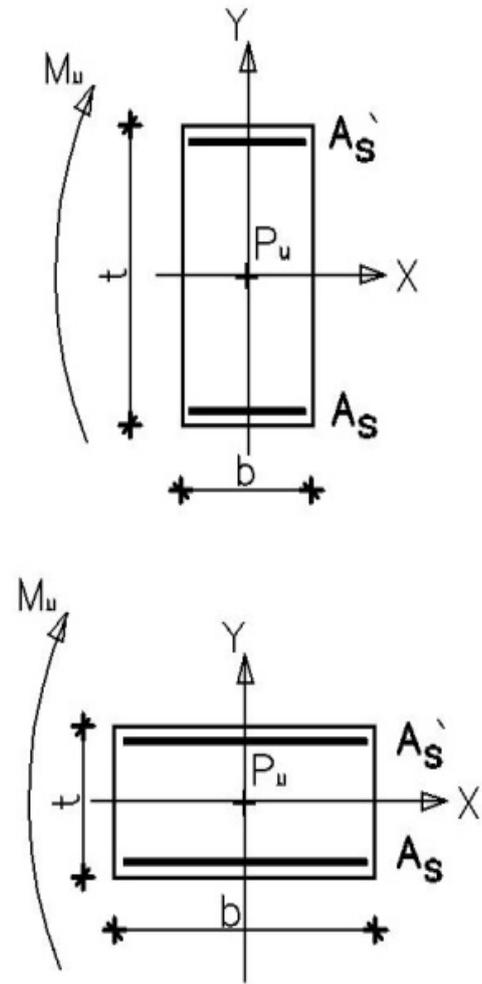
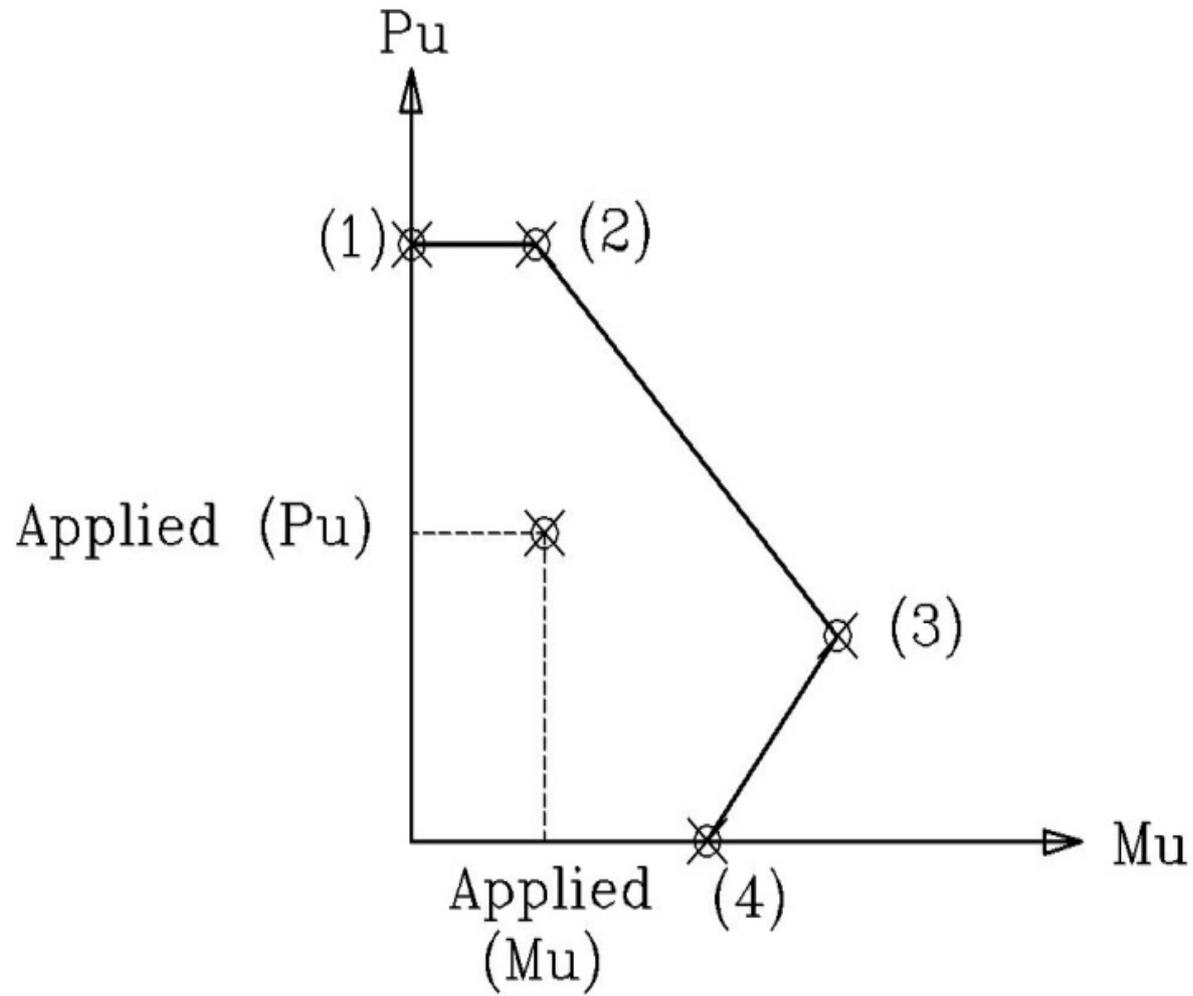


