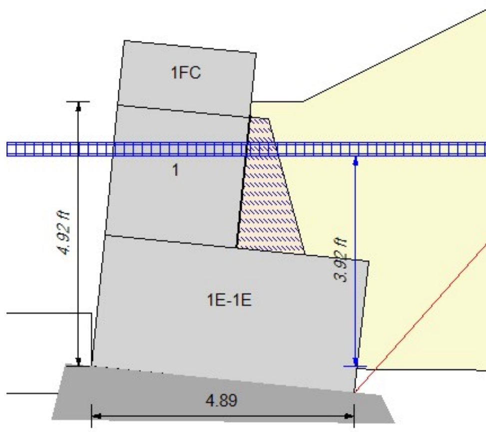
ULTRABLOCK, INC

PRRWF20241913 UltraWall



Project:	Centeris Voltage Park - North Pond
Location:	Puyallup, WA
Designer:	KDH
Date:	11/26/2024
Section:	5' Total H
Design Method:	AASHTO_LRFD_2020
Design Unit:	UltraBlock: 1

Seismic Acc: 0.250g

SOIL PARAMETERS	Φ	coh	γ
Retained Soil:	33 deg	0 lbf/ft2	125 lbf/ft3
Foundation Soil:	32 deg	0 lbf/ft2	120 lbf/ft3
Leveling Pad:	40 deg	0 lbf/ft2	140 lbf/ft3
Crushed Stone Lvlng Pad			

GEOMETRY

Design Height:	4.92 ft	Live Load:	0.00 lbf/ft2
Wall Batter/Tilt:	0.00/ 5.70 deg	Live Load Offset:	0.00 ft
Embedment:	1.00 ft*	Live Load Width:	0.00 ft
Leveling Pad Depth:	0.50 ft		
Slope Angle:	26.6 deg	Dead Load:	0.0 lbf/ft2
Slope Length:	30.0 ft	Dead Load Offset:	0.0 ft
Slope Toe Offset:	1.0 ft	Dead Load Width:	0.00 ft
Leveling Pad Width:	5.92 ft	D.L. Embedment:	0.00 ft

Vert δ on Single Dpth

* Note: For all designs the passive resistance in front of the wall units is ignored for sliding calculations.

Water

Front Height:	3.92 ft
Internal Ht:	3.92 ft
Drainage Depth:	1.00 ft

KEVEN D. HOFFMANN
STATE OF WASHINGTON
53734
REGISTERED
PROFESSIONAL ENGINEER

12/09/2024

City of Puyallup
Building
REVIEWED
FOR
COMPLIANCE
SKinnear
01/06/2025
10:20:45 AM
CITY OF PUYALLUP
STATE OF WASHINGTON

Calculations required to be provided by the Permittee on site for all Inspections

RESULTS (Static / Seismic)

CDR Sliding: 2.04 (lvlpd) / 1.54 CDR Brng: 1.71 / 4.36

Eccentricity (e/L): 0.26 (e/L <= 0.33) / [0.27 (e/L <= 0.40)] Bearing: 1338 / 955 / 1053 (Service)

Ecc Internal(e/L): 0.10 (e/L <= 0.45)

Name	Elev.	ka	kae	Pae	Paw1	Paw2	Paw3	Pif	Pwd	(Pwr)	PaT	PaTs	CDRsl	seisCDRsl	e/L	Seis e/L (Pae/Pir)
1FC	4.84	0.360	0.000	0	0	0	0	106	0	0	0	106	30247.69	73.14 / 36.62	0.03	0.00
1	2.42	0.254	0.254	87	0	0	59	260	70	-70	59	459	43.00	22.54 / 16.33	0.10	0.00
1E-1E	0.00	0.701	0.701	917	44	343	403	494	479	-479	791	2244	2.04	2.28 / 1.54	0.24	0.00

Column Descriptions:

ka: active earth pressure coefficient; kae: active seismic earth pressure coefficient

Paw1: active earth pressure of soils above the water line

Paw2: active earth pressures (1) of submerged soils below the water line

Paw3: active earth pressures (2) of submerged soils below the water line

Pwd: driving pressures of water from behind the face

Pwr: resisting pressures of water in front of wall

Pif: Inertia of the facing units, Pir: Inertia of the gravel fill behind the units.

