

Protecting the earthen heritage located in seismic areas

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Abstract

Throughout the world, many earthen dwellings and historical monuments are at risk because they have been built with earth, and earthen structures have consistently shown extremely poor structural behaviour during earthquakes. Every single earthquake occurring in these areas has caused unacceptable loss of life, property damage and heritage destruction. Earthquakes are recurrent and construction damage is cumulative. It is urgent, therefore, to devise low-cost, easy-to-implement seismic reinforcement systems and to make them available to the actual dwellers and to heritage conservation professionals. A group of researchers at the Pontificia Universidad Católica del Perú has been working towards that goal, especially on improving the seismic capacity of one-storey adobe structures. They have proposed construction methodologies for a seismic reinforcement system consisting of a mesh of nylon ropes that confines all earthen walls. This reinforcement system would control the wall displacements and prevent the overturning of wall portions that may occur due to seismic shaking. To validate the effectiveness of the nylon rope mesh reinforcement on two-storey adobe dwellings, shaking table tests were conducted on unreinforced and half-scale reinforced adobe models, simulating the actions of slight, moderate, and strong seismic ground shaking. These models were designed to include the main construction features of typical adobe dwellings in the Peruvian Andes. The results of the experimental tests showed that the rope mesh reinforcement system was able to preserve the structural stability of the tested reduced-scale adobe models under strong motions, thus preventing collapse. It is expected that the proposed reinforced system would also improve the seismic performance of one and two-storey adobe constructions, reducing in this way their inherent high seismic risk.