Illinois Department of Transportation

Abbreviated Structure Geotechnical Report

Original Report Date: 4-30-2018	**Proposed SN:** 050-8802	**Route:**	FAP 46 (IL 251)
Revised Date: 7-7-18	**Existing SN:** N/A	**Section:**	(1)I-2
Geotechnical Engineer: Terry McCleary at McCleary Engineering		**County:**	LaSalle
Structural Engineer: James Clinard, Chamlin & Associates		**Contract:**	66F12

Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing): These are new retaining structures to replace the existing wingwalls of the 10 ft. x 8 ft. box culvert, SN 050-2524, currently in place. The south wingwall has failed and fallen forward into the channel while the north wingwall appears to be in fair to good condition. Both wingwalls are recommended for replacement due to their age and condition. The proposed wingwalls are to be soldier pile walls set approximately 12 ft. back from the east end of the culvert on the south side and approximately 9 ft. back on the north side. This difference in setback is to account for the skew of the box culvert. Above and to the south of the culvert the slope is failing. A separate soldier pile wall is being designed to hold the roadway in place. This project is to stabilize the lower portion of the slope by re-establishing the resistance forces at the toe with the installation of a new wingwall. The new wingwalls will be taller than the existing wingwalls as the depth above the culvert increases with the setback location of the new wingwalls. See the attached TSL drawing for a more detailed pictorial description of what is to be constructed.

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): Numerous borings were taken during the investigation of the slope failure above the wingwalls. Because of the terrain, no borings were taken at the exact locations of the proposed wingwalls. The borings taken nearest to the wingwalls are BH-6, BH-20 and I-4. The existing culvert sets in the bottom of an old ravine with cohesive, shaley clay fill placed above to make a smooth, but increasing grade from US 6 to the south of the culvert to Shooting Park Road to the north of the project. The founding soil beneath the culvert and proposed walls is a gray and red shale bedrock.

The soils encountered in boring BH-6, taken south, but in line with the proposed south wingwall, are soft to stiff soils over medium stiff clay loam over a very thin layer of coal over stiff clay loam over hard red and gray shaley clay over hard gray shale over limestone.

Boring BH-20, taken in 1962, north and east of the north wingwall encountered a reddish brown clay. The ground surface elevation at that time was 547.1 ft. and the boring was terminated at elevation 538.8 ft. This is above the bottom of the footing and does not provide any information of the soil/bedrock below.

Boring I-4, circa 2017, was taken east of the existing sheet pile wall and south and west of the proposed wingwall, approximately 30 ft. west of BH-6. This boring was terminated in the hard red clay (possibly very weathered shale). Like boring BH-20, this boring was stopped above the bottom of the culvert and only provides information of the soils to be retained by the proposed wingwalls and not the founding material.

Please see the boring logs in the supporting documents attached to this report.

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 material taken from the slope grading operation is to remain on site and be placed north and away from the end of the existing culvert and proposed north wingwall. Here the soils will be placed and allowed to consolidate without effect on the proposed wingwalls. The amount of soil taken from the slope is expected to be minimal and spread over this area in a final thickness less than 3 ft. thick. A paved ditch in this area will be replaced with a storm sewer run to convey the current drainage from the north down to the channel. No additional testing or analysis is recommended at this time.

The wingwalls are to be soldier piles drilled and socketed in the gray shale and limestone bedrock formations below, therefore a footing bearing pressure is not provided in this report.

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: It is understood that only minimal slope restoration work is to be completed. This will be as a result of the installation of new soldier pile wing walls of the existing culvert at the bottom of the ravine. It is expected that the slope will be shaped to drain, prepared and seeded with a seed mixture adequate for a 1:3 slope. Following the IDOT Specifications for Road and Bridge Construction 2016, a Class 3, Northern Illinois Slope mixture with an excelsior blanket is recommended. The factor of

safety, FS, for the existing slope is approximately 0.5, which suggests the slope will continue its progression down the slope. It is understood the retaining wall is to support the roadway facility, but the slopes migration will be allowed to continue until an equilibrium is met and the slope surface will stop moving. The exposed height of the south wingwall is 14.75 ft. at its highest point adjacent to the existing box culvert. The exposed height of the north wingwall is 12.75 ft. at its highest point adjacent to the existing box culvert. A global stability check for the south was performed using the commercially available SLIDE 6.0 software. The analysis resulted in an undrained factor of safety, FS = 0.88 above the wall and > 5.0 for a failure surface traveling from above the wall, under the wall and ending up in front of the wall. The flattening and smoothing the slope above the was modeled and resulted in an FS = 2.0 The graphical results of the analysis are included in the supporting documents attached to this report. No further testing or analysis is recommended at this time. The District requests the installation of an inclinometer at one of the soldier piles to facilitate long term monitoring of slope movement.

Indicate at each substructure, the 100-year and 200-year total scour depths in the Hydraulics report, the non-granular scour depth reduction, the proposed ground surface, and the recommended foundation design scour elevations: Scour is a concern at the end of the existing culvert. The end of the existing culvert is to remain at its current location and the proposed wingwalls are to be purposely set back away from the end of the culvert. By setting the proposed wingwalls back away from the end of the culvert and placing riprap between the walls and the end of the culvert, the scour concern is abated.

Determining the seismic soil site class, the seismic performance zone, the 0.2 and 1.0 second design spectral accelerations and indicate if that the soils are liquefiable: This site is in a seismic performance zone, SPZ = 1 and has a seismic soil site class of "C", an SDs = 0.122 and an SD1 = 0.070. A liquefaction analysis was not perforrned because the SPZ is 1. The seismic data should not be put on the TSL unless the wall was designed to carry seismic loadings.

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 drilled soldier pile wall is recommended for use at this location because of the close proximity of bedrock. The soldier piles are to be drilled and socketed in the bedrock formation found at the bottom of the culvert elevation of 537.75 ft. The embedment depth is estimated to be 8 ft. with a tip elevation of 529.75 ft.

Using a combination of active pressure coefficients found in Table 1.0, a 14.75 ft. retained height, a 6.5 ft. soldier pile spacing, an anchor set at 5 ft. below the top of the wall, a 1:3 slope behind the wall and a unit weight of the retained soils of 130 pcf, the horizontal pressure is estimated to be near 1070 psf per linear ft. of wall. By IDOT policy, the resistance from top 3 ft. of soil on the passive side of the wall is ignored. With this height and slope configuration, an anchor is needed to stay with a common sized piles, HP10x42 and even 14x73 at the max height of the wall, 14.75 ft. In the analysis, an anchor was set at 5 ft. down from the top of the pile and extends back behind the wall at 90-degree angle between the anchor and the wall. While at the lower retained heights an anchor may not be needed, the author recommends their use for the entire length of wall to overcome the possible increase in loading on the wall if the slope above continues to move. A plate anchor such as a helical anchor will likely not work at this location because of the strength of material it would likely twisted into. A grouted tendon is recommended for these wingwall.

A load factor of 1.35 was used for the active soil pressure side of the wall and a resistance factor of 0.75 was used on the passive side of the wall. With the proposed granular embankment materials being placed behind the proposed wall and with no facing being placed over the pre-cast concrete lagging, the effects of the groundwater is expected to be negligible, nevertheless, the water table was included in the analysis.

Table 1.0, Earth Pressure Coefficients at point of Maximum Ht.

Visual Soil Classification	Unit Wt.	Ka, (actual)	Ave Ka, (actual)	Ka, (trapezoidal)	Kp
Boring BH-6, (2000)					
Soft Clay Fill	105	0.98	0.51	2.21	N/A
Stiff Clay Fill	120	0.63			N/A
V. Stiff to Hard Shaley Clay	125	0.44			3.45
Hard Shale/Limestone	140	0.55	0.44	N/A	3.45

Note:

- In the analysis, we ignored the resistance of the upper 3 ft. of soil on the passive side of the wall because of the seasonal softening of these soils.
- Using a trapezoidal envelope which is recommended for anchored soldier pile walls, a Ka = 1.56 at the short end of the wall and a Ka = 2.21 at the tall end of the wall (14.75 ft.) is recommended.

With negligible vertical load on the pile and the primary use of the pile being for lateral resistance the customary pile design table was not included in this report. Instead, a few pile sizes were used in the evaluation of the soldier pile wall option. The piles were analyzed using an equilibrium method with the commercially available software, Shoring V8. Two pile sizes were evaluated, HP10x42 and HP14x73. One inch of lateral movement was targeted for the analysis. The larger pile, HP14x73 was initially evaluated without an anchor. The pile failed and an anchor was added. With an anchor is needed to restrict the movement, the smaller pile with an anchor is the more economical installation and is shown in Tables 2.0 and 3.0.

The software, Shoring V8, utilizes an effective pile width greater than or equal to the actual width on the passive side of the equation. The piles are to be socketed in the hard shale/limestone bedrock. With this in mind the arching width of passive resistance was increased by a factor of 2. See the soil pressure diagrams and analysis results attached to this report.

Table 2.0, Summary of Results for boring BH-6 (2000) Wingwalls

Exposed Wall Height, ft. (height ignoring top 3 ft. of passive resistance)	Pile Size	Estimated Lateral Movement at Top of Pile, inches	Socket Tip Elevation, Ft.	Active Pressures (triangular), psf	Active Pressures (trapezoidal) psf
14.75 (w/anchor)	HP10x42	0.47	529.75	1070	860
9.75 (w/anchor)	HP10x42	0.00	529.75	750	600

Note:

- A 6.5 ft. soldier pile spacing was used in generating Table 2.0. Alternate spacing can be analyzed upon request.
- The anchor is set at 5 ft. below the top of wall at the walls maximum height, 14.75 ft., near the box culvert. For the other soldier piles, setting the anchor at 0.5H was assumed.
- The triangular and trapezoidal pressures shown in Table 2.0 are for 14.75 ft. and 9.75 ft. of exposed wall height. These wall heights are during construction.
- Active pressures shown in Table 2.0 are triangular and trapezoidal apparent pressure envelope and not actual. The pressures shown the in the graphical results are apparent pressure envelops to account for the anchoring of the wall.
- A socket diameter of 2 ft. was used. To simulate the shale/limestone formation an arching affect factor of 2.0 was used. This is believed to be conservative and could be increased if needed.
- See the attached graphical results

Table 3.0, Summary of Results for SN50-8802 using HP10x42

Soldier Pile Number (south to north)	Exposed Wall Height, ft.	Boring #	Estimated Lateral Movement at Top of Pile, inches	Embedment Depth Below Cut (537.75 ft.)	Anchor depth below top of wall, ft.	Unfactored Force on Anchor, kips
SP1	0(9.75)	BH-6	0.0 (0.08)	8	1	0(20.1)
SP2	2.95(10.75)	BH-6	0.0 (0.12)	8	1	3.1(25.9)
SP3	5.9(11.83)	BH-6	0.01(0.27)	8	2	9.6(34.3)
SP4	8.85(12.92)	BH-6	0.0(0.34)	8	4	22.1(39.7)
SP5	11.8 (14)	BH-6	0.2(0.52)	8	4	34.3(44.0)
SP6	14.75	BH-6	0.47	8	5	49.7
SP7	12.75	BH-6	0.32	8	5	39.5
SP8	8.5(11.65)	BH-6	0.01(0.18)	8	4	21.3(33.6)
SP9	4.25(9.75)	BH-6	0.0(0.11)	8	2	6.1(20.1)
SP10	0(7.75)	BH-6	0.0(0.03)	8	1	0(13.4)

Note:

- An analysis was performed for the maximum and minimum wall heights. Many of the values in Table 3.0 are interpolated/extrapolated between these data points. A 6.5 ft. soldier pile spacing was used in generating Table 3.0. Alternate spacing can be analyzed upon request.
- A 10° down angle from horizontal was used in the generation of the estimated force on the anchors.
- The exposed wall height values to the left of the ( ) in Table 3.0 are upon completion of the project. The values inside the ( ) in are associated with the height of wall during construction
- The trapezoidal pressures shown in Table 2.0 were used in the analysis to estimate the lateral movement at the top of the pile. At the max height location of the wall the largest amount of lateral movement occurred in the pile below the top, but was still not near the 1-inch maximum threshold set by IDOT.
- A friction angle between the wall and the soil was not utilized. The use of friction between the back of the wall and the soil backfill ultimately reduces the pressures on the wall.

In conclusion, the author recommends using a minimum embedment depth of 8 ft. below the cut line. The socket tip elevation shown in Table 2.0 is based on this depth. Table 2.0 provides just a sample of pile sizes and shapes available, additional piles can be analyzed upon request. The recommended pile size, HP10x42, with the anchor meets the criteria of less than 1 inch of movement. Please see the results of our analysis at the end of the attachments of this report. These results should be confirmed by the design engineer as additional details of the project become more evident during Phase II of the project.

Calculate the estimated water surface elevation and determine the need for cofferdams (type 1 or 2), and seal coat: The estimated water surface elevation is just above the flowline of the existing culvert. With the soldier pile wingwalls being a top down construction method and the work being away from the end of the culvert, cofferdams are not expected to be used, therefore neither a type 1 or 2 cofferdam selection was made for this report.

Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns: If soil retention is deemed necessary the pay item "Temporary Soil Retention System" should be utilized because the bedrock is so shallow.

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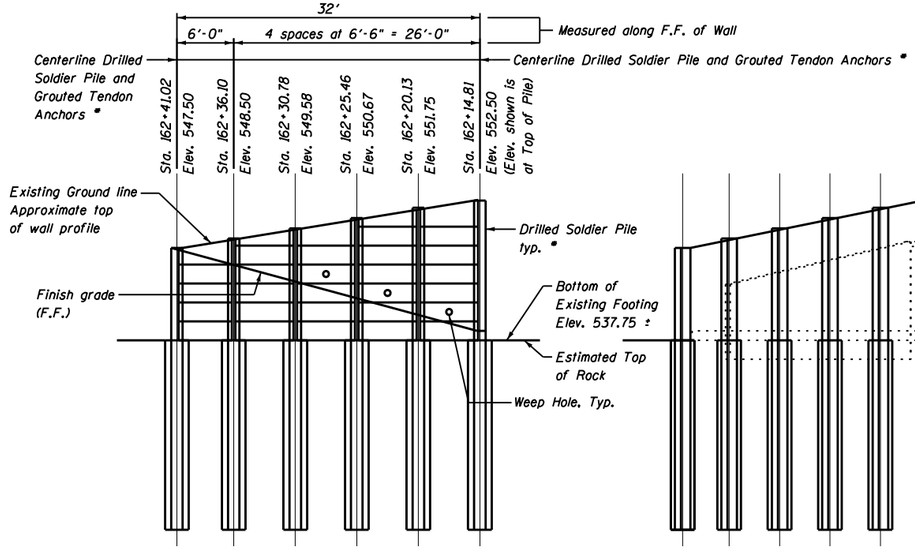
Peru, IL 61354
terry@mcclearyengineering.com
Office Phone: (815) 780-8486

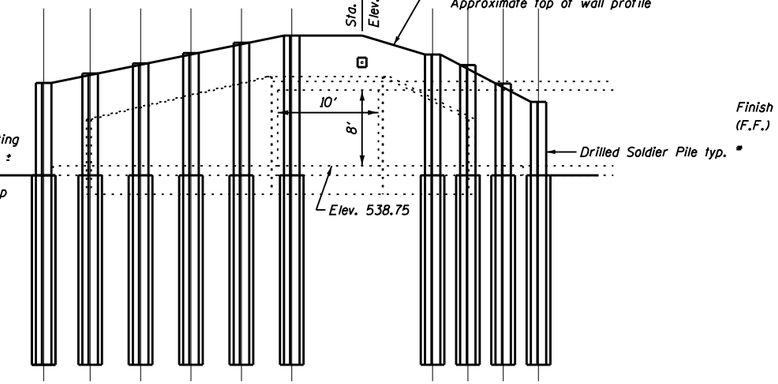
BENCHMARK 1
CHISELED SQUARE TOP OF WALL
SOUTH OF CONTROL POINT 251511
Sta 170+01.86
36.3502 LT.
N 1700365.8430
E 768236.4840
ELEV. 586.78

Existing Structure:
10'x8' Cast-in-place Concrete Box Culvert SN 050-2524
Section 1Z
Built 1961
374' Between Headwalls
Variable Wall and Slab Thicknesses
20° Lt Fwd Skew

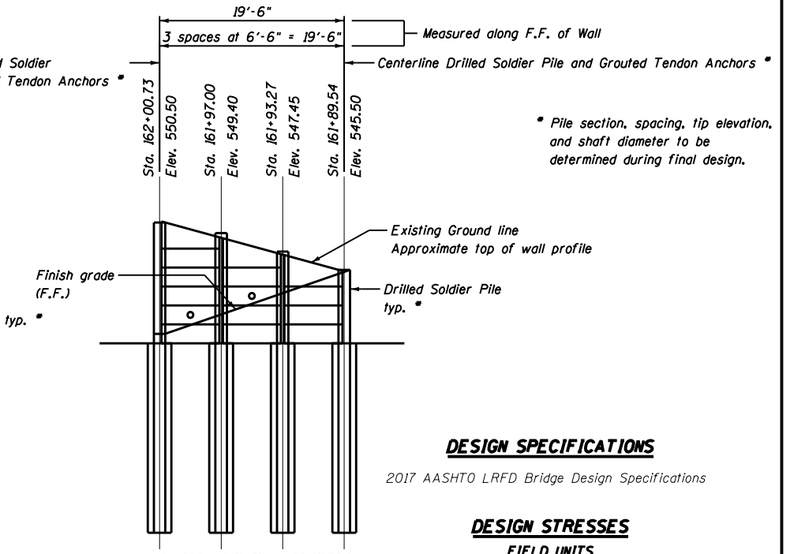
Traffic Control:
Outside Lane Closure



ELEVATION SOUTH WALL
(Looking at F.F. of wall)
(Looking Southwest)



ELEVATION
(Looking at F.F. of wall)
(Looking West)



ELEVATION NORTH WALL
(Looking at F.F. of wall)
(Looking Northwest)

* Pile section, spacing, tip elevation, and shaft diameter to be determined during final design.

