Illinois Department of Transportation

Abbreviated Structure Geotechnical Report

Original Report Date: 4-10-2017	**Proposed SN:** 038-2029	**Route:**	FAP 840 (US 45/52)
Revised Date: 6-19-2017	**Existing SN:** 038-0116	**Section:**	(138 BR-1)BR
Geotechnical Engineer: Michael Short, IDOT District 3		**County:**	Iroquois
Structural Engineer: Michael Haley, Lin Engineering, LTD.		**Contract:**	66E24

Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing): The proposed structure is a double barrel 12' span by 10' rise precast concrete box culvert. The structure will be perpendicular to the roadway. Guardrail will be replaced in all four quadrants. A preliminary TSL drawing is attached.

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): Soil borings from September 2015 are attached. The existing structure, built in 1928, is a single span concrete slab bridge on closed abutments and spread footings. The existing bridge is not skewed.

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 profile of the roadway is being raised by about 1'. A site visit found no signs of settlement at the existing structure. Because the fill is minimal, the soil is not anticipated to experience any additional loading that would result in settlement. No further analysis for settlement is warranted.

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 side slopes are being flattened and will range from 1:4 (V:H) to 1:3 (V:H). The proposed side slopes are a maximum of about 10 feet high at the culvert ends. A site visit indicated no slope stability problems with the existing structure. No further slope stability analysis is required.

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: Not applicable to closed bottom box culverts per ABD Memo 14.2.

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: Not applicable to box culverts.

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: A precast concrete box culvert is acceptable. The soils under the proposed box culvert will not require removal and replacement to support the proposed structure. If the box culvert is specified to be precast, the only aggregate needed under the box culvert is the 6 inches required by Article 540.06 of the Standard Specifications.

Horizontal cantilever wingwalls are feasible; however the District prefers the use of either a soldier pile or sheet pile wingwall due to their faster construction. If the length of the wingwall exceeds the maximum allowable length for horizontal cantilever wingwalls, then L-type wingwalls or a horizontal cantilever wingwall with gabion extensions are feasible. If one of these options is selected, please contact the SGR author to provide the factored bearing resistance and unit sliding resistance values for the foundation soils under the wingwall.

Soldier pile and permanent sheet pile wingwalls are feasible, and are the preferred wingwall types. However, if sheet pile wingwalls are used, the existing hard till soils may need to be removed to elevation 621.5, because these soils may be difficult to drive the sheet piles through. These soils should be replaced with aggregate meeting the requirements of Note 1 of Article 540.02 of the Standard Specifications. The need for removal of the hard till soils should be determined by the contractor with consideration of the sheet pile type and the driving equipment to be used. The contractor needs to accept all risk associated with installing the sheet piles. Weep holes should be cut

into the sheet pile wingwalls to provide adequate drainage. Design parameters for soldier pile and permanent sheet pile wingwalls are attached. A suggested sequence of sheet pile wingwall construction is provided below:

