EX/PROD/T/314/2025

B.PRODUCTION ENGG., Examination, 2025

(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. Show nominal diameter of Screw Thread with a sketch . (2)

b. Give relation between core diameter and nominal diameter of Screw Thread . (2)

c. With a sketch show butt welded joint. (2)

d. With a sketch show lap welded joint. (2)

e. Give sketches of Riveted joint in single shear and double shear. (4)

f. Give sketch of a square sunk key fitted with a shaft and a boss. (2)

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

h. Give sketch of a protected Rigid Flange coupling. (4)

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

j. Write down the condition for determination of shaft diameter when shaft is subjected to combined bending and twisting using maximum shear stress theory. (2)

k. Write down the condition for determination of shaft diameter when shaft is subjected to combined bending and twisting using maximum principal stress theory. (2)

l. Give relationship between Torque (N.m) experienced by a shaft running at N rpm transmitting a given Power (KW). (2)

m. Write down the relation between Torque (N.m) transmitted by a shaft and its angle of twist 'Φ (degrees), shaft having diameter 'd', length 'l', rigidity modulus 'G'. (2)

2. A steel plate subjected to a force of 5 KN and fixed to a channel by means of three identical bolts as shown in Fig. 1. The bolts are made from plain carbon steel 45C8 (S_{yt} = 380 N/ mm^2) and the factor of safety is 3. Determine the size of bolts. (20)

3. A bracket is fastened to the steel structure by means of six identical bolts as shown in Fig. 2. Assume the following data:

L_1 = 300 mm l_2 = 200 mm l_3 = 100 mm l = 250 mm P= 50 KN

Neglecting shear stress, determine the size of bolts, if the maximum permissible tensile stress in any bolt is limited to 100 N/ mm^2. (20)

4. A crane-runway bracket is fastened to the roof truss by means of two identical bolts as shown in Fig. 3. Determine the size of bolts, if the permissible tensile stress in the bolts is limited to 75 N/ mm^2. (30)

5. A steel plate 100 mm wide and 10 mm thick is welded to another steel plate by means of double parallel fillet welds as shown in Fig. 4. The plates are subjected to a static tensile force of 50 KN. Determine the required length of the welds, if the permissible shear stress in the weld is 94 N/ mm^2. (20)

6. A welded connection, as shown in Fig. 5 is subjected to an eccentric load of 60 KN in the plane of the welds. Determine the size of the welds, If the permissible shear stress for the weld is 100 N/ mm^2 . Assume static conditions. (30)

7. Two plates each 5 mm thick, are connected by means of four rivets as shown in Fig. 6. The permissible stresses for rivets and plates in tension, shear and compression are 80 N/mm^2, 60 N/mm^2 and 120 N/mm^2 respectively. Determine: i) diameter of rivets ; (20)
ii) width of the plate; and
iii) efficiency of the joint

8. Two tie-bar plates of a bridge structure, 250 mm wide and 20 mm thick, are connected by a double-strap butt joint as shown in Fig. 7. The rivets and the plates are made of steel. The permissible stresses in tension, shear and compression are 80 N/ mm^2, 60 N/ mm^2 and 120 N/mm^2 respectively.

i) Determine the diameter of the rivets by taking the empirical relationship, $d = 6\sqrt{t}$ where t is plate thickness.

ii) Determine the number of rivets by equating strength of the plate with the strength of the rivets. Assume the shear resistance of one rivet in double shear is 1.875 times its resistance in single shear.

iii) Determine m, p_t , t_1 , and p.

iv) Determine the efficiency of the joint. (30)

9. A cylindrical steam pressure vessel of 1 m inside diameter is subjected to an internal pressure of 2.5 MPa. Design a double-riveted, double-strap longitudinal butt joint for the vessel. The straps are of equal width. The pitch of the rivets in the outer row should be twice the pitch of the rivets in the inner row. Zigzag pattern is used for rivets in inner and outer rows. The efficiency of the riveted joint should be at least 70%. The permissible tensile stress for the steel plate of pressure vessel is 80 N/ mm^2. The permissible shear stress for rivet material is 60 N/ mm^2.Assume that the rivets in double shear are 1.875 times stronger than in single shear and the joint does not fail in crushing.

Determine: i) thickness of the plate;

ii) diameter of the rivets;

iii) pitch of the rivets;

iv) distance between inner and outer rows of the rivets;

v) margin;

vi) thickness of the straps; and

vii) efficiency of the joint.

