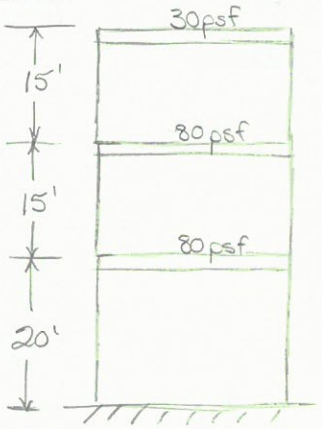
GIVEN



Floor Area = 90' x 90'
Risk Category II
Seismic Category D (max)

Seismic Performance Factors:
$R = 8$
$C_d = 5$
$\Omega_o = 3$

REQUIRED

- Story shear and allowable drift by ASCE 7-10

SOLUTION

Design Accelerations

FEMA P695 → $S_{DS} = 1.0$ $S_{D1} = 0.6$ $S_1 = 0.6$

Seismic Response Coefficient, C_s

Approximate Fundamental Period (§12.8.2.1)

$$T_a = C_t h_n^x = (0.02)(50')^{0.75} = 0.376s \quad \text{(Eq. 12.8-7, Table 12.8-2)}$$

$$C_s = \frac{S_{DS}}{R/I_e} = \frac{1.0}{8/1.00} = 0.125 \quad \text{(Eq. 12.8-2)}$$

$$C_{s,max} = \frac{S_{D1}}{T\left(R/I_e\right)} = \frac{0.6}{(0.376)(8/1.00)} = 0.199 \quad \text{(Eq. 12.8-3)}$$

$$C_{s,min1} = 0.044 S_{DS} I_e \geq 0.01 = (0.044)(1.0)(1.0) = 0.044 \quad \text{(Eq. 12.8-5)}$$

$$C_{s,min2} = \frac{0.5 S_1}{R/I_e} = \frac{(0.5)(0.6)}{8/1.00} = 0.0375 \quad \text{(Eq. 12.8-6)}$$

$C_s = 0.125$

Design Base Shear

Effective seismic weight = $(80+80+30)(90.90) = 1539$ kip (§12.7.2)

$V = C_s W = (0.125)(1539) = \underline{192.4 \text{ kip}}$

Vertical Distribution

$$C_{vx} = \frac{w_x h_x^{\,k}}{\sum_{i=1}^{n} w_i h_i^{\,k}} \qquad \text{(Eq. 12.8-12)}$$

$T < 0.5s, \quad k = 1$

$$\sum_{i=1}^{n} w_i h_i^{\,k} = (80)(8100)(20)^{1.0} + (80)(8100)(35)^{1.0} + (30)(8100)(50)^{1.0}$$

$$= 47790 \text{ kip} \cdot \text{ft}$$

$$C_{v1} = \frac{(80)(8100)(20)^{1.0}}{47790\,000} = 0.271$$

$$C_{v2} = \frac{(80)(8100)(35)^{1.0}}{47790\,000} = 0.474$$

$$C_{v3} = \frac{(30)(8100)(50)^{1.0}}{47790000} = 0.254$$

$$1.000$$

$F_1 = (0.271)(192.4) = 52.18$ kip

$F_2 = (0.474)(192.4) = 91.31$ kip

$F_3 = (0.254)(192.4) = 48.92$ kip

192.4 kip

(Eq. 12.8-11)

Story Shear

$$V_x = \sum_{i=x}^{n} F_i \qquad \text{(Eq. 12.8-13)}$$

$V_1 = F_1 + F_2 + F_3 = 192.4$ kip

$V_2 = F_2 + F_3 = 140.2$ kip

$V_3 = F_3 = 48.9$ kip

Allowable Drift

$\Delta_a = 0.020 h_{sx}$ (Table 12.12-1; Risk category II, "All other structures")

$$\Delta_{a,1} = (0.020)(20') = 0.4' = 4.8''$$
$$\Delta_{a,2} = (0.020)(35') = 0.7' = 8.4''$$
$$\Delta_{a,3} = (0.020)(50') = 1.0' = 12''$$