

# **Specification for Masonry units**

## **Part 1:**

### **Clay Masonry Units**

Public Review Draft April 2019

PUBLIC REVIEW DRAFT

## TECHNICAL COMMITTEE REPRESENTATION

The following organizations were represented on the Technical Committee:

National Housing Corporation  
Kenya Clay Products Ltd.  
Coast Clay Works Ltd.  
Consumer Information Network  
University of Nairobi  
Kenya Industrial Research & Development Institute  
Architectural Association of Kenya  
M&O Consulting Engineers  
Kenya Association of Manufacturers,  
Lake Basin Development Authority  
Kenya National Federation of Jua Kali Association  
Kenya Bureau of Standards — Secretariat

## REVISION OF KENYA STANDARDS

In order to keep abreast of progress in industry, Kenya Standards shall be regularly reviewed. Suggestions for improvements to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

© Kenya Bureau of Standards, 2019

*Copyright. Users are reminded that by virtue of Section 25 of the Copyright Act, Cap. 130 of 2001 of the Laws of Kenya, copyright subsists in all Kenya Standards and except as provided under Section 25 of this Act, no Kenya Standard produced by Kenya Bureau of Standards may be reproduced, stored in a retrieval system in any form or transmitted by any means without prior permission in writing from the Managing Director.*

# **Specification for Masonry units**

## **Part 1:**

### **Clay Masonry Units**

#### **KENYA BUREAU OF STANDARDS (KEBS)**

**Head Office:** P.O. Box 54974, Nairobi-00200, Tel.: (+254 020) 605490, 602350, Fax: (+254 020) 604031  
E-Mail: [info@kebs.org](mailto:info@kebs.org), Web: <http://www.kebs.org>

#### **Coast Region**

P.O. Box 99376, Mombasa-80100  
Tel.: (+254 041) 229563, 230939/40  
Fax: (+254 041) 229448

#### **Lake Region**

P.O. Box 2949, Kisumu-40100  
Tel.: (+254 057) 23549, 22396  
Fax: (+254 057) 21814

#### **Rift Valley Region**

P.O. Box 2138, Nakuru-20100  
Tel.: (+254 051) 210553, 210555

## Foreword

This Kenya Standard was prepared by the Clay and Clay Products Technical Committee under the guidance of the Standards Projects Committee and in accordance with the procedures of the Kenya Bureau of Standards.

The standard has been developed to replace KS 02-547:1983, Specification for burnt clay building blocks and KS 02-300: 1983, Specification for burnt building bricks. This standard is by all means more comprehensive and captures the development in the clay industry over the years. This standard may not give specific dimensions for the clay units but would give values of other parameters to be attained in the test methods.

During the development of this standard, reference was made to the following document:

BS EN 771-1:2011+A1:2015, EN 771, Specification for masonry units consists of: Part 1: Clay masonry units.

KS 02-547:1983, Specification for burnt clay building blocks

KS 02-300: 1983, Specification for burnt building bricks

Acknowledgement is hereby made for the assistance received from these sources.



## **Specification for Masonry units**

### **Part 1:**

## **Clay Masonry Units**

### **1 Scope and field of application**

This Kenya Standard specifies the characteristics and performance requirements for masonry units manufactured from clay for which the main intended uses are protected or unprotected masonry structure (see definitions 3.3 and 3.4) (e.g. Facing and rendered masonry, loadbearing or non-loadbearing masonry structures, including internal linings and partitions, for building and civil engineering).

NOTE For control purposes, regardless of the use or the compressive strength, that is Protected Units (P) or Category II Units respectively, the properties of Unprotected Units (U) and Category I Units shall apply.

It defines the performance related to e.g. Dimensional tolerances, strength, density measured according to the corresponding test methods contained in separate Kenyan Standards.

This Kenya Standard does not specify standard sizes for clay masonry units, nor does it specify standard work dimensions, angles and radii of specially shaped clay masonry units. This Kenyan Standard does not include method of measurement of angles and radii characteristics of specially shaped clay masonry units.

This Kenya Standard does not cover requirements for the following: units for paving, flue liners and storey height clay masonry units and clay masonry units with an incorporated thermal insulation material bonded to the faces of the unit susceptible to be exposed to fire. It does, however, include clay masonry units for external chimney masonry

### **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.

DKS 2802-1 Masonry units — Test Methods — Part 1: Determination of compressive strength.

DKS 2802-2 Masonry units — Test Methods — Part 2: Determination of net volume and percentage of voids of clay masonry units by hydrostatic weighing.

DKS 2802-3 Masonry units — Test Methods — Part 3: Determination of the active soluble salts content of clay masonry units.

DKS 2802-4 Masonry units — Test Methods — Part 4: Determination of water absorption of clay masonry damp proof course units by boiling in water.

DKS 2802-5 Masonry units — Test Methods — Part 5: Determination of volume and percentage of voids and net volume of clay and calcium silicate masonry units by sand filling.

DKS 2802-6 Masonry units — Test Methods — Part 6: 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.

DKS 2802-7 Masonry units — Test Methods — Part 7: Determination of net and gross dry density of masonry units (except for natural stone).

DKS 2802-8 Masonry units — Test Methods — Part 8: Determination of dimensions.

DKS 2802-9 Masonry units — Test Methods — Part 9: Determination of moisture expansion of large horizontally perforated clay masonry units.

DKS 2802-10 Masonry units — Test Methods — Part 10: Determination of flatness of faces of aggregate concrete, manufactured stone and natural stone masonry units.

DKS 2802-11 Masonry units — Test Methods — Part 11: Determination of water absorption of clay and calcium silicate masonry units by cold water absorption.

DKS 2802-12 Masonry units — Test Methods — Part 12: Determination of initial shear strength.

DKS 2803 Masonry and masonry products — Methods for determining thermal properties.

DKS 2804-1 Fire classification of construction products and building elements — Part 1: Classification using data from reaction to fire tests.

KS ISO 12572, hydrothermal performance of building materials and products - Determination of water vapour transmission properties.

### **3 Term and definitions**

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

NOTE Annex B to this Kenya Standard is informative and gives descriptions of such matters as applications, exposure and durability.

