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**Dense and lightweight aggregate concrete  
masonry units — Specification**

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## Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

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.

DRS 628 was prepared by Technical Committee RSB/TC 9, *Civil engineering and building materials*.

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

BS EN 771-3:2011 +A1:2015, *Specification for masonry units Part 3: Aggregate concrete masonry units (Dense and lightweight aggregates)*

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

## Committee membership

The following organizations were represented on the Technical Committee on *Civil engineering and building materials* (RSB/TC 9) in the preparation of this standard.

ASTRIK International

CAMOSAG Ltd

Cleaner Production and Climate Innovation Centre (CPCIC)

Consulting Engineering Group (CEG Ltd)

HOSHAN LTD

Independent Experts

NPD Ltd

Rwanda Housing Authority (RHA)

Rwanda Inspectorate, Competition and Consumer Protection Authority (RICA)

Rwanda Transport development Agency (RTDA)

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

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# Dense and lightweight aggregate concrete masonry units — Specification

## 1 Scope

This Draft Rwanda Standard specifies the characteristics and performance requirements of aggregate concrete masonry units made from dense and lightweight aggregates or a combination of both for which the main intended uses are common, facing or exposed masonry in load bearing or non-load bearing building and civil engineering applications. The units are suitable for all forms of walling, including single leaf, external leaf to chimneys, cavity wall, partitions, retaining, and basement. They can provide fire protection, thermal insulation, sound insulation and sound absorption.

This Standard is applicable to aggregate concrete masonry units of an overall non-rectangular parallelepiped shape, specially shaped and accessory units.

This Standard does not specify standard sizes for aggregate concrete masonry units, nor standard work dimensions and angles of specially shaped aggregate concrete masonry units.

It does not apply to:

- a) storey height panels, chimney flue linings or units intended for use as a damp-proof course;
- b) units with an incorporated thermal insulation material bonded to the faces of the unit susceptible to be exposed to fire.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 ISO 12572, *Hygrothermal performance of building materials and products — Determination of water vapour transmission properties*

RS 108, *Mortar for masonry — Specification*

RS 524, *Masonry units test methods — Determination of thermal properties*

RS 537, *Masonry units test methods — Determination of compressive strength*

RS 543, *Masonry units test methods — Determination of water absorption of aggregate concrete, autoclaved aerated concrete, manufactured stone and natural stone masonry units due to capillary action and the initial rate of water absorption of clay masonry units*

RS 536, *Masonry units test methods — Determination of dimensions*

RS 539, *Masonry units test methods — Determination of flexural strength*

RS 538, *Masonry units test methods — Determination of initial shear strength*

RS 547, *Fire classification of construction products and building elements — Classification using data from reaction to fire tests*

### **3 Terms and definitions**

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

#### **3.1**

##### **masonry unit**

preformed component intended for use in masonry construction

#### **3.2**

##### **common masonry**

unit masonry unit normally intended for use with no faces left visible

#### **3.3**

##### **facing masonry unit**

masonry unit intended for use with one or more faces left visible and which may or may not be exposed to external climatic conditions

#### **3.4**

##### **exposed masonry unit**

facing masonry unit exposed to external climatic conditions without render or other equivalent protection

#### **3.5**

##### **aggregate concrete masonry unit**

masonry unit manufactured from, cementitious binder, aggregates and water and which may contain admixtures and additions and colouring pigments and other materials incorporated or applied during or subsequent to unit manufacture

#### **3.6**

##### **co-ordinating size**

size of a co-ordinating space allocated to a masonry unit including allowances for joints

**3.7****work size**

size of a unit specified for its manufacture, to which the actual size conforms to permissible deviations

**3.8****actual size**

size of a unit as measured

**3.9****regular-shaped masonry unit**

masonry unit with an overall rectangular parallelepiped shape

Note 1 to entry: Examples of different shapes of concrete masonry units are shown in Annex C.

**3.10****specially shaped masonry unit**

masonry unit which is not a rectangular parallelepiped

**3.11****accessory unit**

unit which is shaped to provide a particular function, e.g. to complete the geometry of the masonry

**3.12****interlocking features**

shaped matched projections and indentations on masonry units

EXAMPLE     Tongue and groove systems

**3.13****hole**

formed void which may or may not pass completely through a masonry unit

### 3.14

#### **frog**

depression formed in one or both of the bed faces of a unit, the total volume of all such depressions which does not exceed a certain limit of the overall volume of the unit, i.e., length × width × height

### 3.15

#### **recess**

depression or indentation in one or more surfaces of a masonry unit

EXAMPLE Mortar pocket, rendering keyway, grooves to provide a discontinuity in the mortar joint, grip hole.

### 3.16

#### **shell**

peripheral solid material between the hole(s) and the face or the header of a unit

### 3.17

#### **web**

solid material between the formed voids in a masonry unit

### 3.18

#### **declared value**

value that a manufacturer is confident of achieving, bearing in mind the precision of the test and the variability of the manufacturing process

### 3.19

#### **Category I masonry units**

units with a declared compressive strength with a probability of failure to reach it not exceeding 5 %

Note 1 to entry: This may be determined via the mean or characteristic value.

### 3.20

#### **Category II masonry units**

units not intended to comply with the level of confidence of Category I units.

**3.21****normalized compressive strength of masonry units**

compressive strength of masonry units converted to the air-dry compressive strength of an equivalent 100 mm wide × 100 mm high masonry unit

Note 1 to entry: See the procedure given in RS 537.

**3.22****mean compressive strength of masonry units**

arithmetic mean of the compressive strengths of masonry units

**3.23****characteristic compressive strength of masonry units**

compressive strength corresponding to a 5 % lower fractile of the compressive strength of masonry units

**3.24****combined thickness of webs and shells**

sum of the thicknesses of the shells and webs from one face or header of a masonry unit to the opposite face or header respectively along whichever path, via the formed voids, gives the smallest value, expressed as a percentage of the unit width or length respectively

**3.25****product group**

products from one manufacturer having common values for one or more characteristic 3.1.26 consignment shipment from the supplier

**3.27****grip hole**

hole in a masonry unit to enable it to be more readily grasped and lifted by hand or machine

**4 Symbols (and abbreviated terms)**

$l$  length, in mm

$l_d$  length of the diagonal, in mm

$w$  width, in mm

$h$  height, in mm

$f_b$  normalized compressive strength, in N/mm<sup>2</sup>

$f_c$  characteristic compressive strength, in N/mm<sup>2</sup>

$f_m$  mean compressive strength, in N/mm<sup>2</sup>

$f_{bi}$  individual result compressive strength, in N/mm<sup>2</sup>

$\lambda_{10, dry}$  unit thermal conductivity of a masonry unit in a dry state at an average temperature of 10 °C

$\chi$  shape factor multiplier used to convert the air-dry compressive strength of the masonry specimens to the normalised compressive strength

## 5 Materials

The specifications of the materials to be used shall be included in the production control documentation. If appropriate Rwanda Standards are available, they shall be used except those aggregates need not comply with grading requirements. If not available, the manufacturer shall specify the materials and have data on their suitability.

