BRITISH STANDARD

BS EN
15435:2008

Precast concrete products — Normal weight and lightweight concrete shuttering blocks — Product properties and performance

ICS 91.100.30

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 15435:2008.

The UK participation in its preparation was entrusted to Technical Committee B/524, Precast concrete products.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Produits préfabriqués en béton - Blocs de coffrage en béton de granulats courants et légers - Propriétés et performances des produits

Betonfertigteile - Schalungssteine aus Normal- und Leichtbeton - Produkteigenschaften und Leistungsmerkmale

This European Standard was approved by CEN on 18 March 2008.

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Foreword

This document (EN 15435:2008) has been prepared by Technical Committee CEN/TC 229 “Precast concret products”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2008, and conflicting national standards shall be withdrawn at the latest by January 2010.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Construction Products Directive (89/106/EC).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

It also takes into account the “Common rules for precast concrete products” in EN 13369.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the properties, performance and test methods of factory made, non-load bearing hollow concrete shuttering blocks made from normal weight or lightweight aggregates or a combination of both. Shuttering blocks may include vertical or horizontal interlocking features and factory installed supplementary insulation. Shuttering blocks are intended to be used to form walls and partitions when filled with concrete or mortar. Concrete shuttering blocks rely on a concrete or mortar infill for their structural performance and are not intended to be used unfilled.

This standard does not cover masonry units covered in EN 771-3.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 772-11, *Methods of test for masonry units — Part 11: Determination of water absorption of aggregate concrete, manufactured stone and natural stone masonry units due to capillary action and the initial rate of water absorption of clay masonry units*

EN 772-14, *Methods of test for masonry units - Part 14: Determination of moisture movement of aggregate concrete and manufactured stone masonry units*

EN 772-16, *Methods of test for masonry units — Part 16: Determination of dimensions*

EN 772-20, *Methods of test for masonry units - Part 20: Determination of flatness of faces of aggregate concrete, manufactured stone and natural stone masonry units*

EN 1745, *Masonry and masonry products — Methods for determining design thermal values*

EN 12390-5:2000, *Testing hardened concrete — Part 5: Flexural strength of test specimens*

EN 12664, *Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Dry and moist products of medium and low thermal resistance*

EN 13369, *Common rules for precast concrete products*

EN 13501-1, *Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests*

EN ISO 12572, *Hygrothermal performance of building materials and products — Determination of water vapour transmission properties* (*ISO 12572:2001)*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
shuttering block
hollow block, sometimes incorporating lateral interlocking, intended as permanent formwork for concrete or mortar infill, for laying dry or with mortar

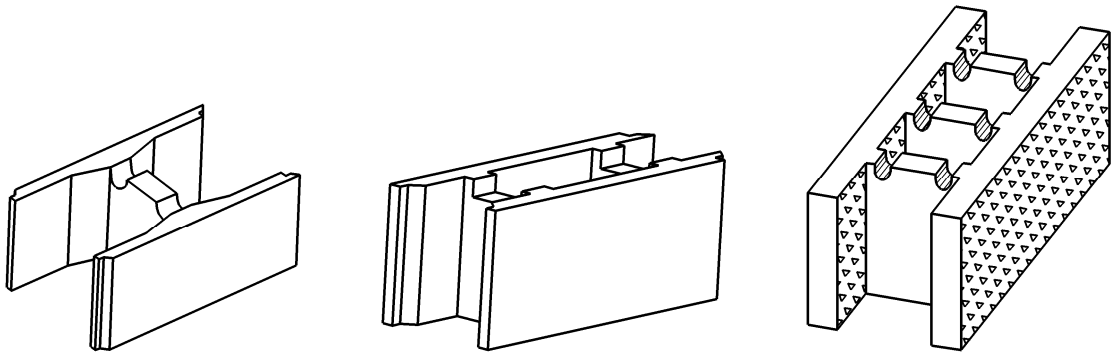


Figure 1 — Example of a shuttering block

3.1.2
shuttering block with supplementary thermal insulation
shuttering block incorporating thermal insulation to enhance thermal resistance

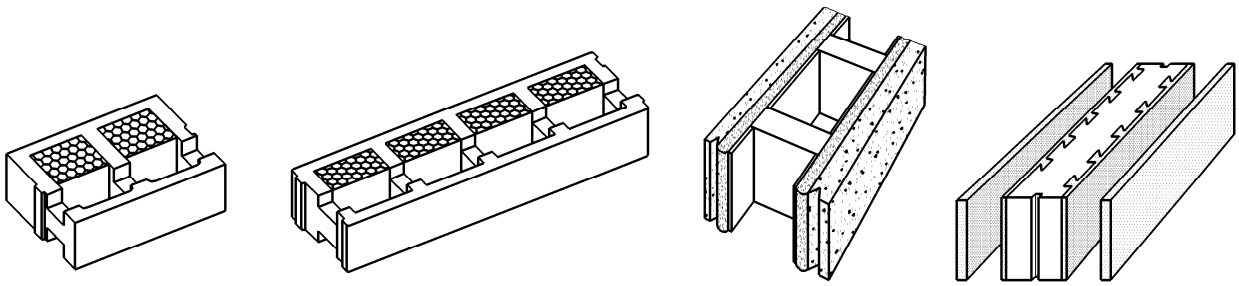


Figure 2 — Examples of shuttering blocks with supplementary thermal insulation

3.1.3
design (nominal) dimension
dimension targeted in the project documentation

3.1.4
actual dimension (of the product)
dimension found by measurement (on the finished product)

3.1.5
specially shaped shuttering block
shuttering block having a shape, such as a corner block, which allows it to fulfil a particular function

3.1.6
interlocking features (horizontal and/or vertical)
shaped matched projections and indentations on shuttering blocks (e.g. tongue and groove systems)

3.1.7
hollow core
shaped void for incorporation of concrete or mortar infill and any supplementary thermal insulation

3.1.8
shell
solid material between the hollow core and the faces of a shuttering block

3.1.9
web
solid material linking the shells of the shuttering block

3.1.10
web recess
formed notch in a web

3.2 Symbols

l	length of the shuttering block in mm
t_b	width of the shuttering block in mm
h	height of the shuttering block in mm
t_{s1}	thickness of the outer shell in mm
t_{s2}	thickness of the inner shell in mm
t_{w1}	(w_1, w_2, etc.) thickness of web in mm
t_c	width of the hollow core (concrete infill) in mm
W_R	width of web recess
t_i	thickness of the insulating material in mm
h_R	Total height of the web in mm ($h_R = h_{R1} + h_{R2}$)
A_R	Total area of the web recess in mm^2
l_d	diagonal of the face
h_w	recessed height of web ($h_W = h - h_{R1} - h_{R2}$)
a_1	length of hollow core
a_2	length of cantilevered shell