#### **3.1 masonry unit**

prefabricated component intended for use in masonry construction

#### **3.2 clay masonry unit**

masonry unit made from clay or other argillaceous materials with or without sand, fuel or other additives fired at a sufficiently high temperature to achieve a ceramic bond

#### **3.3 protected masonry**

masonry which is protected against water penetration and is not in contact with soil and ground water

Note 1 to entry:

it can either be masonry in external walls which is protected, (e.g. by a layer of suitable render or by cladding), or it can be the inner leaf of a cavity wall or it can be an internal wall. It may or may not be loadbearing.

#### **3.4 unprotected masonry**

masonry which may be exposed to rain, freeze/thaw and/or may be in contact with soil and ground water without a suitable protection

Note 1 to entry:

It can either be masonry in external walls which is fully unprotected, or which is intended to be provided by a limited protection (e.g. by a thin layer of render). It may or may not be loadbearing.

#### **3.5 P unit**

clay masonry unit for use in protected masonry.

#### **3.6 U unit**

clay masonry unit for use in unprotected masonry

#### **3.7 coordinating size**

size of the coordinating space allocated to a masonry unit including allowances for joints and tolerances



**3.8 work size**

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

**3.9 actual size**

size of a masonry unit as measured

**3.10 regular-shaped masonry unit**

masonry unit with an overall rectangular parallelepiped shape

**3.11 specially shaped masonry unit**

masonry unit which is not a rectangular parallelepiped

**3.12 accessory unit**

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

**3.13 interlocking features**

shaped matched projections and indentations on masonry units

example        tongue and groove systems.

**3.14 vertical perforation**

formed void that passes completely through a masonry unit perpendicular to the bed face

**3.15 horizontal perforation**

formed void that passes completely through a masonry unit parallel to the bed face

**3.16 cell**

formed void that does not pass through a masonry unit

**3.17 frog**

depression formed in one or both bed faces of a unit

**3.18 recess**

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

example mortar pocket, rendering keyway, grip hole.

**3.19 grip hole**

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

**3.20 shell**

peripheral material between a perforation and the surface of a masonry unit

**3.21 web**

solid material between the perforations in a masonry unit

**3.22 declared value**

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

**3.23 mean compressive strength of masonry units**

arithmetic mean of the compressive strengths of masonry units

**3.24 normalized compressive strength**

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

NOTE    See the procedure given in DKS 2802-1.

**3.25 damp proof course unit**

clay masonry unit which, when laid in two courses with broken bond in a strong cementitious mortar, will resist rising damp in masonry

**3.26 high precision clay masonry unit**

clay masonry unit with small dimensional tolerance especially in unit height

**3.27 vertically perforated or hollow clay masonry unit**

clay masonry unit with one or more formed voids that pass completely through a masonry unit perpendicular to the bed face

**3.28 horizontally perforated or hollow clay masonry unit**

clay masonry unit with one or more formed voids that pass completely through a masonry unit parallel to the bed face

**3.29 clay masonry unit for concrete or mortar infill**

clay masonry unit with special perforation suitable for concrete or mortar infill

**3.30 clay masonry unit for masonry panels**

clay masonry unit suitable for production of reinforced masonry or masonry storey height panels with vertical channels for mortar or concrete infill

**3.31 clay masonry subject to severe exposure**

masonry or elements of masonry which, under end use conditions, are subjected to saturation with water (driving rain, ground water) combined with frequent freeze/thaw-cycling, due to climatic conditions and absence of protective features

**3.32 clay masonry subject to moderate exposure**

masonry or elements of masonry which, under end use conditions, are exposed to moisture and freeze/thaw-cycling, excluding constructions subjected to severe exposure

**3.33 clay masonry subject to passive exposure**

masonry or elements of masonry which, under end use conditions, are not intended to be exposed to moisture and freezing conditions

**3.34 category I masonry units**

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

NOTE This may be determined via the mean or characteristic value.

**3.35 category ii masonry units**

units not intended to comply with the level of confidence of category i units

**3.36 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

**3.37 product group**

products from one manufacturer having common values for one or more characteristics

**3.38 consignment**

shipment from the supplier

**3.39 product type**

set of representative performance levels or classes of a construction product, in relation to its essential characteristics, manufactured using a given combination of raw materials or other elements in a specific production process.

## **4 Materials and manufacture**

See 3.2, 8.3.4 and 8.3.5.

## 5 Requirements for clay masonry units

### 5.1 General

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

**NOTE** It should be noted that the test methods are not usually applicable to specially shaped and accessory units as defined in 3.11 and 3.12.

In general, for specially shaped clay masonry units it will be satisfactory to declare the properties as that determined on units of a rectangular parallelepiped shape and of the same product type which has been subjected to a similar manufacturing process.

The conformity criteria given in the following sub clauses relate to product type determination (see 8.2) 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 and a confidence level of 95 %.

For production evaluation, the manufacturer shall define the conformity criteria in the factory production control documentation (see 8.3).

The manufacturer shall declare whether the unit fulfils the requirements for P units (see Figure 2) or U units (see Figure 3).

### 5.2 P or U units sizes

The standard Sizes of units (P or U) shall conform to Table 1. The format of walling blocks shall be designated in terms of their coordinating sizes, which with the exception of Widths include the thickness of a mortar joint. This is taken for the purpose of this standard as equal to 10 mm.

**Table 1 — Standard dimensions for (P or U) units**

Length (mm)		Height (mm)		Width (mm)	
Nominal size	Work size	Nominal size	Work size	Nominal size	Work size
200	190	225	225	75	65
225	215	300	300	100	90
300	290	400	400	150	140
				200	190
				225	215
				300	290

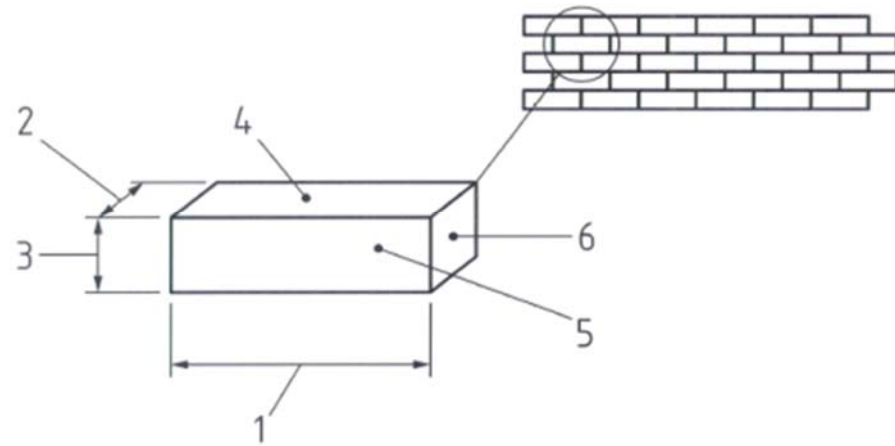
### 5.3 U units: intended to be used in unprotected masonry

#### 5.3.1 Dimensions and tolerances (U units)

##### 5.3.1.1. Dimensions (U units)

The dimensions of a clay masonry unit shall be declared by the manufacturer in mm for length, width, and height, in that order (see Figure 1). They shall be given in terms of work size.

