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February 13, 2018

Our ref: 18-03

Tangled Ride, LLC  
66 Brook Bay Road  
Mercer Island, Washington 98040

ATTENTION: Mr. Greg and Mrs. Kristin Hart

RE: PERMANENT RETAINING WALL DESIGN CALCULATIONS & PLANS  
HART RESIDENCE  
6025 – 77<sup>TH</sup> AVENUE SE, MERCER ISLAND, WA

Dear Greg and Kristin:

Ground Support PLLC is pleased to present to Tangled Ride, LLC and yourselves our design calculations and plans for a permanent soil nailed retaining wall for the proposed Hart Residence, located at 6025 – 77<sup>th</sup> Avenue SE, Mercer Island, Washington. We have completed the retaining wall design submittal in accordance with our contract proposal dated February 8, 2018. The project background and soil conditions, and the retaining wall design calculations and plans are described in the following sections.

## **1. PROJECT BACKGROUND AND SOIL CONDITIONS**

In preparing the permanent retaining wall design submittal, we have reviewed the following geotechnical report, and architectural and civil drawing files:

- "Geotechnical Report, Hart Residence, 6025 - 77th Avenue SE, Mercer Island, WA", prepared by the Galli Group, dated July 6, 2017.
- The electronic drawing files in the plan set titled: "Tangled Ride Residence, 6025 77th Ave. SE, Mercer Island, WA 98040", dated January 18, 2018, prepared by Stuart Silk Architects.
- The electronic drawing files titled "Profile", and "Drainage Plan South", of the plan set titled: "Tangled Ride Residence, 6025 77th Ave. SE, Mercer Island, WA 98040", dated January 31, 2018, prepared by D. R. Strong Consulting Engineers.

We understand that the proposed permanent soil nailed retaining wall will, for the most part, serve as the eastern wall of the new residence structure, which is being excavated into the adjacent hillside to the east. The soil nails will be permanent and epoxy-coated, there will be a temporary 4" shotcrete facing constructed top-down, and the soil nails will have plates with

headed-studs at the connection which will be embedded into a permanent shotcrete or single-side formed concrete wall designed by the structural engineer of the residence. Also, this wall will extend to the north away from the building and will serve as a stand-alone site retaining wall adjacent to the parking area. At the south end of the permanent wall, we have included a small temporary soil nailed portion to deal with some temporary cuts needed to construct the stairwell and landing at the south end of the building.

Based on the above referenced civil plans, the proposed top of shoring wall grades (when looking at the face of the wall), vary from elevation 40 feet at the left end, increasing up to a high point of elevation 43.5 feet near the wall middle, and then trending back downward to about elevation 38 feet at the right end of the permanent wall. The bottom of excavation / temporary shotcrete wall profile ranges from elevation 31 feet at the left end (1-ft below the parking grade), and steps down to about elevation 18 feet throughout the main building region, resulting in a total shotcrete wall height ranging from 0 to nearly 26 feet, and roughly 3,040 square feet of temporary shotcrete wall facing. Note that the final finish floor elevation is 2-ft higher in the main structure, closer to elevation 20 feet, and that the grade right behind the wall is lower than the actual top of wall, so that the highest retained cut height is about 21 feet. Now, in order to accomplish this within the 10-ft to 20-ft wide space between the wall and the property line, a tight pattern of 2 to 5 rows of nails, spaced 5-ft to 5.5-ft horizontally and 4-ft to 5-ft vertically will be utilized.

Based on the referenced geotechnical report, the subsurface conditions throughout the project site generally consist of a thin veneer of top soil, underlain by very dense glacial till. Therefore, based on the recommendations in the geotechnical report, we have utilized the following soil strength parameters and pullout values for stability analyses of the permanent soil nailed wall:

Soil Unit	Soil Unit Weight (pcf)	Soil Friction (deg)	Soil Cohesion (psf)	Design Pullout Resistance (k/ft)
Glacial Soils	120	36	200	4

For the purposes of design of the wall, the water table has been assumed to occur at or beneath the base of the excavation, in accordance with the findings from the geotechnical investigation. However, localized perched pockets or stringers of water may be encountered at the face of the excavation at any depth of excavation and in any season. The geocomposite drain board strips will be used to control the water encountered at the wall face. Standard sump pumps may be required to remove water from the base of the excavation as construction proceeds.

## **2. RETAINING WALL DESIGN CALCULATIONS AND PLANS**

### **2.1 General Design and Loading Considerations**

We have performed the shoring wall design in accordance with the 2015 International Building Code, generally accepted standards of practice for shoring wall design, and the following standard design publication: "Publication No. FHWA-IF-03-017, Geotechnical Engineering Circular No. 7, Soil Nail Walls." There is no significant surcharge behind the wall, other than the sloped hillside condition, which was considered in the soil nail stability analyses presented below.

## 2.2 Soil Nail Wall Stability Analyses

The soil nail wall stability design calculations are contained in Appendix A. Static and seismic stability analyses have been performed for the critical stages of excavation in accordance with the referenced FHWA publication using our proprietary soil nail design spreadsheet program. A total of three (3) soil nail design cross-sections were considered, with a total of nine (9) analyses reported below. The geometry plot and the input and output files are provided for each stability analysis in Appendix A. The files contained in Appendix A are named: 11-FT, 11-FT-E1, 11-FT-E2, 20-FT, 20-FT-E1, 20-FT-E2, 23-FT, 23-FT-E1, and 23-FT-E2. These file names refer to the overall design wall height in feet, and the type of analysis. For example, the file 23-FT-E1 refers to the section on the wall where the total cut height is 23 feet (down to base of footing), and it considers the first FHWA seismic or earthquake analysis which examines surfaces inside the nail pattern. (Note that the design section locations are indicated on the wall elevation sheets of the plans.) The results in Appendix A indicate the critical nail lengths, nail strengths, and nail head strengths as determined for each series of slip surfaces searched in each soil nail stability analysis.

Note that for the temporary construction condition, the wall height is roughly 2 feet deeper for the footing excavation. However, because the required factor of safety is decreased from 1.5 to 1.35, we have found that the permanent condition is more critical than the temporary condition in all cases. For the permanent soil nail wall, two seismic slope stability analyses were performed for the final wall height for each of the three sections, by considering a pseudo-static acceleration of 0.25g (corresponding to a peak ground acceleration of in excess of 0.60g). Seismic loading was only found to be more critical to the design than the permanent static loading condition for the determination of nail lengths. The force requirements were substantially less.

The results of the analyses indicate that the required soil nail lengths range from 10 to 20 feet, and the required threadbar sizes range from #8 to #9 grade 75 bars. The maximum required soil nail facing capacity is found to never exceed the input or seed value of 10 kips. See Section 2.3 and Appendix B for a discussion of the facing design calculations.

## 2.3 Temporary & Permanent Wall Facing Design Calculations

Based on all of the soil nail wall analyses, a soil nail wall facing nominal strength of up to 10 kips is required. (However, this is based on the permanent condition analyses. For the temporary construction facing, the required strength is significantly less due to the lower factor of safety.) The temporary shotcrete wall facing design calculations are contained in Appendix B and have been performed in general accordance with the methods and recommendations in the referenced FHWA soil nail design manual. The shotcrete facing is designed as a typical soil nail wall facing that spans in all directions from the localized nail head supports.

For the temporary construction facing, the calculations are presented in Figures B-1 and B-2 for the failure modes of flexure and punching shear, respectively. From experience and precedent, a standard 4-inch construction facing, which has been successfully used in similar soils and excavations to depths up to 50 feet, will be adequate. The standard facing consists of a minimum 4-inch thick shotcrete wall with a single layer of 6"x6"-W2.9xW2.9 steel mesh placed near the center of the facing, with an additional two #4 tic-tac-toe bars, and a 3/4"x9"x9" bearing plate. The strength of this standard facing is computed to be 43.5 kips.

For the permanent wall facing, which is to be designed by others, the facing is connected to the nail heads with a group of four headed studs welded to the bearing plate. The design calculations for this system will ultimately be performed by the building structural engineer, for they are still

finalizing the wall thickness and reinforcing at this time. We may examine the strength of the headed studs per the FHWA manual, and we find that the nominal strength for a set of four 5/8" headed studs attached to a 3/4"x9"x9" bearing plate is about 73.6 kips (Figure B-3).

## 2.4 Catchment Wall Considerations

Per the geotechnical report, the catchment wall is ultimately to be designed to carry a 100 pcf triangular equivalent fluid loading over a 5-ft wall height to represent the effects of colluvium moving against the wall in the future. The structural engineer will design this, but we may examine its effects on the nails. The service loading on the first row of nails is estimated in the sketch in Appendix B based on the nail prying under the lateral force and moment of the catchment loading. For nails on about a 5.5-ft spacing, the added load per nail is likely to be on the order of 18 to 29 kips. Therefore, we have simply added additional #9 grade 75 nails in between the main schedule of nails in the first row, to carry this load alone. This bar has an allowable load of about  $(0.6)(75 \text{ ksi})(1 \text{ in}^2) = 45 \text{ kips}$  which is more than adequate. And the nail head strength from Section 2.3 above is adequate to carry this load as well.

## 2.5 Deflection Estimate

Based on our experience and precedent with the very dense soils present at this site, we estimate that the maximum horizontal and vertical retaining wall movements will be on the order of 0.05% to 0.1% of the wall height. Because the walls are up to 23 feet high, this means that we estimate that the deflections at the face of the top of the walls may be on the order of 1/4".

## 3. SHORING DESIGN PLANS

Our design plans consist of nine (9) drawing sheets bound separately from this letter report. The number and title for each sheet are indicated as follows:

SH1.0-1.1	Cover Sheet and Notes
SH2.0	Plan View
SH3.0	Wall Elevation
SH4.0	Cross-Sections
SH5.0	Details
SH6.0	Soil Nailing Sequence
SH7.0-7.1	Specifications

**4. CLOSURE**

We trust that the permanent retaining wall design submittal is in accordance with your needs at this time. We have enjoyed working with you on this project. If you have any questions, please call us anytime at 425-488-1143 or 425-922-1501.

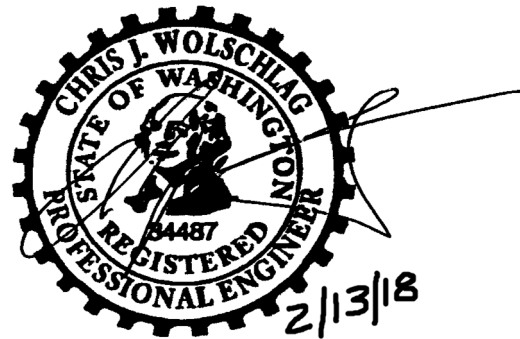
Sincerely,

GROUND SUPPORT PLLC

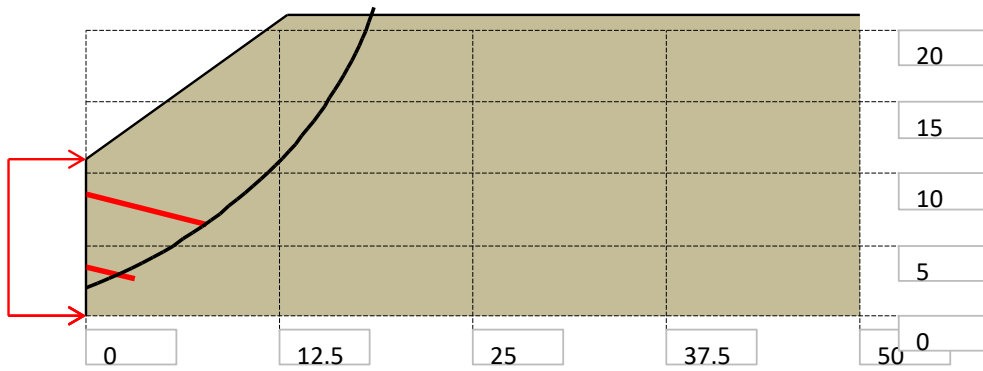


Chris J. Wolschlag, S.E., Ph.D.  
Partner

hart residence report r0 021318.docx



APPENDIX A  
SOIL NAIL WALL STABILITY ANALYSES



11-FT

<b>Analysis Mode</b>	
Design(D)/Factor of Safety(FS)	D

<b>Analysis Type</b>	
Soil Nail(SN)/Tie Back(TB)/Active EP(AEP)/Passive EP(PEP)	SN

<b>General</b>	
Toe Segment No.	1
Toe Specification Type (X/Y)	Y
Toe Y Value	2
X-Base	0
Y-Base	0
Minimum Toe Angle (deg)	20
Maximum Toe Angle (deg)	80
No. Toe Angles	20
Minimum Exit X Value	5
Maximum Exit X Value	45
No. Exit Points	20
Water Unit Weight	62.4
Seismic Coefficient (g's)	0

<b>Factors of Safety</b>	
Service Load Design(SLD)/Load-Resistance Factor Design(LRFD)	SLD
FS - Cohesion	1.5
FS - Friction Angle	1.5
Strength Factor - Nail Tendon	0.55
Strength Factor - Nail Head	0.67
Strength Factor - Pullout	0.5
	0
	0
	0
	0
	0



Soil	Cohesion	Friction	Unit Wt.	Pullout
1	200	36	120	8000

Piezo	X	Y

Node	X	Y
1	0	0
2	0	11
3	13	21
4	50	21
5	0	4

Segment	Node 1	Node 2	Top Soil #	Bot. Soil #	Top PO #	Bot. PO #
1	1	2	0	1	0	1
2	2	3	0	1	0	1
3	3	4	0	1	0	1

Surcharge	Node 1	P1	Node 2	P2	Angle

Nail	Xs	Ys	Length	Dip	Tendon Str.	Head Str.	Fixed?	Spacing	Tieback?
1	0	8.5	1	15	10000	10000	0	5.5	0
2	0	3.5	1	15	10000	10000	0	5.5	0

Face Press	Node 1	P1	Node 2	P2	Angle
1	1	0.5	6	1	0
2	6	1	2	1	0

Analysis Type: Soil Nail

Analysis Mode: Design

Nail Head Strength Factor (Multiplier): 1.00

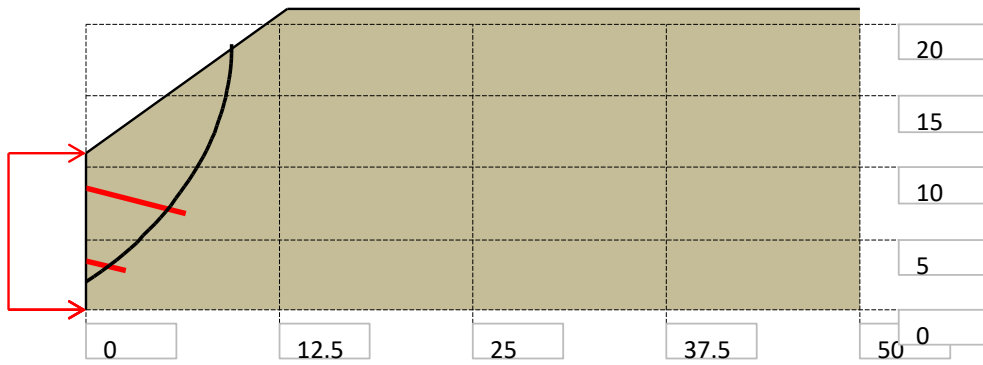
Nail	Length	Capacity	Slip Surf.
1	8.1	10689	69
2	3.3	8338	114

