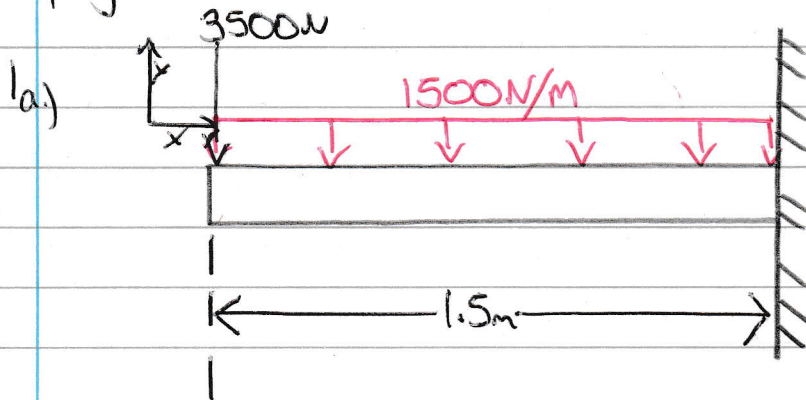


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$$EI = 2.2 \times 10^6 \text{ Nm}^2$$

$$a) y = \frac{\overset{PL}{FL^3}}{3EI} + \frac{\overset{udl}{wL^4}}{8EI} \quad / \quad y = \frac{(-3500)(1.5^3)}{(3)(2.2 \times 10^6)} + \frac{(-1500)(1.5^4)}{(8)(2.2 \times 10^6)}$$
$$(-1.79 \times 10^{-3}) + (-431.46 \times 10^{-6})$$

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

$$b) \therefore y_{\max} = 5 \times 10^{-3} \text{ m}$$

$$y_{\max} = y_{udl} + y_{pl} \quad / \quad y_{\max} - y_{udl} = y_{pl}$$

$$\therefore (5 \times 10^{-3}) - (431.46 \times 10^{-6}) = y_{pl} \quad / \quad y_{pl} = 4.57 \times 10^{-3} \text{ m}$$

$$y = \frac{FL^3}{3EI} \quad \therefore \frac{y 3EI}{L^3} = F \quad / \quad \frac{(4.57 \times 10^{-3})(3)(2.2 \times 10^6)}{1.5^3} = F$$

$$F = 8936.8 \text{ N}$$

$$\Delta F = 5436.8 \text{ N}$$

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$$\phi_o = 0.045 \text{ m}$$

$$\phi_i = 0.035 \text{ m}$$

$$p = 115 \times 10^5 \text{ N/m}^2$$

a) Boundary Conditions

Inside surface, $r = r_i = 0.0175 \text{ m}$

$$\sigma_R = -p = -115 \times 10^5 \text{ N/m}^2$$

Outer surface, $r = r_o = 0.0225 \text{ m}$

$$\sigma_R = 0$$

b.) inner

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

$$-115 \times 10^5 = a - \frac{b}{0.0175^2}$$

$$-115 \times 10^5 (0.0175^2) = (0.0175^2) a - b$$

$$(115 \times 10^5)(0.0175^2) = b - (0.0175^2) a$$

$$\therefore (115 \times 10^5)(0.0175^2) = (0.0225^2) a - (0.0175^2) a$$

$$(115 \times 10^5)(0.0175^2) = a(0.0225^2 - 0.0175^2)$$

$$\frac{(115 \times 10^5)(0.0175^2)}{(0.0225^2) - (0.0175^2)} = a$$

$$a = 17.61 \times 10^6$$

$$b = (0.0225^2)(17.61 \times 10^6)$$

$$b = 8.92 \times 10^3$$

outer

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

$$0 = a - \frac{b}{0.0225^2}$$

$$0 = (0.0225^2) a - b$$

$$b = (0.0225^2) a$$

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$$c) \quad a = 17.61 \times 10^6 \\ b = 8.92 \times 10^3$$

$$r_i = 0.0175 \text{ m}$$

$$r_o = 0.0225 \text{ m}$$

$$\sigma_c = a + \frac{b}{r^2}$$

$$\text{Inner} = (17.61 \times 10^6) + \frac{(8.92 \times 10^3)}{0.0175^2} = 46.74 \times 10^6 \text{ N/m}^2$$

$$\text{outer} = (17.61 \times 10^6) + \frac{(8.92 \times 10^3)}{0.0225^2} = 35.23 \times 10^6 \text{ N/m}^2$$

