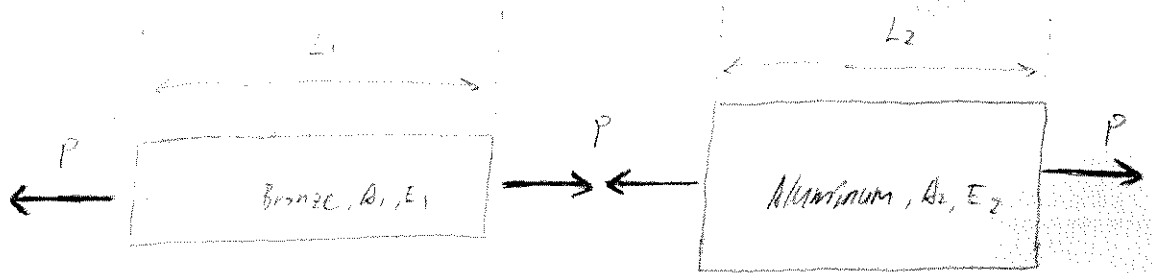


9.44) a)



$$\delta_{L_1} = \delta_{T_1} + \delta_{R_1}$$

where  $\delta_T = \alpha(\Delta T)L$

$$\delta_{L_2} = \delta_{T_2} + \delta_{R_2}$$

$$\delta_R = PL/AE$$

$$\delta_{L_1} + \delta_{L_2} = 0.5 \text{ mm}$$

$$\Rightarrow (\delta_{T_1} + \delta_{R_1}) + (\delta_{T_2} + \delta_{R_2}) = 0.5 \text{ mm}$$

$$(\alpha_1 \Delta T L_1 + PL_1/A_1 E_1) + (\alpha_2 \Delta T L_2 + PL_2/A_2 E_2) = 0.5 \text{ mm}$$

$$\Rightarrow (26 \times 10^{-6} / ^\circ\text{C})(96^\circ\text{C})(0.35 \text{ m}) + P(0.35 \text{ m}) / (1500 \text{ mm}^2) \left( \frac{1 \text{ m}^2}{10^6 \text{ mm}^2} \right) (105 \times 10^9 \frac{\text{N}}{\text{m}^2})$$

$$+ (23.2 \times 10^{-6} / ^\circ\text{C})(96^\circ\text{C})(0.45 \text{ m}) + P(0.45 \text{ m}) / (1800 \text{ mm}^2) \left( \frac{1 \text{ m}^2}{10^6 \text{ mm}^2} \right) (73 \times 10^9 \frac{\text{N}}{\text{m}^2})$$

$$= 0.5 \text{ mm}$$

Solve for P

$$\Rightarrow P = \cancel{-199519 \text{ N}} \quad 217 \text{ kN}$$

$$\Rightarrow \sigma_1 = \frac{P}{A_1} = \frac{-199519 \text{ N}}{1500 \text{ mm}^2 \left( \frac{1 \text{ m}^2}{10^6 \text{ mm}^2} \right)} = -1.33 \times 10^8 \text{ Pa} \quad \sigma_2 = \frac{P}{A_2} = \frac{199519 \text{ N}}{1800 \text{ mm}^2 \left( \frac{1 \text{ m}^2}{10^6 \text{ mm}^2} \right)} = 1.11 \times 10^8 \text{ Pa}$$