# Design of Shear walls & Cores

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يتم حساب القدرة الإنشائية لتحمل أى عنصر إنشائى أحمال ضغط محورية من خلال المعادلة التالية:

$$P_u = 0.35 A_c f_{cu} + 0.67 f_y A_s$$

حيث  $P_u$  = أقصى حمل ضغط محورى يمكن أن يتحمله القطاع الخرسانى.

$A_c$  = مساحة المقطع الخرسانى.

$f_{cu}$  = المقاومة المميزة للخرسانة.

$f_y$  = إجهاد الخضوع أو إجهاد الضمان لحديد التسليح المستخدم فى القطاع.

$A_s$  = إجمالى مساحة مقطع حديد التسليح المستخدم فى القطاع.

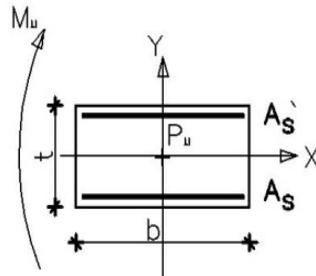
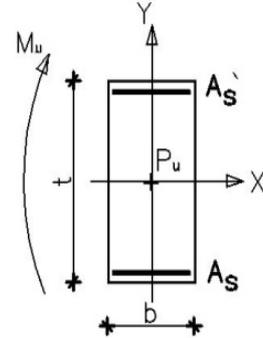
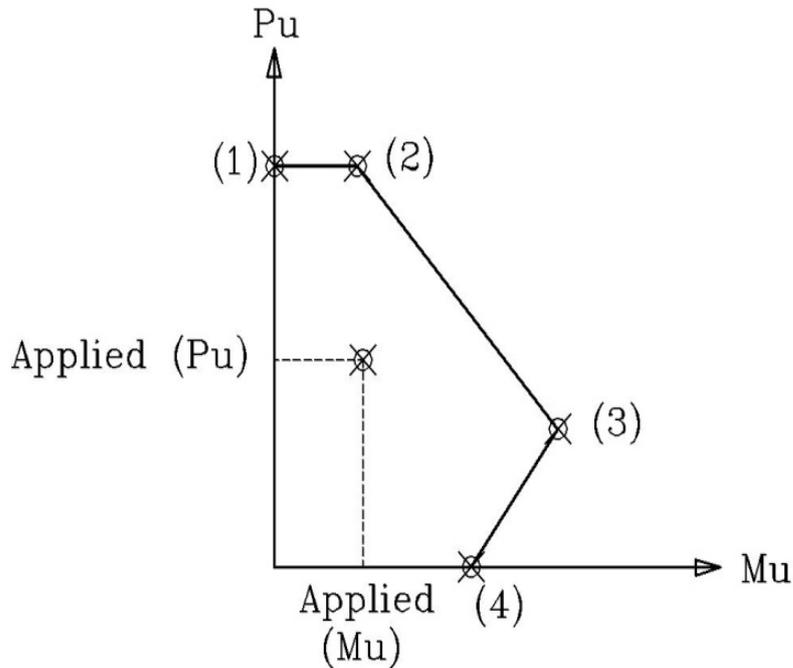
- نقطة رقم (2): و تمثل مقاومة القطاع لقوى الضغط المحورى مصحوبة بعزوم إنحناء ناتجة من حدوث زحزحة دنيا لقوة الضغط المحورى.

