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CLIENT ODOT
PROJECT CUY-271.00
SUBJECT RW#2 (SW1) Soil Nail Wall
GEOTECHNICAL Retaining Wall Analysis

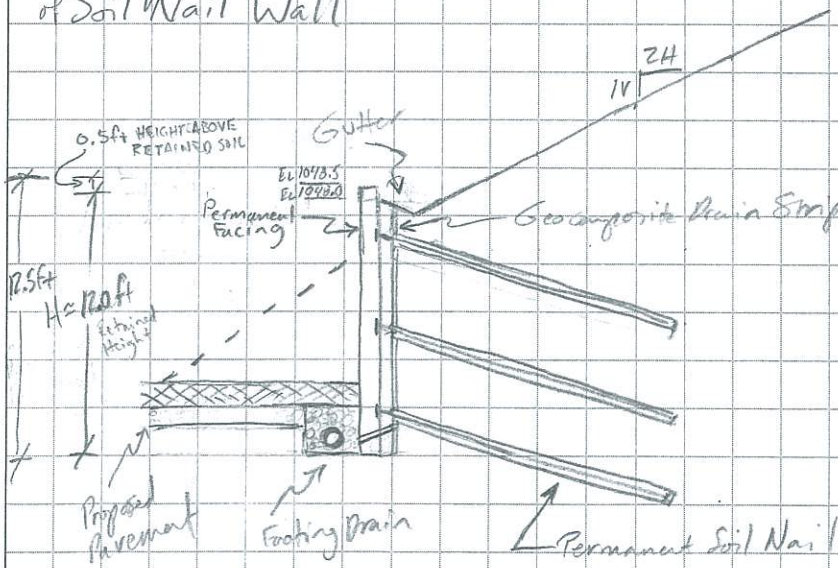
PROJECT NO. 1122-1001.00
SHEET NO. 1 OF 6
COMP. BY MJH DATE 7/21/2014
CHECKED BY EWT DATE 7-21-14

REVISED BY EWT on 9-25-14 ← REV CHK'D BY EWT DATE 8-5-14
REV, BY MJH ← REV CHK'D BY EWT DATE 9-25-14
DATE 8-01-2014

I Given: ⇒ USE ALLOWABLE STRESS DESIGN (ASD) ⇐ SINCE LRFD FACTORS ARENT AVAILABLE YET.

(i) Wall Type: Cut Wall ⇒ Soil Nail
(ii) Wall Height: 12.5 ft ; Retained Soil Height: 12.0 ft
(iii) Back Slope: 2H:1V
(iv) Soil Conditions: Stiff - Very Stiff cohesive soils
Unit Weight, γ = 130 pcf
Cohesion, c' = 300 psf
Friction Angle, ϕ' = 25°
Ultimate Bond Stress = 6 psi
} Table 6.1.3, ProGeotech, Inc Final SSE Report dated 7/8/2014
(v) No structure being supported by wall (Abutment supported on piles) ; FS = 1.3
(vi) Battered Piles as close as 16ft from back face of wall (to be verified by others) } for Global Stability

II Conceptual Sketch (NTS) of Soil Nail Wall



III Analysis

(a) External Stability ⇒ use SNAIL Win, v.3.10 Soil Reinforcement Program by California DOT

* ~~Assume~~ 2' wide gutter.

Consider: 14' Nail Length with 3.5' CTC spacing vert & horiz.; ie $S_v = S_h = 3.5$ ft
Top nail 2.0' below top of retained soil (ie 2.5' below top of wall)

(a) Global Stability ⇒ Min FS = 1.5 (below toe) 3 rows of nails
Min FS = 1.5 (at toe) nails @ 15° below horizontal
2 similar to sliding No groundwater
6" Diameter Nail Hole with No.8 Rebar ⇒ $A_s = 0.79$ in^2, $f_y = 60$ ksi

Critical FS = 1.5 > Min Required FS_G = 1.3, considering not supporting structure
OK

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CLIENT ODOT
PROJECT CUY-271-0.00
SUBJECT RW#2 (SW1) Soil Nail Wall
Retaining Wall Analysis

PROJECT NO. 1177-1001.00
SHEET NO. 2 OF 6
COMP. BY WSH DATE 7/21/2014
CHECKED BY GWT DATE 7-21-14
Rev BY WSH DATE ~~8-05-2014~~
REVCHECKED BY GWT DATE 8-5-14
Rev BY WSH DATE 9-26-14
Rev CHECKED BY GWT DATE 9-26-14

III, (i), (a) Global Stability Analysis (continued

Min. Factor of Safety = 1.5 using SNAILWin 3.10

↳ Results report for FS=1.0 Max. Average Reinforcement Working Force, T_{avg-s}, is 0.00 kips/level
Which results in a Maximum Design Nail Load, T_{max-s}, of 0 kips.
Since $T_{avg-s} = 0$ check global stability utilizing conventional limit equilibrium slope stability software Slope/W by GEOSLOPE, International
↳ Minimum factors of safety using Slope/W are similar to those calculated by SNAILWin
↳ Min Factor of Safety for Global Stability without wall* is 1.3 using soil parameters from ProGeotech, Inc. Indicating nails may not fully mobilize loads since slope w/ cut is stable. This is all predicated upon water table below base of wall.
Consider long term condition where drain for wall is plugged and seepage/run off from embankment slope creates buildup in hydrostatic pressure behind wall. Consider water backed up to height of 6ft behind wall and analyze

*with wall min FOS = 1.6

Slope/W Global Stability Min FS = 1.3 with elevated water level with Nail Pullout Force ≈ 2,200 lbs
for FS ≈ 1.3 Nail Pullout generally 1,600 to 2,600 lbs

Considering No load from Wall + only hydrostatic pressure the load on wall is,

$P_H = \frac{1}{2}\gamma_w H_w^2 S_h = \frac{1}{2}(62.4\,pcf)(6ft)^2(3.5ft) = 3931$ lbs per column of nails
where $\gamma_w = 62.4$ pcf (unit weight of water)
$H_w = 5ft$ (height of water)
$S_h = 3.5ft$ (horizontal spacing of soil nails)
This load would be concentrated mainly on bottom nail

For reference, typical head nail tensile force varies from $0.6K_A\gamma H$ to $0.75K_A\gamma H$ which corresponds to approximately 0.6 to 0.7 times the maximum nail service load (ie T_{max-s} or maximum design nail tensile force), Section 5.6.2 of FHWA GEC #7

