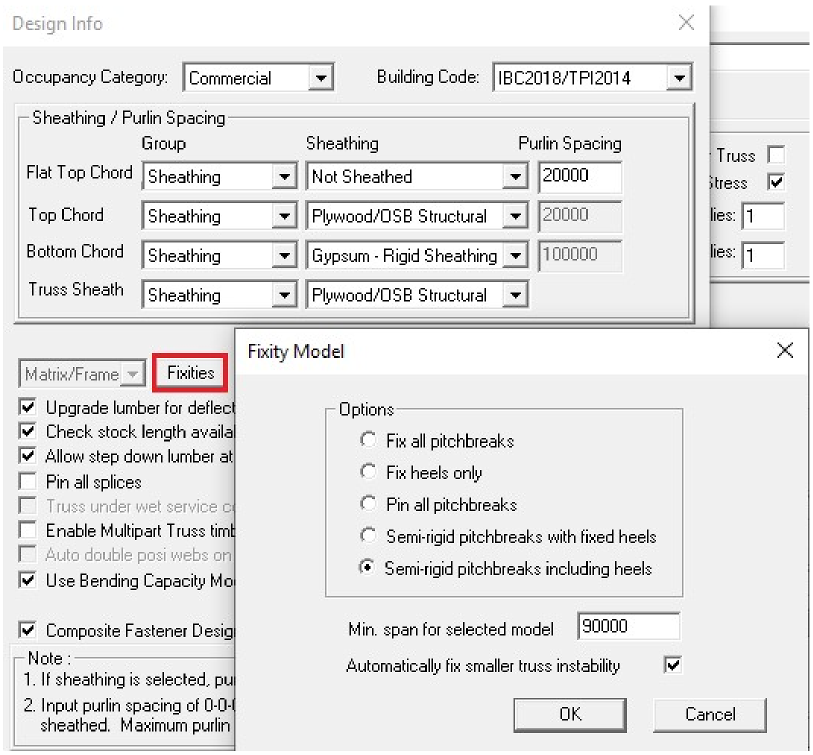
MiTek®

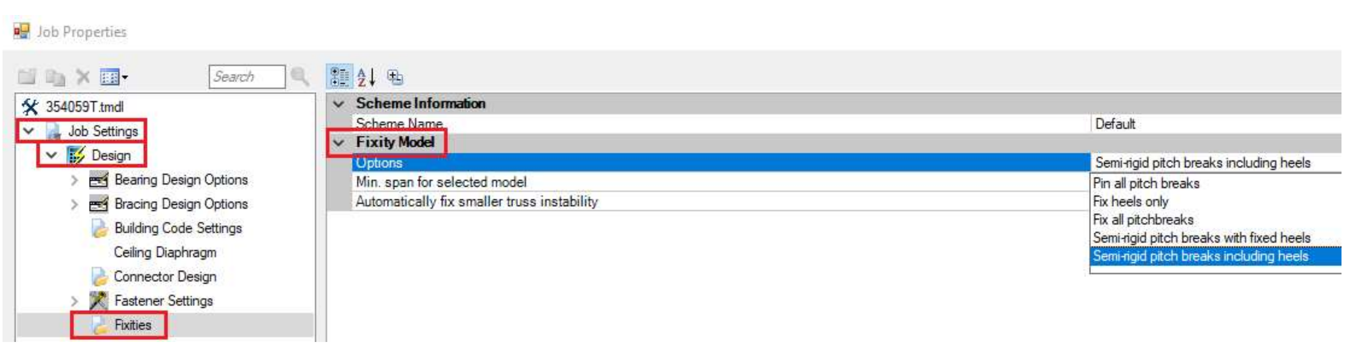
The Fixities Options in MiTek 20/20 Engineering and Structure with Truss Design.

We are often asked what the purpose of the Fixities Options are in the MiTek Engineering software and why a person should pick one fixity option over another. The purpose of this article is to help you understand what each option is and how these options will affect your truss design.

