Unsymmetrical Bending

The stress σ is given by

$$\frac{P}{A} + \frac{I_{xy}\,x - I_{yy}\,y}{I_{xy}^2 - I_{xx}\,I_{yy}} M_x + \frac{I_{xy}\,y - I_{xx}\,x}{I_{xy}^2 - I_{xx}\,I_{yy}} M_y$$

P is the axial force

A is the area of section

I_{xx} is the second moment of area about the x-axis

I_{yy} is the second moment of area about the y-axis

I_{xy} is the product moment of area

M_x is the BM about the x-axis

M_y is the BM about the y-axis

The location of the neutral axis is given by $\sigma =$

<u>Note 1</u>

$I_{xy} = 0$ for a rectangle

<u>Note 2</u>

Shift theorem

$I_{xy} = I_{x_c y_c} + Ahk$

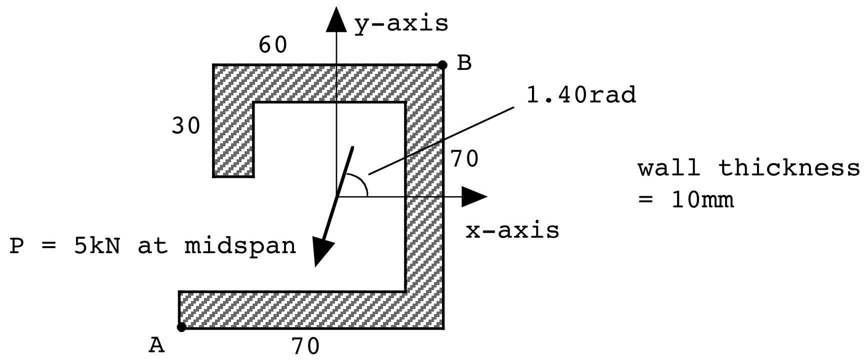
Unsymmetrical Bending

Qu.1

A bar has the cross-section shown in Fig.1 and is used as a simple beam of length 2m. Determine the maximum tensile and compressive stresses in the beam.

x_C = 28mm y_C = 35mm I_{xx} = 1.330 x 10^6 mm^4 I_{yy} = 917 x 10^3 mm^4

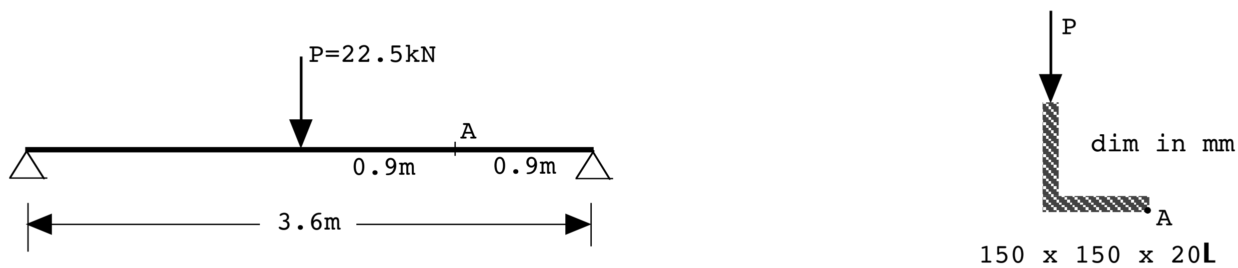
I_{xy} = 30 x 10^3 mm^4 α = 0.215rad σ_A = 91.5N/mm^2 σ_B = -75.8N/mm^2



Qu.2

In Fig.2 find the stress at point A.

I_{xx} = I_{yy} = 11.596 x 10^6 mm^4 I_{xy} = -6.79 x 10^6 mm^4



Qu.3

In Fig.3 determine the largest value of M so that the allowable stress does not exceed 80N/mm^2. All dimensions are in mm.

M = 266.8 N-mm