COST-EFFECTIVE MITIGATION STRATEGY DEVELOPMENT FOR BUILDING RELATED EARTHQUAKE RISK

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THE PRIMARY OBJECTIVE OF THIS RESEARCH IS TO DEVELOP COST-EFFECTIVE STRATEGIES TO MITIGATE DAMAGE, INJURY AND BUSINESS DISRUPTION ASSOCIATED WITH THE MOST VULNERABLE BUILDINGS IN AUSTRALIAN BUSINESS DISTRICTS TO EARTHQUAKES. THE RESEARCH WILL PROVIDE AN EVIDENCE-BASE FOR COST-EFFECTIVE RETROFIT DECISION MAKING.

WHAT IS THE PROBLEM?

Earthquake hazard has only been recognised in the design of Australian buildings since 1995. This failure has resulted in the presence of many buildings in communities that present a high risk to property, life and economic activity. These buildings also contribute the most to post-earthquake emergency management logistics and community recovery needs.

With an overall building replacement rate of 2% nationally the legacy of vulnerable building persists in all cities and predominates in many business districts of lower growth regional centers. The two most vulnerable building types that contribute disproportionately to community risk are load bearing unreinforced masonry and low ductility reinforced concrete frames.

WHY IS IT IMPORTANT?

Earthquakes can cause catastrophic impacts and losses. In contrast to New Zealand, Australia has no requirements for the retrofit of high risk building types. An impediment to this is a lack of reliable information on the true cost of severe earthquake events, the options for retrofit and the cost effectiveness of these in the context of Australian seismicity.

HOW ARE WE GOING TO SOLVE IT?

The research will involve a broad collaboration of Australian experts on earthquake vulnerability and risk. It will also draw upon existing data developed by these and other researchers on the historical performance of Australian building types in Australian and New Zealand earthquakes. Analytical modelling validated against experimental research will develop a detailed understanding of performance of a range of mitigation strategies.

PROJECT ACTIVITIES

Building stock classification

A literature review has been conducted to study seven published schemas developed in the United States, Europe, New Zealand, Australia and in support of the United Nation's Global Assessment of Risk 2015 Report (GAR15). The review identified key building attributes strongly correlated to earthquake damage.

The selected key attributes are Building *Usage, Construction Period, Proximity to Coast, Primary Lateral Load Resisting System, Storey Height Range, Wall Type, Wall Material and Roof Material*. Based on these 8 attributes a new building schema is proposed for the project.

Figure 1. Damage to reinforced concrete frame building following the 1989 Newcastle Earthquake.

Review of existing retrofit options

Existing publically available research on retrofitting of earthquake prone buildings and a review of their effectiveness in the context of historical earthquake such as the Darfield and Christchurch earthquakes will be undertaken.

Figure 2. Retrofitted unreinforced masonry building in Christchurch, New Zealand.

Development of Australian specific retrofit options

New strategies will be developed for Australian buildings and all appropriate strategies will be costed for key building types through the engagement of quantity surveying specialists. The research may also entail experimental testing of some retrofit options.

Economic loss models for business interruption and casualty costs

The non building damage related costs of severe earthquakes are large with the cost of disrupted economic activity often several times greater. Further, unlike most natural hazards, earthquake occurs without any warning and injuries caused by poor construction can be severe. Loss models will be developed to quantify these broader economic costs at the scale of major business district precincts.

Cost benefit analysis and national assessment

Retrofit options entail an investment that will be realised over future years through reduced losses. In this exercise all selected retrofit options will be assessed against a range of severities and likelihoods of earthquake ground shaking. Furthermore, utilising a nationally consistent definition of building exposure developed by Geoscience Australia an assessment will be made of national retrofit needs.

END-USERS PERSPECTIVE

The outcomes of this research will be integrated into earthquake impact and risk assessments. They will, therefore, enable a better understanding of current earthquake risk to communities, the demands on emergency management and the opportunities for reducing these.