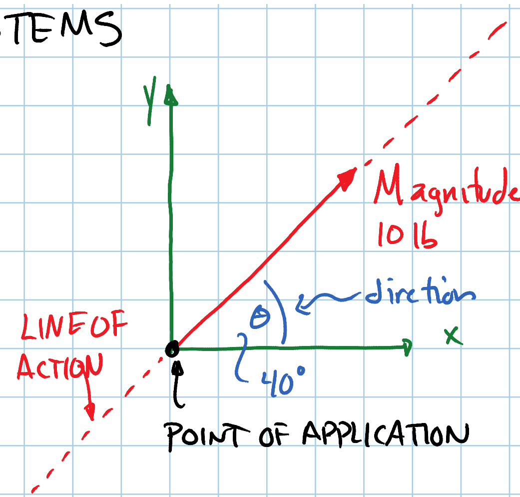
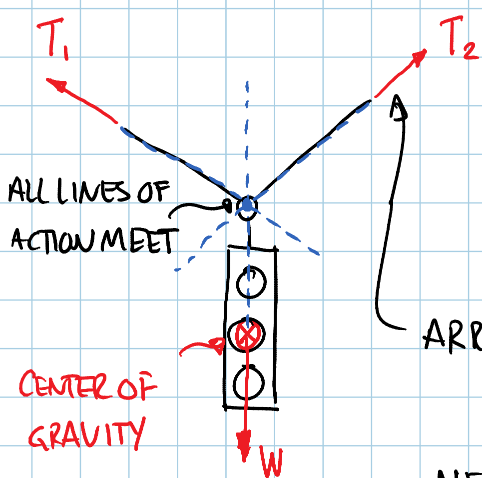
2D CONCURRENT FORCE SYSTEMS

Wednesday, November 30, 2011
12:25 PM

2D → planar

CONCURRENT → ALL LINES OF ACTION MEET AT A SINGLE POINT





CABLES CAN ONLY SUPPORT AN AXIAL TENSILE LOAD.

ARROW POINTING AWAY FROM BODY INDICATES TENSION.

NEWTON'S 2ND LAW: $F = m \cdot A$

IN STATICS NOTHING IS TRANSLATING OR ROTATING

TRANSLATING → MOVING IN X, Y, OR Z

ROTATING → SPINNING ABOUT AN AXIS

IF NOTHING IS MOVING THEN A (ACCELERATION) = 0

THEREFORE → $\therefore F = 0 \Rightarrow \Sigma F = 0$

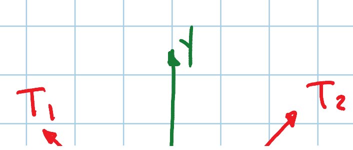
Σ → SIGMA = SUMMATION

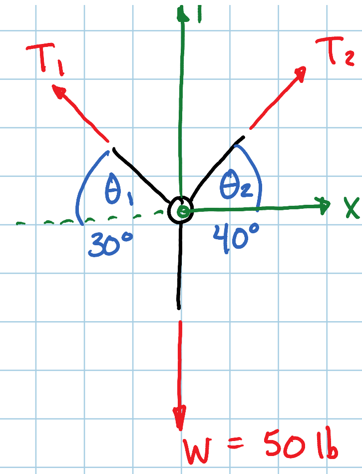
SUMMATION OF FORCES IN THE X-DIRECTION = 0 → $\Sigma F_x = 0$

$$\left.\begin{array}{l} \Sigma F_x = 0 \\ \Sigma F_y = 0 \\ \Sigma F_z = 0 \end{array}\right\} \text{EQUATIONS OF STATIC EQUILIBRIUM}$$

DRAW A FBD (FREE BODY DIAGRAM)

① SKETCH THE BODY OF INTEREST

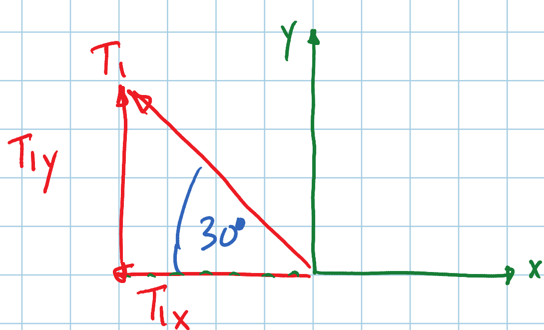




1. SKETCH THE BODY OF INTEREST
2. APPLY FORCES ACTING ON BODY (INTERNAL FORCES, BODY WEIGHT, WIND LOADS, EXTERNAL FORCES, CONTACT FORCES)
3. APPLY A COORDINATE SYSTEM
4. DIMENSION THE BODY
5. LABEL VARIABLES

ONCE YOU HAVE A FBD,
APPLY EQUILIBRIUM EQUATIONS

$$\sum F_x = 0$$
$$\sum F_y = 0$$



$$\sin\theta = \frac{opp}{hyp}$$

$$\cos\theta = \frac{adj}{hyp}$$

$\cos 30° = \dfrac{T_{1x}}{T_1}$ SOLVE FOR $T_{1x} = T_1 \cdot \cos 30°$

$\sin 30° = \dfrac{T_{1y}}{T_1}$ SOLVE FOR $T_{1y} = T_1 \cdot \sin 30°$

$$\sum F_x = 0 = -T_1 \cdot \cos 30° + T_2 \cdot \cos 40°$$

T_1 has a negative x-component

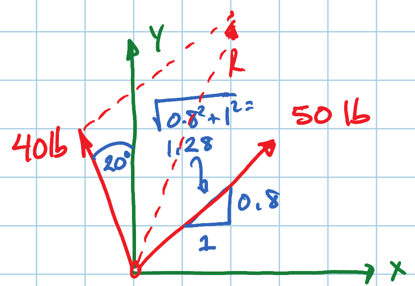
$$\sum F_y = 0 = T_1 \cdot \sin 30° + T_2 \cdot \sin 40° - 50 lb$$

BY SIMULTANEOUS EQUATIONS:

$T_1 = 40.76 \text{ lb}$
$T_2 = 46.08 \text{ lb}$

CHECK TO MAKE SURE THE ANSWERS SEEM REASONABLE

TO FIND A RESULTANT: (NOT EQUILIBRIUM)



X-COMPONENT OF THE RESULTANT

$$\Sigma F_x = -40\text{lb}\cdot \sin 20^\circ + 50\text{lb}\cdot \frac{1}{1.28} = 25.4 \text{ lb} = R_x$$

$$\Sigma F_y = 40\text{lb}\cdot \cos 20^\circ + 50\text{lb}\cdot \frac{0.8}{1.28} = 68.8 \text{ lb} = R_y$$

$$\text{RESULTANT} = \sqrt{R_x^2 + R_y^2}$$

$$= \sqrt{(25.4\text{lb})^2 + (68.8\text{lb})^2}$$

$$R = 73.3 \text{ lb}$$

$$\theta = \text{ANGLE OF RESULTANT} = \tan^{-1}\frac{R_y}{R_x}$$

$$= \tan^{-1}\frac{68.8\text{lb}}{25.4\text{lb}}$$

$$\theta = 69.7^\circ$$