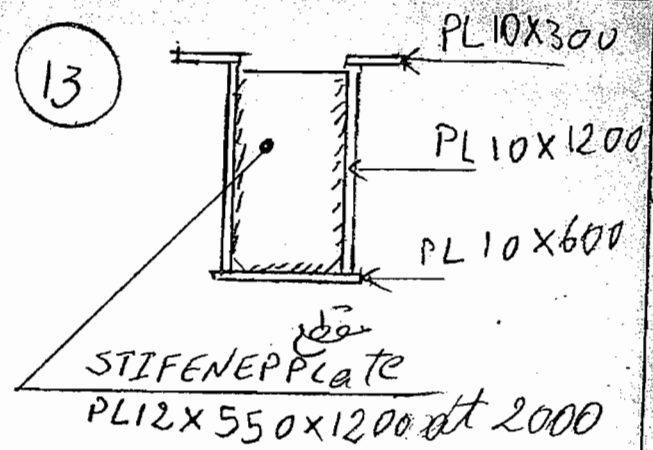
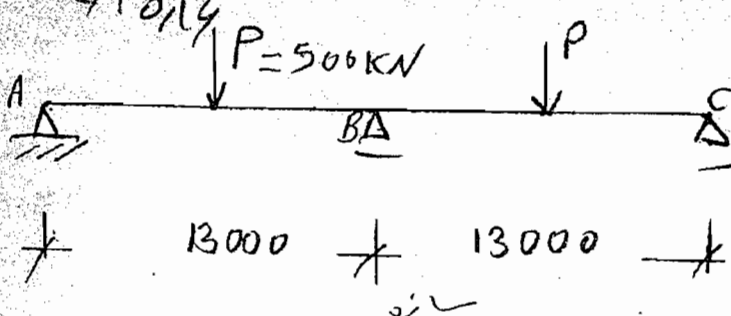


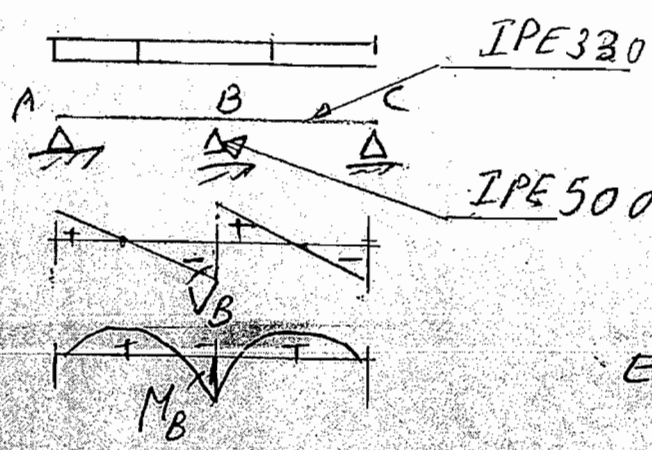
استفاده از جزوه و کتاب آزاد بوده و بی رد و بدل در میان امتحان مجموع است

تعداد مثلاً $n=4$ که مجموع ضربات $= 40$ ، زمان امتحان $= 4$ ساعت

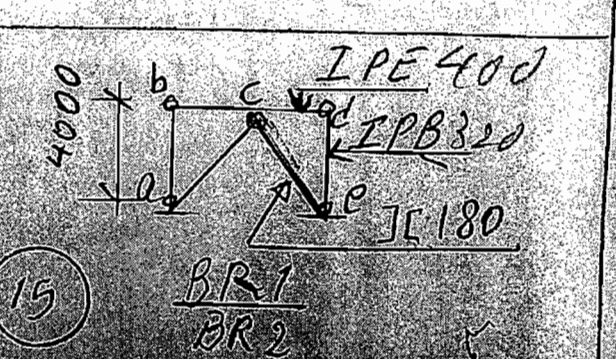
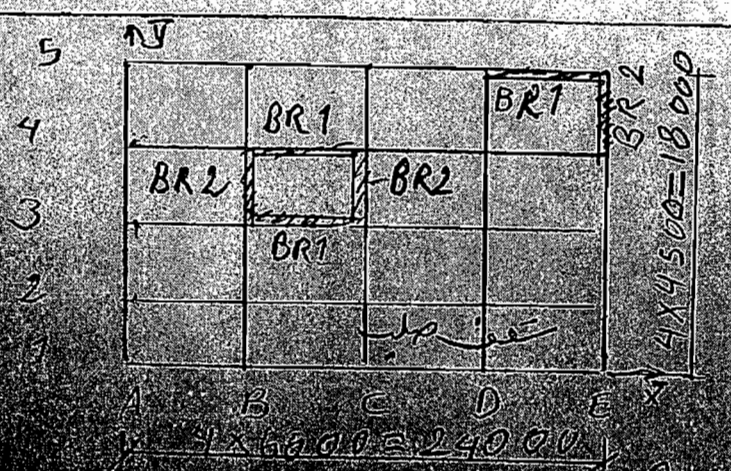
1	0.17
2	0.15
3	0.12
4	0.14



۱- سازه فوق کنترل گردد. سازه در تمام طول بر عیارش باشد (است. ST 37) بارگذاری گدای



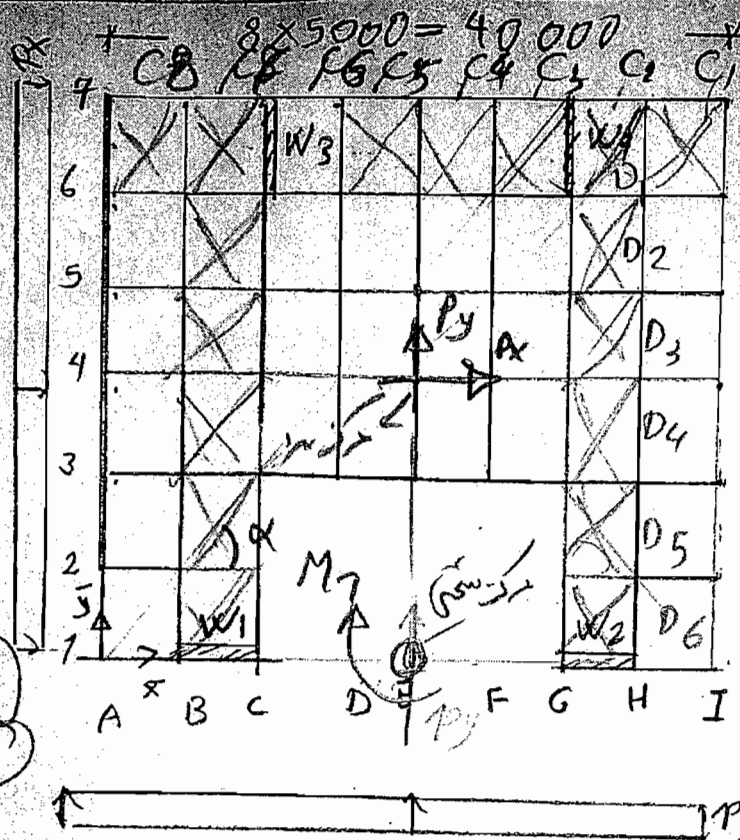
۲- پلیر یکسره ABC در-
تکانه گان B طراحی و رسم گردد
بال قدرمان همه پلیرها هم تراز
مستند
 $M_B = 90 \text{ kNm}$
 $V_B = 10 \text{ kN}$
عوض ST 37 بارگذاری گدای گدای E 43