## 6 Requirements for aggregate concrete masonry units.

### 6.1 General

The requirements and properties specified in this Draft Rwanda Standard shall be defined in terms of the test methods and other procedures referred to in this Draft Rwanda Standard.

NOTE A declared value may be chosen from the classification system, if any, of the place of manufacture/use of the units.

It should be noted that the standard test methods are not always applicable to specially shaped and accessory units as defined in 3.10 and 3.11.

The conformity criteria given in the following subclauses related to product type determination and, when relevant, to consignment testing (see Annex A). For the compressive strength of Category I units use a 50 % fractile ( $p = 0,50$ ) for mean values or 5 % fractile ( $p = 0,05$ ) for characteristic values and a confidence level of 95 %.

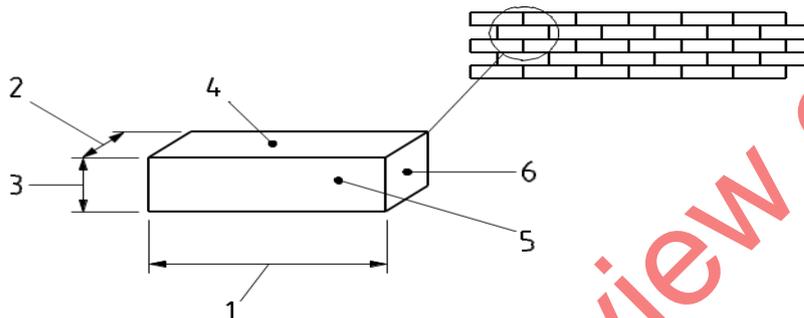
For production evaluation, the manufacturer shall define the conformity criteria in the factory production control documentation.

## 6.2 Dimensions and tolerances

### 6.2.1 Dimensions

The manufacturer shall declare the dimensions of the aggregate concrete masonry units in mm for length, width and height, in that order (see Figure 1). They shall be given in terms of work size.

NOTE 1 In addition the co-ordinating size may be given.



#### Key

- 1 length
- 2 width
- 3 height
- 4 bed
- 5 face
- 6 header

NOTE 2 This relates to the normal use of the masonry unit in the wall.

Figure 1 — Dimensions and surfaces

### 6.2.2 Dimensional tolerances

#### 6.2.2.1 Tolerances

The tolerances on declared work sizes of individual regular shaped units shall conform to Table 1. Closer tolerances may be declared for one or more dimensions. The manufacturer shall declare the tolerance category of the units.

**Table 1 — Limit deviations in millimetres**

<b>Tolerance category</b>	<b>D1</b>	<b>D2</b>	<b>D3</b>	<b>D4</b>
Length	+3	+1	+1	+1
	-5	-3	-3	-3
Width	+3	+1	+1	+1
	-5	-3	-3	-3
Height	+3	± 2	± 1,5	± 1,0
	-5			

Tolerances for non-regular shaped and accessory units shall be as given in Table 1 or as declared by the manufacturer.

These tolerances shall not apply to the dimensions between the surfaces of units which are manufactured to be non-planar.

If sampled in accordance with A.2 and tested in accordance with RS 536 (method a)), the results shall conform to the declared tolerance category.

#### **6.2.2.2 Flatness of bed faces**

When aggregate concrete masonry units are declared as tolerance category D4 for use with thin layer mortar, the manufacturer shall also declare the maximum deviation from flatness of the bed faces.

If sampled in accordance with A.2 and tested in accordance with Annex C, the deviation from flatness of the bed faces shall not exceed the declared value.

#### **6.2.2.3 Plane parallelism of bed faces**

When aggregate concrete masonry units are declared as tolerance category D4 for use with thin layer mortar, the manufacturer shall also declare the maximum deviation from plane parallelism of the bed faces.

If sampled in accordance with A.2 and tested in accordance with RS 536 (method d), the deviation from plane parallelism of the bed faces shall not exceed the declared value.

### **6.3 Configuration and appearance**

#### **6.3.1 Configuration**

When relevant to the uses for which aggregate concrete masonry units are put on the market, the configuration shall be declared. The declaration may include one or more items such as those in the following list, as relevant:

- shape and features, including the direction of any formed voids (by means of a drawing or illustration, when relevant);

- volume of all formed voids as a percentage of the length × width × height of the unit;
- volume of the largest of any formed voids as a percentage of the length × width × height of the unit;
- volume of grip holes as a percentage of the length × width × height of the unit;
- thickness of webs;
- thickness of shells;
- combined thickness of webs and shells from face to face;
- combined thickness of webs and shells from header to header;
- area of voids on a bed face as a percentage of the length × width of the unit.

The requirements for shape and features will normally apply to regular shaped units, but need not apply to the surfaces or arises of units with special shapes or to accessory units.

Units may be provided with recesses or interlocking features and with sharp, rounded or chamfered arises. The total volume of frogs shall not exceed 20 % of the overall volume of the unit, i.e., length × width × height.

Each declared value shall be stated as either an upper limit or a lower limit or as a range of values. When aggregate concrete masonry units are sampled from a consignment in accordance with A.2 and tested in accordance with RS 536 and RS 537 Annex A, if necessary, the mean value derived from measurements of the test sample shall be within the range or limit declared.

### 6.3.2 Appearance

#### 6.3.2.1 Flatness of surfaces of facing units

When the surface of facing units is declared by the manufacturer to be plain, they shall not deviate from a plane by more than  $(0,1\sqrt{l_d})$  mm or 2 mm whichever is the greater, where  $l_d$  is the length of the diagonal of the surface of the unit declared plane, based on the actual size of the unit.