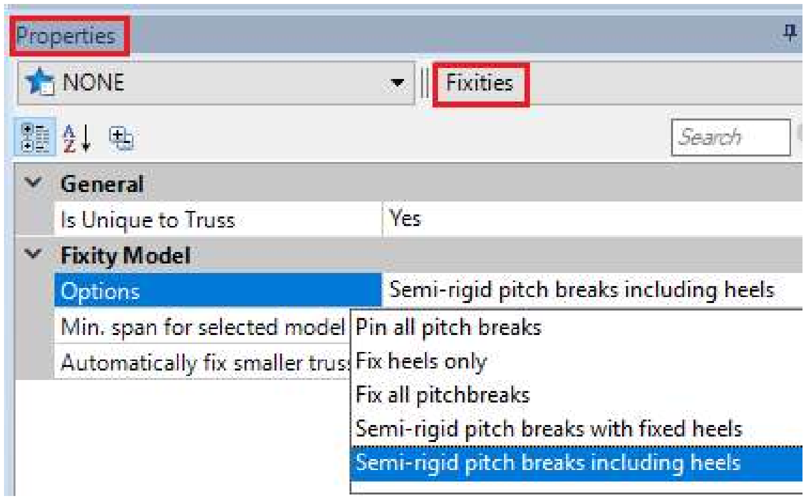
To begin, there are five *Fixities* options that can be found in the Fixities on the Design Info screen in MiTek 20/20 Engineering:



And in the File – Setup – Job Properties – Job Settings – Design – Fixities section on Job level in Structure with Truss Design:



And in The Properties – Fixities section on Truss level:



The difference between Fixed, Pinned or Semi-rigid pitch breaks.

A pinned or hinged joint is a joint between structural members which allow an unlimited angle of rotation between them, which means no bending forces are transferred through the joints and all of the forces transferred are axial. A pinned joint can most accurately be described as a joint acting like a hinge on a door. For example, if you had an open face jack truss with a pinned heel joint, the top chord would fold down onto the bottom chord because the heel would not have any resistance to rotation or moment. Now, let's take a look at a pinned joint in a common truss where we know that the top chord is in compression and the bottom chord is in tension. In this case, the plate at the heel joint resists these "axial" forces of compression and tension but does not resist any moment from the loads in the middle of the panels. This translates into all the moment being carried by the lumber and the plates only resisting the axial forces. This design method, in theory, causes higher lumber CSI's (Combine Stress Index) and lower plate JSI's (Joint Stress Index).

On the other hand, if we have a rigid joint at the heel of that exact same common truss, we allow no rotation to occur between the top and bottom chords. As the joint rigidity is increased, the bending forces in the adjacent members will increase at the joint but decrease in the middle of the adjacent panels. Larger plates are sometimes required because they are designed for more bending moment, but at the same time, the member's lumber grade adjacent to the joint will often be lower. Generally, smaller sizes and/or lower grades of lumber are required when rigidity is added to a pitch break.

In a real metal plate connected wood truss, actual joint behavior is complicated, as joints are not fully rigid or fully pinned. The rigidity of the joints is somewhere in–between, commonly referred to as "semi-rigid", which means the joint transfers some bending force due to partial rigidity. The degree of rigidity at a pitch break may vary with applied load, panel length, lumber size and grade, and plate size/gauge. We make an assumption that a semi-rigid joint is halfway between pinned and rigid, where the plate at the heel resists 50% of the rotation or moment.

So why would you use one of these analysis methods over another and what does MiTek recommend?

MiTek recommends that you go with the most economical, realistic and safe option. Through research and testing, MiTek engineers have found that the most realistic option is semi-rigid joints. We have also found semi-rigid analysis to be the most economical choice for most truss designs while accurately calculating actual truss performance. The semi-rigid analysis creates a balance between keeping chord lumber grades low without there being a significant increase in plate sizes so that the overall truss is competitively designed. There are some who feel that heel plates should be fairly large compared to other pitch break plates and therefore heel joints should be designed as fully rigid with the rest of the pitch breaks semi-rigid. This option is available as “Semi-rigid pitch breaks with fixed heels”.

The last choice to be made is the span to be entered under “Min. span for selected model”.

This option provides the ability to pin all of the pitch breaks for trusses shorter than the span entered here. This tool is extremely helpful because short span trusses typically don’t require higher grade chord lumber even if the pitch breaks are all pinned and therefore, you can pin these joints to get the smallest possible plates. The best length to be entered here is really dependent on the minimum chord grade lumber used for your designs, the loading and the panel lengths.

The **“Automatically fix smaller truss instability”** should always be checked as it will make a small un-triangulated truss work without compromising safety or the competitiveness of the design.

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