Information for Site Use

Modifying Trussed Rafters on Site

The basis rule here is **DO NOT MODIFY TRUSSED RAFTERS** on site unless the prior permission for the modification is obtained from the Trussed Rafter Designer.

Trussed rafters are designed for a purpose and should never be cut, notched, drilled or otherwise modified without full consideration of the resultant effect.

If for some reason an adjustment in the geometry or internal structure of the truss is required by the site, ***REFER BACK*** to the Trussed Rafter Fabricator. He will have the engineering design for the units supplied and is in the ideal position to co-ordinate any action which may be needed.

Do's and Don'ts on Site

Site storage
Bearers should be placed on a level, hard and dry surface. A waterproof covering must be used to protect components against rain and sun and to allow good air circulation. In vertical storage, bearers must be high enough to keep rafter overhangs clear of the ground. In horizontal storage, bearers must be arranged at close centres to give level support.

Fit it right
Fixing problems are eliminated in roof construction by the use of proprietory Builder Products. Proprietory joist hangers, restraint straps, connector plates, framing anchors, truss clips and shoes save time, money and produce a quality job. Your MiTek fabricator will advise you as to the right products for the job.

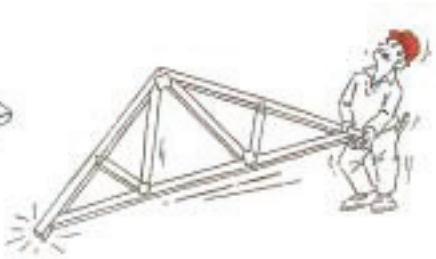
Think don't cut
Trussed rafters are designed and fabricated for a particular purpose - and to save work. Trusses must not be cut under any circumstance. Truss spacings can usually be adjusted to take hatch openings and chimney breasts. For large chimney breasts, trusses are specially designed and supported.
Don't cut or guess, consult your trussed rafter supplier if you are in doubt.

Handling
Care in the handling trusses must be taken at all times. 'See-sawing' trusses on walls or scaffolding must be avoided and where necessary an extra man should be used to prevent the truss being distorted. Large trusses handled mechanically should be adequately supported.

Bracing
The Building Designer will have detailed the permanent roof bracing. Permanent roof bracing is required to ensure the stability of the roof. Each roof requires longitudinal and diagonal bracing. In specific cases bracing is also required to stabilise long web members. Temporary bracing must be fixed during erection to ensure that trusses are maintained in a vertical plane.

Support your tank
The extra load of a water tank requires careful support. Additional trimmers across the joists support the bearers.

DO STORE ON SITE CAREFULLY



DO HANDLE WITH CARE

DO FIX IT RIGHT

TRUSSES DO NEED BRACING

DON'T CUT

DO SUPPORT YOUR TANK

IF IN DOUBT - ASK!

Supporting Water Tanks

Water tank support for standard Fink Trusses

Figure 68

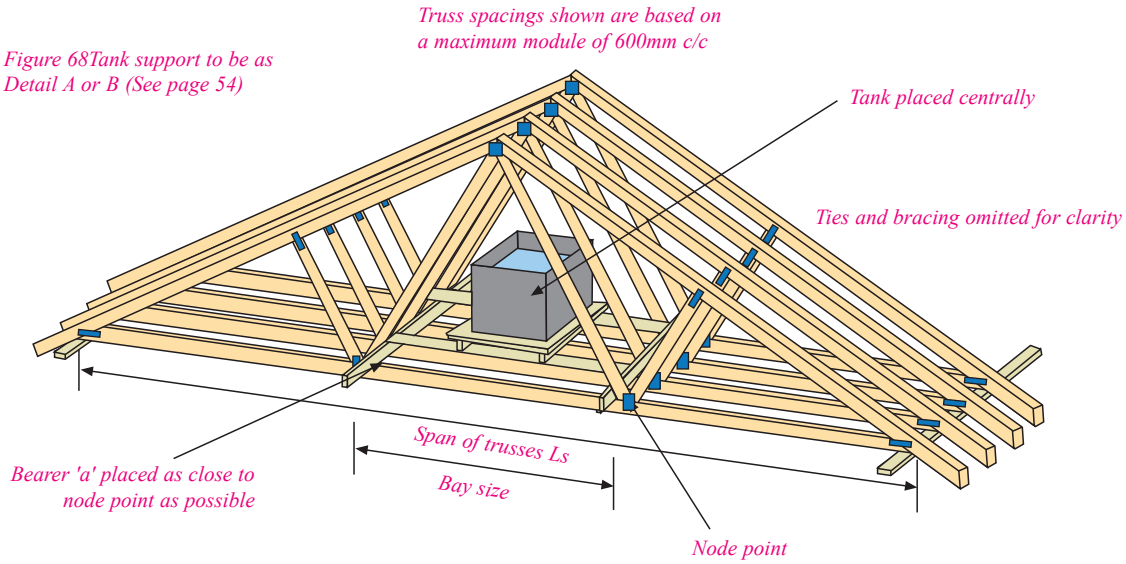
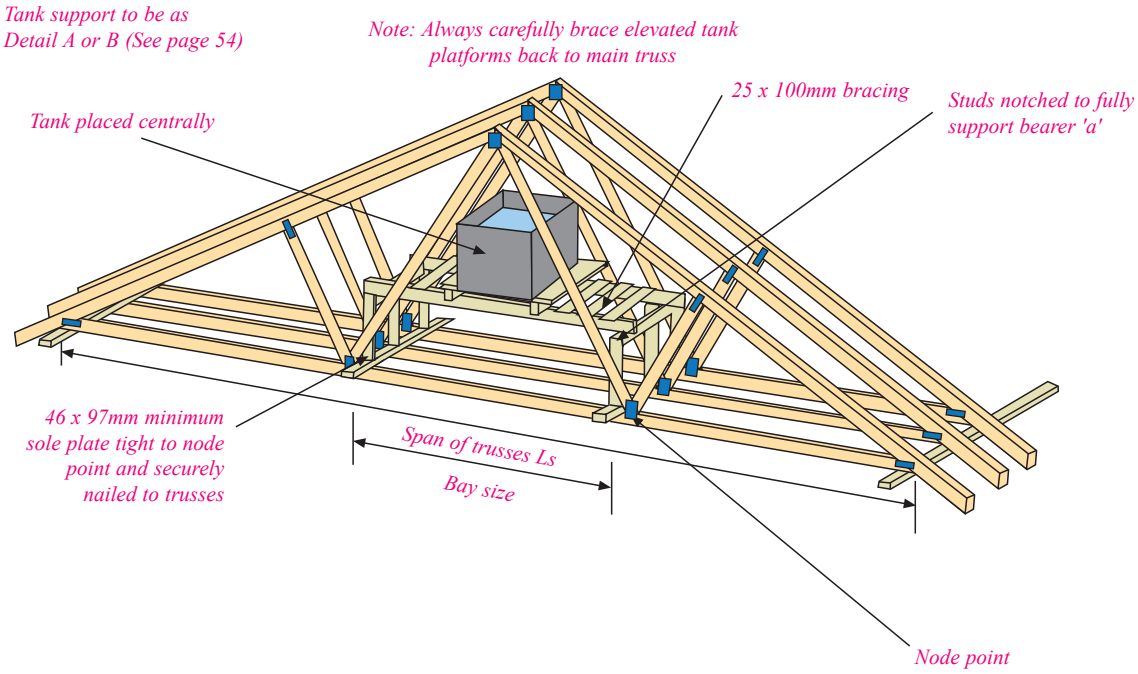


Figure 69

Water tank support platform

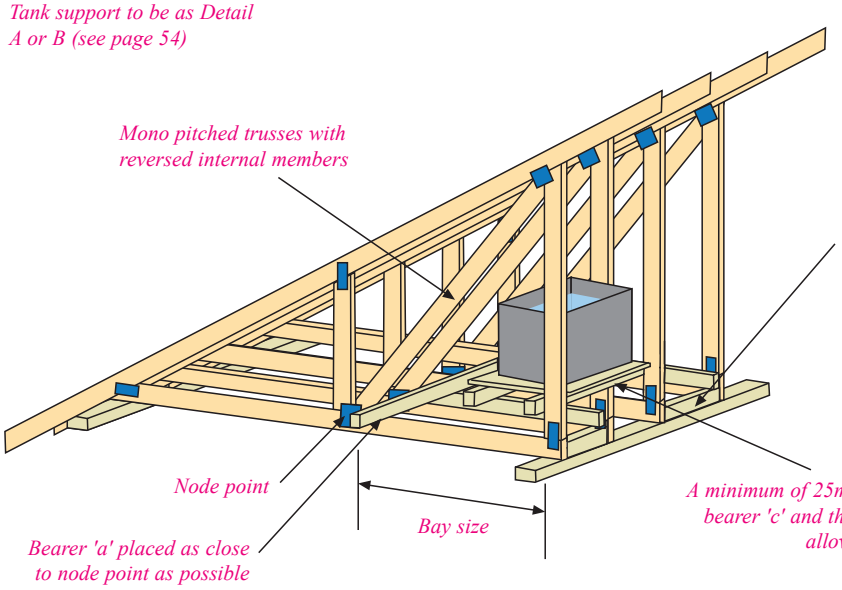


Supporting Water Tanks

Water tank support for Mono Pitch Trusses

Figure 70

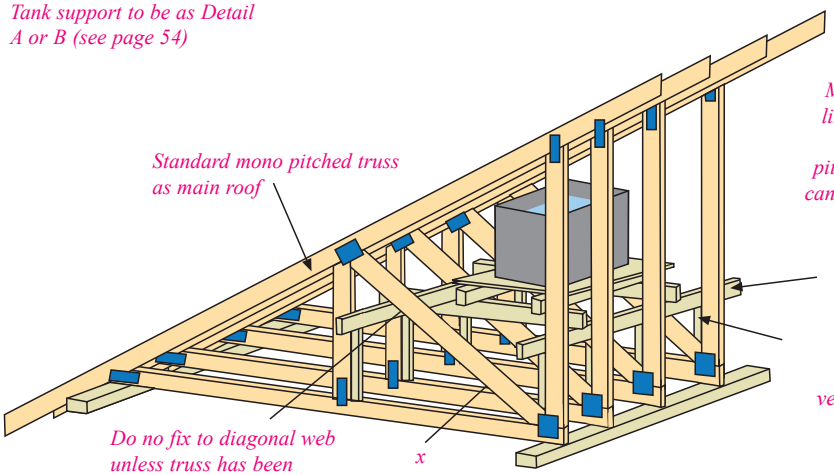
Tank support to be as Detail A or B (see page 54)



Water tank support platform for Mono Pitch Trusses

Figure 71

Tank support to be as Detail A or B (see page 54)



Supporting Water Tanks

Water tank support for Small Span Trusses

Figure 70

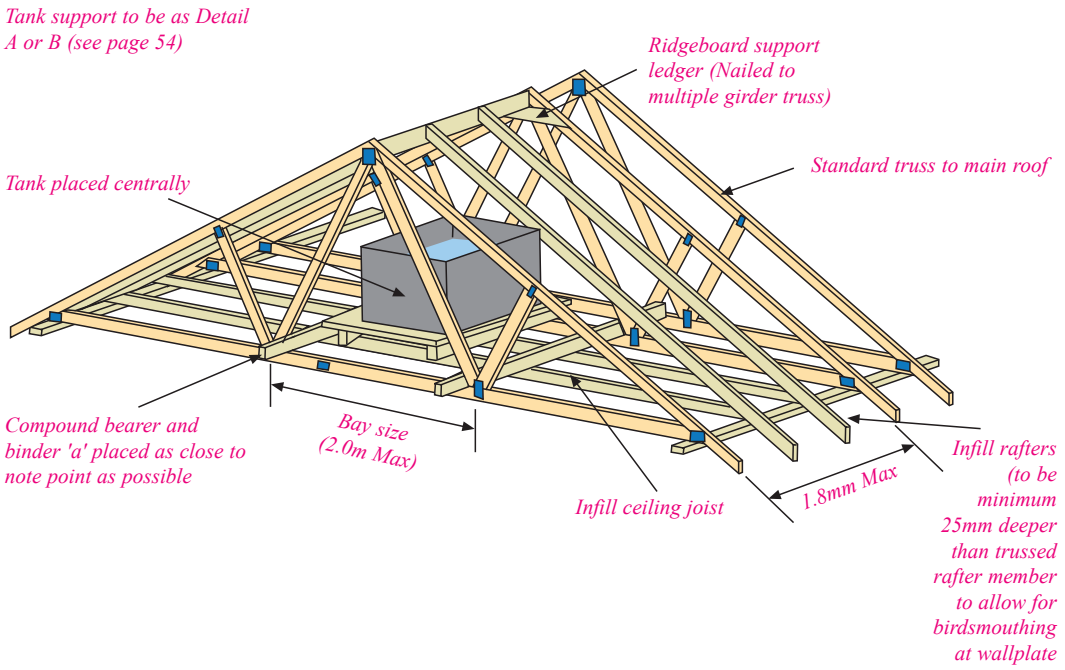
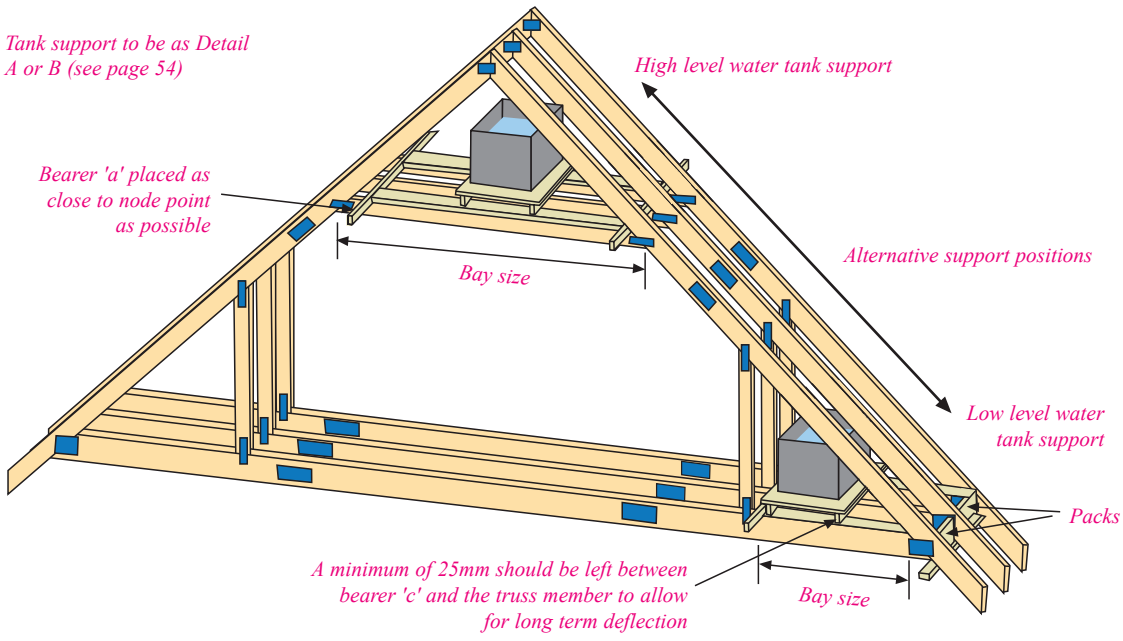


Figure 70

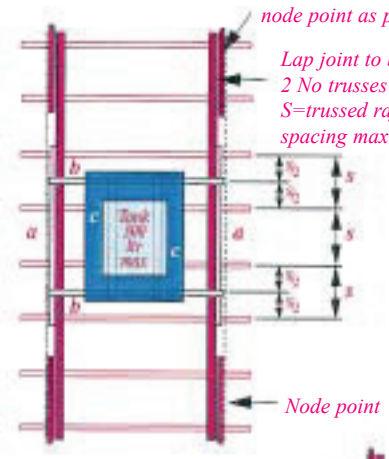
Water tank support for Open Plan Attic Trusses



Supporting Water Tanks

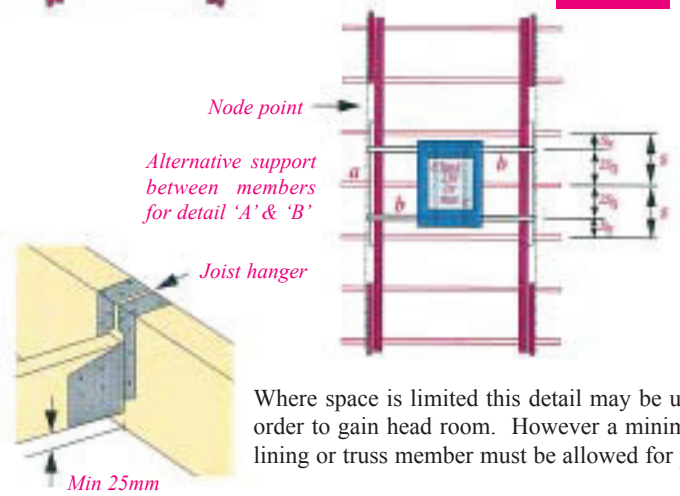
Detail 'A'

Figure 74



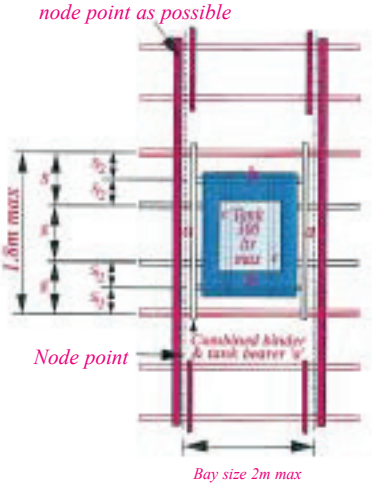
Detail 'B'

Figure 75



Detail 'C'

Figure 76



If water tanks are to be supported on the trussed rafters in accordance with the details shown then the provision for these must be taken into account at the design stage.

Otherwise, the additional loads imposed by the water tanks must be supported independent of the trussed rafters.

Where space is limited this detail may be used between members a & b and b& c in order to gain head room. However a minimum clearance of 25mm above the ceiling lining or truss member must be allowed for possible long term deflection.

Table 1: Sizes for support member

Tank capacity to marked water line	Minimum member size (mm) a and c	b	Max span Ls for fink trussed rafters (m)	Max bay size for other configurations (m)
Detail 'A' not more than 300 litres on 4 trussed rafters	47 x 72	2/35 x 97 or 1/47 x 120	6.50	2.20
	47 x 72	2/35 x 120 or 1/47 x 145	9.00	2.80
	47 x 72	2/35 x 145	12.00	3.80
Detail 'B' not more than 230 litres on 3 trussed rafters	47 x 72 47 x 72	1/47 x 97 2/35 x 97 or 1/47 x 120	6.50 9.00	2.20 2.80
	47 x 72	2/35 x 120 or 1/47 x 145	12.00	3.80
Detail 'C' not more than 300 litres on 2 multiple trusses as shown	1/72 x 145 or 2/35 x 145	1/72 x 145 or 2/35 x 145	6.00	2.00

Note: Support members may be of any species with a permissible bending stress not less than that of European redwood/whitewood of C16 strength class or better.

Hatch and Chimney openings

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 Trussed Rafter Designer.

The principle behind the methods and details given in this section is to ensure that no individual trussed rafter is subject to a load significantly greater than that applied, were it at standard spacing.

Figure 77a shows a system suitable for openings greater than 10% over standard and up to twice standard spacing. Battens and plasterboard should be given extra support.

Support of the loose timbers is provided in line with each truss joint by a purlin, binder or ridge board and by trimmers at the actual opening.

Figure 77a

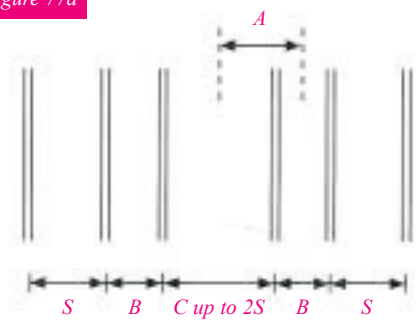
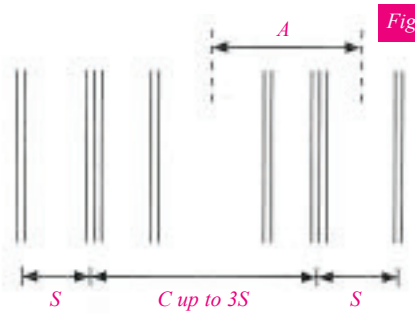


Figure 77b

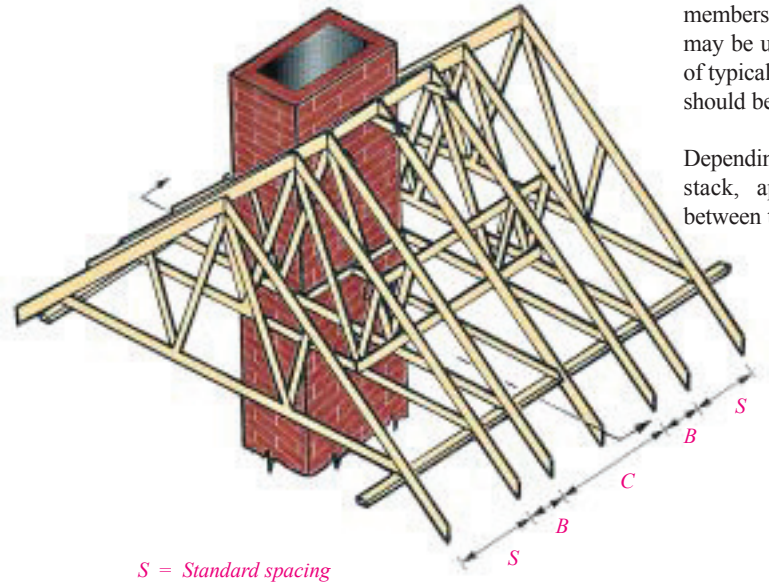


When the two trimming trusses at each side of the opening (figure 77b) are actually nominally fixed together with nails, at say 600mm centres along all members, an opening of up to three standard spacings may be used. Deeper purlins, binders and ridge board of typically 47 x 175mm and trimmers of 47 x 125mm should be installed.

Depending on the design of the chimney flue and stack, appropriate clearance should be allowed between timber and chimney.

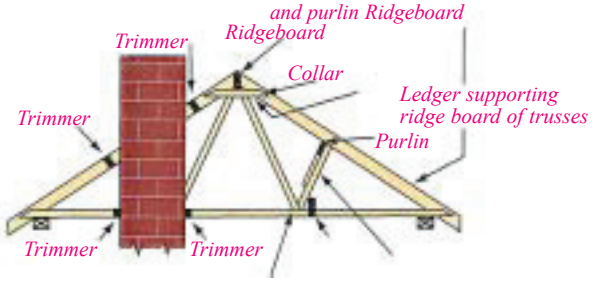
Although intended primarily for trussed rafters, the above principles can also be used for framing with Attic Frames. Raised Tie or Extended joist trusses require careful consideration when framing around hatch or chimney openings, as often reinforcing timbers (Scabs) are already required on the 'standard' unit and it is often not possible to design multiple ply units of this type.

Figure 77c



S = Standard spacing
C = Chimney opening
B = Reduced spacing
A = Effective spacing

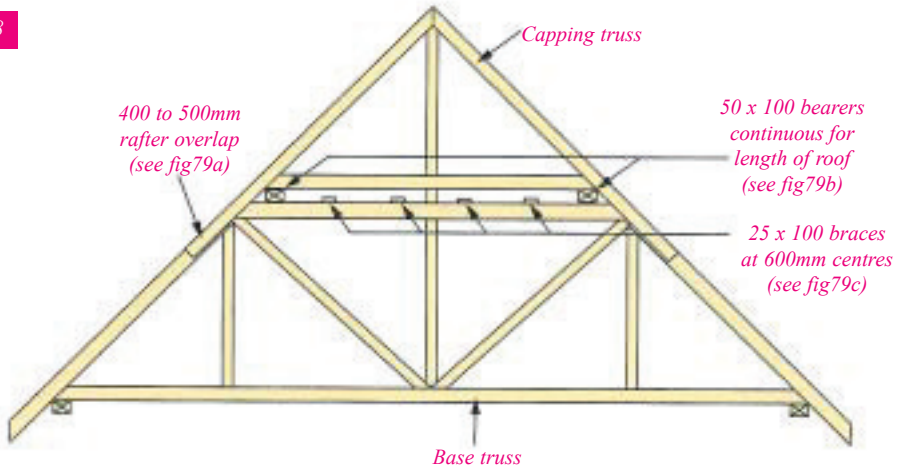
Figure 77b



Two Tier Construction

It is necessary to use two tier trussed rafters when the vertical dimension of a single component would be too large for manufacturing or transportation. This dimension is generally 3.9 - 4.4m but your MiTek fabricator will advise you when to expect trusses in this form.

Figure 78



The two tier truss (figure 78) comprises a flat-topped base truss and a triangular capping truss, fitting alongside the base truss on longitudinal bearers. Each truss may be one of a large selection of types. The base truss will generally be made as high as practical but not so high that the span of the capping truss is less than 2-3m. Although a duo-pitched shape is shown in figure 78, all basic configurations can be constructed by the two tier method.

The bracing of the flat top chord of the base truss is important in ensuring its performance in compression.

The base trusses should be erected, full permanent bracing installed and battens fixed, up to the top position of the capping trusses. The resulting structure then forms a safe, rigid working platform for the erection of the capping trusses. Tiling or loading of the base trusses should not proceed until the capping trusses are fully installed and braced.

Figure 79a

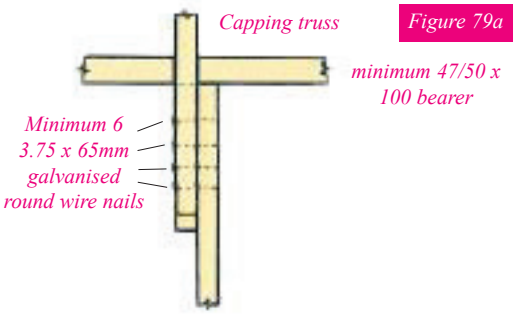


Figure 79b

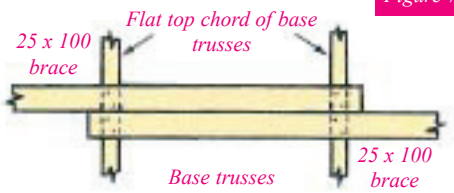


Figure 79d

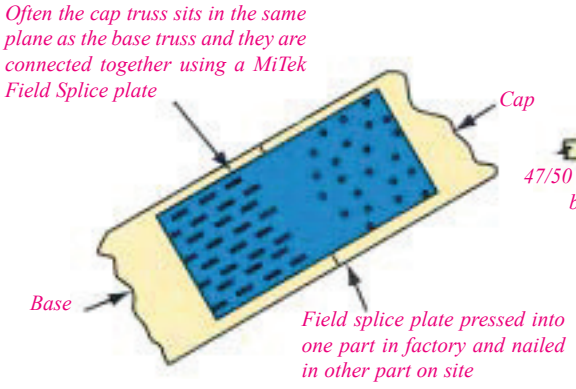
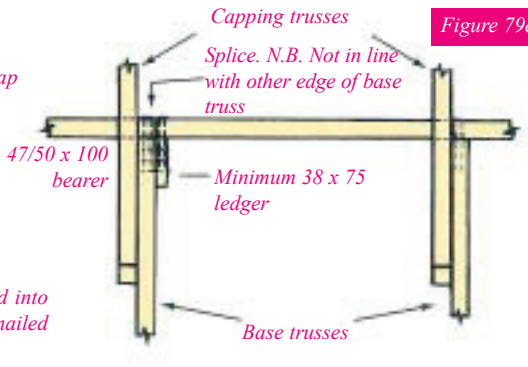


Figure 79c

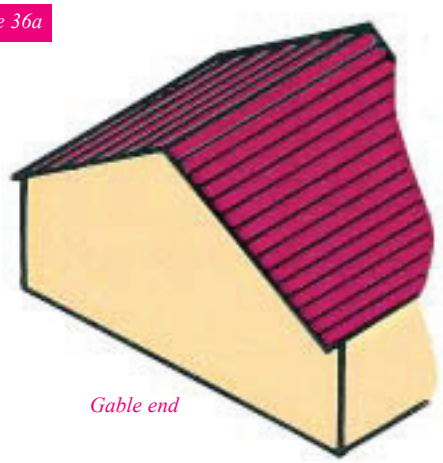


Hip Ends and Corners

Typical Roof Features - Hipped Ends

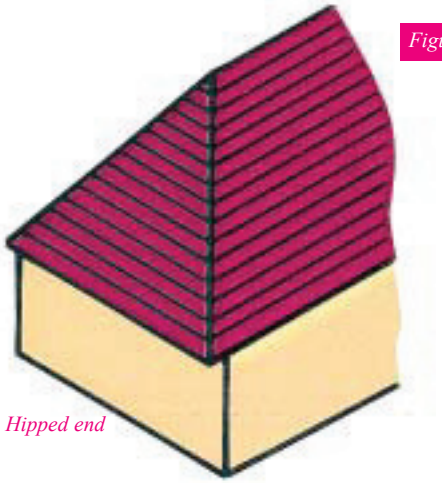
The most common end shapes are the Gable End, which allows the simplest roof framing and uses most support wall surface; the Hipped End which offers a simple wall solution at the expense of a more complex roof structure, and the Dutch Hip and Gable Hip, which are compromises between a gable and hip, easily formed using trussed rafters.

Figure 36a



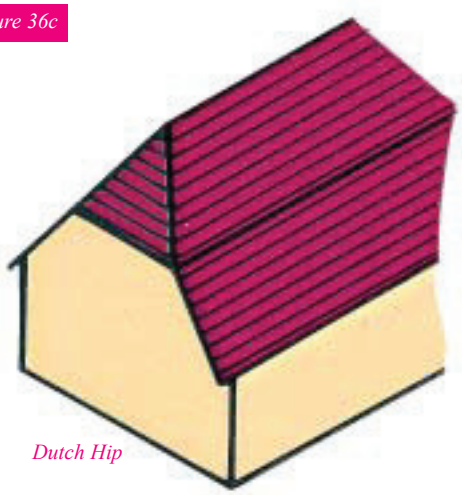
Gable end

Figure 36b



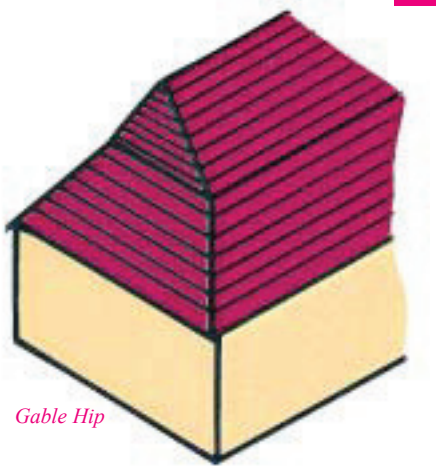
Hipped end

Figure 36c



Dutch Hip

Figure 36d



Gable Hip

Figure 37a

Action of hip end

Figure 37b

Traditional hipped end

Most traditional hipped ends behave like an inverted conical basket and, under load, the tendency for its rim (the wall plate) to spread is resisted by friction (lateral force on the wall), tension in the rim (tension and bending in the wall plate) and tension in the weft (the tiling battens). In the long term the results are sagging hip boards and rafters, bulging walls and characteristic horizontal cracks in the masonry at the inside corners of the dwellings roughly 300-600mm below ceiling level.

However, hipped end systems develop by MiTek do not depend on tension in battens, or a massive wallplate and horizontal resistance from the walls. With suitable bracing, the trussed rafter hip roof provides the walls with the stability required by Building Regulations.

Hip Ends and Corners

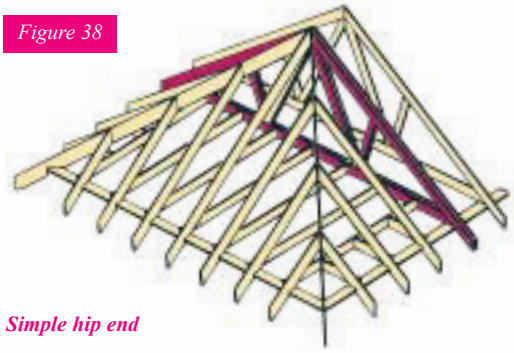
Hipped Ends

The simplest form of hipped end consists of a multi-ply girder of standard trusses securely nailed or bolted together, which support loose rafters and ceiling joists, as in figure 38.

This is the most inexpensive form of hip because no special trusses are needed other than the girder, but their use is limited to spans up to 5m.

Loose rafter and ceiling joist sizes should be taken from Approved Document A to the Building Regulations. Hip boards should be supported off the girder by means of a ledger. The ceiling joists should be supported by proprietory joist hangers.

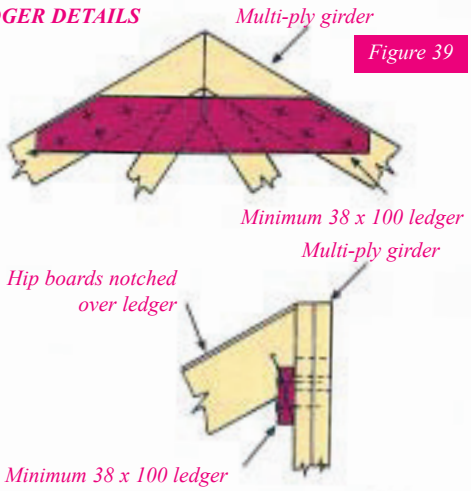
Figure 38



Simple hip end

LEDGER DETAILS

Figure 39



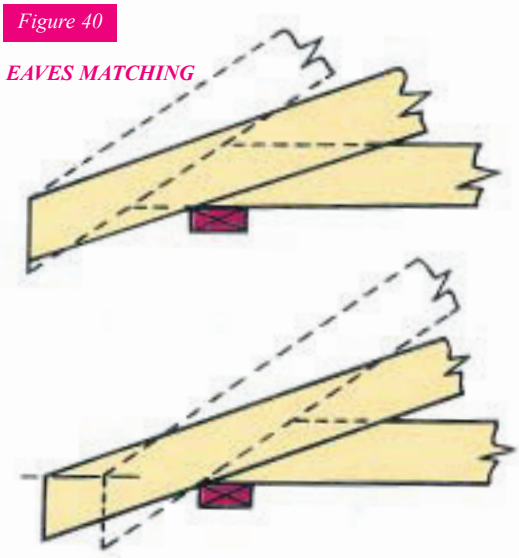
If the end pitch is different to the pitch of the main roof, the eaves details should be discussed with your trussed rafter supplier. It is advisable to ensure that the top extremities of rafter overhangs are at the same level to provide for continuous guttering. Note that whilst adjustments can be dealt with on site in loose timber construction, the mono-pitched trusses used in other hip types must be made correctly in the factory.

It should also be noted that all forms of hip construction employing a hip board exerts a horizontal thrust at the wallplate corner junction. Having taken up any horizontal movement, of course, the structure becomes stable. Movement of the wallplate can be controlled by fixing a 1200mm length of galvanised steel restraint strap around the outside. See figure 41.

MiTek trussed rafter suppliers can provide detailed advice on hipped end roof details.

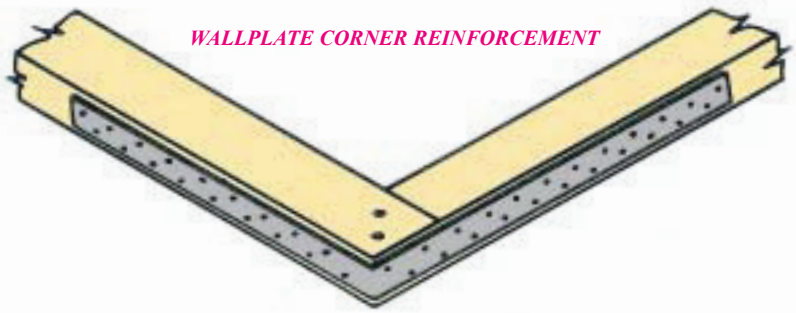
Figure 40

EAVES MATCHING



WALLPLATE CORNER REINFORCEMENT

Figure 41



Hip Ends and Corners

Hipped Ends - 'Stepdown'

The step-down hip system uses flat top hip trusses of progressively diminishing height from the ridge to the girder truss position. This system is rarely used as each truss is different to make. The number of step-down hip trusses is determined by the need to maintain reasonable sizes for the loose ceiling joists and hip board in the hipped corner infill areas. For these reasons, the span of mono-pitch trusses is not usually greater than 3 metres in the case of regular hips, where the hip end pitch is the same as the pitch of the main roof.

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

Fortunately, this system is flexible in accommodating large spans and irregular hips with unequal roof pitches and employs standard, designed truss types throughout.

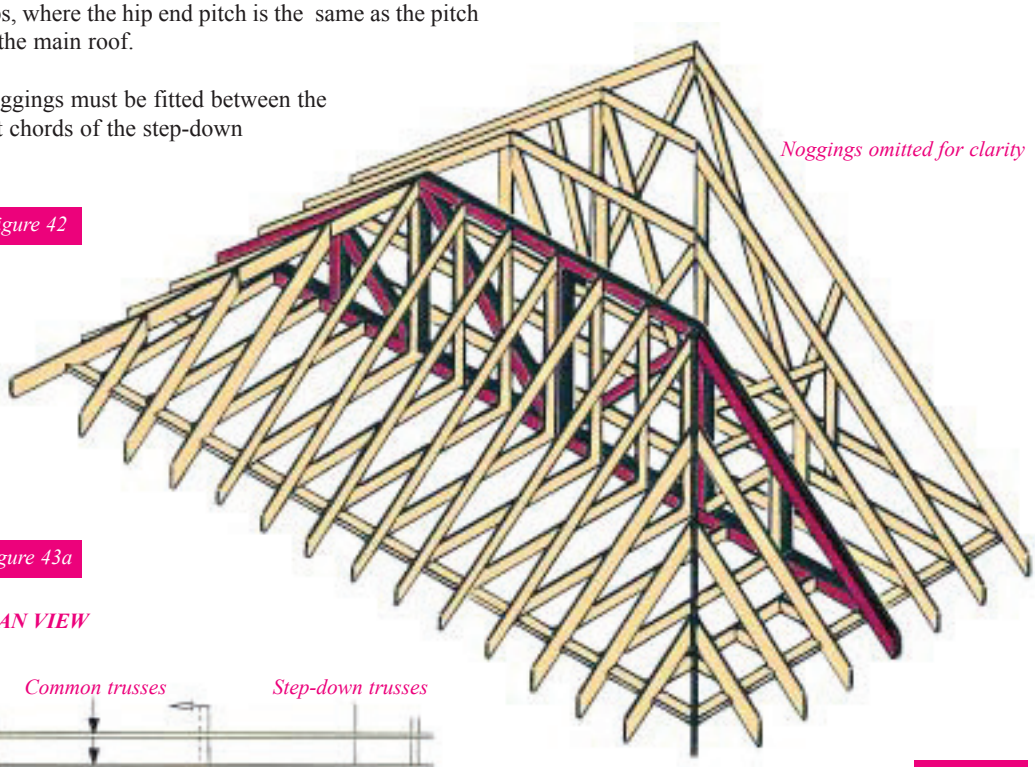


Figure 42

Figure 43a

PLAN VIEW

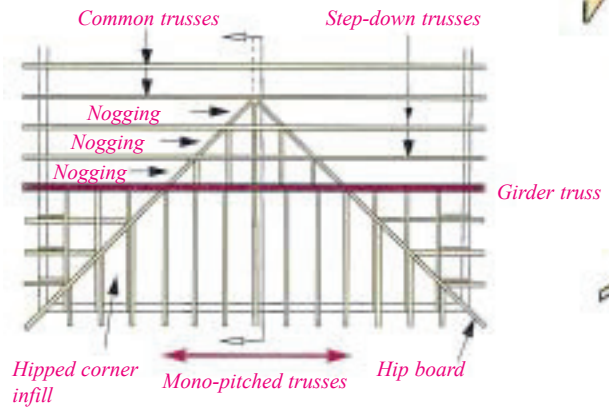


Figure 43b

SECTION

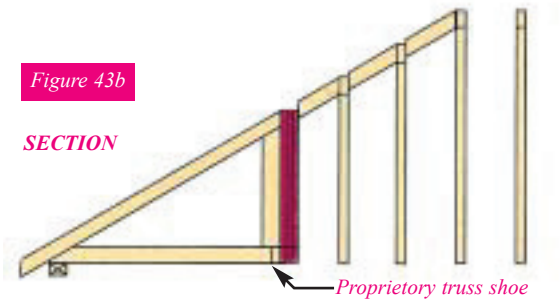
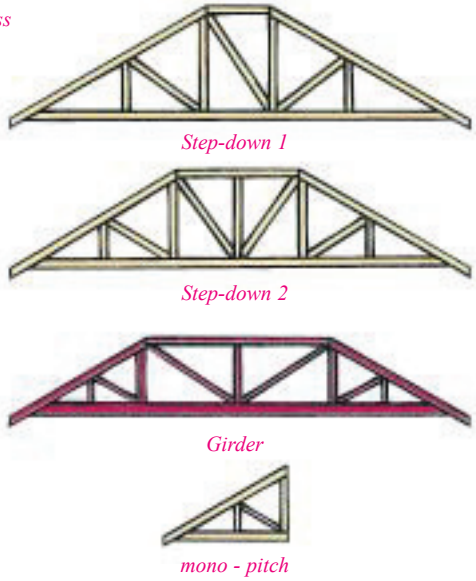


Figure 43c

TRUSS COMPONENTS



Hip Ends and Corners

Hipped Ends - 'Flying Rafter'

Of the many types of hip systems this one has an obvious manufacturing advantage: There is only one basic hip truss profile. All the hip trusses, including those forming the girder truss are identical; and the mono-pitch trusses supported off the girder have the same profile as the sloped part of the hip trusses, which speeds up fabrication and reduces the overall cost of the hip system.

The rafters of the mono-pitched trusses and/or hip trusses are extended and are site cut to fit against the upper hip board. Off-cuts may be required to be nailed in position to the rafters of the hip trusses. For the longer rafters props may be required to run down to the trusses underneath.

The flat parts of the top chords of the hip trusses and girder must be securely braced together to ensure stability.

The hip corner may be constructed from pre-fabricated rafter/joist components commonly called Open Jacks or all the corner can be framed with loose rafters, joists and hipboards on site. The hip board is notched over the girder truss and supported off ledgers at the apex of the hip.

This system offers the advantage of continuous rafters and thus easily constructed smooth roof slopes.

Typical spans using this construction with one primary multi-ply hip girder would be 9.6 metres.

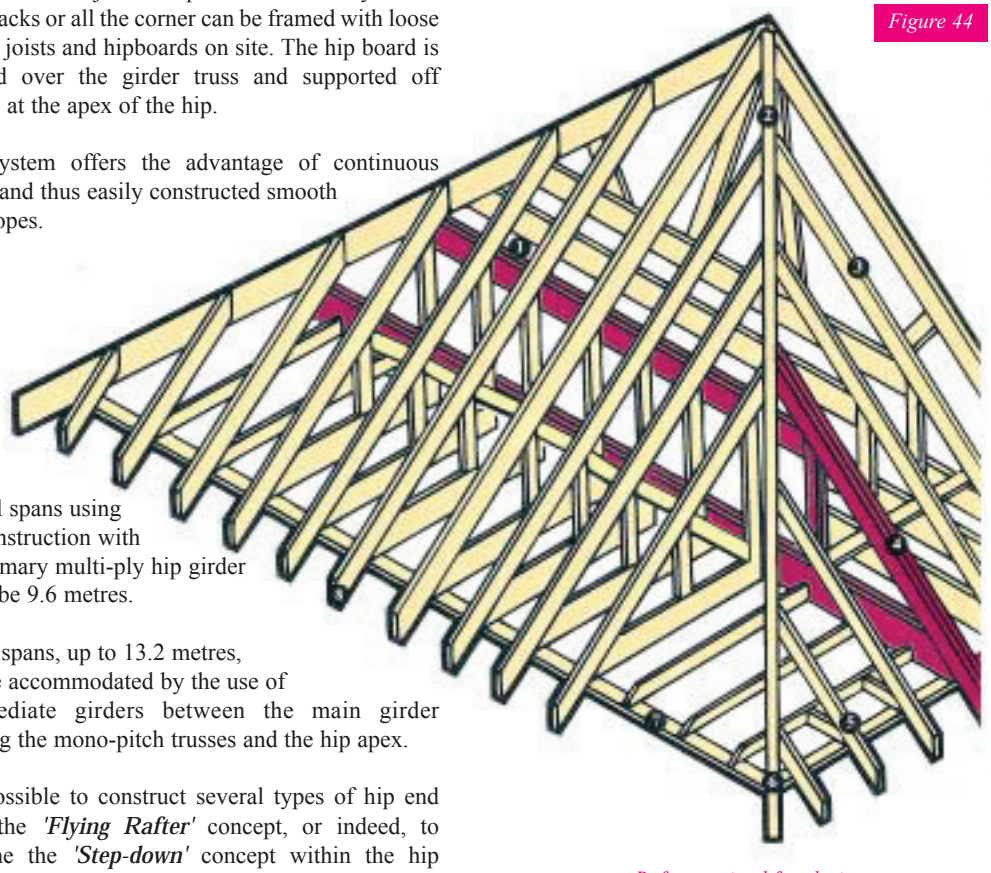
Larger spans, up to 13.2 metres, may be accommodated by the use of intermediate girders between the main girder carrying the mono-pitch trusses and the hip apex.

It is possible to construct several types of hip end using the *'Flying Rafter'* concept, or indeed, to combine the *'Step-down'* concept within the hip trusses with the *'Flying Rafters'* on the hip end mono-pitch trusses.

Please contact your truss supplier if you have a preference for a particular method of construction, as the MiTek design system can encompass any method.

1. Flat top chords require bracing
2. Ledger under to support hip boards
3. 'Flying Rafters' on hip trusses (may require props to trusses below)
4. Girder
5. Infill rafters
6. Hipboard
7. Infill ceiling joists
8. Mono-pitch trusses

Figure 44



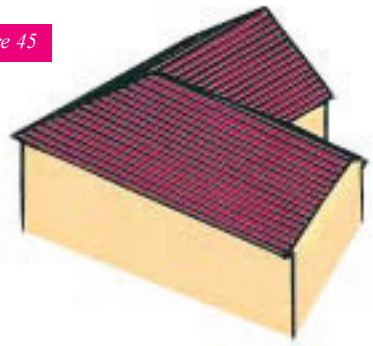
Rafters omitted for clarity

Hip Ends and Corners

Hipped Corners

A hipped corner is formed by the intersection, at 90 degrees, of two roofs which may, or may not be the same span or pitch.

Figure 45



Hipped corners for mono-pitched and other roof shapes are based on the same principles described below for duo-pitched roofs.

The common framing consist of a SECONDARY half-hip girder truss supported by a PRIMARY duo-pitch girder truss. An internal load-bearing wall or beam support can often be used to perform the function of the primary girder truss.

The duo-pitch girder truss is specially designed for the exceptional loads it carries and includes a wider than normal vertical web to which a proprietory girder hanger can be fixed to carry the half-hip girder.

Figure 46a

COMPONENTS OF HIPPED CORNER

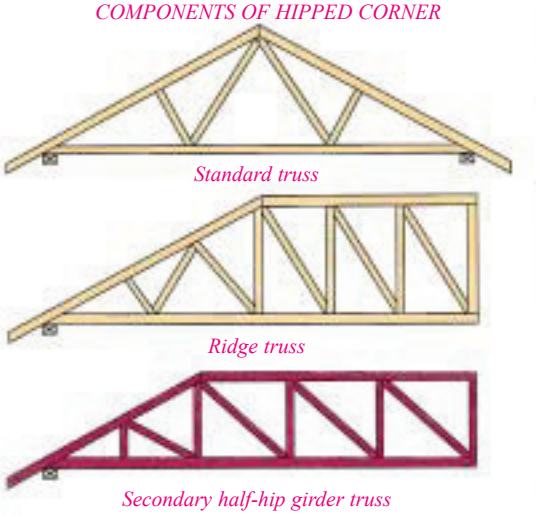
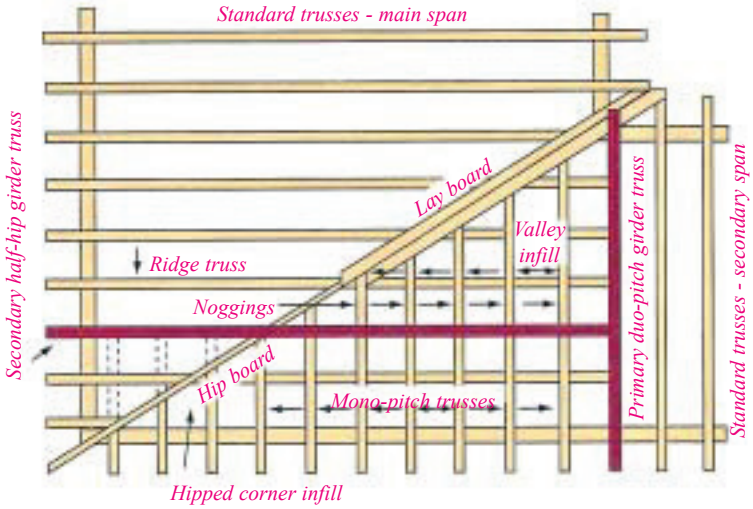


Figure 46b

PLAN VIEW



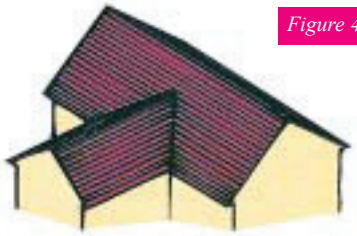
The roof is built up in the valley area using a mono-pitched valley set so that the half-hip girder carries the mono-pitch trusses and hipped corner infill, in the same way as at a hipped end. The span of the mono-pitch trusses is not generally greater than 3 metres and more than one half-hip truss may be needed between the ridge truss and the half-hip girder.

The details shown correspond to the method of construction used in the Step-down hipped end, in which noggins have to be sited between trusses to support the tiling battens.

Hipped corners with a Flying Rafter can also be provided.

Valley Intersections

Figure 47a



'Tee' Intersections and Valley Infill

The basic junction of two roofs is known as a 'Tee' intersection, where a valley line will be formed at the point of intersection of the two sloping planes. The construction around the valley area is commonly formed by the use of either timber rafters, valleyboards and ridgeboards (not recommended) or by the use of pre-fabricated valley frames.

Figure 47b

It is strongly recommended that valley frames be used in junction areas, as these provide the quickest, cheapest and most structurally effective solution to the roof framing in these areas.

The use and function of the valley frames are more important than they appear. The individual components transfer the roof loadings to the top chords of the underlying standard trusses in a uniform manner. Acting with the tiling batten between each neighbouring pair of components, they provide lateral stability to the same chords.

Some variations on the basic system are shown in figure 49. Others occur from time to time and suitable layouts can be easily devised by MiTek trussed rafter suppliers.

The layboards shown in figure 48 are in short lengths and supported off battens nailed to the sides of the rafters, to lie flush with the tops of the rafters. This enables the felt and tiling battens to be carried through into the valley. The tile manufacturers advise should be sought to ensure correct tile and pitch suitability.

In many cases, the support for the main roof trusses may be provided by a multi-ply girder truss as shown in figure 48, with the incoming trusses supported in proprietory Girder Truss Shoes at each intersection.

It is common practice on site to erect the girder truss first and position the incoming trusses afterwards.

All MiTek girders are designed to resist stresses induced in the bottom chords by the supported trusses. The connector plates on girders will typically be considerably larger than those on the standard trussed rafters.

Figure 48

TEE INTERSECTIONS

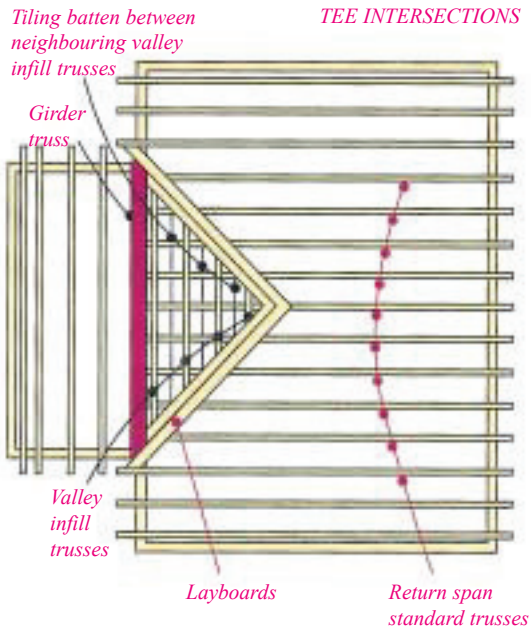


Figure 49

As described above, the valley construction should include intermediate tiling battens between neighbouring valley infill trusses, to provide the correct restraint for the rafters of the underlying trusses.

Figure 50

TYPICAL GIRDER TRUSSES

Bracing Trussed Rafters and Roofs

Bracing in trussed rafter roofs is essential and performs specific and separate functions:

1. TEMPORARY BRACING

Temporary bracing is required during erection of the trussed rafters to ensure that the trusses are erected vertically plumb, at the correct centres and in a stable condition for the continuation of construction.

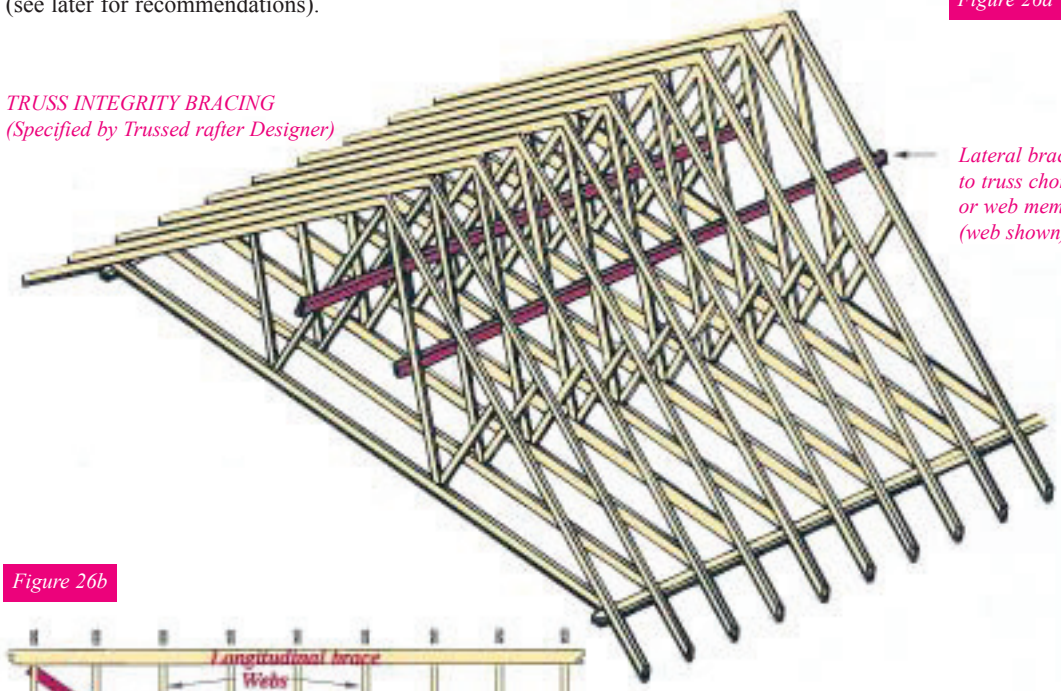
This bracing is the responsibility of the roof erector, (see later for recommendations).

2. TRUSS INTEGRITY BRACING

Bracing may be required by the trussed rafter design to prevent out-of-plane buckling of a member or members within the truss. This bracing must be provided to ensure the structural integrity of the trussed rafter. It is the responsibility of the Trussed Rafter Designer to inform the building designer if this is required.
See figure 26a, 26b and 26c.

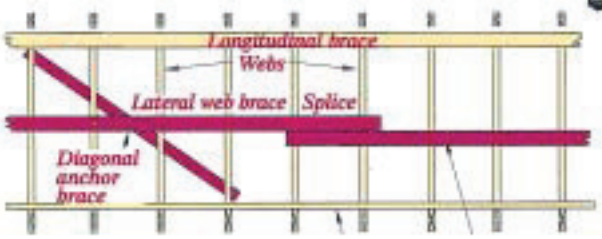
Figure 26a

TRUSS INTEGRITY BRACING
(Specified by Trussed rafter Designer)



Lateral brace to truss chord or web member (web shown)

Figure 26b



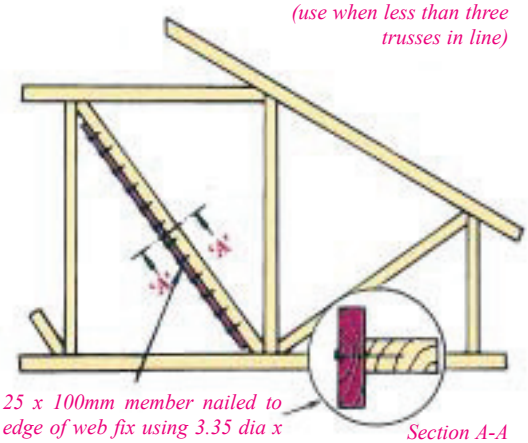
LATERAL WEB BRACING
One shown (with splice) at mid point of webs. For two braces, locate at third-point of webs. Diagonal anchor braces as shown at 6m intervals. All braces 25 x 100 free of major defects and fixed with two 3.35 x 65mm galvanised nails at all cross-overs.3.

3. ROOF STABILITY BRACING

In addition to the above bracing, extra bracing will often be required to withstand external and internal wind forces on the walls and roof. This area of bracing design is the responsibility of the Building Designer (or Roof Designer if one has been appointed) and includes such areas as diagonal wind bracing, chevron bracing to internal members, longitudinal bracing at truss node points, etc.

Figure 26c

ALTERNATIVE WEB STABILITY BRACE
(use when less than three trusses in line)



25 x 100mm member nailed to edge of web fix using 3.35 dia x 65mm long R/W galvanised nails, at 150mm centres.

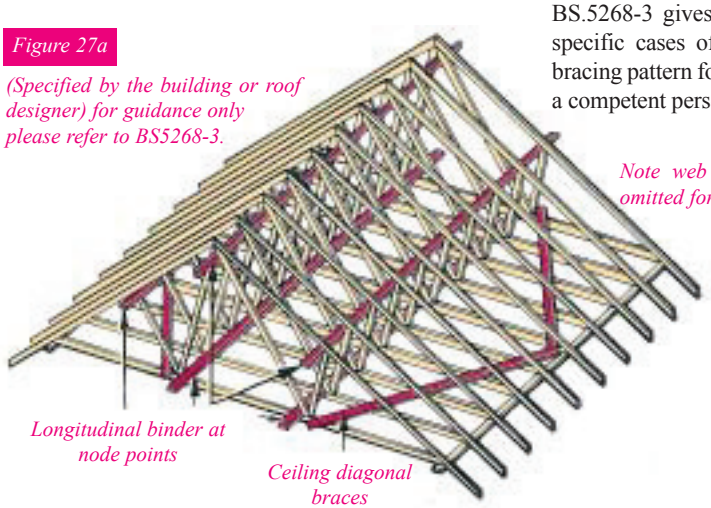
Section A-A

Bracing Trussed Rafters and Roofs

BS.5268-3 gives some recommendations for certain specific cases of roofs; for other types of roof the bracing pattern for roof stability should be designed by a competent person. See figure 27a, 27b, 27c and 27d.

Figure 27a

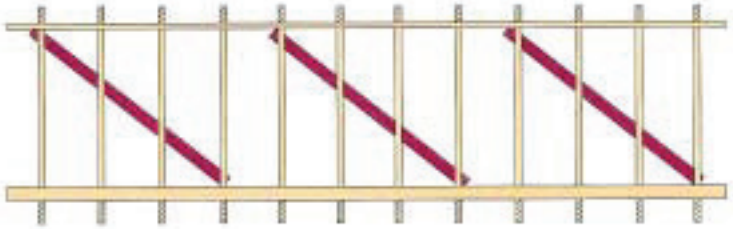
(Specified by the building or roof designer) for guidance only please refer to BS5268-3.



Note web chevron and rafter diagonal bracing omitted for clarity, see following details.

Figure 27b

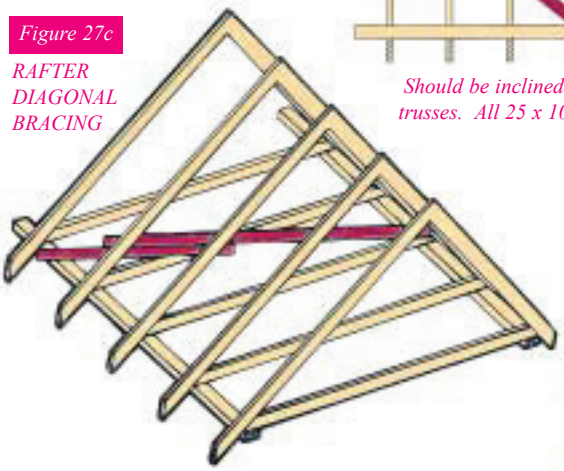
WEB CHEVRON BRACING



Should be inclined at approximately 45(and each nailed to at least three trusses. All 25 x 100mm free of major defects and fixed with 3.35 x 65mm galvanised nails at all cross-overs.

Figure 27c

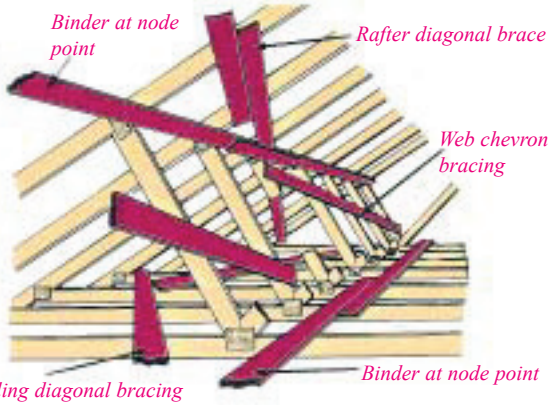
RAFTER DIAGONAL BRACING



(One only shown and spliced) webs and all other bracing omitted for clarity. Braces to be 25 x 100mm free of all major defects and fixed with two 3.35 x 65mm galvanised nails at all cross-overs including wall plate. Braces to be inclined at approximately 45(to the tiling battens and repeat continuously along the roof.

Figure 27d

INTERVAL VIEW



Design responsibility

Specifiers and designers should understand that Truss integrity bracing is the responsibility of the Trussed Rafter Designer who must inform the Building Designer if such bracing is required. Whereas Roof Stability bracing (and any additional specialist bracing) is the responsibility of the Building Designer (or Roof Designer if one has been appointed). The Building Designer is responsible for detailing ALL bracing.

The Building Designer has access to information pertinent to the structure i.e. walls, and the forces being transferred from them, which the Trussed Rafter Designer cannot determine. (See also section 1.2 on Design Responsibilities).

Please refer to BS 5268-3 for further guidance on bracing of roofs for domestic situations.

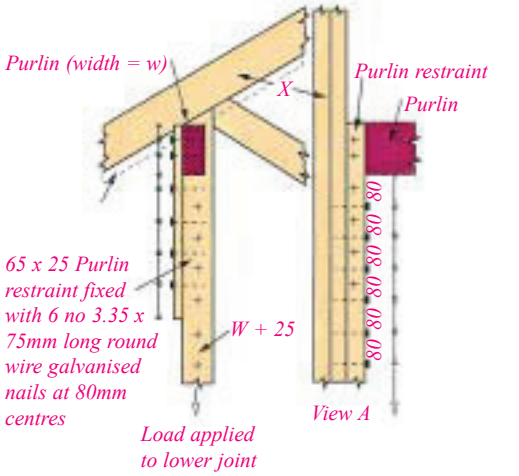
Loose Timber Connection Details

The use of loose infill members and purlins is quite common on the more complex trussed rafter roofscapes. The nett result is an increased load imposed upon the trussed rafters, which has to be accommodated in the design and the requirement of a secure fixing of the loose timbers to the trusses.

It is important to position incoming purlins at the node points of the trusses and details 80 to 83 show practical fixing methods for variants in web arrangements at a joint.

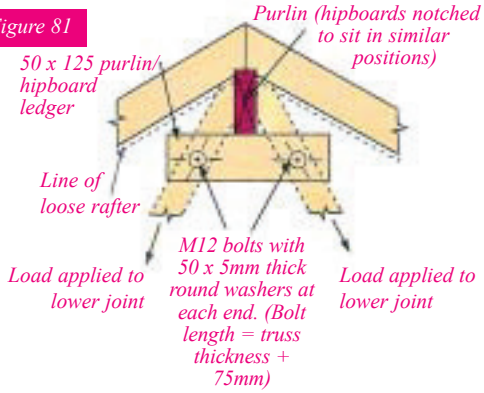
Figure 80 *For skew corner situation read in conjunction with figure 82*

Use similar detail at apex for hipboard support



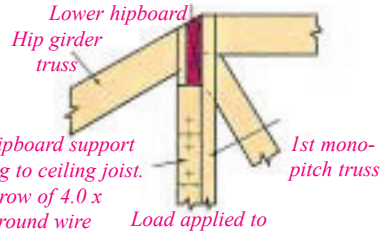
Purlin support post. Size 50 x (W + 25), extending to ceiling joist. Fix with one row of 4.0 x 100mm long round wire galvanised nails at 80mm centres for full length of post

Figure 81



Max allowable load for this detail: 4.0Kn for C24
5.0Kn for TR26

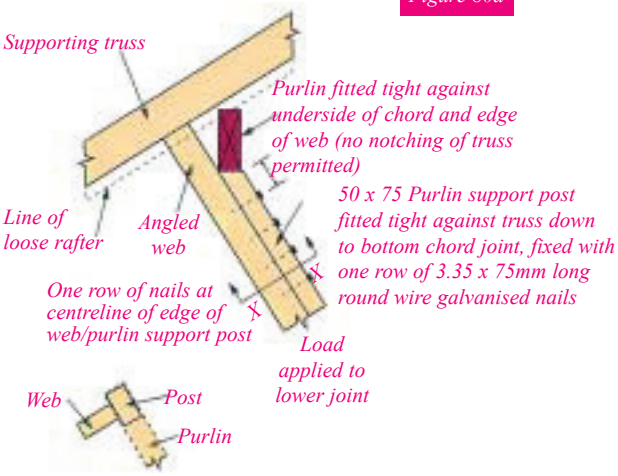
Figure 83



It is necessary to manufacture trussed rafters either side of a loose infill area, with webs that align to ease the fixing.

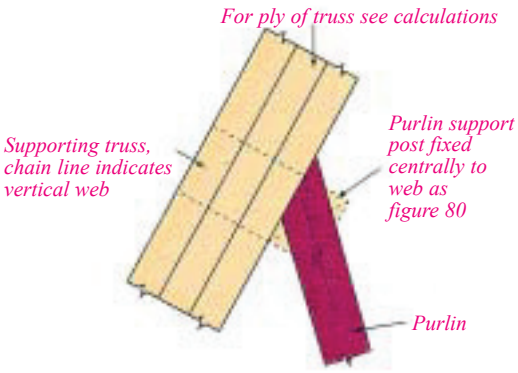
It is also practical to manufacture trussed rafters with wider than normal webs to allow more tolerance for the fixing of the infill members, and is essential for the fixing of special girder hangers where larger size bolts are required.

Figure 80a



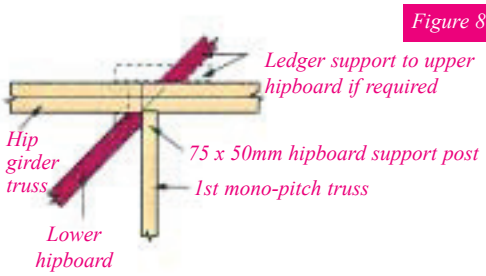
Section X - X

Figure 82



NB. Centreline of oncoming purlin is set out to intersect with centre point of purlin support post/ledger

Figure 83a



NB. To support lower edge of upper hipboard use 50 x 150 hipboard ledger bolted to vertical/angled web using M12 bolts (refer to purlin, hipboard support at apex with non-vertical webs for typical fixing details See figure 81)

Bearing Details

The greatest loads to which normal trusses are subjected are the upward forces/reactions from the support through the bearings. Except for very small trusses, the line of action of these forces should be close to the centre of a joint, or a structural penalty, in the form of very large timber sizes, will be incurred owing to large bending moments.

The standard eaves detail (figure 84a) is satisfactory if the shift is not greater than 50mm, or not greater than on third of the scarf length. The 'Alternate' or 'French' heel (figure 84b) is considered in the same way but the key position is where the line of the underside of the rafter intersects the underside of the ceiling tie.

Another point to note is that as a truss ends at a vertical chord, (figure 84c) there is little scope for tolerance on length or verticality.

Where trusses are to be supported off the face of a wall (figure 84d), placing a nib at the heel of the truss is the most common solution. It is good practice to allow a nominal gap between the vertical chord of the truss and the masonry, for constructional tolerance (figure 84e and 84f). Depending on the reaction, and the grade and size of the timber in the bottom chord, a simple extension of the bottom chord may suffice (figure 84e) to form a 'nib'.

Should the bending or shear stress in the nib be excessive the whole joint can be reinforced. (figure 84f). At greater spans it is possible to use the detail in figure 84g to locate the point of intersection of the principle forces vertically over the bearing.

Figure 84a

Standard heel joint

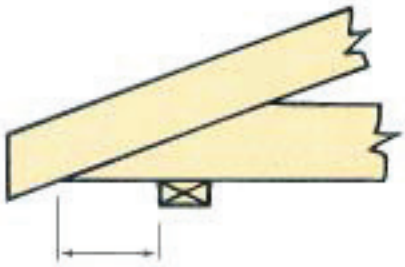


Figure 84b

French heel joint (Girder Heel)

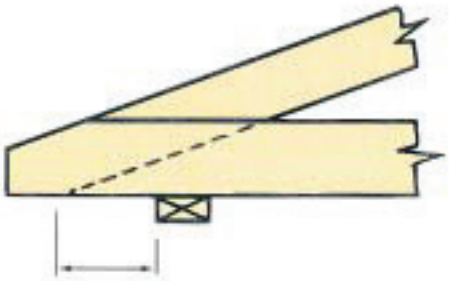


Figure 84c

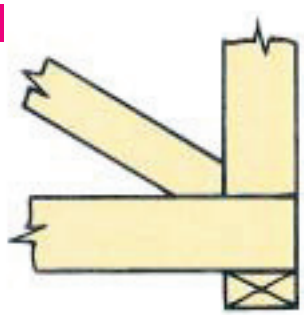


Figure 84d

Figure 84e

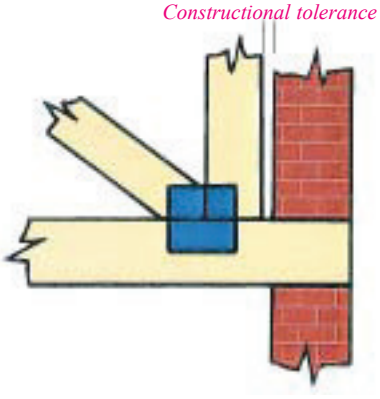
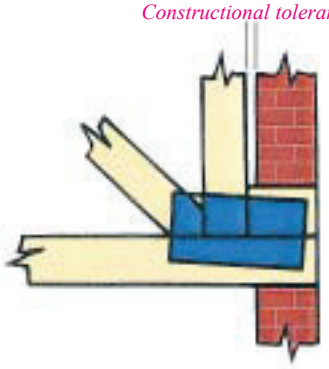


Figure 84f



Bearing Details

Consideration should also be given to protecting the timber and fasteners against dampness and aggressive ingredients in the mortar by using a dpc between truss and masonry.

Trusses can also be supported off the face of a wall by use of suitable hangers. The installation instructions should be noted especially concerning the minimum height of masonry above the hanger flange and the maximum gap between the end of the trusses and the back plate of the hangers. The effect of the eccentric loading on walls loaded in this way should also be assessed.

Figure 84g

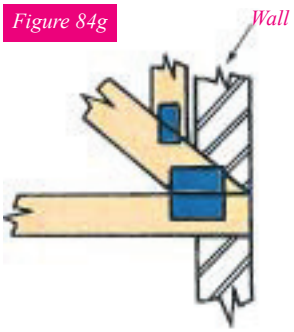


Figure 84h

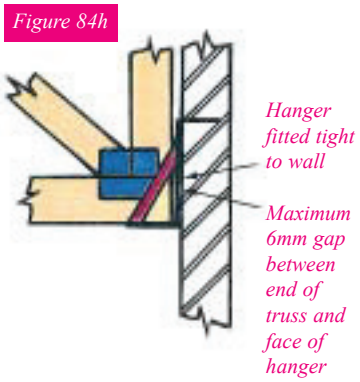


Figure 84j

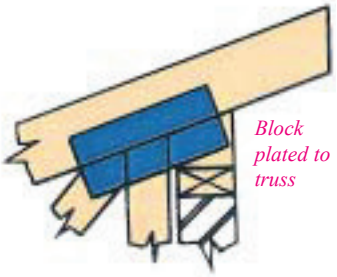


Figure 85

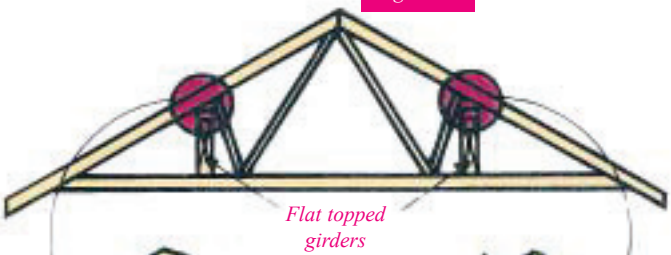


Figure 85a

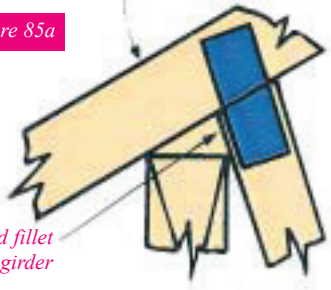
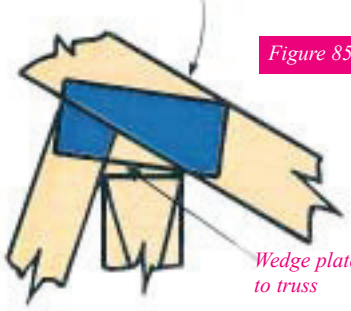


Figure 85b



Top hung fixings (figure 84j) are not common since, at ceiling level, the wall generally needs lateral restraint from the roof against wind and the ceiling ties need to be stabilised.

Flat topped girders supporting trusses (figure 85) can be supplied with a shaped fillet (figure 85a); or trusses may have a wedge or block plated into the joint to provide a horizontal bearing surface (figure 85b).

Ventilation and Condensation

General

Roofs incorporating trussed rafters should be designed to service class 1 & 2 as defined in BS 5268: Parts 2 & 3. Guidance on the prevention of condensation in roofs is given in BS 5250.

Trussed rafters using metal fasteners should not be used where there is likely to be aggressive chemical pollution, unless special precautions are taken to ensure durability of the roof timbers and fasteners. Consideration should also be given to the possibility of the corrosion of fasteners in contact with some type of insulation materials.

Reasonable access to the roof space should be provided to allow periodic inspection of the timber and fasteners.

Thermal Insulation

In the majority of trussed rafter roofs, the insulation required to comply with the statutory regulations for thermal transmittance (U value), is provided by placing the insulating material between the ceiling tie members on top of the ceiling board. Placing insulation at this level results in a COLD ROOF SPACE.

Alternatively, the insulation may be fixed at rafter level, resulting in a WARM ROOF SPACE. A warm roof space is normally constructed where habitable rooms are to be provided within the roof, as in Attic or Room in the Roof construction.

Ventilation

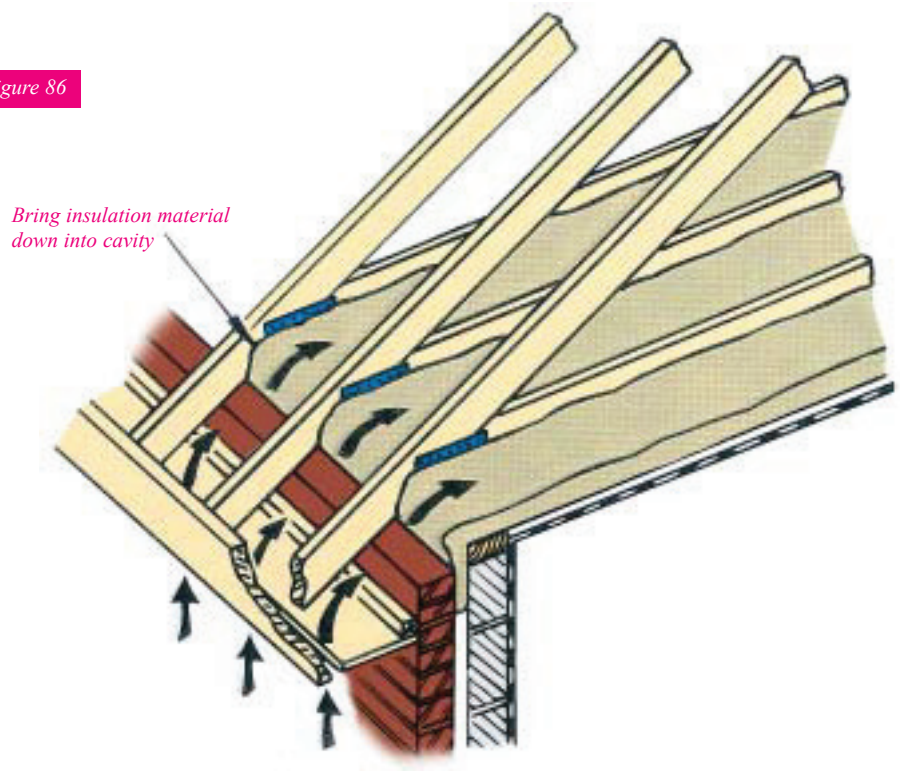
It is essential that cold roof spaces are effectively ventilated to the outside to prevent condensation, which may form in the roof void.

In addition, to minimise ingress of water vapour into the roof space from rooms below, all joists and service entry holes in the ceiling construction should be sealed effectively.

The location and size of ventilation openings should be determined by the Building Designer, taking particular account of possible blockage by insulating materials, sound transmission, spread of fire and entry of birds, driving rain or snow. Openings should be located near ceiling level in the eaves or external walls enclosing the roof space, or both, and should be equally distributed between at least two opposite sides of the roof. Additional ventilators may also be placed in the ridge.

The size and number of openings may be calculated, taking into account all the relevant factors, but disregarding any fortuitous ventilation through the roof covering, or they may be specified in accordance with the recommended minimum openings given on the following page. These are expressed as the minimum width of a continuous gap but, alternatively, a series of discrete openings of an equivalent total area may be specified, provided that the least dimension of any opening, gap or mesh is not less than 4mm.

Figure 86



Ventilation and Condensation

The ventilation of mono-pitched roofs at ceiling level only may allow air to stagnate at the apex of the roof. To prevent this, high level or ridge ventilation, equivalent in total area to that given in the table, should be provided in addition to the ventilation at ceiling level.

Similarly, air stagnation may occur in duo-pitched roofs of more than 20 degree pitch, or 10.00m span and consideration should be given to the provision of additional high level or ridge ventilation, equivalent to a continuous gap 5mm wide.

When insulation material is close to the roof covering, as at the eaves, or where it is placed at rafter level to form a warm roof space, (as in attic and raised tie construction),

Minimum ventilation openings

Pitch of roof (degrees)	0 to 15	Above 15
Low level ventilation at ceiling level. Minimum width of continuous gap on at lease two opposite sides of roof.	25	10
High level ventilation for mono-pitched roofs at or near the ridge. Minimum width of continuous gap.	5	5

Figure 87

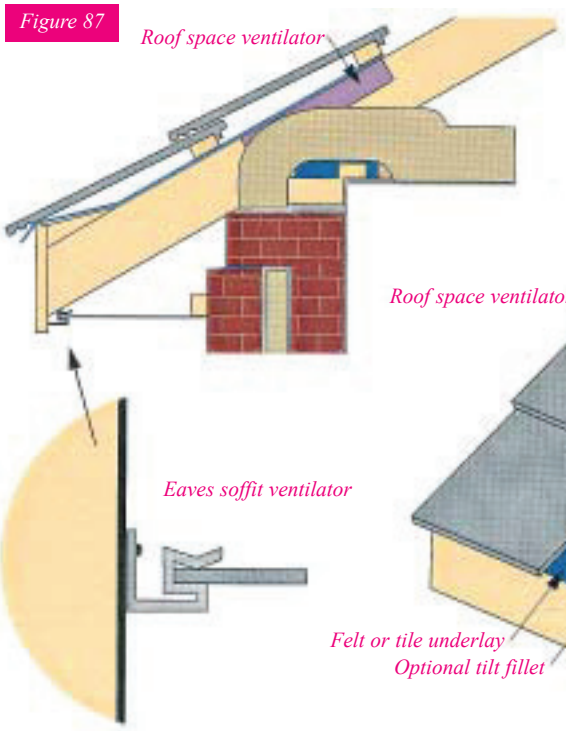
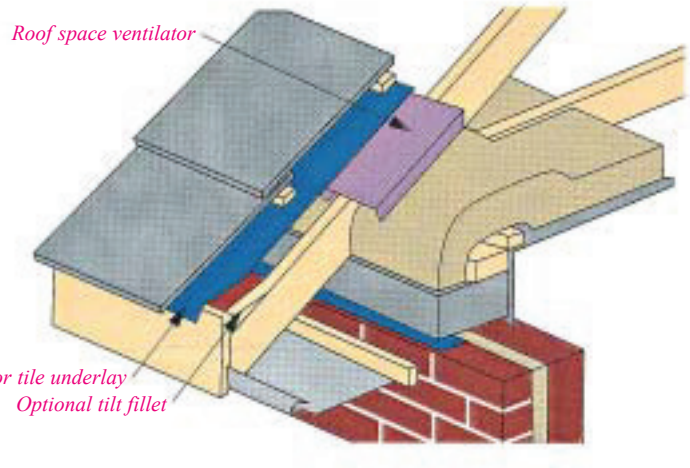


Figure 88

Figure 89



it is essential to provide an air gap or not less than 50mm between the top of the insulation and the underside of the roof covering or sarking. This gap, which should allow uninterrupted air circulation immediately above the insulation, should be ventilated to the outside at the eaves and, when insulation is placed at the rafter level, also at the ridge. The minimum opening at the eaves to provide adequate ventilation of the air gap above the insulation in a warm roof space should not be less than that shown in the table for low level ventilation and the ridge ventilation should be not less that that provided by a continuous gap 5mm wide. In normal circumstances, further ventilation of warm roof spaces is not required.

Site Storage and Handling

Introduction

(General Information relating to Health and Safety issues in Trussed Rafter Construction).

When the Construction (Design and Management) Regulations were published in 1994, a fundamental change in approach was initiated with regard to the attitude toward and significance of issues relating to Health and Safety in the Construction Industry. Since that time, a raft of further supporting legislation has been drafted and published which together now document in great detail the duties, obligations and responsibilities of those engaged in the process of Construction, from members of the original design team to trainee operatives working on site.

In order to fully understand and implement the requirements of these Regulations it is necessary to appreciate and recognise these new philosophies by making the necessary changes in working practices to elevate the profile of Health and Safety issues across the full spectrum of Construction Activities. This can be achieved by undertaking Risk Assessments, designing out hazards where evident, providing sufficient resources at all times, proper training and good levels of communication channels within the design team and on site.

The advice that is set out within the Sections of this handbook which provide assistance relating to issues of Health and Safety is therefore illustrative only and does not form prescriptive advice on any of the matters discussed. It is vital that each project should be approached by the parties involved as a fresh challenge from the point of view of Health and Safety to allow creative and innovative solutions to be developed. Readers of this handbook are therefore encouraged to fully acquaint themselves with the various Regulations, and particular:-

Health and Safety at Work Act 1974
Construction (Design and Management) Regulations 1994
Management of Health and Safety at work Regulations 1992
Provision and Use of Work Equipment Regulations 1992

Construction (Health, Safety and Welfare) Regulations 1996 - (CHSW Regulations 1996)
Manual Handling Operations 1992
Workplace (Health, Safety and Welfare) Regulations 1992

Unloading Trussed Rafters

(Information for the safe unloading of trussed rafters).

When the delivery of trussed rafters arrives on site the contractor(s) involved should be prepared and already allocated sufficient and suitable resources to ensure that trussed rafters are unloaded safely and in a manner so as not to overstress or damage the trusses. This operation will have been subject to a Contractors General Risk Assessment and then detailed in a safe working method statement that has been approved by the principal contractor or the person responsible for Health and Safety on site. Normally trussed rafters will be delivered in tight bundles using steel or plastic bindings. This will often require mechanical handling equipment, such as a forklift or crane, to enable the safe manoeuvring of these large units. The safe working method statement should accommodate any special handling instructions or hazards specified by the designer in his risk assessment for the truss design.

Site Storage of Trussed Rafters

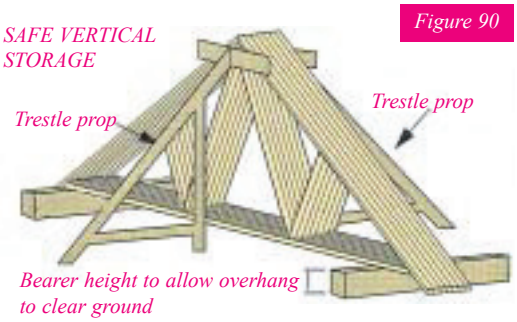
(Methods for the proper and safe storage of trussed rafters on site).

Trussed Rafters can be safely stored vertically or horizontally at ground level or on any other properly designed temporary storage platform above ground level. Whichever method and location is chosen the temporary support should be set out to ensure that the units do not make direct contact with the ground or any vegetation and be so arranged as to prevent any distortion. The delivery of trussed rafters should wherever possible be organised to minimise site storage time, however where longer periods of storage are anticipated then the trusses should be protected with covers fixed in such a way as to allow proper ventilation around the trusses.

When stored vertically, bearers should be positioned at the locations where support has been assumed to be provided in the design with stacking carried out against a firm and safe support or by using suitable props.

Figure 90

SAFE VERTICAL STORAGE

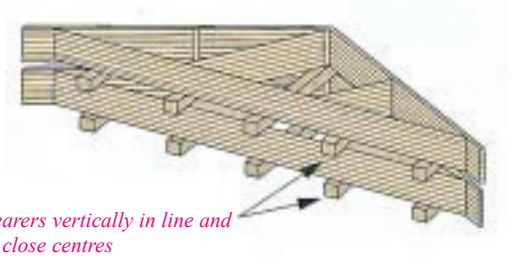


Site Storage and Handling

When trusses are stored horizontally, level bearers should be positioned beneath each truss node (minimum) to prevent any deformation and distortion. (See figure 91 below).

Figure 91

SAFE HORIZONTAL STORAGE



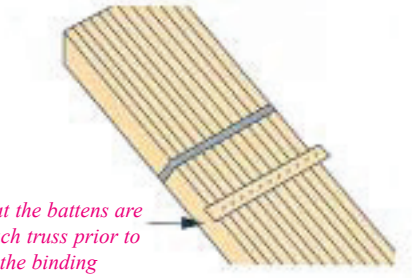
Bearers vertically in line and at close centres

No other method of storing trussed rafters is considered to be suitable, except where specific provision has been made in the design for an alternative temporary support load case.

At such time when it is necessary to remove the pre-tensioned bindings from a bundle of trusses, extreme care should be exercised. As a precaution against destabilisation of the whole bundle of trusses, it is recommended that prior to the removal of the bands, timber battens are fixed across the bundle at several locations with a part driven nail into every truss. Such a simple precaution will allow the safe removal of single trusses once the steel bands are removed. A suggested arrangement of batten locations for a standard Fink truss is shown in figure 92 below.

Figure 92

DIAGRAM ILLUSTRATING SAFE METHOD OF BREAKING A BUNDLE OF TRUSSES



Ensure that the battens are fixed to each truss prior to release of the binding

Alternative details relating to this procedure and which involve the unbundling of the trusses whilst on the back of the lorry should be communicated by the contractor to the truss manufacturer prior to their delivery to site.

Manual Handling of Trussed Rafters

(Information relating to manoeuvring trussed rafters around the site using manual handling techniques).

With careful consideration manual handling methods can be safely employed to move trussed rafters around a construction site, although the choice of method will depend to a large extent on the particular circumstances of the lifting operation. Such operation will generally be identified in a contractors safe working method statement that takes account of all the assessed risks and which utilises and refers only to the resources which are available to the site. The preparation of this method statement should be undertaken sufficiently in advance to ensure the adequate planning and co-ordination of the task and sourcing of any special equipment that may be required. For example, a situation where the manual handling of trussed rafters may be appropriate might be the lifting of single trusses on to residential units not exceeding two storeys in height.

Whatever technique is adopted to manually manoeuvre trussed rafters it is vital that the technique takes full account of any special instructions issued by the designer to ensure that the structural integrity of the units is maintained and that there is no risk of damage to the trusses.

Mechanical Handling of Trussed Rafters

(Information relating to manoeuvring trussed rafters around the site using mechanical handling techniques).

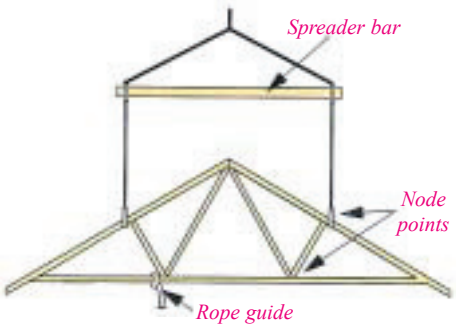
Where it is not possible for reasons of safety or other practical considerations to implement manual handling techniques to manoeuvre trussed rafters, other means that involve the use of mechanical handling or lifting equipment will be necessary. Using such equipment gives the option of being able to move larger and heavier loads and consequently, the ability to raise completely or partially assembled sections of roof that have been pre-assembled at another location (for example, on the ground level superstructure of an adjacent plot). Similar considerations to those identified in the section relating to manual handling remain relevant, although as the size of the loads increase, issues of instability and potential distress/damage to the trussed rafters becomes more critical. For this reason, it is vital that trusses or sections of roof are only lifted at locations approved by the truss designer, such locations being preferably marked on the units at the time of their manufacture. Where appropriate, the use of spreader bars and strongbacks may be required to ensure an even distribution of lifting points.

Site Storage and Handling

An example of the use of a spreader bar is shown in figure 93 below.

Figure 93

MECHANICAL HANDLING



Where bundles of trusses are raised to roof level, caution should be exercised in the removal of the restraining bands (see section 3.11 figure 92). Should these bundles of trusses be stored either on a temporary working platform or at eaves level, the contractor should take the necessary steps to ensure that the supporting structure has sufficient strength and that a storage system as illustrated in either figure 90 or 91 is constructed.

Designated slewing areas should be cordoned off and the movement of operatives either restricted or prohibited within this area during all lifting operations.

At all times, strict adherence with the Contractors method statement should be observed.

Where circumstances and design considerations dictate that pre-assembled sections of roof, such as hips etc., (or indeed, complete roofs) are raised in one single lifting operation, particular attention should be given to the method of lifting the assembled sections. Such large and unwieldy loads require that checks should at least be made regarding the following:-

- Prevailing weather conditions, with particular reference to wind speed.
- A survey of obstacles in the slewing area, including scaffolds, towers and overhead services.
- A survey of the accuracy of construction and setting out of the pre-assembled roof structure.
- Underground services locations to avoid damage by the use of large cranes etc.

These sorts of techniques have the potential to save significant amounts of time and money on site whilst additionally offering significant Health and Safety benefits to all employees and personnel, although they generally require early design input and planning to ensure sufficient strength is inherent during the lifting procedure. Typical benefits which may be associated with improvements in matters relating to Health and Safety include:-

The immediate provision of stable sections of roof, away from which infill sections of roof can be constructed, rather than relying on temporary bracing.

- All assembly operations are carried out at ground level and therefore the risk of operatives falling is totally eliminated.
- The risk of operatives being struck by falling objects during an alternative roof level assembly is significantly reduced.

Clearly, there are many other benefits relating to speed, efficiency and the overall costs associated with the construction process.

Mechanical handling and lifting operations are essential where the scope of the works falls outside of simple residential scale projects.

Erection Procedure

Assembly of trussed rafter roofs

(Information relating to the assembly of trussed rafter components and infill)

Once the trussed rafters have been safely raised to eaves level utilising either the methods or principles outlined previously and assuming that all the necessary information has been forwarded by the Roof Designer to the contractor, then it is possible for the assembly of the trussed rafter roof construction to commence. In similar fashion to the other work tasks associated with trussed rafter roof construction, the assembly of the roof components should be carried out in strict accordance with a contractor prepared safe working method statement ***(see section 3.13 for a typical example of a Contractors General Risk Assessment and supporting Method Statement).***

Whichever method of raising the trusses is utilised, the principal risks associated with assembling trussed rafter roofs in their final location are either falling, temporary instability and collapse of the partially complete structure or being struck by a falling truss/object. All of these issues need to be addressed to safely proceed with the operation. The manner in which any other residual site hazards should be dealt with should be based on the principle of a hierarchy of risk control. This principle states that the most desirable option is to design out the hazard and subsequent risk completely at the design stage and the least desirable option is to provide personal protection systems such as restraint harnesses (i.e. protection after a fall).

With regard to assembling trussed rafter roof structures, the most desirable approach for standard storey height construction (up to 3.0m from floor to ceiling) is to provide both a perimeter working platform externally and either a full or partial working platform internally and erecting the trusses using the standard erection procedure as shown in figure 94a. A useful modification to the basic bracing procedure is to rigidly brace the first truss back to the external scaffold to allow roof assembly to proceed unencumbered in a direction away from that first truss.

Alternatives to this approach might involve the combination use of working platforms and safety nets or, in situations where the potential fall distances are sufficient to allow their safe use, the installation of larger nets and/or restraint harnesses.

At all times, the Designers and Contractors should undertake proper Risk Assessments of the tasks in hand and draft appropriate method statements accordingly. Where the trussed rafter designer/manufacturer is also engaged to erect the roof structure then the method statement would be prepared by him and approved by the principal Contractor (who is responsible for the Health and Safety of all personnel, directly employed or otherwise, on the site). Some amendment or reassessment of the proposed working method may be necessary before the Principal Contractor allows the work to commence.

Erection Procedure

The builder should consider, in conjunction with the Building Designer, the erection procedures to be used and the provision of temporary bracing, rigging and any other specialised equipment required to erect the trusses safely and without damage, in accordance with the design requirements and having due regard to possible windy conditions.

Permanent bracing should be of minimum size 22 x 97mm free of major defects and fixed with two 3.35 x 65mm galvanised round wire nails at each cross-over.

The following procedure is suggested for most domestic size roofs.

1. - Mark the position of each truss along both wallplates.

2. - Erect the first truss (truss A in figure 94a) at the point which will coincide with the uppermost point of the diagonal brace F when it is installed later. Use the temporary raking braces B fixed to the rafter members and the wallplates to hold this truss in the correct position, straight and vertical. For clarity, only on raking brace is shown in the figure but they should be fixed to both rafter members and be of sufficient length to maintain the truss in position, during the erection of the remaining trusses.

3. - Erect truss C and brace back to A with temporary battens D at suitable intervals along the rafter and ceiling tie members. Repeat this procedure until the last truss E is erected.

4. - Fix the permanent diagonal braces F ensuring that each top end is as high up the last trussed rafter A as is possible and that each bottom-end extends over the wallplate to which it should be fixed. For clarity, only one permanent brace is shown in the figure, but they should be installed on both sides of the roof.

5. - Fix the longitudinal members G, making sure that the ceiling ties are accurately spaced at the correct centres.

6. - Fix all remaining longitudinal, diagonal and chevron bracing required on the internal members of the trusses as specified.

7. - Additional trusses may be erected by temporarily 'bracing-off' the completed end.

Figure 94a

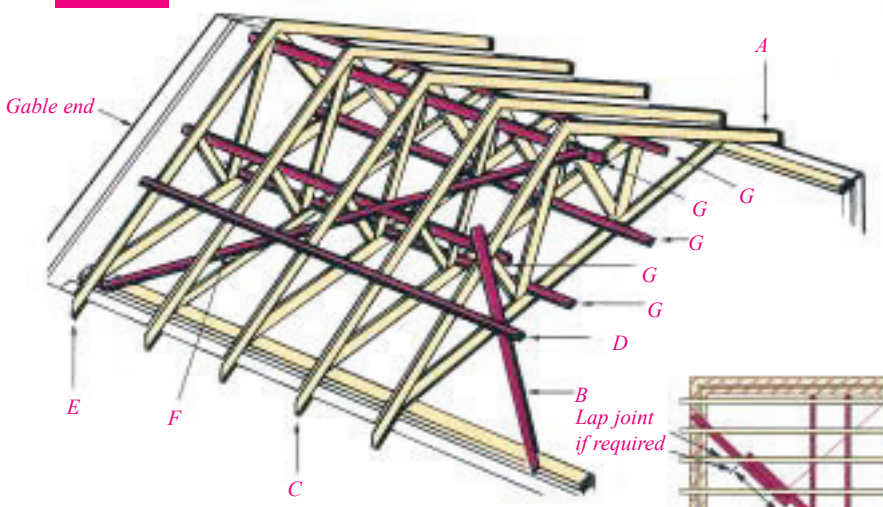
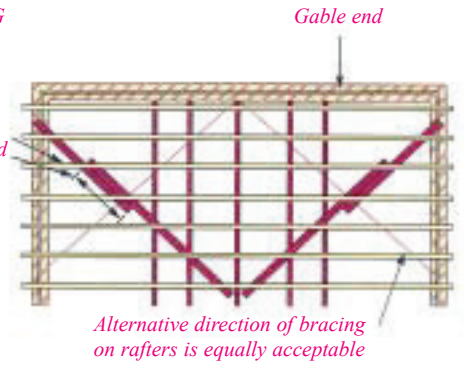


Figure 94b



Immediately prior to the fixing of the permanent bracing and the tiling battens or sarking, all trussed rafters should be checked for straightness and vertical alignment. Whilst every effort should be made to erect trusses as near vertical as possible, the maximum deviations from the vertical shown in the following table may be permitted.

Maximum deviation from vertical

Rise of truss (m)	1	2	3	4 or more
Deviation from vertical (mm)	10	15	20	25

After erection, a maximum bow of 10mm may be permitted in any trussed rafter provided that it is adequately secured in the complete roof to prevent the bow from increasing. For rafter members, this maximum bow is measured from a line between the apex and the eaves joint.

Risk Assessments and Method Statements

(This section is intended to give general guidance to Contractors regarding appropriate controls for assessing and documenting the risks associated with construction task).

Perhaps it is appropriate under this section to note that the undertaking of Risk Assessments and compilation of Method Statements (where appropriate) is the **LEGAL DUTY OF ALL CONTRACTORS** as it is for Designers under the Construction (Design and Management) Regulations 1994. Such Assessments are necessary to appraise hazards and their associated risks in order that these risks may be either minimised or controlled.

The responsibilities and obligations of Contractors are primarily laid down in the following Regulations:

Health and Safety at Work Act 1974

Construction (Design and Management) Regulations 1994

Management of Health and Safety at Work Regulations 1992

Provision and Use of Work Equipment Regulations 1992

Construction (Health, Safety and Welfare) Regulations 1996 - (CHSW Regulations 1996)
Manual Handling Operations 1992

Workplace (Health, Safety and Welfare) Regulations 1992

Examples of a typical Risk Assessment and supporting Method Statement are given on pages 76 and 77. These are presented to illustrate the difference between a Contractors Standard Health and Safety Policy which should include provision for all 'Standard' risks - as documented in the Contractors General Risk Assessment (which may simply be an amended sheet from the Company Health and Safety Policy Manual) and PPE/Manual Handling Risk Assessments and/or detailed Method Statements which are custom written to deal with specific, non-standard or particularly risky aspects of work.

Risk Assessments and Method Statements

Contractors general risk assessment for the erection and assembly of roof trusses

Under the Management of Health and Safety at Work Regulations 1992 contractors are required to undertake and record risk assessments for site specific tasks and locations of work. These Risk Assessments can be used to i) identify provision within tender/contract documents regarding matters relating to Health and Safety, ii) check Health and Safety conditions on site, iii) developing safe system of work and Method Statements where required and iv) provide information on hazards to operatives/personnel at the place of work.

By way of an example which illustrates typical criteria for assessing the risks associated with a particular work task the following example assessment has been prepared:-

Project Title: Housing Estate, Anywhere
Client: J Bloggs + Co
Description of Works: General Roof Activities

Document Reference No: RA/Gen/OJA
Date: **/**/**
Author: AJF

Hazards:	Risk Ratings	
(This list should also refer to those hazards identified in the roof Designers Risk Assessment and also those contained in the site Health and Safety Plan), e.g:	Without Controls	With Controls
Persons falling -	High	Low
Falling objects -	Medium	Low

Harm:
Significant injuries or fatalities without controls

Persons in Danger:
Roof operatives, other operatives in the vicinity, general public as passers by

Controls:
This section should typically include information relating to the design and use of the following:- Ladders, Scaffolds, Working Platforms, Storage Areas, Edge Protection and Barriers, Lifting Equipment, Disposal of waste, PPE, Warning Notices, Checking Procedures, Adverse weather, Plant Maintenance etc.

PPE:
Safety Helmets, Protective Footwear and Gloves should be worn

Additional Assessments Required?
Manual Handling (where appropriate) activities and PPE

Method Statement Required?
Yes, see method statement ref. MG/GEN/OJ

Can the Work Task be adequately controlled?
Yes

Specific Legislation and other Informative Guidance Documents:
CHSW Regs 1996: CDM Regs 1994: Manual Handling Regs 1992 etc

Information, Instruction and Training:
See Company Training Information - No operatives shall carry out any activity without proper training as noted therein

Emergency Procedures:
Display Procedure in site offices, Ensure personnel know how to raise alarm, provide Adequate First Aid Kit

Monitoring Procedures:
This shall be the responsibility of the Site Manager to organise and implement according to established procedure

Any other Items:
As appropriate

Signed: .....

Date: .....

Risk Assessments and Method Statements

Task Description:
Erection of Trussed Rafter Roof Structure using Manual handling Method Ref 01.

Project Title:
Housing Development at Muddy Lane, Newtown, Smoke City

Ref:
No:
Date:
Author:

This Safe Working Method Statement has been prepared for the following work. No other work than that referred to must be carried out.

Location of Work Task:
House type A (South Facing only) on Muddy Lane

Project Title:
Erection and Installation of trussed Rafter Roof Structure to House Type A

Safe Working Method:

For additional reference regarding this method statement refer to Contractors sketch ref. ***/** as illustrated on page (?) of this site installation guide. At all times this method statement assumes that all appropriate design considerations have been incorporated and allowed for within the design and layout of the temporary working platforms. Additionally, it should be noted that this method statement refers only to those operations which have been designated as having a higher level of risk, for all matters associated with this operation reference shall be made and working practices adopted which comply with the Contractors general Risk Assessment for roof work.

Part 1:

1. Construct external perimeter scaffold as per detail in a manner to ensure sufficient manoeuvring space around loading platform. Locate vertical truss restraint standards at position to allow unobstructed lifting to eaves level working platform. All edge protection to both the eaves level and the loading level platforms must be constructed and fixed before any lifting operations take place. Similarly, erect internal working platforms at a level (typically) 300mm below ceiling tie level.

Under no circumstances whatsoever shall any edge protection be removed to facilitate these operations.

2. According to the recommendations of the Manual Handling Risk Assessment use x No. Personnel to manually lift individual trusses via the truss restraint standards to the eaves level working platform. Move trusses along the length of the roof to their final position (where they shall immediately be fixed by carpenters using temporary/permanent bracing - see part 2 of this method statement). NB. Girder trusses shall be raised as single component plies and then the ceiling tie members (min) bolted together according to the details provided by the truss manufacturer and in locations marked by him on the trusses; rafter and web members may be nailed according to further details provided by the truss manufacturer.

NB. Roof Bracing Details which will include sizes and location of Rafter and Chevron Bracing etc, shall be installed in accordance with the roof designers layout drawing.

Part 2:

3. When the first truss has been raised and located in its final position by the truss handling team, the carpenters shall immediately provide temporary diagonal restraints at a minimum of three locations to hold the truss vertical and so as to act as a rigid start point for the erection of the remainder of the trusses. This temporary restraint shall preferably be located outside of the roof structure i.e. Fixed to the external perimeter scaffold. The positioning of the temporary braces in this way will then allow unobstructed passage to the truss handling team as further trusses are raised and located in their final position.

NB. Wherever possible, Carpenters should use pre-nailed bracing members (accurately marked out to coincide with the truss centres) to ensure that truss erection progresses smoothly and quickly.

4. As soon as sufficient trusses have been temporarily positioned, the carpenters shall commence the fixing of internal permanent bracing to create fully stable sections of roof. Where necessary for carpenters to work at higher levels than the main internal working platform then either stepladders or temporary trestles shall be used between trusses constructed or positioned on the main platform. Under no circumstances shall operatives be allowed to climb within the temporarily braced roof structure.

5. As soon as permanently braced sections of roof have been completed, it shall be allowed for operatives to locate working platforms within the roof structure by positioning suitable boards directly on top of the ceiling ties. These platforms can then be used for the installation of services etc. Similarly, at this time it is appropriate to allow the removal of the external temporary props in order to allow any gable masonry construction to be commenced. Gable construction should not have been allowed to commence prior to this stage as it is the stability of the roof construction which provides restraint to the gable masonry construction.

NB. The dismantling of the internal working platform shall only be allowed to commence below completed areas of roof construction as such time when no work is being carried out overhead.

6. Further areas of roof construction (if appropriate) shall be carried out according to the identical principles outlined above.

Construction Check List

Job No: _____ Contractor: _____
Site: _____ Block: _____
Inspector: _____ Date: _____

OK ☑ NOT OK ☒

	Yes	No
Trussed Rafters		
Correct quantity, positions and orientation	☐	☐
Centres not greater than specified	☐	☐
Verticality and bow after erection within code limits	☐	☐
No damage or unauthorised modifications	☐	☐
Girders/Multiple trusses connected together in accordance with specification	☐	☐
Properly seated on wallplates, hangers, etc.	☐	☐
Bracing correct size and in correct position	☐	☐
Bracing connected to each truss as specified	☐	☐
Bracing laps extended over a minimum of 2 trusses	☐	☐
Bracing of truss rafter compression members are installed as specified	☐	☐
Valley set is correctly set out and braced as specified	☐	☐
Valley set is supported on bevelled bottom chord or supported on fillet	☐	☐
Loose Timbers		
Correct sizes, position and grade	☐	☐
Centres not greater than specified	☐	☐
Birdsmouth, joints, scarfs etc., accurately and correctly made	☐	☐
Properly seated on wallplates, hangers, etc.	☐	☐
Fixings are to specification	☐	☐
Structural Metalwork		
Truss clips, framing anchors and other vertical restraints present and fully nailed	☐	☐
Hangers correct to specification and fixed as specified	☐	☐
Gable restraint straps present and correctly fixed including pack between members	☐	☐
Tank Platform		
Correctly positioned and constructed as specified	☐	☐
Loads applied to trusses as allowed for in design	☐	☐
Special Items		
Services in position specified and do not clash with webs	☐	☐
Roof ventilated as specified	☐	☐
Trap hatch formed to specification	☐	☐
Sarking if applicable, is to specification	☐	☐
Tiles fixed are correct weight as specified in design	☐	☐

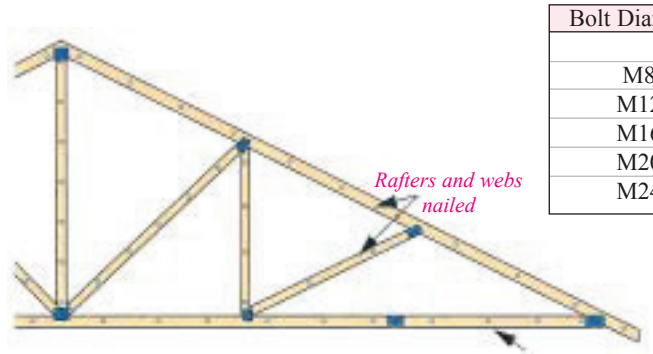
Comments

Nailing and Bolting

Scab Members

Rafter sizes in raised tie trusses often need to be increased, since the entire weight of the roof structure is supported on the extended rafters resulting in large bending forces. Even then, timber scabs or reinforcing members are often necessary and it is essential that they are correctly fitted whenever specified. Scabs may be required on one or both faces of the extended rafter and may also be required on multiple trusses. The truss manufacturer may fix the scabs in the factory prior to delivery or may provide the scabs loose, with a fixing detail to allow them to be secured on site. Scabs on multiple trusses will invariably require bolting - large plate washers should be used with all bolts.

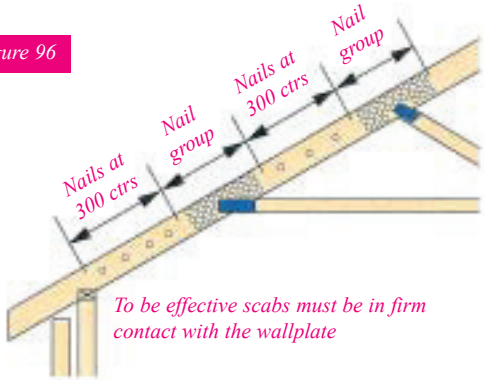
Figure 95



Typical Scab Nailing Positions

Scabs may be fixed by the manufacturer or on site using a nailing or bolting details provided by the manufacturer.

Figure 96



Girder Trusses

Girder trusses are designed to carry more load than that from the standard trussed rafter spacing. They consist of two or more trussed rafters fastened together. Typically, girder trusses carry other trussed rafters or infill timbers on shoes attached to the ceiling tie of the girder.

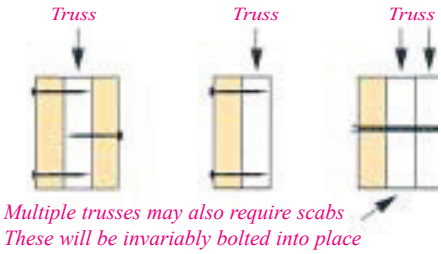
Girders are fastened together by nails or bolts. When fastened together on site, bolts must be used for at least the ceiling tie members, in positions marked by the truss manufacturer. In all cases, the nails or bolt must be positioned strictly in accordance with the manufacturer's instructions.

See TRA Information Sheet 9804 'Girder Trusses (Principal Trusses) Definitions and Connecting Together On Site'.

Washers must be used under the head and nut of each bolt.

Bolt Diameter	Washer Size	
	Diameter	Thickness
M8	24mm	2mm
M12	36mm	3mm
M16	48mm	4mm
M20	60mm	5mm
M24	72mm	6mm

Figure 97



Nails and bolts should either be inherently corrosion resistant or protected by a corrosion resistant coating.

Attic Frames 2 & 3 Part Construction

All the trusses (or frames) are generally of two basic types depending on how they are supported.

Type 1:
(Figure 98a) is characterised by a load-bearing support at or near mid-span and as a result generally has heavy joists propping relatively light rafters. The truss may need to be supplied in kit form for completion on site if it is too high for fabrication or transportation. The kit form, while requiring some site fabrication, does make for straightforward erection as the floor joists can be installed first, providing a safe, rigid working platform.

Figure 98a

Type 2:
(Figure 98b) is free spanning between wallplates and as a result the floor is suspended from the rafters which consequently are relatively heavy and often as heavy as the floor joists. The associated kit form is usually different to that for type 1 in order to facilitate erection and to ensure that the more important joints are made under factory controlled conditions. However, substantial connections, often employing MiTek field splice plates, fully nailed or bolts, have to be made between the capping and base components, handling and erection of these heavy units needs to be carefully supervised.

Figure 98b

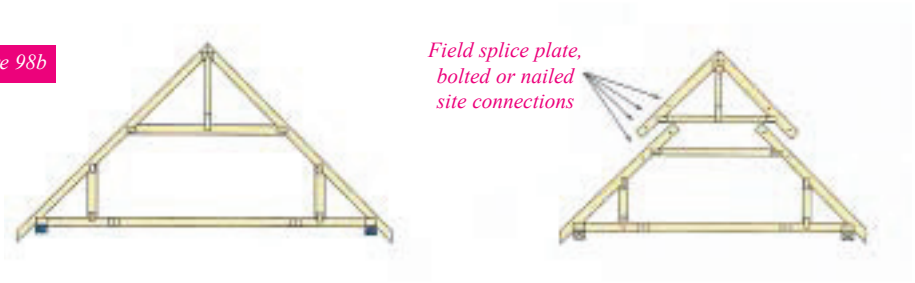
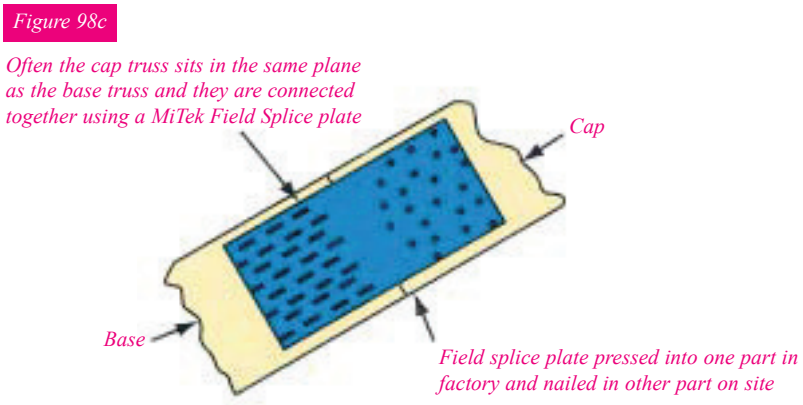


Figure 98c



Attic Frames - Bracing

Permanent bracing is required in all roofs for four reasons:

a. to maintain rafter stability
b. to prevent dominoeing
c. to form diaphragms to transmit wind loads to shear walls
d. to maintain the stability of internal compression members

By far the most serious matter which arises in roof surgeries is rafter (roof) instability, arising from lack of suitable bracing.

Permanent bracing is the responsibility of the Building Designer. The advice and recommendations given here are given in the interests of good building practice and are not to imply responsibility accepted by MiTek. They should be considered as the necessary minimum.

Figure 99a

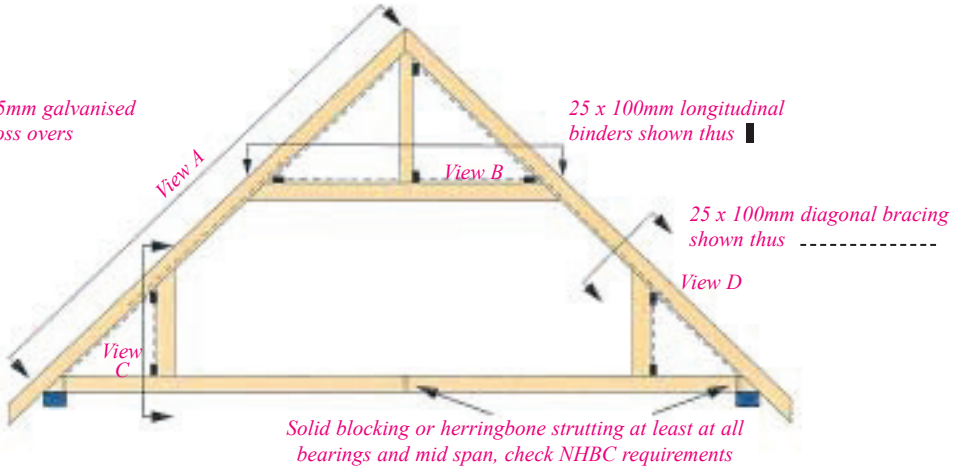
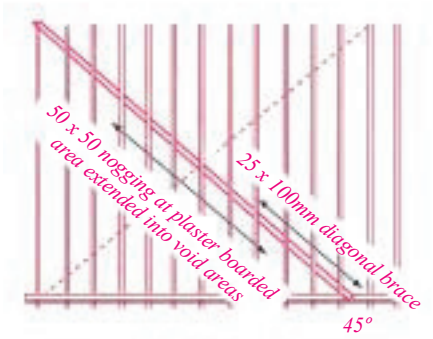
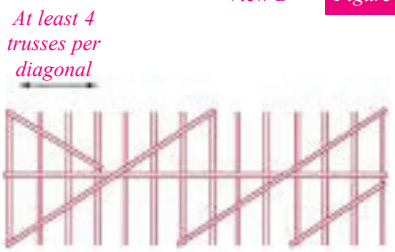


Figure 99b *View A*



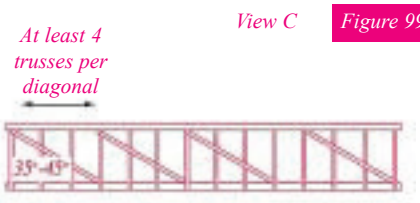
Note: Bracing shown must be installed both sides of ridge and repeat at intervals (with a minimum of two) along roof. Alternate rising to left and to right. Where the roof is short the second line of bracing may cross as shown by the broken line.

View B *Figure 99c*



Two diagonals each end. One diagonal alternatively each side of centre line elsewhere

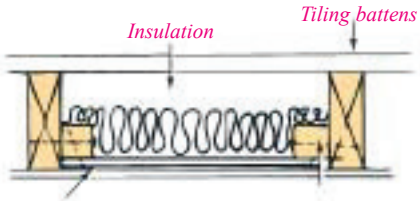
View C *Figure 99d*



Diagonals repeat continuously along building, they may rise to left or right or vary

Figure 99e *View D*

Alternative to one line of diagonal rafter bracing



Tight fitting 12mm plywood fixed with 60mm nails at 250mm centres

50 x 50 ledgers fixed with 100mm nails at 250mm centres

The structural action of diagonal bracing is the completion of triangulation in various planes, in order to form rigid diaphragms. For example, in the plane of the rafters this is provided by rafters, tiling battens and the bracing members.

The effectiveness of the noggined parts of the diagonals in figure 99b might be open to question, as it is very dependent on the quality of installation. Suitable alternatives are plywood diaphragms (figure 99e).

Attic Frames - Environment

Fire

Room-in-the-roof constructions is in an unusual position in regard to fire regulations. The floor, of course, must have the usual, minimum modified half-hour endurance. However, additional precautions should be taken to prevent spread-of-fire into the roof cavities and to ensure the integrity of the connectors for the full half hour.

Alternative solutions are:

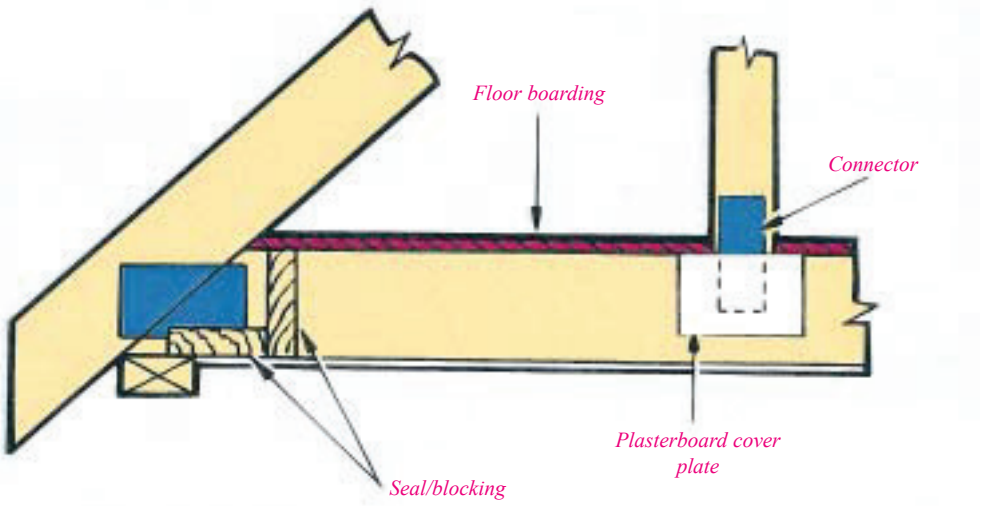
a. Continue the floor boarding into the side triangles sealing it to the wall plate as shown (figure 100a) and protect the connectors with 12.7mm plasterboard cover plates.

b. Install under the floor joists a ceiling lining capable of providing full or almost full protection eg:

1.12.7mm 'Fireline' plasterboard
2.Normal 12.7mm plasterboard plus a 5mm plaster skim coat
3.12.7mm plus 9.5mm plasterboard with staggered joints

If compliance with the ventilation requirements of the Building Regulations is to be effected through eaves vents, these should be made impassable to fire.

Figure 100a



Insulation and Ventilation

Thought should be given to the type and location at an early stage, as this might well determine the depth of rafter to be adopted.

A cool regime (figure 100b) required ventilation to control condensation. An airgap of not less than 50mm should be provided between the top of the insulation and the underside of the roof covering.

With a 100mm mineral wool quilt the smallest standard finished size of timber to provide the necessary depth is 147mm.

Warm roof regimes (figure 100c) need the same ventilation with, in addition, ridge vents providing at least a 5mm minimum continuous gap.

Figure 100b

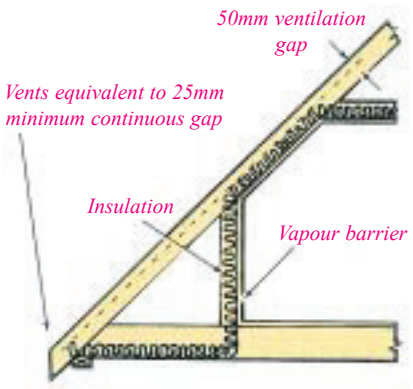
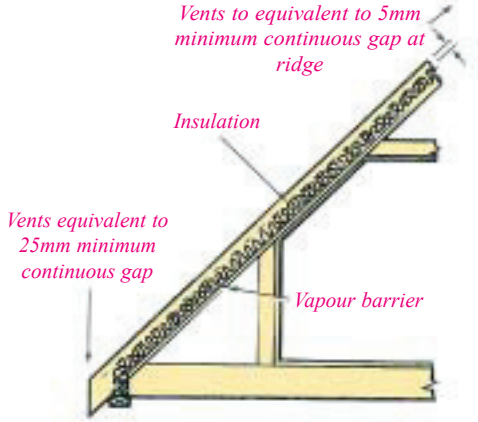


Figure 100c

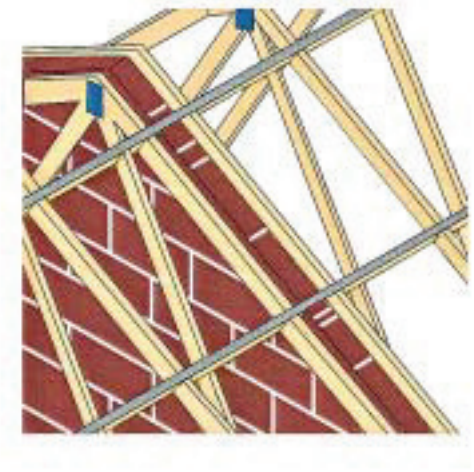


General Construction details

In general, it is preferable to use one of the proprietary types of fixings, 'A', between the ends of the trussed rafters and the wall plates or bearings as shown in figure 103.

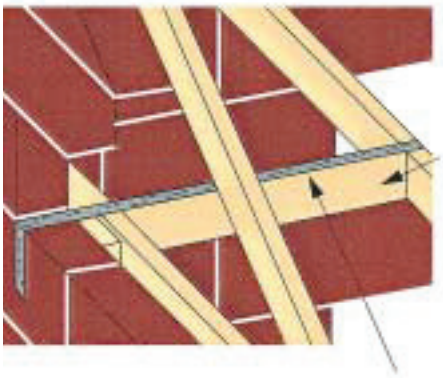
Where proprietary fixings are not used, the minimum fixing at each bearing position should consist of two 4.5 x 100mm long galvanised round wire nails, which are skew nailed from each side of the trussed rafter into the wallplate or bearing. Where nailing through the punched metal plate cannot be avoided, the nails should be driven through the holes in the fasteners. This method of fixing should not be used with stainless steel metal plate fasteners or where the workmanship on site is not of a sufficiently high standard to ensure that the fasteners, joints, timber members and bearings will not be damaged by careless positioning or overdriving of nails.

Figure 101



The Building Designer should ensure that, when required, adequate holding down fixings, 'C', are specified for both the trussed rafter and the wall plates or bearings.

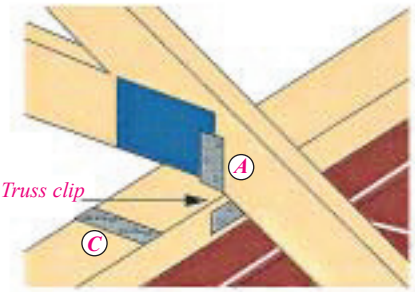
Figure 102 Restraint strap at ceiling level



Noggings to be provided and set horizontal unless the strap has a twist to line it up with the roof slope

Strap fixed to solid noggings with a minimum of four fixings of which at least one is to be in the third joist/rafter or in a noggin beyond the third joist/rafter

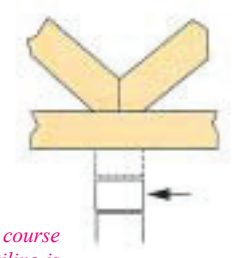
Figure 103



Internal non-loadbearing walls

It is advisable to erect non-loadbearing walls after the tiling has been completed thus allowing deflection to take place under the dead load, thereby reducing the risk f cracking appearing in the ceiling finishes. If partitions are of brick or block, then as an alternative the final course may be omitted until tiling has been completed

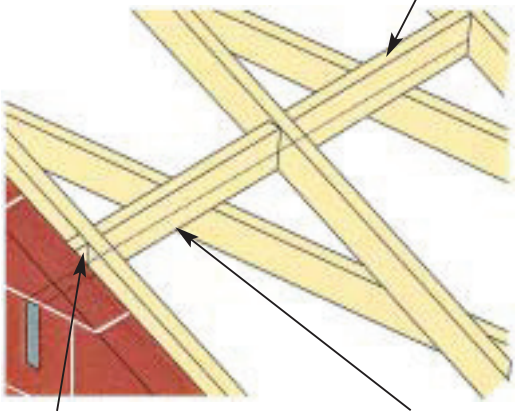
Figure 104



Partition

Omit final course until tiling is completed

Figure 105 Restraint strap at rafter level



Packing piece between inner leaf and first rafter

Strap bedded under a cut block

General Construction details

Hogging over party walls

Party walls should be stopped 25mm below the tops of rafters. During construction layers of non-combustible compressible fill such as 50mm mineral wool should be pressed onto the locations shown to provide a fire stop as figure 106.

Continuity across party walls

If the tiling battens are required to be discontinued over a party wall, then lateral restraint must be provided in addition to that required to transfer longitudinal bracing forces.

This should consist of straps adequately protected against corrosion. These straps should be spaced at not more than 1.5m centres and be fixed to two rafter members and noggins on each side of the party wall by 3.35mm diameter nails with a minimum penetration into the timber of 32mm.

Hipboards

Fixing over flat-top girder

Where hipboards pass over and are supported on flat top girder trusses, the hipboard must be notched in order to achieve the correct height for the hipboard and to provide horizontal bearing. The flying rafter of the truss may need to be trimmed but in no circumstances should the flat chord or the rafter below the joint be cut. In most cases the hipboard is supplied in two parts which can be joined over the flat top truss. One method of providing the necessary fixing is illustrated in figure 108.

Figure 106

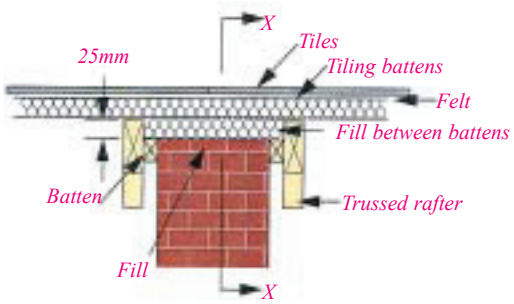


Figure 107

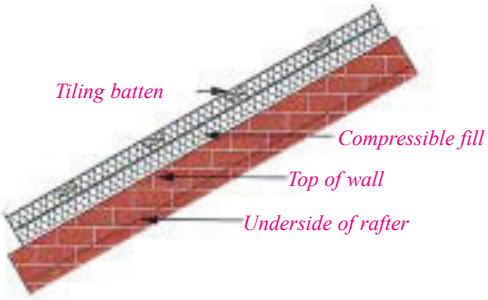


Figure 108

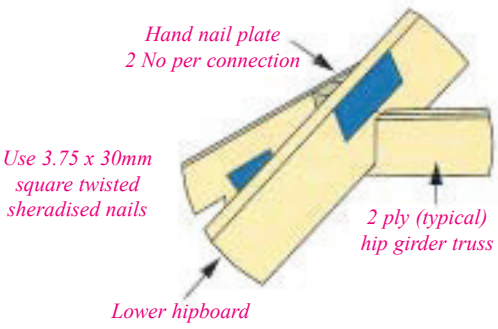
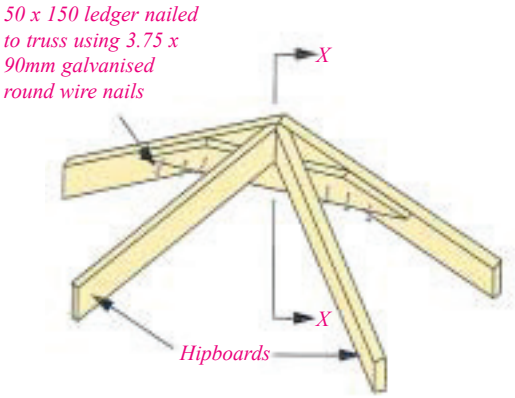
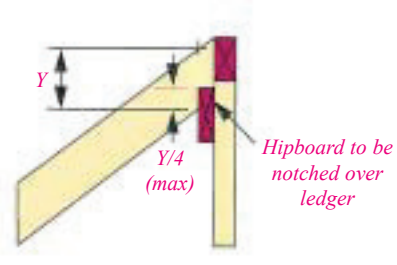


Figure 109



Hipboard to be notched over girder truss and butted together over centre of girder.



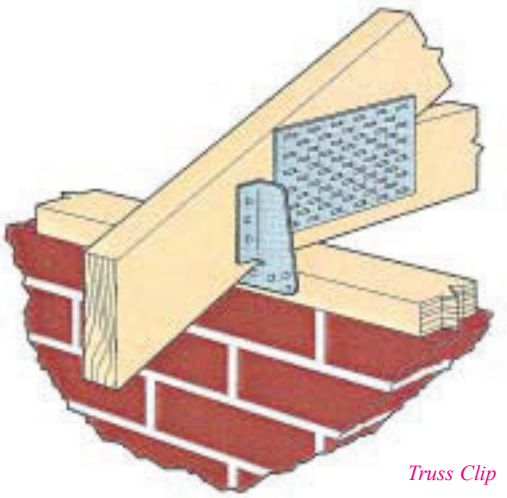
Section X - X

Builders Metal Work

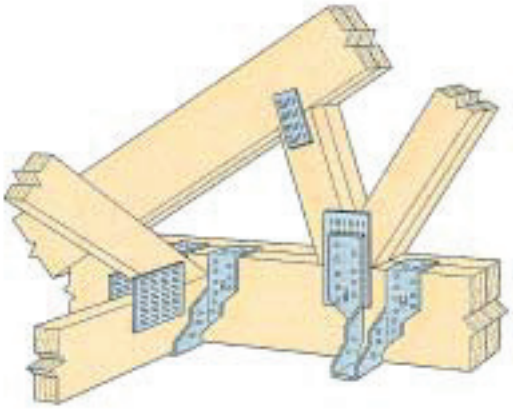
Metalwork for timber-to-timber and truss to masonry connections are always required at some point in a roof structure.

MiTek Industries Limited are leading suppliers of all fixings necessary for the erection of trussed rafter roofs.

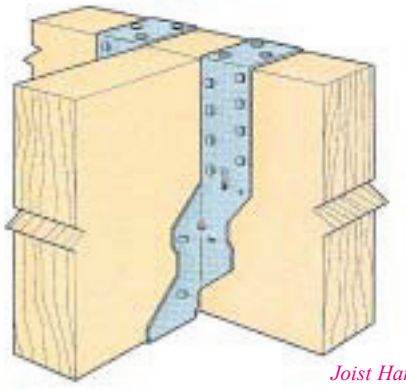
A separate catalogue is available detailing the full range of fixings we stock and supply, but detailed below are just some of the products available.



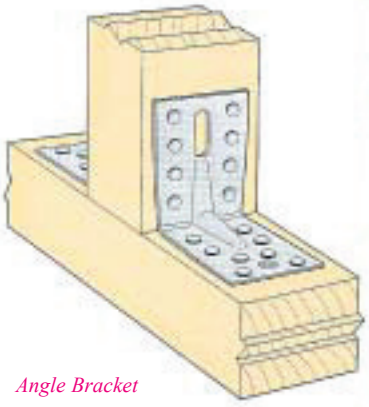
Truss Clip



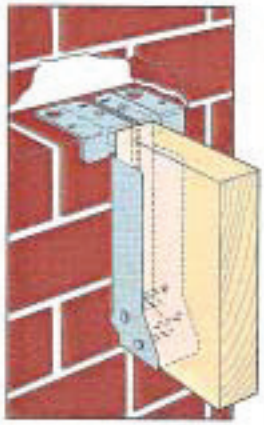
Truss Hanger



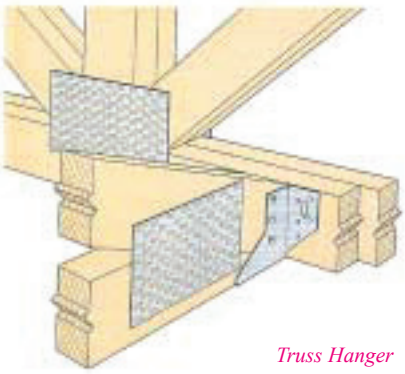
Joist Hanger



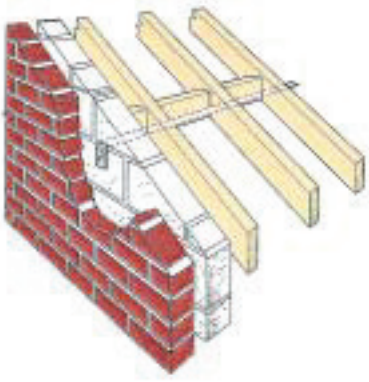
Angle Bracket



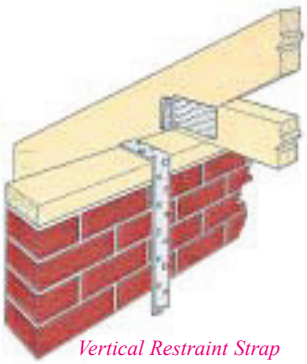
Masonry Hanger



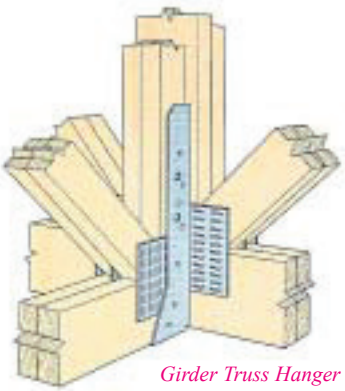
Truss Hanger



Lateral Restraint Strap



Vertical Restraint Strap



Girder Truss Hanger