On-going R&D Projects in COST Member Countries

(Nov. 2011)

Countries A-G

Belgium

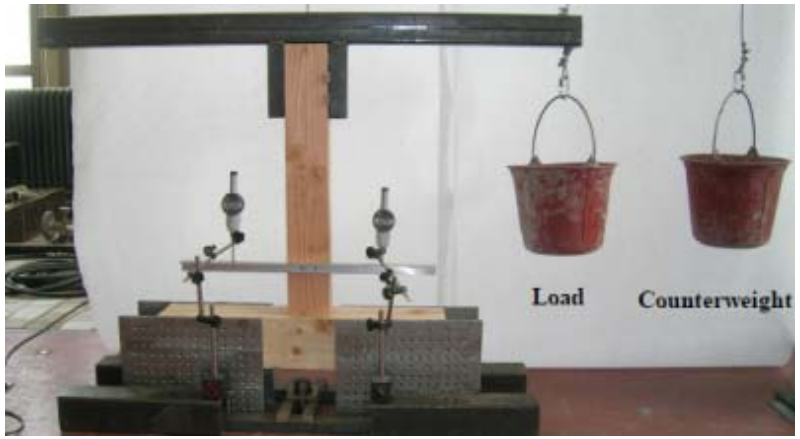
University of Mons

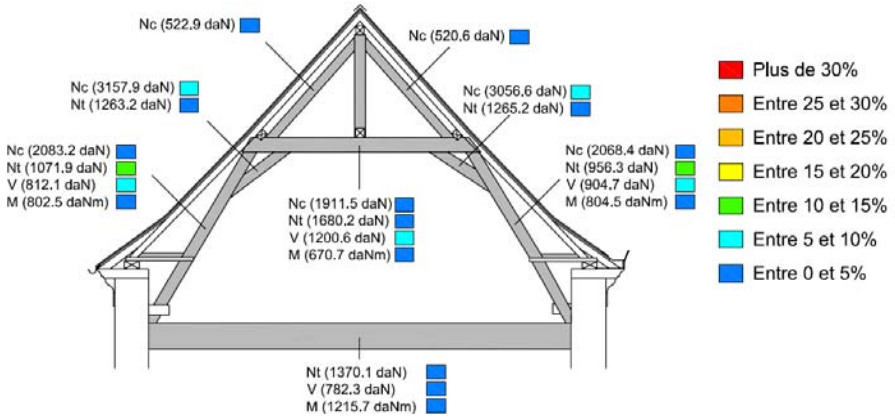
Department of Structural Mechanics

FE modeling of timber connections: Semi rigid analysis of structures

Old carpentry connections

- Numerical (FEM) and experimental study of old carpentry joints.
- Study of the influence of the rotational, normal and shear stiffness on the global behavior

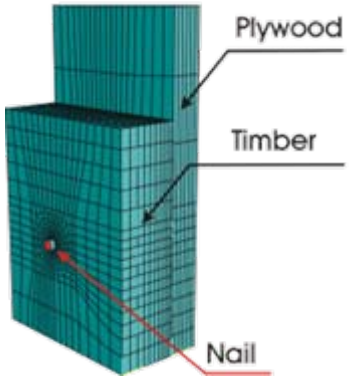


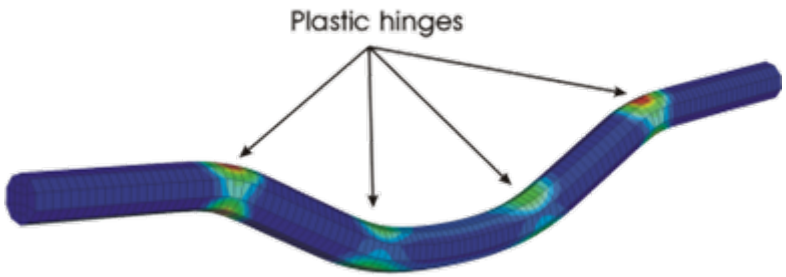


FE modeling of timber connections: Semi rigid analysis of structures

Connections with dowelled type fasteners

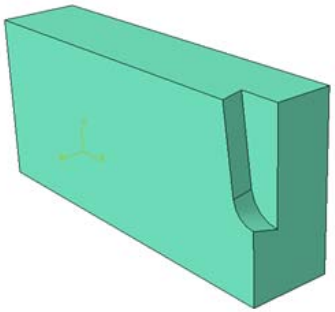
- Introduction of a specific finite element called “Finite Semi-Rigid Element” between the ends of the jointed members.
- The stiffness of the FSRE is computed from the geometry of the joints and embedding stiffness of all fasteners, along and perp. to the grain.

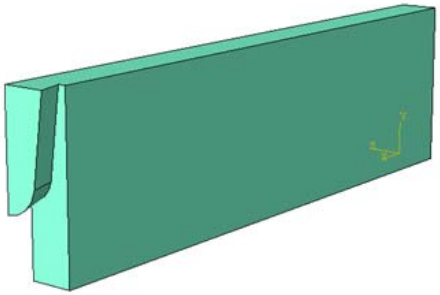


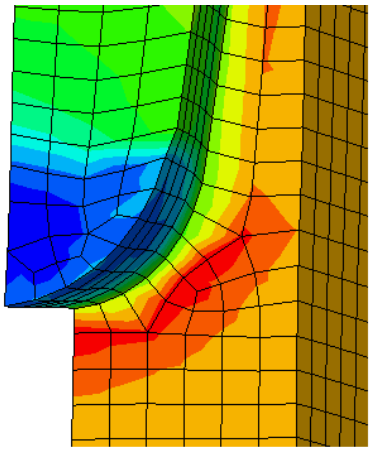


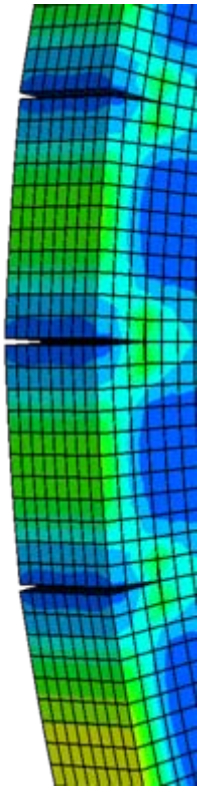
Prediction of ULS of old carpentry joints

- Study of failure criteria for wood (Tsaï, Norris, Hashin…)
- Development of CPT (crack propagation tool).
- Proposition of practical parametrical design guidelines









Bulgaria

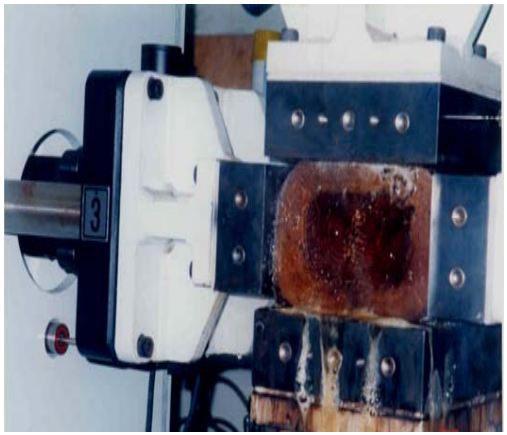
University of Forestry Sofia

Faculty of Forest Industry

Wood modification as a result of compression

The small diameter logs have specific dimensional and qualitative characteristics which limits their effective use.

→ **Solution:**



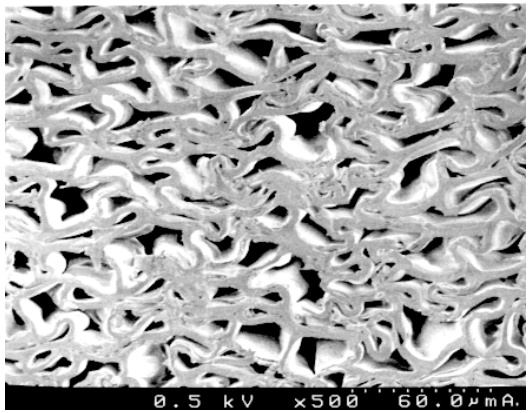
Increasing the wood density by changing its structure as a result of heating pressure treatment is one of the methods to improve physical and mechanical properties of wood.

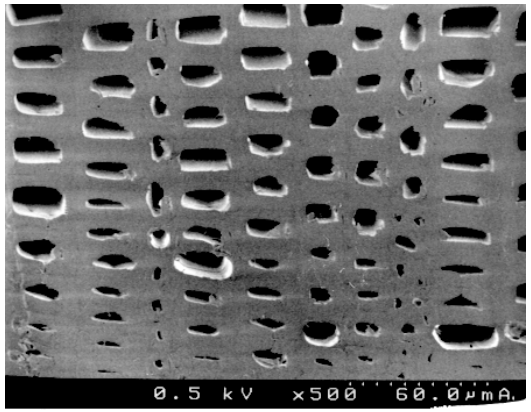
Wood modification as a result of compression

Experimental studies to increase the density and dimensional stability of wood by two methods of compressing.

On-going research work:

- Investigation of the recovery ratio of compressed wood after treatment in hot and cold water, and its bending strength.
- Changes in the microstructure of compressed wood by using of scanning electron microscope.





Croatia

University of Osijek

Faculty of Civil Engineering

University of Rijeka

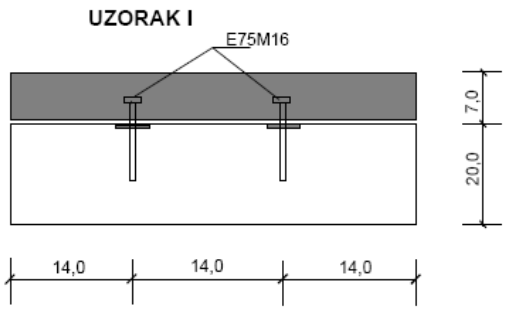
Faculty of Civil Engineering

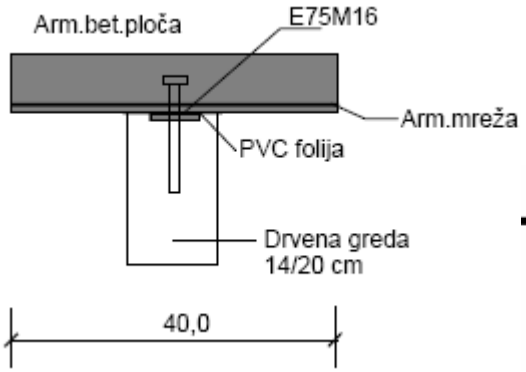
University of Zagreb

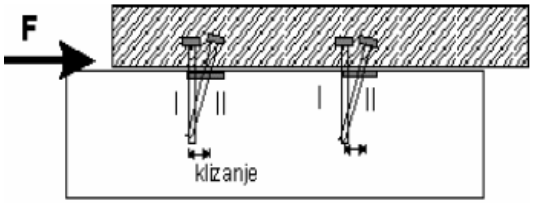
Faculty of Civil Engineering

Rheological slipping module of composite wood-concrete structures

- Investigation of the rheological behavior of wood-concrete structures connected by dowels, behavior under long-term constant load
- Impact of the dowel's size on the joint deformability and indoor physical conditions on the behavior of the composite structure were monitored







Rheological slipping module of composite wood-concrete structures

- Change in micro-climate conditions has a significant impact on slipping of small samples due to the hygroscopic property of wood and on the characteristics of concrete and joint
- Biggest increment of slipping is in the initial seven-day period

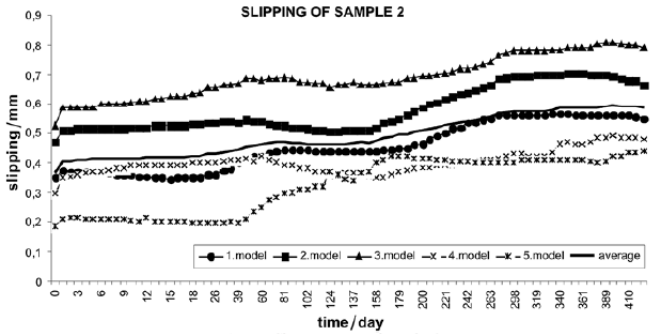
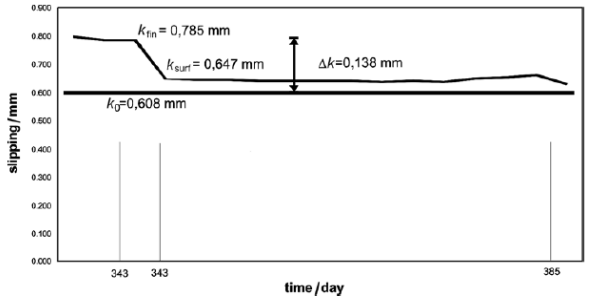


Figure 7 Slipping curves of samples 2



Universities of Rijeka & Zagreb
Faculty of Civil Engineering

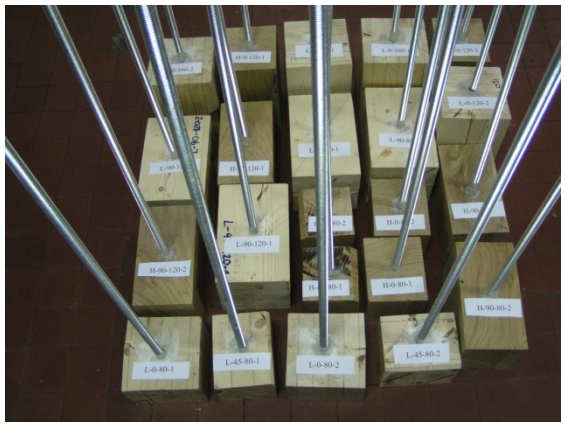
Failure mechanisms and behavior models of innovative connections in timber structures

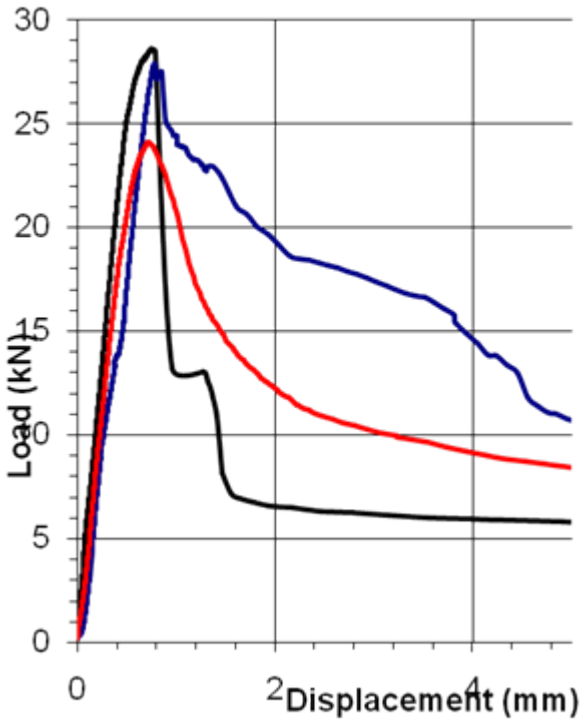
- Angular connections of timber frame structures and also connections and extensions in timber truss: 1. with FRP, 2. with glued steel roads
- EC5 standard with its regulations do not cover this area of research