The requirements for flatness shall not apply to the surfaces of units which are manufactured to be non-planar.

If sampled in accordance with A.2 and tested in accordance with Annex C, the results shall comply with the value given above.

#### 6.3.2.2 Surface appearance of facing units

When required, the surface of facing units may have conformity established on the basis of comparison with any approved samples. Comparison shall be made from a distance of 3 m in normal daylight conditions. This conformity shall be established before the units are used.

## 6.4 Density

### 6.4.1 Gross dry density of the units

The gross dry density of the units shall be declared in  $\text{kg/m}^3$  by the manufacturer.

NOTE This declaration may be made for the evaluation of:

- loading;
- airborne sound insulation;
- thermal insulation;
- fire resistance.

In addition, the manufacturer may declare the minimum and maximum individual values of gross dry density.

### 6.4.2 Net dry density of the concrete

When relevant to the uses for which the unit is put on the market, the manufacturer shall declare the net dry density of the concrete units in  $\text{kg/m}^3$ .

In addition, the manufacturer may declare the minimum and maximum individual values of net dry density.

### 6.4.3 Tolerances

The mean values of the samples tested shall not deviate by more than  $\pm 10\%$  from the declared values. Closer deviations may be declared.

If sampled in accordance with A.2 and tested in accordance with RS 537 Annex C, the results shall comply with the declared values.

## 6.5 Mechanical strength

### 6.5.1 Compressive strength

#### 6.5.1.1 General

The strength of the masonry units in compression shall be declared in  $\text{N/mm}^2$  by the manufacturer (declared value, see 3.18). The declared value shall be either the characteristic 5 % fractile  $f_c$  or the mean 50 % fractile  $f_m$  compressive strength of the units.

In addition, the manufacturer shall declare:

- whether the aggregate concrete masonry unit is Category I or Category II;
- the normalized compressive strength when relevant.

If sampled in accordance with A.2 and tested in accordance with RS 537, the results for characteristic strength and mean strength, shall not be less than the declared value.

The declaration shall relate to and indicate the orientation(s) of the units as tested, the method(s) of bedding the units and whether any voids present are intended to be fully filled with mortar. The manufacturer shall declare the conditioning regime and the surface preparation used.

Note Whole units or parts of units may be tested in any orientation other than the orientation of normal use of the units, provided there is adequate correlation between the direction of testing and of use.

When the units are conditioned in accordance with RS 537, the results shall be brought to the air-dry condition in accordance with RS 537.

Whole units or parts of units may be tested in any orientation other than the orientation of normal use of the units, provided there is adequate correlation between the direction of testing and of use.

The compressive strength which is the value used for assessing compliance with the specification, may be normalised for design application. To convert declared compressive strength into the normalized compressive strength, the following instruction shall be followed:

- c) convert the compressive strength of the unit to an equivalent compressive strength relevant to the air-dry conditioning regime. The values to be used as multipliers for this conversion, when it is needed, are:
  - 1) 1.0 for units conditioned to air-dry condition or 6 % moisture content in accordance with RS 537
  - 2) 0.8 for units conditioned to oven dry condition in accordance with RS 537; and
  - 3) 1.2 for units conditioned by immersion in accordance with RS 537.
- d) In order to obtain the normalised compressive strength,  $f_b$ , the air-dry compressive strength of masonry units is multiplied by a shape factor,  $\chi$ , given in Table 2 where the width and height should be determined in accordance with RS 536.

Note In the case where tests have been carried out on specimens cut from whole units, the normalized strength derived from the test results for cut specimens is that which applies to the whole units from which they were cut.

**Table 2 — Shape factor  $\chi$  to allow for the tested dimensions of the specimens after surface preparation**

Width mm	50	100	150	200	≥ 250
Height <sup>a</sup> mm					
40	0,80	0,70	-	-	-

50	0,85	0,75	0,70	-	-
65	0,95	0,85	0,75	0,70	0,65
100	1,15	1,00	0,90	0,80	0,75
150	1,30	1,20	1,10	1,00	0,95
200	1,45	1,35	1,25	1,15	1,10
≥ 250	1,55	1,45	1,35	1,25	1,15
NOTE Linear interpolation between adjacent values of shape factor is permitted. a height after surface preparation.					

### 6.5.1.2 Testing of specimens cut from units

Units which cannot be conveniently tested whole, may be sawn into test specimens having the same  $w$  to  $h$  ratio as the original unit, provided that the specimen length as tested is not less than the value of  $h$  of the specimen.

Sawn test specimens shall be representative of the original unit section.

The value of  $h$  of any sawn specimen shall be not less than 100 mm. If the value  $h$  of a sawn specimen is less than one half the height of the original unit, then specimens shall be sampled from both the upper and lower parts of the original unit. A sketch indicating the relationship between the cut specimen and the whole unit shall be included in the test report.

### 6.5.2 Bending tensile strength

The mean bending tensile strength of units, having a  $w$  less than 100 mm and a ratio of  $l_d$  to  $w$  greater than 10, may be declared by the manufacturer instead of compressive strength.

When a specified number of aggregate concrete masonry units is sampled from a consignment in accordance with A.2 and tested in accordance with Annex D, the results shall not be less than the declared value.

## 6.6 Thermal properties

When relevant to the uses for which the units are put on the market and in all cases for masonry units intended to be used in elements subject to thermal insulation requirements, the manufacturer shall provide the mean  $\lambda_{10}$ , dry unit-value and the determination model as prescribed in RS 524 or alternatively give gross dry density (6.4.1) or net dry density (6.4.2) and configuration (6.3.1).

Additionally, another fractile may be provided. In such cases both the additional fractile and the corresponding  $\lambda_{10}$ , dry unit-value shall be given.

When the aggregate concrete masonry units are sampled in accordance with Annex A and tested in accordance with RS 524 following the model provided, then the obtained  $\lambda$ -value of the specified number of aggregate concrete masonry units shall be not greater than the provided  $\lambda$ -value.

When relevant to the use for which the units are put on the market, the value of specific heat capacity given in RS 524 may be provided.

## 6.7 Durability

When relevant to the uses for which the units are put on the market, the manufacturer shall evaluate and declare resistance of the units by reference to the provisions valid in the intended place of use of the units until an applicable Standard is available.

