INTERNATIONAL STANDARD 4013

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Concrete — Determination of flexural strength of test specimens

Béton — Détermination de la résistance à la flexion des éprouvettes

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4013 was developed by Technical Committee ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, and was circulated to the member bodies in January 1976.

It has been approved by the member bodies of the following countries :

Australia	India	Romania
Austria	Israel	South Africa, Rep. of
Belgium	Italy	Spain
Bulgaria	Korea, Dem.P.Rep. of	Turkey
Canada	Mexico	United Kingdom
Czechoslovakia	New Zealand	U.S.A.
Denmark	Norway	U.S.S.R.
Egypt, Arab Rep. of	Poland	Yugoslavia
Germany	Portugal	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

France
Netherlands

Printed in Switzerland

Concrete — Determination of flexural strength of test specimens

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method for the determination of the flexural strength of test specimens of hardened concrete by means of a constant moment in the centre zone (two-point loading).

The method of loading by a centre-point load may also be used and is given in the annex.

2 REFERENCES

ISO 1920, *Concrete tests — Dimensions, tolerances and applicability of test specimens.*

ISO 2736, *Concrete — Sampling, making and curing of test specimens.* [1)]

3 TEST SPECIMENS

3.1 Requirements

The test specimens (prisms) used for flexural tests shall meet the requirements of ISO 1920 and ISO 2736.

3.2 Checking of dimensions

Measure the length L (see figures 1 and 2) and the lateral dimensions of the cross-section (d_1 parallel to the direction of mould-filling; d_2 normal to the direction of mould-filling) to the nearest millimetre.

Check the evenness of surface along the lines where the loading forces and the supporting reactions will be applied, for compliance with ISO 1920 (i.e. 0,05 mm per 100 mm length).

3.3 Determination of mass of test specimens

Before weighing test specimens which have been cured in water or in a moist atmosphere, wipe off all surplus water. Determine the mass of all test specimens with an accuracy of ± 0,25 %.

4 APPARENT DENSITY

Calculate the apparent density of the test specimen by dividing its mass, determined in accordance with 3.3, by its volume, calculated from the dimensions determined in accordance with 3.2.

5 APPARATUS

The test may be carried out using any reliable testing machine of sufficient power and capable of applying the loads continuously and vertically.

The device for applying the loads shall consist of two supporting rollers and two load-applying rollers (or one load-applying roller for loading by a centre-point load — see annex).

All rollers shall be manufactured from steel and shall have a circular cross-section with a diameter of 20 to 40 mm; they shall be at least 10 mm longer than the width of the test specimen.

All rollers except one shall be capable of rotating around their axes.

All rollers except one supporting roller shall be capable of being inclined in a plane normal to the longitudinal axis of the test specimen.

The distance l between the supporting rollers (i.e. the span) shall be equal to 3 d.

All rollers shall be adjusted in their correct position with all distances having an accuracy of ± 0,5 mm.

The measuring range shall be chosen so as to avoid the breaking load being in the lowest one-fifth of the range. The precision of the machine and the load indication shall be such that the ultimate load can be determined with an accuracy of ± 1 %. For the purpose of rough production control, test machines with an accuracy for the load indication of ± 3 % may be used.

1) At present at the stage of draft.

6 PROCEDURE

Place the test specimen in the testing machine, correctly centred and with the mould-filling direction normal to the direction of loading (see figure 1). Do not begin to apply the load until all loading and supporting rollers are resting evenly against the test specimen.

Apply the load, at a rate of 0,06 ± 0,04 N/(mm^2·s), steadily and without shock. The lower loading rates should be chosen for low strength concretes and the higher loading rates for high strength concretes. Once adjusted, maintain the rate of loading without change until failure occurs. Record the maximum load read on the scale as the breaking load.

Disregard failures outside the middle one-third of the distance between the supporting rollers.

7 EXPRESSION OF RESULTS

The flexural strength, f_{cf}, in newtons per square millimetre, is given by the equation

$$f_{cf} = \frac{F \times l}{d_1 \times d_2^2}$$

where

F is the breaking load, in newtons;

$d_1 = d_2 = d$ are the lateral dimensions of the cross-section, in millimetres;

l is the distance, in millimetres, between the supporting rollers.

The flexural strength shall be expressed to the nearest 0,1 N/mm^2.

