Exam Date & Time: 06-Dec-2023 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

FIRST SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOV 2018

MECHANICAL DESIGN-I [MME 3153]

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

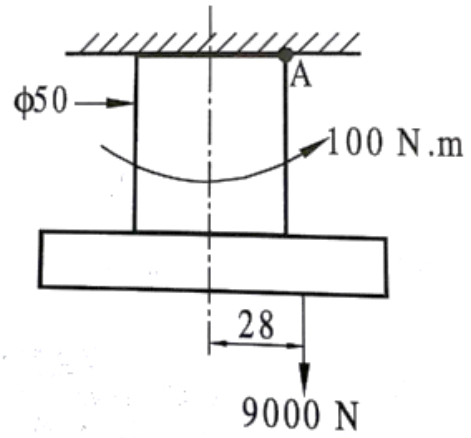
A

Answer all the questions.

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

1) A 50 mm diameter steel rod supports a 9000 N load and in addition it is subjected to a torsional moment of 100 Nm as shown in Fig. 1a. Determine the maximum normal and shear stresses.

A)



(5)

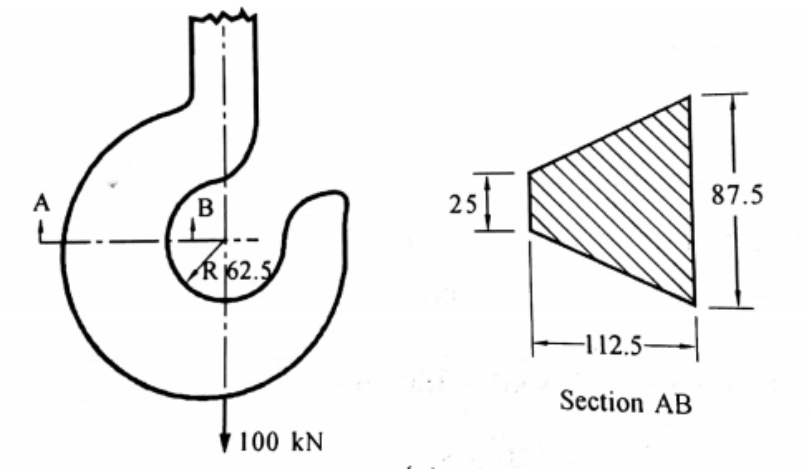
Fig. 1a

B) Define stress concentration. Explain in brief (i) Haigh's theory of failure and (ii) the causes of stress concentration. (5)

2) A cold drawn steel stepped shaft whose diameter changes from d to 1.7d with a fillet radius of 0.1d subjected to a torque that varies from -12×10^4 N-mm to 48×10^4 N-mm. Determine the size of the shaft. Take factor of safety as 1.5 and notch sensitivity factor as unity, Ultimate tensile strength as 450 MPa, Yield stress and endurance strength as 300 MPa and 225 MPa respectively. (5)

A)

B) Fig 2b shows a 100 kN crane hook. Calculate the maximum shear stress and specify its location. All dimensions are in mm.



(5)

Fig 2b

3) A) A horizontal shaft of steel is supported by two bearings 1.5 m apart. A gear 20º involute tooth 200 mm in diameter, is located 400 mm to the right of the left bearing. The gear mounted on the shaft is driven by a pinion directly behind it. A 600 mm diameter pulley is keyed to the shaft 600 mm to the left of the right-hand bearing. The pulley mounted on the shaft drives another pulley with a horizontal belt directly behind it. The ratio of belt tensions is 3.2. The shaft rotates clockwise as seen from the left bearing. The drive transmits 30 kW at 210 rpm. Determine the maximum moment and diameter of the shaft. Assume the permissible shear stress for the shaft material as, τ_{max}=55 MPa. Take $C_m$and $C_t$as 2 and 1.5 respectively. (8)

B) A shaft of 65 mm diameter transmits power at maximum shear stress of 67 MPa. The shear stress in the key should not exceed 75% of the shear stress developed in the shaft. Take the maximum crushing stress in the key as 2.5 times the maximum shear stress in the key. The dimensions of the key are 18 mm ×11 mm. Determine the length of key. (2)

4) A) To join two plates of 17 mm thickness with a double riveted butt joint, it has been suggested to use chain type riveting to simplify the design process. It is crucial to mention that the allowable tensile stress for the plate is 100 MPa, while the allowable stresses for shear and crushing of the rivets are 62 MPa and 160 MPa respectively. For this scenario, sketch a labelled riveted joint and determine the following:

i) Optimum pitch: The optimum pitch in this case refers to the final value of the longitudinal pitch. (5)

ii) Width of the cover plate: This measurement can be determined by taking the transverse pitch as 2.25 times the diameter of the rivet hole.

iii) Crushing strength of the rivets.

B) A welded connection is as shown in Fig 4b. If the allowable stress is 100 N/mm^2, determine the size of weld. All dimensions are in mm. (5)

