Draft

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Indian Standard

SPECIFICATION FOR CONCRETE MASONRY UNITS

PART 3 AUTOCLAVED CELLULAR (AERATED) CONCRETE BLOCKS

(Second Revision)

1. SCOPE

This standard (Part 3) covers the requirements of the autoclaved cellular (aerated) concrete blocks having density up to 1000 kg/m^3.

2. REFERENCES

2.1 The following Indian standard is a necessary adjunct to this standard of **Annexure - A**.

IS No.	Title
2185(Part 1): 2005	Concrete Masonry Units – Specification: Hollow and Solid Concrete Blocks

3. TERMINOLOGY

3.0 For the purpose of this standard, the following definitions shall apply.

3.1 Autoclaved — Steam curing of concrete products, sandlime bricks, asbestos cement products, hydrous calcium silicate insulation products, or cement in an autoclave at maximum ambient temperatures generally between 170 and 215° C.

3.2 Block — A concrete masonry unit, either hollow (open or closed cavity), or solid (other than units used for bonding, such as a half block), any one of the external dimensions of which is greater than the corresponding dimension of a brick as specified in IS:3952-2013, and of such size and mass as to permit it to be handled by one man. Furthermore, to avoid confusion with slabs and panels, the height of the block shall not exceed either its length or six times its width.

3.3 Block Density — The density calculated by dividing the mass of a block by the overall volume, including holes or cavities and end recesses.

3.4 Drying Shrinkage — The difference between the length of specimen which has been immersed in water and then subsequently dried to constant length, all under specified conditions; expressed as a percentage of the dry length of the specimen.

3.5 Gross Area— The total area occupied by a block on its bedding face, including areas of the cavities and end recesses.

3.6 Height — The vertical dimension of the exposed face of a block, excluding any tongue or other device designed to provide mechanical keying.

3.7 Length — The horizontal dimension of the exposed face of a block, excluding any tongue or other device designed to provide mechanical keying.

3.8 Width — The external dimension of a block at the bedding plane, measured at right angles to the length and height of the block.

3.9 A/c to BS-EN 771-4 Recess — Depression or Indentation in one or more surfaces of a masonry units (e.g. mortar pocket, rendering keyway).

4. DIMENSIONS AND TOLERANCES

4.1 Concrete masonry building units shall be made in sizes and shapes to fit different construction needs. They include stretcher, corner, double corner or pier, jamb, header, bull nose, and partition block, and concrete floor units.

4.2 Concrete Block

Concrete block, hollow (open or closed cavity) or solid shall be referred to by its nominal dimensions. The term 'nominal' means that the dimension includes the thickness of the mortar joint. Actual dimensions shall be 10 mm short of the nominal dimension (or 6mm short in special cases where finer jointing is specified).

***Note - After going through the AAC manufacturing process, it is noted that the industry commonly produces blocks with nominal dimensions rather than actual dimensions. For example, if a block's nominal dimension is 600x200x150 mm, the actual dimension should be 590x190x140 mm, as per the IS code. So, there is need to be changes in above paragraph.**

4.2.1 The nominal dimensions of the concrete block shall be as follows:

Length 400, 500, 600 or 625 mm
Height 200 or 100 mm
Width 50, 75, 100, 150, 200, 250 or 300mm.

In addition, block shall be manufactured in half length of 200, 250 or 300 mm to correspond to the full lengths. Full length and half-length U-blocks may also be manufactured for the purpose of band and lintels.

The nominal dimensions of the units are so designed that taking account of the thickness of mortar joints, they will produce wall lengths and heights which will conform to the principles of the modular co-ordination.

4.2.2 Blocks of sizes other than those specified in **4.2.1** may also be used by mutual agreement between the purchaser and the supplier. In the case of special concrete masonry units such as jallie wall blocks and ornamental blocks, the specified sizes may not necessarily apply.

4.2.3 The maximum variation in the length of the units shall not be more than ± 5 mm and the maximum variation in the height and width of units, not more than ± 3 mm (*see* Fig 1 for mode of measurement).

4.3 Subject to the tolerance specified in **4.2.3** and the provisions of **4.4** the faces of masonry units shall be flat and rectangular, opposite faces shall be parallel, and all arises shall be square. The bedding

surfaces shall be at right angles to the faces of the blocks.

4.4 Blocks with special Faces — Blocks with special faces shall be manufactured and supplied if so specified.

5. CLASSIFICATION

5.1 The autoclaved cellular concrete blocks shall be classified in two grades according to their compressive strengths as indicated in Table 1.

