Design					
Check					

**WATERWAY INFORMATION TABLE**

Flood Event	Freq. Yr.	Discharge Ft <sup>3</sup> /s	Waterway Opening-ft <sup>2</sup>		Natural H.W.E. ft.	Head-ft.		Headwater Elev. ft.	
			Existing	Proposed		Existing	Proposed	Existing	Proposed
			Drainage Area = 35.7 sq. mi.			Existing Overtopping Elev. = 652.85 at Sta. 145 + 62		Proposed Overtopping Elev. = 652.85 at Sta. 145 + 62	
Design	10	1900	634	941	645.4	0.2	0.1	645.6	645.5
Base	50	2950	752	1106	646.8	0.5	0.3	647.3	647.1
Scour Design Chk	100	3400	805	1179	647.4	0.5	0.3	647.9	647.7
Max. Calc.	200	3872	851	1241	647.9	0.8	0.4	648.7	648.3
	500	4490	907	1317	648.5	0.8	0.6	649.3	649.1

10 Year velocity through existing bridge = 3.1 ft/s      10 Year velocity through proposed bridge = 2.1 ft/s

**DETAILS**  
**U.S. ROUTE 45 OVER FLAT BRANCH**  
**FAP 824 (US 45) SEC. (20XB) B-1**  
**COLES COUNTY**  
**STATION 143 + 10.00**  
**STRUCTURE NO. 015-0080**

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

DESIGNED -	BRENDA PAGAN-FIGUEROA
CHECKED -	NEPHITALI RIVERA MARTINEZ
DRAWN -	GLENN W. STOVER
CHECKED -	B.P.F./N.R.M.

8/6/2020 - 8:22:31 AM

SHEET 2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
824	(20XB) B-1	COLES	-	-
CONTRACT NO. 74362				
ILLINOIS FED. AID PROJECT				

MODEL: 0150080-74362-TSL-002  
FILE NAME: pw:\planroom\dot.illinois.gov\PWIDOT\Documents\DOT Offices\Bureau of Bridges and Structures\Projects\0150080\CADD Plans\0150080-74362.dgn

SUBSTRUCTURE===== South Abutment  
 REFERENCE BORING ===== 1  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 648.97 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 646.97 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

**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
<b>497</b> KIPS	<b>497</b> KIPS	<b>273</b> KIPS	<b>60</b> FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 600 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 ===== 137.81 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 51.68 KIPS

PILE TYPE AND SIZE ===== Steel HP 12 X 63  
 Plugged Pile Perimeter===== 4.000 FT. Unplugged Pile Perimeter===== 5.883 FT.  
 Plugged Pile End Bearing Area===== 1.000 SQFT. Unplugged Pile End Bearing Area===== 0.128 SQFT.

BOT. OF LAYER ELEV. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			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.)
				SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
644.71	2.26	2.00		10.5		54.0	15.5		21.0	21	0	0	12	4
642.21	2.50	3.10		15.7	43.4	51.4	23.0	5.6	41.7	42	0	0	23	7
639.71	2.50	1.80		10.9	25.2	60.9	16.0	3.2	57.6	58	0	0	32	9
637.21	2.50	1.70		10.5	23.8	53.1	15.4	3.0	70.6	53	0	0	29	12
634.71	2.50	0.40		3.2	5.6	61.9	4.7	0.7	76.0	62	0	0	34	14
632.21	2.50	0.80		5.9	11.2	114.1	8.7	1.4	90.6	91	0	0	50	17
629.71	2.50	4.10		19.3	57.5	104.0	28.4	7.3	115.3	104	0	0	57	19
627.21	2.50	2.00		11.6	28.0	107.2	17.1	3.6	131.3	107	0	0	59	22
624.71	2.50	1.40		9.2	19.6	212.6	13.5	2.5	157.1	157	0	0	86	24
619.71	5.00		62	18.1	115.8	155.5	26.6	14.8	174.1	155	0	0	86	29
614.71	5.00	2.90	Hard Till	29.9	40.6	193.7	43.9	5.2	219.1	194	0	0	107	34
609.71	5.00	3.50		34.3	49.0	302.3	50.4	6.3	279.0	279	0	0	153	39
604.71	5.00		66	20.1	123.3	301.9	29.6	15.8	306.0	302	0	0	166	44
599.71	5.00		55	14.8	102.8	463.0	21.8	13.1	346.5	346	0	0	191	49
594.71	5.00		100	82.5	249.1	483.3	121.4	31.8	459.9	460	0	0	253	54
589.71	5.00		100	43.1	186.8	464.1	63.4	23.9	515.3	464	0	0	255	59
588.71	1.00		Shale	49.8	124.6	513.9	73.3	15.9	588.6	544	0	0	283	60.3
587.71	1.00		Shale	49.8	124.6	563.8	73.3	15.9	661.9	564	0	0	340	61.3
586.71	1.00		Shale	49.8	124.6	613.6	73.3	15.9	735.2	644	0	0	337	62.3
585.91	0.80		Shale		124.6			15.9			0	0		

