



## The mock-up: A complementary element to understand the mechanical behavior of cradled panel paintings

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# The mock-up: A complementary element to understand the mechanical behavior of cradled panel paintings

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## Introduction

Using a mock-up, we aim to recreate the mechanical stresses applied to the panel during the thinning process and throughout the installation of the cradle.

### The original panel

Pietà, Flemish painted oak panel, Church of Saint-Denis, Liege, Belgium, 1070 x 683 x 3 mm. 4 boards: quarter and half quarter cutting. 19<sup>th</sup> century cradle: 10 vertical uprights and 12 horizontal crosspieces, common spruce.



Fig.1. (a) Front and (b) back faces of the panel studied.

## Materials and Methods

Historical Sources – 18<sup>th</sup> and 19<sup>th</sup> centuries:

MÉRIMÉE, J.-F.-L., *De la peinture à l'huile*, Paris, ed.Mme Huzard-Vallat, 1830, p.260.

HORSIN-DEON, S., *De la conservation et de la restauration des tableaux*, Paris, 1851, p.36.

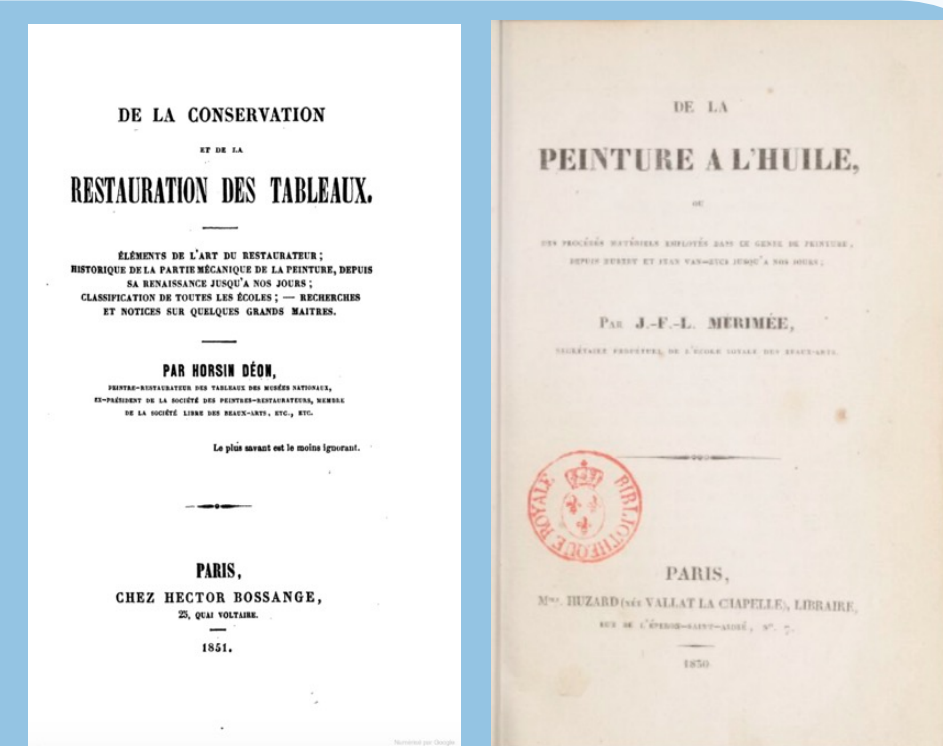


Fig.2a.2b. Two sources.

Three phases:

- 1 **Manufacturing process.**
  - Selection of oak boards;
  - Gluing: 10% fish glue / 100 ml of water;
  - Preparation CaCO<sub>3</sub> and oil glazes.
- 2 **Thinning process** ( Only panel 4b )
  - Before: 2 months 43% RH / 19°C; → Deflection of 3mm.
  - Thinning atmosphere: 80% RH / 24 hours; → Thickness 8 mm to 3 mm.
- 3 **Installing the cradles.**
  - 7 fixed uprights and 9 sliding crosspieces;
  - Gluing: 50% bone glue / 100ml water and press for 24 hours.



Fig.3a. Thinning process.



