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## Abstract

Most of the Spanish cultural heritage is exposed to natural hazards. This fact is opposed to a sustainable development, which is the cultural heritage base, because its goal is to be passed down to future generations (Andalusian Cultural Heritage Law 2007). The impact of natural hazards on the Spanish cultural heritage has been checked over the Lorca earthquake (May 11th, 2011). The impact is higher for rapid onset phenomena, but prevention measures are not projected for avoiding them. Natural hazards prevention implies hazard identification, analysis and also risk assessment and management. The cultural heritage in urban areas of Andalusia (Spain) is very rich, but it is not completely considered in town planning, regardless of the fact that they might be placed in hazard-prone areas. Town planning cannot reduce the exposition of this cultural heritage but hazards and vulnerability can be reduced. Hazards and vulnerability of elements at risk must be known to design suitable prevention measures.

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## Keywords

Natural hazards • Cultural heritage • Prevention • Town planning • Legislation

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## 76.1 Introduction

Spain has the second largest number of Cultural World Heritage sites in the world. According to the Spanish Ministry of Education, Culture and Sports, the number of Properties of Cultural Interest in Spain is around 16,000. Most of them are castles, usually placed on promontories where they are exposed to landslides and rock falls, palaces or churches, usually constructed near rivers where they are

exposed to floods. Despite most of the cultural heritage is supposedly placed in safer places than modern buildings because those places were chosen some centuries ago, it could be affected by natural hazards. This fact is opposed to a sustainable development, because its goal is to be passed down to future generations (Andalusian Cultural Heritage Law 2007).

When this cultural heritage was built, the historical record of natural hazards was generally short, but long enough for destructive floods or earthquakes. Because of that, Rodríguez-Pascua et al. (2012) suggest that deterministic methods should be used when designing cultural heritage hazard maps.

The impact of natural hazards on the Spanish cultural heritage has been checked over the Lorca earthquake (May 11th, 2011). Some of Lorca's heritage damaged by the 2011 earthquake was also affected by the 1674 Lorca seismic crisis (Feriche et al. 2012). In the last centuries some Andalusian cultural heritage has been partially destroyed, for

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example the historical center of Málaga by the 1680 earthquake (Goded et al. 2012).

The natural hazards impact is higher for rapid onset phenomena, but prevention measures have not been planned yet to avoid them. The Spanish cultural heritage exposed to natural hazards is studied just to project local corrective measures when it is affected by them. Town planning cannot reduce the exposition of this cultural heritage but hazards and vulnerability can be reduced. Prevention through non-structural measures, such as land use planning, is difficult to apply to cultural heritage. Moreover, preventive structural measures prior to natural hazards occurrence are better than corrective measures applied afterwards, because they are cheaper and safer.

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## 76.2 Cultural Heritage and Natural Hazards

UNESCO adopted a Convention concerning the Protection of the World Cultural and Natural Heritage in 1972; meanwhile the Committee of Ministers of the Council of Europe adopted a Recommendation on the Protection of the Architectural Heritage against Disasters (93/9).

Italy is one of the pioneer nations establishing mechanisms, management operational protocols, and producing documents such as the Risk Map of Cultural Heritage (*Carta del Rischio*) in 1987 (Baldi 1992), which takes into account various natural hazards.

Initial approaches adopted by the international community in relation to risks and heritage have been focused on steps towards protection measures on the intentional destruction of this heritage (UNESCO 1954) but also on taking post-intervention measures, searching for the collaboration of competent services, avoiding any cultural heritage damage, and allocating funds for damage repair (UNESCO 1976). The Charter of Toledo (ICOMOS 1986) recognized the importance of the heritage protection and an expressed willingness to prevent and minimise the risks of its destruction according to criteria consistent with the protection of the cultural heritage.

Furthermore, the Charter of Noto (Noto Consultory 1986), on the Italian side, proposed a protection of historical centres towards seismic risks in the region of Eastern Sicily through seismic hazard maps; priority for intervention schemes; appropriateness of criteria definition; and intervention techniques for possible seismic risks. The Charter of Washington (ICOMOS 1987) highlighted the preventive measures against natural hazards, being these prevention or repair measures specific to the type of building or asset. The objectives of the Kobe Conference on Cultural Heritage Risk Management (2005) highlighted the integration of the cultural heritage into the disaster reduction policies, involving local communities in developing action plans on risk

management. In addition, the Xi'an Declaration (ICOMOS 2005) pointed out the need to respond to the changing process of heritage areas caused by natural disasters, establishing planning tools and practices to preserve and manage the environment. Moreover, the Lima Declaration (ICOMOS 2010) focused on prevention through urgent measures to possible damages caused in seismic prone areas. However, La Valletta Principles (ICOMOS 2011) focused on risks and the nature of the prevention and damage repair tools.

Multidisciplinary studies have primarily focused on the issues resulting from seismic natural hazards and, to a lesser extent, in floods and mass movements. Subsequent to the analysis of the effects and the consequences of disasters, planning and protocols on natural hazard management have necessarily followed, especially aimed at improving protection and future prevention measures, being effective in the educational training fields, and the preparation of management planning.

