Exam Date & Time: 01-Dec-2023 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

FIFTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOV 2023

DESIGN OF MACHINE ELEMENTS [MME 3155]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) A steel cantilever member shown in figure 1 is subjected to a transverse bending load at its end that varies from 50 N to -150 N, and an axial load varies from -125 N to 500 N. Determine the required diameter at the change of cross section for infinite life assuming factor of safety 2.

A) Assume the theoretical stress concentration factor for bending and axial load are 1.5 and 1.6 respectively. The properties of beam material are ultimate stress is 560 MPa, yield stress is 460 MPa and endurance limit is 280 MPa. Assume axial load factor is 0.7, bending load factor is 1, size factor 0.85 and surface factor as 0.86. (5)

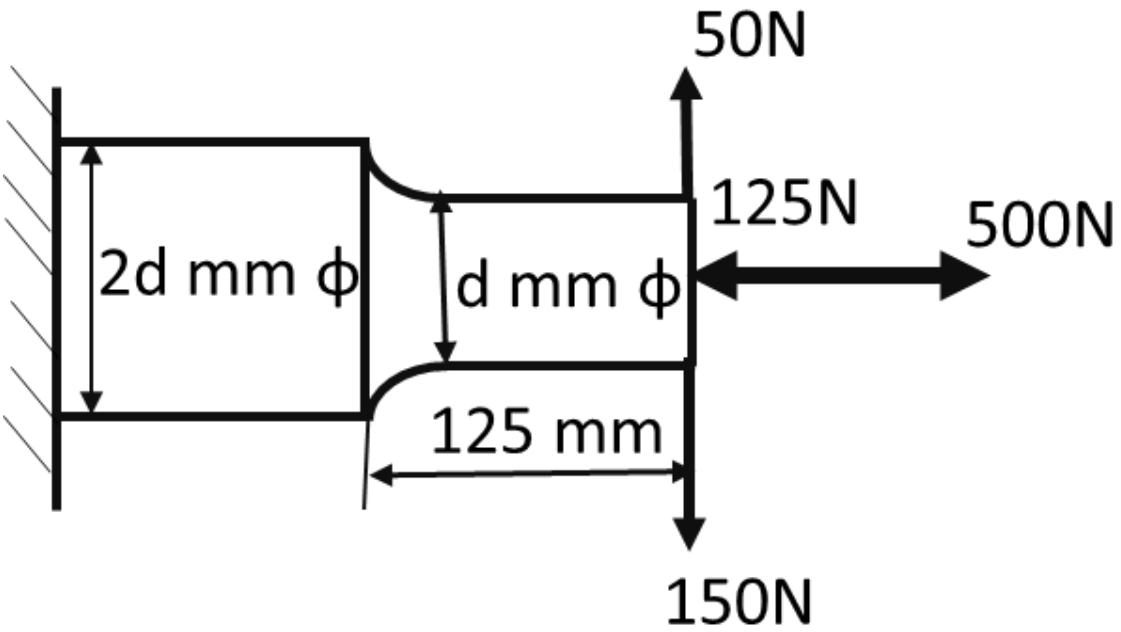


Figure 1

B) Determine the stress induced at critical points A and B on the loaded member as shown in figure 2. (3)

