Date: / /20

(13)

(b) Stout act column

$le = L/2$ (for fixed ended)

$$le = \frac{10}{2} = 5ft$$

$$I = I_y = \frac{2 \times (0.75)^3}{12} = 0.07 in^4$$

$$P_{cr} = \frac{n^2 E I \pi^2}{le^2} = \frac{(1)^2 (10.3 \times 10^6)(0.0 \ldots (3.14)^2}{(5 \times 12)^2}$$

$$P_{cr} = \frac{7108771.6}{(60)^2}$$

$$P_{cr} = 1974658.16$$

$$P \text{ safe load} = \frac{1974.658}{2}$$

$$= 987.329316$$

Q3

Given data

length = 10ft

$E = 10.3 \times 10^6$

b = 0.75

h = 2

factor of safety = 2

Required:-

a) Safe load at hinged = ?

b) Safe load at fixed = ?

Solution:

a) for hinged columns

$l_e = l$

$I = \frac{(0.75)(2)^3}{12} = 0.5 \; in^4$

$P_{cr} = \frac{n^2 E I \pi^2}{l_e^2} = \frac{(1)^2(10.3\times10^6)(0.5)\pi^2}{(10\times12)^2}$

$P_{cr} = \frac{50776940}{14400} = 3526.178 \; lb$

P Safe load $= \frac{P_{cr}}{\text{factor of safety}} = \frac{3526178}{2}$

$= 1763.08878$

Signature

Solving the equation

$$P = 1638.6\,lb$$

Now

$$S_c = \frac{M_x y}{I_x} + \frac{M_y a}{I_y}$$

$$8000 = \frac{48\,P\cos 60 \times (5.937) + 48\,P\sin 60 \times 0.5}{10.7}$$

Solving the equation

$$P = 2104.9\,lb$$

for case 1

$$P_{cr} = \frac{4\pi^2 EI}{L^2}$$

So the maximum load P applied should 1638.6 lb

Date: / /20

10

So,

$$f_A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \quad \text{comp}$$

$$f_C = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \quad (\text{Tension})$$

Now M_x and M_y

So $M_x = \frac{P\cos 60 \times (16 \times 12)}{4}$

$$\boxed{M_x = 48P\cos 60}$$

$$M_y = \frac{P\sin 60 (16 \times 12)}{4}$$

$$\boxed{M_y = 48P\sin 60}$$

Now

$$f_A = \frac{M_x y}{I_x} + \frac{M_y a}{I_y}$$

$$\Rightarrow 1200 = \frac{48P\cos 60° \times 3.077}{112.6}$$

$$\frac{48P\sin 60 \times 3.8}{[redacted]6}$$

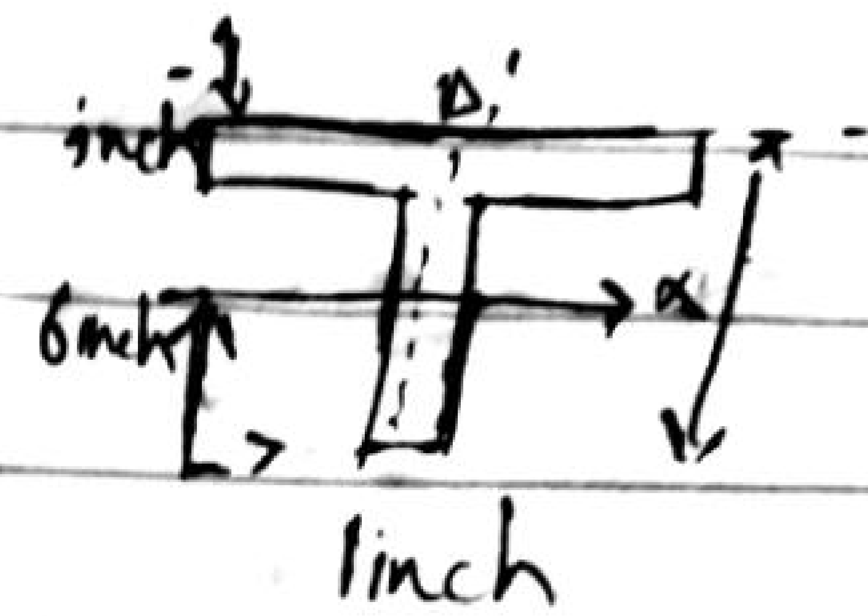
18.7

Date: / /20

(9)

