



**SLOVENSKI STANDARD**  
**SIST EN 13224:2004+A1:2007**

**01-julij-2007**

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Precast concrete products - Ribbed floor elements

Betonfertigeteile - Deckenplatten mit Stegen

Produits préfabriqués en béton - Éléments de plancher nervurés

Ta slovenski standard je istoveten z: **EN 13224:2004+A1:2007**

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English Version

## Precast concrete products - Ribbed floor elements

Produits préfabriqués en béton - Éléments de plancher  
nervurés

Betonfertigteile - Deckenplatten mit Stegen

This European Standard was approved by CEN on 24 June 2004 and includes Corrigendum 1 issued by CEN on 25 May 2005 and Amendment 1 approved by CEN on 3 May 2007.

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 Management Centre or to any CEN member.

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.

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COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

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## Contents

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.

	page
Foreword.....	4
Introduction .....	6
1 Scope .....	7
2 Normative references .....	7
3 Terms, definitions, and symbols.....	7
3.1 Terms and definitions .....	7
4 Requirements .....	7
4.1 Material requirements .....	7
4.2 Production requirements .....	8
4.3 Finished product requirements.....	8
4.3.1 Geometrical properties .....	8
4.3.2 Surface characteristics .....	9
4.3.3 Mechanical resistance.....	9
4.3.4 Resistance and reaction to fire .....	10
4.3.5 Acoustic properties .....	10
4.3.6 Thermal properties .....	10
4.3.7 Durability .....	10
4.3.8 Other requirements.....	11
5 Test methods.....	11
5.1 Tests on concrete .....	11
5.2 Measuring of dimensions and surface characteristics .....	11
6 Evaluation of conformity.....	11
6.1 General.....	11
6.2 Type testing.....	11
6.3 Factory production control.....	12
7 Marking and labelling .....	12
8 Technical documentation .....	12
Annex A (informative) Examples of elements .....	13
Annex B (normative) Minor floor elements.....	14
B.1 General.....	14
B.2 Additional requirements for Minor Floor Elements.....	14
B.2.1 General.....	14
B.2.2 Dimensions.....	14
B.2.3 Minimum strength of concrete .....	15
B.3 Special rules for Minor Floor Elements .....	15
B.3.1 Bearing length.....	15
B.3.2 Transverse load distribution .....	15
B.3.3 Detailing.....	16
Annex C (informative) Unintended negative moments.....	18
Annex D (informative) Thermal maps.....	21

<b>Annex E</b> (informative) <b>Transverse load distribution</b> .....	<b>25</b>
<b>Annex F</b> (informative) <b>Diaphragm action</b> .....	<b>26</b>
<b>Annex Y</b> (informative) <b>Choice of CE marking method</b> .....	<b>27</b>
<b>Y.1</b> <b>General</b> .....	<b>27</b>
<b>Y.1</b> <b>Method 1</b> .....	<b>27</b>
<b>Y.2</b> <b>Method 2</b> .....	<b>27</b>
<b>Y.3</b> <b>Method 3</b> .....	<b>27</b>
<b>Annex ZA</b> (informative) <b>Clauses of this European Standard addressing essential requirements or other provisions of EU Directives</b> .....	<b>28</b>
<b>ZA.1</b> <b>Scope and relevant characteristics</b> .....	<b>28</b>
<b>ZA.2</b> <b>Procedure for attestation of conformity of precast ribbed floor elements</b> .....	<b>29</b>
<b>ZA.2.1</b> <b>System of attestation of conformity</b> .....	<b>29</b>
<b>ZA.2.2</b> <b>EC Certificate and Declaration of conformity</b> .....	<b>30</b>
<b>ZA.3</b> <b>CE marking and labelling</b> .....	<b>31</b>
<b>ZA.3.1</b> <b>General</b> .....	<b>31</b>
<b>ZA.3.2</b> <b>Declaration of geometrical data and material properties</b> .....	<b>32</b>
<b>ZA.3.3</b> <b>Declaration of product properties</b> .....	<b>34</b>
<b>ZA.3.4</b> <b>Declaration of compliance with a given design specification</b> .....	<b>37</b>
<b>Bibliography</b> .....	<b>39</b>

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[SIST EN 13224:2004+A1:2007](https://standards.iteh.ai/catalog/standards/sist/a66fd34-2684-48a3-88c2-ddc28a6c15b9/sist-en-13224-2004a1-2007)

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## Foreword

This document (EN 13224:2004+A1:2007) has been prepared by Technical Committee CEN/TC 229 "Precast concrete products", the secretariat of which is held by AFNOR.

