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Preskušanje strjenega betona - 16. del: Ugotavljanje krčenja betona

Testing hardened concrete - Part 16: Determination of the shrinkage of concrete

Prüfung von Festbeton - Teil 16: Bestimmung des Schwindens von Beton

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Testing hardened concrete - Part 16: Determination of the shrinkage of concrete

Essais pour béton durci - Partie 16 : Détermination du retrait du béton

Prüfung von Festbeton - Teil 16: Bestimmung des Schwindens von Beton

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

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European foreword

This document (prEN 12390-16:2018) has been prepared by Technical Committee CEN/TC 104 "Concrete and related products", the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document is based on ISO 1920-8.

This standard is one of a series concerned with testing concrete.

The series EN 12390, *Testing hardened concrete*, is composed of the following parts:

— *Part 1: Shape, dimensions and other requirements of specimens and moulds*

— *Part 2: Making and curing specimens for strength tests*

— *Part 3: Compressive strength of test specimens*

— *Part 4: Compressive strength – Specification for testing machines*

— *Part 5: Flexural strength of test specimens*

— *Part 6: Tensile splitting strength of test specimens*

— *Part 7: Density of hardened concrete*

— *Part 8: Depth of penetration of water under pressure*

— *Part 13: Determination of secant modulus of elasticity*

— *Part 14: Semi-adiabatic method for the determination of heat released by concrete during its hardening process (in preparation)*

— *Part 15: Adiabatic method for the determination of heat released by concrete during its hardening process (in preparation)*

— *Part 16: Determination of shrinkage of concrete (in preparation)*

— *Part 17: Determination of creep of concrete in compression (in preparation)*

1 Scope

This document specifies the procedure for the determination of total shrinkage of concrete specimens in drying conditions.

NOTE 1 Possible shrinkage or length changes occurring before 24 h of age, and which may have significant amplitude and/or consequences, e.g. for high performance concrete and/or in case of restraint, may need to be measured according to a complementary procedure not covered by the present standard.

NOTE 2 Information on a simplified procedure for the determination of autogenous shrinkage is given in Annex A.

The test is suitable for specimens having a declared value of D of the coarsest fraction of aggregates actually used in the concrete (D_{max}) not greater than 32 mm.

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 12350-1, *Testing fresh concrete - Part 1: Sampling*

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*

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 http://www.iso.org/obp

3.1
total shrinkage
relative change of length in defined conditions of temperature and relative humidity

Note 1 to entry: Total shrinkage is the sum of autogenous and drying shrinkage as defined in EN 1992-1-1:2004, 3.1.4 (6).

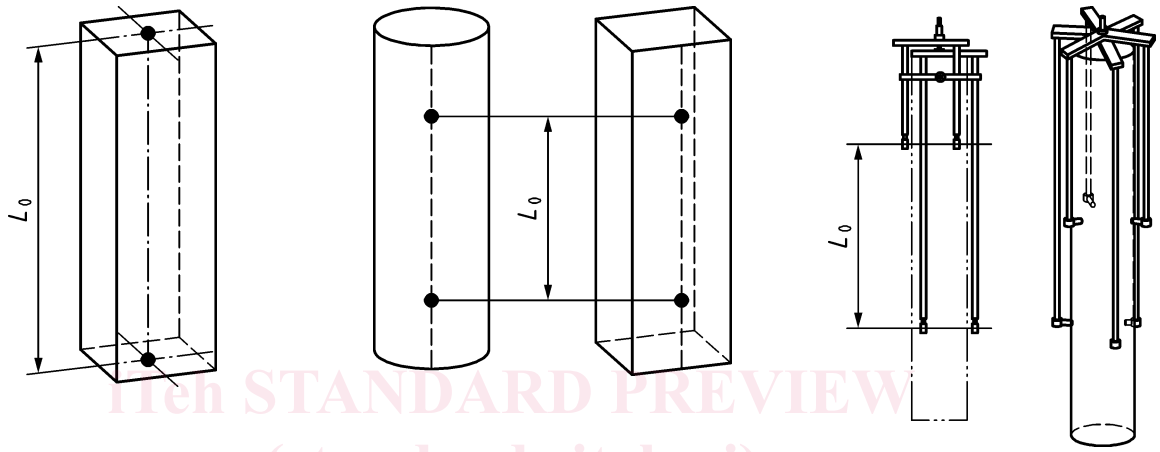
3.2
autogenous shrinkage
shrinkage occurring in isothermal conditions and in the absence of moisture exchange between the specimen and the surrounding environment

3.3
drying shrinkage
conventionally defined as the difference between total shrinkage and autogenous shrinkage

3.4
base or gauge length
length used as reference base for strain measurement

Note 1 to entry: Gauge length (L_0) may be along the principal axis, along a straight line laying on the lateral surface of the specimen and parallel to the principle axis or between two planes.

