TRANSMITTAL OF SHOP DRAWINGS

DATE: 8/16/2023	6	NEW SUBMITTAL		RESUBMITTAL

TO: Tim Brugger, PE

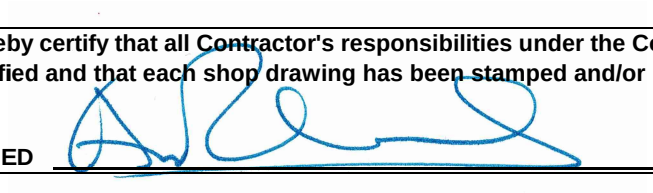
FROM: Northern Underground LLC

PROJECT: Brooks Street Greenspace

ITEM NO.	DESCRIPTION OF ITEM SUBMITTED (Type, size, model number, etc.)	MANUFACTURER OR SUPPLIER	SPECIFICATION PARAGRAPH & PAGE NO.	SPECIFICATION REQUIREMENTS		BID ITEM NO.
				Meets	Does Not Meet	
1	Retaining wall design	GEOWALL DESIGNS		x		
2	Versa Lok	Versa Lok		x		
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

LIST ALL VARIANCES FROM CONTRACT DOCUMENT REQUIREMENTS

I hereby certify that all Contractor's responsibilities under the Contract Documents with respect to review and submission of the above Shop Drawings have been satisfied and that each shop drawing has been stamped and/or marked to indicate Contractor's compliance with the Shop Drawing review requirements.

SIGNED  **NAME (printed) & TITLE** Aaron Rosenlund Manager

GEOWALL DESIGNS

"BUILT FROM THE GROUND UP"

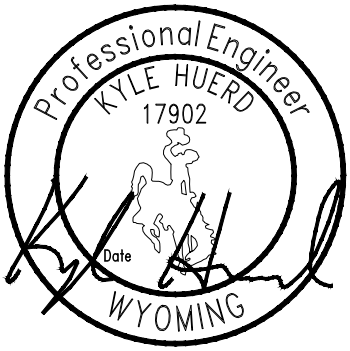
DESIGN REPORT FOR:

23NOU001

BROOKS STREET GREENSPACE
SHERIDAN, WY

August 15, 2023

REV 0



Index

1.0 Site Review

This project includes twelve retaining walls. Walls 1 - 4 are apart of a set of tiered walls located on the North West side of the project site. Wall 1 has a maximum height of 2.33-feet and horizontal length of 19.33-feet. Wall 2 has a maximum height of 4.33-feet and horizontal length of 61.33-feet. Wall 3 has a maximum height of 2.75-feet and horizontal length of 29.33-feet. Wall 4 has a maximum height of 4.75-feet and horizontal length of 71.33-feet. Wall 5 is located on the North side of the project site and has a maximum height of 2.75-feet and a horizontal length of 121.33-feet. Walls 6 - 12 are tiered walls located on the South side of the project site. Wall 6 has a maximum height of 2.75-feet and horizontal length of 11.33-feet. Wall 7 has a maximum height of 2.75-feet and horizontal length of 28.00-feet. Wall 8 has a maximum height of 3.75-feet and horizontal length of 14.00-feet. Wall 9 has a maximum height of 4.75-feet and horizontal length of 26.67-feet. Wall 10 has a maximum height of 1.75-feet and horizontal length of 12.00-feet. Wall 11 has a maximum height of 2.75-feet and horizontal length of 6.67-feet. Wall 12 has a maximum height of 7.25-feet and horizontal length of 36.67-feet. The plans and the specifications conflict, which the design of the retaining walls follow the NCMA requirements which has a minimum embedment based on 6" of the design engineer requirements. Based on the contract plans showing 2 to 3 feet of embedment, the walls have been designed to follow the specification requirements.

2.0 Design Methodology

The proposed walls have been designed in accordance with the NCMA (National Concrete Masonry Association) design methodology. The walls have been designed using soil reinforcement with portions designed as gravity (without reinforcement). 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 Versa-Lok Standard 6" units using the standard 7.1° 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 utilize 5XT geogrid soil reinforcement. Refer to the product technical data for the corresponding tensile properties and strength reduction factors.

4.0 Soil Properties

Site soils information was not provided at the time of design. The soil strengths shown were assumed and shall be verified by the project geotechnical engineer. GeoWall Designs, LLC should be contacted if the noted soil strengths are not met as a redesign may be required.

Zone	Description	ϕ	c'	Y
Reinforced Soil 1	Sand - SM/SP	32°	0 psf	125 pcf
Retained Soil 1	Lean Clay - CL	25°	0 psf	125 pcf
Retained Soil 2	Gravel - GP	38°	0 psf	110 pcf
Foundation Soil 1	Lean Clay - CL	25°	50 psf	125 pcf

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	Flat
2	100	N/A	Flat	Flat
3	100	N/A	3H:1V	Flat
4	100	N/A	3H:1V	Flat
5	100	N/A	Flat	Flat
6	100	N/A	Flat	Flat
7	100	N/A	Flat	4H:1V
8	100	N/A	4H:1V	4H:1V
9	100	N/A	Flat	4H:1V
10	100	N/A	4H:1V	3H:1V
11	100	N/A	3H:1V	Flat
12	100	N/A	2H:1V	Flat

6.0 Hydraulic Conditions

6.1 Water Application

The proposed wall(s) 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 estimated 1-second peak ground acceleration (S_{D1}) is less than 0.08g and is therefore neglected.

8.0 Wind 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.

9.0 External Stability and Settlement

Global Stability has been evaluated by GeoWall Designs, LLC using soils noted in section 4.0 and shall be verified by the project geotechnical engineer hired by the contractor. 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 during field verification. 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. GeoWall Designs, 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 GeoWall Designs, 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

Morrison-Maierle plan set for: Brooks Street Greenspace, Project No.: 6014.002, Last Dated: 03/01/2023

American Engineering Testing report titled: Proposed Brooks Street Greenspace, Project No.: P-0004856, Last Dated: 07/7/2022

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

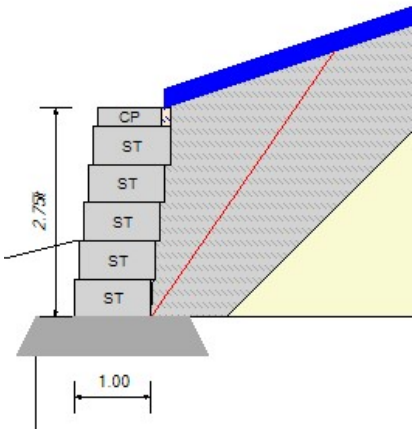
IBC-2018 International Building Code, 2018

Appendix Item B: Final Calculations

Calculations attached after this sheet

REA Analysis

Project:	Brook Street Greenspace
Location:	Sheridan, WY
Designer:	KAH
Date:	8/14/2023
Section:	Section 3
Design Method:	NCMA_09_3rd_Ed, Ignore Vert. Force
Design Unit:	Versa-Lok



SOIL PARAMETERS	φ	coh	γ	
Select Soil:	38 deg	0psf	110pcf	
Retained Soil:	25 deg	0psf	125pcf	
Foundation Soil:	25 deg	50psf	125pcf	
Leveling Pad:	40 deg	0psf	135pcf	Crushed Stone

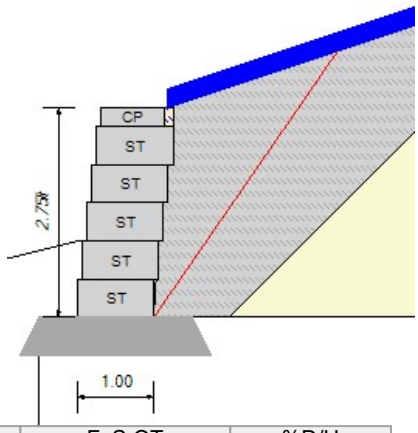
GEOMETRY

Design Height:	2.75ft	Live Load:	100psf
Wall Batter/Tilt:	7.10/ 0.00 deg	Live Load Offset:	0.00ft
Embedment:	1.00ft	Live Load Width:	50ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf
Slope Angle:	18.4 deg	Dead Load Offset:	4.0ft
Slope Length:	50.0ft	Dead Load Width:	50ft
Slope Toe Offset:	0.0ft	D.L. Embedment:	0ft
Leveling Pad Width:	2.00ft		
Vert δ on Single Dpth		Toe Slope Angle:	14.00
		Toe Slope Length:	10.00
		Toe Slope Bench:	0.00

Select Fill Offset:	1.00
Select Fill Angle:	45.00

FACTORS OF SAFETY

Sliding:	1.50	Overturning:	1.50
Bearing:	2.00		



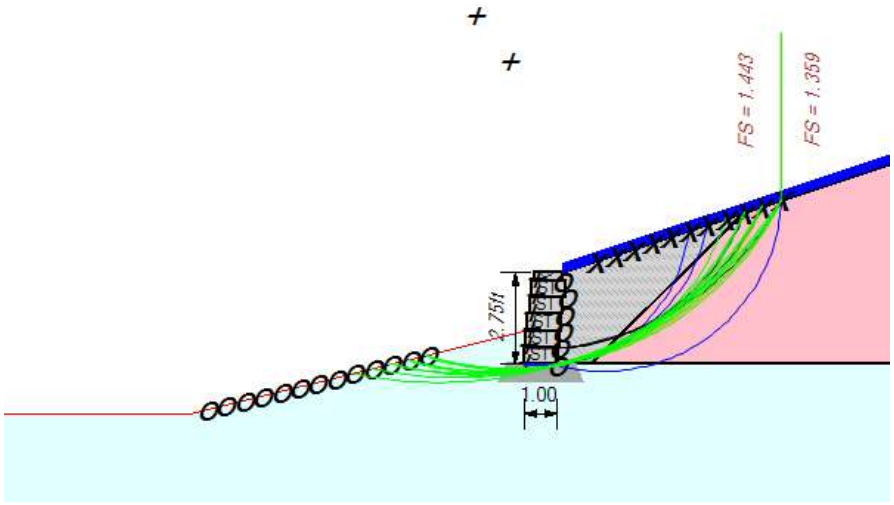
RESULTS

FoS Sliding:	1.59 (lvlpd)	FoS Overturning:	1.70
Bearing:	369.93	FoS Bearing:	10.06

Name	Elev.[dpth]	ka	Pa	Paq	PaT	FSsl	FoS OT	%D/H
CP	2.50[0.25]	0.271	1	0	1	>100	--	333%
ST	2.00[0.75]	0.199	6	15	21	32.28	7.60	133%
ST	1.50[1.25]	0.210	18	26	44	5.44	4.16	80%
ST	1.00[1.75]	0.210	35	37	72	4.14	2.86	57%
ST	0.50[2.25]	0.210	59	47	106	3.39	2.16	44%
ST	0.00[2.75]	0.210	88	58	145	1.59	1.70	36%

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 = 1.359
2.75ft
1.00

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	7.68	4.91	1.00	0.00	-0.46	8.97	9.09	1.359
2	7.13	4.73	1.00	0.00	-0.21	7.89	7.99	1.373
2	6.58	4.55	1.00	0.00	0.02	6.90	6.97	1.428
2	6.03	4.36	1.00	0.00	0.21	5.99	6.04	1.492
2	5.48	4.18	1.00	0.00	0.38	5.15	5.19	1.575
2	4.93	4.00	1.00	0.00	0.52	4.40	4.42	1.677
3	7.68	4.91	1.00	0.00	2.39	5.11	5.29	1.875
2	7.68	4.91	1.06	0.50	0.26	8.86	8.40	2.065
2	7.13	4.73	1.06	0.50	0.47	7.81	7.33	2.178
2	6.58	4.55	1.06	0.50	0.66	6.83	6.35	2.279

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
1	7.68	4.91	-3.98	0.01	-1.47	10.35	10.64	1.443
1	7.68	4.91	-2.88	0.28	-0.31	8.77	8.87	1.444
1	7.68	4.91	-3.43	0.15	-0.90	9.57	9.76	1.445
1	7.68	4.91	-4.53	-0.13	-2.02	11.10	11.50	1.458
1	7.13	4.73	-2.88	0.28	-0.36	8.09	8.20	1.469
1	7.13	4.73	-3.43	0.15	-0.92	8.82	9.03	1.475
1	7.68	4.91	-5.08	-0.27	-2.56	11.83	12.36	1.475
1	6.58	4.55	-3.43	0.15	-0.95	8.08	8.31	1.476
1	6.58	4.55	-2.88	0.28	-0.41	7.42	7.55	1.490
1	7.13	4.73	-3.98	0.01	-1.47	9.53	9.85	1.492

STRUCTURAL PROPERTIES:

N is the normal force [or factored normal load] on the base unit
The default leveling pad to base unit shear is 0.8 tan(φ) [AASHTO 10.6.3.4] or
may be the manufacturer supplied data. φ is assumed to be 40 degrees for a stone leveling pad.

OVERVIEW

REA Wall calculates stability assuming the wall is a rigid body. Forces and moments are calculated about the base and the front toe of the wall. The base block width is used in the calculations. The concrete units and granular fill over the blocks are used as resisting forces.

EARTH PRESSURES

The method of analysis uses the Coulomb Earth Pressure equation (below) to calculate active earth pressures. Wall friction is assumed to act at the back of the wall face. The component of earth pressure is assumed to act perpendicular to the boundary surface. The effective δ angle is δ minus the wall batter at the back face. If the slope breaks within the failure zone, a trial wedge method of analysis is used.

EXTERNAL EARTH PRESSURES

Effective δ angle (2/3 retained phi)	δ =25.3 deg
Coefficient of active earth pressure	ka =0.210
External failure plane	ρ = 55 deg
Effective Angle from horizontal	θ =97.10 deg
Coefficient of passive earth pressure: kp = (1 + sin(φ)) / (1 - sin(φ))	kp =0.00

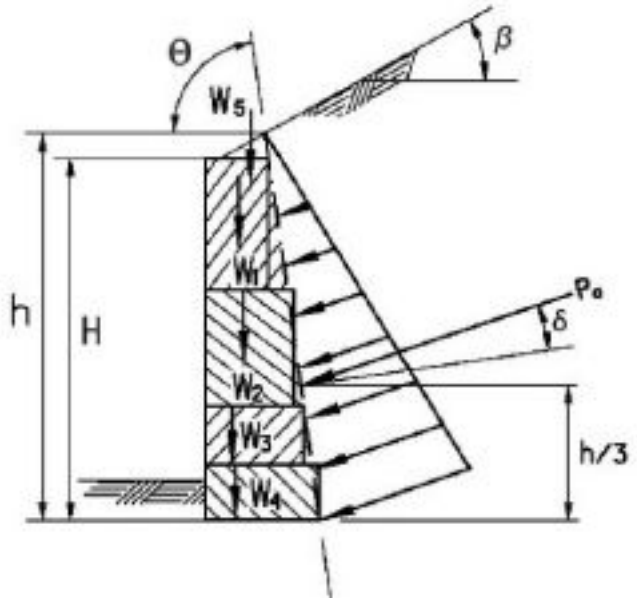
$$k_a = \frac{\sin^2(\theta + \phi')}{\Gamma[\sin^2 \sin(\Theta - \delta)]}$$

in which:

$$\Gamma = \left[1 + \sqrt{\frac{\sin(\phi' + \delta)\sin(\phi' - \beta)}{\sin(\Theta - \delta)\sin(\Theta + \beta)}}\right]^2$$

where :

δ = friction angle between fill and wall (degrees)
β = angle of fill to the horizontal (degrees)
θ = angle of bck face of wall to the horizontal (degrees)
φ'f = effective angle of internal friction (degrees)



FORCE DETAILS

The details below shown how the forces are calculated for each force component. The values shown are not factored. All loads are based on a unit width (ppf / kNpm).

Layer	Block Wt	Soil Fill Wt	Soil Wt
1	25	0	3
2	60	0	0
3	60	0	0
4	60	0	0
5	60	0	0
6	60	0	

Block Weight (Force v (Block Wt + Infill Soil)) = 325ppf X-Arm = 0.63ft
Soils Block Weight (Force v) = 3ppf X-Arm = 1.14ft

Active Earth Pressure Pa = 88ppf
Pa_h (Force H) = Pa cos(δ - batter) = 88 x cos(25.3 - (7.1)) = 83ppf
Y-Arm = 0.92ft
Pa_v (Force V) = Pa sin(δ - batter) = 88 x sin(25.3 - (7.1)) = 27ppf
X-Arm = 1.06ft

Live Load Pq = 58ppf
Pq_h (Force H) = Pq cos(δ - batter) = 58 x cos(25.3 - 7.1) = 55ppf
Y-Arm = 1.38ft
Pq_v (Force V) = Pq sin(δ - batter) = 58 x sin(25.3 - 7.1) = 18ppf
X-Arm = 1.09ft

FORCES AND MOMENTS

The program resolves all the geometry into simple geometric shapes to make checking easier. All x and y coordinates are referenced to a zero point at the middle of the base block for eccentricity calculations.

LOADS FOR OVERTURNING ABOUT THE TOE

Name	Force (V)	Force (H)	X-len	Y-len	Mo	Mr
Face Blocks(W1)	325	--	0.63	--	--	206
Soil Wedge(W2)	3	--	1.14	--	--	3
Pa_h	--	83	--	0.92	76	--
Pa_v	27	--	1.06	--	--	29
Pq_h	--	55	--	1.38	76	--
Pq_v	18	--	1.09	--	--	20
Sum V / H	373	138		Sum Mom	152	257

W0: stone within units W1: facing units
W2: soil wedge behind the face
X-Len: is measured from the center of the base (+) Driving, (-) Resisting.
Pa_h: horizontal earth pressure Pa_v: vertical earth pressure
Pq_h: horizontal surcharge pressure Pq_v: vertical surcharge pressure

BEARING LOADS: NCMA

Name	Force (V)	Force (H)	X-len	Y-len	Mo	Mr
Face Blocks(W1)	325	--	-0.13	--	--	-43
Soil Wedge(W2)	3	--	-0.64	--	--	-2
Pa_h	--	83	--	0.92	76	--
Pa_v	27	--	-0.56	--	--	-15
Pq_h	--	55	--	1.38	76	--
Pq_v	18	--	0.00	--	--	0
Sum V / H	373	138		Sum Mom	152	-60

BASE SLIDING

Sliding at the base is checked at the block to leveling pad interface between the base block and the leveling pad.

