



SLOVENSKI STANDARD

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Montažni betonski izdelki - Škatlasti nosilci

Precast concrete products - Box culverts

Betonfertigteile - Hohlkastenelemente

Produits préfabriqués en béton - Cadres enterrés

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ICS:

91.100.30

Beton in betonski izdelki

Concrete and concrete products

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EUROPEAN STANDARD
NORME EUROPÉENNE
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English Version

Precast concrete products - Box culverts

Produits préfabriqués en béton - Cadres enterrés

Betonfertigteile - Hohlkastenelemente

This European Standard was approved by CEN on 17 April 2006 and includes Amendment 1 approved by CEN on 22 August 2008 and Amendment 2 approved by CEN on 22 October 2011.

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 CEN-CENELEC Management Centre or to any CEN member.

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

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EN 14844:2006+A2:2011 (E)

Foreword

This document (EN 14844:2006+A2:2011) has been prepared by Technical Committee CEN/TC 229 "Precast concrete products", the secretariat of which is held by AFNOR ^{A1} and was examined by and agreed with a joint working party appointed by the Liaison Group CEN/TC 229-CEN/TC 250, particularly for its compatibility with structural Eurocodes ^{A1}.

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of an identical text or by endorsement, at the latest by May 2012, and conflicting national standards shall be withdrawn at the latest by August 2013.

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

This document includes Amendment 1, approved by CEN on 2008-08-22, and Amendment 2, approved by CEN on 2011-10-22.

This document supersedes ^{A2} EN 14844:2006+A1:2008 ^{A2}.

The start and finish of text introduced or altered by amendment is indicated in the text by tags ^{A1} ^{A1} and ^{A2} ^{A2}.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

^{A2} *deleted text* ^{A2}

This standard is one of a series of product standards for precast concrete products.























For common aspects reference is made to EN 13369, *Common rules for precast concrete products*, from which also the relevant requirements of EN 206-1, *Concrete — Part 1: Specification, performance, production and conformity* are taken.

The references to EN 13369:2004 by CEN/TC 229 product standards are intended to make them homogeneous and to avoid repetitions of similar requirements.

^{A2} Eurocodes are taken as a common reference for design aspects. The installation of some structural precast concrete products is dealt with by EN 13670, *Execution of concrete structures*. ^{A2}

The programme of standards for structural precast concrete products comprises the following standards, in some cases consisting of several parts:

- EN 1168, *Precast concrete products — Hollow core slabs*
- EN 12794, *Precast concrete products — Foundation piles*
- EN 12843, *Precast concrete products — Masts and poles*
- EN 13225, *Precast concrete products — Linear structural elements*
- EN 13693, *Precast concrete products — Special roof elements*
- EN 13747, *Precast concrete products — Floor plates for floor systems*

-  EN 13978-1, *Precast concrete products — Precast concrete garages — Part 1: Requirements for reinforced garages monolithic or consisting of single sections with room dimensions* 
- EN 13224, *Precast concrete products — Ribbed floor elements*
-  EN 14843 , *Precast concrete products — Stairs*
- EN 14844, *Precast concrete products — Box culverts*
-  EN 14991 , *Precast concrete products — Foundation elements*
-  EN 14992 , *Precast concrete products — Wall elements : Products properties and performances*
-  EN 15037-1 , *Precast concrete products — Beam-and-block floor systems — Part 1: Beams*
-  EN 15037-2 , *Precast concrete products — Beam-and-block floor systems — Part 2: Concrete blocks*
-  EN 15037-3, *Precast concrete products — Beam-and-block floor systems — Part 3: Clay blocks* 
-  EN 15037-4, *Precast concrete products — Beam-and-blocks floor systems — Part 4: Expanded polystyrene blocks* 
-  prEN 15037-5, *Precast concrete products — Beam-and-block floor systems — Part 5: Lightweight blocks for simple formwork* 
-  EN 15050 , *Precast concrete bridge elements*
-  EN 15258 , *Precast concrete products — Retaining wall elements*

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This standard defines in Annex ZA the application methods of CE marking to products designed using the relevant EN Eurocodes (EN 1992). Where, in default of applicability conditions of EN Eurocodes to the works of destination, design provisions other than EN Eurocodes are used for mechanical strength, the conditions to affix CE marking to the product are described in ZA.3.4.

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this European Standard.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The Construction Products Directive sets out Essential Requirements to be considered, depending upon the use made of the product. For box culverts it was mandated that the requirements for mechanical resistance and stability should be considered. For these requirements this standard will mainly refer to clauses of EN 1992-1-1, *Eurocode 2: Design of concrete structures — Part 1-1: General rules and rules for buildings*.

