ATTACHMENT 2
HILFIKER WALL DESIGN CALCULATION

Hilfiker Retaining Walls
CONFIDENTIAL

AASHTO 98 ASD DESIGN METHOD
Pinon Ridge

MSEW(3.0): Update # 10.2

PROJECT IDENTIFICATION

Title: Pinon Ridge
Project Number: 080403BE
Client: Hilfiker Retaining Walls
Designer: TAJ
Station Number:

Description:

WWW 2' Lifts

Company's information:

Name: Collins Engineers, Inc.
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Auburn, CA 95602
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Original date and time of creating this file: September 14, 2010

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL MATS/GRIDS as reinforcing material.

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SOIL DATA

REINFORCED SOIL

Unit weight, γ	125.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	125.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	125.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$	30.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 lb/ft ^{2}

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3362 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 30.14 N γ= 22.40

SEISMICITY

Not Applicable

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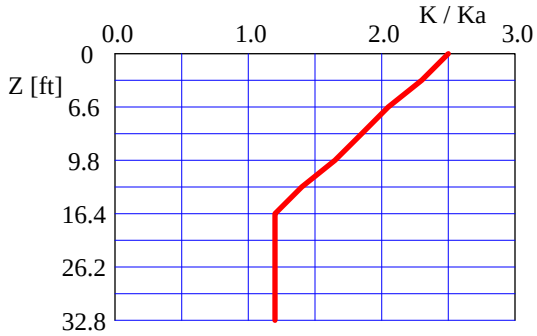
INPUT DATA: Metal mats/grids (Analysis)

D A T A	Metal mats type #1	Metal mats type #2	Metal mats type #3	Metal mats type #4	Metal mats type #5
Yield strength of steel, Fy [kips/in ²]	65.0	65.0	65.0	65.0	65.0
Gross width of grid, b [in]	12.0	12.0	12.0	12.0	12.0
Vertical spacing, Sv [ft]	Varies	Varies	Varies	Varies	Varies
Design cross section area, Ac [in ²]	0.05	0.05	0.08	0.12	0.15
Thickness of transverse element, t [in]	0.2	0.2	0.2	0.2	0.2
Distance between transverse bars, St [in]	12.0	10.5	10.5	21.0	21.0
Friction angle along reinforcement-soil interface,	ρ				
@ the top	34.00	34.00	34.00	34.00	34.00
@ 19.7 ft or below	34.00	34.00	34.00	34.00	34.00
Pullout resistance factor, F*					
@ the top	0.29	0.33	0.33	0.18	0.21
@ 19.7 ft or below	0.14	0.16	0.16	0.09	0.10
Scale-effect correction factor, α	1.00	1.00	1.00	1.00	1.00

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 ft	2.50
3.3 ft	2.30
6.6 ft	2.05
9.8 ft	1.85
13.1 ft	1.65
16.4 ft	1.40
19.7 ft	1.20



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INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	10.01	[ft]	{ Embedded depth is E = 0.01 ft, and height above top of finished bottom grade is H = 10.00 ft }
Batter, ω	0.0	[deg]	
Backslope, β	26.6	[deg]	
Backslope rise	1.5	[ft]	Broken back equivalent angle, I = 4.28° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E

Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 451.0 [lb/ft ²]

ANALYZED REINFORCEMENT LAYOUT:

SCALE:

0 2 4 6 8 10 [ft]

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ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, Fs = 3.62, Meyerhof stress = 2532 lb/ft².
Foundation Interface: Direct sliding, Fs = 1.617, Eccentricity, e/L = 0.1648, Fs-overturning = 2.80

METAL MATS				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	Fs-overall [pullout resistance]	Fs-overall [connection break]	Fs-overall [metal mats strength]	Metal mats strength Fs	Pullout resistance Fs	Direct sliding Fs	Eccentricity e/L	Product name
1	0.00	8.75	3	N/A	N/A	N/A	5.533	8.546	1.889	0.1648	W7-8X10.5
2	2.00	8.75	3	N/A	N/A	N/A	2.952	3.659	2.099	0.1190	W7-8X10.5
3	4.00	8.75	2	N/A	N/A	N/A	1.945	3.128	2.360	0.0777	W4.5-8X10.5
4	6.00	8.75	2	N/A	N/A	N/A	2.232	2.637	2.689	0.0397	W4.5-8X10.5
5	8.00	9.00	1	N/A	N/A	N/A	2.725	2.502	3.187	-0.0005	W4.5 C&P
6	10.00	9.00	1	N/A	N/A	N/A	6.655	4.076	3.515	-0.0680	W4.5 C&P

