
Concrete building blocks — Specification

ICS 91.100.30

Reference number

DRS 266: 2021

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Foreword

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The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

RS 266 was prepared by Technical Committee RSB/TC 009, *Building materials and civil engineering*.

In the preparation of this standard, reference was made to the following standards:

- 1) IS 2185-1: 2005, Concrete masonry units — Specification — Part 1: Hollow and solid concrete blocks
- 2) MS 71: 2000, Concrete building blocks — Specification

The assistance derived from the above source is hereby acknowledged with thanks.

This second edition cancels and replaces the first edition (RS 266: 2015) of which has been technically revised.

Committee membership

The following organizations were represented on the Technical Committee on *Building materials and civil engineering* (RSB/TC 009) in the preparation of this standard.

B. J Construction Ltd

Bridge to Prosperity

City of Kigali

Green Pact Africa

MASS Design

NPD Ltd

Rwanda Housing Authority (RHA)

Rwanda Inspectorate, Competition and Consumer Protection Authority (RICA)

Standards for Sustainability (SfS)

University of Rwanda/College of Science and Technology (UR-CST)

Rwanda Standards Board (RSB) – Secretariat

Concrete building blocks — Specification

1 Scope

This Draft Rwanda Standard specifies the requirements, sampling and test methods for concrete building blocks.

It applies to solid, hollow or cellular concrete building blocks including aerated blocks.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

RS EAS 18-1, *Cement — Composition, specifications and conformity criteria for common cements*

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

3.1

block

masonry unit either hollow or solid exceeding the size of a brick in any dimension.

3.2

brick

masonry unit that does not exceed 300 mm in length, 130mm in width, and 120 mm in thickness.

3.2

lot

not more than 1 000 blocks of the same type ,manufacturer, submitted at any one time for inspection and test

3.3

work size

size of block specified for manufacture to which the actual size should conform subject to specified tolerance

3.4

cross area

area occupied by block on its bedding face

3.5

masonry unit

pre-formed component intended for use in masonry construction

3.6

actual dimension (of the product)

dimension found by measurement (on the finished product).

4 Requirements

4.1 Classification of blocks

4.1.1 Type A

Dense aggregate solid or hollow concrete blocks of density not less than 1 500 kg/m³. This type of blocks is suitable for general use in building as load-bearing walls.

4.1.2 Type B

Dense aggregate hollow concrete or light aggregate, solid or hollow concrete blocks of density less than 1 500 kg/m³. Dense aggregate blocks of this class are suitable for general use in building as load-bearing walls.

4.1.3 Type C

Light aggregate, solid or hollow concrete blocks of density less than 1 500 kg/m³ for use in internal non-load bearing walls and partitions (including panels in framed construction).

4.2 Materials

4.2.1 Cement

Cement used in the manufacture of blocks shall conform to RS EAS 18-1.

4.2.2 Aggregates

The aggregates at the mixer shall be acceptably clean and free from deleterious matter and shall all pass through a sieve of nominal aperture size 19 mm.

4.2.3 Water

Water used for mixing shall be free from matter harmful to concrete and its reinforcement, and also free from substances which would impair the concrete block performance.

4.2.4 Additives or admixture

Additives or admixture which do not have deleterious effects and which do not affect adversely the properties or durability, or both, of the block with the passage of time may be used.

4.3 Finishes

4.3.1 Appearance

Blocks shall be free from cracks and other defects which would interfere with the proper laying of the blocks or impair with strength, durability or appearance of the construction.

4.3.2 Form

Subject to the tolerances given in 4.3.5, the face of the blocks shall be flat and rectangular. Opposite faces shall be parallel and all areas shall be square.

4.3.3 Surface texture

When intended for use with rendering or plastering, the surface texture of the blocks shall be such as to provide a suitable key for rendering.

4.3.4 Dimensions

4.3.4.1 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 (length and height only) shall be 10 mm short of the nominal dimensions. The nominal dimensions of blocks are the following:

- a) length: 400 mm, 500 mm or 600 mm;
- b) height: 100 mm or 200 mm ; and
- c) width: 100 mm, 150 mm, 200 mm, 250 mm or 300 mm.

4.3.4.2 The nominal dimensions of the units are so designed that taking account of the thickness or mortar joints, they shall produce wall lengths and heights which shall conform to the principles of modular coordination.

