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Assignment # 03

Subject :- MosII

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Given Data:

$l_e = 6ft$

$l_e = 0.7l$

$E = 10.3 \times 10^6$ psi

Factor of safety = 2

$b = 3/4$ in $h = 2$ in

Req:

Safe central load = P

Sol:

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

$$\therefore P_{cr} = \frac{\pi^2 EAr^2}{l_e^2} \rightarrow (1)$$

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

$$r = \sqrt{\frac{\frac{1}{12}bh^3}{bh}}$$

$$\therefore r = \sqrt{h^2/12}$$

$$r = b/2\sqrt{3}$$

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

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

$$\boxed{r = 0.216\ in}$$

Now

$$P_{cr} = \frac{\pi^2 E A}{(le/r)^2}$$

$$P_{cr} = \frac{(3.14)^2 (10.3\times10^6)(1.5\ in^2)}{\left(\frac{0.7\times1}{r}\right)^2}$$

$$= P_{cr} = \frac{9.8596\times15.45\times10^6}{\left(\frac{0.7\times72}{0.216}\right)^2}$$

$$= P_{cr} = \frac{152.33}{5444.4}$$

$$P_{cr} = 2.7979\times10^{-3}\ psi$$

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

For P_{safe}:

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

$$P_{safe} = \frac{2.7979}{2}$$

$$\boxed{P_{safe} = 1.3989\ ksi}$$

pb # 02

Given data:

load = 20 kips = 2.4×10^5 psi

length $l = 10$ ft

$E = 29 \times 10^6$ psi

req:

length of each side = ?

sol:

As we know that

$$\frac{le}{r} = \sqrt{\frac{\pi^2 E}{\sigma_p}} \Rightarrow le/r = \sqrt{\frac{(3.14) \times (29 \times 10^6)}{2.4 \times 10^5}}$$

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

$$le/r = 34.5$$

$$r = le/34.5$$

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

$$r = 120/34.5$$

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

1st method :-

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

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

$$b^2 = (9.4)^2 \times 12$$

$$b^2 = 138.72$$

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

$$b = 11.77$$

2nd method

$$I/A = Ar^2$$

$$A = I/r^2$$

$$b^2 = b^4/12 / r^2$$

$$1 = b^2/12r^2$$

$$b = 12r^2$$

$$b = 11.77$$

(5)

Q3:

Given data

load = 20 kips = 2.4×10^5 psi

length = l = 10 ft

$E = 1.6 \times 10^6$ psi

Req:

length of each cable = ?

Sol:

As we know that

$$le/r = \sqrt{\frac{\pi^2 E}{6P}}$$

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

$$le/r = \sqrt{\frac{9.8596 \times 1.6 \times 10^{-5}}{2.4}}$$

$$le/r = \sqrt{65.730}$$

$$le/r = 8.107$$

$$r = le/8.107$$

$$r = 10 \times 12/8.107$$

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$r = 14.802$ inch

1st method

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

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

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

$b^2 = 2629.190$

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

$b = 51.275$

2nd method

$I = Ar^2$

$A = I/r^2$

$A^2 = \frac{b^4}{12} / r^2$

$I = A^2/12r^2$

$A^2 = 12r^2$

$A^2 = 2629.190$

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

$A = 51.275$

Q=04

Given data:

Column = 36mm × 45mm

$E = 200 \times 10^9$ Pa

$G_P = 240 \times 10^6$ Pa

L = 12m

Factor of safety = 2.5

To find: (a) q = l/min = ?

(b) P safe = ?

Sol:

As we know that

$$G_P = \frac{E\lambda^2}{(l_e/r)^2}$$

$$l_e/r = \sqrt{\frac{E\lambda^2}{G_P}}$$

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

$$l_e/r = 90.64$$

Now $r = \sqrt{b^2/12}$

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

$$r = 12.99\,mm$$

Now

$$le = 90.64 \times 12.99$$

$$le = 1177.44\,mm$$

Now ~~factor~~ for pin Hinge

$$L = le$$

$$l_{mm} = 1177.44\,mm$$

(part A)

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

$$P_{cr} = \frac{(3.14)^2 (200 \times 10^9)(19950)(12.99)^2}{(12 \times 1000)^2}$$

$$P_{cr} = 32.2243\,KN$$

Now

For $P_{safe} = ?$

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

(9)

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

$$P_{safe} = 12.8937 \text{ GN}.$$