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Section "B"

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Subject: MOS II

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Problem NO# 1106

TWO C 310 X 45 channel are Welded together so They have equal moments of inertia about the principle axies. Determine the momentum length of a Column having this Section assuming pinned ends. E 200 GPa. and A Proprtinal limit as. 240 mpa. what will be the safe load of Column. length carry 12m with a factor of sefty 2.5?

Solution: Given Data.

$E = 200\ GPa \Rightarrow 200 \times 10^9\ Pa$

$6 = 240\ MPa$

$L = 12m = 12000mm$

facter of Safty = 2.5

Pinned ended $Le = L$

$\Rightarrow$ C 310 X 45 $\rightarrow$ From The Table we have

$$Area = 5690\ mm^2$$

$$Depth = 305\ mm$$

$$width = 80\ mm$$

$$Thickness = 12.7\ mm$$

So

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

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

$r = 109 \rightarrow$ from Table

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

$$L = 109 * 90.64$$

$$L = 9879.64\ m$$

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

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

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

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

Now we can find $P \longrightarrow$ safe

So we have formula.

$$P_{safe} = \frac{P\ critical}{facter\ of\ safty}$$

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

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

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 one End fixed.

So $Le = 0.7L$

Required :→

Safe Centred Load →?

Solution :→

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

$$P_{cr} = \frac{\pi^2 E A r^2}{Le^2} \quad \text{— (1)} \quad \therefore I = Ar^2$$

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

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

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

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

New we find $P_{critical} = ?$

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

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

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

$$P_{cr} = 2.7975 \times 10^3 psi$$

$$P_{cr} = 2.7975 ksi$$

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

$$P_{saf} = \frac{2.7979}{2} = 1.3.98 \text{ ksi}$$

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

Problem No# 1104

Solution:.

Given Data:

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

length L = 10 ft

$E = 29 \times 10^9$ 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

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

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

$$34.5 = \frac{\sqrt{\frac{29 \times 10^9 (3.14)^2}{2.4 \times 10^5}}}{\sqrt{A}}$$

$$34.5 = \frac{\sqrt{29 \times 10^9 (3.14)^2}}{\frac{\sqrt{2.4 \times 10^5}}{\sqrt{A}}}$$

$$34.5 = \frac{\sqrt{29 \times 10^9 (3.14)^2} \cdot \sqrt{A}}{\sqrt{2.4 \times 10^5}}$$

$$\frac{34.5 * \sqrt{2.4 * 10^5}}{29 * 10^9 (3.14)^2} = \sqrt{A}$$

$$\sqrt{A} = \frac{34.5 * \sqrt{2.4 * 10^5}}{\sqrt{29 * 10^9 (3.14)^2}}$$

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

$$A = 9.99 \times 10^{-4} \text{ in}^2$$

But sid is Roundeel.

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

$$\frac{1}{4}\pi d^2 = 9.88 \times 10^{-4}$$

$$\sqrt{a^2} = \sqrt{\frac{9.88 \times 10^{-4}}{\frac{1}{4}\pi}}$$

$$d = \sqrt{\frac{9.88 \times 10^{-4}}{\frac{1}{4}\pi}}$$

$$d = 0.356$$

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problem # 1105

Solution $\therefore$ Load $= 20$ kips.

$$= 2.4 \times 10^5 \text{ psi}$$

$$L = 10 \text{ ft}$$

(10)

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

$$\frac{le}{r} = \sqrt{\frac{(3.14)^2 (11.6 \times 10^6)}{2.4 \times 10^5}}$$

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

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

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

$$r = 14.81$$

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

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

(11)

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

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

$$(\sqrt{A})^{2} = (0.995)^{2}$$

$$A = 0.998$$

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

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

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

$$d = 1.12\,in$$