BRITISH STANDARD

BS EN
12615:1999

Products and systems for the protection and repair of concrete structures — Test methods — Determination of slant shear strength

The European Standard EN 12615:1999 has the status of a British Standard

ICS 91.080.40

National foreword

This British Standard is the English language version of EN 12615:1999. It supersedes BS 6319-4:1984, which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee B/517, Concrete, to Subcommittee B/517/8, Repair and protection of concrete, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 9 and a back cover.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12615

May 1999

ICS 91.080.40

English version

Products and systems for the protection and repair of concrete structures — Test methods — Determination of slant shear strength

Produits et systèmes pour la protection et la réparation de structures en béton — Méthodes d'essais — Détermination de la résistance au cisaillement

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken — Prüfverfahren — Bestimmung der Druckscherfestigkeit

This European Standard was approved by CEN on 16 April 1999.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 12615:1999 E

Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 104, Concrete (performance, production, placing and compliance criteria), 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of an identical text or by endorsement, at the latest by November 1999, and conflicting national standards shall be withdrawn at the latest by November 1999.

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

It has been prepared by Subcommittee 8, Products and systems for the protection and repair of concrete structures, (Secretariat AFNOR).

1 Scope

This European Standard describes a method for the determination of the strength of a structural bond between two concrete substrates. The method can be used to measure the slant shear bond strength in the following combinations:

— hardened concrete bonded to hardened concrete;

— fresh concrete bonded to hardened concrete.

The test can be carried out with either dry or wet hardened concrete substrates.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 196-1, *Methods of testing cement — Part 1: Determination of strength*.

prEN 1766, *Products and systems for the protection and repair of concrete structures — Test methods — Reference concretes for testing*.

3 Test method

The slant shear test is carried out on restored concrete prisms having the dimensions shown in Figure 1 and with a bond surface inclined at an angle of 60° to the cross-sectional axis of the prism. For tests involving the bonding of hardened concrete to hardened concrete a smaller, alternative prism size of 40 mm × 40 mm × 160 mm can be used in appropriate circumstances. The test is performed by applying a compressive force along the longitudinal axis of the restored prism until fracture occurs.

4 Equipment

a) *Steel moulds*, for producing concrete test pieces of size 100 mm × 100 mm × 400 mm conforming to prEN 1766, alternative 40 mm × 40 mm × 160 mm conforming to EN 196–1.

b) *Concrete mixer*, as in prEN 1766.

c) *Grit blasting equipment*.

d) *Concrete saw*, mounted on cutting bench.

e) *Suitable frame*, for clamping the cut test pieces together during the bonding, for example see Figure 2.

f) *Compression testing machine*, capable of applying a constant rate of loading of between 1 kN and 10 kN per second with a capacity of at least 200 kN (for prisms 40 mm × 40 mm × 160 mm) and with a capacity of at least 1 000 kN (for prisms 100 mm × 100 mm × 400 mm).

g) *Steel wire brush*.

5 Test procedure

5.1 Preparation of test pieces

The test pieces shall be cast in steel moulds using reference concrete Type C (0,40) in accordance with prEN 1766. When the alternative prism size of 40 mm × 40 mm × 160 mm is used for bonding hardened concrete to hardened concrete the reference concrete Type MC (0,40) shall be used. After curing for 28 days in accordance with prEN 1766 the test pieces shall be removed from the water and then cut at an angle of 60° to their cross-sectional axis as shown in Figure 1 in order to provide components for bonding. Saw cutting shall be carried out on a suitable bench such that the angle between each bonding surface and the longitudinal axis of the corresponding prism does not differ by more than 1° and the flatness of the surface is to within a tolerance of 0,5 mm. Spalling of the cut edges shall not exceed 1 % of the bonded surface area.

5.2 Substrate surface preparation

The concrete surfaces to be bonded shall be cleaned in running water using a steel wire brush and then grit blasted in accordance with prEN 1766. The test pieces shall then be conditioned as defined below depending upon whether bonding is to be carried out on a dry or wet hardened concrete substrate.

5.3 Conditioning

The resin and hardener component of the bonding agent shall be conditioned before mixing to the test temperature of (21 ± 2) °C.

a) Dry surface

Condition test components for 48 h at (21 ± 2) °C and a RH of (60 ± 10) %. Dust shall be removed by brushing immediately prior to application of the bonding agent.

b) Wet surface

Condition test components by immersion in water at room temperature for 48 h. The area to be bonded shall be placed in a vertical position for 15 min at (21 ± 2) °C and a RH of (60 ± 10) % to allow free water to drain off before application of the bonding agent.

c) Extreme temperatures

For testing at extremes of environmental conditions, alternative conditioning and test temperatures as specified by the supplier shall be used.

