BS EN 1995-1-1:2004 +A2:2014

Incorporating corrigendum June 2006

Eurocode 5: Design of timber structures —

Part 1-1: General — Common rules and rules for buildings

ICS 91.010.30; 91.080.20



NO COPYING W

National foreword

This British Standard is the UK implementation of EN 1995-1-1:2004+A2:2014, incorporating corrigendum June 2006. It supersedes BS EN 1995-1-1:2004+A1:2008, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by $\boxed{\text{A1}}$.

The UK participation in its preparation was entrusted by Technical Committee B/525, Building and civil engineering structures, to Subcommittee B/525/5, Structural use of timber.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Where a normative part of this EN allows for a choice to be made at the national level, the range and possible choice will be given in the normative text, and a note will qualify it as a Nationally Determined Parameter (NDP). NDPs can be a specific value for a factor, a specific level or class, a particular method or a particular application rule if several are proposed in the EN.

To enable BS EN 1995-1-1:2004+A2:2014 to be used in the UK the latest version of the NA to this Standard containing these NDPs should also be used. At the time of publication, it is NA to BS EN 1995-1-1:2004+A1:2008.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Amd. No.	Date	Comments
16499 Corrigendum No. 1	31 July 2006	Implementation of CEN corrigendum June 2006. Modifications to 6.5.2 , 8.2.2 , 8.3.1.1 and 8.3.1.2
	31 January 2009	Implementation of CEN amendment A1:2008
	31 May 2014	Implementation of CEN amendment A2:2014

Amendments/corrigenda issued since publication

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 15 December 2004

© The British Standards Institution 2014. Published by BSI Standards Limited 2014

ISBN 978 0 580 83727 2

This is a preview. Click here to purchase the full publication.

EUROPEAN STANDARD NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1995-1-1:2004+A2

May 2014

ICS 91.010.30; 91.080.20

Incorporating corrigendum June 2006

English version

Eurocode 5: Design of timber structures - Part 1-1: General -Common rules and rules for buildings

Eurocode 5: Conception et calcul des structures en bois -Partie 1-1 : Généralités - Règles communes et règles pour les bâtiments Eurocode 5: Bemessung und Konstruktion von Holzbauten - Teil 1-1: Allgemeines - Allgemeine Regeln und Regeln für den Hochbau

This European Standard was approved by CEN on 16 April 2004.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION COMITÉ EUROPÉEN DE NORMALISATION EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

© 2004 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members. Ref. No. EN 1995-1-1:2004: E

This is a preview. Click here to purchase the full publication.

Contents P	age
Foreword	6
SECTION 1 GENERAL	10
 1.1 Scope 1.1.1 Scope of EN 1995 1.1.2 Scope of EN 1995-1-1 1.2 NORMATIVE REFERENCES 1.3 ASSUMPTIONS 1.4 DISTINCTION BETWEEN PRINCIPLES AND APPLICATION RULES 1.5 TERMS AND DEFINITIONS 1.5.1 General 1.5.2 Additional terms and definitions used in this present standard 1.6 SYMBOLS USED IN EN 1995-1-1 	10 10 11 13 13 13 13 13 13
SECTION 2 BASIS OF DESIGN	19
 2.1 REQUIREMENTS 2.1.1 Basic requirements 2.1.2 Reliability management 2.1.3 Design working life and durability 2.2 PRINCIPLES OF LIMIT STATE DESIGN 2.2.1 General 2.2.2 Ultimate limit states 2.3 Serviceability limit states 2.3 BASIC VARIABLES 2.3.1 Actions and environmental influences 2.3.1.1 General 2.3.2 Load-duration classes 2.3.2 Materials and product properties 2.3.2 Load-duration and moisture influences on strength 2.3.2 Load-duration and moisture influences on deformations 2.4 VERIFICATION BY THE PARTIAL FACTOR METHOD 2.4.1 Design value of geometrical data 2.4.3 Design resistances 2.4.4 Verification of equilibrium (EQU) 	19 19 19 19 19 20 21 21 21 22 22 22 22 24 25 25
SECTION 3 MATERIAL PROPERTIES	26
 3.1 GENERAL 3.1.1 Strength and stiffness parameters 3.1.2 Stress-strain relations 3.1.3 Strength modification factors for service classes and load-duration classes 3.1.4 Deformation modification factors for service classes 3.2 SOLID TIMBER 3.3 GLUED LAMINATED TIMBER 3.4 LAMINATED VENEER LUMBER (LVL) 3.5 WOOD-BASED PANELS 3.6 ADHESIVES 3.7 METAL FASTENERS 	26 26 26 26 26 26 27 28 29 29 29
SECTION 4 DURABILITY	30
4.1 RESISTANCE TO BIOLOGICAL ORGANISMS4.2 RESISTANCE TO CORROSION	30 30
SECTION 5 BASIS OF STRUCTURAL ANALYSIS	31
5.1 GENERAL	31

