

Institut Pascal (UMR6602 UCA/CNRS) – Group M3G/S20

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Title of thesis : *Influence of natural and imparted ageing on the toughness of wood*

Summary of the thesis topic :

When used with care and protected against biological attack or fire, wood can withstand loads over considerable periods of time: its stiffness and strength change little as a result of slow oxidation. It does, however, become more brittle: the energy required to break a unit of surface area, or toughness, decreases sharply. Whether restoring wooden heritage objects, such as paintings on wood or musical instruments, or repairing or adapting old buildings to new uses, this phenomenon is a concern for conservators. Similar effects are observed in heat-treated wood, which is intended to improve dimensional stability and fungal resistance by reducing hygroscopicity: its brittleness is its main weakness for structural use. For this reason, such modifications are often assimilated to an ageing process, even if the equivalence with natural ageing is only partial and subject to debate. In this context, the objective of the thesis is to characterise the influence of ageing, whether natural or imparted, on the toughness of wood.

The first obstacle to be overcome is methodological. Old wood is often available in limited quantities, especially since the areas near the surface of the parts, which are subject to the action of ultraviolet rays and weathering, must be purged. However, the propagation of fracture in wood is subject to a scale effect due to the existence of a finite size elaboration zone, which requires the use of large enough specimens to obtain an intrinsic estimate of the toughness. The bias resulting from the use of small specimens, or specimens obtained by assembling several woods, should be studied on modern wood before applying the chosen method to old wood.

A second difficulty is to obtain dated old wood, which will be used to study the effect of natural ageing of wood. For this, the establishment of an interdisciplinary collaborative network is essential, preferably with an international dimension to extend the possibilities of sampling.

A third obstacle is the need to take into account the variability of wood. It is naturally impossible to obtain modern wood that is the exact equivalent of ancient wood to serve as a comparative reference. The usual method of overcoming this difficulty is to use as a reference not a single modern wood, but a set of samples encompassing the variability of old woods, and to apply appropriate structure-property relationships.