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EARTHQUAKE LOSS ASSESSMENT AND INDUCED SEISMICITY: PROJECT PRESENTATION AND PROGRESS

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This work presents the progress on a project aimed at evaluating earthquake losses in a case in which the seismicity pattern of an area is altered by the seismicity induced by human-related activity. The project is funded by MAPFRE Foundation, which belongs to a Spanish insurance company with international implantation.

The issue of induced seismicity or, in more general terms, the seismicity that strictly has not a natural origin, is increasingly receiving attention from the industry and from the scientific community. This may be related to different human activities that modify the natural state of stresses within the Earth's crust as a result of fluid injection related to hydrocarbon extraction and storage, dam constructions, etc. This seismicity is characterized by small-sized events that often have their source in areas where no earthquake events were reported in the past. However, there are occasions in which the earthquake events present a larger magnitude and are felt by the population, eventually causing damage to structures or other built assets, and therefore involving economic losses.

A procedure to estimate earthquake damage and losses is a seismic risk assessment. This comprises several factors, including the evaluation of the expected seismic ground motion, the characterization of the seismic vulnerability distribution of exposed elements and the economic value of these elements. A number of factors are considered in the project:

- The seismic action will be defined consistently with the seismic hazard expected in the target area. Poissonian models of earthquake occurrence are abandoned and time-dependent models are implemented. The increase of earthquake rate will imply an increase of expected ground motion for a given probability level in a time frame.
- Seismic vulnerability will be assessed considering the potential damage to structural and non-structural elements. A prospective analysis will be carried out to identify the main building typologies and the corresponding vulnerability classes of the target area, establishing their geographical distribution.

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- The damage distribution is obtained using an empirical method. As the expected damage related to the induced seismicity is not expected to be of a high degree (not involving structural elements), the damage related to non-structural elements are expected to make a difference.
- The costs associated to different damage types observed in the European Macroseismic Scale will be quantified using the cost tables used in the construction industry and fixed by the regional administrations. This confers a realistic base to the cost estimates obtained in the project.

Results of this risk study would inform about the economic impact of the induced seismicity on the same distribution of exposed, vulnerable elements. Whereas this impact is evaluated in conventional dwelling buildings, the approach followed in this work could be extrapolated to other exposed elements, such as lifelines and public infrastructures and other facilities.

Complementing this body of work, risk mitigation measurements which may be of interest for guiding mitigation policies are also investigated. Specifically, several reinforcement measurements intended to prevent damage to non-structural elements will be developed, including the cost of their implementation. At the same time, the repair and replacement cost of the same damaged elements will be assessed. Combining reinforcement and repair cost estimates, specific benefit/cost relations of developing certain mitigation measurements could be calculated. At the end, this would help determining the interest of following a risk reduction strategy based on retention and/or transfer of the expected risk.