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The new provisions for the seismic design of timber buildings in Europe

M. Follesa[a], M. Fragiacomo[b,c,*], D. Casagrande[c], R. Tomasi[d], M. Piazza[e], D. Vassallo[a], D. Canetti[e], S. Rossi[e]

[a] dedaLEGNO, Via Masaccio 252, 50132 Florence, Italy
[b] Department of Civil, Construction-Architectural and Environmental Engineering, University of L'Aquila, Via Giovanni Gronchi 18 - Zona industriale di Pile, 67100 L'Aquila, Italy
[c] CNR IVALSA – National Research Council of Italy, Trees and Timber Institute, Via Biasi 75, 38010 San Michele all'Adige, Italy
[d] Department of Mathematical Sciences and Technology, Norwegian University of Life Sciences, Universitetstunet 3, 1433 Ås, Norway
[e] Department of Civil, Environmental and Mechanical Engineering, University of Trento, Via Mesiano, 20, 38123 Trento, Italy

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ABSTRACT

This paper presents the results of the ongoing work on the revision of the provisions for the seismic design of timber buildings in Europe included within Chapter 8 of Eurocode 8. The most recent research results and technical developments regarding both wood-based materials and structural systems have been implemented into the proposed new version together with the application of the capacity design to each structural system. The main objectives are to update the few and incomplete provisions included in the current version to the current state-of-the-art and to correct some misleading rules. This manuscript represents the authors' point of view on the basis of a scientific research background and the design common practice regarding different key aspects in the seismic design of timber structures.

1. Introduction

Timber structural systems have increasingly become a viable alternative to other traditional structural materials like concrete, steel and masonry, mainly because of their excellent properties related to sustainability, energy efficiency, speed of construction and high seismic capacity. According to [1] the market share of wood-based residential buildings goes from less than 1% in Spain to 12% in Germany, 15% in Austria, 18% in Switzerland and Belgium, 21% in UK and 30% in Ireland, in 2006. A similar percentage (6.4%) has been estimated in Italy in 2014 [2] with an increasing expected growth in the next years. With specific attention to the mechanical behaviour of timber structural systems, several shaking table tests and extensive numerical simulations have been carried out in the last years within international research programmes, showing their excellent structural performances in case of seismic events. A tangible outcome of the obtained results in the research field is given by the increasing number of medium-rise buildings constructed in earthquake-prone areas with different level of seismicity in the last 10–15 years (Fig. 1).

The revision process of the structural Eurocodes and therefore of Eurocode 8 [3] began in 2015 with the formal establishment of CEN (European Committee of Standardization) Project Teams tasked to prepare new drafts of the different sections, and the final updated version is expected to be released around 2020.

Among the different materials, the Chapter related to the seismic design of timber buildings is probably the one which needs major changes, being the current version rather old and short and considering that the construction practice for timber buildings evolved in the last years much more rapidly and radically than for other materials, especially concerning earthquake design.

This paper presents a proposal of modification of the current provisions; the proposal has been partly presented in [4] and it is still under discussion within the CEN/TC250/SC8 committee 'Design for Earthquake Actions', sub-group WG3 'Timber' and for this reason it should considered as a draft version, since many changes may occur before its final published version. This manuscript represents the authors' point of view on the basis of a scientific research background and the design common practice, and it shall be not assumed as the final Standard version.

* Corresponding author.
E-mail addresses: follesa@dedalegno.com (M. Follesa), massimo.fragiacomo@univaq.it (M. Fragiacomo), casagrande@ivalsa.cnr.it (D. Casagrande), roberto.tomasi@nmbu.no (R. Tomasi), maurizio.piazza@unitn.it (M. Piazza), vassallo@dedalegno.com (D. Vassallo), canetti.davide@gmail.com (D. Canetti), simone.rossi@unitn.it (S. Rossi).

