



The Choice in Brick

# MATERIAL SPECIFICATION TO BS3921:1985



## Design for Homes CPD Material

Hanson Bricks Tel: 0990 258 258 E-Mail: [info@hansonbrick.com](mailto:info@hansonbrick.com)

© 2000 Hanson Bricks Europe  
MS BS3921 -1 (08/2000)



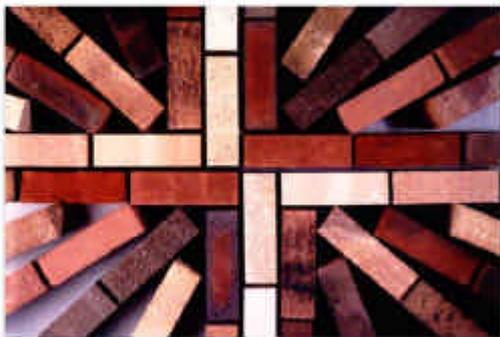
## MATERIAL SPECIFICATION to BS 3921:1985

### 1) Material specification to BS3921

This presentation covers reference to raw materials, characteristics of clays, reference to BS3921 clauses, brickwork appearance and mortar.

### 2) 'Kaleidoscope of Colours'

We are fortunate in the UK to have a vast array of clay types, giving many colours and textures.



### 3) Geology Map of the UK

This is due in part to the great variation in the geology giving rise to, for example, the stock type units manufactured in the south east and the engineering clays further north. Basically, as we move from the South East to the North West, the clay types become older and in general stronger and of greater density when fired.





#### 4) Different Brick Types Stock/Handmade Bricks

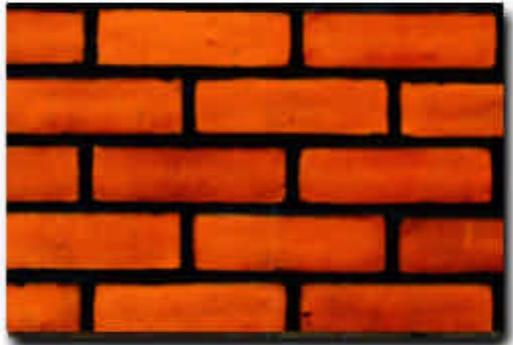
The characteristics of the raw materials may be reflected in the brick types. Stock bricks are typically of high water absorption, low strength and of irregular texture and shape.

#### Machine Made Bricks

These are of more consistent shape and size. Typical of the clays found in the Midlands – with average strength and water absorption.

#### 5) Different Brick Types Engineering Bricks

Bricks from Northern England are usually strong and dense – engineering quality, high strength, low water absorption, straight sharp edges.



#### 6) Construction Teams

Historically, there were thousands of small brickworks situated throughout the UK and their products were generally used locally due to the limitations on transport. Nowadays it is not unusual to have the entire construction team scattered throughout the country and bricks being deployed at great distances from their place of production. This scenario is basically the major cause of misunderstanding over brick characteristics leading to errors in design, detailing and bricklaying.



## BS 3921:1985

SPECIFICATION FOR CLAY BRICKS

## BS 5268

MASONRY DESIGN AND DETAILING

### 7) British Standards

There are two British Standards of notable importance for clay brickwork.

#### BS3921

is the material specification standard.

#### BS5268

on the other hand is concerned with masonry design and detailing.

We shall consider BS3921 in this presentation.

### 8) BS 3921

#### Introduction

In essence the main area of consideration is water absorption, durability and dimensional tolerance.

#### CLAUSE 0 Introduction



- 0.1 water absorption
- 0.2 durability
- 0.3 tolerances

#### CLAUSE 3 Sizes



Co-ordinating Size (sizes mm)			Work Size (sizes mm)		
Length	Width	Height	Length	Width	Height
225	112.5	75	215	102.5	65

Table 1

### 9) Co-ordinating Sizes

There is often criticism of brickmakers because of 'conservative tolerance' on dimensions.

## CLAUSE 4 - LIMITS OF SIZE (mm) Dimensional Deviations



Work Size	Overall Measurement of 24 Bricks	
	Maximum	Minimum
215	5235	5085
102.5	2505	2415
65	1805	1515

Table 2

### 10) Dimensional Tolerance

Bricks are checked for size by measuring 24 bricks laid end to end for length and the variation of  $\pm 75\text{mm}$  is to account for the different clay/brick types. Stock bricks have a greater variation in size by the very nature of their physical properties.

### 11) Dimensional Tolerance

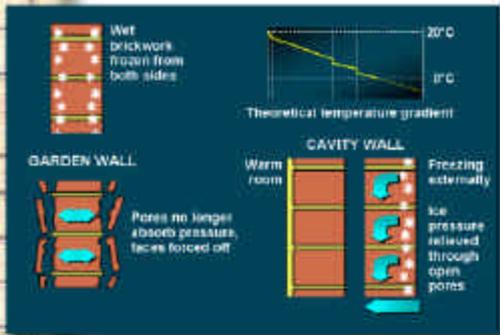


### 12) Durability

The durability of bricks is perhaps the most important aspect and often the subject of extensive discussions.



