Practical Roof Solutions

Hipped Ends

The good performance of MiTek designed hipped ends does not depend on tension in battens, a massive wallplate and horizontal thrust on walls. Indeed, with suitable bracing, walls are provided with the stability called for by the Building Regulations. The most simple and lowest cost form of MiTek hipped end, (shown in figure 11a) consists of a multi-ply girder of standard trusses securely fixed together and supporting loose rafters and ceiling joists. Such constructions are limited to spans generally not exceeding 5m. Sizes of rafters and ties can be found in approved document 'A' of the Building Regulations. Hip boards should be supported off the girder by means of a ledger and the ceiling joists by means of proprietory joist hangers.

The 'step-down' system incorporates flat-top hip trusses of progressively diminished height from the ridge to the girder. The number of step-down trusses is determined by the necessity of maintaining reasonable sizes for the loose ceiling joists and hip board on the hipped corner infill areas, as shown in figure 11b. For these reasons the span of the mono-pitch trusses is not usually greater than 3m in the case of regular hips (where the end pitch is the same as the pitched of the main roof).

Noggings have to be fitted between the flat chords of the step-down hip trusses to support the tiling battens. The web configurations of the various truss types shown (including the mono-pitch) are typical but will be chosen to provide the best structural solutions.

This step-down hip system is no longer very popular as it requires many different truss profiles to be made.

The 'flying rafter' hip system show in figure 11c has the manufacturing advantage of there being only one basic hip truss profile. All of the hip trusses, including those forming the girder are similar, and the mono-pitch trusses supported off the girder usually have the same profile as the sloped part of the hip trusses which speeds up fabrication.

The rafters of the mono-pitched trusses are site cut to sit against the upper hip board and the off-cuts are nailed in position to the rafters of the hip trusses. The flat parts of the top chords of the hip trusses and girder are well braced together to prevent instability.

While the hipped corner infill is shown as prefabricated rafter-joist components (open jacks), it is usually cheaper to site fabricate in these areas. The lower hip board is typically notched and supported off a 50 x 50mm post nailed to the girder truss. The upper hip board can be supported off ledgers and in some cases is propped off the hip trusses underneath.

The system offers the advantage of continuous rafters and consequently easily constructed smooth roof slopes. On long spans it may be necessary to use a second hip girder between the apex and monos.

Figure 11a

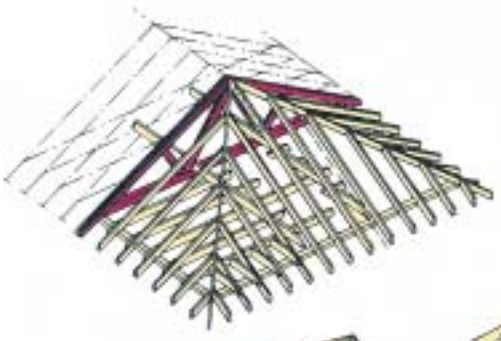


Figure 11b

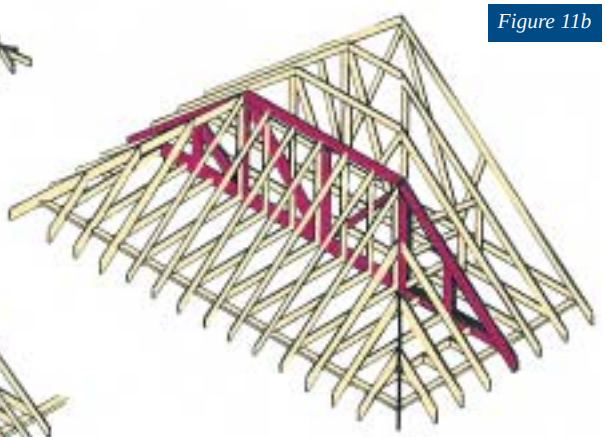
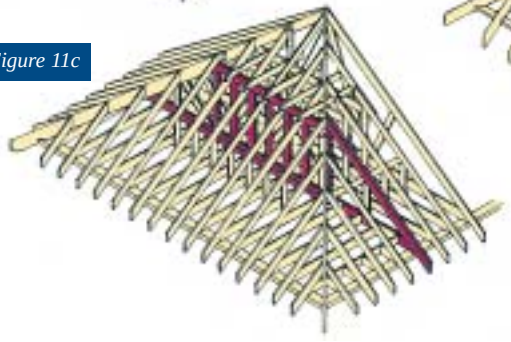


