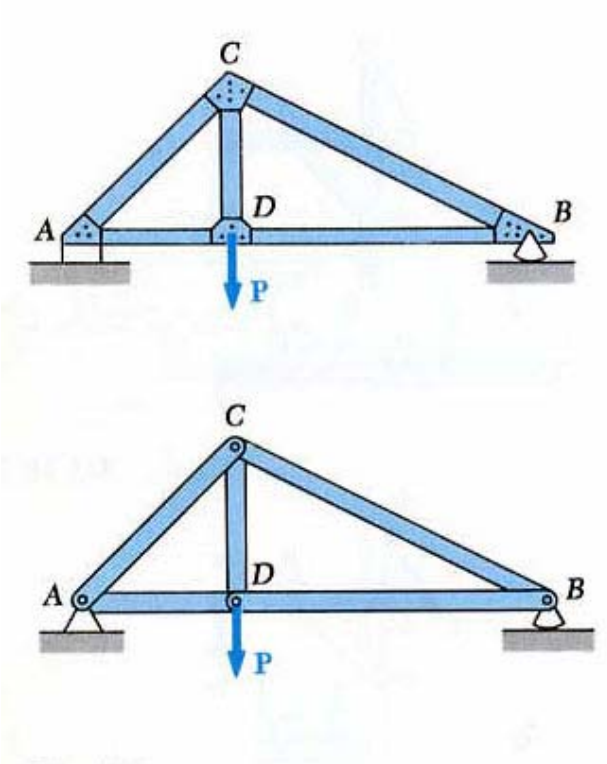
Truss – Assumptions

There are four main assumptions made in the analysis of truss

1. Truss members are connected together at their ends only.
2. Truss are connected together by frictionless pins.
3. The truss structure is loaded only at the joints.
4. The weights of the members may be neglected.

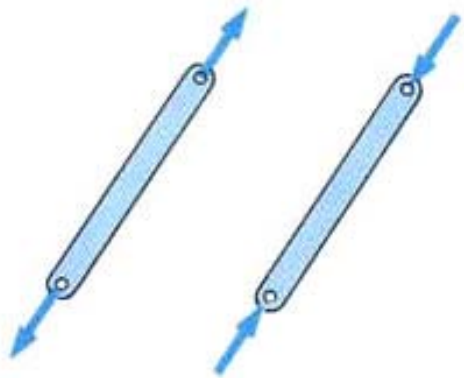
Simple Truss

The basic building block of a truss is a triangle. Large truss are constructed by attaching several triangles together A new triangle can be added truss by adding two members and a joint. A truss constructed in this fashion is known as a simple truss.



Method of Joints -Truss

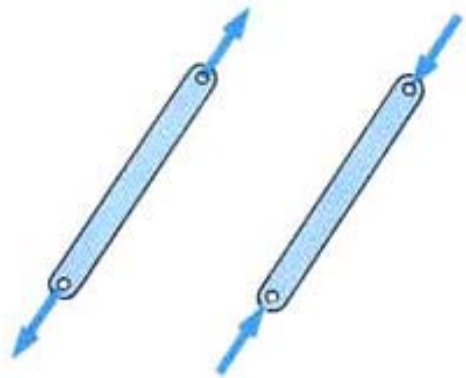
The truss is made up of single bars, which are either in compression, tension or no-load. The means of solving force inside of the truss use equilibrium equations at a joint. This method is known as the method of joints.



Method of Joints -Truss

The method of joints uses the summation of forces at a joint to solve the force in the members. It does not use the moment equilibrium equation to solve the problem. In a two dimensional set of equations,

