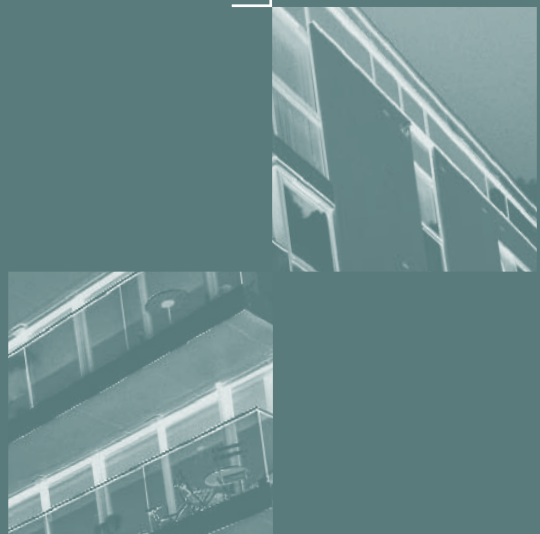


# Chapter 7.2

## Pitched roofs

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Effective from 1 January 2012



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## SCOPE

This Chapter gives guidance on meeting the Technical Requirements and recommendations for pitched roofs, including trussed rafter and traditional cut roofs, vertical tiling, weatherproofing and insulation.

## DESIGN STANDARDS

### 7.2 - D1 Design shall meet the Technical Requirements

Design that follows the guidance below will be acceptable for pitched roofs.

## STATUTORY REQUIREMENTS

### 7.2 - D2 Design shall comply with all relevant statutory requirements

Designs should be in accordance with relevant Building Regulations and other statutory requirements.

## LOADBEARING STRUCTURE

### 7.2 - D3 All pitched roof structures shall be designed to support applied loads and self weight without undue movement

Items to be taken into account include:

#### (a) dead and imposed loads

Dead and imposed loads should be calculated in accordance with BS EN 1991-1-1, BS EN 1991-1-3 and BS EN 1991-1-4. Dead loads include the self weight of the roof structure and the roof covering. Imposed loads include snow loadings and the weight of water tanks, insulation, etc.

Structural timber should be specified according to the strength classes in BS EN 338. Timber specifications when using BS 4978 grading rules (eg GS) should be in accordance with BS EN 1912 or strength class specified and also include the timber species.

#### (b) wind loads

Wind loads appropriate to the site location should be calculated in accordance with BS EN 1991-1-4. The roof should be designed to resist wind uplift. This resistance is often provided by the weight of the roof itself but holding down straps should be provided where the self weight of the roof is insufficient.

#### (c) holding down straps

Holding down straps may be required in certain geographical locations and with certain types of roof construction. Some roof covering manufacturers provide detailed guidance.

Where holding down straps are necessary, they should have a minimum cross section of 30mm x 2.5mm and be fixed at maximum 2m centres. Steel straps with a galvanized finish are normally acceptable. The design should detail how straps are to be fixed and what materials are to be used. The durability of fixings should be compatible with the straps.

#### (d) sizing and spacing of members

Sizing and spacing of rafters and ceiling joists should be as:

- Clause D5 for trussed rafter roofs
- Clause D6 for traditional cut roofs.

Generally, the spacing of rafters and ceiling joists should be not more than 600mm. The spacing of ceiling joists should suit the thickness and size of the plasterboard sheets or other ceiling finish. Plasterboard sheets may be fixed at the following joist centres:

- 9.5mm sheets - up to 450mm spacing
- 12.5mm and 15mm sheets - up to 600mm spacing

Proprietary roof systems should be designed by an Engineer in accordance with Technical Requirement R5.

#### (e) size and spacing of tile battens

The size and spacing of tile battens should be in accordance with the roof covering manufacturer's recommendations, but not less than shown in the table in Appendix 7.2-D.

Nails for fixing battens should be 3.35mm (10 gauge) x 65mm long. Galvanized smooth round nails are acceptable, except where the maximum basic wind speed is over 26m/s (from National Annex Figure NA.1 of BS EN 1991-1-4), where ring shank nails should be specified.

### 7.2 - D4 All pitched roof structures shall be designed so as to transmit loads and give restraint to the supporting structure without undue movement

Items to be taken into account include:

#### (a) wall plates

Normally, trussed rafter roofs and traditional cut roofs should be supported on timber wall plates.

Wall plates should be as detailed in Clause D6(b) with regard to the table concerning minimum sizes. Fixings to connect the roof structure to the wall plate should be specified having regard to the roof construction and the exposure conditions of the site.

For trussed rafter roofs not subject to uplift, the minimum fixing should be two 4.5mm x 100mm long galvanized round wire nails, skew nailed, one from each side of the trussed rafter. Alternatively, truss clips can be used, fixed in accordance with manufacturers' instructions.

In Scotland, nails should be appropriate to wall plate dimensions.

#### (b) holding down straps

In situations where the roof is required to resist uplift, skew nailing is unlikely to provide sufficient strength. Appropriate metal straps should be used.

#### (c) lateral restraint straps

For dwellings of masonry construction, restraint should be provided at rafter level for gable walls. Larger gable or separating walls may also require restraint at ceiling level. See Sitework clause S3.

Guidance in assessing when ceiling restraint is needed can be found in Building Regulations.

Lateral restraint straps should have a minimum cross section of 30mm x 5mm and a minimum anchorage downturn of 100mm. The level of galvanizing for straps and their fixings should be in accordance with Tables A.1 and A.2 of BS EN 845-1. (reference should be made to Appendix 6.1-F). Sheradizing is not acceptable in Northern Ireland and the Isle of Man. Straps should be of sufficient length to be fixed to three trusses and should be fixed with solid blocking.

In framed roofs, as an alternative, purlins and pole plates can also provide restraint if the timber abuts a gable construction. Where purlins are used to provide restraint they should not be spaced at more than 2m centres, unless the design shows they are adequate at greater spacing.

In trussed rafter roofs, an alternative is to provide restraint through gable ladder detailing.

#### (d) timber frame construction

For dwellings of timber frame construction, the designer should ensure stability in accordance with BS EN 1995-1-1.

## TRUSSED RAFTER ROOFS

### 7.2 - D5 Trussed rafters shall be designed to support applied loads and self weight without undue movement

Items to be taken into account include:

#### (a) recognised design standards

Trussed rafters should be designed in accordance with BS 5268-3 (or PD 6693-2 when published). Truss manufacturers may have their own computer programs for calculating truss designs in accordance with the British Standard.

#### (b) design information

To ensure that trussed rafters are correctly designed and fabricated, and are suitable for their intended purpose, an accurate specification is necessary.

BS 5268-3 (or PD 6693-2 when published) gives a list of information to be supplied to the truss manufacturer, including the:

- height and location of building with reference to unusual wind conditions
- profile of the trussed rafter, including camber, if required
- span of the trussed rafter
- pitch or pitches of the roof

# 7.2 Pitched roofs

- method of support and position of supports
- type and weights of roof tiles or covering, including sarking, insulation and ceiling materials
- size and approximate position of any water tanks or other equipment to be supported on the trussed rafters
- overhang of rafters at eaves and other eaves details
- positions and dimensions of hatches, chimneys and other openings
- use of the building with reference to any unusual environmental conditions
- type of preservative treatment, where required
- spacing of trussed rafters and special timber sizes, where these are required to match existing construction.

The building designer should ensure that the design of the roof as a whole is satisfactory in achieving the overall stability of the complete structure. This includes its connection to, and compatibility with, the supporting structure and adjacent elements of the building.

### (c) bracing

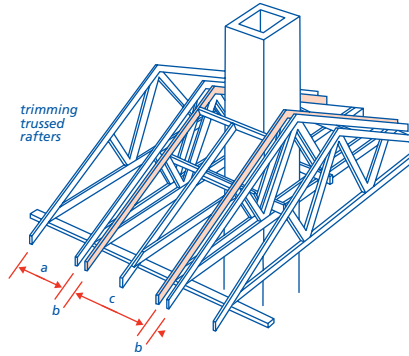
The building designer should specify all bracing. Trussed rafter roofs should be braced in accordance with Table 1 in Appendix 7.2-B, unless the roof is designed and braced in accordance with BS 5268-3 (or PD 6693-2 when published).

All timber bracing to trussed rafters should be at least 100mm x 25mm in section and twice nailed to each trussed rafter and to the wallplate. Nailing should be 3.35mm (10 gauge) x 65mm long galvanized round wire nails.

### (d) spacing

Trussed rafters should not be spaced at centres greater than 600mm. Where this cannot be achieved, eg to accommodate hatch openings or chimneys, the spacing of trussed rafters may be increased as shown below provided that the spacing between centres of trimming trussed rafters does not exceed 2 times the design spacing of trussed rafters and that b is smaller than or equal to 2a - c, where:

- a = design spacing of trussed rafters
- b = distance between centres of trimming trussed rafter and adjacent trussed rafter
- c = nominal width of required opening.



### (e) mono-pitch trusses and girder trusses

Hipped roofs constructed with trussed rafters will generally require a series of diminishing mono-pitched trusses supported by a girder truss.

The bearing of mono-pitched trusses into shoes should be as follows:

Span	Minimum bearing length	Minimum thickness of truss member
Less than 4m	50mm	35mm
4m or more	75mm	35mm

Alternative bearings should be designed by an Engineer in accordance with Technical Requirement R5.

### (f) water tank support

Where water tanks are supported by roof trusses, their load should be transferred to the node points of the trussed rafter and spread over at least three trussed rafters in accordance with BS 5268-3 (or PD 6693-2 when published).

A correct method of water tank support is shown in Appendix 7.2-C.

Proprietary tank support systems should be assessed in accordance with Technical Requirement R3.

### (g) multiple trussed rafters

All multiple and reinforcing timbers to simple or multiple trussed rafters should be designed to be permanently fastened together. The timber members should be either fixed together during manufacture or, alternatively, fully detailed drawings and specifications showing the fixing method should be supplied to the site to enable the components to be assembled correctly.

### (h) roofs incorporating valleys or other special features

Roofs with hips, valleys or other special features should be designed by an Engineer in accordance with Technical Requirement R5. Standard designs supplied by manufacturers which incorporate these features will usually be acceptable.

### (i) combined trussed rafter and cut roofs

Particular care is needed where trussed rafters and a cut roof are combined in a roof design. The designer should provide details of the complete roof. Trussed rafters supporting traditional cut roof members should be designed by an Engineer in accordance with Technical Requirement R5.

### (j) strutting to attic trusses

The part of an attic truss which forms a floor should have strutting in accordance with Appendix 7.2-E.

## TRADITIONAL CUT ROOFS

### 7.2 - D6 Cut roofs shall be designed to support applied loads and self weight without undue movement

Items to be taken into account include:

#### (a) recognised design standards

Sizes of certain roof members for basic pitched roofs are given in TRADA Eurocode 5 span tables (3rd edition) and BS 8103.

Where spans, sizes, spacing or strength classes of timber are outside the scope of authoritative tables or where the form of roof is other than a basic pitched roof, the roof should be designed by an Engineer in accordance with Technical Requirement R5. Calculations should be based on BS EN 1995-1-1 and BS 5268-3 (or PD 6693-2 when published).

#### (b) member sizes

Unless the roof is designed by an Engineer in accordance with Technical Requirement R5, traditionally, nominal sizes of members would be as follows:

Member	Minimum size (mm)
Struts and braces	100 x 50
Wall plates (Scotland)	100 x 25
Wall plates (Northern Ireland & the Isle of Man)	100 x 38
Wall plates (other)	75 x 50
Hips	rafter cut + 25
Valleys	32 thick
Ridges	rafter cut + 25

#### (c) triangulation

In the design of a cut roof, timber members should be triangulated or otherwise arranged to form a coherent structure. All forces inherent in the design should be resolved. The method of fixing or jointing members should be specified.

Particular care should be taken to ensure adequate triangulation when designs incorporate hips and valleys, and when cut roofs are used in conjunction with trussed rafters.

Details of all structural members should be provided.

**(d) strutting to cut roofs**

Any part of a cut roof which forms a floor should have strutting in accordance with Appendix 7.2-E.

**TIMBER TREATMENT**

**7.2 - D7 Measures shall be taken to ensure durability of timber**

Items to be taken into account include:

**(a) treatment against House Longhorn Beetle**

In some areas of the UK, treatment against House Longhorn Beetle is required. Reference should be made to relevant Building Regulations. Reference should also be made to Chapter 2.3 'Timber preservation (natural solid timber)' (Design).

**(b) timber requiring treatment**

The following timber members should be either naturally durable or suitably treated:

- fascias
- bargeboards
- soffits
- tiling battens
- other trim.

These timber members should, where appropriate, also be painted or stained in accordance with the recommendations in Chapter 8.5 'Painting and decorating' (each section).

In pitched roofs with a fully supported weatherproofing membrane, the following timber members should be either naturally durable or suitably treated:

- rafters
- purlins
- ceiling joists
- bracing
- sarking
- wall plates
- battens for fixing vertical cladding.

The level of durability of all the above members can be achieved by natural durability or treatment with preservative. Reference should be made to Chapter 2.3 'Timber preservation (natural solid timber)' (each section) for guidance.

**WEATHERTIGHTNESS**

**7.2 - D8 Roofs shall be designed to satisfactorily resist the passage of rain and snow to the inside of the building**

Items to be taken into account include:

**(a) weathertightness of roof coverings**

Roofs with a tile or slate covering should be designed in accordance with BS 5534 : Parts 1 and 2.

**(b) tiles**

For tiled roofs, the pitch, gauge and lap should be within the limits given in Table 1

of Appendix 7.2-A, unless the manufacturer specifies otherwise.

Fixings for single and double lap tiles should be designed in accordance with BS 5534 and BS EN 1991-1-4. Where tile manufacturers have computer programs based on these British Standards, their recommendations should be followed.

Tables 2 and 3 of Appendix 7.2-A contain minimum fixings for tiles. The tile manufacturer will be able to advise on any additional nails or clips required for a particular location. A fixing schedule produced by the tile manufacturer, based on The Zonal Method, is acceptable.

To avoid the use of small sections of cut tiles, which are difficult to fix, double tiles, tile-and-a-half or half tiles should be used where available from the manufacturer.

**(c) slates**

Natural slates should be fixed in accordance with BS 5534 and BS EN 1991-1-4. Each slate should be nailed twice when centre nailed.

**(d) roof coverings other than tiles or slates**

Lead sheet roofing should be in accordance with BS 6915.

Other types of sheet roofing should be in accordance with the relevant parts of CP 143.

Roofs with the following traditional coverings should be designed in accordance with satisfactory custom and practice:

- natural stone
- shingles
- thatch.

Thatching should be as recommended by the Thatch Advisory Service or other appropriate authority in accordance with Technical Requirement R3.

Proprietary roof coverings including roof lights should be assessed in accordance with Technical Requirement R3.

**(e) roof underlays**

An underlay should be provided for all tiled roofs.

The underlay may be felt to BS EN 13707 or a proprietary sarking membrane complying with Technical Requirement R3. Where the underlay is exposed at eaves level it should be UV resistant or type 5U felt. Alternatively, proprietary eaves guards may be used. A type 1F felt may be used for the remainder of the roof.

To prevent the underlay sagging at the eaves and forming a water trap behind the fascia, the underlay should be supported by a continuous fillet or proprietary eaves support tray.

**(f) rigid sarking**

In areas of severe exposure, a rigid sarking with underlay is recommended and is normal practice in Scotland.

The choice of rigid sarking should take account of the type and fixing of the roof covering. The following materials are acceptable:

- tongued and grooved or square edged boarding to BS 1297
- bitumen impregnated insulating board to BS 1142 : Part 3 (sarking and sheathing grade)
- exterior grade plywood to BS EN 636 service class 3
- type P5 chipboard to BS EN 312
- oriented strand board type OSB3 to BS EN 300
- proprietary products which have been assessed in accordance with Technical Requirement R3.

To avoid damage from condensation, proprietary insulation boards should be used strictly in accordance with the recommendations given in the independent assessment.

**(g) flashings and other weathering details where a pitched roof abuts a vertical surface**

Where a roof abuts a vertical surface, cover flashings, stepped cover flashings, soakers, secret gutters and back or parapet gutters should be provided as necessary. Where the roof is over an enclosed area the wall construction should include cavity trays linked to the flashings. Reference should be made to Sitework clause 7.2 - S12(f) for details.

Cover flashings should be tucked 25mm into a brick joint or chase not less than 75mm above the intersection with the roof.

Flashings and soakers should be of non-ferrous metal and of the same material to avoid electrolytic action.

Where lead is used, soakers should be at least Code 3 and flashings, gutters, saddles, etc should be Code 4 or better.

In the case of gutters behind parapet walls, provision should be made for an overflow in case the outlet becomes blocked.

**(h) weathering details where a pitched roof intersects with a continuous waterproof membrane**

For information on intersections with flat roofs, gutters or valleys, reference should be made to Sitework clause 7.2 - S12(e).

**(i) pipes**

Where soil pipes, vent pipes or other pipes penetrate roof tiling, a lead slate flashing, or a purpose-made accessory to form a weathertight joint, should be used.

If lead slates are used, they should be supported (eg using exterior grade plywood) to prevent the lead sagging.

# 7.2 Pitched roofs

## (j) chimneys

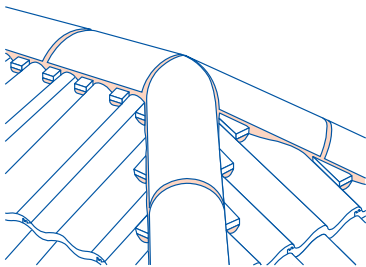
Flashings should connect with the chimney dpcs. The normal flashing components are shown in Sitework clause 7.2 - S12(g). Components will vary depending on whether the chimney intersects the roof at eaves or ridge level and the type of roof covering. Reference should be made to roof covering manufacturers' information sheets.

For more detailed information on the construction and weatherproofing of chimneys, reference should be made to Chapter 6.8 'Fireplaces, chimneys and flues'.

## (k) ridges and hips

All ridge and hip tiles should be mechanically fixed with self sealing non-ferrous fixings into timber battens. Where proprietary systems are used they should be fixed in accordance with manufacturer's recommendations.

Where ridge and hip tiles are bedded on mortar to rolled tiles, concealed or decorative dentil tiles should be fully bedded into all joints in excess of 25mm thick.



Proprietary dry fixed systems should be assessed in accordance with Technical Requirement R3.

## (l) valleys

Valleys should be formed with purpose-made valley tiles or as an open valley lined with glass reinforced plastic (GRP), lead or other material acceptable under Technical Requirement R3.

Where slates or plain tiles are used, a laced valley, swept valley or mitred tiles with soakers may also be used. Valley tiles should be fixed in accordance with the manufacturer's recommendations and small cut tiles should be avoided.

GRP or other materials should be lapped in accordance with manufacturer's recommendations. Minimum Code 4 lead or other suitable saddle flashing is required at the head of all valleys.

## (m) verges

Where slates or plain tiles are used, the verge should project 38mm to 50mm beyond the gable wall or bargeboard. Interlocking tiles can project 30mm to 60mm.

Unless a proprietary dry verge system or cloaked verge is used, tiles should be bedded into a minimum 100mm wide bed of mortar on an undercloak of cement-based board, plain tile or slate which in turn should be bedded onto the gable wall with mortar or suitable bedding sealant. Plain tiles should not be used as an undercloak below 30° pitch or on a bargeboard.

Where verge clips are specified, these should be twice nailed to battens and sized to ensure that they are in direct contact with the top surface of the verge tile.

At verges:

- cut plain tiles are not acceptable and purpose made plain tile-and-a half or half tile should be used
- cut single lapped interlocking tiles should not be used
- natural slate verges should be formed with full slates and either slate-and-a half or half slates that are a minimum 150mm wide.

Consider using an overhanging verge (by means of a gable ladder) to provide better weather protection to the gable wall, especially in exposed positions or where cavity insulation is used.

## (n) proprietary roof coverings

Proprietary roof coverings should comply with Technical Requirement R3.

## 7.2 - D9 Vertical tiling and slating shall adequately resist the passage of rain and snow to the inside of the building

Items to be taken into account include:

### (a) moisture barrier

A moisture barrier should be provided behind all vertical tiling and slating.

Moisture barriers should be:

- underfelt or equivalent where the wall structure is solid brickwork or blockwork. See Design clause 6.1- D14(c)
- a breather membrane where the supporting structure is of timber construction.

For detailed information on the use of moisture barriers in association with timber frame construction, reference should be made to Chapter 6.2 'External timber framed walls'.

### (b) batten size

Batten sizes should comply with Design clause D3(e).

## (c) fixing

Every tile or slate should be nailed twice and comply with the general requirements of BS 5534.

## (d) weathering details

Bottom edges should be finished with an under-course tile. At dormer cheeks, the tiles or slates should be specified to be cut close to the slope of the roof, over a flashing fixed to the side of the dormer.

At internal or external angles, purpose made corner tiles or soakers should be used to form a weathertight joint.

Where pitched roofs abut masonry walls, a stepped flashing should be specified, turned behind the tiles. Details are shown in Sitework clause 7.2 - S12.

For information regarding vertical double lap tiling or slating on walls, reference should be made to Chapter 6.1 'External masonry walls' (Design and Sitework) or Chapter 6.2 'External timber framed walls'.

## INSULATION AND CONTROL OF CONDENSATION

### 7.2 - D10 Roofs directly above habitable rooms shall be adequately insulated

The BRE Report 'Thermal insulation: avoiding risks' discusses aspects of insulation relevant to pitched roofs. In England and Wales account should be taken of Accredited Construction Details.

Insulation should be of sufficient thickness to meet the requirements of Building Regulations.

To reduce the risk of freezing, and condensation on pipework, the guidance in Sitework clause 7.2 - S14 should be followed.

### 7.2 - D11 Measures shall be taken to control condensation

Items to be taken into account include:

#### (a) ventilation of main roof spaces

Pitched roofs with insulation at ceiling level should always be ventilated to the outside air to minimise the risk of condensation.

For roofs that incorporate a high water vapour resistance (type HR) underlay (eg types 1F/5U felts):

- eaves ventilation should be provided on opposite sides of the roof to permit cross ventilation. Reference should be made to Sitework clause 7.2 - S11(a) for illustrations showing where ventilation should be provided
- where the roof pitch is 15° or more, cross ventilation should be provided to the roof void equivalent to a 10mm slot running the full length of the eaves

- where the ceiling follows the slope of a 'cold roof' regardless of pitch or where a cold roof has a pitch less than 15°, cross ventilation should be provided to the roof void equivalent to a 25mm slot running the full length of the eaves. A nominal 50mm clearance should be maintained between the insulation and the roof underlay
- where the roof pitch exceeds 35° or when the span exceeds 10m, high level ventilation, equivalent to a continuous 5mm opening, should be used in addition to eaves ventilation
- the means of providing cross ventilation to mono-pitched roofs should be in accordance with BS 5250 which indicates eaves ventilation together with the equivalent of a continuous 5mm slot at high level.

For unventilated cold roofs that incorporate a low water vapour resistance (type LR) underlay (eg a vapour permeable underlay):

- ridge or high level ventilation equivalent to a continuous opening of 5mm should be provided in accordance with BS 5250.

Where vapour permeable underlays are used on sloping roofs, with areas over covered by non-permeable materials (eg flat roofed areas of mansard roofs), ventilation equivalent to a continuous opening of 5mm should be provided at the highest point of each roof slope.

#### (b) position of vapour checks

Vapour control layers should be used in roof constructions where the ceiling board is fixed to the rafters.

In normal pitched roofs where insulation is placed over a horizontal ceiling and the void above is ventilated, a vapour control layer is not recommended. Moisture from the dwelling will be diffused through the ceiling and removed by roof space ventilation.

Vapour control layers, where required, should be placed on the warm side of insulation.

#### (c) ventilation of dormers

Pitched dormers should be ventilated from eaves to eaves or, where necessary, from eaves to ridge.

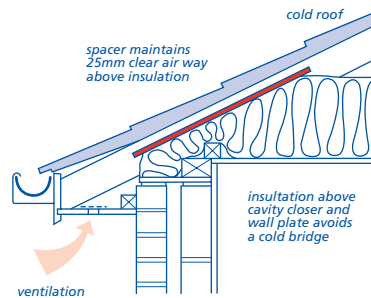
Flat roofed dormers of cold deck construction should be ventilated. The ventilation path should not be blocked by the timber structure, strutting, etc (reference should be made to Chapter 7.1 'Flat roofs and balconies' (Design and Sitework)).

#### (d) methods of ensuring unobstructed ventilation

Ventilation openings where the least dimension exceeds 10mm should be protected to prevent the entry of birds, etc.

Acceptable protection of openings can be provided by using materials complying with Materials clause 7.2 - M5(j).

A spacer in the eaves should be used so that ceiling insulation can be installed over and beyond the wall plate. This minimises the cold bridge without blocking the ventilation. The spacer should be of sufficient length to maintain the ventilation above the insulation.



#### (e) other methods of reducing condensation

Methods of reducing condensation, such as draughtstripping loft hatches and sealing holes for services, are given in Sitework clause 7.2 - S14.

## FIRE SPREAD

### 7.2 - D12 Roofs shall adequately resist fire spread

Items to be taken into account include:

#### (a) roof coverings

Slates and concrete or clay tiles are designated AA when tested to BS 476 : Part 3 and therefore can be used without limitation on any pitched roof. The use of some other materials is restricted by statutory requirements, particularly in relation to their distance from site boundaries (reference should be made to Building Regulations). These include:

- bitumen felt slates
- wood shingles
- thatch.

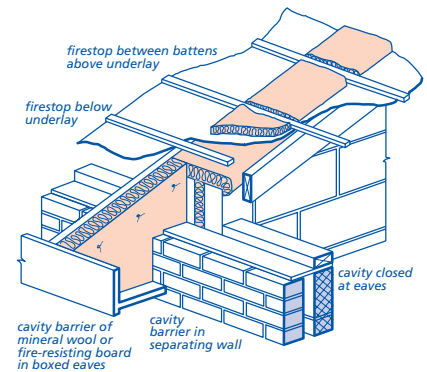
#### (b) chimneys and flue pipes

Combustible material, such as roof timbers and sarking felt, should be kept away from heat sources as described in Chapter 6.8 'Fireplaces, chimneys and flues' (Design).

### 7.2 - D13 Junctions between roofs and compartment or separating walls shall adequately resist fire spread

The junction between a separating or compartment wall and a roof should be firestopped. If there are gaps, fire, smoke and flame can spread from one compartment to the next across the wall.

Mineral wool fire-stopping should be used to allow for movement in the roof timber, and avoid 'hogging' of the roof which is often associated with mortar fire-stopping.



Where a wall separates an integral garage from the rest of a dwelling, other arrangements are possible provided the principle of half-hour fire separation is maintained.

## ACCESS

### 7.2 - D14 Roof voids shall be provided with suitable access

Access should be provided to:

- the main roof space, and
- roof voids that contain cisterns, tanks and the like.

Access is not required to other roof voids containing only water pipes.

#### SIZE OF OPENINGS

Access openings should be not less than 520mm in any direction.

Where equipment (eg heating and ventilation equipment) is located in a roof space the size of the opening should permit its removal.

Access openings should not be located directly over stairs or in other hazardous locations.

#### PROVISION OF WALKWAYS

Boarded walkways should be provided:

- between the access opening and any cistern or other permanent equipment located in the roof space, and
- at each cistern or other permanent equipment suitably located for maintenance purposes and at least 1m<sup>2</sup> in area.

Boarding should be securely fixed without compressing the loft insulation.

## ROOF DRAINAGE

### 7.2 - D15 Roof drainage shall adequately carry rainwater to an outfall

Items to be taken into account include:

**(a) provision of gutters and downpipes**  
Roofs greater than 6m<sup>2</sup> in area should be provided with rainwater gutters and downpipes. Consideration should also be given to the provision of rainwater drainage to roof areas less than 6m<sup>2</sup> for example dormer and porch roofs.

[Rainwater pipes passing through dwellings should be insulated in accordance with Sitework clause 8.1 - S8\(c\).](#)

#### **(b) sizes**

Gutters and downpipes should be of sufficient size to accommodate normal rainfall.

Care is needed in sizing gutters where dormer roofs interrupt the run-off from a pitched roof. The gutter should be sized to cope with the concentrated flows.

#### **(c) discharge from one roof to another**

Where water from a large roof surface discharges onto another surface, precautions should be taken to prevent erosion of the lower surface.

#### **(d) discharge into drainage system**

Unless designed otherwise, shoes should be provided to rainwater downpipes.

## PROVISION OF INFORMATION

### 7.2 - D16 Designs and specifications shall be produced in a clearly understandable format and include all relevant information

Full details of trussed rafter roofs should be available on site, including the following:

- layout drawing of trusses and associated items
- bracing requirements
- trimming around chimneys, access hatches, etc
- mono-pitch and lean-to roofs
- girder trusses, multiple trusses and diminishing trusses and how they are fixed together and supported on truss shoes, layboards or similar
- roof intersections (ie hips and valleys).

Assembly drawings are also important where there are complicated roof shapes or where trussed rafter and framed roofs are used in combination.

The drawings should show:

- the number and type of fixings for roof coverings
- means of providing eaves ventilation
- fire-stopping at separating wall and boxed eaves
- flashing details at abutments, chimneys, etc

- supports for water cisterns in the roof space
- restraint strapping
- position, thickness and limits of insulation.

### 7.2 - D17 All relevant information shall be distributed to appropriate personnel

Ensure that design and specification information is issued to site supervisors and relevant specialist subcontractors and/or suppliers.

## MATERIALS STANDARDS

### 7.2 - M1 All materials shall:

#### **(a) meet the Technical Requirements**

#### **(b) take account of the design**

Materials that comply with the design and the guidance below will be acceptable for pitched roofs.

Materials for pitched roofs shall comply with all relevant standards, including those listed below. Where no standard exists, Technical Requirement R3 applies (see Chapter 1.1 'Introduction to the Standards and Technical Requirements').

References to British Standards and Codes of Practice include those made under the Construction Products Directive (89/106/EEC) and, in particular, appropriate European Technical Specifications approved by a European Committee for Standardisation (CEN).

## STRUCTURAL TIMBER

### 7.2 - M2 Structural timber shall be of the appropriate grades and sizes to support the imposed loads

Structural timber should be specified according to the strength classes in BS EN 338. Roof members are usually C16, C24 or TR26.

Timber specifications when using the BS 4978 grading rules should be accordance with BS EN 1912 or strength class specified and also include the timber species.

### 7.2 - M3 Structural timber shall be of suitable durability

Structural timber should be pre-treated with preservative where specified by the designer. Chapter 2.3 'Timber preservation (natural solid timber)' (each section) recommends methods of preservative treatment.

Use of reclaimed materials is covered in Materials clause M6.

## RESTRAINT STRAPS AND HOLDING DOWN STRAPS

### 7.2 - M4 Strapping shall be of adequate strength and durability

Lateral restraint straps should have minimum cross section dimensions of 30mm x 5mm. Vertical holding down straps should have minimum cross section dimensions of 30mm x 2.5mm.

Mild steel straps and fixings should be protected against corrosion in accordance with Tables A.1 and A.2 of BS EN 845-1. (see Appendix 6.1 - F). Fixings and straps should be compatible. Sheradizing is not acceptable in Northern Ireland and the Isle of Man.

Straps should be ordered to the correct length and with the correct number of bends and/or twists required by the design.

## ROOFING MATERIALS

### 7.2 - M5 Roofing materials shall be of the quality, type and dimensions required by the design

Items to be taken into account include:

#### **(a) roof coverings**

The following roof coverings are acceptable:

- clay tiles and fittings to BS EN 1304
- concrete tiles and fittings to BS EN 490 and BS EN 491
- fibre cement slates and fittings to BS EN 492
- natural slates to BS EN 12326 (see Appendix 7.2 - F).
- shingles should be of Western Red Cedar, suitably treated and be Grade 1 to the Canadian Standards Association.

Natural stone should be used in accordance with established custom and practice.

Thatch should be as recommended by the Thatch Advisory Service or other appropriate authority in accordance with Technical Requirement R3.

Use of reclaimed materials is covered in Materials clause M6.

Proprietary coverings should be assessed in accordance with Technical Requirement R3.

#### **(b) fixings**

Clout or slate nails for fixing slates and tiles should be one of the following and at least 38mm long:

- aluminium to BS 1202 : Part 3
- copper to BS 1202 : Part 2
- silicon bronze.

Galvanized steel nails are not suitable for fixing slates and tiles because of the risk of damaging the galvanizing but may be used to fix battens and underlay. Nails for fixing battens should be at least 30mm longer

than the batten thickness. Ring shank nails should be used when specified by the designer.

Tile clips should be of aluminium or stainless steel.

### (c) flashings

The following are acceptable:

- milled lead sheet to BS 1178. Flashings, gutter linings, etc should be at least Code 4, soakers may be Code 3
- aluminium and aluminium alloys to BS 1470 (0.6mm to 0.9mm thick) and protected from contact with mortar by a coating of bituminous paint
- zinc alloy to BS 6561 and 0.6mm thick
- copper to BS 2870, 0.7mm thick is suitable for gutters, 0.55mm thick fully annealed is suitable for flashing, soakers and saddles.

To prevent electrolytic action where metal items may be in contact, eg flashings and soakers, these should not be of different metals.

Proprietary flashings should be assessed in accordance with Technical Requirement R3.

### (d) underlays

Underlay may be felt to BS EN 13707.

Proprietary underlays should be assessed in accordance with Technical Requirement R3. Manufacturer's recommendations should be followed.

Where the underlay is exposed at eaves level it should be UV resistant or type 5U felt. Alternatively, proprietary eaves guards can be used. A type 1F felt may be used for the remainder of the roof.

To minimise the risk of condensation in the case of a fully supported underlay above rigid sarking, underlays should have a low vapour resistance, preferably less than 0.25MNs/g. Underlays with a higher vapour resistance may need increased ventilation to the roof space and between the underlay and sarking. Manufacturers' recommendations should be followed.

### (e) rigid sarking

The following materials are acceptable:

- tongued and grooved or square edged boarding to BS 1297
- bitumen impregnated insulating board to BS 1142 : Part 3 (sarking and sheathing grade)
- exterior grade plywood to BS EN 636 service class 3
- type P5 chipboard to BS EN 312
- oriented strand board type OSB3 to BS EN 300
- proprietary products which have been assessed in accordance with Technical Requirement R3.

### (f) battens and counter battens

Battens and counter battens should be to the sizes specified in the design. Timber

used for battens and counter battens should be as listed in BS 5534 and be marked accordingly, (see Appendix 7.2-D).

Battens should be preservative treated unless the timber is naturally durable.

Reference should be made to Chapter 2.3 'Timber preservation (natural solid timber)' (Materials) for guidance on the timber types and classes requiring treatment. Cut ends of tile battens that are in contact with mortar should be treated with a liberal brush coating of preservative.

### (g) insulation

Thermal insulation should be to the design specification.

The following materials are acceptable:

- mineral fibre mats to BS EN 13162
- blown mineral fibre to BS 5803 : Part 2
- blown cellulose fibre to BS 5803 : Part 3
- proprietary materials assessed in accordance with Technical Requirement R3.

Insulation of water pipes should be in accordance with Chapter 8.1 'Internal services' (Materials).

### (h) fascias, bargeboards and soffits

Timber used for fascias, bargeboards, soffits, etc should be pre-treated with preservative. Reference should be made to Chapter 2.3 'Timber preservation (natural solid timber)' (Materials) for guidance on preservative treatments.

The following materials are also acceptable:

- exterior grade plywood to BS EN 636 service class 3
- high density fibre reinforced calcium silicate board that meets the performance requirements of BS 3536
- glass fibre reinforced cement (GRC) board that meets the performance requirements of BS 3536
- proprietary products which have been assessed in accordance with Technical Requirement R3.

### (i) fire-stopping and cavity barriers

Cavity barriers in boxed eaves should be wire reinforced mineral wool blanket, at least 50mm thick. Ordinary mineral wool quilt is acceptable as fire-stopping above separating walls.

### (j) protection to ventilation openings

Ventilation openings where the least dimension exceeds 10mm should be protected to prevent the entry of birds, etc.

Acceptable protection of openings can be provided by:

- rigid fabrications with width of opening greater than 3mm and less than 10mm (no restriction on length)
- rigid fabrications with round holes greater than 3mm and less than 10mm in diameter

- square or rectangular mesh where the clear opening size is greater than 3mm and less than 10mm.

### (k) roof mortar

Roofing mortar should be 1:3 cement:sand with plasticiser. The mix should be based on sharp sand with soft sand added to achieve workability. The proportion of sharp sand should not be less than 1/3 of the total sand content.

Alternatively, proprietary mortar mixes may be accepted by NHBC if they are shown to have similar strength, durability and workability.

## RECLAIMED MATERIALS

**7.2 - M6 Reclaimed materials shall be:**

**(a) of the type, size and quality required in the design**

**(b) suitable for re-use**

Materials recovered from older buildings, such as timber, slate or tile, may be re-used only with the prior agreement of the NHBC. Independent certification of suitability may be required.

## SITWORK STANDARDS

**7.2 - S1 All sitework shall:**

**(a) meet the Technical Requirements**

**(b) take account of the design**

**(c) follow established good practice and workmanship**

Sitework that complies with the design and the guidance below will be acceptable for pitched roofs.

## WALL PLATES

**7.2 - S2 Wall plates shall be bedded to distribute roof loads and fixed to prevent wind uplift**

Roof construction details should be available on site, particularly for combination and specialist roofs.

Wall plates should be bedded to line and level using nails or straps to hold them down in accordance with the design requirements.

Wall plates should generally be in lengths of not less than 3m but shorter lengths should extend over at least 3 joists/rafters or trusses. Wall plates should be joined using half-lapped joints at corners and in running lengths. In Scotland, where 100mm x 25mm wall plates are used, they should be in long lengths and butt jointed.

Where required, holding down straps should be fixed to the wall plate at maximum 2m centres. If the strap is not turned into a bed joint, it should be fixed to the wall with at least four screw fixings.

# 7.2 Pitched roofs

## STRAPPING

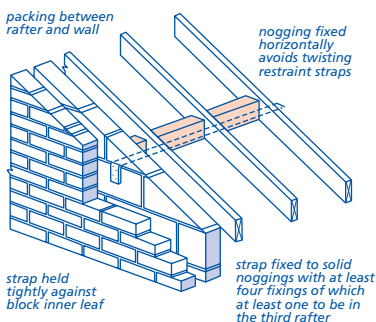
**7.2 - S3 Straps shall be used, where necessary, to restrain gable and separating walls and hold down the roof against wind uplift**

### RESTRAINT STRAPS

Restraint straps, or a restraining form of gable ladder, are required to provide stability to walls. They should be installed as shown in the design and at not more than 2m centres for buildings up to three storeys (two storeys in Scotland). Higher buildings straps should be spaced at not more than 1.25m centres.

Restraint straps should be fixed to solid noggings with a minimum of four fixings of which one should be in the third rafter. The fixings should be four steel screws or four 75mm x 4mm (8 SWG) round nails.

Rafters should not be notched to make the straps flush with the rafter. Straps should go under rafters and over ceiling joists. The turn-down should be on a substantial piece of blockwork, preferably the centre of an uncut block.

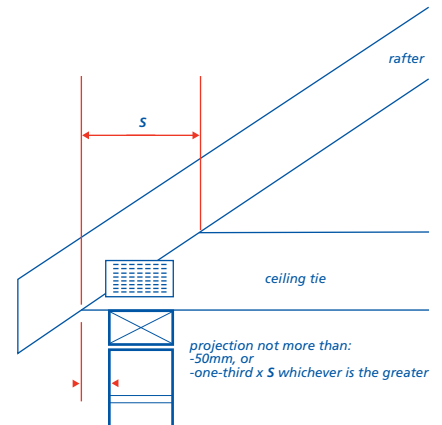
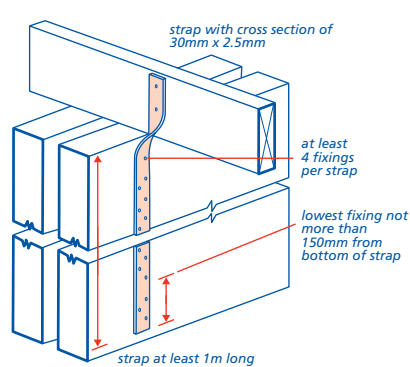


### HOLDING DOWN STRAPS

If the design specifies holding down straps to prevent the roof being lifted off the supporting structure, they should be at 2m centres (maximum).

Where straps are fixed to masonry, hardened nails 4mm in diameter x 75mm long or No 12 wood screws x 50mm long into plugs should be used.

The number of fixings should be in accordance with design requirements and the lowest fixing should be within 150mm of the bottom of the vertical strap.



## TRUSSED RAFTERS

**7.2 - S4 Trussed rafters shall be protected from damage before and during construction**

Items to be taken into account include:

### (a) storage

To avoid distortion and prevent damage, trussed rafters should be stored clear of the ground, either flat on level bearers placed under joints (for short term storage) or vertically and propped (for long term storage).

Trusses should be protected against weather to prevent corrosion of truss plates and deterioration of the timber. Ventilation should be provided.

Any damaged trussed rafters or trussed rafters with loose plates should be rejected, not repaired.

### (b) handling

To prevent distortion during construction, trussed rafters should be carried upright (if carried flat, bending can loosen the fasteners).

**7.2 - S5 Trussed rafters shall be erected in accordance with fabricators' instructions**

Detailed guidance on the use and handling of trussed rafters is given in the International Trussed Rafter Association Technical Handbook available from trussed rafter suppliers.

Detailed drawings should be available on site to show the layout of the trussed rafters, especially at hips, valleys and trimmings to chimneys, etc.

Trussed rafters should be supported only at the junction between the ceiling tie and rafter, unless specifically designed otherwise, eg as a cantilever.

Trussed rafters should be evenly spaced and vertical. Temporary bracing should be provided to control the spacing and keep trusses vertical.

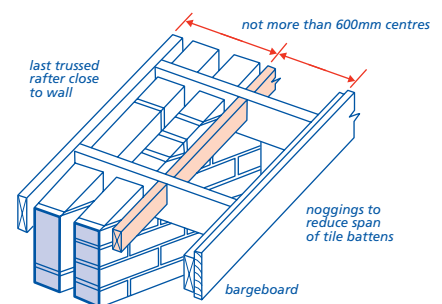
Trussed rafters should be fixed to the wall plates either:

- in accordance with the design, or
- using double skew nailing or truss clips.

Avoid damaging the metal truss plates, trussed rafters or wall plates.

The spacing or structure of trusses should not be altered without the designer's approval.

Where the width of gable ladders exceeds that of the trussed rafter centres, noggings should be provided to reduce the span of the roofing tile battens.



The gable ladder can be used to provide restraint to the external wall if:

- there is blocking between the last trussed rafter and the inner leaf (at a maximum of 2m spacing), and
- the soffit board is cut carefully and then fixed securely so as to restrain the outer leaf.

**7.2 - S6 Trussed rafters shall be braced to prevent distortion**

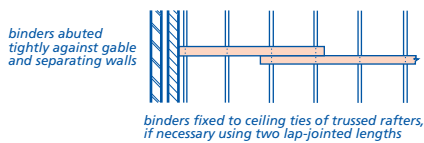
The roof should be braced using at least 100mm x 25mm timber. All bracing should be twice nailed with 3.35mm (10 gauge) x 65mm long galvanized round wire nails to every trussed rafter it crosses and to the wallplate.

The minimum bracing requirements are shown in Appendix 7.2-B. Additional bracing may be needed in exposed areas. Check the design drawings for special requirements.

All bracing should be completed before starting to lay the roof covering.

Longitudinal binders should butt solidly against the wall at each end. This is most easily achieved by fixing the binder in two lap-jointed lengths.

Braces and binders, where not continuous, should have lapped joints and be nailed to at least two trusses.



The part of an attic truss which forms a floor should have strutting in accordance with Appendix 7.2-E.

## TRADITIONAL CUT ROOFS

### 7.2 - S7 Roof timbers shall be of the grades and sizes shown on the drawings

Structural timber should be marked to show its strength class (normally C16 or C24). Alternatively, evidence of species and grade should be available to determine the equivalent strength class.

The correct size of timber should be used for each member, as shown on the design drawings.

### 7.2 - S8 Construction of traditional cut roofs shall ensure adequate structural stability

Items to be taken into account include:

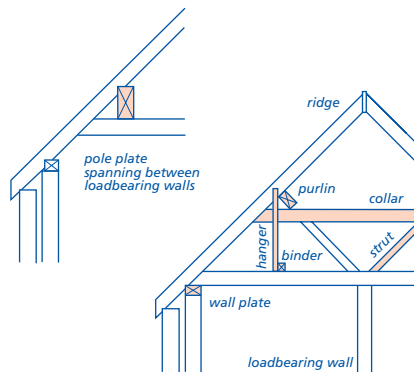
#### (a) location of members

All members should be accurately located. Purlins and binders should be built in, where necessary. In a typical traditional roof, the basic timber members are:

- **RAFTER:** carries the weight of the roof finish, eg tiles, tile battens and underfelt
- **CEILING JOIST or TIE:** triangulates the rafters, stopping the walls and roof spreading outwards; supports the ceiling finish and any walkways, etc
- **RIDGE:** provides fixing and spacing for the tops of rafters
- **PURLIN:** supports long span rafters to prevent deflection and increase stiffness
- **STRUTS:** give support to purlins to prevent deflection and transmit roof loading to loadbearing structure below.
- The following are extra members which may be used on large roofs:
- **COLLAR:** ties the roof together at purlin level

- **CEILING BINDERS and HANGERS:** support long span ceiling joists
- **POLE PLATES:** similar to purlins but used where ceiling joists are above wall plate level.

Positions of standard structural members are shown in the diagrammatic representation below:



#### (b) prevention of distortion and overloading

The design details for sizes of timber members should be followed.

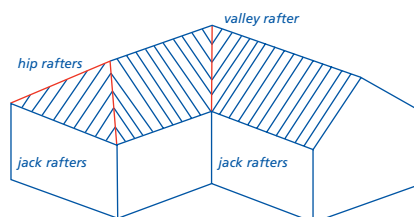
All framing should be completed before roof coverings are laid.

If a roof is not a simple triangle, all members should be fully supported and tied together. If necessary, temporary support to long span members should be used until the framing is complete.

#### (c) valley and hip construction

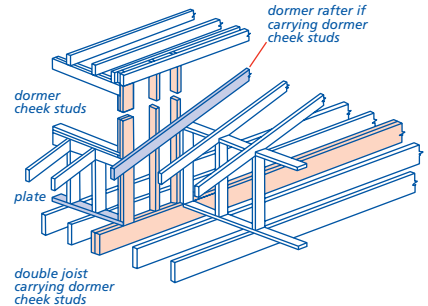
Particular care is needed in the construction of valleys and hips:

- **Valley rafters** carry load from both sections of the roof. Valley rafters will need to be larger than ordinary rafters to take the extra load and to provide full bearing for the splay cut of Jack rafters. (Long valley rafters may need intermediate support.)
- **Hip rafters** provide spacing and fixing for jack rafters. They need to be a deeper section than other rafters to take the top cut of the jack rafters. Purlins should be mitred at hips, and lip cut to accept the bottom of the hip rafter.



#### (d) dormer construction

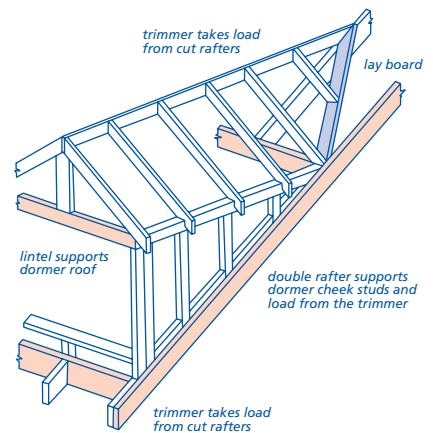
On most dormers, the dormer cheek studs should be supported either by a double rafter or by a double floor joist.



Where cheek framing does not extend to floor level, a double rafter will give necessary support to the cheek. The two rafters must be fixed together.

Trimming members around dormers should be large enough to take the extra load from the cut main roof members and dormer framing and cladding, as detailed in the design.

Dormers should be framed up so they are independent of the window frame, using a suitable lintel over the opening.

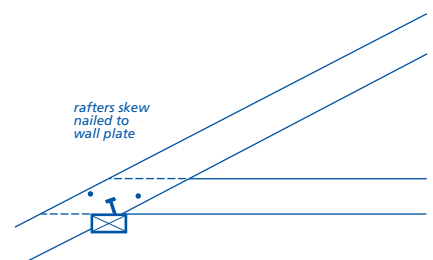


#### (e) jointing of members

All joints should be cut accurately to fit tightly. When they are nailed, care should be taken not to split members.

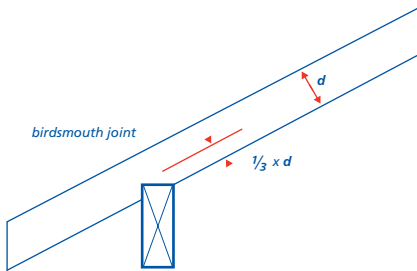
The following should be used at main connections:

- **RAFTERS** to ceiling joists: nailed lapped joint. The rafter should be birdsmouthed over and skew nailed to the wall plate

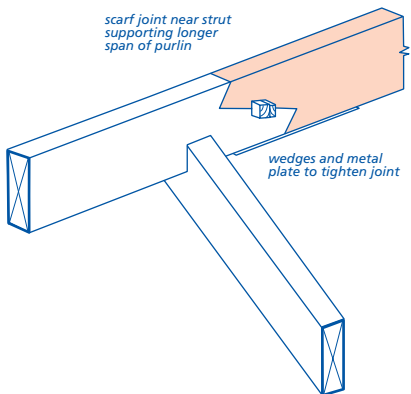
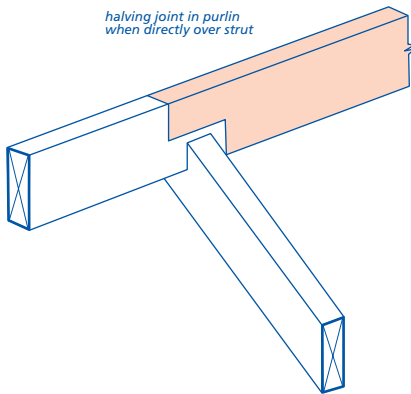


# 7.2 Pitched roofs

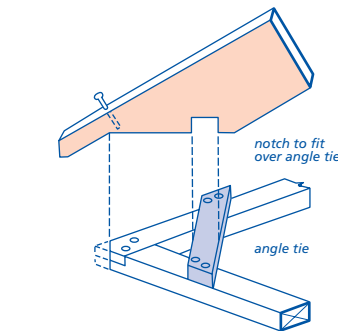
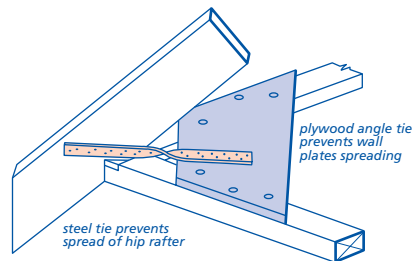
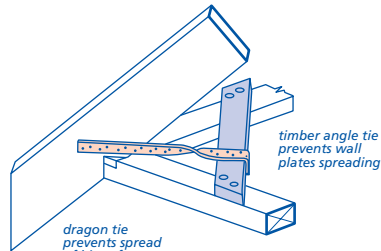
- **RAFTERS to purlin:** a birdsmouth joint should be used if the purlin is fixed vertically



- **PURLIN connections:** support should be provided directly under joint or use a scarf joint. Any scarf joint should be made near a strut so that the joint supports the longer span.



Angle ties should be used on hipped roof corners to prevent the wall plates spreading. For heavily loaded hip rafters, eg where they are carrying purlins, dragon ties or similar bracing should be used to prevent hip rafter spread.



- (f) **strutting to cut roofs**  
Any part of a cut roof which forms a floor should have strutting in accordance with Appendix 7.2-E.

## WATER TANK SUPPORTS

**7.2 - S9 Loads from water cisterns shall be transferred to:**

- (a) **the node points of trussed rafters**  
In trussed rafter roofs, tank stands should be supported at the node points of the trussed rafters and the load spread over at least three trusses.

Correct supports are illustrated in Appendix 7.2-C.

- (b) **suitable bearers in traditional cut roofs**  
In traditional cut roofs, tank stands should be supported as shown in the design.

## FASCIAS, BARGE BOARDS AND SOFFITS

**7.2 - S10 Fascias, bargeboards and soffits shall be selected, fixed and treated against decay in accordance with the design**

Items to be taken into account include:

### (a) timber quality

Timber for external feature work should be free from wany edges, large knots and resinous pockets, splits and other unsightly defects.

### (b) fixing

All joints should be cut and fixed neatly. Mitred angles and splay joints should be used to prevent exposure of end-grain. Butt joints to fascias should be splayed. Fascia boards should have two fixings into each rafter and be fixed at a height that maintains the correct pitch in accordance with the tile manufacturer's recommendations.

### (c) treatment against decay

Where preservative treated timber is cut or planed, a liberal brush coating of preservative should be applied.

All untreated timber that is to be painted should be knotted and primed all round before fixing. When timber requires a stained finish, one coat of stain should be applied before fixing.

## ROOFING MATERIALS

**7.2 - S11 Roofing materials shall be installed in accordance with the design**

Items to be taken into account include:

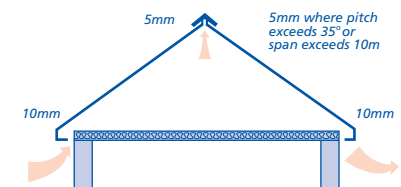
### (a) ventilation

All roof voids should be ventilated to prevent condensation problems.

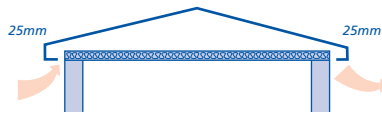
Ventilation openings where the least dimension exceeds 10mm should be protected with mesh to prevent entry of birds, etc.

Where proprietary eaves ventilators are used, they should be fixed in accordance with the manufacturer's instructions.

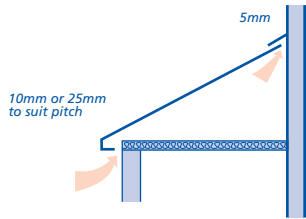
For roofs that incorporate a high water vapour resistance (type HR) underlay ventilation should be provided on opposite sides of the roof space, equivalent to a continuous gap of the width shown in the following drawings:



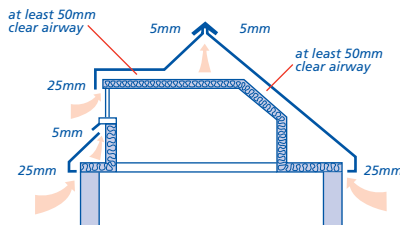
ROOF PITCH OVER 15°



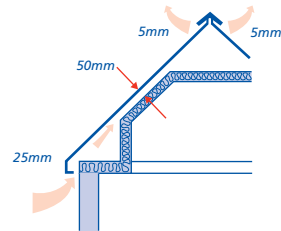
ROOF PITCH BELOW 15°



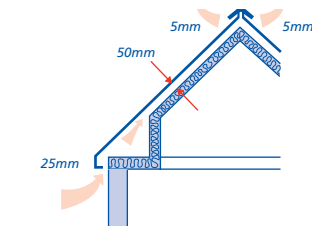
MONO-PITCHED ROOF



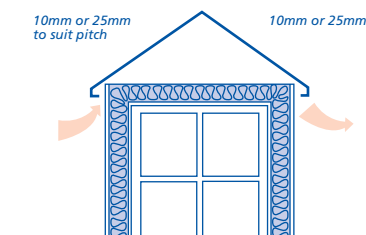
ROOM-IN-ROOF (flat roof dormer)



ROOM-IN-ROOF (partially sloping ceiling)

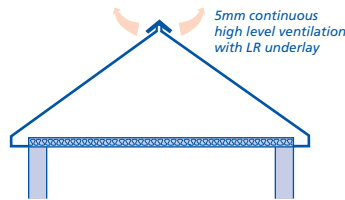


ROOM-IN-ROOF (completely sloping ceiling)



PITCHED ROOF DORMER

For unventilated cold roofs that incorporate a low water vapour resistance (type LR) underlay, (eg a vapour permeable underlay) and insulation over a horizontal ceiling ridge or high level ventilation equivalent to a continuous opening of 5mm should be provided in accordance with the design.



### (b) underlays

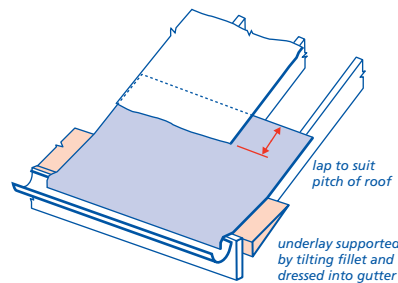
Horizontal laps should be as follows:

Pitch	Minimum horizontal lap (underlay not fully supported)
Less than 15°	225mm
15° to 34°	150mm
35° and above	100mm

Vertical laps in the underlay should occur only over rafters and be securely fixed. Horizontal laps should be securely fixed by regular roofing battens.

Underlay should be supported at eaves level by a tilting fillet or proprietary eaves support tray. Where the underlay is exposed at eaves level it should be UV resistant or type 5U felt. Alternatively, proprietary eaves guards can be used. A type 1F felt may be used for the remainder of the roof.

Underlay or eaves guards should be dressed into the gutter.



Where traditional mortar pointing is used to bed ridge tiles, the underlay should extend over the ridge. Underlay should continue over hips to form a 150mm minimum lap parallel with the hip rafter.

At valleys, a strip of underlay should be laid under the main roof underlay and held down by the valley battens, where used.

The main roof underlay should be cut to the valley batten line.

The underlay should be supported and turned up at least 100mm at all abutments to prevent rain and snow being blown into the roof space.

Particular care is needed where pipes project through the underlay. Torn underlay around pipes can lead to the ceiling becoming wet and stained. To avoid water penetration the underlay should be cut neatly to fit tightly around service penetrations.

### (c) battens and counter battens

Battens should be set out in straight lines, parallel to the ridge and to the gauge required by the tile or slate. The lap should not be decreased because this would reduce weathertightness. The lowest batten should be fixed so that the tile projects not less than 50mm over the gutter.

Battens should be:

- at least 1.2m long
- supported by at least three rafters
- butt jointed on a rafter, and
- nailed to every rafter.

Batten ends should be cut square and nails skew driven on each side of the joint. Where battens are spaced at more than 200mm, not more than one batten in any group of four should be joined over any one truss or rafter. Not more than three joints should be made together in twelve consecutive battens when the gauge is 200mm or less.

Battens on rigid sarking boards should be supported on counter battens to allow free drainage of any water that may reach the underlay. Counter battens should be fixed through to the rafters and not to the sarking boards alone. Battens should be fixed through counter battens to rafters.

Battens should be fixed with cut or wire nails. The nail shank can be smooth, annular ringed or helically threaded. Nails can be steel or aluminium. In coastal areas, steel nails should be hot dip galvanized.

### (d) slates and tiles

Slates should be fully nailed over the whole roof.

The design should specify the number of fixings for clay and concrete tiles. Tables 2 and 3 of Appendix 7.2-A contain minimum fixings for tiles. Additional nails and clips may be necessary in accordance with the design. A fixing schedule produced by the tile manufacturer, based on BS 5534 or The Zonal Method, is acceptable.

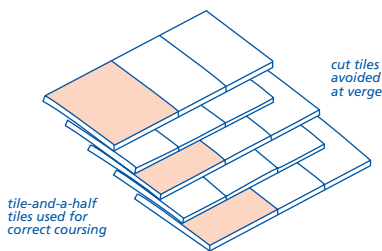
Careful setting out will improve the finished appearance of the roof and helps to avoid problems such as unequal overhangs at verges and often makes it possible to avoid excessive tile cutting at

# 7.2 Pitched roofs

abutments, chimneys and similar obstructions. Small sections of cut tiles are difficult to fix and should be avoided. This can be achieved by incorporating tile sizes such as double size tiles, tile and a half or half tiles where these are available.

Single lap Interlocking tiles have a tolerance of approximately 3mm in the joint. For double lapped plain tiles and slates, joints should be slightly open. This allows some flexibility in setting out and should avoid tile cutting.

Bottom edges of double lapped slate and plain tile roofs should be finished with an under-eaves course.



Where verge clips are specified by the manufacturer, these should be twice nailed to the tile batten and be in full contact with the upper tile surface to prevent tile lift.

Tiles to be bedded on mortar should be wetted first on their contact surface. Surface water should be allowed to drain before fixing. Substantial thicknesses of mortar bedding may be needed, eg beneath rolled tiles. To prevent shrinkage of large mortar joints, concealed or decorative dentil tiles should be fully bedded into all joints in excess of 25mm thick.

Proprietary dry fixed systems should be assessed in accordance with Technical Requirement R3.

## (e) roof mortar

Roofing mortar should be 1:3 cement:sand with plasticiser. The mix should be based on sharp sand with soft sand added to achieve workability. The proportion of sharp sand should not be less than 1/3 of the total sand content.

Alternatively, proprietary mortar mixes may be accepted by NHBC if they are shown to have similar strength, durability and workability.

Mortar bedding and jointing should be completed in one operation.

## (f) other roof coverings

When using the following materials, the detailing and workmanship should follow the design and recognised good building practice:

- sheet metal roofing including lead, copper and zinc
- thatch
- cedar shingles.

Thatching should be as recommended by the Thatch Advisory Service or other appropriate authority in accordance with Technical Requirement R3.

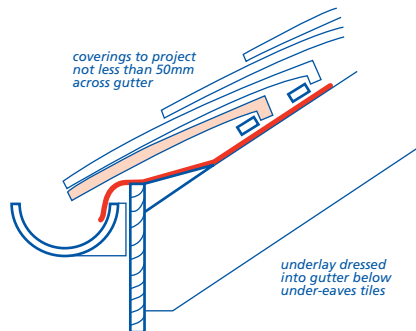
## FLASHINGS AND WEATHERINGS

### 7.2 - S12 Flashings and weatherings shall be constructed to prevent damp entering the dwelling

Items to be taken into account include:

#### (a) eaves

Tiles, slates and hip tiles should overhang to the centre of the gutter. For slates or plain tiles, an under-eaves course should be used. Fascia boards should be fixed at a height that maintains the correct pitch in accordance with the tile manufacturer's recommendations.



To prevent the underlay sagging at the eaves and forming a water trap behind the fascia, the underlay should be supported by a continuous fillet or proprietary eaves support tray.

#### (b) verges

All verge tiles and slates should be bedded on an undercloak. Alternatively, proprietary dry verge systems should be fixed in accordance with manufacturers' recommendations.

The undercloak should be installed to a true line and bedded on roofing mortar struck off flush with the external surface of the wall. Alternatively, a suitable exterior grade bedding sealant could be used in accordance with manufacturer's recommendations. Where a bargeboard is used, the undercloak should be securely nailed to a true line.

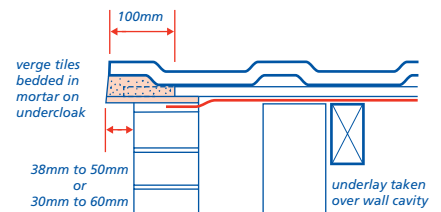
The undercloak should be installed at the correct level to ensure that the line of the tiling is maintained where it passes over the wall.

Where slates or plain tiles are used the verge should project 38mm to 50mm beyond the gable wall or bargeboard. Interlocking tiles can project 30mm to 60mm.

Tile battens should finish 25mm to 50mm from the face of the protecting undercloak. Cut ends of tile battens that are in contact with mortar should be treated with a liberal brush coating of preservative.

#### At verges:

- cut plain tiles are not acceptable and purpose made plain tile and a half or half tile should be used
- cut single lapped interlocking tiles should not be used
- natural slate verges should be formed with full slates and either slate and a half or half slates that are a minimum 150mm wide.

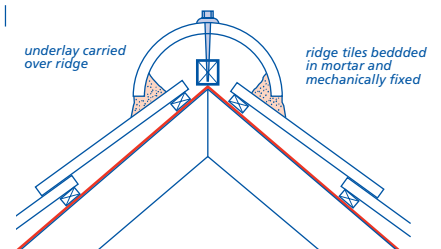


The undercloak should lap the roof underlay but not tilt inwards. Wet bedded verge tiles or slates should be fully bedded on roofing mortar having a minimum width of 100mm. Verge slates or tiles should be bedded on the undercloak and completed in one operation.

Where required by the design interlocking single lap tiles should be secured with clips and twice nailed in position at the tile lap, as well as bedded in mortar. Verge clips should be in full contact with the tile to resist uplift.

#### (c) ridges and hips

Where ridge and hip tiles are bedded on mortar they should be mechanically fixed with self sealing non-ferrous fixings into timber battens. Where proprietary systems are used they should be fixed in accordance with manufacturer's recommendations.



Mortar bedding and pointing should be completed in one operation and achieve a nominal joint thickness of 10mm. To prevent shrinkage of large mortar joints, concealed or decorative dentil tiles should be fully bedded into all joints in excess of 25mm thick. See Design clause D8(k).

Where wet bedded tiles are used at hips, they should be supported at the base of the hip by a galvanized hip iron and project to the centre line of the gutter.

#### (d) valleys and hidden gutters

Construction should be adequate in relation to:

- depth
- width
- undercloaking
- pointing
- adequate support
- pitch.

Valleys should be formed with one of the following:

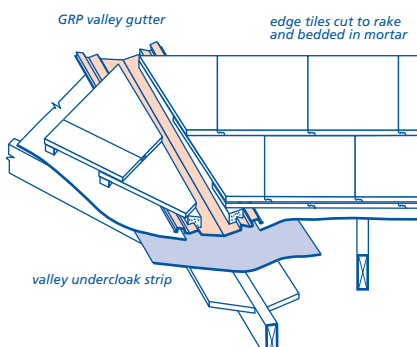
- pre-formed GRP
- valley coursing tiles (plain tiles)
- valley trough tiles (interlocking tiles)
- non-ferrous metal
- a proprietary system.

Where roof coverings are of plain tiles or slates, laced and swept valleys may be used or, alternatively, a mitred valley with soakers. The true pitch of the valley should not be less than the minimum allowed pitch and GRP or other materials should be lapped in accordance with manufacturer's recommendations. Minimum Code 4 lead or other suitable saddle flashing is required at the head of all valleys.

#### PROPRIETARY SYSTEMS

Proprietary gutter or valley systems should be securely fixed on to suitable supports and in accordance with the manufacturer's recommendations. Where ply is used for support it should be exterior grade.

Non-ferrous metal saddle flashings or other approved proprietary flashings should be used at intersections and abutments. Lead flashings should be at least Code 4 (colour coded blue).



#### VALLEY USING VALLEY TILES

In roofs with plain tiles, purpose-made valley coursing tiles should be used. Adjacent roof tiles should be cut neatly to form a smooth junction, preferably cutting from tile-and-a-half tiles.

A laced valley, swept valley or mitred tiles with soakers may also be used. All valley tiles should be fixed in accordance with

the manufacturer's recommendations and small cut tiles should be avoided.

For single lap interlocking tiles, purpose-made valley trough tiles should be supported by gutter boards. Roof tiles should be cut to the correct rake. Mechanical cutting gives a neater appearance than hand cutting. The tiles should be bedded in mortar, leaving a minimum 100mm wide channel (125mm minimum for pitches below 30°).

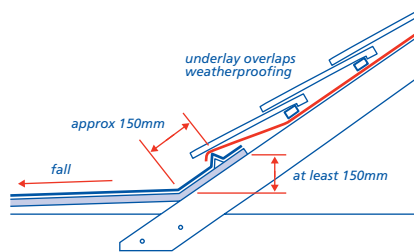
#### LEAD-LINED VALLEY

Lead-lined valleys should be Code 4 (colour coded blue) or Code 5 (colour coded red) and supported on gutter boards of 19mm thick exterior grade ply or as specified. Lead in valleys should be laid in lengths not exceeding 1.5m and be lapped 150mm at each length. Tiles should be cut and bedded as for valley trough tiles except that the mortar should be bedded on an undercloak (for example slate) to prevent direct contact between the lead and the mortar. Mortar should not bridge the welt detail.

#### (e) flat roof intersection

Where a flat roof adjoins a pitched roof, or where valleys or gutters occur, the waterproof membrane should be carried up under the tiling to a height of 150mm above the flat roof, valley or gutter and lapped by the roofing underlay.

The lowest course of tiles/slates should not touch the roof membrane.



#### Note

Where the flat roof is over a dormer, it is recommended that the flat roof should be designed and constructed with a fall to the front or sides.

Flat roofs should comply with Chapter 7.1 'Flat roofs and balconies' (Sitework).

#### (f) abutments

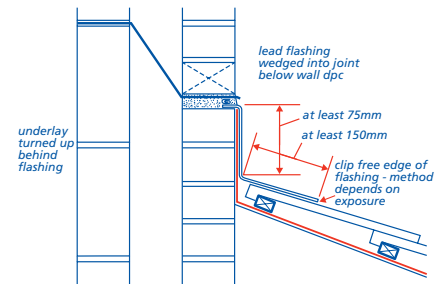
All abutments should be weatherproofed using non-ferrous metal flashings. Lead flashings should be at least Code 4 (colour coded blue), while soakers are normally Code 3 (colour coded green). Normally, lead flashings should not exceed 1.5m in length, with laps of not less than 100mm.

Flashing should be tucked into a mortar joint or chase 25mm deep and at least 75mm above the tiling level and lead wedged in place. The joint should be

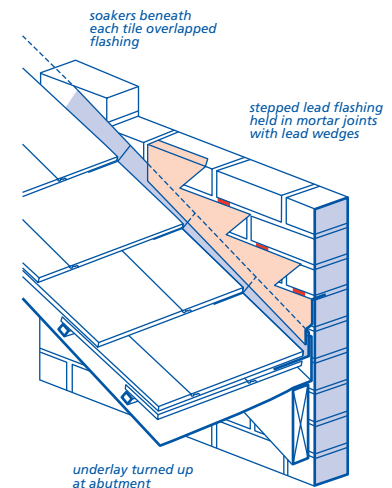
pointed in cement mortar or using suitable exterior grade sealant in accordance with the manufacturer's recommendations.

Cavity trays should be linked to the flashing to prevent water penetrating into an enclosed area where a:

- flat or pitched roof over an enclosed area abuts a wall
- balcony abuts a wall.

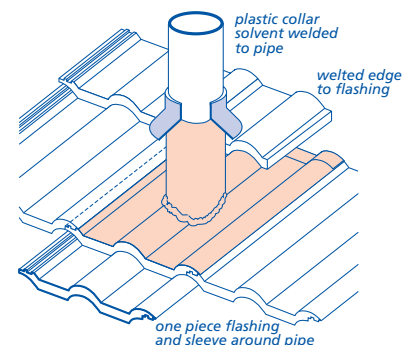


Where a pitched roof abuts the wall at an angle, a stepped cavity tray linked to a stepped flashing should be used. Stepped flashings should be cut from a strip at least 150mm wide. Soakers or a secret gutter should be installed at abutments where slates, flat interlocking tiles or plain tiles are used.



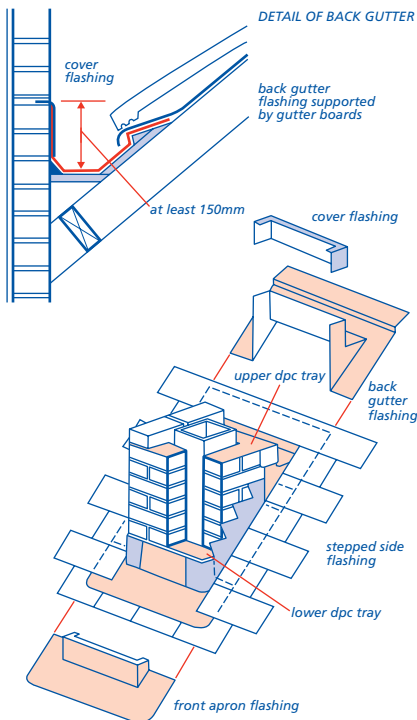
#### (g) projections through the roof

A purpose-made one-piece flashing and upstand should be used around pipes projecting through the tiling.



# 7.2 Pitched roofs

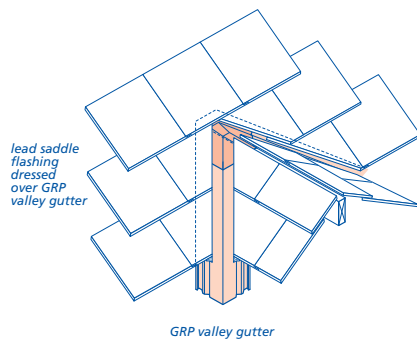
Chimney flashings should link with the chimney dpc trays. An example is shown below.



### (h) changes in roof slope

Flashings or soakers should be used where there is a change in roof slope of 5° or more, eg at mansards and sprockets.

A saddle flashing should be used where a ridge meets the main roof.



## FIRESTOPPING

**7.2 - S13 Pitched roofs shall be constructed to offer adequate resistance to the spread of fire**

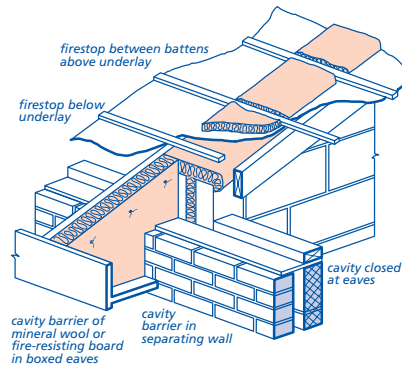
Firestopping and cavity barriers should be provided:

- at junctions between cavities
- above separating walls
- within boxed eaves of separating walls.

The separating wall should stop about 25mm below the top of adjacent roof trusses.

A soft fire-resistant packing, such as mineral wool, should be used to allow for movement in roof timbers and prevent 'hogging' of the tiles.

A cavity barrier should be provided within boxed eaves. The cavity barrier should be wire reinforced mineral wool blanket, at least 50mm thick, nailed to the rafter and carefully cut to shape to fully seal the boxed eaves.

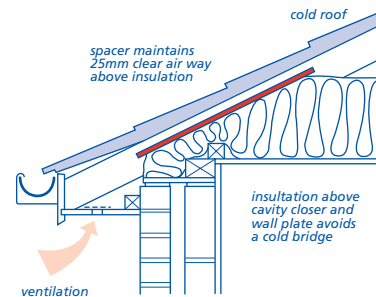


## THERMAL INSULATION

**7.2 - S14 Thermal insulation and ventilation of roofs shall prevent the adverse effects of condensation**

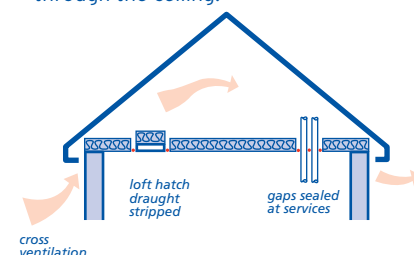
To avoid condensation forming in the roof space ensure that:

- ventilation of the roof is provided in accordance with the design
- insulation does not block any ventilation paths
- insulation is laid over the whole loft area, including the wall plate
- there are no gaps in the insulation.



The amount of moist air entering the loft space from the dwelling should be controlled by:

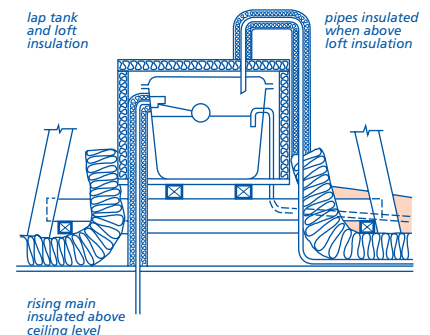
- draughtstripping the loft hatch or using a proprietary loft hatch
- ensuring that the hatch is heavy enough (or suitably fixed) to compress the draught seal
- the use of appropriate down lighters that limit air leakage
- sealing gaps where services pass through the ceiling.



The guidance above will assist in reducing the risk of condensation occurring but is not acceptable as an alternative to cross ventilation of the roof space.

To reduce the risk of freezing and condensation on pipework, the following precautions should be taken:

- place roof insulation above and around water tanks but not below them
- locate water pipes below the main roof insulation whenever possible
- insulate all water services above the main roof insulation, including cisterns and vent pipes.



It is recommended that the cold rising main be insulated above ceiling level even if it is below the main roof insulation (condensation that forms on uninsulated cold water pipes located below the main roof insulation can result in damage to ceilings and decorations).

## ROOF DRAINAGE

**7.2 - S15 Roof drainage shall adequately carry rainwater to an outfall**

Items to be taken into account include:

### (a) fixing and jointing gutters and downpipes

Rainwater gutters and downpipes should be fixed in the positions indicated by the design using the correct type of fittings for internal and external angles, outlets, etc to ensure efficient drainage of the roof. Gutters and downpipes should be supported and jointed in accordance with the manufacturer's recommendations.

Rainwater pipes passing through dwellings should be insulated in accordance with Sitework clause 8.1 - S8(c).

### (b) falls

Gutters should be laid with sufficient fall towards the outlet, unless designed to be flat, and be provided with stop ends.

### (c) satisfactory outfall

If a downpipe discharges above ground level or above a drainage gully, a shoe should be fixed to the end of the pipe to prevent walls becoming saturated.

## Appendix 7.2-A

**Roof tile fixings**
**Table 1 - Recommended limits of pitch, gauge and lap for roof tiles**

Type of tile	Gauge	Minimum head-lap (mm)	Minimum permissible pitch (°)
Plain (double-lap)	not more than 1/3 length-lap	65 normally for clay tiles 75 in severe exposure conditions	35 <sup>1</sup> (clay) 35 (plain concrete)
Concrete (single-lap interlocking)	determined by design to comply with manufacturers' recommendations	75 or to manufacturer's specific recommendations	30 (Note: For pitches below 30, evidence shall be provided as to suitable performance)
Slates (double-lap)	not more than 1/3 length-lap	54 <sup>2</sup> minimum, increase with lower pitch and severe exposure conditions	20 subject to head lap

**Notes**

- 1 Clay tiles that do not meet the dimensional and geometric requirements given in BS EN 1304 should be laid at pitches not less than 40°.
- 2 For pitches greater than 45° in sheltered and moderate exposure zones only. See BS 5534 table 5 for other pitches and exposures.

**Table 2 - Minimum fixings for single lap interlocking clay and concrete tiles**

Location	Fixings
Verges, abutments and each side of valleys and hips	The end tile in each course should be fixed (nail and/or clip)
Eaves and top edges	Each tile in the first course at the eaves and last course at the ridge/top edge should be fixed (nail and/or clip)
General roof area	For rafter pitches below 45° - tiles should be fixed in accordance with manufacturer's recommendations. For rafter pitches between 45° and 55° - all tiles should be nailed or nailed and clipped. For rafters pitches of 55° and above - all tiles should be nailed and the tail of each tile should be mechanically fixed.

**Notes**

- 1 Additional nails or clips may be required depending on pitch and degree of exposure. Follow the manufacturer's recommendations. A fixing schedule produced by the tile manufacturer, based on The Zonal Method, is acceptable. Evidence of calculations in compliance with Technical Requirements R3 and R5 may be required.
- 2 Nails should be in accordance with BS 5534 and be not less than 3.35mm diameter and should penetrate at least 15mm into battens.

**Table 3 - Minimum fixings for double lap clay and concrete plain tiles**

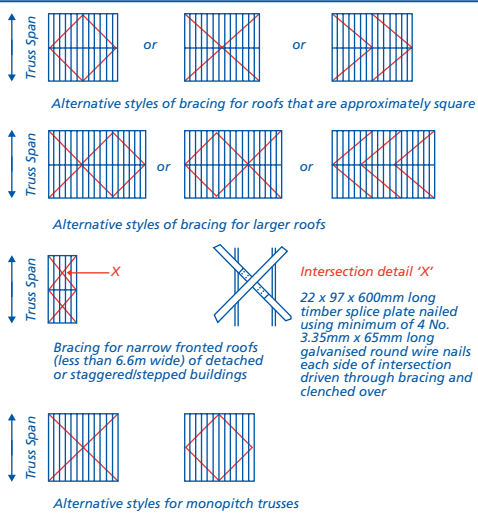
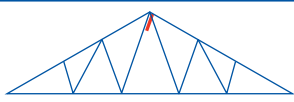
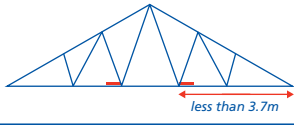
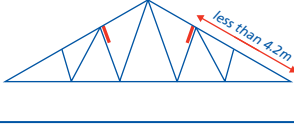
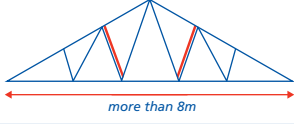
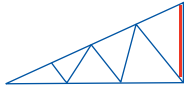
Location	Fixings
Verges, abutments and each side of valleys and hips	The end tile in each course should be twice nailed
Eaves and top edges	Each tile in the first two courses at the eaves and last two courses at the ridge should be twice nailed or otherwise mechanically fixed.
General roof area	<b>Nibbed tiles</b> For rafter pitches below 60° - each tile in every fifth course should be twice nailed. For rafter pitches 60° and above - all tiles should be twice nailed. <b>Nibless tiles</b> All tiles should be twice nailed.

**Notes**

- 1 Additional nails or clips may be required depending on pitch and degree of exposure. Follow the manufacturer's recommendations. A fixing schedule produced by the tile manufacturer, based on The Zonal Method, is acceptable. Evidence of calculations in compliance with Technical Requirements R3 and R5 may be required.
- 2 Nails should be in accordance with BS 5534 and be not less than 2.65mm diameter and should penetrate at least 15mm into battens.

## Appendix 7.2-B

### BRACING REQUIREMENT FOR TRUSSED RAFTER ROOFS

Type of bracing	Position of bracing	Where applicable
A Diagonal rafter bracing (at approx. 45° on plan)	 <p>Alternative styles of bracing for roofs that are approximately square</p> <p>Alternative styles of bracing for larger roofs</p> <p>Bracing for narrow fronted roofs (less than 6.6m wide) of detached or staggered/stepped buildings</p> <p>Intersection detail 'X' 22 x 97 x 600mm long timber splice plate nailed using minimum of 4 No. 3.35mm x 65mm long galvanised round wire nails each side of intersection driven through bracing and clenched over</p> <p>Alternative styles for monopitch trusses</p>	All trussed rafter roofs unless rigid sarking such as <u>OSB</u> , timber boarding or plywood is used.
B Longitudinal bracing member at ridge node point		All trussed rafter roofs unless rigid sarking such as <u>OSB</u> , timber boarding or plywood is used
C Longitudinal binders at ceiling node points	 <p>less than 3.7m</p>	All ceiling node points, but may be omitted where spacing between braced nodes does not exceed 3.7m
D Longitudinal bracing member at rafter node point	 <p>less than 4.2m</p>	All rafter node points, but may be omitted where spacing between braced nodes does not exceed 4.2m or unless rigid sarking such as <u>OSB</u> , timber boarding or plywood is used
E Chevron bracing between webs	 <p>more than 8m</p>	Where the span exceeds 8m. For monopitch roofs of any span and duopitch roofs over 11m span, bracing should be designed by an Engineer in accordance with Technical Requirement R5.
F Diagonal bracing to end vertical of monopitch trusses		Where not restrained by masonry wall, or cladding in plywood or similar rigid sheet material

## CONDITIONS AND LIMITATIONS ON THE USE OF STANDARD TRUSSED RAFTER BRACING

1 The use of standard bracing does not apply to buildings erected on long stretches of open, level or near level country with no shelter. Examples include flat coastal fringes, fens, airfields and moorland.

The height and location of the building, roof pitch and span are also important. Appendix A of BS : 5268 : Part 3 (AMD.5931) gives full details but as a general guide standard bracing is acceptable for the following situations:

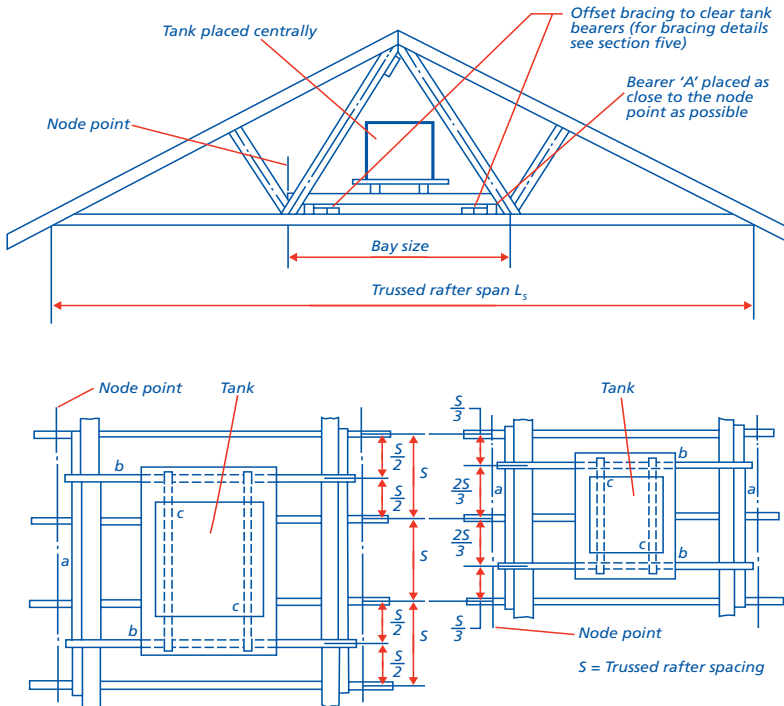
Roof type	Max pitch (°)	No of storeys	Maximum span (m)		
			England & Wales	Scotland	N Ireland & the Isle of Man
Duo-pitch	35	1	10.6	9.8 (8.6)	9.8 (8.6)
		2	9.1	7.7 (7.2)	7.7 (7.2)
		3	8.5	7.2 (6.0)	7.2 (6.0)
	30	1	12.0	11.6 (10.6)	11.6 (10.6)
		2	11.5	10.0 (8.7)	10.0 (8.7)
		3	10.2	8.8 (7.5)	8.8 (7.5)
Mono-pitch	35	1	5.6	4.9 (4.3)	4.9 (4.3)
		2	4.5	4.2 (3.6)	4.2 (3.6)
		3	4.3	3.6 (3.0)	3.6 (3.0)
	30	1	6.6	5.8 (5.1)	5.8 (5.1)
		2	5.8	5.0 (4.4)	5.0 (4.4)
		3	5.1	4.4 (3.7)	4.4 (3.7)
	25	1	8.1	7.3 (6.5)	7.3 (6.5)
		2	7.2	6.4 (5.6)	6.4 (5.6)
		3	6.4	5.6 (4.5)	5.6 (4.5)

- 2 Figures in brackets apply to areas of Scotland either north or west of Ullapool and to areas of Northern Ireland north east of Londonderry. The maximum span of the trussed rafters is 12m, the maximum height of the building is 8.4m to the underside of ceiling tie and the maximum rafter spacing is 600mm.
- 3 The maximum length of unsupported masonry between buttressing walls, piers or chimneys is 9m.
- 4 The bracing is for either duo-pitched or mono-pitched roofs.
- 5 The minimum size for bracing members is nominal 25mm x 100mm (3mm tolerance).
- 6 All bracing members to be nailed with 2 No 3.35mm diameter x 65mm long galvanized round nails to every trussed rafter they cross.
- 7 The trusses are supported only at their ends.
- 8 The roof (including hip ends) is rectangular in shape.
- 9 Longitudinal bracing members may be lap-jointed provided the overlap is nailed to at least two trussed rafters. They should extend the full length of the roof and tightly abut gable and party walls. Longitudinal bracing members should permit diagonal bracing to pass.
- 10 At least four diagonal rafter braces are required in every roof. In narrow fronted roofs and mono-pitched roofs, where braces cross, use the intersection detail 'x' above.
- 11 Diagonal rafter bracing should be at approximately 45° to the rafters on plan. Chevron bracing should be at approximately 45° to the web members. Diagonal bracing and chevron bracing should be across all trussed rafters, but small gaps (2 trussed rafters between sets of bracing and 1 trussed rafter adjacent to gable or separating walls) are permitted in the middle of an otherwise fully braced roof.
- 12 Rafter diagonal bracing and longitudinal bracing at rafter level may be omitted where rigid sarking boards are used. Rigid sarking boards (eg chipboard, plywood, osb) should be fixed with 3.0mm diameter x 50mm long galvanised round wire nails at 200mm centres to every trussed rafter.
- 13 All trusses should have a ceiling of plasterboard or other suitable material. (For trussed rafters at 600mm centres, 12.5mm plasterboard is required.) Where there is no plasterboard, such as in garages, longitudinal binder bracing (Type C above) is to be used at all ceiling node points and additional diagonal ceiling bracing is required.
- 14 Bracing to satisfy particular conditions shall be in addition to that detailed in the above table.
- 15 The ITPA Technical Handbook gives further details and advice on construction.

# 7.2 Pitched roofs

## Appendix 7.2-C

### Tank support details



#### Sizes for support members

Total tank capacity to marked waterline	Min. member sizes		Max. trussed rafter span for Fink configuration	Max. bay size for other configurations
	a and c	b		
	mm		m	m
Detail A Not more than 300 L supported on four 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 L supported on three trussed rafters	47 x 72	1/47 x 97	6.50	2.20
	47 x 72	2/35 x 97 or 1/47 x 120	9.00	2.80
	47 x 72	2/35 x 120 or 1/47 x 145	12.00	3.80

NOTE: Support members may be of any species with a permissible bending stress not less than that of European redwood/whitewood of GS stress grade (see 14.1).

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7.2

### Appendix 7.2-D

#### Sizes and spacing of tile battens

The sizes and spacing of tile battens should be specified from the table below.

Batten lengths should be sufficient to span over not less than three consecutive supports.

The actual batten thickness (smaller dimension) should not be less than that given in the table nor more than 3mm oversize. Actual batten width should be within  $\pm 3$ mm of the basic size.

BS 5534 requires the batten to be marked with the following information - supplier, species, origin, 'graded BS 5534', and size.

	450mm span mm	600mm span mm
<b>Slates</b> (double lap)		
Natural: sized or random	25 x 50	25 x 50
Fibre cement or concrete	25 x 38	25 x 50
<b>Clay and concrete tiles</b>		
Double lap	25 x 38	25 x 38
Single lap	25 x 38	25 x 50

### Appendix 7.2-E

#### Strutting for attic trusses and cut roofs that have a floor

If the distance D exceeds 2.5m between

- the node points which form the width of the floor of the attic truss or
- the supports to a floor within a cut roof,

then additional strutting should be provided as follows;

Distance D	Rows of strutting
Under 2.5	none needed
2.5 to 4.5	1 (at centre of span)
Over 4.5	2 (at equal spacing)

Either herringbone strutting (38mm x 38mm timber) or solid strutting not less than three-quarters the depth of the floor and at least 38mm thick should be used.

### Appendix 7.2-F

#### Durability classification of natural slates

Natural slates should have the characteristics given in the tables below.

Characteristics	Code/grade from BS EN 12326
Water Absorption (not more than 0.6%)	A1
Thermal Cycle	T1
Carbonate Content (not more than 20%)	S1

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