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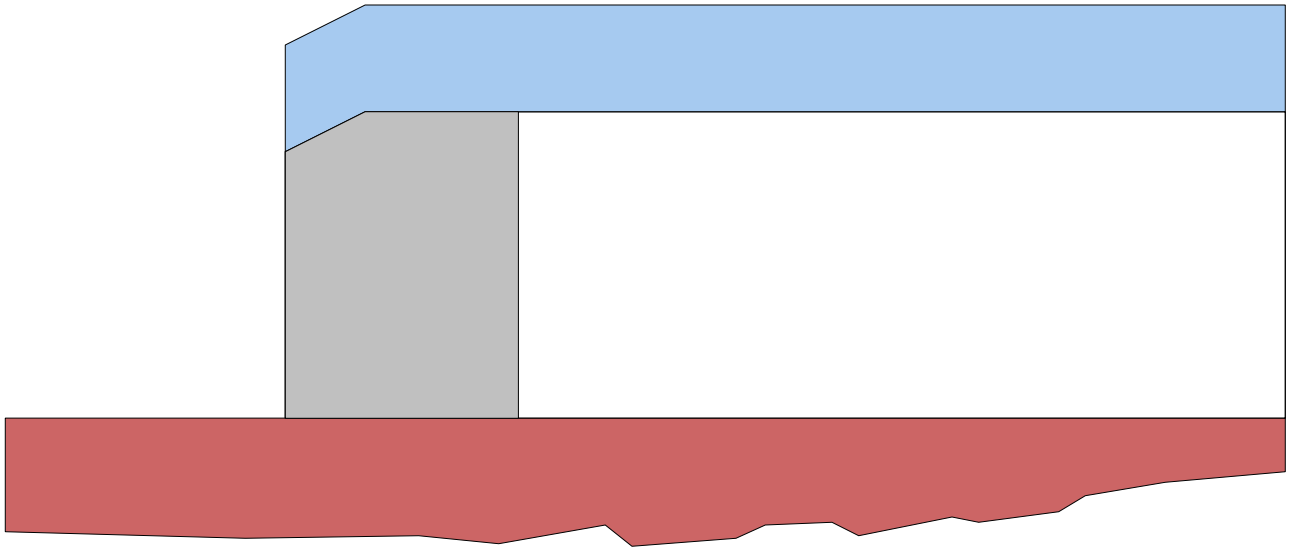
BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	9174	N/A	[lb/ft ²]
Meyerhof stress, σ_V	2532.5	N/A	[lb/ft ²]
Eccentricity, e	1.10	N/A	[ft]
Eccentricity, e/L	0.126	N/A	
Fs calculated	3.62	N/A	
Base length	8.75	N/A	[ft]



SCALE:

0 2 4 6 8 10 [ft]

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DIRECT SLIDING for GIVEN LAYOUT (for METAL MATS/GRIDS reinforcements)

Along reinforced and foundation soils interface: Fs-static = 1.617

#	Metal Mats Elevation [ft]	Metal Mats Length [ft]	Fs Static	Fs Seismic	Metal Mats Type #	Product name
1	0.00	8.75	1.889	N/A	3	W7-8X10.5
2	2.00	8.75	2.099	N/A	3	W7-8X10.5
3	4.00	8.75	2.360	N/A	2	W4.5-8X10.5
4	6.00	8.75	2.689	N/A	2	W4.5-8X10.5
5	8.00	9.00	3.187	N/A	1	W4.5 C&P
6	10.00	9.00	3.515	N/A	1	W4.5 C&P

ECCENTRICITY for GIVEN LAYOUT

At interface with foundation: e/L static = 0.1648; Overturning: Fs-static = 2.80

#	Metal Mats Elevation [ft]	Metal Mats Length [ft]	e / L Static	e / L Seismic	Metal Mats Type #	Product name
1	0.00	8.75	0.1648	N/A	3	W7-8X10.5
2	2.00	8.75	0.1190	N/A	3	W7-8X10.5
3	4.00	8.75	0.0777	N/A	2	W4.5-8X10.5
4	6.00	8.75	0.0397	N/A	2	W4.5-8X10.5
5	8.00	9.00	-0.0005	N/A	1	W4.5 C&P
6	10.00	9.00	-0.0680	N/A	1	W4.5 C&P

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RESULTS for STRENGTH **[N**Live Load included in calculating Tmax**) / (Actual stress)]**

#	Metal Mats Elevation [ft]	Coverage ratio, Rc=b/Sh	Horizontal spacing, Sh [ft]	Long-term strength Fy·Ac·Rc/b [lb/ft]	Tmax [lb/ft]	Tmd [lb/ft]	Specified minimum Fs-overall static	Actual calculated Fs-overall static	Specified minimum Fs-overall seismic	Actual calculated Fs-overall seismic
1	0.00	1.000	1.000	5226	944.43	N/A	N/A	5.533	N/A	N/A
2	2.00	1.000	1.000	5226	1770.06	N/A	N/A	2.952	N/A	N/A
3	4.00	1.000	1.000	3101	1593.99	N/A	N/A	1.945	N/A	N/A
4	6.00	1.000	1.000	3101	1389.04	N/A	N/A	2.232	N/A	N/A
5	8.00	1.000	1.000	3101	1137.90	N/A	N/A	2.725	N/A	N/A
6	10.00	1.000	1.000	3101	465.88	N/A	N/A	6.655	N/A	N/A

RESULTS for PULLOUT Live Load NOT included in calculating Tmax

NOTE: Live load is not included in calculating the overburden pressure used to assess pullout resistance.

#	Metal Mats Elevation [ft]	Coverage Ratio Rc=b/Sh	Tmax [lb/ft]	Tmd [lb/ft]	Le [ft] (see NOTE)	La [ft]	Avail.Static Pullout, Pr [lb/ft]	Specified Static Fs	Actual Static Fs	Avail.Seism. Pullout, Pr [lb/ft]	Specified Seismic Fs	Actual Seismic Fs
1	0.00	1.000	706.0	N/A	8.75	0.00	6033.0	N/A	8.546	N/A	N/A	N/A
2	2.00	1.000	1269.8	N/A	7.55	1.20	4646.4	N/A	3.659	N/A	N/A	N/A
3	4.00	1.000	1059.6	N/A	6.35	2.40	3314.0	N/A	3.128	N/A	N/A	N/A
4	6.00	1.000	817.2	N/A	5.30	3.45	2154.9	N/A	2.637	N/A	N/A	N/A
5	8.00	1.000	531.6	N/A	5.55	3.45	1330.1	N/A	2.502	N/A	N/A	N/A
6	10.00	1.000	147.9	N/A	5.55	3.45	602.8	N/A	4.076	N/A	N/A	N/A

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