



Question One (10 Marks)

1. The ability of a material to absorb energy in the elastic range of stress is ...
(a) Stiffness | (b) Strength | (c) Toughness | (d) Resilience
2. The maximum shear stress occurs on a plane making an angle of ... with part axis.
(a) 0° | (b) 45° | (c) 90° | (d) otherwise
3. If a part is subjected to double shear stress, there is (are) ... shear plane(s).
(a) 1 | (b) 2 | (c) 3 | (d) otherwise
4. For a bar restrained by fixed supports from both sides, if the temperature is decreased by a certain amount, the bar is subjected to ... stress.
(a) Tensile Thermal | (b) Compressive Thermal | (c) Shear | (d) Combined
5. The factor of safety is defined as the ratio between ultimate strength to
(a) Tensile strength | (b) Yield Strength | (c) Allowable stress | (d) otherwise

Question Two (15 Marks)

A uniform concrete slab of total weight W is to be attached, as shown in Fig. 1, to two rods whose lower ends are on the same level. Determine the ratio of the areas of the rods so that the slab will remain level.

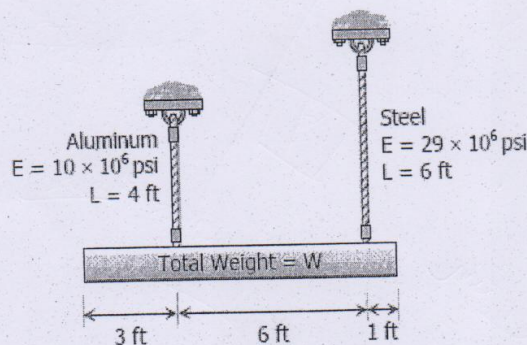


Fig. 1

Question Three

(10 Marks)

Determine the maximum torque that can be applied to a hollow circular steel shaft of 100-mm outside diameter and an 80-mm inside diameter without exceeding a shearing stress of 60 MPa or a twist of 0.5 deg/m. Use $G = 83 \text{ GPa}$.

Question Four

(15 Marks)

A single horizontal force P of 150 lb magnitude is applied to end D of lever ABD as shown in Fig. 2. Determine (a) the normal and shearing stresses on an element at point H having sides parallel to the x and y axes, (b) the principal planes and principal stresses at the point H .

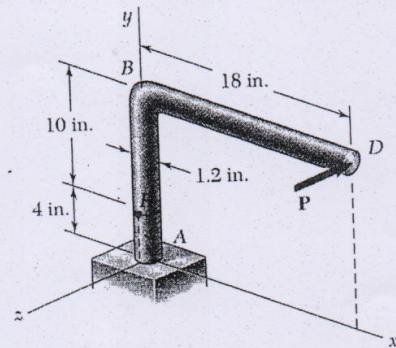


Fig. 2

Good Luck
Dr. Noha Fouda



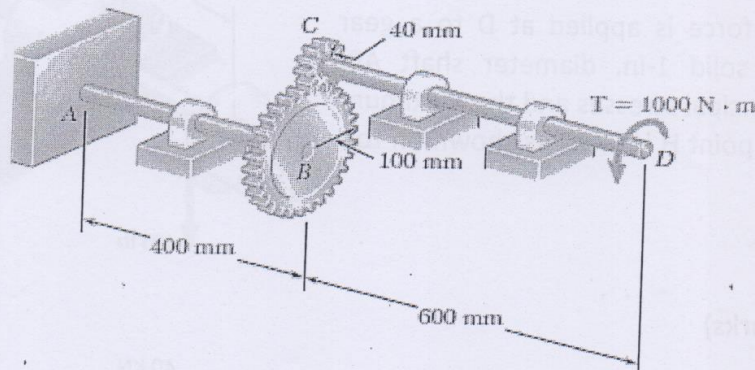
Final Exam
Strength of materials (PDE181)
Time: 2 Hrs
Marks : 50



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

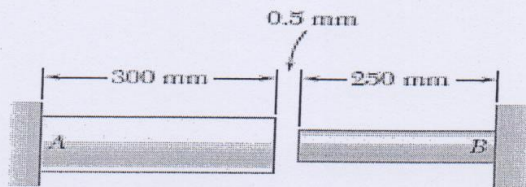
Problem 1: (10 marks)

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.



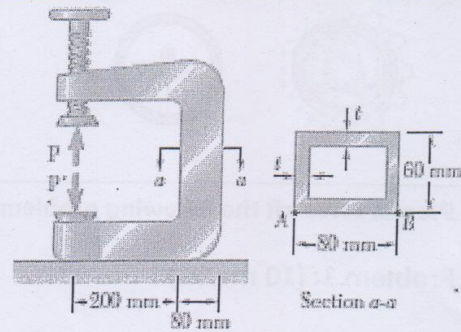
Aluminum
 $A = 2000 \text{ mm}^2$
 $E = 75 \text{ GPa}$
 $\alpha = 23 \times 10^{-6}/^\circ\text{C}$

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

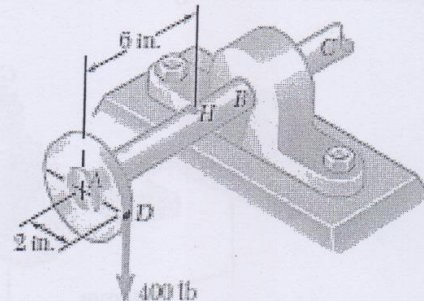
P.T.O.

Problem 3: (10 marks)

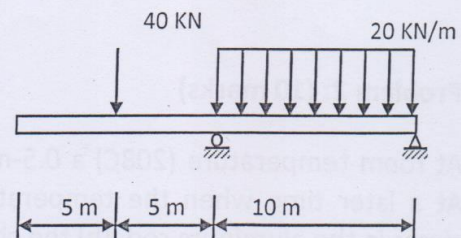
The vertical portion of the press shown consists of a rectangular tube of wall thickness $t = 10$ mm. Knowing that the press has been tightened on wooden planks being glued together until $P = 20$ kN, determine the stress at (a) point A, (b) point B.

**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-ElSeaz