$\Rightarrow T_{max-s} = \frac{0.6K_A\gamma H}{0.6}$ using $K_A = 0.333$ (Ref. pg. 22 Silt & Clay/Sand, Embankment Fill for Soldier Pile Wall ↳ No backwall slope & $\phi = 30°$)
account for 2H:1V slope in the wall height:
$\therefore H = 12.0 + (\frac{1}{2})\times(14\times\cos 15) = 18.8ft$ $\gamma = 130$ pcf

$T_{max-s} = \frac{0.6(0.333)(130)(18.8)}{0.6} \times S_v^2 = 814\,psf \times (3.5ft)^2 = 9970$ lbs $= 10.0$ kips
for spacing S_v 3.5 ft

Consider Parametric Study of T_{max-s} with varying effective cohesion (using SNAILWin) variation in

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CLIENT ODOT
PROJECT CUY-271-0.00
SUBJECT RW#2 (SW1) Soil Nail Wall
Retaining Wall Analysis

PROJECT NO. 1122-1001.00
SHEET NO. 3 OF 6
COMP. BY AJH DATE 7/21/2014
CHECKED BY SWT DATE 7-21-14
Rev B1 RECHECKED BY HJH DATE 8-05-2014
Rev Checked by SWT Date 9-26-14 effective RECHECKED BY SWT DATE 8-5-14
Revised by HJH DATE 9-22-2014

Parametric Study of SNAILWin v3.10 output for varying cohesion of embankment fill & nat. soil
(All other parameters held constant, including no groundwater impact)

c' (psf)	Critical F.S.*	Reinf. Stress Level (ksi) L1	L2	L3	(A) Avg Reinf. Stress plotted (ksi)	(B) Avg Reinf. Load level (kips), T_{avg}	(C) "Max Avg Reinf. Working Force" kips/level, $T_{avg\text{-}s}$	(D) Max Reinf Force, kips T_{max}	(E) Max. Design Nail Load, kips $T_{max\text{-}s}$	$\frac{T_{max\text{-}s}}{T_{max}} = \frac{T_{avg\text{-}s}}{T_{avg}}$
0	0.73 (0.88)	4.217	6.975	9.782	6.975	5.510	N/A (SYSTEM CALCULATE)	N/A	N/A	
50	0.90 (0.96@TOE)	0.914	4.690	8.698	4.761	3.761	N/A	N/A	N/A	
75	0.98 (1.05@TOE)	0.278	4.415	8.551	4.415	3.488	5.359	6.755	10.380	
80	0.99 (1.06@TOE)	0.278	4.415	8.551	4.415	3.488	4.814	6.755	9.323	
100	1.04 (1.08@TOE)	0.278	4.415	8.551	4.415	3.488	3.931	6.755	7.613	
150	1.15 (1.20@TOE)	0.278	4.415	8.551	4.415	3.488	2.440	6.755	4.725	
200	1.26 (1.31@TOE)	0.278	4.415	8.551	4.415	3.488	6.949	6.755	1.838	
250	1.37 (1.42@TOE)	0.000	3.921	8.277	4.033	3.189	0.000	6.539	⊖	
300	1.49 (1.52@TOE)	0.000	3.821	8.277	4.033	3.189	0.000	6.539	⊖	
300*	1.51 (1.52@TOE)	0.000	3.821	8.277	4.033	3.189	0.000	6.539	⊖	

*design case w/ 350 psf for natural foundation soil

*Critical F.S. generally at node below toe which is at a depth of 2ft below base of wall.

For purposes of parametric study the same effective cohesion, c', was used for embankment and foundation soils except for final case (design case).

Recommend using Max Design Nail Head Force, $T_{max\text{-}s}$ = 10 kips based upon consideration of the "rule of thumb" value which is similar to calculated value from SNAILWin output with an effective cohesion, c' of ~80 psf.

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CLIENT ODOT
PROJECT CUY-271-0.00
SUBJECT RW# 2 (SW1) Soil Nail Wall
Retaining Wall Analysis

PROJECT NO. 1122-1001.00
SHEET NO. 4 OF 6
COMP. BY HHH DATE 7/18/2014
CHECKED BY EWT DATE 7-31-14
REV BY HHH DATE ~~8-05-2014~~
REV CHECKED BY EWT DATE 8-5-14
REV BY HHH DATE 8-26-14
REV CHECKED BY EWT DATE 8-26-14

III Analysis Summary

Global Stability ⇒ $FS_{G\,min} = 1.3$ ← Note this is an extreme case
$= 1.5$ w/ elevated water level behind wall (Sta and up in slope
w/ long term water level (SNAIL Win
$FS_{G\,min} = 1.6$ using Slope/W

Max. Reinf Force, $T_{max} \approx 6.5$ kips

Recommended Maximum Design Nail Head Force, $T_{max\text{-}s} = 10$ kips

Design Summary Considerations

Nail Pattern: Square
Nail Spacing: Vertical = 3.5 ft
Horizontal = 3.5 ft
Nail Inclination = 15° =
Nail Number (Per Column) = 3
Nail Length, L = 14 ft
Nail Bar, Threaded No. 8
60 ksi Steel
Drill hole, Minimum Diameter = 6 in
Corrosion Protection
Ultimate Bond Strength, $Q_u = \pi \times 6 \times 6 = 113$ lbs/ft ($q_u = 6$ psi)
Max Wall Height H = 12.0 ft

