November 14, 2022
Project No. J-0165

McCullough Architects
2910 First Avenue South, Suite 201
Seattle, WA 98124

Attention: Matt Glaser

Subject: Response to Comments
7216 93rd Avenue SE, Lot 1
Mercer Island, Washington

Dear Mr. Glaser:

This letter presents our response to comment received from by the City of Mercer Island, for the project located at the above refenced site. The comments received involved providing calculations for earth pressures used in design of the temporary soldier pile shoring wall and providing details and analysis of proposed temporary shoring block walls located near the southeast corner of the proposed new home.

Earth Pressure Calculations

Earth pressures recommended for design of the soldier pile shoring wall were performed using the Rankine Theory. The calculations have resulted in a revision to the previously recommend earth pressures. As shown on the attached calculation sheet, the revised earth pressures for design are as follows:

Active Earth Pressure for Level Backslope = 37 pcf
Passive Earth Pressure = 390 pcf
Soil Surcharge Due to 1H:1V Backslope = 3 feet

Temporary Block Wall Shoring

Temporary block wall shoring is proposed to support foundation excavations at the southeast corner of the proposed new house. Temporary cuts of 10 to 12 feet in height are anticipated for this area. Recommended details for construction of these walls are attached to this letter along with stability analyses for these walls. The following recommendations are also provided:

1. All blocks should be founded upon a subbase that has been compacted to a firm and unyielding condition as determined by the geotechnical engineer or their representative.

2. All blocks should be placed level and true and all soil should be removed from the top of the blocks prior to placing the next row.

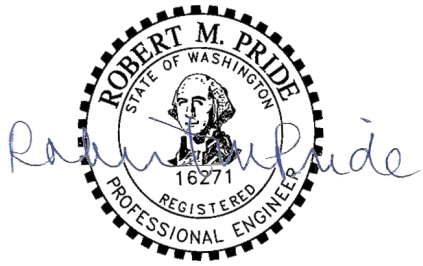
3. Blocks should be staggered so that the block above covers the ends of the two blocks below.

4. Fill behind the wall should consist of clean, free draining, granular soil free of deleterious material approved by SGP.

5. Walls should be constructed with only 15 linear feet of cut open and exposed at one time. Bottom two rows of blocks to be placed prior to opening a new cut.

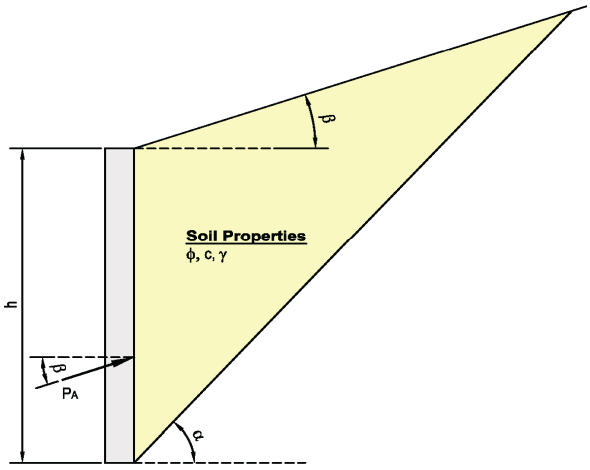
6. The walls require periodic observation of construction by the geotechnical engineer or their representative.

Respectfully,



Robert M. Pride, P. E.
Principal Geotechnical Engineer

Attachments: Earth Pressure Calculations
Earth Pressure Diagram
Block Wall Details
Block Wall Stability Analyses



Rankine's Active Wedge

Rankine's theory is the simplest formulation proposed for earth pressure calculations and it is based on the following assumptions:

- The wall is smooth and vertical.
- No friction or adhesion between the wall and the soil.
- The failure wedge is a plane surface and is a function of soil's friction ϕ and the backfill slope β
- Lateral earth pressure varies linearly with depth.
- The direction of the lateral earth pressure acts parallel to slope of the backfill
- The resultant earth pressure acts at a distance equal to one-third of the wall height from the base.

