ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

IfB
Institut für Baustoffe - *Holzphysik*
Institute for Building Materials - *Wood Physics*

Institute for Building Materials (IfB)
Wood Physics

Prof. Dr. P. Niemz

ETH Zürich

- 155 years old (founded 1855)
- 16 departments (technical orientation)
- 13‘000 students
- 400 PhD students / year
- 6000 employees
- 350 professors
- Budget 2010: 1000 Mio SFr

Locations

City Zürich

Zürich Hoenggerberg

Institute for Building Materials at ETH Zürich

- Research groups:
  - Physical Chemistry of Concret (Robert Flatt)
  - Wood Physics (Peter Niemz)
  - Wood Based Materials (Ingo Burgert)
  - Computational Physics of Engineering Materials (Hans Herrmann)
  - Corrosion and Durability (Bernhard Elsener)

ETH Zürich, campus „Hönggerberg“

Wood Research at the ETH Zürich

- D-BAUG
  - Institute for Building Materials (IfB); Wood Physics (Prof. Niemz)
  - Institute of Structural Engineering (IBK); Steel, Timber and Composite Structures (Prof. Fontana, Prof. Frangi (Timber construction, since 5/2010)

- D-UWIS
  - Lectures in wood science and wood technology
  - Forest faculty was closed (2002)

Main fields of research at IfB, Wood Physics

- Structure-property relationships of wood and wood-based materials and their computer-based modelling
- Non-destructive testing
- Bonding of solid wood
- Heat and moisture transfer in wood

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Important Prof.at the ETH (Wood Area)

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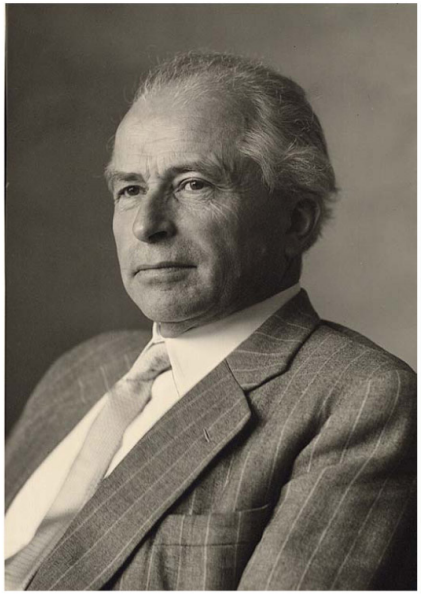
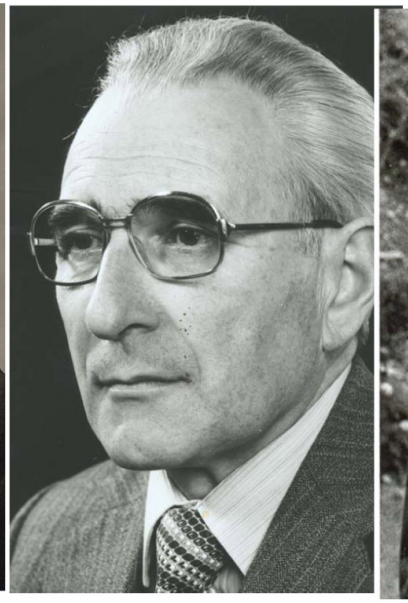
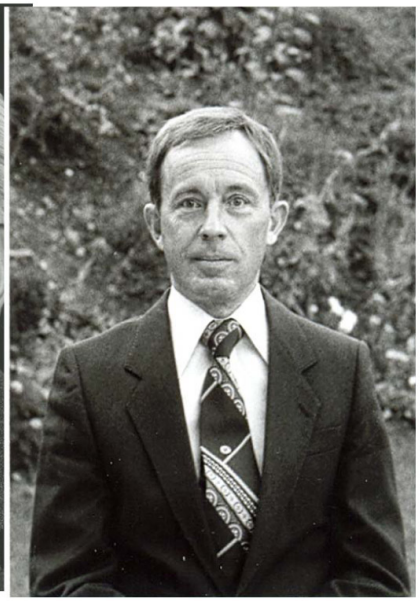




Knuchel Frey-Wyssling Bosshard Kucera

1884-1964 1900-1966 1925-1996 1942-2000

orientation: Wood Biology, microtechnique

Fred Fahrni: 1907-1970: basic investigation for particleboards (Dr.h.c. an ETH), Lab owner (Ingenieurbüro Fahrni)

Organisation chart of the Wood Physics Group

Prof. Dr. P. Niemz (head of the group) ——— A. Merletti (secretary)

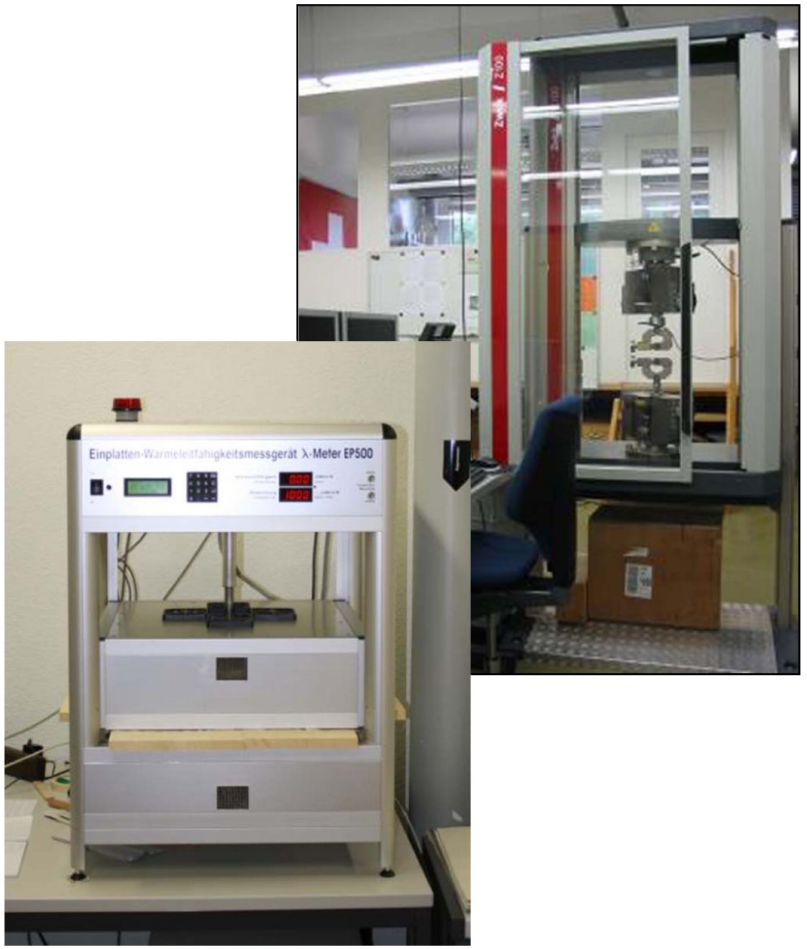
ETH budget
- Dr. S. Clauss (deputy)
- T. Schnider (lab manager)
- S. Croptier (lab technician)

3rd party funding
- P. Hass (PhD student)
- Dr.S. Hering (project)
- M. Zauner (PhD student)
- S. Ammann (PhD student)
- C. Lanvermann (PhD student)
- S. Sanabria (PhD student)
- C. Ritschel (PhD student)
- V. Brombacher (PhD student, externe)
- V. Krackler (1-year project)
- M. Wetzig (1-year project)
- F. Michel (1-year project)

Guests / Students
- 2-3 academic guests / year
- 4-8 students writing BSc / MSc theses (ETH, foreign countries)

Equipment

- Basic equipment
  - 2 testing machines *(Zwick)*
  - Thermal conductivity measurement tool *(Lambda Messtechnik)*
  - Surface roughness measurement device *(Hommel)*
  - Image correlation system VIC 2D *(Limess)*
  - … etc.



