SLOVENSKI STANDARD
oSIST prEN 1992-4:2013

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Evrokod 2: Projektiranje betonskih konstrukcij - 4. del: Projektiranje pritrjevanja za uporabo v betonu

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

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

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

Ta slovenski standard je istoveten z: **prEN 1992-4**

ICS:

21.060.01	Vezni elementi na splošno	Fasteners in general
91.010.30	Tehnični vidiki	Technical aspects
91.080.40	Betonske konstrukcije	Concrete structures

oSIST prEN 1992-4:2013 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

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ICS 91.010.30; 91.080.40

Will supersede CEN/TS 1992-4-1:2009, CEN/TS 1992-4-2:2009, CEN/TS 1992-4-3:2009, CEN/TS 1992-4-4:2009, CEN/TS 1992-4-5:2009

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 draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 250.

If this draft becomes a European Standard, 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.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

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Contents

Foreword

This document (prEN 1992-4:2013) has been prepared by Technical Committee CEN/TC 250 “Structural Eurocodes”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

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

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 (2), and

b) the installation complies with the requirements of 4.5.

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), Note;

— 4.4.2.1(1), Note 1;

— 4.4.2.2.(1), Note;

— 4.4.2.3(1), Note;

— 4.6(2), Note 2;

— Annex B (informative);

— C.2(2), Table C.1;

— D.2(1), Note.

1 Scope

1.1 General

(1) This EN 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.

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 the CEN/TR “Design and Use of Inserts for Lifting and Handling Precast Concrete Elements”, by CEN/TC 229.

(2) This EN is intended for safety related applications in which the failure of fastenings will 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 may be either statically determinate or statically indeterminate. Each support may consist of one fastener or a group of fasteners.

(4) This EN is valid for applications which fall within the scope of the series EN 1992. In applications where special considerations apply, e.g. nuclear power plants or civil defence structures, modifications may be necessary. The transmission of the fastener loads to the supports of the concrete member shall be shown for the ultimate limit state and the serviceability limit state according to EN 1992-1-1.

(5) This EN does not cover the design of the fixture. The design of the fixture shall be carried out to comply with the appropriate Standards.

(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, Table E.1 should be given in a European Technical Product Specification 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)] (Figure 1.1) and applies to:

a) cast-in fasteners such as headed fasteners, anchor channels with rigid connection between anchor and channel;

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

c) post-installed bonded anchors, bonded expansion anchors and bonded undercut anchors.

NOTE Connections with post-installed ribbed reinforcing bars should be covered by a European Technical Product Specification and comply with the requirements of EN 1992-1-1.

(2) For other types of fasteners modifications of the design provisions may 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.

