IS 4139 (1989): calcium silicate bricks [CED 4: Building Limes and Gypsum Products]

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IS 4139 : 1989
( Reaffirmed 2004 )

*Indian Standard*

# CALCIUM SILICATE BRICKS — SPECIFICATION

*( Second Revision )*

भारतीय मानक

## कैल्सियम सिलीकेट ब्रिक्स — विशिष्टि

( दूसरा पुनरीक्षण )

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First Reprint AUGUST 1992

UDC 691.316-431



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NEW DELHI 110002

*October* 1989

Price Group 2

**Building Limes and Lime Products Sectional Committee, BDC 4**

## FOREWORD

This Indian Standard ( Second Revision ) was adopted by the Bureau of Indian Standards on 15 March 1989, after the draft finalized by the Building Limes and Lime Products Sectional Committee had been approved by the Civil Engineering Division Council.

Calcium silicate bricks derive their strength from the formation of calcium silicate hydrates in crystallized form by the reaction of hydrated lime with active siliceous materials. Such active materials include finely ground sand/siliceous rock and fly ash. The chemical reaction leading to formation of calcium silicate hydrates ( and calcium aluminates in case of addition of fly ash ) are carried out under autoclaving at elevated temperature and pressure of steam. Materials, such as, ground sand containing mostly quartz, the crystalline form of silica, react rather slowly and require prolonged autoclaving at high steam pressure. Limited quantity of fly ash may be used in the mix. Coloured calcium silicate bricks can also be made by adding lime fast pigments to the raw mix before pressure casting. These bricks may be used for masonry construction just like burnt clay bricks. Calcium silicate bricks may also be used as facing bricks. There is good scope for production of such bricks on a commercial scale and their use, specially in those areas where good clay is not available for manufacture of burnt clay bricks. This would also help in boosting the rural economy and rural housing. The production of calcium silicate bricks on a commercial scale has already started in the country. This standard lays down the essential requirements of calcium silicate bricks to help in the control of its quality in manufacture and use. Requirements of fly ash lime bricks are being covered under a separate standard 'Indian Standard Specification for fly ash lime bricks ( *under preparation* )'.

This standard was first published in 1967 under the title 'Specification for sand lime brick' and subsequently revised in 1976. The present revision under the modified title has been taken up to allow the use of fly ash, a waste product from thermal power stations, in the manufacture of such bricks. This revision also allows the manufacture of such bricks in conventional sizes by mutual agreement between the purchaser and the manufacturer. Requirements regarding drying shrinkage have been modified in this revision.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values ( *revised* )'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

# AMENDMENT NO. 1 JULY 2011
# TO
# IS 4139 : 1989 CALCIUM SILICATE BRICKS — SPECIFICATION

***( Second Revision )***

(*Second cover*, *Foreword*, *para* 2, *last sentence*) — Substitute the following for the existing:

'Requirement of fly ash lime bricks have been covered in IS 12894 : 2002 Specification for pulverized fuel ash lime bricks.'

(*Page* 1, *clause* **2.1**) — Substitute the following for the existing:

'**2.1** The following Indian Standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

| *IS No*. | *Title* |
|---|---|
| 3495 (Parts 1to 4) : 1992 | Methods of tests of burnt clay building bricks (*third revision*) |
| Part 1 | Determination of compressive strength |
| Part 2 | Determination of water absorption |
| Part 3 | Determination of efflorescence |
| Part 4 | Determination of warpage |
| 5454 : 1978 | Methods of sampling of burnt clay building bricks (*first revision*) |
| 15648 : 2006 | Pulverized fuel ash for lime pozzolana mixture application' |

(*Page* 1, *clause* **4.1**, *second sentence*) — Substitute the following for the existing:

'In addition, limited quantity of pulverized fuel ash conforming to IS 15648 may be used in the mix.'

**Amend No. 1 to IS 4139 : 1989**

(*Page* 1, *clause* **7.1**, *line* 4) — Delete ‘: 1976’.