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



**Key**

- |   |        |   |        |   |        |
|---|--------|---|--------|---|--------|
| 1 | Length | 3 | Height | 5 | Face   |
| 2 | Width  | 4 | Bed    | 6 | Header |

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

**Figure 1 — Dimensions and surfaces**

For units of special shape that fit within the envelope of a rectangular parallelepiped shape, the length, width and height are those for the tightest envelope. For other shapes these dimensions are defined in 5.3.2.

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

The measurement procedure shall be in accordance with DKS 2802-8.

### 5.3.1.2 Dimensional tolerances (U units)

#### 5.3.1.2.1 Tolerances (U units)

The manufacturer shall also declare which of the tolerance categories for mean values in 5.3.1.2.2 the clay masonry units fulfil.

When relevant to the uses for which the unit is placed on the market, the manufacturer shall also declare which of the range categories in 5.3.1.2.3 a given consignment of the clay masonry units fulfils.

NOTE This additional declaration may be made for example in relation to:

- a) achievement of the required accuracy (planarity, bonds and thin layer joints) of the masonry;
- b) Use of detailed project drawings to achieve these requirements.

#### 5.3.1.2.2 Tolerances of the mean value (U units)

When clay masonry units are sampled from a consignment in accordance with Annex A and tested in accordance with DKS 2802-8, the difference for all dimensions between the declared value and the mean value derived from measurements of the test sample shall be not greater than the declared one of the following categories, where the value shall be rounded to the whole mm:

#### 5.3.1.2.3 Range (U units)

When declared and regular-shaped clay masonry units are sampled from a consignment in accordance with Annex A and tested in accordance with DKS 2802-8, the maximum range for any given dimension (i.e. the difference between the largest and smallest determined dimensions on individual units) to be found within the test sample shall be within the declared one of the three categories indicated below, where the value shall be rounded to the whole mm:

Category	Maximum range
R1:	$0,6 \sqrt{\text{(work size dimension)}} \text{ mm}$
R2:	$0,3 \sqrt{\text{(work size dimension)}} \text{ mm}$
or Rm:	a range in mm declared by the manufacturer (may be wider or closer than the other categories).

NOTE For some types of facing masonry where different production lots are mixed to achieve an overall consistent appearance, the category Rm may be satisfactory.

#### 5.3.1.2.4 Flatness of bed faces (U units)

When clay masonry units are intended to be used with thin layer mortar, the manufacturer shall declare the maximum deviation from flatness of the bed faces.

When regular-shaped clay masonry units are sampled from a consignment in accordance with Annex A and tested in accordance with DKS 2802-10, the deviation from flatness of the bed faces shall not exceed the declared value.

### 5.3.1.2.5 Plane parallelism of bed faces (U units)

When clay masonry units are intended to be used with thin layer mortar, the manufacturer shall declare the maximum deviation from plane parallelism of the bed faces.

When regular-shaped clay masonry units are sampled from a consignment in accordance with Annex A and tested in accordance with DKS 2802-8, the deviation from plane parallelism shall not exceed the declared value.

