SLOVENSKI STANDARD
SIST EN 12269-2:2004

01-april-2004

Določevanje sprijemnosti med armaturnim železom in avtoklaviranim celičastim betonom s »preskusom nosilca« - 2. del: Dolgotrajni preskus

Determination of the bond behaviour between reinforcing steel and autoclaved aerated concrete by the beam test - Part 2: Long term test

Bestimmung des Verbundverhaltens zwischen Bewehrungsstahl und dampfgehärtetem Porenbeton mit Hilfe der Balkenprüfung - Teil 2: Langzeitprüfverfahren

Détermination du comportement d'adhérence entre les barres d'armatures et le béton cellulaire autoclavé par la méthode d'essai de poutre - Partie 2: Essai de longue durée

Ta slovenski standard je istoveten z: **EN 12269-2:2003**

ICS:

91.100.30	Beton in betonski izdelki	Concrete and concrete products

SIST EN 12269-2:2004 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12269-2

December 2003

ICS 91.080.40; 91.100.30

English version

Determination of the bond behaviour between reinforcing steel and autoclaved aerated concrete by the “beam test” - Part 2: Long term test

Détermination du comportement de l'adhérence entre les barres d'armatures et le béton cellulaire autoclavé par la méthode d'essai de poutre - Partie 2: Essai de longue durée

Bestimmung des Verbundverhaltens zwischen Bewehrungsstahl und dampfgehärtetem Porenbeton mit Hilfe der Balkenprüfung - Teil 2: Langzeitprüfverfahren

This European Standard was approved by CEN on 1 September 2003.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists 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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

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

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Foreword

This document EN 12269-2:2003 has been prepared by Technical Committee CEN/TC 177 “Prefabricated reinforced components of autoclaved aerated concrete or lightweight aggregate concrete with open structure”, 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 2004, and conflicting national standards shall be withdrawn at the latest by June 2004.

The European Standard EN 12269 consists of the following parts:

- Part 1: Short term test;
- Part 2: Long term test.

In order to meet the performance requirements as laid down in the product standard for prefabricated components of autoclaved aerated concrete a number of standardized test methods are necessary.

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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies a method of determining the long term bond behaviour between reinforcing bars and autoclaved aerated concrete (AAC) in prefabricated reinforced components according to prEN 12602. The test method is conceived to obtain values for the long term bond strength $f_{b,l}$ which are obtained in a final short term test. The test is performed for different combinations of AAC type, bar shape, and corrosion protection systems.

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 (including amendments).

EN 678, *Determination of dry density of autoclaved aerated concrete.*

EN 679, *Determination of compressive strength of autoclaved aerated concrete.*

EN 12269-1:2000, *Determination of the bond behaviour between reinforcing steel and autoclaved aerated concrete by the “beam test” – Part 1: Short term test.*

prEN 12602, *Prefabricated reinforced components of autoclaved aerated concrete.*

3 Principle

The long term bond behaviour of reinforcing bars embedded in AAC is investigated in two steps as follows:

1) Sustained loading of a prismatic test specimen (beam) by a constant transverse quarter point load for a period of 1 year at an elevated temperature of (50 ± 5) °C. The test specimen contains in longitudinal direction one single reinforcing bar situated on the longitudinal median plane near the bottom surface (see EN 12269-1).

2) Final short term test according to EN 12269-1 on this test specimen in order to determine the long term bond strength $f_{b,l}$ obtained from final short term test.

The long term bond strength $f_{b,l}$ is defined as the ultimate bond stress (residual bond strength) achieved at the final short term test.

4 Apparatus

a) a saw for cutting test specimens from reinforced components;

b) a core drill with a diameter of the cutting edge of (200 to 300) mm, depending on the specimen height, for removing the AAC in the tensile zone of the cross-section in the midspan area of the beam;

c) a straight-edge and 0,1 mm feeler gauges for checking the planeness of surface areas where loads and support reactions are transmitted;

d) a room capable of maintaining a temperature of (50 ± 5) °C and a relative humidity of (55 ± 5) %, for conditioning of test beams prior to the test and for the execution of the long term loading and the final short term test;

e) for the long term loading: a loading system with a capacity of at least 20 kN, allowing the application of a constant quarter point transverse load (see Figure 1) on a test beam with a span of (600 to 1200) mm for a period of 1 year at a temperature of (50 ± 5) °C.

