BRITISH STANDARD

BS EN 12390-6:2009

Testing hardened concrete

Part 6: Tensile splitting strength of test specimens

ICS 91.100.30

BSI British Standards

National foreword

This British Standard is the UK implementation of EN 12390-6:2009. It supersedes BS EN 12390-6:2000 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/517/1, Concrete production and testing.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Essais sur béton - Partie 6 : Détermination de la résistance en traction par fendage d'éprouvettes

Prüfung von Festbeton - Teil 6: Spaltzugfestigkeit von Probekörpern

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Foreword

This document (EN 12390-6:2009) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by June 2010, and conflicting national standards shall be withdrawn at the latest by June 2010.

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 12390-6:2000.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

This standard is one of a series concerned with 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*

The main change from the previous edition of this European Standard has been to provide an alternative specification for packing strips and requires the selected loading rate to be applied after the initial load does not exceed approximately 20 % of the anticipated failure load.

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

Introduction

This test method was one of a number examined in a laboratory inter-comparison part-funded by the EC under Measurement and Testing programme, contract MAT1-CT94-0043. The programme and other references showed the following:

a) Tensile splitting strengths measured between the normal plane platens of testing machines gave the same results as those using the special curved platens, originally described in ISO 4018. Although, therefore these curved platens have been optionally retained in this standard, they are not necessary for the measurement.

b) The material used for the packing strips affects the apparent tensile strength measured. This has led to the decision to standardize on hardboard strips, since they provided the lowest standard deviations.

c) The apparent tensile strength measured depends upon the shape and size of the test specimen used:

   1) cubes gave higher measured tensile strengths than cylinders, by approximately 10 %;

   2) 150 mm cubes gave lower measured tensile strengths than 100 mm cubes;

   3) the effect of cylinder size on measured tensile strength was not found to be significant, possibly due to the variability of the data.

As a result of these conclusions from the laboratory programme, this standard restricts the measurement of tensile splitting strength to cylindrical specimens used with hardboard packing strips, which is the reference method. However, as some countries still test cubical or prismatic specimens, their use has been retained in a normative annex. In cases of dispute, the reference method is the use of cylinders of 150 mm diameter and 300 mm length.

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

1 Scope

This European Standard specifies a method for the determination of the tensile splitting strength of cylindrical test specimens of hardened concrete. A method using cubic or prismatic specimens is included in normative Annex A.

2 Normative references

The following referenced documents are indispensable for the application 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 of 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 316, *Wood fibre boards — Definition, classification and symbols*

3 Principle

A cylindrical specimen is subjected to a compressive force applied to a narrow region along its length. The resulting orthogonal tensile force causes the specimen to fail in tension.

4 Apparatus

4.1 Testing machine, conforming to EN 12390-4, curved steel loading pieces may be used in place of conventional plane platens, when tests are carried out on cubic or prismatic specimen.

4.2 Jig (optional), for positioning the specimen and the packing strips. The jig shall not restrict the deformation of the specimen during the test.

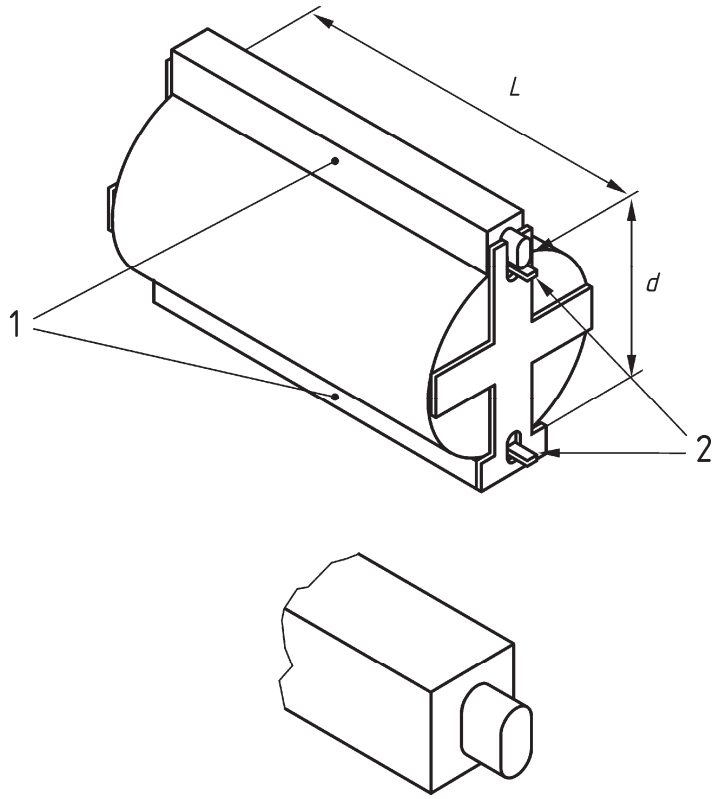
NOTE Suitable jig for cylindrical specimens is shown in Figure 1.

