Evaluation of impacts of natural disasters on built systems for multi-risk management

SMART PhD 2024, in collaboration with RiskAPP Srl
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Background
Italy is one of the most sensitive countries in the world to catastrophic natural events. UNISDR (2017) showed that Italy ranks fourth (behind Japan, the United States and China) for average expected losses caused by natural disasters. Floods are the most frequent hazard, followed by earthquakes, which are responsible for the greatest economic losses. Together, earthquakes and floods account for over 80% of economic losses due to natural hazards (CRED EM-DAT 2015). Earthquakes in the last 50 years have cost the Italian state €180 billion (ICPD 2018, https://www.protezionecivile.gov.it/static/5cffeb32c9803b0bddce533947555cf1/Documento_sulla_ Valutazione_nazionale_dei_rischi.pdf), while economic losses related to climate events, between 1980 and 2015, are estimated at €65 billion (European Environment Agency). These figures put Italy in second place in Europe. Moreover, ongoing climate change is exacerbating the impacts of various natural events, such as floods and flash floods, debris flows, storms, and tornadoes (IPCC 2023, https://www.ipcc.ch/report/sixth-assessment-report-cycle/). Despite this, only 6% of the damage suffered is insured against these events (Willis Towers Watson 2017). There is therefore a clear need to invest in the understanding and management of natural risks, and in the development of rational models for assessing the impact of climate-change related hazards on built systems.

Aim
This project aims to develop applied research to support the multi-risk management, mitigation, and transfer process. It intends to develop new methodologies for multi-risk analysis, based on the integration of different hazard and vulnerability models, on the use of Machine Learning techniques for the rapid characterisation of the building exposure, and on the use of AI and Data Science techniques for the processing of large amounts of data (such as structural monitoring data). Based on these methodologies, the PhD project then seeks to develop a CatNat model for the assessment of natural disaster losses, specific to the Italian context.

Expected results. The main tasks of the PhD project are:
- identification of the most up-to-date hazard models for the various natural events in Italy;
- identification of available vulnerability-exposure models for classes of buildings, related to the Italian built environment;
- development of capacity-vulnerability models for hazards other than seismic;
- development of CatNat models for estimating natural disaster losses, specific financial-insurance modules, and modules for assessment and mitigation of risks; for the purpose of pricing insurance products;
- creation of operational tools to be implemented into digital platforms for rapid risk assessment and automatic risk profiling, for prioritisation and insurance purposes.

Possible Collaboration: ReLUIS (Laboratories University Network of Seismic Engineering); Department of Civil Protection; Insurance and Insurtech Companies.