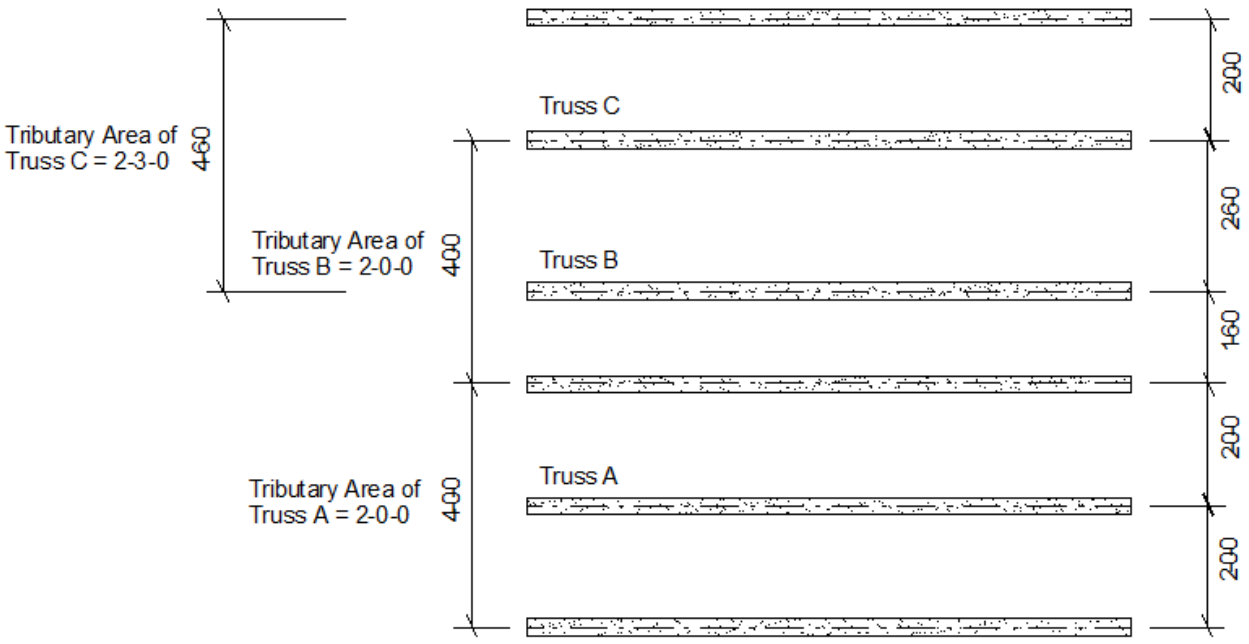
How do I determine the tributary area of a truss?

Tributary area is defined as half of the opening adjacent to both sides of the truss in question. The spacing as shown on MiTek engineering drawings is a tributary area carried by the trusses. The spacing between the trusses may be of any combination as long as the tributary area does not exceed the spacing shown on the engineering drawings.

Each truss is designed to support one-half the roof / floor load on each side. For example, if the distance to an adjacent truss is 30" on one side, and 18" on the other side, the minimum design spacing would be the sum of one-half of the 30" of roof / floor load (15") and one-half of the 18" (9"), which equals 24". This would be equivalent to the minimum tributary area that the truss would need to be designed to carry. Therefore, whether one adjacent truss is 30" away and 18" on the other, the tributary load is the same for the truss as when the adjacent trusses are both 24" away. It is acceptable for as built conditions to have a smaller spacing than what is shown on the truss design drawings.



How does MiTek engineering software determine loading on a girder truss from a carried truss?

The process that the loading from layout in the MiTek software suite goes through is a little more intricate than just applying the reaction of the carried truss to the girder truss. Below in Figure 1, is an example section of a layout. The diagonal hatch lines represent the tributary area (half the distance to the adjacent truss) of the girder and a carried truss. The girder is spaced at 2 ft on center; therefore, it picks up loading from both faces. The carried truss running perpendicular to the girder picks up load on both sides for its full length as well. Consequently, a redundant loading area is created, as shown in the doubly hatched area in Figure 1. The loading from each hatched section is being applied to both the girder truss and the carried truss, if the full reaction from the carried truss is applied to the girder truss.

There is no reason to design for the load twice, thus the loading from layout will take a reduction equal to the load over the shaded area on the carried truss reaction before applying it to the girder truss. The dimensions of the shaded area are half the spacing of the trusses horizontally and the full spacing vertically. Or for trusses 24 inches on center, 1 ft x 2 ft, which creates an area of 2 ft^2.