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
1	-52.12	67.84	5.06	64.21	1.47
2	-76.58	98.73	5.56	64.21	1.47
3	-141.73	181.03	6.13	64.21	1.56
4	-27.97	41.64	5.00	61.05	1.67
5	-38.75	56.92	5.74	61.05	1.80
6	-59.40	86.17	6.54	61.05	3.06
7	-96.21	138.34	7.23	61.05	3.06
8	-235.82	336.19	8.02	61.05	3.27
9	-23.07	38.85	5.67	57.89	3.27
10	-30.25	50.32	6.47	57.89	3.40
11	-40.86	67.26	7.26	57.89	3.55
12	-60.11	98.00	8.14	57.89	3.66
13	-98.46	159.26	9.03	57.89	3.79
14	-243.77	391.35	10.06	57.89	3.80
15	-13.42	26.32	5.00	54.74	3.80
16	-15.93	30.87	5.67	54.74	3.80
17	-19.43	37.20	6.43	54.74	3.80
18	-24.31	46.05	7.26	54.74	3.91
19	-32.44	60.78	8.26	54.74	4.11
20	-42.55	79.10	9.13	54.74	4.17
21	-66.55	122.58	10.39	54.74	4.29
22	-137.26	250.72	11.92	54.74	4.29
23	-239.24	435.50	12.69	54.74	4.32
24	-11.65	26.16	5.67	51.58	4.32
25	-13.69	30.41	6.42	51.58	4.32
26	-16.43	36.08	7.26	51.58	4.32
27	-20.16	43.81	8.19	51.58	4.44
28	-25.54	54.98	9.24	51.58	4.61
29	-33.25	70.99	10.38	51.58	4.73
30	-45.67	96.74	11.67	51.58	4.82
31	-72.67	152.76	13.20	51.58	4.93

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
32	-208.72	435.01	14.39	51.58	5.17
33	-8.77	23.09	5.68	48.42	5.17
34	-10.09	26.26	6.43	48.42	5.17
35	-11.75	30.27	7.26	48.42	5.17
36	-13.93	35.50	8.19	48.42	5.17
37	-16.80	42.40	9.22	48.42	5.17
38	-20.45	51.19	10.32	48.42	5.17
39	-26.01	64.55	11.67	48.42	5.26
40	-34.79	85.67	13.17	48.42	5.41
41	-64.10	156.17	14.73	48.42	5.81
42	-185.54	448.22	16.08	48.42	6.00
43	-7.53	23.36	6.42	45.26	6.00
44	-8.62	26.46	7.26	45.26	6.00
45	-10.00	30.35	8.19	45.26	6.00
46	-11.70	35.18	9.20	45.26	6.00
47	-13.94	41.55	10.37	45.26	6.00
48	-16.82	49.70	11.66	45.26	6.00
49	-20.71	60.75	13.09	45.26	6.00
50	-30.10	87.38	14.64	45.26	6.22
51	-56.26	161.59	16.41	45.26	6.43
52	-164.63	468.99	17.95	45.26	6.43
53	-6.35	23.77	7.25	42.11	6.43
54	-7.25	26.84	8.18	42.11	6.43
55	-8.35	30.62	9.22	42.11	6.43
56	-9.71	35.30	10.37	42.11	6.43
57	-11.41	41.12	11.66	42.11	6.43
58	-13.60	48.64	13.09	42.11	6.43
59	-18.13	64.14	14.69	42.11	6.63
60	-27.18	95.19	16.48	42.11	6.85
61	-48.55	168.44	18.27	42.11	6.85
62	-142.78	491.51	20.01	42.11	6.85
63	-5.19	24.30	8.18	38.95	6.85
64	-5.90	27.35	9.22	38.95	6.85
65	-6.77	31.10	10.39	38.95	6.85
66	-7.81	35.55	11.66	38.95	6.85
67	-9.11	41.15	13.09	38.95	6.85
68	-11.45	51.18	14.69	38.95	6.97
69	-15.43	68.30	16.47	38.95	7.20
70	-23.43	102.65	18.45	38.95	7.20
71	-46.68	202.53	20.71	38.95	7.20
72	-709.67	3050.75	23.30	38.95	7.20
73	-4.02	24.93	9.22	35.79	7.20
74	-4.55	27.97	10.37	35.79	7.20
75	-5.19	31.62	11.66	35.79	7.20

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
76	-5.97	36.04	13.09	35.79	7.20
77	-7.22	43.16	14.69	35.79	7.24
78	-9.17	54.32	16.47	35.79	7.48
79	-12.48	73.15	18.45	35.79	7.48
80	-19.04	110.59	20.64	35.79	7.48
81	-38.33	220.61	23.18	35.79	7.48
82	-527.08	3007.86	26.09	35.79	7.48
83	-2.81	25.63	10.37	32.63	7.48
84	-3.18	28.69	11.66	32.63	7.48
85	-3.61	32.34	13.09	32.63	7.48
86	-4.25	37.69	14.68	32.63	7.48
87	-5.18	45.54	16.46	32.63	7.71
88	-6.64	57.81	18.45	32.63	7.73
89	-9.12	78.66	20.66	32.63	7.73
90	-14.03	119.86	23.13	32.63	7.73
91	-27.77	235.31	25.93	32.63	7.73
92	-299.42	2517.53	29.27	32.63	7.73
93	-1.55	26.43	11.66	29.47	7.73
94	-1.75	29.53	13.09	29.47	7.73
95	-2.01	33.71	14.68	29.47	7.73
96	-2.39	39.63	16.46	29.47	7.86
97	-2.94	48.30	18.44	29.47	7.91
98	-3.78	61.66	20.64	29.47	7.91
99	-5.22	84.30	23.11	29.47	7.91
100	-8.02	128.45	25.88	29.47	7.91
101	-15.38	244.39	29.00	29.47	7.91
102	-121.80	1921.97	32.93	29.47	7.91
103	-0.24	30.69	14.68	26.32	7.91
104	-0.27	35.32	16.46	26.32	7.97
105	-0.33	41.78	18.42	26.32	8.02
106	-0.41	51.39	20.65	26.32	8.02
107	-0.53	66.00	23.12	26.32	8.02
108	-0.72	89.40	25.80	26.32	8.02
109	-1.10	135.70	28.95	26.32	8.02
110	-2.01	246.55	32.42	26.32	8.02
111	-11.85	1439.95	37.18	26.32	8.02
112	1.23	28.30	14.68	23.16	8.02
113	1.41	32.04	16.46	23.16	8.02
114	1.65	37.17	18.44	23.16	8.07
115	1.99	44.33	20.65	23.16	8.07
116	2.47	54.66	23.11	23.16	8.07
117	3.20	70.31	25.86	23.16	8.07
118	4.38	95.47	28.92	23.16	8.07
119	6.52	141.04	32.36	23.16	8.07

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
120	11.25	241.83	36.24	23.16	8.07
121	51.50	1099.87	42.18	23.16	8.07
122	2.81	29.45	16.46	20.00	8.07
123	3.23	33.59	18.44	20.00	8.07
124	3.80	39.16	20.63	20.00	8.07
125	4.61	47.02	23.11	20.00	8.07
126	5.74	58.12	25.85	20.00	8.07
127	7.42	74.47	28.90	20.00	8.07
128	10.05	100.22	32.33	20.00	8.07
129	14.55	144.17	36.16	20.00	8.07
130	23.48	231.43	40.46	20.00	8.07
131	42.20	414.33	44.61	20.00	8.07



11-FT-E1

<b>Analysis Mode</b>	
Design(D)/Factor of Safety(FS)	D

<b>Analysis Type</b>	
Soil Nail(SN)/Tie Back(TB)/Active EP(AEP)/Passive EP(PEP)	SN

<b>General</b>	
Toe Segment No.	1
Toe Specification Type (X/Y)	Y
Toe Y Value	2
X-Base	0
Y-Base	0
Minimum Toe Angle (deg)	20
Maximum Toe Angle (deg)	80
No. Toe Angles	20
Minimum Exit X Value	5
Maximum Exit X Value	10
No. Exit Points	20
Water Unit Weight	62.4
Seismic Coefficient (g's)	0.41

<b>Factors of Safety</b>	
Service Load Design(SLD)/Load-Resistance Factor Design(LRFD)	SLD
FS - Cohesion	1.1
FS - Friction Angle	1.1
Strength Factor - Nail Tendon	0.74
Strength Factor - Nail Head	0.91
Strength Factor - Pullout	0.67
	0
	0
	0
	0
	0

Soil	Cohesion	Friction	Unit Wt.	Pullout
1	200	36	120	8000

Piezo	X	Y

Node	X	Y
1	0	0
2	0	11
3	13	21
4	50	21
5	0	4

Segment	Node 1	Node 2	Top Soil #	Bot. Soil #	Top PO #	Bot. PO #
1	1	2	0	1	0	1
2	2	3	0	1	0	1
3	3	4	0	1	0	1

Surcharge	Node 1	P1	Node 2	P2	Angle

Nail	Xs	Ys	Length	Dip	Tendon Str.	Head Str.	Fixed?	Spacing	Tieback?
1	0	8.5	1	15	10000	10000	0	5.5	0
2	0	3.5	1	15	10000	10000	0	5.5	0

Face Press	Node 1	P1	Node 2	P2	Angle
1	1	0.5	6	1	0
2	6	1	2	1	0



Analysis Type: Soil Nail

Analysis Mode: Design

Nail Head Strength Factor (Multiplier): 1.00

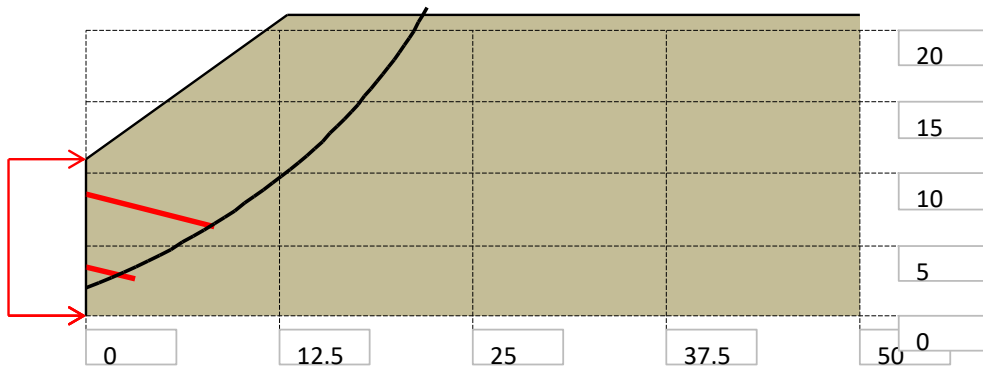
Nail	Length	Capacity	Slip Surf.
1	6.7	10762	115
2	2.7	8448	125

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
1	-136.51	204.96	5.00	67.37	1.24
2	-267.03	399.02	5.25	67.37	1.33
3	-40.33	69.74	5.06	64.21	1.53
4	-41.46	71.65	5.11	64.21	1.53
5	-42.77	73.84	5.15	64.21	1.53
6	-44.28	76.38	5.20	64.21	1.53
7	-52.93	90.91	5.43	64.21	1.61
8	-55.74	95.63	5.50	64.21	1.61
9	-59.11	101.29	5.57	64.21	1.61
10	-77.76	132.62	5.85	64.21	1.69
11	-85.68	145.92	5.94	64.21	1.69
12	-96.01	163.28	6.03	64.21	1.73
13	-167.48	283.33	6.39	64.21	1.76
14	-219.16	370.14	6.51	64.21	1.86
15	-21.17	42.49	5.00	61.05	1.86
16	-21.92	43.92	5.09	61.05	1.86
17	-22.79	45.59	5.18	61.05	1.86
18	-23.83	47.58	5.28	61.05	1.86
19	-25.52	50.79	5.44	61.05	1.86
20	-26.23	52.16	5.50	61.05	1.86
21	-28.39	56.29	5.68	61.05	1.86
22	-30.50	60.32	5.83	61.05	1.89
23	-33.52	66.10	6.02	61.05	3.03
24	-37.10	72.95	6.21	61.05	3.10
25	-42.17	82.64	6.44	61.05	3.18
26	-48.53	94.80	6.67	61.05	3.24
27	-64.11	124.59	7.08	61.05	3.39
28	-72.54	140.71	7.23	61.05	3.39
29	-83.85	162.34	7.40	61.05	3.46
30	-151.96	292.57	7.92	61.05	3.53
31	-214.81	412.75	8.13	61.05	3.59

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
32	-13.83	32.41	5.01	57.89	3.59
33	-14.13	33.07	5.08	57.89	3.59
34	-14.54	33.98	5.18	57.89	3.59
35	-14.97	34.93	5.27	57.89	3.59
36	-15.58	36.26	5.40	57.89	3.59
37	-16.23	37.70	5.53	57.89	3.59
38	-17.00	39.39	5.67	57.89	3.59
39	-17.89	41.35	5.83	57.89	3.59
40	-19.01	43.81	6.01	57.89	3.59
41	-20.16	46.34	6.19	57.89	3.59
42	-21.97	50.32	6.44	57.89	3.59
43	-24.01	54.81	6.68	57.89	3.61
44	-26.73	60.78	6.97	57.89	3.71
45	-30.00	67.98	7.27	57.89	3.80
46	-33.72	76.17	7.56	57.89	3.86
47	-41.95	94.25	8.05	57.89	4.01
48	-50.60	113.29	8.43	57.89	4.09
49	-64.70	144.31	8.87	57.89	4.17
50	-107.38	238.17	9.58	57.89	4.26
51	-143.46	317.52	9.88	57.89	4.30
52	-9.63	26.70	5.00	54.74	4.30
53	-9.83	27.22	5.08	54.74	4.30
54	-10.03	27.72	5.16	54.74	4.30
55	-10.32	28.49	5.28	54.74	4.30
56	-10.59	29.18	5.38	54.74	4.30
57	-10.98	30.17	5.53	54.74	4.30
58	-11.39	31.21	5.67	54.74	4.30
59	-11.86	32.43	5.83	54.74	4.30
60	-12.42	33.86	6.01	54.74	4.30
61	-13.01	35.39	6.19	54.74	4.30
62	-13.85	37.53	6.43	54.74	4.30
63	-14.78	39.93	6.68	54.74	4.30
64	-15.76	42.44	6.92	54.74	4.30
65	-17.41	46.67	7.29	54.74	4.30
66	-19.02	50.80	7.61	54.74	4.30
67	-21.20	56.39	7.99	54.74	4.38
68	-23.92	63.37	8.40	54.74	4.49
69	-28.51	75.14	8.97	54.74	4.65
70	-32.99	86.65	9.42	54.74	4.73
71	-39.66	103.76	9.96	54.74	4.82
72	-6.94	23.18	5.00	51.58	4.82
73	-7.06	23.56	5.08	51.58	4.82
74	-7.20	23.99	5.18	51.58	4.82
75	-7.37	24.51	5.29	51.58	4.82

