Composite Bar :-

Two or more materials combined together to foam a new material is known as composite. The Property of New Material may not be the Properties of Parent Material.

Governing Principle :-

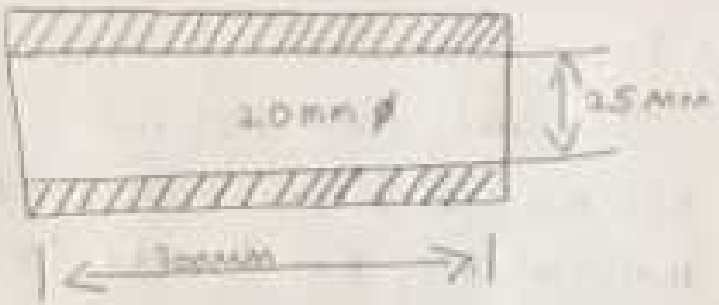
① Total load = Load of Bar$_1$ + Load of Bar$_2$

$$P = P_1 + P_2$$

② Elongation of Bar$_1$ = Elongation of Bar$_2$

$$\frac{P_1 L_1}{A_1 E_1} = \frac{P_2 L_2}{A_2 E_2}$$

① A mild steel rod of 20mm diameter and 30mm long is enclosed centraly inside the hollow copper tube of External diameter 30mm Internal diameter 25 mm. The Ends of the Rod and Tube are Brazed together and the composite Bar is Subjected an axial Pull of 50kN. If E - steel and Copper are 200GPA and 100GPA Respectively. Find the stress develope in Rod and Tube



$D_s = 20mm$ $L = 300mm$

$D_c = 30mm$ $d_c = 25mm$

$E_c = 100\ GPa = 1 \times 10^5\ N/mm$

$E_s = 200\ GPa = 2 \times 10^5\ N/mm^2$

Solution:

$$P = P_s + P_c$$

$$50,000 = P_s + P_c$$

$$\frac{P_s L_s}{A_s E_s} = \frac{P_c + P_c}{A_c + A_c}$$ ($L_s = L_c$ ∴ We can ignore

$$P_s = \frac{P_c}{A_c E_c} \cdot A_s E_s = \frac{314.16 \times 2 \times 10^5}{215.98 \times 1 \times 10^5}$$

$$P_s = 2.91\ P_c$$

Substituting P_c form of P_c

$$50,000 = 2.91 P_c + P_c$$

$$= 12787.$$

$$P_s = 2.91 \times 12787.7 = 37212.2N$$

Stress developed in steel rod = P_s/A_s= 37210/314.16

= 118.4 N/mm^2

Stress developed in Copper tube =P_c/A_c=12787/215.98

= 59.2 N/mm^2