Universities of Rijeka & Zagreb
Faculty of Civil Engineering

Failure mechanisms and behavior models of innovative connections in timber structures

- New knowledge about load capacity and applicability of described compounds
- Comparison of results in laboratory tests of materials and adhesives with numerical models





Composite joint of timber truss girders assambled in the field

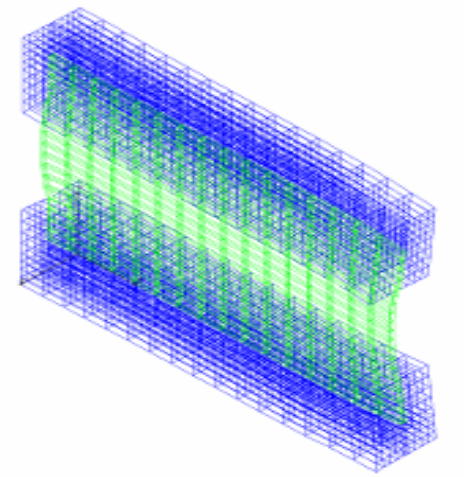
- Connection based on glass or carbon fiber-reinforced timber elements and built-in steel tube connected with glued-in steel rods under tension
- Theoretically and experimentally study to obtain the strength and stiffness of joints

Composite joint of timber truss girders assambled in the field

- The profitability of truss girder assemble with “new” connections compared to laminated beam and truss girder assemble with steel plates will be analyzed
- Obtain a more simple solution as opposed to commonly used steel plate connection

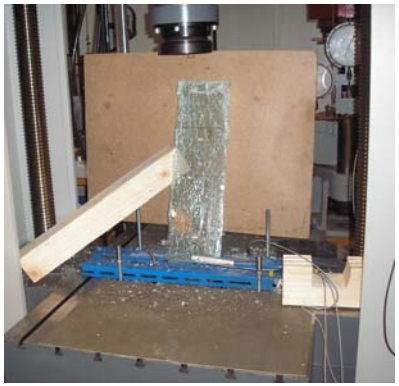
Timber-structural glass and steel-structural glass composites

- High mechanical properties of glass make it interesting for structural applications
- The goal is to examine the composite load-bearing systems, wood-bearing capacity of glass that would have the ability to transfer loads from both of its components



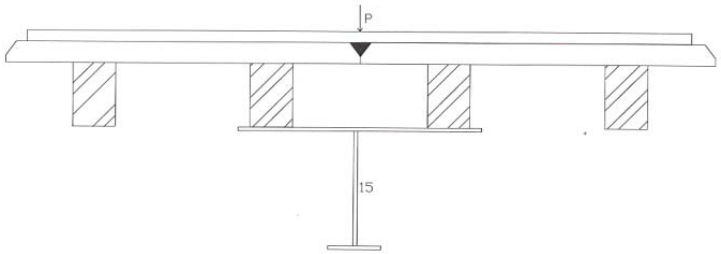
Timber-structural glass and steel-structural glass composites

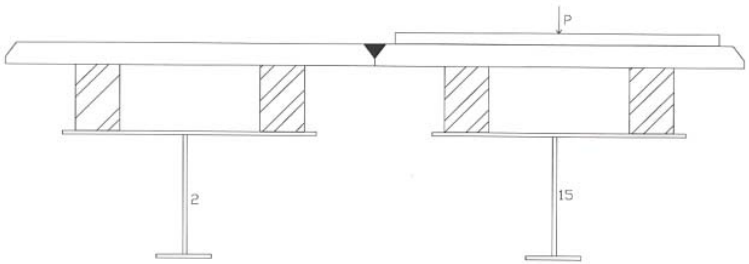
- The two materials are connected by gluing (both materials and composite were tested)
- Ductility and better mechanical properties allow the design of structural and aesthetic very interesting structural solutions (roof racks, ceiling systems, vertical load-bearing facade systems)



Prefabricated composite structures: wood – lightweight concrete connected with epoxy glue

- Serviceability and bearing capacity of the structural composite elements made of wood beams and prefabricated lightweight concrete plates glued by three several types of glue are compared.
- Prefabricated plates are connect only by gluing or by combining glue and steel bars. Bending and pull out tests are compared.





Prefabricated composite structures: wood – lightweight concrete connected with epoxy glue

Contact between two prefabricated plates are made in two ways:

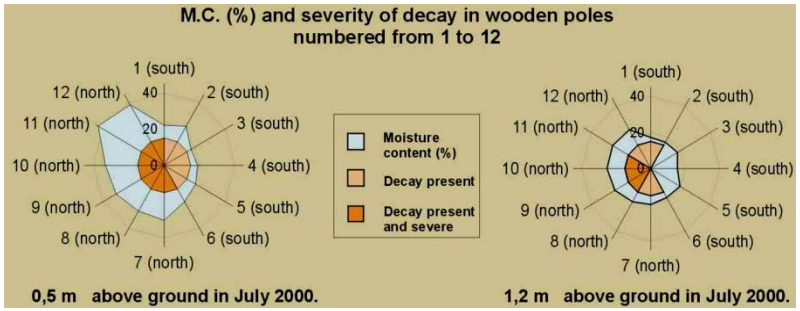
1) with steel bars and glue and
2) only by glueing

University of Zagreb
Institute for Wood Science

Reconstruction of wooden pavilion ECHO in Park Maksimir - Zagreb

Objectives:

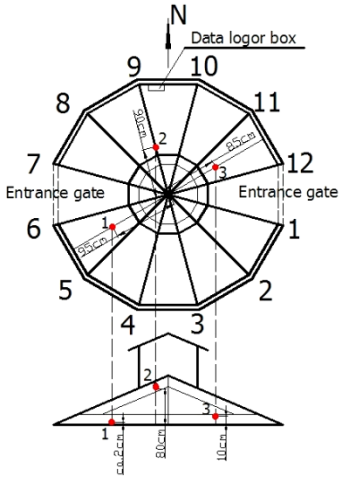
- Determine the wood species, pattern of degradation, weak points
- Reconstruction guidelines: wood species, new glulam and metal construction elements, long time monitoring of MC in the construction

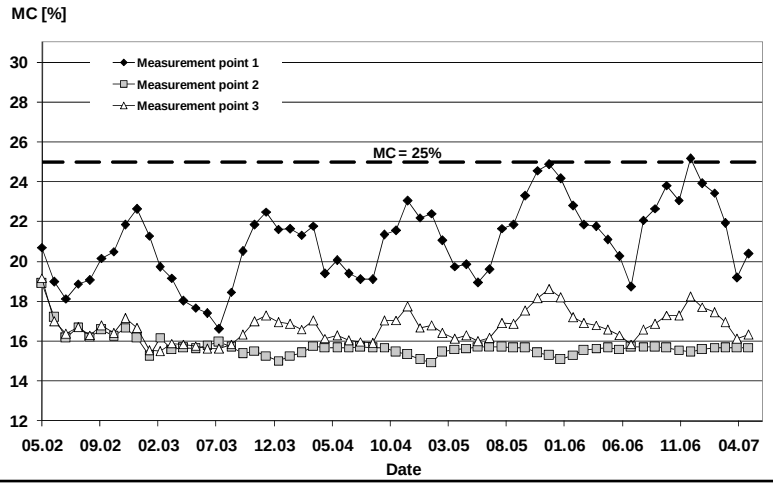


Reconstruction of wooden pavilion ECHO in Park Maksimir Zagreb

Results:

- wood species before: silver fir and spruce, after: oak, larch, spruce
- construction not safe, parts decayed, several panels displaced, ect.
- monitoring the MC of roof construction from May, 2002 – April, 2007





Czech Republic

Czech Technical University Prague

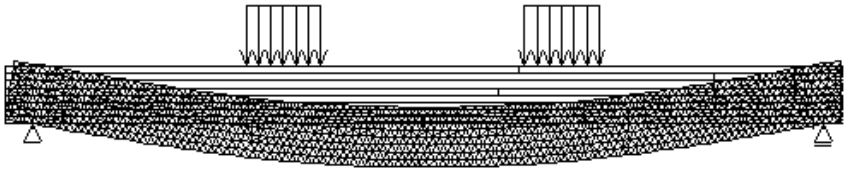
Department of Mechanics & Steel and Timber Structures

Czech Technical University, Prague

Dep. of Mechanics & Steel and Timber Structures

Calculation models for safety verification of wood structures

Modeling of the mechanical performance of enhanced wood-based systems based on FEM and probabilistic methods



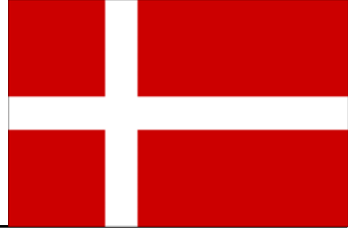
Calculation models for safety verification of wood structures

- Glued structural timber members with higher performance
- Using fiber reinforced polymers as reinforcement

Further work

- Advanced Methods for Design
- Strengthening and evaluation of glued laminated timber

Denmark



Technical University of Denmark

Department of Civil Engineering

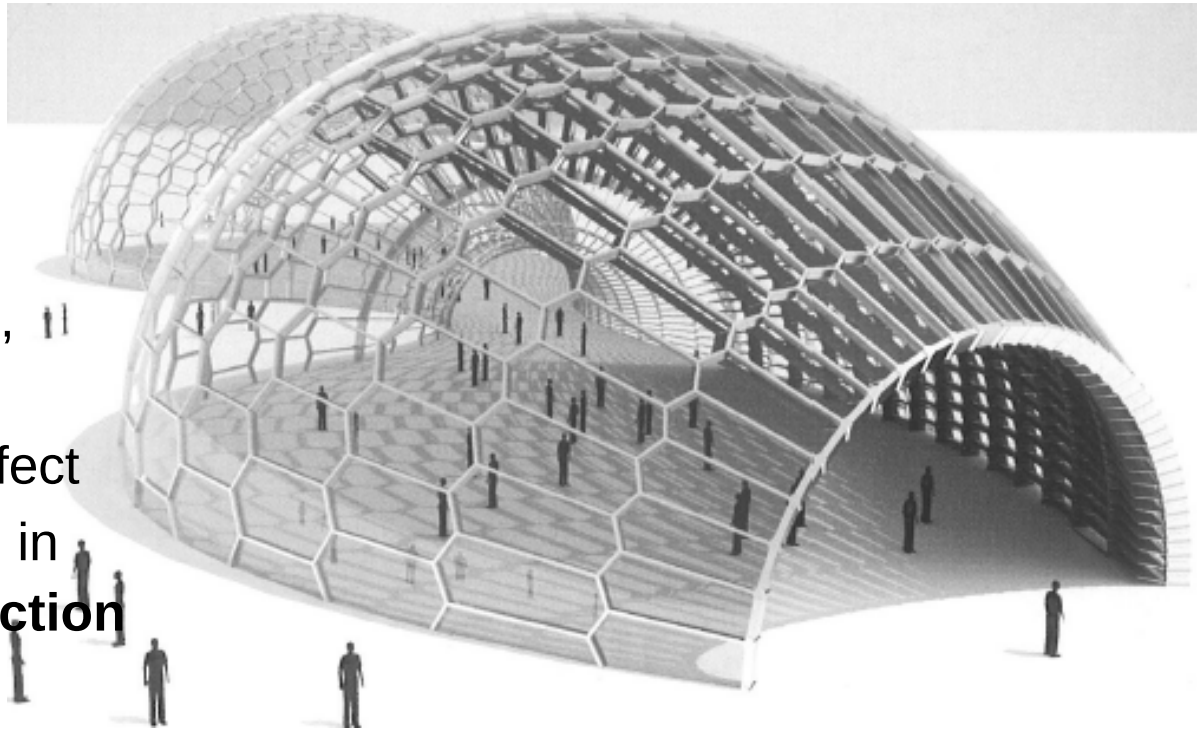
The Royal Danish Academy of Fine Arts

School of Architecture (KADK), Institute for Technology

FE-analysis of glued conical shaped connection in architectural freeform structures in wood

Analysis aims:

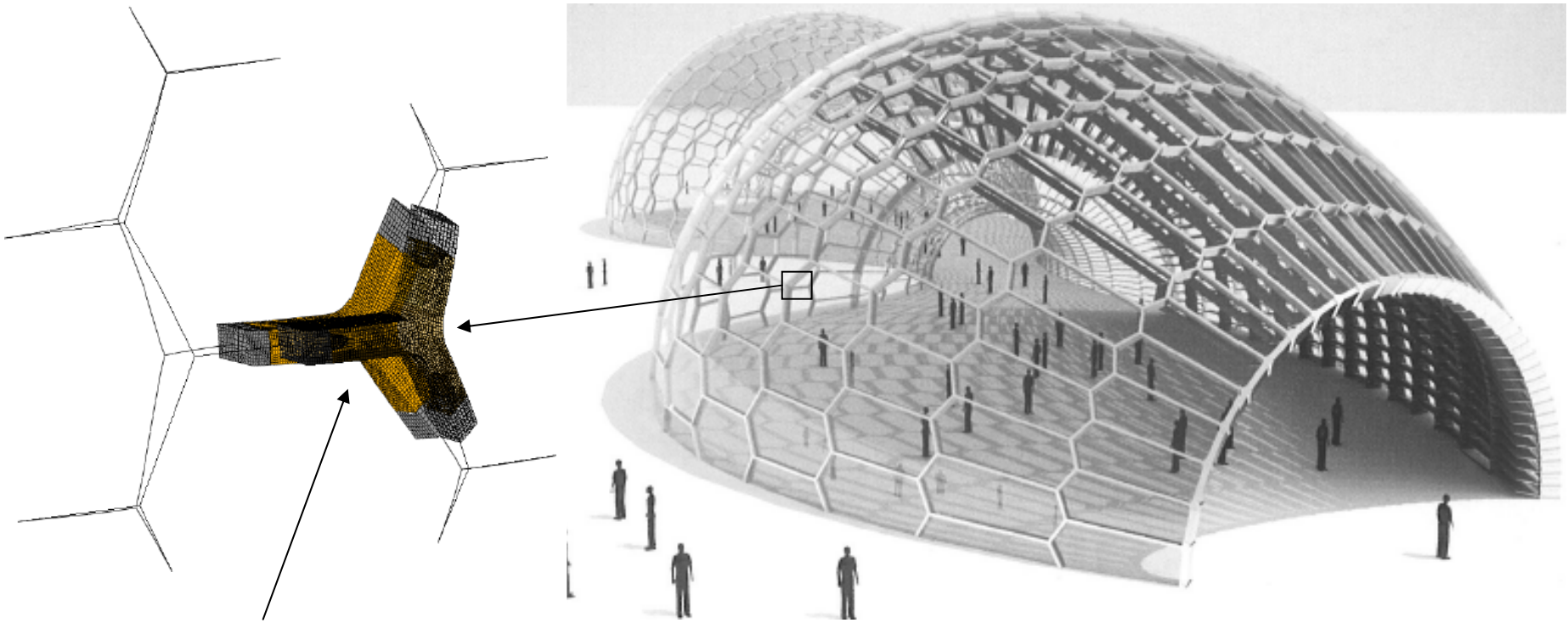
Parameters affect as cone depth, taper angle, annual ring orientation and **rubber foil joint** affect to the stress distribution in **conical shaped connection** in architectural freeform structures.