5.4 Number of test pieces

For each combination of surface preparation, moisture condition of substrate and bonding agent to be investigated, at least three specimens shall be tested. In addition at least three uncut reference test pieces 100 mm × 100 mm × 400 mm, alternatively 40 mm × 40 mm × 160 mm, shall be prepared and tested.

5.5 Manufacture of test prisms

5.5.1 *Bonding hardened concrete to hardened concrete*

The components of the bonding agent shall be mixed at the test temperature and applied in a layer 1 mm thick to the prepared concrete bonding surfaces of each test component all in accordance with the manufacturer's instructions. Place the mating pair of test components in the clamping frame (see Figure 2) and apply pressure by transverse and then longitudinal clamping until adhesive is extruded from the visible upper bond line. Each assembly of half prisms shall be perfectly centred and checked using a straight edge. Otherwise the clamping device shall be adjusted in order to ensure that the edges of the test piece are correctly aligned.

The restored test pieces shall be removed from the clamping frame 24 h after the bonding agent has been applied and cured for 7 days at (21 ± 2) °C before testing, or as otherwise specified.

5.5.2 ***Bonding fresh concrete to hardened concrete***

The components of the bonding agent shall be mixed at the test temperature and then applied in a layer of thickness in accordance with the manufacturer's instructions to the prepared concrete bonding surface of one test component all in accordance with the manufacturer's instructions. Place this component at the bottom of a 100 mm × 100 mm × 400 mm steel mould, pour in the fresh concrete, compact and place on a suitable vibrating table, all in accordance with prEN 1766.

The restored test pieces shall be removed from the moulds 24 h after the bonding agent has been applied and cured for 28 days in water at (21 ± 2) °C before testing, or as otherwise specified.

5.6 Testing

Each end of a restored test piece shall be checked and if necessary ground and/or capped to achieve parallelism and squareness of the end faces. A compression test to failure shall then be carried out in accordance with EN 196–1 using the standard procedure for the testing of cubes or cylinders for compressive strength. The load at failure (F) in N and the mode of failure shall be recorded.

A similar compression test to failure shall be conducted on each reference specimen and the load at failure (F) in N shall be recorded. The reference specimens shall have been subjected to the same curing and storage conditions and be tested at the same age as the restored test pieces.

5.7 Calculation of shear bond strength

The shear bond strength (f_b) in N/mm^2 for each restored test piece shall be calculated as:

$$f_b = \frac{F\sqrt{3}}{40\,000}$$ for specimen 100 mm × 100 mm × 400 mm;

$$f_b = \frac{F\sqrt{3}}{6\,400}$$ for specimen 40 mm × 40 mm × 160 mm.

5.8 Failure modes

Type A: Cohesion failure within either concrete substrate.

Type B: Adhesion failure at one of the adhesive concrete interfaces.

Type C: Cohesion failure within the adhesive.

Type D: Adhesion failure at both of the adhesive concrete interfaces.

If there is a mix of these failure types, make a visual assessment to determine the surface area percentage for each type of failure and express this as a ratio, for example:

A:C = 60:40

6 Test report

The report shall include the following information:

a) identification of all the constituents in the adhesive mix including manufacturer's name, code numbers if applicable, type description and date of production;

b) the number and type of test specimens and reference specimens, including the size of specimen and reference substrate to prEN 1766;

c) method of curing, cutting and surface preparation of the concrete test components;

d) surface condition of concrete substrate at the time of application of the bonding agent, e.g. dry or wet;

e) method of mixing and application of the bonding agent;

f) the period of time between mixing and application of the bonding agent;

g) the period of time between application of the bonding agent and closing the joint;

h) method of curing the restored test pieces and whether bond is hardened concrete to hardened concrete or fresh concrete to hardened concrete;

i) the failure load, F, in N of each test specimen and each reference specimen;

j) the shear bond strength, f_b, in N/mm^2 of each test specimen;

