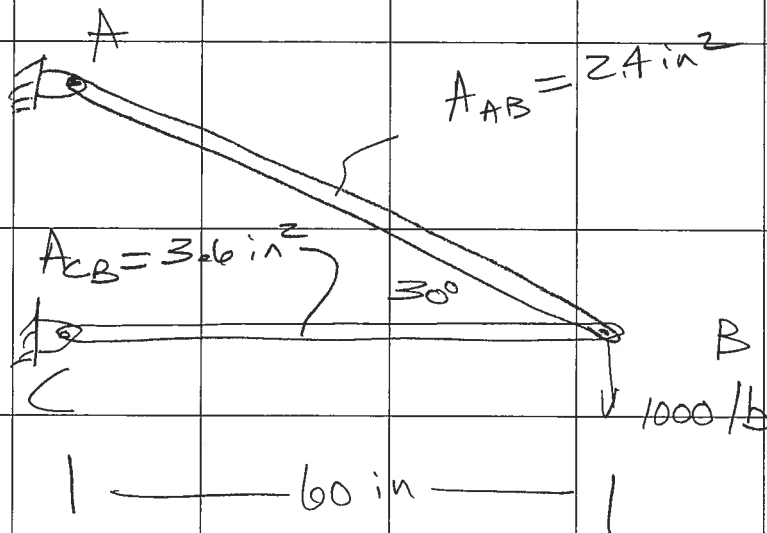
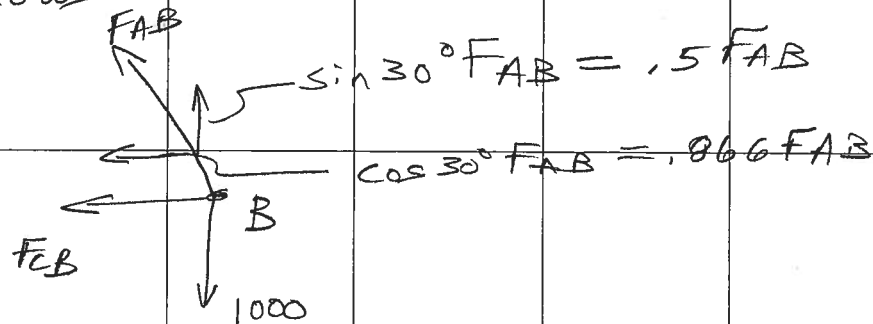


The truss ABC is loaded as shown. The area of bar AB is 2.4 in^2 and the area of bar CB is 3.6 in^2 . Assume that $E = 10 \times 10^6 \text{ psi}$.



Calculate the strain energy in members AB and CB individually. Find the total strain energy by summing these two values and use this result to calculate the vertical deflection at B in the direction of the 1000 lb load.

First it is necessary to determine the forces in members AB and CB as follows



$$+\uparrow \sum F_y = 0$$

$$.5 F_{AB} - 1000 = 0$$

(1)

$$\underline{F_{AB} = 2000 \text{ lb}}$$

Tension (2)

$$+\rightarrow \sum F_x = 0$$

$$-F_{CB} - .866 \overset{2000}{F_{AB}} = 0$$

(3)

$$F_{CB} = -(.866)(2000)$$

(4)

$$\underline{F_{CB} = -1732 \text{ lb Compression}}$$

(5)

The strain energy U in member AB is calculated as follows

$$U_{AB} = \frac{P_{AB}^2 L_{AB}}{2 EA}$$

(6)

$$\text{where } L_{AB} = \frac{60 \text{ in}}{\cos 30^\circ} = 69.28 \text{ in} \quad (7)$$

$$U_{AB} = \frac{(2000 \text{ lb})(69.28 \text{ in})}{2 (10 \times 10^6 \frac{\text{lb}}{\text{in}^2})(2.4 \text{ in}^2)} \quad (8)$$

$$U_{AB} = 5.77 \text{ in-lb} \quad (9)$$

The strain energy in member CB is calculated as follows:

$$U_{CB} = \frac{P_{CB}^2 L_{CB}}{2 E_{CB} A_{CB}} \quad (10)$$

$$U_{CB} = \frac{(-1732 \text{ lbs})^2 (60 \text{ in.})}{2 (10 \times 10^6 \frac{\text{lb}}{\text{in}^2})(3.6 \text{ in}^2)} \quad (11)$$

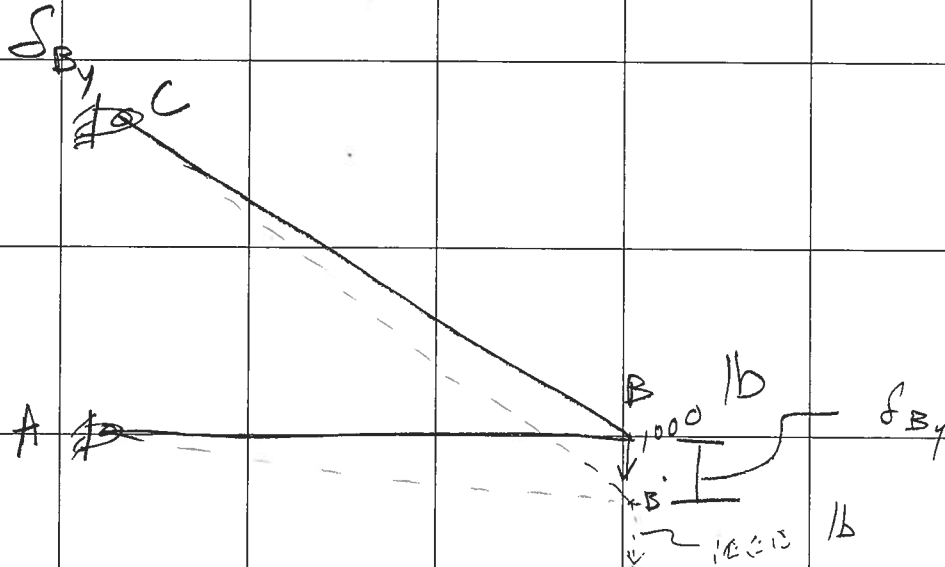
$$U_{CB} = 2.50 \text{ in-lb} \quad (12)$$

This value is positive even though its internal force is compression

The total strain energy in the structure is then given as (13)

$$U_{\text{Total}} = U_{AB} + U_{CB} = 5.77 + 2.50 = \underline{8.27 \text{ in-lb}}$$

The deflection at B in the vertical direction is found by equating the external work of the 1000 lb force as it moves through the displacement



The external work is

$$W = \frac{1}{2} (1000 \text{ lb}) (\delta_{By} \text{ in}) \quad (14)$$

$$W = 500 \delta_{By} \text{ in-lb} \quad (15)$$

Then

$$W = \sum U \quad (16)$$

$$500 \delta_{By} = 8.27 \text{ in-lb} \quad (17)$$

	S_0	$\sum B_y =$	$\frac{8.27 \text{ in-lb}}{500 \text{ lb}}$		(18)
		$\sum B_y =$	1.654 in. $\downarrow$		(19)
			in the direction of the 1000 lb force		