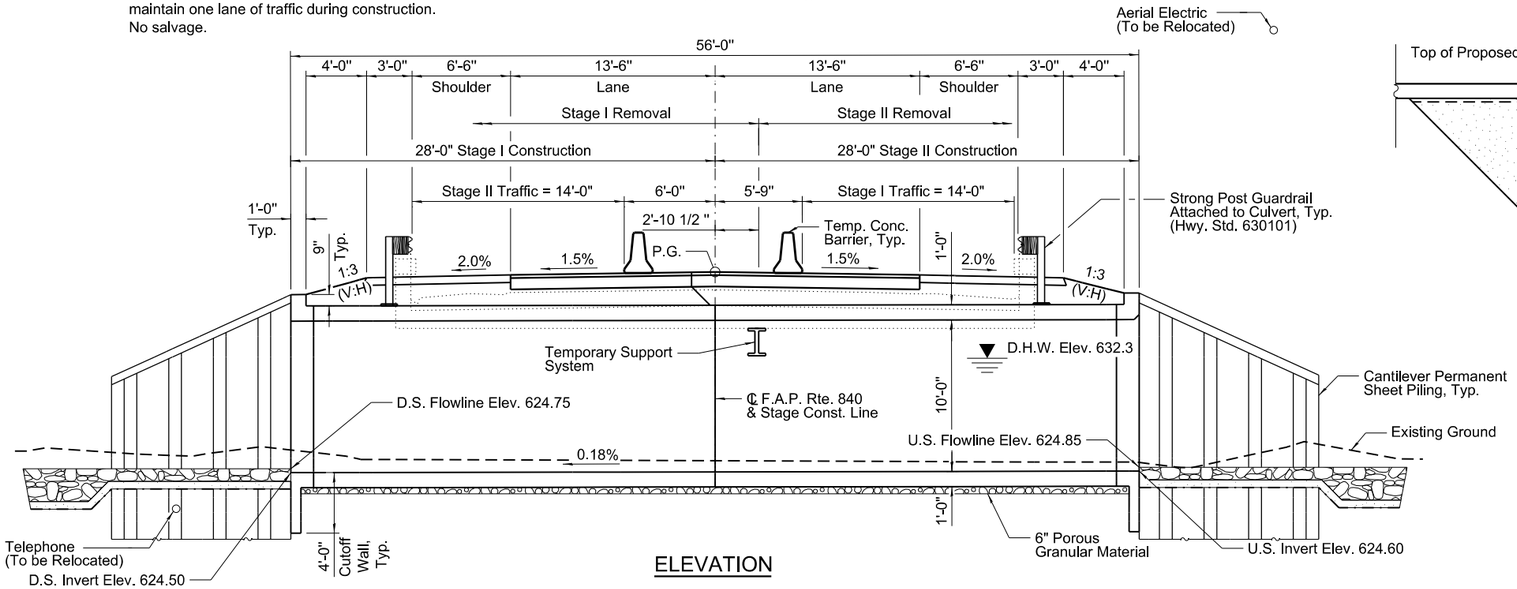
1. Remove soils above elevation 621.5.
2. Install steel sheet pile wingwalls.
3. Place aggregate and complete grading in front of the sheet pile wingwalls.
4. Place aggregate on the back side of the sheet pile wingwalls.
5. Install weep holes in the sheet pile wingwalls.
6. Complete backfill and grading on the back side of the sheet pile wingwalls.

Calculate the estimated water surface elevation and determine the need for cofferdams (type 1 or 2), and seal coat: The structure can be constructed using conventional methods of water diversion determined by the contractor.

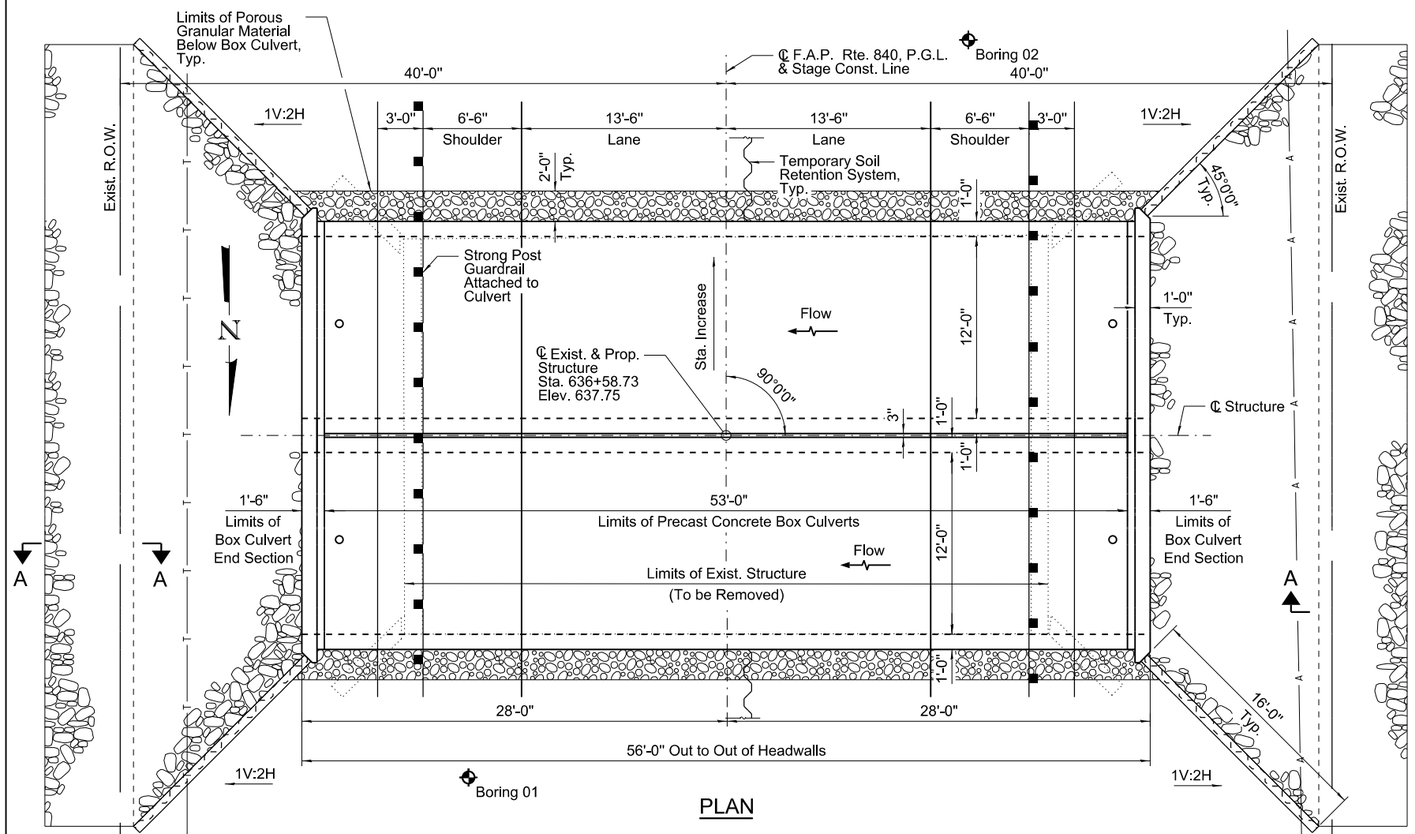
Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns: Stage construction is proposed for this project, however temporary sheet piling is not feasible because the soils with a strength exceeding 4.5 tsf are above the depth of sheet pile embedment. A temporary soil retention system will be required.

