Submittal Review Sheet

******PLEASE USE THE SPACES BELOW FOR COMMENTS AND STAMPS******

SAUNDERS

SUBMITTED FOR GENERAL CONFORMANCE WITH THE CONTRACT DOCUMENTS EXCEPT AS NOTED. REVIEW OF THIS SUBMITTAL DOES NOT RELEASE THE SUBCONTRACTOR OF ITS RESPONSIBILITY TO CONFORM WITH THE PLANS AND SPECIFICATIONS NOR DOES THIS REVIEW RELEASE THE SUBCONTRACTOR FROM VERIFYING THE ACCURACY OF QUANTITIES AND FIELD DIMENSIONS.

Submittal Package Number: 323200-003 Retaining Wall Calculations for Review
Signed: Alec Hallman
Date: 04/26/2024
SAUNDERS CONSTRUCTION, INC.

LANDMARK CONSULTANTS, INC.

Approved	Furnish as Corrected
Rejected	Revise and Resubmit
✕ Not Required for Review	Submit Specified Item

This review is only for general conformance with the design concept and the information given in the Construction Documents. Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with the requirements of the plans and specifications and applicable laws, codes and regulations. Approval of a specific item shall not include approval of an assembly of which the item is a component. The Contractor is responsible for: dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of the Work with that of all other trades and performing all Work in a safe and satisfactory manner.

Landmark Consultant, Inc.

By

05/10/2024
Date

☐ NO EXCEPTION TAKEN
☐ REVISE AND RESUBMIT
☐ APPROVED AS NOTED
☒ SEE CONSULTANT REVIEW
☒ RECEIVED FOR RECORD ONLY
☐ REJECTED

Architect's or architect's consultant review is for general conformance of the submittal to the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications nor departures therefrom. The Contractor remains responsible for detail and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes and techniques of assembly, and for performing work in a safe and satisfactory manner.

359 DESIGN, LLC

BY: Griffin Gilbert **DATE:** 05.13.24

Reviewed for Code Compliance

06/21/2024

SOIL STRUCTURES ENGINEERING

Earth Retention ▪ Foundations ▪ Steel and Concrete Structures

DESIGN REPORT & CALCULATIONS

FOR

THE AMBLE
STEAMBOAT SPRINGS, CO

REV# 0

(SSE PROJECT # 24SSL010)

SUBMITTED BY:

BENJAMIN T. DAISS, P.E.
April 20, 2024

I HEREBY CERTIFY THAT THIS REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION. THE CALCULATIONS SUBMITTED MODEL WORST CASE CONDITIONS AND COVER ALL OF THE PROPOSED RETAINING WALLS DETAILED WITHIN THE SHOP DRAWING SUBMITTAL ACCOMPANYING THIS REPORT.

DATE: 4/20/24

BENJAMIN T. DAISS, P.E. LICENSE NO. 60191

Index

1.0 Scope Review

This project includes two site retaining walls specified as Redi-Rock in the contract plans located along the south entry drive. Wall 1 is designed with a maximum height of 7.50-feet and horizontal length of 228.08-feet. Wall 2 is designed with a maximum height of 9.00-feet and horizontal length of 147.58-feet. A 2H:1V slope is shown above wall 1 and 2 with the top of wall stepping below the finished grade at top of wall which will increase the slope at top of wall steps. The general contractor and project owner shall ensure proper erosion control measures are taken throughout the service life of the proposed retaining walls. SSE is not responsible for stability of the slope located above the top of wall.

2.0 Design Methodology

The proposed walls have been designed in accordance with the NCMA (National Concrete Masonry Association) design methodology. Refer to the NCMA Design Manual for Segmental Retaining Walls, 3rd edition for additional design and construction requirements.

3.0 Wall System

3.1 Modular Block Wall Units

The walls have been designed using Redi-Rock 28" and 41" units using the standard 5.2° wall batter. Refer to the manufacturers information for additional details on the proposed retaining wall system and its material properties.

3.2 Soil Reinforcement

The proposed walls are designed as gravity walls and do not require soil reinforcement.