The beam shall rest on two supporting rollers through steel distribution plates having a width of (50 ± 2) mm and a thickness of ≥ 10 mm, extending over the full width of the beam. At least one of the rollers shall be capable of being inclined in a plane perpendicular to the longitudinal axis of the beam.

The supporting rollers shall be placed at a distance of 50 mm from the end surfaces of the beam.

The load shall be applied equally to both beam parts, using a bridge profile resting on two rollers positioned perpendicularly to the longitudinal axis of the beam with a distance of 200 mm. Between the rollers and the upper surface of the beam steel distribution plates with a width of (50 ± 2) mm and a thickness of ≥ 10 mm, extending over the full width of the beam, shall be inserted.

Both the supporting rollers and the load-applying rollers shall be manufactured from steel and shall have a circular cross-section with a diameter between (15 to 40) mm. Their length shall be at least equal to the width of the beam. The axes of all rollers shall be parallel to each other. Each roller, except one of the supporting ones, shall be capable of rotating around its longitudinal axis and of being inclined in a plane normal to the longitudinal axis of the beam. After correct centring in the testing machine, the axes of inclination of the three inclinable rollers shall be situated on a vertical plane which shall not deviate by more than ± 1 mm from the axis of the compression force of the testing machine.

The middle axis between the loading rollers or the supporting rollers, respectively, shall not deviate from the vertical axis of the testing machine (axis of the vertical compression force) by more than ± 1 mm.

f) for the final short term test: the same or a similar loading system as for e), but with a capacity of approximately 30 kN. Deflections shall be determined at midspan by means of a transducer and shall be used for control of rate of movement of the platen of the testing machine or of the loading device.

g) a measuring system, capable of simultaneous measuring and registration of the following data:

— longitudinal strain in the bar at midspan (accuracy 2 % of the final measured value);

— slip of the bar at both ends relative to the end surface of the beam (accuracy 0,01 mm).

5 Test specimens

5.1 Sample

The sample for the preparation of the test specimens shall be taken in such a manner that it is representative of the product to be investigated.

5.2 Shape and size of test specimens

The test specimens shall be beams according to Figure 1 which are cut from a reinforced component in a way that the longitudinal bar, of which bond is to be tested, is disposed in the vertical centre plane of the beam with a cover of (10 to 30) mm with respect to the bottom face. If there are further longitudinal bars in the lower part (tension zone when tested) of the beam, they shall be cut at mid-span. The beam shall contain no transverse reinforcement within the AAC.

For usual components the following dimensions shall be used:

— total height: h = 200 mm;

— width: $b = 20\ \phi$, where ϕ is the nominal diameter of the steel bar (without corrosion protective coating), in millimetres;

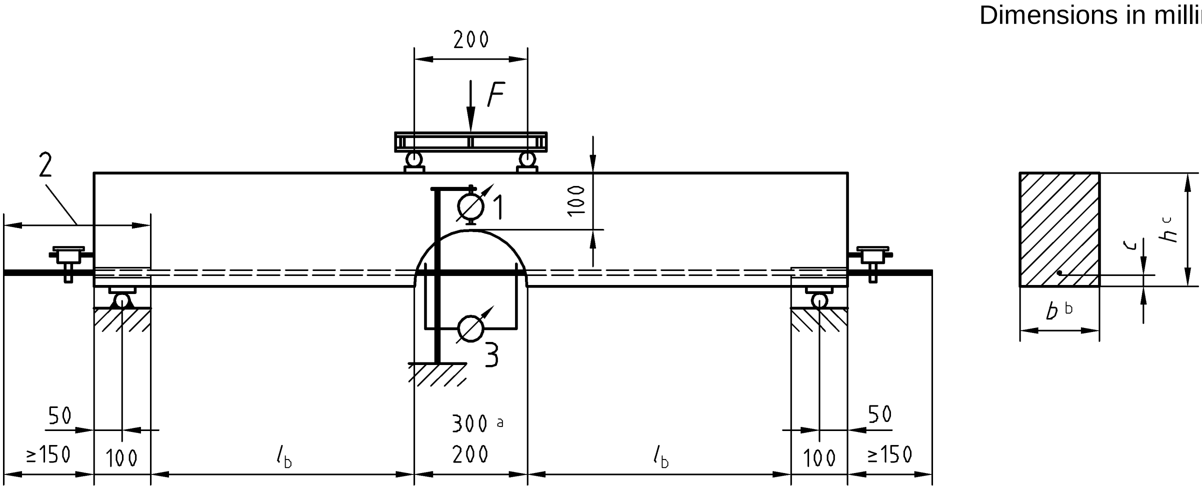
— concrete cover: 10 mm $\leq c \leq$ 30 mm.

