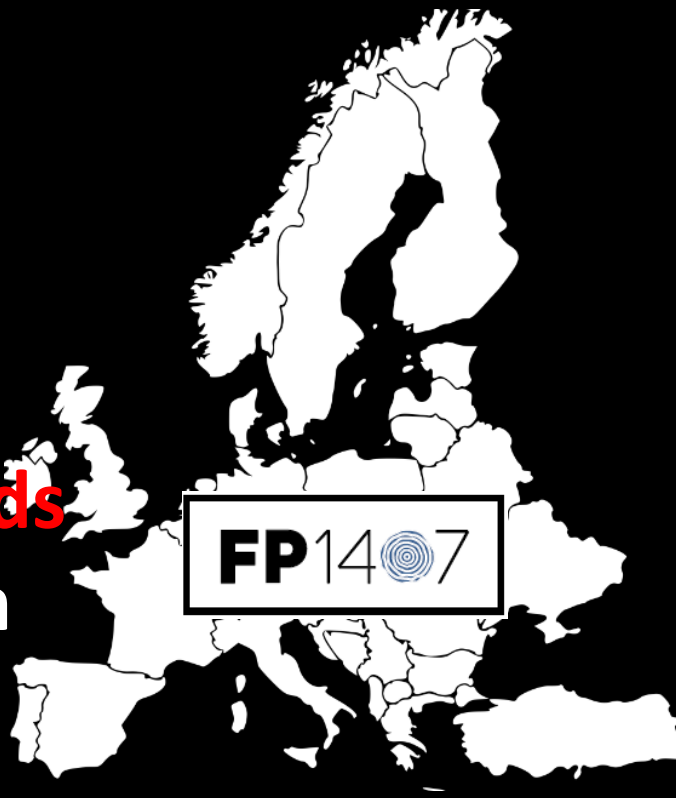
University of Ljubljana
Biotechnical Faculty
Department of Wood Science and Technology



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

Manja Kitek Kuzman
University of Ljubljana, Department of Wood Science and Technology
Dick Sandberg
Luleå University of Technology, Wood Science and Engineering

COST Action FP1407 2nd Conference "Innovative production technologies and increased wood products recycling and reuse" Brno, Czech Republic 29 – 30th September 2016

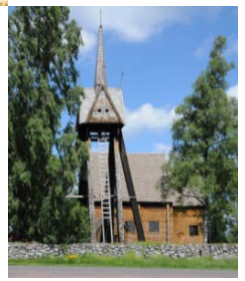
Tradition - a proof of the craftsmanship of woodmasters

Diferent traditiona typs of wooden houses

Wooden shipard house, Velika planina, SI

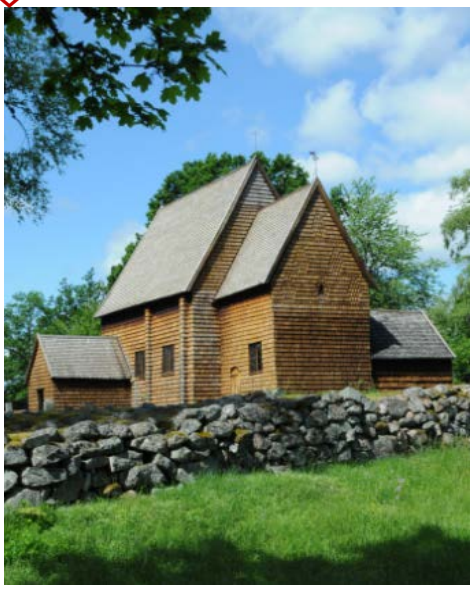
Farmstead in Gorenjska, SI

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.



Stave church Grandhult church, Småland, S

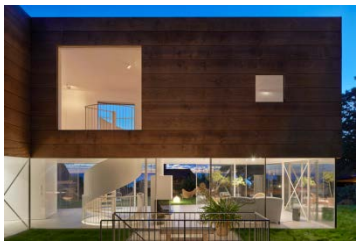
Traditional I swedish house | *falun red*, S