Helmut Pottmann, Andreas Asperl, Michael Hofer, and Axel Kilian. Architectural Geometry. 2007.

Technical University of Denmark
Department of Civil Engineering

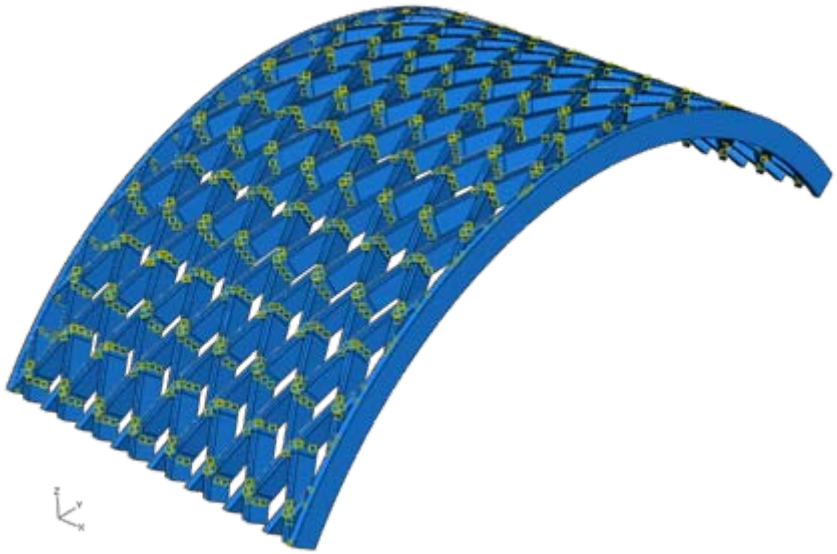
FE-analysis of glued conical shaped connection in architectural freeform structures in wood

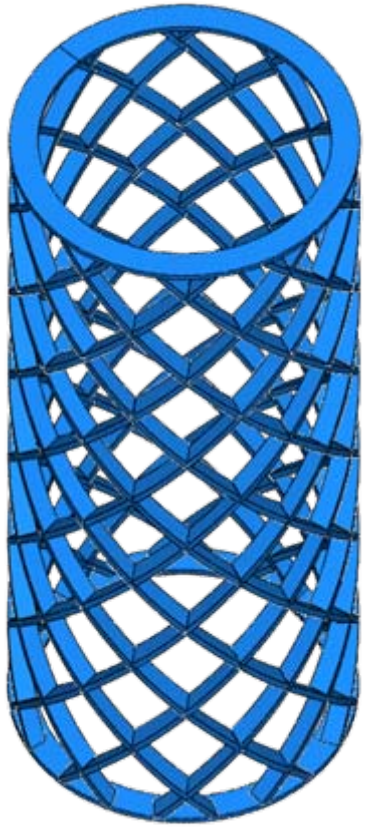


Adaptive modeling of a 3-directional element with conical shaped joints

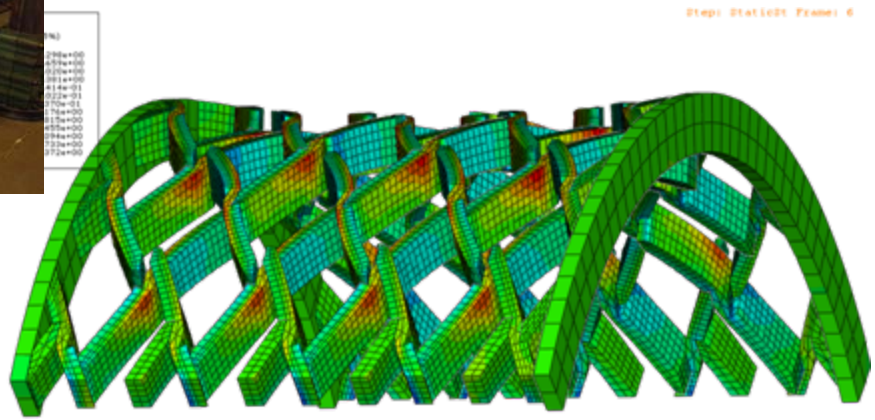
Modeling of (dowel free) connections in arch structures

- Optimize the arch geometry, pattern and the geometry of the connections.
- Parametric controlled finite element model





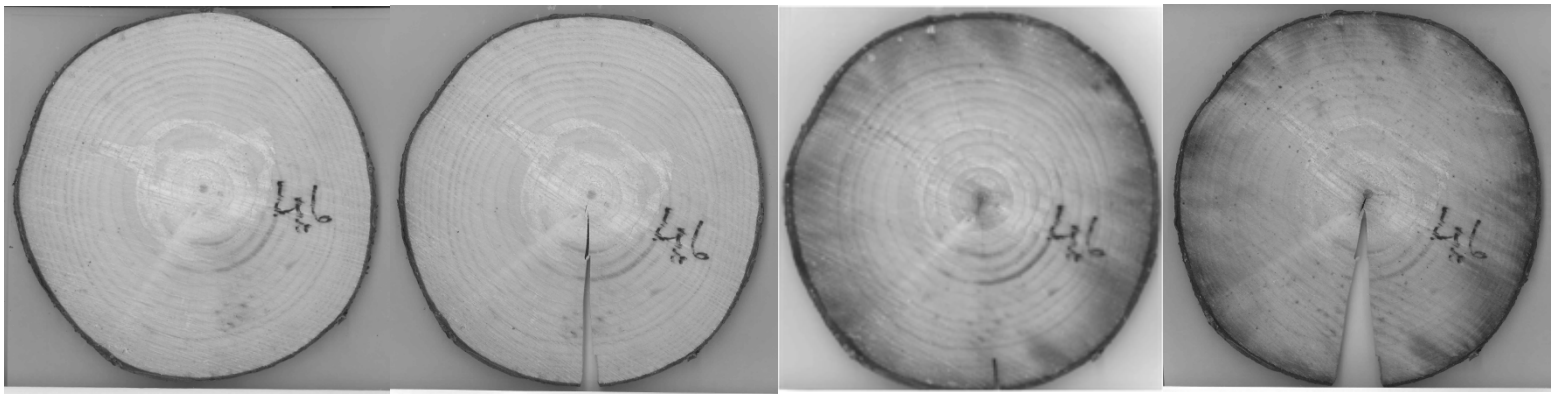
Modeling of (dowel free) connections in arch structures



Moisture induced stresses and fracture in wood

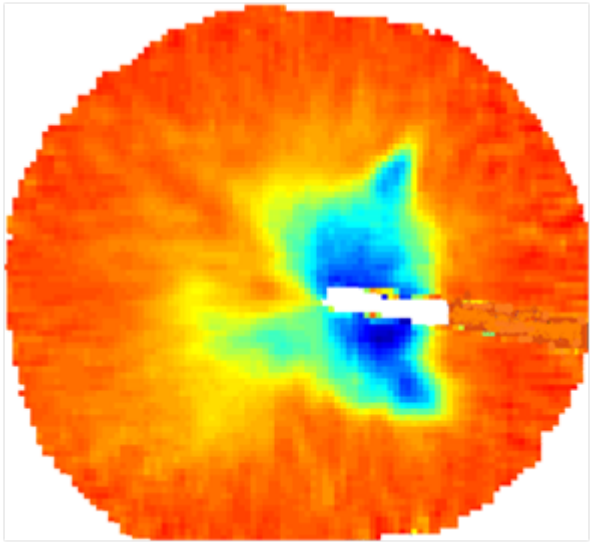
Objectives:

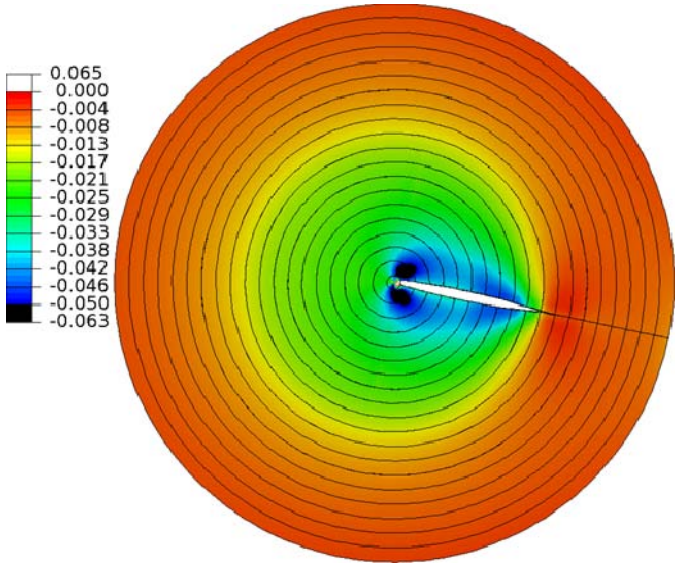
Extend the material knowledge to enable the development of new and accurate models for **distortion and crack propagation** in wood during drying and later in the service life of the final timber products.



Moisture induced stresses and fracture in wood

Tangential strain distribution after 25 h drying





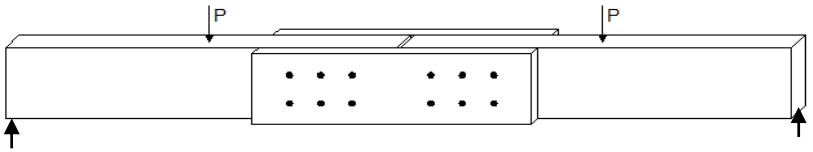
Experiment (ARAMIS)

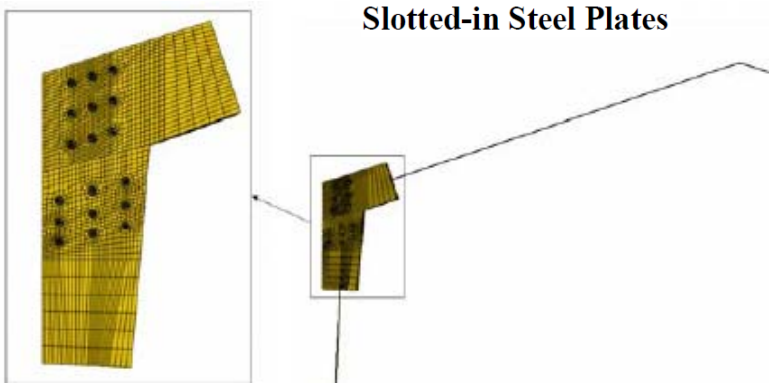
Simulations (ABAQUS)

Simulation of force distribution in mechanical connections subjected to moment action

Objectives:

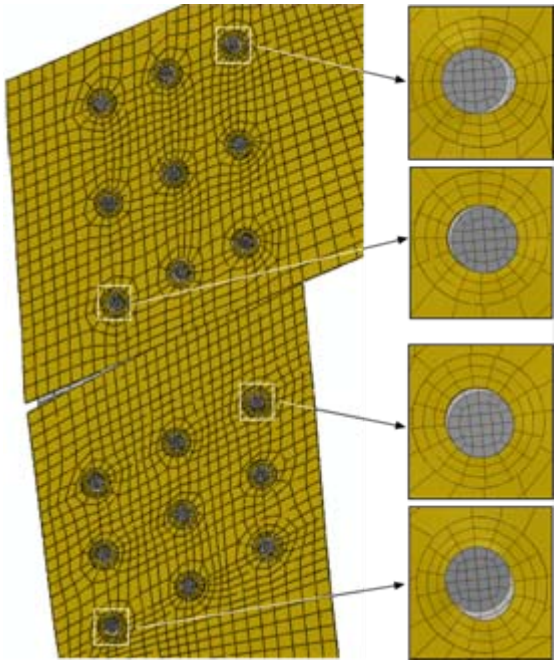
F**orce distribution in a dowel type connections** subjected to moment action if the direction and / or size of the forces found from numerical calculations differ from the force distribution found from the conventional hand calculation method.

