Vernacular Slating in the East Midlands

SPAB Regional Technical Advice Note

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Contents

This Advice Note describes the production and use of the roofing slates and stones of the East Midlands of England. It includes the metamorphic Swithland slates, the Jurassic limestones - Collyweston slates and similar stones from the Northampton and Banbury area - and briefly, the Magnesian limestones. It deals with the maintenance and repair of roofs, considers details specific to the traditions of roofing in the region and explains, where appropriate, adaptations to incorporate modern requirements, such as improved thermal performance.

Cover image: Swithland slating near Leicester. The house was reslated in 2003.
Photo: Terry Hughes

1 Introduction

In the roofscape of the English Midlands, which is otherwise dominated by tiles and Welsh slates, four areas still display vernacular stone roofs: Swithland slate in and around Leicester; Magnesian limestones to a small extent between Mansfield and Doncaster; Collyweston stone slate near Stamford in Lincolnshire but used over a much wider area, even as far away as New York state, USA; and other Jurassic stones in the Northampton area.

The products of small quarries and mines, these slates are all random-sized with distinctive features and are formed into roofs with characteristic techniques which are regionally important.

Swithland slate is a true metamorphic slate of Cambrian age (Swithland Formation). Fissile beds of limestone were worked in the Magnesian Limestone (Cadeby Formation), the Middle Lias, Northampton Sand and Lincolnshire Limestone Formations, and the Great Oolite Group (see table 1); some were split by natural frost action.

Formation			Stone slate sources
Jurassic	Great Oolite Group	Oxford Clay	
		Kellaways sand and clay	
		Cornbrash	
		Blisworth Limestone*	Oundle (possibly Yardley Chase)
		Rutland Formation (Upper Estuarine Series)	Pytchley, Hoping Hill, Helmdon, Kettering, Wellingborough, Northampton, Duston
	Lincolnshire Limestone Formation	Upper	
		Lower (Collyweston Slate)	Wothorpe, Burghley Park, Wittering, Collyweston, Duddington, Deene Park
		Grantham, Formation (Lower Estuarine Series)	
	Northampton Sand Formation	Variable Beds	Duston, Harlestone, Pitsford, Weston Favell
		Ironstone	
	Middle Lias		Sulgrave, Chacombe, Banbury
Permian	Magnesium Limestone	Cadeby Formation	Steetley, Bakestone Moor, Whitwell (possibly Worksop)

Table 1: Historical sources of stone slates in the East Midlands

* Blisworth Limestone is known locally as Oundle limestone

Specialised slate and stone roofs are rare. Indeed, some types may have disappeared long ago, but they are important to the history of local economies and cultural heritage, and wherever they still exist they should be carefully conserved. They are major elements in the character of historic buildings and settlements, and help give individual buildings, towns and villages their sense of place.

This is in part due to the materials themselves, with their different colours, textures and sizes, but also to the way in which they are laid and detailed.

This Advice Note explains the basics of Swithland, Collyweston and other limestone slating practices and the local variations (see boxouts on 'Terminology' and 'Dimensions').

Terminology

Technical terms used in this guidance and not explained in the text are defined in our online glossary and that of the Stone Roofing Association.[1] The meanings of some words are variable and need to be understood before reading on:

Slate: Strictly, this term should be applied only to stones derived from sediments which have undergone low-grade metamorphism – the process of compression and heating under which the sedimentary minerals are recrystallised and reorientated perpendicular to the compression. They can be split into thin, strong and flexible sheets which are not parallel to the original sedimentary bedding layers. In practice, where the specific type of rock is not relevant or is obvious, the term slate can be used to mean other roofing stones, such as shales, limestones or sandstones.

Shales: These are splittable rocks which have not undergone metamorphism, or less so than true slates.

Stone slates: A commonly used but geologically deprecated term for splittable sedimentary rocks. In geology texts, the term tilestone is often used instead.

Cleavage: The property of true slates which allows them to be split. Also a verb, to cleave. In quarries, the synonyms rive or riving are also common (see figure 1).

Fissile, fissility: The property of sedimentary stones which allows them to be split along bedding planes (see figure 1). In Collyweston, the fissile stone is known as log.

Random slates: Slates with a variety of lengths and widths often sold by weight. They are usually described in the form longest to shortest lengths in inches by random width, for example, 24 – 12 x R.

Tally slates: All slates in a consignment or on a roof of the same length and width sold by count.

Slate length: The length of slates sold by quarries is the overall dimension from the tail to the head (bottom edge to top edge). However, for top-fixed slates – all the slates in this Advice Note – the effective length is the dimension from the tail to the bottom of the fixing hole and this is typically 25 mm (or 1") less than the overall length (see figure 2). This is important, because it is the length to the fixing hole which is used to establish the gauging of the roof and hence the area that can be covered with a given quantity of slates. Failure to appreciate this can result in expensive underestimates of the cost of a roof. When carrying out random roof surveys or recording, it is the length to the fixing hole which should be measured.

Gauge: The spacing of laths or battens up the roof slope. In random slating, the gauge is variable and is proportional to the slate length. There is more than one system:

- Proportionation: Any system for setting out the slating – gauging the laths or battens – in which the gauge is determined by dividing the slate length by a number. This is usually done with a slater's stick (see boxout in section 6.1 on 'Using a slater's marking stick to gauge a roof'). Examples of proportioning include dividing by three – slating in thirds (see figure 3) - or three point five (three-and-a half pin slating).

- Calculating the gauge from a specified head lap using the equation:
  Gauge = (length – head lap)/2
  This is the system universally applied to tally and some random slating.

Dimensions

Although metric dimensions were adopted long ago, many slaters still work in inches and some slate manufacturers still make imperial size slates and quote approximate metric equivalents. In this Advice Note, where past practices are described and where direct quotations are provided from historical documents, the inch dimensions are used. Otherwise, and for descriptions of modern practice, approximate metric equivalents are given with the imperial dimensions in brackets.

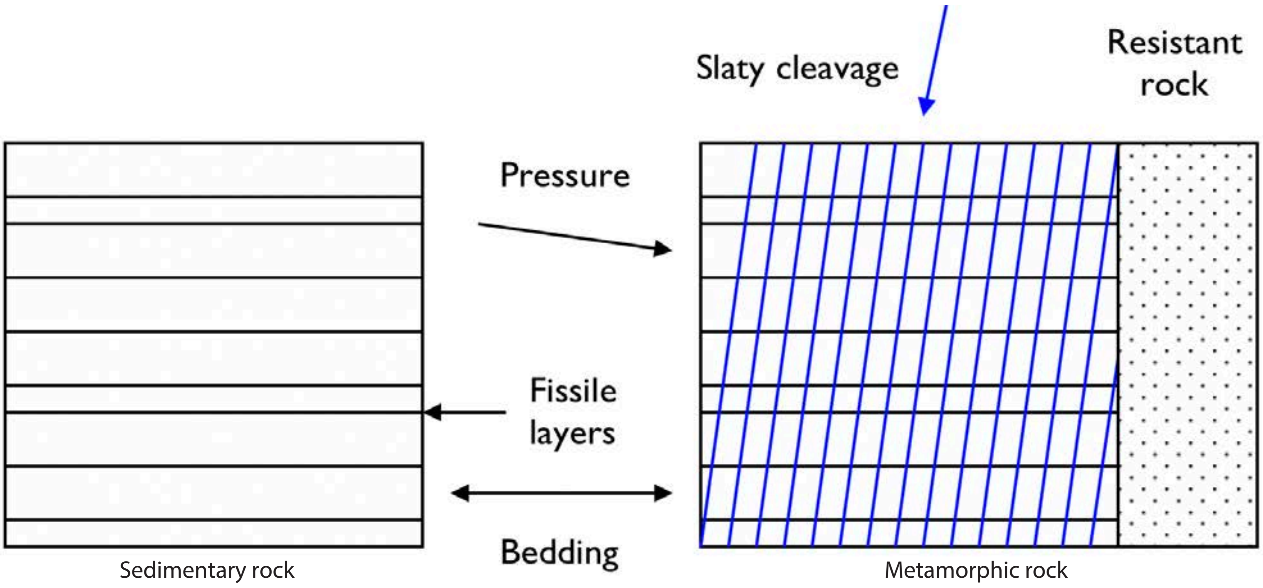


Figure 1: Bedding and cleavage. Sandstones and limestones are sedimetary rocks which are fissile along the bedding layers. Metamorphic rocks, such as slates, schists and phylites, have been changed from sediments by pressure and heat in the Earth's crust. They split along the resultant cleavage planes almost always at an angle to the bedding. Illustration: Terry Hughes

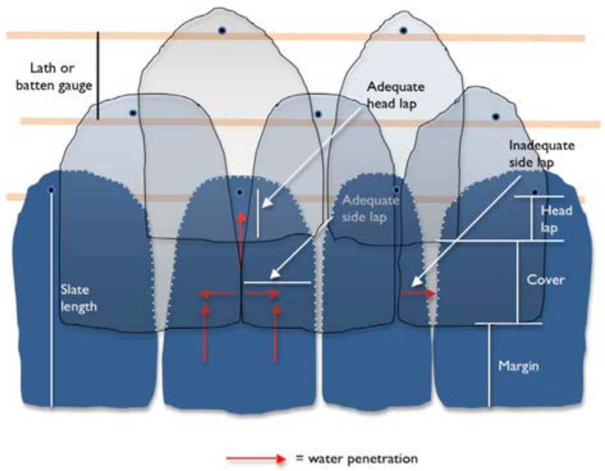


Figure 2: Laps and gauges. Quarries describe and sell slates by their overall length from the head to the tail. The effective length of top-fixed slates is about 1" (25 mm) less because the distance above the fixing hole has to be discounted when setting out the roof. Failure to appreciate this can result in expensive under-estimates of the cost of a roof. Illustration: Terry Hughes

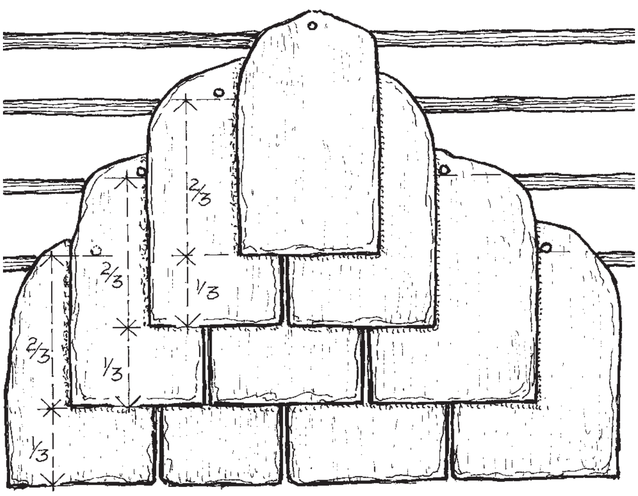


Figure 3: Slating in thirds. In the proportioning system slating in thirds, the slate length is divided by three. Illustration: Terry Hughes

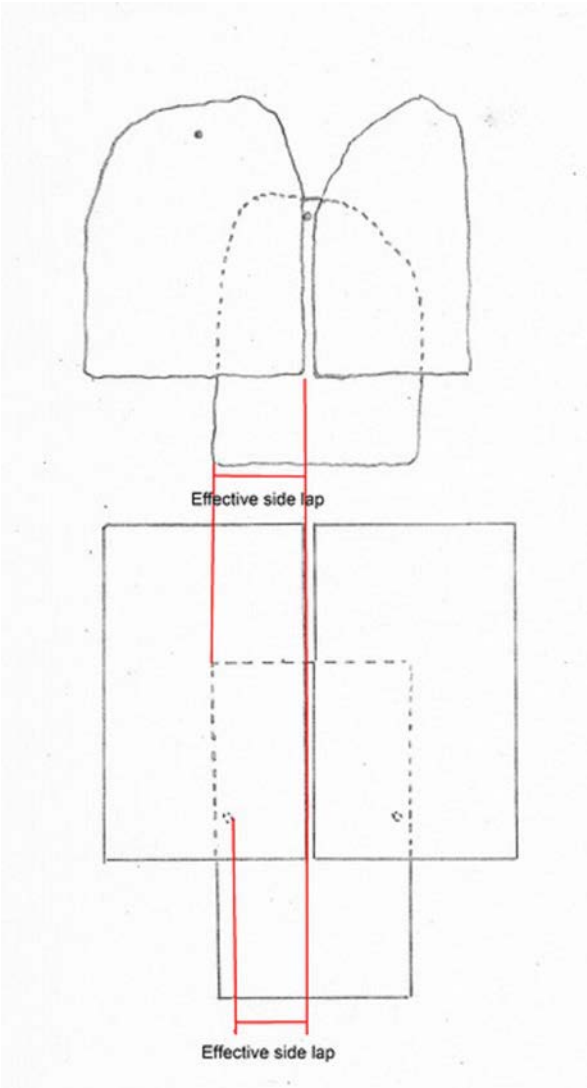


Figure 4: The effective width of head-fixed slates is greater than if they are centre-nailed. Following the introduction of BS 680 roofing slates in 1944, quarries adopted the 'slate width not less than half the length' limitation for all slates but this was, in fact, only necessary for centre-fixing. The consequent elimination of the narrower slates traditionally used in scantle slating has changed the appearance of roofs. For the conservation of old roofs, the existing lengths and widths should be recorded and the narrow examples included in the specification and order to the quarry. Illustration: Terry Hughes

Whilst the slates and stones themselves are durable and may last hundreds of years, the roofs have a finite life determined by the fixings used to support them. Pegs and laths rot and nails rust. Roofs are known that may be between 150 and 200 years old, but there will be very few *in situ* any older than this. Older buildings may well have had their roofs renewed two, three or more times during their existence, and although the original slates may be salvaged and reused once or twice, the act of stripping and re-laying a roof potentially destroys most of the evidence of the earlier roofing techniques.

It is very important that the details of roofs are recorded before the slating is stripped and that the information obtained is used to formulate appropriate specifications for reslating. Surviving examples are likely to contain valuable information about traditional craft techniques as well as reflecting local variations.

In general, the existing form and details of each historic building should be respected and retained during any campaign of repair. This extends not only to the overall appearance of the building but also to the construction methods employed.

The broad principle of retaining existing details does not mean that they should simply be replicated without thought. There are situations where details may need to be sensitively adapted to improve performance: but, if so, this should follow careful analysis in such a way that the traditional local form and appearance is maintained, along with appropriate statutory consents.

Unfortunately, many roofs are mistakenly deemed to be inadequate even though they have performed satisfactorily for more than 100 years and have reached the point of needing repair only because of iron nail failure. These roofs are simply stripped and discarded with no attempt to understand their construction and detailing. Also, in recent years there has been a tendency to use modern slating recommendations and detailing for historic roofs, as exemplified by British Standards, without regard to visual and technical needs. This is inappropriate for conservation, not least because such modern standards omit vernacular techniques (see boxout on 'Vernacular slates and British Standards'). The issue of differences between modern and historic slating should be dealt with at the design stage of a project.

2 Recording and assessment

2.1 Recording and condition surveys

Any work on a historic roof should always be based on an understanding of the existing construction and how well it has performed. Each surviving example is likely to contain valuable information about historic craft techniques. It is important that the recording of such information is undertaken before the slating is stripped and that the results are used to develop a specification for the reslating. The level of recording entailed should be proportional to the significance of the building. Recording will minimise the possibility of delays and errors in the ordering of any new slates; and, importantly, will give the owner of the building more certainty over the final cost. If no survey is done, assumptions about the quantities of slates needed will have to be made at the time of specifying the work in order to obtain prices.

Where defects occur, they are frequently down to poor maintenance, unsuitable alterations or inadequately sized members, and result in decay or distortion of the roof. It is important to distinguish these factors from inherently poor design or construction.