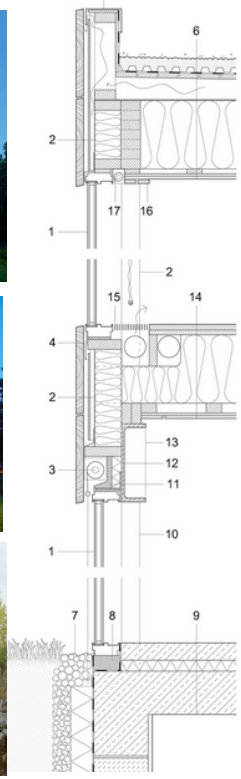


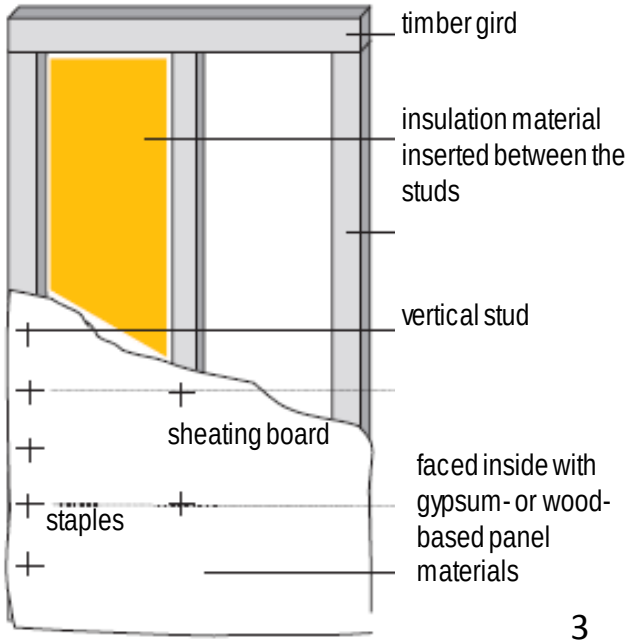
Frame-Panel construction

Dominant methods of timber construction

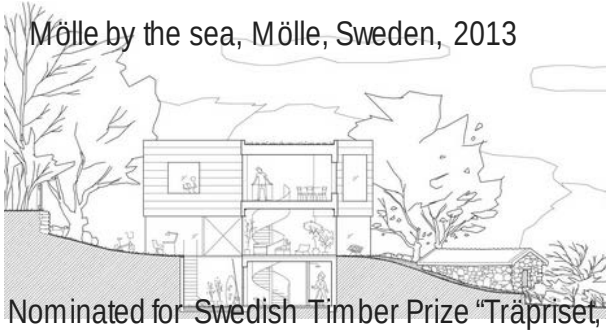
Mölle by the sea, Mölle, Sweden, 2013







SINGEL PANEL CONSTRUCTION

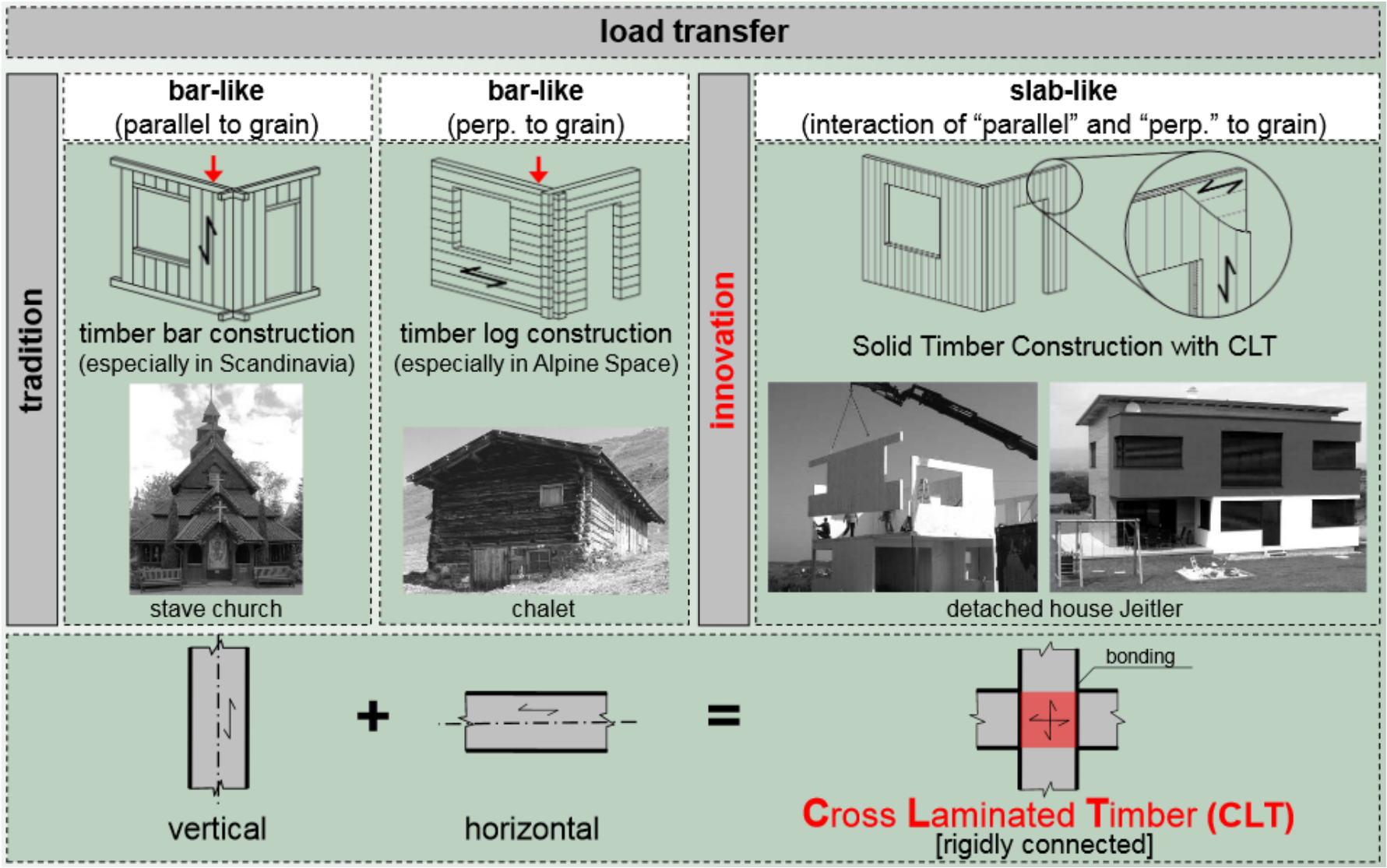


Nominated for Swedish Timber Prize "Träpriset,

www.archdaily.com/498686/molle-by-the-sea-elding-oscarson

Solid Timber Construction (SCT)

Innovation based on tradition



http://clta.jp/wp-content/uploads/2013/10/20131024_SCHICKHOFER

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

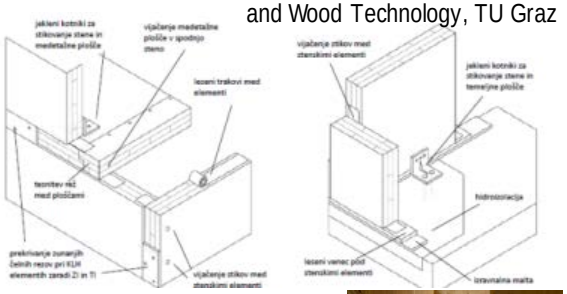
CLT for supporting framework

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

Wall unit on its way at Hyttkammaren in Falun

Assembly of floor structures at Limnologen in Växjö

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



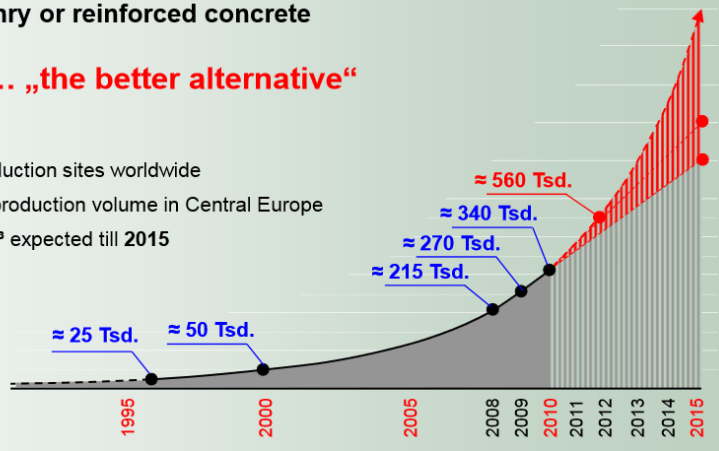
The wooden form of Waugh Thistleton's Murray Grove, London

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. m^3 of productiom potential worldwide can be expected at latest of 2015

Off site prefabrication

The trend toward a higher degree of prefabrication

www.trabyggnadskansliet.se

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

Prefabricated modules for single family house are assembled on-site.

