

DESIGN CALCULATIONS

PRRWF20250442

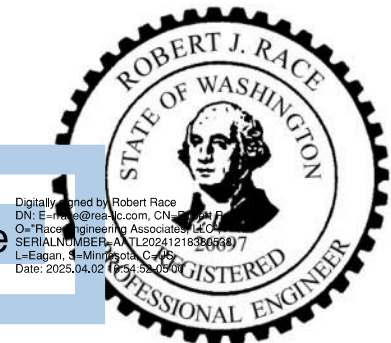
EAST TOWN CROSSING PUYALLUP, WA

These calculations must be on site and made available by the Permittee for all inspections.

SUBMITTED BY:

Robert Race, P.E.

Robert Race



I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATIONS, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF WASHINGTON.

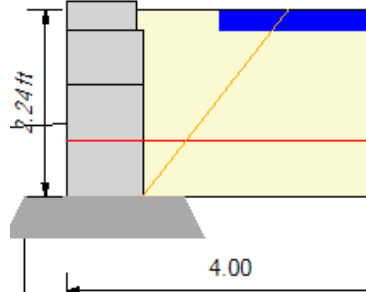
DATE: April 2, 2025

ROBERT J. RACE, P.E. LICENSE NO. 26697

REA Analysis

Project: EAST TOWN CROSSING PIONEER IMPROVEMENTS
 Location: PUYALLUP, WA
 Designer: rjr
 Date: 3/24/2025
 Section: Wall 1, S_41.0_to_47.0
 Design Method: NCMA_09_3rd_Ed, Ignore Vert. Force
 Design Unit: GeoWall Plus 4.0: PL

Seismic Acc: 0.400g
 Design Method: AASHTO 2020, Kavazanjian
 Design Equation: AASHTO 2020, A11.5.1-1



SOIL PARAMETERS	Φ	coh	γ
Reinforced Soil:	32 deg	0 lbf/ft ²	120 lbf/ft ³
Retained Soil:	32 deg	0 lbf/ft ²	120 lbf/ft ³
Foundation Soil:	32 deg	50 lbf/ft ²	120 lbf/ft ³
Leveling Pad:	40 deg	0 lbf/ft ²	135 lbf/ft ³
Leveling Pad:	Crushed Stone		

GEOMETRY

Design Height:	2.24 ft (1.37 ft Exp.)	Live Load:	100	Live Load 2:
Wall Batter/Tilt:	0.00/ 0.00 deg	Live Load Offset:	1.00 ft	LL2 Offset:
Embedment:	0.87 ft	Live Load Width:	9 ft	LL2 Width:
Leveling Pad Depth:	0.50 ft	Dead Load:	0 lbf/ft ²	
Back Slope Angle:	0.0 deg	Dead Load Offset:	0.0 ft	
Back Slope Length:	0.0 ft	Dead Load Width:	0.00 ft	
Back Slope Toe Offset:	0.0 ft			
Vertical δ on Single Depth		Toe Slope Angle:	3.30 deg	
		Toe Slope Length:	45.00 ft	
		Toe Slope Bench:	0.00 ft	

FACTORS OF SAFETY (Static / Seismic)

Sliding:	1.50 / 1.13	Pullout:	1.50 / 1.13
Overturning:	2.00 / 1.50	Tension/Uncertainties:	1.50 / 1.13
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.13
Unit/Unit Shear:	1.50 / 1.13		

RESULTS (Static / Seismic)

FoS Sliding:	5.69 / [3.73]	FoS Overturning:	25.01 / [12.15]
Bearing	354 / [292]	FoS Bearing:	32.33 / [39.64]
FoS Pullout	8.91 / [5.56]		
Total Pullout	484	FoS Total Pullout	6.01
Total Pullout (S)	484	FoS Total Pullout (S)	5.32
Top FoSot:	3.00	FoS Connection:	24.19

ID	Height	Length	Name	Ta _{tn} [Ta _{tns}]	Rc %	TMax [Tmd]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS SeisPO	FS Sldg
1	0.67	4	3XT	1330 [2893]	100	76 [33]	26.29 [26.63]	876 [1168]	17.31 [15.10]	6.37 [5.56]	15.87 [12.81]

Column Descriptions:

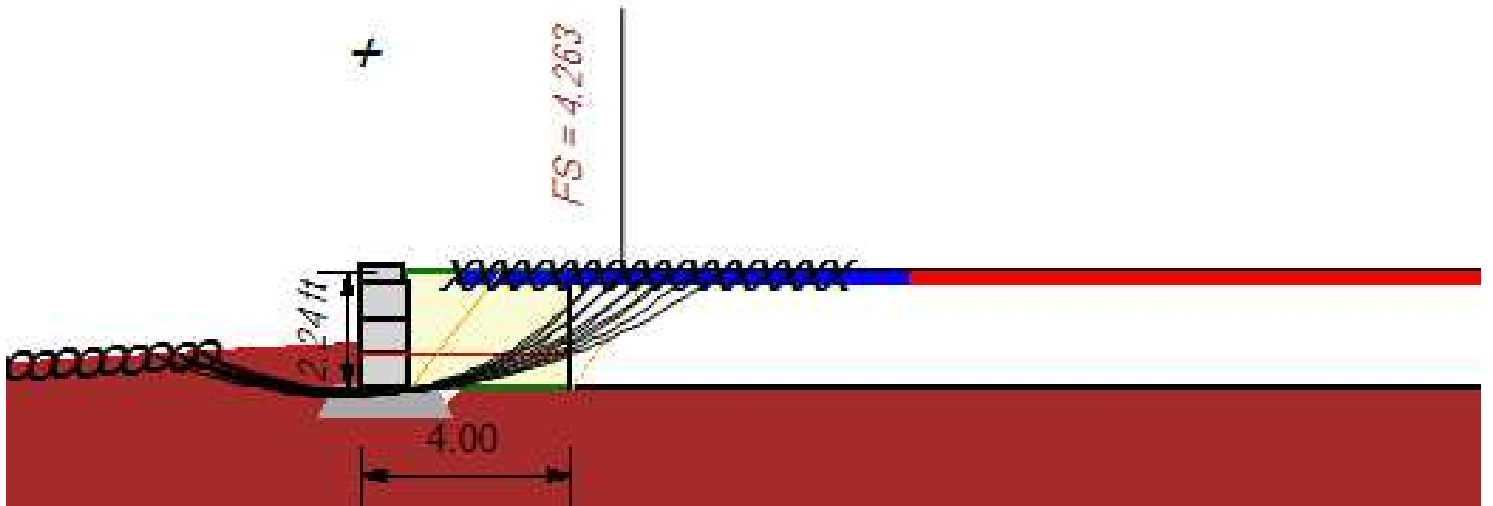
- Ta: allowable geogrid strength
- Rc %: percent coverage for geosynthetics
- EP (Pa) internal active earth pressure
- LL (Pql) earth pressure due to live load surcharge
- DL (Pqd) earth pressure due to dead load surcharge
- Tmax maximum earth pressure on geosynthetic layer
- FSstr factor of safety on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

CONNECTION RESULTS TABLE

Connection results compare the load on the connection (pullout at the face) to the resistance of the connection. In the NCMA design methodology the connection load accounts for the loading 'over the active zone' in the failure plane from each reinforcing layer. Note that live load (LL) in T_{max} for the reinforcing layer is the load calculated from the base of the wall and maybe larger then LL for the connection (T_{cn})

AASHTO design methodology (Simplified or Stiffness) the connection load, T_o, is equal to the T_{max} in the reinforcing. In Limit equilibrium the the connection load (T_o) is less than the T_{max} in the reinforcing layer as it is calculated at each layer of reinforcing, similar to the Trial Wedge Method using in REA software.

