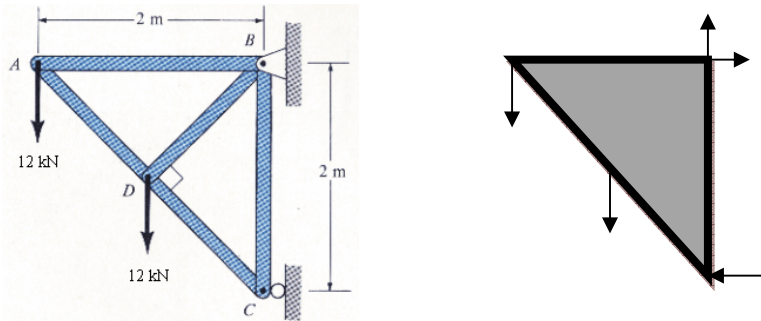


Engineering Statics HW 4 Notes

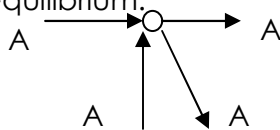
In most cases dealing with trusses it will be very helpful to draw a free body diagram of the truss as a whole with external reactions.



Notice that the internal members and their arrangement are ignored and only external forces and reactions are drawn.

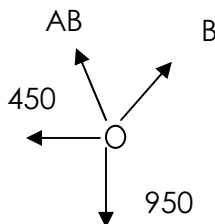
1. Write the equations for the free body diagram related to external and reaction forces. I would sum the moments about point A first because there is only one unknown, C_y . Then the sum of forces in the x direction because there is only one unknown A_x , and then the sum of forces in the y direction, again because there is only one unknown, A_y .

Now that external forces and reactions have been solved, you can approach each joint. Each joint must also satisfy the fact that the sum of forces is equal to zero. I would be inclined to draw a free body diagram of each joint and its equations of equilibrium.



$$\Sigma F_x = 0 = A_x + AC + 6/10 * AB$$

$$\Sigma F_y = 0 = A_y - 8/10 * AB$$

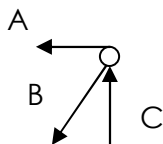


You previously solved for A_x , solve for AB , then AC .

$$\Sigma F_x = 0 = BC * (.707) - 6/10 * AB - 450$$

$$\Sigma F_y = 0 = 8/10 * AB + (.707) * BC - 950$$

You just solved for AB , now solve for BC .



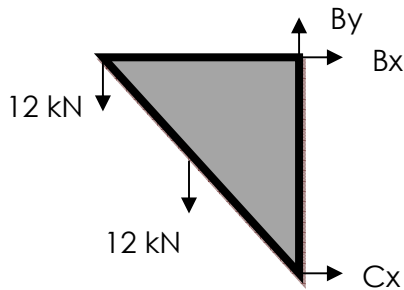
$$\Sigma F_x = 0 = -AC - (.707) * BC$$

$$\Sigma F_y = 0 = C_y - (.707) \cdot BC$$

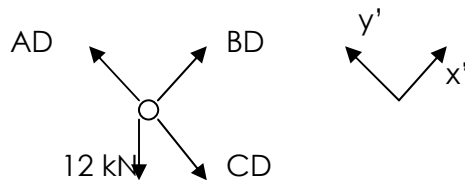
You just solved for BC, now solve for AC.

My rule of thumb when drawing the free body diagram is to represent the truss members in tension – that is, draw the arrows coming out of the joint. If the sign of the force is negative, then that means that the member is in compression, otherwise it's in tension. Also notice that sometimes the equation wasn't necessary. But sometimes, like the very last equation here, it might have been an easier way to solve for BC.

- As before, draw a free body diagram of the entire truss using only external and reaction forces. Solve for the forces at B and C.

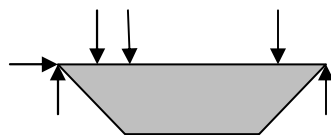


Draw a free body diagram for each joint and write the equations for the sum of forces at each. There are no moments at joints (ever) in trusses, so there is no need for an equation describing the sum of moments. The only 'tricky' joint is D. The forces at this joint can be better described if you rotate your working axes by 45 degrees:



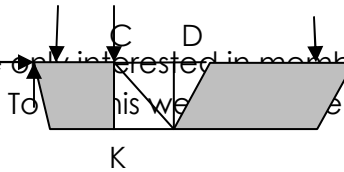
Forces AD and CD are parallel with each other, and BD is perpendicular to them. Set up equations describing the forces according to axes x' and y' .

