SLOVENSKI STANDARD
SIST EN 13369:2004

01-oktober-2004

Nadomeġļa:
SIST EN 13369:2002

Skupna pravila za montažne betonske izdelke

Common rules for precast concrete products

Allgemeine Regeln für Betonfertigteile

Regles communes pour les produits préfabriqués en béton

Ta slovenski standard je istoveten z: EN 13369:2004

ICS:

91.100.30	Beton in betonski izdelki	Concrete and concrete products

SIST EN 13369:2004 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13369

July 2004

ICS 91.100.30

Supersedes EN 13369:2001

English version

Common rules for precast concrete products

Règles communes pour les produits préfabriqués en béton

Allgemeine Regeln für Betonfertigteile

This European Standard was approved by CEN on 19 March 2004.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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Ref. No. EN 13369:2004: E

Contents

Foreword

This document (EN 13369:2004) has been prepared by Technical Committee CEN/TC 229 “Precast concrete products”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by January 2005, and conflicting national standards shall be withdrawn at the latest by January 2005.

This document supersedes EN 13369:2001.

This document includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

This European Standard is intended to outline the general common requirements applicable to a large variety of precast concrete products manufactured in a factory environment. It will act as a reference standard for other standards to enable a more consistent approach to standardisation in the field of precast concrete products and to reduce the variations brought about by a large number of standards being produced in parallel by different groups of experts. At the same time it allows those experts the flexibility to include variations in specific product standards where they are required.

This standard has been produced as part of the total CEN programme for construction and is in phase with associated standards EN 206-1 for concrete and EN 1992 for the design of concrete structures. As it is not a harmonized standard it may not be used in isolation for the purpose of CE marking of concrete products.

The design of structural products should be verified to ensure the fitness of their properties for the particular application, particular attention being paid to design co-ordination with other parts of the construction.

1 Scope

This European Standard specifies the terminology, requirements, basic performance criteria, test methods and evaluation of conformity that will be referred to by specific product standards unless they are not appropriate. It may also be used to specify products for which there is no standard. Not all of the requirements (clause 4) of this standard are relevant to all precast products.

If a specific precast concrete product standard exists it takes precedence over this standard.

The precast products dealt with in this standard are factory produced for building and civil engineering works. This standard may also be applied to products manufactured in temporary plants on site if the production is protected against adverse weather conditions and controlled following clause 6 provisions.

The analysis and design of precast concrete products is not within the scope of this standard but it does offer, for non seismic zones, information about:

— the choice of partial safety factors defined by the pertinent Eurocode;

— the definition of some requirements for prestressed concrete products.

This standard applies to compact concrete with no appreciable amount of entrapped air other than entrained air and with a dry density equal to or greater than 800 kg/m^3. It does not cover prefabricated reinforced components of lightweight aggregate concrete with open structure.

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.

2.1 General references

National documents take precedence until Eurocodes are published as European Standards.

EN 1990, *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.*

2.2 Concrete

EN 206-1:2000, *Concrete - Part 1: Specification, performance, production and conformity.*

EN 933-1, *Tests for geometrical properties of aggregates - Part 1: Determination of particle size distribution - Sieving method.*

EN 934-2, *Admixtures for concrete, mortar and grout - Part 2: Concrete admixtures - Definitions, requirements, conformity, marking and labelling.*

EN 1097-6, *Tests for mechanical and physical properties of aggregates - Part 6: Determination of particle density and water absorption.*

EN 12390-2, *Testing hardened concrete - Part 2: Making and curing specimens for strength tests.*

EN 12390-3, *Testing hardened concrete - Part 3: Compressive strength of test specimens.*

EN 12390-7, *Testing hardened concrete - Part 7: Density of hardened concrete.*

EN 12504-1, *Testing concrete in structures - Part 1: Cored specimens - Taking, examining and testing in compression.*

2.3 Steel

prEN 10080:1999, *Steel for the reinforcement of concrete - Weldable reinforcing steel - Part 1: General requirements*.

