Column size → W 10 x 33

Pin - Pin column → $K_y = 1.0$

$L = 10\text{ ft} \rightarrow L_x = 20'$, $L_y = 20'$

Along x-axis

Effective length → $(K_x)\cdot(L_x)$

$1 \times 10' = 10'$

Along y-axis

Effective length → $(K_y)(L_y)$

$(1) \times (10') = 10'$

Column choosen: W10 x 33

$E = 29000\text{ ksi}$
$I_x = 171\text{ in}^4$
$I_y = 36.6\text{ in}^4$

Buckling strength:

x-axis: $P_{cr-x} = \dfrac{\pi^2 E I_x}{(K_x L_x)^2}$

$= \dfrac{\pi^2 \times 29000 \times 171\text{ in}^4}{(1 \times 10' \times 12)^2} = 3398.85\text{ kips}$

y-axis:

$P_{cr-y} = \dfrac{\pi^2 \cdot E \cdot I_y}{(K_x \cdot I_x)^2}$

$= \dfrac{\pi^2 \times 29000 \times 36.6}{(1 \times 10' \times 12)^2} = 727.47\text{ kips}$

Effective lengths:

$r_x = 4.19\text{ in}$ $r_y = 1.94\text{ in}$

$\rightarrow \dfrac{K_x L_x}{r_x} = \dfrac{1 \times 10' \times 12\text{ in}}{4.19} = 28.639$

$\rightarrow \dfrac{K_y \cdot L_y}{r_y} = \dfrac{1 \times 10' \times 12}{1.94} = 61.86 \rightarrow$ Slenderness ratio governs

Column strength.

$$\frac{K_y \cdot L_y}{r_y} = \frac{10'}{\frac{1.44}{4.19}} = 21.60 \text{ ft.}$$

Factored design load:

$P_u = 1.2(D) + 1.6(L)$ $\quad D = 150$

$P_u = 1.2(150) + 1.6(50)$ $\quad L = 50$

$= 260$

Column Design	Second level	A-2

DL=20 LL=40

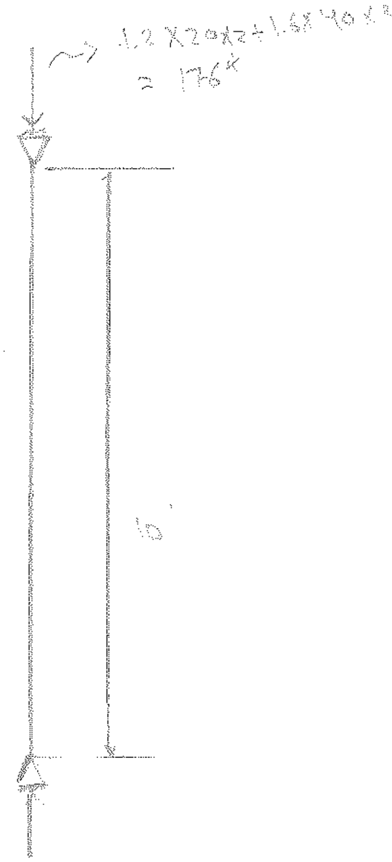
K=1 → Column (Pinned - Pinned)

Col W10X33

$I_x = 171$ → AISC 14th

$I_y = 36.6$ $r_y = 1.94$ $F_y = 50$

$r_x / r_y = 2.16$



$\frac{KL}{r_y} = \frac{1 \times 12 \times 10}{1.94} = 61.85$

$4.71\sqrt{\frac{E}{F_y}} = 4.71\sqrt{\frac{29000}{50}} = 113.43$

$\frac{KL}{r_y} < 4.71\sqrt{\frac{E}{F_y}}$

$F_e = \frac{\pi^2 E}{61.85^2} = 74.82$

$F_{cr} = 0.658^{\frac{F_y}{F_e}} F_y$

$= 0.658^{\frac{50}{74.82}} 50$

$= 37.8$

$A = 9.71$

$\phi P_n = 0.9 F_{cr} \times A$

$= 0.9 \times 9.71 \times 37.8 = 330^k > 176^k$ OK

Column Design	Second floor	4-B

$K = 1$

$r_y = 1.94$

W10×33

$\frac{KL}{r_y} = \frac{10\times12\times1}{1.94} = 61.85$

$4.71\sqrt{\frac{E}{F_y}} = 113.43$

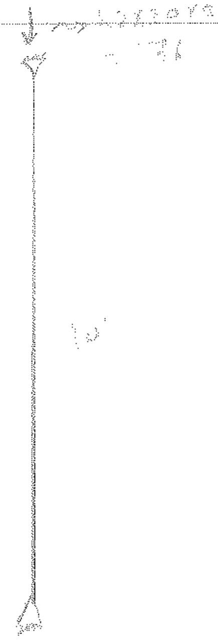
$4.71\sqrt{\frac{E}{F_y}} > \frac{KL}{r_y}$

