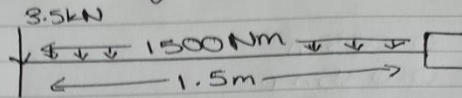


Q1)

1.5m
3.5kN1500Nm
 $2.2 \times 10^6 \text{ Nm}^2$

$$a) \frac{fL^3}{3EI} + \frac{WL^4}{8EL}$$

$$= -\frac{3500 \times 1.5^3}{3 \times 2.2 \times 10^6} + \frac{-1500 \times 1.5^4}{8 \times 2.2 \times 10^6}$$

$$= -\frac{63}{35200} + -\frac{243}{563200}$$

$$= -2.22 \times 10^{-3} \text{ m}$$

b)

~~$$y = y_{PL} + y_{UDL}$$~~

$$y = y_{PL} + y_{UDL}$$

$$y_{PL} = y - y_{UDL}$$

$$y_{PL} = -0.005 - (-4.31 \times 10^{-4})$$

$$y_{PL} = -4.569 \times 10^{-3}$$

$$y_{PL} = \frac{fL^3}{3EI}$$

$$= f = \frac{y_{PL} \times 3EI}{L^3}$$

$$f = \frac{-4.569 \times 10^{-3} \times 3 \times 2.2 \times 10^6}{1.5^3}$$

$$f = \frac{-30155.4}{3.375}$$

$$f = -8934.93 \text{ N}$$

$$Df = -5434.93 \text{ N}$$

Stress Analysis ACH1A5015

Q2)

$$\begin{aligned}d_o &= 0.045 \text{ m} \\ d_i &= 0.035 \text{ m} \\ P &= 115 \times 10^5 \text{ N/m}^2\end{aligned}$$

$$\begin{aligned}r_o &= 0.023 \text{ m} \\ r_i &= 0.018 \text{ m}\end{aligned}$$

~~$r_o = 0.023 \text{ m}$~~

a) $\sigma_r = p_o$ at r_o and $\sigma_r = -p_i$ at $r = r_i$

$$b) \quad A = \frac{p_i r_i^2 - p_o r_o^2}{r_o^2 - r_i^2}$$

$$A = \frac{115 \times 10^5 \times 0.018^2}{0.023^2 - 0.018^2}$$

$$A = 18.18 \times 10^6$$

$$B = \frac{(p_i - p_o) r_o^2 r_i^2}{r_o^2 - r_i^2}$$

$$B = \frac{(115 \times 10^5) \times 0.023^2 \times 0.018^2}{0.023^2 - 0.018^2}$$

$$B = 9.61 \times 10^3$$

Stress Analysis ACHA 5015

Q3)

$$\begin{aligned} a) \quad \epsilon_x &= -10 \times 10^{-6} \\ \epsilon_y &= 13 \times 10^{-6} \\ \nu &= 0.20 \\ E &= 165 \times 10^9 \text{ N/m}^2 \end{aligned}$$

$$\sigma_x = \frac{E}{1-\nu^2} (\epsilon_x + \nu \epsilon_y) = \frac{165 \times 10^9}{1-0.2^2} (-10 \times 10^{-6} + (0.2 \times 13 \times 10^{-6}))$$

$$\sigma_x = -1.27 \times 10^6 \text{ N/m}^2 \text{ Negative so compressive}$$

$$\sigma_y = \frac{E}{1-\nu^2} (\epsilon_y + \nu \epsilon_x) = \frac{165 \times 10^9}{1-0.2^2} (13 \times 10^{-6} + (0.2 \times -10 \times 10^{-6}))$$

$$\sigma_y = 1.89 \times 10^6 \text{ N/m}^2 \text{ positive so tensile}$$

b)

~~$$\sigma_x = -1.27 \times 10^6 \text{ N/m}^2 + 1.5 \times 10^6 \text{ N/m}^2$$~~
~~$$\sigma_y = 1.89 \times 10^6 \text{ N/m}^2 - 2 \times 10^6 \text{ N/m}^2$$~~