Collection of „wood defects“

Joinery

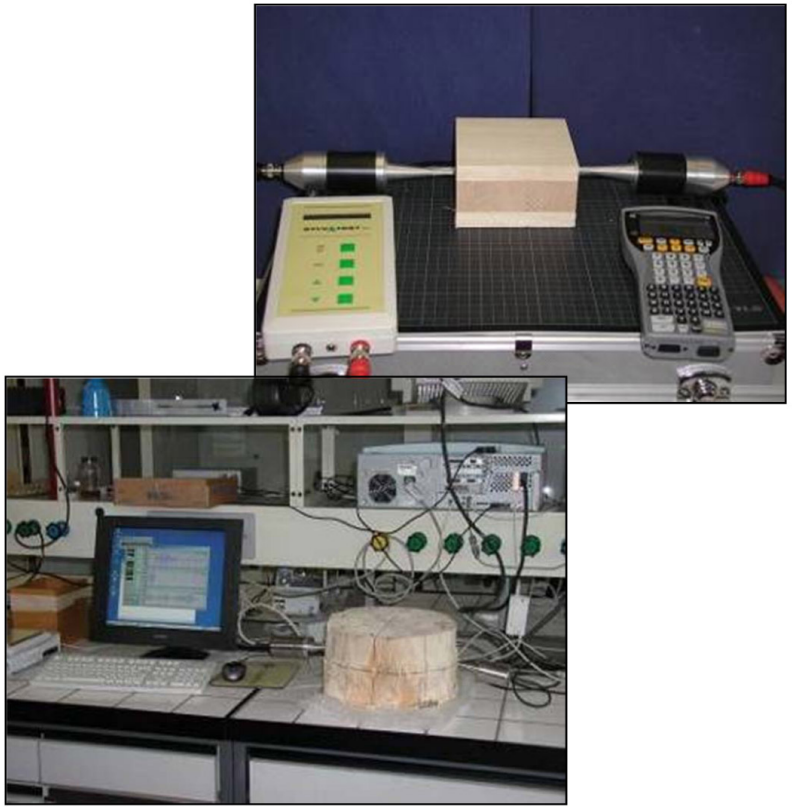
Press and climatic chamber

Laboratories and climatised rooms

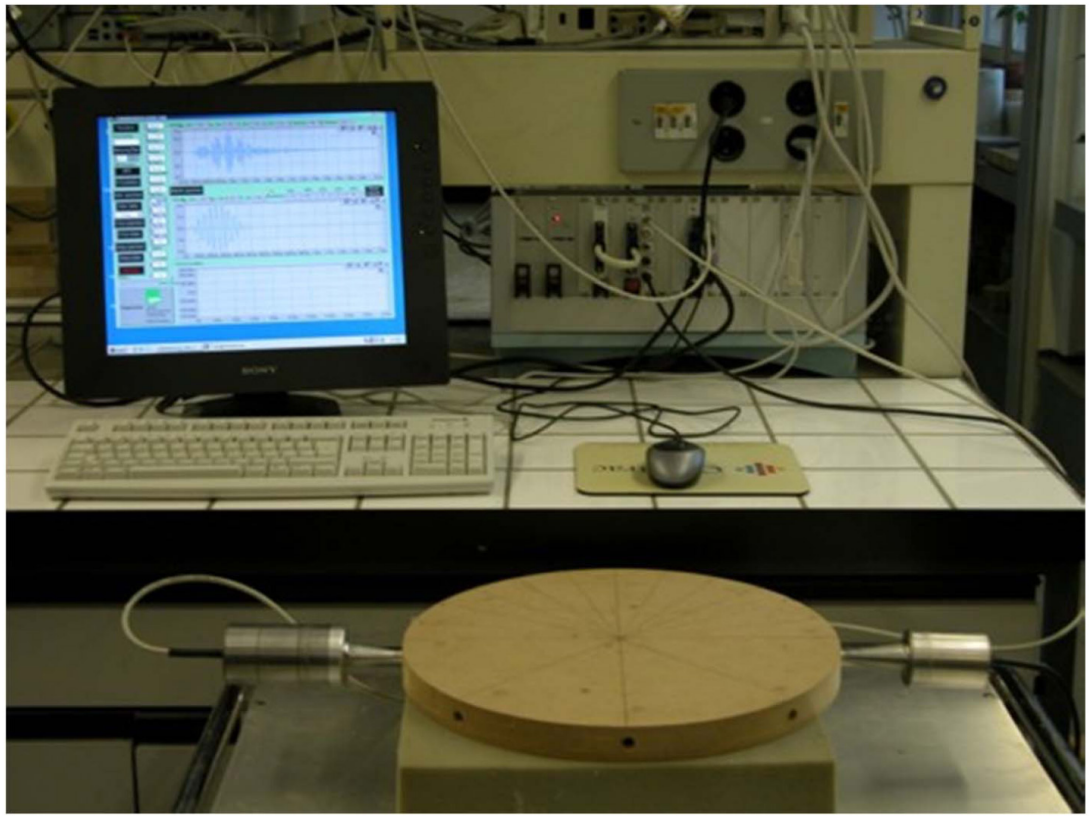
- 20° C and 50, 65, 85, 93% RH

Non-destructive material testing

- Silvatest duo
- USH *(Fraunhofer Institut für zerstörungsfreie Prüfung)*
- PCUS 10 NF *(Fraunhofer)*
- Eigenfrequency measuring instrument MK5 Industrial *(Lemmens)*
- Acoustic emission measuring device
- … etc.