Where:

h = height of pressure surface on the wall.
P_a = active lateral earth pressure resultant per unit width of wall.
P_p = passive lateral earth pressure resultant per unit width of wall.
β = angle from backfill surface to the horizontal.
α = failure plane angle with respect to horizontal.
ϕ = effective friction angle of soil.
K_a = coefficient of active lateral earth pressure.
K_p = coefficient of passive lateral earth pressure.
γ = unit weight of soil.

$$K_a = \cos\beta \frac{\cos\beta - \sqrt{\cos^2\beta - \cos^2\phi}}{\cos\beta + \sqrt{\cos^2\beta - \cos^2\phi}}$$

$$K_p = \cos\beta \frac{\cos\beta + \sqrt{\cos^2\beta - \cos^2\phi}}{\cos\beta - \sqrt{\cos^2\beta - \cos^2\phi}}$$

$$K_O = (1 - \sin\phi)(1 - \sin\beta)$$

The failure plane angle α can be determined as

$$\alpha = \left(45 - \frac{\phi}{2}\right) + \frac{1}{2}\left(Arc\sin\left(\frac{\sin\beta}{\sin\phi}\right) + \beta\right)$$

Given: **(Rankine's Theory)**

First Layer:

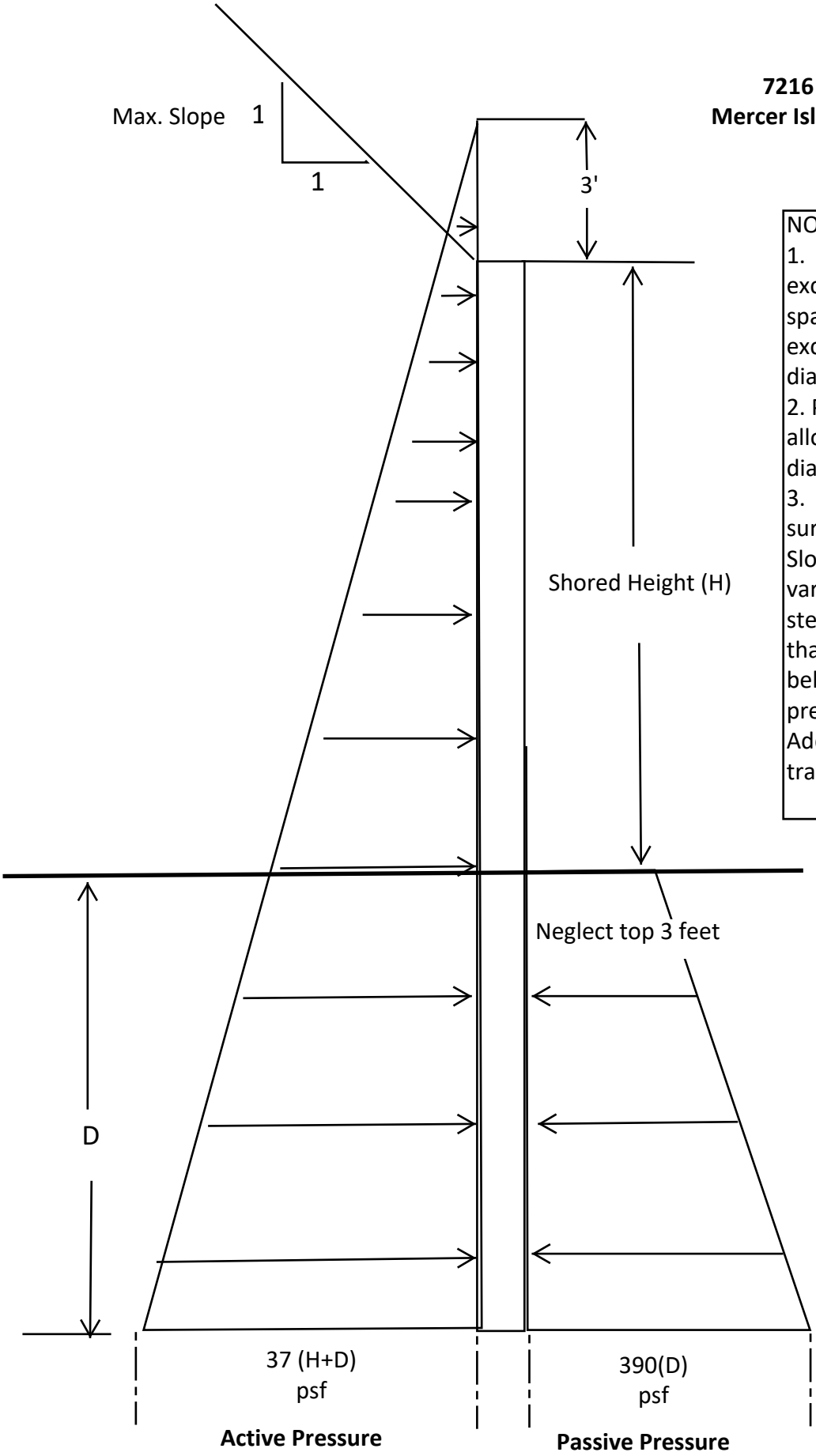
Soil Description: **Medium dense to dense silty SAND**