ID	Height	Length	Name	%Coverage	Pa	LL	LL2	Tcn	TaCn	FSPkCn
1	0.67	4	3XT	100	54	22	0	54	1314	24.19



GLOBAL RESULTS

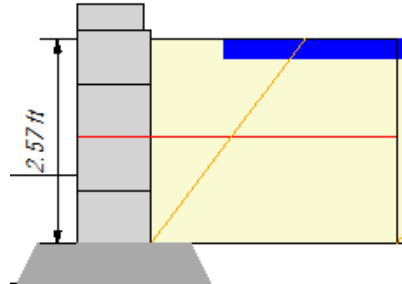
Global stability is a global analysis (Bishop) with the failure planes originating at the top of the slope / wall and exiting out below the wall in the area in front of the structure. For MSE walls, the resistance of the geogrid reinforcement is included in the resisting forces. The curve may go through 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	Mo	Mr	FoS
1	4.97	2.24	-3.00	0.70	0.03	6.39	6.45	1580.30	6746.51	4.26
1	5.42	2.24	-3.45	0.67	-0.13	7.74	7.81	1967.36	8467.12	4.30
1	5.42	2.24	-3.00	0.70	0.17	7.15	7.18	1758.08	7594.02	4.31
1	5.87	2.24	-3.00	0.70	0.31	7.93	7.95	1951.08	8431.59	4.31
1	4.97	2.24	-3.45	0.67	-0.26	6.91	7.01	1755.21	7603.40	4.33
1	4.52	2.24	-3.00	0.70	-0.10	5.65	5.74	1394.36	6040.74	4.33
1	6.31	2.24	-3.45	0.67	0.14	9.49	9.52	2407.49	10493.22	4.35
1	4.52	2.24	-3.45	0.67	-0.38	6.10	6.24	1556.60	6811.74	4.37
1	5.87	2.24	-3.90	0.65	-0.29	9.26	9.33	2407.59	10634.66	4.41
1	6.76	2.24	-3.45	0.67	0.28	10.40	10.42	2627.63	11623.73	4.42

REA Analysis

Project: EAST TOWN CROSSING PIONEER IMPROVEMENTS
 Location: PUYALLUP, WA
 Designer: rjr
 Date: 3/24/2025
 Section: Wall 2, S_44.0_to_85.0
 Design Method: NCMA_09_3rd_Ed, Ignore Vert. Force
 Design Unit: GeoWall Plus 4.0: PL

Seismic Acc: 0.400g
 Design Method: AASHTO 2020, Kavazanjian
 Design Equation: AASHTO 2020, A11.5.1-1



SOIL PARAMETERS	Φ	coh	γ
Reinforced Soil:	32 deg	0 lbf/ft ²	120 lbf/ft ³
Retained Soil:	32 deg	0 lbf/ft ²	120 lbf/ft ³
Foundation Soil:	32 deg	50 lbf/ft ²	120 lbf/ft ³
Leveling Pad:	40 deg	0 lbf/ft ²	135 lbf/ft ³
Leveling Pad:	Crushed Stone		

GEOMETRY

Design Height:	2.57 ft (1.70 ft Exp.)	Live Load:	100	Live Load 2:	
Wall Batter/Tilt:	0.00/ 0.00 deg	Live Load Offset:	1.00 ft	LL2 Offset:	10 ft
Embedment:	0.87 ft	Live Load Width:	9 ft	LL2 Width:	25 ft
Leveling Pad Depth:	0.50 ft	Dead Load:	0 lbf/ft2		
Back Slope Angle:	0.0 deg	Dead Load Offset:	0.0 ft		
Back Slope Length:	0.0 ft	Dead Load Width:	0.00 ft		
Back Slope Toe Offset:	0.0 ft				
Vertical δ on Single Depth					

FACTORS OF SAFETY (Static / Seismic)

Sliding:	1.50 / 1.13	Pullout:	1.50 / 1.13
Overturning:	2.00 / 1.50	Tension/Uncertainties:	1.50 / 1.13
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.13
Unit/Unit Shear:	1.50 / 1.13		

RESULTS (Static / Seismic)

FoS Sliding:	5.40 / [3.47]	FoS Overturning:	19.88 / [9.80]
Bearing	421 / [347]	FoS Bearing:	27.20 / [33.38]
FoS Pullout	4.08 / [2.58]		
Total Pullout	308	FoS Total Pullout	2.88
Total Pullout (S)	308	FoS Total Pullout (S)	2.62
Top FoSot:	6.95	FoS Connection:	15.53

ID	Height	Length	Name	Ta _{tn} [Ta _{tns}]	Rc %	TMax [Tmd]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS SeisPO	FS Sldg
1	1.33	4	3XT	1330 [2893]	100	104 [44]	19.20 [19.55]	853 [1138]	12.32 [10.70]	2.97 [2.58]	21.27 [17.25]

Column Descriptions:

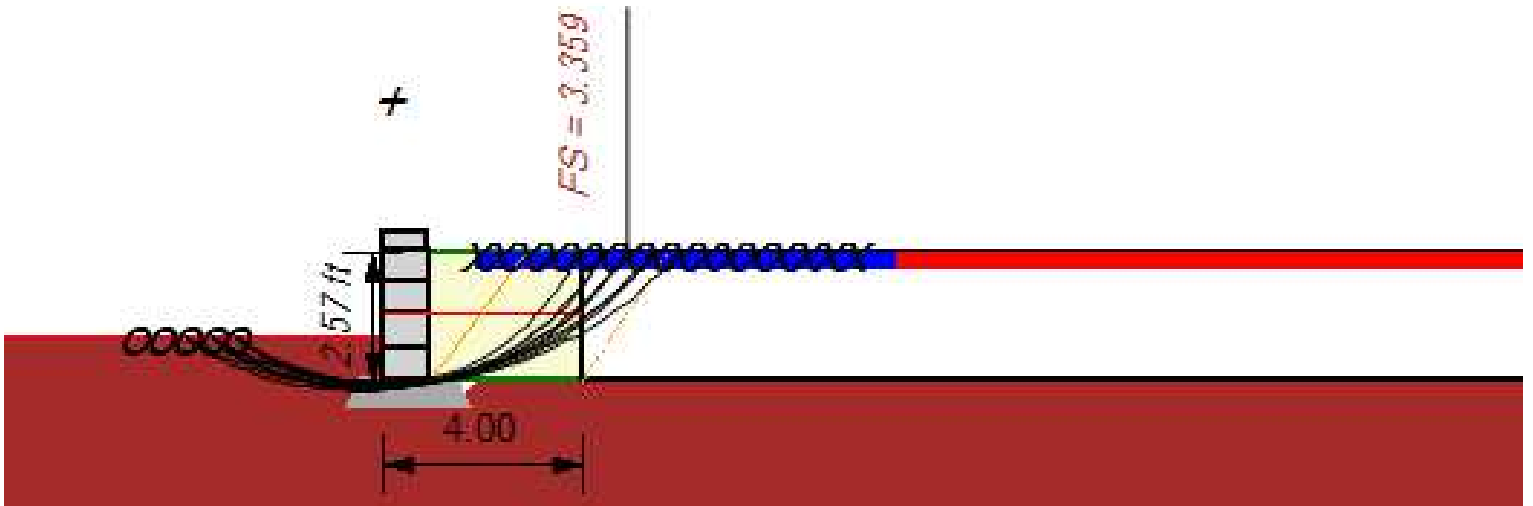
- Ta: allowable geogrid strength
- Rc %: percent coverage for geosynthetics
- EP (Pa) internal active earth pressure
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AASHTO design methodology (Simplified or Stiffness) the connection load, T_o, is equal to the T_{max} in the reinforcing. In Limit equilibrium the the connection load (T_o) is less than the T_{max} in the reinforcing layer as it is calculated at each layer of reinforcing, similar to the Trial Wedge Method using in REA software.