4.3 Packing strips, conforming to EN 316, made of hardboard, of density equal or greater than 900 kg/m³ and dimensions, width (a) = (15 ± 1) mm; thickness (t) = (4 ± 1) mm and a length greater than the length of the line of contact of the test specimen.

Alternatively, packing strips may be used if they meet the following hardness criterion:

When submitted to a punching test by means of a rod of circular cross section, having a diameter of (16 ± 0,5) mm and applying a force at a rate of (48 ± 10) kN/min, the instantaneous penetration when the force of (20 ± 5) kN is achieved shall be equal to (1,2 ± 0,4) mm.

Packing strips shall be used only once.



Key

1 Steel loading piece
2 Hardboard packing strips
L Length of specimen
d Diameter of specimen

Figure 1 — Jig for testing cylindrical specimens

5 Test specimens

5.1 General

The test specimens shall be cylindrical, conforming to EN 12390-1, but a length/diameter ratio as low as 1 shall be acceptable for cores. Specimens cast in moulds shall conform to EN 12390-1 and EN 12390-2.

The specimens shall be examined and any abnormalities observed shall be reported.

5.2 Adjustment of test specimens

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

a) uneven surfaces shall be levelled by grinding;

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

5.3 Marking

Unless a centring jig is used, two lines shall be marked along which to apply the load. These lines shall be opposite each other in an axial plane and the extremities of the two lines shall be connected over each end of the specimen, to define clearly the plane of loading.

6 Procedure

6.1 Specimen preparation

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

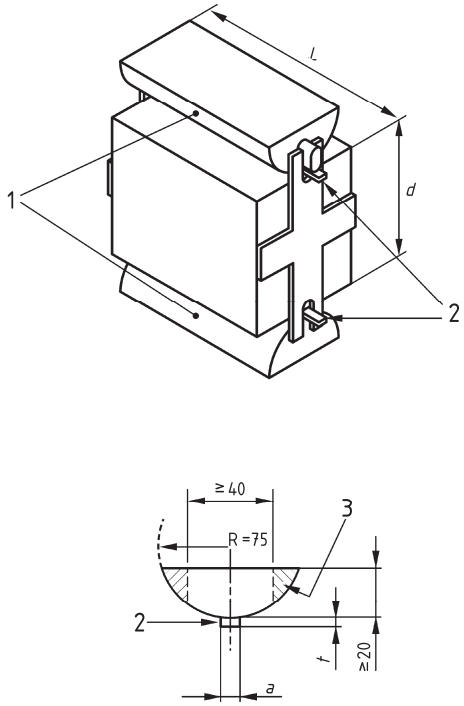
Wipe the bearing surfaces of the jig, packing strips, loading pieces and platens. Clean and remove any loose grit or other extraneous material from the surface of the specimen that will be in contact with the packing strips.

6.2 Specimen positioning

Place the test specimen centrally in the testing machine, optionally using a jig. Carefully position packing strips and, if required, loading pieces, along the top and bottom of the plane of loading of the specimen.

Ensure that the upper platen is parallel with the lower platen, during loading.