For example, if the trusses have the loading 42/10/0/10 or 52 psf on the top chord and 10 psf on the bottom chord, the reductions that can be taken from the open-faced jacks are as follows:

→52 psf x 2 ft^2 = 104 lbs on the top chord

→10 psf x 2 ft^2 = 20 lbs on the bottom chord

If the reactions on the open-faced jacks were 63 lbs on the top chord and 36 lbs on the bottom chord, then the reactions being applied to the girder truss would be:

→63 lbs – 104 lbs = 59 lbs (uplift)

→36 lbs – 20 lbs = 16 lbs (down)

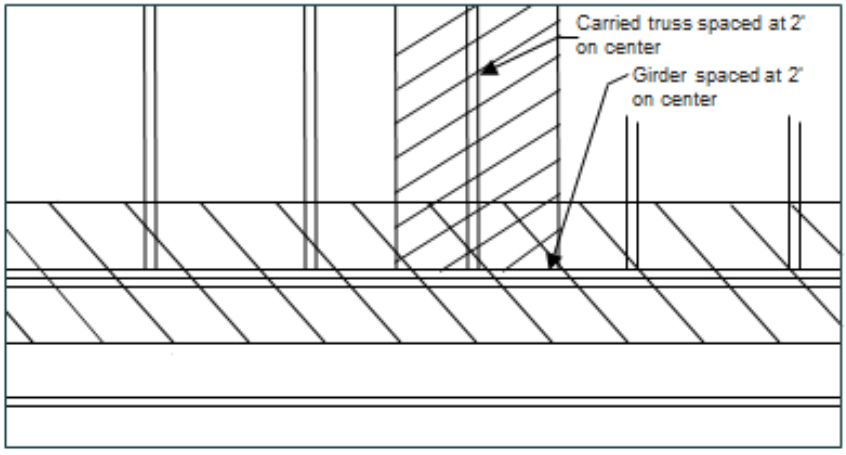


Figure 1

Am I allowed to move a truss if there are obstructions?

Typically, trusses are spaced evenly. Truss Design Drawing shows how far apart trusses are designed to be. Occasionally trusses are installed directly in the path of large drainpipe or other obstructions. Can a truss be moved to avoid obstructions? The answer is maybe.

As shown in Figures 2 and 3 below, moving a single truss can affect the tributary area of the adjacent truss, thus affecting the amount of load it carries. Instead of carrying 2 ft of tributary area as designed, the adjacent truss now carries 2’ 1-1/2” of tributary area. Depending on how close the combined stress index (CSI) values are to 1.0 on the original truss design, increasing the on center spacing to reflect the new tributary area could result in overstressed lumber and plate failures. In addition, in our example the ability to apply repetitive stress is lost, per section 6.4.2.1 of ANSI/TPI 1 (National Design Standard for Metal Plate Connected Wood Truss Construction) repetitive member design values cannot be applied to trusses spaced more than 24 inches on center.

