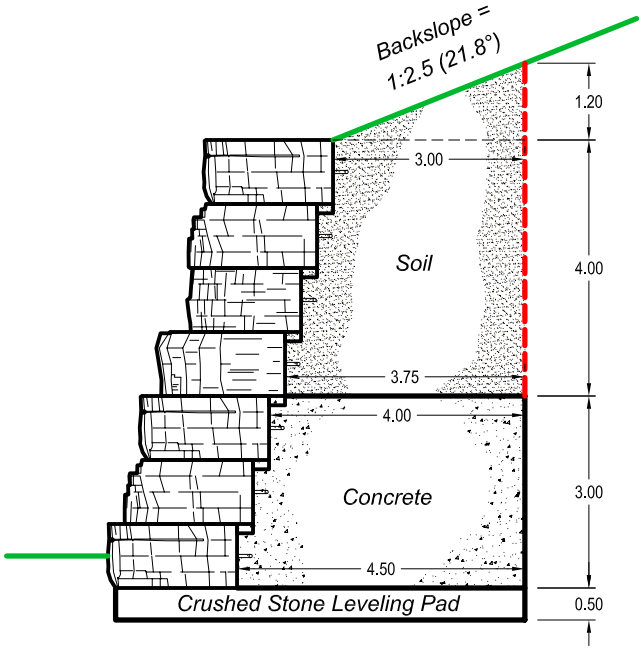
ROSETTA HARDSCAPES, LLC
05481 US 31 SOUTH CHARLEVOIX, MI 49720
877-777-6558 • 231-237-9656 Fax • www.discoverrosetta.com

PROJECT:	SHEET:
Sample Wall Calculations *H = 7', ϕ = 28°, Load Condition C*	*1 of 4*
PREPARED BY:	DATE:
Rosetta Hardscapes, LLC	*04-29-08*

The following are sample calculations for a Rosetta Hardscapes block gravity wall with cast-in-place concrete backfill. They are intended to serve as reference information for Design Professionals only. Wall design requires a detailed understanding of engineering concepts, and must be prepared by a Licensed Professional Engineer. Global stability has not been checked, and must be addressed by the Professional Engineer responsible for final wall design. These preliminary calculations assume fully drained conditions. Final wall design shall address both internal and external drainage.



DESIGN BLOCK PROPERTIES

h_{block} = 12" W_{block} = 17.3" (average width)
L_{block} = 65.8" G_u = 8.1" (from theoretical toe)
γ_{block} = 140 lb/ft^3 Block Setback = 3" horizontal
Interface shear = 360 + N tan 26° lb/ft

SOIL PROPERTIES

(Retained and Foundation Soil)
ϕ = 28°, c = 0 lb/ft^2, γ = 120 lb/ft^3

CRUSHED STONE LEVELING PAD

ϕ_{LP} = 40°, c_{LP} = 0 lb/ft^2, γ_{LP} = 130 lb/ft^3

CONCRETE BACKFILL

f'_c = 2500 lb/ft^2, γ = 140 lb/ft^3

EARTH PRESSURE COEFFICIENTS

(Coefficients for Analysis of Full Height Wall Section)
ϕ = 28°, δ = 2/3 ϕ = 18.7°, ω = 0°, β = 21.8°
Coulomb active earth pressure coefficient, k_a = 0.4878
Coulomb inclination of failure surface, α = 44.2°

WALL SLIDING CHECK

(Sliding Calculations made at the base of the stone leveling pad, neglecting any soil in front of wall)

Earth Pressure Forces Acting on Wall

$P_a = k_a \times 1/2 \times \gamma \times H^2 = 0.4878 \times 0.5 \times 120 \times 8.7^2 = 2215.3$ lb/ft
$P_{ah} = P_a \cos(\delta-\omega) = 2215.3 \times \cos 18.7° = 2098.4$ lb/ft (horizontal component)
$P_{av} = P_a \sin(\delta-\omega) = 2215.3 \times \sin 18.7° = 710.2$ lb/ft (vertical component)

