SLOVENSKI STANDARD
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Preskušanje strjenega betona - 5. del: Upogibna trdnost preskušancev

Testing hardened concrete - Part 5: Flexural strength of test specimens

Prüfung von Festbeton - Teil 5: Biegezugfestigkeit von Probekörpern

Essai pour béton durci - Partie 5 : Résistance à la flexion sur éprouvettes

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ICS:

91.100.30	Beton in betonski izdelki	Concrete and concrete products

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EUROPEAN STANDARD

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English Version

Testing hardened concrete - Part 5: Flexural strength of test specimens

Essai pour béton durci - Partie 5 : Résistance à la flexion sur éprouvettes

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This European Standard was approved by CEN on 29 April 2019.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 12390-5:2019) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, the secretariat of which is held by SN.

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of an identical text or by endorsement, at the latest by December 2019, and conflicting national standards shall be withdrawn at the latest by December 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 12390-5:2009.

It is recognized as good practice to include measurement of density prior to the determination of flexural strength, as a check on compaction of the concrete.

The two-point method of loading has been taken as the reference method, but the use of centre-point loading has been included as a normative annex. An inter-comparison of the two-point and the centre-point methods has been made as part of a test programme, part-funded by the EC under the Measurement and Testing Programme, contract MAT I-CT-94-CO43. The centre-point method gave results which were consistently 13 % higher than those from the two-point method.

This standard is one of a series on testing concrete.

EN 12390, *Testing hardened concrete*, consists 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 11: Determination of the chloride resistance of concrete, unidirectional diffusion;*

— *Part 12: Determination of the potential carbonation resistance of concrete: Accelerated carbonation method (in preparation);*

— *Part 13: Determination of secant modulus of elasticity in compression;*

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

— *Part 15: Adiabatic method for the determination of heat released by concrete during its hardening process;*

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

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

— *Part 18: Determination of the chloride migration coefficient (in preparation).*

This edition includes the following significant technical changes with respect to EN 12390 5:2009:

— editorial revision;

— technical corrections;

— curing procedure aligned with EN 12390-3.

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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This document specifies a method for the determination of the flexural strength of specimens of hardened concrete.

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 12390-4, *Testing hardened concrete — Part 4: Compressive strength — Specification for testing machines*

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

3 Terms and definitions

No terms and definitions are listed in this document.

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

4 Principle

Prismatic specimens are subject to a bending moment by the application of load through upper and lower rollers. The maximum load sustained is recorded and the flexural strength is calculated.

5 Apparatus

5.1 Testing machine

The test shall be carried out using a testing machine conforming to EN 12390-4.

5.2 Force application

The device for applying loads (see Figure 1) shall consist of:

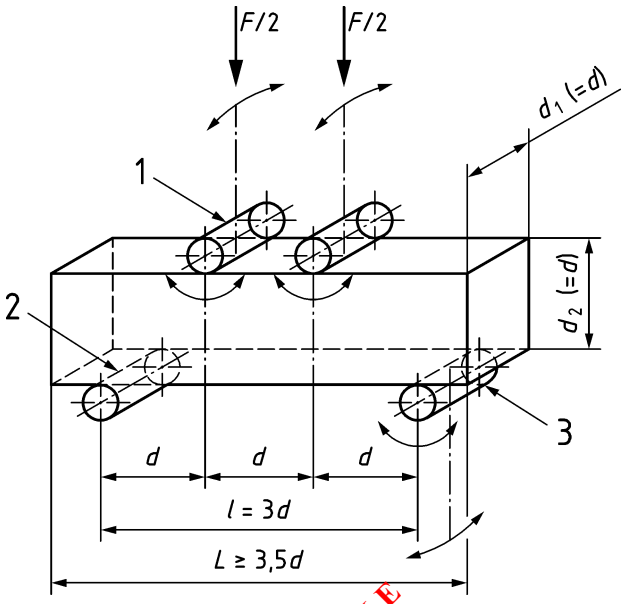
1) two supporting rollers;

2) two upper rollers carried by an articulated cross member, which divides the load applied by the machine equally between the two rollers.

