Stone Slate Roofs in County Clare

Information and Guidance Leaflet




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1. Introduction

Stone can be used as roofing material when it *naturally cleaves or can be riven into suitable thin layers* (Oliver 1997, 310). When this is feasible, stone can be used in a similar way to the laying of tiles and slates In Europe stone has been widely used as a roofing material for vernacular buildings. For example in Norway, massive flagstones are used to cover the roofs of houses, boat sheds and farm buildings, measuring 750 mm (29 inches) wide to as much as 1500 mm (5 ft) square (ibid, 311).

In describing this roof covering the term stone slate has been used. Strictly speaking this stone is not a slate but rather a sedimentary stone meaning that unlike metamorphic slate they split along bedding planes. The term “stone slate” is also used by English Heritage (*Stone Slate Roofing, Technical advice note,* English Heritage 1998, 2), providing a generic term to describe a roof covering which is known under various names.

In west Clare, the stone slates used on houses are generally known as slates while the thicker ones used on out-buildings are known as flags. The stone used is often referred to as Liscannor stone. Liscannor stone does not specifically relate to an individual quarry, it is the name given to a number of fissile sandstones that have been worked in the area around the Cliffs of Moher and Liscannor village, Co. Clare. More specifically the stone is described variously as Moher, Luogh and Doonagore slate, flag and flagstone. The Moher, Luogh and Doonagore slates are called after the quarries from which they are taken.

2. Geological Background & Historical Use of Stone Slate in Clare

In west Clare roofs of stone slates can be seen as far north as Doolin to as far south as Kilrush and as far east as Corofin. They would appear to be mainly prevalent in the Liscannor, Doolin and Ennistymon area probably due to the long tradition of quarrying in this area. The use of stone as a roofing material in west Clare is partly explained by the underlying geology, which is largely shaped by sandstone formations. However they are most prevalent in the Liscannor area due to continued tradition of quarrying in the area.

The Geological Background of County Clare

The rocks of County Clare belong to the Carboniferous Period and are part of the Mississippian and Pennsylvanian sub-periods. The dominant rock types are limestone, sandstone and shale and range in age from 345 to 315 Million years old. The older limestone is overlain by the younger sandstone and shale. In north and mid Clare the landscape is dominated by limestone which forms the internationally important karst region of the Burren. Elsewhere in west Clare the geology is dominated by shales and sandstones which are spectacularly exposed along the coast from Doolin to the Shannon Estuary.

Sandstone is a sedimentary rock composed of sediment particles with a grain size of between 2mm and 1/16mm, usually formed when sand is deposited in layers and subsequently lithified. Distinguishable layers are called beds and were originally horizontal. The stone is a hard siliceous sandstone consisting of between 70% and 90% silica making it hard and durable. In this region of Clare, Liscannor stone was formed interbedded with shales and it is only in particular areas where it occurs in regular flat beds that it can be quarried and split to produce *flat slabs which are used outdoors and indoors for paving, cladding and furniture* (Pavia & Bolton 2000, 57). It is the bed thickness along with other factors such as colour, durability and skid resistance that normally determines the use to which a stone may be put (Flegg 2001, 6 & 10) (Halpin 2003, 14).

The Moher Flags provide a record of an ancient river delta; the sands which form the Moher flags were carried from the south by large rivers which deposited the sediment into a shallow sea. The sands were affected by waves which produced the ripple marks which are common on some surfaces. The stone quarried near Liscannor and Miltown Malbay also displays the fossilised tracks of unknown creatures which may have been molluscs, anthropods or worms which burrowed through the soft sand and mud. The rivers, sea and burrowing creatures were all buried and preserved 315 million years ago. It is the fossilised tracks that give the Moher flags their characteristic appearance. After being buried under a substantial thickness of sediment the sands eventually got cemented and turned into rock. It took over 300 million years for the rock to travel from where it was formed near the equator to where it is now. During that long process of plate tectonic movement many fractures were formed which affect the quarrying process now. The spacing of the fractures determines the maximum size of a slab that can be extracted. The environment in which the sand was deposited was similar to the modern day Mississippi Delta. Here millions of tons of sand and silt pour out in periodic layers from the great river into the sea, eventually building up enough sand and mud to form land.

Liscannor stone is a general term given to a number of quarry works located in the area around the Cliffs of Moher and Liscannor Village. This is probably due to the fact that it was from Liscannor pier that the rock was once shipped. It includes the current quarries at Luogh and Moher, and in the past also included the now closed quarry works at Doonagore. Today Liscannor stone has come to describe any fissile sandstone that displays the fossilised trails of marine activity such as that quarried at Moher and Miltown Malbay.