This document shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2007 and conflicting national standards shall be withdrawn at the latest by December 2007.

This document includes Amendment 1, approved by CEN on 2007-05-03 and includes Corrigendum 1 issued by CEN on 2005-05-25.

This document supersedes EN 13224:2004.

The start and finish of text introduced or altered by amendment is indicated in the text by tags  $\boxed{A_1}$   $\boxed{A_1}$ .

The modifications of the related CEN Corrigendum have been implemented at the appropriate places in the text and are indicated by the tags  $\boxed{AC}$   $\boxed{AC}$ .

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 Construction Products Directive (89/106/EEC) of European Union (EU).

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

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 products*, from which also the relevant requirements of the *EN 206-1: Concrete - Part 1: Specification, performances, production and conformity* are taken.

The references to EN 13369 by CEN/TC229 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 an European prestandard. In all countries it can be accompanied by alternatives for national application and it shall not be treated as a European Standard.

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*
- prEN 12794, *Precast concrete products - Foundation piles*
- EN 12843, *Precast concrete products - Masts and poles*
- EN 13224, *Precast concrete products - Ribbed floor elements*
- EN 13225, *Precast concrete products - Linear structural elements*
- EN 13693, *Precast concrete products - Special roof elements*
- prEN 13747, *Precast concrete products - Floor plates for floor systems*

- prEN 13978, *Precast concrete products - Precast concrete garages*
- prEN 14843, *Precast concrete products – Stairs*
- prEN 14844, *Precast concrete products - Box culverts*
- prEN 14991, *Precast concrete products - Foundation elements*
- prEN 14992, *Precast concrete products - Wall elements: Products properties and performances*
- prEN 15037, *Precast concrete products - Beams for beam-and-block floor systems*

This standard defines in Annex ZA the application methods of CE marking to products designed using the relevant EN Eurocodes (EN 1992-1-1 and EN 1992-1-2). 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.

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## 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 and resistance to fire reference is made to EN 1992-1-1 and EN 1992-1-2. Additional complementary rules are provided where necessary.

Clauses 4.3.3 and 4.3.4 of this document includes specific provisions resulting from the application of EN 1992-1-1, and EN 1992-1-2 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 and EN 1992-1-2.

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## 1 Scope

This document identifies the requirements, the basic performance criteria and evaluation of conformity for precast ribbed elements made of reinforced or prestressed normal weight concrete, used in floors or roofs. The elements consist of a top slab and one or more (usually two) ribs, containing the main longitudinal reinforcement; a bottom slab and transverse ribs may also be present.

Some examples of precast elements considered in this document are shown in the Informative Annex A.

This document covers terminology, performance criteria, tolerances, relevant physical properties, test methods and aspects of transport and erection.

This document does not cover load bearing capacity determined by testing.

## 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 1991-1-6:2003, *General actions – Actions during executions*.

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

## 3 Terms, definitions, and symbols

### 3.1 Terms and definitions

For the purpose of this document, the definitions given in EN 1992-1-1:2004 and EN 13369:2004 and the following apply.

#### 3.1.1

##### **ribbed precast concrete element**

precast unit consisting in a slab stiffened by one or more ribs

#### 3.1.2

##### **minor floor element**

ribbed precast floor elements having limited dimensions, which are in compliance with the normative Annex B

## 4 Requirements

NOTE Requirements for minor floor elements are listed in the Annex B.

### 4.1 Material requirements

For general aspects, constituent materials of concrete, reinforcing and prestressing steel, inserts and connectors, the relevant clauses of EN 13369:2004 4.1 shall apply. In particular the ultimate tensile and tensile yield strength of steel shall be considered.

**4.2 Production requirements**

The production of precast ribbed elements shall comply with the requirements in EN 13369:2004, Clause 4.2.

NOTE In addition to Clause 4.2.2 of EN 13369:2004, for cast-in-situ concrete considered to act compositely with precast units in the structural resistance (e.g. structural toplayer), the minimum strength class is C 20/25.

In particular the compressive strength of concrete shall be considered.