NOTE When the intended use of the product provides a complete protection against water penetration (e.g., a suitable layer of render, cladding, inner leaf of a cavity wall, internal walls), no reference to freeze/thaw resistance is required.

## 6.8 Water absorption by capillarity

When relevant to the uses for which units are put on to the market and in all cases for units intended to be used in exposed external elements (see 3.4), the manufacturer shall declare in  $\text{g/m}^2\text{s}$  the maximum water absorption coefficient due to capillary action of the exposed face of the unit.

If sampled in accordance with A.2 and tested in accordance with RS 543 for an immersion time of  $(10 \pm 0,2)$  min, the results shall not be more than the declared value.

## 6.9 Moisture movement

When relevant to the uses for which the unit is put on the market and in all cases for units intended to be used in elements subject to structural requirements, the moisture movement (shrinkage and expansion) of units shall be declared by the manufacturer.

If sampled in accordance with A.2 and tested in accordance with relevant applicable Standard, the results shall not be more than the declared value.

## 6.10 Water vapour permeability

When relevant to the uses for which the masonry unit is put on the market and in all cases for units intended to be used in external elements, the manufacturer shall provide information on the water vapour permeability through the water vapour diffusion coefficient tabulated values given in RS 524 or determined in accordance with RS ISO 12572.

## 6.11 Reaction to fire

For units intended to be used in elements subject to fire requirements the manufacturer shall declare the reaction to fire classification of the masonry unit.

For masonry units containing a mass or volume fraction of  $\leq 1,0$  % (whichever is the most onerous) of homogeneously distributed organic materials the declaration may be fire Class A1 without the need to test.

Masonry units containing a mass or volume fraction of  $> 1,0$  % (whichever is the most onerous) of homogeneously distributed organic materials shall be classified in accordance with RS 547 and the appropriate reaction to fire class declared.

Information on reaction to fire class of supplementary insulating material shall be given on the basis of relevant applicable Standards as declared by the supplier of the insulating material.

## 6.12 Shear bond strength

### 6.12.1 General

For aggregate concrete masonry units intended to be used in elements subjected to structural requirements, the shear bond strength of the unit in combination with mortar shall be declared in terms of the characteristic initial shear strength in accordance with RS 538. The declaration may be made either on the basis of fixed values as in 6.12.2 or tests as in 6.12.3. The manufacturer shall declare whether the value of bond strength has been obtained from the fixed values or from test.

NOTE In most cases it is expected that the use of fixed values will be sufficient.

### 6.12.2 Declaration based on fixed values

When no declaration is made in accordance with 6.12.3 the characteristic initial shear strength of the unit in combination with mortar may be declared based on the following values:

— 0.15 N/mm<sup>2</sup> for general purpose and lightweight mortar;

— 0.3 N/mm<sup>2</sup> for thin layer mortar.

NOTE Declarations based on these values remain the responsibility of the manufacturer using them and are to be supported by Appropriate Technical Documentation.

### 6.12.3 Declaration based on tests

The characteristic initial shear strength of the unit in combination with a specific type of mortar specified in accordance with RS 108 may be declared based on tests on masonry units sampled from a consignment in accordance with Annex A and tested in accordance with RS 538. The characteristic initial shear strength shall not be less than the declared value.

NOTE Bond strength depends on the mortar, the masonry unit and the workmanship.

## 6.13 Flexural bond strength

When relevant for the intended place of use and the intended application, the flexural bond strength of units and mortar shall be declared. The declaration shall give the characteristic flexural strength of the masonry either in the plane of failure perpendicular to the bed joints or the plane of failure parallel to the bed joints or both, as relevant together with the mortar and unit specification for which the declaration is valid.

When aggregate concrete masonry units are sampled in accordance with Annex A and tested in accordance with RS 539, the characteristic flexural strength shall not be less than the value declared.

## 7 Description, designation and classification of aggregate concrete masonry units

### 7.1 Description and designation of units

The description and designation of an aggregate concrete masonry unit shall comprise at least the following:

- e) number and date of issue of this Working Draft Rwanda Standard;
- f) type of unit (see Clause 3);
- g) work size dimensions and tolerance category (see 6.2);
- h) compressive or bending tensile strength (where appropriate, see 6.5);
- i) configuration and appearance (see 6.3).

When relevant to the uses for which the units are put on the market, the description and designation may include:

- j) gross dry density (see 6.4.1);
- k) net dry density declared for the concrete, (see 6.4.2);
- l) coordinating size (see 6.2.1);
- m) moisture movement (see 6.9);
- n) thermal properties (see 6.6);
- o) other properties.

### 7.2 Classification

Specification of the properties of the units may be given by reference to classification systems provided those systems are based only on single properties included in this Standard and do not themselves constitute a barrier to trade.

This does not remove the requirement that all manufacturers claiming compliance with this Standard shall state declared values of the properties of their products, when required.

## 8 Marking

The following particulars shall be clearly marked on one of the following: the packaging, the delivery note, any certificate supplied with the masonry units, or 5 % of the units with a minimum of 4 per pack:

- a) the name, trademark or other means of identification of the manufacturer;

b) means of identifying the date of manufacture of the units;

c) means of identifying the units and relating them to their description and designation.

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## Annex A (normative)

### Sampling for determination of product type and for independent testing of consignments

#### A.1 General

This sampling procedure shall apply for product type determination and in the event that there is a requirement for an assessment of product compliance by independent testing.

Only those characteristics declared by the manufacturer shall be assessed by this procedure.

The number of units required to determine compliance with the specification shall be sampled from a consignment of up to 200 m<sup>3</sup> or part thereof (see Table A.1).

#### A.2 Sampling procedure

##### A.2.1 General

NOTE The choice of the method of sampling will normally be dictated by the physical form of the consignment in question.

##### A.2.2 Random sampling

Whenever possible the random sampling method shall be used in which every masonry unit in the consignment has an equal chance of being selected for the sample. The appropriate number of units shall be selected at random from positions throughout the consignment without any consideration being given to the quality of those selected except that units damaged in transit shall not be selected.

NOTE In practice, random sampling is normally only convenient either when the units forming the consignment are being moved in loose (unpacked) form from one place to another or when they have been split into a large number of small stacks e.g., on scaffolding awaiting laying.

##### A.2.3 Representative sampling

###### A.2.3.1 General

When random sampling is impracticable or not convenient (e.g., when the units form a large stack or stacks with ready access to only a limited number of units) a representative sampling procedure shall be used.

