University of Pisa

Department of Civil and Industrial Engineering

School of Civil Engineering

Master of Science in Building and Structural Engineering

Master's Degree Thesis

Linear Analyses Options for the Seismic Assessment of Automated Multi-Depth Warehouse

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Abstract

Automated Rack Supported Warehouses (ARSWs) represent the future of storage technology. They offer some advantages compared to non-automated conventional Steel Racks built and employed thus far in the field. However, the seismic behaviour of Automated Rack Supported Warehouses is not well understood, owing to the lack of relevant research and the structural complexity.

Past ARSWs collapses, due to earthquakes, evidenced fragile collapse mechanisms of ARSWs. In addition, studies about ARSWs' seismic behaviour proved low levels of ductility and overstrength of ARSWs. These observations suggest investigating the seismic behaviour of these structures through linear analyses. Whereas, ARSWs non-linear analyses may involve extreme computational commitment and provide incoherent results. To better understand the behaviour of these complex structures a single Multi-Depth ARSW, designed for moderate seismicity, is modelled in detail and assessed. The seismic behaviour of the structure is investigated through 2D Modal Response Spectrum Analysis and 2D Time History Dynamic Linear Analysis.

However, as expected, both sets of results show that brittle failures dominate the structure response under seismic loads. In addition, an unsuitable strength of some base plates makes the structure inadequate to withstand to seismic action. Therefore, a new structural solution is proposed, by selectively strengthening base plates, in order to provide enough strength to withstand to seismic action and then, to enhance the seismic performances of the Multi-Depth ARSW.

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