Wooden Construction in Europe: Increasing the use of sustainable building products

Economic Commission for Europe
Timber Committee
Seventieth session
Geneva, 16–17 October 2012

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Coordinator Building with wood
Chairman CEI Bois WG Construction

Timber in Construction

Status:

- Residential buildings
- Large span constructions

Garden settlement »Am Hofgartel«

Address
Am Hofgartel / Paulasgasse
1110 Wien
Design
Geiswinkler & Geiswinkler –Architekten
Building Owner
Neues Leben
Timber construction company
Speiser GesmbH, Schweinern
Completion
2003
Photographer
Manfred Seidl

Comment:

The use of industrial prefabricated light-weight wooden exterior walls as secondary construction material on a reinforced concrete skeleton is seen positive economically and with respect to building physics. The composite construction especially in urban regions is seen trend-setting.

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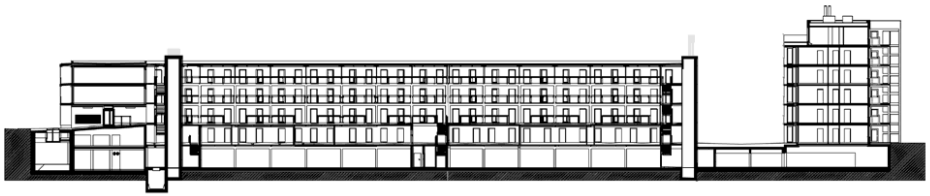
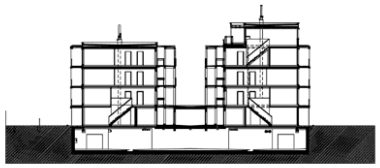




multistorey residential building Spöttlgasse

Address
Spöttlgasse
1210 Wien
Design
Hubert Riess
Building Owner
Sozialbau AG
Timber construction company
Kulmer Holzbau, Pischelsdorf
Completion
10/2005
Photographer
proHolz Austria

Comment:
The first part of a multistorey residential building (4 floors) on a massive ground floor in Vienna fascinates with its astonishing courageous and progressive approach. The designer has succeeded in convincing the building owner as well as the representatives of the city of Vienna of the feasibility of a multistorey residential building recognising the legal requirements.

Passive House „Kammelweg“
Multistorey residential building

Address
Kammelweg
1210 Wien

Design
Prof. H. Kaufmann & Johannes Kaufmann
Building owner
Arge Schertler/Mischek

Structure: reinforced concrete
Exterior walls: prefabricated timber elements integrated into the building shell
Height: 7 floors

Murray Grove, London

- 9 storey residential building
- Made of cross-laminated timber elements
- Carbon sink: 188 tons of CO2 stored in structures
- Comparison: Similar concrete building would have caused 124 tons of CO2 emissions

- Fast: erecting the structural frame took only 27 days with a team of 4 professionals

Bridport House, London, UK

- 8 storey residential scheme
- Made of cross-laminated timber elements
- Carbon sink: 1152 tons of CO2 stored in the timber structure
- Carbon avoided by not using concrete structure: 892 tons of CO2

- Construction time 10 weeks
- Comparison to traditional concrete construction 21 weeks

Trends in residential buildings

- in principle trend towards four floors or more

- More combined constructions with non load bearing timber walls up to 22 m and higher
- But also load bearing structure in timber
- Low energy buildings
- Passive houses
- Increasing prefabrication of timber elements

- CO2 sink
- Wellbeing and ecological aspects

Trends in residential buildings – fire performance

Country	Without measure	With measure	Necessary measure
Austria	11 m alignment level, 4 storeys	Exceptions possible, open	Attestation of similar safety level
Germany	7 m alignment level	13 m alignment level	Capsuled construction
Switzerland	6 storeys	Up to high rise building level	Non combustible facades or futher measures
Finland	9 m, 2 storeys	26 m, 8 storeys	Non combustable coverings, Sprinklers
England & Wales	7 storeys for timber frame constructions otherwise no limitations		Sprinklers, fire compartmentation

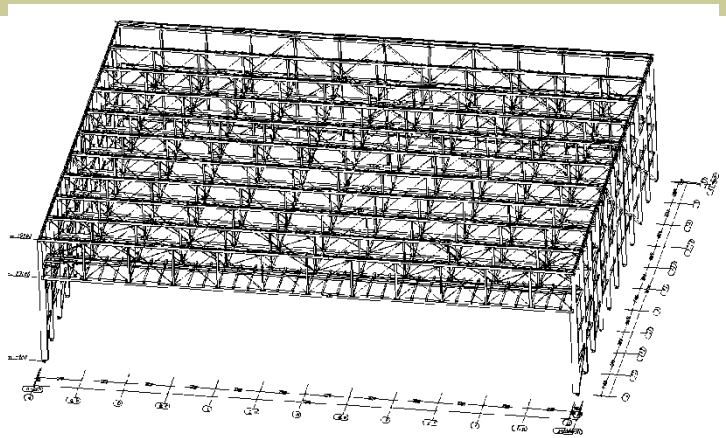
Unicomm – Logistic center in Dueville, Italy

- 3.300 m³ Glulam
- 36.000 m² ground floor
- in 4 months constructed and finalised

Comment:

This construction shows that even large projects can be completed easily and on time also with todays existing production capacities and appropriate engineering.