Forces Resisting sliding = W1 + W2 + Pav + Pqv
325 + 3 + 27 + 18 N =373ppf

Resisting force at pad = (N * 0.8 * tan(slope) + intercept x L)
373 x0.8 x tan(40.0) + 0.0 Rf =219

Driving force is the horizontal component of
Pah + Pqh
83 + 55 Df =138

FSsl = Rf / Df FSsl =1.59

OVERTURNING ABOUT THE TOE

Overturning at the base is checked by assuming rotation about the front toe by the block mass and the soil retained on the blocks. Allowable overturning can be defined by eccentricity (e/L). For concrete leveling pads eccentricity is checked at the base of the pad.

Moments Resisting Overturning = M1 + M2 + MPav + MPqv

206 + 3 + 29 + 20 Mr =257ft-lbs

Moments causing Overturning = MPah + MPqh

76 + 76 Mo =152ft-lbs

FSot = Mr / Mo

FSot =257 / 152 FSot =1.70

ECCENTRICITY AND BEARING

Eccentricity is the calculation of the distance of the resultant away from the centroid of mass. In wall design the eccentricity is used to calculate an effective footing width.

Calculation of Eccentricity

SumV = + W1 + W2 + Pav + Pqv

+ 325 + 3 + 27 + 18 — SumV = 373

Moment Resisting — Mr = -60

Moment Driving — Md = 152

e = (SumMr + SumMd)/(SumV)

e = (92 /373.14) — e =0.246ft

Calculation of Bearing Pressures

Qult = c * Nc + q * Nq + 0.5 * γ* (B') * Ng

where:

Nc =20.72

Nq =10.66

Ng =10.88

c =50.00psf

q = 187.50psf(soil weight above base of leveling pad)

B' = B - 2e + lvlpad = 1.01ft

Gamma =125pcf

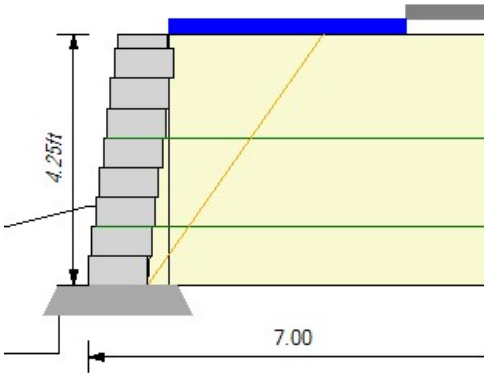
Calculate Ultimate Bearing, Qult — Qult =3721psf

Bearing Pressure = (SumVert / B') + (LP width * gamma) — sigma = 369.93psf

Calculated Factors of Safety for Bearing — Qult/sigma =10.06

REA Analysis

Project:	Brook Street Greenspace
Location:	Sheridan, WY
Designer:	KAH
Date:	8/14/2023
Section:	Section 2
Design Method:	NCMA_09_3rd_Ed, Ignore Vert. Force
Design Unit:	Versa-Lok



SOIL PARAMETERS	φ	coh	γ
Reinforced Soil:	32 deg	0psf	125pcf
Retained Soil:	25 deg	0psf	125pcf
Foundation Soil:	25 deg	50psf	125pcf

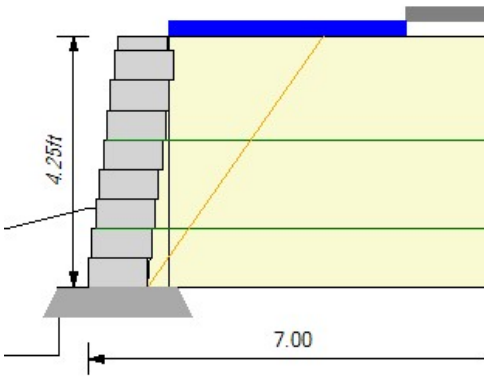
Leveling Pad: Crushed Stone

GEOMETRY

Design Height:	4.25ft (2.92ft Exp.)	Live Load:	100psf
Wall Batter/Tilt:	7.10/ 0.00 deg	Live Load Offset:	0.00ft
Embedment:	1.33ft	LL2 Width:	4ft
Leveling Pad Depth:	0.50ft	Dead Load:	601psf
Slope Angle:	0.0 deg	Dead Load Offset:	4.0ft
Slope Length:	0.0ft	Dead Load Width:	50ft
Slope Toe Offset:	0.0ft		
Vertical δ on Single Depth		Toe Slope Angle:	14.00
		Toe Slope Length:	10.00
		Toe Slope Bench:	0.00

FACTORS OF SAFETY

Sliding:	1.50	Pullout:	1.50
Overturning:	2.00	Uncertainties:	1.50
Bearing:	2.00	Connection:	1.50
Shear:	1.50	Bending:	1.50



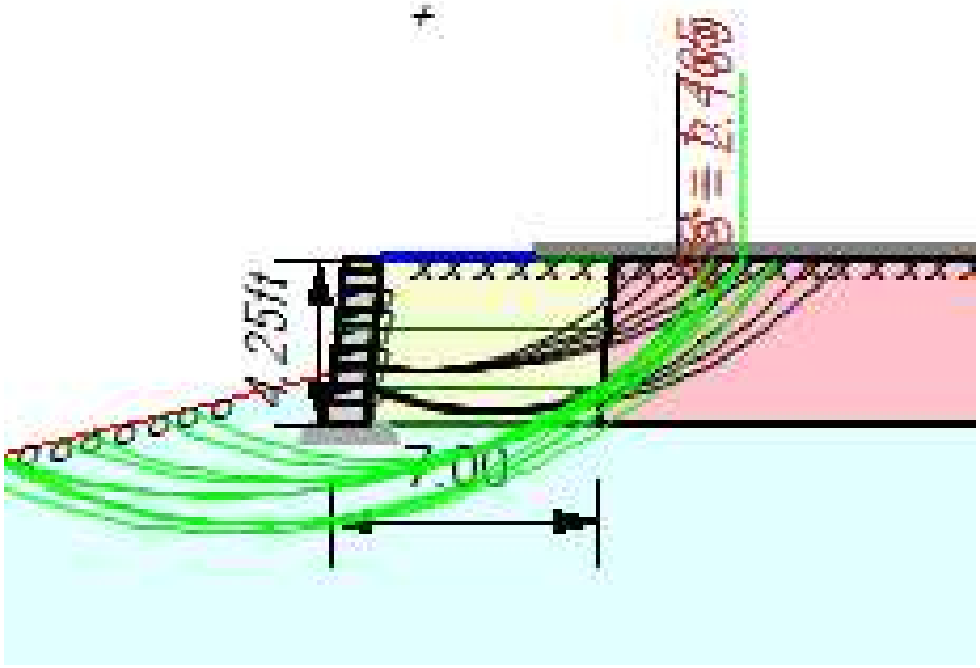
RESULTS

FoS Sliding:	2.41	FoS Overturning:	11.27
Bearing	760	FoS Bearing:	9.66
Pullout	25.16		
Total Pullout	5,430	FoS Total Pullout	19.11
Top FoSot:	3.52	FoS Connection:	5.74

ID	Height	Length	Name	Ta	Pa	LL	TMax	FSStr	TaCn	FSPkCn	FSPo	FSSldg	GridEmbedment
2	2.5	7	5XT	1786	86	34	120	22.35	458	5.74	18.09/[120]	6.15	4.56
1	1	7	5XT	1786	108	14	122	21.99	497	6.13	26.78/[122]	3.42 [2.41]	5.42

Column Descriptions:

Ta: allowable geogrid strength
Rc %: percent coverage for geosynthetics
EP (Pa) internal active earth pressure
LL (Pql) earth pressure due to live load surcharge
DL (Pqd) earth pressure due to dead load surcharge
Tmax maximum earth pressure on geosynthetic layer
FSstr factor of safety on geogrid strength (Ta/Tmax)
Ta cn allowable tension on the connection
FS Pkcn, factor of safety on the connection (Ta cn/Tmax)
FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)
Grid Embedment, depth of embedment beyond the theorectical failure plane.


2.50
7.00

GeoWall Designs

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	9.16	4.25	1.19	1.50	2.44	10.81	9.40	2.189
2	10.01	4.25	1.19	1.50	2.57	12.60	11.18	2.191
3	11.71	4.25	1.12	1.00	4.46	9.00	8.67	2.216
3	10.86	4.25	1.12	1.00	4.22	7.92	7.59	2.224
2	8.31	4.25	1.19	1.50	2.30	9.21	7.79	2.230
3	10.01	4.25	1.12	1.00	3.99	6.94	6.60	2.285
3	12.56	4.25	1.12	1.00	4.70	10.16	9.84	2.315
2	10.86	4.25	1.19	1.50	2.70	14.56	13.15	2.324
3	13.41	4.25	1.12	1.00	4.94	11.42	11.10	2.331
2	11.71	4.25	1.19	1.50	2.84	16.71	15.29	2.393

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
3	10.86	4.25	-8.78	-0.86	-2.91	16.86	18.67	1.465
3	10.86	4.25	-4.53	0.20	0.86	10.99	12.06	1.468
4	10.86	4.25	-8.78	-0.86	-1.70	12.22	14.88	1.474
3	11.71	4.25	-8.78	-0.86	-2.67	18.28	20.09	1.481
3	10.86	4.25	-6.23	-0.22	-0.60	13.15	14.51	1.482
3	10.01	4.25	-3.68	0.41	1.29	9.00	9.93	1.483
4	10.01	4.25	-8.78	-0.86	-1.97	11.21	13.86	1.484
3	10.86	4.25	-7.08	-0.44	-1.35	14.33	15.84	1.489
4	10.86	4.25	-9.63	-1.07	-2.41	13.22	16.01	1.489
4	11.71	4.25	-8.78	-0.86	-1.43	13.29	15.95	1.491

GEOGRID REINFORCING

STRUCTURAL PROPERTIES: Mirafi

GEOGRID PROPERTIES

Name	Tult	RFcr	RFd	RFid	Ci	Cd	Alpha	Ltds
5XT	4700	1.45	1.10	1.10	0.80	0.80	0.80	2679

CONNECTION STRENGTHS

Geogrid	Slope 1	Intercept 1	Peak Break	Slope 2	Intercept 2	Max Normal	Rup Conn	Conn Creep	Tlot (%)	Tlot
3XT	24.00	793	-1	0.00	0	1363	False	1.45	100	3500
5XT	18.00	621	-1	0.00	0	3013	False	1.45	100	4700
8XT	23.00	635	-1	0.00	0	3451	False	1.45	100	7400
10XT	32.00	755	-1	0.00	0	2968	False	1.45	100	9500

SHEAR STRENGTHS

Slope 29 deg

Intercept 450psf

CALCULATION RESULTS

OVERVIEW

REA Wall calculates stability assuming the wall is a rigid body. Forces and moments are calculated about the base and the front toe of the wall. The base block width or bottom reinforcement length is used in the calculations. The concrete units, granular fill over the blocks or reinforced zone soils are used as resisting forces.

EARTH PRESSURES

The method of analysis uses the Coulomb Earth Pressure equation (below) to calculate active earth pressures. Wall friction is assumed to act at the back of the wall face. The component of earth pressure is assumed to act perpendicular to the boundary surface. The effective delta angle is delta minus the wall batter at the back face (assumed to be vertical). If the slope breaks within the failure zone, a trial wedge method of analysis is used.

INTERNAL EARTH PRESSURES

Effective internal Delta angle (2/3 phi)	delta =21.3 deg
Coefficient of active earth pressure	ka =0.228
Internal failure plane	ρ = 55.0 deg

EXTERNAL EARTH PRESSURES

Effective external Delta angle	delta =25.00 deg
Coefficient of active earth pressure	ka =0.357
External failure plane	ρ = 50.0 deg

where :

δ = friction angle between fill and wall (degrees)
β = angle of fill to the horizontal (degrees)
θ = angle of bck face of wall to the horizontal (degrees)
φ'f = effective angle of internal friction (degrees)

FORCES AND MOMENTS

REA Wall resolves all the geometry into simple geometric shapes to make checking easier. All x and y coordinates are referenced to a zero point at the front toe. The wall image can be exported to CAD for a more detailed output.

Loads for Overturning about the FRONT TOE of the structure

Name	Force (V)	Force (H)	X-len	Y-len	Mo	Mr
Face Blocks(W1)	505	--	0.88	--	--	444
Soil(W2)	125	--	1.24	--	--	155
Soil(W3)	2995	--	4.18	--	--	12522
Soil(W4)	141	--	7.18	--	--	1009
LL(W7)	400	--	3.36	--	--	1345
DL(W8)	1302	--	6.45	--	--	8394
Pa_h	--	384	--	1.42	544	--
Pqd_h	--	741	--	2.13	1574	--
Sum (V, H)	5467	1125		Sum Mom	2118	23869

W0: leveling pad
W1: facing units
W2: soil wedge behind the face
W3: rectangular area in MSE area
W4: the wedge at the back of the mass
W5: slope area over the mass
W6: Rectangle zone in broken back
W7: Live load over the mass
W8: Dead load over the mass
W9: Force Pa
W10: Surcharge load Paq
W11: Dead Load Surcharge Paqd

X-Len: is measured from the center of the base (+) Driving, (-) Resisting.

Pa_h: horizontal earth pressure
Pa_v: vertical earth pressure
Pq_h: horizontal surcharge pressure
Pq_v: vertical surcharge pressure

BASE SLIDING

Sliding at the base is checked at the soil-to-soil interface between the reinforced mass and the foundation soil.

Forces resisting sliding = (SumVr- W0 - W1 - W7)	
5,467 - 0 - 505 - 400	SumVr = 4,562ppf
Resisting force = SumVr x tan(25) + c x L + Base Shear	Rf1 =2,713
where L is the base width	
where Base Shear = N tan(40.0) * 0.8	339.00
Driving force is the horizontal component of Pah + Pqh+ Pdh	Df = 1,125
Factor of Safety = Rf/Df	FSsl =2.41

OVERTURNING ABOUT THE TOE

Overturning at the base is checked by assuming rotation about the front toe by the block mass, soil retained on the blocks or within the reinforced zone. Allowable overturning can be defined by eccentricity (e/L) or by the ratio of resisting moments divided by overturning moment (FSot).

Moments resisting overturning = Sum(M1 to M6) + MPav + MPqv	Mr =23,869ft-lbs
Moments causing overturning = MPah + MPqh	Mo =2,118ft-lbs
Factor of safety = Mr/Mo	FSot =11.27 OK

ECCENTRICITY AND BEARING

Eccentricity is the calculation of the distance of the resultant away from the centroid of mass. In wall ReinDesign the eccentricity is used to calculate an effective footing width, or in rigid structure, it is used to calculate the pressure distribution below the base.

Calculation of Eccentricity

e = (SumMr + M7 + SumMo)/SumV

Mr = -2,902.13

Mo = 3,799.11

e = (-2,902.13 + 54.92 + 3,799.11) /5,467.15) e =0.166

Calculation of Bearing Pressures

Qult = c*Nc + q*Nq + 0.5*gamma*(B')*Ng

where:

Nc =20.72

Nq =10.66

Ng =10.88

c =50.00psf

q =166.25psf

B' =6.67ft

Calculate Ultimate Bearing, Qult Qult =7,343.93psf

Applied Bearing Pressures = (SumVert / B' + (2B + LP depth)/2 * LP depth *gamma)

sigma =759.96psf

Calculated Factors of Safety for Bearing Qult/sigma =9.66

GeoWall DESIGNS

TENSION CALCULATIONS

Tmax is the maximum tension in the reinforcing based on the earth pressure and surcharge loads applied. In the NCMA design method, earth pressures are calculated using the Coulomb Earth pressure equation. Infinite surcharge loads are applied as q x ka. In designs were there is a broken back slope, or the surcharge is not uniform over the area, a tie-back wedge analysis method is used.

FS = (Tal * FS_tn) / Tmax

TABLE OF RESULTS

Elevation[ft]	ka	z	sv	Name[ft]	Tult[ppf]	Ta[ppf]	Rc %	Tmax[ppf]	FS
2.50	0.228	1.25	2.50	5XT	4,700	1,786	100	120	22.35
1.00	0.228	3.13	1.25	5XT	4,700	1,786	100	122	21.99

PULLOUT CALCULATIONS

Pullout is the amount of resistance of the reinforcing has to a pullout failure based on the Tmax applied and the depth of embedment (resistance). In an NCMA design the failure place is defined as the Coulomb failure plane which varies with face batter, backslope angle, and surcharge loads applied. All failure planes begin at the tail. of the facing units.

For AASHTO calculations, the live load surcharge is not included in the Tmax value for pullout.

Failure Plane Angle (ρ) = 55.0 Deg

NOTE: The pullout capacity is limited by the LTDS of the reinforcing layer, not the ultimate pullout capacity calculated.

F* = 0.67 x tan(φ) = 0.67 x 0.62 = 0.42
Le = embedment length = Li - block depth - hi * Tan(90 - ρ)
La = Li - Le
sv = geogrid spacing
Rc = % coverage
α = scale effect correction
Pullout = 2 x Le x F* x sv x α x Rc

TABLE OF RESULTS

Elevation[ft]	Normal[lbf]	Ci	% Coverage	Tmax[ppf]	Le[ft]	La[ft]	Pullout_[Pr][ppf]	FS PO
2.50	2168.86	0.80	100	120	4.56	2.44	2168	18.09
1.00	3262.52	0.80	100	122	5.42	1.58	3262	26.78

CONNECTION CALCULATIONS

Connection is the amount of resistance of the reinforcing has to a pullout failure from the facing units based on the Tmax applied and the normal load on the units. In an AASHTO LRFD design, creep on the connection may be applied for frictional and mechanical connections. In NCMA or AASHTO 2002, a frictional failure is based on the peak connection capacity divided by a factor of safety. For a rupture connection the capacity is the peak load divided by a creep reduction factor and a factor of safety.

Frictional Connection

Peak Connection = N(ppf) tan(slope) + intercept

Rupture Connection

Connection Capacity = [N(ppf) tan(slope) + intercept] / RFcr

RFcr can be a value obtained from long-term testing or by default could be the creep reduction factor of the geogrid reinforcing.