(CED 4)

Reprography Unit, BIS, New Delhi, India

# *Indian Standard*

# CALCIUM SILICATE BRICKS — SPECIFICATION

## *( Second Revision )*

## 1 SCOPE

**1.1** This standard covers the requirements regarding classification, general quality, dimensions, compressive strength and drying shrinkage of calcium silicate bricks used in buildings.

## 2 REFERENCES

**2.1** The Indian Standards listed below are necessary adjuncts to this standard.

| *IS No.* | *Title* |
|---|---|
| IS 3495 ( Parts 1 to 4 ) : 1976 | Methods of test for burnt clay building bricks ( *second revision* ) |
| IS 3812 : 1981 | Specification for fly ash for use as pozzolana and admixture ( *first revision* ) |
| IS 5454 : 1978 | Methods of sampling of burnt clay building bricks ( *first revision* ) |

## 3 GENERAL QUALITY

**3.1** Bricks shall be sound, compact and uniform in shape. Bricks shall be free from visible cracks, warpage, organic matter, large pebbles and nodules of free lime. Bricks shall be solid and with or without frog.

**3.2** The bricks shall have smooth rectangular faces with sharp and square corners and shall be uniform in colour. When bricks of a particular colour are required, it shall be by mutual agreement between the purchaser and the manufacturer.

## 4 MATERIALS

**4.1** Bricks shall be made of finely ground sand/siliceous rock and lime. In addition, limited quantity of fly ash conforming to IS 3812 : 1981 may be used in the mix.

## 5 CLASSIFICATION

**5.1** The calcium silicate bricks shall be of four classes depending upon their average compressive strength as given below:

| *Class Designation* | *Average Compressive Strength* ($N/mm^2$) | |
|---|---|---|
| | Not Less Than | Less Than |
| 7·5 | 7·5 | 10 |
| 10 | 10 | 15 |
| 15 | 15 | 20 |
| 20 | 20 | — |

## 6 DIMENSIONS AND TOLERANCES

**6.1** The size of the calcium silicate bricks shall be 190 mm × 90 mm × 90 mm and 190 mm × 90 mm × 40 mm. For an individual brick, the tolerance on length shall be ± 3 mm and that on breadth and height ± 2 mm.

NOTE — By agreement between the purchaser and the manufacturer, calcium silicate bricks may be manufactured in other sizes also. The tolerance requirements on length, breadth and height shall remain the same as given above.

## 7 PHYSICAL CHARACTERISTICS

### 7.1 Compressive Strength

The minimum average compressive strength of calcium silicate bricks shall not be less than that specified for each class in **5.1** when tested as described in IS 3495 ( Part 1 ) : 1976. The compressive strength of any individual brick shall not fall below the minimum average compressive strength specified for the corresponding class of bricks by more than 20 percent.

NOTE — In case any of the test results for compressive strength exceed the upper limit for the class, the same shall be limited to upper limit of the class for the purpose of calculating the average value.

### 7.2 Drying Shrinkage

The average drying shrinkage of calcium silicate bricks when tested as described in Annex A shall be not greater than that given in Table 1 ( *see* Note ).

NOTE — Drying shrinkage of brick used under permanently damp conditions is of no significance and the drying shrinkage test for the bricks intended to be used under these conditions may not be carried out.

**Table 1 Drying Shrinkage of Calcium Silicate Bricks**

| Class Designation | Drying Shrinkage ( Percent of Wet Length ) |
|---|---|
| 7·5 | 0·06 |
| 10 | 0·06 |
| 15 | 0·04 |
| 20 | 0·04 |

## 8 SAMPLING AND CRITERION FOR CONFORMITY

**8.1** The sampling of the bricks and the criterion for conformity shall be as given in IS 5454 : 1978.

**9 MARKING**

**9.1** Each brick shall be marked in a suitable manner with the manufacturers' identification mark or initials and the class of brick.