Further inland the surface of the rock shows various ripple marks (Doonagore) *in some areas and is completely smooth in others* (Luogh). *Colours can vary from blue/black to grey to brown with some russet hues* (The Rock Shop, Liscannor, 2002). In Luogh townland, *the rock is typically smooth and is grey and brown in colour* (ibid.). The now closed quarry at Doonagore produced grey/green flags with a dimple marked surface *reflecting the passageways made by a marine worm* with ripple marked rock also occurring (ibid.). The rippled surface can indicate shallow water deposition as seen on modern sandy beaches.

In the past a similar type of sandstone was quarried near Ennistymon. The Ducks quarry south of Ennistymon also had the fossilised traces of worm activity in some examples but is generally semi-smooth. Its colour varies from brown to dark grey (The Rock Shop, Liscannor, 2002). In the past stone was also quarried from the area of the Falls in Ennistymon requiring the River Inagh to be diverted (Paddy Maher 16/01/03, pers. comm.).

The thin bedded Namurian sandstone was also quarried at Moneypoint and Knockerra near Kilrush. The sandstone was also quarried at Aylevarro near Cappagh. The quarries at Moneypoint were only a short distance from Doonogurroge Castle, Killimer, where there are still flags on the outbuildings of the castle. This stone was also characterised by fossilised tracks of sea snails and worms. The quarries at Moneypoint closed in the early 1900s.

Outline of Historical Production

From the preceding section it is clear that local stone was ideal for the many uses. The thick blocky beds could be used as building stone while the thinner beds provided for a variety of purposes, flags for flooring, paving for yards, upright flags for walls and stone slates for roofing.

There are a number of examples of early buildings with evidence of stone slates roofs. These include Kilmacrehy Church (RMP No. CL015-08301) in Laghcloon townland on the Lahinch-Liscannor Road (Fig. 1). It consists of an early 12th century parish church with nave and chancel with a small porch of 16th century origin (Spellissy & O'Brien 1987, 138). The church is built of mortared roughly coursed local fissile sandstone. Interestingly thin flags are used at eaves level of the main nave and chancel to channel water off the roof (now gone). Stone slates/thin flags are also used to top the sidewalls of the porch.

Figure 1: Kilmacrehy Church, Liscannor. View of 16th century porch with stone slate capping

Another example is Doonagore Castle, Doonagore, Doolin (RMP:CL-08-03 & RPS: 275) dating to *circa* 1500 and is a more unusual tower-house of its time as it was built to a circular plan (Fig. 2). The tower was ruinous in 1913 and was extensively restored in the 1960s. *It is one of the three round tower houses in Co.Clare, all in the N.W corner. The others are Newtown - Ballyvaughan (also restored), and*

Faunarooska which is almost demolished (Ua Cróinín & Breen 1995). The three storey tower house *is very well built of local flagstone in erratic mortared courses* (ibid.).According to Hugh Weir, prior to the 1960s it had the remains of a beehive shaped Liscannor stone roof (Weir, H. October 2002, pers. comm.). The quarry for the building of the castle itself *came from the worked out quarry of Trá Leacain* (Spellissy & O'Brien 1987, 66). Trá Leacain (the strand of the flagstones) is located WSW of Doonagore Castle along the cliff edge. Surviving sections of the quarry face are still clearly visible. The stone walls of buildings and field boundaries in this area appear to consist of the Trá Leacain stone (Shannon, M. 22/02/03, pers. comm.).

