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Dimensionering av infästningar till betong – Plastdesign av fästanordningar med skruv och efterinstallerade infästningar

Design of fastenings for use in concrete – Plastic design of fastenings with headed and post-installed fasteners

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Information about the content of this document is available from the SIS, Swedish Standards Institute, telephone +46 8 555 520 00. Standards may be ordered from SIS, who can also provide general information about national and international standards.

Dokumentet är framtaget av kommittén för Betongkonstruktioner, SIS/TK 556.

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TECHNICAL REPORT

RAPPORT TECHNIQUE

TECHNISCHER BERICHT

CEN/TR 17081

September 2018

ICS 21.060.01; 91.080.40

English Version

Design of fastenings for use in concrete - Plastic design of fastenings with headed and post-installed fasteners

Bemessung der Verankerung von Befestigungen in Beton - Traglastverfahren für Befestigungsmittel von Kopfbolzen und Dübel

This Technical Report was approved by CEN on 9 April 2017. It has been drawn up by the Technical Committee CEN/TC 250.

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European foreword

This document (CEN/TR 17081:2018) has been prepared by Technical Committee CEN/TC 250 "Structural Eurocodes", the secretariat of which is held by BSI.

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Introduction

It is intended that this document is used in conjunction with EN 1992-4.

The numerical values for reliability parameters are recommended values and may be changed in a National Annex, if required. The recommended values apply when the installation complies with the requirements of EN 1992-4:2018, 4.6.

1 Scope

This Technical Report gives provisions for design of ultimate limit states in addition to EN 1992-4 for headed and post-installed fasteners excluding concrete screws, which only transmit static actions to the concrete, when the loads on individual fasteners are determined according to plastic analysis of the joint where only equilibrium conditions but no compatibility conditions are considered. Fatigue, impact and seismic loads are not covered.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

EN 1992-4:2018, *Eurocode 2 — Design of concrete structures — Part 4: Design of fastenings for use in concrete*

EN 1993-1-8:2005, *Eurocode 3: Design of steel structures — Part 1-8: Design of joints*[2)]

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions and symbols given in EN 1992-4:2018 and the following symbols apply.

f_{cd} design value of concrete compressive strength;

F_{Rdu} concentrated design resistance for concrete.

4 Field of application

4.1 General

Significant redistribution of forces in individual fasteners of fastenings is implicit in plastic analysis. Therefore, this analysis is acceptable only when the failure is governed by ductile steel failure of the fastening under tension, shear or combined tension and shear loads. The behaviour of the base plate might be elastic or plastic (see EN 1993-1-8). The analysis should be used for ultimate limit state only. This document applies only to fastenings subjected to axial and/or shear forces with bending moment in one direction (see Figure 1).