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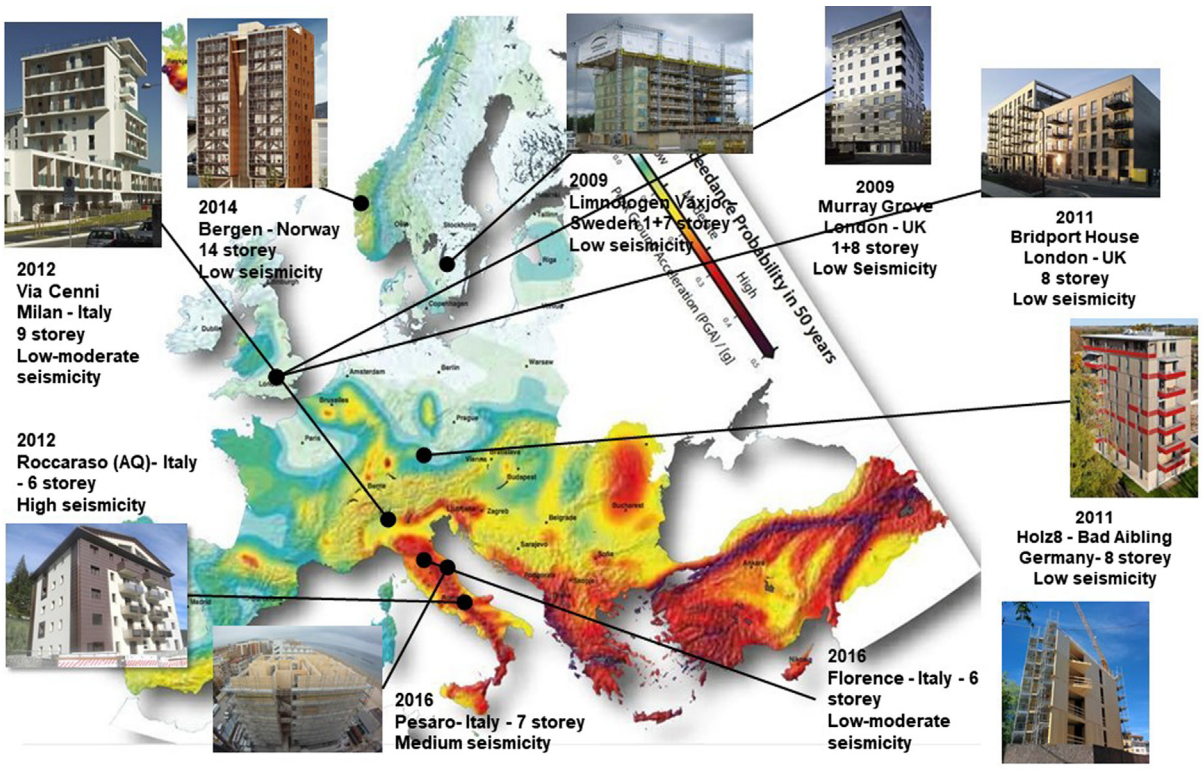

Fig. 1. Medium -rise timber buildings built in recent years in European areas with different levels of seismic hazard (European Seismic Hazard map from the SHARE web site http://www.share-eu.org).

2. Brief history of the timber Chapter in Eurocode 8

The provisions for the seismic design of timber buildings are included within the Chapter 8 of Eurocode 8. Three different versions of this Chapter have been released, starting from the first, 1988, up to the current, 2004, version as discussed in the next sub-sections. Fig. 2 shows a timeline of the different issues.

2.1. The first 1988 edition

The first edition of the Chapter related to the seismic design of timber buildings, included in the first issue of Eurocode 8 in 1988 [5], was composed by only four pages, and it was based on the Background Document presented by Ceccotti and Larsen [6]. Since this first release, the Chapter already contained the general framework of the current version and was divided into different parts: (i) *General criteria*, where the general principles of the seismic design of timber structures were given; (ii) *Materials*, which made reference to the relevant parts of Eurocode 5 [7] and where a first ductility classification was provided for joints with mechanical fasteners; (iii) *Structural types and Ductility Classes*, where three Ductility Classes (respectively Non-dissipative, Low-dissipative and Medium-dissipative structures) and some structural types were defined; (iv) *Behaviour factors and damping ratio*, where a conservative value of the behaviour factor q = 1 was proposed for the three Ductility Classes and for all structural types (however, in the Background Document [6], a first proposal of behaviour factor greater than one was given, with q values ranging from 1 to 2.5); (v) *Safety verifications, limitations, detailing* where values of the partial safety

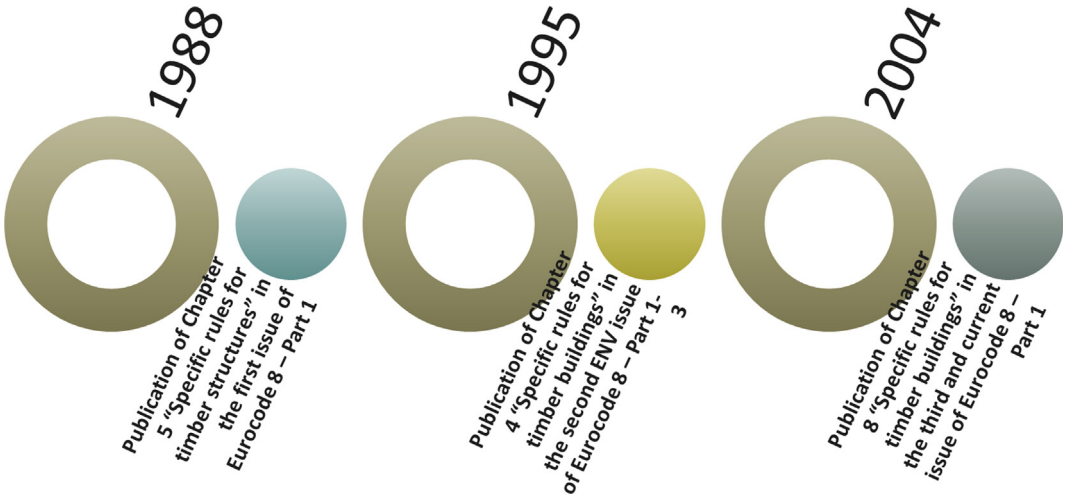

Fig. 2. Timeline of the different issues of the chapter for the seismic design of timber buildings of Eurocode 8.