Structural timber design to Eurocode 5 (IS EN 1995-1-1) rules

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The first code of practice issued in the United Kingdom on the structural use of timber (CP 112 of 1952) was based on research and experience of Canadian, United States and British war-time construction. It enabled the construction industry in the UK to build timber structures and use timber structural elements for a period of fifteen years without serious challenge to its validity.

It was first revised by the British Standards Institution in 1967, with the addition of new data in regard to grades of timber for use, development of glued laminated construction and the structural use of plywood. The 1967 version referenced eight British standards and two British codes of practice, the first of which (CP 3) dealt with basic data for the design of buildings and also loadings, and CP 98 which set out the requirements for preservative treatment for constructional timber.

Eurocode 5: Design of timber structures — Part 1-1: — General — Common rules and rules for buildings was published by CEN (European Committee for Standardisation) in November 2004. National standards bodies in each member state of the EU and European Free Trade Association (EFTA) countries are obliged to give this European standard the status of a national standard without any alteration. In Ireland the responsibility for publication is with the National Standards Authority of Ireland.

Eurocode 5 relies for implementation on a number of other Eurocodes and on a very large number of material and production standards. Eurocode 5 is referenced as *EN 1995: Design of timber structures*, and consists of Part 1-1 as described, *Part 1-2: General rules — Structural Fire Design* and *Part 2: Bridges*. EN 1995 is intended to be used in conjunction with:

EN 1990: 2002 Eurocode — Basis of design

EN 1991: Eurocode 1 — Actions on structures

EN Standards: In respect of construction products relevant to timber structures.

COFORD has published a handbook that sets out the manner in which IS EN 1995-1-1 and other Eurocodes interact in the design process (Harrington, Jacob and Short 2006). It indicates and includes summarised information about the

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What are Eurocodes?

Eurocodes are a set of harmonised structural design codes for building and civil engineering works. They are being developed by the European Standards Organisation, CEN, on foot of a mandate from the European Commission.

The objective of the programme is to eliminate technical obstacles to trade and to improve the competitiveness of the European construction industry - and the professionals and industries connected with it, both within and outside the European Union.

Eurocodes serve as reference documents for the following purposes:

- A framework for drawing up harmonised technical specifications for construction products in the context of the Construction Products Directive.
- A means of demonstrating compliance of building and civil engineering works with National Regulations and with the essential requirements No.1 (mechanical resistance and stability) and No. 2 (safety in case of fire) of the Construction Products Directive, Council Directive 89/106/EEC.
- A basis for specifying public procurement contracts for construction works and related engineering services.

standards required to be used to facilitate the implementation of the design principles and application rules of Eurocodes. The handbook is for use by professional design engineers in the public and private sectors who are involved with design and/or construction of timber elements, assemblies and/or timber structures. It also provides the basic information for management in entities producing and/or manufacturing structural solid timber, glued laminated timber, laminated veneer lumber, wood-based panels, metal fasteners and prefabricated wall, floor and roof diaphragm elements. It enables design engineers, architects and specifiers to use tabulated information to select specific element materials for building construction.

Basis of design - IS EN 1990 Eurocode 1990

The basis of design of timber structures as applied in EN 1995 is required to be in accordance with EN 1990 which sets out the principles and requirements for safety, serviceability and durability of structures, describes the design and verification procedures and provides guidelines for related aspects of structural reliability. The general assumptions of EN 1990 are:

- the choice of the structural system and the design of the structure is made by appropriately qualified and experienced personnel.
- execution is undertaken by personnel having the appropriate skill and experience.
- adequate supervision and quality control is provided during execution of the work, i.e. in design offices, factories, production and fabrication plants and on site.
- the construction materials and products are used as specified in EN 1990 or in EN 1991 and in Eurocodes EN 1992 to EN 1999 or in the relevant execution standards, or referenced material or product specifications.
- the structure will be adequately maintained and used in accordance with the design assumptions.

EN 1990 and all other Eurocodes make provision for a National Annex whereby the National Standard implementing a Eurocode is permitted to have a choice in respect of Nationally Determined Parameters (NDPs) for specific procedures or classes or values.

Actions on structures (IS EN 1991) - Eurocode 1

EN 1991-1-1 (Eurocode 1) provides design guidance and actions for the structural design of buildings and civil engineering works, including data for densities of construction materials and stored materials, self-weight of construction elements and imposed loadings for buildings.

EN 1991-1-1 also includes provision for a National Annex whereby the National Standard implementing 1991-1-1 is permitted to have a choice in respect of Nationally Determined Parameters (NDPs).

Eurocode 5 as a structural timber limit state design code

EN 1995-1-1 is a limit state design code which requires structural stability to be in accordance with two specifically defined states, within which the structure complies in relation to particular performance criteria. These limit states are:

- Ultimate limit state — associated with collapse or with other forms of failure which include loss of equilibrium, excessive deformation, transformation into a mechanism, rupture or loss of stability.
- Serviceability limit state — associated with deformation which affects the appearance or effective use of the structure, vibrations which cause discomfort to people or damage to the structure, damage or cracking which is likely to adversely affect the durability of the structure.

The ultimate limit state criteria ensure that the probability of failure is acceptably low and the serviceability limit state criteria ensure satisfactory behaviour under service (working) actions. In special circumstances limit state criteria involving fatigue and fire resistance may require to be considered.

The basic requirements of EN 1990: 2002 section 2 are deemed to be satisfied for timber structures when limit state design, in conjunction with the partial factor method using EN 1990:2002 and EN 1991 for actions and their combinations and EN 1995 for resistances, and its rules for serviceability and durability, are applied. Regulatory authorities in each member state have the right to determine values related to safety from a range of values, classes or symbols.

Eurocodes recognised for construction works

Member states of the European Union and the European Free Trade Association recognise that Eurocodes are appropriate for the following purposes:

- as a framework for drawing up harmonised technical specifications for construction products.
- as a basis for specifying contracts for the execution of construction works and related engineering services.
- as a means of validating compliance of building and civil engineering works with the essential requirements of Council Directive 89/106/EEC particularly regarding mechanical resistance and stability.

The application of EN 1995-1-1 for design of structural timber and timber structures relies on data provided in numerous CEN standards. Eurocode 5 refers to fifty-three normative standards and a number of these refer to several other EN standards in regard to compliance.

Reference

Harrington, J., Jacob, M. and Short. C. 2006. *Handbook on structural timber design to Eurocode 5 (IS EN 1995-1-1) rules including strength-capacity tables for structural elements*. COFORD, Dublin.