Tal_cn = Allowable connection capacity = Tult_cn / FScn

Rc = % coverage

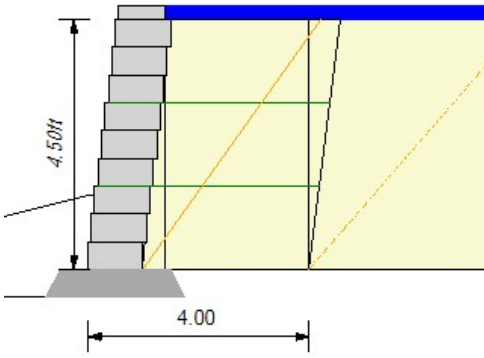
FS = Tal_cn * FScn/Tmax

TABLE OF RESULTS

Elev[ft]	Name	Tmax[ppf]	Rc %	N[ppf]	Tult_cn	Tac[ppf]	FS
2.50	5XT	120	100	205	756	458	5.74
1.00	5XT	122	100	385	821	497	6.13

REA Analysis

Project:	Brook Street Greenspace
Location:	Sheridan, WY
Designer:	KAH
Date:	8/14/2023
Section:	Section 2
Design Method:	NCMA_09_3rd_Ed, Ignore Vert. Force
Design Unit:	Versa-Lok



SOIL PARAMETERS	φ	coh	γ
Reinforced Soil:	32 deg	0psf	125pcf
Retained Soil:	25 deg	0psf	125pcf
Foundation Soil:	25 deg	50psf	125pcf

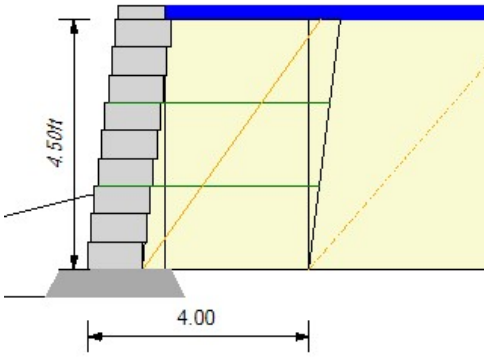
Leveling Pad: Crushed Stone

GEOMETRY

Design Height:	4.50ft (3.17ft Exp.)	Live Load:	100psf
Wall Batter/Tilt:	7.10/ 0.00 deg	Live Load Offset:	0.00ft
Embedment:	1.33ft	LL2 Width:	50ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf
Slope Angle:	0.0 deg	Dead Load Offset:	0.0ft
Slope Length:	0.0ft	Dead Load Width:	0ft
Slope Toe Offset:	0.0ft		
Vertical δ on Single Depth		Toe Slope Angle:	14.00
		Toe Slope Length:	5.00
		Toe Slope Bench:	0.00

FACTORS OF SAFETY

Sliding:	1.50	Pullout:	1.50
Overturning:	2.00	Uncertainties:	1.50
Bearing:	2.00	Connection:	1.50
Shear:	1.50	Bending:	1.50



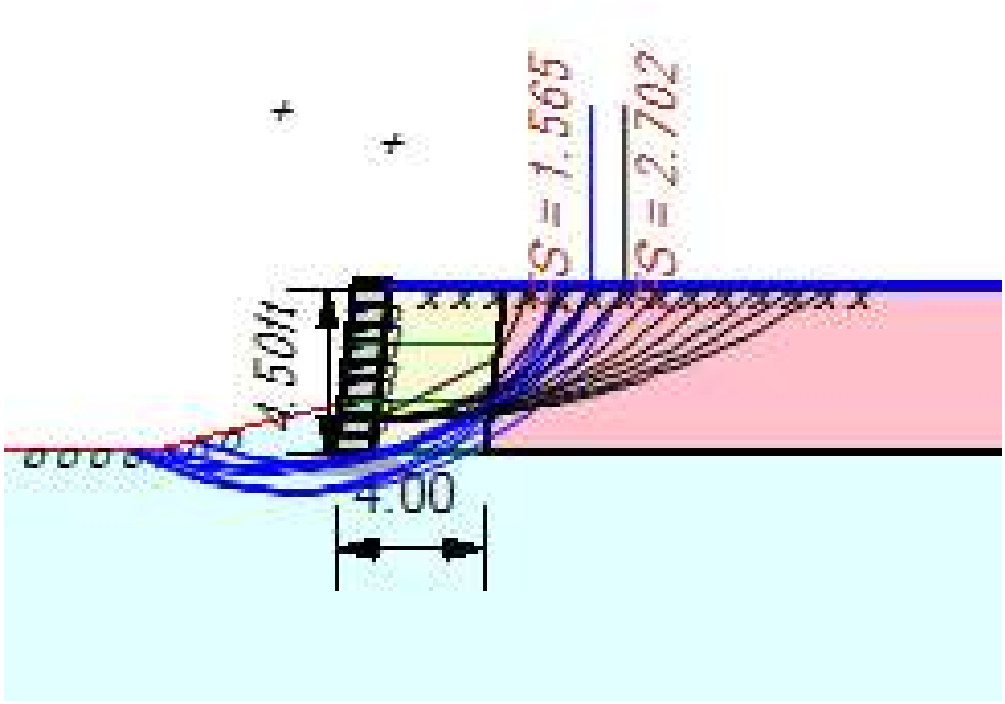
RESULTS

FoS Sliding:	3.18	FoS Overturning:	8.89
Bearing	601	FoS Bearing:	9.06
Pullout	3.31		
Total Pullout	1,024	FoS Total Pullout	3.59
Top FoSot:	5.22	FoS Connection:	4.75

ID	Height	Length	Name	Ta	Pa	LL	TMax	FSStr	TaCn	FSPkCn	FSPo	FSSldg	GridEmbedment
2	3	4	5XT	1786	70	50	119	22.42	458	5.76	1.93/[119]	19.19	1.23
1	1.5	4	5XT	1786	124	33	157	17.04	497	4.75	5.05/[157]	8.20 [3.18]	2.12

Column Descriptions:

Ta: allowable geogrid strength
Rc %: percent coverage for geosynthetics
EP (Pa) internal active earth pressure
LL (Pql) earth pressure due to live load surcharge
DL (Pqd) earth pressure due to dead load surcharge
Tmax maximum earth pressure on geosynthetic layer
FSstr factor of safety on geogrid strength (Ta/Tmax)
Ta cn allowable tension on the connection
FS Pkcn, factor of safety on the connection (Ta cn/Tmax)
FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)
Grid Embedment, depth of embedment beyond the theorectical failure plane.


S = 1.565
S = 2.702
2.50M
4.00

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	7.79	4.50	1.12	1.00	1.40	8.59	7.59	2.702
2	8.69	4.50	1.12	1.00	1.47	10.19	9.19	2.733
2	6.89	4.50	1.12	1.00	1.32	7.19	6.19	2.739
2	9.59	4.50	1.12	1.00	1.54	11.99	11.00	2.814
2	5.99	4.50	1.12	1.00	1.23	5.99	4.99	2.922
2	10.49	4.50	1.12	1.00	1.61	14.00	13.00	2.968
2	11.39	4.50	1.12	1.00	1.67	16.20	15.21	3.096
2	5.09	4.50	1.12	1.00	1.12	5.00	4.00	3.116
2	12.29	4.50	1.12	1.00	1.74	18.61	17.63	3.209
2	13.19	4.50	1.12	1.00	1.80	21.23	20.24	3.380

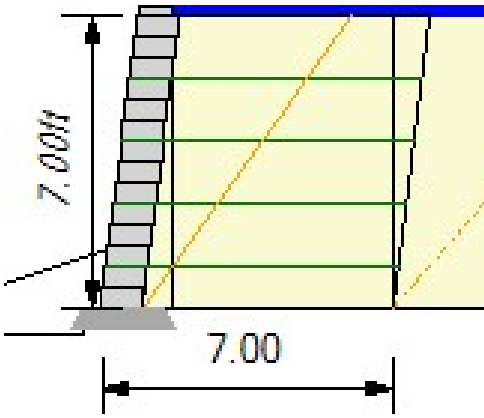
GLOBAL RESULTS

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
1	6.89	4.50	-4.63	0.17	-1.53	9.42	9.75	1.565
2	6.89	4.50	-5.53	0.08	-1.25	7.71	8.75	1.591
1	6.89	4.50	-5.53	0.08	-2.14	10.22	10.69	1.599
2	5.99	4.50	-5.53	0.08	-1.51	6.82	7.85	1.609
1	6.89	4.50	-3.73	0.40	-0.68	8.31	8.48	1.618
2	5.99	4.50	-4.63	0.17	-0.82	6.03	6.99	1.619
1	7.79	4.50	-5.53	0.08	-2.11	12.08	12.47	1.620
1	7.79	4.50	-4.63	0.17	-1.48	11.12	11.39	1.628
1	5.99	4.50	-3.73	0.40	-0.79	7.01	7.24	1.629
2	7.79	4.50	-5.53	0.08	-0.98	8.67	9.71	1.637

REA Analysis

Project:	Brook Street Greenspace
Location:	Sheridan, WY
Designer:	KAH
Date:	8/14/2023
Section:	Section 1
Design Method:	NCMA_09_3rd_Ed, Ignore Vert. Force
Design Unit:	Versa-Lok



SOIL PARAMETERS	φ	coh	γ
Reinforced Soil:	32 deg	0psf	125pcf
Retained Soil:	25 deg	0psf	125pcf
Foundation Soil:	25 deg	50psf	125pcf

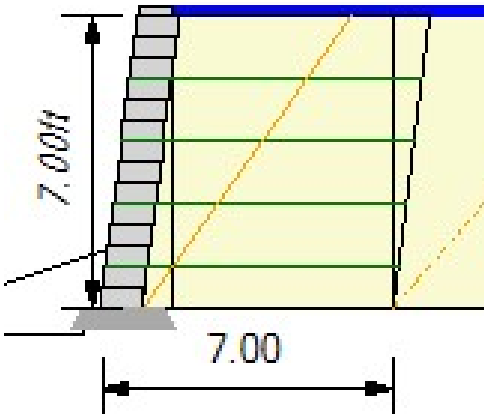
Leveling Pad: Crushed Stone

GEOMETRY

Design Height:	7.00ft (5.67ft Exp.)	Live Load:	100psf
Wall Batter/Tilt:	7.10/ 0.00 deg	Live Load Offset:	0.00ft
Embedment:	1.33ft	LL2 Width:	50ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf
Slope Angle:	0.0 deg	Dead Load Offset:	0.0ft
Slope Length:	0.0ft	Dead Load Width:	0ft
Slope Toe Offset:	0.0ft		
Vertical δ on Single Depth		Toe Slope Angle:	18.40
		Toe Slope Length:	6.00
		Toe Slope Bench:	0.00

FACTORS OF SAFETY

Sliding:	1.50	Pullout:	1.50
Overturning:	2.00	Uncertainties:	1.50
Bearing:	2.00	Connection:	1.50
Shear:	1.50	Bending:	1.50



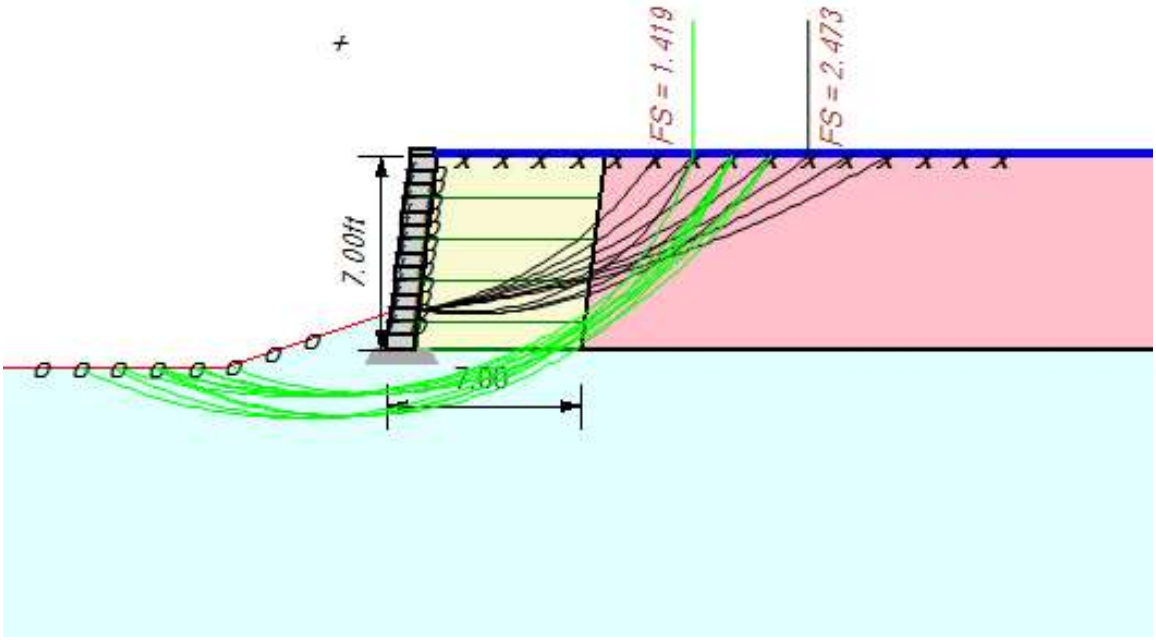
RESULTS

FoS Sliding:	3.76	FoS Overturning:	12.18
Bearing	891	FoS Bearing:	8.50
Pullout	7.41		
Total Pullout	8,486	FoS Total Pullout	10.58
Top FoSot:	6.80	FoS Connection:	3.67

ID	Height	Length	Name	Ta	Pa	LL	TMax	FSStr	TaCn	FSPkCn	FSPo	FSSldg	GridEmbedment
4	5.5	7	5XT	1786	70	50	119	22.42	458	5.76	4.33/[119]	27.77	2.76
3	4	7	5XT	1786	124	33	157	17.04	497	4.75	8.69/[157]	12.52	3.64
2	2.5	7	5XT	1786	186	33	219	12.22	536	3.67	11.61/[219]	7.89	4.53
1	1	7	5XT	1786	203	28	230	11.64	575	3.75	17.63/[230]	5.73 [3.76]	5.41

Column Descriptions:

Ta: allowable geogrid strength
Rc %: percent coverage for geosynthetics
EP (Pa) internal active earth pressure
LL (Pql) earth pressure due to live load surcharge
DL (Pqd) earth pressure due to dead load surcharge
Tmax maximum earth pressure on geosynthetic layer
FSstr factor of safety on geogrid strength (Ta/Tmax)
Ta cn allowable tension on the connection
FS Pkcn, factor of safety on the connection (Ta cn/Tmax)
FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)
Grid Embedment, depth of embedment beyond the theorectical failure plane.


FS = 1.419
FS = 2.473
7.00ft
7.00

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.

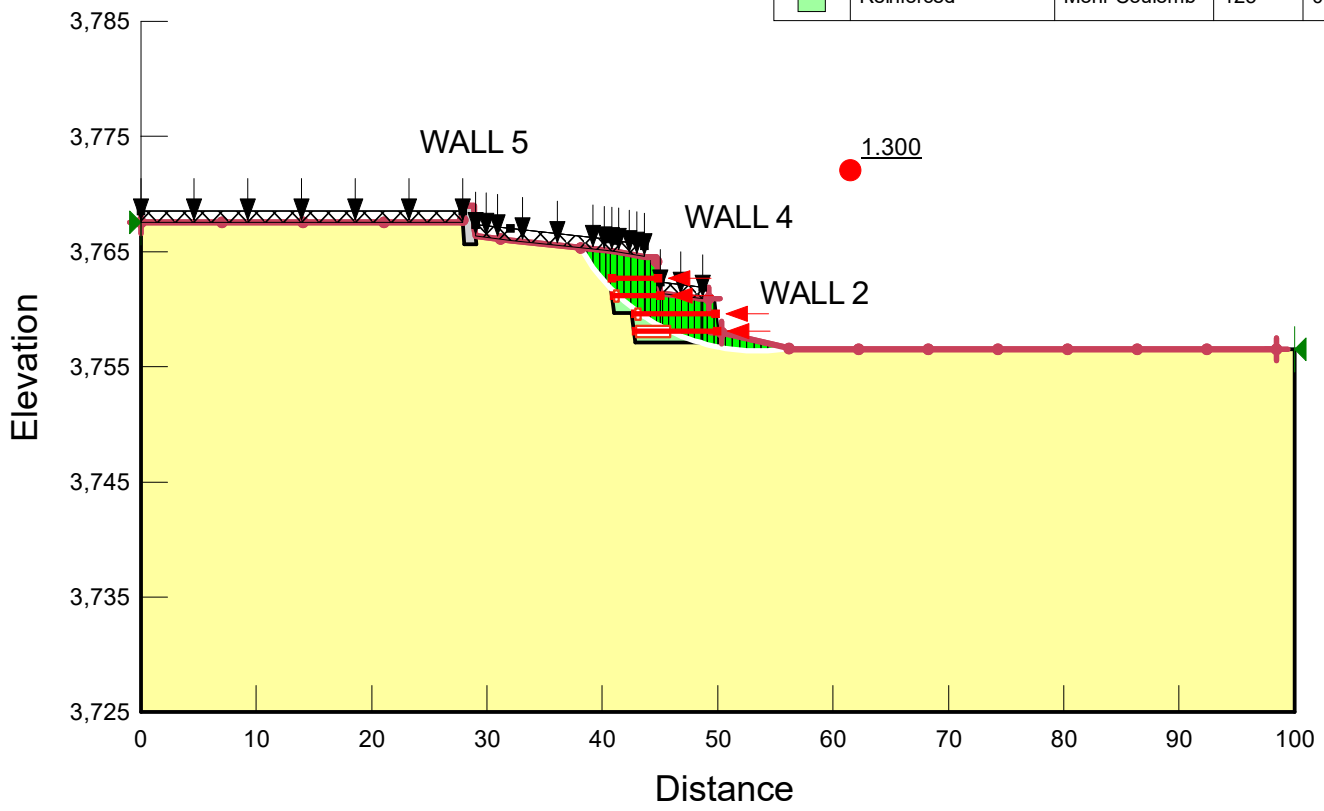
ID	Enter Point X	Enter Point Y	Exit Point X	Exit Point Y	Center X	Center Y	Radius	FoS
2	15.31	7.00	1.19	1.50	-1.99	30.52	29.20	2.473
2	12.51	7.00	1.19	1.50	-1.59	21.60	20.29	2.477
2	11.11	7.00	1.19	1.50	-1.41	17.87	16.58	2.490
3	11.11	7.00	1.19	1.50	2.73	10.41	9.04	2.508
2	13.91	7.00	1.19	1.50	-1.78	25.82	24.50	2.514
3	12.51	7.00	1.19	1.50	2.96	12.25	10.90	2.559
2	16.71	7.00	1.19	1.50	-2.21	35.72	34.38	2.566
2	9.71	7.00	1.19	1.50	-1.25	14.63	13.35	2.616
2	18.11	7.00	1.19	1.50	-2.43	41.40	40.06	2.618
3	13.91	7.00	1.19	1.50	3.18	14.35	13.00	2.638

