Short description of the centre		
Centre Technique du Bois et de l'Ameublement The Wood and Furniture Technical Centre created in 1952 *Staff:* 260 *Location*: Paris (furniture, training, standardisation, direction, communication, quality), Bordeaux (Construction Group, 130 people) and in Pont-A-Mousson (Scanwood system: subsidiarisation of former Automation department) General Head: Daniel Guinard Head of Timber Construction Group: Georges Henri Florentin Head of Research Department: Frédéric Rouger http://www.ctba.fr		
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Main topics	Activities	% resources
1-logging, sawmilling and panels (28% of the CTBA activities), **2-wood used in construction: structure, frame timber, joinery, and wood-based panels (49% of the CTBA activities),** **3-furniture (23% of the CTBA activities),** in the following areas: harvesting, drying, detection, qualification, machining, preservation, coating, gluing, elaboration, furniture design, environment, construction.	Studies and Research Certification Testing Consultancy Dissemination of technical information Awareness campaigns and expertise Standardisation Maintenance of the European level Technology watch Training	23.1% 20.3% 13.6% 11.5% 8.7% 5.6% 5.2% 5.2% 3.6% 3.2%

Main equipment:

Wood qualification laboratory (Non destructive testing equipment: Xray, stress grader, stress wave, vibration method)

Chemistry laboratory.

Biology laboratory (entomological, mycological, and ecotoxicological activities).

Mechanics laboratory (bending, tension, compression, fatigue, shear tests on structural components and connections).

Physics laboratory includes 3 acoustic measurement cells.

Workstation

Activities related to the field of COST Action E24

Characterisation of National Timber resources and other related studies

The acquisition of these data is essential for an optimised use of the wood and provides database for numerical model and probabilistic approach.

Characterisation of the national resource

The qualification of the national Timber resource allows to definite the visual grading of the different species used for the elaboration of French standard NF B 52 001 about Regulations governing the use of timber in structure_ Visual classification for the use of the main coniferous and deciduous wood types in structures.

Selection of samples, physical measures (density, humidity, nodosity) mechanical (tension, bending, compression) tests are realised by the CTBA.

The species studied in the last 15 years are given in the table 1.

Species	Sample size	Sampling French areas
Scot pine	2 400	5
sitka spruce	1 100	1
common spruce	3 800	10
Poplar i4551, Robusta	2 400	8
douglas fir	2 300	7
maritime pine	2 000	4
black pine	1 700	6

Table 1: species studied in the last 15 years in France

Mechanical characterisation of European larch (1998-2000)

At the present time, larch is not among the species concerned by French standard NF B 52 001—Rules for use of timber in construction—of 1998. This absence is in no way connected with the mechanical performances of larch, but rather to a lack of data about this species. These projects have been undertaken to introduce larch into this standard.

160 trees have been selected from 18 stands. Harvesting and cross-cutting of the trees carried out in 1998 were continued via the sawing, drying and planing aiming at the preparation of 1800 commercial sized samples, subject to non destructive and destructive testing.

Mechanical behaviour of small diameter round wood used in structure (97-98)

The main purpose of this European program was to develop building system using small diameter round wood. This timber is currently earmarked mainly for pulping, but it might well be possible to make structural use of it. Round wood is available in quantity at low cost.

In this study, the CTBA realised the characterisation of Douglas fir round wood and developed non destructive measurement techniques, in such a way to propose optimal wood grading; it is also involved in the promotion of building systems. This research has led to a greater awareness on the part of manufacturers about structural round wood use by way of a market study and the presentation of experimental data en bending, tension and compression for calculation codes.

Non destructive testing and grading

Modelling of glued-laminated timber under bending stresses (97-98)

This study consisted in modelling the mechanical behaviour of straight and curved glued laminated wooden beams using a deterministic and probabilistic approach. The interest of this programme lied in comparing the models with experimental results (glued laminated timbers of 12 meters length was tested in bending).

To do this, CTBA was helping with the mechanical grading of square-edged timber which will be used to make the glued laminated beams; it also provided its partners non destructive measurement values for the models implemented parameters.

Machine stress grading of maritime pine for structural uses (1998-2000)

The main purpose of this project is to develop and establish on an industrial site a machine inspection system helping to make better use of wood products designed for structure purposes (handling pallets, glued laminated framework), in companies in the Aquitaine region.