Make a neat sketch of the joint showing all dimensions. (40)

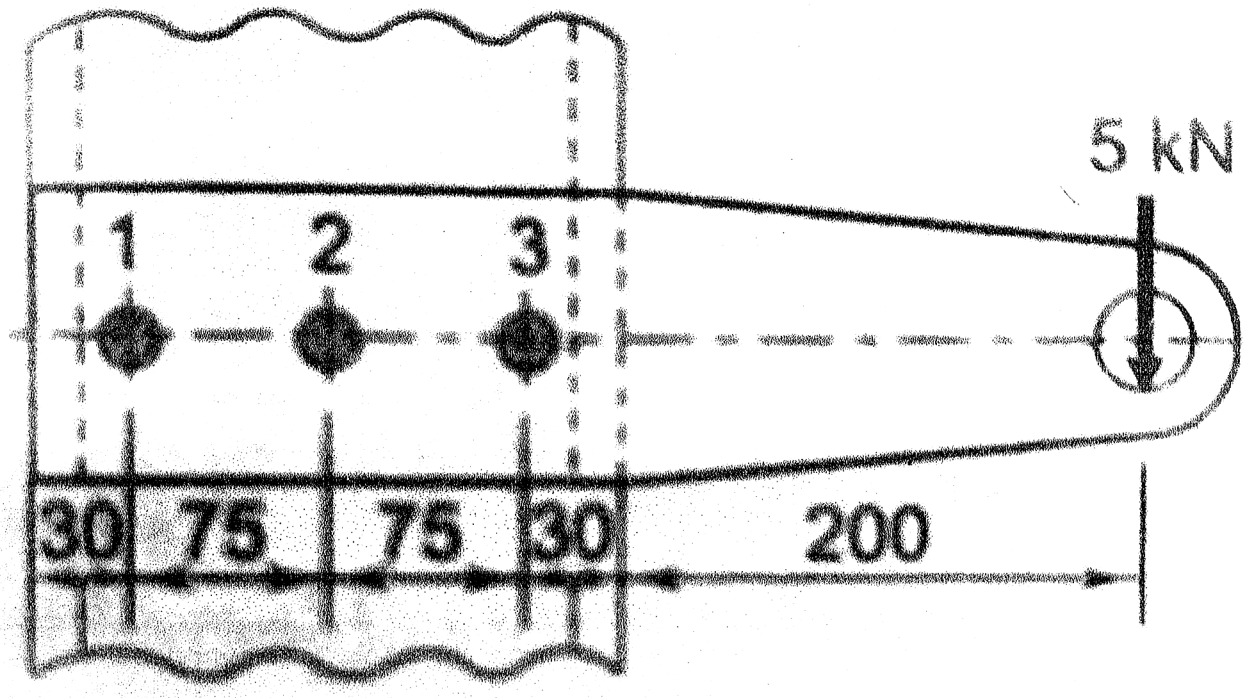

FIG. 1

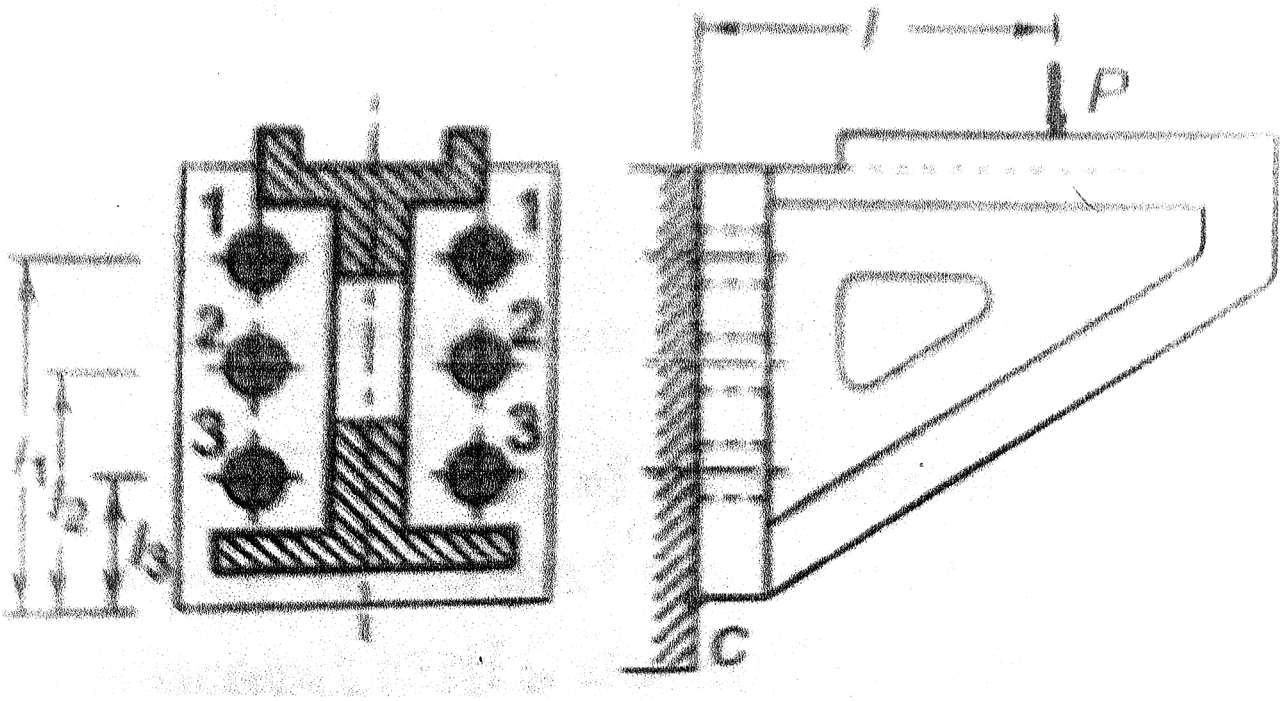

FIG. 2