prEN 10138-1, *Prestressing steels - Part 1: General requirements.*

prEN 10138-2, *Prestressing steels - Part 2: Wire.*

prEN 10138-3, *Prestressing steels - Part 3: Strand.*

prEN 10138-4, *Prestressing steels - Part 4: Bars.*

2.4 Fire performance

EN 13501-1, *Fire classification of construction products and building elements - Part 1: Classification using test data from reaction to fire tests.*

EN 1991-1-2, Eurocode *1: Actions on structures - Part 1-2: General actions - Actions on structures exposed to fire.*

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

2.5 Acoustic insulation

EN ISO 140-3, *Acoustics - Measurement of sound insulation in buildings and of building elements – Part 3: Laboratory measurements of airborne sound insulation of building elements (ISO 140-3:1995).*

EN ISO 140-6, *Acoustics - Measurement of sound insulation in buildings and of building elements – Part 6: Laboratory measurements of impact sound insulation of floors (ISO 140-6:1998).*

EN ISO 717-1, *Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation (ISO 717-1:1996)*.

EN ISO 717-2, *Acoustics - Rating of sound insulation in buildings and of building elements - Part 2: Impact sound insulation (ISO 717-2:1996)*.

2.6 Thermal resistance

EN ISO 10456:1999, *Building materials and products - Procedures for determining declared and design thermal values (ISO 10456:1999).*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 General

3.1.1
concrete product
mass produced concrete unit manufactured in accordance with a product standard or this standard

NOTE Examples of concrete products are roof tiles, blocks, flags, garden furniture, etc., as opposed to precast products which normally will be structural units.

3.1.2
precast element
concrete unit cast and cured in a place other than the final location in the works

3.1.3
precast product
precast element designed and manufactured in accordance with a product standard or this standard

3.1.4
(concrete) cover
distance from the surface of embedded reinforcement to the nearest concrete surface

3.1.5
design (nominal) cover
value of the cover quoted in the project documentation (equal or greater to the minimum cover plus the permitted negative deviation)

3.1.6
minimum cover
minimum required value for actual cover

3.1.7
actual cover
cover measured on the finished product

3.1.8
type of concrete
concrete of a continuing factory production made with the same mix design and the same batching, casting and curing techniques, for the same strength class of the hardened material

3.2 Dimensions

3.2.1
principal dimensions
length, width, depth or thickness

3.2.2
critical dimension
dimension having a critical influence on an essential performance of the product, such as the product resistance and/or the building stability

3.2.3
design (nominal) dimension
dimension targeted in the project documentation

3.2.4
actual dimension (of the product)
dimension found by measurement (on the finished product)

3.3 Joints

3.3.1
joint
any type of interface between adjacent components

3.3.2
structural joint
any type of connection between products able to transmit forces (e.g. tensile, compressive, flexural or shear forces)

3.3.3
movement joint
joint that permits relative movement

3.3.4
expansion joint
movement joint for expansion (e.g. thermal) of the adjacent parts

3.4 Special devices

3.4.1
shear connector
connection device which transmits shear forces

3.4.2
anchorage (post-tensioned construction)
device to connect the end of a tendon to the concrete of a structural product and retain the force in the tendon

3.4.3
tie
tensile reinforcement for the connection of the parts of a structure

3.4.4
fastening
jointing device used for connecting one part to another

3.5 Supporting elements

3.5.1
bearing
support on which precast products are placed

3.5.2
bearing pad
element interposed between the supported product and the bearing

3.5.3
mortar bed
bearing pad composed of mortar

3.6 Tolerances

3.6.1
tolerance
permitted variation of dimension

3.6.2
deviation
difference between an actual dimension and the corresponding design dimension

3.6.3
production tolerance
tolerance on thickness, length, straightness, planarity, or other dimensions after production of a precast unit

3.6.4
erection tolerance
tolerance on local placing, verticality, horizontality, or other characteristics of the construction assembly after installation

3.6.5
construction tolerance
tolerance in a measure arising from a combination of production, setting out, site work and erection tolerances