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications

DESIGN STRESSES

FIELD UNITS

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

EXISTING

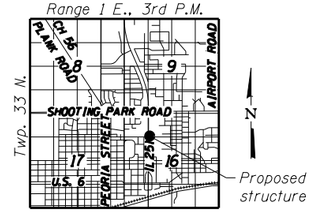
fs = 20,000 psi (Reinforcement)
fc = 1,400 psi (Barrel)
fc = 1,000 psi (Wing Walls)

PRECAST UNITS

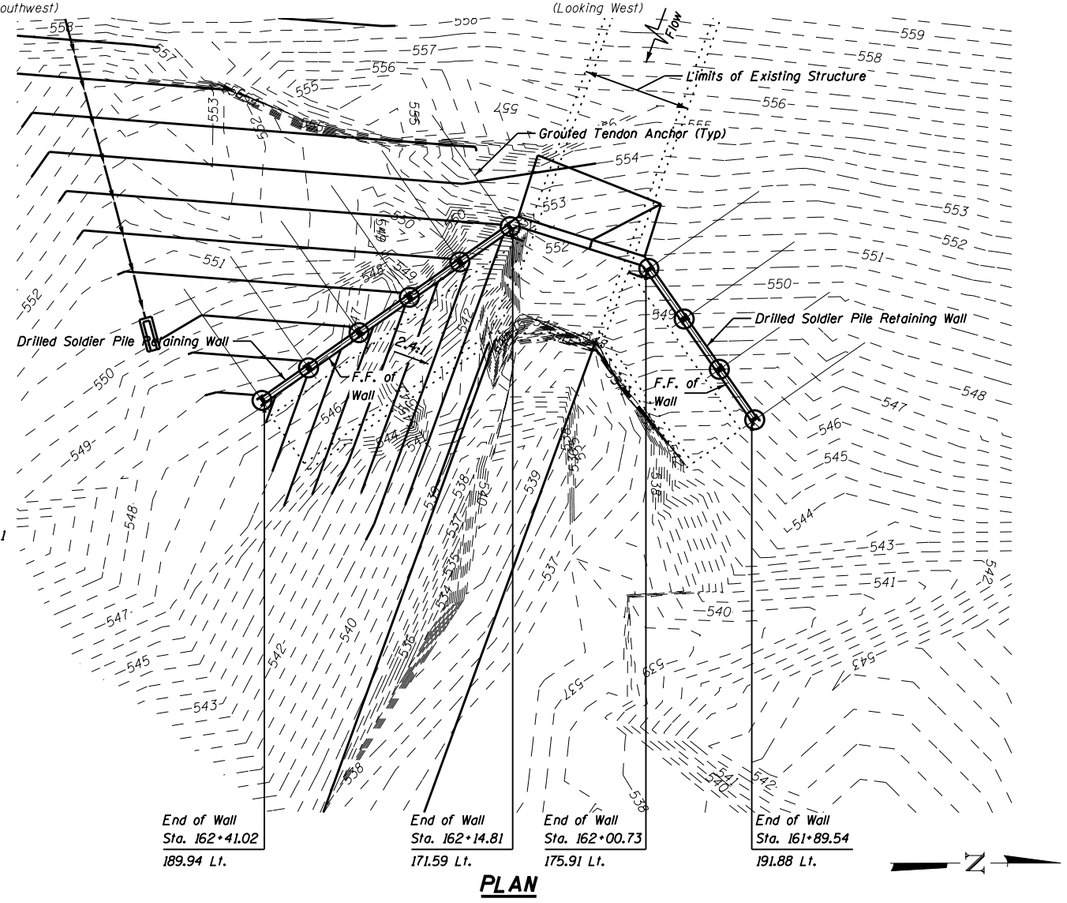
f'c = 6,000 psi
fy = 60,000 psi (Reinforcement)

HIGHWAY CLASSIFICATION

F.A.P. 46 - IL 251
Functional Class: Other Principal Arterial
ADT: 8050 (2015); 10600 (2038)
DHV: .084
Design Speed: 45 m.p.h.
Posted Speed: 45 m.p.h.



LOCATION SKETCH



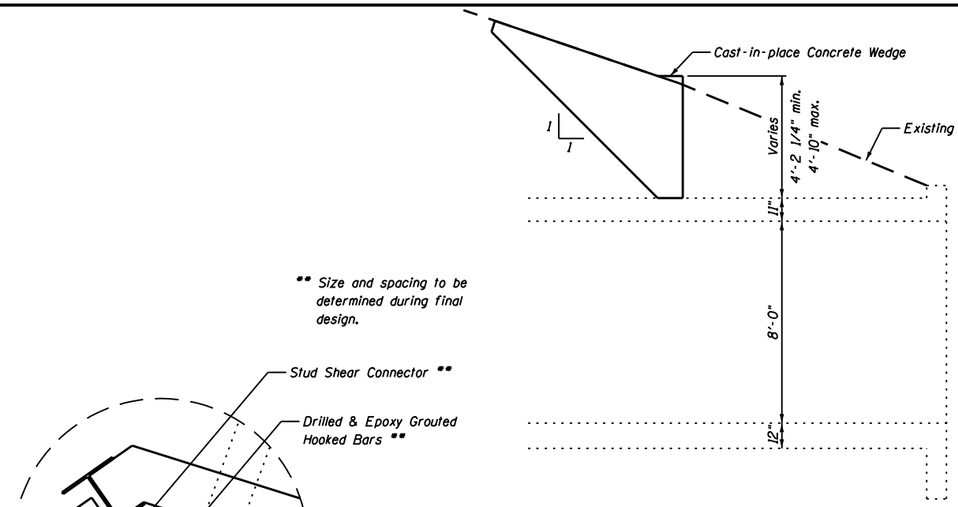
Offsets are measured from Baseline IL 251 to front face of wall.
F.F. - Front Face

PLAN

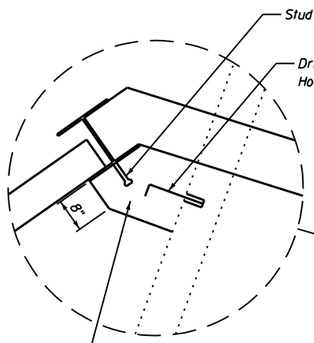
GENERAL PLAN & ELEVATION
IL ROUTE 251
F.A.P. 46
SECTION (1)I-2
LASALLE COUNTY
STATION 161+89.54 TO 162+41.02
STRUCTURE NO. 050-8802

FILE NAME = D366F12-sht-TSL-CULVERT.dgn	USER NAME = CHAMLIN	DESIGNED JKC	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION		F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
CHAMLIN & ASSOCIATES, INC.		DRAWN LAG	REVISED -			46	(1)I-2	LaSalle		
	PLOT SCALE = $SCALE$	CHECKED JKC	REVISED -					CONTRACT NO. 66F12		
	PLOT DATE = $DATE$	DATE 7/5/18	REVISED -		SCALE: 1"=8' SHEET 1 OF 2 SHEETS STA. 162+23.20 TO STA. 163+64.00		ILLINOIS FED. AID PROJECT			

D366F12-sht-TSL-CULVERT.dgn 7/9/2018 9:19:46 AM User=angel

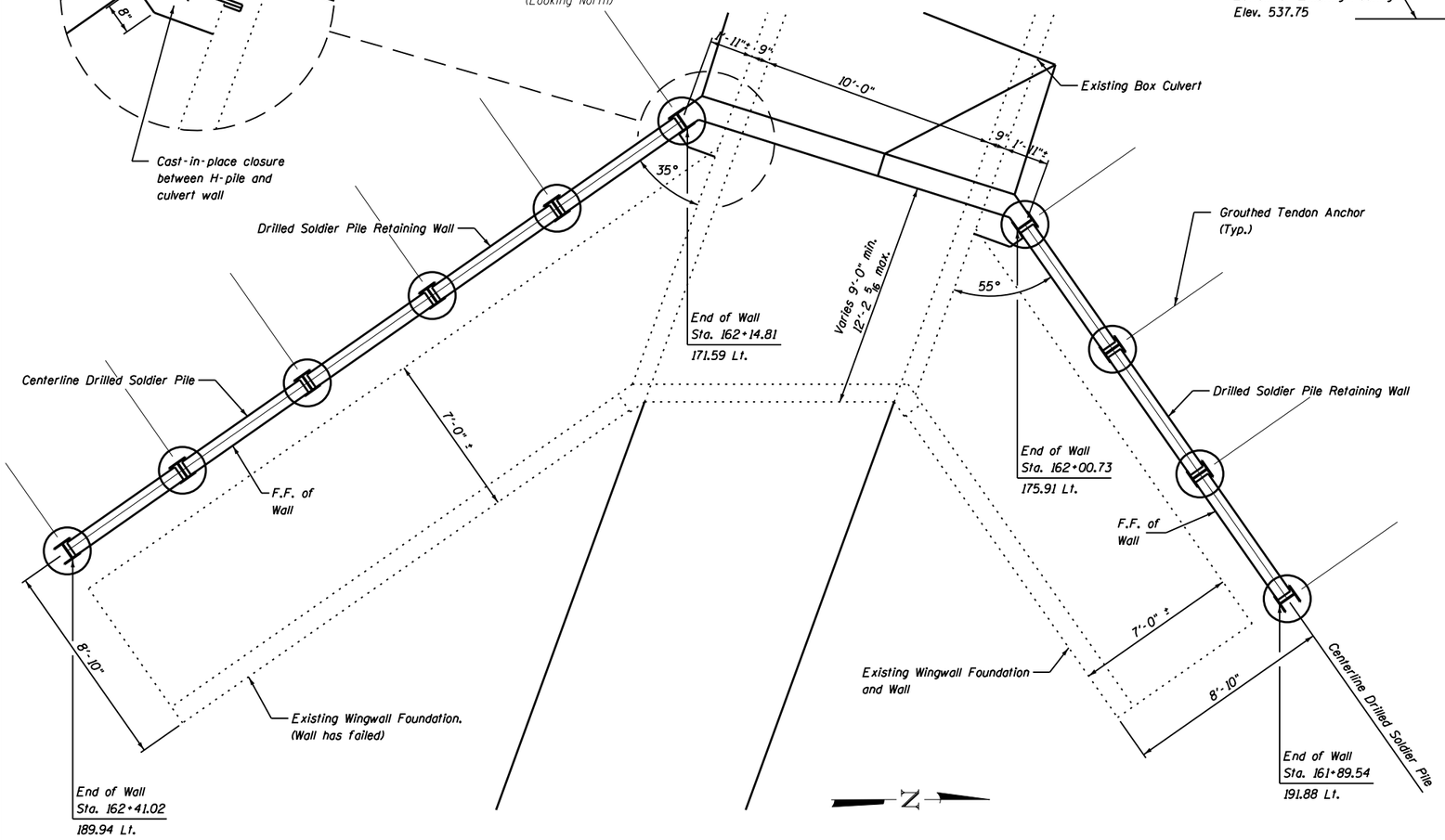


** Size and spacing to be determined during final design.

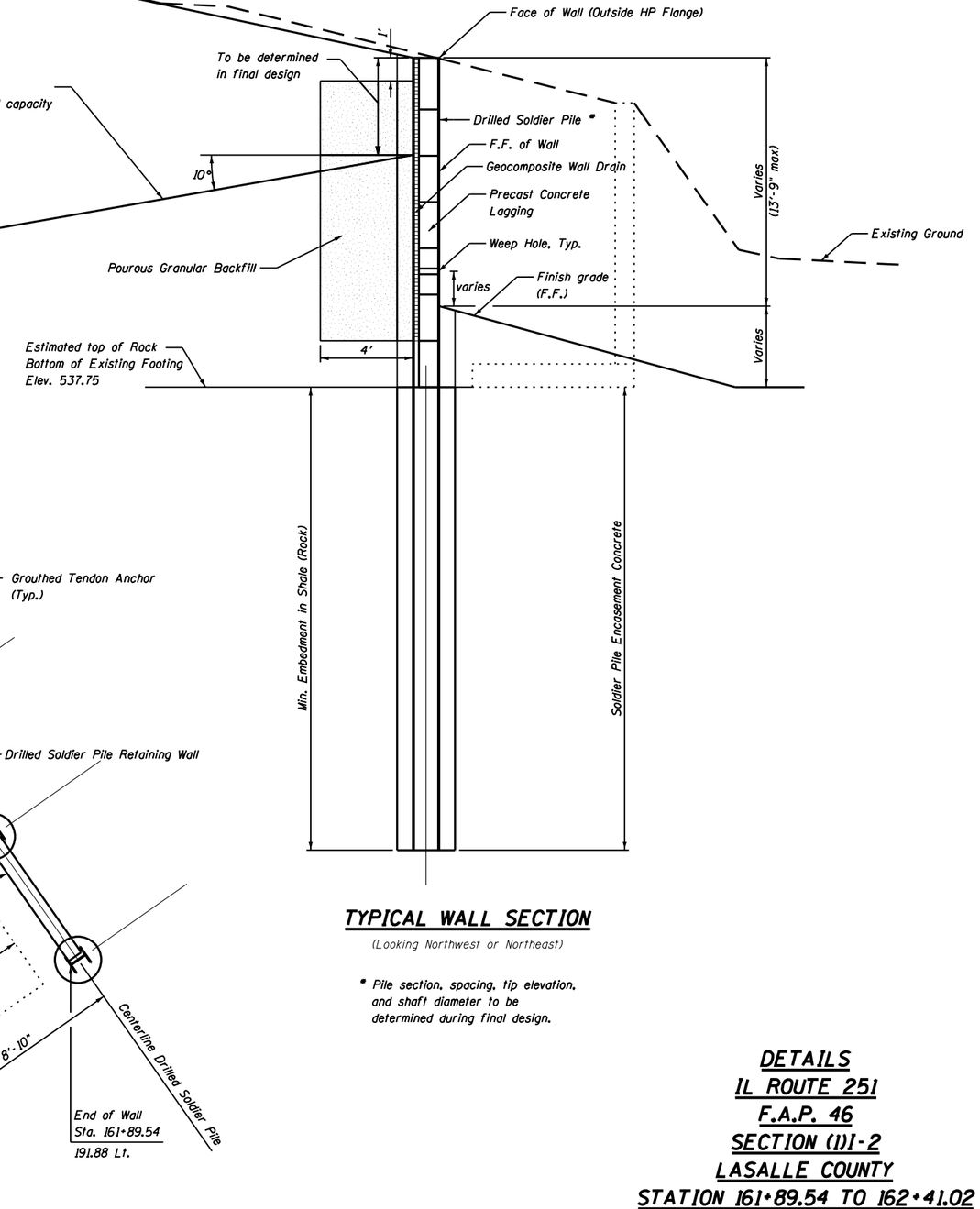


WALL SECTION ABOVE BOX CULVERT

(Looking North)



PLAN



TYPICAL WALL SECTION

(Looking Northwest or Northeast)

* Pile section, spacing, tip elevation, and shaft diameter to be determined during final design.