Paq: live surcharge earth pressure

Paqd: dead surcharge earth pressure

(PaC): reduction in load due to cohesion

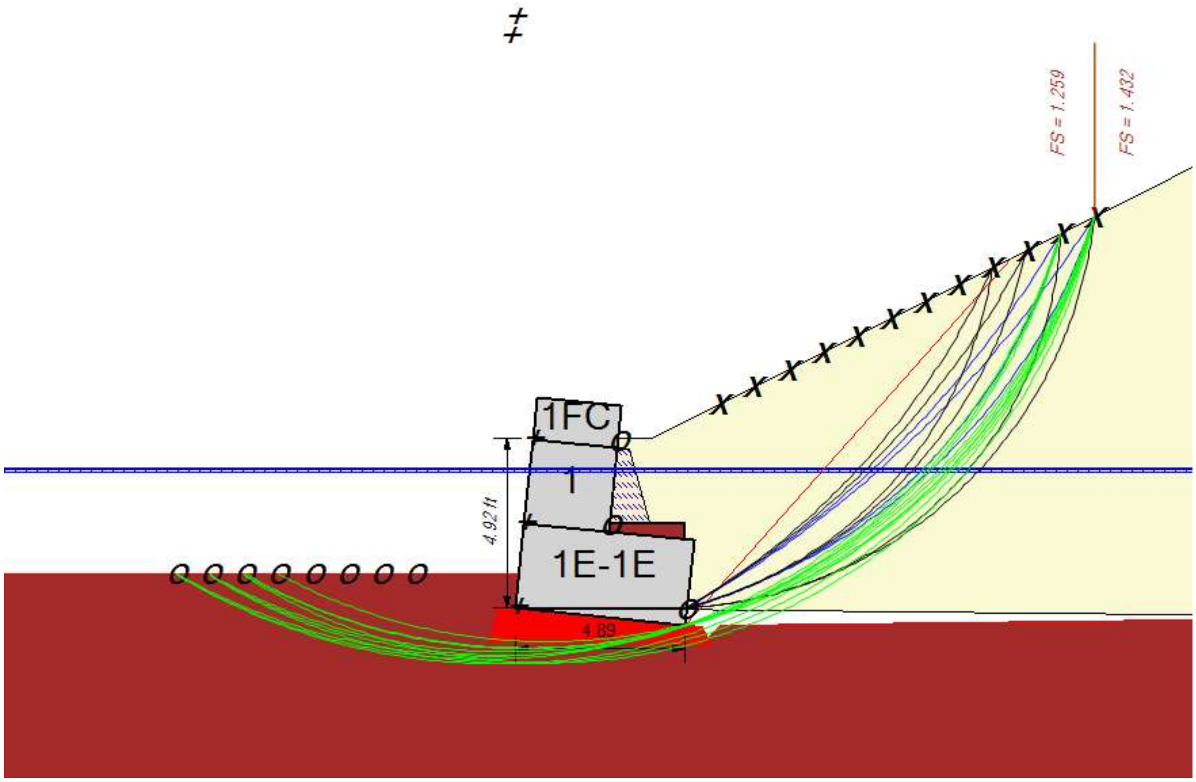
PaT: sum of all earth pressures

CDRsl (lvlPad): 'Capacity/Demand Ratio' for sliding at each layer. (CDR sliding below the leveling pad)

e/L: eccentricity/base width ratio

e/L (Srvs): service state condition eccentricity/base width ratio

%D/H: ratio of based depth to height (warning for narrow walls, < 35%)