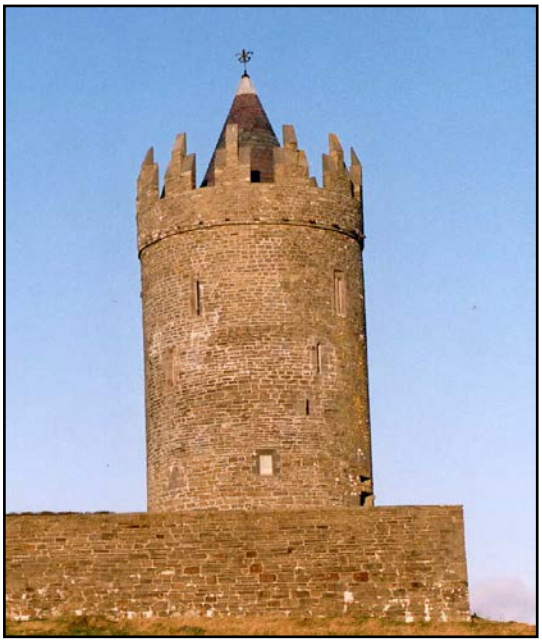

Figure 2: View of Doonagore Castle

The earliest written reference to quarrying and stone slate roofing in west Clare dates to 1808 with Hely Dutton's description of the raising of thin flags and the use of stone slates in the Ennistymon area. However it is not until 1845 that quarrying is mentioned in the Liscannor area, when Wilkinson describes Moher Flags being used in Ennistymon.

3. Traditional Stone Slate Roofing Techniques

This outline of the traditional methods of stone slating in County Clare has been compiled from a variety of sources. Firstly information compiled during a study of stone roofs by the author, secondly from further fieldwork and local information.

Information on past roofing methods was also acquired from quarry owners and house owners. Information on the English system was received from Terry Hughes, an independent slate and stone roofing consultant based in England.

Bennett and Pinion in their 1948 book titled *Roof Slating and Tiling* describe the construction techniques of a simple roof. The roof would comprise of timbers set at a pitch of 35º with hips and ridge. The roof itself comprises of rafters (4" by 2") placed at 14" centres, and supported midway up their length by purlins (7" by 3"). The rafters stop down onto a fascia 5" by 1", and support a tiling fillet (3" by 2"). The eaves project 10" from the exterior wall face. One chimneystack stands out from the ridge, the rafters on the lower front being held off by trimmers (4" by 2"). The ridge board (9" by 1 ½") at the top of the roof and the hip rafters (7" by 2") at the angles receive the upper ends of the common rafters (Bennet & Pinion 2000 ed., 15).

Roof Construction

The stone slate roofs differ slightly from this system of construction. In northwest Clare, the stone slates are quarried locally (today and in the past) and generally consist of either the Luogh or Moher Slate. The size and weight of the slates (max. of 1150mm x 880mm to min. of 450mm x 450mm with thickness varying between 13mm to 25mm - ½" to 1") imposed a number of restrictions and added requirements on the house, builder and slater. Most buildings have simple gable ended roofs with very little or no examples of hipped roofs, dormer windows, or valleys. This paucity of roof types reflects the limitations imposed by the large and somewhat cumbersome stone slates but also reflects the simple vernacular architectural style. Given the immense roof weight that buildings and roofs would have to support, many roofs display solid timber trusses and purlins. Pitches of more than 40º are generally not found. Rafter centers were generally in the region of between 310mm to 380mm. In nearly all cases battens were attached directly onto the rafters. There was only one example of roofing felt found near St. Brigids Well, Lisannor. Stout to more slender purlins were also sometimes used measuring between 185mm and 150mm in section. Through purlins were generally used with one example of butt purlins used at Moher Lodge, Liscannor. The wall thicknesses varied between 540mm to 755mm. In all cases a ridge plank was used to form the apex.

Laying & Fixing

The stone slates were generally randomly sized, with varying widths and lengths. The slates were laid to diminishing courses with the heavier and larger slates placed near the eaves and the smaller ones near the ridge. Each successive course of slates was chosen to provide adequate head and side lap over the previous course of slates. According to local sources the traditional system was to lay the battens to the size of the flag or slates coming out of the quarry at that time. However, there was little in the line of information on specific methods of slate laying employed, but it is likely that it was similar to methods employed in England.