۳- طراحی و رسم پلیرها
بارگذاری گدای گدای E 43

سازمان نظام مهندسی ساختمان
تهران - خرداد ۱۹

مهندسین مشاور - دانشکده مهندسی - دانشکده عمران - تهران



$$\frac{10}{60} = 29.16$$

10

$$6 \times 6000 = 36000$$

فصل ۱۰ - جان سقف ساختمانی داده شده است - سقف با حداقل مهاربندی باید برگرد
این برای باید برگردانده تمام ساختمان با الی الی W4 نشان داده شده است

$$P_y = 15 \text{ kN/m}, P_x = 12 \text{ kN/m}$$

$$P_x = 12 \times 3.6 = 432 \text{ kN}$$

$$P_y = 40 \times 15 = 600 \text{ kN}$$

$$M_T = 432 \times (1800)$$

$$C_1 = \frac{1}{\sin \alpha} \times 15 \times P_x$$

$$C_2 = 2C_1$$

$$C_3 = 2C_1$$

$$C_4 = C_1$$

$$\frac{M_T}{4 \times 500} \times \frac{1}{\sin \alpha}$$

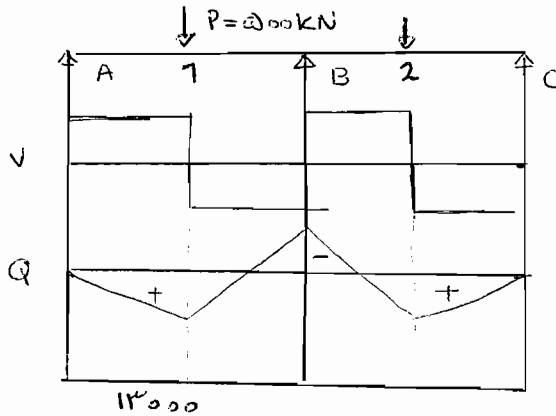
معماری از Py

Py

$$6 \times 12$$

$$\frac{13}{77} = 0,17$$

-۱



8+37

یک بر علیه کمایش جانبی نگهداری شده است $F_b \leq 0,77 F_y$

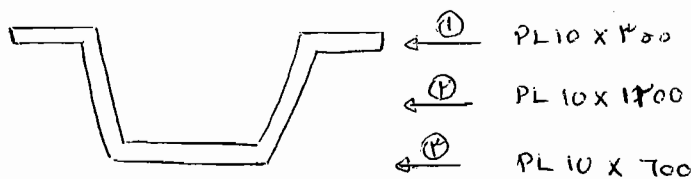
$$V_A = 0,3125 \times 500 = 156,25$$

۲- محاسبه نیروها

$$V_{BE} = 0,6875 \times 500 = 343,75$$

$$M_A = 0,15625 \times 500 \times 13 = 1015,625 \text{ kNm}$$

$$M_B = -0,6875 \times 500 \times 13 = -4506,25 \text{ kNm}$$



۳- نوع مقطع



۱-۲ در وسط دهانه - ندر مشقت PL 10

$$\frac{b}{t} = \frac{30}{1} = 30 \quad \> 11 \rightarrow \text{فشرده}$$

$$\> 17 \rightarrow \text{غیر فشرده}$$

$$> 17 \rightarrow \text{ناایمنی لازم}$$

۱-۲ نوع مقطع نامراسه

۲-۳ در وسط دهانه - ندر مشقت

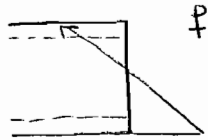


۱-۲ نوع مقطع

$$\frac{b}{t} = \frac{70}{1} = 70 \quad \> 32,5$$

$$\> 32,5$$

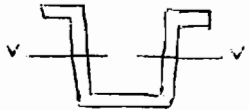
۳-۳) جابجایی - تحت اثر بار حاصل از خمش



$$\frac{b}{t} = \frac{140}{1} = 140 \quad \text{مردود} \quad \< 110$$

مردود ≤ 170

جان مقطع غیرمردود منبسطه که نشان موصوفی ناشی از خمش مطروح نیست



۴- محاسبه مشخصات مقطع - مقطع از لحاظ ابعاد متعارف است، محور از وسط مقطع می‌گذرد.

$$I = 2 \times 1 \times \frac{140^3}{12} + 21 \times 70 \times (70 + 0.5)^2 = 727240 \text{ cm}^4$$

$$S = \frac{I}{71} = 11921 \text{ cm}^3$$

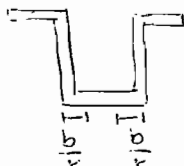


$$M = -1218.77 \text{ kNm}$$

$$f = \frac{1218.77}{11921} \approx -10.2 \text{ kN/cm}^2$$

۵- کنترل تنش بر روی لبه گانه B

کنترل تنش منشی



محاسبه تنش محار خمش

پای خنیا اجرا شده دارد به مثلی

$$b_e = \frac{7V_0 t}{\sqrt{f}} \left[1 - \frac{133}{\frac{b}{t} \sqrt{f}} \right] = \frac{7V_0 \times 10}{\sqrt{102}} \left[1 - \frac{133}{\frac{700}{10} \sqrt{240}} \right] = 574 \text{ mm} \leq 700$$

بعلا امتداد کم محل ثقل عوفت می شود

$$I_e = 727240 - (70 - 574) \times 1 \times (70 + 0.5)^2 = 717714$$

$$S_e = \frac{I_e}{71} = 11775 \text{ cm}^3$$

$$f = \frac{1218.77}{11774} = -10.37 \text{ kN/cm}^2$$

$$b_e \approx \dots \approx 570 \text{ mm}$$

$$Q = \frac{A_e}{A}$$

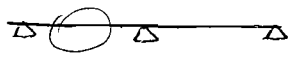
$$D_b = 70 - 57 = 13 \text{ cm}$$

$$A = 2 \times 1 \times 140 + 2 \times 1 \times 12 + 1 \times 70 = 370 \text{ cm}^2$$

$$A_e = 370 - (70 - 57) \times 1 = 357 \text{ cm}^2$$

$$Q = \frac{357}{370} = 0.965$$

$$F_b = Q(0.7F_y) = 0.965 \times (0.7F_y) = 143 \text{ N/mm}^2$$



کنترل تنش خمشی در وسط دهانه به ندرت



$$M = 1010, 13$$

المانی

- مانع از = مانع از

$$\frac{h}{t} = \frac{r_o}{1} = r_o \geq \frac{r_{10}}{\sqrt{F_y}} = 27 \rightarrow$$

$$Q_s = \frac{109 \times 10^3}{F_y \left(\frac{b}{t}\right)^2} = \frac{109 \times 10^3}{r_o \times (r_o)^2} = 0, 000$$

$$F_b = 0, 000 \times (0, 7 F_y) = 0, 7 F_y \text{ KN/cm}^2$$

$$F_b = \frac{1010, 13}{11921} = 0, 085 \text{ KN/cm}^2 \neq 0, 7 F_y$$

جواب نمی دهد. مانع از نداشت

$$\frac{h}{t} = \frac{r_o}{1} = r_o \geq \frac{1010}{\sqrt{F_y}} = 7, 5$$

- کنترل برش درست نیست. باید

$$7, 5 \frac{1010}{\sqrt{F_y}} \leq \frac{h}{t_w} = r_o \leq 27 \rightarrow F_v = \frac{F_y}{1, 89} C_v \leq 0, 7 F_y$$