3.5
measurement points
positions along the principal axis (Figure 1 a)), along a straight line laying on the lateral surface of the specimen and parallel to the principal axis (see Figure 1 b)) or in two planes (see Figure 1 c))



a) measurement points along the principal axis

b) measurement points in a line parallel to the principal axis

c) measurement points in two planes

Figure 1 — Measurement points

4 Principle

Test specimens are subject to changes in length in defined conditions of temperature and relative humidity.

If autogenous shrinkage is to be determined by the simplified procedure, which is needed for the calculation of drying shrinkage, additional specimens are required which are sealed in a protective envelope when moulded or immediately after stripping from the mould (see Annex A).

5 Apparatus

5.1 Drying room or cabinet

A drying room or cabinet with suitably controlled temperature and humidity, for storing specimens in air.

The drying room or cabinet shall meet the following requirements:

a) Air shall be circulated through the room or cabinet in a uniform manner so that the specified conditions are attained adjacent to all specimens under test.

   The air velocity should not exceed 0,5 m/s near the specimens.

b) The temperature in the room or cabinet shall be maintained at (20 ± 2) °C.

c) The relative humidity in the room or cabinet shall have a target value of between 50 % and 70 % and maintained within ± 5 % of the target value. Other values may be used if allowed by national provisions valid in the place of use.

d) The temperature and relative humidity of the room or cabinet shall be monitored throughout the duration of the test and recorded at intervals not exceeding 24 h.

The drying room or cabinet shall be fitted with suitable racks for storing specimens. The racks shall permit free circulation of air around specimens, except for necessary supports, and shall be so situated with respect to the nearest wall or other obstruction that air circulation is not restricted in the intervening space. The horizontal supports shall consist of non-absorptive members having a total bearing width supporting the specimen of not more than 25 mm.

5.2 Length change measuring system

5.2.1 General

The length change measuring device shall have a resolution of at least 0,001 mm and a maximum permissible error of ± 0,01 mm for gauge lengths of 400 mm or more and ± 0,005 mm for gauge lengths less than 400 mm. Gauges relying on friction contact shall not be used.

5.2.2 Callipers or rule

Capable of determining the gauge length with a maximum permissible error of ± 2,0 mm.

5.2.3 Reference bar (optional)

If a specific reference bar is required, it shall be made of invar metal or other material that has a similar coefficient of expansion over the range of test temperatures.

The reference bar shall be compatible with the measuring apparatus used.

The central section of the reference bar may be covered by a rubber tube, or equivalent material to minimize the effect of temperature change during handling.

5.3 Balance

Capable of weighing the specimens with a maximum permissible error of ± 0,02 %.

5.4 Gauge studs

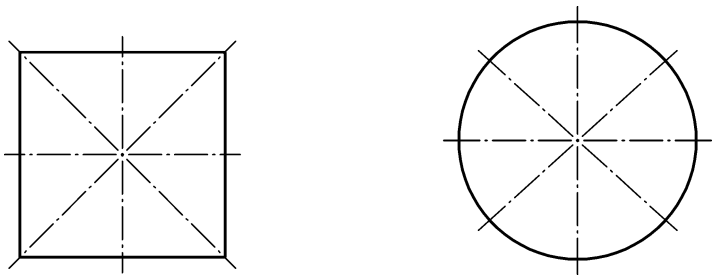
When used, gauge studs shall be made of a hard non-corrosive material that does not react with the concrete and which can be securely fixed on or within the concrete, taking care that no mineral oil or other contaminant remains on the surface of the gauge stud that comes into contact with the concrete.

The design of the studs shall be compatible with the measuring apparatus used.

