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PROBABILISTIC APPROACH OF THE FAILURE OF *LOVOA TRICHILIOIDES* AND *TRIPLOCHITON SCLEROXYLON*

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ABSTRACT

The aim of this work is the probabilistic modeling of the failure of *Lovoa trichilioides* and *Triplochiton scleroxylonspecies*. A general presentation of the wood while focusing on the Weibull distributions was carry out. Parameters of the Weibull distribution for each of the materials were determined. We remark that when the Weibull shape parameter is small, the failure stresses dispersion is greater and the Weibull scale parameter increase or decrease depending on the stress. It is also shown that *Lovoa trichilioides* exhibits a high dispersion of breaking stress in contrast to *Triplochiton scleroxylon*. A comparison of the experimental data with the statistical laws allowed us to show that the three-parameter Weibull distribution better models the failure than the normal and the two-parameter Weibull distributions. The studies of variance prove that the failure stresses of *Triplochiton scleroxylon* vary less in comparison with that of *Lovoa trichilioides*.

KEYWORDS: Timber, bending, failure, modeling, Weibull distribution.

INTRODUCTION

In the Growth and Employment Strategy Paper (GESP 2010-2020), Cameroon forecasts an average growth of 2.5% per year in the forestry sector by 2020, but, unfortunately, reports indicate that this objective cannot be achieved in view of the bad exploitation and valorization of wood, which weakens the economy. Yet a good valorization not only allows to increase the added value but also to increase higher transformations. The advancement towards new transformations calls for mastery of the properties of these materials. Moreover, the control of the behavior of a material is an essential parameter in the use of the latter. This requirement is more so for material, which is, the only one derived from a living organism. The biological nature of the material is dependent on numerous parameters, physical parameters such as temperature, moisture variations, fiber orientation and selective fracture in the fiber direction, Young's modulus and the Poisson coefficients. It is with a view to better knowing this material by the mastery and understanding of these properties that we have opted to work on the failure of wood material (Talla 2008, Mukam 1990). The study of the rupture of material prefigures the interval use of the material, in order to avoid its early failure as part of a structure. It is, therefore, urgent to study the failure of the different species of our heritage in order to derive the maximum benefit. Thus, this work proposes to study, using a statistical approach (Vincent 1998) the modeling of the failure behavior of some species of Cameroonian wood, particularly *Triplochiton scleroxylon* and *Lovoa trichilioides*. The choice of these species is in line with the work of the laboratory (Talla et al. 2015) and the fact of an increasingly high exploitation and exportation each year in the country.

Study on the failure of materials

Failure types

The theory of fracture mechanics is a way to estimate the stability of cracks that can occur due to defects. It allows predicting the evolution of the crack until the ruination of the structure. Rupture is characterized (at least locally) by the irreversible separation of a continuous medium on either side of a generating surface. We notice two types of rupture: ductile and fragile fracture in which we differentiate several models of rupture of which we have:

- The composite model is made of a material whose cross-section is made of identical parallel fibers, each possessing a fragile mode of rupture.
- The perfect plastic model is such that when one of the components reaches its resistance limit, it maintains the load or stress level by deforming while transmitting it to the other elements of the cross-section.
- The perfect fragile model occurs when one of the constituent elements of the test specimen's ruptures, causing the whole test specimen to rupture.

Fragile fracture and Weibull theory

The statistical theory of the weakest link applies to these fragile fractures. It rests on a few fundamental assumptions to be carefully checked in practice.The solid is considered as the juxtaposition of perfectly independent elements, and the fracture of the weakest element results in the rupture of the whole solid.

- To each element corresponds a probability of rupture $P_0(\sigma)$ under a given constraint or stress. The probability of survival of the element is (Dupeux 2004), that of n elements is valid according to the hypothesis of independence (Askeland and Fulay 2008); the probability of rupture is given by:

$$\Pr(\sigma) = 1 - [1 - P_0(\sigma)]^n \tag{1}$$

The function $P_o(x)$ is unknown, while $P_r(x)$ is arduous to determine (Le et al. 2012). However, one can use the Cramer approximation, (Mukam 1990), which is only valid when the number of links is significant. It can be used for a fragile material having several links.