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

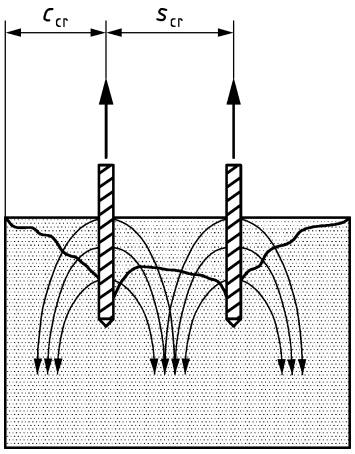
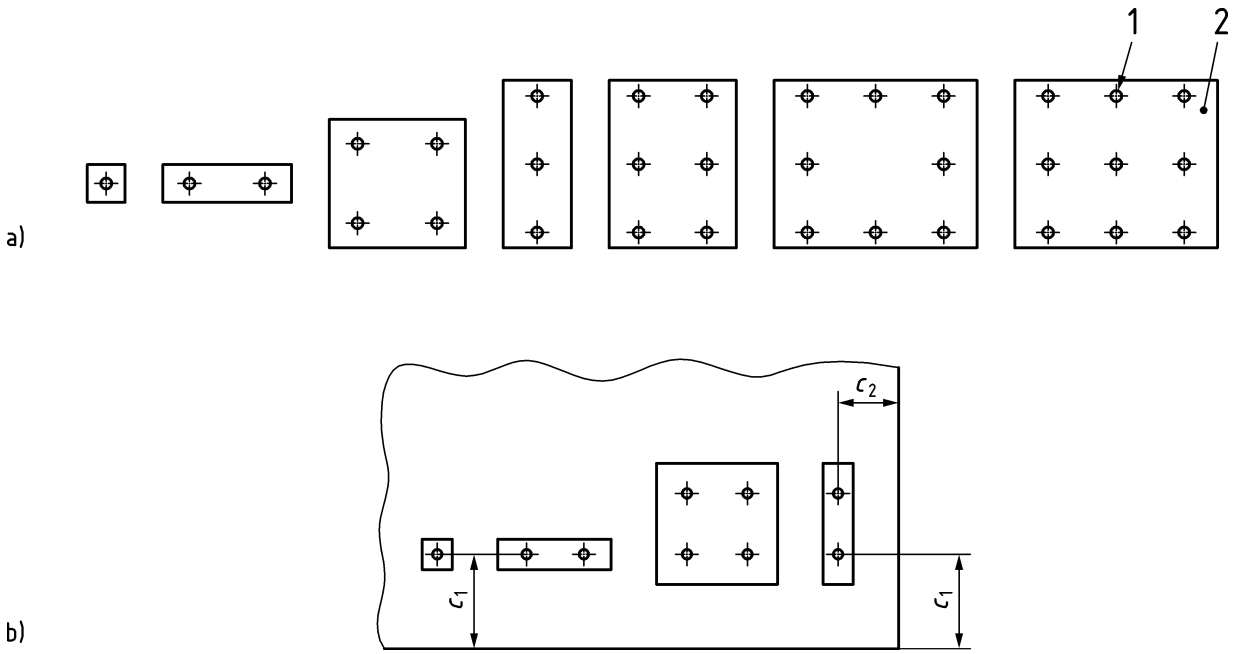


Figure 1.1 — Fastener design theory, example

(4) This EN applies to single fasteners and groups of fasteners. In a fastening group the loads are applied to the individual fasteners of the group by means of a common fixture. In this EN it is assumed that in a fastener group only fasteners of the same type and size are used.

The configurations of fastenings with cast-in place headed fasteners and post-installed fasteners covered by this EN are shown in Figure 1.2.

For anchor channels the number of fasteners is not limited.



Key
1 Fastener
2 Steel plate

a) Fastenings without hole clearance for all edge distances and for all load directions, and fastenings with hole clearance according to Table 6.1 situated far from edges ($c \geq \max\{10\, h_{ef}\,,\ 60 d_{nom}\}$) for all load directions and fastenings with hole clearance according to Table 6.1 situated near to an edge ($c < \max\{10\, h_{ef}\,,\ 60 d_{nom}\}$) loaded in tension only

b) Fastenings without and with hole clearance according to Table 6.1 situated near to an edge ($c < \max\{10\, h_{ef}\,,\ 60 d_{nom}\}$) for all load directions

Figure 1.2 — Configuration of headed and post-installed fastenings covered by this EN

NOTE Configuration with three fasteners is not recommended close to an edge ($c_i < 100$mm) as there are no safe design models for shear loads.

1.3 Fastener dimensions and materials

(1) This EN applies to fasteners with a minimum diameter or a minimum thread size of 6 mm (M6) or a corresponding cross section. In general, the effective embedment depth should be: $h_{ef} \geq 40$ mm. The actual value for a particular fastener shall be taken from the relevant European Technical Product Specification. In case of post-installed chemical fasteners the effective embedment depth is limited to $h_{ef} \leq 20 d_{nom}$. In case of fasteners for multiple use for non-structural applications as addressed in 7.3 the minimum thread size is 5 mm (M5) and the effective embedment depth shall be at least 30 mm, which in special cases (internal exposure conditions only) can be reduced to 25 mm.

