



Reg. No. :

Name :

**Third Semester B.Tech. Degree Examination, October 2016
(2013 Scheme)
13.304 : MECHANICS OF SOLIDS
(MNPSU)**

Time : 3 Hours

Max. Marks : 100

PART – A

Answer **all** questions. **Each** question carries **4** marks.

- I. a) What is complimentary shear stress ? Explain briefly.
- b) The bulk modulus of elasticity of a material is half its Young's modulus of elasticity. Find its Poisson's ratio.
- c) Show that planes carrying maximum shear stress are inclined at 45° with the principal planes.
- d) What is pure bending ? Give an example of a beam with loading which produces pure bending.
- e) What is buckling of long columns ? Explain briefly. 20

PART – B

Answer **one full** question from **each** Module. **Each** question carries **20** marks.

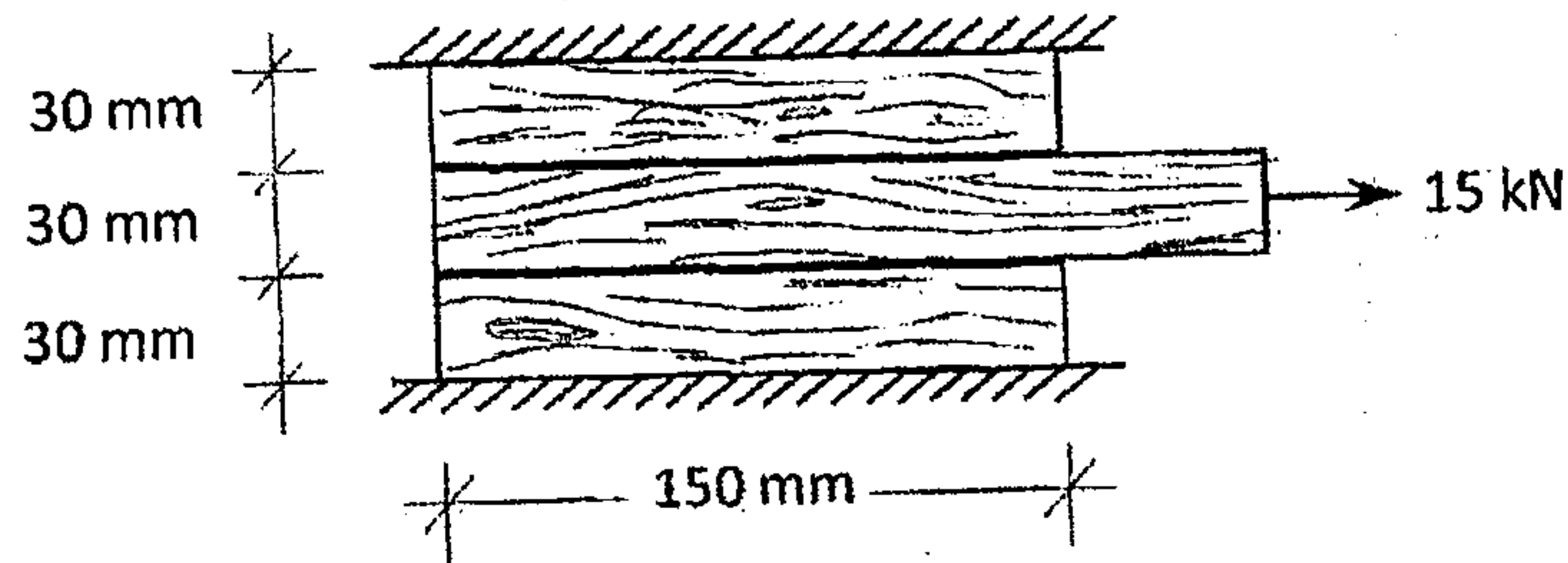
Module – I

- II. a) A steel punch can be worked to a compressive stress of 800 N/mm^2 . Find the least diameter of the hole which can be punched through a steel plate of 12 mm thick, if its ultimate shear strength is 315 N/mm^2 . 10
- b) A steel bar has length 500 mm and diameter 30 mm at 25°C . It is placed between two rigid supports which are 500.3 mm apart. Find the stress induced in the bar if it is heated to 100°C . Take coefficient of linear expansion of steel as $12 \times 10^{-6}/^\circ\text{C}$ and modulus of elasticity of steel as 200 GPa. Also find the reactions developed at supports. 10