SH1 = 21.50 ft Top of Soli Layer

Soil properties:

γ =	120	pcf		K_a =	0.307	**P_a =**	**36.87 pcf**
γ_w =		pcf				P_{aw} =	36.87 pcf
γ_s =	120	pcf or =	pcf	K_p =	3.25	**P_p =**	**390.55 pcf**
ϕ =	32	°				P_{pw} =	390.55 pcf
C =	0			K_o =	0.470	P_a =	56.41 pcf

7216 93rd Ave SE
Mercer Island, Washington



NOTES:
1. Active pressure above excavation acts over one pile spacing. Active pressure below excavation acts over one pile diameter.
2. Passive pressures are allowable acting over 2 pile diameters.
3. Active pressure includes surcharge for slope behind wall. Slope inclination and height will vary with topography but no steeper than 1H:1V and no taller than 6.5 feet. Where slope behind wall is flat then active pressure of 37 psf may be used. Add appropriate surcharges for traffic or parking.

TEMPORARY SHORING
DRILLED WIDE FLANGE PILES
EARTH PRESSURE DIAGRAM

J-0165

NOTES

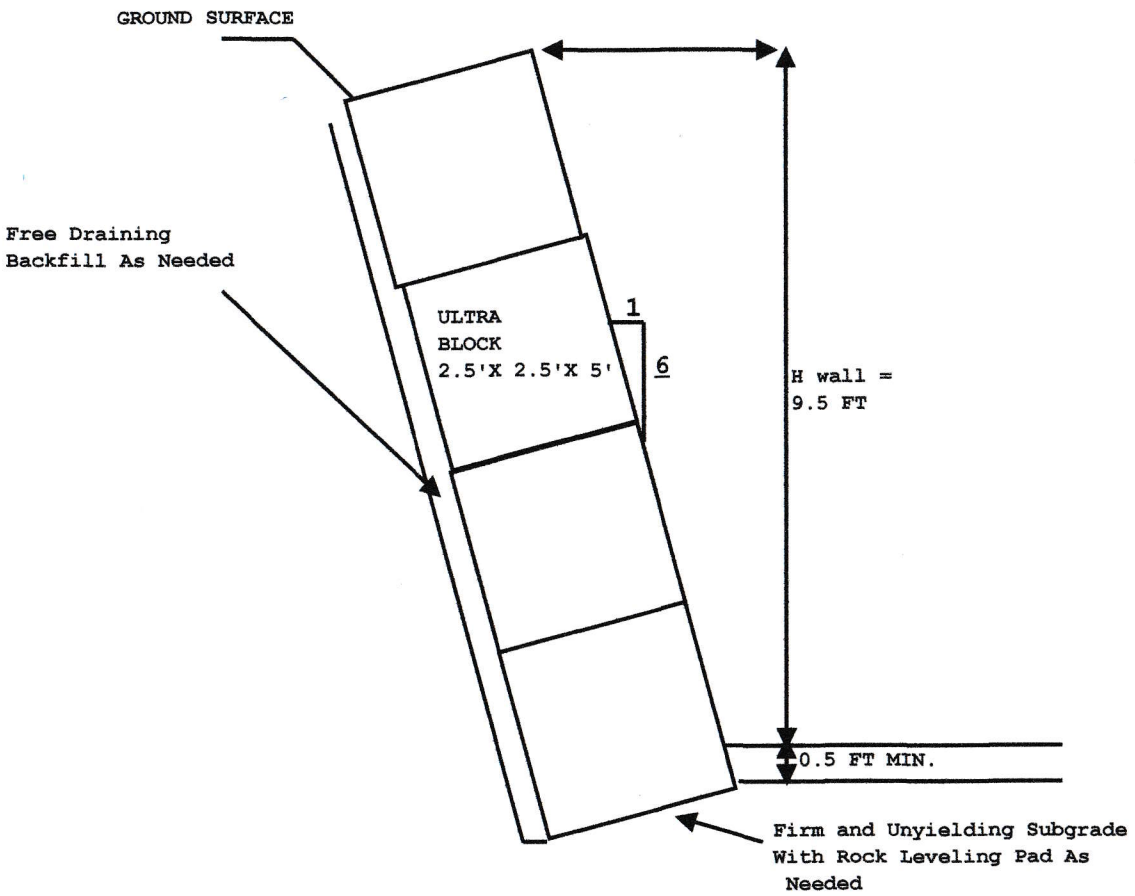
1. All blocks should be founded upon a subbase that has been compacted to a firm and unyielding condition as determined by the geotechnical engineer or their representative.