(2) This EN covers metal fasteners made of either carbon steel (ISO 898, EN 10025, EN 10080), stainless steel (EN 10088, ISO 3506) or malleable cast iron (ISO 5922). The surface of the steel may be coated or uncoated. This EN is valid for fasteners with a nominal steel tensile strength $f_{uk} \leq 1000$ N/mm². This strength limit does not apply to concrete screws. The binding material of bonded fasteners may be made primarily of resin, cement or a combination of the two. In addition inorganic fillers may be used.

1.4 Fastener loading

(1) Loading on the fastenings may be static, quasi-static, fatigue, impact and seismic. The suitability of the fastener to resist fatigue, impact and seismic loadings is specifically stated in the relevant European Technical Product Specification. Anchor channels subjected to fatigue loading or seismic loading are not covered by this EN.

NOTE Design rules for anchor channels subjected to fatigue loading or seismic loading may be found in the CEN/TR "Anchor channels" which is under preparation.

(2) The loading on the fastener resulting from the actions on the fixture (e.g. tension, shear, bending or torsion moments or any combination thereof) will generally be axial tension and/or shear. When the shear force is applied with a lever arm a bending moment on the fastener will arise. Any axial compression on the fixture should be transmitted to the concrete either without acting on the fastener or via fasteners suitable for resisting compression.

(3) In case of anchor channels shear in the direction of the longitudinal axis of the channel is not covered by this EN.

NOTE Design rules for anchor channels with loads acting in the direction of the longitudinal axis of the anchor channel may be found in the CEN/TR "Anchor channels" which is under preparation.

1.5 Concrete strength

(1) This EN is valid for fasteners installed in members using normal weight concrete with strength classes in the range C12/15 to C90/105 all in accordance with EN 206-1. However in the design of fastenings the strength class is limited to C60/75 even if the structure uses a higher strength class. The range of concrete strength classes in which particular fasteners may be used is given in the relevant European Technical Product Specification and may be more restrictive than stated above.

1.6 Concrete member loading

(1) In general fasteners are prequalified for applications in concrete members under static loading. If the concrete member is subjected to fatigue or seismic loading, prequalification of the fastener specific to this type of loading and a corresponding European Technical Product Specification are required.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 206-1, *Concrete — Part 1: Specification, performance, production and conformity*

EN 1990, *Eurocode — Basis of structural design*

EN 1991-1, *Eurocode 1: Actions on structures*

EN 1992-1-1:2004, *Eurocode 2: Design of concrete structures — Part 1-1: General rules and rules for buildings*

EN 1993-1-1:2005, *Eurocode 3: Design of steel structures — Part 1-1: General rules and rules for buildings*

EN 1993-1-8:2005, *Eurocode 3: Design of steel structures — Part 1-8: Design of joints*

EN 1998-1:2004, *Eurocode 8: Design of structures for earthquake resistance — Part 1: General rules, seismic actions and rules for buildings*

EN 10025-1, *Hot rolled products of structural steels - Part 1: General technical delivery conditions*

EN 10080, *Steel for the reinforcement of concrete - Weldable reinforcing steel - General*

EN 10088-2, *Stainless steels — Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*

EN 10088-3, *Stainless steels — Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes*

ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1*: *Bolts, screws and studs with specified property classes – Coarse thread and fine pitch thread*

ISO 898-2, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 2*: *Nuts with specified property classes – Coarse thread and fine pitch thread*

ISO 3506-1*, Mechanical properties of corrosion-resistant stainless-steel fasteners – Part 1: Bolts, screws and studs*

ISO 3506-2, *Mechanical properties of corrosion-resistant stainless steel fasteners – Part 2: Nuts*

ISO 5922, *Malleable cast iron*

3 Definitions and symbols

3.1 Definitions

3.1.1
anchor
element made of steel or malleable iron either cast into concrete or post-installed into a hardened concrete member and used to transmit applied loads (see Figures 3.1 to 3.3). In this EN 'anchor' and 'fastener' are used synonymously. In the case of anchor channels, one or more steel anchors is/are rigidly connected to the back of the channel and embedded in concrete

