BRITISH STANDARD

BS EN
1356 : 1997

Performance test for prefabricated reinforced components of autoclaved aerated concrete or lightweight aggregate concrete with open structure under transverse load

The European Standard EN 1356 : 1996 has the status of a British Standard

ICS 91.100.30

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee B/523, Prefabricated concrete and lightweight aggregate concrete with open structure, upon which the following bodies were represented:

Aggregate Concrete Block Association
Autoclaved Aerated Concrete Association
British Masonry Society
British Precast Concrete Federation Ltd.
Department of the Environment (Building Research Establishment)
Institution of Structural Engineers
Local Authority Organizations

This British Standard, having been prepared under the direction of the Sector Board for Building and Civil Engineering, was published under the authority of the Standards Board and comes into effect on 15 December 1997

Amendments issued since publication

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The following BSI references relate to the work on this standard:
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Contents

National foreword

This British Standard has been prepared by Technical Committee B/523 and is the English language version of EN 1356 : 1996 *Performance test for prefabricated reinforced components of autoclaved aerated concrete or lightweight aggregate concrete with open structure under transverse load*, published by the European Committee for Standardization (CEN).

Cross-references

Publication referred to	Corresponding British Standard
EN 678 : 1993	BS EN 678 : 1994 *Determination of the dry density of autoclaved aerated concrete*
EN 769 : 1993	BS EN 679 : 1994 *Determination of compressive strength of autoclaved aerated concrete*
EN 991 : 1995	BS EN 991 : 1996 *Determination of the dimensions of prefabricated reinforced components made of autoclaved aerated concrete or lightweight aggregate concrete with open structure*
EN 992 : 1995	BS EN 992 : 1996 *Determination of the dry density of lightweight aggregate concrete with open structure*
EN 1353 : 1996	BS EN 1353 : 1997 *Determination of moisture content of autoclaved aerated concrete*
EN 1354 : 1996	BS EN 1354 : 1997 *Determination of compressive strength of lightweight aggregate concrete with open structure*

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 8, an inside back cover and a back cover.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 1356

December 1996

ICS 91.100.30

Descriptors: Concrete, cellular concrete, aggregates, reinforcing materials, prefabricated elements, mechanical tests, breaking load, sag, cracking (fracturing), mechanical strength, procedure

English version

Performance test for prefabricated reinforced components of autoclaved aerated concrete or lightweight aggregate concrete with open structure under transverse load

Essai de performance sous charge transversale des éléments préfabriqués armés de béton cellulaire autoclavé ou de béton de granulats légers à structure ouverte

Bestimmung des Tragverhaltens von vorgefertigten bewehrten Bauteilen aus dampfgehärtetem Porenbeton oder aus haufwerksporigem Leichtbeton unter quer zur Bauteilebene wirkender Belastung

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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.

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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

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 177, Prefabricated reinforced components of autoclaved aerated concrete or light-weight 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 1997, and conflicting national standards shall be withdrawn at the latest by June 1997.

In order to meet the performance requirements as laid down in the product standards for prefabricated components of autoclaved aerated concrete and of lightweight aggregate concrete with open structure, 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, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

1 Scope

This European Standard specifies a method of determining the mechanical performances of prefabricated reinforced components of autoclaved aerated concrete (AAC)[1)] or lightweight aggregate concrete with open structure (LAC) according to prEN 1520 under transverse load. These include:

– the midspan deflections for different load levels;

– the cracking load;

– the ultimate load by progressive loading until collapse;

– the position and the shape of fracture.

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 dry density of autoclaved aerated concrete*
EN 679	*Determination of compressive strength of autoclaved aerated concrete*
EN 991	*Determination of the dimensions of prefabricated reinforced components of autoclaved aerated concrete or lightweight aggregate concrete with open structure*
EN 992	*Determination of dry density of lightweight aggregate concrete with open structure*
EN 1353	*Determination of moisture content of autoclaved aerated concrete*
EN 1354	*Determination of compressive strength of light weight aggregate concrete with open structure*
prEN 1520	*Prefabricated components of lightweight aggregate concrete with open structure*

3 Principle

The component (e.g. floor slab, roof slab, or wall slab, beam) is simply supported at both ends in horizontal position and loaded by two vertical line loads in the outer quarter points of the span until collapse in order to determine the deflection and cracking behaviour and the loadbearing capacity.