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
76	-7.54	25.03	5.40	51.58	4.82
77	-7.73	25.60	5.51	51.58	4.82
78	-7.99	26.40	5.67	51.58	4.82
79	-8.27	27.24	5.83	51.58	4.82
80	-8.59	28.22	6.01	51.58	4.82
81	-8.98	29.43	6.22	51.58	4.82
82	-9.39	30.67	6.43	51.58	4.82
83	-9.90	32.22	6.68	51.58	4.82
84	-10.50	34.05	6.96	51.58	4.82
85	-11.18	36.14	7.25	51.58	4.82
86	-12.13	39.05	7.63	51.58	4.82
87	-13.11	42.02	7.99	51.58	4.82
88	-14.39	45.92	8.42	51.58	4.87
89	-15.97	50.76	8.89	51.58	5.01
90	-17.83	56.44	9.38	51.58	5.13
91	-5.53	22.68	5.53	48.42	5.13
92	-5.68	23.23	5.67	48.42	5.13
93	-5.85	23.86	5.83	48.42	5.13
94	-6.04	24.59	6.01	48.42	5.13
95	-6.27	25.43	6.21	48.42	5.13
96	-6.52	26.39	6.43	48.42	5.13
97	-6.82	27.51	6.68	48.42	5.13
98	-7.17	28.81	6.96	48.42	5.13
99	-7.56	30.27	7.25	48.42	5.13
100	-8.06	32.13	7.61	48.42	5.13
101	-8.65	34.35	8.00	48.42	5.13
102	-9.31	36.79	8.41	48.42	5.21
103	-10.12	39.85	8.89	48.42	5.38
104	-11.12	43.55	9.42	48.42	5.54
105	-4.34	22.75	6.22	45.26	5.54
106	-4.49	23.47	6.43	45.26	5.54
107	-4.67	24.33	6.68	45.26	5.54
108	-4.88	25.33	6.96	45.26	5.54
109	-5.13	26.53	7.28	45.26	5.54
110	-5.41	27.86	7.61	45.26	5.54
111	-5.73	29.40	7.99	45.26	5.54
112	-6.11	31.22	8.41	45.26	5.54
113	-6.56	33.37	8.88	45.26	5.70
114	-7.10	35.94	9.41	45.26	5.88
115	-7.75	39.04	10.00	45.26	6.05
116	-3.32	23.78	7.26	42.11	6.05
117	-3.48	24.84	7.61	42.11	6.05
118	-3.67	26.07	7.99	42.11	6.05
119	-3.88	27.48	8.41	42.11	6.05

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
120	-4.14	29.16	8.89	42.11	6.05
121	-4.43	31.11	9.41	42.11	6.18
122	-2.20	24.80	8.41	38.95	6.18
123	-2.33	26.14	8.89	38.95	6.23
124	-2.48	27.70	9.41	38.95	6.44
125	-0.95	25.18	9.41	35.79	6.67



11-FT-E2

<b>Analysis Mode</b>	
Design(D)/Factor of Safety(FS)	D

<b>Analysis Type</b>	
Soil Nail(SN)/Tie Back(TB)/Active EP(AEP)/Passive EP(PEP)	SN

<b>General</b>	
Toe Segment No.	1
Toe Specification Type (X/Y)	Y
Toe Y Value	2
X-Base	0
Y-Base	0
Minimum Toe Angle (deg)	20
Maximum Toe Angle (deg)	80
No. Toe Angles	20
Minimum Exit X Value	10
Maximum Exit X Value	45
No. Exit Points	20
Water Unit Weight	62.4
Seismic Coefficient (g's)	0.25

<b>Factors of Safety</b>	
Service Load Design(SLD)/Load-Resistance Factor Design(LRFD)	SLD
FS - Cohesion	1.1
FS - Friction Angle	1.1
Strength Factor - Nail Tendon	0.74
Strength Factor - Nail Head	0.91
Strength Factor - Pullout	0.67
	0
	0
	0
	0
	0

Soil	Cohesion	Friction	Unit Wt.	Pullout
1	200	36	120	8000

Piezo	X	Y

Node	X	Y
1	0	0
2	0	11
3	13	21
4	50	21
5	0	4

Segment	Node 1	Node 2	Top Soil #	Bot. Soil #	Top PO #	Bot. PO #
1	1	2	0	1	0	1
2	2	3	0	1	0	1
3	3	4	0	1	0	1

Surcharge	Node 1	P1	Node 2	P2	Angle

Nail	Xs	Ys	Length	Dip	Tendon Str.	Head Str.	Fixed?	Spacing	Tieback?
1	0	8.5	1	15	10000	10000	0	5.5	0
2	0	3.5	1	15	10000	10000	0	5.5	0

Face Press	Node 1	P1	Node 2	P2	Angle
1	1	0.5	6	1	0
2	6	1	2	1	0

Analysis Type: Soil Nail

Analysis Mode: Design

Nail Head Strength Factor (Multiplier): 1.00

Nail	Length	Capacity	Slip Surf.
1	8.6	10442	40
2	3.3	8171	109

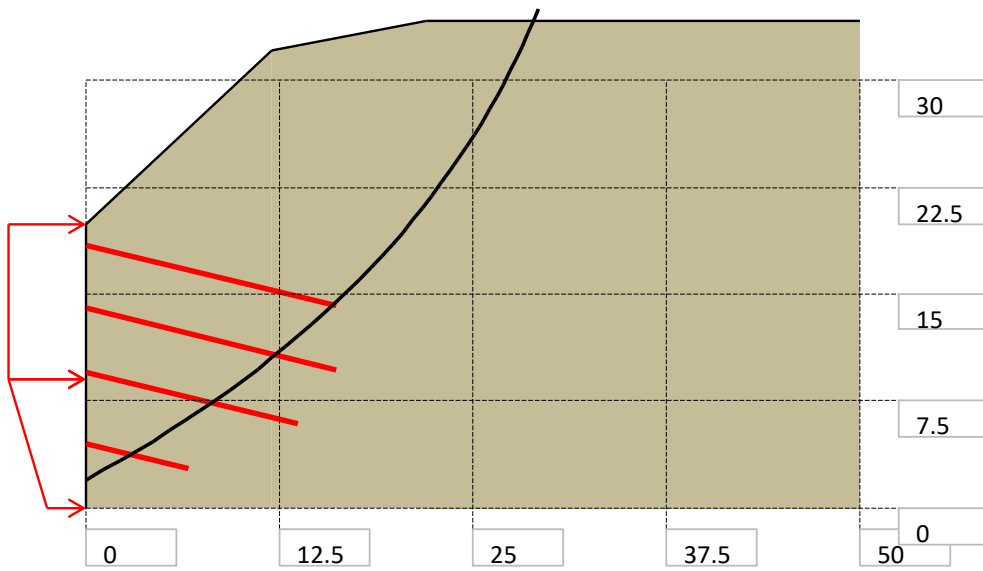
Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
1	-203.22	448.94	10.16	57.89	1.69
2	-53.84	140.16	10.75	54.74	2.11
3	-62.63	162.70	11.09	54.74	2.11
4	-106.81	276.07	12.09	54.74	2.11
5	-143.49	370.19	12.51	54.74	2.11
6	-20.77	65.42	10.05	51.58	4.17
7	-23.60	74.05	10.60	51.58	4.24
8	-26.98	84.38	11.16	51.58	4.27
9	-34.01	105.83	12.07	51.58	4.39
10	-41.54	128.84	12.82	51.58	4.43
11	-80.14	246.69	13.90	51.58	4.79
12	-141.26	433.29	14.40	51.58	4.94
13	-12.33	48.10	10.00	48.42	4.94
14	-13.68	53.12	10.59	48.42	4.94
15	-15.34	59.34	11.24	48.42	4.94
16	-17.46	67.28	11.98	48.42	4.94
17	-20.20	77.50	12.80	48.42	4.94
18	-26.22	100.02	13.70	48.42	5.16
19	-40.63	153.88	14.74	48.42	5.48
20	-82.57	310.66	15.78	48.42	5.69
21	-8.45	42.36	10.59	45.26	5.69
22	-9.28	46.34	11.25	45.26	5.69
23	-10.29	51.16	11.98	45.26	5.69
24	-11.52	57.04	12.79	45.26	5.69
25	-13.79	67.89	13.70	45.26	5.69
26	-17.61	86.14	14.67	45.26	5.87
27	-25.66	124.61	15.85	45.26	6.18
28	-52.40	252.43	17.28	45.26	6.45
29	-96.40	462.69	17.96	45.26	6.48
30	-4.78	33.39	10.00	42.11	6.48
31	-5.15	35.81	10.59	42.11	6.48



Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
32	-5.58	38.65	11.24	42.11	6.48
33	-6.10	42.02	11.97	42.11	6.48
34	-6.70	45.98	12.78	42.11	6.48
35	-7.70	52.57	13.70	42.11	6.48
36	-9.26	62.76	14.70	42.11	6.48
37	-11.75	79.17	15.83	42.11	6.56
38	-16.14	107.96	17.06	42.11	6.78
39	-27.00	179.24	18.51	42.11	6.96
40	-54.88	362.26	19.72	42.11	7.04
41	-2.65	29.50	10.00	38.95	7.04
42	-2.83	31.39	10.59	38.95	7.04
43	-3.04	33.58	11.24	38.95	7.04
44	-3.29	36.14	11.97	38.95	7.04
45	-3.58	39.14	12.79	38.95	7.04
46	-4.01	43.58	13.69	38.95	7.04
47	-4.63	50.01	14.70	38.95	7.04
48	-5.53	59.40	15.83	38.95	7.04
49	-6.94	74.07	17.09	38.95	7.15
50	-9.39	99.49	18.49	38.95	7.32
51	-14.51	152.60	20.04	38.95	7.41
52	-29.42	307.41	21.68	38.95	7.41
53	-1.01	26.67	10.00	35.79	7.41
54	-1.07	28.20	10.59	35.79	7.41
55	-1.15	29.97	11.24	35.79	7.41
56	-1.23	32.00	11.96	35.79	7.41
57	-1.33	34.40	12.79	35.79	7.41
58	-1.46	37.68	13.70	35.79	7.41
59	-1.64	42.15	14.70	35.79	7.41
60	-1.90	48.30	15.83	35.79	7.41
61	-2.26	57.19	17.08	35.79	7.45
62	-2.79	70.09	18.43	35.79	7.64
63	-3.75	93.48	20.05	35.79	7.76
64	-5.57	137.90	21.79	35.79	7.78
65	-11.10	273.18	23.86	35.79	7.78
66	-115.50	2822.45	26.09	35.79	7.78
67	0.36	27.29	11.25	32.63	7.78
68	0.38	28.99	11.97	32.63	7.78
69	0.41	30.96	12.79	32.63	7.78
70	0.45	33.47	13.69	32.63	7.78
71	0.49	36.78	14.70	32.63	7.78
72	0.56	41.18	15.83	32.63	7.78
73	0.64	47.21	17.08	32.63	7.78
74	0.76	55.76	18.48	32.63	7.88
75	0.94	68.51	20.03	32.63	7.99

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
76	1.24	89.37	21.78	32.63	8.04
77	1.79	128.03	23.73	32.63	8.04
78	3.11	221.22	25.92	32.63	8.04
79	17.61	1243.31	28.92	32.63	8.04
80	1.83	28.33	12.79	29.47	8.04
81	1.97	30.33	13.69	29.47	8.04
82	2.14	32.89	14.70	29.47	8.04
83	2.37	36.21	15.83	29.47	8.04
84	2.68	40.60	17.08	29.47	8.04
85	3.09	46.56	18.48	29.47	8.08
86	3.67	54.92	20.03	29.47	8.22
87	4.53	67.21	21.77	29.47	8.30
88	5.87	86.51	23.70	29.47	8.30
89	8.24	120.72	25.88	29.47	8.30
90	13.35	194.32	28.33	29.47	8.30
91	24.66	357.25	30.49	29.47	8.30
92	3.24	27.90	13.69	26.32	8.30
93	3.49	29.94	14.70	26.32	8.30
94	3.82	32.53	15.83	26.32	8.30
95	4.24	35.89	17.08	26.32	8.30
96	4.79	40.31	18.48	26.32	8.30
97	5.54	46.27	20.03	26.32	8.39
98	6.57	54.51	21.76	26.32	8.47
99	8.06	66.47	23.70	26.32	8.47
100	10.36	84.87	25.87	26.32	8.47
101	14.13	114.99	28.26	26.32	8.47
102	20.70	167.51	30.74	26.32	8.47
103	39.71	319.54	33.88	26.32	8.47
104	330.62	2645.54	37.78	26.32	8.47
105	5.03	29.70	15.83	23.16	8.47
106	5.51	32.36	17.08	23.16	8.47
107	6.13	35.78	18.48	23.16	8.47
108	6.94	40.26	20.03	23.16	8.47
109	8.03	46.25	21.77	23.16	8.58
110	9.51	54.43	23.69	23.16	8.58
111	11.63	66.10	25.86	23.16	8.58
112	14.76	83.32	28.25	23.16	8.58
113	19.92	111.74	31.01	23.16	8.58
114	29.14	162.58	34.06	23.16	8.58
115	48.25	267.86	37.33	23.16	8.58
116	217.22	1198.88	42.52	23.16	8.58
117	6.08	27.44	15.82	20.00	8.58
118	6.60	29.60	17.08	20.00	8.58
119	7.25	32.33	18.48	20.00	8.58

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
120	8.09	35.84	20.03	20.00	8.58
121	9.18	40.41	21.76	20.00	8.58
122	10.63	46.45	23.70	20.00	8.58
123	12.54	54.46	25.81	20.00	8.58
124	15.29	65.98	28.25	20.00	8.58
125	19.21	82.38	30.93	20.00	8.58
126	25.18	107.34	33.92	20.00	8.58
127	35.10	148.81	37.27	20.00	8.58
128	54.15	228.50	41.07	20.00	8.58
129	90.25	379.52	44.63	20.00	8.58



20-FT

<b>Analysis Mode</b>	
Design(D)/Factor of Safety(FS)	D

<b>Analysis Type</b>	
Soil Nail(SN)/Tie Back(TB)/Active EP(AEP)/Passive EP(PEP)	SN

<b>General</b>	
Toe Segment No.	1
Toe Specification Type (X/Y)	Y
Toe Y Value	2
X-Base	0
Y-Base	0
Minimum Toe Angle (deg)	20
Maximum Toe Angle (deg)	80
No. Toe Angles	20
Minimum Exit X Value	5
Maximum Exit X Value	45
No. Exit Points	20
Water Unit Weight	62.4
Seismic Coefficient (g's)	0

<b>Factors of Safety</b>	
Service Load Design(SLD)/Load-Resistance Factor Design(LRFD)	SLD
FS - Cohesion	1.5
FS - Friction Angle	1.5
Strength Factor - Nail Tendon	0.55
Strength Factor - Nail Head	0.67
Strength Factor - Pullout	0.5
	0
	0
	0
	0
	0

