

Contribution to BRGM special volume of Geosciences on “10 major challenges for the Earth Sciences”

Avec quoi construirons-nous demain? - défis pour la pierre du patrimoine en Ecosse.

Tomorrow's buildings - challenges for the stone-built heritage in Scotland

Introduction

Indigenous stone sourced from Scotland and northern England forms a major component of Scotland's pre-1919 building stock. Traditionally Scottish stone was also used for roofing, streets, pavements and bridges and all forms of walling. Today's global market has encouraged the importation of stone for new-build cladding and for new city streetscapes. Whilst this may positively influence public acceptance of the use of natural stone, consideration needs to be given to the use of 'like for like' indigenous materials for repair and conservation thus ensuring that the unique character Scotland's stone-built heritage is not lost.

The UK Government's response to the Rio Earth Summit on Sustainable Development (1992) notes '.... it will become increasingly important to have reliable information about the nature, quantity and location of mineral resources as workable reserves in environmentally acceptable areas become scarcer.'... Legislative planning for minerals working varies from country to country in the UK but Government minerals planning policy now makes specific reference to the identification of national building stone resources. There are pressing needs both to understand the performance and to source supplies of indigenous stone, and to ensure that these resources are used appropriately.

The use of stone in the evolving architecture of Scotland

Scotland's rich geodiversity is reflected in its stone-built heritage. Bedrock and superficial deposits have been used in Scotland for over 5000 years. This stone-building pedigree can be traced back to the earliest days of prehistoric dry stone construction in Northern Scotland. Vernacular buildings of the Highland and Islands were constructed of locally available metamorphic rocks including metasandstone, quartzite, psammite and gneiss. Slate belts of the Grampian Highlands were exploited on a major scale for roofing. In southern Scotland greywacke sandstone was used traditionally. Often, difficult-to-work stone was accompanied by more easily cut sandstone for quoins, door and window surrounds. Igneous rocks, especially the granites of Aberdeenshire and Galloway were extensively used. Locally volcanic rocks are locally an important element of the built heritage.

Sandstone is the commonest stone used in Scotland. In the Midland Valley most of the towns and villages and cities were constructed of locally available Devonian and Carboniferous sandstones. From the late 19th century with the development of rail transport, Scottish cities utilized stone from northern England. Sources of Permian to

Triassic red sandstone from southern Scotland and Cumbria became popular. These materials reached the North American building market often as ship ballast.

Devonian flagstones (laminated, fine-grained sandstones suitable for paving) were exploited in Caithness and Orkney and exported to UK cities, Europe, North America and Australia. Angus, too had a thriving 'pavement' quarry industry from the 17th to 19th centuries which also exported its products widely.

Requirement for indigenous stone

In the 1850s Scotland had over 700 working quarries supplying local, national and international needs. Today there are approximately 20 quarries supplying exclusively building and pavement stone. With the recognition of the importance of local character to the Scottish economy in terms of value to tourism and to architectural, historical, cultural identity, the requirement for indigenous stone for the repair and maintenance of the stone-built heritage has increased. However, there are many challenges to tackle.

Stone in the 21st century

Several factors influence the fact that today most stone used in Scotland either for new build or for repair and maintenance is imported from other parts of the United Kingdom or from overseas. Issues include:

- a sharp decline in the production of stone post World War I especially as reinforced steel and concrete construction took off in the inter-war years
- a concomitant decline in the skilled workforce both to work stone and to pass on traditional stone masonry techniques
- cost of local stone production in comparison with overseas sources
- limited availability of stone from currently active Scottish quarries
- the incompatibility of modern techniques for fixing of stone and traditional construction methods
- fashion-led architectural designs frequently specifying a standard product in terms of dimensions, colour and physical properties
- ignorance of past Scottish stone industry, of the resources which have been used and the specific stone types used in buildings
- failure to recognise the geological properties which define the aesthetic quality of the built heritage
- a complex geology which may deter the development of stone resources
- a dependence by architects and others who specify stone on limited and sometimes unrepresentative information provided by stone producers

To compound these issues, until recently little attempt has been made to systematically quantify and qualify sources of Scottish stone, so that we still do not have a clear picture of available resources. With the Scottish Stone Liaison Group (www.sslg.co.uk) BGS is embarking on a resource audit programme to address this situation.

The need for technical specification

Whether for modern construction or for repair the decision to select a particular stone type should be dependant upon a number of criteria. Major factors are the functional

suitability, e.g. physical characteristics such as strength, durability, uniformity and dimensional aspects such as bed height and block size. The stone must also be capable of being worked, sawn, dressed and tooled appropriately. Modern functional requirements demand specific criteria, e.g. for slip resistance for natural stone paving, or structural engineering characteristics for stone cladding panels. Many of the requisite criteria relating to laboratory testing are given in British and European Standard documents relating to a particular product. Testing methods are being harmonised under the European Committee for Standardization (CEN). Although laboratory tests are an important guide to the predicted performance of a stone type, lessons can be learnt from the past performance of a stone type in a structure which may have been exposed to the weathering environment for long periods of time in many cases over hundreds of years.

Solutions - linking materials to skills

Best practice for specification of stone particularly for repair and conservation demands a rigorous analytical approach. For example, BGS, through its building stone assessment service (following BS EN 12407: 2000 Natural Stone Test Methods – Petrographic Examination) provides architects and builders with petrological advice on the original masonry, the types of decay, and recommends best options for replacement stone. As part of this process BGS is able to use its national collections of rock specimens from former and current quarries.

A recent SSLG project has provided for the first time a systematic assessment of building stone resource and stone masonry skills requirements for the City of Glasgow. BGS developed a methodology for the assessment of the city's stone façades. Photographic survey of façades together with sampling and petrographical analysis enabled the identification of the source and the analysis of stone decay. The derived database of type and quantity of stone required has provided planning authorities and home owners with a precise figure of how much stone will be required to maintain the city centre over the next 20 years.

Imported stone is not always satisfactory for repair work in terms of mineralogical and textural characteristics. Reliance upon physical laboratory test data is not sufficient to identify matching stone types where differences in mineral composition, microscopic texture and porosity characteristics can exist. The consequences of using inappropriate replacement stone could be serious, both in terms of changing the appearance of the built heritage and causing accelerated damage to the original historic fabric especially in an increasing wetter climate. Increased availability of indigenous stone would partly alleviate this problem. The challenge is to identify the resources via resource audits and encourage the stone industry to reopen or open quarries to supply the variety of stone needed to safeguard Scotland's built heritage.

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