Monday, February 27, 2017 1:08 PM

Wed. March 1st

Announcements

Sign up for the Quiz 3 Retake!

Sunday – Tuesday
March 5-7

If retake score is higher than 1st score, final score will be calculated as:

$$S_{Final} = \frac{2}{3} S_{Retake} + \frac{1}{3} S_{1st}$$

If retake score is lower, then

$$S_{Final} = S_{1st}$$

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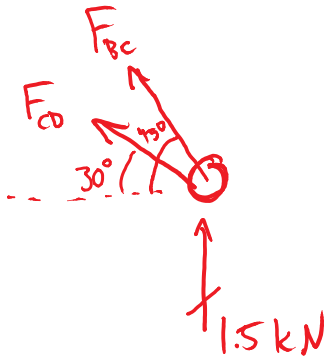
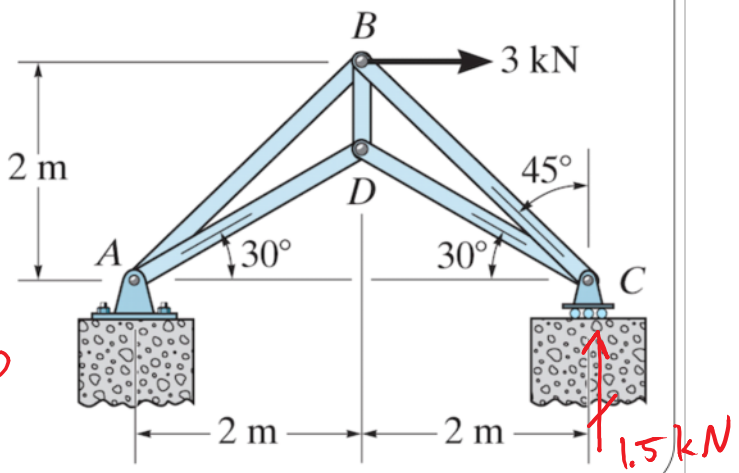
We will determine the force in each member of the truss and indicate whether the members are in tension or compression.

Evaluate the forces F_{CD} and F_{BC}

FBD of the pin at C





$\Sigma F_x = 0$

$\Rightarrow -F_{CD}\cdot\cos 30^\circ - F_{BC}\cdot\cos 45^\circ = 0$

$F_{CD} = -F_{BC}\cdot\dfrac{\cos 45^\circ}{\cos 30^\circ}$

$F_{CD} = -F_{BC}\dfrac{\sqrt{2}/2}{\sqrt{3}/2} = -F_{BC}\cdot\sqrt{2/3}$

$\Sigma F_y = 0 \Rightarrow 1.5\,kN + F_{CD}\cdot\underbrace{\sin 30^\circ}_{1/2} + F_{BC}\cdot\underbrace{\sin 45^\circ}_{\sqrt{2}/2} = 0$

$\frac{1}{2}F_{CD} + \frac{\sqrt{2}}{2}F_{BC} = -1.5\,kN$

$\frac{1}{2}\left(-F_{BC}\sqrt{2/3}\right) + \frac{\sqrt{2}}{2}F_{BC} = -1.5\,kN$

solve: $F_{BC} = -5.02\,kN$ Compression

$F_{CD} = 4.1\,kN$ Tension

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We will determine the force in each member of the truss and indicate whether the members are in tension or compression.

6) Evaluate the force $\boldsymbol{F}_{\mathbf{DA}}$:

A. 4.10 kN (tension)

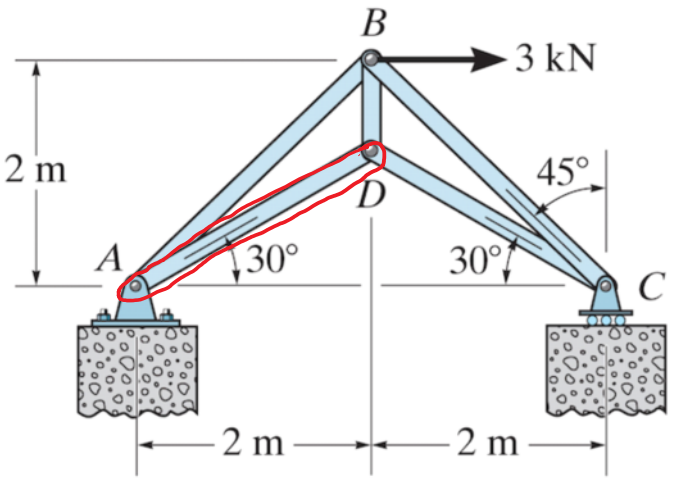
B. 4.10 kN (compression)

C. 7.10 kN (tension)

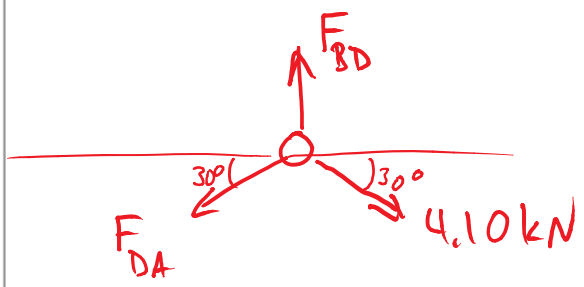
D. 7.10 kN (compression)

E. None of the above

$F_{CD} = 4.10\,kN$



FBD @ D



$\sum F_x = 0$

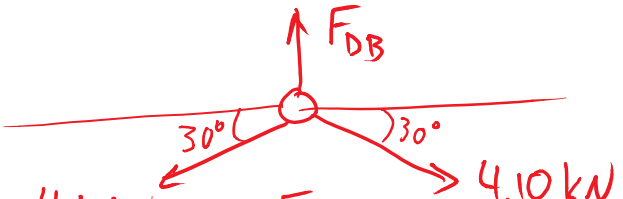
$(4.10\,kN)\cos 30° - F_{DA}\cdot\cos 30° = 0$

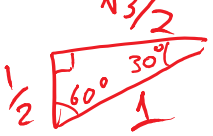
$F_D = 4.10\,kN$ Symmetry!

We will determine the force in each member of the truss and indicate whether the members are in tension or compression.

7) Evaluate the force $\boldsymbol{F_{DB}}$:

A. 4.10 kN (tension)
B. 4.10 kN (compression)
C. 7.10 kN (tension)
D. 7.10 kN (compression)
E. None of the above





$\Rightarrow \sin 30° = 1/2$

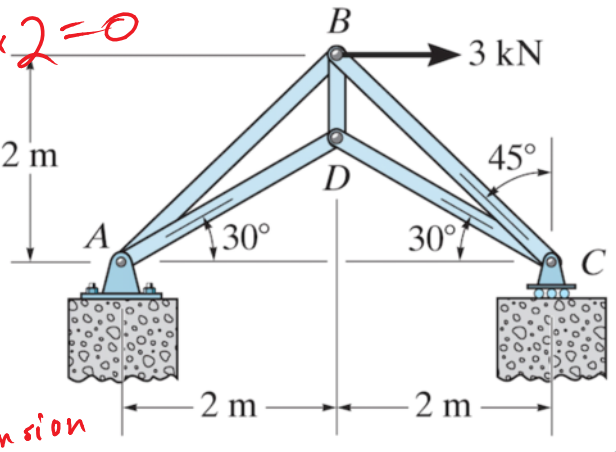
$\Sigma F_y = F_{DB} - (4.10kN)\sin 30° \times 2 = 0$

