



Quantifying ductility in timber structures

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ARTICLE INFO

Article history:

Available online 5 April 2011

Keywords:

Timber structure
Ductility
Test
Verification
Connection

ABSTRACT

The recent introduction of a common basis for structural design in Europe has led to a comprehensive set of standards covering the most used building materials. The basic principles of proper design are stated in EN 1990 and the actions are specified in EN 1991. For timber structures the governing regulations are given in EN 1995 (Eurocode 5), with the exception of seismic design which is covered by EN 1998.

EN 1995 complies with the principles of EN 1990, but it is only concerned with requirements for mechanical resistance, serviceability, durability and fire resistance. When it comes to the principle stating that potential damage shall not be disproportionate to the original cause, and the principle statement on limitations of potential damage, EN 1995 offers very little help on how to fulfil these principles. In ultimate limit states there are no recommendations or guidance on deformations, rotations or other measures for evaluation of, to what extent, a timber structure fulfils the basic principles of EN 1990.

Ductility and robustness of timber structures are high on the agenda of the COST action E55. Contributions are needed in order to develop methods for verification of compliance with the basic principles of EN 1990. The most common opinion in recent literature is that this can be achieved by utilization of plastic deformation of metallic fasteners. However, although numerous experimental results on the behavior of timber structures, timber connections and metallic fasteners are reported, no unified methods exist for evaluation of these results in this context. In EN 1995, the required properties are not stated, nor is there any method available for verification. In the paper some procedures are proposed and discussed. Furthermore, some ductility measures are used in evaluations of examples from tested structural timber connections. The results are discussed in view of the definition of ductility and the basic requirements of design put forward in EN 1990.

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1. Introduction

1.1. Background

The recent introduction of a common basis for structural design in Europe has led to a comprehensive set of standards covering the most used building materials. The basic principles of proper design are stated in EN 1990 [1] and the actions are specified in EN 1991. For timber structures the governing regulations are given in EN 1995 (Eurocode 5) [2], with the exception of seismic design which is covered by EN 1998 [3].

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to the original cause, and the statement on limitations of potential damage, EN 1995 offers very little help on how to fulfill these principles. For the ultimate limit state there is no guidance to how one can evaluate to what extent a timber structure fulfils the basic principles of EN 1990.

Ductility and robustness of timber structures are currently being discussed in COST action E55 “Modelling the performance of timber structures”. A common opinion in recent literature is that enhanced robustness of timber structures can be achieved by utilization of plastic deformation of metallic fasteners. However, although numerous experimental results on the behavior of timber structures, timber connections and metallic fasteners are reported, no unified methods exist for evaluation of these results in this context. In EN 1995 the required properties are not stated, nor is there any method available for verification. In this paper a procedure for quantification of the so-called ductility is proposed and discussed. The procedure is applied to two test examples from structural timber connections. The intention is to contribute towards the development of methods for verification of compliance to the basic principles of EN 1990.

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