SLOVENSKI STANDARD
SIST EN 989:2001

01-april-2001

Ugotavljanje sprijemnosti med armaturnimi palicami in avtoklaviranim celiļ astim betonom s preskusom izvleka

Determination of the bond behaviour between reinforcing bars and autoclaved aerated concrete by the the "Push-Out" test

Bestimmung des Verbundverhaltens zwischen Bewehrungsstahl und dampfgehärtetem Porenbeton mit Hilfe der Ausdrückprüfung

Détermination par un essai d'adhérence par poussée du comportement d'adhérence entre les armatures et le béton cellulaire autoclavé

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English version

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

The European Standards exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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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

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Foreword

This European Standard has been prepared by the Technical Committee CEN/TC 177 "Prefabricated reinforced components of autoclaved aerated concrete or light-weight aggregate concrete with open structure", of which the secretariat 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of an identical text or by endorsement, at the latest by November 1995, and conflicting national standards shall be withdrawn at the latest by November 1995.

In order to meet the performance requirements as laid down in the product standard for prefabricated components of lightweight aggregate concrete with open structure a number of standardized test methods are necessary.

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

1 Scope

This European Standard specifies a method of determining the bond behaviour between reinforcing bars and autoclaved aerated concrete (AAC) [1]. The test may be used for quality control purposes. Values to be used in design cannot be derived from the test results.

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 678 Determination of the dry density of autoclaved aerated concrete

EN 679 Determination of the compressive strength of autoclaved aerated concrete

3 Principle

Test specimens are taken from reinforced components by cutting them in transverse direction. A compressive force is applied onto the cut end of a reinforcing bar while the opposite surface of the test specimen is supported in such a way that pushing-out of the loaded bar is not hindered. The force is increased at a prescribed steady rate until the bond fails and the bar is pushed-out. The slip of the bar relative to the concrete is measured at the free end, and the load-slip curve is recorded.

[1] A standard about "Prefabricated reinforced components of autoclaved aerated concrete" is in preparation

4 Apparatus

a) a saw for cutting test specimens from reinforced AAC components without excessive heating, vibration or shock;

b) a testing machine or a loading device capable of applying a compression force at the required steady rate without shock and with an accuracy of 2% of the ultimate push-out force;

c) a distance frame to be inserted between the upper surface of the test specimen and the upper bearing block of the testing machine. The frame consists of two sufficiently rigid steel platens which are connected by bolts long enough to provide sufficient space for the accommodation of the slip measuring device;

d) an intermediate layer of soft fibre board (thickness 10 mm to 20 mm, density 250 kg/m^3 to 300 kg/m^3, with four holes of 20 mm diameter) between the upper surface of the test specimen and the distance frame;

e) a hemispherical metal piece, e. g. the head of a cup-headed bolt for centering and transmission of the load to the reinforcing bar;

f) a device for measuring the slip between the reinforcing bar and the AAC with an accuracy of 1/100 mm and for recording the load-slip curve;

g) a ventilated drying oven, maintainable at a temperature of (105 ± 5) °C;

h) a balance for weighing test specimens to an accuracy of 0,1 %.

5 Test specimens

5.1 Sampling

The test specimens shall be taken from reinforced components in such a manner that they are representative of the products to be investigated.

5.2 Shape and size of test specimens

The test specimens are prismatic sections taken from reinforced AAC components in such a way that the cross section of the test specimen corresponds to the section of the component.

The length of the test specimens shall be 200 mm. The bond length to be tested shall be (180 ± 5) mm.

5.3 Number of test specimens

The number of test specimens shall be such that bond behaviour can be determined on at least five sections of longitudinal reinforcing bars. At least three different longitudinal bars shall be tested.

5.4 Preparation of test specimens

The test specimens are obtained by cutting the component in tranverse direction with a saw as specified in 4 a). Care shall be taken that there are no cross bars connected with the longitudinal bars to be tested.

To avoid undue influence of burrs, each end of the bars to be tested shall be separated from the surrounding AAC to a depth of about 10 mm, e. g. by means of a core drill of suitable diameter (see figure 1).

5.5 Conditioning of test specimens

The test specimens shall be stored in such a manner that, when tested, they have a temperature of (20 ± 5) °C (see note 1) and a moisture content of (6 ± 2) % by mass (see note 2).

