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Technological Transference Tools to Diffuse Low-Cost Earthquake Resistant Construction with Adobe in Rural Areas of the Peruvian Andes

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Abstract : In Peru, there are more than two million houses made of adobe (sun dried mud bricks) or rammed earth (35% of the total houses), in which almost 9 million people live, mainly because they cannot afford to purchase industrialized construction materials. Although adobe houses are cheap to build and thermally comfortable, their seismic performance is very poor, and they usually suffer significant damage or collapse with tragic loss of life. Therefore, over the years, researchers at the Pontifical Catholic University of Peru and other institutions have developed many reinforcement techniques as an effort to improve the structural safety of earthen houses located in seismic areas. However, most rural communities live under unacceptable seismic risk conditions because these techniques have not been adopted massively, mainly due to high cost and lack of diffusion. The nylon rope mesh reinforcement technique is simple and low-cost, and two technological transference tools have been developed to diffuse it among rural communities: 1) Scale seismic simulations using a portable shaking table have been designed to prove its effectiveness to protect adobe houses; 2) A step-by-step illustrated construction manual has been developed to guide the complete building process of a nylon rope mesh reinforced adobe house. As a study case, it was selected the district of Pullo: a small rural community in the Peruvian Andes where more than 80% of its inhabitants live in adobe houses and more than 60% are considered to live in poverty or extreme poverty conditions. The research team carried out a one-day workshop in May 2015 and a two-day workshop in September 2015. Results were positive: First, the nylon rope mesh reinforcement procedure was proven simple enough to be replicated by adults, both young and seniors, and participants handled ropes and knots easily as they use them for daily livestock activity. In addition, nylon ropes were proven highly available in the study area as they were found at two local stores in variety of color and size.. Second, the portable shaking table demonstration successfully showed the effectiveness of the nylon rope mesh reinforcement and generated interest on learning about it. On the first workshop, more than 70% of the participants were willing to formally subscribe and sign up for practical training lessons. On the second workshop, more than 80% of the participants returned the second day to receive introductory practical training. Third, community members found illustrations on the construction manual simple and friendly but the roof system illustrations led to misinterpretation so they were improved. The technological transfer tools developed in this project can be used to train rural dwellers on earthquake-resistant self-construction with adobe, which is still very common in the Peruvian Andes. This approach would allow community members to develop skills and capacities to improve safety of their households on their own, thus, mitigating their high seismic risk and preventing tragic losses. Furthermore, proper training in earthquake-resistant self-construction with adobe would prevent rural dwellers from depending on external aid after an earthquake and become agents of their own development.

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