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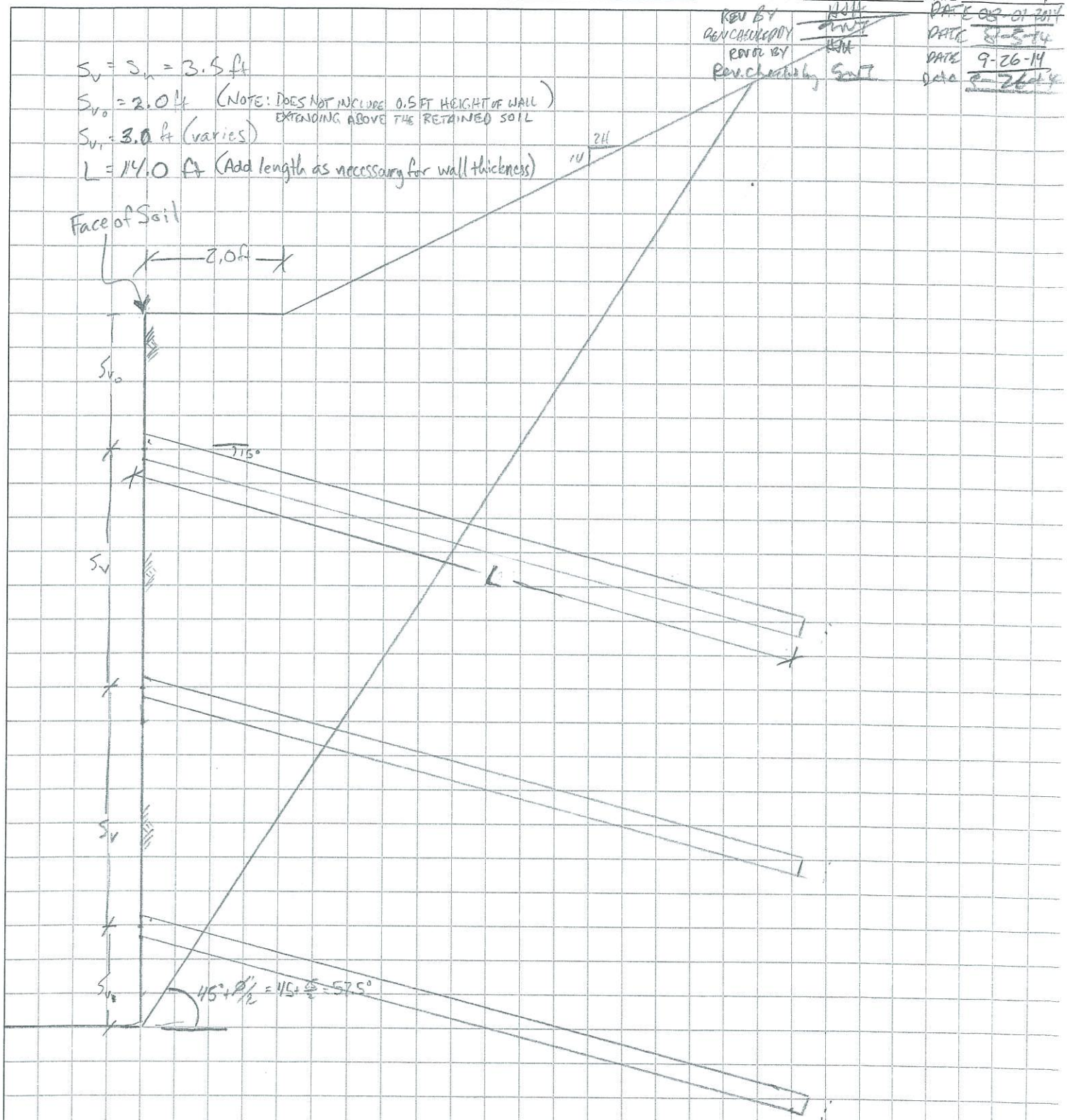
CLIENT ODOT
PROJECT CUY-271-0.00
SUBJECT RW#2 Soil Nail Wall
SCHEMATIC

PROJECT NO. 1122-1001.00
SHEET NO. 5 OF 6
COMP. BY HJH DATE 7/21/2014
CHECKED BY CWT DATE 7-21-14
REV BY HJH DATE 08-01-2014
QA/QC BY CWT DATE 8-5-14
REVISED BY HJH DATE 9-26-14
Rev. Checked by CWT Date 9-26-14

$S_v = S_h = 3.5$ ft
$S_{v_0} = 2.0$ ft (NOTE: DOES NOT INCLUDE 0.5 FT HEIGHT OF WALL EXTENDING ABOVE THE RETAINED SOIL)
$S_{v_1} = 3.0$ ft (varies)
L = 14.0 ft (Add length as necessary for wall thickness)



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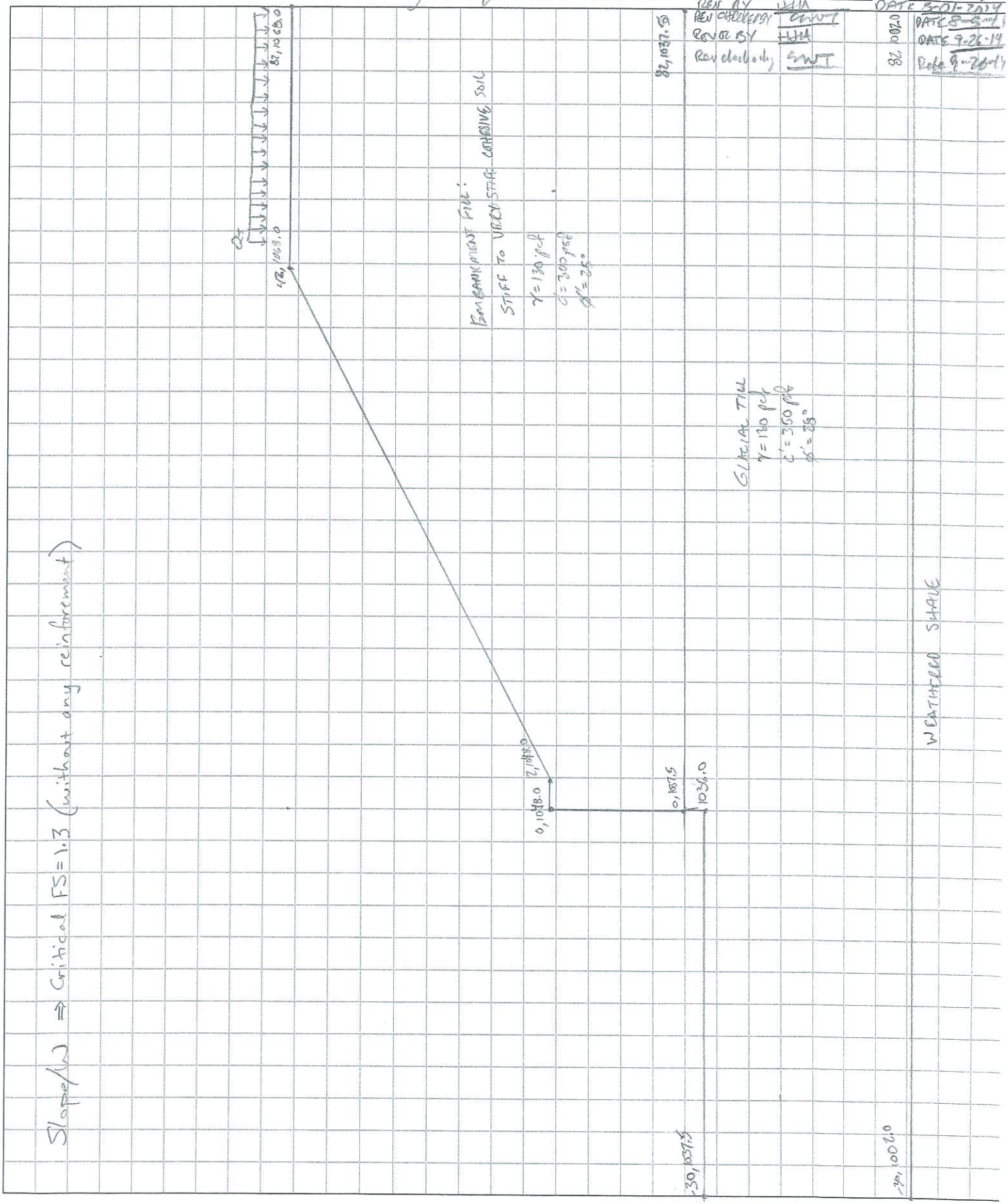
CLIENT ODOT
PROJECT CUY-271.00
SUBJECT RW#2 Soil Nail Wall
Global Stability - Slope/W