2. All blocks should be placed level and true and all soil should be removed from the top of the blocks prior to placing the next row.

3. Blocks should be staggered so that the block above covers the ends of the two blocks below.

4. Fill behind the wall should consist of clean, granular soil free of deleterious material approved by SGP.

5. The walls require periodic observation of construction by SGP..



ROBERT M. PRIDE
STATE OF WASHINGTON
16271
REGISTERED
PROFESSIONAL ENGINEER

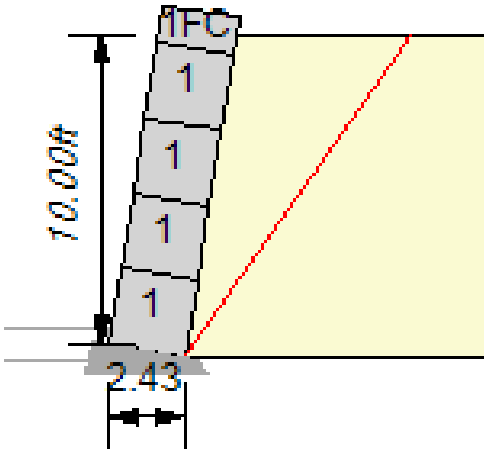
Robert M. Pride

10 FOOT CUT

Name: **Premier Homes** **PO Box 1639** **Mercer Island, WA**	Drawing: **Figure 3**	Project: **7216 93rd Ave SE**	Drawn: **JNS**	Notes:	**Robert M. Pride, P.E.** **13203 Holes Point Dr. NE** **Kirkland, WA 98034**
Cat: **Temporary Ultra Block Wall**	Scale: **1:1**	Date: 10/6/22	Rev: **RMP**		

UltraWall

Project:	Premier Homes
Location:	Mercer Island, WA
Designer:	JML
Date:	11/10/2022
Section:	Section 1
Design Method:	NCMA_09_3rd_Ed, Ignore Vert. Force
Design Unit:	UltraBlock



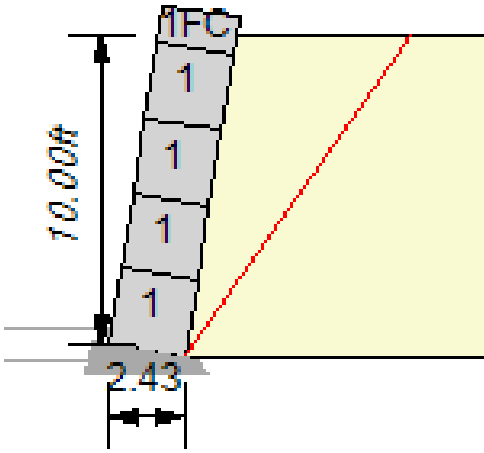
SOIL PARAMETERS	φ	coh	γ	
Retained Soil:	32 deg	0psf	120pcf	
Foundation Soil:	32 deg	0psf	120pcf	
Leveling Pad:	40 deg	0psf	135pcf	Crushed Stone

GEOMETRY

Design Height:	10.00ft	Live Load:	0psf
Wall Batter/Tilt:	0.00/ 9.00 deg	Live Load Offset:	0.00ft
Embedment:	0.50ft	Live Load Width:	0ft
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	D.L. Embedment:	0ft
Leveling Pad Width:	3.46ft		
Vert δ on Single Dpth			

FACTORS OF SAFETY

Sliding:	1.50	Overturning:	1.50
Bearing:	2.00		



RESULTS

FoS Sliding:	2.79 (lvlpd)	FoS Overturning:	1.68
Bearing:	1286.99	FoS Bearing:	6.33

Name	Elev.[dpth]	ka	Pa	PaT	FSsl	FoS OT	%D/H
1FC	9.71[0.29]	0.216	6	6	100	--	854%
1	7.28[2.72]	0.216	125	125	100	15.17	91%
1	4.86[5.14]	0.216	396	396	50.38	5.03	48%
1	2.43[7.57]	0.216	820	820	25.17	2.63	32%
1	0.00[10.00]	0.216	1397	1397	2.79	1.68	25%

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.