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- III. a) A steel flat of cross section $25 \text{ mm} \times 6 \text{ mm}$ carries a tensile load of 10 kN . Find the stress induced in the cross section. If a circular hole of diameter 12 mm is made, find the maximum stress induced in the cross section. 10
- b) Three pieces of wood are glued together and subjected to a force of 15 kN as shown in fig. (i). The cross section of each member has 60 mm width and 30 mm thickness. If the length of the glued surface is 150 mm , find the average shear stress in the glued joints. 10



Module – II

- IV. a) The cross sectional area of a bar of length 1.0 m is 100 mm^2 for the central 0.10 m and 200 mm^2 for the remaining 0.90 m . Find the total strain energy stored in the bar if it is subjected to an axial pull of 15 kN . Assume modulus of elasticity of the material of the bar as 200 GPa . 12
- b) The strains along the length, width and thickness directions of a rectangular prism of size $250 \text{ mm} \times 100 \text{ mm} \times 70 \text{ mm}$ are respectively 18×10^{-5} (tensile), 6×10^{-5} (compressive) and 4×10^{-5} (compressive) respectively. Find the change in volume of the prism. Indicate whether the volume increases or decreases. 8
- V. The state of stress on two planes passing through a point in a strained body is given below :

Plane	Normal stress (MPa)	Shear stress (MPa)
A	37	25
B	52	18

The normal stresses are tensile and shear stresses are clockwise (about a point inside the body). Draw the Mohr's circle and determine the following :

- i) Principal stresses
- ii) Inclination of principal planes with plane A
- iii) Maximum shear stress
- iv) Angle between planes A and B.



Module - III

VI. Draw the BMD and SFD of the beam loaded as shown in fig. (ii). Find the maximum value of BM and locate the point where it occurs.

