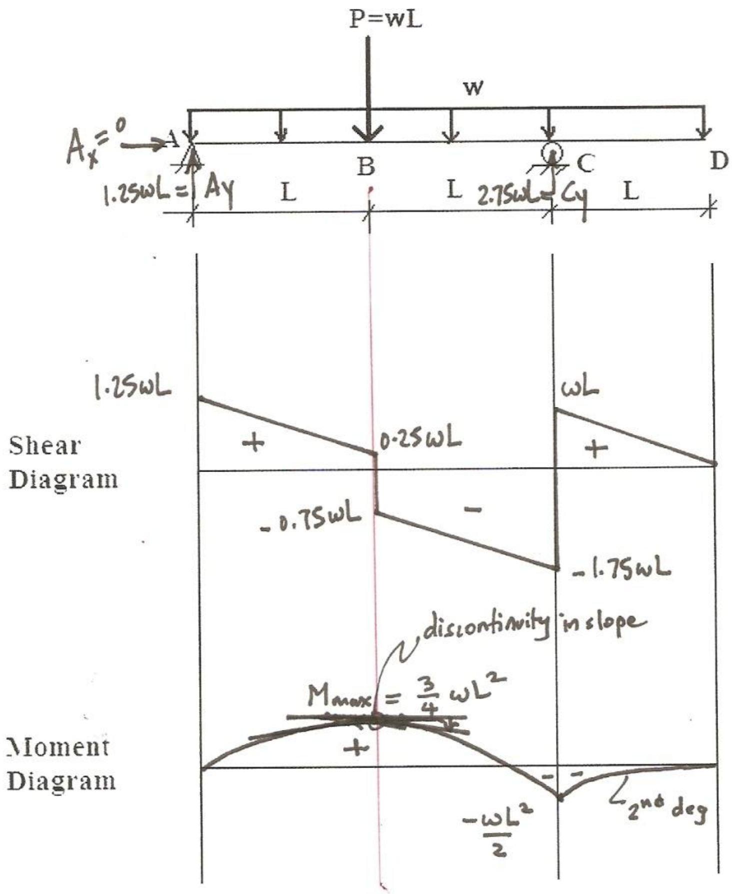
Name: **ID#:** **Sec#:**

Problem 1(15%)

Beam (**ABCD**) is subjected to a uniform load *w* (N/m) from **A** to **D** and a concentrated force **P=*w*.L** at **B**. The support at **A** is a hinge and a roller at **C**.

a) Draw the shear and moment diagrams.