Dimensions in millimetres



Key

1	Steel loading piece	*d*	Height of specimen
2	Hardboard packing strips	R	Radius of loading piece
3	Segment may be trimmed	a	Width of packing strip
L	Length of specimen	*t*	Thickness of packing strip

Figure 2 — Curved loading pieces

6.3 Loading

Ensure that the specimen remains centred when the load is first applied, either by means of a jig or by temporary supports.

Select a constant rate of stress within the range 0,04 MPa/s (N/mm²·s) to 0,06 MPa/s (N/mm²·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.

The required loading rate is given by the formula:

$$R = \frac{s \times \pi \times L \times d}{2}$$

where:

R is the required loading rate, in Newtons per second (N/s);

L is the length of the specimen, in millimetres (mm) (see Figure 2);

d is the designated cross-sectional dimension, in millimetres (mm);

s is the stress rate, in megapascals per second (MPa/s) or in Newtons per square millimetre per second (N/mm²·s).

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

When using automatically controlled testing machines, check the rate of loading periodically, to ensure that the rate is constant.

Record the maximum load indicated.

6.4 Examination of specimen

Examine the fractured specimen and the appearance of the concrete and record, if unusual.

7 Expression of results

The tensile splitting strength is given by the formula:

$$f_{ct} = \frac{2 \times F}{\pi \times L \times d}$$

where

f_{ct} is the tensile splitting strength, in megapascals (MPa) or in Newtons per square millimetre (N/mm²);

F is the maximum load, in Newtons (N);

L is the length of the line of contact of the specimen, in millimetres (mm);

d is the designated cross-sectional dimension, in millimetres (mm).

NOTE For deviations from the standard method in respect of the dimensions of the specimen, the strength calculation may be based on the actual dimensions of the test specimen.

Express the tensile splitting strength to the nearest 0,05 MPa (or N/mm²).

8 Test report

The test report shall include:

a) identification of the test specimen;

b) details of adjustment (if appropriate);

c) surface moisture condition at time of test;

d) date of test;

e) appearance of concrete and type of fracture (if unusual);

f) tensile splitting strength of specimen, to nearest 0,05 MPa (or N/mm²);

g) any deviation from the standard test method;

h) a declaration from the person technically responsible for the test that it was carried out in accordance with this document, except as detailed in item g).

The report may include:

i) condition of specimen on receipt for storage;

j) age of specimen at time of test (if known);

k) appearance of the concrete (if unusual).

9 Precision

There is currently no precision data for this test.

Annex A
(normative)

Determination of tensile splitting strength using cubic or prismatic specimens

A.1 Scope

This annex specifies a method for the determination of the tensile splitting strength of cubic and prismatic test specimens of hardened concrete.

A.2 Normative references

See Clause 2.

A.3 Principle

A prismatic specimen is subjected to a compressive force applied to a narrow region. The resulting orthogonal tensile force causes the specimen to fail in tension.

A.4 Apparatus

A.4.1 Testing Machine, conforming to EN 12390-4, curved steel loading pieces may be used in place of or in addition to conventional plane platens (see Figure 2).

A.4.2 Jig (optional); a jig may be used for positioning the specimen and the packing strips. The jig shall not restrict the deformation of the specimen during the test.

A.4.3 Packing strips

See 4.3.

A.5 Test specimens

A.5.1 Requirements

The test specimens shall be cubic or prismatic, conforming to EN 12350-1, EN 12390-1 and EN 12390-2.

The specimens shall be examined and any abnormalities observed shall be reported.

A.5.2 Adjustment of test specimens

See 5.2.

A.5.3 Marking

See 5.3.

A.6 Procedures

The requirements of 6.1 apply.

The plane of loading shall be perpendicular to the trowelled surface.

A.7 Expression of results

See Clause 7.

NOTE The result obtained from testing a prismatic specimen of concrete is likely to be some 10 % higher than that obtained from testing a cylindrical specimen of the same concrete.

A.8 Test report

The test report shall include the items listed in Clause 8 and in addition it shall be stated that the specimen was cubic or prismatic and the dimensions of the specimen shall be reported.

A.9 Precision

There is currently no precision data for this test.

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