PROJECT NO. 1122-1001
SHEET NO. 6 OF 6
COMP. BY HJH DATE 7/17/2014
CHECKED BY CWT DATE 7-21-14

REV BY HJH DATE 8-5-2014
REV CHECKED BY CWT DATE 8-5-14
REV BY HJH DATE 9-26-14
REV checked by CWT Date 9-26-14



9-25-2014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**************************************************
*    CALIFORNIA DEPARTMENT OF TRANSPORTATION     *
*          ENGINEERING SERVICE CENTER            *
*     DIVISION OF MATERIALS AND FOUNDATIONS      *
*   Office of Roadway Geotechnical Engineering   *
*    Date: 09-25-2014          Time: 16:26:28    *
**************************************************
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Project Identification - CUY-271-0.00 SW-1 Soil Nail Wall

--------- WALL GEOMETRY ---------

(updated 9-25-2014) for Stage 2 Review Comments regarding Frost Depth

Vertical Wall Height	=	12.0 ft	
Wall Batter	=	0.0 degree	
		Angle (Deg)	Length (Feet)
First Slope from Wallcrest.	=	0.0	2.0
Second Slope from 1st slope.	=	26.6	46.0
Third Slope from 2nd slope.	=	0.0	40.0
Fourth Slope from 3rd slope.	=	0.0	0.0
Fifth Slope from 3rd slope.	=	0.0	0.0
Sixth Slope from 3rd slope.	=	0.0	0.0
Seventh Slope Angle.	=	0.0	

(2H:1V Slope)

--------- SLOPE BELOW THE WALL ---------

First Slope Angle below Toe.	=	0.0 degrees
First Slope Distance from Toe.	=	0.0 ft
Second Slope Angle.	=	0.0 degrees
Second Slope Distance from Toe.	=	0.0 ft
Vertical Depth of Search.	=	10.0 ft
Number of Searches below wall Toe.	=	5

--------- SURCHARGE ---------

THE SURCHARGES IMPOSED ON THE SYSTEM ARE:

Begin Surcharge - Distance from toe	=	45.0 ft
End Surcharge - Distance from toe	=	100.0 ft
Loading Intensity - Begin	=	250.0 psf/ft
Loading Intensity - End	=	250.0 psf/ft

--------- OPTION #1 ---------

Factored Punching shear, Bond & Yield Stress are used.

--------- SOIL PARAMETERS ---------

Soil Layer	Unit Weight (Pcf)	Friction Angle (Degree)	Cohesion Intercept (Psf)	Bond* Stress (Psi)	Coordinates of Boundary XS1 (ft)	YS1 (ft)	XS2 (ft)	YS2 (ft)	
1	130.0	25.0	300.0	3.0	0.0	0.0	0.0	0.0	(Embankment Soil)
2	130.0	28.0	350.0	3.0	-40.0	0.0	100.0	0.0	(Foundation Soil) and considers

↖ Bond stress is factored allowable FS=2.0; ie q_{ult}=6.0psi

* Bond Stress also depends on BSF Factor in Option #5 when enabled.

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--------- WATER SURFACE ---------

NO Water Table defined for this problem.

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 100.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels	= 3
Horizontal Spacing	= 3.5 ft
Yield Stress of Reinforcement	= 60.0 ksi
Diameter of Grouted Hole	= 6.0 in
Punching Shear	= 220.0 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (in)	Bond Stress Factor
1	14.0	15.0	2.0	1.00	1.00
2	14.0	15.0	3.5	1.00	1.00
3	14.0	15.0	3.5	1.00	1.00

File: CUY271-SW1_rev02_H=12.0ft
Page - 3

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
Toe	1.52	50.0	23.5	32.7	44.4	28.0

Reinf. Stress at Level 1 = 0.000 Ksi
2 = 3.821 Ksi (Pullout controls...)
3 = 8.277 Ksi (Pullout controls...)

$A_s = 0.79 in^2$
$T_{avg} = 4.033 ksi \times 0.79 in^2 = 3.189 kips$
$T_{max} = 8.277 ksi \times 0.79 in^2 = 6.539 kips$

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
2.00	1.51	50.0	30.0	34.6	40.9	26.4

Reinf. Stress at Level 1 = 0.000 Ksi
2 = 3.094 Ksi (Pullout controls...)
3 = 6.800 Ksi (Pullout controls...)

HH 9-25-14

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
4.00	1.54	50.0	27.6	39.5	50.7	23.7

Reinf. Stress at Level 1 = 0.000 Ksi
2 = 0.219 Ksi (Pullout controls...)
3 = 4.178 Ksi (Pullout controls...)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
6.00	1.59	60.0	27.2	33.7	37.7	37.9

Reinf. Stress at Level 1 = 0.000 Ksi
2 = 0.000 Ksi
3 = 1.809 Ksi (Pullout controls...)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
8.00	1.66	60.0	29.4	41.3	40.2	31.4

Reinf. Stress at Level 1 = 0.000 Ksi
2 = 0.000 Ksi
3 = 0.267 Ksi (Pullout controls...)