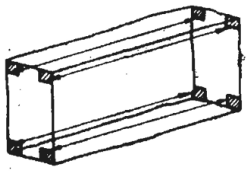
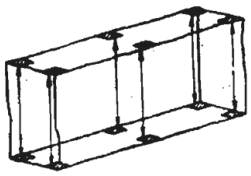
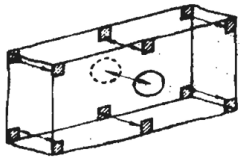
	(a). Four Positions for Checking Length of Whole Blocks and for Measuring Length of Cut Specimens
	(b). Six Positions for Checking Height of Whole Blocks
	(c). Seven Measurements of Thickness

FIG. 1 CHECKING AND MEASURING DIMENSIONS OF BLOCKS

TABLE 1 PHYSICAL PROPERTIES OF AUTOCLAVED CELLULAR CONCRETE BLOCKS

(*Clauses* 5.1,9.3,9.4,9.5,12.2,12.3 and 12.4)

SL No.	DENSITY IN OVEN DRY CONDITION	COMPRESSIVE STRENGTHS MIN		THERMAL CONSUCTIVITY IN AIR DRY CONDITION
		Grade 1	Grade 2	
(1)	(2)	(3)	(4)	(5)
	Kg/m^3	N/mm^2	N/mm^2	W/m.K
i	451 to 550	2.0	1.5	0.21
ii	551 to 650	4.0	3.0	0.24
iii	651 to 750	5.0	4.0	0.30
iv	751 to 850	6.0	5.0	0.37
v	851 to 1000	7.0	6.0	0.42

6. MATERIALS

6.1 Cement — Cement complying with any of the following Indian Standards may be used at the discretion of the manufacturer:

a) 33 grade ordinary Portland cement, conforming to IS 269-2015 (✓),
b) 43 grade ordinary Portland cement, conforming to IS 269-2015 (✓),
c) 53 grade ordinary Portland cement, conforming to IS 269-2015 (✓),
d) Portland slag cement conforming to IS 455-2015 (*fifth revision*)✗,

e) Portland pozzolana cement, fly ash based conforming to IS 1489 (Part 1),
f) Portland pozzolana cement, calcined clay based conforming to IS 1489 (Part 2),
g) Supersulphated cement conforming to IS 6909-1990✕,
h) Rapid hardening Portland cement conforming to IS 8041-1990✕,
i)
j) White Portland cement conforming to IS 8042-2015, and
k) Hydrophobic Portland cement conforming to IS 8043-1991.

*Note
(✕) This sign indicates that it may remove from the IS code.
(⩘) This sign indicates that the most recent revision of that specific IS code is being referenced

6.1.1 Use of fly ash conforming to IS: 3812 (Part 1) - 2013 may be permitted to a limit of 20 percent in cement conforming to IS: 269-2015. However, it shall be ensured that blending of fly ash with cement is as intimate as possible, to achieve maximum uniformity.

6.2 Lime — The lime shall satisfy the requirements for Class C lime Specified in IS: 712-1984.

6.3 Aggregate — The aggregate used for the manufacture of cellular concrete blocks shall conform to the following requirements:

a) Sand — Conforming to IS: 383-2016 except for the grading which may be made to suit the product and silica content shall not be less than 80 percent.

b) Fly Ash — Conforming to IS: 3812(part 1)-2013 with loss on ignition not more than 5 percent.

c) Granulated Blast Furnace Slag — Generally conforming to Notes 1 and 2 of 4.2 of IS: 455-2015(⩘) may be used.

6.4 Water — The water used in the manufacture of concrete masonry units shall be free from matter harmful to concrete or reinforcement, or matter likely to cause efflorescence in the units and shall meet the requirements of IS: 456-2000.

6.5 Additives or Admixtures — Additives or admixtures may be added either as additives to the cement during manufacture, or as admixtures to the concrete mix. Additives or admixtures used in the manufacture of concrete masonry units may be:

a) accelerating, water-reducing and air-entraining admixtures conforming to IS: 9103-1999.
b) waterproofing agents conforming to IS: 2645-2003, and
c) coloring pigments.

Where no Indian Standards apply, the additives or admixtures shall be shown by test or experience, to be not detrimental to the durability of the concrete.

7. MANUFACTURE

7.1 The aerated structure or the cells of the cellular concrete blocks shall be formed by generating of a gas by chemical action, with the mix, prior to hardening with the aid of suitable chemical foaming agents and mixing devices. The cells in the block shall be disturbed evenly throughout its volume. Broad principles for the manufacture of the autoclaved cellular concrete blocks are given in Appendix A for guidance only.

