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Unbound and hydraulically bound mixtures — Part 41: Test method for the determination of the compressive strength of hydraulically bound mixtures

Ungebundene und hydraulisch gebundene Gemische - Teil 41: Prüfverfahren zur Bestimmung der Druckfestigkeit hydraulisch gebundener Gemische

Mélanges traités et mélanges non traités aux liants hydrauliques - Partie 41: Méthode d'essai pour la détermination de la résistance à la compression des mélanges traités aux liants hydrauliques

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Unbound and hydraulically bound mixtures - Part 41: Test method for the determination of the compressive strength of hydraulically bound mixtures

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This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 227.

If this draft becomes a European Standard, 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.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

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European foreword

This document (prEN 13286-41:2020) has been prepared by Technical Committee CEN/TC 227 “Road materials”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 13286-41:2003.

The following changes have been made in comparison with EN 13286-41:2003:

— editorial changes;

— to cater for the wide range of strengths possible for hydraulically bound mixtures – from < 1 MPa to 50 MPa or more;

— an increase in the permitted ‘time window’ for rupture of the specimen.

This document is one of a series of standards as listed below.

— EN 13286-1, Unbound and hydraulically bound mixtures — Part 1: Test methods for laboratory reference density and water content — Introduction, general requirements and sampling

— EN 13286-2, Unbound and hydraulically bound mixtures — Part 2: Test methods for laboratory reference density and water content — Proctor compaction

— EN 13286-3, Unbound and hydraulically bound mixtures — Part 3: Test methods for laboratory reference density and water content — Vibrocompression with controlled parameters

— EN 13286-4, Unbound and hydraulically bound mixtures — Part 4: Test methods for laboratory reference density and water content — Vibrating hammer

— EN 13286-5, Unbound and hydraulically bound mixtures — Part 5: Test methods for laboratory reference density and water content — Vibrating table

— EN 13286-7, Unbound and hydraulically bound mixtures — Part 7: Cyclic load triaxial test for unbound mixtures

— EN 13286-40, Unbound and hydraulically bound mixtures — Part 40: Test method for the determination of the direct tensile strength of hydraulically bound mixtures

— EN 13286-41, Unbound and hydraulically bound mixtures — Part 41: Test method for the determination of the compressive strength of hydraulically bound mixtures

— EN 13286-42, Unbound and hydraulically bound mixtures — Part 42: Test method for the determination of the indirect tensile strength of hydraulically bound mixtures

— EN 13286-43, Unbound and hydraulically bound mixtures — Part 43: Test method for the determination of the modulus of elasticity of hydraulically bound mixtures

— EN 13286-44, Unbound and hydraulically bound mixtures — Part 44: Test method for the determination of the alpha coefficient of vitrified blastfurnace slag

— EN 13286-45, Unbound and hydraulically bound mixtures — Test methods — Part 45: Test method for the determination of the workability period of hydraulically bound mixtures

— EN 13286-46, Unbound and hydraulically bound mixtures — Part 46: Test method for the determination of the moisture condition value

— EN 13286-47, Unbound and hydraulically bound mixtures — Part 47: Test methods for the determination of California bearing ratio, immediate bearing index and linear swelling

— EN 13286-48, Unbound and hydraulically bound mixtures — Part 48: Test method for the determination of the degree of pulverisation

— EN 13286-49, Unbound and hydraulically bound mixtures — Part 49: Test method for the determination of the accelerated swelling of soil treated by lime and/or hydraulic binder

— EN 13286-50, Unbound and hydraulically bound mixtures — Part 50: Method for the manufacture of test specimens of hydraulically bound mixtures using Proctor equipment or vibrating table compaction

— EN 13286-51, Unbound and hydraulically bound mixtures — Part 51: Method for the manufacture of test specimens of hydraulically bound mixtures using vibrating hammer compaction

