Truss analysis

Examine The Truss handout, to become familiar with the shape we are analyzing. This triangle represents your house when looked at from one of the gable ends. Point A is the ridge, and points B and C are the eaves.

For the truss to be stable, points A, B, and C must all experience balanced forces in the x and y direction.

# Point A

We will start our analysis at each point with a free body diagram. This will show all the forces acting on that point.

Put a sheet of blank paper on your blackboard, draw a dot or small circle in the center, and label the point ‘A’. For each force acting on A, draw a vector going into A in the direction of that force.

## X and Y Components

For a force called F\_rafter there are 2 components, F\_rafter-x and F\_rafter-y. Examine the Vector Components handout to visualize how these components add together to equal F\_rafter.

Put a new page on your blackboard, and draw Free Body Diagram of point A again, but for each diagonal force, draw the x and y components instead of the diagonal vector.

## Equilibrium equation of point A in the y direction

0 = 2 \* (F\_rafter-y) - 2 \* ½ \* (F\_load)

Find your Total Rafter Force (from The Roof System lesson). Write this number again for easy reference, and label it F\_load.

Substitute the value of F\_load into the equation and then solve for F\_rafter-y.

## Record the Angle of Your Roof Truss

Using a protractor, measure the angle between your beam and your rafter, or calculate it with the following equation (Roof\_angle) = arctan(roof\_height/tributary\_width).

## Calculate F\_rafter

(F\_rafter) \* sin(Roof\_angle) = (F\_rafter-y)

We know the roof angle and we know F\_rafter-y from the last calculation. Now, substitute them both in and solve for F\_rafter.

## Equilibrium Equation of Point A in the X Direction:

0 = (F\_rafter-x) - (F\_rafter-x)

## Calculation of F\_rafter-x

(F\_rafter) \* cos(Roof\_angle) = (F\_rafter-x)

We know F\_rafter and the angle of the roof. Now, substitute these into the equation and solve for F\_rafter-x

# Point B

Reference your Truss handout again to find point B.

## Draw the Free Body Diagram

Draw the Free Body Diagram of Point B, showing the forces from the load, the rafter, the beam, and the column.

## Elaborate on the Free Body Diagram

Next, on another page, draw the Free Body Diagram again with the x and y components separated and labeled.

## Equilibrium Equation of Point B in the Y Direction:

0 = (F\_column) - ½(F\_load) - (F\_rafter-y)

We know F\_rafter-y and ½ F\_load from earlier calculations. Substitute these values in to calculate F\_column.

## Equilibrium Equation of Point B in the X Direction:

0 = (F\_rafter-x) + (F\_beam)

We know F\_rafter-x from a previous calculation. Substitute it in and solve for F\_beam.

# Point C

Reference your Truss handout again to find point C.

## Draw the Free Body Diagram

Draw the Free Body Diagram of Point C, showing the forces from the load, the rafter, the beam, and the column.

## Elaborate on the Free Body Diagram

Next, on another page, draw the Free Body Diagram again with the x and y components separated and labeled.

## Equilibrium Equation of Point C in the Y Direction:

0 = (F\_column) - ½(F\_load) - (F\_rafter-y)

We know F\_rafter-y and ½ F\_load from earlier calculations. Substitute these values in to calculate F\_column.

## Equilibrium Equation of Point C in the X Direction:

0 = - (F\_beam) - (F\_rafter-x)

We know F\_rafter-x from a previous calculation. Substitute it in and solve for F\_beam.