BRITISH STANDARD

BS EN
12350-6:2000

Incorporating
Corrigendum No.1

Testing fresh concrete —

Part 6: Density

The European Standard EN 12350-6:1999 has the status of a British Standard

ICS 91.100.30

National foreword

This British Standard is the English language version of EN 12350-6:1999. It will supersede BS 1881-107:1983 which will be withdrawn in 2003 when the full package of concrete standards is available.

The UK participation in its preparation was entrusted by Technical Committee B/517, Concrete, to Subcommittee B/517/1, Concrete production and testing, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 5 and a back cover.

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This British Standard, having been prepared under the direction of the Sector Committee for Building and Civil Engineering, was published under the authority of the Standards Committee and comes into effect on 15 January 2000

ISBN 0 580 35296 X

Amendments issued since publication

Amd. No.	Date	Comments
11077 Corrigendum No.1	September 2000	National foreword supersession details updated

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12350-6

October 1999

ICS 91.100.30

English version

Testing fresh concrete — Part 6: Density

Essai pour béton frais —
Partie 6: Masse volumique

Prüfung von Frischbeton —
Teil 6: Frischbetonrohdichte

This European Standard was approved by CEN on 5 September 1999.

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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

Ref. No. EN 12350-6:1999 E

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 104, Concrete (performance, production, placing and compliance criteria), 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 April 2000, and conflicting national standards shall be withdrawn at the latest by December 2003.

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

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

It is based on the International Standard ISO 6276: *Concrete, compacted fresh — Determination of density.*

The results of a recent laboratory inter-comparison, part-funded by the EC under the Measurement and Testing programme, contract MAT1-CT94-0043mtp, have been taken into account. The compaction of specimens using hand tamping, vibrating table, or internal (poker) vibrator are accepted as equivalent. However, the use of an internal vibrator to compact specimens containing entrained air should be carried out with caution.

A procedure for calibrating the container has been included as a normative annex A.

A draft for this standard was published in 1996 for CEN enquiry as prEN 12383. It was one of a series of individually numbered test methods for fresh or hardened concrete. For convenience it has now been decided to combine these separate draft standards into three new standards with separate parts for each methods, as follows:

— *Testing fresh concrete* (EN 12350:1999);
— *Testing hardened concrete* (prEN 12390:1999);
— *Testing concrete in structures* (prEN 12504:1999).

This series EN 12350 includes the following parts where the brackets give the numbers under which particular test methods were published for CEN enquiry:

EN 12350: *Testing fresh concrete*
Part 1: *Sampling* (former prEN 12378:1996).
Part 2: *Slump test* (former prEN 12382:1996).
Part 3: *Vebe test* (former prEN 12350:1996).
Part 4: *Degree of compactability* (former prEN 12357:1996).
Part 5: *Flow table test* (former prEN 12358:1996).
Part 6: *Density* (former prEN 12383:1996).
Part 7: *Air content — Pressure methods* (former prEN 12395:1996).

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.

Contents

1 Scope

This European standard specifies a method for determining the density of compacted fresh concrete both in the laboratory and in the field.

NOTE It may not be applicable to very stiff concrete which cannot be compacted by normal vibration.

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 12350-1:1999, *Testing fresh concrete — Part 1: Sampling.*

3 Principle

Fresh concrete is compacted into a rigid and watertight container of known volume and mass and is then weighed.

4 Apparatus

4.1 *Container*, watertight, of sufficient rigidity to retain its shape, made of metal not readily attacked by cement paste, having a smooth internal face, with the rim machined to a plane surface. The rim and base shall be parallel. The smallest dimension of the container shall be at least four times the maximum nominal size of the coarse aggregate in the concrete, but shall be not less than 150 mm. The volume of the container shall be not less than 5 l.

The standard requires in **4.1**, that the volume of the container shall be not less than 5 l, but a smaller volume may be suitable for production control testing.

4.2 *Filling frame, (optional)*

Filling may be simplified by using a filling frame fitted tightly to the container.

4.3 *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 minute), the diameter of the internal vibrator not exceeding approximately one-quarter of the smallest dimension of the container;

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.

4.4 *Balance or scales*, capable of determining the mass of the compacted concrete to an accuracy of 0,1 % of the mass of the concrete.

4.5 *Straight-edged scraper*, made of steel, not less than 100 mm greater in length than the maximum internal dimension of the top of the container.

4.6 *Scoop*, of approximately 100 mm width.

4.7 *Two steel trowels or floats.*

4.8 *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.

4.9 *Shovel, with square mouth.*

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

4.10 *Mallet.*

5 Sampling

The sample shall be obtained in accordance with EN 12350-1.

The sample shall be re-mixed, using the remixing container and square mouth shovel, before carrying out the test.

6 Procedure

6.1 Calibration

Calibrate the container in accordance with annex A, to obtain the volume of the container (V).