Benchmark: BM 7 - Cut square on top of NW wingwall on S.N. 038-0116 over Langan Creek Sta. 636+46.03, 22.04' Rt., Elev. 635.92

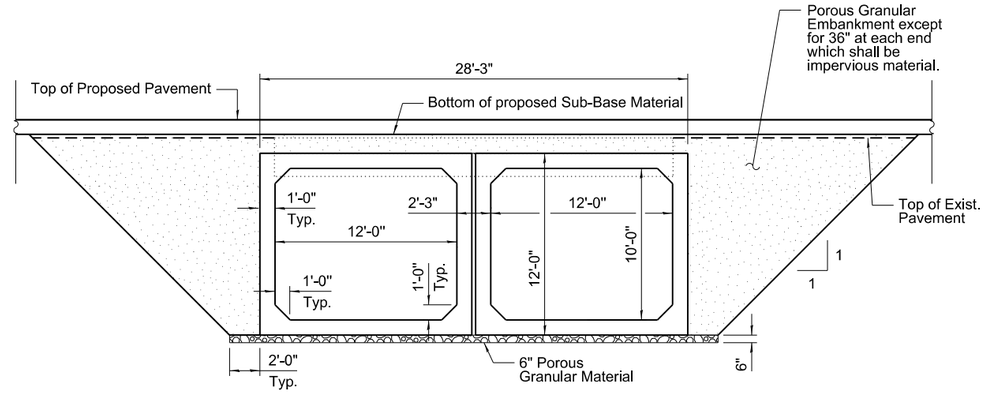
Existing Structure: S.N. 038-0116 was built in 1926 under SBI 49, Section 138-B at Sta. 636+58. The wearing surface was modified under three different contracts between 1970 and 2000. Existing structure is a single span slab bridge with a deck thickness of 30.5", 26'-0" bk. to bk. abutments, 42'-2" out to out deck with no skew. The Contractor shall remove and replace the existing structure. Stage Construction shall be utilized to maintain one lane of traffic during construction.
No salvage.



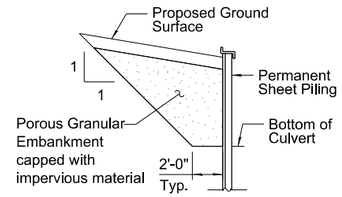
ELEVATION



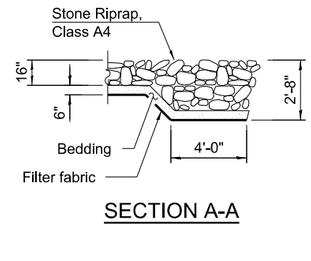
PLAN



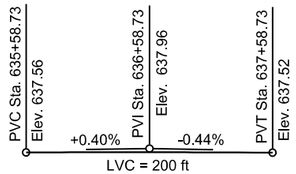
SECTION THROUGH PRECAST BOX CULVERT



SECTION THROUGH WING WALL



SECTION A-A



PROFILE GRADE
(along ℄ F.A.P. Rte. 840)

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications,7th Edition with 2016 Interims

LOADING HL-93

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

DESIGN STRESSES

PRECAST UNITS
f'c = 5,000 psi
fy = 65,000 psi (Welded Wire Rein.)

