Natural Stone

the oldest sustainable material

Federation Stone Great Britain

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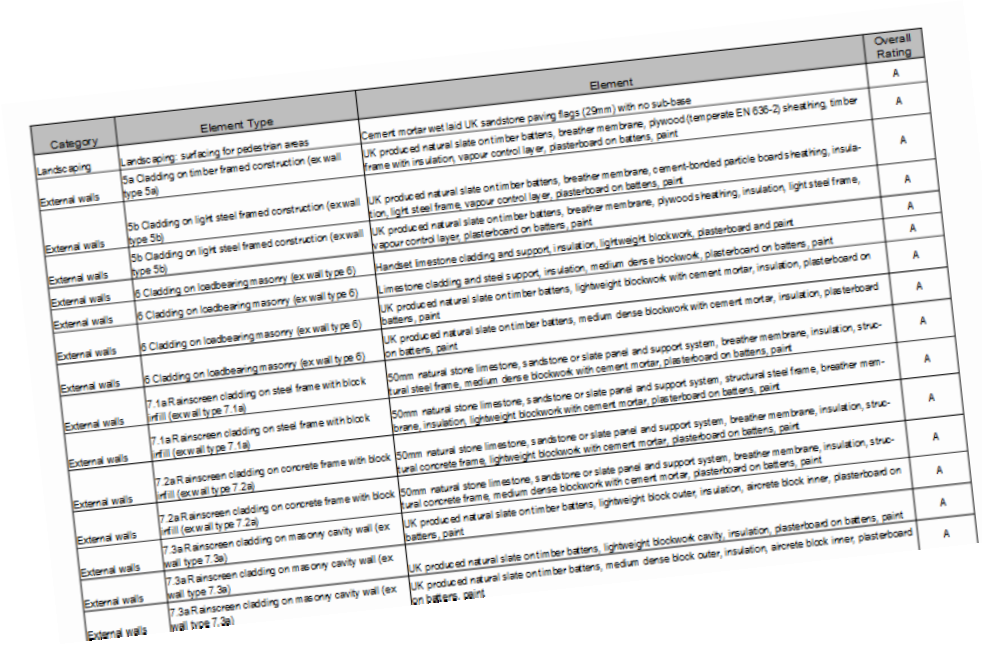
Natural Stone. The Oldest Sustainable Material

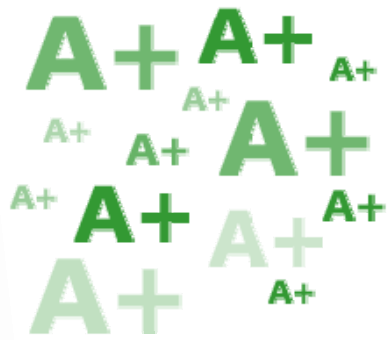
The oldest rocks on Earth have been dated at some 4 billion years old. The very mechanism of earth building is ultimately a continuous process of rock formation, consumption and sustainable re-generation. Natural stone used on construction projects provides the timeless essence of solidity, quality and prestige and mirrors the basic mechanism of earth building as stone is worked for new build projects and subsequently reused with time. The ideal cradle to grave material.

But how can the true 'sustainability' of a material like stone be measured? How can you tell if the materials and components being specified for a project have a low environmental impact? Green specifications are constantly changing as new materials and standards are developed and our understanding of what it means to be sustainable evolves. Although the details of green specifications are not fixed, there is a general consensus that for a building to be sustainable it needs to use materials that, improve energy efficiency, reduce waste and pollution, conserve natural resources such as water and wood, are non-toxic, use renewable energies and have a long life-span. Natural stone is typically one of these materials. There are a number of reports which clarify and attempt to measure the "green list" and sustainability of stone.

The Green Guide (online) http://www.thegreenguide.org.uk/ gives manufacturers and producers the opportunity to examine their environmental credentials and gives designers and specifiers online access to a wealth of independent information. Components are rated on a system that reflects the best environmental performance/least environmental impact across the entire life cycle from 'cradle to grave', within comparable specifications. In general natural stone performs very well across a range of categories in which it is included in the Green Guide.