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

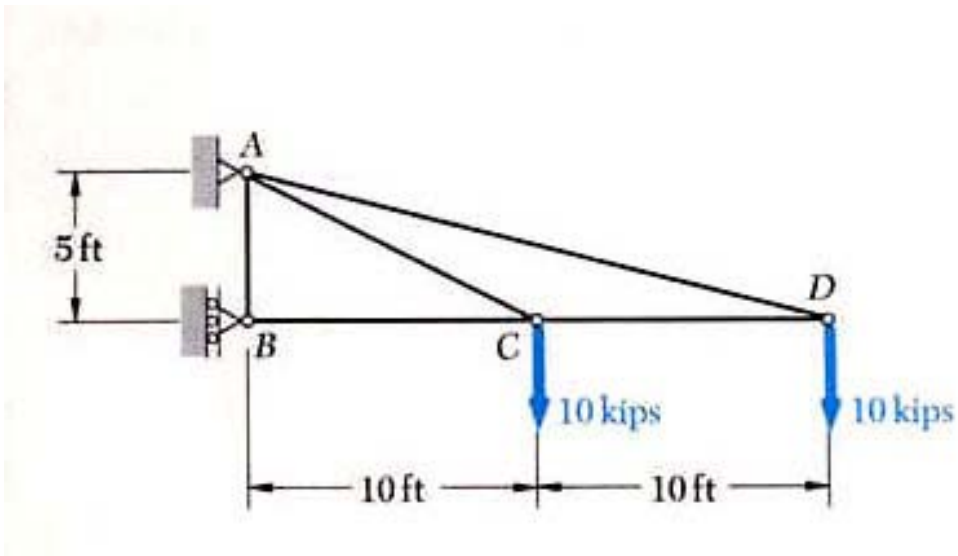


In three dimensions,

$$\sum F_z = 0$$

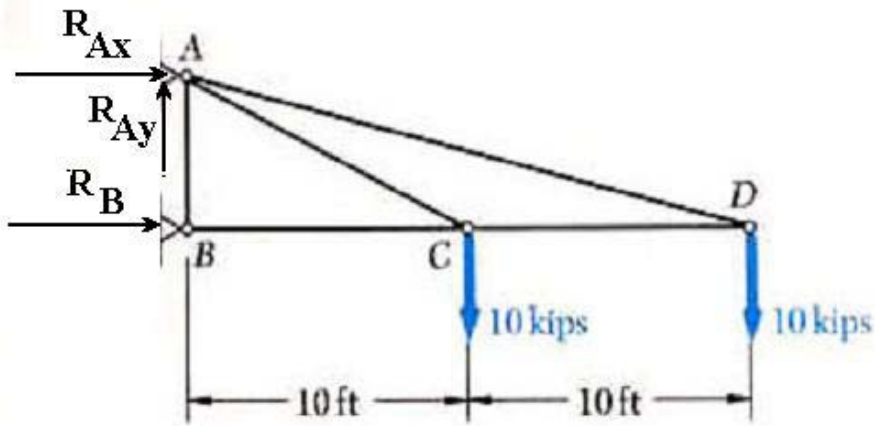
Truss – Example Problem

Determine the loads in each of the members by using the method of joints.



Truss – Example Problem

Draw the free-body diagram. The summation of forces and moment about B result in



$$\sum F_x = 0 = R_{Ax} + R_B$$

$$\sum F_y = 0 = R_{Ay} - 10 \text{ kips} - 10 \text{ kips} \Rightarrow R_{Ay} = 20 \text{ kips}$$

$$\sum M_A = 0 = R_B(5 \text{ ft}) - 10 \text{ kips}(10 \text{ ft}) - 10 \text{ kips}(20 \text{ ft})$$

$$\Rightarrow R_B = 60 \text{ kips}$$

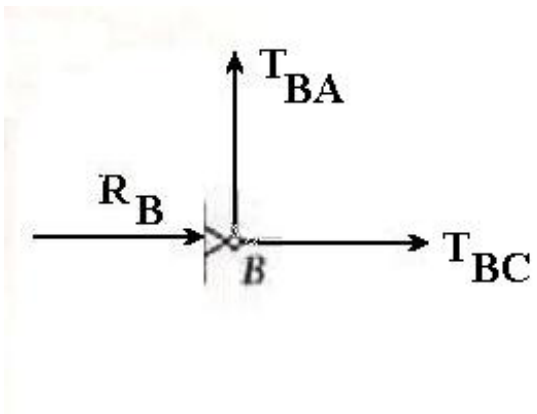
$$\Rightarrow R_{Ax} = -60 \text{ kips}$$

