

ETH zürich



ETH House of Natural Resources

Modern timber construction: Office building and research lab



Winner of Schweighofer Award 2015

IBK - Institute of Structural Engineering

Post-tensioned timber frame using hardwood

At ETH Zurich, a new very effective post-tensioned timber frame structure using hardwood was developed.

From research into practice In 2010, a project to develop a new post-tensioned timber frame structure has started at the Institute of Structural Engineering (IBK).

The beam-column connection using glued-laminated timber impresses with a high controlled quality and a fast on-site erection due to the simple design of the system. It shows the great potential of post-tensioned timber frames in particular for multi-storey timber buildings.

Fast and flexible construction Columns and beams are prefabricated. The post-tensioning is done on-site.

The result is an efficient connection which automatically centres itself.



Construction of the pre-stressed timber frame

The post-tensioned timber frame has been successfully implemented in the top two storeys of the *ETH House of Natural Resources* and forms the framework for the floor elements. The construction is – apart from the steel tendon to apply the prestressing – realised without any metallic fasteners in the connection. An extension of the structure **to add additional storeys upwards is possible.**

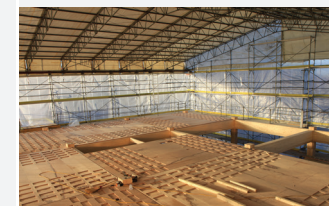
Hybrid floor system using beech and concrete

The new floor system was realised in a timber-concrete composite system using the excellent material properties of beech laminated veneer lumber.

Innovative designs with beech Beech has fantastic mechanical material properties, but is nowadays typically used for energy production and furniture making. In order to support the use of beech as a building material, the development of innovative structures and novel applications for beech is necessary.

structural components using beech laminated veneer lumber (LVL).

The timber-concrete composite floor system uses beech LVL as formwork during the construction and reinforcement when it is in service. Additionally, a visibly appealing slab underside is achieved.



Construction of hybrid floor

At the Institute of Structural Engineering of ETH Zurich, a comprehensive research project has been initiated to develop new

The composite slab is designed to have a ductile structural behaviour; a property that appreciates every engineer.

In addition to the impressive mechanical and practical building properties, the composite slab is ecological and also economical (price) competitive.

Map of

Campus ETH Hönggerberg, Zurich



■ ETH House of Natural Resources

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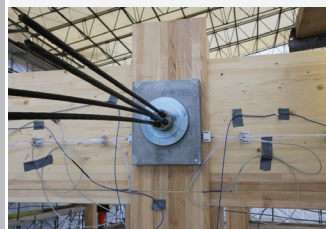
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Monitoring and dynamic tests

The comprehensive measuring system serves to detect the behaviour of the building over a period of several years.

Each movement is documented In the *ETH House of Natural Resources* a dense sensor network has been installed to detect the behaviour of the structure during construction and operation.

For example, 16 load cells were installed to monitor the prestressing force in each tendon of the post-tensioned timber frame construction.



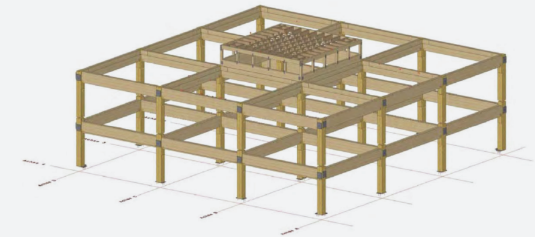
Monitoring during construction

In addition, optical strain measurement systems were installed, which record the strain distribution in the timber frame in the long term.

Recorded data improves design models The composite slab is monitored by measuring the relative displacement between the beech LVL plate and the concrete plate. The absolute deformations of the entire building are further recorded with a tachymeter.

Recorded data is used to develop new design models and constantly improve existing design models.

Questions & Answers Advantages & Arguments



Timber frame structure of *ETH House of Natural Resources*

Why building like that?

Wood is a renewable, particularly sustainable and locally available building material. The high degree of prefabrication ensures a high quality and a fast on-site erection.

Who is interested in this structure?

Innovative, modern builders and investors who are planning an office or residential building or topping up of existing buildings.

Who can build like that?

Contact us if you are interested to realise your building as an innovative and eco-friendly timber system.

What does it cost?

The construction of the *ETH House of Natural Resources* and the extensive monitoring of the innovative building systems leads to accurate in-depth information of the structural behaviour. Experience shows that the timber-concrete composite floor and the post-tensioned timber frame are competitive with conventional construction systems.

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