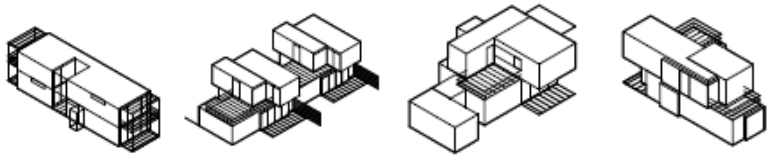
www.marles.com/hise/en

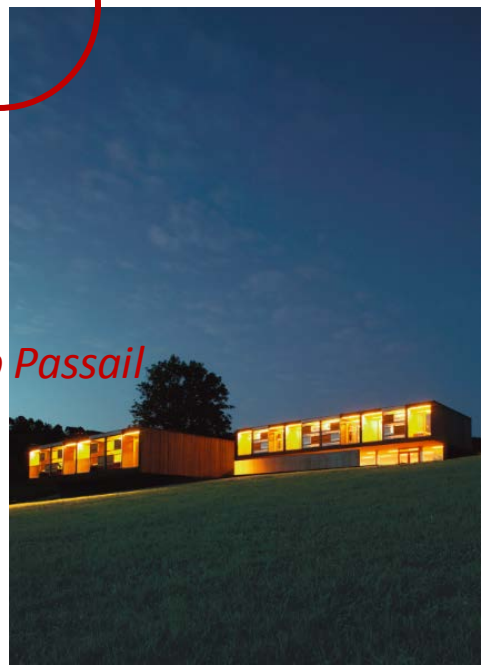
Prefabricated window is assembled on-site

⌂ 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.

Modular system

Prefabricated components of wood





Camp Wildalpen, Camp Passail

Source:"Holzbox"
Foto: W. Luttenberger

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

Spatial cells Residential appartments Skagersvägen

Stockholm

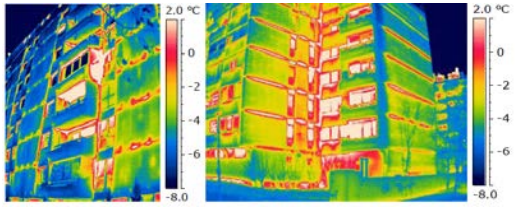
To achieve the unbroken vertical lines that run up the facade, the architect designed the cladding piece by piece.

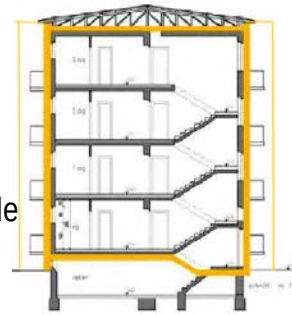
Type of building | residential, 33 appartments
Location | Skagersvägen 22-26, Årsta, Stockholm
Building year | december 2013
Architect | OWC Björn Ahrenby, Joan Anguita, Anna Montagut
Construction company | Moelven (Moelven's modular system)
www.martinsons.se
Construction description | 112 box units built around a spruce frame - prefabricated modules
Energy performance | energy class: low-energy
Area | 4817 m^2
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

Residential area Dieselweg 4 – Graz, Austria





Key technologies

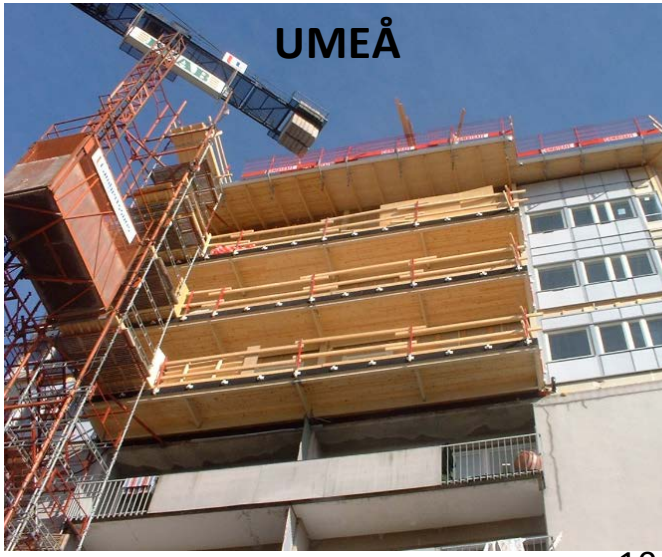
- Solar façade
- Pre-fabrication of facade modules
- Energy concept based onrenewable energy sources
- New heating- and DHW supply system installed between the façade and existing wall
- Decentralized ventilation systems with heat recovery
- Control and remote maintenance via internet

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 Aibing, 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

