PART 3
PRODUCT SPECIFICATION AND PHYSICAL PROPERTIES

(SABS 227: *Burnt Clay Masonry Units*)

3.1 OVERALL DIMENSIONS AND TOLERANCES (REFER SABS 227:4.2)

The most commonly used and manufactured brick size is the "Imperial Brick". It is 222 mm long x 106 mm wide x 73 mm high with a mass between 3 and 3,5 kg, depending on the materials used, the degree of vitrification and the perforations provided (see Table 1 for tolerances).

TABLE 1: TOLERANCES ON WORK SIZES

Class of unit	Tolerances (mm)		
	Length	Width	Height
	Individual units		
FBX	±5	±3	±3
FBS	±7	±4	±4
FBA and non-face	–	–	–
	Average 32 units		
FBX	±2,5	±1,5	±1,5
FBS	±3,5	±2	±2
FBA	–	–	–
NFP, NFX	±3,5	±2	±2

Individual manufacturers may offer tighter tolerances than the above.

Other sizes of bricks and blocks are made by individual manufacturers. Various combinations of dimensions in millimetres are:

- Length: 220 190 222 290 390
- Width: 110 106 140 150 190
- Height: 73 90 114 190 90

3.2 WARPAGE AND TOLERANCE (MEASURED ACROSS THE LENGTH OR ACROSS DIAGONAL CORNERS) (REFER SABS 227: 4.3)

- FBX Products: Individual 5 mm; in not more than three units shall the warpage exceed 3mm.
- FBS & Engineering: Individual not to exceed 5 mm
- FBA & NFP: No requirement

3.3 BRICK STRENGTH (REFER SABS 227:4.4)

A wide range of bricks is available in this country. Bricks vary in compressive strength due to the differing qualities of raw material and the method of firing. The compressive strengths can range from 3,5MPa for NFP, to greater than 50MPa for face brick extra and engineering products.

Standard testing is carried out on a sample of 12, to prescribed procedures. Local manufacturers should be able to meet specific needs.

Modern methods of manufacture produce bricks with consistent qualities, but bricks are made from naturally occurring materials and the compressive strength of individual bricks in a given batch inevitably varies.

Note: The compressive strength of clay bricks is not always indicative of their durability.

Clay products for load-bearing designs can be provided to suitable close tolerances and strength.

3.4 EFFLORESCENCE (Refer SABS 227:4.5)

Efflorescence is the crystallisation of soluble salts on or near the surface of brickwork that results from the evaporation of water carrying salts through or from the brickwork. Efflorescence can be no more than an unsightly deposit on newly laid brickwork that soon disappears or it can be serious, causing unsightly permanent discolouration or even the failure of plaster, paintwork or face finishes.

This is often caused by poor waterproofing or detailing. SABS 227 describes degrees of efflorescence and the limits of efflorescence caused by salts in the clay bricks during manufacturing.

Degree of efflorescence:

- *Nil:* no perceptible deposit of salts;
- *Slight*: a very thin deposit of salts, just perceptible, or a small quantity of salts occurring only on the edges of a unit;
- *Moderate*: a deposit heavier than “slight”, but that has not caused powdering or flaking of the surface;
- *Heavy*: a thick deposit of salts covering a large area of the unit, but that has not caused powdering or flaking of the surface; and
- *Serious*: a deposit of salts that has caused powdering or flaking of the surface.

When units are tested in accordance with SABS 227, the numbers that exhibit efflorescence shall not exceed the limits given in Table 2, for special or normal grade, appropriate to the class of the units.

