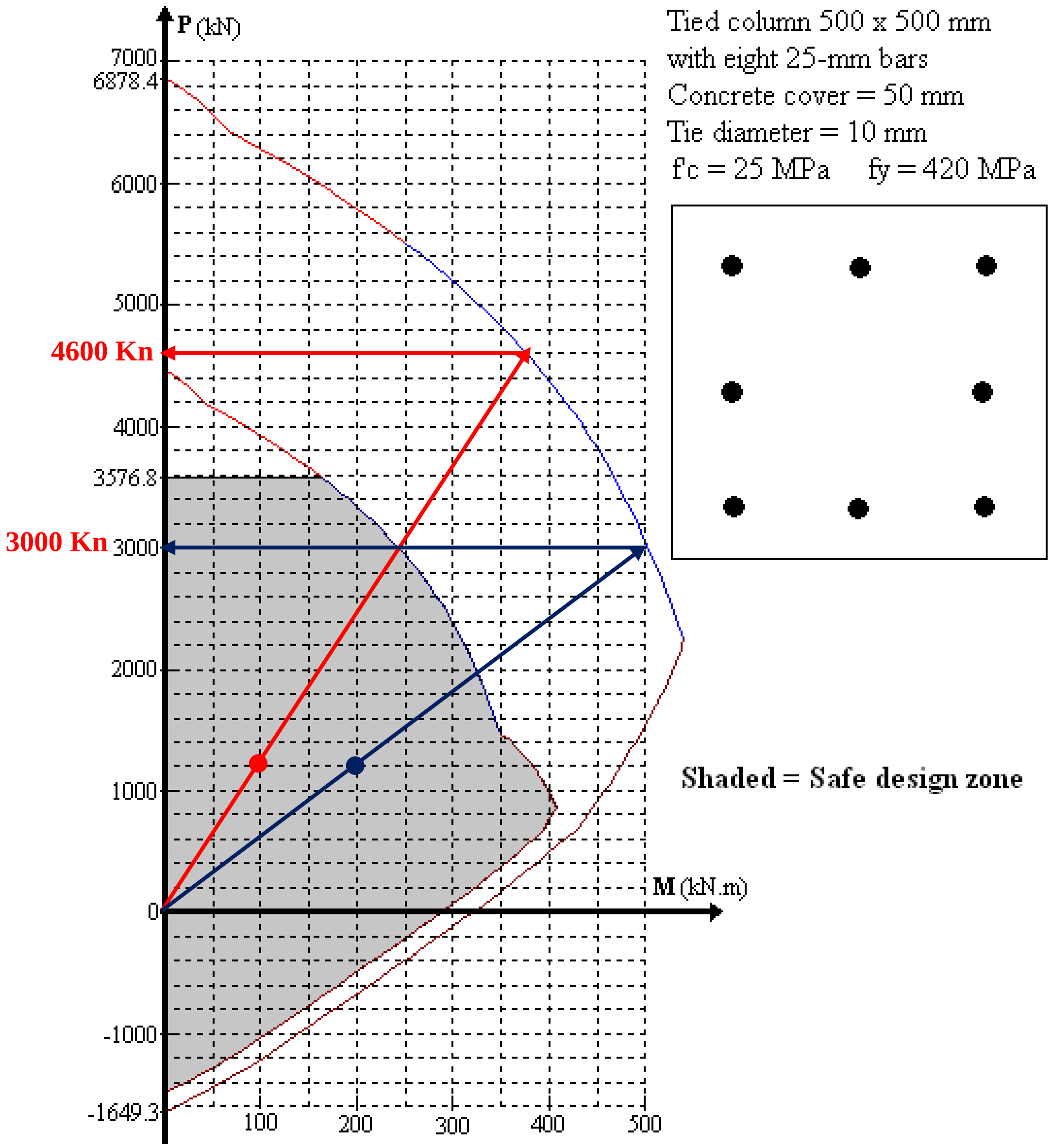


Bresler reciprocal method :-

All points are located in shaded area (safe zone)

$$P_o = 6878.4\ Kn$$

$$\frac{1}{P_n} = \frac{1}{P_{nx}} + \frac{1}{P_{ny}} - \frac{1}{P_{no}} = \frac{1}{4600} + \frac{1}{3000} - \frac{1}{6878.4} = 4.0534 * 10^{-3}\ \ 1/Kn$$

$$P_n = 2467.05\ Kn \Rightarrow \quad \emptyset P_n = 0.65 * 2467.05 = 1603.58\ Kn > P_u$$

$$ok\ the\ column\ is\ safe$$

$$f'_c = 25\text{ MPa} \quad , \quad f_y = 420\text{ Mpa} \quad , \quad L = 5500 \quad , \quad P_u = 1200\text{ Kn}$$

$$K = 0.9 \quad , \quad M_1 = 140\text{ Kn.m} \quad , \quad M_2 = 180\text{ Kn.m}$$