Truss – Example Problem

Look at Joint B

$$\sum F_x = 0 = T_{BC} + R_B = T_{BC} + 60 \text{ kips} \Rightarrow T_{BC} = -60 \text{ kips}$$

$$\sum F_y = 0 = T_{BA} \Rightarrow T_{BA} = 0 \text{ kips}$$



Truss – Example Problem

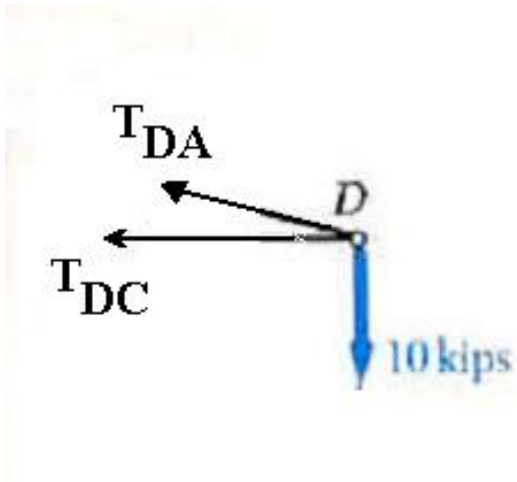
Look at Joint D and find the angle

$$\alpha = \tan^{-1}\left(\frac{5 \text{ ft.}}{20 \text{ ft.}}\right) = 14.04^{\circ}$$

$$\sum F_x = 0 = -T_{DC} - T_{DA}\cos\alpha$$

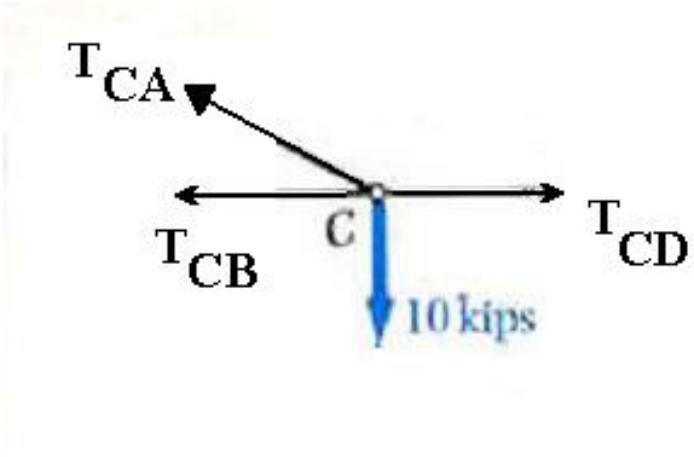
$$\sum F_y = 0 = T_{DA}\sin\alpha - 10 \text{ kips} \Rightarrow T_{DA} = 41.231 \text{ kips}$$

$$T_{DC} = -40 \text{ kips}$$



Truss – Example Problem

Look at Joint C and find the angle



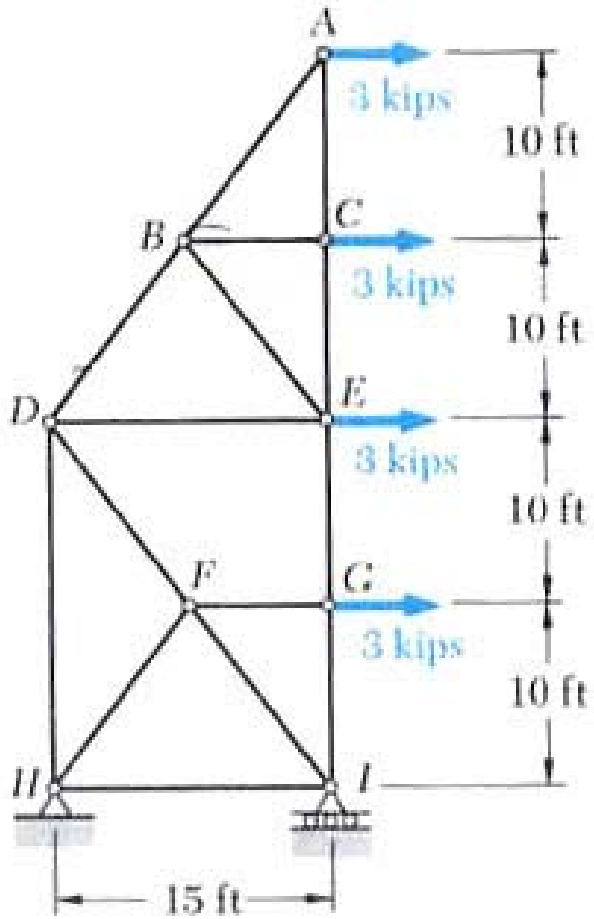
$$\beta = \tan^{-1}\left(\frac{5 \text{ ft.}}{10 \text{ ft.}}\right) = 26.565^{\circ}$$

