SLOVENSKI STANDARD
SIST EN 15037-1:2008

01-junij-2008

Montažni betonski izdelki - Stropni sistemi iz nosilcev in polnil - 1. del: Nosilci

Precast concrete products - Beam-and-block floor systems - Part 1: Beams

Vorgefertigte Betonerzeugnisse - Rippen-rund Balkendecken mit Zwischenbauteilen - Teil 1: Träger

Produits préfabriqués en béton - Systèmes de planchers à poutrelles et entrevous - Partie 1: Poutrelles

Ta slovenski standard je istoveten z: EN 15037-1:2008

ICS:

91.060.30	Stropi. Tla. Stopnice	Ceilings. Floors. Stairs
91.100.30	Beton in betonski izdelki	Concrete and concrete products

SIST EN 15037-1:2008 **en**

EUROPEAN STANDARD

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EN 15037-1

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ICS 91.100.30

English Version

Precast concrete products - Beam-and-block floor systems - Part 1: Beams

Produits préfabriqués en béton - Systèmes de planchers à poutrelles et entrevous - Partie 1: Poutrelles

Betonfertigteile - Balkendecken mit Zwischenbauteilen - Teil 1: Balken

This European Standard was approved by CEN on 30 June 2007.

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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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, 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 United Kingdom.

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The numbering of clauses is strictly related to EN 13369: *Common rules for precast concrete products*, at least for the first three digits. When a clause of EN 13369 is not relevant or included in a more general reference of this standard, its number is omitted and this may result in a gap on numbering.

Foreword

This document (EN 15037-1:2008) has been prepared by Technical Committee CEN/TC 229 “Precast concrete products”, the secretariat of which is held by AFNOR, and was examined by and agreed with a joint working party appointed by the Liasion Group CEN/TC 229-TC 250, particulary for its compatibility with structural Eurocodes.

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 October 2008, and conflicting national standards shall be withdrawn at the latest by April 2011.

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).

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

European Standard for beam-and-block floor system is made of 5 parts:

— EN 15037-1, *Precast concrete products - Beam-and-block floor systems — Part 1: Beams*

— prEN 15037-2, *Precast concrete products - Beam-and-block floor systems — Part 2: Concrete blocks*[1)]

— prEN 15037-3, *Precast concrete products - Beam-and-block floor systems — Part 3: Clay blocks*[1)]

— prEN 15037-4, *Precast concrete products - Beam-and-block floor systems — Part 4: Polystyrene blocks*[1)]

— prEN 15037-5, *Precast concrete products - Beam-and-block floor systems — Part 5: Lightweight blocks* [1)]

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 the EN 206-1: *Concrete — Part 1: Specification, performance, production and conformity* are taken.

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

Eurocodes are taken as a common reference for design aspects. The installation of some structural precast concrete products is dealt with by ENV 13670-1: *Execution of concrete structures — Part 1: Common rules*, which has at the moment the status of a European Prestandard. In all countries it can be accompanied by alternatives for national application and it should not be treated as a European Standard.

The program 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*

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1) to be developed

EN 13224, *Precast concrete products — Ribbed floor elements*

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, *Precast concrete products — Precast concrete garages*

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*

EN 15050, *Precast concrete products — Bridge elements*

prEN 15258, *Precast concrete products — Retaining wall elements*

This standard defines in Annex ZA the application methods of CE marking to products designed using the relevant EN Eurocodes (EN 1992-1-1:2004 and EN 1992-1-2:2004). 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 and/or fire resistance, the conditions to affix CE marking to the product are described in ZA.3.4.

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, 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 United Kingdom.

Introduction

The evaluation of conformity given in this standard refers to the completed precast elements which are supplied to the market and covers all the production operations carried out in the factory.

For design rules reference is made to EN 1992-1-1:2004. Additional complementary rules are provided where necessary.

