The value of Global Heritage Stone Resource Designation in enhancing and recovering our legacy and culture

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Abstract

Historical buildings in Europe and around the world are inevitably starting to show the damage that natural processes and anthropogenic actions, over time, have inflicted on them. Deterioration is shown not only in the aesthetic features of buildings but also in the main structural foundations of constructions. Results of unwise actions have been widely observed in the restoration of some buildings even in parts of UNESCO World Heritage cities and sites (e.g. Salamanca, Cáceres, Bath, Oxford, and Turin). Important natural stones have been identified in these, as well as other, places that are likely to be nominated as Global Heritage Stone Resources to promote their proper use in construction, maintenance and/or restoration. This work illuminates some problems associated with bad practices and emphasises the need to use, as far as possible, appropriate original natural stone in restoration in order to avoid further consequences. Knowledge and promotion of the Global Heritage Stone concept should help in drawing attention to these issues.

Natural stone has been used in construction for thousands of years but is affected by the same processes of weathering by water, wind, frost, heating and biological activity as surface exposures of the same rocks. Inevitable progressive deterioration reflects the nature and properties of the stone, the passage of time and the ambient conditions, both natural and anthropogenic, to which it is exposed. Causes of deterioration of stone through alteration, damage and decay are varied including cracking and deformation; detachment; loss of material through erosion and mechanical damage; effects of discolouration and surface deposits; and biological colonisation (e.g. algae, bacteria) (ICOMOS-ICS 2008). Many stone-built structures are in urban areas. Particularly since large scale industrialization, these have been exposed to aggressive attack by pollutants accelerating the rate of decay. Because of early industrialization and large numbers of historically important structures, Western Europe is a useful area for observing causes and possible approaches to reducing future damage to the historical, cultural and architectural heritage.

Article 4 of the UNESCO "Convention concerning the protection of the World cultural and natural heritage" states that "*Each State Party to this Convention recognizes the duty of ensuring the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage*" (whc.unesco.org/en/conventiontext). This can help to protect national heritage and can contribute to income from tourism. Governments address this obligation in different ways depending on their national priorities and provisions for protecting heritage. However, positive efforts can be undermined by political instability and loss of control. Wars and vandalism have endangered historical areas and sites for centuries causing damage or, in some cases, complete loss (Fig.1). Recent and current political instability in some places, including some UNESCO World Heritage sites, is a matter for continuing concern but can only be solved by conflict resolution. More widely, deterioration from anthropogenic activities, whether conscious or unconscious, or caused by climate and weather (http://whc.unesco.org/en/danger) can be addressed by good practices for repair and maintenance (Pereira *et al.,* 2015a, b).

Inappropriate maintenance and repair, development projects, inadequate management systems, and insufficient legal protection can threaten either important structures or groups of individually less important buildings that, together, comprise significant conservation areas. The rate of deterioration of stone depends on the initial quality and can progress to the point when only replacement can secure the future of the building or monument.

Intervention at the right time can preserve, or extend the life of, the cultural heritage but technically and aesthetically appropriate materials must

Fig. 1 - Gigantic buda of Bamiyán (Afganistán), before (photo: Muzzamil Pasha (Reuters)) and after the Taliban destruction in 2001 (photo: Sayed Salahuddin (Reuters)).The original Buddha was carved out of the sandstone of the cliff. The restoration should use that same sandstone if it was to take place properly.

be selected to retain both visual appearance and structural integrity of constructions. The recommendation is to use the original types of stone for maintenance and repair but that may be impossible if resources have been worked out, built over or, otherwise, have become inaccessible. In that case, detailed and readily accessible technical information is needed to identify the most appropriate alternatives.

Inappropriate actions in the repair and maintenance of buildings occur widely, even in parts of UNESCO World Heritage cities and sites (e.g. Salamanca and Cáceres, Spain; London, UK; and Turin, Italy). Some illustrative examples of problems observed by the author in these, and some other, locations in Western Europe are:

Cities of Salamanca, Spain; Turin, Italy and Oxford, UK.

