CLASSIFICATION AND SAMPLING OF TROPICAL WOOD SPECIES FOR STRENGTH AND DURABILITY ASSIGNMENTS

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ABSTRACT: Strength class assignments and durability class assignments of wood species to be used in structures are necessary to make it possible for the engineer to design safe and durable timber structures. As a result of sustainable managed forests, more tropical wood species with relative small batch size, are coming on the market. In Europe, strength class and durability class assignments are allocated to wood species, identified by their botanical name. In practice this gives problems because the trade names may not represent the botanical wood species and the representativeness of the underlying tests is unclear. This object of this paper is to start a discussion on the classification of structural timber for strength and durability. It is proposed to make classifications on measurable characteristics of the timber, not on the tree.

KEYWORDS: tropical wood species, strength classification, durability classification.

1 INTRODUCTION

In Europe, strength class assignments for structural timber based on visual grading are listed in EN 1912 [1], for durability aspects so called 'Durability classes' have been established which are listed in EN 350-2[2]. In these assignment it is assumed that the sampling is representative for the timber that is brought on the market. In general, timber originates from tree species (wood species) which are recognised by unique botanical names. It seems, that in practice it is very difficult to determine the wood species. The allocation is related to the material by its trade name and botanical name, and the source area [1] of the wood species which have to be linked. Since the Plant Systematic is based on morphological features of the tree such as flowers, leaves, fruits, etc., these features cannot be used in the later production chain of timber because of their absence. From the nineteen century plant anatomy has attracted attention in relation with wood anatomical features [3]. These anatomical features has been used to identify wood species as far they are distinctive enough. When timber has to be judged at the timber traders storage or in a laboratory, the relation with a wood species can only be laid by comparison of wood anatomical features. In many cases trade names cover more than one botanical wood species which cannot always be distinguished by wood anatomical features. In some cases wood species of the delivered timber cannot be identified on 'Species' level but be determined at a higher hierarchical level of the plant systematic such as 'Family' or 'Genus'. A second problem is the definition of the source area which raises the question how representative the test results are for wood species which are widely spread over continents like Latin America or Africa.

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2 STRENGTH CLASS ASSIGNMENTS

2.1 CASE STUDY

For strength assignments the test results must be linked to a visual grade for the species. In the sampling the uncertainty in strength influencing parameters should be addressed. These can be divided in three groups: genetics, growing conditions and processing. In the laboratory the genus and visual characteristics like knots and grain angle can be determined. The different locations of the samples must take care of the representativeness for the stated source area.

As a case 5 samples of timber under the trade name cumaru were studied. In table 1 the locations of the samples and the 5-percentile values of the bending strength is given. This table shows huge variation within and between locations, which cover a large area. Cumaru is related to the wood species *Dipteryx odorata* (Aubl.) Willd.. Depending on the Plant Systematic the genus Dipteryx consists up to 23 species [4] which are not all

distinguishable by wood anatomical features [5]. Therefore in practise cumaru is a mixture of Dipteryx species. For the 5 subsamples the genus could be determined by microscopic research, but not the individual species.

Table 1: *5-percentile bending strength values of 5 cumaru subsamples*

subsample	Location	5% bending strength (N/mm^2)
1	Brazil	76,8
2	Brazil	58,7
3	Brazil	100,9
4	Peru	46,0
5	Bolivia	56,0

2.2 POSSIBLE CLASSIFICATIONS

A possible classification method for timber for strength assignments could be based on wood anatomical features which are applicable on a practical identification level and origin of the timber. This could be the genus level, see figure 1, but also a higher level

Figure 1: *Cumaru tree where the species can be determined by botanical features (left), wood anatomic structure of a cumaru species where only the genus can be determined (right).*

3 DURABILITY CLASS ASSIGNMENTS

3.1 INTRODUCTION

Wood durability has been classified in so called Durability Classes (DC) [2]. Durability concerns natural durability against micro-organisms such as fungi. In general, natural durability is strictly connected to a tree species (wood species) independent from their origin. Usually natural durability has been determined by field or laboratory testing against fungi which take several month or even years. To today there is no method available where natural durability of a single piece of timber can be determined at that moment. Therefore the wood species of the timber has to be known. For tropical timber, wood anatomical features are often not distinctive enough to identify the wood species. Another important aspect of durability assignment of wood species is the representativeness of the population and the reliability of the classified values. Both aspects have been intensively discussed by the members of the European Standardisation Committee CEN TC38 WG21. Research has shown [7] that durability of a wood species can have large scatter which is not taken into account in the classification system, which could be explained by a mix of wood species in the sample or the variation of natural durability within the same species. In order to investigate this, large samples are necessary to get reliable test data. Statistical sampling is concerned with selecting a subset of individuals from a defined population in order to estimate the characteristic of the whole population [6]. However this is not appropriate for tree species which are spread over continents.

3.2 POSSIBLE CLASSIFICATIONS

From practical point of view it is not necessary to identify the tree species if the natural durability of the timber could be determined at each piece in situ. In this case also the origin of the timber has not to be known. Extractive configurations in the wood are governing to great extend the natural durability of wood [8]. By sophisticated methods such as NIR a fingerprint of the chemical formation could be taken from each piece of timber. However, these fingerprints has to be tested against fungi resistance. Finally a database would be set up in time where 'fingerprints' will be connected to durability classes. For example if tannins configurations have a certain resistance against fungi, then timber with this configuration could be supposed as durable and assigned to classification system.

4 CONCLUSIONS

Currently for both strength grading and natural durability assignments the identification of tropical wood species is necessary. This causes uncertainty because of the wood identification methodology. A novel approach as well for strength grading as natural durability assignments should be by using only features which can be measured or determined from the single piece of timber in situ. Hereby the identification of the specific wood species will not be necessary anymore. Thus the properties which have been determined belong to the population of the timber which have entered the market.

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