

Structural hyper-resisting element for life threatening earthquake risk

Summary

The objectives of this thesis have been defined along with the purposes of the SHELTER project targeting studying and developing an inventive solution called SHELTER as a lifeguard inside a vulnerable building to seismic activities. During an earthquake, these structural vulnerabilities such as ductility and strength deficiencies against large sudden movements cause a moderate to extensive collapse in these building types. Therefore, strengthening techniques for improving these building behaviours, their maintenance, as well as saving people's lives are crucial. These methods are not at hand because of conundrums such as financial budgets, the consent of all building residents, lack of comprehensive plans, etc.

The SHELTER package is a proper approach for mitigating the risk to these building occupants for the time gap between the preparation of a long-term plan for the rehabilitation strategy and all buildings becoming reinforced or even after having strengthened structures. Besides a robust steel structure, low expected cost, fast, low intervention and architectural compatibility can be mentioned as properties of this under-developing solution compared to the strengthening techniques.

The structure of the SHELTER unit, whether when the SHELTER is installed on the lower floors or the upper ones, has been designed for different worst-case scenarios that may occur during the building collapse in an earthquake. In addition to the strong SHELTER structure, a safety chair is designed to reduce the impact force on the people inside the SHELTER falling from a higher altitude. An on-site Earthquake Early Warning System is also included in this unit that can notify residents about imminent earthquakes to reach themselves to the SHELTER. Since the time between a destructive earthquake event and the rescue team's arrival to the confined people inside the SHELTER may take longer, requisites and emergency items for several days, for example, different types of canned food, water, entertainment devices, etc., are considered to be placed in the areas between the frames for survivors waiting for help. The path to reaching the objectives of this project and this thesis involve different numerical analyses and experimental campaigns, such as static tests, shaking table experiments and others, on different parts of the SHELTER component.

Keywords

Seismic-prone zone, shelter, life guard, Catalan vaulting, innovative solution, building vulnerability.



Schematic view of SHELTER (Structural Hyper-resisting Element for Life Threatening Earthquake Risk) with a safety chair and a dummy.



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