



Natural Stone as

a Sustainable Building material

How natural stone can impact the “green” architectural design process in the future.

Natural stone as a sustainable building material is not a new idea. Stone has been used by humans for thousands of years and will also be used by the coming generations. The main reason was because of its solidity and long lasting life cycle. Examples as Petra in Jordan, the pyramids in Egypt, Phantemon in Greece and Colosseum in Italy. All of them built of stones that was easy to process as sandstone, limestone, travertine or marble.

When we today consider the so called Paris agreement, signed the 22.04.2016 by 177 countries worldwide, in order to build up a global consensus that we must reduce use of energy and reliance on carbon pollution not renewable energy based on different resources as oil, gas and coal, causing irreversible damage to our planet. For that specific reason, natural stone has become even a much more important role as a sustainable building material. Not only because of its long lasting and high durability but even more because of another specific reason. For architects and designers, this means fundamentally changing the way we design buildings and determine their success. Traditional building and construction method consume large quantities of natural resources and account for a significant portion of the greenhouse gas emissions that affect the climate change. Worldwide, the building sector accounts for more than 40% of the world's energy usage. This is hardly new and already in 2006, AIA the American Institute of Architects became the first adopter of the 2030 challenge. This in order to achieve a carbon neutral building industry within 2030. The only possible way to obtain such a challenging goal, is to start integrating energy modeling techniques already from the very beginning of the planning stage of any kind of projects. Until recently, there has been a dichotomy between artistic design and sustainable strategy. We are now entering an era where the gap has to be bridged. With the current global attitude regarding environmental sustainability, it is clear that a good energy design and a selection of sustainable building materials, has to become essential part of all the architect's planning process.



The life cycle of a building material regarding the impact of embodied carbon.

Natural stone, the oldest sustainable building material we have on earth. Natural stone used on construction projects also provides the timeless essence of solidity, quality and prestige.

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 being 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, wood, oil, gas, coal, are non-toxic, use renewable energies while being processed 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.

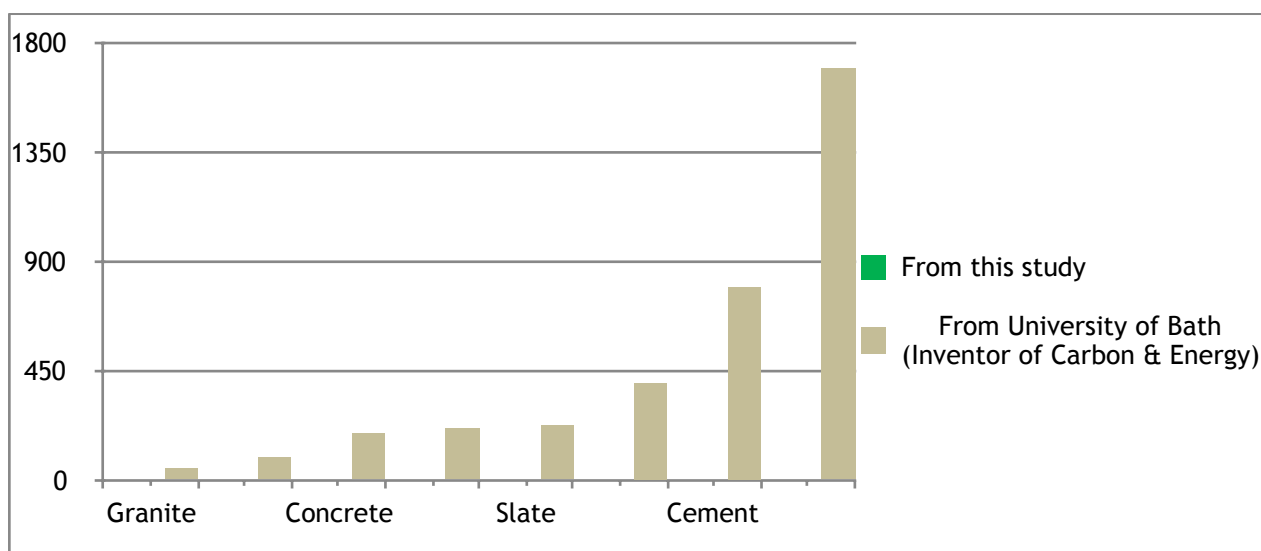
In UK you will find a public list called “The green guide”. This list gives manufacturers and producers the opportunity to examine their environmental credentials and gives architects, designers and specifies worldwide access to a wealth of independent information. Components are rated on a system that reflects the best environmental performance/least environmental impact across the entire life cycle from “cradle to grave” with comparable specifications. In general natural stone performs very well across a range of categories in which it is included in “The green guide”.