**Pile Design Table for South Abutment utilizing Boring #1**

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
<b>Metal Shell 12"Φ w/.25" walls</b>			<b>Steel HP 10 X 42</b>			<b>Steel HP 12 X 84</b>		
69	38	14	86	47	22	94	52	17
105	58	17	122	67	29	107	59	19
111	61	19	153	84	34	110	61	22
120	66	22	228	125	39	160	88	29
216	119	29	234	129	44	200	110	34
258	142	34	281	155	49	287	158	39
<b>Metal Shell 14"Φ w/.25" walls</b>			<b>Steel HP 10 X 57</b>			<b>Steel HP 14 X 73</b>		
82	45	14	88	48	22	312	172	44
129	71	17	125	69	29	360	198	49
132	73	19	156	86	34	472	260	54
142	78	22	233	128	39	664	365	63
257	141	29	240	132	44	<b>Steel HP 14 X 89</b>		
306	169	34	290	160	49	75	41	14
<b>Metal Shell 14"Φ w/.312" walls</b>			454	250	61	107	59	17
82	45	14	<b>Steel HP 12 X 53</b>			128	70	19
129	71	17	88	49	17	130	71	22
132	73	19	103	57	19	186	102	24
142	78	22	106	58	22	191	105	29
257	141	29	153	84	24	238	131	34
306	169	34	154	85	29	330	182	39
<b>Metal Shell 16"Φ w/.312" walls</b>			192	105	34	362	199	44
84	46	12	273	150	39	410	226	49
95	52	14	298	164	44	545	300	54
155	85	19	337	185	49	578	318	60
165	91	22	<b>Steel HP 12 X 63</b>			<b>Steel HP 14 X 89</b>		
299	164	29	91	50	17	76	42	14
357	196	34	104	57	19	110	60	17
<b>Metal Shell 16"Φ w/.375" walls</b>			107	59	22	130	71	19
84	46	12	155	86	29	132	72	22
95	52	14	194	107	34	191	105	24
155	85	19	279	153	39	194	106	29
165	91	22	302	166	44	241	133	34
299	164	29	346	191	49	337	185	39
357	196	34	460	253	54	369	203	44
<b>Steel HP 8 X 36</b>			497	273	60	421	232	49
68	37	22	<b>Steel HP 12 X 74</b>			555	305	54
96	53	29	92	51	17	705	388	62
120	66	34	106	58	19	<b>Steel HP 14 X 102</b>		
177	97	39	109	60	22	77	42	14
181	99	44	158	87	29	112	62	17
226	125	49	197	108	34	131	72	19
285	156	54	283	156	39	133	73	22
286	157	60	307	169	44	195	107	24
			354	195	49	196	108	29
			466	256	54	244	134	34
			589	324	62	341	188	39
						373	205	44
						429	236	49
						562	309	54
						810	445	63
						<b>Steel HP 14 X 117</b>		
						78	43	14
						114	63	17
						133	73	19
						135	74	22
						199	109	29
						248	136	34
						348	191	39
						379	208	44
						440	242	49
						572	315	54
						929	511	63
						<b>Precast 14"x 14"</b>		
						93	51	12
						105	58	14
						165	91	17
						169	93	19
						181	99	22