The need of a resistance to fire of 90 minutes was one of the most important advantages of timber.



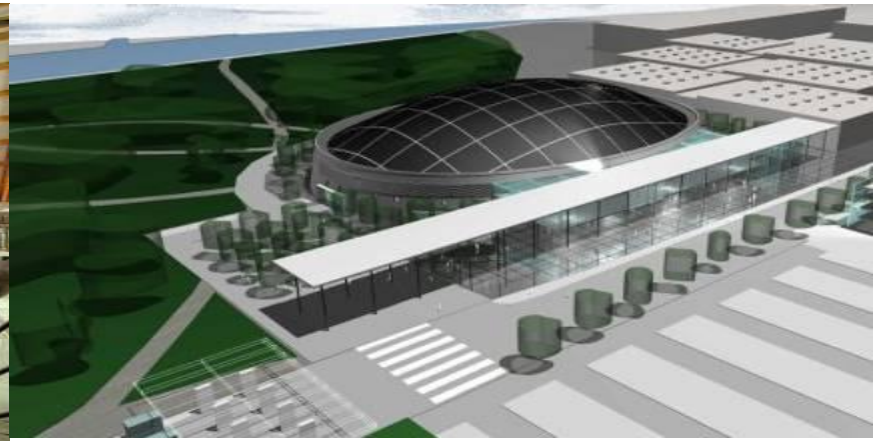
VIP Hangar, VIA Vienna

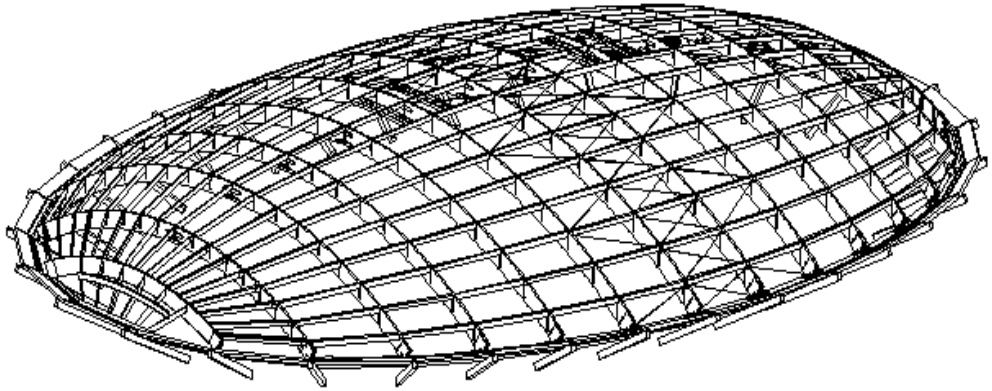
- 75 m free span
- 20 m height
- 550 m³ Glulam
- about 1850 to reduction in CO_2 due to „timber instead of steel“
- Area 75 x 60 m

Comment:

This Hangar for airplanes during the EU presidency shows that was originally designed as a steel construction was constructed in timber without major changements. At first glance there is no difference with regard to the slenderness of the construction. The easy fulfilment of the needs of resistance to fire and the possibility to ignore the deformations due to temperature (characteristic of steel constructions) had been advantages of the timber construction.

Building owner
VIA Flughafen Wien AG
architect/engineer
Holzbauer und Partner Architekten und ZT Ges.m.b.H.





