

# Sustainable development: an opportunity for dimension stone

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*Thinking in terms of sustainable development means taking into account future generations and their survival. This concept is not just a passing fancy if we want a future for our planet. Nor is it incompatible with natural stone quarrying and processing*

**S**ustainable development is an increasing demand by modern society. Sustainable development will also have an increasing impact on the future of the dimension stone industry. Sustainable development has been best defined in 1987 by the "World Commission on Environment and Development thus: Sustainable Development is development that "meets the needs of the present without compromising the ability of future generations to meet their own needs." Sustainable development presents an opportunity that the dimension stone industry must embrace.

### Sustainability Advantages with Dimension Stone

#### **Durability: Sustainability at its best**

The capacity of stone to withstand decay or wear is its greatest asset in

the human drive for sustainable development. Durability is also of foremost concern as sustainability is considered in developing new regulations governing building.

For those fortunate to visit Australia, a stopover at Uluru (also known as Ayers Rock) is essential. Uluru is also a huge testimony by itself to the durability of stone. With a circumference of 9.4 km, the gigantic single rock monolith towers 340 metres above the surrounding landscape and investigations on the constituent sandstone and the surrounding area suggest an age of the monolith of at least 60 million years.

Uluru provides the strongest evidence for the sustainability of stone as a construction product. It demonstrates that some stone has a capability of resisting the depredations of wind, rain, frost and major temperature changes for periods at least 10,000 times longer than the age of the pyramids, a time that much exceeds the time span



Uluru (also known as Ayers Rock) in central Australia has existed for at 60 million years. It exemplifies the incredible durability of stone.



*The Arch of Constantine in Rome (built in 4th century) is an example where recycled marble from former Roman constructions was used. It is an ideal example demonstrating that stone has long been recycled.*



*The Obelisk in the Place de La Concorde was manufactured from granite in Ancient Egypt in about 1300BC. It exemplifies the durability of stone as well as stone recycling.*

of the human species on earth. Thus stone can have a proven durability greater than any other earth material known.

However, stone durability is not universal. There are also many soft stones, because stone, as commercially utilised, includes materials composed of a vast range of different minerals. The rock texture and consistency are other variable characteristics that affect the strength of stone.

The major issue with respect to stone durability is not to question this undoubted quality (and hence sustainability with respect to alternative products), but to achieve its wider recognition in the debate on sustainability. To attain this, society must recognise a greater need to build for permanence, rather than for one or two generations. The life cycle cost of a building product has to be considered not just the initial costs of manufacture and utilisation.

#### **Recycling opportunities**

Recycling is a factor of increasing importance with the sustainability of mineral products and sustainability in general. It is a value worth promoting with stone both in general competition with alternative building products as well as with the selection from a range

of stone types. In general, the more durable the stone and the greater its thickness, the better its value is for recycling.

The recycling of stone has a history longer than any other construction product, another argument in its favour. It can be exemplified by the reuse of marble in the late stages of the Roman Empire (eg Arch of Constantine in Rome, completed 315AD ) and by the reuse of Roman marble columns by the Arabs in the 8th century Mosque of Cordoba in medieval Spain. In international cities such as New York, Paris and Rome, well-preserved obelisks from ancient Egypt are highly regarded.

Stone recycling results not only from the prestige of stone and its preservation of history, but also from its ready availability on an existing building site, ie an economic consideration.

Even if stone is not recycled as a dimension stone product, the material may be recycled as an alternative product by being crushed for road metal or construction sand or otherwise used as a filling material.

#### **Comparative sustainability with alternative construction materials**

The comparative sustainability of stone to alternative construction products is an essential aspect in promoting it in a

commercial world where most industries are advocating their environmental credentials.

The move towards sustainability will not likely condemn certain materials from future use and favour alternatives, however it will lead to sparing use of those materials whose production require high energy consumption and create pollution, whilst favouring natural, recyclable and durable products.

**Timber** is an obvious alternative to stone, especially in domestic construction. It is often advocated as a preferred construction material because the resource is natural and renewable. The favourable sustainability advantage for stone in this instance is obviously its durability. Examination of the archaeological record testifies to the durability of stone construction at times



Large amounts of electricity are used to produce metal products with associated release of greenhouse gases. This is a major argument against their sustainability when compared with stone. Increased toxicity levels and toxic by-products with metals is also a sustainability problem.



Dry Rot fungus is the cause of major decay in timber. A durable stone presents no problem similar to this.

when timber was also often in common use. Timber rots, fails or is eaten by termites over a relatively short period of time; well chosen stone will not. Timber will also burn in a fire and requires a renewal of its surface finish, such as painting or varnishing, at regular intervals. Major efforts to increase the durability

of timber, especially in Australia, often involve using copper chromium arsenate. Even though alternative, more benign preservatives are being used in Europe, this toxic preservative also discredits many timber products in terms of sustainability. Another challenge with timber products is the increasing use of pressed wood-chip products, which utilise formaldehyde-emitting glues.