5.2 Men 5.3 Con 5.4 Assi 5.4.1 5.4.2 5.4.3 5.4.3 5.4.4	IBERS INECTIONS EMBLIES General Frame structures Simplified analysis of trusses with punched metal plate fasteners Plane frames and arches	31 32 32 32 33 33 34
SECTION 6	ULTIMATE LIMIT STATES	36
6.1 DES 6.1.1 6.1.2 6.1.3 6.1.4 6.1.5 6.1.6 6.1.7	IGN OF CROSS-SECTIONS SUBJECTED TO STRESS IN ONE PRINCIPAL DIRECTION General Tension parallel to the grain Tension perpendicular to the grain Compression parallel to the grain Compression perpendicular to the grain Bending Shear	36 36 36 36 36 36 38 38
6.1.8 6.2 DES 6.2.1 6.2.2 6.2.3 6.2.4 6.3 STAI	Torsion IGN OF CROSS-SECTIONS SUBJECTED TO COMBINED STRESSES General Compression stresses at an angle to the grain Combined bending and axial tension Combined bending and axial compression BILITY OF MEMBERS	39 40 40 40 40 40 41
6.3.1 6.3.2 6.3.3 6.4 DES SHAPE 6.4.1 6.4.2 6.4.3 6.5 NOT 6.5.1 6.5.2	General Columns subjected to either compression or combined compression and bend Beams subjected to either bending or combined bending and compression IGN OF CROSS-SECTIONS IN MEMBERS WITH VARYING CROSS-SECTION OR CURVED General Single tapered beams Double tapered, curved and pitched cambered beams CHED MEMBERS General Beams with a notch at the support	41 ding41 42 44 44 45 49 49 49
6.6 SYS	TEM STRENGTH	50 52
7.1 JOIN 7.2 LIMI 7.3 VIBR 7.3.1 7.3.2 7.3.3	T SLIP TING VALUES FOR DEFLECTIONS OF BEAMS AATIONS General Vibrations from machinery Residential floors	52 52 53 53 53 53 53
SECTION 8	CONNECTIONS WITH METAL FASTENERS	56
8.1 GEN 8.1.1 8.1.2 8.1.3 8.1.4 8.1.5 8.2 LATE 8.2.1 8.2.2 8.2.3 8.3 NAIL 8.3.1	ERAL Fastener requirements Multiple fastener connections Multiple shear plane connections Connection forces at an angle to the grain Alternating connection forces ERAL LOAD-CARRYING CAPACITY OF METAL DOWEL-TYPE FASTENERS General Timber-to-timber and panel-to-timber connections Steel-to-timber connections ED CONNECTIONS Laterally loaded nails	56 56 56 58 58 58 58 58 58 60 62 62

BS EN 1995-1-1:2004+A2:2014 EN 1995-1-1:2004+A2:2014 (E)

