A review on wall-to-timber floor anchorages in URM buildings

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Abstract

Out of plane failure of unreinforced masonry walls is considered one of the most vulnerable seismic hazards in medium and high earthquake-prone regions. Efficient structural connections enable global equilibrated mechanisms, ensuring the "box-behavior". Timber floors are widely used as horizontal diaphragm in historical constructions, and their connection to the boundary walls is crucial to facilitate internal force redistribution and to restrain out of plane walls. Wall-to-floor anchorages are typical in existing historical buildings, and innovative solutions are proposed nowadays by engineers as strengthening devices. Unfortunately, they are often too invasive or unsustainable solutions, applied without reliable seismic design and evaluation through valid models.

This paper presents a literature review on the traditional and innovative wall-to-timber floor anchors used in unreinforced masonry buildings taking into account experimental works, analytical and numerical studies.

Keywords: wall-to-floor anchors; unreinforced masonry buildings; out of plane failure; state of the art.

1. Introduction

Out-of-plane (OOP) failure of unreinforced masonry (URM) walls is considered the first mode of failure and the last desirable (1), cause of catastrophic damages, as shown in past and recent seismic events (1931 M7.8 Hawke's Bay earthquake; 2009 M6.3 L'Aquila earthquake). Old masonry buildings were often built without the application of seismic concepts and practices, reacting poorly even under low and medium intensity earthquakes (2). The big variety on material types and geometry forces the analyst to study each problem as unique, considering (when possible) the experimental material properties. Without proper axial wall-to-floor connections the OOP walls (perpendicular to the direction of seismic forces) are highly vulnerable to OOP damages and failures (3). A sufficiently rigid diaphragm (relatively to structural walls) should also be connected to lateral in-plane (IP) walls (parallel to the direction of seismic forces) through

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