$$V = 208, 50 \text{ KN}$$

$$\frac{Q}{h} =$$

$$Q = 200 \text{ cm} \quad h = 120 \text{ cm}$$

$$\frac{Q}{h} = 1, 7 V \geq 1$$

$$C_v = 0, 7 + \frac{1}{\left(\frac{Q}{h}\right)^2} = 0, 7 + \frac{1}{(1, 7)^2} = 0, 78$$

$$C_v = \frac{210 \times 10^3 \text{ KN}}{F_y \left(\frac{h}{t_w}\right)^2} = \frac{210 \times 10^3 \times 0, 78}{r_o \times \left(\frac{120}{1}\right)^2} = 0, 78 \leq 0, 78$$

$$F_v = \frac{210}{1, 89} \times 0, 78 = 81, 0 \text{ N/mm}^2$$

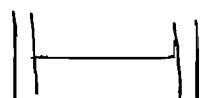
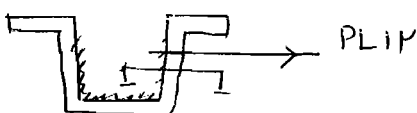
$$F_v = \frac{V}{A_w} \rightarrow A_w = 2 \times 1 \times 120 = 240 \text{ cm}^2$$

$$F_v = \frac{208, 50}{240} = 0, 87 \text{ KN/cm}^2 \leq F_v = 81, 0$$

$$I_{st} > \left(\frac{h}{\omega_0}\right)^2$$

سفت کننده

$$\left(\frac{h}{\omega_0}\right)^2 = \left(\frac{120}{\omega_0}\right)^2 = 12, 1 \text{ cm}^2$$

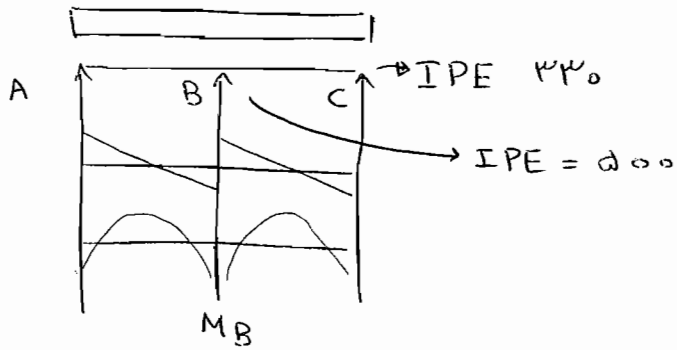


$$\frac{\omega_0}{r} = 27, 0 \text{ cm}$$

$$I_{st} = 1, 2 \times \frac{27, 0^4}{12} + 1, 2 \times 27, 0 \times \left(\frac{27, 0}{2} + 0, 7\right)^2 = 1970 \text{ cm}^4$$

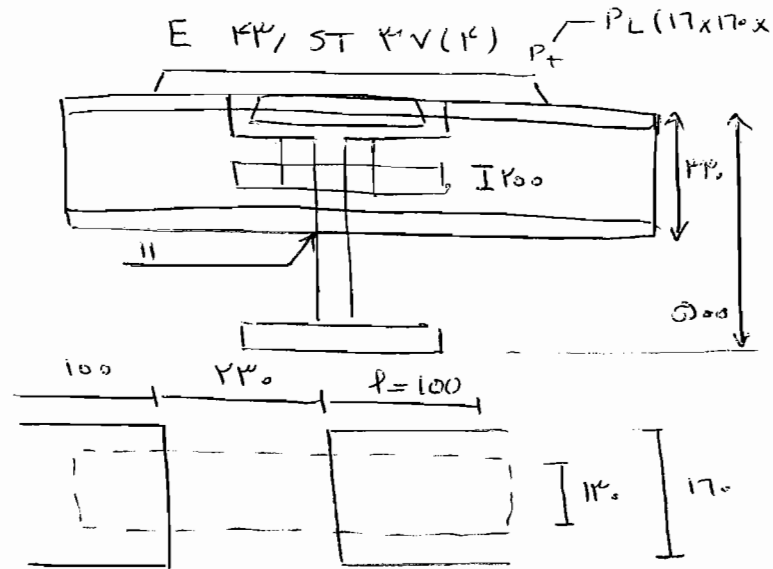
$$\frac{I_y}{I_x} = 0,125$$

رسم



$$M_B = 90 \text{ kNm}$$

$$V_B = 10 \text{ kN}$$



IPE 330	IPE = 200
b = 170	170
t = 11 mm	19 mm
h = 330	200
t_w = 11 mm	12
I = 11770	
S = 1177	
C = 29,5	

$$M = 90 \frac{\text{kN}}{\text{m}}$$

$$V_B = 10 \text{ kN}$$

$$F_B = \frac{90 \times 10^3}{1177} = 76,4 \text{ kN/cm}^2 \leq F_v = 0,4 F_y = 9,7$$

ف - تنش برشی در محل اتصال

$$A_w \approx 330 \times 0,75 = 247,5$$

۱- تنش برشی در محل اتصال

$$F_v = \frac{10}{247,5} = 0,04 \text{ kN/cm}^2 \leq F_v = 0,4 F_y = 9,7$$

$$h_w = 330 - 2 \times 17 = 296$$

$$P_f = \frac{M_F}{h'} = \frac{M_F}{h-t} = \frac{90 \times 10^3}{330-17} = 283 \text{ kN}$$

۲- تنش برشی در محل اتصال

$$A_1 = \frac{P_f}{F_t} = \frac{P_f}{0,7 F_y} = \frac{283}{14,7} = 19,2 \text{ cm}^2$$

۳- تنش برشی در محل اتصال

در محل اتصال ①

$$b_1 = 170 - 2 = 168 \text{ cm}$$

$$P_L \quad 17 \times 13$$

$$A_1 = 1,7 \times 13 = 20,1 \text{ cm}^2$$

$$\text{---} > 19,7 \text{ cm}^2$$

$$b_w = \min t = \min (1,15, 17) = 1,1 \text{ cm}$$

نسبت حوض

$$A_{w1} = \frac{P_F}{F_w} = \frac{283}{13} = 21,8 \text{ cm}^2$$

$$21,8 = A_{w1} = l_w \times (0,7 b_{w1}) = l_w (0,7 \times 1,1) \Rightarrow l_w = 28,13 \text{ cm}$$

$$2u + b_1 = l_w = 28,13 \rightarrow u = 7,7 \text{ cm}$$

$$u = 10 \text{ cm}$$

$$A_2 > A_F = 17 \times 1,15 = 18,15 \text{ cm}^2$$

۲- اتصال لایه‌ای - صفحه‌ای، PLⓅ

$$A_2 = 17 \times 1,15 = 18,15 \text{ cm}^2$$

$$> 18,15$$



$$b_w = 10 \text{ mm}$$

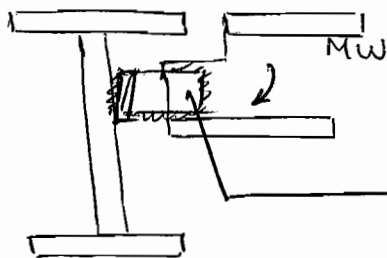
نسبت حوض

حوض ورق PLⓅ

$$P(b_w \times 0,7) \times 17 \times F_w = P_w$$

$$\rightarrow P_w = P(10 \times 0,7) \times 17 \times 13 = 291,2 \text{ kN}$$

$$> P_F = 283 \text{ kN}$$



PL 10 x 100 x 100

حوض حین

نسبت از محس

$$I_w = 0,75 \times \frac{(33 - 2 \times 1,15)^3}{12} = 180,8$$

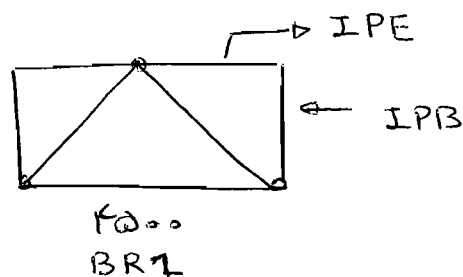
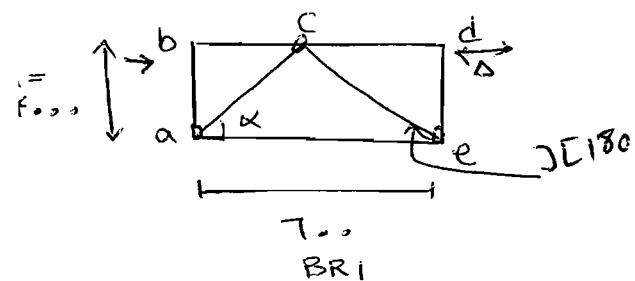
$$M_w = 90 \times \frac{180,8}{11770} = 13,8 \text{ kNm}$$

