# Descriptive aspects of wood as an ally in sustainable civil construction: A statistical analysis

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## ABSTRACT

With the global trend of using renewable materials and low energy consumption, wood has reappeared in the national construction scene as an ally in sustainable construction. As it is a natural input, it is non-toxic and does not harm the environment, as well as does not oxidize and has good resistance, thus being a safe option for structures and users. Being the result of the growth of a living being, it implies variations in its characteristics depending on the environment in which the trees develop, different physical and mechanical characteristics are added. To understand these characteristics, a descriptive statistical analysis and correlation and regression model are applied with the SPSS© program with the main physical quantities of tree species used as inputs in the national civil construction. From the correlation matrix, the quantity that has the greatest correlation between the variables is the density, so density is considered as the dependent variable for the regression and the others as independent variables, namely: height, diameter, years of cut, dry density, yield strength, modulus of rupture and strength of the fibers. Thus, a multiple linear regression model was created where the values of $R^2$ and adjusted $R^2$ indicate that the model can explain more than 90% of the phenomenon and that the correlation between the variables is positive.

**Keywords:** Construction, Sustainability, Wood, Descriptive statistics.

## 1 INTRODUCTION

Wood is the basis of the production chain of various industrial and manufactured products, which have strategic importance in the economy of numerous countries in the world, including Brazil. As a construction material, wood has several properties that make it very attractive compared to other construction materials, and can act in a secondary way in the execution of a work, being applied in shoring, forms, frames, scaffolding and even in the sheds of the work (Júnior; Silva; Soares, 2017).

On a permanent basis, wood is used as a coating, roof, furniture and even in foundations, in addition to the possibility of complete construction of the property in wood. Vectors of its high viability are commonly cited as vectors of its high viability: low energy consumption for its processing, high specific resistance, thermal and electrical insulation characteristics, in addition to being a material that is easy to work with manual or mechanical (Martini, 2003; Zenid, 2018).

Among the various possible uses, it can be classified according to the purpose (Zenid, 2009, p.22), as follows:

a) Heavy civil construction for outdoor environments: encompasses the pieces of sawn wood used for marine piles, piers, bridges, immersed works, poles, crosses, piles, struts and railway sleepers, heavy structures, observation towers, beams, with reference to the wood of angico-preto (*Anadenanthera macrocarpa*);
b) Heavy civil construction for internal environments: encompasses pieces of sawn wood in the form of beams, rafters, planks and planks used in roof structures, where peroba-rosa wood (*Aspidosperma polyneuron*) was traditionally used;
c) Lightweight external and internal civil construction for structural purposes: brings together the pieces of sawn wood in the form of planks and spikes used in temporary uses (scaffolding, shoring and concrete formwork) and the slats and rafters used in secondary parts of roof structures. Paraná pine wood (*Araucaria angustifolia*) was the most used wood for decades in this group;
d) Lightweight internal civil construction for architectural purposes: covers pieces of sawn and processed wood, such as ceilings, panels, wainscoting and trims, where the wood has color and designs considered decorative;
e) Light civil construction for indoor environments and general utility: these are the same uses described in the previous item, but for non-decorative woods;
f) For frames: covers the pieces of sawn and processed wood, such as doors, shutters, frames. The reference is the Paraná pine wood, already mentioned;
g) For domestic floors: includes the various types of sawn and processed wood pieces, such as running boards, studs, heels and parquet.

With the global trend of using low-energy and renewable materials, wood has reappeared in the construction scene, as it meets the necessary requirements of resistance and durability (Silva; Soares, 2017). Its use allows for a cleaner work with very low material waste. However, safety is also present in its characteristics, as it has a better weight-to-strength ratio than its direct competitors, steel and reinforced concrete (Júnior; Silva; Soares, 2017).

Another advantage is the availability of the product in the market, since it has been used in civil construction for a long time, in addition to being a natural and safe product; Wood, being a natural input, is non-toxic and does not harm the environment. Based on the information presented, a present study of the correlations between the physical properties of wood is justified, since it is the result of the growth of a living being, implying variations in its characteristics according to the environment in which it develops. Including different species of trees, each with its own anatomical, physical and mechanical characteristics (Zenid, 2018).