34-storey Wooden Skyscraper is presented by architect CF Møller

Development and implentation of timber construction

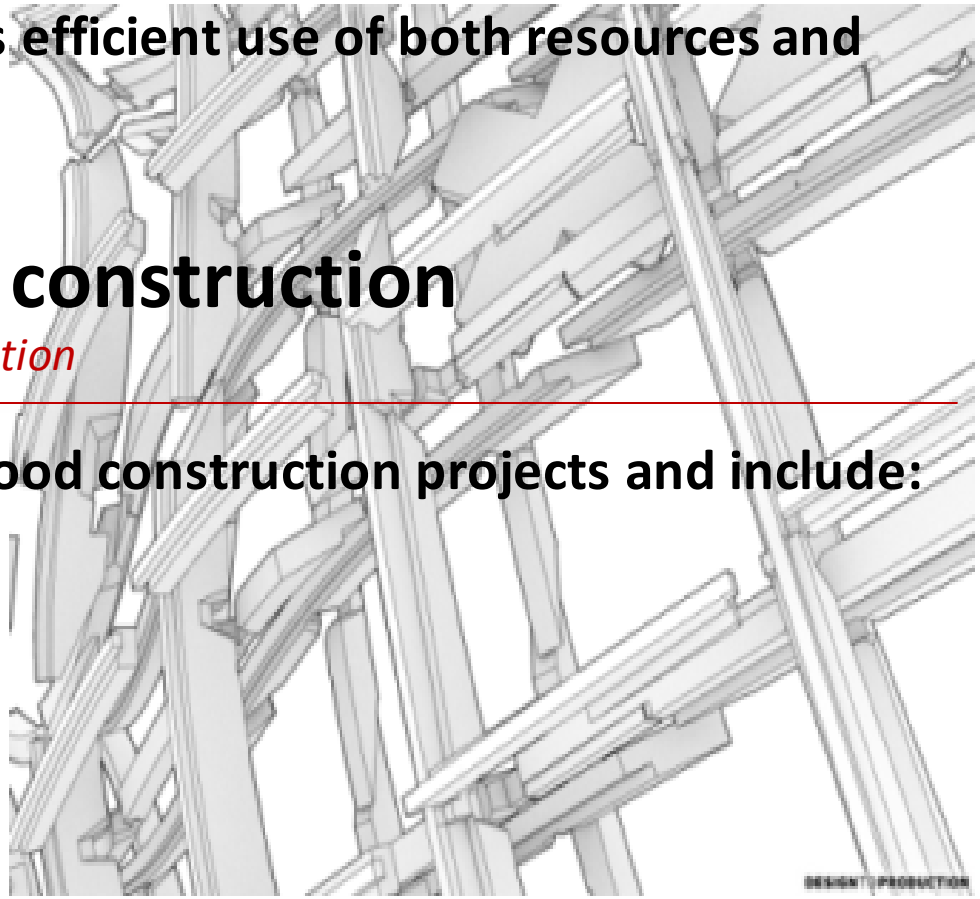
in multi-storey buildings is on different levels in different European countries

+ 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

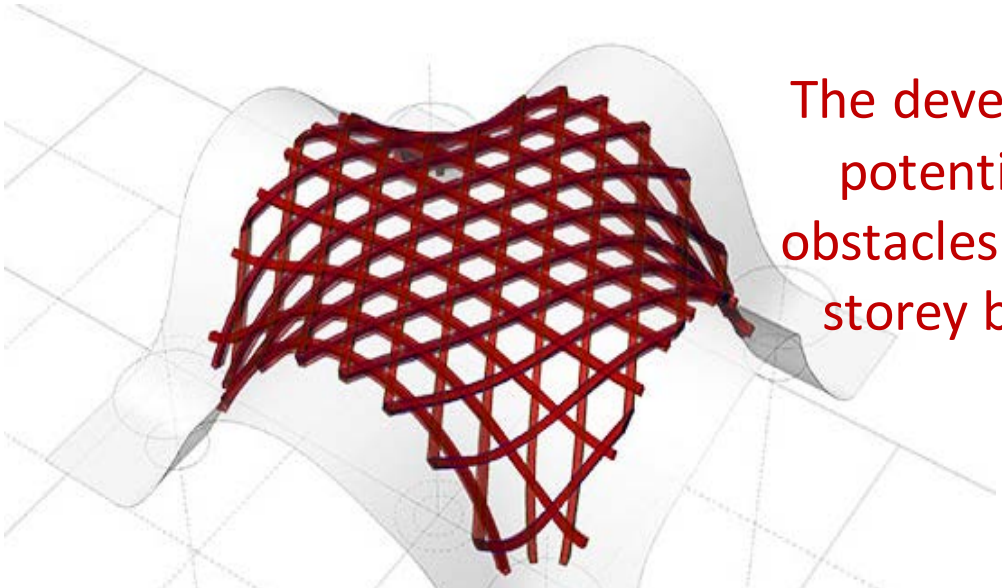
! the cost of facade maintenance

! installations

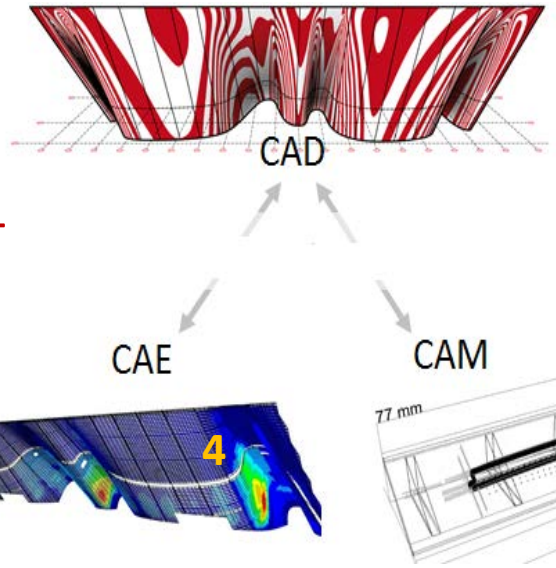
! weather protection.

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.

www.archdaily.com/498686/molle-b

Le Curbusier: The chapel of Notre Dame du Haut in Ronchamp

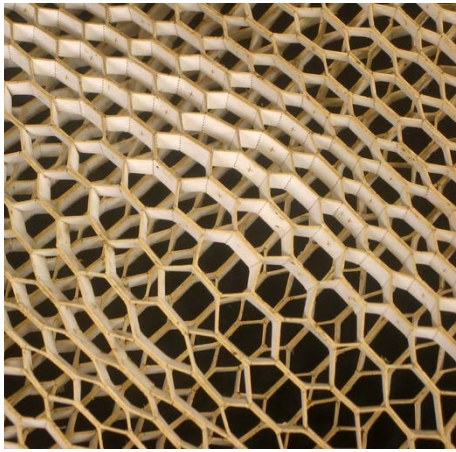
.....He quickly became fascinated, however, with the remarkable adaptability of concrete, and with its sculptural and structural potential. **Concrete's ability to** take any shape and to be enhanced by the surfaces of various molding forms entranced Le Corbusier.....