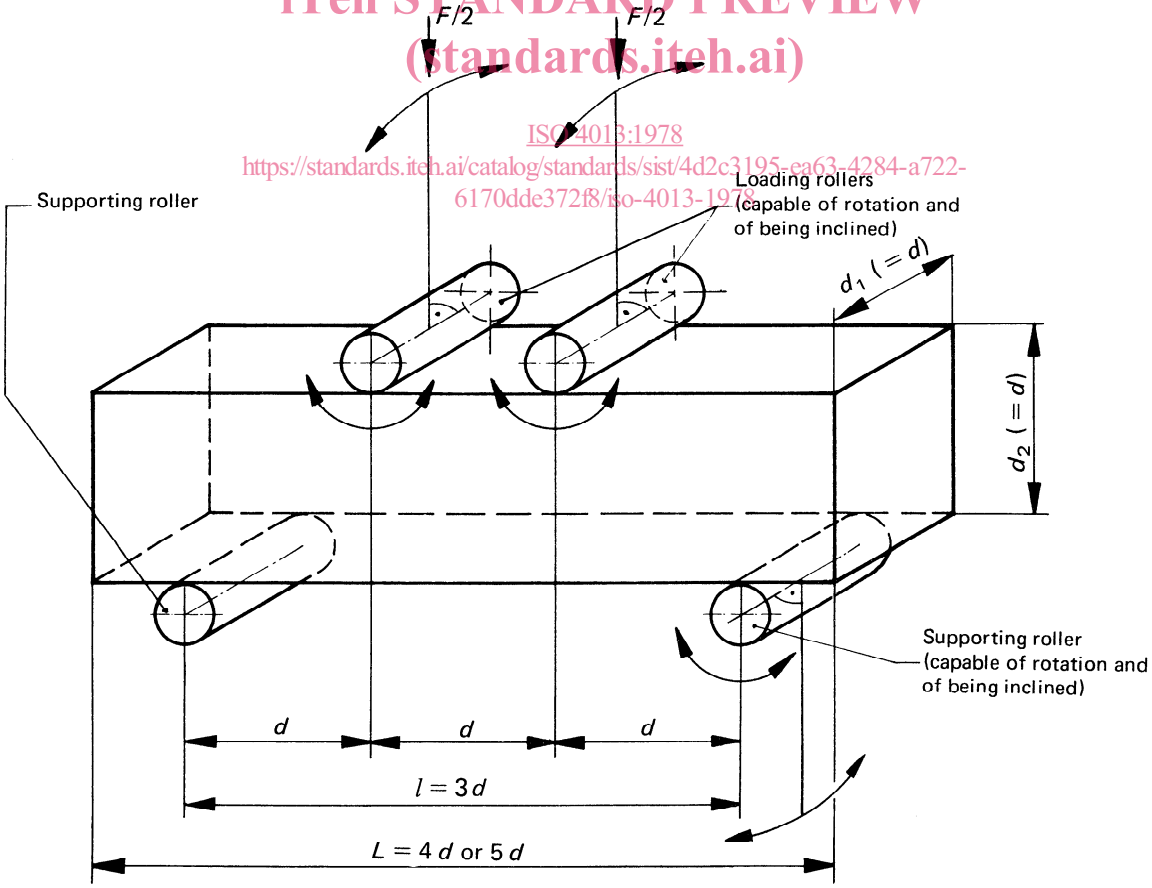

FIGURE 1 — **Arrangement of loading of test piece (two-point loading)**

8 TEST REPORT

Every report on flexural tests of concrete specimens shall refer to this International Standard and shall include the following data :

8.1 Data to be given by the producer of the test specimen

8.1.1 *Mandatory data*

a) identification of the test specimen;

b) date of production;

c) conditions of curing and storage;

d) required age of the specimen at the time of testing.

8.1.2 *Optional data*

e) building project;

f) part or component of the building;

g) flexural strength required;

h) type of cement and water-cement ratio;

i) type of admixture used (if any).

8.2 Data to be given by the test laboratory

a) condition of specimen when received;

b) any surface treatment;

c) marking of the specimen;

d) date of receipt of the specimen;

e) type and dimensions of the specimen;

f) conditions of curing and storage, and moisture condition;

g) date of test;

h) age of the specimen at the time of testing;

i) apparent density of the specimen;

j) failure load;

k) flexural strength determined;

l) other remarks.