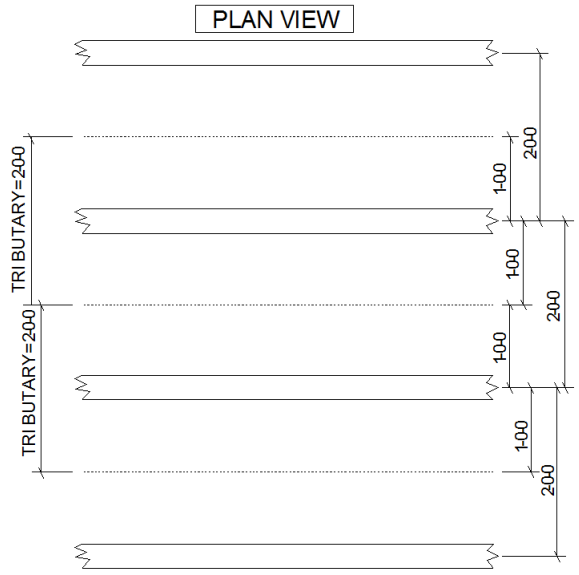


Figure 2

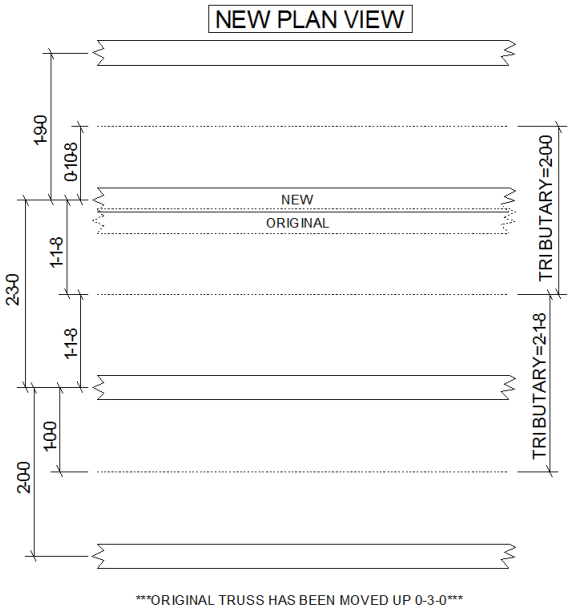


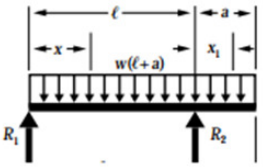
Figure 3

Any truss modification should be reviewed by a qualified engineer to ensure the modification will not compromise the truss design.

How do I determine the tributary area and loading of a truss with outlookers?

An outlooker can be defined as a framing member that supports the portion of the roof beyond the face of a gable end truss. It is necessary to remember that gable trusses with outlookers having an overhang of more than 1 ft will be under loaded if designed to support the load generated by a tributary area equal to 2 ft of roof load only. To account for additional loading on the gable end and interior common truss, it is best to calculate the loads manually by using the equations shown in Figure 4, while keeping the on center spacing at 2 ft. When unsure of how to calculate these loads, please have the trusses in question reviewed by a MiTek Design Engineer. Please see Example 1 on page 3 of 3 for instructions on how to manually calculate the uniform loading (plf) to be applied on the gable end (R_2) and common truss (R_1).

Beam Overhanging One Support – Uniformly Distributed Load

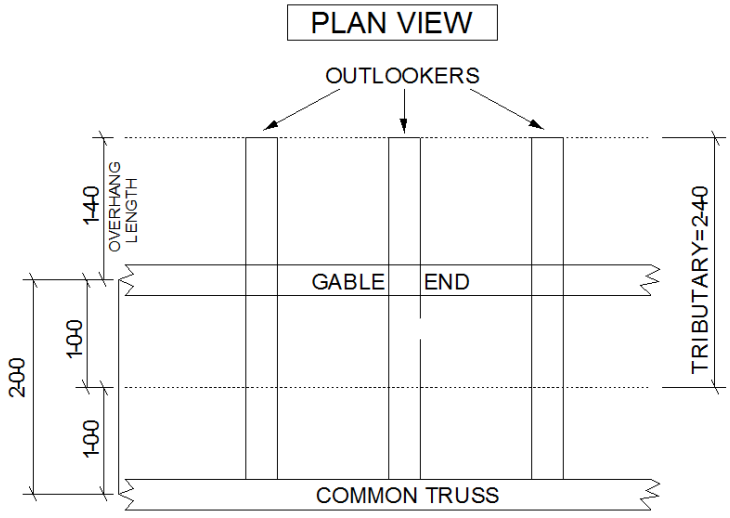


$$R_1 = V_1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad = \frac{w}{2\ell}(\ell^2 - a^2)$$

$$R_2 = V_2 + V_1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad = \frac{w}{2\ell}(\ell + a)^2$$

Figure 4 (NDS 2005 Edition)

Example:



<u>Use the equations from Figure 4 for both live and dead load calculations:</u>

w = 40 psf (30 psf live load + 10 psf dead load)

a = 1.33 ft

ℓ = 2 ft

R_1 = (40 psf/(2 x 2 ft)) x (2 ft^2 – 1.33 ft^2) = 23 plf (downward load)

R_2 = (40 psf/(2 x 2 ft)) x (2 ft + 1.33 ft)^2 = 111 plf (downward load)

****A gable end (R_2) truss run at 2 ft o.c. spacing yields a uniform load of 80 plf. Thus, 31 plf needs to be added to the gable end truss so that the loading adds up to the 111 plf value shown in the above calculation. Please keep in mind that R_1 value for the common truss shown above is less than 80 plf and therefore nothing needs to be added to the original 2 ft o.c. spacing drawing. However, when an outlooker is longer than 2 ft, the R_1 value becomes negative and uplift loading must be applied to the common truss. To apply the uplift loading, first add a new user defined load case that is copied from the first load case and make sure to have "edit this load case only" checked on before applying the uplift.****

For additional information, or if you have questions, please contact the MiTek Engineering department.