2.2 Structural deterioration, rafter settlement and deflection

Most historic roofs will have moved during their lives. Commonly, because of inadequate restraint by couples etc, the eaves will have spread, pushing out the walls, and the ridge settled. Rafters may also have settled along their length or adjacent to walls. These features give roofs much of their character and should not be rectified unless there is a clear structural reason to do so.

Some roofs were constructed with a concave upwards curve in the rafters that helps the slates to sit tightly together. This should not be misinterpreted as settlement.

Every effort should be made to conserve the structure that supports the roof covering. The roof structure is frequently one of the least altered parts of an old building and may provide valuable clues about its history. These range from smoke-blackened timbers where

Vernacular slates and British Standards

Durability

Swithland slates

In principle, BS 12326-1, the product standard for metamorphic roofing slates, could be used to test Swithland slates but the test methods (water absorption, thermal cycling and sulfur dioxide exposure) are intended for newly manufactured slate, so reused slates cannot be expected to pass. For reused slates, it is normal to test for soundness by tapping with a hammer and dressing off any softened parts. New facsimile slates or slates from other sources should have a declaration of performance - see box out on 'Metamorphic slate durability' below.

Limestones

There are no formal tests for limestone roofing slates. The best guide to durability of new slates is evidence of successful use of slates from the same source over a long period of time.

Strength

BS EN 12326 requires the bending strength (modulus of rupture) of slates to be tested across, and along, the slate's long dimensions (longitudinal and transverse orientations) and from this a slate's minimum individual thickness is calculated. This could be applied to confirm the strength of reused Swithland slates but because they are so thick it is probably pointless.

Grain

Some slate has bending strengths which are significantly different in the longitudinal and transverse directions. This is known as grain. It has nothing to do with surface texture or mineral veins in a slate. BS 680:1944, the former roofing slate standard, required the grain to be longitudinal in the slates (parallel to the long edge). This was to ensure that the maximum strength was in the direction which best resisted loadings on a roof, such as wind forces or roof settlement.

It is not sensible to apply this to all slates. Swithlands have such coarse cleavage that they can only be split so thickly that they have more than adequate strength, irrespective of the grain direction. Other slates have almost equal strength in the two orientations, so they have no grain. Grain orientation is not a requirement in BS 12326-1, although the direction of maximum strength should be declared.

Minimum width

BS 680 also set a limit on the width of slates - they should be no narrower than half their length. This was because the design recommendations for sizes of slates and their minimum head laps, which were set in relation to roof pitch and the rain exposure of the building, assumed the width of the slates. This limit came to be adopted by all slate quarries but not for stone slates (BS 680 did not apply to them anyway) and narrower slates fell out of production.

This limitation also assumed the slates would be centre-fixed, that is, fixed with nails roughly halfway up the slates, one on each side. This had become standard practice for new slating by 1944. However, vernacular slates and stones always were, and still are, head-fixed. The difference this makes for driving rain resistance is that centre-fixing reduces the effective width of the slate by the distance of the nails from the edges - about 25 mm, but this can be larger. Consequently, they are effectively 50 mm narrower than top-fixed (see figure 4) so top-fixed slates with widths less than half their length are satisfactory. BS EN 12326-1 does not set a minimum width limit but BS 5534 *Code of Practice for Slating and Tiling* includes recommendations and a means for calculating minimum widths for top-fixed metamorphic slates.

Other dimensions

BS EN 12326-1 also includes limitations for deviations from length, width, edge straightness, rectangularity and flatness, none of which should be applied to reused Swithland slates or limestones.

Fire and dangerous substances

Swithland slate would be deemed to satisfy fire requirements and, even though BS EN 12326-1 does not apply to them, so would limestone slates. Neither release dangerous substances.

BS5534 *Code of Practice for Slating and Tiling*

This is primarily a code for new roofing. The scope states: 'The recommendations contained in this British Standard might not be appropriate for the re-slating or re-tiling of some old roofs, particularly where traditional and/or reclaimed materials are used. Users intending to adopt any of these recommendations for old roofs, and especially for historically or architecturally important buildings, are advised to consult the local planning authority or an appropriate conservation organization to check their suitability.'

an open fire in a medieval hall preceded a chimney, to remnants of early decoration and evidence of smoke bays or louvres. Many old roof structures also constitute fine examples of craftsmanship. Jointing is often exemplary and features such as crown posts, moulded beams and traceried early spandrels may be found.

A technical assessment will frequently indicate that stabilisation of the roof structure is all that is necessary. However, deflection or settlement of the structure may have created undulations in the roof slope which are impossible to slate without gaps, especially for larger slates or stones. In this case, it is acceptable (and essential) to ease the undulations by packing under the laths or similar (see figure 5). Where settlement is less severe, gaps under the slates can be reduced by using narrow slates which will fit more tightly across the undulations.

2.3 Nail failure

Rusting of iron nails used to fix laths or slates is the main cause of slates becoming detached from the roof. Loss of slates individually indicates that it is the slate nails which are failing. This will be a gradual process and they can be refixed for a time. If lath nails fail, several slates in a course will slip.

2.4 Lath failure

Lath failure is indicated by courses of dropped slates or undulations in the roof plane (see figure 6). If the failure is extensive then the roof will need to be reslated. Laths may be unable to carry the weight of the slates if they have been weakened by rot or insect attack.

2.5 Slate failure

All the slates and stones covered by this Advice Note are durable and will reach the end of their lives only after many, commonly hundreds, of years. Typically, the process of slate ageing is a general softening in the overlapping parts of the slates. Less durable slates may fail for three main reasons: the presence of deleterious materials; inherent weakness; or because of mechanical stress (see boxout on ‘Metamorphic slate durability’).

The stone slates covered by this Advice Note which are currently produced are from long-established mines or quarries.[2]


5(a)


5(b)

Figure 5: Movement of the roof structure: **(a)** Distortion may not require any correction or perhaps just needs stabilising. If there are severe or abrupt undulations, though, they can be impossible to slate over without the slates gapping, even if small or narrow slates are used. In this case the undulations can be eased. **(b)** If undulations are eased only by the minimum necessary to allow tight slating, the special interest of the roof will be conserved.

Photos: Terry Hughes

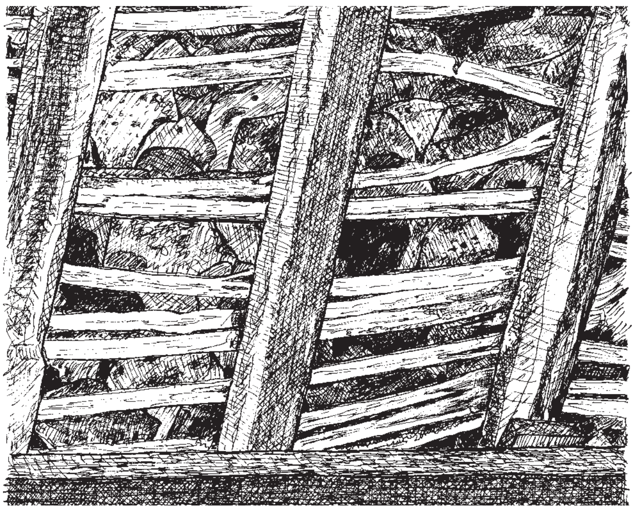


Figure 6: If whole courses of slates have slipped, the cause is usually failed lath nails. Illustration: Ray Harrison

Metamorphic slate durability

The current standards for roofing slates are BS EN 12326-1 *Product Specification* and BS EN 12326-2 *Methods of Test*. They are revised from time to time. BSI and the NFRC can advise on the latest versions. They do not apply to stone slates.

There have been problems with imported slates in recent years. These are caused by inclusions - carbonates (calcite etc) or metallic minerals, collectively known as pyrite or pyrites. They can be present in the slate as distinct crystals or veins or be dispersed within the slate's structure. When exposed on a roof, expansive reaction take place, converting pyrite to iron oxide and carbonate to bicarbonate or sulfate. These can result in staining, cracking, flaking or blistering of the roofing slate. Some forms of pyrite can be stable so its susceptibility cannot be decided visually. Other failures have been the result of mudstones and siltstones being sold as slates. Some of these disintegrate very quickly on roofs.

Slates should conform to BS EN 12326-1 *Product Specification* and should be tested by the quarry once a year or for every 25 000 tonnes of finished slates they produce, whichever arises soonest. It is particularly important that they conform to the scope of the standard which defines a slate geologically. Quarries must provide a Declaration of Performance based on the Assessment and Verification of Constancy of Performance (AVCP) of the slate. This was formerly known as a Certificate of Conformity.

Specifiers should be aware that it is not safe to simply specify 'slates conforming to BS EN 12326-1'. This is because the durability tests in the standard have more than one level of conformity and such a specification allows slate with any of the conformity levels to be supplied. The range of conformity levels was necessary to accommodate all the slates produced throughout Europe, some of which are less durable than is acceptable in the UK market. A specification should state the conformity level for three of the tests: water absorption – less than 0.6% or more than 0.6%; thermal cycling - T1, T2 or T3; and sulfur dioxide exposure - S1, S2 or S3. (Slates in lower categories and with lower water absorption - lower than 0.3% ideally - are the most durable.) There are other tests which need to be considered as well.

Rust-staining indicates the presence of oxidising metallic minerals and a general whitening of the slates will usually be the result of a high carbonate content, although this can also be caused by carbonates leaching out of mortar or by lead-staining. A specialist report will be needed to determine whether the slates already on a roof should be replaced. It is important to understand that although oxidisation of pyrite can be a serious problem (which in recent times has been associated mainly with imported slates) not all pyrite oxidises and some will do so without causing problems.

Slate breakage can be due to wind forces, roof settlement or imposed loads, such as people walking on the roof or, more importantly, because the slates are inherently weak. Wind damage is usually localised on the lee side of hips, ridges or other changes in the roof shape. Broken slates can be replaced individually but if the cause is wind damage a review of the fixing method or slating technique is advisable. Failure due to inherent weakness is usually a symptom of imported slates which are too thin.

A roofing slate's strength is a function of its thickness and the inherent strength of the rock, known as its modulus of rupture (MoR). Hence an inherently weak rock will only be satisfactory if it is made thicker than one with a higher MoR. BS EN 12326-1 specifies the minimum thickness for slates in relation to their MoR and size. The minimum thickness for specific slates should be declared by the manufacturer.

3 Work in general

3.1 Conservation approach

The demands of conservation impose additional considerations when working on an old building. In particular, a number of overriding principles should be borne in mind when dealing with vernacular slate roofs, in addition to the specific practices described later (sections 4 to 12).

The SPAB exists foremost to promote 'conservative repair'. For the Society, the value of an old building lies in its antiquity through the mental associations this evokes. It believes that the intrinsic nature of old buildings is best protected by maximising the retention of their historic fabric, while minimising any disturbance affecting their overall integrity.

The SPAB's view is that conservative repair is achieved by adhering to the following key principles:

- Carry out work essential to the long-term wellbeing of an old building.
- Employ compatible methods and materials.
- Obtain sound information about the history, construction and condition of an old building, as well as user needs, before making any serious interventions.

3.2 Selecting an architect or surveyor

An architect or building surveyor may be employed on larger, more complex projects, or projects where the reslating is only part of the work. This should give the client protection if things go wrong, and a competitive tendering procedure should ensure that value for money is obtained. Professional advisers should be selected who have the right knowledge and experience to specify and inspect the work. For sources of names see section 14.1.

3.3 Selecting a slater or slating company

It is most important to ask skilled and knowledgeable slaters to tender for the work. The primary consideration should be that they take a conservation approach. All too often slaters will strip a roof without looking at its materials, gauging or detailing, and then replace it inappropriately.

It is usually unwise to make a selection based on cost alone, as an inexperienced slater may simply have underestimated the cost after accidentally leaving out a step in the slating process. Problems can also arise if the main contractor is allowed to choose the slater because this, too, may be primarily on the basis of cost. Rather, a shortlist of suitable roofers should be established and within these the key is to ensure parity of tendering and check tenders for completeness. Only then can a choice be made, and it should not necessarily be on the lowest price.

The National Federation of Roofing Contractors operates an accreditation scheme for heritage roofing companies, which includes those working with Swithland slates, and Collyweston and other limestones (see section 14.1). If you intend using an unaccredited company, you should do your own checks for their competence.

There are vocational qualifications (VQs) for roof slating and tiling, and construction site management (conservation) (see table 2).[3] These qualifications may be required by clients or be included in grant conditions. The training and tests in roofing VQs are practical in nature but do not encompass conservation *per se*, and the options selected by trainees on VQ courses may not cover the East Midlands roof types. So even for companies with these qualifications, it would still be wise to confirm and ensure that they will take a conservation approach to the works, and apply authentic techniques and detailing based on an examination of the roof during stripping. For the roofs covered specifically by this Advice Note, the options selected by trainees on VQ courses may not cover Swithland or Collyweston slating.

Older but highly skilled slaters might not have such qualifications, but this should not disqualify them from consideration.
A slater should be able to show roofs which they have worked on successfully and provide references. It is wise to view roofs that a company has repaired or reslated, preferably

VQ title	S/VQ level	CSCS Card
Roof Slating & Tiling	2	Blue
Roof Slating & Tiling (including random slating)	3	Gold
Diploma in Heritage Skills Roof Slating & Tiling	3	Gold + Heritage skills
Construction Site Supervisor Conservation	3	Gold
Construction Site Management Conservation	6	Platinum
Conservation Consultancy	7	Black

Table 2: Vocational qualifications in roofing

recently. Although an external view cannot reveal all the mistakes which may have been made, examples of good workmanship to look out for include:

- Evenly diminishing margins – no margins taller (longer) than ones lower in the slope.
- Tidy mortar – neatly finished at the ridge, hips, verges, abutments and, where appropriate, at the tails of slates.
- Ridge tiles fitting closely onto the slating without thick mortar beds. Roof undulations, curves in the ridge tiles and uneven stone roofing can make it difficult to avoid mortar showing, but it should be minimised.
- In the roof space there should be no signs of leaks or dampness but these would be visible only where underlay is absent.
- Similarly, no tail-bedding mortar should be visible from the underside, only head-bedding. Do not confuse either with torching.

The slater should be asked to provide a statement covering all the steps in reslating a roof, including:

- Survey and recording – how the roof will be inspected before and during stripping to ensure historical details will be conserved and technical detailing will be replicated or, if necessary, improved. This may be subcontracted to a specialist surveyor and may have been carried out prior to tendering.
- Specification review – advising on unsuitable or impractical aspects of the specification.
- Method statement – a description of how the work will be organised and executed.
- An explanation, or ideally a demonstration, of how the slating will be set out on the roof (lath gauging). This can be done by demonstrating making the marking rod which will be used on the roof.
- The reslating process – a description of the process of carrying out the work. This aspect is important because comparison between tenderers will highlight any step which has been omitted.
- How they will deal with any faults or damage caused, for example, when dismantling scaffolding.

Quotations should state the total area of the slating work to be done, so that differences can be checked and any aspects which are unknown until the roof is stripped should be clearly explained. It is also very important that all quotes are based on the correct gauging system.

3.4 Specifications

Any work on historic roofs should always be based on an understanding of the existing roof and how well it has performed. Ideally, a survey to record and photograph the constructional details should be carried out prior to writing the specification. This will involve some opening up of the roof. The survey should cover the general slating; eaves, valley, verge, abutment, hip, ridge and dormer window details; and the slate sizes, condition and gauging. It should also assess whether the roof has performed satisfactorily or deteriorated prematurely because of some inherent defect. Care and experience are needed to differentiate between cause and effect. The survey should be carried out by a slating consultant, experienced contractor, architect or building surveyor.