$F_e = \frac{\pi^2 \times 29000}{61.85^2} = 74.82$

$F_{cr} = 0.658^{\frac{50}{74.82}} \times 50 = 37.8$

$\phi P_n = 0.9 \times F_{cr} \times A$

$= 0.9 \times 9.71 \times 37.8 = 330 > 176$ OK



Column Design | First Floor | A-2

$DL = 20 \quad LL = 40$

$K = 1$

W10X33

$r_y = 1.94$

$\frac{KL}{r_y} = \frac{12 \times 12}{1.94} = 74.22$

$4.71\sqrt{\frac{E}{F_y}} > \frac{KL}{r_y}$

$\downarrow$

113.43

$F_{cr} = 0.658^{\frac{50}{51.96}} \cdot 50$

$F_e = \frac{\pi^2 E}{(KL/r)^2} = 51.96$

$= 33.47$

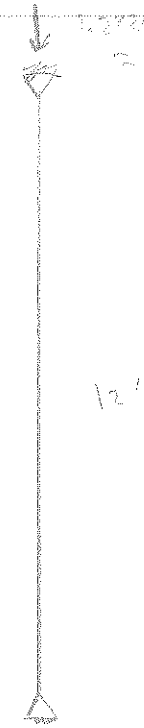
$A = 9.71$

$\phi P_n = 0.9 F_{cr} \times A = 0.9 \times 9.71 \times 33.47$

$= 292^{K} > 264 \quad OK$

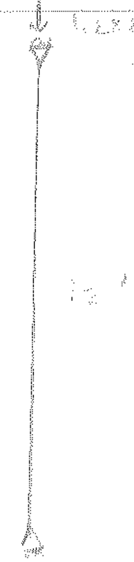
$1.2 \times 20 \times 32 + 1.6 \times 40 \times 3$

$= 264$



Column Design | First Floor | 7-B

$1.2 \times 20 + 1.6 \times 40$ [illegible]



$DL = 20 \quad LL = 40$

$K = 1$

$r_y = 1.94$

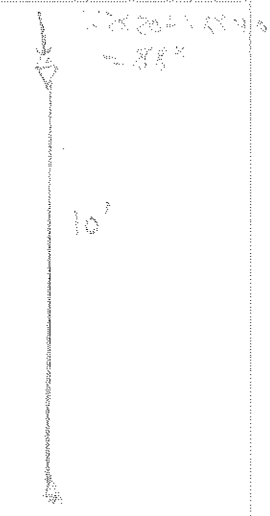
W10X33

$\frac{KL}{r_y} = \frac{12 \times 12}{1.94} = 74.22$

$4.71\sqrt{\frac{E}{F_y}} = 113.43$

$F_{cr} = 0.658^{\frac{F_y}{F_e}} \times 50$ [illegible] $\qquad F_e = \frac{\pi^2 \times 29000}{74.22^2}$ [illegible]

$\phi P_n = 0.9 F_{cr} \times A = 0.9 \times 31.37 \times 33$ ... $= 294^k > 88^k$ OK



DL = 20   LL = 40

K = 1

W10X33

$r_y = 1.94$

$\frac{KL}{r_y} = \frac{1 \times 12 \times 10}{1.94} = 61.82$

$4.71\sqrt{\frac{E}{F_y}} = 4.71\sqrt{\frac{29000}{50}} = 113.43$

$\frac{KL}{r_y} < 4.71\sqrt{\frac{E}{F_y}}$

$F_e = \frac{\pi^2 E}{(61.82)^2} = 74.9$

$F_{cr} = 0.658^{\frac{50}{74.9}} \times 50 = 37.8$

A = 9.71

$\phi P_n = 0.9 \times F_{cr} \times A = 0.9 \times 9.71 \times 37.8 = 330^k > 88^k$

$DL = 20 \quad LL = 40$

$K = 1$

W10x33

$r_y = 1.94$

$$\frac{KL}{r_y} = \frac{1 \times 12 \times 8.95}{1.94} = 55.13^k$$

$$F_{cr} = 0.658^{\frac{50}{94}} \times 50 = 40 \qquad F_e = \frac{\pi^2 \times 29000}{(55.13)^2} = 94$$

$$\phi P_n = 0.9 \times 40 \times 9.71 = 341.56^k > 88 \quad OK$$