

THE CITY OF EDINBURGH – LANDSCAPE AND STONE

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Abstract. The City of Edinburgh, capital of Scotland, owes its unique character and sense of place to its spectacular geological setting, its people and its buildings. The cityscape is defined by its rocky natural landscape, moulded by glaciers, and by the fabric and varying architecture of the city's buildings which employed much indigenous building stone. The local sandstones, some of the finest in Britain, supplied the majority of buildings constructed within the World Heritage Site of the New and Old Towns. Today's challenge is to plan for development of a thriving city whilst ensuring that both the stone-built heritage and the historical spirit of the city are maintained for future generations. Appropriate stone selection and safeguarding of resources form a vital part of good conservation practice.

Historical background to the City of Edinburgh

The City of Edinburgh, Scotland UK, once described as the 'Grey Athens of the North', is characterised by stone. Spectacularly set in a hilly, glaciated landscape underlain by sedimentary and igneous rocks of Devonian and Carboniferous age, today's City embraces the Early Carboniferous volcano of Arthur's Seat. Although there is evidence of early human settlement in the Edinburgh region from about 5000 BC, the earliest mention of Din Eidyn (Fort of Eidyn) can be found in a narrative poem of the late 6th century AD known as Y Gododdin. The oldest surviving building is the 12th century, fortress-like, stone-built St Margaret's Chapel which lies within the Castle perched on the Castle Rock, a hard volcanic basalt plug. The 'Old Town' and its High Street developed down an east-dipping ridge from this fortified position. The craggy west side of Castle Rock and the ridge to the east underlain by glacial debris form a classic example of a 'Crag and Tail' landform (Figure 1). The high ground was surrounded by poorly draining hollows of which the depression to the north of the Castle was known as the Nor' Loch.

During the 17th and early 18th centuries, the Old Town population outgrew the space available within the confines of the protective, stone-built,

Telfer and Flodden walls. The Act of Union of 1707 and the suppression of the Jacobite insurgencies in 1715 and 1745 resulted in a political and economic climate which encouraged the citizens of Edinburgh and their leaders to consider expansion beyond the City walls. The topographic constraints imposed by the Nor' Loch meant that the initial development of the City took place to the south outside the city walls.



Figure 1. Aerial view of the Old Town of the City of Edinburgh from the west. The Castle Rock is in the foreground and Arthur's seat in the middle distance. BGS © NERC 1998. All rights reserved.

In 1751 the Town Council published a pamphlet entitled “Proposals for carrying on certain public works in the City of Edinburgh”. This document, endorsed by the Lord Provost, George Drummond, proposed a New Town to the north connected to the Old Town by a bridge. By 1755 the population of the city stood at 57,000 and the need to expand the city was becoming an imperative. Draining of the Nor' Loch began in 1759, and the foundation stone of the North Bridge was laid in 1763. It was not until 1772 that the bridge became fully operational, owing to an earlier collapse.

The Town Council sponsored a competition to produce an overall plan for the new development in 1766. It was won by 23 year old James Craig and developed in published form as a symmetrical grid layout. The streets were originally lined with individual town houses constructed of the finest sandstone

locally available, including from the famous Craigleith quarries to the west of the city. This First New Town, between Charlotte and St Andrew Squares, was substantially complete by 1830. The success of the First New Town stimulated a demand for further expansion that prompted a number of schemes developed between 1800 and 1830.

Continued development of the city, to the north of the early New Town and to the south of the Old Town continued throughout the rest of the 19th century. The population of Edinburgh nearly doubled from 136,000 (1831) to 261,000 (1891) and many citizens were housed in rows of stone-built Victorian tenements (apartments) which remain as a major legacy to today's building stock. 20th century expansion of the city was characterised by a massive programme of villa building developments and, post 2nd World War, Council and private housing estates. Building in stone declined severely after the 1st World War although stone clad properties continued to be constructed well into the 1930s. Modern office block developments of the 1960s typically consisted of bare concrete or stone-clad concrete structures.

Today's modern city, with a population exceeding 460,000 (2006), embraces the Old Town and the New Town, together with the Port Town of Leith on the Firth of Forth and sprawling suburbs. Edinburgh's Old and New Town World Heritage Site was inscribed on UNESCO's World Heritage Sites list in 1995 in recognition of the outstanding architectural, historical and cultural importance of the Old and New Towns of Edinburgh.

