Seismic Load Example

9-05-01

Given: Residential structure in Memphis, TN

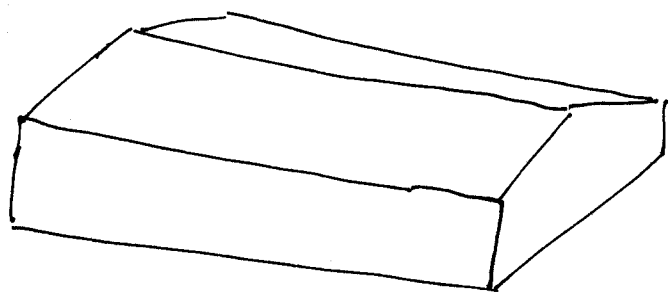
2800 ft², light frame wood construction

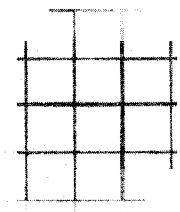
height at top of roof = 23 ft

wood shear walls, roof & floor diaphragms

clay tile roof, 5:12 roof slope

site conditions are soft clay > 40 ft deep





Find: Design base shear force on building

Solution:

Design data:

Reference: Standard Building Code - 1999

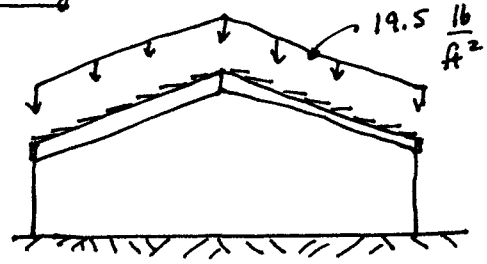
Design Method: Equivalent Base Shear

Location: Memphis, TN

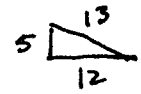
Peak Velocity-Related Acceleration Coeff. = 0.30

Peak Acceleration Coeff. = 0.30

Calculate Dead Load of Building

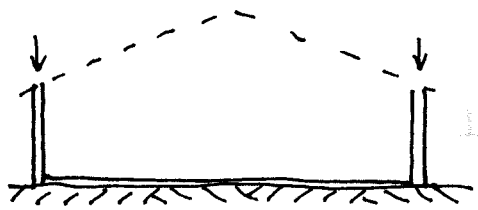


Roof & Walls



Tile roofing	10.0	psf
½ inch plywood sheathing	1.5	psf
roof framing	4.0	psf
Insulation	1.0	psf
gypsum ceiling	2.8	psf
miscellaneous	0.2	psf
total	19.5	psf

based on ft² in house



Floor & Walls

wall framing ~~& sheathing~~	4.0	psf
floor ~~framing~~	1.0	psf
wall sheathing	1.8	psf
gypsum wall board	2.8	psf
miscellaneous	0.4	psf
total	10.0	psf

based on ft² in house

Roof Dead Load (on horizontal projection of house) = $(19.5 \text{ psf})\left(\frac{13}{12}\right) = 21.1 \text{ psf}$

Floor & Wall Dead Load = 10.0 psf

Total Dead Load = 31.1 psf

Total Weight of Building = $(31.1 \text{ psf})(2800 \text{ ft}^2) = 87,080 \text{ lb.}$

use W = 87,000 lb.

Seismic Design Data

A_v : from SBC Figure 1607.1.5.A $A_v = 0.30$

A_a : from SBC Figure 1607.1.5.B $A_a = 0.30$

for Residential structure = Seismic Hazard Exposure Group I
(from SBC Table 1607.1.6)

from Table 1607.1.8 Seismic Performance Category = D

based on deep soft clay foundation
from SBC Table 1607.3.1 Site Coefficient (S_4) = 2.0

Response Modification Factor, $R = 6.5$
from SBC Table 1607.3.3
for light framed walls w/ shear panels

Deflection Amplification Factor $C_D = 4$

Solution for Base Shear

$$V = C_S W$$

$$C_S = \frac{1.2\, A_V\, S}{R\, T^{2/3}}$$

$C_a = 1.3$ from SBC Table 1607.4.1.2 for $A_V = 0.3$

$$T \simeq T_a C_a$$

$$T_a = C_T h_n^{3/4}$$

use $C_T = 0.02$ for light frame wood structure

$h_N = 23$ ft

$$T_a = (0.02)(23\text{ ft})^{3/4}$$

$$T_a = 0.21 \text{ sec.}$$

$$T \simeq T_a C_a = (0.21 \text{ sec})(1.3) = 0.27 \text{ sec}$$

$$C_S = \frac{1.2\, A_V\, S}{R\, T^{2/3}} = \frac{(1.2)(0.3)(2.0)}{(6.5)(0.27)^{2/3}}$$

$$C_S = 0.12$$

also, C_S need not be less than $C_S = \frac{2.5\, A_a}{R}$

$$C_S \quad \frac{2.5\, A_a}{R} = \frac{(2.5)(0.30)}{6.5} = 0.12$$

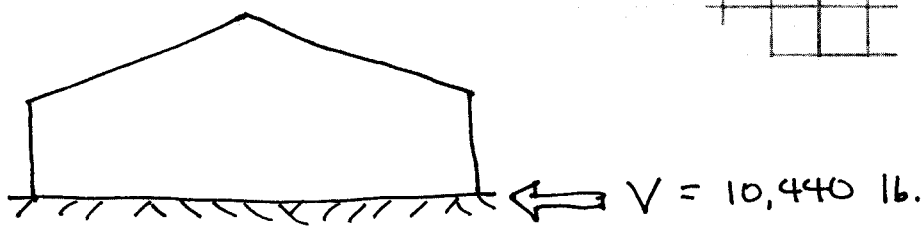
use $C_S = 0.12$

Base Shear

$V = C_s W$

$= (0.12)(87,000\ lb)$

$V = 10,440\ lb.$



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