
# Scottish Roofs

## Selection of slates

## for the

## Repair and Maintenance of Traditional Buildings

Dr Joan A Walsh

December 2016

# Scottish roofs:

# Selection of slates for the repair and maintenance of traditional buildings

**Introduction**

Slate is a fine-grained low-grade metamorphic rock derived from argillaceous sediments or occasionally, as in the case of Westmoreland slate, from volcanic ash. The principal minerals are quartz and platy minerals such as white mica and chlorite. Quartz imparts durability while the high proportion of platy minerals enables the rock to be split into slabs and used as a roofing material (Figure 1). Other accessory minerals, in spite of being present only at low concentrations, have a large impact on the visual and weathering properties of the slate. Examples of accessory minerals are the carbonates; calcite and dolomite, and the iron ores; haematite and pyrite, as discussed below.

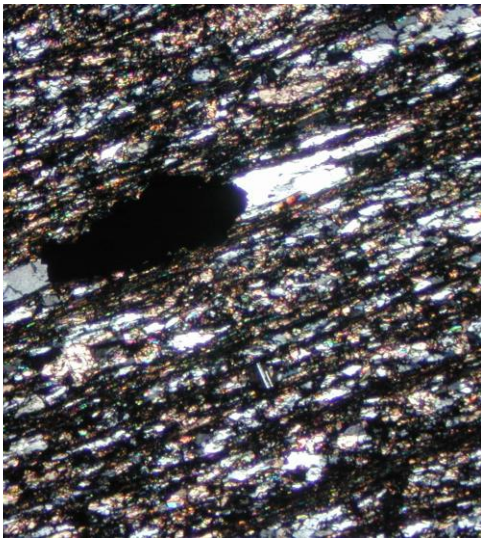

*Figure 1 Micro-photo of slate; crystals of quartz (white and grey) are separated by platy minerals, such as white mica and chlorite, which appear multi coloured under the microscope.*

Although all slates have a similar geological origin, the type of slate produced is affected by the environment in which the original sediments were deposited and the degree of deformation or metamorphism that has taken place. For example slates formed from mud laid down in an oxidising environment contain iron oxides such as haematite which give the slates a purple hue. In contrast, slates formed from mud laid down in anoxic conditions contain graphite and the iron ore mineral, pyrite. These slates range in colour from dark grey to almost black depending on the amount of graphite present.

In general Scottish slate is coarser grained than others and as a result the roofing slates are thicker and more irregular than e.g. their Welsh counterparts. This has resulted in random sized slates of differing thicknesses laid in diminishing courses, giving Scottish roofs their distinctive appearance (Figure 2).

Although often referred to collectively as Scotch slate, not all Scottish slate is the same; different type of slate were produced in different parts of the country, contributing to the local distinctiveness of the vernacular architecture. The type of Scottish slate found on roofs today depends not only on the durability of the material but is also a function of the accessibility of the quarries in the 18th and early 19th centuries.

The most important of the slate producing areas are described below and listed in Table 1.

*Figure 2 Scottish slates are thicker and more irregular than other non-Scottish slates.*

| | Iron ore | Graphite | Colour | Durability |
|---|---|---|---|---|
| Macduff | Haematite | Low | Purple and grey green | Very high |
| Highland Boundary | Haematite | Low | Grey purple and green | Medium |
| Easdale and nearby islands | Pyrite | Medium | Blue grey | High |
| Ballachulish | Pyrite | High | Blue black | Very high |

*Table 1 Roofing slates were produced in several areas in Scotland each with its own unique appearance and weathering characteristics.*

**Macduff Slate**

This slate was produced from small quarries located on the northern slopes of a range of hills just south of Huntly in Aberdeenshire. Production was small scale and episodic and the lack of suitable transport in the 18th century has resulted in their use being confined to the north-east of Scotland. It is a very durable material and is still found on roofs in the area over a hundred and fifty years after production ceased (Figure 3).

*Figure 3 Macduff slate is very durable and is still in use over 150 years after production ceased.*

**Highland Boundary Slate**

This slate was produced from a series of quarries just north of the Highland Boundary Fault stretching from Arran in the west to Dunkeld in the east. Although production was also small scale and transport difficult, the proximity of some of the quarries to the industrial central belt of Scotland has resulted in this slate being used locally in nearby towns. Aberfoyle, one of the Highland Boundary quarries, survived into the 20th century when inaccessibility to water transport was no longer a problem. It was one of four quarries reopened after World War 2 when the Scottish Slate Company came into being in 1947 and was worked until 1954. As a result this slate was used extensively in Stirling and other nearby towns. Today Highland Boundary slate is still found in conservation areas and on historic buildings, but is now reaching the end of its service life and increasingly needs to be replaced (Figure 4).