8.3.1.1	General	62
8.3.1.2	Nailed timber-to-timber connections	64
8.3.1.3	Nailed panel-to-timber connections	67
8.3.1.4	Nailed steel-to-timber connections	67
8.3.2	Axially loaded nails	67
8.3.3	Combined laterally and axially loaded nails	69
8.4 STAI	PLED CONNECTIONS	69
8.5 BOL	TED CONNECTIONS	71
8.5.1	Laterally loaded bolts	71
8.0.1.1 8.5.1.2	Bolted nanel-to-timber connections	71
8513	Bolted steel-to-timber connections	73
8.5.2	Axially loaded bolts	73
8.6 Dov	/FLLED CONNECTIONS	73
8.7 SCR	EWED CONNECTIONS	74
8.7.1	Laterally loaded screws	74
8.7.2	Axially loaded screws	74
8.7.3	Combined laterally and axially loaded screws	77
8.8 CON	NECTIONS MADE WITH PUNCHED METAL PLATE FASTENERS	77
8.8.1	General	77
8.8.2	Plate geometry	77
8.8.3	Plate strength properties	77
8.8.4	Plate anchorage strengths	78
8.8.5	Connection strength verification	78
8.8.5.1	Plate anchorage capacity	78
8.8.5.2	Plate capacity	80
8.9 Spli	T RING AND SHEAR PLATE CONNECTORS	81
8.10 Too	THED-PLATE CONNECTORS	84
SECTION 9	COMPONENTS AND ASSEMBLIES	87
9.1 COM	IPONENTS	87
9.1.1	Glued thin-webbed beams	87
9.1.2	Glued thin-flanged beams	89
9.1.3	Mechanically iointed beams	90
9.1.4	Mechanically jointed and glued columns	91
9.2 Ass	EMBLIES	91
9.2.1	Trusses	91
9.2.2	Trusses with punched metal plate fasteners	92
9.2.3	Roof and floor diaphragms	93
9.2.3.1	General	93
9.2.3.2	Simplified analysis of roof and floor diaphragms.	93
9.2.4	Wall diaphragms	94
9.2.4.1	General	94
9.2.4.2	Simplified analysis of wall diaphragms – Method A Simplified analysis of wall diaphragms – Method B	94 07
9.2.4.3	31 Construction of walls and nanels to meet the requirements of the simplified a	nalvsis97
9.2.4	4.3.2 Design procedure	98
9.2.5	Bracing	100
9.2.5.1	General	100
9.2.5.2	Single members in compression	100
9.2.5.3	Bracing of beam or truss systems	101
SECTION 10	STRUCTURAL DETAILING AND CONTROL	103
10.1 Gen	ERAL	103
10.2 Mat	ERIALS	103
10.3 Glu	ED JOINTS	103
10.4 CON	NECTIONS WITH MECHANICAL FASTENERS	103
10.4.1	General	103
10.4.2	Nails	103
10.4.3	Bolts and washers	103

10.4.4 10.4.5 10.5 Assel 10.6 Tran 10.7 Cont 10.8 Spec 10.8.1 10.8.2 10.9 Spec 10.9.1 10.9.2	Dowels Screws MBLY SPORTATION AND ERECTION 'ROL IAL RULES FOR DIAPHRAGM STRUCTURES Floor and roof diaphragms Wall diaphragms IAL RULES FOR TRUSSES WITH PUNCHED METAL PLATE FASTENERS Fabrication Erection	104 104 105 105 105 105 106 106 106
ANNEX A (MULTIPLE DO	INFORMATIVE): BLOCK SHEAR AND PLUG SHEAR FAILURE AT WEL-TYPE STEEL-TO-TIMBER CONNECTIONS	108
ANNEX B (INFORMATIVE): MECHANICALLY JOINTED BEAMS	110
B.1 SIMPL <i>B.1.1</i> <i>B.1.2</i> <i>B.1.3</i> <i>B.1.4</i> B.2 EFFEC B.3 NORM B.4 MAXIM B.5 FASTE	IFIED ANALYSIS Cross-sections Assumptions Spacings Deflections resulting from bending moments CTIVE BENDING STIFFNESS MAL STRESSES MUM SHEAR STRESS ENER LOAD	110 110 110 110 110 112 112 112 112
ANNEX C (INFORMATIVE): BUILT-UP COLUMNS	114
C.1 GENE C.1.1 C.1.2 C.2 MECH C.2.1 C.2.2 C.2.3 C.3 SPAC C.3.1 C.3.2 C.3.3 C.4 LATTH C.4.1 C.4.2 C.4.3	RAL Assumptions Load-carrying capacity IANICALLY JOINTED COLUMNS Effective slenderness ratio Load on fasteners Combined loads ED COLUMNS WITH PACKS OR GUSSETS Assumptions Axial load-carrying capacity Load on fasteners, gussets or packs CE COLUMNS WITH GLUED OR NAILED JOINTS Assumptions Load-carrying capacity Shear forces	114 114 114 114 115 115 115 115 116 117 117 117 118 120
ANNEX D (IN	FORMATIVE): BIBLIOGRAPHY	121

Foreword

This European Standard EN 1995-1-1 has been prepared by Technical Committee CEN/TC250 "Structural Eurocodes", the Secretariat of which is held by BSI.