$1/2$

$F_{DB} - 4.10kN = 0$

$F_{DB} = 4.10kN$

Tension

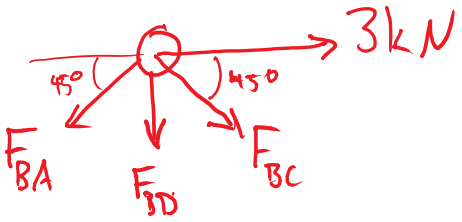


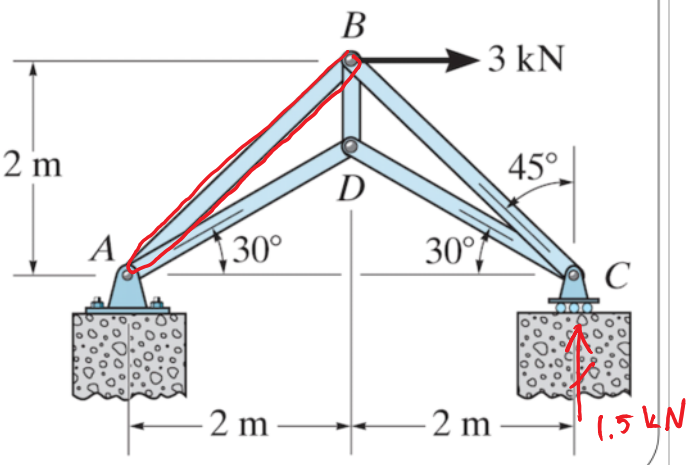
We will determine the force in each member of the truss and indicate whether the members are in tension or compression.

Evaluate the force F_{AB}:

FBD @ B

$F_{BC} = -5.02\,kN$





$\Sigma F_x = 0$

$-F_{BA}\frac{\sqrt{2}}{2} + F_{BC}\frac{\sqrt{2}}{2} + 3kN = 0$

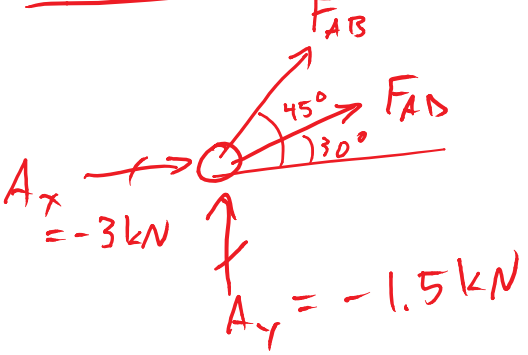
$F_{BA} = \left(F_{BC}\frac{\sqrt{2}}{2} + 3kN\right)\sqrt{2}$

$= F_{BC} + \sqrt{2}\cdot 3kN$

$= (-5.02\,kN) + 3\sqrt{2}\,kN$

$F_{BA} = -0.777\,kN$ compression

At A



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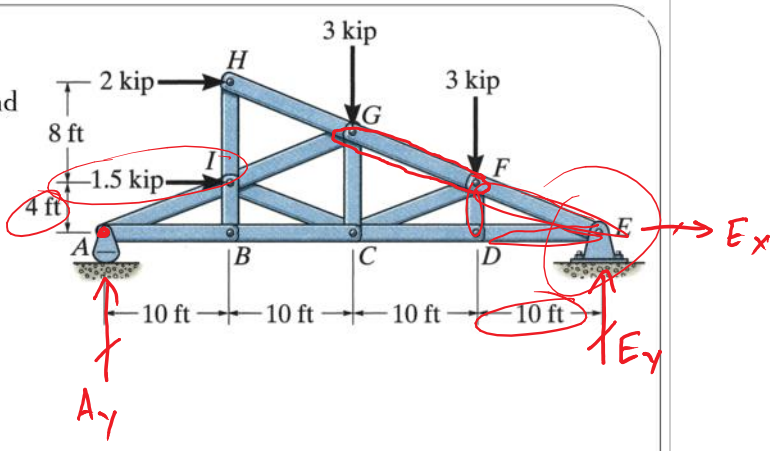
Example 2)
Determine the force in member *FG* of the truss and state if the member is in tension or compression.



