

Cleavage Parallel to the Grain for *Schizolobium amazonicum* Wood Specie

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Abstract Wood is one of the main raw materials utilized by man. It can be applied in furniture and package industries, and also in components for building construction, including structures. For all these purposes, it is necessary to know the physical and mechanical properties of wood specie being used. Brazilian Code ABNT NBR 7190:1997 (Design of Timber Structures), in its Annex B, presents methods for determining wood mechanical properties, among them the cleavage parallel to grain. This property is important because it relates to the design of bolted and nailed joints in timber structures. In this context, the present research aims to the experimental determination of cleavage strength parallel to grain strength for *Schizolobium amazonicum* (Paricá) wood specie recently used for structural purposes, in Brazil. With raising availability, due to the great production in planted areas, Paricá can achieve some segments in Brazilian exportation trade. Results showed that cleavage strength for *Schizolobium amazonicum* is lower when compared with traditional tropical essences, but sufficient for several structural applications.

Keywords Cleavage parallel to the grain strength, Mechanical properties, Wood

1. Introduction

Wood is a natural material and its species usually present different values of physical and mechanical properties, influenced by several factors, as example: tree origin and age, grain direction, moisture content [1-3]. Researches about physical and mechanical properties have been carried out aiming to provide subsidies for better use of wood in building construction, industries of furniture and packaging, among the different sectors that can pursue it as a raw material [4, 5].

Wood can be be applied for structural purposes like bridges [6], roofs [7, 8], footbridges [9], frameworks [1] and some kind of packages, if their physical, strength and stiffness properties are known, for allowing the designs development according to Standard Codes, as the Brazilian ABNT NBR 7190:1997 - Design of Timber Structures [10].

Annex B of Code ABNT NBR 7190:1997 [10] provides experimental procedures for determining wood physical and

mechanical properties, necessary to substantiate structural design. Cleavage strength parallel to grain is a very important one, mainly for design of structural joints, for all types of structures. Brazilian procedures for determining cleavage strength are similar to the adopted by ASTM D143 [11].

Although to know the values of cleavage parallel to grain strength is essential in evaluation of structural joints, it's fundamental to observe that some related problems can occur due to procedures of nailing and screwing [12-16]. Other import cracking causes to consider, as reported by several researches, are moisture content changes, mainly if occurred in short time intervals, in wood drying [1, 3, 17].

In this context, the present research aims to the experimental determination of cleavage strength parallel to grain strength for *Schizolobium amazonicum* (so-called Paricá) wood specie recently used for structural purposes, in Brazil. With raising availability, due to the great production in planted areas, Paricá can achieve some segments in Brazilian exportation trade, aspect that valorizes this paper.

2. Material and Methods

The experimental procedures of this work were carried out

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in two institutions: in Wood and Timber Structures Laboratory (LaMEM), Structural Engineering Department (SET), São Carlos Engineering School (EESC), São Paulo University (USP); and in FUMEC University, Belo Horizonte, both in Brazil.

For this research, lumber of *Schizolobium amazonicum* specie (twenty pieces), obtained from a planted forest, located Northern Region of Brazil (Paragominas, Pará State), was used.

The specimens (Fig. 1) were prepared, one per piece, in standard condition of moisture content (12%), according to ABNT NBR 7190: 1997 [10]. Half of the specimens were tested in LaMEM and half in FUMEC installations.



(a)



(b)

Figure 1. (a) Pieces of *Schizolobium amazonicum* Wood specie for specimens preparation; (b) Standard specimens for determination of cleavage strength

Tests were carried out in a universal testing machine AMSLER, with 250 kN capacity (Fig. 2).



(a)



(b)

Figure 2. (a) Universal testing machine AMSLER; (b) Testing cleavage specimen

Cleavage strength (f_s) is provided by the ratio between " F_s ", the force required to reach rupture in cleavage test, and the specimen cross-section (A), according to Equation 1.

$$f_s = \frac{F_s}{A} \quad (1)$$

3. Results

Table 1. Cleavage strength of *Schizolobium amazonicum* [MPa]

Statistical parameters	Values
X_m	0.35
S_d	0.14
$VC [\%]$	39
Min	0.23
Max	0.68

Table 1 presents the mean values of cleavage strength (X_m), standard deviation (Sd), variation coefficient (VC) and maximum (Max) and minimum (Min) values obtained by Standard tests.

Schizolobium amazonicum wood specie is classified as strength class C20 of dicotyledonous, according to the Brazilian Code ABNT NBR 7190:1997 [18, 19].

Dias and Lahr [20] reported for others wood species of the same strength class: Cedro (*Cedrella sp.*), Cedrorana (*Cedrelinga catenaeformis*) and Quarubarana (*Erismia uncinatum*) cleavage parallel to the grain strength values higher (0.4; 0.5 and 0.5 MPa, respectively) than those determined in this research to *Schizolobium amazonicum*. This can be explained based on wood density. Although they are included in the same strength class, the density of *Schizolobium amazonicum* is 40% inferior, compared to the density of three mentioned species. As a result, special attention should be taken by the designers when working with Paricá for structural purposes.

Florentino et al. [21] researched cleavage strength parallel to the grain for Pinus species, (*Pinus elliottii* var *elliottii* and *Pinus caribaea* var *hondurensis*) finding higher average values (0.4 MPa). This can be explained once Pinus genus belongs to coniferous and the tropical species to dicotyledonous. Anatomical differences between them are considerable.

Unfortunately, no more references in this matter were met. By the other side, this reinforces the importance of the present work.

4. Conclusions

Schizolobium amazonicum presents a little low average value of cleavage strength parallel to the grain, in comparison with other Brazilian wood species (of same strength class, C20).

Even so, it's possible to consider *Schizolobium amazonicum* sufficient for structural purposes, since proper joints calculation is carried out.

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