

Problem 1. The state of plane stress at a point is shown on the element in Fig.1.

(1) Construct the Mohr's circle (10%)

(2) Represent this state of stress on an element oriented 30° counterclockwise from the position shown (10%)

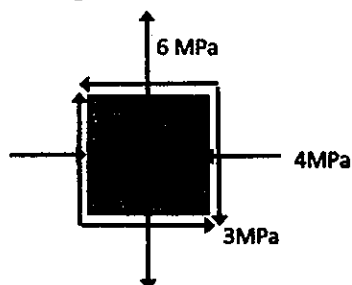


Fig. 1

Problem 2. The rectangular block shown in Fig.2 is subject to a uniform pressure 0.5 MPa. Take $E = 4 \text{ MPa}$, Poisson's ratio is 0.35.

(1) Determine the dilatation (5%)

(2) Determine the change in length of each side (5%)

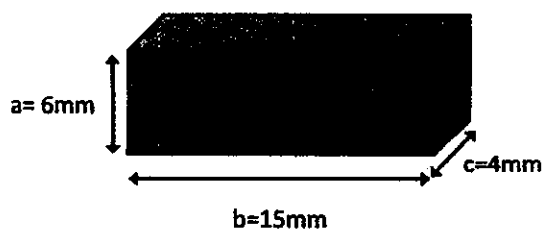


Fig. 2

Problem 3. (10%) Draw the shear and moment diagrams of the cantilever beam shown in Fig. 3.

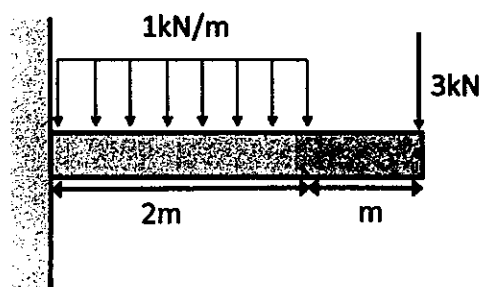


Fig. 3

Problem 4. (10%) Determine the displacement of point A of the cantilever beam when M is applied at its end as shown in Fig.4. EI is constant.

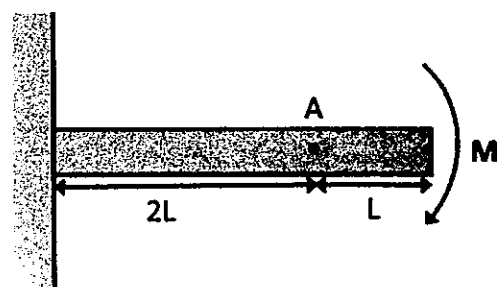


Fig. 4

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Problem 5. (18%) The stress-strain diagram for an elastic fiber that makes up human skin and muscle is shown in Fig. 5. Please determine the following parameters relevant to the mechanical properties of this elastic fiber:

- (1) Range of the elastic region (in strain)
- (2) Range of the plastic region (in strain)
- (3) Proportional limit
- (4) Elastic limit
- (5) Failure strength
- (6) Modulus of resilience
- (7) Modulus of toughness
- (8) Modulus of elasticity
- (9) Tangent modulus

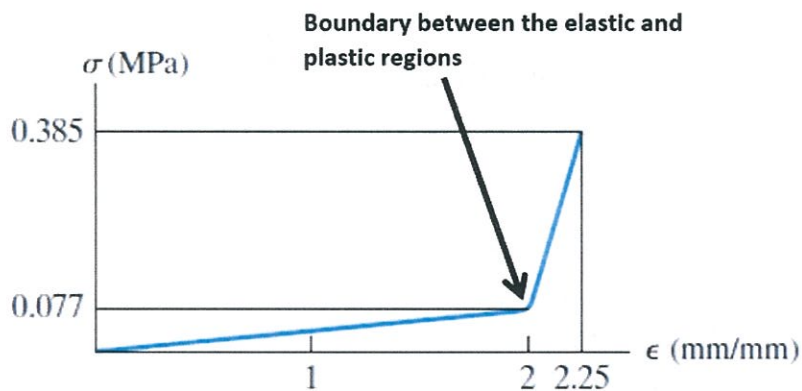


Fig. 5

Problem 6. The dimensions and stress-strain diagram of a square hollow bar made of a metal alloy is shown in Fig. 6. Please answer the following two questions:

- (1) Determine the elongation of the bar when it is subjected to the axial force $P = 100$ kN. (8%)
- (2) If this axial force is increased to $P = 360$ kN and then released, find the permanent elongation of the bar. (8%)

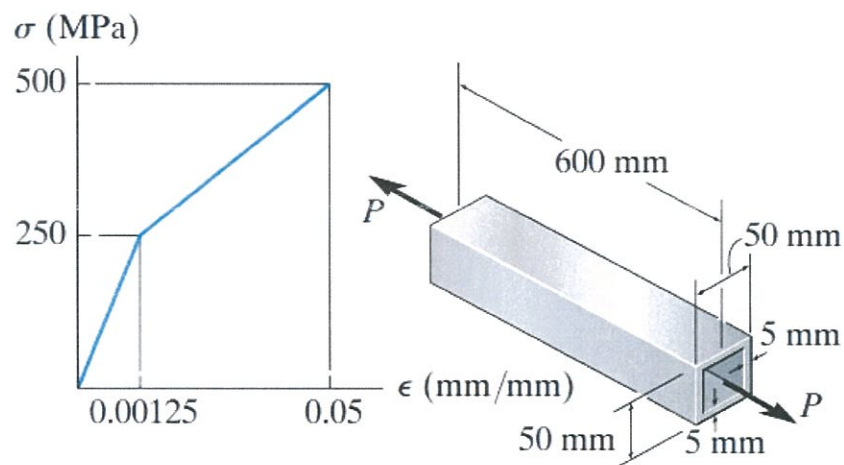


Fig. 6

Problem 7. (16%) Determine the dimension a of a beam having a square cross section in terms of the radius r of a beam with a circular cross section if both beams are subjected to the same internal moment which results in the same maximum bending stress.

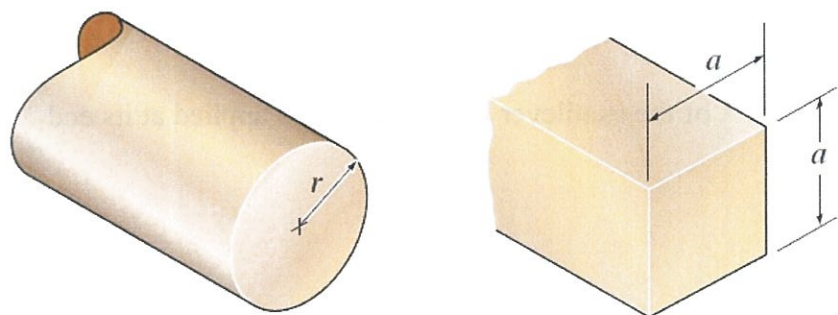


Fig. 7

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