Category	Element Type	Element	Overall Rating
Landscaping	Landscaping: surfacing for pedestrian areas	Cement mortar wet laid UK sandstone paving flags (29mm) with no sub-base	A
External walls	5a Cladding on timber framed construction (ex wall type 5a)	UK produced natural slate on timber battens, breather membrane, plywood (temperate EN 636-2) sheathing, timber frame with insulation, vapour control layer, plasterboard on battens, paint	A
External walls	5b Cladding on light steel framed construction (ex wall type 5b)	UK produced natural slate on timber battens, breather membrane, cement-bonded particle board sheathing, insulation, light steel frame, vapour control layer, plasterboard on battens, paint	A
External walls	5b Cladding on light steel framed construction (ex wall type 5b)	UK produced natural slate on timber battens, breather membrane, plywood sheathing, insulation, light steel frame, vapour control layer, plasterboard on battens, paint	A
External walls	6 Cladding on loadbearing masonry (ex wall type 6)	Handset limestone cladding and support, insulation, lightweight blockwork, plasterboard and paint	A
External walls	6 Cladding on loadbearing masonry (ex wall type 6)	Limestone cladding and steel support, insulation, medium dense blockwork, plasterboard on battens, paint	A
External walls	6 Cladding on loadbearing masonry (ex wall type 6)	UK produced natural slate on timber battens, lightweight blockwork with cement mortar, insulation, plasterboard on battens, paint	A
External walls	6 Cladding on loadbearing masonry (ex wall type 6)	UK produced natural slate on timber battens, medium dense blockwork with cement mortar, insulation, plasterboard on battens, paint	A
External walls	7.1a Rainscreen cladding on steel frame with block infill (ex wall type 7.1a)	50mm natural stone limestone, sandstone or slate panel and support system, breather membrane, insulation, structural steel frame, medium dense blockwork with cement mortar, plasterboard on battens, paint	A
External walls	7.1a Rainscreen cladding on steel frame with block infill (ex wall type 7.1a)	50mm natural stone limestone, sandstone or slate panel and support system, structural steel frame, breather membrane, insulation, lightweight blockwork with cement mortar, plasterboard on battens, paint	A
External walls	7.2a Rainscreen cladding on concrete frame with block infill (ex wall type 7.2a)	50mm natural stone limestone, sandstone or slate panel and support system, breather membrane, insulation, structural concrete frame, lightweight blockwork with cement mortar, plasterboard on battens, paint	A
External walls	7.2a Rainscreen cladding on concrete frame with block infill (ex wall type 7.2a)	50mm natural stone limestone, sandstone or slate panel and support system, breather membrane, insulation, structural concrete frame, medium dense blockwork with cement mortar, plasterboard on battens, paint	A
External walls	7.3a Rainscreen cladding on masonry cavity wall (ex wall type 7.3a)	UK produced natural slate on timber battens, lightweight block outer, insulation, aircrete block inner, plasterboard on battens, paint	A
External walls	7.3a Rainscreen cladding on masonry cavity wall (ex wall type 7.3a)	UK produced natural slate on timber battens, lightweight blockwork cavity, insulation, plasterboard on battens, paint	A
External walls	7.3a Rainscreen cladding on masonry cavity wall (ex wall type 7.3a)	UK produced natural slate on timber battens, medium dense block outer, insulation, aircrete block inner, plasterboard on battens, paint	A



Stone rain screen cladding generally performs as an 'A' or 'A+' rated component. In fact nearly half of all stone related components achieve an A or A+ rating and the majority are rated C or above.

Stone is therefore truly the oldest sustainable material and merits its place in any sustainable development.

Other available data also supports the stone sustainability argument. A report produced by SISTech in collaboration with Heriot-Watt University, Edinburgh, for Historic Scotland comparing the embodied carbon of natural stone with other building materials quantifies the environmental advantages of using stone.

By ambitious carbon reduction targets in the Climate Change (Scotland) Act 2009, Historic Scotland commissioned sustainability researchers SISTech to under-stand the embodied carbon in natural stone used in the construction and repair of Scotland's buildings.

As part of a bigger programme to tackle energy efficiency related issues in traditionally constructed buildings, the rationale behind the project was to understand the impact of imported stone compared with indigenously produced stone and to quantify the impact of the UK stone industry.