Question(2)Part(B)

Given



$L = 16ft$

$I_x = 12.6 \, inch^4$

$I_y = 18.7 in^4$

$f_c = 12000 \; Psi$

$f_t = 8000 \; Psi$

Solution:

By looking figure we can figure out that maximum compression would accure on a and maximum tension c at B. There will tension as well a compression which will reduce that effect of each other So we will calculate Stress at A and C.

Date: / /20

8

Now Put values of I_z, I_y and α in eq (2)

$$\tan\alpha = \frac{I_z}{I_y}\tan 30$$

$$\Rightarrow \tan\alpha = \frac{2.812\times10^{-5}}{1.25\times10^{-5}}(\tan 30^\circ)$$

$$\tan\alpha = -14.4129$$

$$\alpha = \tan^{-1}(-14.4129)$$

$$\alpha = \tan^{-1}(-14.4129)$$

$$\alpha = 1.5$$

$$\alpha = 1^\circ 30' 5''$$

Date: / /20

7

In this case, N.A passes through 2,4 & 0

$$\sigma = \frac{M\cos}{I_z} y + \frac{M\sin\theta}{I_y} z \quad (1)$$

$$\sigma = \frac{M\cos\theta}{I} y + \frac{M\sin\theta}{I_y} z$$

consider a point 'A' on N.A lies Quadrant 2, where Bending stress due to $P\cos\theta$ is compressive

ε_1

- Bending stress due to $P\sin\theta$ is tensile

$$eq (1) = 0 = -\frac{M\cos\theta}{I_z} y_A + \frac{M\sin\theta}{I_y}$$

$$= -\frac{m\cos\theta}{I_z} y_A + \frac{m\sin\theta}{I_y} z_A$$

$$\Rightarrow \frac{M\cos}{I_z} y_A + \frac{m\sin\theta}{I_y} z_A$$

$$\frac{y_A}{z_A} = I_z \frac{\sin\theta}{\cos\theta} \Rightarrow$$

$$\tan\alpha = \frac{I_z}{I_y} \tan\theta \rightarrow (2)$$

Date: / /20

(6)

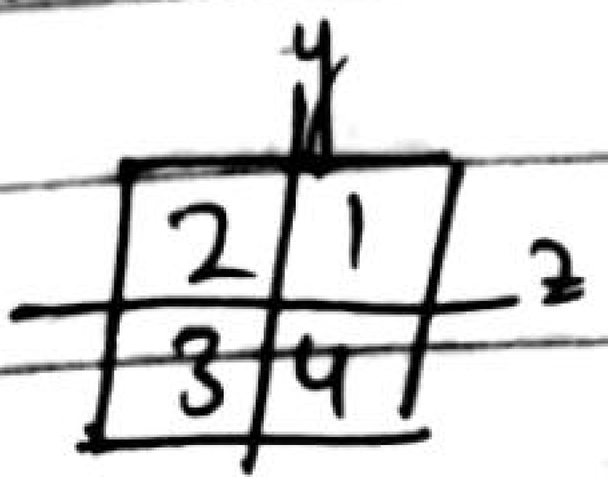
$M_y = 12 \sin 60$

$M_y = -11.8563$

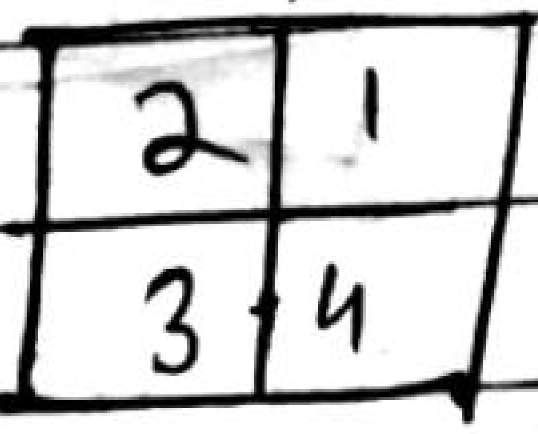
$\sigma = \left(\frac{Mz}{I_z}\right) + \left(\frac{My}{I_y}\right)$

