

# Developments in performance-based seismic design and assessment: an Italian perspective

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## Summary

In recent decades, earthquake engineering has developed significantly from traditional objectives that focused on ensuring the life safety of building occupants. The economic impact of the 1994 Northridge earthquake in the US highlighted the need for a paradigm shift in the way building performance ought to be defined. From a building owner's perspective, what is of immediate interest is the direct financial burden of repairing or replacing their building. From a building occupant's point of view, the safety of the building and the risk of casualty via structural collapse are of more immediate concern. This seminar considers these two aspects: economic losses and structural collapse. They are discussed in relation to the assessment and retrofit of existing buildings and design new ones.

Prior to the introduction of seismic design provisions in the 1970s, Italian construction typically comprised of gravity load designed reinforced concrete (RC) frame buildings with masonry infill. Their performance and ways in which shrewd retrofitting of both structural and non-structural elements for maximum impact on performance are investigated. Furthermore, the Italian Ministry of Infrastructure and Transport issued a Ministerial Decree in 2017 (Decreto Ministeriale 58/2017) outlining a framework with which to classify the seismic risk of existing buildings on a letter-based scale from A+ to G commonly referred to as *Sismabonus* due to the tax deductions the Italian government is willing to offer to building owners who upgrade their building performance. This framework and future improvements are also examined.

For what concerns the design of new buildings, a novel conceptual design framework that employs both expected annual loss (EAL) and collapse risk as design tools and requires very little building information at the design outset is presented. This framework allows designers to arrive at a number of feasible structural solutions without the need for any detailed design calculations or numerical analysis. It is intended to form the first step in seismic design to identify suitable typologies and layouts. This way, engineers, architects, and clients can make more informed decisions at the beginning of design before further refinement.

## Biography

Gerard J. O'Reilly (1989) is an assistant professor at the *Scuola Universitaria Superiore IUSS Pavia*, completing his Bachelor and Master degrees in Civil Engineering in Ireland in 2010 and 2013, with a period as a visiting researcher at the University of California, Berkeley in 2012. He obtained his PhD in Earthquake Engineering and Engineering Seismology from the *Scuola Universitaria Superiore IUSS Pavia* in 2016 and continued as a post-doctoral researcher until early 2019.

Primary research interests include the seismic design and assessment of structures to incorporate innovative aspects of performance-based earthquake engineering; the seismic vulnerability of existing structures and ways that different retrofitting measures (both structural and non-structural) may improve their seismic performance. These include the incorporation of economic losses and collapse risk directly in the design process as a general effort towards the next-generation of design codes, as well as the *Sismabonus* classification guidelines recently introduced in Italy. Much of this research also relates to different projects in collaboration with the EUCENTRE Foundation and the ReLUISS consortium on the assessment of existing school buildings and ways in which limited resources allocation may be prioritised. He has also been involved in various European projects, such as BRACED and DiSTEEL funded by the European Commission Research Fund for Coal and Steel and FP7 funding lines, relating to the shake table testing and design of steel frame structures. More recently, he currently collaborates on the development of simplified tools for the regional assessment of bridge infrastructure in Italy,

Israel and North Macedonia exposed to seismic hazard and ageing effects as part of the INFRA-NAT project funded by the EU European Civil Protection and Humanitarian Operations.