## CLAUSE 5 Durability

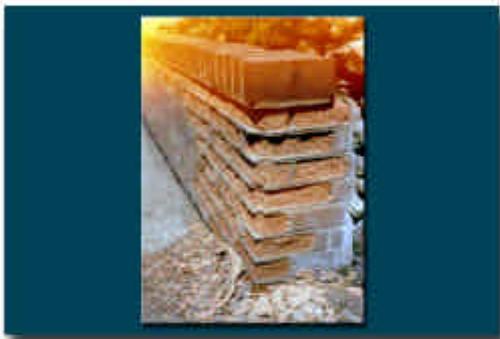


### 13) Freeze/Thaw Action

Frost action is particularly severe in the UK since the varied weather saturation, repeated wetting and drying and cyclic frosting.

### 14) Frost Failures - Brick

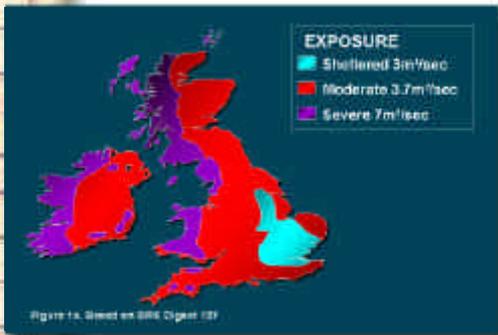
Both bricks and mortar may suffer damage due to the action of frost causing either facial spalling of bricks or weathering/deterioration of joints.



### 15) Frost Failures - Mortar

Correct masonry detailing is essential if frost failure is to be avoided and this can only be achieved if the appropriate bricks are used in the appropriate situation.

Additionally the mortar specification is all important.



## 16) Assessment of a Brick's Suitability for Use

Bricks are classified in BS3921 in terms of durability designation.

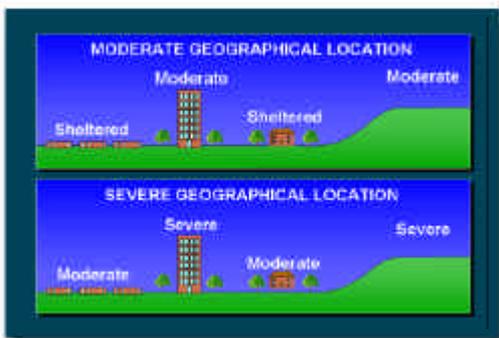
The assessment of a brick's suitability for use in a given location is dependent upon three factors

### i) The geographical location

## 17) Assessment of a Brick's Suitability for Use

### ii) Topographical location

This takes account of the immediate surroundings e.g. hills, buildings, trees and the sheltered protection which they offer. It will be noted that exposure categories for identical topography will differ with respect to geography.



## 18) Assessment of a Brick's Suitability for Use

### iii) Exposure of specific building elements to frost action

Building elements which are potentially prone to saturation, e.g. cappings, copings and chimneys may require more durable bricks.



Designation	Frost Resistance	Soluble Salt Content
FL	Frost resistant	Low
FN	Frost resistant	Normal
ML	Moderately frost resistant	Low
MN	Moderately frost resistant	Normal

Table 5

## 19) Durability Designation

“F” quality bricks are frost resistant. They are suitable for use in all building situations.

“M” quality bricks are moderately frost resistant. They may be used in all situations except those areas which are subjected to prolonged saturation accompanied by repeated freeze/thaw cycles.

## 20) Durability Designation

The second in the durability designation refers to the soluble salt content of the bricks.

“L” means that the salt content for the specified salts must not exceed the given values.



### SOLUBLE SALT CONTENT

Low Soluble Salts (L)	
Sodium, Na <sup>+</sup>	0.03%
Potassium, K <sup>+</sup>	0.03%
Magnesium, Mg <sup>++</sup>	0.03%
Sulphate, SO <sub>4</sub>	0.50%



### SOLUBLE SALT CONTENT

Normal Soluble Salts (N)	
Sodium, Na <sup>+</sup>	} 0.25%
Potassium, K <sup>+</sup>	
Magnesium, Mg <sup>++</sup>	
Sulphate, SO <sub>4</sub>	1.8%

\* Sum of Sodium, Potassium and Magnesium

## 21) Durability Designation

“N” signifies “Normal” soluble salt content.

Whereas this originally indicated “no limits” on soluble salt levels, the current British Standard revision introduced specific limits as shown in this table. The level of soluble salts has no direct bearing on a brick’s liability to efflorescence.



## 22) Freeze Thaw Test

Although not yet mandatory, a test for frost resistance of brickwork has been devised. As is seen here, a refrigeration unit is used to perform a freeze/thaw cycle test. The panels of the doors are made up of the brickwork to be tested. These brick panels are repeatedly subjected to saturation by water, freezing, thawing and heating. This rigorous test is repeated. For a brick to be classified as frost resistant the panel must survive 100 cycles.