To proceed, we define a random variable α_n such as:

$$\alpha_n = nP(X_n) \tag{2}$$

Letting $B_n(u) = F(\alpha_n \le u)$ *with* $0 \le u \le n$, it becomes:

$$B_n(u) = 1 - \left[1 - \frac{u}{n}\right]^n \tag{3}$$

Thus, the probability density of the random variable α is then:

$$P(u) = e^{-u} \tag{4}$$

The relation (4) shows the sequence of the random variable X_n converges to a distribution to a random variable Y such that

$$\Upsilon = P^{-1}\left(\frac{\alpha}{n}\right) \tag{5}$$

The resistance of any material is always bounded by a finite value or at the null limit (Gumbel 1958) showed that only one function satisfies this criterion:

$$\begin{cases} P(x) = \dfrac{\beta(x-\gamma)^{\beta-1}}{\alpha^{\beta}}, \ \gamma \le x, \ \alpha, \beta, \gamma \ge 0 \\ P(x) = 0, \quad \textit{elsewhere} \end{cases} \tag{6}$$

Knowing the distribution function corresponding to this density function and for large values of n, with some change of variables one obtains the following distribution function:

$$\begin{cases} P(x) = 1 - \exp\left[-n\left(\dfrac{x-\gamma}{\alpha}\right)^{\beta}\right], \gamma \le x, \alpha, \beta \succ 0, \gamma \ge 0 \\ P(x) = 0, \quad \textit{elsewhere} \end{cases} \tag{7}$$

Eq. 7 is the three-parameter Weibull distribution function.

Taking a specimen of volume V, divided into n identical volumes V_0 such that $n = \frac{V}{V_0}$, we note that Eq. 7 depends on the volume of the test specimen. By hypothesis, the resistances of these different components are mutually independent and identically distributed according to the Weibull law. For this reason, it follows that the distribution function of the whole volume gives:

$$\begin{cases} P(\sigma) = 1 - \exp\left[-\dfrac{V}{Vo}\left(\dfrac{\sigma-\gamma}{\alpha}\right)^{\beta}\right], \ \gamma \le \sigma, \alpha, \beta \succ 0, \ \gamma \ge 0 \\ P(\sigma) = 0, \quad \textit{elsewhere} \end{cases} \tag{8}$$

γ - represents a single stress below which the probability of rupture is zero, in some cases, we assume $\gamma = 0$, and we obtain the Weibull function with two parameters.

β - is the Weibull modulus which is an indicator of dispersion; the lower it is, the greater the dispersion or wider base.

Statistical modeling of materials

Bending behavior

Bending is the deformation of an object, which results in a curvature. In the case of a beam, it tends to bring the two ends closer together. The bending test of a beam is a mechanical test used to test bending strength; here we use the so-called four-point flexion. From the laws of behavior, the distribution of stresses can be determined. Since the ultimate tensile stress is greater than that in compression, the distribution of the tensile stress does not follow the Navier linear distribution. In fact, after the compressed fibers have reached the ultimate compressive stress, static equilibrium implies an increase in tensile stress and a lowering of the neutral axis. The final rupture is therefore due to an exceeding of the strength of the tensile fibers. Thus, starting from the Euler-Bernoulli equation, better known as the equation of the deformation, the deflection f_1 at the point and the deflection f_2 at the point are given respectively, by Eqs. 9 and 10.

$$f_1 = \frac{1}{96EI} PL^3 \tag{9}$$

$$f_2 = \frac{11}{768EI} PL^3 \tag{10}$$

Probability of ruination, mean and standard deviation of the distribution

As earlier observed, we consider here a chain composed of n links with the following assumptions:

- The rupture results from the rupture of the weakest element;
- The resistances of the links are mutually independent;
- Each link follows the same distribution function.