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
4	11.11	7.00	-8.43	-0.67	-1.77	11.09	13.51	1.419
3	12.51	7.00	-7.03	-0.67	-1.56	14.12	15.77	1.427
3	13.91	7.00	-7.03	-0.67	-1.22	15.88	17.54	1.464
3	12.51	7.00	-11.23	-0.67	-3.38	15.59	18.06	1.466
4	12.51	7.00	-9.83	-0.67	-2.38	13.99	16.45	1.467
3	13.91	7.00	-9.83	-0.67	-3.33	19.77	21.45	1.473
4	12.51	7.00	-8.43	-0.67	-1.38	12.49	14.93	1.473
3	12.51	7.00	-8.43	-0.67	-2.62	15.88	17.54	1.476
3	13.91	7.00	-8.43	-0.67	-2.27	17.76	19.43	1.481
3	12.51	7.00	-5.63	-0.54	-0.43	12.52	14.06	1.485

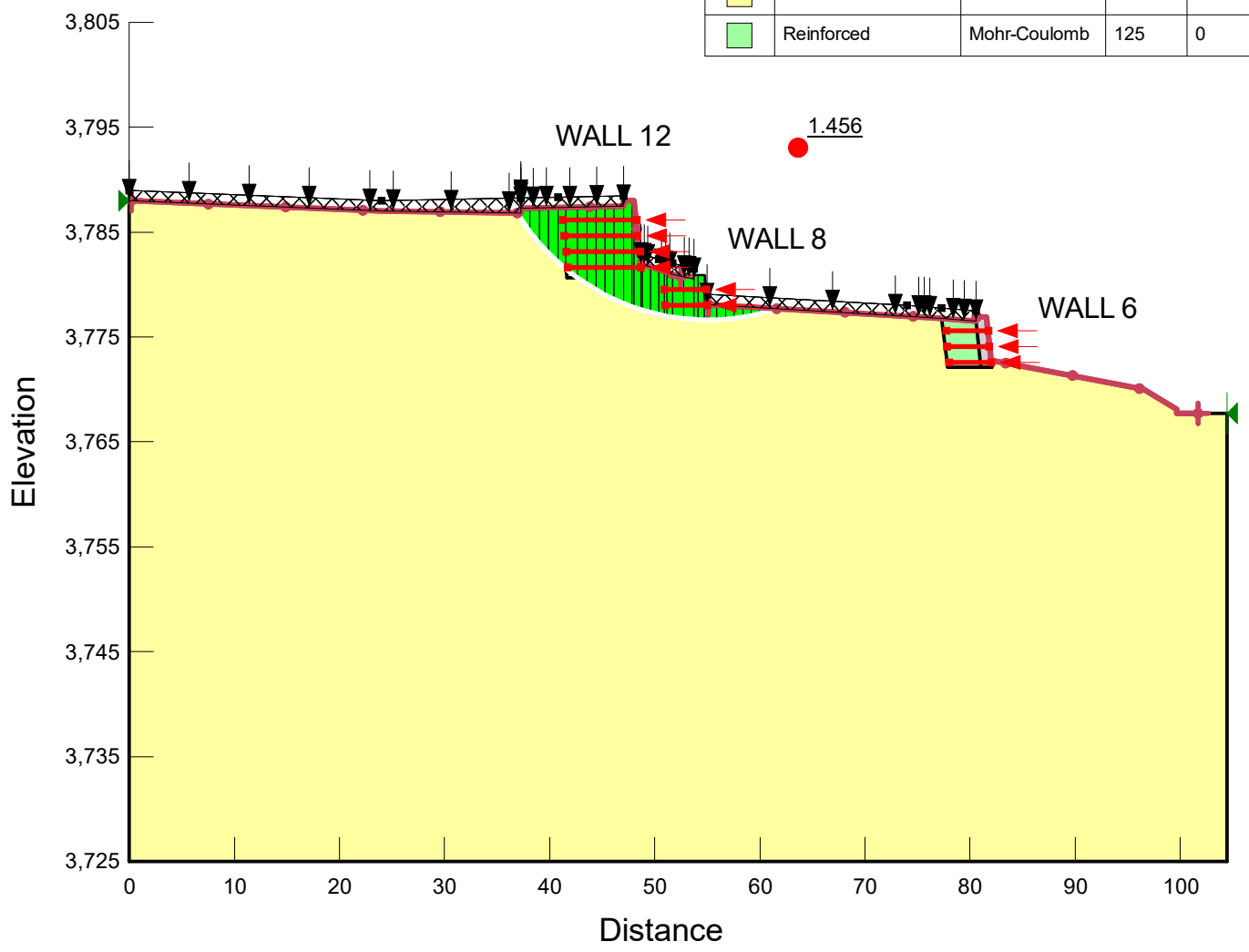
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)
	Block	High Strength	145			
	Foundation/Retained	Mohr-Coulomb	125	50	25	0
	Reinforced	Mohr-Coulomb	125	0	32	0



GeoWall Designs

SLOPE/W Analysis	
Brooks Street Greenspace A-A.gsz	
08/15/2023	1:200

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)
	Block	High Strength	145			
	Foundation/Retained	Mohr-Coulomb	125	50	25	0
	Reinforced	Mohr-Coulomb	125	0	32	0



GeoWall Designs

SLOPE/W Analysis

Brooks Street Greenspace B-B.gsz

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GEOWALL DESIGNS

"BUILT FROM THE GROUND UP"

BROOKS STREET GREENSPACE
SHERIDAN, WY

RETAINING WALL (RW) CONSTRUCTION ADDRESSED BY THESE DRAWINGS ARE PART OF A SIGNIFICANTLY LARGER PROJECT BEING BUILT BY THE GENERAL CONTRACTOR, WHO HAS SEPARATELY RETAINED AN EARTHWORK GRADING CONTRACTOR TO ASSIST IN DEVELOPING THE SITE FOR THE OWNER. THE OWNER HAS RETAINED A PROJECT GEOTECHNICAL ENGINEER TO ADVISE IT ON MATTERS RELATIVE TO CONSTRUCTION AND WHO WILL BE PROVIDING QUALITY ASSURANCE TESTING AND OBSERVATION OF THE RW CONSTRUCTION WORK FOR THE OWNER. OUTLINED BELOW IS A BRIEF SUMMARY OF THE RESPONSIBILITIES OF EACH OF THE PARTIES REQUIRED BY THE RW CONSTRUCTION, AS OUTLINED IN THESE DRAWINGS, TO ENSURE A QUALITY CONSTRUCTION PROJECT:

A. GENERAL/EARTHWORK CONTRACTOR SHALL BE RESPONSIBLE FOR OVERALL SITE GRADING AND STORM WATER CONTROL, BEFORE, DURING, AND AFTER RW CONSTRUCTION, UNTIL THE PERMANENT PAVING AND STORM WATER DRAINAGE CONTROLS ARE ALL IN PLACE AND OPERATIONAL. DAMAGE TO EXISTING RW CONSTRUCTION BY POORLY CONTROLLED STORM WATER DRAINAGE SHALL NOT BE THE RESPONSIBILITIES THE RW CONTRACTOR OR RW DESIGNER.

B. GENERAL/EARTHWORK CONTRACTOR SHALL BE RESPONSIBLE FOR EROSION AND SEDIMENTATION CONTROL, BEFORE, DURING, AND AFTER RW CONSTRUCTION.

C. OWNER AND/OR GENERAL CONTRACTOR SHALL PROVIDE SURVEYING SERVICES SUFFICIENT TO LOCATE THE WALL, HORIZONTALLY AND VERTICALLY ON THE SITE FOR CONSTRUCTION PURPOSES.

D. GENERAL/EARTHWORK CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING A BEARING SURFACE AT THE BOTTOM RETAINING WALL ELEVATION THAT MEETS THE BEARING REQUIREMENTS SHOWN ON THESE DRAWINGS. THE BEARING SURFACE AND ALL AREAS INTO WHICH THE RW CONTRACTOR WILL PLACE AND COMPACT FILL MUST BE CLEARED, GRUBBED AND ALL DELETERIOUS SOILS AND/OR ORGANIC MATTER REMOVED TO PROJECT GEOTECHNICAL ENGINEER'S SATISFACTION, AS PROVIDED IN THEIR DAILY PROJECT REPORTING.

E. THE OWNER'S PROJECT GEOTECHNICAL ENGINEER SHALL OBSERVE AND PROVIDE WRITTEN APPROVAL THAT THE "ALLOWABLE" BEARING CAPACITY AT THE BOTTOM RETAINING WALL ELEVATION AND WITHIN THE ENTIRE REINFORCED (GEOGRID) ZONE IN EACH LOCATION MEETS OR EXCEEDS THE MINIMUM REQUIREMENTS SHOWN ON THESE DRAWINGS. THE RW CONTRACTOR WILL NOT BEGIN CONSTRUCTION WITHOUT THE APPROVAL.

F. THE OWNER AND/OR GENERAL CONTRACTOR SHALL PROVIDE THE FILL SOILS TO THE RW CONTRACTOR TO UTILIZE FOR RW CONSTRUCTION. THOSE FILL SOILS SHOULD BE TESTED PRIOR TO STARTING RW CONSTRUCTION, AND PERIODICALLY THROUGHOUT THE PROJECT, TO ENSURE THEY MEET THE SPECIFICATION OUTLINED HEREIN. RW CONTRACTOR WILL NOTIFY THE OWNER'S GEOTECHNICAL ENGINEER AND/OR THE GENERAL/EARTHWORK CONTRACTOR WHEN A CHANGE IN FILL SOIL APPEARANCE, CONSISTENCY, OR GRADATION LOOKS TO BE DETRIMENTAL, OR HAS REASON TO BELIEVE THE SOIL BEING PROVIDED DOES NOT MEET THE PROJECT SPECIFICATIONS. HOWEVER, THE OWNER'S GEOTECHNICAL ENGINEER SHALL BE RESPONSIBLE FOR DETERMINING WHETHER THE FILL MATERIALS MEET AND ARE PLACED ACCORDING TO THE SPECIFICATIONS IN THESE DRAWINGS.

G. THE OWNER AND/OR OWNERS REPRESENTATIVE SHALL BE RESPONSIBLE FOR CONTRACTING THE SPECIAL INSPECTOR AND OBTAINING SUFFICIENT DATA THROUGHOUT THE RW CONSTRUCTION TO SATISFY THE REQUIREMENTS OF THE LOCAL GOVERNING AUTHORITY TO SECURE APPROVAL OF THE RETAINING WALL CONSTRUCTION AND BY PERFORMING THE DUTIES OUTLINED IN SPECIFICATION 8.0.

SHEET INDEX

No.	Date	Revision	Drawn	Design	Check
7					
6					
5					
4					
3					
2					
1					
0	15 AUG 2023	RELEASED FOR CONSTRUCTION	CF	CF	KH

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Title: TITLE SHEET

Project: BROOKS STREET GREENSPACE
SHERIDAN, WY

SEGMENTAL RETAINING WALL PLANS

Project No:	Date:	Scale:	Sheet No:
23NOU001	15 AUG 2023	N.T.S.	RW-1.0

Professional Engineer
KYLE HUERD
17902
Date
WYOMING

1.0 MATERIALS

1.1 BACKFILL SOILS

1.1.1 REINFORCED FILL 1 MATERIALS SHALL BE APPROVED IN WRITING BY GEOWALL DESIGNS AND THE OWNER'S REPRESENTATIVE AND SHALL MEET THE STRENGTH REQUIREMENTS AS DEFINED IN SECTION 6.0. THE REINFORCED BACKFILL MATERIAL SHALL MEET THE FOLLOWING GRADATION:

SIEVE SIZE	PERCENT PASSING
2"	100%
3/4"	75-100%
No. 4	30-100%
No. 40	0-60%
No. 200	0-25%

PLASTICITY INDEX (PI) LESS THAN 10

THE PH SHALL BE BETWEEN 3 AND 9.

1.1.2 REINFORCED BACKFILL AND RETAINED SOIL/FILL MATERIALS SHALL BE FREE OF EXCESS MOISTURE, ROOTS, MUCK, SOD, SNOW, FROZEN LUMPS, ORGANIC MATTER OR OTHER DELETERIOUS MATERIALS. ALL ROCK PARTICLES AND HARD EARTH CLODS SHALL BE LESS THAN FOUR INCHES IN THE LONGEST DIMENSION. REINFORCED BACKFILL MATERIALS WHICH DO NOT MEET THIS CRITERIA SHALL BE CONSIDERED UNSUITABLE AND REMOVED.

1.1.3 DRAINAGE FILL SHALL CONSIST OF CLEAN CRUSHED STONE, CRUSHED GRAVEL, OR CRUSHED RECYCLED CONCRETE MEETING THE FOLLOWING GRADATION TESTED IN ACCORDANCE WITH ASTM C-136:

SIEVE SIZE	PERCENT PASSING
1.5"	100%
1.0"	95-100%
1/2"	25-60%
No. 4	0-10%
No. 8	0-5%

LOSS BY WASHING 2.0% MAX

1.1.4 LEVELING PAD SHALL CONSIST OF DENSE-GRADED, OPEN-GRADED CRUSHED STONE OR CRUSHED GRAVEL. IF OPEN GRADED AGGREGATE IS USED IN WATER APPLICATION, LEVELING PAD SHALL BE WRAPPED WITH NON-WOVEN GEOTEXTILE.

1.2 GEOGRID REINFORCING TYPE SHALL BE AS SHOWN OR APPROVED EQUAL. THE GEOGRID MANUFACTURER SHALL PROVIDE A MATERIAL CERTIFICATION THAT THE PRODUCT SHIPPED TO THE PROJECT MEETS OR EXCEEDS THE ULTIMATE, LONG TERM DESIGN STRENGTH, AND CONNECTION STRENGTH USED IN THE DESIGN.

1.3 BLOCK FACING SHALL BE VERSA-LOK STANDARD, 6" UNITS. UNITS SHALL MEET ASTM C1372 FOR DRY CAST BLOCK OR C1776 FOR WET CAST CONCRETE, EXCEPT MANUFACTURED CONCRETE VERTICAL DIMENSIONAL TOLERANCE SHALL BE +/- 1/16". CONCRETE SHALL BE OF ORIGINAL PRODUCTION MIX WITH A MINIMUM COMPRESSIVE STRENGTH OF 4,500 PSI. AIR CONTENT, MIX DESIGN, ABSORPTION, AND FREEZE THAW EXPOSURE CLASS SHALL MEET THE SPECIFICATIONS AS REQUIRED BY THE CONTRACT DOCUMENTS AND INDUSTRY BEST PRACTICES.

1.4 FILTER FABRIC SHALL BE 4 oz/sy (MIN.) NON-WOVEN, NEEDLE PUNCHED, POLYPROPYLENE GEOTEXTILE - ERS 400N OR EQUAL.

1.5 DRAIN PIPE SHALL BE 4" DIAMETER SINGLE WALL HDPE PIPE WITHOUT FILTER SOCK, OR APPROVED EQUAL. PIPE AND PIPE FITTINGS SHALL MEET ASTM F405 AND F667. 4" FLEX DRAIN IS A PRE APPROVED ALTERNATE.

2.0 TECHNICAL REQUIREMENTS

2.1 THE OWNER'S REPRESENTATIVE OR GRADING CONTRACTOR SHALL SUBMIT TO GEOWALL DESIGNS THE GRADATION AND STRENGTH PARAMETERS OF THE REINFORCED BACKFILL MATERIAL, RETAINED SOIL/FILL AND FOUNDATION SOIL, FOR APPROVAL PRIOR TO PROCEEDING WITH CONSTRUCTION. WORK SHALL NOT PROCEED UNTIL THIS SUBMITTAL IS APPROVED BY GEOWALL DESIGNS.

2.2 PRIOR TO CONSTRUCTION OF THE WALLS, THE GRADING CONTRACTOR SHALL CLEAR AND GRUB THE REINFORCED BACKFILL ZONE AREA, REMOVING TOP SOILS, BRUSH, SOD OR OTHER ORGANIC OR DELETERIOUS MATERIALS. ANY UNSUITABLE SOILS SHALL BE OVER-EXCAVATED, REPLACED AND COMPACTED WITH REINFORCED BACKFILL MATERIAL TO PROJECT SPECIFICATIONS OR OTHERWISE DIRECTED BY THE OWNER'S GEOTECHNICAL ENGINEER.

2.3 THE GEOTECHNICAL ENGINEER SHALL CONFIRM THAT THE SITE HAS BEEN PROPERLY PREPARED AND THE DESIGN PARAMETERS IN SECTION 6.0 ARE APPROPRIATE PRIOR TO FILL PLACEMENT. A WRITTEN CONFIRMATION SHALL BE PROVIDED TO GEOWALL DESIGNS PRIOR TO FILL PLACEMENT.

2.4 FILL SHALL BE PLACED IN HORIZONTAL LAYERS NOT EXCEEDING 10" (INCHES) IN UNCOMPACTED THICKNESS FOR HEAVY COMPACTION EQUIPMENT. FOR ZONES WHERE COMPACTION IS ACCOMPLISHED WITH HAND OPERATED EQUIPMENT, FILL SHALL BE PLACED IN HORIZONTAL LAYERS NOT EXCEEDING 6" (INCHES) IN UNCOMPACTED THICKNESS. ONLY HAND-OPERATED EQUIPMENT SHALL BE ALLOWED WITHIN THREE FEET OF THE BACK FACE OF WALL FACING.

2.5 FILL MATERIALS SHALL BE PLACED FROM THE BACK OF THE FACING UNITS TOWARDS THE ENDS OF THE GEOGRID TO ENSURE FURTHER TENSIONING OR AS DIRECTED BY THE MANUFACTURER.

2.6 TESTING METHODS AND VERIFICATION OF FILL SHALL BE COMPACTED AS SPECIFIED BY PROJECT SPECIFICATIONS OR TO A MINIMUM 95% (98% MINIMUM FOR WALLS EXCEEDING 10 FT) OF THE MAXIMUM DRY DENSITY AND WITHIN +/-2% OF THE OPTIMUM MOISTURE CONTENT IN ACCORDANCE WITH STANDARD PROCTOR (ASTM D698). MATERIAL SPECIFICATIONS AND COMPACTION TESTING IS THE RESPONSIBILITY OF THE OWNER'S REPRESENTATIVE.

2.6.1 WHERE COMPACTION OF STONE BACKFILL CANNOT BE VERIFIED USING IN-SITU FIELD DENSITY TEST METHODS, THE FILL SHALL BE COMPACTED USING APPROPRIATE VIBRATORY EQUIPMENT AS APPROVED BY THE SITE GEOTECHNICAL ENGINEER. THE CONTRACTOR SHALL MAKE A SUFFICIENT NUMBER OF PASSES WITH APPROVED ROLLING EQUIPMENT UNTIL THE SURFACE SHOWS NO VISIBLE SIGN OF FURTHER CONSOLIDATION. THE SITE GEOTECHNICAL ENGINEER SHALL APPROVE MEANS AND METHODS AND VERIFY COMPACTION.

