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Preskušanje strjenega betona - 17. del: Določanje lezenja betona pri tlačnem preskusu

Testing hardened concrete - Part 17: Determination of creep of concrete in compression

Prüfung von Festbeton - Teil 17: Bestimmung des Kriechens von Beton unter Druckspannung

Essais pour béton durci - Partie 17 : Détermination du fluage du béton en compression

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Testing hardened concrete - Part 17: Determination of creep of concrete in compression

Prüfung von Festbeton - Teil 17: Bestimmung des Kriechens von Beton unter Druckspannung

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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 12390-17:2018) 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 1920-9 and ASTM C512-02.

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 describes the procedure for determining the creep (total, autogenous (basic) and drying) of hardened concrete test specimens subjected to a sustained longitudinal compressive load.

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*

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

EN 12390-13, *Testing hardened concrete - Part 13: Determination of secant modulus of elasticity in compression*

prEN 12390-16, *Testing hardened concrete - Part 16: Determination of shrinkage of concrete*

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
initial strain
strain measured immediately after the application of the test load on the specimen

3.2
creep
time-dependent strain under constant load obtained in defined conditions of temperature and relative humidity

3.2.1
total creep
strain measured under constant load in defined conditions of temperature and relative humidity

3.2.2
autogenous (basic) creep
strain measured in isothermal conditions and in the absence of moisture exchange between the specimen and the surrounding environment

3.2.3
drying creep
conventionally defined as the difference between total and autogenous (basic) creep

3.3
shrinkage strain
strain of specimens determined in accordance with EN 12390-16

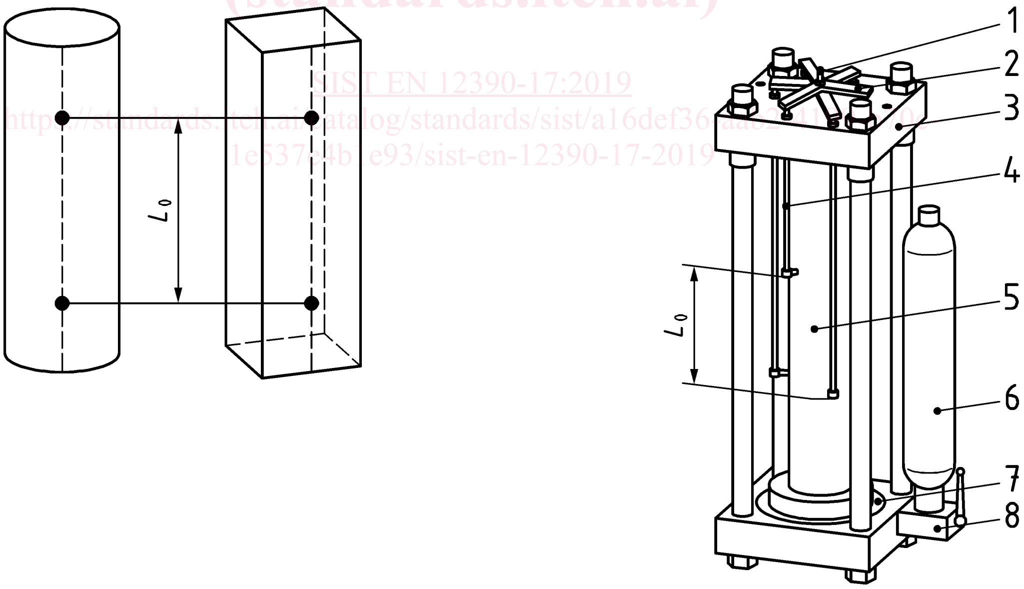
3.4
total strain:
strain measured during the test

Note 1 to entry: This strain is the sum of initial strain, creep and shrinkage.

3.5
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.

