COST Office
149 avenue Louise
1050 Brussels, Belgium
Tel: +32 (0)2 533 3800
Fax: +32 (0)2 533 3890
E-mail: office@cost.esf.org
http://www.cost.esf.org

COST IE0601 - Reference code: COST-STSM-IE0601-04639
Beneficiary: Dr. Paolo DIONISI VICI, Ph.D. Wood Science

Subject: Final Report of the activities developed during the STSM

Summary
The starting reasons of this STSM are described in the first final report and I won't describe how it started, referring to the previous Final Report.

This second final report describes the second STSM carried on during the period 10-15 May 2009. As previously discussed the measurement points were identified. During this second part of the mission three of the four Deformometric Kits were installed where the access to the ship was not dangerous for the conservation of the structure and the logging started. One Kit position needs an external structure to access the ship without walking on its bottom because of safety reasons and it will be applied in a near future. This report will describe the installation procedure and the expected results.

1. Verification of the instrumentation
After the first visit it was necessary to build some parts that have been constructed or assembled on my suggestion, referring to the structural tools that were afforded and solved in our previous interventions. The standardization in the procedure of assembling the Deformometric Kit will allow a better comparison of the obtained results, simplifying the conversion of the electrical data logged in significant deformation data, avoiding possible mistakes. According to this goal, a deep attention has been reserved to the references of the transducers names and position.

2. The choice of the measurement points
The points chosen for the installation of the four Deformometric Kit are the following:
1. one plank from fresh oak, radially cut, same thickness as the plank on ship (ca 3 cm): this sample has been chosen as a dummy whose deformation can be considered as a general reference of the reactivity of the species used in the building of the ship;
2. one plank of archaeological oak from same find, radially cut, ca 3 cm: this sample will give information about the reactivity of the archaeological material free from any kind of constraint;
3. one plank of the ship on which we can see there is minimal stress due to load (gravity, weight of other ship members etc) on deformation/stress diagrams from FE-model: the measurement will give information about the magnitude of the hygromechanic response that is totally unknown at the moment;
4. one plank of the ship on which there is maximum stress/loads on deformation/stress diagrams as obtained from the FE-model: as in the upper case, the system will hopefully give information about the hygromechanic behaviour of this part of the structure under the highest levels of mechanical stress; it will be interesting to analyse the delayed effects (if they're present);
as already described in the summary, this measurement point will be set up in a near future after the construction of a structure that will allow to avoid any contact with ship's structure.

The settings of the Deformometric Kit
The connection of the transducers structure to the planks has been carried on as in other past case studies using wood screws 20 mm long, screwed in the wooden elements at a depth of 15 mm,

exluding the support of the Deformometric Kit. The mechanical connection looks tight enough to support the system. At present the only system that has significant cantilever stresses is the one put on the vertical boards near the edge of the ship, in the other cases this is nota a problem, due to the horizontal position of the planks.

3. The data analysis

3.1 Deformation data

All the measurements obtained from the conversion of the electrical signals logged can be converted in linear or angular deformation referred to the surface of the planks, according to trigonometric relations; a spreadsheet with all the formulas necessary for the interpretation of the results has been discussed with the Norwegian colleagues and left to them as an analysis tool. A particular attention has been paid to the verification of the initial distances between the connection points on the planks, because the possibility to obtain absolute measurements depends on this geometric parameter.

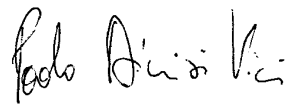
3.2 Physical analysis

A synthetic way to relate the deformative logged data to the microclimatic series is the use of a parameter that joins Temperature and Relative Humidity in one single value, that is the potential EMC to which wood could tend when in stable conditions for the necessary time.

As well known, this value can be obtained using the Hailwood-Horrobin formula, or some others present in literature. This formula relies on experimental parameters considered as an average between the different wood species, but it can't be applied “as is” to such a physically-chemically modified wood; in order to get an experimentally verified relation between the material under monitoring and the microclimatic data, we decided to set up some tests in order to obtain sorption isotherms on some samples obtained from the same burial area. The samples will be put in a climatic chamber with different salt saturated solutions at stable temperatures and monitored in weight until they reach the stability according to the standards.

4. Expected results

The Deformometric Kit will hopefully give information about the dimensional reactivity of selected points on the ship to climatic variations. This STSM was intended as a first stage approach and initial results will be described in future papers that will be presented at next COST meetings.



Paolo Dionisi Vici
Ph.D. Wood Science

IVALSA-CNR, San Michele all'Adige