University of Nottingham
Department of Mechanical Engineering

MM2MS3 Mechanics of Solids 3
Exercise Sheet 2 – Asymmetrical Bending

1. For the section shown in Figure Q1, determine:

   (a) The position of the Centroid, C
   (b) 2nd Moments of Area and Product Moment of Area about the x-y axes through C
   (c) The Principal 2nd Moments of Area
   (d) The directions of the Principal Axes

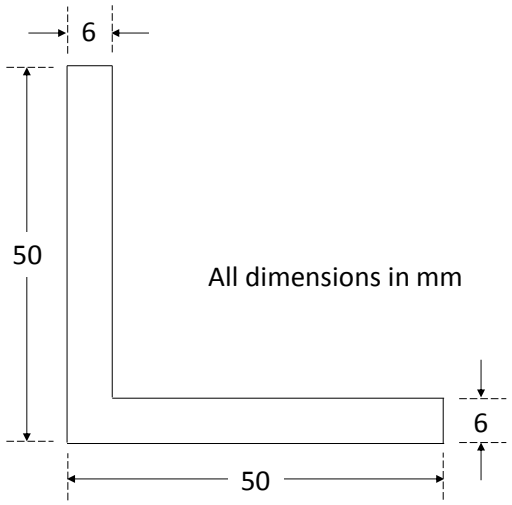

Fig Q1

[Ans: a) 14.7mm from bottom and left edges, b) I_x = 131,257.96mm^4, I_y = 131,257.96mm^4 & I_{xy} = -77,234.04mm^4, c) I_p = 208,491.1mm^4 & I_Q = 54,023.92mm^4, d) 45° anti-clockwise from x-y axes]

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2. Calculate (a) the Principal 2nd Moments of Area and (b) the directions of the Principal Axes for the section shown in Figure Q2.

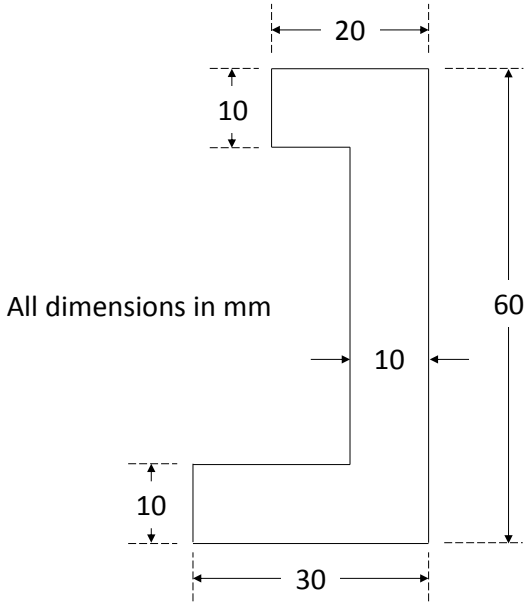

Fig Q2

[Ans: a) I_p = 367,810.05mm^4 & I_Q = 44,967.75mm^4, b) 6.97°]

3. A box section beam, 300mm wide, 450mm deep, with a uniform wall thickness of 25mm is subjected to a uniform bending moment, M. The plane of bending is inclined at an angle of 30° to the longer principal axis of the section. Determine the maximum permissible bending moment if the maximum stress in the beam is not to exceed 120MPa.

[Ans: 334.54kNm]

4. A 50mm by 30mm by 5mm angle is used as a cantilever of length 500mm, with the 30mm leg horizontal and uppermost. A vertical load of 1000N is applied at the free end. Determine (a) the position of the neutral axis and (b) the maximum tensile and compressive bending stresses.

[Ans: a) 86.79°, b) 201.18MPa & -94.38MPa]

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5. Calculate (a) the position of the Neutral Axis and (b) the maximum tensile stress for the section shown in Figure Q5 when a Bending Moment of 225Nm is applied about the x-axis in the sense shown.

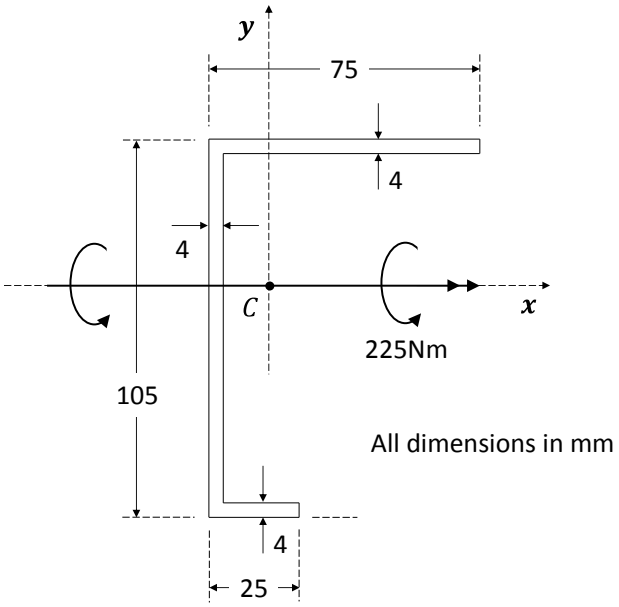

Fig Q5

[Ans: a) 42.82° (anti-clockwise) from the x-y axes, b) 14.22MPa]