SLOVENSKI STANDARD
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Brizgani beton - 1. del: Definicije, zahteve in skladnost

Sprayed concrete - Part 1: Definitions, specifications and conformity

Spritzbeton - Teil 1: Begriffe, Festlegungen und Konformität

Béton projeté - Partie 1 : Définitions, spécifications et conformité

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Will supersede EN 14487-1:2005

English Version

Sprayed concrete - Part 1: Definitions, specifications and conformity

Béton projeté - Partie 1: Définitions, spécifications et conformité

Spritzbeton - Teil 1: Begriffe, Festlegungen und Konformität

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 104.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

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European foreword

This document (prEN 14487-1:2021) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, the secretariat of which is held by SN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 14487-1:2005.

In comparison with the previous edition, the following technical modifications have been made:

— Table 3 has been added;

— Table 13 has been modified;

— Normative references have been updated.

This document has taken EN 206 as a basis. Some clauses which apply to sprayed concrete refer to EN 206 because of their importance. Other clauses have been modified to meet the specific requirements of sprayed concrete.

This document is only operable with product standards for constituent materials (i.e. cement, aggregates, additions, admixtures, fibres and mixing water) and related test methods for sprayed concrete which form the package defined below. For this reason, the latest date of withdrawal of national standards (DOW) conflicting with this document is determined by TC 104 to be 2023-04-05.

Introduction

This document will be applied in Europe under different climatic and geographical conditions, different levels of protection and under different, well-established, regional traditions and experience. Classes for concrete properties have been introduced to cover this situation. Where such general solutions were not possible, the relevant clauses contain permission for the application of EN 206 or other standards valid in the place of use.

This document incorporates rules for the use of constituent materials that are covered by European Standards. Other by-products of industrial processes, recycled materials etc. are in current use based on local experience. Until European specifications for these materials are available, this document will not provide rules for their use, but instead refers to the recommendations given in EN 206 to apply national standards or provisions valid in the place of use of the concrete.

This document defines tasks for the specifier, producer and user. For example, the specifier is responsible for the specification of concrete, Clauses 5 and 6 and the producer is responsible for conformity and production control, Clause 7. The user is responsible for placing the concrete in the structure. In practice there may be several different parties specifying requirements at various stages of the design and construction process e.g. the client, the designer, the contractor, the concreting sub-contractor. Each is responsible for passing the specified requirements, together with any additional requirements, to the next party in the chain until they reach the producer. In the terms of this document, this final compilation is known as the “specification”.

Further explanations and guidance on the application of this document are given in Annex A.

1 Scope

This document is applicable to sprayed concrete, to be used for repair and upgrading of structures, for new structures and for strengthening of ground.

This document covers:

— classification related to consistence of wet mix;

— environmental exposure classes; young, hardened and fibre reinforced concrete;

— requirements for constituent materials, for concrete composition and for basic mix, for fresh and hardened concrete and all types of fibre reinforced sprayed concrete;

— specification for designed and prescribed mixes;

— conformity.

This document is applicable to wet mix as well as dry mix sprayed concrete. The substrates to which sprayed concrete can be applied include:

— ground (rock and soil);

— sprayed concrete;

— different types of formwork;

— structural components constituted of concrete, masonry and steel;

— drainage materials;

— insulating materials.

Additional or different requirements may be needed for applications not within this document, for instance-refractory uses.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 197-1, *Cement - Part 1: Composition, specifications and conformity criteria for common cements*

EN 206:2013+A1:2016, *Concrete - 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 934-5:2007, *Admixtures for concrete, mortar and grout - Part 5: Admixtures for sprayed concrete - Definitions, requirements, conformity, marking and labelling*

EN 934-6, *Admixtures for concrete, mortar and grout - Part 6: Sampling, assessment and verification of the constancy of performance*

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 1504-3, *Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - Part 3: Structural and non-structural repair*

EN 1542, *Products and systems for the protection and repair of concrete structures - Test methods - Measurement of bond strength by pull-off*

EN 12350-2, *Testing fresh concrete - Part 2: Slump test*

EN 12350-3, *Testing fresh concrete - Part 3: Vebe test*

EN 12350-5, *Testing fresh concrete - Part 5: Flow table test*

EN 12350-6, *Testing fresh concrete - Part 6: Density*

EN 12390-5, *Testing hardened concrete - Part 5: Flexural strength of test specimens*