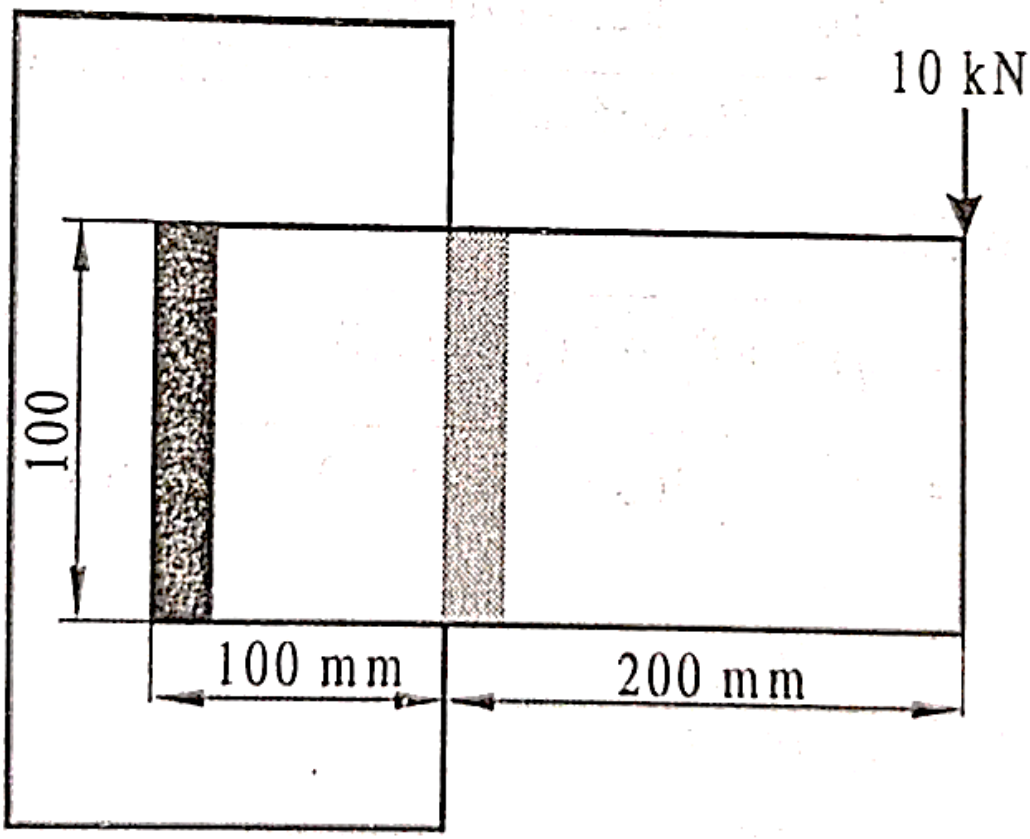


Fig 4b

5) The following data are given for the bracket shown in Fig 5a. P=25 kN, *e*=100mm, l_1=150 mm, l_2=25 mm. Bolts are made of steel with yield point stress as 380 MPa and factor of safety 2.5. Using maximum shear stress theory, find the size of the bolt. (5)

A)

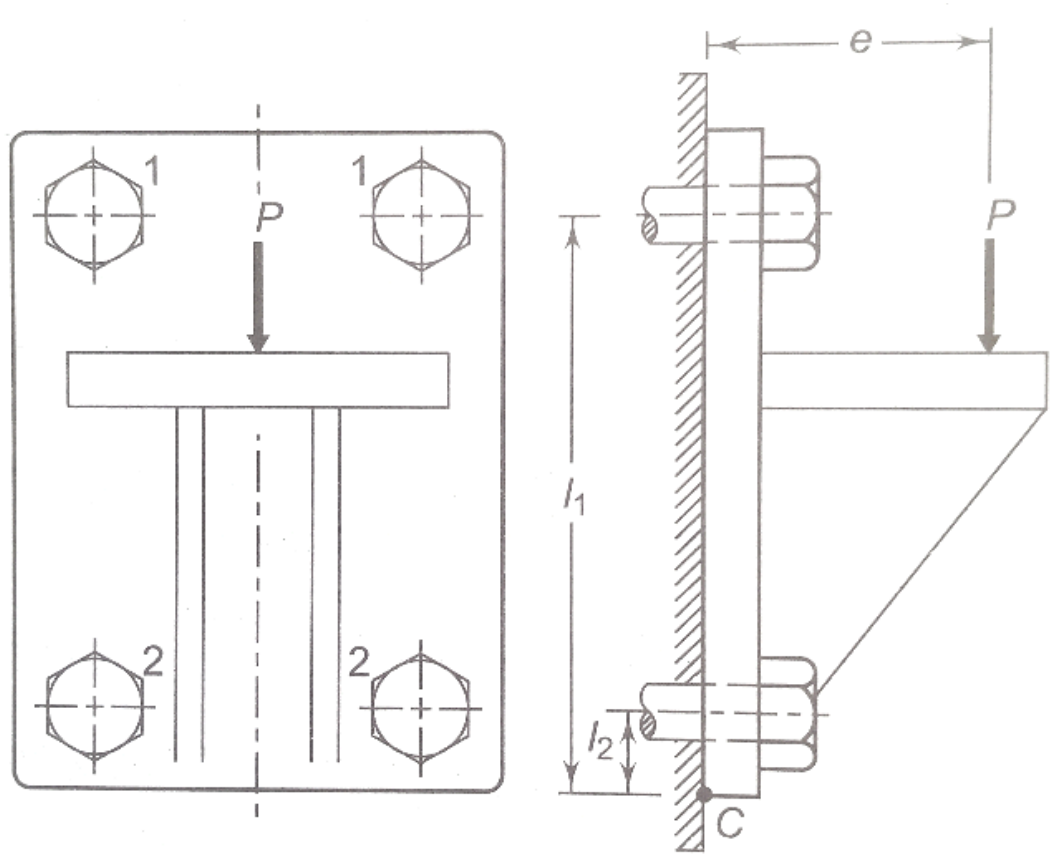


Fig 5a

B) A power transmission screw having a single start square thread with a nominal diameter of 36 mm and pitch 6 mm propels a weight of 25 kN. The collar has a mean diameter of 45 mm. The coefficient of friction at thread is 0.15 and the coefficient of friction at the collar is 0.2. Determine:

(i) The torque required to raise the load (5)

(ii) The efficiency

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