MEC 331 Assignment

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Assignment

Question 1.7:

Solution

$$\sum F_{(x)} = 0, \sum F_{(y)} = 0$$

$$F_{BD} - F_{CE} = -20$$

$\sum M_{(c)} = 0 \ (0.040)F_{BD} + (0.025 + 0.040)(20 \times 10^3) = 0$

$$F_{BD} = 32.5 \times 10^3.$$

This force is a Tension force

$\sum M_{(b)} = 0 \ -(0.040)F_{CE} - (0.025)(20 \times 10^3) = 0$

$$F_{BD} = -12.5 \times 10^3.$$

This force is a compression force
The area of link in tension $A = (0.008)(0.036 - 0.016) = 150 \times 10^{-5}$
For two parallel links, $A_t = 320 \times 10^{-6}$
the tensile stress in link AB
Link BD

$$\delta_{BD} = \frac{F_{BD}}{A} = \frac{32.5 \times 10^3}{320 \times 10^{-4}} = 101.56 \times 10^6 or 101.6MPa$$

The area of link in Compression $A_t = (0.008)(0.036) = 288 \times 10^{-6}$
For two parallel links, $A_c = 576 \times 10^{-6}$
the compressing stress in link CE
Link CE

$$\delta_{CE} = \frac{F_{CE}}{A} = \frac{-12.5 \times 10^3}{320 \times 10^{-4}} = -21.7 \times 10^6 or 21.7MPa$$

Question 1.26:

Solution

$$A = bt$$

where b = 50mm and t = 6mm

$$P = -\delta \times A = -(-140 \times 10^6)(50 \times 10^{-3} \times 6 \times 10^{-3}) = 42KN$$

Pin: $T_p = \frac{P}{A_p}$ and $A_p = \frac{\pi}{4}d^2$

- The diameter,d of the pins

$$d = \sqrt{\frac{4 \times A_p}{\pi}} = \sqrt{\frac{4 \times P}{\pi \times \tau_p}} = \sqrt{\frac{4 \times 42 \times 10^3}{\pi \times 80 \times 10^6}} = 0.025m$$

- The average Bearing stress in the link

$$\delta_b = \frac{P}{d \times t} = \frac{42 \times 10^3}{0.025 \times 0.006} = 280MPa$$

Question 1.11:

Solution

$$\sum M_a = 0, D_x = (45 + 30)(480) = 0$$

$$D_X = 900lb$$

Using Member DEF as a free body

$$\sum F = 0$$

$$\frac{3}{5}D_y - \frac{4}{5}D_x = 0$$

$$D_y = \frac{4}{5}D_x = 1200lb$$

Now Taking Moment at different points of the beam DEF,

$$\sum M_f = 0$$

$$-(30)(\frac{4}{5}F_{BE}) - (30 + 15)D_y = 0$$

$$F_{BE} = -2250lb$$

$$\sum M_E = 0$$

$$-(30)(\frac{4}{5}F_{CE}) - (15)D_y = 0$$

$$F_{BE} = 750lb$$

Area of member BE is A $= 2in \times 4in = 8in^2$

Area of the cross section which occurs at the pin is $A_{min} = (2)(4.0 - 0.5) = 7.0in^2$

$$\delta_{BE} = \frac{f_{BE}}{A} = \frac{-2250}{8} = -281psi$$

$$\delta_{CE} = \frac{f_{CE}}{A_{min}} = \frac{750}{7.0} = 107.1psi$$

Question 1.15:

Solution

$$\delta = \frac{p}{t \times L}$$

$$\delta = \frac{8 \times 10^3}{15 \times 10^{-3} \times 90 \times 10^{-3}} = 5.93MPa$$

Question 1.16:

Solution

$$F = 12KN = 12 \times 10^3 N$$

The average shear stress in the glue is 120 psi $\tau = 120psi$

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

$$A = \frac{F}{\tau} = \frac{5800}{120} = 48.333in^2$$

let L = length of glue Area and W = width = 4in

$$A = L \times W$$

$$l = \frac{A}{W} = \frac{48.333}{4} = 12.083in$$

L = $2L+$ gap = $(2 \times 12.08) + \frac{1}{4}$ = 24.42in

Question 1.17:

Solution

For Steel,

$$A_1 = \pi \times d \times t = \pi(0.6)(0.4) = 0.7540in^2$$

$$\tau_1 = \frac{P}{A_1}$$

$$P = A_1 \times \tau_1 = (0.7540)(18) = 13.57kips$$

for Aluminum

$$A_2 = \pi \times d \times t = \pi(1.6)(0.25) = 1.2566in^2$$

$$\tau_2 = \frac{P}{A_2}$$

$$P = \tau_2 \times A_2 = (1.2566)(10) = 12.57kips$$

Limiting value of P is the Smaller Value: P = 12.57kips

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Solution

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where b = 50mm and t = 6mm

$$P = -\delta \times A = -(-140 \times 10^6)(50 \times 10^{-3} \times 6 \times 10^{-3}) = 42KN$$

Pin: $T_p = \frac{P}{A_p}$ and $A_p = \frac{\pi}{4}d^2$

- The diameter,d of the pins

$$d = \sqrt{\frac{4 \times A_p}{\pi}} = \sqrt{\frac{4 \times P}{\pi \times \tau_p}} = \sqrt{\frac{4 \times 42 \times 10^3}{\pi \times 80 \times 10^6}} = 0.025m$$

- The average Bearing stress in the link

$$\delta_b = \frac{P}{d \times t} = \frac{42 \times 10^3}{0.025 \times 0.006} = 280MPa$$

Question 1.18:

Solution

Seven surfaces carry the total load P = 1200lb

Area

$$A = (7)(\frac{7}{8})d = \frac{49}{8}d$$

$$\tau = \frac{P}{A}$$

$$A = \frac{P}{\tau}$$

$$\frac{49}{8}d = \frac{1200}{120}$$

Therefore, d = 1.683in

Question 1.23:

Solution

- Maximun Average Normal Stress In the Wood

$$A_{net} = 1 \times (4 - \frac{5}{8}) = 3.375in^2$$

$$\delta = \frac{P}{A_{net}} = \frac{1500}{3.375} = 444.44psi$$

- Distance B from which the average shaering stress is 100psi onn the surface indicated by the dashed lines

$$\tau = \frac{P}{A} = \frac{P}{2 \times b \times t}$$

Makinig B the subject of the formualr

$$b = \frac{P}{2 \times t \times \tau} = \frac{1500}{2 \times 1 \times 100} = 7.5in$$

- Average Bearing Stress On the Wood

$$\delta = \frac{P}{A_b} = \frac{P}{d \times t} = \frac{1500}{1 \times \frac{5}{8}} = 2400psi$$