4.3.4.3 Blocks of sizes other than those specified in 4.3.4.1 may also be used by mutual agreement between the purchaser and the supplier. In the case of special concrete masonry units such as screen wall blocks and ornamental blocks, the specified sizes may not necessarily apply.

4.3.5 Tolerances

The dimensions of the blocks shall be measured in accordance with annex A and may vary from the work size as follows:

- a) the maximum variation in the length of the individual block shall not be more than ± 5 mm and the maximum variation in height and width of the unit, not more than ± 3 mm.
- b) face shells and webs shall increase in thickness from the bottom to the top of the unit. Depending upon the core moulds used, the face shells and webs shall be flared and tapered or straight tapered, the former providing a wider surface for mortar. The thickness of the face shell and web shall be not less than the values given in Table 1, as appropriate.

Table 1 — Minimum face shell and web thicknesses

All dimensions in mm

Nominal block width	Face shell thickness	Thickness of web
100 or less	25	25
Over 100 to 150	25	25
Over 150 to 200	30	25
Over 200	35	30

4.4 Density

The block density of type A block whether solid, hollow, or cellular, shall be not less than 1 500 kg/m³ when determined in the manner described in Annex B and similarly the density of type B and C shall not exceed 1 500 kg/m³.

4.5 Moisture content

When determined by the method described in Annex C, the moisture content of blocks at time of delivery to the purchaser shall not exceed 40 % of the total water absorption of the blocks.

4.6 Strength

4.6.1 Compressive strength

When tested in accordance with Annex D, the average compressive strength of an individual block (other than type C) shall comply with the values given in Table 2 appropriate to the type and designation of the block specified.

Table 2 — Compressive strength of class A and B blocks

Block type	Grade	Minimum compressive strength	
		Average of 10 blocks (N/mm ²)	Lowest individual blocks (N/mm ²)
A	A(5)	5.0	4.0
	A(7)	7.0	6.0
	A(10)	10.0	8.2
	A(20)	20.0	16.5
	A(28)	28.0	22.0
B	B(3.5)	3.5	2.8
C	B(5)	5.0	4.0
	C(3)	3.0	2.4
	C(4)	4.0	3.2

4.6.2 Breaking load

For type C blocks, the average transverse breaking load of the sample and the corresponding lowest transverse breaking load of any individual block thereof, when determined in accordance with Annex E, shall be not less than the values appropriate to the size given in Table 3.

Table 3 — Transverse breaking load for type C blocks

Work size of block (mm)		Minimum transverse breaking load (N)	
Height	Width	Average of 6 blocks	Lowest individual blocks
190	90	1745	1396
215	100	2435	1948

4.6.3 Other strengths

When blocks of type A or type B of other strengths are required, they shall comply with the requirements of this standard except that the purchaser and the supplier shall agree on the values for the average compressive

strength. The strength for the lowest individual block shall be not less than 80 % of the agreed average compressive strength.

4.7 Drying shrinkage

The average drying shrinkage determined in accordance with Annex F, shall not exceed the following:

- a) Type A: 0.05 %, maximum;
- b) Type B: 0.07 %, maximum; and
- c) Type C: 0.08 %, maximum

4.8 Wetting expansion

The average value of the wetting expansion of the sample shall not exceed the appropriate value given for drying shrinkage in 4.7, when determined in accordance with Annex G, by more than 0.02 %.

4.9 Curing

The blocks, unless steam cured, shall be continuously damp cured for at least seven days, followed by a minimum drying and maturing period of two weeks before dispatch.

5 Marking

5.1 Each block shall bear an approved mark by which the manufacturer can be identified.

5.2 Each consignment of blocks shall be accompanied by a dispatch or delivery note in which the following information shall be included:

- a) manufacturer's name;
- b) size, type and designation of blocks; and
- c) date of manufacture of the blocks.

6 Certificates

The supplier shall satisfy by regular periodical testing that, at the time of delivery, the blocks comply with the requirements of this standard and, if required, the supplier shall provide to the purchaser a certificate to this effect.

7 Sampling and conformity

7.1 Sampling

Sampling shall be carried out only on blocks ready for dispatch. The purchaser may take as samples from every lot (every 1 000 blocks or part thereof) the number of blocks required for carrying out the tests (see Table 4). The samples so drawn shall be deemed to represent the lot.