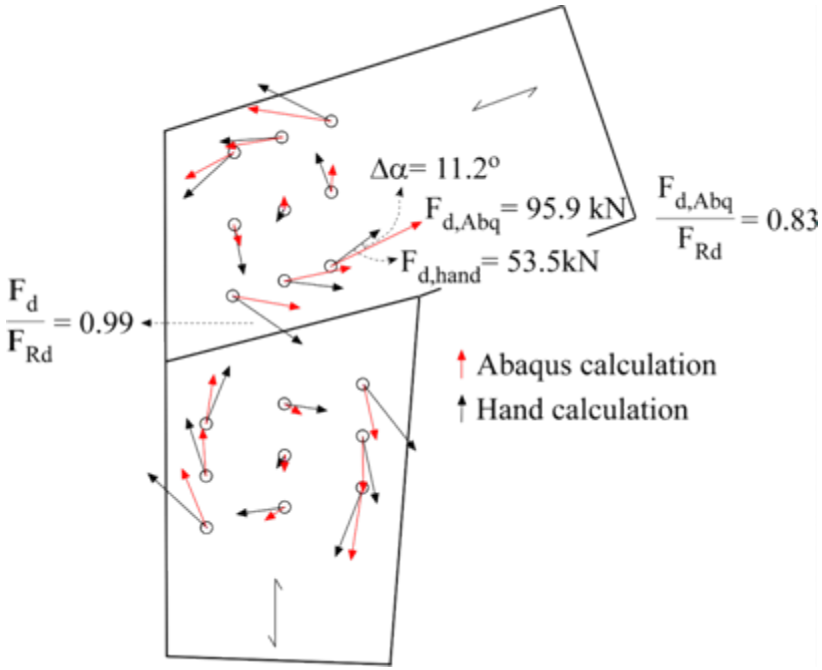




Simulation of force distribution in mechanical connections subjected to moment action

Deformations and force distribution within the frame corner

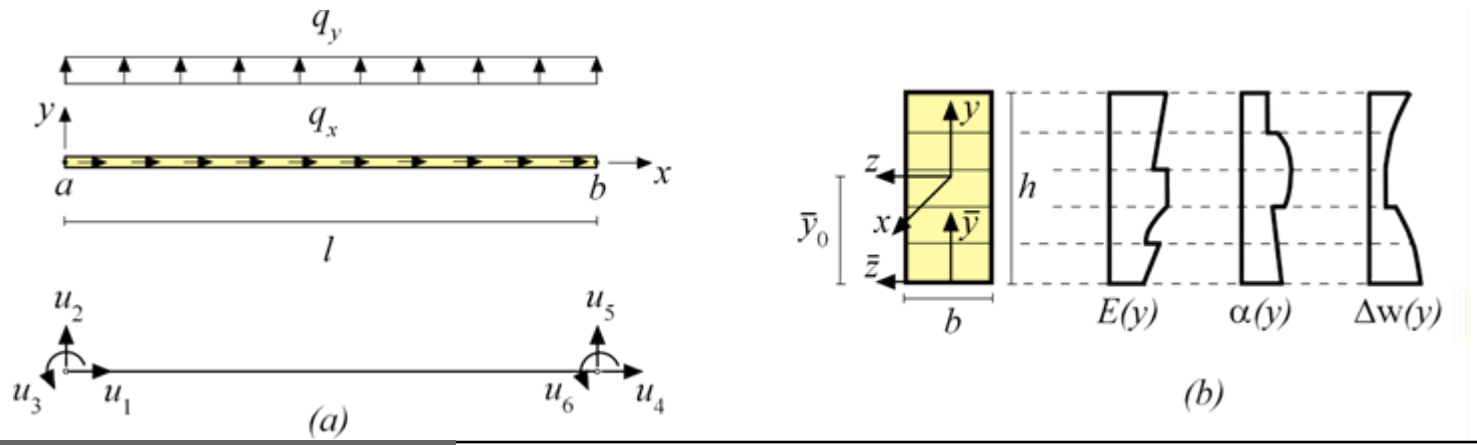




Non linear modeling of moisture related and visco-elastic deformations in inhomogeneous timber beams

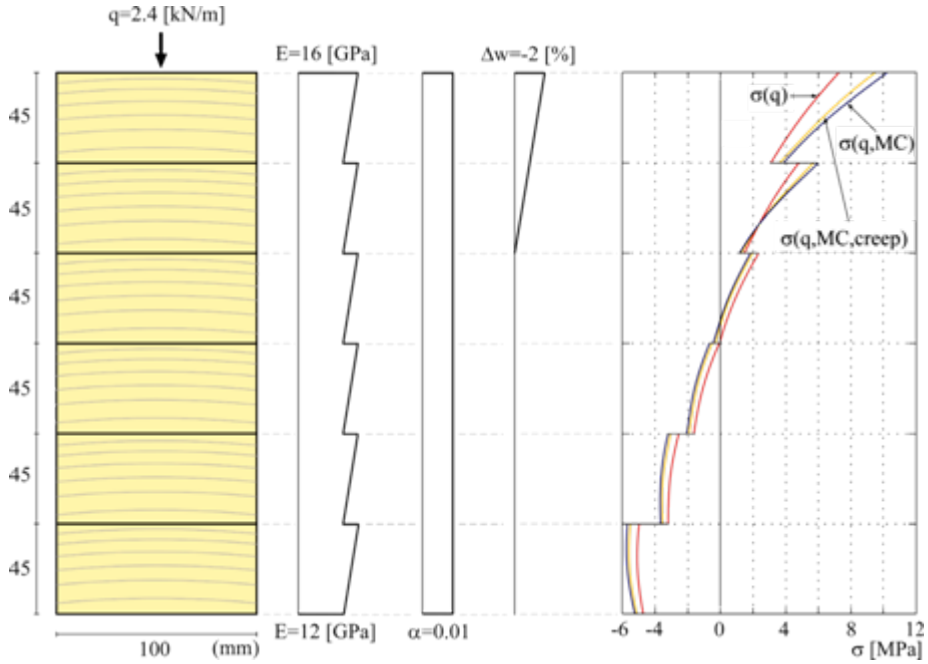
Objectives:

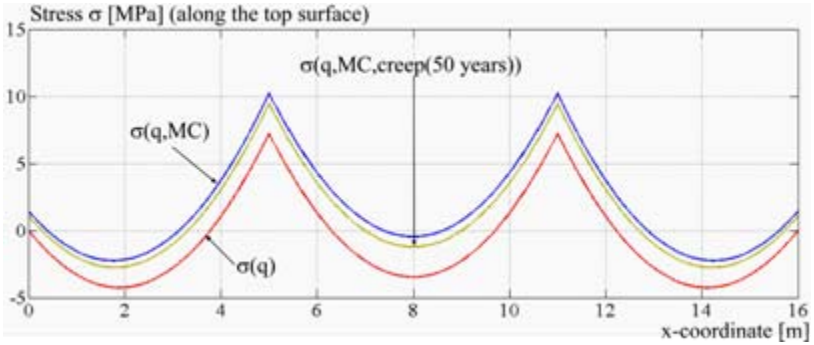
To study how MOE and shrinkage properties have influence on stress distribution in laminated timber beams subjected to combined mechanical and environmental load action.



Non linear modeling of moisture related and visco-elastic deformations in inhomogeneous timber beams

Stress distribution over the cross section (at the beam support)

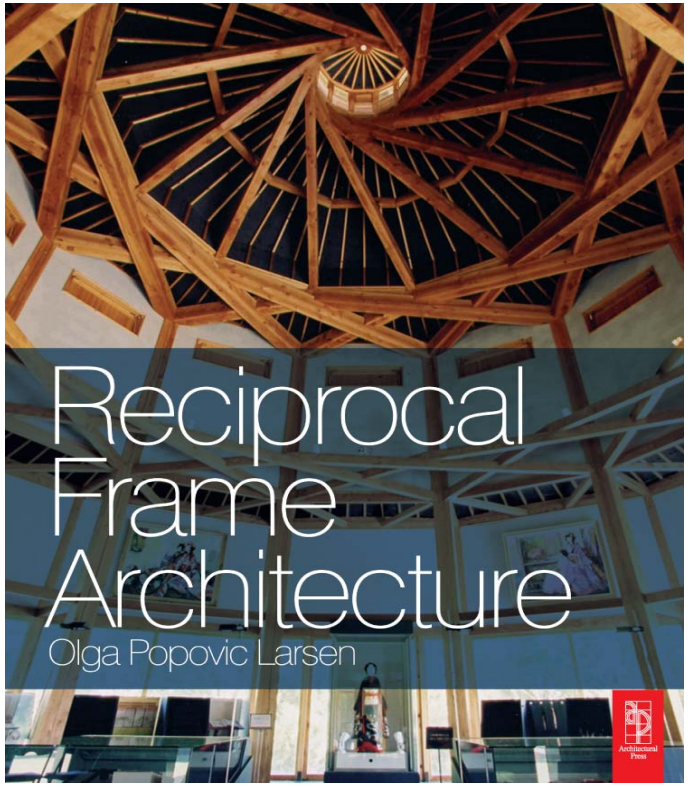




The Royal Danish Academy of Fine Arts School of Architecture (KADK)

Reciprocal frame structures

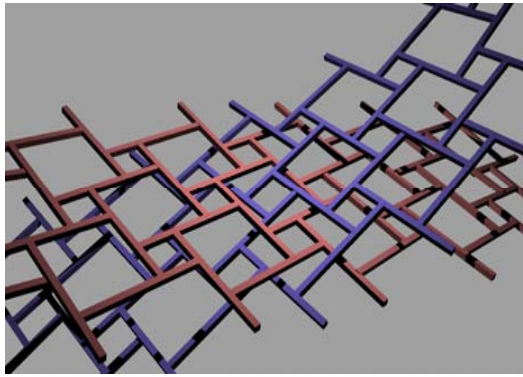
- The main aim of the project is to explore new possible structural morphologies of reciprocal frames
- The explorations are mainly done using physical models



The Royal Danish Academy of Fine Arts School of Architecture (KADK)

Reciprocal frame structures

Morphology explorations
doubly curved and straight



The Royal Danish Academy of Fine Arts School of Architecture (KADK)

Wood for Good:
Innovation in timber design & research

Main aims:
Bridge the gap between
Research-Practice-Teaching

Bring closer
Research + Teaching + Practice

The one day symposium brought together
Architects, Structural Engineers, Contractors,
Artists and Researchers
from Denmark, Sweden, Norway and UK.

The Royal Danish Academy of Fine Arts School of Architecture (KADK)

Wood for Good:
Innovation in timber design & research

Presentations included:
Timber bridges
Gridshells
Reciprocal Frames
Cross-laminated timber

A book was published with all the presentations

A new project/network was innitiated

FYR of Macedonia

University Ss.Cyril and Methodious, Skopje

Institute of Earthquake Engineering and Engineering Seismology

University Ss.Cyril and Methodious, Skopje

Faculty of Civil Engineering

UKIM-IZIIS, Skopje

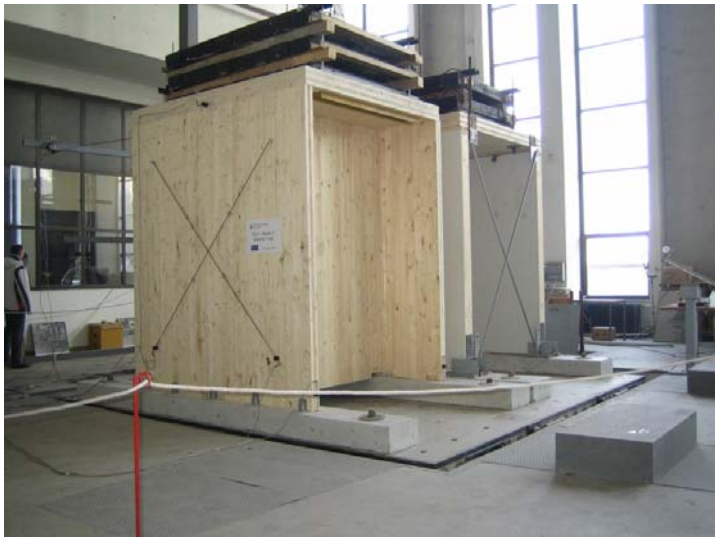
Earthquake Engineering and Engineering Seismology

Racking strength of massive wooden XLam panels

- Performance characteristics of solid wooden wall panel elements subjected to lateral loads (experimental / analytical approach)
- Testing under combined constant vertical / cyclic horizontal loads and different boundary conditions → 2D FE Models using FELISA/3M

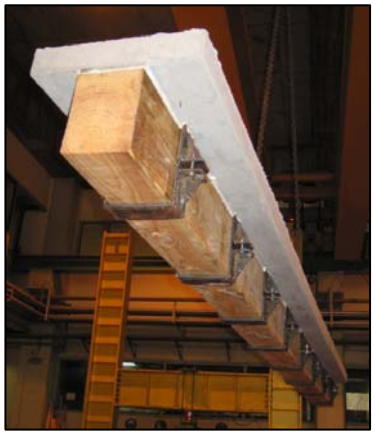
Racking strength of massive wooden XLam panels

- Mechanical properties of the dynamic response of tested models and development of a reliable analytical model
- Future steps: Numerical verification of the tests; development of more sophisticated 2D/3D constitutive relationships for connections (FEM)



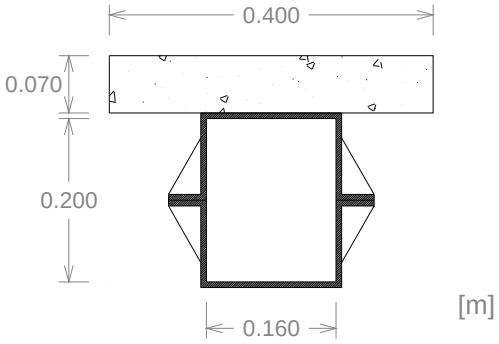
Earthquake protection of historical buildings by innovative reversible technologies - Timber-concrete-steel composite slabs

- Improvement of earthquake behavior of timber floors by introducing a concrete slab, which increases in-plane rigidity and keeps the shape of the building.
- Lab tests (push-out tests) varying in:
  type of the device surface (rubber or rough steel surface), number of bolts, angle of stiffeners, pre-stress applied to the bolts and loading protocol
- Experimental results: connection between
  device and timber / device, timber and concrete

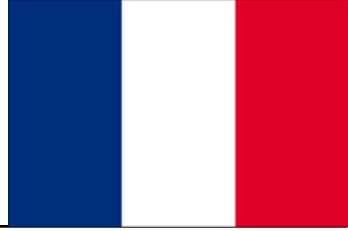


Earthquake protection of historical buildings by innovative reversible technologies - Timber-concrete-steel composite slabs

- Beam test: 6 Composite full-scale timber-concrete beams
  (4 models with devices with rubber, 2 with rough steel,
  different spacing between the devices)
- Data obtained: beam deflection; mid-span vertical relative displacement timber/concrete slab; relative sliding timber/concrete, timber/devices
- Future steps: Long term behavior under permanent bending loading



France



Arts et Métiers ParisTech, Cluny

LaBoMaP

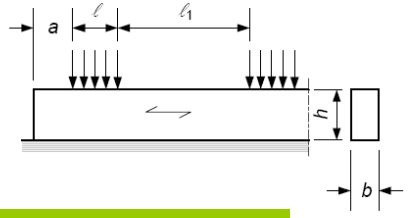
LERMAB, Epinal

Nancy University

ENSTIB

Timber in compression perpendicular to the grain

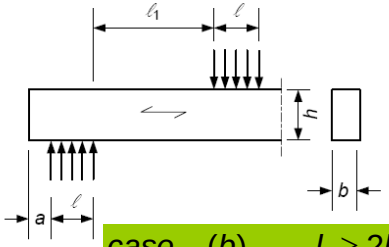
- Test method for compression strength perpendicular to the grain was changed and strength values for softwood in EN 338 were reduced.
- Consequently, a change in Eurocode 5 was necessary to ensure an equivalent resistance level in compression perpendicular to the grain.