$$V = 10 \text{ kN}$$

نسبت ورق و ورقها نسبت به ورق

[illegible]

$\uparrow \quad \quad \quad \uparrow \quad - P_y = 9. \frac{\text{kN}}{\text{m}}$



BR7 *intcomp* 18

$$N_{DC} = H$$

$$N_{AC} = -N_{EC} = \frac{H}{Y \cos \alpha}$$

$$N'_{bc} = 1$$

$$N'_{ac} = -N'_{ec} = \frac{1}{r' \cos \alpha}$$

$$\Delta = H \cdot \gamma \cdot \frac{l}{LE Ag} + \gamma \frac{H}{\gamma \cos \alpha} \times \frac{1}{\gamma \cos \alpha} \cdot \frac{1}{EA_b} \sqrt{\left(\frac{p}{r}\right)^2 + h^2}$$

$$= H \frac{l}{\gamma E Ag} + \frac{\sqrt{\left(\frac{p}{r}\right)^2 + h^2}}{\gamma \cos^2 \alpha E A_b}$$

$$H = 1 \rightarrow k = \frac{1}{\Delta} \rightarrow E = 1/1 \times 10^8 \frac{\text{kJ}}{\text{cm}^3}$$

$$h = 100 \text{ cm}$$

$$\tan \alpha = \frac{r_{\infty}}{r_{00}} \rightarrow \alpha = \omega r_1 / \mu$$

	A
$A_g = \text{IPE } 400$	11.8
$A_c = \text{IPB } 44$	171
$A_b = 2 \text{ UD } 80$	$4 \times 41 = 164$

$$\Delta BR_{1x} = \frac{700}{2 \times 2.1 \times 10^4 \times 1.7} + \frac{\sqrt{(700)^2 + (200)^2}}{200 \times 2.1 \times 10^4 \times 0.7} \rightarrow 2000$$

$$= (1.79 + 1.77) \times 10^{-4} = 3.56 \times 10^{-4} \text{ cm/kN}$$

$$KBR_{1x} = \frac{1}{3.56 \times 10^{-4}} = 0.29 \times 10^4$$

$$p = 2000$$

$$h = 200$$

$$\tan \alpha = \frac{200}{200} = 1 \rightarrow \alpha = 45^\circ$$

BRP cross

$$\Delta BR_y = \frac{200}{2 \times 2.1 \times 10^4 \times 1.7} + \frac{\sqrt{(200)^2 + (200)^2}}{200 \times 2.1 \times 10^4 \times 0.7} \rightarrow 2000 = (1.79 + 1.77) \times 10^{-4}$$

$$= 3.56 \times 10^{-4} \text{ cm/kN}$$

$$KBR_y = 0.29 \times 10^4 \text{ kN/cm}$$

$$x_c = \frac{\sum k y_i x_i}{\sum k y_i}$$

مركز ثقل

$$y_c = \frac{\sum k y_i y_i}{\sum k y_i}$$

$$k_x = 2 \times 0.29 \times 10^4 = 0.58 \times 10^4 \text{ kN/cm}$$

$$k_y = 2 \times 0.29 \times 10^4 = 0.58 \times 10^4$$

$$x_c = \frac{0.19}{0.58} [7 + 12 + 12] = 12 \text{ m}$$

$$y_c = \frac{0.19}{0.58} [9 + 12 + 12] = 12 \text{ m}$$

$$K_P = 10^4 [0.19 \times 1000 + 0.19 \times 2000 + 0.19 \times 1000 + 0.19 (2000 + 2000)]$$

$$= 209000 \times 10^4 \text{ kP cm}$$

مركز ثقل

$$H_x = 0$$

$$H_y = 90 \times 12 = 1080 \text{ kN}$$

$$M_T = 1080 \times 12 = 12960 \text{ kNAA}$$

مركز ثقل

$$H_{X1} = H_X \cdot \frac{K_{Xi}}{K_X} + \frac{M_T}{K_P} \cdot (K_i \cdot y)$$

$$H_{Xr} = 0 + \frac{74 \times 100 \times 100}{409600} \times (0.19 (-400)) = 0 - 1.1$$

$$H_{Xr} = \quad + \quad // \quad \times (0) = 0$$

$$H_{X\omega} = \quad + \quad // \quad \times (0.19 \times 400) = 0 + 1.1 =$$

$$H_{yB} = \frac{1170 \times 0.19}{0.007} + // (0.19 \times 1000) = 320 + 190 = 510$$