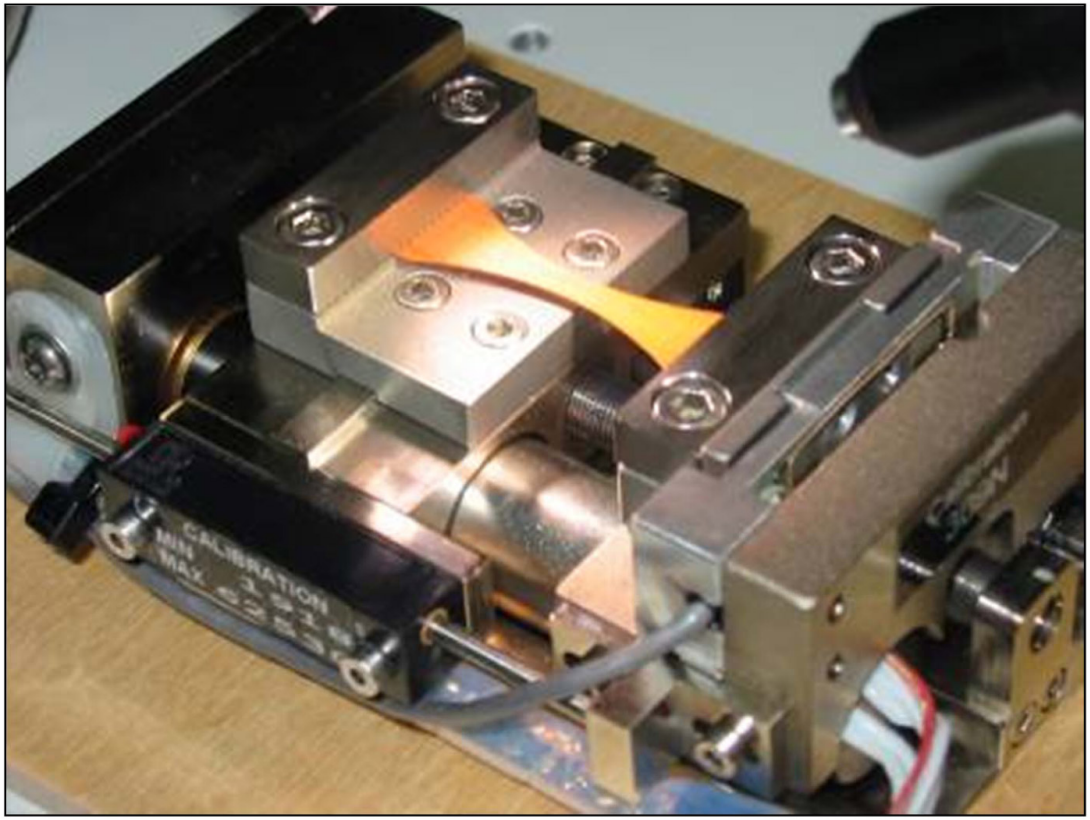


USH instrument (*Fraunhofer Institute*)…



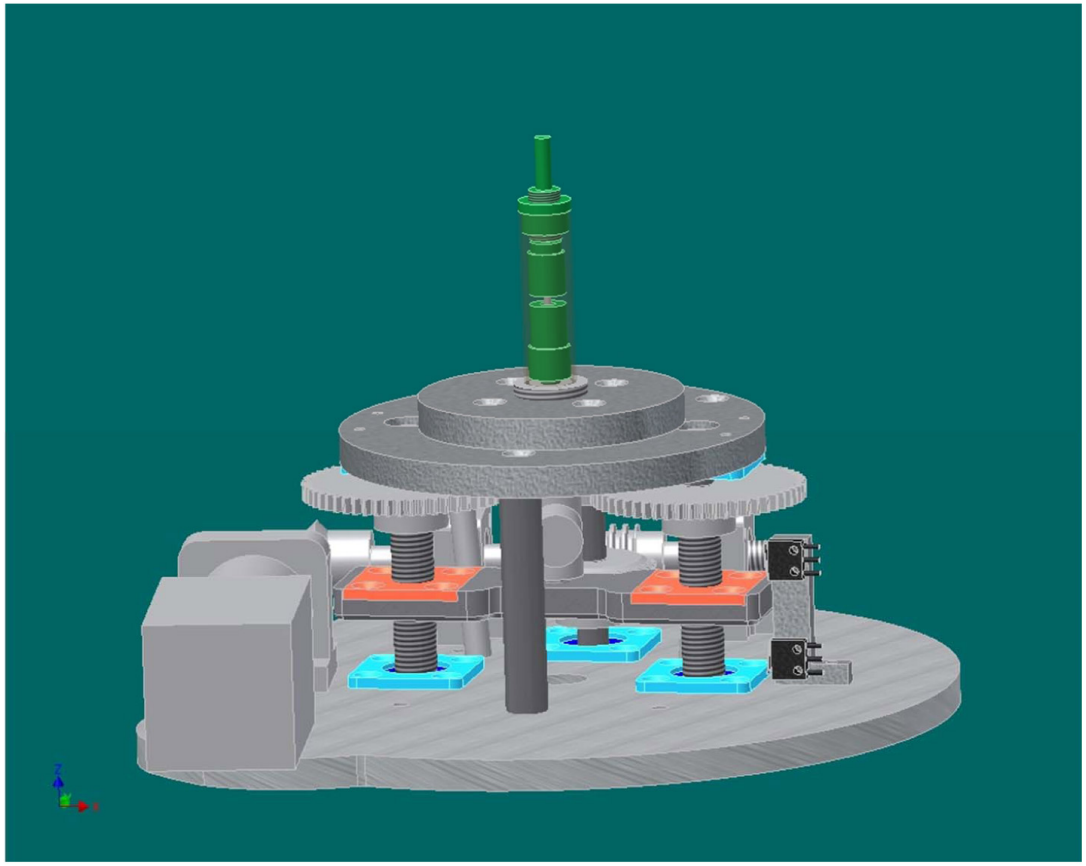
- … for sound velocity measurement

Micro testing device …



… for tensile, bending, compression and shear tests in situ in an ESEM (*Deben*).