This European Standard shall be given the status of a National Standard, either by publication of an identical text or by endorsement, at the latest by May 2005, and conflicting national standards shall be withdrawn at the latest by March 2010.

This European Standard supersedes ENV 1995-1-1:1993.

CEN/TC250 is responsible for all Structural Eurocodes.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Background of the Eurocode programme

In 1975, the Commission of the European Community decided on an action programme in the field of construction, based on article 95 of the Treaty. The objective of the programme was the elimination of technical obstacles to trade and the harmonisation of technical specifications.

Within this action programme, the Commission took the initiative to establish a set of harmonised technical rules for the design of construction works which, in a first stage, would serve as an alternative to the national rules in force in the Member States and, ultimately, would replace them.

For fifteen years, the Commission, with the help of a Steering Committee with Representatives of Member States, conducted the development of the Eurocodes programme, which led to the first generation of European codes in the 1980s.

In 1989, the Commission and the Member States of the EU and EFTA decided, on the basis of an agreement¹ between the Commission and CEN, to transfer the preparation and the publication of the Eurocodes to CEN through a series of Mandates, in order to provide them with a future status of European Standard (EN). This links de facto the Eurocodes with the provisions of all the Council's Directives and/or Commission's Decisions dealing with European standards (e.g. the Council Directive 89/106/EEC on construction products – CPD – and Council Directives 93/37/EEC, 92/50/EEC and 89/440/EEC on public works and services and equivalent EFTA Directives initiated in pursuit of setting up the internal market).

The Structural Eurocode programme comprises the following standards generally consisting of a number of Parts:

EN 1990:2002	Eurocode: Basis of Structural Design
EN 1991	Eurocode 1: Actions on structures
EN 1992	Eurocode 2: Design of concrete structures
EN 1993	Eurocode 3: Design of steel structures
EN 1994	Eurocode 4: Design of composite steel and concrete structures
EN 1995	Eurocode 5: Design of timber structures
EN 1996	Eurocode 6: Design of masonry structures
EN 1997	Eurocode 7: Geotechnical design
	-

¹ Agreement between the Commission of the European Communities and the European Committee for Standardisation (CEN) concerning the work on EUROCODES for the design of building and civil engineering works (BC/CEN/03/89).

BS EN 1995-1-1:2004+A2:2014 EN 1995-1-1:2004+A2:2014 (E)

EN 1998	Eurocode 8: Design of structures for earthquake resistance
EN 1999	Eurocode 9: Design of aluminium structures

Eurocode standards recognise the responsibility of regulatory authorities in each Member State and have safeguarded their right to determine values related to regulatory safety matters at national level where these continue to vary from State to State.

Status and field of application of Eurocodes

The Member States of the EU and EFTA recognise that Eurocodes serve as reference documents for the following purposes:

as a means to prove compliance of building and civil engineering works with the essential requirements of Council Directive 89/106/EEC, particularly Essential Requirement N°1 –
 Mechanical resistance and stability – and Essential Requirement N°2 – Safety in case of fire ;

- as a basis for specifying contracts for construction works and related engineering services ;

 – as a framework for drawing up harmonised technical specifications for construction products (ENs and ETAs)

The Eurocodes, as far as they concern the construction works themselves, have a direct relationship with the Interpretative Documents² referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standards³. Therefore, technical aspects arising from the Eurocodes work need to be adequately considered by CEN Technical Committees and/or EOTA Working Groups working on product standards with a view to achieving full compatibility of these technical specifications with the Eurocodes.

