SIMPSON Strong-Tie®

Trusses

Good practice of choosing timber connectors for truss roofs.

Metal connectors for **Trusses**

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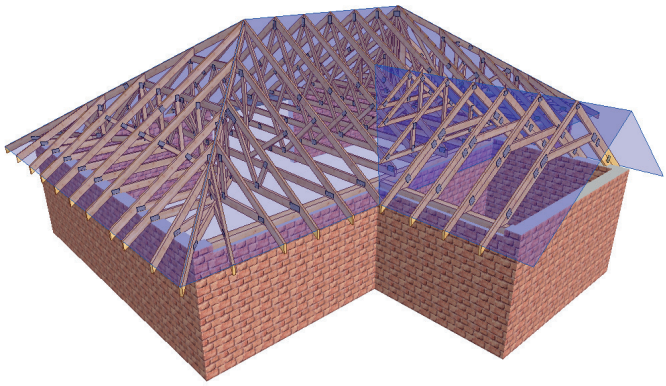
A few years ago prefabricated roof trusses were seen as an alternative to steel or concrete roof constructions for roofing of all types of halls. From year to year, this technology is more popular not only in industrial or agricultural facilities, but also in multi-family and single-family housing. As the experience of Western countries shows, the popularity of trusses is and will be increasing, so it is worth knowing what metal connectors we can use for their installation.



Pic. 1. General view of the roof

The roof that I will solve, in terms of the selection of connectors, is modeled to try to present most of the typical connections we can deal with. It is a fairly popular gable block with a T-shape with two hip ends. To discuss the different ways of supporting trusses, some of them are traditionally based on a wall plate, some directly on the concrete, and some on a steel beam.

Supporting trusses on the bearing

The main issue to be solved is the matter of supporting the trusses on the bearing, which can be - as I mentioned before - wall plate, concrete, steel beam. The most common solution is installation on a sole plate. Usually this connection is obtained using a pair of angle brackets. The most universal angle bracket designed for truss assembly is the ACRL10520 connector (Fig. 2.). It allows to make a traditional connection between a truss and a wall plate using ring nails to create the Pinned (non-sliding) support. What is equally important, using instead of nails, the M10 bolt through the oblong hole, we obtain roller (sliding) support. This is a very important issue, especially with larger truss spans.

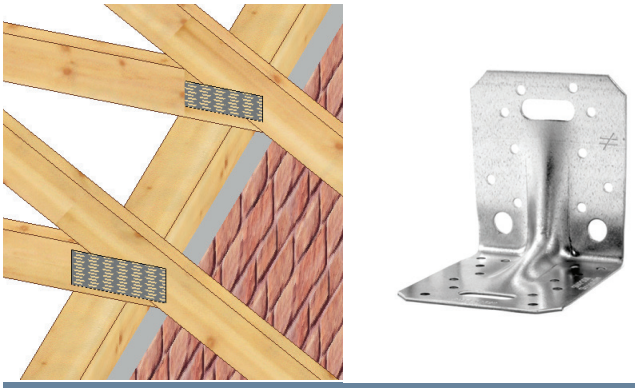


Fig. 2. Supporting the truss on a wall using ACRL10520 angle brackets

Another popular way of mounting, is to use a truss clip. This solution is definitely faster and easier to install (Fig. 3)