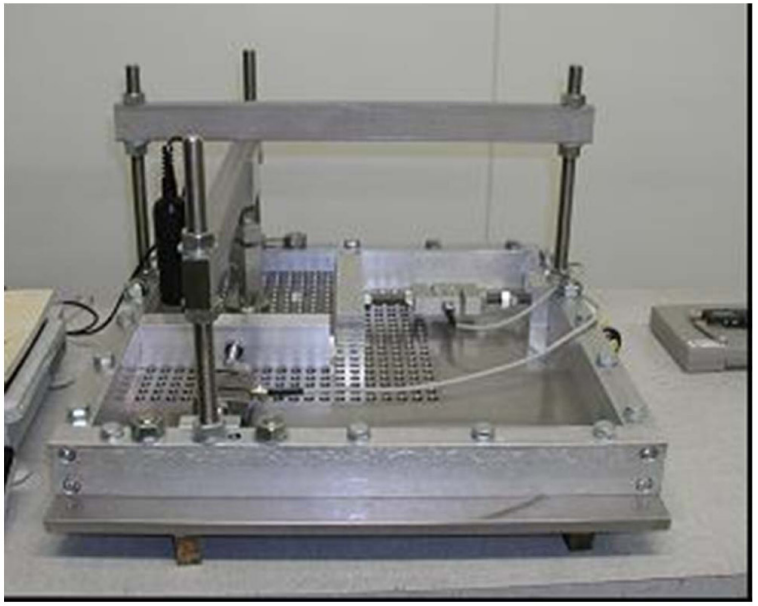
Testing machine for the synchrotron

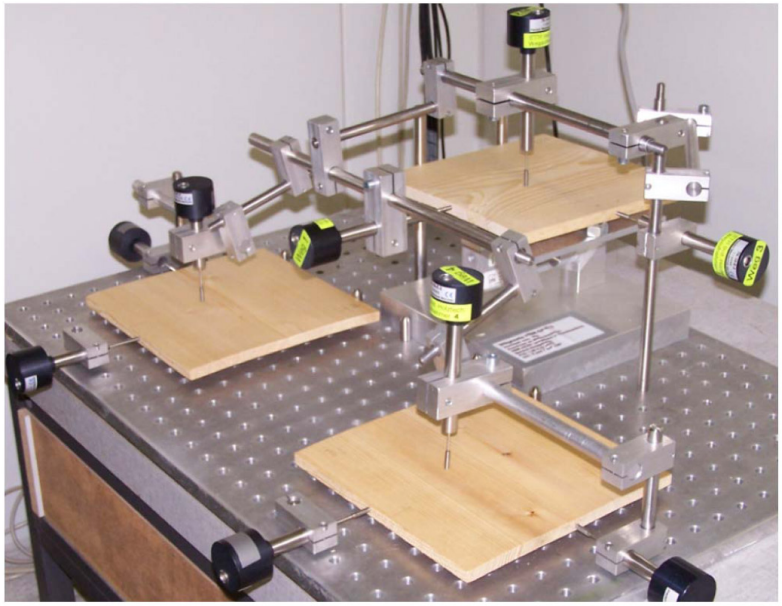


Measuring equipment for…

… deformation…

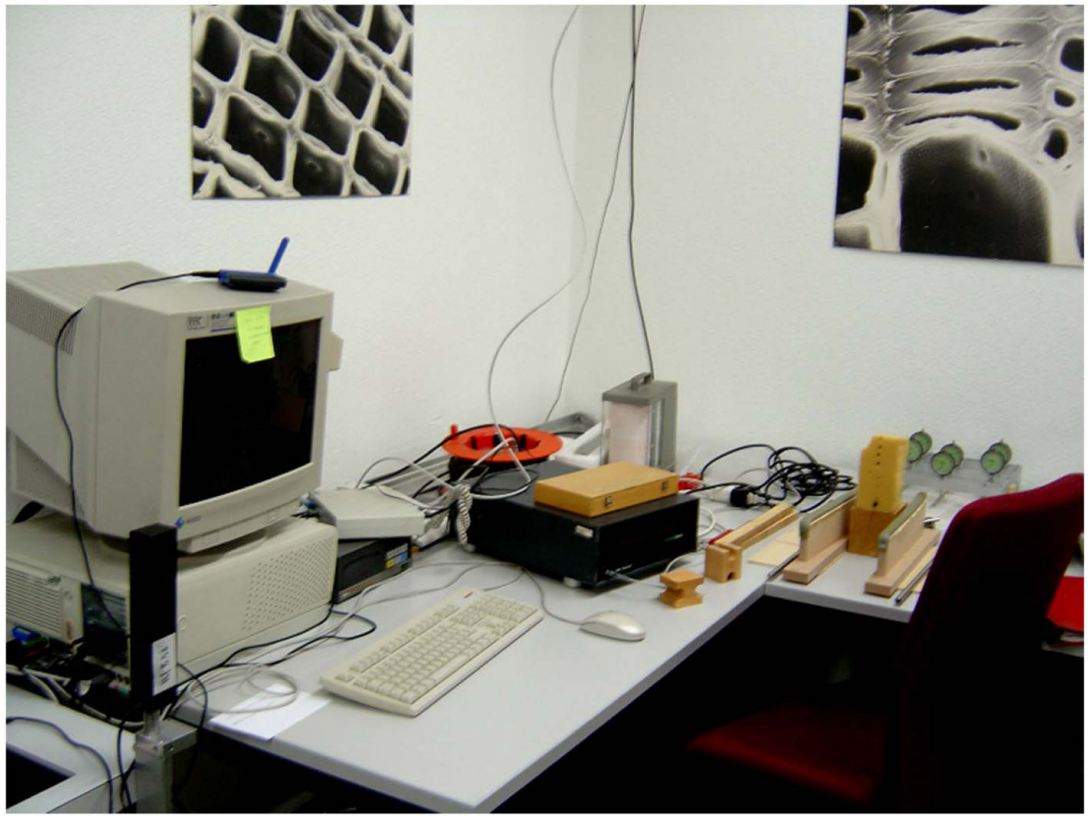
… and swelling pressure.





Direct digital data aquisition

Eigenfrequency measuring device

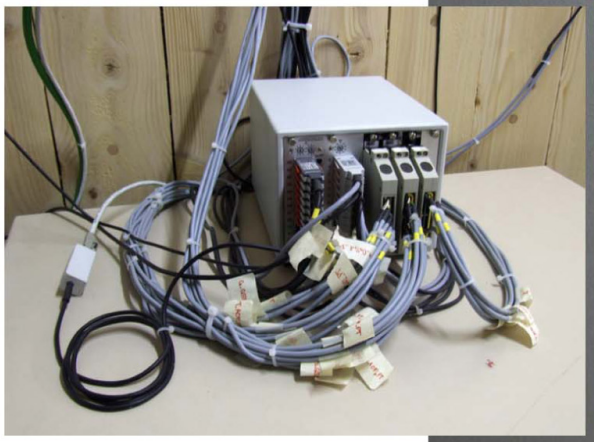


- MK5 Industrial

ESEM (property of the IfB)

Wheathering stand

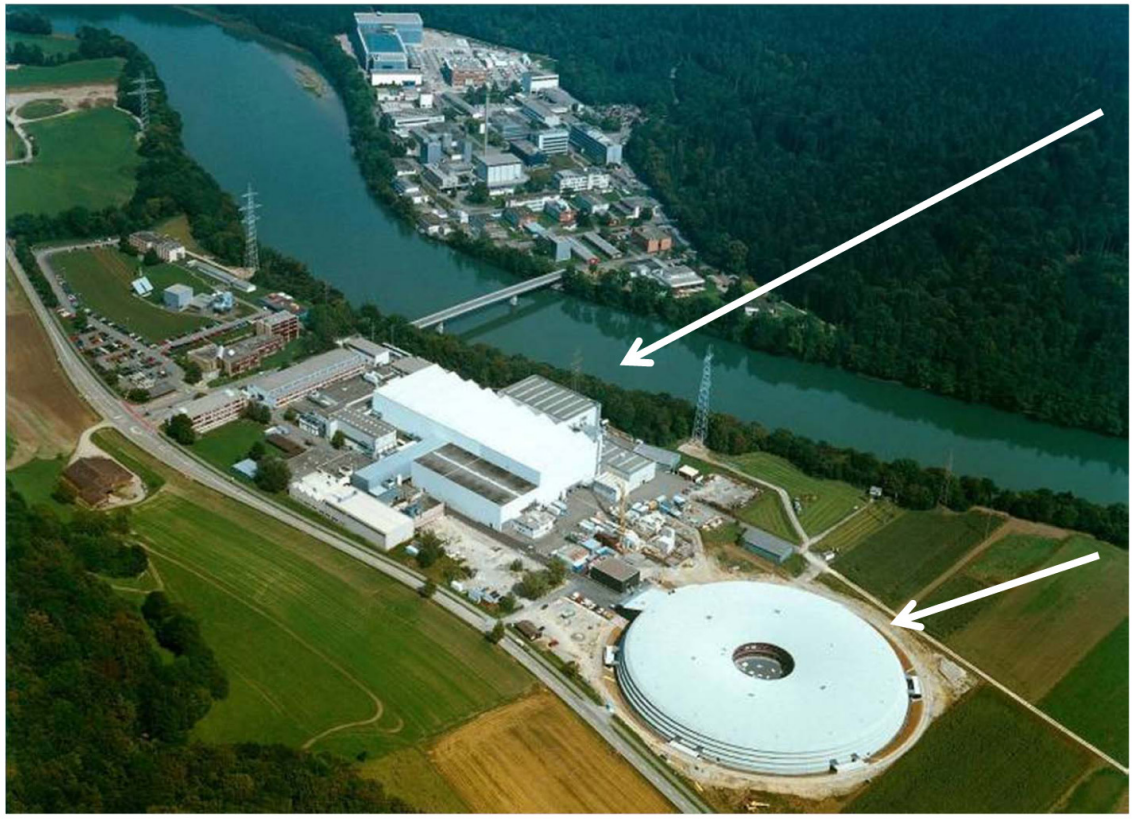
Tests from moisture and heat transfer in wooden walls



ETH building hall …

… for large scale experiments.