Table 2: Degree of efflorescence

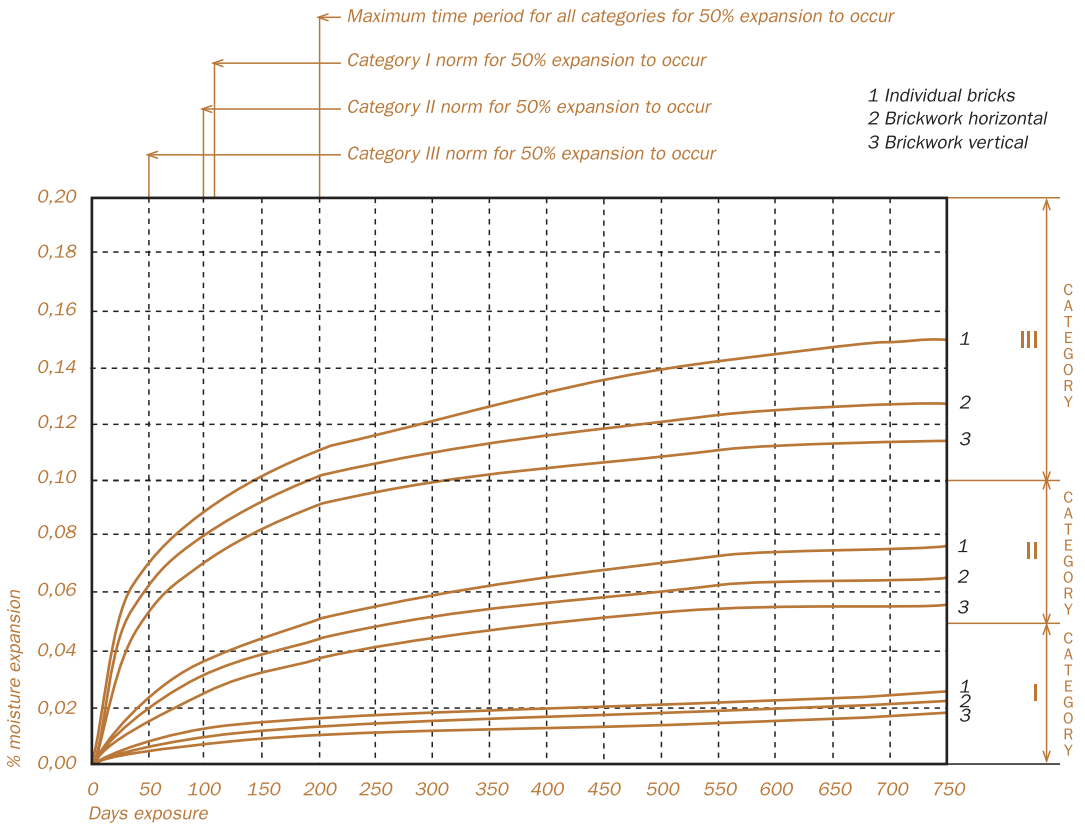
Grade	Class of unit	Number of units that exhibit efflorescence		
		Degree of efflorescence		
		Slight	Moderate	Heavy
Special	FBS	20	–	–
	FBX	20	–	–
	FBA	20	–	–
	NFP	10	10	–
	NFX	10	10	–
Normal	FBS	10	10	–
	FBX	10	10	–
	FBA	10	10	–
	NFP	–	10	10
	NFX	–	10	10

3.5 IRREVERSIBLE MOISTURE EXPANSION (Refer SABS 227:4.7)

Burnt clay masonry units, in general, shall have an irreversible moisture expansion of not more than 0,20% and, in faced applications, a demonstrated satisfactory performance with respect to durability, unless it can be reasonably demonstrated by other means that the units are fit for purpose.

Burnt clay masonry units undergo an irreversible moisture expansion, which occurs as a result of the absorption of moisture from the atmosphere after firing. This expansion, which is characteristic of all porous ceramic products, commences once the unit starts absorbing moisture from the atmosphere – hence the term moisture expansion. Moisture expansion must be considered when designing and constructing a brick structure (see Figure 1).

Figure 1: Typical rates of irreversible moisture expansion in bricks and brickwork



Notes on irreversible moisture expansion

There is no difference in the expansion of perforated and solid bricks. Bricks stored in air expand in the same manner as bricks cooled from the kiln in a drier.

There are no cost-effective ways of accelerating the irreversible moisture expansion of ceramic materials.

The rate of expansion decreases steadily with the passage of time.

3.6 OTHER PROPERTIES

3.6.1 Durability: Selection criteria

The best indicator of a product's durability performance in any application is at least 5 years' satisfactory performance in the application concerned.

A single global value of compressive strength alone is not an adequate criterion for a product's likely durability in an exposed application. The present minimum requirement for facing of 17MPa average compressive strength fails to cater for the requirements of varying exposure zones.

Currently, a direct determination of durability does not exist in the form of a proven accelerated weathering test or some other performance-based evaluation, although a programme of research and of measuring the performance of products is ongoing.

Durability is the ability of a material to withstand the combined effects of the weathering agents of moisture, soluble salts, frost and thermal changes.

Exposure is the severity of these weathering actions, varying from mild to severe, and depending on both regional geographic conditions, and micro-climatic conditions with regard to the building's height and the material's position within the building.

Parapets and copings, for example, are clearly subject to more severe exposure conditions than face brickwork protected by overhanging eaves. Internal face brickwork is not subject to the same degree of exposure as external, unrendered brickwork. This section is primarily concerned with the selection of bricks for external face brick applications.

The use of facings and non-facings selected for durability in an area geographically close to the factory manufacturing the bricks poses few problems. The local knowledge of the exposure conditions and of the performance of the bricks concerned, which is generally available from the brick manufacturer, specifiers and building contractors, will ensure that only products suited for the intended purpose will be used.

It is when bricks are specified by an architect or client far from the location of the manufacturer, with the building undertaken by a contractor who is not familiar with the properties and performance of the particular brick, that the risk of a brick being used that is not suited to a particular application is increased.

Exposure zones

In parts of southern Africa, where the climate and peculiar local conditions combine to produce a harsh environment, certain types of face bricks used externally may suffer from weathering.