*Figure 4 Highland Boundary slate on the Royal Cottage by the shores of Loch Katrine has reached the end of its service life and needs to be replaced.*

**Slate from Easdale and other Slate Islands.**

The Scottish slate industry started on the slate islands, although it is not known for certain which one. It is known however that a million slates were being produced annually from the Island of Easdale in 1745. Shortly afterwards quarries were opened on the nearby islands and production quickly expanded, rising to a peak of 10 million slates by the middle of the 19th century. Proximity to the sea was a mixed blessing, it enabled transport by ship to other parts of Scotland but the quarries were vulnerable to flooding and storm damage (Figure 5). Although production began to decline towards the end of the 19th century, some of the quarries were reopened after World War 2 and survived until 1966. It is a blue grey slate often with a crinkly surface called crenulation cleavage. The iron ore mineral is present as pyrite, sometimes as individual crystals (Figure 6) and sometimes disseminated throughout the slate.

*Figure 5 Ellanabeigh and Easdale Island. The quarry in the middle ground was flooded in 1881 and never reopened.*

*Figure 6 Easdale is a blue grey slate often with a crinkly surface. In this example the crystals of pyrite are unchanged after years of weathering,*

**Ballachulish Slate**

The main Ballachulish quarry at East Laroch opened at the end of the 17th century and annual production had expanded to over 15 million slates a hundred years later. It too was close to the shore enabling transport by sea. Unlike the Slate Islands, which were surrounded by turbulent waters, Ballachulish had the added advantage of a particularly sheltered harbour so that the slates could be transferred from shore directly onto the vessels along planks. Ballachulish slate is similar to Easdale in colour and composition making it impossible to visually distinguish between them in hand specimen. The former, however, is often identified on a roof due to its distinctive sheen most noticeable after rain or in sunlight. This is due to a more intense metamorphism than normally found in slate which in turn accounts for its longevity.

*Sizes of Ballachulish slates*

Traditionally Scottish slates were smaller thicker and more irregular than Welsh or English slates. Although standardisation was introduced into North Wales in 1738, the so called nobility sizes, it was never really adopted in Scotland. Slates were often referred to as 'sizeable' or 'undersized' and 'peggies' but the dimensions to which these terms referred varied from one slate area to another.

Although data on the sizes for Ballachulish slates is limited (Table 2), what is known is pertinent to the historic buildings today. In the mid-19th century McGregor in the New Statistical Accounts gives the dimensions of 'sizeable' and 'undersized slates' as shown in Table 2.

| Year | Size | Size inches | Metric mm | References |
|---|---|---|---|---|
| 1845 | Sizeable | 14 x 8 | 350 x 200 | McGregor NSA |
| | Undersized | 10 x 6 | 250 x 150 | |
| 1916 | Countesses | 20 x 10 | 500 x 250 | Bailey |
| | Full Size | 120 sq in | | |
| | Peggies13 x 7 | 13 x 7 | 330 x 180 | |

*Table 2: The dimensions of Ballachulish slates in the mid-19th and early 20th centuries*

Although discrete sizes are shown in Table 2 it should be emphasised that all slates between 10 and14 inches long were referred to as 'sizeable'. Similarly the widths of the slates were highly varied with no slate rejected because of failing to fit the specification. It was the responsibly of the slater to grade the slates according to their lengths when laying them on the roof, starting with the larger slates at the bottom and gradually reducing in length towards the eaves. .

**Importance of natural slate to the built environment**

Slate and flagstone have been used as a roofing material since Roman times but up to the time of the Industrial Revolution their use was limited to prestigious houses in areas where the material was available locally. The Industrial Revolution was a period of rising population, rapid growth of cities and improved transport facilities. The use of slate became more widespread, replacing thatch and other short lived roofing materials. Peak production from Easdale and Ballachulish coincided with the rapid growth of the towns and cities and

was used widely throughout Scotland. This slate is still found extensively in conservation areas.

*Figure 7 Ballachulish slate is used extensively in conservation areas throughout Scotland*

As the use of slate became more widespread, slates from other parts of Britain were also used in Scotland, especially in areas, such as the southwest of the country, which were readily accessible by sea. Although sometimes mistaken for Highland Boundary slate, Westmoreland slate is usually recognised by its green colour. Slates from the Penryhn area of North Wales are readily identified by their purple colour and regular dimensions. The grey slates from Blaneau Ffestiniog area of North Wales are less easily recognised as the colour blends in with Ballachulish and Easdale slate, described above. Instead these slates are usually identified by their dimensions which are thinner and more regular than their Scottish counterparts.

