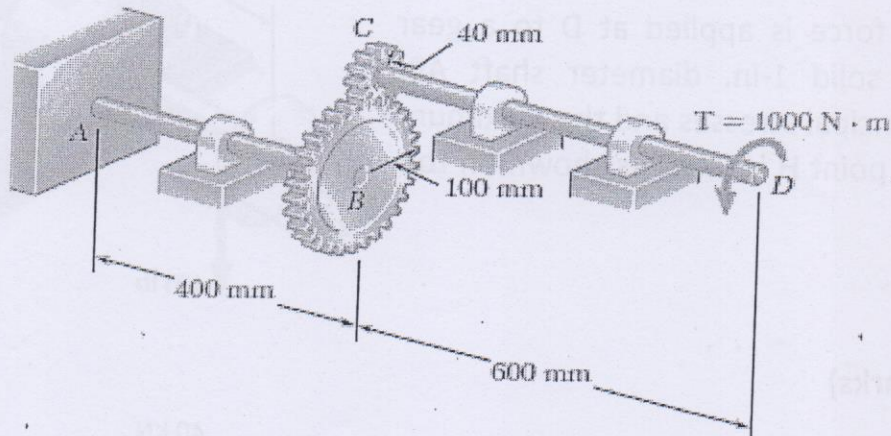




Please, solve all the following problems with clear net sketch and force analysis diagrams

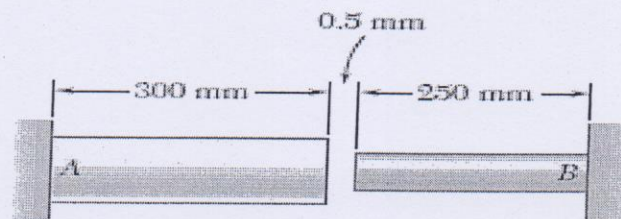
Problem 1: (10 marks)

The design of the gear-and-shaft system shown requires that steel shafts of the same diameter be used for both AB and CD. It is further required that max torsional shear stress ≤ 60 MPa and that the angle Φ_D through which end D of shaft CD rotates not exceed 1.58. Knowing that $G = 77$ GPa, determine the required diameter of the shafts.



Problem 2: (10 marks)

At room temperature (20°C) a 0.5-mm gap exists between the ends of the rods shown. At a later time when the temperature has reached 140°C, determine (a) the normal stress in the aluminum rod, (b) the change in length of the aluminum rod.



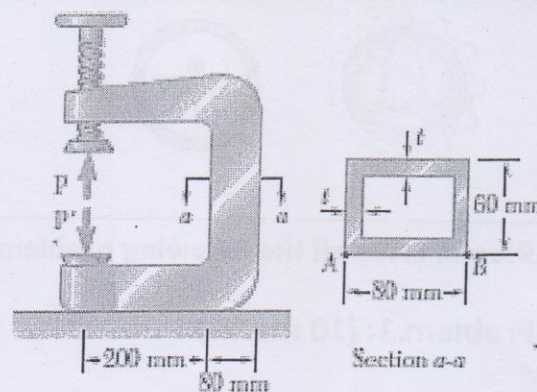
Aluminum
 $A = 2000 \text{ mm}^2$
 $E = 75 \text{ GPa}$
 $\alpha = 23 \times 10^{-6}/^\circ\text{C}$

Stainless steel
 $A = 800 \text{ mm}^2$
 $E = 190 \text{ GPa}$
 $\alpha = 17.3 \times 10^{-6}/^\circ\text{C}$

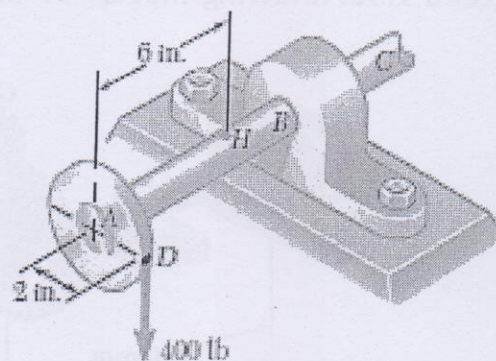
P.T.O.

Problem 3: (10 marks)

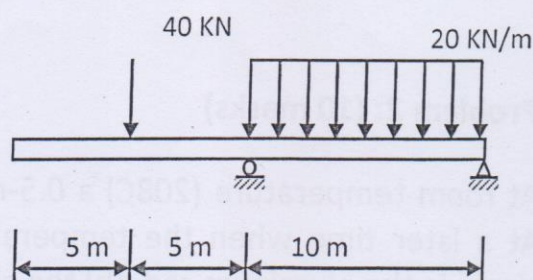
The vertical portion of the press shown consists of a rectangular tube of wall thickness $t = 10$ mm. Knowing that the press has been tightened on wooden planks being glued together until $P = 20$ kN, determine the stress at (a) point A, (b) point B.

**Problem 4: (10 marks)**

A 400-lb vertical force is applied at D to a gear attached to the solid 1-in. diameter shaft AB. Determine the principal stresses and the maximum shearing stress at point H located as shown on top of the shaft.

**Problem 5: (10 marks)**

For the beam and loading shown, Construct the shear force diagram and the bending moment diagram. Also, determine the minimum required width b , knowing that for the grade of timber used, $\sigma_{all} = 5.12$ MPa and $\tau_{all} = 825$ kPa.



Wishing all you have the strength and good well to catch our dream

Dr./ Mona Abou-Elaz