2.7 WHERE REQUIRED, CAP UNITS SHALL BE PERMANENTLY SECURED TO THE BLOCK UNITS USING AN OUTDOOR CONSTRUCTION ADHESIVE FOR CONCRETE MASONRY OR HARDSCAPES SUCH AS LIQUID NAILS (OR EQUIVALENT). ADHESIVE SHALL BE PLACED PER MANUFACTURERS RECOMMENDATIONS.

2.8 AN APPROVED SET OF CONSTRUCTION DRAWINGS AND CONTRACT SPECIFICATIONS SHALL BE ON-SITE AT ALL TIMES, DURING CONSTRUCTION OF THE RETAINING WALLS.

3.0 GEOGRID PLACEMENT

3.1 GEOGRID SHALL BE PLACED AT THE LOCATIONS AND ELEVATIONS SHOWN ON THE CONSTRUCTION DRAWINGS.

3.2 GEOGRID LENGTH SHALL BE AS SHOWN ON THE CONSTRUCTION DRAWINGS. GEOGRID LENGTH IS MEASURED FROM THE FRONT FACE OF WALL UNITS TO THE TAIL OF GEOGRID UNLESS OTHERWISE NOTED.

3.2.1 GEOGRID REINFORCEMENT SHALL BE CONTINUOUS THROUGHOUT THEIR EMBEDMENT LENGTH(S).

3.2.2 GEOGRID SHALL BE PLACED AT THE COVERAGE AS SHOWN IN 6.2.1.

3.3 PRIOR TO PLACING FILL, THE GEOGRID MATERIALS SHALL BE PLACED IN BETWEEN BLOCK COURSES. REMOVE GEOGRID SLACK AND ANCHOR GEOGRID PRIOR TO FILL PLACEMENT AND COMPACTION.

3.4 CONSTRUCTION EQUIPMENT SHALL NOT BE OPERATED DIRECTLY ON THE GEOGRID. A MINIMUM FILL THICKNESS OF SIX INCHES IS REQUIRED FOR OPERATION OF TRACKED VEHICLES OVER THE GEOGRID. TURNING OF VEHICLES SHOULD BE KEPT TO A MINIMUM TO PREVENT DISPLACING THE FILL AND/OR THE GEOGRID.

3.5 GEOGRID SHALL BE ROLLED OUT WITH THE LONG AXIS OF THE APERTURES (MACHINE DIRECTION) PERPENDICULAR TO THE WALL FACE FOR UNIAXIAL GEOGRID.

3.6 A MINIMUM OF 3 INCHES OF FILL MATERIAL SHALL BE PLACED BETWEEN OVERLAPPING LAYERS OF GEOGRID, UNLESS OTHERWISE SHOWN.

4.0 CHANGES

4.1 NO CHANGES TO THE GEOGRID LAYOUT, INCLUDING, BUT NOT LIMITED TO, LENGTH, GEOGRID TYPE, OR ELEVATION, SHALL BE MADE WITHOUT THE EXPRESSED PRIOR WRITTEN CONSENT OF GEOWALL DESIGNS.

4.2 NO CHANGES TO THE WALL FACING TYPE SHALL BE MADE WITHOUT THE EXPRESSED PRIOR WRITTEN CONSENT OF GEOWALL DESIGNS.

5.0 DRAINAGE

5.1 AT THE END OF EACH WORK DAY, BACKFILL SURFACE SHALL BE COMPACTED WITH A SMOOTH PLATE COMPACTOR TO MINIMIZE PONDING OF WATER AND SATURATION OF THE BACKFILL.

5.2 PERMANENT AND TEMPORARY SURFACE WATER DIVERSION AND EROSION CONTROL SHALL BE AS REQUIRED AND PROVIDED BY THE OWNER OR OWNER'S REPRESENTATIVE. SURFACE WATER SHALL BE DIVERTED AWAY FROM THE REINFORCED FILL ZONE AND WALL FACE DURING WALL CONSTRUCTION OR AT THE END OF EACH WORK DAY.

No.	Date	Revision	Drawn	Design	Check
7					
6					
5					
4					
3					
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Title: CONSTRUCTION NOTES

Project: BROOKS STREET GREENSPACE
SHERIDAN, WY

SEGMENTAL RETAINING WALL PLANS

Project No:	Date:	Scale:	Sheet No:
23NOU001	15 AUG 2023	N.T.S.	RW-2.0

Professional Engineer
KYLE HUERD
17902
Date
WYOMING

6.0 DESIGN PARAMETERS

6.1 DESIGN OF THE REINFORCED SOIL STRUCTURE IS BASED ON THE FOLLOWING EFFECTIVE PARAMETERS (COHESION ONLY APPLICABLE FOR GLOBAL STABILITY):

ZONE	DESCRIPTION	ϕ	C'	Y
REINFORCED SOIL 1	SAND - SM/SP	32°	0 PSF	125 PCF
RETAINED SOIL 1	LEAN CLAY - CL	25°	0 PSF	125 PCF
RETAINED SOIL 2	GRAVEL - GP	38°	0 PSF	110 PCF
FOUNDATION SOIL 1	LEAN CLAY - CL	25°	50 PSF	125 PCF

6.1.1 DESIGN METHODOLOGY: NCMA THIRD EDITION, IBC-2018, AND ASCE 7-16

6.2 FACTORS OF SAFETY

6.2.1 INTERNAL STABILITY:

MIN. FACTOR OF SAFETY FOR GEOGRID PULLOUT =	1.5
MIN. FACTOR OF SAFETY FOR BLOCK CONNECTION =	1.5
MIN. FACTOR OF SAFETY FOR FACING STABILITY =	1.5
MIN. FACTOR OF SAFETY FOR SLIDING AT LOWEST GEOGRID =	1.5
PERCENT COVERAGE OF GEOGRID =	100%

6.2.2 EXTERNAL STABILITY:

MIN. FACTOR OF SAFETY FOR OVERTURNING (GRAVITY) =	1.5
MIN. FACTOR OF SAFETY FOR OVERTURNING (MSE) =	2.0
MIN. FACTOR OF SAFETY FOR SLIDING =	1.5
MIN. FACTOR OF SAFETY FOR BEARING (THEORETICAL) =	2.0

6.2.3 OVERALL / GLOBAL STABILITY:

MIN. FACTOR OF SAFETY FOR GLOBAL STABILITY (CRITICAL/NON CRITICAL) = 1.5/1.3

6.2.4 SEISMIC

MIN. FACTORS OF SAFETY ARE 75% OF STATIC CONDITIONS	
1-SECOND DESIGN PEAK GROUND ACCELERATION =	N/A

6.3 SURCHARGE LOADING

LIVE LOAD (LANDSCAPE AREAS) =	100 PSF
LIVE LOAD (ROAD/PARKING AREAS) =	N/A
DEAD LOAD =	N/A

6.4 BEARING

6.4.1 APPLIED BEARING
MAXIMUM APPLIED BEARING PRESSURE = (SEE ELEVATION VIEWS)

6.4.2 ULTIMATE BEARING CAPACITY CALCULATED USING SOIL PARAMETERS NOTED IN SECTION 6.0 AND GEOMETRIC PROPERTIES OF THE RETAINING WALL. GEOTECHNICAL ENGINEER SHALL DETERMINE ACTUAL BEARING CAPACITY BASED ON FIELD CONDITIONS AND LABORATORY RESULTS.

6.5 FENCE LOADING

WALLS ARE NOT DESIGNED FOR ANY CONCENTRATED FENCE LOADS. SLEEVE-ITS SHALL BE USED WHERE POSTS CANNOT BE PLACED A MINIMUM OF 3.00' FROM WALL FACE. CONTRACTOR TO VERIFY POST SPACING UTILIZED DOES NOT EXCEED LOAD LIMITS BASED ON IBC LOADING FOR PEDESTRIAN HANDRAILS OR THE DESIGN LOAD, WHICHEVER IS GREATER.

6.6 HYDRAULIC CONDITIONS

6.6.1 WATER APPLICATION
THE DESIGN DOES NOT CONSIDER HYDROSTATIC WATER PRESSURE AND ASSUMES WATER IS SUFFICIENTLY BELOW BOTTOM OF STRUCTURE SO AS NOT TO INFLUENCE STRUCTURE STABILITY.

6.6.2 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 LOCATIONS.

6.7 WIND LOADING (ASD)

WIND LOAD HAS NOT BEEN EVALUATED IN THE DESIGN OF THE BELOW GRADE STRUCTURE. ALL ABOVE FREE STANDING STRUCTURES PLACED WITHIN A 1H:1V OF THE WALL FACING SHALL BE RELOCATED OR REDESIGNED AS TO NOT APPLY ANY ADDITIONAL LATERAL LOADING.

7.0 SPECIAL PROVISIONS

7.1 THE DESIGN PRESENTED HEREIN IS BASED ON SOIL PARAMETERS, FOUNDATION CONDITIONS, GROUNDWATER CONDITIONS, AND LOADINGS STATED IN SECTION 6.0., AND INTERPOLATED FROM INFORMATION PROVIDED BY OTHERS. GEOTECHNICAL DATA IS INTERPOLATED FROM REPORT PREPARED BY AMERICAN ENGINEERING TESTING, REPORT #: P-0004856, DATED 07/7/2022.

7.2 WALL ELEVATION VIEWS AND LOCATIONS AND GEOMETRY OF EXISTING STRUCTURES AND GRADE ABOVE AND BELOW THE WALLS MUST BE VERIFIED BY THE CONTRACTOR, TO MATCH ELEVATIONS SHOWN IN THE CONTRACT DOCUMENTS, PRIOR TO CONSTRUCTION.

7.3 GEOWALL DESIGNS ASSUMES NO LIABILITY FOR INFORMATION SUPPLIED BY OTHERS SUCH AS GEOTECHNICAL REPORT, SITE PLAN, AND WATER ELEVATIONS.

7.4 THE SOIL DESIGN PARAMETERS STATED IN SECTION 6.0 SHALL BE VERIFIED BY THE PROJECT GEOTECHNICAL ENGINEER. WRITTEN VERIFICATION OF DESIGN PARAMETERS SHALL BE SUBMITTED TO GEOWALL DESIGNS AND THE OWNER'S REPRESENTATIVE PRIOR TO COMMENCING WITH CONSTRUCTION.

7.5 IF ANY ROCK FORMATIONS AND/OR GROUNDWATER (NOT ADDRESSED WITHIN THESE PLANS) ARE ENCOUNTERED DURING THE CONSTRUCTION OF THIS WALL, IMMEDIATELY CONTACT GEOWALL DESIGNS AT 952-303-4190 AND THE OWNER'S REPRESENTATIVE.

7.6 ANY REVISIONS TO DESIGN PARAMETERS STATED IN SECTION 6.0 OR STRUCTURE GEOMETRY SHALL REQUIRE DESIGN MODIFICATIONS PRIOR TO PROCEEDING WITH CONSTRUCTION.

7.7 ALL PIPES AND UTILITIES WITHIN 100 FEET OF THE RETAINING WALL MUST BE CONSTRUCTED WITH WATER TIGHT JOINTS.

7.8 THE SITE GEOTECHNICAL ENGINEER OR OWNER'S REPRESENTATIVE SHALL BE RESPONSIBLE FOR EVALUATING TOTAL AND DIFFERENTIAL SETTLEMENTS.

7.9 THE OWNER OR OWNER'S REPRESENTATIVE SHALL BE RESPONSIBLE FOR THE SELECTION OF PERMANENT EROSION PROTECTION AND PERMANENT VEGETATION FOR SLOPES LOCATED ABOVE OR BELOW THE PROPOSED RETAINING WALL(S).

8.0 QUALITY ASSURANCE

8.1 DUTIES OF THE SPECIAL INSPECTOR:

8.1.1 THE SPECIAL INSPECTOR SHALL OBSERVE THE WORK REQUIRING SPECIAL INSPECTION FOR CONFORMANCE WITH THE APPROVED DESIGN DRAWINGS AND SPECIFICATIONS.

8.1.2 THE SPECIAL INSPECTOR SHALL FURNISH REPORTS TO BE KEPT AT THE SITE FOR USE BY THE BUILDING OFFICIAL, THE CONTRACTOR, AND THE ENGINEER OF RECORD. IF SPECIAL INSPECTION IS PROVIDED BY ANYONE OTHER THAN THE ENGINEER OF RECORD, REPORTS SHALL BE SUBMITTED TO THE OFFICE OF THE ENGINEER OF RECORD ON A WEEKLY BASIS. ALL DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE CONTRACTOR FOR CORRECTION, THEN IF UNCORRECTED, TO THE DESIGN AUTHORITY AND THE BUILDING OFFICIAL.

8.1.3 UPON COMPLETION OF THE ASSIGNED WORK, THE SPECIAL INSPECTOR SHALL COMPLETE AND SIGN A FINAL REPORT CERTIFYING THAT TO THE BEST OF HIS/HER KNOWLEDGE, THE WORK IS IN CONFORMANCE WITH THE APPROVED PLANS AND SPECIFICATIONS, AND THE APPLICABLE WORKMANSHIP PROVISIONS OF THE CODE.

8.2 SEE THE "SPECIAL INSPECTION SCHEDULE" FOR THE TYPES, EXTENTS, AND FREQUENCY OF SPECIFIC ITEMS REQUIRING SPECIAL INSPECTIONS AS PART OF THIS PROJECT.

SPECIAL INSPECTION SCHEDULE

REQUIRED SPECIAL INSPECTION AREAS:	FREQUENCY OF TESTING		COMMENTS:
	CONTINUOUS	PERIODIC	
RETAINING WALLS			
GEOGRID		X	INSPECTION SHALL BE MADE OF THE TYPE, LOCATION, ORIENTATION, AND EXTENT OF GEOGRID PLACEMENT IN EACH WALL
DRAIN TILE INSTALLATION		X	INSPECTION SHALL BE MADE OF THE PLACEMENT, LOCATION, AND VENTING TO DAYLIGHT
SOILS			
EXCAVATIONS		X	VERIFY EXCAVATION ARE EXTENDED TO PROPER DEPTHS AND HAVE REACHED REQUIRED MATERIAL SUFFICIENT TO SUPPORT THE DESIGN
FIELD DENSITY		X	IN ACCORDANCE WITH ASTM D-6938 OR ASTM D-1556
MOISTURE-DENSITY RELATIONSHIPS		X	IN ACCORDANCE WITH AASHTO OR ASTM CRITERIA AS SPECIFIED FOR SUBGRADE, LEVELING PAD, AND BACKFILL
GRADATION ANALYSIS		X	IN ACCORDANCE WITH ASTM D-422
WALL BACKFILL		X	VERIFY USE OF PROPER MATERIALS, DENSITIES, LIFT THICKNESS DURING PLACEMENT AND COMPACTION OF BACKFILL

TESTING MAY BE PERIODIC IN NATURE BUT CONTINUOUS THROUGHOUT CONSTRUCTION AS REQUIRED BY IBC.

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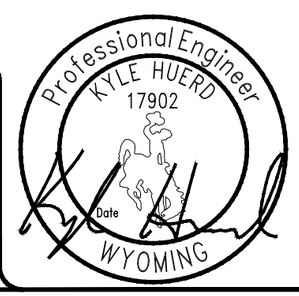

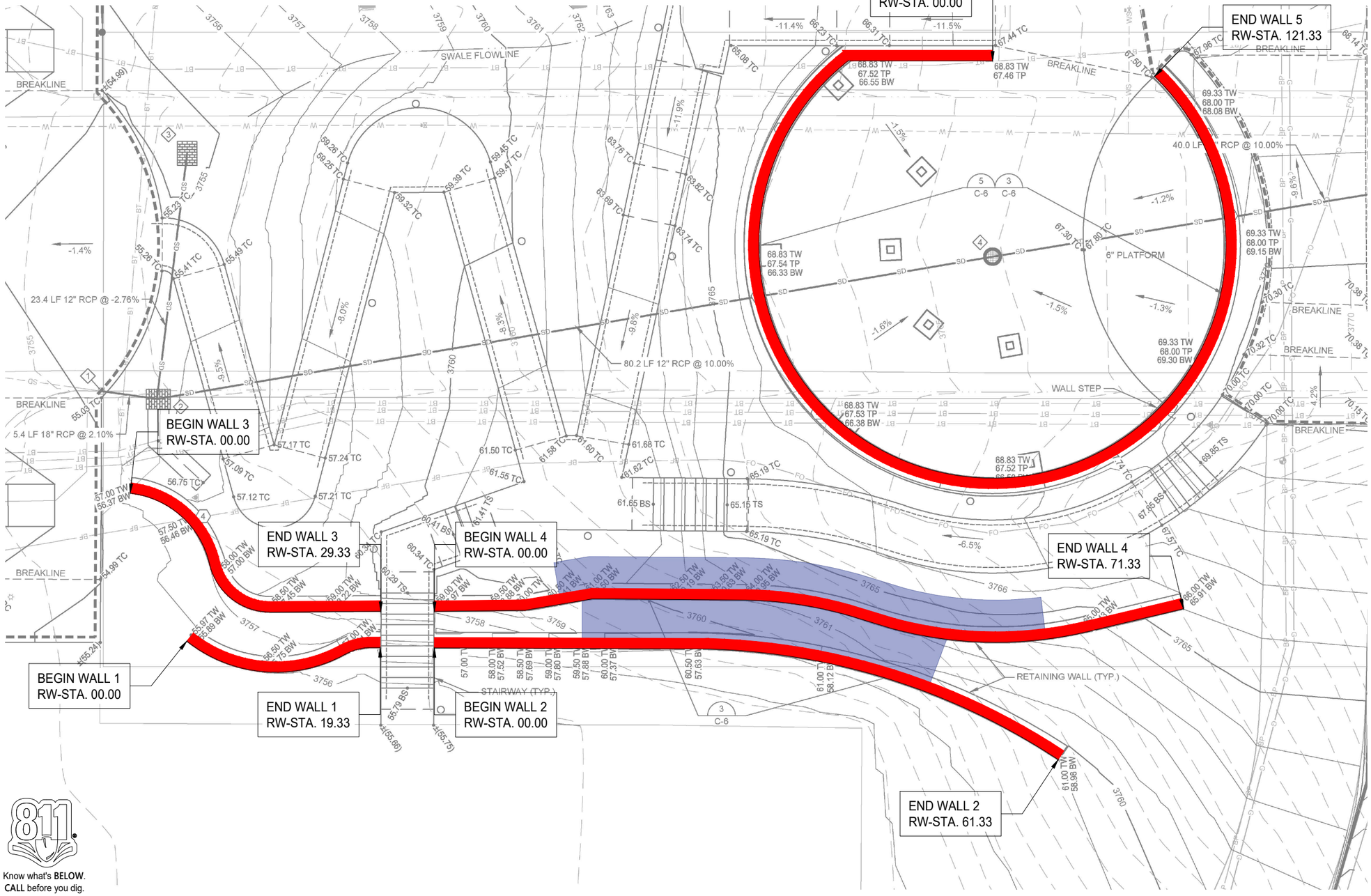

NOTE:

1. SITE PLAN IS FOR ILLUSTRATIVE PURPOSES ONLY AND IS TAKEN FROM THE CONTRACT PLANS PREPARED BY MORRISON-MAIERLE LAST DATED 03/01/2023.
2. NORTH ARROW DIRECTION IS APPROXIMATE, REFER TO CONTRACT PLANS FOR ACTUAL HEADING.
3. REFER TO CONTRACT PLANS FOR ALL HORIZONTAL ALIGNMENT AND ACTUAL SITE GEOMETRY.