ID	Height	Length	Name	%Coverage	Pa	LL	LL2	Tcn	TaCn	FSPkCn
1	1.33	4	3XT	100	76	28	0	82	1280	15.53



GLOBAL RESULTS

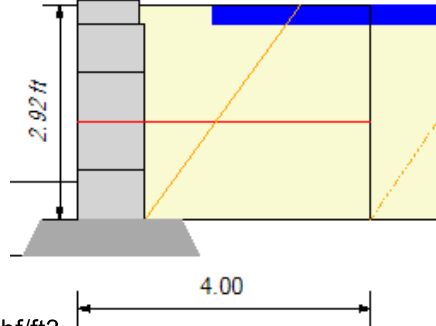
Global stability is a global analysis (Bishop) with the failure planes originating at the top of the slope / wall and exiting out below the wall in the area in front of the structure. For MSE walls, the resistance of the geogrid reinforcement is included in the resisting forces. The curve may go through 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	Mo	Mr	FoS
1	4.92	2.57	-3.00	0.87	0.12	5.65	5.70	1736.84	5851.75	3.36
1	4.40	2.57	-3.00	0.87	-0.04	4.95	5.04	1517.22	5182.67	3.41
1	4.92	2.57	-3.51	0.87	-0.18	6.11	6.21	1941.83	6759.10	3.48
1	3.89	2.57	-3.00	0.87	-0.19	4.28	4.42	1298.78	4534.22	3.49
1	5.43	2.57	-3.00	0.87	0.28	6.37	6.41	1963.48	6924.94	3.52
1	5.43	2.57	-3.51	0.87	-0.03	6.91	6.97	2202.39	7783.79	3.53
1	4.40	2.57	-3.51	0.87	-0.33	5.35	5.49	1686.57	6093.99	3.61
1	5.43	2.57	-4.03	0.87	-0.32	7.43	7.53	2415.35	8794.41	3.64
1	5.95	2.57	-3.51	0.87	0.13	7.73	7.77	2468.76	9071.94	3.67
1	4.92	2.57	-4.03	0.87	-0.48	6.57	6.71	2132.29	7835.94	3.67

REA Analysis

Project: EAST TOWN CROSSING PIONEER IMPROVEMENTS
 Location: PUYALLUP, WA
 Designer: rjr
 Date: 3/24/2025
 Section: Wall 3, S_8.0_to_40.0
 Design Method: NCMA_09_3rd_Ed, Ignore Vert. Force
 Design Unit: GeoWall Plus 4.0: PL

Seismic Acc: 0.400g
 Design Method: AASHTO 2020, Kavazanjian
 Design Equation: AASHTO 2020, A11.5.1-1



SOIL PARAMETERS	Φ	coh	γ
Reinforced Soil:	32 deg	0 lbf/ft ²	120 lbf/ft ³
Retained Soil:	32 deg	0 lbf/ft ²	120 lbf/ft ³
Foundation Soil:	32 deg	50 lbf/ft ²	120 lbf/ft ³
Leveling Pad:	40 deg	0 lbf/ft ²	135 lbf/ft ³
Leveling Pad:	Crushed Stone		

GEOMETRY

Design Height:	2.92 ft (2.42 ft Exp.)	Live Load:	100 lbf/ft ²
Wall Batter/Tilt:	0.00/ 0.00 deg	Live Load Offset:	1.00 ft
Embedment:	0.50 ft	LL2 Width:	9 ft
Leveling Pad Depth:	0.50 ft	Dead Load:	0 lbf/ft ²
Back Slope Angle:	0.0 deg	Dead Load Offset:	0.0 ft
Back Slope Length:	0.0 ft	Dead Load Width:	0.00 ft
Back Slope Toe Offset:	0.0 ft		
Vertical δ on Single Depth			

FACTORS OF SAFETY (Static / Seismic)

Sliding:	1.50 / 1.13	Pullout:	1.50 / 1.13
Overturning:	2.00 / 1.50	Tension/Uncertainties:	1.50 / 1.13
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.13
Unit/Unit Shear:	1.50 / 1.13		

RESULTS (Static / Seismic)

FoS Sliding:	4.83 / [3.04]	FoS Overturning:	15.88 / [7.77]
Bearing	454 / [360]	FoS Bearing:	22.58 / [28.80]
FoS Pullout	5.21 / [3.15]		
Total Pullout	403	FoS Total Pullout	2.89
Total Pullout (S)	403	FoS Total Pullout (S)	2.70
Top FoSot:	2.92	FoS Connection:	15.15

ID	Height	Length	Name	Ta _{tn} [Ta _{tns}]	Rc %	TMax [Tmd]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS SeisPO	FS Sldg
1	1.33	4	3XT	1330 [2893]	100	108 [50]	18.39 [18.21]	853 [1138]	11.80 [10.02]	3.71 [3.15]	15.70 [12.50]

Column Descriptions:

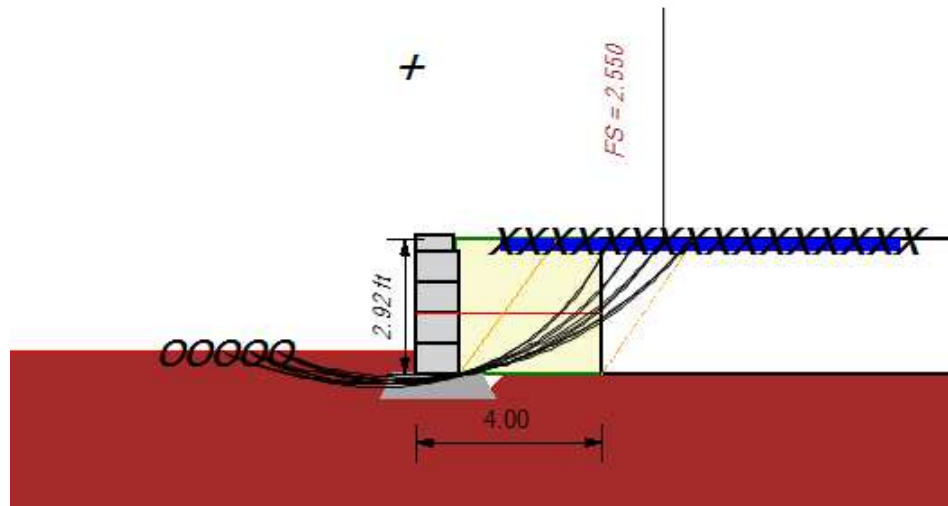
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Rc %: percent coverage for geosynthetics
EP (Pa) internal active earth pressure
LL (Pql) earth pressure due to live load surcharge
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ID	Height	Length	Name	%Coverage	Pa	LL	Tcn	TaCn	FSPkCn
1	1.33	4	3XT	100	77	31	84	1280	15.15



