KEY PARAMETERS IN PRE-EVENT DATA COLLECTION FOR EMERGENCY RESPONSE AND SEISMIC LOSS ESTIMATION FOR BUILDINGS

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Abstract

This study provides a simplified methodology for pre-event data collection to support a faster and more accurate seismic loss estimation. Existing pre-event data collection frameworks are reviewed. Data gathered after the Canterbury earthquake sequences are analysed to evaluate the relative importance of different sources of building damage. Conclusions drawns are used to explore new approaches to conduct pre-event building assessment.

Potential research areas

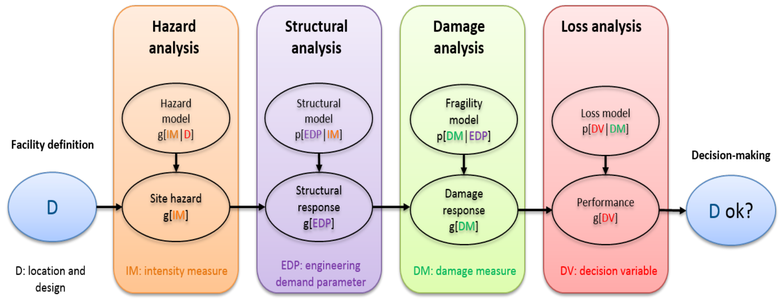
- Study the different sources driving building damage [9]
- Reduce the variation of assessments
- Simplify the building pre-evaluation technique to reduce the costs assessments
- Develop tools to convey loss estimation results for stakeholders

A simplified methodology for pre-event data collection

Background

PEER performance-based earthquake engineering approach

The PEER's Performance-Based Earthquake Engineering methodology includes four stages. The approach uses the probabilistic relationship at each of individual components to predict the likely loss for the design life of a given structure. Seismic losses are assumed to be a chain of occurrence of hazard, structural performance, fragility and decision variable. The performance of the building is typically expressed as monetized representation of the 3 D's (death, damage and downtime). The PEER methodology uniquely enables uncertainties to be taken into account at each stage of the analysis [1].



PEER analysis methodology Porter (2003)

2010-2011 Canterbury Earthquakes

Significant levels of building damage followed the Canterbury earthquakes [2]. The events brought a change to the access of insurance and growth in insurance premiums in New Zealand [3-5]. Insurance claims from the Canterbury earthquake sequence grossly exceeded previous model predictions and this highlighted the need for better seismic loss model.

Induced seismicity

There is an increase in induced seismicity worldwide from various mining and power generation operations. Anthropogenic activities bring seismic risk to regions previously not affected by natural earthquakes [6]. This has a significant impact on society and economy [7].

Current assessment of earthquake prone buildings

Since July 2017, building owners are required to conduct seismic assessment of existing buildings in New Zealand following the Technical Guidelines for Engineering Assessments (New Zealand Society for Earthquake Engineering (NZSEE), 2017) [8].

The current seismic assessment of building is safety driven and focuses on the retrofit decision. This presents a major opportunity for useful pre-event building data to be collected for an accurate seismic loss prediction.

Research focus

Review of pre-existing data collection framework

- Census of existing data collection tools in New Zealand, USA and France
- Identification and comparison of the capabilities and limitations in each framework

Collection of historical empirical earthquake damage data

- Access to data from the 2010-2011 Canterbury Earthquake Sequence
- Curation and quantitative studies of observational datasets collected

Sensitivity analysis

- Study of the different parameters causing building damage
- Identification of the factors causing uncertainty and their interaction on the total output uncertainty
- Identification of the factors influencing post-earthquake decisions on buildings and affecting insurance policies

Improvement of the seismic assessment methodology

- Comparison of empirical and analytical results in damage/fragility development
- Transferring of principles, like the Pareto principle (80/20 rule) used in fire assessment, to pre-earthquake assessment of buildings
- Predicting the damage of a complete building based on seismic damage analysis of typical storeys

Work to date

- Identified current challenges in building damage estimation
- Studied the current tools available in New Zealand, USA and France to conduct a pre-earthquake assessment on existing buildings like the Technical Guidelines for Engineering Assessments in New Zealand, FEMA P-58 in the USA, and the 'code construction' in France

Future work

- **To identify the key building parameters driving pre-event data collection**
- **To improve the process of data collection for emergency response and loss estimation**
- **To improve the methodology and tools for pre-event data collection to enable a more accurate and simple initial loss estimation in buildings**
  - Identify key building parameters for an initial seismic assessment
  - To develop a tool that enables the seismic assessment of existing buildings in France
  - To contribute to the community effort via the Global Earthquake Model (GEM)

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