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 processong“





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 processong

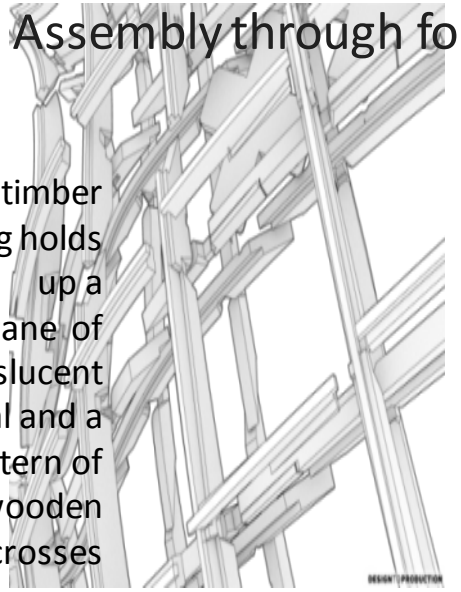
Developing the geometry, designing the supporting framework and generating production data are all decentralized, yet interconnected, processes. An integrated exchange of data with clearly defined interfaces makes seamless project management possible.

organise
optimaze
simplify
materialize

Assembly through form

2

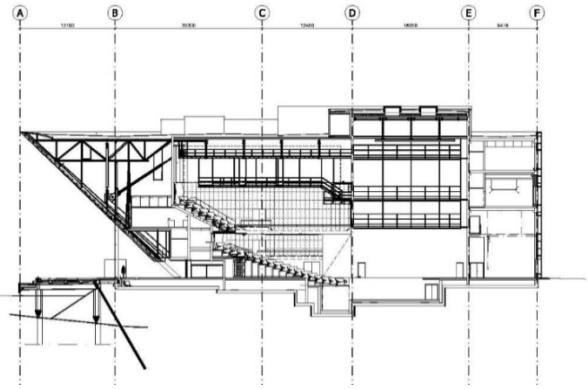
Curved timber framing holds up a membrane of translucent material and a pattern of wooden crosses



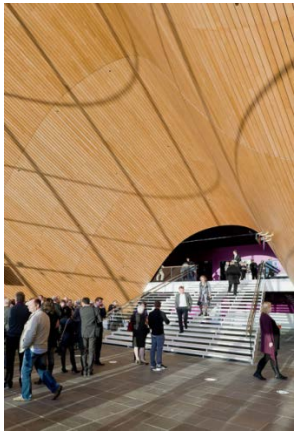
www.archdaily.com/498686/molle-by-the-sea-elding-oscarson

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.

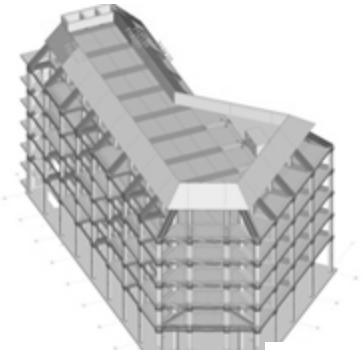


Performing Art Centre

Location | Kristiansand, Norway
Year of construction |2012
Architect | ALA Architects
Area | 24,600 m^2
Owner | Teater- og Konserthus for Sørlandet

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 m^2

Office building of the Swatch group

Biel, Switzerland

A flowing timber grid-shell roof that unites two structures.

The decorative wooden cross beams.

Campus of timber buildings

Location | Biel, Switzerland
Year of construction | 2015 in progres
Architect | Shigeru Ban Architects
Number of floors | 6
Owner | Swatch group

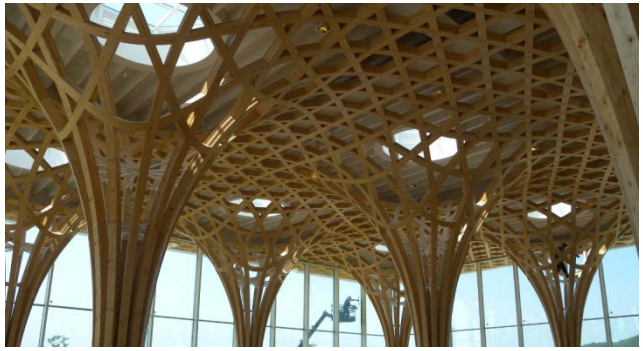
Japanese architect Shigeru Ban has revealed his competition-winning design for a campus of timber buildings to house the headquarters of watch brands Swatch and Omega in Biel, Switzerland.

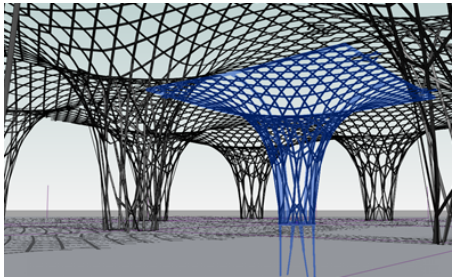
www.archdaily.com/498686/molle-by-the-sea-elding-oscarson

The Yeoju golf clubhouse

5-storey building in Zürich, Switzerland

www.archdaily.com/498686/molle-by-the-sea-elding-oscarson

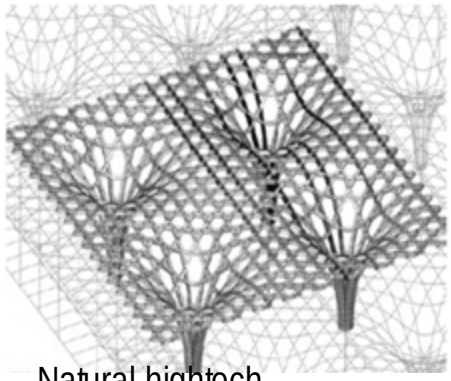




The roof over the main building measures 36 x 72 m

Sport, leisure building

Location | Yeoju, Korea
Year of construction | 2010
Architect | Shigeru Ban Architects
Area | 16,000 m^2 facility
Number of floors | 3 floors
Prize | 2014 Pritzker Prize