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## 76.3 Natural Hazards in the Spanish Cultural Heritage

In the last decades, the Spanish Historical Heritage Law (Act 16/85) defined, at state level, the conceptual update of Historical Heritage, selecting the intervention criteria, providing a suitable use of them for the community and setting up a vigilant policy in order to create the necessary educative, technical and financial incentives. Some provisions established references to conservation matters and the setting up of preliminary studies on the analysis of the conservation status. However, Spanish Historical Heritage Law did not include direct and comprehensive measures referred to natural risks that may affect them. The update of the new cultural heritage catalogues and the inclusion of archaeological maps should be accompanied by the need of including a risk map into the cultural heritage conservation plans.

The National Plans are management tools for Cultural Heritage promoted by the Spanish Cultural Heritage Institute. Some of them are related to natural hazards prevention. Thus the Preventive Conservation National Plan (2011) establishes natural hazards prevention (specifically for earthquakes and floods) through the risk identification, analysis and assessment. The ideas of *Carta del Rischio* (Baldi 1992) are considered by the National Plan of Cathedrals and the National Plan of Abbeys, Monasteries and Convents, allowing to plan the conservation and restoration interventions in order to prevent stability and leak tightness problems related to earthquakes, rock falls or hydrology. They will be considered as urgent interventions. The National Plan for Cultural Landscape considers seismic hazard and rock falls.

In Spain, Culture affairs competence was transferred to the 17 Autonomous Communities (Spanish regions), which actually have a cultural or historical heritage legislation with no direct references to natural hazards. The Historical Heritage Andalusian Law was first enacted in 1991 and was amended during 2007 due to the integration into it of the Andalusian Urban Ordainment Law (Law 7/2002). They establish the competence of the Regional Government over Historical Heritage when "...there is a risk of destruction or deterioration of it". However, it is not compulsory to design a Conservation Project to conduct emergency works to prevent people or goods from that risk (Historical Heritage Andalusian Law).

## 76.4 National and Regional Spatial Planning and Urban Legislation

The recast text of the national Land Act, enacted by Royal Legislative Decree 2/2008, and most of the regional spatial planning and urban legislation, enforces to classify hazard-prone areas as unsuitable to development. The transposition of the Directive 2007/60/EC on the assessment and flood risk management into the national Royal Decree 910/2010 establishes that flood hazard maps and flood risk maps are compulsory at river basin district level. The land use planning will take into account both maps. Flood prone areas should also be considered as unsuitable to development. In accordance with the provisions of the Spanish Strategic Environmental Assessment (Law 6/2006), an Environmental Sustainability Report (ESR) is compulsory to be carried out, and must include a natural hazards map, as it is established by the Land Act. The ESR will be included in the General Urban Planning. The map is important in order to know the cultural heritage exposition to natural hazards and to plan structural countermeasures.

Most of the enacted regional laws about spatial and urban planning agree on carrying out natural hazards maps. According to the Civil Protection Basic Standards for floods a municipal civil protection plan is mandatory, and should also include a hazard map. Regarding earthquakes this plan is compulsory in towns with intensity higher than 7 (EMS) in the national seismic hazard map. However after analysing some Spanish urban plannings it is observed that most of them do not include natural hazards maps and when they are included, the map scale is too big.

One of the most visited monuments in Spain, the Alhambra of Granada, is placed in a highly seismic area. At least for the last five centuries, the fault of the San Pedro cliff and associated faults located at the bottom/on the foothills of the Alhambra hill, has been active (Justo et al. 2008). The

Alhambra walls were partially destroyed by different earthquakes several times. Nowadays the top of the cliff is closer to the Alhambra because the slope toe erosion by the river Darro during floods triggered some mass movements in the cliff. However, the Urban Planning of Granada city only includes a partial flood map and a mass movements map at scale 1:50,000.

Towns with a high seismic hazard, almost half of them in Andalusia, do not have a seismic civil plan (or a seismic hazard map).

Hazards maps are not enough. It is not possible to get a risk map without having vulnerability and exposition maps. Hazards and vulnerability of elements at risk must be known to design the preventive measures in the case that this cultural heritage is exposed to natural hazards. Due to the fact that some damage are related to restoration techniques, structural measures must be carefully studied. In addition, those measures cannot affect greatly the cultural heritage.

Town planning cannot reduce the exposition of cultural heritage but hazards and vulnerability can be reduced.

A detailed risk map of cultural heritage included in the General Urban Plannings would mean to operate researching on the identification and risk analysis of natural hazards; on conservation and techniques methods; on criteria selection and working methods; and on the coordination of activities and the optimization of resources (Preventive Conservation National Plan). All this would help to develop a multidisciplinary relationship and to integrate a technical-scientific methodology approach in the cultural heritage field. As a result of that, damage would be minimised and that, together with a good knowledge of the materials and construction technology, would allow proposing intervention models to agree with a suitable conservation (Baldi 1992) based on sustainability patterns.

## 76.5 Conclusions

In Spain, cultural heritage legislation have never considered town plannings and vice versa. The preventive conservation of cultural heritage to natural hazards is not present in town plannings. Hazard maps to be included in town plannings, according to the national Land Act, should be enforced at a detailed scale. The *Carta del Rischio* proposed by the Spanish Cultural Heritage Institute should focus on the study of the degree of conservation and the vulnerability of the cultural heritage. The coordination of all administrations which are competent in cultural heritage affairs and town plannings is recommended in order to save money and to spend it in preventive measures instead.

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