Salzburg Arena

- 81 m free span
- length 107 m
- height 26 m
- 7.500 kg max. load
- Area 11.000 m²

Design/engineering
KSP Engel & Zimmermann

Comment:

This hall for events is very special with regard to its universal possibilities. With about 6.800 seats is offers a suitable location for sporting events and concerts with pretentious needs particular about acoustics. Given the engineering concept it is allowed to fix a stagecraft up to 205 to (=2050kN) on the load bearing structure additional to an already increased snowload

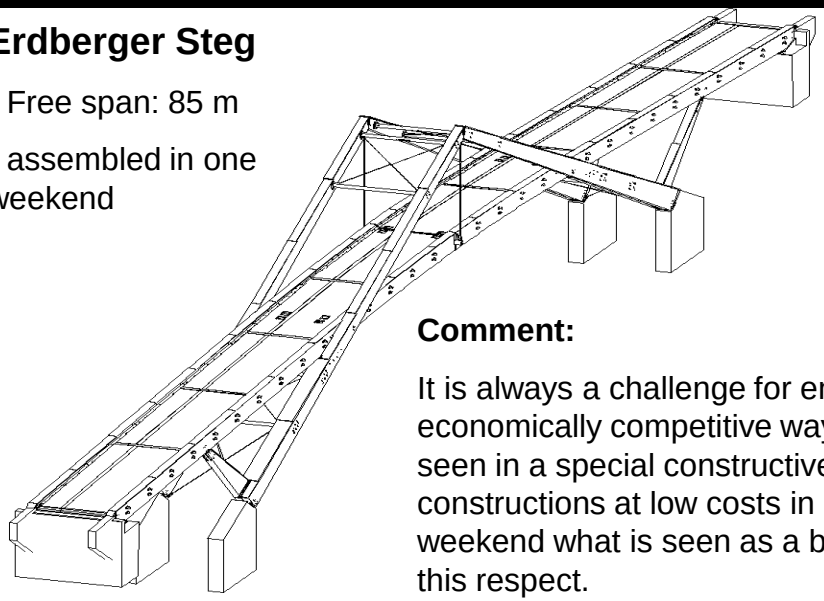
Advertising chair XXXLutz, Nuremberg (Germany)
world record – highest chair on earth!

With an height of 25 m this chair exceeds to so far highest chair in Washington D.C./USA, by 8,75 m. To guarantee a long period of utilisation, a roofing foil is affixed on the surface.

Building owner
NH-Immobilien GmbH
Engineering
kw-holz
architect:
Requat & Reinthaller & Partner

Erdberger Steg

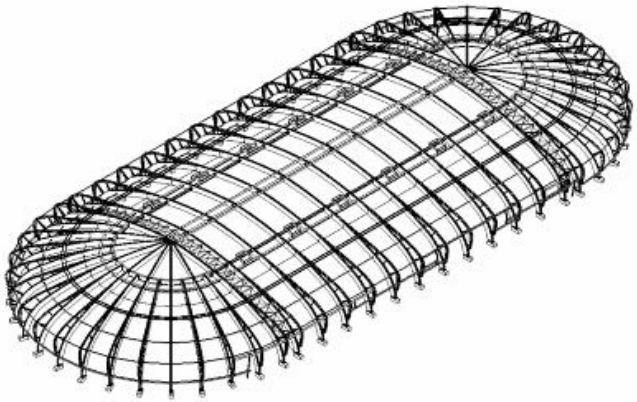
- Free span: 85 m
- assembled in one weekend



Comment:

It is always a challenge for engineers to succeed in designing timber constructions in an economically competitive way. Especially this is applicable to bridges. A need of timber bridges is seen in a special constructive timber protection in order to fulfill the desire of longlasting constructions at low costs in repair and maintenance. The assembly in-situ was only allowed on one weekend what is seen as a big plus for timber. This bridge was awarded at the last WIENWOOD in this respect.

Building owner
Stadt Wien, MA 29 Brücken- und Grundbau
Design/engineering
Zeininger Architekten



Speed skating arena Erfurt

- 13.000 m² area
- 1.600 m³ Glulam
- 80 m free span
- length 186 m
- height 17 m

Building owner
Stadtverwaltung Erfurt
architect/engineer
Planungsgemeinschaft Pohl & Deyle

Comment:

The later roofing of an already existing speed skating arena was a big challenge for the engineers, especially with regard to the assembly in-situ of the large span structure. The successful completion has clearly shown that more and better skills in engineering and statics are needed in timber constructions in order to be able to enter a new field of activities.