FIELD UNITS
f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (Sheet Piling)

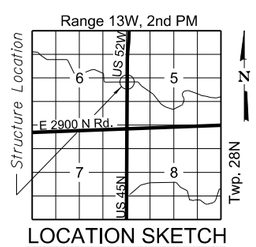
HIGHWAY CLASSIFICATION

F.A.P. Route 840 (US 45/52)
Functional Class: Minor Arterial
ADT: 3914 (2019), 4779 (2039)
DHV: 1004 (2039)
ADTT: 15.8%
Design Speed: 55 mph
Posted Speed: 55 mph

WATERWAY INFORMATION

Drainage Area = 2.64 sq. mi. Low Grade Elev. = 635.39 @ Sta. 642+90

Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	277	137	167	631.6	0.0	0.0	631.6	631.6
Design	50	439	155	185	632.3	0.3	0.2	632.6	632.5
Base	100	524	162	192	632.6	0.4	0.3	633.0	632.9
Overtopping									
Max. Calc.	500	690	172	202	633.0	0.6	0.4	633.6	633.4



LOCATION SKETCH

GENERAL PLAN AND ELEVATION
US 45 / 52 OVER LANGAN CREEK TRIB.
F.A.P. RTE. 840 SEC. (138 BR-1)BR
IROQUOIS COUNTY
STATION 636+58.73
S.N. 038-2029

LIN ENGINEERING,LTD.
Consulting Engineers
Springfield, Illinois

USER NAME =	DESIGNED - VPT	REVISED -
FILE NAME =	CHECKED - MTH	REVISED -
PLOT SCALE =	DRAWN - CGY	REVISED -
PLOT DATE =	CHECKED - VPT	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
840	(138BR-1)BR	IROQUOIS		
		CONTRACT NO. 66E24		
	ILLINOIS FED. AID PROJECT			

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/30/15

ROUTE FAP 840 (US 45/52) **DESCRIPTION** US 45/52 over a Drainage Ditch, 3.52 miles North of US 52 **LOGGED BY** Larry Myers

SECTION 138BR **LOCATION** NW 1/4, **SEC.** 5, **TWP.** 28N, **RNG.** 13W, 2nd **PM**,
Latitude 40.93822, **Longitude** -87.866673

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

STRUCT. NO. 038-0116 (Exist.)
Station 636+58.73

BORING NO. 01 (N.E. Quad.)
Station 636+24
Offset 16.0 ft Lt.
Ground Surface Elev. 636.15 ft

Surface Water Elev. 625.78 ft
Stream Bed Elev. 624.58 ft

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

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
				Augered Shoulder Stone, Black Silty Clay Loam / Silty Loam Fill
633.65				
	2			Stiff Black Silty Clay Loam / Silty Clay Fill
	3 3	1.5 P	18	
-5	2			
	2 3	2.0 P	29	
628.65				
	3			Hard Brown & Gray Silty Clay Loam Till
	4 3	*	19	* Sample 7.5' - 9.0' ribboned inside the split spoon
-10	4			
	7 9	8.8 S	18	
	5			
	6 8	7.4 S	19	
621.65				
-15	3			Very Stiff Brown Silt with some Clay
	3 4	2.5 P	21	
619.15				
	3			Stiff Gray Silty Clay Loam Till
	4 5	2.0 P	22	
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
	2			Stiff Gray Silty Clay Loam Till *(continued)*
	3 4	1.4 B	21	
	2			
	2 4	1.5 B	22	
-25	1			
	2 3	1.2 B	22	
	1			
	3 4	1.3 B	22	
-30	1			
	3 3	1.2 B	22	
-35	2			
	4 5	2.0 B	21	
599.65				
				End of Boring
-40				

SOIL BORING 038-0116.GPJ IL_DOT.GDT 10/27/15

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)

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/30/15

ROUTE FAP 840 (US 45/52) **DESCRIPTION** US 45/52 over a Drainage Ditch, 3.52 miles North of US 52 **LOGGED BY** Larry Myers

SECTION 138BR **LOCATION** NE 1/4, **SEC.** 6, **TWP.** 28N, **RNG.** 13W, 2nd **PM**,
Latitude 40.938031, **Longitude** -87.866796