The use of stone

In Views of Edinburgh (1829: 36) Thomas Shepherd stated "For situation and durability of its building materials, few cities have equal advantages to Edinburgh, and there is, perhaps, no town of which the general and distant effects are more picturesque and striking". A common thread running through Edinburgh's history of development is stone. Its natural heritage and landscape is determined by the variations in hardness of sedimentary and igneous lithologies and their resistance to weathering. Its buildings are dominated by locally quarried sandstone so that the stone-built heritage literally grows out of the bedrock foundations of the city. Robert Louis Stevenson in his Picturesque Notes described the city in the 19th century as "A dream in masonry and living rock". As with so many Scottish towns and cities, this local stone character imparts a sense of place and confirms the uniqueness of location which the citizens and visitors alike may take for granted. Only when changes to familiar streetscapes, and new developments arise do people realise the character of a place is under threat.

The early sandstone quarries were often temporary features situated around the houses and lands within or immediately outside the town walls. Permission to open quarries was usually granted on condition that they were filled in later. The first houses were built on the crag and tail to the east of the Castle

and were seldom more than two storeys high. They were constructed of timber obtained from the nearby forest and thatched with straw. The fire risks were so great that, in 1425, the third Parliament of James I introduced laws with the result that henceforth most building was to be in stone (Grant 1880, 27). Early sources of stone included the pink coarse-grained sandstone of Devonian age from the outlying village of Craigmillar and Carboniferous blonde sandstones close by and within the town. Igneous rocks were also used in early construction (e.g. for parts of the Castle). At Salisbury Crags in Holyrood Park some of Edinburgh's oldest quarries worked a dolerite sill. This durable rock, colloquially known as whinstone, was used extensively as 'calsey stanes' (setts) for the streets of Edinburgh and as a source of rubble for buildings on the south side of the city. These workings ceased in the 1830s because of public concerns about damage to the landscape character (McMillan, Gillanders and Fairhurst 1999, 117).

Edinburgh's New Town employed formal design in stone from the late 18th century (Youngson 1966). Except for the grandest buildings early buildings were constructed of harled rubble. Over time the fronts of the smartest town houses showed off a range of unharled, masonry styles, from rock-faced in the basement to broached ashlar or V-rusticated polished ashlar in ground floor elevations and polished ashlar above. Side walls consisted of coursed rubblework. As the pace of building accelerated, the old quarries within the expanding city could not produce the block sizes, quality and quantities of stone demanded by New Town architects and developers. New quarries developed on the west side of the city. The most famous quarries were those of Craigleith, Ravelston, Redhall and Hailes which supplied exceptionally durable, thickly bedded quartz arenite sandstone of Early Carboniferous age (McMillan, Gillanders, and Fairhurst 1999; Hyslop 2004). The continuity of bed allowed the winning of long sections suitable for columnar and monumental work.

The development of the canal and railway networks allowed stone to be transported from further afield (McMillan, Gillanders, and Fairhurst 1999, 105-109). From the mid 19th century, the sandstone quarries of West Lothian and Angus supplied stone both for public buildings and tenements. As local sources of pale coloured Carboniferous sandstones dwindled, supplies for masonry were imported from northern England, particularly Northumberland. By the end of the 1800s Permian to Triassic red sandstone from the south of Scotland were also reaching the Scottish cities (Boyle, 1909). The Caledonian Hotel, Edinburgh was described as 'a wonderfully blousy intrusion into West End Edinburgh' (McKean 1982, 51). Roofing slates were transported from Argyllshire slate belt and flagstones (laminated, fine-grained sandstones suitable for paving) of excellent quality were brought from Caithness and Angus.

Conservation policies and practices - the relevance of geology

Today’s city embodies the rich stone-built heritage of earlier generations together with both stone-clad concrete buildings of the 20th century and early 21st century. Safeguarding this early tangible heritage and many other less tangible (e.g. historical) heritage assets of the city is a matter of concern for everyone. At the forefront the City of Edinburgh Council, city centre managers and Edinburgh World Heritage have developed strategies and policies for maintaining and safeguarding the cultural and economic well being of the city.

The World Heritage Site Management Plan (Edinburgh World Heritage 2005) outlines a series of elements of significance (Table 1) that make up the Outstanding Universal Value of the World Heritage Site and identifies the risks that these might face. It is obvious that both the natural geological heritage and the employment of stone in a variety of constructions and townscapes can be seen to influence many of these elements.

