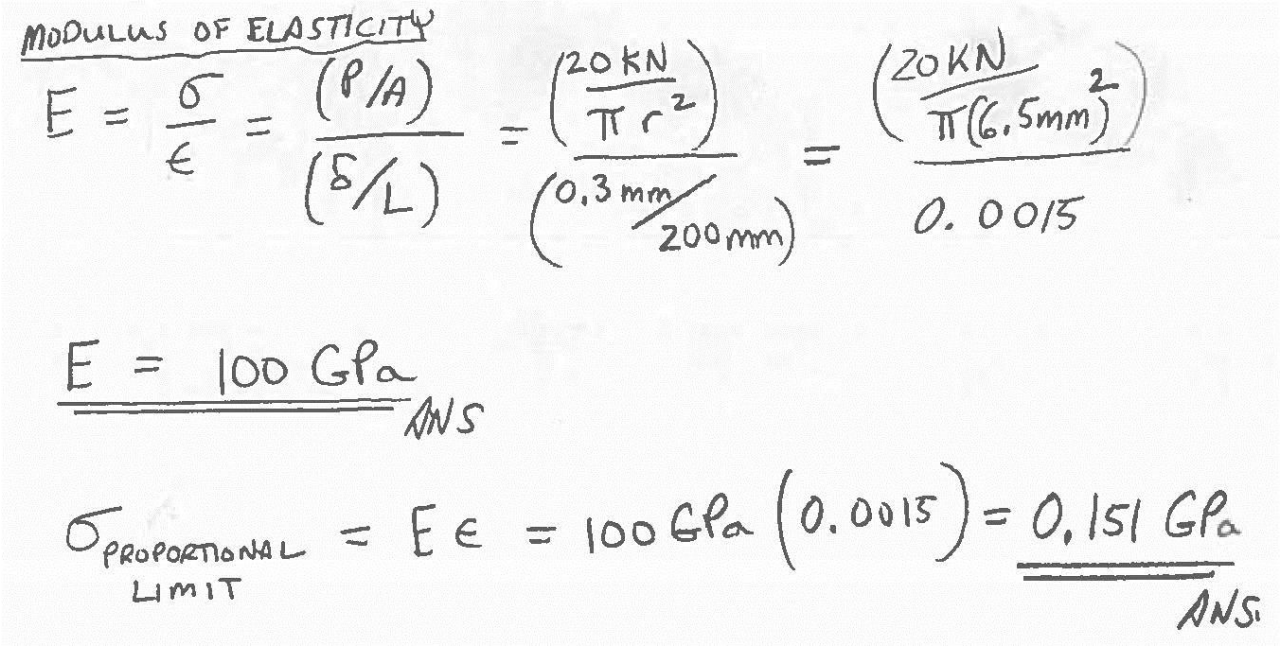
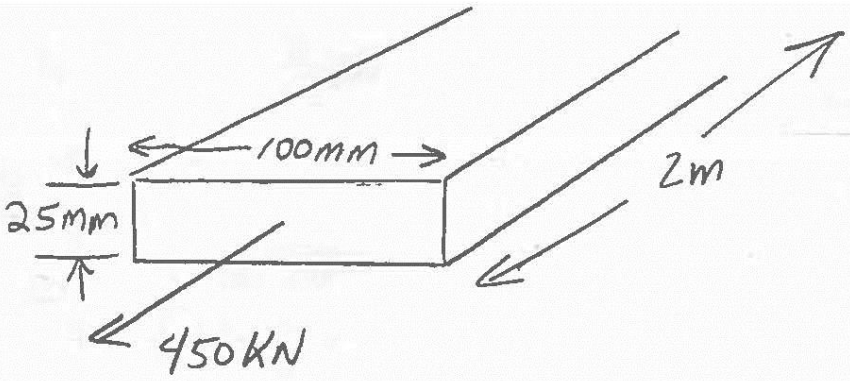
MOOC – "Mechanics of Materials I"
Week Two Quiz Solution

Problem 1) A circular section of material is tested. The original specimen is 200 mm long and has a diameter of 13 mm. When loaded to its proportional limit, the specimen elongates by 0.3 mm. The total axial load is 20 kN. Determine the modulus of elasticity and the proportional limit.