case (*a*) $l_1 \geq 2h$

$k_{c,90} = 1.25$ *Solid timber*

$k_{c,90} = 1.5$ *Glulam*



case (*b*) $l_1 \geq 2h$

$k_{c,90} = 1.5$ *Solid timber*

$k_{c,90} = 1.75$ *Glulam if* $l \leq 400\,mm$

$$\sigma_{c,90,d} \leq k_{c,90} \cdot f_{c,90,d}$$

In other cases

$k_{c,90} = 1$

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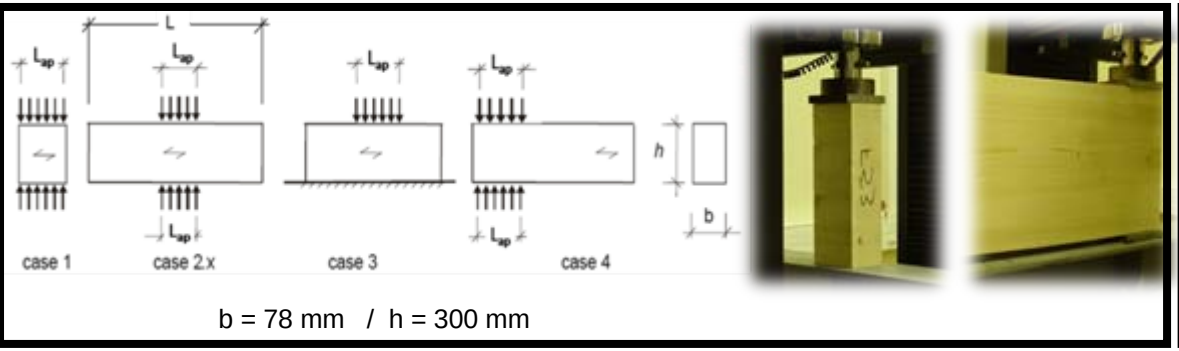
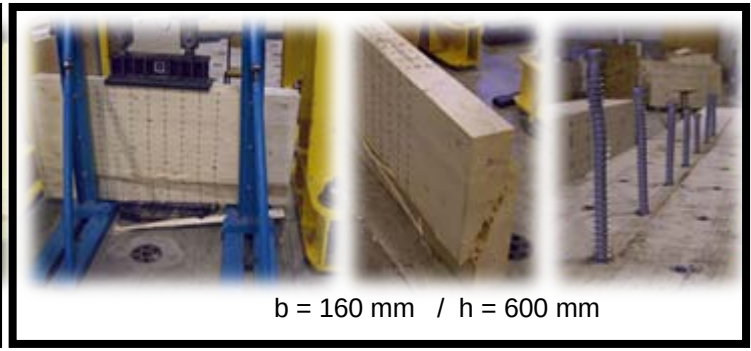
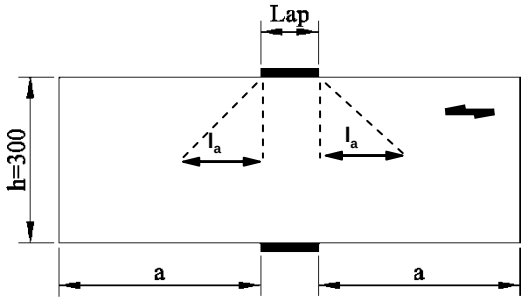


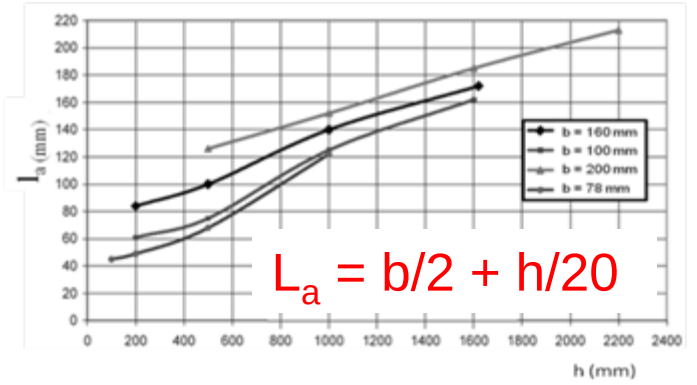
b = 78 mm / h = 300 mm



b = 160 mm / h = 600 mm

- Experimental tests in compression perp. to the grain using screws as reinforcements.
- Numerical model for rule of calculation.





Further on-going work

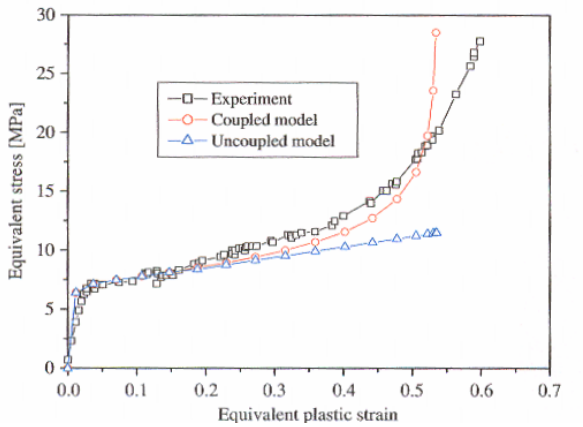
- Better understand the behaviour of the srews
- Optimize spacing rules, PhD on this topic

ENSTIB, Nancy University

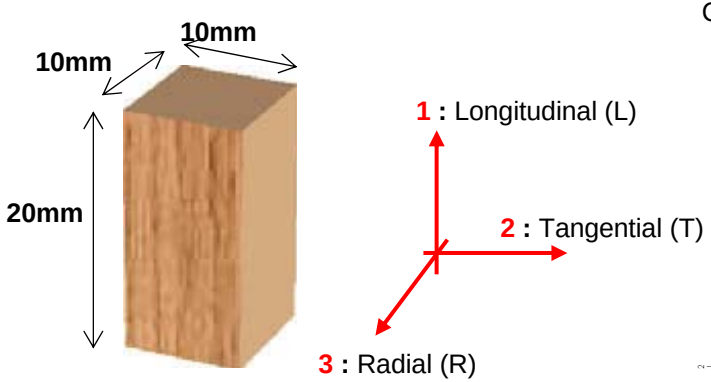
LERMAB, Epinal

Numerical modeling of the behavior of timber under large deformations and related timber structural systems

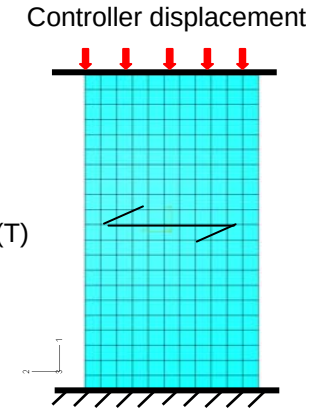
- Prediction of the elasto-plastic wood behavior under large deformations
- Anisotropic Hill's criterion
- Model that accounts for densification in radial compression and brittle failures in tension and shearing, implementation in ABAQUS



Stress-strain curves under radial compression



(a). Sample geometry



(b). F-E model

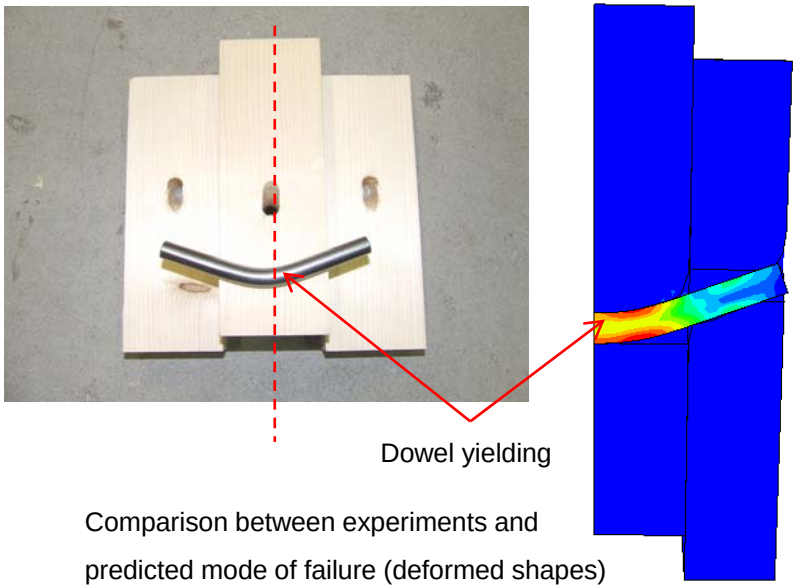
ENSTIB, Nancy University

LERMAB, Epinal

Numerical modeling of the behavior of timber under large deformations and related timber structural systems

Work in progress:

- Development of simplified numerical models for nailed / screwed joints
- Development of specific finite elements for multi-physic behavior of timber: visco-elasto-mecanosorptive creep
- Micro-mecanical constitutive modelling of timber under large deformations



Comparison between experiments and predicted mode of failure (deformed shapes)

Germany

University of Kassel

Building Rehabilitation and Timber Engineering

Mainz University of Applied Sciences

Trier University of Applied Sciences

Timber Structures and Structural Design

Technical University of Munich

Chair for Timber Structures and Building Construction

Holzforschung München

Bauhaus-University of Weimar

Chair of Timber and Masonry Engineering

Adhesive bonded hybrid constructions from timber and concrete - Influence of thermal / hygrothermal conditions on bonding strength

Objectives

- New insight in long term loading behavior of bonded hybrid structures
- Enhance the knowledge about swelling and shrinkage behavior of wood and HP concrete under changing thermal and humidity cond.

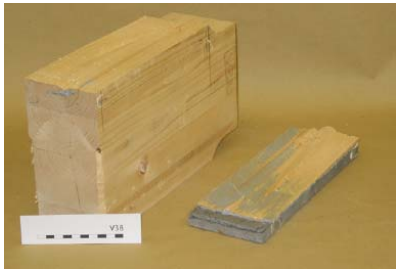
Further on-going work

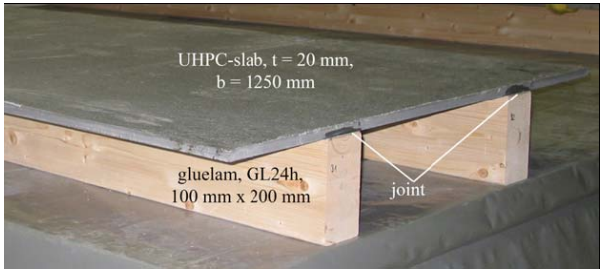
- Experimental studies under artificial and natural climate conditions on different scales
- Numerical studies using a cohesive interface to represent failure of adhesive bonded hybrid constructions

University of Kassel

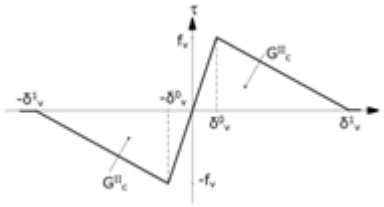
Building Rehabilitation and Timber Engineering

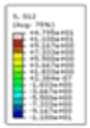
Adhesive bonded hybrid constructions from timber and concrete - Influence of thermal / hygrothermal conditions on bonding strength

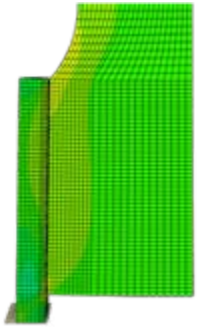


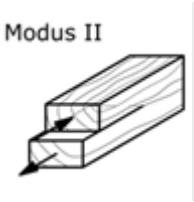


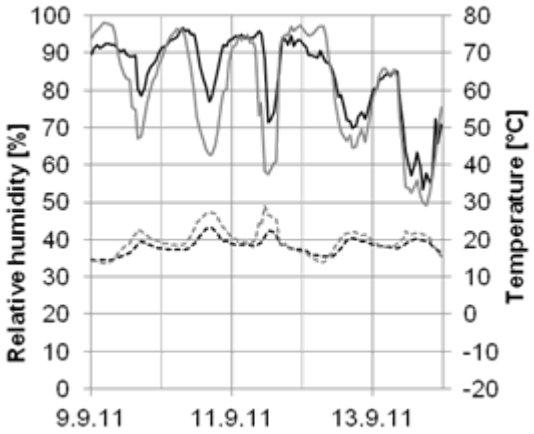
small scale → **full scale**











Optimization of timber multi-storey buildings against earthquake

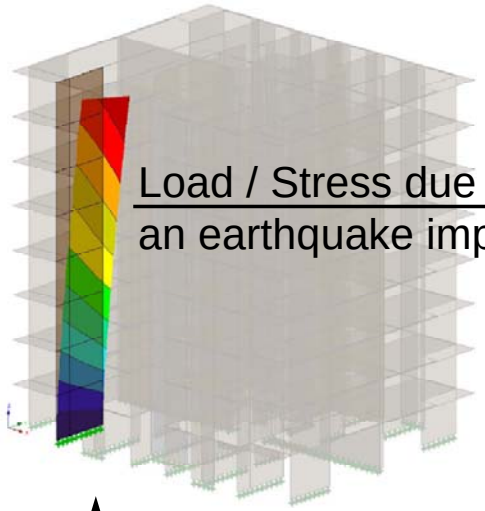
- Objectives: optimization and standardization of timber buildings in terms of earthquake design
- Preliminary design – case study on multi-storey buildings
- Experimental tests (monotonic, cyclic) on connections and wall elements (CLT, light-frame)
- Modeling (numerical simulation) in cooperation with Sassari + Trieste

Further on-going work:

- Experimental investigation on connections and anchoring details
- Full scale tests on timber-framed and CLT wall elements
- Development of performance-based calculation tools

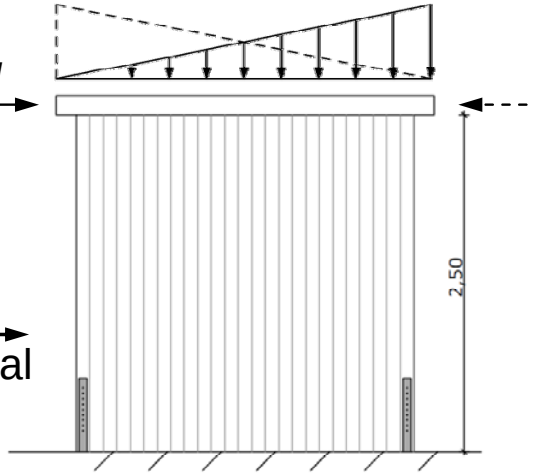
Optimization of timber multi-storey buildings against earthquake

Benchmark object

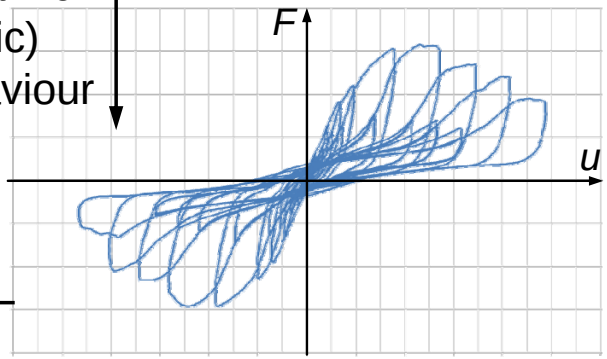


Load / Stress due to an earthquake impact

Test conditions (vertical, horizontal loading)



Dynamic (cyclic) behaviour



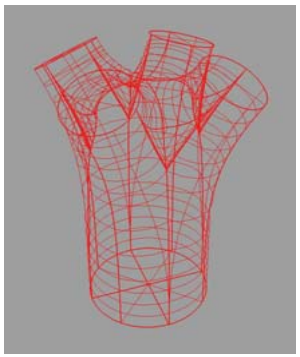
Analysis enhancement and optimization

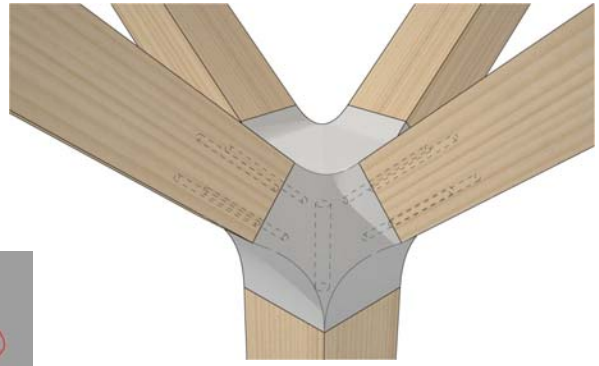
Calculation model

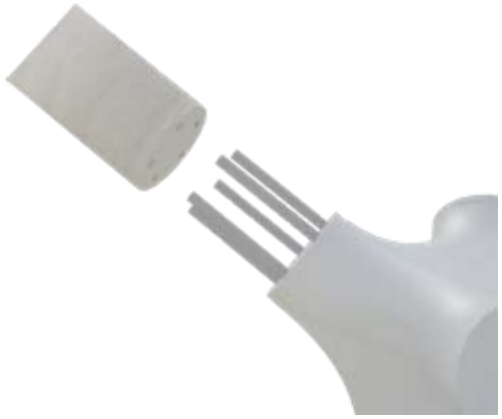
Mainz & Trier University of Applied Sc.
Timber Structures and Structural Design

UHPC-composite joints with force- and formoptimized design

Spatial structures are usually fitted by expensive steel knots, where the shape of force trajectories is often unrespected.