### 5.3.2 Configuration (U units)

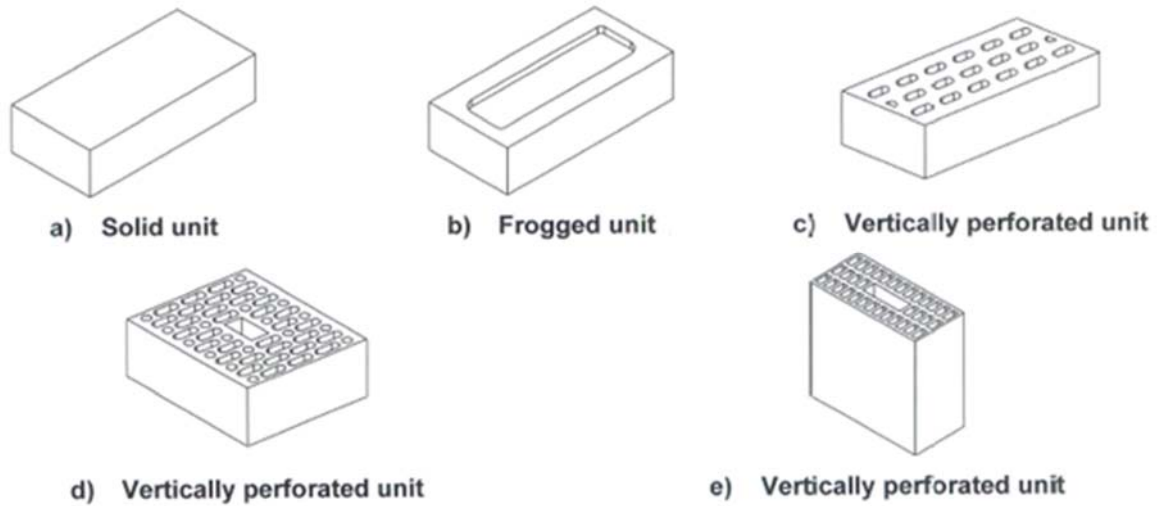


Figure 2 —Examples of U units

## 5.3.3 General (P units)

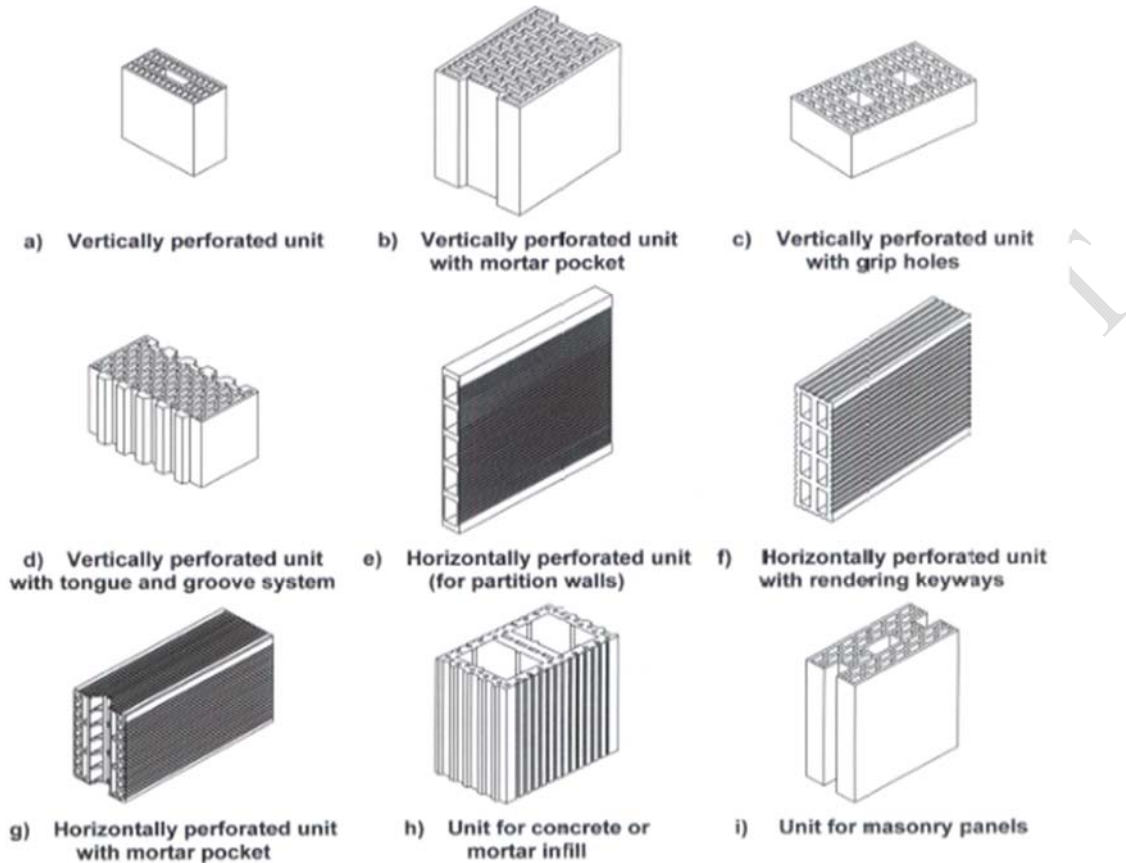


Figure 3 — Examples of P units

When relevant to the uses, for which clay masonry U units are placed on the market, the configuration shall be declared. The declaration may be made by reference to one or another of the groups defined in EN 1996-1-1 or EN 1996-1-2 and/or it may include one or more items such as those in the following list, as relevant:

- a) Shape and features, including the direction of perforations (by means of a drawing or illustration, when relevant);
- b) volume of all formed voids as a percentage of the length x width x height of the unit;
- c) volume of the largest of any formed voids as a percentage of the length x width x height of the unit;
- d) volume of grip holes as a percentage of the length x width x height of the unit;
- e) thickness of webs;
- f) thickness of shells;
- g) combined thickness of webs and shells from face to face;
- h) combined thickness of webs and shells from header to header;
- i) area of voids on a bed face as a percentage of the length x width of the unit;

j) Total volume of frogs as a percentage of the length x width x height of the unit.

NOTE The header of clay masonry units may have interlocking features, e.g. Mortar pockets, tongue and groove systems. The face of clay masonry units may have a surface-profile (rendering keyways).

For units of special shape the dimensions to be considered as length, width and height of the unit shall be given.

Each declared value shall be stated as either an upper limit or a lower limit or, alternatively, given as a range of values. When clay masonry units are sampled from a consignment in accordance with Annex A and tested in accordance with DKS 2802-8, DKS 2802-5 and DKS 2802-2, the mean value derived from measurements of the test sample shall be within the range or limit declared.

### **5.3.4 Density (U units)**

#### **5.3.4.1. Gross dry density (U units)**

When relevant to the uses for which the unit is placed on the market and in all cases for masonry units intended to be used in elements subject to acoustic requirements, the gross dry density of clay masonry units shall be declared by the manufacturer.

NOTE 1 The manufacturer may also provide information to show how the declared gross dry density fits into a national classification system.

When the gross dry density is declared, the manufacturer shall also declare which of the deviation categories in 5.3.3.3 applies. This declaration does not apply to units of special shape.

For solid units with or without cells (e.g. frogs or recesses intended to be filled with mortar), the declaration of the gross dry density and its deviation may be taken equal to the net dry density according to 5.3.3.2.

NOTE 2 This declaration may be made for evaluation of:

- a) loading;
- b) airborne sound insulation;
- c) resistance to fire;
- d) Thermal insulation.

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

#### **5.3.4.2. Net dry density (U units)**

When relevant to the uses for which the unit is placed on the market, the net dry density of clay masonry units shall be declared by the manufacturer.

NOTE The manufacturer may also provide information to show how the declared net dry density fits into a national classification system.

When the net dry density is declared the manufacturer shall also declare which of the deviation categories in 5.3.3.3 Applies. This declaration does not apply to units of special shape.

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

#### **5.3.4.3. Tolerances (U units)**

When clay masonry units are sampled from a consignment in accordance with Annex A and tested in accordance with DKS 2802-7, the mean gross and net dry density derived from measurements of the test sample shall not differ from the manufacturer's declared dry density by more than one of the following categories:

- a) D1: 10 %



b) D2: 5 %  
or

c) Dm: a deviation in % as a whole number declared by the manufacturer (may be wider or closer than the other categories).

**5.3.5 Compressive strength (U units)**

When relevant to the uses for which the unit is placed on the market and in all cases for masonry units intended to be used in elements subject to structural requirements, the mean compressive strength shall be declared by the manufacturer. When relevant, the manufacturer shall also declare the normalized compressive strength. In general, for specially shaped clay masonry units the compressive strength may be declared as that determined on units of a rectangular parallelepiped shape which have been subjected to a similar manufacturing process. If the shape of a specially shaped clay masonry unit has a function in resisting load this shall be taken into account by testing representative samples of whole units but the declaration of strength is based upon loading the largest rectangular area normal to the load expected in the brickwork.