8. SURFACE TEXTURE AND FINISH

8.1 Concrete masonry units can be given a variety of surface textures ranging from a very fine close texture to a coarse open texture by the proper selection, grading, and proportioning of aggregates at the time of manufacture. Textures may also be developed by treating the face of the units while still green by wire brushing or combing, by slightly eroding the surface by playing a fine spray of water upon it, and by splitting (split block). Colour may be introduced by incorporating non-fading mineral pigments in the facing concrete, or by applying a coloured cement grout or paint to the face the units soon after they are removed from moulds. Selected coloured aggregates may also be used in the facing and exposed by washing with water or dilute hydrochloric acid.

8.2 Well-made concrete masonry may not require plaster in case of unimportant buildings in low rainfall areas; two or three coats of a cement paint being sufficient to render it resistance to rain water. If, however, it is intended to plaster concrete masonry, the blocks shall have a sufficiently rough surface to afford a good key to the plaster. Waterproofing admixtures may be used for preparing the plaster.

9. PHYSICAL REQUIREMENTS

9.1 General — All units shall be sound and free of cracks or other defects which interfere with the proper placing of units or impair the strength or performance of the construction. Minor chipping resulting from the customary methods of handling during delivery, shall not be deemed grounds for rejection.

9.1.1 Where units are to be used in exposed wall construction, the face or faces that are to be exposed shall be free of chips, cracks, or other imperfections, except that if not more than 5 percent of a consignment contains slight cracks or small chippings not larger than 25mm, this shall not be deemed grounds for rejection.

9.2 Dimensions — The overall dimensions of the units when measured as given in **4.2.3** shall be used in accordance with **4.2.1** subject to the tolerance mentioned in **4.2.3**.

9.3 Blocks Density — The blocks density shall conform to the requirements specified in Table 1 when tested in accordance with **10.1**.

9.4 Compressive Strength — The minimum compressive strength, being the average of twelve units, shall be as prescribed in Table 1 when tested in accordance with **10.2**.

9.5 Thermal Conductivity — The thermal conductivity shall not exceed the values specified in Table 1 when tested in accordance with **10.3**.

9.6 Drying Shrinkage — The drying shrinkage shall not more than 0.05 percent for Grade 1 blocks and 0.10 percent for Grade 2 blocks when tested in accordance with **10.4**.

9.7 Water Absorption — The water absorption of autoclaved cellular concrete blocks shall be 33 percent to 47 percent (A/c to manufacturers) when tested in accordance with **10.5**.

10 TESTS

10.1 Block Density — The block density shall be determined in the manner described in IS: 6441 (Part 1)-1972.

10.2 Compressive Strength — The compressive strength shall be determined in accordance with IS: 6441 (Part 5) 1972.

10.3 Thermal Conductivity — The thermal conductivity shall be determined in accordance with IS:

3346-1980.

10.4 Drying Shrinkage — The drying shrinkage shall be determined in the manner described in IS: 6441 (Part 2)-1972.

10.5 Water Absorption Test – The water absorption of autoclaved cellular (aerated) concrete blocks shall be determined in the manner described in Appendix – B.

11. SAMPLING

11.1 Lot — In any consignment, all the blocks of the same size and from the same batch of manufacture shall be grouped together into a minimum number of groups of 10 000 blocks or less. Each such group shall constitute a lot.

11.2 From each lot a sample of 24 blocks shall be selected at random. In order to ensure randomness of selection, all the blocks in the lot may be arranged in a serial order. Starting from any random block every r^{th} block may be selected till the requisite number is obtained, r being the integral part of N/24, where N is the lot size.

11.3 The required number of blocks shall be taken at regular intervals during the loading of the vehicle or the unloading of the vehicle depending on whether sample is to be taken before delivery or after delivery. When this is not practicable, the sample shall be taken at random from across the top of the stacks, the sides accessible and from the interior of the stacks by opening trenches from the top.

11.4 The sample of blocks shall be marked for future identification of the consignment it represents. The blocks shall be kept under cover and protected from extreme conditions of temperature, relative humidity and wind until they are required for test. The tests shall be undertaken as soon as practicable after the sample has been taken.

11.5 Number of Tests

11.5.1 All the 24 blocks shall be checked for dimensions and inspected for visual defects.

11.5.2 Out of 24 blocks, 12 blocks shall be subjected to the test for compressive strength, 3 blocks to the test for density, 3 blocks to the test for thermal conductivity, and 3 blocks to the test for drying shrinkage. The remaining 3 blocks shall be reserved for re-test for drying shrinkage if need arises.

12. CRITERIA FOR CONFORMITY

12.1 The number of blocks with dimensions outside the tolerance limit and or with visual defects, among those inspected, shall not be more than two.