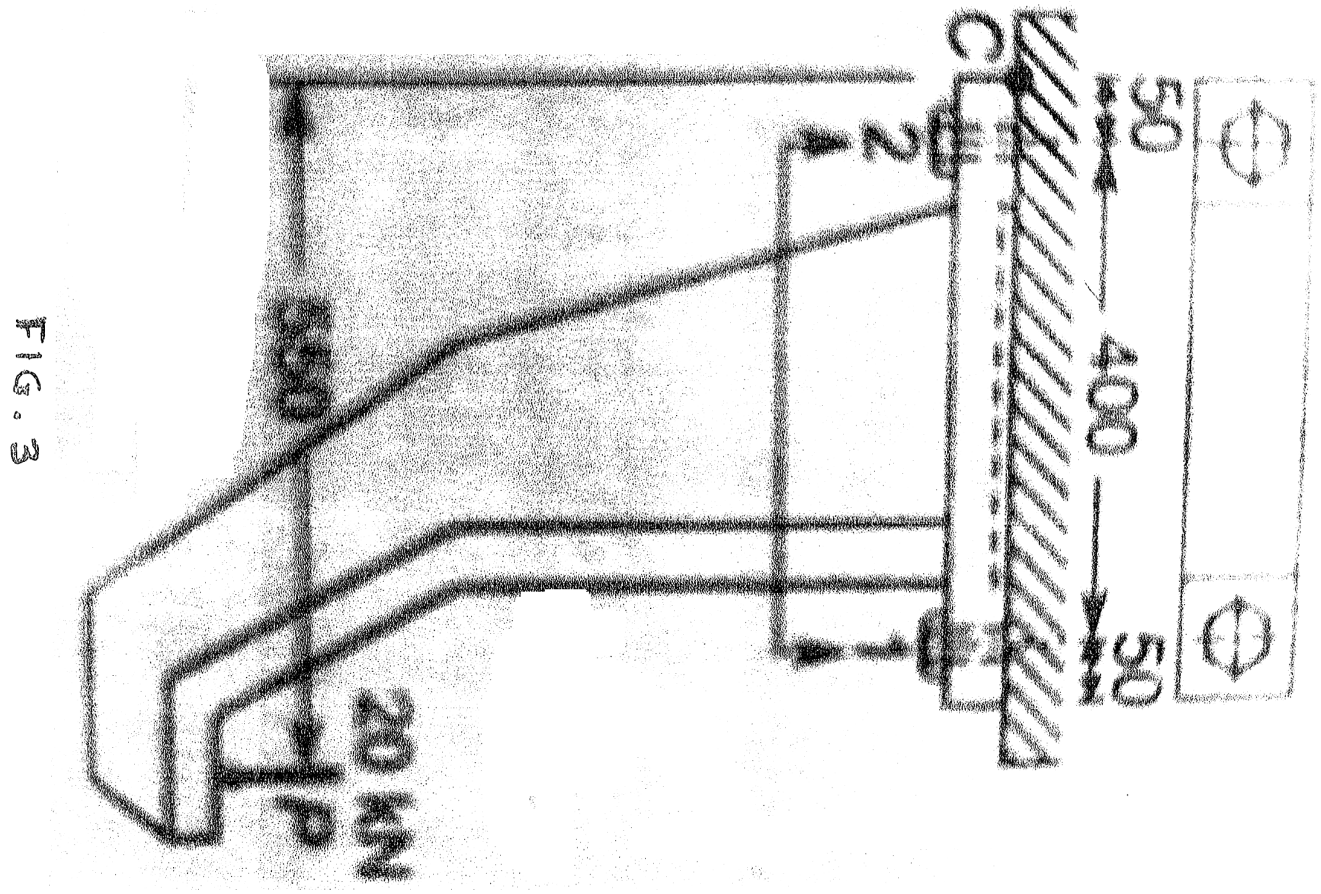

FIG. 3

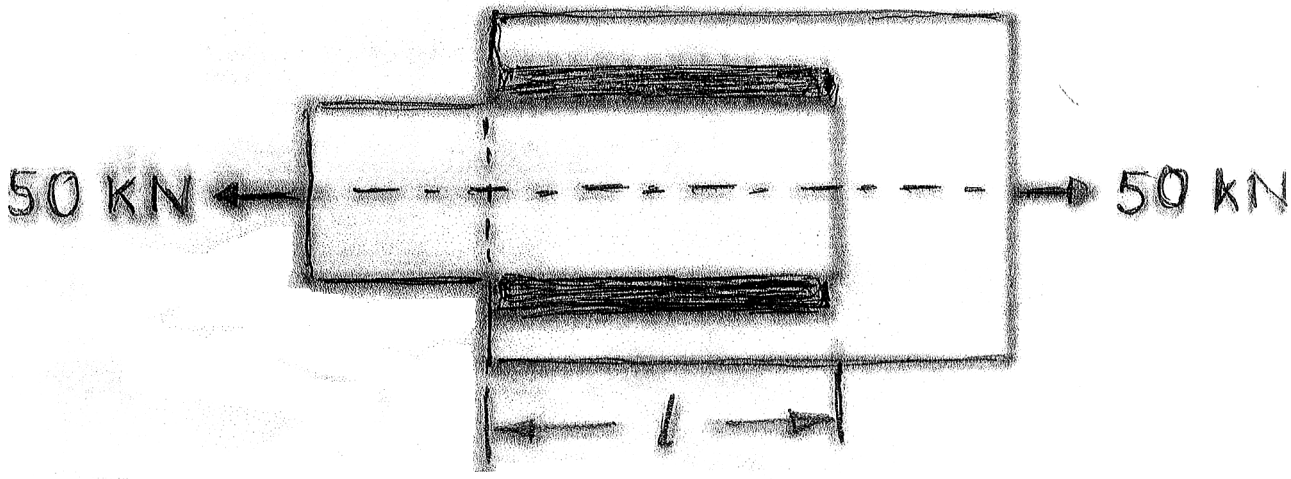