4.0 Soil Properties

Site soils information was obtained from the geotechnical report prepared by Northwest Colorado Consultants, Inc. dated 12/20/2022. The soil strengths shown were assumed and shall be verified by the project geotechnical engineer. Soil Structures Engineering, LLC should be contacted if the noted soil strengths are not met as a redesign may be required.

Zone	Description	ϕ	c'	ϒ
Retained Soil 1	Gravel - GP	38°	0 psf	110 pcf
Foundation Soil 1	Lean Clay - CL	25°	100 psf	125 pcf

Refer to the referenced soils report for additional information regarding the site soil conditions and geotechnical engineers' recommendations.

5.0 Maximum Surcharge Loadings & Slope Conditions

Below are the maximum surcharge and site slope conditions as evaluated within this design. The noted extremes may not be present for the entire length of any given wall. Dead load surcharge loadings are applied in addition to any equivalent geometric loadings applied within the design calculations. Refer to the contract civil plans for locations of all anticipated surcharge locations and grade geometry.

Wall No.	Live Load (psf)	Dead Load (psf)	Toe Slope	Back Slope
1	100	N/A	Flat	2H:1V
2	100	N/A	Flat	2H:1V

6.0 Hydraulic Conditions

6.1 Water Application

The proposed walls are not located within a wetland application and the ground water elevation is assumed to be located sufficiently below bottom of wall as to not influence overall stability. The project geotechnical engineer shall consider fluctuations in seasonal ground water elevations during the verification external failure mechanisms.

6.2 Erosion Control & Prevention

The contractor shall ensure positive drainage is maintained both during and after construction. Erosion prevention and protection shall be maintained above and below the retaining wall as designed by others. All downspouts, swales, and drainage features shall be diverted away from the wall location.

7.0 Seismic Conditions

The calculated 1-second peak ground acceleration (S_{D1}) is 0.103g. Given the relatively low PGA and standard reduction in required factors of safety for seismic designs, static calculations govern the overall design. The calculations submitted do not include seismic sections for clarity. Seismic calculations may be provided upon request.

8.0 Wind & Snow Conditions

No additional surcharge due to wind is anticipated or included within this design of below grade structures. All freestanding, above grade structures shall be designed or relocated to not influence the below grade retaining wall within a 1H:1V zone of influence. Refer to ASCE 7-16 for additional information on surcharge applications. Additional surcharges for snow are excluded unless specifically included in the defined surcharge loadings. Snow shall not be stored or piled above the proposed retaining wall(s).

9.0 External Stability and Settlement

Global Stability has been evaluated by Soil Structures Engineering, LLC using soils noted in section 4.0 and shall be verified by the project geotechnical engineer. Local Bearing Capacities and Settlement are not covered under the scope of this design and shall be evaluated under the scope of the project geotechnical engineer. The foundation soils at each wall location shall be capable of supporting the applied bearing capacities shown within the shop drawings without failure or excessive settlement.

10.0 Limitations of Report

The design presented within this report is based on the information provided. Soil Structures Engineering, LLC accepts no liability for verifying site geometry, soil parameters, or ensuring all information provided is up to date. The contractor and/or owner's representative shall notify Soil Structures Engineering, LLC of any changes or conflicts with the actual site geometry prior to construction. Verification of site soil conditions, bearing capacities, anticipated settlement, and global stability shall be completed as directed within the construction plans and project specifications.

Appendix Item A: Design References

Landmark Consultants, Inc. plan set for: The Amble, Steamboat Springs, CO, Project No.: 2571-001, Last Dated: 03/15/2024

Northwest Colorado Consultants, Inc. report titled: Supplimental Subsoil and Foundation Investigation, The Amble - Steamboat Grand Phase II, Steamboat Springs, Colorado, Project No.: 21-12448, Last Dated: 12/20/2022

NCMA Design Manual for Segmental Retaining Walls, 3rd Edition

NCMA SRW Best Practices, 2nd Printing, 2017

ASCE 7-16 Minimum Design Loads and Associated Criteria

IBC-2021 International Building Code, 2021

Appendix Item B: Final Calculations

Calculations attached after this sheet

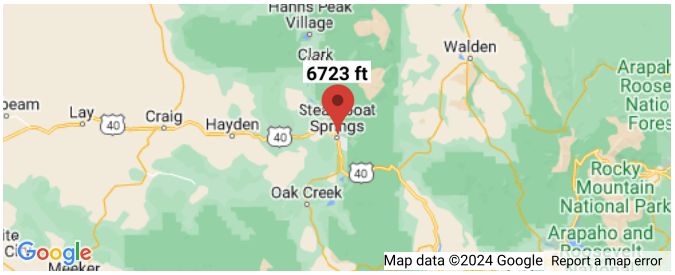
This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