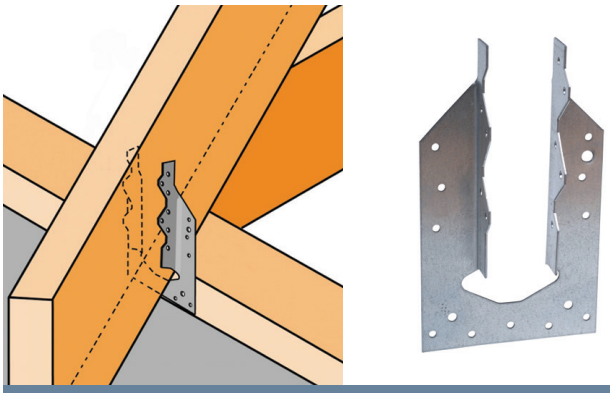
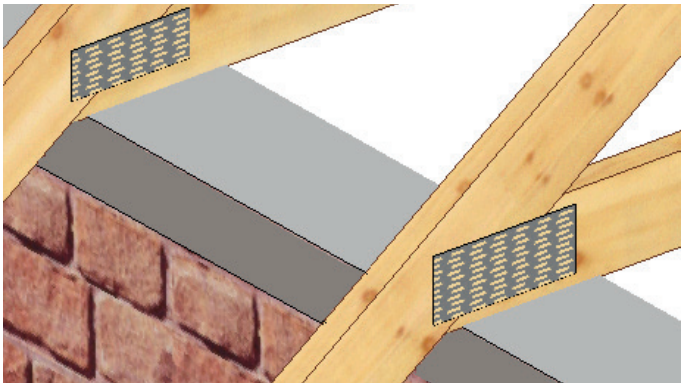


Fig.3. Support using a PFP truss clip

What if the trusses are mounted directly to the concrete? is enough to use the same angles as for wooden wall plate. Of course, instead of hammered nails, we use mechanical or chemical anchors for concrete.

The ACRL10520 angle in this case also allows us to implement a sliding or non-sliding support, assumed by the designer. The only difference in the assembly which we must pay attention to is turning the angle brackets so that it is mounted to the support with the other flange (Fig. 4.).



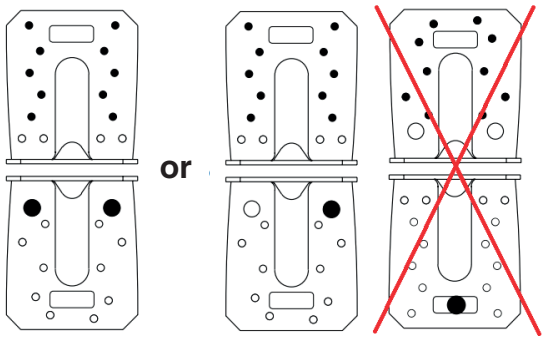


Fig. 4. Correct and incorrect assembly of angle brackets to the concrete

The girder resting on a steel I-beam creates quite a lot of problems..

The first solution that comes to mind is welding the angles to the beam. This is not only inconsistent with the purpose of these connectors and the provisions of the technical approval, but also incorrect from a practical point of view. The angles used are made of steel with a thickness between 2-3mm. Welding such thin elements to thick beams raises many technological problems. Moreover, welding damages the protective zinc layer.

The second natural way to solve this connection is a bolted connection. In place of anchor holes, we install metric bolts connecting angles to the steel beam. This, of course, requires drilling in the top flange of an steel I-beam.

Theoretically, this is a simple matter, but in practice every contractor will avoid drilling in a steel beam whose flanges may have a thickness exceeding 20mm. So what's the alternative?

HE connectors that eliminate the need for welding or drilling in steel. These joints are "hooked" to the bottom of the upper I-beam flange and nailed to the side of the girder (Fig. 5.). It should be remembered that they are used in pairs, in a diagonal arrangement. If we want to obtain a higher load capacity, you can use up to 4 joints in combination.

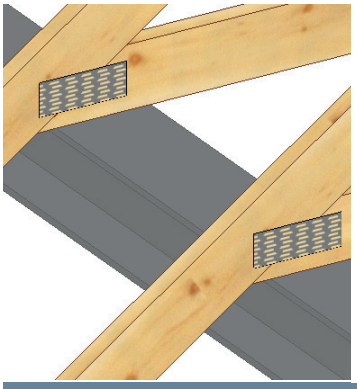


Fig. 5. Truss base on steel using a steel beam anchor HE

Hip ends ...

Many rather complex connections can appear in the construction of hip end roofs. Due to the high popularity of such roofs, it is worth analyzing various ways to solve roof hip ends. Each method of constructing an hip end generates different connections, in which various specialized connectors are used.

