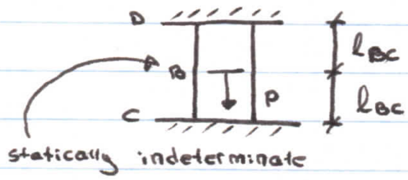
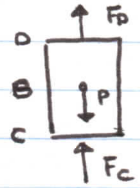
Oct. 25/16

The resultant stress or displacement can be determined...



F.B.D.



$+\uparrow \Sigma F_y = 0$

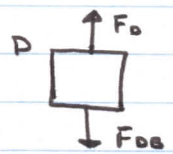
$F_D - P + F_C = 0$

(4.4) Force Method For Analysis of Axially Loaded Members

$\delta_{D/C} = 0$ ✓ deformation compatibility

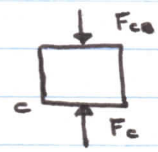
$$\delta = \Sigma \frac{F l}{AE} \qquad \delta_{D/C} = \delta_{D/B} + \delta_{B/C}$$

<u>DB</u>



$F_{DB} = F_D$
(T)

<u>BC</u>

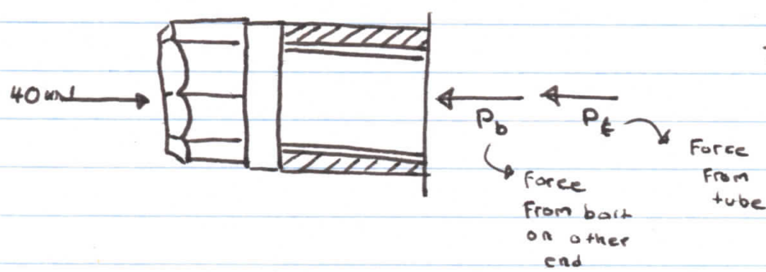


$F_{CB} = F_C$ (C)

$$\delta_{D/C} = \delta_{D/B} + \delta_{B/C} \Rightarrow \frac{F_{DB} \cdot l_{DB}}{AE} + \frac{(-F_{CB}) \cdot l_{CB}}{AE}$$

$$\Rightarrow \frac{F_D \, l_{DB}}{AE} - \frac{F_C \cdot l_{CB}}{AE} = 0$$

Example 4-2 (From textbook)



$\overset{+}{\rightarrow} \Sigma F_x = 0$

$40 - P_b - P_t = 0$ (Eq. 1)

(Eq. 2) From deformation compatibility.

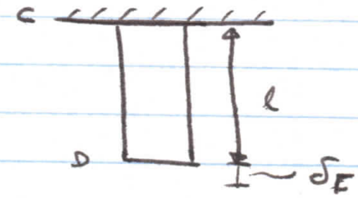
$\delta_b = \delta_t$

$$\frac{P_b \cdot (0.15\,m)}{(\pi/4 \cdot 0.02^2)\,E} = \frac{P_t \cdot (0.15\,m)}{(\pi/4\,(0.06^2 - 0.05^2))\,E}$$

Bolt: $\sigma_b = P_b / A_b$

Tube: $\sigma_t = P_t / A_t$

(4.5) Thermal Stress



$\delta_T = \alpha \Delta T \cdot l$

ΔT = temperature change
°C F

l = original length of member

α = coefficient
$1/°C$ $1/°K$ $K = 273 + °C$

Next Assignment Questions

4-5	4-37
4-13	4-41
4-31	4-69

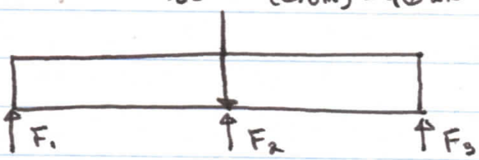
Oct. 27/16

Solution: (Example 4.11 from board)

- Final position of the top of each (post) is parallel to its original position. "rigid member"
- Seperposition principle : ΔT + loading for analysis.
- suppose the deformation : $\delta_F > \delta_{\Delta T}$

