Understanding Bearing Size at a Wall or Beam.

The first thing to consider with bearing sizes is the minimum required by the building codes.

Per 2018 IRC, International Residential Code for One- and Two-Family Dwellings, Sec. R802.6 - When a ceiling joist is supported directly on wood or metal the minimum bearing size required is 1-1/2 inches, when supported directly on masonry or concrete then 3 inches is the minimum bearing size.

Per 2018 IBC, International Building Code, Sec. 2308.7.3.1 - When a ceiling joist is supported directly by the top wall plate, wood, the minimum bearing size required is a 1-1/2 inches. At MiTek it is our opinion that this includes wood trusses.

The next factor to consider is the material used at the bearing. Note there are two members at this location, the truss member and the wall plate. Both members are critical in the calculations for the bearing size needed, although we typically only consider the truss material. The lumber design property used in most applications is the $F_{C\perp}$ – Compression Perpendicular to Grain. Example values of $F_{C\perp}$ include SPF (spruce-pine-fir) – 425 psi (pounds per square inch), DFL (douglas-fir-larch) – 625 psi, HF (hem-fir) – 405 psi and SP (southern pine) – 565 psi. Note, that these values are the typical, and there are grades of material that can have higher values.

To check the reaction capacity of a single ply truss on a 2x4 wall:

$$Bearing\ Area\ = Truss\ Width \times Bearing\ Width = 1.5\ in\ \times 3.5\ in\ = 5.25\ in^2$$

$$Reaction\ Capacity = F_{C\perp} \times Bearing\ Area$$

$$For\ SPF\ this\ works\ out\ to\ 425\ psi\ \times 5.25\ in^2 = 2231\ lbs$$
$$For\ DFL -\ 625\ psi\ \times 5.25\ in^2 = 3281\ lbs$$
$$For\ HF -\ 405\ psi\ \times 5.25\ in^2 = 2126\ lbs$$
$$And\ for\ SP -\ 565\ psi\ \times 5.25\ in^2 = 2966\ lbs$$

Or to find the bearing width required of a single ply truss with SPF and a maximum gravity reaction of 1975 lbs.:

$$Bearing\ Area = \frac{Reaction}{F_{C\perp}} = \frac{1975\ lbs}{425\ psi} = 4.65\ in^2$$

$$Bearing\ Width = \frac{Bearing\ Area}{Truss\ Width} = \frac{4.65\ in^2}{1.5\ in} = 3.1\ in$$

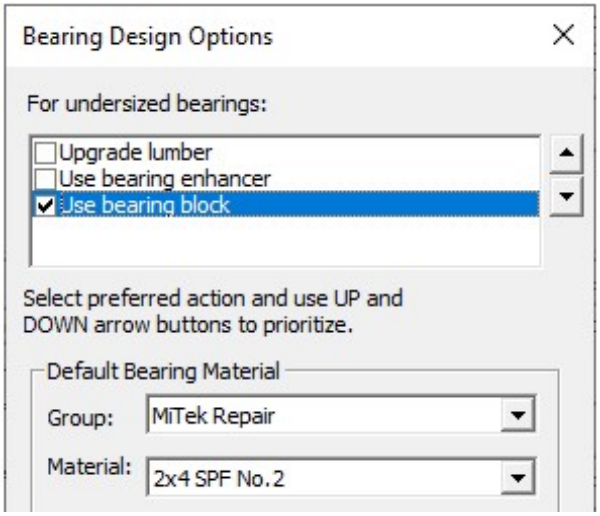
For DFL required bearing width = 2.1 in, for HF = 3.25 in and for SP = 2.33 in.

Note that these results differ by a considerable amount. Where this is important is that trusses are typically manufactured with better grades and or species of material than the wall framing.