(Pure Normal force  $\{P_u\}$  accompanied with bending moment =  $P_u \times e_{\min}$ )

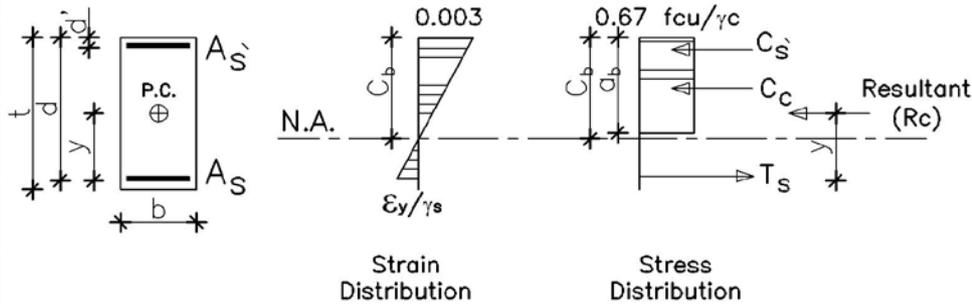
Where:  $e_{\min}$  = minimum eccentricity of  $P_u$

$$e_{\min.} = 0.05 \times t$$

$t$  = Section dimension parallel to the applied bending moment



← حساب النقطة رقم (3)



Re-substitute in equation no. 13 to get  $C_c$

$$R_c = C_c + C_s' - T_s$$

Resultant force  $\{R_c\}$  is applied at a point called "Plastic centroid" (P.C.)

**Location of Plastic Centroid (P.C.):**

$$y = \frac{c_s' \times (d - d') + C_c \times (d - \frac{a_b}{2})}{R_c}$$

From Equilibrium:

$$C_s' + C_c = T_s \quad \dots\dots\dots(10)$$

Where:

$$C_s' = A_s' \times \frac{f_y}{\gamma_s} \quad \dots\dots\dots(11)$$

$$T_s = A_s \times \frac{f_y}{\gamma_s} \quad \dots\dots\dots(12)$$

$$C_c = 0.67 \frac{f_{cu}}{\gamma_c} a_b b \quad \dots\dots\dots(13)$$

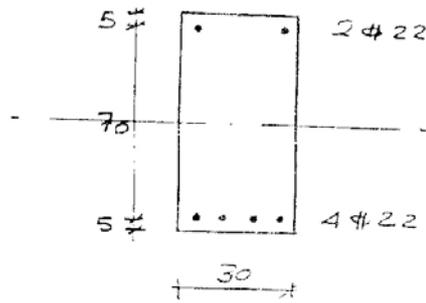
$$\therefore A_s' \times \frac{f_y}{\gamma_s} + 0.67 \frac{f_{cu}}{\gamma_c} a_b b = A_s \times \frac{f_y}{\gamma_s} \quad \longrightarrow \quad \text{Get } a_b$$

$$C_b = a_b / 0.80$$

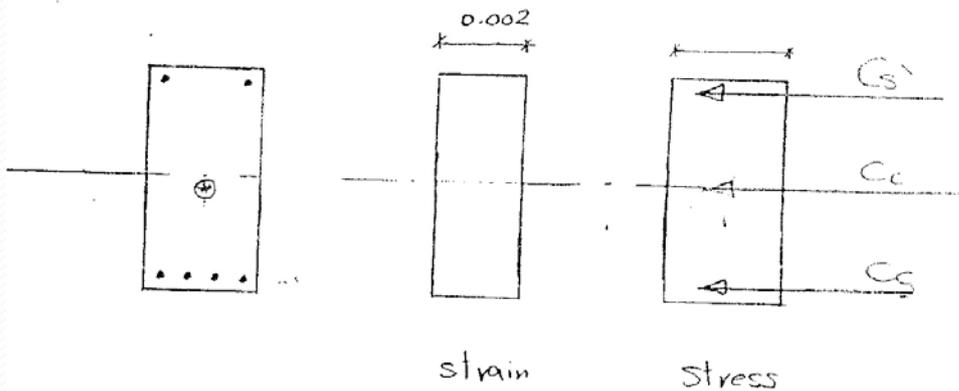
$$P_b = C_c + C_s' - T_s$$

$$M_u = \sum M \text{ of } (C_c, C_s', \text{ and } T_s) \text{ about the point of Plastic centroid.}$$

① Draw an approximate interaction diag. for the shown section for  $f_{cu} = 250 \text{ kg/cm}^2$  &  $f_y = 3600 \text{ kg/cm}^2$



Point ① Axial load



For Unsymmetric Sections  $\rightarrow$  find Plastic Centroid

$$C_c = \frac{0.67 \times 250}{1.75} \times 30 \times 80 \times \frac{1}{1000} = 229.7 \text{ ton}$$

$$C_s = 4 \times 3.8 \times \frac{3600}{1.36} = 40.235 \text{ ton}$$

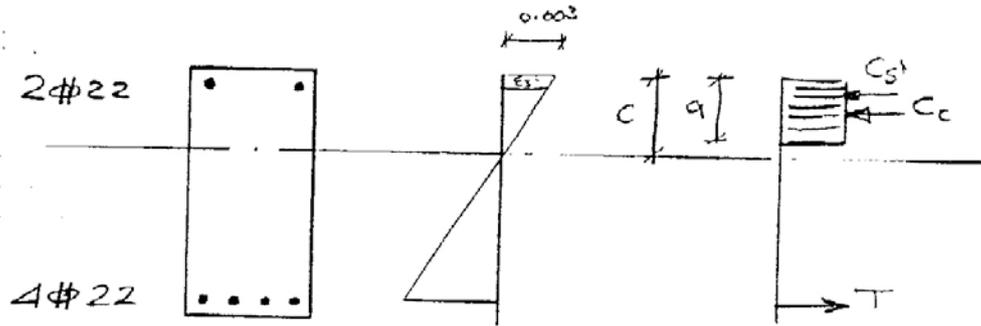
$$C_s' = 2 \times 3.8 \times \frac{3600}{1.36} = 20.118 \text{ ton}$$

$$\bar{y} = \frac{40.235(0.35) - 20.118(0.35)}{229.7 + 40.235 + 20.118} = 2.42 \text{ cm}$$

$$P_{\text{total}} = 290.05 \text{ ton} + M = 7.0 \text{ m.t}$$

$$P_{\text{axial}} = [0.35(250)(30 \times 80) + 0.67 \times 3600 \times 613.8] = 265 \text{ ton}$$

Point ② Pure flexure



assume  $A_s, A_s'$  at yield

$$T = C_c + C_s'$$

$$4 \times 3.8 \times \frac{3600}{1.15} = \frac{0.67 \times 250}{1.5} \times 30 \times a + 2 \times 3.8 \times \frac{3600}{1.15}$$

$$a = 7.1 \text{ cm}$$

$$c = \frac{7.1}{0.8} = 8.875 \text{ cm}$$

$$\frac{\epsilon_s'}{0.003} = \frac{8.875 - 5}{8.875}$$

$$\epsilon_s' = 0.00131 < \frac{\epsilon_y}{1.15}$$

$$\epsilon_y = 0.0018$$

$\mu_{max} = 0.97$

$A_s'$  is not at yield

$$4 \times 3.8 \times \frac{3600}{1.15} = \frac{0.67 \times 250}{1.5} \times 30 \times 0.8c + 2 \times 3.8 \times f_s'$$

$$6260.87 = 352.63 C + f_s' \quad \text{--- ①}$$

$$f_s' = 6000 \left( \frac{c-5}{c} \right) \quad \text{--- ②}$$

from ① & ②

$$c = 9.6 \text{ cm}$$

$$a = 7.68$$

$$f_s' = 2875 \text{ cm}^2$$

$$M = (2 \times 2.875 \times 3.8)(0.7) + \frac{0.67 \times 250 \times 30 \times 7.68 \times 71.16}{1.5 \times 1000 \times 100}$$

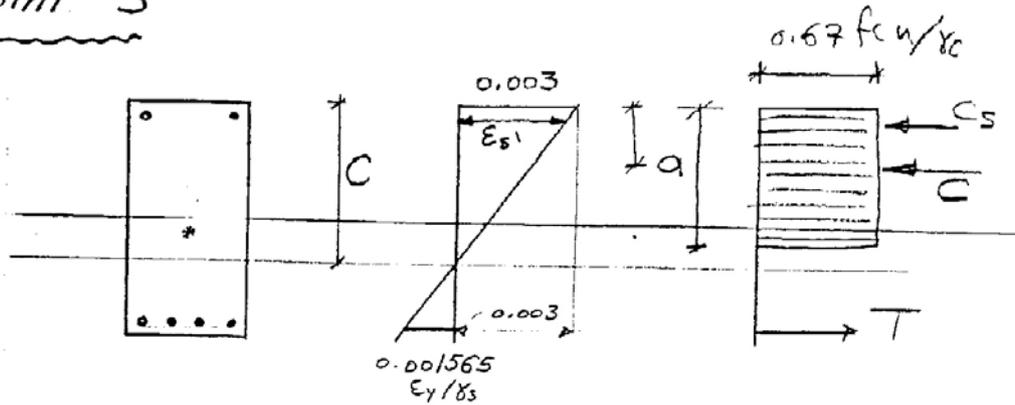
$$= 15.295 + 18.31 = 33.6 \text{ m.t}$$

$A_s'$

Concrete

Point 3

(3)



From strain distribution.

$$\frac{0.003}{0.001565 + 0.003} = \frac{C}{75}$$

$$C = 49.29$$

$$a = 39.43$$

$$\frac{\epsilon_{s1}}{0.003} = \frac{49.29 - 5}{49.29}$$

$$\epsilon_{s1} = 0.0027 \gg \epsilon_{y/8s}$$

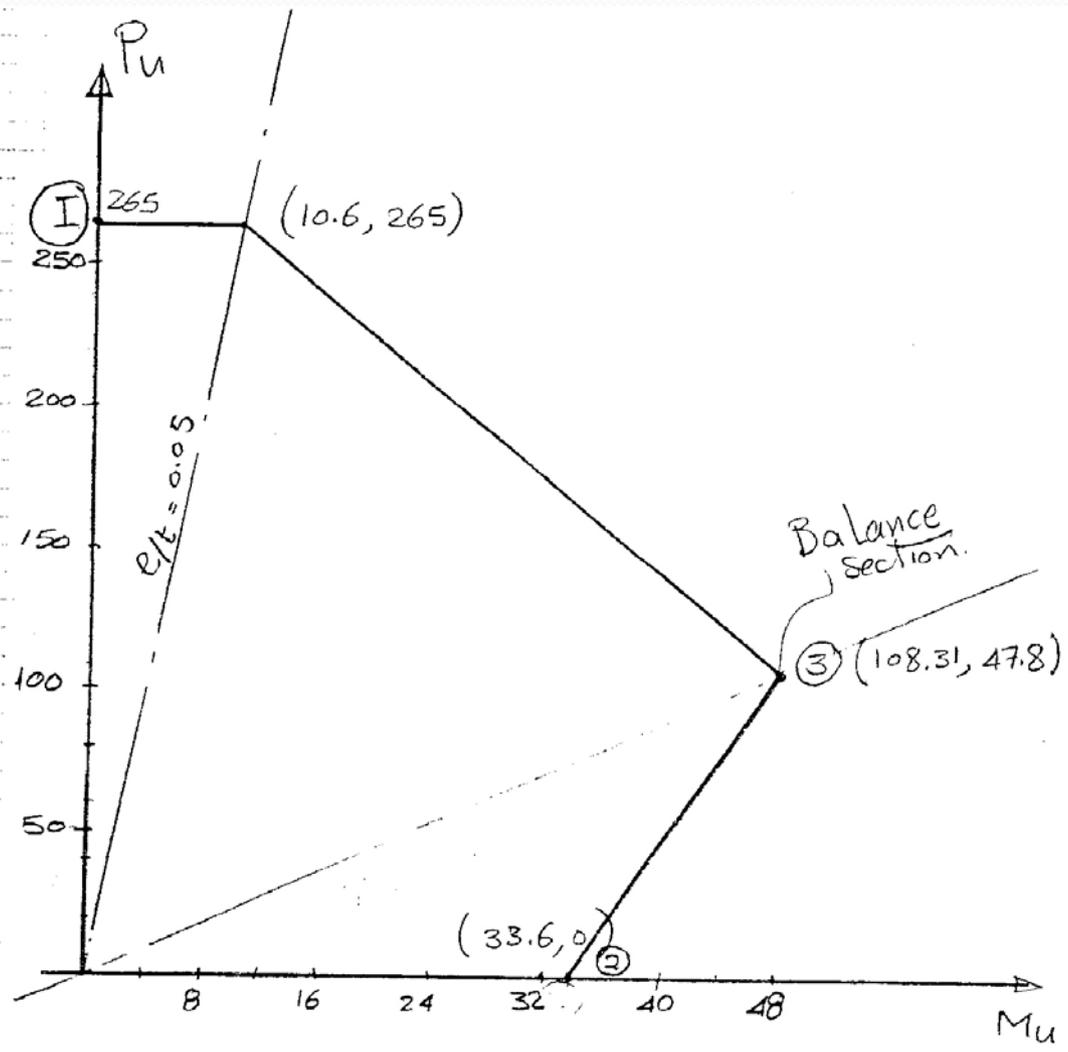
$$C_s' = 2 \times 3.8 \times \frac{3.6}{1.15} = 23.79 \text{ ton}$$

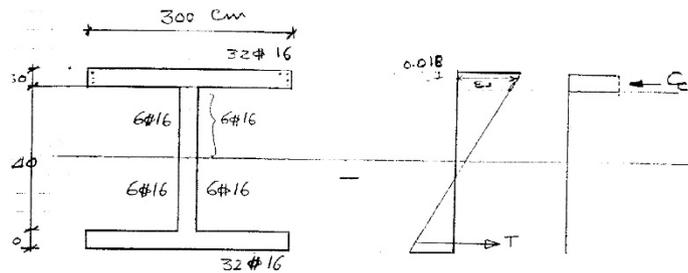
$$C_c = \frac{0.67 \times 250 \times 30 \times 39.43}{1.5 \times 1000} = 132.1 \text{ ton}$$

$$T = 4 \times 3.8 \times \frac{3.6}{1.15} = 47.58 \text{ ton.}$$

$$P_u = 108.31 \text{ ton.}$$

$$M_u = 23.79 \left( 0.35 + \frac{0.0242}{0.3742} \right) + 132.1 \left( 0.35 + \frac{0.024 - 0.197}{0.1792} \right) + 47.58 \left( 0.35 - \frac{0.024}{0.326} \right) = 47.80 \text{ m.t}$$