Trends in large span constructions

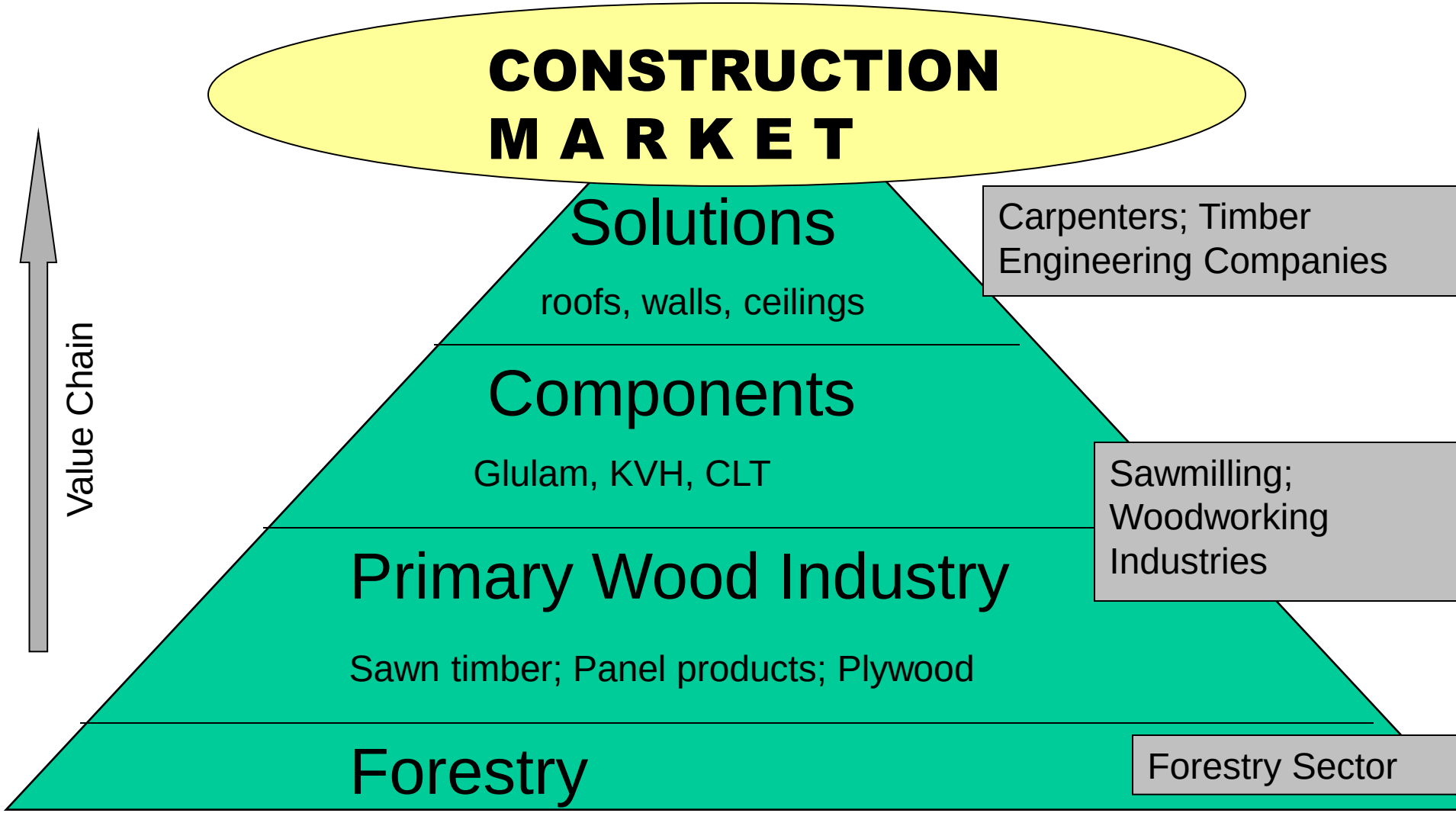
- Innovative products and tools deserve innovative knowledge (screws, joints, glued in steel members)
- Size of constructions has steadily increased during last years

Level 1	Span < 5m	Dimensions: 6x12cm 16x60cm	Internal forces [kN, kNm] 60 200	Use of timber 80 m³	Residential buildings, offices
Level 2	Span < 50 m	12x32cm 24x240cm	600 2.000	800m³	Multipurpose centers, industrial buildings
Level 3	Span < 500 m	120x80cm 80x300cm	6.000 20.000	8.000 m³	Exhibition halls, Sporting facilities

Basic Needs of the Construction Market

- safety and reliability of the material
  - raw material
  - products
- competitiveness
  - competitors: concrete, bricks and steel
- slim, understandable, userfriendly technical framework
  - Standards and Codes (e.g.: Eurocodes)
  - supporting tools (EDV)
- Competence (Training and Education)
  - Architects, Designers and Engineers
  - Engineering companies, builders
- Information
  - Lobbying, PR and Marketing

Sector Structure



Characteristics of sector structure

- Only SME´s (carpenters) at top of the value chain
  - act locally
  - lack of ressources: money, people, power
  - lack of critical mass to influence policy makers

- Lack of knowledge and understanding downstream (sawmillers, forest owners, panel industry)
  - about construction market
  - about technical needs of construction market

Brief SWOT-Analyis

Strengths	Weaknesses
•Prefabrication •Speed •Sustainability	•Error rate in details •Fire protection •Durability
Opportunities	**Threats**
•Ecological buildings •Building systems	•Other systems with the same potential

