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EDITORIAL

SEISMIC PERFORMANCE OF NON-STRUCTURAL ELEMENTS (SPONSE) AND LEARNING FROM EARTHQUAKES (LFE): NEW ZEALAND PERSPECTIVE

Rajesh P Dhakal[1]

This issue of the NZSEE Bulletin presents four papers covering diverse topics spanning into seismic performance of non-structural elements (SPONSE) and learning from earthquakes (LFE). The first paper by Haymes et al. [1] presents a practice-oriented method to generate floor displacement and acceleration response spectra for elastically responding structures. This method enables improved prediction of floor acceleration demands for acceleration sensitive non-structural components and contents provided the building period is known. Given the floor acceleration profile currently specified in NZS1170.5; i.e. the *New Zealand Loadings Standard for Earthquake Actions*, for seismic design of parts and components is crude, this paper provides useful information that can potentially help refine the guidelines related to floor acceleration demands for non-structural components and contents in buildings.

The next two papers [2, 3] in this issue present experimental investigation on seismic performance of two different drift-sensitive non-structural components. The paper by Carradine et al. [2] presents experimentally generated fragility functions for residential windows typical of New Zealand practice. Similarly, the paper by Arifin et al. [3] reports an experimental testing of a commercial glazing system using a unique test setup that can simultaneously spray water at different pressure levels and apply cyclic inter-storey drift reversals. This setup enables assessing the water resistance capacity of a glazing system in addition to its physical response to reversed cyclic inter-storey drifts. Based on the experimental results, water leakage fragility curves are developed for a common commercial glazing system used in New Zealand.

In addition to the 2016 special issue of the Bulletin on SPONSE and papers on different non-structural components published by New Zealand researchers in conferences [4-6] and journals [7-14], the first three papers in this issue provide further evidence that New Zealand researchers are among the leading contributors to the global research effort on this important topic.

Non-structural elements (NSEs) refer to secondary components of a building which include: (i) architectural elements (e.g. cladding, glazing, ornaments, ceilings, partitions etc.); (ii) building services and equipment (e.g. lifts, escalators, generators, pumps, sprinklers, HVAC, ducts and pipework, cable-trays etc.); and (iii) building contents (e.g. computers and servers, furniture, shelves etc.). Despite not contributing to either vertical or lateral resistance of the building, NSEs are necessary to make a building complete and functional. Moreover, the cost of NSEs significantly exceed the cost of structural components in a building [15].

In recent earthquakes, significant damage has been reported to NSEs [16-18], which has led to a significant financial loss in the form of repair cost and, more importantly, business interruption costs. Research has shown that financial loss due to damage to NSEs in an earthquake can be significantly more than the structural damage repair cost [19]. In additional to the direct repair cost, damage to NSEs often lead to lengthy business interruption, which can have more dire financial implications.

In New Zealand, since the bitter experience of the 2010-11 Canterbury Earthquake Sequence the awareness of importance of NSEs in buildings has significantly increased and researchers and practitioners alike have started paying greater attention to scrutinising the state of practice on design and installation of NSEs [4, 7, 20-26]. Increased impetus and greater resource allocation to improve SPONSE have led to extensive research, which helped in understanding inherent weaknesses in traditionally designed/installed NSEs [2-4, 8] and developing novel methods and technologies to design and build low-damage NSEs [10, 13, 14, 27]. Utilising the enhanced understanding of SPONSE, seismic assessment methods have also been developed for different NSEs [6, 28].

Despite all these efforts, New Zealand construction industry is still facing significant issues related to seismic design and installation of NSEs. The past poor performance of NSEs has been identified as a system failure within the industry [26]. The main reasons of this poor state are: (i) inadequate procurement/tendering practice; (ii) design guidelines inconsistent with state-of-the-knowledge; (iii) lack of coordination among different NSE-related trades; (iv) faulty installations not identified due to poor quality control; and (v) non-compliance to existing New Zealand Standards. These problems cannot be solved by improving only a single aspect of the spectrum and will need all stakeholders to work together to achieve the expected performance. Researchers and practitioners are currently working together to address these issues and I believe the industry will start reaping the benefits of these efforts in the near future.

The final paper in this issue [29] presents a summary of the building damage observed in the 2017 Puebla, Mexico earthquake. This adds to the already-rich LFE report series archived in the Bulletin over the years. In addition to the special issues of the Bulletin published on recent New Zealand earthquakes (i.e. the 2010 Darfield earthquake, 2011 Christchurch earthquake and 2016 Kaikōura earthquake), it has also published reconnaissance reports on major overseas earthquakes including the 1985 Mexico earthquake [30], 2008 Wenchuan earthquake in China [31], 2009 Padang earthquake in Indonesia [32], 2015 Gorkha earthquake in Nepal [33], 2016 Kumamoto earthquake in Japan [34, 35] and the 2016 Meinong earthquake in Taiwan [36]. Given the geological similarity between the soft lakebed in Mexico City and soft soil deposits

[1] *Editor-in-Chief, Bulletin of the NZSEE, rajesh.dhakal@canterbury.ac.nz (Fellow)*

in New Zealand cities, the ground motion characteristics and the building performance in this earthquake will be of significant interest to New Zealand earthquake engineers and seismologists. Moreover, as a large number of New Zealand buildings are being retrofitted using different technologies, the performance of buildings in Mexico that were retrofitted after the 1985 earthquake will also be of keen interest to New Zealand engineers.

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