HORIZONTAL EARTHQUAKE LOAD : $E_h = 54$ lb

VERTICAL EARTHQUAKE LOAD : $E_v = 33$ lb

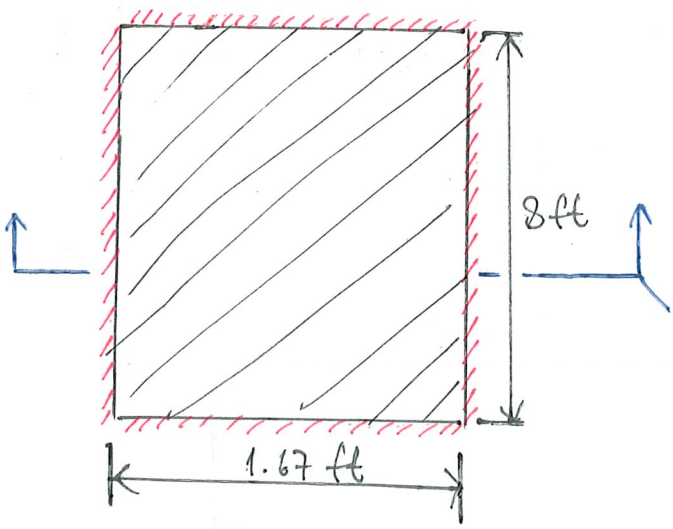
STRUCTURAL ANALYSIS :

* PER SECTION 2205.1, PARA. 1 OF IBC-2018 & THE EXCEPTION NOTED IN SECTION 2205.2.1.1 OF IBC-2018, ALL STRUCTURAL ELEMENTS USED IN THIS PROJECT SHALL BE DESIGNED IN ACCORDANCE WITH AISC 360-2016 UNLESS SPECIFICALLY NOTED OTHERWISE.

FLOOR PLATE :

MATERIAL : CARBON STEEL, ASTM A1011, GRADE 36, TYPE 1

FLEXTURE DESIGN :



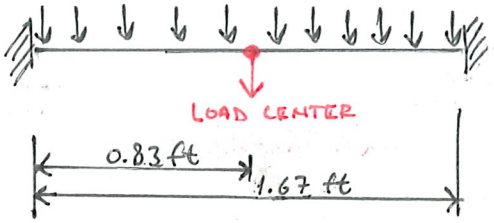
APPLIED LOADS :

DEAD LOAD : $D = 11.26$ lb/ft²

LIVE LOAD : $L = 60$ lb/ft²

$D = 90.08$ lb/ft

$L = 480$ lb/ft



SECTION A-A

$F = 0$ $\quad L_r = 0$ $\quad R = 0$

$H = 0$ $\quad S = 0$

LOAD COMBINATIONS:

* PER SECTION 1605.2 OF IBC-2018 & SECTION 2.3.6 OF AISC 7-2016, THE MOST CRITICAL LOAD COMBINATION IS DEFINED BY EQUATION 16-2 OF IBC-2018.

$$1.2(D+F) + 1.6(L+H) + 0.5(L_r \text{ OR } S \text{ OR } R) \quad [\text{EQ. 16-2, IBC-2018}]$$

$$(1.2 \times 90.08) + (1.6 \times 480) \approx 876.1 \text{ lb/ft} = w$$

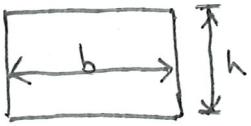
$$M_{max} = M_u = \frac{wL^2}{8} = \frac{876.1(1.67)^2}{8} \approx 305.42 \text{ lb·ft} \approx 3.67 \text{ kip·in}$$