NOTE 1 DKS 2802-1 gives instructions on how to convert the unit compressive strength into the normalized compressive strength.

In addition, the manufacturer shall declare whether the clay masonry unit is Category I.

When the clay masonry units are sampled from a consignment in accordance with Annex A and tested in accordance with DKS 2802-1, then:

a) mean compressive strength of the specified number of clay masonry units from a consignment shall be not less than the declared compressive strength;

b) Individual strengths of specimens measured within the test sample shall be not less than 80 % of the declared value.

The declaration shall relate to and indicate the orientation(s) of the clay masonry units as tested, the methods of bedding the units and whether any voids present are intended to be fully filled with mortar.

NOTE 2 The manufacturer may provide information to show how the declared compressive strength fits into a national classification system.

NOTE 3 For tapered units special provisions apply, see DKS 2802-1.

**5.3.5.1 Compressive strength values ( U units)**

When tested in accordance with DKS 2802-1, the compressive strength for clay units for non-load bearing blocks shall not be less than 3N/mm<sup>2</sup> and the compressive strength for clay units for load bearing blocks shall not be less than 7N/mm<sup>2</sup>.

**Table 2 — Clay masonry units — Strength classes**

Designation	Grade	MIN. Compressive strength (N/mm <sup>2</sup> )
Engineering Units	U - A	48
Category I Units (Severe conditions)	U - B	28
Category I Units load bearing	U - C	7
Category I Units non – load bearing	U - D	3

**5.3.6 Thermal properties (U units)**

When relevant to the uses for which the units are placed 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 DKS 2803 or alternatively give net dry density or gross dry density and configuration.

In addition another fractile may be used. If so the used fractile shall be provided together with the additional provided  $\lambda_{10,dry,unit}$  -value.

When the clay masonry units are sampled in accordance with Annex A and tested in accordance with DKS 2803 following the model provided, then the obtained A-value of the specified number of clay masonry units shall be not greater than the provided  $\lambda$ -value.

When relevant to the use for which the units are placed on the market the value of specific heat capacity given in DKS 2803 may be provided.

### **5.3.7 Durability (U units)**

The freeze/thaw resistance category of a clay masonry unit shall be declared by the manufacturer by reference to its applicability to masonry or elements subjected to passive, moderate, and severe exposure (see B.3).

- FO - Passive exposure
- F1 - Moderate
- F2- Severe

Until a Kenyan Method of test is available, the freeze/thaw resistance shall be evaluated and declared to the provisions valid in the intended place of use of the units.

### **5.3.8 Water absorption (U units)**

#### **5.3.8.1 External element (U units)**

For clay masonry units intended to be used in external elements with the face of the unit being exposed the water absorption of a consignment shall be declared by the manufacturer. When clay masonry units are sampled from the consignment in accordance with Annex A and tested in accordance with DKS 2802-11, the mean water absorption of the specified number of clay masonry units shall be not greater than the declared water absorption.

#### **5.3.8.2 Damp proof courses (U units)**

The water absorption of clay masonry units intended to be used in damp proof courses shall be declared by the manufacturer. When clay masonry units are sampled from a consignment in accordance with Annex A and tested in accordance with DKS 2802-4, the mean water absorption of the specified number of clay masonry units shall be not greater than the declared water absorption.

NOTE There is no general relationship between water absorption and compressive strength or durability.

#### **5.3.9 Initial rate of water absorption (U units)**

When relevant for the intended use the range of the initial rate of water absorption of a consignment of clay masonry units shall be declared by the manufacturer. If so and when clay masonry units are sampled from the consignment in accordance with Annex A and tested in accordance with DKS 2802-6 using an immersion period of  $(60 \pm 2)$  s the mean initial rate of water absorption of the specified number of clay masonry units shall fall within the declared range of the initial rate of water absorption.

#### **5.3.10 Active soluble salts content (U units)**

When the intended use of the product only provides limited protection (e.g. thin layer of render) or the product in the intended use is exposed to weather the content of active water soluble salts shall be declared by the

manufacturer on the basis of the categories given in Table 3. When clay masonry units are sampled from the consignment in accordance with Annex A and tested in accordance with DKS 2802-3, the content of water soluble salts shall not be greater than the declared active soluble salts content.

Table 3 — Active soluble salts content categories

Category	Total % by mass not greater than	
	Na <sup>+</sup> + K <sup>+</sup>	Mg <sup>2+</sup>
S0	No requirement	No requirement
S1	0,17	0,08
S2	0,06	0,03

NOTE See B.4 for further information.

**5.3.11 Moisture movement (U units)**

In countries where there is a requirement for moisture movement, it shall be evaluated and declared to the provisions valid in the intended place of use of the units.

**5.3.12 Reaction to fire (U units)**

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 s 1,0 % by mass or volume (whichever is the most onerous) of homogeneously distributed organic materials the declaration may be fire Class A 1 without the need to test.

Masonry units containing > 1,0 % by mass or volume (whichever is the most onerous) of homogeneously distributed organic materials shall be classified in accordance with DKS 2804-1 and the appropriate fire classification declared.

**NOTE** Attention is drawn to the Commission Decision 96/603/EC as amended by the Commission Decision 2000/605/EC in which non-combustible masonry units containing not more than 1,0 % by mass or volume (whichever is the more onerous) of homogeneously distributed organic materials are classified as reaction to fire Class A1 without testing.

**5.3.13 Water vapour permeability (U units)**

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 DKS 2803 or determined in accordance with KS ISO 12572.

**5.3.14 Bond strength (U units)**

**5.3.14.1 General (U units)**

For clay masonry units intended to be used in elements subjected to structural requirements the bond strength of the unit in combination with mortar shall be declared in terms of the characteristic initial shear strength in accordance with DKS 2802-12. The declaration may be made either on the basis of fixed values as in 5.2.14.2 or tests as in 5.2.14.3. 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.

**5.3.14.2 Declaration based on fixed values (U units)**

When no declaration is made under 5.3.13.3, the characteristic initial shear strength of the unit in combination with mortar may be declared by reference to EN 998-2:2010, Annex C.

