

EUROMECH Colloquium 556

“Theoretical, Numerical and Experimental Analyses in Wood Mechanics”

27 – 29 May, 2015, Dresden, Germany

Chairperson: Prof. Michael Kaliske

Co-Chairperson: Prof. Josef Eberhardsteiner

Background

Wood is one of the oldest materials used by mankind. Timber and wooden products continue to be widely used in architecture and industry. Wood finds a huge variety of applications ranging from large-span glued laminated timber beams and load-carrying components in Civil Engineering, through musical instruments to pressure, heat and moisture modified material for new, innovative products. Apart from the mechanical and aesthetic quality of the material, its eco-friendly features are highly significant and are likely to grow in the future.

In order to provide the desired, optimised components and to develop new applications, deep mechanical knowledge, theoretical modelling, experimental investigations and numerical simulation approaches are required. Features to be identified include anisotropic elasticity, ductile plasticity, brittle fracture and time-, moisture- and temperature-dependency. Moreover, wood shows properties that depend on length scales so that it might be described as a composite structure instead of a homogeneous material. The features depend on a large number of influence factors like growth conditions and yield a significant amount of scattering with respect to its properties. Much research is required in order to understand and describe wood properly from the mechanical point of view. Currently, lively and advanced research activities are under way in order to develop a comprehensive knowledge. EUROMECH Colloquium 556 aimed to bring wood-mechanical scientists together for the presentation of their research and to provide a platform for fruitful discussions.

There were altogether about 50 participants and 39 presentations, among them three keynote lectures, by:

Erik Serrano (Lund University, Sweden);
Ingo Burgert (ETH Zurich, Switzerland);
Hans Joachim Blaß (KIT Karlsruhe, Germany).

There were many opportunities during the Colloquium for discussion and informal dialogue between participants. A large number of different issues can be categorised into experimental and theoretical/numerical analysis.

Experimental Analysis

In different sessions, knowledge was shared concerning the specific material properties of exotic wood species and timber which are important for an appropriate analysis of them. The participants gained insight into topics such as the behaviour of moulded wooden beech tubes and the influence of climate on an antique violin during a concert. Further, the mechanical behaviour of joints, such as dowel connections, was considered. Measurement techniques for damage detection in wood and wooden structures were discussed in other sessions. Techniques for the optical measurement of strains in living trees under bending, and the monitoring of deformations in the famous Mona Lisa painting were described.

Theoretical and Numerical Analysis

The theoretical and numerical analysis of wood and wooden or timber structures is highly dependent on the results of experimental analysis. For all developed and applied theories and material models, verification by experiment is essential. In recent research projects, discussed at the Colloquium, wood failure mechanisms have been studied intensively. Therefore, one session dealt with the simulation of

fracture. Different theories and models, such as XFEM, were introduced. Simulation of timber structures continues to be a major challenge. Due to the high variability of all properties of this natural material and inhomogeneities such as knots, there is large uncertainty in the behaviour of timber.

The inclusion of knot orientation and element in FE element formulations, as well as representation of uncertain parameters by randomness or fuzziness, were presented. Another aspect was the modelling of wooden products, such as wood shear walls, furniture or cross-laminated timber. Hygro-mechanical coupling was pointed out as a predominant influence on the performance of wood. Theoretical models and investigations for the origin of swelling and shrinkage gave an insight into the microstructure of wood, while different models for simulating moisture transport and its effect on the mechanical behaviour of wooden structures were discussed. The practical relevance of numerical analyses on the macro-scale was underlined by case studies concerning panel paintings and a violin. Recent advances in understanding the physical properties of wood, the mechanical behaviour of wood based products, and in simulating related problems, were discussed at EUROMECH Colloquium 556. The Colloquium has helped to stimulate collaboration that will lead to better understanding of this fascinating material and its products.

Finally, the organisers wish to thank EUROMECH for making this fruitful scientific colloquium possible, and for financial and organisational support.