RETAINING WALL UNITS

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.

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 breaks within the failure zone, a trial wedge method of analysis is used.

EXTERNAL EARTH PRESSURES

Effective δ angle (2/3 retained phi)	δ =21.3 deg
Coefficient of active earth pressure	ka =0.216
External failure plane	ρ = 54 deg
Effective Angle from horizontal	θ =99.00 deg
Coefficient of passive earth pressure: kp = (1 + sin(φ)) / (1 - sin(φ))	kp =0.00

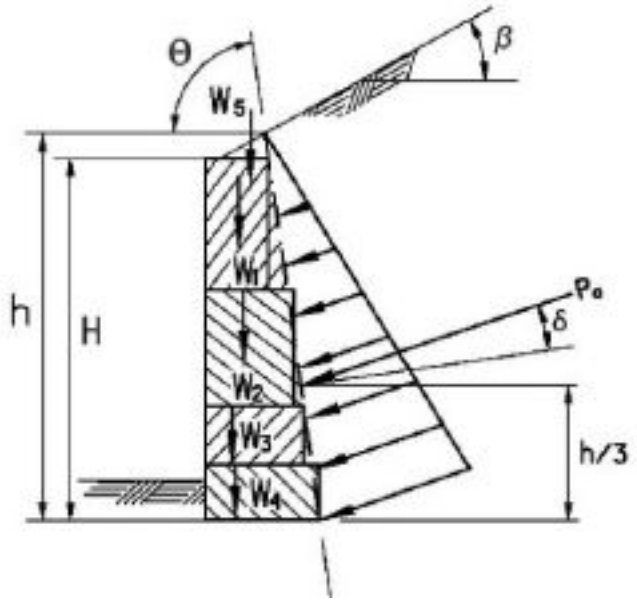
$$k_a = \frac{\sin^2(\theta + \phi')}{\Gamma[\sin^2 \sin(\Theta - \delta)]}$$

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)



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.

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	423	0	0
2	846	0	0
3	846	0	0
4	846	0	0
5	846	0	

Block Weight (Force v (Block Wt + Infill Soil)) = 3807ppf X-Arm = 2.08ft
Soils Block Weight (Force v) = 0ppf X-Arm = 3.17ft

Active Earth Pressure Pa = 1397ppf

Pa_h (Force H) = Pa cos(δ - batter) = 1397 x cos(21.3 - (9.0)) = 1365ppf

Y-Arm = 3.46ft

Pa_v (Force V) = Pa sin(δ - batter) = 1397 x sin(21.3 - (9.0)) = 0ppf

X-Arm = 2.43ft

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)	3807	--	2.08	--	--	7917
Pa_h	--	1365	--	3.46	4724	--
Pa_v	0	--	2.43	--	--	0
Sum V / H	3807	1365		Sum Mom	4724	7917

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)	3807	--	-0.87	--	--	-6272
Pa_h	--	1365	--	3.46	4724	--
Pa_v	0	--	-1.21	--	--	0
Sum V / H	3807	1365		Sum Mom	4724	-6273

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
3807 N =3807ppf

Resisting force at pad = (N * 0.8 * tan(slope) + intercept x L)
3807 x0.8 x tan(40.0) + 0.0 Rf =3,807

Driving force is the horizontal component of
Pah
1365 Df =1,365

FSsl = Rf / Df FSsl =2.79

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

7917 Mr =7917ft-lbs

Moments causing Overturning = MPah

4724 Mo =4724ft-lbs

FSot = Mr / Mo

FSot =7917 / 4724 FSot =1.68

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

+ 3807 — SumV = 3807

Moment Resisting — Mr = -6273

Moment Driving — Md = 4724

e = (SumMr + SumMd)/(SumV)

e = (-1549 /3807.34) — e =0.000ft

Calculation of Bearing Pressures

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

where:

Nc =35.49

Nq =23.18

Ng =30.21

c =0.00psf

q = 120.00psf(soil weight above base of leveling pad)

B' = B - 2e + lvlpad = 2.96ft

Gamma =120pcf

Calculate Ultimate Bearing, Qult — Qult =8144psf

Bearing Pressure = (SumVert / B') + (LP width * gamma) — sigma =1286.99psf

Calculated Factors of Safety for Bearing — Qult/sigma =6.33

NOTES

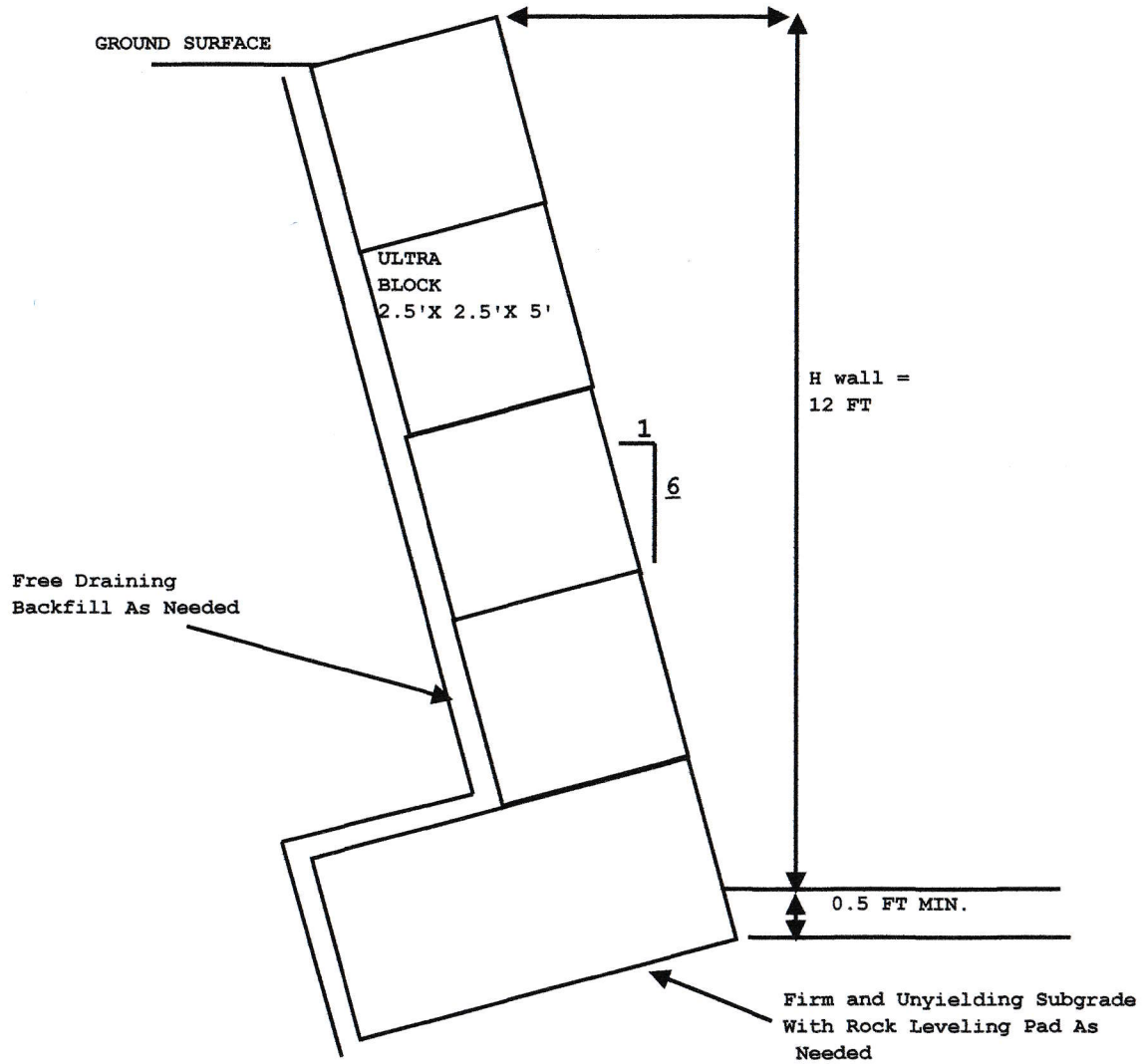
1. All blocks should be founded upon a subbase that has been compacted to a firm and unyielding condition as determined by the geotechnical engineer or their representative.

