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## Core document of the COST Action E34

# Bonding of Timber

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in Co-operation:  
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# Preface

This Core document is one of the main outcomes of the work within the COST Action E34. It reflects the work done in the three Working Groups and summarizes in comprehensive form the actual state as well as development needs and work ongoing. According to the structure within E34 it is organized into three different parts, reflecting the three Working Groups.

In E34 "Bonding of Timber" three special topics had been chosen for the ongoing work:

- bonding of timber at the site in repairing wooden constructions
- bonding of green/wet wood to overcome the mentioned problems of moisture content induced changes in shape, and
- various principles of the bonding process of timber and wood on a basic and partly theoretical level.

Bonding of timber and wood has a long history of several thousand years and has overcome the limitations given by size and shape of the naturally grown trees. Especially the use of various adhesives as auxiliary means for rejoining has enabled a huge diversity of applications, which climaxed in actual approx. 180 bill. m<sup>3</sup> of annual global production of wood based products. Bonding of timber also especially shows a high degree of flexibility in process and in preserving the naturally wooden appearance.

Bonding of timber (for practice) on site deals with the rehabilitation of buildings, which shows an increasing economical and social importance in most European countries. A great number of these buildings either are of "common" timber frame construction or incorporate more or less complex timber structures that need specific interventions, including reinforcement or repair due to previous overloading, insect attack or decay due to fungal activity, or to glue line delamination in glued members. The work in WG1 concentrated on reinforcement techniques for structural timber elements, based on the use of structural adhesives on site either on their own or in conjunction with steel plates or rods or fibre reinforced materials. Such techniques are very valuable, as they minimise disturbance to the building and to its occupants during the intervention. Besides, repair techniques involving the use of glues are versatile, effective, and less time and cost consuming than alternative traditional methods and materials. Question of improvement of structural adhesives, proper working conditions (e.g. procedures for applying, controlling and checking penetration of the adhesive), suitable test methods to evaluate bond line performance, and the application of existing or new EN or national test and performance standards have been addressed during the work.

The task of WG2 "Green/wet wood gluing" was to help to bring this new technology successfully to the market place and hence to aid the better utilisation of the European renewable wood resources. Again, questions of proper technology, of suitable standards (adapting existing standards or creating new standards), and quality control systems were central points of attraction. The use of wet gluing systems offers many advantages particularly for the utilisation of the lower grade portion of European wood by re-engineering and enhancing the quality of softwood thus making more efficient use of a valuable and renewable natural resource.

WG3 "Timber and wood bonding process" concentrated among others with some basic topics like (i) monitoring the hardening and gelling behaviour of adhesives and resins, (ii) various sophisticated analytical techniques like FT-NIR for the structural characterization of formaldehyde-based resins or the use of Confocal Laser Scanning Microscopy (CLSM) to examine fibre-adhesive interactions, (iii) on special effects occurring during the bonding process and influencing the adhesion process and the bonding quality, like the effect of temperature and wood moisture content on wood properties, and (iv) on the modelling of the hot press process.

We have now completed this State of the Art report and have created a platform for building scientific cooperation and partnership across Europe and to facilitate the development of consortia for EU funded research projects. "Europe" can speak with a single voice speaking throughout such COST Actions and the outcome created during the work and published like in this Core document.

Finally, let me express my special gratitude to all authors of this Core document and all other colleagues, who have contributed valuable input. All this work you have done was beside of your daily business in industry, at the university or at your research institutes. It was a pleasure for me to work with you and I am looking forward with great pleasure and interest to the continuation of this cooperation even after the finalization of our COST Action E34.

Manfred Dunky  
Chairman E34  
"Bonding of Timber"

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- bonding of timber at the site in repairing wooden constructions
- bonding of green/wet wood to overcome the mentioned problems of moisture content induced changes in shape and
- various principles of the bonding process of timber and wood on a basic and partly theoretical level.

This Core Document shall serve as a platform for building scientific cooperation and partnership across Europe and will support "Europe" to speak with one single voice throughout COST Actions like E34.

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