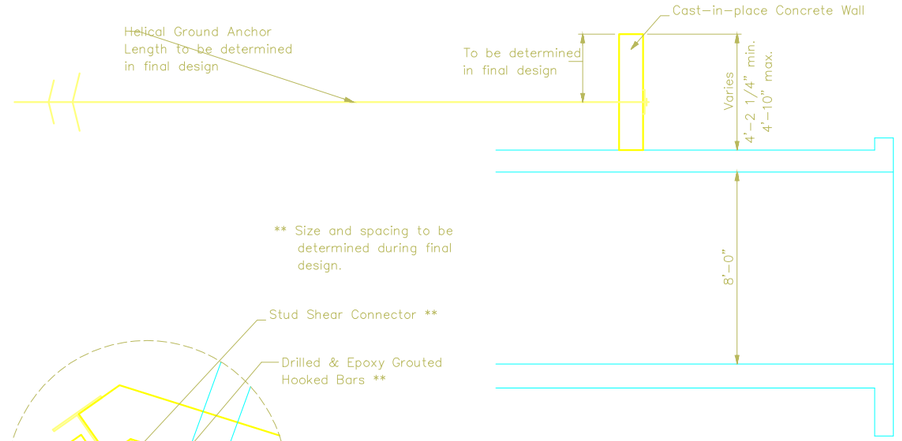
DETAILS
IL ROUTE 251
F.A.P. 46
SECTION (1)I-2
LASALLE COUNTY
STATION 161+89.54 TO 162+41.02
STRUCTURE NO. 050-8802

FILE NAME = D366F12-sht-TSL-CULVERT-DETAIL.dgn	USER NAME = CHAMLIN	DESIGNED JKC	REVISED -
CHAMLIN & ASSOCIATES, INC.		DRAWN LAG	REVISED -
	PLOT SCALE = $SCALE$	CHECKED JKC	REVISED -
	PLOT DATE = $DATE$	DATE 7/5/18	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

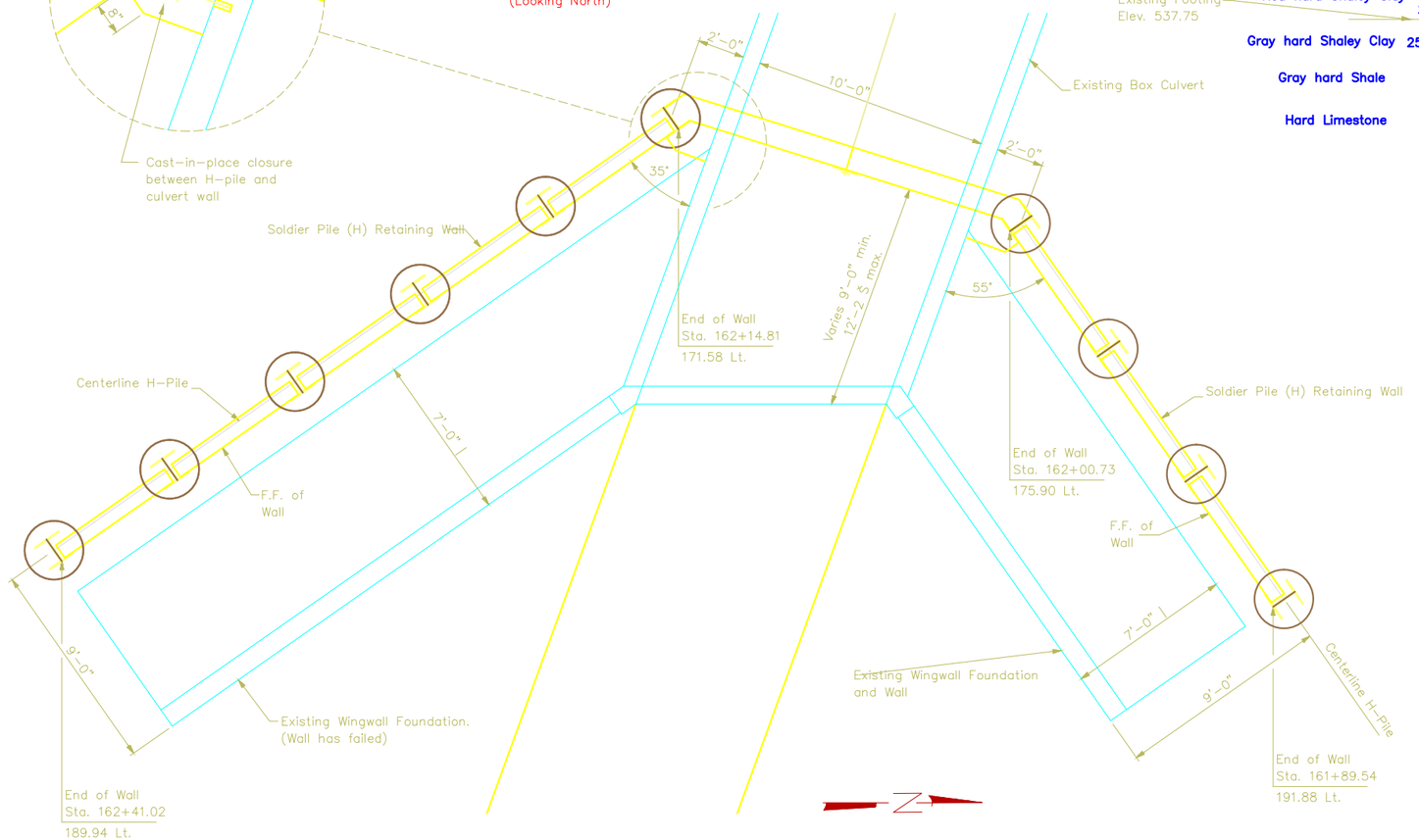
SCALE: 1"=8' | SHEET 2 OF 2 SHEETS | STA. 162+23.20 TO STA. 163+64.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
46	(1)I-2	LaSalle		
		CONTRACT NO. 66F12		
	ILLINOIS FED. AID PROJECT			

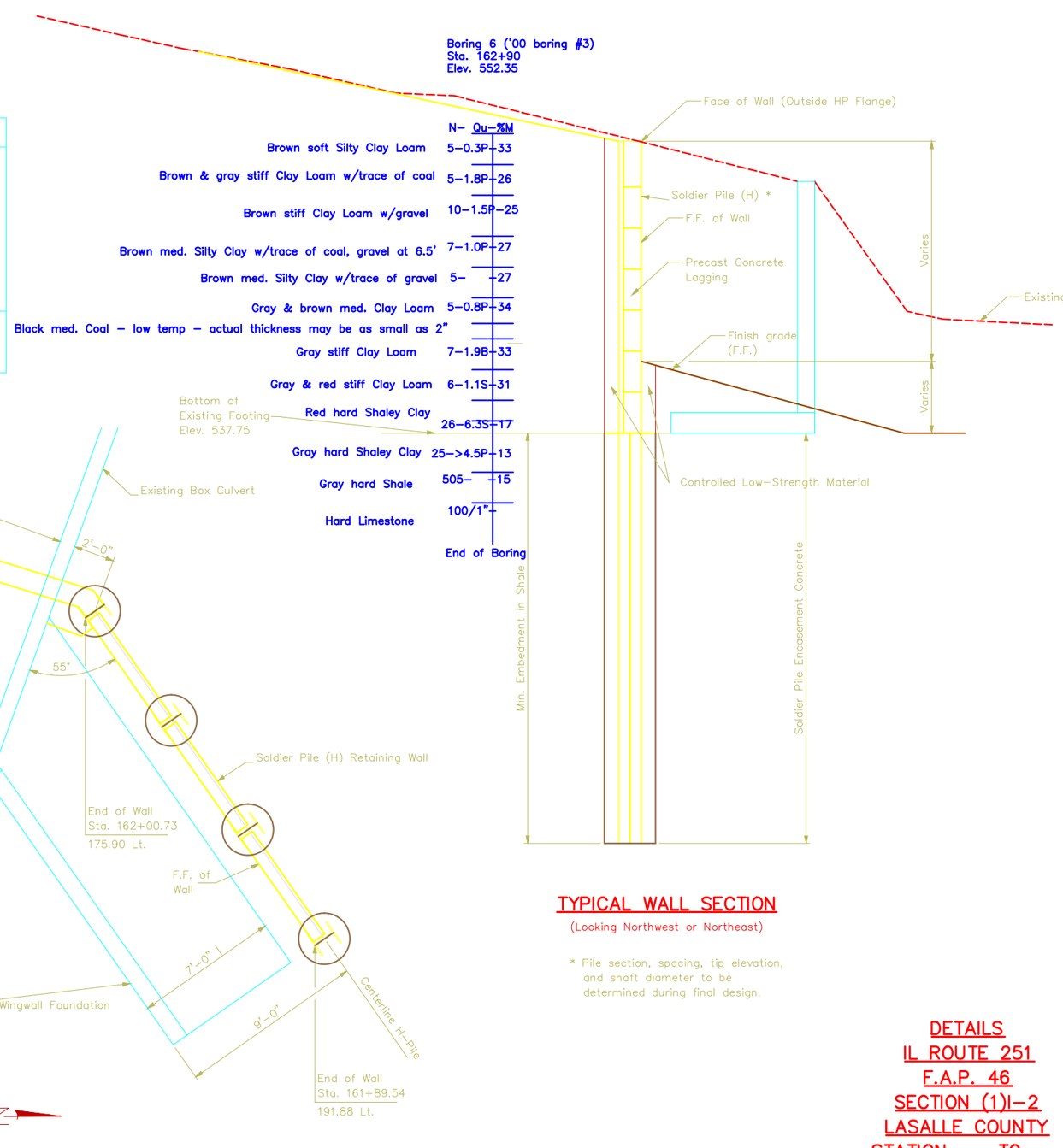


WALL SECTION ABOVE BOX CULVERT

(Looking North)



PLAN



TYPICAL WALL SECTION

(Looking Northwest or Northeast)

* Pile section, spacing, tip elevation, and shaft diameter to be determined during final design.

DETAILS
IL ROUTE 251
F.A.P. 46
SECTION (1)I-2
LASALLE COUNTY
STATION __ TO __
STRUCTURE NO. 050-8802

FILE NAME = D366F12-sht-TSL.dgn	USER NAME = CHAMLIN	DESIGNED - ___	REVISED - ___	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION			
CHAMLIN & ASSOCIATES, INC.		DRAWN - ___	REVISED - ___				
	PLOT SCALE = $SCALE$	CHECKED - ___	REVISED - ___				
	PLOT DATE = $DATE$	DATE - ___	REVISED - ___				

SCALE: 1"=8'	SHEET 2 OF 2 SHEETS	STA. 162+23.20 TO STA. 163+64.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
46	(1)I-2	LaSalle	___	___
		CONTRACT NO. 66F12		
	ILLINOIS	FED. AID PROJECT		

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 6/22/00

ROUTE FA 46 (IL 251) **DESCRIPTION** IL 251 North Bound Slope Failure South of Shooting Park Road in Peru **LOGGED BY** DPS

SECTION (1)I **LOCATION** NW 1/4, **SEC.** 16, **TWP.** 33N, **RNG.** 1E, 3rd **PM**,
Latitude , **Longitude**

COUNTY LaSalle **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE**

STRUCT. NO.
Station

BORING NO. 6 ('00 Boring #3)
Station 162+90 ***
Offset 190.0 ft Lt. ***
Ground Surface Elev. 552.35 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter ft
Upon Completion * ft
After 24 **Hrs.** ** ft

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Brown Soft Silty Clay Loam			2		
			2	0.3	33
	550.85		3	P	
Brown & Gray Stiff Clay Loam with trace of Coal			2		
			3	1.8	26
	549.35		2	P	
Brown Stiff Clay Loam with Gravel			2		
			2	1.5	25
			4	P	
	547.35	-5	4		
Brown Medium Silty Clay with trace of Coal, Gravel at 6.5'			2		
			2	1.0	27
	545.85		5	P	
Brown Medium Silty Clay with trace of Gravel			2		
			2		27
	544.35		3		
Gray & Brown Medium Clay Loam			1		
			2	0.8	34
	543.02		3	B	
Black Medium Coal - Low Temp - Actual thickness of Coal may be as small as 2"	542.35	-10	4		
					115
			2		
Gray Stiff Clay Loam			2	1.9	33
	540.85		5	B	
Gray & Red Stiff Clay Loam			1		
			2	1.1	31
	539.35		4	S	
Red Hard Shaley Clay			5		
	538.35		11	6.3	17
Gray Hard Shaley Clay			15	S	
		-15	19	6.9	17
			8	S	
			17	>4.5	13
	535.85		52	P	
Gray Hard Shale			11		
			19		15
	534.35		81/1"		
Hard Limestone * Hole Collapsed at 15.0 Ft. at Completion. No Groundwater above this point.			100/0"		
		-20			

** At 24 hours, no Groundwater above top of hole collapse at 15.0 Ft.

*** Station and Offset estimated from notes in file and 2016 survey data.
End of Boring

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
-25			
-30			
-35			
-40			

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

BBS, form 137 (Rev. 8-99)

SOIL BORING IL 251 NBL SLIDE.GPJ IL_DOT.GDT 11/6/17

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 4/14/62

ROUTE FA 46 (IL 251) **DESCRIPTION** IL 251 North Bound Slope Failure South of Shooting Park Road in Peru **LOGGED BY**

SECTION (1)I **LOCATION** NW 1/4, **SEC.** 16, **TWP.** 33N, **RNG.** 1E, 3rd **PM**,
Latitude , **Longitude**

COUNTY LaSalle **DRILLING METHOD** Hand Auger **HAMMER TYPE**

STRUCT. NO. 050-2524
Station 161+47

BORING NO. 20 ('62 Boring #6)
Station 161+57
Offset 202.0 ft Lt.
Ground Surface Elev. 547.10 ft

Surface Water Elev. ft
Stream Bed Elev. ft

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

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Soil Type Not Recorded				
546.10				
Reddish Brown & Gray Clay				27
545.10				
Reddish Brown Clay				28
544.10				
Reddish Brown & Gray Clay				26
				26
	-5			
				33
541.10				
Reddish Brown Clay				26
				28
539.30				
Reddish Brown & Gray Clay 538.80				27
Sampled with Iwan type Auger from behind South East Wingwall				
Top of Headwall Elevation = 548.42	-10			
End of Boring				
	-15			
	-20			