Weight Calculations

Weight of Concrete Blocks = 7 x (1' x 1.44') x 140 lb/ft^3 = 1411.2 lb/ft
Weight of Poured-In-Place Concrete = (4.0'+4.25'+4.5') x (1') x 140 lb/ft^3 = 1785 lb/ft
Weight of Soil Above Concrete = [(3.0'+3.25'+3.5'+3.75')x(1') + (1/2x3.0'x1.2')] x 120 lb/ft^3 = 1836 lb/ft
Weight of Crushed Stone = (0.5' x 5.94') x 130 lb/ft^3 = 386.1 lb/ft

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WALL SLIDING CHECK - CONTINUED

Sliding Resistance, $RS_{sl} = (\Sigma W + P_{av}) \times \tan \phi_f + W_{block} \times c_f$

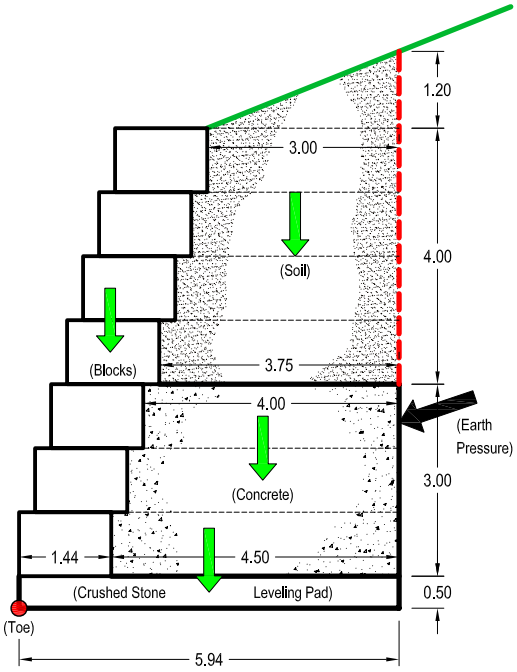
$RS_{sl} = (1411.2 + 1785 + 1836 + 386.1 + 710.2) \times \tan 28° + 1.44 \times 0$

$RS_{sl} = 3258.6$ lb/ft

Factor of Safety Against Sliding, $FS_{SL} = RS_{sl} / P_{ah} = 3258.6 / 2098.4 = 1.55 > 1.5$ - OK for Sliding

WALL OVERTURNING CHECK

(Overturning calculations made at the toe of the wall on the bottom of the stone leveling pad, neglecting any soil in front of wall)



Location of Forces for Moment Calculation

Rosetta Blocks

$X_u = G_u + 1/2 \times (H - h_{block}) \times \tan \omega_{blocks} = 0.675 + 1/2 \times (7.0\text{-}1.0) \times \tan 14.0° = 1.425'$

Cast-In-Place Concrete

X_{conc} = [(4.0x1)x3.940' + (4.25x1)x3.815' + (4.5x1)x3.690'] / [(4.0x1) + (4.25x1) + (4.5x1)] = 3.810'

Crushed Stone Leveling Pad

$X_{stone} = L_{stone} / 2 = 2.97'$

Soil Above C.I.P. Concrete

X_{soil} = [(1/2 x3.0'x1.2')x4.94' + (3.0'x1')x4.44' + (3.25'x1')x4.315'+ (3.5'x1')x4.16'+ (3.75'x1')x4.065'] / [(1/2 x 3.0'x1.2') + (3.0'x1') + (3.25'x1') + (3.5'x1')+ (3.75'x1')] = 4.316'

Horizontal Component of Earth Pressure Force

$X_{Pah} = 1/3 \times H = 1/3 \times 8.7 = 2.90'$

Vertical Component of Earth Pressure Force

$X_{Pav} = L_{stone} = 5.94'$

Overturning Moment

$M_{OT} = P_{ah} \times X_{Pah} = 2098.4 \times 2.90 = 6085.4$ lb ft / ft

Resisting Moment

$M_{resist} = \Sigma(W_i \times X_i) + P_{av} \times X_{Pav}$ = (1411.2x1.425 + 1785x3.810 + 1836x4.316 + 386.1x2.97) + 710.2x5.94 = 22101.3 lb ft / ft

