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Agrément Certificate
20/5774
Product Sheet 1

PRECAST CONCRETE SHUTTERING BLOCKS SYSTEM

STEPOC STRUCTURAL SHUTTERING BLOCK SYSTEM

This Agrément Certificate Product Sheet (1) relates to the Stepoc Concrete Shuttering System, comprising hollow concrete shuttering blocks which are dry laid and combined with infill concrete and steel reinforcement to form a reinforced masonry wall. The system is for use above and below ground level in internal, external and retaining walls subjected to vertical and lateral loadings in orthogonal directions.

(1) Hereinafter referred to as 'Certificate'.

CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Strength and stability — the system is suitable for use above and below ground level in internal, external and retaining walls subjected to vertical and lateral loadings in orthogonal directions (see section 6).

Behaviour in relation to fire — Stepoc blocks, infill concrete and steel reinforcing bars have a reaction to fire classification of A1 as defined in the national Building Regulations (see section 9).

Durability — the system will have a service life of not less than 50 years (see section 14).

The BBA has awarded this Certificate to the company named above for the system described herein. This system has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

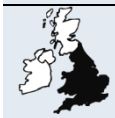
On behalf of the British Board of Agrément

Date of First issue: 25 February 2021

Hardy Giesler
Chief Executive Officer

Regulations

In the opinion of the BBA, the Stepoc Concrete Shuttering System, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):



The Building Regulations 2010 (England and Wales) (as amended)

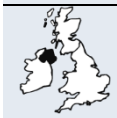
Requirement:	**A1**	**Loading**
Comment:		The system can sustain and transmit the design loads to the foundation or supporting structure. See section 6 of this Certificate.
Requirement:	**A2**	**Ground movement**
Comment:		Walls designed for, and constructed from, the system can satisfy this Requirement. See section 6.1 of this Certificate.
Requirement:	**A3**	**Disproportionate collapse**
Comment:		The system can contribute to a construction satisfying this Requirement. See section 6 of this Certificate.
Requirement:	**B3(1)(2)(3)(a)(4)**	**Internal fire spread (structure)**
Comment:		The system can contribute to a construction satisfying this Requirement. See section 9 of this Certificate.
Requirement:	**B4(1)**	**External fire spread**
Comment:		The system can contribute to a construction satisfying this Requirement. See section 9 of this Certificate.
Requirement:	**C2(a)**	**Resistance to moisture**
Comment:		The system can contribute to satisfying this Requirement. See sections 10.1 to 10.3 of this Certificate
Requirement:	**E1**	**Protection against sound from other parts of the building and adjoining buildings**
Requirement:	**E2(a)**	**Protection against sound within a dwelling-house etc**
Comment:		Walls constructed from the system can contribute to satisfying these Requirements. See sections 8.1 and 8.2 of this Certificate.
Regulation:	**7(1)**	**Materials and workmanship**
Comment:		The system is acceptable. See section 14 and the *Installation* part of this Certificate.
Regulation:	**7(2)**	**Materials and workmanship**
Comment:		The system is acceptable. See section 9 of this Certificate.

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	**8(1)**	**Durability, workmanship and fitness of materials**
Comment:		The system satisfies the requirements of this Regulation. See section 14 and the *Installation* part of this Certificate.
Regulation:	**9**	**Building standards applicable to construction**
Standard:	1.1(a)(b)	Structure
Comment:		The system can sustain and transmit the design loads to the foundation or supporting structure. See section 6 of this Certificate.

Standard:	1.2	Disproportionate collapse
Comment:		The system can contribute to a construction satisfying this Standard. See section 6 of this Certificate.
Standard	2.1	Compartmentation
Standard:	2.2	Separation
Standard:	2.3	Structural protection
Standard:	2.5	Internal linings
Standard:	2.6	Spread to neighbouring buildings
Standard:	2.7	Spread on external walls
Standard:	2.9	Escape
Comment:		The system can contribute to a construction satisfying these Standards, with reference to clauses 2.1.1(2), 2.1.8(2), 2.1.9(2), 2.1.10(2), 2.1.11(2), 2.1.12(2) and 2.1.13(2), 2.2.2 to 2.2.5(1)(2), 2.2.6(1)(2), 2.2.7(1)(2), 2.3.1(1)(2), 2.3.2(1)(2), 2.3.3(1)(2), 2.3.4(1)(2), 2.3.5(1)(2), 2.5.1(1)(2), 2.6.1(1)(2), 2.6.2(1)(2), 2.6.3(1)(2), 2.6.5(1)(2), 2.6.6(1)(2), 2.6.7(1)(2), 2.7.0 (1)(2), 2.9.1(1)(2), 2.9.2(1)(2), 2.9.3(1)(2), 2.9.5(1)(2), 2.9.11(1)(2), 2.9.12(1)(2) and 2.9.13(1)(2). See section 9 of this Certificate.
Standard:	3.4	Moisture from the ground
Comment:		The system can contribute to satisfying this Standard. See sections 10.1 to 10.3 of this Certificate.
Standard:	5.1	Noise separation
Comment:		Walls constructed from the system can contribute to satisfying this Standard, with reference to clauses 5.1.1(1)(2) to 5.1.5(1)(2). See sections 8.1 and 8.2 of this Certificate.
Standard:	5.2	Noise reduction between rooms
Comment:		Walls constructed from the system can contribute to satisfying this Standard, with reference to clauses 5.1.1(1)(2), 5.1.2(1)(2), 5.1.4(1)(2), 5.1.7(2), 5.1.8(1), 5.2.1(1)(2) and 5.2.2(1)(2). See sections 8.1 and 8.2 of this Certificate.
Regulation:	**12**	**Building standards applicable to conversions**
Comment:		Comments given for this system under Regulation 9, Standards 1 to 6, also apply to this Regulation, with reference to clause 0.12.1(1)(2) and Schedule 6(1)(2).

