

مثال:

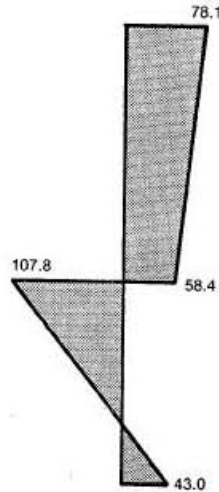
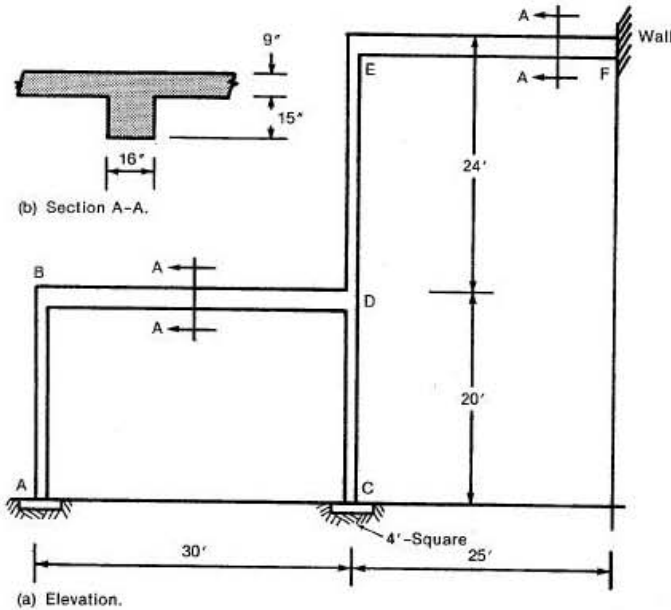
Macgregor، ۱۲-۲

طراحی ستون در قاب  
باربندی شده

ستون CD و DE

$f_c = 3 \text{ ksi}$

$f_y = 60 \text{ ksi}$



(c) Moments in columns CD and DE, (ft-kips)

Fig. 12-28  
Braced frame—Example 12-2



۱- در محاسبه نیروها با تحلیل قاب  
۲- محاسبه ترکیبات بارگذاری  
آیا

	Column CD	Column DE
Service loads, P	Dead = 80 kips Live = 24 kips	Dead = 50 kips Live = 14 kips
Service moments at tops of columns	Dead = -60 ft-kips Live = -14 ft-kips	Dead = 42.4 ft-kips Live = 11.0 ft-kips
Service moments at bottoms of columns	Dead = -21 ft-kips Live = -8 ft-kips	Dead = -32.0 ft-kips Live = -8 ft-kips

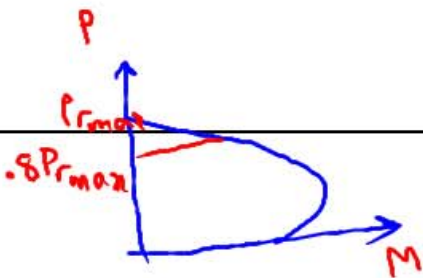
$$1.25D + 1.5L$$

$$P_u = 1.25 \times 50 + 1.5 \times 14 = 83.5 \text{ kips}$$

$$M_{u_{top}} = 69.5 \text{ ft.kip}$$

$$M_{u_{bot}} = -52 \text{ ft.kip}$$

۳- انتخاب اولیه ابعاد ستون



$$.8(.85 f_{cd} A_g + A_{st} f_{yd}) = P_u$$

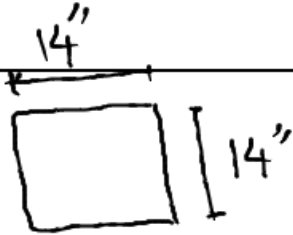
$$A_g (.8 [ .85 f_{cd} + \rho_{st} f_{yd} ]) = P_u$$

$$A_g \gg \frac{P_u}{.4 f_c + .68 \rho_{st} f_y} \quad \frac{P_u}{.45 (f_c + \rho_{st} f_y)}$$

