Collapse Performance of Limited Ductile High-Strength Reinforced Concrete (HSRC) Columns in Earthquakes

Saim Raza[1,2]

[1] PhD Scholar, Department of Civil and Construction Engineering, Swinburne University of Technology, VIC [2] Bushfire and Natural Hazards CRC Associate Student Researcher; Contact: sraza@swin.edu.au

Is the capacity of high-strength reinforced concrete columns in Australian infrastructure adequate for collapse prevention in a rare or very rare earthquake event?

PROBLEM STATEMENT

- The current construction practices in Australia result in limited to moderately ductile reinforced concrete (RC) columns, which are characterized by relatively low drift capacities in contrast to ductile RC columns in regions of higher seismicity.
- Rare or very rare earthquake events in Australia may impose larger drift demands on these columns, thereby making them vulnerable to collapse.

RESEARCH OBJECTIVES

- Experimentally evaluate the collapse performance of HSRC columns representative of typical Australian construction.
- Develop a loading protocol, representative of the actual earthquake loading on the column. The loading protocol is shown in Figure 1.
- Propose a simplified model for predicting force-drift response of RC column

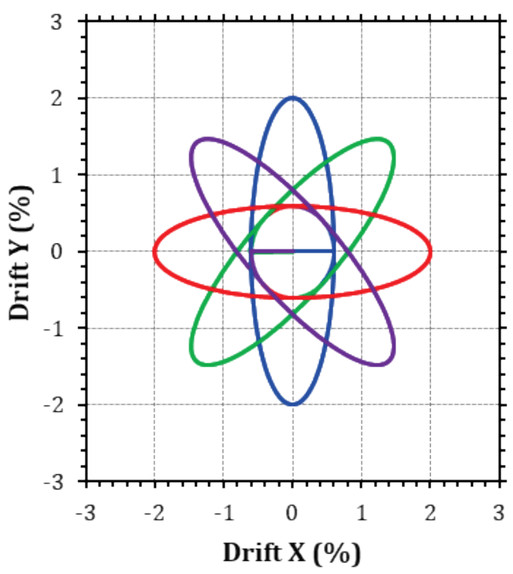

Figure 1: Proposed earthquake loading protocol

KEY RESULTS

- The results of the experiments shown in Figure 2 indicate that, while the columns supporting low to moderate axial load(n=0.15-0.3) have higher drift capacity than the minimum limit of 1.5% specified by the Australian earthquake standard, the heavily loaded columns (n=0.45) possess a very low collapse drift capacity in the order of 1.0%.

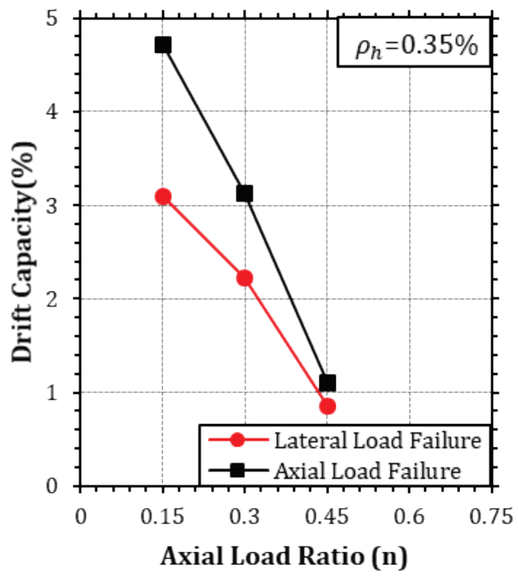

Figure 2: Reduction in drift capacity with axial load

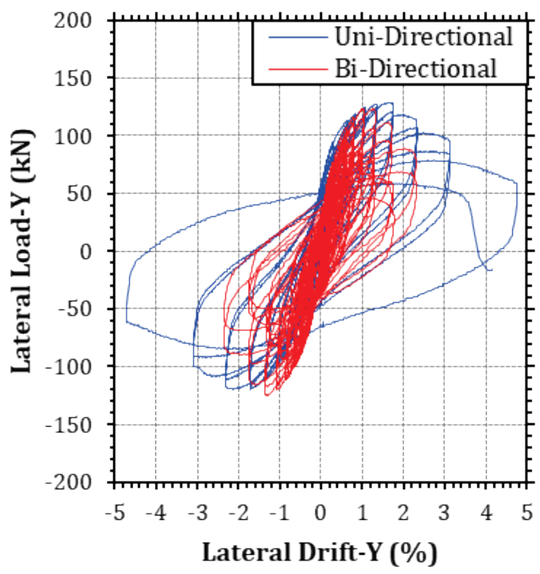

Figure 3: Load-drift behavior (uni-directional vs bi-directional)

- The displacement capacity of column reduces by 50% if the loading is bi-directional as opposed to uni-directional as shown in Figure 3. Hence, there is a need to incorporate biaxial displacement capacity of the column (which is not considered conventionally) in the analysis and design.

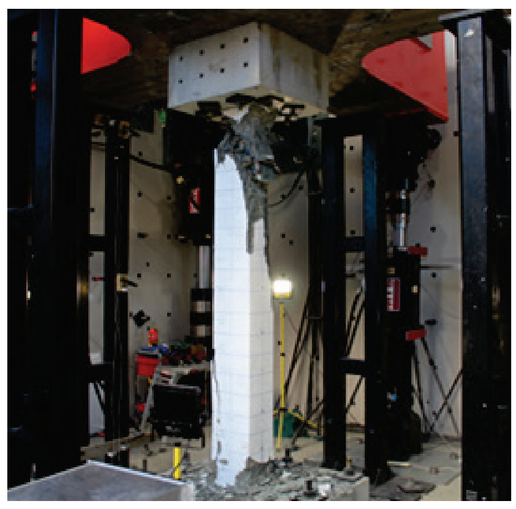

Figure 4: Column tested till collapse

END-USER PERSPECTIVES

- The findings of this project would result in the improvement of the existing seismic design procedure, which will, in turn, enhance the earthquake resilience of the infrastructure in Australia.
- The proposed force-drift model would enable structural design engineers to estimate the drift capacity of RC column with reasonable accuracy.

Australian Government
Department of Industry, Innovation and Science
Business Cooperative Research Centres Programme

Research Supervisors
Dr. Hing Ho Tsang
Prof. John Wilson
Dr. Scott Menegon