(1) Technical Handbook (Domestic).
(2) Technical Handbook (Non-Domestic).



The Building Regulations (Northern Ireland) 2012 (as amended)

Regulation:	**23(a)(i)(iii)(b)(i)**	**Fitness of materials and workmanship**
Comment:		The system is acceptable. See section 14 and the *Installation* part of this Certificate.
Regulation:	**28(a)**	**Resistance to moisture and weather**
Comment:		Suitably finished walls constructed from the system can contribute to satisfying this Regulation. See sections 10.1 to 10.3 of this Certificate.
Regulation:	**30(a)**	**Stability**
Comment:		The system can sustain and transmit the design loads to the foundation or supporting structure. See section 6 of this Certificate.
Regulation:	**31**	**Disproportionate collapse**
Comment		The system can contribute to a construction satisfying this Regulation. See section 6 of this Certificate.

Regulation:	**35**	**Internal fire spread — Structure**
Regulation:	**36(a)**	**External fire spread**
Comment:		The system can contribute to a construction satisfying these Regulations. See section 9 of this Certificate.
Regulation:	**49**	**Protection against sound from other parts of the building and from adjoining buildings**
Regulation:	**50(a)**	**Protection against sound within a dwelling or room for residential purposes**
Comment:		Walls constructed from the system can contribute to satisfying these Regulations. See sections 8.1 and 8.2 of this Certificate.

Construction (Design and Management) Regulations 2015
Construction (Design and Management) Regulations (Northern Ireland) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

See sections: *3 Delivery and site handling* (3.1, Table 4) and *18 Procedure* (18.26).

Additional Information

NHBC Standards 2021

In the opinion of the BBA, the Stepoc Concrete Shuttering System, with steel reinforcement and concrete infill, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements in relation to NHBC Standards, Chapters 3.1 *Concrete and its reinforcement*, 5.1 *Substructure and ground bearing floors*, 6.1 *External masonry walls,* 6.3 *Internal walls* and 10.2 *Drives, paths and landscaping.*

CE marking

The Certificate holder has taken the responsibility of CE marking the Stepoc Blocks in accordance with harmonised European Standard BS EN 15435 : 2008.

Technical Specification

1 Description

1.1 The Stepoc Concrete Shuttering System consists of precast concrete blocks (200, 256 and 325 mm width) with concrete infill of strength class C32/40 in accordance with BS EN 206 : 2013, and reinforced with steel reinforcement. The Stepoc blocks form a temporary shutter and, when the concrete infill is cured, form a load bearing or non-load bearing shell for external, internal and retaining walls. See Figures 1, 2 and 3 of this Certificate for various configurations of Stepoc concrete blocks 200, 256 and 325 mm used as single skin.

1.2 The blocks are manufactured in accordance with BS EN 15435 : 2008, with the nominal characteristics given in Table 1 of this Certificate. The reaction to fire, water vapour permeability, dry shrinkage/ moisture movement, declared thermal conductivity and durability of the blocks are as follows:

- Reaction to fire: Euroclass A1
- Water vapour permeability (μ): 5/15
- Dry shrinkage/ moisture movement ($mm.m^{-1}$): 0.52
- Declared thermal conductivity ($W \cdot m^{-1} \cdot K^{-1}$): 1.00
- The Stepoc blocks have suitable durability for use in exposure class XF2.

