

## Integrated seismic and energy performance of existing buildings

### Summary

The occurrence of past earthquakes highlighted the vulnerability of reinforced concrete (RC) buildings, which constitute a large part of the building stock of European countries. Most of these buildings were built before the introduction of modern codes hence they lack appropriate seismic resistance. The Portuguese building stock, which includes around 50% of RC buildings, is particularly vulnerable to seismic hazard, due to the seismicity of the country and to the characteristics of many of the buildings, as has been demonstrated in recent studies.

Moreover, the energy performance of this type of buildings is highly unsatisfactory (due to a number of deficiencies such as the lack of insulation, the use of the energy deficient fenestration surfaces and the old and inefficient mechanical equipment used for heating and cooling) which result in high energy consumptions, hence high economic losses and increased CO<sub>2</sub> emissions. In this way, the assemblance of a retrofiting approach which could simultaneously reduce buildings seismic vulnerability and increase their energy efficiency is essential. However, the actual retrofiting interventions on existing buildings are destined to reduce the seismic vulnerability or the energy consumption alone. For these reasons, current European policies are pushing towards a sustainable renovation of existing buildings, with the purpose of reducing seismic vulnerability and increasing energy efficiency at the same time and in the least invasive way.

Hence, a multi-criteria decision-making framework is therefore the likely most promising approach to integrate seismic, energy, economic and environmental considerations in the selection of optimal retrofiting interventions. However, such a comprehensive framework is still missing for existing RC Portuguese buildings.

The main goal of this research plan is to propose a framework to integrate, in an optimal manner, the seismic and energy retrofiting of existing RC buildings, with a view to minimise the economic losses and environmental impacts. This framework is applied to pre-1983, non-seismically designed, RC buildings in Lisbon but can be easily reproduced in other geographic areas and to other RC building typologies.

### Keywords

Seismic and Energy retrofiting, existing RC buildings, economic losses, environmental impact, seismic assessment.



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