ASSIGNMENT I

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DEPARTMENT : BE (civil)

SECTION : "B"

SUBJECT : MOS II

INSTRUCTOR : SIR SAQIB.

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QUESTION No.1

GIVEN DATA:

$L = 6ft$

$E = 10.3 \times 10^6 Psi$

Factor of Safety = 2

$b = 3/4''$, $h = 2''$

$Le = 0.7L$

REQUIRED DATA:

Safe central load = ?

SOLUTION:

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

$$\Rightarrow P_{cr} = \frac{\pi^2 EAr^2}{Le^2} \quad \text{—①}$$

Now

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

$$\Rightarrow r = \sqrt{\frac{kb^3/12}{bk}}$$

$$\Rightarrow r = \sqrt{b^2/12}$$

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

$$\Rightarrow r = \frac{0.75}{3.46}$$

$$\Rightarrow \boxed{r = 0.216''}$$

Now

$$P_{cr} = \frac{\pi^2 E A}{(l_e/r)^2}$$

$$\Rightarrow P_{cr} = \frac{(3.14)^2 (16.3 \times 10^6)(1.5 in^4)}{\left(\frac{0.7 \times l}{r}\right)^2}$$

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

$$\Rightarrow P_{cr} = \frac{152.33 \times 10^6}{54444.4}$$

$$\Rightarrow \boxed{P_{cr} = 2.7979 K lb}$$

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(3)

For Safe:

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

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

$$\Rightarrow \boxed{P_{safe} = 1.3989 \text{ K lb}}$$

QUESTION No.2

GIVEN DATA:

Load = 20 KiPs = 2.4×10^5 Psi

Length = L = 10ft

$E = 29.10^6$ Psi

REQUIRED DATA:

Length of each side = ?

(4)

Solution:

As we know that
The Section beam is square.

Now

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

$$\Rightarrow le/\gamma = \sqrt{\frac{(3.14)^2 \times (29 \times 10^6)}{2.4 \times 10^5}}$$

$$\Rightarrow le/\gamma = \sqrt{119 \times 10^3}$$

$$\Rightarrow le/\gamma = 34.5$$

$$\Rightarrow \gamma = le/34.5$$

$$\Rightarrow \gamma = \frac{10 \times 12}{34.5}$$

$$\Rightarrow \boxed{\gamma = 3.4 \text{ inch}}$$

Now we know that

$$I = A\gamma^2$$

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7954

(5)

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

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

$$\Rightarrow 1 = \frac{b^2}{12 r^2}$$

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

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

$$\Rightarrow \boxed{b = 11.77 \text{ inch}}$$

As the beam is square so both sides will be 11.77 inch.

QUESTION No. 3.

GIVEN DATA:

Load, $P = 60 \text{ kips} = 2.4 \times 10^5 \text{ Psi}$

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⑥

length, $L = 10ft$

$E = 1.6 \times 10^6$ Psi

REQUIRED DATA:

length of both sides = ?

SOLUTION:

As we know that the beam is square.

So

$$Le/r = \sqrt{\frac{\lambda^2 E}{6P}}$$

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

$$\Rightarrow Le/r = 8.1074$$

$$\Rightarrow r = \frac{10 \times 12}{8.1074}$$

$$\Rightarrow \boxed{r = 14.80 \text{ inch}}$$

Now

$$I = Ar^2$$

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

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

$$\Rightarrow h^2 = 12r^2$$

$$\Rightarrow h^2 = 12 \times (14.80)^2$$

$$\Rightarrow \boxed{h = 51.27 \text{ inch}}$$

As the beam is square so both side is 51.27 inches.

QUESTION No. 4

GIVEN DATA:

Column = 310 mm x 45 mm

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(8)

$E = 200 \times 10^9$ Pa

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

$L = 12$ m

Factor of safety = 2.5

REQUIRED DATA:

(a) $L_{min} = ?$

(b) $P_{safe} = ?$

SOLUTIONS:

PART (a):

As we know that

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

$$\Rightarrow L/r = \sqrt{\frac{E\pi^2}{\sigma_p}}$$

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

$$\Rightarrow le/r = 90.64 \quad \text{---} (1)$$

Now

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

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

$$\Rightarrow r = 12.99 mm$$

Now eq(1) becomes.

$$le = 90.64 \times 12.99$$

$$\Rightarrow le = 1177.44 mm$$

Now for Pin hing support

$$le = L$$

So

$$\boxed{L_{min} = 1177.44 mm}$$

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Part (b)

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

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

$$\Rightarrow P_{cr} = 39.9343 \text{ GN}$$

Now

P_{safe}:

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

$$\Rightarrow P_{safe} = \frac{39.9343}{2.5}$$

$$\Rightarrow \boxed{P_{safe} = 15.8937 \text{ GN}}$$