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THE SOCIETAL ROLE OF THE MASONRY CONSTRUCTIONS

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ABSTRACT

Our society is currently being affected by a global crisis, not only economic. A new paradigm of sustainability is needed, which can be inspired in some past values. In the construction sector some actions, such as the recovery of the structural masonry, need to be taken to save resources for all. The occurrence of recent worldwide seismic events argues for an adequate seismic design and assessment of our life buildings, for which some principles and examples are presented.

SOCIETAL VALUE

A worldwide economic crisis is currently affecting all sectors and aspects of our society. The construction sector is a crucial segment of the global economy, because our life is spent most of the time inside buildings. In this sector, a regained paradigm of sustainability is needed, by promoting the use of local resources as close as possible to its primary state (Figure 1). A more recent example of sustainability and development in construction is observed in the growing Brazilian economy, where the unreinforced block masonry is an emergent typology.

Figure 1: Masonry building in Monção, Portugal

However, in the Portuguese case the unreinforced masonry system has been decreed as unsafe to seismic events. This verdict is countered by making a visit to the old villages and cities of Portugal. On the other hand, Figure 2 indicates the fraction of low-height buildings (1-2 storeys) as the higher historically constructed in Portugal. According to Torre (2010), new construction within this fraction of buildings, by using structural masonry instead the reinforced concrete system, is safe and allows a significant economy. An immediate saving of 6-9 T€ can be obtained for each family. Furthermore, for a predicted construction in last decade of 500 thousands of 1-2 storey buildings, a 25% economy allows at short term a macroeconomic saving of 350 M€/year (0.2% of the Portuguese GNP). Savings from energetic and durability sides are expected at medium and long term.

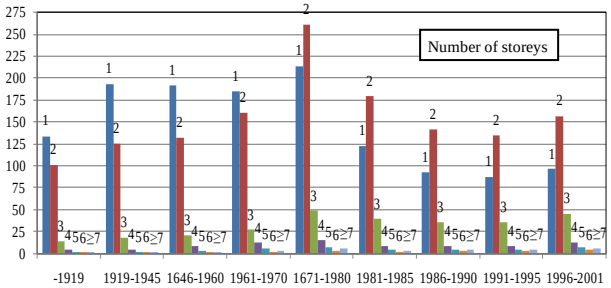

Figure 2: Thousands of buildings constructed by epoch

On the other hand, the historical buildings, which are made mainly of masonry, represent a great patrimonial and cultural value of each country, which in the case of Portugal is the principal attractive for the tourism sector. Then, the preservation action on buildings, in particular the assessment of its seismic vulnerability, is an important and current issue to consider. The effects of recent earthquakes, e.g. in Chile and Lorca, have demonstrated that more important than the material which is used for building, is the need of adequate design procedures and practices for construction.

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THE SEISMIC FACTOR

Earthquakes are natural events with a very unpredictable character, given the huge complexity and number of variables involved. Typically, its possibility of occurrence is associated with a level of seismicity recorded for a given region. This factor is considered as determinant in the design of buildings, due to the extraordinary nature of the induced actions. The simulation of a seismic event requires, in any case, a given level of simplification. In this context, a scheme of lateral forces applied statically to the building modelled through macro-elements has been considered, for design and assessment purposes, as a simple way to simulate the seismic effects (e.g. in Figure 3).

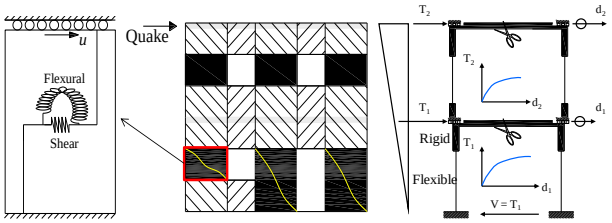

Figure 3: Approach for seismic analysis by Marques and Lourenço (2011)

Several tools specifically developed for seismic analysis of masonry structures are currently developed and validated to assess simple building configurations. However, the competitiveness of the structural masonry against the reinforced concrete system requires the development and validation of tools for seismic design being capable to simulate complex configurations of buildings (e.g. in Figure 4). This kind of constructions is frequently used in the expansion of urban areas.

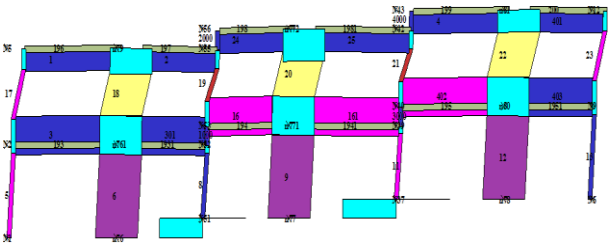

Figure 4: Model of a masonry building aggregate

The assessment of the seismic vulnerability of historical masonry buildings is another important issue, for which tools are needed to act timely and efficiently in the seismic retrofitting and reinforcement. This is the case for the 1887 "Old Municipal Chambers" (OMC) building in Christchurch, New Zealand, which was damaged by recent earthquakes. For this building, two models have been made using micro- and macro-element approaches, aiming a complementary study to support the reinforcement actions on the building.

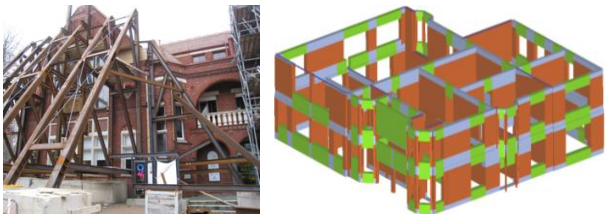

Figure 5: Actual shoring and macro-model of the OMC

CONCLUSION

Masonry constructions represent a past value which needs to be preserved, mainly of earthquakes, but also an example to build our future with all societal gains.

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Rui Marques is a researcher in geotechnical and structural fields. He has also studied Artificial Intelligence (AI) techniques of Data Mining and Evolutionary Algorithms, which he has applied to geotechnical and structural applications, namely a computational prototype to manage the work of geomaterial compaction in transport infrastructures.
Rui Marques has collaborated in several R&D projects, in the fields of transport infrastructures and masonry constructions. He has participated in studies for design and seismic assessment of new and existing masonry constructions. He is author of about 20 publications.