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

STRUCT. NO. 038-0116 (Exist.)
Station 636+58.73

BORING NO. 02 (S.W. Quad.)
Station 636+91
Offset 17.0 ft Rt.
Ground Surface Elev. 635.95 ft

Surface Water Elev. 625.78 ft
Stream Bed Elev. 624.82 ft

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

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Augered Shoulder Stone, Black & Brown Silty Clay Loam Fill			
633.45			
Stiff Black & Brown Silty Clay Loam Fill	2		
	3 3	1.5 P	25
-5			
	3		
	2 3	2.0 P	21
628.45			
Very Stiff Brown & Gray Silty Clay Loam Till	2		
	3 4	3.1 B	20
-10			
	3		
	4 5	3.9 B	20
623.95			
Hard Gray & Brown Silty Clay Loam Till	5		
	9 14	8.9 S	17
-15			
	3		
	4 5	4.5 B	20
618.95			
Very Stiff Gray Silty Clay Loam Till	3		
	4 5	3.0 B	21
-20			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Stiff Gray Silty Clay Loam Till *(continued)*	3		
	4 5	3.2 B	21
	2		
	3 5	2.5 B	21
611.45			
-25			
Stiff Gray Silty Clay Loam Till	2		
	2 3	2.0 B	22
	2		
	2 2	1.8 B	21
-30			
	1		
	2 3	1.9 B	22
-35			
	1		
	2 3	2.0 B	19
599.45			
End of Boring			
-40			

SOIL BORING 038-0116.GPJ IL_DOT.GDT 10/27/15

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)

Mc Cleary Engineering

"Specializing in Geotechnical Solutions"

April 5, 2017

Mr. Kevin Marchek
Illinois Department of Transportation
Attn: Mike Short
700 East Norris Drive
Ottawa, IL 61350

PTB 153/36
Various Geotechnical Reports, Various Routes, Various Counties
Region 2/District 3
P-93-024-09
WO#22, Lateral Earth Pressures for SN038-2029
US 45/52

Mr. Short;

Please find attached the requested soil properties for short term (undrained) and long term (drained) conditions for the above project. The use of cohesion in the design of retaining walls must be with caution as the cohesion can result in shallower and less robust walls than what may be needed. Boring B-1 and B-2 are very similar in strengths, therefore boring B-1 was arbitrarily chosen for use in the analysis. Please see the attached soil pressure diagram for the sheet pile option with and without granular backfill behind the wall. They differ slightly from what was submitted on March 30th, 2017.

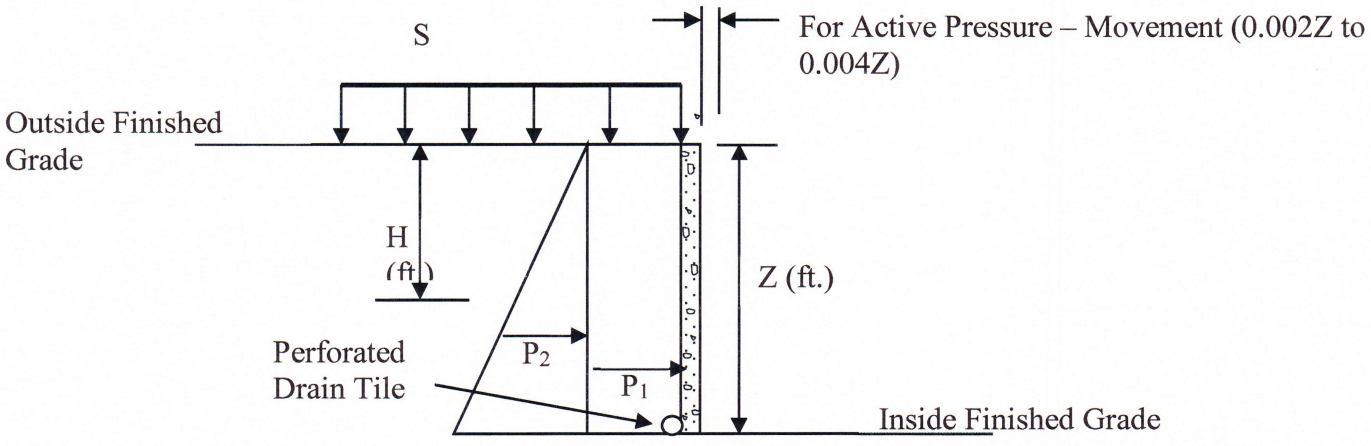


Figure 1, Earth Pressure Schematic

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

Table 1 - Earth Pressure Coefficients for the use with flexible retaining walls less than 20 ft. in height

