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Ugotavljanje tlaļ ne trdnosti betona iz lahkega agregata z odprto strukturo

Determination of compressive strength of lightweight aggregate concrete with open structure

Bestimmung der Druckfestigkeit von haufwerksporigem Leichtbeton

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

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Determination of compressive strength of lightweight aggregate concrete with open structure

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

Bestimmung der Druckfestigkeit von haufwerksporigem Leichtbeton

This European Standard was approved by CEN on 3 June 2005.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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Foreword

This European Standard (EN 1354:2005) 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of an identical text or by endorsement, at the latest by January 2006, and conflicting national standards shall be withdrawn at the latest by January 2006.

This document supersedes EN 1354:1996.

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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and 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 EN 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

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 992, *Determination of the dry density of lightweight aggregate concrete with open structure*

EN 1520, *Prefabricated reinforced components of lightweight aggregate concrete with open structure*

EN 12350-1, *Testing fresh concrete - Part 1: Sampling*

EN 12390-1, *Testing hardened concrete - Part 1: Shape, dimensions and other requirements for specimens and moulds*

EN 12390-2, *Testing hardened concrete - Part 2: Making and curing specimens for strength tests*

EN 12390-4, *Testing hardened concrete - Part 4: Compressive strength - Specification for testing machines*

EN 12504-1, *Testing concrete in structures - Part 1: Cored specimens - Testing, examining 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 EN 12390-4 for testing machines of machine class 1 or 2;

b) calipers, capable of reading the dimensions of the test specimens to an accuracy of 0,1 mm;

c) 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) equalising layers of soft fibreboard with a thickness of (12 ± 2) mm and a density of (250 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 equalising layers shall not exceed that of the loadbearing surfaces of the test specimen by more than 5 mm (see NOTE 1);

e) balance, capable of determining the mass of the test specimens to an accuracy of 0,1 %;

f) ventilated drying oven, capable of maintaining a temperature of (105 ± 5) °C (see NOTE 2);

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

NOTE 2 In addition a ventilated drying oven capable of maintaining a temperature of (40 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 1 Experience has shown, that the strength results are practically the same in both cases. In EN 1520 both are considered as cube strength.

NOTE 2 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 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 EN 12504-1 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) days before the compression test and stored until the test in air at (20 ± 5) °C and (50 ± 15) % relative humidity. The moisture content at the compression test shall be ≥ 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 day 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 dimension and the shape of test specimens

The dimensions and the shape of the test specimens shall be checked according to EN 12504-1.

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, equalising layers of soft fibreboard, as specified in 4 d), shall be inserted between the loadbearing surfaces of the test specimen and the platens of the compression testing machine. In this case, for each compression test a new set of fibreboard equalising layers shall be used.

The test specimen shall be seated centrally and loaded uniformly (see NOTE 1).

The load shall be applied until rupture in a continuous and uniform manner, without shock, at a constant rate in order to reach the maximum load within (30 to 120) s (see NOTE 2). The maximum load carried by the test specimen shall be recorded.

After the compression test the test specimen or at least 80 % of its mass shall be dried at (105 ± 5) °C to constant mass in order to determine the dry density of the LAC according to EN 992 and to determine the actual moisture content during the compression test (see, however, the note in Clause 7).

NOTE 1 In order to obtain uniform load transmission, it may be necessary to adjust the spherically seated upper platen of the compression testing machine by hand so that it is parallel to the upper loadbearing surface of the test specimen before it is brought to contact with it.

NOTE 2 For LAC with unknown strength a value of (0,1 ± 0,05) MPa per s may be assumed as a guidance value of loading rate.

Constant rate of loading should be maintained at least during the latter half of the loading phase. During the application of the first half of the anticipated maximum load a higher rate of loading is permitted.

7 Test results

The compressive strength of the test specimen i is determined according to equation (1):

$$f_{ci} = \frac{F_i}{A_{ci}} \qquad i = 1, 2, 3\ (4, 5, 6) \tag{1}$$

where

f_{ci} is the compressive strength of the test specimen i, in MPa;

F_i is the maximum load at failure, in Newton's;

A_{ci} is the loadbearing cross sectional area of the test specimen, determined from the dimensions measured according to 5.5, in square millimetres.

The compressive strength of each individual test specimen and the mean value of the test set shall be expressed to the nearest 0,1 MPa.

NOTE 1 If in exceptional cases a test set includes test specimens of different sizes (e.g. cylinders with a diameter of 50 mm and 100 mm) it is recommended to convert the strength results of the test specimens with the smaller diameter (or