Illinois Department of Transportation

Memorandum

To:	Carl Puzey Attn: Brad Hessing
From:	Michael A. Short MAS By: Jeremy Brown
Subject:	Structure Geotechnical Report Disposition *
Date:	August 28, 2020

* SN: 038-2567
Route: FAP 332A (IL 1)
Section: (17RB)ES
County: Iroquois
Contract No.: 66F01

Attached is the Structure Geotechnical Report for the subject project. This disposition is to provide revisions to the SGR for SN: 038-2567 which was submitted to the Bureau of Bridges and Structures for review by Mark Jones of McCleary Engineering. These revisions are being provided by Jeremy Brown (IDOT D3 Geotechnical Engineer). The responses below are direct responses to the speed letter that was provided from the Bridge Office.

1. The calculated factored bearing resistance in the SGR can be ignored since it is not required for the design of a Reinforced Concrete Cast-in-Place Box Culvert per AASHTO section 12 "Buried Structures and Tunnels Liners" table 12.5.5-1.

2. The designer shall not use the lateral earth pressure recommendations from the SGR for the design of the wing walls. The IDOT Culvert Manual provides the lateral earth pressures that should be used in the design of the wing walls for the Reinforced Concrete Cast-in-Place Box Culvert.

If you have any questions, please contact Jeremy Brown at 815-433-7098.

JB:bs/StructureGeotechReport_#66F01

This SGR has been updated. See memo dated August 28th, 2020 for changes.

Illinois Department of Transportation

Abbreviated Structure Geotechnical Report

Original Report Date: 3/31/20 **Proposed SN:** 038-2567 **Route:** FAP 332A (IL 1)
Revised Date: **Existing SN:** 038.-0028 **Section:** (17RB)ES
Geotechnical Engineer: Terrence McCleary of McCleary Engineering **County:** Iroquois
Structural Engineer: William Vegrzyn of V3 Companies **Contract:** 66F01

Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing): The proposed box culvert, SN 038-2567, is a double cell 9 x 9 x 80.0 ft. cast in place concrete box culvert with L-Type Two-Way Cantilevered and Horizontal Wingwalls. This structure is replacing SN 038-0028 (built 1952) and carries the two 11 ft. driving lanes with 6 ft. shoulders of Illinois Route 1 over Gay Creek at Sta. 80+50. Soft soils reported in SB-02 (south end of culvert) may require replacing with a porous granular material. Both the existing and proposed structures have a 45° left ahead skew. See the attached TS&L drawing for further information.

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 038-0028 is a single span RC bridge on closed abutments with timber piles driven to bearing. The as-built plans for the original structure show an inverted concrete slab connected to the abutments and wingwalls to provide channel protection. No prior soil data was available at the time of this report. Two 37 ft. borings taken on March 6 & 7 of 2017 at the NW & SE corners of the existing structure. Standard split spoon samplers were used to determine the standard penetration rate at 2.5 ft. intervals down to 31.5 ft. at which it was opened up to 5 ft. intervals. The boring on the north side (SB-01) shows more sand content than the south side.

Boring SB-01 was taken in the NW quad, has a ground elevation of 687.19 and was drilled through 2.5 ft. of shoulder stone mixed with soil. Below the shoulder stone is 9.5 ft. of a very stiff to hard Silty Clay Loam Fill. Under the fill is 13.0 ft. of very stiff to hard Silty Clay Loam Till with some intermingled sand down to elevation 662.69 ft. Beneath that layer is 2.5 ft. of hard clay till before going into 9.5 ft. of very stiff Sandy Clay Till to close out the boring at elevation 650.69 ft. The water table was encountered in the Silty Clay Loam Till soil at an elevation of 664.7 ft. Bedrock was not encountered in this boring.

Boring SB-02 was taken in the SE quad, has a ground elevation of 687.22 ft. and was drilled through 2.5 ft. of shoulder stone mixed with soil. Below the shoulder stone is again 9.5 ft. of very stiff Silty Clay Loam Fill, however, unlike SB-01, the next 5 ft. of soil under the fill was a stiff to soft Silty Clay Loam with Organics. This soil with organics ends at elevation 670.22 ft. where the very stiff Sandy Clay Loam Till begins and continues to the bottom of the boring at elevation 650.72 ft. The water table was encountered in the Sandy Clay Loam Till layer at an elevation of 664.7 ft. Bedrock was not encountered in this boring.

No additional borings are required at this time. See the attached soil borings and soil profile for further information.

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: The proposed roadway will retain the same vertical and horizontal alignment as the existing roadway. There are no existing settlement issues and future settlement is of minimal concern as there is only a minor increase in loading on the founding soils between the existing abutments. Boring SB-02 reports a Stiff to Soft Gray & Black Silty Clay with Loam Layers and Organics between elevations ±670 and ±675 ft. The TSL shows the proposed elevation of the bottom of the concrete box to be at ±673.4 ft. The unsuitable material would need to be removed during construction, however, much of this material may have been previously excavated during the 1952 construction of the 12 inch thick inverted slab described above. The extent of the remaining removal and replacement will need to be determined during construction. No further testing is recommended.

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: The proposed structure will maintain the same grade of the roadway. The new box culvert will have a larger out to out dimension pushing the ditches out away from the road—resulting in proposed side slopes being flatter than the existing side slopes near the structure. The existing slopes are stable and no further testing is required. No further testing is recommended.

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: From All Bridge Designer Memorandums 14.2, a Design Scour Table is not required for closed bottom box culverts. The Design Scour elevations would be the bottom of the cut off wall. The design invert elevations are 674.35 ft. upstream and 674.25 ft. downstream. A conservative scour analysis was performed for a proposed bridge at this location; results showed abutment scour depths greater than 5 ft. (geotechnical analysis of the soils suggests this scour depth could be reduced by as much as 50%), however, due to no reported scour problems at the existing structure and aggradation was noted to be the general tendency at this site, it was noted the results of the scour analysis were probably highly exaggerated. The proposed structure will have the inlet and outlet aprons protected with riprap to mitigate any potential scour.

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 box culvert is a buried structure. Per Section 2.3.10 of the Departments of Bridge Manual, seismic data is not needed for most walls or buried structures. However, if desired the seismic site class was determined to be C. The SD1 = 0.079 g. the SDs = 0.124 g. The Seismic Performance Zone (SPZ) for this structure = 1, therefore no liquefaction analysis was performed.

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: It is understood that the shorter wingwalls are to be horizontal cantilevers attached to the proposed box culvert. The longer wingwalls are to be L-type Two-Way cantilever wingwalls. For the box culvert itself, both strength and service limit states were used to analyze the spread footing option. As can be seen in boring 01 and 02, the soils beneath an assumed bottom of footing elevation of 673.3 ft. are very stiff to hard sandy clay and silty clay loam till soils. The strengths in the 20 ft. of soil under the footing are stiff with an average Qu=3.9 tsf. Because of these high Qu values the factored bearing resistance from a strength limit state approach is quite high at 10.2 ksf.

Using an estimated load of 1020 psf, the settlement of the proposed box culvert was calculated using the formulas found in the AASHTO Design Manual. At this load the estimated settlement is 0.58 inches at boring SB-1 and 0.75 at boring SB-2. The service limit state bearing resistance value of 2.0 ksf is based on a 1-inch tolerable settlement. With an estimated 3 ft. of fill above the top of the culvert this bearing resistance should be sufficient. For the wing walls, the active lateral earth pressure is estimated to be 650 lbs./ft. of wall (61.2 psf).

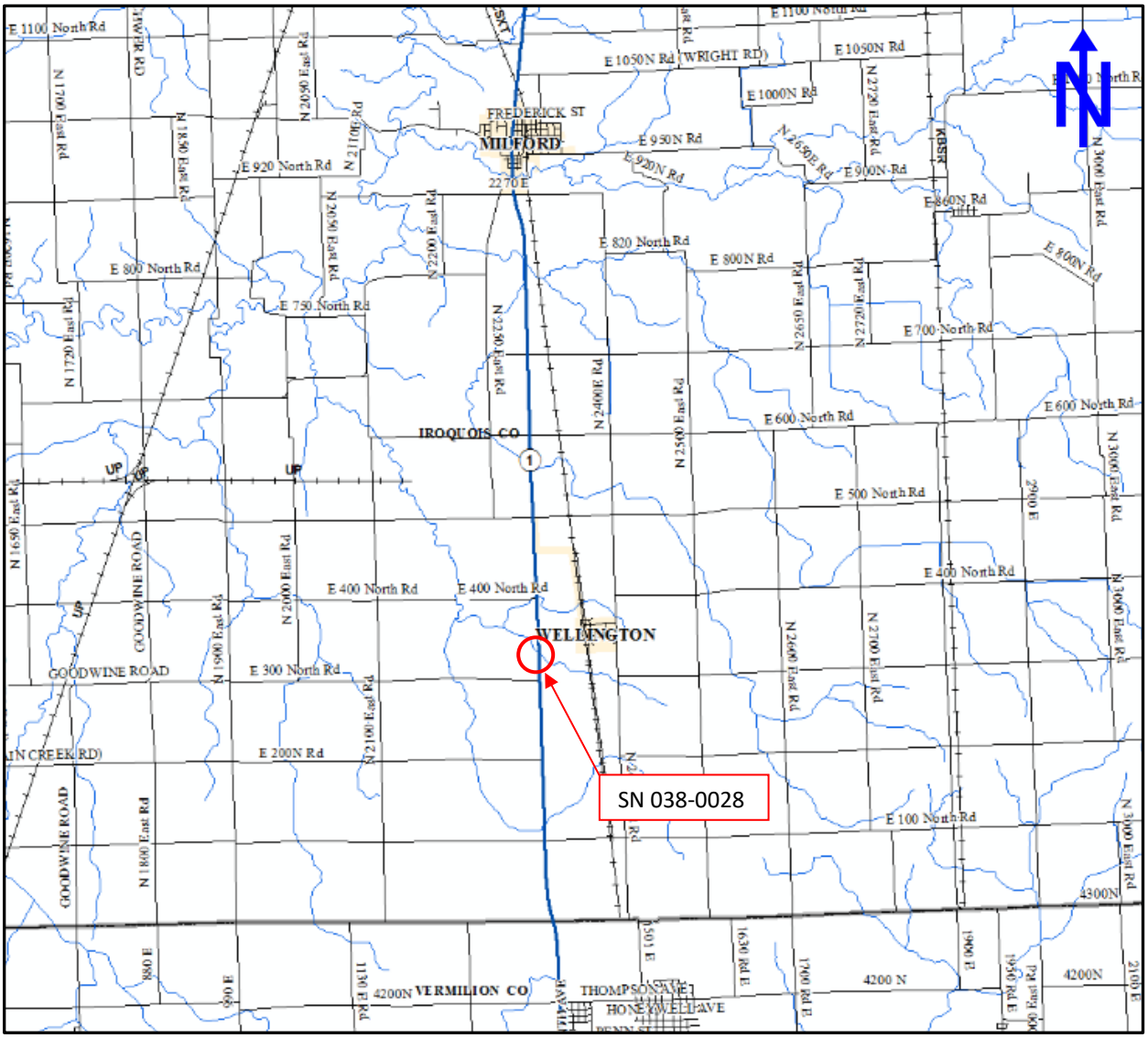
Calculate the estimated water surface elevation and determine the need for cofferdams (type 1 or 2), and seal coat: For box culvert construction the contractor is responsible for diverting the flow of water from the construction using a method approved by the engineer. This is often accomplished with a diversion culvert pipe.

Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns: The road will remain open during construction by use of stage construction. Soil retention at the stage line will be required. Although SB-02 shows a ±5 ft. layer of Hard Silty Clay Loam Till / Hard Clay Till with unconfined compressive strengths of ±5.1 tsf, the blow counts (17 and 18 blows/ft.) indicate this to be a drive-able layer. We recommend there are no geotechnical considerations which would restrict driving temporary sheet piling to the design depth.

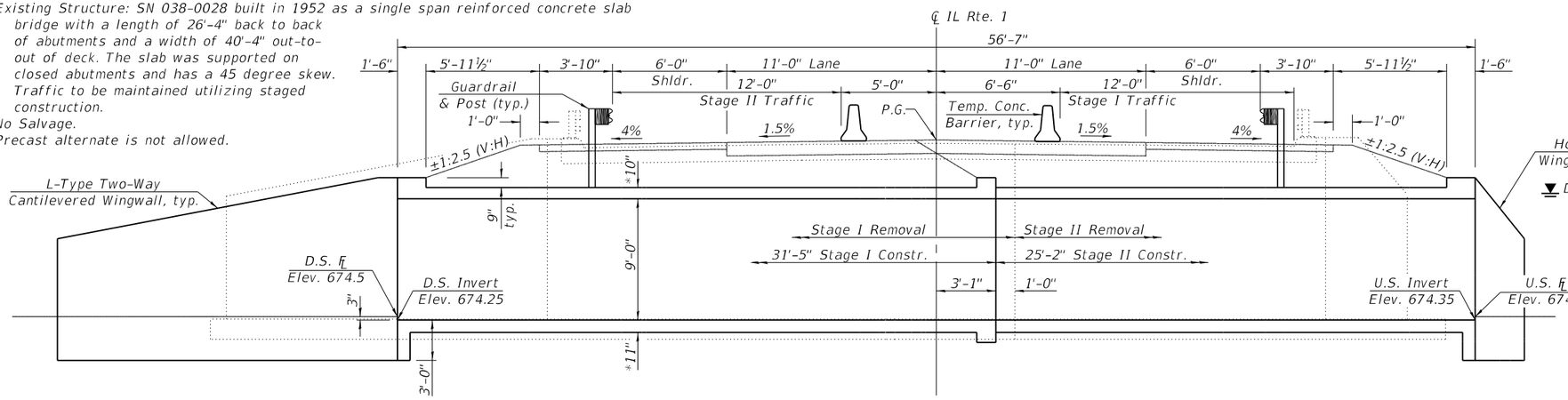
This report was prepared by
Mark Jones of McCleary Engineering
terry@mcclearyengineering.com
Office Phone 815-780-8486

Illinois Professional Engineer
License No.062 043271 Exp. 11/2021

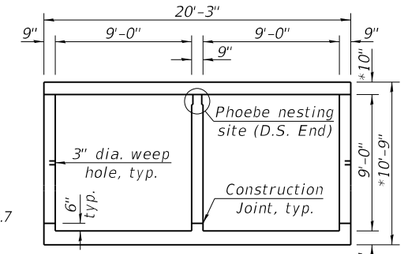
Location Map



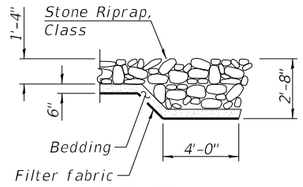
Benchmark: Chiseled square on top of northwest wingwall, Sta. 80+17.98, 20.69' Rt., Elev. 687.635.
Existing Structure: SN 038-0028 built in 1952 as a single span reinforced concrete slab bridge with a length of 26'-4" back to back of abutments and a width of 40'-4" out-to-out of deck. The slab was supported on closed abutments and has a 45 degree skew. Traffic to be maintained utilizing staged construction.
No Salvage.
Precast alternate is not allowed.



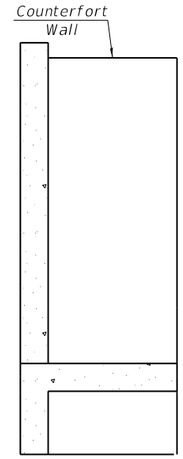
LONGITUDINAL SECTION
(Horz. dims. at rt. angles to ℄ roadway)



SECTION THRU BARREL
*Slab Thickness may be refined in final design



SECTION A-A



SECTION B-B
L-Type Two-Way Cantilevered Wingwall

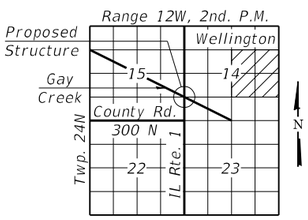
PROFILE GRADE
(along ℄ IL Rte. 1)

WATERWAY INFORMATION

Drainage Area = 1.70 sq. mi. Low Grade Elev. 687.06 @ Sta. 79+00

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.
	10	418	116	155	682.4	0.2	0.0	682.6	682.4
Design	50	689	138	182	683.7	0.9	0.2	684.6	683.9
Base	100	812	144	189	684.1	1.2	0.6	685.2	684.7
Scour Check	200	941	147	193	684.3	1.5	0.8	685.8	685.1
Max. Calc.	500	1110	150	197	684.5	2.0	1.2	686.4	685.7
Overtopping	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

10-Year Outlet Velocity from Existing Structure = 3.8 fps
10-Year Outlet Velocity from Proposed Structure = 3.1 fps



LOCATION SKETCH

HIGHWAY CLASSIFICATION
F.A.P. Rte. 332A - IL Rte. 1
Functional Class: Other Principal Arterial
ADT: 2385 (2021); 2835 (2041)
ADTT: 568 (2021); 675 (2041)
DHV: 0.110
Design Speed: 55 m.p.h.
Posted Speed: 55 m.p.h.
Two-Way Traffic
Directional Distribution: 50:50

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
fy = 60,000 psi (Reinforcement)

Boring #2

GENERAL PLAN AND ELEVATION
ILLINOIS ROUTE 1 OVER
GAY CREEK
F.A.P. RTE. 332A - SEC. (17RB)ES
IROQUOIS COUNTY
STATION 80+50.00
STUCTURE NO. 038-2567

USER NAME = ____	DESIGNED - B. Vegrzyn	REVISED - ____	
	CHECKED - D. Greifzu	REVISED - ____	
PLOT SCALE = ____	DRAWN - B. Vegrzyn	REVISED - ____	
PLOT DATE = ____	CHECKED - D. Greifzu	REVISED - ____	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 1 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
332A	(17RB)ES	IROQUOIS		
		CONTRACT NO. 66F01		
		ILLINOIS	FED. AID PROJECT	

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Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 3/6/17

ROUTE FAP 332A (IL 1) **DESCRIPTION** IL 1 over Gay Creek, 0.16 miles South of Wellington **LOGGED BY** Larry Myers

SECTION 17-RB **LOCATION** SE 1/4, **SEC.** 15, **TWP.** 24N, **RNG.** 12W, 2nd **PM**,
Latitude 40.5362, **Longitude** -87.692386

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

STRUCT. NO. 038-0028 (Exist.)
Station 80+50

BORING NO. 01 (NW Quad)
Station 79+98
Offset 15.0 ft Rt.
Ground Surface Elev. 687.19 ft

Surface Water Elev. 675.69 ft
Stream Bed Elev. 675.11 ft

Groundwater Elev.:
First Encounter 664.7 ft ▼
Upon Completion 667.2 ft ▽
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
				Augered Shoulder Gravel, Thin Asphalt Shoulder, Black Silty Clay Loam Fill
684.69				
	3			Very Stiff to Hard Black & Gray Silty Clay Loam Fill with some Gravel / Concrete Debris
	4 5	3.5 P	21	
-5				
	4			
	5 4	4.0 P	24	
	2			
	6 5	2.5 P	25	
-10				
	2			
	4 3	2.5 P	26	
675.19				
	2			Very Stiff to Hard Gray Silty Clay Loam Till with Minor Sand Seams
	4 5	2.5 B	16	
-15				
	4			
	4 7	4.1 B	17	
	4			
	5 6	4.2 B	18	
▽ -20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
	4			Very Stiff to Hard Gray Silty Clay Loam Till with Minor Sand Seams *(continued)*
	4 7	4.0 B	16	
▼	4			
	7 11	5.1 S	18	
662.69				
-25				Hard Gray Clay Till
	5			
	7 10	5.0 S	25	
660.19				
	3			Very Stiff Brown to Gray Sand Clay Loam Till with Heavy Gravel Pieces
	5 7	3.5 P	13	
-30				
	4			
	5 7	3.4 B	13	
-35				
	6			
	5 5	3.6 B	17	
650.69				
				End of Boring
-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 038-0028.GPJ IL_DOT.GDT 4/3/17

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 3/7/17

ROUTE FAP 332A (IL 1) **DESCRIPTION** IL 1 over Gay Creek, 0.16 miles South of Wellington **LOGGED BY** Larry Myers

SECTION 17-RB **LOCATION** SW 1/4, **SEC.** 14, **TWP.** 24N, **RNG.** 12W, 2nd **PM**,
Latitude 40.535913, **Longitude** -87.692268

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

STRUCT. NO. 038-0028 (Exist.)
Station 80+50

BORING NO. 02 (SE Quad)
Station 81+02
Offset 15.0 ft Lt.
Ground Surface Elev. 687.22 ft

Surface Water Elev. 675.69 ft
Stream Bed Elev. 674.50 ft

Groundwater Elev.:
First Encounter 664.7 ft ▼
Upon Completion 667.2 ft ▽
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Augered Shoulder Stone, Black Silty Clay Loam Fill			
684.72			
Very Stiff Black & Gray Silty Clay Loam Fill	3		
	3 4	2.0 P	26
-5	2		
	3 4	2.5 P	24
	3		
	3 5	2.2 B	25
-10	2		
	5 6	3.1 B	21
675.22			
Stiff to Soft Gray & Black Silty Clay with Loam Layers & Organics	3		
	2 2	1.5 P	21
-15			
WH = Weight of Hammer	WH		
	WH 2	0.5 P	31
670.22			
Very Stiff Gray Sandy Clay Loam Till with Loam Layers	5		
	5 5	3.0 P	14
667.72			
▽ -20			
Very Stiff to Hard Brownish Gray to Gray Silty Clay Loam Till with some Silt Layers *(continued)*	2		
	5 7	3.8 S	17
▼	5		
	5 5	4.1 S	17
-25	4		
	5 6	3.6 S	22
	5		
	5 5	3.9 S	23
-30	5		
	6 6	4.2 S	18
-35	4		
	5 7	4.4 S	19
650.72			
End of Boring			
-40			