FS = 1.259
FS = 1.432
1FC
1
4.92 ft
1E-1E
4.89

COMPOUND RESULTS

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

ID	Enter Point X	Enter Point Y	Exit Point X	Exit Point Y	Center X	Center Y	Radius	FoS
3	16.72	11.32	4.92	0.00	-0.06	16.99	17.71	1.43
2	16.72	11.32	4.92	0.00	-11.96	29.41	33.91	1.44
2	15.73	10.82	4.92	0.00	-10.02	25.75	29.77	1.49
3	15.73	10.82	4.92	0.00	0.68	15.05	15.63	1.49
4	16.72	11.32	4.92	0.00	4.15	12.61	12.64	1.54
2	14.75	10.33	4.92	0.00	-8.22	22.35	25.92	1.54
3	14.75	10.33	4.92	0.00	1.35	13.24	13.71	1.56
4	15.73	10.82	4.92	0.00	4.48	11.25	11.26	1.62
2	13.76	9.84	4.92	0.00	-6.56	19.22	22.38	1.62
3	13.76	9.84	4.92	0.00	1.95	11.57	11.94	1.64
2	12.78	9.35	4.92	0.00	-5.04	16.36	19.15	1.71
3	12.78	9.35	4.92	0.00	2.48	10.03	10.32	1.75
2	11.80	8.85	4.92	0.00	-3.66	13.76	16.21	1.84
2	10.81	8.36	4.92	0.00	-2.42	11.43	13.58	2.00
2	9.83	7.87	4.92	0.00	-1.32	9.36	11.25	2.22
2	8.84	7.37	4.92	0.00	-0.38	7.55	9.23	2.54
5	16.72	11.32	2.70	2.42	6.17	12.45	10.61	4.90
4	16.72	11.32	2.70	2.42	4.36	15.30	12.98	5.08
5	15.73	10.82	2.70	2.42	6.23	11.26	9.51	5.33
4	15.73	10.82	2.70	2.42	4.60	13.78	11.52	5.47

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	Mo	Mr	FoS
1	16.72	11.32	-8.80	1.00	-0.20	16.43	17.67	85197.97	106747.02	1.26
1	16.72	11.32	-7.82	1.00	0.36	15.87	16.97	81569.52	102034.43	1.26
1	16.72	11.32	-9.79	1.00	-0.75	16.99	18.37	89416.52	112833.33	1.27
2	16.72	11.32	-9.79	1.00	-0.51	16.36	17.95	90283.07	115276.75	1.29
2	16.72	11.32	-7.82	1.00	0.90	14.59	16.15	82923.74	106466.66	1.29
1	15.73	10.82	-8.80	1.00	-0.32	15.35	16.67	74846.82	96000.57	1.29
1	15.73	10.82	-7.82	1.00	0.24	14.82	16.00	71149.02	91315.94	1.29
2	16.72	11.32	-8.80	1.00	0.20	15.46	17.03	86213.28	110832.84	1.29
1	15.73	10.82	-9.79	1.00	-0.86	15.88	17.35	78742.61	101607.44	1.30
1	16.72	11.32	-6.84	1.00	0.94	15.30	16.27	77424.94	99857.91	1.30

DESIGN DATA
Load Factors for Design

AASHTO Table 3.4.1-1 & 3.4.1-2

Load Case	Str_Max	Str_Min	Extreme Max	Extreme Min	Service
Str I Dead Load (DC)	1.25	0.90	1.00	1.00	1.00
Soil Load Driving (EH)	1.50	0.90	1.00	1.00	1.00
Str I Vert Earth Load (EV)	1.35	1.00	1.00	1.00	1.00
Dead Load Surcharge (ES)	1.50	0.75	1.00	1.00	1.00
Live Load (LL, PL, LS)	1.75	0.00	1.00	0.00	1.00

Application of Load Factors

Group	DC	EV	LS	EH	Probable Use
Strength I-a	0.90	1.00	1.75	1.50	BC/EC/SL
Strength I-b	1.25	1.35	1.75	1.50	BC (max. value)
Service I	1.00	1.00	1.00	1.00	Settlement

Notes: BC - Bearing Capacity; EC - Eccentricity; SL - Sliding

By Inspection:

- Strength I-a (minimum vertical loads and maximum horizontal loads) will govern for the case of sliding and eccentricity (overturning); and
- For the case of bearing capacity, maximum vertical loads will govern, and the factored loads must be compared for Strength I-b.

DESIGN DATA
Load Factors for Design

MINIMUM DESIGN REQUIREMENTS

Minimum embedment depth	Min_emb = 1.00 ft

INPUT DATA
Geometry

Wall Geometry	
Design Height, top of leveling pad to finished grade at top of wall	H = 4.92 ft
Embedment, measured from top of leveling pad to finished grade	emb = 1.00 ft
Leveling Pad Depth	Thickness = 0.50 ft
Face Batter, measured from vertical	i = 0.00 deg
Slope Geometry	
Back Slope Angle, measured from horizontal	β = 26.60 deg
Back Slope Toe Offset, measured from back of the face unit	STL_offset = 1.00 ft
Back Slope Length, measured from toe to crest	SL_Length = 30.00 ft
NOTE: If the back slope toe is offset or the slope breaks within three times the wall height, a Coulomb Trial Wedge method of analysis is used.	
Toe Slope Angle, measured from horizontal	β = 0.00 deg
Toe Slope Crest Offset, measured from front of the face unit	STL_offset = 0.00 ft
Toe Slope Length, measured from crest to toe	SL_Length = 0.00 ft