Recommendations for beam-and-block floor systems are presented in informative annexes about monolithism of composite floor systems (Annex C), detailing of supports and anchorage reinforcement (Annex D), design of composite floor systems (Annex E), design of self-bearing beams (Annex F), diaphragm action (Annex G), resistance to fire (Annex K) and acoustic insulation (Annex L).

According to 1.2 of EN 1992-1-1:2004 the complementary rules, given in informative annexes in this standard, comply with the relevant principles given in EN 1992-1-1.

Because of the fact that the experimental evidence is mainly based on elements with limited depth and width this standard is applicable to elements with these limited dimensions. This limitation is not intended to prohibit the application of elements with larger sizes, but the experience is not yet wide enough to draw up standardised design rules.

In 4.2.3, 4.3.2, 4.3.3 and 4.3.4, this standard includes specific provisions resulting from the application of EN 1992-1-1:2004 and EN 1992-1-2:2004 rules made specific for the concerned product. The use of these provisions is consistent with a design of works made with EN 1992-1-1:2004 and EN 1992-1-2:2004.

1 Scope

This European Standard deals with the requirements, the basic performance criteria and evaluation of conformity for precast beams made of reinforced or prestressed normal weight concrete according to EN 1992-1-1:2004, with or without clay shell, used in conjunction with blocks in compliance with prEN 15037-2 or prEN 15037-3 or prEN 15037-4 or prEN 15037-5, with or without cast in-situ concrete for the construction of beam-and-block floor and roof systems. Examples of typology of floor and roof systems are given in Annex B.

It is essential that the total depth of the beam be comprised between 60 mm and 500 mm and the beams be at centres of not more than 1,00 m.

For higher depth, it is essential that the precast concrete beams be in compliance with EN 13225.

The products covered by this standard are intended to be used as structural floor and roof systems, including parking areas for light vehicles corresponding to traffic category F of EN 1991-1-1:2002, which are not subjected to fatigue loading.

The products may be used in seismic areas provided they fulfil the requirements specific to this use.

2 Normative references

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

EN 1990:2002, *Eurocode — Basis of structural design*

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

EN 1992-1-2:2004, *Eurocode 2: Design of concrete structures — Part 1-2: General rules — Structural fire design*

EN 10080:2005, *Steel for the reinforcement of concrete — Weldable reinforcing steel — General*

EN 12390-4:2000, *Testing hardened concrete — Part 4: Compressive strength — Specification for testing machines*

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

prEN 15037-2, Precast concrete products — Beam-and-block floor systems — Part 2: Concrete blocks