**Ceramic Tiles** are a major competitor with stone in the flooring market. In contrast to stone, ceramic tiles are energy intensive to produce and such energy is generally sourced from non-renewable sources such as coal, oil or gas. **Bricks**, which compete with stone especially in domestic housing, are considered to require even more energy to manufacture. Ceramic tiles are rated in the United Kingdom by the Government-funded "Sustainable Homes" initiative together with concrete, steel and aluminium, as

energy intensive materials. According to Canadian Government reports, ceramic tiles are listed as requiring 5.7 times more energy to produce than "shaped stone" whilst bricks (various types) require 16-32 times more energy to produce than the same stone reference.

**Cement**, especially mixed with sand in concrete and in its contemporary prestressed form, has replaced stone in much large-scale construction. The production of cement involves the crushing and heating of limestone results in significant release of carbon dioxide, a major cause of greenhouse or global temperature increase. Cement production creates 5% of global man-made carbon dioxide. 50% of this carbon dioxide originates from the chemical process of producing clinker from limestone. In the production of a basic stone product, no greenhouse gases are produced, thus providing a major advantage over cement in terms

of sustainability. In addition, cement production also requires 60-130 kg of fuel oil and 110 kWh of electricity to produce one tonne of cement, much of which will result in further greenhouse emissions.

**Iron and steel** will compete favourably with stone in construction because of their strength and ductility. **Aluminium** is also being increasingly used in construction for the additional reason of its lightweight. Both only partly compete with stone in the construction materials sector, where they are used as roofing and walling. As with ceramic tiles, a major issue of sustainability involved with these materials is the

energy required in their production. It takes 13kWh of energy to produce 1kg of aluminium from alumina, 20% of which is used in construction. Other more toxic metals, such as lead in steel making, may be alloyed during production to improve construction qualities. Even though stone does require energy to quarry and process, it is not at the same levels that are required for the production of aluminium or steel. Both industries are putting considerable research effort to reduce energy consumption and to increase recycling. In addition to energy usage, aluminium-refining production also creates 70 million tonne of red

mud tailings every year, which may be hazardous and difficult to dispose of.

**Zinc** is another construction metal that is widely used for galvanising or coating steel. In this way it is widely used in some parts of world for roofing and competes with roofing slate. From a sustainability perspective, zinc is commonly produced in conjunction with more toxic metals such as lead, and may have toxic by products such as cadmium, mercury or arsenic. Zinc itself is currently under sustained research and its toxicity levels are being lowered. Unfortunately zinc from roofing also cannot easily be separated from iron and recycled.



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**Plastics or petrochemical-derived materials** are used in an increasing array of construction products. These may be fundamentally made from or are treated in some way by organic chemical substances, many of which originate from petrochemicals (that is from natural petroleum or coal resources). Concerns about this derivation arise in the first instance because the natural reserves of petroleum are limited. As with metals production, the initial production of most plastics also involves significant quantities of energy.

Most plastics, for example Poly Vinyl Chloride (PVC), are also suspect in terms of long-term toxic emissions. PVC is used in flooring and roofing, even though its major use (48.5%) is in pipes. When it is produced, carcinogens are emitted. When it burns, it will release toxic hydrogen chloride. All organic materials, when burnt, produce carbon monoxide.

Natural stone presents none of these challenges, even though stone is rarely considered as a potential substitute. However stone suppliers need to recognise that the sustainability of their product is decreased if organic resins or sealants are used to enhance "product quality".

### **Embodied Energy in Construction**

There are significant international efforts to encourage the development of more

sustainable buildings. One line of research has been to develop the concept of embodied energy, ie the energy required acquiring, processing and manufacturing a building material and to transport it to a building site and use it in construction. The lower the embodied energy of material, the more sustainable the material. As a building material, stone, especially when sourced locally, has a very low embodied energy. When expressed in mega joules of energy per kilogram of material, brick has 3 times the embodied energy of stone; gypsum wall board has 7.7 times and glass has 20 times. A related concept is recurring embodied energy, the energy consumed to "maintain, repair, restore, refurbish or replace" material during the life of a building. If well chosen, the durability of stone will also demonstrate superiority in this regard.

The stone industry should utilise more concepts such as embodied energy to promote the comparative sustainability of stone in construction.

### **Sustainability in employment / Regional development**

Sustainability also has a broader social dimension. From this perspective, sustainability refers to creation of employment and maintenance of communities.

The stone industry thrives in regional areas, often close to a resource, yet distant from a nation's principal

population centres. Regional development, employment generation and thus community sustainability are significant issues. Other aspects of social sustainability centre on the stone industry characteristic of being labour intensive. It is also most successful via small business and involves significant value adding in product manufacturing thus generating wealth.

These aspects of social sustainability requires more intensive promotion with economic development agencies if the tide of world population movement into large cities is to be halted and if regional communities are to thrive.