Problem 2) A rectangular test section of material is slowly loaded with a 450 kN axial load. The original cross-section is 25 mm by 100 mm. The original length is 2 meters. Once fully loaded, the 100 mm side measures 99.96 mm and the length has increased by 2 mm. Calculate Poisson's ratio and Young's modulus.



$$\epsilon' = \frac{\delta_{LAT}}{W_o} = \frac{-0.04\ mm}{100\ mm} = -0.0004$$

$$\epsilon = \frac{\delta_{LONG}}{L_o} = \frac{2\ mm}{2000\ mm} = 0.001$$

POISSON'S RATIO

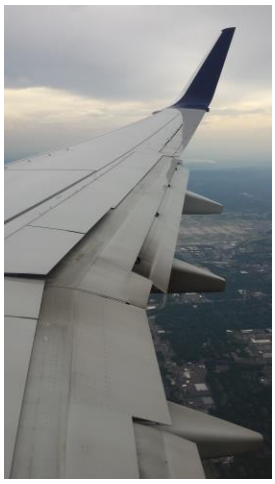
$$\nu = -\frac{\epsilon'}{\epsilon} = -\frac{(-0.0004)}{0.001} = 0.4 \quad \text{ANS}$$

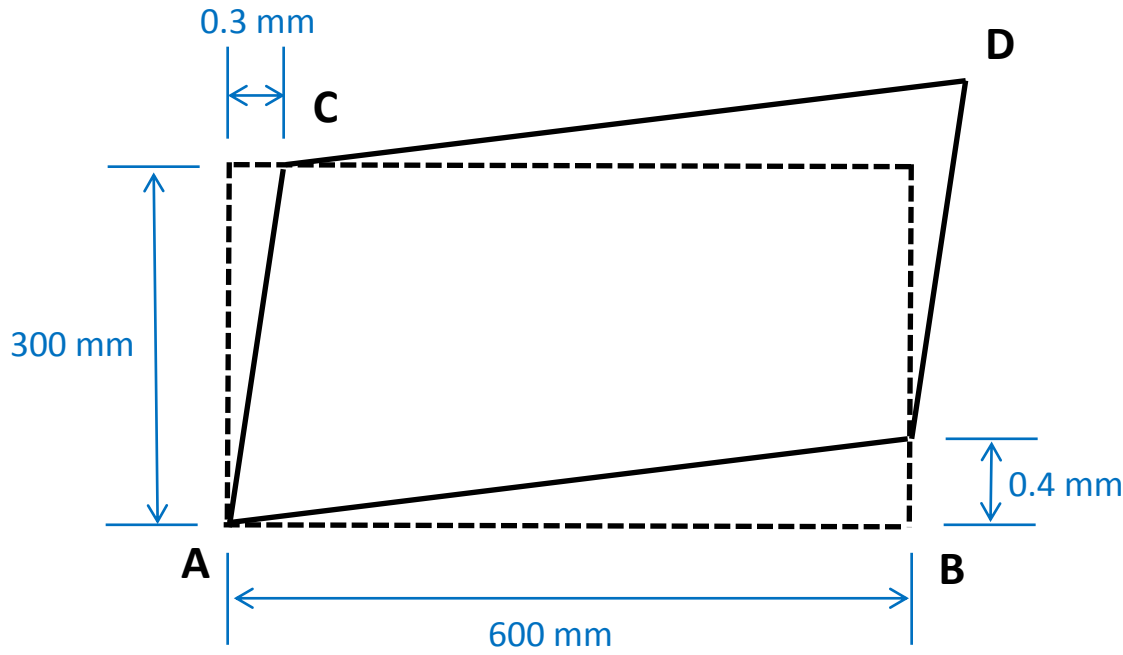
YOUNG'S MODULUS

$$E = \frac{\sigma}{\epsilon} = \frac{(P/A)}{(\delta/L)} = \frac{\left[\frac{450\ kN}{(25mm)(100\ mm)}\right]}{\left[\frac{2\ mm}{2000\ mm}\right]}$$

$$E = 180\ \frac{kN}{mm^2} = 180\ GPa \quad \text{ANS}$$

Problem 3) A thin rectangular plate section of an airplane is uniformly deformed as shown below. (We will learn how to measure strains later in the course.) Compute the shear strain at point A. The original sides AB and AC were orthogonal in the undeformed plate.





$$\gamma_1 = \tan^{-1}\left(\frac{0.3\ mm}{300\ mm}\right) = 0.001$$

$$\gamma_2 = \tan^{-1}\left(\frac{0.4\ mm}{600\ mm}\right) = 0.000667$$

$$\gamma = \gamma_1 + \gamma_2 = 0.00167\ rad = 1670\ \mu\ rad$$

ANS.