Seismic Vulnerability Assessment of a 17th Century Colonial Adobe Church in the Central Valley of Chile

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ABSTRACT

This paper focuses on the seismic vulnerability assessment of the San Judas Tadeo´s church in Malloa (Chile), an iconic example of Colonial Chilean architecture. This small adobe structure is a single-nave building consisting of the nave, a bell-tower located in the façade, two external wooden galleries and a number of additional units such as the sacristy, chapel, and two services areas.

The Church has survived several strong earthquakes larger than Mw>8. Besides, after the February 27th, 2010 Maule event it showed remarkable resilience due to the implementation of traditional timber retrofits inserted in the earthen walls. The use of traditional wooden devices such as bond beams, corner keys, and wooden gables, proved to be effective solutions against strong earthquakes.

Therefore, this church appears as a relevant case of the use of seismic resistant constructive techniques of the17th century colonial architecture and the study of its seismic behaviour holds great interest and relevance.

Aimed to assess the seismic vulnerabilityof the monument, a complete study of the church was carried out using a multi-level approach comprising historical research, in situ surveys, crack pattern analysis, physical and mechanical characterization of materials, and local and global structural analyses. In particular, the linear and incremental kinematic approaches with limit analysis have been employed with the aim of interpreting the local mechanisms activated during the 2010 Maule earthquake. In these models, the effect of friction of masonry-to-masonry and timber-to-masonry interfaces, as well as the limited tensile strength of masonry, was all considered.

This study results prove the general validity in the field of timberseismic retrofitting of unreinforced adobe buildings.