Soil	Cohesion	Friction	Unit Wt.	Pullout
1	200	36	120	8000

Piezo	X	Y

Node	X	Y
1	0	0
2	0	20
3	12	32
4	22	34
5	50	34
6	0	9

Segment	Node 1	Node 2	Top Soil #	Bot. Soil #	Top PO #	Bot. PO #
1	1	2	0	1	0	1
2	2	3	0	1	0	1
3	3	4	0	1	0	1
4	4	5	0	1	0	1

Surcharge	Node 1	P1	Node 2	P2	Angle

Nail	Xs	Ys	Length	Dip	Tendon Str.	Head Str.	Fixed?	Spacing	Tieback?
1	0	18.5	1	15	10000	10000	0	5	0
2	0	14	1	15	10000	10000	0	5	0
3	0	9.5	1	15	10000	10000	0	5	0
4	0	4.5	1	15	10000	10000	0	5	0

Face Press	Node 1	P1	Node 2	P2	Angle
1	1	0.5	6	1	0
2	6	1	2	1	0

Analysis Type: Soil Nail

Analysis Mode: Design

Nail Head Strength Factor (Multiplier): 1.00

Nail	Length	Capacity	Slip Surf.
1	16.7	35382	56
2	16.7	36123	84
3	14.2	36431	105
4	6.9	27323	105

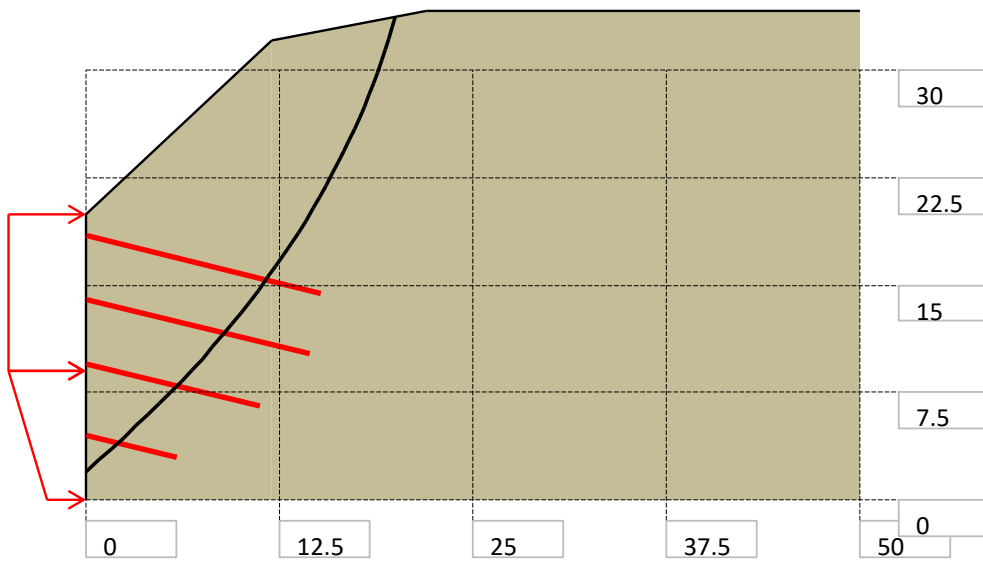
Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
1	-154.03	141.46	5.55	73.68	4.33
2	-258.71	236.25	6.25	73.68	4.63
3	-536.33	487.63	6.84	73.68	4.90
4	-62.40	65.09	5.03	70.53	4.90
5	-77.05	79.91	5.70	70.53	5.01
6	-96.58	99.66	6.35	70.53	5.27
7	-132.12	135.59	7.11	70.53	5.56
8	-215.10	219.50	8.03	70.53	5.88
9	-400.82	407.29	8.81	70.53	6.15
10	-48.55	56.83	5.72	67.37	6.15
11	-57.82	67.30	6.46	67.37	6.15
12	-69.10	80.03	7.16	67.37	6.15
13	-93.51	107.60	8.25	67.37	6.56
14	-132.27	151.38	9.31	67.37	6.89
15	-190.20	216.80	10.21	67.37	7.11
16	-333.42	378.54	11.23	67.37	7.36
17	-34.19	45.18	5.67	64.21	7.36
18	-39.16	51.47	6.42	64.21	7.36
19	-45.57	59.56	7.23	64.21	7.36
20	-55.28	71.83	8.23	64.21	7.36
21	-67.31	87.02	9.18	64.21	7.39
22	-86.71	111.53	10.33	64.21	7.72
23	-122.61	156.88	11.71	64.21	8.11
24	-227.85	289.81	13.11	64.21	8.81
25	-782.76	990.78	14.26	64.21	9.30
26	-32.81	48.50	7.25	61.05	9.30
27	-37.83	55.61	8.18	61.05	9.30
28	-44.47	65.02	9.22	61.05	9.30
29	-54.22	78.84	10.46	61.05	9.30

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
30	-67.36	97.46	11.76	61.05	9.30
31	-90.36	130.05	13.04	61.05	9.43
32	-146.03	208.95	14.51	61.05	10.14
33	-456.51	648.94	16.27	61.05	10.79
34	-27.99	46.70	8.18	57.89	10.79
35	-31.97	53.06	9.22	57.89	10.79
36	-36.88	60.90	10.33	57.89	10.79
37	-43.76	71.89	11.66	57.89	10.79
38	-54.06	88.34	13.02	57.89	10.79
39	-76.24	123.78	14.76	57.89	10.92
40	-120.06	193.76	16.44	57.89	11.69
41	-322.28	516.73	18.47	57.89	12.60
42	-24.11	45.68	9.22	54.74	12.60
43	-27.35	51.55	10.37	54.74	12.60
44	-31.36	58.83	11.64	54.74	12.60
45	-37.07	69.17	13.04	54.74	12.60
46	-46.42	86.12	14.64	54.74	12.60
47	-63.23	116.57	16.47	54.74	12.60
48	-100.84	184.73	18.55	54.74	13.36
49	-247.17	449.88	20.89	54.74	14.15
50	-23.51	50.78	11.66	51.58	14.15
51	-27.07	58.17	13.09	51.58	14.15
52	-32.28	68.97	14.69	51.58	14.15
53	-39.96	84.90	16.40	51.58	14.15
54	-54.03	114.08	18.45	51.58	14.15
55	-81.81	171.73	20.66	51.58	14.62
56	-204.45	426.15	23.44	51.58	15.33
57	-20.25	50.71	13.09	48.42	15.33
58	-23.40	58.28	14.68	48.42	15.33
59	-27.93	69.16	16.46	48.42	15.33
60	-34.83	85.76	18.44	48.42	15.33
61	-46.36	113.50	20.66	48.42	15.33
62	-70.58	171.76	23.12	48.42	15.60
63	-179.70	434.18	26.17	48.42	16.00
64	-17.32	51.13	14.68	45.26	16.00
65	-20.06	58.91	16.46	45.26	16.00
66	-23.98	70.03	18.44	45.26	16.00
67	-29.90	86.82	20.65	45.26	16.00
68	-40.15	115.90	23.11	45.26	16.00
69	-63.59	182.39	25.91	45.26	16.25
70	-157.86	449.79	29.17	45.26	16.25
71	-12.84	46.01	14.68	42.11	16.25
72	-14.54	51.85	16.44	42.11	16.25
73	-16.92	60.02	18.44	42.11	16.25



Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
74	-20.27	71.48	20.65	42.11	16.25
75	-25.49	89.39	23.11	42.11	16.25
76	-34.50	120.27	25.74	42.11	16.41
77	-54.13	187.59	28.76	42.11	16.41
78	-136.50	469.95	32.50	42.11	16.41
79	-10.44	46.84	16.46	38.95	16.41
80	-11.88	53.06	18.44	38.95	16.41
81	-13.85	61.51	20.65	38.95	16.41
82	-16.73	73.87	23.11	38.95	16.41
83	-21.41	93.99	25.85	38.95	16.53
84	-29.74	129.78	28.91	38.95	16.53
85	-47.85	207.56	32.34	38.95	16.53
86	-113.96	491.56	36.22	38.95	16.53
87	-8.05	47.91	18.43	35.79	16.53
88	-9.21	54.51	20.65	35.79	16.53
89	-10.81	63.65	23.11	35.79	16.53
90	-13.24	77.48	25.85	35.79	16.53
91	-17.09	99.48	28.90	35.79	16.53
92	-23.93	138.45	32.31	35.79	16.53
93	-38.79	223.22	36.14	35.79	16.53
94	-89.31	511.33	40.38	35.79	16.53
95	-5.63	49.30	20.65	32.63	16.53
96	-6.47	56.39	23.11	32.63	16.53
97	-7.69	66.58	25.85	32.63	16.53
98	-9.46	81.51	28.86	32.63	16.63
99	-12.36	105.86	32.31	32.63	16.63
100	-17.14	145.98	35.95	32.63	16.63
101	-28.13	238.32	40.36	32.63	16.63
102	-2.75	45.27	20.65	29.47	16.63
103	-3.11	50.96	23.10	29.47	16.63
104	-3.61	58.83	25.85	29.47	16.63
105	-4.32	70.03	28.90	29.47	16.74
106	-5.37	86.66	32.30	29.47	16.74
107	-7.03	112.86	36.10	29.47	16.74
108	-9.92	158.38	40.34	29.47	16.74
109	-0.37	46.75	23.11	26.32	16.74
110	-0.42	53.02	25.84	26.32	16.74
111	-0.49	61.69	28.90	26.32	16.74
112	-0.59	73.94	32.30	26.32	16.74
113	-0.74	92.00	36.09	26.32	16.74
114	-0.98	120.54	40.37	26.32	16.74
115	2.18	48.50	25.84	23.16	16.74
116	2.51	55.43	28.90	23.16	16.74
117	2.95	64.92	32.30	23.16	16.74

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
118	3.58	78.31	36.09	23.16	16.74
119	4.49	97.79	40.32	23.16	16.74
120	4.39	44.87	25.85	20.00	16.74
121	4.97	50.54	28.90	20.00	16.74
122	5.75	58.15	32.30	20.00	16.74
123	6.81	68.50	36.08	20.00	16.74
124	8.28	82.88	40.30	20.00	16.74



20-FT-E1

<b>Analysis Mode</b>	
Design(D)/Factor of Safety(FS)	D

<b>Analysis Type</b>	
Soil Nail(SN)/Tie Back(TB)/Active EP(AEP)/Passive EP(PEP)	SN

<b>General</b>	
Toe Segment No.	1
Toe Specification Type (X/Y)	Y
Toe Y Value	2
X-Base	0
Y-Base	0
Minimum Toe Angle (deg)	20
Maximum Toe Angle (deg)	80
No. Toe Angles	20
Minimum Exit X Value	5
Maximum Exit X Value	20
No. Exit Points	20
Water Unit Weight	62.4
Seismic Coefficient (g's)	0.41

<b>Factors of Safety</b>	
Service Load Design(SLD)/Load-Resistance Factor Design(LRFD)	SLD
FS - Cohesion	1.1
FS - Friction Angle	1.1
Strength Factor - Nail Tendon	0.74
Strength Factor - Nail Head	0.91
Strength Factor - Pullout	0.67
	0
	0
	0
	0
	0

Soil	Cohesion	Friction	Unit Wt.	Pullout
1	200	36	120	8000

Piezo	X	Y

Node	X	Y
1	0	0
2	0	20
3	12	32
4	22	34
5	50	34
6	0	9

Segment	Node 1	Node 2	Top Soil #	Bot. Soil #	Top PO #	Bot. PO #
1	1	2	0	1	0	1
2	2	3	0	1	0	1
3	3	4	0	1	0	1
4	4	5	0	1	0	1

Surcharge	Node 1	P1	Node 2	P2	Angle

Nail	Xs	Ys	Length	Dip	Tendon Str.	Head Str.	Fixed?	Spacing	Tieback?
1	0	18.5	1	15	10000	10000	0	5	0
2	0	14	1	15	10000	10000	0	5	0
3	0	9.5	1	15	10000	10000	0	5	0
4	0	4.5	1	15	10000	10000	0	5	0

Face Press	Node 1	P1	Node 2	P2	Angle
1	1	0.5	6	1	0
2	6	1	2	1	0

Analysis Type: Soil Nail

Analysis Mode: Design

Nail Head Strength Factor (Multiplier): 1.00

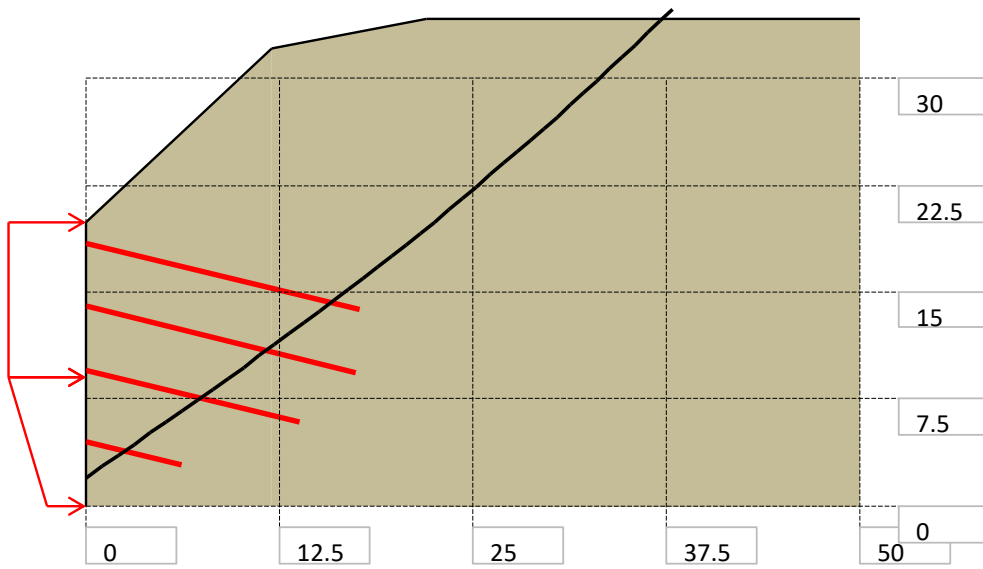
Nail	Length	Capacity	Slip Surf.
1	15.7	36471	85
2	15.0	37354	98
3	11.6	37354	98
4	6.1	27841	98

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
1	-103.79	124.65	5.22	73.68	0.00
2	-121.21	145.23	5.50	73.68	0.00
3	-147.61	176.43	5.80	73.68	0.00
4	-164.87	196.83	5.96	73.68	0.00
5	-225.21	268.13	6.32	73.68	0.00
6	-367.32	436.06	6.73	73.68	4.25
7	-50.67	69.04	5.05	70.53	4.25
8	-54.15	73.65	5.27	70.53	4.25
9	-58.43	79.31	5.52	70.53	4.25
10	-63.82	86.44	5.79	70.53	4.31
11	-70.75	95.62	6.09	70.53	4.47
12	-85.97	115.75	6.62	70.53	4.76
13	-101.33	136.07	7.02	70.53	4.91
14	-124.84	167.18	7.46	70.53	5.10
15	-164.99	220.30	7.97	70.53	5.30
16	-248.32	330.55	8.54	70.53	5.48
17	-332.84	442.38	8.85	70.53	5.60
18	-33.27	51.47	5.04	67.37	5.60
19	-34.70	53.60	5.23	67.37	5.60
20	-37.38	57.58	5.57	67.37	5.60
21	-39.51	60.74	5.82	67.37	5.60
22	-43.54	66.73	6.24	67.37	5.60
23	-46.94	71.79	6.55	67.37	5.60
24	-53.61	81.71	7.09	67.37	5.60
25	-59.68	90.74	7.50	67.37	5.60
26	-67.75	102.73	7.96	67.37	5.78
27	-85.80	129.57	8.74	67.37	6.09
28	-105.87	159.41	9.35	67.37	6.30
29	-139.55	209.48	10.05	67.37	6.52

