

In today's competitive world of trusses, component manufacturers are always looking for ways to generate more efficient truss designs. Occasionally, truss designs need to be changed in order to be sealed and the objective of this document is to avoid truss design parameters that are sent to engineers to be designed and sealed, but then must be changed. The following is a list of some of the most common problems MiTek engineers see when reviewing customer truss submittals.

1. Wrong building or wind codes.

Be familiar with what building code your state requires and be sure to use a wind code compatible with the building code you are using.

IBC2006 / IRC2006 and IBC2009 / IRC2009 Codes are based on ASCE 7-05, "Minimum Design Loads for Buildings and Other Structures".

IBC2012 / IRC2012, FBC2010 / FRC2010, FBC2014 / FRC2014, IBC2015 / IRC2015 and MNSRC2015 are based on ASCE 7-10, "Minimum Design Loads for Buildings and Other Structures". ASCE 7-10 edition was the first edition of ASCE 7 where the wind speed maps are based on the occupancy category and which provides "ultimate" wind speed. These "ultimate" wind speeds are higher than "basic" wind speeds from previous editions of ASCE-7. For example, according with ASCE 7-10 the minimum velocity for Occupancy Category II, is 115mph; Category I (agricultural) 105mph; and Categories III and IV (more than 300 people or essential occupancy) is 120mph for most of the same regions where 90 mph wind speed previously applied. If you design trusses with a building code based on ASCE 7-10 you have to use these wind maps for inputting wind velocity in the MiTek Engineering program.

If you design trusses with a building code based on ASCE 7-16, IBC-2018 or IRC-2018, input of the correct wind speed may get even more confusing as ASCE 7-10 wind maps and wind speeds are updated in ASCE 7-16. There are significant changes to the contours and wind speeds. To help you determine what wind speed to use for various locations, please visit the Helpful Resources section of our website, located on the bottom of page in Resources – Engineering – Engineering Support:

<https://www.mitek-us.com/resources/Engineering-Support/>

HELPFUL RESOURCES

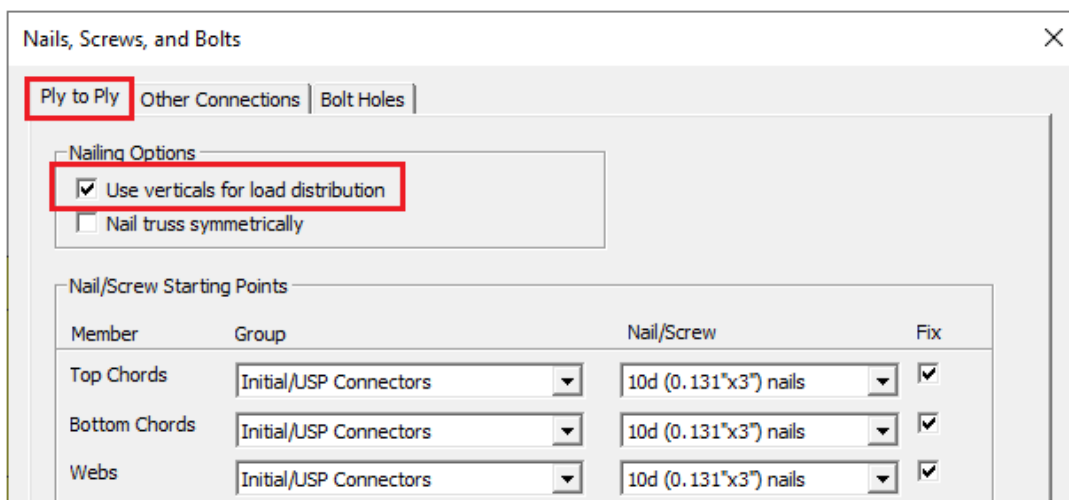
View the following website for useful resources.

- Find out what code your state has adopted: [International Codes Adoption by State](#) (Opens a PDF)
- View side-specific ground snow and basic wind speed information that can be used to determine design snow and wind loads for buildings and other structures [Applied Technology Council \(ATC\)](#). *[By clicking this link you will be leaving the MiTek website. MiTek is not responsible for any content on these websites.]*

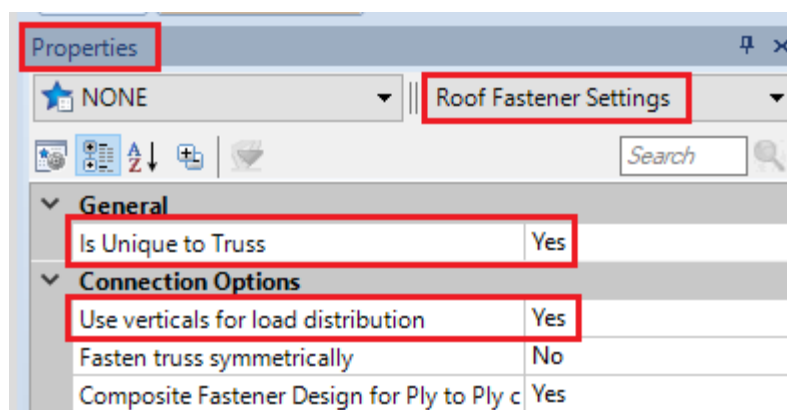
The Applied Technology Council's (ATC) Wind Speed by Location is free of charge web-based tool that may be used to access wind speed data for various locations.

2. Multiple-Ply Connections.

Multiply girders perform according to the design only if all plies are properly attached together. Be sure it is possible to transfer loads from one ply to the next on girder trusses. When we have load applied to a multiply girder truss, in order to design the fasteners, we assume all plies take an equal amount of load. If fasteners required to distribute loads equally between plies cannot be calculated by software, the warning ***“Special connection required to distribute bottom chord / top chord / web loads equally between all plies”*** or ***“Ply to ply nailing inadequate”*** will appear in the note section of the truss design drawing. If you have a vertical web directly above large concentrated load, you can try to use this vertical to transfer load. To turn it on in MiTek 20/20 Engineering go to Design Info - Nails/Screws/Bolts, check the “Use verticals for load distribution” box as shown below:



In Structure with Truss Design in Properties dialog box select “Roof Fastener Settings”, change to “Yes” in “Is Unique to Truss” in General section and to “Yes” in “Use verticals for load distribution” in Connection Options section as shown below:

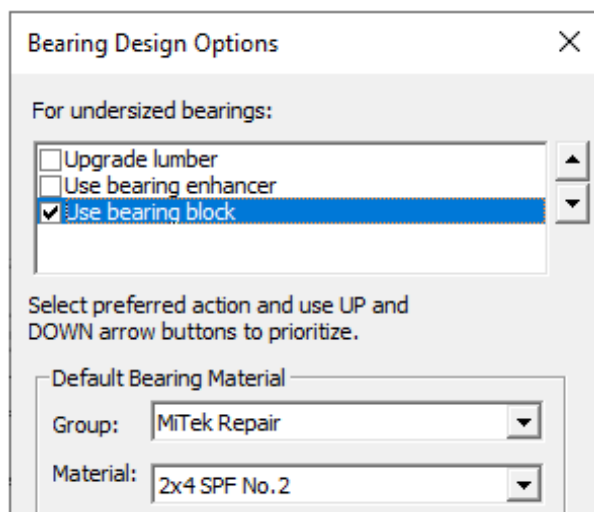


After selection is made, Redesign the truss. If ply-to-ply connection note does not go away, try changing the type of nail or fastener you are using. Structural screws can transfer more load than nails. The length of the fasteners used to make ply-to-ply connections should not exceed the thickness of the multiple-ply truss. If these options do not fix the problem, submit the truss to your MiTek Design Engineer for help.

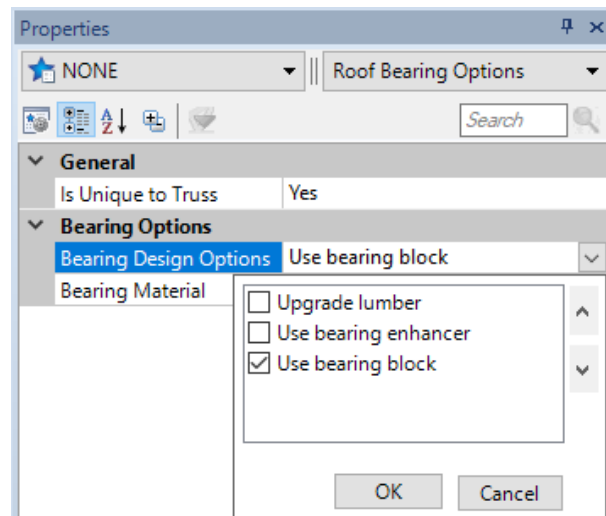
3. Bearing undersized.

The first thing to consider with bearing sizes is the minimum required by the building codes. The minimum bearing size is 1-1/2 inches. MiTek engineering software 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.

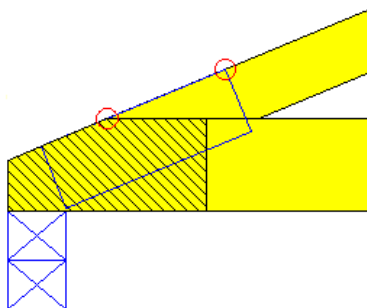
One way to correct this problem is to click on Bearing Design Options, and check any of the options available. To turn it on in MiTek 20/20 Engineering go to Design Info – Bearing Design Options. In Structure with Truss Design, in the Properties dialog box select “Roof/Floor Bearing Options”, and after 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*



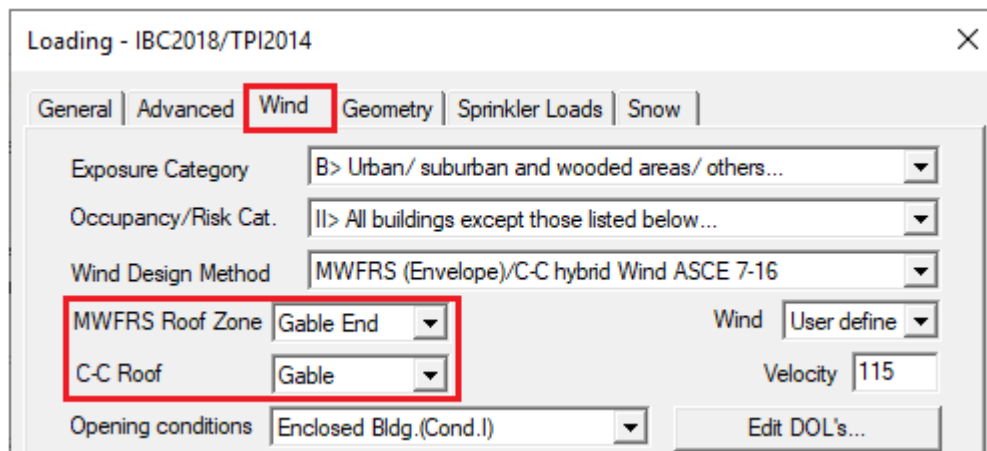
When using the Bearing Block option to fix an undersized bearing, care must be taken on trusses with long scarf cuts at the heel. The Bearing Block ignores the scarf cut when calculating the nailing requirements. The nailing pattern and quantity of nails shown may be impossible to achieve. Also use caution 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.

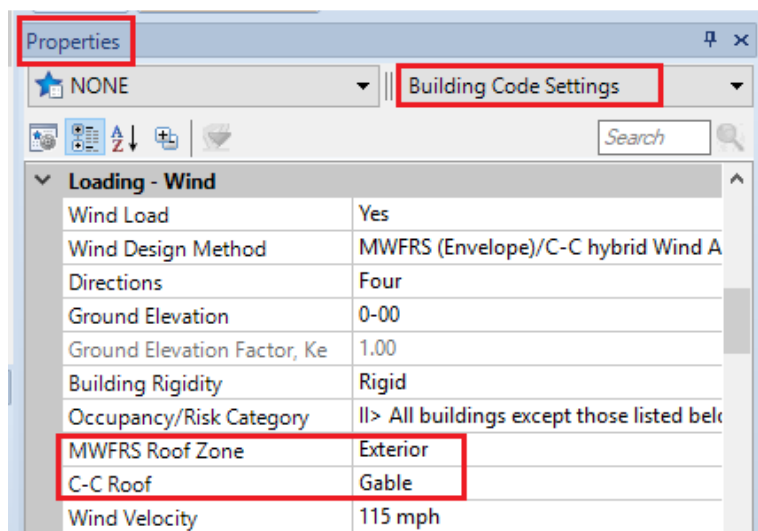
If a vertical member comes down directly above a bearing, like a web at an interior bearing or at a raised heel, you may be able to run the vertical through the bottom chord, so the end grain of the vertical member is sitting directly on the bearing, which gives a much higher crushing value. Be aware this will fix the crushing on the truss only and not the top plate of the wall. The program assumes you are using the same material on the top plate as the bottom chord of your truss unless set up otherwise. When in doubt, have these trusses reviewed by your MiTek Design Engineer.