If necessary, the test specimens shall be dried or moistened until their mass lies within the calculated limits (see note 2). Subsequently they shall be stored prior to testing for at least 3 d in plastic bags or similar sealing to achieve a sufficiently uniform moisture distribution within the AAC.

The actual moisture content shall be verified by determining the mass of the test specimens in the humid state immediately before the test and after drying at (105 ± 5) °C until constant mass has been obtained. The error in determining the mass shall not exceed 0,1 % of the mass of the test specimen. The mass of the test specimen is considered constant if after 24 h of further drying the mass has not changed by more than 0,2 %.

The moisture content μ_m^l is calculated as follows:

$$\mu'_m = (m_h - m_d)/(m_d - m'_s) \cdot 100$$

where

μ'_m is the moisture content, in per cent by mass;

m_h is the mass of the test specimen in the humid state, in kilograms;

m_d is the mass of the dried test specimen immediately after removal from the drying oven, in kilograms;

m'_s is the mass of the steel reinforcement contained in the test specimen, in kilograms.

NOTE 1: Other temperature may be chosen in special cases. This shall be indicated in the test report.

NOTE 2: In order to achieve the prescribed moisture content within the test specimens the following procedure is recommended: The required humid mass of the test specimen is calculated using the following equation:

$$m_{h,r} = m_{d,ref}\,(1 + \mu''_m/100) - (m''_s\,\mu''_m/100)$$

where

$m_{h,r}$ is the required mass of the test specimen in the humid state, in kilograms;

$m_{d,ref}$ is the dry mass of a reference specimen with the same dimensions and the same reinforcement taken from the same component, the dry mass, in kilograms, being determined according to the last paragraph of 5.5;

m''_s is the mass of the reinforcement, determined either by weighing or by calculation from the dimensions of the reinforcing bars and the density of steel (7 850 kg/m³), in kilograms;

μ''_m is the prescribed moisture content, in per cent by mass ((6 ± 2) % by mass).

6 Procedure

A suggested testing arrangement is shown in figure 1.

The hemispherical metal piece is fixed on top of the bar to be pushed-out, e. g. by means of adhesive tape. Then the test specimen is placed upside down on the lower bearing block of the testing machine or loading device, respectively, where it rests on the hemispherical metal piece and two or more auxiliary wedges which are used to hold the test specimen in position in the beginning of the test. The fibre board is placed on top of the test specimen with the hole for the feeler or the transducer over the bar to be tested. Then the distance frame for the accommodation of the slip measuring device is brought into position, the four holes in the bottom plate coinciding with the corresponding holes in the fibre board. The slip measuring device is applied, the three legs resting on the concrete surface and the feeler of the transducer being in contact with the end of the reinforcing bar. Then a certain preload is applied which is sufficiently high to press the test specimen and the distance frame firmly enough against the bearing blocks of the testing machine to hold them securely in upright position. The auxiliary wedges are removed and the load is increased at an approximately steady rate calculated to achieve rupture after 60 s to 90 s. During the loading procedure the load-slip curve is recorded.

7 Test results

The bond strength f_b is calculated as follows:

$$f_b = F_u / (\pi \cdot L \cdot d)$$

where:

f_b is the bond strength, in newtons per square millimetre;

F_u is the maximum load carried by the bar, in newtons;

L is the effective bond length (total length of the test specimen minus the depth of the recesses at the ends of the bar), in millimetres, determined to the nearest mm;

d is the nominal diameter of the reinforcing bar (not including coating), in millimetres, determined to the nearest 0,1 mm.

The bond strength f_b of the individual bars tested and the mean value shall be expressed to the nearest 0,1 N/mm^2.

8 Test report

The test report shall include the following:

a) identification of the product;

b) date of manufacture or other code;

c) place and date of testing, testing institute and person responsible for testing;

d) number and date of issue of this European Standard;

e) dry density and compressive strength of the product determined in accordance with the relevant standards EN 678 and EN 679, respectively;

f) type of corrosion protection;

g) location in the cross section of the component of the bars tested (e. g. bottom layer or top layer);