12.2 For density, the mean value shall be within the range specified in Table 1.

12.3 For compressive strength, the mean value, say $\bar{X}$ shall be determined. The test results shall be grouped into groups of 4 and individual values of ranges shall be determined and average range $\bar{R}$ calculated from these values and shall satisfy the following condition:

$$\bar{X} - 0.6\,\bar{R} \geq \text{minimum value specified in Table 1.}$$

12.4 For thermal conductivity, the mean value shall be equal to or less than the value specifies in Table1.

12.5 For drying shrinkage, all the test specimens shall satisfy the requirements of the test. If one or more specimens fail to satisfy the requirements, the remaining 3 blocks shall be subjected to these tests. All these blocks shall satisfy the requirements.

13. MANUFACTURER'S CERTIFICATE

13.1 The manufacturer shall satisfy himself that the masonry units conform to the requirements of this specification and, if requested, shall supply a certificate to this effect to the purchaser or his representative.

14. INDEPENDENT TESTS

14.1 If the purchaser or his representative requires independent tests, the samples shall be taken before or immediately after delivery, at the option of the purchaser or his representative and the tests shall be carried out in accordance with the specification.

14.2 The manufacturer shall supply free of charge the units required for testing.

15. STORAGE

15.1 General requirements of storage of autoclaved cellular (aerated) concrete blocks shall be as described in IS: 4082-1996.

16. MARKING

16.1 Each lot of concrete masonry units manufactured in accordance with this specification shall be suitably marked with the following information:

a) The Identification of the manufacturer;
b) The grade and block density of the unit;
c) The month and year of manufacture.

16.1.1 Each block may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks). Act and Rules and Regulations conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producers. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

A P P E N D I X A

(*Clause 7.1*)

MANUFACTURE OF AUTOCLAVED CELLULAR CONCRET BLOCKS

A-1. Cellular concrete blocks involve the use of aerated concrete which is made by introducing air or other gas into a slurry composed of cement (see 6.1) or lime (see 6.2) and siliceous filler (see 6.3) so that when the mixture sets hard after autoclaving, a uniform cellular structure is obtained. There are several ways in which air-cells or other voids may be formed in the slurry as to result in cellular structure after autoclaving the principle ones of which are the following:

a) By the formation of gas by chemical reaction within the mass during the liquid or plastic stage, in the same way as carbon dioxide is formed and used in aerating bread and baked products; and
b) By introducing air from without, either by adding to the slurry in the mixer a preformed stable

foam such as is used in fire fighting or by incorporating air by whipping (with the aid of an air-entraining agent), in the manner in which egg-white may be whipped to a light cream or foam.

A-2. Suitable steam-curing is practically in making cellular concrete blocks with cement as binder and the same is absolutely essential when lime is used. Generally, auto claving is done for about 14 to 18 hours at about 700 kPa and about 185°C, the heating and raising of pressure or cooling and lowering of pressure being generally gradual over a period of few hours.

A-3. Although simple in principle, the commercial production of autoclaved cellular concrete blocks is quite elaborate in practice. The sand or other siliceous material is generally ground in ball mills to their required degree of fineness which is usually comparable with the fineness of ordinary Portland cement.

A P P E N D I X B

(Clause 10.5)

METHOD FOR THE DETERMINATION OF WATER ABSORPTION

B-1. APPARATUS

B-1.1 The balance used shall be sensitive to within 0.5 percent of the mass of smallest specimen tested.

B-1.2 Three full size units shall be used.

B-2. PROCEDURE

B-2.1 Saturation – The test specimens shall be completely immersed in water at room temperature for 24 hours. The specimens shall then be weighed, while suspended by a metal wire and completely submerged in water. They shall be removed from the water and allowed to drain for one minute by placing them on a 10 mm or coarser wire mesh, visible surface water being removed with a damp cloth, and immediately weighed.

B-2.2 Drying – Subsequent to saturation, all specimens shall be dried in a ventilated oven at 110 + 5 °C for not less than 24 hours and until two successive weighing's at interval of 2 hours show an increment of loss not greater than 0.2 percent of the last previously determined mass of the specimen.

B-3. CALCULATION AND REPORT

B-3.1 Absorption – Calculate the absorption as follows:

$$\text{Absorption (kg/m}^3\text{)} = \frac{A-B}{A-C} \times 1000$$

$$\text{Absorption (percent)} = \frac{A-B}{B} \times 100$$

Where

A = wet mass (kg),
B = dry mass (kg), and
C = suspended immersed mass (kg)

B-3.2 Report – Report the results as the average for three units.