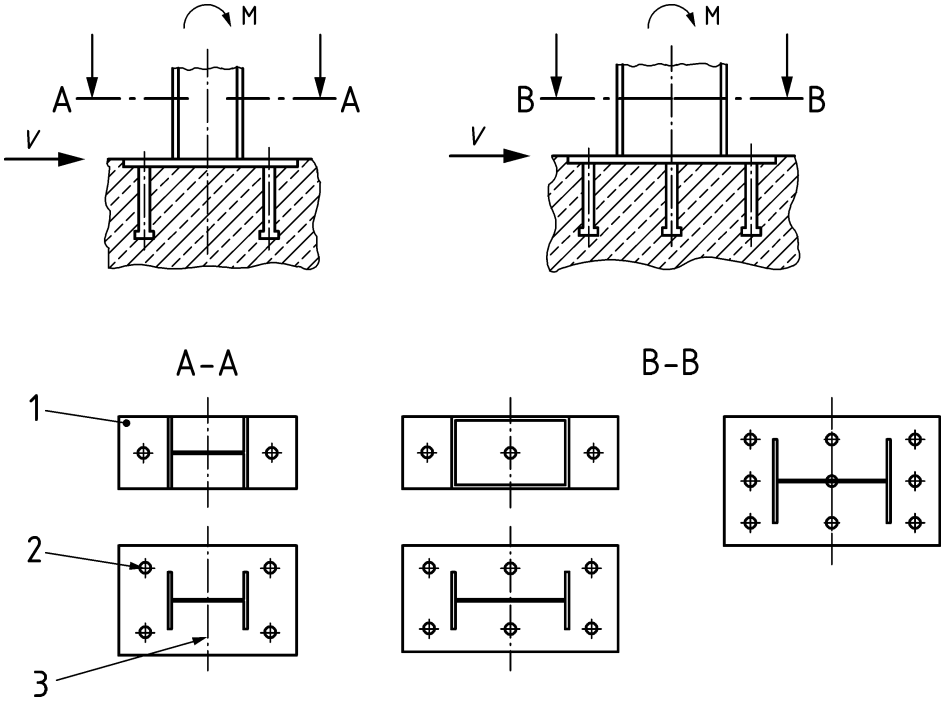
4.2 Conditions for ductile behaviour

To ensure a ductile steel failure, the following conditions shall be met:

1) This standard is impacted by the amendment EN 1992-1-1:2004/A1:2014 and corrigenda EN 1992-1-1:2004/AC:2008 and EN 1992-1-1:2004/AC:2010.

2) This standard is impacted by the corrigenda EN 1993-1-8:2005+AC:2005 and EN 1993-1-8:2005+AC:2009.

a) Fastening arrangements shown in EN 1992-4:2018, Figure 1.2 a) are covered in this document. The fixture may be subjected to axial and/or shear forces with a bending moment in one direction (Figure 1). For other forms of the attachment than shown in Figure 1 the principles can be applied using engineering judgement.

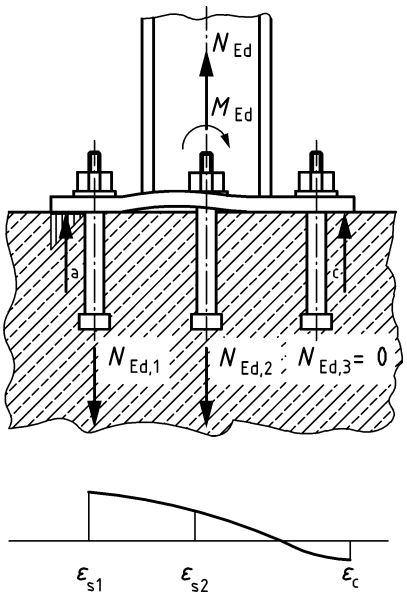


Key

1 fixture
2 fastener
3 axis of bending

Figure 1 — Fastening arrangements for which the plastic design approach may be used - Examples

Flexible fixtures may be used if the resultant nonlinear load distribution and associated prying forces are taken into account (see Figure 2).



Key

a prying force

c compression force

Figure 2 — Fastening with a flexible fixture loaded subject to a bending moment and axial tension - Example

b) The design resistance of a fastener as governed by concrete failure shall exceed the design resistance as governed by steel failure. Resistance models given in Clause 6 will satisfy this requirement.

c) The nominal steel strength of the fasteners shall not exceed f_{uk} = 800 MPa, the ratio nominal steel yield strength to nominal ultimate strength shall not exceed f_{yk} / f_{uk} = 0,8, and the rupture elongation (measured over a length equal to 5 *d*) shall be at least 12 %.

d) Fasteners with a constant cross section (e.g. shaft or threaded rod) along the embedment depth shall have a stretch length with constant steel strain of at least 8 *d.*

e) Fasteners that incorporate a reduced section along the embedment depth (e.g. thread on a smooth shaft) shall satisfy the following conditions:

1) For fasteners loaded in tension, the strength N_{uk} of the reduced cross-section shall either be greater than 1,3-times the yield strength N_{yk} of the unreduced section or the stretch length of the reduced section shall be ≥ 8 *d* (*d* = nominal fastener diameter outside reduced section).

2) For fasteners loaded in shear, the start of the reduced section shall either be ≥ 5 *d* below the concrete surface or in the case of a threaded fastener, the threaded part shall extend ≥ 2 *d* into the concrete.

3) For fasteners loaded in combined tension and shear, the conditions (1) and (2) above shall be met.

f) The steel fixture should be embedded in the concrete or fastened to the concrete surface without an intermediate layer or with a levelling layer of mortar see 5.2.