SOIL BORING IL 251 NBL SLIDE.GPJ IL_DOT.GDT 11/6/17

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)

Mc Cleary Engineering
3705 Progress Blvd
Peru, Il 61354
815 780-8486

SOIL BORING LOG

Solutions You Can Build On

Date 9/6/17

ROUTE IL 251 **DESCRIPTION** IL 251 NB Slope failure sout of Shooting Park Rd. in Peru **LOGGED BY** TLM

SECTION (1)I-2 **LOCATION** South 1/2, **SEC.** 16, **TWP.** T33N, **RNG.** R1E,
Latitude 41.334518, **Longitude** -89.119649

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

STRUCT. NO. _____
Station _____

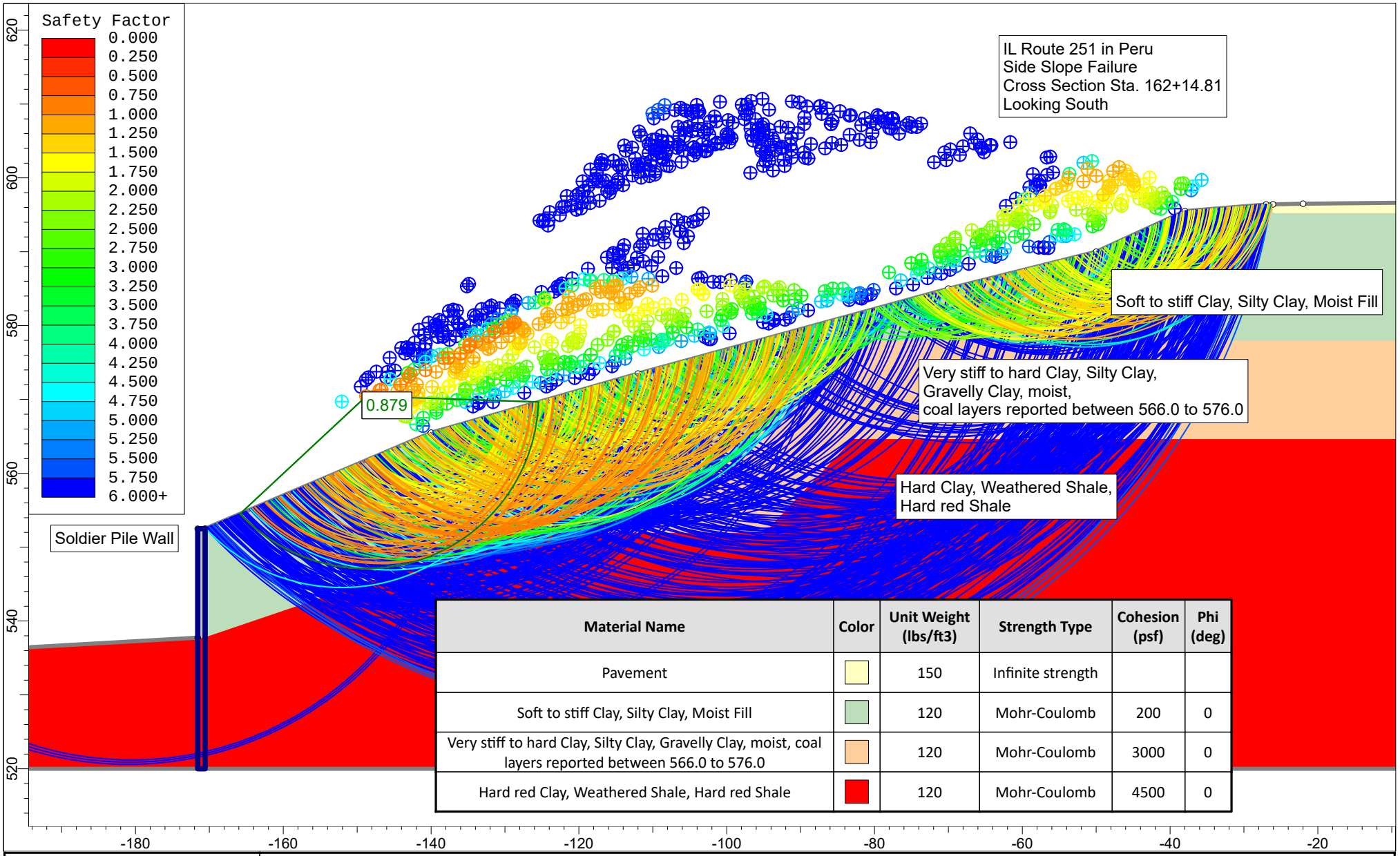
BORING NO. I-4
Station 162+92.8
Offset 157.4 ft Lt.
Ground Surface Elev. 566.08 ft

Surface Water Elev. _____ ft
Stream Bed Elev. _____ ft

Groundwater Elev.:
First Encounter _____ ft
Upon Completion dry ft
After _____ **Hrs.** dry ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Med. stiff to soft red/brown/black Clay (recent fill) moist		4		
		2 1		26
563.08				
Med. stiff gray Clay, moist, trace gravel		7		
		3 5	0.8 B	25
560.58	-5			
Hard red Clay, moist (likely weathered Shale)		4		
		5 6	4.5 P	18
		6		
		8 13	3.5,+4.5 S,P	13
	-10			
		16		
		21 39	3.7 S	11
		20		
		38 54	4.5 P	10
	-15			
		21		
		52 104	4.5 P	10
548.08				
End of Boring				
	-20			

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



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Pavement		150	Infinite strength		
Soft to stiff Clay, Silty Clay, Moist Fill		120	Mohr-Coulomb	200	0
Very stiff to hard Clay, Silty Clay, Gravelly Clay, moist, coal layers reported between 566.0 to 576.0		120	Mohr-Coulomb	3000	0
Hard red Clay, Weathered Shale, Hard red Shale		120	Mohr-Coulomb	4500	0

McCleary Engineering

SLIDEINTERPRET 6.039

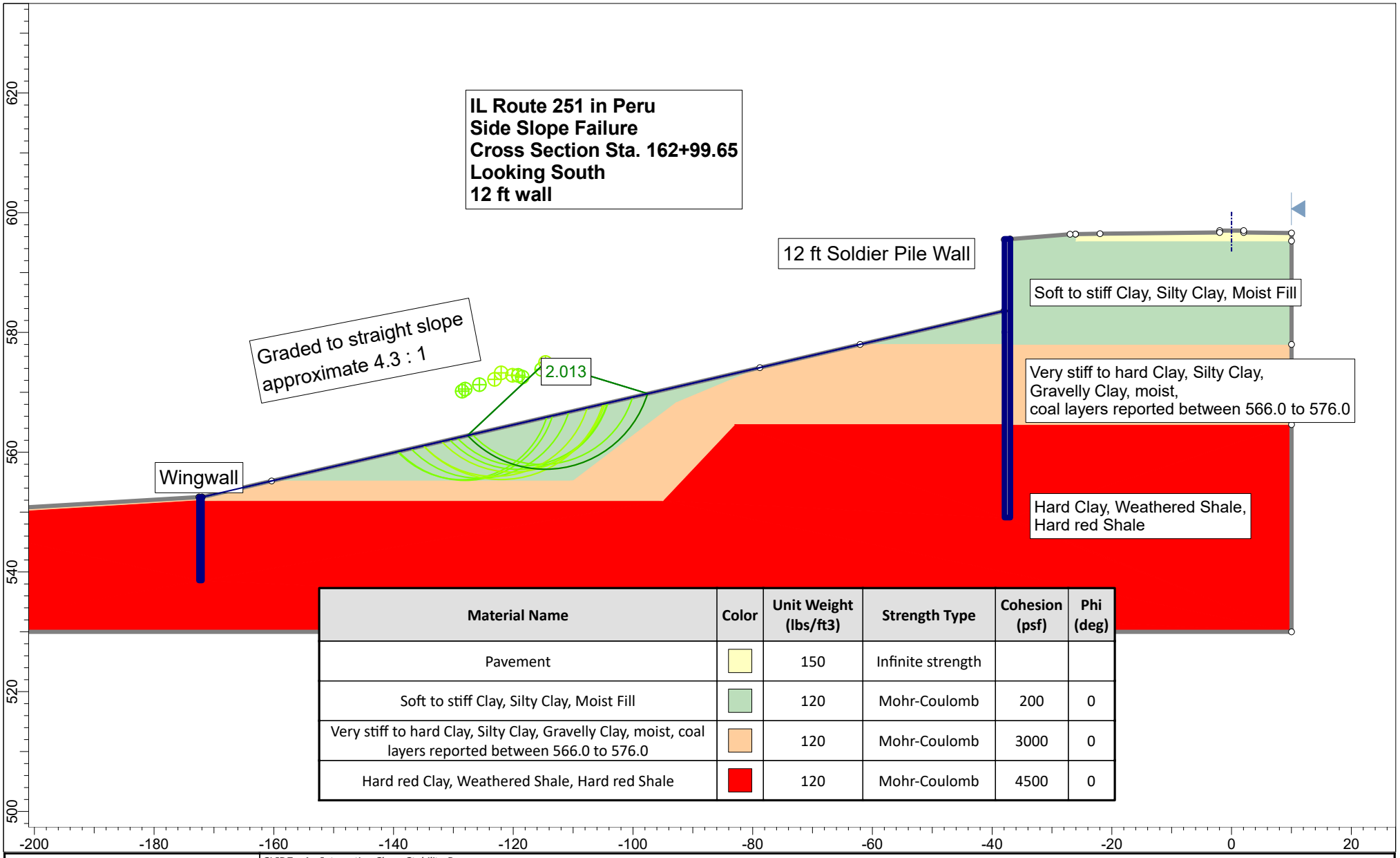
SLIDE - An Interactive Slope Stability Program

IL 251 Proposed Soldier Pile Wall SN 050-8802

Analysis Description: IL 251 SN 050-8802 - UnDrained Conditions - dwg.slim Slope Analysis

Drawn By: MJ | *Scale*: 1:215 | *Company*: McCleary Engineering

Date: 11/10/2017, 1:32:14 PM | *File Name*: IL 251 SN 050-8802 - UnDrained Conditions - dwg.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Pavement		150	Infinite strength		
Soft to stiff Clay, Silty Clay, Moist Fill		120	Mohr-Coulomb	200	0
Very stiff to hard Clay, Silty Clay, Gravelly Clay, moist, coal layers reported between 566.0 to 576.0		120	Mohr-Coulomb	3000	0
Hard red Clay, Weathered Shale, Hard red Shale		120	Mohr-Coulomb	4500	0

McCleary Engineering

SLIDEINTERPRET 6.039

SLIDE - An Interactive Slope Stability Program

IL 25 in Peru Slope Stability Analysis

Analysis Description: IL 251 SN 050-8801 UnDrained Conditions- 12 ft wall dwg.slim Slope Analysis

Drawn By: MJ | *Scale*: 1:266 | *Company*: McCleary Engineering

Date: 11/10/2017, 1:32:14 PM | *File Name*: IL 251 SN 050-8801 UnDrained Conditions- 12 ft wall dwg.slim

Illinois Department of Transportation

SEISMIC SITE CLASS DETERMINATION

PROJECT TITLE=====IL 251 Wingwalls 050-8802

Substructure 1

Base of Substruct. Elev. (or ground surf for bents)	537.5	ft.
Pile or Shaft Dia.	24	inches
Boring Number	6 (2000)	
Top of Boring Elev.	552.35	ft.
Approximate Fixity Elev.	525.5	ft.

Individual Site Class Definition:

N (bar): 100 (Blows/ft.) Soil Site Class C <----Controls
N_{ch} (bar): (Blows/ft.) NA
s_u (bar): 5 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	550.9	1.50	5	0.30	b
	549.4	1.50	5	1.80	
	547.9	1.50	6	1.50	
	546.4	1.50	7	1.00	
	544.9	1.50	5	1.00	
	543.4	1.50	5	0.80	
	541.9	1.50	7	1.90	
	540.4	1.50	6	1.10	b
	539.4	1.00	16	6.30	
	538.4	1.00	27	6.60	
	537.9	0.50	52	7.00	b
100.0	425.6	112.30	600	5.00	

Substructure 2

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

Individual Site Class Definition:

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

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

Substructure 3

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

Individual Site Class Definition:

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

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

Substructure 4

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

Individual Site Class Definition:

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

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

Global Site Class Definition:

N (bar): 100 (Blows/ft.) Soil Site Class C <----Controls
N_{ch} (bar): (Blows/ft.) NA
s_u (bar): 5 (ksf) Soil Site Class C <----Controls

USGS Design Maps Summary Report

User–Specified Input

Report Title SN050-8801
Fri February 16, 2018 23:45:05 UTC

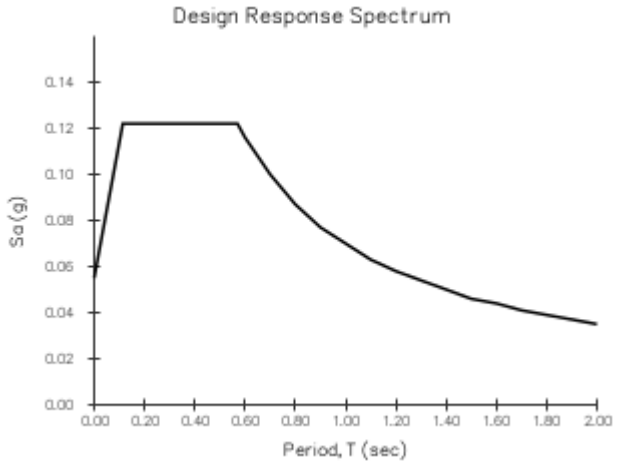
Building Code Reference Document 2009 AASHTO Guide Specifications for LRFD Seismic Bridge Design
(which utilizes USGS hazard data available in 2002)

Site Coordinates 41.33481°N, 89.12006°W

Site Soil Classification Site Class C – "Very Dense Soil and Soft Rock"

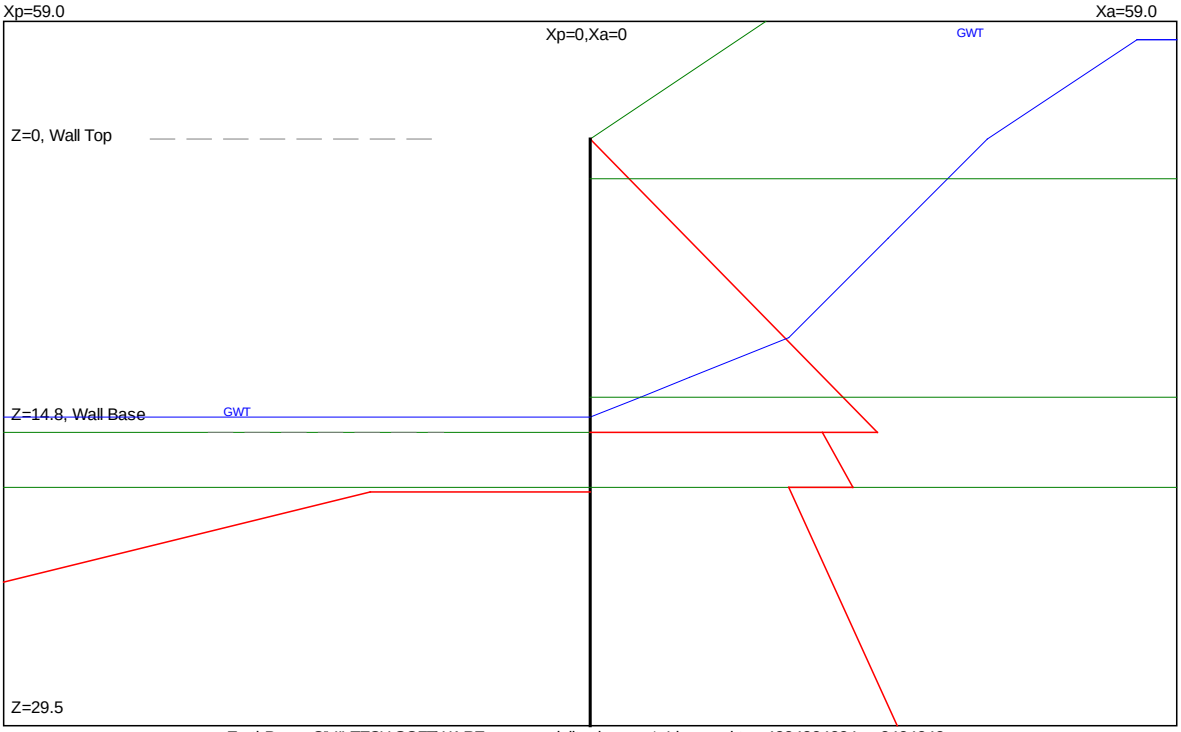
USGS–Provided Output

PGA =	0.046 g	**A_s =**	0.055 g
S_S =	0.102 g	**S_{DS} =**	0.122 g
S_1 =	0.041 g	**S_{D1} =**	0.070 g