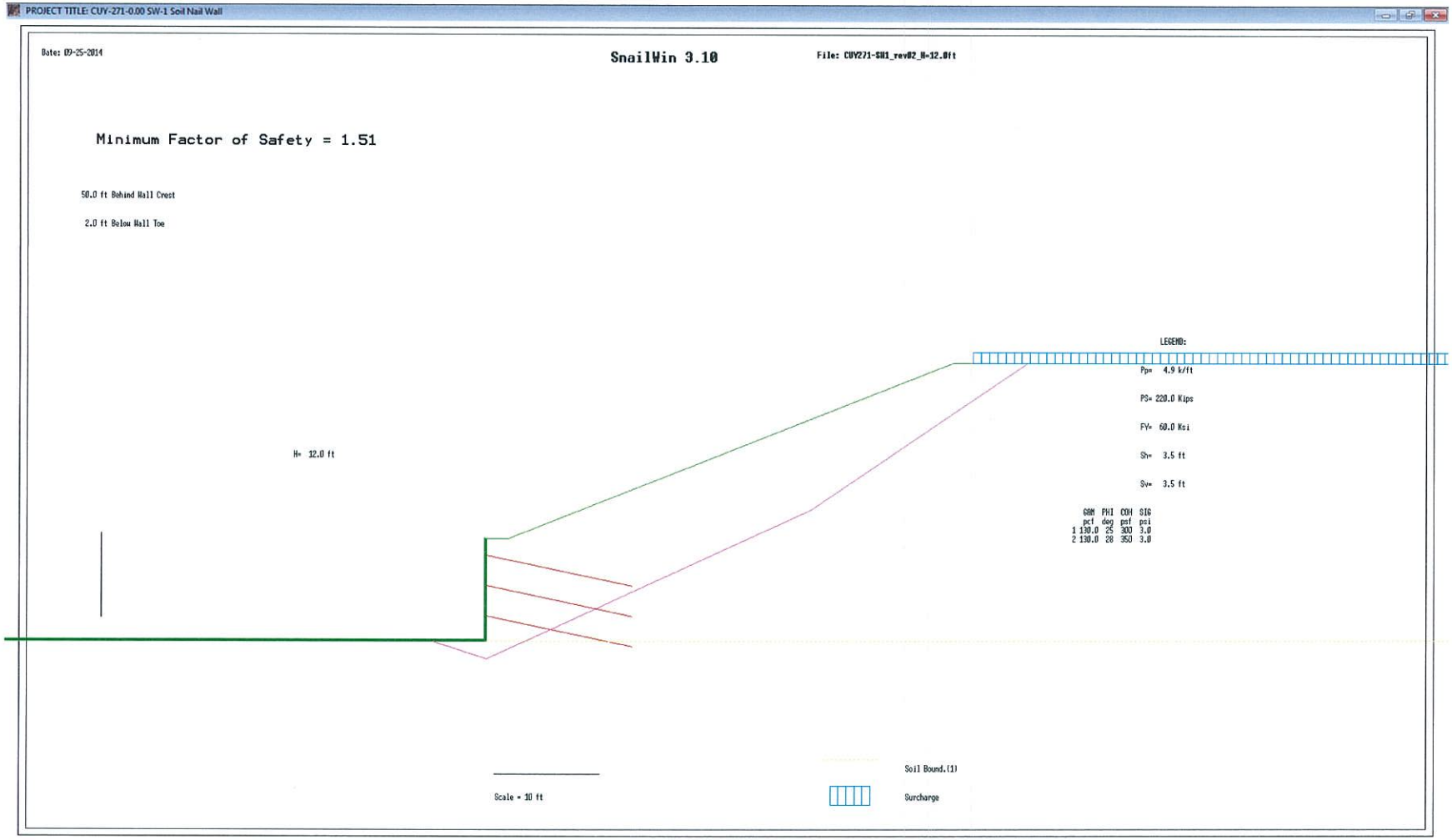
DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
10.00	1.71	60.0	29.6	34.5	40.4	39.4

Reinf. Stress at Level 1 = 0.000 Ksi
2 = 0.000 Ksi
3 = 0.000 Ksi

```
**********************************************************************
*                For Factor of Safety = 1.0                          *
*         Maximum Average Reinforcement Working Force:               *
*                      0.000 Kips/level                              *
**********************************************************************
```

$\rightarrow T_{avg\text{-}s} = 0 \Rightarrow T_{max\text{-}s} = T_{max}\left(\frac{T_{avg\text{-}s}}{T_{avg}}\right) = 0$

Indicates max design nail head force, $T_{max\text{-}s}$, is zero.
Doesn't seem reasonable for long term condition. Determine $T_{max\text{-}s}$ using rule of thumb approach ⇒ Rule of thumb approach estimate is $T_{max\text{-}s} = 10$ kips which is similar to SNAILWin method with soil cohesion between 75 and 80 psf with all other parameters held constant.


PROJECT TITLE: CUY-271-0.00 SW-1 Soil Nail Wall
Date: 09-25-2014
SnailWin 3.10
File: CUY271-SW1_rev02_H=12.0ft
Minimum Factor of Safety = 1.51
50.0 ft Behind Wall Crest
2.0 ft Below Wall Toe
H= 12.0 ft
LEGEND:
Pp= 4.9 k/ft
PS= 220.0 Kips
FY= 60.0 Ksi
Sh= 3.5 ft
Sv= 3.5 ft
GAM PHI COH SIG
pcf deg psf psi
1 130.0 25 300 3.0
2 130.0 28 350 3.0
Soil Bound.(1)
Scale = 10 ft
Surcharge

MAW 9-25-14


PROJECT TITLE: CUY-271-0.00 SW-1 Soil Nail Wall
Date: 09-25-2014
SnailWin 3.10
File: CUY271-SW1_rev02_H=12.0ft
Minimum Factor of Safety = 1.52
50.0 ft Behind Wall Crest
0.0 ft Below Wall Toe
H= 12.0 ft
LEGEND:
PS= 220.0 Kips
FY= 60.0 Ksi
Sh= 3.5 ft
Sv= 3.5 ft
GAM PHI COH SIG
pcf deg psf psi
1 130.0 25 300 3.0
2 130.0 28 350 3.0
Scale = 10 ft
Soil Bound.(1)
Surcharge

