State of the art and future trends in timber-house technologies in Slovenia and Sweden

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Tradition - a proof of the craftsmanship of woodmasters

Different traditional types of wooden houses

Paying attention to the tradition of construction in the planning of the new, improved and modern is the only path towards preserving a nation’s culture and the features of the cultural landscape.

- Farmstead in Gorenjska, SI
- Stave church Grandhult church, Småland, S

Traditional Swedish house | Falun red, S

Wooden shipard house, Velika planina, SI
Frame-Panel construction

Dominant methods of timber construction

Mölle by the sea, Mölle, Sweden, 2013

Realisation

Nominated for Swedish Timber Prize "Träpriset", 2016

Timber gird

Insulation material inserted between the studs

Vertical stud

Sheathing board

Faced inside with gypsum- or wood-based panel materials

Staples
Solid Timber Construction (SCT)

Innovation based on tradition

load transfer

bar-like (parallel to grain)
timber bar construction (especially in Scandinavia)
stave church

bar-like (perp. to grain)
timber log construction (especially in Alpine Space)
chalet

slab-like (interaction of “parallel” and “perp.” to grain)
Solid Timber Construction with CLT
detached house Jeitler

text:

vertical + horizontal = Cross Laminated Timber (CLT) [rigidly connected]

Source: Prof. G. Schickhofer | Institute of Timber Engineering and Wood Technology | Graz University of Technology: CLT Forum 2013 in Tokyo
CLT for supporting framework

Solid laminated wood panels are: ‘... the concrete of the 21st century.’ Michael Green Architect (2012)

Gerhard Schickhofer, Institute of Timber Engineering and Wood Technology, TU Graz

Re-organisation | shifting market shares → concrete | CLT

- CLT is not competing with current | past timber engineering
- ... but substitutes mineral based building products like masonry or reinforced concrete

→ CLT, ... „the better alternative“

- > 35 production sites worldwide
- 95% of production volume in Central Europe
- 1 Mio. m³ expected till 2015

Global production of CLT 1995-2015:
35 production sites worldwide
95% of production volume in Central Europe:
Austria 65%, Germany 26%, Switzerland 6%
1 Mio. m³ of production potential worldwide can be expected at latest of 2015

The wooden form of Waugh Thistleton's Murray Grove, London
Off site prefabrication

The trend toward a higher degree of prefabrication

Examples of off-site prefabrication: a building with prefabricated panels or modules is faster, less weather dependent and provides better control over costs.

Far more common today is the prefabrication of various components: off-site building, which is regarded and accepted as a high-qualitative and less expensive production method.

Prefabricated modules for single familyhouse are assembled on-site.

Prefabricated window is assembled on-site.

www.trabyggnadskansliet.se

www.marles.com/hise/en
Modular system

Prefabricated components of wood

Working with modular systems is a huge help, since it is difficult to design traditionally and then translate the design to an industrial context.

Camp Wildalpen, Camp Passail

Source: “Holzbox”
Foto: W. Luttenberger

Camp Wildalpen, Camp Passail
Spatial cells Residential appartments Skagersvägen

*Stockholm*

Long facade in innovative modules

To achieve the unbroken vertical lines that run up the facade, the architect designed the cladding piece by piece.

**Type of building** | residential, 33 appartments  
**Location** | Skagersvägen 22-26, Årsta, Stockholm  
**Building year** | December 2013  
**Architect** | OWC Björn Ahrenby, Joan Anguita, Anna Montagut  
**Construction company** | Moelven (Moelven's modular system)  
**www.martinsons.se**  
**Construction description** | 112 box units built around a spruce frame - prefabricated modules  
**Energy performance** | energyclass: low-energy  
**Area** | 4817 m²  
**Number of floors** | 3 floors  
**Fasad** | untreated ceder wood panel  
**Owner of the building** | Åke Sundvall Projekt AB  
**Price** | The Nominated for the 2016 Swedish Timber Price
Fabricated large-scale façade wooden moduls

Thermal modernisation

Key technologies

- Solar façade
- Pre-fabrication of façade modules
- Energy concept based on renewable energy sources
- New heating- and DHW supply system installed between the façade and existing wall
- Decentralized ventilation systems with heat recovery
- Control and remote maintenance via internet
Additional stories or extensions to roof

Timber - great potential for modernizing older buildings

Effective additional floors of CLT

Martinsons’ construction system in glulam and CLT offers unique possibilities for additional floors to existing buildings. Thanks to the construction parts’ strength compared to their low weight, additional floors can be made without expensive and time-consuming frame reinforcements which are often required with the use of other materials.
Present stage and future suggestions for multi-storey buildings

Wooden Sky Scrapers

→ **1995-2005** 3 - 5 storey buildings in several European countries, i.e. 4 - 5 storey buildings in Sweden (Växjö, Uppfinnar)

→ **2008** 8 - storey condominiums in Växjö, Sweden

→ **2009** 9 - storey condominiums in London, UK

→ **2011** 7 - storey multy-family house in Berlin, Germany

→ **2012** 8 - storey condominium in Bad Aibling, Germany

→ **2013** 9 - storey apartment building, Milano, Italy

→ **2013** 10 - storey building in Melbourne, Australia

→ **2013** 14-storey apartment building, Bergen, Norway

→ **2020 ??** 30 - storey building proposed for Canada

→ **2025 ??** 34 - storey building proposed for Stockholm, Sweden

? 80-storey building, London, UK
Development and implementation of timber construction

*in multi-storey buildings is on different levels in different European countries*

- renewable and available locally
- beautiful, sensuous and has superb technical characteristic,
- timber construction leads the way in terms of energy-efficient building,
- timber construction because of its efficient use of both resources and money.