4. Gable end trusses run as interior wind zone.

If a truss is at the end of the building, be sure the roof zone is set to exterior or gable end zone in the wind loading tab if applicable.



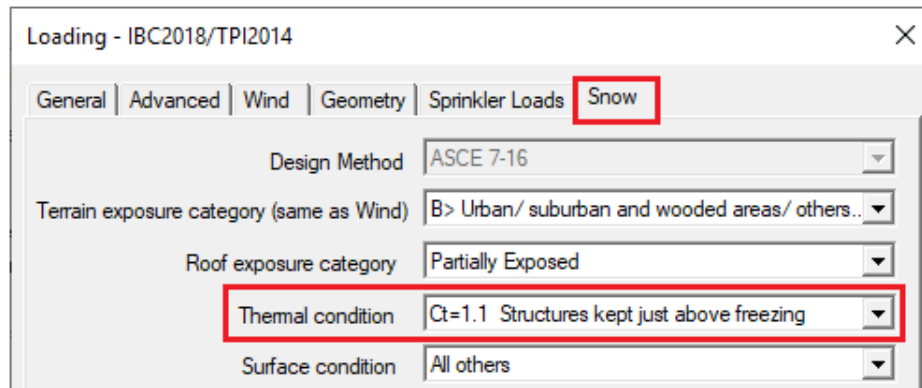
Wind Loading Dialog Box in MiTek 20/20 Engineering



Loading – Wind Section in Building Code Settings in Structure with Truss Design

5. Thermal factor needs to be selected correctly

Thermal factors should only be set to 1.0 if the roof trusses will be heated and kept above freezing at all times. This may occur in some commercial buildings where a drop ceiling is used. If drywall and/or insulation is being used on the bottom chord of the roof truss (most residential) the thermal factor or Ct factor should be set to 1.1 because the heat from the building will not escape into the enclosed truss area. For unheated agricultural buildings, a Ct factor of 1.2 should be used.



Snow Loading Dialog Box in MiTek 20/20 Engineering

Loading - Snow	
Consider Snow Load	Yes
Design Method	ASCE 7-16
Snow Load Location	Ground (Pg)
Snow Load	25.0 lb/ft ²
Roof Exposure Category	Partially Exposed
Windswept	No
Exposure Factor Ce	1.0
Overhang Snow Load Factor	2.00
Thermal Condition	Ct=1.1 Structures kept just above freezing
Roof R' Value	30.00

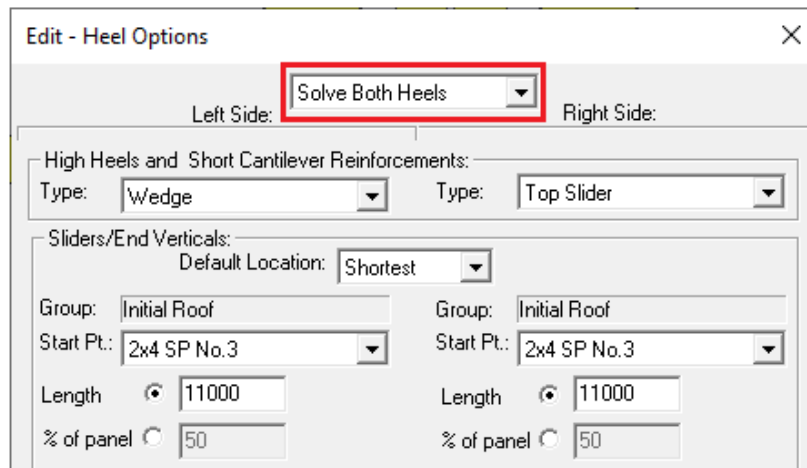
Loading – Snow Section in Building Code Settings in Structure with Truss Design

6. Corner girders missing load.

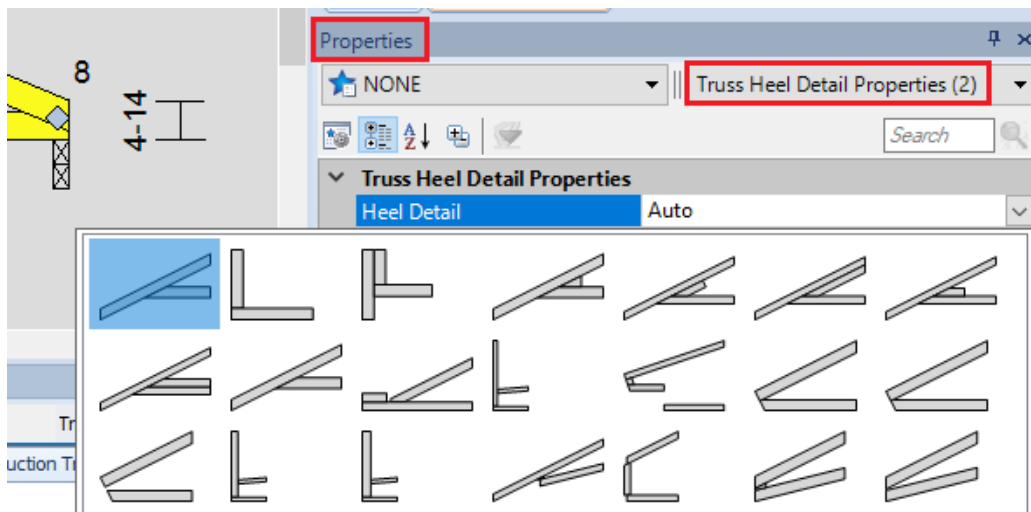
Many times, on cantilevered corner girders, you will need to make sure additional load for framing and fascia loads are added at the end of the girder or cantilevered section. Since framing is often used instead of trusses, layout does not put this additional load on the end of a corner girder. If a structural fascia is being used, a concentrated load will need to be added at the end of the corner girder and also at the end of the other truss which will be supporting the other end of the fascia. For detail how this can be achieved for symmetric corners with Girder Loading in MiTek Engineering software please refer to [Cantilever Corner Girder Loading Tool](#) technical article on MiTek United States website www.mitek-us.com in Resources -Engineering – Technical Articles – Helpful Design Tips. Currently this feature is only available for trusses designed in MiTek 20/20 Engineering and is not active for trusses designed in Structure with Truss Design.