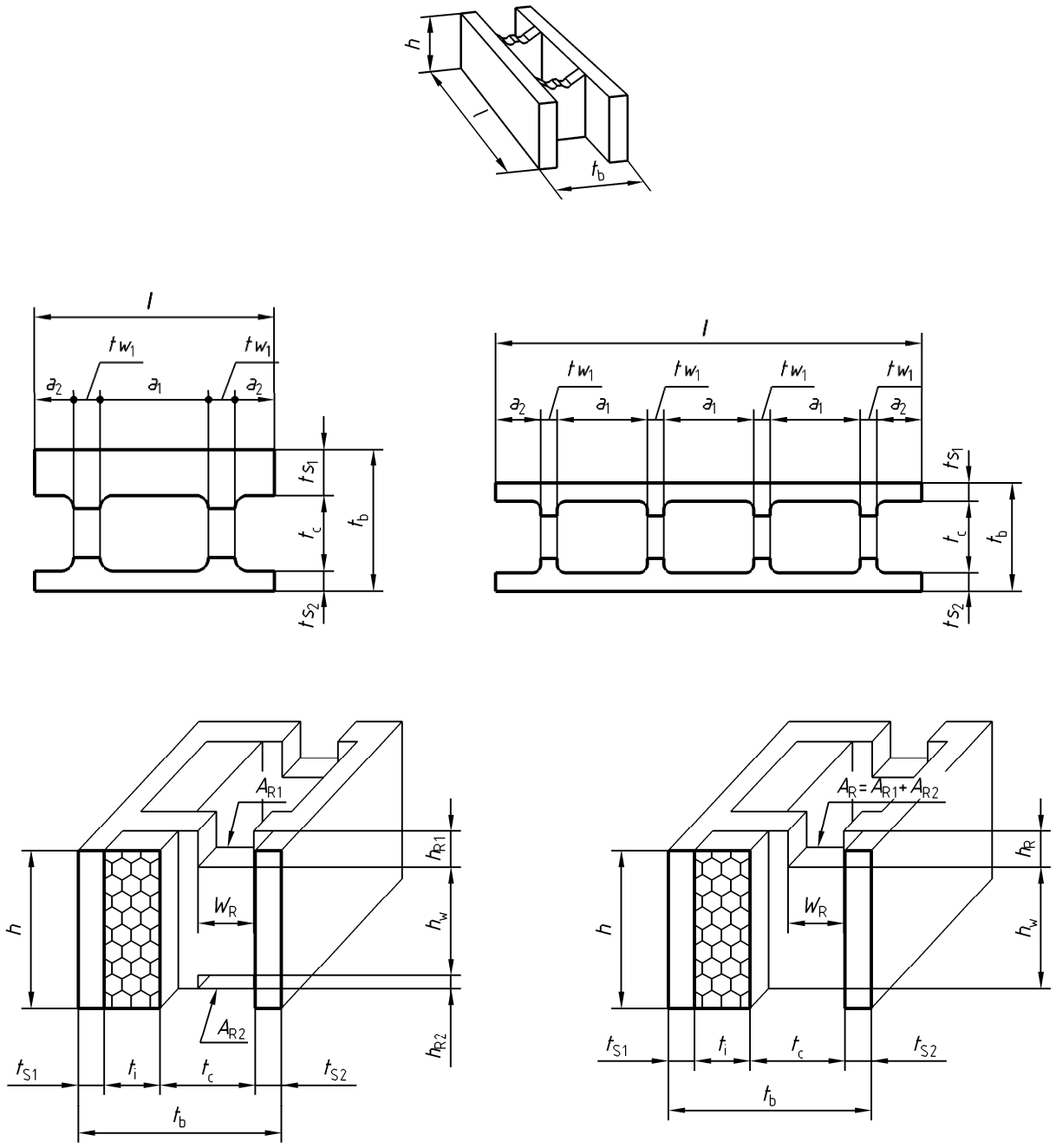


Figure 3 — Geometric specification symbols

4 Requirements

4.1 General

The requirements and properties specified in this European Standard shall be defined in terms of the test methods and other procedures referred in this European Standard.

NOTE The standard test methods are not always applicable to specially shaped shuttering blocks as defined in 3.1.5.

4.2 Raw materials and concrete

Materials for shuttering block concrete shall comply with EN 13369. Any supplementary thermal insulation material shall comply with an appropriate European standard.

4.3 Dangerous substances

Shuttering blocks shall not release any dangerous substances in excess of the maximum permitted levels specified or permitted in the national regulations valid in the place of use.

4.4 Geometric properties

4.4.1 Dimensions

The dimensions of the shuttering blocks shall be declared in millimetres for length, width and height, in that order (see Figure 3). The dimensions of voids and web recesses shall be declared in millimetres. They shall be given in terms of work size and be shown on diagrams. Tolerances on declared work sizes of individual regular shaped shuttering blocks shall conform to Table 1. Closer deviations may be declared by the manufacturer for one or more dimensions.

The thickness of shell(s) and web(s) shall be declared.

Table 1 — Permissible deviations in millimetres

Length (l)	Width (t_b)	Height (h)	Dimensions of voids and web recesses
+5 -5	+5 -5	+3 -5	+10 -4

4.4.2 Web recess area

When web recesses are included the minimum web recess area shall be declared. The web recess area shall be determined in accordance with 5.1.4.

4.4.3 Flatness

4.4.3.1 Flatness of external faces of facing shuttering blocks

When the surface of facing shuttering blocks is declared as plane, it shall not deviate from a plane by more than 0,1 $\sqrt{l_d}$ mm or 2 mm whichever is the greater, where l_d is the length of the diagonal of the face. The flatness of external faces of facing shuttering blocks shall be determined in accordance with 5.1.5.

4.4.3.2 Flatness of bed faces

When the shuttering blocks are dry-stacked the flatness of bed faces shall be determined in accordance with 5.1.6.The deviation from flatness shall not exceed 3 mm.

4.4.4 Squareness

When required, squareness between the side-faces and both bed faces for shuttering blocks to be dry-stacked shall not deviate by more than 5 mm when measured in accordance with 5.1.3.2. or 3 mm when measured in accordance with 5.1.3.3.

4.4.5 Appearance of facing shuttering blocks

When required, the appearance of facing shuttering blocks may have compliance established on the basis of comparison with any approved samples. Comparison shall be made from a distance of 3 m in normal daylight conditions. This compliance shall be established before the shuttering blocks are used.

4.5 Density

The net dry density of the shuttering blocks shall be declared in kg/m^3. The mean value of the test samples shall not differ from the declared value by more than ± 10 %. The dry density shall be determined according to 5.2.

For factory production control purposes, density may be verified by weighing individual shuttering blocks.

4.6 Moisture movement

When required, the moisture movement of the shuttering blocks (shrinkage and expansion) shall be declared.

Moisture movement shall be determined according to EN 772-14.

4.7 Reaction to fire

For concrete shuttering blocks intended to be used in elements subject to fire requirements, the manufacturer shall declare the reaction to fire classification of the shuttering block.

Shuttering blocks containing a mass or volume fraction of a maximum of 1,0 % (whichever is the most onerous) of homogeneously distributed organic materials, are classified as Class A1 without the need to test.

Shuttering blocks containing a mass or volume fraction more than 1,0 % (whichever is the most onerous) of homogeneously distributed organic materials shall be classified in accordance with EN 13501-1 and the appropriate reaction to fire class declared.

Information on reaction to fire class of supplementary insulating material shall be given on the basis of European standards as declared by the supplier of the insulating material.

NOTE Attention is drawn to the Commission Decision 96/603/EC, as amended by Commission Decision 2000/605/EC, in which non-combustible shuttering blocks containing not more than a mass or volume fraction of 1,0 % (whichever is the more onerous) of homogeneously distributed organic materials are classified as reaction to fire Class A1 without testing.

4.8 Water vapour permeability

When required, the water vapour permeability shall be declared according to tabulated values in EN 1745 or determined according to EN ISO 12572.

4.9 Mechanical strength

4.9.1 General

The mechanical strength of shuttering blocks shall be sufficient to allow handling and withstand the filling pressure on the shells.

For factory production control purposes mechanical strength may be verified by testing compressive strength in accordance with EN 772-1.

When relevant, the thermal insulation adhesion shall be determined according to 5.3 and declared.

NOTE Determination of thermal insulation adhesion can be relevant for blocks where thermal insulation binds together two block halves, see last block type in Figure 2.

4.9.2 Tensile strength of webs

The mean tensile strength shall be determined only when the web width is less than the shell width and/or the web height is less than 80 % of the shuttering block height.

The tensile strength in N/mm² of the webs $f_{t,fl}$ shall be determined on the smallest section of the webs according to 5.3 and shall not be less than the design value $f_{t,\min}$.

Shuttering blocks shall be tested according to 5.3 and Annex A, the results evaluated according to Annex D.

4.9.3 Flexural strength of shells

The mean flexural strength in N/mm² of the shell $f_{f,m}$, shall not be less than $f_{f,\min}$.

The flexural strength of the shells shall be determined on the thinnest shell according to 5.3.

Shuttering blocks shall be tested according to 5.3 and Annex B, results evaluated according to Annex D.

4.10 Acoustic properties

When required, the manufacturer shall supply information on the acoustic properties.

NOTE 1 The acoustic properties depend mainly on the density and configuration of the shuttering blocks and/or on the mass of the finished walls.

NOTE 2 Airborne sound insulation is a property of the finished walls.

4.11 Thermal properties

When required, the manufacturer shall supply information on the thermal properties.

The thermal conductivity shall be declared on the basis of tabulated values given in EN 1745 or determined in accordance with EN 12664.

NOTE The thermal properties depend mainly on the thermal conductivity of the shuttering blocks, the concrete or mortar infill, any supplementary insulation and the geometry of the shuttering blocks.

4.12 Water absorption by capillarity

When required, the maximum water absorption by capillarity shall be declared in g/m².s.

The test is carried out in accordance with EN 772-11 for a time in contact with water of (10,0 ± 0,2) min.

NOTE The result obtained according to EN 772-11 should be divided by 24,49 to express this value in g/m^2.s.

4.13 Durability

When required freeze-thaw resistance shall be declared by reference to the provisions valid in the intended place of use until an appropriate European standard is available.

5 Test methods

5.1 Geometric properties

5.1.1 General

The geometric properties are measured on complete shuttering blocks.

The results are evaluated according to Annex D.

5.1.2 Dimensions

The length, width and height of shuttering blocks shall be measured according to method c) of EN 772-16.

The length and width of each hollow core shall be measured at the centre of the hollow core at the top and bottom of the shuttering block. Mean values of the length and width are calculated from each pair of measurements, rounded to the nearest millimetre, then compared with the declared dimensions.

5.1.3 Squareness

5.1.3.1 General

The squareness shall be measured on a low wall or directly on shuttering blocks.

5.1.3.2 Measurement on low wall

A low dry-stacked test-wall shall be built as specified.

The first course shall contain at least four shuttering blocks and shall be at least two metres long.

The height h_e of the low wall shall be at least one metre.

NOTE

Effective height of the low wall (he)

$$he = \frac{\sum_{1}^{4} hi}{4}$$

hi = $h1$, $h2$, $h3$, $h4$

Effective verticality of the low wall (Ve)

The batter or opposite batter is measured at ends of the wall on both sides.

