

Date :- 30/04/2020

time :- 11:00

Module code :- Engineering Science M4X02192

Name :- Calum McGowan Franklin 1803213

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1. $\phi = 5m$

$l = 8m$

$k = 1.7 W/mK$

$h = 12 W/m^2K$

$Q =$

$x = 0.2m$

int temp = 341K

ext temp = 288K

Conduction

$$Q = \frac{-k A (T_2 - T_1)}{x}$$

$$A = \frac{\pi (5^2)}{4} \times 8$$

$$A = 157.08 m^2$$

~~$$Q = (-1.7)(157.08)(341 - 288)$$~~

$$Q = \frac{(-1.7)(157.08)(288 - 341)}{0.2}$$

$$Q = 70.76 \times 10^3 W$$

$Q = 70.76 kW$ - conduction

$$Q = h A (T_2 - T_1)$$

~~$$Q = (12)(157.08)(341 - 288)$$~~
$$Q = (12)(157.08)(341 - 288)$$

$$Q = 99.9 \times 10^3$$

$Q = 99.9 kW$ - convective

Total heat transfer is 170.66 kW

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2.)

$$\tau = 304 \times 10^6 \text{ N}$$

$$F = 165 \times 10^3 \text{ N}$$

$$A_s = \frac{F}{\tau} \quad / \quad A = \frac{165 \times 10^3}{304 \times 10^6}$$

$$\text{bolt } \varnothing = 0.012 \text{ m}$$

$$A_s = 542.76 \times 10^{-6} \text{ m}^2$$

$$A_b = \frac{\pi(0.012)^2}{4} \quad / \quad A_b = 1.13 \times 10^{-4} \text{ m}^2$$

$$\frac{542.76 \times 10^{-6}}{1.13 \times 10^{-4}} = 4.8$$

5 bolts needed

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3.)

$$G = 78 \times 10^9 \text{ N/m}^2$$

$$l = 0.14 \text{ m}$$

$$\theta =$$

$$T = 10 \text{ Nm}$$

$$S = 5 \times 10^{-3} \text{ m}$$

$$J = \frac{5\sqrt{3}}{8} \times S^4$$

$$\therefore J = 6.77 \times 10^{-10} \text{ m}^4$$

$$\frac{T}{J} = \frac{G\theta}{l} \quad / \quad \frac{Tl}{JG} = \theta \quad / \quad \frac{(10)(0.14)}{(6.77 \times 10^{-10})(78 \times 10^9)} = \theta$$

$$\theta = 0.027 \text{ radians}$$

$$\frac{0.027 \times 360}{2\pi} = 1.55^\circ$$

$$\theta = 0.02 \text{ radians}$$

$$0.02 \times \frac{360}{2\pi} = 1.15^\circ$$

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4.)

$$M = 6200 \text{ Nm}$$

$$B = 0.065 \text{ m}$$

$$E = 210 \times 10^9 \text{ N/m}^2$$

$$D = 0.11 \text{ m}$$

$$\sigma =$$

$$b = 0.04 \text{ m}$$

$$R =$$

$$d = 0.08 \text{ m}$$

$$I = \frac{(0.065)(0.11^3)}{12} - \frac{(0.04)(0.08^3)}{12}$$

$$I = 5.50 \times 10^{-6} \text{ m}^4$$

$$y = D/2 \therefore y = 0.11/2 \quad y = 0.055 \text{ m}$$

$$\frac{My}{I} = \sigma \quad \frac{(6200)(0.055)}{(5.50 \times 10^{-6})} = \sigma$$

$$\sigma = 62 \times 10^6 \text{ N/m}^2$$

$$\frac{M}{I} = \frac{E}{R} \quad R = \frac{EI}{M} \quad \frac{(210 \times 10^9)(5.50 \times 10^{-6})}{(6200)} = R$$

$$R = 186.29 \text{ m}$$