Project	Job #	Date
Stone Strong Gravity Retaining Wall		May 2003

STRUCTURAL ANALYSIS OF GRAVITY RETAINING WALL MAXIMUM HEIGHT OF 9 FEET USING 6 SF BLOCKS

Discussion of Analysis: As the wall is constructed, granular fill is placed in the voids. This creates a "blow-out" force acting on the front and back faces of the block as well as on the webs which define the void. The pressure on the webs is balanced by fill on both sides. The blow-out force on the back face can be considered to be balanced by the active earth pressure of the backfill. The front face must be analyzed for an unbalanced pressure due to the blow-out force.

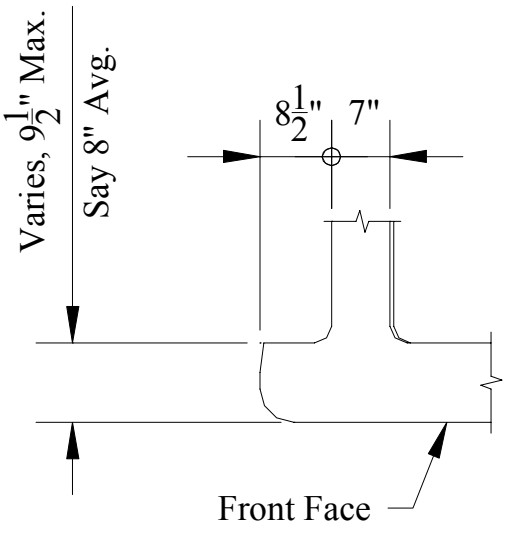
For the fill materials specified, the blow-out force will be taken equal to the at-rest pressure of the fill material assumed to be 40 pcf equivalent fluid pressure. This pressure theoretically increases proportional to the height of the fill. However, the pressure is limited to some maximum fill height above which the granular fill becomes "suspended" by friction on the wall. For this analysis any friction will be ignored and the blow-out force will be calculated using the full height of the column of fill in the void.

For this analysis, ACI 318-2002 *Building Code Requirements for Structural Concrete* will be used. The capacity of the block will be checked using Chapter 22 for Structural Plain Concrete. Only concrete with a 28-day compressive strength of 4000 psi or more shall be used. All concrete shall meet the quality, mixing, and placing requirements of ACI 318. Under no circumstances shall returned or rejected concrete be used.

See Notes on page 5 of 5 for important limitations.

ANALYSIS OF FRONT FACE

Thickness of front face varies due to architectural form liner. Assume an average thickness of 8". Critical section for moment is at face of the web.



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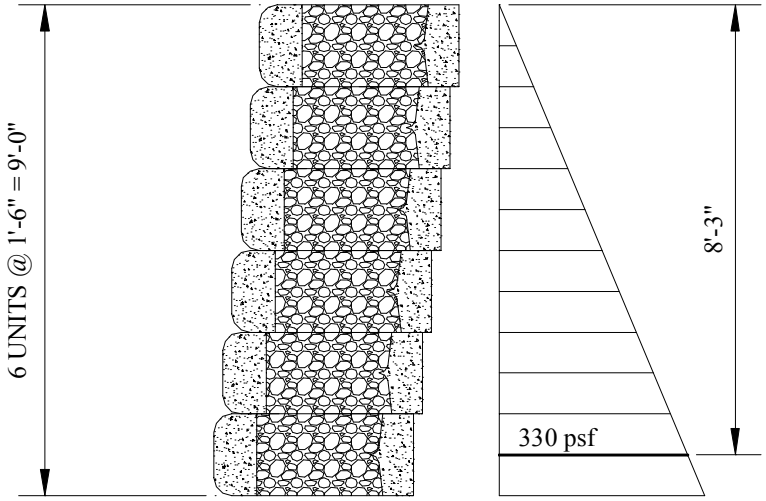
For design purposes, use the pressure at mid height of the block as the average pressure. Consider a 9' tall wall.