Paul Scherrer Institute (PSI), Villigen



- Spallation neutron source (SINC)
- Synchrotron radiation source (SLS)

Projects

- **PhD projects (wood: structure-properties)**

  - Multiscale experimental characterization of wood under moisture and mechanical loading / Sinergia (C. Lanvermann; *SNF project*)

  - Orthotropic properties of beech (T.Ozyhar)

  - Properties of aged wood used for cultural heritages (K. Kranitz, ETH founded)

Projects

- **PhD projects (adhesives)**

  - Structure property relationships of one component moisture curing liquid polyurethane adhesive systems for engineered wood (O. Kläusler; *cooperation partners PURBOND AG*

  - Penetration behavior of adhesives into wood, property changes of the interphase and fracture behaviour of the glue-line (P. Hass; *SNF project*)

  - Mechanics of adhesives joints / comportment of adhesive joints under climatic exposure (S. Hering; *COST Action E34/E53*)

  - Ultrasonic diagnostics of the integrity of glued timber components (S. Sanabria; *cooperation with Empa: Electronics/Metrology*)
  - Delamination of glued wood (S. Ammann)

Projects

- **PhD projects NDT and thermal properties**

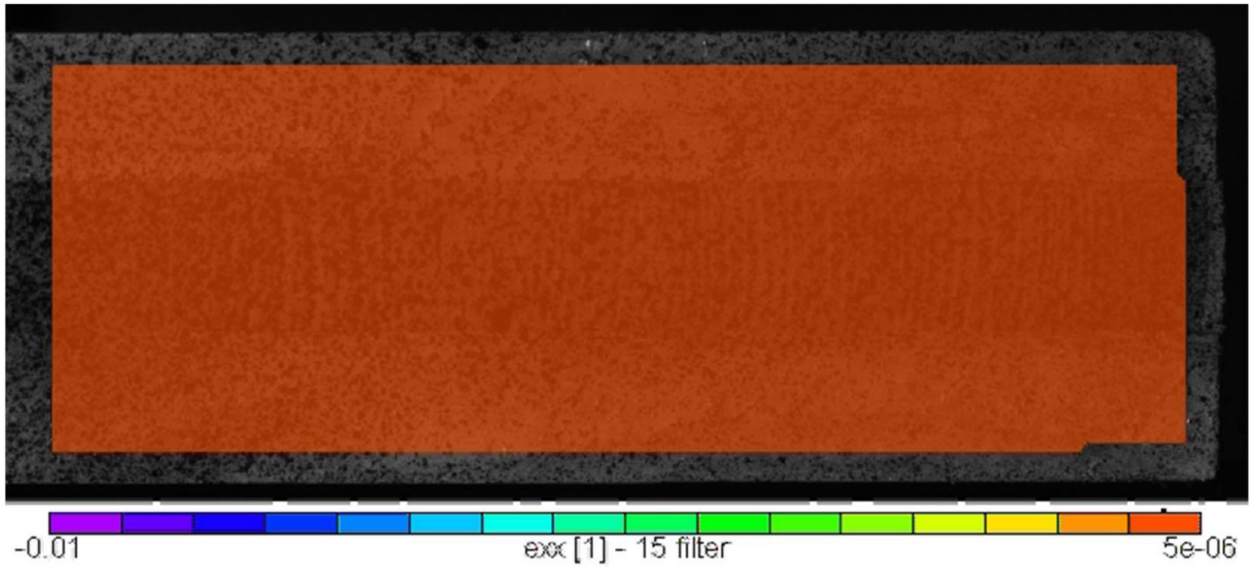
  - Design, construction and experimental application of mechanical testing equipment for in-situ tomographies on miniature wood specimens at the synchrotron beamline "TOMCAT" (PSI, Villigen) (M. Zauner; *COST project, Action FP0802*)

  - Acoustic emission and video image correlation from plywood
  - (F. Ritschel)

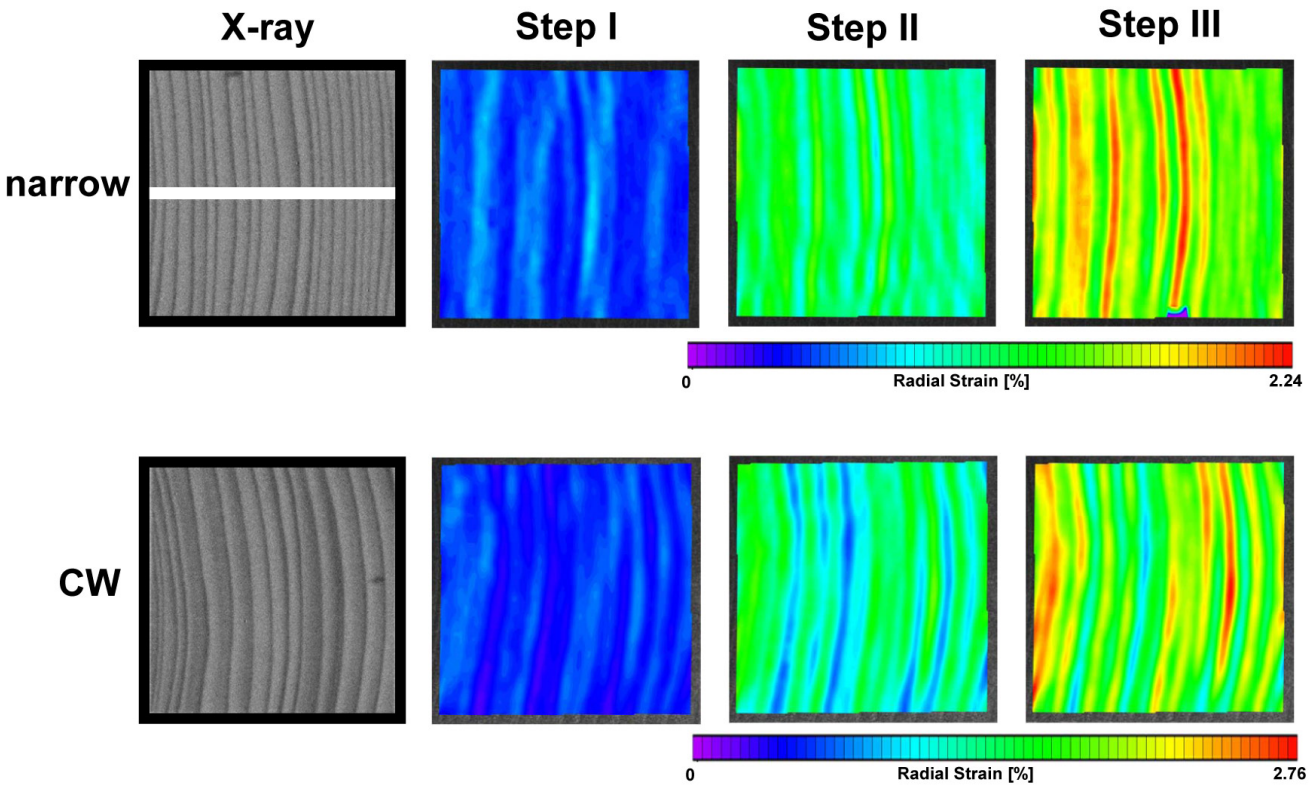
  - Measurement and simulation of heat and moisture transfer in wooden wall constructions (M. Joscak; *funding: Fonds zur Förderung der Wald- und Holzforschung, Regio Plus*)