7. Manually changing heel conditions such as wedges or sliders (turning heel solving off).

If you design trusses in MiTek 20/20 Engineering, make all changes to the heel of the truss through Edit-Heel Options and always leave “Solve Both Heels” turned on. If you design trusses in Structure with Truss Design, make all changes to the heel in Properties - Truss Heel Detail Properties. If you do make a change manually, the heel solving will be turned off and the heels may not be checked properly. This will ensure the proper size plates, wedges, and sliders at the heels. If you don’t use Heel Options / Truss Heel Detail Properties, you may get a note saying **“Heel reinforcement inadequate”** or the heels simply may not be checked.



Edit – Heel Options Dialog Box in MiTek 20/20 Engineering

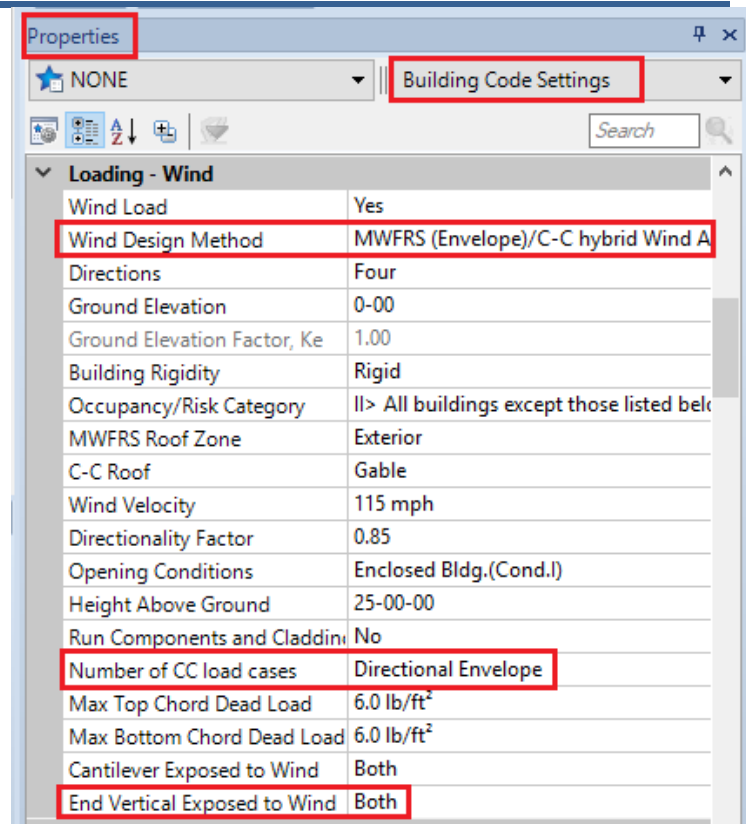


Truss Heel Detail Properties in Structure with Truss Design

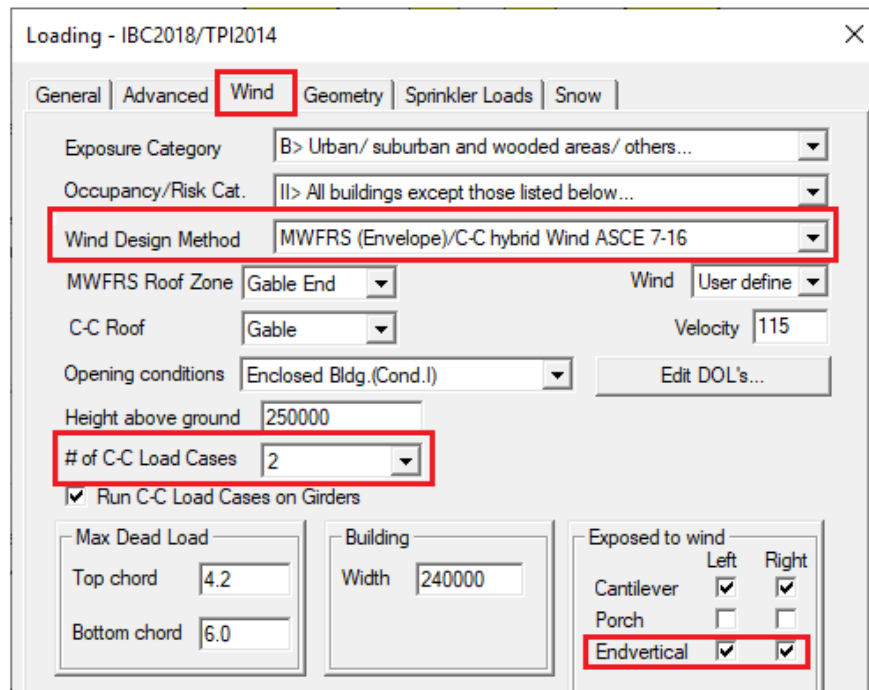
As a side note, if Multi-Point Analysis Method is turned on in Design Info (MiTek 20/20 Engineering) / Multi-Point Analog Method in Roof Design General Preferences – Design Info (Structure with Truss Design), sliders of a predefined length less than $\frac{1}{2}$ of the heel panel may be used.

8. Flat trusses with a parapet.

If a truss with a flat top chord is on a structure with a parapet surrounding it, additional loads may need to be added to the top chord for snow drifting. Also, make sure that either Components and Cladding or Hybrid wind method is used and ensure that the parapet member is defined as a **“top chord”** and end vertical(s) must be exposed to wind. Finally, select (2) Components and Cladding load cases, if you design trusses in MiTek 20/20 Engineering; or Directional Envelope, if you design trusses in Structure with Truss Design.