###### A.2.3.2 Sampling from a stack

The consignment shall be divided into at least six real or imaginary sections, each of a similar size. An equal number of units shall be selected at random from within each section in order to give the required number of

units without any consideration being given to the quality of those selected except that units damaged in transit shall not be selected.

NOTE It will be necessary to remove some sections of the stack or stacks in order to gain access to the units within the body of such stacks when taking samples.

### A.2.3.3 Sampling from a consignment formed of packs

At least six packs shall be selected at random from the consignment. The packaging shall be removed and an equal number of units shall be sampled at random from within each of the opened packs in order to give the required number of units without any consideration being given to the quality of those selected except that units damaged in transit shall not be selected.

### A.2.4 Dividing the sample

When the sample is to provide units for more than one test, the total number shall be collected together and then divided by taking units at random from within the total sample to form each successive sub-sample.

### A.2.5 Number of units required for testing

The sample size for each test shall be in accordance with Table A.1.

**Table A.1 — Number of units required for a test**

Property	Clause of this standard containing requirements	Test method	Number <sup>a</sup> of units per sample	
			1st <i>n</i> <sub>1</sub>	2nd <i>n</i> <sub>2</sub>
Dimensions	6.2.1 and 6.2.2.1	RS 536	6	10
Flatness of bed faces	6.2.2.2	Annex C	3	
Plane parallelism of bed faces	6.2.2.3	RS 536	3	
Configuration and appearance	6.3	RS 536, RS 537(Annex A), Annex C	3 by default. <sup>b</sup>	6 by default. <sup>b</sup>
Density	6.4	RS 537( Annex C)	6	10
Mechanical strength	6.5	RS 537, Annex D	6 <sup>c</sup>	10 <sup>c</sup>
Water absorption by capillarity	6.8	RS 543	3	6
Moisture movement	6.9	Relevant applicable standard.	6	12
Reaction to fire	6.11	RS 547	3 except for class A1 without testing	
Thermal properties	6.6	RS 524	3 when obtained by testing	

Property	Clause of this standard containing requirements	Test method	Number <sup>a</sup> of units per sample	
			1st <i>n</i> <sub>1</sub>	2nd <i>n</i> <sub>2</sub>
Water vapor permeability	6.10	RS ISO 12572 or RS 524		
Shear bond strength	6.12	RS 538 Procedure A Procedure B	Type I specimen 27 18	Type II specimen 18 12
Flexural bond strength	6.13	RS 539	number of units needed for 3 wallettes	
<p><sup>a</sup> If appropriate e.g., when the units are not affected by test procedure the same units may be used for different tests.</p> <p><sup>b</sup> The number of units to be tested should be subject to agreement between the parties.</p> <p><sup>c</sup> Where units require cutting as described in 6.5.1.2 above, the number of units required should be adjusted so that the sample size can be conveniently satisfied.</p>				

### A.3 Place and dates of inspection and testing

The location of the laboratory or place for inspection and testing, the dates and representation by the parties shall be subject to agreement between them. The agreed tests shall be carried out in the sequence agreed by the parties. If a particular property of a batch of units shows non-compliance (as described in Annex B), the remaining tests may be carried out by agreement between the parties.

## Annex B (normative)

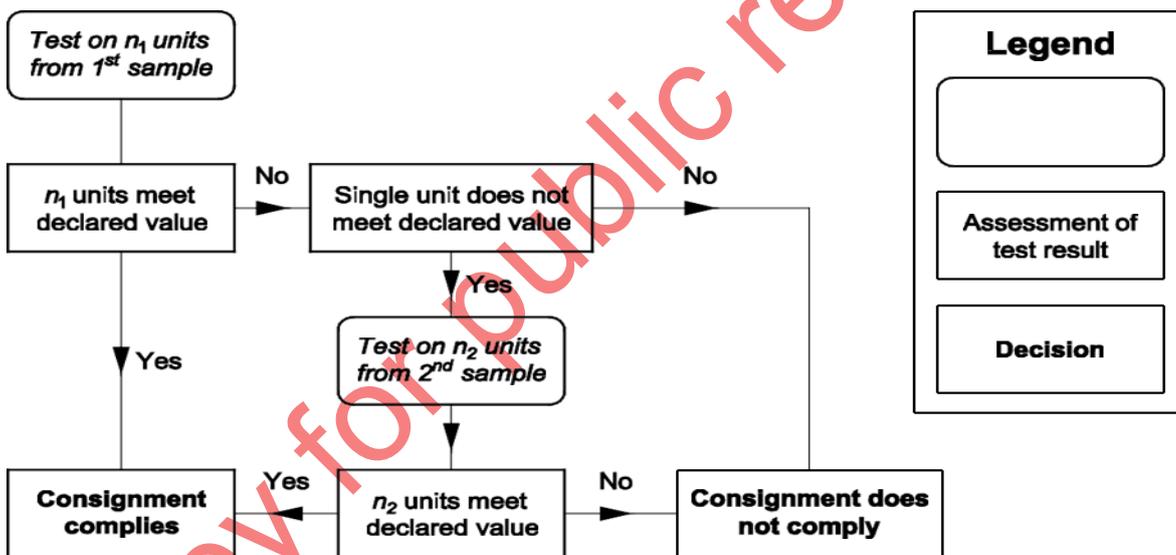
### Compliance criteria for product type determination and for independent testing of consignments

#### B.1 Dimensions and tolerances

The mean value of the measurements taken of any one dimension on a single unit shall not vary from the manufacturer's declared work size by more than the tolerances given in 6.2 for the declared tolerance category. The assessment of compliance shall be based on the procedure shown in Figure B.1.

#### B.2 Configuration and appearance

The geometry, shape and features of the unit shall comply with the requirements given in 6.3 or with the manufacturer's declared properties. The assessment of compliance shall be based on the procedure shown in Figure B.1.