Pressure = 40 pcf * 8.25' = 330 psf



Cantilever:

Span = 8.5" (to face of web, ignoring fillets)

M_u = 1.6 * 330 psf * (8.5"/12)^2 / 2 = 132 lb-ft per foot of width

h = 8"

S = 12"*(8")^2 / 6 = 128 in^3

ΦM_n = 0.55 * 5 * $\sqrt{4000}$ * 128 in^3 / 12 = 1855 lb-ft > 132 lb-ft OK

V_u = 1.6 * 330 psf * 8.5"/12 = 374 lb per foot of width

ΦV_n = 0.55 * 4/3 *$\sqrt{4000}$ * 12" * 8" = 4450 lb > 374 lb OK

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Middle Span:

Span = 2' center to center of webs

M_u = 1.6 * 330 psf * $(2')^2$ / 12 = 176 lb-ft per foot of width
(conservatively taken at centerline of web)

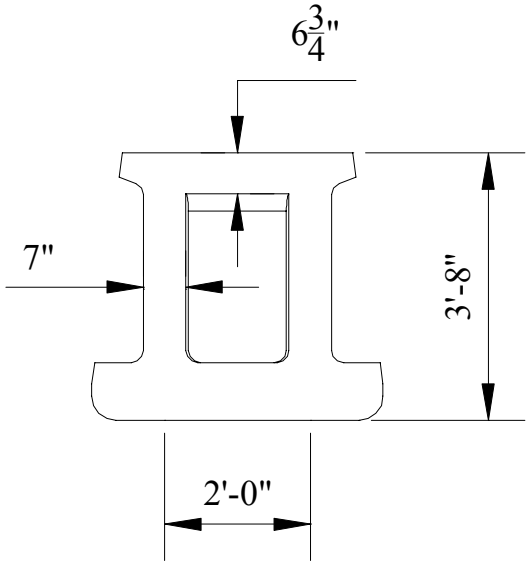
ΦM_n = 1855 lb-ft (from above) > 176 lb-ft OK

V_u = 1.6 * 330 psf * 1' = 528 lb per foot of width
(conservatively taken at centerline of web)

ΦV_n = 4450 lb (from above) > 528 lb OK

ANALYSIS OF BACK FACE

The back face should not see unbalanced pressure as discussed above. However, an analysis of the capacity can be made. The short cantilever portions will not control.



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Middle Span:

h = 6.75”

$S = 12”*(6.75”)^2 / 6 = 91\ in^3$

$\Phi M_n = 0.55 * 5 * \sqrt{4000} * 91\ in^3 / 12 = 1320$ lb-ft

Span = 2’ to centers of webs

$M_u = 1.6 * w * (2')^2 / 12$ at centerline of web

Critical section for moment is at face of web at x = 3.5”/12 = 0.292’
$M_u = 1.6 * w/12 * [6*2'*x - (2)^2 - 6x^2) = 1320$ lb-ft

w = 9800 psf (Does not control. See below.)

$\Phi V_n = 0.55 * 4/3 *\sqrt{4000} * 12” * 6.75” = 3757$ lb

Shear is checked at face of web at x = 3.5”
$V_u = 1.6 * w * 8.5”/12 = 3757$ lb per foot of width

w = 3310 psf ← Controls over flexure

This capacity far exceeds any pressure resulting from the gravity wall analysis. Note that the mass in the back face is important for stability against overturning.

ANALYSIS OF WEBS

During construction, the block is picked up by lifting devices in the webs. The webs must also be able to resist the blow-out forces on the front face.

Web shear during lifting:

Approximate weight of front face = 750 lb

Web height = 18” – 5” notch = 13”

$V_u = 1.4 * 750$ lb = 1050 lb

$\Phi V_n = 0.55 * 4/3 *\sqrt{4000} * (2@7” webs) * 13” = 8440$ lb > 1050 lb OK

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Web tension resisting blow-out:

Factored blow-out on front face = 1.6 * 330 psf * 1.5' * 4' = 3170 lb

Say tension capacity of web = 0.55 * 5 * √4000 * (2@7" webs) * 13"
= 31,650 lb > 3170 lb OK

NOTES:

The analysis provided in these example calculations are for general information purposes only. Anyone making use of this information does so at their own risk and assumes all liability resulting from such use. The soil properties used in these calculations are assumed based on general soil types and may not be applicable to any given project. Site specific design should be performed by a licensed Professional Engineer who is familiar with the actual site conditions and materials, including the supporting and retained soils and ground water.