SUBSTRUCTURE===== South Pier (Pier 1)  
 REFERENCE BORING ===== 1953 - Sta. 142+87  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 651.00 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 631.40 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

**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
<b>497</b> KIPS	<b>497</b> KIPS	<b>273</b> KIPS	<b>63</b> FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1052 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 ===== 241.54 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 90.58 KIPS

PILE TYPE AND SIZE ===== Steel HP 12 X 63  
 Plugged Pile Perimeter===== 4.000 FT. Unplugged Pile Perimeter===== 5.883 FT.  
 Plugged Pile End Bearing Area===== 1.000 SQFT. Unplugged Pile End Bearing Area===== 0.128 SQFT.

BOT. OF LAYER ELEV. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			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.)
				SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
626.40	5.00	1.20		16.4		73.8	24.1		31.4	31	0	0	17	25
623.90	2.50	4.10		19.3	57.5	93.2	28.4	7.3	59.9	60	0	0	33	27
621.80	2.10	4.10		16.2	57.5	73.0	23.9	7.3	79.1	73	0	0	40	29
619.30	2.50	1.50		9.6	21.0	82.6	14.1	2.7	93.2	83	0	0	45	32
616.80	2.50	1.50		9.6	21.0	132.8	14.1	2.7	112.6	113	0	0	62	34
614.30	2.50		33	3.6	61.7	132.2	5.3	7.9	117.3	117	0	0	65	37
611.80	2.50	4.10	30	19.3	57.5	243.6	28.4	7.3	157.5	158	0	0	87	39
609.30	2.50		80	14.2	149.5	220.4	20.9	19.1	173.7	174	0	0	96	42
606.80	2.50		60	8.6	112.1	247.7	12.6	14.3	188.6	189	0	0	104	44
601.80	5.00		70	22.3	130.8	270.0	32.9	16.7	221.5	221	0	0	122	49
596.80	5.00		70	22.3	130.8	292.3	32.9	16.7	254.3	254	0	0	140	54
591.80	5.00		70	22.3	130.8	308.4	32.9	16.7	286.4	286	0	0	158	59
590.80	1.00			49.8	124.6	358.3	73.3	15.9	359.7	358	0	0	197	60.2
589.80	1.00			49.8	124.6	408.1	73.3	15.9	433.0	408	0	0	224	61.2
588.80	1.00			49.8	124.6	457.9	73.3	15.9	506.3	458	0	0	252	62.2
587.80	1.00			49.8	124.6	507.8	73.3	15.9	579.5	508	0	0	279	63.2
586.80	1.00					124.6		15.9						

**Pile Design Table for South Pier (Pier 1) utilizing Boring #1953 - Sta. 142+87**

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
<b>Metal Shell 12"Φ w/.25" walls</b>			<b>Steel HP 10 X 42</b>			<b>Steel HP 12 X 84</b>		
137	75	37	153	84	44	121	67	37
<b>Metal Shell 14"Φ w/.25" walls</b>			180	99	49	165	91	39
106	58	32	207	114	54	180	99	42
167	92	37	335	184	62	196	108	44
<b>Metal Shell 14"Φ w/.312" walls</b>			<b>Steel HP 10 X 57</b>			229	126	49
106	58	32	158	87	44	262	144	54
167	92	37	185	102	49	664	365	64
515	283	42	212	117	54	<b>Steel HP 14 X 73</b>		
<b>Metal Shell 16"Φ w/.312" walls</b>			454	250	64	139	76	37
124	68	32	<b>Steel HP 12 X 53</b>			186	102	39
199	109	37	153	84	39	206	113	42
<b>Metal Shell 16"Φ w/.375" walls</b>			169	93	42	223	123	44
124	68	32	184	101	44	262	144	49
199	109	37	216	119	49	301	166	54
638	351	42	248	137	54	578	318	63
749	412	44	418	230	62	<b>Steel HP 14 X 89</b>		
<b>Steel HP 8 X 36</b>			<b>Steel HP 12 X 63</b>			142	78	37
145	80	49	158	87	39	193	106	39
167	92	54	174	96	42	211	116	42
286	157	63	189	104	44	229	126	44
			221	122	49	268	148	49
			254	140	54	308	169	54
			497	273	63	705	388	64
			<b>Steel HP 12 X 74</b>			<b>Steel HP 14 X 102</b>		
			162	89	39	144	79	37
			177	97	42	197	108	39
			192	106	44	214	118	42
			225	124	49	233	128	44
			258	142	54	273	150	49
			589	324	64	312	172	54
						810	445	64
						<b>Steel HP 14 X 117</b>		
						147	81	37
						203	112	39
						220	121	42
						239	132	44
						279	153	49
						319	175	54
						929	511	64
						<b>Precast 14"x 14"</b>		
						135	74	32