# ANNEX A

*( Clause 7.2 )*

## METHOD FOR DETERMINATION OF DRYING SHRINKAGE

### A-1 TEST SPECIMEN

**A-1.1** Of the samples selected in accordance with **8.1**, three shall be tested for drying shrinkage.

### A-2 APPARATUS ( *see* Fig. 1 )

#### A-2.1 Measuring Apparatus

A measuring apparatus shall be used which incorporates a micrometer gauge or a suitable dial gauge reading accurately to 0·002 mm. This gauge shall be rigidly mounted in a measuring frame and shall have a recessed end which may be located upon a 5-mm diameter ball or other reference point cemented on the specimen. The other end of the frame shall have a similar recessed seating which may be located upon the other ball or the reference point in the specimen. An Invar steel rod of a suitable length with 5 mm diameter hemispherical ends, or with 5 mm diameter steel balls mounted in the ends,

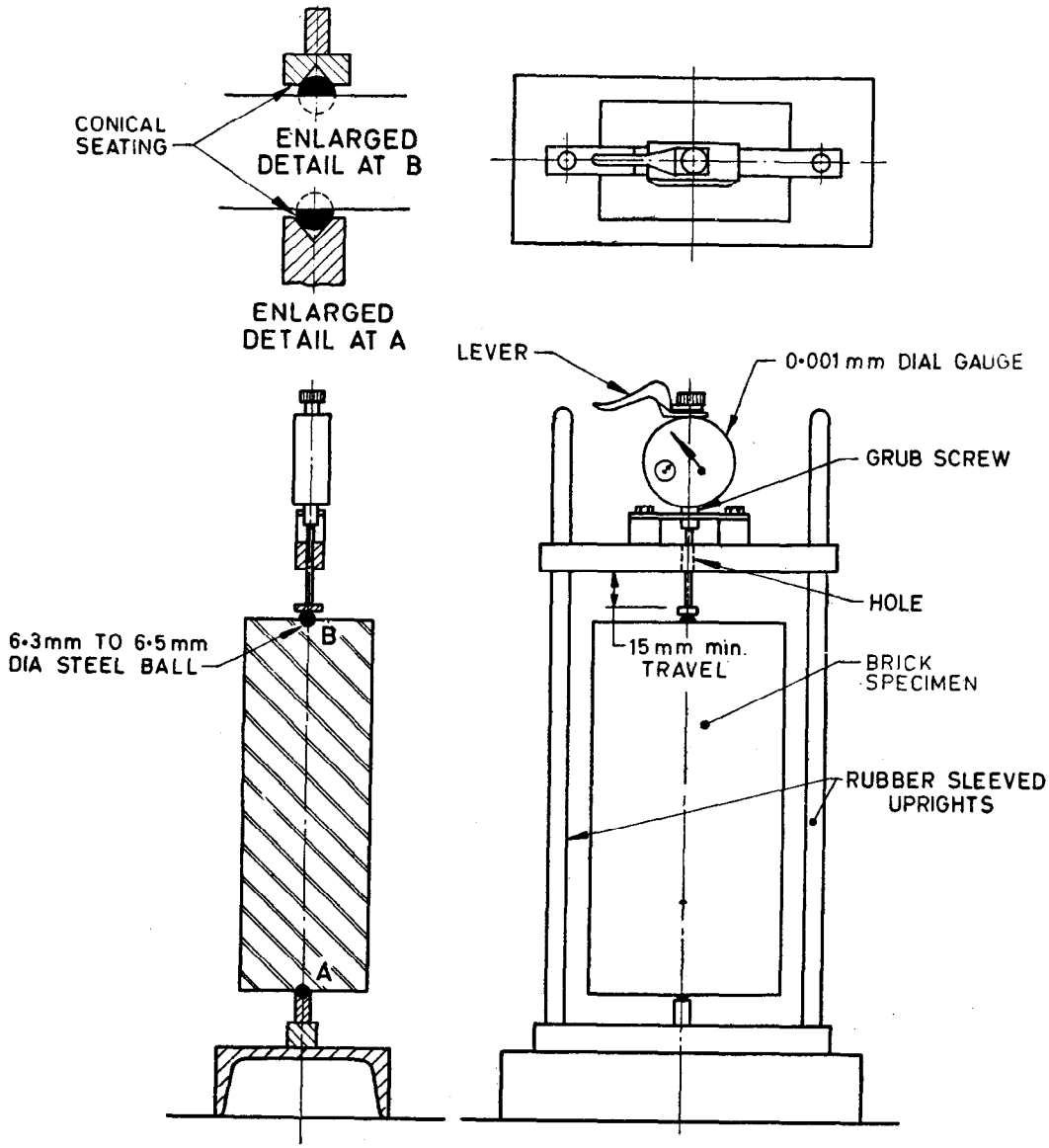


FIG 1 TYPICAL APPARATUS FOR DRYING SHRINKAGE

shall be used as a standard of length against which readings of the gauge may be tested, thus enabling corrections to be made for any changes in the dimensions of the apparatus between successive measurements of a test specimen. The apparatus should preferably be adjusted for specimens of different lengths and Invar rods of lengths near to those of the specimens to be tested should be available.

**A-2.2 Drying Oven**

The drying oven shall comply with the following requirements:

a) It shall have an internal volume equivalent to not less than 8 litres per specimen, with a minimum total volume of 50 litres.

b) It shall be reasonably air-tight and shall be provided with a fan to keep the air circulating effectively during the drying of the specimens.

c) It shall be maintained at a temperature of 50 ± 1°C.

d) The humidity of the air in the oven shall be controlled at approximately 17 percent relative humidity by means of saturated calcium chloride solution. Suitable dishes or trays containing this solution shall be provided to give an exposed area of solution not less than 10 $cm^2$ for each litre volume of the oven. The dishes or trays shall contain sufficient solid calcium chloride to show it above the surface of the solution throughout the test.

