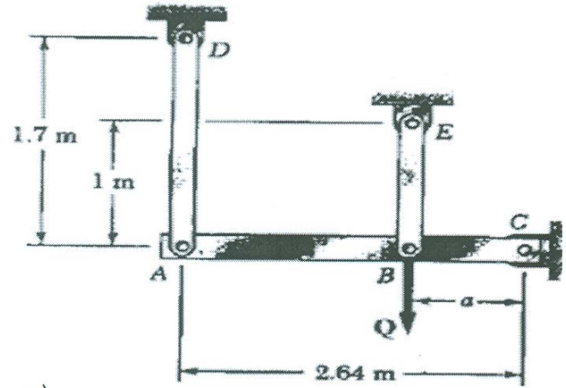
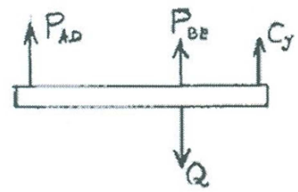


The rigid bar ABC is supported by two links, AD and BE, of uniform 37.5 mm x 6 mm rectangular cross section and made of mild steel with E= 200 GPa. The magnitude of the force Q applied at B is 260 kN. Knowing that a=0.64 m, determine,

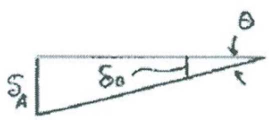
a) The value of the normal stress in each link
b) The deflection of point B

a)



Statics: $\Sigma M_c = 0 \quad 0.640(Q - P_{BE}) - 2.64\, P_{AD} = 0$

Deformation: $\delta_A = 2.64\,\theta, \quad \delta_B = a\theta = 0.640\,\theta$



Elastic Analysis:

$A = (37.5)(6) = 225\ mm^2 = 225 \times 10^{-6}\ m^2$

$P_{AD} = \frac{EA}{L_{AD}}\delta_A = \frac{(200\times10^9)(225\times10^{-6})}{1.7}\delta_A = 26.47\times10^6\,\delta_A$

$= (26.47\times10^6)(2.64\,\theta) = 69.88\times10^6\,\theta$

$\sigma_{AD} = \frac{P_{AD}}{A} = 310.6\times10^9\,\theta$

$P_{BE} = \frac{EA}{L_{BE}}\delta_B = \frac{(200\times10^9)(225\times10^{-6})}{1.0}\delta_B = 45\times10^6\,\delta_B$

$= (45\times10^6)(0.640\,\theta) = 28.80\times10^6\,\theta$

From Statics $\quad Q = P_{BE} + \frac{2.64}{0.640}P_{AD} = P_{BE} + 4.125\,P_{AD}$

$= [28.80\times10^6 + (4.125)(69.88\times10^6)]\theta = 317.06\times10^6\,\theta$

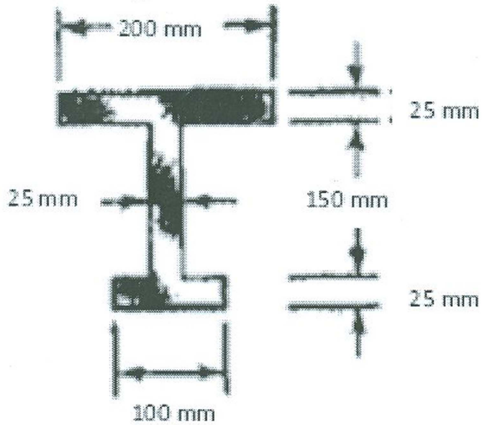
260000 N = $317.06\times10^6\,\theta \rightarrow \theta = 820.03\times10^{-6}$

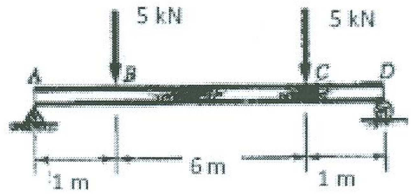
$P_{AD} = 69.88\times10^6\,\theta$ = 57304 N = 57.31 kN $\sigma_{AD} = \frac{P_{AD}}{A_{AD}} = \frac{57304}{225} = 254.68\ MPa$

$P_{BE} = 28.80\times10^6\,\theta$ = 23617 N = 23.617 kN $\sigma_{BE} = \frac{P_{BE}}{A_{BE}} = \frac{23617}{225} = 104.96\ MPa$

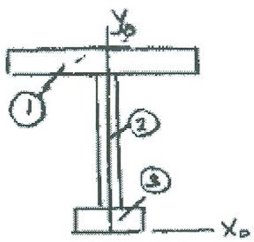
b) $\delta_B = \frac{P_{BE}\,L_{BE}}{E\,A_{BE}} = \frac{23617x1000}{200x10^3x225} = 0.542\text{mm}$

2-





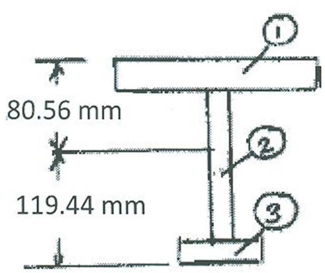
Two vertical forces are applied to a beam of the cross sectio shown above. Determine the maximum tensile and compressive stresses in portion BC of the beam.



	A	$\bar{y}_0$	$A\bar{y}_0$
1	5000	187.5	937500
2	3750	100	375000
3	2500	12.5	31250
Σ	11250		1343750

Y_0= 1343750/11250=119.44 mm

Neutral axis lies 119.44 mm above the base

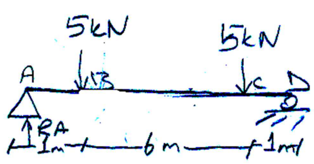


$$I_1 = \frac{1}{12} b_1 (h_1)^3 + A_1 (d_1)^2 = \frac{1}{12} \times (200) \times (25)^3 + 5000 \times (68.06)^2 = 23421234,67 \text{ mm}^4$$

$$I_2 = \frac{1}{12} b_2 (h_2)^3 + A_2 (d_2)^2 = \frac{1}{12} \times (25) \times (150)^3 + 3750 \times (19,44)^2 = 8448426 \text{ mm}^4$$

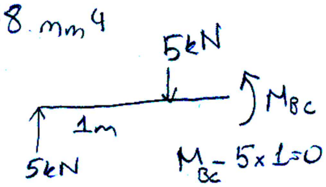
$$I_3 = \frac{1}{12} b_3 (h_3)^3 + A_3 (d_3)^2 = \frac{1}{12} \times (100) \times (25)^3 + 2500 \times (106,94)^2 = 28720617,33 \text{ mm}^4$$

$$I = I_1 + I_2 + I_3 = 60590278 \text{ mm}^4$$



$\Sigma M_D = 0$ $\quad 8R_A - 5\times 7 - 5\times 1 = 0$

$R_A = 5 \text{ kN}$



$M_{BC} - 5\times 1 = 0$

$M_{BC} = 5 \text{ kNm}$

$$\Rightarrow (\sigma_{max})_{comp} = -\frac{M_{BC}\, y_{top}}{I} = -\frac{5\times 10^6 \times 80.56}{60590278} = -6.65 \text{ MPa}$$

$$(\sigma_{max})_{tens} = -\frac{M_{BC}\, y_{bot}}{I} = \frac{-5\times 10^6 \times (-119.44)}{60590278} = 9.86 \text{ MPa}$$