SOIL BORING 038-0028.GPJ IL_DOT.GDT 4/3/17

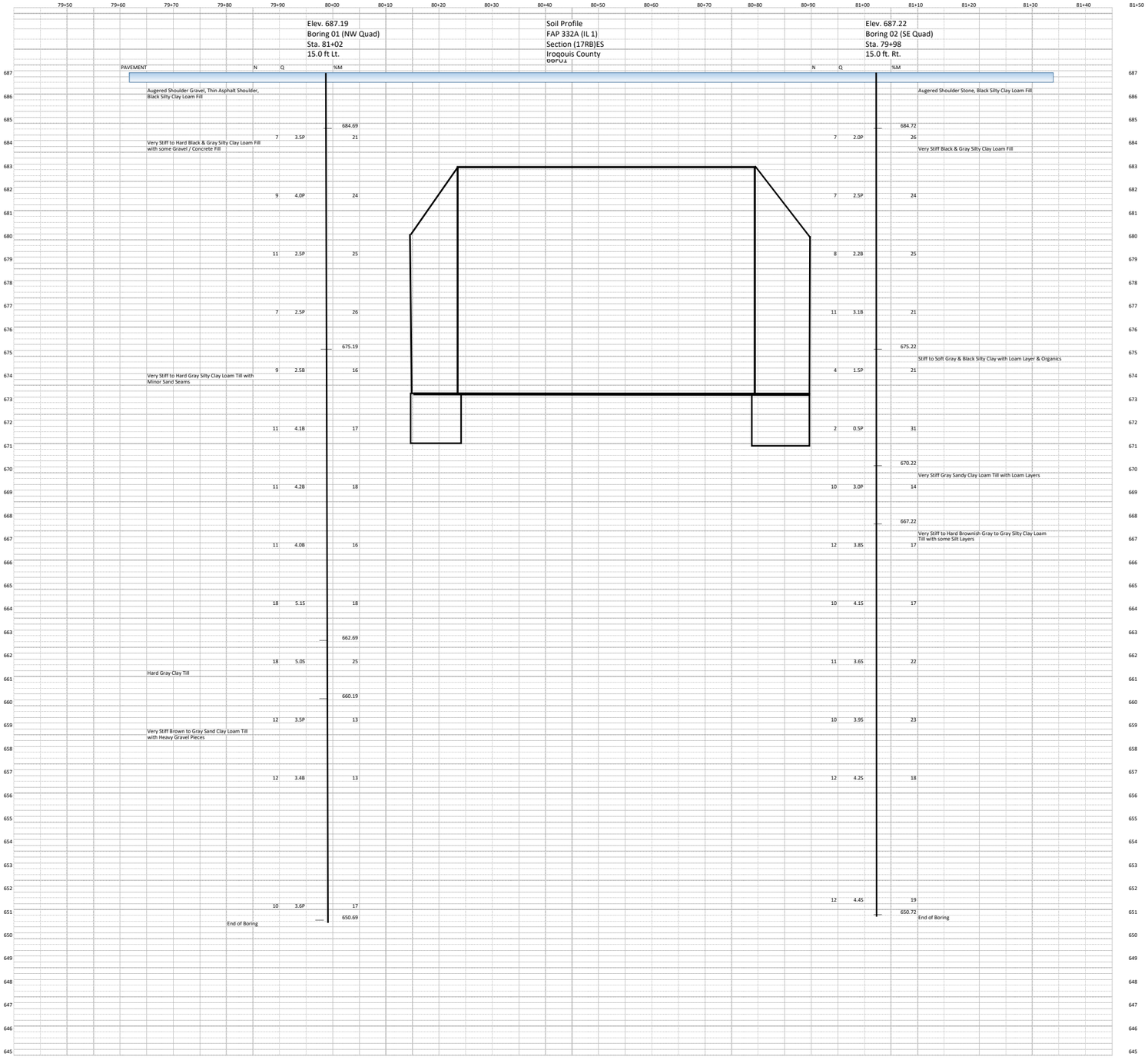
The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, form 137 (Rev. 8-99)

Soil Profile
FAP 332A (IL 1)
Section (17RB)ES
Iroquois County
DISTRICT

Elev. 687.19
Boring 01 (NW Quad)
Sta. 81+02
15.0 ft Lt.

Elev. 687.22
Boring 02 (SE Quad)
Sta. 79+98
15.0 ft. Rt.



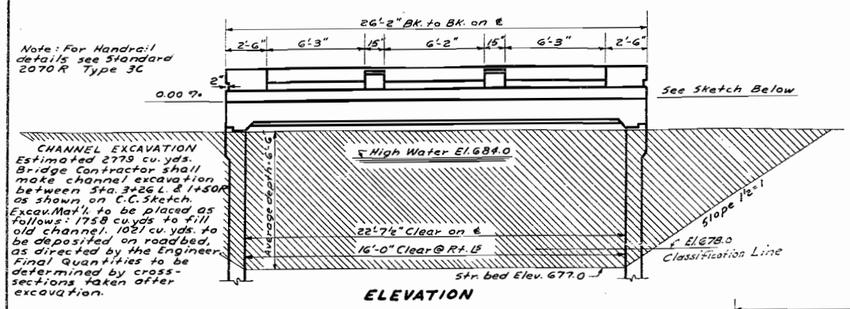
B.M. #8 on N.E. Wing of Bridge Abutment
Left Sta 79+64 Elev. 685.80
Existing Structure: R.C. Slab Bridge 30' Clear Span
30' Rdwy. with RC Abuts. Wings & Brick Handrail.
Superstructure only to be removed by Contractor
after Construction of new Bridge.

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

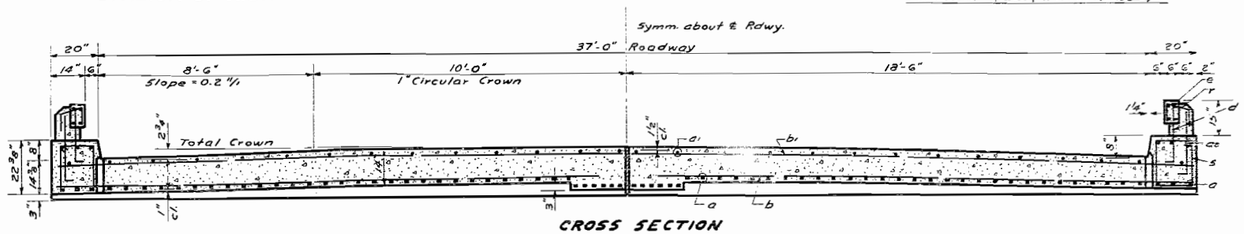
F.A. ROUTE NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
1	17RB	Iroquois	10	6

SHEET NO. 1 2 SHEETS

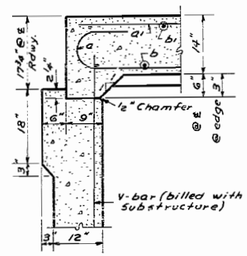
FED. ROAD DIST. NO. | STATE | FED. AID PROJECT: F-2(22)



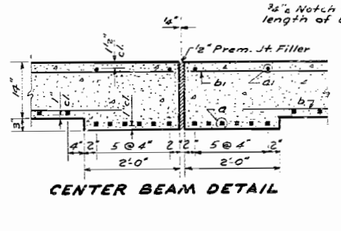
ELEVATION



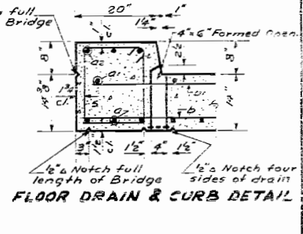
CROSS SECTION



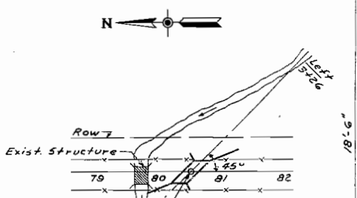
SECTION A-A



CENTER BEAM DETAIL

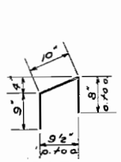


FLOOR DRAIN & CURB DETAIL



SKETCH CHANNEL CHANGE

PLAN



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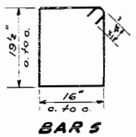

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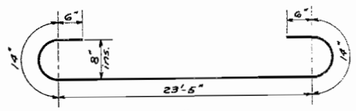
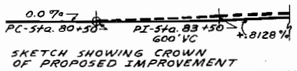


BAR a

D.L. DEFLECTION DIAGRAM
In addition to D.L. Deflection the Contractor shall allow for settlement & shrinkage of forms.



SKETCH SHOWING CROWN OF PROPOSED IMPROVEMENT

GENERAL NOTES

Class X Concrete shall be used thru-out, except as noted.
Handrail Concrete shall be used in Handrail.
Handrail shall not be poured until false-work has been removed.
The Concrete slab on either side of center joint shall be poured in one continuous operation.
The falsework on one side of the center joint shall not be removed until after the floor slab and curb are poured on the other side.
Back of Abutments and wing walls, from the top of the slab or top of the wall to the top of the footing, shall be water proofed in accordance with Article 51.20 of the Std. Specs. Adopted Jan. 2, 1952.

For backfill behind abutments with fixed tops see Art. 50.10 of the Standard Spec's.

See Sheet 2A for Pile Plan and Footing Revisions
See Sheet 2B for Details of Invert Slab.

TOTAL BILL OF MATERIAL

Item		Super	Sub.	Total	
Class X Concrete	cu.yd	49.6	+148.1	197.7	250
Handrail Concrete	cu.yd	1.2	~203.1	1.2	
Reinforcement Bars	lbs.	10380	7750	15130	
Name Plate	ea.	one		one	
Removal Exist. Structure	ea.			one	
Channel Excavation	cu.yd.	**	2779	2779	
Class A Excav. for Str.	Cu.Yds.			~~50~~	60
Class B Excavation for Str.	Cu.Yds.			~~350~~	480
Class A Concrete	Cu.Yds.		57.5	57.5	
Untreated Timber Piles	Lin. Ft.		3800	3800	
Pavement Fabric	Sq. Yds.		385	385	

STRESSES
fs = 20,000
fc = 1200 (Superstr)
fc = 800 (Substr.)
n = 10
Loading H20-516-44

STATION 80 + 50
BUILT IN BY
STATE OF ILLINOIS
F.A. RT. 1 SECTION 17RB
PROJECT F2 (22)
LOADING H20-516

NAME PLATE
See Standard 1882

BILL OF MATERIAL - SUPERSTR.

Bar	No.	Size	Length	Shape
a	74	1" ø	26'-9"	
a1	28	⅝" ø	24'-3"	
a2	6	1" ø	26'-0"	
b	44	⅝" ø	27'-6"	
b1	24	⅝" ø	27'-9"	
d	36	⅝" ø	3'-3"	
e	8	⅝" ø	24'-0"	
r	16	½" ø	2'-3"	
s	52	½" ø	6'-6"	
Class X Concrete			cu.yds.	49.6
Handrail Concrete			cu.yds.	1.2
Reinforcement Bars			lbs.	10380
Name Plate			ea.	One

All reinf. bars shall conform to A.S.T.M. Specifications A 305

WATERWAY INFORMATION
Drainage Area = 1500 Acres
Character = rolling
"C" (Talbot) = 0.3
Opening Required = 72 sq. ft.
Opening Provided = 112 sq. ft.