IL 251 Soldier Pile Wall

South Wingwall (Trapezoid Envelope)



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

/9/2018 File: C:\Users\User\Downloads\Upload Files to ShareFile (to be deleted)\IL 251 Soldier Pile Wing Wall SGR\IL 251 South Soldier Pile Wingwall 14.75 ft. tall.ep

* INPUT DATA *

Wall Height=14.8 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	105.2	115.8	20	0.0	2	2	Soft Clay
2	120.0	130.0	27.95	0.0	10	2	Stiff Clay
3	130.0	142.0	33.95	0.0	25	2	Very Stiff S
4	137.0	150.0	40	0.0	60	1	Eq. Clay

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-266.0	800.0	1	Soft Clay
2	2.0	0.0	2.0	800.0	2	Stiff Clay
3	13.0	0.0	13.0	800.0	3	Very Stiff S
4	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Active Side:

Point	Z-water	X-water
1	14.0	0.0
2	13.0	5.0
3	12.0	10.0
4	10.0	20.0
5	5.0	30.0
6	0.0	40.0
7	-5.0	55.0
8	-10.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	14.8	0.0	14.8	800.0	3	Very Stiff S
2	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Passive Side:

Point	Z-water	X-water
1	14.0	0.0
2	14.0	800.0

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 2. Seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 7.89 per one linear foot (or meter) width along wall height
Total Static Force above Base= 7.89. Distributed in Triangular Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	14.75	1.07	0.0725	0.6895

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
14.75	0.87	17.50	0.98	0.0427	0.5358
17.50	0.74	29.50	1.15	0.0338	0.3855

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 0.75

Z1	Pp1	Z2	Pp2	Slope	Kp
17.75	0.82	29.50	4.38	0.303	3.4550

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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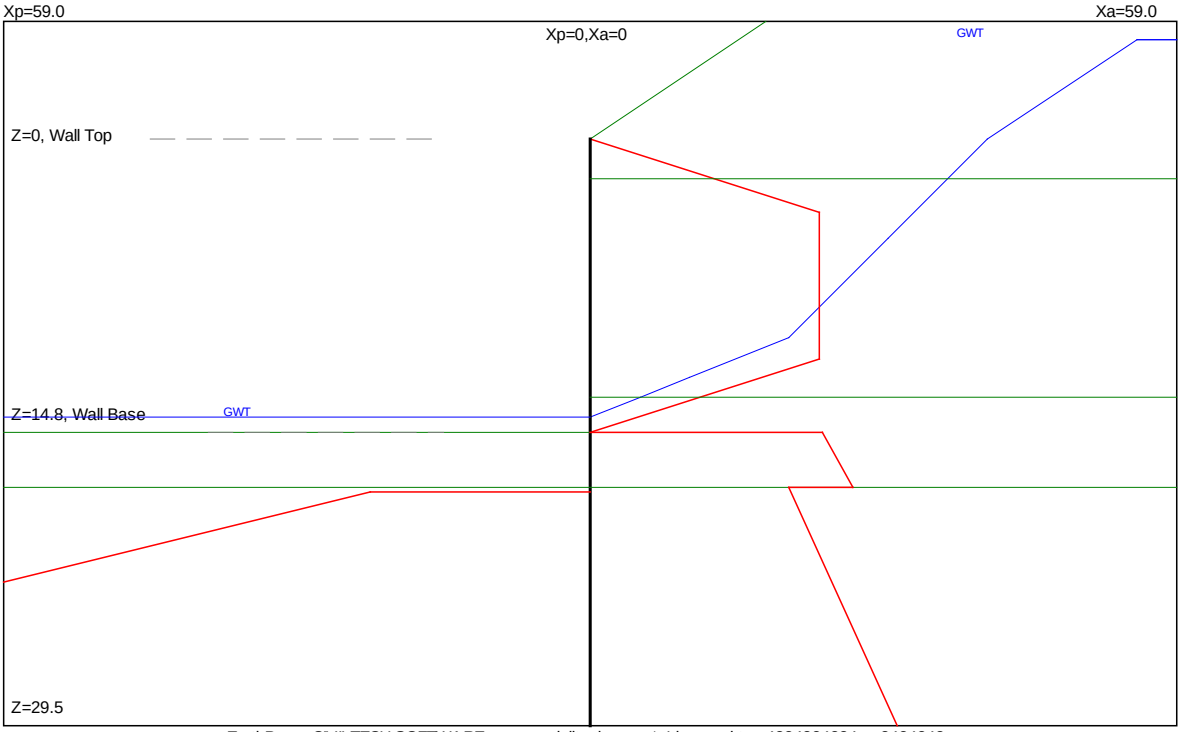
IL 251 Soldier Pile Wall

South Wingwall (Trapezoid Envelope)



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

/9/2018 File: C:\Users\User\Downloads\Upload Files to ShareFile (to be deleted)\IL 251 Soldier Pile Wing Wall SGR\IL 251 South Soldier Pile Wingwall 14.75 ft. tall.ep

* INPUT DATA *

Wall Height=14.8 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	105.2	115.8	20	0.0	2	2	Soft Clay
2	120.0	130.0	27.95	0.0	10	2	Stiff Clay
3	130.0	142.0	33.95	0.0	25	2	Very Stiff S
4	137.0	150.0	40	0.0	60	1	Eq. Clay

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-266.0	800.0	1	Soft Clay
2	2.0	0.0	2.0	800.0	2	Stiff Clay
3	13.0	0.0	13.0	800.0	3	Very Stiff S
4	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Active Side:

Point	Z-water	X-water
1	14.0	0.0
2	13.0	5.0
3	12.0	10.0
4	10.0	20.0
5	5.0	30.0
6	0.0	40.0
7	-5.0	55.0
8	-10.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	14.8	0.0	14.8	800.0	3	Very Stiff S
2	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Passive Side:

Point	Z-water	X-water
1	14.0	0.0
2	14.0	800.0

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 2. Seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 7.89 per one linear foot (or meter) width along wall height
Total Static Force above Base= 7.89. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	3.69	0.86	0.2321	2.2065
3.69	0.86	11.06	0.86	0.0000	0.0000
11.06	0.86	14.75	0.00	-0.2321	-1.9344

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
14.75	0.87	17.50	0.98	0.0427	0.5358
17.50	0.74	29.50	1.15	0.0338	0.3855

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 0.75

Z1	Pp1	Z2	Pp2	Slope	Kp
17.75	0.82	29.50	4.38	0.303	3.4550

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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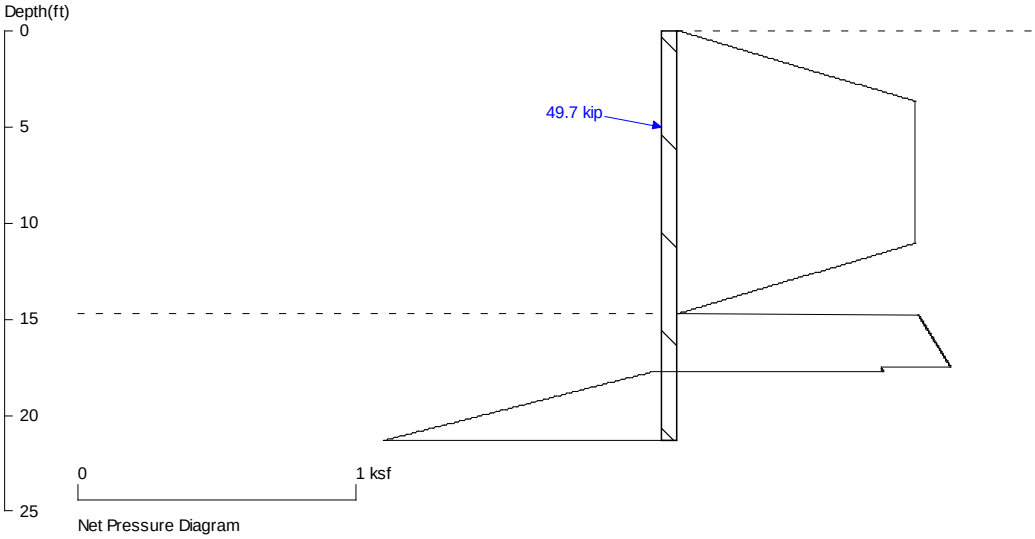
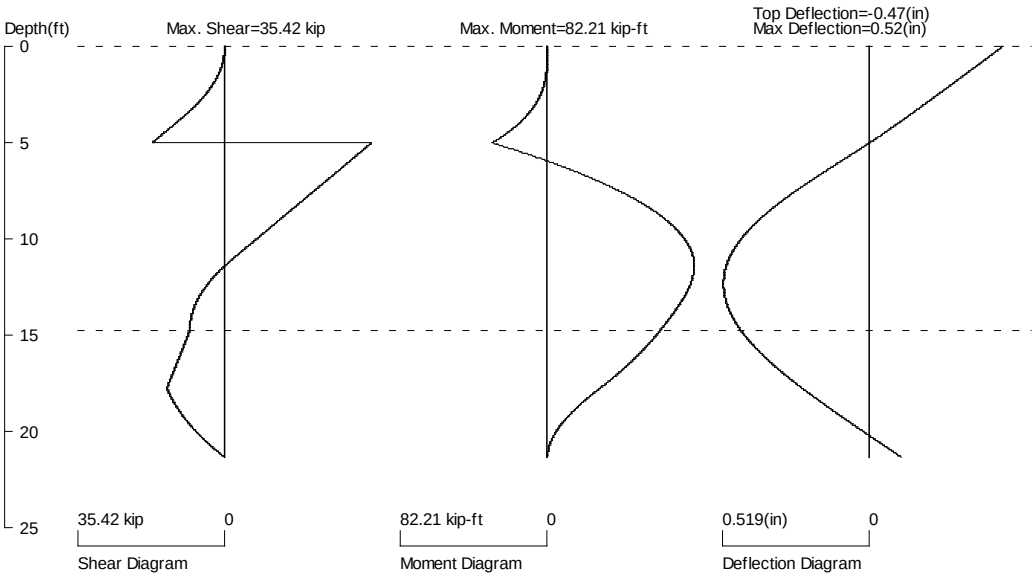
IL 251 Soldier Pile Wall

South Wingwall (Trapezoid Envelope)





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.5 foot or meter

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

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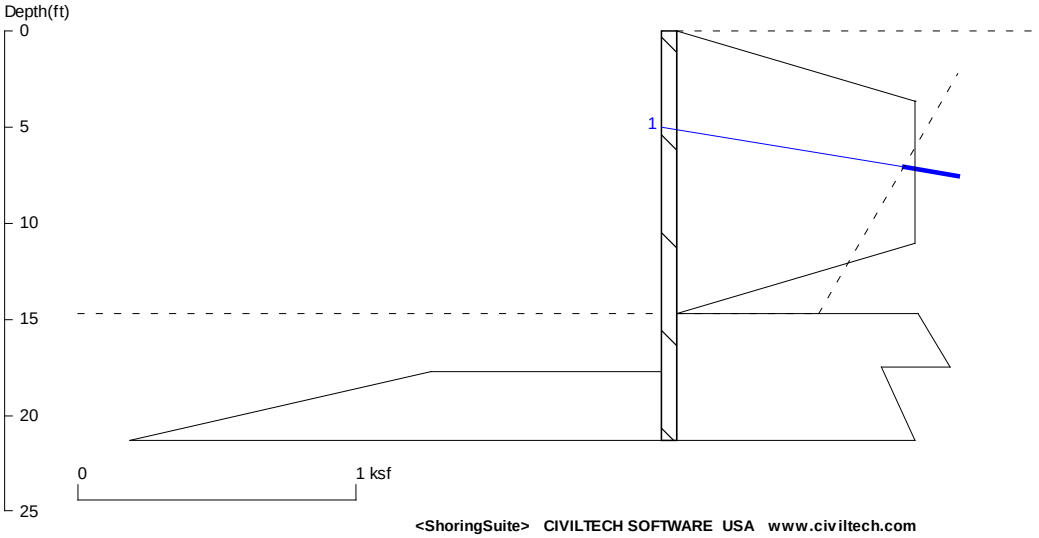
IL 251 Soldier Pile Wall

South Wingwall (Trapezoid Envelope)



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File: C:\Users\User\Downloads\Upload Files to ShareFile (to be deleted)\IL 251 Soldier Pile Wing Wall SGR\IL 251 South Sol

Wall Height=14.8 Pile Diameter=2.0 Pile Spacing=6.5 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=6.59 (8~10ft is recommended!!!) Min. Pile Length=21.34 (in graphics and analysis)
MOMENT IN PILE: Max. Moment=82.21 per Pile Spacing=6.5 at Depth=11.40

PILE SELECTION:
Request Min. Section Modulus = 24.9 in3/pile=408.24 cm3/pile, Fy= 60 ksi = 414 MPa, Fb/Fy=0.66
HP10X42 has Section Modulus = 43.4 in3/pile=711.20 cm3/pile. It is greater than Min. Requirements!
Top Deflection = -0.47(in) based on E (ksi)=29000.00 and I (in4)/pile=210.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	5.0	10.0	6.0	49.7	49.0	8.6	12.0	7.4

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	3.688	0.856	0.232124
3.688	0.856	11.06	0.856	0.000000
11.06	0.856	14.75	0.000	-0.23212
*	Below	Base		
14.75	0.866	17.50	0.983	0.042654
17.50	0.733	132.7	4.392	0.031753

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
17.75	0.829	132.7	35.55	0.301957