~~$$\epsilon_x = \frac{1}{E} (\sigma_x - \nu \sigma_y) = \frac{1}{165 \times 10^9} (-1.27 \times 10^6 - (0.2 \times 1.89 \times 10^6))$$~~
~~$$\epsilon_x = -1.5 \times 10^{-6}$$~~
~~$$\epsilon_y = \frac{1}{E} (\sigma_y - \nu \sigma_x) = \frac{1}{165 \times 10^9} (1.89 \times 10^6 - (0.2 \times -1.27 \times 10^6))$$~~
~~$$\epsilon_y = 2 \times 10^{-6}$$~~

$$\sigma_x = 20 \times 10^6$$

$$\sigma_y = -15 \times 10^6$$

$$\epsilon_x = \frac{1}{E} (\sigma_x - \nu \sigma_y)$$

$$\epsilon_x = \frac{1}{165 \times 10^9} (20 \times 10^6 - (0.2 \times -15 \times 10^6))$$

$$\epsilon_x = 1.39 \times 10^{-4}$$

$$\epsilon_y = \frac{1}{E} (\sigma_y - \nu \sigma_x)$$

$$\epsilon_y = \frac{1}{165 \times 10^9} (-15 \times 10^6 - (0.2 \times 20 \times 10^6))$$

$$\epsilon_y = -1.15 \times 10^{-4}$$

Stress Analysis ACH15015

Q4) $D = 0.2 \text{ m}$
 $L = 0.39 \text{ m}$
 $t = 1.5 \times 10^{-3} \text{ m}$
 $\sigma_{\max} = 100 \times 10^6 \text{ N/m}^2$
 $n_L = 0.9$
 $n_c = 0.6$

$$\sigma_c = \frac{p D}{2 t n_L}$$

$$P = \frac{2 t n_L \sigma_c}{D}$$

~~$P_{\max c} = \frac{2 \times 1.5 \times 10^{-3} \times 100 \times 10^6}{0.2}$~~
 ~~$P_{\max c} = 1.5 \times 10^3 \text{ N/m}^2$~~

$$P_{\max c} = \frac{2 \times 1.5 \times 10^{-3} \times 0.9 \times 100 \times 10^6}{0.2}$$

~~$P_{\max c} = 1350 \times 10^3 \text{ N/m}^2$~~
 $1350 \times 10^3 \text{ N/m}^2$

$$\sigma_c = \frac{p D}{2 t n_c}$$

$$P = \frac{2 t n_c \sigma_c}{D}$$

~~$P_{\max c} = \frac{2 \times 1.5 \times 10^{-3} \times 100 \times 10^6}{0.2}$~~

$$P_{\max c} = \frac{2 \times 1.5 \times 10^{-3} \times 0.6 \times 100 \times 10^6}{0.2}$$

$$P_{\max c} = 900 \times 10^3 \text{ N/m}^2$$

~~$P_{\max} = 1350 \times 10^3 \text{ N/m}^2$~~ ~~$P_{\max} = 900 \times 10^3 \text{ N/m}^2$~~

Stress Analysis ACMA 5015

Q5) $L = 0.35\text{m}$
 $P = 50 \times 10^6 \text{ N/m}^2$
 $E = 165 \times 10^9 \text{ N/m}^2$
 $\nu = 0.3$

a) $K = \frac{E}{3(1-2\nu)} = \frac{165 \times 10^9}{3(1-(2 \times 0.3))} = 137.5 \times 10^9 \text{ N/m}^2$

$$K = \frac{\sigma}{\epsilon_v} = \frac{-P}{\epsilon_v}$$

$$\epsilon_v = \frac{-P}{K} = \frac{-50 \times 10^6}{137.5 \times 10^9} = -363.64 \times 10^{-6}$$

$$\epsilon_v = \frac{\Delta V}{V}$$

$$\Delta V = \epsilon_v V = -363.64 \times 10^{-6} \times (0.35)^3$$

$$\Delta V = -15.59 \times 10^{-6} \text{ m}^3$$

- b) Orthotropic materials have different elastic constants depending on the direction.