Thus, the function of distribution of the resistance is written as:

$$P(\sigma) = 1 - \prod [1 - P(\sigma)]^n \tag{11}$$

If the volume V of a specimen is composed of n identical volumes V_o, then:

$$P(\sigma) = 1 - \exp\left[-\frac{1}{Vo} \iiint_V \left(\frac{\sigma(x,y,z)}{\alpha} \right)^\beta dV \right] \tag{12}$$

Let us introduce the Bernoulli-Euler theory, which gives the distribution of the stresses in each cross section of the beam:

$$\begin{cases} \sigma(x,y,z) = \sigma_0 \dfrac{2xy}{ah};\ 0 \le x \le a \\ \sigma(x,y,z) = \sigma_0 \dfrac{2y}{h};\ a \le x \le L/2;\ 0 \le y \le h/2 \end{cases} \tag{13}$$

In this relationship, σ_o is the ultimate stress, h is the height of the cross section of the test piece and α the distance between the sharp edges. The Eq. 13 can also take the form:

$$\sigma(x,y,z) = \sigma_0 g(x,y,z) \tag{14}$$

As a result, the resistance distribution function becomes:

$$P(\sigma) = 1 - \exp(-KB_v V \sigma_0{}^\beta) \tag{15}$$

Relation in which we let:

$$B_v = \frac{1}{V} \iiint_V g^\beta(x,y,z) dV \quad \text{and} \quad K = \frac{1}{V_0 \alpha^\beta}$$

where: V - stretched volume,
K - characteristic of the material,
B_v - stress distribution function.

Considering Eq. 13 and after integration we obtain:

$$B_v = \frac{1}{2(1+\beta)^2} \left[1 + \beta \left(\frac{L-2a}{L} \right) \right] \tag{16}$$

Bohannan (1996) demonstrated this expression to characterize the effect of dimensions on certain rectangular pieces in flexion. In this expression, ***L*** and ***a*** describe the loading history and are such that

$$\frac{a}{L}=\frac{1}{4} \tag{17}$$

from which (16) reduces to:

$$B_v=\frac{1}{4(1+\beta)^2}(2+\beta) \tag{18}$$

Knowing the expression for B_v, we can calculate the mean and the standard deviation of the distribution, which gives:

$$M(\sigma)=(KB_vV)^{\frac{-1}{\beta}}\Gamma(1+\frac{1}{\beta}) \tag{19}$$

For the average and the standard deviation, it is:

$$E_{typ}(\sigma)=\left(KB_vV\right)^{\frac{-1}{\beta}}\left[\Gamma\left(1+\frac{2}{\beta}\right)-\Gamma^2\left(1+\frac{1}{\beta}\right)\right]^{\frac{1}{2}} \tag{20}$$

We deduce from the above the coefficient of variation (CV) of the distribution as:

$$CV=\frac{E_{typ}}{M(\sigma)}=\frac{\left[\Gamma\left(1+\frac{2}{\beta}\right)-\Gamma^2\left(1+\frac{1}{\beta}\right)\right]^{\frac{1}{2}}}{\Gamma\left(1+\frac{1}{\beta}\right)} \tag{21}$$

In view of the preceding relation, it must be noted that it is independent of the loading state and the volume of the beam. The knowledge of the coefficient of variation allows us to calculate the parameter of the material and to determine the coefficient by the Eq. 22:

$$K=\frac{1}{V}\left[\frac{\Gamma\left(1+\frac{1}{\beta}\right)}{M(\sigma)}\right]^{\beta} \tag{22}$$

The parameter is given by:

$$\alpha=\left(KV_0\right)^{\frac{-1}{\beta}} \tag{23}$$

Since there is a correlation between the density of a material and its resistance, we use it to determine the location parameter γ which is often considered as zero but corresponds to the minimum measured value. (Mukam 1990, Talla 2008).

The quality of the adjustment will be made by using the Chi square test (Ndipouakouyou et al. 2001, Walpole et al. 1978) defined by:

$$\chi^2=\sum_{i=1}^{k}\frac{\left(n_i-n'_i\right)^2}{n'_i} \tag{24}$$

where: n_i - indicates the observed frequencies,
n_i' - theoretical frequencies of the sample.

