

Computer modeling of polychrome wood response to climatic variations

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Wooden cultural objects - mechanism of damage

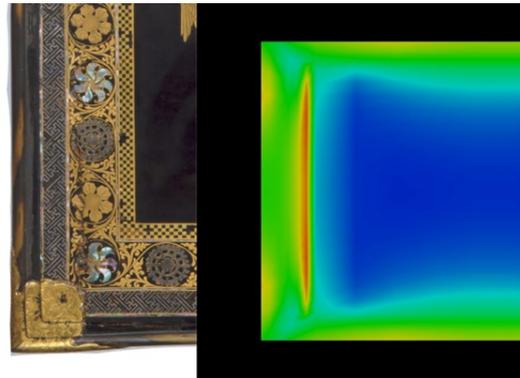
Variations of the air parameters in the environment of objects lead to absorption or desorption of moisture and dimensional change.

Deformation or failure of wooden elements result from their restrained dimensional response due to a rigid construction or different orientations of grain direction.

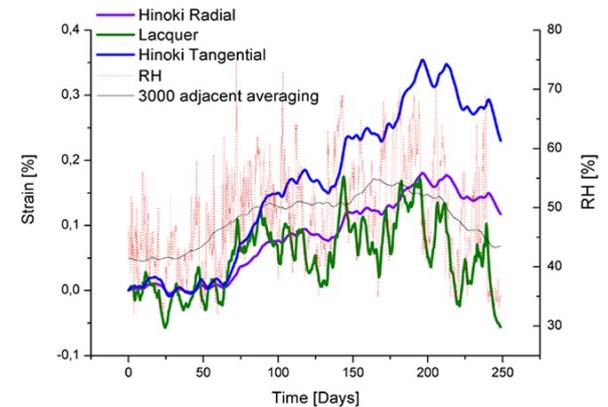
Damage of decorative layers is due to different dimensional responses of materials constituting the surface: wood, glue, gesso, paint, leading to stress on the interfaces between them.



Victoria & Albert Museum, an exquisitely decorated piece of Japanese export lacquer, Kyoto, around 1640.



Assembly of cross grained wooden elements in the chest lid (longitudinal cleats restraining radial planks) has led to stress and physical damage.

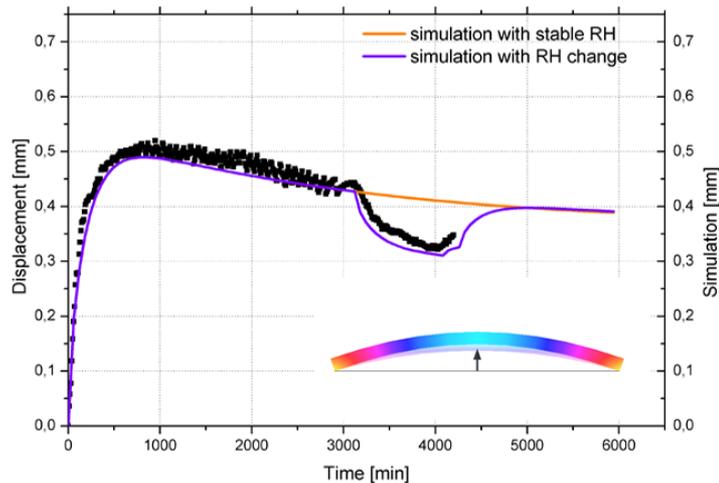


Dimensional response of materials constituting the lacquer object to real fluctuations of relative humidity measured during one year of exposition at the Victoria & Albert Museum.

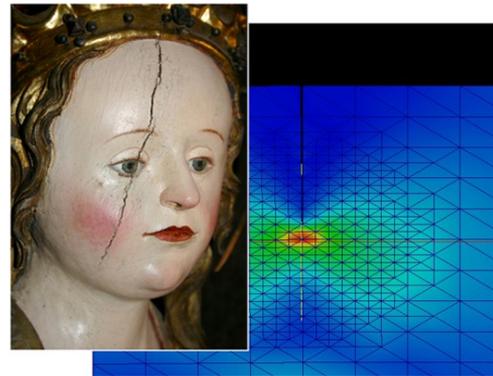
Mathematical modeling - computer simulations

The mathematical modeling of elastic deformations based on a constitutive relation between stresses and deformations is applied.

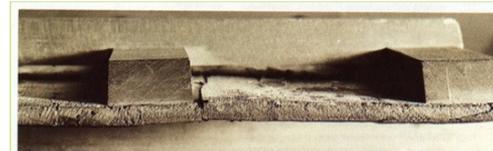
- simulations conducted using finite element methods for orthotropic material.
- straightforward handling of geometrically complex, multilayer structures.
- modeling of non-linear responses of wood and decorative materials.



Dynamic deformation of a wooden panel with one face masked by an impermeable coating to imitate a panel painting in response to a step change of relative humidity (70-30%).



Influence of a crack in the material structure on the spatial distribution of stresses caused by drying of restrained wood; utilizing flexible grid refinements based on geometric criteria.



Many panel paintings have been reinforced with rigid cradlings. A complex deformation pattern in response to variations in relative humidity appears in such paintings.