$\sigma = \frac{1.851}{2.812\times10^{-5}} + \frac{(-11.8563)}{1.25\times10^{-5}} = 882628 \ N/m^2$

Sign convention



If we take compression as negative and tension as positive and the beam is a simply supported



\+ - Quad 1,4 -ve

\+ - 3,4 +ve

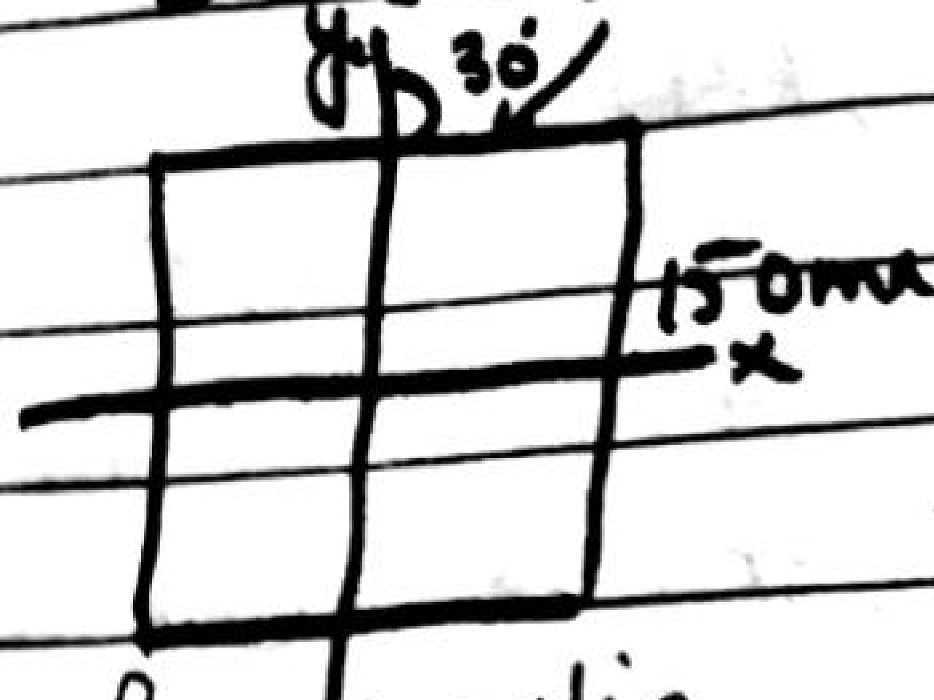
Incase unsymmetrical loading the neutral axis lies at an angle of 'α' the principle axis and the algebric sum of stress at N.A is zero.

Signature

Date: / /20

(5)

Question 2(a)



moment of inertia

$$I_z = \frac{bh^3}{12} = \frac{0.1(0.15)^3}{12} = I_z = 2.8125\times10$$

Now

$$I_y = \frac{hb^3}{12} = \frac{0.15(0.1)^3}{12}$$

$$I_y = 1.25\times10^{-5}$$

$$\sigma = \frac{M_z y}{I_z} + \frac{M_y z}{I_y}$$

$$\sigma = \frac{M\cos\theta}{I_z} + \frac{M\sin\theta}{I_y}$$

where

$$M = \cos\theta = P\cos\theta = M_z$$

$$= 12\cos 60° = M_z$$

$$M_z = 1.8510$$

$$M\sin\theta = P\sin\theta = M_y$$

Date: / /20

4

$$t = \frac{(62.2) \times (26 \times 12) \times (22 \times 12)}{6000 \times 2}$$

$t = 0.24''$

Date: 23/ 6 / 20 MOS II (8)