DESIGNED M. G. Carrel
CHECKED A. K. Lawton
DRAWN mgc Sauerman
CHECKED A.K.L.

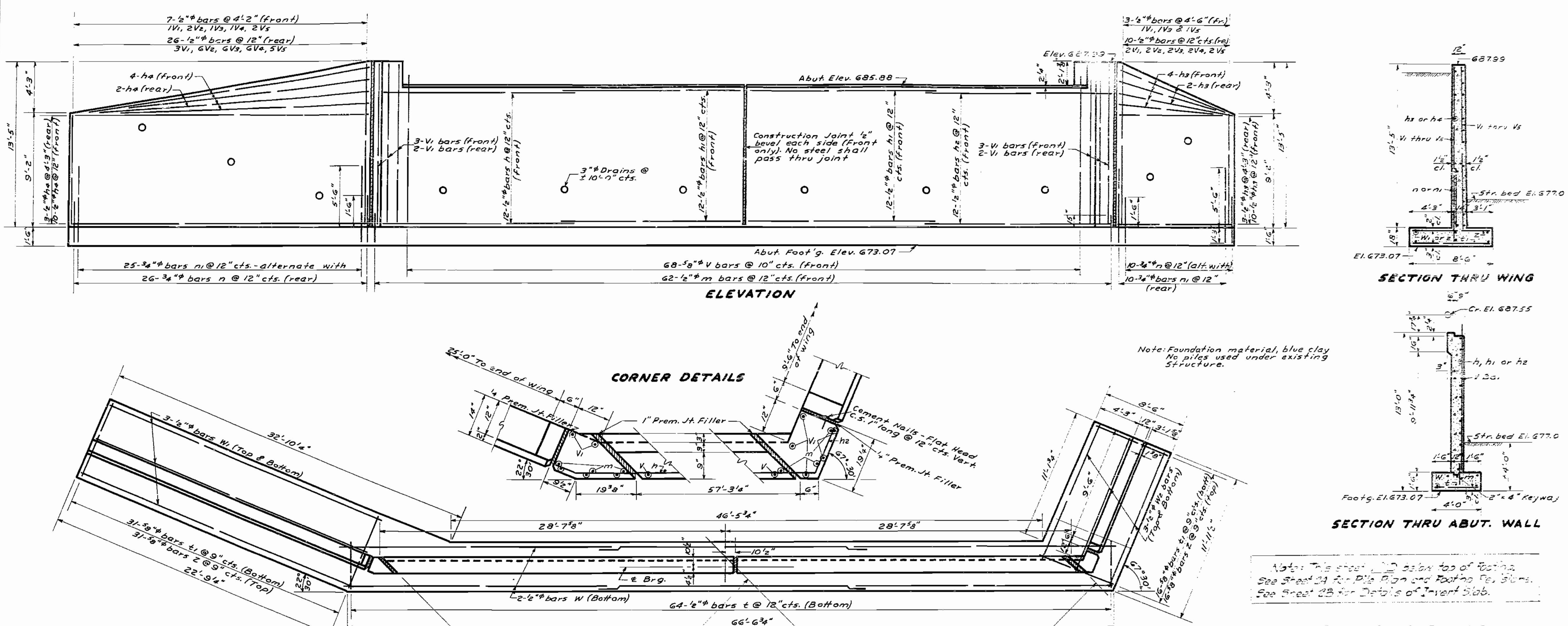
7-11 1952
EXAMINED
BRIDGE ENGINEER
PASSED
ENGINEER OF DESIGN
APPROVED
CHIEF HIGHWAY ENGINEER

Revised for Footing Changes 7-9-52 WFW
Excavation for Structures added 2-21-52 H.P.G. + H.R.L.

PROJECT F-2(22)
F.A. RT. 1 - SECTION 17RB
IROQUOIS COUNTY
STATION 80 + 50

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

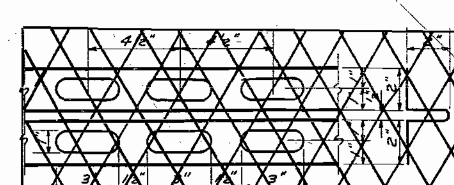
F.A. RT. 1 | 17RB | Iroquois | 10 | 7 | SHEET NO. 2 | 2 SHEETS | F-2(22)



Note: This sheet ... below top of Footing.
See Sheet 2A for Pile Plan and Footing Revisions.
See Sheet 2B for Details of Invert Slab.

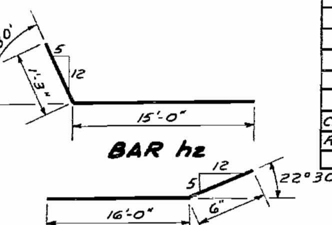
PLAN

Roadway symm. when rotated 180°



~~Copper Seal shall be 16 oz. Cold Rolled Annealed Copper with perforated flanges, splices if necessary shall be soldered or brazed. Cost shall be included in Contract unit price for Class X Concrete.~~

~~COPPER SEAL DETAIL~~



BAR h2

BAR h

BILL OF MATERIAL - SUBSTRUCTURE

Bar	No.	Size	Length	Shape	Bar	No.	Size	Length	Shape
V	136	⅝"φ	12'-6"		m	124	½"φ	2'-6"	
V1	34	½"φ	13'-0"		n	72	¾"φ	2'-9"	
V2	20	½"φ	12'-0"		n1	70	¾"φ	6'-9"	
V3	20	½"φ	11'-0"						
V4	18	½"φ	10'-0"		z	94	⅝"φ	8'-0"	
V5	20	½"φ	9'-0"		t	128	½"φ	3'-6"	
					t1	94	½"φ	8'-0"	
h	24	½"φ	16'-6"						
h1	48	½"φ	15'-0"		W	12	½"φ	22'-9"	
h2	24	½"φ	16'-3"		W1	12	½"φ	22'-3"	
h3	38	½"φ	9'-6"		W2	12	½"φ	11'-6"	
h4	38	½"φ	25'-0"						
Class X Concrete cu.yds.	~~148.7~~ 203.1								
Reinforcement Bars lbs.	7750								

DESIGNED	M. G. Carrel
CHECKED	H. J. Lawson
DRAWN	M. G. C. Sausaman
CHECKED	H. L. L.

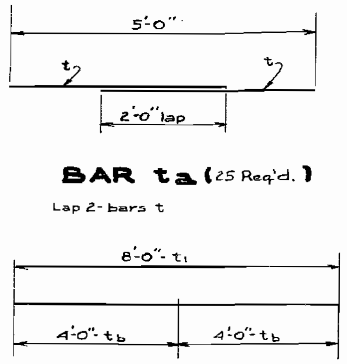
EXAMINED: BRIDGE ENGINEER
PASSED: ENGINEER OF DESIGN
APPROVED: CHIEF HIGHWAY ENGINEER

Revised - 4-18-52 Copper Seal out

Revised for Footing Changes 7-9-52 W.E.M.

PROJECT F-2 (22)
F.A. RT. 1 - SECTION 17RB
IROQUOIS COUNTY
STATION 80+50

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



BAR ta (25 Req'd.)

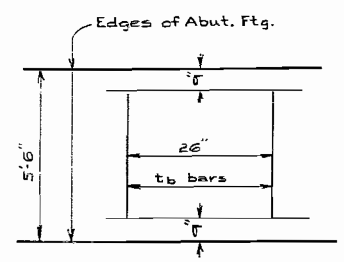
Lap 2 - bars t

BAR t_b (26 Req'd.)