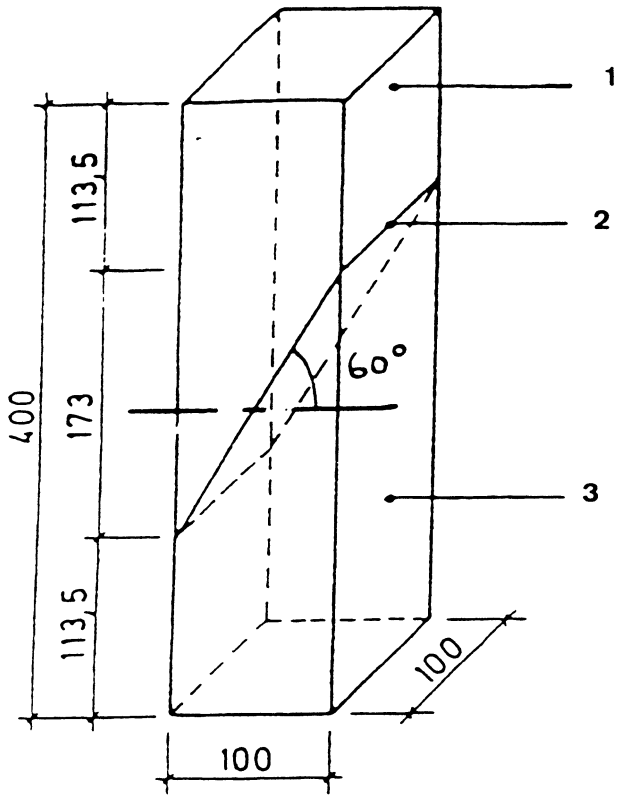
k) the failure mode of each test specimen;

l) any deviation from this standard test procedure;

m) date of the test;

n) reference to this European Standard.

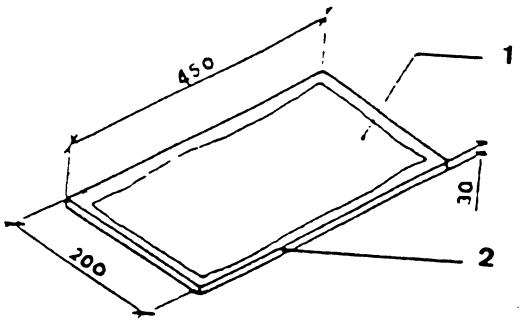
Dimensions in millimetres



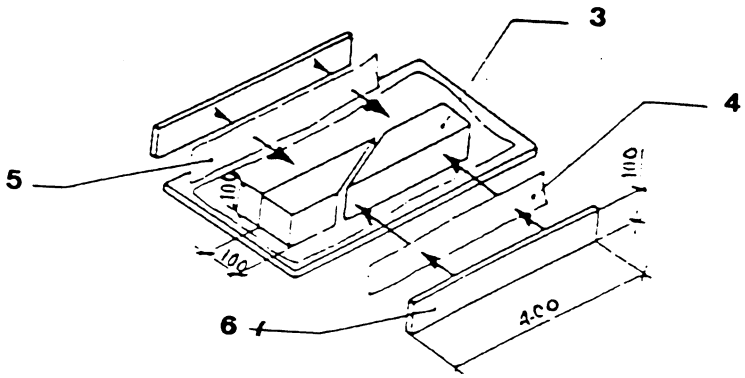
Key
1 Hardened concrete or fresh concrete
2 Bonding agent
3 Hardened concrete

Figure 1 — Geometry and shape of the specimen

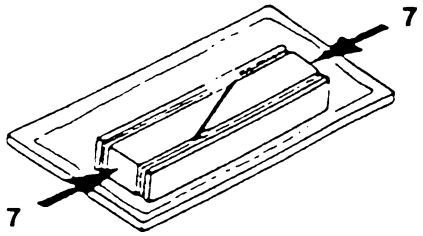
Dimensions in millimetres



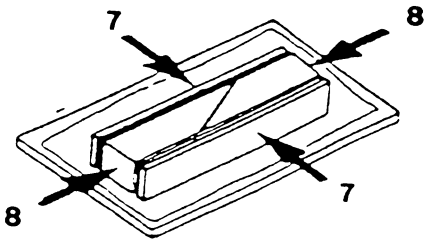
a) Stage 1



b) Stage 2



c) Stage 3



d) Final stage

Key

1	Sheet of polyethylene	5	Polyethylene membrane
2	Backing (plywood)	6	Plywood
3	Concrete test piece	7	Clamp
4	Polyethylene membrane (laid against concrete test piece)	8	Pressure due to clamp

Figure 2 — Test piece clamping frame

Annex A (informative)
Bibliography

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[2] RILEM 52 RAC, *Slant shear strength.*

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