3.6
measurement points
positions along the principle axis along a straight line laying on the lateral surface of the specimen and parallel to the principal axis (see Figure 1 a)) or in two planes (see Figure 1 b))



a) Measurement points in a line parallel to principal axis

b) Measurement points in two planes

Key

1	LVDT	5	specimen
2	measurement triangle	6	nitrogen accumulator
3	creep frame	7	load platen
4	invar rod	8	3 way valve

Figure 1 — Measurement points

4 Principle

Test specimens are subjected to a constant compressive load in defined conditions of temperature and relative humidity.

5 Apparatus

5.1 Loading frame

The loading frame shall be sufficiently rigid to ensure uniform loading of the specimen(s) and capable of applying and maintaining the required load to within ± 3 % on the specimen or group of specimens for the duration of the test, irrespective of any change in the dimension of the specimen(s).

NOTE 1 An example of a schematic diagram of a loading frame with 3 specimens operated by a hydraulic arrangement for the measurement of total or autogenous (basic) creep is given in Figure 2. Similar arrangements can also be used for a spring-loaded system in which only the system of loading will be different.

Load shall be measured with a maximum permissible error of ± 2 %.

The flatness tolerance for any plates or platens shall be 0,05 mm for the area in contact with the specimen.

NOTE 2 For the purpose of this European Standard, flatness can be assessed by the measurement of straightness in four positions (see EN 12390-1:2012, Annex B).

A maximum of 3 specimens may be stacked for simultaneous loading in a single loading frame.

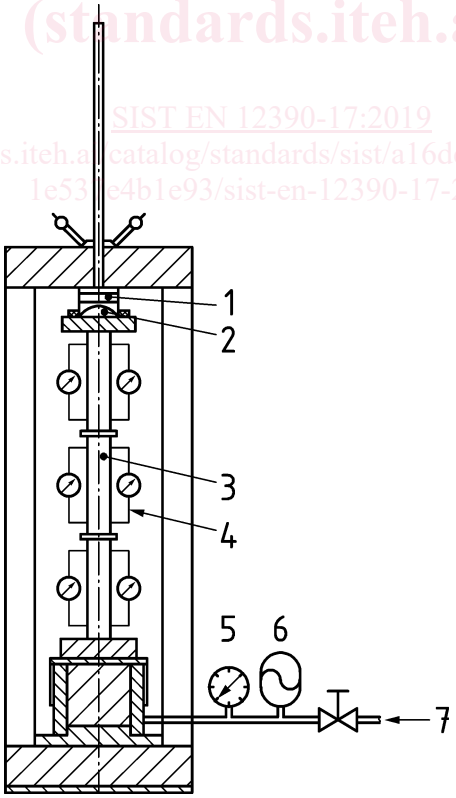


Figure 2 — Example of schematic diagram of a loading frame operated by hydraulics for the measurement of creep in the case of 3 specimens tested simultaneously.

5.2 Drying room or cabinet

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

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 0,5m/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 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.

5.3 Length change measuring system

5.3.1 General

The length change measuring device shall have a resolution of at least 0,001 mm and a maximum 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.

5.3.2 Calipers or rule

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

5.3.3 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.

5.4 Balance

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

5.5 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 principle axis or in two planes (see 5.3.1 for position of gauge studs on prism specimens).

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

5.6 Base or gauge length

The base or gauge length shall be at least $L/2$, where L is the specimen length, with 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.

6 Test specimens

6.1 Shape and dimensions

The test specimens shall be moulded (cylinder or prism) 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 $2 \leq L/d \leq 7$.

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 total strain 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 creep.

Sufficient specimens should be taken to enable the determination of shrinkage and if required secant modulus, testing at different ages.

For the interpretation of the test results to be significant, the determinations of shrinkage and creep shall be made on specimens of the same shape and cross-section, from the same batch of concrete and subjected to the same conditions of storage prior to and during testing.

Companion specimens shall be available for the determination of compressive strength as described in 7.3 and shall be made from the same batch of concrete.

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 specimens in accordance with EN 12390-2. The date and 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 specimens

Specimens 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 studs shall be securely fixed before the commencement of the test.