GLOBAL RESULTS

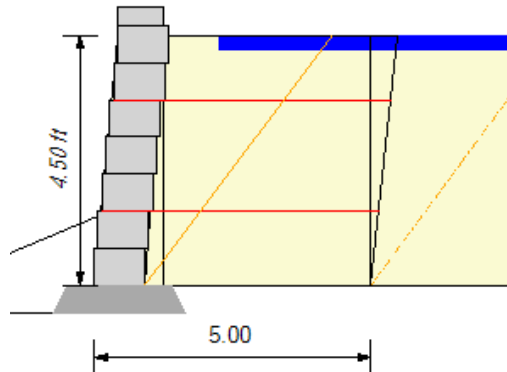
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ID	Enter Point X	Enter Point Y	Exit Point X	Exit Point Y	Center X	Center Y	Radius	Mo	Mr	FoS
1	5.34	2.92	-3.00	0.50	-0.24	6.55	6.65	2936.42	7510.40	2.55
1	4.75	2.92	-3.00	0.50	-0.35	5.65	5.79	2510.15	6490.26	2.58
1	5.92	2.92	-3.00	0.50	-0.11	7.52	7.59	3390.23	8871.85	2.61
1	4.17	2.92	-3.00	0.50	-0.46	4.81	5.00	2115.71	5555.36	2.62
1	5.92	2.92	-3.58	0.50	-0.46	8.11	8.23	3751.54	9933.69	2.64
1	5.34	2.92	-3.58	0.50	-0.58	7.07	7.22	3263.43	8656.45	2.65
1	5.34	2.92	-4.17	0.50	-0.91	7.57	7.78	3574.06	9558.25	2.67
1	4.75	2.92	-3.58	0.50	-0.69	6.09	6.29	2796.17	7562.12	2.70
1	5.92	2.92	-4.17	0.50	-0.80	8.68	8.85	4104.53	11200.95	2.72
1	4.17	2.92	-3.58	0.50	-0.79	5.17	5.44	2366.39	6463.50	2.72

REA Analysis

Project: EAST TOWN CROSSING PIONEER IMPROVEMENTS
 Location: PUYALLUP, WA
 Designer: rjr
 Date: 3/24/2025
 Section: Wall 4, S_20.0_to_23.0
 Design Method: NCMA_09_3rd_Ed, Ignore Vert. Force
 Design Unit: GeoWall Plus 4.0: PL

Seismic Acc: 0.400g
 Design Method: AASHTO 2020, Kavazanjian
 Design Equation: AASHTO 2020, A11.5.1-1



SOIL PARAMETERS	ϕ	coh	γ
Reinforced Soil:	32 deg	0 lbf/ft ²	120 lbf/ft ³
Retained Soil:	32 deg	0 lbf/ft ²	120 lbf/ft ³
Foundation Soil:	32 deg	50 lbf/ft ²	120 lbf/ft ³
Leveling Pad:	40 deg	0 lbf/ft ²	135 lbf/ft ³
Leveling Pad:	Crushed Stone		

GEOMETRY

Design Height:	4.50 ft (3.28 ft Exp.)	Live Load:	100 lbf/ft ²
Wall Batter/Tilt:	6.20/ 0.00 deg	Live Load Offset:	1.00 ft
Embedment:	1.22 ft	LL2 Width:	10 ft
Leveling Pad Depth:	0.50 ft	Dead Load:	0 lbf/ft ²
Back Slope Angle:	0.0 deg	Dead Load Offset:	0.0 ft
Back Slope Length:	0.0 ft	Dead Load Width:	0.00 ft
Back Slope Toe Offset:	0.0 ft		
Vertical δ on Single Depth		Toe Slope Angle:	40.40 deg
		Toe Slope Length:	1.98 ft
		Toe Slope Bench:	0.00 ft

FACTORS OF SAFETY (Static / Seismic)

Sliding:	1.50 / 1.13	Pullout:	1.50 / 1.13
Overturning:	2.00 / 1.50	Tension/Uncertainties:	1.50 / 1.13
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.13
Unit/Unit Shear:	1.50 / 1.13		

RESULTS (Static / Seismic)

FoS Sliding:	5.12 / [3.03]	FoS Overturning:	14.41 / [7.00]
Bearing	645 / [567]	FoS Bearing:	21.99 / [25.49]
FoS Pullout	4.28 / [2.05]		
Total Pullout	1,495	FoS Total Pullout	5.30
Total Pullout (S)	1,495	FoS Total Pullout (S)	4.60
Top FoSot:	12.61	FoS Connection:	8.96

ID	Height	Length	Name	Ta _{tn} [Ta _{tns}]	Rc %	TMax [Tmd]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS SeisPO	FS Sldg
2	3.33	5	3XT	1330 [2893]	100	96 [69]	20.83 [17.55]	853 [1138]	13.36 [9.68]	2.83 [2.05]	27.08 [22.02]
1	1.33	5	3XT	1330 [2893]	100	160 [53]	12.50 [13.59]	922 [1229]	8.66 [7.36]	7.67 [6.52]	10.06 [7.50]

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
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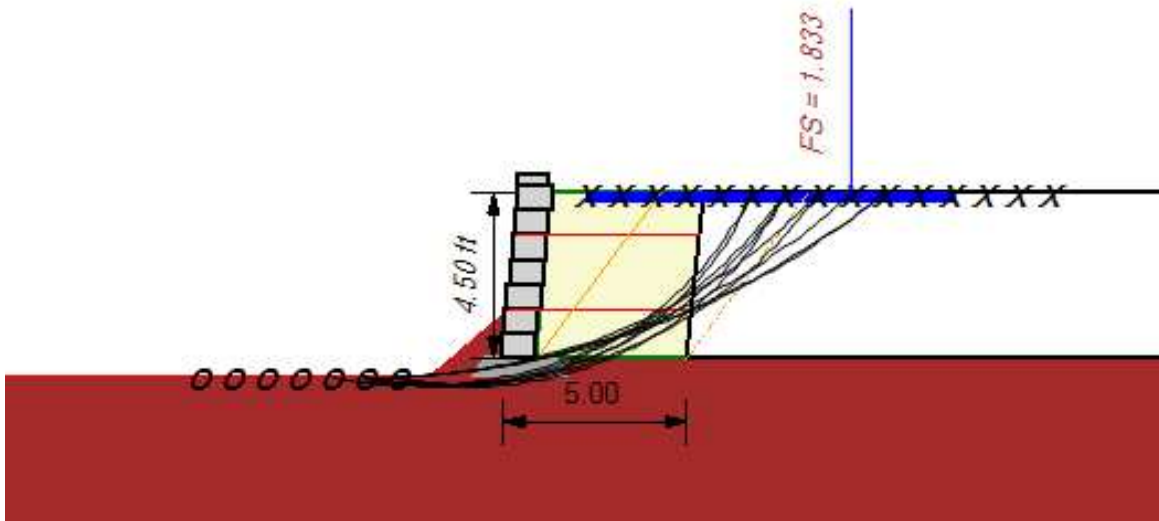
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ID	Height	Length	Name	%Coverage	Pa	LL	Tcn	TaCn	FSPkCn
2	3.33	5	3XT	100	63	33	63	1280	20.26
1	1.33	5	3XT	100	135	25	154	1382	8.96