Selected results

- Swelling of a three-layer particle board, determined with video image correlation

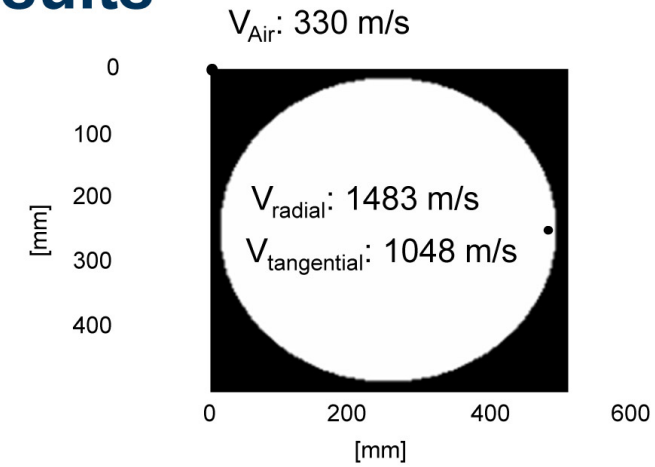


Comparison of radial strain distribution

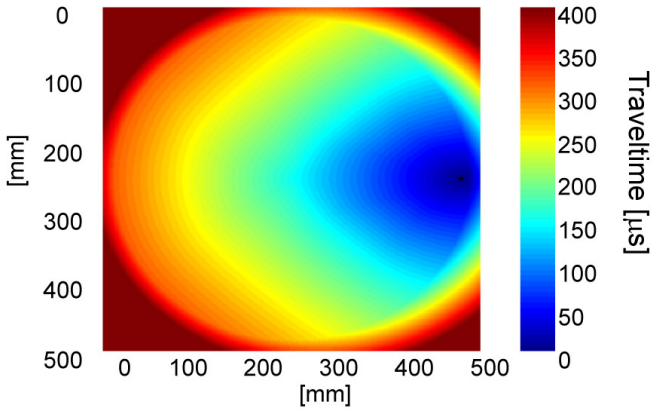


Selected results

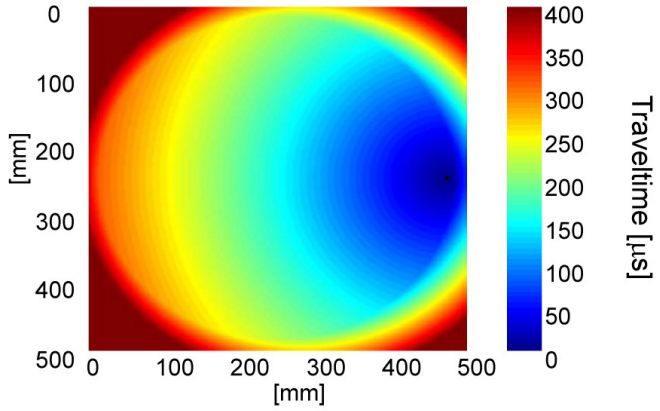
- Synthetic example: Anisotropic travel times



Model



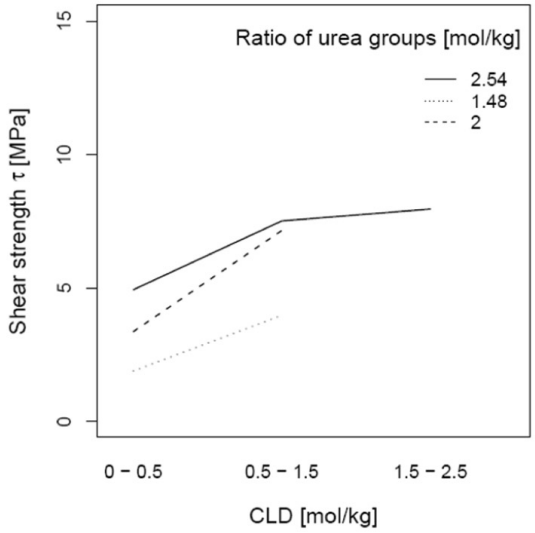
Anisotropic



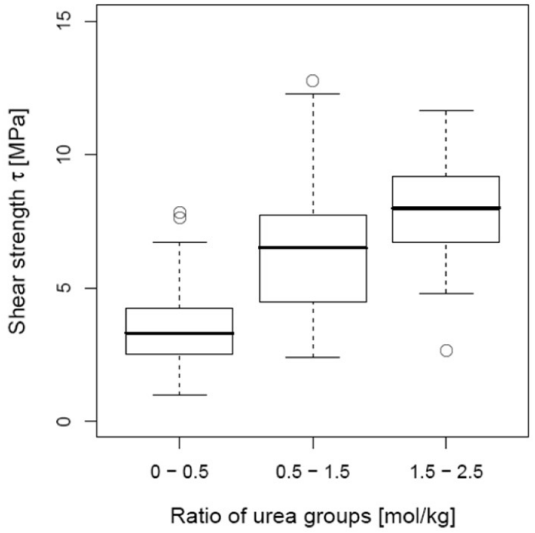
isotropic

Selected results

- Influence of the chemical composition on the shear strength of adhesives



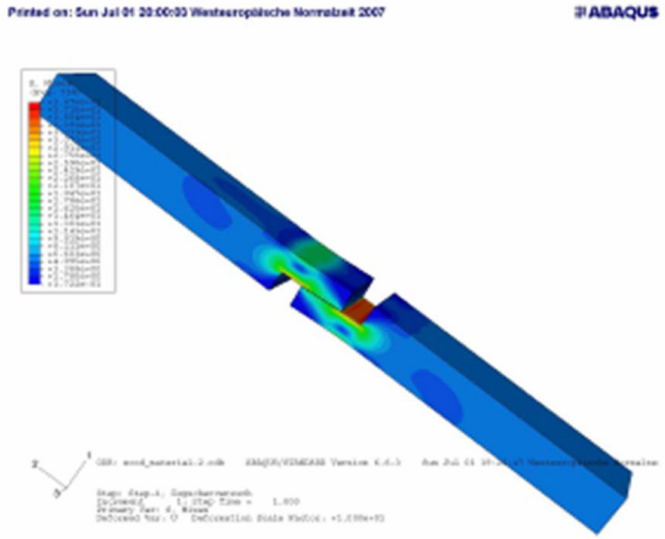
Temperatur level: 200°C



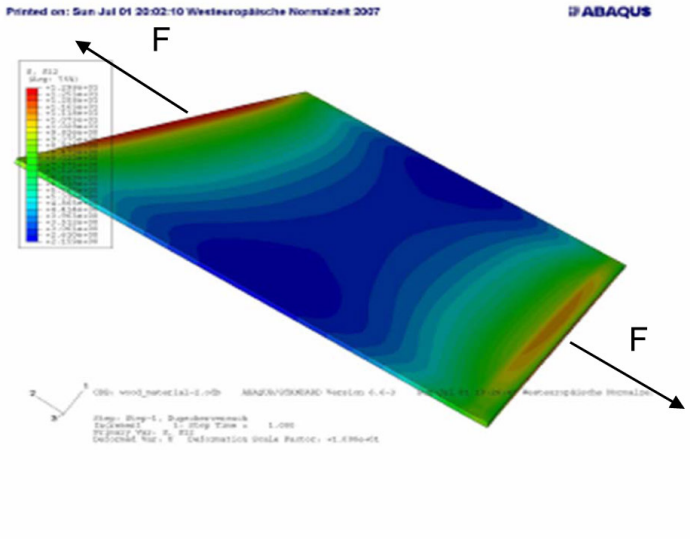
Temperatur level: 200°C

Selected results

- Modelling approaches: FE calculation of the stress distribution within an adhesive joint



