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Skupna pravila za montažne betonske izdelke

Common rules for precast concrete products

Allgemeine Regeln für Betonfertigteile

Règles communes pour les produits préfabriqués en béton

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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 21 January 2013.

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN 13369:2013) 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of an identical text or by endorsement, at the latest by October 2013, and conflicting national standards shall be withdrawn at the latest by October 2013.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 supersedes EN 13369:2004.

The main technical changes that have been made in this new edition are the following ones:

a) Scope: precast concrete product made of heavyweight, light and normal concrete; concrete using fibres (steel, polymer or other) is also covered;

b) Normative references have been updated while taking the Bibliography into account;

c) Terms and definitions have been reviewed;

d) Requirements;

e) New clause for reclaimed crushed and recycled coarse aggregates;

f) New wording and requirements for the subclause “Curing (protection against drying out)”;

g) New requirements: tensile strength, shrinkage, dry density;

h) Productions tolerances are revised;

i) New clause on Performance related design;

j) Evaluation of conformity;

k) Type testing, new Annex P, Survey of type testing;

l) Concrete strength, conformity criteria;

m) Annex G, Test of water absorption;

n) Annex Q, Use of reclaimed crushed and recycled coarse aggregates in concrete.

EN 13369 is a common reference for the following group of specific product standards prepared by Technical Committee CEN/TC 229:

— EN 1168, *Precast concrete products — Hollow core slabs*;

— EN 12737, *Precast concrete products — Floor slats for livestock*;

— EN 12794, *Precast concrete products — Foundation piles*;

— EN 12839, *Precast concrete products — Elements for fences*;

— EN 12843, *Precast concrete products — Masts and poles*;

— EN 13198, *Precast concrete products — Street furniture and garden products*;

— 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 13748-1, *Terrazzo tiles — Part 1: Terrazzo tiles for internal use*;

— EN 13748-2, *Terrazzo tiles — Part 2: Terrazzo tiles for external use*;

— 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 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 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-block floor systems — Part 4: Expanded polystyrene blocks*;

— EN 15050, *Precast concrete products — Bridge elements*;

— EN 15258, *Precast concrete products — Retaining wall elements*;

— EN 15435 *Precast concrete products — Normal weight and lightweight concrete shuttering blocks — Product properties and performances*;

— EN 15498, *Precast concrete products — Wood-chip concrete shuttering blocks — Product properties and performances*.

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

Introduction

This document is intended to outline the general common requirements applicable to a large variety of precast concrete products manufactured in a factory environment. It acts as a reference standard for other standards to enable a more consistent approach to standardization in the field of precast concrete products and to reduce the variations brought about by a large number of standards 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 refers to the relevant specifications of associated standards EN 206 (all parts) for concrete and EN 1992 for the design of concrete structures. The installation of some precast concrete products is dealt with by EN 13670.

As it is not a harmonised standard, it may not be used on its own for the purpose of CE marking of precast concrete products.

The design of precast concrete 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 requirements, the basic performance criteria and the evaluation of conformity for unreinforced, reinforced and prestressed precast concrete products made of compact light-, normal- and heavyweight concrete according to EN 206-1 with no appreciable amount of entrapped air other than entrained air. Concrete containing fibres for other than mechanical properties steel, polymer or other fibres is also covered. It does not cover prefabricated reinforced components of lightweight aggregate concrete with open structure.

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 concrete products.

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

The precast concrete 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.

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 206-1:2000[1)], *Concrete — Part 1: Specification, performance, production and conformity*

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

EN 1008, *Mixing water for concrete — Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete*

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

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

EN 1992-1-2:2004[3)], *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*

1) This document is impacted by the stand-alone amendments EN 206-1:2000/A1:2004 and EN 206-1:2000/A2:2005.

2) This document is impacted by the corrigendum EN 1992-1-1:2004/AC:2010.

3) This document is impacted by the corrigendum EN 1992-1-2:2004/AC:2008.

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: Bar*

EN 12350-7, *Testing fresh concrete — Part 7: Air content — Pressure methods*

EN 12390-1, *Testing hardened concrete — Part 1: Shape, dimensions and other requirements for specimens and moulds*

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*

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

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

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

EN ISO 10456, *Building materials and products — Hygrothermal properties — Tabulated design values and procedures for determining declared and design thermal values (ISO 10456)*

ASTM C173 / C173M - 10b, *Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method*

3 Terms and definitions

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

3.1 General

3.1.1
precast concrete product
product which is made of concrete and manufactured in accordance with this standard or a specific product standard in a place different from the final destination of use, protected from adverse weather conditions during production and which is the result of an industrial process under a factory production control system and with the possibility of sorting before delivery

Note 1 to entry: In relevant European Standards, the shorter term “Precast product” is often used.