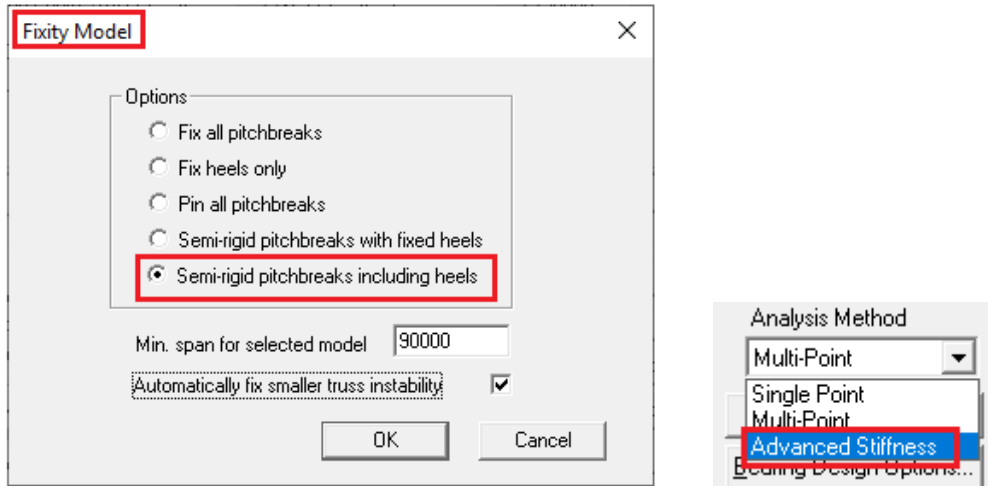
*Loading – Wind Section in Building Code Settings
in Structure with Truss Design*



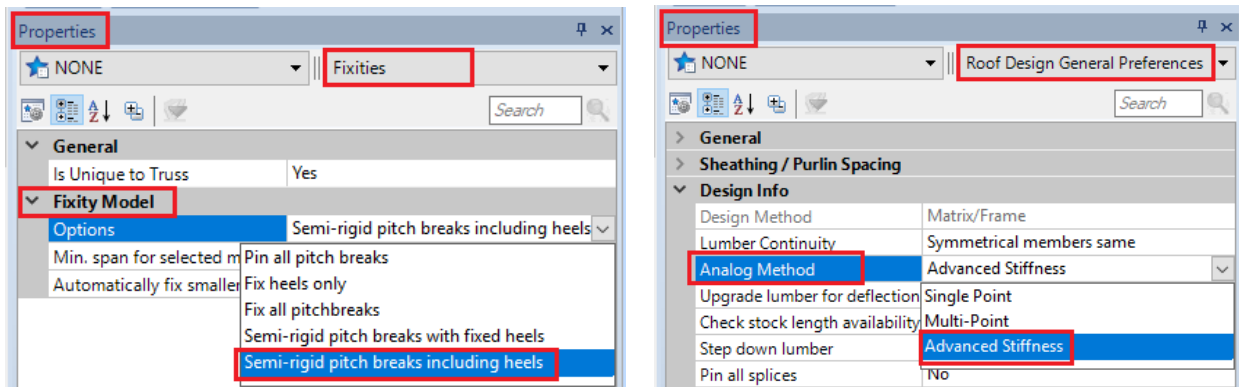
Wind Loading Dialog Box in MiTek 20/20 Engineering

10. Large trusses not triangulated at the heels.

In order to cut costs, sometimes designers leave out webs that form the triangles which make a truss structurally sound. While these trusses may run, some designs may not be structurally viable and should be avoided or reviewed by an engineer. To avoid this, add webs to triangulate trusses, especially at the heels if the truss span is 20' or longer. Also, make sure you use Semi-Rigid joints or use the Advanced Stiffness Method anytime you have an un-triangulated truss. These options are found under Design Info in MiTek 20/20 Engineering or in Properties in Structure with Truss Design.



MiTek 20/20 Engineering



Structure with Truss Design

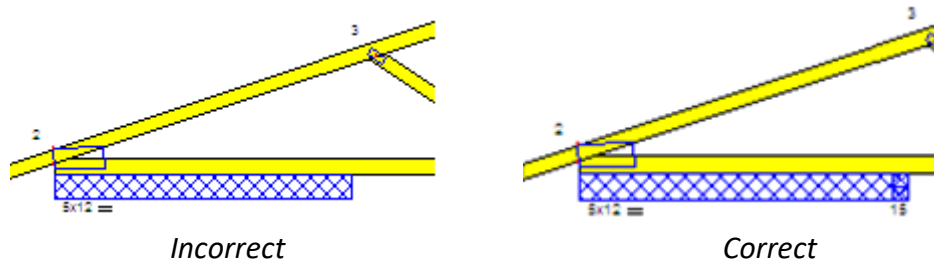
11. Long bearings that end in the middle of a truss panel.

If you have a long bearing where the end of that bearing is not located at a joint (i.e. the end of the bearing is in the middle of a panel and there is no joint number associated to the end of the bearing), the program may not be checking the truss for induced shear and bending at that location. If you see one of these long bearings with no joint / number at its end, it may be necessary to add an additional smaller bearing at that point to mimic the effects of the bearing stopping there. This is especially true for girder trusses.

An example of how to check this is as follows: If you have a 6-0-0 bearing ending in the middle of a truss panel, you can input a new 0-3-8 bearing at 6-0-0 and aligned at the end of the longer bearing.

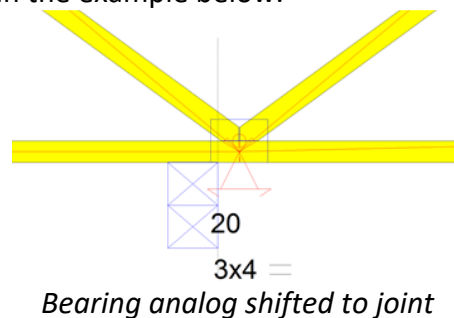
The two bearings will actually overlap as you can see in the right picture. You will notice a new joint number (15) being inserted at the new bearing location and it will now give a reaction at the end of the bearing. To ensure proper truss designs submitted for review, the truss designer should always ensure that the truss model accounts for a bearing point at the inside edge of any bearing wider than 12 inches.

An easy way to avoid this is to add a web at the location where a large bearing stop.

