

Abstract

Modernized standards and the latest advancements are the basics needed for planning and building multi-story buildings with timber. It is a great achievement of modern timber structural engineers to calculate the lateral rigidity of timber structures with respect to wind and earthquakes without resorting to the use of steel or concrete structures. Earthquake design is an important aspect in the structural analysis of multi-story timber buildings. Actual research and experience show that the danger of seismic activity in Switzerland has long been underestimated. It has been proven that in an occurrence of a strong earthquake enormous damage is caused to structures and a loss of lives must also be taken into account.

PIRMIN JUNG GmbH has recognized the importance of this topic. Its aim is to extend its lead in this new field of earthquake design procedures.

Current standards are treating this designing aspect in a different and even stronger view than before; however, there are still great gaps in timber specific designing applications. The aim of this thesis is to produce a dossier, which provides the employees of PIRMIN JUNG GmbH with detailed information about earthquake-safe timber construction techniques. The basic knowledge, generated in the thesis of Niklaus Wirz in 2007, has been further delved into in order to boost the sensibilities of the engineering team PIRMIN JUNG. This thesis should make it possible, with the use of various aids, to design and calculate earthquake compatible timber structures.

The literature, together with Niklaus Wirz's thesis and the drafts of the Lignatec 2009, focus on the basic fundamentals relating to earthquake themes and lateral rigidities of buildings. The development and programming of electronic tables were the key points in the complex calculations. Parameter studies and a prime example, as well as various aids for pre-calculations were developed.

Differentiated analysis by means of a sensitivity analysis of the prime example shows how sensitive changes in location and the building characteristics react in an earthquake. A decisive role is played by the parameters of the building ground, as well as the ductile behaviour of the structure itself. Earthquake zones and building ground classifications can be redundant factors. The leading impact must, in practice, be discussed from case to case. While low buildings typically generate higher forces in an earthquake, wind is often the leading impact on buildings with more than three stories. The calculation of capacity is increasing in importance with the background of the ductile behaviour of buildings. In this thesis, appropriate procedures are shown with which in the pre-calculation phase, brittle and formable structures are coordinated. Complex and interactive calculation procedures, which are necessary for the structural analysis, are supported through electronic tables.

The applications of standards related to multi-story timber constructions are very complicated and are in various points unsatisfactory. In particular, the importance of the calculation of capacity and the accurate identification of the basic frequency are inadequately examined. With this dossier and the electronic tables the engineers from PIRMIN JUNG have a tool to calculate and design an earthquake compatible structure without generating significant added costs.