CHAPTER 3

PRODUCT SPECIFICATION AND PHYSICAL PROPERTIES

CLAYBRICK for good

Environmentally Friendly

PRODUCT SPECIFICATION AND PHYSICAL PROPERTIES

Overall Dimensions and Tolerance

The most commonly used and manufactured brick size is the 'Imperial Brick'. It is 222mm (long) x 106mm (wide) x 73mm (high) with a mass of between 2,4kg and 3,3kg, depending on the materials used, the degree of vitrification and the perforations provided.

Table 3.1 - Tolerance on work sizes

Tolerance on Work Sizes			
Class of Unit	**Tolerance (mm)**		
	Length	**Width**	Height
	Individual Units		
FBX	±5	±3	±3
FBS	±7	±4	±4
FBA, NFP, NFX	-	-	-
	Average 32 Units		
FBX	±2.5	±1.5	±1.5
FBS	±3.5	±2	±2
FBA	-	-	-
NFP, NFX	±3.5	±2	±2

Other sizes of bricks and blocks are made by individual manufacturers in various dimensions. Some of the more common sizes available are seen in the table at the bottom of this page.

Warpage and Tolerance

Measured Across the Length or across Diagonal Corners:

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

Brick Compressive Strength

A wide range of bricks are available in this country. Bricks vary in compressive strength due to the differing qualities of raw material used and the method of firing. The compressive strengths can range from 7 MPa 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. Most, if not all, local manufacturers are able to produce clay bricks to specified compressive strengths.

Modern methods of manufacture are used to produce bricks of consistent quality, but given that bricks are made from naturally occurring materials, 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 special applications can be provided to specific tolerances and strengths.

Efflorescence

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. SANS 227 - Burnt Clay Masonry Units: Table 4 ,describes degrees of efflorescence and the limits of efflorescence caused by salts in the clay bricks during manufacturing.

The degrees of efflorescence are as follows:

Nil:	No perceptible deposit of salts
Slight :	A very thin, slightly noticeable deposit of salts occurring on the edges of a unit only
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 that has not caused powdering or flaking to the surface
Serious:	A deposit of salts that has caused powdering or flaking of the surface.

When units are tested in accordance with SANS 227 the numbers that exhibit efflorescence shall not exceed the limits given in Table 3.2, for special or normal grade, appropriate to the class of the units.

Combinations of Brick Dimensions (mm)										
Length	222	222	222	222	220	190	190	290	290	390
Width	90	40	90	140	110	90	106	90	150	190
Height	73	73	114	114	73	90	90	90	190	90

Table 3.2 Degree of Efflorescence

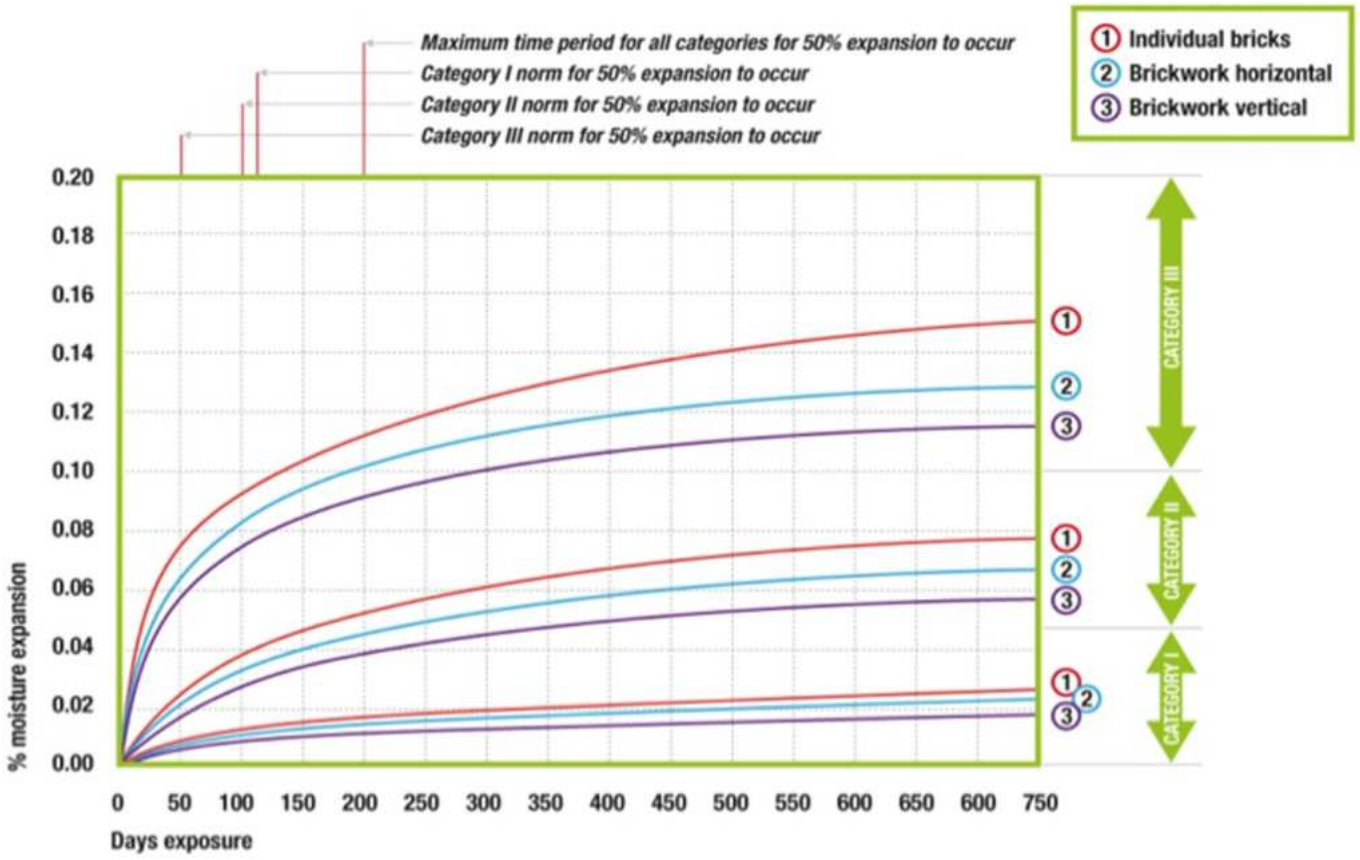
Degree of Efflorescence				
Grade	Class of Unit	Number of Units that Exhibit Efflorescence		
		Degree of Efflorescence		
		Slight	Moderate	Heavy
Special	FBS	20	-	-
	FBX	20	-	-
	FBA	20	-	-
	NFP	10	10	-
	NFX	10	10	-
Normal	FBS	10	10	-
	FBX	10	10	-
	FBA	10	10	-
	NFP	-	10	10
	NFX	-	10	10

