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PREDICTING THE MECHANICAL BEHAVIOUR OF SOLID PINE TIMBER ELEMENTS THROUGH NON AND SEMI-DESTRUCTIVE METHODS

José S. Machado[1], Pedro Palma[2]

ABSTRACT: Timber elements can be foreseen as lengthwise composites of clear and knot zones, being the clear wood zones greatly responsible for stiffness and the weakest zones (worst knots shown by the timber element) for the ultimate strength capacity. In the present study non destructive techniques (ultrasounds and visual grading) and semi-destructive techniques (tension meso-specimens and core drilling) are used and tested as tools for evaluating clear wood properties. These properties are then used to predict the global modulus of elasticity of maritime pine timber beams. The results obtained delivered important information concerning variability within and between timber pieces. The non and semi-destructive techniques used have shown a reasonable capability to predict the clear wood properties and to deliver a good prediction of the global bending modulus of elasticity.

KEYWORDS: Meso-specimens, tension testing, visual grading, ultrasounds, core drilling

1 BACKGROUND

A reasonable knowledge about the quality of the different timber species used, by means of criteria as the durability and experience from other works and a correct visual selection at the forest site, sometimes by selecting wood elements in such a way that stresses in the trunk of the tree were similar to the stresses subject in-service in the structure, practice often used in naval construction, Figure 1, are perhaps some of the reasons for the longevity recognized to timber structures in different countries.

Albeit all the details taken at the time of erection of the structure the appraisal of old timber structures often faces the fact that no information is available about the reference strength values taken into consideration when the structure was erected. This is also true since in most cases strength values were not even considered but only the experience gathered by the carpenter from previous works.

Therefore, there is a clear need for tools and procedures for predicting the mechanical behaviour of timber elements and joints, in order to allow a more accurate structural safety analysis of existing timber structures.

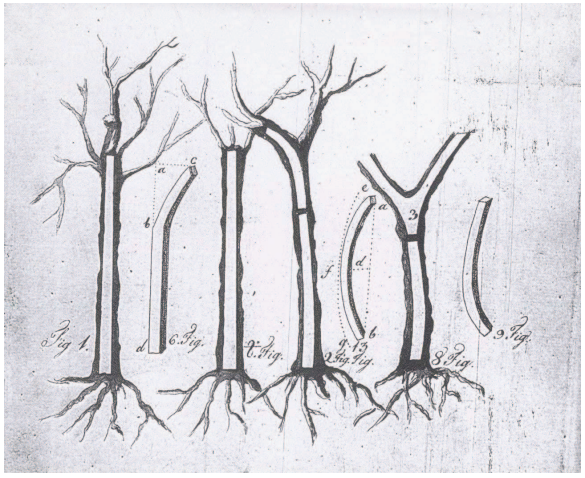

Figure 1: *Selection having in mind the stresses suffered by a piece of timber while in the tree's trunk. Portuguese picture from the XVIII century*

A first step should comprise the identification of the wood species involved, since it defines the range of values that can be expected for the mechanical properties. However, a large variability remains on the mechanical behaviour of the structural elements.

Consequently the next step should comprise the analysis of a particular timber member or a group of timber members for the assessment of its or their *reference properties*. The concept of *reference properties* and

[1] José Saporiti Machado, Timber Structures Division, Laboratório Nacional de Engenharia Civil, Av. do Brasil 101, 1700-066 Lisboa, Portugal. Email: saporiti@lnec.pt
[2] Pedro Palma, Timber Structures Division, Laboratório Nacional de Engenharia Civil, Av. do Brasil 101, 1700-066 Lisboa, Portugal. Email: ppalma@lnec.pt