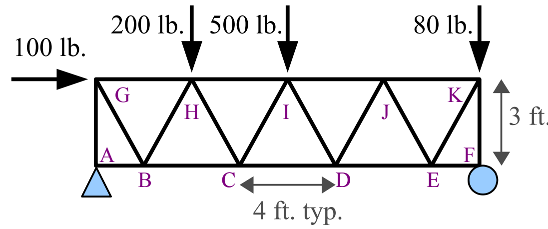
ET 190 – Statics

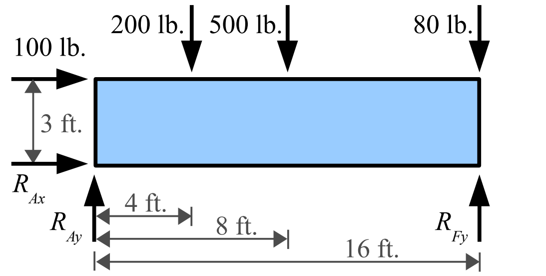
Method of Sections



The Method of Joints is the best way to calculate the tensile or compressive forces in every member of a truss. However, if you only need the forces in a few members, the Method of Sections will save you time.

Problem Find the forces in members *ID* and *CD*.

Step 1 Calculate reaction forces at the supports, using three equations: $\Sigma M=0$, $\Sigma F_x=0$, and $\Sigma F_y=0$. Treat the truss as a solid body, since reaction forces depend only on external forces and dimensions.



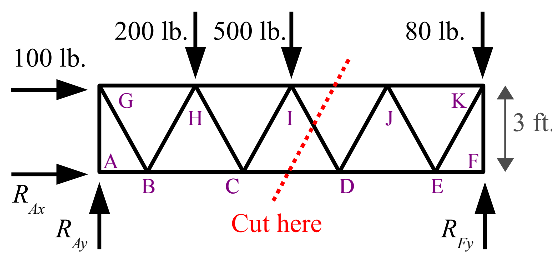
$$\Sigma M_A=0=-3\,\text{ft.}(100\,\text{lb.})-4\,\text{ft.}(200\,\text{lb.})-8\,\text{ft.}(500\,\text{lb.})$$
$$-16\,\text{ft.}(80\,\text{lb.})+16\,\text{ft.}\,R_{Fy}$$

$$R_{Fy}=\frac{-3\,\text{ft.}(100\,\text{lb.})-4\,\text{ft.}(200\,\text{lb.})-8\,\text{ft.}(500\,\text{lb.})-16\,\text{ft.}(80\,\text{lb.})}{16\,\text{ft.}}$$
$$=398.75\,\text{lb.}$$

$$\Sigma F_y=0=R_{Ay}+R_{Fy}-200\,\text{lb.}-500\,\text{lb.}-80\,\text{lb.}$$
$$R_{Ay}=-398.75\,\text{lb.}+200\,\text{lb.}+500\,\text{lb.}+80\,\text{lb.}=381.25\,\text{lb.}$$
$$\Sigma F_x=0=100\,\text{lb.}+R_{Ax}\rightarrow R_{Ax}=-100\,\text{lb.}$$

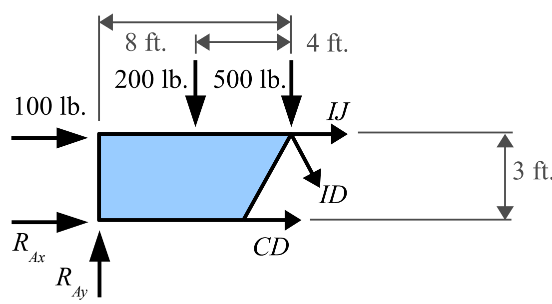
Since R_{Ax} is negative, the arrow is drawn backwards. Draw the arrow the same way in all subsequent diagrams, and use $R_{Ax}=-100\,\text{lb.}$

Step 2 Cut the truss. The cut must pass through a member you are solving for. The cut does not have to be vertical, or even straight, but it should pass through the fewest possible members. In this problem, a single cut passes through members *ID* and *CD*. In some problems, you may need to make more than one cut to calculate all the required forces.



Step 3 Draw one portion of the cut truss. Draw cut members as if they were external forces acting on the cut portion.

Step 4 Use $\Sigma M_I=0$, $\Sigma F_x=0$, and $\Sigma F_y=0$ to calculate the forces in the cut members.

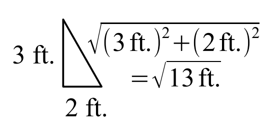


$$\Sigma M_I=0=3\,\text{ft.}\,CD+4\,\text{ft.}(200\,\text{lb.})+3\,\text{ft.}\,R_{Ax}-8\,\text{ft.}\,R_{Ay}$$

$$CD=\frac{-4\,\text{ft.}(200\,\text{lb.})-3\,\text{ft.}(-100\,\text{lb.})+8\,\text{ft.}(38125\,\text{lb.})}{3\,\text{ft.}}=850\,\text{lb.}$$

CD is positive, so the arrow is drawn correctly. *CD* = 850lb. tension.

The vertical component of *ID* is $\frac{3}{\sqrt{13}}ID$.



$$\Sigma F_y=0=R_{Ay}-200\,\text{lb.}-500\,\text{lb.}-\frac{3}{\sqrt{13}}ID$$

$$ID=\frac{381.25\,\text{lb.}-200\,\text{lb.}-500\,\text{lb.}}{3/\sqrt{13}}=-383.09\,\text{lb.}$$

ID is negative, so the arrow is drawn backwards.

ID = 383.09 lb. compression.

Alternate Solution Use the other portion of the cut truss. This solution looks simpler…instead of three applied loads and two reaction forces, there is only one applied load and one reaction force. Use $\Sigma F_y = 0$ to find *ID*, then use $\Sigma M_J = 0$ to find *CD*.