ESO 202A/204: Mechanics of Solids (2016-17 II Semester)
Assignment No. – 5

5.1 Given that σ_{xx} = -100 MPa, σ_{yy} = -50 MPa, τ_{xy} = -20 MPa, E = 100 GPa, ν = 0.2. Find principal strains, maximum shear strains and their directions.

5.2 A circle 300 mm in diameter is scribed (it is not a hole) on a mild steel plate before the plate is stressed as shown in Fig 5.2. After stressing, the circle deforms to an ellipse. Calculate the lengths of the major and minor axes of the ellipse and also find their directions. Take E = 200 GPa and ν = 0.3.

5.3 A composite hoop consists of a brass hoop of 100 mm internal radius and 2 mm thickness, and a steel hoop of 102 mm radius and 2 mm thickness. Both hoops are 50 mm wide normal to the plane of the hoop. If the composite hoop is heated uniformly to a temperature of 75°C above the room temperature, estimate stresses in the brass and steel hoops.

$\alpha_{brass} = 20 \times 10^{-6}/°C$ $\alpha_{steel} = 10 \times 10^{-6}/°C$ E_{brass} = 100 GPa E_{steel} = 200 GPa

5.4 A long, thin-walled cylindrical tank of length L just fits between two rigid end-walls when there is no pressure in the tank. Estimate the force exerted on the rigid walls by the tank when the pressure is p and the material of the tank obeys Hooke's law (**Problem 5.20 of text book**).

5.5 A steel pipe is held between two rigid walls as shown in Fig. 5.5. When mounted, the temperature of the pipe was 20°C. The pipe is then cooled to a uniform temperature of -15°C by a cold fluid flow. Determine the state of stress and strain in the pipe. Can this be characterized as a plane stress/ plane strain situation? Take $\alpha = 12 \times 10^{-6}/°C$.

5.6 An aluminium rod A, and a steel tube B, support a load P (Fig.5.6). The following data apply to A and B: E_{St} = 200 GPa, E_{Al} = 150 Gpa, Y_{St} = 600 MPa, Y_{Al} = 400 MPa, $(d\sigma/d\varepsilon)_{plas}$ = 19 GPa for steel and 15 GPa for aluminium. What is the maximum load for elastic behaviour throughout? What is the total deflection due to a load which is 1.5 times that of this load? Hint: plastic part of deflection, $\delta_{plas} = \frac{(\sigma - Y)L}{\left(\frac{d\sigma}{d\varepsilon}\right)_{plas}}$, where L = length.

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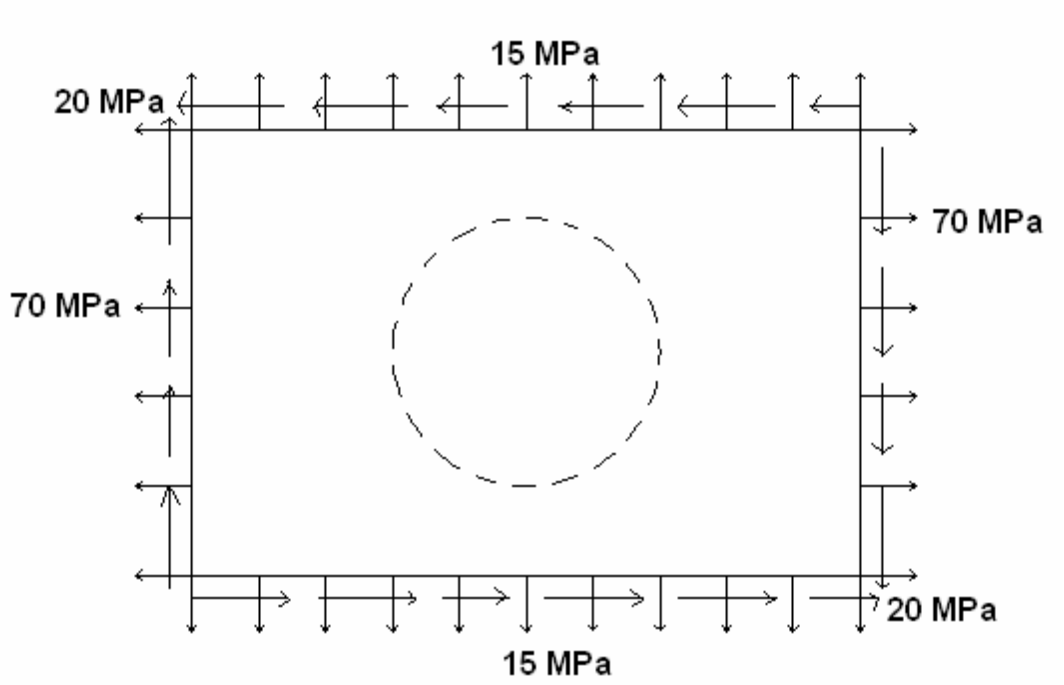