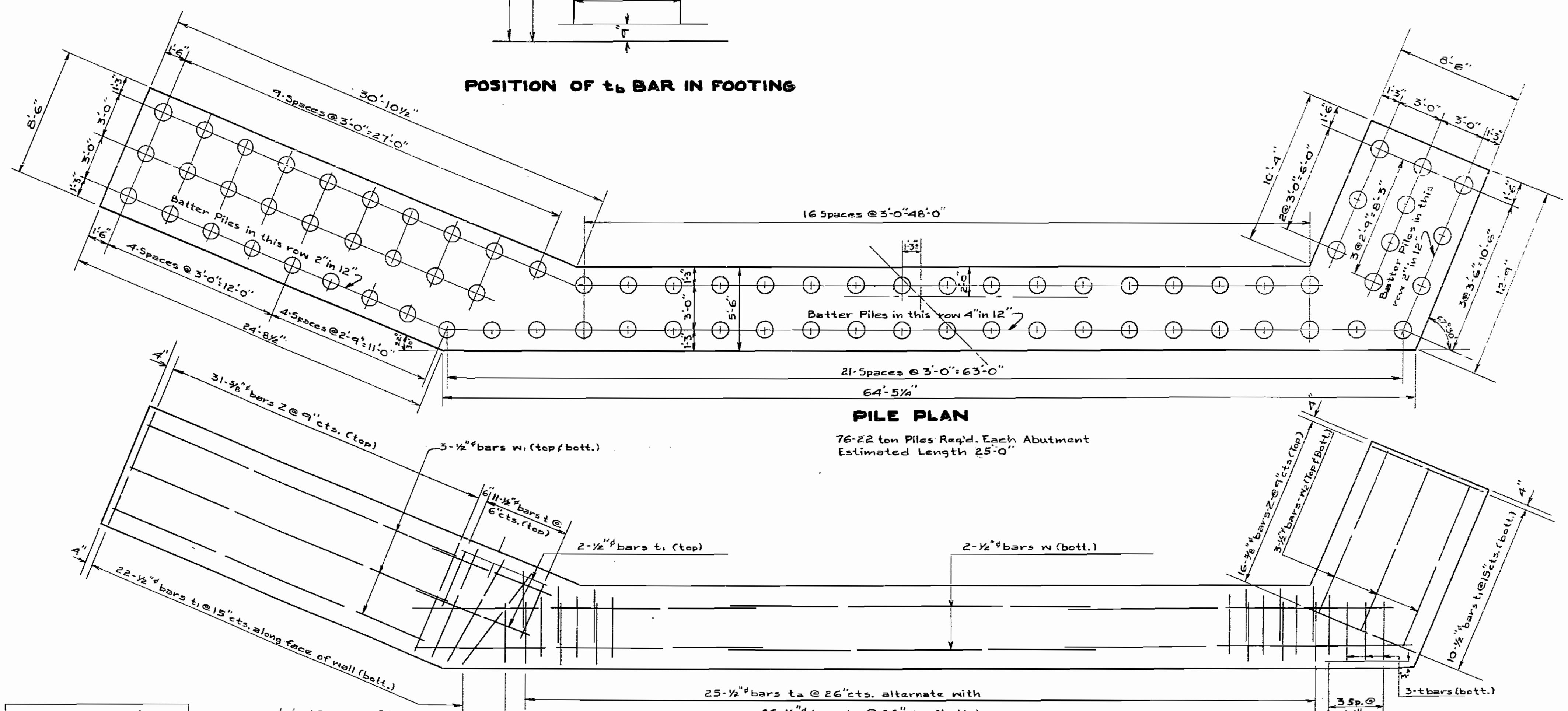
Make from bars t_1

BILL OF REVISED FOOTING BARS

BAR	NO.	SIZE	LENGTH	SHAPE
ta	25	½"ϕ	5'-0"	——
tb	26	½"ϕ	4'-0"	——



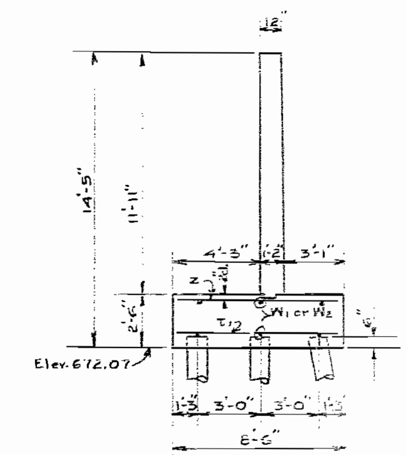
POSITION OF t_b BAR IN FOOTING



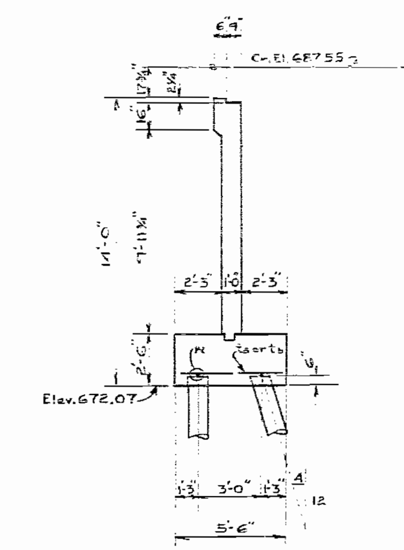
PILE PLAN

76-22 ton Piles Req'd. Each Abutment
Estimated Length 25'-0"

REINFORCEMENT PLAN



SECTION THRU WING



SECTION THRU ABUT. WALL

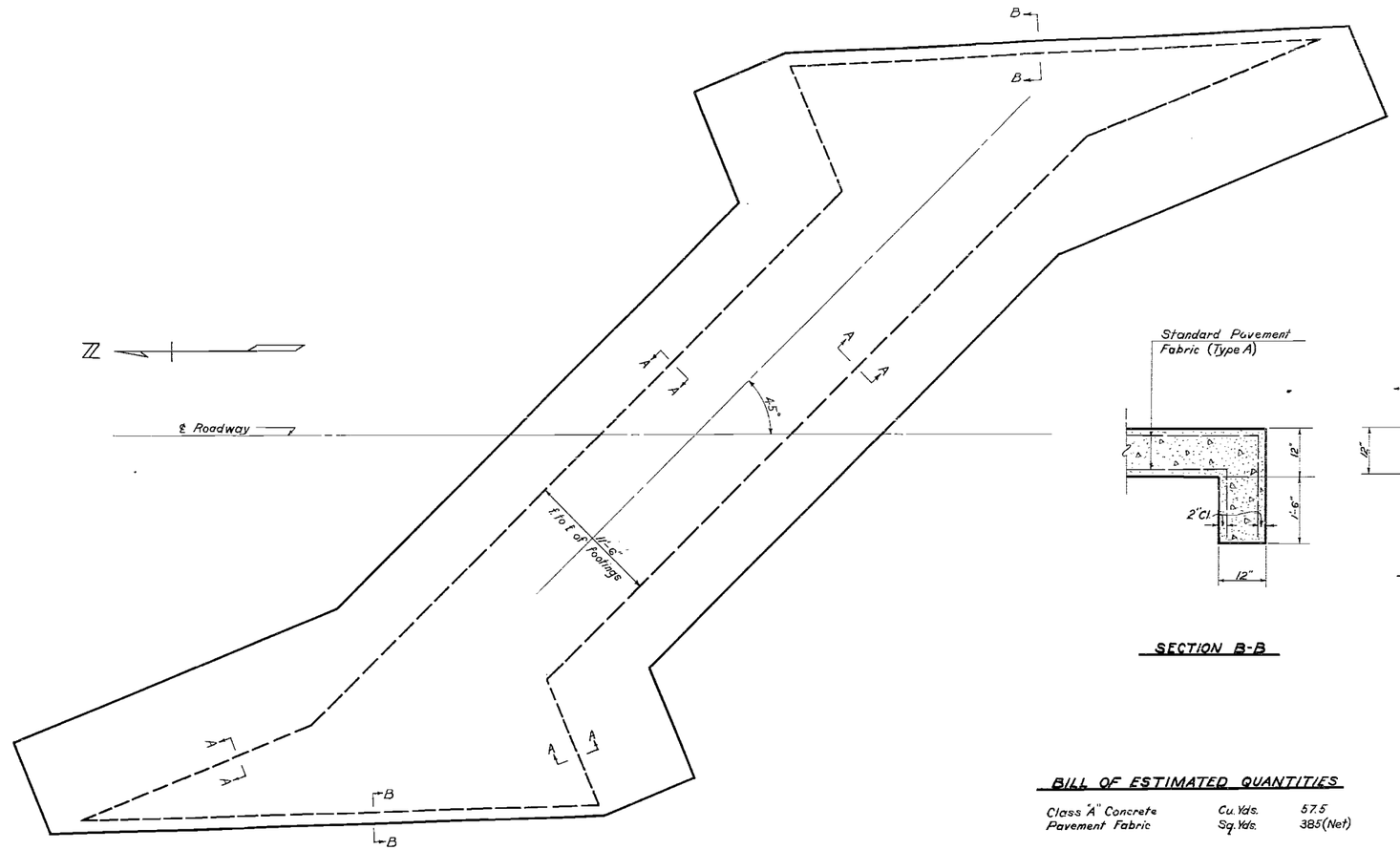
DESIGNED	W. J. Wiley
CHECKED	R.C. Hahn
DRAWN	G. S. Harris Stone
CHECKED	R.C. Hahn

July 10 1952
EXAMINED W E Hanson
ENGINEER OF BRIDGE AND TRAFFIC STRUCTURES
PASSED
ENGINEER OF DESIGN
APPROVED
CHIEF HIGHWAY ENGINEER

REVISED FOOTING DETAILS
PROJECT F-2(22)
F.A.RT.1 SECTION 17-RB
IROQUOIS COUNTY
STATION 80+50

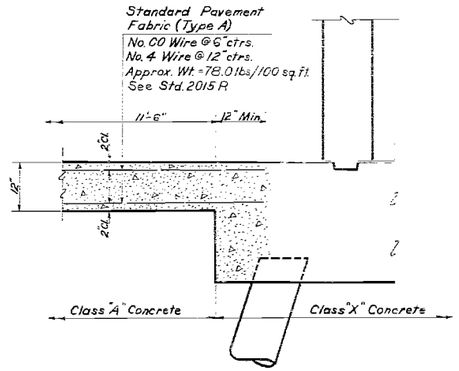
STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS & BUILDINGS
DIVISION OF HIGHWAYS

				SHEET NO. 28
F.A.P. 1	17 R-B	Iroquois	10	78 SHEETS 2
F.A.S. ROUTE NO.		SECTION	F-2(22)	



PLAN
Scale 3/16"=1'-0"

SECTION B-B



SECTION A-A

BILL OF ESTIMATED QUANTITIES

Class "A" Concrete	Cu. Yds.	57.5
Pavement Fabric	Sq. Yds.	385 (Net)

DESIGNED	W. F. Wiley
CHECKED	R. C. Hahn
DRAWN	W. F. W. Gates
CHECKED	R. C. Hahn

July 10 1952

EXAMINED W. E. Havens
ENGINEER OF BRIDGE AND TRAFFIC STRUCTURES

PASSED
ENGINEER OF DESIGN

APPROVED
CHIEF HIGHWAY ENGINEER

DETAILS OF INVERT SLAB
PROJECT F-2(22)
F.A.P. RT. 1 SECTION 17-RB
IROQUOIS COUNTY
STATION 80+50

B.M. - No. 18 ⊠ on S.E. Wing of Br. Abut. 1ft. Left Sta. 192+89, Elev. 697.20
Existing Structure - One Span R.C. Slab, R.C. Substructure, Span 16' & 30 ft. Rdy. - To be removed by Bridge Contractor before starting new Bridge.

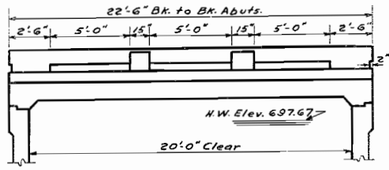
STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS & BUILDINGS
DIVISION OF HIGHWAYS

F.P.	COUNTY	TOTAL SHEETS	SHEET NO.
1	IROQUOIS	10	8

SHEET NO. 1
2 SHEETS

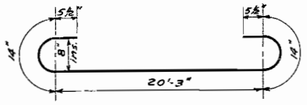
FED. ROAD DIST. NO. 1 | ILLINOIS | FED. AID PROJECT F-2(22)

