



Moisture content and temperature effects on reinforcements in timber structures

Julie Lartigau, Emmanuel Maurin, Jean-Luc Coureau, Philippe Galimard

► To cite this version:

Julie Lartigau, Emmanuel Maurin, Jean-Luc Coureau, Philippe Galimard. Moisture content and temperature effects on reinforcements in timber structures. 4th International Conference of COST action IE0601: "Wood science for cultural heritage", Oct 2010, Izmir, Turkey. hal-03407856

HAL Id: hal-03407856

<https://hal.science/hal-03407856>

Submitted on 28 Oct 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Moisture content and temperature effects on reinforcements in timber structures

Julie LARTIGAU⁽¹⁾

Emmanuel MAURIN⁽²⁾, Jean-Luc COUREAU⁽¹⁾, Philippe GALIMARD⁽¹⁾

(1) US2B (CNRS/INRA/Université Bordeaux 1)

(2) LRMH

Aim of study : Information on short-term and long-term durability of connections by glued-in rods in timber structures. Experimental and numerical investigations.

Background



Damage of wood by biological agents

Reduction of its mechanical properties

Need to repair

Glued-in rods

- ◆ Process developed in 1970's
- ◆ Decayed wood substituted by sound one
- ◆ Structural loads transferred by means of threaded steel bars bonded to wood

Great conservation of the original material



Experiments



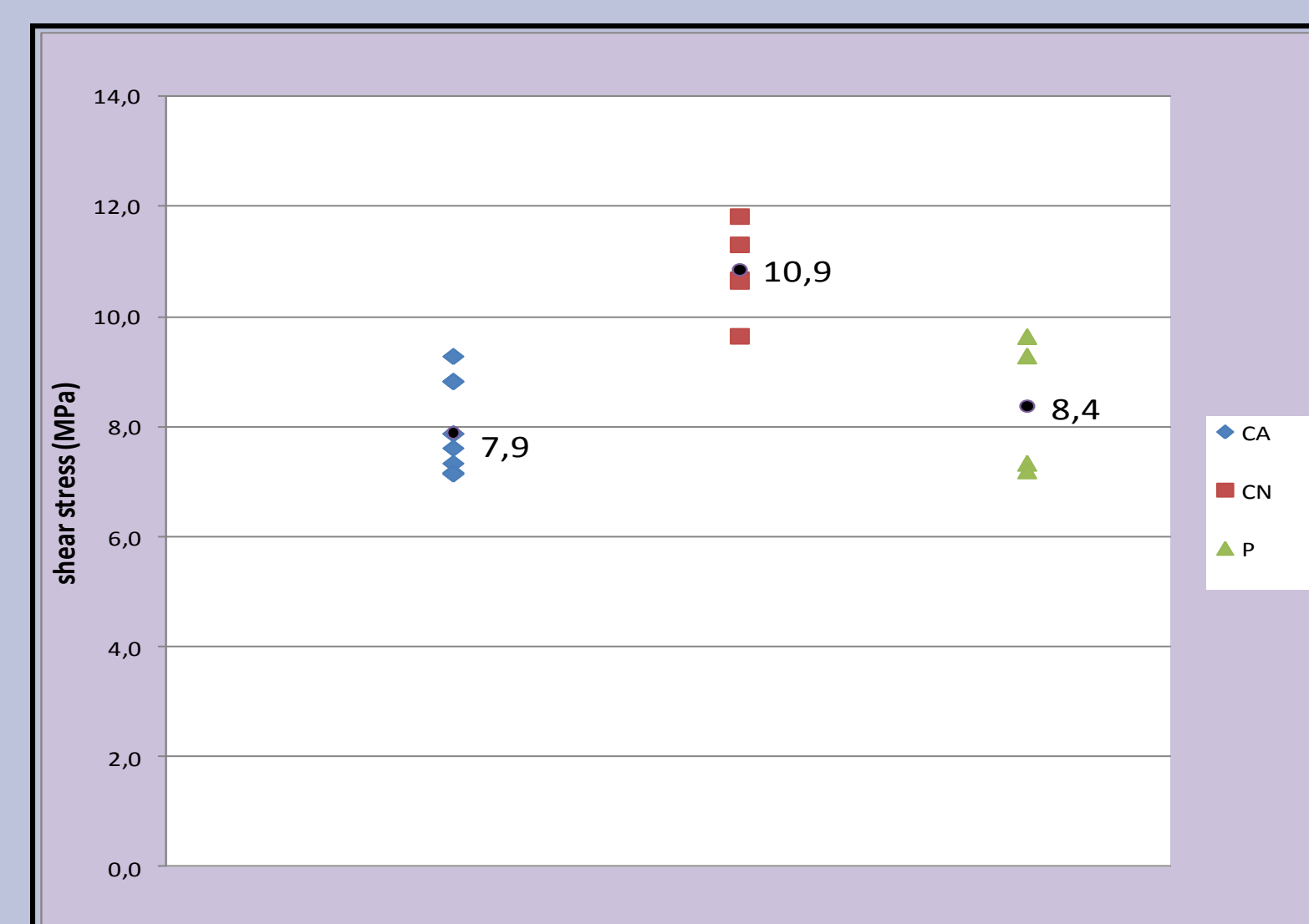
3 types of wood performed: ancient oak, new oak and fir
Small size specimens: cubic shape (50 mm edge)
Use of threaded steel bars and epoxy adhesive
Short-term tests on « pull-compression »