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	6.50
2	14.75	2.00

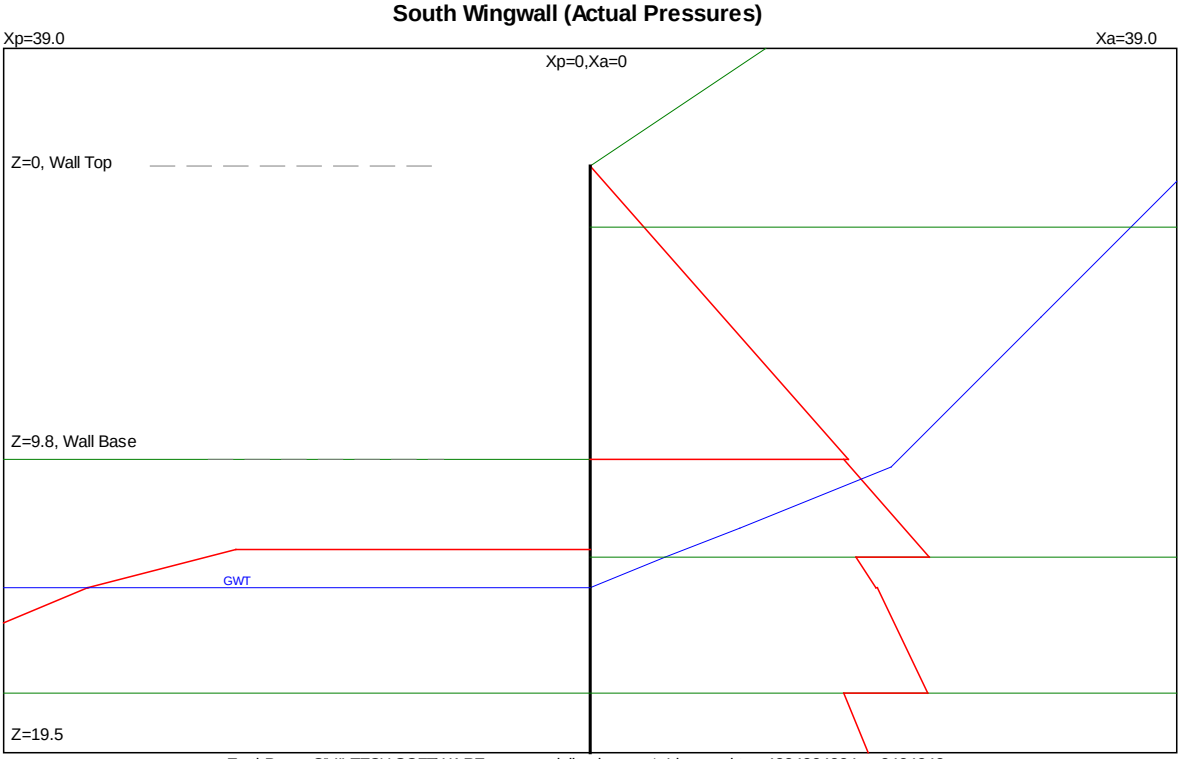
PASSIVE SPACING:

No.	Z depth	Spacing
1	14.75	4.00

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

IL 251 Soldier Pile Wall

South Wingwall (Actual Pressures)



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

7/9/2018 File: C:\Users\User\Downloads\Upload Files to ShareFile (to be deleted)\IL 251 Soldier Pile Wing Wall SGR\IL 251 South Soldier Pile Wingwall 9.75 ft. tall.ep8

* INPUT DATA *

Wall Height=9.8 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	105.2	115.8	20	0.0	2	2	Soft Clay
2	120.0	130.0	27.95	0.0	10	2	Stiff Clay
3	130.0	142.0	33.95	0.0	25	2	Very Stiff S
4	137.0	150.0	40	0.0	60	1	Eq. Clay

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-266.0	800.0	1	Soft Clay
2	2.0	0.0	2.0	800.0	2	Stiff Clay
3	13.0	0.0	13.0	800.0	3	Very Stiff S
4	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Active Side:

Point	Z-water	X-water
1	14.0	0.0
2	13.0	5.0
3	12.0	10.0
4	10.0	20.0
5	5.0	30.0
6	0.0	40.0
7	-5.0	55.0
8	-10.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	9.8	0.0	9.8	800.0	3	Very Stiff S
2	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Passive Side:

Point	Z-water	X-water
1	14.0	0.0
2	14.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 2. Seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 3.65 per one linear foot (or meter) width along wall height

Total Static Force above Base= 3.65. Distributed in Triangular Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	9.75	0.75	0.0768	0.7297

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
9.75	0.74	13.00	0.99	0.0760	0.6336
13.00	0.77	14.00	0.83	0.0578	0.4447
14.00	0.83	17.50	0.98	0.0427	0.5370
17.50	0.74	19.50	0.81	0.0354	0.4044

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 0.75

Z1	Pp1	Z2	Pp2	Slope	Kp
12.75	1.03	14.00	1.46	0.344	2.6455
14.00	1.46	17.50	2.20	0.211	2.6455
17.50	2.78	19.50	3.41	0.318	3.6280

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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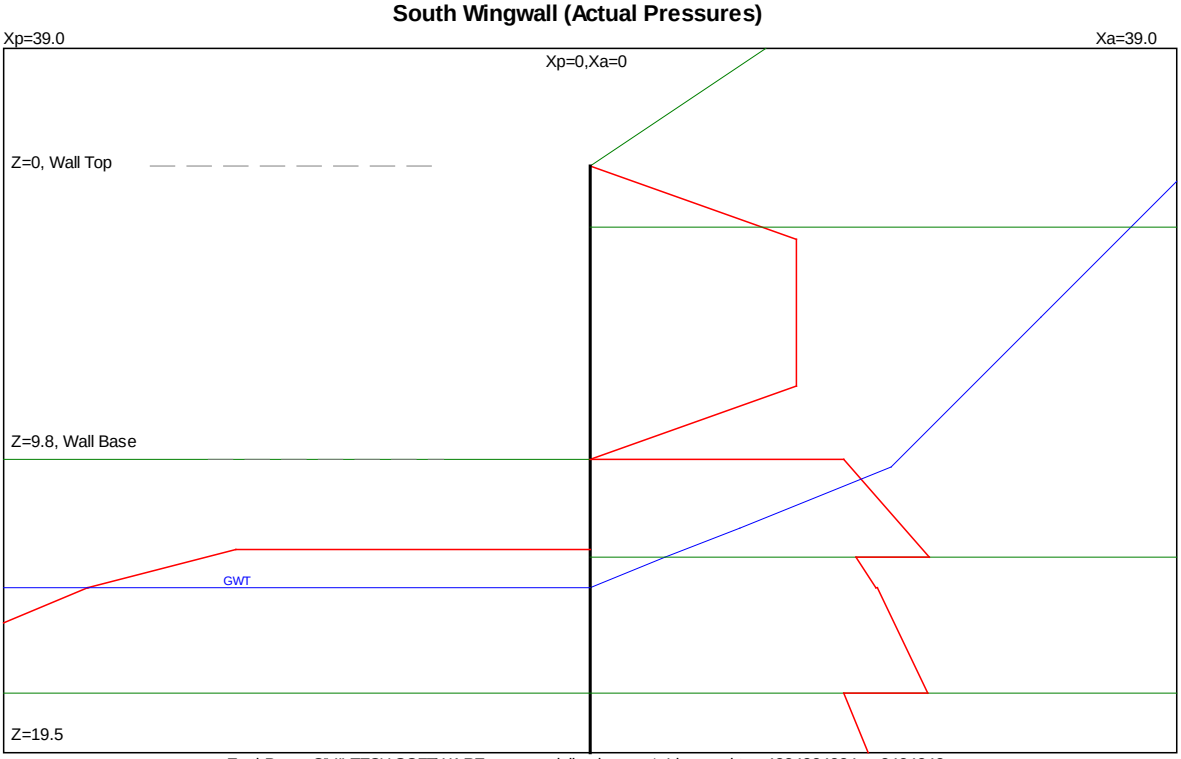
IL 251 Soldier Pile Wall

South Wingwall (Actual Pressures)



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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* INPUT DATA *

Wall Height=9.8 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	105.2	115.8	20	0.0	2	2	Soft Clay
2	120.0	130.0	27.95	0.0	10	2	Stiff Clay
3	130.0	142.0	33.95	0.0	25	2	Very Stiff S
4	137.0	150.0	40	0.0	60	1	Eq. Clay

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-266.0	800.0	1	Soft Clay
2	2.0	0.0	2.0	800.0	2	Stiff Clay
3	13.0	0.0	13.0	800.0	3	Very Stiff S
4	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Active Side:

Point	Z-water	X-water
1	14.0	0.0
2	13.0	5.0
3	12.0	10.0
4	10.0	20.0
5	5.0	30.0
6	0.0	40.0
7	-5.0	55.0
8	-10.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	9.8	0.0	9.8	800.0	3	Very Stiff S
2	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Passive Side:

Point	Z-water	X-water
1	14.0	0.0
2	14.0	800.0

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 2. Seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 3.65 per one linear foot (or meter) width along wall height
Total Static Force above Base= 3.65. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	2.44	0.60	0.2456	2.3349
2.44	0.60	7.31	0.60	0.0000	0.0000
7.31	0.60	9.75	0.00	-0.2456	-2.0469

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
9.75	0.74	13.00	0.99	0.0760	0.6336
13.00	0.77	14.00	0.83	0.0578	0.4447
14.00	0.83	17.50	0.98	0.0427	0.5370
17.50	0.74	19.50	0.81	0.0354	0.4044

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 0.75

Z1	Pp1	Z2	Pp2	Slope	Kp
12.75	1.03	14.00	1.46	0.344	2.6455
14.00	1.46	17.50	2.20	0.211	2.6455
17.50	2.78	19.50	3.41	0.318	3.6280

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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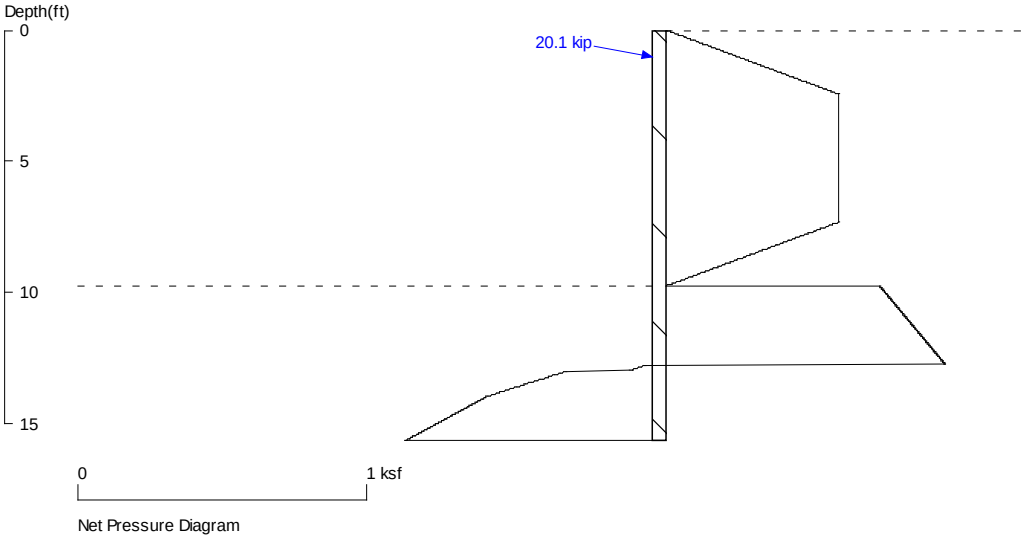
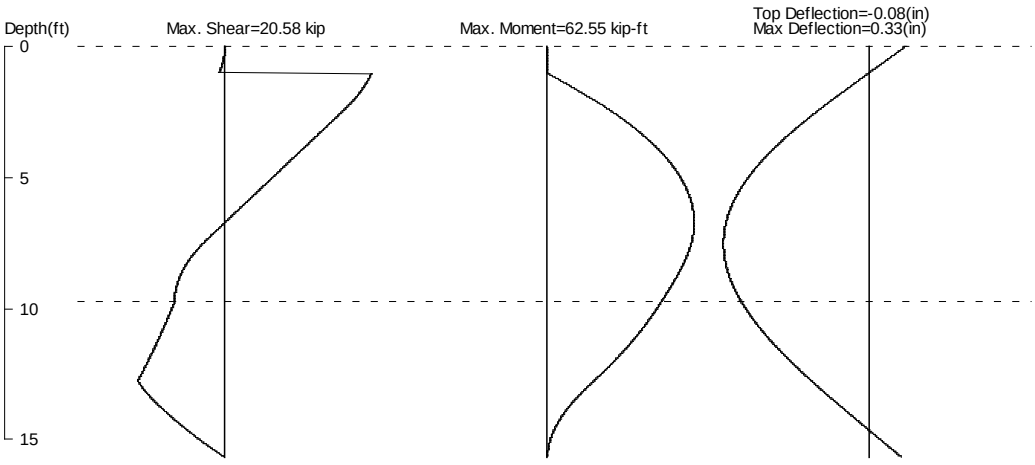
IL 251 Soldier Pile Wall

South Wingwall (Actual Pressures)



Net Pressure Diagram



Shear Diagram | Moment Diagram | Deflection Diagram

PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.5 foot or meter

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

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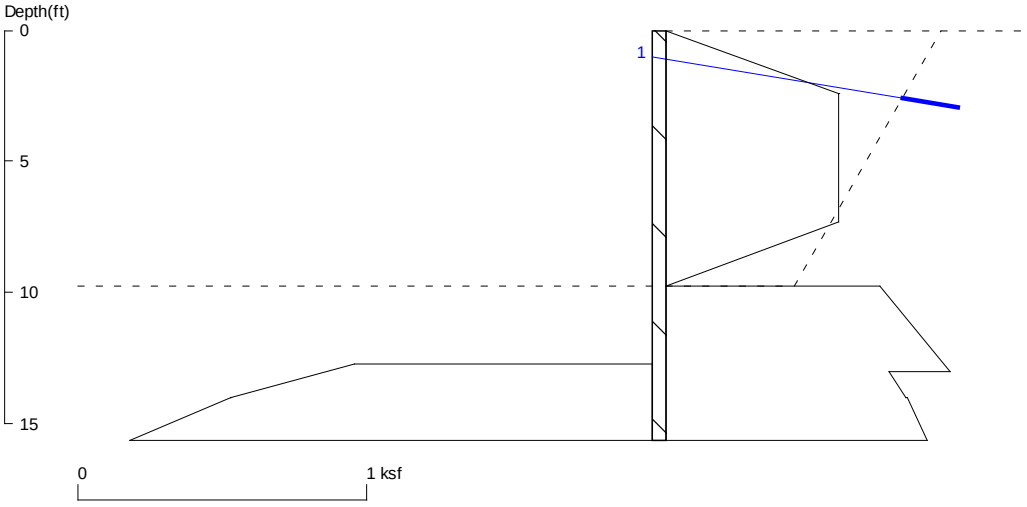
IL 251 Soldier Pile Wall

South Wingwall (Actual Pressures)



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Wall Height=9.8 Pile Diameter=2.0 Pile Spacing=6.5 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=5.92 (8~10ft is recommended!!!) Min. Pile Length=15.67 (in graphics and analysis)
MOMENT IN PILE: Max. Moment=62.55 per Pile Spacing=6.5 at Depth=6.71

PILE SELECTION:
Request Min. Section Modulus = 22.7 in3/pile=372.72 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
HP10X42 has Section Modulus = 43.4 in3/pile=711.20 cm3/pile. It is greater than Min. Requirements!
Top Deflection = -0.08(in) based on E (ksi)=29000.00 and I (in4)/pile=210.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	1.0	10.0	6.0	20.1	19.8	3.5	9.1	3.0

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	2.438	0.599	0.245634
2.438	0.599	7.313	0.599	0.000000
7.313	0.599	9.750	0.000	-0.24563
*	Below	Base		
9.750	0.739	13.00	0.986	0.076031
13.00	0.773	14.00	0.831	0.057813
14.00	0.834	17.50	0.983	0.042747

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
12.75	1.032	14.00	1.462	0.343916