Based on the survey findings the specification can be prepared. Where modifications are required to fulfil other objectives, such as environmental performance, they should be based on sound information. In particular, care should be taken when insulation is introduced and/or a means of venting any moisture from the batten space is provided. It would be wise to discuss the practical and technical implications of any innovations with the appointed slater before confirming the specification.

This Advice Note includes roof details that vary across the region and which should be replicated during repairs or reslating. In the Northampton area, there is a crossover between Collyweston and Cotswold roofing styles and details, so those which ought to be applied on a particular roof should be based on research, a survey or other reliable information rather than assumptions.

A written specification will allow the work to be detailed and standards of materials and workmanship to be set out, so that all slaters who are pricing the work can do so against the same document. The prices can then be judged on an equal basis. If the work includes more than slating, and is to be managed by a main contractor, a good specification will ensure that the method and standard of slating can be understood by all who tender and can be met by the contractor or slating subcontractor. Under certain contracts, a particular slating firm can be nominated. The specification should cover the following issues:

- Survey and recording, if required.
- Policy on retention of historic details and materials.
- Slate source, size range, thickness.
- Gauging and head lap.
- Side lap (for random slating the requirement is to set perpendicular joints approximately central over the slate below; for larger slates a minimum side lap can be stated).
- Battens or laths and fixings (sizes and materials).
- Slate fixing method (nailed or peg-hung).
- Slate fixings (nails or pegs, sizes and materials).
- Mortar, if required, including any preparation procedures and precautions to ensure satisfactory curing.
- Underlay.
- Insulation and means of ventilation.
- Details for eaves, verges, abutments, hips, valleys, dormer windows and ridges.

3.5 Listed building consent

For listed buildings, most changes to the construction details will require listed building consent from the local authority. Relevant changes include:

- Reslating of a roof at the end of its life, where renewal would affect the building's character.
- Removal and alteration of material and/ or detail of archaeological or historic importance.
- Alteration of detailing affecting, for example, ridges, valleys, hips, abutments or verges, or the style and size of dormer windows.
- Change from one slate or stone type to any other slate, stone or to clay or concrete tiles, imitation slates or sheet products.
- Use of slate or stone of a different geological type, including another source quarry within a particular geological type.
- Change from riven laths to sawn battens, or the reverse.
- Introduction of counter-battens, which significantly raise the roofline.
- Change of slate fixing method, for instance, top-hung to centre-nailed.
- Change in the overall range of slate lengths, which would significantly affect the roof's character.
- Use of new slates or stones that have been prepared using non-traditional methods, such as sawn edges which have not been dressed to give a bevelled edge.
- Change of ridge or hip material, such as from one stone type to another or to reconstituted stone, concrete or clay ridges.
- Introduction of building service or ventilation details that would significantly affect the character of the building.

Local policy on these issues should be checked before making proposals for alterations. The policy is likely to cover three main options:

- Completely authentic reslating – an exact replication of the existing style and techniques.
- External appearance authentic, but modern methods adopted; for example, nailing rather than peg-hanging.
- Either of the other two, but including modern innovations such as insulation.

The third option is most likely to be driven by building regulations.

3.6 Building regulations and other controls on roofing work

In addition to listed building consent, or - for many places of worship - a faculty, building regulations approval will be required for any increase or decrease in the weight of the roof covering.

Where more than 25% of the roof area is to be replaced, the person intending to do the work has a legal obligation to contact the local authority building control department in relation to the upgrading of insulation to comply with Part L of the Building Regulations 2010 (see section 4.8).

All bats and some birds and plants which live on, or in, roofs are protected. This will often limit the time of year when work can be done. The county wildlife trusts will be able to advise, and other sources of information are given in section 14.4. Currently, only BS 747 1F bitumen roofing felt is permitted in roofs where bats are present.

With fully-bedded roofs, such as those of Collyweston slates, bats will not be able to enter unless the mortar has fallen away. However, if access is necessary for small bats, it is possible to leave small areas of the tail-bedding open.

4 Repairs and reslating

4.1 Alteration of details

It is normally assumed that a like-for-like repair or reslating – same slates, same gauging, same bedding, if originally used, etc – will perform satisfactorily in the future. However, the implications of the recent increasing incidence of deluge rain and more severe storm force winds should be considered in deciding on the gauging and fixing method. An improved specification can usually be adopted without an impact on the appearance of the roof, but specialist advice may be needed so that all the implications of changes are taken into account and an integrated solution achieved. Simply applying the recommendations for each element in isolation is unlikely to be successful.

4.2 Structural repairs

All roofwork should be carried out from a safe means of access that does not damage the roof.[4] Scaffolds should be designed to carry the weight of stacked slates or stones, and with a wide area to allow sorting and redressing. Otherwise, the slates will need to be taken to the ground for sorting.

It is better to repair rather than replace roof timbers. Consult a suitably experienced structural engineer where necessary (the SPAB may be able to suggest names) and leave only minor repairs to the roofer. While conventional carpentry techniques alone will frequently be suitable, strengthening using stainless steel may be justified where it allows more timber to be retained than would otherwise be possible. Resins and consolidants should be used with great care, and other means of reinforcement, such as plastic rods, should be employed only where they can be justified.[5]

Keeping roof spaces clear of rubbish and debris discourages decay. Where active decay exists, the first priority is to eliminate the causes of dampness and promote drying. Chemical treatments are frequently unnecessary and should only be used judiciously where justified as a secondary measure, for example, when it is difficult to reduce moisture levels sufficiently.

Degraded surface material should not be removed (defrassed) without good reason.[6] Serious mutilation can result. Timbers may be vacuumed or brushed down, though take care not to remove any medieval smoke-blackening or evidence of early decoration that is of archaeological value.

4.3 Slates

Although slate roofs which are reaching the end of their lives can be kept weathertight for many years by regular maintenance, eventually they will have to be stripped and reslated - typically when 5-10% of the slates have slipped or been lost. The decision to reslate is often precipitated by the repeated cost of scaffolding for repairs.

When carrying out repairs the primary aim must be to retain the maximum amount of historic fabric without compromising the effectiveness of the roof. The existing slates should be reused where they are still sound or, if they are damaged or softened, they may be dressed down to remove any defective areas. They are then sorted into length sets and the number of courses of each length can be calculated.

The individuality of these roofs derives from the mix of slate sizes. Historically, no attempt was made to supply a specific mix of sizes and this policy should be respected for most reslating work today. How the slates were positioned and the detailing was mainly a response to the climate.

Only slates from local sources can produce an authentic appearance. Slates from other locations should not be used unless there is no local source, and only after careful assessment of their suitability and durability.[7]

For extensive reslating, new slates should be used to make up any shortfall and supplied in a mix of sizes as they arise in the quarry or mine. This may be local authority policy and a condition for any grant-supported works. Claims of unavailability or long delivery times should always be checked with the quarries. It may be worth delaying the project for a few months until the right slates can be produced, since the life of a well-slated roof is likely to be in excess of 100 years.

If slates need to be specially made, the producer will need a detailed specification as to what is required and almost always time to organise production. An order might include sizes, quantities, colour, texture and, most importantly, the date the work is to commence and, for large projects, the scheduling for each stage. It is always wise to discuss the order and programme of work well in advance. If a roof is to be stripped and reslated, there will inevitably be uncertainty about the quantities of slates needed until the numbers of reusable slates are known. Experienced slaters or independent consultants can advise on this before stripping commences.

Only where it is impossible to obtain suitable new slates should the use of slates reclaimed from other buildings be considered, and this should always be from a known source to discourage theft. Reclaimed slates will not last as long as new, and their use inevitably means some other building will have lost its historic roof. Often, they are sourced from several other roofs, so their remaining life will be mixed. They should be checked for softening and damage, especially around the fixing holes. Affected areas can be dressed off but this may result in a shortage of the longer sizes, with a consequent change in the appearance of a roof. It is better aesthetically and for reasons of durability to consolidate old slates onto one or more slopes and to use the new ones on others.

4.4 Slate repairs

The thickness and size of missing or damaged slates must be determined and matched, and this will probably involve opening up the slating.

If the slates are head-fixed, it may be possible to swing adjacent slates aside to hang the new ones.

Where Swithland slates are centre-nailed (which is not traditional), a triangle of slates should be removed so that each one can be accessed for refixing and the last one slid up and fixed with a tingle. Inevitably, any head-bedding, tail-bedding for Collywestons or torching will be damaged and this should be renewed.

Collyweston roofs are always wet-laid, ie tail-bedded in mortar (see section 10.7). This will deteriorate eventually and need to be renewed. It is possible to rake out the old mortar and point in new, but this is a stopgap repair that will need to be repeated within ten years.

4.5 Lath and batten fixings

Lath nails should be no less durable than galvanised or Sherardised and sized to suit the laths or battens. Stainless steel nails are sometimes specified, especially in marine situations, but not all types are equally durable. There have been failures associated with AISI Grade 304 in coastal areas, and current advice is to avoid this grade for roofs and use only Grade 316.[8]

Small nails will be needed for fixing thin riven laths to avoid splitting them or the laths can be pre-drilled. Alternatively, cleats (cooper's hooks) can be used (see figures 7 and 8).

For 50 x 25 mm softwood battens, a 3.35 mm shank diameter is recommended in BS 5534. Shank length and diameter should be chosen to provide adequate pullout resistance for the building's situation, height etc.[9]

4.6 Slate fixings

The traditional fixings for wet- or dry-laid slates were soft- or hardwood pegs. They were roughly square in section, whittled to a slight taper and forced into the hole until almost flush with the surface of the slate.

On a pegged roof where the underside is to be visible, wooden pegs should be used and are prevented from twisting or falling out by the addition of a small dab of mortar on top (pin pointing) or by torching. Otherwise, nails can be used in the same way as pegs.

Figure 7: Cleats, also known as cooper's hooks, can be made by blacksmiths or nail manufacturers. Photo: Terry Hughes

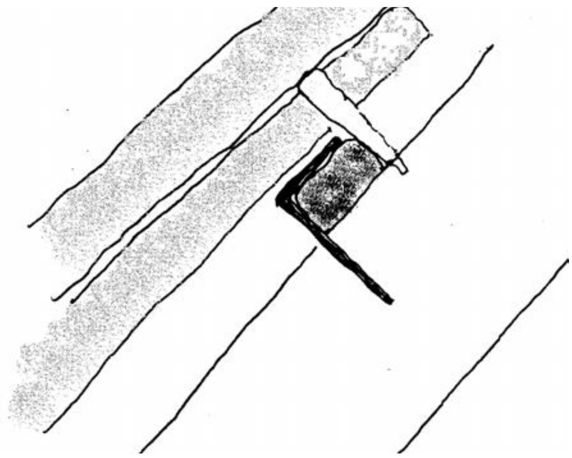


Figure 8: Cleats support the whole width of a lath and hence the weight of heavy slates. Ilustration: Ray Harrison

Where wood or metal pegs are used over underlay they must not be so long as to risk puncturing it, especially close to the rafters. Counter-battens may be necessary to prevent this but these can create other problems at abutments etc.

For slate nailing, copper nails are the most durable option. Aluminium nails are also suitable but should be avoided where they might be in contact with lime mortar. Ring-shanked nails should not be used for slating, because it will be impossible to remove the slates for reuse in the future without breaking them. Although suitable for fixing laths and battens, stainless steel nails are too smooth to provide adequate pullout resistance for the slates themselves in most situations.

BS 5534 recommends 3.35 mm shank diameter copper nails, in part to ensure an adequate head diameter of 10 mm (3 x the shank diameter). If a thinner nail is necessary, 3.00 mm shank copper nails are available to order with 10 mm heads. The nail length should provide a minimum of 15 mm penetration into the batten in addition to the thickness of the slate(s). BS 5534 provides model calculations for determining slate nail dimensions for adequate pullout resistance.

Hook-fixing is not traditional and should not be used on old roofs.

4.7 Laths, battens and sarking boards

Historically, riven laths were used for all types of slating and are satisfactory for peg-hanging all the slating types in this Advice Note. Made from a variety of woods, including oak and sweet chestnut, they are typically 25 mm wide by at least 6 mm thick and 900 to 1 800 mm long. They are available from specialist suppliers. Being riven, they are not uniform and impart undulations to the slating, which gives a more lively and less mechanical appearance to the roof. Also, they are less prone to beetle attack than sawn battens. For small peg-fixed slates, battens need to be narrower near the ridge to allow space to insert the pegs between them as the gauge reduces.

Formal guidance for slating, such as BS 5534, recommends thicker battens of 50 x 25 mm, which are regarded as providing a safe platform for slaters to work on. If riven laths are used, a risk assessment may be needed to justify their use. Alternatively, a cripple or slater’s heel is a suitable working platform.[10] Changing from riven laths to thicker sawn battens will raise the roof level and may lead to problems at abutments and verges. Listed building consent will be required where a building is listed.

Slating was commonly fixed directly to sarking boards and these should be retained wherever possible. They fulfil most of the functions of underlay in keeping out draughts, powdery snow and dust, reducing the wind uplift force acting on the slates and forming a moisture buffer.

Under correctly laid slating there is no need to include an underlay over boarding and its addition will reduce the ventilation of moisture from the roof space. Even the addition of a vapour permeable membrane will lead to a lower the rate of ventilation of moisture than the presence of no membrane at all. To ensure ventilation through the boards, they can be laid with penny gaps.

If an underlay is needed to provide temporary weather protection it can be removed as slating progresses.

4.8 Insulation and ventilation

Vernacular roofs were built with inherently good ventilation, which prevented moisture build-up and condensation in all but the most adverse conditions. This is one of the main reasons such roofs have survived for so long. Underlays were not included in old roofs and draughtproofing was provided by lime mortar torching. This would temporarily absorb moisture and release it when the weather was more favourable.

Part L of the Building Regulations 2010 requires the addition of roof insulation for most substantial repairs to habitable or heated buildings, including partial reslating. The threshold for ‘substantial’ is 25% of the roof repaired or replaced. However, listed buildings, buildings in conservation areas, scheduled monuments, places of worship and most unheated non-domestic buildings are exempt.[11]

Installing insulation can increase the condensation risk in the roof structure and affect other parts of the building unless precautions are taken.[12]

It will be difficult for many older buildings to achieve statutory target U-values without compromising their appearance and it may be impossible. Part L allows for exemptions and special consideration for historic buildings to enable building control officers to take a sensible view in order to conserve the appearance and character of the building and not introduce technical risks.[13]

To prevent condensation problems, the first step should always be to reduce the amount of moisture reaching the roof. This has two aspects: elimination at source, especially for bathrooms and kitchens; and the installation of a vapour control layer at the top floor ceiling or at the rafters. To be effective, a vapour control layer must be sealed at all joints, perimeters and penetrations, but this can be very difficult as a retrofit.

Having minimised the moisture reaching the roof space, it is important to ventilate any that does. This can be done with eaves, high-level or ridge ventilators, or with vapour-permeable membranes. Ventilation product manufacturers provide guidance on the amount of ventilation required and the levels their products achieve under **ideal** conditions. Where Agrément Certificates are available, they should always be checked for the limitations applying to their products. For example, many vapour-permeable membranes will only achieve adequate performance provided a vapour control layer is installed below the roof.

It is preferable to place insulation at ceiling level rather than in the rafter depth, because it is easier to provide ventilation through the roof space via eaves to eaves, eaves to ridge or through gable walls. However, this may be undesirable where there is a historic ceiling or lining.

Providing ventilation for insulation placed in, or above, the rafters can involve raising the slating on counter-battens, leading to problems of detailing and changes to the building's appearance at eaves, abutments, below copings and at verges. Secret gutters can be used at abutments to avoid the need to cut into the wall to reposition flashings or string courses. But they will need regular maintenance to avoid blocking by leaves or other debris.

Where there is natural ventilation, at the eaves, for example, it is very important that it is not impaired by the insulation. Roofing specialists are the best source of advice on this rather than insulation installers, who probably know little about roof construction.