Why timber is used in construction

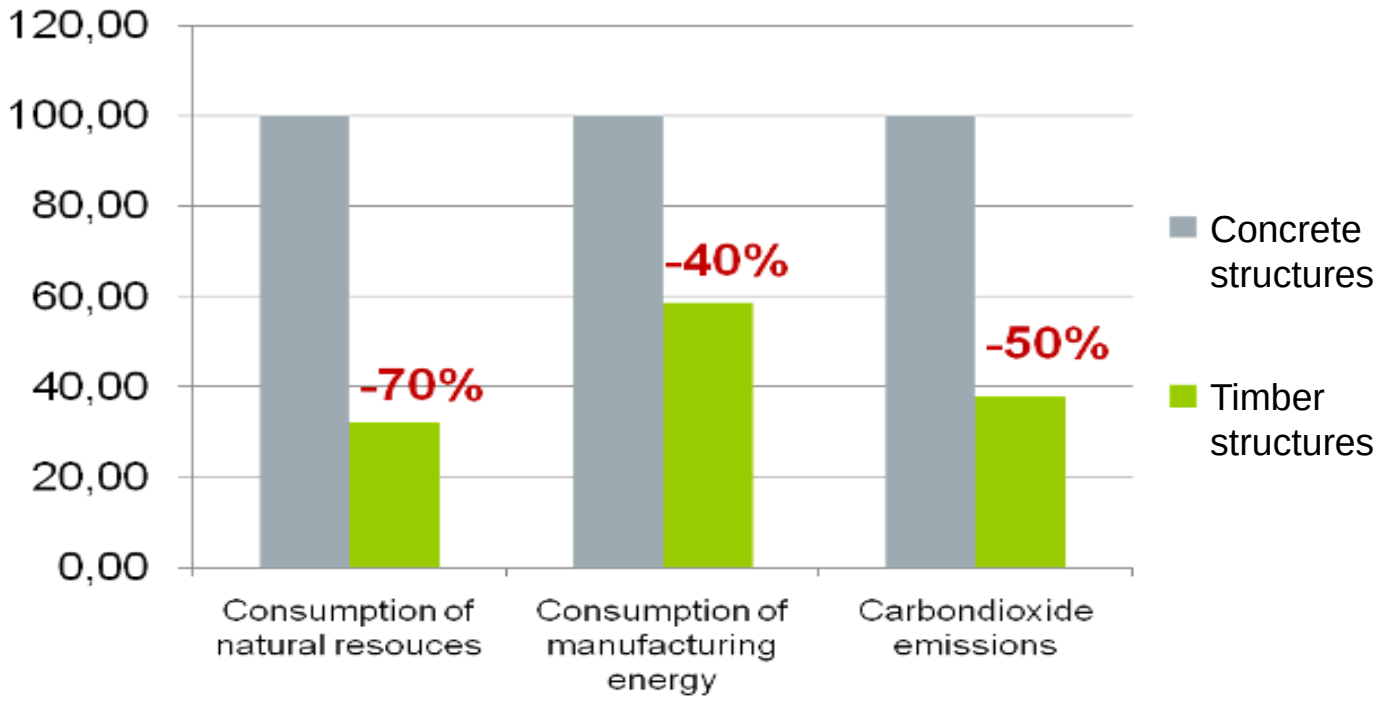
- Sustainable building material
- Contributes to climate
- Can reduce CO_2
- 1 m³ timber stores 0.9 t CO_2

The ecological footprint of the construction sector is huge and will increase in future

- The construction sector consumes half of the raw materials and produces 40 % of waste (EU R&D project RELIEF 2003).
- Most of the raw materials are not renewable
- The construction sector will further increase worldwide:
  - Increase of population
  - People move into towns
  - Increase of social life
- Non renewable resources will decrease