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3.)

$$\epsilon_1 = -10 \times 10^{-6}$$

$$\epsilon_2 = 13 \times 10^{-6}$$

$$\nu = 0.20$$

$$E = 165 \times 10^9 \text{ Pa}$$

$$a.) \sigma_1 = \frac{E}{(1-\nu^2)} (\epsilon_1 + \nu \epsilon_2) \therefore \sigma_1 = \frac{165 \times 10^9}{1-0.20^2} (-10 \times 10^{-6} + (0.20)(13 \times 10^{-6}))$$

$$\sigma_1 = -1.27 \times 10^6 \text{ N/m}^2, \text{ compressive}$$

$$\sigma_2 = \frac{E}{(1-\nu^2)} (\epsilon_2 + \nu \epsilon_1) \therefore \sigma_2 = \frac{165 \times 10^9}{1-0.20^2} (13 \times 10^{-6} + (0.20)(-10 \times 10^{-6}))$$

$$\sigma_2 = 1.89 \times 10^6 \text{ N/m}^2, \text{ tensile}$$

$$b.) \sigma_1 = 20 \times 10^6 \text{ Pa}$$

$$\sigma_2 = -15 \times 10^6 \text{ Pa}$$

$$\epsilon_1 = \frac{1}{E} (\sigma_1 - \nu \sigma_2) \therefore \epsilon_1 = \frac{1}{165 \times 10^9} (20 \times 10^6 - (0.20)(-15 \times 10^6))$$

$$\epsilon_1 = 139.39 \times 10^{-6}$$

$$\epsilon_2 = \frac{1}{E} (\sigma_2 - \nu \sigma_1) \therefore \epsilon_2 = \frac{1}{165 \times 10^9} (-15 \times 10^6 - (0.20)(20 \times 10^6))$$

$$\epsilon_2 = -115.15 \times 10^{-6}$$

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4.)

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

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

$$t = 1.5 \times 10^{-3}$$

$$\sigma_{\max} = 100 \times 10^6 \text{ Pa}$$

$$r_L = 0.9$$

$$r_c = 0.6$$

$$p = ?$$

longitudinal

$$\sigma_L = \frac{pD}{4t r_L} \bigg/ \frac{\sigma_{\max} 4t r_L}{D} = p \bigg/ \frac{(100 \times 10^6)(4)(1.5 \times 10^{-3})(0.6)}{0.2} = p$$

$$\text{long. } p = 1.8 \times 10^6 \text{ N/m}^2$$

Circumferential

$$\sigma_c = \frac{pD}{2t r_L} \bigg/ \frac{\sigma_{\max} 2t r_L}{D} = p \bigg/ \frac{(100 \times 10^6)(2)(1.5 \times 10^{-3})(0.9)}{0.2} = p$$

$$\text{Circ. } p = 1.35 \times 10^6 \text{ N/m}^2$$

$$\text{max allowable pressure} = 1.35 \times 10^6 \text{ N/m}^2$$

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5.)

$$l = 0.35 \text{ m}$$

$$p = 50 \times 10^6 \text{ Pa}$$

$$\nu = 0.3$$

$$E = 165 \times 10^9 \text{ Pa}$$

$$a) \quad K = \frac{E}{3(1-2\nu)} \quad / \quad K = \frac{165 \times 10^9}{3(1-2 \times 0.3)} \quad / \quad K = 1.375 \times 10^{11} \text{ N/m}^2$$

$$\epsilon_v = \frac{3}{E} (-p + \nu 2p) \quad / \quad \epsilon_v = \frac{3}{165 \times 10^9} (-50 \times 10^6 + (0.3)(2)(50 \times 10^6))$$

~~$$\epsilon_v = -220.64 \times 10^{-6}$$~~

$$\epsilon_v = -363.64 \times 10^{-6}$$

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

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

6.)

Orthotropic material means that the elastic content at the material change dependent on the direction you analyse the material. An example of this could be wood, as the grain possesses different elastic properties dependent on direction.