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Understanding BS EN 771-3: Aggregate concrete masonry units

Important guidance for specifiers and users on a new Standard for aggregate concrete blocks

Introduction

BS EN 771-3: Aggregate concrete masonry units (Dense and lightweight aggregates) is a new harmonized Standard for aggregate concrete bricks and blocks. It will replace BS 6073-1 in April 2006 after a 12-month period of co-existence.

There is no doubt that over a period of 24 years BS 6073-1 has served our industry well in developing concise and unambiguous specifications for aggregate concrete bricks and blocks used in far ranging applications.

Like most British Standards it has been necessary to adapt BS 6073-1 to suit an enlarged market as well as to reflect up to date materials testing and regulatory requirements.

This Guide to BS EN 771-3: has been prepared to assist anyone involved in the design, specification and ordering of aggregate concrete blocks to understand the changes and thereby continue to make the specification and procurement of aggregate concrete blocks as straightforward as possible.

Background

BS EN 771-3 Aggregate concrete masonry units is written as a performance standard which means that all requirements are based on the finished product, rather than prescriptive standards which limit the materials that can be used in manufacture.

- Unlike BS 6073, BS EN 771-3 requires a manufacturer to conduct limited type testing and have a documented factory production control system. A third party to monitor the factory production control system is not essential.
- The test methods for the required properties are listed in BS EN 771-3. Some of these test methods are familiar but others are new.

- Groupings of units are introduced.
- Categories of units are introduced.
- It contains a national foreword and a national annex, which between them explain the essential differences between BS 6073 and BS EN 771-3.

Requirements

- **Dimensions**

These have to be declared in the order: Length, width & height. (e.g. 440mm x 100mm x 215mm). This is an important distinction between the previous custom of specifying and ordering blocks based on dimensions in the order of length x height x width (thickness).

BS EN 771-3 gives 4 tolerance classes (D1, D2, D3 & D4). Class D1 (+3, -5mm on all dimensions) is the most appropriate for common block applications. Tolerance D4 is intended solely for blocks to be laid with thin joint mortar, a technique rarely used in the UK.

Closer tolerances on any dimension may also be declared by the manufacturer for any tolerance category.

The test method for dimensions is BS EN 772-16.

- **Configuration**

Reference is made to the requirements of the groupings of units used in the European Masonry Design Code (BS EN 1996-1-1).

BS EN 1996-1-1 puts lower limits on:

Shell thickness
Web thickness

but these limits are generally much lower than used in current UK designs and are normally easily complied with using current aggregate block products.

BS EN 1996-1-1 also categorizes units according to void percentages as follows:

Group 1	$\leq 25\%$ formed vertical voids by volume
Group 2	$> 25\% \leq 60\%$ formed vertical voids by volume
Group 3	$> 25\% \leq 70\%$ formed vertical voids by volume
Group 4	$> 25\% \leq 50\%$ formed horizontal voids by volume

See Annex A for full details of the requirements for unit groupings.

Blocks currently described as 'solid' will become Group 1 units. Cellular and hollow blocks will, depending on void content, will be described as Group 1 or 2 units. Group 3 and 4 units are not commonly manufactured for use in the UK.

Configuration also covers flatness requirements for the faces of facing quality units only, and flatness requirements for the bed surfaces of units to be used with thin layer mortar in D4 tolerance category.

There is also a requirement for the parallelism of bed faces of units to be used with thin layer mortar in conjunction with the D4 tolerance category. For facing units there is an optional but strongly recommended procedure for the site approval of the appearance of unit prior to their use.

- **Density**

The gross dry density of the blocks has to be declared by the manufacturer. The standard also requires net dry density to be given when it is relevant to the application. The net dry density is rarely likely to be a necessity in practice.

A density tolerance of + or – 10% is allowed on both gross and net density.

The appropriate test method is BS EN 772-13.

The compressive strength will need to be declared air dry. The conditioning and surface preparation used need to be declared by the manufacturer. The appropriate test method is BS EN 772-1.

Annex B gives new strengths referred to in Building Regulations and British Standards. These are slightly higher than strengths determined to BS 6073.