LEGEND:

TOP OF WALL

APPROXIMATE GEOGRID COVERAGE

SCALE UNIT

10 5 0 10 20

NORTH

811 Know what's **BELOW**. **CALL** before you dig.

No.	Date	Revision	Drawn	Design	Check
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0	15 AUG 2023	RELEASED FOR CONSTRUCTION	CF	CF	KH

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GEOWALL DESIGNS
"BUILT FROM THE GROUND UP"
MN: 1548 CLIFF ROAD E, BURNSVILLE, MN 55337
CO: 1850 WOODMOOR DRIVE SUITE 201, MONUMENT, CO 80132
952.303.4190
WWW.GEOWALLDESIGNS.COM

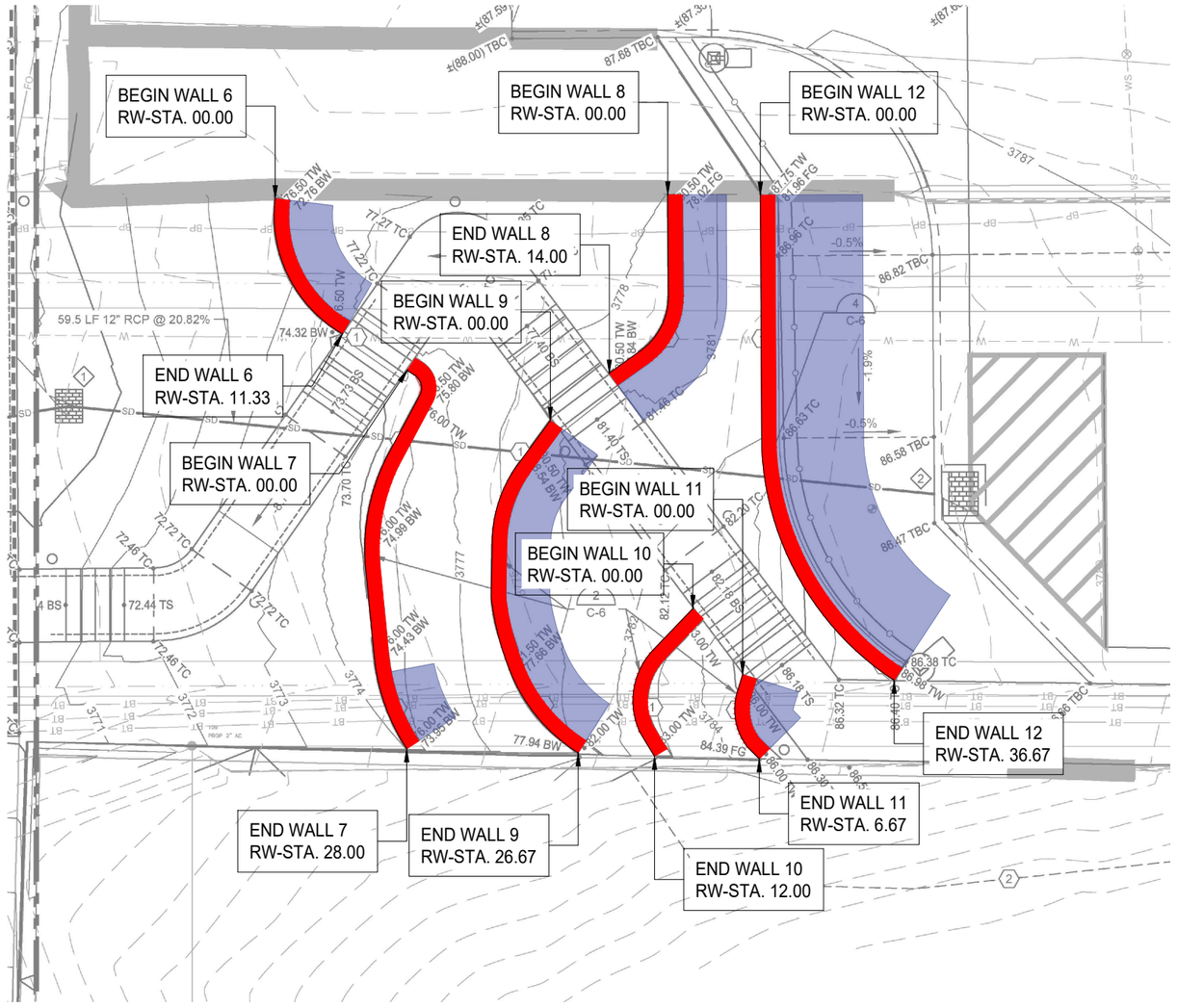
Title: WALL LOCATION PLAN VIEW

Project: BROOKS STREET GREENSPACE
SHERIDAN, WY

SEGMENTAL RETAINING WALL PLANS

Project No:	Date:	Scale:	Sheet No:
23NOU001	15 AUG 2023	########	RW-3.0

Professional Engineer
KYLE HUERD
17902
Date
WYOMING



NOTE:

1. SITE PLAN IS FOR ILLUSTRATIVE PURPOSES ONLY AND IS TAKEN FROM THE CONTRACT PLANS PREPARED BY MORRISON-MAIERLE LAST DATED 03/01/2023.
2. NORTH ARROW DIRECTION IS APPROXIMATE, REFER TO CONTRACT PLANS FOR ACTUAL HEADING.
3. REFER TO CONTRACT PLANS FOR ALL HORIZONTAL ALIGNMENT AND ACTUAL SITE GEOMETRY.

LEGEND:

TOP OF WALL

APPROXIMATE GEOGRID COVERAGE

SCALE UNIT

10 5 0 10 20

NORTH

811 Know what's **BELOW**. **CALL** before you dig.

No.	Date	Revision	Drawn	Design	Check
7					
6					
5					
4					
3					
2					
1					
0	15 AUG 2023	RELEASED FOR CONSTRUCTION	CF	CF	KH

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Project: BROOKS STREET GREENSPACE
SHERIDAN, WY

SEGMENTAL RETAINING WALL PLANS

Project No:	Date:	Scale:	Sheet No:
23NOU001	15 AUG 2023	########	RW-3.1

Professional Engineer
KYLE HUERD
17902
Date
WYOMING

GENERAL NOTES:

1. ALL ELEVATIONS AND DISTANCES ARE SHOWN IN FEET ALONG FACE OF WALL.
2. MINIMUM REINFORCEMENT LENGTH (RL_{MIN}) IS LISTED ALONG WALL FRONT FACE PROFILE. MINIMUM LENGTH IS MEASURED FROM FRONT FACE OF BLOCK TO TAIL OF GEOGRID.
3. THE WALLS SHALL BE CONSTRUCTED USING VERSA-LOK: STANDARD 6" UNITS AND 5XT GEOGRID SOIL REINFORCEMENT. SEE SHEET RW-2.0 FOR MATERIAL SPECIFICATIONS.
4. SEE MANUFACTURER'S INFORMATION FOR ADDITIONAL DETAILS ON THE BLOCK SYSTEM SHOWN.

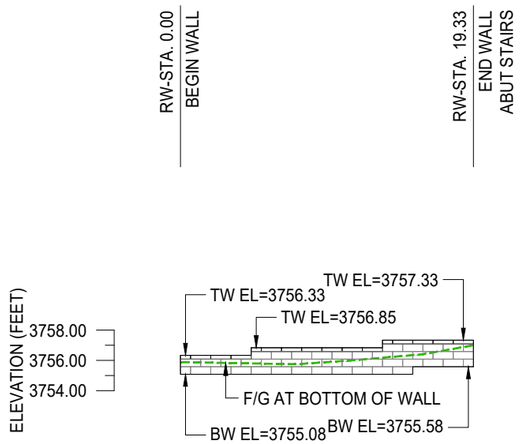
LEGEND:

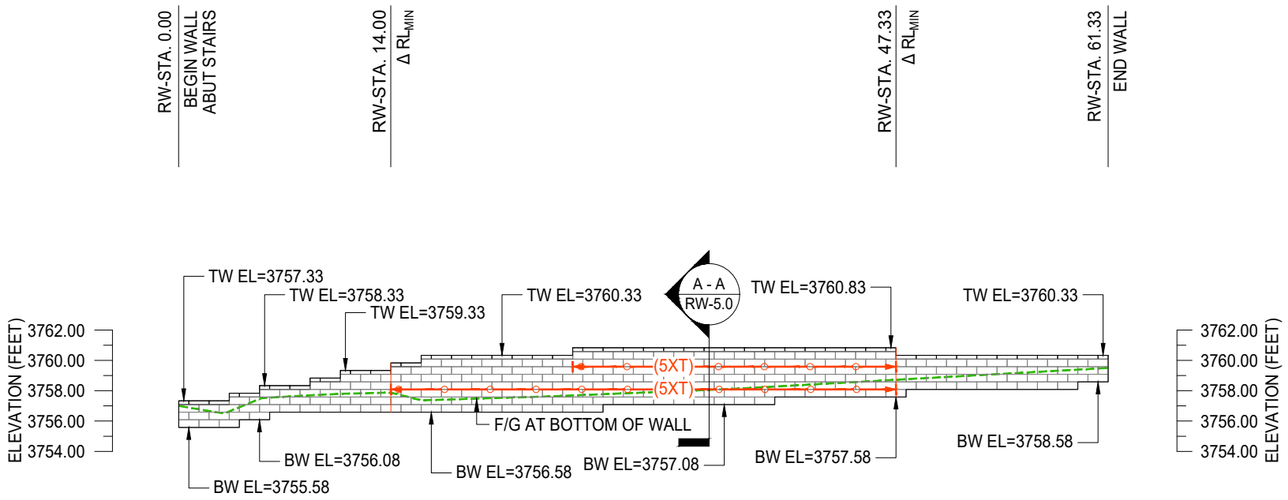
TOP OF WALL ELEVATION (TOP OF CAP) TW EL= XX.XX

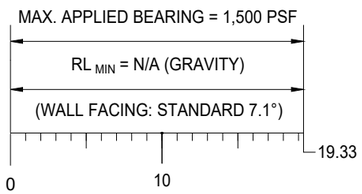
BOTTOM OF WALL ELEVATION (BOTTOM OF BLOCK) BW EL= XX.XX

FINISHED GRADE LINE

5XT GEOGRID (5XT)

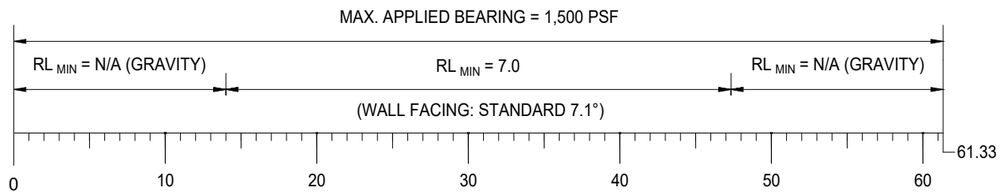






WALL 1 ELEVATION

DISTANCE SHOWN IN FEET ALONG FRONT FACE



WALL 2 ELEVATION

DISTANCE SHOWN IN FEET ALONG FRONT FACE

No.	Date	Revision	Drawn	Design	Check
7					
6					
5					
4					
3					
2					
1					
0	15 AUG 2023	RELEASED FOR CONSTRUCTION	CF	CF	KH

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Title: WALLS 1 & 2 ELEVATION

Project: BROOKS STREET GREENSPACE
SHERIDAN, WY

SEGMENTAL RETAINING WALL PLANS

Project No:	Date:	Scale:	Sheet No:
23NOU001	15 AUG 2023	1" = 10'	RW-4.0

Professional Engineer
KYLE HUERD
17902
Date
WYOMING

GENERAL NOTES:

1. ALL ELEVATIONS AND DISTANCES ARE SHOWN IN FEET ALONG FACE OF WALL.
2. MINIMUM REINFORCEMENT LENGTH (RL_{MIN}) IS LISTED ALONG WALL FRONT FACE PROFILE. MINIMUM LENGTH IS MEASURED FROM FRONT FACE OF BLOCK TO TAIL OF GEOGRID.
3. THE WALLS SHALL BE CONSTRUCTED USING VERSA-LOK: STANDARD 6" UNITS AND 5XT GEOGRID SOIL REINFORCEMENT. SEE SHEET RW-2.0 FOR MATERIAL SPECIFICATIONS.
4. SEE MANUFACTURER'S INFORMATION FOR ADDITIONAL DETAILS ON THE BLOCK SYSTEM SHOWN.

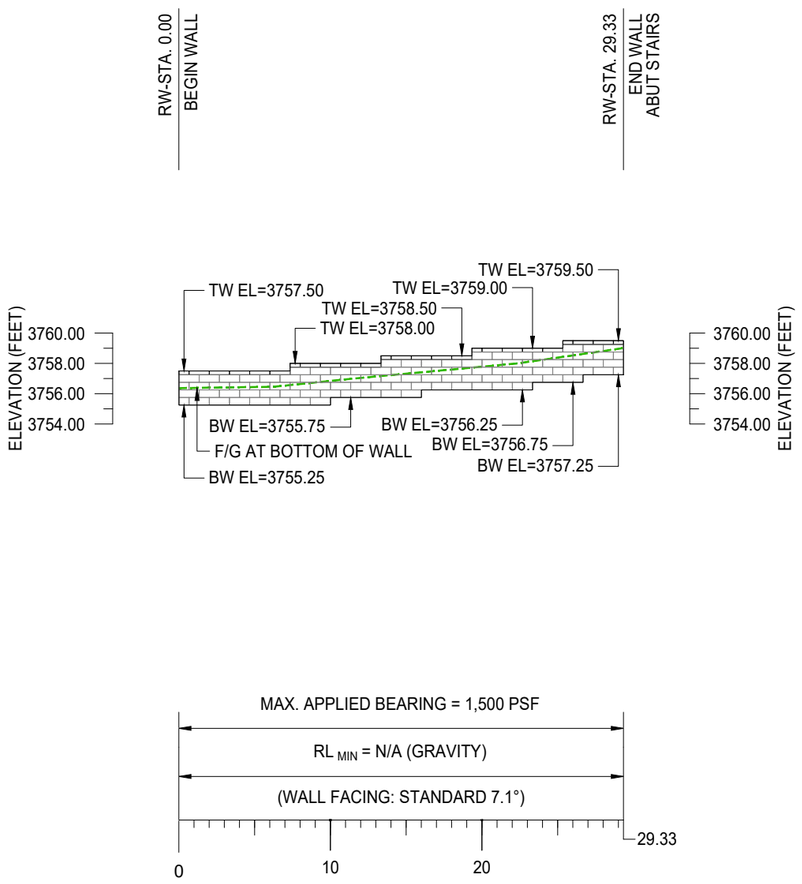
LEGEND:

TOP OF WALL ELEVATION (TOP OF CAP) TW EL= XX.XX

BOTTOM OF WALL ELEVATION (BOTTOM OF BLOCK) BW EL= XX.XX

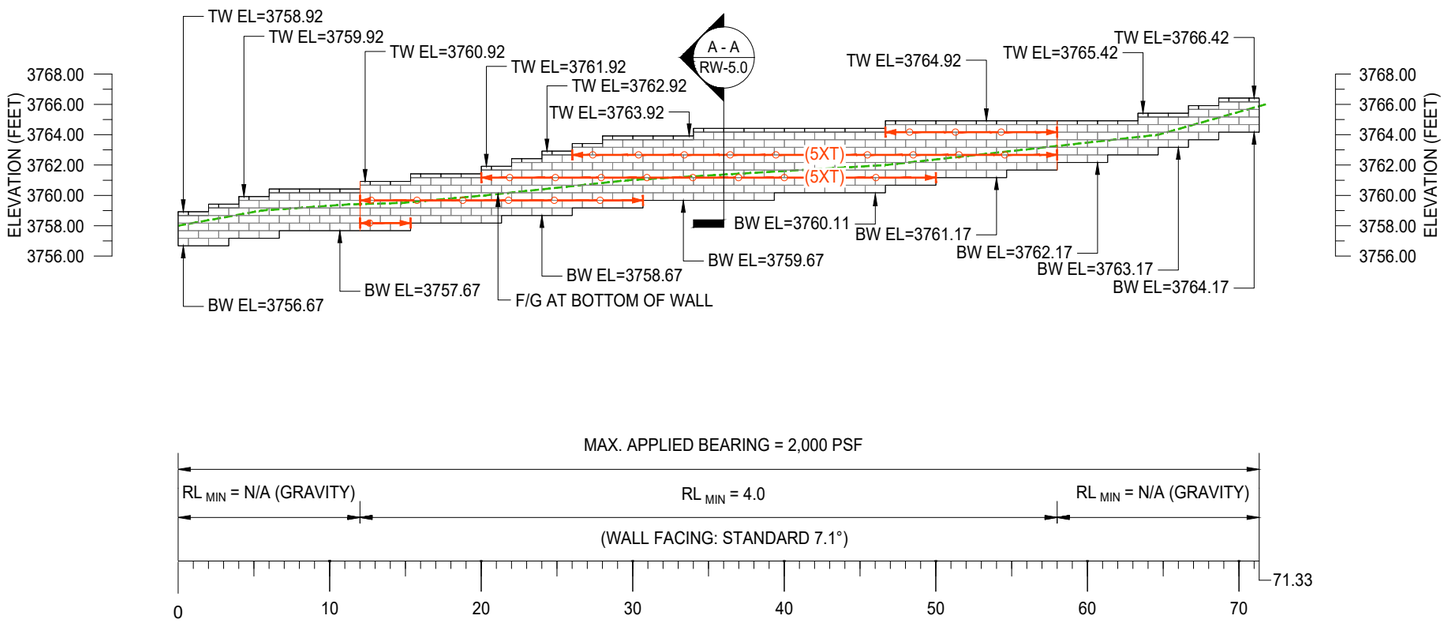
FINISHED GRADE LINE

5XT GEOGRID (5XT)



WALL 3 ELEVATION

DISTANCE SHOWN IN FEET ALONG FRONT FACE



WALL 4 ELEVATION

DISTANCE SHOWN IN FEET ALONG FRONT FACE

No.	Date	Revision	Drawn	Design	Check
7					
6					
5					
4					
3					
2					
1					
0	15 AUG 2023	RELEASED FOR CONSTRUCTION	CF	CF	KH

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Title: WALLS 3 & 4 ELEVATION

Project: BROOKS STREET GREENSPACE
SHERIDAN, WY

SEGMENTAL RETAINING WALL PLANS

Project No:	Date:	Scale:	Sheet No:
23NOU001	15 AUG 2023	1" = 10'	RW-4.1

Professional Engineer
KYLE HUERD
17902
Date
WYOMING

GENERAL NOTES:

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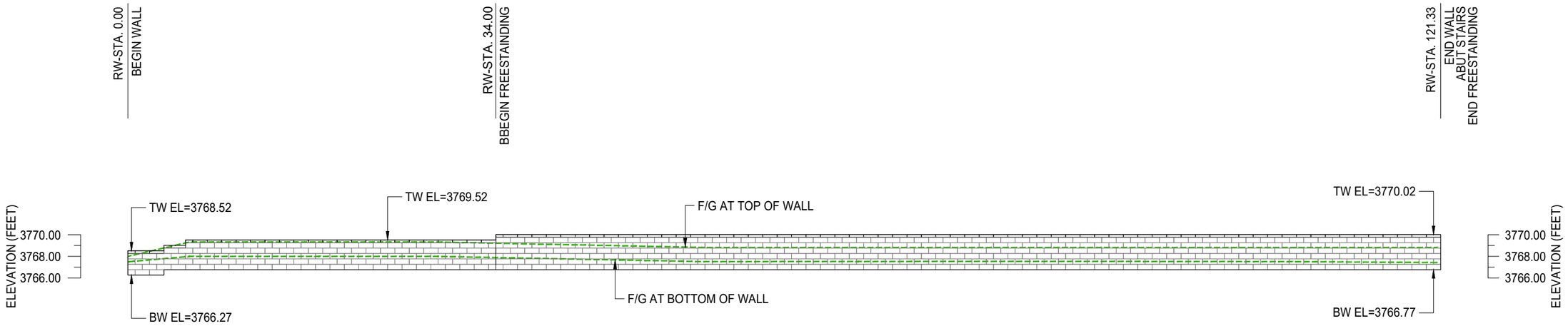
4. SEE MANUFACTURER'S INFORMATION FOR ADDITIONAL DETAILS ON THE BLOCK SYSTEM SHOWN.