**5.3.14.3 Declaration based on tests (U units)**

The characteristic initial shear strength of the unit in combination with one or more specific type of mortar specified in accordance with EN 998-2 may be declared based on tests on clay masonry units sampled from a consignment in accordance with Annex A and tested in accordance with Specification for mortar for masonry 2802-12. 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.

### **5.3.15 Dangerous substances**

National regulations on dangerous substances may require verification and declaration on release, and sometimes content, when construction products covered by this standard are placed on those markets.

In the absence of Kenyan harmonized test methods, verification and declaration on release/content should be done taking into account national provisions in the place of use.

## **6 Description, designation, designation code and classification of clay masonry units**

### **6.1 Description and designation**

#### **6.1.1 P units**

A description and designation of a clay masonry unit shall comprise at least the following:

- a) The number and date of issue of this Kenya Standard;
- b) Type of unit (see 5.1);
- c) Dimensions and tolerances (mean value) (see 5.2.1);
- d) Gross dry density and tolerances (see 5.2.3);
- e) Compressive strength (see 5.2.4);

When relevant to the uses for which the unit is placed on the market, the description and designation shall include:

- f) Configuration (see 5.2.2);
- g) Tolerances (range) (see 5.2.1);
- h) Net dry density and tolerances (see 5.2.3);
- i) Thermal properties (see 5.2.5);
- k) Category of active soluble salts content G (see 5.2.8);
- l) Moisture movement and its basis (see 5.2.9);
- m) Reaction to fire (see 5.2.10);
- n) Water vapour permeability (see 5.2.11);
- o) Bond strength (see 5.2.12);
- p) Dangerous substances (see 5.2.13).

#### **6.1.2 U units**

A description and designation of a clay masonry unit shall comprise at least the following:

- a) The number and date of issue of this Kenyan Standard;
- b) Type of unit (see 5.1);
- c) Dimensions and tolerances (mean value) (see 5.3.1);
- d) Compressive strength (see 5.3.4);

When relevant to the uses for which the unit is placed on the market, the description and designation shall include:

- e) Configuration (see 5.3.2);
- f) Tolerances (range) (see 5.3.1);
- g) Gross and net dry density and tolerances (see 5.3.3);
- h) Water absorption (see 5.3.7);
- i) Initial rate of water absorption (see 5.3.8);
- j) Thermal properties (see 5.3.5);
- l) category of active soluble salts content (see 5.3.9);
- m) Moisture movement and its basis (see 5.3.10);
- n) Reaction to fire (see 5.3.11);
- o) Water vapour permeability (see 5.3.12);
- p) Bond strength (see 5.3.13);
- q) Dangerous substances (see 5.3.14).

## **6.2 Classification**

Specification of the properties of clay masonry 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.

## **7 Marking**

The following particulars shall be clearly marked on one of the following: the units, the packaging, delivery note or any certificate supplied with the clay masonry units:

- a) Name, trademark, or other means of identification of the manufacturer of the unit;
- b) Means of identifying the clay masonry units and relating them to their description and designation.

## **8 Assessment and verification of constancy of performance(AVCP)**

### **8.1 General**

The manufacturer shall demonstrate compliance for his product with the requirements of this Kenya Standard and with the declared 15) performance for the product properties by carrying out both:

- a) product type determination (see 8.2), which can be physical testing, calculation, reference to tabulated values or combinations of these methods;
- b) Factory production control (see 8.3).

Alternative methods of test to the reference methods specified in this Kenyan Standard may be adopted except for the product type determination tests and in case of dispute, provided that these alternative methods satisfy the following:

- a) A correlation can be shown to exist between the results from the reference method and those from the alternative method; or
- b) A safe relationship can be demonstrated when using the alternative method compared to the reference methods and
- c) The information on which the relationship is based is available.

## 8.2 Product type determination

After completion of the development of a new product type and before placing on the market, appropriate product type determination shall be carried out to confirm that the properties predicted from the development meet the requirements of this standard and the performance of the characteristics to be declared for the product.

Whenever a major change in the source, blend, or nature of raw materials occurs, or when there is a change in processing conditions, leading to what the manufacturer considers will constitute a new product type being produced, the appropriate product type determination shall be repeated.

The manufacturer may define product groups. The product group may differ according to the characteristics in question.

In the product type determination process, a manufacturer may take into consideration already existing results.

A manufacturer may use the product type determination results determined by someone else (e.g. another manufacturer or a research, technology and development service provider) to justify his own declaration of performance regarding a product that is manufactured according to the same design and with raw materials, constituents and manufacturing methods of the same kind, provided that permission is given by the owner of the results, and the results are valid for both products.

The tests to be conducted shall be the tests or calculations as described in Table A.2 for the properties selected from the following list relevant to the manufacturer's declaration for the product type's intended use:

- a) dimensions;
- b) dimensional tolerances, including flatness and plane parallelism of bed faces;
- c) configuration;
- d) dry density and tolerances;
- e) compressive strength;
- f) thermal properties;
- g) freeze/thaw resistance;
- h) water absorption;

- i) initial rate of water absorption;
- j) active soluble salts content;
- k) moisture movement;
- l) reaction to fire;
- m) Bond strength.

NOTE Sampling for product type determination tests shall be in accordance with Annex A. The results of the product type determination shall be recorded.

### **8.3 Factory production control**

#### **8.3.1 General**

The manufacturer shall establish, document and maintain a factory production control system to enable continuing conformity with this Kenyan Standard and the declared performance of the characteristics of the products placed on the market.

The factory production control system may consist of procedures related to the process only (full process control and consequently no finished product testing, i.e. 8.3.6 does not apply), to finished products only (consequently no process control, i.e. 8.3.5 does not apply) or any combination of both. Consequently conformity criteria depend on the individual factory production procedures.

As appropriate, the responsibility, authority and interrelation of all personnel who manage, perform and verify work affecting the quality of masonry unit products shall be established.

The factory production control system shall describe the control procedure of production, the regular checks by the manufacturer and his testing, depending on the combination of the procedures related to process control and/or finished product testing. Controls and tests may include the characteristics of raw materials and finished products, the procedure of production, the production equipment or the production machines, the test equipment or the testing instruments and the marking of the product.

The test results shall be recorded.

