

Seismic Losses and Consequences

The aim of the course is to provide theoretical and practical insights into the procedures available in literature for the evaluation of seismic losses and consequences.

Loss estimation is usually based on the definition of consequence functions, representing the distribution of the loss on a set of discrete performance or damage levels. Loss may involve casualties, repair costs, and downtime. The consequence functions can be derived from different approaches: i) experimental tests; ii) empirical data from post-earthquake survey; iii) analytical data related to the building structural response. In the course, the pros and cons of these approaches will be discussed and practical tools available in literature will be shown (as those proposed in FEMA P-58 [2012]). Particular attention will be devoted to the economic losses since the attention to this aspect is increasing in risk analyses for different scopes: cost-benefit evaluations; reparability decisions; the knowledge of the economic impact and the resilience of a society after the occurrence of an earthquake; and the calibration of insurance premia. The valuable data collected after the L'Aquila 2009 earthquake (Di Ludovico et al. 2017a, 2017b) will be examined in detail since they provided a unique dataset to calibrate functions based on the empirical approach (approach ii). The restoration policy and the procedures regulating the reconstruction process will be illustrated together with their outcomes in first phase of the reconstruction process (the so-called "light damage" reconstruction), addressed to recover the usability of slightly damaged buildings and, then, in the second phase (the so-called "heavy damage" reconstruction) that involved buildings outside the historical centres assessed as unusable due to high structural and/or non-structural risk. A simple methodology for assessing reparability through scenario-based simulation of building damage state and expected repair costs is also presented.

The data presented support in establishing priorities and reconstruction policies for use in the aftermath of future earthquakes.

- **MODULE I - *Marco Di Ludovico and Serena Cattari*: Seismic loss assessment: basics on fragility and consequence functions**
- **MODULE II - *Marco Di Ludovico*: Empirical approach: experience of damage assessment and recovery policies from L'Aquila 2009 earthquake**
- **MODULE III - *Marco Di Ludovico and Ciro Del Vecchio*: Seismic loss scenarios accounting for direct and indirect costs – Actual repair costs using the FEMA P-58 methodology**
- **MODULE IV - *Serena Cattari*: Critical issues on the development of fragility curves and risk analyses**