



# EARTH USA 2011

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**Title:**

Simple and Effective Seismic Retrofit Techniques for Earthen Masonry Buildings

**Abstract:**

Although earthquakes over historic time have destroyed uncountable earthen structures, killing and injuring hundreds of thousands people, it's only been in the last three decades that engineers and architects have investigated the types of damage and to develop simple cost-effective techniques of reinforcing these buildings in order to mitigate the great risks to people who live, work, or worship in these buildings. It is generally assumed that adobe structures are highly vulnerable to earthquake shaking. However, specific types of damage can be expected to occur, and these can and need to be addressed by simple, yet effective retrofit techniques in order to mitigate building collapse.

Field studies of seismic performance of earthen buildings have been carried out in several countries, including: Peru, Mexico, Chile, and other Latin American countries, the U.S., and Iran. In addition, shake-table tests of models have been conducted in Peru, Mexico, the U.S., and Iran, among others, duplicating several of the types of damage observed in the field. These tests have been used to study the efficacy of different reinforcing measures, generally known as stability-based retrofit techniques.

This paper presents the principles of stability-based retrofit systems for earthen buildings to:

1. Ensure structural continuity of the walls;
2. Prevent out-of-plane overturning of walls;
3. And limit relative displacement across cracks in walls.

Stability-based retrofit techniques promise to provide simple and effective life-safety measures for mitigating the vast number of deaths and injuries related to damage and collapse of earthen buildings during seismic events.