SUBSTRUCTURE===== North Pier (Pier 2)  
 REFERENCE BORING ===== 1953 - Sta. 143+33  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 651.00 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 631.40 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

**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
<b>497</b> KIPS	<b>497</b> KIPS	<b>273</b> KIPS	<b>69</b> FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1047 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 ===== 240.48 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 90.18 KIPS

PILE TYPE AND SIZE ===== Steel HP 12 X 63  
 Plugged Pile Perimeter===== 4.000 FT. Unplugged Pile Perimeter===== 5.883 FT.  
 Plugged Pile End Bearing Area===== 1.000 SQFT. Unplugged Pile End Bearing Area===== 0.128 SQFT.

BOT. OF LAYER ELEV. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			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.)
				SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
626.90	4.50	15	Very Fine Silty Sand	4.2		49.5	6.2		12.0	12	0	0	7	24
624.40	2.50	26	Very Fine Silty Sand	4.0	45.3	29.3	6.0	5.8	14.8	15	0	0	8	27
621.90	2.50	30		9.6	21.0	55.2	14.1	2.7	31.1	31	0	0	17	29
619.40	2.50	20	Hard Till	2.2	37.4	38.7	3.2	4.8	31.9	32	0	0	18	32
616.90	2.50	10	Hard Till	1.1	18.7	39.8	1.6	2.4	33.5	33	0	0	18	34
614.40	2.50	10	Hard Till	1.1	18.7	44.7	1.6	2.4	35.6	36	0	0	20	37
611.90	2.50	12	Hard Till	1.3	22.4	173.0	1.9	2.9	53.7	54	0	0	30	39
609.40	2.50	80	Hard Till	14.2	149.5	187.2	20.9	19.1	74.6	75	0	0	41	42
606.90	2.50	80	Hard Till	14.2	149.5	201.4	20.9	19.1	95.5	96	0	0	53	44
601.90	5.00	80	Hard Till	28.4	149.5	229.8	41.8	19.1	137.3	137	0	0	76	49
596.90	5.00	80	Hard Till	28.4	149.5	258.3	41.8	19.1	179.1	179	0	0	99	54
591.90	5.00	80	Hard Till	28.4	149.5	286.7	41.8	19.1	220.9	221	0	0	121	59
586.90	5.00	80	Hard Till	28.4	149.5	290.2	41.8	19.1	259.5	260	0	0	143	64
585.90	1.00		Shale	49.8	124.6	340.0	73.3	15.9	332.8	333	0	0	183	65.1
584.90	1.00		Shale	49.8	124.6	389.8	73.3	15.9	406.1	390	0	0	214	66.1
583.90	1.00		Shale	49.8	124.6	439.7	73.3	15.9	479.4	440	0	0	242	67.1
582.90	1.00		Shale	49.8	124.6	489.5	73.3	15.9	552.7	489	0	0	269	68.1
581.90	1.00		Shale	49.8	124.6	539.3	73.3	15.9	625.9	539	0	0	297	69.4
580.90	1.00		Shale		124.6			15.9						