2. All blocks should be placed level and true and all soil should be removed from the top of the blocks prior to placing the next row.

3. Blocks should be staggered so that the block above covers the ends of the two blocks below.

4. Fill behind the wall should consist of clean, granular soil free of deleterious material approved by SGP.

5. The walls require periodic observation of construction by SGP..



12 FOOT CUT

ROBERT M. PRIDE
STATE OF WASHINGTON
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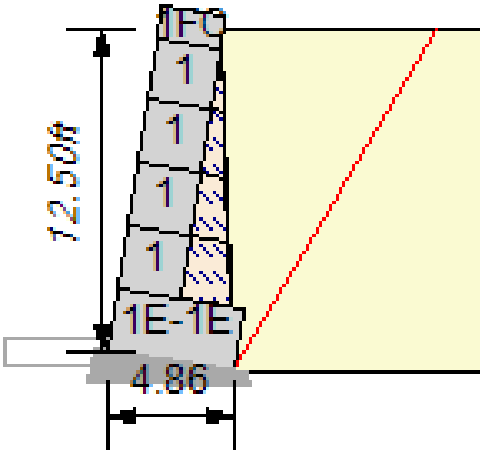
PROFESSIONAL ENGINEER

Name: Premier Homes PO Box 1639 Mercer Island, WA	Drawing: Figure 3	Project: 7216 93rd Ave SE	Drawn: JNS	Notes:	Robert M. Pride, P.E. 13203 Holes Point Dr. NE Kirkland, WA 98034
Cat: Temporary Ultra Block Wall	Scale: 1:1	Date: 10/6/22	Rev: RMP		

UltraWall

Project:	Premier Homes
Location:	Mercer Island, WA
Designer:	JML
Date:	11/10/2022
Section:	Section 1
Design Method:	NCMA_09_3rd_Ed
Design Unit:	UltraBlock



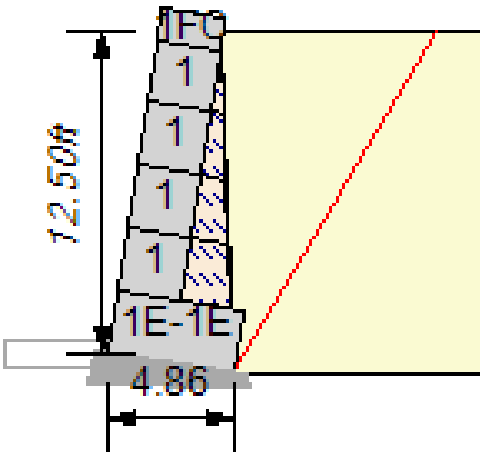
SOIL PARAMETERS	φ	coh	γ	
Retained Soil:	32 deg	0psf	120pcf	
Foundation Soil:	32 deg	0psf	120pcf	
Leveling Pad:	40 deg	0psf	135pcf	Crushed Stone

GEOMETRY

Design Height:	12.50ft	Live Load:	0psf
Wall Batter/Tilt:	0.00/ 9.00 deg	Live Load Offset:	0.00ft
Embedment:	0.50ft	Live Load Width:	0ft
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	D.L. Embedment:	0ft
Leveling Pad Width:	5.92ft		
Vert δ on Single Dpth			

FACTORS OF SAFETY

Sliding:	1.50	Overturning:	1.50
Bearing:	2.00		



RESULTS

FoS Sliding:	2.48 (lvlpd)	FoS Overturning:	1.64
Bearing:	1451.47	FoS Bearing:	7.83

Name	Elev.[dpth]	ka	Pa	PaT	FSsl	FoS OT	%D/H
1FC	12.14[0.36]	0.216	7	7	100	--	684%
1	9.71[2.79]	0.216	130	130	100	14.16	88%
1	7.28[5.22]	0.216	406	406	49.09	4.84	47%
1	4.86[7.64]	0.216	835	835	24.72	2.56	32%
1	2.43[10.07]	0.216	1417	1417	15.06	1.64	24%
1E-1E	0.00[12.50]	0.292	3088	3088	2.48	1.66	39%

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.

RETAINING WALL UNITS

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.