Collyweston slating is a sealed system so if there is any sort of membrane or underlay installed, or a ceiling is fixed to the rafters, it is vital that the batten space is ventilated. This will usually necessitate eaves ventilators and a high-level vent(s) in the roof slope or at the ridge. This constitutes a change of appearance and will require listed building consent where a building is listed.

4.9 Mortar

The use of mortar has a long history in roofing. It has been applied to improve the wind resistance of slates and prevent draughts, as well as for bedding slates, ridges and hips, pointing verges and forming abutment fillets or flaunches.

Lime rather than cement was the binder for most roofing mortars before the early 20th century and is being used increasingly for this purpose today. Roofs move under the influence of wind and temperature, so it is essential to use a flexible bedding mortar to avoid cracking.

Strong cement mortars (1:3 or 1:4 cement:aggregate) should be avoided because of their inherent rigidity and impermeability. This results in cracking and loss of adhesion, which can allow water into the fabric where it will be trapped and cause decay. Old roofing slates (sometimes irreplaceable) are likely to be damaged beyond repair when later rebedding or re-laying is necessary if they have previously been laid in cement mortar. Where they are bedded and pointed with lime mortar, roofs can be repaired or reslated without, or with very little, loss.

The recent resurgence of hydraulic limes in Britain, and their development and increased use in both conservation and new-build work, now makes it possible to use lime mortars which are durable in exposed conditions. Historically, mortars for bedding Collyweston slates may have been non-hydraulic or only weakly hydraulic. Hydraulic lime mortars are more commonly specified today to give a speedier set and greater durability.

There is a wide variation of mixes using different strengths of hydraulic lime and varying proportions of aggregate. These need to be selected to suit local weather conditions and building exposure. The ideal is to keep a balance between a mortar that is robust enough to withstand the level of exposure but at the same time remains sufficiently soft and flexible to avoid causing damage to the slates or the roof structure.

Due to the level of exposure to wind, rain and sun to which roofs are naturally subject, some movement of slates is inevitable. The softer, richer and more flexible mortars (possibly also containing hair) are likely to cope best with movement, but the tougher and harder mortars will tolerate conditions of extreme exposure better. The type of lime and form in which it is used will also affect adhesion. Hydraulic lime is less 'sticky' than non-hydraulic lime. Lime may be included in the form of quicklime, lime putty or bagged dry hydrate. Generally, working from the former to the latter of the three, the extent of adhesion and workability will be in descending order.[14]

Table 3 indicates typical lime-based mixes that can be used for work on old slate roofs. It is not exhaustive. For example, hot lime is now sometimes used for roofing and should be considered where investigation of the roof indicates it was originally used successfully.

The aggregate should be a clean and well-graded sharp sand with angular particles, which will bind closely with the lime and leave minimal voids. Generally, the thickness of mortar beds for slating should be no more than 5 mm but inevitably may be thicker, due to the unevenness of some slate surfaces. The size of the largest aggregate particles should normally be about one-third of the mortar bed thickness. But where thicker beds are unavoidable, it is important to keep the aggregate size sufficiently large to prevent cracking.

The mortar should be mixed in a pan, paddle or drum mixer for a minimum of 30 minutes. Only mix sufficient quantities for immediate use unless a trial has been carried out to show that they may be knocked up safely without the need to add further water. Non-hydraulic lime that is kept damp may usually be left overnight, as can certain weaker hydraulic limes at times. This is inadvisable, however, with NHL 5 and some NHL 3.5 limes.

The principle of mixing is to achieve a good dispersion of lime and other constituents with the dry sand before any water is added. Once the dry mix is fully dispersed water should be added slowly, allowing time for this to become fully mixed before deciding on the amount needed to achieve good workability. Bear in mind that too much water will decrease the mortar strength by holding the grains apart, thus leaving an open structure when dry.

Lime takes time to cure. To gain the benefits of lime mortar in connection with roof slating, the normal recommendations for curing and

Increasing strength ↓

Roofing application	Mortar mix (ratio by volume)	Comments
Torching, except on exposed roof slopes or where lap is not ideal	1:3 non-hydraulic lime:soft sand plus hair	The bedding mix immediately below is likely to be more suitable for torching on exposed roof slopes, especially where not heated from the underside. This also applies where slates are being reused or an ideal lap cannot be acheived for various reasons.
Bedding for wet-laid, ridge or hip slates, forming fillets, and pointing verges and flashings	1:2 NHL 3.5:aggregate	For use in sheltered and moderately exposed locations in reasonable weather
	1:2 NHL 5:aggregate	For use in very exposed locations or cold weather

Increasing permeability and flexibility ↑

Table 3: Selection of mortars

Notes

(i) NHL denotes a natural hydraulic lime. Natural hydraulic limes are classified under BS EN 459-1:2015 as NHL 2, NHL 3.5 and NHL 5 in order of increasing strength. The classes refer to the compressive strength in megapascals of a 1:3 lime:sand mix by mass (approxomiately 1:1.5 by volume) after 28 days. Users should be aware, however, that the strength continues to grow considerably over the first couple of years so the final result may be a much stronger mortar. It is also important to note that the NHL classification accommodates a wide range of strength within each class.

(ii) Cement:lime:aggregate mortars are often used for work on the roofs of old buildings but great care must be taken to control the mix proportions on site to avoid the problems associated with excessive strength.

(iii) Pre-mixed lime mortars are available that minimise material handling and quality control problems on site. It is advisable to clarify with the manufacturer, though, whether any additives are present, as some will be unsuitable for conservation work.

(iv) The inclusion of well-graded crushed limestone for, or as part, of the aggregate will aid moisture entrainment and carbonation, and enhance frost resistance.

(v) Where lime mortar is applied in thicknesses greater than 15 mm, the same principles should be followed as with external lime render, ie use more than one coat, incorporate hair in the first of these and ensure the aggregate is sufficiently coarse.

tending apply. This requires planning ahead and arranging for the access provided for the roofer to remain in place for at least two, preferably four, weeks following completion of the slating. Protection of all new limework against the weather is almost always required. If possible, working should be avoided in the winter months when there is a risk of frost, because freezing and expansion of water can damage uncarbonated areas. To prevent this, layers of hessian or another insulating material must cover the roof (leaving air gaps). The use of anti-freezing agents in mortars is not recommended.

Rapid drying of the mortar by the wind or sun will produce a light-coloured surface with an increase in the deposition of lime binder and risk of cracking and powdering; when this occurs the work will have to be redone. All lime mortars must harden in the presence of moisture. Covering with polythene sheeting over damp hessian will provide a climate that encourages carbonation. A fine mist spray applied daily for a minimum of four weeks where this is practical is also beneficial.

5 Specification and detailing

5.1 Slating specifications

Specifications should include the materials to be used, methods of application and the detailing of local areas, such as eaves, hips and valleys. All slating should be specified and constructed to resist wind uplift and provide adequate head, side and shoulder laps to resist driving rain (see figure 2). Slates should be laid without gaps underneath them – as arises, for instance, where two underlying slates are of unequal thickness.

Single-sized (tally) slates are sorted into sets of equal thickness and laying them with the thickest at the eaves, grading down to the thinnest at the ridge. This is not possible for random-sized slates or stones because they have to be positioned on the slope where their length dictates. They can be sorted across the roof in each course – thick to thin from left to right and right to left in alternate courses, or thick to thin from verges to the middle. This is known for Swithlands but is not done for wet-laid Collywestons where the mortar bedding takes up any variation. Alternatively, slates must be selected as they are laid to ensure those adjacent to them are equally as thick.

There is little reason for variation in the general slating. The gauging rules are normally applied consistently to all slopes unless there are different pitches across an intersection, such as a hip or a close-mitred valley. In those cases, the margins should be coursed across the pitch change. To do this the gauging is worked out on the lowest pitch (because it is the most vulnerable to driving rain). The lines of the tails are then struck across to the steep side. Slates long enough to provide the required lap are selected for each course and the laths fixed to suit (see figure 9). This can also be worked out by calculation or scale drawing.

5.2 Eaves

The slating should overhang at the eaves to discharge water into the gutters where they exist, or well away from the walls if not. Where there are no gutters long slates will be needed to give an adequate throw.

A tilt must be provided to lift the tails of the undereaves slates and ensure the subsequent courses lie tightly onto each. This is done either by fixing tilting fillets, by raising a fascia board or, if the rafters are set back on the wallhead, by packing up the masonry. If the rafters are well back from the outer face of the wall, they may provide a sufficient tilt (see figure 10). If rafters extend beyond the wall, the slating can be protected by soffit boards.

5.3 Verges

Verge slating is traditionally finished with a slight overhang to the gable wall and a mortar fillet under the slates, or abutting a raised coping (see figure 11). On later buildings, bargeboards or external rafters were adopted. The slating is often raised slightly to direct water back onto the roof slope.

5.4 Ridges

Ridges are closed with stone or clay ridge tiles or crests, which are sometimes decorative. They should be back-bedded in mortar that should not, as far as possible, show at the long edges, and pointing is omitted. Roof undulations, curves in the ridge tiles and uneven stone roofing can make it difficult to avoid mortar showing but this should be minimised. For the treatment of dormer ridges see section 5.9.

5.5 Hips

Before lead and ridge tiles became commonly available hip slates were mitred and bedded with clay or mortar (see figure 12(a)) but they are susceptible to wind damage and, therefore,

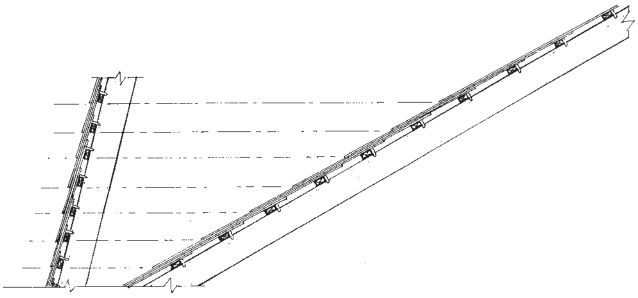


Figure 9: Where hip or valley slating on two slopes of different pitches is to be close-mitred, the gauging and margins are worked out for the lower pitch. The margins should then be replicated for the corresponding courses on the steeper pitch and the slate lengths selected to ensure adequate head laps.
Illustration: Ray Harrison

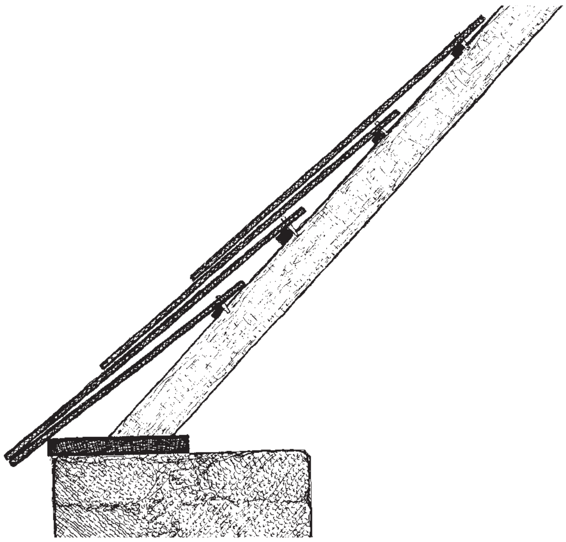


Figure 10: A tilt must be provided to lift the tails of the undereaves slates and ensure subsequent courses lie tightly onto each other. There are a number of ways this can be done: by fixing a tilting fillet, raising a fascia board or, if the rafter is set back on the wallhead, by packing up the masonry. If the rafter is well back from the outer face of the wall, it may provide sufficient tilt.
Illustration: Ray Harrison

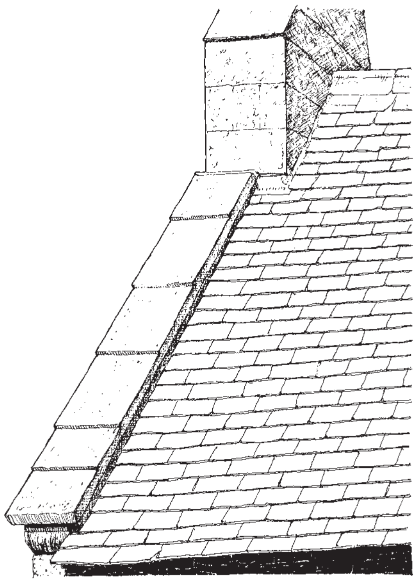


Figure 11: Verge slating can oversail the wallhead by 1 or 2" (25 to 50 mm) or finish against a raised outer wall which is coped. The latter is thought to be intended to prevent wind damage and is probably a legacy of thatching. On vernacular buildings, the abutment is often only applied to the most wind-susceptible gable but is common on all gables of professionally designed buildings, such as churches. It is often difficult to make a watertight joint, resulting in the adoption of secret gutters which need regular cleaning to prevent them becoming blocked with leaves and other debris and leaking.
Illustration: Ray Harrison

are not common in the region. To reduce the risk of wind damage, wider slates are selected for the raking cut. An alternative wind-resistant option is to use clay or stone ridge tiles (see figure 12(b)). If the hip is mitred it is normally weathered today with lead soakers, and if the adjacent slopes have uneven pitches it is good practice to adjust the gauging and hence the margins, so that they course across the hip (see figure 9).

5.6 Valleys

The difficulty of making a watertight valley has been tackled with ingenuity, especially before the ready availability of lead for soakers. Various methods relying on slates laid up the centre of the valley, sometimes bedded in clay or mortar, have been used in the past, and these add to the character of the building. There is no reason why they cannot be replicated and if their effectiveness is in doubt lead soakers can be interleaved unobtrusively in each course. This is far preferable to an open lead valley on an old roof.

On Swithland roofs two valley types are seen: Welsh, and a swept version (see figure 13(a)) but there are very few examples of either and they may be non-vernacular, later innovations. Today, non-traditional lead-lined and close-mitred types are most common. Collyweston valleys are always laced (see figure 13(b)).

There are many subtleties in the way valleys are constructed. Some, for example, have slightly raised slating to turn water away from the junctions, so when they are repaired or renewed this possibility should be checked. The existing details should always be reinstated.

The pitch of a valley is lower than the main slopes, so longer slates are needed to be able to course the slating across. Even longer slates are an advantage because they will provide a larger head lap. Suitable sizes should be put on one side during the preparation stage. In Collyweston valleys, the diagonal dimension of the roughly square slates laid point down gives extra length and lap.