Salamanca was recognized as UNESCO world heritage site in 1988, mainly because the homogenous construction of the old town using local natural stone and the optimum state of conservation. Buildings in central Salamanca were constructed using Villamayor sandstone (García Talegón *et al.,* 2015) and Salamanca sandstone (Nespereira *et al.,* 2010; Pereira and Cooper, 2014) for most of the structures. However granite was used for lower parts of the buildings after it was realized that the sandstones were not resistent to water absorption and became weak under critical conditions (Pereira *et al.,* 2015a). Humidity and contamination have had negative influences on the sandstones leaving some buildings in a very poor state. Mortar was used to disguise the deterioration, a common mistake because it can react chemically with minerals in the stone especially where the stone has a high water absorption coefficient. The reactions cause accelerating deterioration as the mortar continues reacting with the sandstone matrix and cement and can lead to complete destruction of the stone. A specific example of bad action can be seen at the Clerecía Church in Salamanca. Originally known as the Royal College of the Company of Jesus, construction began during the 17th century in Baroque style using Salamanca sandstone in the lower part and Villamayor sandstone in the upper part of the building. This church is part of Salamanca World Heritage site. The lower part deteriorated unevenly, due to the water adsorption through the more porous parts of the stone, and several inappropriate actions including covering with mortar in some parts and replacement of blocks in the frontage of the church. Limited understanding of natural stone led the architects in charge of the restoration of the Clerecía Church to use various igneous rocks to replace the sandstone. The result is a poor aesthetic effect that could have been easily avoided by awareness of available local material (Pereira and Cooper, 2014).

Similar circumstances have been observed in, for example, Turin, Italy, where attempts were made to obscure deterioration of the Floresto Marble by covering it with mortar and Oxford, UK where mortar has been used to “repair” limestone. Granites, as well as sedimentary rocks can be affected adversely by inappropriate coverings although the result is less dramatic than in the case of sandstones and limestones, at least in the short term but is still aesthetically undesirable.

Poor practice can, therefore, involve poor initial selection of stone; the use of technically or aesthetically incompatible stone during repair and maintenance of structures due either to lack of awareness of the need for appropriate materials or to secure materials at lower cost without appreciating the longer term consequences of damage and costs; or inappropraite use of mortar or cement. There is a need to raise awareness and understanding of the importance of good practices for the maintenance and repair of our natural stone heritage.

The Global Heritage Stone Resource (GHSR) and Global Heritage Stone Province (GHSP) concepts were developed by the Heritage Stone Task Group (a working group within the International Union of Geological Sciences) at the 33th International Geological Congress of 2010 in Oslo as a step towards improving the situation. The initiative aims to establish new formal international geological designations for important types of natural stone that have been widely used and/or have widespread cultural and architectural recognition (GHSR) and of areas (GHSP) that contain more than one type of stone that would qualify for GHSR status (Cooper *et al.,* 2013). It also aims to develop internationally accepted standard approaches to the reporting of technical and aesthetic characteristics of natural stones used for repair and maintenance of historic buildings, monuments and structures as well as for new construction. Formalization should help to increase awareness of the potential uses of various GHSR and provide important information for those engaged in using stone for repair and maintenance. Stones that have been used in heritage construction and sculptural masterpieces, as well as in utilitarian (yet culturally important) applications are obvious candidates for GHSR status.

The heritage stone designation can, if properly disseminated, create increased awareness of available and appropriate natural stone amongst professional workers in geology, engineering, architectural and artistic work, in stone/building conservation and among the general public. In addition, the designation can enhance international cooperation for research on, and documentation of, natural stone resources. This has already been demonstrated by numerous enthusiastic contributions to specific sessions in international meetings and publications dedicated to this topic (e.g. Pereira *et al.,* 2015a; Pereira *et al.,* 2015b). Success of the GHSR and GHSP designations should also help to encourage proper management of natural stone resources including future protection of important dimension stone resources from sterilization by other forms of development (Cooper *et al.,* 2013).

Conclusions

As far as possible, similar natural stone from the original source should be used to minimise adverse consequences for the historic and architectural heritage. If that is impossible, a very similar material is required. Use of inappropriate stone or treatment with incompatible mortars can have structurally and financially damaging consequences or be aesthetically unsightly. Inappropriate use usually arises because of a lack of information and awareness amongst commissioners and specifiers of works and budget constraints leading to selection of cheaper alternatives. Initial selection of suitable stone is important but inappropriate attempts at repair exacerbate problems even in some World Heritage Sites. Selected examples from Western Europe illustrate inappropriate use of mortar and replacement of stone. The Global Heritage Stone initiative has been launched to encourage

standard reporting of technical data on, and to improve recognition of, the internationally most important heritage stones; promote their proper use in construction, maintenance and repair, and to stress the need to safeguard important stone resources for future use. A very important consideration today is the possibility of reconstruction of the world heritage that has been destroyed due to army conflicts. In this case, the original and proper stone should be used to resemble the original treasure as much as possible.

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