TABLE 1. Elements of significance defining Outstanding Universal Value (Edinburgh World Heritage 2005)

Landscape setting	Topography of hills and valleys (its geological setting) Juxtaposition of the Old and New Towns (the architectural contrasts and the influence of the natural landscape) Valley of the Water of Leith (a small but significant river which flows through the city to the Firth of Forth)
Urban Form and Landscape	Contrasting characteristics of the Site Outstanding Townscape Historic Buildings (the majority of which are stone-constructed) Historic Interiors Statues and Monuments Parks, Gardens and Graveyards
History and Heritage	Historic City and Capital of Scotland Communities Intellectual tradition, education and law Edinburgh - Festival City

A balance always needs to be made between strong conservation and heritage policies and those policies to maintain the City Centre as a viable economic entity, including the regionally important Princes Street shopping area. Recognising the need to respond to the challenges of a capital city centre ‘The Edinburgh City Centre Action Plan 2005-10’ (Edinburgh City Centre Management et al. 2005) set out a series of aims to: –

- Encourage the creation of additional high quality retail floor space whilst

ensuring an effective balance between shopping, leisure, living and working within the city centre.

- Preserve that unique sense of place, create the conditions for a vibrant yet safe street life, and encourage continuing private sector developments and improvements.
- Pursue new and integrated public transport facilities, new walking and cycling routes, and more welcoming transport interchanges, and improved car parking arrangements – safeguarding the City’s most precious asset, its world class environment.

The City Council’s Cultural Policy (City of Edinburgh 1999) states under Objective 8 that the aim is “to preserve and interpret Edinburgh’s heritage” and emphasises that “Edinburgh has an important built and natural heritage.” The Council believes it is important to foster the public interest in the City’s heritage and states that this can be achieved through: –

- Preserving and enhancing the City’s built heritage
- Arranging displays on aspects of the City’s history
- Carrying out archaeological and social history research
- Developing close links between the City’s schools and its museums and galleries
- Maintaining and encouraging the enjoyment of the City’s natural heritage of parks and open spaces
- Interpreting the City’s architectural and historical background and identifying ways of making it more accessible to the public
- Collecting and preserving artefacts relating to the City’s heritage.

The City Council aims to ensure that new development within the area is of the highest design quality. New development should: –

- Fit within and complement the urban grain and massing characteristics of the area in which they are located
- Make use of the existing historic palette of building materials, particularly natural stone
- Retain and reinforce the standard plot widths and height of street elevations, avoiding long single elevations, even where larger land packages have been assembled
- Include wherever possible the planting of native deciduous trees
- Retain the character of the New Town Gardens.

Sourcing of Stone for repair

The process of safeguarding the City’s heritage and that of other Scottish towns and cities includes the assessment of locally available stone resources, which may provide the best geological match for repair work (Hyslop, McMillan, and Maxwell 2006; McMillan and Hyslop 2008). In the mid- to late- 19th century

Scotland had over 700 working quarries (Hunt 1859) supplying local, national and, in some cases, international needs, yet by the end of the 20th century the country was left with approximately 20 quarries supplying exclusively building and pavement stone of which 15 were producing sandstone (McMillan 1997). Today some 12 Scottish quarries are producing sandstone in the form of dimension stone, block stone and building stone and an additional 3 producing flagstone (Cameron et al. 2008).

The careful sourcing of stone is not new. To meet the demand for stone in the 19th century architects and builders searched for new material, which matched the colour and physical properties of stone in existing buildings. The first detailed published account of Edinburgh's building sandstones was written by George Craig (c.1852 - 1928), architect to the Leith School Board. His paper (Craig 1893) showed that, even then, when natural stone was much more widely used, it was difficult to ascertain the source of many of the stones used in older buildings. Craig hoped that his work would be a useful "first contribution to a branch of practical local geology that has been but little investigated, though full of both economic and scientific interest". Much knowledge was lost as a result of the huge decline in the use of natural stone following the First World War as concrete started to gain the ascendancy. Strategic interest in stone resources was revived in the 1930s and resulted in several publications by the Geological Survey of Great Britain over the period 1930-49 (for references see McMillan and Hyslop 2008). However today few detailed records are kept of modern uses of stone or markets and reference is usually in the form of reports in trade journals or in published national statistics.