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
30	-207.02	309.81	10.85	67.37	6.75
31	-273.30	408.34	11.29	67.37	6.88
32	-27.76	48.62	5.87	64.21	6.88
33	-29.38	51.36	6.19	64.21	6.88
34	-31.27	54.53	6.54	64.21	6.88
35	-34.12	59.32	7.02	64.21	6.88
36	-37.33	64.70	7.50	64.21	6.88
37	-41.03	70.92	7.99	64.21	6.88
38	-47.19	81.26	8.70	64.21	6.88
39	-52.96	90.96	9.25	64.21	6.88
40	-62.87	107.61	10.05	64.21	7.06
41	-77.54	132.25	10.94	64.21	7.34
42	-96.61	164.29	11.79	64.21	7.59
43	-133.84	226.83	12.62	64.21	7.91
44	-351.79	592.93	13.92	64.21	8.59
45	-24.18	48.24	7.00	61.05	8.59
46	-26.02	51.76	7.49	61.05	8.59
47	-28.33	56.16	8.06	61.05	8.59
48	-30.92	61.12	8.63	61.05	8.59
49	-34.26	67.51	9.30	61.05	8.59
50	-38.65	75.91	10.07	61.05	8.59
51	-43.98	86.09	10.87	61.05	8.59
52	-51.89	101.22	11.87	61.05	8.59
53	-64.32	125.00	12.82	61.05	8.59
54	-89.98	174.06	13.97	61.05	9.21
55	-151.36	291.43	15.21	61.05	9.94
56	-382.51	733.42	16.37	61.05	10.51
57	-20.48	47.03	8.03	57.89	10.51
58	-22.07	50.55	8.63	57.89	10.51
59	-24.00	54.79	9.30	57.89	10.51
60	-26.30	59.84	10.02	57.89	10.51
61	-29.26	66.35	10.87	57.89	10.51
62	-32.89	74.35	11.79	57.89	10.51
63	-38.47	86.60	12.82	57.89	10.51
64	-47.32	106.07	13.97	57.89	10.51
65	-62.61	139.71	15.25	57.89	10.56
66	-90.58	201.23	16.54	57.89	11.24
67	-217.18	479.65	18.37	57.89	12.50
68	-17.55	47.03	9.31	54.74	12.50
69	-18.97	50.66	10.03	54.74	12.50
70	-20.72	55.16	10.87	54.74	12.50
71	-22.93	60.84	11.83	54.74	12.50
72	-25.75	68.06	12.82	54.74	12.50
73	-29.93	78.79	13.96	54.74	12.50

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
74	-36.52	95.70	15.30	54.74	12.50
75	-47.10	122.87	16.74	54.74	12.50
76	-65.72	170.64	18.25	54.74	13.07
77	-109.17	282.13	19.91	54.74	14.32
78	-15.06	47.99	10.87	51.58	14.32
79	-16.36	51.94	11.77	51.58	14.32
80	-18.06	57.15	12.82	51.58	14.32
81	-20.33	64.08	13.96	51.58	14.32
82	-23.47	73.66	15.23	51.58	14.32
83	-28.09	87.76	16.66	51.58	14.32
84	-35.32	109.86	18.24	51.58	14.32
85	-47.70	147.63	19.97	51.58	14.98
86	-12.83	49.98	12.82	48.42	14.98
87	-14.15	54.88	13.96	48.42	14.98
88	-15.88	61.35	15.23	48.42	14.98
89	-18.28	70.35	16.66	48.42	14.98
90	-21.72	83.18	18.24	48.42	14.98
91	-9.75	48.59	13.96	45.26	14.98
92	-10.74	53.34	15.24	45.26	14.98
93	-12.06	59.63	16.66	45.26	14.98
94	-13.85	68.19	18.24	45.26	14.98
95	-6.96	47.68	15.24	42.11	14.98
96	-7.67	52.38	16.66	42.11	14.98
97	-8.62	58.56	18.24	42.11	14.98
98	-9.86	66.76	19.98	42.11	15.70
99	-4.35	47.14	16.66	38.95	15.70
100	-4.80	51.86	18.24	38.95	15.70
101	-1.84	46.92	18.24	35.79	15.70





20-FT-E2

<b>Analysis Mode</b>	
Design(D)/Factor of Safety(FS)	D

<b>Analysis Type</b>	
Soil Nail(SN)/Tie Back(TB)/Active EP(AEP)/Passive EP(PEP)	SN

<b>General</b>	
Toe Segment No.	1
Toe Specification Type (X/Y)	Y
Toe Y Value	2
X-Base	0
Y-Base	0
Minimum Toe Angle (deg)	20
Maximum Toe Angle (deg)	80
No. Toe Angles	20
Minimum Exit X Value	20
Maximum Exit X Value	45
No. Exit Points	20
Water Unit Weight	62.4
Seismic Coefficient (g's)	0.25

<b>Factors of Safety</b>	
Service Load Design(SLD)/Load-Resistance Factor Design(LRFD)	SLD
FS - Cohesion	1.1
FS - Friction Angle	1.1
Strength Factor - Nail Tendon	0.74
Strength Factor - Nail Head	0.91
Strength Factor - Pullout	0.67
	0
	0
	0
	0
	0

Soil	Cohesion	Friction	Unit Wt.	Pullout
1	200	36	120	8000

Piezo	X	Y

Node	X	Y
1	0	0
2	0	20
3	12	32
4	22	34
5	50	34
6	0	9

Segment	Node 1	Node 2	Top Soil #	Bot. Soil #	Top PO #	Bot. PO #
1	1	2	0	1	0	1
2	2	3	0	1	0	1
3	3	4	0	1	0	1
4	4	5	0	1	0	1

Surcharge	Node 1	P1	Node 2	P2	Angle

Nail	Xs	Ys	Length	Dip	Tendon Str.	Head Str.	Fixed?	Spacing	Tieback?
1	0	18.5	1	15	10000	10000	0	5	0
2	0	14	1	15	10000	10000	0	5	0
3	0	9.5	1	15	10000	10000	0	5	0
4	0	4.5	1	15	10000	10000	0	5	0

Face Press	Node 1	P1	Node 2	P2	Angle
1	1	0.5	6	1	0
2	6	1	2	1	0

Analysis Type: Soil Nail

Analysis Mode: Design

Nail Head Strength Factor (Multiplier): 1.00

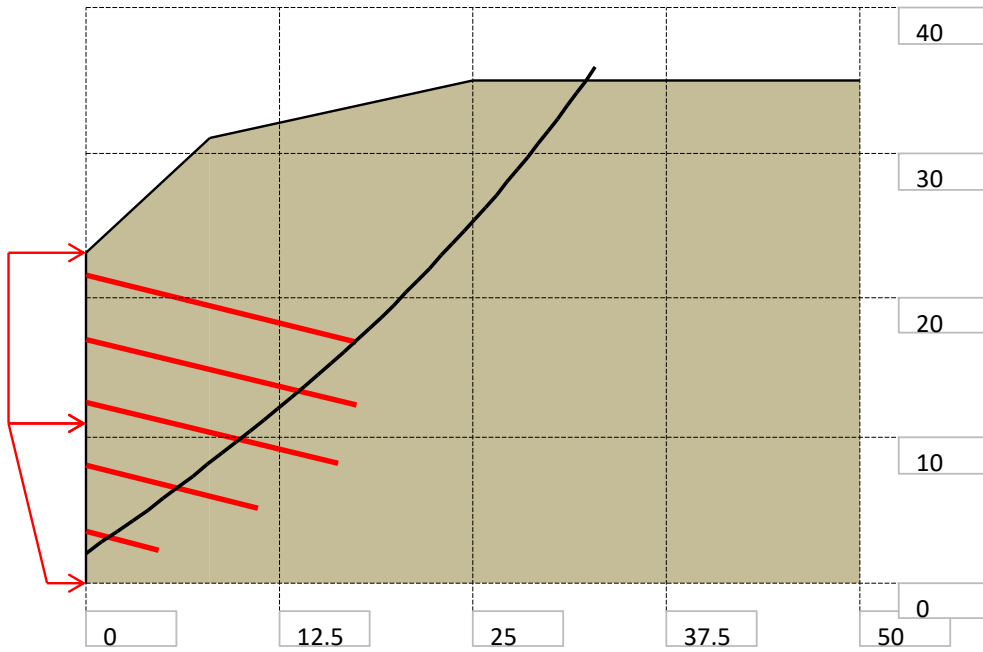
Nail	Length	Capacity	Slip Surf.
1	18.3	29951	37
2	18.0	31443	87
3	14.3	31443	87
4	6.4	23582	87

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
1	-118.18	305.24	20.11	54.74	11.40
2	-186.07	479.42	21.02	54.74	11.84
3	-220.62	568.08	21.28	54.74	11.84
4	-275.36	708.54	21.55	54.74	12.05
5	-52.41	162.02	20.44	51.58	12.05
6	-59.31	183.09	21.01	51.58	12.39
7	-62.90	194.05	21.26	51.58	12.39
8	-81.50	250.83	22.21	51.58	12.97
9	-90.92	279.61	22.52	51.58	13.07
10	-146.59	449.58	23.57	51.58	13.58
11	-188.88	578.70	23.96	51.58	13.72
12	-272.17	833.02	24.39	51.58	13.97
13	-27.24	103.82	20.08	48.42	13.97
14	-28.53	108.66	20.43	48.42	13.97
15	-30.45	115.84	20.90	48.42	13.97
16	-32.30	122.75	21.30	48.42	13.97
17	-35.94	136.36	22.00	48.42	13.97
18	-40.52	153.47	22.65	48.42	13.97
19	-47.90	181.04	23.45	48.42	14.10
20	-57.22	215.88	24.19	48.42	14.41
21	-71.55	269.45	24.98	48.42	14.72
22	-118.73	445.84	26.27	48.42	15.24
23	-161.99	607.55	26.82	48.42	15.24
24	-16.38	80.30	20.01	45.26	15.24
25	-17.09	83.69	20.43	45.26	15.24
26	-17.94	87.75	20.90	45.26	15.24
27	-18.94	92.51	21.40	45.26	15.24
28	-20.22	98.64	22.00	45.26	15.24
29	-21.94	106.85	22.64	45.26	15.24

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
30	-24.37	118.48	23.42	45.26	15.24
31	-27.26	132.25	24.18	45.26	15.24
32	-31.55	152.77	25.07	45.26	15.24
33	-37.69	182.13	26.04	45.26	15.59
34	-50.97	245.57	27.38	45.26	16.06
35	-69.89	336.01	28.47	45.26	16.32
36	-111.08	532.87	29.62	45.26	16.53
37	-1207.19	5771.12	31.51	45.26	16.92
38	-10.23	69.16	20.42	42.11	16.92
39	-10.63	71.80	20.89	42.11	16.92
40	-11.11	74.95	21.41	42.11	16.92
41	-11.69	78.72	22.00	42.11	16.92
42	-12.38	83.29	22.60	42.11	16.92
43	-13.37	89.79	23.36	42.11	16.92
44	-14.58	97.71	24.17	42.11	16.92
45	-16.15	108.04	25.07	42.11	16.92
46	-18.27	121.93	26.06	42.11	16.92
47	-21.18	141.07	27.15	42.11	16.92
48	-25.76	171.13	28.42	42.11	16.92
49	-33.32	220.77	29.82	42.11	16.92
50	-48.18	318.28	31.39	42.11	17.31
51	-79.20	521.94	32.88	42.11	17.44
52	-870.59	5717.50	35.16	42.11	17.68
53	-5.40	58.02	20.00	38.95	17.68
54	-5.55	59.58	20.41	38.95	17.68
55	-5.74	61.55	20.89	38.95	17.68
56	-5.95	63.77	21.41	38.95	17.68
57	-6.20	66.39	21.99	38.95	17.68
58	-6.52	69.70	22.64	38.95	17.68
59	-6.91	73.76	23.36	38.95	17.68
60	-7.40	78.77	24.17	38.95	17.68
61	-8.00	85.08	25.06	38.95	17.68
62	-8.78	93.18	26.06	38.95	17.68
63	-9.81	103.84	27.17	38.95	17.68
64	-11.11	117.33	28.33	38.95	17.68
65	-13.23	139.35	29.80	38.95	17.68
66	-16.27	170.89	31.33	38.95	17.68
67	-21.51	225.24	33.07	38.95	17.78
68	-32.30	337.27	35.03	38.95	17.99
69	-53.33	555.52	36.71	38.95	17.99
70	-1876.48	19479.75	39.50	38.95	17.99
71	-2.04	51.70	20.00	35.79	17.99
72	-2.09	52.95	20.42	35.79	17.99
73	-2.14	54.35	20.88	35.79	17.99

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
74	-2.21	56.05	21.41	35.79	17.99
75	-2.29	58.01	21.99	35.79	17.99
76	-2.39	60.41	22.64	35.79	17.99
77	-2.51	63.29	23.36	35.79	17.99
78	-2.65	66.79	24.17	35.79	17.99
79	-2.83	71.09	25.06	35.79	17.99
80	-3.05	76.45	26.06	35.79	17.99
81	-3.33	83.25	27.17	35.79	17.99
82	-3.69	92.08	28.41	35.79	17.99
83	-4.17	103.84	29.79	35.79	17.99
84	-4.84	120.11	31.33	35.79	17.99
85	-5.80	143.71	33.04	35.79	17.99
86	-7.27	179.46	34.90	35.79	18.13
87	-10.19	250.86	37.22	35.79	18.30
88	-15.95	391.52	39.53	35.79	18.30
89	-69.88	1708.38	43.17	35.79	18.30
90	0.64	46.97	20.00	32.63	18.30
91	0.65	47.96	20.42	32.63	18.30
92	0.67	49.09	20.89	32.63	18.30
93	0.69	50.38	21.40	32.63	18.30
94	0.71	51.92	21.99	32.63	18.30
95	0.73	53.74	22.64	32.63	18.30
96	0.76	55.91	23.36	32.63	18.30
97	0.80	58.54	24.17	32.63	18.30
98	0.84	61.52	25.02	32.63	18.30
99	0.90	65.49	26.05	32.63	18.30
100	0.97	70.25	27.17	32.63	18.30
101	1.05	76.25	28.41	32.63	18.30
102	1.16	83.92	29.79	32.63	18.30
103	1.31	94.00	31.33	32.63	18.30
104	1.50	107.63	33.04	32.63	18.30
105	1.77	126.85	34.96	32.63	18.30
106	2.18	155.52	37.10	32.63	18.30
107	2.84	202.06	39.48	32.63	18.30
108	3.84	272.68	41.76	32.63	18.30
109	3.06	46.08	21.41	29.47	18.30
110	3.14	47.28	21.98	29.47	18.30
111	3.24	48.74	22.64	29.47	18.30
112	3.36	50.43	23.36	29.47	18.30
113	3.50	52.44	24.16	29.47	18.30
114	3.67	54.85	25.06	29.47	18.30
115	3.87	57.74	26.05	29.47	18.30
116	4.11	61.28	27.16	29.47	18.30
117	4.42	65.65	28.41	29.47	18.30

