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Abstract diploma work:
Earthquake design and cross bracing of multistorey timber buildings

(Original in German: «Erdbebenbemessung und Aussteifung mehrgeschossiger Gebäude in Holzbauweise»)

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In the Swiss Alps and foothills of the Alps, as well as in the area of the Rhein valley, regular earthquake activities are recorded. The past has shown that even in Switzerland earthquakes of middle to high magnitudes can be expected. Until recently, the earthquake safety precautions in timber construction were barely considered. Partly out of ignorance or generated out of the opinion, that in an earthquake, the behaviour of timber structures is generally favourable which makes the designing unnecessary. With the trend of designing multi storey buildings, a change in thinking has occurred.

Today, earthquake design and dimensioning is an important part of the structural analysis of multi storey timber buildings. The main feature of these calculations is to detect the basic frequency of the building. The dynamics of the structure can be approximately identified, in using the basic frequency of the building and taking into account the various foundation soil compositions. The close investigation of earthquake phenomena shows clearly that the effects of this natural occurrence are influenced by many factors.

Basic knowledge of this topic enables the timber construction engineer to recognize the important factors and help therefore to improve the understanding of the effects of the earthquake event. The earthquake safety precautions of the building mainly depend on the quality of the draft concept. The design of the timber structure, its details, connectors and anchors are of special significance.

The close cooperation of architect and timber engineer in the preliminary draft can guarantee a multi storey structure with an optimal utilisations comfort and safety. The lateral rigidity of multi storey timber buildings is primarily generated by constructing shear panels in walls and ceilings.

The comparison of various wall and ceiling systems clarifies that horizontal rigidities of these different systems differ in a great manner. Load bearing timber panel walls, are appropriate in areas of frequent earthquake activity, as they have an optimal ductile behaviour.

In an event of an earthquake the behaviour of such building elements is very complex, however, this phenomena can be explained through various mathematical calculative methods. The Rayleigh mathematical method is very suitable for the identification of the basic frequency. The calculations are extensive, however the precise dynamic analysis finally leads to better assumptions for the dimensioning of the structure in case of an earthquake. Modelling the structure with a software program is quite difficult especially for timber walls planked with a panel. By calculating an alternative stiffness, it is possible to build a realistic equivalent system. The structural analysis is thereby simplified.

By modelling such systems in 3D, the response spectrum method can be used for the analysis. The advantage of the response spectrum method is, that the earthquake action is not confined to be determined by using the basic frequency, but can be generated directly within the calculations of the design spectrum.

With the response spectrum method, even complex systems with asymmetrical structures can be dimensioned where the application of the usual equivalent force method is obsolete. In this thesis, the main aspects in the special field of earthquake dimensioning are shown. It shows a sensible approach for a realistic structural analysis of multi storey timber buildings in earthquakes.