Factor of Safety Against Overturning, $FS_{OT} = M_{resist} / M_{OT} = 22101.3 / 6085.4 = 3.63 > 1.5$ - OK for Overturning

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BEARING CAPACITY CHECK

Moment Arm for Foundation Reaction, X_o = Σ Moments / Σ Vertical Forces

X_o = (22101.3 - 6085.4) / (1411.2 + 1785 + 1836 + 386.1 + 710.2) = 2.61 ft

Eccentricity of Resultant Vertical Bearing Force, e = B/2 - X_o = 5.94/2 - 2.61 = 0.36 ft

Equivalent Footing Width for Eccentrically Loaded Wall, $B'_f = L_{stone} - 2\,e = 5.94 - 2 \times 0.36 = 5.22$ ft

Ultimate Bearing Capacity of the Foundation Soil,

$Q_{ult} = c_f N_c + 1/2\ \gamma_f B'_f N_\gamma + \gamma_f H_{emb} N_q$

From ***Figure 4-5, Bearing Capacity Factors*** from NCMA's Design Manual for Segmental Retaining Walls, 2nd Edition: $\phi = 28°$, $N_c = 25.80$, $N_\gamma = 16.72$, $N_q = 14.72$

$Q_{ult} = 0 + 1/2 \times 120 \times 5.22 \times 16.72 + 120 \times 0.5 \times 14.72 = 6119.9$ lb / ft^2

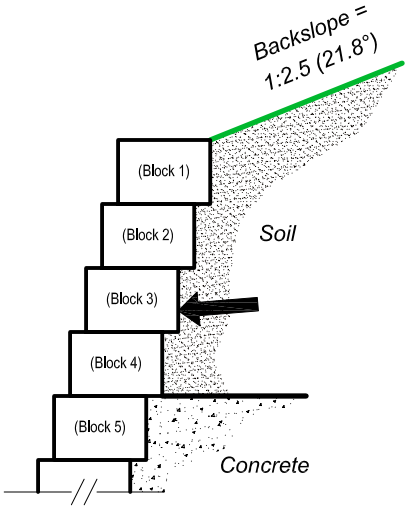
Applied Bearing Pressure,

Q_a = Σ Vertical Forces / B'_f = 6128.5 / 5.22 = 1174.0 lb / ft^2

Factor of Safety Against Bearing Capacity Failure, $FS_{Bearing} = Q_{ult} / Q_a$ = 6119.9 / 1174.0 = 5.21 > 2.0 - OK for Bearing Capacity of Foundation Soils

INTERNAL STABILITY CHECKS ON BLOCK 4-5 INTERFACE

(Check block interface immediately above the Cast-In-Place Concrete Layer)



EARTH PRESSURE COEFFICIENTS

(Coefficients for Analysis of Internal Block Interface Above Cast-In-Place Concrete Layer)

$\phi = 28°$, $\delta = 2/3\ \phi = 18.7°$, $\omega = 14°$, $\beta = 21.8°$

Coulomb active earth pressure coefficient, k_a = 0.3417

Coulomb inclination of failure surface, $\alpha = 41.8°$

INTERFACE SHEAR CHECK ON THE BLOCK 4-5 INTERFACE

(Check Interface Shear Capacity of Block Above Cast-In-Place Concrete Layer)

Earth Pressure Forces Acting on Wall

$P_{a(4)} = k_a \times 1/2 \times \gamma \times H^2 = 0.3417 \times 0.5 \times 120 \times 4.0^2 = 328.0$ lb/ft

$P_{ah(4)} = P_{a(4)} \cos(\delta-\omega) = 328.0 \times \cos 4.7° = 326.9$ lb/ft