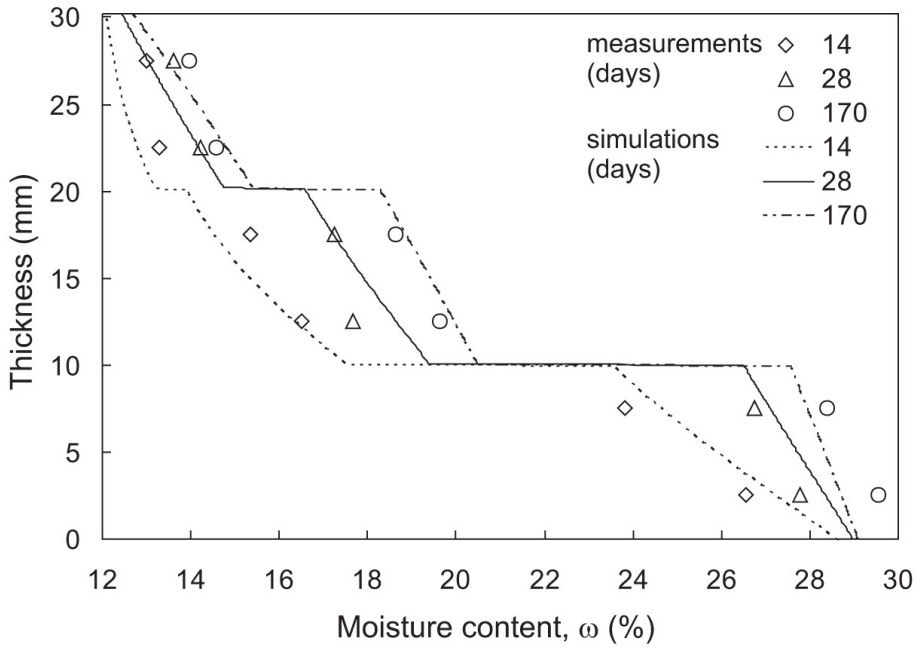
- Von Mises stress



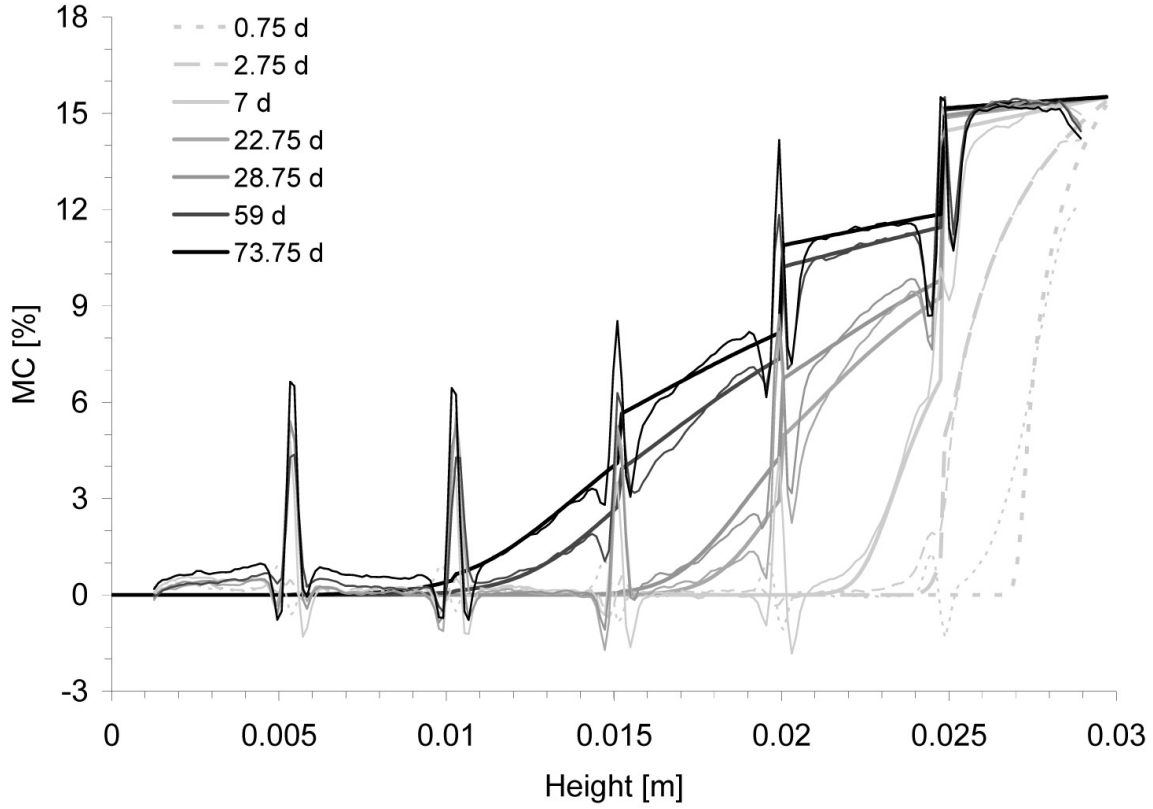
- Shear stress in the glue line

Selected results

- Modelling approaches: Moisture content distribution in a three-layered solid wood panel

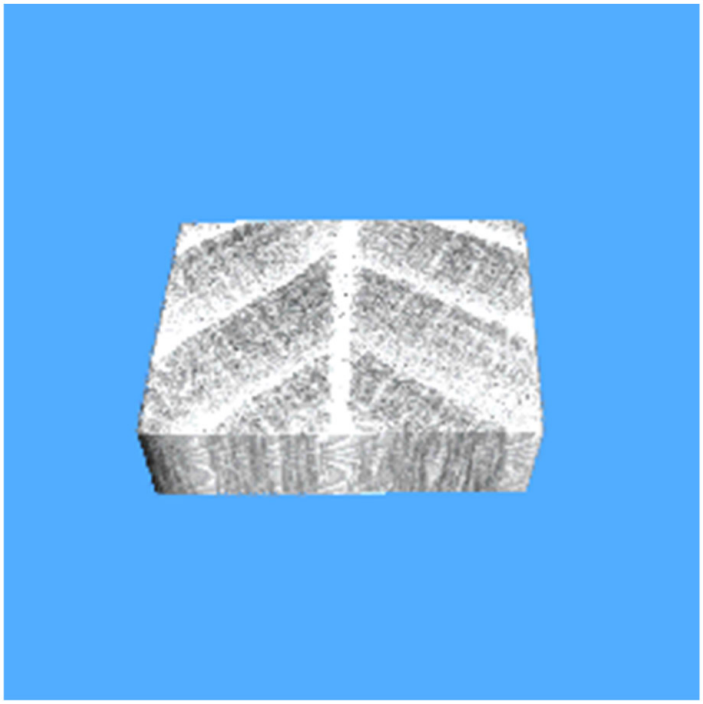


MC through the samples with 1, 3 and 5 adhesive joints results = fine lines; model curves = fat lines), 1-K-PUR