+



GLOBAL RESULTS

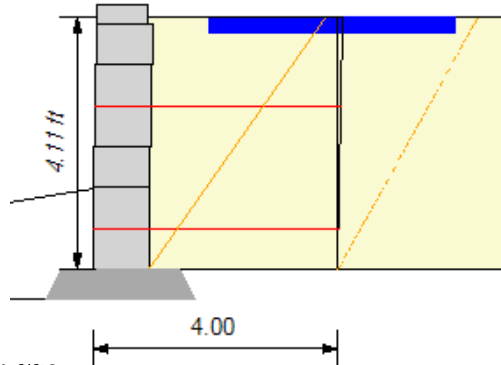
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ID	Enter Point X	Enter Point Y	Exit Point X	Exit Point Y	Center X	Center Y	Radius	Mo	Mr	FoS
1	9.47	4.50	-2.87	-0.47	-3.26	18.32	18.79	22146.50	40808.53	1.83
2	7.67	4.50	-2.87	-0.47	-0.79	8.78	9.48	12243.73	22848.33	1.86
2	6.77	4.50	-2.87	-0.47	-0.96	7.66	8.34	10275.98	19178.54	1.86
1	8.57	4.50	-2.87	-0.47	-2.88	15.21	15.68	18185.12	34250.68	1.87
2	6.77	4.50	-3.77	-0.47	-1.69	8.78	9.48	11568.73	21933.03	1.89
2	7.67	4.50	-3.77	-0.47	-1.52	10.01	10.71	13748.89	26255.52	1.90
1	10.37	4.50	-3.77	-0.47	-3.61	21.68	22.15	26460.05	50592.97	1.91
2	7.67	4.50	-4.67	-0.47	-2.25	11.34	12.05	15172.95	29130.06	1.91
2	8.57	4.50	-3.77	-0.47	-1.35	11.34	12.05	16136.01	31019.87	1.92
1	10.37	4.50	-2.87	-0.47	-3.70	21.88	22.36	26752.47	51445.64	1.92

REA Analysis

Project: EAST TOWN CROSSING PIONEER IMPROVEMENTS
 Location: PUYALLUP, WA
 Designer: rjr
 Date: 3/24/2025
 Section: Wall 5, S_43.0_to_51.0
 Design Method: NCMA_09_3rd_Ed, Ignore Vert. Force
 Design Unit: GeoWall Plus 4.0: PL

Seismic Acc: 0.400g
 Design Method: AASHTO 2020, Kavazanjian
 Design Equation: AASHTO 2020, A11.5.1-1



SOIL PARAMETERS	Φ	coh	γ
Reinforced Soil:	32 deg	0 lbf/ft ²	120 lbf/ft ³
Retained Soil:	32 deg	0 lbf/ft ²	120 lbf/ft ³
Foundation Soil:	32 deg	50 lbf/ft ²	120 lbf/ft ³
Leveling Pad:	40 deg	0 lbf/ft ²	135 lbf/ft ³
Leveling Pad:	Crushed Stone		

GEOMETRY

Design Height:	4.11 ft (2.80 ft Exp.)	Live Load:	100 lbf/ft ²
Wall Batter/Tilt:	1.00/ 0.00 deg	Live Load Offset:	1.00 ft
Embedment:	1.31 ft	LL2 Width:	4 ft
Leveling Pad Depth:	0.50 ft	Dead Load:	0 lbf/ft ²
Back Slope Angle:	0.0 deg	Dead Load Offset:	0.0 ft
Back Slope Length:	0.0 ft	Dead Load Width:	0.00 ft
Back Slope Toe Offset:	0.0 ft		
Vertical δ on Single Depth		Toe Slope Angle:	35.80 deg
		Toe Slope Length:	0.90 ft
		Toe Slope Bench:	0.00 ft

FACTORS OF SAFETY (Static / Seismic)

Sliding:	1.50 / 1.13	Pullout:	1.50 / 1.13
Overturning:	2.00 / 1.50	Tension/Uncertainties:	1.50 / 1.13
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.13
Unit/Unit Shear:	1.50 / 1.13		

RESULTS (Static / Seismic)

FoS Sliding:	4.15 / [2.50]	FoS Overturning:	9.69 / [4.71]
Bearing	644 / [557]	FoS Bearing:	19.61 / [23.47]
FoS Pullout	2.44 / [1.32]		
Total Pullout	1,304	FoS Total Pullout	4.82
Total Pullout (S)	1,304	FoS Total Pullout (S)	4.57
Top FoSot:	4.27	FoS Connection:	9.88

ID	Height	Length	Name	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS SeisPO	FS Sldg
2	2.67	4	3XT	1330 [2893]	100	130 [76]	15.37 [14.06]	876 [1168]	10.12 [7.93]	1.68 [1.32]	17.92 [14.76]
1	0.67	4	3XT	1330 [2893]	100	146 [41]	13.62 [15.39]	944 [1259]	9.67 [8.53]	7.41 [6.54]	7.43 [5.64]

Column Descriptions:

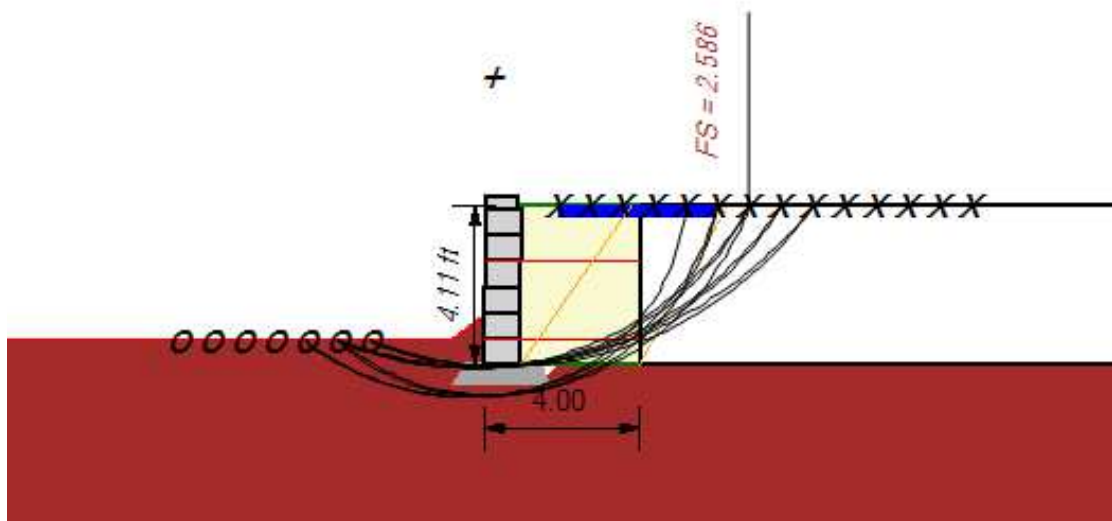
- Ta: allowable geogrid strength
- Rc %: percent coverage for geosynthetics
- EP (Pa) internal active earth pressure
- LL (Pql) earth pressure due to live load surcharge
- DL (Pqd) earth pressure due to dead load surcharge
- Tmax maximum earth pressure on geosynthetic layer
- FSstr factor of safety on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

CONNECTION RESULTS TABLE

Connection results compare the load on the connection (pullout at the face) to the resistance of the connection. In the NCMA design methodology the connection load accounts for the loading 'over the active zone' in the failure plane from each reinforcing layer. Note that live load (LL) in T_{max} for the reinforcing layer is the load calculated from the base of the wall and maybe larger then LL for the connection (T_{cn})

AASHTO design methodology (Simplified or Stiffness) the connection load, T_o, is equal to the T_{max} in the reinforcing. In Limit equilibrium the the connection load (T_o) is less than the T_{max} in the reinforcing layer as it is calculated at each layer of reinforcing, similar to the Trial Wedge Method using in REA software.