FIG. 4

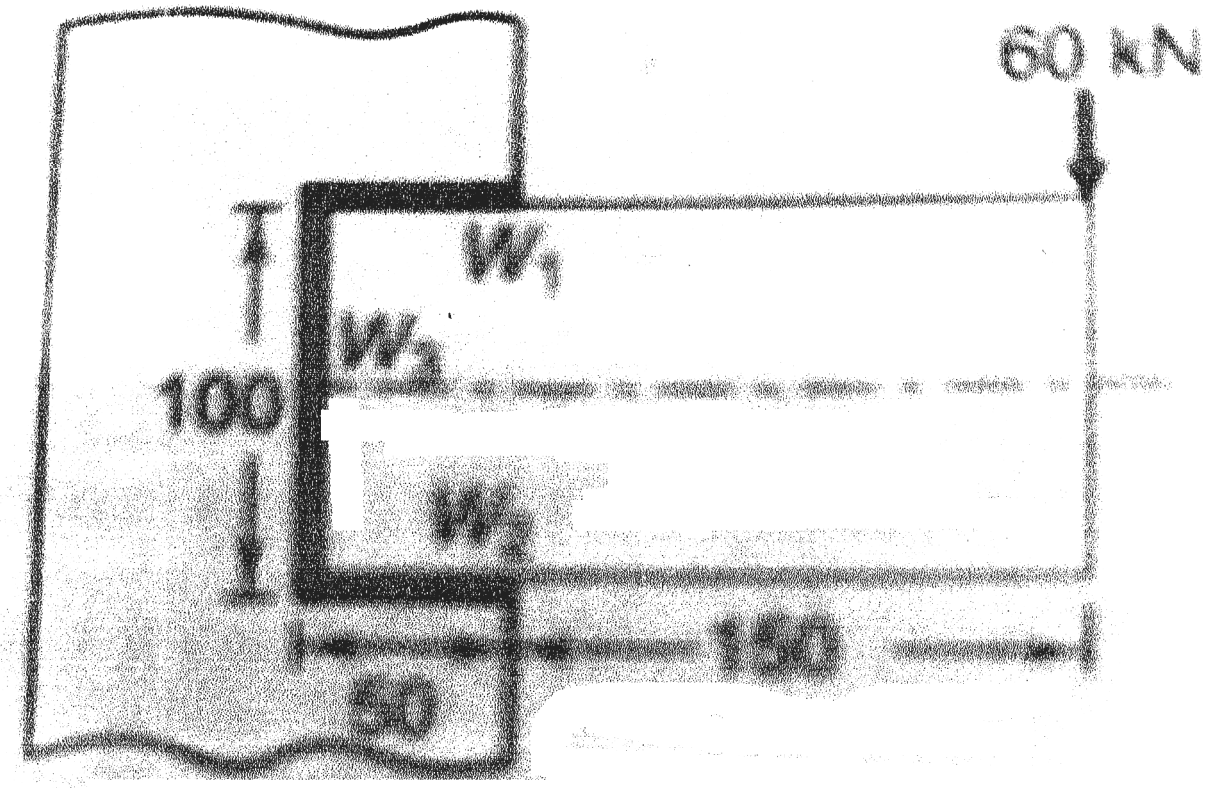

FIG. 5

