EX/PROD/T/315/2024

B.PRODUCTION ENGG., Examination, 2024

(3RD Year, 1ST Semester)

DESIGN OF ENGINEERING SYSTEM – I

(Paper/Subject Code: PROD/PC/B/T/314)

Time: 3 hours **Full marks : 100**

(Answer 20 marks from Question No. 1 which is compulsory and answer 80 marks from rest)

1.

a. What is tensile stress area of Screw Thread ? (2)

b. What is core diameter of Screw Thread – show with a sketch ? (2)

c. How core diameter is related to nominal diameter of Screw Thread ? (2)

d. With a sketch show parallel fillet weld. (2)

e. With a sketch show transverse fillet weld. (2)

f. What is leg and throat of fillet weld – show with sketch ? (2)

g. Find relation between leg and throat of fillet weld. (2)

h. What is efficiency of Riveted Joint ? (4)

i. What is Gib head taper Sunk key ? How much taper is provided ? Give complete sketch. (4)

j. What is Muff coupling ? Give complete sketch. (4)

k. What is the difference between protected and unprotected Rigid Flange coupling ? Give sketch. (4)

l. What is the difference between shaft and axle ? Give example. (2)

m. Write down the formula for determination of shaft diameter using maximum shear stress theory. Define all notations used. (2)

n. Write down the formula for determination of shaft diameter using maximum principal stress theory. Define all notations used. (2)

o. Write down the relationship between Power (KW) and Torque (N.m) transmitted by a shaft running at N rpm. (2)

p. Write down the relation between Torque (KW) transmitted by a shaft and its angle of twist 'Φ' (degrees), shaft having diameter 'd', length 'l', rigidity modulus 'G'. (4)

2. The layout of a shaft carrying two pulleys 1 and 2 and supported on two bearings, A and B is shown in Fig.1. The shaft transmits 7.5 KW power at 360 rpm from pulley 1 to pulley 2. The diameters of pulley 1 and 2 are 250 mm and 500 mm respectively. The masses of pulley 1 and 2 are 10 Kg and 30 Kg respectively. The belt tensions act vertically downward and ratio of belt tensions on tight to slack side for each pulley is 2.5 : 1. The shaft is made of plain carbon steel 40C8 having yield tensile stress S_{yt}=380 N/mm^2 and the factor of safety is 3. Estimate suitable diameter of the shaft. (30)

3. A wall bracket is attached to the wall by means of four identical bolts, two at A and two at B, as shown in Fig.2. Assuming that the bracket is held against the wall and prevented from pitting about point C by all four bolts and using an allowable tensile stress in the bolts as 35 N/mm^2, determine the size of the bolts on the basis of maximum principal stress theory. (20)

4. A cast-iron bracket fixed to the steel structure is shown in Fig.3. It supports a load P of 25 KN. There are two bolts at A and two bolts at B. The distances are, l_1= 50 mm, l_2= 200 mm, l = 400 mm. Determine the size of the bolts, if maximum permissible tensile stress in the bolts is 50 N/mm^2. (30)

5. A steel plate, 100 mm wide and 10 mm thick, is joined with another steel plate by means of a single transverse and double parallel fillet welds, as

shown in Fig. 4. The joint is subjected to a maximum tensile force of 55 KN. The permissible tensile and shear stresses in the weld material are 70 and 50 N/mm^2, respectively. Determine the required length of each parallel fillet weld. (20)

6. A welded connection, as shown in Fig. 5 is subjected to an eccentric force of 7.5 KN. Determine the size of welds if the permissible shear stress for the weld is 100 N/mm^2. Assume static conditions. (20)

7. A brake band attached to the hinge by means of a riveted joint as shown in Fig.6. Determine the size of the rivets needed for the load of 10 KN. Also, determine the width of the band. The permissible stresses for the band and rivets in tension, shear and compression are 80, 60, 120 N/mm^2 respectively. Assume , margin (m) = 1.5 d, transverse pitch (p_t) = p. Find the pitch of the rivets. (20)

8. Two flat plates subjected to a tensile force P are connected together by means of double strap butt joint as shown in Fig. 7. The force P is 250 KN and the width of the plate 'w' is 200 mm. The rivets and plates are made of same material (steel) and the permissible stresses in tension, shear and compression are 70, 60,and 100 N/mm^2 respectively.

