

Lloyd John

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182396

(ACHA Soils)

Stress and Analysis

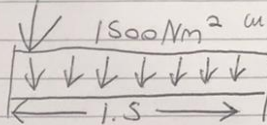
F 3.5 kN

Q1

a)

$$L = 1.5 \text{ m}$$

$$EI = 2.2 \times 10^6 \text{ N/m}^2$$



$$y_{\max} = y_{\text{ude}} + y_{\text{PL}} \quad y_{\max} = \frac{wL^4}{8EI} + \frac{FL^3}{3EI}$$
$$y_{\max} = \frac{1500 \times (1.5)^4}{8 \times 2.2 \times 10^6} + \frac{3500 \times (1.5)^3}{3 \times 2.2 \times 10^6}$$

$$y_{\text{ude}} = 431.46 \times 10^{-6}$$

$$y_{\text{PL}} = 1789.77 \times 10^{-6}$$

$$y_{\max} = 2.22 \times 10^{-3}$$

b)

$$y_{\text{ude}} = y - y_{\text{PL}}$$

$$y_{\text{PL}} = y - y_{\text{ude}}$$

$$y_{\text{PL}} = 5 \times 10^{-3} - 431.46 \times 10^{-6} - 4.57 \times 10^{-3}$$

$$y_{\text{PL}} = \frac{FL^3}{3EI}$$

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

$$F = \frac{4.57 \times 10^{-3} \times (3 \times 2.2 \times 10^6)}{1.5^3} = 8.96 \times 10^3 \text{ N}$$

$$\Delta F = 8.96 \times 10^3 - 3500 = 5460 \text{ N}$$

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Stress Analysis

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$$d_o = 0.45 \text{ m} \quad r_o = 0.225$$

$$d_i = 0.35 \text{ m} \quad r_i = 0.175$$

$$p = 115 \text{ Bar} \times 10^5 \text{ r/n}^2$$

$$@ r_o = 0.225 \quad \sigma_r = 0$$

$$\sigma_r = a - \frac{b}{r^2}$$

$$0 = a - \frac{b}{0.225^2}$$

$$0 = b - (0.225^2)a$$

$$@ r_i = 0.175 \quad \sigma_r = -p = -115 \times 10^5$$

$$-115 \times 10^5 = a - \frac{b}{(0.175)^2}$$

$$3445312.5 = -\frac{b}{(0.175)^2} + \frac{b}{(0.225)^2}$$

$$a = \frac{3445312.5}{0.225^2 - 0.175^2}$$

$$a = 172.27 \times 10^6$$

$$b = -8.72 \times 10^6$$

$$a = 172.27 \times 10^6$$

$$b = -(0.225)^2 \times 172.27 \times 10^6$$

$$b = -8.72 \times 10^6 = -8.72 \text{ MPa}$$

$$a = 172.27 \times 10^6 = 172.27 \text{ MPa}$$

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Q3

$$a) \quad \sigma_x = \frac{E}{1-\nu^2} (E_x + \nu E_y)$$

$$\sigma_x = \frac{165 \times 10^9}{1-0.20^2} (-10 \times 10^{-6} + (0.20 \times 13 \times 10^{-6}))$$

$$\sigma_y = \frac{165 \times 10^9}{1-0.20^2} (13 \times 10^{-6} + (0.20 \times -10 \times 10^{-6}))$$

$$\text{compressive} = \sigma_x = -1.27 \times 10^6 \text{ Pa}$$

$$\text{tensile} = \sigma_y = 1.89 \times 10^6 \text{ Pa}$$

b)

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

$$E_x = \frac{1}{165 \times 10^9} (20 \times 10^6 - (0.20 \times -15 \times 10^6))$$

$$E_x = 139.40 \times 10^{-6} \mu\text{E}$$

$$E_y = \frac{1}{165 \times 10^9} (-15 \times 10^6 - (0.20 \times 20 \times 10^6))$$

$$E_y = -115.15 \times 10^{-6} \mu\text{E}$$

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Q4

$$d = 0.2 \text{ m}$$

$$L = 0.39 \text{ m}$$

$$r_L = 0.39 \text{ m}$$

$$r_C = 0.6 \text{ m}$$

$$\sigma_{\max} = 100 \times 10^6 \quad E = 1.5 \times 10^{-3} \text{ m}$$

$$\sigma_L = \frac{PD}{4Er_C}$$

$$P = \frac{4Er_C \sigma_L D}{D}$$

$$P_{\max L} = \frac{(4 \times 1.5 \times 10^{-3}) \times 0.6 \times 100 \times 10^6}{0.2} = 1.8 \times 10^6$$

$$P_{\max L} = 18 \text{ Bar}$$

$$\sigma_C = \frac{PD}{2Er_L}$$

$$P = \frac{2Er_L \sigma_C D}{D}$$

$$P_{\max C} = \frac{(2 \times 1.5 \times 10^{-3}) \times 0.9 \times 100 \times 10^6}{D}$$

$$P_{\max C} = 13.5 \text{ Bar} \quad = 1.35 \times 10^6$$

$$\therefore P_{\max} = 13.5 \text{ Bar}$$

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Q5

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

$$K = \frac{165 \times 10^9}{3(1 - 2 \times 0.3)} = 137.5 \times 10^9$$

$$E_v = \frac{-P}{K}$$

~~mm~~ $E_v = \frac{-50 \times 10^6}{137.5 \times 10^9} = -363.66 \times 10^{-6}$

$$E_v = -363.66 \times 10^{-6}$$

$$\Delta v = L^3 \times E_v$$

$$E_v = \frac{\Delta v}{v}$$

$$Dv = E_v V = -363.66 \times 10^{-6} \times (0.35)^3$$

$$Dv = ~~mm~~ -15.59 \times 10^{-6} \text{ m}^3$$

b) Orthotropic materials have different material properties along three ~~axis~~ perpendicular axes (axial, radial and circumferential). Example of this is wood.