## A-3 PREPARATION OF SPECIMENS

**A-3.1** Two reference points consisting of 5 mm diameter steel balls or other suitable reference points providing a hemispherical bearing shall be cemented with neat rapid-hardening Portland cement or other suitable cementing material at the centre of each end of each specimen after drilling or cutting a shallow depression. After fixing, the surface of the steel balls shall be wiped clean of cement, and dried and coated with lubricating grease to prevent corrosion. The specimens shall then be completely immersed in water for four days, the temperature being maintained at 27 ± 2°C at least for the last four hours.

## A-4 PROCEDURE

**A-4.1** Immediately after removal of the specimens from the water, the grease shall be wiped from the steel balls and the length of each specimen measured to an accuracy of 0·002 mm by the apparatus described in **A-2.1**. This shall be taken as the wet length.

NOTE — The instruments reading required is not the absolute length of the specimen but the difference in length between the specimen and an Invar rod of approximately the same length.

**A-4.2** The specimens shall then be dried for at least 44 hours in an oven of the type described in **A-2.2** at the specified temperature and humidity. The specimens shall then be removed from the oven and cooled for at least four hours in a desiccator containing solid calcium chloride or a saturated solution of calcium chloride. Each specimen shall then be measured as described in **A-4.1**, at a temperature of 27 ± 2°C.

**A-4.3** The cycle of drying, cooling and measuring shall be repeated until constant length is attained, that is, when the difference between two consecutive readings separated by a period of drying of at least 44 hours, followed by cooling for at least four hours, is less than 0·005 mm. The final reading shall be taken as the dry length.

**A-4.4** During the above drying process, further wet specimens shall not be placed in the same oven and there shall be free access of air to all surfaces of the specimens.

## A-5 CALCULATION OF DRYING SHRINKAGE

**A-5.1** The drying shrinkage shall be calculated for each specimen as the difference between the wet length and the dry length expressed as a percentage of the wet length. The arithmetic mean of the drying shrinkage of three bricks shall be taken as the drying shrinkage of the batch under test.

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Doc : No. BDC 4 ( 4568 )

**Amendments Issued Since Publication**

| Amend No. | Date of Issue | Text Affected |
|---|---|---|
| | | |
| | | |
| | | |

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