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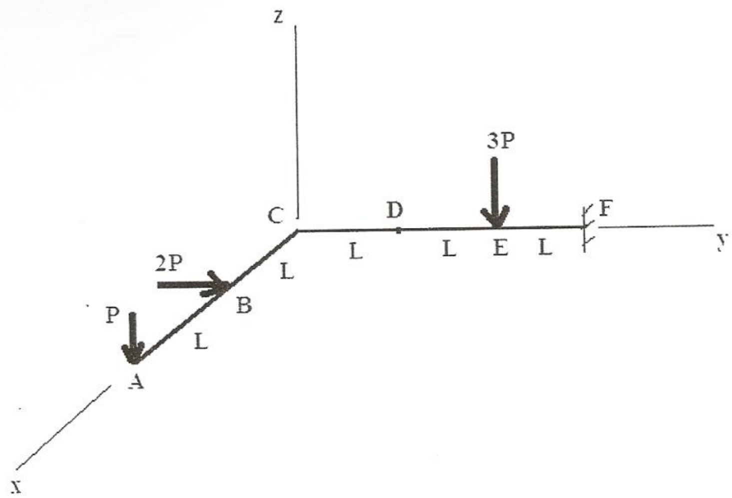
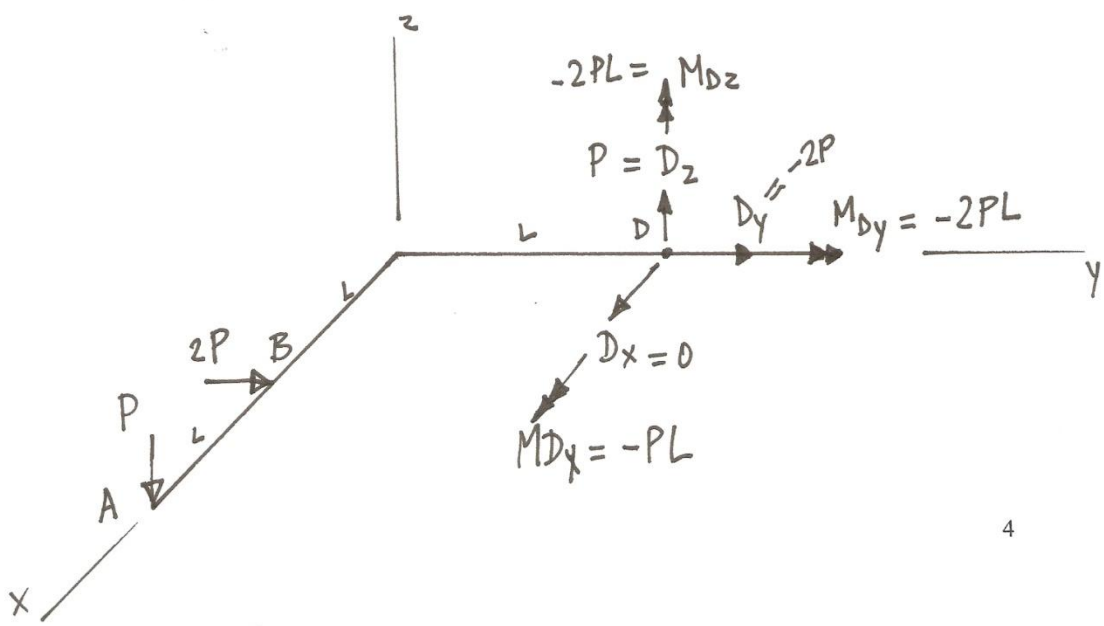
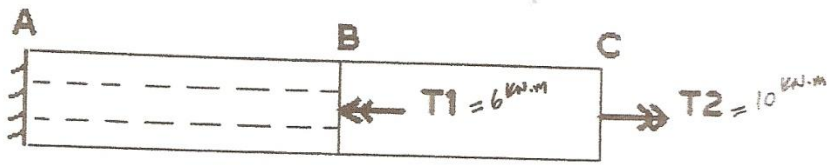
Problem 2(10%)



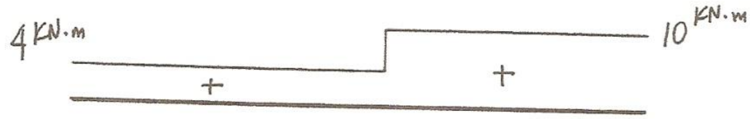
Bracket **A-F**, located in the xy-plane, is fixed at **F** and subjected to loads **P**, **2P** and **3P** at **A**, **B** and **E**, respectively. Distances AB, BC, CD, DE and EF are all equal to L. The loads at **A** and **E** are along the z-axis and the one at **B** along the y-axis. Bar AC is along the x-axis and CF is along the y-axis. The angle between the x- and y-axes is 90°.

a) Determine the internal forces and moments at **D** and show their directions.