$$H_{yC} = \quad + // (0.19 \times 1000) = 320 +$$

$$H_{yE} = // + // (0.19 \times (-1000)) = 320$$

$$\Delta X_r = \frac{H_{Xr}}{K_{Xr}}$$

$$\Delta X_r =$$

$$\Delta X_{\omega} =$$

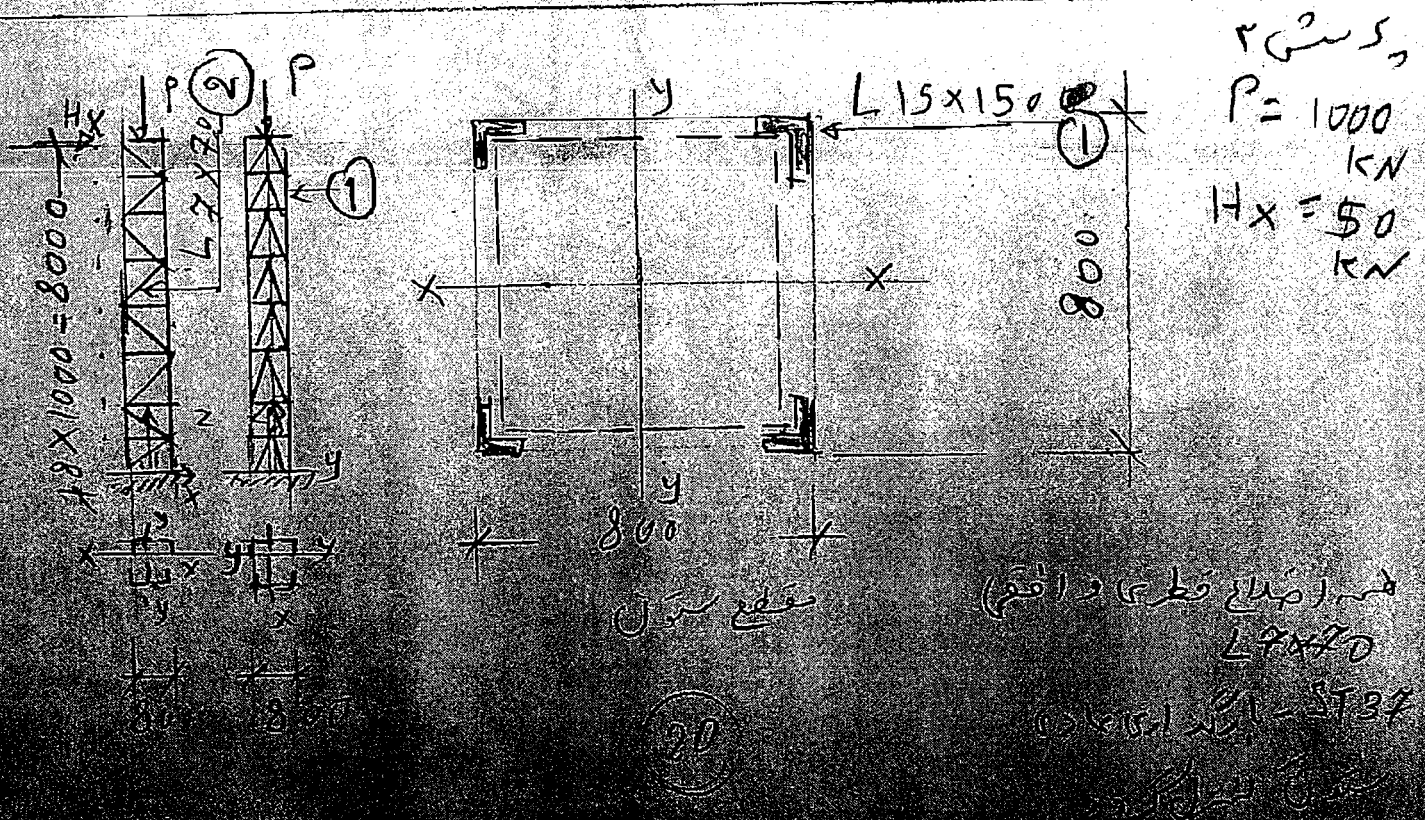
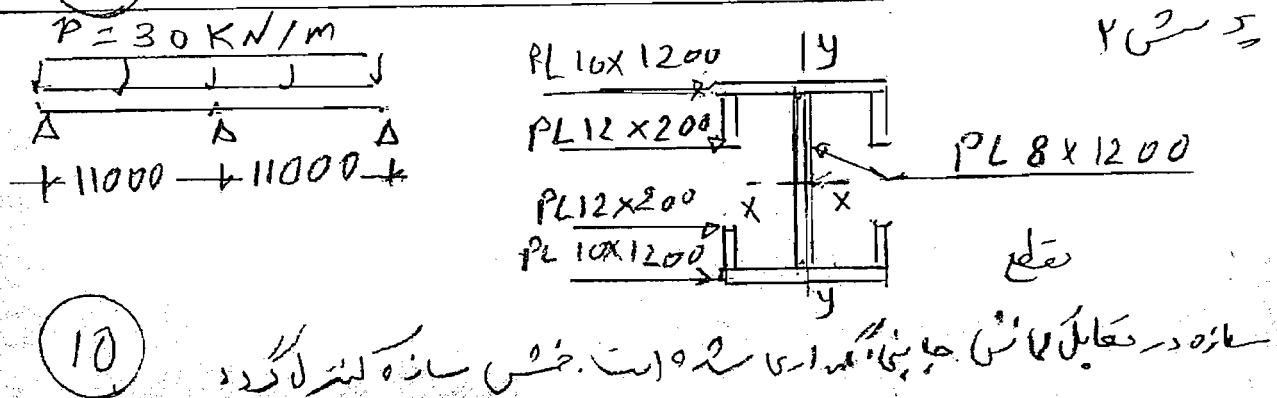
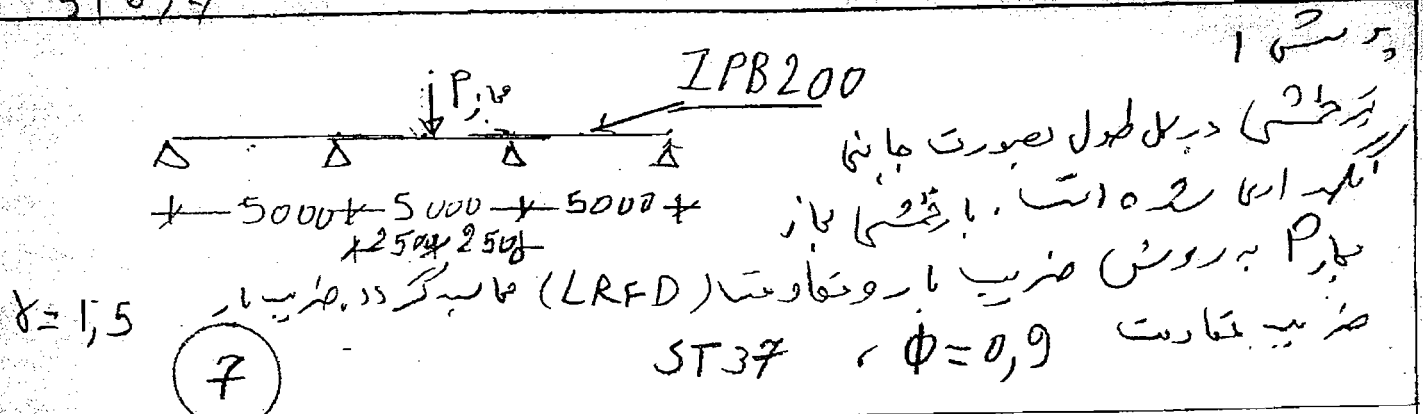
$$\Delta H_{yB} =$$

$$\Delta H_{yC} =$$

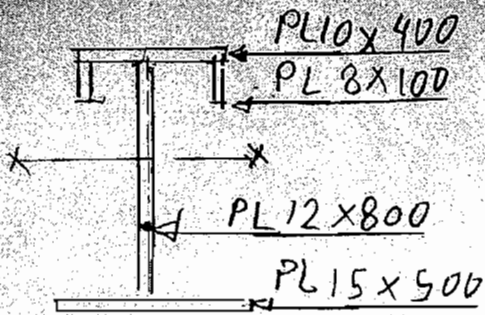
$$\Delta H_{yE} =$$

$$\phi = \frac{M_T}{K_P} = \frac{74 \times 100 \times 100}{409600 \times 10^6} = 1.8 \times 10^{-6} \text{ Rad}$$

1	0,7	تعداد ستون ها = مجموع مخرات = 6 - عدد اتصالات = 3 سازه
2	0,22	استفاده از جداول کتاب آزاد بوده ولی ردیف دکن ضمن اطمینان تصدیق است
3	0,29	
4	0,5	
5	0,4	

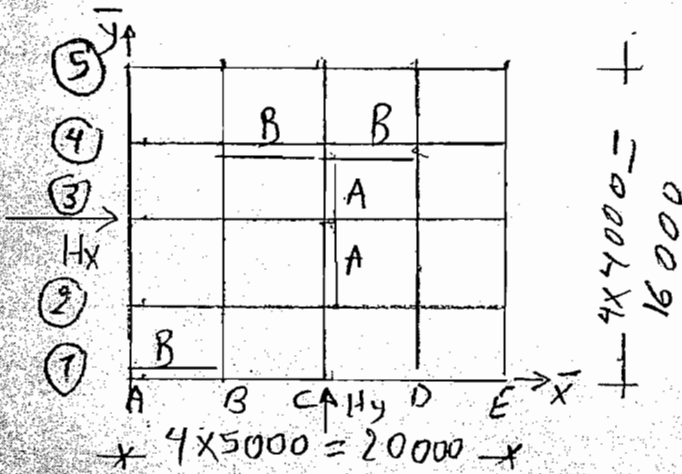


درستی - هم بارهای متمرکز در حالت
ایستایی و خمیری و هم چینی ضرب شکل
حول محور x محاسبه گردد
ST 37

