BS EN 1992-4:2018

BSI Standards Publication

Eurocode 2 - Design of concrete structures

Part 4: Design of fastenings for use in concrete

National foreword

This British Standard is the UK implementation of EN 1992-4:2018. It supersedes DD CEN/TS 1992-4-3:2009, DD CEN/TS 1992-4-2:2009, DD CEN/TS 1992-4-4:2009, DD CEN/TS 1992-4-1:2009 and DD CEN/TS 1992-4-5:2009, which are withdrawn.

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 EN 1992-4 to be used in the UK, the NDPs will be published in a National Annex, which will be made available by BSI in due course, after public consultation has taken place.

The UK participation in its preparation was entrusted to Technical Committee B/525/2, Structural use of concrete.

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

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

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

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English Version

Eurocode 2 - Design of concrete structures - Part 4: Design of fastenings for use in concrete

Eurocode 2 - Calcul des structures en béton - Partie 4 : Conception et calcul des éléments de fixation pour béton

Eurocode 2 - Bemessung und Konstruktion von Stahlbeton- und Spannbetontragwerken - Teil 4: Bemessung der Verankerung von Befestigungen in Beton

This European Standard was approved by CEN on 9 March 2018.

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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 CEN-CENELEC Management Centre has the same status as the official versions.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 1992-4:2018) has been prepared by Technical Committee CEN/TC 250 “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 March 2019 and conflicting national standards shall be withdrawn at the latest by March 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes CEN/TS 1992-4-1:2009, CEN/TS 1992-4-2:2009, CEN/TS 1992-4-3:2009, CEN/TS 1992-4-4:2009 and CEN/TS 1992-4-5:2009.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document differs from CEN/TS 1992-4-1:2009, CEN/TS 1992-4-2:2009, CEN/TS 1992-4-3:2009, CEN/TS 1992-4-4:2009 and CEN/TS 1992-4-5:2009 as follows:

— The content of the CEN/TS 1992-4 series is condensed and completely revised to be published as one single standard covering the design of the different types of cast-in situ and post-installed fastening systems.

— Normative references are updated. Some standards given in the CEN/TS 1992-4 series are moved to an added Bibliography.

— 1.2 (5) and Fig.1.2: The configurations of fastenings with headed or post-installed fasteners covered by EN 1992-4 are described in more detail.

— 1.3 (1), 1.3(2) and 7.3: Provisions on fasteners for fastening statically indeterminate non-structural systems are added. Details of the design method are given in CEN/TR 17079, *Design of fasteners for use in concrete - Redundant non-structural systems.*

— 4.4.2.2 and Table 4.1: Partial material safety factors for accidental design situations are introduced which are about 15% smaller than for permanent and transient design situations.

— 6.2.1 (2): More specific conditions to ensure a rigid fixture are given and provisions in case of an elastic, but flexible fixture are added.

— 7 to 11: The verifications are based on the characteristic concrete cylinder strength and not cube strength and the factors k_i for calculating the basic characteristic resistances for the different failure modes are adjusted accordingly.

— 7.2.1.4 (1), Formula (7.1) and 7.2.1.4 (7): The factor $\psi_{M,N}$ is introduced to take into account the favorable effect of a compression force between fixture and concrete in case of bending moments with or without axial force on the concrete cone resistance.

— 7.2.1.6 (2), Formula (7.14): The product dependent factor ψ_{sus} is introduced to take account of the influence of sustained load on the bond strength of post-installed bonded fasteners for the verification of combined pull-out and concrete failure

— 7.2.2.5 (13) and Clause 7.4.2.5 (7): The factor $\psi_{re,V}$ to take into account the effect of edge reinforcement and closely spaced stirrups or wire mesh on the characteristic resistance for concrete edge failure is limited to cracked concrete.

— 7.4.1.3 (2) and 7.4.2.3 (2): For the verification of anchor channels for local flexure of channel lips under tension loads and shear loads without lever arm the influence of closely spaced channel bolts is considered.

— 7.4.1.7, Formula (7.69): For the verification of anchor channels for concrete blow-out failure the factor $\psi_{g,Nb}$ is deleted.

— 7.4.2.3.1 and Table 7.5: For the verification of anchor channels subjected to shear forces without lever arm in case of steel failure the failure modes 'anchor' and 'connection between anchor and channel' are added.

— 7.4.2.5 (2): Formula (7.78) is modified. The influence of edge distance on the basic characteristic resistance in case of concrete edge failure is taken into account with $c_1^{4/3}$ instead with $c_1^{1,5}$.

— 7.4.3 and Table 7.6: In case of interaction of shear and tension loads acting on anchor channels provisions are given for the different modes of steel failure and for failure modes other than steel failure.