Note: For Handrail Detail see Std. 2070-R Type 3-C

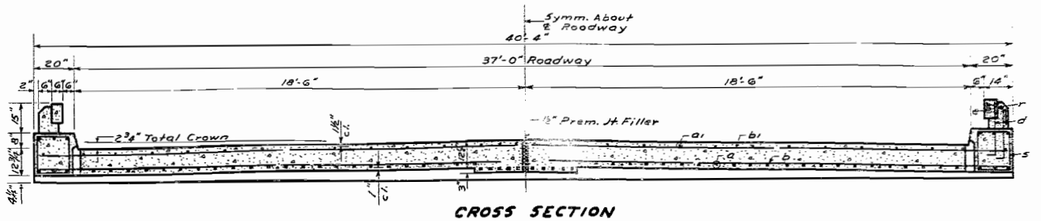


ELEVATION

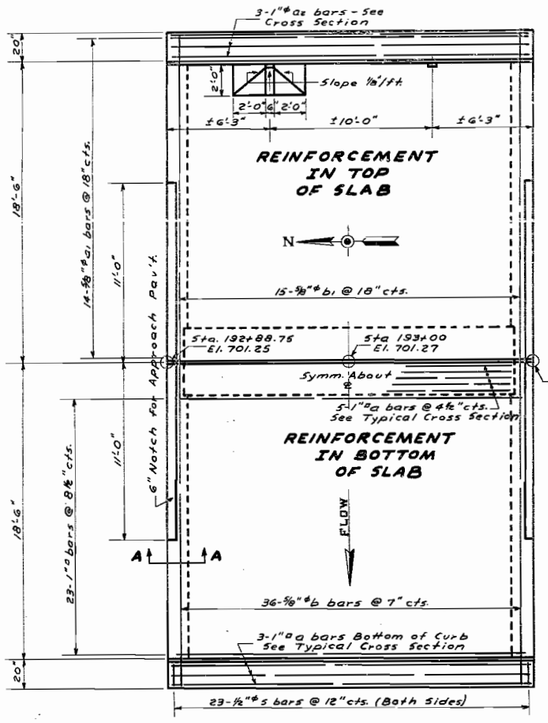
Elev. 691.07
Earth Classification Line



BAR a



CROSS SECTION

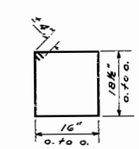


REINFORCEMENT IN TOP OF SLAB

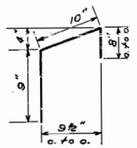
REINFORCEMENT IN BOTTOM OF SLAB

PLAN

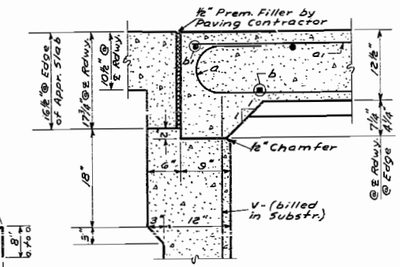
BAR d



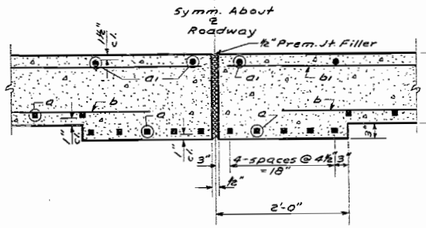
BAR s



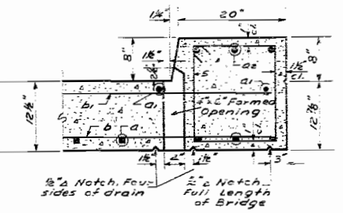
BAR r



SECTION A-A



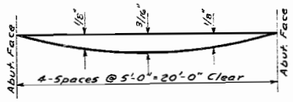
CENTER BEAM DETAIL



FLOOR DRAIN & CURB DETAIL

STATION 193+00
BUILT 195 BY
STATE OF ILLINOIS
F.A.RT. 1 SEC. 17-R-B
F.A. PROJ. F-2(22)
LOADING H20-S16

NAME PLATE
Std. 1882



D.L. DEFLECTION DIAGRAM

GENERAL NOTES

Class X Concrete shall be used throughout except as noted.
Handrail Concrete shall be used in the handrail.
Handrail shall not be poured until the falsework has been removed.
The concrete on either side of center joint shall be poured in one continuous operation.
The falsework on one side of the center joint shall not be removed until after the floor slab and curb are poured on the other side.

For backfill behind abutments see Art. 50.10 of the standard specs.
The drop box is to be included in the Bridge Contract.
Foundation Material, blue clay. No piles used under existing Structure.
Back of Abutments and wing walls, from the top of the slab or top of the wall to the top of the footing, shall be waterproofed in accordance with Article 5LBD of the Std. Specs. Adopted Jan. 2, 1952.

WATERWAY INFORMATION

Drainage Area	= 2000 Acres
Character	= Rolling
"C" (Talbot)	= 0.3
Opening Required	= 92 Sq. Ft.
Opening Provided	= 153 Sq. Ft.

STRESSES

f_s = 20,000 psi
f_c = 1,200 psi (Super)
f_c = 800 psi (Sub)
n = 10
H-20-S-16 Loading (1944)

BILL OF MATERIAL - SUPER

Bar	No.	Size	Length	Shape
a	62	1"⊕	23'-6"	
a1	28	⅝"⊕	21'-0"	
a2	6	1"⊕	22'-0"	
b	72	⅝"⊕	19'-0"	
b1	30	⅝"⊕	19'-9"	
d	36	⅝"⊕	3'-3"	
e	8	⅝"⊕	20'-6"	
r	16	½"⊕	2'-3"	
s	46	½"⊕	6'-9"	
Class X Concrete			cu.yds.	36.1
Handrail Concrete			cu.yds.	1.1
Reinforcement Bars			lbs.	8,490
Name Plate			each	One

All reinf. bars shall conform to A.S.T.M. Specifications A 305.

TOTAL BILL OF MATERIAL

Item		Super	Sub.	Total
Class X Concrete	cu.yds.	36.1	107.8	143.9 *
Handrail Concrete	cu.yds.	1.1	—	1.1
Reinforcement Bars	lbs.	8490	5670	14,160 *
Removal of Exist. Str.	ea.			One
Name Plate	ea.	One	—	One
Class A Excav. for Str.	cu.yds.			360

* Does not include quantities in Drop Box. See Road Plan Sheet, "Details of Special Drainage, Sta. 193+00 to Sta. 196+00."

Class B Excav. for Str.	Cu.Yds. 350

PROJECT F-2(22)
F.A. RT. 1 SEC. 17-R-B
IROQUOIS COUNTY
STA. 193+00

DESIGNED	Carroll C. Taylor	
CHECKED	James J. Mavering	
DRAWN	C.T. Sausaman	
CHECKED	James J. Mavering	
EXAMINED		7-11-1950
PASSED		BRIDGE ENGINEER
APPROVED		ENGINEER OF DESIGN
		CHIEF HIGHWAY ENGINEER

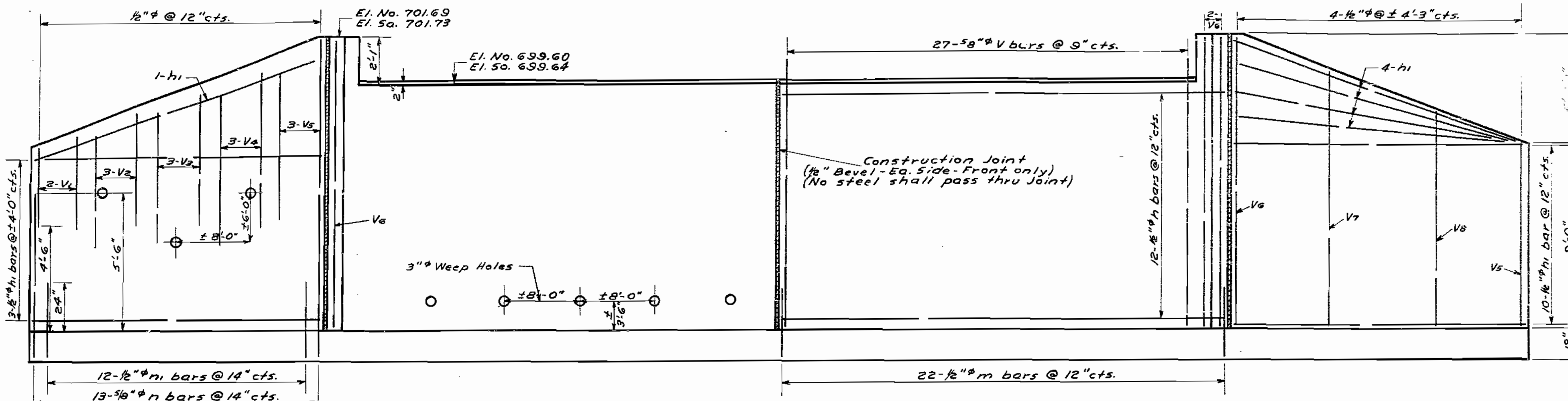
2-21-52 Excavation for Structures added. H.P.G.

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

F.A. ROUTE NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
1	17R-B	Iroquois	10	9

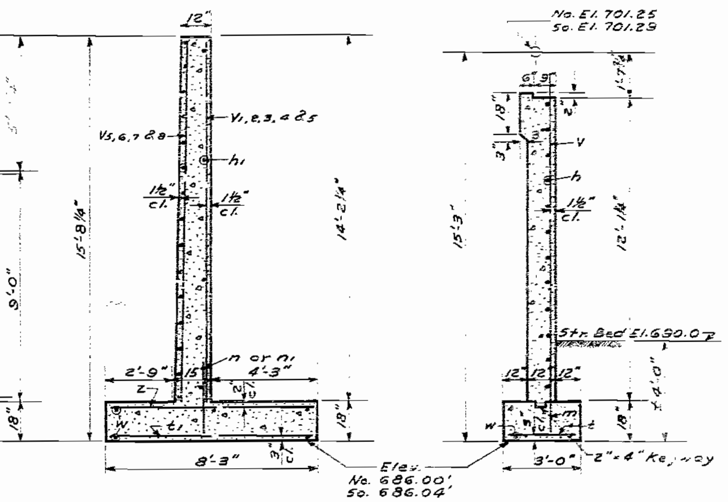
FED. ROAD DIST. NO. 7 — FED. AID PROJECT F-2(22)

SHEET NO. 2
2 SHEETS



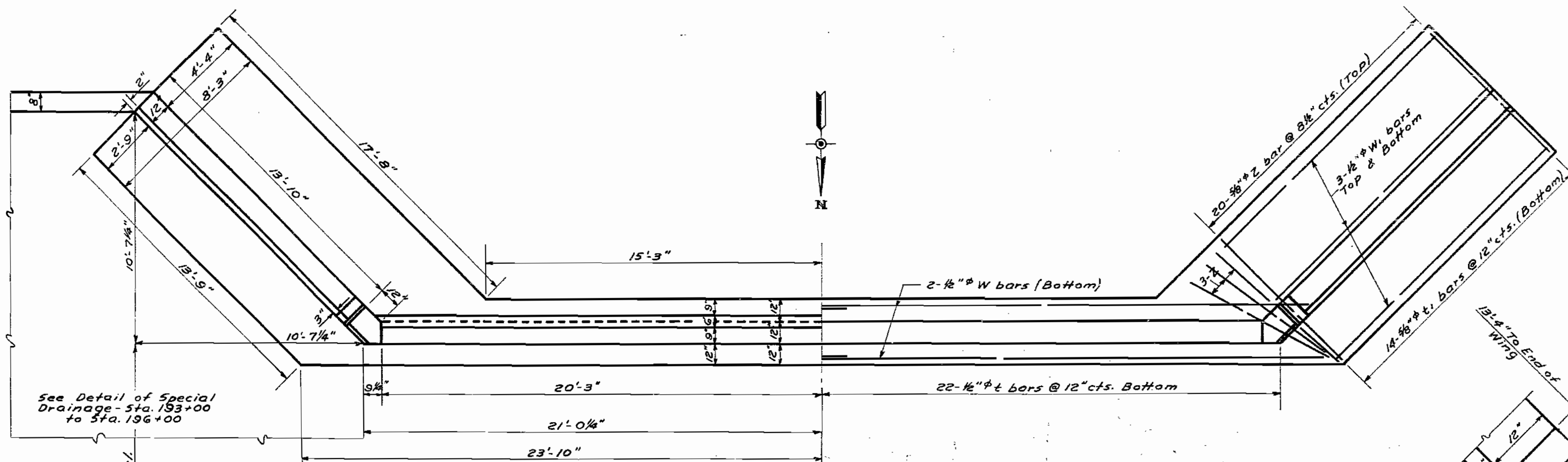
HALF ELEVATION SHOWING REINFORCEMENT IN BACK FACE

HALF ELEVATION SHOWING REINFORCEMENT IN FRONT FACE



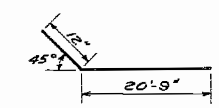
SECTION THRU WING

SECTION THRU ABUTMENT

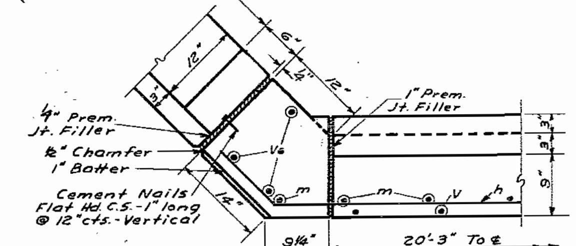


HALF PLAN SHOWING DIMENSIONS

HALF PLAN SHOWING REINFORCEMENT

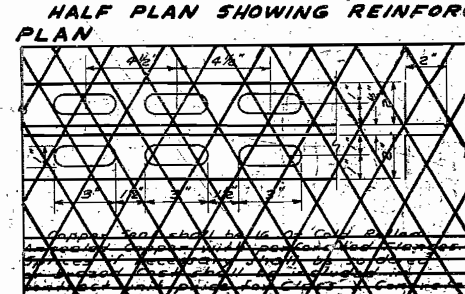


BAR h



WING CORNER DETAIL

PLAN



FLOW

BILL OF MATERIAL-SUB.