5.7 Abutments

The junctions between the slating and abutting walls and chimneys can be difficult to make watertight. Historically, abutments did not include soakers and relied on mortar fillets (flaunching) to prevent water penetration, sometimes with slates bedded into the mortar to help protect it (see figure 14). These were known as listings in some regions. Also, the slating might be tilted slightly by raising the

Figure 12: Hips: **(a)** Mitred hips are vulnerable to wind so wide slates should be used to ensure sufficient width and, therefore, strength, at the top of the raking cut. **(b)** An alternative wind-resistant hip is achieved by bedding on heavy ridge tiles supported by a hip iron at the eaves. Photos: Terry Hughes

Figure 13: Valleys: **(a)** There are very few pre-19th-century Swithland roofs and those that still exist do not generally include valleys (or hips). The valleys that are seen today – Welsh and a swept type – seem to be non-vernacular innovations. Later still, even these have regrettably been replaced with open lead and close-mitred types. **(b)** Collyweston Slate valleys are always laced. Photos: Terry Hughes

Figure 14: Abutments: **(a)** Before the availability or affordability of lead for soakers, abutments were weathered with simple mortar fillets. **(b)** Because fillets are prone to cracking and leaks, one technique to help prevent this is to bed slates, thin stones or tiles into the mortar. In some regions these are known as listings. Photos: Terry Hughes

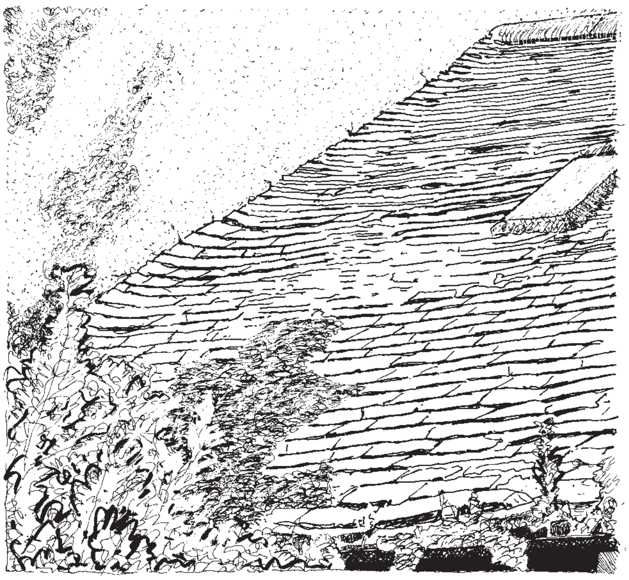


Figure 15: To reduce the amount of water abutments had to resist, the abutting slating was raised by bedding up the slates or packing up the laths. This is surprisingly effective. Illustration: Ray Harrison

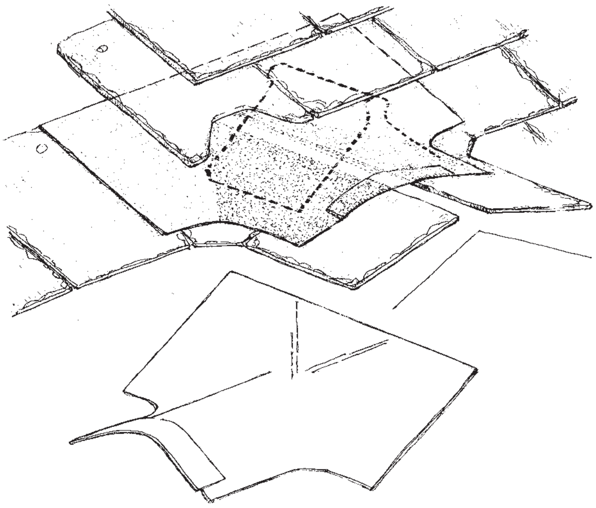
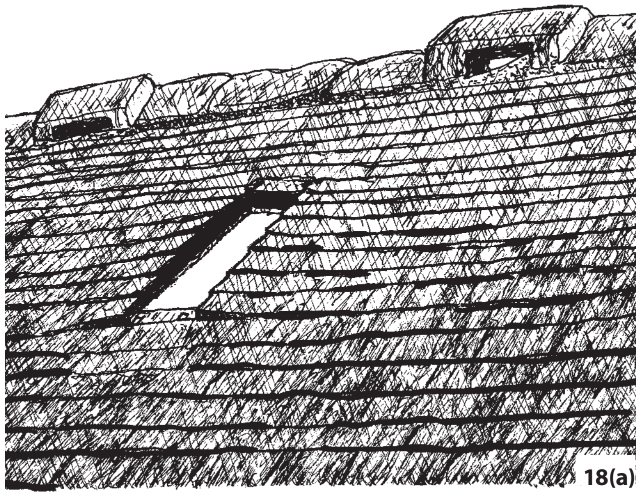


Figure 17: A lead saddle is now a common way of weathering a dormer ridge where it meets the main slating. Illustration: Ray Harrison

16(a)

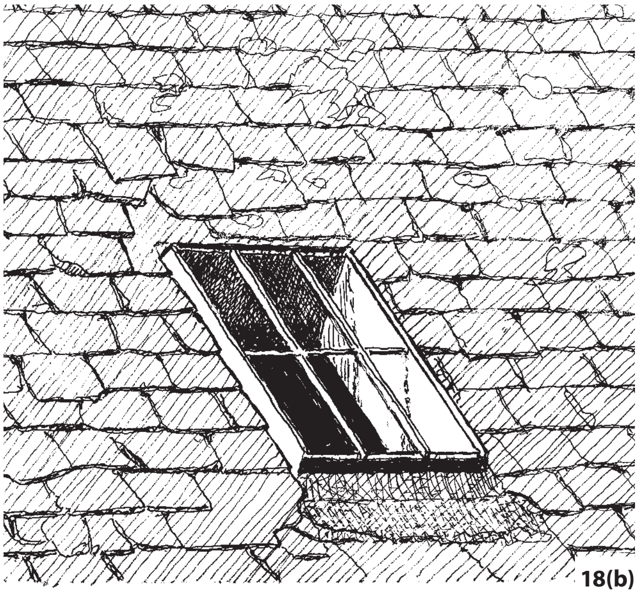
Figure 16: Dormers: **(a)** Collyweston dormers can be below, breaking or above the eaves and are monopitch, gabled or hipped. **(b)** Dormer ridges were traditionally swept up into the main roof slope. Photos: Terry Hughes



18(a)

Figure 18: Rooflights: **(a)** In their simplest form, rooflights are just a sheet of glass substituted for a slate or inserted into the slope and the slating overlaid. These are common on farm buildings. **(b)** Where the extra cost was acceptable, cast iron lights are used. Illustrations: Ray Harrison

16(b)



18(b)

last rafter, packing the laths or bedding up the slates to direct water away from the junction (see figure 15).

It is possible to conserve the appearance of abutments but to include concealed lead soakers. These and cover flashings became common once lead was economical, but the latter can be visually intrusive and mortar flaunchings are preferred. Nonetheless, the flaunchings can be problematic as they often crack and leak. Listings reduce this. Alternatively, when renewing fillets the risk of cracking can be reduced by avoiding hard mortar and incorporating stainless steel mesh screwed to the masonry joints.

5.8 Dormer windows and rooflights

The position of dormer windows can be below, through or above the eaves, or wholly within the roof slope (see figure 16(a)). The cheeks are sometimes slate-clad or covered with single slate panels (see figure 16(b)). Traditionally, ridges were swept up into the main slopes but now the alternative of weathering the junctions with lead saddles is common (see figure 17).

Rooflights are an alternative to dormers and being much cheaper to install are common on industrial, farm and similar buildings. They are an important feature of many farm buildings but are usually quite small. In their simplest form a sheet of glass is substituted for a slate or inserted into the slope and the slating overlaid (see figure 18(a)). Where the extra cost was acceptable, cast iron lights are found (see figure 18b)). The scale of the rooflights in relation to the roof slope is a major consideration in roof renewal.

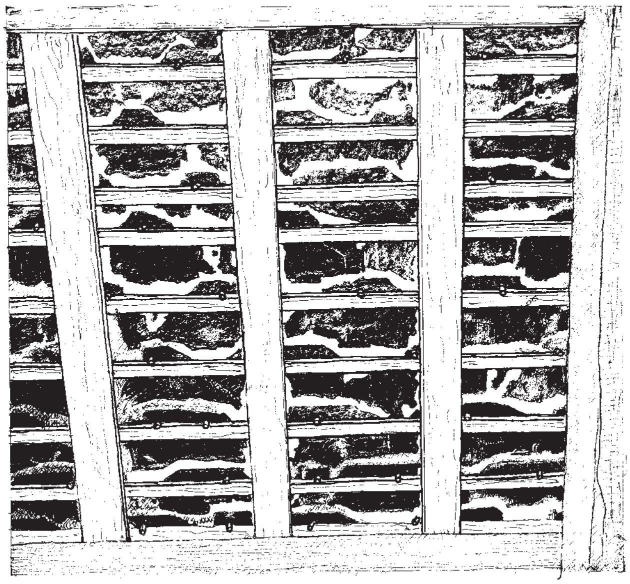


Figure 19: Torching is applied to the underside of the slates and may just cover the top of the slates (single torching) or their backs completely between the laths (full torching). Illustration: Ray Harrison

The provision of new glazing at roof level is one of the most sensitive issues involving work to old buildings. It can be very intrusive, especially if large and dominating the roof slope. It should be positioned to minimise disturbance of existing roof timbers. Conservation types which emulate the look of traditional cast iron rooflights will generally be preferable with slender-section steel and a vertical emphasis. Bespoke sizes can be made where rooflights of standard dimensions are unsuitable. The use of excessive flashings between the rooflight and roof should be avoided to maintain the character of the building.

5.9 Torching

Torching stabilises the slate heads and pegs, keeps out draughts and wind-blown snow, and conserves the historic appearance of the roof from inside. It should never be omitted from any repair work unless underlay is installed.

Torching is applied to the underside of the slates and may just cover the top of them (single torching) or their backs completely between the laths (full torching). If a second coat is applied, this can be trowelled or floated as the background of laths and pegs will be sufficiently covered to allow this. It is very important that torching is not forced too far down between the slates, to avoid drawing water to the laths and rafters (see figure 19).

Both domestic and agricultural buildings are found with two-coat work, which indicates its importance. It became more common in houses when roof spaces were adapted for home workshops or other accommodation. In shippons or cow houses, it was used because cattle will not tolerate drips.

5.10 Farm buildings

These tend to remain unaltered for long periods and are often the best source of information on early roof structures and slating techniques. Detailing is less elaborate than on domestic buildings and this should be respected in repairs. Verges and eaves often have little overhang and gutters are seldom included. Lighting for storage areas or livestock was not important, so it was often provided by substituting a few slates with glass or installing small cast iron rooflights rather than dormer windows (see figure 18). Good ventilation is important for livestock but this was usually provided by openings in walls rather than roofs or by raising a few ridge tiles.

6 Random slating

6.1 Random slating

All the slates in this Advice Note are random-sized and always double-lapped so that each course is overlapped by the next but one course above. They are laid in courses of equal slate length but diminishing in length from eaves to ridge. There may be one or several courses of a given slate length depending on the mix of slates and the roof dimensions (see boxout on 'Using a slater's marking stick to gauge a roof').

All forms of slating are set out to achieve head and side laps of sufficient size to resist the penetration of driving rain over the heads or sides of slates, or through the fixing holes (see figure 20). The head lap can be specified as a fixed or varying dimension, or set as a proportion of the lengths of slates (see figures 2 and 4). In random slating head laps always reduce upslope. This is economical because the head lap reduces as the slate lengths reduce and is satisfactory because slates near the ridge carry less water.

The region's four vernacular slate roof types use their own slating systems. Swithland and Collyweston roofs are set out as described in section 1. For Magnesian limestones and some roofs around Northampton, the existing details should always be checked. A Cotswold style is the most likely unless the slates are Collywestons.

Swithland slates are narrow and limestones are heavily shouldered, so for the laps to be effective roof pitches are comparatively steep - certainly 40° and more commonly 45 to 55°.

As well as the slating techniques which apply, some of the detailing at hips, valleys, verges and abutments is specific to the slates or locality. Slate wall cladding is uncommon.

6.2 The slating process

The steps in random head-fixed slating are:

- For reused slates, check the slates for softness and damage and dress off to sound material.
- Hole the slates and check for any damage.
- Sort the slates into length sets, usually at the same time as holing (see the boxout on 'Using a slater's marking stick to gauge a roof'). Typically, for Swithland slates these are at half-inch or inch steps. For Collywestons it is 1" (25 mm) steps in the lower courses and half an inch in the upper (15 mm).
- Set the first batten to provide the required eaves overhang.
- Fix a lath or batten for the undereaves slate.
- Lath the remainder of the roof at the appropriate gauges for the reducing slate lengths and head laps, making adjustments at the change courses.
- Carry the slates onto the roof.
- Fix the slates.

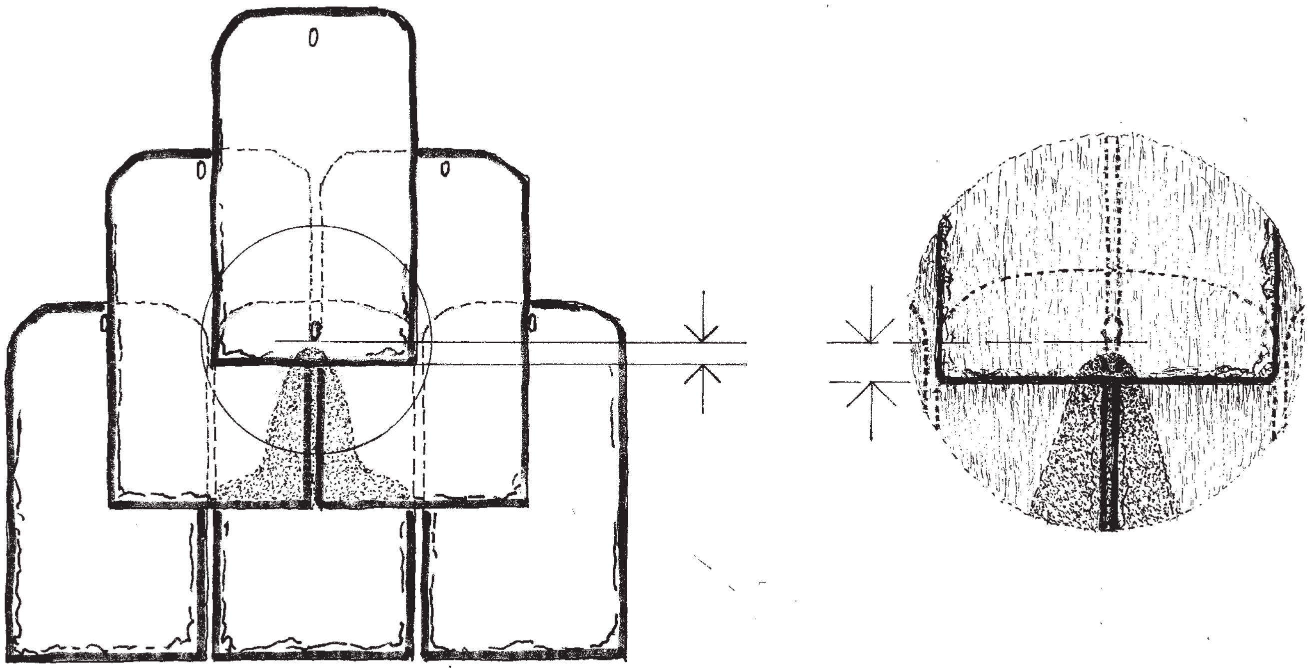


Figure 20: All forms of slating are set out to achieve head and side laps of sufficient size to resist driving rainwater penetration over their heads or sides or through the fixing holes.
Illustration: Ray Harrison

Using a slater's marking stick to gauge a roof

All the slate types in this Advice Note were traditionally set out with a slater's marking stick, and this should continue. Sticks vary regionally but have a mark for each slate length and a pin at one end (see figure 21(a)). The marks can be numbers or symbols and do not necessarily designate inch lengths. Some also include head lap marks – usually one, two and three inches – or lath gauges corresponding to each slate length.

The stick is first used to sort the slates into length sets, known as a parting in Collyweston. This is usually in inch of half-inch steps. Once complete, the total width of each length is measured or estimated and these are divided by the roof width to determine how many courses can be laid in each length.

The stick is then used to set out or gauge the roof (see figure 21(b)). This process can be difficult to understand (deliberately so in the past, to protect the trade from outsiders) but is second nature to a slater. The position of all the laths on the roof is set out to margins (skirts in Collyweston terminology) and these and the lath gauges diminish all the way up the roof. This is different to modern tally slating which calculates lath or batten gauges starting with a specified head lap.

The process involves using the slate lengths on the stick to mark lath gauges onto one or a pair of rods, which are the length of a rafter plus the eaves overhang. These are then placed on either side of the roof and a string line snapped across the rafters to mark the top of the laths.