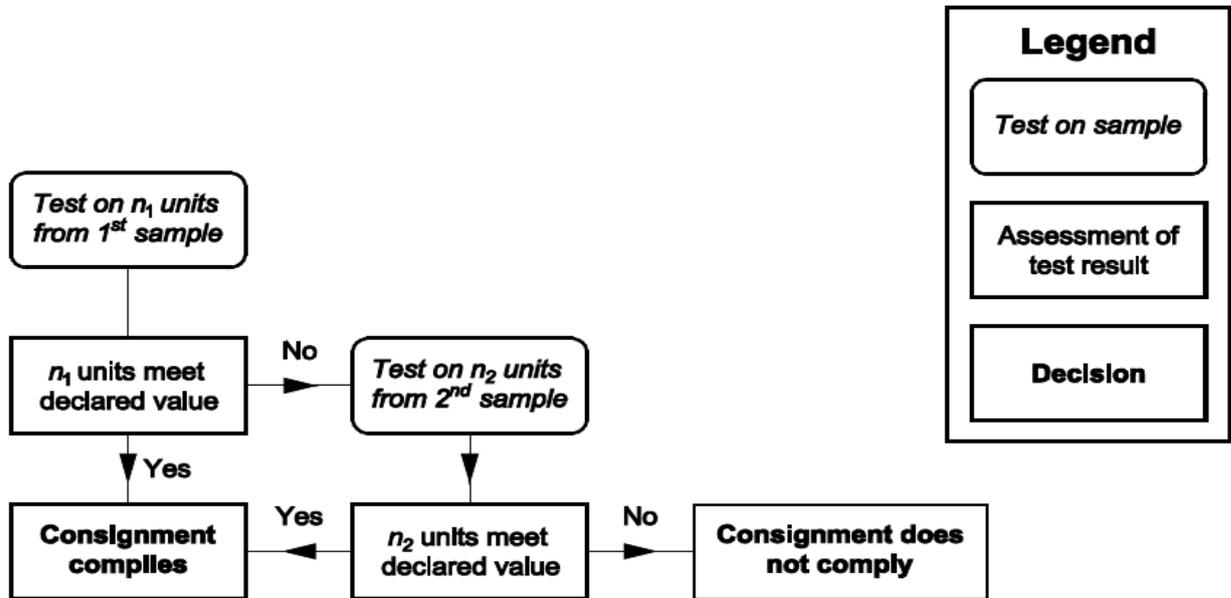
#### Key

$n_1$  and  $n_2$  are as given in Table A.1

Figure B.1 — Procedure for the assessment of the dimensions and water absorption of units

### B.3 Density

The mean value of the dry density of the unit shall comply with the requirements given in 6.4 or with the manufacturer's declared properties. The assessment of compliance shall be based on the procedure shown in Figure B.2 Configuration and appearance (see 6.3)



Key

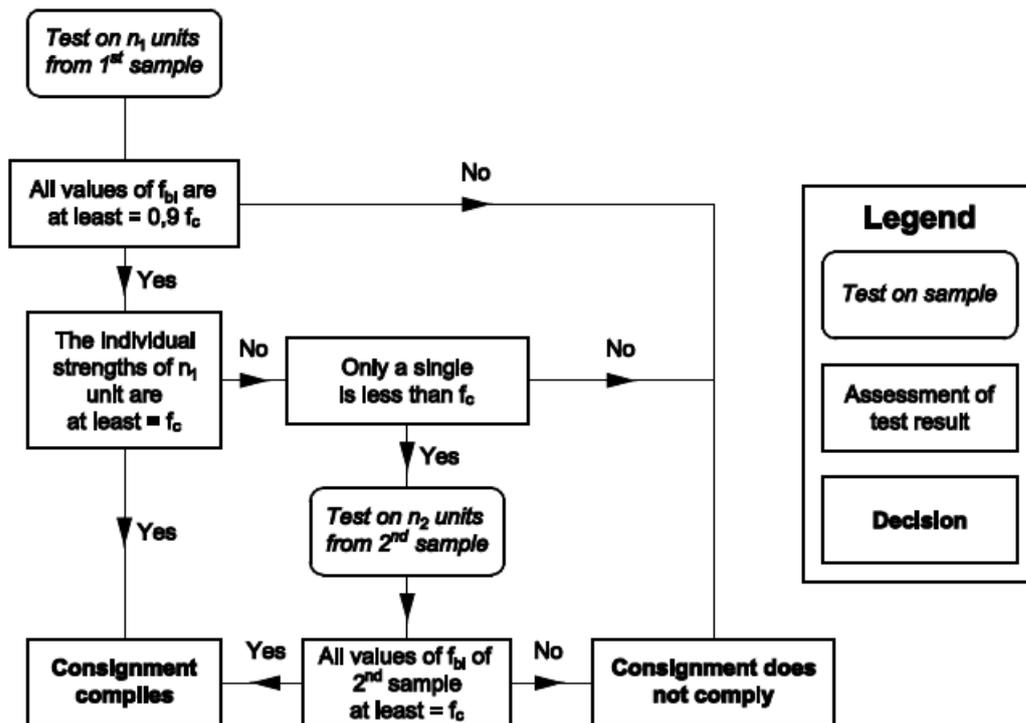
$n_1$  and  $n_2$  are as given in Table A.1.

Figure B.2 — Procedure for the assessment of the density and moisture movement of units

### B.4 Mechanical strength

#### B.4.1 Characteristic strength

The characteristic strength when declared shall comply with the requirements given in 6.5. The assessment of compliance shall be based on the procedure shown in Figure B.3.



**Key**

$f_c$  is the declared characteristic compressive strength, in MPa (N/mm<sup>2</sup>).

