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Preskušanje svežega betona - 7. del: Vsebnost zraka - Metode s pritiskom

Testing fresh concrete - Part 7: Air content - Pressure methods

Prüfung von Frischbeton - Teil 7: Luftgehalte - Druckverfahren

Essais sur béton frais - Partie 7 : Détermination de la teneur en air - Méthode de la compressibilité

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ICS:

91.100.30	Beton in betonski izdelki	Concrete and concrete products

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Testing fresh concrete - Part 7: Air content - Pressure methods

Essais pour béton frais - Partie 7 : Teneur en air - Méthode de la compressibilité

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This European Standard was approved by CEN on 20 January 2009.

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

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Foreword

This document (EN 12350-7:2009) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, 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of an identical text or by endorsement, at the latest by October 2009, and conflicting national standards shall be withdrawn at the latest by October 2009.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 12350-7:2000.

The results of a laboratory inter-comparison, in part funded by the EC under Measurement and Testing Programme, Contract MAT1-CT-94-0043 which investigated these two methods of measuring air content, did not find significant difference between them. However, it was found in this programme that the use of an internal vibrator to compact specimens of air entrained fresh concrete should only be done with caution, if loss of entrained air is to be avoided.

The determination of the aggregate correction value for the two methods has been included in normative Annexes A and B.

The method of calibrating the two types of apparatus has been included in normative Annexes C and D.

This standard is one of a series concerned with testing fresh concrete.

This series EN 12350 includes the following parts:

EN 12350 Testing fresh concrete

Part 1: Sampling;

Part 2: Slump-test;

Part 3: Vebe test;

Part 4: Degree of compactability;

Part 5: Flow table test;

Part 6: Density;

Part 7: Air content — Pressure methods;

Part 8: Self-compacting concrete - Slump-flow test (in preparation);

Part 9: Self-compacting concrete - V-funnel test (in preparation);

Part 10: Self-compacting concrete - L-box test (in preparation);

Part 11: Self-compacting concrete - Sieve segregation test (in preparation);

Part 12: Self-compacting concrete - J-ring test (in preparation).

CAUTION — When cement is mixed with water, alkali is released. Take precautions to avoid dry cement entering the eyes, mouth and nose whilst mixing concrete. Prevent skin contact with wet cement or concrete by wearing suitable protective clothing. If cement or concrete enters the eye, immediately wash it out thoroughly with clean water and seek medical treatment without delay. Wash wet concrete off the skin immediately

The following amendments have been made to the 2000-04 edition of this standard:

— editorial revision

— detailing and clarification of filling and compacting procedures of concrete in the container

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard describes two methods for determination of air content of compacted fresh concrete, made with normal weight or relatively dense aggregate of maximum size up to 63 mm.

NOTE Neither method is applicable to concretes made with lightweight aggregates, air cooled blast-furnace slag, or aggregates with high porosity, because of the magnitude of the aggregate correction factor, compared with the entrained air content of the concrete.

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

EN 12350-6, *Testing fresh concrete – Part 6: Density*

3 Principles

3.1 General

There are two test methods, both of which use apparatus which employ the principle of Boyle-Mariotte's law. For the purpose of reference, the two methods are referred to as the water column method and the pressure gauge method and the apparatus as a water column meter and a pressure gauge meter.

3.2 Water column method

Water is introduced to a predetermined height above a sample of compacted concrete of known volume in a sealed container and a predetermined air pressure is applied over the water. The reduction in volume of the air in the concrete sample is measured by observing the amount by which the water level is lowered, the water column being calibrated in terms of percentage of air in the concrete sample.

3.3 Pressure gauge method

A known volume of air at a known pressure is merged in a sealed container with the unknown volume of air in the concrete sample. The dial on the pressure gauge is calibrated in terms of percentage of air for the resulting pressure.

4 Water column method

4.1 Apparatus

4.1.1 Water column meter, (see Figure 1), consisting of:

a) **Container**, a cylindrical vessel of steel or other hard metal, not readily attacked by cement paste, having a nominal capacity of at least 5 l and a ratio of diameter to height of not less than 0,75 nor more than 1,25. The outer rim and upper surface of the flange and the interior surfaces of the vessel shall be machined to a smooth finish. The container shall be watertight and in addition it, and the cover assembly,

shall be suitable for an operating pressure of approximately 0,1 MPa (N/mm2) and be sufficiently rigid to limit the pressure expansion constant, e (see A.8), to not more than 0,1 % air content;