$$\sum F_{\text{y}} = 0 = T_{\text{CA}} \sin\beta - 10 \text{ kips} \Rightarrow T_{\text{CA}} = 22.361 \text{ kips}$$

$$\begin{aligned}\sum F_{\text{x}} &= 0 = T_{\text{CD}} - T_{\text{CA}} \cos\beta - T_{\text{CB}} \\ &= \left(-40 \text{ kips}\right) - \left(22.361 \text{ kips}\right)\cos\left(26.565^{\circ}\right) - \left(-60 \text{ kips}\right) \\ &= 0\end{aligned}$$

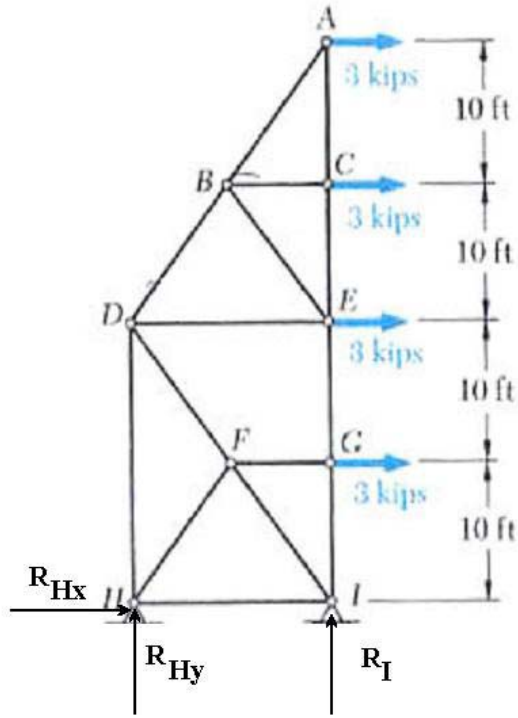
Example Problem

Determine the forces in members FH, DH,EG and BE in the truss using the method of sections.



Truss – Example Problem

Draw the free-body diagram. The summation of forces and moment about H result in



$$\sum F_x = 0 = R_{Hx} + 3 \text{ kips} + 3 \text{ kips} + 3 \text{ kips} + 3 \text{ kips}$$

$$\Rightarrow R_{Hx} = -12 \text{ kips}$$

$$\sum F_y = 0 = R_{Hy} + R_I$$

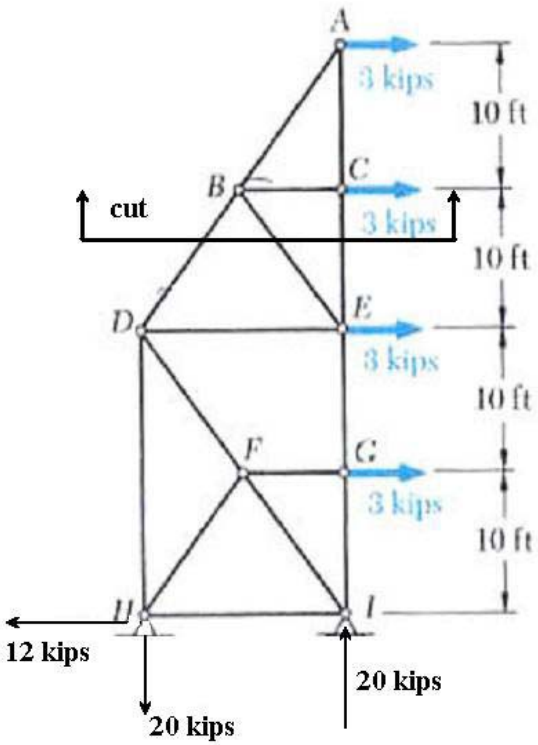
$$\sum M_H = 0 = R_I(15 \text{ ft}) - 3 \text{ kips}(10 \text{ ft}) - 3 \text{ kips}(20 \text{ ft}) - 3 \text{ kips}(30 \text{ ft}) - 3 \text{ kips}(40 \text{ ft})$$