Other positions of the loads may be chosen if required (e.g. for the determination of the shear capacity or for the verification of the anchorage capacity of the longitudinal reinforcement). This shall be indicated in the test report.

An intermediate unloading may be carried out after the service-ability limit state has been reached in order to measure the residual deflection due to short term loading.

4 Apparatus

a) *A device*, for applying two equal vertical loads at two lines at the outer quarter points of the span (see however second paragraph of clause **3**) and perpendicular to the span of the tested components (see figure 1). The device shall be capable of increasing the load continuously and without shock and maintaining a chosen load level constant for the required time (2 to 5) min. The force applied shall be measured to an accuracy of 3 %.

b) *A provision*, for measuring the midspan deflections of the component due to the imposed load to an accuracy of 0,1 mm.

c) *A provision*, for measuring the midspan deflection of the component due to the dead weight of the component to an accuracy of 0,5 mm.

d) *A provision*, for measuring the camber (negative deflection at midspan in unloaded state before testing), if any, to an accuracy of 1 mm.

e) *A weighing device*, for determining the weight of the component to an accuracy of 3 %. Alternatively the weight may be determined by calculation, if possible (e.g. in the case of solid components), from the dry density, the moisture content, and the dimensions of the component. This shall be indicated in the test report.

5 Test specimens

5.1 Sample

The test specimen is a whole prefabricated reinforced component.

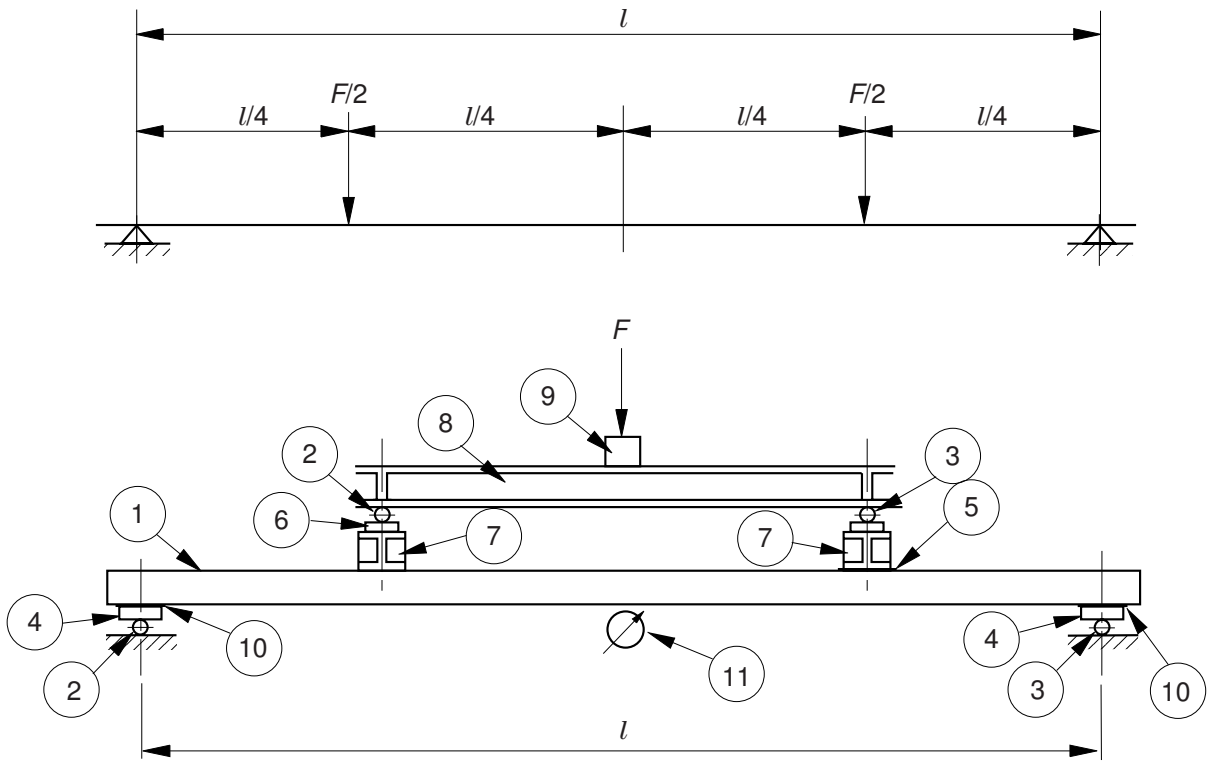
It shall be selected in such a manner that it is representative of the product to be investigated.