Table 4 — Number of blocks required for each test

Test to be performed	Number of blocks required	
	Type A or B	Type C

Visual inspection and checking dimensions ¹	(10)	(10)
Determination of density	3	3
Determination of moisture content	3	3
Determination of drying shrinkage and/or wetting expansion	4	4
Determination of strength	10	5
Total blocks required for full sets of tests	20	15
¹ Sample available for other test		

7.2 Conformity

A lot shall be deemed to conform to the requirements of this standard if, after inspection and testing of the sample taken in accordance with 7.1 no defective is found.

8 Inspection

Visual examination of the sample drawn in accordance with 7.1 for compliance with the requirements of 4.3 shall be done.

Annex A (normative)

Method of measuring dimensions

A.1 Test specimen

Ten blocks taken at random from the sample drawn in accordance with 9.1

A.2 Apparatus

Overall dimensions shall be measured with a steel scale graduated in 1 mm divisions. Face shell and web thickness shall be measured with a caliper rule graduated in 0.5 mm divisions and having parallel jaws neither not less than 15 mm nor not more than 25 mm in length.

A.3 Procedures

Using apparatus stated in A.2, measure to the nearest 1 mm the length, height and thickness of each test specimen. Record for each block seven individual measurements.

A.4 Calculations

Calculate to the nearest 1 mm the average of the seven measurements of each block. Take these averages to be the dimensions of the block, to be used for determination of gross volume and gross area.

Annex B (normative)

Method of testing block density

B.1 Test specimens

Select at random three blocks from the sample drawn in accordance with 7.1.

B.2 Calculations

B.2.1 Measure the mass of each block as received to the nearest 50 g.

B.2.2 Calculate the gross volume of each of the three to the nearest 1 000 mm³ in accordance with A.4. Then calculate the density of each block to the nearest 10 kg/m³.

$$\text{Density} = \frac{\text{Mass (as received), kg}}{\text{Gross volume, cm}^3} \times 10^6$$

B.2.3 Report the mean density of the 3 blocks to the nearest 10 kg/m³ as the block density as received.

B.3 Alternative

B.3.1 If the as-received density exceeds the specified block density, determine the oven –dry block density by drying the 3 blocks for 24 h in a ventilated oven having the temperature controlled at 105 °C ± 3 °C.

B.3.2 Cool the blocks for 6 h to 8 h and measure their mass. Repeat the process of drying and cooling until the loss in mass for one cycle does not exceed 50 g.

B.3.3 Calculate the oven-dry block density as in B.2 using the oven-dry mass and record the results to the nearest 10 kg/m³ as oven-dry density.

Annex C (normative)

Moisture content

C.1 Test specimens

Three whole blocks taken at random from the samples selected for test shall be used.

C.2 Apparatus

A weigh balance sensitive to within 10 g, drying oven capable of maintaining $105\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$; and a water tank.

C.3 Procedure

Determine the mass as received, A, or each of the test specimens to the nearest 10 g. Then completely immerse the test specimens at room temperature for 24 h, after which period they shall be wiped dry using a damp cloth and their mass, B, determined immediately. Subsequent to saturation all specimens shall be dried to constant mass, C, in ventilated oven maintained at a temperature of $105\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

C.4 Calculation

C.4.1 Calculate the water absorption and moisture content as follows:

$$\text{Total absorption, \%} = \frac{B-C}{C} \times 100$$

$$\text{Moisture content, \%} = \frac{A-C}{C} \times 100$$

where

A mass as received;

B saturated mass of unit; and

C Oven-drying mass of unit.

C.4.2 Report all the results separately for each block and also the mean of the 3 blocks, to the nearest 0.5 %.

Annex D (normative)

Methods of testing compressive strength

D.1 Test specimens

For the determination of compressive strength, take ten blocks, previously measured in accordance with Annex A. Normally, the specimens are whole blocks. Where the blocks are claimed to have such a high compressive strength that the capacity of the machine is likely to be exceeded, the blocks may be cut as far as possible symmetrically about an axis perpendicular to the original length. Discard the remainder of the block.

D.2 Apparatus

Compressive strength testing machine.

D.3 Procedure

D.3.1 Each block shall be immersed in water maintained between $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for a period of 24 h, and then bedded with flat layers of mortar composed of cement and sand in the ratio of one to one by weight, on both bed faces. The mortar bed shall at no point be less than 5 mm clear of the block, and shall be true to the square. All cavities shall be completely filled with the mortar. Surplus mortar shall be trimmed off flush with the sides of the block. A minimum period of 24 h shall elapse before the bedding of the opposite bed-face. During this period, the block shall be covered with a damp sack. Another period of 24 h shall elapse before the cubes are immersed in water. The period of immersion shall be such that the mortar shall have a compressive strength of not less than 28.0 N/mm^2 .