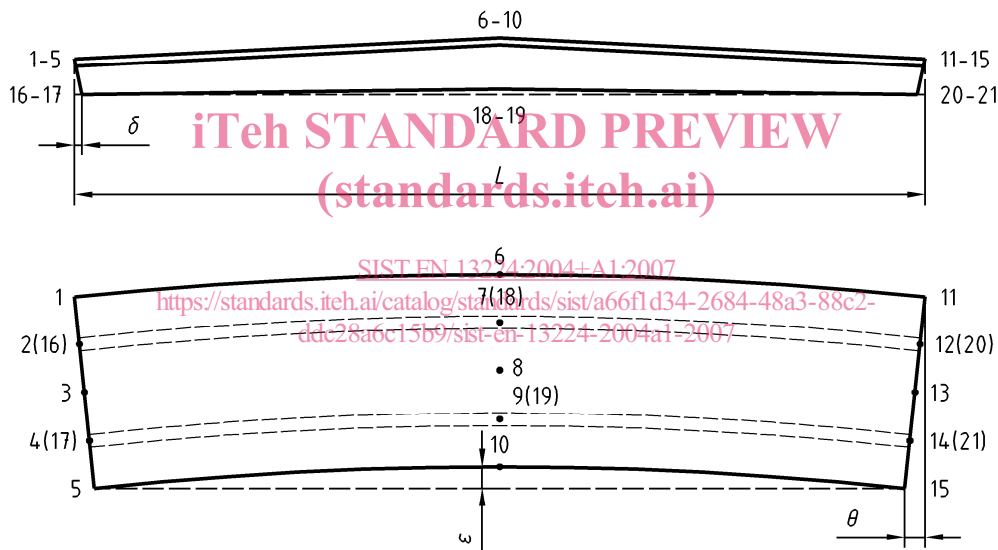
For minor floor elements, strength classes shall comply with B.2.3.

**4.3 Finished product requirements**

**4.3.1 Geometrical properties**

**4.3.1.1 Production tolerances**

Complementary to Clause 4.3.1.1 of EN 13369:2004 the following tolerance shall apply (Figure 1).



**Figure 1 — Reference points for standard check of tolerances**

DIMENSION	PERMITTED DEVIATION (mm)
Skewness ( $\theta$ )	$\pm 15$
Lateral bow ( $\epsilon$ )	$\pm 10$ or $L/1\ 000$ (whichever is greater)
Planarity	$\pm 15$
Angular deviation of ribs ( $\delta$ )	$\pm 15$

Methods of measurements are given in 5.2.

For prestressed elements the values of tolerance in lateral bow ( $\epsilon$ ) and angular deviation of ribs ( $\delta$ ) can be increased by 50 %; this includes the effect of prestressing tolerances.

The differences in camber or sag, with respect to the declared value, shall be not greater than  $L/500$ .

For minor floor elements according to Annex B, the permitted deviation on length is  $\pm 25$  mm.

#### 4.3.1.2 Minimum dimensions

Clause 4.3.1.2 of EN 13369:2004 shall apply.

#### 4.3.1.3 Longitudinal connections

If the precast units are connected along their longitudinal edges by means of a cast in situ mortar or concrete joint, the minimum joint width shall be at least 30 mm at the top to allow satisfactory casting. The joint face shall be provided with at least one groove. The size shall be appropriate with regard to the shear resistance of the grout.

If tie bars are to be anchored within the joint, the joint width at the tie bar level shall be at least three times the diameter of the bar to enable a satisfactory bond and a complete encasing of the bar.

If welded connections are used, the connection devices should be designed in order to allow an easy compensation of camber and erection deviations and welding execution.

#### 4.3.1.4 Concrete cover

For the protection against corrosion Clause 4.3.7 of EN 13369:2004 shall apply.

For minor floor elements see Annex B.

#### 4.3.2 Surface characteristics

Clause 4.3.2 of EN 13369:2004 shall apply.

#### 4.3.3 Mechanical resistance

Clauses 4.3.3.1 to 4.3.3.5 of EN 13369:2004 shall apply except 4.3.3.4.2007

For minor floor elements see Annex B.

For transverse distribution of loads see Annex E.

For diaphragm actions see Annex F.

##### 4.3.3.1 Transient situations

For transient situations, Clause 4.3.3.6 of EN 13369:2004 shall apply.

Unless compensating devices are used during lifting, each suspension point should be verified on the basis that only two are being active.

In the erection phases in which the access of workers on the elements can be expected, the construction loads of EN 1991-1-6 shall be considered and the supports for safety devices shall withstand the appropriate horizontal force, placed in the most unfavourable position of the upper side of the protection rail.

##### 4.3.3.2 Shear reinforcement

It is allowed to omit the transversal shear reinforcement where it is not required by the resistance to loads or fire verification provided adjacent units are connected.

