Short description of laboratory

VTT/Building and Transport/Timber structures research group
P.o. box 1806, FIN-02044 VTT
Head of research group: Prof. Alpo Ranta-Maunus
http:///www.vtt.fi/rte/ts
Tel : +358 9 4561 Fax: +358 9 456 7027 mail: firstname.lastname@vtt.fi

Main topics	Example of activities	Number of scientists
Basic research on wood material behaviour	Drying technology of sawn timber, calculation methods for drying stresses and mass transfer Creep and duration of load for wooden products, experiments and modelling Warping of plywood panels, models and experiments Reliability studies for wooden products and structures Material properties of engineered wood products	**11**
Timber structures and product development	Development of wooden floors, Vibration of floors, FEM-calculations and development of testing methods Timber-concrete composite elements Nailplate joints and dowelled joints Connections made of glued in rods Agricultural wooden buildings Wood panel products Wood product certification	

Main equipment: Chemical analysing facilities (FTIR, GLC etc), SEM and microscopic facilities, Weathering chambers, Equipment for the manufacture of wood-based panels, Structural testing of small and full scale structures, Access to full-scale fire and acoustic tests for building elements, CNC-equipment for 3-dimensional machining of wood, X-ray scanning of logs, panels and sawn timber, Pressurized drying chamber and normal drying chambers, Impregnation plant, Thermal treatment plant, Full Scale test houses

Reliability studies for wooden products and structures

(A. Ranta-Maunus, M. Fonselius, J. Kurkela, M. Kortesmaa, T. Toratti)

As part of the European harmonisation of building codes, the questions on determination of design values for loads and materials are of interest and the motivation for this research. The result of the structural reliability analysis depends strongly on the load and strength distribution types used. The following conclusions are based mainly on the use of Gumbel distribution for variable loads.

When the number of experiments allow, the determination of 5% fractile of strength should be based on the function fitting on the lower tail of the strength values, for instance 10% (see figure 1). All smooth functions fitted to tail data gave good estimates of the 5% fractile. When the 5% fractile is determined from a funtion fitted to all data, up to a 5% error was made (in one case 9%). 3 parameter Weibull distribution gave in all calculated cases 5% fractile within an accuracy of 3%.

When fitted functions are used in the reliability analysis, it is essential that the fit is good in the lower tail area, the lowest values being most important. When fitted to the same data a 2-parametric Weibull gives the most pessimistic prediction for the tail, normal distribution being next to it, lognormal and 3-parameter Weibull being most optimistic. In one example, a 2 parameter Weibull gave 10 times higher failure probability than 3 parameter Weibull.

The analysis suggests that γ_M = 1.2 to 1.3 is reasonable for timber structures when γ_G = 1.2 and γ_M = 1.5 (see figure 2).

This activity is organised through two separate projects: - a national 10 month project which has ended by the end of 2000 and a 2 year Nordic project which will end by the end of 2001. A report of the reliability studies carried out by VTT will soon be published (*Reliability analysis of timber structures, Alpo Ranta-Maunus, Mikael Fonselius, Juha Kurkela, Tomi Toratti. VTT research notes 2001).*

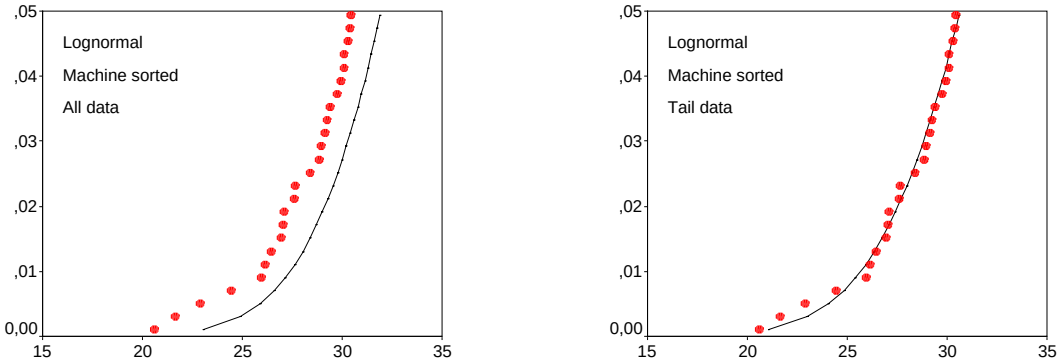

Figure 1. *An example of the cumulative distributions of the bending strength for machine sorted spruce as fitted to a statistical distribution using all the data or just the tail data.*

Figure 2. *An example analysis describing the material safety factors γ_M needed for: - a target annual failure probability $P_f = 10^{-5}$ or $\beta = 4.27$, - when perm. load G follows normal distribution with COV= 0.05 and charac. value is 50 % fractile, - variable load Q follows Gumbel distribution with COV = 0.4, - partial factors for loads are $\gamma_G = 1.2$ and $\gamma_Q = 1.6$, - strength follows lognormal distribution having COV = 0.05, 0.1, 0.2, 0.3 or 0.4*