Given that

Factor of Safety : 2

$E = 10.3 \times 10$ psi

length = 6 ft

b = 3/4 inch , h > 2 inch

Condition

→ one end hinged & one end fixed

So

$$l_e = 0.7L$$

Required,

$$\text{Per} \quad \frac{\pi^2 E I}{L_e^2}$$

$$\text{Per} \quad \frac{\pi^2 E A r^2}{L_e^2} \quad \therefore I = Ar^2$$

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

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

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

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

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

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

To find crippling load,

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

$$= \frac{(3.14)^2 (10.3 \times 10^6)(1.5 \sin^2)}{(0.7LN)^2}$$

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

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

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

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

for P_{safe}

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

$$P_{safe} = \frac{2.7979}{2}$$

$$= 1.3988 \text{ KSi}$$

No2:

Given data

$L = 310mm \times 45mm$

$E = 200 \times 10^9 Pa$

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

$C = 12m$

Factor of Safty = 2.5

Required:

$L_{mm} = ?$

$P_{safe} = ?$

Solution:

As we know that

$$\sigma_P = \frac{F \pi^2}{(l_e/r)^2}$$

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

$$\frac{l_e}{r} = \sqrt{\frac{(3.14)^2 \times (200 \times 10^3)}{240 \times 10^3}}$$

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

Now

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

$$r = \sqrt{\frac{(45)^2}{12}} \Rightarrow \boxed{r = 12.99mm}$$

Part B =

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

$$P_{cr} = \frac{3.14^2 (200 \times 10^9)(1950)(12.99)^2}{(12 \times 1000)^2}$$

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

For P_{safe}

$$\frac{P_{cr}}{\text{Factor of Safety}}.$$

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

$$\boxed{P_S = 12.8937 \text{ GN}.}$$