— EN 13286-52, Unbound and hydraulically bound mixtures — Part 52: Method for the manufacture of test specimens of hydraulically bound mixtures using vibrocompression

— EN 13286-53, Unbound and hydraulically bound mixtures — Part 53: Method for the manufacture of test specimens of hydraulically bound mixtures using axial compression

— CEN/TS 13286-54, Unbound and hydraulically bound mixtures — Part 54: Test method for the determination of frost susceptibility — Resistance to freezing and thawing of hydraulically bound mixtures

1 Scope

This document describes a test method for the determination of the compressive strength of specimens of hydraulically bound mixtures. This document applies to specimens manufactured in the laboratory or prepared from cores.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 12390-3:2019, *Testing hardened concrete - Part 3: Compressive strength of test specimens*

EN 13286-50, *Unbound and hydraulically bound mixtures - Part 50: Method for the manufacture of test specimens of hydraulically bound mixtures using Proctor equipment or vibrating table compaction*

EN 13286-51, *Unbound and hydraulically bound mixtures - Part 51: Method for the manufacture of test specimens of hydraulically bound mixtures using vibrating hammer compaction*

EN 13286-52, *Unbound and hydraulically bound mixtures - Part 52: Method for the manufacture of test specimens of hydraulically bound mixtures using vibrocompression*

EN 13286-53, *Unbound and hydraulically bound mixtures - Part 53: Methods for the manufacture of test specimens of hydraulically bound mixtures using axial compression*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
hydraulically bound mixture
mixture that hardens by hydraulic and/or pozzolanic and/or sulfatic and/or carbonatic reaction, which usually has a workability to suit compaction by rolling and which is generally used in bases, sub-bases and capping layers

3.2
compressive strength
stress at failure of a specimen when tested in uniaxial unconfined compression

3.3
slenderness ratio
ratio of the length to the diameter of a cylindrical specimen

4 Principle

A specimen is subjected to a compressive force until failure. The maximum load sustained by the specimen is recorded and the compressive strength is calculated.

5 Apparatus

5.1 Compression testing machine

The precision of the machine and the load indication shall be capable of loading and measurement to accuracy of ± 1 %.

NOTE 1 Test specimens of hydraulically bound mixtures can be either cylindrical or cubical, with nominal dimensions as small as 50 mm (diameter) and as large as 300 mm (height), and with ultimate compressive strengths varying from 0,5 N/mm² to normal concrete strengths. Machines complying with EN 12390-4 can be suitable for stronger specimens.

The machine shall have two steel loading platens with faces having a Rockwell hardness of at least 55 HRC for a depth of approximately 5 mm. The loading platens shall be at least as large as, and preferably larger than, the faces of the specimen to which the load is applied. The surface flatness of the platens and the surfaces by which they are supported shall be 0,03 mm or better.

NOTE 2 Auxiliary platens having a minimum thickness of 25 mm and fulfilling the same requirements as the original platens can be used.

The upper platen shall have a spherical seating of dimension such that the deformation of the platen under normal loading does not exceed the tolerance of flatness. The combination of the upper platen and spherical seating shall be designed to permit easy alignment of the platen to the specimen but to become immobile as the force on the specimen increases. The seating shall have its centre at the surface of the platen, or at a point whose distance from the platens is less than 1 mm. The diameter of the seating shall not exceed 150 mm.

Provision shall be made for positive location of specimens at the centre of the lower platens; visual alignment shall not be used.

6 Test specimen

The manufacture of the specimen shall be in accordance with EN 13286-50, EN 13286-51, EN 13286-52 or EN 13286-53. The type of compaction and curing of the specimen shall be stated in the test report.

7 Test procedure

7.1 Dimensions

The dimensions of the specimen shall be measured with an accuracy of 0,5 %.

7.2 Mass

The specimen shall be weighed to an accuracy of ± 0,25 % and compared to the mass at the time of manufacture. The change in mass shall be recorded.

