

30-04-20

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Question 1

$$D = 5m$$

$$H = 8m$$

$$h = 12 \text{ W/m}^2\text{K}$$

$$k = 1.7 \text{ W/mK}$$

$$T_2 = 68 + 273 = 341 \text{ K}$$

$$T_1 = 15 + 273 = 288 \text{ K}$$

$$\text{Thickness} = 200 \text{ mm} = 0.2 \text{ m}$$

$$Q = \frac{-kA(T_2 - T_1)}{x} = \frac{-1.7 \times (5 \times 8) (341 - 288)}{0.2} = 18.08 \times 10^3 \text{ W}$$

$$Q = hA(T_2 - T_1)$$

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Question 2.

Formulas

$$A = \frac{165 \times 10^3}{304 \times 10^{-6}} = \underline{542.76 \times 10^6 \text{ N}^2} \quad \gamma = \frac{F}{A}$$

$$A = \frac{\pi d^2}{4} \quad ?$$

$$A = \frac{F}{\gamma}$$

$$A = \frac{\pi d^2}{4}$$

1. $4A = \pi d^2$

2. $\frac{4A}{\pi} = d^2 \Rightarrow d = \sqrt{\frac{4A}{\pi}}$

$$d = \sqrt{\frac{4(542.76 \times 10^6)}{\pi}} = 26.28 \times 10^{-3} \text{ m}$$

$$\therefore \text{No of bolts} = \frac{d}{12 \times 10^{-3}} = \frac{26.28 \times 10^{-3}}{12 \times 10^{-3}}$$

$$= 2.19$$

$$\therefore = \underline{\underline{2 \text{ bolts}}}$$

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Question 3-

Formulas

$$\frac{\tau}{J} = \frac{T}{r} = \frac{G\theta}{L}$$

$$G = 78 \times 10^9 \text{ Pa}$$

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

$$L = 140 \text{ mm} = 0.14$$

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

$$J = 5 \sqrt{\frac{3}{8}} \times 0.005^4 = \underline{\underline{6.77 \times 10^{-10} \text{ m}^4}}$$

$$\theta = \frac{TL}{JG} = \frac{10 \times 0.14}{6.77 \times 10^{-10} \times 78 \times 10^9} = \underline{\underline{26.51 \times 10^{-3} \text{ rad}}}$$

$$26.51 \times 10^{-3} \times \frac{360}{2\pi} = \underline{\underline{1.52^\circ}}$$

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Question 4.

Formulas

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

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

$$E = 210 \times 10^9$$

$$y = \frac{D}{2} = \frac{110 \times 10^{-3}}{2} = \underline{\underline{0.055 \text{ m}}}$$

$$B = 65 \text{ mm} = 0.065 \text{ m}$$

$$I = \frac{BD^3}{12} - \frac{bd^3}{12}$$

$$D = 110 \text{ mm} = 0.11 \text{ m}$$

$$b = 40 \text{ mm} = 0.04 \text{ m}$$

$$d = 80 \text{ mm} = 0.08 \text{ m}$$

$$I = \frac{0.065 \times 0.11^3}{12} - \frac{0.04 \times 0.08^3}{12} = \underline{\underline{5.5 \times 10^{-6} \text{ m}^4}}$$

$$R = \frac{EI}{M} \Rightarrow \frac{210 \times 10^9 \times 5.5 \times 10^{-6}}{6200} = \underline{\underline{186.29 \text{ m}}}$$

$$\sigma = \frac{Ey}{R} \Rightarrow \frac{210 \times 10^9 \times 0.055}{186.29} = \underline{\underline{62 \times 10^6 \text{ N/m}^2}}$$