The eaves course mark for the longest slate is positioned on the rod allowing for the eaves overhang. The second and third course marks, which might each be the same length or shorter, are placed for the appropriate head lap and to give equal or diminishing margins. All the subsequent gauges are similarly marked, but always keeping an eye on whether any have produced a longer margin (a pig course or gaper) or too small a head lap. If so, the mark is lowered on the rod. Inevitably, because every mark affects each subsequent one up the rod and the gauging rod might not reach the ridge at the first attempt, it is quite normal to repeat the process to get the whole rod right.

21(a)

21(b)

Figure 21: Gauging: **(a)** Slater's marking sticks vary regionally but all have a mark for each slate length and a pin at one end. The marks can be numbers or symbols and do not necessarily designate inch lengths. Some also include head lap marks – usually 1, 2 and 3" lengths – or lath gauges corresponding to each slate length.
(b) The stick is used to set out the margins and the lath gauges and these diminish all the way up the roof. Photos: Terry Hughes

6.3 Preparing the slates

Any slates which are to be reused must be checked for damage or softened areas and dressed off. They are then holed about 25 mm (1") from the top and the length measured from the hole to the tail (see figure 2). At the same time they are sorted into inch or half-inch length sets.

The total width is measured or estimated for each length and these values are divided by the roof width to give the number of courses available for each slate length. Leftover slates are added to a course(s) higher up the roof. If the slates are to be fixed with wooden pegs, these can be inserted before taking them up to the roof.

6.4 Fixing the slates

The slates are hung on the laths with wooden or metal pegs or nailed, working one or several courses progressively across the roof. Each slate is selected and laid so that its perpendicular joints are approximately central over the slates below (see figure 2).

Wind uplift is mainly resisted in top-fixed slates by their weight and their overlapping arrangement rather than by pegs or nails, but head-bedding with the small amount of mortar helps with this.

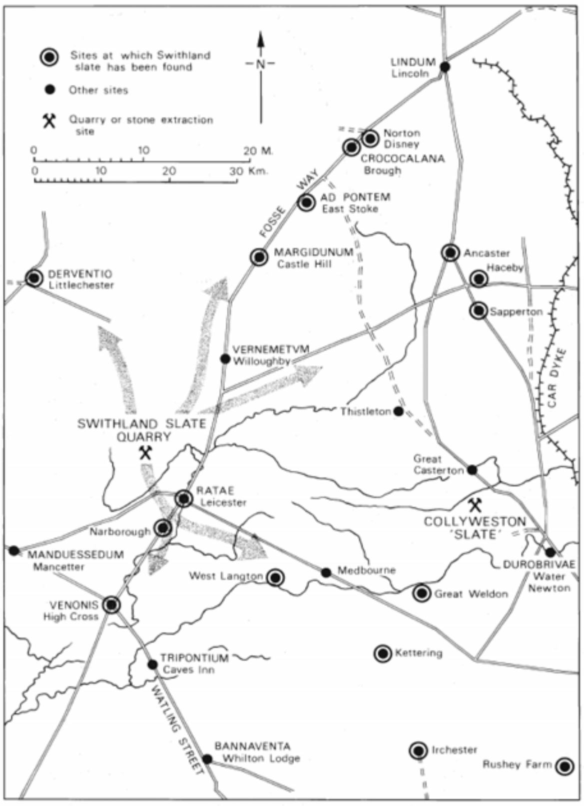


Figure 22: Swithland slates were used from Roman times and were so valued that they were carried as far as 50 miles (80 km) away. Illustration: McWhirr [15]

7 Swithland slating

7.1 Swithland history

The first evidence of the use of Swithland slate for roofing is from Roman archaeological sites, including Narborough and West Langton in Leicestershire, Haceby in Lincolnshire, and as far as 50 miles (80 km) away at Great Staughton in Cambridgeshire (see figure 22).[16] As at other Roman sites the slates are hexagonal (see figure 23). These are often described as diamond-shaped or four-sided, but the actual hexagonal shape is fundamental to the way they are laid to form a watertight roof.

There appears to have been no post-Roman quarrying until the 17th century (or at least no evidence of it). From then, and especially from the mid-18th century, there was a substantial local industry which took advantage of river transport along the Soar and Trent and ultimately along the Grand Union Canal to London. It was, however, the canals and later the railways which brought about this industry's demise by allowing access for cheaper Welsh slates.

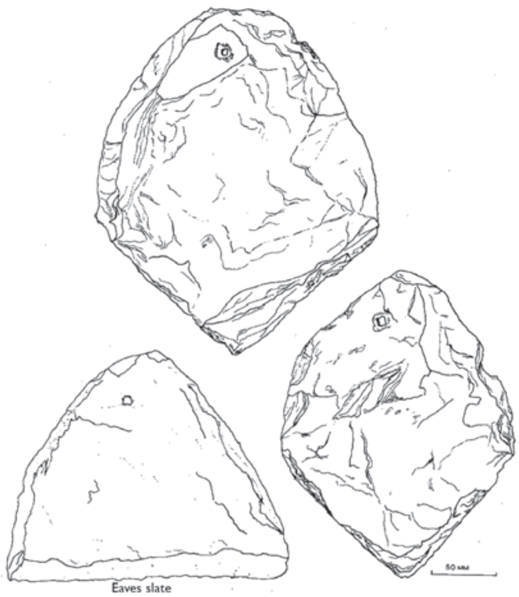


Figure 23: As at other Roman sites the slates are hexagonal. These are often described as diamond-shaped or four-sided but the actual hexagonal shape is fundamental to the way they are laid to form a watertight roof.
Illustration: McWhirr [17]

Figure 24: It is possible to obtain facsimile Swithland Slates made from Welsh slate rock. However, a mix of standard sizes from the stock at a quarry will not produce a convincing roof. Photo: Terry Hughes

The last operations, Northern Pit and Great Pit in Swithland Wood, Leicestershire, closed in 1838 and 1887. Ironically, what was probably Swithland slate's greatest roof was a product of the railways, when slates from Groby Park in Leicestershire were taken by canal for St Pancras Station hotel in London. Sadly, these have been mainly replaced with green Westmorland slate.

7.2 Swithland sources

Swithland slate was quarried in, and around, Charnwood Forest in the part of Leicestershire between Leicester, Loughborough and Coalville. There were three areas of production: to the west of Swithland village at the Brand estate and in Swithland Wood; in the Hangingstone Hills north-west of Woodhouse; and at Groby.

7.3 Swithland production

Post-medieval working of Swithland slate was on a small scale, purely as a vernacular material. The small pits in Swithland Wood are thought to be early slate workings, perhaps dating from the mid-13th century. Eventually, industrial-scale production developed in the wood and at the Brand where some of the old quarries were worked to depth. These are now flooded. There is currently no production and initiatives to reopen a quarry have foundered for lack of commitment.

Roofing slates were sold in two classes: by the score for the large sort; and by sixscore for the common kind.[18]

The quarries made a range of slate products besides roofing slates, famously including gravestones. But, except for St Pancras Station hotel, they were limited to local markets by the cost of transport and, from the 19th century, by competition from the Welsh quarries. Even at St Pancras, which had been intended to be a shop window for East Midland's manufacturing, the developers decided to slate Barlow's engine shed with Welsh slate because of the cost saving.

Although there is no production of Swithland slates today, reasonable facsimiles matching purple or grey slates can be made using slate from Welsh quarries (see section 14.2.1). If these options are adopted, a specification covering colour, thickness and a range of sizes should be agreed with the supplier. A mix of standard sizes from the quarry's stocks will not produce a convincing roof (see Figure 24).

7.4 Swithland slates

Swithland slates have a distinctive texture due to their comparatively coarse cleavage. Their colour varies. Those from the Swithland quarries are grey, from Woodhouse Eaves they are purple and the Groby slate is greenish. Colours are sometimes mixed on roofs, probably because they have been sourced from several other roofs for reslating.

They are made in random sizes ranging from 30 to 10" long (762 to 254 mm) and 14 to 3" wide (356 to 76 mm). A distinctive feature is that many are very narrow for their length. This has implications for the roofs, primarily that they are steely pitched, and how they are laid.

7.5 Swithland roofs

Random slates generally are laid to fairly steep pitches – at least 40˚ and as steep as 55˚. This is especially important due to their coarse texture and because they include a significant proportion narrower than half their length. Low pitches, such as on church aisles, are vulnerable to leaks.

Earlier roofs were simple in form – plain gable to gable with no hips or valleys. During the 18th and 19th centuries, Swithland roofs were popular on higher status buildings and roof detailing changed. Valleys, hips and dormer windows became more common and decorative brickwork was introduced under eaves and verges. Professionally designed buildings such as the National Trust's Stoneywell in Leicestershire adopted details from other regions and traditions. The process continues and even though the quality of slating work is often very good some non-traditional elements have been introduced, for instance, swept valleys, eyebrow dormers, large rooflights and conical hips.

From the 19th century, Welsh slates started to be used for repairs and new buildings, and in the 20th they replaced Swithland slate completely on some roofs. These replacements were tally slates and are smoother and usually thinner, so they are not a good substitute. However, it is possible to make truly random slates of similar colours from more coarsely cleaved Welsh slate.

7.6 Preparation and gauging

The slater sorts the slates and gauges the roof as described in section 1.

7.7 Fixing

The slates can be hung to the laths or battens with softwood, hardwood (as traditionally) or metal pegs, or nailed to battens.

If the slates are pegged, head-bedding will secure the pegs and improve wind resistance. Metal pegs usually have heads which lock them in place (see figure 4).

In recent years, top-fixed Swithland slates have been reused with centre-nailing. This is unnecessary and risks water leaking through the nail holes unless the laps are increased. If it is adopted, the slates' tops must be dressed off to avoid the risk of leaks through the old holes and the head lap, and minimum width specified to take into account that the centre-nailing reduces the slates' effective width by about 50 mm (2").

7.8 Eaves

On earlier buildings there would be no gutters but large overhangs provided to throw water away from the walls. One or two courses of much larger and thicker slates at the eaves give the roof a distinctive appearance (see figure 25(a)). They would be heavy enough to resist wind uplift even when head-fixed. To give an even larger overhangs, wallheads were sometimes corbelled with decorative brickwork or terracotta (see figure 25(b)).

Gutters on rise-and-fall brackets have often been added to earlier buildings and those of later date have fascia boards. Where there is a gutter, the undereaves and eaves slates are positioned to give an overhang of typically 50 or 75 mm (2 or 3").

7.9 Verges

Like the eaves, early verges simply oversailed the walls by a few inches (75 mm or so) with mortar fillets under the slates. The slating is finished with wide and narrow slates from the stock. These are still to be seen on farms and outbuildings (see figure 26(a)).

Figure 25: The eaves of Swithland roofs are often formed with one or two courses of much larger and thicker slates, giving the roofs a distinctive appearance **(a)**. During the 19th century, a large eaves overhang was formed by corbelling the wallhead with decorative brickwork **(b)**. Photos: Terry Hughes

Later roofs include bargeboards or raised parapets against which the slates are butted and mortared, especially on churches (see figure 11). Alternatively, the slating was carried well over the wallhead with decorative brickwork or terracotta (see figures 26(b) and 26(c)).

On some roofs the slating is tilted to turn water onto the slopes and minimise run-off down gables.

7.10 Abutments

Historically, joints between the slating and the walls were formed with mortar fillets (flaunching) without lead soakers. Pieces of slate, known in some regions as listings, were bedded into the flaunches to protect them (see figure 14(b)). The abutment slating was also raised to turn water away from the vulnerable junctions (see figure 15).

Later, lead soakers or secret gutters were introduced with mortar flaunches or cover flashings. Secret gutters are prone to blockage by leaves and other debris, and need regular cleaning. They are best avoided if at all possible. Regrettably, they are often the only solution when insulation and/or ventilation is introduced that would otherwise raise the roof surface too much under a coping or moulding.

7.11 Valleys

Earlier (pre-18th century) buildings would have avoided including valleys because of the difficulty of making them watertight with narrow slates and without expensive lead. The few slate valleys known appear to be a swept type although they may include lead soakers (see figure 13(a)).

7.12 Ridges and hips

Ridges would most commonly have been covered with angled or hogsback tiles, but stone ridges have also been used. On later buildings, roll-top and decorative tiles were introduced.

Narrow slates do not lend themselves to raking cuts so hips are barely known on earlier roofs. Where they have been adopted, wider slates are selected from the bulk and it is likely that the earliest – 17th century – would have been bedded onto mortar or clay rather than having lead soakers. This would have had a good chance of being successful, because water flows away from the joint.


26(a)


26(b)


26(c)

Figure 26: On early roofs, verges simply oversailed the wall by a few inches (75 mm or so) with a mortar fillet under the slate **(a).** With later roofs, verges were extended with decorative brickwork or terracotta **(b and c)**.

Photos: Terry Hughes

On later roofs, hips are either covered with clay ridge tiles or lead, or, more rarely, mitred and soakered. On mitred hips the slates need to be selected, cut and fixed carefully to avoid wind damage. On covered hips the heavy hip tiles ensure the slates are secure.

7.13 Curved slating

There are successful examples of conical roofs but they are not common (see figure 27).

7.14 Dormer windows and rooflights

Dormer windows are uncommon and the valleys are usually lead-lined or mitred and soakered indicating that even on older roofs they are later introductions.

Rooflights are also not common. Where they exist and need attention they should be repaired or renewed to match the existing units. If cast iron framed lights need to be replaced, conservation types are the most suitable option.

7.15 Wall cladding

Cladding seems to be non-existent with Swithland slating.

7.16 Mortar

Lime mortar is used for head-bedding the slates and with hair for torching, as well as external pointing at verges and abutments. One example is known, St Michael and All Saints' Church at Thorpe Satchville in Leicestershire, where the head-nailed slating was solid-bedded in hot lime onto the ceiling laths (see figure 28).[19]

Figure 27: Curved Swithland slating is rare even though the long narrow slates are well-suited to conical roofs. Photo: Terry Hughes

8 Limestone slating

8.1 Limestone appearance

The appearance of roofs made with different limestones varies in texture and colour as a result of how the slates are made and laid, and the detailing at hips, valleys etc.

Thickness differs between stones, such as Collywestons, which are thinly split by frosting, and the thicker hand-split examples more common to the south of the region from Oxfordshire to Dorset.

Surfaces range from smooth, Collyweston, for example, to quite heavily textured for Cotswold Forest Marble and Magnesian limestones (see figure 29). The form of the edges is a product of the traditional methods used to shape and size the slates and should always be conserved. Sawn edges are not acceptable.

The weathered colour of the stones can range from grey to yellow but this will often be masked by growths of white to grey lichens that are distinctive (and unlike those on acidic sandstones). There is one exception to this; where cement mortar is used for tail-bedding it promotes the growth of black moss.

Although there is a large diversity of stone slates in the UK, the majority fall into one of three types:

- Small sizes producing roofs with many courses of each size.
- Intermediate sizes with fewer courses but several of each size.
- Large sizes with few courses and often only one or two of each size.

All the limestone slates are small with numerous courses on a roof, as many as 60.

The type of roofing stone influences the style and appearance of a roofscape in two ways. Directly, in the texture of the roof surface in terms of the width and height of the margins and in the number of courses; and indirectly, in the way intersections, such as hips and valleys, can be constructed. The difficulty of constructing the latter with some types of slates, also constrained planforms for historic buildings.

Being generally small, limestones are amenable to laying to curves, such as in laced or swept valleys, and to domes and conical roofs where small and tapered slates are necessary to ensure a close fit.

