A database for spatial variability assessment of mechanical parameters of Ozigo specie under long-term bending tests in Gabon

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ABSTRACT: This paper focuses on the mechanical behavior of Ozigo wood beams subjected to long-term creep in three environments (air-conditioned inside a building, outside unsheltered and outside sheltered). The purpose is to develop a database that will be useful to evaluate the influence of spatial variability of mechanical parameters/properties on the reliability of beams with or without cracks. To this aim, three points bending tests were performed on 81 specimens at laboratory scale. The results obtained show a significant spatial variability for specimens belonging to the same beam. It was also found that the mean modulus of elasticity (MOE) and the failure stress (FS) of the air-conditioned beam are greater than the same parameters measured at unsheltered and sheltered environments.

Keywords: Spatial variability; Timber; Ozigo, Modulus of Elasticity; Failure Stress; *Dacryodes buettner*

1. INTRODUCTION

Since 1950, almost all Gabonese forest production is exported. Before 2010, the law required that 75% of the logs were treated locally but the analyzes show that only 25% to 35% were treated before this date. It is why the Gabonese government, in the perspective of an emerging Gabon, decided to ban log exports since January 2010, paving the way for local processing and extension of tropical species in local and sub-regional buildings. However, the mechanical behavior of tropical woods in their environment is a real challenge for the prediction of the behavior of tropical timber structures subject to thermo-hygro mechanical loads (Pambou Nziengui et al. 2017).

Several studies found that the consideration of the spatial variability is crucial to improve the reliability.

2 MATERIAL AND METHODS

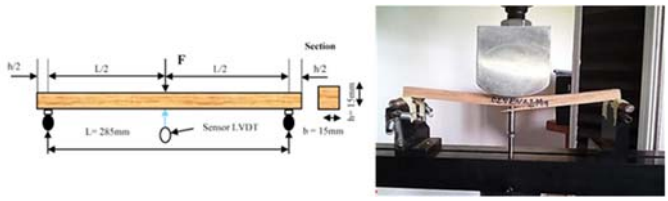

Figure 1. Experimental device for three-point bending tests

2.1 Materials and environment of the study

The specimens were extracted from three wooden beams *Dacryodes buettneri* (89mm×176 mm×3090 mm) previously subjected to a creep test in tropical atmospheres and three previously mentioned environments during 9 years (Figures 2a to 2c). These beams were sawn into nine sections 340 mm long. These sections are subdivided into three portions in height referred here as upper, middle and lower, (Figures 2d and 2e). Among these specimens, only three (right side) were tested by section (81 test pieces of section 15mm×15mm and 300mm long).

Figure 2. a) Air-conditioned environment. b) Unsheltered outdoor environment. c) Sheltered outdoor environment d) Alignment of the beam. (e) Test specimens for the characterization of spatial variability.

3 RESULTS AND DISCUSSION

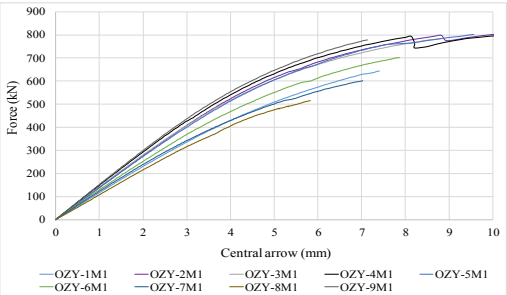

Figure 3. Force vs central arrow results for specimens at upper part in air-conditioned environment.

Figure 3 presents the spatial distribution of the values of MOE obtained from results such as given in Figure 4. We note that the average MOE (for all the specimens) is 11697.05 MPa; this result is slightly higher (15%) than the MOE reported in Manfoumbi (2012) 10700 ± 1550MPa but it is lower (9%) than the value given in CIRAD (2011) which is 13820 ± 2273 MPa.

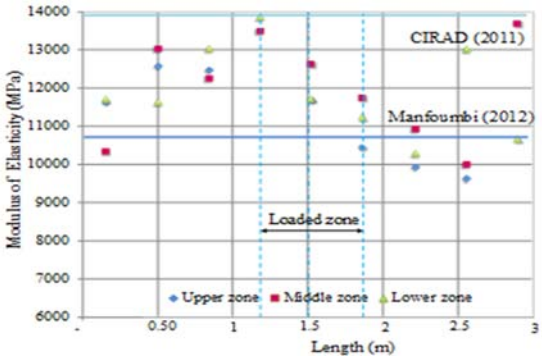

Figure 4. Spatial distribution of MOE for the air-conditioned environment

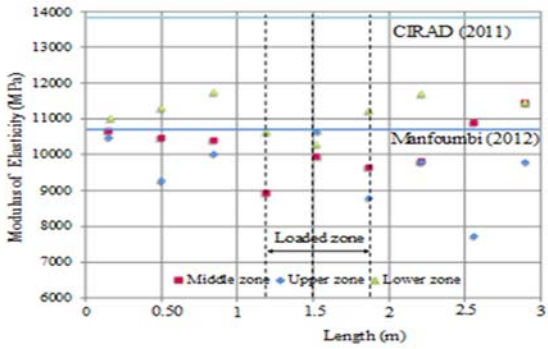

Figure 5. Spatial distribution of MOE for the unsheltered outdoor environment

Figure 5. We observe that the calculated average MOE is 10318.65 MPa of the beam is 4 % lower than the results obtained by Manfoumbi (2012) and 25% smaller than the reported by the CIRAD (2011).

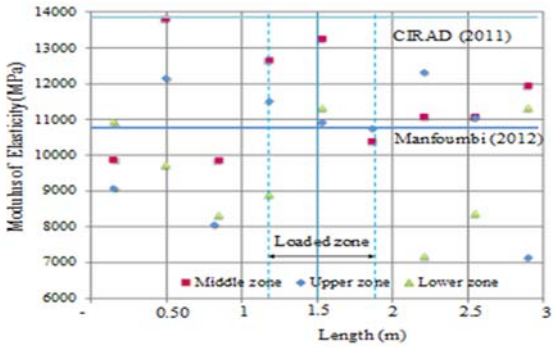

Figure 6. Spatial distribution of MOE for the sheltered outdoor environment

The MOE (10460.48 MPa) of the sheltered outdoor environment is respectively 2% and 24% lower than those reported by Manfoumbi (2012) and CIRAD (2011).

4 CONCLUSIONS AND OUTLOOK

The spatial variability of MOE and the FS after three-bending test of specimens submitted to long-term loading in specific environment have been presented. The results show that the MOE of the beam in air-conditioned medium is greater to the MOE of the beam in unsheltered and sheltered outdoor environments. This drop-in rigidity is due to the aging of the material, the duration of loading, climatic effects and exposures of beams to environments exteriors.

The overall results indicate that there is a real spatial variability of the studied parameters. The results obtained in this phase will be completed with more 3-points binding tests as well as compression and traction test to complete the database. This database will be useful for characterizing and then generating “random fields” taking into account the uncertainties and spatial variability of these parameters.

5. REFERENCES

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