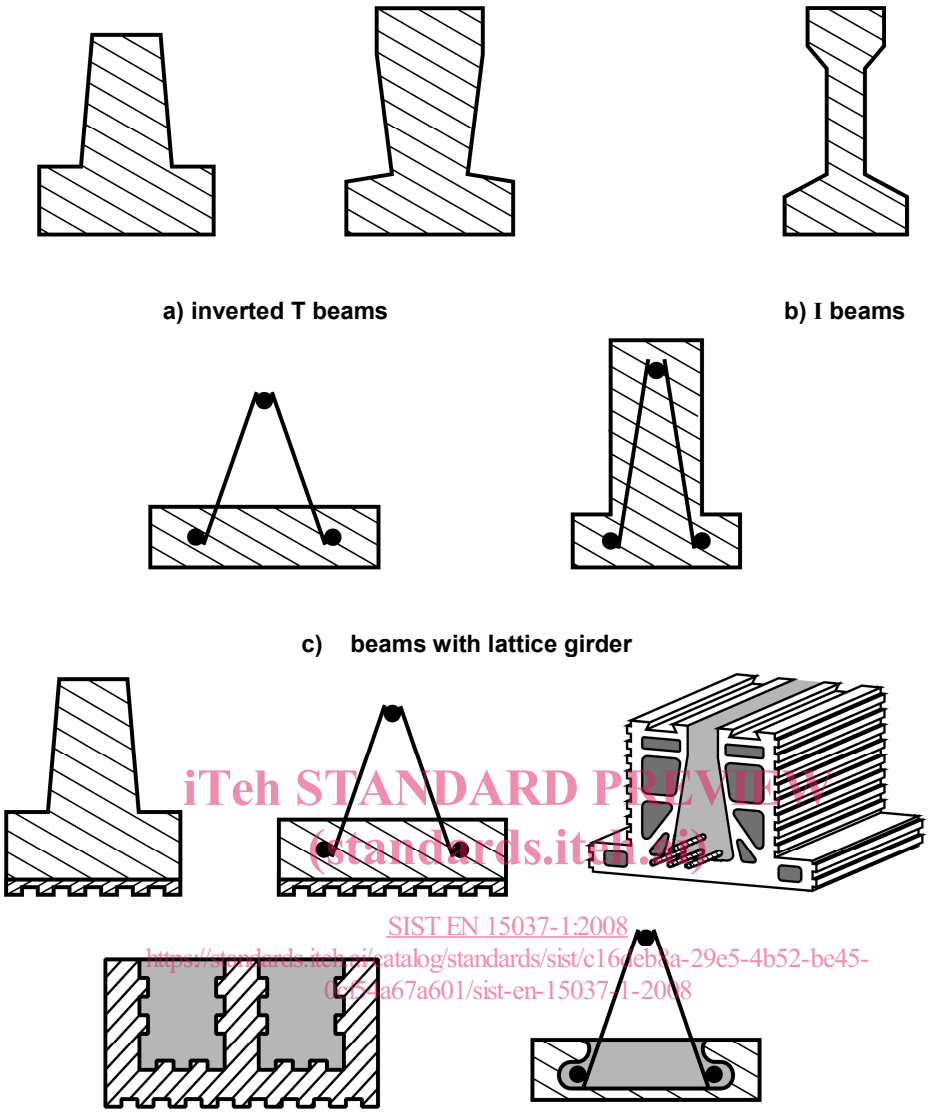
prEN 15037-3, Precast concrete products — Beam-and-block floor systems — Part 3: Clay blocks

3 Terms and definitions

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

3.1
beam
linear structural element of small cross-sectional area, made of reinforced concrete or prestressed concrete, entirely or partially precast

NOTE It may include elements which may or may not contribute to its strength (e.g. clay lower toe, clay shells) as shown in Figure 1



a) inverted T beams

b) I beams

c) beams with lattice girder

d) beams with clay shells

Figure 1 — Examples of beams

3.2
prestressed concrete beam
beam prestressed by pretensioning of prestressing steel which constitute the main reinforcement of the floor system

3.3
reinforced concrete beam
beam whose longitudinal reinforcement made of reinforcing steel constitutes the main reinforcement of the floor system

3.4
self-bearing beam
reinforced or prestressed concrete beam which provides the final strength of the floor system independently of any other constituent part of the floor system

3.5
non self-bearing beam
reinforced or prestressed concrete beam which provides the final strength of the floor in conjunction with cast in-situ concrete, and possibly with blocks

3.6
block
elements placed between beams made of normal weight or lightweight concrete, clay, polystyrene, plastic or wood composite (see also prEN 15037-2, prEN 15037-3, prEN 15037-4 and prEN 15037-5)

3.7
connecting reinforcement
reinforcement anchored on both sides of the interface between the beam and the cast in-situ concrete

NOTE It may consist of the diagonals of lattice girder, individual or continuous reinforcement in the form of loops, possibly with a longitudinal bar welded at the top and/or bottom (see Figure 2)

a) lattice girder **b) loop reinforcement**

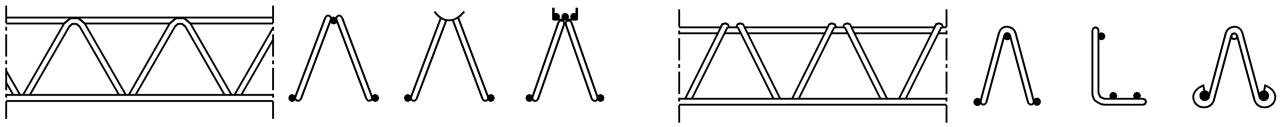
Figure 2 — Examples of connecting reinforcement