3.7 Durability

3.7.1
durability
ability of a construction or a component to maintain adequate levels of stability and serviceability during its design working life under intended use with anticipated maintenance but without excessive unforeseen maintenance

3.7.2
working life
period of time during which the performance of the product in the works will be kept at a level compatible with the fulfilment of the performance requirements of the works, provided it is properly maintained

3.7.3
design working life
working life assumed for the design purposes

3.7.4
environmental condition
ambient actions on the construction affecting its durability

3.8 Mechanical properties

3.8.1
potential strength (of concrete)
concrete strength derived from tests on cubes or cylinders conforming to EN 12390-3 made and cured in laboratory conditions in accordance with EN 12390-2

3.8.2
structural (actual) strength (of concrete)
concrete strength derived from tests on specimens (drilled cores or cut prisms) extracted from the finished product (direct structural strength) or deduced from tests on standard specimens (as for potential strength) but cured in factory conditions as close as possible to the structural product (indirect structural strength)

3.8.3
characteristic strength
value of strength below which 5 % of the population of all possible strength determinations of the volume of concrete under consideration are expected to fall

3.8.4
design strength (of material)
value obtained by dividing the characteristic strength by the pertinent partial safety factor

3.9 Reinforcement (of concrete products)

3.9.1
prestressed reinforcement
prestressing steel (wire, strand or bars) subjected to pre- or post-tensioning

3.9.2
reinforcement
steel (bars, wire, strand, welded mesh or fabric, lattice girder) not subjected to pre- or post-tensioning

4 Requirements

4.1 Material requirements

4.1.1 General

Only materials with established suitability shall be used.

For a particular material, the establishment of suitability may result from an European Standard which refers specifically to the use of this material in concrete or in concrete products; in absence of an European Standard it may also result, under the same conditions, from an ISO standard.

Where this material is not covered by an European or International Standard, or if it deviates from the requirements of these standards, the establishment of suitability may result from:

— the relevant national standards or provisions valid in the place of use of the product which refer specifically to the use of this material in concrete or in concrete products;

or

— a European Technical Approval specifically for the use of this material in concrete or concrete products.

4.1.2 Constituent materials of concrete

EN 206-1:2000, 5.1.2 to 5.1.6 shall apply.

4.1.3 Reinforcing steel

Reinforcing steel (bars, coils and welded fabric) shall comply with prEN 10080, meet the requirements for the technical class specified for the precast product and, where applicable, shall comply with properties given by EN 1992-1-1, when this code is used in design.

Indented bars and wires, with diameters from 6 mm to 14 mm (included), complying with the properties given in annex N, may be used in conjunction with EN 1992-1-1 and national provisions as regards to crack width, transmission length and splitting failure.

Other types of reinforcing steel may be used according to relevant national standards or national provisions valid in the place of use of the product, provided they are fit for the intended purpose and have the required properties.

4.1.4 Prestressing steel

Prestressing steel (wire, bars and strand) shall comply with prEN 10138-1, prEN 10138-2, prEN 10138-3, prEN 10138-4 and, where applicable, with properties given by EN 1992-1-1, when this code is used in design.

Other types of prestressing steel may be used according to relevant national standards or national provisions valid in the place of use of the product.

Information on relaxation of the prestressing steel is given in EN 1992-1-1:2004, 3.3.2.

4.1.5 Inserts and connectors

Mechanical inserts and connectors shall:

a) resist the design actions;

b) have the necessary ductility;

c) maintain these properties for the lifetime of the product.

4.2 Production requirements

4.2.1 Concrete production

4.2.1.1 General

For concrete composition, type of cement, use of aggregates, additions and admixtures, and for resistance to alkali-silica reaction, chloride content and concrete temperature, EN 206-1:2000, 5.2 shall apply.

For specification of concrete EN 206-1:2000 shall apply.

NOTE When concrete is specified by the manufacturer, basic requirements (EN 206-1:2000, 6.2.2) are given in the design documentation and additional requirements (EN 206-1:2000, 6.2.3) are normally not relevant for precast concrete.

