16ME207- STRENGTH OF MATERIALS

UNIT I - STRESS STRAIN DEFORMATION OF SOLIDS

**Deformation of simple and compound bars
under axial load**

Problems:

1.) A steel bar is 900 mm long; its two ends are 40 mm and 30 mm in diameter and the length of each rod is 200 mm. The middle portion of the bar is 15 mm in diameter and 500 mm long. If the bar is subjected to an axial tensile load of 15kN, find its total extension.

Take E = 200 GN/m2 (G stands for giga and 1G = 109).

Problems:

2.) The bar shown in Fig. is subjected to tensile load of 50 kN. Find the diameter of the middle portion if the stress is limited to 130 MN/m2. Find also the length of the middle portion if the total elongation of the bar is 0.15 mm. Take E = 200 GN/m2.
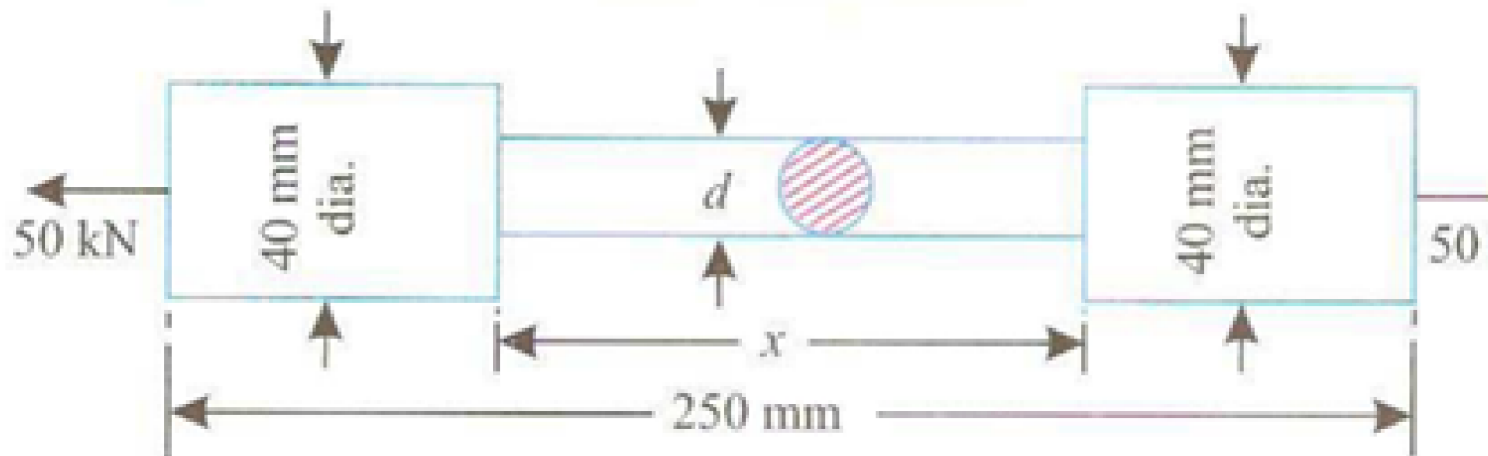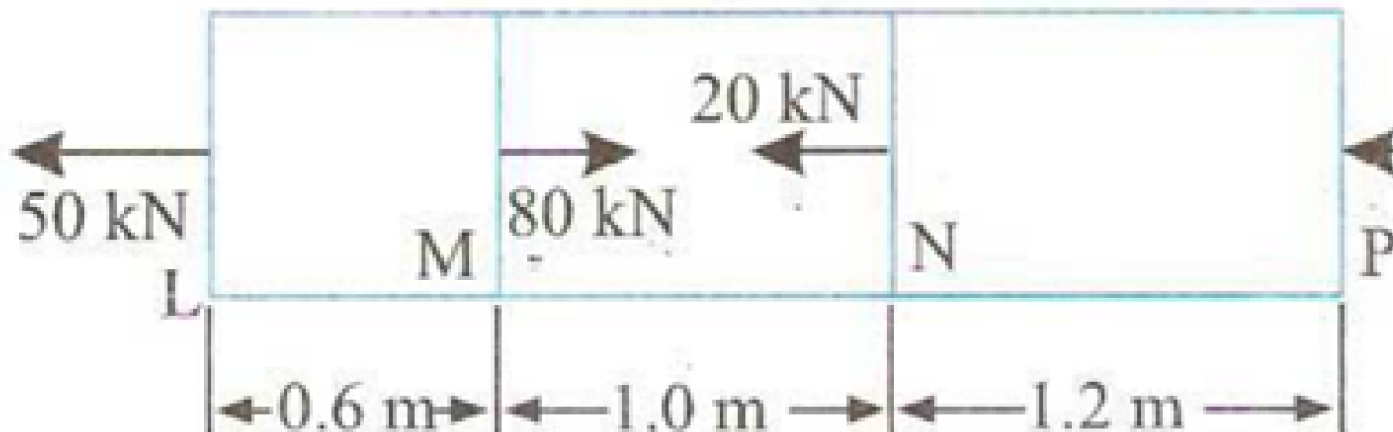
Problems:

3.) A steel tie rod 50 mm in diameter and 2.5 m long is subjected to a pull of 100 kN. To what length the rod should be bored centrally so that the total extension will increase by 15 percent under the same pull, the bore being 25 mm diameter? Take E = 200 GN / m2.

Principle of super position Problems:

1.) A brass bar having cross-sectional area of 1000 mm2 is subjected to axial forces shown in the Fig. Find the total elongation of the bar. Modulus of elasticity of brass = 100 GN/m2.
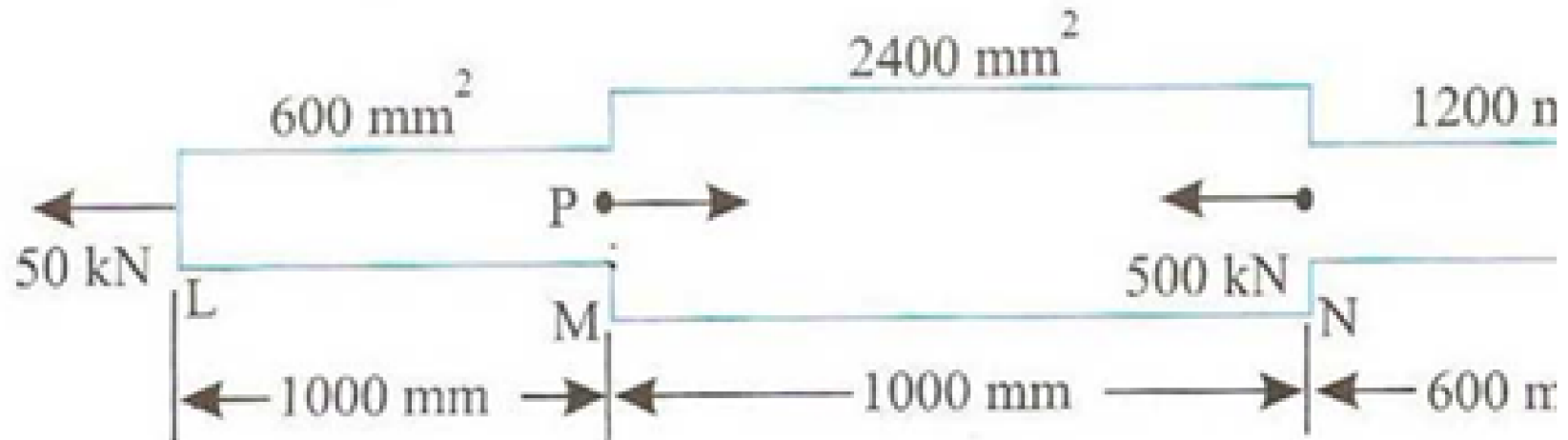
Principle of super position Problems:

2.) A member LMNP is subjected to point loads as shown in Fig. Calculate:

Force P necessary for equilibrium. Total elongation of the bar.

Take E = 210 GN/m2.

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Deformation of Compound bars under Axial Load – Problems

1.) A concrete column of cross-sectional area 400 mm x 400 mm is reinforced by four longitudinal 50mm diameter round steel bars placed at each corner. If the column carries a compressive load of 300 kN, determine :

i. Loads carried;

ii. The compressive stress produced in the concrete and steel bars. Young's modulus of elasticity of steel is 15 times that of concrete.

Deformation of Compound bars under Axial Load – Problems

2.) A copper rod of 40 mm diameter is surrounded tightly by a cast-iron tube of 80 mm external diameter, the ends being firmly fastened together. When put to a compressive load of 30 kN, what load will be shared by each? Also determine the amount by which the compound bar shortens if it is 2 m long.

Take:　　Ec.i = 175 GN/m2, and Ec = 75 GN/m2.