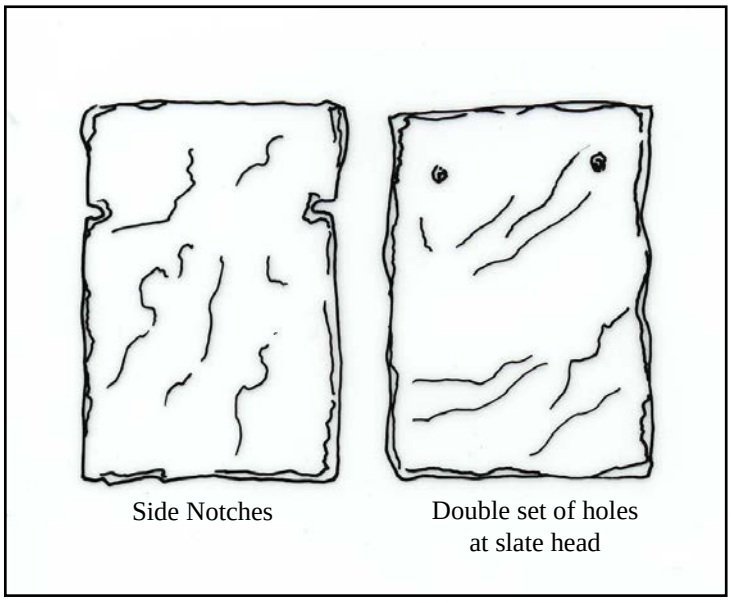

Figure 3: Illustration of Stone Slates

The randomly sized slates are initially sorted by length (length below the nail/peg holes) and the total width of each length measured. This width is then divided into the width of the roof to give the number of courses for each length. The roof battening is then set out to suit. However, as the spacing of the battens is calculated (spacing/gauging is calculated by subtracting the head lap from the length and dividing by 2) adjustments have to be made at each change of course (when the slate length reduces). This is achieved by increasing the head lap in the equation by half the difference in the lengths (e.g. if the slates reduce from 24" to 22" the head lap is increased from 3" to 4"). If this adjustment is not made, in effect 2" is removed from the bottom edge of the shorter slates and the head lap will be too small and there will be wide margins above narrow margins (Hughes, 28/02/03, pers.comm.).

Laps

The average head lap varied between 127mm and 203mm (between 5" and 8" on roof case studies). This lap was larger than in the case of natural slate due to the characteristic undulations of the sandstone especially found in the Moher slate with its characteristic fossilised trails. Luogh slate due to its smoother nature could be laid to a lesser lap. It was imperative that a range of widths was available to the slater to allow sufficient side laps otherwise slates would have to be cut to fit which in today's terms would be a waste of expensive slates and labour.

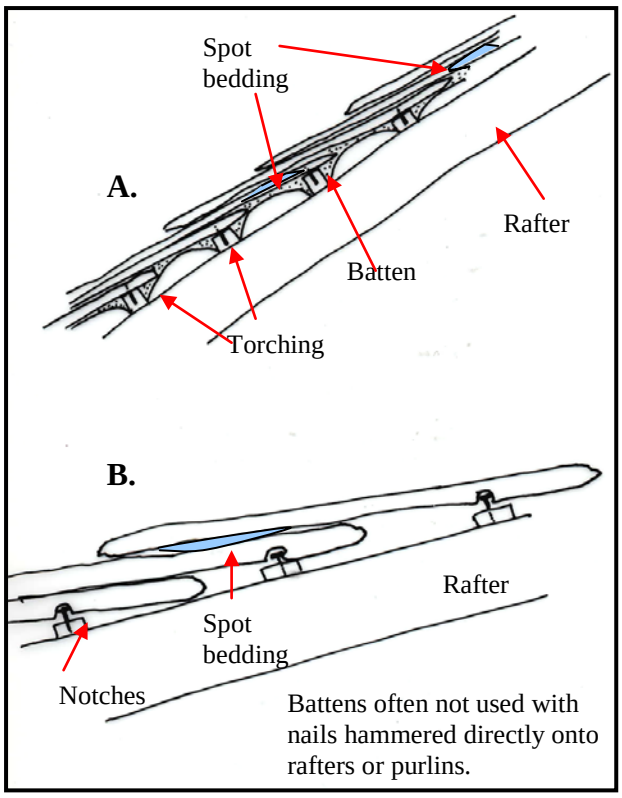

Figure 4: Diagram showing methods of attaching/hanging stone slate. A: Stone slates attached with nails through holes at head of slate. B: Thick stone slates (flags) hung from notches on underside of slates

Fixing

The slates were attached by iron nails through a double set of holes near the head of the slate or via side notches (Fig. 3 & 4). The heavier and thicker slates (known locally as flags) used on outbuildings were often just hung from nails, which rested in notches picked out from the underside of the stone. The stone slates used on outbuildings are known as flags due their immense weight and size and could be up to 55mm (2") thick. The immense size and weight of the stone meant that as a rule they stayed insitu. Battens were often not used so nails were hammered directly into rafters or purlins. A house in Doolin, prior to its present Luogh slate roof, had an earlier stone slate roof. The stone slates of this earlier roof were attached to battens with bog deal pegs. The pegs tapered to a point which were inserted into the battens to attach the stone slates (Shannon, M. 22/02/03, pers. comm.).

