

Please note that the techniques described below involve a heavy use of member modifications, it is vital to pay close attention to member definitions (web, chord, etc.).

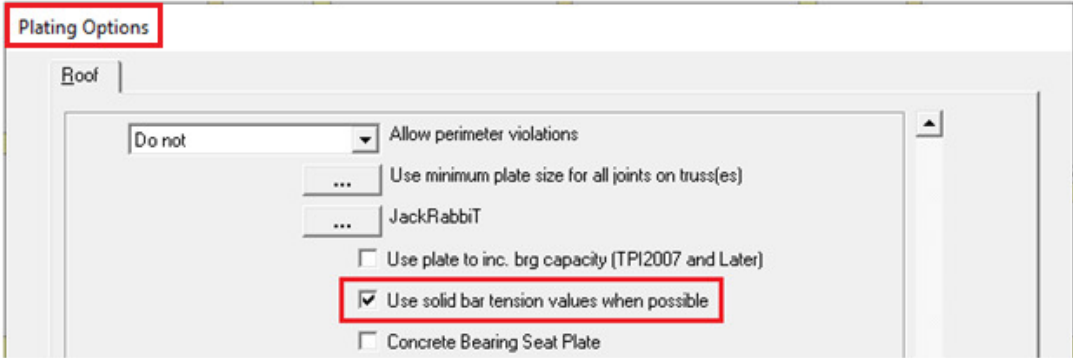
Perimeter Geometry

Truss geometry can play a sizable roll in the performance of agricultural trusses. Such geometry includes the roof pitch, heel heights, overall heights, and span. Typically, a truss pitch and span are dictated by the building designer. Unlike normal commercial and residential jobs, truss heel height is often a variable that can be easily changed on ag trusses. There is an old saying that “Deeper is cheaper,” which holds true with heel heights. If the heel height can be increased, it is important to keep in mind this adjustment during the truss design phase.

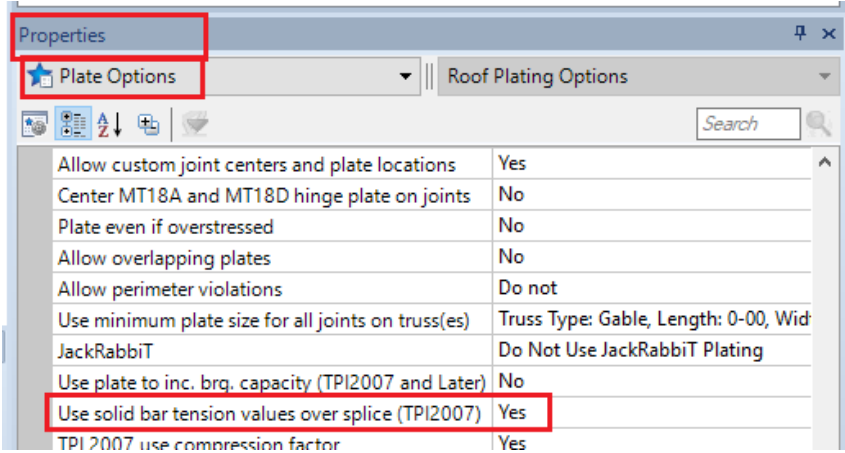
Materials (Lumber/Plating)

Available materials (lumber, stocked plates) often control a design. There can be times where a chord force is high enough, that a large, high gauge splice plate is required. Typically, this occurs on bottom chord splices. It is possible that such a large splice plate is required that a larger chord size is required just to get the splice joints to plate. There are several options available that can eliminate the requirement of larger chords.

One option is to turn on “Use solid bar tension values when possible” in Edit - Plate Options in MiTek 20/20 Engineering:

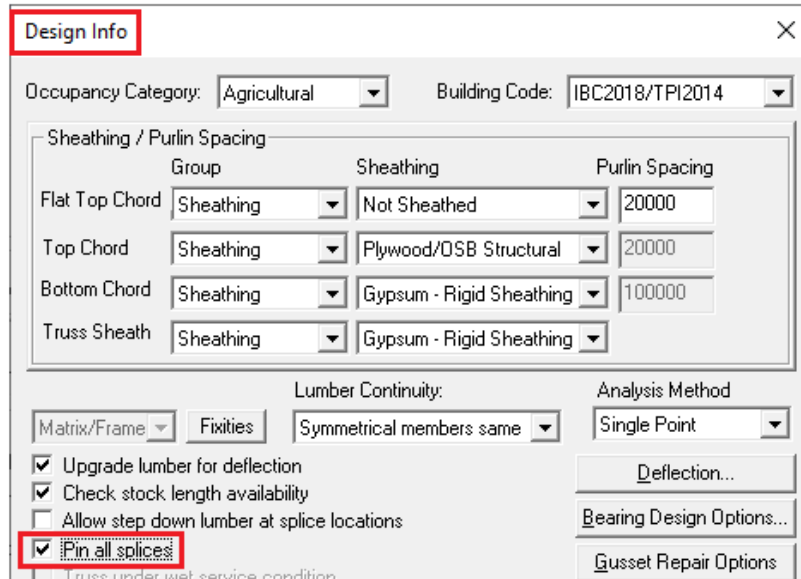


Or select “Yes” for “Use solid bar tension values over splice (TPI2007)” in Properties - Plate Options in Structure with Truss Design:



TPI requires that connector plate manufacturers utilize a tension value when the slots of a plate are located directly over the splice. Due to the decreased cross section of steel in this situation, the allowable tension value is limited compared to when the “solid bar” of steel is over the splice. Special measures should be taken to ensure that the shop understands the high degree of accuracy required on these splice joints.

A second option in bottom chord splicing includes the use of “Pin all splices” in Edit – Design Info in MiTek 20/20 Engineering:



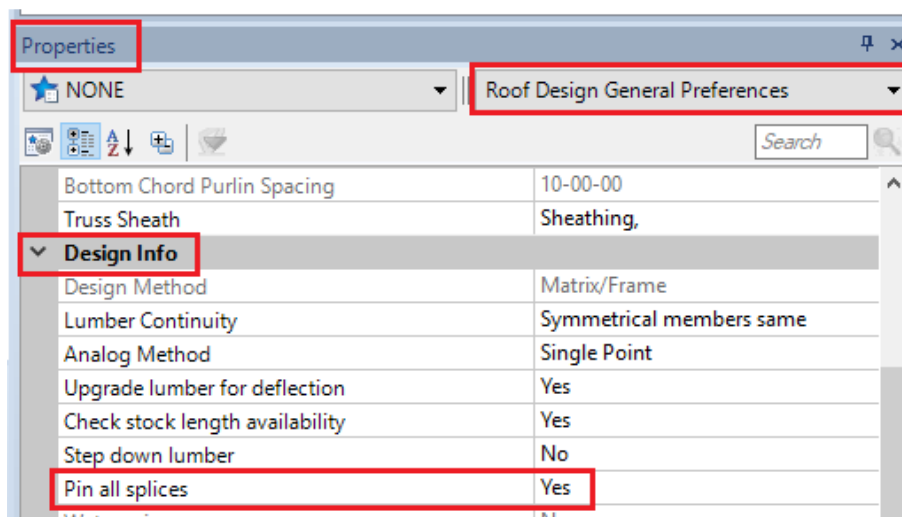
Sheathing / Purlin Spacing			
	Group	Sheathing	Purlin Spacing
Flat Top Chord	Sheathing	Not Sheathed	20000
Top Chord	Sheathing	Plywood/OSB Structural	20000
Bottom Chord	Sheathing	Gypsum - Rigid Sheathing	100000
Truss Sheath	Sheathing	Gypsum - Rigid Sheathing	

Lumber Continuity: Matrix/Frame Fixities Symmetrical members same

Analysis Method: Single Point

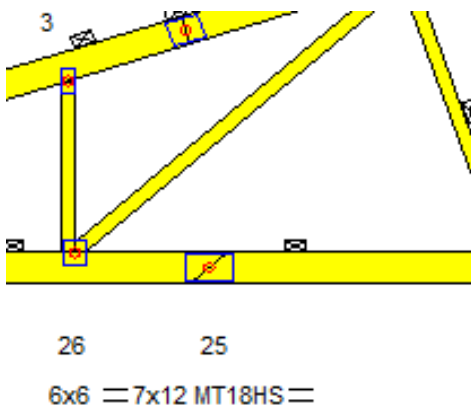
Upgrade lumber for deflection
 Check stock length availability
 Allow step down lumber at splice locations
 Pin all splices

Or select “Yes” for “Pin all splices” in Properties – Roof Design General Preferences – Design Info in Structure with Truss Design:



Roof Design General Preferences	
Bottom Chord Purlin Spacing	10-00-00
Truss Sheath	Sheathing,
Design Info	
Design Method	Matrix/Frame
Lumber Continuity	Symmetrical members same
Analog Method	Single Point
Upgrade lumber for deflection	Yes
Check stock length availability	Yes
Step down lumber	No
Pin all splices	Yes

This selection modifies the truss model such that the moment is always zero at a splice location. This reduces the total overall stresses induced on a splice to only the tension force, which can significantly affect a splice in a long bottom chord panel. This, however, can increase chord stresses, therefore caution is advised.



