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Acoustic Emission Technique to monitor real-time wood fracture properties in room temperature

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Nowadays, environment effects, and in particular the reduction of greenhouse effect, are one of the most important issues that are of great concern to the research community. As per the Kyoto protocol and the COP 21 meeting, the use of wood in civil engineering structures reminds one solution for the regulation of these effects by minimizing both CO_2 emission and the use of grey energy. Since the wood mechanical behaviour is quite complex due to its anisotropic constitution, the coalescence of various defects (nodes, orientation of annual rings, …) during its service life, the increasing use of wood as structural material in civil engineering is a major challenge, and needs to increase scientific efforts in understanding the mechanical behaviour of timber structures.

In order to bring some responses to these scientific problems, the JCJC 2013 CLIMBOIS research project (Moutou Pitti *et al.* 2014) is dealing with the effects of climatic and mechanical variations on the durability of notched timber structures. Material cracking is one of the most important factors involved in the collapse of structures. However, if the crack initiation is detected earlier, and the monitoring of the crack propagation within the materials is under control, the structural integrity of buildings can be easily evaluated by sending alerts. Within the framework of this research project, the study carried out herein is devoted to both an identification of failure

mechanisms in wood material, and an evaluation of the crack length evolution during fracture tests. The proposed methodology includes fracture tests under constant environmental conditions as well as statistical and probabilistic analysis of the acoustic emission (AE) results (Diakhate *et al.* 2017). Fig.1 shows some results of mode I fracture tests.

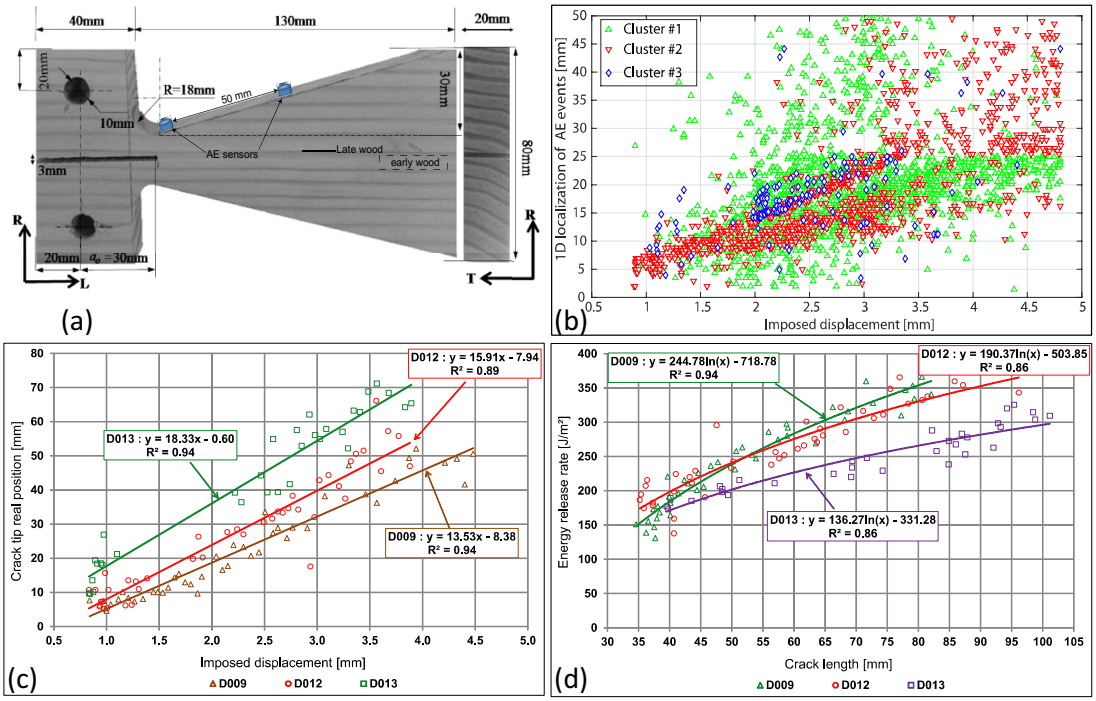

Figure 1: Mode I fracture test on wood material: (a) Modified DCB specimen – (b) Cluster analysis of acoustic emission activity within wood material – (c) Monitoring the crack tip propagation – (d) Energy release rate versus crack length

The results show the ability of the proposed technique to identify the crack tip advance. In the coming work, the proposed methodology will by generalised to different moisture content rates and mixed mode configurations in order to investigate the behaviour of timber structure submitted to outdoor conditions coupled with complex loadings.

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