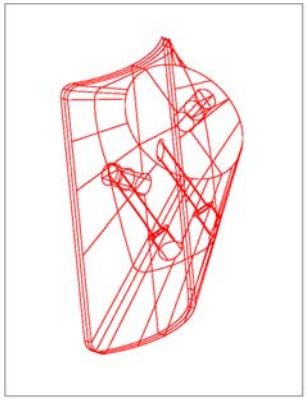
Solution:

CAE/CAM-process creates UHPC-composite joints with force- and formoptimized design and simple fastening methods with laminated bar connections

Mainz & Trier University of Applied Sc.
Timber Structures and Structural Design

UHPC-composite joints with force- and formoptimized design

- Experimental research of new-type timber-composite joints in round wood truss structures.
- Numerical formfinding and CAM-process



On-going research work:

- Material tests of fracture behavior and embedding strength of fasteners.
- Model calibration with lab tests.

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Timber Structures and Structural Design

HP Timber-composite joints for round wood truss structures

- The structural performance of truss structures depend on the strength of the connections.
- The full structural capacity cannot be used due to the low embedding strength of fasteners.

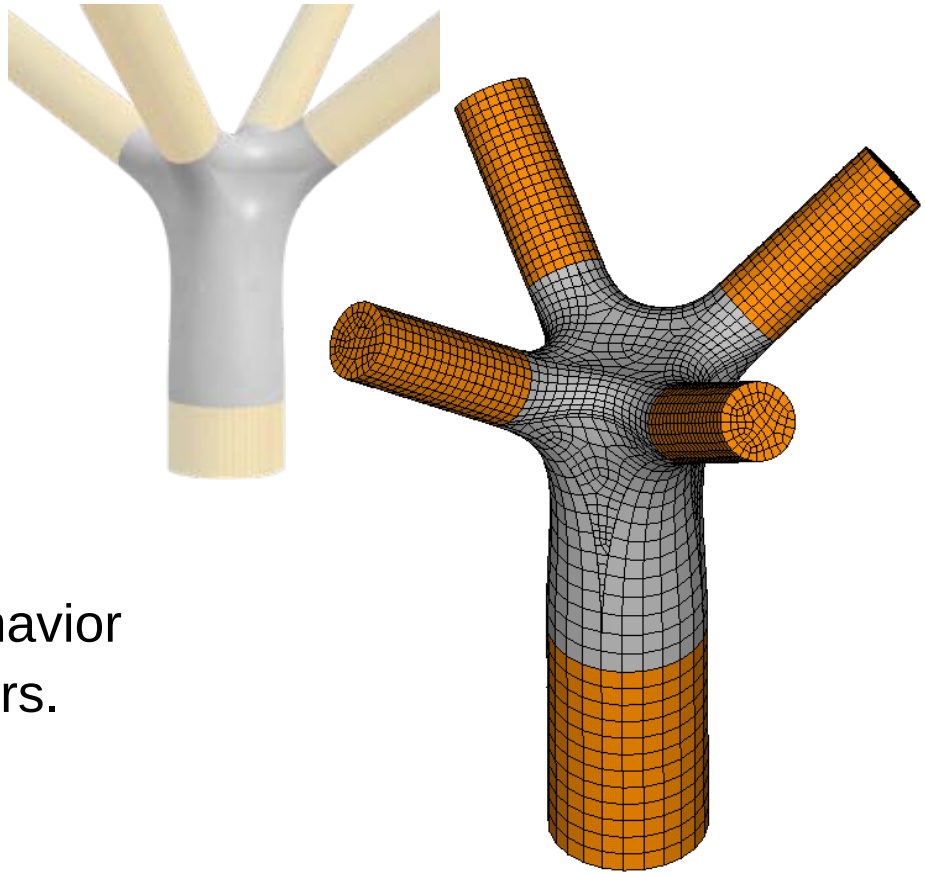
Solution:

Timber-composite joints
with dowel-type fasteners
embedded in high-performance
ceramic materials.

Mainz & Trier University of Applied Sc.
Timber Structures and Structural Design

HP Timber-composite joints for round wood truss structures

- Experimental research of new-type timber-composite joints in round wood truss structures.
- Investigations on embedding effects and withdrawal resistance.

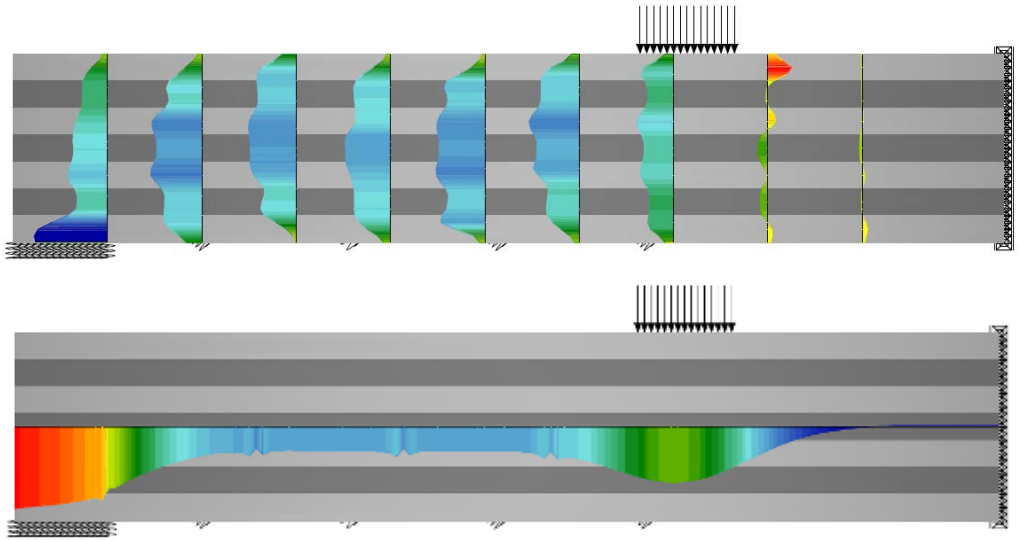


On-going research work:

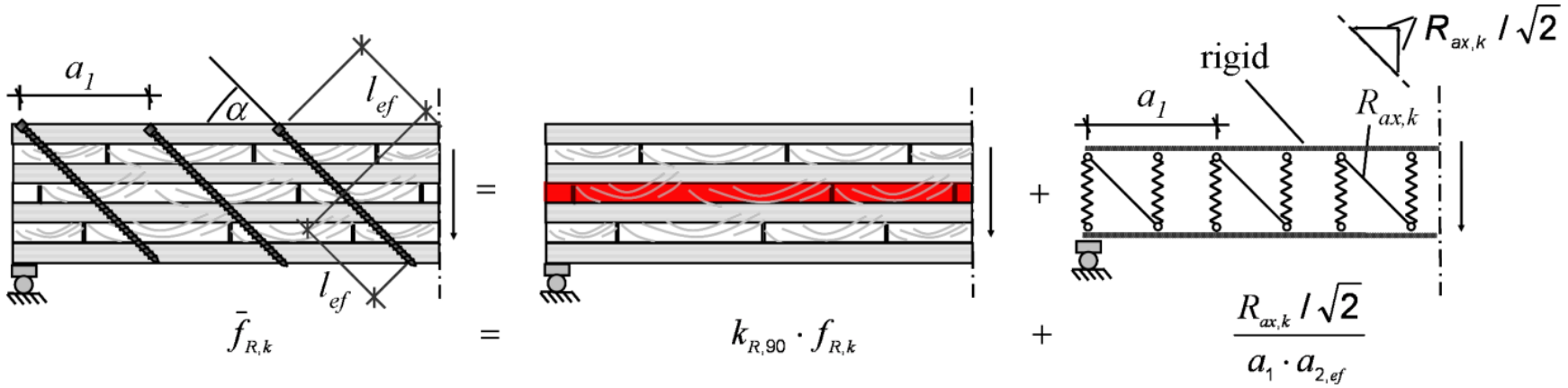
- Numerical modeling of fracture behavior and embedding strength of fasteners.
- Model calibration with lab tests.

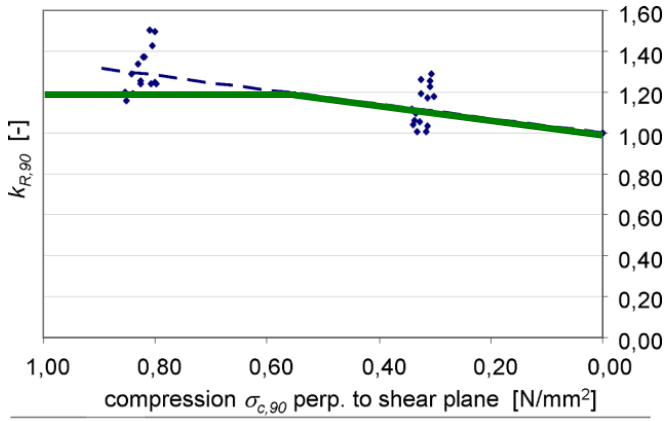
Design concept for CLT – reinforced with self-tapping screws

- Decrease shear stresses in CLT elements
- Use interaction of stresses (shear + compression perp.)
- Design concept for reinforced CLT



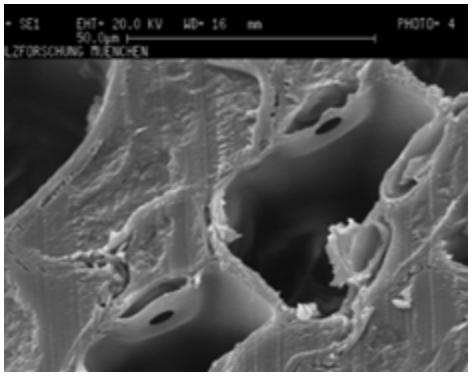
Design concept for CLT – reinforced with self-tapping screws

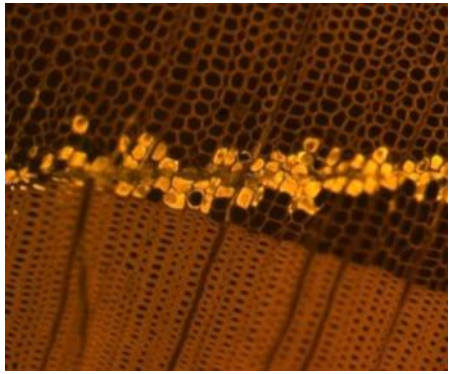




Adhesives for load-bearing timber structures

- InnovaTUM - LignovaTUM
- Possibilities of glueing different types of wood

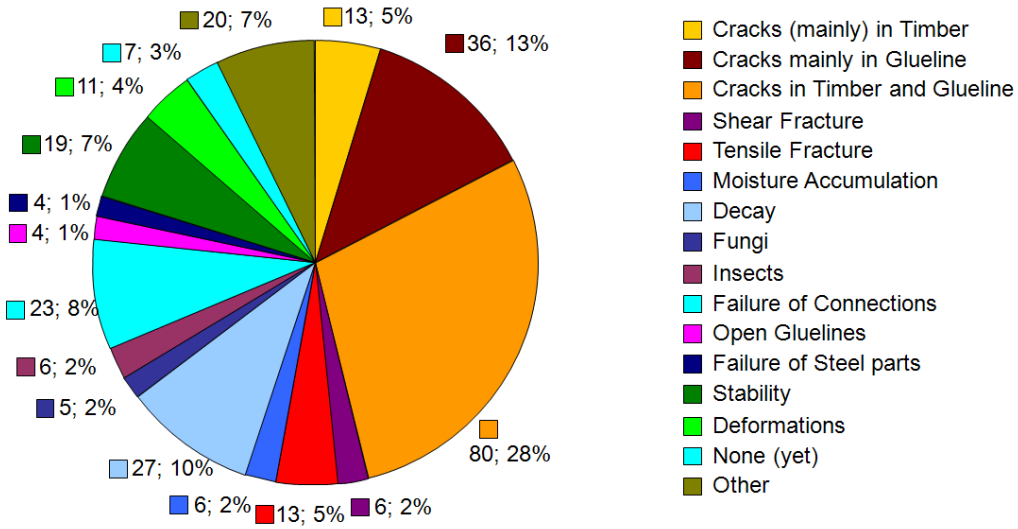


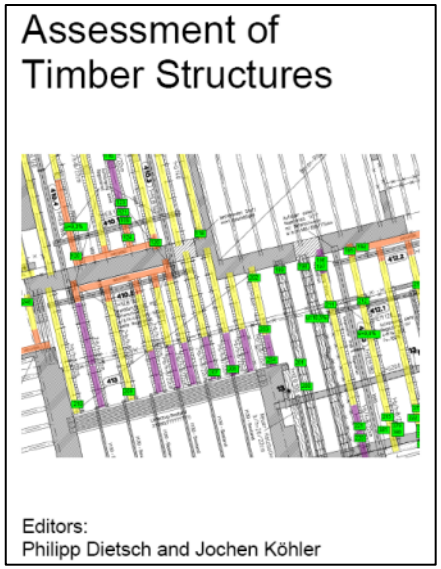


Assessment of large-span timber structures

- Acquire knowledge on typical failure mechanisms
- Evaluate different assessment methods for timber structures