Fig.3b. Cradle process.



Fig.3c. Cradle process.

### Difficulties

Homogeneity, precision, controlled glue application.



Fig.4a. Front and back, unthinned panel, 818 x 525 x 7 mm.

Fig.4b. Front and back, thinned panel, 1030 x 507 x 3 mm.

Methodology: 15% humidity variations, monitoring: 10 days / 9 months.

## Results and discussion

### The unthinned panel – 7 mm thick

➤ After 24 hours:  
13 mm deflection.

➤ Over 9 months:  
Deflection of 8mm  
36% RH.

Blocked, no cracks.

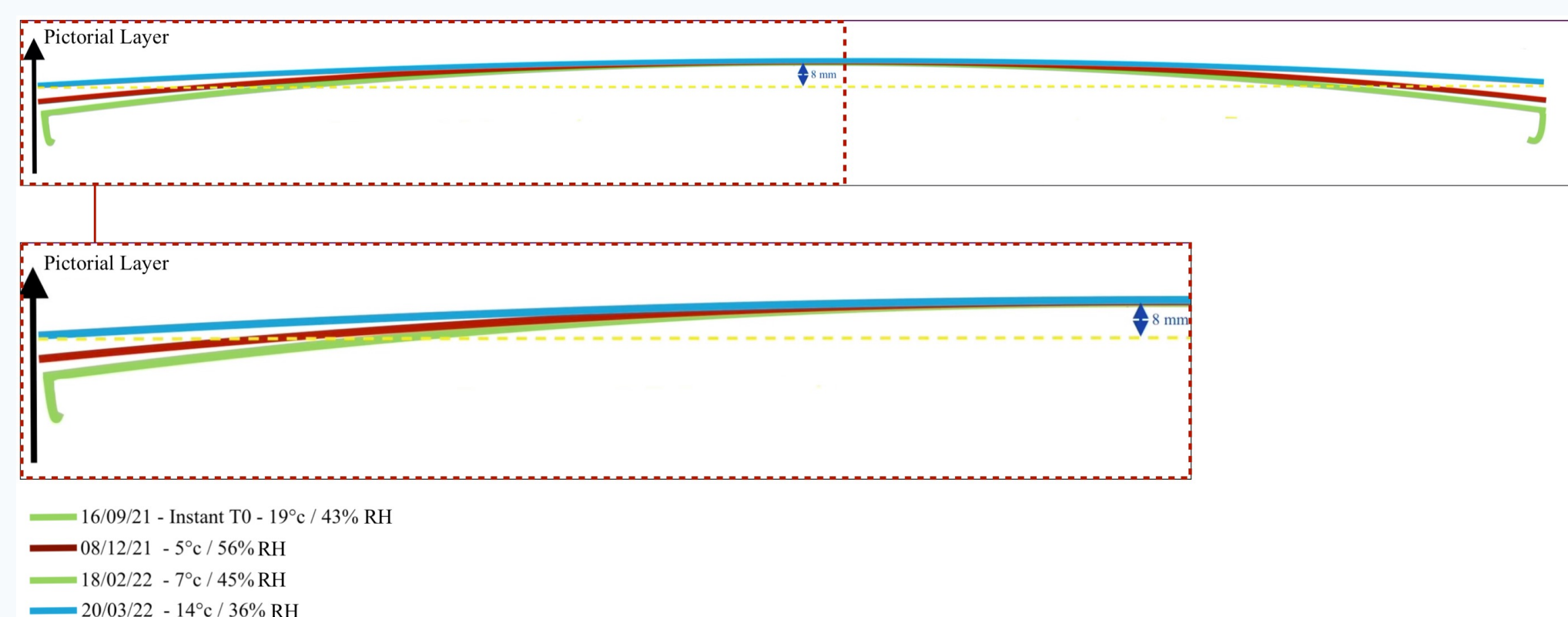


Fig.5a. Monitoring, unthinned panel Fig.4a.

### The thinned panel – 3 mm thick

➤ After 24 hours:  
Deflection 6 mm, sliding crosspieces.

➤ Over 9 months:  
Constant curvature,  
sliding crosspieces.