$$R_u \leq \phi R_n \quad [\text{EQ. B3-1, AISC 360-2016}]$$

$$M_u \leq \phi M_n$$

$b = 8 \text{ ft} = 96 \text{ in}$

$h = 0.25 \text{ in}$



$\phi = 0.9$

$$M_n = F_y Z \leq 1.6 F_y S_x \quad [\text{EQ. F11-1, AISC 360-2016}]$$

$F_y = 36.3$ ksi

$$S_x = \frac{bh^2}{6} = \frac{96(0.25)^2}{6} = 1 \text{ in}^3$$

$$Z = \frac{bh^3}{4} = \frac{96(0.25)^3}{4} = 0.375 \text{ in}^3$$

$F_y Z \approx 13.612$ kip·in

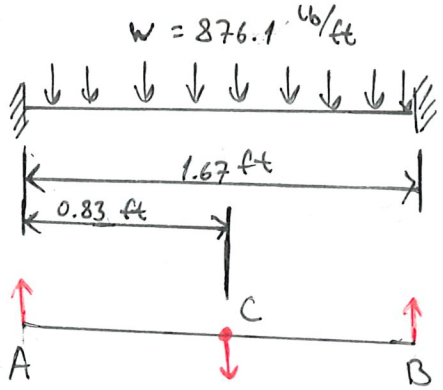
$1.6 F_y S_x = 58.08$ kip·in

$\therefore M_n = 13.612$ kip·in

$$M_u \leq \phi M_n \implies 3.67 \leq 0.9 \times 13.612$$

$3.67 \text{ kip·in} < 12.25 \text{ kip·in} \therefore$ ok ✓

SHEAR DESIGN:



$V_c = 876.1 \times 1.67$

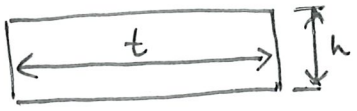
$V_c \approx 1{,}463.09$ lb

$V_A = V_B = \frac{V_c}{2}$

$V_A = V_B = 731.55$ lb $= V_u$

$R_u \leq \phi R_n$ [EQ. B3-1, AISC 360-2016]

$V_u \leq \phi V_n$



$\phi = 0.9$

$h = 0.25$ in

$t = 96$ in

$V_n = 0.6 F_y A_w C_{v2}$ [EQ. G4-1, AISC 360-2016]

$F_y = 36.3$ ksi

$A_w = th = 96 \times 0.25 = 24 \text{ in}^2$

C_{v2}: [SECTION G4., AISC 360-2016]

$k_v = 5$

$E = 29{,}000$ ksi

$\frac{h}{t} = \frac{0.25}{96} \approx 0.0026$

$1.1\sqrt{\frac{k_v E}{F_y}} = 1.1\sqrt{\frac{(5)(29{,}000{,}000)}{36{,}300}} \approx 69.5 > \frac{h}{t}$

$C_{v2} = 1.0$ [EQ. G2-9, AISC 360-2016]

$V_n = 0.6 \times 36{,}300 \times 24 \times 1.0$

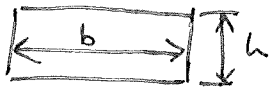
$V_n = 522.72$ kip

$V_u \leq \phi V_n \Rightarrow \quad 0.732 \leq 0.9 \times 522.72$

0.732 kip < 470.448 kip $\therefore$ ok ✓

DEFLECTION:

$\Delta_{max} = \dfrac{5wL^4}{384EI}$ $\quad D = 11.26\ lb/ft^2$ $\quad L = 60\ lb/ft^2$ $\quad I = \dfrac{bh^3}{12}$



$w^{D+L} \approx 90.08\ lb/ft \approx 7.51\ lb/in$ $\quad b = 96$ in

$w^{L} = 480\ lb/ft = 40\ lb/in$ $\quad h = 0.25$ in

$L = 1.67\ ft = 20$ in $\quad I = \dfrac{(96)(0.25)^3}{12} = 0.125\ in^4$

$$\Delta_{max}^{D+L} = \frac{(5)(40+7.51)(20)^4}{(384)(29{,}000{,}000)(0.125)}$$

$\Delta_{max}^{D+L} \approx 0.028$ in $< \dfrac{L}{240} \approx 0.083$ in $\therefore$ ok ✓ [TABLE 1604.3, IBC-2018]

$$\Delta_{max}^{L} = \frac{(5)(7.51)(20)^4}{(384)(29{,}000{,}000)(0.125)}$$

$\Delta_{max}^{L} \approx 0.005$ in $< \dfrac{L}{360} \approx 0.055$ in $\therefore$ ok ✓ [TABLE 1604.3, IBC-2018]

* THE FLEXTURE, SHEAR STRESS & DEFLECTION CALCULATIONS SHOWN ABOVE HAVE BEEN CONSIDERED AS ACTING ON A ONE-WAY SLAB DUE TO THE ASPECT RATIO OF THE PLATE $\left(\frac{8}{1.67}\right)$ BEING > 4.