Table 1 Nominal characteristics and dimension details of Stepoc 200, 256 and 325 blocks

Stepoc type	Dimensions L x W x H (mm)	Web recess area (mm^2)	Flexural strength of shells ($N.mm^{-2}$)	Tensile strength of webs ($N.mm^{-2}$)
200 Full-length standard (L2)	400 x 200 x 225	8720	6.40	-
200 Full-length plain end (L3)	400 x 200 x 225	3960	5.60	
200 Half-length plain end (L4)	200 x 200 x 225	0	4.90	
256 Full-length standard (V2)	400 x 256 x 225	13100	6.40	
256 Full-length plain end (V3)	400 x 256 x 225	6370	6.40	
256 One-third length standard (V5)	133 x 256 x 225	6370	5.90	
256 One-third length plain end (V6)	133 x 256 x 225	0	5.90	
325 Full-length standard (Z2)	325 x 325 x 225	26050	7.40	1.00
325 Full-length plain end (Z3)	325 x 325 x 225	16110	6.40	1.00
325 Half-length standard (Z4)	162.5 x 325 x 225	16110	5.70	1.00

1.3 The concrete for the blocks complies with BS EN 206 : 2013, BS 8500-1 : 2015 and BS 8500-2 : 2015, with the addition of an admixture complying with BS EN 934-6 : 2019.

Table 2 Specification of concrete for Stepoc blocks

Description	**Characteristic**
Strength class	C32/40
Minimum cement content	380 $kg.m^{-3}$
Cement and combination types	Cement and combination types to suit the design chemical class (DC-Class) up to DC-2 in accordance with Tables A.6 and A.12 of BS 8500 -1 : 2015. See the Durability section of this Certificate
Maximum w/c ratio	According to Table A.12 of BS 8500-1 : 2015, to suit the DC-Class up to DC-2
Aggregate	Maximum aggregate size must be 10 mm; aggregate must comply with BS EN 12620 : 2002

1.4 Stepoc 200 blocks are 200 mm wide and accommodate a single layer of vertical and horizontal reinforcement laid in a half-bond configuration. The range of blocks is shown below (see Figure 1 of this Certificate for further detail).

- Full-length standard (L2)
- Full-length plain end (L3)
- Half-length plain end (L4)

1.5 Stepoc 256 blocks are 256 mm wide, can accommodate two layers of horizontal reinforcement and are laid in a one-third-bond configuration. Stepoc 256 can accommodate up to two layers of vertical reinforcement, where necessary, to achieve the required structural resistance. The range of blocks is shown below (see Figure 2 of this Certificate for further detail).

- Full-length standard (V2)
- Full-length plain end (V3)
- Third-length standard (V5)
- Third-length plain end (V6)

1.6 Stepoc 325 blocks are 325 mm wide, can accommodate two layers of horizontal reinforcement and are laid in a half-bond configuration. Stepoc 325 can accommodate up to two layers of vertical reinforcement, where necessary, to achieve the required structural resistance. The range of blocks is shown below (see Figure 3 of this Certificate for further detail).

- Full-length standard (Z2)
- Full-length plain end (Z3)
- Half-length standard (Z4)

Figure 1 Configurations of Stepoc 200 blocks: full-length standard, full-length plain end and half-length plain end. All blocks are 225 mm high (all dimensions in mm)