HAM 9.25.14


PROJECT TITLE: CUY-271-0.00 SW-1 Soil Nail Wall
Date: 09-25-2014
SnailWin 3.10
File: CUY271-SW1_rev02_H=12.0ft
Minimum Factor of Safety = 1.54
50.0 ft Behind Wall Crest
4.0 ft Below Wall Toe
H= 12.0 ft
LEGEND:
Pp= 11.5 k/ft
PS= 220.0 Kips
FY= 60.0 Ksi
Sh= 3.5 ft
Sv= 3.5 ft
GAM FHI COH SIG
pcf deg psf psi
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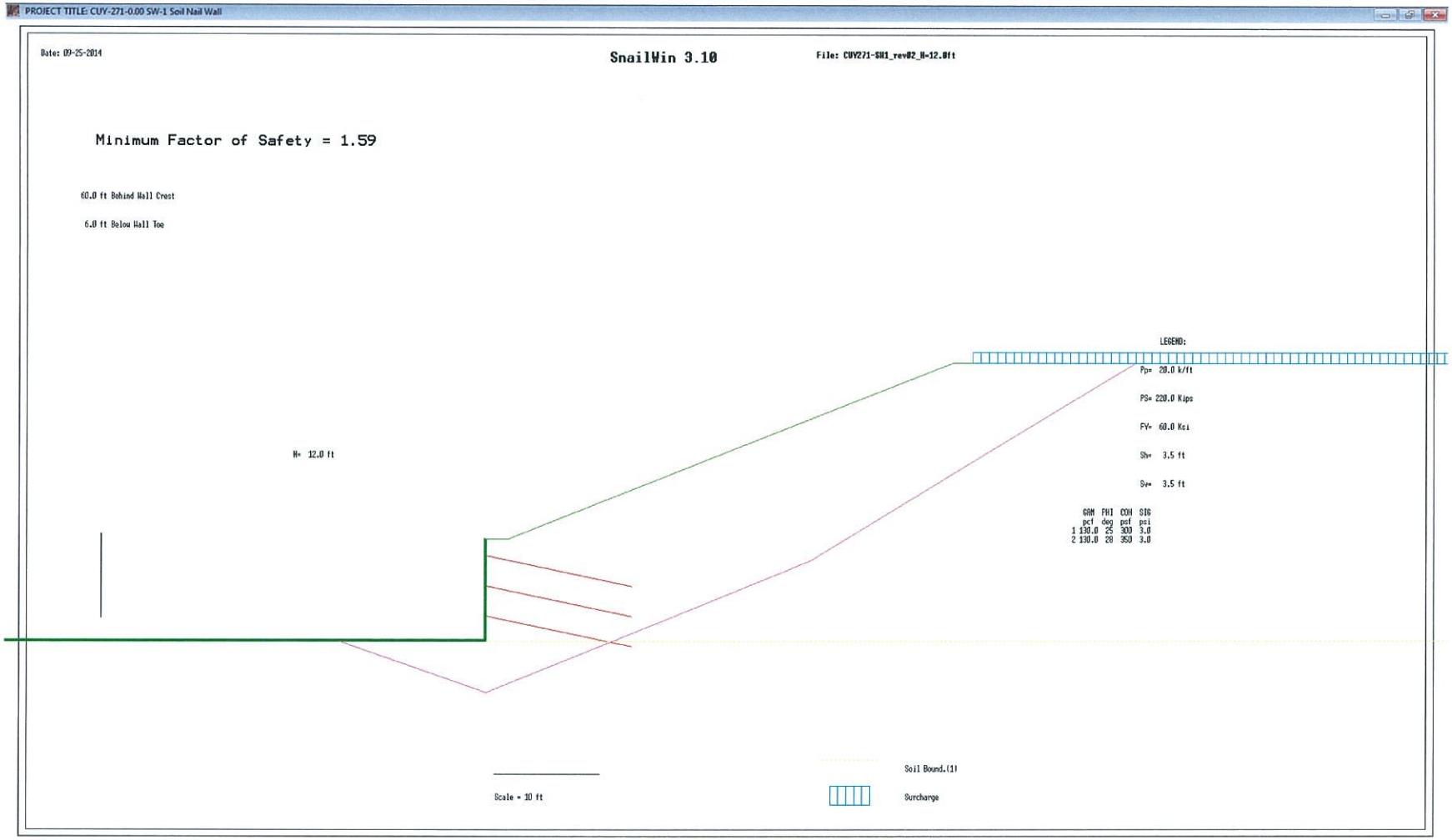
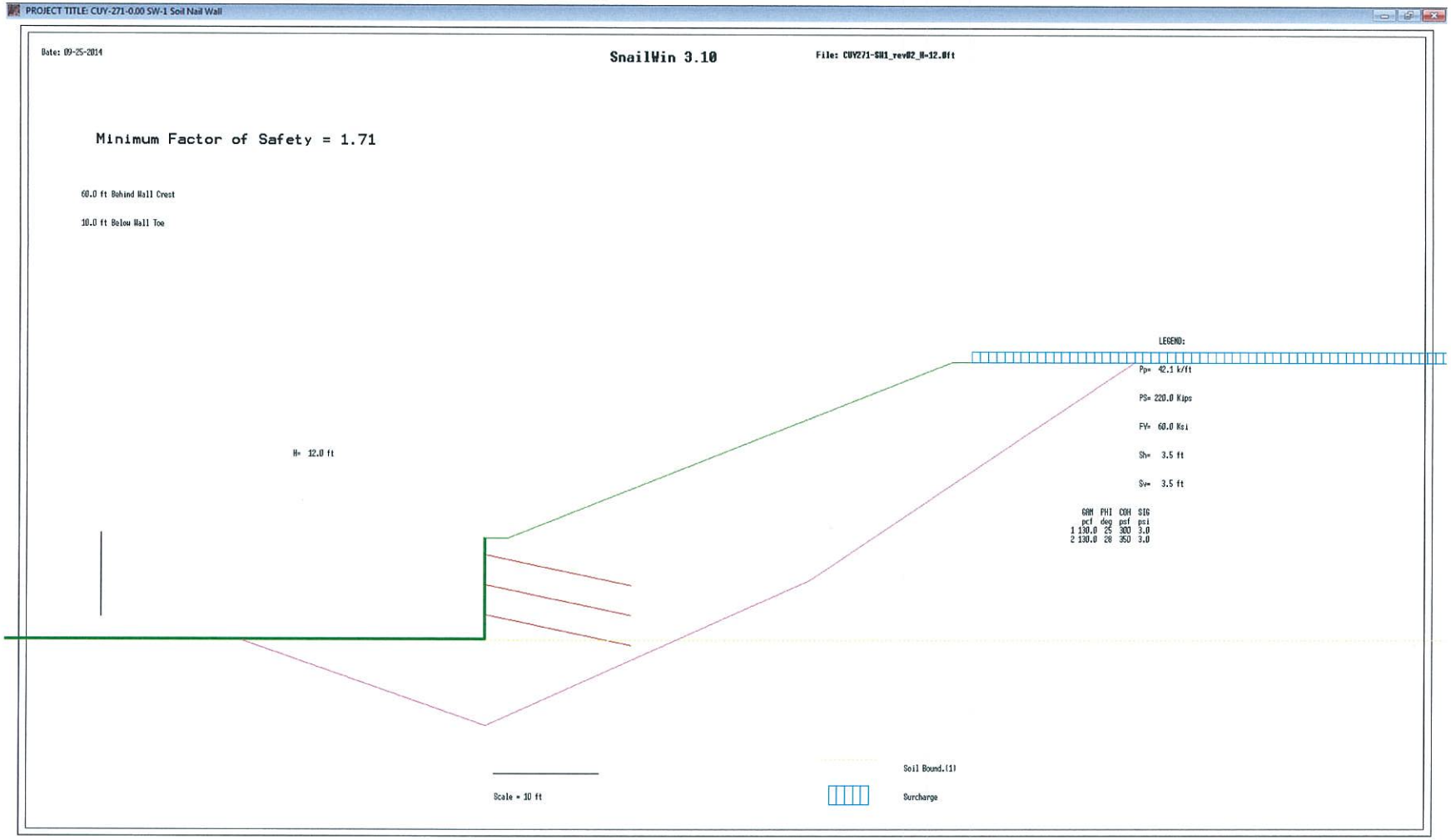
2 130.0 28 350 3.0
Scale = 10 ft
Soil Bound.(1)
Surcharge


