



## STRENGTH ASSESSMENT OF TYPICAL WALL-DIAPHRAGM CONNECTIONS IN NEW ZEALAND UNREINFORCED MASONRY BUILDINGS

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### ABSTRACT

Most unreinforced masonry (URM) buildings in New Zealand consist of solid URM bearing walls and flexible timber diaphragms (floor and roof), and insufficient or absent positive anchorage between URM walls and diaphragms has previously been identified to be the most common reason for out-of-plane wall and gable failures in URM buildings during earthquakes. A series of case studies was performed to determine typical details for wall-diaphragm connections, to ensure that realistic specimens were reproduced in laboratory testing to accurately assess their strength. It was found that typical wall-diaphragm connections in New Zealand were through-bolt anchors, where one end of a threaded steel rod was bolted with a steel bearing plate at the exterior face of the URM wall and the other end was welded to a rectangular steel plate that bolted to the timber joist. This type of anchor was believed to be applied as a retrofit technique to most New Zealand URM buildings following the 1931 Hawke's Bay earthquake. In order to assess the strength and possible modes of failure of the wall-diaphragm connections, two types of testing were conducted as follows: (1) pull-out tests on URM wall with typical through-bolt anchor type; and (2) bolted timber connection tests loaded parallel to the timber grain.

**KEYWORDS:** wall-diaphragm connection, bolted timber connection, pull-out test, steel-wood-steel bolted timber connection test, unreinforced masonry structure

### INTRODUCTION

Unreinforced masonry (URM) buildings are typically the structures with the highest risk of failure during an earthquake, and the requirement to seismically upgrade these earthquake-risk buildings (ERB) in New Zealand was mandated by The Building Act 2004 [1]. Importantly, these URM buildings form a significant percentage of New Zealand's building stock and represent the predominant national architectural heritage [2, 3].