Broadly, experience and SABS 0249: *Masonry Walling* have shown that southern Africa may be grouped into four exposure zones.

Zone 1 Protected: All inland areas more than 30 km from the coastline.

Zone 2 Moderate: The 30 km zone along the coast, but excluding the sea spray zone.

Zone 3 Severe: This consists of the following:

- the sea spray zone such as the seaward sides of Durban Bluff and other exposed coastal headland areas;
- the 15 km coastal zone from Mtunzini northwards to the Mozambique border, including Richards Bay; and
- the coastal belt of Namibia.

Zone 4 Very severe:

- areas such as Walvis Bay where moisture from the sea mist and high ground water tables, soluble sulphates in the soil, and/or rapid temperature changes combine to create the most severe exposure and weathering conditions; and
- industrial areas where high acid or alkaline discharges occur.

Recommended exposure zones for facings

In several instances, special selection of clay facings from a factory can provide a product with enhanced durability performance suited to more severe exposure applications.

Recommended specifying and ordering procedure

To assist the industry in supplying the client with the correct type of brick for any application, it is recommended that the type of brick required for the application should be clearly stated or specified in bills of quantities or on architectural drawings and the expected exposure zone should be identified.

3.6.2 Initial rate of absorption (Refer SABS 0164-1.B–4.1.1)

The bond between brick and mortar is largely influenced by the demand of the brick to absorb water by suction and the ability of the mortar to retain the water necessary for the hydration of cement.

Structural units of clay with an initial rate of absorption exceeding 1,8kg/m^2.min. should be moistened prior to laying to reduce the rate to between 0,7 and 1,8kg/m^2.min. This is a requirement of SABS 0164-1: *The structural use of masonry Part 1: Unreinforced masonry walling*.

3.6.3 Fire resistance

Values of fire resistance of typical clay brick walls are given in Figure 2.

FIGURE 2: FIRE RESISTANCE AND ACOUSTIC INSULATION VALUES FOR CLAY BRICK WALLS

UNIT	NFP CLAY BRICK	CLAY BRICK MAXI	FBA/NFP CLAY BRICK	NFP CLAY BRICK	NFP CLAY BRICK	FBA/NFP CLAY BRICK	FBA CLAY BRICK	FBA/NFP CLAY BRICK
PLASTER	12 mm cement/ sand both sides	12 mm cement/ sand both sides	none	12 mm cement/ sand both sides	12 mm cement/sand both sides	12 mm cement/sand inside only	none	12 mm cement/sand inside only
THICKNESS	106	90	106	140	222	222	222	222
ACOUSTIC INSULATION*	45dB	43dB	44dB	45dB	49dB	49dB	47dB	48dB
FIRE RATING*								
Load bearing	120 min	30 min	120 min	60 min	240 min	240 min	240 min	240 min
Non-load bearing	120 min	60 min	120 min	90 min	240 min	240 min	240 min	240 min

*Indicative figures only

Fire resistance rating is a measure of the length of time a walling element will resist a fully developed fire. Failure occurs in an element when its resistance is overcome in a defined way. Firstly, if it collapses or its structural ability is impaired, it is said to have failed at the time of collapse. Secondly, a wall can fail if it develops cracks and fissures through which hot gas or flame can pass and, thirdly, an element can fail if the temperature on the side away from the fire exceeds a certain level.

3.6.4 Acoustic insulation

Values of acoustic insulation of typical clay brick walls are given in Figure 2.

Acoustic insulation, measured in decibels (dB), is the ability of a wall to resist the transmission of airborne sound. The measurement is based on a logarithmic scale and is not linear, which implies that halving or doubling of insulation value would be represented by a 6dB change.

As mass is the best defence against noise penetration, the heavier walling products will generally perform better.

3.6.5 Thermal properties

The thermal properties of a wall are related to its ability to transmit or resist the movement of heat and to its capacity to store thermal energy.

Thermal transmittance

Thermal transmittance, (U value) is measured in Watts (W) per square metre (m^2) per degree Celsius, $W/m^2\ ^oC$ as the rate of heat flow through an element, e.g. a wall. The lower the U value, the better the insulation properties of the wall: it has a greater resistance to the flow of heat. The U value not only takes into account the resistance offered by the wall, but also the outside and inside surface resistance. Since the U value notionally provides a measure of the heat flow through a wall, it is the figure used to compare the performance of different constructions and to make energy-use calculations.

Thermal capacity

Thermal capacity is measured in Joules (J) per square metre (m^2) per degree Celsius, $J/m^2\ ^oC$, and is a measure of the degree of heat that can be stored by a wall. Clay brick walls, with their high thermal capacity, have the ability to store heat during the day and release this heat at night. In climatic regions where there are high temperatures during the day and low temperatures at night, this results in thermally comfortable dwellings with a reduction in energy consumption to cool or heat the buildings.