



12 Pages

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SURNAME:

FORENAME(S):

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

54%

mark Agood
K. L.

Q1.)

$$\epsilon_x = -12 \times 10^{-6}$$

$$\epsilon_y = 16 \times 10^{-6}$$

$$\nu = 0.25$$

$$E = 163 \text{ GPa}, 163 \times 10^9$$

$$i.) \quad \sigma_x = \frac{E}{(1-\nu^2)} (\epsilon_x + \nu \epsilon_y) \quad /$$

$$\sigma_x = \frac{163 \times 10^9}{(1-0.25^2)} (-12 \times 10^{-6} + 0.25 \times 16 \times 10^{-6}) \quad /$$

$$\sigma_x = \cancel{-1.39} - 1.39 \text{ MPa N/m}^2 \quad /$$

$$= \underline{\text{compressive}}$$

$$\sigma_y = \frac{E}{(1-\nu^2)} (\epsilon_y + \nu \epsilon_x)$$

$$\sigma_y = \frac{163 \times 10^9}{(1-0.25^2)} (16 \times 10^{-6} + 0.25 \times -12 \times 10^{-6}) \quad /$$

$$\sigma_y = 2.26 \text{ MPa N/m}^2 \quad /$$

$$= \underline{\text{Tensile}}$$

$$ii.) \quad \sigma_x = 25 \text{ MPa}, 25 \times 10^6$$

$$\sigma_y = -20 \text{ MPa}, -20 \times 10^6$$

$$\nu = 0.25$$

$$E = 163 \times 10^9$$

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

$$\epsilon_x = \frac{1}{163 \times 10^9} (25 \times 10^6 - 0.25 \times -20 \times 10^6) \quad /$$

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

$$\epsilon_x = 184.05 \times 10^{-6} \quad /$$

$$= 184.05 \mu\epsilon$$

$$\epsilon_y = \frac{1}{163 \times 10^9} (-20 \times 10^6 - 0.25 \times 25 \times 10^6) \quad /$$

$$\epsilon_y = -161.04$$

$$\epsilon_y = -161.04 \mu\epsilon. \quad /$$

Q2.)

$$L = 300 \text{ mm}, \text{ } \phi = 0.3 \text{ m}$$

$$P = 55 \text{ MPa}$$

$$E = 163 \times 10^9$$

$$\nu = 0.3$$

$$K = ? , 135.84 \times 10^9$$

i.)

$$K = \frac{E}{3(1-2\nu)}$$

$$K = \frac{163 \times 10^9}{3(1-2 \times 0.3)}$$

$$K = 135.84 \times 10^9$$

$$= 135.84 \text{ GPa MM}$$

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ii.)

$$K = \frac{\sigma}{\epsilon_V}$$

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

~~$$135.84 \times 10^9 \times \epsilon_V$$~~

$$\epsilon_V = \frac{-55 \text{ MPa}}{135.84 \times 10^9}$$

$$\epsilon_V = -404.88 \times 10^{-6}$$

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iii.)

$$\epsilon_V = \frac{\Delta V}{V} \quad \text{or} \quad \epsilon_V = \frac{\Delta V}{V} \times \frac{V}{V}$$

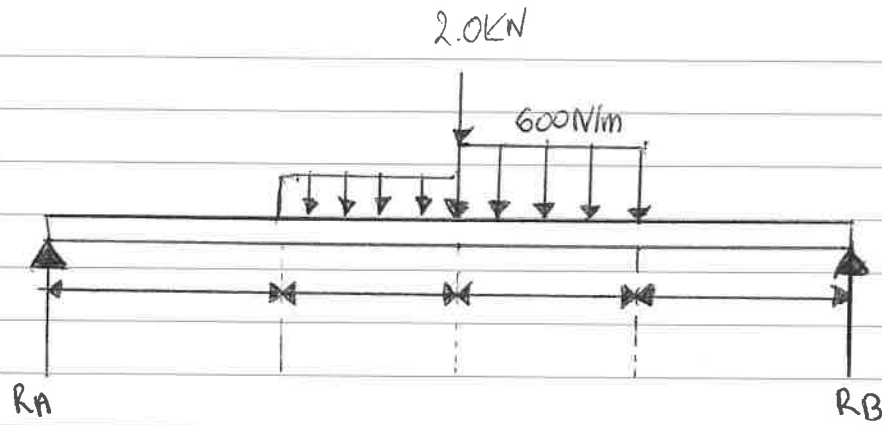
$$\Delta V = \epsilon_V \times V = -404.88 \times 10^{-6} \times$$