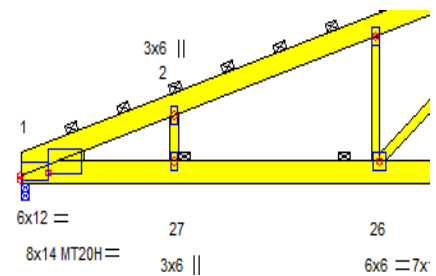
A third option is to cut the splice at a beveled angle. You would have to modify the splice manually and it must be cut at a 45-degree angle as shown in picture. Special attention should be paid to chord lengths to ensure that the chord member being modified is within the stocked lumber lengths. The principle at play with beveled splices is that you can increase the shear length across the splice.

Yet another option is to consider expanding your plate inventory. MiTek offers several high strength plate options and sizes, and you should not overlook the use of the MiTek 18 gauge Super High Strength “M18SHS” plate.

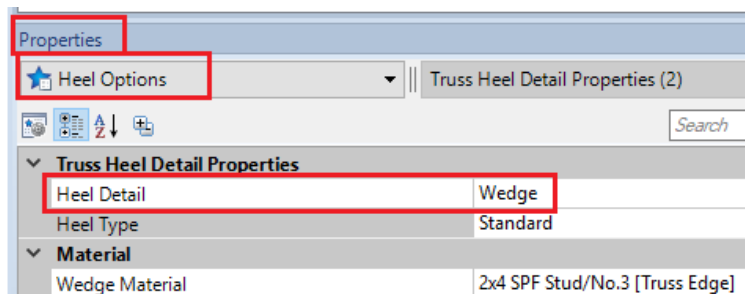
This plate type is manufactured with a higher grade of steel compared to the standard MT18HS and offers superior performance in tension splice utilizations.

Webbing / Panel Points

Another technique that is often beneficial to agricultural truss design includes the location of panel points and optimization of those panel points. Often, a short vertical web located close to the heel of the truss can accomplish multiple goals. You can place a web (recommended length of 0-11-14 to economize cutting) just inside the heel which serves to share heel panel moments between both chords, effectively engaging the bottom chord to share in the top chord heel panel moments. See picture for an example. While this short web is inexpensive, it can make great improvements in the performance of an agricultural truss heel. If a heel panel remains overstressed, you might consider adding a wedge via “Edit - Heel Options” in MiTek 20/20 Engineering:



Or in Properties – Heel Options – Heel Detail in Structure with Truss Design:



A secondary benefit of this short web, and specifically, its location, is that now the first panel point is typically 3-4 feet from the truss heel. This enables the truss designer to move the remainder of the truss panel points closer together (which helps to alleviate high bending moments within the truss), or eliminate a panel point altogether.

After adjusting the webbing as described above, it is often beneficial to manually decrease chord sizes and grades. Due to the nature of a truss, higher overall forces are typically located at the ends of a truss. Knowing this, you can often change chord sizes and grades at the interior of the truss. When doing so, splice plates can often become an issue, and you should utilize the principles described earlier in this article to mitigate problems. Additionally, if a chord size or grade is slightly overstressed, you should proceed to the next step in this article.

Modifying panel points and their locations should be an iterative process. You can accomplish panel point adjustments manually, however if you are using MiTek 20/20 Engineering under the “Tools” menu, you will find a tool called “Move Joint”. This allows the user to move a joint left or right a specified distance. Using this tool can easily move panel points for chords that are slightly overstressed, and in doing so, reduce the stresses enough to achieve an efficient use of lumber. If you are using Structure with Truss Design you can find similar tool “Panel Points” in the Ribbon Bar.

While the steps described in this article can take a bit of time to complete, we are confident that you will find these tools to be helpful. For additional information, or if you have questions on these features, please contact the MiTek Engineering department.