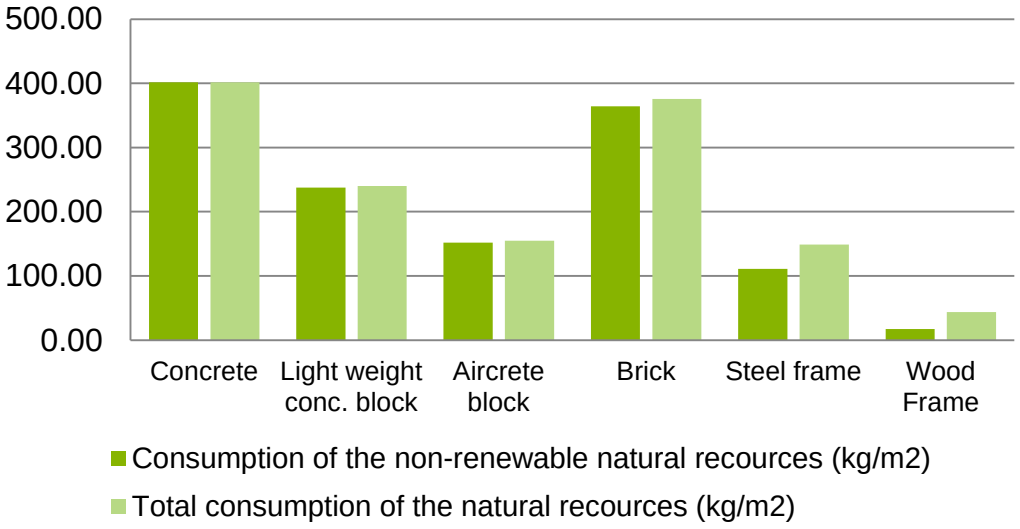
Comparision

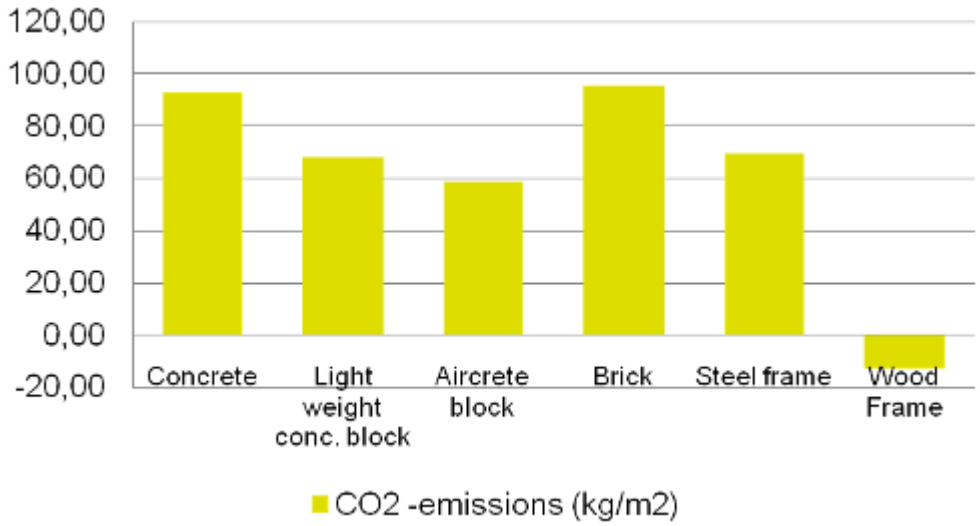
- If European homes were built out of wood instead of concrete, the environmental load caused by housing construction would reduce substantially



Source: Building information environmental declarations

The environmental impact of timber structures

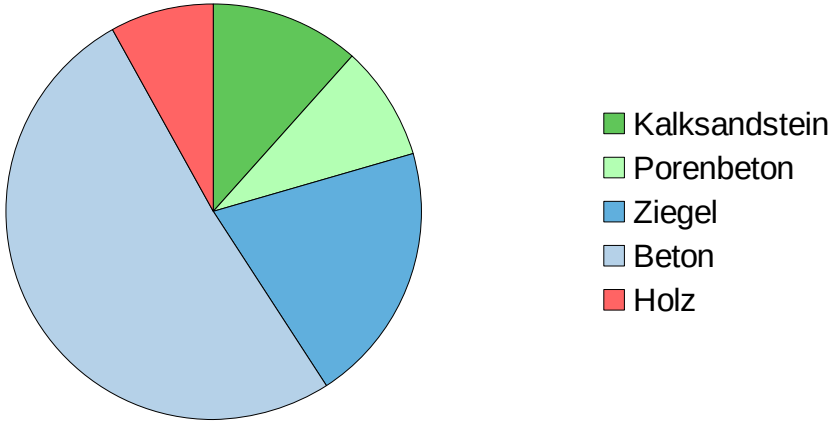




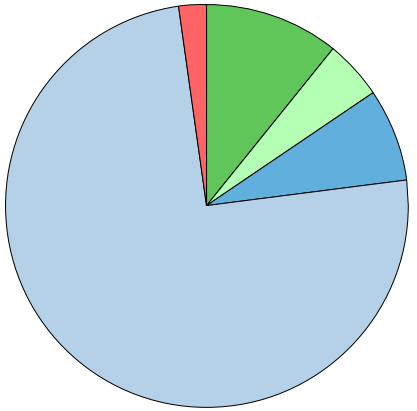
- Timber structures can be built by using less natural resources than other structures.
- Timber houses/construction store CO2.
- Timber has low embodied energy.