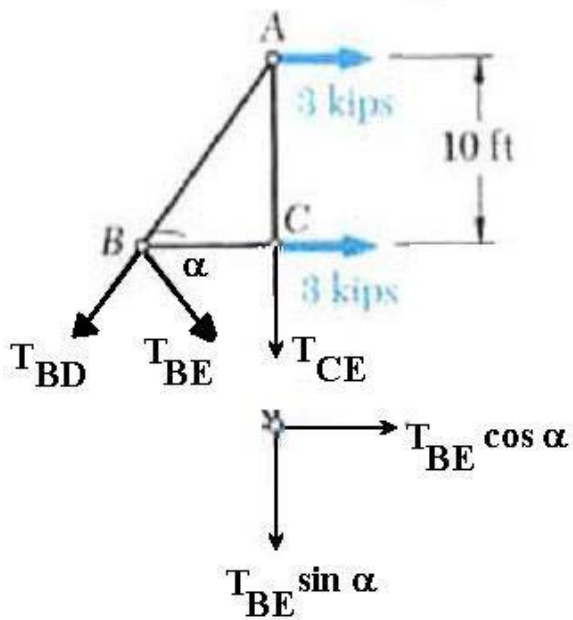
$$\Rightarrow R_I = 20 \text{ kips}$$

$$\Rightarrow R_{Hy} = -20 \text{ kips}$$

Truss – Example Problem

Do a cut between BD and CE





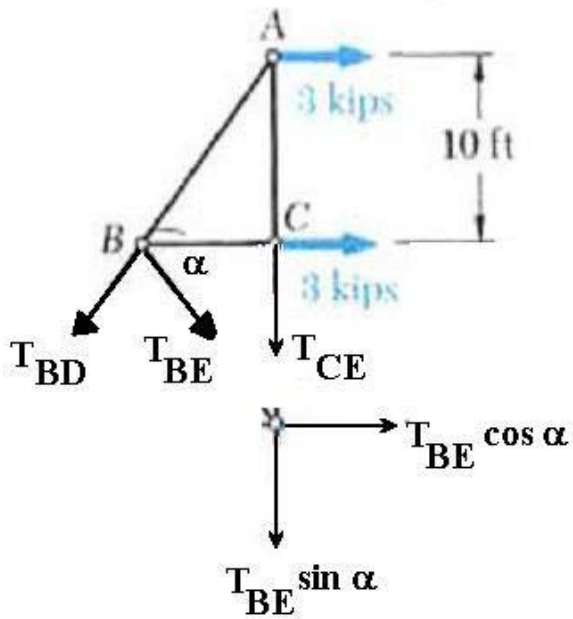
Truss – Example Problem

Take moment about A

$$\alpha = \tan^{-1}\left(\frac{10 \text{ ft}}{7.5 \text{ ft}}\right) = 53.13^0$$