The main aims of the study were to quantify a carbon footprint of the sandstone, granite and slate produced in Scotland and the UK, and compare this with the footprint of imported stone.

SISTech, working with Heriot-Watt University, used a sample of UK quarries to examine the carbon emissions at each stage in the extraction, processing and transport of the stone, aligned with the BSI PAS (Publicly Available Standard) 2050, the current UK standard for carbon accounting. This was the first time a study of this kind had been undertaken in this way

An investigation into the structure, transport modes and stone producing areas within the biggest export countries was also carried out and used to model the carbon associated with transporting stone from Spain, Poland, India and China to Scotland.

The results of the research show that within the UK, the carbon footprints of sandstone and granite are lower than those of other build-ing materials - 64kg of C02 equivalent (C02e) per tonne of sandstone and 93kg per tonne for granite concrete 84

The carbon footprints of stone and other common construction materials are shown in Figure 1.

Figure 1. Embodied carbon of common construction materials

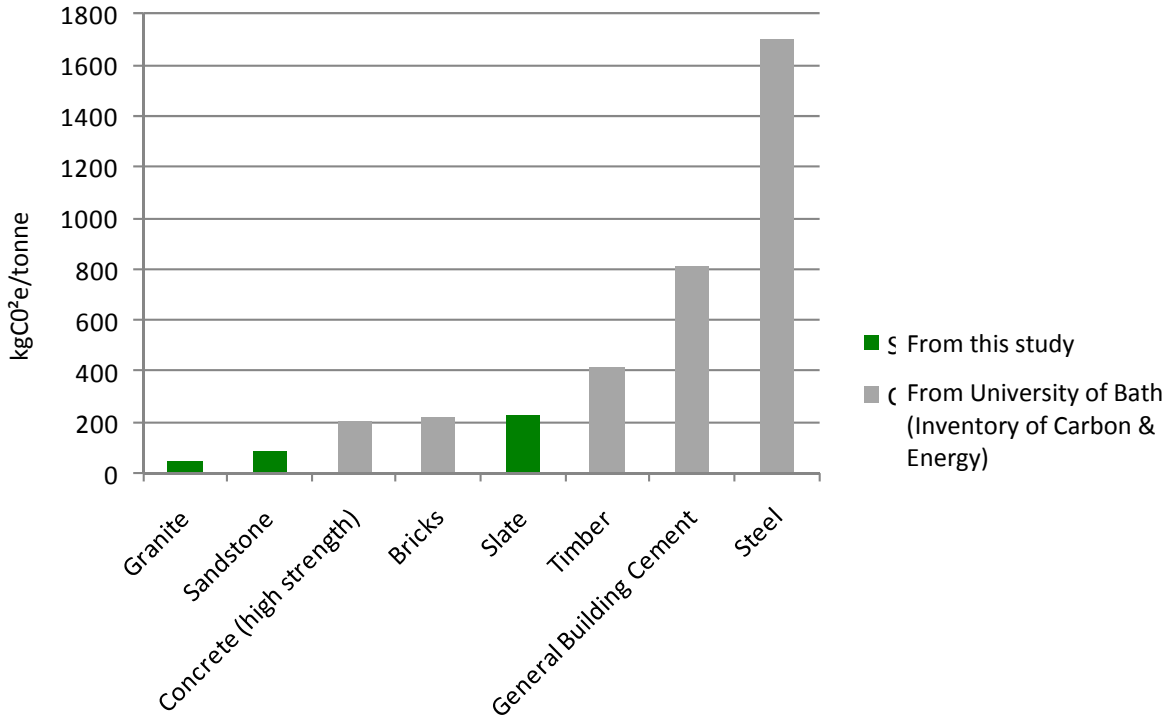
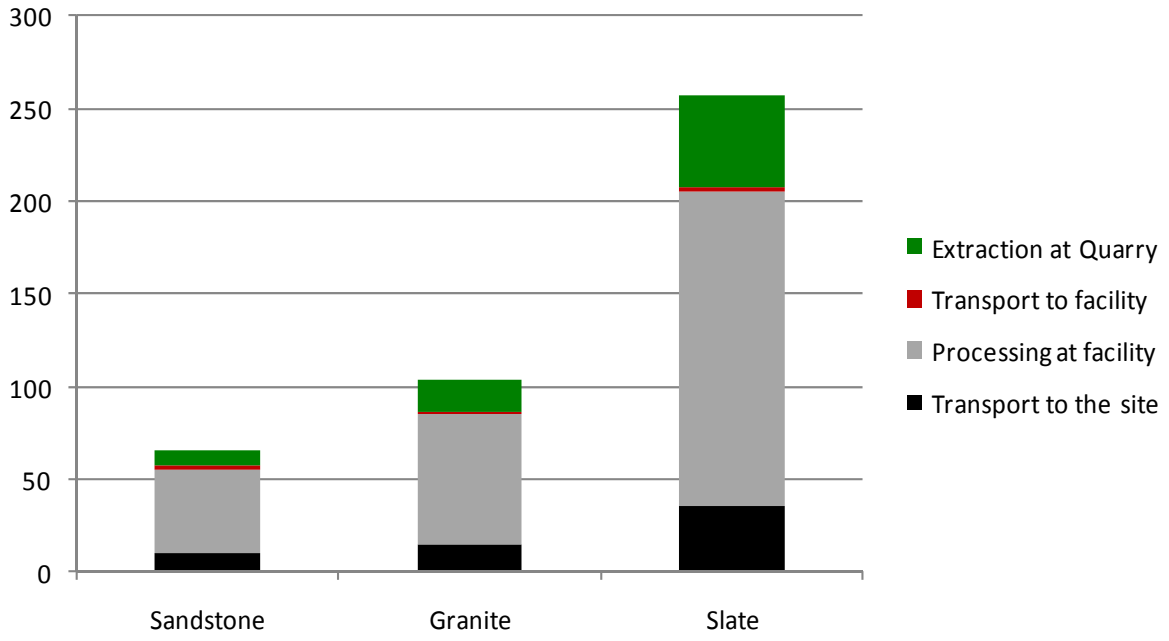