In addition, there is a very favorable condition for forest exploitation in Brazil, with a large degraded and underutilized area that serves as a *locus* to expand the activity of the forestry sector. This sector is already one of the largest and is growing rapidly, with an area of 9 million hectares, with an economic representation in the order of R$ 65 billion (Pitzahn, 2016).

## 2 METHODOLOGY

### 2.1 CLASSIFICATION OF VARIABLES

In the present study, we will work with two nominal qualitative variables, the national and international occurrence of wood. And the quantitative variables will be the height, diameter, years for cutting, density, dry density, yield strength, modulus of rupture and strength of the fibers; the variable was years for continuous cutting and the other variables were discrete.

### 2.2 DDESCRIPTION OF SAMPLE COLLECTION

All the information contained in the database came from a specific research medium. The database used information on 50 species of trees of national occurrence from all regions of the country provided by The *Wood Database*©, described below:

Table 1 – 50 species of trees whose wood are used in national construction

| Common name | Scientific name | National Occurrence |
|---|---|---|
| Angelim araroba | *Andira fraxinifolia Benth* | Atlantic Forest |
| Angelim ferro | *Dinizia excelsa Ducke* | Amazon Region |
| Angelim Stone | *Hymenolobium petraeum Ducke* | Amazon Region |
| Angelim Real Stone | *Dinizia excelsa Ducke* | Amazon Region |
| Whiteness | *Sebastiania Commersoniana* | Atlantic Forest |
| Jaferana | *Andira sp* | Amazon Region |
| Canafistula | *Peltophorum dubium* | Southeast and Northeast |
| Thick skin | *Vochysia sp* | Scrubland |
| Castle | *Gossypiospermun praecox* | South |
| Bitter Cedar | *Cedrela sp. z o.o.* | Amazon Region |
| Cedar Twelve | *Pachira quinata* | Atlantic Forest |
| Champagne | *Dipteryx sp* | Amazon Region |
| Cupiúba | *Goupia glabra AubI* | Amazon Region |
| Catiúba | *Qualea paraensis* | Amazon Region |
| Eucalyptus Alba | *Eucalyptus Alba* | South and Southeast |

| | | |
|---|---|---|
| Eucalyptus Camaldulensis | *Eucalyptus Camaldulensis* | South and Southeast |
| Eucalyptus Citriodora | *Eucalyptus Citriodora* | South and Southeast |
| Cloeziana Eucalyptus | *Eucalyptus Cloeziana* | South and Southeast |
| Dunnii Eucalyptus | *Eucalyptus Dunnii* | South and Southeast |
| Eucalyptus Grandis | *Eucalyptus Grandis* | South and Southeast |
| Eucalyptus Maculata | *Eucalyptus Maculata* | South and Southeast |
| Eucalyptus Maidene | *Eucalyptus Maidene* | South and Southeast |
| Eucalyptus Microcorys | *Eucalyptus Microcorys* | South and Southeast |
| Eucalipto Paniculata | *Eucalyptus Paniculata* | South and Southeast |
| Eucalyptus Propinqua | *Eucalyptus Propinqua* | South and Southeast |
| Eucalyptus Punctata | *Eucalyptus Punctata* | South and Southeast |
| Eucalyptus Saligna | *Eucalyptus Saligna* | South and Southeast |
| Eucalyptus Tereticornis | *Eucalyptus Tereticornis* | South and Southeast |
| Eucalyptus Triantha | *Eucalyptus Triantha* | South and Southeast |
| Eucalyptus Umbra | *Eucalyptus Umbra* | South and Southeast |
| Eucalyptus Urophylla | *Eucalyptus Urophylla* | South and Southeast |
| Garapa Roraima | *Apuleia leiocarpa* | Amazon Region |
| Guaiçara | *Luetzelburgia auriculata* | Atlantic Forest |
| Guarucaia | *Parapiptadenia rigida* | Scrubland |
| Ipê | *Handroanthus albus* | Atlantic Forest |
| Jatoba | *Hymenaea courbaril* | Atlantic Forest |
| Black Blonde | *Cordia trichotoma* | Scrubland |
| Maçaranduba | *Manilkara huberi* | Atlantic Forest |
| Cassava | *Didymopanax morototonii* | Amazon Region |
| Yellow Oiticica | *Rigid Lycania* | Amazon Region |
| Paraná Pine | *Araucaria angustifolia* | Atlantic Forest |
| Pinus caribaea | *Pinus caribaea* | South and Southeast |
| Pinus bahamensis | *Pinus bahamensis* | South and Southeast |
| Pinus hondurensis | *Pinus hondurensis* | South and Southeast |
| Pinus elliottii | *Pinus elliottii* | South and Southeast |
| Pinus oocarpa | *Pinus oocarpa* | South and Southeast |
| Pinus taeda | *Pinus taeda* | South and Southeast |
| Quarubarana | *Erisma uncinatum Warm* | Amazon Region |
| Sucupira | *Bowdichia virgilioides* | Scrubland |
| Tatajuba | *Bagassa guianensis Aubl)* | Amazon Region |
| Umbuzeiro | *Spondias tuberosa* | Amazon Region |

