
British Standard

Testing concrete

Part 105. Method for determination of flow

Essais du béton

Partie 105. Méthode de détermination de l'étalement

Prüfverfahren von Beton

Teil 105. Verfahren zur Bestimmung des Fließverhaltens

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Foreword

This Part of this British Standard, prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Committee describes a new test method for workability additional to those familiar from BS 1881 : Part 2 : 1970 (superseded by BS 1881 : Parts 102, 103 and 104 published in 1983). The use of superplasticizing admixtures to produce flowing concrete of very high workability has led to a requirement for such a test. Four methods of determining workability of concrete are given in BS 1881, these being the slump, compacting factor, Vebe and flow. The methods are appropriate to concrete mixes of different workabilities as follows:

Workability	Method
Very low	Vebe time
Low	Vebe time, compacting factor
Medium	Compacting factor, slump
High	Compacting factor, slump, flow
Very high	Flow

There are no unique relationships between the values yielded by the four tests. Relationships depend upon such factors as the shape of the aggregate, the sand fraction and the presence of entrained air.

No estimate of repeatability or reproducibility is given in this Part of this British Standard. Reference should be made to BS 5497 : Part 1 for further information on the determination of repeatability and reproducibility.

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British Standard

Testing concrete

Part 105. Method for determination of flow

1. Scope

This Part of BS 1881 specifies the method for determination of the flow of concrete of high to very high workability. The method applies to plain and air-entrained concrete, having a flow diameter of 500 mm to 650 mm when tested by the method in this Part of BS 1881, made with light-weight, normal weight or heavy aggregates having a nominal maximum size of 20 mm or less. It does not apply to aerated concrete or no fines concrete.

NOTE. The titles of the publications referred to in this standard are listed on the inside back cover.

2. Definitions

For the purposes of this Part of this British Standard the definitions in BS 5328 and BS 1881 : Part 101 apply.

3. Apparatus

3.1 Flow table, consisting of a flat plate, on which concrete can be placed, hinged to a rigid base on to which it can fall from a fixed height. The essential dimensions of the flow table and a suitable form of construction are shown in figure 1.

The flow table top shall be constructed from a flat metal plate* of minimum thickness 1.5 mm, not readily attacked by cement paste or liable to rust. The top shall have a plan area of 700 mm × 700 mm and a flatness of within 1.5 mm, as defined in BS 308 : Part 3. The centre of the table shall be scribed with a cross, the lines of which run parallel to and out to the edges of the plate, and with a central circle 200 mm in diameter. The under surface of the plate shall be reinforced in order to prevent distortion of the flat surface. The front of the flow table top shall be provided with a lifting handle as shown in figure 1. The total mass of the flow table top shall be 16 ± 1 kg.

The flow table top shall be hinged to a base frame using externally mounted hinges in such a way that no aggregate can become trapped easily between the hinges or hinged surfaces. The front of the base frame shall extend a minimum of 120 mm beyond the flow table top in order to provide a toe board. An upper stop similar to that shown in figure 1 shall be provided on each side of the table so that the lower front edge of the table can only be lifted 40 ± 1 mm.

The lower front edge of the flow table top shall be provided with two hard rigid stops which transfer the load to the base frame. The base frame shall be so constructed that this load is then transferred directly to the surface on which the flow table is placed so that there is minimal tendency for the flow table top to bounce when allowed to fall.

* Galvanized steel is suitable.

3.2 Mould made of a metal* not readily attacked by cement paste or liable to rust and of minimum thickness 1.5 mm. The interior of the mould shall be smooth and free from projections, such as protruding rivets, and shall be free from dents. The mould shall be in the form of a hollow frustrum of a cone having the following internal dimensions:

diameter of base: 200 ± 2 mm
diameter of top: 130 ± 2 mm
height: 200 ± 2 mm

The base and the top shall be open and parallel to each other and at right angles to the axis of the cone. The mould shall be provided with two metal foot pieces at the bottom and two handles above them (see figure 2).

3.3 Tamping bar, made of a suitable hardwood, having a square section of side 40 ± 1 mm and at least 200 mm long. A further 120 mm to 150 mm shall be turned to a circular section to form a handle to the bar (see figure 3).

3.4 Scoop, about 100 mm wide.

3.5 Sampling tray, minimum dimensions 900 mm × 900 mm × 50 mm deep, of rigid construction and made from a non-absorbent material not readily attacked by cement paste.

3.6 Square mouthed shovel, size 2, complying with BS 3388.

3.7 Rule, of minimum length 700 mm and having 5 mm sub-divisions along its entire length.

4. Sampling

Obtain the sample of fresh concrete by the procedure given in BS 1881 : Part 101 : 1983, for sampling on site, or BS 1881 : Part 125, for sampling in a laboratory.