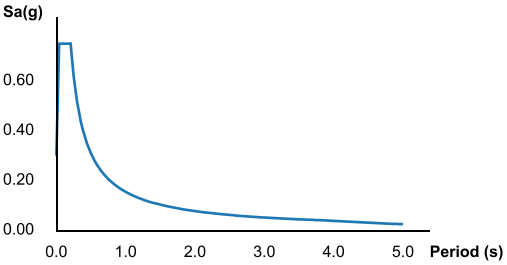
Hazards by Location

Search Information

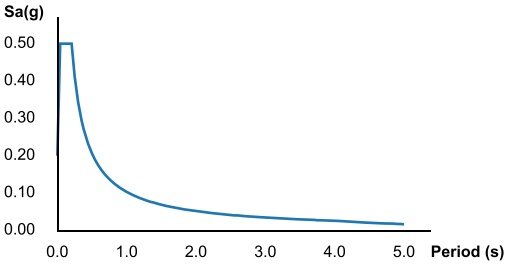
Address:	Steamboat Springs, CO 80487, USA
Coordinates:	40.4849769, -106.8317158
Elevation:	6723 ft
Timestamp:	2024-04-20T20:32:28.023Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	II
Site Class:	C



MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	0.594	MCE_R ground motion (period=0.2s)
S_1	0.103	MCE_R ground motion (period=1.0s)
S_{MS}	0.75	Site-modified spectral acceleration value
S_{M1}	0.154	Site-modified spectral acceleration value
S_{DS}	0.5	Numeric seismic design value at 0.2s SA
S_{D1}	0.103	Numeric seismic design value at 1.0s SA

Additional Information

Name	Value	Description
SDC	D	Seismic design category
F_a	1.262	Site amplification factor at 0.2s
F_v	1.5	Site amplification factor at 1.0s
CR_S	0.906	Coefficient of risk (0.2s)
CR_1	0.946	Coefficient of risk (1.0s)
PGA	0.417	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.5	Site modified peak ground acceleration
T_L	4	Long-period transition period (s)
SsRT	0.594	Probabilistic risk-targeted ground motion (0.2s)
SsUH	0.656	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.103	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.109	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)

PGAd	0.5	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Please note that the ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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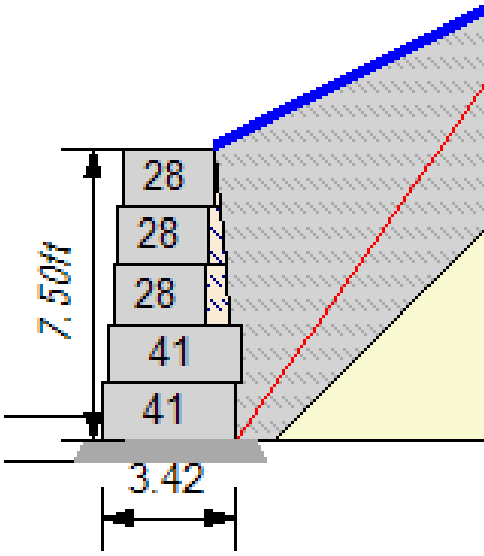
REA Analysis

Project:	24SSL010 The Amble
Location:	Steamboat Springs, CO
Designer:	BTD
Date:	4/20/2024
Section:	Section 1
Design Method:	NCMA_09_3rd_Ed
Design Unit:	Redi-Rock