Influence of type of wood on mechanical behavior

First results on experiments



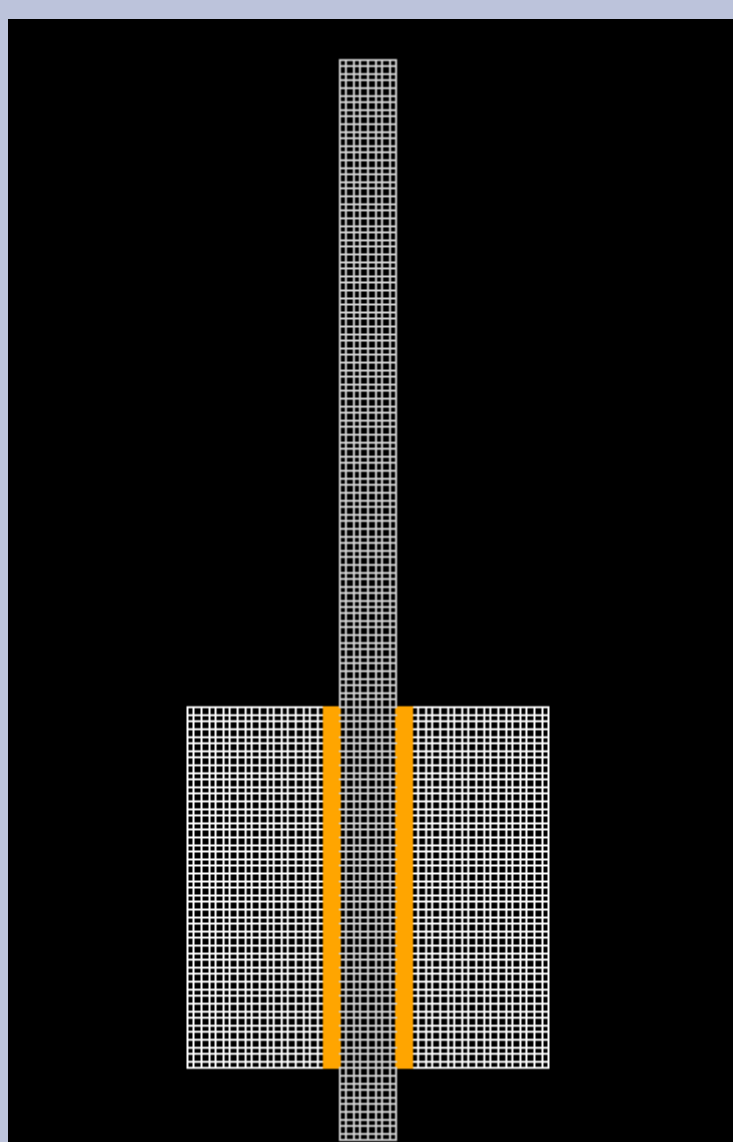
Failure at timber/glue interface



CA : ancient oak
CN : new oak
P : fir

Shear stress : $\tau = P_{\max} / (\pi d_{\text{hole}} L)$

Finite element modeling

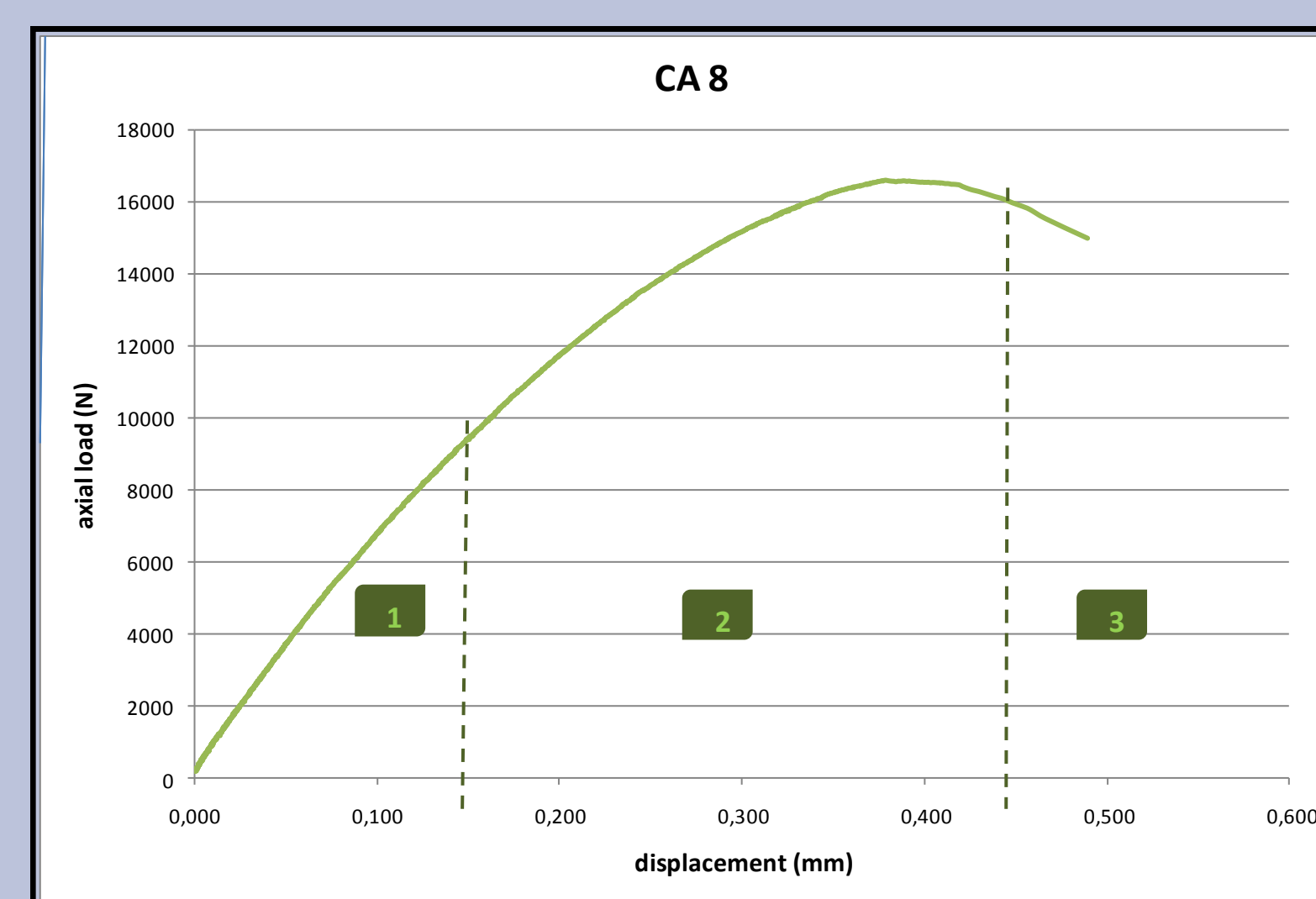


- ◆ Calibration on elasticity
- ◆ 2D axial-symmetric model
- ◆ Meshing improved on joints' elements

Wood	Steel	Epoxy
$E_L = 14\,400 \text{ MPa}$	$E = 210\,000 \text{ MPa}$	$E = 1 \text{ GPa}$
$G_{LR} = 1\,260 \text{ MPa}$		

Influence of E_L , G_{LR} and E_{glue} on stiffness of the connection (k_{ass})

Setting up of an **experimental design**
Analysis of variance



1: Elastic zone

Linear part of the curve
Slope is the stiffness of the connection

2 : Damage zone

Decrease of the stiffness
Beginning of damage in glued interface

3 : Failure

First results on modeling

Mechanical properties	Influence on k_{ass}
Modulus of elasticity of wood: E_L	18 %
Shear modulus of wood: G_{LR}	34 %
Modulus of elasticity of glue: E_{glue}	48 %

Conclusion and perspectives

- ◆ Failure occurred only in the wood close to the glue line, in all samples (adhesive failure)
- ◆ Ancient oak samples revealed lower pullout strength than new oak (lower of 25%)
- ◆ The experimental design indicated a significant impact of E_{glue} on stiffness of the connection
- ◆ Samples made with massive epoxy will be tested on tensile test, in order to really know its mechanical properties
- ◆ Series of experiments, taking account of new parameters (T and MC) will be carried out