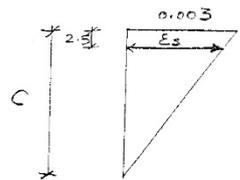
Point 1.  $A_c = 2.52 \text{ m}^2$   $A_s = 88 \times 2.01 = 176.88$

$$P_u = 0.35 \frac{(250)}{1000} (25200) + 0.67 \times 3.6 \times 176.88$$

$$= 2205 + 426.63$$

$$= 2631.63 \text{ ton}$$

Point 2. pure moment  
assume  $A_s$  &  $A_s'$  at yield



$$T = C_c + C_s$$

$$32 \times 2.01 \times \frac{3600}{1.15} = \frac{0.67 \times 250 \times \alpha \times 300}{1.5} + 15 \times 2.01 \times f_y / 1.15$$

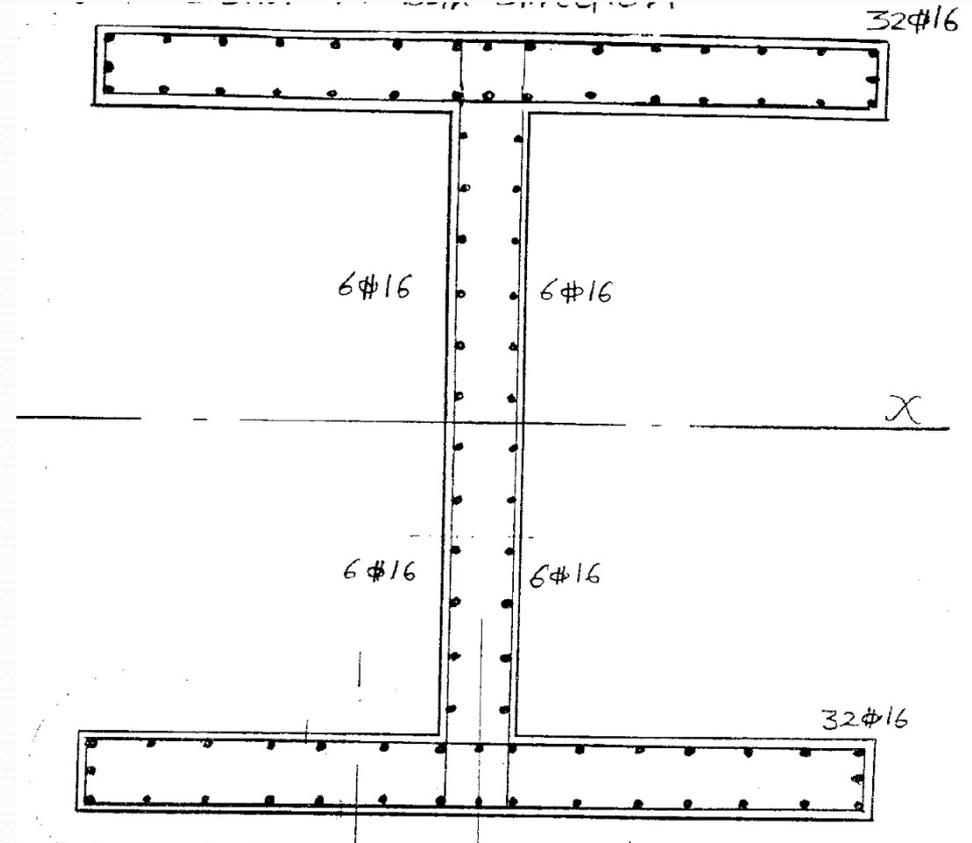
$$\alpha = 3.19 \text{ cm} \quad C = 3.99$$

$$\epsilon_s' = 0.003 \left( \frac{3.99 - 1.8}{3.99} \right) \quad \epsilon_s' = 0.00158 > \epsilon_y / 1.15$$

