The Chilterns
CONSERVATION BOARD

Chilterns

Buildings Design Guide

Chilterns Roofing Materials

Supplementary Technical Note

The Chilterns

an Area of Outstanding Natural Beauty

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

Acknowledgements

This Technical Note has been published by the Chilterns Conservation Board which would like to express its thanks to Dr. James Moir who has researched and written this Note.

Thanks must also go to members of the Advisory Group who have given extensive help and advice voluntarily.

Thanks also to Colin White, Chilterns Conservation Board Planning Officer for his help in organising the Group and input into revisions to the text.

Particular thanks are also due to the following:

Tim Amsden *(SMT Conservation)*
Martin Andrew *(Wycombe District Council)*
George Crutcher *(Formerly of South Bedfordshire District Council)*
Nick Doggett *(CGMS Consulting)*
Roger Evans *(Former Buckinghamshire Historic Buildings Officer)*
Jimmy Goodchild *(Goodchild Roofing)*
Simon Jones *(Simon Jones, Architect)*
Glyn Kuhn *(Polar Design)*
Jim Matthews *(HG Matthews)*
Catherine Murray *(Chiltern District Council)*
Ian Pritchett *(IJP Building Conservation Ltd.)*
Derek Rogers *(Architect)*

All photographs are by Dr. James Moir unless otherwise acknowledged. All drawings are by Simon Jones and Glyn Kuhn.

The Chilterns Conservation Board wishes to acknowledge the generous grant aid made available by the following organisations towards the cost of producing this Note:

The Countryside Agency (now Natural England)
South East England Development Agency,
Chiltern District Council,
South Oxfordshire District Council,
Dacorum Borough Council,
South Bedfordshire District Council,
Wycombe District Council,
Bovingdon Brickworks Ltd,
Dunton Brothers and
H G Matthews.

Cottages (Penn)

Chilterns Buildings Design Guide - Chilterns Roofing Materials, Supplementary Technical Note

ISBN 0-9545242-4-1

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

Foreword

The Chilterns Conservation Board recognises the importance of good design in the built heritage of the Chilterns Area of Outstanding Natural Beauty (AONB). We published the Chilterns Buildings Design Guide in 1999 and have supplemented it with Technical Notes on Brick and Flint.

The intention of these publications is to make property owners, builders and architects aware of the need to protect the distinctive character of our buildings and settlements.

The Board wishes to encourage the use of appropriate materials for roofs and has, therefore, prepared this Technical Note.

The previous notes have encouraged the use of sustainable local resources. This one follows the same pattern in promoting the use of tiles, as well as other appropriate materials, in new developments in the Chilterns. The methods of tile use have changed little over the centuries. They came in a variety of shapes sizes and colours and have been used on every type of building. Tiles are, once again, being made in the Chilterns in the traditional manner for the first time for 50 years.

We only need to see a line of traditional buildings in a Chilterns town or village to recognise the harmony of brick and flint walls crowned with tiles of local manufacture.

Sir John Johnson

Chairman, Chilterns Conservation Board

March 2007

School Complex (Ibstone)

Contents

Chapter 1

Introduction

1.1 Roofing materials have a major influence upon the built environment of the Chilterns and the character of its individual buildings. The first impression approaching a village or town is often the view of its roofs seen from a distance. The hilly terrain allows views over buildings and creates roofscapes which would not otherwise be seen. Roofs should, therefore, be designed to the highest standards and clad in attractive materials which make a positive contribution to the character of the area.

1.2 Many roof types and styles can be found in the Chilterns, and thatch, slate, corrugated iron, lead and wooden shingles cover a proportion of the region's older buildings. However, plain clay tiles are universally predominant and their textural richness and distinctive dark orange or red colour leave a lasting visual impression. Such tiles have an unbroken history since the early medieval period and this long usage has invested the region's buildings with a particularly strong and consistent character and identity. That identity has nevertheless been eroded by the appearance of new roofing materials and forms; some have a place but others are used in inappropriate contexts.

Clay roofs characterise this village (Little Missenden) (Image © GeoPerspectives.com)

1.3 ***The Objectives of the guidance are to:***

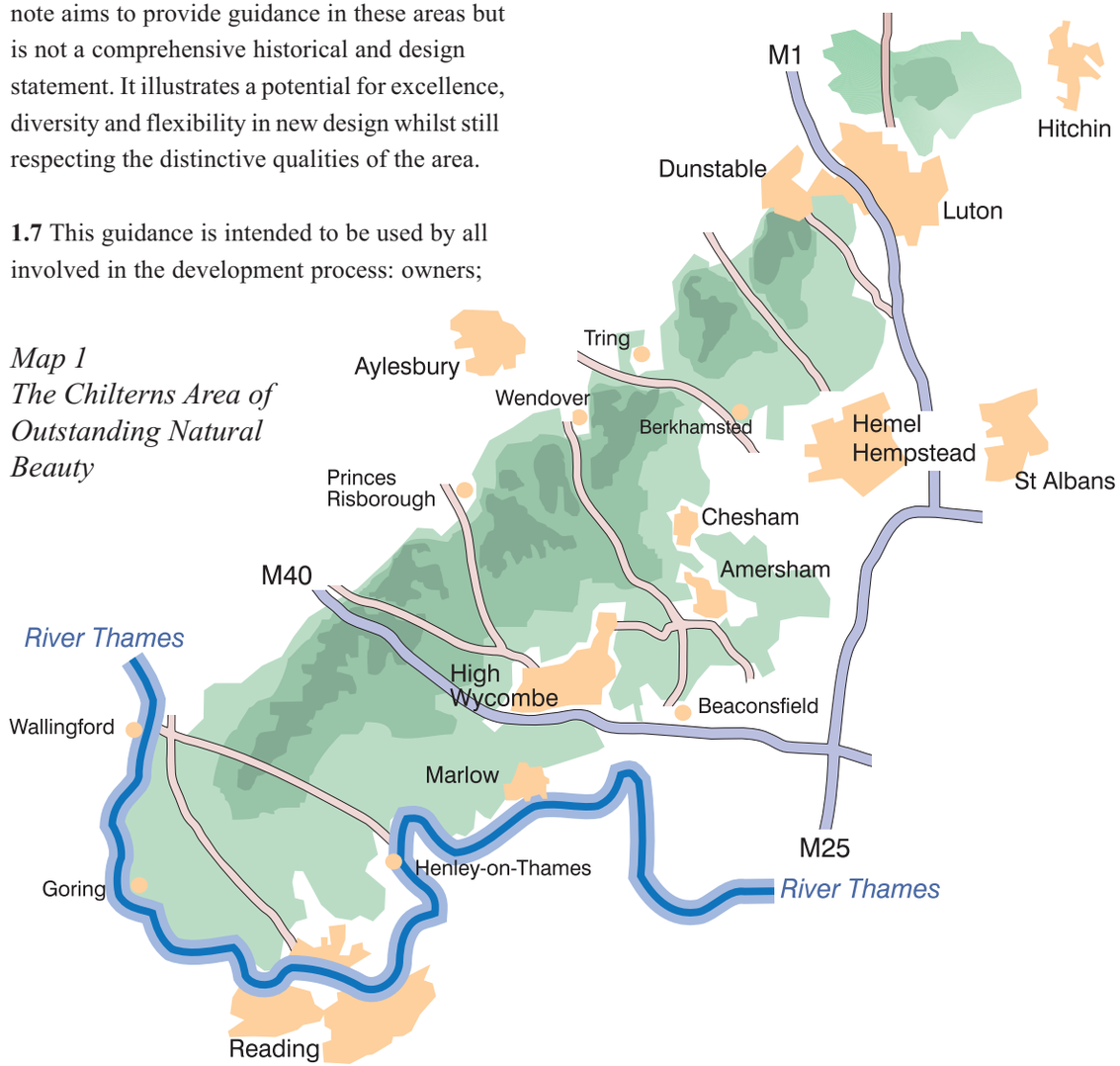
- Raise awareness of the quality of the traditional built character of the Chilterns AONB by highlighting the importance of local styles and forms of roofing
- Create respect for the historical diversity of roofs in the region
- Re-establish traditional character in areas of the AONB where it has been damaged or eroded
- Protect the distinctive character of the built environment by encouraging good repair practices
- Foster an interest in reviving traditional materials and skills in the region so as to encourage a more sustainable approach to roofing
- Promote the appropriate use of roofing materials in new developments so as to create respect for the traditional built character of the AONB
- Encourage roofing of the highest standard to inspire high quality design in new developments

1.4 Much of the Chiltern Hills is designated an Area of Outstanding Natural Beauty (AONB). The Chilterns Conservation Board is responsible for conserving and enhancing the natural beauty of the AONB, increasing the understanding and enjoyment of its special qualities, and fostering the economic and social well-being of local communities, within the AONB. It may offer assistance to local authorities with the aim of ensuring their policies and practices are co-ordinated and consistent with guidance that has been adopted.

1.5 To this end, the Chilterns Buildings Design Guide was published in 1999 to provide guidance on how to achieve high quality design in new developments. The Guide provides a framework for protecting and enhancing the identity of the traditional built character of the Chilterns, which has been steadily eroded by the use of standardised designs and non-local materials. This series of Technical Notes is intended to supplement the Chilterns Building Design Guide by providing additional guidance on the appropriate use of materials.
(visit **www.chilternsaonb.org** *the Chilterns AONB website for details of other Technical Notes.)*

1.6 All new building work, including extensions and conversions, will require careful consideration of the roof design and its covering; repairs to existing buildings may also involve changing the roofing material or improving its performance. This note aims to provide guidance in these areas but is not a comprehensive historical and design statement. It illustrates a potential for excellence, diversity and flexibility in new design whilst still respecting the distinctive qualities of the area.

1.7 This guidance is intended to be used by all involved in the development process: owners; architects; designers; developers; builders; planning authorities; parish councils and any organisation or individual with an interest in the built environment of the Chilterns AONB.



Map 1
The Chilterns Area of Outstanding Natural Beauty

Streetscape (Nettlebed)

1.8 The note is a material planning consideration and will contribute to decision-making on planning applications. Local planning authorities will be invited to adopt it as a material consideration so as to ensure consistency across the 15 local planning authorities within which the AONB lies. If adopted, the planning authorities will expect all relevant planning applications in the AONB to demonstrate how these guidelines have been taken into account. Contact the Conservation Board to check on the status of the note. Adherence to the guidelines does not mean that development proposals will necessarily be approved because other planning policies will apply. Specific design and planning guidance is also likely to apply to buildings that have been listed or are situated in conservation areas. The local planning authority should be contacted for details.

1.9 This note was the subject of public consultation prior to adoption. The views of consultees were taken into account and in some cases changes were made. A copy of all the representations made during the consultation period and the Conservation Board's response is available from the Chilterns AONB office.

Sustainability

1.10 Roofs play a key role in enhancing the built environment of the Chilterns. The use and re-use of traditional materials will help retain the existing identity of the Chilterns and create attractive new developments of lasting character. Many artificial and natural but non-indigenous materials are imported into the region. Apart from their visual impact, they are likely to be costly in energy to produce and to transport; their life expectancy may also be far less than a traditional roofing product. With increasing concern for the environment, development should aim to use materials which produce lasting buildings. Materials that can be recycled and repaired rather than thrown away or replaced should be encouraged. However, they must be technically appropriate for new work, should always be carefully sourced and should not involve materials being stolen from a historic building.

Concrete tiles and flat roofs – alien materials and form in the Chilterns (Hemel Hempstead)

1.11 Clay is a natural material; roof tiles are durable, natural, sustainable products that improve with age and weathering. A number of small firms in the south of England produce hand-made clay-peg tiles which blend well with local examples; their use supports craft skills and economies of scale in production. Clay tiles are still competitive in terms of costs, are perhaps the easiest and most economical roofing material in terms of fixing, and have a life of sixty years or more with little need for care or maintenance.

Reviving the Chilterns tile making industry (H. G. Matthews)

1.12 Until the Second World War, tiles were produced in conjunction with locally-made bricks; and it is this which may once again provide a springboard for a renewal of the craft. Re-establishing local tile production offers one of the key conservation opportunities in the region for the 21st c. Brick manufacturers in the Chilterns are ideally placed to pioneer the re-introduction of tilemaking given the relative ease with which the skills and machinery required to mould brick specials can be adapted and transferred to tile making. There is a real possibility that roof tiles will once again be produced commercially in the Chilterns.

1.13 The Government is committed to the reduction of greenhouse gases as a result of the Kyoto Accord on Climate Change. In terms of roof design, the impact is to require more insulation on the envelope, limit heat loss from pipes and ducts, and assist in providing more energy efficient heating, cooling and ventilation systems. Roof design and performance therefore have a major role to play in determining the building's overall energy performance. The combination of covering, underlay and insulation are controlled by Building Regulations; within these constraints, roofs can become effective solar heaters; rainwater harvesting systems can capture water run-off; and

New construction using prototype Chiltern tiles

Chiltern District Council Foyer, demonstration model showing local, sustainable, building materials (Amersham) (Photo by C. White)

roof surfaces can positively support and enrich the ecology of the surrounding environment.

1.14 The convergence of conservation policies (to preserve historic buildings by encouraging sympathetic renovations and extensions) and sustainability agendas (to stimulate local industries to keep transport costs low) has created a 'niche' opportunity to revive the Chiltern tilemaking industry.

Chapter 2

Background

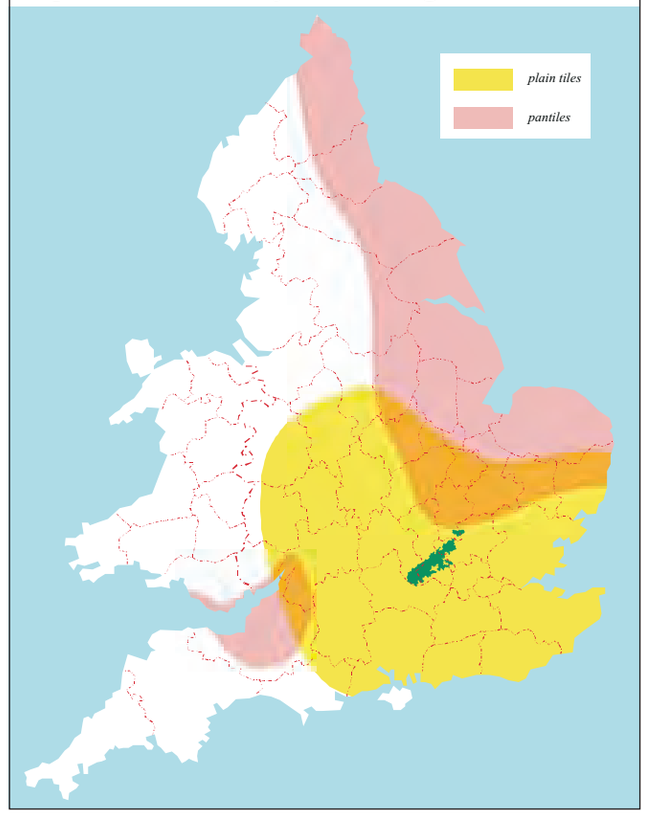
2.1 No stone suitable for producing slates is available in the Chilterns. In many areas of the region, deposits of clay-with-flints overlaying the chalk bed rock have for centuries yielded clay suitable for both brickmaking and tile making – this opportunity for dual output is historically why peg tiles were the most commonly used roofing material in the Chilterns.

2.2 Differences in the clay inevitably produce subtle variations across the Chilterns in tile colour and texture, but these tend not to be as pronounced as for the region's bricks. Differences in hand moulding, fuel, firing time, temperature and position within the kiln can also all affect the tile's appearance.

2.3 Most tiles are rectangular in shape, but variously shaped tiles laid in a variety of patterns may be encountered, sometimes promoted by large estates aiming to achieve a distinctive design. Profiled tiles are found in the north east of the region, spilling over from the pantiled areas of East Anglia.

Shaped and patterned tiling (Little Kimble)

Map 2 Distribution of Tiles in England



2.4 In the Chilterns, little elaboration and decoration is found in tile roofs. Pitches are relatively steep; eaves tend to be finished with plain half-round guttering; and gables rather than hips produce straight verges without recourse to bargeboards.