3.1.2
(concrete) cover
distance between the surface of the reinforcement closest to the nearest concrete surface(including links and stirrups and surface reinforcement where relevant) and the nearest concrete surface

3.1.3
concrete family
group of concrete compositions for which a reliable relationship between relevant properties is established and documented

3.1.4
tendon
prestressing unit (wire, strand or bar) subjected to pre- or post-tensioning

3.1.5
lightweight concrete
concrete with a closed structure and with an oven-dry density of 800 kg/m^3 to 2 000 kg/m³

3.1.6
normal weight concrete
concrete with an oven-dry density of 2 000 kg/m^3 to 2 600 kg/m³

3.1.7
heavyweight concrete
concrete with an oven-dry density of more than 2 600 kg/m³

3.2 Dimensions

3.2.1
principal dimensions
length, width, depth or thickness

3.2.2
nominal dimension
dimension declared in the technical documentation and targeted at manufacture

3.3 Tolerances

3.3.1
tolerance
sum of the absolute values of the upper and the lower permitted deviation

3.3.2
deviation
difference between an actual measure and the corresponding nominal dimension

3.4 Durability

3.4.1
durability
ability of a precast concrete product to satisfy, with anticipated maintenance, the design performance requirements during its design working life under the influence of the expected environmental actions

3.4.2
design working life
assumed period for which a structure or part of it is to be used for its intended purpose with anticipated maintenance but without major repair being necessary

3.4.3
environmental conditions
physical or chemical impacts to which the precast concrete product is exposed and which result in effects on the concrete or reinforcement or embedded metal that are not considered as loads in structural design

3.4.4
ambient conditions
hygrothermic conditions in the factory which result in effects on the hardening process of the concrete

3.5 Mechanical properties

3.5.1
potential strength
compressive concrete strength derived from tests on cubes or cylinders moulded and cured in laboratory conditions in accordance with EN 12390-2

3.5.2
structural strength
compressive concrete strength derived from tests on specimens (drilled cores or cut prisms) taken from the precast concrete product (direct structural strength) or derived from tests on moulded specimens cured in the same ambient conditions as the product itself (indirect structural strength)

3.5.3
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

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 be based on a European Standard which refers specifically to the use of this material in concrete or in precast concrete products; in absence of a European Standard, it may also result, under the same conditions, from an ISO Standard.

Where this material is not covered by a European or ISO Standard, or if it deviates from the requirements of these standards, the establishment of suitability may be based on:

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

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

4.1.2 Constituent materials of concrete

4.1.2.1 General

EN 206-1:2000, 5.1 shall apply.

4.1.2.2 Reclaimed crushed and recycled coarse aggregates

Reclaimed crushed and recycled coarse aggregates, mixed in concrete with other aggregates, shall not adversely alter the rate of setting and hardening of concrete, nor shall it be detrimental to the durability of the precast concrete product in the end use conditions.

The amount of crushed recycled aggregates obtained from precast concrete products manufactured in the same factory, can be used up to 10 % in weight of the total content of aggregates in the concrete mix with no further testing of the mechanical strength of the product or of hardened concrete properties other than testing of compressive concrete strength.

Where required and for specific applications, the amount of reclaimed aggregates might be limited to 5 % in weight.

More detailed recommendations on the use of reclaimed crushed and recycled coarse aggregates are given in Annex Q.

Alternative provisions are under development in the upcoming version of EN 206-1 and should be considered.

4.1.3 Reinforcing steel

Reinforcing steel (bars, coils and welded fabric) shall comply with EN 10080. Other types of reinforcing steel may be used according to provisions valid in the place of use of the product (e.g. EN 1992-1-1:2004, 3.2).

NOTE Recommendations on indented bars and wires are given in Annex N.

4.1.4 Prestressing steel

Prestressing steel (wire, bars and strand) shall comply with prEN 10138-1, prEN 10138-2, prEN 10138-3 and prEN 10138-4.

Other types of prestressing steel may be used according to provisions valid in the place of use of the product (e.g. EN 1992-1-1:2004, 3.3).

4.1.5 Inserts and connectors

Mechanical inserts and connectors shall:

a) resist the design actions;

b) have the necessary ductility.

Permanent connecting parts and fasteners shall maintain these properties for the design working life of the precast concrete product.

Provisions valid in the place of use of the product shall be taken into account.