**Replacement Slates**

Slate is still being produced in Cumbria and North Wales so that it is possible to obtain new slates for repairs and maintenance of buildings roofed with these slates. However since the mid-20$^{th}$ century, there has been no new Scottish slate produced. Since then Scotland's historic buildings have had to rely on salvaged slates for repairs and restoration. Good quality second-hand Scottish slate has become increasingly difficult to source. Highland Boundary slate is no longer obtainable and furthermore has reached the end of its service life. Although Ballachulish slate is very durable, on very old buildings it too may have reached the end of its service life and be impractical to re-use. As a result it is no longer possible to rely on second-hand Scottish slate to maintain the visual integrity of the built environment. It is therefore necessary to find an alternative source, matching as closely as possible the colour and dimensions of the original

*Figure 8 Traditional Scottish slates in this Glasgow tenement have been replaced with Spanish slates and concrete tiles*

With the introduction of highly mechanised cutting techniques, it is no longer practical to replicate the randomness of Scottish slates. As a result, most re-slating uses slates of regular sizes which do not match the original indigenous material. However SIGA Natural Slate, in liaison with Welsh Slate, is introducing slates with a mixture of sizes in order better to match traditional Scottish roofs. Slates from the Cwt y Bugail Quarry in North Wales are currently being marketed as SIGA 120. They are available in a range of sizes, varying in length from 400mm down to 300mm at 25mm intervals and in width from 375mm down to 200mm, also at 25mm intervals. These sizes are roughly equivalent to those produced in the Ballachulish Quarry in the 19$^{th}$ century and still found on roofs today (Table 2). Although they are not truly random, the change from one size to the next is not readily apparent (Figure 9).

As already mentioned, the colour of the Cwt y Bugail slates is blue grey, which although paler than Ballachulish, will darken with age and blend in with the original material (Figure 10).

The most important criterion when choosing replacement slates is durability. Slates from Cwt y Bugail Quarry have a good reputation and are found on roofs over a hundred year old.

*Figure 9a The Augustine United Church, George IV Bridge Edinburgh has been re-slated with SIGA 120 slates from Cwt y Bugail Quarry.*

*Figure 9b Augustine United Church has been re-slated with SIGA 120, produced in a range of sizes to replicate the randomness of the original Scottish slate.*

*Figure 10 SIGA 120 slates on the right are visually indistinguishable from reclaimed Scottish, probably Ballachulish on the left of this this test panel*

**Conclusions**

Scottish buildings are traditionally roofed with Scottish slate. There is however no new source of Scottish slate for the maintenance of roofs in conservation areas and other historic buildings. For many years after production ceased it had been possible to rely on recycled Scottish slates. As time passes, supplies of good quality second hand slates have become difficult to source, making it increasingly necessary to rely on non-Scottish slates. In most cases the regular dimensions of the new imported slate is in stark contrast to the irregularity of the indigenous material.

In an attempt to minimise the impact of non-Scottish slates in conservation areas, SIGA Natural Slate are producing a Welsh grey slate in a wide range of sizes to replicate the diminishing courses on the traditional Scottish roof. The slate is blue grey from the Cwt y Bugail Quarry in North Wales and is highly suitable as a replacement for Ballachulish and Easdale slates, the most widely used of all Scottish slates.

About the author:

Dr Joan Walsh has a BSc in Chemistry and Mathematics from the National University of Ireland and a BSc in Geology from the University of Glasgow. In 1995 she was commissioned by Historic Scotland to survey all the slate quarries in Scotland with a view to

identifying a new source of Scottish slate. This work formed the basis of her doctorate which she was awarded in 2000. The work was published by Historic Scotland as a Research Report, Scottish Roofing Slate: Characteristics and Tests, and a Technical Advice Note Scottish Slate Quarries.

Based on the findings of this research, the Scottish Stone Liaison Group extracted blocks of slate from quarries representing two different types of Scottish slate. The slates were tested using procedures developed as part of her doctorate. The results of this work were published by Historic Scotland as two Research Reports: (1) Ballachulish Slate; Extraction and testing of slate from Khartoum Quarry, Argyll and (2) Macduff Slate; Extraction and testing of slate from the Hill of Foudland, Aberdeenshire.

From 2000 to 2006 she was a senior research fellow at the University of Paisley (now the University of the West of Scotland). The scope of her research expanded to include slates from the rest of Britain and slates imported from around the world. During that time she was the leader of a project on "Improving materials testing and technical information in the UK roofing slate industry" under the Partners in Industry Open 2002 Project sponsored by the Department of Trade and Industry.

She also acted as an adviser to Historic Scotland on the impact of the new European standard for natural slate on Scottish roofing practices.

In 2006 she became an independent consultant geologist giving advice to architects, builders and home owners on all matters relating to natural roofing slates. This included identifying the provenance of used slates, testing and reporting on the quality and performance of slates and interpretation of the European Standard for slate. She gives frequent talks at seminars and workshops on roofing slate.