Eaves

The top of the sidewalls had a projecting eaves course consisting of projecting slabs/flags, over which the first two slate courses projected (Fig. 5). The wall was

then built up further with rubble to create the eaves roof slope. The wall plate was laid on the interior side of this wall. The first course of stone slates was usually bedded on top of the wall and would appear to have also been nailed into the first batten. This course, though shorter in length than successive courses, was very wide. The second course of slates was attached to the second batten and was laid so that the tails of the first and second course would meet. The first and second courses projected an average of 100mm from the exterior wall face to allow rainwater to run off.

Ridges & Copings

The ridge appears always to be composed of clay ridge tiles of blue-black/dark grey colour, which blend in well with the stone roof. The ridge was bedded in mortar. The stone slates were generally not carried onto the outer edge of the building, as most of them had copings. Copings were traditionally composed of stone slabs bedded in mortar.

NB. Prior to the use of clay ridge tiles, these were often cut from blocks of limestone and sandstone, particularly for churches and castles / tower houses, (See examples at Dysert O'Dea Castle museum, Corofin. Note by R UaCróinín ACO Co. Clare.

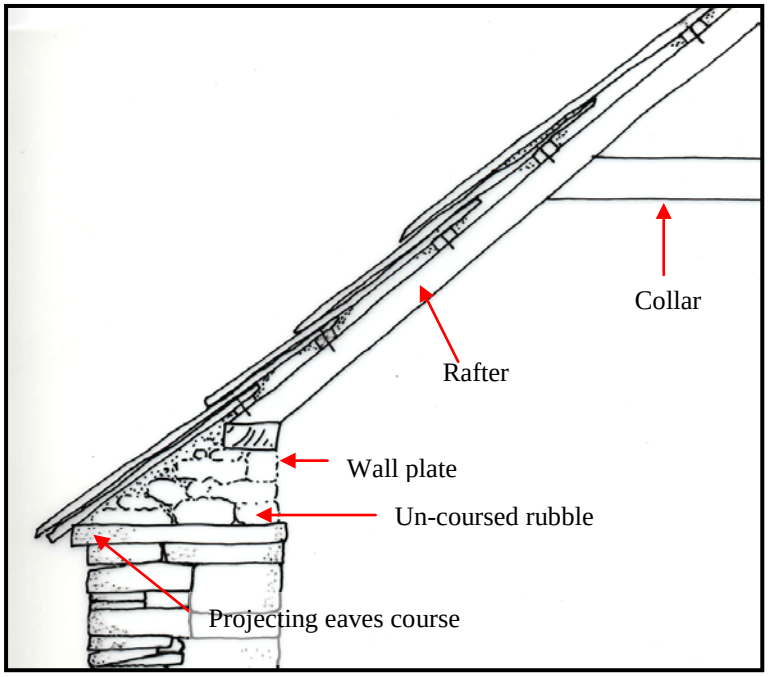

Figure 5: Partial section through stone slated roof showing eaves detail, collared rafter roof, wall plate, torching & courses