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
118	4.80	71.10	29.79	29.47	18.30
119	5.28	78.02	31.32	29.47	18.30
120	5.90	86.97	33.03	29.47	18.30
121	6.72	98.86	34.94	29.47	18.30
122	7.89	115.61	37.11	29.47	18.30
123	9.54	139.50	39.51	29.47	18.30
124	11.99	174.72	42.09	29.47	18.30
125	5.53	46.20	23.36	26.32	18.30
126	5.73	47.79	24.16	26.32	18.30
127	5.97	49.70	25.06	26.32	18.30
128	6.25	51.98	26.06	26.32	18.30
129	6.59	54.71	27.16	26.32	18.30
130	7.01	58.04	28.40	26.32	18.30
131	7.52	62.15	29.79	26.32	18.30
132	8.16	67.23	31.32	26.32	18.30
133	8.95	73.58	33.01	26.32	18.30
134	9.99	81.89	34.94	26.32	18.30
135	11.34	92.71	37.07	26.32	18.30
136	13.17	107.30	39.45	26.32	18.30
137	15.72	127.68	42.10	26.32	18.30
138	7.92	45.66	25.06	23.16	18.30
139	8.26	47.49	26.05	23.16	18.30
140	8.65	49.68	27.17	23.16	18.30
141	9.13	52.31	28.40	23.16	18.30
142	9.71	55.52	29.78	23.16	18.30
143	10.42	59.43	31.32	23.16	18.30
144	11.30	64.27	33.03	23.16	18.30
145	12.41	70.37	34.94	23.16	18.30
146	13.81	78.11	37.07	23.16	18.30
147	15.63	88.10	39.43	23.16	18.30
148	18.03	101.33	42.06	23.16	18.30
149	21.23	118.99	44.94	23.16	18.30
150	10.45	45.70	27.16	20.00	18.30
151	10.96	47.83	28.40	20.00	18.30
152	11.57	50.41	29.79	20.00	18.30
153	12.32	53.52	31.32	20.00	18.30
154	13.22	57.31	33.03	20.00	18.30
155	14.35	62.02	34.94	20.00	18.30
156	15.74	67.85	37.06	20.00	18.30
157	17.51	75.25	39.43	20.00	18.30
158	19.78	84.74	42.08	20.00	18.30



23-FT



<b>Analysis Mode</b>	
Design(D)/Factor of Safety(FS)	D

<b>Analysis Type</b>	
Soil Nail(SN)/Tie Back(TB)/Active EP(AEP)/Passive EP(PEP)	SN

<b>General</b>	
Toe Segment No.	1
Toe Specification Type (X/Y)	Y
Toe Y Value	2
X-Base	0
Y-Base	0
Minimum Toe Angle (deg)	20
Maximum Toe Angle (deg)	80
No. Toe Angles	20
Minimum Exit X Value	5
Maximum Exit X Value	45
No. Exit Points	20
Water Unit Weight	62.4
Seismic Coefficient (g's)	0

<b>Factors of Safety</b>	
Service Load Design(SLD)/Load-Resistance Factor Design(LRFD)	SLD
FS - Cohesion	1.5
FS - Friction Angle	1.5
Strength Factor - Nail Tendon	0.55
Strength Factor - Nail Head	0.67
Strength Factor - Pullout	0.5
	0
	0
	0
	0
	0

Soil	Cohesion	Friction	Unit Wt.	Pullout
1	200	36	120	8000

Piezo	X	Y

Node	X	Y
1	0	0
2	0	23
3	8	31
4	25	35
5	50	35
6	0	11

Segment	Node 1	Node 2	Top Soil #	Bot. Soil #	Top PO #	Bot. PO #
1	1	2	0	1	0	1
2	2	3	0	1	0	1
3	3	4	0	1	0	1
4	4	5	0	1	0	1

Surcharge	Node 1	P1	Node 2	P2	Angle

Nail	Xs	Ys	Length	Dip	Tendon Str.	Head Str.	Fixed?	Spacing	Tieback?
1	0	21.5	1	15	10000	10000	0	5	0
2	0	17	1	15	10000	10000	0	5	0
3	0	12.5	1	15	10000	10000	0	5	0
4	0	8	1	15	10000	10000	0	5	0
5	0	3.5	1	15	10000	10000	0	5	0

Face Press	Node 1	P1	Node 2	P2	Angle
1	1	0.5	6	1	0
2	6	1	2	1	0

Analysis Type: Soil Nail

Analysis Mode: Design

Nail Head Strength Factor (Multiplier): 1.00

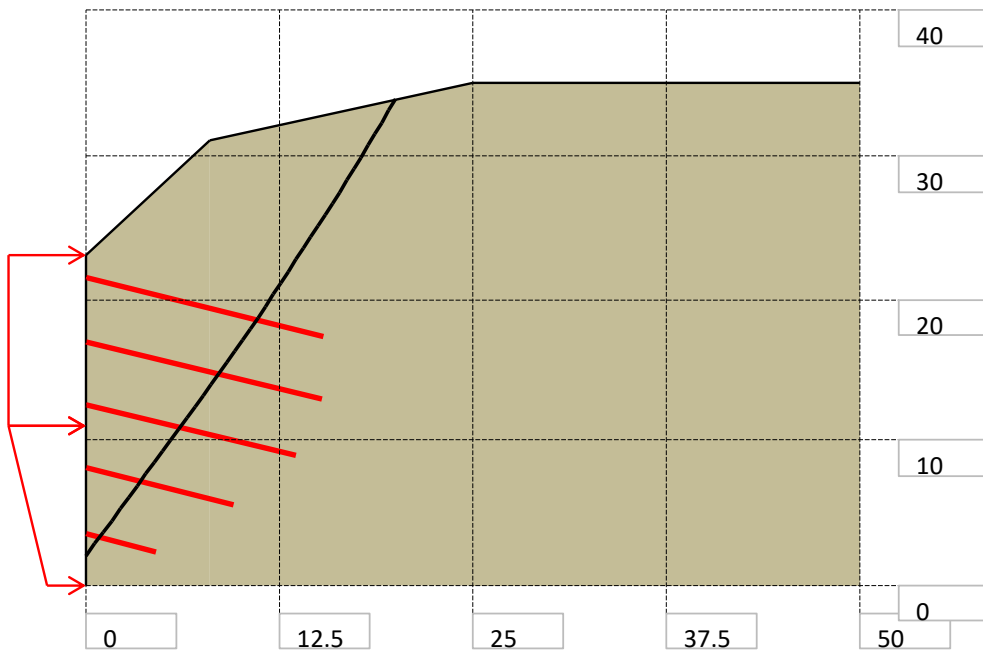
Nail	Length	Capacity	Slip Surf.
1	18.1	34224	45
2	18.1	34711	77
3	16.9	35189	94
4	11.5	30391	94
5	4.9	23193	94

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
1	-313.24	255.67	5.32	76.84	4.14
2	-119.07	109.82	5.57	73.68	4.85
3	-156.82	143.99	6.20	73.68	5.21
4	-237.88	217.39	6.95	73.68	5.68
5	-399.17	363.43	7.60	73.68	5.97
6	-69.21	71.98	5.67	70.53	5.97
7	-83.82	86.75	6.40	70.53	6.01
8	-109.15	112.36	7.31	70.53	6.49
9	-147.36	151.01	8.15	70.53	6.92
10	-245.89	250.63	9.05	70.53	7.40
11	-555.35	563.54	9.82	70.53	7.87
12	-46.67	54.70	5.65	67.37	7.87
13	-54.20	63.21	6.44	67.37	7.87
14	-63.64	73.87	7.25	67.37	7.87
15	-78.40	90.54	8.21	67.37	7.87
16	-105.49	121.13	9.24	67.37	8.13
17	-154.32	176.28	10.22	67.37	8.57
18	-323.68	367.54	11.40	67.37	9.27
19	-43.90	57.46	7.24	64.21	9.27
20	-51.11	66.57	8.18	64.21	9.27
21	-62.10	80.44	9.22	64.21	9.27
22	-80.32	103.45	10.35	64.21	9.27
23	-121.82	155.88	11.75	64.21	10.12
24	-228.33	290.43	13.10	64.21	10.77
25	-769.80	974.40	14.27	64.21	11.18
26	-37.05	54.51	8.21	61.05	11.18
27	-42.79	62.64	9.23	61.05	11.18
28	-51.41	74.86	10.37	61.05	11.18

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
29	-65.50	94.82	11.66	61.05	11.18
30	-90.39	130.10	13.04	61.05	11.44
31	-145.72	208.50	14.52	61.05	12.11
32	-443.81	630.93	16.30	61.05	12.96
33	-31.54	52.38	9.22	57.89	12.96
34	-36.39	60.12	10.37	57.89	12.96
35	-43.09	70.82	11.59	57.89	12.96
36	-54.06	88.34	13.02	57.89	12.96
37	-76.20	123.70	14.77	57.89	13.02
38	-119.43	192.75	16.47	57.89	13.88
39	-310.86	498.50	18.53	57.89	14.64
40	-27.25	51.37	10.40	54.74	14.64
41	-31.32	58.75	11.66	54.74	14.64
42	-37.06	69.15	13.03	54.74	14.64
43	-46.43	86.13	14.65	54.74	14.64
44	-62.76	115.73	16.47	54.74	14.64
45	-100.02	183.24	18.61	54.74	15.33
46	-170.86	311.60	20.29	54.74	15.57
47	-23.49	50.73	11.66	51.58	15.57
48	-27.06	58.14	13.08	51.58	15.57
49	-32.25	68.90	14.69	51.58	15.57
50	-39.97	84.93	16.43	51.58	15.57
51	-53.38	112.74	18.45	51.58	15.67
52	-79.39	166.71	20.67	51.58	16.33
53	-139.53	291.46	22.91	51.58	16.61
54	-420.61	874.60	25.15	51.58	16.93
55	-20.26	50.72	13.09	48.42	16.93
56	-23.39	58.25	14.68	48.42	16.93
57	-27.86	68.99	16.46	48.42	16.93
58	-34.31	84.51	18.38	48.42	16.93
59	-45.59	111.65	20.66	48.42	16.93
60	-66.23	161.29	23.13	48.42	17.09
61	-116.96	283.29	25.75	48.42	17.36
62	-361.69	871.87	28.07	48.42	17.55
63	-17.32	51.12	14.68	45.26	17.55
64	-20.03	58.83	16.46	45.26	17.55
65	-23.88	69.74	18.44	45.26	17.55
66	-29.59	85.93	20.65	45.26	17.55
67	-38.73	111.86	23.12	45.26	17.55
68	-56.26	161.58	25.86	45.26	17.65
69	-101.64	290.32	28.65	45.26	17.74
70	-312.08	887.25	31.29	45.26	17.74
71	-12.84	46.01	14.68	42.11	17.74
72	-14.57	51.96	16.48	42.11	17.74

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
73	-16.88	59.85	18.44	42.11	17.74
74	-20.14	71.04	20.65	42.11	17.74
75	-24.91	87.40	23.11	42.11	17.74
76	-32.76	114.31	25.86	42.11	17.74
77	-49.47	171.60	28.92	42.11	17.85
78	-99.00	341.39	32.38	42.11	17.85
79	-2025.37	6945.54	36.29	42.11	17.85
80	-10.44	46.84	16.46	38.95	17.85
81	-11.87	52.99	18.44	38.95	17.85
82	-13.80	61.28	20.65	38.95	17.85
83	-16.47	72.78	23.11	38.95	17.85
84	-20.50	90.06	25.85	38.95	17.85
85	-27.80	121.45	28.94	38.95	17.85
86	-42.86	186.13	32.42	38.95	17.90
87	-85.53	369.43	36.19	38.95	17.90
88	-1636.74	7033.47	40.56	38.95	17.90
89	-8.05	47.92	18.44	35.79	17.90
90	-9.18	54.38	20.65	35.79	17.90
91	-10.68	62.88	23.07	35.79	17.90
92	-12.85	75.28	25.85	35.79	17.90
93	-16.32	95.06	28.90	35.79	17.90
94	-22.26	128.97	32.31	35.79	18.09
95	-33.54	193.28	35.97	35.79	18.09
96	-69.01	395.57	40.43	35.79	18.09
97	-5.62	49.25	20.65	32.63	18.09
98	-6.43	56.05	23.11	32.63	18.09
99	-7.54	65.31	25.85	32.63	18.09
100	-9.19	79.24	28.90	32.63	18.09
101	-11.77	100.92	32.31	32.63	18.09
102	-16.17	137.81	36.11	32.63	18.09
103	-24.88	211.02	40.35	32.63	18.09
104	-2.75	45.31	20.66	29.47	18.09
105	-3.10	50.81	23.11	29.47	18.09
106	-3.56	58.10	25.85	29.47	18.09
107	-4.22	68.53	28.90	29.47	18.09
108	-5.19	83.79	32.30	29.47	18.09
109	-6.68	107.35	36.09	29.47	18.09
110	-9.29	148.44	40.44	29.47	18.09
111	-0.37	46.70	23.10	26.32	18.09
112	-0.42	52.63	25.84	26.32	18.09
113	-0.48	60.78	28.90	26.32	18.09
114	-0.58	72.22	32.30	26.32	18.09
115	-0.72	88.90	36.10	26.32	18.09
116	-0.93	114.38	40.33	26.32	18.09

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
117	-1.26	154.48	44.87	26.32	18.09
118	2.17	48.34	25.84	23.16	18.09
119	2.48	54.90	28.90	23.16	18.09
120	2.90	63.86	32.30	23.16	18.09
121	3.49	76.33	36.08	23.16	18.09
122	4.33	94.35	40.32	23.16	18.09
123	4.94	50.27	28.90	20.00	18.09
124	5.68	57.49	32.30	20.00	18.09
125	6.68	67.27	36.09	20.00	18.09
126	8.07	80.81	40.31	20.00	18.09



23-FT-E1

Analysis Mode	
Design(D)/Factor of Safety(FS)	D

Analysis Type	
Soil Nail(SN)/Tie Back(TB)/Active EP(AEP)/Passive EP(PEP)	SN

General	
Toe Segment No.	1
Toe Specification Type (X/Y)	Y
Toe Y Value	2
X-Base	0
Y-Base	0
Minimum Toe Angle (deg)	20
Maximum Toe Angle (deg)	80
No. Toe Angles	20
Minimum Exit X Value	5
Maximum Exit X Value	20
No. Exit Points	20
Water Unit Weight	62.4
Seismic Coefficient (g's)	0.41

Factors of Safety	
Service Load Design(SLD)/Load-Resistance Factor Design(LRFD)	SLD
FS - Cohesion	1.1
FS - Friction Angle	1.1
Strength Factor - Nail Tendon	0.74
Strength Factor - Nail Head	0.91
Strength Factor - Pullout	0.67
	0
	0
	0
	0
	0



