

HAMAD

2

2. Select preliminary sizes:

To use same cross-section for both columns:

$$A_g \approx 152.8 / 0.85 \approx 179.8 \text{ in}^2 \quad \text{Try } (14 \times 14)$$

3. Are the columns slender?

$$\frac{K l_u}{r} < 34 - 12 \frac{M_1}{M_2}$$

- column CD: $l_u = 20 - 2 = 18 \text{ ft}$
 $r \approx 0.3h = 0.3 \times 14 = 4.2 \text{ in.}$

$$\nu_{top} = \frac{\sum (EI / l_c)_{col}}{\sum (EI / l_c)_{beam}} \quad I_c = 0.7 I_g = 0.7 \times \frac{14 \times 14^3}{12} = 2240.93 \text{ in}^4$$

$$I_b = 0.35 I_g = 0.35 \times \frac{12 \times (24)^3}{12} = 6451.2 \text{ in}^4$$

$$l_{c1} = 24 \times 12 = 288 \text{ in}$$

$$l_{c2} = 19 \times 12 = 228 \text{ in}$$

$$\nu_{top} = \frac{2240.93/288 + 2240.93/228}{6451.2/360} = 0.98 \quad 57000 \sqrt{0.000}$$

$$\nu_{bot} = \frac{4 E I_c / l_c}{I_p (K_s) \text{ subgrade modulus}} = \frac{4 \times 3.12 \times 10^6 \times 2240.93 / 288}{\frac{40 \times (48)^3}{12} \times 150 \text{ lb/in}^3}$$

$$= 1.73$$

from Nomograph $K = 0.806 \approx 0.81$

$$\text{So } \frac{K l_u}{r} = \frac{0.81 \times 18 \times 12}{4.2} = 41.7 > 34 - 12(-0.4) = 38.8$$

→ slender

- Column DE: $l_u = 24 - 2 = 22 \text{ ft}$
 $r \approx 4.2 \text{ in.}$

$$\nu_{top} = \frac{2240.93/288}{6451.2/25 \times 12} = 0.36$$

$$\nu_{bot} = 0.98$$

from Nomograph $K = 0.71$

$$\text{So } \frac{K l_u}{r} = \frac{0.71 \times 22 \times 12}{4.2} = 44.6 > 34 - 12(0.75) = 25$$

→ slender

$\frac{K l_u}{r} < 100$ for both cases \Rightarrow OK use ACI moment magnification method