Actions to be taken when the control test values or criteria do not meet those specified should be documented by the manufacturer.

#### **8.3.2 Testing and measuring equipment**

All relevant weighing, measuring and testing equipment, that has an influence on the declared values, shall be verified and regularly inspected.

#### **8.3.3 Production equipment**

When the factory production control system includes process control procedures, all production equipment, that forms part of these procedures and has an influence on the declared values shall be regularly inspected.

#### **8.3.4 Raw materials**

As appropriate, the manufacturer shall define the acceptance criteria of raw materials and the procedures operated to ensure that these are met.

#### **8.3.5 Production process**

As appropriate, the relevant features of the production processes shall be defined giving the frequency of the manufacturer's checks together with the required criteria. Actions to be taken when the criteria are not achieved shall be specified by the manufacturer.

### **8.3.6 Finished product testing**

As appropriate, the factory production control system shall incorporate a sampling plan and the frequency of testing of the finished product. The results of sampling and testing shall be recorded.

The sample shall be representative of the production.

Depending on the corrective measure, nonconformities may result in higher frequencies of testing than the ones used.

### **8.3.7 Statistical techniques**

When reasonably practicable and applicable, the results of checks and testing shall be interpreted by means of statistical techniques, by attributes or by variables, to verify the product characteristics and to determine if the production conforms to the compliance criteria and the product conforms to the declared values.

NOTE One method of satisfying this conformity criterion is to use the approach given in ISO 12491.

### **8.3.8 Marking and stock control of products**

The marking and stock control shall be documented. Individual products or/and a defined quantity of products (e.g. a consignment of products) should be identifiable and traceable.

### **8.3.9 Traceability**

As appropriate, systems of traceability shall be given in the factory production control system.

### **8.3.10 Non-conforming products**

The procedure for dealing with nonconforming products shall be documented. Products that do not conform to the requirements or the performance of the product type shall be segregated and marked accordingly. However, these products may be reassessed by the manufacturer and assigned to another product type. The manufacturer shall take action to avoid a reoccurrence of the nonconformity.



## Annex A (normative)

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

#### A.1 General

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

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

The required number of clay masonry units to determine compliance with the specification shall be sampled from a consignment of masonry units not more than 20 m<sup>3</sup> (see figure 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 masonry units shall be selected at random from positions throughout the consignment without any consideration being given to the condition or 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 masonry units forming the consignment are being moved in a 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 masonry units form a large stack or stacks with ready access to only a limited number, 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 not more than four clay masonry units shall be selected at random from within each section in order to give the required number without any consideration being given to the condition or quality of those selected except that units damaged in transit shall not be selected.

NOTE 1 It will be necessary to remove some sections of the stack or stacks in order to gain access to masonry units within the body of such stacks when taking samples.

NOTE 2 Sampling from a stack may not be satisfactory when testing for active soluble sulfates because contamination from the ground or other sources may occur.

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

At least six packs shall be selected at random from a consignment. The band around one blade or slice in each pack shall be removed and an equal number of not more than four units shall be sampled at random from within each of the broken blades or slices in order to give the required number without any consideration being given to the condition or 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 clay masonry units for more than one test, the total number shall be collected together and then divided by taking masonry units at random from within the total sample to form each successive sub-sample.

The exact number of clay masonry units required for the test(s) as given in Table A.1 and Table A.2 shall be taken at random from those sampled from the consignment by one of the methods given in A.2.3.

## 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 Number	Test Method (s)	Number of units <sup>a</sup>	
Dimensions	5.2.1	DKS 2802:8	10	
Flatness of bed faces	5.2.1.2.4	DKS 2802:10	3	
Plane parallelism of bed faces	5.2.1.2.5	DKS 2802:8	3	
Configuration	5.2.2	DKS 2802:8 DKS 2802:2 DKS 2802:5	10	
Gross dry density	5.2.4.1	DKS 2802:7	10	
Net dry density	5.2.4.2	DKS 2802:7	10	
Compressive strength	5.1 and 5.2.5	DKS 2802:1	10	
Thermal resistance	5.2.6	DKS 2803	-	
Water vapour permeability	5.2.13	DKS 2803 or KS ISO 12572		
Freeze / thaw resistance	5.2.7	b	c	
Water absorption	5.2.8	DKS 2802:11(external elements) DKS 2802:4(damp proof course units)		
Initial rate of water absorption	5.2.9	DKS 2802:6		
Moisture movement	5.2.11	b	c	
Active soluble salts content	5.2.10	DKS 2802:3	10	
Reaction to fire	5.2.12	DKS 2804:1	-	
Bond strength	5.2.14	DKS 2802:12  Procedure A Procedure B	Type I specimen 27 18	Type II specimen 18 12
Dangerous substances	5.2.15	National provision in place of use of unit	National provisions	
<sup>a</sup> if appropriate e.g when the units are not affected by a test procedure, the same test units may be used for different test.				
<sup>b</sup> Testing according to provisions valid in the intended place of use of the units.				
<sup>c</sup> The used provisions give the number to be tested.				

## Annex B (informative)

### Additional information

#### B.1 Use of clay masonry units

Clay masonry units are used for a large variety of applications, and each requires performance levels to be specified. Some applications are traditional and the related specification is laid down in standards or traditional rules for good practice. These rules often have a local character, due to climate, building traditions, locally available materials, maintenance traditions, etc. Other applications might be new and non-traditional, and formulation of the performance levels for materials and execution are in that case the responsibility of the designer.

Particular applications are:

- a) Common masonry

Masonry used outside or inside having no claim to an attractive appearance. It may or may not be load bearing.

- b) Protected masonry

Masonry which is protected against water penetration. It can either be masonry in external walls which is protected by a suitable layer of render or by a cladding or it can be the inner leaf of a cavity wall or it can be an internal wall. It may or may not be loadbearing.

- c) Rendered/plastered masonry

Masonry used outside or inside which will be rendered/plastered. It may or may not be loadbearing.

- d) Thermal insulating masonry

Masonry which in itself significantly contributes to the thermal insulation function of an external wall. The masonry consists mainly of highly perforated clay masonry units. It may or may not be loadbearing.

- e) Facing masonry

Masonry used outside or inside that is intended to have an attractive appearance. It is constructed from attractive masonry units using a standard of workmanship and mortar joint finish appropriate to the masonry unit type. It may or may not be loadbearing.