Other available data also support the stone sustainability argument. A report produced by SISTech in collaboration with Heriot-Watt University of Edinburgh, Scotland, for “Historic Scotland” comparing the embodied carbon of natural stone with other building materials, quantifies the environmental advantages of using stone. *PS. Edinburgh historically also called the granite city.(red.)*

By ambitious carbon reduction targets in the 2030 challenge, Historic Scotland commissioned sustainability researches SISTech to understand the embodied carbon in natural stone used in the construction and repair of Scotland’s buildings.

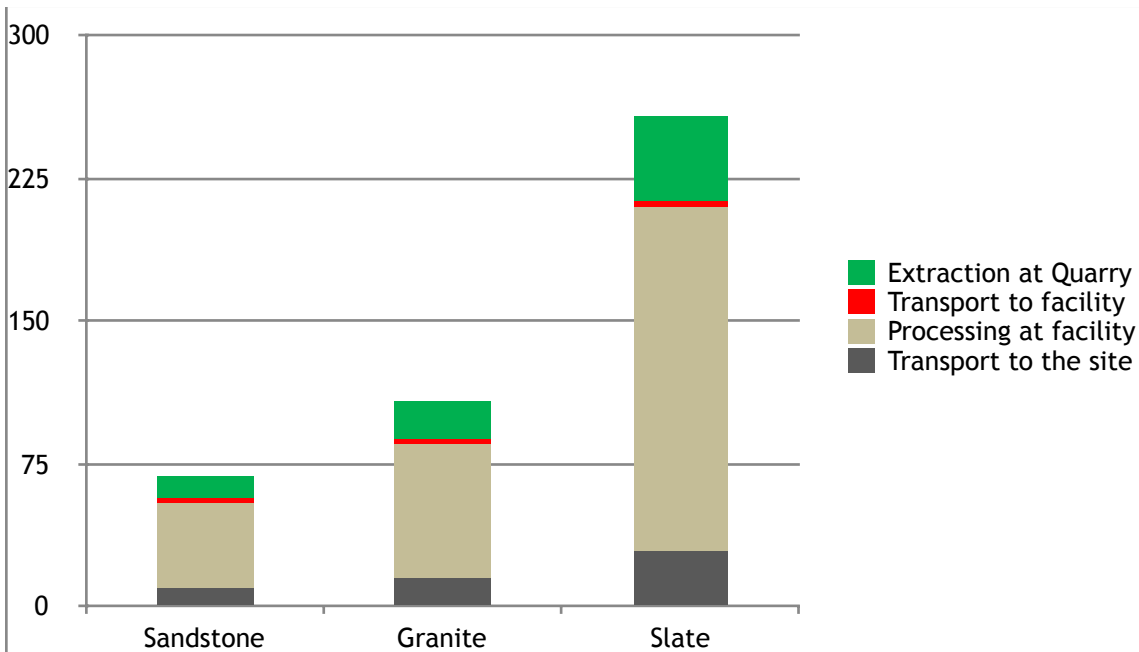
SISTech, working together with Heriot-Watt University, also used a sample of different stone quarries to examine the carbon emission at each stage in the extraction, processing and transport of the stone, aligned with the BSI PAS 2050 (Publicly available standard), the current UK standard for carbon accounting. This was the first time a study of this kind had been undertaken in this way. The carbon footprints of stone and other common construction materials are shown in the Figure 1:

Figure 1: Embodied carbon of common construction materials



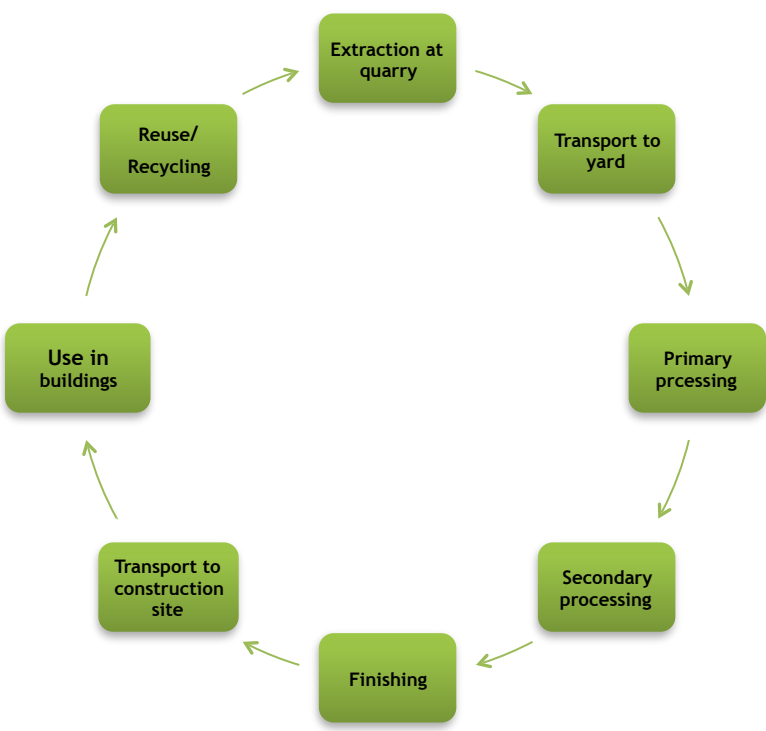
The next figure shows the disaggregated footprints for each type and the allocation of carbon to the main stages in the life cycle of the stone.

Figure 2: Embodied carbon in natural stone regarding extraction, processing and distribution



The main conclusion of this part of research confirm that indigenous natural stone is a low carbon building material compared with any other kind of construction materials. The main carbon impacts are very low related to processing the stone, transport of stone to site and volume of waste produced. However quarrying and processing of any kind of stone are not very energy intensive compared to the production processes of other materials, such as brick, concrete, different composite materials, plastic, glass, steel and aluminum. In addition stone can easily be re-used or recycled.

Figure III: Embodied carbon in natural stone regarding its lifecycle from quarry to project



The research also concluded that there is potential for further reducing emissions in stone processing by using electricity generated from renewable sources. The report also highlights that by using green electricity sources to power the processing of stone, the stone industry could further reduce its carbon footprint and, with support from the construction industry, the carbon footprint as a whole. The message to

the worlds construction industry must be now is the time to recognize the potential of green energy to power the indigenous stone industry and in turn to reduce the carbon emission of the construction industry as a whole.

Figure IV: 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: Galvanized sheet	2820

Source: This project and University of Bath ICE

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.

Most companies will have an environmental policy and a phased restoration-plan that can be compared with the actual operation. Some sites will have to measure the carbon footprint of their operation and also having a written plan showing the policies in order 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 in comparison to the manufacturing works and the final destination of the stone will also have an impact on the carbon footprint of the stone, although it can be difficult to be specific about the actual figures. A large number of factors come into play and an accurate comparison can be difficult. All depending of the transportation methods; truck, train, shipping etc.



NATURAL STONE WILL GIVE SUSTAINABILITY TO THE FUTURE BUILDING INDUSTRY

The aim of the dimensional stone industry is to be a leader in sustainable construction by taking a proactive role in setting and delivering a sustainable solution in all aspects of the industry from cradle to grave.

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

Architects should consider the whole life cost (WLC) of their proposals when designing new buildings, which means they must take account of the running cost of any new building. 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 stone can ambient the local 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 during the wintertime, thus reducing the total operation costs.

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



NATURAL STONE IS AHEAD OF ALL BUILDING MATERIAL IN ITS “GREEN” CREDENTIALS. THE STONE INDUSTRY WILL CONTINUE TO INNOVATE AND DRIVE THE ENVIRONMENTAL COSTS OF USING NATURAL STONE. THE MESSAGE IS CLEAR; STONE IS ENVIRONMENTALLY THE RIGHT CHOICE AND WILL CONTINUE TO BE.

Stone as a natural product, is inherently earth friendly. Natural Stone currently offers many attractive, environmentally friendly attributes, including an enduring life cycle, ease of care and maintenance, recyclability, and quarry and manufacturing best practices. Using Natural Stone shows that you take responsibility to care for the earth by actively striving to preserve, restore or improve the natural environment. Conserving resources, preventing pollution and minimizing waste in order to be ecofriendly through “green” building industry.

Sources:

- Arch Daily (US) – Stone federation (GB) – Natural stone council (US) - Stone Universe Inc. (IT,NO)