Natural hightech

Non-Standard Architecture in wood

Digital Crafting

Non-Standard
requires individualisation

- 100% Exceptions
- Knowledge + Innovation
- Craftmanship
- Quality

Larg Scale
requires rationalisation

- 100% Standards
- Efficiency + Automation
- Industrial Apprpach
- Quantaty

Non-Standard Architecture
requirs integration

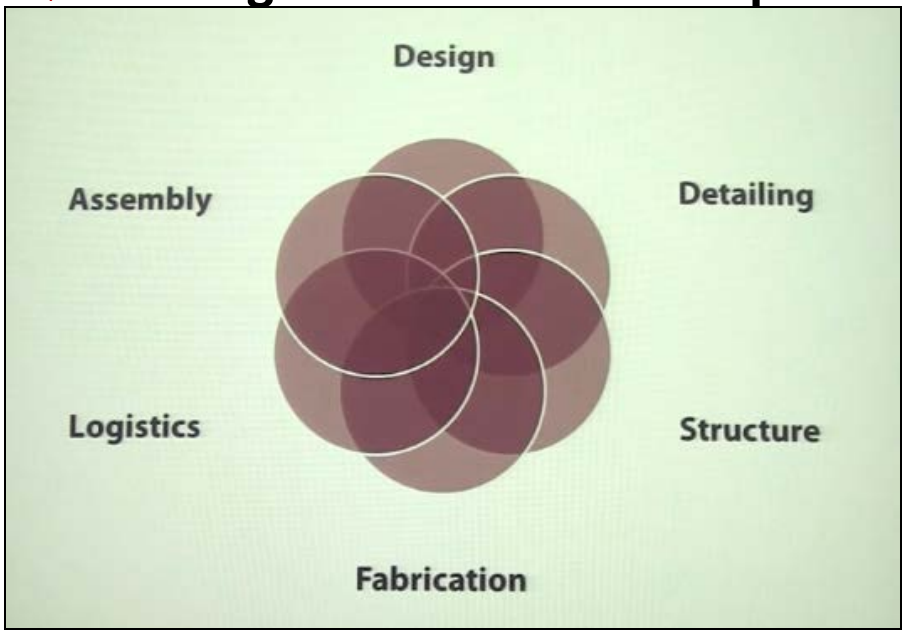
- 100% Systematisation
- Continous Workflow
- Mas-Customization

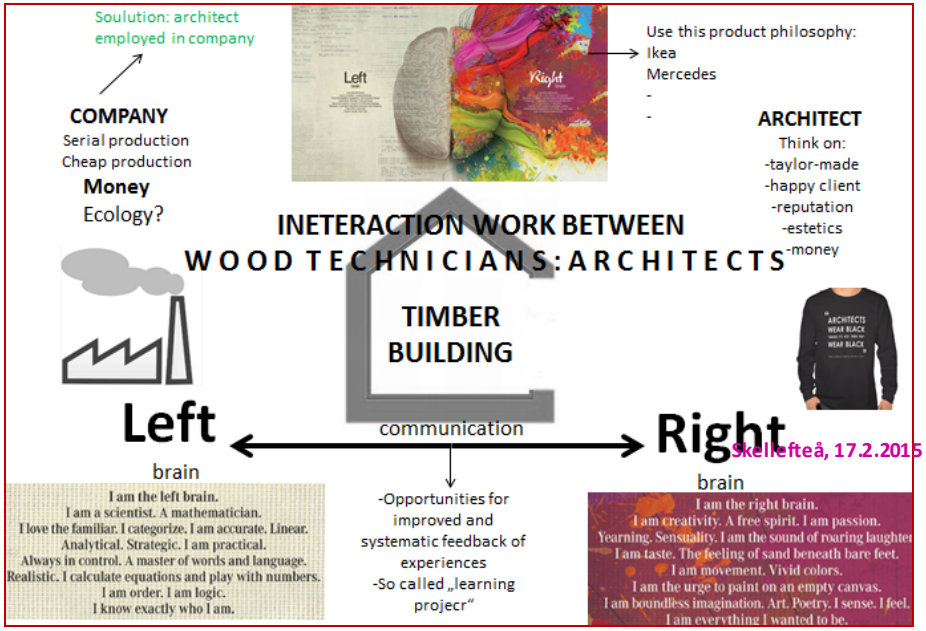
As an architect, you design for the present, with an awareness of the past, for a future which is essentially unknown. *N. Foster*

Conclusion

We see opportunities for further development and future trends in:

- → **High prefabrication as a basic princip,**
- → **Modular building,**
- → **Partnership and increased responsibilities for planning and construction,**
- → **Improved and systematic feedback of experiences,**
- → **Demonstration projects are vital, Team coopertion**
- → **Communication development (interdisciplinary)**
- → **Looking for a new material practice in timber architecture**





Architects work like that...

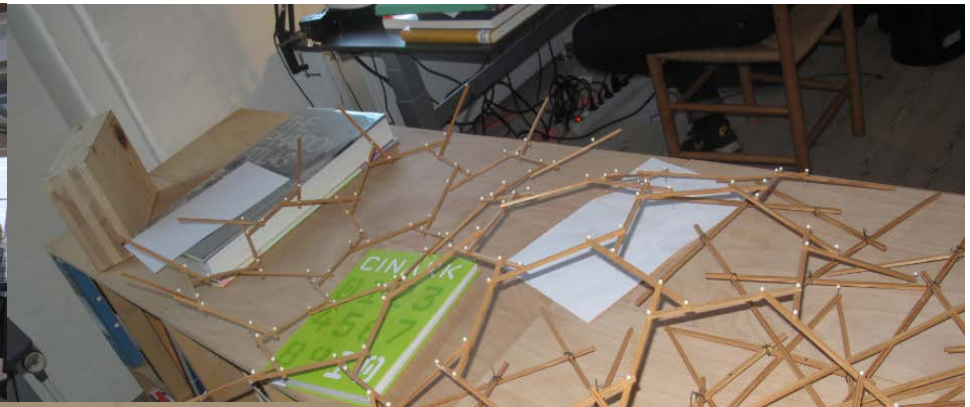
Laval Universite, Ecole d'architecture, Canada

Architects work like that…

Columbia University Graduate School of Architecture, Planning and Preservation

Architects work like that...