Surcharge Loading	
Live Load, assumed transient loading (e.g. traffic)	LL = 0.00 lbf/ft2
Live Load Offset, measured from back face of wall	LL_offset = 0.00 ft
Live Load Width, assumed strip loading	LL_width = 0.00 ft

Soil Parameters

Retained Zone

Angle of Internal Friction	Φ = 33.00 deg
Cohesion	coh = 0.00 lbf/ft2
Moist Unit Weight	γ = 125.00 lbf/ft3

Foundation

Angle of Internal Friction	Φ = 32.00 deg
Cohesion	coh = 0.00 lbf/ft2
Moist Unit Weight	γ = 120.00 lbf/ft3

Leveling Pad

Angle of Internal Friction	Φ = 40.00 deg
Cohesion	coh = 0.00 lbf/ft2
Moist Unit Weight	γ = 140.00 lbf/ft3

RETAINING WALL UNITS

STRUCTURAL PROPERTIES:

N is the normal force [or factored normal load] on unit to unit interface
The unit to unit shear is N x Tan(0.0) + 3619.6

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(40), or 34 deg. [AASHTO LRFD 10.6.3.4-2] or may be the manufacturer supplied data.
[Note: concrete to concrete has a coefficient of Φ0.6 N.

Table of Values:

CALCULATION RESULTS

OVERVIEW

UltraWall 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 or live load break within the failure zone, a trial wedge method of analysis is used.

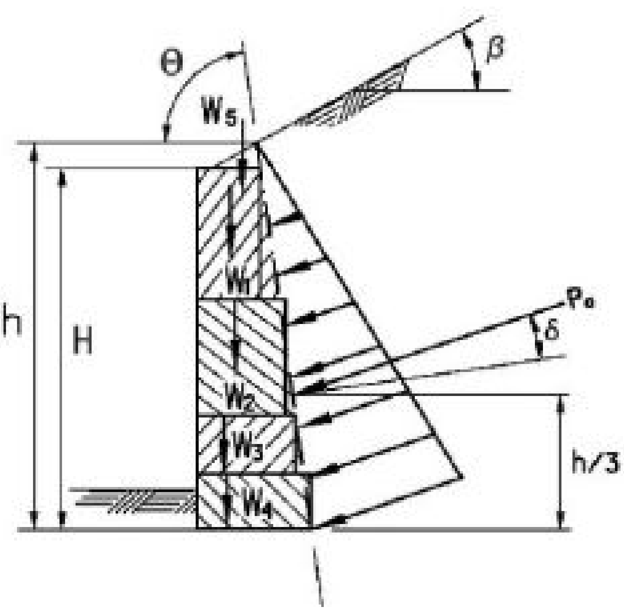
EXTERNAL EARTH PRESSURES

Effective δ angle (3/4 retained phi)	δ = 24.8 deg
Coefficient of active earth pressure	ka = 0.701
External failure plane	ρ = 47 deg
Back Face Angle from horizontal	θ = 69.14 deg
Coefficient of passive earth pressure	kp = 0.00

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

in which:

$$\Gamma = \left[\, 1+\sqrt{\frac{\sin(\phi'_f+\delta)\sin(\phi'_f-}{\sin(\theta-\delta)\sin(\theta+\beta}} \right.$$



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 Infill Wt	Soil Wedge Wt
1	423.04	0.00	0.47
2 w	616.29	0.00	174.56
3 w	937.94	0.00	

Block Weight = 1977.26 lbf/ft X-Arm = 3.86 ft
Soil Infill Weight = 0.00 lbf/ft X-Arm = 0.00 ft
Soils Wedge Weight = 175.04 lbf/ft X-Arm = 3.47 ft

