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Determination of compressive strength of lightweight aggregate concrete with open structure

Bestimmung der Druckfestigkeit von haufwerksporigem Leichtbeton

Détermination de la résistance à la compression du béton de granulats légers a structure ouverte

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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.

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

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 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of an identical text or by endorsement, at the latest by June 1997, and conflicting national standards shall be withdrawn at the latest by June 1997.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 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 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.

1 Scope

This European Standard specifies a method of determining the compressive strength of lightweight aggregate concrete with open structure (LAC) according to prEN 1520.

The reference test method uses test specimens (cores or cubes) taken from prefabricated components.

Test specimens cast separately in moulds may also be used. This alternative procedure is described in Annex A.

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 992	Determination of dry density of light-weight aggregate concrete with open structure
prEN 1520	Prefabricated components of lightweight aggregate concrete with open structure
ISO 1920:1976	Concrete tests - Dimensions, tolerances and applicability of test specimens
ISO 2736-1:1986	Concrete tests - Test specimens - Part 1: Sampling of fresh concrete
ISO 2736-2:1986	Concrete tests - Test specimens - Part 2: Making and curing of test specimens for strength tests
ISO 4012:1978	Testing concrete - Determination of compressive strength of test specimens
ISO/DIS 7034:1983	Cores of hardened concrete - Taking, examination and testing in compression

3 Principle

The compressive strength is determined on test specimens taken from prefabricated components. It is defined as the ratio between the rupture load in axial compression and the cross-sectional area of the test specimen.

4 Apparatus

- a) a compression testing machine which meets the requirements of ISO 4012:1978 (see note 1);
- b) calipers, capable of reading the dimensions of the test specimens to an accuracy of 0,1 mm;
- c) a straight-edge (at least as long as the longest diagonal of the test specimen surfaces, in the case of cylinders: at least as long as the generatrices) and a 0,5-mm feeler gauge;

- d) equalizing layers of soft fibreboard with a thickness of (12 ± 2) mm and a density of $(250 \text{ to } 400)$ kg/m³ to be inserted between the loadbearing surfaces of the test specimens and the platens of the compression testing machine (not required in the case of levelling the loadbearing surfaces by grinding or capping). The edge length or the diameter of the equalizing layers shall not exceed that of the loadbearing surfaces of the test specimen by more than 5 mm (see note 2);
- e) a balance, capable of determining the mass of the test specimens to an accuracy of 0,1 %;
- f) a ventilated drying oven, capable of maintaining a temperature of (105 ± 5) °C (see note 3);
- g) equipment for drilling cores from reinforced components, with water cooled diamond bit and sufficiently rigid so that the cores can be obtained with straight sides with a minimum of surface irregularities and disturbances;
- h) any saw suitable for cutting reinforced LAC components.

NOTE 1: Compression testing machines complying with ISO 4012:1978 may need adaption to test specimens smaller than 90 mm in diameter.

NOTE 2: The use of equalizing layers with larger size may give higher strength results, especially for LAC in the lower strength range, due to the effect of lateral restraint.

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NOTE 3: In addition a ventilated drying oven capable of maintaining a temperature of $(40 \text{ to } 60)$ °C can be helpful for conditioning of test specimens.

5 Test specimens

5.1 Sample

The sample for the preparation of the test specimens (usually at least one prefabricated component) 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 cores with a length equal to the diameter, or cubes. The preferred diameter or edge length, respectively, is 100 mm (reference test specimens).

NOTE: In the case of hollow core components or multilayer components it may be necessary to use smaller test specimens.

5.3 Number of test specimens

A test set shall consist of at least three test specimens. If test specimens with a diameter or an edge length below 70 mm or less than three times the maximum aggregate size are used, at least six test specimens shall be tested.