The total length of the beam shall be chosen such that $l_b = 40\phi \pm 50$ mm on each side, where l_b is the bond length over which the bar is in contact with the AAC.

If, in exceptional cases, the cover of the longitudinal bar exceeds 30 mm, beams with a total height of h = 300 mm shall be used.

At both ends of the beam, the reinforcing bar to be tested shall protrude for at least 150 mm over the vertical end face of the AAC.

Dimensions in millimetres



Key

1 Transducer for vertical displacement
2 Free bar end
3 Strain measuring base
l_b Bond length = 40 $\phi \pm$ 50
c Concrete cover
[a] (200 to 250) mm for concrete cover c = (10 to 30) mm or 300 mm for concrete cover c > 30 mm, respectivly
[b] $b = 20\,\phi$, where ϕ is the diameter of the reinforcing bar
[c] h = 200 mm for concrete cover c = (10 to 30) mm and h = 300 mm for concrete cover c > 30 mm

Figure 1 — Test specimen and loading arrangement

5.3 Number of test specimens

A test set shall consist of three test specimens.

Whenever possible, one test specimen shall be prepared from the upper third of the component, one from the middle and one from the lower third, in the direction of rise of the mass during manufacture (see Figure 2).

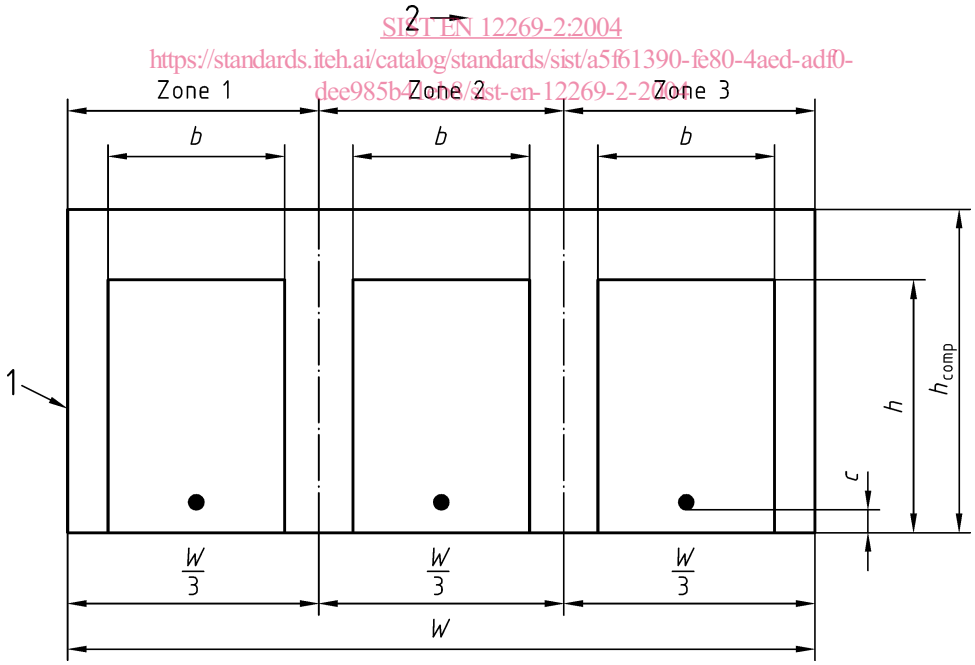
5.4 Preparation of test specimens

The test specimens shall be cut from the reinforced component, taking special care to avoid any early damage of bond. All surfaces shall be levelled sufficiently to ensure correct dimensions. The planeness of the surfaces shall be checked along the lines where the loading forces and the support reactions will be applied, by means of a straight edge and, if necessary, by means of feeler gauges. Deviations by more than 0,1 mm in these areas shall be corrected by grinding.

At both ends of the beam, the AAC shall be removed from around the bar to be tested over a length of 100 mm in order to eliminate the influence of support pressure on bond.

At midspan the beam shall be provided with a semi-cylindrical hole, diameter (200 to 250) mm for beams with a total height of h = 200 mm (used for concrete cover c = (10 to 30) mm) and 300 mm for beams with a total height of h = 300 mm (used for concrete cover c > 30 mm). This hole is drilled horizontally (or cut out otherwise), perpendicularly to the longitudinal axis, leaving the bar free over a sufficient length in order to fix a strain measuring device. The corrosion-protective coating shall be carefully removed by mechanical means from that part of the bar, where the strain measuring device is to be attached.

NOTE Measuring of steel strains is necessary to determine the tensile force in the bar since this cannot be determined directly from the applied load by calculation, due to the fact that the lever arm of internal forces will vary with increasing load and deflection.



Key

1 Cross-section of component