Source: The Authors (2023)

## 2.3 DATA ANALYSIS

The statistical program SPSS (*Statistical Package for Social Science*) was used to generate regression and correlation models between the variables. The program allows the use of data in various formats to generate reports, calculate descriptive statistics, conduct complex statistical analysis and prepare graphs.

## 3 RESULTS AND DISCUSSIONS

### 3.1 POSITION AND DISPERSION MEASUREMENTS

It is of interest to present this data through descriptive measures that synthesize the characteristics of the distribution. To represent a set of data in a condensed way, some measures of position and dispersion will be used (Medeiros, 2019).

#### 3.1.1 Calculation of Position Measures

Position measurements are used to locate the distribution of raw data (or frequencies) on the axis of variation of the variable in question (Balieiro, 2008). Chart 2 below shows the values for the position measurements referring to the mean, mode, and median.

Table 2 – Position Measures

| Position Measures | Height (m) | Diam. (m) | Cutting (years) | Dens. (kg/m3) | Dens. seca (kg/m3) | Lim. Drain. (MPa) | Courage. Rupt. (MPa) | Resist. Fibras (MPa) |
|---|---|---|---|---|---|---|---|---|
| Media | 22,3 | 1,1 | 15,2 | 824,6 | 665,7 | 15,2 | 101,3 | 9,9 |
| Fashion | 30,0 | 0,6 | 15,0 | 690,0 | 730,0 | 20,0 | 83,0 | 9,8 |
| Medium | 20,0 | 1,0 | 15,0 | 825,0 | 640,0 | 14,6 | 97,0 | 9,8 |

Source: The Authors (2023)

#### 3.1.2 Calculation of Dispersion Measures

The information provided by position measures needs to be complemented by dispersion measures. They aim to show how much the data are dispersed around the central region. Therefore, they characterize the degree of variation in a data set (Balieiro, 2008). Chart 3 shows the dispersion measures for the variables, which are the maximum value, minimum, amplitude, standard deviation, variance, and dispersion coefficient.

Table 3 – Dispersion Measures and Dispersion Coefficient

| Dispersion Measures | Height (m) | Diam. (m) | Cutting (years) | Dens. (kg/m3) | Dens. seca (kg/m3) | Lim. Drain. (MPa) | Courage. Rupt. (MPa) | Resist. Fibras (MPa) |
|---|---|---|---|---|---|---|---|---|
| Maxim | 55,0 | 3,4 | 40,0 | 1220,0 | 1100,0 | 23,6 | 174,0 | 15,7 |
| Minimal | 5,5 | 0,4 | 5,0 | 500,0 | 410,0 | 7,1 | 50,0 | 5,6 |
| Amplitude | 49,5 | 3,1 | 35,0 | 720,0 | 690,0 | 16,5 | 123,0 | 10,1 |
| Standard deviation | 10,1 | 0,6 | 6,4 | 195,7 | 169,8 | 3,9 | 28,9 | 2,4 |
| Variance | 102,4 | 0,4 | 41,4 | 38304,8 | 28829,0 | 15,5 | 834,4 | 5,7 |
| Dispersion coefficient | 45,38% | 57,36% | 42,22% | 23,73% | 25,50% | 25,84% | 28,50% | 24,03% |

Source: The Authors (2023)

The amplitude as a measure of dispersion is limited. This measurement only depends on the extreme values, i.e. it is not affected by the dispersion of the maximum and minimum internal values. The standard deviation measures the variability of the set in terms of deviations from the arithmetic mean. It is always a non-negative quantity and expressed in the same unit of measurement as the variable (Medeiros, 2019).