Figure 2 shows the disaggregated footprints for each stone type and the allocation of carbon to the main stages in the life cycle of the stone.

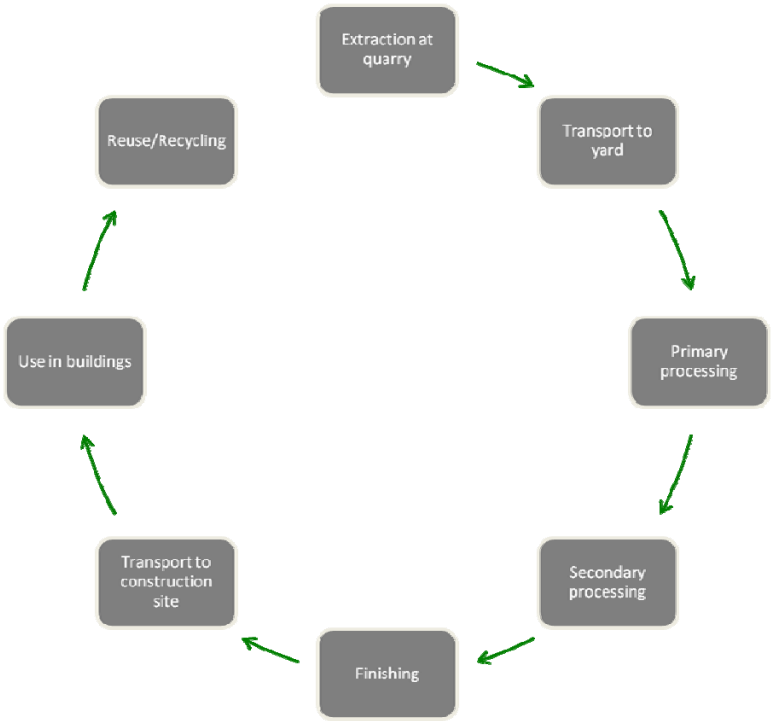
Figure 2. Embodied carbon in natural stone:
Extraction, Processing and Distribution



The main conclusion of this part of the research confirmed that indigenous natural stone is a low carbon building material compared with other construction materials.