Figure 11c



Rafter noggings not shown for clarity

Practical Roof Solutions

T Intersection & Valley Infill

The 'T' is probably the most common kind of roof intersection (as demonstrated in figure 12). The roof truss arrangement at this feature includes a specially designed girder truss (shown in figure 13), usually consisting of two to four individual trusses connected together with nails or bolts, which support the incoming trusses. Support of the incoming trusses is off the bottom chord of the girder through girder truss shoes.

The design of the valley frame infill continues the rafter profiles of the opposing roof slopes to form an intersection, and transfers the tile loading uniformly to the top chords of the underlying trusses.

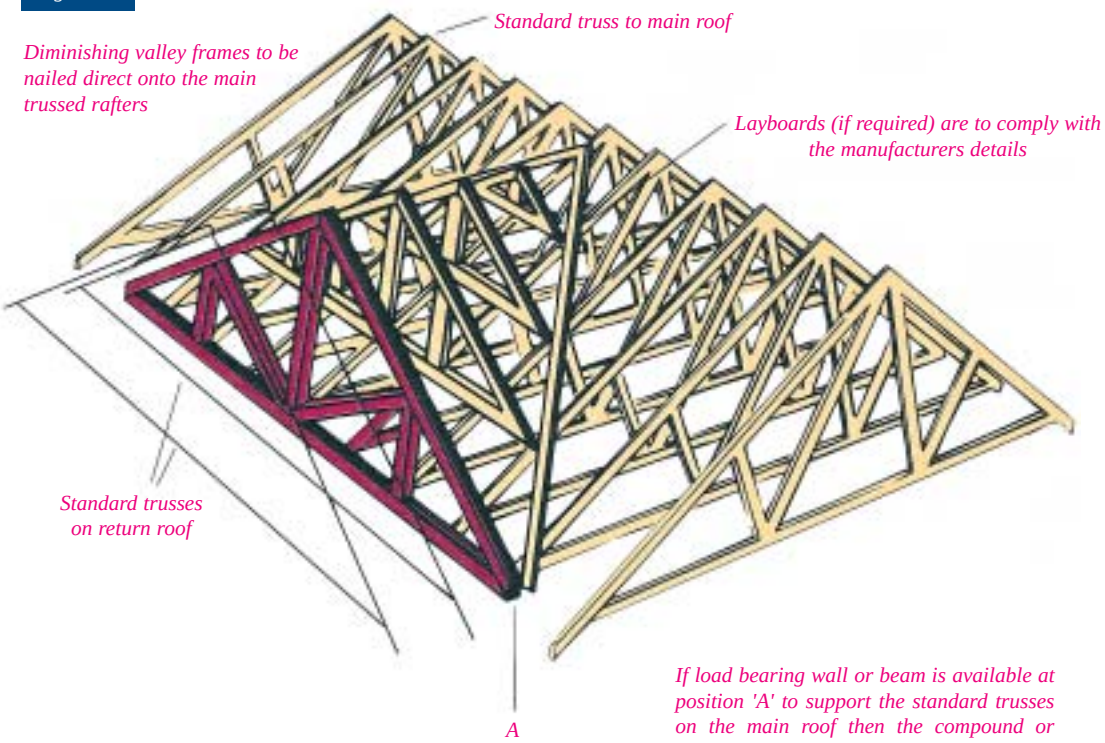
Figure 13

Typical girder truss

Howe

Double Howe

Figure 12



If load bearing wall or beam is available at position 'A' to support the standard trusses on the main roof then the compound or girder trusses can be substituted for a standard truss on the return roof