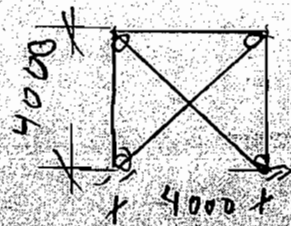


8

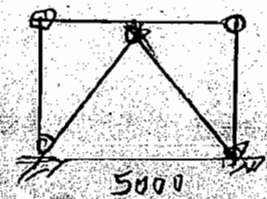
درستی - نیروها فقط بین اجزاء
باید ارائه و تقسیم گردد سقف
موجب است - تغییر شکل ساده
محاسبه گردد



$H_x = 140 \text{ kN}$
 $H_y = 120 \text{ kN}$
ستون IPB 220
تیر PF 300
قطر یال L 8 x 80



A
درستی

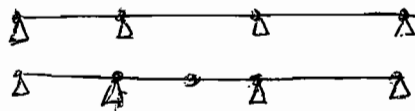
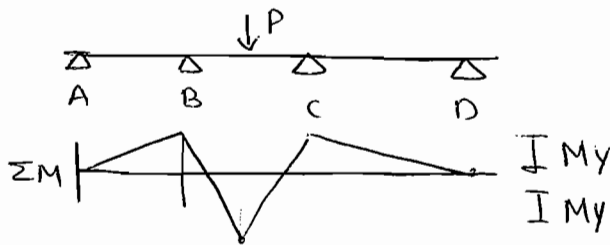


B
درستی

15

$$\frac{V}{I_0} = 0.17$$

(1)



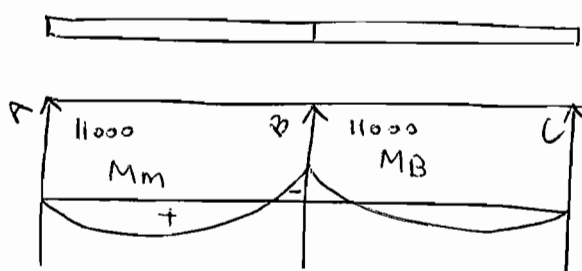
$$\Sigma M = \frac{P \cdot l}{4} = 2 M_y \quad M_y = \frac{P l}{8}$$

$$P = P \cdot \gamma = 1.0 P$$

$$(\phi \cdot Z \cdot F_y) = \gamma \cdot P \cdot \frac{l}{8} \Rightarrow B = \frac{\phi \cdot Z \cdot F_y}{\frac{\gamma \cdot l}{8}}$$

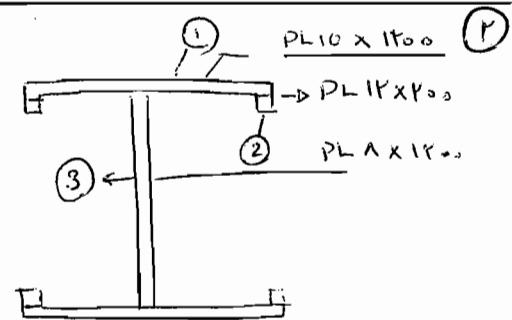
$$I P 200 \rightarrow Z_x = 742$$

$$P = \frac{0.19 \times 742 \times 22}{1.0 \times \frac{200}{8}} = 14.1 \text{ KN}$$



$$P = 3.0 \frac{\text{KN}}{\text{m}}$$

$$\frac{1.0}{1.8} = 0.12$$



$$\frac{1.0}{1.8} = 0.12$$

$$M_B = -0.12 P l^2 = -0.12 \times 3.0 \times 11^2 = 40.7 \text{ KN/m}$$

$$M_x = 0.075 P l^2 = 0.075 \times 3.0 \times 11^2 = 26.0 \text{ KN/m}$$

$$F_b = \phi (0.17 F_y)$$

$$\text{وقتی } \frac{100}{12} = \frac{b}{t} = \frac{1.72}{\sqrt{F_y}} = 11 \leq 11 \rightarrow \text{مقطع فشرده}$$

$$\frac{h_e}{t} = \frac{7.0}{1.0} = 7.0 > 12.0 \rightarrow \text{مقطع فشرده}$$

$$\text{وقتی } \rightarrow \text{مقطع فشرده} \rightarrow b_e = \frac{7.0 t}{\sqrt{F}} \left[1 - \frac{1.72}{\frac{1.0}{\sqrt{F}}} \right]$$

$$I = 1/12 \times \frac{140^4}{12} + F \times \left(1/12 \times \frac{140^4}{12} + 1/12 \times 140 \times (70 - 10t)^2 \right) + F \times 1 \times 140 \times 70^2$$

$$= 14470000$$

$$S = \frac{14470000}{71} = 203802.8 \text{ cm}^3$$

$$f = \frac{M}{S} = \frac{140000 \times 10^4}{203802.8} = 687.4 \text{ N/mm}^2$$

$$b_e = \frac{700 \times 14}{\sqrt{687.4}} \times \left[1 - \frac{144}{\frac{700}{10} \sqrt{687.4}} \right] = 927 \text{ mm} \geq 70$$

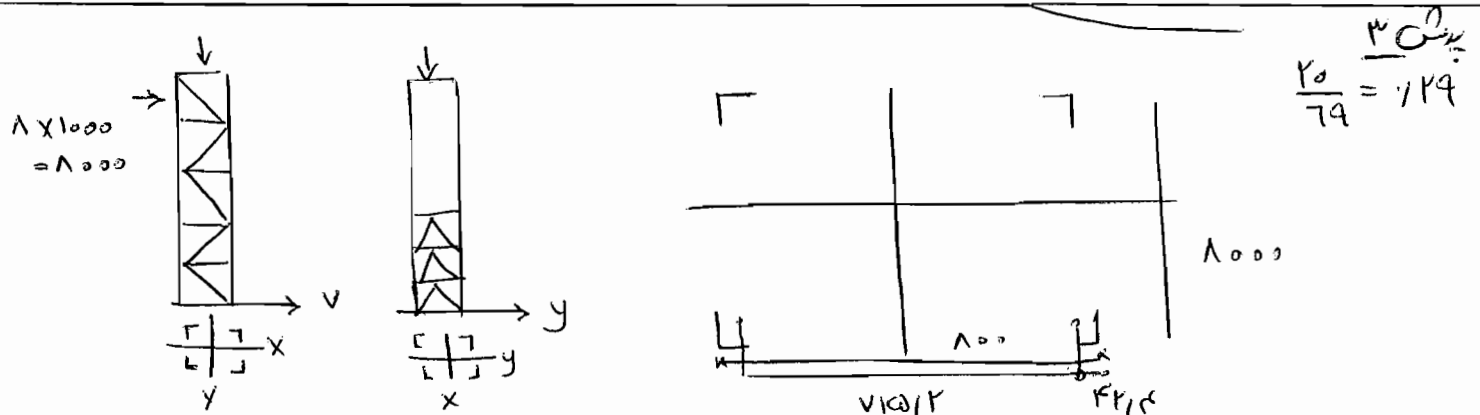
مقطع مربعی است -

$\phi = 1$

$\frac{d}{tw} = \frac{140}{14} = 10 \leq \frac{1400}{\sqrt{F_y}} = 110$ در حد است