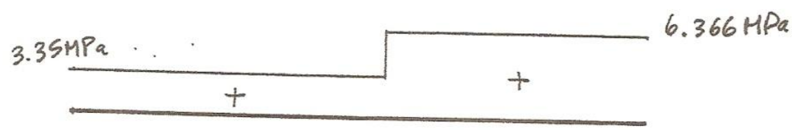




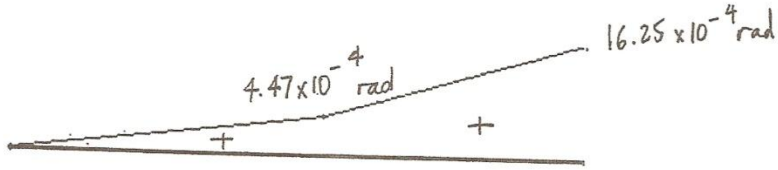
T- diag



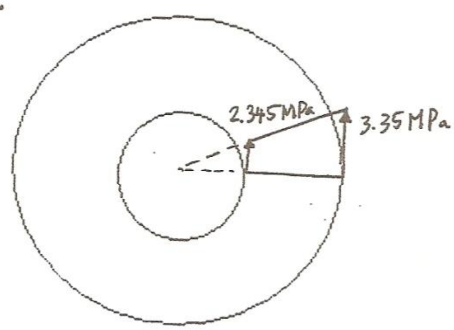
τ- diag



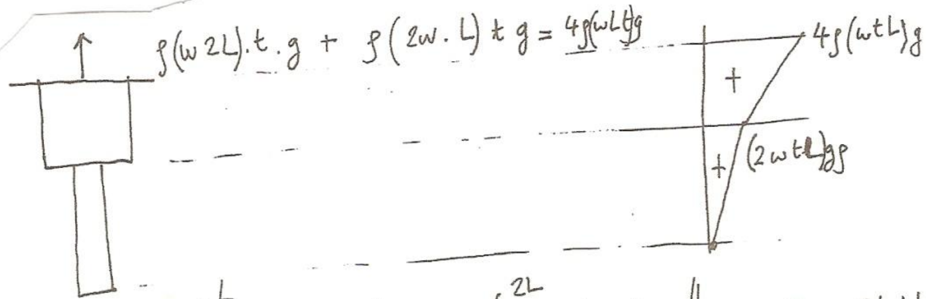
ϕ diag



<u>τ(r) @ A</u>



$$\tau(r) = \frac{T_A r}{J_{AB}}$$



$$\Delta_C - \cancel{\Delta_A}^{0} = \int_0^L \frac{\left(2G - G\frac{x}{L}\right)dx}{(2wt)E} + \int_0^{2L} \frac{\left(G - \frac{Gx}{2L}\right)dx}{(wt)E} \quad \Big\| \text{ Let } G = 2(wtL)\rho g$$

$$\Delta_C = \frac{G}{(2wtE)}\left[2x - \frac{x^2}{2L}\right]_0^L + \frac{G}{(wtE)}\left[x - \frac{x^2}{4L}\right]_0^{2L}$$

$$\Delta_C = \frac{G}{(2wtE)}\cdot\left[2L - \frac{L^2}{2L}\right] + \frac{G}{(wtE)}\cdot\left[2L - \frac{4L^2}{4L}\right]$$

$$\Delta_C = \frac{3GL}{4wtE} + \frac{GL}{wtE} = \frac{7}{4}\frac{GL}{wtE} = \frac{7}{4}\frac{(2wtL)\rho g}{wtE}$$

$$\boxed{\Delta_C = \frac{7}{2}\frac{\rho g L^2}{E}}$$

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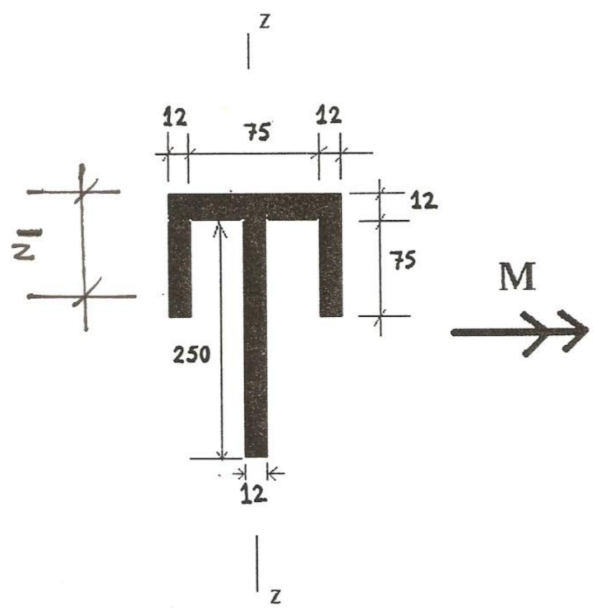
Problem 5(25%)

A beam, with cross section shown below, is subjected to a moment **M** of 6 KN.m with direction as shown. The cross-section is symmetric with respect to the z-axis.

a) Determine the maximum tensile and compressive bending stresses and their locations on the cross-section.



(All dimensions are in mm)

$\bar{z} = 84.71$ mm

$I_{yy} = 34.277 \times 10^6$ mm^4

$$\sigma_{top} = \frac{6 \times 10^6 \text{ N.mm} \times 84.707 \text{ mm}}{34.277 \times 10^6} = 14.83 \text{ MPa (T)}$$

$$\sigma_{bot} = \frac{6 \times 10^6 \times (262 - 84.707)}{34.277 \times 10^6} = 31.03 \text{ MPa (C)}$$