Deformation of Compound bars under Axial Load – Problems

3.) Figure shows a round steel rod supported in a recess and surrounded by co-axial brass tube. The upper end of the rod is 0.1 mm below that of the tube and an axial load is applied to a rigid plate resting on the top of the tube. Determine the magnitude of the maximum permissible load if the compressive stress in the rod is not to exceed 110 MN/m2 and that in the tube is not to exceed 80MN/m2.
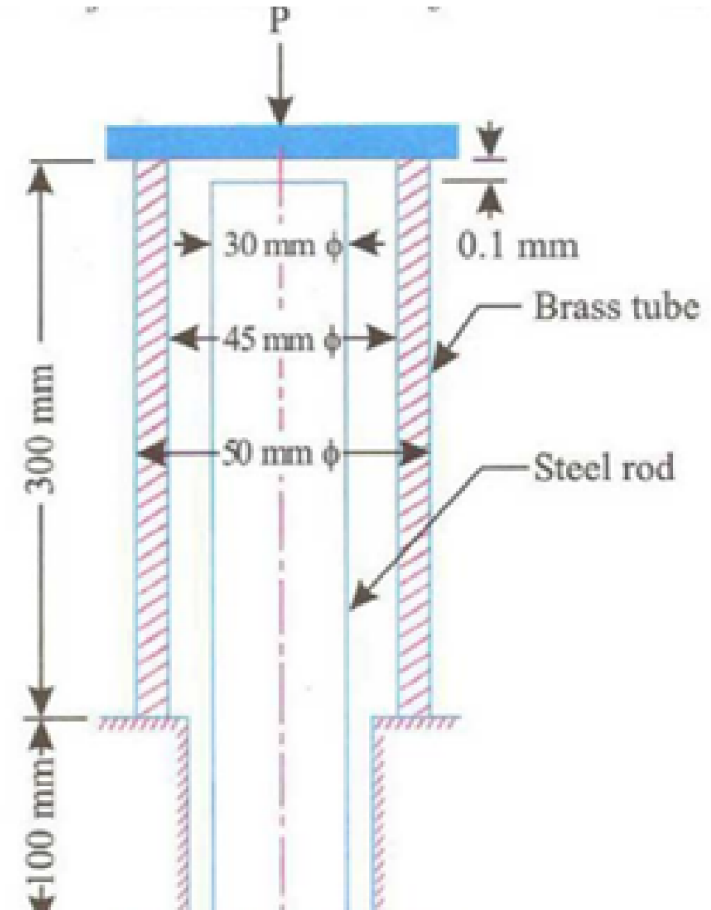
Find the amount by which the tube will be shortened by the load if the compressive stress in the tube is the same as that in the rod.
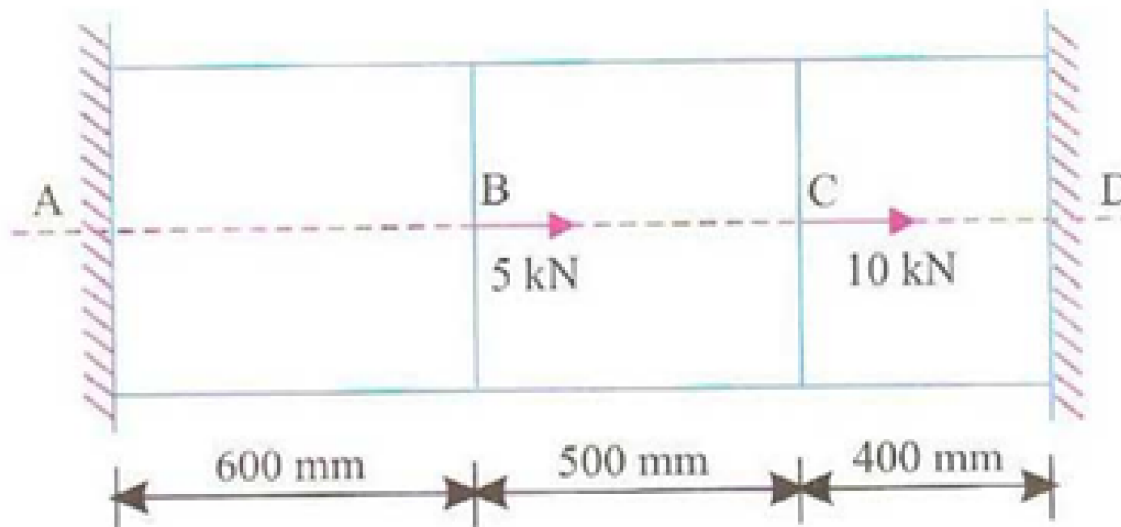
Take: Es = 200 GN/m2;

Eb = 100 GN/m2.

Deformation of Compound bars under Axial Load – Problems

Problems:

4) A straight uniform bar AD is clamped at both ends and loaded as shown in Fig. Initially the bar is stress free. Determine the stresses in all the three parts (AB, BC, CD) of the bar if the cross-sectional area of bar is 1000 mm2.

Problems:

5) For the bar shown in Fig., calculate the reaction produced by the lower support on the bar. Take E = 200 GN/m2. Find also the stresses in the bars.