Active Earth Pressure Pa = 916.70 lbf/ft

Pa_h (Force H) = Pa cos(δ - ω) = 916.70 x cos(24.75 - (-20.86)) = 553 lbf/ft

Y-Arm = 1.64 ft

Pa_v (Force V) = Pa sin(δ - ω) = 916.70 x sin(24.75 - (-20.86)) = 565 lbf/ft

X-Arm = 4.27 ft

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 ECCENTRICITY ABOUT THE CENTER OF THE BASE

Name	Factor γ	Force (V)	Force (H)	X-len	Y-len	Mo	Mr
Face Blocks(W1)	1.00	1977.26		-1.415			-3280.12
Soil Wedge(W2)	1.00	175.04		-1.026			-179.88
Pa_h	1.00		552.95		1.754	969.77	
Pa_v	1.00	564.92		-1.796			-1113.12
Sum V / H	1.00	2717	553		Sum Mom	970	-4573

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

FORCES AND MOMENTS FACTORED FOR Str I-a

UltraWall increases all driving forces and reduces the resisting forces by the factors shown for Str I.

FACTORED LOADS: Str Ia

Name	FactorMax γ	FactorMin γ	ForceSldg (V)	ForceEcc (V)	Force (H)	X-len	Y-len	Mo	Mr
Face Blocks(W1)	1.25	0.90	1779.53	1779.53		-1.415			-2952.11
Soil Wedge(W2)	1.35	1.00	175.04	175.04		-1.026			-179.88
Paw_h	1.50				829.43		1.754	1454.66	
Paw_v		0.90	847.38	847.38		-1.796			-1001.81
Sum V / H			2802	2802	829		Sum Mom	1455	-4802

FORCES AND MOMENTS FACTORED FOR Str I-b

UltraWall increase resisting forces and increases driving forces by the factors shown for Str I-b.

FACTORED LOADS: Str Ib

Name	Factor γ	Force (V)	Force (H)	X-len	Y-len	Mo	Mr
Face Blocks(W1)	1.25	2471.58		-1.415			-4100.15
Soil Wedge(W2)	1.35	236.30		-1.026			-242.83
Pa_h	1.50		829.43		1.754	1454.66	
Pa_v	1.50	847.38		-1.796			-1669.68
Sum V / H		3555	829		Sum Mom	1455	-6013

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

N = W1(DCr)+ W2(EVr) + Pav(EHd)

(1,977 x 0.90) + (175 x 1.00) + (565 x 1.50)

N = 2,802 lbf/ft

Sliding between Concrete Units and Leveling Pad/Drain Mat (Rf1)

Resisting force at pad = (θ N tan(slope)) x RFsl

RF1 = (0.8 x 2,802 x tan(40.00) + 0.0) x 0.90 — Rf1 = 1,693

Driving force is the horizontal component of

Pah(EHd)

DF = (553 x 1.50) — Df = 829

CDR = (Rf1 / Df) — CDR = 2.04

ROW TO ROW SLIDING

Sliding between rows is checked at the interface between two adjacent rows.

Details of the calculation are shown on the previous page. The leveling pad interaction is now replaced with the unit/unit interaction.

RESULTS TABLE FACTORED

Elev[ft]	N[lbf/ft]	Shear Intcpt	Resisting Force	Driving Force[lbf/ft]	CDR Sliding/Shear
4.84	380.73	3,257.59	3,463.19	0.11	30,247.69
2.42	935.39	3,257.59	3,762.71	87.51	43.00

ECCENTRICITY

Eccentricity at the base is checked by assuming rotation by the block mass and the soil retained on the blocks. Allowable overturning can be defined by eccentricity (e/L).

Moments Resisting =
M1(DCr) + M2(EVr) + MPav(EHd)
((-3,280 x 0.90) + (-180 x 1.00) + (-1,113 x 1.50)

Mr = 4,802 ft-lbs

Moments Driving = MPah(EHd) + M0(EVd)
(970 x 1.50) + (0 x 1.35) + (0 x 1.50)

Mo = 1,455 ft-lbs

e = (Mr - Mo)/ N
e = (4,802 - 1,455) /2,802 e = 1.19
e/L = 1.19 / 4.92 e/L = 0.24

ROW TO ROW ECCENTRICITY

Eccentricity is checked by assuming rotation by the block mass and the soil retained on the blocks about the row below. Factored eccentricity can be defined by eccentricity/Length (e/L).