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 breaks within the failure zone, a trial wedge method of analysis is used.

EXTERNAL EARTH PRESSURES

Effective δ angle (3/4 retained phi)	δ =24.0 deg
Coefficient of active earth pressure	ka =0.292
External failure plane	ρ = 58 deg
Effective Angle from horizontal	θ =87.60 deg
Coefficient of passive earth pressure: kp = (1 + sin(φ)) / (1 - sin(φ))	kp =0.00

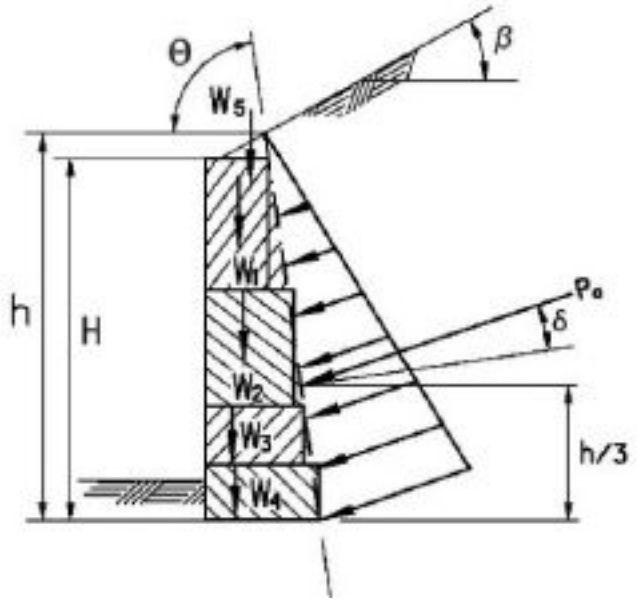
$$k_a = \frac{\sin^2(\theta + \phi')}{\Gamma[\sin^2 \sin(\Theta - \delta)]}$$

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)



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.

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	423	0	0
2	846	0	0
3	846	0	0
4	846	0	0
5	846	0	0
6	1692	0	

Block Weight (Force v (Block Wt + Infill Soil)) = 5499ppf X-Arm = 2.51ft
Soils Block Weight (Force v) = 0ppf X-Arm = 4.10ft

Active Earth Pressure Pa = 3088ppf
Pa_h (Force H) = Pa cos(δ - batter) = 3088 x cos(24.0 - (-2.4)) = 2766ppf
Y-Arm = 4.42ft
Pa_v (Force V) = Pa sin(δ - batter) = 3088 x sin(24.0 - (-2.4)) = 1373ppf
X-Arm = 4.69ft

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)	5499	--	2.51	--	--	13815
Pa_h	--	2766	--	4.42	12235	--
Pa_v	1373	--	4.69	--	--	6436
Sum V / H	6872	2766		Sum Mom	12235	20251

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)	5499	--	-0.08	--	--	-5839
Pa_h	--	2766	--	4.42	12235	--
Pa_v	1373	--	-2.26	--	--	-4052
Sum V / H	6872	2766		Sum Mom	12235	-9892

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 + Pav
5499 + 1373 N =6872ppf

Resisting force at pad = (N * 0.8 * tan(slope) + intercept x L)
6872 x0.8 x tan(40.0) + 0.0 Rf =6,872

Driving force is the horizontal component of
Pah
2766 Df =2,766

FSsl = Rf / Df FSsl =2.48

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 + MPav
13815 + 6436 Mr =20251ft-lbs

Moments causing Overturning = MPah
12235 Mo =12235ft-lbs

FSot = Mr / Mo
FSot =20251 / 12235 FSot =1.66

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 + Pav

+ 5499 + 1373 — SumV = 6872

Moment Resisting — Mr = -9892

Moment Driving — Md = 12235

e = (SumMr + SumMd)/(SumV)

e = (2343 /6872.39) — e =0.341ft

Calculation of Bearing Pressures

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

where:

Nc =35.49

Nq =23.18

Ng =30.21

c =0.00psf

q = 120.00psf(soil weight above base of leveling pad)

B' = B - 2e + lvlpad = 4.73ft

Gamma =120pcf

Calculate Ultimate Bearing, Qult — Qult =11365psf

Bearing Pressure = (SumVert / B') + (LP width * gamma) — sigma =1451.47psf

Calculated Factors of Safety for Bearing — Qult/sigma =7.83