NOTE Recommendations for the design of some anchors can be found in CEN/TS 1992-4 (all parts); recommendations for the design of lifting and handling devices, can be found in CEN/TR 15728.

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, air content and concrete temperature, EN 206-1:2000, 5.2 and 5.3 shall apply.

For specification of concrete EN 206-1 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 and compaction of concrete

Concrete shall be placed and compacted so as to retain no appreciable amount of entrapped air other than entrained air (e.g. to achieve sufficient frost resistance) to avoid detrimental segregation and to ensure that the reinforcement shall be properly embedded.

4.2.1.3 Curing (protection against drying out)

The concrete shall be protected during curing so that loss in strength and cracking due to temperature and shrinkage and that, if relevant, detrimental effects on durability, are avoided.

All surfaces of newly cast concrete may be protected by one of the methods listed in Table 1 or by any other method applicable in the place of use, unless it is shown by tests and inspection on the finished product or on representative samples, that other means are relevant in the production environment.

Table 1 — Protection against drying out

Method	Typical means of protection
A - Without addition of water	— keeping the concrete in an environment with a relative humidity above 65 % for CEM I and CEM II/A, 75 % for all the other types of binders; — keeping the formwork in place; — covering the concrete surface with vapour-resistant sheets
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
C – Use of curing compounds	Curing compounds used shall conform to provisions valid in the place of use

For methods A and B, the protection shall be maintained until the compressive strength of the sample at the end of curing ($f_{c,cure}$) is equal to or greater than the smallest value of the parameters D_d;f_{ck} and $f_{c,L}$ (cylinders or cubes). The parameters D_d et $f_{c,L}$ are defined in Table 2.

$$f_{c,cure} \geq \text{MIN}\ (D_d;f_{ck}\ ;\ f_{c,L}) \qquad (1)$$

NOTE f_{ck} is the characteristic compressive strength of the concrete at the age of 28 days targeted by the manufacturer.

The measure of the mean compressive strength $f_{c,cure}$ shall be done on concrete samples that are submitted to the same protection against drying out as the product.

For design working life of more than 50 years, or for specific local environmental conditions, other values may be given following the requirements valid in the place of use.

The degree of hardening in Table 2 may either be measured by testing a concrete sample or estimated by calculation using a hardening law based on initial type testing or the maturity concept.

The test result shall be obtained from an individual specimen or the average of the results when two or more specimens made from one sample are tested at the same age.

Table 2 — Minimum strength of the concrete at the end of protection against drying out

Exposure conditions in the place of use (EN 206-1 exposure classes)	Degree of hardening D_d %	Cylinder/cube $f_{c,L}$ MPa
X0, XC1	only requirements on $f_{c,L}$ apply.	12/15
XC2, XC3, XC4, XD1, XD2, XF1	35	12/15[a]
All other exposure conditions (wetting/drying cycles)	50	16/20[b]

[a] This value has to be substituted by $0{,}25.f_{ck}$ if $0{,}25.f_{ck} \geq 12$ MPa (cylinder); 15 MPa (cube).

[b] This value has to be substituted by $0{,}35.f_{ck}$ if $0{,}35.f_{ck} \geq 16$ MPa (cylinder); 20 MPa (cube).

Other means than those defined in Table 2 may be employed if the value of the water absorption of the concrete, measured according to the test procedure defined in Annex G, does not exceed 10 % (in relative proportion) of the value of water absorption of the concrete complying with the requirements in Table 1. The water absorption test is run on (30 ± 1) mm thick samples that include the surface exposed to the environment.

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 concerned.

— Depending on material and climatic conditions, more restricting requirements may apply to the heat treatment of outdoor products in certain areas according to provisions valid in the place of use. The following conditions shall be fulfilled when the maximum mean temperature T_{mean} within the concrete exceeds 40 °C during the curing process unless previous positive experience has shown that special measures are not necessary to avoid micro cracking and/or durability defects: a preheating period shall be applied during which T_{mean} does not exceed 40 °C;

— the temperature difference between adjacent parts of the product during the heating and the cooling phases shall be limited to 20 °C.

The duration and heating rate of the full heating and cooling period (if appropriate) shall be documented.

During the full heating and cooling period T_{mean} 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 T_{mean}[a]
Predominantly dry or moderate humidity	— $T_{mean} \leq 85$ °C [b]
Wet and cyclic wet	— $T_{mean} \leq 65$ °C

[a] Individual values may be 5 °C higher.

[b] When 70 °C < $T_{mean} \leq 85$ °C initial tests shall have demonstrated that the structural strength at 90 d corresponds with normal evolution of hardening with respect to the structural strength obtained at 28 days.