Jack truss – hip girder connection

The connection that appears in each hip end is jack rafer – hip girder conneciotion (Fig. 6.). Jack trusses joining girder at 90 deg. Angle can be connected using standard BSNN hangers. In addition, to prevent the truss from tipping over and to connect the top chord of the jack truss to the hip girder, we use the SPF purlin rafter connector here.

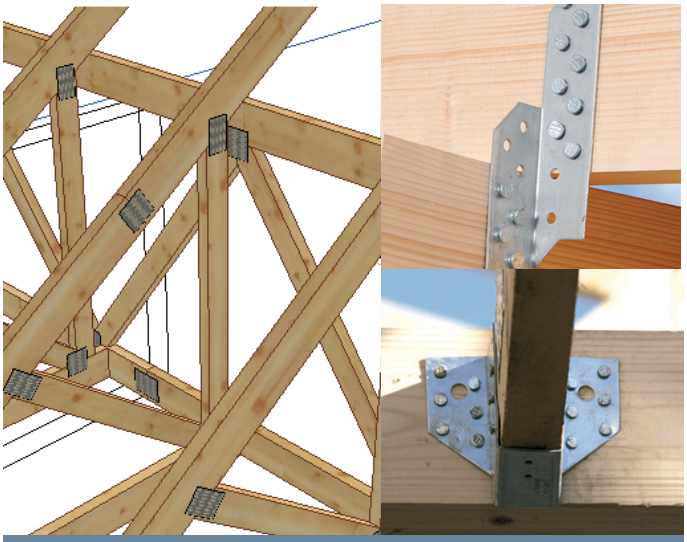


Fig. 6. Supporting jack trusses on hip girder. Top chord SPF connector. Botton chord - BSNN hanger.

Hip truss connections at a 45-degree angle are more problematic. Depending on how the designer constructed the hip end, different connections may occur.

Single connection at 45 degrees.

Such connections appear in the connections of hip girder with hip truss or jack trusses with hip truss (Fig. 7.). The ET260 hanger is a great solution for this detail. The main advantage of this connector is the fact that the same connector can make connections at an angle of 45 degrees both left and right. Its small height - 97mm allows installation even at low cross-sections of the bottom truss chord. Fig. 7. Single connections at degrees angle using the ET260 hanger.

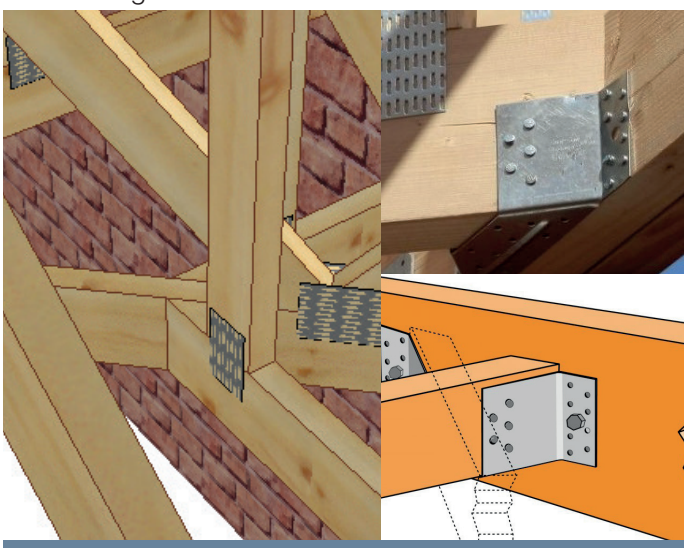


Fig. 7. Single connections at degrees angle using the ET260 hanger

Double connection at 45 degrees.

Such a connection appears in the hip end roof if two trusses (hip turss and jack truss) are to be supported on the hip girder in one place (Fig. 8.). Instead of using various weird and not fully quantifiable solutions in terms of capcities, just use the ETC connector.