5.2 Measurement of component

Before the load test, the dimensions of the component shall be measured according to EN 991 and its weight shall be determined to an accuracy of 3 %, e.g. by means of a weighing device suspended from a crane.

If a horizontal component (e.g. floor or roof slab, beam) is produced with a camber (negative deflection) in order to compensate for deflections due to dead weight and imposed load, this shall be measured at midspan in unloaded state before testing while the component is resting without restraint on one of its longitudinal edges.

[1)] A European Standard for 'Prefabricated reinforced components of autoclaved aerated concrete' is in preparation at CEN.



1. Prefabricated reinforced component
2. Steel rod, Ø 20 mm, horizontally movable (roller)
3. Steel rod, e.g. Ø 20 mm, fixed to distribution plate 4 or flat steel bar respectively
4. Distribution plate, width (50 2) mm, thickness 10 mm, extending over the full width of the component
5. Equalizing layer consisting of cement mortar, gypsum plaster, or soft fibreboard
6. Flat steel bar, e.g. 15 mm X 50 mm
7. Rigid steel section with a width of at least 100 mm, extending over the full width of the component
8. Beam for distribution of the load equally on rigid steel section
9. Load application device
10. Equalizing layer consisting of cement mortar, gypsum plaster or soft fibreboard
11. Provision for measuring the midspan deflections

Figure 1. Typical loading arrangement

The camber shall be determined, to an accuracy of 1 mm, as the distance from the bottom side of the component at midspan to a straight-edge or a stretched string extending in the longitudinal axis of the component at the bottom side from one end to the other. Alternatively, the measurement may be performed at both longitudinal edges. In this case the camber shall be taken as the mean value of the two individual measurements.

5.3 Determination of midspan deflection of a horizontal component due to dead weight

The midspan deflection of the component due to its dead weight may be measured by any provision allowing an accuracy of 0,5 mm.

A suitable means is for example a string stretched along one of the longitudinal edges from support to support and a mm scale applied at midspan. A zero reading is taken while the component is resting without restraint on the other longitudinal edge, so that the dead weight causes no deflection perpendicular to the plane of the component. Then the component is turned to a horizontal position and placed on its supports as described in **6.2** so that the dead weight is activated and the deflection can be measured as the difference between the zero reading and the subsequent reading of the measuring provision.

5.4 Conditioning of component

The component shall not be frozen during the load test, and large temperature and moisture gradients within the component shall be avoided.

6 Load test

6.1 Temperature conditions

The test may be carried out at any temperature of the test premises between + 5 °C and + 40 °C. If the temperature differs by more than ± 5 °C from + 20 °C this shall be indicated in the test report.

6.2 Support conditions

The component shall be placed horizontally and simply supported at both ends, the compression zone under service conditions at the top.

The supports shall extend over the full width of the component. They shall be rounded and one or both shall be movable horizontally in the direction of the span (roller).

The support reactions shall be transmitted to the bottom side of the component by means of distribution plates which are at least as long as the width of the component. They shall be made of steel and have a width of (50 ± 2) mm and a thickness of at least 10 mm.

In the case of slabs the support distribution plates shall be positioned directly adjacent to the ends of the component. In the case of beams the required minimum support length shall be taken into account. In both cases other support conditions may be chosen. These shall be indicated in the test report.

Where the bottom surface of the component is not plane in the support area, an equalizing layer of mortar, gypsum plaster, or soft fibreboard shall be used between the bottom surface of the component and the distribution plates.

6.3 Loading arrangement

A typical loading arrangement is shown in figure 1.

The load shall be imposed by means of two equal vertical line loads, normally acting in the outer quarter points of the span (see second paragraph of clause **3**), on the upper surface of the component and distributed over its full width by means of rigid steel sections placed into a bed of mortar or gypsum plaster or on a soft equalizing layer, e.g. consisting of soft fibreboard.