The databases (CTBA and LRBB) established over the past ten years on maritime pine represent the foundations of a mechanical grading system for this species, based on an assessment of the quality of the wood. A reliability analysis on the handling pallets mechanical behaviour was developed with the Monte Carlo method and a finite element model.

Mechanics of structure and connection - Numerical models

Modelling of the mechanical behaviour of toothed metal connectors (91-96)

Among connections currently used in wood structures, toothed metal connectors have an important place. The behaviour of this type of assembly brings complex phenomena into play (major displacement, elasto-plasticity…).
This study has led to the development of a modelling method using finite elements of the connector, and has made it possible to deduce an overall force displacement law, which may be incorporated in a calculation cod for semi-rigid structures.

Characterisation of drift pin mechanical behaviour (2000-2001)

A connection using drift pin was developed by a *bureau d'études* to realise the joint in the height of wooden column. Each column is divided in four elements and each column quarter is constituted of 20 *carrelets de section 150*150 mm2*. A connection, situated on the end of each *carrelet,* is constituted of axis of a length of 1120 mm and 9 drift (see figure 2).
In this project, CTBA realised

7 an experimental determination of the mechanical strength in tension of the connections: 20 oak *carrelets* of 3 m of length with a connection on each end were tested in tension. The average value of load is 670 kN. Test were realised with a une machine de capacité de 2000 kN.

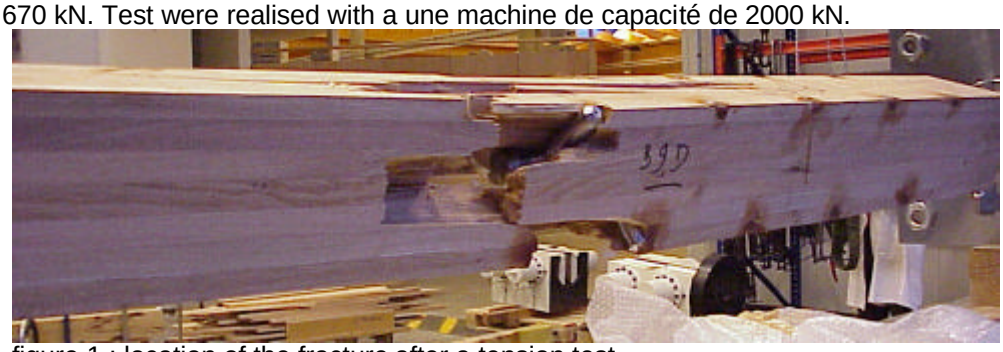

figure 1 : location of the fracture after a tension test.

7 a finite element model of the mechanical behaviour of column quarter submitted of an humidity gradient between the centre and the periphery to evaluate the increase of stresses.