Earth Pressure Conditions	Coefficient for Retained Soil Type	Equivalent Fluid Pressure (psf/lin. ft. of wall)	Surcharge Pressure, P_1 (psf)	Earth Pressure, P_2 (psf)
Active, K_a	Granular – 0.33 Cohesive - 0.50	40 60	0.33 x Surcharge 0.50 x Surcharge	40 x H 60 x H
At-Rest, K_o	Granular – 0.46 Cohesive - 0.65	55 78	0.46 x Surcharge 0.65 x Surcharge	55 x H 78 x H
Passive, K_p	Granular – 3.00 Cohesive - 2.00	360 240	--- ---	--- ---

Figure 1 and Table 1 are applicable for the following conditions:

- For active earth pressure, the wall must rotate about the base or dredge line with top lateral movements
- For passive earth pressure, the wall must move horizontally back into the soil to mobilize resistance.
- For walls that are not expected to move, at rest earth pressures are recommended for design.
- Grade in front and behind the wall is relatively flat
- Uniform surcharge, where S is the surcharge pressure, 250 psf traffic load.
- In-situ soil backfill weight is a maximum of 120 pcf
- Horizontal backfill, compacted to at least 95% of standard Proctor maximum dry density
- Loading from heavy compaction equipment was not included
- No groundwater acting on the wall
- Well maintained drain tile at toe of wall with a clean, free draining granular material behind the wall. To use the coefficients for the granular soil type, the clean, free draining granular backfill should extend from the heal of the wall footing upward at a 45° angle from the horizontal plane. This material should also be capped with a cohesive material to prevent surface water from entering the backfill.
- Earth pressures do not take into account the effects of frost, swell or forces from compactive efforts while placing backfill.
- No safety factor included
- Per Section 3.11.3.1 of the IDOT Bridge Manual, 2012, ignore passive pressure in top 3 ft. below dredge line on passive side of wall.
- Ignored cohesion and used a long term friction value for a drained condition.
    - $\phi = 27.5^\circ$ degrees for stiff soils
    - $\phi = 30^\circ$ degrees for very stiff soils
    - $\phi = 32^\circ$ degrees for hard soils
- Used a $\phi = 34^\circ$ degrees for granular backfill

If you have any questions, please don't hesitate to contact me at your convenience.

Respectfully submitted,

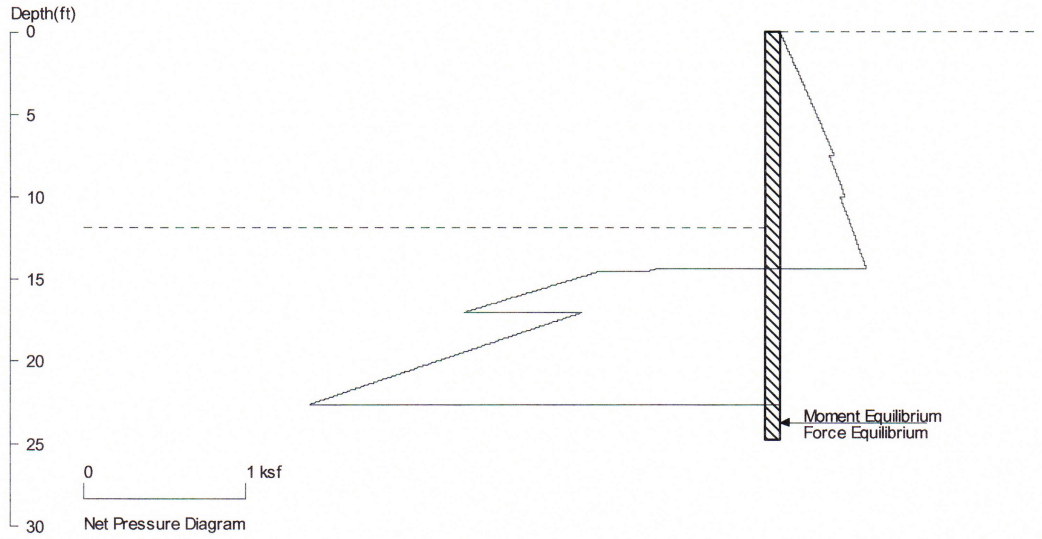
Terrence L. McCleary, P.E.