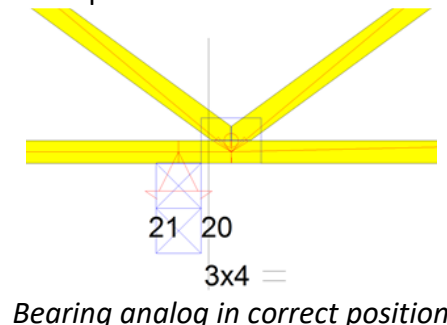


12. Bearing is located close to a joint but is not under the joint.

Another bearing issue that often causes design problem occurs when a bearing location is automatically shifted by the design software to a joint, when in reality the bearing is located away from the truss joint. This usually happens when a bearing is located close to a joint but is not under the joint as shown in the example below.



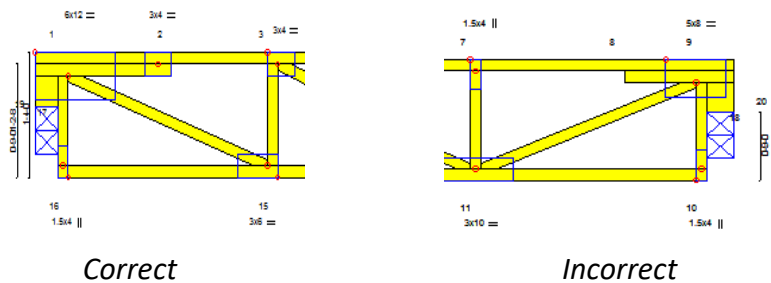
When this condition exists, the truss designer may need to shift the bearing left or right or adjust the bearing width so as to force a separate joint for the bearing location away from the truss web joint as shown in the example below.



In short, when designing trusses, always check to ensure the analog bearing conditions used for member design reflect the actual conditions in the field. If there is doubt as to whether the bearing is close enough to a joint to be modeled at the joint the designer should contact his or her engineer at MiTek to confirm the design model.

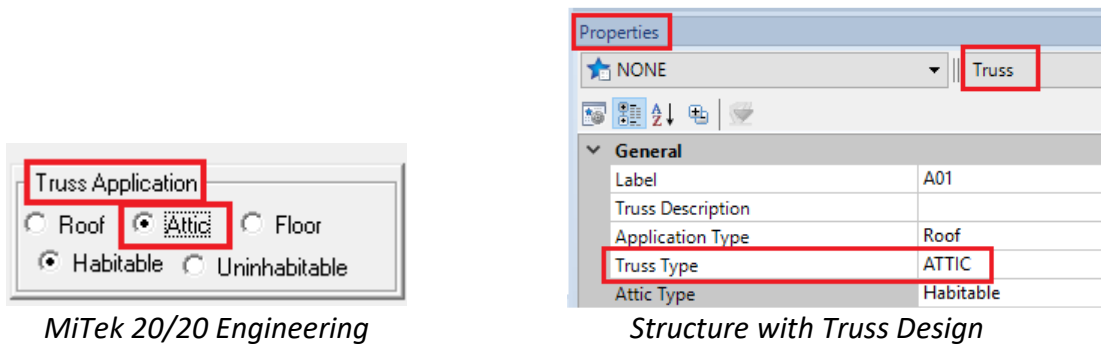
13. Top chord bearing floor trusses.

When using top chord bearing floor trusses, it will usually be required to have a double top chord above the bearing. Be sure the stacked top chord extends far enough into the truss so it can be attached with at least 2 plates. If it does not plate the stacked member with at least two plates, extend it manually until a second plate is added, or simply run it back to the next vertical web.



14. No room load on attic trusses.

When you create an attic truss be sure to define the truss as an attic under Truss Application in Truss Basics, if you design trusses in MiTek 20/20 Engineering; or in Properties – Truss – Truss Type, if you design trusses in Structure with Truss Design. This will ensure your attic has the required additional load added to the attic room area. If an attic truss is created manually, you will need to manually add the additional loads to the floor and ceiling area.



Also, if you remove a section of bottom chord in a room or you have sloping walls in an attic, the program will not add any load to the room even if it is defined as an Attic. Load will need to be added manually to the floor, ceiling, and walls on these truss types.

Residential attic rooms with over 7' height may be used as habitable space and must be checked with minimum 30 psf live load in the room.

15. Splicing in heel panels and two splices in the same panel.

While the program checks all of the following properly, it is still recommended to keep top and bottom chord splices out of the first panel of a truss. Try to move the splices beyond the first web so the chord member will be attached by at least two plates before the splice occurs. It is also recommended to keep from having multiple splices in the same truss panel and to avoid placing multiple splices in an Attic room. Finally, avoid a splice in the top chord of an attic truss in the sloped ceiling area of the room. These rules are not required when the truss is designed with semi-rigid joints or the Advanced Stiffness Method.

16. Valleys and piggy backs with large vertical web spacing.

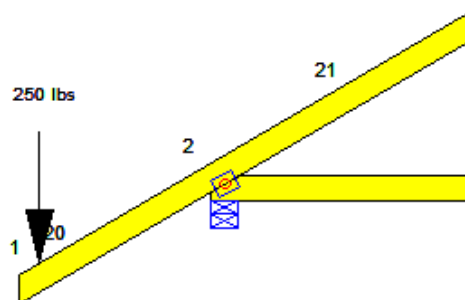
For valley and piggyback cap trusses, be sure the vertical studs do not exceed a 4-0-0 on center spacing. Piggyback cap trusses with a minimum No.2 grade lumber on chords and a maximum top chord total load not more than 30 PSF may have stud spacing up to 6-0-0 on center.

17. Maximum panel lengths and overhang lengths.

For roof trusses, use the maximum panel lengths set in the software: maximum top chord panel length of 9' for a 2x4 and 12' for a 2x6 lumber; maximum bottom chord panel length of 12' for a 2x4 and 14' for a 2x6 lumber. The software will give you a warning if you exceed these limits.

For 4x2 floor trusses use a maximum 30" top chord panel length and 48" for 2x4 floor trusses.