2 Direction of rise
W Width of component

Figure 2 — Sampling scheme for test specimens

5.5 Conditioning of test specimens

Prior to the test, the test specimens shall be stored with enough free space around them enabling sufficient air circulation for a period of 14 d in a room with a constant temperature of (50 ± 5) °C and a relative humidity of (55 ± 5) %.

6 Testing procedure

6.1 Long term loading

The long term loading shall take place in a room with a constant temperature of (50 ± 5) °C and a relative humidity of (55 ± 5) %.

After placing the beam on the supporting rollers, the transducers for measuring the slip at the bar ends shall be attached, and the strain measuring device shall be installed on the free part of the bar at midspan. After carrying out the necessary reference measurements (zero readings of slip and steel strain) the load applying system, consisting of a bridge profile, two rollers, and the respective distribution plates, is brought into position on the surface of the test specimen.

Subsequently, the required long term load shall be applied continuously within about 2 min. The load level is controlled by measuring the steel strain. The load shall be gradually increased until the steel strain corresponding to the specified long term bond stress has been reached.

The long term bond stress level depends on the declared characteristic short term bond strength $f_{b,k}$ determined from the results of tests according to EN 12269-1 and the declared reduction coefficient k_2 which takes into account long term and temperature influences. The specified constant long term bond stress level is equal to $\tau_{b,l} = 0{,}5\ k_2\ f_{b,k}$ where $k_2 \leq 1{,}0$.

The corresponding steel strain ε_s at midspan is determined from equation (1).

$$\varepsilon_s = \frac{2\, f_{b,k} \cdot l_b \cdot k_2}{E_s \cdot \phi} \tag{1}$$

where:

$f_{b,k}$ is the characteristic short term bond strength;

l_b is the measured bond length (length of embedment) in one half of the test specimen;

k_2 is the reduction coefficient for long term and temperature influences;

E_s is the modulus of elasticity of the reinforcing steel;

ϕ is the nominal bar diameter (without corrosion protective coating), in millimetres.

During the loading procedure, a graph slip versus steel strain shall be recorded for each bar end. Furthermore, the development of slip under sustained loading shall be measured

The tensile force in the steel shall be kept constant for 1 year and verified every two weeks. After that period the beam shall be unloaded and the remaining slip shall be measured within 5 min.

6.2 Final short term test

Within 4 h after unloading of the beam a final short term test according to clause 6 of EN 12269-1:2000 is performed. During the test the temperature of the reinforcing bar shall be maintained at (50 ± 5) °C.