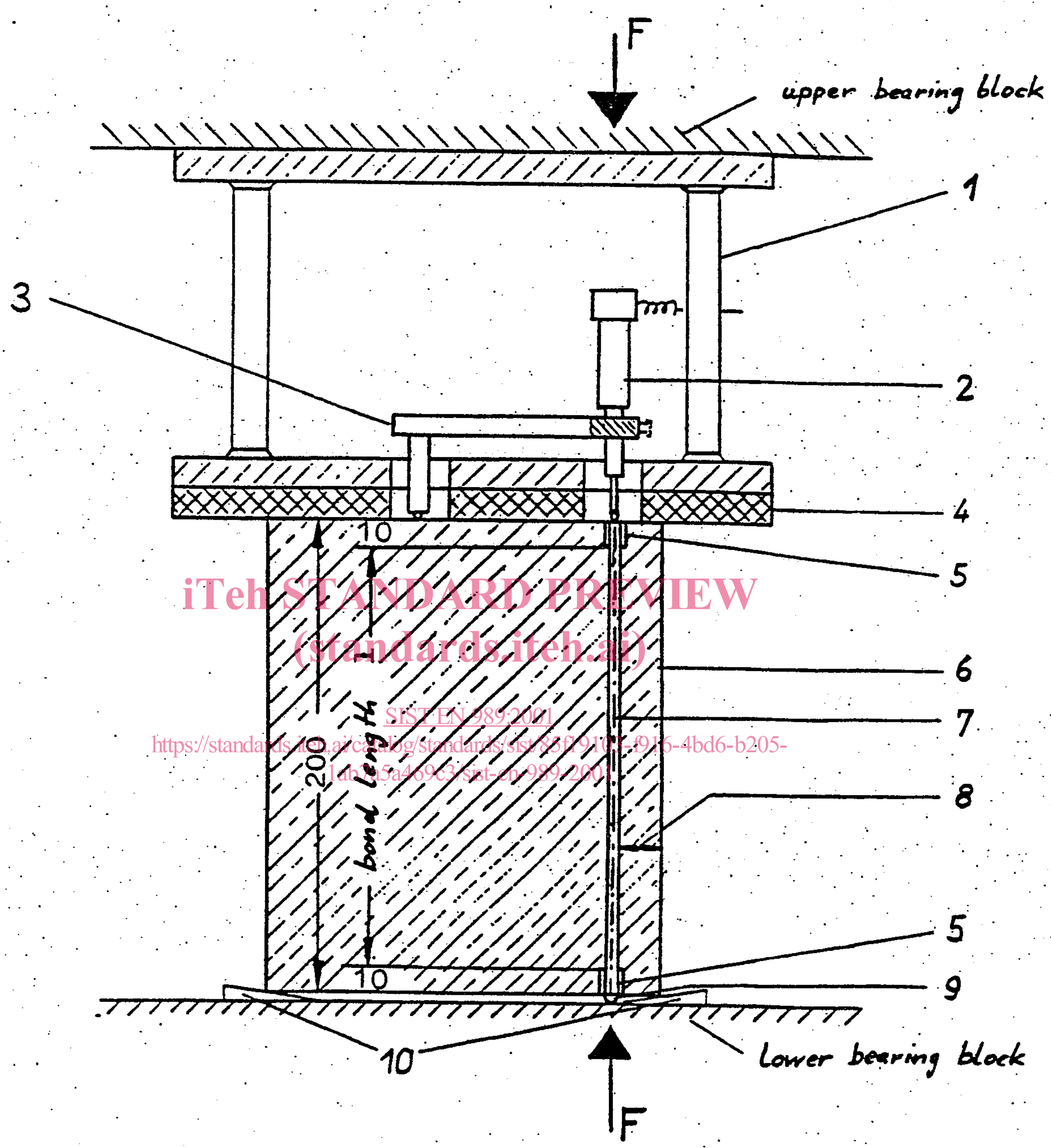
h) shape and dimension of bars;

j) moisture content of the test specimens;

k) for each individual bar tested: L, d, concrete cover, F_u, f_b, and load-slip curve;

l) mean value of f_b for all tested bars of the same diameter.

Dimensions in millimetre



1 distance frame
2 displacement transducer
3 holder for transducer (see figure 2)
4 soft fibre board
5 recess
6 AAC test specimen
7 reinforcing bar with diameter *d*
8 concrete cover
9 hemispherical metal piece (see figure 3)
10 Temporary support (wedges) to locate test specimens to be removed after applying sufficient pre load to hold the test specimens in upright position

Figure 1: Suggested arrangement for push-out test