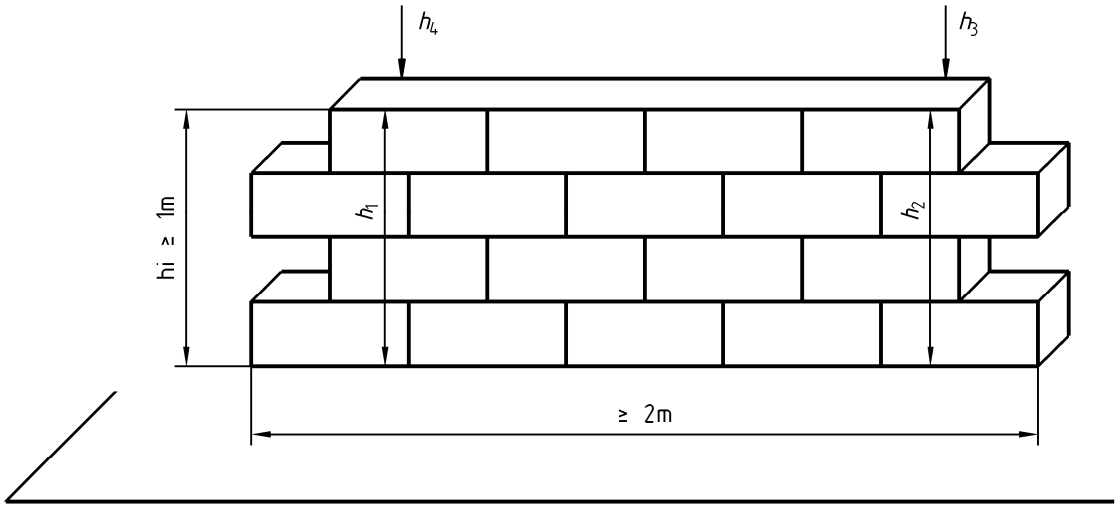
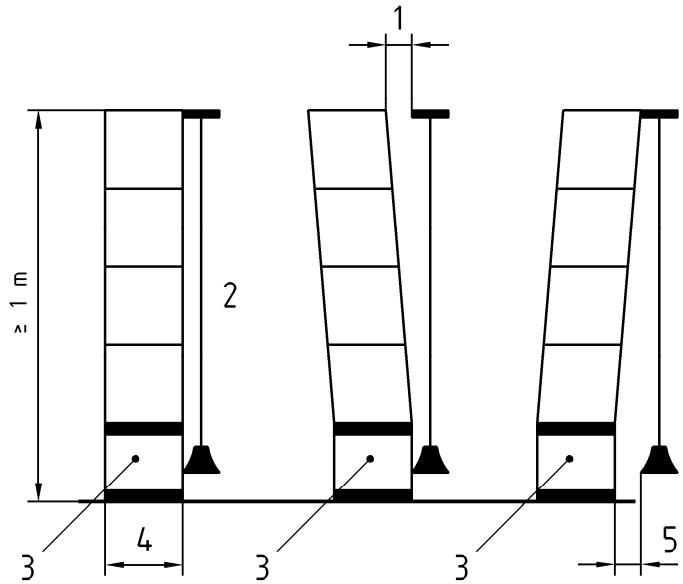


Figure 4 — Principle of measurement of squareness of a low wall

— Squareness (pe)

$$pe = hi_{max} - hi_{min} \quad (1)$$



Key

1 Batter (Ve)
2 Perpendicularity level = 0 mm
3 Base
4 Thickness of the low wall
5 Opposite batter (Ve)

Figure 5 — Definition of batter and opposite batter

5.1.3.3 Measurement on shuttering blocks

The deviation from squareness of the side-faces and both bed faces shall be measured using a steel angle and feeler gauges and given in millimetres.

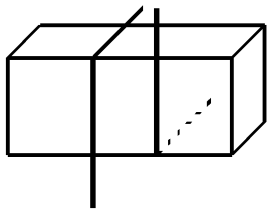


Figure 6 — Measurement of squareness directly on shuttering blocks

5.1.4 Web recess area

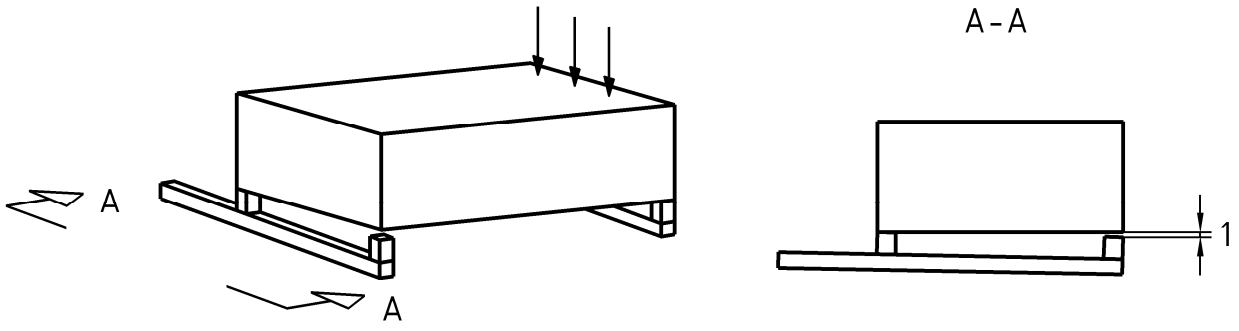
The area of each web recess shall be determined to the nearest 10 mm^2, by measurement and calculation.

5.1.5 Flatness of external faces of a facing shuttering block

The deviation from flatness of the face shall be measured in accordance with Figure 7. The result shall be expressed in millimetres.

5.1.6 Flatness of bed faces

The deviation from flatness of bed faces shall be measured in accordance with Figure 7. The result shall be expressed in millimetres.



Key

1 Deviation

Figure 7 — Measurement of flatness of bed face

5.2 Density

The oven dry density shall be established from three cut test specimens having individual volumes of at least 3 000 cm^3, which have been dried to constant mass at 105 °C ± 5 °C.

A specimen may be comprised of more than one cut piece of shuttering block if each piece has a minimum volume of 750 cm^3.

Constant mass (m_u) is considered to have been reached when the results of two successive weighings carried out at 24 h intervals differ by not more than 0,5 % of the mass of the specimen.

The volume (V_u) of each specimen or constituent piece of a specimen is measured to the nearest millimetre and each specimen is weighed to the nearest gram. The gross dry density of each specimen is calculated to the nearest 5 kg/m^3 for densities up to 1 000 kg/m^3 and, above this, to the nearest 10 kg/m^3. The dry density of each specimen is calculated according to:

$$\rho_{u,n} = \frac{m_{u,n}}{V_{u,n}} \times 10^6 \quad (2)$$

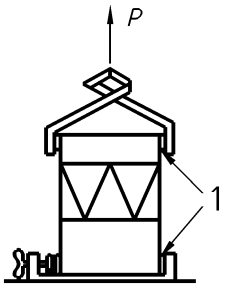
Density is established as the mean value of the density of the three test specimens and evaluated in accordance with Annex D.

5.3 Mechanical strength

For reference testing of mechanical strength shuttering blocks shall be stored in the laboratory at a temperature of $\geq$ 15 °C and a relative humidity of $\leq$ 65 % for 28 days.

For factory production control mechanical strength tests can be carried out at less than 28 days (e.g. prior to delivery).

Thermal insulation adhesion is determined by tension test according to Figure 8.



Key

1 Softening pad e.g. rubber

Figure 8 — Thermal insulation adhesion test

6 Classification

Specification of the properties of the shuttering blocks may be given by reference to national classification systems on the condition that those systems are based only on single properties included in this European standard and do not themselves constitute a barrier to trade.

This condition does not remove the requirement that all manufacturers claiming compliance with this European standard shall state declared values of the properties of their products, when required.

NOTE Details of classification systems in current use may be given in informative national annexes.

7 Marking

The following information shall be marked clearly on the packaging, the delivery note, the certificate accompanying the shuttering blocks or on 5 % of the shuttering blocks, with at least four per pack of shuttering blocks:

a) name, trademark or other means of identifying the manufacturer;

b) means of identifying the date of manufacture of the shuttering blocks;

c) means of identifying the shuttering blocks and relating them to their description and designation.

NOTE For CE marking and labelling, Article ZA.3 applies. Where Article ZA.3 requires the CE marking to be accompanied by the same information as required by this article, the requirements of the latter can be considered to have been met.

8 Evaluation of conformity

8.1 General

The manufacturer shall demonstrate the compliance of the product with the requirements of this European Standard and with the values stated for the product specifications by carrying out both:

— initial type testing of the product (see 8.2) ;

— factory production control (see 8.3).

Test methods other than the reference methods specified in this European Standard may be adopted, except for initial type tests and in the event of a dispute, provided that these alternative methods satisfy the following conditions:

a) correlation can be demonstrated between the results from the reference test and those from the alternative test and

b) information on which such correlation is based is available.

8.2 Initial type testing

When a new product type is developed, and before offering it for sale, appropriate initial type tests shall be carried out to confirm that the achieved properties of the product meet the requirements of this European Standard and the values stated by the manufacturer. Type testing consists of a complete set of tests or other procedures described in this European standard. Whenever a major change occurs in the raw materials, the proportions used or the production process, which would change the properties of the finished product, the appropriate initial type test shall be repeated.

