LINKING BUILDING PROPERTIES TO EARTHQUAKE-INDUCED DAMAGE AND BUSINESS DOWNTIME USING FEMA P-58 AND REDI ASSESSMENTS

Gemma Cremen & Jack W. Baker
Dept. of Civil & Environmental Engineering, Stanford University, USA
Sonia Giovinazzi
Dept. of Civil & Natural Resources Engineering, University of Canterbury, New Zealand
Erica Seville
Resilient Organisations, New Zealand

1. Inputs

Building Properties
Obtained from the Christchurch Earthquake Building Assessment (CEBA) database
- Building Age
- Building Period
- Building Type and Lateral System (e.g. Reinforced Concrete Shear Wall)
- Number of stories
- Floor Footprint Area

Ground Motion
Used ground motions for the M6.2 22 February 2011 Christchurch Earthquake
Obtained for each building from Bradley (2012)

2. Calculations

FEMA P-58 & REDI Assessments
The FEMA P-58 Methodology is a probabilistic prediction methodology for evaluating building performance under earthquake loads.

The REDI framework is a resilience-based design initiative that measures building performance in terms of a modified version of the P-58 Methodology, involving a more complex repair time calculation.

3. Outputs

P-58 Repair Cost

REDI Downtime

Comparisons

The P-58 methodology appears to overestimate repair costs. However, there are significant limitations to this initial analysis, which future efforts will attempt to eliminate.

The REDI methodology generally appears to predict larger downtimes than those recorded. Future work will address this issue in more detail.

4. Benchmarks

Building Damage Benchmark
% Building Damage field of the CEBA database, collected during Building Safety Evaluation (tagging) procedures

Building Downtime Benchmark
Organisations’ Duration of Closure due to the Christchurch Earthquake, as captured in the Economics of Resilient Infrastructure (ERI) survey

Challenges with Data & Possible Strategies to overcome them

To ensure consistency of the downtime comparison metrics in particular, buildings used for the analyses should adhere to the following criteria:
- Tenant organisation does not have >1 location
- Tenant organisation did not relocate as a result of the 22 February 2011 earthquake
- Building is not located within an area that was ever within the confines of the CBD cordon

Unfortunately, there is a lack of building property and/or downtime data available for buildings that satisfy these criteria.

Possible strategies to gather such data that will be looked into in the future include:
- Visually inspecting relevant buildings to obtain building property information
- Conducting phone call interviews with tenants of relevant buildings to determine their earthquake-induced duration of closure
- Contacting Canterbury Employers’ Chamber of Commerce to collect information on appropriate tenant organisations