THAPAR INSTITUTE OF ENGINEERING AND TECHNOLOGY, PATIALA

UES 017: SOLIDS AND STRUCTURES

B.E. – 2nd Year (CIE, MP, MEE) **Session: 2020-2021**

Tutorial Sheet No. 3 **(Strains and Material Constants)**

1.	A 500 mm long, 16 mm diameter rod is observed to increase in the length by 300 µm, and to decrease in the diameter by 2.4 µm when subjected to an axial load of 25 kN. Determine the modulus of elasticity, Poisson's ratio and shear modulus.
2.	A piece of 50 x 250 x 10 mm steel plate, is subjected to uniformly distributed stresses along its edges as shown in Fig. 1. (a) If P_x= 100 kN and P_y = 200 kN then determine the change in thickness of plate. (b) Determine the P_x alone which will cause the same change in thickness as in (a). Let E=200 GPa and ν=0.25.
3.	A structural steel plate with E = 210 GPa and ν=0.3 has the dimension as shown in Fig. 2 before loading. The plate is then subjected to a state of plane stress in xy plane with σ_x=150 MPa. For what value of stress σ_y will the dimension Y of the plate remain unchanged? What will be the final dimension of the plate in the other two directions?
4.	A circle of diameter 200 mm, is scribed on an unstressed 18 mm thick aluminium plate as shown in Fig. 3. Forces acting in the plane of the plate later cause normal stresses σ_x = 85 MPa and σ_z= 150 MPa. Determine the change in (i) the length of diameter AB and CD, (ii) thickness of plate and (iii) volume of plate. Let E=70 GPa and ν=1/3.
5.	A plastic sheet, 12.5 mm thick, is bonded to the pin jointed steel frame. Determine the magnitude of force P that would result in 4 mm horizontal displacement of bar AB. Use G = 0.5 GPa for the plastic and neglect the deformation of the steel frame.

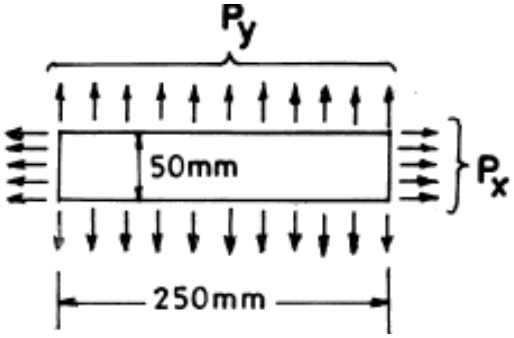

Fig. 1

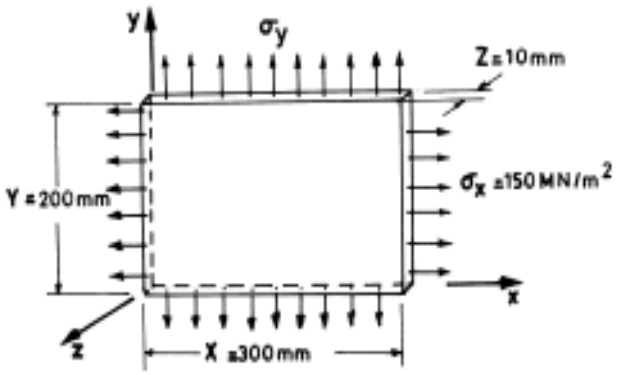

Fig. 2

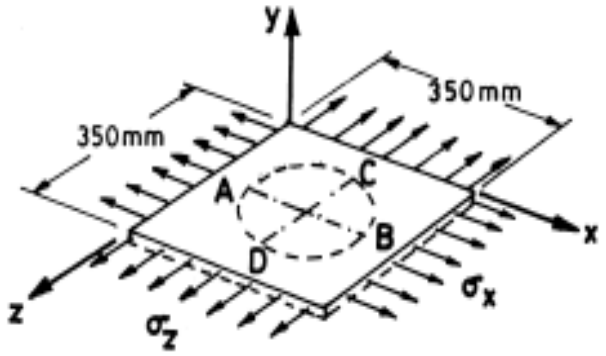

Fig. 3

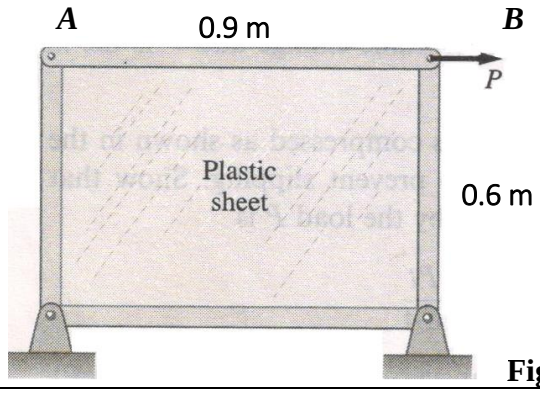

Fig. 4