

# Uncertainty of Visual Inspection on the Reliability Analysis of Timber Elements

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## Abstract

In this work, the uncertainty related to the process of visual inspection of timber elements as a method to define different strength classes is quantified. For that aim, visual inspection was made to different chestnut timber elements at local and global scales. The inspection was made by sixteen different inspectors, with low experience, and by an expert for benchmark analysis. The uncertainty of the visual inspection process was measured by the analysis of these independent observations obtained under the same conditions of measurement, resulting in the quantification of the experimental standard deviation to characterize the variability of the observed values and of the experimental standard deviation of the mean to characterize the uncertainty of the process. A reliability analysis was also made using random samples including the uncertainty from the visual inspection process, obtaining reduction factors for a specific case study.

**Keywords:** visual inspection; timber; uncertainty; reliability.

## 1 Introduction

The first step to evaluate the safety of existing timber structures is to carry out a visual inspection to its elements. During this visual inspection, the conservation level and defects of the elements are analyzed and catalogued according to specific standards, which will after be the basis for visual grading. Visual strength grading results in the indication of values or allowable stress levels for key mechanical properties, which due to its correlation to other properties, allow for the characterization of the material and further structural analysis. However, besides the difficulty of assessing an existing timber structure in situ, the accuracy of visual inspection may be compromised by its subjective nature inherited by the expertise of different inspectors and lack of

common rules for measuring defects. Nowadays, the rehabilitation of buildings is increasing and thus a higher demand for inspection of existing structures. Unfortunately, due to lack of experts in this area, this demand also leads to inspections made by inspectors with less experience. Therefore, it is crucial that the uncertainty of this process is included in the safety level assessment.

This work, considers the results of an experimental campaign made by different inspectors, as to measure the uncertainty of the visual inspection process. After, those results are applied in a case study to evidence the influence of including such uncertainty.

## 2 Experimental campaign

In this work, seven timber boards with dimensions 7×4×300 cm<sup>3</sup>, obtained from old timber beams,