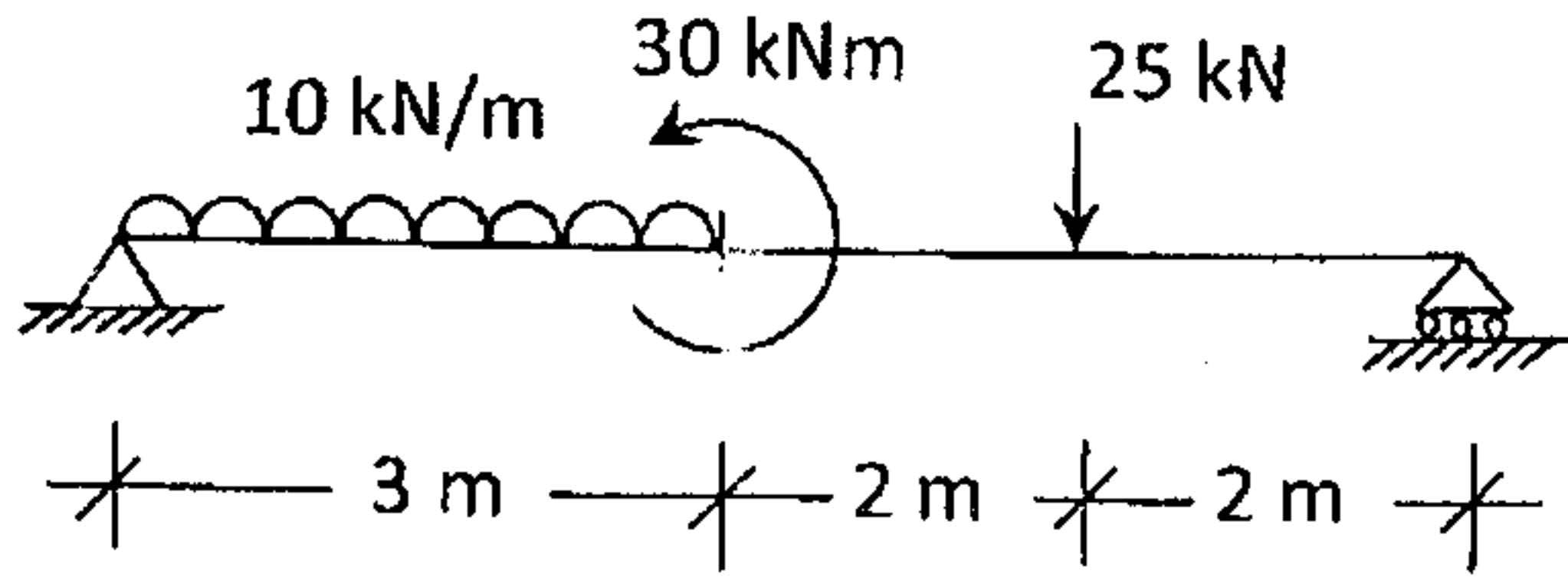


Fig. (ii)

VII. Find the slope and deflection at the free end of the cantilever beam shown in fig. (iii). Beam has uniform flexural rigidity.

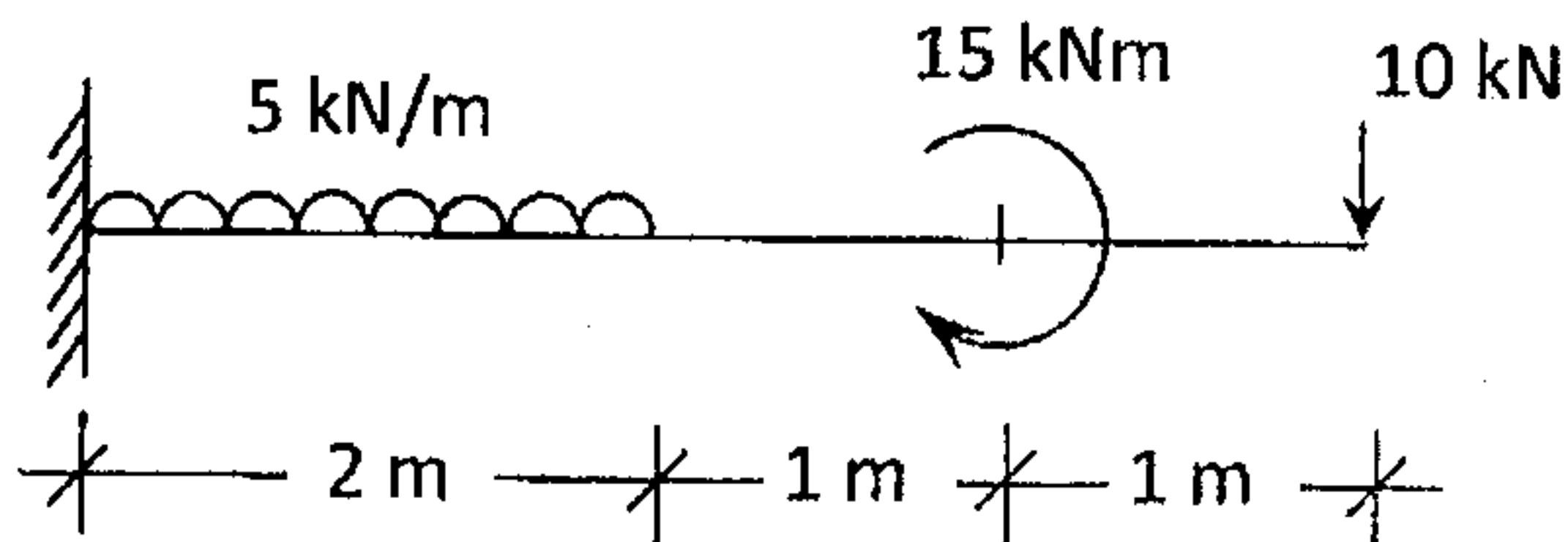


Fig. (iii)