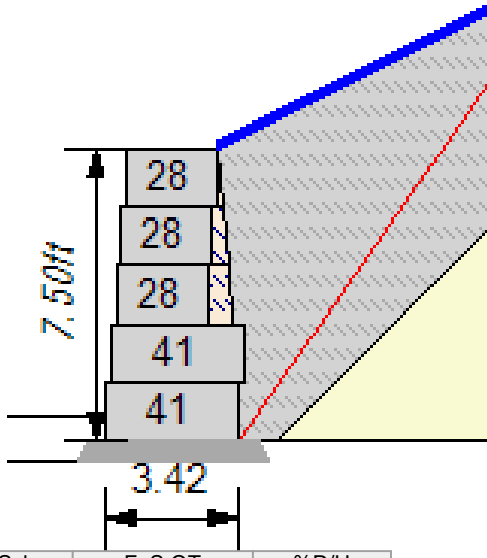
SOIL PARAMETERS	φ	coh	γ	
Select Soil:	38 deg	0psf	110pcf	
Retained Soil:	25 deg	100psf	125pcf	
Foundation Soil:	25 deg	100psf	125pcf	
Leveling Pad:	38 deg	0psf	110pcf	Crushed Stone

GEOMETRY

Design Height:	7.50ft	Live Load:	100psf
Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	0.00ft
Embedment:	0.67ft	Live Load Width:	100ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf
Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
Slope Length:	20.0ft	Dead Load Width:	0ft
Slope Toe Offset:	0.0ft	D.L. Embedment:	0ft
Leveling Pad Width:	4.42ft		
Vert δ on Single Dpth			
Select Fill Offset:	1.00		
Select Fill Angle:	45.00		