Previous type tests on the same products may be considered if they comply with the requirements of this standard.

The type tests shall correspond to the reference tests mentioned in Table C.1 for the properties selected for the manufacturer’s declaration according to the intended use of this product type.

Sampling for initial type testing shall be carried out in accordance with Annex C.

The number of shuttering blocks to be tested shall be as given in Table C.1 and the criteria specified in Clause 4 shall be met.

The results of the initial type tests shall be recorded.

NOTE To determine the performance characteristics allowing for compliance with the CE marking provisions, see Table ZA.1.

8.3 Factory production control

8.3.1 General

A factory production control system shall be set up and documented. This system shall be made up of internal production control procedures in order to ensure that the products put on the market comply with this European Standard and the values stated by the manufacturer.

The factory production control system shall consist of procedures, regular inspection and tests and the utilisation of the results to control raw and other incoming materials, equipment, the production process and the product.

An example of a suitable inspection scheme for factory production control is given in Annex E.

The results of inspections requiring action and the results of tests shall be recorded.

The action to be taken when control values or criteria are not met shall be given.

8.3.2 Raw materials

The specifications of the raw materials used and the procedures to be implemented to ensure that they comply shall be documented.

8.3.3 Production process

The relevant features applicable to the plant and the production process shall be defined, giving the frequency of the inspections, checks and tests, together with the criteria required both on equipment and on work progress. The action to be taken when inspection parameters or criteria are not complied with shall be stated. All test equipment shall be verified and the procedure, frequency and criteria documented.

8.3.4 Finished product testing

A sampling plan and the conformity criteria shall be set out for the testing of finished products, the results of which shall be recorded and available. All test equipment shall be verified and the procedure, frequency and criteria documented.

8.3.5 Stock control

Stock control of finished products, together with the procedures for dealing with non-compliant products shall be documented.

Annex A
(normative)

Determination of web tensile strength

A.1 Principle

The method determines the tensile strength directly or uses a standard compression (or flexural) testing machine in conjunction with a special device which converts the compressive force (normal) into a tensile force.

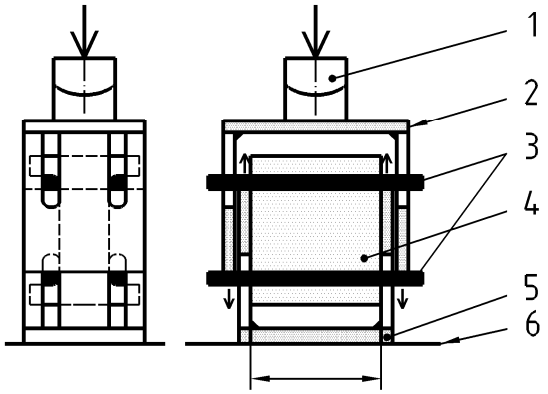
A.2 Apparatus

Tensile testing machine or compression testing machine.

When the compression testing machine is used, a special device comprising two interlocking U shapes with holes for two pairs of 20 mm diameter rods is needed.

Two rods are used to support the specimen and two rods are used to transmit the tensile force to the specimen. The lower part of the device is static.

The upper part of the device can be moved with the movements of the platen of the compression testing machine.



Key

1 Hinge
2 Upper section of the frame
3 Rods
4 Specimen (web)
5 Lower section of the frame
6 Platen of the testing machine

Figure A.1 — Test equipment for web tensile strength test

A.3 Procedure

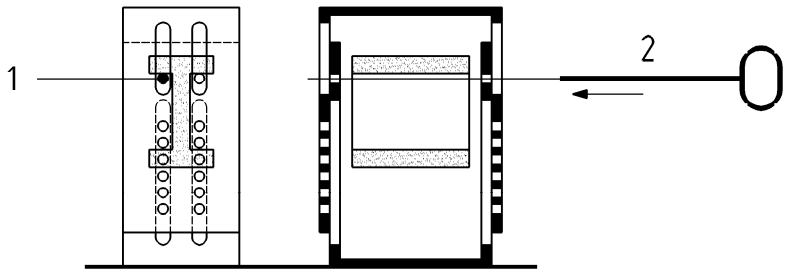
Six webs are cut from six shuttering blocks (see Figure A.6).

The shoulders on either side of the webs shall extend at least 40 mm from the web.

When tensile testing machine is used, the tensile force is submitted to the test specimen according to the principle shown in Figure A.6.

When compression testing machine is used the two parts of the steel device (see Figure A.2) are assembled and the two retaining rods are inserted through the frame and under the shoulders of a test specimen.

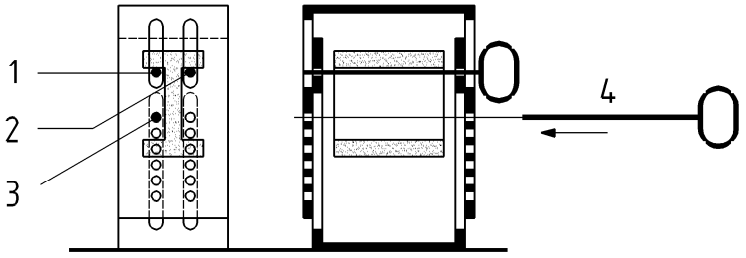
The two pull rods are then inserted through the frame using holes in close proximity to the lower shoulders of the test specimen (see Figure A.3) and the specimen is centred on the retaining rods (see Figure A.4). It is possible to introduce a flexible packer between block and rod for the adjustment of the location of the rods.



Key

1 Retaining rod 1
2 Retaining rod 2

Figure A.2 — Insertion of two retaining rods to support the specimen

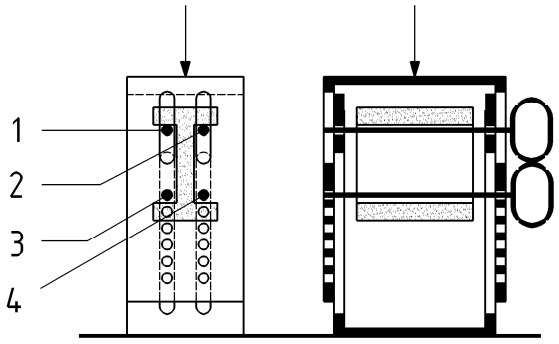


Key

1 Retaining rod 1
2 Retaining rod 2
3 Pull rod 1
4 Pull rod 2

Figure A.3 — Insertion of two retaining rods to support the specimen

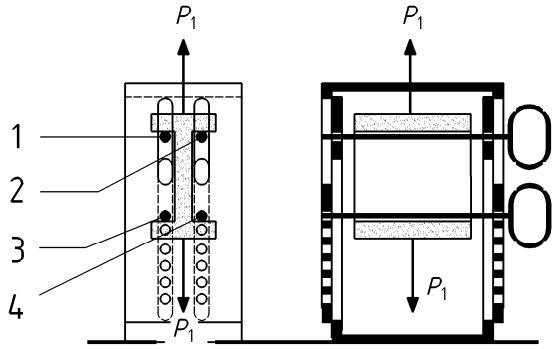
The moving platen of the compression testing machine is then activated until the pull rods are in light contact with the lower shoulders of the test specimen. Packaging pieces may be used, if the shoulder geometry on either side of the web is different



Key

1 Retaining rod 1
2 Retaining rod 2
3 Pull rod 1
4 Pull rod 2

Figure A.4 — Centring of specimen on the retaining rods



Key

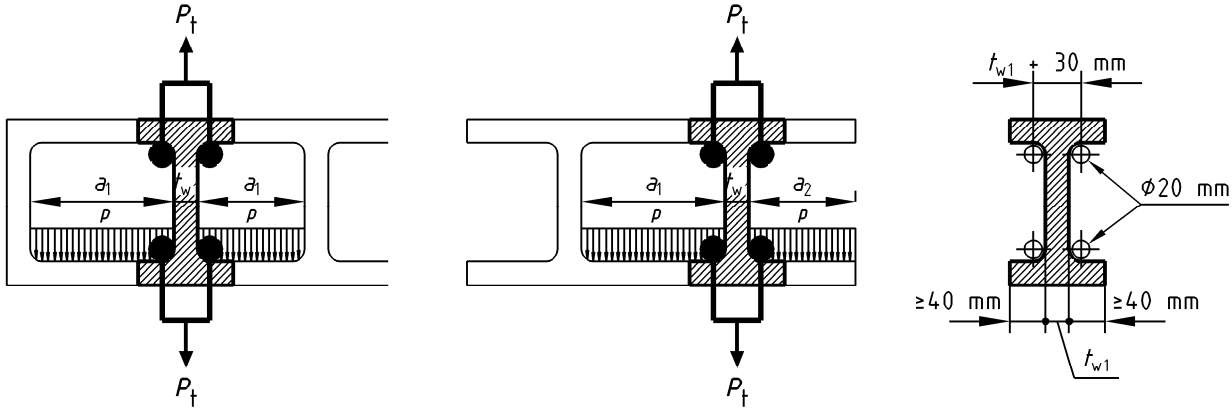
1 Retaining rod 1
2 Retaining rod 2
3 Pull rod 1
4 Pull rod 2

Figure A.5 — Web undergoing tensile strength test

The load is applied at a rate of $(0{,}10 \pm 0{,}05)$ N/mm^2 per second. A constant loading rate shall be maintained for at least the second half of the loading. During the first half of the assumed maximum load a higher rate of loading is permitted (see Figure A.5).