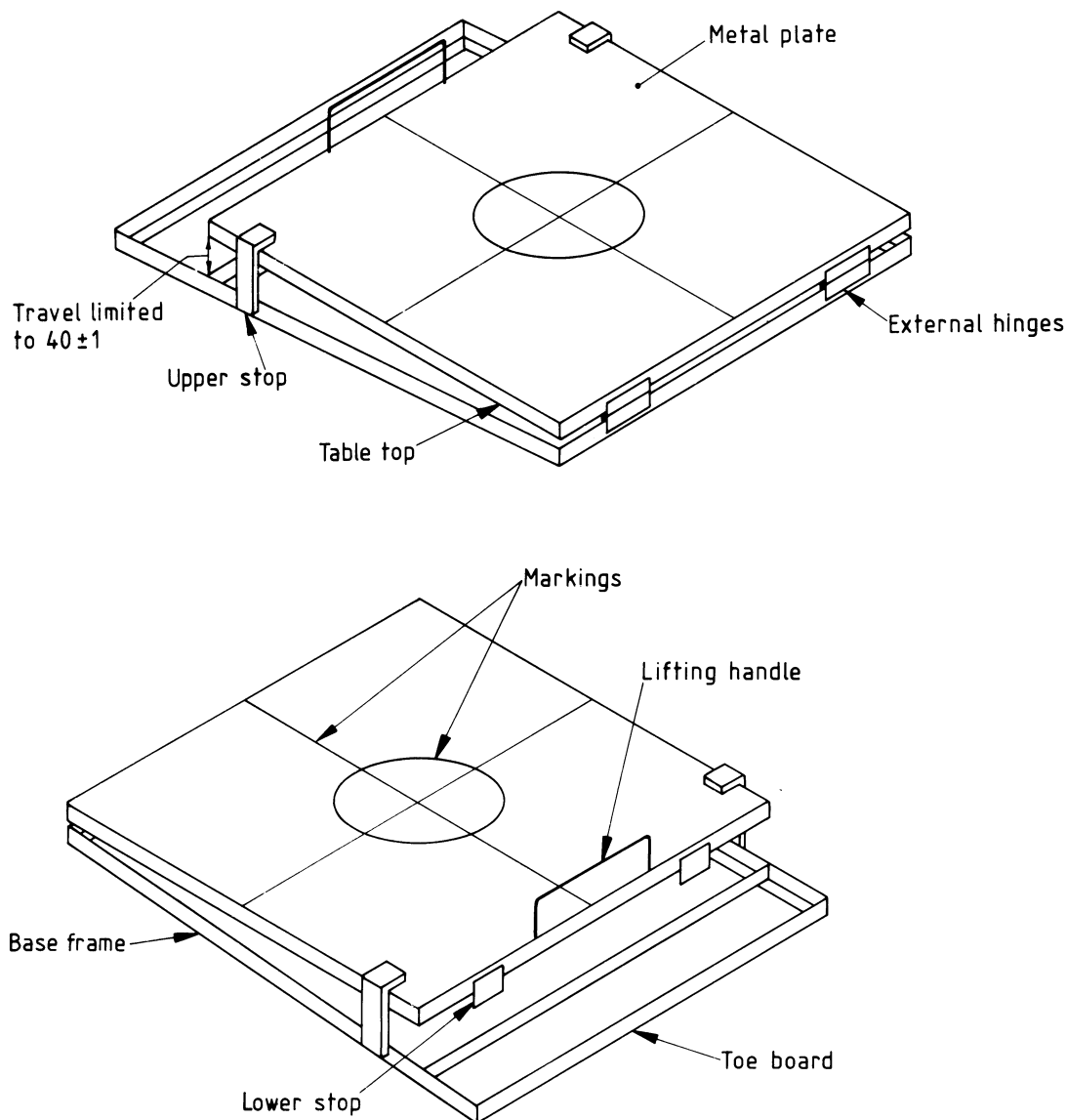
Commence the determination of flow as soon as possible after sampling.

5. Preparing the sample for test

Empty the sample from the container(s) on to the sampling tray. Ensure that no more than a light covering of slurry is left adhering to the container(s).

Thoroughly mix the sample by using the shovel to turn the concrete over from the outside of the tray towards the centre, working progressively once round all four sides of the tray.

Caution. When cement is mixed with water, alkali is released. Take precautions to avoid dry cement entering the eyes, mouth and nose when 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.



Dimension is in millimetres.

Figure 1. Typical flow table

6. Procedure

Place the flow table on a flat, horizontal and solid surface free from external vibration or shock. Ensure that the hinged top of the table can be lifted to the correct limit of its travel and is then free to fall to the lower stop. Check that the table is so supported that, when the top of the table falls to the lower stop, there is minimal tendency for the top to bounce.