$F_b = 1 \times (0.7 F_y) = 147 \text{ KN/cm}^2$

مقطع مربعی



$L = 10 \times 10 = 100$

$I_e = 1440$

$A_1 = 144$

$I_{x1} = 144 \times 144$

$i_{min} = 144/144$

$A = 144 \times 144 = 144 \text{ cm}^2$

$I_x = 144 \times 144 + 144 \times 144 \times \left(\frac{1700}{144} \right)^2 = 144 \times 144 \times 144 = I_y$

$S_x = \frac{144 \times 144 \times 144}{144} = 144 \times 144$

$r_x = 144 \text{ cm}$

$H_x = 10 \text{ KN}$

$M_y = 10 \times 10 = 100 \text{ KNm}$

$k = 1$

$\phi_w = 144 \times 144 = 1700 \text{ cm}$

$$y = \frac{1700}{17} = 100 \text{ mm}$$

8. مستطيل

$$r_{xe} = \sqrt{\lambda_x^2 + \lambda_y^2}$$

$$\lambda_i = \pi \sqrt{\frac{A_i S r}{r A_d L_i b r}}$$

$$A = 177$$

$$A_d = 177 \times 11,9 = 2106 \text{ cm}^2$$

$$S = \sqrt{177^2 + 11,9^2} = 177,4 \text{ mm}$$

$$\lambda_i = \pi \sqrt{\frac{177 \times 177,4}{2106 \times 100}} = 9$$

$$L_i = 100 \text{ cm}$$

$$b = 11,9 \text{ cm}$$

$$\lambda_e = \sqrt{177,4^2 + 9^2} = 177,4$$

$$F_a = 177 \text{ N/mm}^2$$

$$\lambda_x = \lambda_y \rightarrow F_a = 177$$

$$F_b \sim L^3$$

$$F_b = F_{by}$$

$$C_b = C_{by} = 1$$

$$d = 10$$

$$A_f = 177 \times 177 = 31369$$

$$L = 100 \text{ cm}$$

$$\lambda_T = \max \left(\frac{L_y}{r_x} \times \frac{r_1}{r_i} \right) = \max \left(\frac{100}{177}, \frac{100}{177} \right) = (177, 177) = 177$$

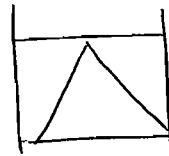
$$F_{bT} = \frac{177000 \times C_b}{L_y b / A_1} = \frac{177000 \times 1}{100 \times \frac{10}{177 \times 177}} = 109 \text{ N/mm}^2$$

$$F_{bc} \rightarrow$$

$$\lambda_{T1} = 177,4 \sqrt{C_b}$$

$$\lambda_{T1} = 177,4$$

$$\lambda_T = 177 < 177,4 \rightarrow F_{bc} = 0,7 F_y = 124,3 \text{ kN/cm}^2$$



$$= L V \times V_0$$

$$L V \times V_0$$

$$A = 11,9$$

$$\Gamma_{min} = 1,95 \text{ cm}$$

کنترل تنش عمودی:

$$\frac{f_a}{0.7 F_y} + \frac{f_b}{F_b} \leq 1$$

$$f_a = \frac{P}{A} = \frac{1000}{14.4} = 69.4 \text{ KN/cm}^2$$

$$f_b = \frac{400 \times 10^2}{2000} = 20 \text{ KN/cm}^2$$

$$\frac{69.4}{14.7} + \frac{20}{14.7} = 1.89 \leq 1$$

کنترل تنش لنگش:

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} \cdot \frac{C_{mg}}{1 - \frac{f_a}{F'_{ey}}} \leq 1$$

$$C_{mg} = 1.89$$

$$F'_{ey} = \frac{100 \times 10^4}{40.4} = 247.5 \text{ N/mm}^2 = 24.75 \text{ KN/cm}^2$$

$$\frac{69.4}{14.7} + \frac{20}{14.7} + \frac{1.89}{1 - \frac{69.4}{24.75}} = 1.89 + 1.89 = 1.98 \leq 1$$

$$P_1 = \frac{1000}{4} + \frac{400 \times 10^2}{2000} \times \frac{1}{4} = 250 + 50 = 300 \text{ KN}$$

کنترل لنگش:

$$\lambda_1 = \frac{\phi_1}{r_{min}} = \frac{100}{2.14} = 46.7 \rightarrow F_a = 141.4 \text{ N/mm}^2$$

$$f_{a1} = \frac{300}{2.14} = 139.7 \leq 141.4 \text{ KN/cm}^2$$



$$V_{xi} = 1.0 \times 1000 = 100 \text{ KN}$$

$$H_y = V_i + H_x = 100 + 50 = 150 \text{ KN}$$

$$\tan \alpha = \frac{100}{50} = 2 \rightarrow \alpha = 63.4^\circ$$

$$B_1 = \frac{150}{2} = 75 \text{ KN}$$

هر بند

$$V \propto V$$

$$A = 916 \text{ cm}^2$$

$$V_{min} = 114 \text{ V}$$

$$\lambda = \frac{\lambda_0}{114} = 0.114 \rightarrow F_{\phi H} = 111.9 \text{ N/mm}^2$$

$$f_a = \frac{F_{\phi H}}{916} = 0.122 \text{ KN/cm}^2 \leq$$

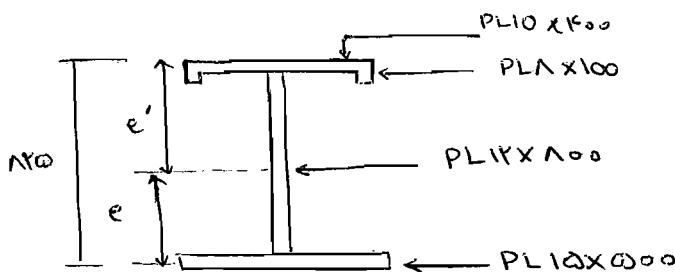
$$D_1 = \frac{B_1}{\cos \alpha} = \frac{F_{\phi H}}{\cos \alpha} = 111.1 \text{ KN} \quad \sigma_k$$

$$d = \sqrt{1.7 + 1.7} = 1.71 \text{ cm}$$

$$\lambda = \frac{1.71}{114} = 0.015 \rightarrow F_a = 95.3 \text{ N/mm}^2$$

$$f_a = \frac{111.1}{916} = 0.122 \leq 0.122 \text{ KN/cm}^2$$

نشان دهنده که این مقدار از حد مجاز کمتر است و مشکلی ندارد.