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$$\Delta V = \epsilon_v \times V = -404.88 \times 10^{-6} \times$$

- iii.) The term orthotropic material ~~anis~~ means the elastic contents are different in the x, y and z angles. ✓

Q3.)



$$R_a = 1312.4 \text{ N}$$

$$R_b = 1387.1 \text{ N}$$

$$i.) \quad = \frac{m}{I} = \frac{\sigma}{y}$$

$$ii.) \quad \text{slope} = \text{[Diagram of beam with point load]} + \text{[Diagram of beam with UDL]}$$

$$= \frac{FL^2}{16EI} + \frac{wl^3}{6EI}$$

$$iii.) \quad \text{deflection} = \frac{wl^4}{8EI}$$

$$iv.) \quad \frac{d^2y}{dx^2} = 1312.4(x) - \frac{100(x-0.5)^2}{2} - \frac{100(x-1.5)^2}{2} - 2000(x-1.5) - \frac{600(x-1.5)^2}{2} - 600(x-2.5) + 1387.1(x-3)$$

$$\frac{dy}{dx} = \frac{1312.4(x)^2}{2} - \frac{100(x-0.5)^3}{6} - \frac{100(x-1.5)^3}{6} - 2000(x-1.5)^2 - \frac{600(x-1.5)^3}{6} - \frac{600(x-2.5)^2}{2} + 1387.1(x-3)^2$$

$$+ 1387.1 \frac{(x-3)^2}{2}$$

Eg 3.)
$$\frac{1312.9 (x)^3}{6} - \frac{100(x-0.5)^4}{24} - \frac{100(x-1.5)^4}{24} - \frac{2000(x-1.5)^3}{6}$$
$$- \frac{600(x-1.5)^4}{24} - \frac{600(x-2.5)^3}{6} + \frac{1387.1(x-3.1)^3}{6} \quad \frac{1}{2} \quad \frac{1}{2}$$

V.)
$$\frac{FL^3}{48EI} = \frac{2K \times 3.1}{48 \times 1 \times 10^6} = 129.16 \times 10^{-6}$$
$$= 129.16 \mu E$$

Q4.)
 $d = 280 \text{ mm}, 0.28 \text{ m}$
 $L = 600 \text{ mm}, 0.6 \text{ m}$
 $n_L = 53\%, 0.55$
 $n_C = 65\%, 0.65$
 $P = 14.6 \times 10^5$
 $\sigma_{max} = 150 \times 10^6$

i.) Circumferential

$$\sigma_c = \frac{PD}{2t n_L}$$

$$\epsilon \times \frac{\sigma_c}{\sigma_c} = \frac{PD}{2t n_L} \times \frac{\epsilon}{\sigma_c}$$

$$\epsilon = \frac{PD}{2 \times \sigma_c \times n_L}$$

$$\epsilon = \frac{14.6 \times 10^5 \times 0.28}{(2 \times 150 \times 10^6 \times 0.55)}$$

$$\epsilon = 2.47 \text{ mm}$$

ii.) Longitudinal

$$\sigma_L = \frac{PD}{4t n_C}$$

$$\epsilon \times \frac{\sigma_L}{\sigma_L} = \frac{PD}{4t n_C} \times \frac{\epsilon}{\sigma_L}$$

$$\epsilon = \frac{PD}{2 \times \sigma_L \times n_C}$$

$$\epsilon = \frac{14.6 \times 10^5 \times 0.28}{2 \times 150 \times 10^6 \times 0.65}$$

$$\epsilon = 2.09 \text{ mm}$$

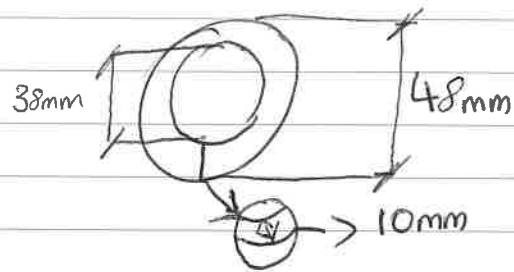
iii). minimum thickness
 $= 2.09 \text{ mm}$

$$t = 10 \text{ mm}$$

$$P = 145 \times 10^{-5}$$

Q5.) external $d = 48 \text{ mm}$
Internal $d = 38 \text{ mm}$

a.)



b.)

$$\sigma_r = a - \frac{b}{r^2} \quad 1/2 \quad \text{Correct eqn}$$

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c.)

$$\sigma_c = a + \frac{b}{r^2} \quad 1/2 \quad \text{Correct eqn}$$