Royal Acadamy of Art Copenhagen, Architecture Programme



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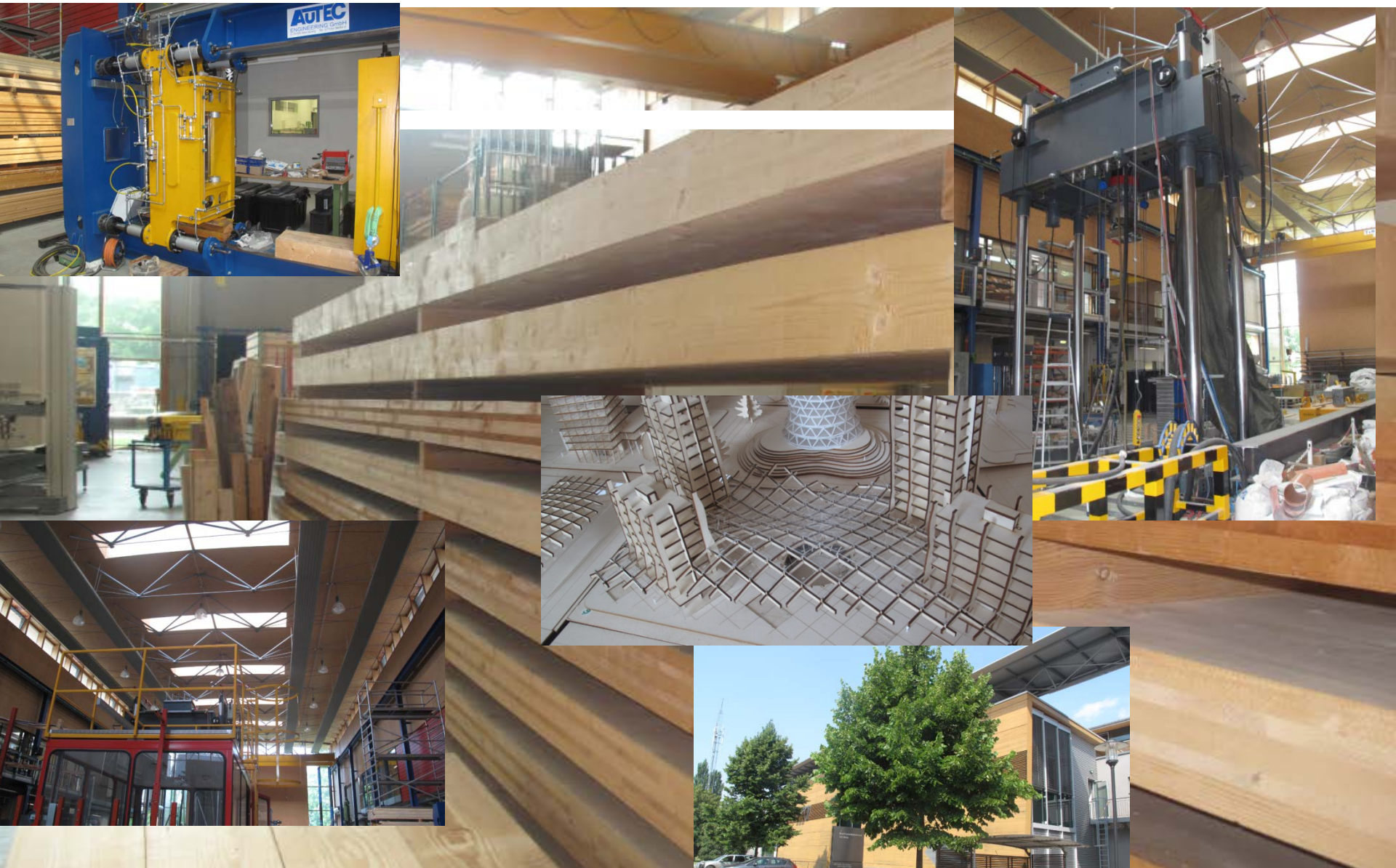
Architects work like that...

Universidade Tecnológica Federal do Paraná, UTFPR, Curitiba, Paraná, Brazil

Architects work like that...

TU Graz, Austria | Institut für Holzbau und Holztechnologie, Faculty of Architecture