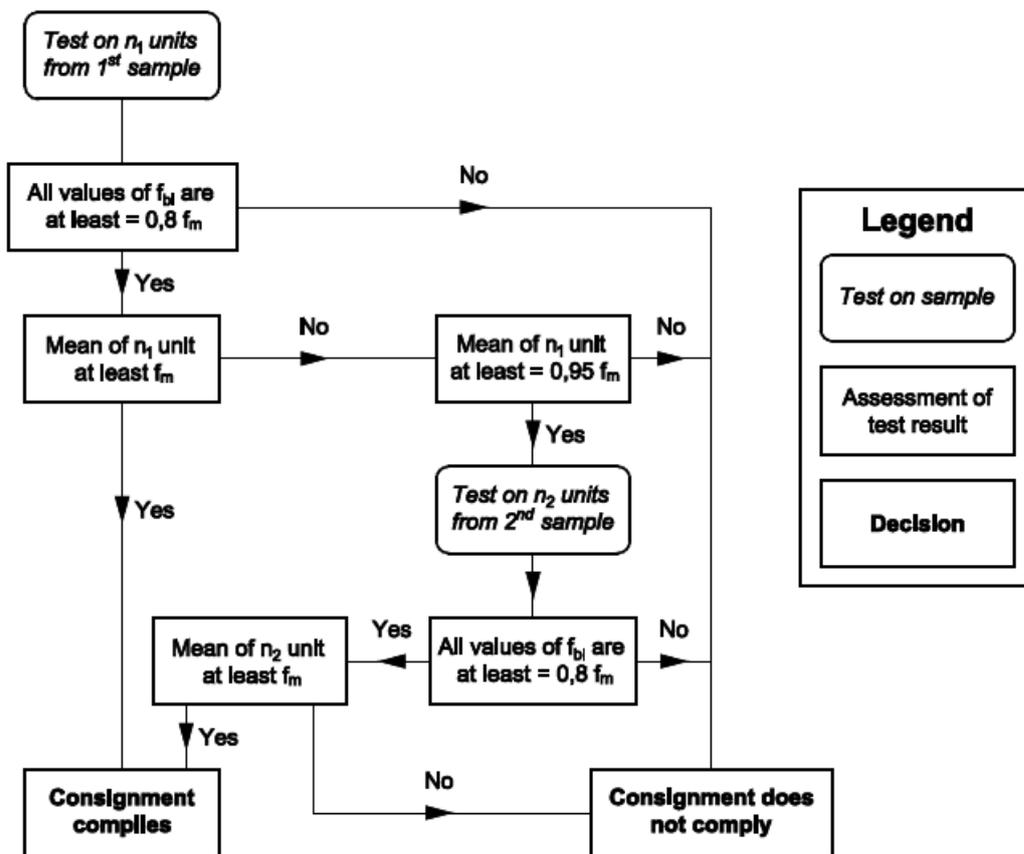
$f_{bi}$  is the individual masonry unit compressive strength, in MPa (N/mm<sup>2</sup>).

$n_1$  and  $n_2$  are as given in Table A.1.

**Figure B.3 — Scheme for the assessment of characteristic strength of units**

**B.4.2 Mean strength**

The mean strength when declared shall comply with the requirements given in 6.5. The assessment of compliance shall be based on the procedure shown in Figure B.4.



**Key**

$f_m$  is the declared mean compressive or bending tensile strength, in MPa (N/mm<sup>2</sup>).

$f_{bi}$  is the individual masonry unit compressive or bending tensile strength, in MPa (N/mm<sup>2</sup>).

$n_1$  and  $n_2$  are as given in Table A.1.

**Figure B.4 — Scheme for the assessment of mean strength of units**

**B.5 Moisture movement and water absorption by capillarity**

The test results shall be compared to the value declared by the manufacturer. The assessment of compliance shall be based on the procedure shown in Figure B.2 for moisture movement and as shown in Figure B.1 for water absorption by capillarity

## **Annex C** **(normative)**

### **Determination of flatness of masonry units**

#### **C.1 Apparatus**

Graduated straight edge which is longer than the diagonal of long faces of the unit being tested

Set of filler gauge capable of measuring with accuracy 0.05mm.

#### **C.2 Preparation of specimen**

##### **C.2.1 Sampling**

The number of samples shall be at least six except in case of determination of flatness of bed face where they shall be at least three

Note a larger number of samples to be selected can be specified in product specification and in such case this number shall be used.

##### **C.2.2 Surface treatment**

Remove any superfluous material adhering to the unit as results of manufacturing process before measuring.

#### **C.3 Procedures**

##### **C.3.1 Unit surface**

Ensure that the masonry unit is positioned in a stable manner prior to measurement. For each face specifies as being plane follow the procedure in C.3.2 and C.3.3. For units specified as suitable for thin layer masonry carry out the procedure in C.3.3.

##### **C.3.2 Measurement of diagonals**

For each surface specified as plane measure the length of the two diagonals with the graduated straight edge to the nearest 0.5mm

##### **C.3.3 Measurement of deviation**

Place the straight edge across each diagonal in turn and use the feeler gauge to measure the distance from the face of the masonry unit to the straight edge. Where the face of the masonry is concave, measure the greatest distance from the surface of the straight edge to the nearest 0.05 mm, where the surface of the masonry is

convex place the straight edge on it such that the greatest distance to the surface on either side of the point of contact are approximately equal. Measure them both to the nearest of 0.05mm.

## C.4 Calculation and expression of results

### C.4.1 Calculation of results

For each surface specified as being plane calculate the mean length of the diagonal in the case of concave faces calculate the mean deviation from flatness as the mean of the maximum distance of the face of masonry unit from the straight edge on each diagonal. In case of convex face calculate the mean of the maximum distance of the face of the masonry unit from the straight edge for each diagonal and then calculate the mean deviation from flatness as the mean of these two results.

### C.4.2 Expression of results

#### C.4.2.1 Flatness of surfaces specified as being plane

Express the mean length of the diagonal to the nearest millimeter. Express the mean maximum deviation from flatness to the nearest 0.1mm.

#### C.4.2.2 Flatness of bed faces

Express the maximum deviation from flatness to the nearest 0.1 mm. Express the mean maximum from flatness to the nearest 0.1mm.

## C.5 Test report

The test report shall contain the following information

- a) The number of this standard
- b) The name of organization that carried out sampling and test method used
- c) Date of testing
- d) Type, origin and designation of masonry unit
- e) Date of receipt of the specimen in the testing laboratory
- f) For each surface specified as being plane the maximum distance from the surface of the masonry unit to the straight edge for each diagonal and the mean deviation for the nearest 0.1mm,
- g) For each surface specified as being plane the maximum distance from the surface of the masonry unit to the straight edge for each diagonal and the mean deviation to the nearest 0.1mm;
- h) For each bed face of units specified as being unsuitable for thin layer masonry the maximum distance from the surface of the masonry unit to the straight edge for each diagonal. The flatness of the bed face is taken as the largest individual distance from the sample of units expressed to the nearest 0.1mm;
- i) Whether the surface of the masonry unit is concave or convex or any other configuration
- j) Remarks if any.

# Annex D (normative)

## Determination of bending tensile strength of aggregate concrete masonry units

### D.1 Apparatus

Test machine capable of applying load without shock at a uniform rate in the range of 10 N/s to 50N/s.

