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SUBJECT :~ MOS II

ASSIGNMENT

QUESTION NO 1

GIVEN

$E = 10.3 \times 10^6$ Psi

Length = 6ft

b = 3/4 inch, h = 2 inch

Factor of safety = 2

SOLUTION :-

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

$$P_{cr} = \frac{\pi^2 E A r^2}{L_e^2} \quad \text{--- (i)}$$

where as $I = Ar^2$

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

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

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

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

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

$$= \frac{0.75}{3.76}$$

$$\therefore \gamma = 0.216 \text{ in}$$

Now, we will find Crippling load

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

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

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

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

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

For P_{safe}

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

$$P_{safe} = \frac{2.7929}{2}$$

$$P_{safe} = 1.3989 \quad \text{Ans}$$

Question No 02

Given that :-

load = 20 kips
length = L = 10 ft
$E = 29.10^6$ psi

Solution :-

As we know that

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

$$\frac{Le}{r} = \sqrt{\frac{(3.14)^2 \times (29 \times 10^6)}{24 \times 10^5}}$$

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

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

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

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

$$r = \frac{120}{34.8}$$

1ST METHOD :-

$$r = \sqrt{\frac{b^2}{12}}$$ after taking under root

$$r^2 * 12 \propto b^2$$

$$b^2 = (3.14)^2 \propto 12$$

$$b^2 = 138.72$$

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

$$b = 11.77$$

2ND Melthad :-

$$I = Ar^2$$

$$A = \frac{I}{r^2}$$

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

$$1 = \frac{h^2}{12r^2}$$

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

$$h = 11.77$$

QUESTION NO 03

GIVEN THAT :-

Load = 20 kips = 2.4×10^5 psi

length = L = 10 ft

E = 1.6×10^6 psi

SOL :-

As we know that

$$\frac{Le}{\gamma} = \sqrt{\frac{\pi^2 E}{6P}}$$

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

$$\frac{Le}{\gamma} = \sqrt{\frac{9.8596 \times 1.6 \times 10^6 \times 10^{-5}}{2.4}}$$

$$\frac{Le}{\gamma} = \sqrt{6.5730}$$

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

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

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

$$\gamma = \frac{120}{8.167}$$

$$\gamma = 14.802 \text{ inch}$$

METHOD 01 :-

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

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

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

$$b^2 = 2629.190$$

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

$$b = 51.275$$

METHOD #02 :-

$$I = Ar^2$$

$$A = \frac{I}{r^2}$$

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

$$1 = \frac{h^2}{12r^2}$$

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

$$h^2 = 2629.19$$

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

$$h = 51.275$$

QUESTION NO 04

GIVEN THAT :-

Column = 36 mm × 45

$E = 200 \times 10^9$ Pa

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

Factor of safety = 2.5

SOLUTION :-

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

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

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

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

NOW

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

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

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

Now

$l_e = 90.64 \times 12.99$

$l_e = 1177.44 \text{ mm}$

Now for pin Hinge

$L = l_e$

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

2nd Part :-

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

$$P_{cr} = \frac{(3.14)^2 (200 \times 10^9)(183950)(12.99)^2}{(12 \times 1000)}$$

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

Now

For $P_{safe} \Rightarrow$

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

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

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