**Pile Design Table for North Pier (Pier 2) utilizing Boring #1953 - Sta. 143+33**

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
<b>Metal Shell 12"Φ w/.25" walls</b>			<b>Steel HP 10 X 42</b>			<b>Steel HP 12 X 84</b>		
106	59	37	145	80	54	145	80	49
364	200	39	180	99	59	187	103	54
<b>Metal Shell 14"Φ w/.25" walls</b>			335	184	67	229	126	59
133	73	37	<b>Steel HP 10 X 57</b>			664	365	70
<b>Metal Shell 14"Φ w/.312" walls</b>			150	83	54	<b>Steel HP 14 X 73</b>		
133	73	37	185	102	59	162	89	49
482	265	39	454	250	70	212	117	54
548	301	42	<b>Steel HP 12 X 53</b>			261	144	59
<b>Metal Shell 16"Φ w/.312" walls</b>			133	73	49	578	318	68
162	89	37	174	96	54	<b>Steel HP 14 X 89</b>		
617	339	39	215	118	59	118	65	44
<b>Metal Shell 16"Φ w/.375" walls</b>			418	230	67	168	93	49
162	89	37	<b>Steel HP 12 X 63</b>			218	120	54
617	339	39	137	76	49	268	148	59
692	381	42	179	99	54	705	388	70
767	422	44	221	121	59	<b>Steel HP 14 X 102</b>		
<b>Steel HP 8 X 36</b>			497	273	69	123	68	44
269	148	67	<b>Steel HP 12 X 74</b>			173	95	49
			141	78	49	223	123	54
			183	101	54	273	150	59
			225	124	59	810	445	70
			589	324	70	<b>Steel HP 14 X 117</b>		
						128	70	44
						179	98	49
						229	126	54
						280	154	59
						929	511	70
						<b>Precast 14"x 14"</b>		
						150	82	34
						169	93	37

SUBSTRUCTURE=====North Abutment  
 REFERENCE BORING=====2  
 LRFD or ASD or SEISMIC=====LRFD  
 PILE CUTOFF ELEV.=====648.20 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING=646.20 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD)=====None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD=====ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD)=====ft

**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
<b>497</b> KIPS	<b>497</b> KIPS	<b>273</b> KIPS	<b>65</b> FT.

TOTAL FACTORED SUBSTRUCTURE LOAD=====600 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=====137.72 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts=====51.65 KIPS

PILE TYPE AND SIZE=====Steel HP 12 X 63  
 Plugged Pile Perimeter=====4.000 FT. Unplugged Pile Perimeter=====5.883 FT.  
 Plugged Pile End Bearing Area=====1.000 SQFT. Unplugged Pile End Bearing Area=====0.128 SQFT.

BOT. OF LAYER ELEV. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			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.)
				SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
643.66	2.54	2.30		12.9		42.4	19.0		22.8	23	0	0	13	5
641.16	2.50	2.10		12.0	29.4	48.8	17.7	3.8	39.7	40	0	0	22	7
638.66	2.50	1.70		10.5	23.8	49.4	15.4	3.0	53.9	49	0	0	27	10
636.16	2.50	1.00		7.1	14.0	53.7	10.5	1.8	64.0	54	0	0	30	12
633.66	2.50	0.80		5.9	11.2	89.1	8.7	1.4	76.4	76	0	0	42	15
631.16	2.50	2.90		14.9	40.6	74.6	22.0	5.2	94.6	75	0	0	41	17
628.66	2.50	0.80		5.9	11.2	77.7	8.7	1.4	103.0	78	0	0	43	20
626.16	2.50	0.60		4.6	8.4	87.9	6.8	1.1	110.4	88	0	0	48	22
623.66	2.50	1.00		7.1	14.0	92.2	10.5	1.8	120.5	92	0	0	51	25
618.66	5.00	0.80		11.8	11.2	120.8	17.4	1.4	140.0	121	0	0	66	30
613.66	5.00	2.00		23.3	28.0	202.0	34.2	3.6	181.7	182	0	0	100	35
608.66	5.00		46	11.2	85.9	284.2	16.5	11.0	207.2	207	0	0	114	40
603.66	5.00		84	31.1	156.9	315.3	45.7	20.1	253.0	253	0	0	139	45
593.66	10.00		84	62.2	156.9	375.6	91.4	20.1	344.2	344	0	0	189	55
585.66	8.00		83	48.6	155.1	393.7	71.5	19.8	411.8	394	0	0	217	63
585.16	0.50			24.9	124.6	418.6	36.6	15.9	448.4	419	0	0	230	63
584.16	1.00			49.8	124.6	468.5	73.3	15.9	521.7	468	0	0	258	64
583.16	1.00			49.8	124.6	518.3	73.3	15.9	595.0	548	0	0	285	65
582.16	1.00			49.8	124.6	568.1	73.3	15.9	668.3	568	0	0	342	66
581.16	1.00			49.8	124.6	617.9	73.3	15.9	741.6	648	0	0	340	67
580.16	1.00			49.8	124.6	667.8	73.3	15.9	814.9	668	0	0	367	68
579.16	1.00			49.8	124.6	717.6	73.3	15.9	888.2	748	0	0	395	69
578.16	1.00			49.8	124.6	767.4	73.3	15.9	961.5	767	0	0	422	70
577.16	1.00			49.8	124.6	817.3	73.3	15.9	1034.8	847	0	0	449	71
576.16	1.00			49.8	124.6	867.1	73.3	15.9	1108.1	867	0	0	477	72
575.16	1.00				124.6			15.9						