A.4 Determining the tensile strength of webs

A.4.1 General



Key

a_1 Length of hollow core in mm

a_2 Length of cantilevered part of the shell in mm

t_{w1} Thickness of web in mm

t_b Width (thickness) of unit in mm

h Height of unit in mm

h_w Height of recessed web in mm

p Filling pressure in N/mm²

P_t Web tensile load in N

Figure A.6 — Tensile strength of web

A.4.2 Calculation of the design tensile strength of the web

For each specimen the design web tensile strength ($f_{t,\min}$) in N/mm² shall be calculated on the basis of the maximum filling pressure of concrete infill ($p_{\max}$) according to Annex F using the formula:

$$f_{t,\min} = \frac{P_{t,\min}}{s_1} \tag{A.1}$$

where

Webs situated between two hollow cores:

$$P_{t,\min} = (\rho_{\max} \times h) \times \left(\frac{a_1}{2} + \frac{a_1}{2} \right) \tag{A.1a}$$

Webs situated between hollow core and cantilevered end of shell:

$$P_{t,\min} = (\rho_{\max} \times h) \times \left(\frac{a_1}{2} + a_2 \right) \quad \text{(A.1b)}$$

where

$f_{t,\min}$ is the design web tensile strength in N/mm²;

$P_{t,\min}$ is the minimum required web tensile failure load in N;

s_1 is the cross-sectional area of recessed web = (t_{w1} x h_w) in mm²;

$\rho_{\max}$ is the maximum filling pressure of concrete infill in N/mm²;

a_1, a_2 is the length of hollow space in mm;

h is the height of block in mm.

A.4.3 Measurement of the web tensile failure load and calculation of the tensile strength of webs

The web tensile failure load ($P_{t,msd}$) in N of six specimens shall be determined.

From the measured web tensile failure load ($P_{t,msd}$) in N calculate the individual values of web tensile strength ($f_{t,msd}$) in N/mm² and, subsequently, the mean tensile strength of webs ($f_{t,m}$) in N/mm²:

$$f_{t,msd} = \frac{P_{t,msd}}{s_1} \quad \text{(A.3)}$$

$$f_{t,m} = \frac{\sum_{i=1}^{6} f_{t,msd,i}}{6} \quad \text{(A.4)}$$

where

$f_{t,msd}$ is the individual value of the web tensile strength in N/mm²;

$P_{t,msd}$ is the measured web tensile failure load in N;

s_1 is the cross-sectional area of recessed web = (t_{w1} x h_w) in mm²;

$f_{t,m}$ is the mean tensile strength of webs in N/mm²;

$f_{t,msd,i}$ is the individual values of the web tensile strength in N/mm².

A.5 Test report

The test report shall contain the following information:

1) laboratory that carried out the tests;

2) date of the tests;

3) description of the shuttering blocks tested;

4) age of the shuttering blocks at the time of the test;

5) individual values of measured tensile force applied to the webs $P_{t,\ msd}$ in N;

6) designed web tensile strength $f_{t,\min}$ in N/mm^2;

7) mean tensile strength of webs $f_{t,\mathrm{m}}$ in N/mm^2.

Annex B
(normative)

Determination of shell flexural strength

B.1 Principle

The method uses a standard flexural strength testing machine.

B.2 Apparatus

The test device consists of a loading roller centred relative to the two lower rollers, all having a diameter of (20 ± 2) mm. The device shall permit the free rotation of the loading roller and of one of the lower rollers as shown in Figure 2 of EN 12390-5:2000.

B.3 Procedure

Six specimens are prepared by cutting sections from shells taken from six shuttering blocks of the same type and with the same dimensions (see Figure B.1).

The required specimen length is that of one core plus the thickness of two webs.

Place the specimen on the testing machine, the support rollers are adjusted so that the distance between them equals the length of the void in the shuttering blocks plus the width of the adjoining web. The specimen is located squarely on the lower rollers with each roller centrally under a web. The upper roller is then located centrally between the two support rollers.

Select a constant loading rate of $(0{,}1 \pm 0{,}05)$ N/mm^2 per second. A constant loading rate should be maintained for at least the second half of loading. For the first part of the assumed maximum load a higher rate of loading is permitted.

B.4 Determining the flexural strength of the shells

B.4.1 General

Record the flexural failure load of the shells ($P_{f,\,msd}$) in N of the six specimens.

h height of shuttering block in mm

a_1 length of hollow space in mm

t_{w1} thickness of web in mm

t_s thickness of shells in mm

ρ filling pressure in N/mm^2

ρ_{max} maximum filling pressure in N/mm^2

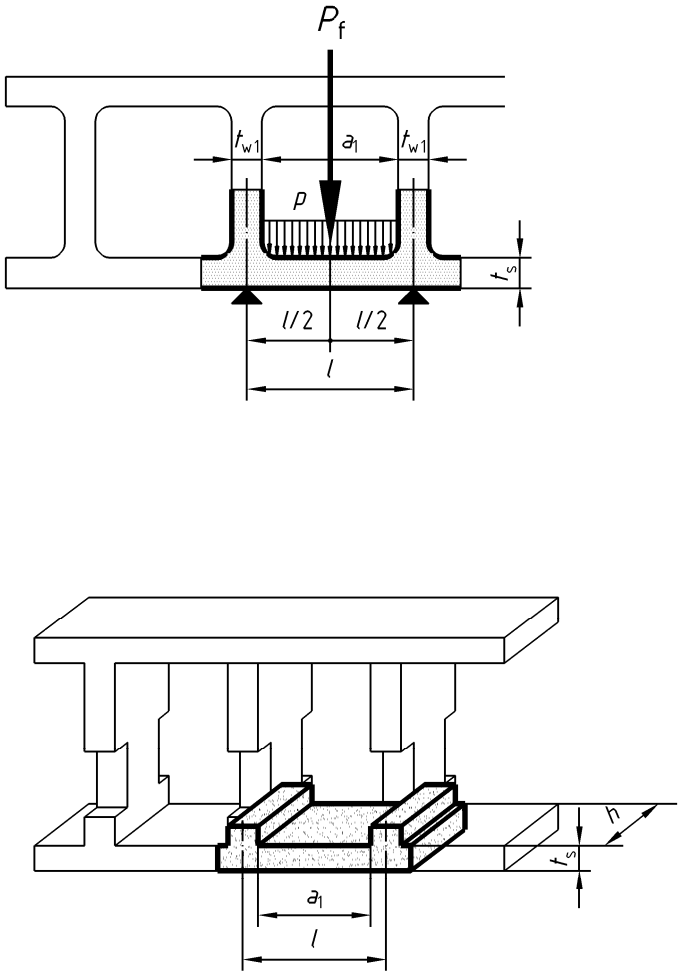
$P_{f,\min}$ minimum shell flexural failure load in N

$P_{f,msd}$ measured shell flexural load in N

$f_{f,\min}$ minimum flexural strength of shells in N/mm^2

$f_{f,msd}$ individual values of flexural strength of shells in N/mm^2

$f_{f,m}$ mean flexural strength of shells in N/mm^2



Where

P_f is the shell flexural load

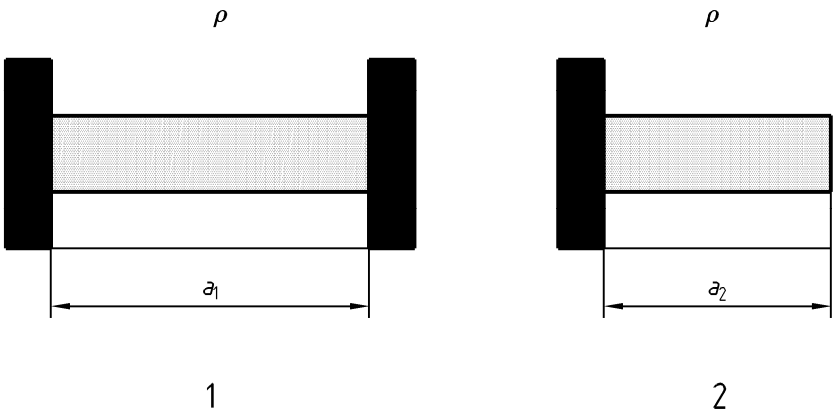
l is the distance between the axis of 2 webs

Figure B.1 — Testing of shell flexural strength

B.4.2 Calculation of the design flexural strength of shells

For each specimen the design shell flexural strength ($f_{f,\min}$) shall be calculated on the basis of the maximum filling pressure of concrete infill ($\rho_{\max}$).

NOTE For calculation of the design shell flexural strength the structural system of a fixed end beam and - as far as given – a cantilever, stressed by a uniformly distributed load, is used.