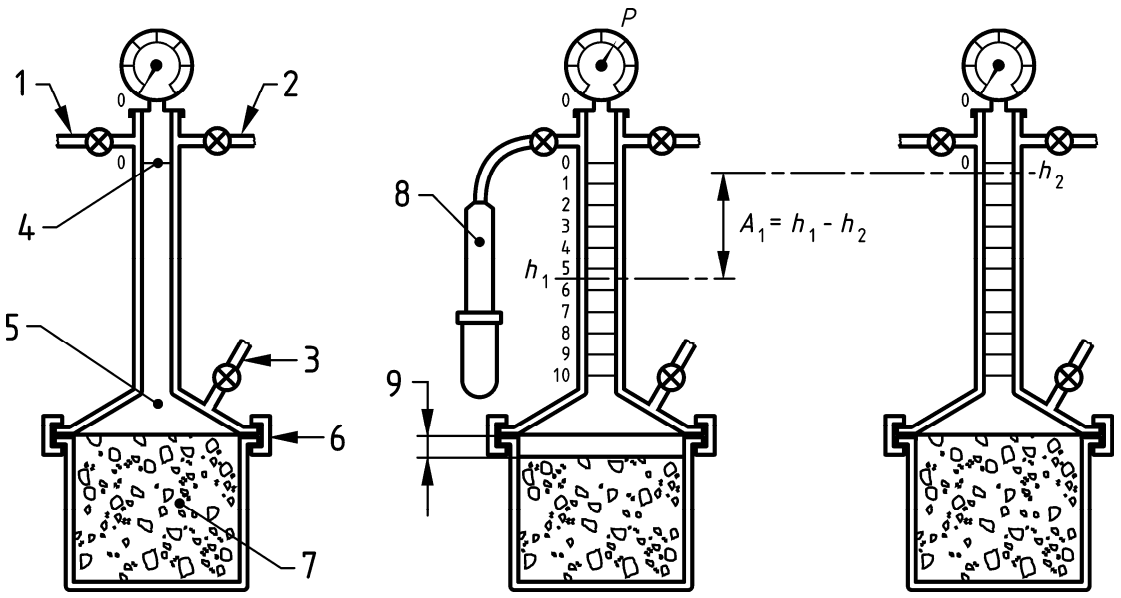
b) **Cover assembly**, a flanged rigid conical cover fitted with a standpipe. The cover shall be of steel or other hard metal not readily attacked by cement paste and shall have interior surfaces inclined at not less than 10° from the surface of the flange. The outer rim and lower surface of the flange and the sloping interior face shall be machined to a smooth finish. The cover shall have provision for being clamped to the container to make a pressure seal without entrapping air at the joint between the flanges of the cover and the container;

c) **Standpipe**, consisting of a graduated glass tube of uniform bore, or a metal tube of uniform bore with a glass gauge attached. The graduated scale shall indicate air content of 0 % to at least 8 % and preferably 10 %. The scale shall be graduated with divisions every 0,1 %, the divisions being not less than 2 mm apart. A scale in which 25 mm represents 1 % of air content is convenient;

d) **Cover**, fitted with a suitable device for venting the air chamber, a non-return air inlet valve and a small valve for bleeding off water. The applied pressure shall be indicated by a pressure gauge connected to the air chamber above the water column. The gauge shall be graduated with divisions every 0,005 MPa (N/mm2), the divisions being not less than 2 mm apart. The gauge shall have a full scale reading of 0,2 MPa (N/mm2);

e) **Deflecting plate or spray tube**, of a thin non-corrodible disc of not less than 100 mm diameter to minimize disturbance of the concrete when water is added to the apparatus. Alternatively a brass spray tube of appropriate diameter which may be an integral part of the cover assembly or provided separately. The spray tube shall be constructed so that when water is added to the container it is sprayed onto the walls of the cover in such a manner as to flow down the sides causing minimum disturbance to the concrete;

f) **Airpump**, with a lead facilitating connection to the non return air inlet valve on the cover assembly. The meter shall be in calibration at the time of the test, using the procedure in Annex C. If the meter has been moved to a location which differs in elevation by more than 200 m from the location at which it was last calibrated, it shall be recalibrated.



a) Zero pressure

b) System operating at pressure *P*

c) Zero pressure release of pressure P

Key:

1	Non-return valve	7	Concrete
2	Air vent or valve	8	Air pump
3	Bleed valve	9	Pressure lowered level
4	Mark	h_1	(reading at pressure P)
5	Water	h_2	(reading at zero pressure after release of pressure P)
6	Clamp		

Figure 1 — Water column method apparatus

NOTE *h1 – h2 = A1* when the container holds concrete as shown in Figure 1
h1 – h2 = G (aggregate correction factor) when the container holds only aggregate and water
A1 – G = Ac (air content of concrete)

4.1.2 Means of compacting the concrete, which may be one of the following:

a) **Internal (poker) vibrator**, with a minimum frequency of approximately 120 Hz (7 200 cycles per exceeding approximately one-quarter of the smallest dimension of the test specimen);

b) **Vibrating table**, with a minimum frequency of approximately 40 Hz (2 400 cycles per minute);

c) **Compacting rod**, of circular cross-section, straight, made of steel, having a diameter of approximately 16 mm, length of approximately 600 mm and with rounded ends;

d) **Compacting bar**, straight, made of steel having a square cross-section of approximately 25 mm × 25 mm and length of approximately 380 mm.