14.00	1.462	17.50	2.199	0.210582

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	6.50
2	9.75	2.00

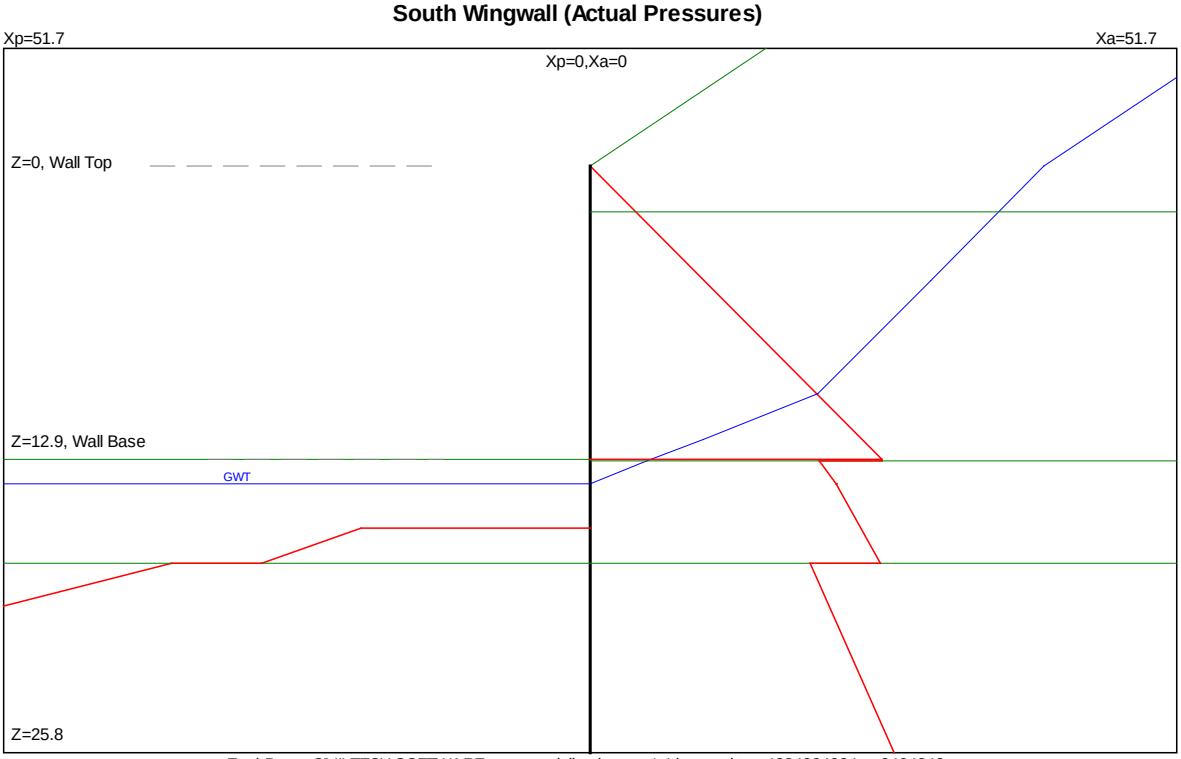
PASSIVE SPACING:

No.	Z depth	Spacing
1	9.75	4.00

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

IL 251 Soldier Pile Wall

South Wingwall (Actual Pressures)



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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* INPUT DATA *

Wall Height=12.9 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	105.2	115.8	20	0.0	2	2	Soft Clay
2	120.0	130.0	27.95	0.0	10	2	Stiff Clay
3	130.0	142.0	33.95	0.0	25	2	Very Stiff S
4	137.0	150.0	40	0.0	60	1	Eq. Clay

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-266.0	800.0	1	Soft Clay
2	2.0	0.0	2.0	800.0	2	Stiff Clay
3	13.0	0.0	13.0	800.0	3	Very Stiff S
4	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Active Side:

Point	Z-water	X-water
1	14.0	0.0
2	13.0	5.0
3	12.0	10.0
4	10.0	20.0
5	5.0	30.0
6	0.0	40.0
7	-5.0	55.0
8	-10.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	12.9	0.0	12.9	800.0	3	Very Stiff S
2	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Passive Side:

Point	Z-water	X-water
1	14.0	0.0
2	14.0	800.0

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 2. Seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 6.37 per one linear foot (or meter) width along wall height
Total Static Force above Base= 6.37. Distributed in Triangular Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	12.92	0.99	0.0763	0.7258

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
12.92	0.98	13.00	0.99	0.0759	0.6324
13.00	0.77	14.00	0.83	0.0578	0.4447
14.00	0.83	17.50	0.98	0.0427	0.5370
17.50	0.74	25.84	1.03	0.0343	0.3911

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 0.75

Z1	Pp1	Z2	Pp2	Slope	Kp
15.92	0.78	17.50	1.11	0.211	2.6455
17.50	1.41	25.84	3.97	0.306	3.4969

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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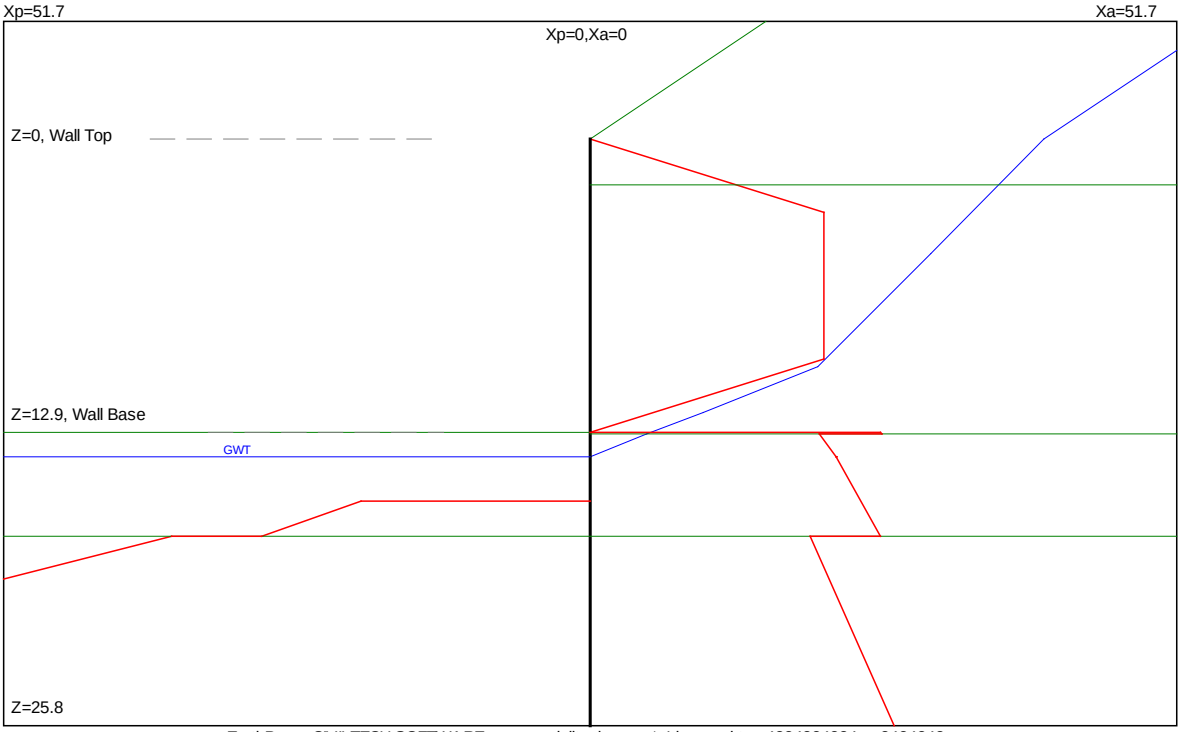
IL 251 Soldier Pile Wall

South Wingwall (Actual Pressures)



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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* INPUT DATA *

Wall Height=12.9 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	105.2	115.8	20	0.0	2	2	Soft Clay
2	120.0	130.0	27.95	0.0	10	2	Stiff Clay
3	130.0	142.0	33.95	0.0	25	2	Very Stiff S
4	137.0	150.0	40	0.0	60	1	Eq. Clay

Ground Surface at Active Side:

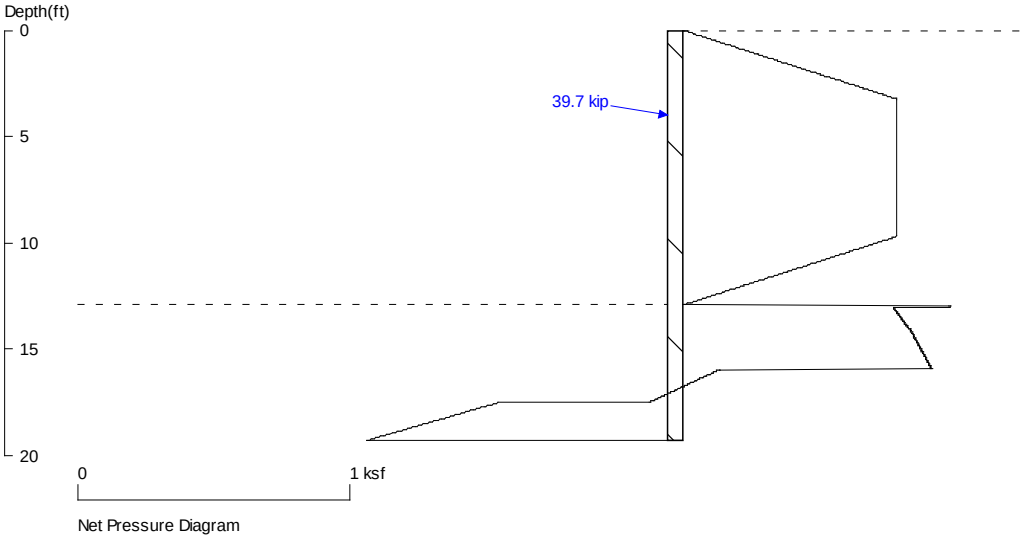
Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-266.0	800.0	1	Soft Clay
2	2.0	0.0	2.0	800.0	2	Stiff Clay
3	13.0	0.0	13.0	800.0	3	Very Stiff S
4	17.5	0.0	17.5	800.0	4	Eq. Clay

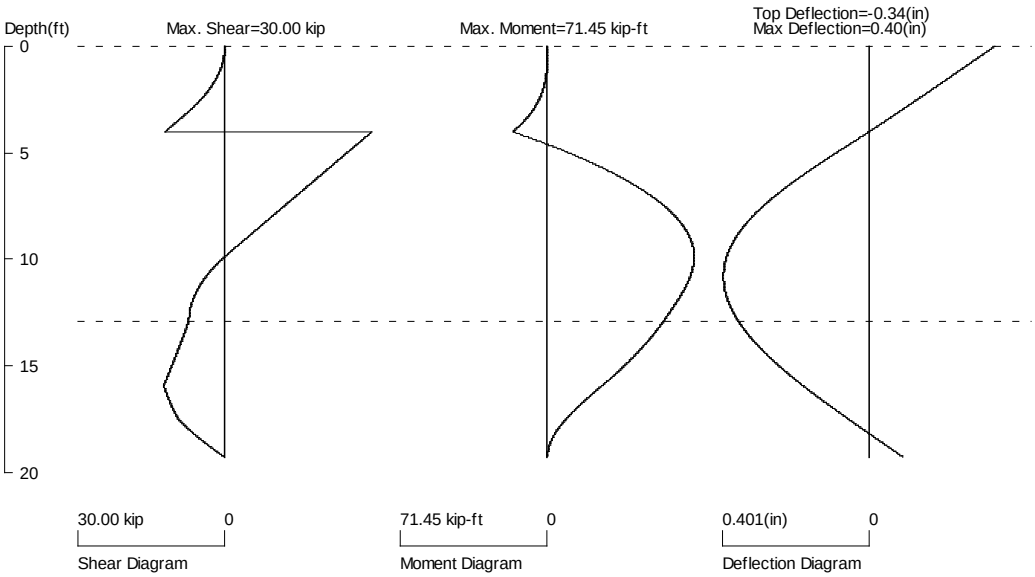
Water Table at Active Side:

Point	Z-w ater	X-w ater
1	14.0	0.0
2	13.0	5.0
3	12.0	10.0
4	10.0	20.0
5	5.0	30.0
6	0.0	40.0
7	-5.0	55.0
8	-10.0	800.0

IL 251 Soldier Pile Wall

South Wingwall (Actual Pressures)





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.5 foot or meter

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

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Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	12.9	0.0	12.9	800.0	3	Very Stiff S
2	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Passive Side:

Point	Z-water	X-water
1	14.0	0.0
2	14.0	800.0

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 2. Seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 6.37 per one linear foot (or meter) width along wall height
Total Static Force above Base= 6.37. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	3.23	0.79	0.2443	2.3224
3.23	0.79	9.69	0.79	0.0000	0.0000
9.69	0.79	12.92	0.00	-0.2443	-2.0360

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
12.92	0.98	13.00	0.99	0.0759	0.6324
13.00	0.77	14.00	0.83	0.0578	0.4447
14.00	0.83	17.50	0.98	0.0427	0.5370
17.50	0.74	25.84	1.03	0.0343	0.3911

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 0.75

Z1	Pp1	Z2	Pp2	Slope	Kp
15.92	0.78	17.50	1.11	0.211	2.6455
17.50	1.41	25.84	3.97	0.306	3.4969

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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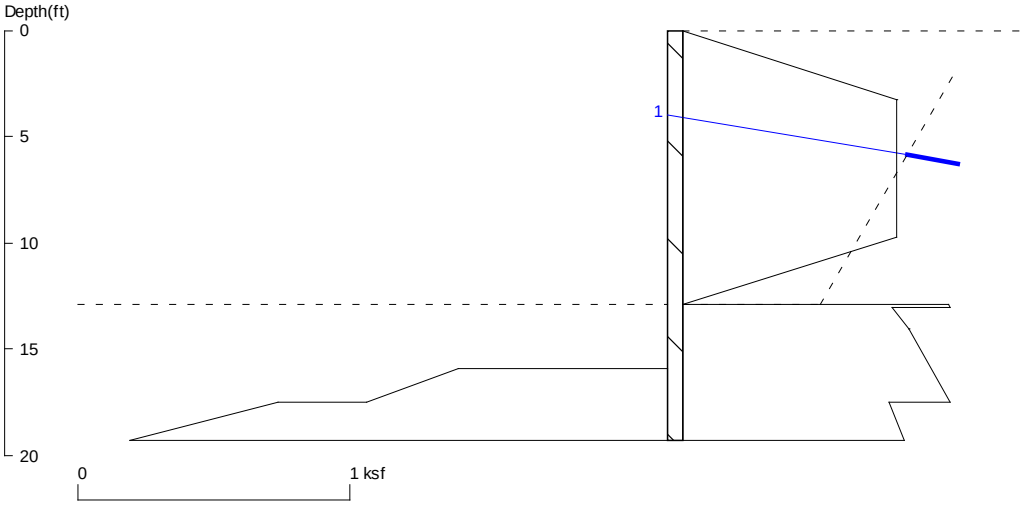
IL 251 Soldier Pile Wall

South Wingwall (Actual Pressures)



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Wall Height=12.9 Pile Diameter=2.0 Pile Spacing=6.5 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=6.39 (8~10ft is recommended!!!) Min. Pile Length=19.31 (in graphics and analysis)
MOMENT IN PILE: Max. Moment=71.45 per Pile Spacing=6.5 at Depth=9.88

PILE SELECTION:
Request Min. Section Modulus = 26.0 in3/pile=425.79 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
HP10X42 has Section Modulus = 43.4 in3/pile=711.20 cm3/pile. It is greater than Min. Requirements!
Top Deflection = -0.34(in) based on E (ksi)=29000.00 and I (in4)/pile=210.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	4.0	10.0	6.0	39.7	39.1	6.9	10.7	5.9

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	3.230	0.789	0.244318
3.230	0.789	9.690	0.789	0.000000
9.690	0.789	12.92	0.000	-0.24431
*	Below	Base		
12.92	0.980	13.00	0.986	0.075891
13.00	0.773	14.00	0.831	0.057813
14.00	0.834	17.50	0.983	0.042747
17.50	0.760	116.2	3.822	0.030996