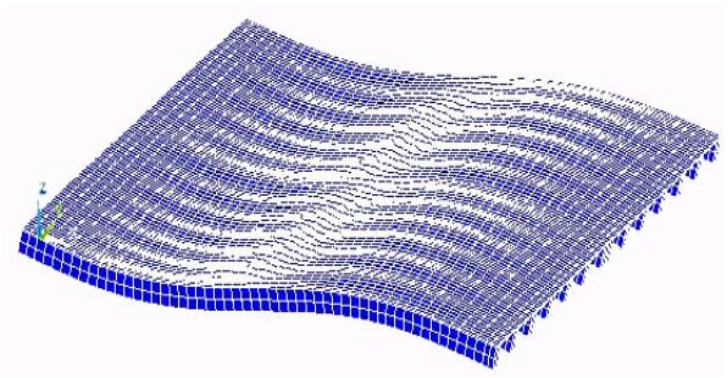
Evaluation of failed Timber Structures – Type of Failure





Human induced floor vibrations in timber buildings

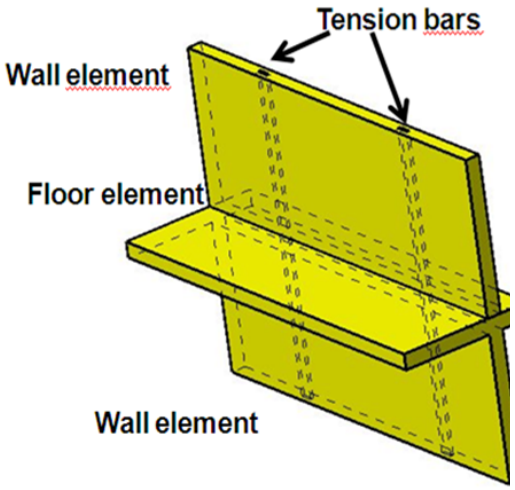
- Establish criteria to control vibrations induced by human normal activities to guarantee the occupants Comfort
- Design rules for human induced floor-vibrations in timber + hybrid struct.
- Development of construction solutions

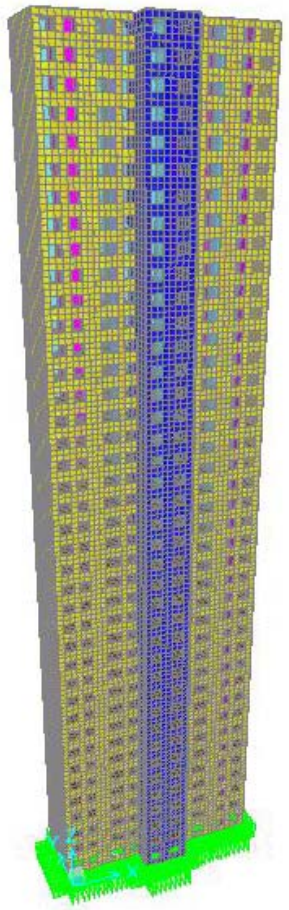


High-rise XLam-concrete buildings

Analyse High-Rise Buildings

- > 30 storeys
- High-rise buildings system engineering
- Concrete cores
- XLAM with tension bars

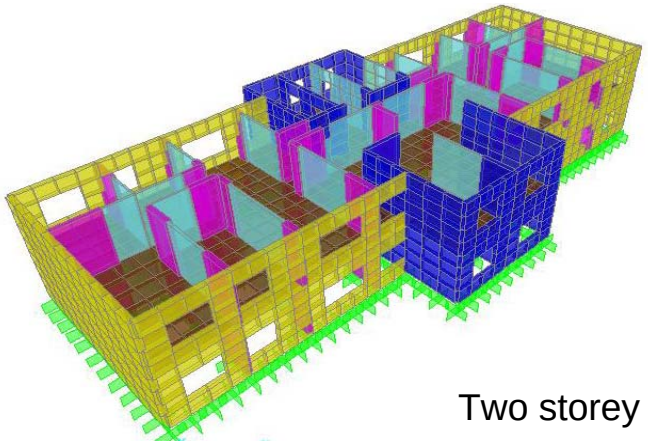




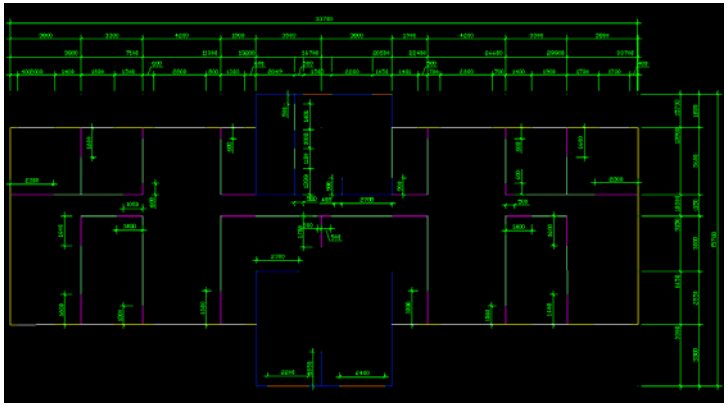
High-rise XLam-concrete buildings

Shanghai-Example (3D-model)

- 40 storeys, floor plan 15.7 m x 33.7 m
- Existing concrete apartment building
- Redesigned with XLAM-concrete core
- Sway analysis, connection models



Two storey view



Glued-laminated timber of European hardwoods

- Develop high strength glulam using hardwood species
- Beech, ash as main alternatives to spruce
- Glues, glue application / approval / quality control
- Finger joints and tests
- Tensile testing of lamellas
- Glulam beams
- Compression perpendicular to the grain

Beech and Spruce glulam with equal strength

Glued-laminated timber of European hardwoods

- Yields in grading
- Machine strength grading of beech and ash
- High capacity joints
- Hybrid beams

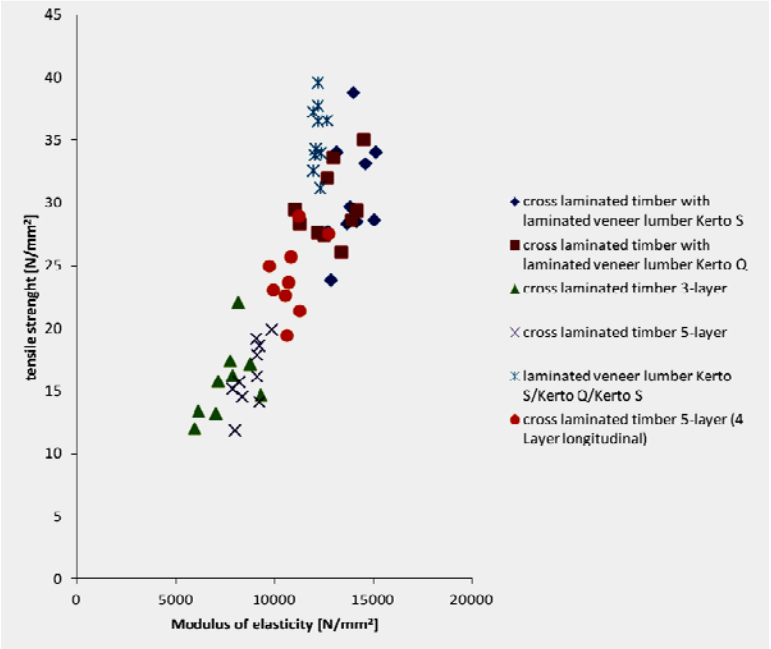
Technical University of Munich
Holzforschung München

Advanced EWP´s for high performance timber trusses

- Modified timber products such as XLam and LVL are used as a basis for long span timber trusses.
- For this XLam is analysed with modified layer orientations and/or additional LVL layers.
- The mechanical properties of Hybrid-glulam as a combination of coniferous species and beech or ash are assessed.
- Prototypes are tested and the mechanical properties are compared with wood compounds which are still used in timber structures.

Advanced EWP´s for high performance timber trusses

Optimized strength and stiffness properties of composite elements for specific applications.
Optimized members in trusses for compression perp. to grain stresses and timber joints with high splitting resistance.



On-going work

Tests of glued-in rods in hybrid-glulam / CLT
Compression perpendicular to grain on hybrid glulam.

Technical University of Munich
Holzforschung München

Development of beech Laminated Veneer Lumber

- Development of high strength LVL
- Support industrial company Pollmeier Hardwoods
- Determination of mechanical properties
- Manufacturing and Gluing

Further on-going work, next steps etc.

- Approval testing to EN 14358
- Determination of depth effect
- Fastener capacity
  (together with Karlsruhe Institute of Technology)
- Production protocols / Quality control

Hybrid wall-slabs made of timber and anhydrite floor for multi-storey buildings

Investigations of anhydrite timber-hybrid elements as shear walls

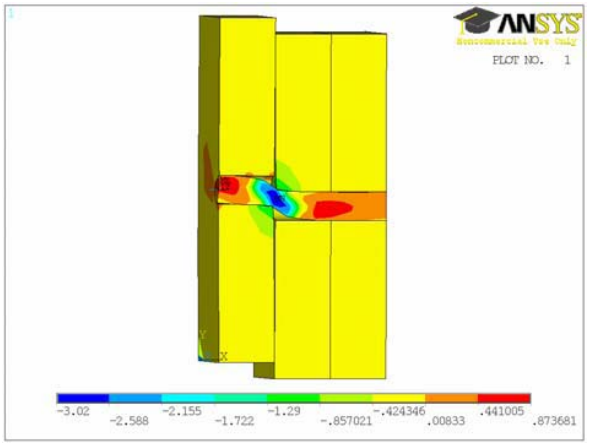
Objectives

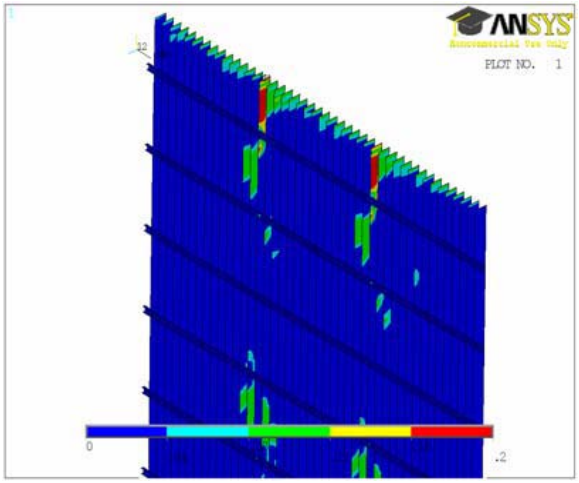
- Shear-walls consisting of board stacks with an additional layer of anhydrite on the surface of the wooden element in direct bound.
- Scope: information about the load-bearing and deformation behavior, in comparison to existing standards.

Hybrid wall-slabs made of timber and anhydrite floor for multi-storey buildings

Further on-going work

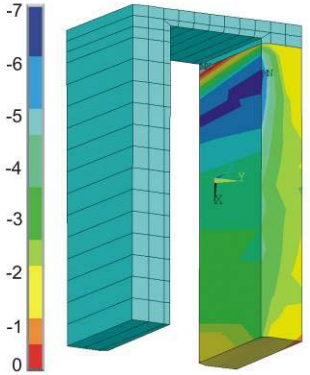
- Enhanced numerical modeling of fracture behavior and further experimental investigations under cyclic loading
- Experimental and numerical study of the joint between timber and anhydrite
- Ecological concept (life-cycle analysis) of the natural hybrid element

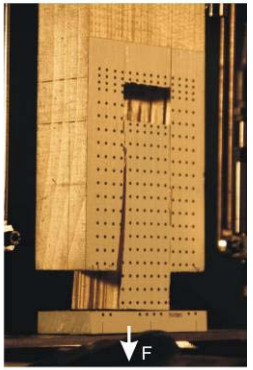




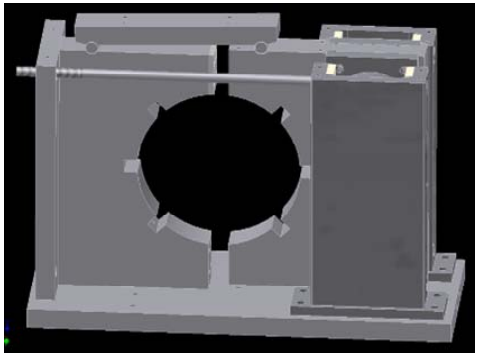
Bauhaus-University of Weimar
Chair of Timber and Masonry Engineering

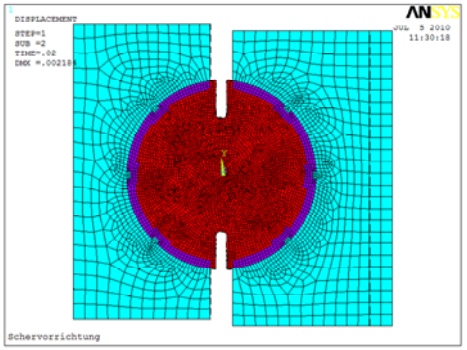
Non-destructive measurement with close-range photogrammetry (CRP)

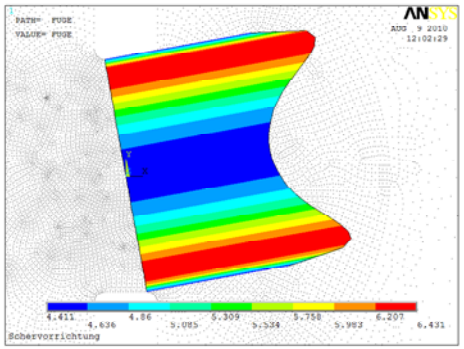




- Determination of strain distribution
- Whole range areas of strain
- Measuring deformations and cracks during lab tests
- Correlation between CRP and numeric analysis (retrial modeling)
- Constitutive equation for material

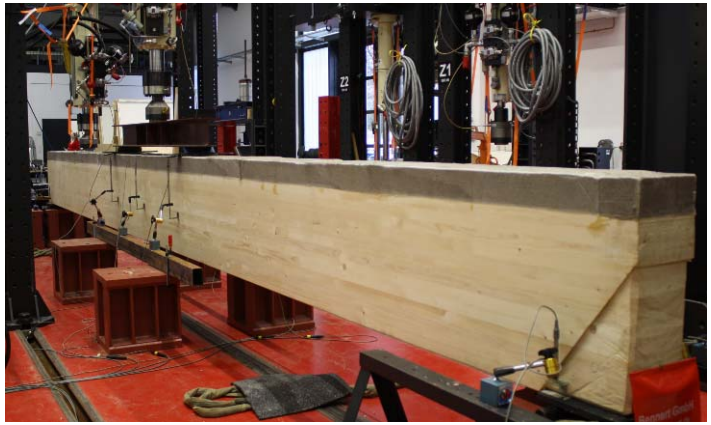






High-performance load-bearing system of timber compound with composites

Development of a high performance load bearing system made by timber in combination with modern composites as FRP and polymer concrete.