The mandate also requires consideration of durability, from the point of view of freeze thaw action and corrosion, which is also addressed by the Eurocodes referred to above.

A₂ *deleted text* **A₂**

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1 Scope

This European Standard deals with both large (structural) and small (non-structural or light structural) box culverts of rectangular cross-section formed monolithically and designed as continuous elements with a joint detail shaped to allow the possible incorporation of sealing materials. Box culverts can be used for creation of voids below ground for conveyance and storage of materials. e.g. conveyance and storage of wastewater, cable tunnels and subways

Ⓐ₂ For the purposes of this European Standard, box culverts having internal cross-sectional dimensions (W and H in Figure 1) less than or equal to 1 250 mm are considered as small (non-structural or light structural). All other units are defined as large. Ⓐ₂ The elements are generally manufactured in factories using either normal weight or lightweight concrete and usually require reinforcing steel. This standard does not include units manufactured from autoclaved aerated concrete, nor prefabricated reinforced box culverts of lightweight concrete with open structure.

Each unit is structurally complete. They are used in combination to form a total structure of appropriate length (including joints) and capacity.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ⓐ₂ EN 206-1:2000, *Concrete — Part 1: Specification, performance, production and conformity* Ⓐ₂

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

EN 13369:2004, *Common rules for precast concrete products*

3 Terms and definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 13369:2004 and the following apply.

3.1.1

corner splay

internal chamfering of the corners

3.2 Symbols and abbreviations

Principal and other dimensions and their symbols are given in Figure 1.

The symbols comply with EN 1992-1-1 as far as possible and are listed:

W internal width

H internal height

L unit length (measured from end of spigot to base of socket for rebated joint – see Figure 1a))

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t_r roof/floor slab thickness

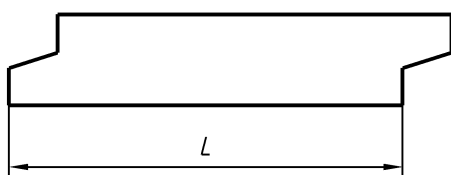
t_w wall thickness

e, f - geometry of the splay, see Figure 1b) below

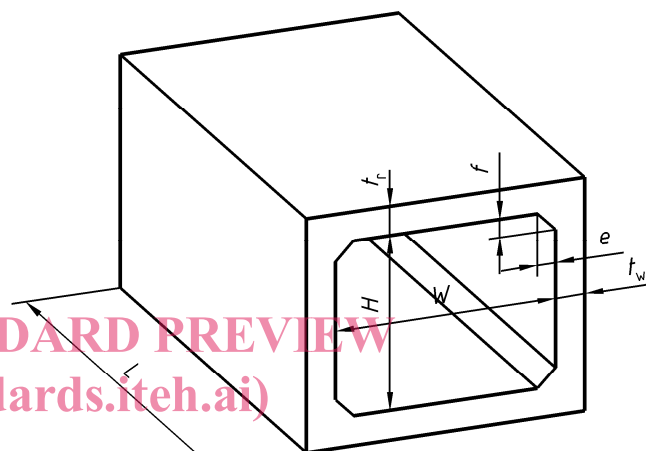
Effective roof span (W_e) = $W + t_w$

Effective wall span (H_e) = $H + t_r$

Spigot and Socket inner and outer overlapping nibs of a rebated joint profile (see Figure 2a))



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Figure 1a) — Unit Length

Figure 1b) — Explanation of symbols

Figure 1 — Principal dimensions and symbols

See Figure 2 for alternative joint configurations.

4 Requirements

4.1 Material requirements

4.1.1 General

Subclause 4.1 of EN 13369:2004 shall apply.

4.2 Production requirements

4.2.1 Concrete production

Subclause 4.2.1 of EN 13369:2004 shall apply.

4.2.2 Hardened concrete

4.2.2.1 Strength classes

Subclause 4.2.2.1 of EN 13369:2004 shall apply. The minimum concrete strength class shall be C30/37.

4.2.2.2 Compressive strength

The compressive strength of hardened concrete shall be declared by the manufacturer. Subclause 4.2.2.2 of EN 13369:2004 shall apply.

The design values of strength properties should be based on partial safety factors for material properties, according to Annex C of EN 13369:2004.

4.2.2.3 Drying shrinkage of lightweight aggregate concrete

For lightweight concrete, the drying shrinkage shall be declared by the manufacturer.

4.2.2.4 Density of lightweight aggregate concrete

The manufacturer shall declare the density of lightweight concrete and it shall be in accordance with EN 206-1:2000, 4.3.2.