28(a)

28(b)

Figure 28: Mortar is used for all the normal techniques of bedding and torching. One unusual example is known, at St Michael and All Angels' Church in Thorpe Sackville, Leicestershire. The slating was solid-bedded in hot lime onto the ceiling laths **(a).** This was renewed as found (**b**). Photos: Terry Hughes

29(a)

29(b)

Figure 29: The texture of limestone slates varies between quite smooth **(a)**, to rough, as with some Cotswold types and Magnesian limestone **(b)**

Photos: Terry Hughes

9 Magnesian Limestone slating

9.1 Magnesian Limestone history

The Magnesian Limestone outcrop extends for 150 miles (240 km) from Nottingham to Sunderland in Tyne and Wear (see figure 30). There are historical records that indicate it may have been a significant stone slate in the past but there are only a few roofs known today, in an area from Mansfield in Nottinghamshire to Doncaster in South Yorkshire – at Steetley, Barlborough and Whitwell on the Derbyshire/Nottinghamshire border. Excavations at Dale Abbey (1162) in Erewash, Derbyshire, discovered Magnesian Limestone roofing along with Swithland slates.

9.2 Magnesian Limestone production

Quarrying for roofing is recorded in Derbyshire at Steetley, Bakestone Moor and at least one of the many small quarries around Gypsy (Gypsyhill) Lane in Whitwell; and possibly in South Yorkshire at a quarry near Gildingwells. It was found in near-surface workings in thicknesses suitable for roofing. Although there are many quarries working the stone for aggregates and several could potentially have fissile stone in their surface levels, there are no active sources of stone slates at present. Currently, the most appropriate stone for repairs would be from one of the Cotswold or Wiltshire limestone quarries.

9.3 Magnesian Limestone slates and roofs

There are so few roofs known that it is risky to draw general conclusions about the slates or roofs. From what is known they are best described as similar to the coarser types of Cotswold stone slates, such as Forest Marble, and seem to have been laid in the same way and with similar detailing.

Figure 30: The Magnesian Limestone Formation extends for 150 miles (240 km) from Nottingham to Sunderland, Tyne and Wear. There are only a few roofs with this slate known today, in an area from Mansfield to Doncaster – at Steetley, Barlborough and Whitwell. Image: Reproduced with the permission of the British Geological Survey © UKRI 2019

10 Collyweston slating

10.1 History of Collyweston slating

There is documentary evidence of the production of Collyweston Slates for Cambridge Castle in 1286. By the 14th century production was well-established with records of 14 000 slates being supplied to Rockingham Castle (Northamptonshire) in 1375 and 5 000 to Oakham Castle in 1383.[20]

The earliest production would have been along the outcrop at the side of the Welland valley to the west of Collyweston and Easton-on-the-Hill in Northamptonshire. However, once the easily accessed outcrop was exhausted, the rock had to be extracted from open quarries and ultimately, as the depth of overburden increased, from mines. Mining continued until about the mid-20th century.

During the 20th century, production declined - partly because of a series of mild winters when frosting was unsuccessful - and by the century's end had effectively ceased. As production reduced, the removal of old slates from buildings for resale and their replacement with unrealistic concrete facsimiles increased to the detriment of the region's unique roofscape. The threat to the more than 2 000 Collyweston-roofed listed buildings had become so serious that the Building Conservation and Research Team at English Heritage (now Historic England) instigated research into an artificial frosting process to obtain slates for the reslating of the Grade I Apethorpe Palace in Northamptonshire. This was the stimulus that resulted in the re-establishment of commercial production. There are now two companies producing slates (see section 14.2.2).

10.2 Collyweston slate sources

Frost-fissile Collyweston Slate rock, known as log, was formed by the precipitation of calcium carbonate into sand and occurs as a distinct bed at the base of the Lincolnshire Limestone Formation.

Although these roofing slates take their name from a single village and its many mines, the productive beds occur intermittently south-westward from Wothorpe, Burghley Park and Wittering, all in Cambridgeshire, and across the border into Northamptonshire through Collyweston and Duddington to Deene Park and Kirby Hall.[21]

Other sources have been suggested, including from the Northampton quarries, such as Duston, but this is because they were promoted using the Collyweston name even though they are from a different geological source.

10.3 Collyweston Slate production

The process of mining and converting Collyweston slate rock (log) into roofing slates has four stages: extraction of the log; freezing and cliving (splitting) to slate thickness; dressing the thin pieces to a roughly rectangular shape; and sorting them by size, known as parting.

Historically, the log was extracted by hand. The sand was excavated from below the stone using a pick and the roof was propped on temporary pillars until an area about 12 or 15' (3.5 to 4.5 m) deep had been cleared (see figure 31). The pillars were then removed and the log allowed to fall. It was stored, usually underground, until there was a period of frost. But the process was arduous, potentially dangerous and slow – taking up to two weeks to release 20 tons/tonnes of log. It was so inherently dangerous that it would not be permitted today.

Collyweston log is converted to roofing slate thicknesses by exposing it to cycles of freezing and thawing, all the time keeping it wet. The process was, therefore, dependent on the arrival of a period of cold weather and involved wetting by hand regularly, day and night for several days. This provided the slater with enough slate for the next summer's roofing work.

During the 20th century, the reliability of suitably prolonged cold spells declined and production almost ceased, with a concomitant increase in the removal of slates from old buildings to enable the repair of others.

If this situation had been allowed to continue, all the Collyweston roofs would have eventually disappeared. To tackle the problem, an artificial process was developed whereby the log was exposed to a series of two to four periods of freezing and thawing in a commercial freezer. This mimics the natural frosting process exactly and is carried out continuously.

Besides the problem of the uncertainty of suitably cold winters, even were everything to be favourable the supply of log would be intermittent and unsuitable for today's roofing industry. A reliable, continuous supply is needed.

To meet this, a method of extracting the log with a remotely controlled – and, therefore, safe – jack hammer has been developed and is in operation by Claude N Smith Ltd. This system undermines the log in the same way as traditionally, but allows it to be dropped and removed for further processing several times a day so that frosting can be a continuous process.

Once the fissile beds in the log can be seen or tested to be ready for splitting, the freezing cycles are stopped and the log split (clived) with a traditional cliving hammer into individual pieces usually more than 9 mm thick but with thinner areas, such as near edges. The split pieces are then reduced to a roughly rectangular shape either by hand-dressing or use of a diamond saw. If sawing is used, the edges are subsequently dressed by hand in the traditional way with a batting hammer. This is essential because it affects the appearance of the roof. Sawn edges are not acceptable for use on historic buildings. Only the bottom edge (the tail) and the two long sides are dressed, the top is left roughly tapered. It is important that the long sides are straight over at least 60% of the length to avoid difficulty with shoulder laps.

Once the slates are made, a fixing hole for a peg or nail is made about 1" (25 mm) from the top edge, either with a metal pick known as a bill and helve or, today, with an electric drill which produces a satisfactory hole but is much quicker.

The final stage of production is parting, sorting the slates by length (to the peg holes). Traditionally, this was into a set of lengths known as a heap or 'thousand' comprising about 840 slates plus thirteen large ones. It should cover about two squares of roof. A roofing square is 100 ft^2 or 9.29 m^2.[22]

The modern processing is essentially the same as the historic process, producing traditional and durable Collyweston roofing slates.

10.4 Collyweston slates

The colour is buff to pale yellow and slates are often blue-hearted. The fissile layers are thin, so frosting produces thin slates normally not less than ¼" (6 mm) thick. Generally, they range in size from 24 to 6" long (600 to 150 mm) but other sizes can be made, if required. It is important that some are approximately square for use as laced valley slates. Bigger sizes are also useful for providing a good eaves overhang where there is no gutter.

10.5 Collyweston slate roofs

Taken together, the thinness of the slates, the mortar bedding and their laced valleys make Collyweston roofs distinctively different from those of all other limestone regions. Frost-split slates were produced elsewhere, in the Cotswolds region, and limestones are bedded in Purbeck and slates in Cornwall. Even when Collyweston roofs are encountered well outside their natural early transport-based region, however, they are unmistakable.

The roofs are nearly always steep – generally, with a pitch of more than 45˚ and as much as 65˚. This ensures water is shed quickly. Shallow pitches as sometimes seen on church aisles can be satisfactory so long as the mortar bedding is intact. The greatest risk to them is that they are easily walked on and the slates broken.

Figure 31: Historically, Collyweston log was mined by extracting the sand from below using a pick and propping the roof on temporary pillars until an area about 12' to 15' (3.5 to 4.5 m) deep had been cleared. The pillars were then removed and the log allowed to fall. Photo: Terry Hughes

Figure 32: Fully bedded Collyweston slating is effectively sealed and cannot readily ventilate moisture from inside the roof. If ventilation is necessary, small gaps (see arrows) can be left in the bedding. This also works as access for small bats. Photo: Terry Hughes

It is not clear why these roofs are always mortar-bedded. The size and shape of the slates and the steepness of the roofs are little different from other limestones, which are never bedded yet perform perfectly well. The bedding will make the slates' heads lay tightly onto the laths, rendering them less susceptible to wind damage and this may be the explanation. It also provides draughtproofing.

10.6 Preparation and gauging

Traditionally, Collyweston slates were supplied as a heap but now, because of the more reliable and continuous production, it is possible to supply a mix of lengths to match an existing roof. The slater sorts the slates and gauges the roof as described in the boxout in section 6.1 on 'Using a slater's marking stick to gauge a roof'.

10.7 Fixing the slates

Historically, slates were hung on riven or, later, sawn square laths with wooden pegs. Today, they are also hung with metal pegs or nailed to battens. They are tail-bedded in mortar (but see section 10.8) which should reach no further up each slate than just to the tail of the overlying slate. It must not reach the laths or battens. The mortar is held or raked back at the slates' tails to provide a water drip and a shadow-line which emphasises the diminishing coursing.

The mortar effectively seals the roof, preventing airflow, so it is better not to lay the slates over an underlay unless ventilation through the batten space can be provided to reduce the risk of moisture entrapment (see section 4.8). This is especially so with a vapour-permeable underlay, which encourages moisture transfer from the roof space. Where bitumen underlay has been installed, it is usually found to have rotted when the roof is stripped for reslating. One option that has been adopted to provide ventilation is to leave small gaps in the mortar bed at the slates' tails. This has also been done for bat access (see figure 32).

Figure 33: Shales or shadows are bedded in a small amount of mortar as the slates are laid to support their span from tail to bed. Photo: Terry Hughes

As the larger slates on the lower courses are laid, slates or shadows are bedded in the mortar underneath them to support their span (see figure 33). This is important because these roofs are often repointed working from ladders, which could break unsupported slates.

Although the slates are sorted into length sets and the lath gauging is decided in advance, knowledge, experience and care are needed to make sure there will be no leaks. The principle is that slates should be chosen and placed so that their perpendicular joints are as close as possible on the centre of the slates below. However, Collyweston slates are shouldered so it is essential to make sure the shoulder lap is adequate (see figure 34). To help with this, shales which cover a large shoulder can also be used.

10.8 Eaves

Slating is set out to give a good throw away from the wall or into the gutter, if there is one. Unlike most slating, the undereaves slates are laid with the bevelled edge upwards. Sometimes the bottom course is only spot-bedded to encourage ventilation.

Occasionally, the bottom of each slope was laid with a large margin and a very small head lap or none at all, apparently for decorative reasons. To prevent leaks on this technically bad detail, large pieces of metamorphic slate were bedded across the top of every slate.

Where bitumen underlay was installed in the past it was sometimes laid over the undereaves slates to prevent it draping. This is always unsuccessful because the underlay rots due to the effect of ultraviolet light and water at the slate joints.

10.9 Verges

Older, vernacular roofs have simple verges with the slating oversailing by 25 to 50 mm with a mortar fillet below. The slating is sometimes raised to turn water back onto the roofs.

On more important buildings, such as churches, the slating often finishes against raised parapets. The junction may be simply mortared, especially where the slating is tight under copings, or soakered and mortar-flaunched.

Where there was room, a cover flashing might be installed and turned under the copings. A simple cover flashing onto the slates without soakers is not reliable as water can drive under them and they look ugly. It is preferable when reslating to install lead soakers, one per course. To ensure the soakers are properly supported, slates with a small shoulder should be selected.

On later or professionally designed roofs the verges are carried over bargeboards.

10.10 Abutments

The slating at abutments is often tilted by raising the batten ends to turn water away from the vulnerable junctions. Abutments are weathered with simple mortar fillets (flaunching) or, more effectively, with soakers and flaunches or cover flashings turned into the masonry. Lead cover flashings can be very large in order to reach stone masonry bedding joints, and look clumsy. For this reason, mortar flaunches are preferred.

10.11 Valleys

The traditional Collyweston valleys are laced and are completely satisfactory if correctly laid (see figure 35(a)). Lead valleys are alien and there is no reason why they should replace laced ones.

The roughly square valley slates are laid diagonally up the valley board and the main slates laid on each side turned to butt against them (see figure 35(b)). The valley slates are wide so they sit up away from the valley board.

They are supported with shales underneath. Where two slopes with different slate lengths and, therefore, margins meet at a valley, it is good practice to adjust two courses of the shorter slates to match one longer slate.

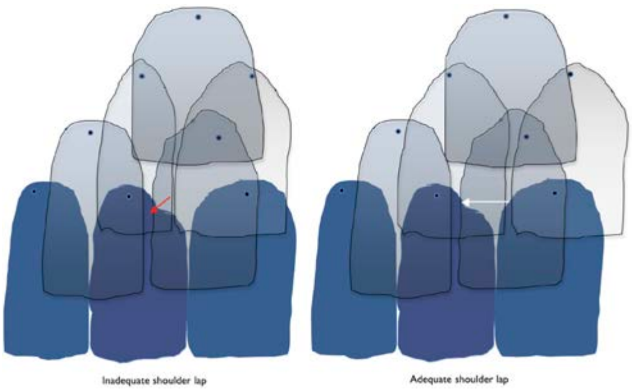


Figure 34: In common with most random slates, the tops are not squared off but left with shoulders. It is essential that when they are laid the perpendicular joints overlying slates are positioned to prevent leaks over the shoulders of the slates below. Illustration: Terry Hughes

If the roof has lead valleys or slating onto aprons, the slating should not be bedded onto the lead because it will inevitably fall out.

10.12 Ridges and hips

Ridges are most commonly closed with hogsback clay tiles or, more rarely, angular clay tiles or stones.

Hips are mitred and formed with wider slate selected from the stock. Historically, they would have been simply mortar-bedded but as lead became more affordable soakers were introduced.

10.13 Curved slating

There are successful examples of conical and domed roofs, and long horizontal curves, but they are not common (see figure 36).

10.14 Dormers and rooflights

Dormer windows are common and the full range of types – monopitch, gabled and hipped – are frequently positioned below, breaking and above the eaves and in the roof slope (see figures 37).

On monopitches, the roof is sometimes formed with one or a few large slates spanning the full width. The ridge is traditionally swept up into the slating above but today is often weathered with a lead saddle.

Rooflights are not common. Where they exist and need attention they should be repaired or renewed to match the existing. If cast iron framed lights need to be replaced, conservation types are the most suitable option.

10.15 Wall cladding

Cladding is not common but is used on dormer cheeks, sometimes as a single large piece of slate. Where it is coursed and lies against a roof slope, it is good practice to match the gauging and margins to the roof slates (see figure 38).

The cladding slates are often found to have deteriorated much faster than the roofing.

10.16 Mortar

The use of non-hydraulic mixes is sometimes specified for bedding Collyweston slate, but these generally lack the durability for the conditions to which the roof is exposed. For appropriate lime-based mixes see section 4.9.

35(a)

35(b)

Figure 35: Valleys in Collyweston slate are traditionally laced **(a)**. This is done laying roughly square slates diagonally up the valley and turning the adjacent slates on each side to butt up against them **(b).** Photos: Terry Hughes

11 Northampton slating

11.1 History of Northampton slating

It is probable that other Jurassic stones were being exploited for roofing as early as Collywestons. Archaeological sites in Northamptonshire have produced stone slates from 1250 from the Upper Estuarine Limestone Rutland Formation, probably worked at Duston and New Duston to the west of Northampton.