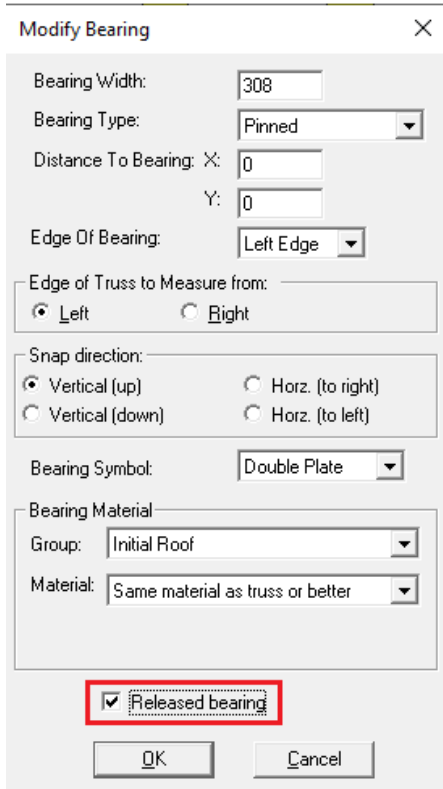
Maximum overhang length: 3' for a 2x4 and 5' for a 2x6 lumber. If these limits are exceeded, overhang must be checked for 250 lbs point load at 6" in from the end of overhang. This will ensure person can stand at the end of overhang, for example, to attach the fascia or for continued maintenance after construction.



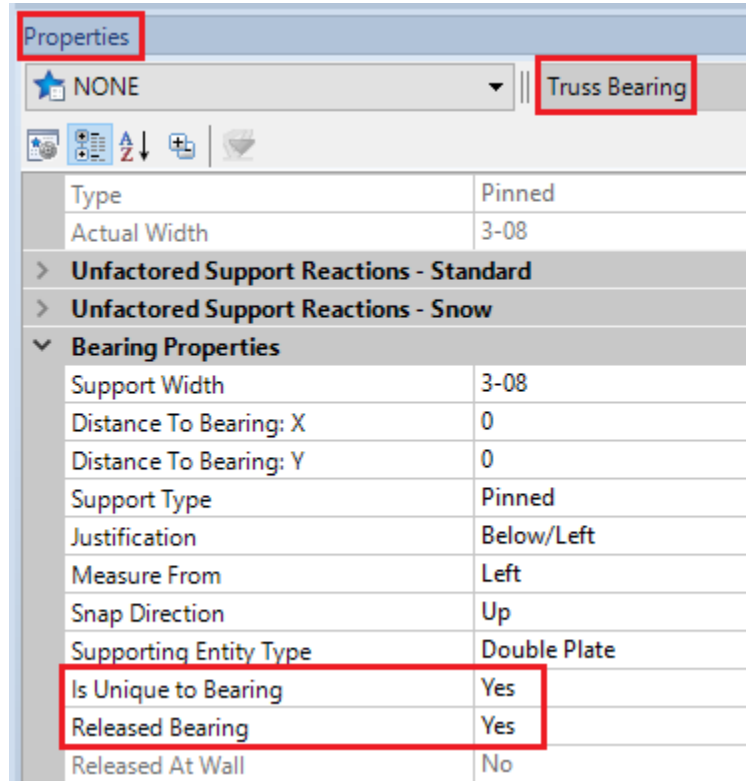
18. Uplift for first load case exceeds limits.

Occasionally you will get this note on trusses due to gravity uplifts that exceed 1000 lbs. This is usually caused by having two bearing locations very close together on one end of the truss. The interior bearing acts as a pivot point causing the short end of the truss to want to pull up. You can either connect the truss for the large amount of uplift or you can try to eliminate the uplift by removing the outside bearing and running the truss as a cantilever or using the **Release**

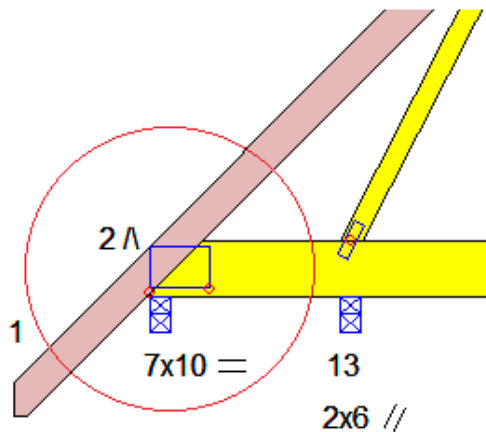
bearing feature on the bearing with the high uplift. If this doesn't solve the problem, submit the truss for review.



MiTek 20/20 Engineering



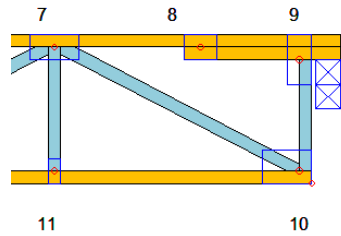
Structure with Truss Design



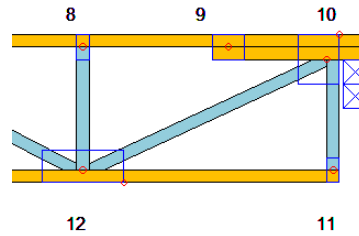
19. Allowable Top Chord Reaction Exceeded.

This error can occur on floor trusses with a raised bearing. When the bearing is raised, the truss will be analyzed as top chord bearing. If the first diagonal web coming off the end of the truss starts on the bottom chord, the allowable top chord reaction is very low. Try reversing the first

diagonal web so it starts from the top chord and proceeds downward to the next joint. This will greatly increase the allowable reaction limit at that location.



Maximum Reaction = 800 lbs

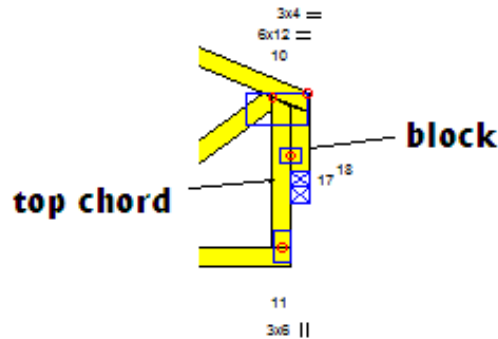


Maximum Reaction = 1800 lbs

This will occasionally happen on roof trusses also. Try reversing the first diagonal web in this situation as well. Also please note that the software does not check top chord bearing reactions at mid-span bearings and so they must be checked manually.

20. Top chord bearing roof trusses/raised bearing truss.

If you have a top chord bearing truss or a truss with a raised bearing sitting on a block, you will have two end verticals. Be sure to define the member sitting on the bearing as a block and define the member stacked next to it as a top chord. This will ensure proper loading and plating, and program will automatically check for top chord reaction limits. This is handled automatically if you use the top chord bearing feature in the program.