Variance measures the variability of the set in terms of squared deviations from the arithmetic mean. It is always a non-negative quantity and expressed in square units of the data set, being difficult to interpret. The dispersion coefficient, on the other hand, is a measure of "relative variability", being useful for comparing the variability of observations with different units of measurement (Medeiros, 2019).

## 3.2 CORRELATION MATRIX

### 3.2.1 Correlation Matrix Calculation

In the broadest sense, correlation is any statistical association, although most often it refers to how close two variables are to having a linear relationship with each other, which is the most well-known form of correlation and called *Pearson* correlation. A correlation matrix is a table that presents the correlation coefficients between variables. Each cell in the table shows the correlation between two variables. Correlation is a number that ranges between -1 and 1, which can also be expressed as a percentage. In statistics it is represented by the letter r. A correlation can be positive ($r > 0$), meaning that both variables move in the same direction, or they are negative ($r < 0$), meaning that they move in opposite directions, i.e., when the value of one variable increases, the value of the other variable decreases. The correlation can also be null or zero, which means that the variables are not related (Rocha, 2018).

### 3.2.2 Correlation Matrix Analysis

Charts 4 and 5 below show the coefficients and the correlation matrix with the use of the variables presented in the database.

Table 4 – Coefficients

| **Model** | **Non-standard coefficients** | | **Standardized coefficients** | | |
|---|---|---|---|---|---|
| | B | Standard Model | Beta | t | Say. |
| Constant | -2,314 | 6,184 | | -0,372 | 0,710 |
| Diameter | 7,233 | 2,169 | 0,461 | 3,335 | 0,002 |
| Court | -0,057 | 0,201 | -0,036 | -0,283 | 0,778 |
| Density | -0,031 | 0,017 | -0,606 | -1,804 | 0,078 |
| Dry Density | -0,031 | 0,018 | 0,522 | 1,744 | 0,088 |
| Yield strength | 0,299 | 0,565 | 0,117 | 0,530 | 0,599 |
| Modulus of rupture | 0,168 | 0,058 | 0,478 | 2,903 | 0,006 |
| Resistance | 0,096 | 0,834 | 0,023 | 0,115 | 0,909 |

Source: The Authors, produced at SPSS (2023)

Table 5 – Correlation Matrix

| | | A | D | C | Of | Some | THE | MR | R |
|---|---|---|---|---|---|---|---|---|---|
| Height | Pearson | 1 | 0,484** | 0,098 | 0,226 | 0,145 | 0,284* | 0,542** | 0,242 |
| | Say. | | 0,000 | 0,493 | 0,110 | 0,110 | 0,044 | 0,000 | 0,087 |
| | N | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Diameter | Pearson | 0,484** | 1 | -0,017 | -0,039 | -0,282* | -0,014 | 0,313* | -0,075 |
| | Say. | 0,000 | | 0,908 | 0,926 | 0,045 | 0,921 | 0,026 | 0,602 |
| | N | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Court | Pearson | 0,098 | -0,017 | 1 | 0,013 | 0,185 | 0,004 | 0,103 | 0,172 |
| | Say. | 0,493 | 0,908 | | 0,926 | 0,195 | 0,980 | 0,470 | 0,228 |
| | N | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Density | Pearson | 0,226 | -0,282* | 0,013 | 1 | 0,869** | 0,836** | 0,591** | 0,772** |
| | Say. | 0,110 | 0,045 | 0,926 | | 0,000 | 0,000 | 0,000 | 0,000 |
| | N | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Densid. drought | Pearson | 0,145 | -0,282* | 0,185 | 0,869** | 1 | 0,733** | 0,386** | 0,745** |
| | Say. | 0,311 | 0,045 | 0,195 | 0,000 | | 0,000 | 0,005 | 0,000 |
| | N | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Drainage | Pearson | 0,284* | 0,014 | 0,004 | 0,836** | 0,733** | 1 | 0,588** | 0,748** |
| | Say. | 0,044 | 0,021 | 0,034 | 0,000 | 0,000 | | 0,000 | 0,000 |
| | N | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Modulus Rupture | Pearson | 0,542** | 0,313* | 0,103 | 0,591** | 0,386** | 0,733** | 1 | 0,527** |
| | Say. | 0,000 | 0,026 | 0,470 | 0,000 | 0,005 | 0,000 | | 0,000 |
| | N | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Resiliency | Pearson | -0,242 | -0,075 | ,0172 | 0,772** | 0,745** | 0,748** | 0,527** | 1 |
| | Say. | 0,087 | 0,602 | 0,228 | 0,000 | 0,000 | 0,000 | 0,000 | |
| | N | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |

** Correlation is significant at level 0.01 (2 ends)

* Correlation is significant at level 0.05 (2 ends)

Legend: A: height, D: diameter, C: cut, De: density, DeS: dry density, LE: yield strength, MR: modulus of rupture and R: Strength.

Source: The Authors, produced at SPSS (2023)

Wood can be influenced by the variables studied in numerous ways, we will pay attention to the main ones. Analyzing the correlation matrix, it is observed that the highest degrees of correlation are that of density with dry density (87%), followed by density with yield strength (84%) and again density with fiber strength (77%); Which was already a predictable result, since the thicker the wood fibers, the greater their weight and consequently their density. Other strong correlations are yield strength with fiber strength (75%), dry density with fiber strength, again (74%) and dry density with yield strength (73%). Therefore, it can be seen that the strongest variables are density, dry density, yield strength and strength of the fibers.

The variables of medium correlation mostly involve the modulus of rupture, which is correlated with density and flow (59%), height (54%), dry density (39%) and diameter (31%). There was also a correlation between the modulus of rupture and the strength of the fibers (53%) and also between the diameter and the height (48%). The modulus of rupture represents the maximum stress that a structural element can withstand before breaking; This is consistent with the results presented, since it is the wood fibers that correspond to the structural strength and the density is strictly linked to the fibers.

Weak correlations strictly involve height and cut; Height was the yield strength (28%), the strength of the fibers (24%), the density (23%), the dry density (14%) and the cut (10%). And the cut with the dry density (18%), with the strength of the fibers (17%) and finally with the modulus of rupture (10%). The height of the trees is not related to the variables mentioned for several reasons, such as the region of occurrence, the temperature of the place, as well as the rainfall regime and other physical and geographical characteristics.

On the other hand, the negative correlations involve the diameter with the dry density (-28%) and with the strength of the fibers (-7%) and with the density (-4%). Like height, the time to cut has a weak correlation with the variables; A tree can take a long time to grow and have low resistance, as well as grow fast and have a higher resistance, so it also depends on other variables that were not measured in the present study. On the other hand, variables with null correlation or less than 3% were discarded from this analysis.

## 3.3 IDENTIFICATION OF DEPENDENT AND INDEPENDENT VARIABLES

From the correlation matrix, it can be seen that the variable that has the greatest correlation between the variables is density, so density is considered as the dependent variable for the regression and the others as independent variables, namely: height, diameter, years of cut, dry density, yield strength, modulus of rupture and strength of the fibers.

## 3.4 HYPOTHESIS TESTING FOR REGRESSION

Hypothesis testing is a process capable of stating, based on sample data, whether a hypothesis under proof is correct or not. It is a statement that admits whether a certain effect is present or not. By hypothesis, we mean a certain conditional statement about a population, and they are classified into two types:

a) null hypothesis (H0), when it is assumed that there is no difference between the information provided by reality and the statement of the hypothesis;

b) alternative hypothesis (H1), when it is assumed that there is a difference between the information provided by reality and the statement of the hypothesis.

Therefore, the testing process consists of accepting or rejecting the null hypothesis (H0), based on the difference between the hypothetical value and its estimated value (Sell, 2005). The steps of hypothesis testing were applied for regression to 95% reliability for the following hypotheses:

$H0 : B = 0$: There is no influence of density on height and/or diameter, years of cutting, dry density, yield strength, modulus of rupture and strength of the fibers;

$H1 : B \neq 0$: Density influences height and/or diameter, years of cutting, dry density, yield strength, modulus of rupture and strength of the fibers.