The table and the mould shall be clean and damp immediately prior to testing but free from superfluous moisture. Place the mould centrally on the table top and hold it in position by standing on the two foot pieces.

Fill the mould with concrete in two equal layers using the scoop, tamping each layer lightly 10 times with the wooden tamping bar. If necessary, add further concrete to maintain an excess above the top of the mould during the final tamping operation. Strike off the concrete flush with the upper edge of the mould and clean the free area of the table top of any excess concrete.

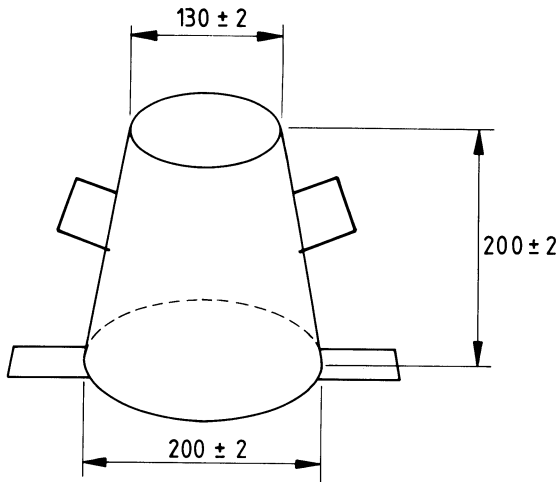
At 30 s after striking off the concrete, slowly raise the mould vertically by the handles over a period of 3 s to 6 s.

While the operator stabilizes the flow table by standing on the toe board at the front of the table, slowly raise the table top by the handle till it reaches the upper stop in such a manner that the table top does not impact hard against the upper stop. Then allow the table top to fall freely to the lower stop. Repeat this cycle to give a total of 15 drops, each cycle taking not less than 3 s nor more than 5 s. In this way the concrete spreads across the table top (see figure 4).

Measure with the rule the total diameter of the concrete spread in two directions, parallel to the table edges. Calculate the arithmetic mean of both diameters as the measurement of flow in millimetres.

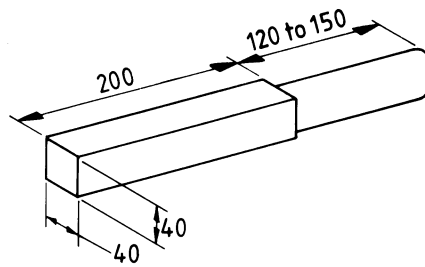
NOTE 1. The concrete spread may also be checked for segregation. The cement paste may segregate from the coarse aggregate to give a ring of paste extending several millimetres beyond the coarse aggregate (see figure 5).

NOTE 2. The workability of a concrete mix changes with time due to hydration of the cement and, possibly, loss of moisture. Tests on different samples should, therefore, be carried out at a constant time interval after mixing if strictly comparable results are to be obtained.



All dimensions are in millimetres.

Figure 2. Concrete mould



All dimensions are in millimetres.

Figure 3. Tamping bar

7. Expression of results

7.1 General

Record the mean of the two flow diameters in millimetres to the nearest 5 mm.

7.2 Precision. Precision data are given in table 1. These apply to flow measurements made on concrete taken from the same sample and when each test result is obtained from a single flow determination.

Table 1. Precision data for flow measurements

Level	Repeatability conditions		Reproducibility conditions	
	s_r	r	s_R	R
mm	mm	mm	mm	mm
555	24.6	69	32.5	91

NOTE 1. The precision data were determined as part of an experiment carried out in 1987 in which precision data were obtained for several tests described in 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.

NOTE 2. 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 3. 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 reproducibility value R on average not more than once in 20 cases in the normal and correct operation of the method.

NOTE 4. For further information on precision, and for definitions of the statistical terms used in connection with precision, see BS 5497 : Part 1.

8. Report

8.1 General. The report shall affirm that the flow was determined in accordance with this Part of BS 1881. The report shall state whether or not a certificate of sampling is available. If available, a copy of the certificate shall be provided.

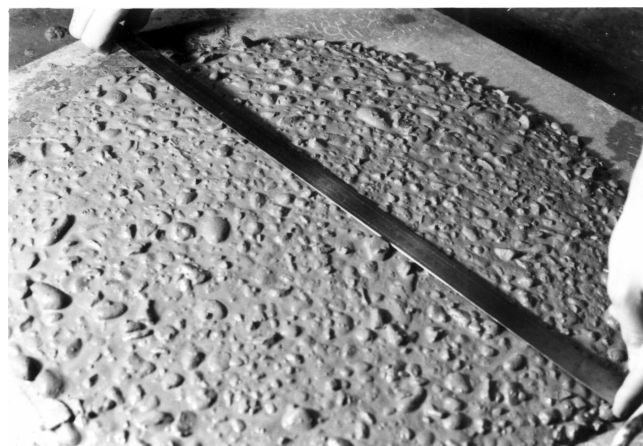
8.2 Information to be included in the test report

8.2.1 Obligatory information. The following information shall be included in the test report:

- date, time and place of sampling and sample identity number;
- time and place of test;
- mean flow diameter in millimetres;
- name of person carrying out test.