4.2.1.2 Placing of concrete

Concrete shall be placed as to retain no appreciable amount of entrapped air other than entrained air and to avoid detrimental segregation.

4.2.1.3 Curing (protection against drying out)

All surfaces of newly cast concrete shall be protected against drying out, by at least one of the methods listed in Table 2, unless it can be shown by tests on the product or otherwise, that no loss in strength or surface cracking will occur in the production environment.

The protection against drying out shall be maintained until the minimum concrete strength (expressed either by the degree of hardening or by the cylinder/cube strength at the end of curing) given in Table 1 is reached. For bridge elements, design working life more than 50 years, or specific to local environmental conditions, other values may be given following the requirements of their destination as indicated in the design documentation.

The concrete strength shall be measured by testing a concrete sample cured in the same manner as the product.

The degree of hardening may be measured either by testing a concrete sample or estimated by calculation using a hardening law based on an initial test and maturity concept.

Table 1 — Minimum concrete strength at the end of protection against drying out

Exposure conditions in the place of use (EN 206-1 exposure classes)		Minimum concrete strength at the end of protection against drying out		
		degree of hardening as % of required strength at 28 days		Cylinder/cube strength N/mm^2
For concrete without reinforcement or embedded metal: all exposures except where there is freeze/thaw, abrasion or chemical attack.	X0	only the requirement on		12/15
For concrete with reinforcement or embedded metal: Dry				
or Permanently wet	XC1	cylinder/cube strength applies		
Wet, rarely dry	XC2, XD2	40	or	16/20
Moderate humidity	XC3			
Moderate saturation				
Without deicing agent	XF1			
Other exposure conditions (cyclic wet and dry)		60	or	25/30

Table 2 — Protection against drying out

Method	Typical means of execution
A - Without addition of water	— keeping the concrete in an environment with a relative humidity above 75 %; — keeping the formwork in place; — covering the concrete surface with vapour-resistant sheets that are secured at the edges and joints to prevent through draughts.
B - Keep the concrete moist by addition of water	— maintaining wet coverings on the concrete surface; — keeping the concrete surface visibly wet by spraying with water; — ponding the concrete surface with water.
C – Use of curing compounds	NOTE Effectiveness of this method should be estimated by initial testing showing that the strength reached with curing compounds is of the same order as the strength obtained by one of the above accepted means of curing.

4.2.1.4 Accelerated hydration by heat treatment

Where heat treatment at atmospheric pressure is applied to concrete during production in order to accelerate its hardening, it shall be demonstrated by initial testing that the required strength is achieved for each concrete family.

In order to avoid microcracking and/or durability defects, the following conditions shall be fulfilled unless previous positive experience has shown that these requirements are not necessary:

— a proper preheating period shall be applied when the heat treatment maximum mean temperature $\overline{T}$ exceeds 40 °C;

— where $\overline{T}$ exceeds 40 °C the temperature difference between adjacent parts of the elements during the heating and the cooling phases shall be limited to 20 °C.

The preheating period and the heating rate shall be documented.

During the full heating and cooling period the maximum mean temperature $\overline{T}$ shall be limited to the values of Table 3. However higher temperatures may be accepted provided the durability of concrete under the specified environment is demonstrated by long term positive experience.

Table 3 — Conditions for accelerated hydration

Product environments	Maximum mean concrete temperature $\overline{T}$ [a]
Predominantly dry or moderate humidity	- $\overline{T} \leq 85$ °C [b]
Wet and cyclic wet	- $\overline{T} \leq 65$ °C.

[a] $\overline{T}$ is the maximum mean temperature within the concrete, individual values may be 5 °C higher.

[b] When 70 °C < $\overline{T} \leq 85$ °C initial tests shall have demonstrated that the required strength is fulfilled at 90 days.

For wet and cyclic wet environments, in case of no long term positive experience, the suitability of the higher temperature treatment shall be demonstrated; the following limits may be a basis for this demonstration: for concrete Na_2Oeq content ≤ 3,5 kg/m^3, for cement SO_3 content ≤ 3,5 % by mass.