BE S²ECURE

Built Environment Safer in Slow and Emergency Conditions through behavioUral assessed/designed Resilient solutions

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Grant number: 2017LR75XK

WP 1 BE and SUOD: State of the Art (SoA), risks and human behaviour

T1.2 - SoA of earthquake (SUOD) impact on BE and related earthquake-induced modifications due to building/aggregate and aggregate/public spaces interfering conditions. Current risk-reduction strategies analysis. Definition of human behavior including crowding conditions by combining SoA data and real-world events analysis

D1.2.1 - MATRIX OF SEISMIC RISK CONDITIONS IN BE PRONE TO EARTHQUAKE

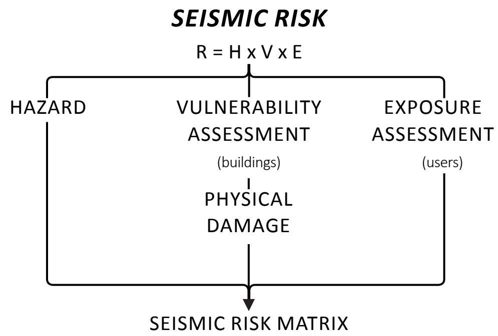
HAZARD: describes the probability of occurrence of an earthquake of a certain severity, within a specific period of time, at a given geographical area by appropriate parameters and it is basically related to the definition of damage scenario. The choice of the parameter to be employed for the ground motion characterization depends on the purpose of the risk analysis performed and must be coherent with the vulnerability assessment method adopted for the seismic building behaviour assessment.

VULNERABILITY: The vulnerability assumes great importance, which factor that may be easily mitigated within the seismic risk analysis, due to the direct impacts in the occurrence of a seismic event; in fact, the physical damage of buildings surrounding the open space may obstruct emergency paths and make the emergency management difficult. For this reason, assessing the building vulnerability in a correct way is the first step required for quantifying the amount of debris. Therefore, the current report provides a detailed and comprehensive literature review of the vulnerability assessment approaches that allow to detect positive aspects and limitations for further applications and improvements. In fact, the approach adopted strictly depends on the scale of the problem. In particular, empirical methods are more suitable for large scale investigation because guarantee accurate results in statistical terms. Instead, analytical models have important implications for providing detailed analysis of the structural behaviour to be directly correlated to the corresponding damage state. Although these models require a significant computational effort, a wealth of structural data is also necessary for the scoring method. In fact, they substantially differ in calculation procedure, while often the input data may be the same.

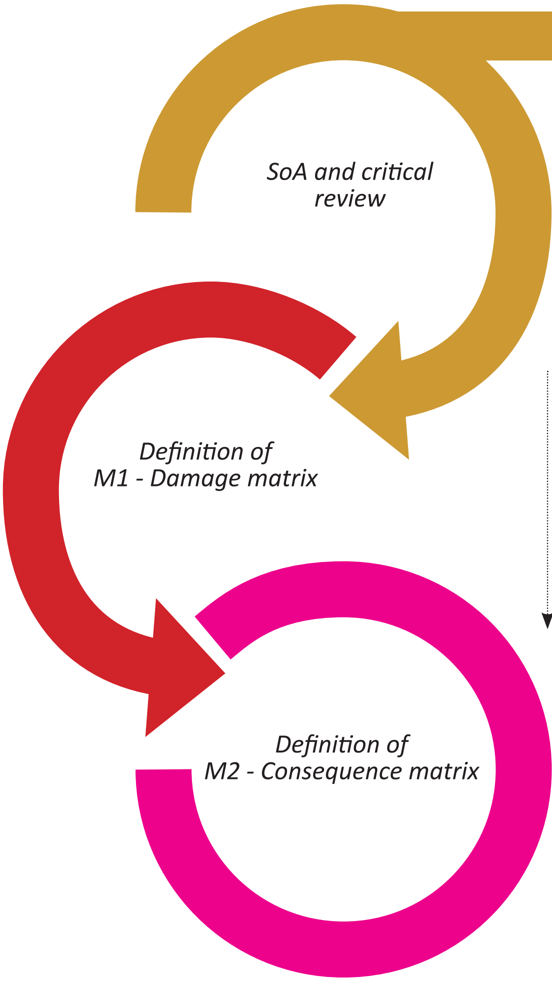
HUMAN EXPOSURE: estimates the distribution of people that may be affected by disasters considering the temporal variation related to the occupancy of buildings varying between use and functions. The exposure assessment has a key rule for implementing risk reduction strategies, although researchers generally model exposure as a minor input for risk assessment leading to an underrepresentation and a lack of understanding of its relevance for reducing seismic risk.

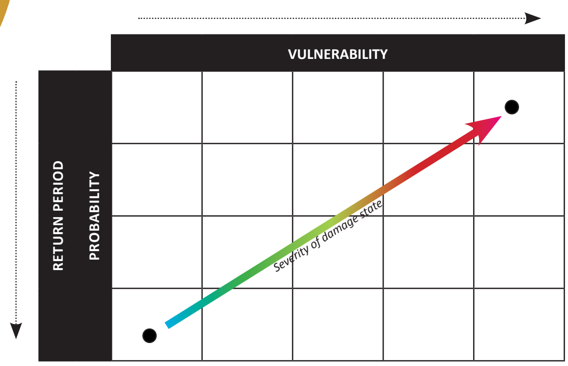
The present report deals with the discussion of the seismic risk of the BE with the aim of developing a seismic risk matrix that encompasses the three factors hazard, exposure and vulnerability, for describing the risk condition of the open space under an earthquake. So that, it provides a broad SoA of the main approaches adopted for assessing and managing the seismic risk highlighting positive aspect and limitation of each methods, in order to identify which of them are more suitable for the aim of evaluating impacts on the BE.

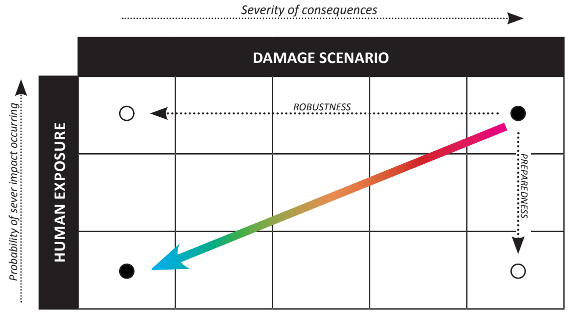
The final step of this deliverable is to carry out a seismic risk assessment aiming at understanding of possible consequences of an earthquake in open space. The methodological approach proposed is focused on the assessment of an earthquake impact starting from physical damages of BE that may affect people living or standing in an open space. So that, the probability and the severity of increasing impacts of an earthquake occurring are described by hazard, vulnerability and exposure parameters through two different matrices either related: the first matrix encompasses hazard (expressed in term of return period) and vulnerability (classes of buildings or buildings aggregates performed by specific methods) information in order to provide a qualitative assessment of physical damage (debris), which will be quantified by geometric methodologies deeply discussed in §3.2 of D1.2.2. The second matrix connects the human exposure, in terms of inhabitants and users of buildings and open areas with the possible damage scenarios resulted from M1, considering how physical damages affect the safety of people and the emergency paths.



SEISMIC RISK ASSESSMENT ON OS







The outcomes of the M2 describe possible scenarios that may be useful to risk management, on the one side, for evaluating priority strategies of protection of human life and safety during emergency, on the other side for identifying necessary retrofitting interventions aimed at avoiding building's failure and damage. The idea behind the "consequence matrix" is handling two key factors: robustness of BE and preparedness of community.