The rapid growth of Edinburgh in the 19th century and the sourcing of building stone from other parts of southern Scotland and northern England meant that not all the stone was of the best quality. Some sandstones used in Edinburgh tenements and other buildings are prone to weathering, and inappropriate cleaning has sometimes exacerbated this. One of the most common problems in such stone is case hardening, where minerals in the stone dissolve and re-deposit near the surface forming a hardened crust over a weak interior. This will not be obvious until the crust is broken (e.g. through cleaning) and the interior becomes subject to rapid decay.

Hyslop (2004) and Hyslop and McMillan (2004) have shown that, despite best intentions, since the 1970s the selection of stone for repair of buildings in the New Town has failed to take into account the varying petrographical properties of replacement stone (Figure 2).

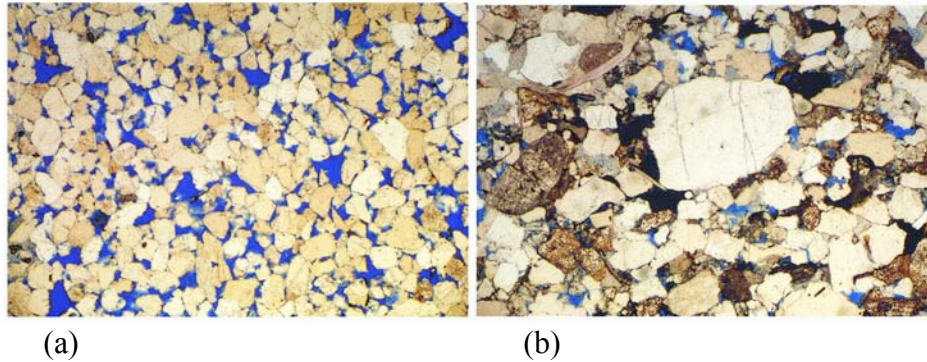


Figure 2. Comparative thin sections of two sandstone types which have superficially similar colour:– a) typically used in the New Town – a well sorted quartz arenite with interconnected porosity b) frequently specified for repair – a more poorly sorted arenite with significant iron oxide content (dark colours) and lower porosity. Each thin section is 4 mm high and is blue dye impregnated to show relative pore space.

The use of replacement stone of different mineralogy and porosity compared with the original sandstone masonry has resulted in both aesthetic degradation (Figure 3) and accelerated physical decay (Figure 4). The importance of undertaking petrographical analysis according to recognised British and European standards (e.g. British Standards Institution 2000) is highlighted and today there is a better appreciation by many architects of this requirement.



Figure 3. Example of the effect of grain size differences between the original sandstone showing a hand-chiselled, fine horizontal broached finish and a coarser grained replacement sandstone showing a machined coarse finish



Figure 4. Accelerated decay in original masonry effected by the replacement sandstone block of different mineralogy and lower porosity.

To satisfy the increasing need for sandstones of similar petrographical properties to those used in the past efforts have been made in recent years to encourage the opening of new quarries or the re-opening of long abandoned workings. An example is Cullaloo Quarry, Fife, across the Firth of Forth from Edinburgh where Carboniferous sandstone was recognised by the early 19th century architects as an alternative to Craigleith Sandstone. Modern petrographical research demonstrates the similarity of the two sandstones (Hyslop and McMillan 2004). Through the intervention of the Scottish Stone Liaison Group (www.sslg.co.uk) this quarry was reopened in 2003 and it is now being routinely used for repair work in Edinburgh.

The longer term value to the City's built heritage of applying geological knowledge to the sourcing and characterisation of indigenous stone can be measured in terms of both aestheticism and technical performance. A 'like for like' petrographical selection policy for replacement stone conforms with national and international conservation criteria and offers a sustainable approach towards safeguarding the historic built environment. The revival of an indigenous stone industry also offers the opportunity to maintain skills in the traditional uses of stone as well as providing an alternative source of materials for new build projects.

Conclusion

Both citizens and visitors are aware of the special character of the City of Edinburgh. The degree to which individuals are conscious of this 'Sense of Place' will vary according to their own life experience and also their willingness to explore and appreciate the history which surrounds them. A fundamental influence on that heritage is the geological foundation which provides a unique backdrop to the City's buildings and varied architecture. The buildings themselves are in the main constructed of the very stone which underlies the City, such that the links between geology and the people can seldom be stronger. To aid public appreciation of the links between the natural and built heritage charitable organisations such as the Edinburgh Geological Society publish interpretative trail leaflets. It is clear that robust strategies and policies for safeguarding the stone built heritage, supported by the public, are necessary for the benefit of the present and future generations.

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