Practical Roof Solutions

Corners

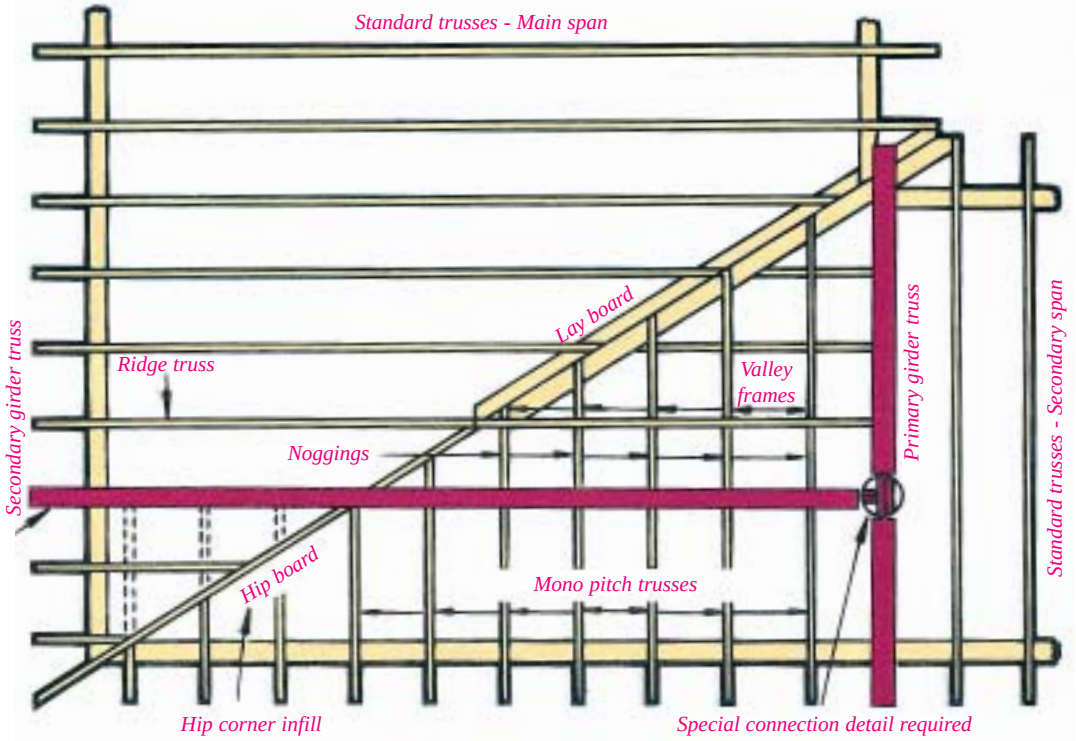
There are two basic methods of forming a corner:

1. Hipped Corner

A hipped corner is formed by the perpendicular intersection of two roofs which may or may not be of the same span.

The principle for the hipped corner construction is the same as for full hips except that the truss profiles are generally sloped on one side only. The support across the junction is again provided by either a girder truss or a wall/beam. When a girder truss is specified provision has to be made for a special hanger to carry the girder truss supporting the hipped end. Mono valley frames are required to complete the framing of the corner.

Figure 14a



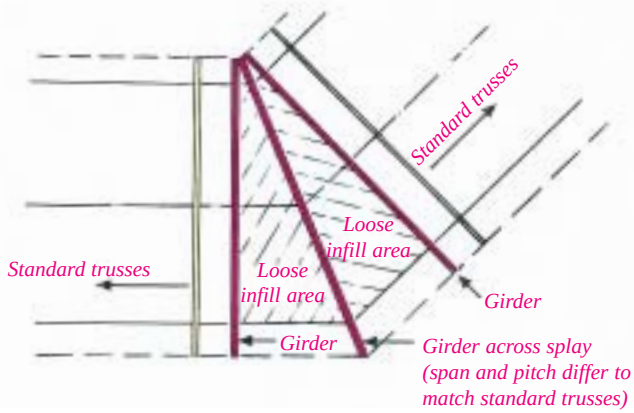
2. Skew Corners or Dog-Legs

A skew corner is formed by the intersection of two roofs at an angle greater than 90 degrees. The corner is generally framed by positioning a girder truss at the extremity of the two straights with an additional girder positioned across the corner as in figure 14b.

The girder units will typically support loose infill on purlins and binders to maintain the roof plane. The feasibility of framing in this manner is dependant solely upon the span of the longest purlin.

It is not recommended to incorporate hipped ends and tee intersections into skew corners unless a feasibility study has been undertaken before planning has become too far advanced.