6.2 Mass of container

Weigh the container to determine its mass (m_1) and record the value indicated.

6.3 Filling the container and compacting the concrete

If a filling frame is used, ensure that the amount of concrete used to fill the container is such that a layer of concrete remains in the filling frame after compaction, with a thickness of 10 % to 20 % of the height of the container.

Compact the concrete in a minimum of two layers.

6.4 Compacting the concrete

6.4.1 *General*

Compact the concrete immediately after placing in the container in such a way as to produce full compaction of the concrete, with neither excessive segregation nor laitance. Compact each layer by using one of the methods described in **6.4.2** or **6.4.3**.

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.

6.4.2 *Mechanical vibration*

6.4.2.1 *Compacting with internal vibrator*

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

NOTE Care should be taken not to damage the container. The use of a filling frame is recommended.

Ensure that the vibrator is kept vertical and not allowed to touch the bottom or sides of the container.

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

6.4.2.2 *Compacting with vibrating table*

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

6.4.3 *Hand compaction,* with compacting rod or bar

Distribute the strokes of the compacting rod, or bar, in a uniform manner over the cross-section of the mould. 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.

6.5 Surface levelling

If a filling frame is used, remove it immediately after compaction.

After the top layer has been compacted, smooth it level with the top of the container, using the steel float. Skim the surface and rim with the straightedge and wipe the outside of the container clean.

6.6 Weighing

Weigh the container with its contents to determine its mass (m_2) and record the value indicated.

7 Calculation of density

The density is calculated from the formula:

$$D = \frac{m_2 - m_1}{V}$$

where

- D is the density of the fresh concrete, in kilograms per cubic metre;
- m_1 is the mass of the container, in kilograms;
- m_2 is the mass of the container plus the mass of the concrete specimen in the container, in kilograms;
- V is the volume of the container, in cubic metres.

Express the density of the fresh concrete to the nearest 10 kg/m^3.

8 Test report

The report shall include:

a) precise identification of the test sample;
b) location of performance of test;
c) date of performance of test;
d) method of compaction;
e) calculated density of the fresh concrete;
f) any deviation from standard test method;
g) a declaration by the person technically responsible for the test that it was carried out in accordance with this standard, except as noted item f).

The report can include:

h) temperature of the concrete sample at time of test;
i) time of performance of the test
j) workability of the concrete.

9 Precision

Precision data are given in Table 1. These apply to density measurements made on concrete taken from the same sample and when each test result represents a single density determination.

Table 1 — Precision data for density of fresh concrete measurements

Range	Repeatability conditions		Reproducibility conditions	
	S_r	r	S_R	R
kg/m^3	kg/m^3	kg/m^3	kg/m^3	kg/m^3
2 300 to 2 400	5,5	15	10,2	29

NOTE 1 The precision data were determined as part of an experiment in the UK in 1987 in which precision data were obtained for several of the tests described in the then BS 1881. The experiment involved 16 operators. The concretes were made using an ordinary Portland cement, Thames Valley sand, and Thames Valley 10 mm and 20 mm coarse aggregates. (Hand compaction using a compacting bar was used.)

NOTE 2 The containers used complied with the requirements of BS 1881:Part 107:

nominal capacity:	0,01 m^3
inside diameter:	200 mm ± 1,5 mm
inside height:	320 mm ± 1,5 mm
minimum thickness of metal:	4 mm
radius between wall and base:	20 mm

NOTE 3 The difference between two test results from the same sample by one operator using the same apparatus within the shortest feasible time interval will exceed the repeatability value r on average not more than once in 20 cases in the normal and correct operation of the method.

NOTE 4 Test results on the same sample obtained within the shortest feasible time interval by two operators each using their own apparatus will differ by the eproducibility value R on average not more than once in 20 cases in the normal and correct operation of the method.

NOTE 5 The precision data includes the procedures of sampling, as well as the determination of density of fresh concrete.

NOTE 6 For further information on precision, and for definitions of the statistical terms used in connection with precision, see ISO 5725.

Annex A (normative)
Calibration of container

A.1 Apparatus

A.1.1 *Scales or balance*, capable of weighing the container empty and also full of water, to an accuracy of 0,1 %.

A.1.2 *Glass plate.*

A.2 Procedure

Weigh the empty container and glass plate to an accuracy of 0,1 % and record the indicated mass.

Place the container on a horizontal surface and fill with water at a temperature of (20 ± 5) °C. Fill the container to overflowing and slide the glass plate over it to exclude any air bubbles.

Weigh the container, glass plate and water to an accuracy of 0,1 % and record the indicated mass.

Calculate the volume of the container by dividing the total mass of water (in kilograms), required to fill the container, by 998 kg/m^3.

Express the volume (V) of the container in cubic metres to an accuracy of 0,1 %.

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