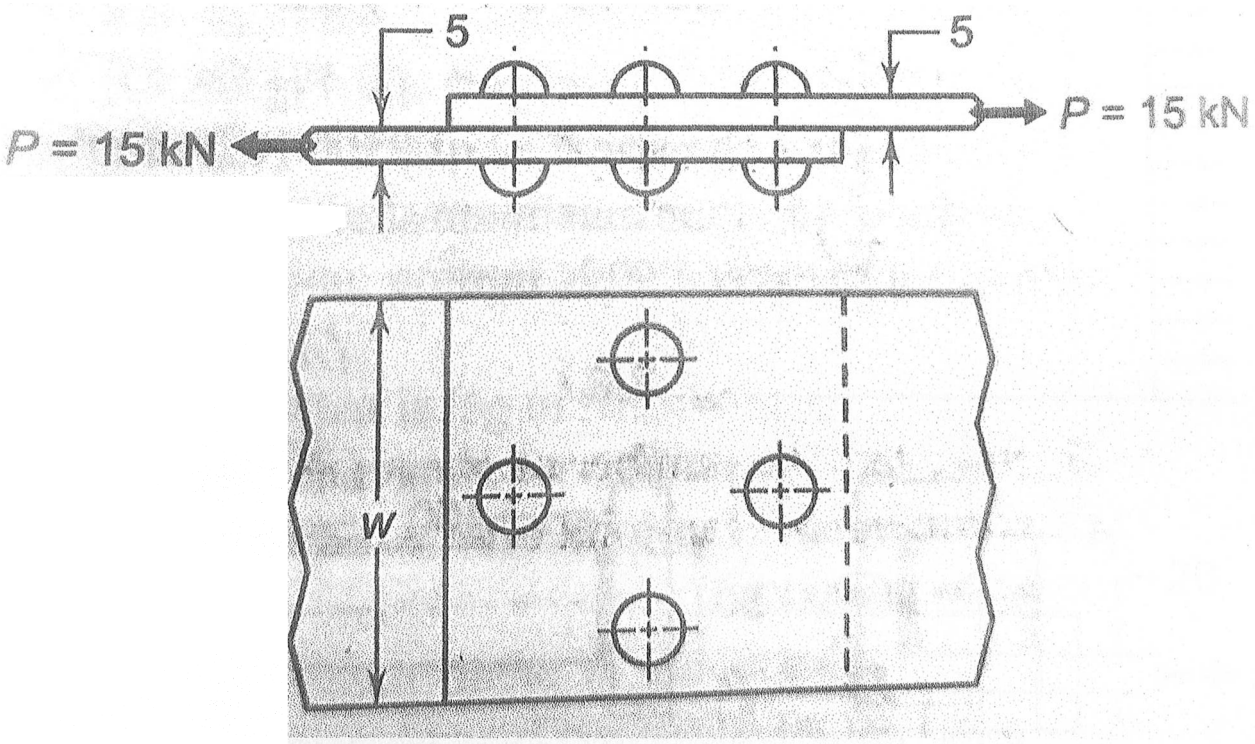

FIG. 6

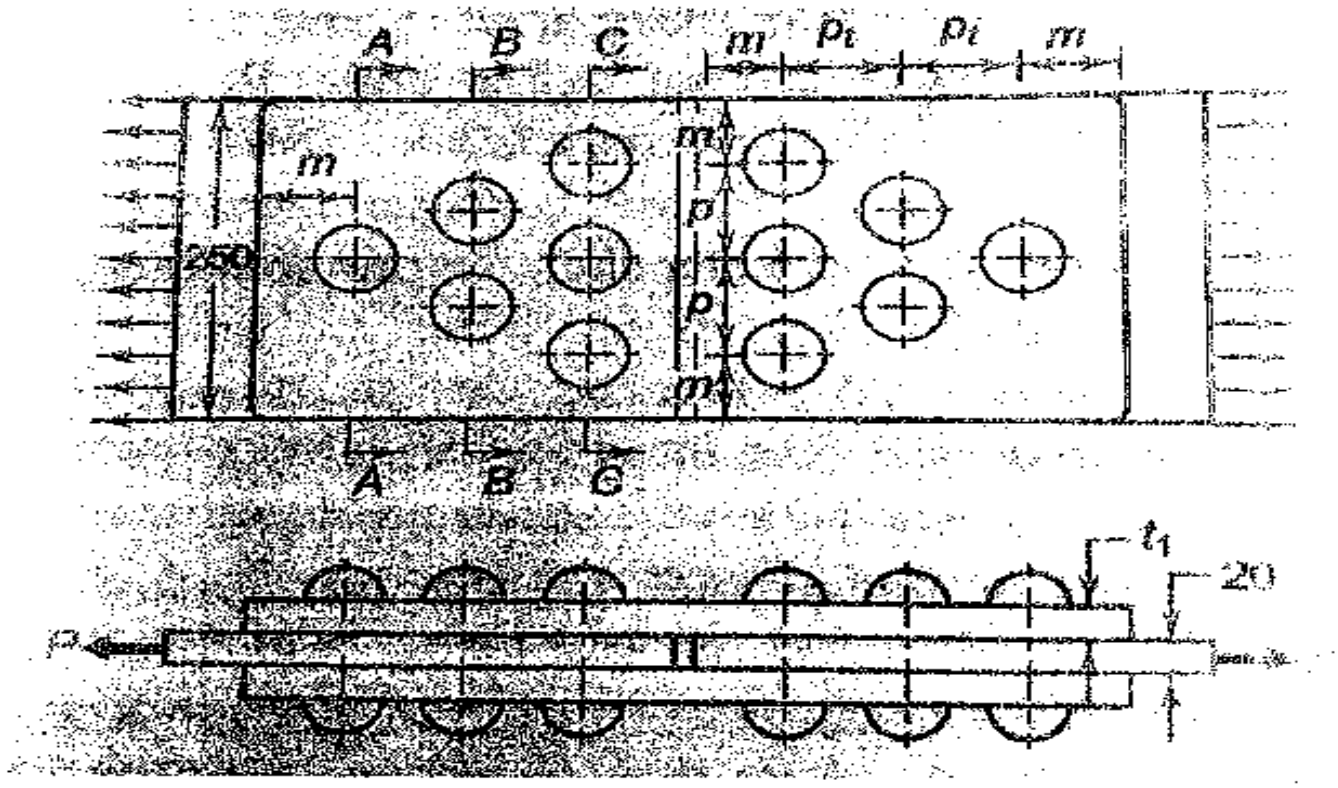

FIG-7