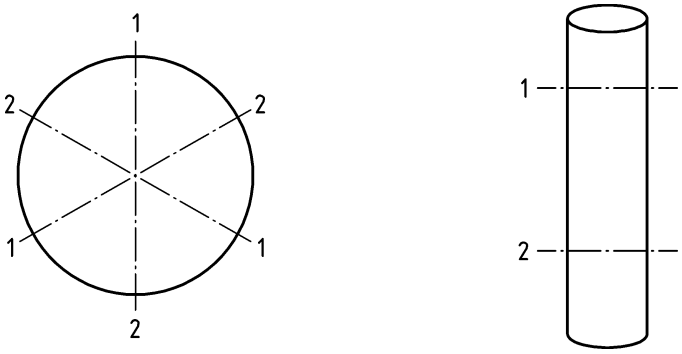
Side face gauge studs shall be arranged such that they are located on a minimum of two measuring lines spaced uniformly around the periphery of the specimen parallel to the principal axis or in two planes (see 5.2.1 for position of gauge studs on prism specimens). In the case of measuring between planes, at least three gauge studs by plane are used.

For prisms, the gauge studs shall not be located on the trowelled face or bottom form face as cast.

End gauge studs shall be arranged so that their principal axis coincides with the principal axis of the test specimen (see Figure 2).



a) Position of end gauge studs on ends of prisms and cylinder specimens



b) Position of gauge studs between planes

Figure 2 — Position of gauge studs

5.5 Base or gauge length

The base or gauge length of the measuring lines shall be at least $L/2$, where L is the specimen length, and the measuring points symmetrically positioned and not located within $d/3$, where d is the specimen diameter or width, of the end of the specimen.

For end gauge studs, (Figure 2 a)), the base or gauge length is the length of the specimen $L_0 = L$ for the adhesion method and for the embedded method $L_0 = L$ - 2 times the embedded part of the studs.

6 Test specimens

6.1 Shape and dimensions

The test specimens shall be moulded (cylinder or prism) or cores complying with the requirements of EN 12390-1 with the exception of nominal dimensions. The ratio between the specimen length L and the dimension d shall be in the range $2 \leq L/d \leq 7$.

NOTE There is the risk that curling may occur with long slender specimens.

If required, the moulds shall allow for the embedment of gauge studs in the specimen.

The size of the specimen has an influence on the shrinkage recorded. For comparison of results obtained from specimens with different shape or dimensions, the concept of notional size h_0 may be used (see EN 1992-1-1:2004 , 3.1.4).

It is recommended to have at least 2 specimens for the determination of shrinkage.

6.2 Sampling

The concrete sample shall be taken in accordance with EN 12350-1.

6.3 Preparation and the filling of the moulds

Prepare, cast and store the specimen(s) in accordance with EN 12390-2. The time (t_{int}) of first contact between cement and water shall be recorded.

Specimen(s) shall be cast within 1 h of t_{int}.

7 Procedure

7.1 Demoulding and preparation of specimen(s)

Specimen(s) shall be demoulded at (24 ± 1) h from the time of casting. Where variations to this time period are necessary, full details shall be noted in the report.

On removal from its mould, each specimen shall be marked with its own unique identification.

When used, surface adhesion gauge studs shall be securely fixed before the commencement of the test.

After demoulding and fixing of gauge studs (if applicable), the specimen(s) shall be weighed, the mass recorded and the gauge length (L_0) measured and recorded. The specimen(s) shall then be placed in the drying room or cabinet.

7.2 Measurement of length change

Before each measurement, clean the gauge stud and the measuring extremities of the measuring device.

After placing the specimen(s) in the drying room (time t_0), measure and record the initial length (relative to the base or gauge length) $l(t_0)$ of each of the specimens without any delay. Where variations to this time period are necessary, full details shall be noted in the report.

In the case of gauge studs located on the side faces of the specimen, $l(t_0)$ is the average of the measurements along each of the measuring lines or between planes.

At each length change measurement, ensure that the readings are stable.

NOTE In the case of end gauge studs, rotating the specimens is a way to improve stability.

Take further measurements $l_{cs}(t)$ on the following dates: t_0+7 d, 14 d, 28 d and 56 d ± 1 d.

Some additional measurements may be recorded if needed at earlier or later ages, e.g. t_0 +3 d ± 1 d and t_0 + 90 ± 1 d.

If the specimens have been removed from the drying room or cabinet, measurements shall be completed within 10 min.

The specimens shall be weighed and the mass recorded at the end of the test and, if required, after each measurement.