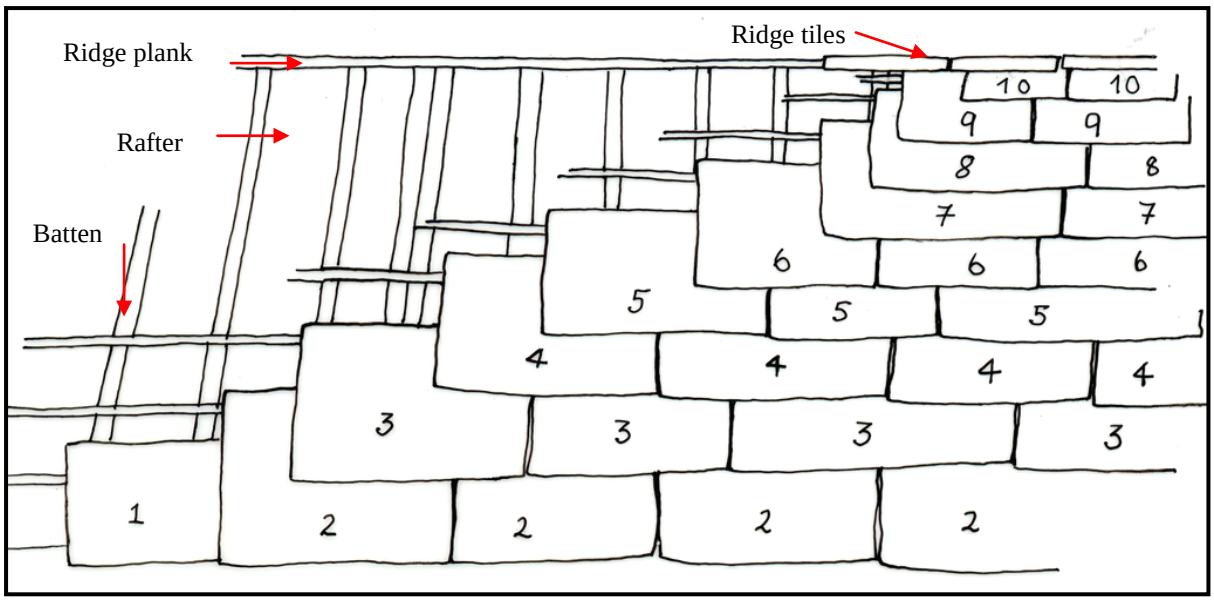

Figure 6: Diagram of simple vernacular roof type with roof of collared rafters, showing rafters, battens, ridge tiles & stone slates laid to diminishing courses.

Torching & Pointing

The underside of the slates was frequently torched and evidence of single, double and fully torched roofs was found (Fig. 7). Torching was a mix of lime, sand and hair which was applied as a render to the underside of the slates. Prior to the availability of roofing felt this was used to weatherproof the roof. *The effectiveness of the torching largely depended on the correct mix of lime, sand and cow hair being used and in the way it was applied. If areas were missed the covering internally would be penetrated by the weather, and if the torching were to intrude too far into the lap, water could soak up through the torching and into the roof void through capillary action. The benefits of torching have in recent years been eclipsed by the general utilisation of roofing felt* (Derbyshire County Council 1996, 4).

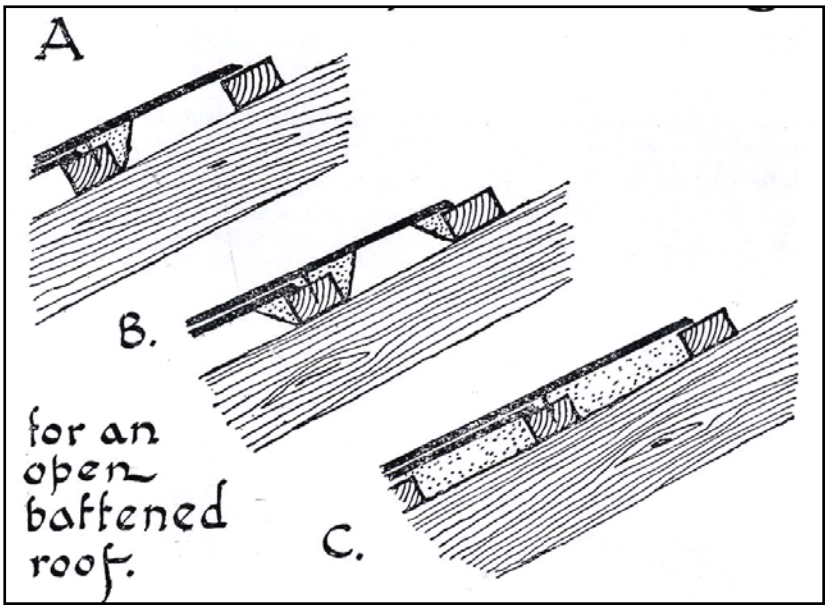

Figure 7: Showing single, double and fully torched slates. A: Single torching is pointing the top edge of the battens. B: Double torching is pointing the top & bottom edges of the battens & C: Fully torching is filling the space between each batten. Figure and text from Bennet & Pinions 1948 *Roof Slating & Tiling* (Bennet & Pinion 2000 ed. 69).

Pointing of the exposed exterior joints with a lime-based mix was also carried out, sometimes in conjunction with torching. The uneven nature of the stone slate, especially Moher, often resulted in some inconsistencies in the sitting of the slates, which over time could allow driving rain or indeed snow to be forced up over the slates and into the roof. Lumps of lime mortar are also used between courses of slates. It would appear to have been used to even off inconsistencies on the base of the flags.

