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SEISMIC VUNURABILITY ASSESMENT OF BUILDINGS BASED ON FRAGILITY CURVES: A REVIEW

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In recent literature, there is increasing number of probabilistic seismic risk assessments performed. The basic ideas of the procedure for performing a probabilistic safety analysis (PSA) of critical structures which could be used also for normal industrial and residential buildings, dams, nuclear power plants or other structures just within the concept of performance based seismic design (PBSD). One of the methods to investigate the vulnerability of existing buildings is to use fracture curves, which can have many applications before and after earthquakes. These curves are used to assess seismic hazard, prioritize structural rehabilitation, crisis management planning, and multi-risk approaches for different natural hazardous zones to estimate the amount of post-earthquake damage based on probabilistic based seismic analysis. This paper investigates the practices and methodologies for assessing seismic vulnerability of the existing steel and concrete structures, in areas exposed to high seismicity and deals with the trend of its development. The study involves an extensive collection and review of analytical, empirical, expert-based and hybrid models for assessing fragility curves available in the technical literature and their evaluation according to a set of qualitative criteria in order to select the most appropriate ones for each type of structure. Also, it reveals of the most recent fragility curves, introduces their advantages and describes the relationship between the intensity of the earth's earthquake and the probable seismic hazard level to accurately determine the correct choice for specialists and engineers for specific performance level. The fragility curves are established to provide a prediction of potential damage during an earthquake. These curves represent the seismic risk assessment and are used as an indicator to identify the physical damage in the strongest mainshock. Apart from the mainshock, probability aftershock must also be investigated to decide whether or when to permit re-occupancy of a building. The fragility function is also directly used to reduce damage cost and loss of life during a seismic event. Therefore, fragility curves can be used as a decision-making tool for both pre- and post-earthquake situations. Moreover, these curves may help develop future local code provisions.

Two main components in the probabilistic seismic risk assessment have been identified. These components include information about ground motion hazard on the location of structure and fragility knowledge with respect to the intensity of the ground motion (Polese et al., 2013) stated four important factors available for a large database, which include the number of stories, age of construction, regularity (in plan, elevation, and in-fill), and position of building in the block (Silva et al., 2014) proposed vulnerability curves using the HAZUS tool (HAZUS, 1999) for risk assessment. The curves were created specifically for buildings in the US.

METHODS TO DEVELOP FRAGILITY CURVES

The fragility curves are an important tool to assess seismic risk. Every building or structure has its own fragility curve. This seismic fragility curves can be used as follows:

1. for assessing potential effects and risks, including functional and loss in economic and lives,
2. for emergency or disaster response planning, and
3. for risk mitigation efforts (retrofitting).

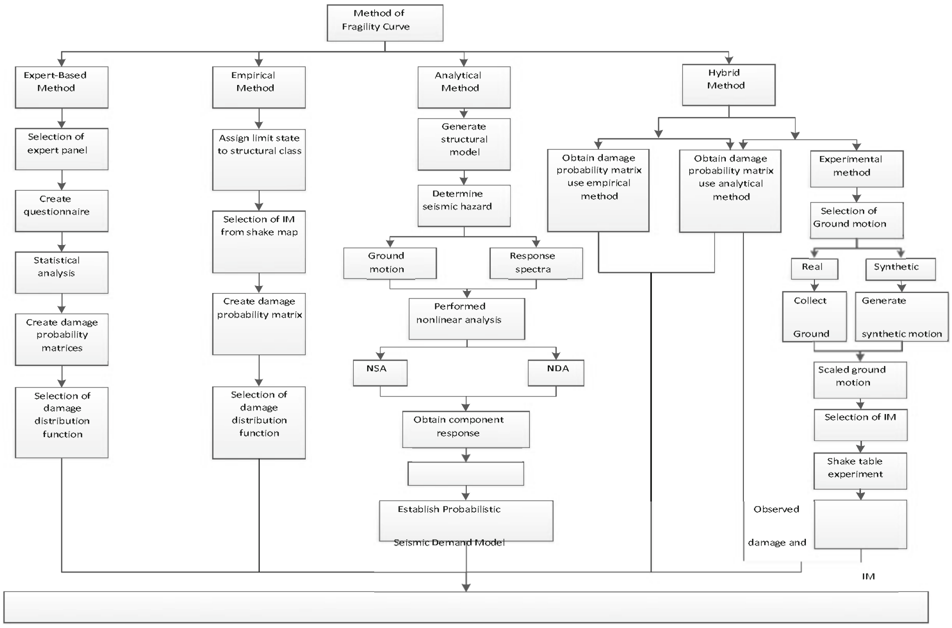

Figure 1. Available methods and procedures to develop the fragility curves (Lee & Moon, 2014).

Table 1. Advantages and disadvantages of each method (Muntasir Billah & Shahria Alam, 2015).

Method	Advantages	Disadvantages
Expert based	Simple method All factors may be included	Very subjective Totally dependent on the panel expertise Not so accurate
Empirical	Show the actual vulnerability Represent a realistic picture	Lack of data Inconsistency in damage observation
Analytical	Less biased All types of uncertainties are considering	Costly computation Takes too long
Hybrid	Considers post-earthquake data Computational effort can be reduced	Require multiple data because of combination of experimental and analytical High inconsistency in demand model

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