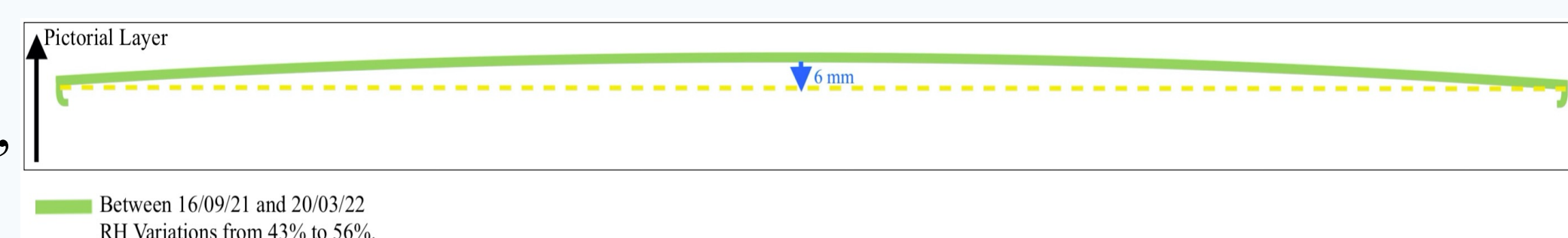


Fig.5a. Monitoring, thinned panel Fig.4b.

After 60 days:

First cracks of 70 mm and 90 mm: upper part of the panel.  
Identical crack to the original panel ( 220 mm ).