Bar	No.	Size	Length	Shape
V	108	⅝"φ	13'-0"	——
V₁	8	½"φ	5'-0"	——
V₂	12	½"φ	6'-0"	——
V₃	12	½"φ	7'-0"	——
V₄	12	½"φ	8'-3"	——
V₅	16	½"φ	9'-3"	——
V₆	16	½"φ	13'-9"	——
V₇	4	½"φ	12'-3"	——
V₈	4	½"φ	10'-9"	——
h	48	½"φ	21'-9"	——/
h₁	72	½"φ	13'-6"	——
m	88	½"φ	2'-6"	——
n	52	⅝"φ	6'-9"	——
n₁	48	½"φ	3'-0"	——
t	88	½"φ	2'-9"	——
t₁	56	⅝"φ	8'-0"	——
W	8	½"φ	24'-0"	——
W₁	24	½"φ	13'-9"	——
z	92	⅝"φ	8'-0"	——
Class X Concrete			cu. yds.	107.8
Reinforcement Bars			lbs.	5670

DESIGNED	Carl C. Taylor
CHECKED	James J. Wavering
DRAWN	C. T. Sausaman
CHECKED	James J. Wavering

EXAMINED ____ 19__ BRIDGE ENGINEER
PASSED ____ ENGINEER OF DESIGN
APPROVED C. M. Hathaway CHIEF HIGHWAY ENGINEER

Revised - 4-18-52 Copper Seal out

PROJECT F-2(22)
F.A. RT. 1 SEC. 17-R-B
IROQUOIS COUNTY
STA. 193+00

McCleary Engineering

Project BEARING Capacity - SN03=-0028
Prop SN038-2567

Page _____ of _____

Calculated By TCM Date 3-24-20

Checked By M Date 3.30.20

Resistance Factor $\varphi_b = 0.45$ for Bearing Resistance
" " $\varphi_s = 0.85$ for Sliding "
" " $\varphi_{ep} = 0.50$ " Passive "

$q_R = \varphi_b q_n$

$q_n = c N_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5 \gamma B N_{\gamma m} C_{w\gamma}$

$N_c = 5.14$ $c = 3.9$ ksf B-02 after weak material is removed/replaced.
$N_q = 1.0$
$N_\gamma = 0.0$ $D_f = 14.25$ ft
$C_{wq} = 1.0$ $S_c = 1 + \left(\frac{B}{5L}\right) = 1 + \left(\frac{20.25'}{5 \cdot 80'}\right)$
$C_{w\gamma} = 1.0$ $S_c = 1.05$

$q_n = 3.9\,\text{ksf}(5.14 \cdot 1.05 \cdot 1.0) + 0.120\,\text{ksf}(14.25\text{ft})(1.0)(1.0)(1.0) + 0$

$q_n = 21.05\,\text{ksf} + 1.71\,\text{ksf}$

$q_n = 22.76\,\text{ksf}$

$q_R = 0.45 \cdot 22.76\,\text{ksf} = 10.24\,\text{ksf}$

3705 Progress Blvd., Suite 2 - Peru, IL 61354
(815) 780-8486 - www.mcclearyengineering.com

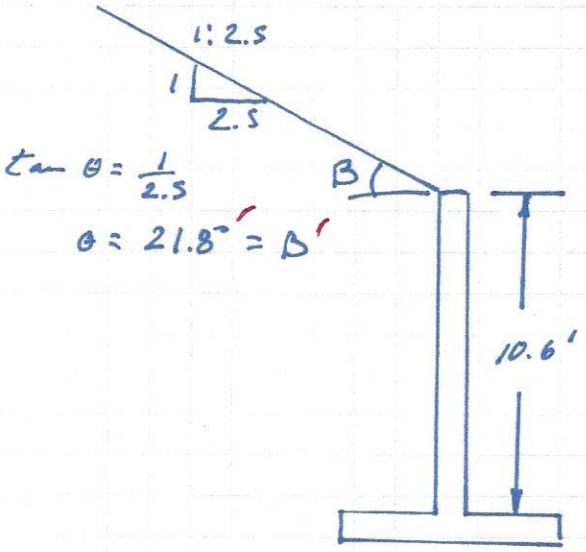
McCleary Engineering

Project Lateral Earth Pressures Prop. SN038-2561

Page _____ of _____

Calculated By 3-25-20 Date TCM

Checked By M Date 3.30.20



$\tan\theta = \frac{1}{2.5}$

$\theta = 21.8° = B'$

$$K_a = \left[\frac{\cos\phi}{1+\sqrt{\sin\phi(\sin\phi-\cos\phi\tan\beta)}}\right]^2$$

$\phi = 28°$

$\beta = 21.8$

$$K_a = \left[\frac{\cos 28}{1+\sqrt{\sin 28(\sin 28-\cos 28\tan 21.8)}}\right]^2$$

$$K_a = \left(\frac{0.88}{1.23}\right)^2$$

$K_a = 0.51$

$\gamma \simeq 120$

γ_{EF} = Eq Fluid Pressure $= K_a\gamma$

$= 0.51(120 lb/ft^3)$

$= 61.2 lb/ft^3$

$\sigma_h = \gamma_{EF} \cdot H$

$\sigma_h = 61.2 lb/ft^3 \cdot (10.6 ft)$

$\sigma_h = 648.7 lb/ft^2$

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Preliminary Settlement Calculations for Proposed Culvert at Existing SN038-0028 Boring SB-02 SE Quad

For Normally Consolidated Cohesive Soils: NC

Calculated by Terry McCleary Apri 3/25/20
Revised

$$S = \left(\frac{C_c \cdot H}{1+e_o}\right)\log\left(\frac{P'_o + \Delta P'}{P'_o}\right)$$

For Overconsolidated Cohesive Soils, CASE I: $\sigma'_{z0} < \sigma'_{zf} \leq \sigma'_c$

$$S = \left(\frac{C_r \cdot H}{1+e_o}\right)\log\left(\frac{P'_o + \Delta P'}{P'_o}\right)$$

For Overconsolidated Cohesive Soils, CASE II: $\sigma'_{z0} < \sigma'_c \leq \sigma'_{zf}$

$$S = \Sigma\left[\frac{C_r}{1+e_o}\cdot H\cdot\log\left(\frac{P'_c}{P'_o}\right) + \frac{C_c}{1+e_o}\cdot H\cdot\log\left(\frac{P'_f}{P'_c}\right)\right]$$

For Granular Soils:

$$S = \left(\frac{H}{C'}\right)\log\left(\frac{P'_o + \Delta P'}{P'_o}\right)$$

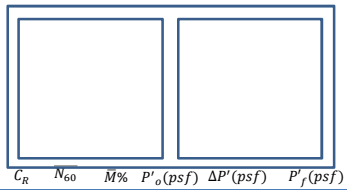
C' *is taken from Figure* 10.6.2.4.2 *of AASHTO LRFD*

$E_m =$ 80

20.25 ft.

1020 psf

Water Table = 667 ft.



Soil Classification from Log

673.3	e	$\gamma'(psf)$	$\bar{Q}_u$ (tsf)	$\bar{N}$	C_b	C_R	$\overline{N_{60}}$	$\bar{M}$%	$P'_o(psf)$	$\Delta P'(psf)$	$P'_f(psf)$	$\overline{N_{1_{60}}}$	C'	$P_c(psf)$	Case #	C_r	C_c	S	C_{vf}
		130																	
Crushed Limestone	N/A	135	0	30	1	0.75	30	N/A	209.25	947.4771	1156.73	92.7	105	N/A	N/A	N/A	N/A	0.26	1.5
670.2																			
		120																	
V. Stiff to Hard SiCL Till	0.378	57.6	3	10	1	0.75	10	14	490.5	839.6341	1330.13	20.2	N/A	13636.36	I	0.0108	0.072	0.10	1.5
667.7																			
		120																	
V. Stiff to Hard SiCL Till	0.297	57.6	4	11	1	0.75	11	11	1052.1	601.31	1653.41	15.2	N/A	18181.82	I	0.0108	0.072	0.38	1.5
650.7																			

Not accurate. No Test Data.

	Not Accurate. Grossly Estimated. Not determined from laboratory testing
	Infromation from Consolidation Test Results
	Information from Borings Log SB-1
	Calculated Data

Sum of Settlement =	**0.75**	**inches**		
Time for 90% of Consolidation =		**min**	**0.0**	**0.0**	**0.0**
		days	**0.0**	**0.0**	**0.0**
		months	**0.0**	**0.0**	**0.0**
		years	**0.0**	**0.0**	**0.0**

This time seems too quick for the amount of settlement. Using the procedure explained in the NAVFAC Manual 7.01 the t90 is greater than 10 years to complete.

e = Void Ratio from Laboratory Test Results

$\gamma'(psf)$ = Effective Unit Weight = Unit Weight from Laboratory testing - 62.4 pcf (Unit Wt. of Water)

$\bar{Q}_u$ (tsf) = Average Unconfined Compressive Strength from field RIMAC testing, info found on boring logs

$\bar{N}$ =Average N-value from SPT testing. The N-value is calculated by adding the last two blow counts of an 18" SPT penetration test.