MATERIALS AND METHODS

Methods

Distribution of constraints in the bending test and presentation of species

For the bending tests, we distinguish 'three-point' and 'four-point' bending tests. We emphasize the advantage of four-point flexion with respect to three-point bending, as (Moussili 1983) did for an experimental study of the mechanical properties of wood material. From the scientific name *Triplochiton scleroxylon* of the family *Sterculiaceae*, *Triplochiton scleroxylon* is an imposing tree sometimes measuring up to fifty meters in height and two meters in trunk diameter. The sapwood is undifferentiated, while the heartwood is white cream to light yellow, but it is very tender. The *Triplochiton scleroxylon* is an African wood and is generally used in woodwork and cabinet making, and to make the plywood. From a gray to yellowish brown appearance, *Lovoa trichilioide*s has well-differentiated sapwood gray or light yellow with a thickness of three to seven centimeters. It is a generally straight and well-shaped wood reaching a height of twenty-five meters for 1.5 m in diameter. It belongs to the *Meliaceae* family whose scientific name is *Lovoa trichilioide*s, *Lovea klaineana*. Used for woodwork, stairs, framework, to cite a few. *Lovoa trichilioides* is present in Africa especially in Ivory Coast, Gabon and Cameroon (CTFC 2011).

Description of the tests

The principle is to determine the deformability of a material under four support points. It is then possible to measure the deflection of the specimen tested as a function of the applied load, at a constant speed. The precautions to be taken for this type of tests are mainly at the level of the supports. Indeed, the test piece must be perfectly perpendicular to the plane of application of the load. The bearings must be fixed cylinders in translation, and those of the ends can rotate freely so as not to put the test piece in pure shear Fig. 1. During this test perpendicular to the grain, the forces are applied gradually and the breaking loads are increased.

Sample implementations

The parallelepiped shape of the samples is highly recommended. It should be noted that these samples should be as regular as possible in order to obtain the most accurate and reproducible measurements and values (Dos 2009). For the species selected for this work, *Triplochiton scleroxylon* and *Lovoa trichilioide*s, all samples were obtained from the same chevron belonging to each species. The specimens were machined according to the woody plane specific to each species, while conforming to standard NF B51-008 (Foudjet et Mukam 1992), which recommends bending specimens such that the length-height ratio is equal to 14:1 with dimensions 320x20x20 mm with 280 mm between two supports.The first step was the identification and demarcation of the radial and tangential direction of the wood in the samples of *Triplochiton scleroxylon* and *Lovoa trichilioide*s. This step is fundamental because it is very important that the samples are not oriented in the other two directions of the wood (radial and tangential), otherwise the results will not be up to expectations (Lafleur 2002, Abels M. 2011). To avoid wood fluctuations to the maximum, wood defects (poor quality wood, irregular samples, knots and cracks) were avoided so that the results were as homogeneous as possible (Lu et al. 2007),the samples are taken from the same volume. In order to minimize the variability of the results, wood defects (poor quality wood, irregular samples, knots and cracks) were avoided so that the results were as homogeneous as possible; the samples produced come from the same log. On this basis hundreds of specimens for each species were selected and stored in the laboratory for drying; taking into account the drying conditions. In order to determine the degree of humidity, the specimens were weighed using OHAUS digital scale balance with a precision of 0.01 g and placed inside a drying machine (MEMERT) regulated to 103°C for 72 hours. Moreover, after extraction of the test pieces from the oven, they were weighed and then immersed in a test tube containing water and graduated in milliliter to evaluate the volume and consequently to deduce the apparent density. The specimens had been drying for five months. All these exercises took place in at the climatic conditions of the Laboratory of Mechanics and modelling of Physical Systems (L2MSP) of the University of Dschang; with a mean temperature of 25oC and a relative moisture content ratio of 70%.