At least the minimum shear reinforcement according to Clause 9.2.2 of EN 1992-1-1 shall be provided in the anchorage zone of prestressing strands, unless a greater area is required by the relevant verification.

In ribs having thickness not exceeding  $\overline{A}_1$  120 mm  $\overline{A}_1$  the shear reinforcement may be shaped in one leg only, placed in the middle plane of the rib and properly anchored beyond the main reinforcement.

#### 4.3.3.3 Shear and negative moments

In elements without shear reinforcement, negative moments and unintended restraining effects at the supports should be considered in the design of the elements and in the detailing of the connections at the supports in order to prevent possible restraint cracks which can initiate shear failure near the support.

Two methods to deal with negative or unintended fixing moments are applicable:

- detailing the connection in such a way that these negative moments will not occur;
- design by calculations. Design methods to consider negative or unintended moments are given in Annex C.

#### 4.3.3.4 Longitudinal shear

Clause 6.2.4 of EN 1992-1-1 shall apply.

If the composite action with a cast on site topping is considered, the producer shall declare the type of roughness of the surface according to clause 6.2.5 of EN 1992-1-1.

#### 4.3.3.5 Bearing system

The bearing system shall allow the longitudinal shortening of elements.

NOTE Soft pads designed according to the actual support conditions are usually suitable. Full restraint supports of prestressed elements at both ends (for instance by welding) should be avoided unless the effect of restrained deformations is carefully taken into account.

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#### 4.3.4 Resistance and reaction to fire

##### 4.3.4.1 Resistance to fire

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Fire resistance dealing with loadbearing capacity R, integrity E and insulation I of ribbed floor elements, expressed in terms of classes, shall be declared following  $\text{A}_1$  4.3.4.1 and 4.3.4.2  $\text{A}_1$  of EN 13369:2004.

Load bearing classification R by calculation may be carried out using the thermal maps given in Annex D.

Load bearing classification R by tabulated data may be made on the basis of data given in EN 1992-1-2 using beam data for the ribs and slab data for the slab, respectively.

NOTE If the option of tabulated data is selected, as they do not take into account the actual position of the reinforcement nor the actual load level, they usually lead to an over dimensioning of the cross section.

##### 4.3.4.2 Reaction to fire

For reaction to fire, Clause 4.3.4.4 of EN 13369:2004 shall apply.

#### 4.3.5 Acoustic properties

Clause 4.3.5 of EN 13369:2004 shall apply.

#### 4.3.6 Thermal properties

Clause 4.3.6 of EN 13369:2004 shall apply.

#### 4.3.7 Durability

Clause 4.3.7 of EN 13369:2004 shall apply.

#### 4.3.8 Other requirements

##### 4.3.8.1 Safety in handling

Clause 4.3.8.1 of EN 13369:2004 shall apply.

##### 4.3.8.2 Safety in use

Clause 4.3.8.2 of EN 13369:2004 shall apply.

### 5 Test methods

Clause 5 of EN 13369:2004 shall apply, with the following rules.

#### 5.1 Tests on concrete

Clause 5.1 of EN 13369:2004 shall apply.

#### 5.2 Measuring of dimensions and surface characteristics

Clause 5.2 of EN 13369:2004 shall apply with the following additional rules (see Figure 1):

Skewness ( $\theta$ ):	(for elements having rectangular shape only), check the distance of points 5 and 15 from straight lines normal to the straight line 1-11, containing respectively the points 1 and 11;
Lateral bow ( $\epsilon$ ):	check the distance of points 6 and 10 from straight lines respectively 1-11 and 5-15;
Planarity:	place the element, subjected to self weight and prestressing (if any) on a horizontal plane; check the distance from each point 16, 17, 20, 21 to the plane containing the remaining three;
Angle deviation of the rib ( $\delta$ ):	check the distance of points 2 and 12 (4 and 14) from straight lines normal to the lines 16-20 (17-21), containing respectively the points 16 and 20 (17 and 21). The effect of self weight and prestressing (if any) shall be evaluated by calculation and deducted from the measurements;
Camber or sag:	measure the maximum distance of the bottom of ribs from straight lines 16-20 and 17-21 respectively and compare to the design value.

### 6 Evaluation of conformity

#### 6.1 General

Clause 6.1 of EN 13369:2004 shall apply.

#### 6.2 Type testing

Clause 6.2 of EN 13369:2004 shall apply.