$P_{av(4)} = P_{a(4)} \sin(\delta-\omega) = 328.0 \times \sin 4.7° = 26.9$ lb/ft

Interface Shear Capacity

$V_{u(4)} = 360 + (W_{w(4)} + P_{av(4)}) \tan 26°$

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INTERFACE SHEAR CHECK - CONTINUED

$W_{w(4)}$ = 4 x (1' x 1.44') x 140 lb/ft^3 = 806.4 lb/ft

$V_{u(4)}$ = 360 + (806.4 + 26.9) tan 26° = 766.4 lb/ft

Factor of Safety Against Shear Capacity Failure, $FS_{shear(4)} = V_{u(4)} / P_{ah(4)}$ = 766.4 / 326.9 = 2.34 > 1.5 - OK for Interface Shear Capacity Between Layers 4 and 5

OVERTURNING CHECK ON THE BLOCK 4-5 INTERFACE

(Check Overturning Capacity of Portion of Wall Above Cast-In-Place Concrete Layer)

Location of Forces for Moment Calculation From the Theoretical Toe on Block 4

Rosetta Blocks: $X_{u(4)} = G_u + 1/2 \times (h_{(4)} - h_{block}) \times \tan \omega_{blocks}$ = 0.675 + 1/2 x (4.0-1.0) x tan 14.0° = 1.05 ft

Horizontal Component of Earth Pressure Force: $X_{Pah(4)} = 1/3 \times h_{(4)}$ = 1/3 x 4.0 = 1.33 ft

Vertical Component of Earth Pressure Force: $X_{Pav(4)} = W_{block} + (1/3 \times h_{(4)}) \tan \omega_{blocks}$ = 1.44 + (1/3 x 4) tan 14° = 1.77 ft

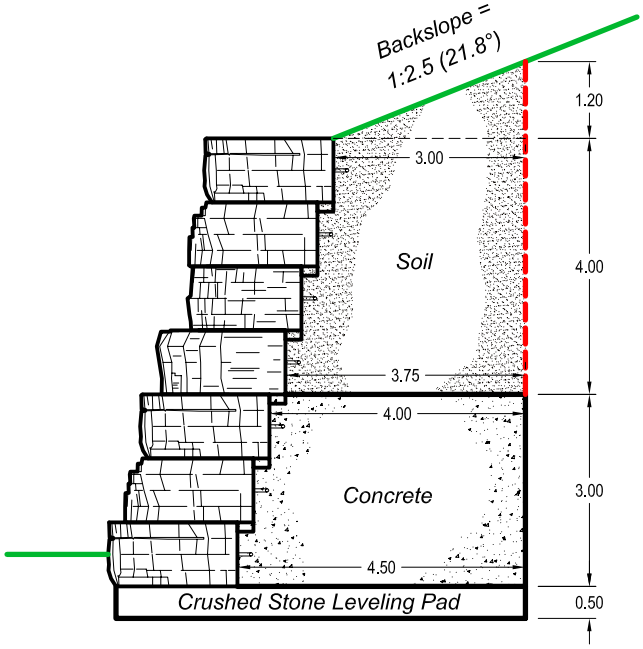
Overturning Moment

$M_{OT(4)} = P_{ah(4)} \times X_{Pah(4)}$ = 326.9 x 1.33 = 434.8 lb ft / ft

Resisting Moment

$M_{resist(4)} = W_{w(4)} \times X_{u(4)} + P_{av(4)} \times X_{Pav(4)}$ = 806.4 x 1.05 + 26.9 x 1.77 = 894.3 lb ft / ft

Factor of Safety Against Overturning, $FS_{OT(4)} = M_{resist(4)} / M_{OT(4)}$ = 894.3 / 434.8 = 2.06 > 1.5 - OK for Overturning Between Layers 4 and 5



SUMMARY

- 7' High Rosetta Block Wall
- Concrete Backfill to Extend 4.5' Behind Bottom Block and 3.0' Above Crushed Stone Leveling Pad
- See Site Specific Design for Full Details