LEGEND:

TOP OF WALL ELEVATION (TOP OF CAP)	TW EL= XX.XX
BOTTOM OF WALL ELEVATION (BOTTOM OF BLOCK)	BW EL= XX.XX
FINISHED GRADE LINE	
5XT GEOGRID	(5XT)



WALL 5 ELEVATION

DISTANCE SHOWN IN FEET ALONG FRONT FACE

No.	Date	Revision	Drawn	Design	Check
7					
6					
5					
4					
3					
2					
1					
0	15 AUG 2023	RELEASED FOR CONSTRUCTION	CF	CF	KH

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Title: WALL 5 ELEVATION

Project: BROOKS STREET GREENSPACE
SHERIDAN, WY

SEGMENTAL RETAINING WALL PLANS

Project No:	Date:	Scale:	Sheet No:
23NOU001	15 AUG 2023	1" = 10'	RW-4.2

Professional Engineer
KYLE HUERD
17902
Date
WYOMING

GENERAL NOTES:

1. ALL ELEVATIONS AND DISTANCES ARE SHOWN IN FEET ALONG FACE OF WALL.
2. MINIMUM REINFORCEMENT LENGTH (RL_{MIN}) IS LISTED ALONG WALL FRONT FACE PROFILE. MINIMUM LENGTH IS MEASURED FROM FRONT FACE OF BLOCK TO TAIL OF GEOGRID.
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4. SEE MANUFACTURER'S INFORMATION FOR ADDITIONAL DETAILS ON THE BLOCK SYSTEM SHOWN.

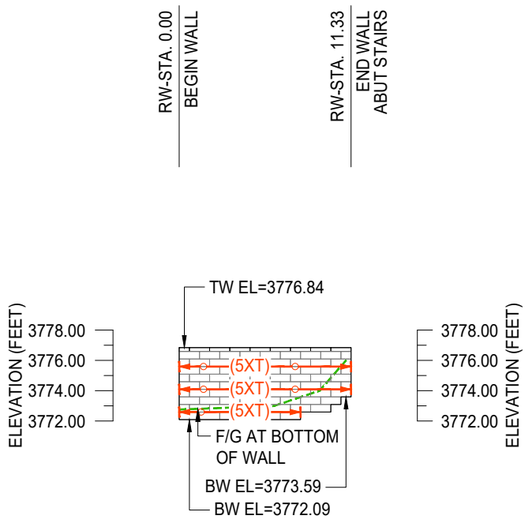
LEGEND:

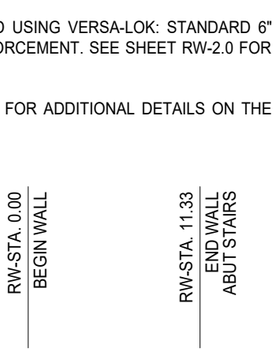
TOP OF WALL ELEVATION (TOP OF CAP) TW EL= XX.XX

BOTTOM OF WALL ELEVATION (BOTTOM OF BLOCK) BW EL= XX.XX

FINISHED GRADE LINE

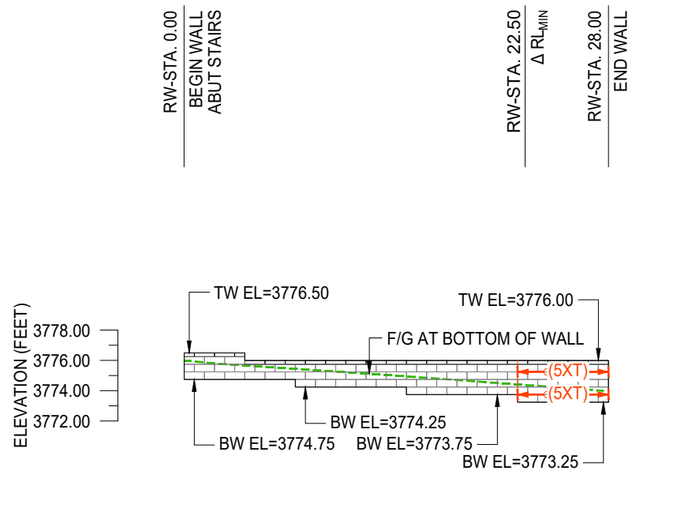
5XT GEOGRID (5XT)

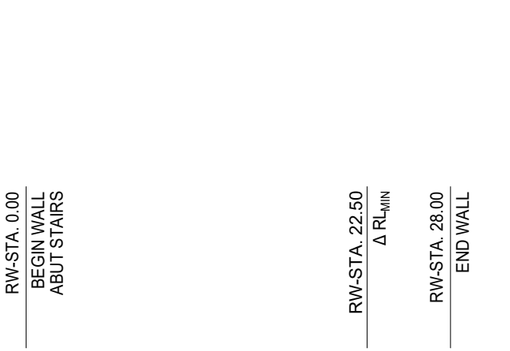




WALL 6 ELEVATION

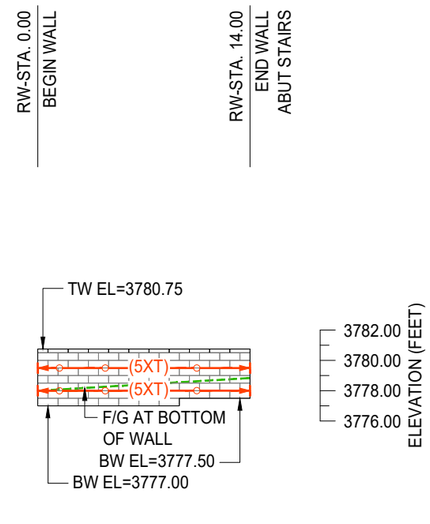
DISTANCE SHOWN IN FEET ALONG FRONT FACE

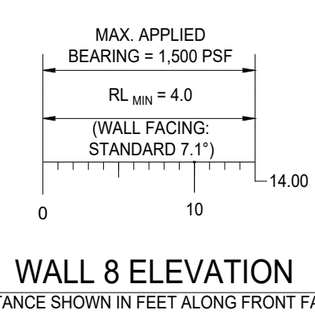




WALL 7 ELEVATION

DISTANCE SHOWN IN FEET ALONG FRONT FACE





WALL 8 ELEVATION

DISTANCE SHOWN IN FEET ALONG FRONT FACE

No.	Date	Revision	Drawn	Design	Check
7					
6					
5					
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1					
0	15 AUG 2023	RELEASED FOR CONSTRUCTION	CF	CF	KH

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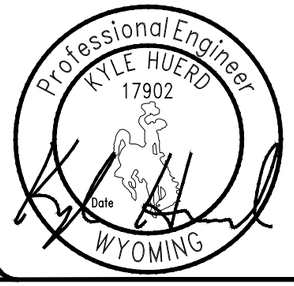
Title: WALLS 6, 7, AND 8 ELEVATION

Project: BROOKS STREET GREENSPACE
SHERIDAN, WY

SEGMENTAL RETAINING WALL PLANS

Project No:	Date:	Scale:	Sheet No:
23NOU001	15 AUG 2023	1" = 10'	RW-4.3

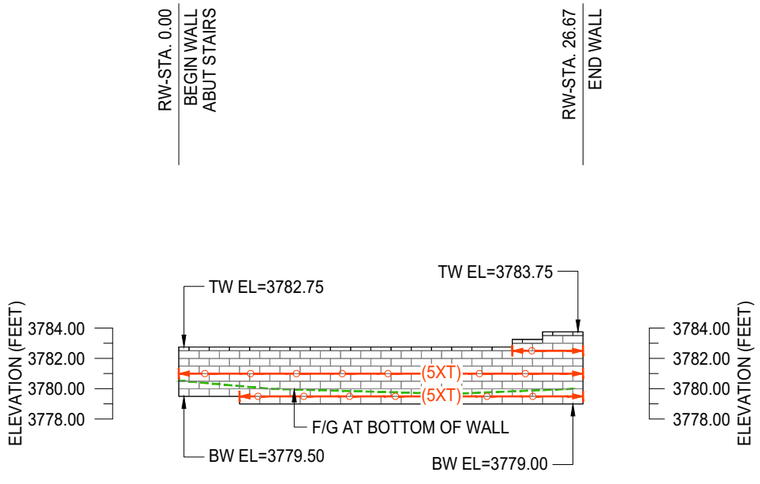


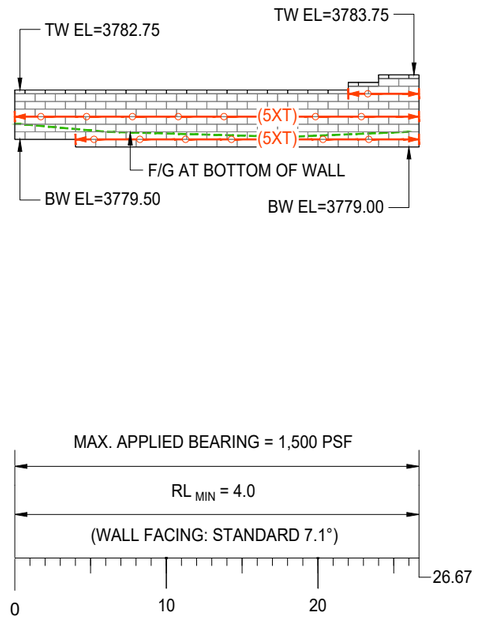
GENERAL NOTES:

1. ALL ELEVATIONS AND DISTANCES ARE SHOWN IN FEET ALONG FACE OF WALL.
2. MINIMUM REINFORCEMENT LENGTH (RL_{MIN}) IS LISTED ALONG WALL FRONT FACE PROFILE. MINIMUM LENGTH IS MEASURED FROM FRONT FACE OF BLOCK TO TAIL OF GEOGRID.
3. THE WALLS SHALL BE CONSTRUCTED USING VERSA-LOK: STANDARD 6" UNITS AND 5XT GEOGRID SOIL REINFORCEMENT. SEE SHEET RW-2.0 FOR MATERIAL SPECIFICATIONS.
4. SEE MANUFACTURER'S INFORMATION FOR ADDITIONAL DETAILS ON THE BLOCK SYSTEM SHOWN.

LEGEND:

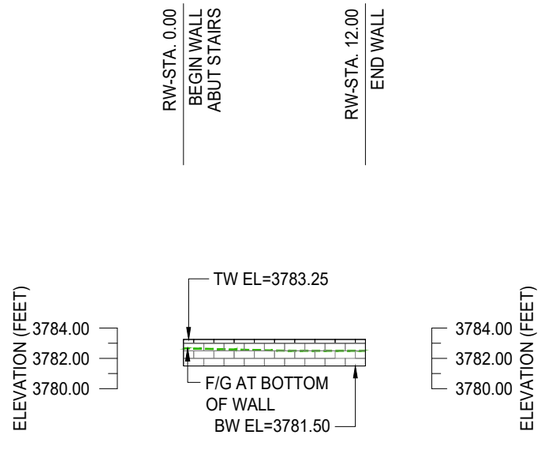
TOP OF WALL ELEVATION (TOP OF CAP)	TW EL= XX.XX
BOTTOM OF WALL ELEVATION (BOTTOM OF BLOCK)	BW EL= XX.XX
FINISHED GRADE LINE	
5XT GEOGRID	(5XT)

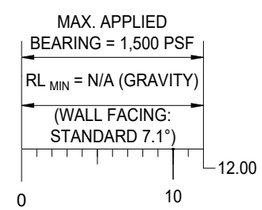




WALL 9 ELEVATION

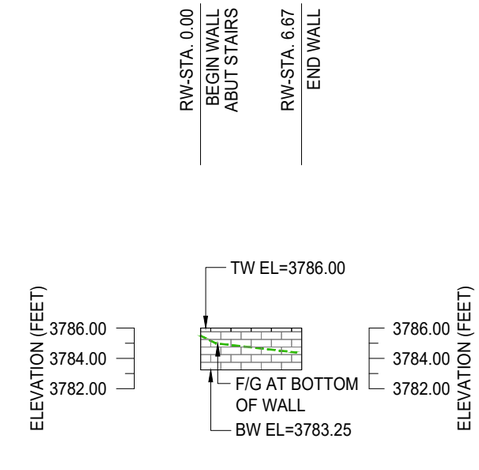
DISTANCE SHOWN IN FEET ALONG FRONT FACE

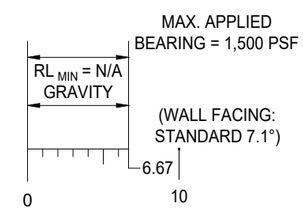




WALL 10 ELEVATION

DISTANCE SHOWN IN FEET ALONG FRONT FACE





WALL 11 ELEVATION

DISTANCE SHOWN IN FEET ALONG FRONT FACE

No.	Date	Revision	Drawn	Design	Check
7					
6					
5					
4					
3					
2					
1					
0	15 AUG 2023	RELEASED FOR CONSTRUCTION	CF	CF	KH

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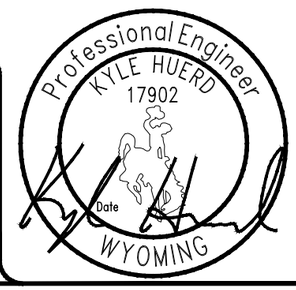
WWW.GEOWALLDESIGNS.COM

Title: WALLS 9, 10, AND 11 ELEVATION

Project: BROOKS STREET GREENSPACE
SHERIDAN, WY

SEGMENTAL RETAINING WALL PLANS

Project No:	Date:	Scale:	Sheet No:
23NOU001	15 AUG 2023	1" = 10'	RW-4.4



GENERAL NOTES:

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2. MINIMUM REINFORCEMENT LENGTH (RL_{MIN}) IS LISTED ALONG WALL FRONT FACE PROFILE. MINIMUM LENGTH IS MEASURED FROM FRONT FACE OF BLOCK TO TAIL OF GEOGRID.
3. THE WALLS SHALL BE CONSTRUCTED USING VERSA-LOK: STANDARD 6" UNITS AND 5XT GEOGRID SOIL REINFORCEMENT. SEE SHEET RW-2.0 FOR MATERIAL SPECIFICATIONS.
4. SEE MANUFACTURER'S INFORMATION FOR ADDITIONAL DETAILS ON THE BLOCK SYSTEM SHOWN.

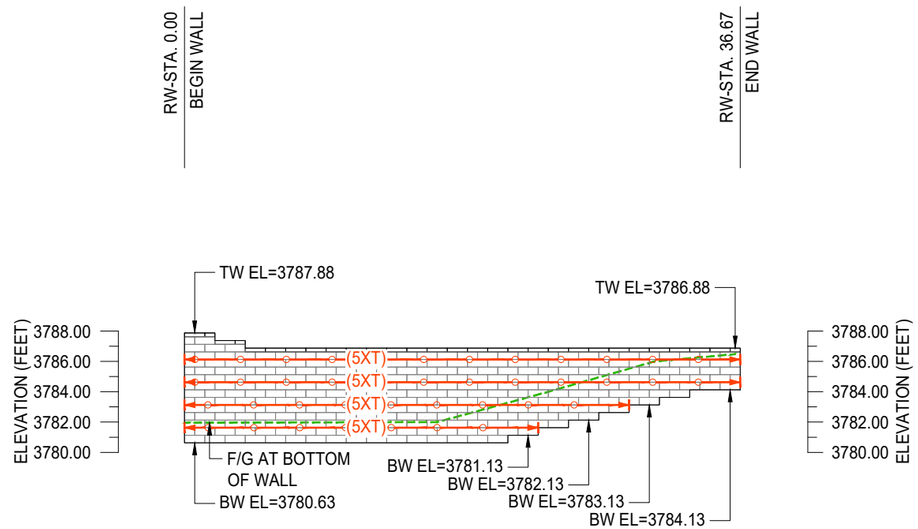
LEGEND:

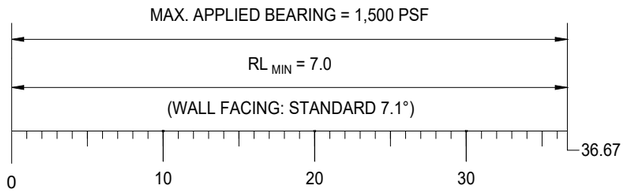
TOP OF WALL ELEVATION (TOP OF CAP) TW EL= XX.XX

BOTTOM OF WALL ELEVATION (BOTTOM OF BLOCK) BW EL= XX.XX

FINISHED GRADE LINE

5XT GEOGRID (5XT)





WALL 12 ELEVATION

DISTANCE SHOWN IN FEET ALONG FRONT FACE

No.	Date	Revision	Drawn	Design	Check
7					
6					
5					
4					
3					
2					
1					
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Title: WALLS 12 ELEVATION

Project: BROOKS STREET GREENSPACE
SHERIDAN, WY

SEGMENTAL RETAINING WALL PLANS

Project No:	Date:	Scale:	Sheet No:
23NOU001	15 AUG 2023	1" = 10'	RW-4.5

Professional Engineer
KYLE HUERD
17902
Date
WYOMING

GENERAL NOTES:

1. THE SECTION SHOWN IS A REPRESENTATIVE WALL SECTION. THE WALL HEIGHTS, ELEVATIONS, TOE SLOPES, AND BACK SLOPES VARY ACCORDING TO THE ELEVATION PLAN AND SITE PLAN RESPECTIVELY.