5.4 Preparation of test specimens

The test specimens shall preferably be taken from the following areas of components:

- solid and hollow core components: from the compression zone; if the shear strength shall be derived from the compressive strength, it may be necessary to take test specimens also from the weakest zone of the component (see note 1) or, if applicable, from the the webs between the hollow cores.
- multilayer components: from the weakest part of the middle layer (see note 2).

Cores shall be taken and prepared according to ISO/DIS 7034:1983 unless otherwise stated in this European Standard. If possible, the axis of the cores shall be chosen parallel to the direction of the compressive stresses in the component. Cubes shall be cut by means of a saw, preferably a circular saw with water cooled carborundum or diamond blade. One axis of the cubes shall be parallel to the direction of the compressive stresses in the component.

The test specimens shall not contain any reinforcing bars in, or close to, the direction of the compressive force during the test. One or two reinforcing bars approximately perpendicular to the direction of the compressive force and with a diameter not exceeding 10 mm may be permitted, but should be avoided, if possible. The presence of steel within a test specimen shall be mentioned in the test report.

The test specimens shall be drilled or cut within a period of (1 to 7) d before the compression test and stored until the test in air at $(20 \pm 5)^\circ\text{C}$ and $(50 \pm 15)\%$ relative humidity. The moisture content at the compression test shall be $\geq 4\%$ by mass. If the moisture content is found to be lower, the test specimens shall be wetted and subsequently stored under the conditions specified above for at least 1 d prior to the compression test.

NOTE 1: Depending on the manufacturing process, the strength can decrease or increase from top to bottom.

NOTE 2: In general, it will not be possible to take test specimens with the required dimensions for the compression test from the thin outer layers of multilayer components. A feasible method would be to take several cores perpendicular to the plane of the component, to separate the outer layers of the cores by cutting and to glue several of these discs one on top of the other until the required length (see 5.2) has been attained. In order to prevent impermissible strength increase by partly filling the interstitial pores with glue, only a minimum amount of glue should be used, and the glue, preferably epoxy resin or cement paste, should have a plastic rather than a liquid consistency. Another possibility would be

to add an additional length to the component and make it homogeneous, using concrete of the outer layers, and to take the test specimens from this part of the component. This method can also be used in the case of hollow core components, where it is not normally possible to take test specimens with the required dimensions from the thin top and bottom layers.

5.5 Checking the dimensions and the shape of test specimens

The dimensions and the shape of the test specimens shall be checked according to ISO/DIS 7034:1983.

Each dimension shall be determined to an accuracy of 0,2 % by at least two measurements, taken at different positions, and the considered dimension is determined by the mean value.

The length of cylinders shall not deviate from their diameter by more than ± 5 %.

5.6 Treating of loadbearing surfaces

The loadbearing surfaces shall not depart from perpendicularity with the longitudinal axis of the test specimen by more than 1°.

In the case of cubes the surfaces approximately perpendicular to the compressive stresses in the component when in use shall be chosen as the loadbearing surfaces.

The loadbearing surfaces of the test specimens shall be plane within 0,5 mm. Planeness shall be checked across two orthogonal diameters or across the two diagonals, respectively, using a straight-edge and, if necessary, a 0,5-mm feeler gauge.

Necessary corrections of perpendicularity and/or planeness shall be made by cutting or grinding or, if applicable, by capping of the loadbearing surfaces.

5.7 Determination of mass of test specimens in air-dry state

Immediately before the compression test the mass of the test specimens shall be determined in the actual air-dry state.

NOTE: The term "air-dry" is not related to a strictly defined moisture content. The air-dry mass or density is therefore no absolute value but may be used for comparing the individual test specimens within a test set or for the calculation of the volume of a concrete sample taken from a crushed compression specimen to determine the dry density in accordance with EN 992.

6 Compression test

The platens of the compression testing machine shall be wiped clean, and the test specimen shall be positioned in the compression testing machine. In the case of test specimens where the loadbearing surfaces have not been capped or levelled by grinding and depart from planeness by more than 0,2 mm, equalizing layers of soft