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ASSIGNMENT: → MOS II

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①

Date: \_\_\_\_\_

Q 1

GIVEN DATA :-

$$l_e = 6 \text{ ft}$$

$$l_e = 0.7L$$

$$E = 10.3 \times 10^6 \text{ psi}$$

factor of safety = 2

REQ: -

$$b = 3/4 \text{ in}, h = 2 \text{ in}$$

safe central load = ?

Sol: -

$$P_{cr} = \frac{\pi^2 EI}{l_e^2}$$

$$P_{cr} = \frac{\pi^2 EA \delta^2}{l_e} \rightarrow \text{①}$$

Now

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

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

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

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

$$\delta = \frac{0.75}{3.46}$$

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

Now

$$P_{cr} = \frac{\pi^2 EA}{(l_e/\delta)^2}$$

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Date:

$$P_{cr} = \frac{\pi^2 EA}{(l/\gamma)^2}$$

$$P_{cr} = \frac{(3.14)^2 (10.3 \times 10^6) (1.5 \text{ in}^2)}{\left(\frac{0.17 \times 6}{\gamma}\right)^2}$$

$$P_{cr} = \frac{9.8596 \times 15.45 \times 10^6}{\left(\frac{0.17 \times 72}{0.216}\right)^2}$$

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

$$\frac{l_e}{\gamma} = 90.64$$

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 h/ye

$$l = l_e$$

$\Rightarrow$

$$l_{min} = 1177.44 \text{ mm}$$

Date: \_\_\_\_\_

Q4

GIVEN DATA: -

Column = 310mm x 45mm

$E = 200 \times 10^9 \text{ Pa}$

$GP = 240 \times 10^6 \text{ Pa}$

$L = 12 \text{ m}$

factor of safety = 2.5

REQ: -

a)  $L_{lim} = ?$

b)  $P_{safe} = ?$

Sol: -

As we know that

$$GP = \frac{E \pi^2}{(le/r)^2}$$

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

Part b

$$P_{cr} = \frac{\pi^2 E A Y^2}{le^2}$$

$$P_{cr} = \frac{(3.14)^2 (200 \times 10^9) (13950) (12.99)^3}{(12 \times 1000)^2}$$

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

Now

for safe:

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



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Date: \_\_\_\_\_

$$P_{safe} = \frac{32,2343 \text{ GN}}{2.5}$$

$$P_{safe} = 12,8937 \text{ GN}$$

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

$$P_{cr} = 2,7979 \times 10^3 \text{ Psi}$$

$$P_{cr} = 2,7979 \text{ ksi}$$

for  $P_{safe}$ :

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

$$P_{safe} = \frac{2,7979}{2}$$

$$P_{safe} = 1,3989 \text{ ksi}$$

(5)

Date: \_\_\_\_\_

Q2

GIVEN DATA: →

$$\text{load} = 20 \text{ kips} = 2.4 \times 10^5 \text{ psi}$$

$$\text{length} = l = 10 \text{ ft}$$

$$E = 29 \times 10^6 \text{ psi}$$

REQ: →

$$\text{length of each side} = l$$

Sol: →

As we know that

$$\frac{l_e}{\delta} = \sqrt{\frac{\pi^2 E}{6}}$$

$$\frac{l_e}{\delta} = \sqrt{\frac{(3.14)^2 (29 \times 10^6)}{2.4 \times 10^5}}$$

$$\frac{l_e}{\delta} = 34.5$$

$$\delta = \frac{l_e}{34.5}$$

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

$$\delta = \frac{120}{34.5}$$

$$\delta = 3.4 \text{ inch}$$

Date: \_\_\_\_\_

1<sup>st</sup> method :-

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

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

$$b^2 = (3.4)^2 \times 12$$

$$b^2 = 138.72$$

$$\sqrt{b^2} = \sqrt{138.72}$$

$$b = 11.77$$

2<sup>nd</sup> method

$$I = A r^2$$

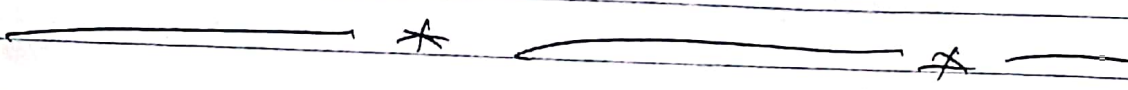
$$A = \frac{I}{r^2}$$

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

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

$$h^2 = 12 r^3$$

$$h = 11.77$$



Date: \_\_\_\_\_

Qs :-

GIVEN DATA :-

$$\text{load} = 20 \text{ kips} = 2.4 \times 10^5 \text{ lbs}$$

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

$$E = 1.6 \times 10^6 \text{ psi}$$

REQ:-

length of each side = ?

sol:-

As we know that

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

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

$$\frac{le}{\gamma} = \sqrt{\frac{9.856 \times 1.6 \times 10^6 \times 10^{-5}}{2.4}}$$

$$= \sqrt{65.730}$$

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

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

$$\gamma = \frac{120}{8.107}$$

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



Date: \_\_\_\_\_

1st Method :-

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

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

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

$$b^2 = 2629.190$$

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

$$b = 51.275$$

2nd Method :-

$$I = A r^2$$

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

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

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

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

$$h^2 = 2629.190$$

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

$$h = 51.275$$