PROJECT TITLE: CUY-271-0.00 SW-1 Soil Nail Wall
Date: 09-25-2014
SnailWin 3.10
File: CUY271-SW1_rev02_H-12.0ft
Minimum Factor of Safety = 1.59
60.0 ft Behind Wall Crest
6.0 ft Below Wall Toe
H= 12.0 ft
LEGEND:
Pp= 20.0 k/ft
PS= 220.0 Kips
FY= 60.0 Ksi
Sh= 3.5 ft
Sv= 3.5 ft
GAM FHI COH SIG
pcf deg psf psi
1 130.0 25 300 3.0
2 130.0 28 350 3.0
Soil Bound.(1)
Surcharge
Scale = 10 ft


PROJECT TITLE: CUY-271-0.00 SW-1 Soil Nail Wall
Date: 09-25-2014
SnailWin 3.10
File: CUY271-SW1_rev02_H=12.0ft
Minimum Factor of Safety = 1.66
60.0 ft Behind Wall Crest
8.0 ft Below Wall Toe
H= 12.0 ft
LEGEND:
Pp= 30.2 k/ft
PS= 220.0 Kips
FY= 60.0 Ksi
Sh= 3.5 ft
Sv= 3.5 ft
GAM FHI COH SIG
pcf deg psf psi
1 130.0 25 300 3.0
2 130.0 28 350 3.0
Scale = 10 ft
Soil Bound.(1)
Surcharge

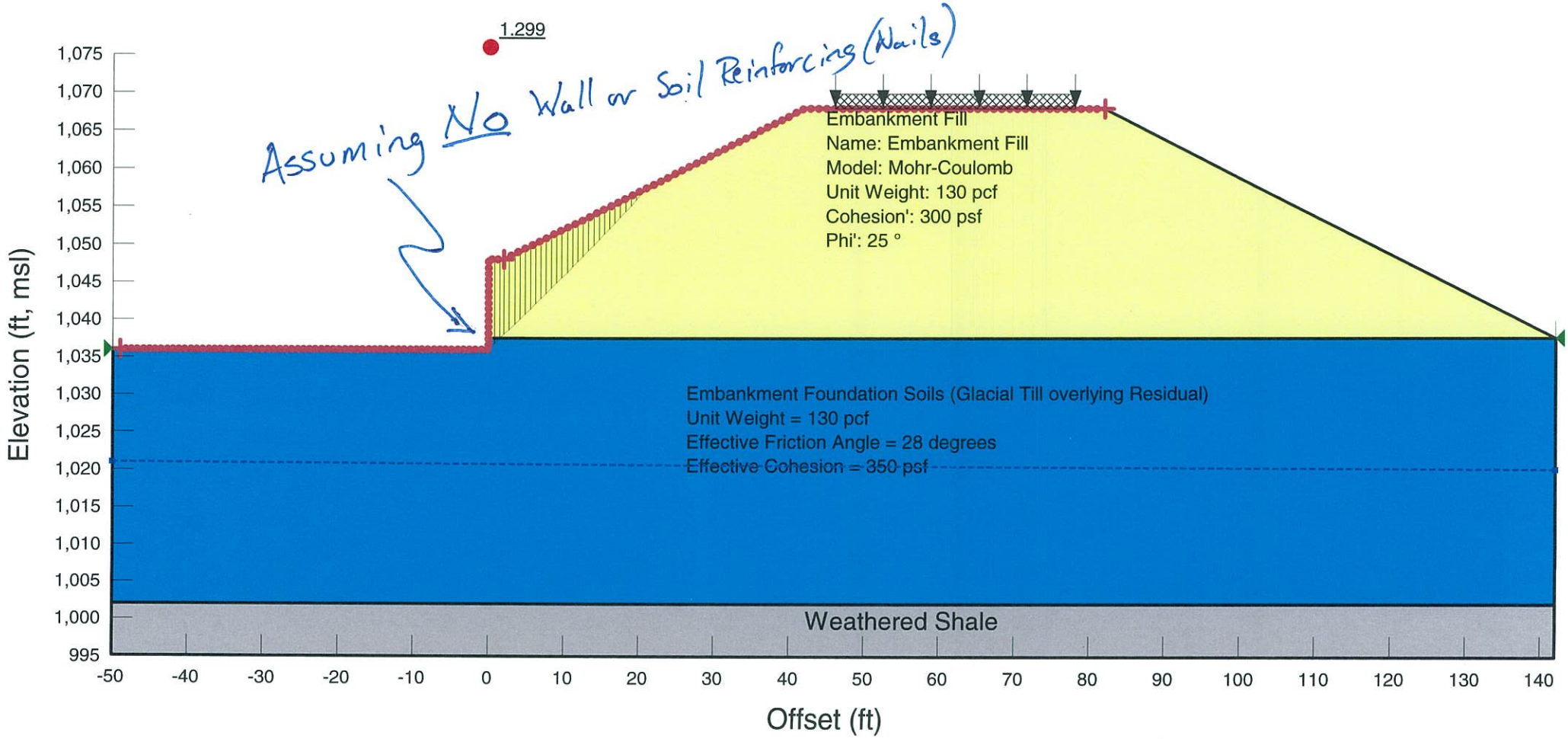
KAM 9-25-14


PROJECT TITLE: CUY-271-0.00 SW-1 Soil Nail Wall
Date: 09-25-2014
SnailWin 3.10
File: CUY271-SW1_rev02_H-12.0ft
Minimum Factor of Safety = 1.71
60.0 ft Behind Wall Crest
10.0 ft Below Wall Toe
H= 12.0 ft
LEGEND:
Pp= 42.1 k/ft
PS= 220.0 Kips
FY= 60.0 Ksi
Sh= 3.5 ft
Sv= 3.5 ft
GAM PHI COH SIG
pcf deg psf psi
1 130.0 25 300 3.0
2 130.0 28 350 3.0
Soil Bound.(1)
Scale = 10 ft
Surcharge

9-25-14

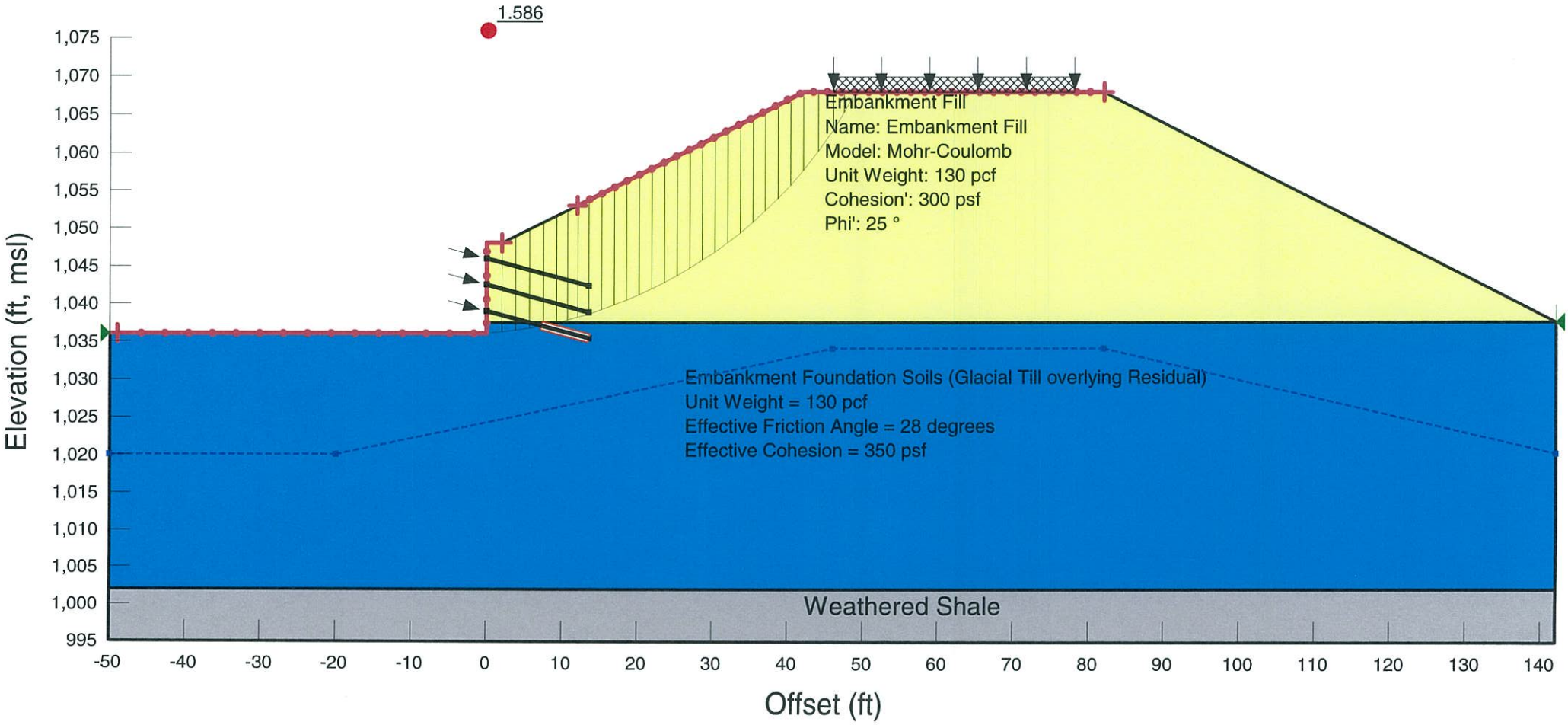
Project No. 1122-1001.00
Project Name CUY-271-0.00
Retaining Wall RW#2 (SW1) - Soil Nail Wall (12.0 ft retained height)
Global Stability Analysis
Long Term Condition (Drained Strength - Effective Shear Stress Parameters)
Spencer Analysis Method
Critical Factor of Safety = 1.299

SLOPE/W Graphic Output
HH 9-26-2014



Project No. 1122-1001.00
Project Name CUY-271-0.00
Retaining Wall RW#2 (SW1) - Soil Nail Wall (12.0 ft retained height)
Global Stability Analysis
Long Term Condition (Drained Strength - Effective Shear Stress Parameters)
Spencer Analysis Method
Critical Factor of Safety = 1.586

SLOPE/W Graphic Output
HAH 9-26-2014



Project No. 1122-1001.00
Project Name CUY-271-0.00
Retaining Wall RW#2 (SW1) - Soil Nail Wall (12.0 ft retained height)
Global Stability Analysis
Long Term Condition (Drained Strength - Effective Shear Stress Parameters)
Spencer Analysis Method
Critical Factor of Safety = 1.338

Elevated Water Level

SLOPE/W Graphic Output
HH 9-26-2014