It is generally agreed (Bennett & Pinion 2000 ed., 48, 69 & 195 & English Heritage 1998, 10-11) that the use of mortar in conjunction with the stone slates has the potential to draw moisture into the roof structure, although English Heritage would argue that the use of mortar bedding and pointing is *regionally specific and local practice should prevail* (English Heritage 1998, 10). However they do state that pointing and bedding should never be combined with torching. It is almost impossible to prevent the two coming in contact and forming a wick which continuously draws in water (English Heritage 1998, 11).

4. General Guidelines for Re-Roofing with Stone Slate

The following examination of stone slate roofing in Clare today has been compiled from a variety of sources: Fieldwork, observation of current practice and conversations with house owners and builders.

Roof Construction

When repairing an historic roof of stone slates it is often believed that roofs had been substantially or totally replaced. Given that these roofs were already supporting stone slate roofs, it is debatable as to whether this work was necessary or not. Many modern builders when confronted with buildings that do not comply with present roofing techniques are sceptical as to their continued survival. However large scale roof replacement is often not necessary. Before starting any re-roofing work it is often advisable to seek professional advice from a conservation engineer which may in the long run save on expense.

Laying & Fixing

Most problems occur at this stage as there is generally no understanding of how the traditional system of slating worked (i.e. stone slates roofs are set to

diminishing/random courses). Because of this often the stone slates are cut to a uniform size to fit the new roof of uniform batten widths, a system which reflects modern practice. However the practice of cutting slates down to size is wasteful given the high price of stone slates. A more economical system of laying slates would be to follow the principles of random slating where you lay the battens to fit the slates rather than the other way round. This would result in less cutting and therefore result in the coverage of a greater area. This in itself would reduce the number of courses and amount of cutting required.

To achieve this, a record of the original should be made recording the distance between each course of slates/battens. The slates should then be carefully removed and each course of slates stacked separately, with the number of each course clearly displayed.

Slates are now attached by galvanised rather than iron nails. While the galvanised nail does have a protective coating, their use is not recommended. Given the weight of a stone slate damage can occur early in the life cycle of the nail damaging allowing the rusting process to begin. The galvanising will last for up to 50 years, but then the nails will rust away. It is far better to use copper (or even aluminium if there is no mortar or lime in the stone.) (Hughes, T. 28/02/03, pers. comm.). According to the Derbyshire County Council's *Technical Advice & Model Specification* pamphlet, slates should be nailed with 50mm – 63mm large headed copper or aluminium nails 8 gauge (ibid., 5.3). Given the long time span expected of a stone slated roof, the use of a longer lasting nail is more appropriate.

Torching & Pointing

Given developments in roofing, torching of the underside of the slates is no longer required because roofing felt is now used. Where pointing is carried out either on new roofs or in the maintenance of existing roofs there is still a belief that cement should be used or, if lime is being used, that cement should be added to the lime mix. The addition of cement is not strictly necessary however *if a simple lime sand mix is used it may get washed out before it sets. English Heritage recommends 1:1:6 cement lime sand* (Hughes, T. 28/03/03, pers.comm.). An hydraulic lime can also be used. Re-pointing of new stone slate roofs can also prove problematic as there is no recess to receive the mix between each slate due to machine cutting, however, with the introduction of felting there is no longer any necessity for it.

5. Present Day Production of Stone Slate in West Clare

The Liscannor stone now encompassing Moher Stone and Luogh stone (and in the past stone from the now defunct works at Doonagore) is used *as flooring, as a cladding on walls, even as paving loggia. Large flags make substantial field boundaries and very large ones are used to cover the roofs of outhouses, while the smaller ones become slates on the main dwelling* (Shaw-Smith 1984, 57).

The quarries producing the thin-bedded siliceous sandstone are located in the northwest of the county in the area around the Cliffs of Moher and also near Milltown Malbay. Many of the townlands in which quarries are still worked have had quarrying since at least 1840, for example at Luogh and Kineilty.

Liscannor Stone Co.

The Liscannor Stone Company is the largest commercial quarry company operating in the area. It operates under the trade name Liscannor Stone and its headquarters is located in Luogh townland on the Doolin-Liscannor Road. The stone is taken from

quarries along the edge of the Cliffs of Moher and also from the hillside quarries in the townland of Luogh.