Attitudes towards wood construction

*The next generation of wood-based construction*

The specific issues of concern in wood construction projects and include:

- fire requirements
- sound proofing
- the cost of facade maintenance
- installations
- weather protection.
Future trends: Free form structures

Production with minimum tolerances and maximum flexibility

The development potential and obstacles in multi-storey building

Digital design and production using CAE (computer-aided engineering), CAD (computer-aided design) and CAM (computer-aided manufacturing) have allowed timber construction to forge ahead into new dimensions of design. Innovative connections, modern wood-based materials and cutting-edge CNC milling offer entirely new possibilities and shape wood into almost any conceivable form.
He quickly became fascinated, however, with the remarkable adaptability of concrete, and with its sculptural and structural potential. Concrete’s ability to take any shape and to be enhanced by the surfaces of various molding forms entranced Le Corbusier.
Le Corbusier turned his attention to the tactile expressiveness of concrete, which could evoke both a primitive purity, and enable buildings to be built on a much grander scale than before.
The architects are talking about:

„Combination of visible wood, digital design and advanced processing“

In contemporary timber structural architecture, the structure remains visible. The structure is the dominant factor of the architectural expression, and is often based on the principles of nature. It shows a perfect match for timber and its variety of advanced possibilities.

We can reach it with: combination of
digital design and
CNC processing
New dimensions in complexity in timber construction
Combination of visible wood, digital design and advanced processing

Developing the geometry, designing the supporting framework and generating production data are all decentralized, yet interconnected, processes. An integrated exchange of data with clearly defined interfaces makes seamless project management possible.

organise
optimaze
simplify
materialize

Curved timber framing holds up a membrane of translucent material and a pattern of wooden crosses.
Kilden Performing Arts Centre

Kristiansand, Norway

Architectural expression for the edifice represents the functionality and sustainability of the local area while also serving as a landmark piece for the entire city.
Tamedia office building

5-storey building in Zürich, Switzerland

Office building
Location | Zurich, Switzerland
Year of construction | 2014
Architect | Shigeru Bahn Architects
Construction description | structural system made entirely of timber, with no metal connectors
Energy performance | energy class: low-energy
Number of floors | 6
Area | 10,120 m²
Japanese architect Shigeru Ban has revealed his competition-winning design for a campus of timber buildings to house the headquarters of watch brands Swatch and Omega in Biel, Switzerland.
The Yeoju golf clubhouse

5-storey building in Zürich, Switzerland

**Sport, leisure building**

Location | Yeoju, Korea
Year of construction | 2010
Architect | Shigeru Ban Architects
Area | 16,000 m² facility
Number of floors | 3 floors
Prize | 2014 Pritzker Prize

The roof over the main building measures 36 x 72 m

Inspirational timber projects
Non-Standard Architecture in wood

*Digital Crafting*

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<th>Non-Standard Architecture</th>
<th>Requires Integration</th>
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<td>100% Systematisation</td>
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<th>Large Scale Architecture</th>
<th>Requires Rationalisation</th>
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As an architect, you design for the present, with an awareness of the past, for a future which is essentially unknown. *N. Foster*
Conclusion

We see opportunities for further development and future trends in:

- High prefabrication as a basic principle,
- Modular building,
- Partnership and increased responsibilities for planning and construction,
- Improved and systematic feedback of experiences,
- Demonstration projects are vital, Team cooperation
- Communication development (interdisciplinary)
- Looking for a new material practice in timber architecture
Architects work like that...

*Laval Universite, Ecole d’architecture, Canada*
Architects work like that...

Columbia University Graduate School of Architecture, Planning and Preservation
Architects work like that...

*Royal Academy of Art Copenhagen, Architecture Programme*
Architects work like that...

Laval Universite, Ecole d’architecture, Canada
Architects work like that...
Architects work like that...

TU Graz, Austria | Institut für Holzbau und Holztechnologie, Faculty of Architecture
We communicate with models

*Timber construction. Wood furniture*
Wood Scientist work like that ...

OSU, Wood Science & Engineering
Cooperation starts in workshop/lab

*Oak Creek Building, 1954*
We have the same goals
*Furniture industry* and *Wood construction sector*

And we need to learn how to achieve them
The Rant House
Škofja Loka

Residential building
Year | 2013
Architecture | prof. Janez Koželj, Tina Ruper Kobe, Blaž Ruper
Architectural firm | 3BIRO, Janez Koželj s.p.
Structural engineer | CBD d.o.o.
Energy efficiency | low-energy
25 kWh/(m²a)
Surface | 184 m²
Site area | 800 m²
U-value (W/m²K) | wall 0.25, roof 0.20, glass 1.10
Construction system | timber-frame, solid timber construction
Construction company | Lamo d.o.o.
Construction time | 1 year
House technique | comfort ventilation with heat recovery, floor heating system, rain water collector
State of the art and future trends in timber-house technologies in Slovenia and Sweden

Future work- book

BiH, Slovenia, Sweden

53% BiH

60% Slovenia

75% Sweden
Future work

Why wood? Wood is sustainable. It's a renewable resource.

1. The Perception of Innovative Engineer Wood Products (EWP) by architects

► The Perception of modified wood by architects

EU countries +
Slovenia
Austria
Italy
Croatia, BiH
Germany
Switzerland
Sweden
Finland
Danemark
Oregon, US
California, US
Washington, US