

Solutions to HOW TO ACE STATICS WITH JEFF HANSON

TRUSSES, FRAMES AND MACHINES SOLUTIONS:

Test Yourself-Trusses, Frames, and Machines

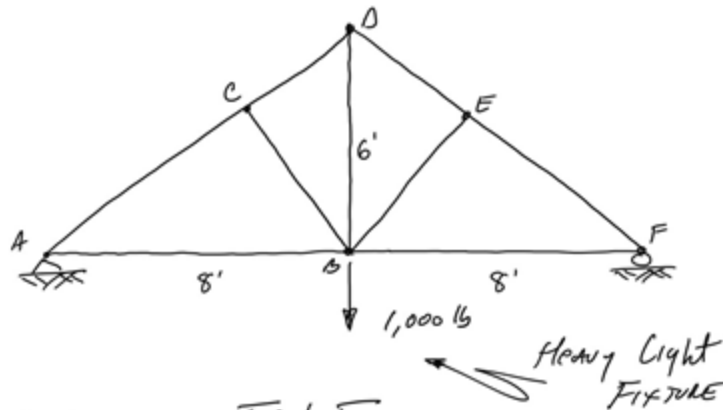
1. Machine
2. Frame
3. Truss
4. Truss
5. Machine
6. Frame
7. Truss
8. Machine
9. Frame

Test Yourself-Tension vs. Compression

1. Tension
2. Compression
3. Compression
4. Tension

Practice problem solution:

IDENTICAL TRUSS: NOW WITH A VERY HEAVY LIGHT
FIXTURE HANGING AT THE CENTER!



FIND THE FORCES IN \overline{AB} & \overline{AC}

1) FIND REACTION FORCES FOR THE TRUSS



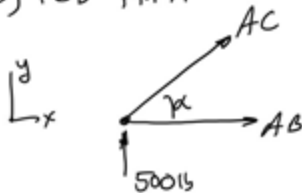
$$\sum F_x = 0 \quad R_3 = 0$$

$$\sum F_y = 0 \quad R_1 + R_2 - 1000 = 0 \quad (1)$$

$$\sum M_1 = 0 \quad -(1000)(8) + R_2(16) = 0 \quad \therefore R_2 = 500 \text{ lb}$$

