



Report on COST E50 Workshop Working Groups 3 & 4

Modeling from Plant Wall to Plank

Napier University, Edinburgh, Scotland

19-20th April 2007

The workshop was based around the question: *“How do we use models at different scales to help understand the behaviour of timber containing reaction wood?”*

The meeting began with an introduction by Dr Barry Gardiner (Forest Research, UK) to the problems caused by reaction wood in wood and how modelling might be able to help address these issues. This was followed by two plenary talks entitled “Properties of Timber Containing Reaction Wood” and “Modelling Wood” by Dr Marie Johansson of Chalmers University, Sweden and Dr Mike Jarvis of Glasgow University, Scotland respectively. Dr Johansson compared the mechanical properties of compression wood and normal wood. The presence of compression wood often results in increased distortion (bow and spring) because of higher longitudinal shrinkage when dried and also to brash failure under loading. Dr Jarvis discussed the philosophy of modelling and presented a review of modelling approaches and under what circumstances which models were appropriate. His talk was illustrated by a discussion of models aimed at explaining the influence of microfibril angle on the mechanical properties of wood fibres.

Two additional talks were presented by Dr Pekka Saranpää (METLA, Finland) and Dr Rupert Wimmer (Boku University, Austria). Dr Saranpää discussed how tree breeding and silviculture affect wood properties between sites, between stems, within stems and within annual rings. He also discussed models of wood properties that he and colleagues are developing. Dr Wimmer discussed the use of path analysis for modelling the relationships between wood attributes and pulp characteristics. Path analysis requires the identification of a causal pathway containing both direct and indirect effects. In this way, the issue of multi-collinearity between variables, which is a problem in multiple linear regression, can be dealt with.

The Workshop then broke into two groups in order to try to answer the following questions:

1. Identify the key problems
2. List the models that we are developing and what data we have
3. Identify issues where we need help from Working Groups 1 and 2
4. Identify what are the essential requirements we require for future effort (models, data, experiments, tools, proposals, collaborations, etc.)

Group I was concerned with working from tree to final product whereas Group II was focussed on scaling up from cell wall upwards (Figure 1).

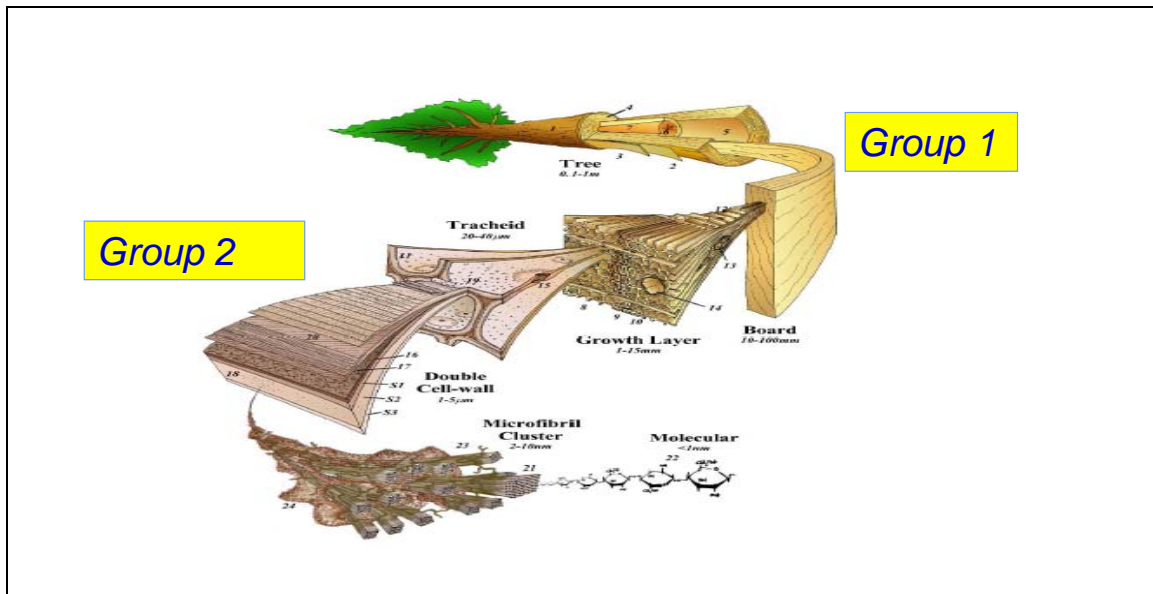


Figure 1. Schematic diagram showing the structure of a softwood tree at a range of scales (after Harrington, 2002).

At the end of the Workshop, the two groups came back together and reported their findings. The key outcomes were:

1. Need to know how important reaction wood is to the wood processing industry?
Have any surveys of end-users and processors been undertaken and if so what conclusions were drawn?
2. Still have a fundamental requirement for how to identify and classify reaction wood despite over 100 years of research in this area.
3. Reaction wood is likely to be more of a problem for high-quality end products such as panels (distortion), glue-laminated beams and solid timber (distortion, stiffness and failure mode)
4. Predicting the location of reaction wood in tree stems is not yet possible
5. The drivers for reaction wood formation and the development of growth stresses in trees are not well understood.
6. Models exist for predicting the mechanical behaviour and distortion of wood but as yet these do not incorporate reaction wood.

7. Require more information on the mechanical and physical properties of reaction wood
8. Need to properly understand the response of timber to fluctuations in moisture content
9. Need improved tools to study cell wall structure
10. Need WG 1 & 2 to tell us whether models for cellulose and lignin are common for all species, better information on the chemistry of fibres and better tools to study cell wall structure (e.g. antibodies)
11. Need to understand the role of cavities which occur during cell wall formation

Finally, the Workshop concluded with key future requirements and potential future work. These were as follows

1. Need to improve the definition of reaction wood and to link this definition to properties and behaviour, rather than simply anatomy.
2. Need to complete a risk analysis to determine the economic cost of reaction wood to the European forest-based industries
3. Require fundamental research on cell wall formation
4. Need to develop a modelling framework to predict the behaviour of sawn timber/laminated timber
5. Require fundamental research into reaction wood and understanding heterogeneity
6. Need to produce a list on the CEMARE Web site of all on-going research into reaction wood in Europe

It was concluded that there is a need for a major coordinated research project and consideration needs to be given to a developing a 7th Framework proposal. In addition to this short report from the meeting, a more thorough summary document will be prepared which will elaborate on the key points covered here. This document will be circulated among the members of the COST action and will hopefully serve as a catalyst for developing future proposals for collaborative research.

Barry Gardiner and John Moore
Edinburgh
3 May 2007