## 3.5 REGRESSION MODEL FITTING

The p-value is the highest significance level value for which the test is significant or it is the highest significance level value that rejects the null hypothesis (H0). P-value is the observed level of significance. For judging, the p-value is compared with the level of significance or tolerated error that is considered most appropriate. The decision criterion for the p-value will be: choose the level of significance α (using the 5% value here); if the p-value < α, then H0 is rejected. It is a measure of the overall significance of the multiple regression equation and a good measure of the adherence of the equation to the sample data (Lapponi, 2000).

For the first regression, it was noticed that the variables "modulus of rupture" and "resistance of the fibers" and the intersection itself obtained a p-value greater than 5%, which makes it necessary to reject the H0 hypothesis and adjust the regression model excluding such variables, thus obtaining new hypotheses:

> H0' : B = 0: There is no influence of density on height, diameter, years of cutting, dry density and yield strength;
>
> H1' : B ≠ 0: Density influences height, diameter, cutting years, dry density and yield strength.

Hypothesis H1' is verified as true, with the p-value within the limit of what is acceptable for the independent variables. With the adjusted R2 value close to 1; with 0.9131. The adjusted $R^2$ value displays the multiple coefficient of determination, which is a measure of the degree of fit of the multiple regression equation to the sample data.

A perfect fit results in $R^2 = 1$, a very good fit results in a value close to 1, and a weak fit results in a value of $R^2$ close to zero. The multiple coefficient of determination of $R^2$ is a measure of adherence of the regression equation to the sample data. The adjusted coefficient of determination is the multiple coefficient of determination $R^2$ modified to take into account the number of variables and the sample size. The coefficient of determination, or coefficient of explanation, R2, measures the portion of the variation in Y explained by the variation in X (Sell, 2005).

And for Statistic F, used to test the joint effect of the independent variables on the dependent one, i.e., it serves to verify whether at least one of the X explains the variation of the Y. Thus, the null hypothesis (H0) will indicate that none of the X affects Y, while the alternative hypothesis (H1) ensures that at least one of the independent variables will influence the dependent variable Y.  within the required degrees of freedom and given a degree of significance. Considering a significance level of 0.05, if F of significance is < 0.05, the regression is significant, but if it is ≥ 0.05, the regression is not significant (Sell, 2005).

As a last check, the F-value of significance is extremely lower than α (5%), with a value of 2.3067 * (10-20), which makes the regression meaningful and good.

The values of $R^2$ and adjusted $R^2$ (0.9153 and 0.9047, respectively) indicate that this multiple linear regression model can explain more than 90% of the phenomenon and that the correlation between the variables is positive. It is also observed that the residues used directly influence the p-value (F-test) for regression.

However, it is possible to observe with the data obtained that the intersection represents more than 32% of the regression model, while the variables height represents 2.9% and years for the cut-off 0.6%, respectively. The others have a low probability of the interference of the variables being attributed to chance in this model.

## 3.6 REGRESSION EQUATION

Regression gives an equation that describes the relationship in mathematical terms. Regression comprises the analysis of sample data to know if and how two or more variables are related to each other in a population, and results in a mathematical equation that describes the relationship. The equation can be used to estimate, or predict, future values of one variable when known or assumed to be known values of the other variable (Stevenson, 1986). Therefore, the following equations were arrived at:

Height (meters): $Y = 48.6335 - 2.9085 * x$ (Eq. 1)

Diameter (meters): $Y = 48.6335 + 89.0138 * x$ (Eq. 2)

Cut-off (years): $Y = 48.63355 - 3.8019 * x$ (Eq. 3)

Dry density (kg/m3): $Y = 48.6335 + 0.80571 * x$ (Eq. 4)

Yield Strength (MPa): $Y = 48.6335 + 16.5763 * x$ (Eq. 5)

By inserting the density (kg/m3) as a value in "x", the other quantities are estimated based on the multiple linear regression model, and it is possible to explain more than 90% of the phenomenon.

## 4 FINAL THOUGHTS

By observing the national scenario of the use of wood as a civil construction material based on its technical information from the statistical analysis tools, it can be stated that:

When choosing the right wood for a given use, it is necessary to consider what are the physical properties and the respective levels required for the wood to perform satisfactorily. From the correlation matrix, it can be seen that the variable that has the greatest correlation between the variables is density, so density is considered as the dependent variable for regression and the others as independent variables, and the hypothesis tests pointed to the influence of density on height, diameter, years of cut, dry density and yield strength.

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