

EFFECTS OF THE CHANGE OF DIMENSION AND NUMBER OF FACES OF POLYHEDRAL SPECIMEN USED IN WOOD CHARACTERIZATION BY ULTRASOUND WAVES

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Abstract

This research aimed to study the influence of theoretical factors related to the shape and dimension of the specimen used for the complete characterization of wood. For the tests were used polyhedral specimens with 26 faces of two different sizes and polyhedral specimens with fewer faces in the characterization of wood, and longitudinal and shear ultrasound transducers of 1000 kHz. The research results indicated that for only three of the twelve elastic parameters involved in the characterization of wood, showed statistically significant differences according to the size and/or the specimen format used.

Key words: Poisson's ratio, elastic constants, modulus of elasticity.

Introduction

The wood to be an orthotropic material has different mechanical properties in three directions perpendicular to each other, longitudinal (L), radial (R) and tangential (T). For complete characterization of wood should be determined 3 longitudinal modulus of elasticity (E_L , E_R , E_T), 3 transverse modulus of elasticity (G_{LR} , G_{LT} , G_{RT}) and 6 Poisson ratios (ν_{LR} , ν_{LT} , ν_{RL} , ν_{RT} , ν_{TL} , ν_{TR}).

Studies carried out by Francois (1995) show that tests for determination of elastic constants with polyhedral specimens of 26 surfaces are more advantageous, because this polyhedron allows to obtain all the elements of the stiffness matrix from a single specimen, saving equipment, cost and time.

The objective was to compare the results of the complete characterization of wood using polyhedron of 26 faces of dimensions traditionally used with polyhedral of dimensions and number of faces differentiated.

Results and Discussion

Image 1 shows the format of the polyhedral specimens used for research, the polyhedron of 26 faces were used in two different sizes. The same figure is also shown the ultrasound test being performed.



Image 1. Polyhedron of 18 and 26 faces (a) and ultrasound test (b).

Statistical results of mean comparison indicated that only three elastic parameters (E_R , E_T e G_{RT}) there was a statistically significant difference (P-value <0.05) for polyhedral formats evaluated (Chart 1). For some other parameters (E_L , ν_{RL} , ν_{LR}), although the mean comparison test indicates the difference between the values for the polyhedral shapes, this was not statistically significant (p-value > 0.05).

Chart 1. Elastic and statistical parameters for the three formats evaluated specimens.

	26 faces	26 faces R	18 faces	P-value
E_L	9865 (ab) (13,2)	8753 (a) (5,6)	10163 (b) (4,6)	0,0602
E_R	2128 (b) (6,4)	1850 (a) (5,1)	1940 (ab) (11,5)	0,0336
E_T	1936 (c) (3,8)	1539 (a) (5,4)	1693 (b) (3,5)	0,0000
G_{RT}	816 (a) (7,0)	924 (b) (1,8)	918 (b) (2,0)	0,0005
G_{LT}	1525 (a) (9,8)	1540 (a) (7,8)	1540 (a) (7,0)	0,9752
G_{LR}	1867 (a) (4,0)	1873 (a) (5,0)	1857 (a) (1,0)	0,9419
ν_{RL}	0,32 (ab) (7,1)	0,33 (b) (4,5)	0,30 (a) (1,1)	0,0587
ν_{TL}	0,06 (a) (24,2)	0,06 (a) (47,6)	0,05 (a) (57,3)	0,8071
ν_{LR}	1,46 (a) (3,8)	1,55 (ab) (6,1)	1,59 (b) (8,3)	0,0979
ν_{TR}	0,32 (a) (15,7)	0,29 (a) (21,2)	0,31 (a) (14,5)	0,6188
ν_{LT}	0,31 (a) (24,8)	0,34 (a) (48,3)	0,33 (a) (60,1)	0,9470
ν_{RT}	0,35 (a) (14,4)	0,34 (a) (15,1)	0,35 (a) (7,6)	0,8849

* Numbers in parentheses indicate the coefficient of variation (%).

** Letters in parentheses indicate the results of the statistical analysis mean comparison.

Conclusions

The research results indicated that only three of the twelve elastic parameters involved in characterizing the wood, presented a statistically significant difference according to size and / or the specimen format used.

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