The Eurocode standards provide common structural design rules for everyday use for the design of whole structures and component products of both a traditional and an innovative nature. Unusual forms of construction or design conditions are not specifically covered and additional expert consideration will be required by the designer in such cases.

National Standards implementing Eurocodes

The National Standards implementing Eurocodes will comprise the full text of the Eurocode (including any annexes), as published by CEN, which may be preceded by a National title page and National foreword, and may be followed by a National annex.

The National annex may only contain information on those parameters which are left open in the Eurocode for national choice, known as Nationally Determined Parameters, to be used for the design of buildings and civil engineering works to be constructed in the country concerned, i.e.:

- values and/or classes where alternatives are given in the Eurocode;
- values to be used where a symbol only is given in the Eurocode;
- country specific data (geographical, climatic, etc.), e.g. snow map;

² According to Art. 3.3 of the CPD, the essential requirements (ERs) shall be given concrete form in interpretative documents for the creation of the necessary links between the essential requirements and the mandates for harmonised ENs and ETAGs/ETAs.

³ According to Art. 12 of the CPD the interpretative documents shall:

give concrete form to the essential requirements by harmonising the terminology and the technical bases and indicating classes or levels for each requirement where necessary ;

indicate methods of correlating these classes or levels of requirement with the technical specifications, *e.g.* methods of calculation and of proof, technical rules for project design, etc. ;

serve as a reference for the establishment of harmonised standards and guidelines for European technical approvals.

The Eurocodes, *de facto*, play a similar role in the field of the ER 1 and a part of ER 2.

BS EN 1995-1-1:2004+A2:2014 EN 1995-1-1:2004+A2:2014 (E)

- the procedure to be used where alternative procedures are given in the Eurocode;
- decisions on the application of informative annexes;
- references to non-contradictory complementary information to assist the user to apply the Eurocode.

Links between Eurocodes and harmonised technical specifications (ENs and ETAs) for products

There is a need for consistency between the harmonised technical specifications for construction products and the technical rules for works⁴. Furthermore, all the information accompanying the CE Marking of the construction products which refer to Eurocodes shall clearly mention which Nationally Determined Parameters have been taken into account.

Additional information specific to EN 1995-1-1

EN 1995 describes the Principles and requirements for safety, serviceability and durability of timber structures. It is based on the limit state concept used in conjunction with a partial factor method.

For the design of new structures, EN 1995 is intended to be used, for direct application, together with EN 1990:2002 and relevant Parts of EN 1991.

Numerical values for partial factors and other reliability parameters are recommended as basic values that provide an acceptable level of reliability. They have been selected assuming that an appropriate level of workmanship and of quality management applies. When EN 1995-1-1 is used as a base document by other CEN/TCs the same values need to be taken.

National annex for EN 1995-1-1

This standard gives alternative procedures, values and recommendations with notes indicating where national choices may have to be made. Therefore the National Standard implementing EN 1995-1-1 should have a National annex containing all Nationally Determined Parameters to be used for the design of buildings and civil engineering works to be constructed in the relevant country.

National choice is allowed in EN 1995-1-1 through clauses:

- 2.3.1.2(2)P Assignment of loads to load-duration classes;
- 2.3.1.3(1)P Assignment of structures to service classes;
- 2.4.1(1)P Partial factors for material properties;
- 6.1.7(2) Shear;
- 6.4.3(8) Double tapered, curved and pitched cambered beams;
- 7.2(2) Limiting values for deflections;
- 7.3.3(2) Limiting values for vibrations;
- 8.3.1.2(4) Nailed timber-to-timber connections: Rules for nails in end grain;
- 8.3.1.2(7) Nailed timber-to-timber connections: Species sensitive to splitting;
- 9.2.4.1(7) Design method for wall diaphragms;
- 9.2.5.3(1) Bracing modification factors for beam or truss systems;
- 10.9.2(3) Erection of trusses with punched metal plate fasteners: Maximum bow;
- 10.9.2(4) Erection of trusses with punched metal plate fasteners: Maximum deviation.

Foreword to amendment A1

This document (EN 1995-1-1:2004/A1:2008) has been prepared by Technical Committee CEN/TC 250 "Structural Eurocodes", the secretariat of which is held by BSI.