$$M_u = 15 \times 2.01 \times \frac{3600}{1.15} \times (285 - 1.8)$$

$$+ \frac{0.67 \times 250 \times 4.22 \times 300}{1.5} (285 - 1.6)$$

$$= 571.1 \text{ m.t}$$

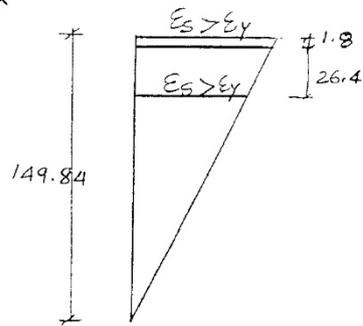


Point 3

From strain distribution

$$C = 285 \left( \frac{0.003}{0.001565 + 0.003} \right) = 187.3 \text{ cm}$$

$$a = 149.84 \text{ cm}$$



$$C_s' = 32 \times 2.01 \times 3.6 / 1.15 = 201.35 \text{ ton}$$

$$C_c = \frac{0.67 \times 250 \times 300 \times 30}{1.5} = 1005 \text{ ton}$$

$$C_{c2} = \frac{0.67 \times 250 \times 30 \times 119.84}{1.5} = 401.46 \text{ ton}$$

$$T = 32 \times 2.01 \times 3.6 / 1.15 = 201.35 \text{ ton}$$

$$P_u = 1406.46 \text{ ton.}$$

$$M_u = 201.35 \times 1.35 + 201.35 \times 1.35$$

$$+ 1005 \times 1.35 + 401.46 (60.08)$$

$$= 2141.59 \text{ m.t}$$

Point 1

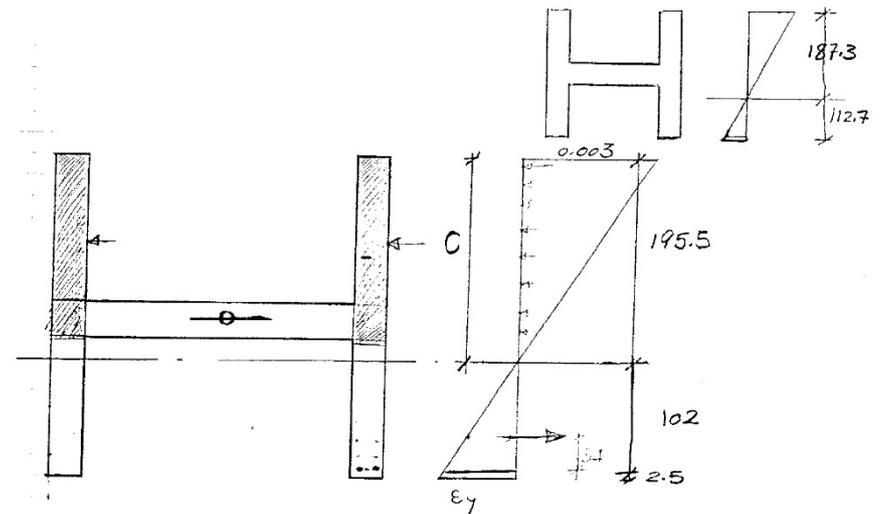
For  $M_y$

$$P_u = 2631.63 \text{ ton.}$$

Point 3

$$C = 195.51 \text{ cm}$$

$$a = 156.41 \text{ cm.}$$



$$C_c = 0.67 \times \frac{250}{1.5} \times 60 \times 156.41 + 0.67 \times \frac{250}{1.5} \times 240 \times 30$$

$$= 1047.95 + 804 = 1851.95 = 1852 \text{ ton}$$

$$C_s' = 11 \times 2 \times 2.01 \times \frac{3.6}{1.15} + 4 \times \frac{3}{2} \times 2.01 \times \frac{3.6}{1.15} + 16 \times 2.01 \times \frac{3.6}{2 \times 1.15}$$

$$+ 16 \times 2.01 \times \frac{3.6}{4 \times 1.15}$$

$$= 138.43 + 18.88 + 50.33 + 25.17 = 232.81 \text{ ton}$$

$$T = \frac{2.01 \times 3.6}{1.15} [6 + 4 \times 0.8 + 4 \times 0.6 + 4 \times 0.4 + 4 \times 0.2] = 88.1 \text{ ton}$$

$$P_u = 1852 + 232.81 - 88.1 = 1996.71 \text{ ton.} \quad (2)$$

$$\begin{aligned} M_u &= 752.375 \quad \{C \cdot Y_{ct}\} \\ &+ 143.775 \quad \{C_s \cdot Y_{ct}\} \\ &+ 107.6 \quad (T \cdot Y_{ct}) \\ &= 1003.75 \text{ m.t} \end{aligned}$$