ID	Height	Length	Name	%Coverage	Pa	LL	Tcn	TaCn	FSPkCn
2	2.67	4	3XT	100	90	40	99	1314	13.25
1	0.67	4	3XT	100	125	22	143	1417	9.88



GLOBAL RESULTS

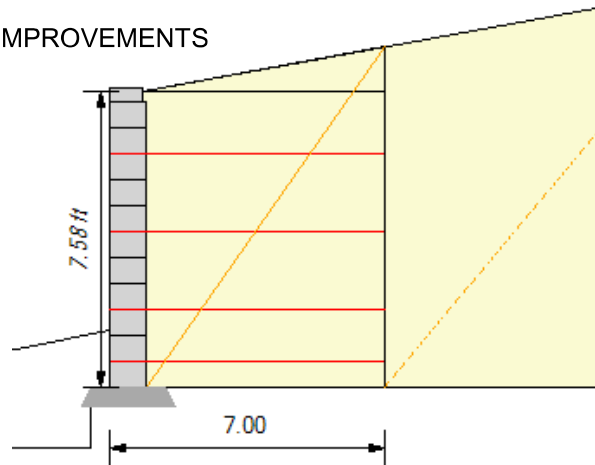
Global stability is a global analysis (Bishop) with the failure planes originating at the top of the slope / wall and exiting out below the wall in the area in front of the structure. For MSE walls, the resistance of the geogrid reinforcement is included in the resisting forces. The curve may go through 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	Mo	Mr	FoS
1	6.82	4.11	-2.98	0.66	0.17	7.38	7.42	6026.69	15626.69	2.59
1	8.47	4.11	-3.80	0.66	0.01	10.66	10.70	9317.17	24240.40	2.59
2	6.00	4.11	-3.80	0.66	0.11	5.21	6.00	5605.16	14622.68	2.60
1	7.65	4.11	-2.98	0.66	0.35	8.48	8.50	7054.78	18408.56	2.60
1	8.47	4.11	-2.98	0.66	0.55	9.66	9.67	8102.53	21310.10	2.62
1	6.82	4.11	-3.80	0.66	-0.35	8.12	8.22	6941.72	18266.64	2.62
2	6.82	4.11	-4.62	0.66	-0.18	6.65	7.45	7543.34	19885.62	2.63
2	6.00	4.11	-4.62	0.66	-0.45	5.90	6.70	6491.68	17124.53	2.63
2	5.18	4.11	-3.80	0.66	-0.15	4.58	5.35	4740.81	12539.34	2.64
1	7.65	4.11	-3.80	0.66	-0.18	9.35	9.42	8082.00	21413.12	2.64

REA Analysis

Project: EAST TOWN CROSSING PIONEER IMPROVEMENTS
 Location: PUYALLUP, WA
 Designer: rjr
 Date: 3/24/2025
 Section: Wall 6, S_25.0_to_29.0
 Design Method: NCMA_09_3rd_Ed, Ignore Vert. Force
 Design Unit: GeoWall Plus 4.0: PL

Seismic Acc: 0.400g
 Design Method: AASHTO 2020, Kavazanjian
 Design Equation: AASHTO 2020, A11.5.1-1



SOIL PARAMETERS	Φ	coh	γ
Reinforced Soil:	32 deg	0 lbf/ft ²	120 lbf/ft ³
Retained Soil:	32 deg	0 lbf/ft ²	120 lbf/ft ³
Foundation Soil:	32 deg	50 lbf/ft ²	120 lbf/ft ³
Leveling Pad:	40 deg	0 lbf/ft ²	135 lbf/ft ³
Leveling Pad:	Crushed Stone		

GEOMETRY

Design Height:	7.58 ft (6.12 ft Exp.)	Live Load:	0 lbf/ft ²
Wall Batter/Tilt:	0.00/ 0.00 deg	Live Load Offset:	0.00 ft
Embedment:	1.46 ft	LL2 Width:	0 ft
Leveling Pad Depth:	0.50 ft	Dead Load:	0 lbf/ft ²
Back Slope Angle:	10.4 deg	Dead Load Offset:	0.0 ft
Back Slope Length:	21.0 ft	Dead Load Width:	0.00 ft
Back Slope Toe Offset:	0.0 ft		
Vertical δ on Single Depth		Toe Slope Angle:	11.50 deg
		Toe Slope Length:	14.70 ft
		Toe Slope Bench:	0.00 ft

FACTORS OF SAFETY (Static / Seismic)

Sliding:	1.50 / 1.13	Pullout:	1.50 / 1.13
Overturning:	2.00 / 1.50	Tension/Uncertainties:	1.50 / 1.13
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.13
Unit/Unit Shear:	1.50 / 1.13		

RESULTS (Static / Seismic)

FoS Sliding:	3.51 / [2.09]	FoS Overturning:	6.78 / [3.75]
Bearing	1,138 / [1,148]	FoS Bearing:	14.92 / [16.26]
FoS Pullout	4.91 / [2.00]		
Total Pullout	10,914	FoS Total Pullout	10.08
Total Pullout (S)	10,914	FoS Total Pullout (S)	8.88
Top FoSot:	3.57	FoS Connection:	4.80

ID	Height	Length	Name	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS SeisPO	FS Sldg
4	6	7	3XT	1330 [2893]	100	117 [170]	17.07 [10.08]	876 [1168]	11.25 [4.58]	4.91 [2.00]	13.69 [11.67]
3	4	7	3XT	1330 [2893]	100	251 [132]	7.94 [7.55]	944 [1259]	5.64 [3.70]	6.91 [4.53]	7.44 [5.74]
2	2	7	3XT	1330 [2893]	100	317 [110]	6.30 [6.78]	1013 [1350]	4.80 [3.56]	11.14 [8.27]	5.10 [3.76]
1	0.67	7	3XT	1330 [2893]	100	237 [66]	8.42 [9.55]	1058 [1411]	6.70 [5.24]	21.42 [16.76]	4.21 [3.05]

Column Descriptions:

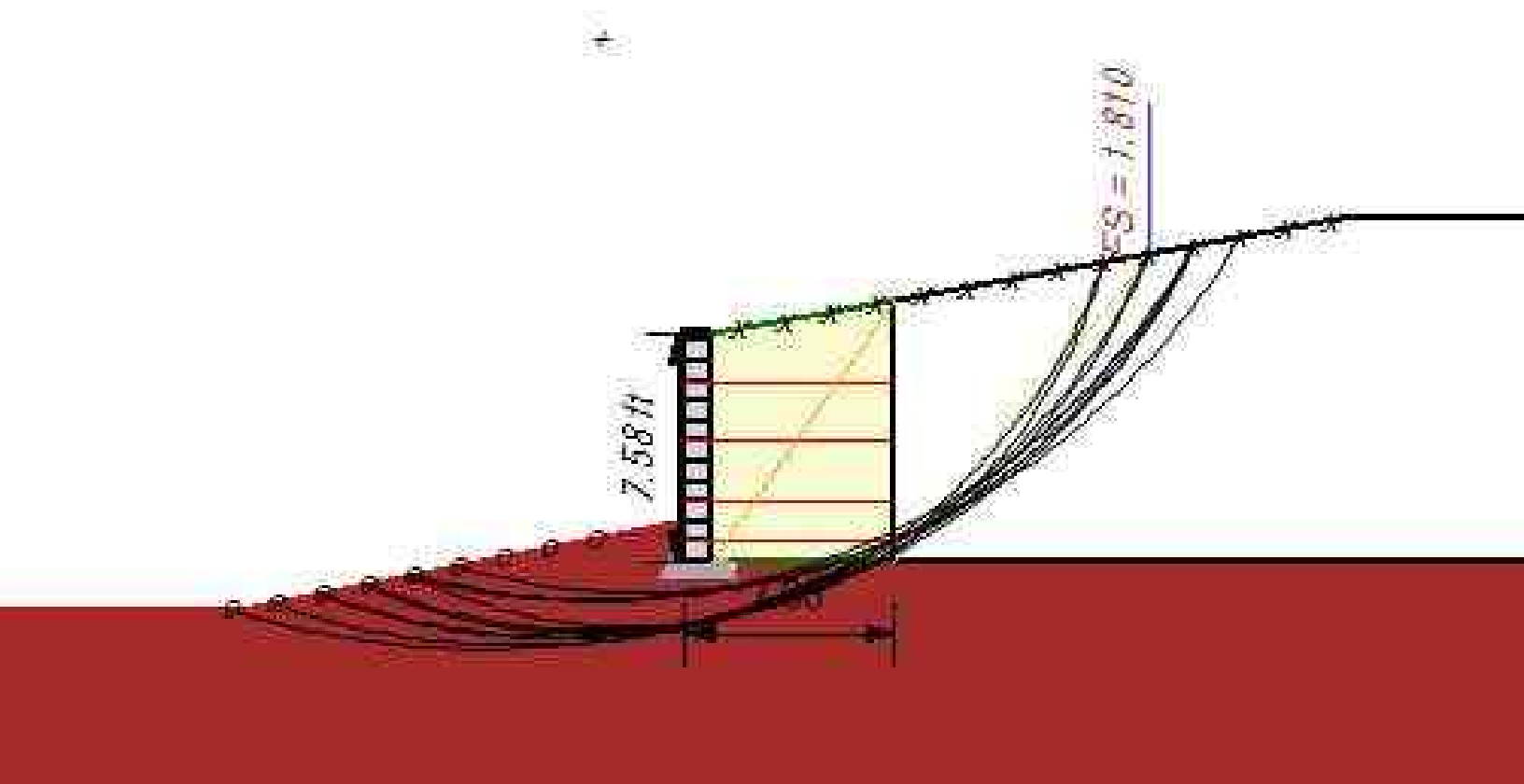
Ta: allowable geogrid strength
Rc %: percent coverage for geosynthetics
EP (Pa) internal active earth pressure
LL (Pql) earth pressure due to live load surcharge
DL (Pqd) earth pressure due to dead load surcharge
Tmax maximum earth pressure on geosynthetic layer
FSstr factor of safety on geogrid strength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

CONNECTION RESULTS TABLE

Connection results compare the load on the connection (pullout at the face) to the resistance of the connection. In the NCMA design methodology the connection load accounts for the loading 'over the active zone' in the failure plane from each reinforcing layer. Note that live load (LL) in T_{max} for the reinforcing layer is the load calculated from the base of the wall and maybe larger then LL for the connection (T_{cn})

AASHTO design methodology (Simplified or Stiffness) the connection load, T_o, is equal to the T_{max} in the reinforcing. In Limit equilibrium the the connection load (T_o) is less than the T_{max} in the reinforcing layer as it is calculated at each layer of reinforcing, similar to the Trial Wedge Method using in REA software.

ID	Height	Length	Name	%Coverage	Pa	Tcn	TaCn	FSPkCn
4	6	7	3XT	100	117	117	1314	11.25
3	4	7	3XT	100	251	251	1417	5.64
2	2	7	3XT	100	317	317	1519	4.80
1	0.67	7	3XT	100	237	237	1588	6.70



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 in front 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	Mo	Mr	FoS
3	15.48	10.27	-10.58	-0.69	-2.84	17.37	19.65	114910.75	208829.15	1.81
3	18.51	10.82	-9.06	-0.38	-2.68	23.42	24.65	139167.99	252837.93	1.81
3	16.99	10.55	-13.61	-1.31	-5.33	22.75	25.44	163446.58	298803.77	1.82
3	16.99	10.55	-7.55	-0.08	-1.39	19.35	20.38	106748.44	195665.28	1.83
3	16.99	10.55	-15.13	-1.53	-6.65	24.66	27.53	176633.63	324165.23	1.83
3	16.99	10.55	-12.10	-1.00	-3.97	20.95	23.41	147996.31	271720.56	1.83
3	13.96	9.99	-9.06	-0.38	-1.78	14.18	16.29	87375.18	160545.16	1.83
3	16.99	10.55	-9.06	-0.38	-2.79	21.18	22.46	121238.22	222829.40	1.83
3	15.48	10.27	-12.10	-1.00	-4.17	18.97	21.48	129006.72	237460.32	1.83
3	13.96	9.99	-10.58	-0.69	-3.07	15.58	17.92	99137.18	182527.54	1.83

REA Analysis

Project: EAST TOWN CROSSING PIONEER IMPROVEMENTS

Location: PUYALLUP, WA

Designer: rjr

Date: 3/24/2025

Section: Wall 7, W7 S_139.0_to_165.0

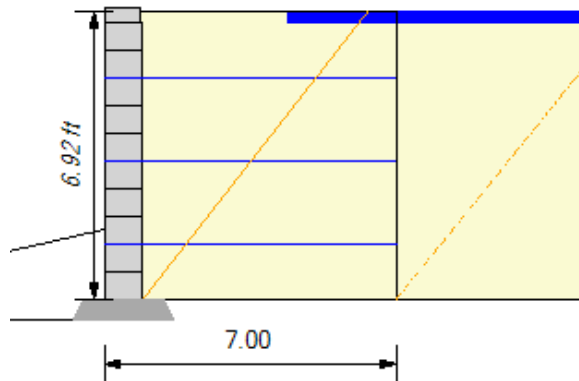
Design Method: NCMA_09_3rd_Ed, Ignore Vert. Force

Design Unit: GeoWall Plus 4.0: PL

Seismic Acc: 0.400g

Design Method: AASHTO 2020, Kavazanjian

Design Equation: AASHTO 2020, A11.5.1-1



SOIL PARAMETERS	Φ	coh	γ
Reinforced Soil:	32 deg	0 lbf/ft ²	120 lbf/ft ³
Retained Soil:	32 deg	0 lbf/ft ²	120 lbf/ft ³
Foundation Soil:	32 deg	50 lbf/ft ²	120 lbf/ft ³
Leveling Pad:	40 deg	0 lbf/ft ²	135 lbf/ft ³
Leveling Pad:	Crushed Stone		

GEOMETRY

Design Height:	6.92 ft (5.25 ft Exp.)	Live Load:	250 lbf/ft ²
Wall Batter/Tilt:	0.00/ 0.00 deg	Live Load Offset:	3.57 ft
Embedment:	1.67 ft	LL2 Width:	50 ft
Leveling Pad Depth:	0.50 ft	Dead Load:	0 lbf/ft ²
Back Slope Angle:	0.0 deg	Dead Load Offset:	0.0 ft
Back Slope Length:	0.0 ft	Dead Load Width:	0.00 ft
Back Slope Toe Offset:	0.0 ft		
Vertical δ on Single Depth		Toe Slope Angle:	12.50 deg
		Toe Slope Length:	4.49 ft
		Toe Slope Bench:	0.00 ft

FACTORS OF SAFETY (Static / Seismic)

Sliding:	1.50 / 1.13	Pullout:	1.50 / 1.13
Overturning:	2.00 / 1.50	Tension/Uncertainties:	1.50 / 1.13
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.13
Unit/Unit Shear:	1.50 / 1.13		

Remove note.
[Calcs; Pg 32 of 36]

Note: Calculations and quantities are for PRELIMINARY ANALYTICAL USE ONLY and MUST NOT be used for final design or construction without the independent review, verification, and approval by a qualified professional engineer.