### **A dimension stone opportunity from two sustainability challenges**

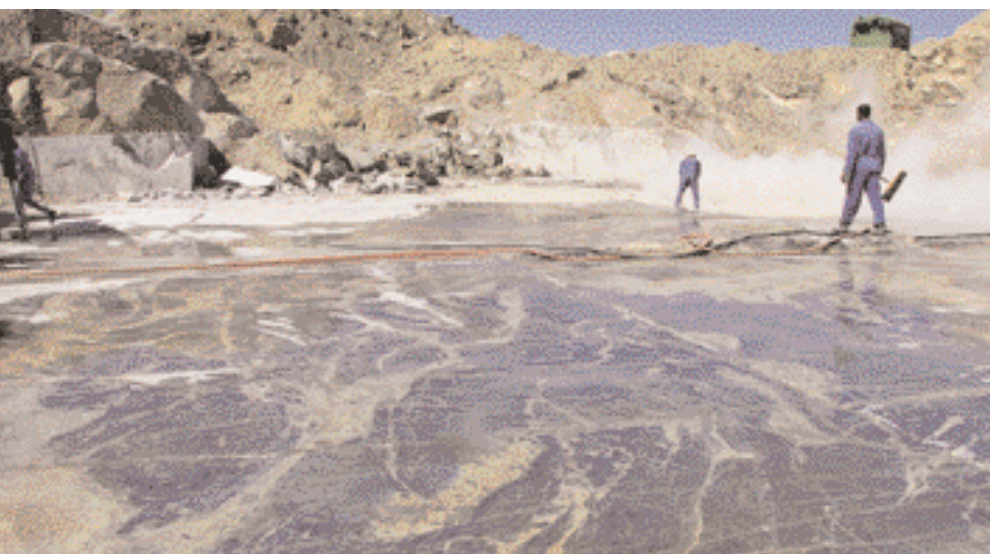
#### **Resource availability**

An immediate challenge today presented to any producer of a mineral resource by detractors is that their industry is not sustainable because a natural resource is being removed that is not being renewed.

This argument is also directed toward dimension stone production and the viewpoint is widely held, even at the highest levels of government. It is an opinion that needs revision and clarification where it occurs, so that the stone industry is not unfairly penalised. Dimension stone resources, as well as other minerals, will renew, but usually over millions of years rather than a few years. For example, millions of years are required to compress sediment into stone, and million of years are required to create new stone resources from the cooling of molten granite at great depths in the earth, coupled with their subsequent elevation to the earth's surface.

Yet despite this lack of rapid renewal, world resources of dimension stone are not being exhausted at an unsustainable rate, because stone resources with block or slab characteristics are very widespread. Mineral resource depletion is often exemplified by petroleum where critical depletion is a serious concern.

From an earth-wide perspective, however, dimension stone underlies huge areas of the planet. Reserves of rare and much sort-after stones, such as blue veined marbles, may become



Stone is a natural product, and man has evolved in a world where stone has been and still is an abundant resource across every continent. (Photo courtesy of Namibia Blue Sodalite PTY Ltd.).



*Dimension stone offers a natural product that is durable and can be manufactured without excessive energy use or toxic waste production. (Photo courtesy of Namibia Blue Sodalite PTY Ltd.).*

exhausted but the overall worldwide resource of stone will never be affected. In contrast to most other mining operations, dimension stone extraction can be also longstanding. In a country such as Australia, where mining of most mineral commodities has been intensive over the past 150 years, it is notable that the only longstanding, ongoing mining/quarrying operations are dimension stone quarries. Virtually every other mine has a much shorter mine life and thus is less sustainable in terms of community development.

**Resource concentration: Natural product**

Another challenge to mining and quarrying that is extended to dimension stone is a sophisticated argument, which states that the concentration of mineral products is detrimental to the planet. This is strongly advocated by an international organisation promoting sustainability, based in Sweden, known as "The Natural Step". This concern is particularly directed at the smelting, production and hence

concentration of metals such as lead, zinc and copper, which have a level of toxicity that may be injurious to plants and animals, including humans if concentration continues at the current, rapidly expanding, rate. Such resources are also seen to be scarce in nature and, in many instances are manufactured into unnatural and persistent products. The proposed solution by "The Natural Step" is to phase down mineral production, enforce recycling and thus reverse the increasing environmental pollution. This argument does not apply to stone, because stone is not concentrated through processing in the same way as most metals. Nor, except in the very rare cases, where a stone contains a toxic, and therefore polluting substance into the immediate human environment. Stone is a natural product, and man has evolved in a world where stone has been and still is an abundant resource across every continent. It is one answer to the proposal by "The Natural Step" that societies work to "eliminate our

contribution to systematic increases in concentrations of substances from the Earth's crust".

**Conclusion**

The international movement towards sustainable development provides new opportunities for the dimension stone industries. Unlike other construction materials, dimension stone offers a natural product that is durable and can be manufactured without excessive energy use or toxic waste production. World dimension stone resources in general will never be exhausted so the industry will offer ongoing prospects for employment especially in regional areas.

A major challenge is to promote these sustainable attributes effectively at a time when alternative products that are not as sustainable as stone have embarked on major marketing campaigns. 🏢

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