## 23) General Views Durability



## 24) General Views Durability



## 25) General Views Durability

## 26) Liability to Efflorescence

A test for “liability to efflorescence” has been withdrawn from The Standard as it is somewhat irrelevant.



## 27) Liability to Efflorescence

Terms such as “nil”, “slight”, “moderate” etc were used to define the area of a brick showing signs of salting during a rather simplistic test. It did not reflect what happens on brickwork.

Nil	No perceptible deposits of salts
Slight	> 10% of brick face covered but no powdering or flaking
Moderate	10% < moderate < 50% of brick face covered no powdering
Heavy	> 50% of brick face covered powdering/flaking present

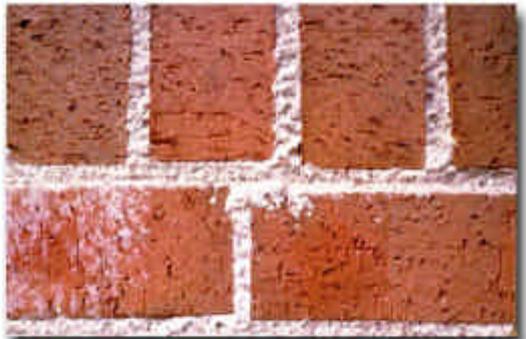


### 28) Types of salt

Salt on the bricks around the perimeter of the units.

### 29) Types of salt

Salt on the mortar joints.



### 30) Types of salt

Salt from the body of the bricks.

Many parameters influence the occurrence of efflorescence including materials workmanship, design details and climatic conditions.





### 31) The Occurrence of Efflorescence on a Gable Wall

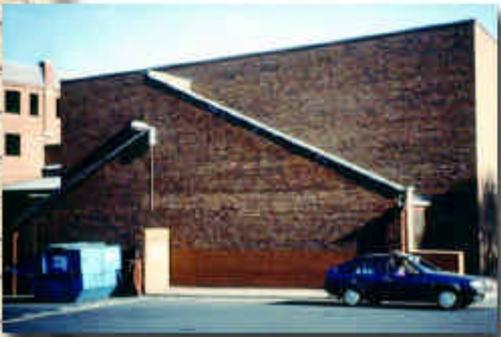
The sequence of images (37, 38 and 39) shows the effect or influence of a detail on the probability of efflorescence occurring.

### 32) The Occurrence of Efflorescence on a Gable Wall



### 33) The Occurrence of Efflorescence on a Gable Wall

The addition of overhanging coping reduced the excessive saturation and eliminated the efflorescence.





	Compressive Strength (N/mm <sup>2</sup> )	Water Absorption (%)
Engineering A	≥70	≤4.5
Engineering B	≥50	≤7.0
DPC 1	≥5	≤4.5
DPC 2	≥5	≤7.0
Others	≥5	no limits

Table 4

### 34) Strength

Bricks are also classed for strength and water absorption. The terms engineering A or B are not so important in modern construction as the consideration of frost resistance and it is a common misconception that only strong dense bricks are durable. Bricks with a high water absorption will readily absorb or expulse water.

### 35) Mortar

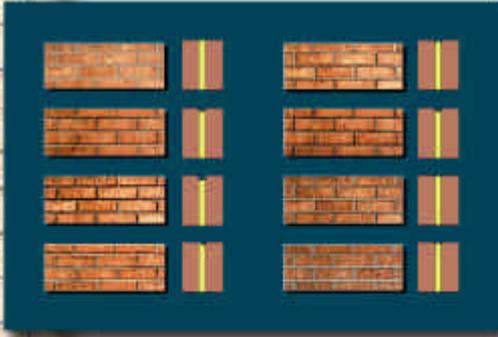
It must be remembered that mortar is a significant part of masonry - nearly 20% and this presents a major influence on the integrity of the wall with respect to strength, durability and resistance to rain penetration.



- 
- BINDERS**
- Hydraulic lime
  - Cement
  - Plasticizer/non hydraulic lime
  - Sulphate resisting cement

### 36) Properties of Mortar

This table shows the basic mix proportion for use in all standard mortars. Changing a mix will influence strength, durability and flexibility. In order to achieve the optimum property a 1:1:5-6 cement:lime:sand – will provide a suitable mix for most situations.



### 37) Joint Profiles

Recessed joints are popular with architects, since they often enhance the brickwork appearance. However, they are not recommended as they reduce the brickwork frost resistance.

### 38) Façade in Single Brick Type and Different Mortars Aesthetic Influence

Both the joint profile and its colour will significantly affect appearance. The strong influence of mortar colour on the appearance of brickwork cannot be over emphasised. This façade is constructed of one brick type only and various mortar colours in order to achieve the desired effect.



MATERIAL SPECIFICATION  
to  
BS 3921:1985

### 39) Material specification b BS3921