WESTERN STATES SEISMIC POLICY COUNCIL
POLICY RECOMMENDATION 20-4

Identification and Mitigation of Unreinforced Masonry Structures

Policy Recommendation 20-4

Unreinforced masonry bearing-wall structures represent one of the greatest life-safety threats and economic burdens to the public during damaging earthquakes. WSSPC recommends that each state, province or territory adopt a program to identify the extent of risk that unreinforced masonry structures represent in their communities and develop recommendations that will effectively address the reduction of this risk.

WSSPC recommends a three-pronged approach: developing an inventory of the seismically vulnerable buildings, analyzing the risk presented by these buildings, and prioritizing the retrofitting of those buildings posing unacceptable risks.

Executive Summary

Unreinforced masonry is recognized by the Federal Emergency Management Agency as one of the structural building types most prone to failure during an earthquake. A review of the U.S. Geological Survey Hazards Program website listing earthquakes that generated 1,000 or more deaths since 1900 shows that unreinforced walls are a significant contributing factor in losses in both the financial sector and human lives.

WSSPC strongly believes that jurisdictions must be proactive to address this threat to their citizens. Legislatively mandated programs and/or local municipally adopted ordinances have proved effective at addressing this risk.

Background

During earthquakes, unreinforced masonry (URM) structures are vulnerable to catastrophic collapse and represent a significant life safety threat. Unreinforced masonry structures are made from brick, hollow clay tile, stone, concrete block, or adobe materials that are not strengthened by the addition of steel or other reinforcement. URM buildings s are still prevalent among virtually all building types and uses including older industrial complexes, schools, mercantile establishments, churches, government buildings, office buildings, university buildings and private residences. Damage to unreinforced masonry structures can be seen in almost every earthquake without limitation to higher seismic regions. The 5.8M 2011 Mineral Virginia event, the Oklahoma swarms including a 5.6M earthquake, the 2014 6.0M Napa California earthquake and the 2001 6.8M Seattle Washington event are just a few recent examples. Even the 2011 5.3M southern Colorado earthquake caused URM damage. Severe damage to URM buildings during the 2008 6.0M Wells, Nevada earthquake prompted the initial version of this Policy Recommendation.

Also, of concern are components of these structures such as walls, unsupported parapets, and fireplace chimneys, which can fall on sidewalk pedestrians or people trying to exit a building. The masonry usually is held together with weak mortar and is unable to resist lateral forces. Wall and roof anchorage tend to be inadequate, allowing floors and roofs to separate from the walls and collapse. Historically, this type of building damage has been a major contributing factor to loss of life in earthquakes throughout the world. URM construction may also present seismic vulnerability in various lifeline sectors and critical infrastructure. Response and recovery activities in damaged unreinforced masonry buildings can involve additional risk to first and second responders.

WSSPC recognizes that there is a societal cost to the inventory and retrofit or replacement of unreinforced masonry buildings, but in areas of high seismicity, failure to address this issue will have expensive and lethal consequences. It is further recognized that resistance by owners and users of URM structures is to be expected when dealing with retroactive building ordinances. However, as can be seen by those jurisdictions that have adopted fire sprinklers retroactively, versus those that have not, even minimal remediation can yield discernible life-saving results. The International Existing Building Code Appendix Chapter 1, the American Society of Civil Engineers National Standard ASCE 41 “Seismic Evaluation and Retrofit of Existing Buildings” and retrofit concepts described in FEMA publications for unreinforced masonry structures are available; however, this in no way negates the need for building specific engineering analysis and design.

Unreinforced masonry buildings are often of historical value to the community and may even have landmark designation. Seismic rehabilitation of such structures will probably necessitate a more in-depth assessment process with detailed evaluation and testing in order to maintain the valued characteristics of the building in terms of historic preservation.

History

- Re-adopted as WSSPC Policy Recommendation 17-4 by unanimous voice vote of the WSSPC members at the April 28, 2017 WSSPC Annual Business Meeting in Oklahoma City, Oklahoma.
- Revised and re-adopted as WSSPC Policy Recommendation 14-4 by unanimous voice vote of the WSSPC members at the July 21, 2014 WSSPC Annual Business Meeting in Anchorage, Alaska.
- Revised and re-adopted as WSSPC Policy Recommendation 11-4 by unanimous vote of the WSSPC members at the April 4, 2011 WSSPC Annual Business Meeting in Boise, Idaho.
- WSSPC Policy Recommendation 17-4 was originally adopted as WSSPC Policy Recommendation 08-4 by unanimous vote of the WSSPC members at the April 22, 2008 WSSPC Annual Business Meeting in Seattle, Washington.