The width of these sections shall be at least 100 m and shall be large enough to ensure that the local pressure on the upper surface of the component does not exceed 80 % of the compressive strength of the concrete.

The load shall be carefully centred with respect to the longitudinal axis of the component.

The weight of the loading arrangement shall be included in the applied load.

6.4 Testing procedure

The component shall be placed on its supports, the provisions for measuring the deflections at midspan shall be applied either in the longitudinal axis of the component or on both longitudinal edges, and a zero reading of the deflection shall be taken.

The imposed load shall be applied in four equal steps up to the specified load. From step to step it shall be increased continuously and without shock. The chosen level shall be reached within approximately 30 s and then be maintained constant for stabilization of deflections, but not less than 30 s and not considerably more than about 2 min if not specified otherwise.

The deflection shall be measured immediately after reaching the chosen load level and at the end of each load step. In determining the deflections any settlement of the supports shall be taken into account.

The loading rate beyond the specified load shall be such that the ultimate load (failure load) is reached within approximately further (5 to 15) min.

The loading sequence (number of load steps, intermediate unloadings) is not fixed in detail and depends on the information to be collected during the test. However, the test shall be performed in such a manner that the following data can be determined:

– deflection and maximum crack width, if any, at the specified load;

– crack load;

– loadbearing capacity (failure load);

– residual deflection after unloading from the specified load, if required; in case of unloading, the weight of the loading device shall be completely removed;

– load deflection diagram, if required.

If the load deflection diagram is determined, the deflection shall be measured at at least four load levels. One of them should correspond to the specified load (see note).

NOTE. It is usually not possible, without special measures, to determine the course of the diagram in the neighbourhood of the ultimate load. This will be possible by using a deflection-controlled loading device.

7 Observations and measurements after completion of the load test

After failure of the component the following observations and measurements shall be made:

– position and shape of fracture;

– type of reinforcement;

– number, diameter, and cover of the rebars;

– type of anti-corrosion coating;

– thickness of individual concrete layers in the case of multilayer components.

In addition, the determination of the following properties can be useful for the evaluation of test results:

– compressive strength of concrete according to EN 679 or EN 1354, respectively;

– dry density of concrete according to EN 678 or EN 992, respectively;

– mass related moisture content of concrete at time of testing, for AAC according to EN 1353, for LAC on the basis of EN 992 and the following provisions:

The test specimens for the determination of the dry density shall be taken in such a way that the moisture content is influenced as little as possible (e.g. no water cooling when cutting or drilling). Immediately after the preparation of the test specimens, before any loss of moisture has occurred, the mass m_{hum} of the individual test specimens in the moist state shall be determined to an accuracy of 0,1 %.

The moisture content μ_m, related to mass, is calculated according to equation (1):

$$\mu_m = 100 \frac{m_{hum} - m_{dry}}{m_{dry}} \quad ...(1)$$

where:

μ_m is the mass related moisture content, in per cent;

m_{hum} is the mass of the test specimen in the moist state, according to EN 992, in kilograms;

m_{dry} is the mass of the dried test specimen, according to EN 992, in kilograms.

8 Test report

The test report shall include the following:

a) description of the component according to the relevant product standard;

b) date of manufacture or other code;

c) date of sampling;

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

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

f) observed damages, if any, of the component prior to testing;

g) weight of component at time of testing;

h) temperature of test premises, when differing by more than ± 5 °C from + 20 °C;

j) loading arrangement, span, and support conditions, when differing from **6.2**;

k) type of equalizing layer between bottom surface of the component and distribution plates and between top surface of the component and transverse steel sections;

l) camber (negative deflection at midspan in unloaded state before testing) of horizontal components, if any;

m) deflection due to dead weight of horizontal components, if of interest;

n) deflection under a load corresponding to the specified load;

p) load corresponding to the formation of the first crack and of other irregularities;

q) crack width at the specified load, if required in the product standard;

r) residual deflection after unloading, if of interest;

s) ultimate load (loadbearing capacity);

t) load chart and load deflection diagram, if required (example see figure 2);

u) position and shape of fracture;

v) type of reinforcement, number, diameter and cover of rebars (actual values);