Key

1 Fixed end beam
2 Cantilever
a_1 Length of hollow space in mm
a_2 Length of cantilevered shell in mm
ρ Filling pressure of concrete infill in N/mm²
$f_{f,\min}$ Design shell flexural strength in N/mm²

Figure B.2 — Static system of calculation design shell flexural strength

— for fixed end part of the shell

$$f_{f,\min} = \frac{\frac{(\rho_{\max} \times h) \times a_1^{\,2}}{24}}{\frac{t_s^{\,2} \times h}{6}} = \frac{(\rho_{\max} \times h) \times a_1^{\,2}}{4 \times t_s^{\,2} \times h} = \frac{\rho_{\max} \times a_1^{\,2}}{4 \times t_s^{\,2}} \qquad \text{(B.1a)}$$

— for cantilevered part of the shell

$$f_{f,\min} = \frac{\frac{(\rho_{\max \times h}) \times a_2^{\,2}}{2}}{\frac{t_s^{\,2} \times h}{6}} = \frac{3 \times \rho_{\max} \times h \times a_2^{\,2}}{t_s^{\,2} \times h} = \frac{3 \times \rho_{\max} \times a_2^{\,2}}{t_s^{\,2}} \qquad \text{(B.1b)}$$

where

$f_{f,\min}$ is the design shell flexural strength in N/mm²;

$\rho_{\max}$ is the maximum filling pressure of concrete infill in N/mm²;

a_1 is the length of hollow space in mm;

a_2 is the length of cantilevered shell

h is the height of shuttering block in mm;

t_s is the thickness of shells in mm.

B.4.3 Measurement of the flexural failure load and calculation of the flexural strength of shells

The shell flexural failure load ($P_{f,msd}$) in N of the six specimens shall be determined:

NOTE In test the system of a suspended beam, stressed by an axial point load, is used.

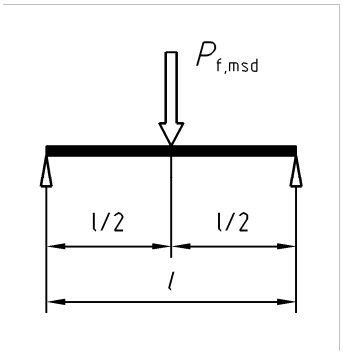


Figure B.3 — Static system of testing the shell flexural failure load

From the measured shell flexural failure load ($P_{f,msd}$) in N calculate the individual values of the shell flexural strength ($f_{f,msd}$) in N/mm².

$$f_{f,msd} = \frac{\frac{P_{f,msd} \times l}{4}}{\frac{t_s^{\,2} \times h}{6}} = \frac{3 \times P_{f,msd} \times l}{2 \times t_s^{\,2} \times h} \qquad \text{(B.2)}$$

where

$f_{f,msd}$ is the individual value of the shell flexural strength in N/mm²;

$P_{f,msd}$ is the measured shell flexural failure load in N;

l is the distance of axis of webs in mm;

t_s is the thickness of shells in mm;

h is the height of shuttering block in mm.

Subsequently, from the individual values of the shell flexural strength ($f_{f,msd}$) calculate the mean flexural strength of shells ($f_{f,m}$) in N/mm².

$$f_{f,m} = \frac{\sum_{i=1}^{6} f_{f,msd,i}}{6} \qquad \text{(B.3)}$$

where

$f_{f,\,m}$ is the mean flexural strength of the shells in N/mm²;

$f_{f,msd,i}$ is the individual values of the shell flexural strength in N/mm².

B.5 Test report

The test report shall contain the following information:

1) laboratory that carried out the tests;
2) date of the tests;
3) description of the shuttering blocks tested;
4) age of the shuttering blocks at the time of the test;
5) individual values of measured shell flexural failure load ($P_{f,\mathrm{msd}}$) in N;
6) $f_{f,\mathrm{min}}$ in N/mm^2;
7) $f_{f,m}$ in N/mm^2.

Annex C
(normative)

Sampling for initial type testing

C.1 General

This sampling procedure shall be used for initial type testing and in the event that there is a requirement for the evaluation of product compliance through independent testing. For independent testing, representatives of all parties must have the opportunity to be present at the time of sampling.

Only those properties declared by the manufacturer shall be evaluated according to this procedure.

The number of shuttering blocks required to determine compliance shall be sampled from a batch of shuttering blocks not exceeding 200 m^3.

NOTE Shuttering blocks manufactured in accordance with this European Standard for which the compliance tests have been inspected by a third party are not normally subject to independent acceptance tests.

C.2 Sampling procedure

NOTE The choice of the sampling method will depend on the physical form of the batch in question.

C.2.1 Random sampling

If possible, the sampling method to be used is a random method whereby all of the shuttering blocks in the batch have an equal probability of being selected as samples. The appropriate number of shuttering blocks shall be chosen at random in positions distributed throughout the batch, without considering the quality of the shuttering blocks selected, with the exception of shuttering blocks damaged during transport, which shall not be selected.

NOTE In practice, random sampling of specimens is only normally appropriate if the shuttering blocks forming the batch are moved in loose form (not packed) from one place to another, or if they have been divided into a large number of small stacks, e.g. on scaffolding awaiting laying.

C.2.2 Representative sampling

C.2.2.1 General

If random sampling of specimens is impossible or inconvenient (e.g. if the shuttering blocks form one or more large stack(s) with easy access to only a limited number of shuttering blocks), representative sampling must be used.

C.2.2.2 Sampling from a stack

The batch shall be divided into at least six real or imaginary parts, each the same size. An even number of blocks must be chosen at random from each part in order to obtain the required number of shuttering blocks without considering the quality of those selected, with the exception of shuttering blocks damaged during transport, which shall not be selected.

NOTE It will be necessary to remove some parts of the stack or stacks in order to gain access to the shuttering blocks located in the middle of such stacks when taking samples.

C.2.2.3 Sampling from a batch made up of pallets

At least six pallets shall be selected at random from the batch. The packaging must be removed and an equal number of shuttering blocks must be selected at random from each of the opened pallets in order to obtain the required number of shuttering blocks without any consideration being given to their quality, with the exception of shuttering blocks damaged during transport, which shall not be selected.

C.2.3 Dividing the sample

When the sample of shuttering blocks is to be used for more than one test, the total number shall be collected together and then divided by taking shuttering blocks at random from the total sample to form each successive sub-sample.

C.2.4 Number of shuttering blocks required for testing

The number of samples for each test shall comply with Table C.1.

Table C.1 — Number of shuttering blocks required for a test

Property	subclause number	Test method	Number of shuttering blocks per sample [a]	
			1st sample n_1	2nd sample n_2
Geometric properties	4.4	See 5.1 EN 772-16 EN 772-20	6	6
Density	4.5	See 5.2	3	6
Moisture movement	4.6	EN 772-14	6	6
Reaction to fire	4.7	EN 13501-1	3, except for Euroclass A1 (without testing)	
Water vapour permeability	4.8	Tabulated value or EN ISO 12572		
Mechanical strength	4.9	See 5.3	6	10
Acoustic properties	4.10	See NOTE 2 of 4.10	-	-
Thermal properties	4.11	Tabulated value or EN 12664		
Water absorption by capillarity	4.12	EN 772-11	3	6
Durability	4.13	Provisions valid in the intended place of use		

[a] As appropriate, for example, when the shuttering blocks are not damaged by a test, the same shuttering block may be used for different tests.

C.3 Place and dates of inspection and acceptance testing

The location of the laboratory or place of inspection and testing, the dates and representation of the parties shall be subject to agreement between them. The agreed tests shall be carried out in the sequence agreed by the parties. If a particular property of a batch of shuttering blocks is found to be non-compliant (as described in Annex D), the remaining tests may be carried out by agreement between the parties.

