MUHAMMAD AZAN QAZI

7894

SecA

Civil engineering
Department.

15 June, 2020.

Q No (02) (1103)

Given Data:

$E = 10.3 \times 10^6$ PSI.

length = 6 ft.

$b = 3/4$ in

$h = 2$ in.

Factor of Safety = 2.

$L_e = 0.7L$.

Required:

Safe Central load = ?

Solution:

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

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

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

$$r = \sqrt{\frac{h b^3/12}{h b}}$$

$$r = \sqrt{\frac{b^2}{12}} = \frac{b}{2\sqrt{3}} = \frac{3/4}{2\sqrt{3}}$$

$r = 0.216$ in.

(2)

$$P_{crippling} = \frac{(3.14)^2(10.3\times10^6)(1.5\,in^2)}{\left(\frac{0.7\times72}{0.216}\right)^2}$$

$$P_{crippling} = \frac{152.37}{54444.5}$$

$P_{crippling} = 2.798\times10^3$ PSI

$P_{crippling} = 2.798$ KSI.

$$P_{s.c.\,load} = \frac{P_{crippling}}{\text{factor of safety}}$$

$$P_{sc.\,load} = \frac{2.798}{2}$$

$P_{safe\ central\ load} = 1.399$ KSI.

(1104)

(3)

(L)

Given Data:

Load = 20 KIPS ~~[illegible]~~

Length = L = 10 ft.

$E = 29 \times 10^6$ PSI

Required:

Length of each Side = ?

Solution:

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

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

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

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

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

$$r = \frac{10 \times 12}{34.5} = 3.4 \text{ inches.}$$

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

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

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

$b^2 = 138.72$

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

$b = 11.77$ in

(1105)

<u>Given Data:</u>

load = 20 KIPS.

length = 10 ft

$E = 1.6 \times 10^6$ PSI.

Required

length of each side = ?

<u>Solution:</u>

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

$$\frac{le}{r} = \sqrt{\frac{(3.14)^2 (1.6 \times 10^6)}{2.4 \times 105}}$$

$$\frac{le}{r} = \sqrt{65.730}$$

$$\frac{le}{r} = 8.107.$$

$$r = \frac{le}{8.107}.$$

$$r = \frac{10 \times 12}{8.107} = 14.802 \text{ inches}.$$

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

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

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

$$b^2 = 2629.190$$

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

$$b = 51.275 \text{ in}$$

(5)

(7)

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

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

$P_{crip} = 32.2343 \times 10^9 N$

$$P_{safe\ Crippling\ load} = \frac{P_{crippling}}{factor\ of\ safety}$$

$$= \frac{32.2343}{2.5} \times 10^9 N$$

$P_{s.c.\ load} = 12.8937\ GN$

(1106)

⑧

Given Data:

Column = (310 × 45) mm

$E = 200 \times 10^9 Pa$.

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

$L = 12m$, factor of Safety = 7.5.

Required:

ⓐ l_{min} = ?

ⓑ P_{safe} = ?

Solution:

ⓐ

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

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

$$\frac{le}{r} = 90.64.$$

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

$r = 12.99mm$.

$le = 90.64 \times 12.99 = 1177.44mm$.

$L = le$ Pin Hinge.

$L_{min} = 1177.44mm$

(b) Safe Central load.

P Crippling load $= \frac{\pi^2 E I}{le^2}$

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

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

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

$r =$ P crippling =

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

$= \frac{P_{crippling}}{2}$

P safe load.

(1102)

(10)

Given Data:

Timber = 50X100mm
$\sigma_p = 30 \times 10^6$ Pa.
$E = 10$ GPa.
Factor of Safety = 2
length = 2m.

Required

(a) Minimum length = ?
(b) Safe Central load = ?

Solution:

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

$$\frac{l_e}{r} = \sqrt{\frac{E\pi^2}{\sigma_p}} = \sqrt{\frac{(3.14)^2 \times 10 \times 9}{30 \times 10^6}}$$

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

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