C_b = Borehole Diameter Factor, used in calculating the N_{60} value

C_R = Rod Length Factor, used in calculating the N_{60} value

$\overline{N_{60}}$ =SPT N value corrected for field procedures

$\bar{M}$% =Average moisture content

$P'_o(psf)$ = Initial stress on soil at the midpoint of the layer

$\Delta P'(psf)$ = Change in stress in the soil layers below the fill

$P'_f(tsf)$ = Final Pressure

$\overline{N_{1_{60}}}$ = SPT N value corrected for effective stress

C' = Bearing Capacity Index, AASHTO

P_c(psf) = Preconsolidation Pressure

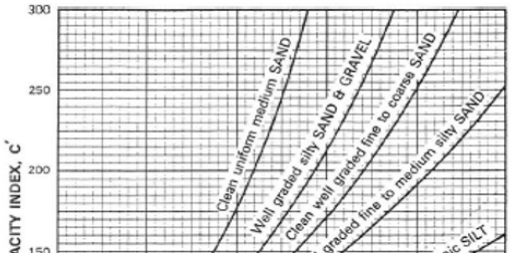
C_r = Recompression Index

C_c = Compression Index

P'_m = Overconsolidation Margin

S = Settlement, inches

C_{vf} = Coefficient of Consolidation at P'_f



Preliminary Settlement Calculations for Proposed Culvert at Existing SN038-0028 Boring SB-01 NW Quad

Calculated by Terry McCleary Apri 3/25/20
Revised

For Normally Consolidated Cohesive Soils: NC

$$S = \left(\frac{C_c \cdot H}{1 + e_o}\right) \log\left(\frac{P'_o + \Delta P'}{P'_o}\right)$$

For Overconsolidated Cohesive Soils, CASE I: $\sigma'_{z0} < \sigma'_{zf} \leq \sigma'_c$

$$S = \left(\frac{C_r \cdot H}{1 + e_o}\right) \log\left(\frac{P'_o + \Delta P'}{P'_o}\right)$$

For Overconsolidated Cohesive Soils, CASE II: $\sigma'_{z0} < \sigma'_c \leq \sigma'_{zf}$

$$S = \Sigma\left[\frac{C_r}{1 + e_o} \cdot \mathrm{H} \cdot \log\left(\frac{P'_c}{P'_o}\right) + \frac{C_c}{1 + e_o} \cdot H \cdot \log\left(\frac{P'_f}{P'_c}\right)\right]$$

For Granular Soils:

$$S = \left(\frac{H}{C'}\right) \log\left(\frac{P'_o + \Delta P'}{P'_o}\right)$$

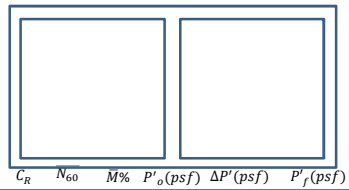
C' *is taken from Figure* 10.6.2.4.2 *of AASHTO LRFD*

E_m = 80

20.25 ft.

1020 psf

Water Table = 667 ft.



Soil Classification from Log	e	$\gamma'(psf)$	$\bar{Q}_u$ (tsf)	$\bar{N}$	C_b	C_R	$\overline{N_{60}}$	$\bar{M}\%$	$P'_o(psf)$	$\Delta P'(psf)$	$P'_f(psf)$	$\overline{N_{1_{60}}}$	C'	$P_c(psf)$	Case #	C_r	C_c	S	C_{vf}	Time with Drainage Single	Double	Expected
673.3		130																				
Very Stiff Silty Clay Loam	0.432	67.6	2.5	9	1	0.75	9	16	33.8	995.4217	1029.22	69.2	N/A	11363.64	I	0.0081	0.054	0.10	1.5	#REF!	#REF!	#REF!
672.3																						
		120																				
V. Stiff to Hard SiCL Till	0.459	57.6	5.3	13	1	0.75	13	17	689.68	644.4618	1334.14	22.1	N/A	24090.91	I	0.00945	0.063	0.48	1.5	37981.72	9495.43	9495.43
650.7																						
		130																				

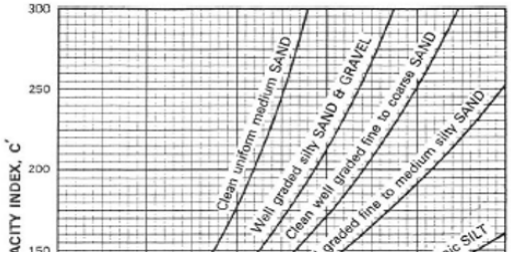
Not accurate. No Test Data.

Not Accurate. Grossly Estimated. Not determined from laboratory testing
Infromation from Consolidation Test Results
Information from Borings Log SB-1
Calculated Data

Sum of Settlement =	**0.58**	**inches**		
Time for 90% of Consolidation =		**min**	#REF!	#REF!	#REF!
		days	#REF!	#REF!	#REF!
		months	#REF!	#REF!	#REF!
		years	#REF!	#REF!	#REF!

This time seems too quick for the amount of settlement. Using the procedure explained in the NAVFAC Manual 7.01 the t90 is greater than 10 years to complete.

e = Void Ratio from Laboratory Test Results
$\gamma'(psf)$ = Effective Unit Weight = Unit Weight from Laboratory testing - 62.4 pcf (Unit Wt. of Water)
$\bar{Q}_u$ (tsf) = Average Unconfined Compressive Strength from field RIMAC testing, info found on boring logs
$\bar{N}$ =Average N-value from SPT testing. The N-value is calculated by adding the last two blow counts of an 18" SPT penetration test.
C_b = Borehole Diameter Factor, used in calculating the N_{60} value
C_R = Rod Length Factor, used in calculating the N_{60} value
$\overline{N_{60}}$ =SPT N value corrected for field procedures
$\bar{M}\%$ =Average moisture content
$P'_o(psf)$ = Initial stress on soil at the midpoint of the layer
$\Delta P'(psf)$ = Change in stress in the soil layers below the fill
$P'_f(tsf)$ = Final Pressure
$\overline{N_{1_{60}}}$ = SPT N value corrected for effective stress
C' = Bearing Capacity Index, AASHTO
P_c(psf) = Preconsolidation Pressure
C_r = Recompression Index
C_c = Compression Index
P'_m = Overconsolidation Margin
S = Settlement, inches
C_{vf} = Coefficient of Consolidation at P'_f



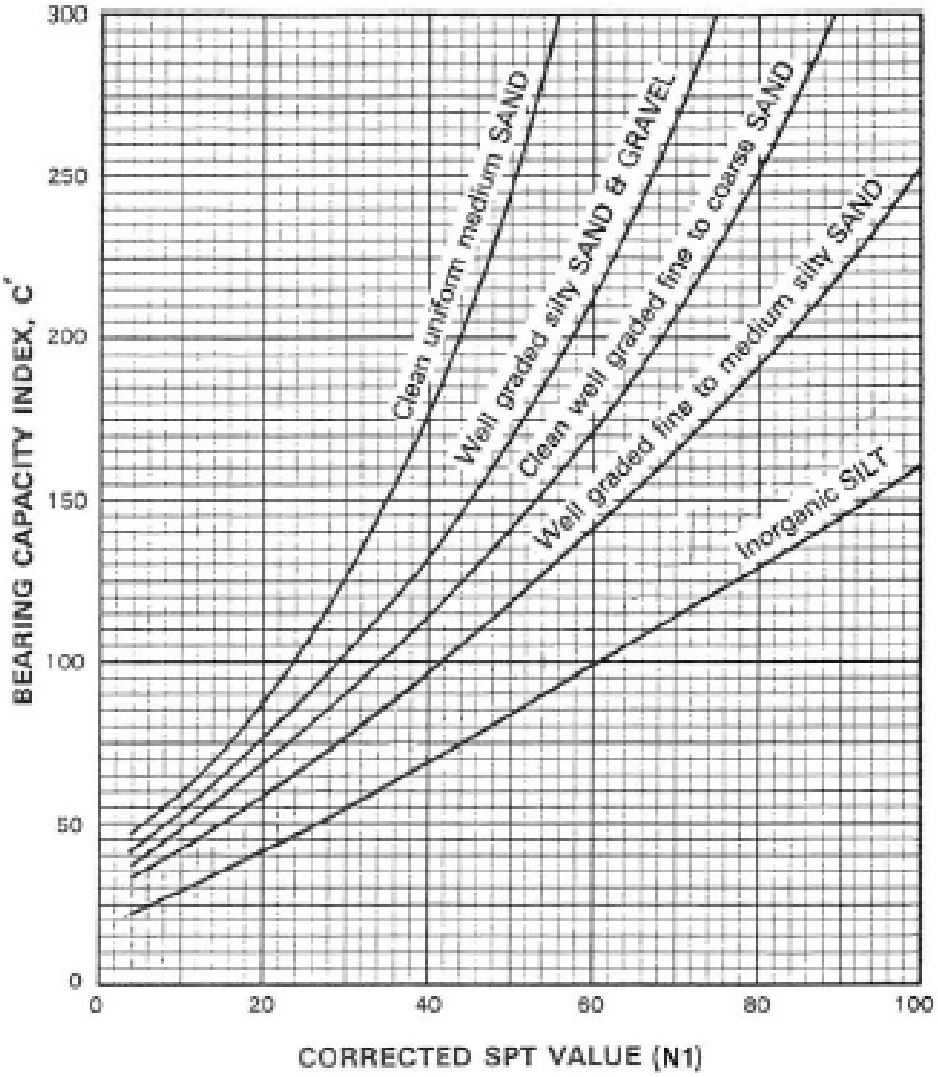


Figure 10.6.2.4.2-1—Bearing Capacity Index versus Corrected SPT (modified from Cheney and Chassie, 2000, after Hough, 1959)

WATERWAY INFORMATION TABLE

Culvert Alternative

Route:	FAP 332 (IL 1)	S.N. (Exist.):	038-0028
Section:	17RB	S.N. (Prop.):	
County:	Iroquois	Waterway:	Trib. to Gay Creek
Station	80+50.00	Date:	2/2/2016

SPF 7/18/19

Drainage Area =	1.70 sq mi	Exist. Low Grade El. = 687.06 @ Sta. 79+00			Prop. Low Grade El. = 687.06 @ Sta. 79+00				
FLOOD	**FREQUENCY**	**Q**	**OPENING - sq. ft.**		**NAT.**	**HEAD - ft.**		**HEADWATER EL.**	
	(yr.)	**(cfs)**	**Exist.***	**Prop.***	**H.W.E.**	**Exist.**	**Prop.**	**Exist.**	**Prop.**
	10	418	116	155	682.4	0.2	0.0	682.6	682.4
Hydraulic Design	50	689	138	182	683.7	0.9	0.2	684.6	683.9
Base/Scour Des.	100	812	144	189	684.1	1.2	0.6	685.2	684.7
Scour Check	200	941	147	193	684.3	1.5	0.8	685.8	685.1
Max. Calc.	500	1110	150	197	684.5	2.0	1.2	686.4	685.7
Overtopping	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

10-year velocity exist 3.8 fps 10-year velocity prop 3.1 fps

Scope of Work: Total Replacement

EXISTING STRUCTURE

Type: RC Slab on closed abutments
Length: 22'-7 1/2" fc-fc along centerline
Spans: 1
Width: 40'-4" out-out
Low Beam: 685.87
Skew: 45° left ahead

PROPOSED STRUCTURE

Type: Double 9' x 9' Conc. Box w/flared wingwalls
Length: 80'-0"
U/S Flowline: 674.6
D/S Flowline: 674.5
Skew: 45° left ahead
U/S Invert: 674.35
D/S Invert: 674.25

Note: Proposed structure details are preliminary; subject to refinement in final design.