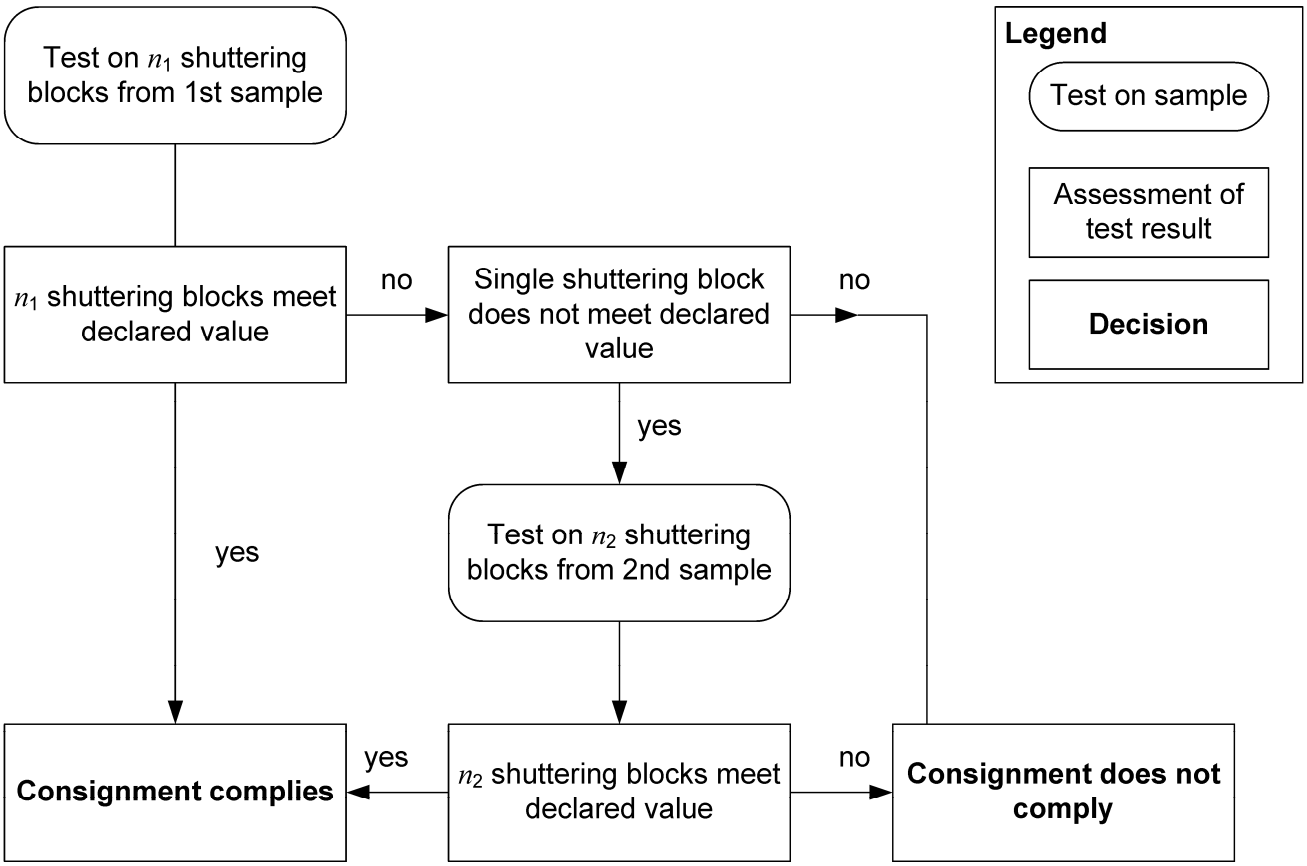
Annex D
(normative)

Compliance criteria for initial type testing and for independent batch acceptance testing

The results of tests on shuttering blocks shall comply with the specifications given in Clause 4 or with the values for the properties stated by the manufacturer.

The evaluation of compliance shall be based on the procedure shown in Figure D.1.

Compliance criteria for initial type testing and for independent batch acceptance testing:



Key

n_1 and n_2 are as given in Table C.1

Figure D.1 — Compliance evaluation procedures

Annex E
(informative)

Example of inspection schemes

E.1 Equipment inspection

Subject		Aim	Method	Frequency [1)]
E.1.1 Testing and measuring equipment				
All testing and measuring equipment		Correct functioning and accuracy	Where applicable calibrating against equipment which has been calibrated traceable to national standards and is used exclusively for this purpose except as indicated in the test method	on (re)installation, after major repair or once per year
E.1.2 Storage and production equipment				
1	Storage of materials	Absence of contamination	Visual inspection or other appropriate method	— on installation — weekly
2	Weighing or volumetric batching equipment	Correct functioning	Visual inspection	Daily
3		Block manufacturer's declared accuracy	Calibrating against equipment which is used exclusively for this purpose	— on (re)installation — Weighing: once a year — Volumetric: twice a year — in case of doubt
4	Mixers	Wear and correct functioning	Visual inspection	Weekly
5	Moulds	Cleanliness and condition	Visual inspection	before using

1) Or as stated in FPC documentation.

E.2 Materials inspection

Subject		Aim	Method	Frequency [1]
E.2.1 All materials				
1	All materials	To ascertain that the consignment is as ordered and from the correct source	Inspection of delivery ticket and/or label on the package showing conformity with the order	each delivery
E.2.2 Materials not submitted to an assessment of conformity before delivery [2]				
1	Cement and other cementitious materials	Conformity with manufacturer's requirements	Appropriate test method	each delivery
2	Aggregates	Conformity with manufacturer's requirements	Visual inspection	each delivery
3	Admixture	Conformity with manufacturer's requirements	Inspection of delivery ticket and/or label on the package showing conformity with the order	each delivery
4	Additions/ pigments	Conformity with manufacturer's requirements	Inspection of delivery ticket and/or label on the package showing conformity with the order	each delivery
5	Water not taken from a public distribution system	Conformity with manufacturer's requirements	Compliance with EN 1008	— first use of new source — in case of doubt
6	Recycled water	Check for solid content and other contaminants	Visual	Weekly
7			Manufacturer's method	in case of doubt

[1] Or as stated in FPC documentation.

[2] Materials not audited by the manufacturer or by a third party acceptable to the manufacturer.

E.3 Production process inspection

Subject		Aim	Method	Frequency [1)]
1	Mixture composition	Conformity with intended composition (weight or volumetric batched)	— Visual on measuring and weighing equipment — Checking against production process documents	Daily
2	Fresh concrete	Correct mixing	Visual check	daily for each mixer
3	Production	Conformity with documented factory procedures	Checking actions against factory procedures	Daily
[1)] Or as stated in FPC documentation.				

E.4 Product inspection

Subject		Aim	Method	Frequency [1, 2,3, 4)]
E.4.1 Product testing				
1	Visual aspects	Compliance with provisions of manufacturer	Visual check	daily
3	Geometrical characteristics	See 4.4.1	See 5.1	weekly one block per machine and type of block
4	Density	See 4.5	See 5.2	weekly one block per machine and type of block
5	Mechanical strength	See 4.9	See Annex A and B	weekly one block per machine and type of block
E.4.2 Marking, storage, delivery				
1	Marking	Marking of product according to Clause 7	Visual check	daily
2	Storage	Segregation of non-conforming product	Visual check	daily
3	Delivery	Correct delivery age, loading and loading documents	Visual check	daily

1) Or as stated in FPC documentation.

2) Initial type testing according to 8.2 of this standard not included.

3) The switching rules apply (see E.5).

4) See 8.1.

E.5 Switching rules

E.5.1 Normal inspection

The rate of sampling should be in accordance with E.4.1.

E.5.2 Normal to reduced inspection

Reduced inspection corresponds to half the rate of normal inspection [1)].

It should be used when normal inspection is effective and the preceding 10 successive samples have been accepted.

A supplementary reduced inspection is allowed if the same conditions as above are satisfied under reduced inspection.

This supplementary reduced inspection should correspond to half the rate of the reduced inspection.

E.5.3 Reduced to normal inspection

When reduced inspection or supplementary reduced inspection is in effect, normal inspection should be reinstated if any of the following occurs :

— sample is not accepted ;

— production becomes irregular or delayed ;

— other conditions warrant that normal inspection should be instituted.

E.5.4 Tightened inspection

Tightened inspection requires the number of blocks in the sample to be doubled.

It should be used if during normal inspection two out of five successive samples fail.

E.5.5 Tightened to normal inspection

Tightened inspection should continue until five successive samples are accepted.

Then normal inspection may be resumed.

E.5.6 Stopped production

If production remains on tightened inspection for ten successive samples, the production line should be deemed to be out of control and stopped.

The production system should be reviewed and any necessary changes made.

Having corrected the production system, production should start again on tightened inspection.

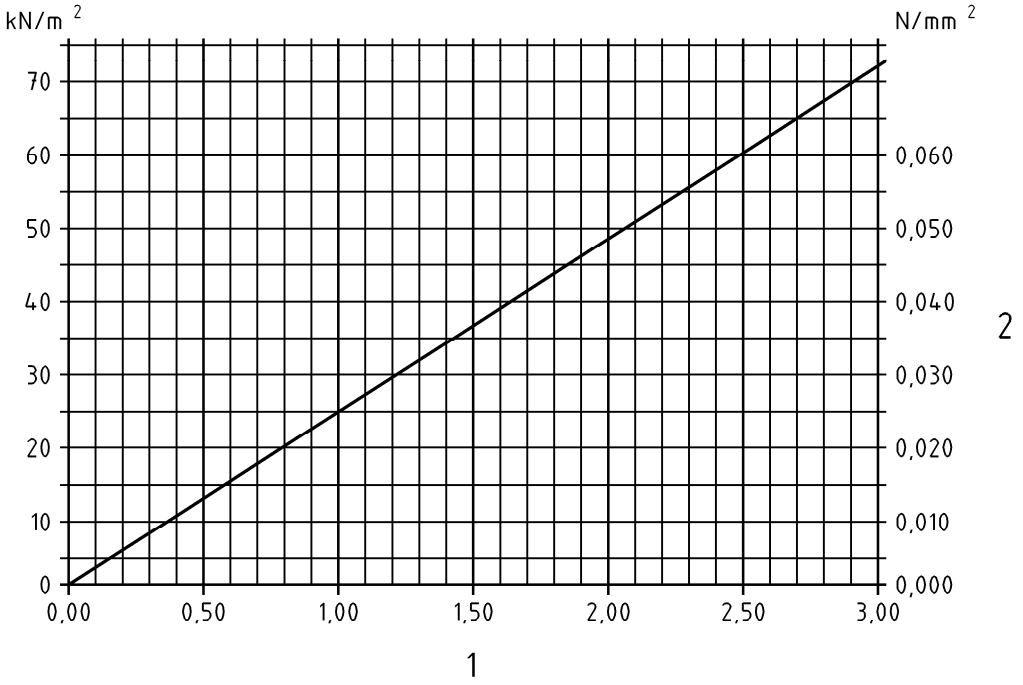
1) If the number of blocks in the sample is even, the reduction should be performed by dividing the number of blocks by two. In the other cases, the rate of sampling should be reduced by two.