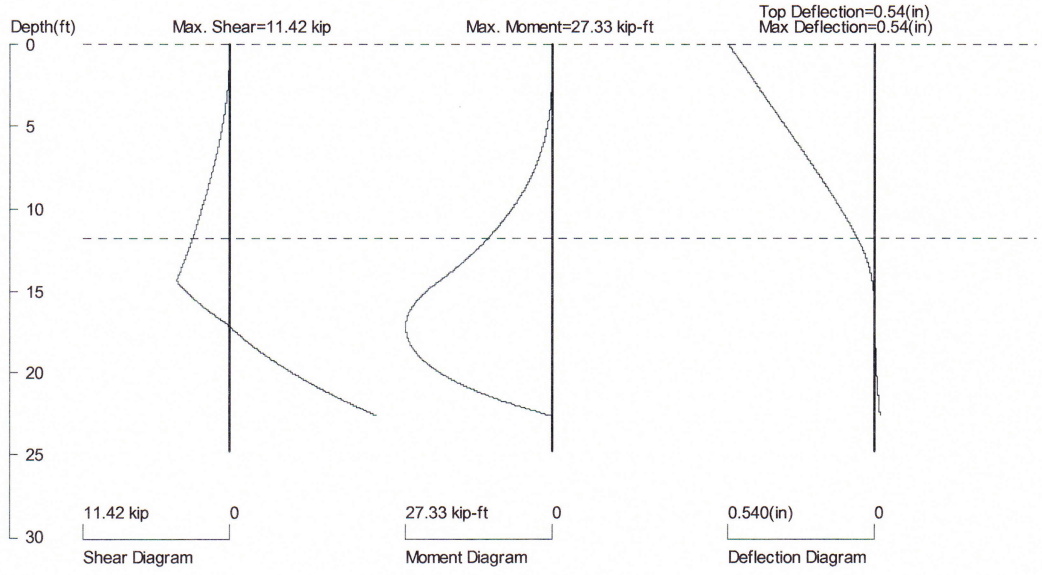
Terrence L. McCleary, P.E.

STATE OF ILLINOIS
062-050019
TERRENCE L.
MC CLEARY
LICENSED ENGINEER

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

SN038-2029 Sheet Pile Wing Walls





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

User Input Pile, HP10X42: E (ksi)=29000.0, I (in4)/pile=210.0

leary Engineering Business Files\IDOT\P93-024-09, District #3 various Geotech\Work Order #22, Materials\Horizontal Soil Pressures for 038-0116\SN038-2029 granular

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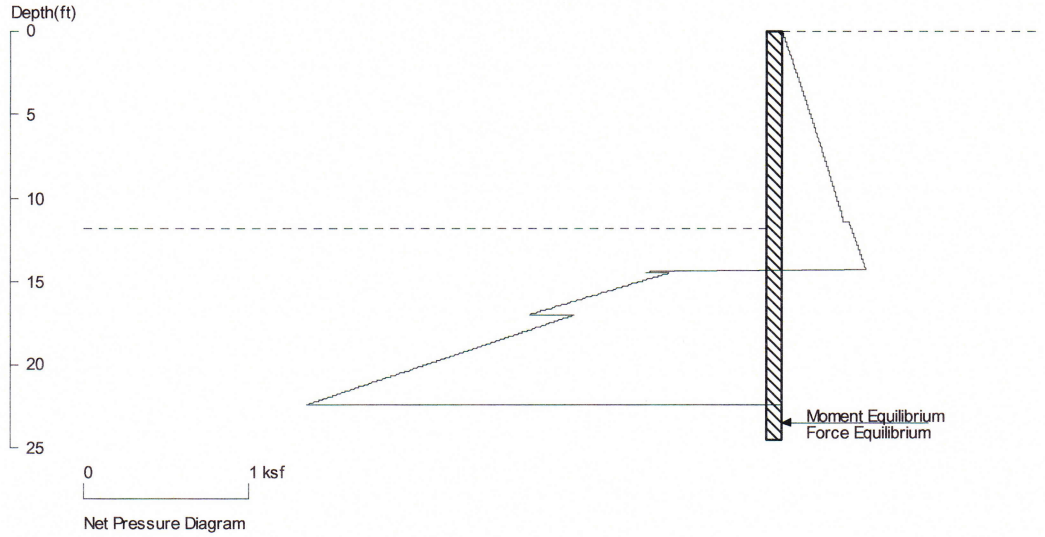
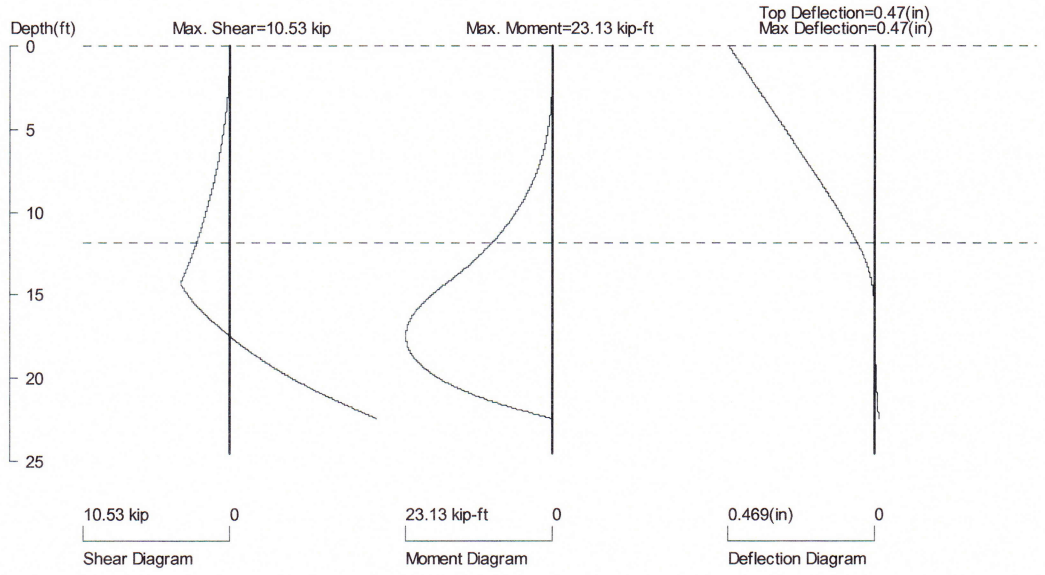
SN038-2029 Sheet Pile Wing Wall with Granular Back





