Date: .....

NAME : MUHAMMAD ILYAS

ID : 7956

SECTION : "B"

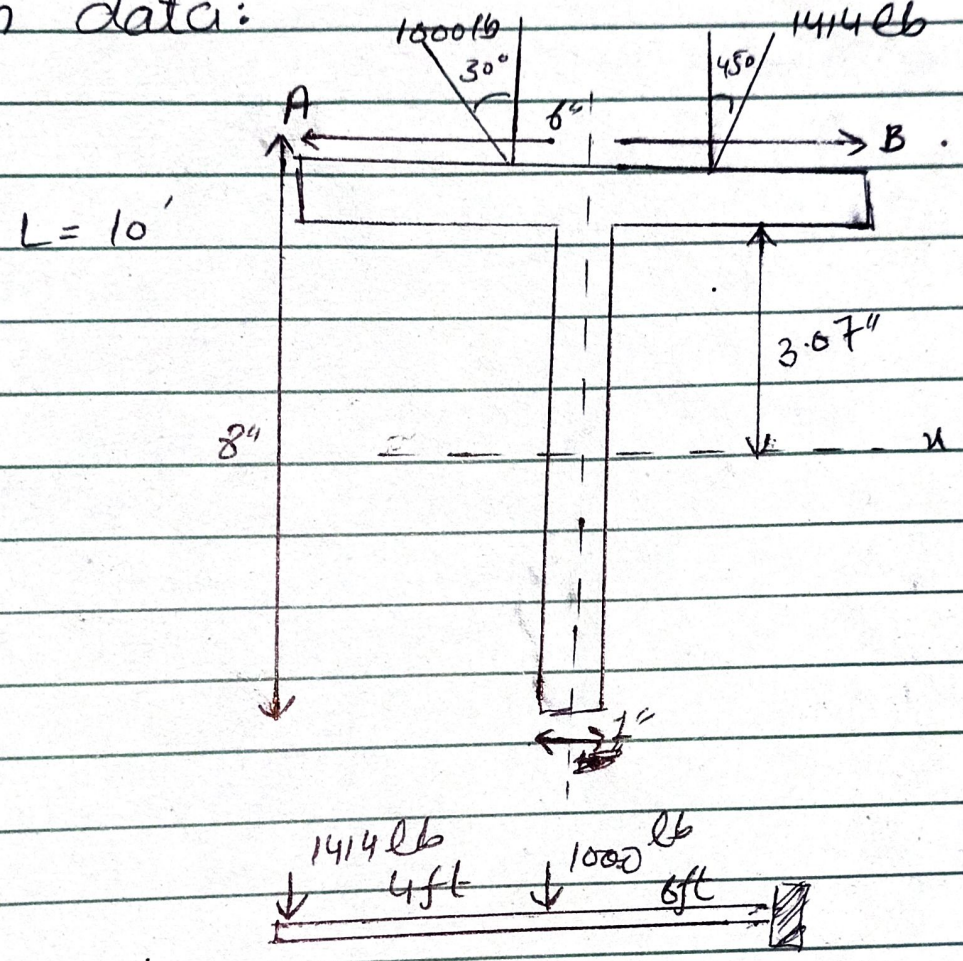
SUBJECT : MOS-2

SEMESTER : 4th

Date:

Question # 02

Given data:



Required:

Inclination of neutral axis at the wall, $\alpha = ?$

Max compression $\sigma_c = 0$

Max tension $= ?$

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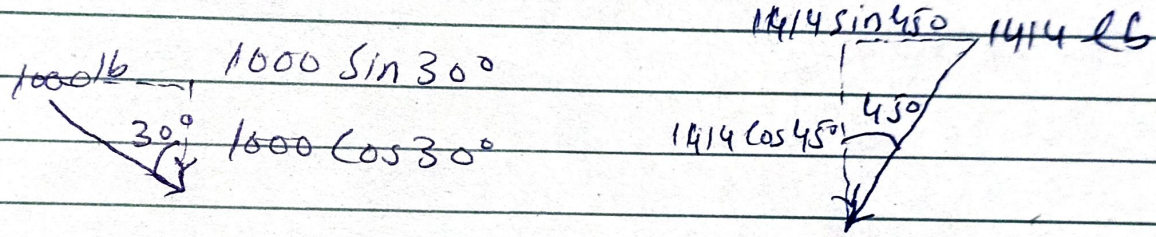
Solution:

First we have to find out moments at x and y.

