SIMPLE STRESSES & STRAINS

STRAIN ENERGY

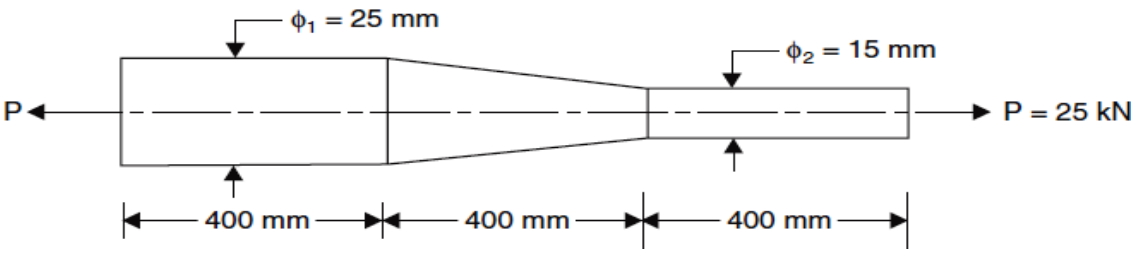
Unit-I

March 2016

1. The extension in a rectangular steel bar of length 400 mm and thickness 10 mm is found to be 0.21 mm. the bar tapers uniformly in width from 100 mm to 50 mm. if the Young's modulus is 200 GPa, determine the axial load on the bar.

2. A steel rod of 1metre long and 200 mm^2 cross-section is subjected to a tensile force of 120 kN in the direction of its length. Calculate the change in volume. Take Poisson's ratio = 0.3 and Young's modulus = 205 MPa.

3. Find the extension of the bar shown in Figure 1 under an axial load of 25 kN. Take Young's modulus = 200 MPa.



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4 .A steel rod of 40 mm diameter is fitted in a copper tube of 60 mm external diameter and 40 mm internal diameter. The assembly is completely fixed at one end while other end is constrained in cross section by rigid plate. If the temperature of the assembly is raised by 60^0C, calculate the stresses developed in copper and steel. Consider the following material properties.

Young's modulus for steel = 200 GPa;Young's modulus for copper = 100 GPa

Coefficient of thermal Expansion for steel = 12×10^{-6} per ^{0}C

Coefficient of thermal Expansion for copper = 18×10^{-6} per ^{0}C.

5. A titanium bar with square cross section with 75 mm side and length 3.0 m is subjected to tensile load of 900 kN along the length direction. Determine the change in the dimensions and increase in volume of the bar. Young's modulus and Poisson's ratio for titanium are 100 GPa and 0.33 respectively. Determine the strain energy developed in the body. What is the increase in the strain energy if the same load is suddenly applied?

6. Draw stress-strain curve for Ductile and brittle materials. **March 2017**

7. A straight bar 500 mm long is 25 mm diameter for 300 mm length and 15 mm dia. for the remaining length. If the bar is subjected to an axial pull of 15 KN, find the extension of the bar. Take E = 200 Gpa.

8. How the stresses in composite bars are found?

9. Three vertical rods equal in length and each 15 mm. diameter are equi-spaced in a vertical plane support a load of 10 KN and the rods are adjusted to share the load equally. If an additional load of 10 KN be added. Determine the stress in each rod. The middle one is of copper and the outer ones are if steel. Take Esteel= 200 Gpa, Ecopper = 100 Gpa.

10. How the temperature stresses are developed? **DEC 2017**

11. A steel bar is placed between two copper bars of same area and length a temp of 15^0C. At this stage, they are rigidly connected together at both ends. When the temperature is raised to 315^0 C, the length of bars increase by 1.6 mm. Find the original length and stresses in bars. Take E_s = 200 Gpa, E_c = 100 Gpa, αs = 0.000012 per ^{0}C, α_e = 0.000018 per ^{0}C.

12. Derive equation for the relation between three elastic moduli.

13. A bar of 25 mm. diameter is subjected to a pull of 70 kN. The extension measured on a gauge length of 200 mm is 0.1 mm and change in diameter is 0.004 mm. Find poisson's ratio and values of three moduli.