   Calculate :- i) the diameter of the rivets,

   ii) the thickness of the plates,

   iii) the dimensions of rivet arrangement i.e. p, p_t and m,

   iv) the efficiency of the joint. (30)

9. A cylindrical pressure vessel with 1.5 m inside diameter is subjected to internal steam pressure of 1.5 MPa. It is made from steel plate by triple riveted double strap longitudinal butt joint with equal straps. The pitch of the rivets in the outer row is twice of the pitch of rivets in inner rows. The rivets are arranged in zigzag pattern. The efficiency of the riveted joint should be at least 80%. The permissible stresses for the plate and rivets in

tension, shear and compression are 80, 60 and 120 N/mm^2 respectively. Assume that the rivet in double shear is 1.875 times stronger than in single shear.

Design the joint and Calculate,

i) thickness of the plate,
ii) diameter of rivets,
iii) pitch of rivets,
iv) distance between rows of rivets,
v) margin,
vi) thickness of straps,
vii) efficiency of the joint.

Draw a neat sketch of the riveted joint showing the calculated values of dimensions. (40)

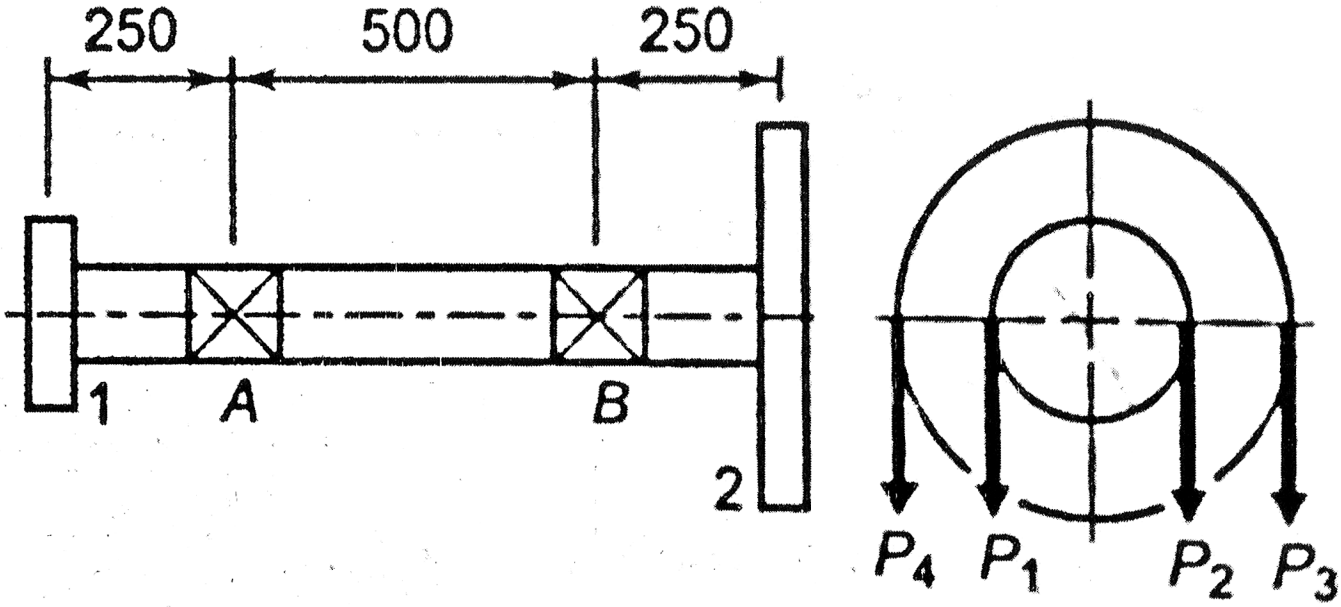

Fig. 1

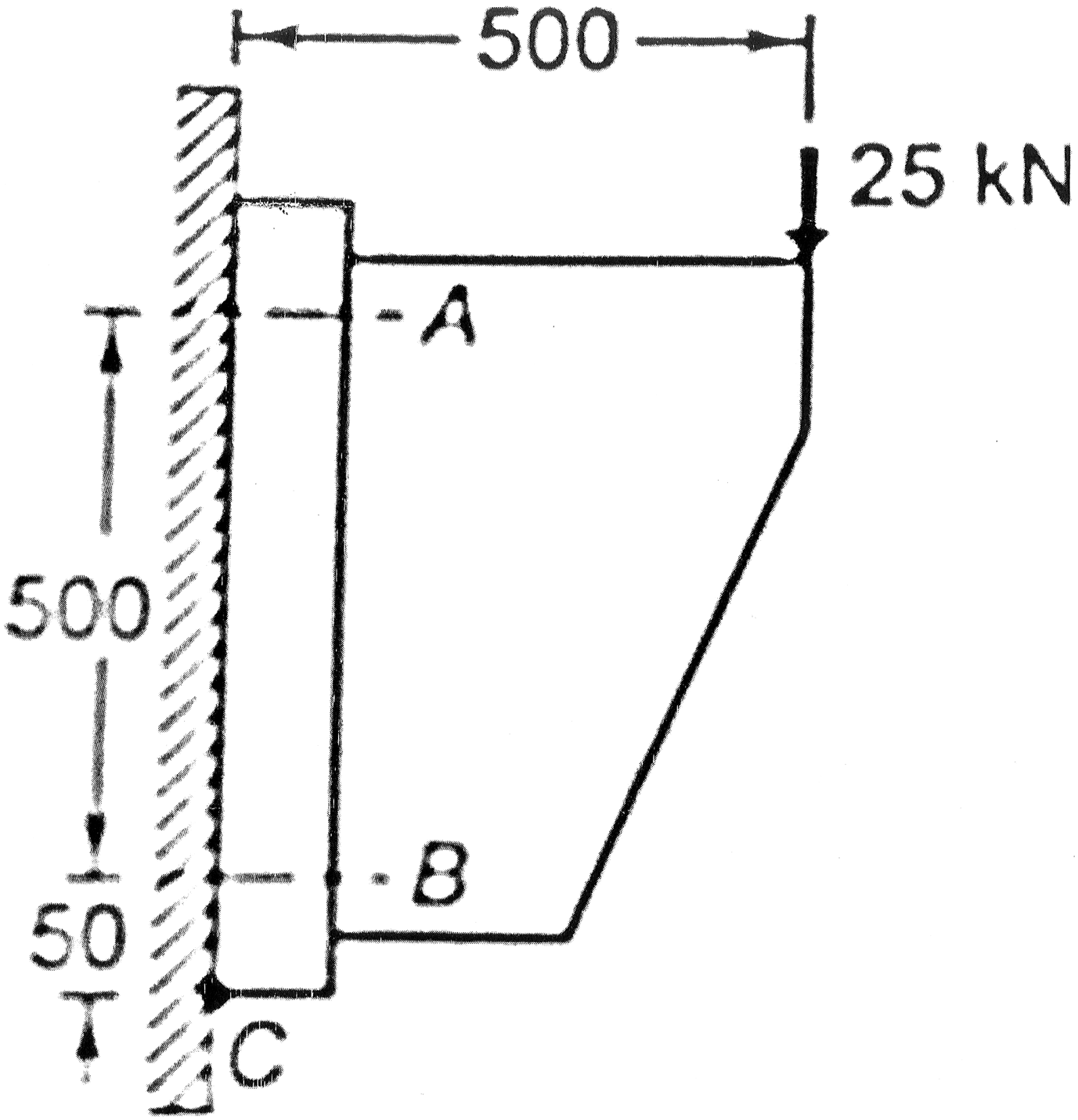

Fig. 2