3.8
shear reinforcement
reinforcement with angle generally between 45° and 90° to the longitudinal axis of the beams

NOTE It is said to be "internal" if it provides only resistance to the shear force of the beam alone. In practice it consists of lattice girders, loop reinforcement, stirrups, etc.

3.9
lattice girder
two dimensional or three dimensional metallic structure comprising an upper chord, one or more lower chords and continuous or discontinuous diagonals which are welded or mechanically connected to the chords

NOTE Figure 3 gives some examples of lattice girders



a) continuous diagonals

b) discontinuous diagonals

Figure 3 — Examples of lattice girders

3.10
beam-and-block floor system
floor made from a combination of parallel beams with blocks placed between them, and possibly with a cast in-situ topping which may or may not act as a compression slab

3.11
compression slab
compressed upper flange of a section of structural floor

NOTE It could be a distribution slab connected to the ribs or a topping by considering the upper part of the rib and the top flange of the resisting blocks

3.12
distribution slab
reinforced monolithic concrete slab cast in situ over the whole floor surface, in order to spread the concentrated loads over the ribs or to ensure the bending of the slab between ribs

4 Requirements

4.1 Material requirements

4.1.1 General

4.1.1 of EN 13369:2004 shall apply.

4.1.2 Constituent materials of concrete

4.1.2 of EN 13369:2004 shall apply.

4.1.3 Reinforcing steel

4.1.3.1 Bars, coils and welded mesh

4.1.3 of EN 13369:2004 shall apply.

4.1.3.2 Lattice girders

Lattice girder shall comply with EN 10080.

4.1.3.3 Connecting reinforcement

Connecting reinforcement, other than lattice girder, shall be ribbed, indented or smooth steel complying with their relevant standards. Where its suitability can be proven prestressing wires or strands can be used.

Their diameter shall be comprised from 4 mm to 8 mm inclusive.

4.1.4 Prestressing steel

4.1.4 of EN 13369:2004 shall apply.

Only tendons (wires or strands) with a diameter less than 13 mm shall be used.

NOTE Other prestressing steel according to national requirements may be used until European specifications are available.

4.1.5 Inserts and connectors

4.1.5 of EN 13369:2004 shall apply.

4.2 Production requirements

4.2.1 Concrete production

4.2.1 of EN 13369:2004 shall apply

NOTE For reinforced concrete beams, the values given in Table 1 of EN 13369:2004 may be reduced with a minimum compressive cylinder strength of 4 MPa at the end of curing.

4.2.2 Hardened concrete

4.2.2.1 Strength classes

4.2.2.1 of EN 13369:2004 shall apply.

4.2.2.2 Compressive strength

4.2.2.2 of EN 13369:2004 shall apply. In addition, the minimum concrete compressive strength on delivery shall not be less than 20 MPa for reinforced beams and 25 MPa for prestressed beams.

NOTE For prestressed concrete beams for which the minimum concrete strength required at time of release is given, it is not necessary to check the strength of the concrete on the delivery date.

The concrete class shall not be less than C25/30 for reinforced beams and C30/37 for prestressed beams.

4.2.3 Structural reinforcement

4.2.3.1 Processing of reinforcing steel

4.2.3.1 of EN 13369:2004 shall apply.

4.2.3.2 Tensioning and prestressing

4.2.3.2.1 Initial tensioning stresses

4.2.3.2.1 of EN 13369:2004 shall apply.

4.2.3.2.2 Accuracy of tensioning

4.2.3.2.2 of EN 13369:2004 shall apply.