The main carbon impacts associated with UK stone are related to processing the stone, transport of the stone to site and volume of waste produced.

However, quarrying and processing of sandstone and granite are not very energy intensive compared with the production processes of other materials, such as brick or concrete.



Perhaps most notably, the research also concluded that there is potential for further reducing emissions in stone production by using electricity generated from renewable sources. Stone Federation is working with members looking at ways this can be achieved.

This report also highlights that by using green electricity sources to power the processing of stone, the British stone industry could further reduce its carbon footprint and, with support from the British construction industry, the carbon foot-print of the UK as a whole.

The message to the UK construction industry must be now is the time to recognise the potential of green energy to power the indigenous stone industry and, in turn, to reduce the carbon emissions of the construction industry as a whole.

Stone vs other building materials

Building materials	kgCO2/tonne
Sandstone	64
Granite	93
Marble	112
General Concrete	130
General Clay Bricks	220
Slate	232
Timber	450
Facing Bricks	520
General Building Cement	830
Steel: Bar and Rod	1710
Steel: Galvanised sheet	2820

Source: This project and University of Bath ICE

The area of the world's land is 149 million km and the ocean is 361 million km. The average depth of the Earth's crust on land is approximately 45km and the oceans is 7.5km, this gives a total volume of about 9 billion km3. The world extraction according to the USGS in 2007 was 1.39 million tonnes which at an average mass of 2.6 tonnes per m3 gives 0.53km3. Assuming that 95% of the earth's crust is unsuitable for dimensional stone, at the current rate of extraction we have enough dimensional stone to last for about 850 million years. This figure ignores the new stone which is being continuously made, probably at a much faster rate than the industry is extracting it.

(using data and research from the University of British Columbia and USGS)

Stone Federation produces Codes of Practice and Guides to best practice to maximise the sustainable and innovative use of stone.

"…the world is now on the cusp of another revolution…the Sustainability Revolution… This will change…our world".

Richard Gillies,
Director of Plan A and Sustainable Business, Marks & Spencer.

"It is important that, as leaders, we help move sustainability into the main stream of our business activities we need to help our organisations to stop thinking about it as purely part of the corporate social responsibility agenda and start thinking about it as an area of business opportunity".

Richard Pamenter, Head of Engineering Glaxo Smith Kline.

"these drivers mean that we need to embrace the holistic approach to sustainability- economically, socially and environmentally to get the right outcome".

Peter Bonfield, CEO, BRE Ltd

"A sustainable business is one that is carbon positive, wastes nothing, is regenerative to environments and has a positive impact on people".

Richard Gillies

"So, what do companies have to do? How can the challenges of climate change be turned into opportunities? First, you have to decouple business growth from environmental impacts that means a new business model with companies having to find ways to grow with fewer resources.
…Rethink the following
How you operate?
What you make your products with?
How you market them?
How you sell them?
How you ask consumers to use them?."

Paul Polman, Chief Executive Officer, Unilever

"The big prize comes from changing consumer habits and behaviours. We know that consumers will not compromise on price, quality or convenience for "greenness". So sustainability has to be built into the design of the product".

Paul Polman, Chief Executive Officer, Unilever

Environmental Impacts

Environmental Management Systems (EMS) can be prepared for all of the extraction processes and certificated to either ISO 14001 or EU Eco-Management and Audit Scheme (EMAS). However, in practice most dimension stone operations are relatively small when compared with aggregate extraction sites and few, if any, are certificated. It becomes even more difficult to complete a comparison of the environmental impacts from pure documentation when the quarry or mine is outside the EU.

In the absence of a documentary comparison, we suggest that you look at the operations and ask questions about the environmental impact of the operations. All UK sites will have strict environmental planning requirements and even the old permissions will have been reassessed under the 1995 Environmental Act.

Most companies will have and Environmental Policy and a phased restoration plan that can be compared with the actual operation. Some sites will have measured the carbon footprint of their operation and also have written a plan showing the policies in place to reduce the emission of greenhouse gases. Similar policies may be in place to reduce the eater extraction and avoid unnecessary waste. The location of the quarry/mine in comparison to the manufacturing works and the final destination of the stone will have a major impact on the carbon footprint on the stone, but it is difficult to be specific about the actual figures, as a large number of factors come into play and accurate comparisons are difficult,

(Selecting the Correct Stone produced by Stone Federation GB)

Sustainability:

An

opportunity

not a cost

Stone Federation is setting targets over the next 10 years based around BES 6001.