Soil	Cohesion	Friction	Unit Wt.	Pullout
1	200	36	120	8000

Piezo	X	Y

Node	X	Y
1	0	0
2	0	23
3	8	31
4	25	35
5	50	35
6	0	11

Segment	Node 1	Node 2	Top Soil #	Bot. Soil #	Top PO #	Bot. PO #
1	1	2	0	1	0	1
2	2	3	0	1	0	1
3	3	4	0	1	0	1
4	4	5	0	1	0	1

Surcharge	Node 1	P1	Node 2	P2	Angle

Nail	Xs	Ys	Length	Dip	Tendon Str.	Head Str.	Fixed?	Spacing	Tieback?
1	0	21.5	1	15	10000	10000	0	5	0
2	0	17	1	15	10000	10000	0	5	0
3	0	12.5	1	15	10000	10000	0	5	0
4	0	8	1	15	10000	10000	0	5	0
5	0	3.5	1	15	10000	10000	0	5	0

Face Press	Node 1	P1	Node 2	P2	Angle
1	1	0.5	6	1	0
2	6	1	2	1	0

Analysis Type: Soil Nail

Analysis Mode: Design

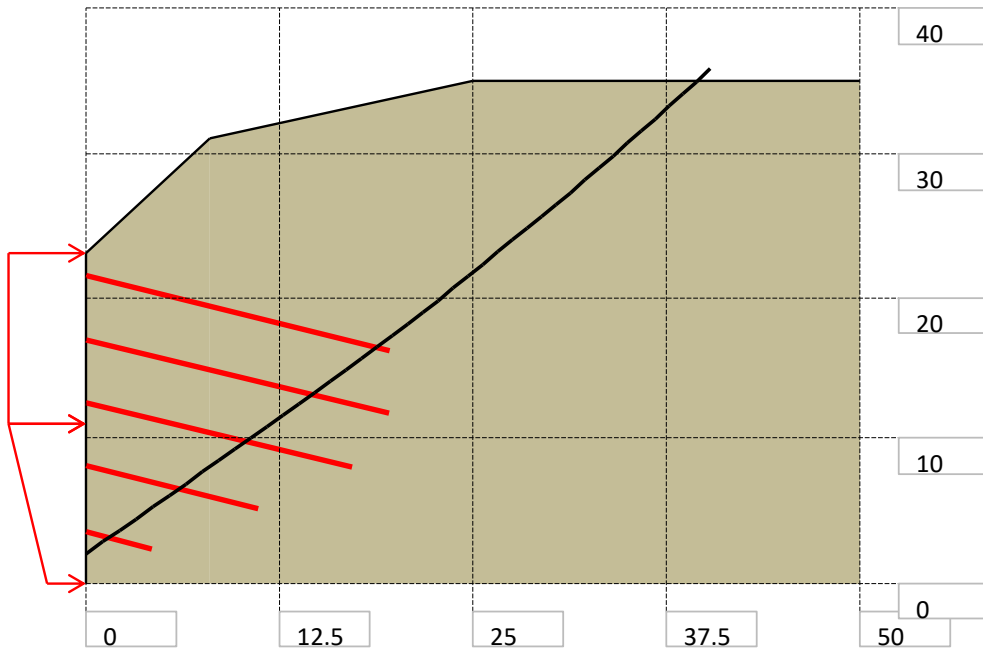
Nail Head Strength Factor (Multiplier): 1.00

Nail	Length	Capacity	Slip Surf.
1	15.9	33941	63
2	15.8	36155	72
3	14.0	36155	72
4	9.9	31225	72
5	4.7	22853	93

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
1	-244.50	260.58	5.26	76.84	0.00
2	-338.59	360.08	5.56	76.84	0.00
3	-414.86	440.73	5.71	76.84	0.00
4	-86.82	104.59	5.28	73.68	0.00
5	-95.49	114.84	5.53	73.68	0.00
6	-106.93	128.36	5.81	73.68	0.00
7	-122.66	146.94	6.12	73.68	0.00
8	-145.49	173.93	6.47	73.68	0.00
9	-181.46	216.43	6.86	73.68	0.00
10	-246.01	292.71	7.29	73.68	0.00
11	-395.80	469.70	7.79	73.68	0.00
12	-51.09	69.59	5.30	70.53	0.00
13	-53.84	73.23	5.52	70.53	0.00
14	-59.18	80.30	5.90	70.53	0.00
15	-63.60	86.14	6.18	70.53	0.00
16	-69.11	93.43	6.49	70.53	0.00
17	-80.40	108.38	7.02	70.53	0.00
18	-91.02	122.43	7.42	70.53	0.00
19	-105.83	142.03	7.88	70.53	0.00
20	-144.84	193.63	8.56	70.53	0.00
21	-202.19	269.51	9.08	70.53	0.00
22	-359.23	477.31	9.68	70.53	0.00
23	-36.53	56.32	5.55	67.37	0.00
24	-38.85	59.76	5.88	67.37	0.00
25	-41.15	63.19	6.19	67.37	0.00
26	-44.00	67.42	6.55	67.37	0.00
27	-48.28	73.78	7.02	67.37	0.00
28	-53.91	82.16	7.57	67.37	0.00

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
29	-58.88	89.55	7.99	67.37	0.00
30	-68.65	104.07	8.59	67.37	0.00
31	-84.49	127.62	9.28	67.37	0.00
32	-114.31	171.96	10.09	67.37	0.00
33	-157.52	236.20	10.73	67.37	0.00
34	-269.00	401.95	11.46	67.37	0.00
35	-33.19	57.75	7.01	64.21	0.00
36	-35.74	62.03	7.50	64.21	0.00
37	-38.87	67.29	8.03	64.21	0.00
38	-43.36	74.84	8.66	64.21	0.00
39	-48.92	84.17	9.28	64.21	0.00
40	-57.19	98.07	10.00	64.21	0.00
41	-70.68	120.73	10.84	64.21	0.00
42	-96.28	163.73	11.82	64.21	0.00
43	-134.11	227.28	12.61	64.21	0.00
44	-350.84	591.34	13.92	64.21	0.00
45	-27.74	55.04	8.03	61.05	0.00
46	-30.02	59.40	8.63	61.05	0.00
47	-33.11	65.31	9.32	61.05	0.00
48	-37.00	72.74	10.04	61.05	0.00
49	-42.61	83.48	10.87	61.05	0.00
50	-50.95	99.43	11.79	61.05	0.00
51	-64.48	125.30	12.82	61.05	0.00
52	-85.01	164.56	13.80	61.05	0.00
53	-150.50	289.77	15.22	61.05	0.00
54	-369.70	708.93	16.39	61.05	0.00
55	-23.73	54.19	9.30	57.89	0.00
56	-25.92	59.01	10.04	57.89	0.00
57	-28.94	65.65	10.90	57.89	0.00
58	-32.80	74.14	11.79	57.89	0.00
59	-38.51	86.70	12.82	57.89	0.00
60	-47.29	106.00	13.97	57.89	0.00
61	-62.27	138.96	15.25	57.89	0.00
62	-90.04	200.04	16.57	57.89	0.00
63	-210.37	464.67	18.43	57.89	0.00
64	-18.95	50.63	10.05	54.74	0.00
65	-20.64	54.95	10.88	54.74	0.00
66	-22.80	60.51	11.79	54.74	0.00
67	-25.76	68.10	12.82	54.74	0.00
68	-29.92	78.76	13.96	54.74	0.00
69	-36.07	94.56	15.24	54.74	0.00
70	-46.00	120.04	16.66	54.74	0.00
71	-64.39	167.21	18.26	54.74	0.00
72	-106.88	276.23	19.99	54.74	15.87

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
73	-16.40	52.07	11.80	51.58	15.87
74	-18.07	57.17	12.82	51.58	15.87
75	-20.33	64.07	13.96	51.58	15.87
76	-23.48	73.70	15.25	51.58	15.87
77	-27.71	86.61	16.59	51.58	15.87
78	-34.57	107.55	18.17	51.58	15.87
79	-12.84	49.98	12.82	48.42	15.87
80	-14.14	54.87	13.96	48.42	15.87
81	-15.89	61.40	15.25	48.42	15.87
82	-18.23	70.17	16.66	48.42	15.87
83	-21.58	82.69	18.24	48.42	15.87
84	-9.75	48.59	13.96	45.26	15.87
85	-10.74	53.32	15.24	45.26	15.87
86	-12.04	59.55	16.66	45.26	15.87
87	-13.75	67.72	18.20	45.26	15.87
88	-6.96	47.67	15.24	42.11	15.87
89	-7.67	52.34	16.66	42.11	15.87
90	-8.60	58.44	18.24	42.11	15.87
91	-4.35	47.14	16.66	38.95	15.87
92	-4.80	51.81	18.24	38.95	15.87
93	-1.84	46.92	18.24	35.79	15.87



23-FT-E2

<b>Analysis Mode</b>	
Design(D)/Factor of Safety(FS)	D

<b>Analysis Type</b>	
Soil Nail(SN)/Tie Back(TB)/Active EP(AEP)/Passive EP(PEP)	SN

<b>General</b>	
Toe Segment No.	1
Toe Specification Type (X/Y)	Y
Toe Y Value	2
X-Base	0
Y-Base	0
Minimum Toe Angle (deg)	20
Maximum Toe Angle (deg)	80
No. Toe Angles	20
Minimum Exit X Value	20
Maximum Exit X Value	45
No. Exit Points	20
Water Unit Weight	62.4
Seismic Coefficient (g's)	0.25

<b>Factors of Safety</b>	
Service Load Design(SLD)/Load-Resistance Factor Design(LRFD)	SLD
FS - Cohesion	1.1
FS - Friction Angle	1.1
Strength Factor - Nail Tendon	0.74
Strength Factor - Nail Head	0.91
Strength Factor - Pullout	0.67
	0
	0
	0
	0
	0

Soil	Cohesion	Friction	Unit Wt.	Pullout
1	200	36	120	8000

Piezo	X	Y

Node	X	Y
1	0	0
2	0	23
3	8	31
4	25	35
5	50	35
6	0	11

Segment	Node 1	Node 2	Top Soil #	Bot. Soil #	Top PO #	Bot. PO #
1	1	2	0	1	0	1
2	2	3	0	1	0	1
3	3	4	0	1	0	1
4	4	5	0	1	0	1

Surcharge	Node 1	P1	Node 2	P2	Angle

Nail	Xs	Ys	Length	Dip	Tendon Str.	Head Str.	Fixed?	Spacing	Tieback?
1	0	21.5	1	15	10000	10000	0	5	0
2	0	17	1	15	10000	10000	0	5	0
3	0	12.5	1	15	10000	10000	0	5	0
4	0	8	1	15	10000	10000	0	5	0
5	0	3.5	1	15	10000	10000	0	5	0

Face Press	Node 1	P1	Node 2	P2	Angle
1	1	0.5	6	1	0
2	6	1	2	1	0

Analysis Type: Soil Nail

Analysis Mode: Design

Nail Head Strength Factor (Multiplier): 1.00

Nail	Length	Capacity	Slip Surf.
1	20.3	28172	27
2	20.3	29569	93
3	17.8	29569	93
4	11.5	25537	93
5	4.4	19489	93

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
1	-115.27	297.78	20.19	54.74	13.12
2	-177.33	457.02	21.12	54.74	13.72
3	-207.46	534.32	21.38	54.74	13.72
4	-253.52	652.51	21.66	54.74	13.83
5	-331.94	853.72	21.97	54.74	14.03
6	-47.38	146.67	20.06	51.58	14.03
7	-50.95	157.58	20.44	51.58	14.03
8	-56.09	173.27	20.91	51.58	14.03
9	-62.03	191.38	21.37	51.58	14.19
10	-72.72	224.03	22.02	51.58	14.48
11	-87.38	268.80	22.69	51.58	14.77
12	-97.46	299.56	23.04	51.58	14.86
13	-159.88	490.16	24.29	51.58	15.38
14	-204.47	626.30	24.73	51.58	15.50
15	-311.50	953.09	25.25	51.58	15.77
16	-26.63	101.53	20.01	48.42	15.77
17	-27.89	106.27	20.37	48.42	15.77
18	-29.93	113.87	20.90	48.42	15.77
19	-32.15	122.18	21.42	48.42	15.77
20	-35.04	132.99	22.01	48.42	15.77
21	-38.75	146.87	22.66	48.42	15.77
22	-43.73	165.47	23.38	48.42	15.77
23	-50.23	189.76	24.14	48.42	15.77
24	-61.15	230.57	25.09	48.42	16.17
25	-76.17	286.72	25.86	48.42	16.48
26	-131.77	494.59	27.24	48.42	17.07
27	-189.47	710.26	27.84	48.42	17.34
28	-16.25	79.68	20.01	45.26	17.34



Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
29	-16.93	82.92	20.42	45.26	17.34
30	-17.75	86.82	20.89	45.26	17.34
31	-18.72	91.47	21.41	45.26	17.34
32	-19.92	97.17	22.00	45.26	17.34
33	-21.49	104.72	22.69	45.26	17.34
34	-23.22	112.98	23.37	45.26	17.34
35	-25.33	123.07	24.10	45.26	17.34
36	-28.69	139.13	25.07	45.26	17.34
37	-33.76	163.35	26.08	45.26	17.34
38	-39.96	192.96	26.99	45.26	17.34
39	-55.16	265.62	28.43	45.26	17.88
40	-93.25	447.63	30.08	45.26	18.43
41	-133.56	640.27	30.84	45.26	18.43
42	-9.84	66.58	20.00	42.11	18.43
43	-10.17	68.78	20.42	42.11	18.43
44	-10.59	71.54	20.93	42.11	18.43
45	-11.03	74.38	21.41	42.11	18.43
46	-11.52	77.61	21.94	42.11	18.43
47	-12.23	82.31	22.64	42.11	18.43
48	-13.04	87.58	23.37	42.11	18.43
49	-13.97	93.70	24.13	42.11	18.43
50	-15.26	102.17	25.06	42.11	18.43
51	-17.07	114.10	26.07	42.11	18.43
52	-19.58	130.53	27.18	42.11	18.43
53	-23.20	154.32	28.42	42.11	18.43
54	-28.31	187.86	29.69	42.11	18.53
55	-39.35	260.31	31.41	42.11	19.05
56	-67.27	443.66	33.38	42.11	19.48
57	-98.61	649.41	34.33	42.11	19.59
58	-5.38	57.86	20.00	38.95	19.59
59	-5.54	59.45	20.42	38.95	19.59
60	-5.71	61.31	20.89	38.95	19.59
61	-5.91	63.35	21.39	38.95	19.59
62	-6.17	66.00	21.99	38.95	19.59
63	-6.46	69.00	22.64	38.95	19.59
64	-6.80	72.56	23.36	38.95	19.59
65	-7.21	76.83	24.16	38.95	19.59
66	-7.72	82.10	25.06	38.95	19.59
67	-8.41	89.31	26.06	38.95	19.59
68	-9.32	98.70	27.17	38.95	19.59
69	-10.53	111.31	28.42	38.95	19.59
70	-12.23	128.90	29.80	38.95	19.59
71	-14.73	154.85	31.34	38.95	19.59
72	-18.71	196.24	33.06	38.95	19.59