1-2% ←

$$A_g \gg \frac{152.8}{.4 (3 + .68 \times .015 \times 60)} = 105 \text{ in}^2$$

10.2" x 10.2"

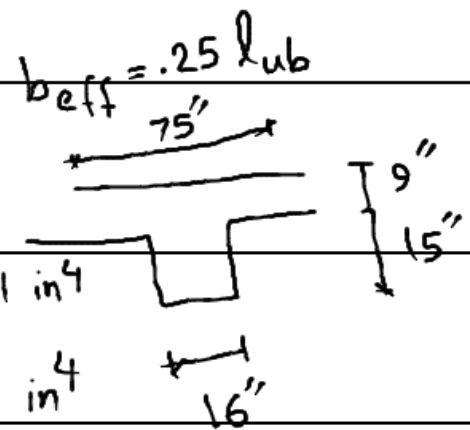


عبارت استون لاغراست؟

$$\frac{k l_u}{r} \leq 34 - 12 \left( \frac{M_1}{M_2} \right)$$

$$l_u = 24' - 2' = 22'$$

$$\psi_D, \psi_E = \frac{\sum \left( \frac{EI}{l} \right)_c}{\sum \left( \frac{EI}{l} \right)_b}$$



$$I_b = .35 I_{gb} = .35 \times \frac{16 \times 24^3}{12} = 6451 \text{ in}^4$$

$$I_c = .7 I_{gc} = .7 \times \frac{14^4}{12} = 2241 \text{ in}^4$$

$$\psi_D = \frac{\frac{2241}{240} + \frac{2241}{288}}{\frac{6451}{360}} = .95$$

$$\psi_E = \frac{\frac{2241}{288}}{\frac{6451}{360}} = .43$$

$$\psi_{min} = .43$$

$$\psi_m = \frac{.43 + .95}{2} = .69$$

$$\min \begin{cases} K = .7 + .1\psi_m = .7 + .1 \times .69 = .77 \\ K = .85 + .05 \times .43 = .87 \end{cases}$$

$$K = .77$$

$$\frac{kl_u}{r} = \frac{.77 \times 264}{.3 \times 14} = 48.4 < 34 - 12 \times \frac{52}{69.5} = 25$$

و، کنترل لنجر حداقل

$$\text{ل. 10-13} \quad e_{min} = 15 + .03h = 26 \text{ mm} = 1''$$

$$\text{ل. 5} \quad M_{min} = 83.5 \times 1 = 83.5 \text{ kip.in} = 7 \text{ ft.kip} < 69.5$$

و،  $EI_e$  ستون

$$EI_e = \frac{.4 E_c I_g}{1 + \beta_d} = \frac{.4 \times 3297 \times 10^3 \times 2241}{1 + .72} = 1.72 \times 10^9 \text{ lb.in}^2$$

$$E_c = 5000 \sqrt{20.7} = 22748 \text{ MPa} = 3297 \text{ ksi}$$

$$I_g = 2241 \text{ in}^4$$

$$\beta_d = \frac{P_{uD}}{P_u} = \frac{1.25 \times 50}{83.5} = .72$$

$$N_c = \frac{\pi^2 EI_e}{(kl_u)^2} = \frac{\pi^2 \times 1.72 \times 10^9}{(.77 \times 264)^2} = 410808 \text{ lb}$$

$N_c \sim 5, V$

$$\delta_b = \frac{C_m}{1 - \frac{N_u}{\phi_n N_c}} \geq 1$$

$$C_m = .6 + .4 \frac{M_1}{M_2} = .6 + .4 \times \frac{52}{69.5} = .9 \geq .4$$

$$\delta_b = \frac{.9}{1 - \frac{83.5}{.65 \times 410.808}} = 1.31 \geq 1$$

$$M_c = \delta_b M_2 = 1.31 \times 69.5 = 91 \text{ kip.ft}$$

$$\begin{cases} P_u = 83.5 \text{ kips} \\ M_c = 91 \end{cases} \longrightarrow 4 \# 10$$