4.2.3.2.3 Minimum concrete strength at time of release

At the time of release of prestressing, the minimum compressive strength, $f_{cmin,p}$, shall be at least (5/3) σ_{cp} where σ_{cp} is the compressive stress developed in the bottom fibre of the beam under the final prestressing force, or 20 MPa, whichever is the greater.

Minimum concrete strength at time of release shall be verified in accordance with 5.1.

4.2.3.2.4 Slippage of tendons

Complementary to 4.2.3.2.4 of EN 13369:2004, the maximum slippage values for protruding tendons should be deduced from Table 1. If the initial prestressing force, σ_0, is lower than the maximum prestressing force, σ_{0max}, as defined in 4.2.3.2.1 of EN 13369:2004, the values of Table 1 shall be reduced by σ_0 / σ_{0max} ratio.

Table 1 — Maximum slippage values for protruding tendons, ΔL_o, in mm

Wires			Strands		
diameter	$f_{cmin,p}$ = 20 MPa	$f_{cmin,p}$ = 30 MPa	diameter	$f_{cmin,p}$ = 20 MPa	$f_{cmin,p}$ = 30 MPa
∅ 4	2,0	2,0	∅ 5,2	2,5	2,5
∅ 5	2,2	2,0	∅ 6,85	2,8	2,5
∅ 6	2,4	2,0	∅ 9,3	3,0	2,5
∅ 7	2,6	2,3	∅ 12,5	3,5	3,0

NOTE “Good” bond conditions are obtained for extruded, slipformed or moulded elements. For the description of “good” and “poor” bond conditions, Figure 8.2 of EN 1992-1-1:2004 applies.

Slippage of tendons shall be verified in accordance with 5.4.2.

4.2.3.2.5 Limit values for prestressing force

The value of the prestressing force is limited by the following two conditions:

a) Minimum prestress

Under the single action of the final prestressing force, the average prestress cross section shall be no less than 2 MPa and the prestress at the bottom fibre shall be at least 4 MPa.

b) Maximum prestress

The maximum tensile stress in the upper fibre of the concrete as a result of the action of the prestressing force and the dead weight of the beam shall be limited.

NOTE A value of 0,30 $f_{cmin,p}^{2/3}$ may be used, where $f_{cmin,p}$ is the strength of the concrete at time of release.

The minimumum compressive stress shall be verified according to 4.2.3.2.3.

4.2.3.2.6 Losses of prestress

The final prestressing force, $P_{m,\infty}$, is equal to the initial prestressing force, P_o, less the total losses ΔP after an infinite time.

For the determination of prestressing losses, in the absence of more accurate calculation, the values should be deduced from Table 2.

Table 2 — Final losses of prestress

Initial stress in the tendons (σ_{0max})	Final losses at infinite time in percentage of initial prestress force ($\Delta P/P_0$ %)
min (0,85 f_{pk}; 0,95 $f_{p0,1k}$)	22 %
0,80 f_{pk}	21 %
0,75 f_{pk}	20 %
0,70 f_{pk}	19 %
0,65 f_{pk}	17 %

4.2.4 Positioning of reinforcement

4.2.4.1 Transfer of bond stress

When a clay toe or a clay shell is present, the distance between the outer surface of the longitudinal reinforcement and the nearest internal face of the clay unit shall not be less than the values given below:

— ∅ mm or 5 mm (whichever is the greater) for prestressed reinforcement;

— ∅ mm or 8 mm (whichever is the lesser) for ordinary reinforcement;

where ∅ is the bar diameter.

4.2.4.2 Correct concreting and compaction of the concrete

Unless it can be justified otherwise, the nominal clear spacing between bars or bundles of bars constituting the main reinforcement shall be at least equal to those as shown in Figure 4, where d_g is the maximum size of aggregate.

For beams with clay shells, the external shape of the beams corresponds to the internal shape of the ceramic shells.