

Mechanical behavior of a painted wooden panel from the heritage subject to hygrothermal variations: role of the reinforcement

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Abstract

This collaborative work brings together the Musée Fabre, furniture and pictorial layer restorers as well as researchers from DAGRI (University of Florence), the PPRIME institute (University of Poitiers) and LMGC (University of Montpellier). The aim of this study is to characterize the mechanical behavior of a painted wooden panel from the heritage subject to controlled variations in the hygrothermal environment.

La Sainte Trinité couronnant la Vierge (16th century, anonymous) is a painted panel showing mechanical variations for many years, requiring the laying of facings in 1998 to prevent the paint layer from further tenting. It is made of four vertical thinned oak boards, assembled by horizontal and

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vertical crossbars (*reinforcement*), probably glued and/or nailed onto them in the 19th c.a. A coating covered the whole backside of the panel. In 1963, the last conservation report suggested a drastic treatment consisting in an additional thinning of the panel and in dubbing the paint layer with another support. In 2017, conservators and curators decided to undertake a new conservation treatment. However, before any conservation act, a thorough study was decided, aiming to characterize the behavior of the panel and understand the occurrence of several new cracks.

These tests were carried out in a room of the museum open to the public. This imposed several constraints, such as the creation of a climatic enclosure and the installation of an adapted optical measurement device. The shape and the deformations of the panel are monitored by the stereo method followed by markers. Two pairs of cameras placed on either side of the panel allow tracking on both sides. Three deformometric devices make it possible to measure, by contact, local deformations and curvatures. Variations in water mass are obtained using a scale.

Variations in relative humidity of +/- 10% were carried out in stages of around two months. The position of the markers is measured every hour, which makes it possible to calculate the local movements of the panel in the three directions. The relief of the panel is concave with an amplitude of 16 mm. The deformations are strongly influenced by the presence of the glued cross-beams, which can be seen as the result of an inappropriate intervention that strongly contributed to the separation and cracking of the boards, and to the damages of the paint layers.

The removal of these cross-beams has been operated by restorers, while local deformations and curvature have been registered by deformometric device, allowing to analyze the mechanical effect of cross-beams onto the panel. The four boards constituting the panel were glued again, and the behavior of the "new" panel subject to hygrothermal variations is characterized. As expected, the panel without cross-bars is much more reactive to the environment. The data obtained by the deformometric sensors are crossed with the optical measurements. Mechanical behavior is related to variations in the mass of water measured.

Keywords : painted wooden panel, cultural heritage, mechanical behavior, hygrothermal variations, image correlation, act of restoration

Biography