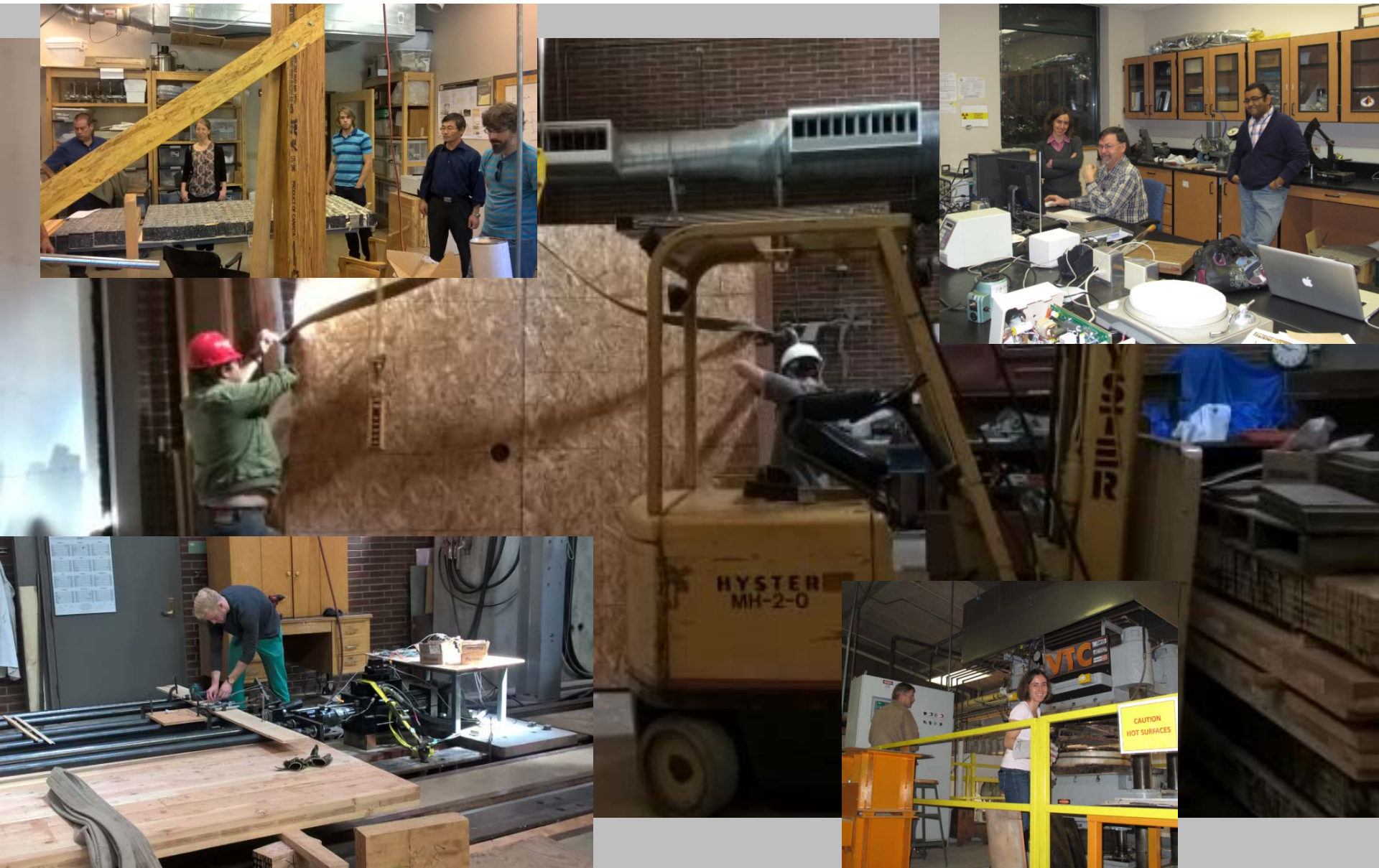


We comunicate with models

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 sectore

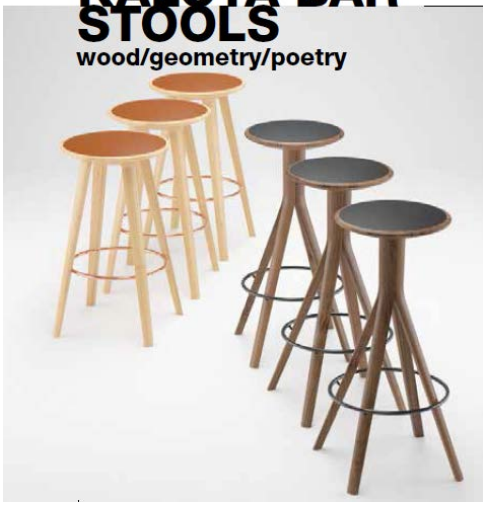
Beatnik™
Sound Station Chair

CHAT LOOP

NOSHI
sculptural kitchen spoons / wood for your food

And we need to learn how to achive them

KALOTA BAR STOOLS
wood/geometry/poetry

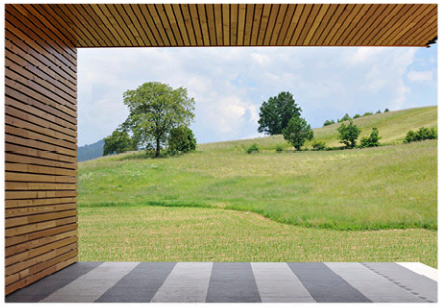


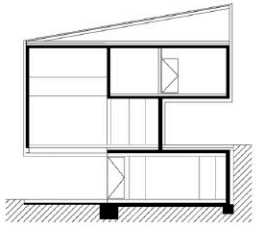
CHOPCHOP
wooden cutting boards / wood for your food

MOSQUITO

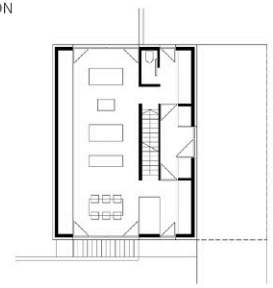
The Rant House

Škofja Loka





SECTION



GROUND FLOOR PLAN

Residential building

Year | **2013**

Architecture | **prof. Janez Koželj, Tina Rupar Kobe, Blaž Rupar**

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**

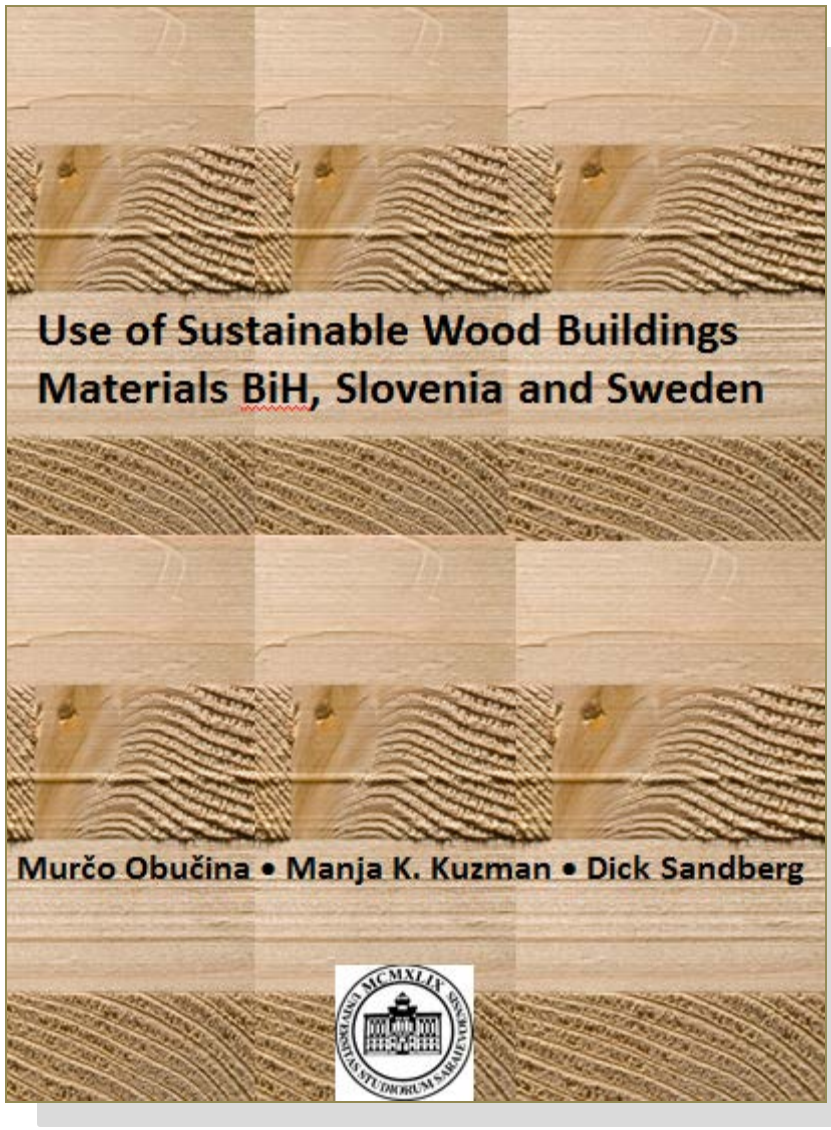
Future work- *book*

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