FROM (1) WE GET $R_1 = 500 \text{ lb}$ ✓

2) FBD PIN A



NOTE: $\tan \alpha = \frac{6}{8} \quad \therefore \alpha = 36.87^\circ$

$$\sum F_y = 0 \quad AC \sin 36.87 + 500 = 0$$

$$\therefore AC = \frac{-500}{\sin 36.87}$$

$$AC = -833.315$$

Compression

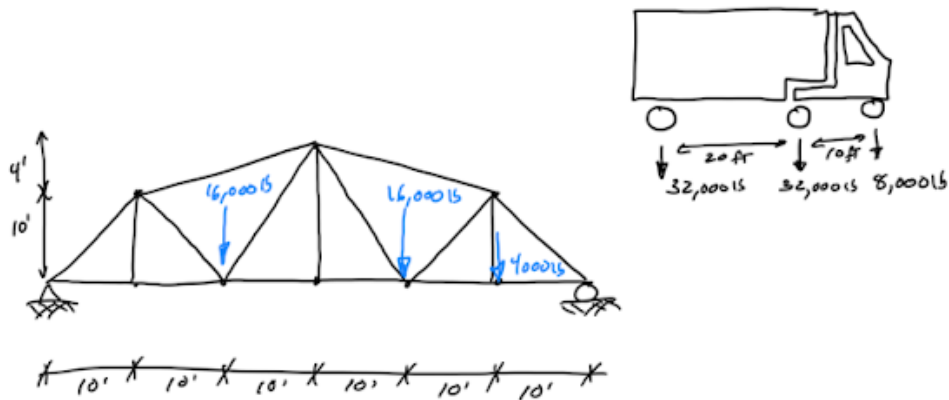
$$\sum F_x = 0$$

$$AC \cos 36.87 + AB = 0$$

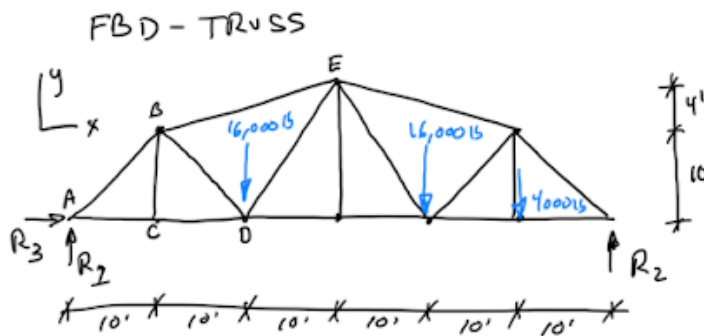
$$AB = -AC \cos 36.87 = -(-833.3) \cos 36.87 = 666.715$$

Tension

Real World Problem Solution:



STEP 1: FIND the Reactions



$$\sum F_x = 0 \quad \boxed{R_3 = 0}$$

$$\sum F_y = 0 \quad R_1 + R_2 - 16,000 - 16,000 - 4,000 = 0 \quad \text{--- (1)}$$

$$\sum M_1 = 0 \quad - (16,000) 20 - (16,000) 40 - (4,000) 60 + (R_2) 60 = 0$$

$$\therefore \boxed{R_2 = 19,333.3 \text{ lb}}$$

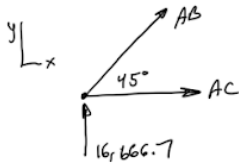
From EQN (1)

$$R_1 + 19,333.3 = 36,000$$

$$\therefore \boxed{R_1 = 16,666.7 \text{ lb}}$$

STEP 2: USE FBDs of JOINTS

FBD JOINT A



$$\sum F_y = 0 \quad AB \sin 45 + 16,666.7 = 0$$

$$AB = -23,570.3 \text{ is Compression}$$

$$\sum F_x = 0$$

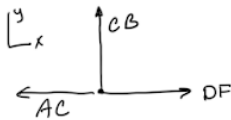
$$AB \cos 45 + AC = 0$$

$$AC = -AB \cos 45$$

$$-(-23,570.3) \cos 45$$

$$\therefore AC = 16,666.7 \text{ is Tension}$$

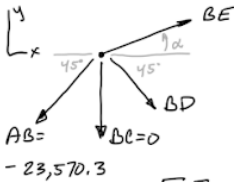
FBD JOINT C



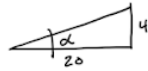
WE ARE ONLY ASKED TO FIND CB IN THIS FBD.

$$\sum F_y = 0 \quad CB = 0$$

FBD PIN B



WE NEED TO FIND α



$$\tan \alpha = \frac{4}{20}$$

$$\therefore \alpha = 11.31^\circ$$

$$\sum F_x = 0 \quad -AB \cos 45 + BD \cos 45 + BE \cos \alpha = 0 \quad (1)$$

$$\sum F_y = 0 \quad -AB \sin 45 - BD \sin 45 + BE \sin \alpha = 0 \quad (2)$$

WE KNOW AB (-23,570.3) BUT WE DON'T KNOW BD OR BE SO WE NEED TO SOLVE THESE TWO EQUATIONS TOGETHER.

$$-(-23,570.3) \cos 45 + BD \cos 45 + BE \cos 11.31 = 0$$

$$-(-23,570.3) \sin 45 - BD \sin 45 + BE \sin 11.31 = 0$$

$$\left[\begin{array}{l} 23,570.5(0.707) + BD(0.707) + BE(0.9806) = 0 \\ 23,570.5(0.707) - BD(0.707) + BE(0.1961) = 0 \end{array} \right]$$

ADD THESE TWO EQNS \rightarrow AND THIS TERM DROPS OUT!

$$33,328.7 + BE = 0$$

$$\therefore BE = -28,323.7 \text{ Compression}$$

WE CAN NOW GET BD BY SUBSTITUTING BE IN EITHER EQUATION

$$23,570.5(0.707) + BD(0.707) + BE(0.9806) = 0$$

$$16,664.3 + 0.707 BD - 28,323.9(0.9806) = 0$$

$$\therefore BD = 15,714.316$$

Tension