Applied materials

Fig. 1 below shows the sketch diagram of the four-point bending test used in this work. The specimen with length L=32 cm was placed horizontally on tow cylindrical supports; one mobile rotationally and the other fixed.

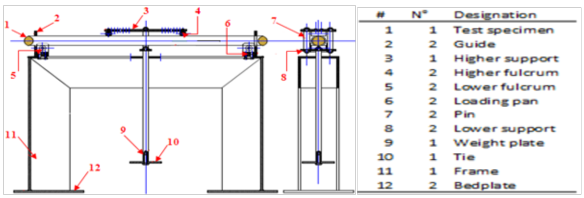

Fig. 1: Bending test device(Talla andFoadieng2010).

A symmetric load is applied at the distance L/4 on any support. At the point of loading and loading is a 30 mm diameter cylindrical steel to minimize cutting effect. The loads are respectively, 0.5, 1, 2, 5 and 10 kg, with a 4 kg vertical support.

RESULTS

Hygroscopic

Before the start of the bending test, the moisture control specimens were weighed and then introduced into an oven at 103°C. After drying for 3 days, the anhydrous specimens were weighed and the moisture content in the present state determined and presented in Tab. 1.

Tab. 1: Moisture content (H) of different species.

Specimen	*Triplochiton scleroxylon*			*Lovoa trichilioides*, *Lovea klaineana*		
	m_H(g)	m_0 (g)	H (%)	m_H(g)	m_0 (g)	H (%)
1	2.04	1.82	12.10	4.50	4.00	12.50
2	2.09	1,85	12.90	4.06	3.60	12.80
3	2.91	2.58	12.80	3.24	2.90	11.70
4	2.60	2.31	12.60	4.19	3.70	13.20
5	2.13	1.88	13.30	4.12	3.62	13.80
6	2.10	1.87	12.30	3.52	3.10	13.50
7	2.27	2.01	12.90	4.56	4.00	14.00
8	2.76	2.46	12.20	4.11	3.64	12.90
9	3.10	2.77	11.90	4.58	4.01	14.20
10	1.84	1.63	12.90	4.59	4.01	14.50
11	2.17	1.93	12.40	4.00	3.57	12.00
12	2.49	2.19	13.70	4.22	3.70	14.10
Mean	2.37	2.11	12.67	4.14	3.65	13.27

Tab. 1 shows moisture content levels on which we work as NF B 51-004 prescribed that are not far from 12%, which is the value of the reference moisture content adopted at the International Conference of Mechanical Engineering of Wood in Geneva in 1949 and which serves as a reference for comparison Woodland.

Modulus of elasticity or Young's modulus of specimens

In order to determine the Young's modulus of each specimen, bending tests are carried out on the device presented on Fig. 1. During these tests, the forces are increased gradually and the breaking loads and the corresponding deflections are recorded. The experimental results allowed us to obtain curves of the same shape as those presented in Fig. 2:

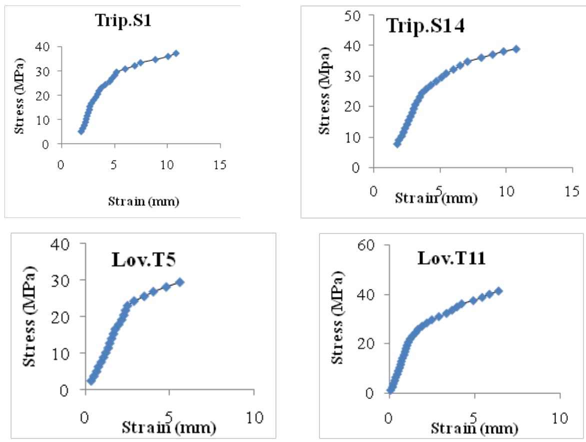

Fig. 2: Strain-Stress curves for bending tests on Triplochiton scleroxylon (Trip.s) and Lovoa trichilioides (Lov.t)

Exploiting Hooke's law with respect to the above curves, we obtain the module of elasticity for the different specimens on Tab. 2 below.