- More of the same.
- This problem should be solved using 'method of sections'. Like before, draw a free body diagram of the entire truss using external and reaction forces.



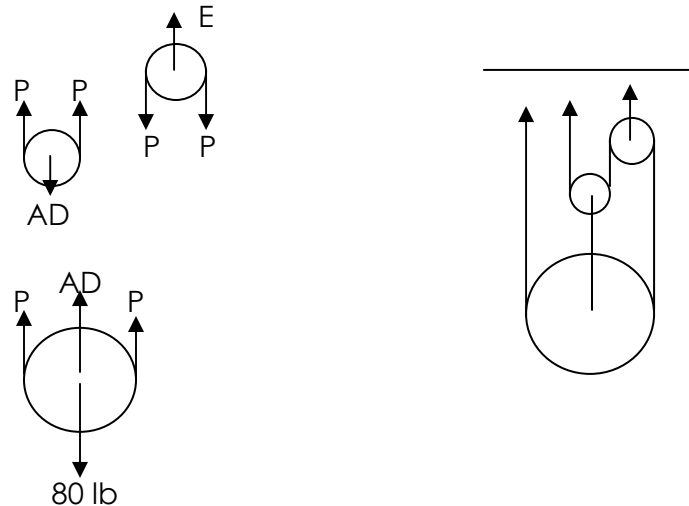
Solve for reactions at A and C.

But we are only interested in members CD, CJ, KJ, and DJ. We will NOT solve for all of the others. To do this we cut the truss into two sections linked by members:



Now it will be much easier to write the equations for each joint.

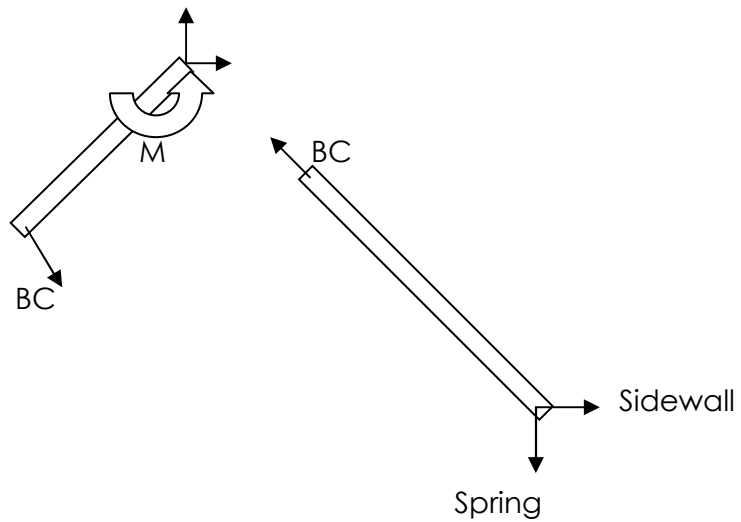
5. More of the same – method of sections.
6. More of the same – method of sections.
7. For a pulley you are best off drawing a free body diagram for each pulley.



Write an equation for the external forces and reactions. Then write a force equation for each pulley. Something to keep in mind is that the tension of the rope is the always the same.

8. Same as above. Draw a free body diagram of the external forces and reactions, and the draw a free body diagram of each pulley and the forces and reaction on each. The solutions will become apparent.
9. You can treat this as a kind of truss where the forces pass through the pin joints. As before, draw a free body diagram of the external and reaction forces. You won't be able to solve these straight away. Draw a free body force diagram of each joint, especially C, and the geometry will present a solution.
10. Similar to above, but with an applied moment for equilibrium. BTW, the spring is in tension, not compression. The first thing to determine is how much the spring has

been stretched when θ is 30 degrees. Knowing that, you can determine the vertical force. Next, draw a free body diagram of each of the two links, AB and BC, with forces at each end.



Write equations of equilibrium for each member and solve for the unknown moment, M . Note that for equilibrium, force BC