Single curvature

$$\frac{0.9 * 5500}{0.3 * 500} \leq 34 - 12\left(\frac{140}{180}\right) \Rightarrow 33 \nleq 24.667$$

$$\Rightarrow \text{slender column(Long column)}$$

$$C_m = 0.6 + 0.4\left(\frac{140}{180}\right) \geq 0.4$$

$$C_m = 0.911$$

$$I_g = \frac{b * h^3}{12} = \frac{500 * 500^3}{12} = 5.2083X10^9 mm^4$$

$$E_c = 4700\sqrt{f'_c} = 4700\sqrt{25} = 23500\text{ Mpa}$$

$$\beta_d = 0.75$$

$$EI = \frac{0.4 * E_c * I_g}{1 + \beta_d} = \frac{0.4 * 23500 * 5.2083X10^9}{1 + 0.75} = 2.798X10^{13} N.mm^2$$

$$P_c = \frac{\pi^2 EI}{(kL_u)^2} = \frac{\pi^2(2.798X10^{13})}{(0.9 * 5500)^2} * 10^{-3} = 11257.384\ Kn$$

$$M_{2_{min}} = p_u * (15 + 0.03h) = 1200 * (15 + 0.03 * 500)10^{-3} = 36\ Kn.m$$

$$M_2 = \max\left(M_2, M_{2_{min}}\right) = 180\ Kn.m$$

$$\delta_{ns} = \frac{C_m}{1 - \frac{P_u}{0.75 * P_c}} \geq 1 \Rightarrow \frac{0.911}{1 - \frac{1200}{0.75 * 11257.384}} = 1.0621$$

$$\therefore \delta_{ns} = 1.0621$$

$$M_c = \delta_{ns} * M_2 = 1.0621 * 180 = 191.17\ Kn.m$$

This point (1200, 191.17) is located in safe zone … OK the column is safe

<u>Problem:2</u>

<u>1)</u>

$$Wu = 1.4(2 + 0.2 * 24) + 1.7(3) = 14.62\ Kn/m^2$$

1) Exterior panel

$$L_n = 6 - \frac{0.3}{2} - \frac{0.3}{2} = 5.7\ m$$

$$h_{min} = \frac{L_n}{30} = \frac{5700}{30} = 190\ mm$$

2) Interior panel

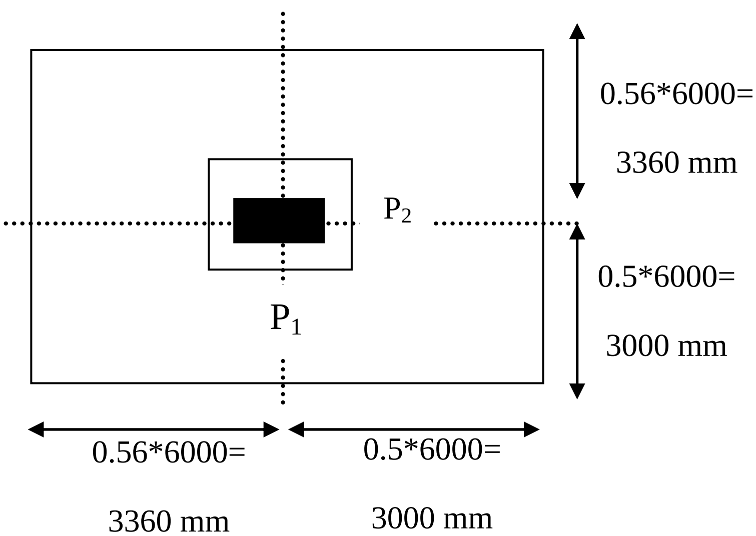
$$L_n = 6 - \frac{0.3}{2} - \frac{0.3}{2} = 5.7\ m$$