Importance of building materials

Building materials used in housing in Germany (2008; relation to built m³)



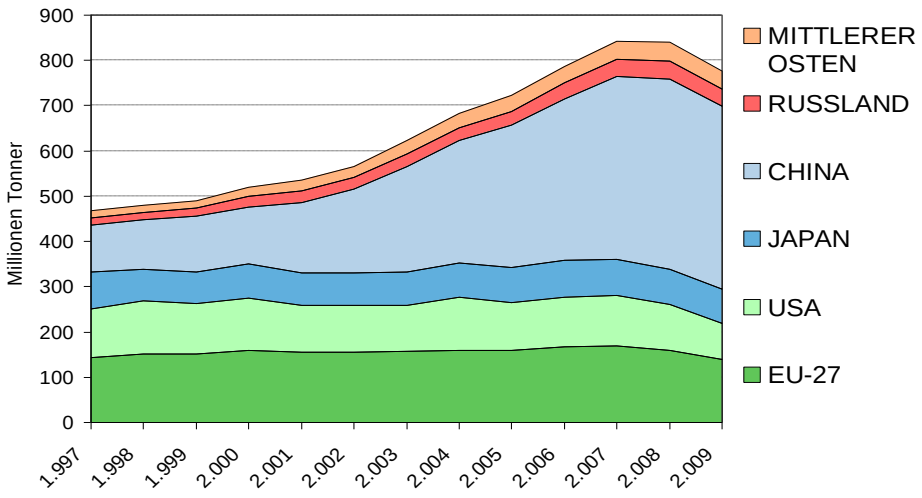
Building materials used in non- housing in Germany (2008; relation to built m³)



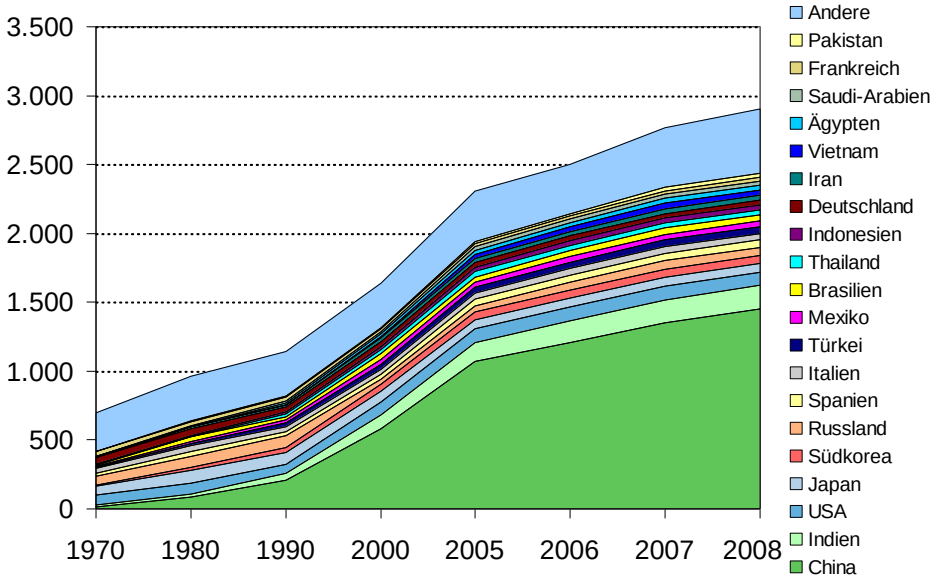
- Concrete is still the most dominating building material
- Bricks are mainly used in housing
- The percentage of timber used in constrcution is still on a low level, although there had been many advertising campaigns
- Chance for timber in the future

Actual use of materials

Steel (Mio. t/year)



Concrete (Mio. t/year)



Source: Jaakko Pöyry

- The construction market offers the biggest potential for the enhanced use of wood and is the main driver for growing the markets for wood-based products.

- Wood in construction is competing against well established materials like concrete, steel and brick. Those materials are challenging wood as a building material in the fields of safety, reliability and also sustainability.

- A new knowledge base is necessary to improve the competitiveness of the industry and remove barriers and limitations for building with wood.

Building With Wood (BWW)

Vision

- "Wood and wood products to become one of the leading materials in construction and interior solutions in terms of value by 2010"

Mission

- „The industry takes the lead to promote wood as a sustainable building material by establishing a new European framework for the use of wood for mass market development and for high standard engineered and architectural solutions."

Objectives

- "Double the market share of wood and wood products in terms of value in construction in Europe by 2010 "

BWW Strategy

- BWW is aimed at the improvement of the legal and technical framework for timber construction in Europe (eg standards and Eurocodes) to support the competitiveness of the industry. The industry itself takes the responsibility to steer and lead this process.