FACTORS OF SAFETY

Sliding:	1.50	Overturning:	1.50
Bearing:	2.00		



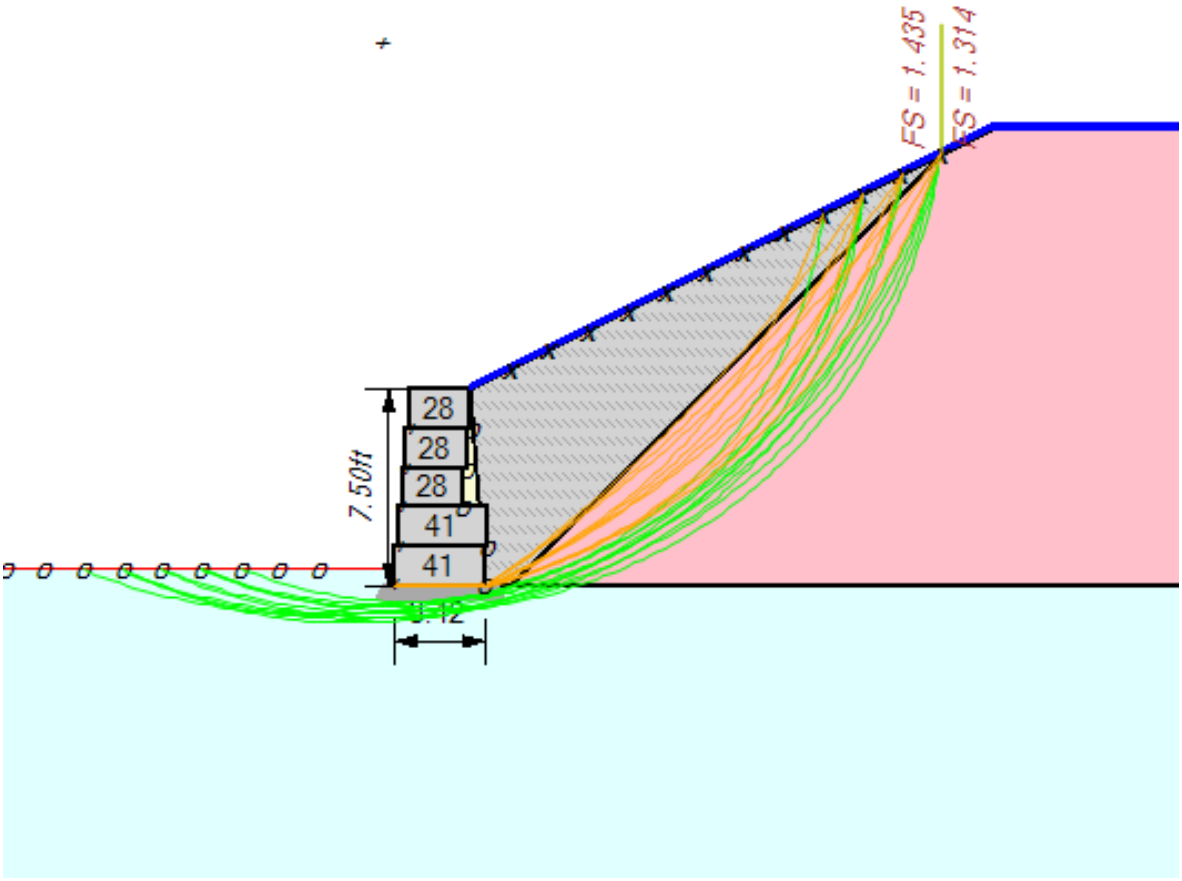
RESULTS

FoS Sliding:	1.81 (lvlpd)	FoS Overturning:	2.13
Bearing:	1395.11	FoS Bearing:	3.89

Name	Elev.[dpth]	ka	Pa	Paq	(PaC)	PaT	FSsl	FoS OT	%D/H
28	6.00[1.50]	0.319	39	48	0	87	>100	11.20	156%
28	4.50[3.00]	0.264	131	79	0	210	52.92	5.09	78%
28	3.00[4.50]	0.264	294	119	0	413	27.90	2.84	52%
41	1.50[6.00]	0.399	790	239	0	1029	13.52	2.66	57%
41	0.00[7.50]	0.382	1181	286	0	1467	1.81	2.13	46%

Column Descriptions:

ka: active earth pressure coefficient
Pa: active earth pressure
Paq: live surcharge earth pressure
Paq2: live load 2 surcharge earth pressure
Paqd: dead surcharge earth pressure
(PaC): reduction in load due to cohesion
PaT: sum of all earth pressures
FSsl(lvl Pad): factor of safety for sliding at each layer. (FS sliding below the leveling pad)
FSot: factor of safety of overturning about the toe.


FS = 1.435
FS = 1.314
28
28
28
41
41
7.50ft

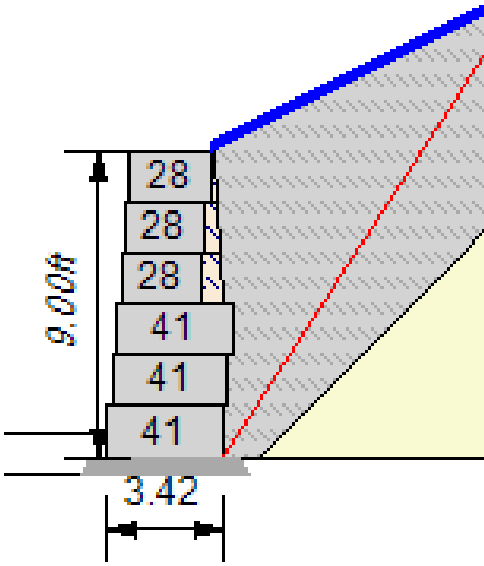
COMPOUND RESULTS

Compound stability is a global analysis (Bishop) with the failure planes originating at the top of the slope / wall and exiting out through the face of the wall. For MSE walls, the resistance of the geogrid reinforcement is included in the analysis and the shear resistance of the face units is included.

ID	Enter Point X	Enter Point Y	Exit Point X	Exit Point Y	Center X	Center Y	Radius	FoS
3	20.92	16.53	3.42	0.00	-12.02	33.87	37.22	1.314
3	19.42	15.78	3.42	0.00	-10.05	29.65	32.57	1.317
4	20.92	16.53	3.42	0.00	-3.39	24.73	25.65	1.335
3	17.92	15.03	3.42	0.00	-8.23	25.75	28.26	1.340
4	19.42	15.78	3.42	0.00	-2.31	21.80	22.54	1.353
2	19.42	15.78	3.42	0.00	-32.56	52.48	63.63	1.358
2	20.92	16.53	3.42	0.00	-37.24	60.57	72.95	1.359
3	16.42	14.28	3.42	0.00	-6.58	22.16	24.31	1.378
2	17.92	15.03	3.42	0.00	-28.21	45.02	55.02	1.379
4	17.92	15.03	3.42	0.00	-1.33	19.09	19.67	1.393