Nineteenth-century geological studies have identified quarries or mines in the Blisworth Limestone in Northamptonshire at: Oundle and Yardley Chase; [23] the Rutland Formation at Pytchley and Helmdon; Northampton Sand Formation at Duston; and the Middle Lias at Sulgrave[24, 25] and Chacombe, near Banbury.[26]

It is not clear whether the stones were frost-splittable, partly because some were often described and sold as Collyweston slates when they were not. Blisworth Limestone was called Pendle by the miners but documentary records suggest it was not frost-split but was suitable for roofs as dug.[27] The term, therefore, should not be confused with its use in the Cotswold quarries, where it is applied to frost-fissile stones. In the Cotswolds, slates suitable as dug are called 'presents'.

All the operations closed many years ago. Consequently, there is a long history of reslating with other stones or different roof products from about 100 years after the quarries were last active. Stone slates from the Cotswolds, Wiltshire and Collyweston have been used for these repairs and their own regional details have been imported along with the slates. So now there is a confusing roofscape with, for example, Collyweston laced valleys present roughly to the north of Northampton and Cotswold swept to the south. Possibly none of these are historically authentic.

In some villages, there are surprising numbers of old houses with asbestos roofs, including corrugated sheets or diamond pattern slates. These probably replaced stone during the early decades of the 20th century. They may well justify conservation in their own right.[26]

Figure 36: There are successful examples of curved Collyweston slating but they are uncommon, as on the Round Church in Cambridge. Photo: Nigel Smith

11.2 Northampton slate production

There is no production of the stone slates around, and to the south-west of, Northampton. Where roofs have been repaired or renewed with other stone slates (or asbestos), it would be appropriate to use the same products for future repairs.

11.3 Northampton slate roofs

The present roofscape includes what may be authentic and original slates (see figure 39) and details mixed in with Collyweston and Cotswold types. It is not possible, therefore, to give clear guidance on their conservation, save to look at a roof closely when it needs repair and to act appropriately, choosing the same or similar stone and replicating the details.

Figure 37: Dormer windows are common in Collyweston roofs and the full range of types – monopitched, gabled and hipped – are commonly positioned below, breaking and above the eaves and in the roof slope. Photo: Terry Hughes

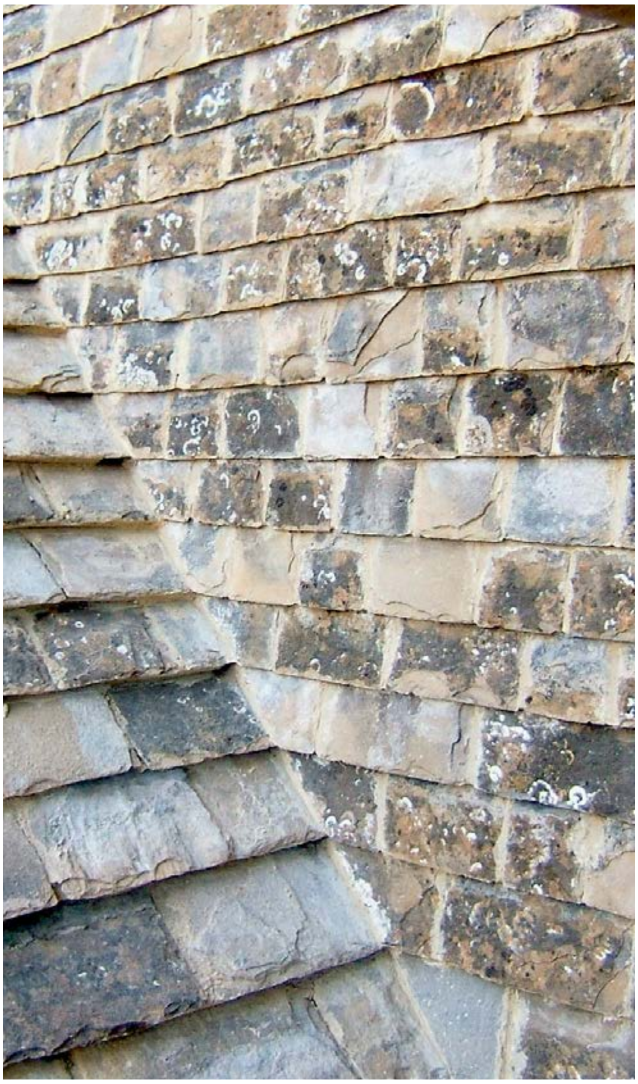


Figure 38: Wall cladding is uncommon with Collyweston slates – and mainly seen on dormer cheeks. Where it is applied, it is good practice to match the coursing with the adjacent slope. Photo: Terry Hughes

Figure 39: The roofscape of the Northampton area is confused because it includes original local stone slates, Collyweston and various Cotswold types. Many are not easily distinguished from each other without petrological analysis. Photo: Terry Hughes

12 Maintenance

12.1 Deterioration

Slate roof deterioration is usually a long-term process. Routine maintenance and repairs can be carried out for many years and will significantly delay the need to strip and reslate. The key is to check often – perhaps twice a year, inside and out if at all possible – and to act quickly. An unattended leak can result in timber rotting or other fabric damage which will seriously exceed the cost of repairs. It is particularly important to keep rainwater gutters – especially horizontal lead gutters – and downpipes clear of debris.

Insulation is also a potential source of dampness because it can cause moist air to condense onto woodwork, so it should not be assumed that dampness always indicates a slating problem.

12.2 Repair

Missing, slipped or broken slates should be replaced as soon as possible. If they are pegged it will probably be possible to lift or rotate adjacent slates to slide a new slate of similar thickness into place. However, this will break any torching or bedding so these should be replaced as well. If the slates are nailed then a slater's ripper should be used to cut or drag out the nail. The replacement can be fixed with a hook, non-ferrous tingle or peg, or with non-ferrous wire inserted internally through the top of the slate and twisted around the batten. For repairs to large areas, a triangle of slates should be stripped so that all except the apex can be refixed with pegs or nails and only the top one(s) will need a tingle or similar fixing.

12.3 Mortar

Where long-established mortar bedding is crumbling or falling away, it can be repointed but this is usually only a temporary reprieve as the lath nails are probably failing as well and new pointing places more stress on them. Fallen torching should be renewed because it holds pegs in place, helps prevent slates being lifted by high winds and protects laths from water damage. Ridge and hip tiles may need rebedding and if the bed is not exposed along the edges a NHL3.5 mortar is suitable. Where it is exposed it will need to be stronger, NHL 5, for example, or the NHL3.5 bedding mix can be pointed up.

12.4 Biannual checklist

Twice a year:

- Internally, check for water-staining or other signs of leaks. These may be much lower on the roof than the leak.
- Clear gutters and downpipes, pitched and horizontal valleys, and secret gutters.
- Replace slipped, broken or missing slates.
- Check if ridges and hips are secure.
- Check leadwork – look for wrinkles and cracks, cuts from slipped slates and flashings coming out of chases.
- See whether mortar beds, fillets or flaunchings are cracked or insecure.
- Look for leaks around roof penetrations, such as rooflights or solar panels.
- Ensure insulation is not blocking ventilation routes, for instance, at the eaves or ridge.

13 References

1 See:
https://www.spab.org.uk/advice/glossary
also:
http://www.stoneroof.org uk/Historic_Roofs/Publications_files/glossary%20v3%205-16.pdf

2 The Stone Roofing Association can provide advice if stone from a new source is being considered

3 The Level 3 NVQ Diploma Roof Slating and Tiling includes random slating. Successful completion entitles candidates to apply for the Construction Skills Certification Scheme (CSCS) Gold Card covering craft skill, job knowledge and understanding. They can extend this with the Level 3 Heritage Special Apprenticeship Programme for Roof Slating and Tiling. This covers the historical, theoretical and technical knowledge and practical skills in historic building conservation, repair and restoration, which leads to the CSCS Card endorsement Heritage Skills. These are the appropriate qualifications for slaters who work on historic roofs. There are similar systems for construction site management of conservation work and for conservation consultancy

4 The National Federation of Roofing Contractors provides a range of health and safety guidance notes. See particularly National Federation of Roofing Contractors 2009a, 2009b and 2013

5 For more about work to roof structures, see SPAB Technical Pamphlet 12 by James Boutwood on *The Repair of Timber Frames and Roofs*

6 For more about reasons not to defrass timber, see SPAB Information Sheet 2 by Peter Locke on *Timber Treatment*

7 Petrological examination of recently imported foreign slates sold as substitutes for Collyweston and Swithland slates proved them to be completely unsuitable and not even geologically correct.

Collyweston slates: The stone, suggested as a potential replacement for Collyweston slate, was a completely different material. Whereas the Jurassic Collyweston stone is a siliceous limestone, the fissility of which can normally only be developed after a period of freezing and thawing, the potential replacement material was a purely siliceous and extremely fine-grained sedimentary stone, the fissility of which was due to thin laminae of fine-grained sandstone. There was a possibility that, after a period of time in service, the potential replacement stone would start to delaminate due to its petrographic structure. As a result of the completely different petrography of the two stones, their surface texture was completely different. Although light coloured, both stones being a pale buff, the chemical differences would have resulted in completely different colonisation on the two materials.

Swithland slate: The stone, suggested as a potential replacement for Swithland slate, was a completely different material to the stone from Charnwood Forest. Whereas the Precambrian Swithland stone is a regionally metamorphosed siltstone with tectonically developed slaty cleavage, the potential replacement material was an unaltered sedimentary stone which had been cleaved along the bedding planes. The surface texture of the two stones was different due to the different nature of these cleavages. The colour of the stones differed due to their different mineralogy. The presence of pyrite in the potential replacement stone could have led to iron staining of the surface as well as a reaction with the calcite in the material to form gypsum. The presence of calcite may have also resulted in the colonisation of the surface by a different organic assemblage to that on the Swithland slate. This, in turn, would have led to a different colour and texture on the weathered surface after a period of exposure. The staining and deterioration of the stone can now be seen on roofs in Swithland village

8 National Federation of Roofing Contractors, 2012

9 BS 5534 provides further guidance

10 See National Federation of Roofing Contractors, 2009a, 2009b and 2013

11 Full explanations on exemptions to the requirement to install roof insulation are given in Part L of the Building Regulations 2010

12 For more about minimising the risk of condensation, see SPAB Technical Advice Note on: Control of Dampness

13 Historic England has published guidance on complying with Part L of the Building Regulations 2010. See Historic England 2016a, 2016b and 2016c

14 Further advice on selecting mortars is included in: Allen *et al*, 2003 (a range of mixes for varying exposure conditions is set out in tables 9 and 10 on pages 36 and 39); Holmes and Wingate, 2002 (chapter 5 is especially relevant and the effect of blending different hydraulic limes with non-hydraulic limes is given in appendix 7 on p293); British Standards Institution, 2015; and Historic England, 2013, pp51-55 (including advice on the range of building limes, from non-hydraulic to NHL 5, and their use for varying levels of exposure)

15 McWhirr, 1988, p5

16 McWhirr, 1988

17 McWhirr, 1988, p3

18 Potter, 1842, pp12-13 of geological appendix. The slates when quarried, split and trimmed are divided into large slates and small slates. All those whose surface exceeds one hundred square inches are called large, those below are called small. The large slates sell for 2s 6d a score the small for 2s 6d per hundred reckoning the long hundred or sixscore

19 This was renewed as found in 2015

20 Ramsey, 2002

21 Woodwood, 1894, pp482-486

22 A Collyweston heap is a quantity of dressed slates of all sizes on the ground made up of seven hundreds (120 slates). A hundred is 40 cases of three slates. It should cover about two squares of roof

23 Sharp in Thompson, 1927 quoted in Sutherland, 2003 describes a quarry west of Oundle where 'Pendle' – the quarrymen's term for any fissile limestone – occurs at the top of the section, and 'splits into thin flags or slates'

24 Thompson in Serjeanton, R M and Adkins, W R D, 1906, p298 notes that the manor at Sulgrave was roofed with stone slates 'probably supplied from Helmdon'. A slate from the manor roof was identified by the British Geological Survey as a yellow-brown, fine- to medium-grained, ferruginous, hard, carbonate-cemented sandstone. It showed fine parallel laminations, variably cemented, as is evident

from the distinct hard 'ribs' that are developed on the weathered edge of the 'slate'. It was very likely to be a Duston slate

25 English Heritage, 2011, p8 describes Duston Pendle as follows:

'Within central Northamptonshire, and particularly in an area stretching from the north and west of Northampton across to the western margins of Wellingborough, limestones (termed 'Pendle') are present within the Northampton Sand Formation and have been used in buildings across much of this area. The limestones typically occur between the lower and upper sandstones of the Duston Member. Around Duston, the limestones may be divided into two informal units. The upper is the Duston Pendle and consists of cross-bedded calcareous sandstones to sandy limestones with ooids and shell debris, and may become an ooidal limestone. It was worked mainly in the 19th century and used in pale, brick-sized blocks in local terraced cottages and some Victorian churches (eg St Matthew's, Northampton).

'The lower unit, or lower bed of the Pendle, has similarities with the Collyweston Slate and consist of cross-bedded units which split along the laminae formed by the fore-sets to form 'slates' that are generally thicker and therefore heavier than those from Collyweston. As with Collyweston Slates, they required winter frosting in order to split the rock. The laminae consist of layers that are alternatively sand-rich, or rich in shell debris, or ooids. This results in different porosities in each layer, making some more susceptible to splitting after wetting and freezing.

'These slates were worked underground, and there are 17th-century references to workings at "Slate-pitt Piece" and around Harlestone and Duston in the 18th century.'

26 There is more information in Hughes, 2003

27 Morton, 1712 quoted in Sutherland 2003, p58

28 The conservation of asbestos cement roofs is covered in English Heritage, 2013, pp587-594

14 Other advice

14.1 Consultants and contractors

Where slating work is being considered, the SPAB may be able to suggest the names of suitable contractors and professionals or advise on courses that teach practical skills. Local authorities may also have lists of architects, surveyors and slaters with experience in local slating.

The names of professionals accredited in building conservation be obtained from the relevant accreditation bodies:

- **Architects (AABC Register)**
  www.aabc-register.co.uk/
- **Building Surveyors (Conservation-Accredited)**
  www.rics.org/
- **Structural Engineers (Conservation Accreditation Register for Engineers)**
  www.istructe.org

The names of contractors accredited in heritage roofing can be obtained from:

- **National Federation of Roofing Contractors**
  020 7638 7663
  www.nfrc.co.uk

14.2 Slate producers

14.2.1 Swithland Slates

There are no operating Swithland slate quarries. The Traditional Slate Company can make slates in traditional formats from Welsh slate rock of similar colours.

- **The Traditional Slate Company**
  01773 549273
  www.traditionalslatecompany.co.uk

14.2.2 Collyweston slates

- **Claude N Smith Ltd**
  01748 444627
  www.claudesmith.co.uk

- **Messenger BCR Group**
  01780 239 800
  www.messengerbcr.co.uk

14.3 Advice on vernacular slating

In addition to the SPAB, advice on vernacular slating can be obtained from:

- **Historic England**
  0121 625 6888
  Email: midlands@HistoricEngland.org.uk
- **Stone Roofing Association**
  www.stoneroof.org.uk

14.4 Advice on protection of animals and plants

- **Natural England**
  0300 060 3900
  www.gov.uk/government/organisations/natural-england
- **The Bat Conservation Trust**
  0345 1300 228
  http://www.bats.org.uk/
- **The Barn Owl Trust**
  01364 653026
  www.barnowltrust.org.uk

14.5 Further reading

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