The bending device consisting two roller supports having the same diameter between 15 and 40 mm, on which the specimen rests and two upper rollers of the same diameter through which the load is applied. The distance between the two support rollers should be at least 4 times the height of the specimen. The two upper rollers should be positioned at the third point of the span.

To allow uniform distribution of the forces the specimen all rollers except one shall be able to oscillate slightly about their centre in a vertical plane perpendicular to the major axis of the specimen.

Weighing instrument capable of weighing to an accuracy of at least 0.1 % of their mass.

### D.2 Preparation of specimens

The minimum number of specimens shall be three, but larger minimum may be specified in the product specification in which case that larger number shall be used.

Whole unit test specimens shall be conditioned by air drying in an environment under the following conditions

Relative humidity	≤65%
Temperature	≥15°C
Duration of	14 days

If during the conditioning process the loss in mass in consecutive weight at not less than 24 intervals is less than 1% of the mass of the unit, the unit may be regarded as air dry.

The method of sampling shall be stated in test report

Measure the dimensions of the specimens in accordance with RS 536.

### D.3 Test procedures

Apply the load gradually and without shock at any convenient rate such that failure occurs within 30s to 90s  
Record the maximum load (p), and position of failure.

## D.4 Calculation of results

Calculate the tensile bending strength of each specimen to the nearest 0.1N/mm<sup>2</sup> using the formula

$$R_{tf} = \frac{Fl}{bh^2}$$

Where

$R_{tf}$  is

$F$  is failure load in Newton

$l$  is distance between supports in millimeters

$b$  is the specimen width in millimeters

$h$  is the specimen height in millimeters

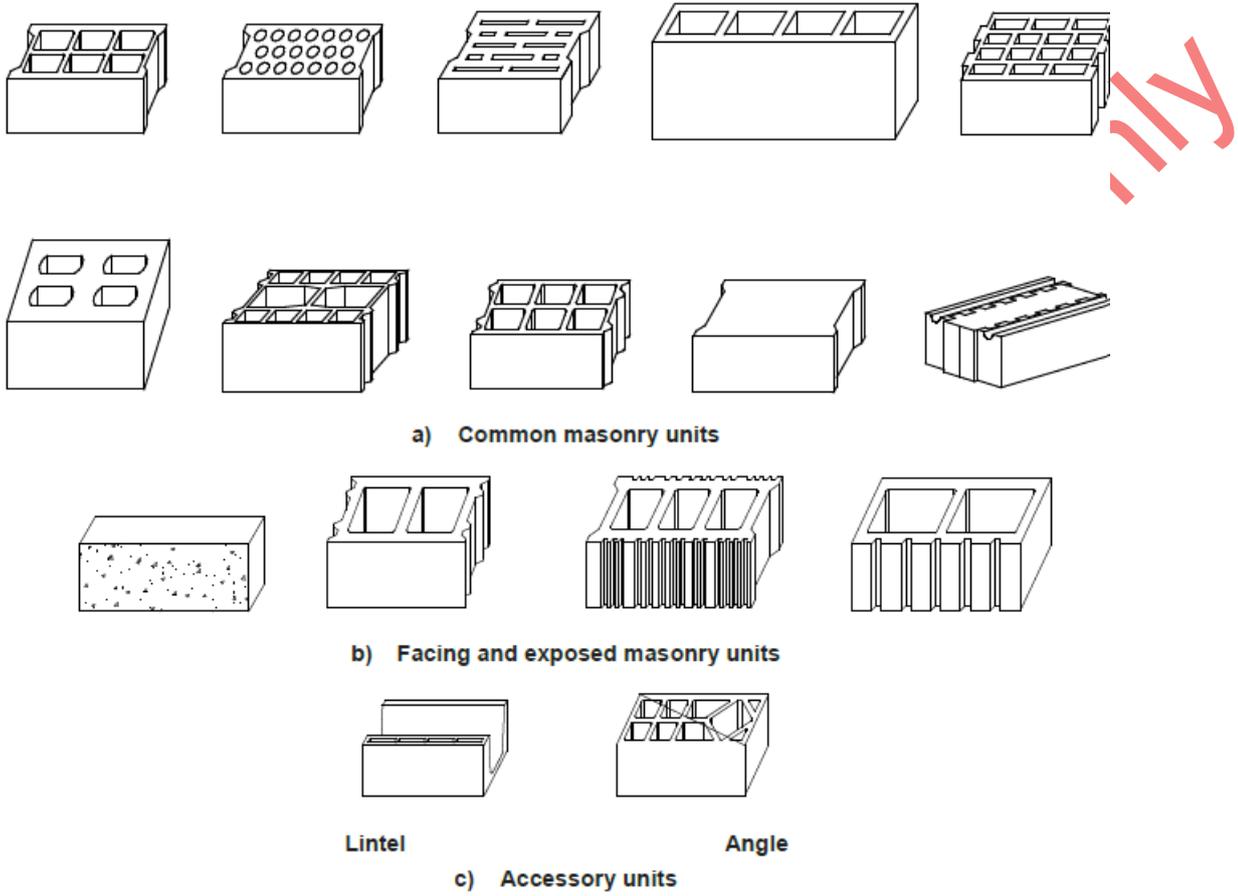
The position of the failure shall be noted in the report. If the fracture occurs in the tension surface outside of the middle third of the span length, the test should be discarded. Three or larger number of specimens referred to in (D.2) shall be determined calculate the tensile bending strength as the mean of the individual results to the nearest 0.1N/mm<sup>2</sup>.

## D.5 Test report

The test report shall contain the following information:

- a) The number of this Standard
  - b) The name and organization that carried out sampling and the method used.
  - c) The date of testing
  - d) Type, origin and designation of masonry unit
  - e) Number of specimens in the sample
  - f) Sketch of the specimen showing orientation of loading and the position of the rollers;
  - g) The failure load in N, position of failure, strength in N/mm<sup>2</sup> to the nearest 0.1 N/mm<sup>2</sup> and dimensions in mm of each specimen. Note any discarded results;
  - h) The mean bending tensile strength in N/mm<sup>2</sup> to the nearest 0.1 N/mm<sup>2</sup>; and
  - i) Remark if any
-

**Annex E**  
(informative)  
**Examples of different shapes of aggregate concrete masonry units**



**Figure C.1 — Examples of different shapes of aggregate concrete masonry units**

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