- BWW prepares and supports research projects to create new knowledge as a new scientific basis for the standardisation process, for new advanced applications and for training and education. BWW provides a platform to address third party money (eg.: FP7; WoodWisdomNet)

- BWW is focused to facilitate the access to „building with wood" (user-friendliness) for the important target groups (architects, engineers, authorities, investors….) by providing knowledge and the necessary supporting tools.

BWW R&D projects 2007 – 2010

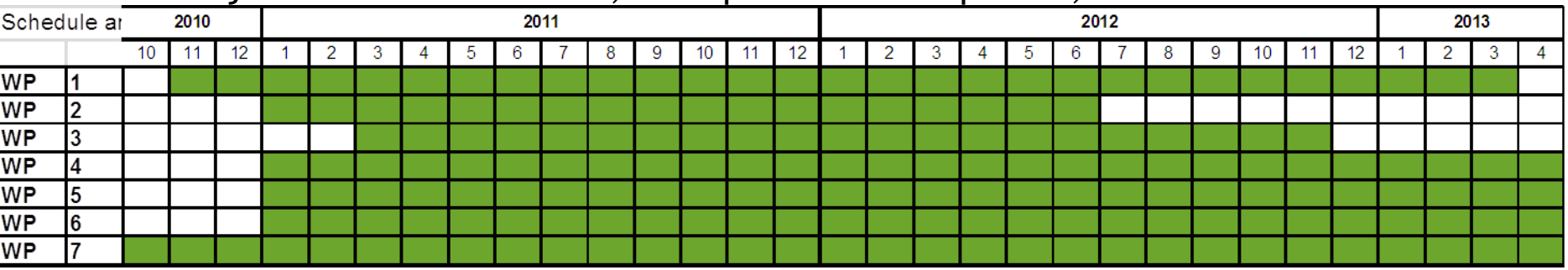
- **„FireInTimber"**Fire resistance of Innovative Timber structures
- **"WoodExter"** Service life and performance of exterior wood above ground
- **"Gradewood"** Grading of timber for engineered wood products
- **"Improved moisture"** Improved glued wood composites - modelling and mitigation of moisture-induced stresses
- **"Mechwood"** Mechanical Characterization of Wood for knowledge-based Timber Industry

Future program and projects (2011 –2013) - running projects

• ECO 2

- **Objectives**: e.g.: holistic understanding of carbon efficiency in the full life-cycle of a building, define technical potential and obstacles for the use of wood in carbon efficient construction, practical solutions for calculating and optimizing the carbon footprint of different wood construction systems

- **Status:** Project has started in 2010; work proceeds as expected;



- **Budget:** € 1.910.175,-- (for three years)

Project leader: Matti Kuittinen, Aalto University

2. Expected outcome

LCA proposal for the wood-working sector.

Principles for optimising carbon footprint of wooden products and houses in **R&D and design** phase.

Reference carbon footprint **calculations** for wood products and wood houses.

Reference structure types for carbon efficient and moisture safe wood construction.

A guidebook for design, development and assessment of **carbon efficient wooden houses**.

Future program and projects (2011 -2013) – running projects

• MechWood II

- **Objectives**: e.g.: Deepening and broadening of knowledge base, effects of long-term loading, studying and modeling the drying behavior in order to optimize drying schedules, evaluating the effects of fatigue loading and dynamic loading, dissemination and transformation as implementing additional features of the material models in commercial static software

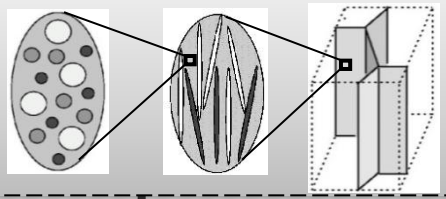
- **Status:** Project has started in 2011

- **Budget:** € 1.200.000,-- (for three years)

- **Project Leader:** Prof. Josef Eberhardsteiner, TU Vienna

MechWood 2 concept

Micromechanical model
(from **MechWood**)



Material properties depending on microstructure

Wood products

Glued laminted timber (TE/GLT/CLT)

Improved understanding of composite

Connections

Dowel joints

Insight into stresses and deformations,
Limit states

Validation

Recommendations for design rules, Support by software

A LOT HAS BEEN DONE

But we still dream that:

- Timber is a „normal“ building material
- The share of timber buildings is more than 35 % in public buildings
- If someone builds a house or building, timber is thought about first
- Timber is well established and widely used

But for that:

- We have to continue working
- We have to remove/overcome barriers (eg: Building regulations)
- We need to show positive examples
- We need to show options also in public projects and procurement
- We need to continue the focused R&D work

tower of babel – even possible in timber