Seismic performance of concrete wall-steel frame hybrid buildings

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Objectives

- To understand and characterise existing concrete wall-steel frame hybrid buildings in New Zealand
- To quantify the performance of concrete wall-steel beam connections
- To quantify the expected seismic performance of concrete wall-steel frame hybrid buildings
Methodology

- Building review and typology
- Experimental test on connections
- Numerical modelling
Building review key findings

• Database of 50 buildings in Auckland and Christchurch

• Five building typologies

- High-rise (8+ storeys) apartment buildings with concrete walls connected with steel beams

- Mid-rise (3-5 storeys) commercial buildings with dual frame-wall systems
Connections

• 60% of the surveyed buildings had bolted connections with headed stud embedment
• Designed for gravity load only
• Assumed pinned
• Aim of experimental test: To quantify the rotation capacity of bolted beam-wall connections
Test specimens

1. Baseline specimen
2. Effect of floor starters
3. Effect of slotted holes
4. Effect of improved anchorage

Floor starters
Slotted holes
Rebar anchors
Test setup

- Full-scale
- Quasi-static cyclic loading

- 610UB113 (3.5m long)
- Slab portion (1.2m x 2.4m)
- Concrete wall (2.4m x 2.4m)
- Bolted connection
- PT bars for gravity load
- Actuator
Numerical model

- OpenSeesPy
- 2D model
- 6 storey commercial building in Christchurch
- Core and perimeter walls and steel frame
Expected outputs

- Building typology
- Validation on existing connection details, identification of possible vulnerabilities, and recommendations on improved detailing
- Design procedure for concrete wall-steel frame connections