1 kip = 1 kilo-pound
= 1000 lbs

1. Find reaction forces

$(\Sigma M)_A = -(1.5\,kip)(4') - (2\,kips)(12') - (3\,kips)(20') - (3\,kips)(30') + (40')\cdot E_y = 0$

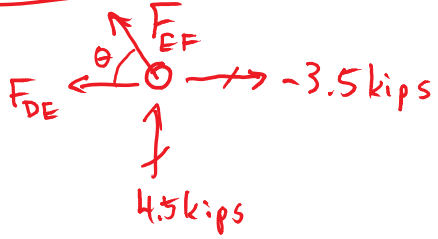
$(-6-24-60-90)\,kips = -40\cdot E_y \Rightarrow \boxed{E_y = 4.5\,kips}$

$\Sigma F_y = 0 \Rightarrow A_y + E_y - 2(3\,kips) = 0$

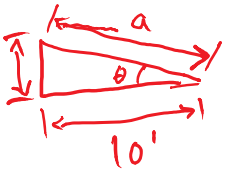
$\boxed{A_y = 6\,kips - E_y = 1.5\,kips}$

$\Sigma F_x = 0 \Rightarrow 3.5\,kips + E_x = 0 \Rightarrow \boxed{E_x = -3.5\,kips}$

FBD @ E



Find θ



$a^2 = (10')^2 + (4')^2 = 116\,ft^2$

$a = \sqrt{116}\,ft$

$\Rightarrow \begin{cases} \sin\theta = \frac{4}{\sqrt{116}} \\ \cos\theta = \frac{10}{\sqrt{116}} \end{cases}$

$\Sigma F_y = 0 \Rightarrow 4.5\,kips + F_{EF}\cdot\sin\theta = 0$

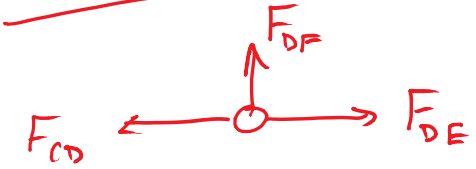
$\boxed{F_{EF} = \frac{-4.5\,kips}{(4/\sqrt{116})} = -12.1\,kips}$

$\Sigma F_x = 0 \Rightarrow -F_{\cdot} - F_{\cdot\cdot}\cdot\cos\theta - 3.5\,kips = 0$

$\Sigma F_x = 0 \Rightarrow -F_{DE} - F_{EF}\cos\theta - 3.5\,\text{kips} = 0$

solve: $\boxed{F_{DE} = 7.75\ \text{kips}}$

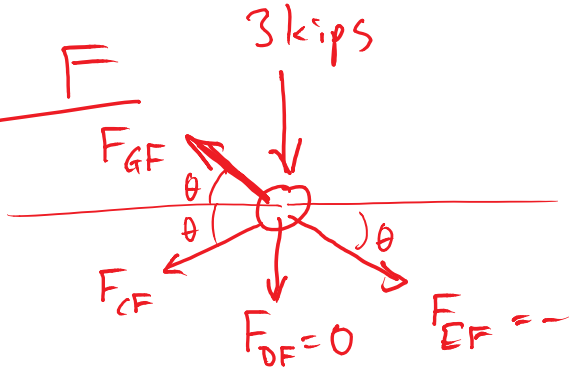
Joint D



$\Sigma F_y = 0$

$\boxed{0 = F_{DF}\ !}$ zero force member

Joint F



$\Sigma F_y = 0$

$\Rightarrow -3\,\text{kips} - F_{EF}\sin\theta - F_{CF}\sin\theta + F_{GF}\sin\theta = 0$

$(F_{GF} - F_{EF} - F_{CF})\sin\theta = 3\,\text{kips}$

F_{GF}, F_{EF}: unknown; F_{CF}: known; $\sin\theta = 4/\sqrt{16}$

$\Sigma F_x = 0$

$\Rightarrow -F_{GF}\cos\theta - F_{CF}\cos\theta + F_{EF}\cos\theta = 0$

$(F_{EF} - F_{GF} - F_{CF})\cos\theta = 0$

$\rightarrow = 0$

simplify to get:

$$\begin{cases} F_{GF} - F_{CF} = 20.18 \text{ kips} \\ F_{GF} + F_{CF} = -12.1 \text{ kips} \end{cases}$$

$F_{CF} = -16.1$ kips comp.

