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Mechanical Properties of Wood Construction Materials from a Building from the 19th Century

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Abstract

Historic buildings are very important for the cultural identity of the humanity, so it's important to preserve it. In order to better understand the behaviour of the woods, is necessary to perform experimental tests to obtain its mechanical properties. With the mechanical properties is possible to develop numerical models that can predict the behaviour of the structure, if well calibrated and verified, which are a viable base for structural design. The present work presents the tests and results obtained from an experimental campaign in specimens of eucalyptus wood from a roof structural beam of a 19th century masonry building, located in the Felgueiras, Portugal. Were performed tests of density and water content, tensile and compression strengths parallel to the fibers.

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Keywords: Wood mechanical properties; Historic buildings; Wood structures; Masonry buildings.

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1. Introduction

Construction has a high environmental impact so it's important to use natural resources and re-use existing ones [1]. There's a lack of studies of the properties of antique woods [2] so is necessary to study it's mechanical properties in order to develop adequate rehabilitation measures and techniques to ensure the security and reliability of these structures. Wood is a complex material, due to its heterogeneity and anisotropy (fibers orientation, rings, presence of nodes, deficiencies, etc.) [3]. The behaviour of old eucalyptus wood was studied through an experimental campaign is specimens from a structural beam from the roof of a masonry building, made in the 19th century, existing in Felgueiras, Portugal [4], and representative of the construction of that century. The building is composed by two floors and the roof, being the ground floor composed by exterior and interior structural masonry walls, the first floor by exterior masonry structural walls and interior wood partition walls and the second floor limited outwardly by the roof and with interior wood partition walls. The roofs are made with wood beams and wooden slats with wood of cone or pine. The experimental campaign includes density and water content tests, parallel to the fibers tensile test and parallel to the fibers compressive tests.

Nomenclature

ρ_H	density (kg/m^3)
m_H	specimen mass (kg)
V_H	specimen volume (m^3)
H	water content (%)
m_h	specimen humid mass (kg)
m_s	specimen dry mass (kg)

2. Experimental tests

This chapter presents the experimental campaign carried out to obtain some mechanical characteristics of the wood of the structural beam from the roof. Was determined the density, water content, tensile and compression strengths parallel to the fibers.

2.1. Density and water content

2.1.1. Procedure and equipment

Using the Portuguese standard NP-616 (1973) [5] is possible to obtain the density of the wood. The specimens of this test had dimensions of $20 \times 20 \times 20\ mm^3$ as it is showed in Fig. 1. The density can be obtain using equation (1). According to the followed standard the water content in this test should be 12% [5]. Were teste 4 specimens.

The water content of the eucalyptus wood was obtained according to Portuguese standard NP-614 (1973) [6] using the specimens with the same dimensions of the ones used density test (Fig. 1). The water or humidity content, H, is the percentage of the coefficient between the specimen with water weight and the dry specimen weight, after drying it in a stove at 100 ℃. The water content is obtained using the equation (2). Were also tested 4 specimens.

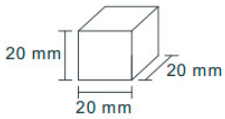

Fig. 1. Specimen dimensions (images from: [3]).

$$\rho_H = \frac{m_H}{V_H}\ (Kg/m^3) \tag{1}$$

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