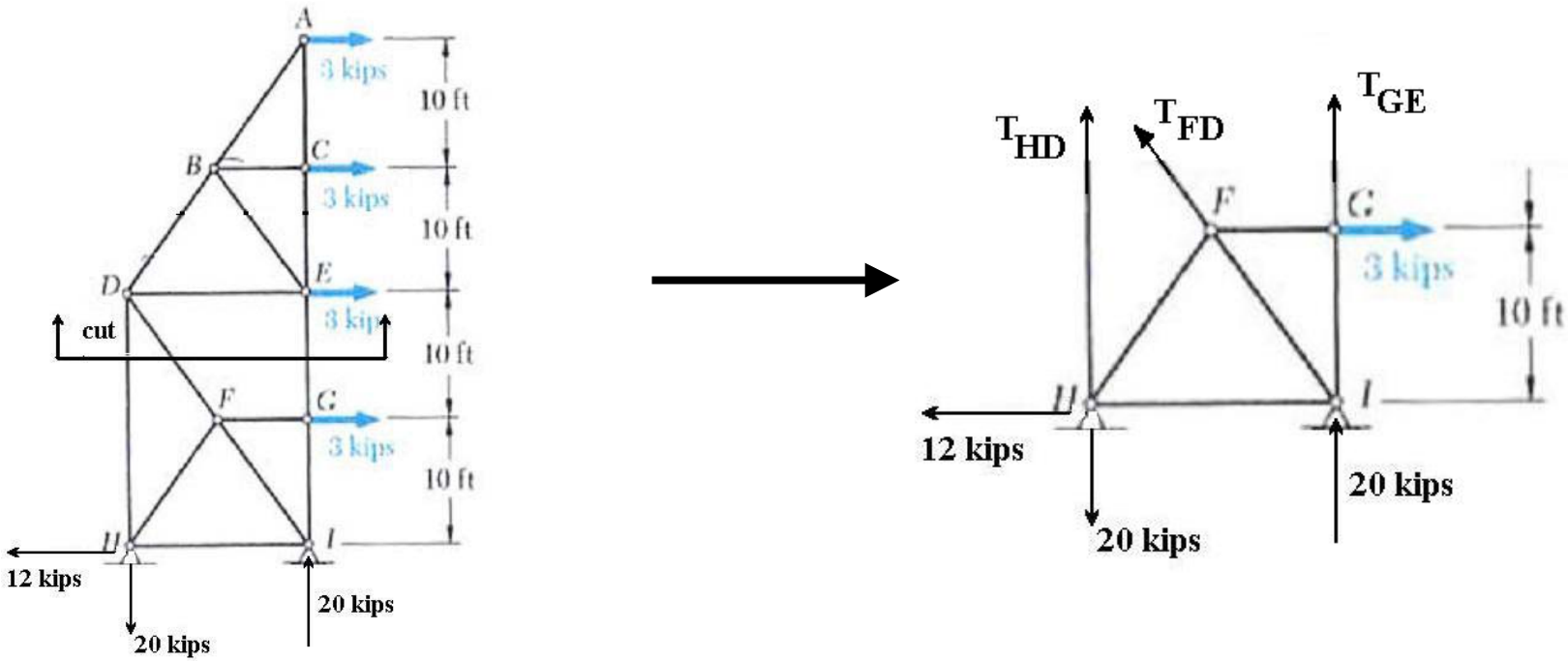
$$\sum M_A = 0 = T_{CE}\cos\left(53.13^0\right)\left(20 \text{ ft}\right) + 3 \text{ kips}\left(10 \text{ ft}\right)$$

$$\Rightarrow T_{CE} = -2.5 \text{ kips}$$



Truss – Example Problem

Do a cut between HD and GE

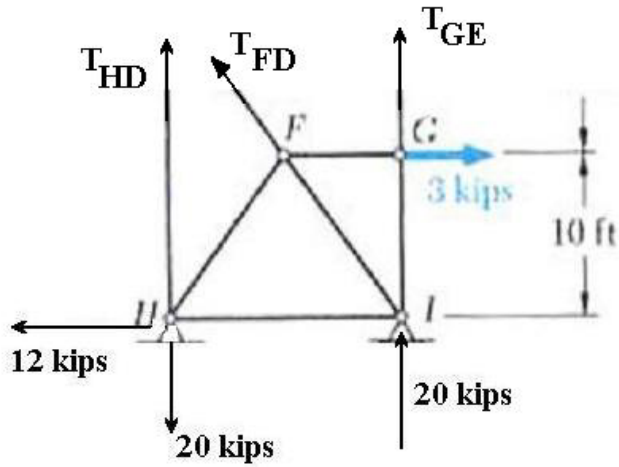


Truss – Example Problem

Take the moment about I

$$\sum M_{\mathrm{I}} = 0 = 20\ \text{kips}(15\ \text{ft}) - T_{\mathrm{HD}}(15\ \text{ft}) - 3\ \text{kips}(10\ \text{ft})$$