REA Analysis 2025.1.19

RESULTS (Static / Seismic)

FoS Sliding:	5.63 / [2.79]	FoS Overturning:	15.83 / [5.76]
Bearing	1,019 / [931]	FoS Bearing:	18.82 / [20.75]
FoS Pullout	3.65 / [1.54]		
Total Pullout	5,241	FoS Total Pullout	6.82
Total Pullout (S)	5,241	FoS Total Pullout (S)	6.03
Top FoSot:	4.03	FoS Connection:	5.07

ID	Height	Length	Name	Ta_tn [Ta_tns]	TMax [Tmd]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS SeisPO	FS Sldg
3	5.33	7	3XT	1330 [2893]	156 [137]	12.77 [9.86]	853 [1138]	8.19 [5.40]	2.33 [1.54]	21.75 [17.14]
2	3.33	7	3XT	1330 [2893]	258 [106]	7.74 [7.95]	922 [1229]	5.36 [4.31]	5.81 [4.67]	10.06 [7.35]
1	1.33	7	3XT	1330 [2893]	306 [88]	6.52 [7.33]	990 [1320]	4.85 [4.14]	11.04 [9.43]	6.58 [4.66]

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 (LTDS/Tmax)
 Ta cn allowable tension on the connection
 FS Pkcn, factor of safety on the connection (PkCn/Tmax)
 FS PO, factor of safety on pullout (Pullout/(Tmax - LL)
 Grid Embedment, depth of embedment beyond the theoretical failure plane.

Remove note.
[Calcs; Pg 33 of 36]

Note: Calculations and quantities are for PRELIMINARY ANALYTICAL USE ONLY and MUST NOT be used for final design or construction without the independent review, verification, and approval by a qualified professional engineer.

REA Analysis 2025.1.19

CONNECTION RESULTS TABLE

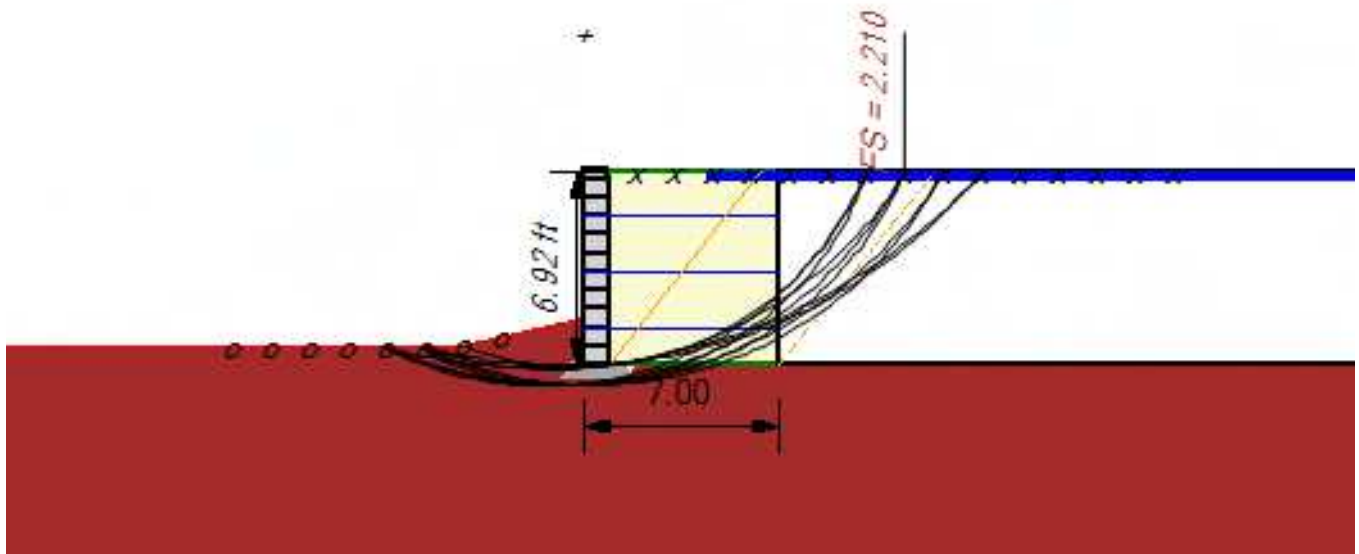
Connection results compare the load on the connection (pullout at the face) to the resistance of the connection. In the NCMA design methodology the connection load accounts for the loading 'over the active zone' in the failure plane from each reinforcing layer. Note that live load (LL) in T_{max} for the reinforcing layer is the load calculated from the base of the wall and maybe larger then LL for the connection (T_{cn})

AASHTO design methodology (Simplified or Stiffness) the connection load, T_o, is equal to the T_{max} in the reinforcing. In Limit equilibrium the the connection load (T_o) is less than the T_{max} in the reinforcing layer as it is calculated at each layer of reinforcing, similar to the Trial Wedge Method using in REA software.

ID	Height	Length	Name	Pa	LL	Tcn	TaCn	FSPkCn
3	5.33	7	3XT	100	56	100	1280	12.80
2	3.33	7	3XT	214	44	214	1382	6.45
1	1.33	7	3XT	270	36	293	1485	5.07

Remove note.
[Calcs; Pg 34 of 36]

Note: Calculations and quantities are for PRELIMINARY ANALYTICAL USE ONLY and MUST NOT be used for final n or construction without the independent review, verification, and approval by a qualified professional engineer.
REA Analysis 2025.1.19



Remove note.
[Calcs; Pg 35 of 36]

Note: Calculations and quantities are for PRELIMINARY ANALYTICAL USE ONLY and MUST NOT be used for final design or construction without the independent review, verification, and approval by a qualified professional engineer.

REA Analysis 2025.1.19

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 in front 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	Mo	Mr	FoS
2	11.52	6.92	-5.77	0.68	-0.03	11.85	12.56	33237.12	73705.76	2.21
2	11.52	6.92	-7.15	0.68	-1.02	13.39	14.12	38108.81	85575.67	2.24
2	12.91	6.92	-7.15	0.68	-0.63	15.06	15.79	43980.00	99760.47	2.26
2	10.14	6.92	-5.77	0.68	-0.42	10.43	11.12	28146.53	64048.25	2.27
1	11.52	6.92	-5.77	0.68	-0.99	14.51	14.64	35333.90	81650.08	2.30
1	10.14	6.92	-4.38	0.70	-0.30	11.23	11.29	25494.63	58942.37	2.31
1	14.29	6.92	-5.77	0.68	-0.52	19.16	19.22	48147.40	111777.37	2.31
2	10.14	6.92	-7.15	0.68	-1.41	11.85	12.56	32386.24	75419.60	2.32
1	14.29	6.92	-7.15	0.68	-1.40	20.86	20.98	53552.31	124751.90	2.32
2	12.91	6.92	-5.77	0.68	0.36	13.39	14.12	38495.16	89731.92	2.32

Remove note.
[Calcs; Pg 36 of 36]

Note: Calculations and quantities are for PRELIMINARY ANALYTICAL USE ONLY and MUST NOT be used for final design or construction without the independent review, verification, and approval by a qualified professional engineer.
REA Analysis 2025.1.19