

# Long Span Wooden Structural Beams Assembled with Four Meter long Timbers using Japanese Traditional Connections

## Takeshi ASAKAWA

Senior Structural Engineer  
Nikken Sekkei Ltd.  
Tokyo, Japan  
[asakawa@nikken.co.jp](mailto:asakawa@nikken.co.jp)

Takeshi ASAKAWA, born in 1969  
received his Master of Architectural  
Engineering degree from the  
University of Kyoto

## Toshihiko KOUNO

Chief Structural Engineer  
Nikken Sekkei Ltd.  
Tokyo, Japan  
[kounot@nikken.co.jp](mailto:kounot@nikken.co.jp)

Toshihiko KOUNO, born in 1957  
received his Master of Architectural  
Engineering degree from the  
University of Tokyo

## Summary

“Wooden Hall” is an office building in Tokyo Japan with a signature column-free hall on the top floor covered by a 25 meter long span wooden roof. The wooden roof consists of several wooden structural beams. The wooden structural beams are assembled with four meter long timbers using traditional Japanese connections. While the connections are quite complicated, they have been fabricated mechanically and quickly at a sawing factory of timber using modern technology. The species of the four meter timbers is Japanese cypress and the connection details use evergreen oak. The details used in this project have been substantiated using material tests, connection tests, bending and shearing experiments (full scale), creep experiments (full scale) and fire resistance verification. In addition, this wooden structure is more ecological than a typical steel or reinforced concrete structure helping Japan achieve our goal of a 25% reduction in CO<sub>2</sub> emissions.

**Keywords:** office building; wooden structure; wooden structural beam; hybrid structure; creep; full scale experiment; fire resistance verification; CO<sub>2</sub> emissions

## 1 . Design concept and plan of this project

### 1.1 The background of this project and design concept

In Japan, wooden structures have been used since ancient times. Today, traditional buildings such as temples and shrines as well as many detached houses are constructed of wood. However, since the 20th century reinforced concrete structures and steel structures have replaced wooden structures. Especially in cities wooden structures are generally not permitted by the Japanese building code because buildings in cities must be designed to resist fire. Therefore most building's main structural system consists of fire resistive materials such as reinforced concrete or steel.

Nowadays, due to the desire to preserve our environment, reduce CO<sub>2</sub> emissions, and revitalize the forest industry in Japan, wooden structures are being reconsidered.

Our client, the Tokyo Cooperative Society for Wholesalers of Wood, requested NIKKEN to design a wooden office building in order to explore effective new uses of wood, explore new possible wooden construction methods, and to revitalize Japan's industry of forestry.

The client requested the following 3 concepts.

- [1] This building has to become an experimental place to advance the widespread use of wood in urban architecture.
- [2] Wood must be used as part of the structure, exterior façade, and interior design with the goal of making the use of wood more widespread in urban architecture while achieving a non-combustible and safe building.
- [3] The wide hall on the top floor has to be covered by a roof embracing the new possibilities of wooden construction.