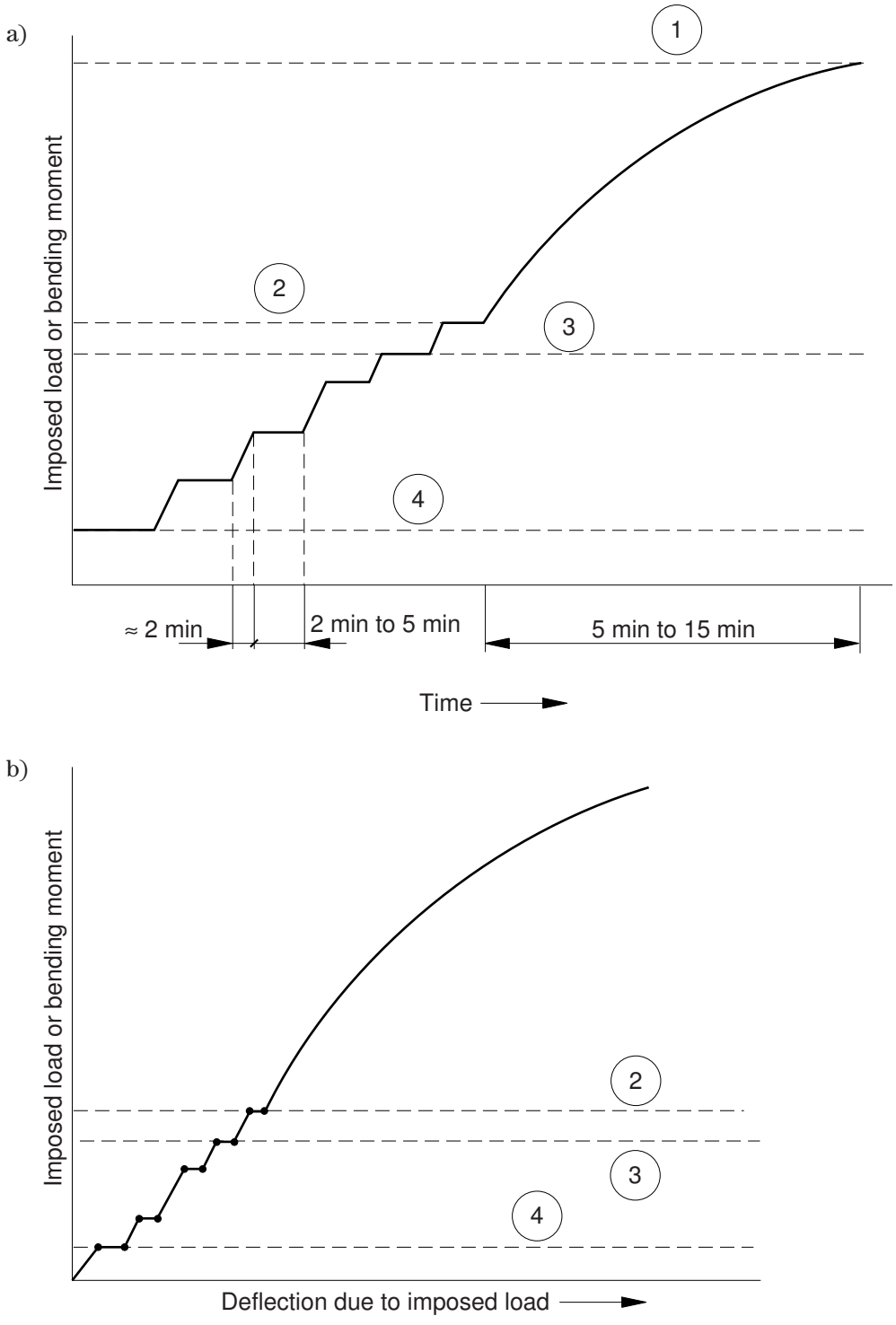
w) type of anti-corrosion coating;

x) thickness of individual concrete layers, in the case of multilayer components;

y) compressive strength, dry density, and mass related moisture content of concrete, if determined;

z) (if appropriate) deviations from the standard method of testing;

aa) a declaration that the testing has been carried out in accordance with this European Standard, except as detailed in **8z**.



1. Ultimate load
2. Serviceability limit state
3. Crack load
4. Weight of loading arrangement

Figure 2. Example for load chart a) and load deflection diagram b)

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