ANNEX

LOADING BY A CENTRE-POINT LOAD[1)]

In the case when a centre-point load is used, the method of test differs from that described, in the following respects :

The loading arrangement consists of one load-applying roller at mid-span; the roller must be free to rotate.

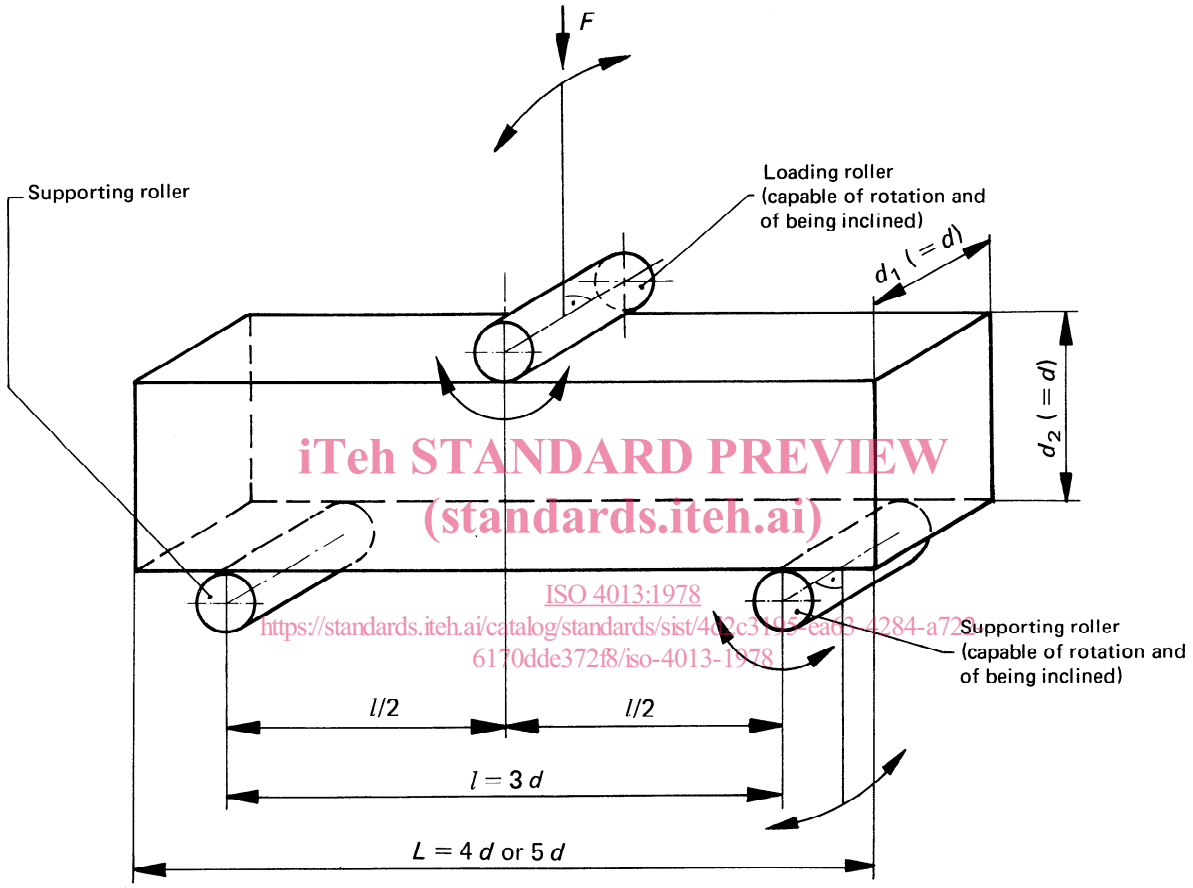

FIGURE 2 – **Arrangement of loading of test piece (centre-point loading)**

The flexural strength, f_{cf}, in newtons per square millimetre, is given by the equation

$$f_{cf} = \frac{3 \times F \times l}{2 \times d_1 \times d_2^2}$$

where

F is the breaking load, in newtons;

$d_1 = d_2 = d$ are the lateral dimensions of the cross-section, in millimetres;

l is the distance, in millimetres, between the supporting rollers.

In the test report (data to be given by the test laboratory), it shall be indicated that the centre-point loading method was applied.

1) This method gives higher values for the flexural strength than the two-point loading method.

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