$$\Rightarrow T_{\mathrm{HD}} = 18\ \text{kips}$$



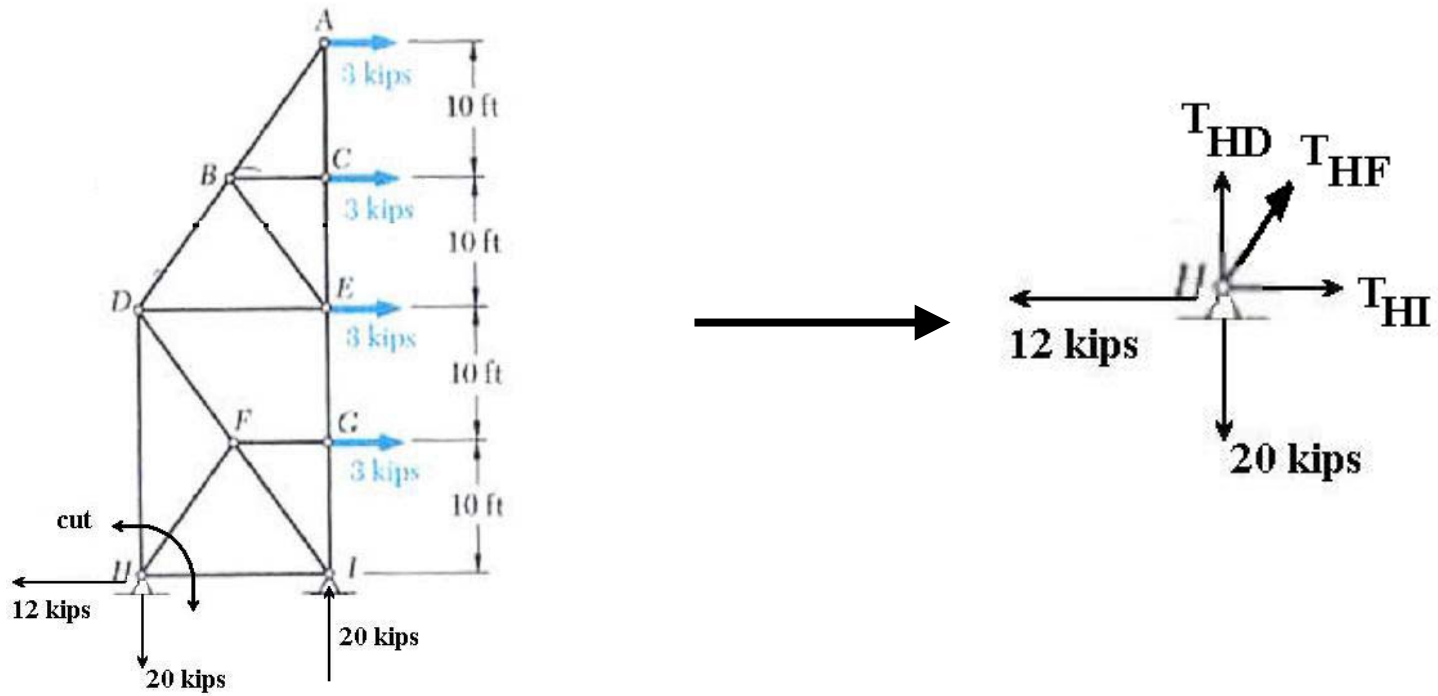
Take the moment about D

$$\sum M_{\mathrm{D}} = 0 = -12\ \text{kips}(20\ \text{ft}) + 20\ \text{kips}(15\ \text{ft}) + 3\ \text{kips}(10\ \text{ft}) + T_{\mathrm{GE}}(15\ \text{ft})$$

$$\Rightarrow T_{\mathrm{GE}} = -6\ \text{kips}$$

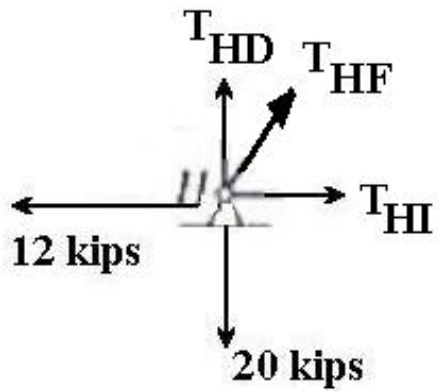
Truss – Example Problem

Do a cut between HD and HI



Truss – Example Problem

Take the sum of forces in y direction



$$\alpha = \tan^{-1}\left(\frac{10\text{ ft}}{7.5\text{ ft}}\right) = 53.13^0$$

$$\sum F_y = 0 = T_{HF}\sin\left(53.13^0\right) + T_{HD} - 20\text{ kips}$$

$$\Rightarrow T_{HF} = \frac{20\text{ kips} - 18\text{ kips}}{\sin\left(53.13^0\right)} = 2.5\text{ kips}$$