Figure 14b



Practical Roof Solutions

Extended Rafters and Extended Joists

Extended rafters and extended joists, as shown in figure 15 require special consideration because the trusses are not fully triangulated to the bearings. As a result of the lack of triangulation, the extended member is subject to exceptionally large bending moments. In the example shown in figure 16 the rafter, or the top chord, is subject to a bending moment no less than ten times that which occurs in a conventionally supported truss.

Standard trusses can be adapted and strengthened to withstand the large bending moments and shear force occurring in the extended member at the rafter-tie junction. This may be accomplished by fixing a strengthening piece to each side of the extended member, using bolts or a special nailing arrangement. Another way to strengthen the extended rafter is by using a factory fitted stack chord as shown on the right-hand side of figure 16.

Large rafter extensions will produce outward thrust and movement at the bearings. This is often a critical factor in design and is rigorously controlled by BS.5268-3.

Figure 15

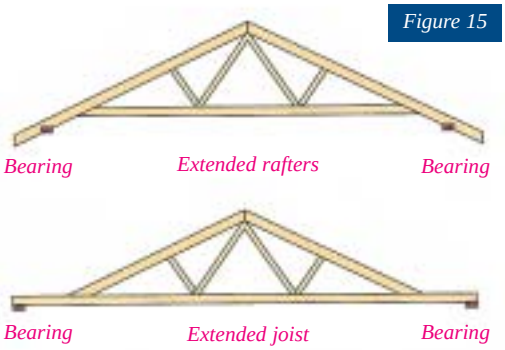
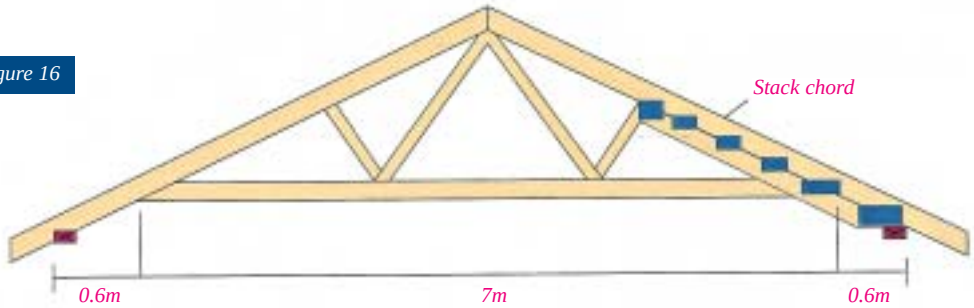


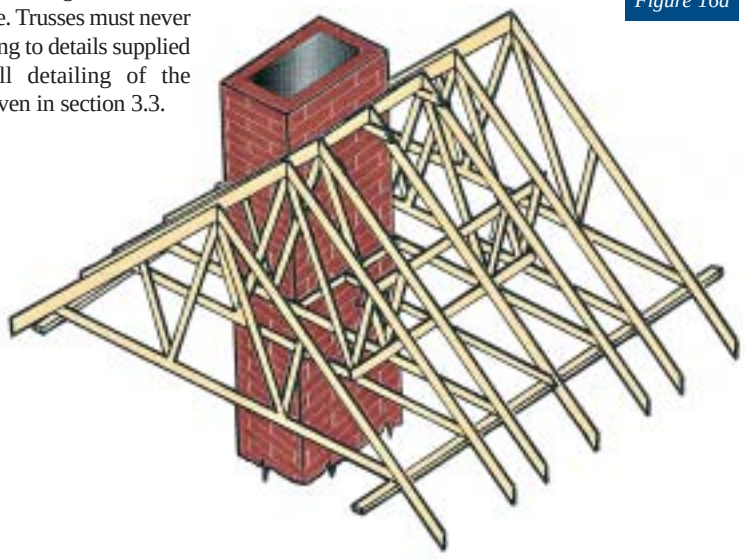
Figure 16



Hatch and Chimney Opening

Where possible, hatches and chimneys should be accommodated in the standard spacing between trusses. Each member and joint in a truss performs an important role essential to the effective functioning of all other parts and the component as a whole. Trusses must never be cut and trimmed except according to details supplied by the truss designer. The full detailing of the construction of these features is given in section 3.3.

Figure 16a



Practical Roof Solutions

Room-in-the Roof: Attic Frames

The special advantage of attic frames is that they enable the upper floor of a building to be totally contained within the roof, increasing the habitable area by 40-50% at little extra cost. The bottom chords become the floor joist of the room, their size having been calculated to cater for increased loads.

Attic Frames can be designed to allow 'clear span' supported at eaves only, (as shown in figure 17a), however for longer spans it may be necessary to incorporate an intermediate support (shown in figure 17b). This will allow either larger internal room dimensions or reduce the timber sections required. Since attic frames are non-triangulated, the timber content will be considerably greater than that required for a comparable trussed rafter.

Figure 17a

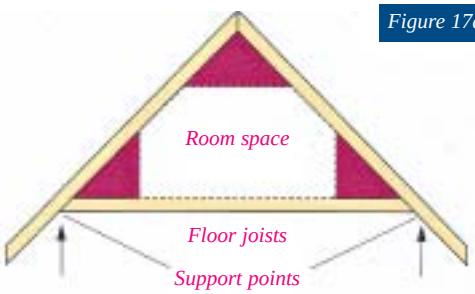
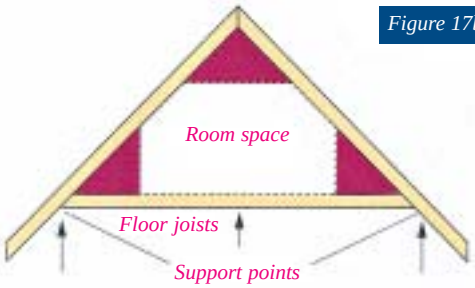


Figure 17b



Where a more complex attic roof layout is being planned, for example where hipped ends, corners or intersections may occur, it is recommended that a truss designer is contacted to prepare a feasibility study at an early stage of the project.

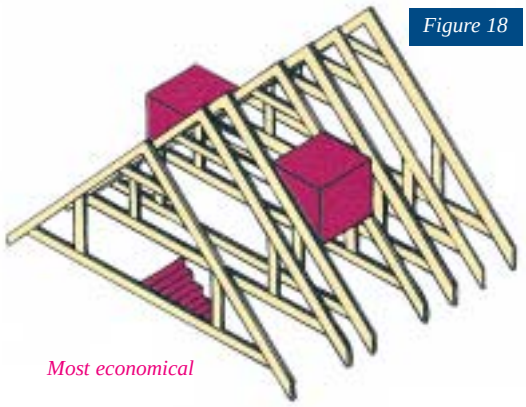
Dormer Window and Stairwell Locations

The same principles that apply to ordinary roof trusses also apply to attic frames. If a truss is severed or weakened at any point the structural integrity of the whole truss is effected. Therefore, if an opening is planned, the roof must be strengthened by additional frames at smaller than standard spacings or girders at each side of the opening. Guidelines to these details are given in section 3.3.

Having acknowledged these principles, there is relative freedom in the methods of framing out the actual openings, however there are sensible economic factors to be considered. Obviously it is of most advantage to locate window openings on different sides of the ridge and directly opposite each other in order that they will lie between the same two trimming trusses. If not, the extent of additional loose infill timber may completely negate the advantages of using prefabricated attic frames. Where possible stairwells should be located parallel to the trusses otherwise, once again, the increase in site infill timber may nullify the benefits of using attic frames.

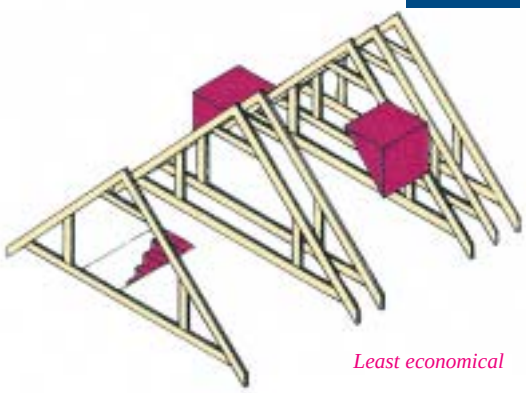
The following diagram (figure 18) demonstrates the most economic method of incorporating openings to the roof space, whilst figure 19 requires increased loose infill timbers and site work if practical recommendations are not followed.

Figure 18



Most economical

Figure 19



Least economical