Steep pitched plain tiled roof (nr. West Wycombe)

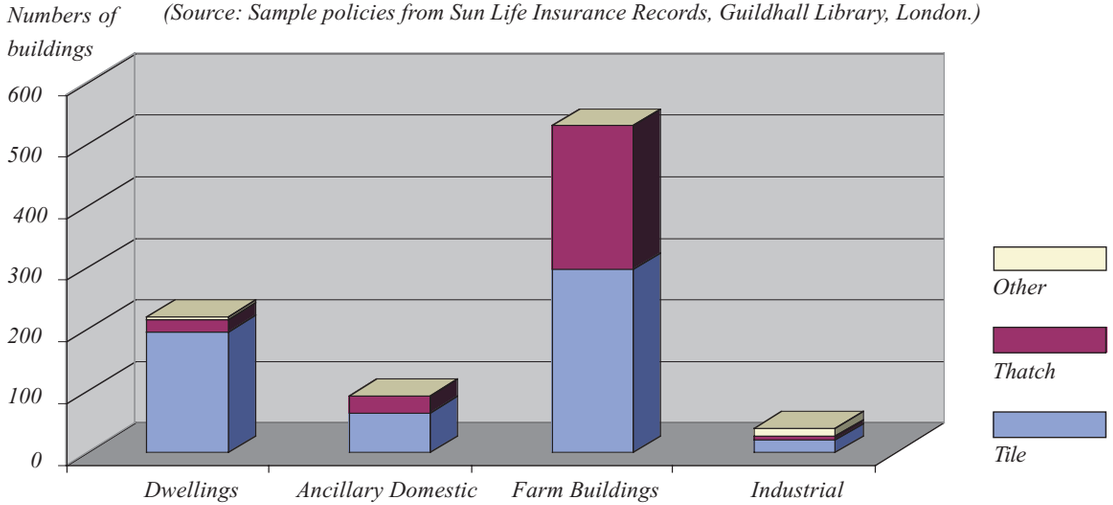
2.5 Other roofing materials have been used in the past. Research into insurance records demonstrate that in 1801, roughly two-thirds of all roofs were tiled, one third thatched *(see Fig 1)*. Slate was just beginning to make an appearance in the area, particularly in the market towns and on large estates such as Ashridge due to the evolving canal network. Some early industrial buildings were experimenting with corrugated iron and even tarred paper. Grander buildings often had metal roofs of lead or copper.

2.6 The market for native Chiltern roofing materials continued to be eroded throughout the 19thc. and 20thc. by imports (both from elsewhere in this country and abroad). The Second World War appears to have placed a final seal on tile production within the region. Tilemakers were recorded at: Ley Hill up to 1928; at Chalfont St Peter to 1935; at Hedgerley up to 1936, and the

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

Fig 1: Chiltern Roofing Materials, 1801

(Source: Sample policies from Sun Life Insurance Records, Guildhall Library, London.)



Allied Brick and Tile Works in Copperkins Lane, Amersham struggled on until c.1949. Subsequently supplies came from tileworks on the margins of the region such as at Reading but these too gradually dried up in the final decades of the 20th c. Although a reasonably healthy hand-made tile making industry survives in England, this is based in the South East and Midlands, using clays that cannot exactly match the colour and texture of native Chiltern tiles.

Evolution of the Roof

2.7 The purpose of a roof is to protect the living space from rain. Early roof designs were based on cruck frames, where the weight of the roof was transferred directly to the ground. Examples of crucks are encountered in the Chilterns but are rare after the end of the 15th c.

2.8 As box-framing emerged, timber roofs evolved to resist the lateral tensions which otherwise would force the walls apart. To prevent sagging, collars were introduced to link pairs or couples of rafters across the building. These might be further stiffened with struts and braces. An alternative method of preventing lateral thrust was to tie the wall-plates together across the building with tie-beams. On these, the principal rafters sat. Tie-beams were used at intervals, effectively dividing the building up into bays. To prevent the trusses or coupled rafters from racking, collar and ridge purlins and windbraces were introduced. Early buildings tended to have 'in-line plans' but larger medieval buildings had cross-wings, resulting in the creation of valleys. As two storey buildings became more common from the 15th c., chimneys

Roofscapes have evolved over time (Hemel Hempstead)

Early chimneys (West Wycombe)

appeared at gable ends, on side walls of cross-wings, or axially set on ridges. When compared to thatch, tiles caused rainwater to run off more quickly. Eaves overhangs steadily reduced as rainwater disposal was increasingly controlled through the introduction of gutters and downpipes.

2.9 Roofs with principal trusses were predominant in the Chilterns between the 15th c. and 19th c., although roof members tended to become more slender over time. This whole period was undoubtedly the heyday for the clay tile, as thatch increasingly fell out of use (particularly in urban areas due to the risk of fire) or became relegated to ancillary buildings. Particularly in towns, roofs became concealed behind parapet walls. Cast iron gutters and downpipes became more universal.

2.10 In the 19th c., new technologies inspired research into new roof forms. Timber trusses still predominated but increasingly they were bolted – the king post roof being a particularly common form; later still the strutted purlin roof emerged. Wider spans were achieved with tensioned metal trusses. Shallower pitches emerged in response to imported materials – at first slate (penetrating the

Principal roof trusses (Fingest)

Dated hopper (Hemel Hempstead)

area with the development of canals and then railways), then sheet metals. The latter also allowed curvilinear roofs to emerge. Decorated ridge tiles became a more common sight, particularly in towns. Gables, bay projections, porches and complicated roof profiles challenged roofers to produce cut roofs to a high standard. Thatch enjoyed a limited revival in the

Parapet walls (Hemel Hempstead)

Arts and Crafts thatch (Penn)

late 19th c. and early 20th c. in conjunction with the Arts and Crafts movement and the emigration of city dwellers in search of their rural idylls.

2.11 In the 20th c., roof structures evolved in two directions. On the one hand, lighter roof trusses were developed and post WWII pitched roofs were built with economic, lightweight, wooden, premanufactured roof trusses designed for shallower pitches – 35 to 40° depending on roof span. From c.1964 the 'W' shaped trussed rafter roof using metal connector plates to join the timbers emerged as the main form of roof construction. These allowed pitches to drop as low as 22 – 30°, and by the early 1970s some roofs were down to 15° for up to 12 metre spans. But as roofs became flatter – or even flat - some structures had to be reinforced to take the heavier materials being developed to make them watertight – concrete tiles, asphalt, felts, and so on. The overloading of older roofs designed for lighter materials was also an unfortunate spin-off.

2.12 Whereas in the 19th c. traditional roof coverings could be accommodated on most roofs, the development of truss construction and materials in the 20th c. have limited some of the contexts in which they would be appropriate or indeed perform at all. The development of glass, plastics, and lightweight materials has allowed spectacular new roof forms to be engineered. Nevertheless, clay tiles have responded to changes in pitch and design remarkably well. They have in fact benefited in recent years from a reaction to low-pitched, trussed rafter roofs - these have been abandoned in favour of steeper pitches to meet space and design requirements by keeping building mass and rooflines down and squeezing more living room out of roof spaces.

Example of poorly designed steep pitched roof with rooms squeezed into roofspace (Flamstead)

Light roof trusses (Berkhamsted)

2.13 Ancillary aspects of roofs have also changed dramatically. Chimneys and stacks have been replaced by metal flues or disappeared altogether. Pressures on space have caused dormers and skylights to sprout on roofs everywhere, breaking up uninterrupted planes. Requirements for ventilation have tended to push eaves overhangs outwards, although increasingly it can be discreetly incorporated in roof slopes and ridges.

Poorly designed modern roof

Historical Manufacture and Use of Tiles

2.14 The word 'tegula' or tile was used to describe several clay products including bricks and paviors as well as roofing tiles.

2.15 Older tiles are difficult to date, but tile-making in the Chilterns is known to date back to the 13th c. and 14th c; tile kilns excavated at Ley Hill may in fact predate the medieval revival of brick. In the 13th c., the price for roof tiles averaged at three shillings per thousand. At Penn and Tylers Green, a floor tile industry flourished between 1340-1390. See article by Miles Green in 'Records of Bucks' Volume 45, page 152 (2005).

2.16 The plain tile is so-called because it describes the 'plane' as opposed to various profiled tiles that were used. From an early date various urban authorities in particular attempted to counter the danger of thatch fires by legislating for the use of tiles. Tiling battens had to be more closely and uniformly spaced as a result.

Early tiles (173 High St., Berkhamsted)

2.17 Apart from fire-resistance, the spread of tiles steadily produced a more uniform and more long-lasting roof covering. The size has changed little since the time of Edward IV when it was required that a plain tile should be 10˚" long by 6˜" wide (most clay tiles today are 10˚" by 6˚" or 265 x 165mm).

2.18 Bricks and tiles were generally manufactured together. Both tiles and bricks were normally made from local clay, which was usually dug by hand in the winter from pits using a clay spade. Having been broken down by the frosts, the clay was then wetted and mixed to a dough-like consistency. Each individual tile was made by hand; the clay was pressed by hand into moulds which had been dusted with sand. The tiles were then allowed to dry on stackable coved racks (to give the required curve) and then burnt in a clamp or kiln made at the building site.

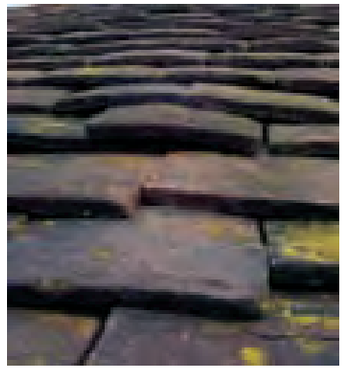
2.19 From 1784 onwards the price of tiles was affected by the Brick Tax to defray the cost of the American War of Independence. Plain tiles attracted a duty of 3*s*.(15p.) and ridge tiles 8*s* (40p.) per 1,000. In 1833 (when the tax on tiles was removed) 42 million tiles were subject to the levy.

Tilemaking and brickmaking – a decorative tiled roof adjacent to bottle kiln (Nettlebed)

2.20 Traditionally, plain tiles were hung from laths. Each tile had two holes formed near its head. Pegs made of oak or Baltic pine were pushed through one or sometimes two of the holes and were hooked over the laths made of riven oak or chestnut which were nailed or sometimes pegged to the rafters. In plain tile roofs the position of the hole varied; the shape of the peg varied; the thickness and contour of the lath varied and the rafters varied in size.

Paw-print in tile (Chiltern Open Air Museum)

2.21 Whatever the uniformity of size in the tiles, the resulting roof was far from uniform in surface and appearance. To aid water run-off, the tiles were curved in length and had a varying curve in width. This cross-camber helped direct water running off one tile to the middle of the tile below. It also created bigger spaces between the tiles, avoiding any capillary paths and allowing proper ventilation. Cross-camber also meant that the bottom edge of each tile was supported on two points, not on a continuous edge which might be far from straight. The tiles thus had a more stable 'sit'. The 1945 British Standard specified only a longitudinal camber.



Cambered roof tiles

Nibbed tiles (173 High St., Berkhamsted)

Early machine-made tiles were completely flat, suffering much frost damage as a result.

2.22 Following a patent granted in 1836, the practice developed of including one or two nibs at the head of each tile in order to hang the tiles from machine-sawn laths. Only certain courses of tiles at the eaves and at levels up the roof were nailed into the laths. However, nibbed tiles did not come into general use until late in the 19th c.

2.23 Normally tiles were bedded in some material which would help to exclude draughts and make the roof resistant to the danger of driven snow, a potential threat even to the steeply-pitched tiled roofs of the Chilterns. The normal bedding used in this region was straw (or hay); and this can still occasionally be found on some surviving roofs. 17th c. accounts refer to moss being used in the Hughenden Valley.

Tiles bedded in straw. Note also the wooden pegs (Fingest)

Decorative clay-tiled 19th c. roof (Flaunden)

2.24 During the 18th c. and early 19th c., fishscale and other variations in shape were sometimes used – Bourne End, for example, has a particular concentration. Subtle banding and patterning effects were also created using different coloured tiles.

2.25 Tiles have occasionally been used to clad walls in the Chilterns as well as roofs; it is a more common practice in the south-east of England. It is found on some Edwardian – mainly Arts and Crafts - houses. Good examples are found

Tile-clad walls (Berkhamsted)

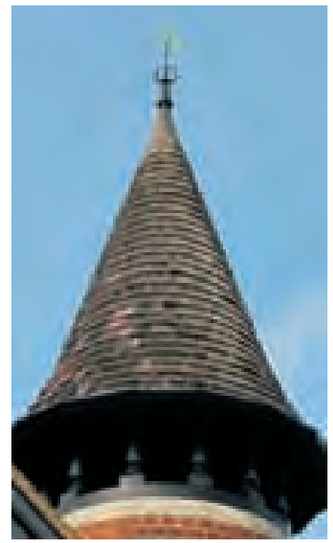
around Goring, Whitchurch and Medmenham. It became more widespread in the post-war era, often as a means of concealing block construction and protecting leaky walls.

2.26 Tile-making machines, though invented in the 19th c., appear to have largely by-passed the Chilterns. However, machine-made tiles, particularly those made from the Etruria marl clays, allowed mass-produced brands such as 'Rosemary,' 'Acme,' 'Dreadnought' and 'Broseley' to make inroads into the region. The Victorian taste for elaborate mixtures of architectural styles and materials also meant that free use was made of tiles in a greater variety of colour and shape. The Hoffman kiln had been developed in the 19th c. and was the favoured method of firing tiles up to the time production ceased. Other processes also evolved - machinery was used to crush, roll and filter the clay and drying rooms were built to speed up the process of reducing moisture content before firing. But by and large, mechanisation had little impact on the Chiltern tile-manufacturers, an obvious contributory factor to production declining in the 20th c.

Other Roofing Materials

Timber

2.27 There is little firm evidence for the use of shingles in the Chilterns except on a few 'superior' buildings. Oak logs were cleft with a froe; pegs were made to hang the shingles from the roofing battens. Because of their weight they are particularly suited to very steep pitches – and thus are encountered occasionally on spires.



Shingled roof (Hemel Hempstead)

Thatch

2.28 Research has indicated that a small number of medieval thatched buildings survive with an original base layer of thatch - this has become blackened by being exposed to smoke from an open hall fire percolating up into the roofspace. No examples in the Chilterns have yet been located, although a number survive in the Vale of Aylesbury. Insurance records demonstrate that in 1801, thatch was particularly common on smaller rural buildings such as cottages, farm buildings, outhouses and rural industrial buildings. The majority of these roofs have since disappeared or been re-covered with another material. It is highly likely that some of these lowly buildings were maintained by farm labourers rather than master thatchers, and base layers may again provide important clues as to idiosyncratic thatching techniques.

2.29 The majority of surviving examples however have been thatched using long straw. Eaves were liggered and ridges were plain. (For further information see English Heritage guidance note 'Thatch and Thatching'.)

Thatch (Wormsley)

Slate (Kensworth)

Slate

2.30 Improved transport links, especially canals and railways, brought slate mainly from Wales, particularly the great Penrhyn quarry at Bethesda in North Wales. In the 20th c., other markets opened up and Spanish and Chinese slates have all appeared on local roofs.

Lead (Nettlebed)

Metal

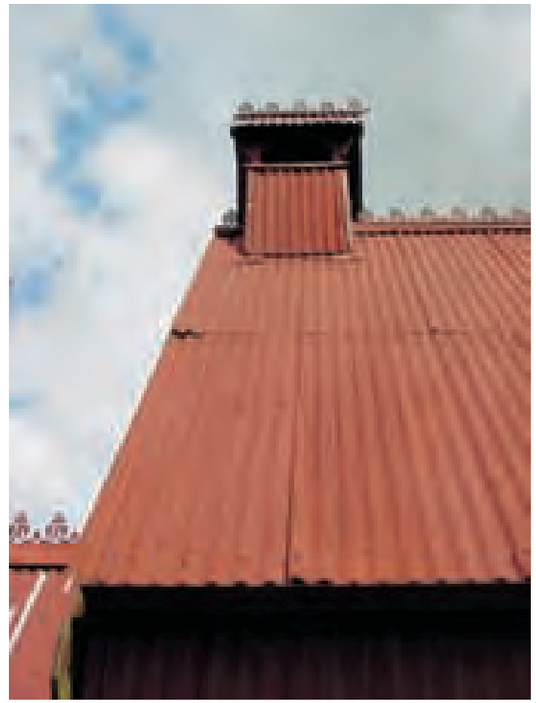
2.31 Grander buildings often had metal roofs of imported lead or copper. (See English Heritage's Technical Handbook: Vol.4: Metals.) Some early industrial buildings experimented with corrugated iron, which gradually covered over and eventually replaced many of the humbler thatched roofs in the region.

Glass

2.32 Large span glass roofs developed from the 1790's and were mainly associated with greenhouses, conservatories, orangeries and other garden structures. Conservatories fell out of favour during the early half of the 20th c., but returned with a vengeance in the second half, unfortunately often using alternative Upvc products.

20th c. introductions

2.33 New materials such as asbestos tiles became particularly prominent on the straggling ribbon development to many Chiltern villages that mushroomed in the interwar period. Flat roofs became common, particularly for extensions, favouring the spread of bitumen based products such as felts and asphalt. Concrete tiles made comparatively little inroads into the Chilterns outside the towns. Similarly, plastic and profiled metal roof coverings have had little impact on the AONB except where light industry has been



Corrugated iron (Henton Chapel, Chiltern Open Air Museum)

allowed; associated roofing products such as fascias, verges and bargeboards, are, by comparison, inappropriately conspicuous. Glazing technology also rapidly advanced, allowing a more inspired range of glass roof applications.

Chapter 3

Designing the Roof

An Inspirational Inheritance

3.1 The typical Chiltern roof has evolved in response to a subtle blend of environmental factors – a gentle inland climate which allows small and relatively light tiles to be placed on, rather than pinned to, the roof and which permits verges and eaves to remain largely exposed rather than having to be shielded by coped gables and tall parapets; a broadly consistent geology which produces clay peg-tiles and associated accessories of a red/orange colour across the region, together with the bricks which blend so harmoniously with the tiled roof coverings; all on a human scale which has left roofs largely uncluttered by complex detailing and over-elaborate ornamentation. The resulting subtle mix of shapes and materials contrast with the consistency and machine-like quality of many modern roofing products.

Characteristic traditional tiled roof under threat (Prestwood)

3.2 Many traditional roofs survive in the Chilterns. Their shape, form and detailing should act as a template to inspire roofing of the highest quality, fit for its present day purpose. Each project will have its unique characteristics but all too often designers ignore this inheritance and fail to ensure new roofs blend in with the existing environment. The essential features to create a balanced design are:

Preliminaries

a. Building type, usage and context

3.3 What is the function of the building and is it fit for its purpose? If new, is the building residential, industrial, commercial, or is it an ancillary/secondary building? Will it need to blend into an existing group of buildings or can its isolated position be exploited to advantage? If extending a building, consider how best to integrate new and old roofs. If the current roof is failing, the survey should identify the repairs required and a methodology to ensure they are carried out with due regard to the surviving historic fabric.

b. Primary material choice

3.4 Decide what roofing material fits best with the context of the project. Should it be combined with other roofing materials? Consider also the immediate built environment – what roofing material has been used most extensively in the area. In most areas of the Chilterns, this will be clay tiles and they should be specified wherever possible. When infilling, matching the materials already present will normally be required.

Tiling in progress (Hemel Hempstead)

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

3.5 With peg tiles, uniformity comes in size and depth of lap. Variety comes in individual shape (where they are handmade), and in colour and texture both bold (in variations in surface) as well as fine (in the sandy texture of each tile). Detailed variations in colour from mix and firing and in the way light catches the expanse of a tiled roof add further subtlety to the finished effect. Clay tiles are also versatile - they can follow ridge or hip, they can be laced, swept or turned around valleys.

3.6 If considering other coverings, bear in mind that artificial materials may not be designed to last as long as clay peg tiles and will not weather in the same attractive way.

c. Planning and legal restrictions

3.7 Planning applications now require design and access statements as a matter of course for most applications in the AONB (see 'Design and access statements – How to write, read and use them', CABE, 2006). At an early stage in the design process contact should be made with the Local Planning Authority for advice regarding development and change of use, or the Conservation Officer if an existing building is listed or situated in a Conservation Area. The Planning Officer for the Chilterns Conservation Board may be contacted for advice, and the guidance in this Technical Note should be applied to the project. Article 4 Directions may be in place, requiring planning permission for specific minor developments involving changes to a roof (which otherwise may not need permission).

3.8 Any planned roofing works must consider the relevant legislation relating to wildlife. There is an obligation under the Wildlife and Countryside Act to consult Natural England about any building work which might affect bats or their roosts. Guidance is available by contacting local bat groups, the Bat Conservation Trust (www.bats.org.uk) or your local Natural England office (www.naturalengland.org.uk), or by reference to Bats in Houses *(see Bibliography)*. Roofs are also important nesting areas for swifts, and allowances should be made for them in connection with any new roofing work. See www.concernforswifts.com for information and further detailed advice about nest holes and nest boxes and their location.

d. Building Control

3.9 The Building Regulations can have a major impact on design parameters, addressing structural, health and safety and energy issues. Local authorities should deal sympathetically with proposals for repair and conversion of historic buildings. The requirements of Approved Document L could seriously erode historic character and a more relaxed approach can be taken in connection with listed buildings, conservation areas and scheduled monuments. Please check Approved Document L and contact your local Conservation Officer and approved Building Control Officer for further advice.

e. Site restrictions and potential

3.10 Consider the site carefully, as this will affect both the aesthetic outcome and the performance of the roof.

3.11 From an aesthetic point of view, should the same pitch be maintained for all elevations? Do not overcrowd a cramped site with an overbearing roof.

3.12 Positioning the building correctly may help to mitigate some of the conditions which the roof may be exposed to such as driving rain, wind, shading from solar intensity etc. The desirability of having trees in close proximity to the roof should be carefully considered. Ease of maintenance will also be affected.

3.13 The Building Regulations 1991 approved Document B stipulate that certain roof coverings cannot be placed

Tiles are versatile enough to adapt to many different roof forms (West Wycombe)

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

nearer to site boundaries than indicated (strict interpretation of this has, for example, prevented new-build thatch within 12m of a boundary) and certain buildings may also need to be separated.

f. Client requirements

3.14 Carefully consider the owner's or client's preferences, who may be seeking distinguished architecture or sustainable solutions in harmony with other existing buildings. Ensure the client is fully briefed regarding the design opportunities relating to roofing.

g. Capital resources

3.15 Cost implications will influence the choice of roofing material. The following table summarises the new-build cost per m^2 for a range of roof coverings.

Design Checklist

- **Do** design the roof using materials and to a scale appropriate to the function of the building and its context
- **Do** obtain all necessary permissions

	Cost of covering (£/m^2)
Pitched roofs	
Clay peg tiles (hand made)	67
Clay peg tiles (machine made)	45
Natural slates (Welsh)	70
Natural slate (Spanish)	55
Man made slates	52
Clay pantiles (hand made)	45
Thatch	95
Concrete interlocking tiles	25
Concrete plain	46
Stainless steel sheet	60
Lead sheet	91
Zinc sheet	56
Copper sheet	61
Aluminium	48
Flat roofs	
Single ply	54

Sources:
Davis, Langdon and Everest, Copper in Architecture and www.homebuilding.co.uk (2002)

The table should be treated as a general guide only. Reclaimed materials may be twice as expensive as new products. The client should also be made aware of the life cycle costs as opposed to just the build cost. This will depend on factors such as typical life expectancy, scrap value and annual maintenance costs. Quoted life cycle costs may pitch the life expectancy of tiles too low – tiled roofs in the Chilterns tend to be well protected from extremes and have been known to last twice as long as the 35 years used in life cycle costing models. It is rare for anything less than 40% of tiles stripped from an old roof to be re-usable; the proportion in many cases will be much higher. A thorough maintenance strategy, if conscientiously applied, will also ensure the roof's life is prolonged beyond normal expectations. It should also be stressed that a clay roof 'adds value' which will exceed the marginal increment to the overall cost of construction that may be associated with the use of clay tiles.

Massing and Geometry

3.16 Roofs can 'make or break' a building. Roofs that are too bulky can overwhelm not only the building itself but also destroy an otherwise balanced street scene.

The roof is over-dominant in this low-walled building

3.17 The geometry of roofs has tended to become more complex, increasing the potential for defects occurring given that the roof will have more intersecting planes.

The roof configurations and tile-cladding to this development do not draw on local precedents

3.18 Careful consideration of the roof geometry can result in better interior ventilation and internal daylight gain.

Tiles laid at a very low pitch (Cadmore End)

3.19 Pitched roofs can span large spaces without imposing on the interior space available. In the Chilterns, relatively steep pitches are common – only in the 19th c. did these flatten out as slate was imported into the region. Traditionally plain clay tiles were laid at 42.5° or 47.5° and this practice should be continued as a roof looks proportionally 'right' at such pitches, rather than the ubiquitous and inaccurate 40° or 45°. While clay plain tiles conforming to the dimensional tolerances given in EN 1304 can be laid on rafter pitches down to a minimum

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

Contrasting pitches for slate and tile (Hemel Hempstead)

of 35°, as a general rule not less than 40° is recommended. Mansard roofs, with much steeper pitches on the lower slope, are occasionally encountered in the Chilterns. Most are of slate, although occasional tiled examples are seen. Where the lower half of the roof is of a shallower pitch, the eaves may appear to be "swept". Flat roofs (actually with slopes up to 10°) only became common in the 20th c. The British Standard code of practice for flat roofs BS 6229 covers design issues. Only specialist contractors trained in the installation of the roof specified should be used.

Mansard (Fingest)

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

Extensive areas of tiling need not create a monotonous effect (Bisham Abbey)

3.20 Clay tiles have been used successfully to cover very large expanses of roof. Wider spans will create more problems as the weight increases. On smaller areas of roof, larger tiles may look clumsy and out of scale.

3.21 Roofs in the Chilterns generally terminate in a gable or, less commonly, in a hip. Half-hips, 'gablets' etc. are only very rarely encountered. The small size of the standard plain tile, however, lends itself to being adapted where necessary to these more unusual complex roof details.

Combined gable and hip (Bledlow)

The incorporation of half hips in Chiltern roof designs can rarely be justified, particularly in conjunction with slender trussed roofs (Great Kingshill)

Secondary roofs to lower extensions, porches etc. usually work best when they echo the shape and form of the principal roof.

Chimney offset tiled with plain bedded verge to blend in with main roof

Gablets or 'Norfolk hips' are, as this name implies, not a traditional feature in the Chilterns (Chinnor)

Massing and Geometry Checklist

- **Do** research techniques and styles in the immediate area
- **Do** respect the relatively steep pitches of traditional Chiltern roofs
- **Don't** create bulky roofs out of proportion to the rest of the building envelope

The extension does not tie in with the existing roof shape

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

Roof and Building Performance

3.22 Roofs have to cope with years of exposure, and many will not be maintained properly, if at all. The roof must be resistant to:
a) *driving rain.* The south-east in particular is prone to short spells of high intensity rain.
b) *wind.* Gales and gusts can particularly affect pitched lightweight roofs, and additional fixings or fixing centres should be used around the perimeter zone of the roof. On the lee side of a building the wind can create a suction on the tiles and the vacuum effect can be significantly higher adjacent to the perimeters. Calculations may affect the specification for fixing tiles. Unequal pitch (asymmetrical) dual pitch roofs present problems in calculating wind loads, and specialist advice should be sought

Fire-damaged steel sheeted roof. A cavity break at mid-point prevented the fire spreading to the right side of the roof. (Hemel Hempstead)

c) *snow and ice*. Dry, wind blown snow can penetrate tiny gaps in roof coverings, particularly where irregular handmade tiles have been used.
d) *aircraft vortices.* These may need to be taken account of given that Luton and Heathrow flightpaths affect the Chilterns. Contact BRE for further advice.
e) *high humidity and temperatures*. Roofs need to be able to withstand movement caused by seasonal heat differences.
f) *excessive solar gain and ultraviolet light*. Climate change is subjecting roofs to more extreme external conditions and solar radiation is increasing in intensity.

Structure

3.23 The most common form of roof for small dwellings is the double cut roof with strutted purlins supporting the rafters. 'Fink and fan' trussed rafters or 'attic trusses' are alternatives. Steel structure roofs consisting of Zed purlins carrying trays over which thermal insulation is laid have also become available.

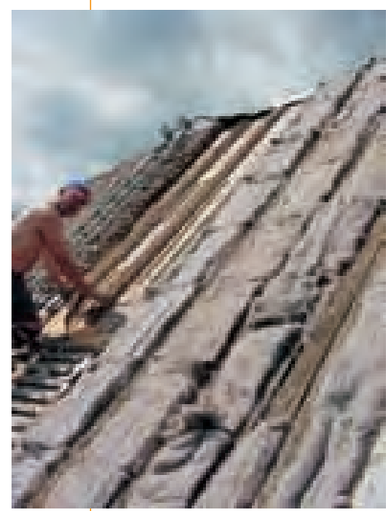
Barriers

3.24 The provision of fire-breaks both within and between buildings and the need to seal elements of the roof should be attended to. Fire can also spread between tiling battens and these too must be sealed. Loft conversions in particular will invoke additional elements of the Regulations.

Service installations, particularly electric cables and ceiling spotlights should not be positioned close to inflammable roof materials.

3.25 The roof is a key element in the maintenance of appropriate internal environments by controlling heat loss, and all materials of a roof, and even the spaces between layers of materials, contribute to the building's thermal performance. The interplay of high humidity, vapour permeability and dampness in roofs is complex. When altering historic buildings, or in modern roofs, the control of condensation is vital and this involves the correct use of ventilation, vapour

Felted roof (Bury)



Sheeps wool insulation being applied between rafters (Henley)

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

Ventilation tiles (near Stokenchurch)

barriers, vapour permeable membranes and insulation. (See BRE *Thermal insulation: avoiding risks*).

3.26 The position of the roof insulation will affect the method of ventilation. The majority of domestic pitched roofs in the Chilterns will have been constructed as 'cold' roofs, with the insulation at ceiling height. Where an impermeable underlay is used, ventilation should be provided into the roof space. If a vapour permeable underlay is used, adequate air movement between the underlay and the tiles can be provided by fixing a 25mm counterbatten over the rafters. To avoid condensation, further ventilation can be introduced by slashing the felt between the top 4 battens at ridge level on both slopes.

3.27 'Warm' roofs have the insulation placed at rafter level. The pressure to utilize loft spaces tends to favour the adoption of this form of roof design. Adequate air paths in the batten cavities and insulation thickness should be incorporated so as to maintain a simple roof profile. This in turn should prevent perimeter detailing such as eaves and verges from becoming too bulky or 'fussy'. The design challenge is to maintain simple, traditional roof profiles that can accommodate new requirements for energy efficiency and ventilation without appearing cluttered.

Performance Checklist

- **Do** ensure full compatibility between roof coverings, barriers and structure
- **Do** ensure all expected conditions are catered for
- **Do** design for sensible, safe maintenance

Material Choice and Combinations

3.28 Plain tile and brickwork go together in being essentially the same material with the same basic method of manufacture and similar degrees of uniformity, variety and versatility. Specific information on tiles appears in the following section.

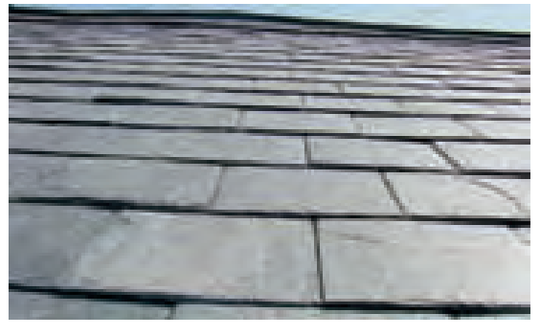
3.29 A traditional Chiltern farmstead might exhibit a hierarchy of roof coverings with peg-tiles on the main farmhouse roof, slates on some farm buildings and thatch on others. Similarly, buildings which have developed organically over time may have a range of roofing materials – often in a similar hierarchy - peg-tiles on the main roof, slate for lower pitched Victorian extensions, flat roofs for more

Tile and thatch (Lewknor)

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

recent kitchen extensions etc. Careful combination of various materials can considerably enrich the aesthetic appeal, but allowances must be made for adjacent roofs to move and for special flashings etc. at the interface.

3.30 By their regular nature, usually lower roof pitches and generally subtle colour variation and texture, slates are suited to creating a more formal and refined impression. Most roofs using natural slates of United Kingdom origin should last at least 100 years. British slate supplies today come from Wales, Cornwall and the Lake District. The slate most commonly encountered in the Chilterns, particularly in mid and later 19thc. buildings is likely to have come from North Wales. This slate is thin and is riven relatively smooth. It can be cut accurately giving a consistent shape and size. The colour ranges from dark grey through to distinct purplish hues to paler silver grey and what is commonly known as blue-grey. When wet these slates have a distinctive shine. Welsh slate is laid in regular spaced courses. Some Westmorland green slates may be encountered, laid in diminishing courses and usually on high quality work. Imported natural slate is now available from Spain, South America and increasingly China. In appearance, these may be hard to differentiate from home produced varieties but they may be less finely riven (and therefore heavier) and have a



Imported Spanish slate (Hemel Hempstead)

rough textured surface. A type appropriate to the building and its setting should be chosen - see BRE *The building slates of the British Isles*. Some imported slates may not pass BS 680 tests. Some Chinese slates have a tendency to discolour and turn 'bald' after fixing. Some Spanish slate has pyrites, which usually sparkles when new, but eventually rusts away, damaging and staining the slate. A variety of artificial fibre/cement slates is also now available. They can be of a similar thickness to natural slate and some have interlocking devices allowing a pitch as low as 15°. The more expensive or premium products will have a high natural slate content, a textured surface and a riven edge. But even the best tend to have a too regular and monotonous appearance. The cheaper ones have a bland, shiny look when new, but soon lose their pigmentation. They will crack if the nails are driven in too far, and the bottom corners curl up if the disc rivet inserted at the foot of the slate is turned down too tightly.

3.31 It is usually recommended to lay slates to a minimum pitch of 25°. A roof of best Welsh slates will weigh about 25kg/m2. In limited cases, it may be appropriate to use diminishing courses, while smaller roofs may use smaller slates to maintain good proportions. Slates may be head or centre nailed. All natural slates should have their 'grain;' running parallel to their length for maximum durability. The modern practice of fixing slates with clips looks very unsightly and should be avoided. Traditionally slates come in a variety of 'standard' sizes from 305 x 205mm ('smalls) through to Countesses (510 x 1205mm); Duchesses (610 x 255mm); and Empresses (610 x 355mm). The slate most widely available is as long as twice its width, the size most frequently encountered in the Chilterns is referred to as 20x10 (508 x 254mm). Spanish slate tends to be 250 x 500mm and generally cannot be fitted to a roof battened out at 9" gauge. The shallower the pitch the larger the slate needed. Ridge tiles for slate are mostly 18" long and are most commonly angle ridges, sometimes roll-top, but seldom "capped",

Well executed slate roof (Nettlebed)

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

Slate roof with lead rolls (Chiltern Open Air Museum)

and either red, blue or black. Alternatively, and on lower pitched roofs in particular, lead rolls might be used. On some Victorian or Edwardian buildings, more elaborate patterned clay ridge tiles may be appropriate over slates. Valleys may be formed by a Code 4 or 5 lead or zinc gutter lining. Sloping edge abutments and junctions on roofs with parapets or chimney stacks or changes in roof pitch (as for example in mansard roofs) should always be detailed with lead flashings (Code 4, 5 or 6) and not cement fillets.

3.32 Less than 5% of buildings in the AONB are thatched. The majority are to be found in the arable areas at either end of the chalk in Bedfordshire and Oxfordshire and on the western side towards the Vale. The performance of thatch depends on a complex set of factors such as the siting of the building, roof shape, quality of material and workmanship etc. Long straw, as opposed to combed wheat reed or water reed, is the 'traditional' form of thatch encountered in the Chilterns. It can 'flow' over roofing structures, allowing great flexibility in 'sculptural' forms. Ridges were also of straw, laid 'flush' and plain in appearance. However, water reed was also imported into the area from c. 1920 to achieve a more 'precise', vernacular appearance on Arts and Crafts buildings; these inevitably would require more elaborate ridges in straw or sedge. Thatched roofs usually have a generous overhang at the eaves without conventional gutters. No new building of more than 1500m3 can have a thatch roof unless it can satisfy the relevant fire test. Figures for the longevity of thatch roofs should all be treated with caution. Long straw should be hollow stemmed, winter grown wheat, at least 30 inches long, with the stems as little bruised as

Drawing straw for long straw thatching (Chiltern Open Air Museum)

Thatched Cottage (Chilterns Buildings Design Awards 2005)

possible and clean of foreign material. Long straw is yealmed – drawn into units – on the ground before being laid on the roof to a minimum depth of 380mm (15 in), commensurate with the pitch angle of the main roof. Coppice materials should be specified for fixings.

3.33 Other roofs only rarely encountered in the Chilterns include:

- ***Profiled tiles*** – pantiles are orange/red in colour with a shallow 'S' shape profile and laid in a regular, wavy grid (unlike the staggered courses of plain tiles) and generally laid at a relatively low pitch (30° to 40°), providing a comparatively lightweight roof structure. Verges are often finished with bargeboards. Ridges are traditionally a third, half round, hogsback or saddleback ridge tiles.

Shingles (Berkhamsted)

Roof constructed with tegulae appropriate to this Roman site and Museum (Verulamium)

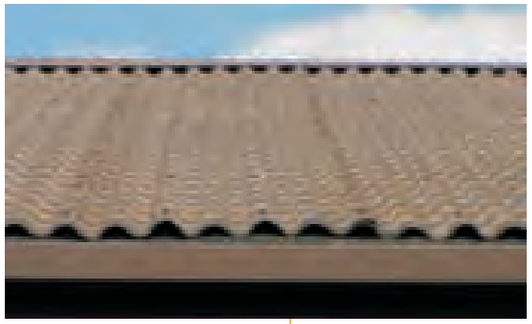
- ***Shingles*** - mainly confined to timber structures and ecclesiastical buildings, and often of cedar, although oak is the tradidional and preferred material. Shingles are relatively lightweight and should have a life of around 50 years. Shingles are normally relatively long in relation to their width: of the order of 300-600mm x 100-325 mm. Thicker oak shingles need to be laid at a pitch of not less than 45º, though cedar shingles may be laid at a pitch of 30º. Bargeboarded verges are preferred. Ridges are usually formed from standard shingles laid horizontally to single lap, close butted at the ridge. Flammability of shingles may impose particular Building Regulation requirements. Cedar shingles are usually treated with a preservative.

Profiled tiled roof (Bledlow Manor)

- ***Metal roofs,*** for which refer to the appropriate Trade Associations. Most metal roofs are laid to comparatively low pitches. Metal roof finishes tend to have a very long life. All metals will absorb oxygen and tarnish unless a protective lacquer is regularly applied. Guidance for design and installation can be obtained from BS 5427-1, the Metal Cladding and Roofing Manufacturers Association and the National Federation of Roofing Contractors. Main standards for lead are BS 1178 and BS 6915. Thicknesses of lead sheet are mainly in the range Code 4 to Code 8; Code 5 should provide adequate durability for most situations. Sheet copper and zinc tend to be laid as fully supported roof coverings. Copper, the main standards for which are contained in BS CP 143: Part 12 and for the material itself, BS 2870, weathers over the years to a blue-green, and the patina forms a protective coating. Zinc usually forms a grey coloured carbonate when exposed to the atmosphere, which affords protection to the bare metal. The main standards for zinc are BS CP 143: Part 5 and BS EN 988. Type A is used for normal roofing and type B for flashings. Material and manufacturing requirements for self-

Metal seamed roof (Hemel Hempstead)

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version



Steel roofing simulating profiled tiled roof – note the fixings! (Hemel Hempstead)

supporting roof coverings are given in the European Standard BS EN 508 Parts 1,2 and 3, which are for steel, aluminium and stainless steel respectively. BS EN 506 applies to copper or zinc self-supporting roof coverings. Gutters for metal covered roofs are often to be found formed integrally with the roof covering. Movement joints will be needed in long gutters of all metals. Corrugated metal roofs have often replaced thatch and tile on outbuildings for over 100 years. Painted either oxide red or black, they cover the roofs of many historic buildings (often barns), having preserved them against the weather when the original roof covering had failed. Corrugated metal roofs look quite different from modern metal sheeting. Their preservation, or replacement on a like for like basis, is advocated.

- ***Glass*** can often be used to great effect, and if low-emissivity and solar-controlled coatings are specified these can offer relatively high performance.
- ***Concrete tiles*** should conform to BS EN 490. Despite efforts to produce them with a variety of profiles and a dressed surface to emulate clay, the original material should always be the first choice for a building in the Chilterns. Dressed concrete tiles do not weather as satisfactorily, and never match the rich colour and texture of real clay tiles.

Material Choice and Combinations Checklist

- **Do** experiment with combinations of materials on complex and hierarchical roofs
- **Do** use slate quarried in the UK
- **Do** use lead or clay detailing in association with slate
- **Do** specify long straw thatching except where an existing roof is coated differently

- **Don't** specify concrete tiles
- **Don't** spoil good tilework by combining it with materials of poor quality

Material Selection and Specification

3.34 In all cases, ensure the finishing material is appropriate for the performance, life and aesthetic required. Ask to see a current, independent test certificate, including, but not limited to British Board of Agrément certification. Ask to see built examples of types similar to that being considered - ideally they should be at least 10 years old.

3.35 For the remainder of this section, it is assumed peg tiles have been selected. Peg tiles are one type of plain tile, the term used for all small-format tiles. The subtle variations and

Machine-made tiles cannot match the subtle textures of hand made ones (South Chilterns)

A traditional waney roof for contrast

aesthetic pleasure of hand made tiles and their weathered appearance give peg tile roofs a special patina and character. Modern substitutes, which lack these variations often result in a dull and monotonously uniform roof.

Weight

3.36 Clay tiles, depending on design, can vary between 39 and 71 kg/m2.

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

Durability

3.37 Tiles meeting the stringent requirements of BS EN 1304 have demonstrated they have the necessary durability for the UK environment. Clay tiles are unique in that they weather favourably and mellow with age. They can improve with exposure.

Thermal capacity

3.38 The thermal insulation contribution of clay tiles and batten cavity can be ignored. Insulation should provide the necessary thermal performance for the building.

Fire resistance

3.39 Clay tiles carried on timber rafters, with or without underfelt, sarking or boarding are listed as having notional AA designations in respect of penetration by fire and flame spread under The Building Regulations 2000 Approved Document B. Clay tiles are deemed to satisfy the UK Building Regulations with respect to external fire performance. The European external fire test will not apply to clay tiles because they are incombustible and have a reaction to fire rating better than class A2.

Colour

3.40 A wide range of clay roof tiles is still available - variations are obtained by controlling the kiln atmosphere to produce rich heather shades. Colour can also be enhanced through the firing process to create a brindle effect, which varies the colour between the outer edge and the centre of the tile. Red/orange colours, which match original clay tiles as closely as possible, look best and are those that the Conservation Board recommends. Tiles should always be mixed from at least three pallets to ensure that any variations in shade and colour give an aesthetically pleasing effect.

This roof demonstrates a failure to mix tile batches

Size

3.41 The standard size for plain tiles is 265mm x 165mm, although smaller sizes down to 255mm x 160mm may also be encountered. Peg tiles are almost invariably smaller than 'plain' tiles.

Shape

3.42 Peg tiles present a wide variety of cambers, which is what makes them interesting. Single camber tiles curve from top to bottom which reduces the capillary action between courses. Double or cross camber tiles are also curved from left to right and should be the preferred choice although single camber tiles may be more appropriate to many Victorian/Edwardian properties (and new houses in styles echoing these periods) where a flatter profile is often encountered. Profiled tiles are in widespread use, but there is little tradition of these types in the Chilterns and their use does little to enhance or respect the distinct character of the region.

Fixings

3.43 Peg tiles are not, of course, nailed. Modern tile pegs are generally aluminium alloy, the larger the head the better. Very old tiles often have over-large peg holes and for these two pegs can be inserted in one hole. Galvanised iron pegs are still available but will rust eventually; they are often also too short. Tile clips are not traditional features of Chiltern peg-tile roofs. Fixings are covered in BS 5534.

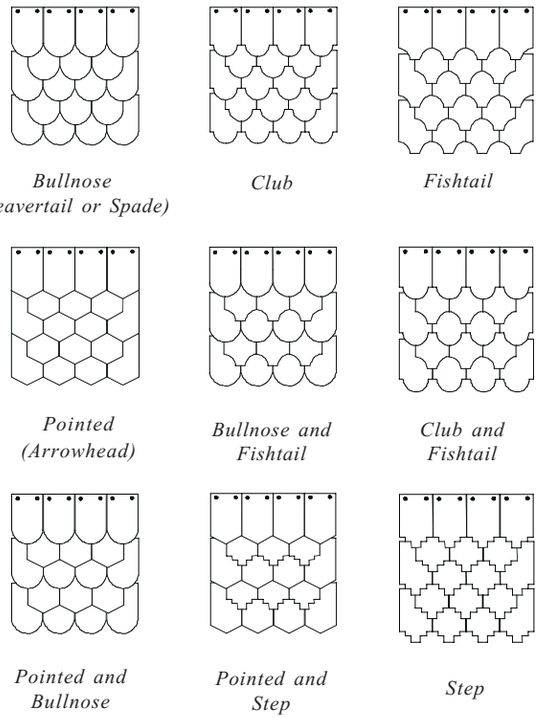
Specials

3.44 Ornamental tiles can have curved edges such as the club and bullnose or beavertail ornamental tiles, a fishtail shape or a pointed end, commonly known as diamond or arrowhead ornamentals. Overuse of special tiles can result in a fussy appearance; and, as they are often placed in vulnerable or exposed situations, maintenance requirements and the future availability of

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

accurate replacements should also be borne in mind.

Fig 2: Drawings of specials



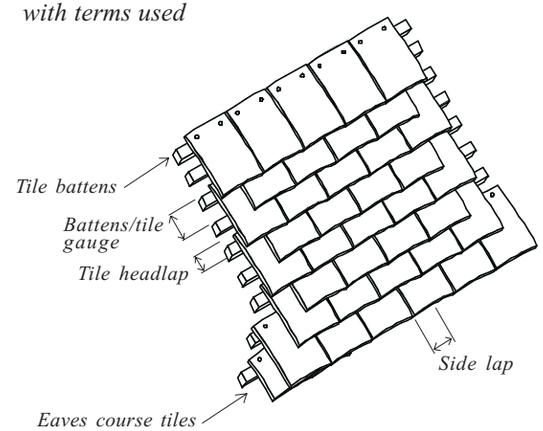
Workmanship

3.45 The code of practice BS 5534 (covering both slating and tiling) should be followed, although this is currently being revised. BS EN 13748-2:2004 covers tiles intended for roofing applications. Tiles should have a gap of up to 3mm between them. The headlap specification in BS 5534 is 65 mm minimum (75mm is recommended in exposed areas.) Batten gauges should fall between 88-100mm and staggering the battens will increase the stability of the roof. The sidelap should be not less than one third of the width of the tile, typically 55 mm. These lap arrangements will provide good protection against rain and snow.

3.46 Peg tiles are not nailed: rather they are once pegged to allow them to be aligned in horizontal coursing. The minimum fixing specification for plain clay tiles is to fix every fifth row (depending on wind calculations) and at all ridges, eaves and verges. Every tile should be nailed twice on pitches of 60° or steeper.

Roof battened out (Brook End Farm)

Fig 3: Sketch showing typical tiled pitched roof with terms used



3.47 For setting out purposes, the eaves tile should overlap the gutter by 50mm. With peg tiling a tile cut in half is often encountered as the eaves course, bedded face down in mortar on a sawn tilt fillet. The top tile is similar but bedded face up onto the last full course.

Tile Checklist

- **Do** design new roofwork to a high specification
- **Do** mix tile batches to create a balanced variation of colour (in the orange/red colour range) on the roof
- **Do** ensure tiles with appropriate camber are selected
- **Don't** overuse specials

Detailing the Roof

Openings

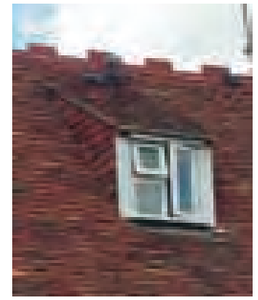
4.1 Early buildings with low rooflines often had upper storeys with dormer windows –sometimes created as a result of the insertion of an upper floor. In larger houses, servants were often accommodated in roofspaces and were lucky if that space was lit by anything else than windows in the gable ends.

Dormers

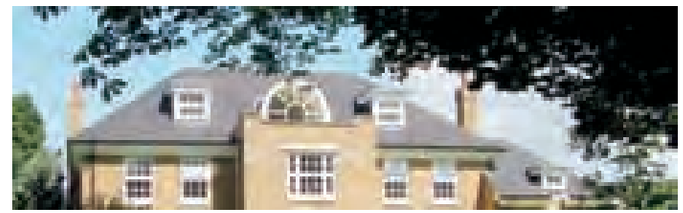
4.2 Dormers can take many different shapes, but certain types are more traditional in the Chilterns than others - simple unadorned pitched and gabled dormers are frequently encountered. In design terms, it is vital to proportion and scale the dormers correctly in relation to the roof mass. Dormers may require special provisions for ventilation. Flat roofs over dormers are often poorly ventilated. Secret gutters can be formed round most dormers, without altering the appearance of a traditional dormer. Mansard roofs, either of slate or tile, from the 18th c. often had more elaborate sash windows. These need careful detailing, particularly where the roof changes plane. It is often difficult to ventilate roof structures over dormers and 'warm' roof construction may have to be used. However, Building Regulations governing 'U' Values in

Traditional dormers - well proportioned

Dormers - less common design but appropriate to the building



Dormers - poor proportions or detailing

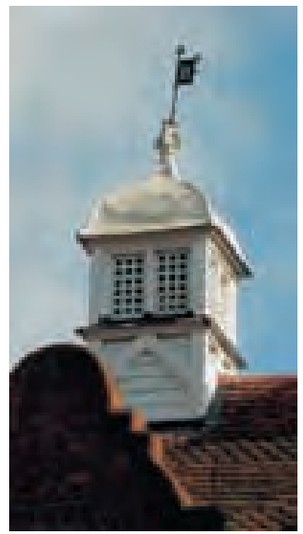


Rooflight in roof of machine-made tiles (Berkhamsted)

relation to dormers may be relaxed in the AONB, allowing simple, traditional designs to be maintained.

Rooflights

4.3 Rooflights are not 'traditional' features of Chiltern buildings and should always be used sparingly and discreetly. However, in buildings undergoing conversion where light *has* to be admitted into a roofspace where previously there was none, rooflights will tend to be the preferred option over dormers because visually they preserve the existing roofline (and usually do not require planning permission). A further distinction needs to be drawn between rooflights (a simple top-hung device, often with a single glazing bar) and a roof window (with centre pivot). Simpler designs (e.g. 'The Conservation Rooflight') should be the preferred option. Rooflights that sit 'in' the roof with secret gutters are more discreet than those which sit 'on' the roof with flashed abutments. There is no British standard for roof lights. The rules governing their selection and use are complex. Roof lights may be designed and inserted as a means of escape and the requirements for size, opening method and height above floor level should be addressed. An alternative to providing daylight and ventilation is to consider the use of sun pipes which may be appropriate on less prominent roofs, though each scheme will need to be considered on its own merits.



Bell turret (Berkhamsted)

Lanterns, Cupolas and Bellcotes

4.4 Grander buildings sometimes incorporated bellcotes, lanterns or cupolas (the latter being domed), usually constructed of timber, lead and glass, to light stairwells etc. Some cast iron variations were introduced in the 19th c. Lanterns, often in Upvc nearly always look clumsy and overfussy on more modest buildings.

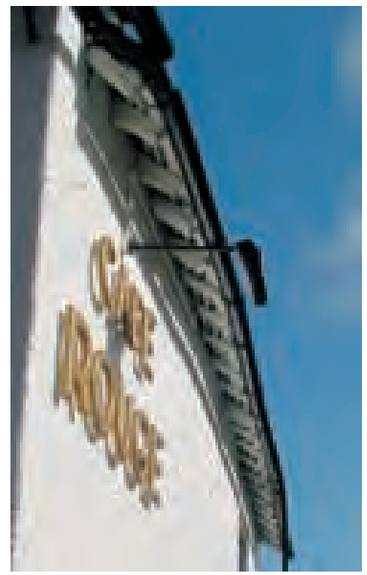
Openings Checklist

- **Do** use openings in roofscapes sparingly
- **Do** use timber for windows, lanterns etc.
- **Don't** oversize openings
- **Don't** specify a dormer if a rooflight will perform the same function

Eaves, Verges and Ridges

Eaves

4.5 Overhanging eaves may be 'closed' or 'open', referring to whether the projecting ends of the rafters are boxed in. In the Chilterns, 'traditional' eaves are 'open', sometimes incorporating a fascia. A 300mm overhang is sometimes recommended to protect the wall, but again, 'traditional' eaves tend to be less pronounced. There is a presumed advantage if the overhang can be provided with a drip e.g. a tile with a sharp arris to the under-surface. This eaves course of tiles should be set at the same pitch as the general tiling, achieved by fixing a timber fillet at the base of the rafters. Where a fascia is used with open eaves, it should be kept proportionate to the depth of the rafters. Upvc should be avoided. The top of the fascia board should be set at the correct level so that eaves courses of tiles are at the same pitch as the tiling in general.



Open eaves (Berkhamsted)

Boxed eaves (Potten End)

4.6 Some Classical designs may incorporate deep 'closed' eaves fashioned with modillioned cornices. In general, however, the boxing in of eaves with soffits should be avoided, they interrupt an otherwise simple transition between wall and roof, and tend to be peppered with vents to compensate for sealing up the roofspace. (Over-fascia ventilation avoids the need for soffit ventilation). Angled transitions in the eaves, e.g. where a gable is introduced, can look particularly clumsy. Where soffits have to be used, boards should be nogged, otherwise sagging may occur. Soffits of plastic or fibre cement board are not recommended.

4.7 With some kinds of roof structure over thick external walls and roof pitches steeper than 45°, there may be difficulty in obtaining a good overhang at the eaves and, at the same time, give adequate clearance for window heads. This may have been the reason for the use of sprockets to give a suitable overhang with flatter pitch. Nailing or bolting sprockets to the sides of rafters, where the fixings operate in shear, is probably better than nailing them to the top of the rafter.

Deep projecting 18th c. eaves with modillion cornice (Hemel Hempstead)

4.8 Where the eaves are kept open, a timber fillet should be fixed to set the eaves courses of tiles at the same pitch as the general tiling. Screens to prevent ingress of birds can be used, or alternatively a proprietary rafter spacer tray with integral screen can be used.

4.9 Where over-fascia ventilation is being provided, a timber batten should be fixed to the outer edge of the masonry to provide a fixing for the ventilator.

4.10 Although there is little surviving evidence that pegtiles were 'torched', mortar is used in a number of details. Tiles to be bedded on mortar should be docked (wetted) beforehand. Caution needs to be exercised as rainwater run-off from fresh mortar may stain tiles.

Fig 4: Eaves with over-fascia ventilation

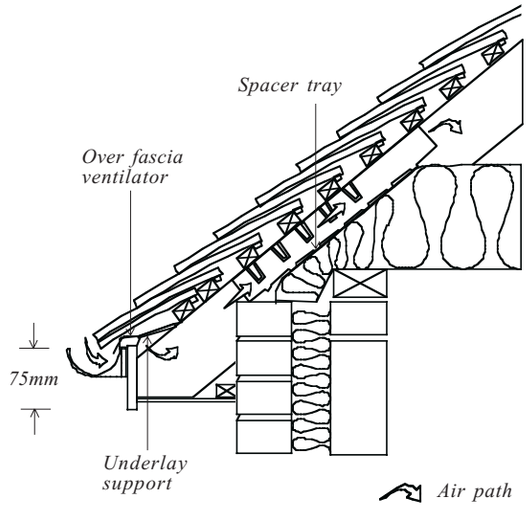
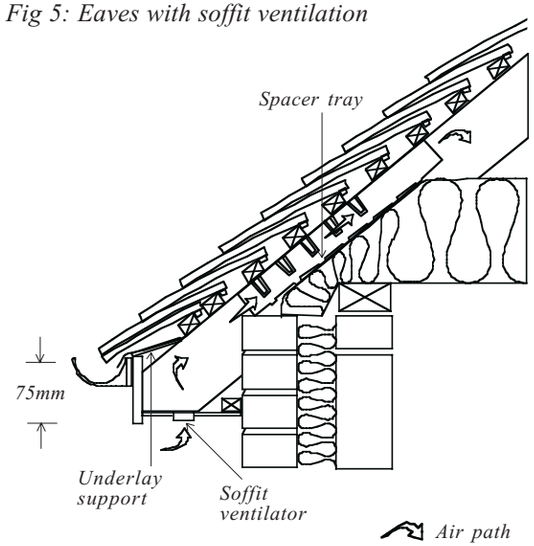


Fig 5: Eaves with soffit ventilation



Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

Fig 6: Open eaves with breathable underlay and counterbattens

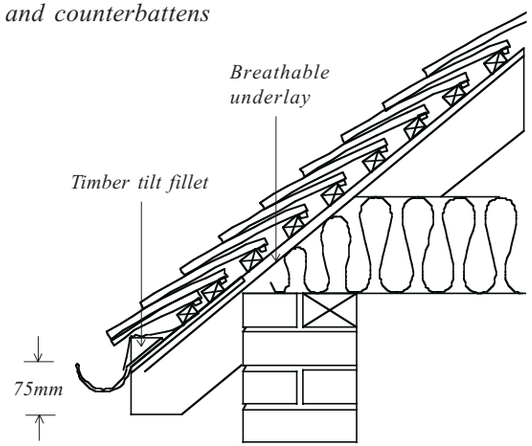
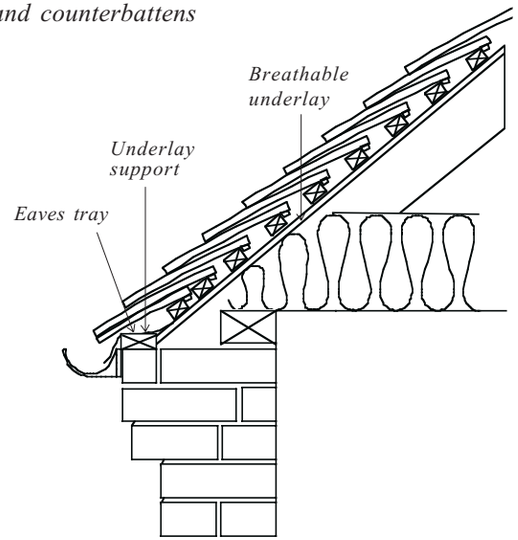


Fig 7: Cottage eaves with breathable underlay and counterbattens



Verges

4.11 Although there is a requirement in BS 5534 for all edge tiles (and slates) to be mechanically fixed, in practice this is more or less impossible to achieve. Instead the half tile is usually bedded in mortar. In plain tile and slate, verges can be canted upwards to assist in diverting water away from the verge (which also has the added effect of countering a potential optical illusion of sagging where the roof surface runs through without such canting).

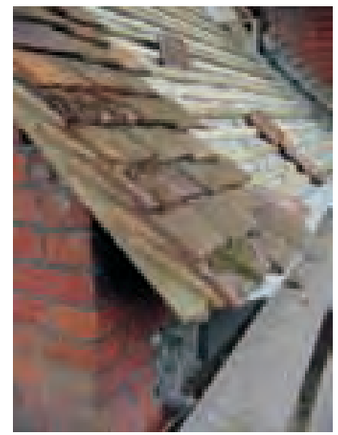
Bedded Verges

4.12 The underlay should lap onto the outer skin of brickwork by 50mm or in the case of an overhanging verge, onto a flying rafter (see BS 800: part 6: 1990 sections 3 and 4). In many cases there is no undercloak and the mortar is struck

Plain bedded verge (Medmenham)

Contrasting verges – half-tile slips to left, tile-and-a-half to right. Note also the valley tiles (Tring)

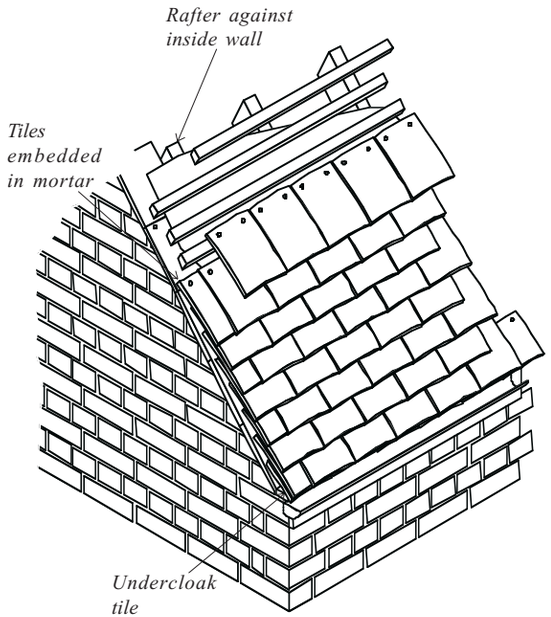
flush with the wall or barge rafter. Where an undercloak course is used, the tiles, placed face side downwards, should project from the wall (or bargeboard) by at least 1"" (35mm), preferably 2" (50mm). The top of each tile should rest about 5mm above the undercloak tile. The bottom will touch the tile below it, and the space between is pointed up with mortar *(see Figure 8).* The use of tile inserts as a form of decoration between the tile surface and the undercloaking, similar to the dentil slips used on ridge tiles, can help to minimize the appearance problems caused by cracking. A



Bedded verge with overuse of mortar (Hemel Hempstead)

variation of this detail is to use a double undercloak. Plain tiles should not be used for undercloaks on roof slopes of below 30° pitch. Tiling battens should be carried over the undercloak and finish 100mm from the verge edge. Half slip tiles are preferable to tile-and-a-half tiles in the case of peg tiling. Always avoid the use of tile-and-a-half tiles of different manufacture, e.g. pink concrete, or Staffordshire, where a piano-keyboard effect results. The bedding, using a lime based mortar, between the top verge course and the undercloak course should be c. 75mm wide and finished flush, leaving the edges clean.

Fig 8: Bedded verge



Substitutes such as cement fibre board or similar are not acceptable. Crow-stepped gables and coped gables are only occasionally encountered in the Chilterns – principally on estate buildings.

Verge with cogged brickwork (Marlow)

Cloaked

4.13 Cloaked verges (using special handed tiles), dry-laid to form a downstand, are not common in the Chilterns.

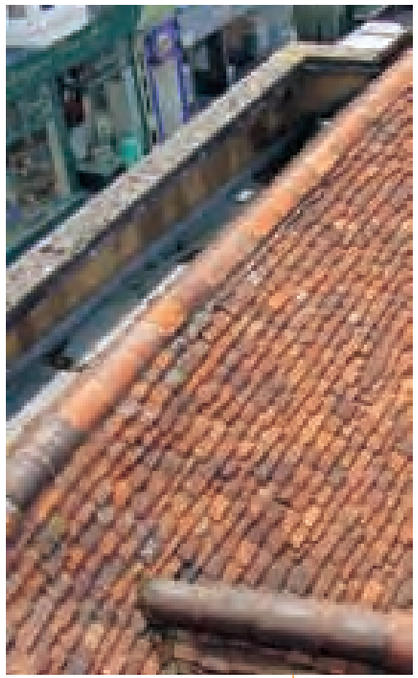
Cloaked verge (Berkhamsted)

Plain timber bargeboards, echoed on the former porch (Monks Risborough)

Bargeboards

4.14 Bargeboards may contribute to the character of certain buildings, and might tend to give more protection to the wall. However, if built of timber they will be subject to wet rot. Plastics are not traditional. The inboard edge of the gable should be securely fixed to the rest of the roof, and care should be taken to ensure that the cantilever effect of the tiles does not impose too great a load on the bargeboard. The underlay should lap onto the flying rafter, and carried over to meet with the undercloak. (see BS 800: part 6: 1990 sections 3 and 4). Again, the tile undercloak course should project from the bargeboard by at least 1°” (35mm), preferably 2" (50mm).

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version



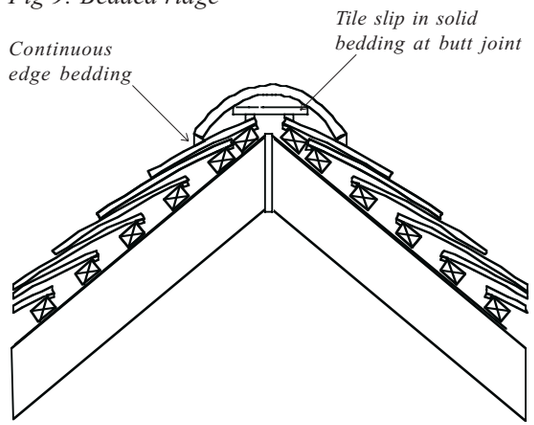
Third-round ridge (Hemel Hempstead)

Ridges

4.15 A great variety of shapes of ridge tile is available. Most roofs in the Chilterns have a shallow, rounded profile (third-round rather than half-round) and often with a slight saddleback effect. Ridges are often hand made in similar colours and textures to peg tiles and are often rather irregular in line due to slight variations in size and shape. This irregularity, within limits, can add considerable interest to an old roof. Some Victorian and Edwardian buildings will sport more elaborate crested ridge tiles. Traditional practice is to bed them solidly on mortar. A 1:3 mortar mix can be used for bedding, preferably air entrained, but this is a comparatively strong mix and could lead to cracking. A high durability mortar is nevertheless required, and an air entrained 1:0.5:4.5 cement:lime:sand is an alternative. Underlay from one side of the roof ridge should overlap the underlay on the other side by not less than 150mm. (For mono pitched roofs, underlay should extend over the mono ridge and top fascia board by not less than 100mm). Finishing courses should be secured over the top tiles. Ridge tiles should be laid by continuously bedding their edges and solidly bedding with tile slips inserted into the mortar at ridge joints.

Where masonry walls support or abut a ridge, all ridge tiles within 900mm of such walls must be mechanically secured by fixing (with nails, clips or wire etc) into the supplementary ridge tile fixing battens as recommended by the manufacturer. The ends of ridges at gables should be filled with mortar and slips of tiles finished flush.

Fig 9: Bedded ridge



4.16 Dry fixed ridge systems exist but are not illustrated here as they are not traditional to the Chilterns. Modern ridge ventilation systems are also not traditional and can be unsightly interrupting the ridge line. It may be possible to cut back roofing felt each side of the ridge apex by 300mm to allow roof void ventilation together with eaves ventilation.

Finials

4.17 Purpose made finials on earlier roofs do not seem to suffer much from storm damage. Some decorative finials, usually of terracotta, are still available and can enhance the finished appearance when used sparingly and on roofs of suitable stature.

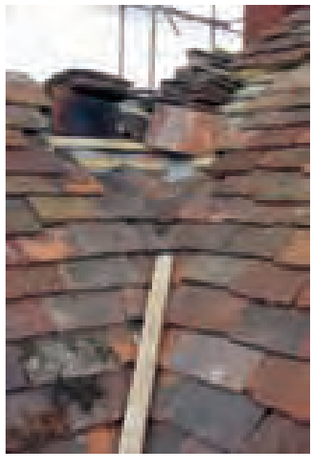
Ridge with crested ridge tiles and finial

Valleys, Hips and Abutments

Valleys

4.18 Valleys are created using either a metal lining or purpose made valley tiles, which became common in the latter half of the 19th c. Valley tiles can be supported on two raking battens, one to each slope; these help to protect the felt from projecting batten ends. Valley tiles can rarely be used across roof slopes of different angles. On major buildings, valleys may be swept or laced,

either to a radius or an acute angle. A double thickness of sarking felt is required and the underlay should be laid from side to side and each course should lap past the centre-line of the valley by not less than 300mm. Where a continuous length of underlay is laid in the valley, each course of felt from either side should be cut to mitre at the centre-line of the valley and lap onto the continuous length by not less than 300mm. Metal and plastic valley materials and units should not be laid directly onto felt underlays because of the risk of adhesion, which can inhibit the free drainage of any moisture or cause the premature failure of the valley material. Lead, if used, should never be laid directly on an unsupported membrane. It should always be supported on lay boards, which needs to be nogged between, or cut into, the rafters. Tiling battens may require additional support where they abut the valleys. Valley gutters slope much more shallowly than the pitch of the roofs they join, and on pitches of less than 20° are particularly prone to leaking. Gutters may be required on porches and bay windows. Open valleys formed with metal lining or pre-formed GRP are not recommended.



Valley being formed for valley tiles (Hemel Hempstead)

Valley formed in slate roof with metal liner (Berkhamsted)

Fig 10: Valley – Tiled

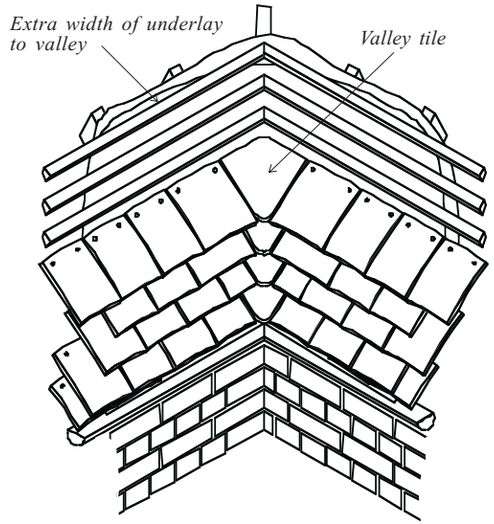
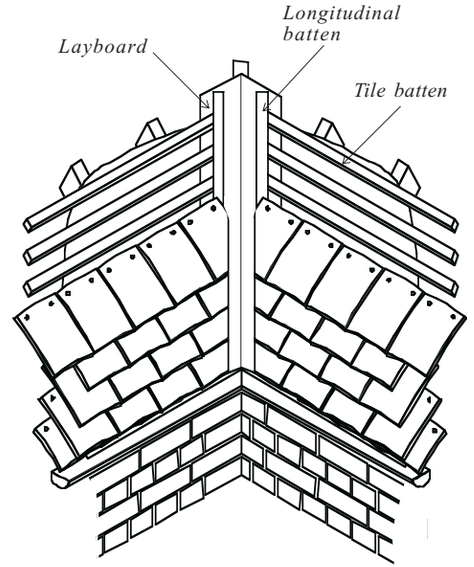
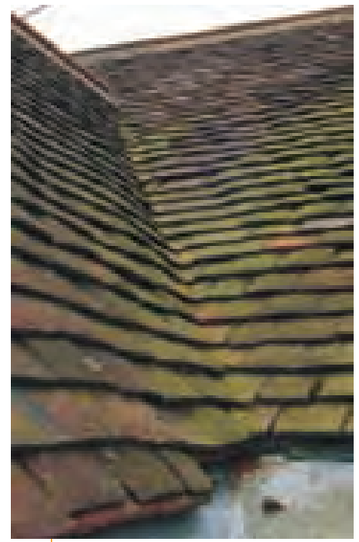


Fig 11: Valley – Lead

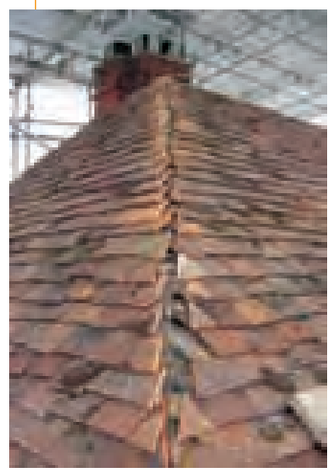




Valley formed with valley tiles (Tring)

Hips

4.19 Hips in plain tiled roofs are usually formed with ridges bedded in mortar and held at the foot on hot dip galvanised hip irons or hooks. For roof pitches under 35° they can be 4mm thick; but over 35° they should be a minimum of 6mm thick. Since the 1970s it has become more common to clip each ridge tile to the hip rafter. Alternative methods of forming hips, possibly giving a neater appearance



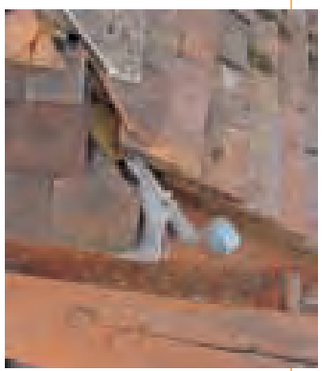
Hip prior to being covered with hip ridges. This illustrates poor practice. One facet should have been completed, the hip ridges being put on as the other facet was going up. (Hemel Hempstead)

Hip with half-round bonnet tile. Note the bonnets are poorly aligned with the tile courses. (Berkhamsted)

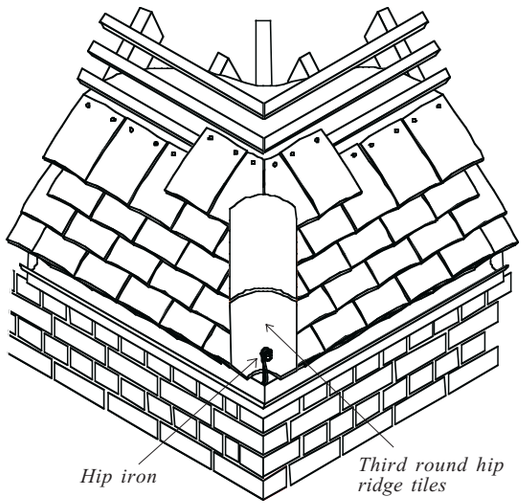
and possibly improved performance, include purpose made hip tiles. Bonnet hips were a feature of Sussex and Kent, and only appeared in the Chilterns in the mid 1930s. Mitred hips in plain tiles should be laid over soakers lapping at least

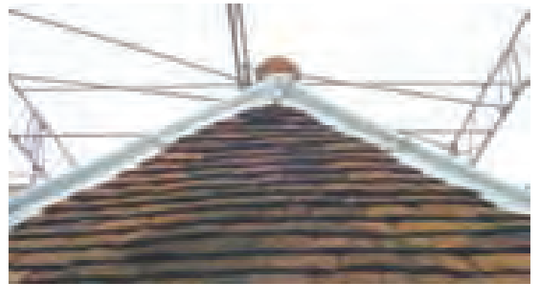
Hip using half-round tiles (Berkhamsted). Note also the intrusive satellite dish and aerial

Fig 12: Hips with hip ridge tiles



Hip iron (Hemel Hempstead)





Hip with lead roll (173 High St., Berkhamsted)

100mm to each side of the hip. On hips, underlay courses should overlap at the hip line by not less than 150mm.

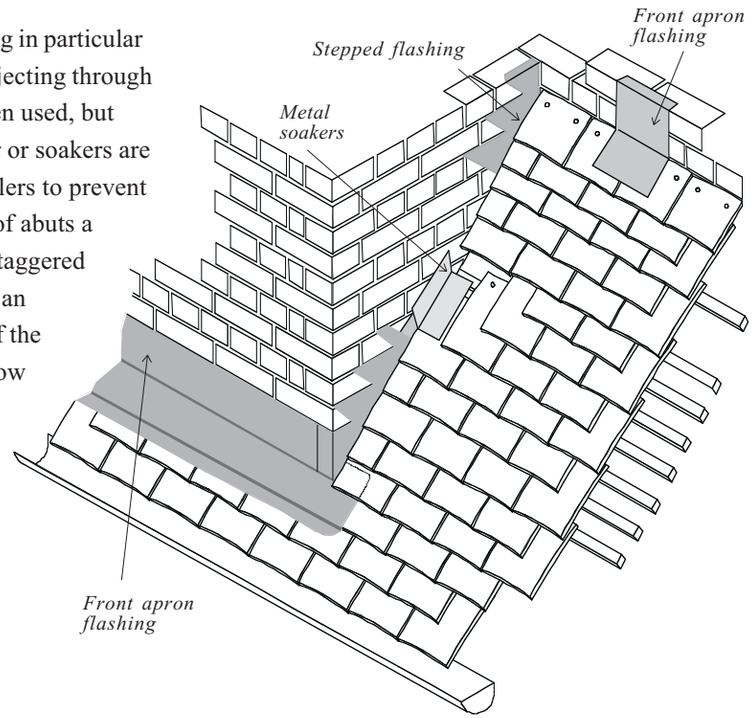
Junctions

4.20 The underlay should overlay the roof junction by a minimum of 150mm in each detail.

Abutments

4.21 Late Victorian terraced housing in particular might include separating walls projecting through the roof. Cement flaunching is often used, but metal flashings over a secret gutter or soakers are best. Copings usually require kneelers to prevent them slipping. Where a pitched roof abuts a separating wall in a stepped-and-staggered situation, part of the roof becomes an external gable, and the outer leaf of the masonry becomes an inner leaf below roof level. Particular care is needed to ensure that rainwater is prevented from reaching the interior. Soakers for plain tiles should be a minimum width of 175mm to give an upstand of 75mm against the wall, and a lap of 100mm under the tiles. A cover flashing then laps the soakers by 50mm – more if it can be arranged. Underlay should be turned up the abutment by not less than 50mm under the flashings. Alternatively, soakers with 50mm may be suitable, using 240mm lead, allowing 100mm of flashing to extend over the tiles as well. The upstand would have 50mm to the 'water line' before the innermost point of the cut for each step, and 25mm turned into each joint.For a brick

Fig 13:
Top edge and side abutments with metal soakers



abutment, the underlay should be detailed to lap over the material forming the back gutter by 100mm to 150mm, depending on the pitch of the roof. Ponding or water traps behind the tilting fillet should be prevented by design. In lieu of lead flashing sometimes cut tiles, set an angle and bedded in lime mortar at junctions to provide weather protection, can be an alternative detail and are probably the only way to flash a roof to an existing flint wall.

Details Checklist

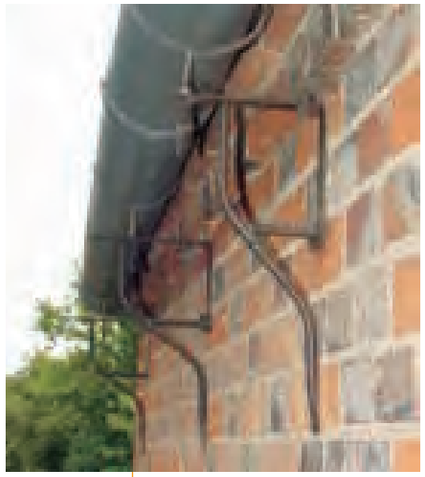
- **Do** ensure consistent use of appropriate lime mortars
- **Do** ensure dressings are correctly detailed
- **Do** use appropriate lime mortars
- **Do** use half-slip tiles at verges rather than tile-and-a-half tiles
- **Do** proportion the eaves overhang
- **Do** ensure valley tiles or hip bonnets are appropriate to the building or local area

- **Don't** specify half-round ridges unless the roof is steeply pitched
- **Don't** specify cloaked verges
- **Don't** specify plastic bargeboards, fascias etc.
- **Don't** over-embellish roofs with unnecessary details
- **Don't** spoil good tilework with 'sloppy' or 'smeary' mortars

Rainwater Goods

4.22 Cast iron or aluminium, or in some cases, lead, will be more appropriate to use rather than plastic. BS 6367 covers rainfall rates to be provided for and therefore the size of guttering required. If gutters are undersized, water spillage can saturate walls and lead to dampness internally. Positioning down pipes in the centre of runs of guttering rather than at ends will reduce the maximum water load on gutters and help to prevent surcharging and overflow. Gutters should be fixed with a slight fall to allow for some vertical movement. A fall of about 1 in 350 (10mm per 3m run) is recommended. Roofs of a more complex design will need special calculations to the requirements of BS 6367. The provision of gratings over rainwater pipes and outlets in gutters is a matter for judgement. BS 6367 recommends they are not provided in outlets smaller than 150mm; wire or plastic balloons may be a better alternative. Where downpipes discharge onto a lower roof, if it is of tile (or slate) the discharge will fan out before reaching the lower gutter – not the case with heavily profiled tiles. Weirs or overflows should be incorporated in the design to prevent spillage of water over the sides of the gutters. It is wise to design to a higher code than set out in the standard. Siphonic drainage systems can remove large quantities of water from a roof quickly, although maintenance requirements are even more severe.

4.23 If gutters are undersized, water spillage can saturate walls and lead to dampness internally. Careful detailing is required where underlays extend into the gutter. Underlays of BS 747 class 1F do not perform sufficiently when exposed and should be reinforced with a more durable felt, e.g. type 5U as specified in BS 747, or a proprietary eaves device.

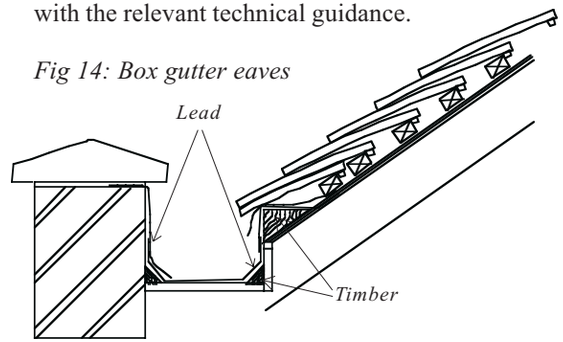


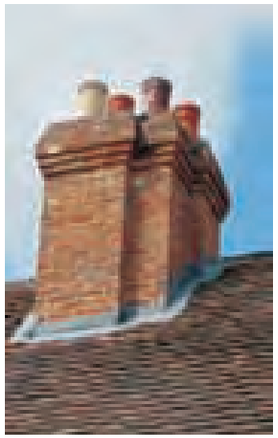
Elegant wrought iron gutter brackets (Ewelme)

4.24 One common occurrence is that of inadequate support for wide valley gutters in pitched roofs, with the consequent risk of fracturing or puncturing the surface of the gutter. If lead is used, it should be in accordance with the relevant technical guidance.

4.25 Box gutters can easily become blocked with debris, and because they are hidden, tend to suffer from lack of routine maintenance. Design and implementation should be in accordance with the relevant technical guidance.

Fig 14: Box gutter eaves





Brick chimney with traditional detailing (Chiltern Open Air Museum)

Leadwork to flashings and valley (Beaconsfield)

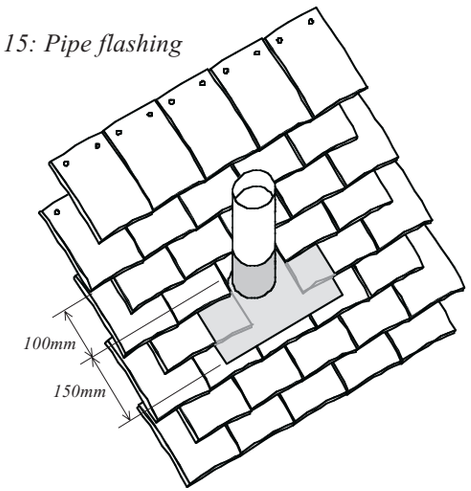
Chimneys, Flues and Vent Pipes

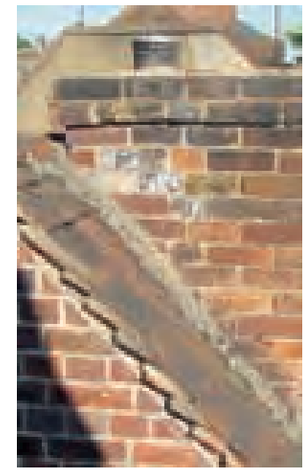
4.26 Stacks are increasingly being omitted from new buildings where heating systems no longer make them a necessity. Maintenance problems are therefore reduced - chimneystacks are inevitably exposed to the 'elements' and to reactions between vastly different internal and external environmental conditions. Mortar flaunching used as flashing may for example crack and eventually fall out allowing moisture to penetrate the roof, leading to timber decay and dampness. However, roofs can look particularly stark without conventional stacks, and to omit them is to deny the possibility of heating rooms using an open fire. With pressure mounting to consume sustainable, renewable resources, the possibility of a reliance on wood as fuel – particularly in the Chilterns - should be accommodated at the design stage. Pointing and flashings need to be particularly robust. Tile fillets around chimneys almost inevitably shrink from the brick as the roof moves, and let in water. Stepped lead flashings are almost invariably preferable. Flashings often have insufficient upstands (sometimes as little as 50mm) - even 150 mm deep flashings may be defeated by strong winds, rain water systems backing up or drifting snow. Flues should avoid piercing the roof in visually sensitive areas; lead (or other shaped material) round SVPs is often not large enough to lap adequately with the adjacent tiles. Air admittance valves can often be used to obviate the need for a soil stack to penetrate the roof covering.

Chimneyless roof (Kingshill)

Lead flashings (Hemel Hempstead)

Fig 15: Pipe flashing





Mortar flashing (Berkhamsted)

Tall brick chimney, recently repointed (Little Missenden)

Pipe flashing (Hemel Hempstead)

Sourcing and Selection

Selecting a Contractor

5.1 Ensure the contractor will keep to the specification. The roofing sector is competitive and contractors might promise cheaper or better materials – these offers should nearly always be treated with suspicion. Check contractors by visiting other sites they have worked on and confirm they observe all Health and Safety requirements (particularly the Working at Height Regulations). Undertake a full risk analysis and eliminate any obvious risks. Ensure no complex procedures take place at height – especially in confined areas. Ensure that adequate guarding and protection are written into the documentation. Wherever possible, avoid or prohibit the use of construction processes that have a fire risk.

Roofing work requires rigorous health and safety measures to be in place

Obtaining Roofing Materials

5.2 Recent evidence of the increase in the use of clay tiles is demonstrated by the 50% increase in the volume of clay tiles produced and sold each year since 1995. The number of suppliers is growing to meet this demand – contact the Chilterns Conservation Board for details.

5.3 If salvaged tiles are being used, nails or pegs should be removed carefully, before stacking, to avoid damaging the holes. Broken, cracked or crumbling tiles should be discarded and further recycled unless they can be cut for eaves, verges or tops. Tiles should be stacked on level ground on boards raised up on blocks. They should be covered with waterproof sheeting during storage. Stacks should not exceed 3 layers to avoid the bottom layers being damaged by the weight of those above. Tiles should be stacked vertically on their long edges. When so stacked on a scaffold they drain quickly when it rains. If stacked on their faces they retain the water and are also more likely to crack.

5.4 Roofing merchants are often extremely knowledgeable and may keep or know of sources of second-hand materials. However, they must be technically appropriate for new work and should always be carefully sourced.

Prototype Chilterns tiles, 2007 (H. G. Matthews)

Chapter 6

Repairs, Alterations and Extensions

Repairs and Maintenance

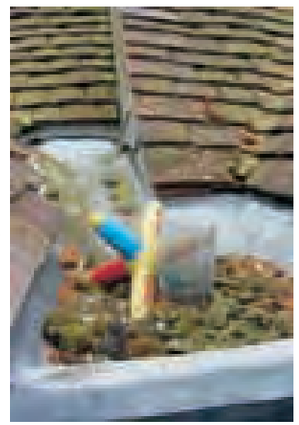
6.1 Gutters and rainwater hoppers should be cleared out annually (BS 6367); more frequently if trees are in the vicinity. The condition of gutter supports should also be checked. Plant growth will often affect gutters and ivy can penetrate the joints between slates and tiles. Careful removal is required so as not to further damage the roof covering. Green algal growth, lichens and moss can occur on many roofs. These natural growths, if not excessive, can add still further textural and colour interest, although they can increase the risk of frost damage to porous tiles and may interfere with drainage occasionally. Careful brushing off, rather than use of power jets or proprietary solutions (both of which can cause terrible damage) will then be necessary. Lead can be treated with a patination oil to prevent staining where it

Poorly maintained gutter (Lewknor)

Lichen growth (Bledlow)

lies above susceptible tiles, slates or glass. Chimneys should be regularly inspected to ensure: they are exactly vertical; that the pointing is sound; that flashings are not lifting and are properly wedged into mortar; that any pots are not cracked or damaged, and that the pot mortar is not cracked or lifting.

6.2 All old clay tile roofs will have weathered, often to a far darker red-brown colour than the original distinctly red/ orange or paler red/ brown colours.



Debris in outlet (Tring)

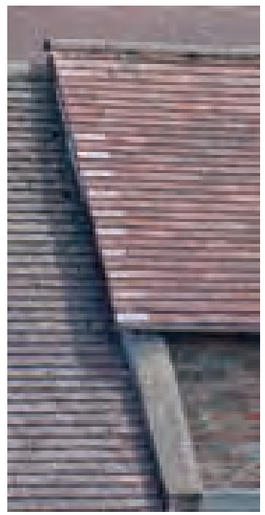
Provided they have been properly fired and fixed, the tiles should last 100 years and more, though manufacturers' guarantees tend to be for much less than this. All types of tiles can suffer nail corrosion. Older tiles with nibs, especially the Etruria marl types, are the ones most likely to delaminate. Some older tiles may be found to be underburnt, giving rise to delamination and deterioration. They do not ring true when tapped, and some can be snapped by light hand pressure. The odd tile may therefore need replacing from time to time, most probably after strong winds. It is often difficult to achieve a very close match – great care is needed in selection. The mixing of modern smooth machine made clay plain tiles or concrete tiles in with an old tile roof is not acceptable. Apart from spoiling the aesthetic purity of an old roof by 'spots' of alien materials, they can look very odd with 'lanes' or courses of jarring tiles, where

Patched repairs (Berkhamsted)

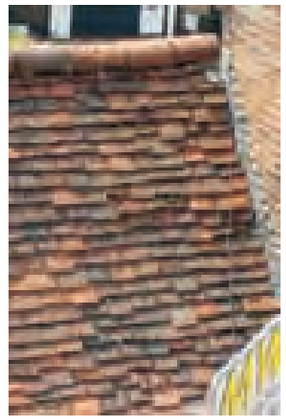
thoughtless repair has been undertaken. Equally, because peg tiles tend to be smaller than other plain tiles; the latter should not be used for repairing peg-tile roofs as forcing in an oversized tile will cause the others to ruck up or break. Tiles from the Loughborough area are usually 11" x 7" and are also not compatible with peg tiles.

6.3 Sprayed treatment of undersides of roofs is not recommended; completely 'wet poulticing' the battens may possibly lead to rot. It will also prevent traditional roofing materials being salvaged for reuse and make further traditional repair difficult if not impossible. Such treatment may also result in restricted roof space ventilation with the consequent risk of fungal and insect attack to roof timbers.

6.4 Where the tiles have come to the end of their useful life, it will be necessary to strip off the existing roof covering. Matching like-for-like traditional repair will not require listed building consent, but it is advisable to agree this work in advance with the Conservation Officer. Consider changing from concrete tiles or other materials to a clay tile roof. It is often possible to convert a flat roof to a pitched roof, allowing tiles to be used. The use of unsuitable modern products can damage a building's resale value, and its structure. When re-roofing with tiles, it is often possible to salvage 75% of the original roofing. Great care will need to be taken in removing and stacking. Tiles should be inspected as they may help to document the history of the building. Nails and pegs should be removed before stacking. In cases where roof pitches are concealed from public view, the salvaged tiles from the original roof should be used on the prominent slopes.



Verge poorly repaired with tile-and-a-half replacements (Berkhamsted)



Tiled roof in poor repair (Hemel Hempstead)

6.5 Apart from replacing tiles that are cracked or delaminated, repairing a roof will offer an opportunity to strengthen a weak roof structure – however excessive 'straightening up' should be avoided. Therefore only those timbers affected by rot etc. should be repaired; sagging or twisted purlins, spreading rafters, and rotating wall-plates should be reinforced or replaced only if they compromise the performance of the roof. The opportunity to replace old sarking and improve flashings round chimneys should always be taken. Any project involving the replacement or re-roofing of a roof involving more than 25% of its area requires the insulation within the building to be upgraded to comply with Part 'L' Building Regulations.

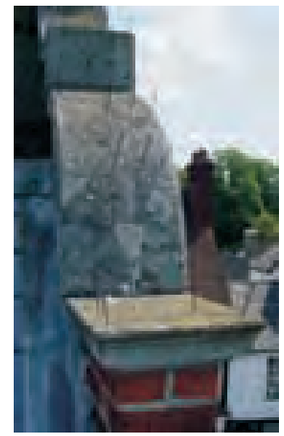
Flat to pitched roof conversion (Christmas Common) (Highly Commended in 2005 Design Awards photos by A. Ingram and C. White)

Roof timbers under repair (above) and roof being stripped (below) both at 173 High St., Berkhamsted

6.6 Care is needed to detail gables, verges, ridges, hips, abutments, parapets, eaves and valleys correctly. In most situations, cut slip tiles should be used at gable verges, not modern tile-and-a-half purpose made tiles. Ornamental tiles should be preserved as they can add to the character of a building. Where tiles are banded, the coursing should be accurately recorded and recreated when the new roof is laid. Existing profiles and mouldings of bargeboards and fascias should be matched. Original rainwater goods should be maintained and retained. Oak pegs and riven oak laths should be reinstated or replaced like-for-like – especially where the underside of the roof is visible – as in barns or outbuildings. Original torching, where the tiles are in good condition, should be repaired with lime-hair mortar.

6.7 Bats are particularly attracted to old roofs and it is a criminal offence under the Wildlife and Countryside Act 1981 to intentionally injure or disturb a bat, damage a bat roost or obstruct the entrance to a bat roost. Swift nests should not be disturbed. Infestation of roofs by edible dormice (Glis glis) is a problem in parts of the Chilterns. Their removal requires a licence issued under the 1981 Act. Grey squirrels can be a problem not least to electric wiring insulation. They, and larger varieties of insects, can be excluded by a provision of a 3-4mm mesh over ventilation slots. Pigeon-proofing measures can help prevent roof coverings being fouled by droppings, but the solution of using wires and pins can itself be unsightly and may damage historic fabric.

6.8 Traditional roofing materials in the Chilterns should not be replaced with alternatives and consent will certainly be required if on listed buildings. Consent is also required if a proposed 'repair' is not a like-for-like repair. Legislation relating to roofs covered with asbestos tiles or sheeting should be strictly observed. If the roof covering is being changed, it is also advisable to discuss the work with officers to determine whether a formal building regulations applications is required. For example, the increase in dead load when Welsh bests are replaced with concrete tiles can be as much as 100%. The Building Regulations 1991 Approved Document A provides for suitable calculations to be made for such replacement coverings. Where a roof is being re-covered adjacent to a roof which is remaining, attention must be paid to achieving weathertightness of the joint between new and old.



Pigeon-proofing (Hemel Hempstead)

Roof tile inscribed 'John Babb 1745' (Chiltern Open Air Museum)

6.9 Where slate roofs are encountered, replacement of the occasional slate due for example to 'nail sickness' (corrosion of nails) is possible by using a tingle inserted under the slate above, and turning up its tail to retain the inserted slate. The top of the inserted slate must be made to rest on the lip of the batten. Proprietary clips which can be nailed in the gap between the upper slates are also available. When re-roofing is required, existing slates should be re-used whenever possible. New slates are expensive and good quality salvaged slate is likely to last longer than artificial imitations.

Changing roofing materials may impose additional loads on the roof structure and may detrimentally affect the character of the building (Hemel Hempstead)

6.10 Always seek appropriate expert advice when maintaining thatch. Trees should not be allowed close to, and clematis and trailing plants should be removed from, thatch. Chimneys should be kept in good condition and the roofspace clear of dangers such as exposed electrical wiring. Materials may be slipping or the surface coat may look messy, but cosmetic repairs may address these problems rather than a complete rethatching. Restoration of thatched properties sometimes leads to unnecessary, undesirable and damaging changes to the roof's appearance. Repair should be on a like-for-like basis. Recoating may add weight to the present thatch – the underlying roof structure should therefore be carefully checked, and the base coat should be restored to a sound and level surface. Gables and eaves may need to be stripped out, and remedial works may be required to eaves, verges (including bargeboards) and chimneys. Ridges will require attention more frequently than the main roof covering.

Tingles (Berkhamsted)

Alterations to this former tile and thatch roof have radically changed the building's appearance (Aldbury)

6.11 Where repairs are required to lead and copper, felt and bitumen is not an acceptable substitute. Lead cast in the traditional way is preferred over milled lead; more recently, industrially produced cast lead sheet has become available.

Conversions

6.12 A consequence of flatter roof designs is lower lofts and less roof space, reduced further by being used for water tanks, pipes, aerials etc. If the roof is of trussed rafter construction (mainly post 1965) the roof will need to be rebuilt using steel to free up the loft space occupied by the closely spaced W trusses; the loft floor may also require strengthening. Detached houses built in the 1970s and 1980s may well require elevation of the roofline to achieve the required ceiling height. Building regulations will apply particularly to structural considerations and fire planning. Internally, traditional stairs will give safe and easy access; other types will gain approval only where space is restricted. For two storeys, the route must discharge to a door leading to an external safe place and not in a room. Escape

Loft conversions should have a minimal impact on the existing roof. Note also the use of diamond patterns in the tiles (Flaunden)

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

Conversions of buildings should seek to minimize the impact on the roofscape. Even here, TV aerials, vents and rooflights break up the formerly unobstructed roof covering. (Leverstock Green)

windows need to be large enough and positioned for easy rescue by ladder. Dormers should be built with a warm deck roof, and cupboards should be within the insulated envelope to ensure continuity of the lining. The rafters of attic trusses normally allow adequate depth for ventilation over insulation.

6.13 Conversions of existing buildings from one use to another will impose design and possibly structural alterations on an existing roof. Requirements for skylights or dormer windows will break up the roofscape and require careful consideration so they do not affect the overall stability of the roof. The requisite permissions should be sought at an early stage – planning permission for change of use and listed building or conservation area consent if the building is so protected.

Well-designed extension – note the saddle ridge and slight change of pitch (Kensworth Church)

Extensions and Alterations

6.14 Any extension should be carefully designed with particular care being taken over roofslope and materials. Extensions tend to be 'roofing intensive' and can easily overwhelm an otherwise balanced exterior. Because of the inherent difficulties of extending roofs on the same roofline and plane – which often results in an ugly and jarring transition of new and old tiles or slate – it is generally desirable to establish a break between the old and the new. Indeed extensions should usually be clearly subordinate in bulk and form, and a physical distinction is likely to be desirable. Do not therefore immediately assume that the roofing material for the extension should match exactly the original covering. Reclaimed tiles tend to 'rob Peter to pay Paul' and it would be preferable to ensure that any reclaimed tiles are used to repair existing tiled roofs rather than used to create new ones. Also it is clear that in the past alternative readily available materials that came to hand were often employed to good effect. Main roofs of clay peg-tiles may have extensions of slate, or

Well executed extension (Turville)

New slate roof to right poorly tied in to existing roof (Jockey End)

sometimes pantiles, thatch or corrugated iron. Careful variation of materials on secondary roofs can thus considerably enrich a design.

6.15 Where extensions are being added to existing dwellings, the main roof may be found not to have any sarking felt. Where this occurs at a valley, the old roof needs to be stripped back a short distance, and a batten laid along the length of the valley over which the new sarking can be lapped.

Repairs Checklist

- **Do** seek specialist advice for repairing traditional roofs
- **Do** identify the causes of any roofing faults before specifying solutions
- **Do** restrict repairs to the minimum necessary
- **Do** match replacement tiles with the existing roof
- **Do** ensure roofs of extensions blend in with or complement existing roofs

- **Don't** spoil roofs by introducing alien materials
- **Don't** use harmful cement based mortars for repairwork
- **Don't** use spray treatments on the undersides of roofs

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

Designing for Sustainability

7.1 Sustainability statements are becoming standard requirements in planning applications. The role of the roof should not be ignored as its design can improve the performance of the whole building envelope. If carefully planned, sustainable features such as photovoltaic cells, solar thermal installations and sun pipes need not detract from the overall appearance of the roof or building. They can often be successfully incorporated in 'traditional' designs, but they may also be particularly appropriate where a bold new design is being considered. Listed building consent will be required for such additions to the roof slopes, and in some cases planning permission will also be required. On some historic roofs such installations would always be detrimental but panel arrays can be mounted on the ground in locations where they would also be less intrusive in an historic building's context. A balance needs to be struck between the objectives of conserving and enhancing the special character of the AONB and the drive for renewable energy.

Photovoltaic (PV) Cells and Solar Thermal Technology

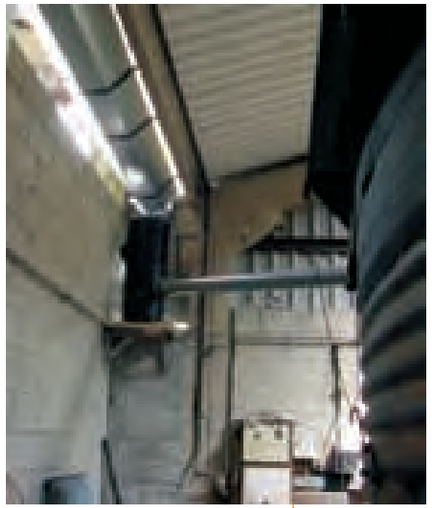
7.2 Solar power is an infinite source of energy, providing pollution and noise-free electricity without using extra space. The systems which harness it are becoming increasingly economically viable and require little maintenance. The sun's energy can be converted directly into electricity using photovoltaic cells. Alternatively, solar radiation can be converted into heat by solar water-heating panels. PV can also be incorporated as canopies and skylights, and also in building facades.

7.3 Grid-connect PV systems are connected to the local electricity network, which acts as an energy storage system, which means the PV system does not need to include battery storage. PV technology is ideally suited to use on sloping rooftops, where modules can simply be mounted using frames. PV roof tiles are also now available which can be fitted as would standard large format tiles. A PV system might consist of a number of PV modules connected together to give the required power – typical modules have a rated power output of around 75-120 Watts peak (Wp) each. A typical domestic system of 1.5-2 kWp may therefore comprise some 12-24 modules covering an area of between 12-40m2. An inverter coverts the low voltage DC to a higher voltage AC. A meter, cables and switches to isolate the PV generator from the building and mains complete the system. A 2 kWp system for a house might cost between £12,000 - £14,000 (tile type systems tend to be more expensive). Grants may be available.

7.4 Domestic water heating systems consist of solar collectors mounted on the roof which heat a water tank via a circulating fluid. The overall area of the panels is typically 3-4 square metres. A control unit, connecting pipes, normal hot water tank, and back up heat source such as gas or electric immersion heater complete the system. A plane inclined about 30 degrees, facing the south would be expected to yield around 1,250 kWh/m2 in the Chilterns . The optimum angle for a south facing collector is 0.9 multiplied by the latitude + 29°. This maximises winter collection and reduces over-production in the summer. The optimum

Solar panels (Photo by C. White)

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version



Rainwater harvesting system, used for watering the greens (Little Hay Golf Complex, Boxmoor)

angle of tilt for the spring and autumn is the latitude minus 2.5°. The optimum angle for summer is 52.5° less than the winter angle.

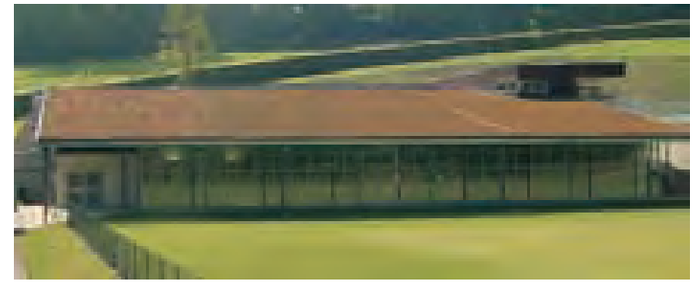
7.5 Design considerations include optimising the placing of the collectors taking into account orientation (due south is the best possible), shade and available area, the choice of system and whether planning permission is required. See **www.greenenergy.co.uk**

Rainwater Harvesting

7.6 Rainwater harvesting is the collection and storage of rain from roofs for future productive use. Water is a precious resource and yet much of it is flushed down the drain. A simple rainharvesting system, with filtered water gathered from the roof into an underground tank, can provide water for toilets, washing machines and gardens, saving up to 50% of mains water used. The payback period for a domestic system is currently 10-15 years, and could be considerably less for a larger scale commercial system. As rainwater harvested from roofs can contain pollutants, it cannot be used for drinking water without suitable treatment. However, in a chalky region like the Chilterns, the use of soft rainwater in washing machines etc. will avoid the build up of limescale. Rainwater Harvesting forms one component of an integrated approach to Sustainable Drainage Systems (SUDS) See **www.ukrha.org**

Green roofs

7.7 The environmental benefits of turf and green roofs are widely recognised, in creating biodiversity, the opportunity to create outdoor roof gardens, savings on energy consumption by enhancing insulation, and providing a constant temperature throughout the year. A 'green' roof is clearly more of an abrupt departure from traditional forms of roofing. However, they can soften harsh edges of buildings in sensitive environments, making them blend in with the surrounding area. It is also perfectly possible to incorporate 'living" roofs on discrete rear extensions. The two principal design considerations are that the structure is capable of supporting the weight of the material when fully saturated and that the construction is watertight. A green roof will therefore usually consist of a waterproofing layer, which must be root-resistant or include a root barrier, a drainage layer, a filter layer and the growing medium. However, methods of construction differ between pitched and flat green roofs. Flat green roofs can either be extensive (ie have a thin layer of growing material such as sedum matting) or intensive (ie greater soil depth with shrubs and even trees). The



Green roof (Berkhamsted)

weight requirements for intensive green roofs are such that they are normally installed over concrete roof decks. Only contractors trained in green roof installation should be used. The system should be supported by manufacturers' and contractors' warranties.

For more information visit **www.livingroofs.org**

Sustainability Checklist

- **Do** use hand-made clay peg-tiles manufactured in the region
- **Do** design for re-usability
- **Do** maximize the building's performance by careful roof detailing
- **Do** design roofs to harness energy-saving natural resources

Glossary

Abutment: the point of junction where the roof slope meets a vertical surface or intrusion (e.g chimney or wall)

Arris hip tile: a purpose made tile, used with plain tiles, which 'wraps' around a hip

Attic: a storey of a house entirely in the roof

Bargeboard: a board, often covered or decorated. attached along the eaves of a roof in front of a gable.

Bonnet hip: a rounded hip tile used with plain tiles which gives the appearance of a lady's bonnet (known as a 'granny's bonnet'). The void beneath hip tiles is filled with pointed mortar

Boxed eaves: eaves in which the members are concealed by simple woodwork

Brace: a timber, either curved or straight, placed diagonally, to strengthen a frame, so as to form an approximate triangle with two structural timbers

Capital: the crowning feature of a column

Cloaked or dry verge: tile used at the verge (gable) which wraps over the edge of the roof

Cogging: the laying of bricks diagonally in a decorative course eg cogged eaves

Collar: a horizontal timber tying together a pair of rafters or principals, always above tie-beam level

Coping: construction or component at top of a wall that is weathered and grooved, and overhangs the wall surface below to throw water clear and provide protection

Corbel: a projection from a wall or reveal designed to support a weight

Cornice: the uppermost of the three main divisions of the Classical entablature. Often used in isolation above an opening. An eaves cornice is a moulding masking the eaves

Coupled: rafters joined by collars

Creasing tile: a flat tile without nibs for decorative features for walls and window sills

Cresting: ornamental finish, or decoration, standing above a horizontal feature such as the ridge of a roof

Cross wing: a range joined to the main range but with its roof running at right angles

Crown post: a form of king post, in that it stands centrally on a tie beam, but to support a collar purlin and generally braced also to one of the collars

Cruck: A curved timber joined with another to make a truss, by which the roof is directly supported from a point no higher than midway up the wall

Cupola: a small dome or domical roof

Decorative hips: a hip tile available in a variety of shaped crests

Decorative ridge: a ridge tile available in a variety of shaped crests

Dentil: one of a row of small blocks in the moulding above the frieze of a classical entablature

Dormer window: a window partly or wholly above the eaves, but vertical and thus breaking the roof-line

Double-camber: a tile arched both horizontally and vertically

Eaves: the overhanging horizontal, lower edge of the roof

Eaves (or Top) Tiles: short tiles used in a single course to give a double course of tiling at the eaves (or ridge)

Eaves soffit: boarding placed under spreading eaves to conceal the rafters or sprockets

Entablature: the horizontal part of a Classical order carried by the columns, and consisting of architrave, frieze and cornice

Eyebrow dormer: a very low dormer over which the main roof lifts and falls without a break

Finial: a terminal feature, e.g. at the end ridge of a gable and with some form of decoration on it, e.g. a scroll, ball top or fleur-de-lys

Flaunching: a mortar fillet designed to throw off water at the junction where a masonry chimney stack penetrates a roof

Froe: an axe-like tool used to split wood along the grain

Full dormer: one in which the entire window is above the eaves line, and the face of the dormer is flush with the wall

Gable: triangular upper part of wall at end of a ridged roof

Gablet: a small gable which stands above one of the pitched sections of a hipped roof and continues to the ridge or similar feature, breaking one of the longer pitches of a roof

Gauge: the distance between two roof battens

Half dormer: only partly projecting into the eaves, but with the window partly above the eaves line

Half hip: the hipped pitch begins halfway up the gable

Hip: the junction of two inclined surfaces which meet at an external angle

Interlocking tile: a single lap tile that connects with adjoining tiles by means of close fitting ribs

Chilterns Roofing Materials Supplementary Technical Note - Adopted Version

King post: a post which stands centrally on a tie beam or collar and directly supports the ridge piece

Kneeler: the base stone of a gable, projecting out from the wall and supporting the coping

Laced: method of weaving together adjacent tiles to turn a roof angle

Lap: the amount by which one tile covers part of another

Ligger: A length of roundwood (usually hazel or willow), often split, laid over the upper surface of a thatch to hold in the eaves and barges of a long straw roof

Mansard roof: one with a steeper pitch and a shallower upper pitch on each side

Mathematical tiles: hanging vertical tiles which gives the appearance of brick cladding

Mitred hip: an abutment of two tiles at the hip

Modillion: a small moulded bracket in the cornice

Pantile: a single lap tile moulded to an S-shape which gives the appearance of 'waves' and 'troughs' on the roof

Parapet: a low wall at the top of a wall, i.e. beyond the eaves line (which the parapet conceals)

Bands picked out in darker tiles (Aldbury)

Peg tile: a tile similar to a plain tile but without nibs and with holes for pegs

Plain tile: small roofing tile (265mm x 165mm) cambered and having no other feature except nibs/nail holes

Plate: the timber into which the feet of the rafters are framed

Principal: one of the rafters of a larger section in a roof which supports the purlins and is framed into the tie beam

Purlin: a longitudinal member in a roof below the ridge piece and above the wall-plate

Queen post: one of two uprights, rising from a tie beam to support a collar

Rafter: one of the sloping timbers in a roof which directly supports the covering

Raking dormer: a window above the eaves with a roof pitched in the same direction as, but shallower than, the main roof

Rainwater head: the hopper, sometimes ornamented, at the junction of a gutter and downpipe

Ridge: the horizontal apex of two slopes on a pitched roof. In tiling, a single course of short tiles is used both sides of the ridge

Ridge tile: tile covering the apex

Roman tiles: half-round overs and unders (true roman); half round overs and flat unders (single Roman); twin half round overs and flat unders (double Roman)

Scantle slate: slates laid in diminishing courses

Single-camber: a traditional plain tile, arched along its length from head to tail

Soaker: metal formed as a side cover piece to extend over a roof covering and overflashed so as to weatherproof the perimeter of roof penetrations or projections

Spire: a tall pyramidal roof

Sprocket: a small timber attached to the rafter to prolong, or reduce the pitch of the eaves

Stack: the structure of masonry appearing on the exterior of a building and acting as a funnel to carry smoke from a fire out of a building

Sun pipe: domed tube that sits on the roof surface with a reflective connecting pipe allowing light to be directed to a room below

Swept eaves: those which project at an angle rather shallower than the main pitch of the roof, being supported on sprockets

Swept valley: one formed by curved slating, tiling or stone rather than by a lead or zinc flashing

Tie beam: structural member passing across a building at the level where the roof structure begins and into which the feet of the principals (if any) are tenoned into

Tile and a half (Gable tile): a tile one and a half times the width of a standard plain tile to maintain a broken bond at verges and abutments. Sometimes called a gable tile

Tingle: a bent metal strip of lead, zinc, copper or aluminium, approx 2" long, used to reposition a slate securely. The strip is nailed to the batten below the slate to be replaced and then turned back as a stirrup to secure the slate

Torched: process of applying mortar to *in situ* tiles to give added security against the weather. 'Single torching' consists of pointing the head of each tile from the inside of the roof. In 'full torching' the vertical joints between adjacent tiles are also pointed

Truss: the triangular figure formed by a tie beam and the two principals

Valley: the junction of two inclined roof slopes which meet at an internal angle, lined with lead or special valley tiles

Verge: the edge of the tiles projecting over the gable

Vertical tiling: general term applied to plain tiles fixed to walls to form a wall cladding, often known as "tile-hanging"

Bibliography

Ashurst, J. and N., *Metals*, Vol. 4, English Heritage Technical Handbook, Practical Building Conservation, 1988

Bennett, F. and Pinion A., *Roof Slating and Tiling*, 1948, reissued (Donhead), 2000

Brockett, P. and Wright, A. *The Care and Repair of Thatched Roofs* (SPAB) Technical Pamphlet No 10, London, 1989.

British Standards Institution, Clay roofing tiles for discontinuous laying. Products, definitions and specifications. *British Standard* BS EN 1304: 1998. London, BSI, 1998

British Standards Institution, Code of practice for slating and tiling. British Standard BS 5534: Part 1: 1997 and Part 2: 1986. London, BSI, 1997 and 1986.

Chilterns Conference, Chiltern Buildings Design Guide, A Countryside Design Summary, 1999

Chilterns Conservation Board, Chilterns Buildings Design Guide, Chilterns Flint: Supplementary Technical Note, 2003

Chilterns Conservation Board, Chilterns Buildings Design Guide, Chilterns Brick: Supplementary Technical Note, 2006

Clay Roof Tile Council, *Plain Tiling Guide* (ND). Available on CRTC website, see www.clayroof.co.uk

Clay Roof Tile Council, *Vertical Tiling Guide* (ND). Available on CRTC website

Dobson, C.G., Roof Tiling, 1931

East Herts District Council *Tiles and Slates* Historic Buildings and Conservation Areas: Guidance Notes, (ND)

English Heritage, *Thatch and thatching: a guidance note*, 2000

Fearn, Jacqueline, *Thatch and Thatching* Shire Album, Reprinted 2005

Harrison, H.W., *Roofs and roofing* BRE Building elements, 2000

Hertfordshire County Council *Tiles and Slates in Hertfordshire* Hertfordshire Conservation File/ Information and Advice 3 (ND)

HSE, *Safety in roofwork* (Guidance Booklet HS(G)33)

Hutson, A. M., *Bats in Houses,* Bat Conservation Trust, 1993 (ISBN 1872745105)

Lead Sheet Association The Lead Sheet Manual
Vol 1: Lead Sheet Flashings 1990
Vol 2 Lead Sheet Roofing 1992
Vol 3 Lead Sheet Weatherings

Lemmen, H. Van, *Ceramic Roofware*, Shire Album 420

Moir J., and Letts, J., *Thatch: Thatching in England 1790-1940.* English Heritage Research Transactions: Research and Case Studies in Architectural Conservation, 5, 1999

Williams, G.B.P, *Chimneys in Old Buildings* (SPAB) Technical Pamphlet No 3, London 1971.

(Berkhamsted, Photo by E. Sumner)

Further Advice

For any new development proposal you should initially contact a Development Control Planning Officer in the Planning Department at your local council. Additionally, if your proposal involves a listed building or is in a Conservation Area, you should contact a Conservation/Listed Buildings Officer. You will also need to contact your Local Building Control Service.

Details of all the councils that cover the Chilterns AONB can be obtained from the Chilterns AONB Office.

The office will also be able to provide details of suppliers, practitioners and other useful contacts. This list may change from time to time, so it is recommended that you check it regularly if you undertake projects at different times.

For further information and advice contact the Chilterns Conservation Board at the following address:

Chilterns AONB Office
The Lodge 90 Station Road
Chinnor Oxon. OX39 4HA

The Chilterns Conservation Board

Tel: 01844 355500 Fax: 01844 355501

Email: office@chilternsaonb.org
website: **www.chilternsaonb.org**

Published with assistance from

ISBN 0 -9545242-4-1

The Chilterns

an Area of Outstanding Natural Beauty