NOTE If the change in mass is greater than 2 %, the resulting compressive strength can be reviewed since it could be unrepresentative of the tested mixture.

7.3 Adjustment of the test specimen

The top and bottom faces of the test specimen shall have an out-of-parallelism tolerance not exceeding 2 mm in 100 mm. Specimens failing this requirement shall either be discarded or rectified by grinding or capping in accordance with EN 12390-3:2019, Annex A.

7.4 Defective specimens

Damaged specimens shall not be tested.

7.5 Specimen positioning

Excess moisture shall be wiped from the surface of the specimen before placing in the test machine.

All testing machine bearing surfaces shall be wiped clean and any loose grit or extraneous material removed from the surfaces of the specimen that will be in contact with the platens or auxiliary platens if used.

No packing shall be used between the specimen and the platens or auxiliary platens.

Cube specimens shall be compressed perpendicularly to or in the direction of casting and the direction recorded.

The specimen shall be centred on the lower platen or auxiliary platen to an accuracy of 1 % of the designated size of the cube or diameter of cylindrical specimens.

At the moment of contact between the specimen and the upper platen, the spherical seating shall be adjusted to achieve uniform contact between the specimen and upper platen.

7.6 Loading

The load shall be applied in a continuous and uniform manner without shock so that rupture occurs within 30 s to 120 s of commencement of loading.

When using manually controlled testing machines and as specimen rupture is approached, any tendency for the selected rate of loading to decrease shall be corrected by appropriate adjustment of the controls.

When using automatically controlled testing machines, the rate of loading shall be periodically checked to ensure that the rate is constant.

The maximum force, F, sustained shall be recorded.

The time between the removal of the test specimens from their curing condition and loading should be minimized in order to avoid loss of moisture.

7.7 Assessment of type of failure

The mode of failure of the specimen shall be noted using Figures 1, 2, 3 and 4. If the failure is satisfactory, the fact shall be recorded. If the failure pattern is unsatisfactory, the fact shall be recorded and the type of failure shall also be recorded using the pattern number indicated in the case of cubes and the pattern letter in the case of cylinders.

NOTE Unsatisfactory failures are usually caused by insufficient attention to the detailed procedures for making, capping (where carried out) and testing specimens. It is also possible for a machine fault to be the cause of an unsatisfactory failure.

8 Expression of result

The compressive strength, R_c, shall be given by the equation:

$$R_c = \frac{F}{A_c} \quad (1)$$

where

R_c is the compressive strength of the specimen of hydraulically bound mixtures, in Newton per square millimetre (N/mm²);

F is the maximum force sustained by the specimen of hydraulically bound mixtures, in Newton (N);

A_c is the cross section area of the specimen of hydraulically bound mixtures, in square millimetres (mm²).

If the actual dimensions of the test specimen are within ± 0,5 % of the designated size, R_c, shall be calculated using the designated size. If the actual dimensions are outside this tolerance, the strength calculation shall be based on the actual dimensions of the test specimen.

The compressive strength shall be expressed to the nearest:

— 0,1 N/mm² for compressive strength values up to 5 N/mm²;

— 0,5 N/mm² for compressive strength values above 5 N/mm².

9 Test report

9.1 Compulsory information

The test report shall refer to this document and shall include the following information:

a) identification of the specimen;

b) shape of specimen;

c) method of specimen manufacture;

d) mass of specimen at the time of test to nearest 10 g;

e) condition at time of weighing (as received/saturated);

f) dimensions of the specimen (actual or designated);

g) method of adjustment (grinding/capping as appropriate);

h) date of test;

i) in the case of cubes, orientation of direction of testing to direction of casting;

j) bulk density of the specimen at the time of test, in kg/m³;

k) compressive strength of specimen to nearest 0,1 N/mm² or 0,5 N/mm² as appropriate;

l) type of failure (satisfactory or not, and if unsatisfactory, in what way);