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Section B

Fourth Semester

Subject ⇒ MOS II

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Problem No # 1106

Two C 310 x 45 channel are littaced togather so They have equal moments of inertia about the principle axes. Determine the manimum length of a Column having this section assuming Pinned ends. E = 200 GPa. and and A proportional limit as 240 Mpa. what will be the safe Load of Column. length carry 12 m with a factor of safty 2.5?

Sol:→ Given data.

$E = 200\ GPa \Rightarrow 200 \times 10^9 pa.$

$\sigma = 240\ Mpa$

$L = 12m = 12000\ mm$

Facter of safty = 2.5

Pinned ends $L_e = L$

(2)

⇒ C 310 × 45 → From The Table we have

Area = 5690 mm^2

Depth = 305 mm

width = 80 mm

Thickness = 12.7 mm

So

$$\frac{P}{A} = \frac{E\pi^2}{\left(\frac{Le}{r}\right)^2} \Rightarrow \frac{Le}{r} = \sqrt{\frac{E\pi^2}{P/A}} = \sqrt{\frac{E\pi^2}{\sigma_P}}$$

$$\frac{Le}{r} = \sqrt{\frac{\pi^2(200 * 10^9)}{240 * 10^6}} = 90.69$$

$r = 109$ → From Table

So $L = r * \frac{Le}{r}$

$L = 109 * 90.64$

$L = 9879.64$ m

$\boxed{L = 9.89\text{ m}}$

(3)

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

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

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

Now we can find P-safe.

So we have formula.

$$P_{safe} = \frac{P_{critical}}{\text{Facter of safty}}$$

$$P_{safe} = \frac{32.2343}{2.5} = 12.89 \text{ GN}$$

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

problem No # 1103

Solution :→

Given Data =

Factor of Safty = 2

$E = 10.3 \times 10^6$ psi

length = 6 ft = 6 * 12 = 72 in

⇒ Support Conditions

one End Hinged and End Fixed.

So $le = 0.7l$

Required :

Safe Central Load = ?

Solution :-

$$P_{rc} = \frac{\pi^2 EI}{le^2}$$

$$P_{cr} = \frac{\pi^2 EAr^2}{le^2} \quad \text{—— (1)} \quad \because I = Ar^2$$

(3)

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

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

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

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

Now we find $P_{critical} = ?$

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

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

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

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

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

(b)

For $P_{safe} = \dfrac{P_{cr}}{\text{Factor of safty}}$

$P_{sf} = \dfrac{2.7979}{2} = 1.398 \text{ Ksi}$

$$\boxed{P_{safe} = 1.398 \text{ Ksi}}$$

XXX

Problem No # 1104.

Solution :→

Given data.

Load = 20 kips ⇒ 2.4×10^5 psi

Length L = 10 ft

$E = 29 \times 10^6$ psi

Required length of Each Bar = ?

So

As we know that

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

$$\frac{Le}{r} = \sqrt{\frac{(3.14)^2 (29 \times 10^9)}{2.4 \times 10^5}}$$

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

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

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

$$r = \frac{10 \times 12}{34.5} = \frac{120}{34.5} = 3.4 \text{ inch}$$

Now

$$\frac{Le}{r} = \sqrt{\frac{E\pi^2}{P/A}}$$ → Required A from this

(8)

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

$$34.5 = \sqrt{\frac{29\times10^9 (3.14)^2}{\frac{2.4\times10^5}{A}}}$$

$$34.5 = \frac{\sqrt{29\times10^9 (3.14)^2}}{\frac{\sqrt{2.4\times10^5}}{\sqrt{A}}}$$

$$34.5 = \frac{\sqrt{29\times10^9 (3.14)^2}\cdot\sqrt{A}}{\sqrt{2.4\times10^5}}$$

$$\frac{34.5 * \sqrt{2.4\times10^5}}{\sqrt{29\times10^9 (3.14)^2}} = \sqrt{A}$$

$$\sqrt{A} = \frac{34.5 * \sqrt{2.4\times10^5}}{\sqrt{29\times10^9 (3.14)^2}}$$

$$(\sqrt{A})^2 = (0.0316)^2$$

$$A = 9.99\times10^{-4}\ in^2$$

But sid is Rounded

(9)

$$\frac{1}{4}\pi d^2 = A$$

$$\frac{1}{4}\pi d^2 = 9.99 \times 10^{-4}$$

$$\sqrt{d^2} = \sqrt{\frac{9.99 \times 10^{-4}}{\frac{1}{4}\pi}}$$

$$d = \sqrt{\frac{9.99 \times 10^{-4}}{\frac{1}{4}\pi}}$$

$$\boxed{d = 0.356}$$

Problem # 1105

Sol ⇒ Load = 20 kips.

⇒ 2.4×10^5 psi

$L = 10$ ft

(10)

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

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

$$\frac{L_e}{r} = 8.10$$

$$r = \frac{L_e}{8.10}$$

$$r = \frac{10 \times 12}{8.10} = \frac{120}{8.10}$$

$$r = 14.81$$

$$\frac{L_e}{r} = 8.10$$

$$8.10 = \sqrt{\frac{\frac{(1.6 \times 10^3)(3.14)^2}{2.4 \times 10^5}}{A}}$$

(11)

B $8.10 = \sqrt{\frac{(1.6\times10^6)(3.14)^2}{\frac{\sqrt{2.4\times10^5}}{\sqrt{A}}}}$

$$\sqrt{A} = \frac{8.10\sqrt{2.4\times10^5}}{\sqrt{(1.6\times10^6)(3.14)^2}}$$

$$(\sqrt{A})^2 = (0.999)^2$$

$$A = 0.998$$

$$A = \frac{1}{4}\pi d^2$$

$$0.998 = \frac{1}{4}\pi d^2$$

$$\sqrt{d^2} = \sqrt{\frac{0.998}{\frac{1}{4}\pi}}$$

$$\boxed{d = 1.12 \text{ in}}$$