→ As the forces are inclined so, first we have to solve it into components.



As max is caused by vertical components of load.

$$M_x = (1000 \cos 30°)\,6 + (1414 \cos 45°)\,12$$

$$M_x = 5196.5 + 11998.18$$

$$\rightarrow \quad M_x = 17194.33 \text{ lb/ft}$$

Now

M_y is caused by horizontal forces, components of load.

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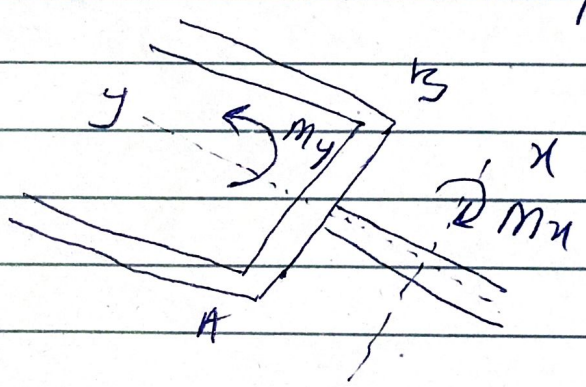
$$My = (1000 \sin 30)\,6 + (1414 \sin 45°)\,12$$

$$My = 3000 + 11498.18$$

$$\boxed{My = 14498.18 \text{ lb/ft}}$$

As the resulting moment My is anti-clockwise which causing tension at "A" and compression at "B"



Now stresses at extreme fibers due to Mx and My.

$$\sigma_x = \frac{M_x y}{I_x}$$

$$\sigma_x = \frac{17194.33 \times 4.07''}{112.6 \text{ in}^4}$$

$$\sigma_x = \frac{17194.33 \times 0.3391}{5.43 \times 10^{-3} \text{ ft}^4}$$

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$$\sigma_x = 3.166 \text{ Mlb/ft}^2 \times 0.33$$

$$\boxed{\sigma_x = 1.0738 \text{ Mlb/ft}^2}$$

$$\sigma_y = \frac{My}{I_y}$$

$$\sigma_y = \frac{14998.18 \times 3''}{18.7 \text{ in}^4}$$

$$\sigma_y = \frac{14998.18 \times 0.25}{9.018 \times 10^4 \text{ ft}^4}$$

$$\sigma_y = 16.624 \text{ Mlb/ft}^2 \times 0.25$$

$$\boxed{\sigma_y = 4.156 \text{ Mlb/ft}^2}$$

Now we have to find out load at "A" and "B" by considering compression as negative and tension as positive.

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$$\rightarrow \sigma_A = \sigma_x + \sigma_y$$

$$\sigma_A = 1.0738 + 4.156$$

$$\boxed{\sigma_A = 5.229 \text{ M lb/ft}^2}$$

$$\sigma_B = \sigma_x - \sigma_y$$

$$\sigma_B = 1.0738 - 4.15$$

$$\sigma_B = -3.08822 \text{ M lb/ft}^2$$

Now we have to find out the angle of neutral axis

$$\tan\alpha = \frac{I_x}{I_y} \cdot \frac{M_y}{M_x}$$

$$\tan\alpha = \frac{5.43 \times 10^{-3}}{9.018 \times 10^{-4}} \times \frac{17199.33}{14998.12}$$

$$\tan\alpha = 6.021 \times 1.146$$

$$\tan\alpha = 6.9026$$

$$\alpha = \tan^{-1}(6.9026)$$

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$\therefore \quad \alpha = 81.756^{\circ}$