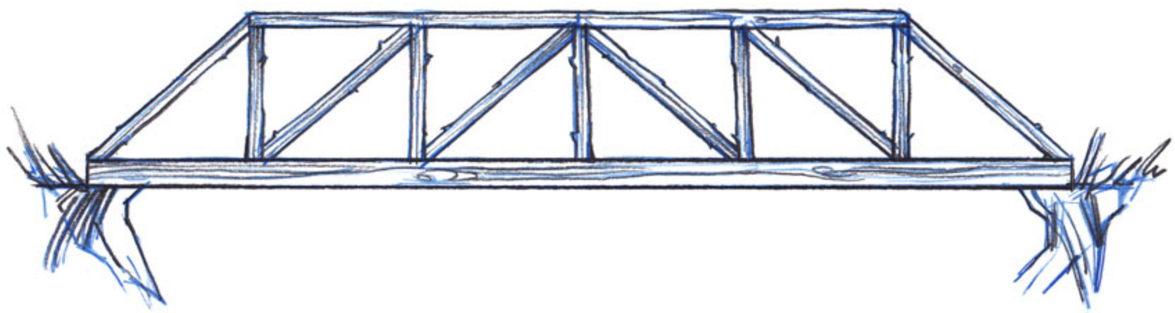
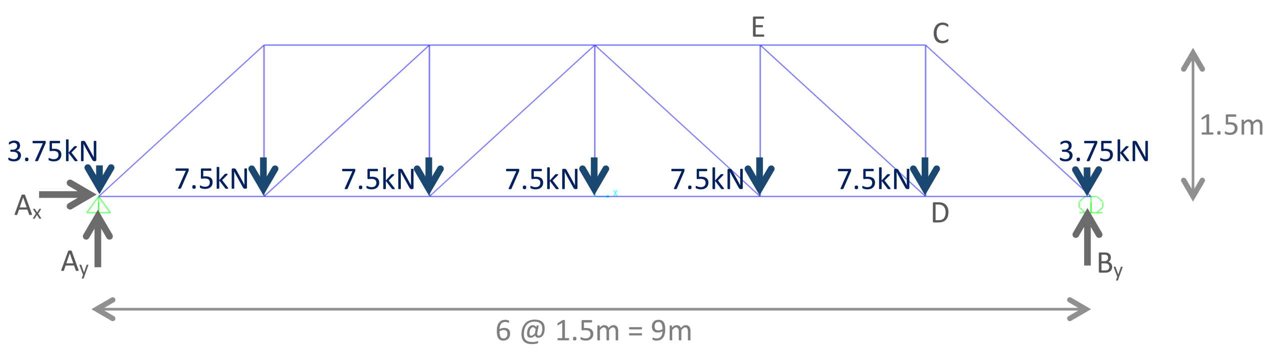
To design a more complicated truss like Owl's truss bridge we would use a similar process of adding loads, likely along the bottom joints, and analyzing the truss joint by joint. This analysis can be done by hand or using a computer program. If you are interested in experimenting with a computer program, I recommend MASTAN 2 (http://www.mastan2.com/), which is a free structural analysis program that you can use to analyze trusses, beams, and much more.



Let's put some loads and dimensions on Owl's bridge. The bridge span is 9m, which is the same as the cable-stayed bridge that Owl initially designed. I'll assume that each panel is 1.5m wide by 1.5m high. Let's assume that the distributed load on the bridge will be about the same as the cable-stayed bridge. The cable-stayed bridge supported a load of 4.48kN/m. Since truss bridges tend to be a bit stronger and stiffer let's design this bridge to support a load of 5kN/m, which translates to point load of 7.5kN (5kN/m * 1.5m) at each of the joints along the bottom of the truss. At the supports a load of 3.75kN (5kN/m * 1.5m/2) will go directly into the support.



Now that we have a working model we can solve for the reaction forces at the supports (A_x, A_y, and B_y). I'll start by using rotational equilibrium to find B_y, then use vertical and horizontal equilibrium to solve for A_y and A_x.

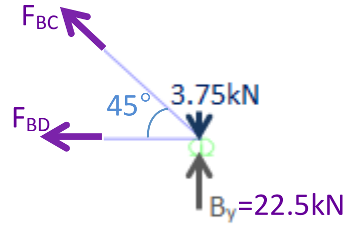
$$\Sigma M_A = 7.5kN*1.5m + 7.5kN*3m + 7.5kN*4.5m + 7.5kN*6m + 7.5kN*7.5m + 3.75kN*9m - By*9m = 0$$
$$B_y = 22.5kN$$

$$\Sigma F_y = A_y + B_y - 3.75kN*2 - 7.5kN*5 = 0$$
$$A_y = 22.5kN$$

$$\Sigma F_x = A_x = 0$$

To determine the forces in each member of the truss we can draw free-body diagrams for each of the joints and progress through the structure, always looking for a joint with two unknown member forces. I'll start with joint B. Note that I always initially assume that the members are in tension and draw them pulling away from the joint.

$\Sigma F_y = 22.5\text{kN} - 3.75\text{kN} + F_{BC} \sin(45°) = 0$
$F_{BC} = -26.5\text{kN}$
The negative sign indicates that this member is in compression

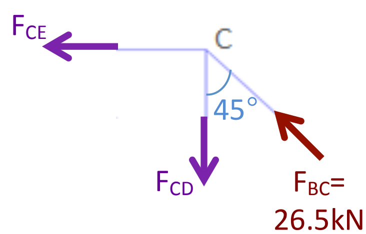


$\Sigma F_x = F_{BC} \cos(45°) + F_{BD} = 0 = -26.5\text{kN}(\cos(45°)) + F_{BD} = 0$
$F_{BD} = 18.75\text{kN}$

Moving on to Joint C, we can continue calculating member forces (note: moving to joint D would not work since there are 3 unknown bar forces there). In the free-body diagram for the joint I drew F_{BC} pushing on the joint since F_{BC} is in compression, which was the result of my previous calculations.

$\Sigma F_y = F_{BC}\cos(45°) - F_{CD} = 26.5\text{kN} \cos(45°) - F_{CD} = 0$
$\mathbf{F_{CD} = 18.75kN}$

$\Sigma F_x = F_{BC} \cos(45°) + F_{CE} = 0 = 26.5\text{kN}(\cos(45°)) + F_{CE} = 0$
$F_{CE} = -18.75\text{kN}$



We could continue to progress through the entire truss joint by joint to find all of the bar forces. We can also turn to a computer program to calculate the forces. Here are the forces I calculated using a computer program (SAP2000). Use the truss simulator to experiment with calculating forces in trusses. Forces shown are in kN; red indicates members in compression (also negative numbers) and purple indicates members in tension (also positive numbers).