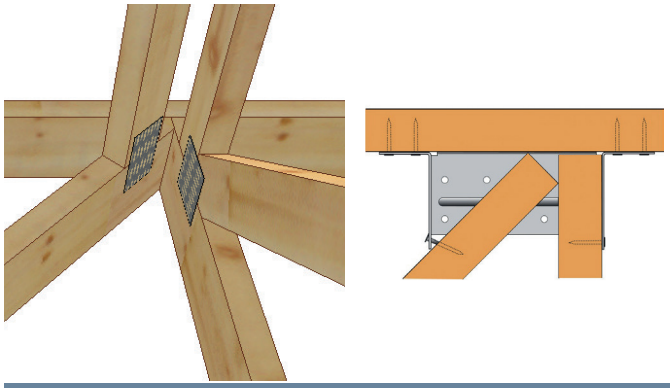


Fig. 8. Double connection at an angle of 45 degrees using the ETC434 hanger

Triple connection at 45 degrees.

Quite rarely used hip end solution. In this construction there is no hip girder, but the two hip trusses and the central jack truss are supported on the main truss in one place (Fig. 9.).

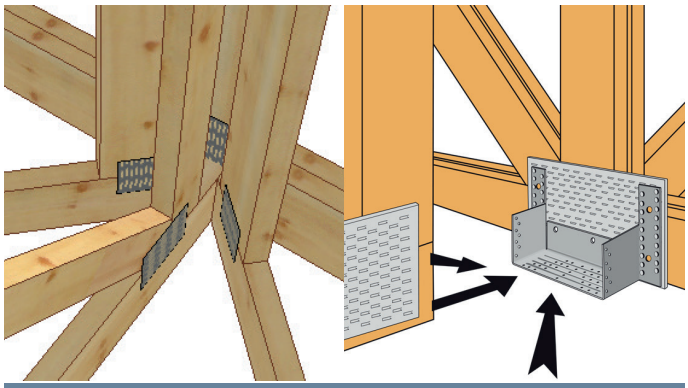


Fig. 9. Triple support at an angle of 45 degrees on the ETC835 hanger

Valleys and dormers

New product that has recently appeared on the market is the VTCR valley truss clip. This connector helps to solve a rather problematic connection of trusses supported on the top of other trusses. This combination usually applies to two cases - the construction of a dormer on a roof slope or a T-shaped building, when one gable slope penetrates the other forming valley (Fig. 10.).

The VTCR clip is adjustable and adapts to the slope. The main truss has nails (Ø3.35x65) at a 45-degree angle, which prevents the wood from splitting.

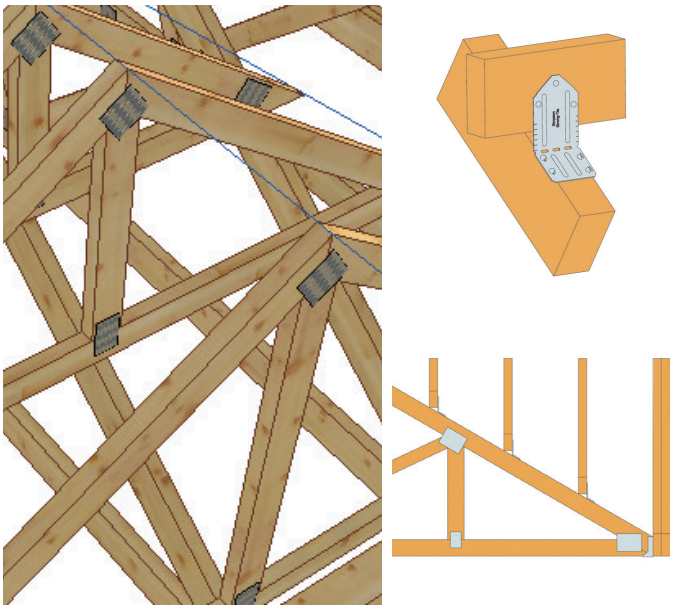


Fig. 10. Supporting valley trusses on VTCR clips

Watch out for spread forces!

The last type of connection I wanted to discuss is the supporting beams resting on a support enabling the transfer of large horizontal (spread) forces. The trusses that generate high horizontal forces are scissor trusses or raised-tie trusses without a bottom chord forming a system resembling a classic rafter-beam system. If we do not properly ensure the transfer of the horizontal forces from the truss, it will tend to spread on the supports (Fig. 11.).