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		

15.92	0.776	17.50	1.108	0.210582
17.50	1.440	116.2	31.27	0.302000

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	6.50
2	12.92	2.00

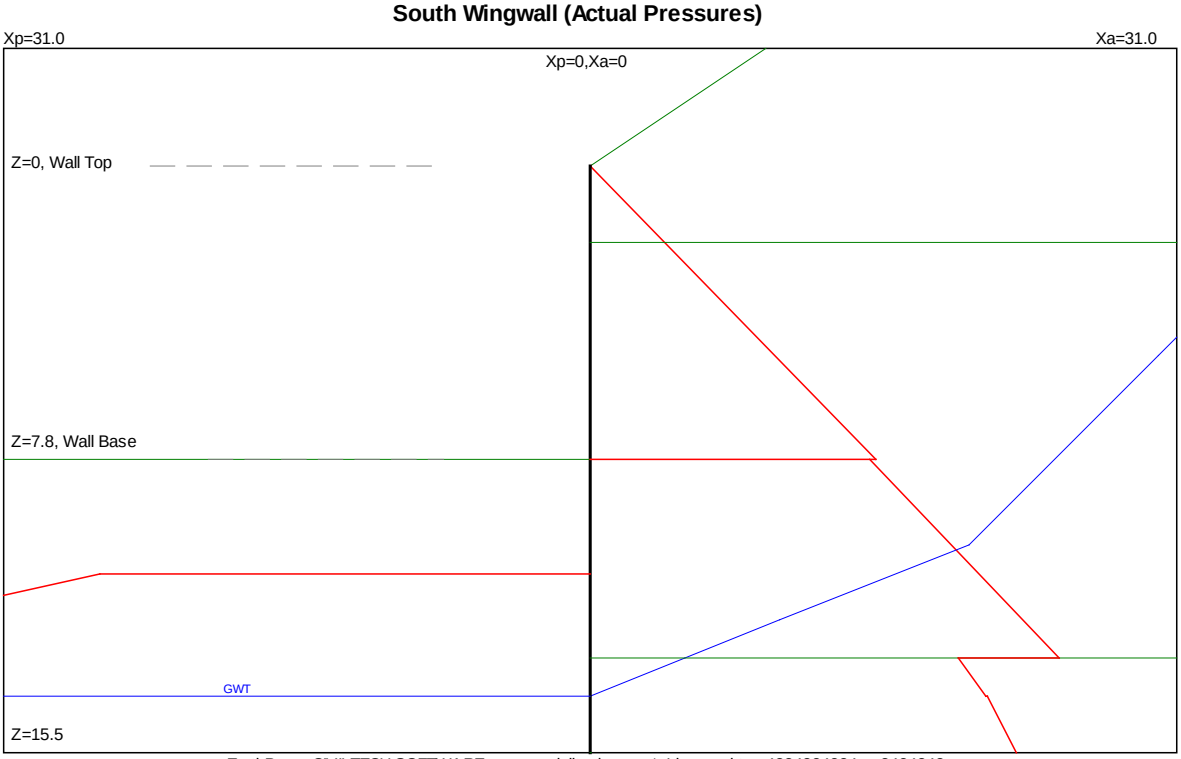
PASSIVE SPACING:

No.	Z depth	Spacing
1	12.92	4.00

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

IL 251 Soldier Pile Wall

South Wingwall (Actual Pressures)



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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* INPUT DATA *

Wall Height=7.8 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	105.2	115.8	20	0.0	2	2	Soft Clay
2	120.0	130.0	27.95	0.0	10	2	Stiff Clay
3	130.0	142.0	33.95	0.0	25	2	Very Stiff S
4	137.0	150.0	40	0.0	60	1	Eq. Clay

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-266.0	800.0	1	Soft Clay
2	2.0	0.0	2.0	800.0	2	Stiff Clay
3	13.0	0.0	13.0	800.0	3	Very Stiff S
4	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Active Side:

Point	Z-water	X-water
1	14.0	0.0
2	13.0	5.0
3	12.0	10.0
4	10.0	20.0
5	5.0	30.0
6	0.0	40.0
7	-5.0	55.0
8	-10.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	7.8	0.0	7.8	800.0	3	Very Stiff S
2	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Passive Side:

Point	Z-water	X-water
1	14.0	0.0
2	14.0	800.0

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 2. Seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 2.32 per one linear foot (or meter) width along wall height
Total Static Force above Base= 2.32. Distributed in Triangular Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	7.75	0.60	0.0773	0.7351

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
7.75	0.59	13.00	0.99	0.0759	0.6325
13.00	0.77	14.00	0.83	0.0578	0.4447
14.00	0.84	15.50	0.90	0.0408	0.5122

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 0.75

Z1	Pp1	Z2	Pp2	Slope	Kp
10.75	1.03	14.00	2.15	0.344	2.6455
14.00	2.15	15.50	2.47	0.211	2.6455

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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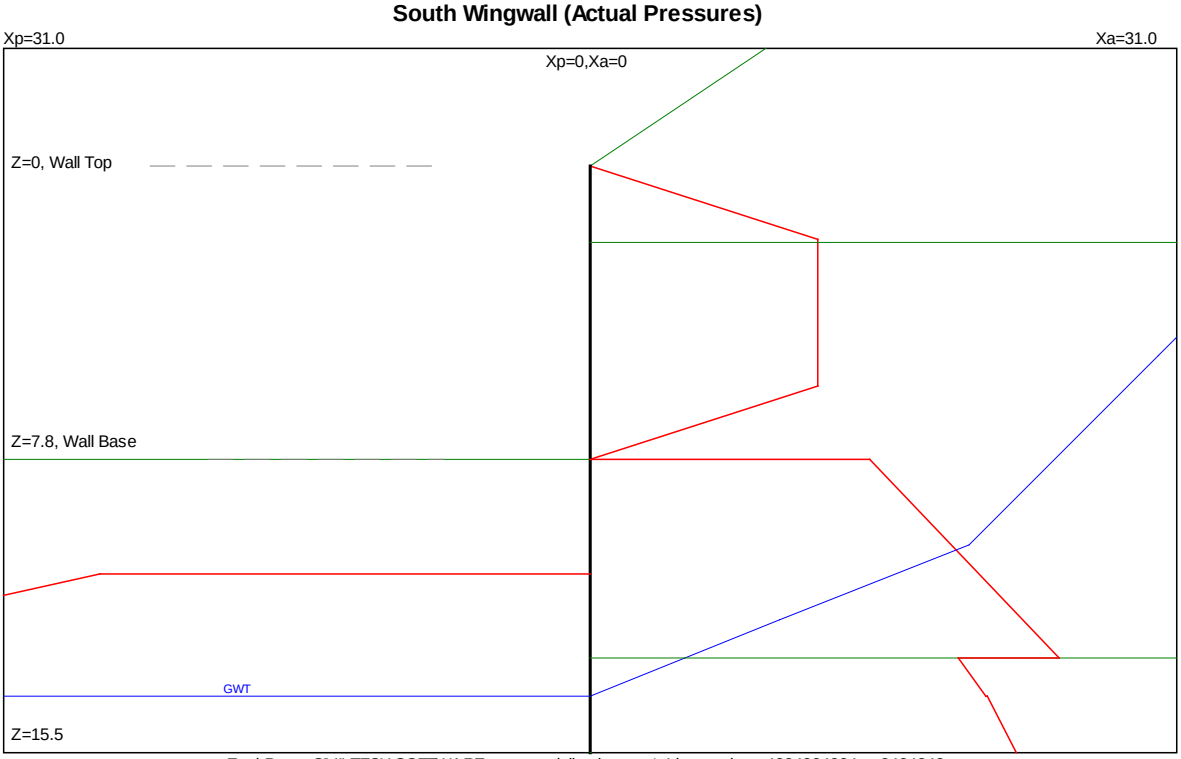
IL 251 Soldier Pile Wall

South Wingwall (Actual Pressures)



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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* INPUT DATA *

Wall Height=7.8 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	105.2	115.8	20	0.0	2	2	Soft Clay
2	120.0	130.0	27.95	0.0	10	2	Stiff Clay
3	130.0	142.0	33.95	0.0	25	2	Very Stiff S
4	137.0	150.0	40	0.0	60	1	Eq. Clay

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-266.0	800.0	1	Soft Clay
2	2.0	0.0	2.0	800.0	2	Stiff Clay
3	13.0	0.0	13.0	800.0	3	Very Stiff S
4	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Active Side:

Point	Z-water	X-water
1	14.0	0.0
2	13.0	5.0
3	12.0	10.0
4	10.0	20.0
5	5.0	30.0
6	0.0	40.0
7	-5.0	55.0
8	-10.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	7.8	0.0	7.8	800.0	3	Very Stiff S
2	17.5	0.0	17.5	800.0	4	Eq. Clay

Water Table at Passive Side:

Point	Z-water	X-water
1	14.0	0.0
2	14.0	800.0

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 2. Seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 2.32 per one linear foot (or meter) width along wall height
Total Static Force above Base= 2.32. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	1.94	0.48	0.2475	2.3523
1.94	0.48	5.81	0.48	0.0000	0.0000
5.81	0.48	7.75	0.00	-0.2475	-2.0622

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1.35

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
7.75	0.59	13.00	0.99	0.0759	0.6325
13.00	0.77	14.00	0.83	0.0578	0.4447
14.00	0.84	15.50	0.90	0.0408	0.5122

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 0.75

Z1	Pp1	Z2	Pp2	Slope	Kp
10.75	1.03	14.00	2.15	0.344	2.6455
14.00	2.15	15.50	2.47	0.211	2.6455

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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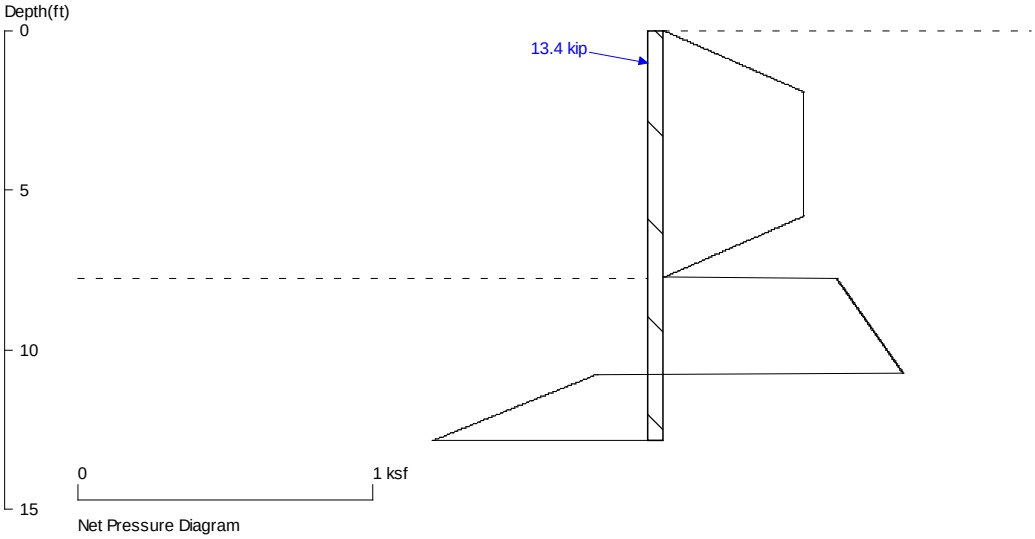
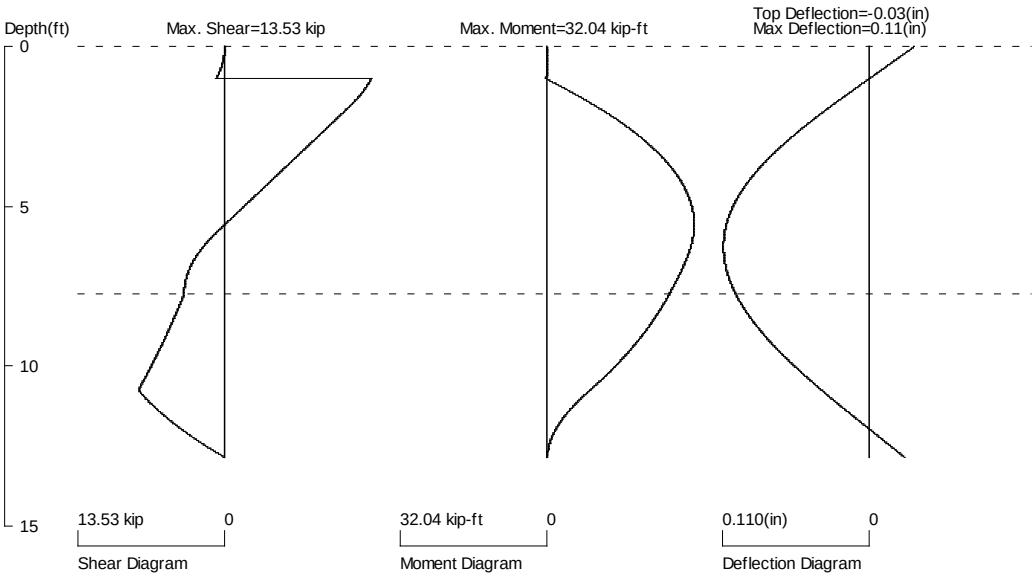
IL 251 Soldier Pile Wall

South Wingwall (Actual Pressures)





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.5 foot or meter

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

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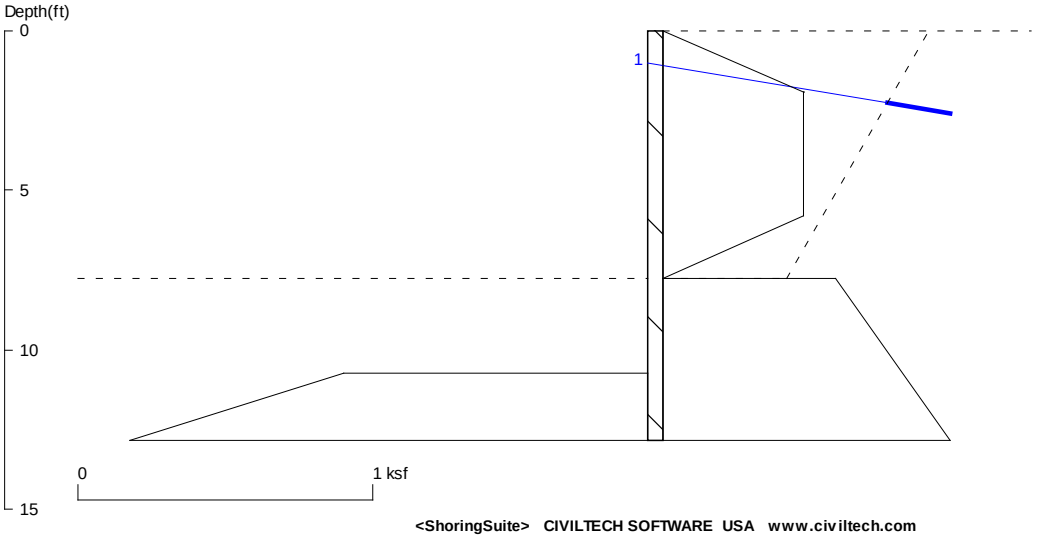
IL 251 Soldier Pile Wall

South Wingwall (Actual Pressures)



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Wall Height=7.8 Pile Diameter=2.0 Pile Spacing=6.5 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=5.10 (8~10ft is recommended!!!) Min. Pile Length=12.85 (in graphics and analysis)
MOMENT IN PILE: Max. Moment=32.04 per Pile Spacing=6.5 at Depth=5.56

PILE SELECTION:
Request Min. Section Modulus = 11.7 in3/pile=190.95 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
HP10X42 has Section Modulus = 43.4 in3/pile=711.20 cm3/pile. It is greater than Min. Requirements!
Top Deflection = -0.03(in) based on E (ksi)=29000.00 and I (in4)/pile=210.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	1.0	10.0	6.0	13.4	13.2	2.3	7.2	2.0

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	1.938	0.479	0.247461
1.938	0.479	5.813	0.479	0.000000
5.813	0.479	7.750	0.000	-0.24746
*	Below	Base		
7.750	0.587	13.00	0.986	0.075901

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
10.75	1.032	14.00	2.149	0.343916

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	6.50
2	7.75	2.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	7.75	4.00

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in