The Federation is collating information from sectors of the industry to benchmark targets for future years reduction impacts. This will shape the future strategy for sustainability to ensure that the performance indicators and targets that have been set are met.

They will look at the ways in which the use of electricity can be reduced and at more innovative ways that stone can be used in an even more sustainable way.

In the built environment, the stone industry minimises the effects of their function on local communities. Sourcing materials locally reduces their carbon footprint by cutting down the distances they are transported.

Ensuring that materials can be reused after their useful life means that the future impact of natural stone will be less. Sustainability must be economically sustainable, robust and durable and competitively priced.

Ecopoints are a measure per tonne of the overall environmental impact of a building material or elemental specification on the average EU citizen. The lower the impact, the lower the ecopoints and the higher the green guide rating for each building element.

Stone

can provide considerable

energy savings

over the lifetime of a

building

Extracts from:

Extraction and Use of Building and Roofing Stone - Sustainability Issues

Produced by the English Stone Forum

- Much emphasis is now placed on reducing waste in all sectors through reduction, reuse and recycling. Much stone can be re-used either in the original structure as a retained facade or recovered for use in another structure built of compatible material. This process of re-use is widely evident in ancient and medieval buildings. If stone cannot be reused and is segregated from other types of waste it can be crushed for use as aggregate. In most cases this requires, less embodied energy compared with construction materials such as bricks, metals and plastics. However it is important to prevent damage to heritage structures (e.g. demolition of disused barns) either commercially or through theft to provide building materials elsewhere.

- An alternative approach is to consider the "material intensity" of the product when used in walling. This takes account of the density of the material. Thus one square metre of stone walling constitutes a greater mass of material than, say, autoclaved aerated concrete blocks. The material intensity has been calculated for some materials using the equation:

Material density = Density (kg/m3) X wall width (Metres)

Results are shown in Table 1 column 3 below, which suggests that natural stone has relatively low embodied energy but high density (which relates to good thermal capacity.

Table 1

Materials	Embodied energy coefficient (megajoules per kilogramme) *	Material density (kg/m2) **
Stone	1.0	216-452 (200mm stone or stone veneer)
Concrete (high strength)	1.4	n/a
Clay bricks	3.0	176 (brick veneer with timber frame) 352 (double brick)
Autoclaved aerated concrete blocks	3.5	100
Plasterboard	6.8	n/a
Timber	8.5	n/a
Glass	18.5	n/a
Steel	35.3	n/a
Aluminium	218.0	n/a

Note: N/A - not available
**Hammond and Jones 2008 (figures exclude energy used for delivery transport)*
***Simpson, Cooper and Pullen 2008*
*(*** Heriot Watt University 2010)*

- Stone buildings/projects last longer and can then be recycled more effectively than other materials.

- Water is effectively reused and recycled at every stage of the dimensional stone cycle, from the extraction process through to the cutting process and the use of water to clean stone buildings.

- In response to the need for sustainable stone products, innovations have been initiated to develop a range of products/innovations which reduce environmental impacts. It is our aim that, in time, all stone products will meet these requirements. Significant progress is being made to improve production processes and the transport network.

- To achieve improved whole life value through the promotion of best practice construction procurement and supply chain integration by encouraging the adoption of the Construction Commitments in both the public and private sector throughout the supply chain.

- To ensure that the materials used in construction have the least environmental and social impact as is feasible both socially and economically.

- “Crushing as aggregate or for use in site landscaping or used in plans for restoration of the site”

- “companies sell limestone fines as agricultural lime”

Examples of Stone Sustainability

Launched by Stone Federation in 2008 as part of its ongoing sustainability strategy, the aim of the Awards is to illustrate the sustainable qualities of natural stone and to recognise and reward outstanding achievement, awareness and innovation in sustainability in the natural stone sector and will act as a benchmark for achieving best practice in this sector from its extraction to all its uses.