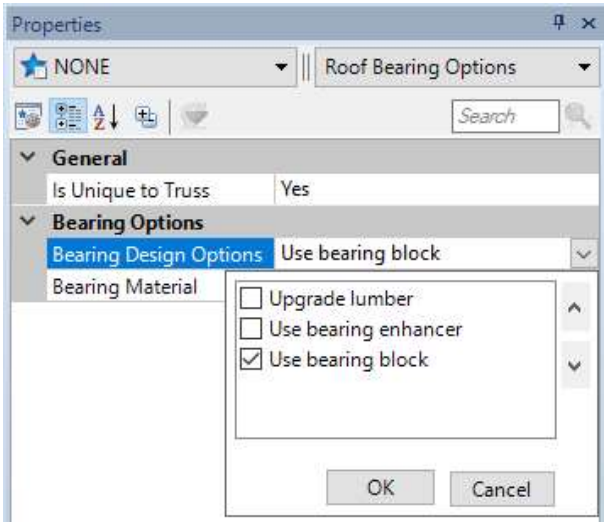
So, as a general rule MiTek recommends that you design your truss components using the lowest expected material. If you know that in your market area wall framing is done using SPF material or your company provides the wall panels built with SPF, that is the material you should have as a default bearing material.

MiTek engineering software gives you many options when it comes to determining the required bearing size. It calculates minimum bearing size, based on default bearing material and compares it with bearing size input by the Truss Designer. So, it is important to specify the actual bearing sizes for the truss. When the minimum required bearing size exceeds the input bearing size, the warning "***Required bearing size at joint(s)… greater than input bearing size***" in the general note section of the Truss Design Drawing is displayed. This warning should not be neglected by the Truss Designer. This warning is due to the bottom chord and/or top plate crushing from the reaction of the truss.

One way to correct this problem is to click on Bearing Design Options, and check any of the options available. To turn it on in MiTek 20/20 Engineering go to Design Info – Bearing Design Options. In Structure with Truss Design, in the Properties dialog box select "Roof/Floor Bearing Options", and after you change to "Yes" in "Is Unique to Truss" in General section, click on the drop-down menu of Bearing Design Options. These options include upgrading lumber, using a bearing block, or using a truss bearing enhancer. If you have these options checked, the program will attempt to fix the undersized bearing problem. If the bearing is still too small you may need to either increase the actual size of the bearing or add a ply to the truss.



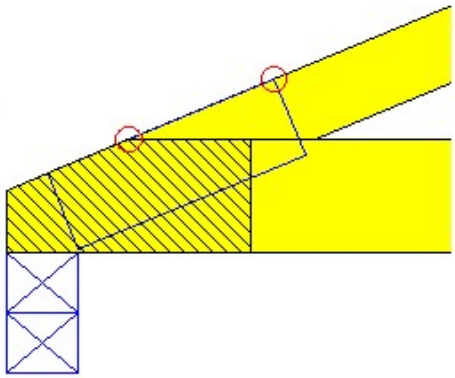
Bearing Design Options in MiTek 20/20 Engineering



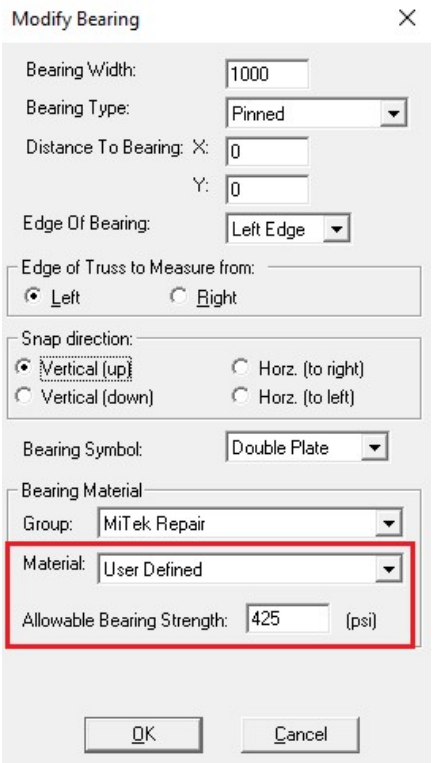
Bearing Options Settings in Structure with Truss Design

Note that when upgrading the truss lumber, you should notify the owner/contractor/framer that the top plate of the wall would need the same change. When using a bearing enhancer, a metal product designed specifically for this purpose, you need room on both faces of the truss for the enhancers.