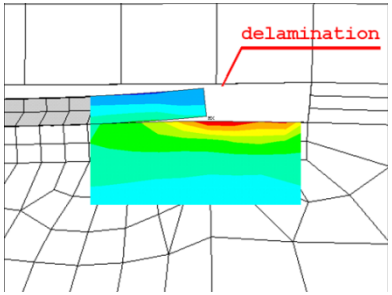


- Timber beams from glued-laminated lumber
- Reinforcement of compression zone by polymer concrete
- Reinforcement of tension zone by FRP

High-performance load-bearing system of timber compound with composites

Investigations

- Experimental investigation for detail design
  - anchorage of FRP
  - bearing / mounting
- Experimental investigation of large size specimen
- Analysis of materials: improvement of mixture, long term behavior
- Numerical analysis



Load-bearing-, deformation- and fatigue behavior of special connectors used for timber-concrete composite road bridges

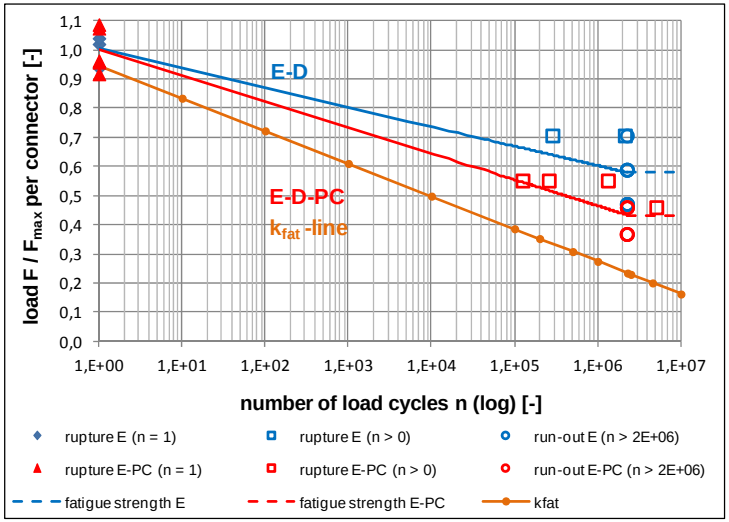
- Ductile connection between concrete deck and log-glued timber main girder
- Shear force transfer with the stud connector
- Joint design: a) direct contact between steel and timber in the facing area and b) polymer concrete layer in the load-bearing area

a) series E

b) series E-PC

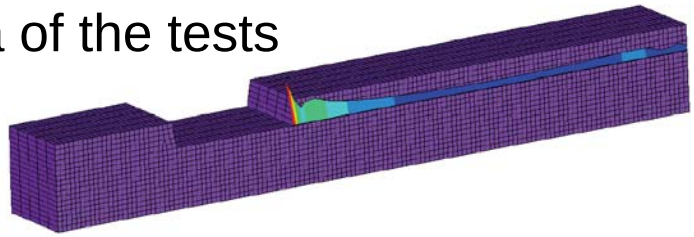
Load-bearing-, deformation- and fatigue behavior of special connectors used for timber-concrete composite road bridges

- Short-time shear- and fatigue tests under cyclic loading
- Elaboration of S-N-lines for both designs of the joint and comparison to the k_{fat}-line according to EC 5, part 2



Further on-going work

Numerical simulations on the basis of extensive data of the tests



FE shear stress over the length of timber in front of the step joint

Greece

National Technical University of Athens

Laboratory for Earthquake Engineering

Aristotle University of Thessaloniki

TEI of Larissa

Department of Wood and Furniture Technology

TEI of Kavala

Department of Forestry

Hellenic Ministry of Culture &
NTUA Archdiocese of Athens

Improving the structural integrity of decayed timber elements in historical buildings

- Restoration of timber structural elements, in a post-Byzantine mansion
- Reinforcement of timber columns in-situ, using carbon fiber bars
- Reinforcement of timber beams in-situ, using carbon fibers tissues
- Reinforcement of timber elements using simple methods

Improving the structural integrity of decayed timber elements in historical buildings

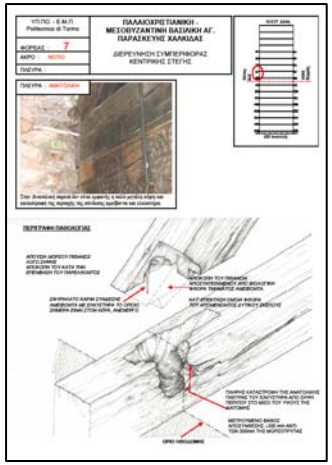
On-going research:

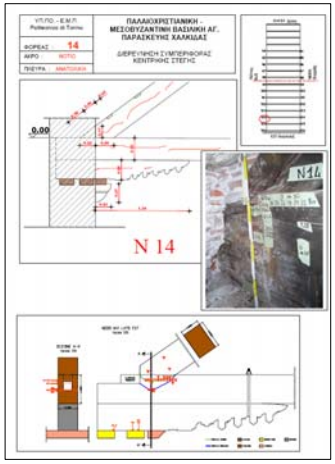
Preservation as much as possible of the authentic material and the authentic structural system (e.g. minimization of replacements of timbers) using simple techniques or more sophisticated ones

National Technical University of Athens & Politecnico di Torino

Improving the structural performance of connections in historical / existing timber buildings

- Improve the structural integrity of decayed timber elements
- Preservation as much as possible of the authentic material and the authentic structural system (e.g. minimization of replacements)

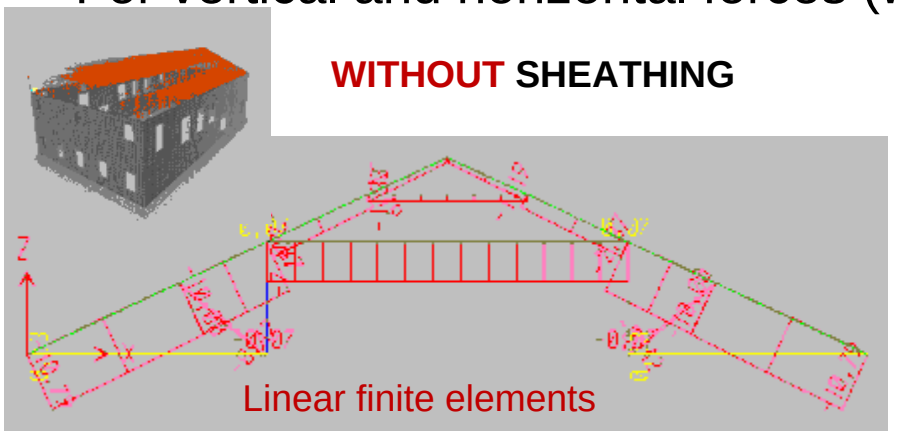


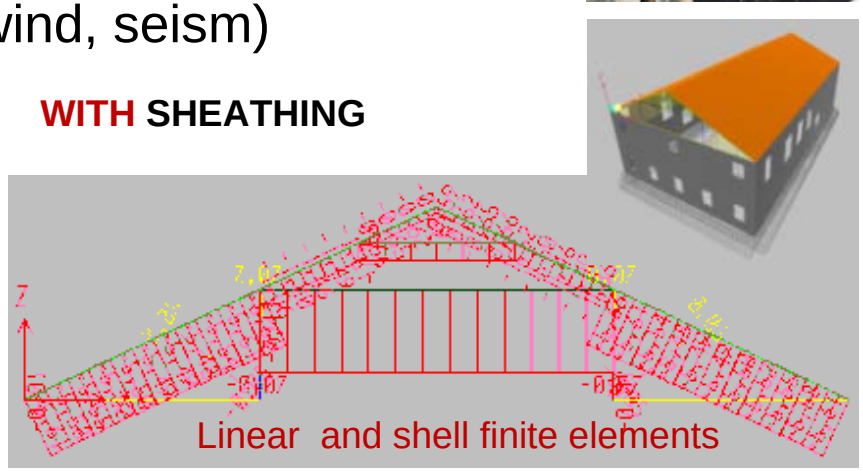


National Technical University of Athens & Aristotle University of Thessaloniki

Improving the structural performance of connections in historical / existing timber buildings

- Investigation of the contribution of the timber sheathing (planks) to overall structural behavior of timber structures using finite element models.
- For vertical and horizontal forces (wind, seism)





50% reduction of axial forces

National Technical University of Athens

Improving the structural performance of timber historical /existing buildings in seismic areas

Aim:
The establishment of diaphragmatic action at the levels of the floor and the roof, using light timber diaphragms

National Technical University of Athens
Earthquake Protection and Planning EPPO

Improving the structural performance of new masonry buildings in seismic areas

Aim:

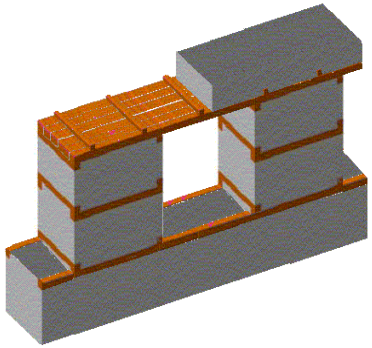
Today it is not possible for new masonry structures to use light timber structures / diaphragms for the roof and the floor (EC6, EC8).

→ Improve the structural performance of historical / new masonry structures in seismic areas using timber reinforcements.

National Technical University of Athens
Earthquake Protection and Planning EPPO

Improving the structural performance of new masonry buildings in seismic areas

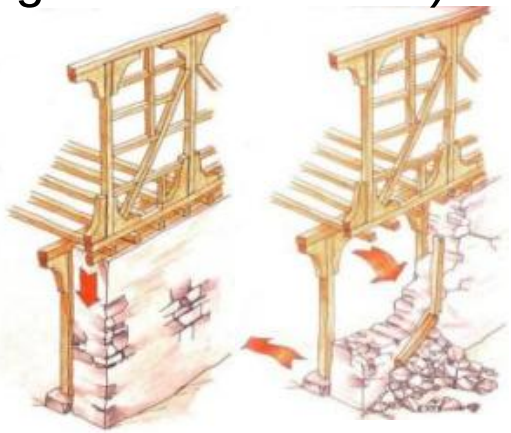
On-going research:
Developing and validating innovative materials and technologies for systemic improvement of seismic behaviour of CH assets.



Studying the past – Learning from the past (seismic areas)

On-going research:

- Observation of existing historical structural systems and their performance in seismic events
- Contribution of their timber parts, interaction of secondary / non structural members (e.g. window frames) with the load bearing system



THE ASEISMIC TIMBER STRUCTURAL SYSTEM OF LEFKAS

Seismic tests of GLIC's two-storied full scale specimen with SIP panels of Kingspan TEK (May 2011)

Evaluation of 1 or 2-store prefabricated wooden frame constructions

Seismic tests (shaking table)

Seismic tests of GLIC's two-storied full scale specimen with SIP panels of Kingspan TEK (May 2011)

Seismic tests (shaking table)

National Technical University of Athens
Laboratory for Earthquake Engineering

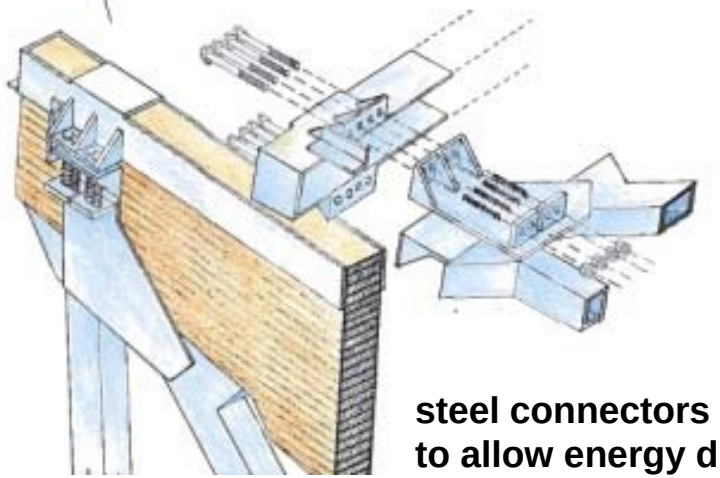
Large span timber structures in high-risk seismic areas (Trikala)

Aim: Improve the structural performance of timber connections / buildings in high risk seismic areas by design

- Independent displacements between structural and non structural members during severe seismic events (evacuation of the buildings)
- Connection design, addressing the possible shrinkage of timber.

Large span timber structures in high-risk seismic areas (Trikala)

Damping mechanism – Use of springs



steel connectors designed to allow energy dissipation

National Technical University of Athens

Dynamic characteristics of large timber structures in different stages of construction using microtremor technique

Aim:

Calibration / evaluation of numerical models for more on-site measurements on different large timber structures

Mechanical and physical properties of cement bonded OSB

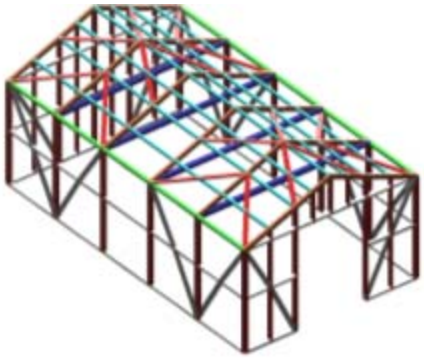
Objectives:

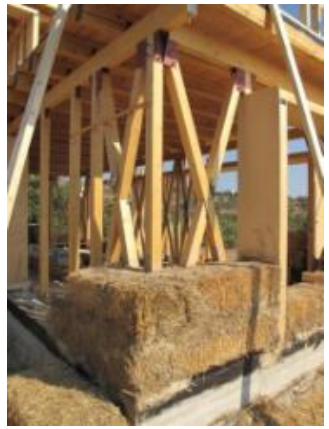
- To look at ways of manufacturing oriented strand boards (OSB) using cement as binder, including the problem of the compatibility between cement and wood and ways of overcoming the problem.
- To improve methods of manufacture and the properties exhibited by common wood composites
- To develop special techniques to accelerate the curing of cement and to improve the properties and finally manufacture of non-wood raw materials – cement composites.

TEI of Larissa, Wood and Furniture Tech. & National Technical University of Athens

Stiffening methods for small, rural, low cost, prefabricated timber structures with diagonal timber or steel members

- No use of plywood – OSB or other wood based panels
- Contribution of the planks to the overall stiffness of a timber structure





TEI of Larissa
Wood and Furniture Technology

ND grading of mechanical properties for Greek wood species, in order to meet EC5 demands

- To produce enough data about mechanical properties of Greek wood species, with no destructive methods
- Diffusion of the results in Greek market, together with low cost evaluating methods
- Fulfill the gap of knowledge, concerning EC5 regulations