2011 NATURAL STONE SUSTAINABILITY AWARDS

Forest Pennant is the first specialist masonry company in the UK to generate its own green electricity.

www.forestpennant.com

Stone cladding is recyclable as a façade material e.g. 95 Gresham Street, London by PAYE Stonework & Restoration Ltd.

www.payestone.co.uk

Marshalls' Stancliffe Stone Quarry at Stoke Hall in Derbyshire gained accreditation to the Wildlife Trusts Biodiversity Benchmark and is the first natural stone business in the UK to achieve and implement this system into its existing integrated management systems.

www.marshalls.co.uk

Winner of the Natural Stone Awards 2008
Sustainability category - Wills Memorial Tower

WR Bedford (Stone Masonry) were appointed main contractors for the cleaning of the Wills Memorial Tower, designed by George Oatley, arguably Bristol's most important 20th century architect, and opened in 1925.

The cleaning was carried out using both nebulous sprays and the Jos vortex system. The amount of water that would be needed was of concern from the tender stage and WR Bedford devised a system to recycle the water used for nebulous spray.

The Tower is one of the largest stone structures in Bristol but was cleaned using just £1,000-worth (1,000m³) of water. The whole restoration work took 12 months to complete.

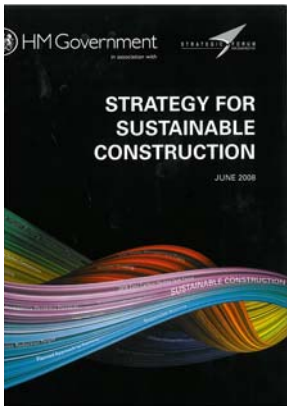
www.wrbedford.com

Albion Stone Plc
Mining rather than quarrying has a lesser impact on the landscape.

Butterflies colonise the Portland Stone Quarries hence the designation of the SSSI (site of special scientific interest) status to the extraction sites.

www.albionstone.com

Strategy for Sustainable Construction



The Government, together with Strategic Forum for Construction issued the strategy for sustainable construction in June 2008.

Stone Federation is working towards their principles and will "collaborate to consider what additional tools and mechanisms are needed to promote both increased use of sustainable materials in construction and improvements in materials themselves".

Stone Federation Sustainability Targets

List of actions and deliverables which contribute to the target	Organisation responsible for activities	Timescale
Survey to gather information on sustainability for the natural stone industry	Stone Federation GB	Current for delivery 2012
Encouraging member companies to complete BES 6001 & 9001	Stone Federation GB	Current for delivery 2015
To achieve improved whole life costs through the promotion of best practice in construction procurement and supply chain integration by encouraging the adoption of the Construction Commitment in both the public and private sectors throughout the supply chain.		
To ensure that materials used in construction using stone have the least environmental and social impact as is feasible both socially and economically.		
To produce a report by BRE Global Generic Environmental Profile of UK produced stones parts one & two.	Stone Federation GB/ BRE Global	Part One already actioned Part Two, commenced March for publication in 2011
To produce a report on the comparison of stone	Stone Federation GB/ Arup	September 2011
To promote training in sustainability		Current for delivery by end 2011
Working in the industry to encourage innovation and design of stone to promote sustainability		Launch of Stone Federation Sustainability Awards in 2008 - Ongoing
To encourage good design for stone buildings/projects to ensure that these are resource efficient, sustainable, durable, resilient and attractive as good design is synonymous with sustainable construction		ongoing
To reduce waste in the extraction process and in the production of stone		ongoing
To lower the amount of electricity used in the industry		ongoing

Ecostone/Hallmarque Scheme

Our aim is that by 2015, the dimensional stone industry will be a leader in sustainable construction by taking a pro-active role in setting and delivering a sustainable solution to all aspects of the industry from cradle to gate/grave.

We recognise that we are in the early stages of industry wide data collection and will continually review the performance targets that we set.

Through it's Hallmarque Scheme, the dimensional stone industry is to link it's sustainable strategy to BES6001- framework standard for the responsible sourcing of construction products. This will enable designers and specifiers to easily source certified materials in order to obtain maximum credits in sustainability assessment measurements such as the code for sustainable homes and BREEAM.

Stone is sustainable because it takes into account critical cost balanced against long term type costs/durability and minimum maintenance.