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

User Input Pile, HP10X42: E (ksi)=29000.0, I (in4)/pile=210.0

leary Engineering Business Files\IDOT\P93-024-09, District #3 various Geotech\Work Order #22, Materials\Horizontal Soil Pressures for 038-0116\SN038-2029 granular

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Blue Ink = Drained (Long Term) Conditions
Red Ink = Undrained (Short Term) Conditions

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/30/15

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BORING NO. 01 (N.E. Quad.)
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Offset 16.0 ft Lt.
Ground Surface Elev. 636.15 ft

Surface Water Elev. 625.78 ft
Stream Bed Elev. 624.58 ft

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

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Augered Shoulder Stone, Black Silty Clay Loam / Silty Loam Fill
633.65				
	2			Stiff Black Silty Clay Loam / Silty Clay Fill
	3	1.5	18	γ = 122.2 pcf, γs = 134.4 pcf, ϕ = 27.5°, c = 1250 psf
-5	3	P		
	2			
	2	2.0	29	
	3	P		
628.65				
	3			Hard Brown & Gray Silty Clay Loam Till γ = 124.6 pcf, γs = 137.1 pcf, c = 2500 psf, ϕ = 30°
	4	*	19	* Sample 7.5' - 9.0' ribboned inside the split spoon
-10	3			
	4			γ = 131.8 pcf, γs = 145.0 pcf, ϕ = 32°, c = 8100 psf
	7	8.8	18	
	9	S		
	5			
	6	7.4	19	
	8	S		
621.65				
-15				Very Stiff Brown Silt with some Clay γ = 124.6 pcf, γs = 137.1 pcf, ϕ = 30°, c = 2500 psf
	3			
	3	2.5	21	
	4	P		
619.15				
	3			Stiff Gray Silty Clay Loam Till γ = 126.6 pcf, γs = 139.2 pcf, ϕ = 27.4°, c = 2000 psf
	4	2.0	22	
	5	P		
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	2			Stiff Gray Silty Clay Loam Till *(continued)*
	3	1.4	21	
	4	B		
	2			
	2	1.5	22	
-25	4	B		
	1			
	2	1.2	22	
	3	B		
	1			
	3	1.3	22	
	4	B		
-30				
	1			
	3	1.2	22	
	3	B		
-35				
	2			
	4	2.0	21	
599.65	5	B		
				End of Boring
-40				

Stiff Cohesive Soils | Stiff | V. Stiff Cohesive Soils | Hard Cohesive Soils | V. Stiff Cohesive Soils | Stiff Cohesive Soils

SOIL BORING 038-0116.GPJ IL_DOT.GDT 10/27/15

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
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BBS, form 137 (Rev. 8-99)