RESULTS TABLE FACTORED

Elev[ft]	Mr[ft lbf/ft]	Mo[ft lbf/ft]	Sum Vertical[lbf]	Ecc[ft]	BlockLength	Ecc/L
4.84	24.68	0.01	380.73	0.06	2.46	0.03
2.42	264.19	43.70	935.39	0.24	2.46	0.10

ECCENTRICITY AND BEARING

Eccentricity is the calculation of the distance of the resultant force away from the centroid of the mass. This measure is an indication of the overturning of the mass. UltraWall uses an allowable eccentricity of 9/20 L for concrete to concrete bearing surfaces and a concrete leveling pad (thickness > 1.0 ft), or L/3 for bearing on soil per the AASHTO LRFD guidelines. Eccentricity is still used as a guide to design in some design methods.

UltraWall calculates three eccentricities:

1) Maximum eccentricity (overturning) where it uses the maximum driving forces combined with the minimum resisting forces (see overturning) [Str I-a]. 2) Maximum bearing where it uses the maximum driving forces combined with the maximum resisting forces [Str I-b]. 3) Service: Maximum bearing where it uses the actual driving forces combined with the actual resisting forces in Service loading.

Calculation of Eccentricity for maximum bearing

Moments resisting = M1(DCd) M2(EVd) + MPa(EHd)

(-3,280 x 1.25) + (-180 x 1.35) + (-1,113 x 1.50)

Mr = 6,013 ft-lbs

Moments driving = + MPah(EHd)

+ (970 x 1.50)

Mo = 1,455 ft-lbs

Nb = W1(DCd) + W2(EVd) + WPa(EHd)

(1,977 x 1.25) + (175 x 1.35) + (565 x 1.50)

Nb = 3,555 lbf/ft

N bearing = W1(DCd) + W2(EVd) + WPlvlpad(EVd) + WPa(EHd)

(1,977 x 1.25) + (175 x 1.35) + (193 x 1.35) + (565 x 1.50)

Nbrg = 3,816 lbf/ft

Calculate Eccentricity (absolute values used for parameters)

e = (Mr - Mo)/ Nb

e = (6,013 - 1,455) /3,555 e = 1.282

BEARING

Bearing Capacity Factors [Foundation]
Nc = 35.490 Myerhoff Eqn
Nq = 23.177 Myerhoff Eqn
Ng = 30.215 Vesic Eqn

Shape Factors [Foundation]
Sc = 1.065
Sq = 1.062
Sg = 0.960

Depth Correction Factor
df = 1.082

Modified Bearing Capacity Factors [Foundation]
Ncm = Nc x Sc = 37.808
Nqm = Nq x Sq = 26.639
Ngm = Ng x Sg = 29.006

Water Correction Factor
Cwq = 0.500
Cwg = 0.500

B'f = B - 2e + lvlPad Thickness (Bearing area at foundation)
B'f = 4.92 - 2 x 1.28 + 0.50 B'f = 2.85 ft

q = embedment * γ
= 1.00 x 120.00 q = 180.00 lbf/ft2

Calculation of Bearing Pressures Foundation
qr = (c * Ncm + q * Nqm * Cwq + 0.5 * γ * B' * Ngm * Cwg) * RFbr
[(0.000 x 37.808) + (120 x 26.639 x 0.500) + (0.5 x 120 x 2.853 x 29.006 x 0.500)] x 0.45

Calculate Factored Bearing, qr qr = 2,287.23 lbf/ft2
Bearing Pressures (σ) Nbrg/B'f = 1,337.88 lbf/ft2
Calculated CDR for bearing qr/σ = 1.71

Design	Sum Vert	Mo	Mr	e	Qal	Sigma	CDR
Strength I-b	3816	1455	-6013	1.282	2287	1338	1.71
Service	2911	970	-4573	1.326	2250	1053	2.14

SEISMIC CALCULATIONS

The loads considered under seismic loading are primarily inertial loadings. The wave passes the structure putting the mass into motion and then the mass will try to continue in the direction of the initial wave. In the calculations you see the one dynamic earth pressure from the wedge of the soil behind the reinforced mass, and then all the other forces come from inertia calculations of the face put into motion and then trying to be held in place.