4.2.3 Structural reinforcement

4.2.3.1 Processing of reinforcing steel

Subclauses 4.2.3 and 4.2.3.1 of EN 13369:2004 shall apply.

4.3 Finished product requirements

4.3.1 Geometrical properties

4.3.1.1 Production tolerances

Units shall have an appropriate joint detail capable of providing sealing and location integrity. Typical arrangements are shown in Figure 2 below.

Types of joints (see Figure 2):

- rebated joint (A);
- nib joint (B);
- butt joint (C).

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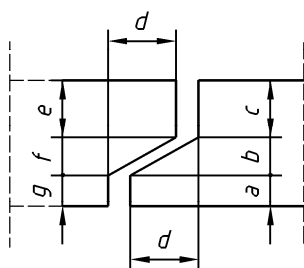


Figure 2a)

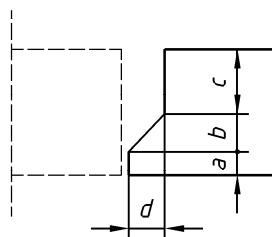


Figure 2b)

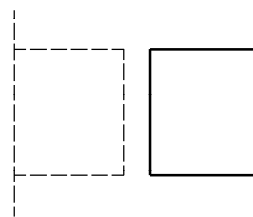


Figure 2c)

Figure 2 — Examples of box culvert joints

For the types of rebated joint illustrated, the spigot and socket shall have a thickness of not less than 45 mm at the root ($a + b$) and a nib length (d) of not less than 45 mm. ~~NOTE~~ Early casts from each mould shall be checked to ensure that joints mate satisfactorily.

NOTE It is suitable that, except for dimensions close to the minimum specified hereafter, the length d of the nib should be in the range from 1,3 to 2 times the nib root dimension $a + b$.

The maximum permissible tolerance from the manufacturer's declared dimensions, measured in accordance with 5.2, shall be as follows:

- thickness of roof/floor slab and wall : ± 10 mm;
- internal width and height of the opening : ± 1 % (min. 10 mm, max. 15 mm);
- length of units : ± 1 % (min. 15 mm);
- joints: (see Figure 2) ; a, b, c, d, e, f, g : ± 10 mm.

4.3.1.2 Minimum dimensions

The nominal thickness for roof, floor and wall shall be not less than 100 mm.

NOTE The length of unit is determined by the maximum weight and overall dimensions which can conveniently be lifted, transported and placed into the works but is not likely to be less than 1 000 mm except where handling or special considerations apply.

4.3.1.3 Nominal size

Box culverts shall be described by their principal dimensions according to 3.2, expressed in sequence:

- WxHxL

The manufacturer shall declare the box culvert nominal dimensions.

The opening may be provided with corner splays, which shall not reduce the rectangular area by more than 10 %.

4.3.1.4 Shape tolerance

Squareness: the difference between the diagonal dimensions of any face or end shall not exceed the following values:

- for any internal dimensions up to 2 000 mm: 10 mm;
- for any internal dimensions greater than 2 000 mm up to 4 000 mm: 15 mm;
- for any internal dimensions greater than 4 000 mm: 20 mm.

NOTE Tolerances might influence the watertightness characteristic of the joints.

4.3.1.5 Cumulative effect

Deviations can be cumulative and the overall effect may need to be considered.

For initial production from a new mould, where required with regard to fit, overlap and stepping shall be determined by placing at least three units onto a common level support, with the units just touching each other. Measured inside the units, the joint width between successive units shall not vary by more than 10 mm and the maximum step between adjacent units should not be more than 15 mm.

4.3.2 Surface characteristics

4.3.2.1 General

Subclause 4.3.2 of EN 13369:2004 shall apply.

Flatness: the deviation from a 1 500 mm straight edge placed in any position on an internal surface shall not exceed 10 mm.

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4.3.2.2 Cracking

Crazing within the cement rich layer, shrinkage or temperature hairline cracks with a surface width not exceeding 0,15 mm and residual cracks caused by testing, having the same limiting surface width are permissible.

4.3.3 Mechanical resistance

4.3.3.1 General

Subclause 4.3.3.1 of EN 13369:2004 shall apply.

4.3.3.2 Verification by calculation

Subclause 4.3.3.2 of EN 13369:2004 shall apply, see also EN 1992-2. For the design of box culverts, additional specific information is given in Annex A.

Different calculation methods may be applied provided they are confirmed by testing (see 4.3.3.3 below).

4.3.3.3 Verification by calculation aided by physical testing

In the case of testing 4.3.3.3 of EN 13369 shall apply and the appropriate design parameters shall be simulated in the test arrangement. The testing rig shall have the capability to apply load in varying positions and intensities to simulate the critical bending, shear and cracking conditions.