- f) Civil engineering masonry

Masonry used in civil engineering works, e.g. drainage works, earth retaining walls, etc., in which masonry units with a high level of durability and compressive strength and a low level of water absorption are sometimes used.

- g) Structural masonry

Masonry used outside or inside that resists loads other than its self-weight. This expression is usually used in situations where the structural design of the masonry has been carried out by an appropriately qualified person. Structural masonry may be facing, common, rendered, or civil engineering masonry. Structural masonry may also be earthquake resistant.

In connection with the applications cited above, the masonry has such performances as:

- a) fire resistance;

- b) sound insulation;
- c) thermal insulation

Which, if needed, requires additional specifications to be made.

Masonry units should be sufficiently durable to resist local exposure conditions so as to maintain the structural and operational integrity of the building.

## **B.2 Durability**

Kenyan codes of practice have not yet been prepared dealing with architectural design and workmanship, encompassing the specification and use of masonry units to ensure that satisfactory durability in service in the finished masonry is achieved. Until these codes become available, it has been found necessary to attach this annex which relates the grades specified for such properties as freeze/thaw resistance and soluble sulfates content to service conditions, including the degree of exposure and risk of saturation.

## **B.3 Freeze/thaw resistance**

### **B.3.1 General**

When making a choice as to which level of freeze/thaw resistance of a masonry unit should be specified for particular elements of clay masonry, it is necessary to assess the likely degree of exposure to which the units are to be subjected, including the protection against saturation of the masonry construction.

The exposure (severe, moderate, and passive) expresses the risk of the masonry being exposed to a high water content coincident with cycles of freezing and thawing, due to local climatic conditions in combination with the design of the construction. The factors forming part of the exposure evaluation are temperature and moisture conditions as well as the occurrence of any aggressive substances. In the evaluation it is necessary to take account of local or national experiences.

The influence of various surface coatings (plastering, painting) should be evaluated particularly in connection with thin layer coatings. A surface coating may result in areas with typical temperate coastal climates in tightened demands for the construction.

The examples given in the following are only indicative to help the user to choose the appropriate materials and are not exhaustive.

### **B.3.2 Masonry subjected to severe exposure**

In the following, examples are given for masonry or masonry elements subjected to severe exposure:

- a) unrendered masonry near to external ground level (approximately two courses above and below) where saturation with freezing can occur;
- b) unrendered parapets where saturation with freezing can occur, e.g. where the parapet is not provided with an effective coping;
- c) unrendered external chimney masonry where saturation with freezing can occur;
- d) cappings, copings, and sills in areas where freezing conditions can occur;
- e) freestanding boundary and screen walls where saturation with freezing can occur, for example if the wall is not provided with an effective coping;
- f) earth retaining walls where saturation with freezing will occur for example where the wall has not been provided with an effective coping or a water proofing treatment on the retaining face.

### B.3.3 Masonry subjected to moderate exposure

In the following, suitable measures to prevent saturation of the masonry are given:

- a) protection to wall heads by roof overhangs or copings;
- b) projecting throated sills;
- c) damp proof courses at the top or base of walls.

### B.3.4 Masonry subjected to passive exposure

In the following, examples are given for masonry or masonry elements subjected to passive exposure:

- a) masonry in external walls if provided with suitable protection, the extent of which depends on climatic conditions: in some parts of Europe, experience suggests that a thick layer of suitable external render provides such a protection; in situations where there is risk of wetting accompanied by freezing, the protection should take the form of an impermeable cladding;
- b) masonry in internal walls and the inner leaves of cavity walls.

## B.4 Sulfate action on mortars and plasters

Sulfate attack on masonry mortars is principally caused by the reaction between sulfate in solution and the tricalcium aluminate (C3A) constituent of Portland cement which forms calcium sulfoaluminate (or ettringite). This reaction only occurs if there is an appreciable C3A content, found in ordinary Portland cement. The risk is greatly reduced by the use of sulfate resisting cement, where the C3A content is limited.

Sulfate attack occurs only if there is a considerable amount of water movement through the masonry. Diffusion alone will not carry sufficient amounts of sulfate to the hydrated cement in the mortar. Water movement may occur by percolation of water through the masonry under the action of gravity, such as in free standing walls, or below clay masonry unit sills where effective damp proof courses have not been provided. Movement of water may also be brought about by evaporation and capillary action, for example, through retaining walls which are not waterproofed on the retaining face, or in external walls between ground level and the damp proof course.

The specification of the level of soluble sulfates content of clay masonry units with the appropriate grade of mortar is a complex matter, which may be dealt with in national design codes.

The risk of saturation can be deduced from the exposure categories mentioned in relation to freeze/thaw resistance in this annex.

The requirement to declare the active soluble salts content category given in 5.3.10 is intended to ensure that under particular service conditions, damage to the masonry units, mortar or render (if any) will not occur. The three categories given in Table 3 specify the maximum content of water soluble sulfates (those of sodium, potassium and magnesium) for use in service conditions where the risks of saturation differ, ranging from expectations of prolonged saturation (S2 with ordinary Portland cement in the mortar or S1 with sulfate resisting cement in the masonry mortar or render undercoat), normal exposure to the weather where the masonry is protected by the design detailing of the building (S1) to completely dry (SO). In addition, soluble

Sulfates, especially magnesium sulfate may cause damage to the units themselves, an effect sometimes known as "cryptoefflorescence", and for this reason, separate requirements for magnesium are given.

For masonry completely protected against water penetration, category SO is assumed to be appropriate. That means no requirement for the content of active soluble salts is necessary.

## **8.5 Efflorescence and staining**

The appearance of efflorescence in a building is a result of wet masonry drying out and may be due to excessive wetting during construction, or due to inadequate protection and design detailing, allowing water to percolate through parts of the completed construction. In addition, soluble materials from the mortar or from any adjacent concrete may contribute to the amount of staining and efflorescence observed in practice.

## **8.6 General Guidance on the appearance of facing clay masonry units**

The appearance of masonry units and the assessment should be the subject of purchase contract. The requirement will vary according to the use to which the masonry units are to be put, and their inherent characteristics, e.g. common facing and handmade should be taken into account. As a guide special attention should be paid to deep or extensive cracks, damage to edges and corners, pebbles and to expansive particles of lime.