2. UPON EXCAVATION, WHERE UNSUITABLE SOILS ARE FOUND, SUBCUT AS REQUIRED BY THE ONSITE GEOTECHNICAL ENGINEER AND REPLACE WITH SUITABLE COMPACTED STRUCTURAL FILL TO ACHIEVE THE REQUIRED BEARING CAPACITY. THE STRUCTURAL FILL SHALL BE COMPACTED TO A MINIMUM 95% STANDARD PROCTOR DENSITY.

3. APPROXIMATE LIMITS OF EXCAVATION VARIES WHERE SUBCUT IS REQUIRED. ACTUAL LIMITS AND SIDE SLOPES SHALL BE DETERMINED BY OSHA REGULATIONS AND MATCH FIELD CONDITIONS AS DETERMINED BY THE CONTRACTOR.

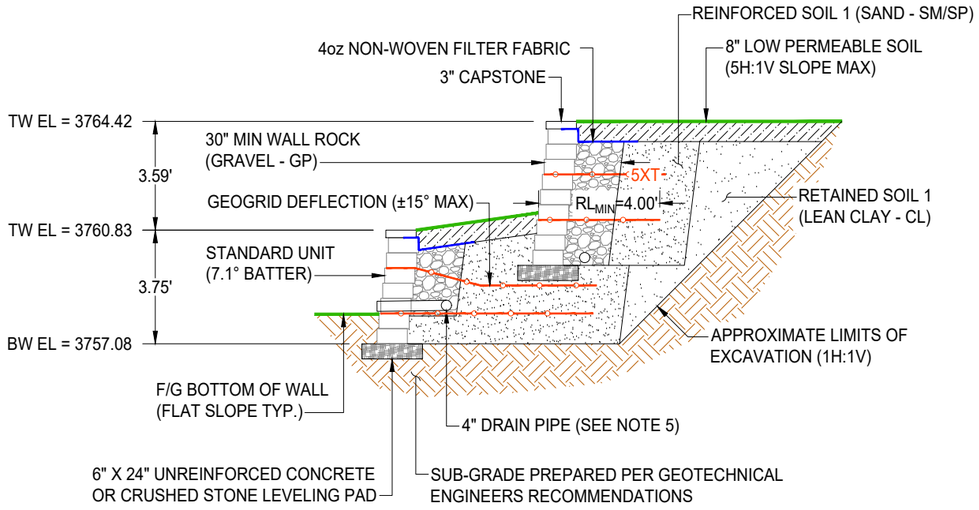
4. THE WALL IS DESIGNED AS A REINFORCED WALL REQUIRING 5XT REINFORCEMENT AT THE ELEVATIONS SHOWN AND SHALL BE CONSTRUCTED WITH VERSA-LOK: STANDARD 6" UNITS USING THE 7.1° BATTER.

5. 4" CORRUGATED PERFORATED DRAINPIPE INSTALLED AS LOW AS POSSIBLE WITH POSITIVE DRAINAGE. OUTLET INTO ONSITE DRAINAGE OR THROUGH WALL FACE AT 30.0' O.C. AND LOW ENDS OF WALL. SEE DETAIL 2/RW-6.0.

6. INSPECT EXCAVATION SLOPES FOR ACTIVE SEEPAGE AND PLACE ADDITIONAL DRAINS WHERE SEEPAGE OCCURS.

7. DO NOT BRING HEAVY COMPACTION OR PAVING EQUIPMENT WITHIN 3' OF THE BACK OF THE VERSA-LOK RETAINING WALL.

8. SEE MANUFACTURER'S INFORMATION FOR ADDITIONAL DETAILS ON THE VERSA-LOK RETAINING WALL SYSTEM.



WALL SECTION A - A

(SECTION CUT: SEE WALL PROFILES)

LEGEND

- LOW PERMEABLE SOIL
- WALL ROCK (GRAVEL - GP)
- REINFORCED SOIL 1 (SAND - SM/SP)
- RETAINED SOIL 1 (LEAN CLAY - CL)
- LEVELING PAD (GRAVEL - GW)
- IN-SITU/STRUCTURAL FILL
- 5XT GEOGRID
- 4 oz NON-WOVEN FILTER FABRIC

No.	Date	Revision	Drawn	Design	Check
7					
6					
5					
4					
3					
2					
1					
0	15 AUG 2023	RELEASED FOR CONSTRUCTION	CF	CF	KH

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Title: WALL SECTION A-A

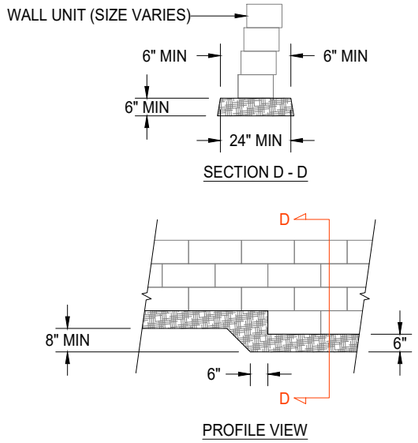
Project: BROOKS STREET GREENSPACE
SHERIDAN, WY

SEGMENTAL RETAINING WALL PLANS

Project No:	Date:	Scale:	Sheet No:
23NOU001	15 AUG 2023	1" = 5'	RW-5.0

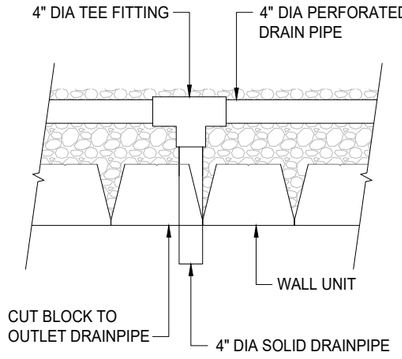
Professional Engineer
KYLE HUERD
17902
Date
WYOMING

NOTES:
1. FOUNDATION SOILS SHALL BE APPROVED BY THE GEOTECHNICAL ENGINEER PRIOR TO PLACEMENT OF THE LEVELING PAD.
2. LEVELING PAD SHALL BE CONSTRUCTED TO THE DIMENSIONS SHOWN USING CRUSHED STONE OR 2,000 PSI UNREINFORCED CONCRETE.



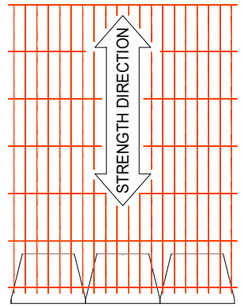
1 LEVELING PAD DETAIL - N.T.S

NOTES:
1. THE DRAINAGE SYSTEM SHALL CONSIST OF A 4" MINIMUM DIAMETER CORRUGATED PERFORATED PLASTIC DRAINPIPE.



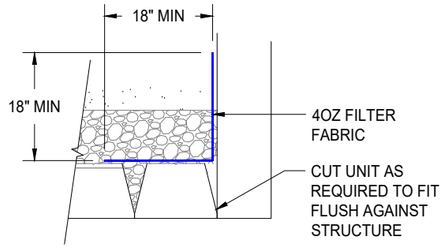
2 DRAIN PIPE OUTLET DETAIL - N.T.S

NOTES:
1. GEOGRID SHALL BE PLACED WITHIN 1" OF THE FRONT FACE OF RETAINING WALL UNITS.
2. GEOGRID SHALL LAY FLAT ON THE WALL UNITS AND COMPACTED BACKFILL SOILS BEHIND RETAINING WALL UNITS UNLESS DEFLECTION IS REQUIRED. GEOGRID SOIL REINFORCEMENT MAY DEFLECT VERTICALLY A MAXIMUM OF 15°.
3. PLACE THE NEXT COURSE OF RETAINING WALL UNITS. PULL GEOGRID TAUT TO REMOVE SLACK AND WRINKLES.
4. STAKE AS REQUIRED TO KEEP GEOGRID TAUT DURING BACKFILL PLACEMENT.



3 GEOGRID ORIENTATION DETAIL - N.T.S

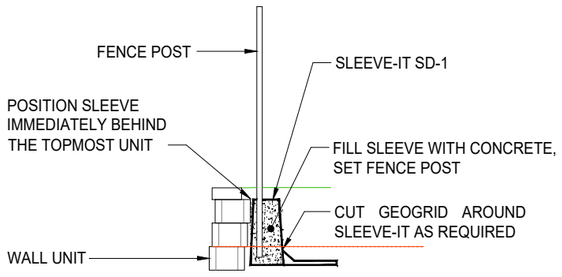
NOTES:
1. PLACE 4OZ FILTER FABRIC ALONG VERTICAL ABUTMENT JOINTS TO ENSURE BACKFILL RETENTION.
2. FABRIC SHALL EXTEND 18" MINIMUM ON BOTH SIDES OF THE ABUTMENT JOINT.



PERPENDICULAR STRUCTURE

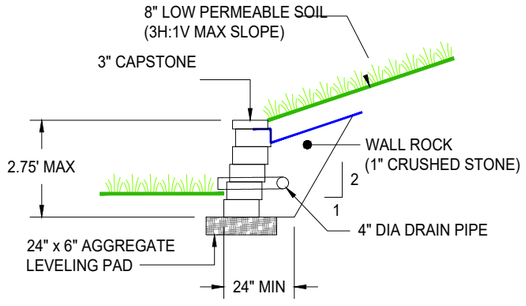
4 TYPICAL ABUTMENT DETAIL - N.T.S

NOTES:
1. SLEEVE-IT FENCE POST FOOTING SHALL BE USED WHERE POST MUST BE PLACED WITHIN 3-FEET OF THE FACE OF WALL. WHERE POSTS ARE LOCATED 3-FEET OR GREATER FROM FACE OF WALL SONO-TUBES SHALL BE USED FOR POST INSTALLATION.
2. FENCING SYSTEMS APPROVED FOR USE WITH THE SLEEVE-IT SD-1 ARE LIMITED TO THE FOLLOWING HEIGHTS: CHAIN LINK UP TO 8 FT, PRIVACY UP TO 6 FT. MAXIMUM POST HEIGHTS ARE GOVERNED BY POST SPACING AND APPLIED LATERAL LOADINGS INCLUDING IBC MINIMUM AND WIND LOADINGS. FENCE CONTRACTOR SHALL ENSURE POST SPACING AND APPLIED LOADS DO NOT EXCEED SLEEVE-IT SD-1 CAPACITY.



5 TYPICAL POST DETAIL - N.T.S

NOTES:
1. THE SECTION SHOWN IS A REPRESENTATIVE WALL SECTION. THE WALL HEIGHTS, ELEVATIONS, TOE SLOPES, AND BACK SLOPES VARY ACCORDING TO THE ELEVATION PLAN AND SITE PLAN RESPECTIVELY.
2. THE WALL IS DESIGNED AS A GRAVITY WALL CONSTRUCTED WITH VERSA-LOK STANDARD: 6" UNITS USING THE 7.1° BATTER.
3. 4" CORRUGATED PERFORATED DRAINPIPE WRAPPED WITH GEOTEXTILE INSTALLED AS LOW AS POSSIBLE WITH POSITIVE DRAINAGE. OUTLET INTO ONSITE DRAINAGE OR THROUGH WALL FACE AT 50.0' O.C. AND LOW ENDS OF WALL.



6 TYPICAL GRAVITY WALL DETAIL - N.T.S

No.	Date	Revision	Drawn	Design	Check
7					
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Title: CONSTRUCTION DETAILS

Project: BROOKS STREET GREENSPACE
SHERIDAN, WY

SEGMENTAL RETAINING WALL PLANS

Project No:	Date:	Scale:	Sheet No:
23NOU001	15 AUG 2023	AS NOTED	RW-6.0

Professional Engineer
KYLE HUERD
17902
Date
WYOMING

Prepared by:

GeoWall Designs

Brooks Street Greenspace
Sheridan County, WY
Final
Material Quantity Estimate

Job No.:	23NOU001
Selected Product:	VERSA-LOK Standard
Date:	8/15/2023
Rev#:	0

Wall #	Wall Length (Feet)	Block Area (Square Feet)	Cap Area (Square Feet)	Total Area (Square Feet)	Grid Type 1 Mirafi 5XT (Square Yards)	Max RL (Feet)	Reinforced Soil 1 Sand - SM/SP (Cubic Yards)	Retained Soil 1 Lean Clay - CL (Cubic Yards)	Retained Soil 2 Gravel - GP (Cubic Yards)	Leveling Pad Gravel - GW (Cubic Yards)	Wall Rock Gravel - GP (Cubic Yards)	Filter Fabric ERS-400N (Square Yards)	4" Drain Pipe Single Wall HDPE (Feet)	4" Outlets (Each)	Fence Post Footing Sleeve-It SD-1 (Each)
1	19.33	27.67	5.00	32.67	N/A	N/A	N/A	N/A	0.73	0.72	1.95	6.77	19.33	1.00	0.00
2	61.33	166.00	20.00	186.00	44.92	7.00	22.95	7.05	1.88	2.27	11.68	21.47	61.33	3.00	0.00
3	29.33	64.00	10.00	74.00	N/A	N/A	N/A	N/A	2.59	1.09	4.50	10.27	29.33	1.00	6.00
4	71.33	230.00	20.00	250.00	44.80	4.00	15.93	11.91	2.47	2.64	16.19	24.97	71.33	3.00	12.00
5	121.33	256.00	35.00	291.00	N/A	N/A	N/A	N/A	10.00	4.49	18.01	42.47	121.33	5.00	0.00
6	11.33	48.33	5.00	53.33	14.47	4.00	4.48	3.82	N/A	0.42	3.40	3.97	11.33	1.00	3.00
7	28.00	50.00	10.00	60.00	5.60	4.00	1.39	0.69	1.03	1.04	3.52	9.80	28.00	1.00	0.00
8	14.00	46.67	5.00	51.67	13.07	4.00	4.32	2.88	N/A	0.52	3.28	4.90	14.00	1.00	0.00
9	26.67	95.00	10.00	105.00	25.20	4.00	8.80	6.27	N/A	0.99	6.69	9.33	26.67	1.00	5.00
10	12.00	18.00	5.00	23.00	N/A	N/A	N/A	N/A	0.50	0.44	1.27	4.20	12.00	1.00	3.00
11	6.67	16.67	5.00	21.67	6.53	4.00	1.54	0.77	N/A	0.25	1.17	2.33	6.67	1.00	2.00
12	36.67	190.33	10.00	200.33	102.90	7.00	38.77	18.29	N/A	1.36	13.39	12.83	36.67	2.00	7.00
Total:	437.99	1208.67	140.00	1348.67	257.48	N/A	98.17	51.69	19.20	16.22	85.05	153.30	437.99	21.00	38.00

Notes:

- Wall quantities are neat and do not include any additional factors for waste, compaction, palletized delivery, non-linear wall volumes, negative backslopes, etc.
- Wall Rock includes 12" drainage column and voids between wall units.
- Reinforced Soil 1 includes backfill from back of drainage zone to tails of soil reinforcement.
- Retained Soil 1 includes 1H:1V wedge located behind the reinforced zone.
- Retained Soil 2 includes 1H:2V wedge located behind the 12" drainage column (wall rock) where designed gravity.
- Filter fabric includes a 3 ft strip for the length of wall separating the top soil from the clean aggregate within backfill zones.
- Sleeve-Its are estimated at 7' C-C for the length of wall.

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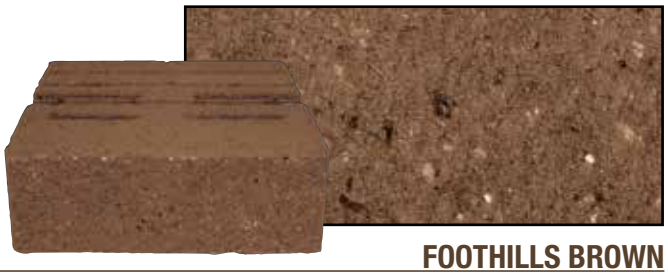
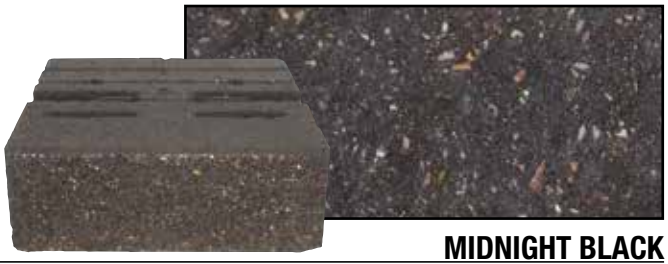
VERSA-LOK is manufactured from high-strength, low-absorption concrete that exceeds industry standards. Units are integrally colored for consistency even when modified and cannot chip or peel, providing a lifetime of virtually maintenance-free performance.

DAKOTA BUFF

NATURAL GRAY

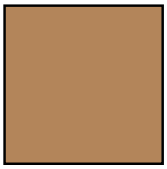


FOOTHILLS BROWN



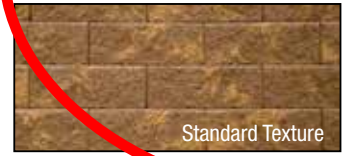
MIDNIGHT BLACK

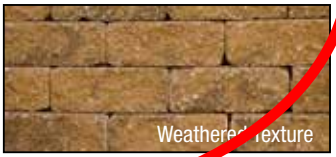
JEWEL CAVE BLEND



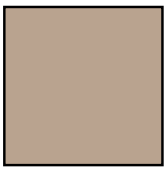
TAN

BROWN





CHARCOAL BLEND



GRAY

BLACK

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