Design Ground Acceleration — As = Fpae * PGA = 0.250

Assumed deformation = — Def = 0.00 in

(with deformation, the kh is reduced by 50%)

Horizontal Acceleration — kh = 0.250

Vertical Acceleration — kv = 0.000

INERTIA FORCES OF THE STRUCTURE

Pif = (W1 * kh)

(1977.26 * 0.250) — Pif = 494.32

SEISMIC THRUST

Coefficient of active seismic earth pressure Kae — Kae = 0.701

D_Kae = Kae - Ka = (0.701 -0.701) — D_Kae = 0.000

Pae = 0.5*gamma*(H)^2 * DKae — Pae = 0.00 lbf/ft

Pae_h = Pae*cos(delta) — Pae_h = 0.00 lbf/ft

Pae_v = Pae*sin(delta) — Pae_v = 0.00 lbf/ft

In AASHTO LRFD, two cases are looked at: 1) 100% Pae and 50% of Pir, and 2) 50% Pae and 100% Pir.

TABLE OF RESULTS FOR SEISMIC REACTIONS

SEISMIC SLIDING

Details are only shown for sliding at the base of blocks, a check is made at the foundation level with the answer only shown.

The vertical resisting forces are
Units(1.0) + SoilWedge(1.0) + Pa_v(1.0)

(1977 * 1.0) + (175 * 1.0) + (565 * 1.0)
Note Pae_v changes between case 1 and case 2, to Pae_v/2)

Case 1, 100% Pae & 50% Pir
SumVs_Pae = 2717

Case 2, 50% Pae & 100% Pir
SumVs_Pir = 2435

Resisting force 1 = (SumVs_Pae * tan(slope) + intercept * L) * RFsl FReS1 = 1698 lbf/ft
Resisting force 2 = (SumVs_Pir * tan(slope) + intercept * L) * RFsl FReS2 = 1634 lbf/ft

The inertial force Pif = Face*kh(1.0) + Soil Wedge*kh*(1.0)
Driving force = + Pa_h(1.0) + Pif_h/2(1.0)
[case 2 is 50% Pae, 100% Pir]

(553 * 1.0) + (494/2 * 1.0)
FDrS1 = 800 lbf/ft
FDrS2 = 1059 lbf/ft

CDR = (FReS1/FDrS1) / (FReS2/FDrS2) CDR = 2.28 / 1.54

SEISMIC ECCENTRICITY

Eccentricity is rotation about the center of the wall and is a check on overturning.

Resisting Moment =
(case 2 is 50% Pae)

MomReS [Pae] = -4573 ft lbf/ft
MomReS [Pir] = -3460 ft lbf/ft

Driving Moment =
Pa_h(1.0) + Pif_h/2(1.0)
(970 * 1.0) + (1604/2 * 1.0)

MomDrS [Pae] = 970 ft lbf/ft
MomDrS [Pir] = 0 ft lbf/ft

e = (Mr - Mo)/ N
e [Pae] = (4573 - 970) /2717 e = 1.33
e/L = 0.27
e [Pir] = (3460 - 0) /2435 e = 1.42
e/L = 0.29

SEISMIC BEARING

Bearing is the ability of the foundation to support the mass of the structure.

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

where:

Nc = 35.49 Myerhoff Eqn

Nq = 23.18 Myerhoff Eqn

Ng = 30.21 Vesic Eqn

c = 0 lbf/ft2

q = (emb + lvl pad) * gamma(EVsr) = 180.00 lbf/ft2

Pae Values (100% Pae, 50% Pir)

Calculate Factored Bearing, Qult (seismic)	Qult = 4,323 lbf/ft2
Equivalent Footing Width, B' = L - 2e + Lvl pad	B' = 2.76 ft
Bearing Pressure = sumVs/B' + B + LP depth/2 * LP depth * gamma	q = 991.64 lbf/ft2
CDR for Bearing = (Qults * RFbr)/Bearing	CDR = 4.36

Pir Values (50% Pae, 100% Pir)

Calculate Factored Bearing, Qult (seismic)	Qult = 6,400 lbf/ft2
Equivalent Footing Width, B' = L - 2e + Lvl pad	B' = 2.87 ft
Bearing Pressure = sumVs/B' + B + LP depth/2 * LP depth * gamma	q = 954.87 lbf/ft2
CDR for Bearing = (Qults * RFbr)/Bearing	CDR = 4.53