NAME:

MUHAMMAD ILYAS

ID :

ID 7956

SECTION:

"B"

SUBJECT :

MOS: 2

SEMESTER:

4th

PROBLEM : 01

Given data:

$$Le = 6\,ft$$

$$E = 10.3 \times 10^6\ Psi$$

Factor of safety = 2

$$b = 3/4\ in$$

$$h = 2in$$

Required;

Safe central load = ?

Solution:

$$P_{cr} = \frac{\pi^2 E I}{Le^2}$$

$$P_{cr} = \frac{\pi^2 E A r^2}{Le^2} \quad \text{— eq (i)}$$

Now;

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

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

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

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

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

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

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

Now

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

$$P_{cr} = \frac{(3.14)(10.3 \times 10^6)(1.5 \text{ in}^2)}{\left(\frac{0.7 \times l}{r}\right)^2}$$

$$P_{cr} = \frac{9.8596 \times 15.45 \times 10^6}{\left(\frac{0.7 \times 72}{0.216}\right)^2}$$

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

$$P_{cr} = 2.798 \times 10^{3} \ Psi$$

$$P_{cr} = 2.798 \ ksi$$

For P_{safe}:

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

$$P_{safe} = \frac{2.798}{2}$$

$$\boxed{P_{safe} = 1.3984 \ ksi}$$

PROBLEM # 02

Given data;

Load = 20 kips = 2.4×10^5 psi

Length = L = 10 ft

$E = 29 \times 10^6$ psi

Required;

Length of each side =?

Solution:

As we know that

$$Le/r = \frac{\pi^2 E}{\sigma_p}$$

$$Le/r = \frac{(3.14)^2 \times (29 \cdot 10^6)}{2.4 \times 10^5}$$

$$Le/r = 1.19 \times 10^3$$

$$Le/r = 34.5$$

$$r = Le/34.5$$

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

$$r = \frac{120}{34.5}$$

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

Now

1st

$$r = b^2/12$$

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

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

$$\boxed{b = 12.04 \text{ in}}$$

2nd

$$I = Ar^2$$

$$A = I/r^2$$

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

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

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

$$\boxed{h = 11.77}$$

PROBLEM # 04

Given data:

Column = 310 x 45mm

$E = 200 \times 10^9 \, Pa$

$\sigma_f = 240 \times 10^6 \, Pa$

$L = 12m$

Factor of safety = 2.5

Required;

a) $L_{min} = ?$

b) $P_{safe} = ?$

Solution;

As we know that

$$\sigma_p = \frac{E \pi^2}{(L_e/r)^2}$$

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

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

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

Now

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

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

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

Now

$$Le = 90.64 \times 12.99$$

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

Now for pin hinge

$$L = Le$$

$$\boxed{L_{min} = 1177.44 \text{ mm}}$$

Part b;

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

$$P_{cr} = \frac{(3.14)^2 (200 \times 10^9)(13950)(12.99)^2}{(12 \times 1000)^2}$$

$$P_{cr} = 32.323 \text{ G.N}$$

Now

For P_{safe}

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

$$P_{safe} = \frac{32.323 \text{ G.N}}{2.5}$$

$$\boxed{P_{safe} = 12.92 \text{ G.N}}$$