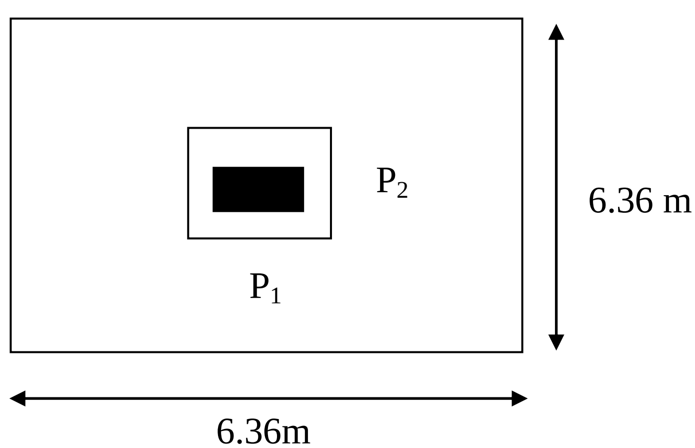
$$h_{min} = \frac{L_n}{33} = \frac{5700}{33} = 172.73\ mm$$

$$h_{min} = Max(190\ ,172.73) = 190\ mm$$

$$h > h_{min} \rightarrow ok$$

<u>2)</u>





$P_1 = C_1 + d_{ave} = 300 + 168 = 468\ mm$

$P_2 = C_2 + d_{ave} = 300 + 168 = 468\ mm$

$V_u = W_u(A_o - A_c) = 14.62\ (6.36 * 6.36 - 0.468 * 0.468) = 588.17\ KN$

b_o=length of critical perimeter= 2*(P_1+ P_2)= 2*(468+ 468)=1872 mm.

β_c=column length ratio $(\frac{long\ side}{short\ side}) = \frac{300}{300} = 1$

$\alpha_s = 40$

$$V_c = \text{Min}\begin{Bmatrix} \left(1 + \frac{2}{1}\right)\frac{\sqrt{25}}{6} * 1872 * 168\ \text{x}10^{-3} = 786.24\ \text{Kn} \\ \left(2 + \frac{40 * 168}{1872}\right)\frac{\sqrt{25}}{12} * 1872 * 168\ \text{x}10^{-3} = 732.48\text{KN} \\ \frac{\sqrt{25}}{3} * 1872 * 168\text{x}10^{-3} = 524.16\ \text{Kn} \end{Bmatrix}$$

$$= 524.16\ \text{KN}$$

$\varphi V_c = 0.75 * 524.16 = 393.12\ Kn < 588.17\ Kn\ \therefore$ two way shear is not ok

3)

	Span B_2-B_3		
L_1 (m)	6		
L_2 (m)	6		
L_n (m)	5.7		
$\boldsymbol{M_o = W_s L_2 \frac{L_n^2}{8}\ (KN.m)}$	356.25		
L_{min} (m)	6		
CS width (m) =0.5 L_{min}	3		
Moment coefficients	0.65	0.35	0.65
-ve and +ve moments	231.56	124.69	231.56
CS moment (%)	75	60	75
CS moments (kN.m)	173.67	74.81	173.67
MS moment (%)	25	40	25
MS moments (kN.m)	57.89	49.88	57.89

4)

$b = 3000\ mm \quad , \quad M_u = 200\ kn.m$

$$d = 200 - 20 - \frac{12}{2} = 174\ mm\ , \qquad R_n = \frac{200/0.9}{3000 * 174^2} * 10^6 = 2.447\ Mpa$$

$$m = \frac{420}{0.85 * 25} = 19.765\ ,$$

$$\rho = \frac{1}{19.765}\left(1 - \sqrt{1 - \frac{2 * 2.447 * 19.765}{420}}\right) = 0.00621$$

$$A_s = 0.00621 * 3000 * 174 = 3239.48\ mm^2\ ,$$

$$A_{s\ min} = 0.0018 * 3000 * 200 = 1080\ mm^2$$

$$S_{max} = \min\left(\frac{113.04}{3239.48} * 3000 = 104.68\ mm, 300mm, 2 * 200 = 400\right)$$
$$= 104.68\ mm$$

$$for\ flexural \rightarrow use\ \emptyset 12@100\ mm$$

5)

$$I_b = 9.56X10^9\ \ mm^4$$

$$I_s = \frac{b * h^3}{12} = \frac{6000 * 150^3}{12} = 1.6875X10^9\ mm^4$$

$$\alpha = \frac{I_b}{I_s} = \frac{9.56X10^9}{1.6875X10^9} = 5.67$$

6)

$$\alpha = 2.5$$

$$\beta = \frac{6000 - 300}{6000 - 300} = 1$$

$$h_{min} = \frac{L_n \left(0.8 + \frac{f_y}{1500}\right)}{36 + 9\beta}$$

$$h_{min} = \frac{5700 \left(0.8 + \frac{420}{1500}\right)}{36 + 9(1)} = 160.8\ mm$$

$$h = 150 < h_{min} \quad not\ ok$$