ES120 Spring 2018 – Section 8 Notes

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Problem 1:

The vertical shear is 25 kN in a beam having the cross section shown. Knowing that $d = 50$ mm, determine the shearing stress at (a) point a, (b) point b.

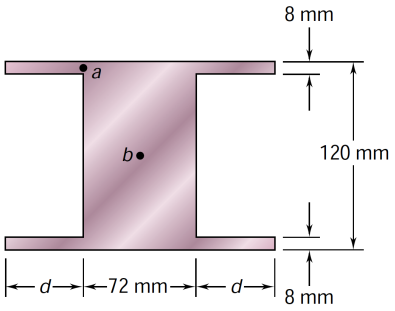

Figure 1

Solution 1

For this problem, let's first begin by computing the moment of inertia of the cross section using the outside parts and the inside part separately and using parallel axis theorem

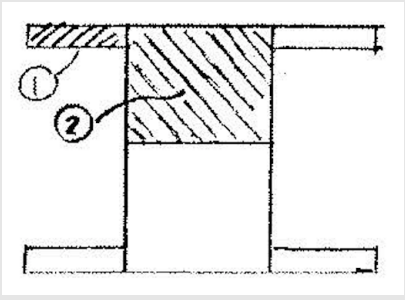

Figure 2

$$I_1 = \frac{1}{12}(50)(8)^3 + (50)(8)(56)^2 = 1.256 \times 10^6 \text{ mm}^4 \tag{1}$$

$$I_2 = \frac{1}{3}(72)(63)^3 = 5.184 \times 10^6 \text{ mm}^4 \tag{2}$$

Such that the total section's second moment of inertia becomes

$$I = 4I_1 + 2I_2 = 15.3933 \times 10^{-6}\ \text{m}^4 \tag{3}$$

Now we can compute the first moment with respect to the neutral axis Q

$$Q_1 = A_1\bar{y}_1 = (50)(8)(56) = 22.4 \times 10^3\ \text{mm}^3 \tag{4}$$

$$Q_2 = A_2\bar{y}_2 = (72)(60)(30) = 129.6 \times 10^3\ \text{mm}^3 \tag{5}$$

Part (a)

Part (b)

Problem 2:

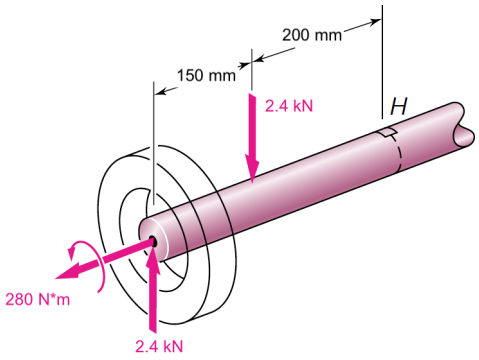

Figure 3

The axle of an automobile is acted upon by the forces and couple shown. Knowing that the diameter of the solid axle is 1.25 in., determine (a) the principal planes and principal stresses at point H located on top of the axle, (b) the maximum shearing stress at the same point.

Solution 2

Part (a)

Part (b)

Problem 3:

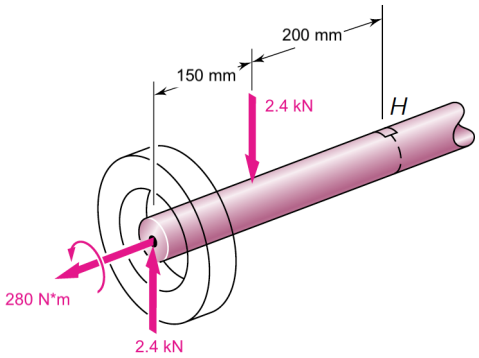

Figure 4

Solve the previous problem using Mohr's circle

Solution 3