4.1.3 Scoop, approximately 100 mm width

4.1.4 Steel trowel or float

4.1.5 Remixing container, flat tray of rigid construction and made from a non-absorbent material not readily attacked by cement paste. It shall be of appropriate dimensions such that the concrete can be thoroughly re-mixed, using the square-mouthed shovel

4.1.6 Shovel, with square mouth

NOTE The square mouth is required to ensure proper mixing of material on the remixing container

4.1.7 Filling frame (optional), filling may be simplified by using a filling frame fitted tightly to the container;

4.1.8 Container with spout, having a capacity of 2 l to 5 l to fill the apparatus with water;

4.1.9 Mallet, soft-faced.

4.2 Procedure

4.2.1 Sampling

Obtain the sample of fresh concrete in accordance with EN 12350-1. Remix the sample before carrying out the test

4.2.2 Filling the container and compacting the concrete

Using the scoop, place the concrete in the container in such a way as to remove as much entrapped air as possible.

Depending on the consistence of the concrete and the method of compaction, the container shall be filled in one or more layers to achieve full compaction by using one of the methods described in 4.2.3 or 4.2.4. Typically, concrete having a consistence equivalent to slump class S3 or greater will only require one layer. In the case of self-compacting concrete, the container shall be filled in one operation and no mechanical compaction shall be applied during filling or after the container is filled.

NOTE 1 Full compaction is achieved using mechanical vibration, when there is no further appearance of large air bubbles on the surface of the concrete and the surface becomes relatively smooth with a glazed appearance, without excessive segregation.

NOTE 2 The number of strokes per layer required to produce full compaction by hand will depend upon the consistency of the concrete.

NOTE 3 Further guidance on methods of compaction for concretes having different consistencies or cast in different sizes of moulds may be given in national annex NA.

NOTE 4 The quantity of material used in the final layer shall be sufficient to fill the container without having to remove excess material. A small quantity of additional concrete may be added if necessary and further compacted in order to fill the container, but the removal of excess material should be avoided.

4.2.3 Mechanical vibration

4.2.3.1 Compacting with internal vibrator

Apply the vibration for the minimum duration necessary to achieve full compaction of the concrete. Avoid over-vibration, which may cause loss of entrained air.

NOTE 1 Care should be taken not to damage the container. The vibrator should be vertical and not allowed to touch the bottom or sides of the container. The use of a filling frame is recommended.

NOTE 2 Laboratory tests have shown that great care is needed if loss of entrained air is to be avoided, when using an internal vibrator.

4.2.3.2 Compacting with vibrating table

Apply the vibration for the minimum duration necessary to achieve full compaction of the concrete. The container should preferably be attached to, or firmly held against, the table. Avoid over-vibration, which may cause loss of entrained air.

4.2.4 Compacting by hand with compacting rod or bar

Distribute the strokes of the compacting rod, or bar, in a uniform manner over the cross-section of the container. Ensure that the compacting rod, or bar, does not forcibly strike the bottom of the container when compacting the first layer, nor penetrate significantly any previous layer. Subject the concrete to at least 25 strokes per layer. In order to remove pockets of entrapped air but not the entrained air, after compaction of each layer, tap the sides of the container smartly with the mallet until large bubbles of air cease to appear on the surface and depressions left by the compacting rod or bar, are removed

4.2.5 Measuring air content

After the concrete has been compacted, strike off level with the top of the container using the compacting rod, and smooth the surface with the steel trowel or float.

Thoroughly clean the flanges of the container and cover assembly. In the absence of the spray tube, place the deflecting plate centrally on the concrete and press it into contact. Clamp the cover assembly in place. Ensure that there is a good pressure seal between the cover and the container. Fill the apparatus with water and tap lightly with the mallet to remove air adhering to the interior surfaces of the cover. Bring the level of water in the standpipe to zero by bleeding through the small valve with the air vent open. Close the air vent and apply the operating pressure, P, by means of the air pump. Record the reading on the gauge tube, h1, and release the pressure. Read the gauge tube again and if the reading, h2, is 0,2 % air content or less record the value (h1 – h2) as the apparent air content, A1, to the nearest 0,1 % air content. If h2 is greater than 0,2 % air content apply the operating pressure, P, again, giving a gauge tube reading h3 and a final reading h4 after release of the pressure. If (h4 – h2) is 0,1 % air content or less record the value (h3 - h4) as the apparent air content. If (h4 - h2) is greater than 0,1 % air content, it is probable that leakage is occurring and the test shall be disregarded.

5 Pressure gauge method

5.1 Apparatus

5.1.1 Pressure gauge meter, an example of which is shown in Figure 2, consisting of:

a) **Container**, a flanged cylindrical vessel of steel or other hard metal, not readily attacked by cement paste, having a nominal capacity of at least 5 l and a ratio of diameter to height of not less than 0.75 or more than 1.25. The outer rim and the interior surfaces of the vessel shall be machined to a smooth finish. The