Que 1 Part (B)

Data:

$H = 26\ ft$

1 allume diameter

$D = 22\ ft$

tangential stress $= 600\ lb/ft^3$

Specific weight of water tank $= 62.4\ lb/ft^3$

we have to find the thickness $= ?$

Solution:

The pressure develop by water $= P = \gamma h$

$$\sigma t = \frac{PD}{2t} = \frac{\gamma h D}{2t}$$

$$\sigma t = \frac{PD}{2t} = \frac{\gamma h D}{2t}$$

$$2t = \frac{\gamma h D}{\sigma t}$$

$$t = \frac{\gamma h D}{\sigma t \times 2}$$

Date: / /20

2

$I = 50034.56 + 20833$

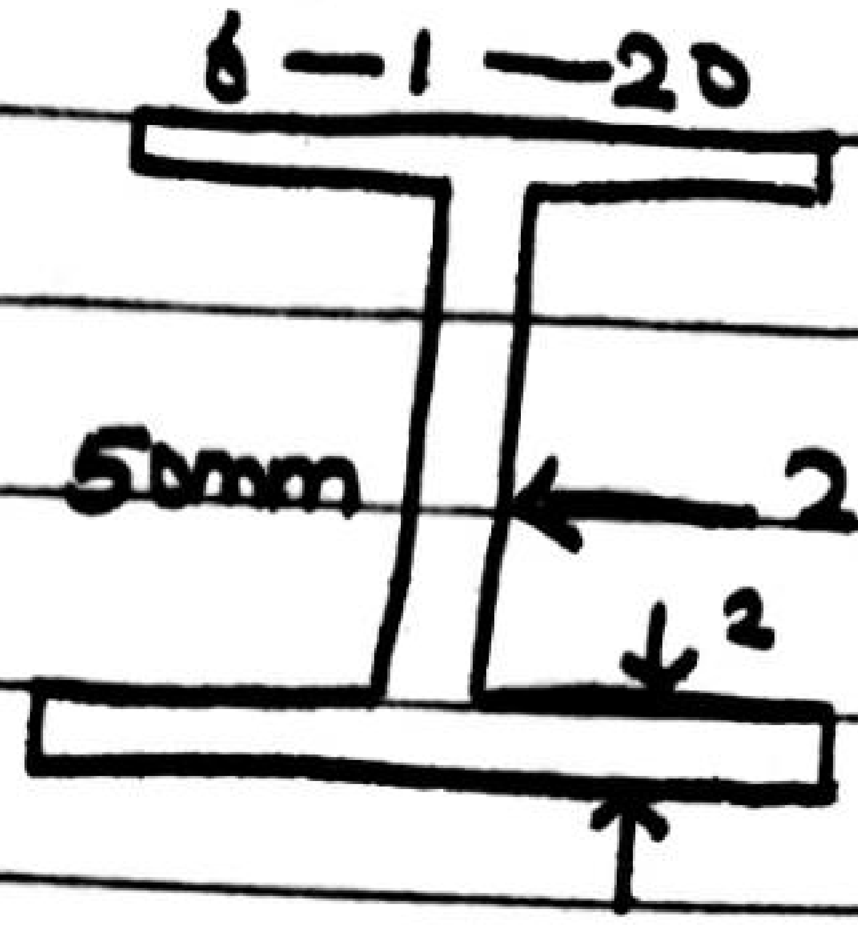
$I = 70867.99\ mm^4$

$e = \dfrac{2(50^2)(25)^2}{4(70867.99} = 11.02mm$

So shear center $e = 11.02mm$

QNO 1 Part 1 :

1



Required :

⇒ location of shear center.

Sol :

As we know

$$e = \rho t \frac{h^2 b^2}{4I}$$

$$I = 2\left(\frac{bh^3}{12} + Ay^2\right) + \left(bh^3 + Ay^2\right)$$

$$= 2\left[\frac{25(2)^3}{12} + (20\times2)(25)^2\right]$$

$$+ \left[\frac{2(50)^3}{12} + 0\right]$$