Climate4Wood: thermo-hygro-mechanical coupled modelling

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Climate4Wood

Climate4Wood is one of the six research projects within the Science4Arts research program initiated and financed by NWO. The Climate4Wood project aims at identifying the effects of climate fluctuations, i.e. temperature and relative humidity fluctuations, on damage resistance of museum collections. The results will be used to formulate reliable standards for climate fluctuations in sustainable museological environments. By means of a museum study and a thermo-hygro-mechanical coupled modelling study climate related damage of oak wooden panels in furniture and paintings is addressed.

Climate related damage

Nowadays, climate related damage is one of the main risks for susceptible oak wooden panels in furniture and paintings. Figure 1 and 2 show a veneered oak wooden cabinet that is part of the Rijksmuseum collection. The photo dated from before 1907 shows climate related damage visible as longitudinal cracks, the photo dated from 1952-1967 shows no visible cracks due to restoration and the photo dated from 2010 shows again longitudinal cracks. To prevent climate related damage, museums apply strict standards for climate fluctuations. As the strict standards result in undesirable high energy demands and costs the challenge is to formulate reliable (broadened) standards while maintaining a low risk of climate related damage.

Objective

To develop and implement a nonlinear thermo-hygro-mechanical coupled model for oak wooden panels where important physical and mechanical (failure) behaviour is derived from experiments.

Methodology

To fulfil the research objective the following tasks are formulated:
1. Literature study – State of the art thermo-hygro-mechanical coupled modelling;
2. Performing physical and mechanical (failure) behaviour experiments and implementation of results;
3. Implementation of creep, relaxation, plasticity, fracture, ageing and cyclic behaviour;
4. Validation numerical model: comparison with in-situ measurements;
5. Derivation and formulation of standards for climate fluctuations;

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