AvH8-65
8th Alexander von Humboldt International Conference
Cusco, Peru, 12 – 16 November 2012

Case study of repairing an adobe colonial building in Cusco Peru

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Many of the historical buildings located in seismic prone areas, like Cusco Peru are built in adobe. Because the adobe as a construction material has showed a poor behavior during earthquakes, it's a great challenge for engineers to propose adequate methodologies to face this problem. This paper deals with the study case of a colonial mansion, built in the mid eighteenth century located in the influence area of the archaeological complex of Koricancha in the historical center of Cusco city.
This construction built in adobe and founded on Inca retaining walls suffered at least two important earthquakes (1950, 1985), which damaged the structure. The repairs that follow those events were in general inadequate. Many of the cracks were just covered with plaster and poor reinforcement was placed in some parts of the structure. Beside this, former tenants took even worse actions like carving walls to enlarge window openings and doors and the addition of poor quality water pipes caused leaking. All of those actions increased the vulnerability of the construction introducing important changes in its structural configuration as well as moisture in the adobe walls. This drastically decreased the strength of some of the walls leading the structure to an incipient state of collapse. The critical stage was reach on March 3, 2006 when the façade walls start falling.
As a first action, bracing was placed in all of the structure prior to the implementation of engineering studies. The National Institute of Culture (now Ministry of Culture), conduct site archaeological and architectural studies for restoration purposes. Studies of soil mechanics and structures and technical study of the dynamic behavior of the building were performed to retrofit the building. A basic study to the dynamic behavior of the building was performed with the help of a 3D dynamic FEM-program. Reinforcement alternatives were developed and analyzed in the program, from which, the most effective were chose based upon effectiveness, cost and applicability.
The selected alternatives were combined and detailed. Wood rigid diaphragms, wood collar beams and steel tensors were used as reinforcement. Due to the historical value of the building, other alternatives such as adding walls, vertical reinforcement as well as mesh, were ruled out. Because it's multidisciplinary approach, the case presented in this study could be considered representative for future studies in historical buildings located in seismic prone areas.