Tab. 2: Young's modulus of the specimens.

Specimen	*Triplochiton scleroxylon*	*Lovoa trichilioides, Lovea klaineana*
	Modulus of elasticity (MPa)	
1	6105.78	9005.23
2	6230.77	9047.60
3	6256.80	9053.93
4	6295.46	9064.77
5	6320.74	9082.54
6	6375.25	9088.41
7	6473.83	9126.65
8	6484.89	9133.48
9	6592.24	9141.41
10	6768.45	9152.72
11	6845.58	9320.80

12	7057.59	9698.02
Mean	**6483.95**	**9159.63**
Standard-deviation	**283.69**	**187.22**
Maximum	7057.59	9698.02
Minimum	6105.78	9005.23

Determination of the Weibull parameters

The data is binned from the least value, such that a class of 4.5 is used for *Triplochitonscleroxylon* and 5.5 for *Lovoa trichilioide*s. The frequency of the data under each class is determined. The results of the plotted bins against frequency are shown in Fig. 3 below.

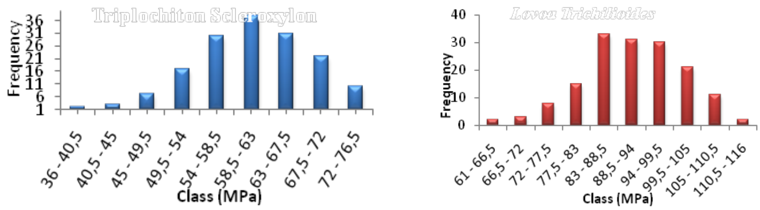

Fig. 3: Frequency diagram of Triplochiton scleroxylon and Lovoa trichilioides.

The statistics and exploitation of Eqs. 18 to 24 permit us to determine the different 2-parameter Weibull distribution. A summary of results are presented in Tab. 3.

Tab. 3: Parameters of 2-parameter Weibull distribution.

	Triplochiton scleroxylon	*Lovoa trichilioide*s *Lovea klaineana*
Mean of distribution (MPa)	60.69	91.39
Standard-deviation (MPa)	7.69	9.92
Variation coefficient CV (%)	12.68	10.85
β- Parameter	9.45	11.15
α- Parameter	63.95	95.64
Number of specimen	160	156
Mean volume of specimen (cm^3)	112 ± 0.03	112 ± 0.03

Application of statistical laws to the specimens

For better characterization, we exploit statistical approach by determining the model of the statistical law and distribution which best describes the behaviour for each specimen. Fig. 4 compares plotted data with Weibull 2-parameter (Daya et al. 2014) and the normal distributions.

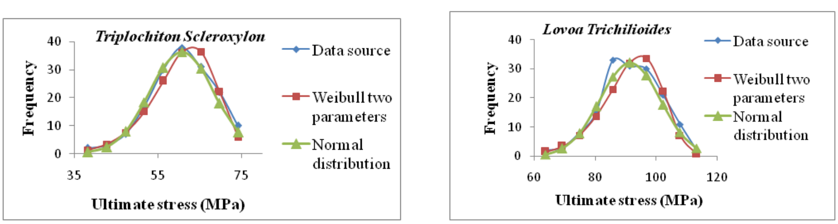

Fig. 4: Comparison of data, Weibull 2-parameter and the normal distributions.

These curves show particularly that the normal distribution adapts better to the experimental data compared to the Weibull distribution with two parameters. Based on this observation, it becomes necessary to make a finer modeling by introducing the location parameter γ (Gupta et al. 1992). This parameter is evaluated by performing a linear regression between the stress and the anhydrous volume. Consequently, 20 samples of the *Triplochiton scleroxylon* and 30 test specimens of *Lovoa trichilioide*s, of the same size, are placed in an oven and after stabilization of the mass, their anhydrous masses and their anhydrous volumes are determined. After having determined their anhydrous densities, the curve of Fig. 5 shows the result of the tests for which the deduced value of γ = 40.05 MPa for the *Triplochiton scleroxylon* and γ = 82.50 MPa for the *Lovoa trichilioide*s.

