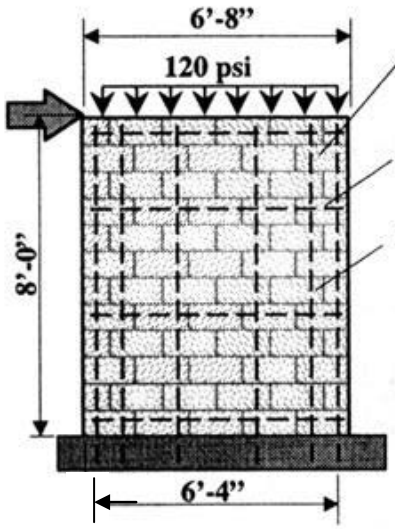
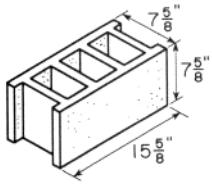
Examples:
Masonry

Example 1

Determine the maximum lateral force, H (by wind), as per MSJC.



8" CMU wall
Type S - PCL mortar
solidly grouted f'_m=3000 psi
Grade 60 steel
#4 @ 32"
2 - #8's each end of wall



Modular size (actual)

Case A: neglect all reinforcement
Case B: consider vertical reinf., neglect horizontal reinf.
Case C: consider vertical and horizontal reinf.
Case D: design horizontal reinforcement for max. shear

Case A: neglect all reinforcement

(M=Hx8' moment arm) $S_g = \frac{7.63 \times 80^2}{6} = 8139\ in^3$

flexure

$-f_a + M/S = F_t \qquad -120 + \frac{96 \times H}{8139} = 0 \qquad H = 10{,}174\ lbs. = 10.2\ kips$

shear

$F_v = 1.5\sqrt{f'_m} = 1.5\sqrt{3000} = 82.2\ psi$ $\qquad f_v = \frac{VQ}{I_n b} = \frac{3V}{2A}$ (solid rectangle)

$V_{max} = \frac{2}{3} F_v bt = \frac{2}{3}(82.2\ psi)(7.63x80) = 33.4\ kips$
(wall area)

Case B: consider only vertical reinforcement

Flexure: neglecting f_a (allowed stress for grade 60 steel)

$M_s = A_s F_s jd = \underbrace{2\ x\ 0.79\ in^2}_{\text{lumping 2 - \#8's}}$ x (32 ksi) x $\underbrace{(0.9 \times 72.0")}_{\text{ave. d for 2 bars}} = 3276$ k-in $\qquad H_{wind} = 34.0\ kips = \frac{3276k-in}{8\ ft(12\ ^{in}/_{ft})}$

(j=0.909 from ρ_b table in Note Set 23.1)

Shear

$M/Vd = \frac{8.0'}{6.0'} = 1.33 > 1$

$for\ \frac{M}{Vd} > 1 \quad F_{vmax} = 2\sqrt{f'_m} = 2.0\sqrt{3000} = 109.5\ psi$ $\qquad f_v = \frac{V}{A_{nv}}$

$$F_{vm} = \frac{1}{2}\left|\left(4.0 - 1.75\left(\frac{M}{Vd}\right)\right)\sqrt{f'_m}\right| + 0.25\left(\frac{P}{A_n}\right) = \frac{1}{2}\left[(4.0 - 1.75(1.33))\sqrt{3000}\right] + 0.25(120\,psi) = 75.8\,psi$$

$V_{max} = A_{nv}F_v = (7.63")(80")(75.8\ psi)/1000 = 46.3\ kips$
(actual width of 8" nominal CMU block)