Fig. 5.2

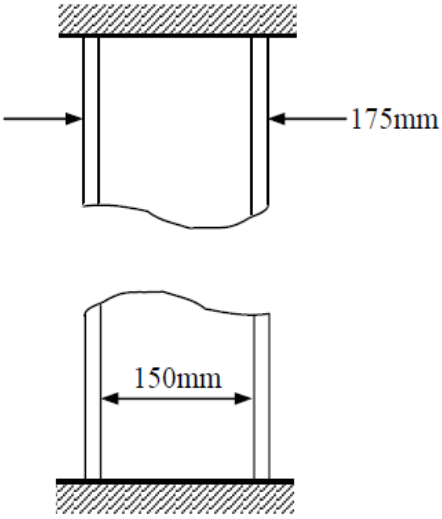

Fig. 5.5

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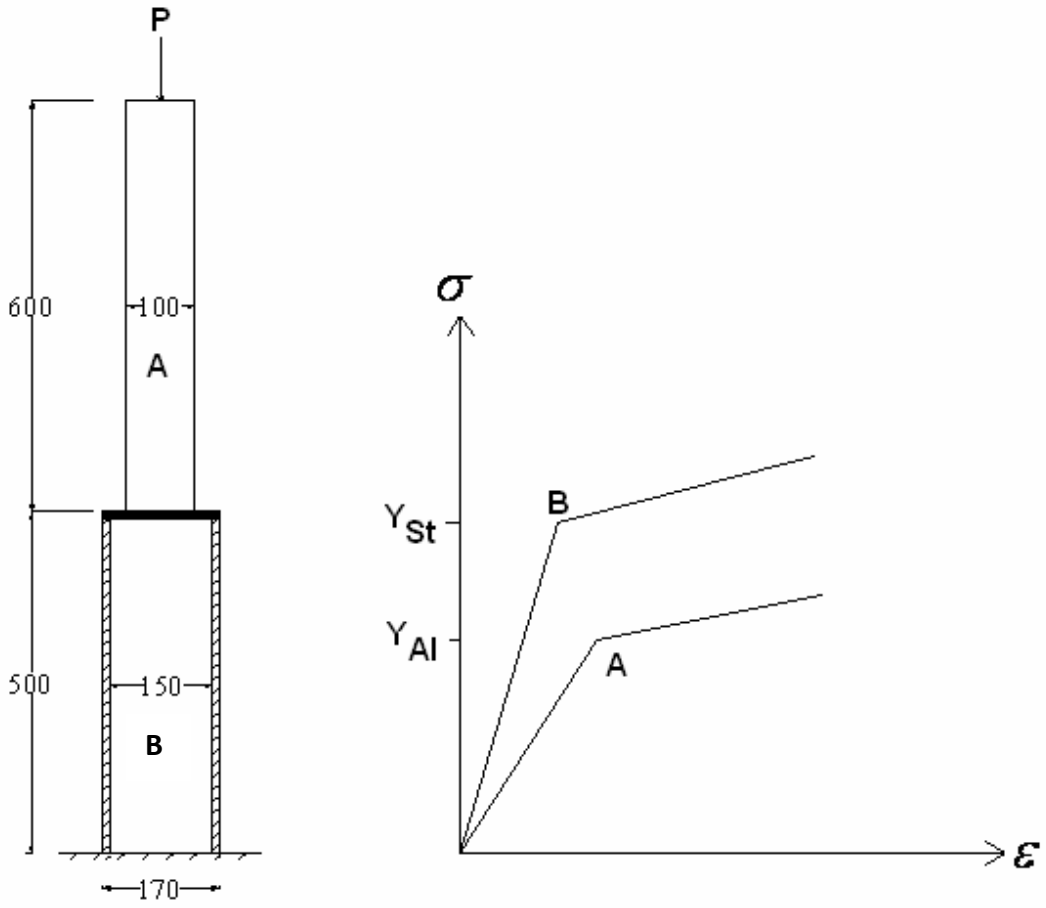

Fig.5.6

All dimensions are in mm