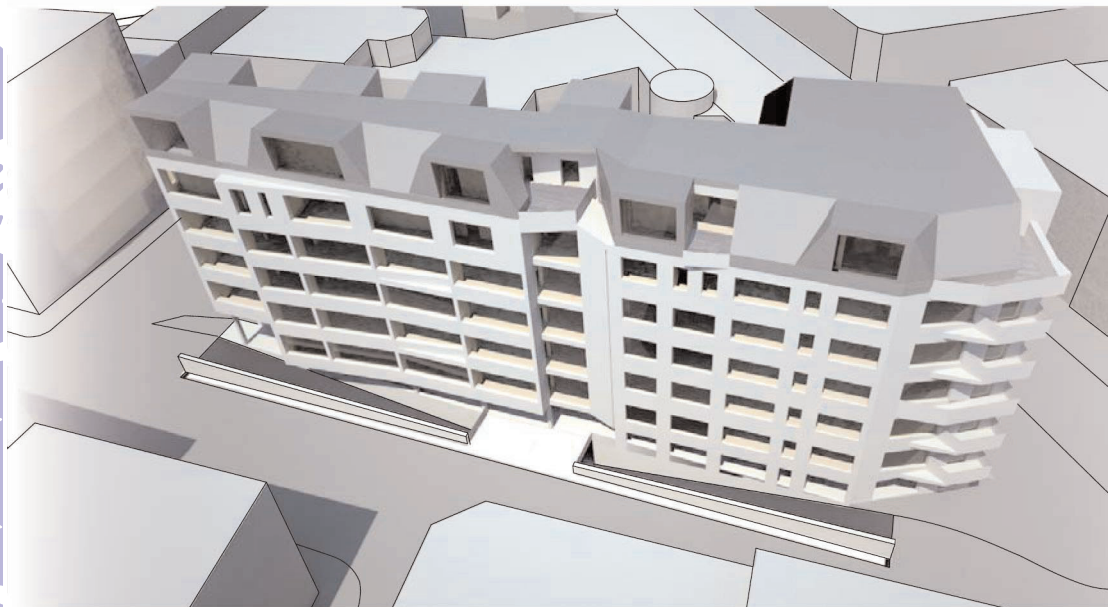


# Feasibility Analysis of Seven-Storeyed Timber Houses

Abridged Report



# **Feasibility Analysis of Seven-Storeyed Timber Houses**

## **Abridged Report**

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**Sponsored by the Municipal Department No. 50 of the City of Vienna**

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## 1. Objective

Over the course of the last few years the use of timber as building material increasingly gained in importance because of its many advantages. In 2001, the building regulations of Vienna were modified to allow the construction of multi-storied timber houses with up to five storeys, provided that the supporting elements for the ground floor are made of mineral materials. With regard to the construction of multi-storied residential buildings in Vienna these construction methods were groundbreaking. The City of Vienna has put emphasis on timber constructions in public housing by organizing a project competition for property developers. At the same time the first six-storied timber house „Holzhausen“ was realised in Switzerland.

The objective of the research project was to find solutions for the construction of a seven-storied timber house in compliance with construction regulations in Vienna. The legal basis for this analysis is the draft of the new building regulations of the City of Vienna which draw from directives of the Austrian Institute of Construction Engineering OIB (directive 2 on fire protection). The structural components of buildings with up to seven storeys (building class 5) are required to have a fire resistance of 90 minutes and, in addition, need to be composed of building materials with at least class A2 fire performance according to EN 13502-1. However, OIB directive 2 also notes that these requirements may not necessarily apply if there is solid proof of measures that guarantee equivalent protection. Two possible measures for compensation were compiled in the course of this analysis – one is based on structural measures and the other on measures in installation engineering. These solutions form the basis for further discussion and can not be seen as general compensatory measures in the construction of timber houses in building class 5.

The building authority was represented by Mrs DI Irmgard Eder (head of Municipal Department No. 37 – division B), Mr. DI Frank Peter advised us as expert for fire protection and Mr. Univ. Prof. DI DI Wolfgang Winter as expert for timber construction.

## 2. Problem

In the last few years numerous multi-storied timber houses were built in the urban areas of Vienna. The City of Vienna has been promoting timber construction in residential building with a project competition for property developers in the course of which 250 flats in 15 high-quality multi-storied timber buildings were realised giving fresh a impetus to the European timber industry. The current building regulations specifically prohibit the construction of six and seven-storied timber houses in Vienna. However, as mentioned above, OIB directive 2 allows for requirements to be compensated with alternative measures.

## 3. Methods

A comparative study of fire protection regulations for multi-storied timber houses in Germany, Switzerland, Sweden and OIB directives in Austria forms the basis of this analysis. Two compensatory measures for the use of timber elements in class 5 buildings are discussed on the basis of a fictitious project for a mixed use corner building with seven storeys on a city centre location.

The first meeting included a basic discussion of the possibilities and risks of timber houses in urban areas and a presentation of current research projects. The following meetings were dedicated to the compilation and discussion of two different fire protection scenarios. In addition, detailed drawings of the joints were developed.

In the course of these meetings a sound foundation of trust between the partners was established. A close cooperation of the building authority, the fire brigade and the timber engineers is important to increase the use of timber in the construction of multi-storied buildings in urban areas.

#### **4. Discussion and Outlook**

The analysis on hand discusses two alternative measures to compensate the level of fire protection in class 5 buildings as required by OIB directive 2. These compensatory measures cannot be applied in general. The building authority has to be consulted in each individual case and specific proof of adequate fire protection is required.

Both measures in discussion prevent the ignition of the timber construction either by the means of structural arrangements or sprinkler systems. The equivalent fire duration was calculated according to EN 1991-1-2. Thus the fire load density of each fire area compares to the fire load of the structural elements on the basis of an ISO-fire curve. Fraction values of 80% as in EN 1991-1-2 were assumed for the fire load, which in comparative studies is considered quite conservative, especially for residential buildings. The calculated equivalent fire durations need to be lower than the so-called 'K-criterion' (criterion of fire protection planking). This criterion expresses the amount of time that passes before the protected timber construction catches fire. According to these calculations fire protection planking that delays ignition for 30 minutes (K-30 planking) is adequate for the project in spite of the high fire load. As classification reports of constructions with K-30 planking have not yet been compiled, the proposed solution of using 15 mm thick gypsum fibre boards is considered very conservative. The data in the analysis was not only compiled with regard to fire protection requirements but also other requirements of building physics such as sound insulation and protection against moisture. The second compensatory measure uses sprinkler systems for fire control. With this measure the fire load of the timber construction has no effect on fire development.

The significance of the fire load of timber constructions in natural fires in particular with respect to the amount of available oxygen has to be analysed in other research projects

In order to fully implement the proposed measures quality assurance during planning procedures and construction, such as it is required in Switzerland and Germany, is reasonable. In addition, prospective residents have to be introduced to the special properties of the building so as to prevent any possible damage to the fire protection planking.

The discussions with the representatives of the building authority and the fire brigade confirmed the importance of an open exchange of views in order to establish mutual understanding. The representatives of the timber industry have to be aware of the doubts of the fire brigade and the building authority and need to understand the risks they see. This cooperation forms the basis for further objective discussions which are necessary to promote the safe use of timber constructions in class 5 buildings and to increase the general use of timber as building material in urban areas.