The manufacturer will declare whether a unit is category I or category II. A category I unit would be approximately equivalent to special category as defined in BS 5628-1 and would require third party certification and monitoring of the production control system.

- **Thermal properties**

In the UK, configuration and density is used primarily as the basis for the declaration of thermal properties. Manufacturers will still be allowed to give thermal resistance values of products using values from CIBSE Guide A. (For cellular/hollow units the thermal resistance can be calculated to BS EN ISO 6946 taking off the surface resistance values).

- **Durability**
Generally durability compliance criteria are to be found in BS 5628-3.
- **Water absorption by capillarity**
Water absorption is only applicable to facing units with no applied finish. The appropriate test method is BS EN 772-11, (Clay and aircrete units use the same test method but using different procedures within the method and these will lead to test results for the products, which cannot be directly compared).
- **Moisture movement**
This will now be declared to a new test method, which is a combination of drying shrinkage and wetting expansion.

The appropriate test method is BS EN 772-14 (Aircrete is tested to BS EN 680 and this will lead to lower values which cannot be compared directly with results to BS EN 772-14).
- **Water vapour permeability**
Tabulated values are likely to be declared in accordance BS EN 1745, BS 5250 & CIBSE Guide Book. If tested, values can be determined to BS EN ISO 12572.
- **Reaction to fire (spread of flame)**
If the manufacturer uses materials that result in a unit containing more than 1% by mass or volume of organic material then he is responsible for the following tests to be carried out:

BS EN ISO 1182 Reaction to fire tests for building materials.
Non- combustibility test.

BS EN ISO 1716 Reaction to fire test for building materials – Determination of the heat of combustion.

And the results need to be classified according to BS EN 13501-1.
- **Shear bond strength**
A value of shear bond strength needs to be given and it is recommended that the tabulated value of 0.15 N/mm² from Annex C of BS EN 998-2 is declared.

(The tabulated value or a measured value is of no practical use as bond strength in practice will be dependent on a number of factors outside the control of the producer and a value could not be guaranteed as being universally applicable, but only for a set of specific conditions, which would be difficult to replicate on site).

- **Flexural bond strength**
This requirement only applies in Finland and therefore a value need not be given as there is no regulatory requirement for this property to be declared in the UK.
- **Classification**
There are no classification systems for masonry units in the UK but there are in some EU countries.
- **Marking**
It is anticipated that product identification details and means of identification of the date of manufacture will be given on delivery documentation and on the product where appropriate.

Annex A

Groupings of concrete units from EN 1996-1-1

	Limits for Masonry Units						
	Group 1 (all materials)	Group 2		Group 3		Group 4	
		Vertical Holes				Horizontal Holes	
Volume of all holes (% of the gross volume)	≤ 25	$> 25; \leq 60$		$> 25; \leq 70$		$> 25; \leq 50$	
Volume of any hole (% of the gross volume)	$\leq 12,5$	Each of multiple holes ≤ 30 gripholes up to a total of 30		Each of multiple holes ≤ 30 gripholes up to a total of 30		Each of multiple holes ≤ 25	
Declared values of thickness ^(b) of webs and shells (mm)	No Requirement	Web	Shell	Web	Shell	Web	Shell
		≥ 15	≥ 18	≥ 15	≥ 15	≥ 20	≥ 20
Declared value of combined thickness ^(a) ^(b) of webs and shells (% of the overall width)	No Requirement	≥ 18		≥ 15		≥ 45	
<p>a) The combined thickness is the thickness of the webs and shells, measured horizontally across the unit at right angles to the face of the wall. The check is to be seen as a qualification test and need only be repeated in the case of principal changes to the design dimensions of units.</p> <p>b) In the case of conical holes, or cellular holes, use the mean of the thickness of the webs and the shells.</p>							

Annex B

Compressive strength of units	
To BS 6073-1	To BS EN 771-3
2.8	2.9
3.5	3.6
5.0	5.2
7.0	7.3
10.0	10.4

Preferred higher unit compressive strengths	
BS 5628-1: 1992 BS 5628-2: 2000	BS 5628-1: 2005 BS 5628-2: 2005 (Not equivalent to 1992 & 2000 strengths)
15	17.5
20	22.5
35	30.0
	40.0

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