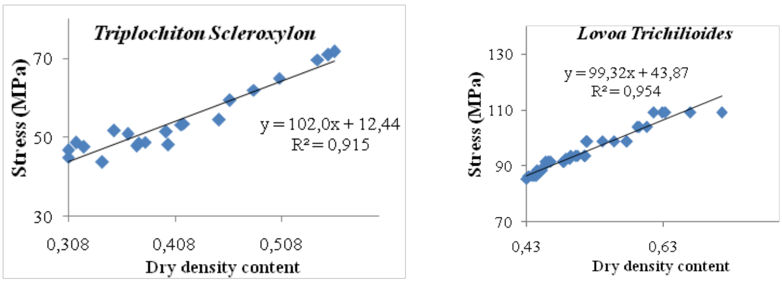

Fig. 5: Determination of the γ parameter.

In order to apply the three-parameter Weibull law (Gupta et al. 1992), the values of stress less than γ is discarded because they correspond to either internal defects or errors in observations or data capture. After this sorting, the rest of the data is used to characterize the three-parameter Weibull distribution as given in Fig. 5. Tab. 4 shows the new Weibull parameter values.

Tab. 4: Weibull distribution with three parameters.

	Triplochiton scleroxylon	*Lovoa trichilioides, Lovea klaineana*
Located-parameter γ (MPa)	40.05	82.5
Mean of distribution (MPa)	62.59	96.07
Standard-deviation (MPa)	6.07	6.53
Variation coefficient CV (%)	9.69	6.79
β- Parameter	12.55	18.18
α- Parameter	65.23	98.93
Number of specimen	147	136
Mean volume of specimen (cm^3)	112 ± 0.03	112 ± 0.03
Abnormalefailure	13	20
Percentage of abnormale failure (%)	8.13	12.82

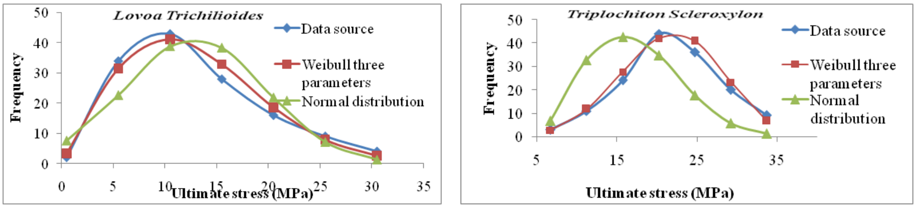

Fig. 6: Comparison of experimental data, three-parameter Weibull distribution and normal distribution.

The corresponding cumulative probability for each specimen is given below (Fig.7).

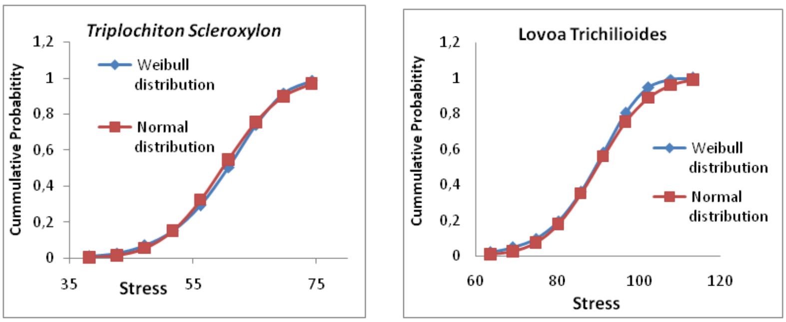

Fig. 7: Cumulative distribution of specimen.