D.3.2 When the mortar strength has attained the required value, the blocks shall be tested, each separately, on the testing machine. The load shall be applied exactly, manually or automatically without chock at a rate within the range of 0.2 N/mm^2 to 0.4 N/mm^2 per second until no greater load can be sustained.

D.4 Calculation

D.4.1 Record the maximum load in Newtons carried by the specimen. During the test, calculate the compressive strength of the block as follows:

$$\text{Compressive strength in N/mm}^2 = \frac{\text{Maximum load, N}}{\text{Gross area, mm}^2}$$

D.4.2 This is reported to the nearest 0.05 N/mm^2 for blocks with an average compressive strength less than 7.0 N/mm^2 and to the nearest 0.1 N/mm^2 for blocks with an average compressive strength of 7.0 N/mm^2 or more.

D.4.3 The arithmetic mean of the compressive strength of the ten blocks is taken as the average compressive strength of the sample and is reported to the same accuracy as the individual results.

Annex E (normative)

Determination of transverse breaking load

E.1 Test specimen

Select at random five blocks from among the ten blocks used for measurement of dimensions in accordance with Annex A.

E.2 Procedure

E.2.1 Immerse the blocks for at least 16 h in water at room temperature. Remove each block from the water and allow to drain for 30 min to 45 min and then test.

E.2.2 Place each block centrally on the cylindrical support bearers with the bedding faces perpendicular to the plane of the bearers. Apply the load without the shock and increase continuously at a rate such that the extreme fibre stress increases at approximately 1.5N/mm^2 per minute, until failure occurs.

E.2.3 Record the maximum load carried by the block during the test to the nearest 25N. The arithmetic mean of the five recorded loads is taken as the transverse breaking load of the sample and is reported to the nearest 25N together with the lowest individual block breaking load.

Annex F (normative)

Methods of testing drying shrinkage

F.1 Test specimen

For the determination of drying shrinkage, take four whole blocks at random from the sample taken and in accordance with 9.1. Cut a test specimen of length approximately 150 mm and cross-section as near as is practically to 75 mm × 75 mm.

F.2 Apparatus

Micrometer gauge, or suitable dial gauge reading accurately to 0.005 mm: drying oven capable of maintaining $105\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ and a water tank.

F.3 Procedure

F.3.1 Using an epoxy-resin compound or other suitable agent, fix a 6 mm diameter steel ball into the centre of each specimen so that half of the surface of the ball protrudes. After the resin has set sufficiently clean the exposed surface of the steel balls and grease them to prevent corrosion. Use the outer extremities of the balls as reference points.

F.3.2 Completely immerse the specimen in clean water at a temperature of $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for four days. Remove the specimen from the water, immediately wipe the grease from the steel balls and measure the length, dry the specimens in the oven for at least 48 h.

F.3.3 Do not place wet specimens in the oven together with partially dried specimens. Cool the specimens for at least four hours in the desiccator and again measure the length.

F.3.4 Repeat this drying and cooling procedure, using drying periods of 24 h, until the difference between consecutive measurements is less than 0.005 mm. Regard the final reading as the dry length.

F.4 Calculation

Calculate the drying shrinkage of each specimen as the difference between the original wet measurement and the dry measurement expressed as a percentage of the dry length. Determine the average value for four specimens and report this as the drying shrinkage of the sample expressed to the nearest 0.005 %.

Annex G (normative)

Wetting expansion

G.1 Test specimen

Use the test specimen used for shrinkage test given in Annex F.

G.2 Apparatus

As given in F.2

G.3 Procedure

G.3.1 Unless the test is carried out immediately after drying shrinkage test, then the test specimen shall be kept in the desiccator for a period not exceeding 3 days.

G.3.2 The specimens are first tested for drying shrinkage in accordance with Annex F and the measurement recorded. Then coat the stainless steel balls with lubricating grease and immerse the specimen in water being maintained at $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. Immediately after the removal of the specimen from the water, wipe the grease from the balls and measure the length of each specimen as described for determining the original wet length.

G.4 Calculations

Calculate the wetting expansion of each specimen and the final wet measurement expressed as a percentage of the length. Report the average value of the wetting expansion to the nearest 0.005 %.

Bibliography

RS 266: 2015, *Concrete building blocks — Specification*

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