$F_{GF} = 4.04$ kips tension

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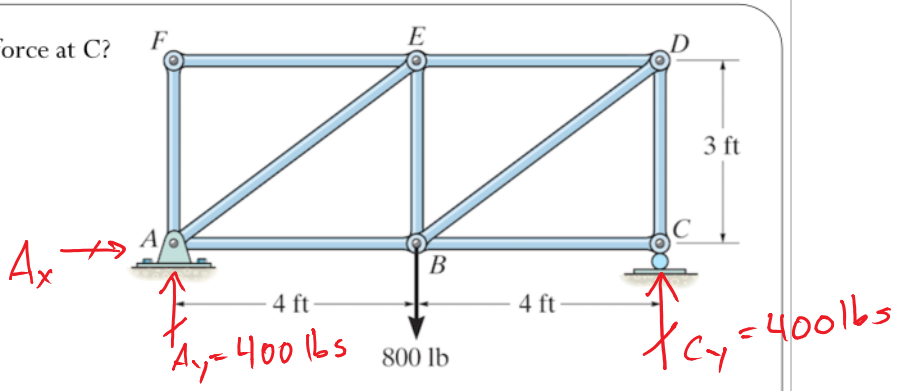
Example 3) What is the reaction force at C?

A. 400 lb↑
B. 200 lb↑
C. 400 lb ↓
D. 200 lb ↓



A_x →

$A_y = 400$ lbs

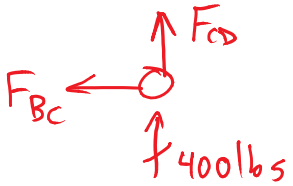
$C_y = 400$ lbs

Use the method of joints to determine the internal force in all the truss members. Use the convention that members in tension have positive internal forces and members in compression have negative internal forces

A. *0*
B. 400 lb
C. −400 lb
D. 666.7 lb
E. −666.7 lb

DC

BC



$\Sigma F_y = 0$

$\Rightarrow F_{CD} = -400$ lbs

Zero force member

$F_{BC} = 0$

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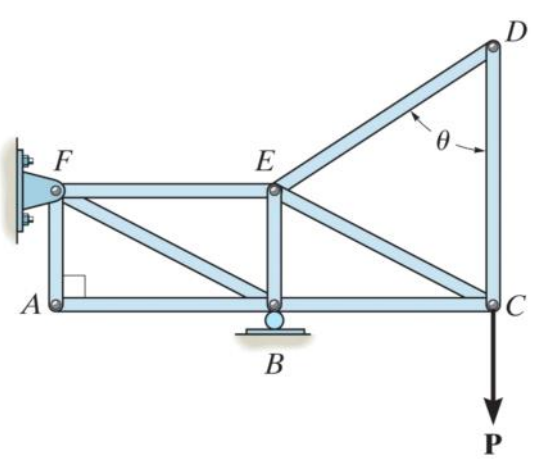
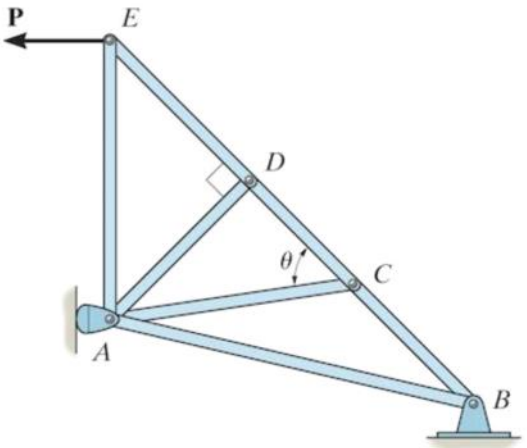
Zero-force members