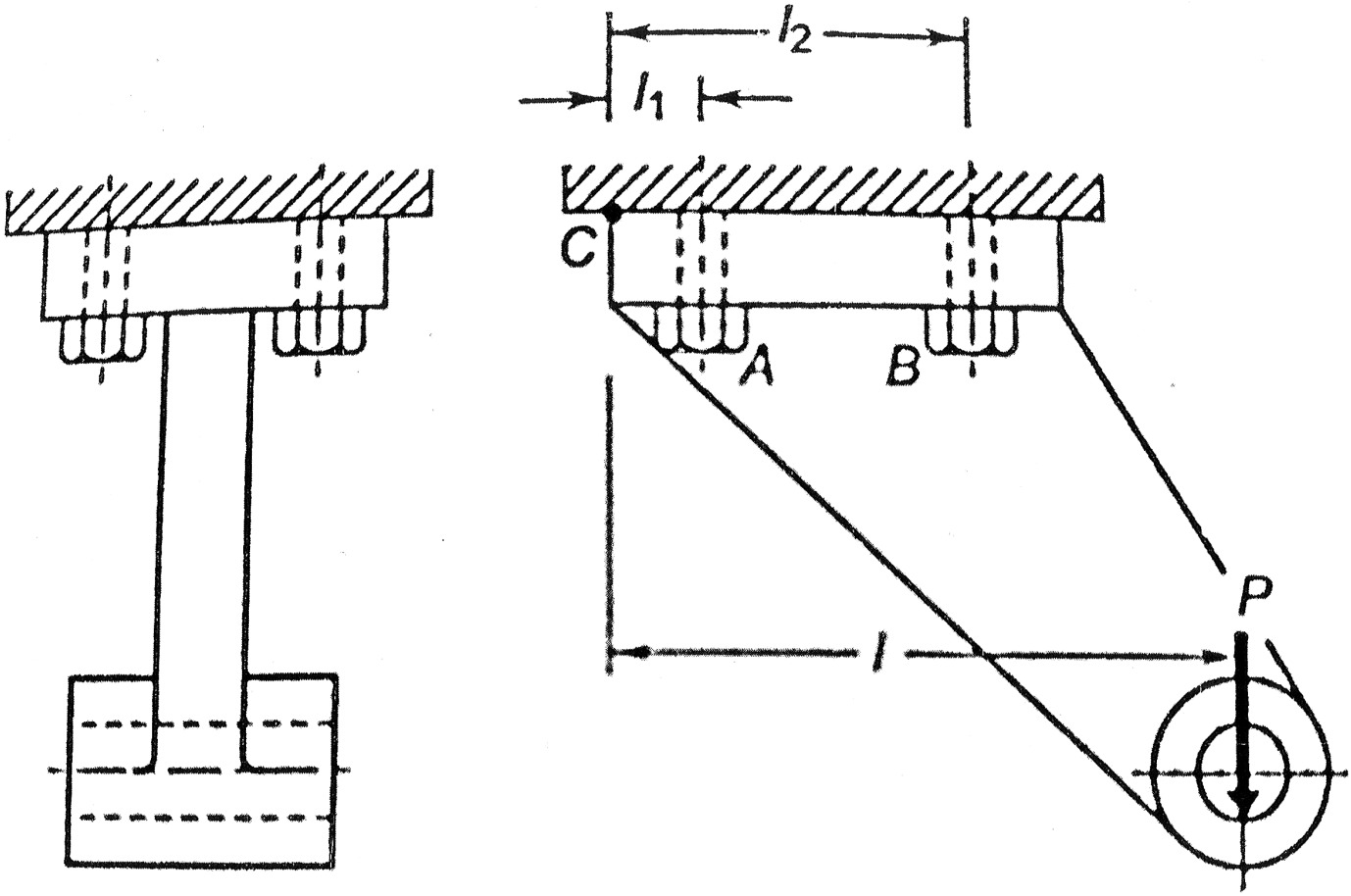

Fig. 3

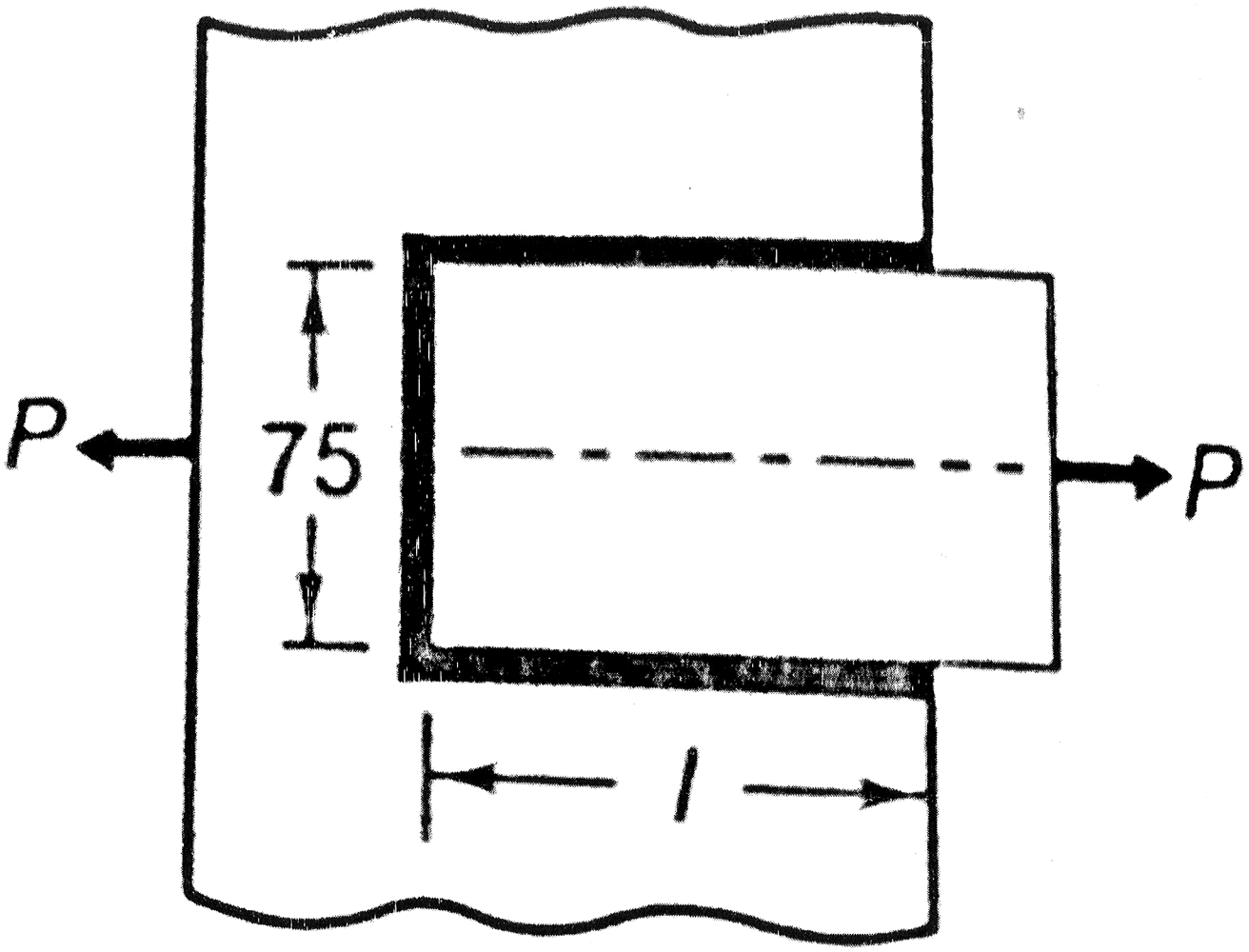

Fig. 4

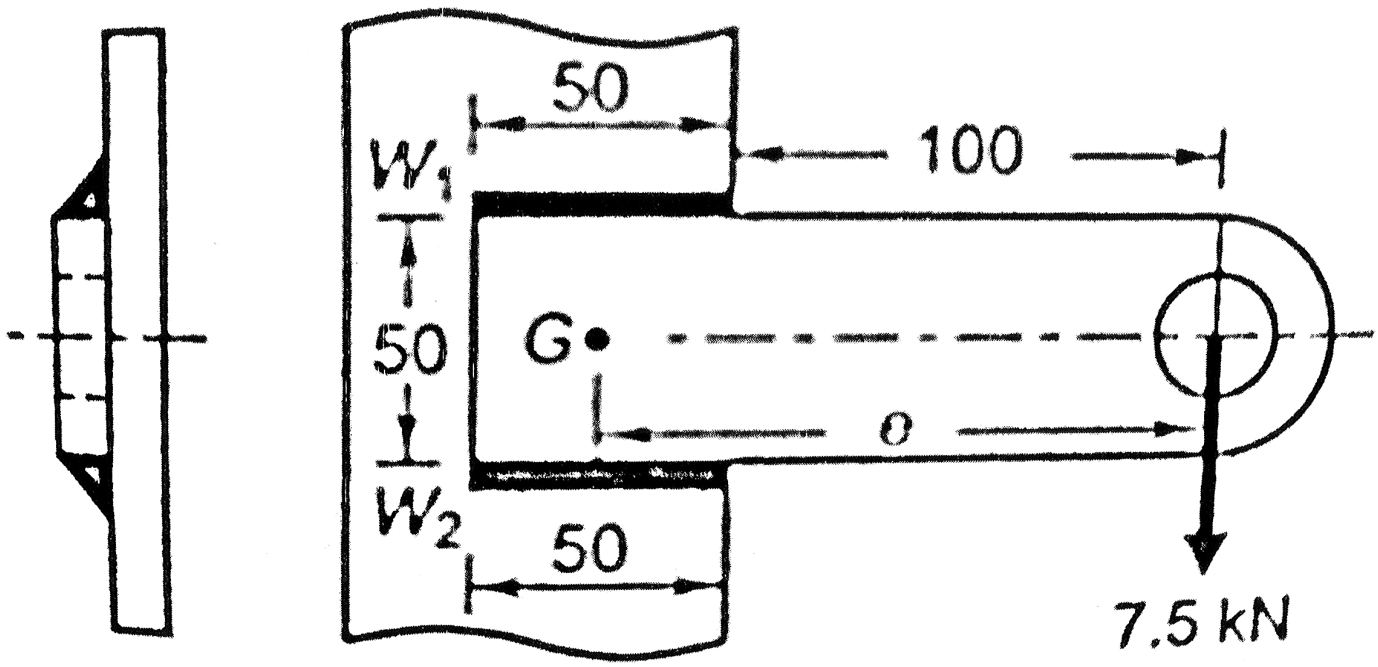

Fig. 5

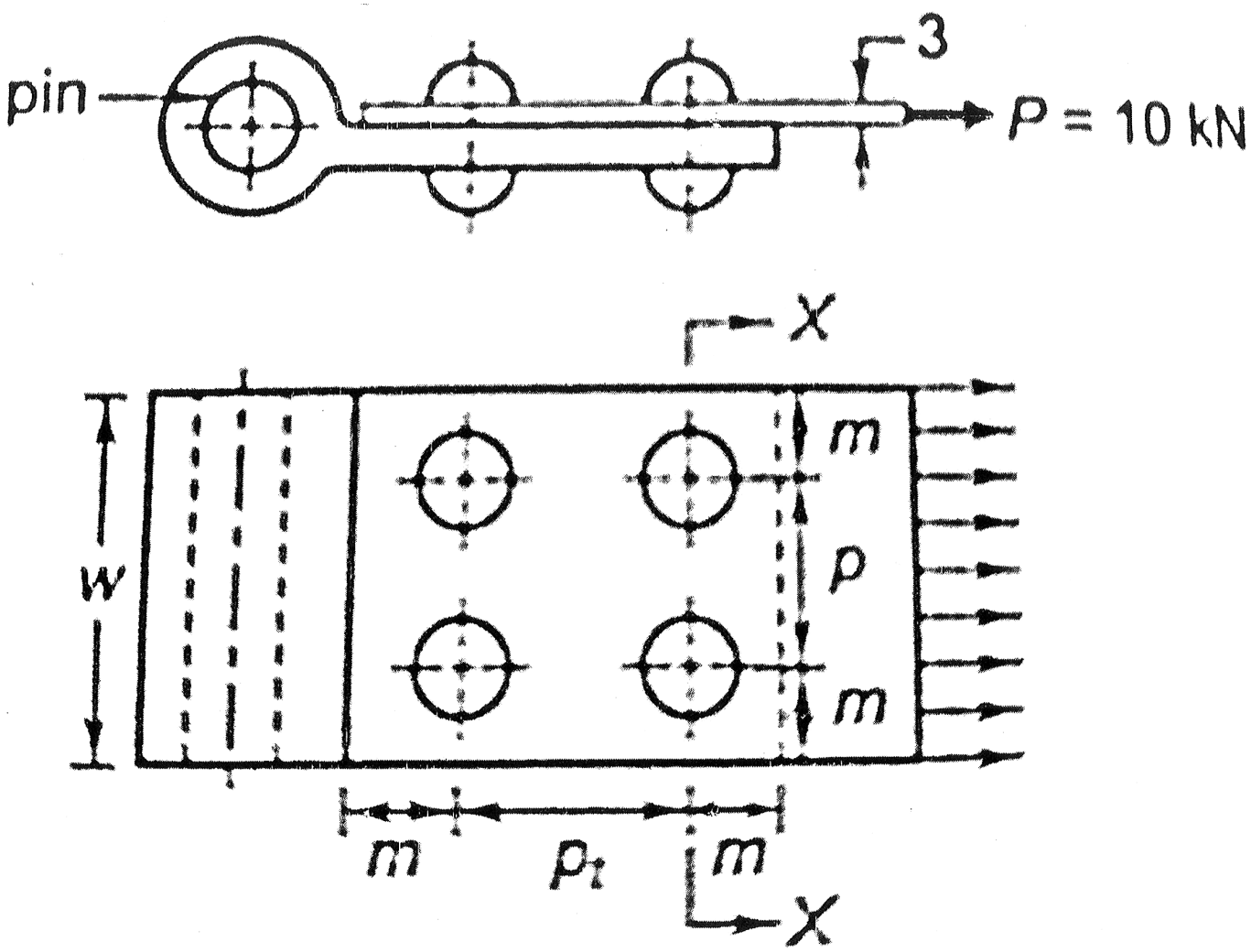

Fig. 6

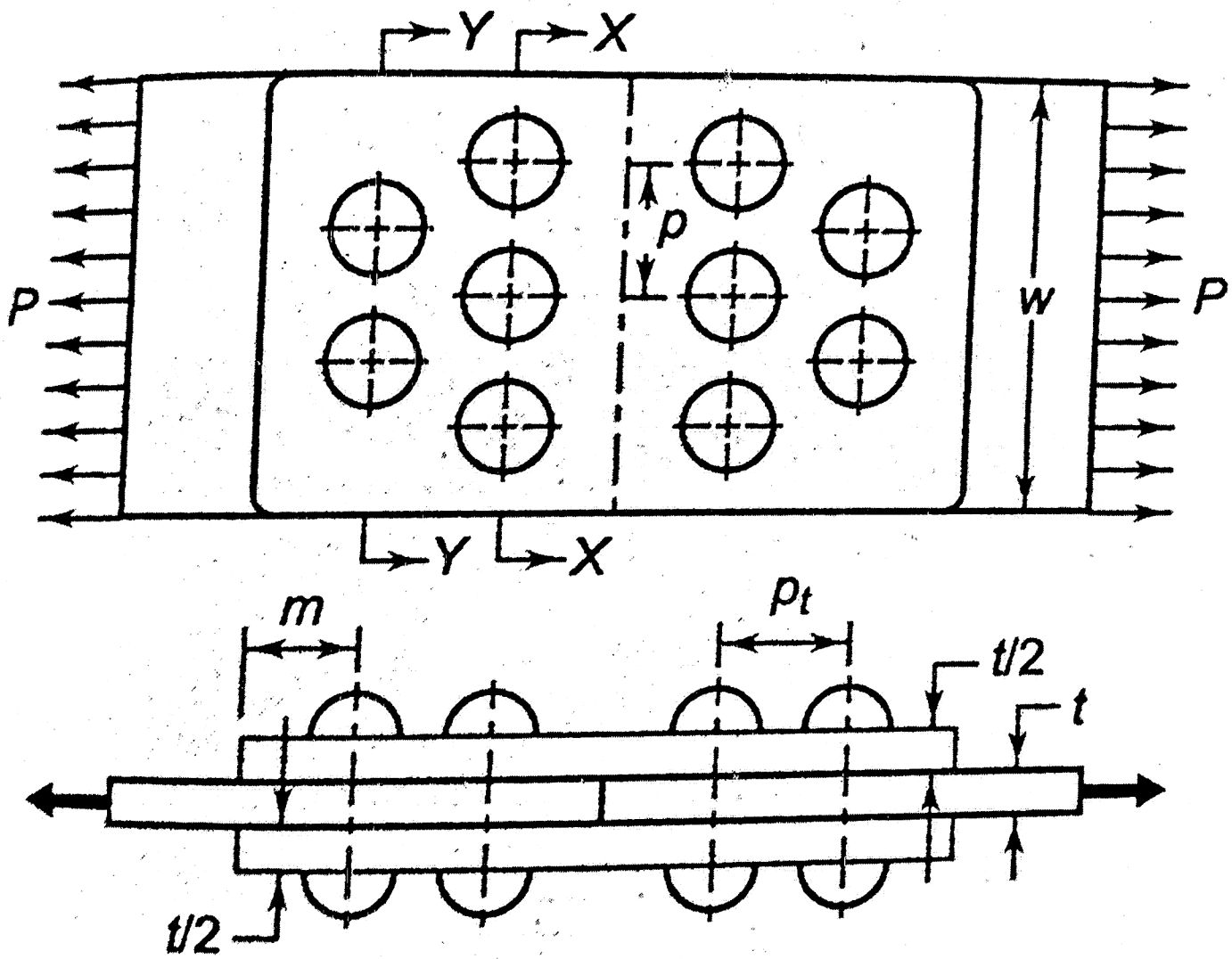

Fig. 7