Architects must now consider the Whole Life Costs (WLC) of their proposals when designing new buildings, which means they must take account of the running costs of their buildings. WLC takes into account, not only material and construction, but also energy, maintenance, operating and disposal costs. Stone is very low maintenance and durable, greatly reducing the energy used in new buildings and make them more pleasing to live or work in compared to lightweight construction materials as they can ambient temperature.

Stone provides the huge advantage of thermal mass as it absorbs heat during the day and releases it at night. This helps to even out the temperature thus reducing the need for air conditioning in the summer and heating devices in winter, therefore helping to reduce operational costs.

During its long life, a stone building lends itself to re-development, adaption's for changes in use, or internal remodelling. Stone buildings remain serviceable for far longer than even their design life and at the end of its usable life, stone can be recycled in a variety of ways.

The role of natural stone in sustainable communities: Stone's unique properties

As a building material, stone has many structural, design and environmental advantages over other building materials. It gives greater soundproofing qualities, offers fire protection both requirements under the Building Regulations and is resistant to water damage and offers increased energy efficiency through thermal mass.

Windsor Castle

It has considerable strength and is very durable and has long life low maintenance costs. Stone for centuries has been pivotal to our heritage, society and sustainable communities. In today's society buildings are usually designed to last only 60 years whilst stone buildings will remain in use for a far greater time/period, spanning the centuries.

St Pauls Cathedral, 1675-1710

Armed Forces Memorial, 2007

The Golden Jubilee Needle, 2004

The UK government is one of the leaders of the sustainable movement in Europe and possibly the world by setting an ambitious timetable towards carbon neutral new buildings by 2020. This is evident from the UK's commitment to the timetabled introduction of the Code for Sustainable Homes.

The Code outlines sustainable methods for the housing sector and aims to be the route for carbon neutral homes which will be affordable. The Code is an environmental rating scheme for new houses being built in England. It assigns houses a rating from Level 1 which requires 10% higher energy performance than current Building Regulation Part L to Level 6 which is carbon neutral. Houses which are built to just the current regulations, have a nil rating. The rating is based on factors which include energy efficiency, water conservation, waste surface management, site waste management, household waste management and the environmental impact of materials used. All new housing has been subject to the Code from May 2008.

The stone industry offers products that assist new houses to conform to the code for sustainable homes. The stone industry has/is investing in supply chain management. There are considerable, continued innovations in the use of natural stone to ensure its continued sustainability.

Stone is already ahead of almost all building materials in its green credentials. This doesn't mean the industry can rest . We will continue to innovate and drive the environmental costs of using stone ever downwards. Our message is clear. Stone is environmentally the right choice and will continue to be.

Stone Federation Sustainability Statement

Stone Federation encourages its members to commit to the delivery of a quality professional service.

The Stone Federation recognises that their members operations have the potential to impact upon the environment and therefore seeks to ensure that the potential harmful effects of their actions are minimised wherever practicable.

The Federation supports the companies to reduce or eliminate their environmental impact throughout their activities by engaging, all staff, partners, stakeholders and customers and encouraging them to follow the approach set out below.

Stone Federation members are encouraged to:

- Identify and comply with all relevant legal requirements.
- Strive to attain a satisfactory balance between economic, social and environmental responsibilities.
- To investigate all areas of energy usage in all areas of the business and establish a programme of reduction with measurable targets.
- Minimise the amount of waste produced by reducing, reusing and recycling, and ensuring careful and responsible disposal of any waste we produce according to legislation requirements.
- Endeavouring to source materials from sustainable resources and to take all reasonable steps to ensure that any stone or other products purchased from the developing world are from an ethical source.
- Ensuring awareness amongst all employees of the importance of environmental
- issues, and providing training appropriate to their responsibilities.
- Ensuring their activities are safe for employees, associates, delegates and others who come into contact with their work.
- Monitoring purchasing practices and internal operations including energy and transport to ensure best use of natural resources and minimum environmental impact.
- Developing relationships with suppliers, customers, contractors and relevant third parties to discuss and promote improvements in environmental performance.
- Seeking to incorporate environmental considerations into future decision-making at all levels.
- Making this policy publicly available to any interested parties.

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