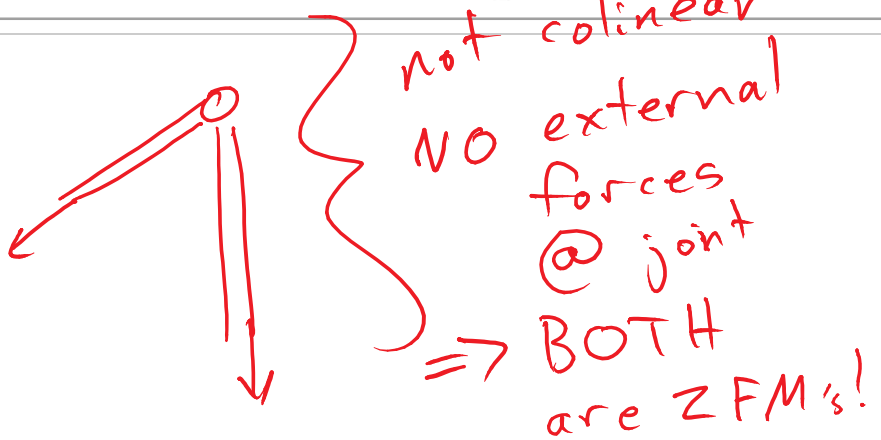
- Particular members in a structure may experience no force for certain loads.
- Zero-force members are used to increase instability
- Identifying members with zero-force can expedite analysis.

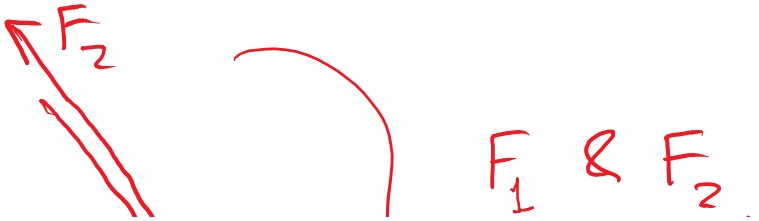
Two situations:

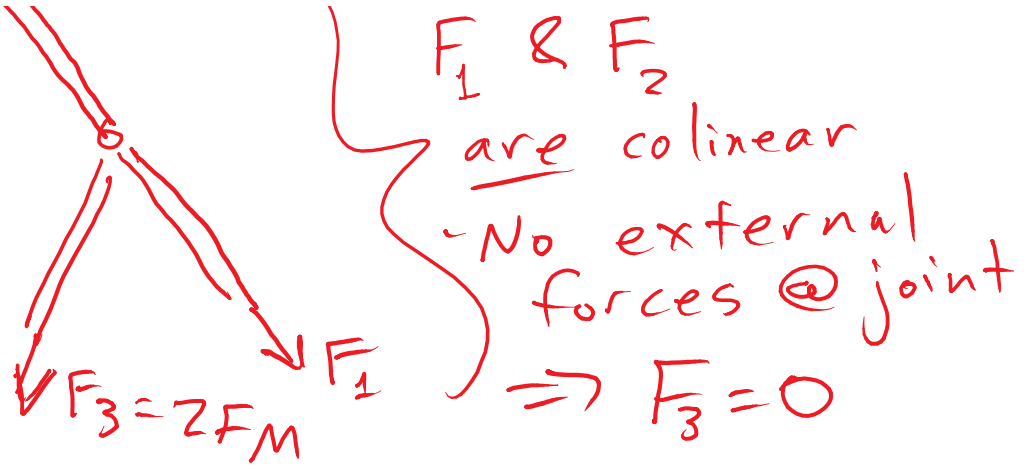
- Joint with two non-collinear members, no external or support reaction applied to the joint → **Both members are zero-force members.** (ZFM)
- Joint with two collinear member, plus third non-collinear, no loads applied to the joint → **Non-collinear member is a zero-force member.**










F_1 & F_2
are colinear
- No external forces @ joint
$\Rightarrow F_3 = 0$
F_1
$F_3 = 2F_M$