REA Analysis

Project:	24SSL010 The Amble
Location:	Steamboat Springs, CO
Designer:	BTD
Date:	4/20/2024
Section:	Section 2
Design Method:	NCMA_09_3rd_Ed
Design Unit:	Redi-Rock



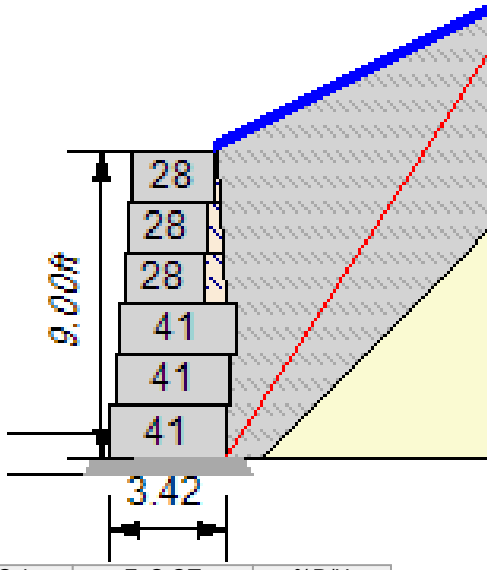
SOIL PARAMETERS	φ	coh	γ	
Select Soil:	38 deg	0psf	110pcf	
Retained Soil:	25 deg	100psf	125pcf	
Foundation Soil:	25 deg	100psf	125pcf	
Leveling Pad:	38 deg	0psf	110pcf	Crushed Stone

GEOMETRY

Design Height:	9.00ft	Live Load:	100psf
Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	0.00ft
Embedment:	0.67ft	Live Load Width:	100ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf
Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
Slope Length:	8.0ft	Dead Load Width:	0ft
Slope Toe Offset:	0.0ft	D.L. Embedment:	0ft
Leveling Pad Width:	4.42ft		
Vert δ on Single Dpth			
Select Fill Offset:	1.00		
Select Fill Angle:	45.00		

FACTORS OF SAFETY

Sliding:	1.50	Overturning:	1.50
Bearing:	2.00		



RESULTS

FoS Sliding:	1.70 (lvlpd)	FoS Overturning:	1.77
Bearing:	1945.33	FoS Bearing:	2.68

Name	Elev.[dpth]	ka	Pa	Paq	(PaC)	PaT	FSsl	FoS OT	%D/H
28	7.50[1.50]	0.319	39	48	0	87	>100	11.20	156%
28	6.00[3.00]	0.264	131	79	0	210	52.92	5.09	78%
28	4.50[4.50]	0.264	294	119	0	413	27.90	2.84	52%
41	3.00[6.00]	0.399	790	239	0	1029	13.46	2.58	57%
41	1.50[7.50]	0.381	1177	285	0	1463	9.92	2.07	46%
41	0.00[9.00]	0.354	1578	319	0	1897	1.70	1.77	38%

Column Descriptions:

ka: active earth pressure coefficient

Pa: active earth pressure

Paq: live surcharge earth pressure

Paq2: live load 2 surcharge earth pressure

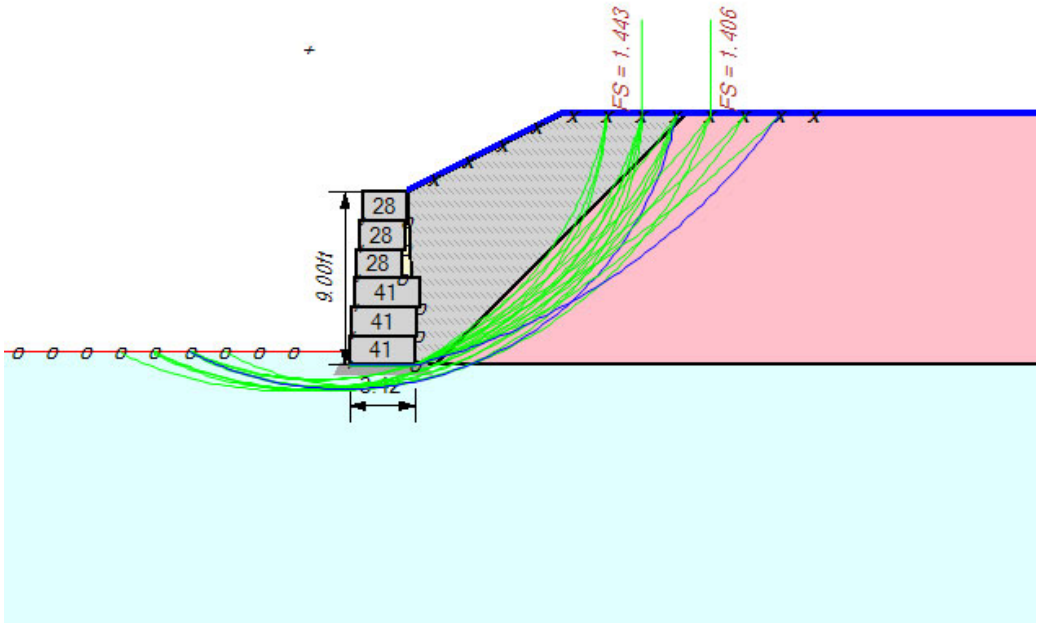
Paqd: dead surcharge earth pressure

(PaC): reduction in load due to cohesion

PaT: sum of all earth pressures

FSsl(lvl Pad): factor of safety for sliding at each layer. (FS sliding below the leveling pad)

FSot: factor of safety of overturning about the toe.


FS = 1.443
FS = 1.406
28
28
28
41
41
41
9.00ft

COMPOUND RESULTS

Compound stability is a global analysis (Bishop) with the failure planes originating at the top of the slope / wall and exiting out through the face of the wall. For MSE walls, the resistance of the geogrid reinforcement is included in the analysis and the shear resistance of the face units is included.

ID	Enter Point X	Enter Point Y	Exit Point X	Exit Point Y	Center X	Center Y	Radius	FoS
2	18.82	13.01	3.42	0.00	-21.33	44.92	51.29	1.406
2	17.02	13.01	3.42	0.00	-20.03	38.13	44.76	1.410
2	20.62	13.01	3.42	0.00	-22.74	52.47	58.62	1.426
3	17.02	13.01	3.42	0.00	-4.39	21.78	23.13	1.431
3	15.22	13.01	3.42	0.00	-4.22	18.78	20.27	1.433
3	18.82	13.01	3.42	0.00	-4.62	25.14	26.39	1.439
2	22.42	13.01	3.42	0.00	-24.23	60.78	66.77	1.456
3	20.62	13.01	3.42	0.00	-4.91	28.89	30.06	1.471
3	13.42	13.01	3.42	0.00	-4.13	16.15	17.82	1.488
3	22.42	13.01	3.42	0.00	-5.24	33.02	34.13	1.502

GLOBAL RESULTS

Global stability is a global analysis (Bishop) with the failure planes originating at the top of the slope / wall and exiting out below the wall in the area infront of the structure. For MSE walls, the resistance of the geogrid reinforcement is included in the resisting forces. The curve may go through the base of the wall and the wall shear would be included. In most cases the failure plane will pass below the structure.

ID	Enter Point X	Enter Point Y	Exit Point X	Exit Point Y	Center X	Center Y	Radius	FoS
2	15.22	13.01	-10.14	0.67	-2.14	16.46	17.70	1.443
2	15.22	13.01	-8.34	0.67	-0.79	14.92	16.13	1.448
2	13.42	13.01	-8.34	0.67	-1.24	13.51	14.67	1.456
2	17.02	13.01	-10.14	0.67	-1.68	18.11	19.39	1.468
2	17.02	13.01	-11.94	0.67	-3.02	19.89	21.19	1.487
2	15.22	13.01	-6.54	0.67	0.56	13.51	14.67	1.489
1	13.42	13.01	-8.34	0.67	-1.67	14.26	15.14	1.496
2	18.82	13.01	-10.14	0.67	-1.22	19.89	21.19	1.498
1	15.22	13.01	-8.34	0.67	-1.55	16.36	17.10	1.498
2	17.02	13.01	-8.34	0.67	-0.34	16.46	17.70	1.502