If the values of the horizontal forces do not exceed 15 kN, you can try to transfer them using standard angle brackets. However, if the forces are greater, use connectors intended for this application. These are connectors from the SFN / SFH group.

Wind bracing system

The topic extremely important especially in simple truss roofs. Proper wind bracing system is crucial issue for whole structure reliability. Remember that the roof is not just a set of individual trusses. It is sometimes a complicated system in which stability issues come to the fore. Simpson Strong-Tie Wind bracing system is more complex topic that can be described in different article.

Of course, it's difficult to present a universal solution for any roof structure. The above guidelines can be treated as a starting point for further analysis of structure nodes. Each of the connections should be verified in terms of their load capacity- and emerging loads. Simpson Strong-Tie support engineers can share with you their knowledge and experience on choosing proper connectors for trusses. Please do not hesitate to contact us if you have any doubts!

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Branch Technical Manager
Simpson Strong-Tie

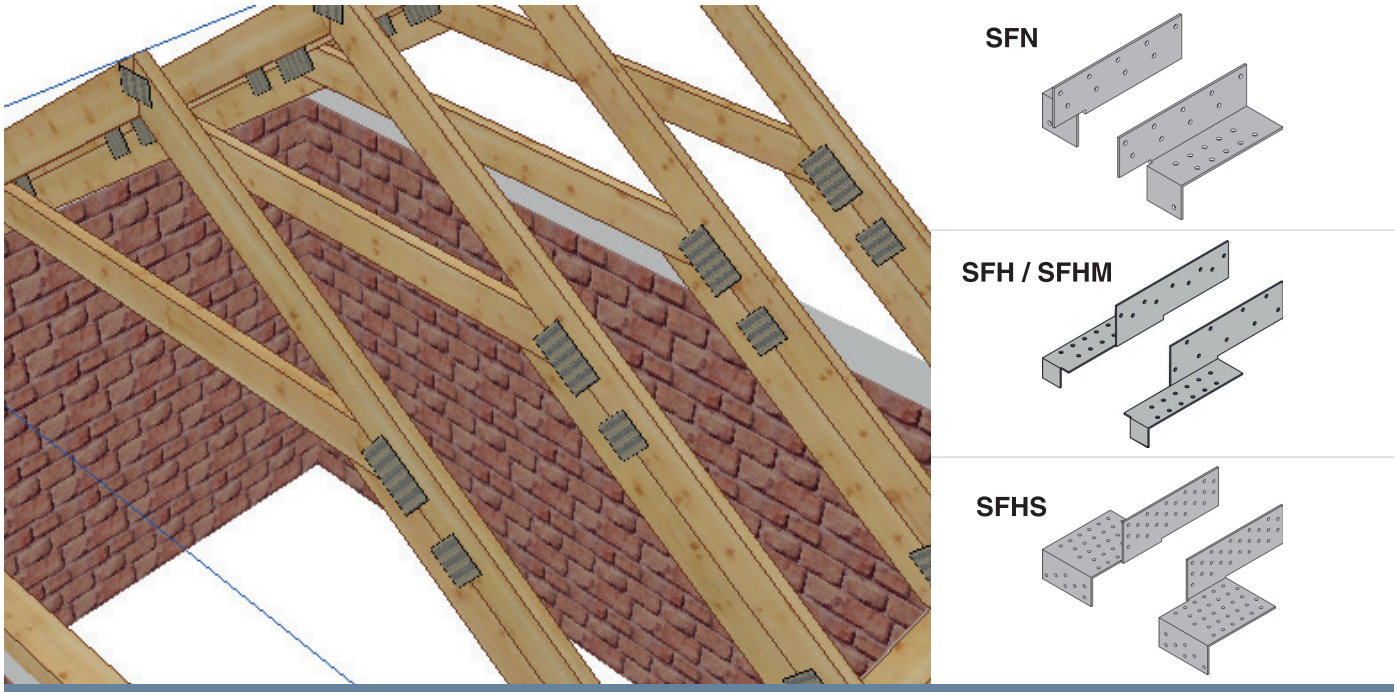

Fig. 11. Connections carrying high horizontal forces

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