Irreversible Moisture Expansion

Water absorption, water-soluble salts and moisture expansion values are best agreed upon between the supplier and the purchaser.

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. 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 3.1.

Burnt clay masonry units undergo an irreversible moisture expansion, which occurs as a result of the absorption of moisture from the atmosphere after firing.



3.1 - Typical rates of irreversible moisture expansion in brickwork

NOTE

- 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.

Other Properties

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 clay 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, specifier and/or building contractor, will ensure that only products suited for their 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 concerned, 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 Masonry Walling has shown that Southern Africa may be grouped into four exposure zones.

Recommended Exposure Zones for Facings

Certain facing bricks may not be suited to external exposure in Zones 3 and 4. The recommended exposure zone to which each product is suited should be indicated by the manufacturer. In several instances, a special selection of clay facings from a factory can provide a product with enhanced durability and 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.

Initial Rate of Absorption

SANS 10164: Part 1. The South African Standard for the structural use of masonry, Part 1: Unreinforced masonry walling covers laying of structural units. 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.

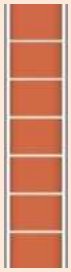
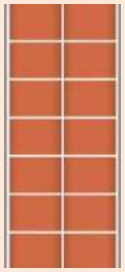
Table 3.3: Exposure zones

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	The sea spray zone such as the seaward sides of Durban Bluff and other exposed coastal headland areas, i.e, the 15km 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.

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.

Fire Resistance

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. Values of fire resistance of typical clay brick walls are given in Figure 3.2.

UNIT	BRICK	CLAY BRICK MAXI	FBA/NFP CLAY BRICK	NFP CLAY BRICK	FBA/NFP CLAY BRICK	FBA/NFP CLAY BRICK	FBA CLAY BRICK	FBA/NFP CLAY BRICK
PLASTER	12mm Cement Plaster both sides	12mm Cement Plaster both sides	None	12mm Cement Plaster both sides	12mm Cement Plaster both sides	12mm Cement/ Plaster inside only	None	12mm Cement Plaster inside only
								
THICKNESS	106	90	106	140	222	222	222	222
ACOUSTIC INSULATION	44db	43db	44db	45db	49db	49db	47db	48db
FIRE RATING* Structural and Non-structural *indicative figures only	30 min 60 min	30 min 60 min	30 min 60 min	30 min 60 min	120 min 240 min	120 min 240 min	120 min 240 min	120 min 240 min

3.2 - Fire resistance and acoustic insulation values for clay brick walls

Acoustic Insulation

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

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 ^{0}C, 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 °C, 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.

The SANS 10400-XA and the SANS 204 Regulations are an attempt made by government to regulate energy use and encourage energy efficiency in building. Clay brick walls where applicable comply with these requirements.

NOTES