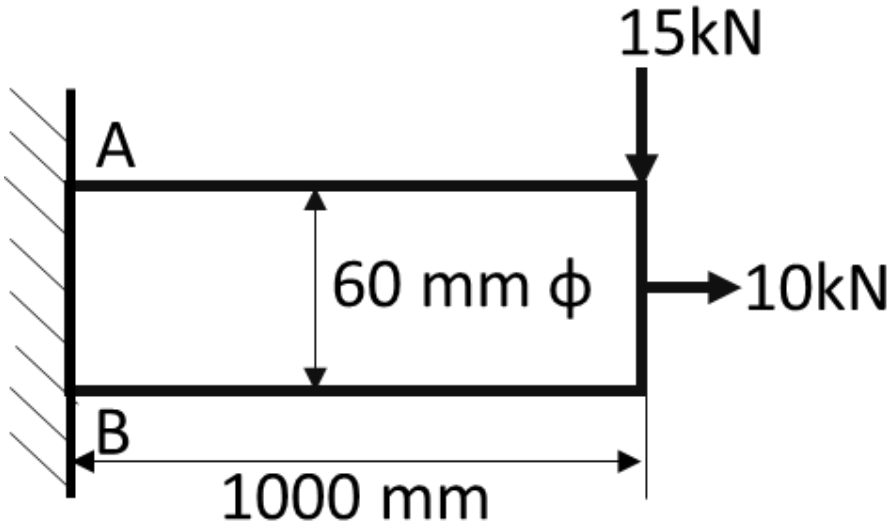
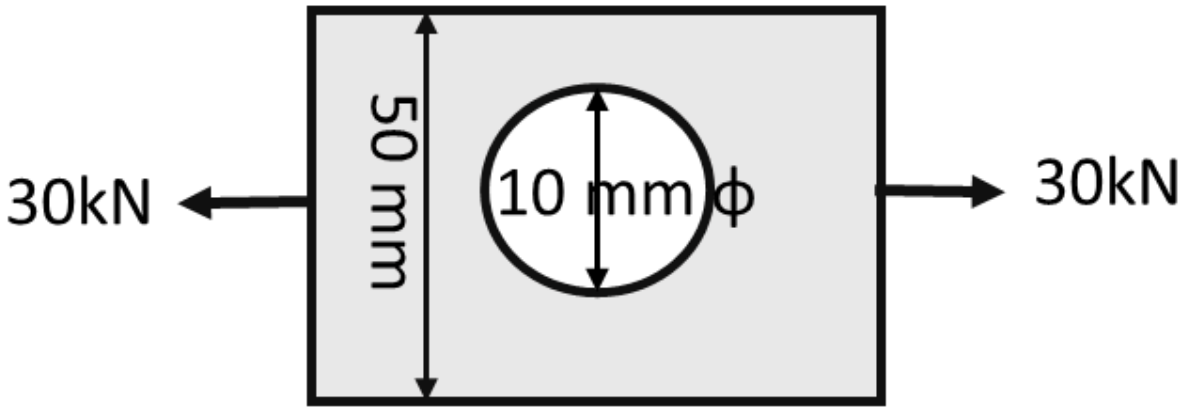


Figure 2

C) A plate made of steel having allowable tensile stress 200 MPa is subjected to axial loading as shown in figure 3. Determine the thickness of plate.



(2)

Figure 3

2) Design a shaft required to transmit 100 kW at 300 rpm. The supported length of the shaft is 3 meters. It carries two pulleys each weighing 1500N supported at 1 meter from the ends respectively. Assuming safe shear stress of 60 MPa, Determine the diameter of the shaft according to maximum shear stress theory. (5)

A)

B) Explain the ASME code used for design of shaft. (3)

C) Explain: (i) Factor of safety (ii) Stress concentration factor. (2)

3) Design a journal bearing to support a load of 6 kN radial load at journal rotates at 750 rpm. The material of the journal hardened steel and babbitt bearing. The oil has a specific gravity of 0.9 at 15 °C and viscosity of 9 centistokes at 82 °C is taken as the limiting temperature of oil. Assume a clearance of 0.003 mm per mm diameter. (5)

A)

B) Analyse the heat generated and dissipated in the bearing designed as per data in Question number 3A. (3)

C) With an example, explain the designation of antifriction bearing by 4-digit number. (2)

4) Design a helical compression spring to carry a load of 500 N with deflection of 25 mm, the spring index may be taken as 8. Allowable shear stress of the spring material is 350 MPa and modulus of rigidity 84 GPa. (5)

A)

B) Derive the Lewis beam strength equation for gear tooth. (3)

C) Explain: (i) Bearing characteristic number in journal bearing

(ii) Wahl's factor used in coil spring design. (2)

5) Design a pair of spur gear with 20° full depth involute teeth to transmit 12 kW power with a gear ratio of 3:1. The number of teeth on pinion is 20 and it runs at 700 rpm. The pinion is made of cast steel, heat treated, and the gear is made of phosphor bronze. (5)

A)

B) Analyse the wear load and dynamic load for spur gear designed as per data given in question 5A. (3)

C) Select a suitable roller bearing for a shaft of 60 mm diameter at 960 rpm. It has been used for 8 hr./day for 7 years and fully utilized. Radial load on the bearing is 5 kN. (2)

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