$$\frac{A}{17} = 10$$

معمولاً

$$A = 110 \times 10 + 12 \times 100 + 12 \times 100 + 10 \times 100 = 220 \text{ cm}^2$$

$$e = \frac{1}{220} [110 \times 10 \times 40 + 12 \times 100 \times 70 + 12 \times 100 \times 70 + 10 \times 100] = 37.7 \text{ cm}$$

$$e' = 44.9$$

$$I_x = 10 \times (44.9 - 10)^2 + 12 \times (10 \times 70^2 \times 12 \times \frac{10^4}{12}) + 110 \times \frac{10^4}{12} + 12 \times 100 \times (44.9 - 110 - 10)^2 + 10 \times (44.9 - 10)^2$$

$$I_y = 220 \times 10^4$$

$$S_T = \frac{220 \times 10^4}{44.9} = 49000 \text{ cm}^3$$

$$S_B = \frac{220 \times 10^4}{37.7} = 58350 \text{ cm}^3$$

$$M_{elT} = F_y \cdot S_T = 12 \times 49000 = 588000 \text{ KNcm}$$

$$M_{elB} = 12 \times 58350 = 700200$$

$$A_{1/2} = \frac{220}{2} = 110 = 10 + 0 \times 70 \Rightarrow a = 10$$

$$a' = 110 - 10 = 100$$

معمولاً

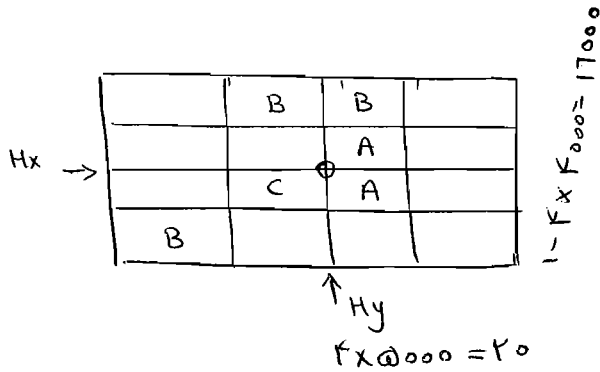
$$Z_x = V \omega \times (22 - 1/2 \omega) + 1/2 \times 22 \times \frac{22}{r} + 1/2 \times \frac{(\omega \cdot \omega - 1)^2}{r} + 17 (\omega \cdot \omega - 1 - \frac{10}{r}) +$$

$$r_0 (\omega \cdot \omega - 1/2 \omega) = V I r_0 \text{ cm}^4$$

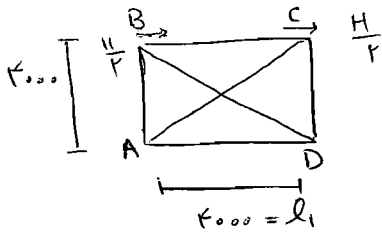
$$M_{PL} = V I r_0 \times r_0 = 141377 \text{ kN cm}$$

$$\alpha_T = \frac{Z_T}{\delta x_T} = \frac{V I r_0}{\omega^3 r_0 V} = 1/2 r$$

$$\alpha_B = \frac{V I r_0}{7 r V} = 1/1$$



$$\frac{10}{22} = 1/2 r$$



معمول

معمول

$$N_{BC} = 0$$

$$N_{BD} = H / \cos \alpha \times 1/2 r$$

$$N_{BA} = (H / \cos \alpha) \times \sin \alpha = H \times \tan \alpha \times 1/2 r$$

$$\Delta = \frac{1}{E A_d} \times \frac{1}{\cos^2 \alpha} \times \frac{1}{r} \times d \times r + \left[\frac{1}{E A_c} \cdot \frac{H \cos^2 \alpha}{r} \cdot h \right] \times r$$

$$d = \sqrt{22^2 + 17^2} = \sqrt{r^2 + r^2} = \sqrt{2} r = 24.25 \quad \tan \alpha = \frac{r}{r} = 1 \rightarrow \alpha = 45^\circ$$

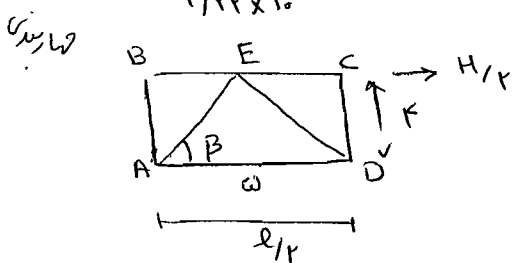
$$I_{PB} 220 \rightarrow A_c = 107$$

$$J_L \Delta x \Delta y \rightarrow A_d = 2 \times 17/18 = 2017 \quad E = 2.1 \times 10^6 \text{ kN/cm}^2$$

$$\Delta A = \frac{H}{E \cdot A_d} = \frac{d}{\cos^2 \alpha} \times \frac{1}{r} + \frac{H}{E A_c} \cdot \frac{\tan^2 \alpha \cdot h}{r} = \frac{24.25}{2.1 \times 10^6 \times 2017} \times \frac{1}{\cos^2 \alpha}$$

$$\times \frac{1}{r} + \frac{H}{2.1 \times 10^6 \times 107} \times \frac{\tan^2 \alpha \times 220}{r} = H (1.00 + 1/18) \times 10^{-6} = 1.12 \times 10^{-6} \frac{\text{cm}}{\text{kN}}$$

$$K_{Ay} = \frac{1}{1.12 \times 10^{-6}} = 1.12 \times 10^6 \text{ kN/cm}$$



$$I_{PB} 220 \rightarrow A_c = 107$$

$$J_L \Delta x \Delta y \rightarrow A_d = 2 \times 17/18 = 2017$$

$$I_{PE} 220 \rightarrow A_g = 2017$$

$$\tan \beta = \frac{r}{22} = 1/7 \rightarrow \beta = 8.1^\circ$$

$$N_{AB} = 0$$

$$N_{BE} = H/r$$

معمول

$$\Delta B = r \times \frac{H}{r} \cdot \frac{1}{r E A_g} \cdot \frac{l_r}{r} + r \times \frac{H}{r \cos \beta} \cdot \frac{1}{r \cos \beta} \cdot \frac{1}{E A_b} \sqrt{h^2 + \left(\frac{l_r}{r}\right)^2}$$

$$= \frac{H}{E A_g} \cdot \frac{l_r}{r} + \frac{H}{E A_d} \cdot \frac{l_d}{r} \Rightarrow \tan \beta =$$

$$\Delta B = H \left(\frac{0.00}{r/1 \times 1.0 \times 0.09/0.0 \times r} + \frac{r \times r}{r/1 \times 1.0 \times r \times 0.7} \times \tan \beta + (0.11 + r/r) \times 1.0 \right)$$

$$= r/r \times 1.0$$

$$K_{Bx} = \frac{1}{r/r \times 1.0} = r/r \times 1.0$$

$$K_x = r \times r/r = 1.19 \times 1.0$$

$$K_y = r \times r/r = 1.76 \times 1.0$$

$$K_p = \sum K_x \cdot y^2 + \sum K_y \cdot x^2$$

$$\bar{x}_c = r \times 0 = 1.0 \text{ m}$$

$$\bar{y}_c = \frac{\sum K_x \cdot y}{K_x} = \frac{0 + r \times 1.0/r \times 1.19}{1.19} = 1 \text{ m}$$

$$K_A = r/r \times 1.0 \times (1 \times 1.0 + r \times 1.0) + (0.11/r) \times 1.0 \times 1.0 = 1.19 \times 1.0$$

$$M_{xi} = H_x \cdot \frac{K_{xi}}{K_x} + M_T \cdot \frac{K_{xi} \cdot y_i}{K_p}$$

$$M_{x1} = 140 \times \frac{1}{r} = 17.7 \text{ kN}$$

$$M_{xr} = 140 \times \frac{1}{r} = 17.7$$

$$M_x = 140 \text{ kN}$$

$$M_y = 140 \text{ kN}$$

$$M_T = -0$$

$$H_{yc} \Rightarrow H_y = \frac{140}{r} = 70 \text{ kN}$$

$$\Delta x_1 = \frac{17.7}{r/r \times 1.0} = \frac{M_x}{K_y} = 10.8 \times 1.0 \text{ cm}$$

$$\Delta x_r = \frac{17.7}{r/r \times 1.0}$$

$$\Delta y_c = \frac{70}{1.19} = r/r \times 1.0$$

