The Answers of ME 208 Quiz 1

1)

Let P_a = portion of axial force carried by shell.

P_c = portion of axial force carried by core.

$$\delta = \frac{P_a L}{E_a A_a} \qquad P_a = \frac{E_a A_a}{L}\delta$$

$$\delta = \frac{P_s L}{E_c A_c} \qquad P_s = \frac{E_s A_s}{L}\delta$$

Total force $\quad P = P_a + P_s = (E_a A_a + E_s A_s)\frac{\delta}{L}$

Data: $P = 160\ kN$

$$A_a = \frac{\pi}{4}(d_o^2 - d_i^2) = \frac{\pi}{4}(0.062^2 - 0.025^2) = 0.002528\ m$$

$$A_s = \frac{\pi}{4}d^2 = \frac{\pi}{4}(0.025)^2 = 0.000491\ m^2$$

$$\frac{\delta}{L} = \varepsilon = \frac{P}{E_a A_a + E_s A_s}$$

$$\varepsilon = \frac{-160000}{(70\times10^9)(0.002528) + (200\times10^9)(0.000491)} = -581.5\times10^{-6}$$

(a) $\sigma_s = E_s\varepsilon = (200\times10^9)(-581.5\times10^{-6}) = -116.3\ MPa$

$\sigma_a = E_a\varepsilon = (70\times10^9)(-581.5\times10^{-6}) = -40.7\ MPa$

(b) $\delta = L\varepsilon = (0.25)(-581.5\times10^{-6}) = -145\times10^{-6}\ m = -0.145\ mm$

2)

$$P = 75 \text{ kN} = 75 \times 10^3 \text{ N} \qquad A = \frac{\pi}{4} d^2 = \frac{\pi}{4}(0.022)^2 = 380.13 \times 10^{-6} \text{ m}^2$$

$$\sigma = \frac{P}{A} = \frac{75 \times 10^3}{380.13 \times 10^{-6}} = 197.301 \times 10^6 \text{ Pa}$$

$$\varepsilon_x = \frac{\sigma}{E} = \frac{197.301 \times 10^6}{200 \times 10^9} = 986.51 \times 10^{-6}$$

$$\delta_x = L\varepsilon_x = (200 \text{ mm})(986.51 \times 10^{-6})$$

$$(a) \qquad \delta_x = 0.1973 \text{ mm}$$

$$\varepsilon_y = -v\varepsilon_x = -(0.3)(986.51 \times 10^{-6}) = -295.95 \times 10^{-6}$$

$$\delta_y = d\varepsilon_y = (22 \text{ mm})(-295.95 \times 10^{-6})$$

$$(b) \quad \delta_y = -0.00651 \text{ mm}$$