

**WESTERN STATES SEISMIC POLICY COUNCIL  
POLICY RECOMMENDATION 18-4**

**Identification and Mitigation of Non-Ductile Concrete Buildings**

**Policy Recommendation 18-4**

WSSPC strongly encourages states, provinces, territories, First Nations, tribes, and local governments with moderate and high seismic hazards create programs to identify non-ductile concrete buildings and develop plans and policies that will effectively reduce these buildings' risks in their jurisdictions.

**Executive Summary**

Non-ductile concrete buildings represent a class of structures considered by earthquake risk managers to be particularly susceptible to significant damage and/or collapse during earthquakes, making them one of the most dangerous threats to life-safety and economic burdens for communities.

WSSPC strongly encourages jurisdictions to be proactive in reducing this threat to communities through legislatively mandated programs and/or municipally adopted ordinances.

## **Background**

Non-ductile concrete buildings are a type of construction in which the walls and columns lack enough reinforcing steel to keep them from collapsing or being damaged beyond repair during earthquakes. These buildings can pose a great threat to life in major earthquakes because, although total collapse of these buildings is rare, just one collapse could cause hundreds of deaths. Ancillary damage due to collapse might include damage to adjacent buildings, prolonged closure of adjacent streets due to cleanup and re-build operations, and loss of work place or residence to numerous persons. In California, non-ductile concrete buildings are generally considered to have been constructed before 1980 and include archaic construction methods dating back to the early 1900s. Low ductility buildings were constructed in Oregon until the mid 1990s.

The 1971 San Fernando, California earthquake caused over \$500 million in property damage in 1971 dollars (over \$3 billion in 2017 dollars) and 65 deaths, due mainly to the collapse of older concrete buildings. A recent initiative by the City of Los Angeles calls for the assessment of all non-ductile concrete buildings constructed before January 13, 1977 and mandatory retrofitting within 30 years. Santa Monica, California, currently has a non-ductile concrete building ordinance.

The failure of these building types in the 1971 San Fernando, California earthquake directly resulted in significant changes to the building codes and standards for concrete buildings. Consequently, construction standards for concrete buildings since the late 1970's have been dramatically improved helping to provide adequate collapse resistance in earthquakes.

Due to the high costs of retrofits and the infrequent occurrence of collapse, it is difficult to justify the cost-effectiveness of retrofits unless the structure is in an area of high seismicity, where the probability of failure is much higher.

This building type is a noteworthy concern since many are of significant size and contain large numbers of occupants. The Mexico City earthquake (1985), Northridge earthquake (1994), and the Great Hanshin (Kobe) earthquake (1995) in Japan, as well as the more recent Christchurch New Zealand earthquake (2011), and Mexico City earthquake (2017) all underscore the vulnerability of non-ductile reinforced concrete structures and the need to mitigate the life safety and infrastructure hazards they pose.

## References

Canterbury Earthquakes Royal Commission, 2011, The Performance of Christchurch CBD Buildings, Volume 2, Final Report, 239 p.

*[http://canterbury.royalcommission.govt.nz/vwluResources/FinalReportVol2Print/\\$file/Final\\_Report\\_Volume\\_2\\_Web.pdf](http://canterbury.royalcommission.govt.nz/vwluResources/FinalReportVol2Print/$file/Final_Report_Volume_2_Web.pdf)*

City of Santa Monica, California, 2017, Mandatory Seismic Retrofit Requirements for Existing Non-Ductile Concrete Buildings: Santa Monica Municipal Code, Building Regulations, Article 8, Chapter 8.80. *<http://www.qcode.us/codes/santamonica/>*