FROST RESISTANCE OF CLAY BRICKS

All masonry materials are potentially vulnerable to damage by cyclic freezing and thawing when a substantial thickness of material at and behind its exposed surface is saturated, or nearly saturated with water.

For practical use in the UK, masonry materials exposed to weather must, to some degree, be resistant to damage by freezing.

Clay Bricks
Resistance to damage by freezing is referred to as “frost resistance”. The property is not an absolute one. The term is frost resistance, not frost proof, and this varies across the range of clay bricks produced for construction work.

Most brick manufacturers make a range of brick products, each one consisting of units of similar technical properties, e.g. strength, water absorption, soluble salts content and frost resistance. Frost resistance of a clay brick is dependent on the raw material, and the preparation, forming and firing processes used to transform it into a semi-vitrified masonry unit. Variations in these factors give rise to differences in frost resistance from modest to very superior performance, but the property presents difficulties in assessment.

For many decades frost resistance has been declared on the basis of the manufacturer’s experience of the use of the product in a variety of building work over a number of years. It must be noted that frost resistance of bricks is independent of their water absorption. In the 1950s research by government and construction industry groups explored tests that would provide reliable guidance for the assessment of frost resistance but, such were the difficulties, it was not until 1985 that a laboratory test was introduced. Although commonly used by manufacturers, it was felt there was too little experience in its use to replace site experience as the means of classifying bricks. In 2006 BS EN 771-1 replaced BS 3921 as the Standard covering clay bricks and the manufacturer is required to declare the exposure conditions in which it is suitable to use each type of brick. The National Annex informs the user that the declaration may be made using the test, since it is now nationally recognised, having achieved international status as TS EN 772-22.

The test simulates bricks in walling by assembling a sample panel of 30 bricks in a rig and subjecting them to 100 cycles of spraying, freezing and thawing. If no significant damage occurs the brick is categorized as being suitably frost resistant for use in structures where there is a high risk of exposure to freezing while in a saturated state.

BS EN 771-1 categorizes three levels of exposure as defined in the following table:

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<table>
<thead>
<tr>
<th>BS EN 771-1 Freeze/thaw resistance category</th>
<th>Exposure</th>
<th>Description of suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Passive</td>
<td>Bricks suitable for internal use and the inner leaf of cavity walls; if used externally bricks are liable to be damaged by frost action if not protected by impermeable cladding or suitable render</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate</td>
<td>Bricks durable except when in a saturated condition and subjected to repeated freezing and thawing</td>
</tr>
<tr>
<td>F2</td>
<td>Severe</td>
<td>Bricks durable in all correctly detailed building situations including those where they are in a saturated condition and subjected to repeated freezing and thawing</td>
</tr>
</tbody>
</table>

It is important to note that clay bricks covered by BS EN 771-1 (BS 3921 was formally withdrawn in 2006), are intended for the construction of masonry structures, e.g. walls, foundations and chimney stacks, normally jointed with mortar. The Standard does not cover bricks to be used for paving, more correctly termed “pavers”, which are covered by a separate Standard, BS EN 1344.

**Design and Specification of Masonry**

BS 5628-3 “Code of practice for the use of masonry - Materials and components, design and workmanship” is now withdrawn and a new document published by the British Standards Institution, PD 6697, includes the information which was available in BS 5628-3 but is missing from BS EN 1996-2: Design considerations, selection of materials and execution of masonry.

It is acknowledged in PD 6697 that not all parts of a masonry structure will be subject to similar risk of damage by freezing in any particular locality. The degree of exposure to wind, rain and temperature is significantly affected by the shelter and protection provided by detail design of building features.

PD 6697 provides information on the many aspects of masonry that need to be taken into account when specifying and designing construction details. Table 15 of the document gives guidance on the choice of bricks, mortar and design details most appropriate for particular masonry situations with regard to durability.

BDA Design Note 7 “Brickwork Durability” contains the same guidance. It is available as a free download from [www.brick.org.uk/category/publications](http://www.brick.org.uk/category/publications).

Only brickwork that is saturated, or nearly saturated, is vulnerable to damage by freezing and therefore recommendations for the design of masonry include provisions that minimize the ingress of water into the body of the brickwork from precipitation or from the ground. The use of protective features such as

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copings and sill details that overhang the wall surfaces below them and are weathered and throated to shed water clear is encouraged.