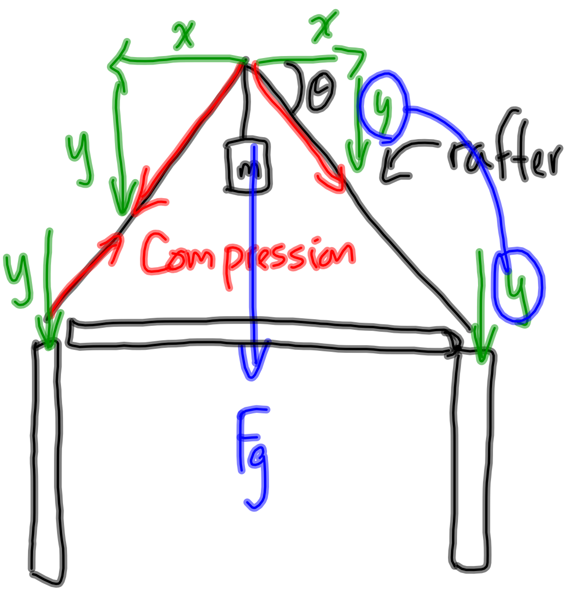
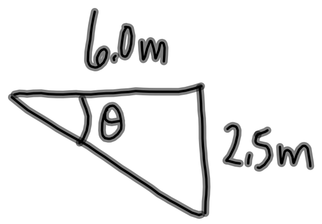
FOP §6-1

5.

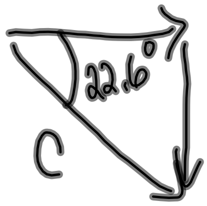




$\tan\theta = \frac{2.5\text{ m}}{6.0\text{ m}}$

$\theta = 22.6°$

a) compression in rafter:



$\frac{F_g}{2} = \frac{981}{2}$

b) tension in the tie:

x-comp of compression

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

$\sin 22.6° = \frac{490.5\text{N}}{C}$

c) compression in the stud:

y-comp. of the compression

$C = \frac{490.5\text{N}}{\sin 22.6°}$

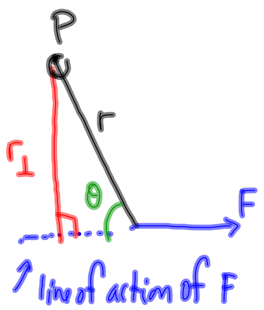
$C = 1275.3$

$C \doteq 1.3 \times 10^3\text{N}$

What's the problem with Large objects?

In large objects, the forces may not act through a common point (usually the centre of mass). This results in a twisting action called <u>torque</u>.

In a static equilibrium problem involving large objects, we must take this twisting action into account. Having a net force of zero is not sufficient..... we must also have a net torque of zero!!



A force, F, acting on an object at a distan[ce] r from the pivot poin[t]

$$\tau = r_\perp F$$

$$\tau = rF\sin\theta$$

where τ is the torque (N·m)

$r_\perp$ is the perpendicular distanc[e] from P to the line of act[ion] of the force (m)

F is the force acting on the [...] (N)

r is the distance from the point of application of [the] force + the pivot point (m)

θ is the angle between the line of action of the force a[nd] the object

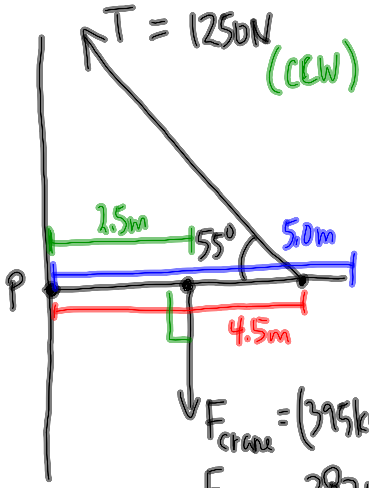
(+) CCW

(−) CW

rotations or twisting caused by F,

but the torque vector is actully perpendicular to the plane that F a[nd r] lie in.

MP|493



$F_{crane} = (395kg)(9.81 m/s^2)$

$F_{crane} = 3874.95N$

CW

⊖

a) Torque from cable:

$\tau = rF\sin\theta$

$\tau = (4.5m)(1250N)\sin 55°$

$\tau = 4607.73\ N\cdot m$

$\vec{\tau} = +4.6\times10^3\ N\cdot m$

$\vec{\tau} = 4.6\times10^3\ N\cdot m$ [out of the board]

* The rotation is in the plane of the board, but torque vector is perpendicular to the plane (3D).

b) the torque from the crane's weight:

$\tau = r_\perp F$

$\tau = (2.5m)(3874.95N)$

$\vec{\tau} = -9.7\times10^3\ N\cdot m$

or $\vec{\tau} = 9.7\times10^3\ N\cdot m$ [into the board]

Since $\tau_T < \tau_{crane}$, the crane has a CW rotation & is NOT in static equilibrium

TO DO:

1. FOP|6-3|#1
2. PP|495

* ladder ⇒ take the bottom of the ladder as your pivot