Mechanics of Solid

Name :- Afrasiyab

ID :- 7899

Sec :- A

Assignment :- 2.

Date :- 15/6/2020.

QNo 1

Given data

$L_e = 6\,ft$ $\qquad L = 0.7L$

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

Factor of safety = 2

$b = 3/4$ inch, $h = 2$ inch

* Condition :- One End is fixed while other ~~the~~ is fixed.

So $L_e = 0.7L$

Required data :- Safe Centroload ?

Solution :- $P_{cr} = \dfrac{\pi^2 E I}{L_e^2}$

$P_{e_1} = \dfrac{\pi^2 E A r^2}{L_e^2}$ $\quad (As\ I = Ar^2)$

(2)

Now As $I = Ar^2$

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

So

$$r = \sqrt{\frac{hb^3}{12 / bh}} = \sqrt{\frac{b^2}{12}}$$

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

$$r = \frac{3/4}{2\sqrt{3}} \Rightarrow \frac{0.75}{3.46}$$

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

Now we find Crippling load

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

$$= \frac{(3.14)^2 (10.3 \times 10^6)(1.5\ in^2)}{(0.7\ L/r)^2}$$

$$Per \Rightarrow \frac{152.33}{54444.4}$$

$$\boxed{Per = 2.7979\ ksi}$$

For Safe Load

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

putting values.

$$\boxed{P_{safe} = 1.0989\ ksi}$$

Ans.

Q No. 2

Given data :

Column = 310 mm × 45 mm

$E = 200 \times 10^9$ Pa

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

Factor of safety = 2.5.

Required :

a) L mm = ?

b) P safe ?

Solution :

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

$$\frac{L_e}{\gamma} = \sqrt{\frac{E\pi^2}{\sigma}}$$

(5)

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

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

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

$$r = \sqrt{\frac{48^2}{12}}$$

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

Now $Le = 90.64 \times 12.99$

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

a)

* Now for hinge pin (6)

$$L = Le$$

$$\boxed{L_{mm} = 1177.44m}$$

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

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

$$P_{cr} = 32.23434N$$

Now ~~factor~~ P safe ?

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

$$P_{safe} = \frac{32.2343\ GN}{2.3}$$

$$\boxed{P_{safe} = 12.8937\ N}$$

Ans.

Q NO 3

Given data

Load = 20 kips = 2.4×10^5 psi

Length = L = 10 ft.

$E = 1.6 \times 10^6$ psi

Required data

Length of Each side ?

Solution:

As we know that

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

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

$$\boxed{\frac{L_e}{r} = 8.107}$$

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

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

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

USA Method.

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

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

$$b^2 = 2629.190$$

(taking square root.)

$$\boxed{b = 51.275'}$$

Ans

~~2nd panel~~

(10)

Q No 4

Given data

Column = 310 mm x 45 mm

$E = 200 \times 10^9$ Pa

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

$L = 12$ m

Factor of safety = 2.5

Required

a) L_{min} ?

b) P_{safe} ?

Solution:

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

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

putting value

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

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

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

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

Now $Le = 90.64 \times 12.99$

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

(part b)

$$Per = \frac{\pi^2 E A r^2}{Le^2} \quad (*)$$

putting values in (*) we get.

putting.

$$P_{cr} = 32.2343 \text{ GN}$$

Now

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

$$\Rightarrow \frac{32.2343}{2.5} \text{ GN}$$

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