21. Avoid low heel height on trusses with small pitch.

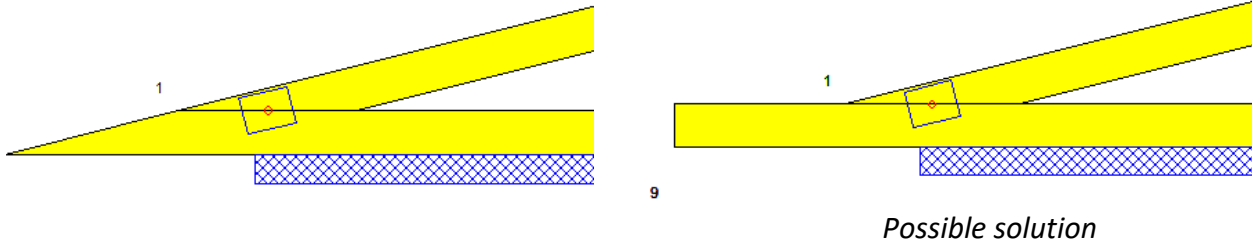
Possible solutions: increase heel height, increase top chord pitch, increase bearing size. Please allow your MiTek Design Engineer to review these designs prior to manufacturing.



Possible solution

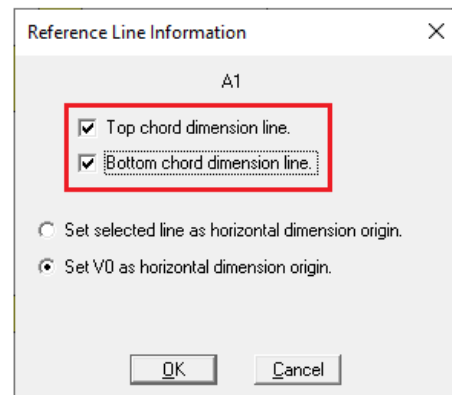
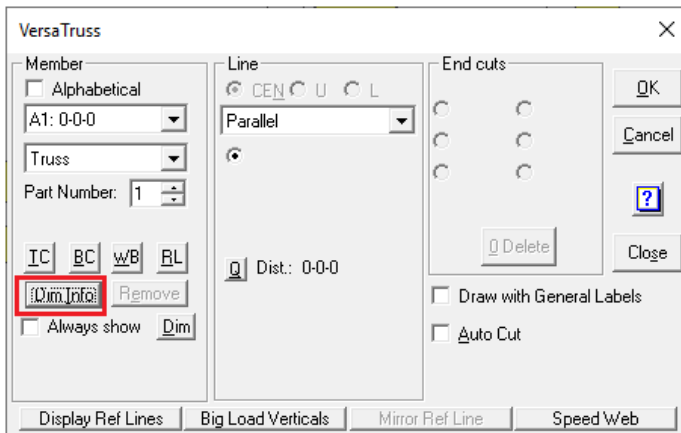
22. Avoid the tapered end of bottom chord on the low pitch cantilevered trusses.

Extreme care is required to avoid damage to the tapered end of the bottom chord during installation due to handling, nailing, or sheathing. Please allow your MiTek Design Engineer to review these designs prior to manufacturing.



23. Incorrect dimension lines.

All joints and pitch breaks must be properly dimensioned. The engineering program will automatically add the dimensions at the proper locations when creating a truss. However, if joints are moved or added or an attic room size is changed using VersaTruss (MiTek 20/20 Engineering), the dimension lines may no longer reference the proper locations. If any of these design changes are made using VersaTruss, you will need to delete the old dimensions and add the new dimensions at the proper locations. Currently this feature is only available for trusses designed in MiTek 20/20 Engineering and is not active for trusses designed in Structure with Truss Design.



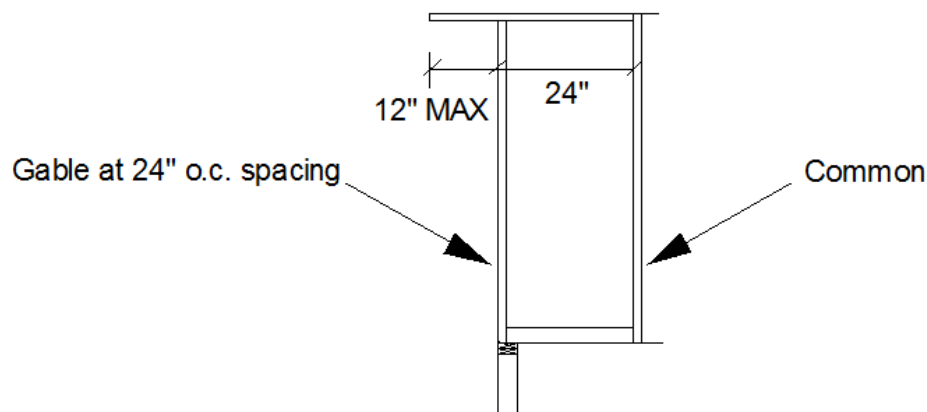
24. Insufficient Scab nailing.

When using the scab feature, be cautious if the note ***“Special connection required between scab...”*** is printed in the notes section of the engineering drawing. The scab may not be adequate even though it is shown on the truss drawing. Try extending the scabs length or switching the type of fasteners used until the program is able to call out a nailing pattern for

the scab. If these options do not eliminate the note, the truss should be reviewed by your MiTek Design Engineer prior to manufacturing.

25. Wrong spacing on gable trusses with outlookers longer than 1'

Gable trusses with outlookers longer than 1' will be under loaded if designed to support the load generated by a tributary area equal to 24" of roof load only. You can either increase truss spacing to accommodate additional tributary area or manually add additional load along top chord. This is especially important on clear span structural gables. When in doubt, have these trusses reviewed by your MiTek Design Engineer.



In Summary:

The above-mentioned items comprise the majority of issues that MiTek engineers must resolve when a job is sent for design and seals. The good news is that they are easily accounted for when considered in the original design stage. By looking for these conditions during component design and addressing them at the beginning of the design process we, as engineers and designers, can continue to provide quality engineered designs that account for true field conditions. For additional information, or if you have questions please, contact the MiTek Engineering department.