# The performance of unreinforced masonry buildings in the 2010/2011 Canterbury earthquakes

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# Part 5: Closing remarks

## Effect of duration of strong ground shaking

- Little useful data available for performance of 'NZ type' URM buildings in longer duration effects
- It is clear that URM buildings degrade and collapse with repeated cycling. Death toll could have been much higher – consider URM demolitions vs deaths
- The trend in recent decades had been for economic losses to be more prominent than death toll, but USA and NZ have not had long duration event



## Fatality comparisons

| Year | Event | Country | Magnitude | Duration (sec) | Depth (km) | Time | Deaths |
|---|---|---|---|---|---|---|---|
| 1931 | Napier | NZ | 7.9 | 150 | 20 | 10.47 | 256 |
| 1989 | Loma Prieta | USA | 6.9 | 17 | 18 | 17.54 | 63 |
| 1994 | Northridge | USA | 6.7 | 15 | 19 | 4.31 | 33 |
| 2001 | Nisqualle | USA | 6.8 | 10 | 52 | 10.54 | 0 |
| 2007 | Gisborne | NZ | 6.8 | 7 | 44 | 20.55 | 0 |
| 2009 | L'Aquila | Italy | 6.3 | 10 | 10 | 3.32 | 308 |
| 2010 | Port-au-Prince | Haiti | 7.0 | 35 | 13 | 16.53 | 316,000 |
| 2010 | Maule | Chile | 8.8 | 180 | 35 | 3.34 | 562 |
| 2010 | Darfield | NZ | 7.1 | 10 | 10 | 4.35 | 0 |
| 2011 | Christchurch | NZ | 6.3 | 7 | 5 | 12.51 | 181 |
| 2011 | Tohoku | Japan | 9.0 | 120-180 | 32 | 14.46 | 25,000 |

# Recommendations

- National rather than regional policy on earthquake strengthening
- Data supports 67%NBS as a minimum. Buildings owners need to be aware that strengthening to 33% may not greatly improve performance above that of unstrengthened building
- Joined buildings need to be treated as a whole when undertaking earthquake strengthening
- Secure all parapets, gables and chimneys to minimise falling hazard to passers-by
  - Further investigate why restrained parapets and gables performed poorly
- Greater knowledge base regarding the earthquake response of this type of building