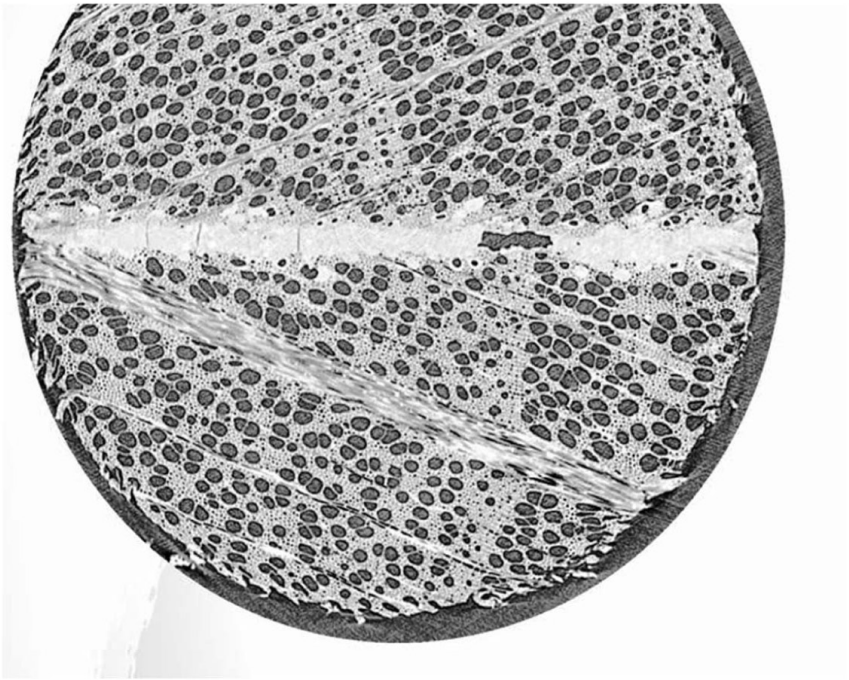
Selected results

- Penetration of adhesives in wood determined with neutron tomography

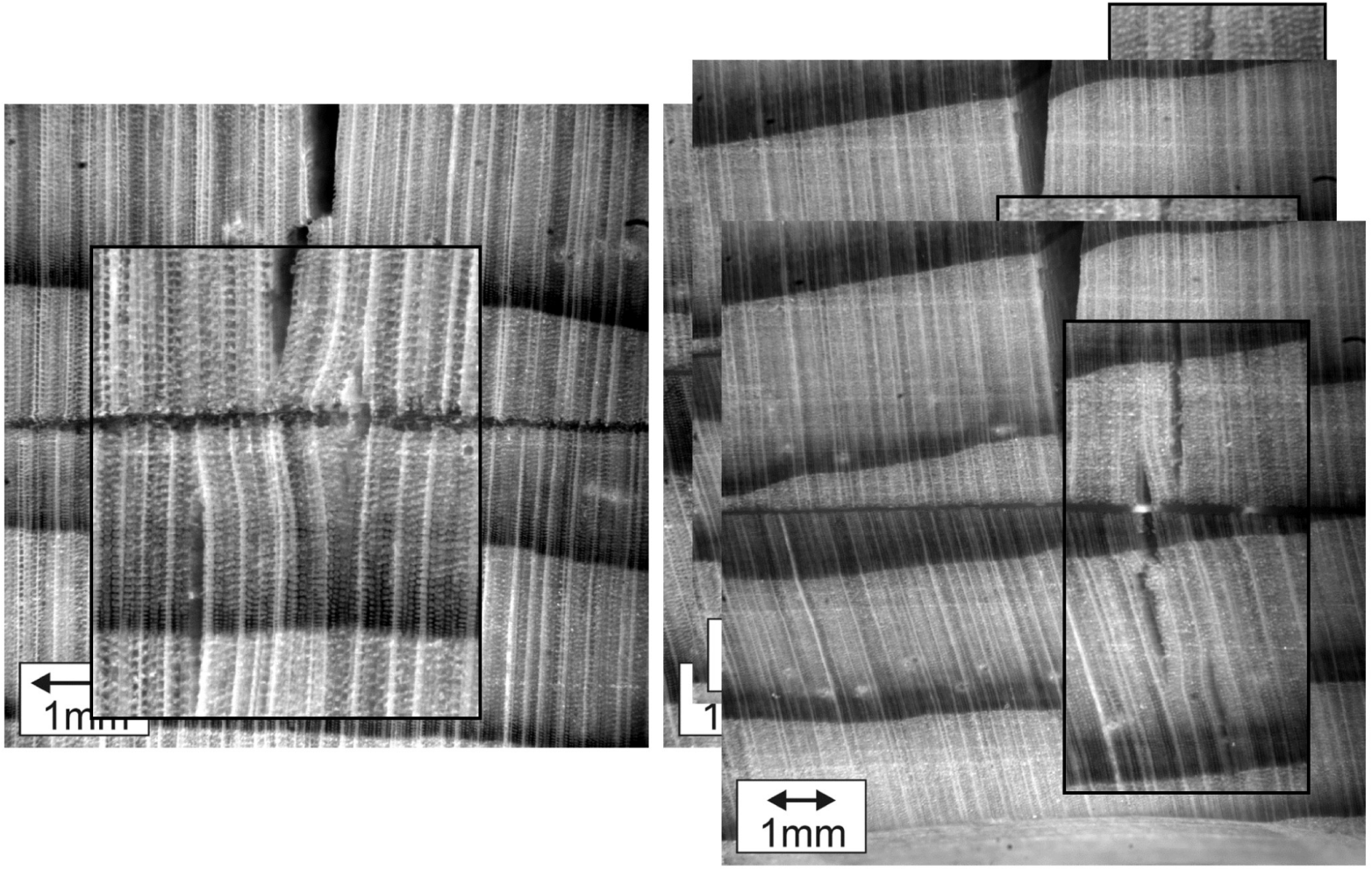


Selected results

- Penetration of adhesives in wood determined with synchrotron tomography



Cracks in a bond line und bending



Education (since 2004)

- D-BAUG
  - Wood physics (MSc)
  - Wood and wood composites (MSc)
  - Introduction to building materials II (BSc)
  - Materials laboratory tests (BSc)
  - Project study „Evaluation of bridges“ (BSc)
  - Advanced laboratory experiments (MSc)

- D-UWIS
  - Forest and landscape products (BSc)
  - Fundamentals of wood elaboration and wood machining (MSc)

Publications

- Number of articles in ISI and other journals (since 2003)
  - 2004: 28
  - 2005: 31
  - 2006: 27
  - 2007: 38
  - 2008: 24
  - 2009: 26
  - 2010: 27 (Tendency ISI,10-15/year)

- Books (since 2002)
  - Dunky, Niemz: Holzwerkstoffe und Leime (Springer 2002)
  - Molnar, Bariska: Wood species of Hungary (Budapest 2002)
  - Niemz (in Wagenführ, A.; Scholz, F.): Taschenbuch der Holztechnik, Kapitel Physik des Holzes und der Holzwerkstoffe (2008)
  - Bucur (Editor): Delamination of Wood… (2 chapters, Springer 2010)