All rollers shall be manufactured from steel and shall have a circular cross-section with a diameter of 20 mm to 40 mm. They shall be at least 10 mm longer than the width of the test specimen.

Three rollers, including the two upper ones, shall be capable of rotating freely around their axis and of being inclined in a plane normal to the longitudinal axis of the test specimen.

The distance, *l*, between the outer rollers (i.e. the span) shall be equal to 3*d*, where *d* is the width of the specimen. The distance between the inner rollers shall be equal to *d*. The inner rollers shall be equally spaced between the outer rollers as shown in Figure 1. All rollers shall be adjusted to the positions illustrated in Figure 1 to a maximum permissible error of 2,0 mm.



Key

1 loading roller (capable of rotation and of being inclined)

2 supporting roller

3 supporting roller (capable of rotation and of being inclined)

Figure 1 — Arrangement of loading of test specimen (two-point loading)

6 Test specimens

6.1 General

The test specimens shall be prisms conforming to EN 12390-1. Specimens cast in moulds shall conform to EN 12350-1 and EN 12390-2. The direction of casting shall be identified on the specimen.

Sawn specimens which meet the requirements of EN 12390-1 may also be tested. The specimens shall be examined and any abnormalities observed shall be reported.

6.2 Adjustment of test specimens

Where the dimensions or shapes of test specimens do not conform to EN 12390-1 because they exceed the respective tolerances, they shall be rejected or adjusted as follows:

1) uneven surfaces shall be levelled by grinding;

2) the deviation of angles shall be corrected by cutting and/or grinding.

7 Procedures

7.1 Preparation and positioning of specimens

After removal of the specimen from curing, the specimen shall be tested for strength as soon as practicable, but within 10 hours. The test facility shall be at a temperature of (20 ± 5) °C (or (25 ± 5) °C in hot climates). Where specimens are to be stored in the testing facility for more than 4 hours they shall be protected from moisture loss e.g. by covering with wet hessian or impermeable membrane.

Wipe clean all testing machine bearing surfaces and remove any loose grit or other extraneous material from the surfaces of the specimen that will be in contact with the rollers.

For specimens stored in water, wipe excess moisture from the surface of the specimen before placing in the testing machine.

Place the test specimen in the machine, correctly centred and with the longitudinal axis of the specimen at right angles to the longitudinal axis of the upper and lower rollers.

Ensure that the direction of loading is perpendicular to the direction of casting of the specimen.

NOTE The test result may be affected by the direction of loading with respect to the direction of casting.

7.2 Loading

Do not apply the load until all loading and supporting rollers are resting evenly against the test specimen. Select a constant rate of stress within the range 0,04 MPa/s ($N/mm^2 \cdot s$) to 0,06 MPa/s ($N/mm^2 \cdot s$). After the application of the initial load, which does not exceed approximately 20 % of the failure load, apply the load to the specimen without shock and increase continuously, at the selected constant rate ± 10 %, until no greater load can be sustained.

During the final stages of the test, the load rate may be affected by the failure mode of the specimen. Nevertheless every effort should be made to maintain the selected loading rate as close as possible.

The required loading rate is given by Formula (1):

$$R = \frac{s \times d_1 \times d_2^2}{l} \quad (1)$$

where

R is the required loading rate, in N/s;

s is the stress rate, in MPa/s ($N/mm^2 \cdot s$);

d_1 and d_2 are the lateral dimensions of the specimen, in mm;

l is the distance between the lower rollers, in mm.

When using manually controlled testing machines, correct, by appropriate adjustment of the controls, any tendency for the selected rate of loading to decrease, as specimen failure is approached.

Record the maximum load indicated.

Report a fracture if it is outside the loading rollers (see Figure 1).