FORESTS, THEIR PRODUCTS AND SERVICES (FPS)

COST Action E55
"Modelling the Performance of Timber Structures"

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Chair: Jochen Köhler

http://www.cost-e55.ethz.ch
http://www.cost.esf.org

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The safe and sustainable use of materials in construction necessitates that the life-cycle performance of structures can be predicted and reassessed with sufficient accuracy. Recent research achievements in the field of materials science and structural reliability provide a framework for the quantification of safety, serviceability, durability and life-cycle costs of structures. These achievements are so far mainly used in the field of concrete and steel structural engineering. The knowledge about the behaviour of timber materials and structures is still considered as being insufficient for its use in such a framework.

The main objective of this Action is to provide the basic framework and knowledge required for the efficient and sustainable use of timber as a structural and building material. This will be achieved by building on three main research activities: the identification and modelling of relevant load and environmental exposure scenarios, the improvement of know-ledge concerning the behaviour of timber structural elements and the development of a generic framework for the assessment of the life-cycle vulnerability and robustness of timber structures. The Action serves as a development platform for the European timber engineering research community to improve the knowledge about the life-cycle performance of timber structures.

Background


Frédéric Beaud/LIGNUM

Timber is an efficient building material, not least in regard to its mechanical properties but also because it is a highly sustainable material considering all phases of the life cycle of timber structures: production, use and decommissioning. Timber is a widely available natural resource throughout Europe; with proper management, there is a potential for a continuous and sustainable supply of raw timber material in the future. Because of the low energy use and the low level of pollution associated with the manufacturing of timber structures the environmental impact is much smaller than for structures built in other materials. In addition, timber is a rather advantageous building material because of its material properties. Timber is a light material and compared with its weight the strength is high; the strength:weight ratio is even higher than for steel.

However, considering its beneficial properties, timber is still not used to its full potential in the building and construction sector. Many building developers, architects and structural engineers do not consider timber as a competitive building material compared with concrete, steel or masonry. Attributes such as high performance regarding reliability, serviceability and durability are generally not associated with timber as a building material. One of the main reasons for this is that timber is a highly complex material; it actually requires a significant amount of expertise to fully appreciate the potential of timber as a structural building material. There are also a number of issues which need further research before timber materials can achieve the same recognition as a high quality building material such as steel and concrete. These issues are the focal point of this Action.

The benefits of the Action are:

- Improving design methods, assessment techniques and maintenance policies for timber structures.
- Creating a knowledge pool for timber as a high performance material.
- Improving the competitiveness of timber and timber products.
- Increasing the use of timber in high performance structures.
- Contributing to a more efficient and sustainable use of forest resources in the European building sector.
- Providing the engineering community with a modern probability based foundation for the efficient performance-based life-cycle design and assessment of timber structures.

Scientific programme


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The objectives and work programme of E55 are shared between three Working Groups (WG):

WG1: System identification and exposures

WG2: Vulnerability of components

WG3: Robustness of systems

WG1: System identification and exposures

An important issue of this working group is the collection and the assessment of failures and malfunctions of timber structures on a European scale. Based on these observations possible gaps and shortcomings in current design and maintenance strategies will be identified and reflected in future considerations.

Specifically the following aspects will be considered by WG1:

- Collecting information about failed or malfunctioning timber structures.
- Analysis of the mechanisms leading to failure and malfunctioning.
- Identification and representation of relevant exposures for the purpose of design and assessment.
- Identification of relevant design and assessment situations, including the identification and mapping of the relevant degradation mechanisms for Europe.

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WG2: Vulnerability of components

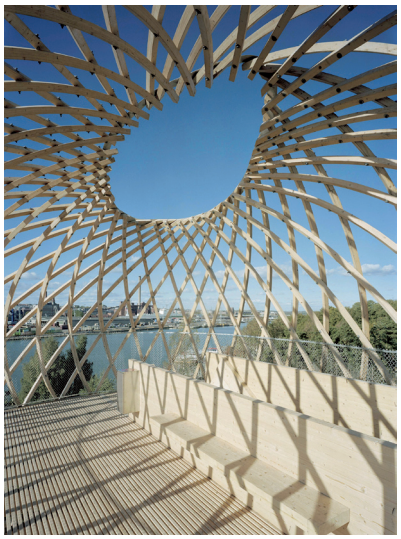
The consideration of the lifetime performance of a timber structure is based on basic models about the relevant aspects of the structural components and connections. These aspects are:

- Basic strength and stiffness properties of graded timber material, glued laminated timber and related products.
- Dependency of these properties on load and climate scenarios which might occur during the lifetime of the structure, and size dependencies.
- Strength and stiffness properties of connections over service-life.
- Modelling of moisture-related degradation and service-life assessment of timber components and connections.

WG3: Robustness of systems

An important aspect for the assessment of the life cycle performance of timber structures is the interaction of structural components in structural systems. System effects in timber structures are pronounced because of multiscale spatial variability of environmental exposures and material properties. Existing numerical methods used to assess the reliability of timber structures need to be evaluated for their possible application to timber systems, and simplified approaches suitable for day-to-day engineering purposes must be identified. Furthermore, consensus on the general characteristics of timber systems regarding redundancy and robustness has not yet been established. To reach a better understanding of these aspects the following activities are planned within WG3:

- Characterisation of multiscale variability in timber structures.
- Analysis of system effects for several types of timber structures.
- Qualification of robustness as a characteristic of timber structures.
- Establishing a framework for reliability based design and assessment of timber structural systems based on these considerations.



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Web-resources:

The webpage of this action: **http://www.cost-e55.ethz.ch**

The webpage of COST: **http://www.cost.esf.org**

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