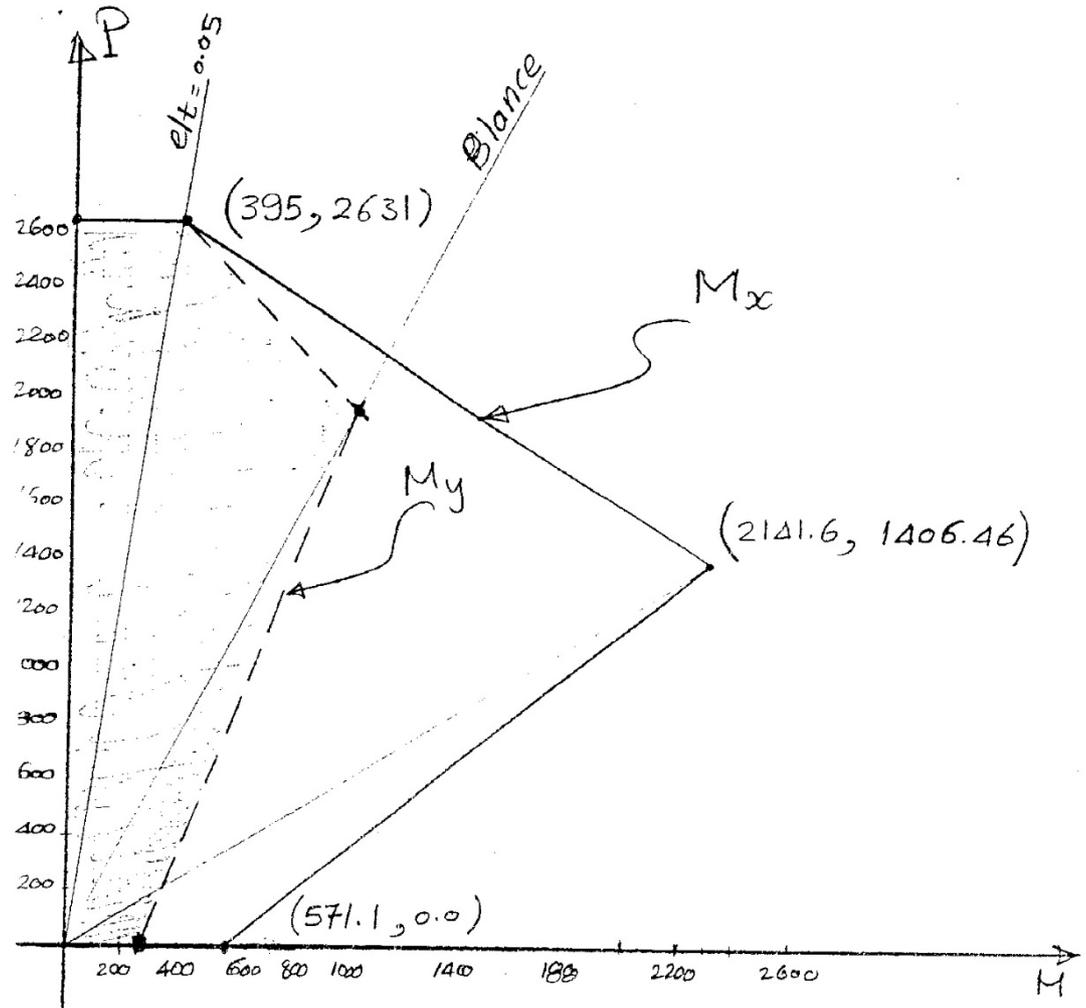
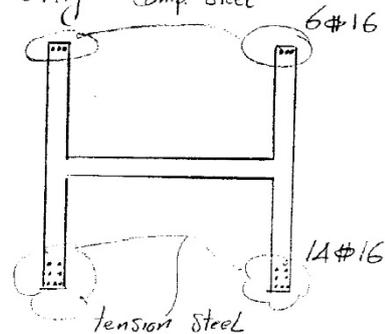
Point 2

$$14 \times 2.01 \times \frac{3600}{1.15} = \frac{0.67 \times 250}{1.5} \times a \times 60 + 6 \times 2.01 \times f_y / 1.15$$

$$a = 7.5 \text{ cm} \quad C = 9.4$$

$$\begin{aligned} M &= 6 \times 2.01 \times \frac{3.6}{1.15} \times 275 + \frac{0.67 \times 250 \times 7.5 \times 160}{1.5} \times 273.75 \\ &= 103.82 + 137.56 \text{ m.t} \\ &= 241.38 \text{ m.t} \end{aligned}$$

\* we assume that only comp steel



# General Notes

$$t_{sh.wall} \leq 120 \text{ mm}$$

$$t_{sh.wall} \leq 5 l$$

$$4\%A_c \leq A_s \leq 0.15\%A_c$$