Date:

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ASSIGNMENT:

MECHANICS OF SOLIDS

ASSIGNMENT NO 1 II

NAME:

MALIK AIMAL KHAN

ID:

7968

SECTION:

B

SUBMITTED TO:

SIR ENGR: MUHMMAD SAQID.

Date: (2)

PROBLEM : NO 1 :

GIVEN:

$L_e = 6 ft$

$E = 10.3 \times 10^6 Psi$

$h = 2 in$

Factor of safety = 2

$b = 3/4 in.$

TO FIND :

SAFE CENTERAL LOAD = ?

SOLUTION:

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

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

As we Know

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

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

Date:

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

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

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

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

$$r = 0.216 \text{ in.}$$

Now

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

Putting values.

$$P_{cr} = \left[\frac{(3.14)^2 (10.3 \times 10^6)\ (1.5\text{in}^2)}{\left(\frac{0.7 \times 1}{r}\right)^2}\right]$$

$$P_{cr} = \left[\frac{9.896 \times 15.45 \times 10^6}{\left(\frac{0.7 \times 7.2}{0.216}\right)^2}\right]$$

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

$P_{cr} = 2.798 \times 10^3$ Psi

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In case of Psafe:

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

$P_{safe} = \frac{2.798}{2}$

$P_{safe} = 1.3989$ Ksi

PROBLEM 2:

GIVEN:

Load = 20 kips

$E = 29 \times 10^6$ Psi

Length = l = 10 ft.

TO FIND:

Length of each side = ?

Date: (5)

SOLUTION:

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

$$\frac{Le}{r} = \frac{\pi^2 E}{2.4 \times 10^5}$$

$$\frac{Le}{r} = \left[\frac{(3.14)^2 (29 * 10^6)}{(2.4 \times 10^5)}\right]$$

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

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

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

$$r = \frac{(10)(12)}{34.5}$$

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

$$r = 3.4 \text{ in} .$$

Date: (6)

Now for 1st one we have:

$$I = \frac{b^3}{12}$$

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

$$b^2 = (3.47)^4 (12)$$

$$b^2 = 12.04 \text{ in.}$$

Now for 2nd one.

$$T = A r^2$$

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

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

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

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

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h = 11.77.

h = 11.77

PROBLEM 4:

GIVEN:

$E = 200 \times 10^9$ Pa

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

Column = 310 x 45 mm

L = 12 m

Factor of safety = 2.5

TO FIND:

$L_{min} = ?$

$P_{safe} = ?$

SOLUTION:

$$\sigma_p = \frac{E\pi^2}{\left(\frac{L_e}{r}\right)^2}$$

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

Date: (8)

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

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

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

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

$$r = 12.98 \text{ mm}.$$

$$L_e = 90.64 \times 12.98$$

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

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For Pin hinge.

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

For Pcs

Date: (9)

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

$$P_{cr} = \frac{(3.14)^2 (200 \times 10^9)(13950)(12.98)}{(12 \times 1000)^2}$$

$$P_{cr} = 32.323 \text{ GN}$$

For P_{SAFE}.

$$P_{SAFE} = \frac{P_{cr}}{\text{Factor of safety}}$$

$$P_{SAFE} = \frac{32.323}{2.5}$$

$$P_{SAFE} = 12.92 \text{ G.N}$$

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