Name Attaullah khan

ID 7933

Section B

Subject MOS 2

Assignment 3

Semister 4th

# Question No 1

Given data:

Factor of Safety = 2

$E = 10.3 \times 10^6$ Psi

Length = 6 ft

$b = 3/4$ inch $\quad h = 2$ inch

one end hing and one end fix

So $L_e = 0.7L$

Req:

Safe central load

Sol:

$$P_{cr} = \frac{\pi^2 EI}{L_e^2}$$

$$P_{cr} = \frac{\pi^2 E A r^2}{L_e^2} \qquad I = Ar^2$$

(2)

Now $r = \sqrt{\frac{I}{A}}$

$$r = \sqrt{\frac{bh^3/12}{bh}}$$

$$= \sqrt{\frac{b^2}{12}}$$

$$= \frac{b}{2\sqrt{3}}$$

$$= \frac{3/4}{2\sqrt{3}}$$

$$= \frac{0.75}{3.46}$$

$r = 0.216$ inch

Now we will find crippling load

(8)

So

$$P_{cr} = \frac{\pi^2 EA}{(Le/r)^2}$$

$$= \frac{(\pi)^2 (10.3 \times 10^6)(1.5\ in)}{(0.7/r^*)^2}$$

$$P_{cr} = \frac{152.33}{54444.4}$$

$$P_{cr} = 2.7979 \times 10^3\ Psi$$

$$P_{cr} = 2.7979\ Ksi$$

$$\text{For safe} = \frac{P_{cr}}{\text{Factor of safety}}$$

$$= \frac{2.79}{2}$$

$$= 1.3989\ Ksi$$

Question No # 2

Given data:

Load = 20 kips = $2.4 \times 10^5$ psi

Length = 10 ft

$E = 29 \times 10^6$ psi

Req'd

length of each side.

Sol:

$$\frac{l_e}{r} = \sqrt{\frac{\pi^2 E}{0.8P}}$$

$$= \sqrt{\frac{\pi^2 \times 29 \times 10^6}{2.4 \times 10^5}}$$

$$\frac{l_e}{r} = \sqrt{1.19 \times 10^3}$$

$$\frac{l_e}{r} = 34.5$$

(6)

$$r = \frac{Le}{34.5}$$

$$r = \frac{10 \times 12}{34.5}$$

$$r = 3.4 \text{ inch}$$

9st method

$$r = \sqrt{\frac{b^2}{12}}$$

$$r^2 \times 12 = b^2$$

$$b^2 = (3.4)^2 \times 12$$

$$\sqrt{b^2} = \sqrt{138.72}$$

$$b = 11.77$$

(9)

2nd method :-

$$I = Ar^2$$

$$A = \frac{I}{r^2}$$

$$b = \frac{b^2}{12} / r^2$$

$$1 = \frac{b^2}{12r^2}$$

$$b^2 = 12r^2$$

$$b = 11.77$$

(7)

Question No = 3

Given:

load = 20 K.Ps = $2.4 \times 10^5$ Psi

Length = L = 10 ft

$E = 1.6 \times 10^6$ Psi

Required data

Length of each side = ?

Sol:

$$\frac{Le}{r} = \sqrt{\frac{\pi^2 E}{61}}$$

$$\frac{Le}{r} = \sqrt{\frac{(3.14)^2 \times (1.6) \times 10^6}{2.4 \times 10^5}}$$

$$\frac{Le}{r} = \sqrt{\frac{9.8596 \times 1.6 \times 10^6 \times 10^5}{2.4}}$$

$$\frac{Le}{r} = 8.107.$$

(7)
(8)

$$r = \frac{Le}{8.107}$$

$$r = \frac{10 \times 12}{8.107}$$

$$r = 14.802 \text{ inch}$$

1st method

$$r = \sqrt{\frac{b^2}{12}}$$

$$r^2 \times 12 = b^2$$

$$b^2 = (14.802) \times 12$$

$$\boxed{b = 51.275}$$

(9)

2nd method

$$I = Ar^2$$

$$A = \frac{I}{r^2}$$

$$h^2 = \frac{hr^2}{12} / r^2$$

$$I = \frac{h^2}{12r^2}$$

$$h^2 = 12r^2$$

$$\sqrt{h^2} = \sqrt{2629.190}$$

$$\boxed{h = 51.275}$$

Question No = 4

Given data

Column = 30mm x 45mm

$E = 200 \times 10^9$ Pa

$\sigma_P = 240 \times 10^6$ Pa

$L = 12m$

Factor of safety = 2.5

Req :

$L_{min} = ?$

$P_{saf} = ?$

Sol :

$$\sigma_P = \frac{E\pi^2}{(l_e/r)^2}$$

(11)

$$\frac{le}{r} = \sqrt{\frac{E\pi^2}{\sigma_p}}$$

$$\frac{le}{r} = \sqrt{\frac{(3.14)^2 \times 200 \times 10^9}{240 \times 10^6}}$$

$$\frac{le}{r} = 90.64$$

Now $r = \sqrt{\frac{D^2}{12}}$

$$r = \sqrt{\frac{(45)^2}{12}}$$

$$r = 12.99 \text{ mm}$$

Now $le = 90.64 \times 12.99$

$$le = 1177.44 \text{ mm}$$

Now For Pin hinge

12

$L = L_e$

$L_{mm} = 1177.44 m.$

Part (b)

$$P_{cr} = \frac{\pi^2 E A r^2}{L_e^2}$$

$$P_{cr} = \frac{\pi^2 (200 \times 10^9)(13950)(1249)^2}{12 \times 1000}$$

$$P_{cr} = 32.23 \text{ GN}$$

Now

$$P_{safe} = \frac{P_{cr}}{\text{factor of safety}}$$

$$P_{safe} = \frac{32.2343}{2.5}$$

$$\boxed{P_{safe} = 12.89 \text{ GN}}$$