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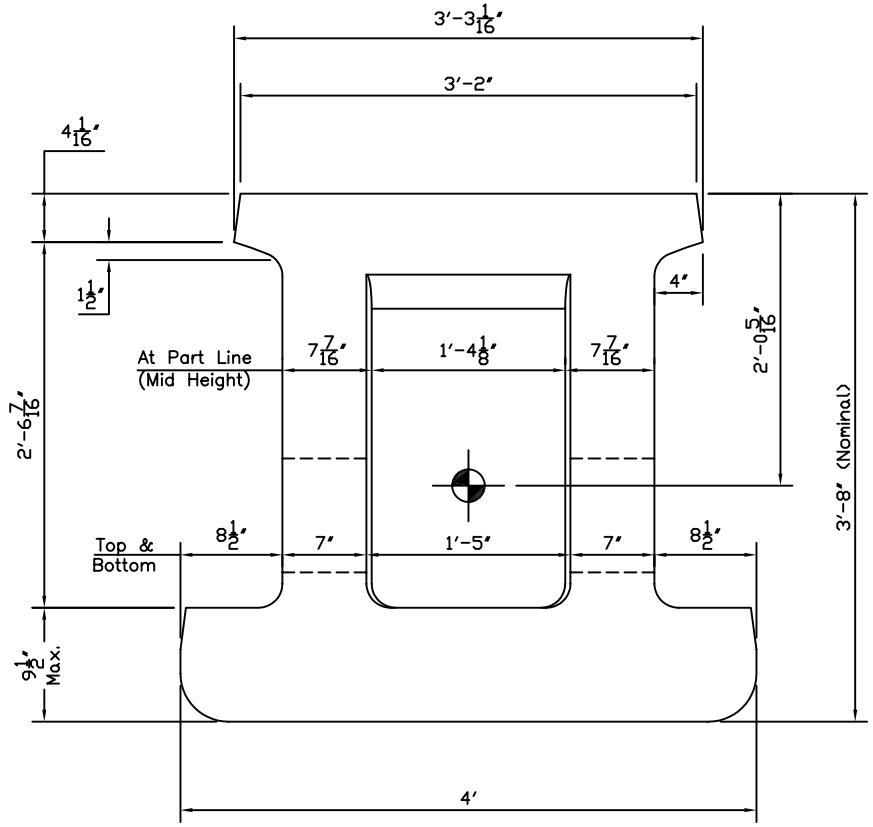

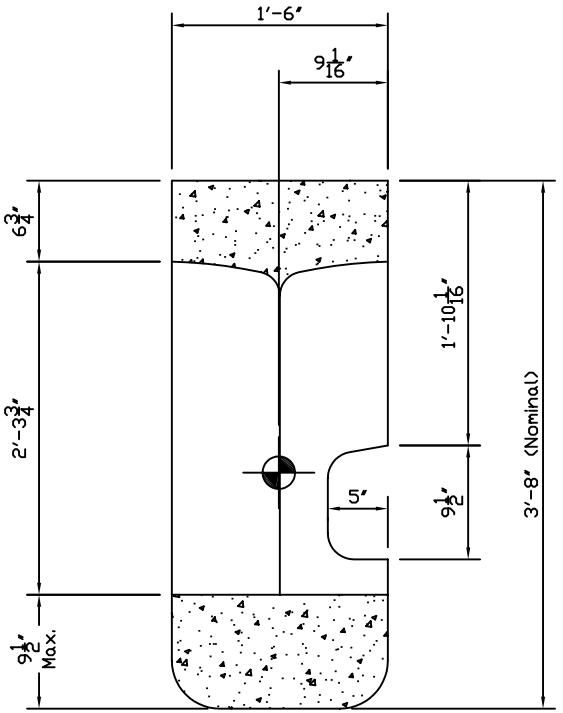

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PROJECT

DETAILS
STONE STRONG SYSTEMS

JOB #	DATE:	FILE: