

COST ACTION IE0601

Short Term Scientific Mission Report

Reference number: COST-STSM-IE0601-2976

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Title: Improving mathematical modelling on deformations and tensions in poplar wood subjected to RH changes

Period: from 19 May 2006 to 24 May 2006

Host institute: LMGC - Universite Montpellier 2 ,34095 Montpellier CDX 5- FRANCE

To MC Chair Prof. Luca Uzielli

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To STSM Coordinato Dr. Anastasia Pournou

Department of Conservation of Antiquities and Works of Art

Technological Educational Institute of Athens

Ag. Spyridonos, Aigaleo

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To the Host: Prof. Joseph Gril

LMGC

Universite Montpellier 2 ,

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France

To the COST Office

Brussels

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Purpose of the visit

The STSM I asked for is deeply connected to painted panels and their problems in conservation. During my PhD studies I carried out different kind of tests to characterize physical and mechanical behaviour of Poplar wood (*Populus alba* L.). The choice of this species is due to the fact that in the centre of Italy painted panels mostly were made by Poplar wood boards (Mona Lisa by Leonardo da Vinci, Tondo Doni by Michelangelo, Primavera by Botticelli, Maestà by Giotto).

In order to improve the conservation of these masterpieces, a deeper knowledge of the wood species is necessary. That is the main reason to carry out physical (water diffusion, shrinkage and swelling coefficients) and mechanical (strength and modulus of elasticity, creep and mechano-sorptive mechanism) tests. During the last year of my PhD (2007), thanks to the existing collaboration between LMGC (Montpellier, France) and DISTAF (Florence, Italy), I could discuss and elaborate the results with Joseph Gril and his team. The main purpose of this collaboration is the validation of a mathematical model proposed by LMGC, able to interpret the deformations of and the stresses in a painted panel subjected to climatic variations, based on the data obtained by the experimental tests carried out at DISTAF.

My mission at LMGC was necessary to improve the following aspects of the work:

- clarify, and possibly improve the test procedures;
- analyse the tested specimens;
- process and analyse the data obtained at DISTAF.

Description of the work carried out during the visit

The STSM started with the presentation of my PhD work to Joseph Gril and his team in order to give an overview of the research to all the team and afterwards more specific meetings were organized.

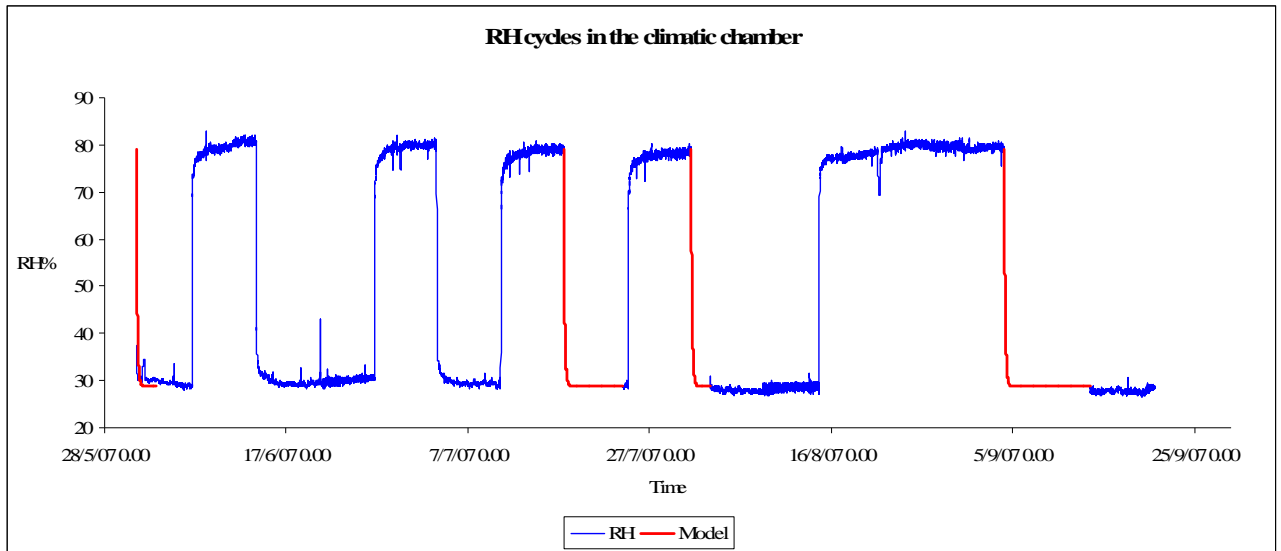
The topics that had to be discussed were:

- materials: explanation of the necessary steps to equip the specimens, their conditioning state at the beginning of the tests and the way to mount them on the measurement devices, description of the apparatus systems;
- methods: description of the methods used to carry out the tests;
- tests: data processing of diffusion and long term load tests (mechano-sorptive tests);
- effects on the specimens: observation at macro level of the test effects on the specimens;
- modelling: a model of the climatic chamber was elaborated in order to describe the climatic conditions inside;
- modelling: a model of the transversal diffusion;
- modelling: improving the existing model that it could interpret stresses and deformations of the specimens subjected to climatic variations (long term loading) in order to be applied to plastic deformations as well.

Description of the main results obtained

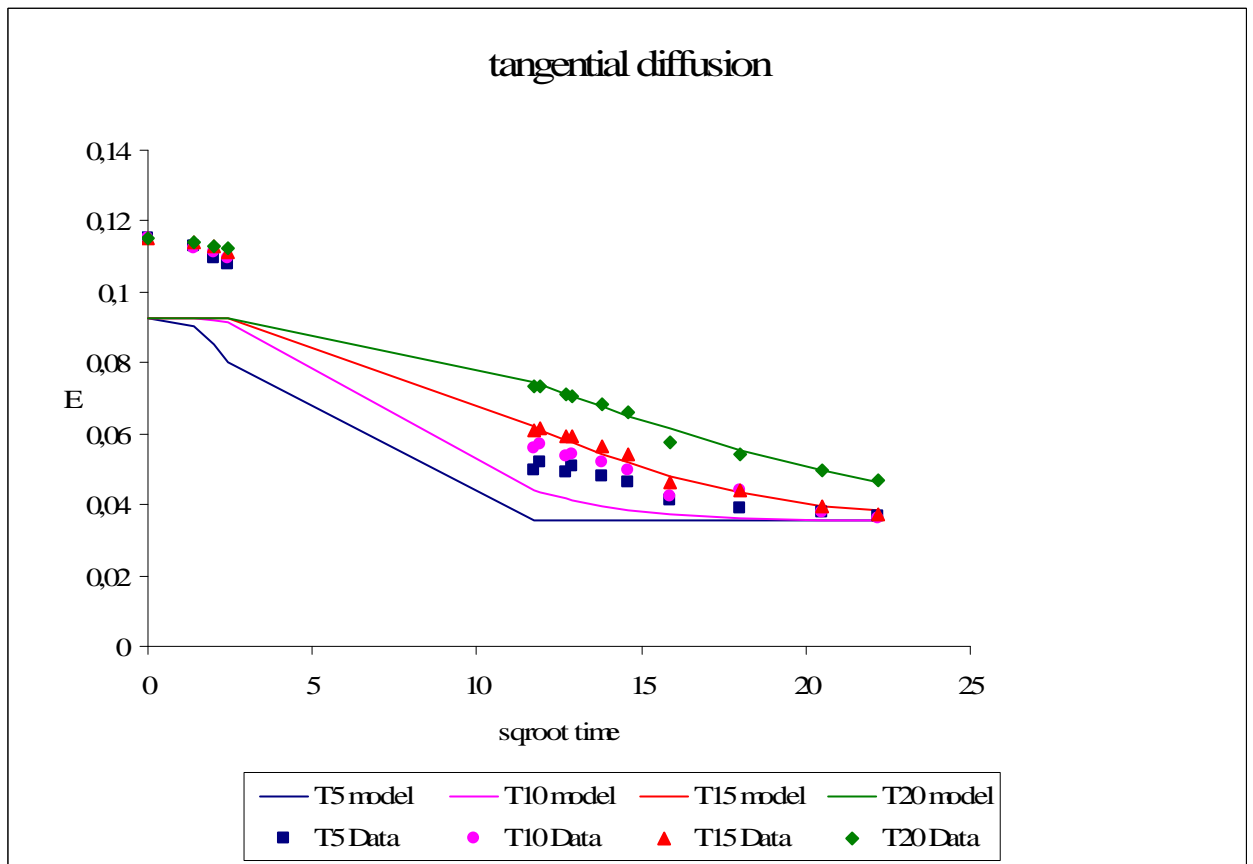
In the frame of the collaboration between LMGC and DISTAF, the main results obtained during the STSM are:

- preparation of a model to describe the climatic conditions variations in the chamber where the tests are carried out, in order to fill gaps in the records.



in light blue the experimental data are shown, while the red line is the model. It accounts for the fast change of the desorption part of the cycles (the vertical line), even if it has to be improved in the slope exactly when the RH% values tend to the equilibrium. ;

- elaboration of a mathematical model that could interpret the diffusion tests. Data are shown as dots and the model is represented by lines. Here below the graph reports only the diffusion along the tangential directions of tested poplar specimens. The tested specimens were characterized by different thickness (5, 10, 15, 20 mm along the tangential directions) and by a waterproofing aluminium sheet that covered the four faces through which the diffusion needed to be prevented.



The model represents quite well the two thicker specimens (15 and 20 mm) behaviour in the middle and final parts of the tests. It has to be improved for the initial part and for the thinner specimens.

Conclusions

The collaboration was really fruitful during the mission. A deep work in discussing and analysing the data was developed. The main results obtained were a deepening both of the physical and the mechanical behaviour of Poplar wood across the grain. Specifically, the model for the diffusion behaviour is at the very beginning of the study and it represents a valid interpretation of the transversal diffusion for the thinner specimens. The long term loading model needs a deeper study to interpret the plastic deformations of the specimens.

Future collaboration

Starting from this mission, more work needs to be done in collaboration between DISTAF and LMGC. The models will be improved and, moreover, other kind of tests on Poplar specimens have been planned at DISTAF and the obtained data will be useful to validate the model arranged by Joseph Gril and his team.

At present, I plan to publish a paper on the first results to be presented at next COST Action IE0601 meeting in Braga (Portugal) on next 5-7 November.