Annex F
(informative)

Filling pressure of concrete infill

Figure F.1 gives the relationship between concrete filling pressure versus recommended filling height for the determination of the design shell flexural strength and design web tensile strength.

This relationship may be used in the absence of a specific determination of concrete filling pressure.



Key

1 Filling height of concrete (m)
2 Filling pressure of concrete

Figure F.1 — Filling pressure of self compacting concrete (24 kN/m^3)

Annex ZA
(informative)

Clauses of this European Standard addressing the provisions of the EU Construction Products Directive

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under mandate M/100 [1)] "Precast Concrete Products", given to CEN by the European Commission and the European Free Trade Association.

The articles of this European Standard shown in this annex comply with the requirements of the mandate given pursuant under the EU Construction Products Directive (89/106/EEC).

Compliance with these clauses confers a presumption of fitness of the concrete shuttering blocks covered by this European Standard for the intended use; reference shall be made to the information accompanying the CE marking.

WARNING — Other requirements and other EU Directives, not affecting suitability for the intended use, can be applicable to the concrete shuttering blocks falling within the scope of this European Standard.

NOTE 1 In addition to any specific clauses relating to dangerous substances contained in this standard, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements must also be complied with, when and where they apply.

NOTE 2 An informative database of European and national provisions on dangerous substances is available on the Construction web site page on EUROPA web site accessed through http://europa.eu.int/comm/enterprise/construction/internal/dangsub/dangmain.htm.

This annex establishes the conditions for the CE marking of the normal weight and lightweight concrete shuttering blocks intended for the uses indicated in Table ZA.1 and show the relevant clauses applicable:

This annex as the same scope as Clause 1 of this standard and defined by Table ZA.1.

1) As amended.

Table ZA.1 — Scope and applicable articles

Product: non-load bearing hollow concrete shuttering blocks Intended use: shuttering blocks intended to be laid dry, or with mortar, and then filled with concrete or mortar for the production of external walls, internal walls and partitions			
Essential characteristics	Requirements Clauses of this European Standard	Levels and/or classes	Notes
Detailing	4.4.1 and 4.4.2	None	Declared values in mm and mm^2
Drying shrinkage / Moisture movement	4.6	None	Declared value in mm/m
Reaction to fire (only for shuttering blocks intended to be used in elements subject to fire requirements)	4.7	Euroclasses A1 to F	Declared reaction to fire
Water vapour permeability (for shuttering blocks intended for use in external walls)	4.8	None	Declared coefficient [1)]
Mechanical strength — Tensile strength of webs — Flexural strength of shells	 4.9.2 4.9.3	 None None	 Declared value in N/mm^2 when relevant (see 4.9.2) Declared value in N/mm^2
Airborne sound insulation	4.10	None	Declared value [1)] for the mass of the shuttering blocks in kg/m^2
Thermal resistance	4.11	None	Declared value [1)]
Durability	4.13	None	Declared value or declared text "do not leave exposed"
[1)] Those characteristics depend on details (layer composition) and other constituents of finished walls.			

The requirement on certain characteristic is not applicable in those Member States where there are no regulatory requirements on that characteristic for the intended use of the product. In this case, manufacturers placing their products on the market of these Member States are not obliged to determine or declare the performance of their products with regard to this characteristic and the option "No performance determined" (NPD) in the information accompanying the CE marking (see Table ZA.3) may be used. The NPD option may not be used, however, where the characteristic is subject to a threshold level.

ZA.2 Procedure for attestation of conformity of concrete shuttering blocks

ZA.2.1 Systems of attestation of conformity

The system of attestation of conformity of non-load bearing hollow concrete shuttering blocks, indicated in Table ZA.1, in accordance with the decision of the Commission 1999/94/EC of 25 January 1999 as given in Annex III of Mandate M/100 “Precast concrete products”, is described in Table ZA.2 for the intended uses and relevant levels or classes:

Table ZA.2 — System(s) of attestation of conformity

Product(s)	Intended Use(s)	Level(s) or class(es)	Attestation of conformity system(s)
Non-load bearing hollow concrete shuttering blocks	Shuttering blocks intended to be laid dry, or with mortar, and then filled with concrete or mortar for the production of externals walls and partitions	—	4 [a]
[a] System 4: see Directive 89/106/EEC (CPD), annex III.2.(ii), third possibility.			

The attestation of conformity of the non-load bearing hollow concrete shuttering blocks in Table ZA.1 must be based on the evaluation of the attestation of conformity procedures indicated in Table ZA.3 resulting from the application of the clauses of this European Standard or other European Standard indicated herein.

Table ZA.3 — Assignment of evaluation conformity tasks for shuttering blocks under system 4

Tasks		Task content	Evaluation of the conformity articles to apply
Tasks under the responsibility of the manufacturer	Factory production control (F.P.C)	Parameters relating to all applicable characteristics in Table ZA.1	8.3
	Initial type testing by the manufacturer	All applicable characteristics in Table ZA.1	8.2
	Initial type testing by the notified laboratory	Reaction to fire	4.7

ZA.2.2 EC Certificate and Declaration of conformity

When compliance with this annex is achieved, the manufacturer or his agent established in the EEA shall draw up and retain a declaration of conformity (EC Declaration of conformity), which entitles the manufacturer to affix the CE marking. This declaration must mention:

— name and address of the manufacturer, or his authorised representative established in the EEA, and place of production;

NOTE 1 The manufacturer may also be the person responsible for placing the product onto the EEA market, if he takes responsibility for CE marking.

— description of the product (type, identification, use, etc.), and a copy of the information accompanying the CE marking;

NOTE 2 Where some of the information required for the Declaration is already given in CE marking information it does not need to be repeated.

— provisions to which the product conforms (i.e. Annex ZA of this EN), and a reference to the ITT report(s) and factory production control records;

— particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc.);

— name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or his representative.

The above mentioned EC declaration and certificate shall be presented in the language or languages of the Member State in which the product is to be used.

ZA.3 CE marking and labelling

The manufacturer or his authorised representative established within the EEA is responsible for the affixing of the CE marking. The CE marking symbol to affix shall be in accordance with Directive 93/68/EEC and shall be shown on the shuttering block (or, when not possible, it may be on the accompanying label, the packaging or on the accompanying commercial documents e.g. a delivery note). The following information shall accompany the CE marking symbol:

— name or identifying mark and registered address of the manufacturer;

— the last two digits of the year in which the marking is affixed;

— the reference to this European Standard;

— description of the product: generic name, material, dimensions, … and intended use;

— information on those relevant essential characteristics listed in Table ZA.1 which are to be declared presented as:

  — declared values and, where relevant , level or class (including “pass” for pass/fail requirements, where necessary) to declare for each essential characteristic as indicated in "Notes" to Table ZA.1;

  — “No performance determined” for characteristics where this is relevant.

The “No performance determined” (NPD) option may not be used where the characteristic is subject to a threshold level. Otherwise, the NPD option may be used when the characteristic, for a given intended use, is not subject to regulatory requirements in the Member State of destination.

Figure ZA.1 gives an example of the information to be given on the product, label, packaging and/or commercial documents.

CE	*CE conformity marking, consisting of the "CE"-symbol given in directive 93/68/EEC.*
AnyCo Ltd,PO Box 21 B-1050	*Name or identifying mark and registered address of the producer*
07	*Last two digits of the year in which the marking was affixed*
EN 15435	*No. of this European standard*
Normal weight concrete shuttering block for use in internal and external walls	*Product description and manufacture identification code / name and information on the regulated specifications*
Reaction to fire — A1	
Water vapour permeability — 5/15	
Mechanical strength	
— tensile strength of webs — 0,8 N/mm^2	
— flexural strength of shells — 1,2 N/mm^2	
Airborne sound insulation / Mass — NPD	
Detailing :	
— dimensions — : xxx mm	
— dimensions tolerances — : xxx mm	
— web recess area — : xxx mm^2	
Drying shrinkage /	
Moisture movement — 0,45 mm/m	
Thermal conductivity — NPD	
Durability — NPD	

Figure ZA.1 — Example of CE marking information

In addition to any specific information relating to dangerous substances shown above, the product should also be accompanied, when and where required and in the appropriate form, by documentation listing any other legislation on dangerous substances for which compliance is claimed, together with any information required by that legislation.

NOTE 1 European legislation without national derogations need not be mentioned.

NOTE 2 Affixing the CE marking symbol means, if a product is subject to more than one directive that it complies with all applicable directives.

Bibliography

[1] EN 772-1, *Methods of test for masonry units — Part 1: Determination of compressive strength*

[2] EN 1008, *Mixing water for concrete — Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete*

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