This volume examines the unique role of engineering geology in cultural heritage (CH) conservation from rapid and slow environmental dynamics, also including climate change impact and disaster risk reduction. It introduces various approaches to protect heritage from irreplaceable loss and considers ways to draw upon heritage as an asset in building the resilience of communities and nations to disasters.

Cultural heritage represents the legacy of the human kind on the planet Earth. It is evidence of millennia of adaptation of humans to the environment. Cultural heritage can be intangible (e.g. traditional knowledge, customs, ritual practices or beliefs) and tangible, the latter including various categories of places, from cultural landscapes and sacred sites to archaeological complexes, individual architectural or artistic monuments and historic urban centres.

The sites and remains are not always in equilibrium with the environment. They are continuously impacted and weathered by several internal and external factors, both natural and human-induced, with rapid and/or slow onset. These include major sudden natural hazards, such as earthquakes or extreme meteorological events, but also slow, cumulative processes such the erosion of rocks, compounded by the effect of climate change, without disregarding the role of humans, especially in conflict situations.

In recent decades, many sites of significant cultural heritage value have suffered damage, occasionally irreversible, from natural and human-induced processes, resulting in the destruction of countless historical properties, museums and archives that hold the history of humanity within their walls. Cultural landscapes and natural heritage are being destroyed, and with them valued ecosystem services. These risks may be extensive, spanning entire countries or regions, or they may be more localised, such as those posed by fires, floods or landslides where they regularly affect particular heritage sites.

Often, disasters also affect traditional knowledge, practices, skills and crafts that ensure the cultural continuity of cultural heritage, as well as the means for its maintenance and conservation.

Typical examples of hazards affecting cultural heritages are the Bam earthquake in Iran (2003), the destruction of Bamiyan Buddhas from Talibans in Afghanistan (2001), the slow weathering of stones in Petra monuments (Jordan), the structural damage, also due to settlements, to Angkor Temples (Cambodia), the collapse of building in Pompei (Italy) and many other cases worldwide.

Against this background, engineering geology and Earth Science in general may play an essential role in the conservation and management of cultural properties. The relevance and potential of these areas of study was not fully appreciated in the past. At present, however, their contribution is increasingly acknowledged as the need for an interdisciplinary approach, which would bring together art history, science, management and socio-economic concerns, has become more and more apparent.

As a matter of fact, the protection of Cultural Heritages from geotechnical and geological hazards is a border area between Science for Conservation of Cultural Heritages and Earth Science. Conservator has to develop the proper restoration project, taking into consideration and having understood geological processes acting on the site and monument; in the mean
time, engineering geology has to implement a mitigation plan and monitoring system that are fulfilling the request of low impact and perfect integration of solutions into the archaeological contest. Typical example of connection points between these two major categories is the usage of solution that can damage the CH or the cultural landscape, even if reducing the natural processes acting on the site; similarly, the use of materials that, during time, can loose original properties, generating salts, oxides, etc., that may affect the integrity and conservation of CH. In this context also the proposed monitoring systems need to fulfil the requirement of low environmental impact and minimum interference with the archaeological remains.

The above reflections, without obviously being exhaustive of the problem list, clearly underline the impact that the Earth Sciences have had in the construction, development and maintenance of the cultural properties; it is self evident that the same disciplines have to assume, today and in the future, a fundamental role in all the policies that are necessary for the protection and conservation of the heritage.

This passage has never been very clear in the past, since the archaeology and the conservation aspects had a strong centrality and autonomy. This point of view is now less evident, with more attention to the integration of different sciences. Indeed it is possible to affirm that the protection of the cultural heritage represents an interdisciplinary process (and not multidisciplinary) to the border-line among art history, science, policies for management and exploitation.

In conclusion, it is possible to say that engineering geology (www.iaeg.info) highly contributes to the conservation of Monuments and Sites, being the science devoted to the investigation, study and solution of the engineering and environmental problems, which may arise as the result of the interaction between geology and the works and activities of man as well as to the prediction of and the development of measures for prevention or remediation of geological hazards.

Thus, Engineering Geology embraces:

• the definition of the geomorphology, structure, stratigraphy, lithology and groundwater conditions of geological formations;
• the characterisation of the mineralogical, physic-geomechanical, chemical and hydraulic properties of all earth materials involved in construction, resource recovery and environmental change;
• the assessment of the mechanical and hydrological behaviour of soil and rock masses;
• the prediction of changes to the above properties with time;
• the determination of the parameters to be considered in the stability analysis of engineering works and of earth masses;
• the improvement and maintenance of the environmental condition and of the properties of the terrain.

From the above it is quite evident as engineering geology (in the widest sense of the term) is a major science for the protection and conservation of cultural heritages from environmental degradation and disruption; then, engineering geology is now more relevant in the current international standards on culture heritage protection and development, which are the result of several decades of ethical reflection, experience, research and consensus building in a rapidly changing world situation.
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