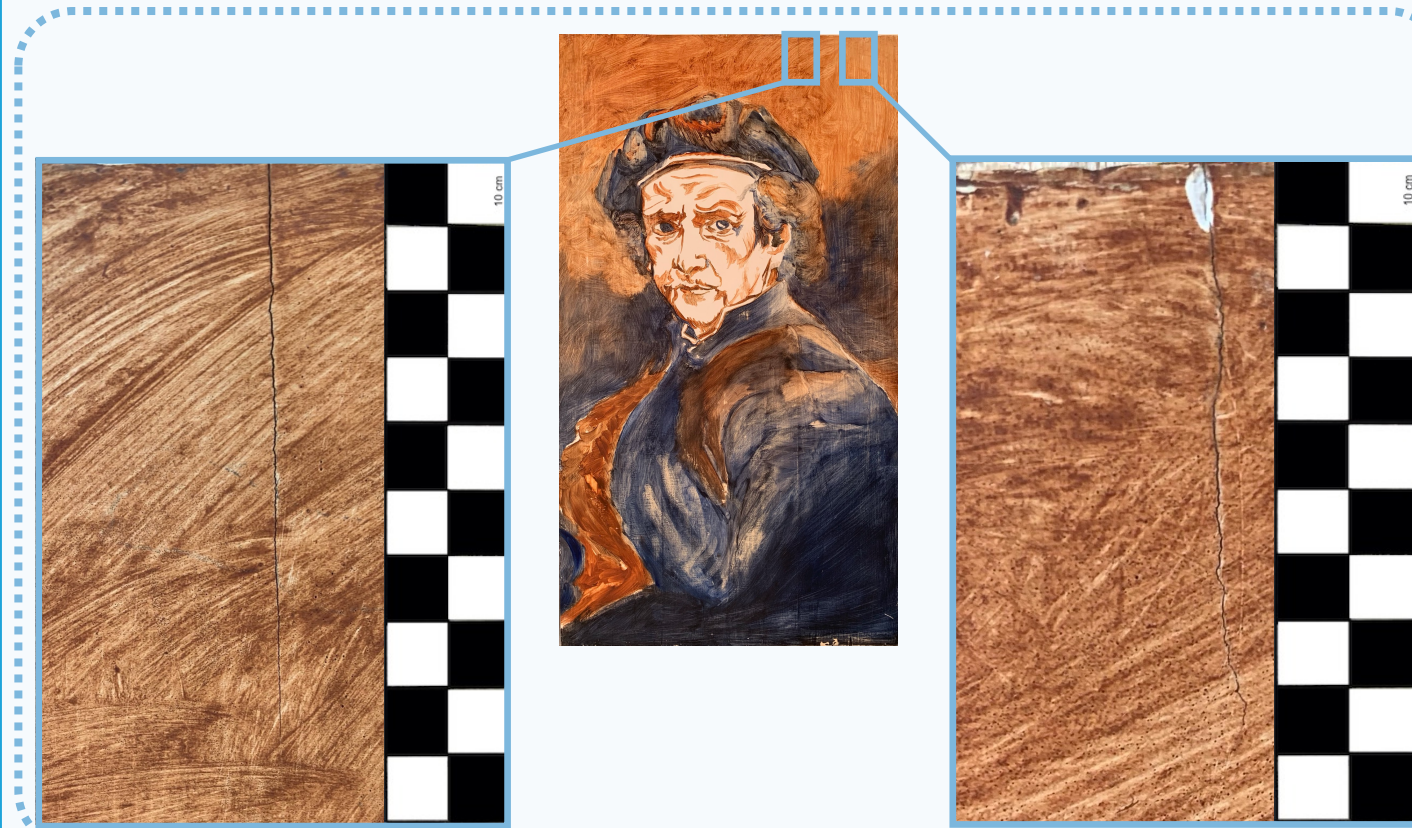


Fig.6a. Detail of two cracks - thinned panel mock-up.



Fig.6b. Detail - crack on the original panel.

### Understanding alterations

- Thinning process → Release of compressive, tensile and shear stresses.
- Installing the cradles → New supply of moisture, high compressive stress and crushing of the fibres.

### The conservation conditions of cradled panels

Humidity variations ⇨ Compression Set  
Heterogeneous swelling: areas under the uprights and free areas + Shear and compressive stresses

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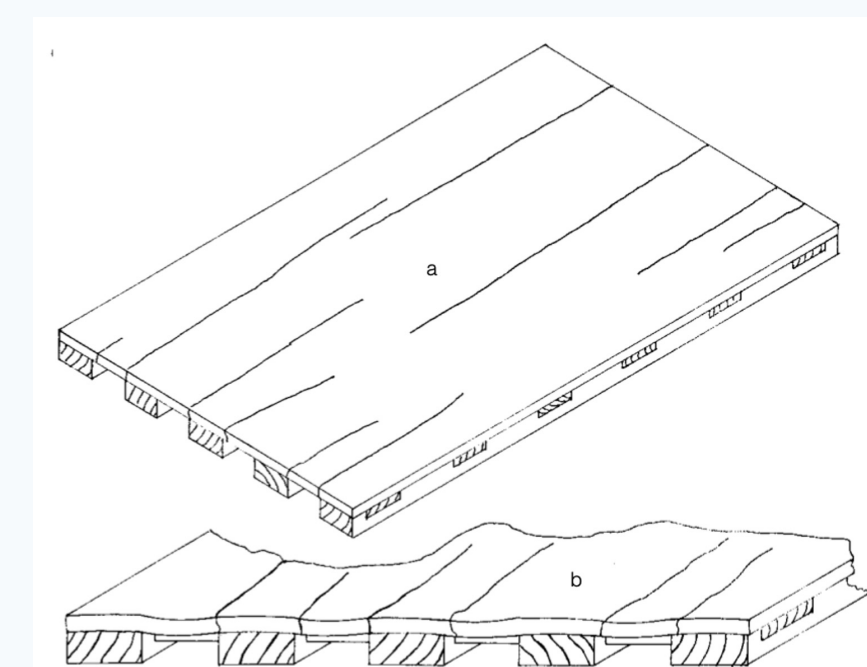


Fig.7. Fractures at the edges with the uprights. ©BOBAK, S. 1995

## Conclusion

- Mock-up usefull to mimic the effects of thinning process and cradle:
  - Mechanical degaviour of the panel depends on its **thickness**, cradle **density** and conservation **environment**;
  - Validation of a numerical approach by a mock-up instead of a historical panel.
- **Interdisciplinary work**, based on proven historical sources and new experimental data:
  - Difficulties of interpreting historical sources (vocabulary, glue).

## References

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