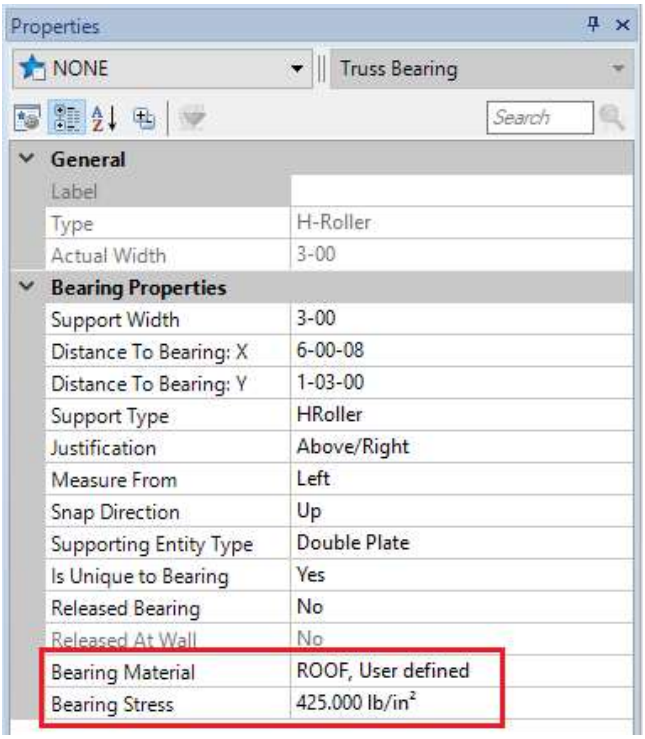
When using the Bearing Block option to fix an undersized bearing, care must be taken on trusses with long scarf cuts at the heel. The Bearing Block ignores the scarf cut when calculating the nailing requirements. The nailing pattern and quantity of nails shown may be impossible to achieve. Also use caution with trusses tying into a girder truss with bearing blocks. If the location of a tie-in truss interferes with the attachment of the bearing block, the bearing block may not be able to be used and other provisions for the bearing requirement may be needed. Note bearing blocks are assumed to be the same lumber grade and species as the bottom chord member, and they are only valid for 1 and 2 ply trusses.



Within the "Default Bearing Material" section, you can setup a lumber inventory that you can then choose a specific material to base the calculations on. One of the options is to use "Same material as truss or better". With this option the owner/contractor/framer should be made aware of this. Another option is "User Defined", here you can input any value you want used in the bearing area calculations.

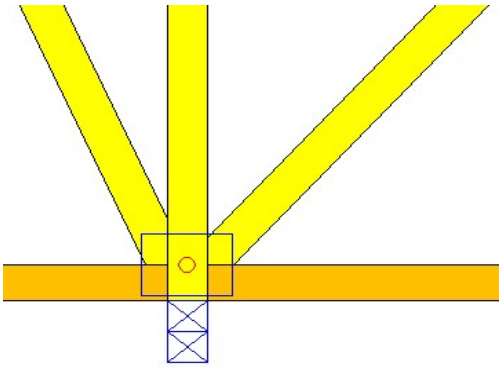


Default Bearing Material in MiTek 20/20 Engineering



Default Bearing Material in Structure with Truss Design

One more option that a Truss Designer can use is running the vertical through the bottom chord, so the end grain of the vertical member is sitting directly on the bearing, which gives a much higher crushing value. Doing this allows the change from Compression Perpendicular to Grain ($F_{C\perp}$) to Compression Parallel to Grain (F_C) value which can be as high as 3x the $F_{C\perp}$ value. Be aware this will fix the crushing on the truss only and not the top plate of the wall. When using this option, the owner/contractor/framer should be notified so that the supporting member is sized accordingly.



Note that the options you select will be reported within the general notes section on the sealed Truss Design Drawing you receive from MiTek. And you need to understand that when you are providing the design parameters to your MiTek Engineering office we are returning an engineered sealed design that reflects your decisions. Sometimes making changes, in a repair scenario, to the bearing area can be very challenging. For additional information, or if you have questions, please contact the MiTek Engineering department.