— Clause 8: The values for the characteristic fatigue resistance in case of concrete related failure modes for $2 \cdot 10^6$ load cycles are reduced.

— Clause 9 and Annex C: The verifications for seismic loading are completely revised.

— Clause 10: Provisions for the verification for fire resistance are added. Informative Annex D provides a design method for cast-in-place headed fasteners, anchor channels and post-installed fasteners exposed to fire.

— Normative Annex E: Characteristics for the design of fastenings to be provided by European Technical Product Specifications are added.

— Annex F: Product specific Sections of the CEN/TS 1992-4 series on assumptions for design provisions regarding execution of fastenings are condensed in this normative Annex.

— Annex G: The design provisions of the CEN/TS 1992-4 series for post-installed fasteners using simplified methods are moved to this informative Annex.

— Annex B of CEN/TS 1992-4:1"Plastic design approach" is moved to CEN/TR 17081, *Design of fastenings for use in concrete – Plastic design of fastenings with headed and post-installed fasteners.*

EN 1992 is composed of the following parts:

— EN 1992-1-1, *Eurocode 2: Design of concrete structures — Part 1-1: General rules and rules for buildings*;

— EN 1992-1-2, *Eurocode 2: Design of concrete structures — Part 1-2: General rules — Structural fire design*;

— EN 1992-2, *Eurocode 2 — Design of concrete structures — Concrete bridges — Design and detailing rules*;

— EN 1992-3, *Eurocode 2 — Design of concrete structures — Part 3: Liquid retaining and containment structures*;

— EN 1992-4, *Eurocode 2 — Design of concrete structures — Part 4: Design of fastenings for use in concrete*.

The numerical values for partial factors and other reliability parameters are recommended values. The recommended values apply when:

a) the fasteners comply with the requirements of 1.2 (3), and

b) the installation complies with the requirements of 4.6.

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

National Annex for EN 1992-4

This EN gives values with Notes indicating where national choices may have to be made. When this EN is made available at national level it may be followed by a National Annex containing all Nationally Determined Parameters to be used for the design of fastenings according to this EN for use in the relevant country.

National choice of the partial factors and reliability parameters is allowed in design according to this EN in the following sections:

4.4.1(2);

4.4.2.2(2);

4.4.2.3;

4.4.2.4;

4.7(2);

C.2(2);

C.4.4(1);

C.4.4(3);

D.2(2).

1 Scope

1.1 General

(1) This European Standard provides a design method for fastenings (connection of structural elements and non-structural elements to structural components), which are used to transmit actions to the concrete. This design method uses physical models which are based on a combination of tests and numerical analysis consistent with EN 1990:2002, 5.2.

Additional rules for the transmission of the fastener loads within the concrete member to its supports are given in EN 1992-1-1 and Annex A of this EN.

Inserts embedded in precast concrete elements during production, under Factory Production Control (FPC) conditions and with the due reinforcement, intended for use only during transient situations for lifting and handling, are covered by CEN/TR 15728.

(2) This EN is intended for safety related applications in which the failure of fastenings may result in collapse or partial collapse of the structure, cause risk to human life or lead to significant economic loss. In this context it also covers non-structural elements.

(3) The support of the fixture can be either statically determinate or statically indeterminate. Each support can consist of one fastener or a group of fasteners.

(4) This EN is valid for applications which fall within the scope of the EN 1992 series. In applications where special considerations apply, e.g. nuclear power plants or civil defence structures, modifications can be necessary.

(5) This EN does not cover the design of the fixture. Rules for the design of the fixture are given in the appropriate Standards meeting the requirements on the fixture as given in this EN.

(6) This document relies on characteristic resistances and distances which are stated in a European Technical Product Specification (see Annex E). At least the characteristics of Annex E are given in a European Technical Product Specification for the corresponding loading conditions providing a basis for the design methods of this EN.

1.2 Type of fasteners and fastening groups

(1) This EN uses the fastener design theory[1)] (see Figure 1.1) and applies to:

a) cast-in fasteners such as headed fasteners, anchor channels with rigid connection (e.g. welded, forged) between anchor and channel;

b) post-installed mechanical fasteners such as expansion fasteners, undercut fasteners and concrete screws;

c) post-installed bonded fasteners and bonded expansion fasteners.

(2) For other types of fasteners, modifications of the design provisions can be necessary.

(3) This EN applies to fasteners with established suitability for the specified application in concrete covered by provisions, which refer to this EN and provide data required by this EN. The suitability of the fastener is stated in the relevant European Technical Product Specification.

1) In fastener design theory the concrete tensile capacity is directly used to transfer loads into the concrete component.