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
73	-25.56	267.34	34.89	38.95	19.81
74	-45.35	472.68	37.28	38.95	20.12
75	-238.27	2475.22	40.10	38.95	20.12
76	-2.03	51.64	20.00	35.79	20.12
77	-2.08	52.78	20.40	35.79	20.12
78	-2.14	54.27	20.89	35.79	20.12
79	-2.21	55.90	21.41	35.79	20.12
80	-2.29	57.80	21.99	35.79	20.12
81	-2.38	60.04	22.64	35.79	20.12
82	-2.48	62.64	23.36	35.79	20.12
83	-2.61	65.74	24.17	35.79	20.12
84	-2.76	69.46	25.06	35.79	20.12
85	-2.96	74.35	26.06	35.79	20.12
86	-3.21	80.51	27.17	35.79	20.12
87	-3.54	88.42	28.41	35.79	20.12
88	-3.97	98.83	29.79	35.79	20.12
89	-4.55	113.00	31.33	35.79	20.12
90	-5.37	133.15	33.05	35.79	20.12
91	-6.62	163.66	34.97	35.79	20.12
92	-8.70	214.47	37.12	35.79	20.12
93	-12.78	313.98	39.52	35.79	20.33
94	-21.87	536.02	41.90	35.79	20.33
95	0.64	46.96	20.00	32.63	20.33
96	0.65	47.93	20.42	32.63	20.33
97	0.67	49.05	20.89	32.63	20.33
98	0.69	50.34	21.41	32.63	20.33
99	0.71	51.83	21.99	32.63	20.33
100	0.73	53.56	22.64	32.63	20.33
101	0.76	55.58	23.36	32.63	20.33
102	0.79	57.95	24.16	32.63	20.33
103	0.83	60.74	25.06	32.63	20.33
104	0.88	64.31	26.06	32.63	20.33
105	0.95	68.70	27.17	32.63	20.33
106	1.02	74.19	28.41	32.63	20.33
107	1.12	81.16	29.79	32.63	20.33
108	1.25	90.20	31.32	32.63	20.33
109	1.43	102.63	33.08	32.63	20.33
110	1.66	119.09	34.95	32.63	20.33
111	2.01	143.46	37.09	32.63	20.33
112	2.57	182.81	39.54	32.63	20.33
113	3.48	246.95	42.11	32.63	20.33
114	3.14	47.29	21.99	29.47	20.33
115	3.24	48.68	22.64	29.47	20.33
116	3.35	50.30	23.36	29.47	20.33

Surface	X Center	Y Center	Surf. X Value	Toe Angle	Lngh Fac
117	3.48	52.18	24.16	29.47	20.33
118	3.64	54.38	25.06	29.47	20.33
119	3.82	57.09	26.05	29.47	20.33
120	4.05	60.40	27.17	29.47	20.33
121	4.34	64.46	28.41	29.47	20.33
122	4.69	69.50	29.78	29.47	20.33
123	5.13	75.89	31.33	29.47	20.33
124	5.69	84.04	33.03	29.47	20.33
125	6.44	94.84	34.95	29.47	20.33
126	7.46	109.48	37.08	29.47	20.33
127	8.89	130.12	39.46	29.47	20.33
128	11.03	160.91	42.11	29.47	20.33
129	5.72	47.72	24.16	26.32	20.33
130	5.94	49.49	25.05	26.32	20.33
131	6.21	51.67	26.06	26.32	20.33
132	6.53	54.24	27.16	26.32	20.33
133	6.93	57.38	28.40	26.32	20.33
134	7.41	61.21	29.78	26.32	20.33
135	8.00	65.96	31.32	26.32	20.33
136	8.74	71.92	33.03	26.32	20.33
137	9.70	79.52	34.94	26.32	20.33
138	10.93	89.39	37.07	26.32	20.33
139	12.57	102.52	39.43	26.32	20.33
140	14.83	120.59	42.07	26.32	20.33
141	8.24	47.41	26.05	23.16	20.33
142	8.62	49.48	27.17	23.16	20.33
143	9.07	51.97	28.40	23.16	20.33
144	9.62	55.00	29.78	23.16	20.33
145	10.29	58.68	31.32	23.16	20.33
146	11.11	63.24	33.03	23.16	20.33
147	12.15	68.92	34.94	23.16	20.33
148	13.42	75.96	37.02	23.16	20.33
149	15.14	85.40	39.44	23.16	20.33
150	17.35	97.61	42.08	23.16	20.33
151	10.93	47.71	28.40	20.00	20.33
152	11.51	50.15	29.78	20.00	20.33
153	12.22	53.11	31.32	20.00	20.33
154	13.08	56.71	33.03	20.00	20.33
155	14.14	61.14	34.94	20.00	20.33
156	15.45	66.64	37.06	20.00	20.33
157	17.11	73.58	39.44	20.00	20.33
158	19.22	82.39	42.07	20.00	20.33

APPENDIX B  
WALL FACING DESIGN CALCULATIONS

Geometry & Miscellaneous Input Data	
Vertical Nail Spacing, $S_V$ (ft)	5.50
Horizontal Nail Spacing, $S_H$ (ft)	5.50
Facing Thickness, $t_F$ (in)	4.00
Facing Usage (Temporary, Permanent)	Temporary
Nail Pattern (Rectangular, Staggered)	Rectangular
Resistance Factor for Facing Flexure, $\phi_F$	1.00
Vertical Bearing Bar Continuity Factor (0 = Cutoff, 1 = Continuous)	0.00
Continuity Factor For All Positive Moment Steel (0 = Cutoff, 1 = Continuous)	1.00

Reinforcement Details	
Steel Depth, $d$ (in)	2.00
Area of a Main Vertical Bar/Wire, $A_{MVI}$ (in <sup>2</sup> )	0.029
Main Vertical Bar/Wire Spacing, $s_{MV}$ (in)	6.0
Area of Vertical Bearing Bar Reinforcement, $A_{VB}$ (in <sup>2</sup> )	0.40
Area of a Main Horizontal Bar/Wire, $A_{MHI}$ (in <sup>2</sup> )	0.029
Main Horizontal Bar/Wire Spacing, $s_{MH}$ (in)	6.0
Area of Waler Bar Reinforcement, $A_{WB}$ (in <sup>2</sup> )	0.40

Material Properties	
Concrete Compressive Strength, $f_C$ (ksi)	4.0
Main Reinforcement Yield Stress, $F_Y$ (ksi)	60.0
Waler/Vertical Bearing Bar Reinforcement Yield Stress, $F_Y$ (ksi)	60.0

Facing Flexure Nailhead Capacity Calculations	
Facing Flexure Factor, $C_F$	3.00
Gross Reinforcement Ratio, Negative Moment, Vertical Direction, $\rho_{NV}$	0.27%
Gross Reinforcement Ratio, Positive Moment, Vertical Direction, $\rho_{PV}$	0.12%
Gross Reinforcement Ratio, Negative Moment, Horizontal Direction, $\rho_{NH}$	0.27%
Gross Reinforcement Ratio, Positive Moment, Horizontal Direction, $\rho_{PH}$	0.27%
Negative Unit Moment Capacity in Vertical Direction, $m^-_V$ (k-ft/ft)	1.244
Positive Unit Moment Capacity in Vertical Direction, $m^+_V$ (k-ft/ft)	0.568
Negative Unit Moment Capacity in Horizontal Direction, $m^-_H$ (k-ft/ft)	1.244
Positive Unit Moment Capacity in Horizontal Direction, $m^+_H$ (k-ft/ft)	1.244
Nominal Nail Head Strength in Vertical Direction, $T_{FN,V}$ (k)	43.5
Nominal Nail Head Strength in Horizontal Direction, $T_{FN,H}$ (k)	59.7
Design Nail Head Strength, $\phi T_{FN}$ (k)	43.5

**FIGURE B-1**  
Shotcrete Facing Strength - Flexure  
Temporary Facing

Soil Nail Wall Facing Analysis & Design	Revised 06/26/06
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Geometric and Material Parameters	
Vertical Nail Spacing, $S_V$ (ft)	5.50
Horizontal Nail Spacing, $S_H$ (ft)	5.50
Facing Thickness, $t_F$ (in)	4.00
Connection Type (Bearing, Headed Stud)	Bearing
Facing Usage (Temporary, Permanent)	Temporary
Resistance Factor for Facing Punching Shear, $\phi_S$	1.00
Plate Width, $b_{PL}$ (in)	9.00
Plate Thickness, $t_{PL}$ (in)	0.75
Permanent Cover to Plate on Soil Side, $C_{PL}$ (in)	0.00
Headed Stud Embedment Length, $L_{HS}$ (in)	0.00
Headed Stud Spacing, $S_{HS}$ (in)	0.00
Grout Column Diameter, $D_{GC}$ (in)	6.00
Concrete Compressive Strength, $f'_C$ (ksi)	4.0

Calculations	
Nail Head Pressure Increase Factor for Punching Shear, $C_S$	3.00
Equivalent Cone Depth, $h_C$ (in)	4.00
Equivalent Top Cone Diameter, $D''_C$ (in)	9.00
Cone Bottom Diameter, $D_C$ (in)	17.00
Effective Cone Diameter, $D'_C$ (in)	13.00
Cone Bottom Area, $A_C$ (in <sup>2</sup> )	227.0
Grout Column Area, $A_{GC}$ (in <sup>2</sup> )	28.3
Shear Stress Area, $A_V$ (in <sup>2</sup> )	163.4
Nominal Punching Shear Stress, $v_N$ (psi)	253.0
Nominal Punching Shear Strength of Facing, $V_N$ (k)	41.3
Strength Ratio From Pressure Concentration, $T_{FN}/V_N$	1.16
Design Nail Head Strength, $\phi_S T_{FN}$ (k)	47.9

**FIGURE B-2**  
Shotcrete Facing Strength - Punching Shear  
Temporary Facing

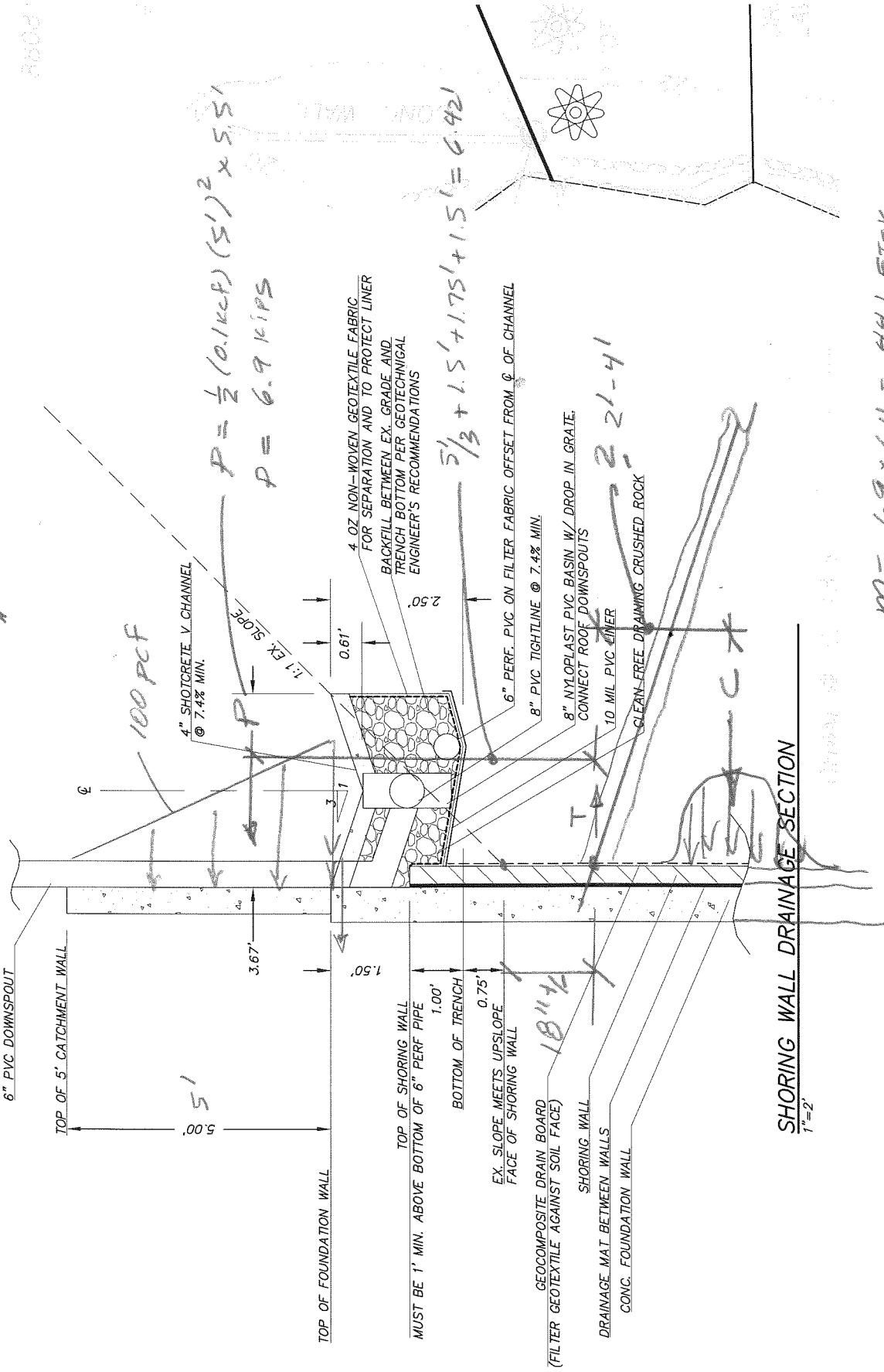
Soil Nail Wall Facing Analysis & Design	Revised 06/26/06
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Geometric and Material Parameters	
Headed Stud Diameter, $D_{HS}$ (in)	0.625
Headed Stud Head Diameter, $D_H$ (in)	1.250
Headed Stud Head Thickness, $t_H$ (in)	0.625
Resistance Factor for Headed Stud Tension, $\phi_{HS}$	1.00
Headed Stud Ultimate Stress, $F_U$ (ksi)	60.0

Calculations	
Total Headed Stud Tension Area, $A_{HS}$ (in <sup>2</sup> )	1.227
Design Headed Stud Strength, $\phi_{HS}T_{FN}$ (k)	73.6

**FIGURE B-3**  
Shotcrete Facing Strength - Headed Stud Tension  
Permanent Facing

MAX  $S_u = 5.5'$



$$P = \frac{1}{2} (0.1 \text{ kcf}) (5')^2 \times 5.5'$$

$$P = 6.9 \text{ kips}$$

$$5' / 3 + 1.5' + 1.75' + 1.5' = 6.42'$$

$$M = 6.9 \times 6.4 = 44.1 \text{ FT-K}$$

$$T_m = M / 2' - 4' \Rightarrow 11 - 22 \text{ kips tens.}$$

$$T = P + T_m = 11 - 22 + 7 = 18 - 29 \text{ kips}$$

SHORING WALL DRAINAGE SECTION  
1"=2'