150 kN · (0.6 m) = 90 kN

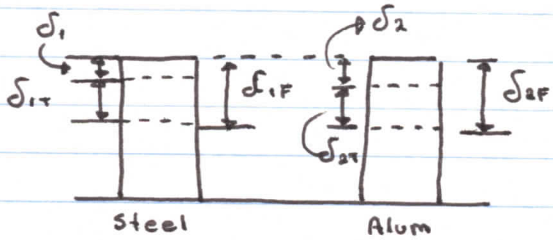
F.B.D.



$$F_1 = F_3$$

$$F_1 + F_2 + F_3 = 90\ kN$$

$$2F_1 + F_2 = 90\ kN \quad \text{Eq } 1$$



$$\Delta T = 80°C - 20°C = 60°C$$

A35 Steel → 0.35 % C
99.60 % Fe
0.05 % other

Deformation compatibility

$$\delta_1 = \delta_2$$

$$\delta_{1F} - \delta_{1T} = \delta_{2F} - \delta_{2T} \quad \text{use } 0.25\ m$$

$$\frac{F_1 \cdot (0.25)}{E_1 \cdot \left(\frac{\pi (0.04)^2}{4}\right)} - \alpha_1 \cdot (60°) \cdot (250\ mm) = \ldots$$

From chart   From chart

$$\ldots = \frac{F_2 \cdot (0.25)}{E_2 \cdot \left(\frac{\pi (0.04)^2}{4}\right)} - \alpha_2 (60°)(0.25\ m) \quad \text{Eq } 2$$

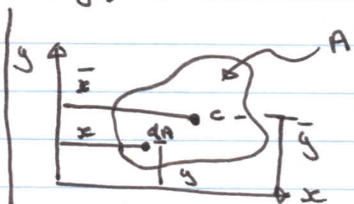
$\therefore$ $F_1 = -1.64 \times 10^4\ N$ (T)

$F_2 = 1.23 \times 10^5\ N$ (C)

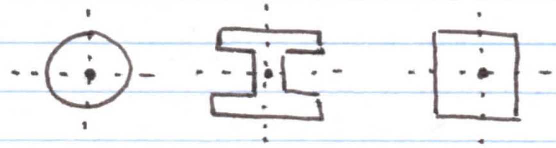
Consider a point (x, y)

$$\bar{x} = \frac{\int x\,dA}{\int dA} = \frac{\int x\,dA}{A}$$

$$\bar{y} = \frac{\int y\,dA}{\int dA} = \frac{\int y\,dA}{A}$$

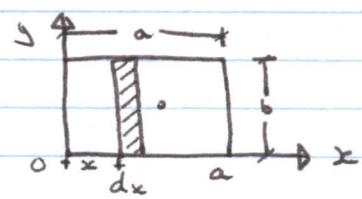


① If an area has an axis of symmetry, the centroid lies on the axis of symmetry.



② If a shape has 2 axes of symmetry the centroid lies at the intersection of these 2 axes.

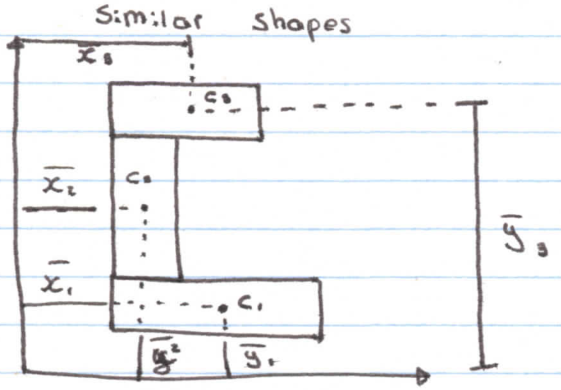
$$\bar{y} = \frac{\int x\,dA}{A} = \frac{\int_0^a xb\,dx}{ab}$$



$$\bar{y} = \frac{b\int_0^a x\,dx}{ab} = \frac{\frac{1}{2}x^2\Big|_0^a}{a} = \frac{1}{2a}(a^2-0) = a/2$$

③ Composite ~~areas~~ areas

The area can be sectioned into several parts, having similar shapes



$$\bar{x} = \frac{\bar{x}_1 A_1 + \bar{x}_2 A_2 + \bar{x}_3 A_3}{A_1 + A_2 + A_3}$$

$$\bar{y} = \frac{\bar{y}_1 A_1 + \bar{y}_2 A_2 + \bar{y}_3 A_3}{A_1 + A_2 + A_3}$$