8.2.2 Additional information. Where appropriate, the following information also shall be included in the test report:

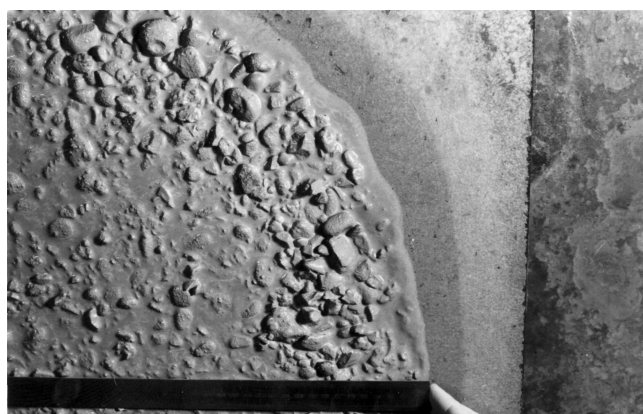
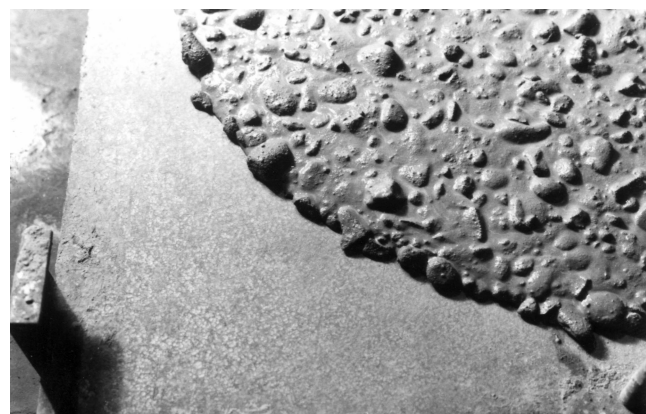
- name of project and place where concrete was used;
- name of supplier and source of concrete;
- date and time of production of concrete or delivery to site;
- specification of concrete mix (e.g. strength grade);
- indication of any tendency for the mix to segregate.



(a) General view of the flow table

(b) Measurement of the flow diameter

Figure 4. Typical concrete spread



(a) Good quality flowing concrete showing no segregation at the perimeter of the sample

(b) Lack of cohesion in the concrete has resulted in grout segregation round the perimeter of the sample

Figure 5. Examples of good quality and segregated concrete mixes

Publications referred to

- BS 308 Engineering drawing practice
 - Part 3 Geometrical tolerancing
- BS 1881 Testing concrete
 - Part 1 Methods of mixing and sampling fresh concrete in the laboratory
 - Part 101 Method of sampling fresh concrete on site
 - Part 102* Method for determination of slump
 - Part 103* Method for determination of compacting factor
 - Part 104* Method for determination of Vebe time
 - Part 125 Methods of mixing and sampling fresh concrete in the laboratory
- BS 3388 Forks, shovels and spades
- BS 5328 Methods for specifying concrete, including ready-mixed concrete
- BS 5497* Precision of test methods
 - Part 1 Guide for the determination of repeatability and reproducibility for a standard test method

* Referred to in the foreword only.

This British Standard, having been prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Committee, was published under the authority of the Board of BSI and comes into effect on **29 February 1984**.

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The preparation of this British Standard was entrusted by the Cement, Gypsum, Aggregates and Quarry Products Standards Committee (CAB/-) to Technical Committee CAB/4 upon which the following bodies were represented:

Association of Lightweight Aggregate Manufacturers
British Aggregate Construction Materials Industries
British Precast Concrete Federation
British Ready Mixed Concrete Association
Cement Admixtures Association
Cement and Concrete Association
Cement Makers' Federation
Concrete Society
County Surveyor's Society
Department of the Environment (Building Research Establishment)
Department of the Environment (Property Services Agency)
Department of the Environment (Transport and Road Research Laboratory)
Department of Transport

Electricity Supply Industry in England and Wales
Federation of Civil Engineering Contractors
Greater London Council
Institute of Concrete Technology
Institution of Civil Engineers
Institution of Highway Engineers
Institution of Municipal Engineers
Institution of Structural Engineers
Institution of Water Engineers and Scientists
National Federation of Building Trades Employers
Royal Institute of British Architects
Royal Institution of Chartered Surveyors
Sand and Gravel Association
Society of Chemical Industry

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

British Civil Engineering Test Equipment Manufacturers' Association
Coopted members

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Amd. No.	Date of issue	Text affected
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