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Creep and moisture interaction on tropical timber structures under outdoor conditions: spatial variability of mechanical parameters

Gustavo Avellaneda-Malagón¹, Nicaise Manfoumbi², Emilio Bastidas-Arteaga¹, Rostand Moutou Pitti^{3,4}

¹ UBL, Université de Nantes, CNRS UMP 61B3, France, gustavo.avellaneda-malagon@etu.univ-nantes.fr, emilio.bastidas@univ-nantes.fr

² Université des Sciences et Technique de Masuku, URMM, BP 941, Franceville Gabon, nicaise.manfoumbi@gmail.com

³ Université Clermont Auvergne, CNRS, 19300 Clermont Ferrand, rostand.moutou_pitti@uca.fr

⁴ CENARST, IRT, 10794 Libreville, Gabon, rostand.moutou_pitti@uca.fr

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ABSTRACT

The investigation of tropical behaviour woods in their environment is a real challenge for the prediction of the structural responses of tropical timber structures subjected to thermo-hygro-mechanical loadings. The present study is focused on the experimental characterization and modelling of the spatial variability of the physical-mechanical parameters (density, modulus of elasticity, compression and flexion) of a solid wood beam subjected to outdoor conditions in the south of Gabon into equatorial Region.

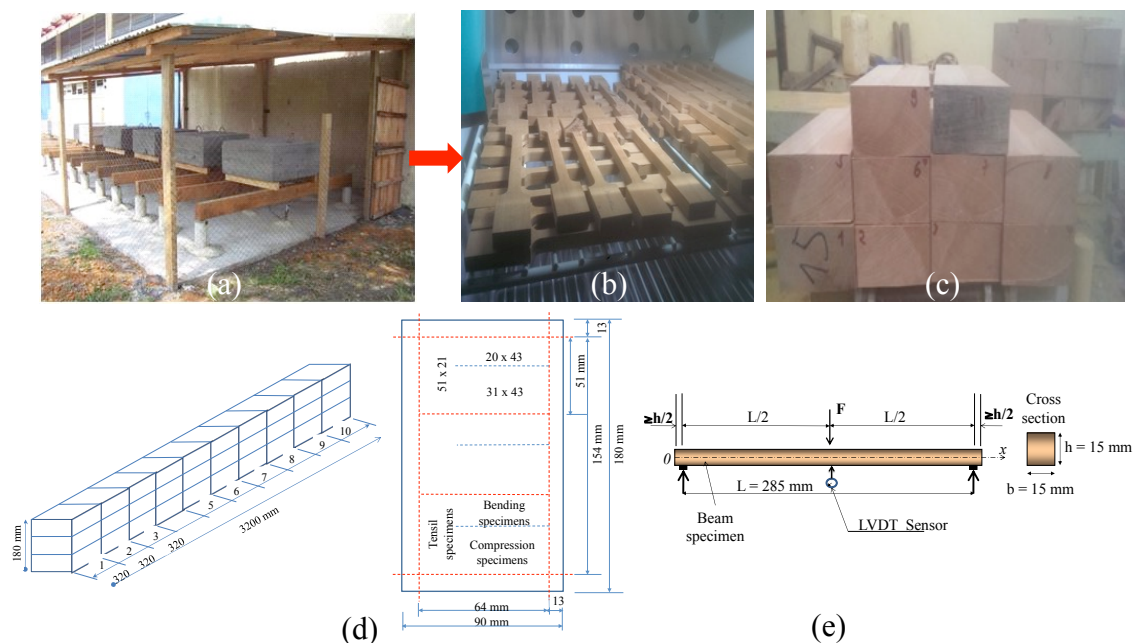


Figure 1: (a) Beams in sheltered outside climate; (b) specimens, (c) cross-sections, (d) Spatial specimen modelling; (e) Experimental device modelling.

The specimens, Figure 1 (b) have been debited from two Moabi specie (*Baillonella Toxisperma*) beams previously subjected to a creep-recovery test in an outdoor tropical

environment during 5 years, Figure 1 (a) (Manfoumbi *et al.*, 2012). The beams were cut into sections 317 mm long. These were also divided into three portions in the height direction, Figure 1 (b-c). From each portion, at least two bending, compression and traction specimens are extracted. Thus, for the two beams the section of specimens are, Figure 1 (d): Compression test: 112 test, 20 x 20 mm² for 120 mm long; Tensile test: 104 test, 10 x 10 mm² per 100 mm long; Bending test: 106 test, 15 x 15 mm² for 300 mm long, Figure 1 (e).

Figure 2 shows an example of the trajectories of bending strength for the first beam, Figure 1 (a). It was observed that different values were measured for a given length. Among the methods available in the literature to represent this spatial variability, we considered the Karhunen-Lòeve Expansion (Ghanem and Spanos, 1991). As in other materials, the covariance kernel that best fitted modeling mechanical properties was the exponential kernel or the autocorrelation function. We have found values of the parameters for autocorrelation function for each timber property. Further work will focus on the propagation of uncertainty and spatial variability on the mechanical models for reliability assessment of the beams with or without cracks.

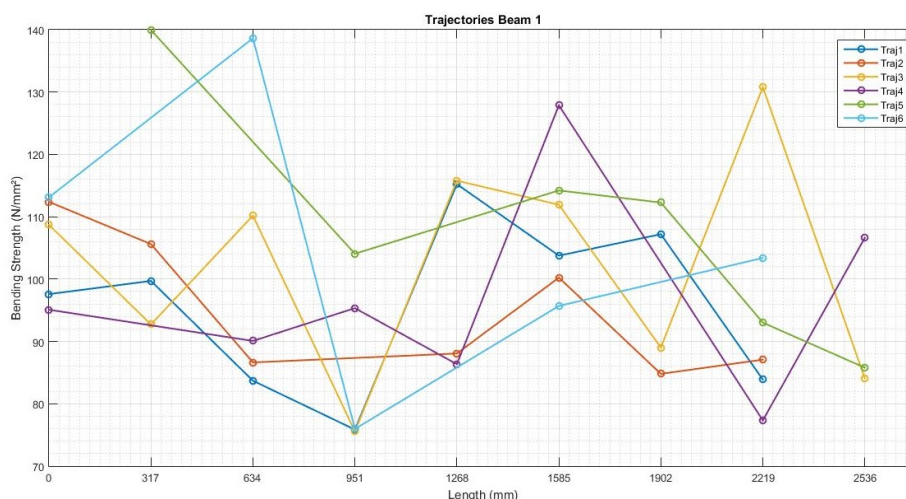


Figure 2: Bending Strength Trajectories for Beam 1.

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