3.1.2
anchor channel
steel profile with rigidly connected anchors (also called channel bar, see Figure 3.2) installed prior to concreting

3.1.3
anchor channel loading: Axial tension
load applied perpendicular to the surface of the base material

3.1.4
anchor channel loading: Combined
axial and shear loading applied simultaneously (oblique loading)

3.1.5
anchor channel loading: Flexure
bending effect induced by a tension load

3.1.6
anchor channel loading: Shear
load acting parallel to the concrete surface and transversely with respect to the longitudinal axis of the channel

3.1.7
anchor group
number of fasteners with identical characteristics acting together to support a common attachment, where the spacing of the anchors does not exceed the characteristic spacing

3.1.8
anchor loading: Axial
load applied perpendicular to the surface of the base material and parallel to the fastener longitudinal axis

3.1.9
anchor loading: Bending
bending effect induced by a shear load applied with a lever arm with respect to the surface of the concrete member

3.1.10
anchor loading: Combined
axial and shear loading applied simultaneously (oblique loading)

3.1.11
anchor loading: Shear
shear induced by a load applied perpendicular to the longitudinal axis of the fastener

3.1.12
anchor spacing
distance between the centre lines of the fasteners

3.1.13
attached element
structural or non-structural component that is connected to the attachment

3.1.14
attachment
assembly that transmits loads to the fastener. In this EN 'attachment' and 'fixture' are used synonymously

3.1.15
base material
material in which the fastener is installed

3.1.16
blow-out failure
spalling of the concrete on the side face of the concrete element at the level of the embedded head with no major breakout at the top concrete surface. This is usually associated with fasteners with small side cover and deep embedment

3.1.17
bonded anchor
Fastener placed into a hole in hardened concrete, which derives its resistance from a bonding compound placed between the wall of the hole in the concrete and the embedded portion of the fastening (see Figure 3.3g))

3.1.18
bonded expansion anchor
bonded anchor designed such that the anchor bolt can move relative to the hardened bonding compound resulting in follow-up expansion (see Figure 3.3h))

3.1.19
cast-in fastener
headed bolt, headed stud, hooked bolt or anchor channel installed before placing the concrete, see headed anchor

3.1.20
channel bolt
screw or bolt which connects the element to be fixed to the anchor channel (Figure 3.2)

3.1.21
characteristic resistance
5 % fractile of the resistance (value with a 95 % probability of being exceeded, with a confidence level of 90 %)

3.1.22
characteristic spacing
spacing required to ensure the characteristic resistance of a single fastener

3.1.23
concrete breakout failure
Failure that corresponds to a wedge or cone of concrete surrounding the fastener or group of fasteners separating from the base material

3.1.24
concrete pry-out failure
failure that corresponds to the formation of a concrete spall opposite to the loading direction under shear loading

3.1.25
concrete related failure modes
failure modes under tension loading: Pull-out failure, combined pull-out and concrete failure (bonded fasteners), concrete cone failure, blow-out failure, splitting failure, anchorage failure of supplementary reinforcement.
Failure modes under shear loading: Concrete pry-out failure, concrete edge failure

3.1.26
concrete screw
threaded anchor screwed into a predrilled hole where threads create a mechanical interlock with the concrete (see Figure 3.3f))

3.1.27
deformation-controlled expansion anchor
post-installed fastener that derives its tensile resistance by expansion against the side of the drilled hole through movement of an internal plug in the sleeve (see Figures 3.3c)) or through movement of the sleeve over an expansion element (plug). Once set, no further expansion can occur

3.1.28
displacement
movement of the loaded end of the fastener relative to the concrete member into which it is installed in the direction of the applied load. In the case of anchor channels, movement of a channel bolt (Fig. 3.2) or the anchor channel relative to the concrete element. In tension tests, displacement is measured parallel to the anchor axis. In shear tests, displacement is measured perpendicular to the anchor axis

3.1.29
ductile steel element
element with sufficient ductility. The ductility conditions are given in the relevant sections