DISCUSSION

The observations of the curves in Fig. 2 show that they exhibit plastic bearings, which are important proof of the ductility of the wood material. From Tab. 2 we can say that the test machine we used to evaluate our results is reliable because the average Young's modulus value in this table is not far from, 7260 MPa for *Triplochiton scleroxylon* and 10460 MPa for the *Lovoa trichilioide*s that we find in the literature (Benoit 2008, Jamala et al. 2013, Gerard et al. 1998). The longitudinal modulus of elasticity is a property of the first technological necessity for structural uses where the pieces of wood are frequently stressed in static flexion along their greatest direction parallel to the grain (Branco et al 2006). The longitudinal modulus of elasticity of the wood stabilized at a theoretical moisture content of 12% is a mechanical characteristic reference. This property characterizes the proportionality between the load and deformation. It is an indicator of the stiffness of wood. These results confirm the variability of the properties of the wood material that depend on the wood's origin in the log. The results of the bending tests are summarized above (Fig. 3) where we have represented the fracture frequencies as a function of the different classes, which makes it possible to evaluate the experimental curve in order to determine the best fit statistical law. The results of the bending tests are summarized in Fig. 3, where we have represented the fracture frequencies as a function of the different classes, which makes it possible to find the best fit statistical law.

The observation of these curves allows us to infer that the three-parameter Weibull better fits the modeling of the rupture in flexion than the normal and two-parameter Weibull distributions. The Chi square test confirms this; x^2 = 2.60 for the three-parameter Weibull distribution compared to 4.30 for the normal distribution and 5.70 for the two-parameter Weibull distribution for the *Triplochiton scleroxylon*. For *Lovoa trichilioide*s specimen, x^2 = 3.50 for the two-parameter Weibull distribution and 3.30 for the normal distribution, versus 2.70 for the three-parameter Weibull distribution. These results are consistent with those obtained for *Raphia vinifera*. L. *Arcaceae* (Talla 2008) and (Shih-Hao 2014, Lu et al. 2007).

Study on varianceof the species

This study consists in evaluating the differences between the average values and the experimental values. For this purpose, our attention will be focused on the standard deviation that characterizes the mean deviation between the stress and the mean stress. Therefore, from Tab. 3 the standard deviation of the *Triplochiton scleroxylon* specimen is 7.69 MPa for an average of 60.69 MPa against 9.92 MPa for an average of 91.39 MPa on *Lovoa trichilioide*s. When Tab. 4 shows that *Lovoa trichilioide*s has 96.07 MPa for mean and 6.53 MPa for standard deviation and *Triplochiton scleroxylon* is 62.59 MPa for mean and 6.07 MPa for standard deviation (Jelf and Fleck 1992).We observed from Tabs. 3 and 4 that the relative percentage of standard-deviation for both specimens is 27% and 57% respectively for *Triplochiton scleroxylon* and *Lovoa trichilioide*s. It means that for the two specimens, the divergences between the experimental values and the mean stress is relatively close for *Lovoa trichilioide*s than the one of *Triplochiton scleroxylon*. But taking particularly the case of each specimen, we remark that standard deviation of the *Lovoa trichilioide*s is nearly 1.3 times the one of *Triplochiton scleroxylon* (Tab. 3). From Tab. 4, we notice that the ratio is 1.07 for the two values, which means that between the mean stress and experimental values, the gap is less important for *Lovoa trichilioide*s than for *Triplochiton scleroxylon*. This gap can be explained either by internal defects in the material that we have not detected, or because of machining faults by the device, or errors in the observations of the data.

CONCLUSIONS

This work focused on "The Probabilistic Approach to the failure of *Triplochiton scleroxylon* and *Lovoa trichilioide*s". We aimed at characterizing in flexion two species, namely *Triplochiton scleroxylon* and *Lovoa trichilioides – Lovea klaineana* by modeling their behavior at failure. At the end of this work, the hygroscopycity of the specimens was measured before the bending tests and their elasticity modulus and breaking load was obtained in laboratory, at 25°C of temperature for the relative humidity ratio of the ambient air close to 70%. After calculations, the different parameters have been determined. Firstly, the two parameters Weibull's distribution was characterized; secondly, the three parameters Weibull's distribution was deduced. Finally, we highlighted that the three parameters Weibull's distribution best models the rupture than normal distribution, but the later give better results than two parameters Weibull's distribution.

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