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

EN 12390-8, *Testing hardened concrete - Part 8: Depth of penetration of water under pressure*

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

EN 12504-2, *Testing concrete in structures - Part 2: Non-destructive testing - Determination of rebound number*

EN 12620, *Aggregates for concrete*

EN 13412, *Products and systems for the protection and repair of concrete structures - Test methods - Determination of modulus of elasticity in compression*

EN 14487-2, *Sprayed concrete - Part 2: Execution*

EN 14488-1, *Testing sprayed concrete - Sampling fresh and hardened concrete*

EN 14488-2, *Testing sprayed concrete - Part 2: Compressive strength of young sprayed concrete*

EN 14488-3, *Testing sprayed concrete - Part 3: Flexural strengths (first peak, ultimate and residual) of fibre reinforced beam specimens*

EN 14488-4, *Testing sprayed concrete — Part 4: Bond strength of cores by direct tension*

EN 14488-5, *Testing sprayed concrete - Part 5: Determination of energy absorption capacity of fibre reinforced slab specimens*

EN 14488-7, *Testing sprayed concrete - Part 7: Fibre content of fibre reinforced concrete*

EN 14889-1:2004, *Fibres for concrete — Part 1: Steel fibres — Definition, specification and conformity*

EN 14889-2:2004, *Fibres for concrete — Part 2: Polymer fibres — Definition, specification and conformity*

ISO 758, *Liquid chemical products for industrial use — Determination of density at 20 degrees C*

ISO 6782, *Aggregates for concrete — Determination of bulk density*

ISO 6784, *Concrete — Determination of static modulus of elasticity in compression*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1 Mix component

3.1.1 Admixtures

3.1.1.1
admixtures for basic mix
material added during the mixing process of concrete in a quantity not more than 5 % by mass of the cement content of the concrete, to modify the properties of the mix in the fresh and /or hardened state

[SOURCE: EN 934-2, definition 3.2.1]

3.1.1.2 Admixtures for projection

3.1.1.2.1
sprayed concrete set accelerating admixture
admixture to develop very early setting and very early hardening of the sprayed concrete differing from set accelerating admixtures

Note 1 to entry: As defined and specified in EN 934-5.

[SOURCE: EN 934-5, definition 3.2.2]

3.1.1.2.2
non-alkaline sprayed concrete set accelerating admixture
sprayed concrete set accelerating admixture with an alkali content not exceeding 1 % by mass of the admixture

Note 1 to entry: Admixture made according to EN 934-5.

[SOURCE: EN 934-5, definition 3.2.3]

3.1.2
additions
finely divided material used in concrete in order to improve certain properties or to achieve special properties

[SOURCE: EN 206, definition 3.1.2.1]

3.1.3
cement
finely ground inorganic material which, when mixed with water, forms a paste that sets and hardens by means of hydration reactions and processes and which, after hardening, retains its strength and stability even under water

[SOURCE: EN 206, definition 3.1.2.8]

3.1.4
aggregate
granular material used in construction. Aggregate may be natural, manufactured or re-cycled

[SOURCE: EN 12620, definition 3.1]

3.1.2 Fibres

3.1.5.1
steel fibres
steel fibres are straight or deformed pieces of cold-drawn steel wire, straight or deformed cut sheet fibres, melt extracted fibres, shaved cold drawn wire fibres and fibres milled from steel blocks which are suitable to be homogeneously mixed into concrete or mortar

[SOURCE: EN 14889-1, definition 3.1]

3.1.5.2
polymer fibres
polymer fibres can be straight or deformed pieces of extruded orientated and cut material which are suitable to be homogeneously mixed into concrete or mortar and which are not affected over time by the high pH of concrete

[SOURCE: EN 14889-2, definition 3.2]

3.2 Product

3.2.1 General

3.2.1.1
basic mix
mixture of cement, aggregates and any other constituents as fed into the spraying machine, excluding any component added at the nozzle. The basic mix may be dry or wet. The basic mix may also contain:

— additions

— admixtures

— fibres

— water

3.2.1.1 Sprayed concrete with fibres

3.2.1.2.1
fibre reinforced sprayed concrete
sprayed concrete, including reinforcing fibres to improve certain properties of concrete

3.2.1.2.2
sprayed concrete with crack reducing fibres
sprayed concrete with fibres that reduces cracking in young sprayed concrete

3.2.1.2.3
sprayed concrete with fibres for fire resistance
sprayed concrete with fibres for improved fire resistance

3.2.1.3
fresh sprayed concrete
concrete prior to setting

3.2.1.4
rebound
part of material that, having been sprayed through the nozzle, does not adhere to the surface of application

3.2.1.5
reference sprayed concrete
sprayed concrete which does not contain admixtures for projection

NOTE This definition cannot be applied to sprayed concrete produced with factory blended dry mix containing admixtures for projection, in this case the admixture compatibility should be controlled according to EN 934-5. The reference sprayed concrete is usually used as reference material for the evaluation of mechanical properties changes with time of sprayed concrete (e.g. strength losses)

3.2.1.6
sprayed concrete
concrete produced with basic mix and projected pneumatically from a nozzle into place to produce a dense homogeneous mass by its own momentum

3.2.1.7
young sprayed concrete
sprayed concrete up to an age of 24 h

3.2.2 Dry mix

3.2.2.1
factory blended dry mix
basic mix with a minimum moisture content not exceeding 0,5 % by mass for the dry process (excluding any component at the nozzle)

3.2.2.2
site batched dry mix
basic mix with a maximum moisture content of the aggregate not exceeding 6 % by mass for the dry process

3.2.3
wet mix
basic mix to be used in the wet process

3.3 Process

3.3.1 dry spraying process

3.3.1.1
pre-wetting
adding water to dry mix before the nozzle, in order to reduce dust and improve mix quality

3.3.1.2
dry mix conveying
method of conveying a dry mix with or without pre-wetting where the necessary amount of additional water is added in the nozzle

3.3.2 wet spraying process

3.3.2.1
dense flow conveying
pump conveying a wet mix to the nozzle, where it is pneumatically projected and compacted by adding high pressure air

3.3.2.2
thin flow conveying
conveying of the basic mix to the nozzle, through hoses or pipes with high pressure air, where the force of the transportation is used to project and compact the mix

3.3.3 General

3.3.3.1
nozzle
general term for the end of the conveying line, through which the mix is discharged

Note 1 to entry: It consists of a mixing unit, into which – depending on the process – water, compressed air and/or admixtures are injected into the flow of the basic mix

3.3.3.2
hose
flexible tube conveying mix

3.3.3.3
pipe
rigid tube conveying mix

3.3.3.4
curing
measures to reduce harmful evaporation and subsequent drying shrinkage of the sprayed concrete

3.4 Properties

3.4.1
early age strength
strength developed by young sprayed concrete

3.4.2
energy absorption capacity
energy, in Joule, absorbed in loading a fibre reinforced plate

Note 1 to entry: As described in EN 14488-5

3.4.3
first peak flexural strength
stress at the determined first peak load which fibre reinforced concrete withstands when subjected to a flexural test

Note 1 to entry: As specified in EN 14488-3

3.4.4
open time
time between mixing and latest possible spraying of the basic mix. It depends on type and quantity of cement, moisture content for the dry mix, type and amount of admixtures and temperature

3.4.5
residual strength
calculated stress in fibre reinforced concrete corresponding to a load in the load-deflection curve recorded during the flexural test

Note 1 to entry: As defined in EN 14488-3

3.4.6
ultimate flexural strength
stress corresponding to the maximum load which unreinforced or fibre reinforced concrete can withstand when subjected to a flexural test

Note 1 to entry: As specified in EN 12390-5 and EN 14488-3

3.5 Execution

3.5.1
free-standing structure
structure formed by spraying concrete against temporary or permanent formwork, which does not act compositely with the ground or an existing structure

3.5.2
repair
replacement of inferior or deteriorated parts of concrete or masonry members

3.5.3
shadow effect
phenomenon of a poorer concrete compaction or voids on the rear side, of for example, a reinforcement bar, which is being sprayed on from one side only