Module - IV

VIII. Analyse the truss loaded as shown in fig. (iv) and find the force in all the members.

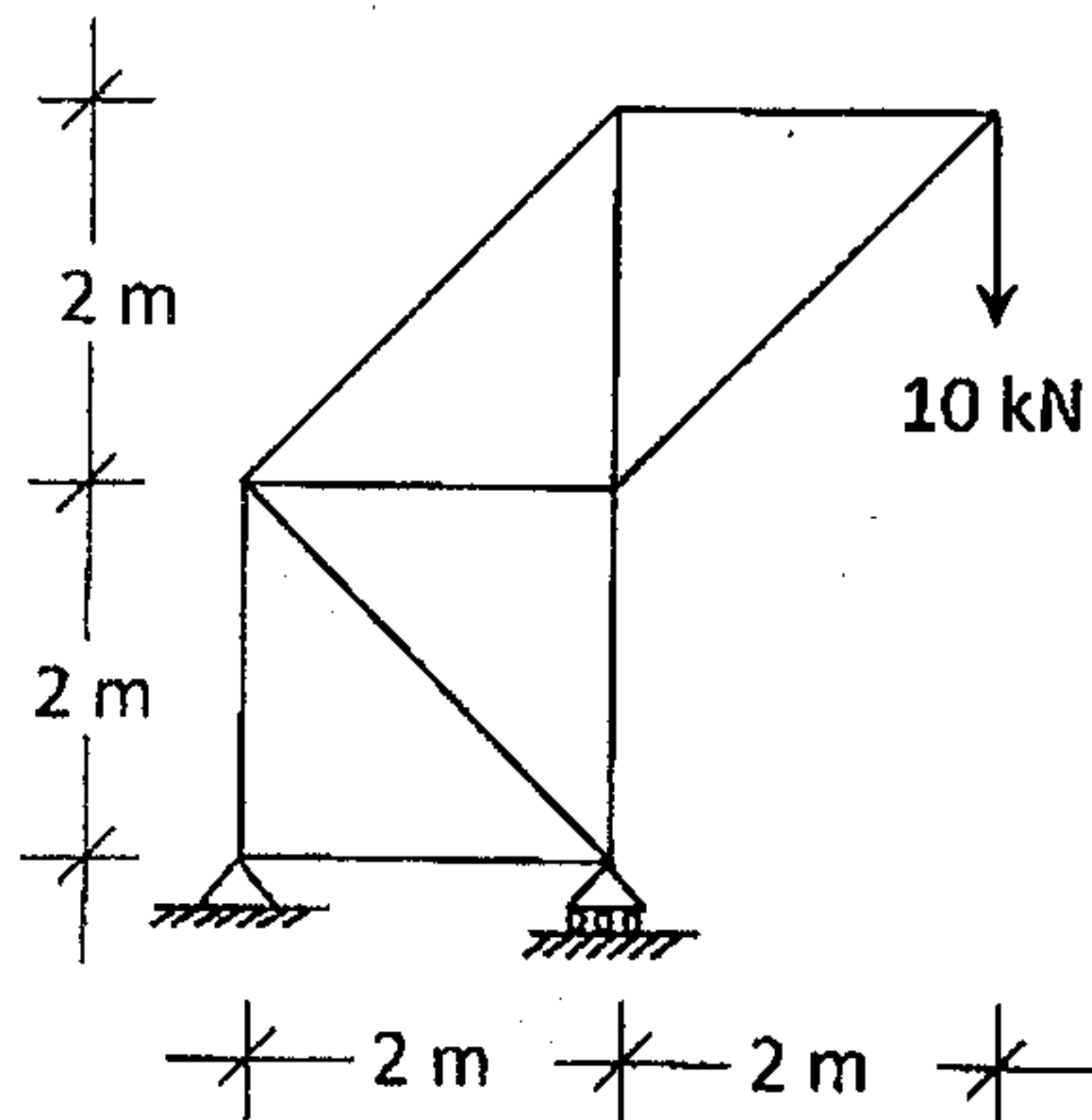
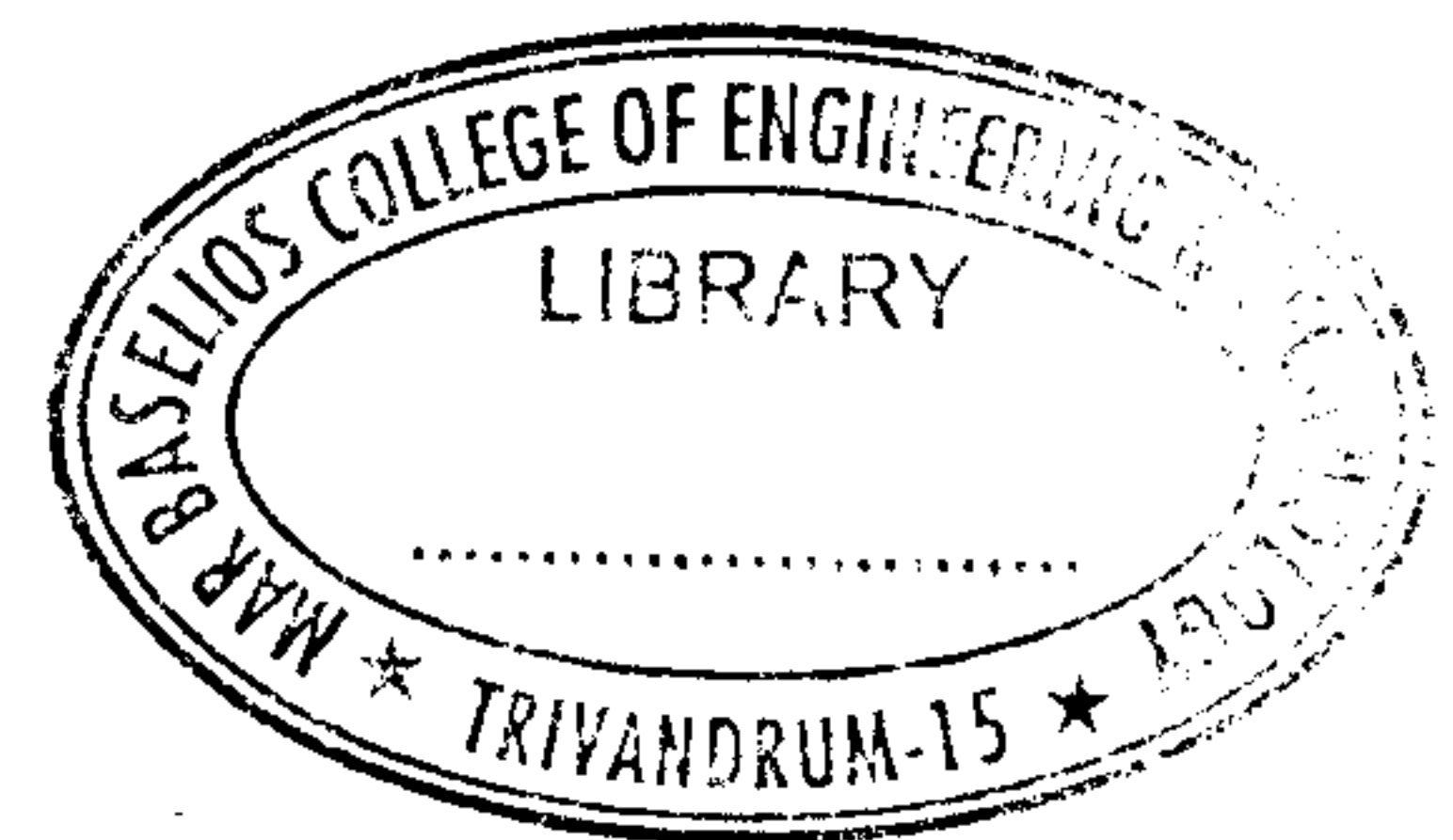


Fig. (iv)



IX. A hollow circular shaft and a solid circular shaft of the same material are to be designed to transmit the same torque T with the same maximum shear stress. If the inner diameter of the hollow shaft is 0.8 times the outer diameter, find (a) the ratio of outer diameter of the hollow shaft to the diameter of the solid shaft and (b) the ratio of the weight of hollow shaft to the weight of the solid shaft.