The first of the Liscannor Stone Company's quarries is situated in Derreen townland and produces sandstone/flagstone. This is mainly used as dimension stone, walling stone, paving stone, flagstone, crazy paving, squared/un-squared flags, 20-50mm thick and 2m by 1m in size, though larger are available (Doyle, Hinch & Cox 2001, 25). Another quarry is based at Kineilty and also produces sandstone/flagstone. Both Derreen and Kineilty are located just west of the Liscannor - Cliffs of Moher Road. The third quarry works operated by Liscannor Stone is Luogh quarry, located near the Doolin-Cliffs of Moher road. It again produces sandstone/flagstone and supplies stone for split and pitch facing stone, fireplaces and stone tables (ibid., 28). The quarry has produced stone slates in the past and has some thin beds that can produce flags thin enough for roofing purposes. The stone slates are generally 1" or more in thickness, less than that is hard to find. The stone slates are worked from the Moher quarries in Derreen and Kineilty. No thin beds are worked in the Luogh quarries.

Liscannor Flagstone Quarries

A second commercial company supplying Liscannor type stone is Liscannor Flagstone Quarries located at Rockmount, Milltown Malbay, Co. Clare. It produces sandstone/flagstone for dimension stone, walling stone, paving stone, stone for floors, walling, fireplaces and garden furniture. The quarry has not had any demand for stone slate but could supply it, as it has thin beds ½" to 4". The stone is similar to that at Moher, with the fossilised worm trails.

Smaller Quarries

There are also a number of smaller companies operating in the area along the Cliffs of Moher (see end for full list of quarries). There is a tradition of small local quarry works usually providing locals with stone for walling, flagstones and also for roofing. Some of these quarries do produce stone slates. For example, the quarries west of Liscannor, have produced stone slates for houses in the area.

While most of the quarries are willing to sell stone slate, the production of the thinner beds is not their main concern. The larger quarries tend to be more expensive. The range of sizes and widths available to purchase varies between quarries. In the past when stone was shaped and sized using hammers, the inevitable breakages resulted in a range of sizes and shapes. Today most slates are cut to a limited range of widths using cutting wheels, with random lengths more common. However, according to one quarry owner, most roofing slates are purchased with widths and lengths specified. This pushes the price up further as the more cutting the quarry does, the more expensive the slate can be. When sold as roofing material it is usually between ½" to 1" thickness. The recommended thickness for roofing houses is ¾". There are no known second hand repositories of this material; second hand stone slate must be sourced individually.

Stone slates do not suffer from age or weather so second hand slates are ideal for roofing.

Sources for Repair and Conservation Work

TABLE OF PRESENT QUARRIES IN WEST CLARE 2008					
Company Details	**Owner**	**Number of Quarries**	**Location/ Townland**	**Produces**	**Stone Slate Production**
Liscannor Stone Co. Ltd. , Luogh, Doolin, Co. Clare. 065-7074078	PJ Ryan	3	Kineilty & Derreen both along the Cliffs of Moher & at Luogh.	Sawn Liscannor flagstones, split walling stone & capping, split limestone, crazy paving & garden furniture	Some ¾" / 2" beds worked at Moher quarries but generally not main concern.
Liscannor Flagstone Quarries. Rockmount, Miltown Malbay, Co. Clare. 065-7084855	Sean O'Connor	1	Slievenalicka	Sawn flags, paving, building stone, window sills, lintels, wall capping, pier caps, stone tables, fire hearths & split limestone.	Has not had any demand for stone slate but could supply it. Has thin beds ½" to 4"
Luogh & Liscannor Stone, Luogh, Doolin, Co. Clare. 065-7074161	?	?	Could not get any information	Luogh, Liscannor, sawn flags, crazy paving, split & dressed stone, rough building stone.	?

TABLE OF PRESENT QUARRIES IN WEST CLARE 2008					
Company Details	**Owner**	**Number of Quarries**	**Location/ Townland**	**Produces**	**Stone Slate Production**
Doolin Flagstone, Luogh, Doolin, Co. Clare. 065-7074091	John Fitzpatrick	1	Luogh	Sawn flagstone for floors & patios, natural smooth or textured surface, various colours, crazy paving, off cuts for building low walls & flower beds.	Low occurrence of thin beds, does not generally supply stone slates.
Liscannor Stone, Ardacra, Liscannor, Co. Clare. 065-7081269	Patrick Considine	1	Slievenageeragh, Cliffs of Moher.	Stone slate, crazy paving, sawn slabs.	High proportion of thin beds varying from ½ " upwards.
Mattie Harhen, Kineilty, Liscannor, Co. Clare. 065-7081745	Mattie Harhen	1	Ballysteen, Cliffs of Moher.	Moher flags for floors, walls, stone slates.	Beds vary between ½ " to 2", so the production of stone slates is not a problem.