**Pile Design Table for North Abutment utilizing Boring #2**

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
<b>Metal Shell 12"Φ w/.25" walls</b>			<b>Steel HP 10 X 42</b>			<b>Steel HP 12 X 84</b>		
90	50	20	74	41	25	90	50	22
99	55	22	96	53	30	95	52	25
106	59	25	148	82	35	125	69	30
131	72	30	168	92	40	187	103	35
313	172	35	206	113	45	216	119	40
<b>Metal Shell 14"Φ w/.25" walls</b>			281	155	55	262	144	45
70	39	12	307	169	63	354	195	55
100	55	17	335	184	64	407	224	63
106	59	20	<b>Steel HP 10 X 57</b>			664	365	68
118	65	22	76	42	25	<b>Steel HP 14 X 73</b>		
126	69	25	98	54	30	93	51	20
157	86	30	152	83	35	106	58	22
399	219	35	174	96	40	111	61	25
<b>Metal Shell 14"Φ w/.312" walls</b>			212	116	45	148	81	30
70	39	12	287	158	55	215	118	35
100	55	17	315	173	63	245	135	40
106	59	20	454	250	66	299	165	45
118	65	22	<b>Steel HP 12 X 53</b>			408	224	55
126	69	25	91	50	25	488	268	63
157	86	30	120	66	30	578	318	65
399	219	35	178	98	35	<b>Steel HP 14 X 89</b>		
<b>Metal Shell 16"Φ w/.312" walls</b>			201	111	40	91	50	17
82	45	12	246	136	45	94	52	20
116	64	17	336	185	55	107	59	22
123	68	20	389	214	63	112	62	25
136	75	22	418	230	64	150	82	30
145	80	25	<b>Steel HP 12 X 63</b>			220	121	35
183	100	30	92	51	25	252	139	40
493	271	35	121	66	30	307	169	45
<b>Metal Shell 16"Φ w/.375" walls</b>			182	100	35	416	229	55
82	45	12	207	114	40	495	272	63
116	64	17	253	139	45	705	388	67
123	68	20	344	189	55	<b>Steel HP 14 X 102</b>		
136	75	22	394	217	63	92	51	17
145	80	25	497	273	65	95	52	20
183	100	30	<b>Steel HP 12 X 74</b>			109	60	22
493	271	35	93	51	25	113	62	25
<b>Steel HP 8 X 36</b>			123	67	30	152	83	30
75	41	30	184	101	35	223	122	35
117	64	35	212	116	40	257	141	40
135	74	40	258	142	45	312	172	45
166	91	45	349	192	55	421	232	55
219	120	55	400	220	63	501	275	63
238	131	63	589	324	67	810	445	68
286	157	64				<b>Steel HP 14 X 117</b>		
						93	51	17
						96	53	20
						110	61	22
						115	63	25
						154	85	30
						227	125	35
						264	145	40
						319	176	45
						429	236	55
						509	280	63
						929	511	70
						<b>Precast 14"x 14"</b>		
						90	49	12
						128	70	17
						135	75	20
						150	82	22
						160	88	25
						199	110	30