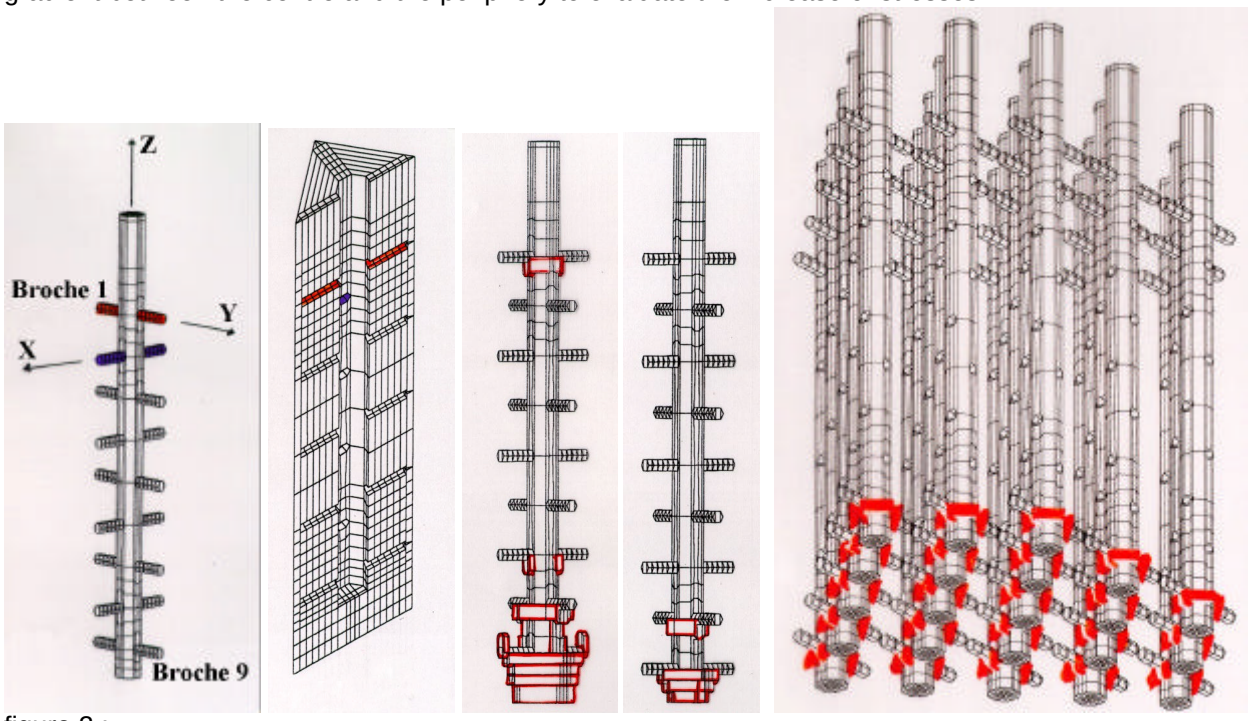

figure 2 :
a : finite element mesh of the connection
b: transversal section YZ of the wood situated around the connection

c: distribution of the wooden elements (in red) submitted to a tension stress higher than 30 MPa when the load applied is 500 kN.
d: distribution of the wooden elements (in red) submitted to a tension stress higher than 40 MPa when the load applied is 500 kN.
E: finite element mesh of quarter column connections.

Local reinforcement of structural elements with composites (1996-99)

With regard to the economic interest of reinforcement solutions, it is hoped to achieve a gain of about 20-30%, in terms of both strength and stiffness.

The study has been carried out dealing with the definition of the requirements of the trade, followed by an experimental phase associated with the digital simulation of possibilities offered by the introduction of composite reinforcements. The simulation is thus based on real tests carried out on composite materials.

What emerges from this is that reinforcement using fibreglass is still the most profitable, economically speaking. With regard to the main families of structural elements which may properly call for a reinforcement, it is possible to identify:

- notched elements, beam supports on masonry work, cantilever beam joints...
- braced elements, especially in roofs,
- elements assembled on an internal metal bracket or gusset,
- girder zones for curved beams and arch eaves.

The elasticity modulus of the composites tested are on about the same scale as those of wood. On the other hand, the failure values are 7 to 10 times higher than those of wood which would indicate a considerable increase in the safety of reinforced specimens.
The digital simulation of reinforced notched specimens also shows that it is possible to achieve local rigidity gains of 20-40% for a single composite sheet, which is henceforth promising from the point of view of new design possibilities.

Selected references

Housing with Sitka spruce : a new challenge
JD. LANVIN, CHOLAT R., CHATELU R., GRAF F.
Proceedings de l'atelier technique Eurowood, 31 mai-1er juin 1999, Florence

Round small diameter timber for construction
A. RANTA- MAUNUS with CTBA participation
Final rapport of the FAIR project CT 95-0091, VTT publication N° 383

A new statistical method for the establishment of machine setting
F. ROUGER
CIB W18, Vancouver, Canada, 1997

Organisation of the seminar on Reliability Based Design of Timber Structures
F. ROUGER, G. ADJANOHOUN, P. CASTERA
Paris, 1997.

Comportement semi-rigide d'un connecteur métallique à dents embouties sous sollicitations statiques
G. ADJANOHOUN, F. ROUGER, N. TALBI,
Annales du Réseau Génie Civil Bois, N°1, 1996

Application of a modified statistical segmentation method to timber machine strength grading
F. ROUGER
Wood & Fiber Science, 28 (4)n pages 438-445, 1996

Strength estimation in wood beams based on neural network and fuzzy logic software
JD. LANVIN, M. HYVERNAUD, G. BESACIER,
10th International Symposium on non destructive testing of wood, Lausanne, 1996