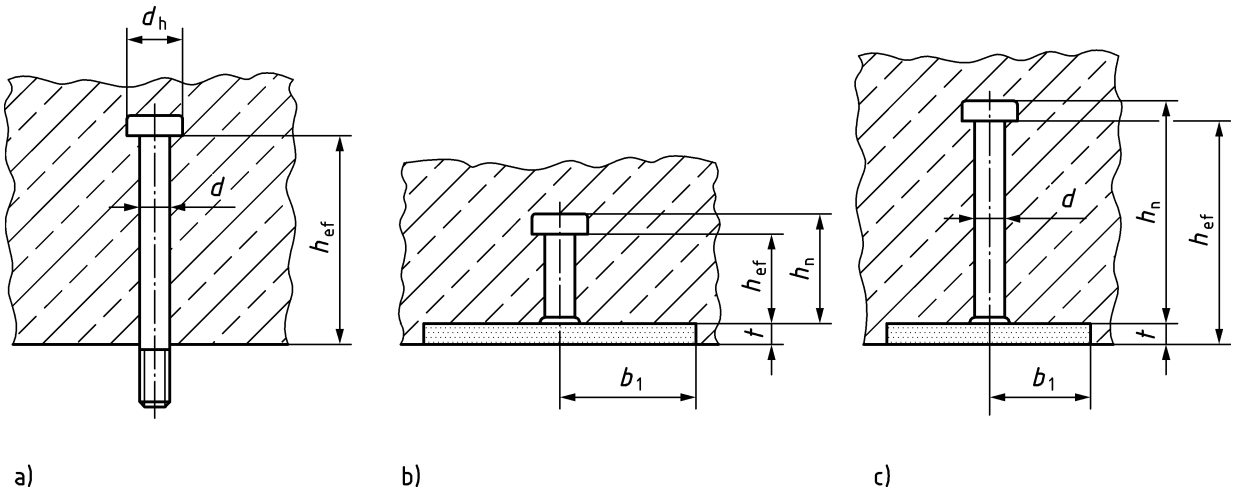
3.1.30
edge distance
distance from the edge of the concrete member to the centre of the fastener

3.1.31
effective embedment depth
the definition of the effective embedment depth for the different types of fasteners is given in Figures 3.1 to 3.3

3.1.32
european Technical Product Specification
harmonized European Product Standard (hEN) or European Technical Approval or European Technical Assessment

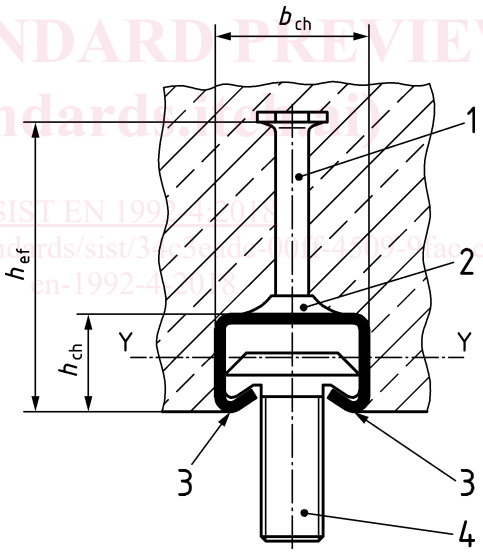
3.1.33
fastener
see anchor

3.1.34
fastening
assembly of fixture and fasteners used to transmit loads to concrete



Key
a) without anchor plate
b) with a large anchor plate in any direction, $b_1 > 0{,}5\ h_n$ or $t > 0{,}2\ h_n$
c) with a small anchor plate in each direction, $b_1 \leq 0{,}5\ h_n$ and $t \leq 0{,}2\ h_n$

Figure 3.1 — Definition of effective embedment depth h_{ef} for headed fasteners



Key
1 anchor
2 connection between anchor and channel
3 channel lip
4 channel bolt

Figure 3.2 — Definitions for anchor channels