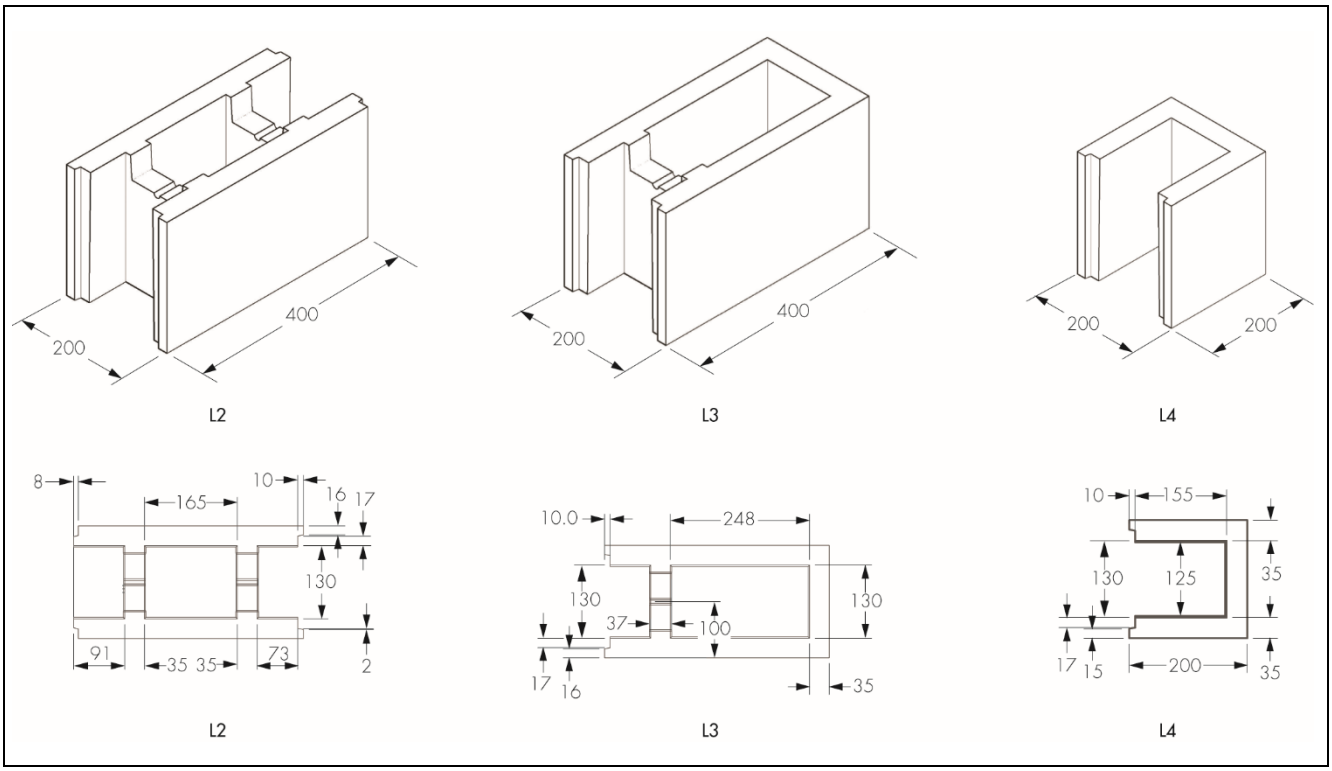


Figure 2 Configurations of Stepoc 256 blocks: full-length standard, full-length plain end, third-length standard and third-length plain end. All blocks are 225 mm high (all dimensions in mm)

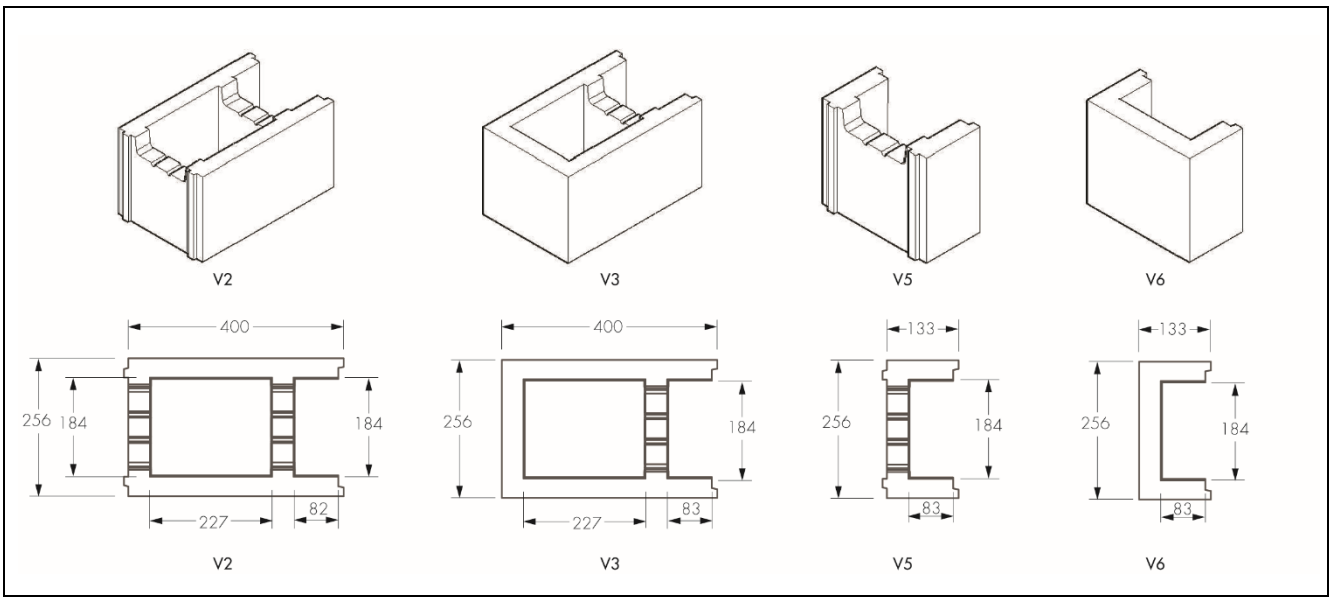
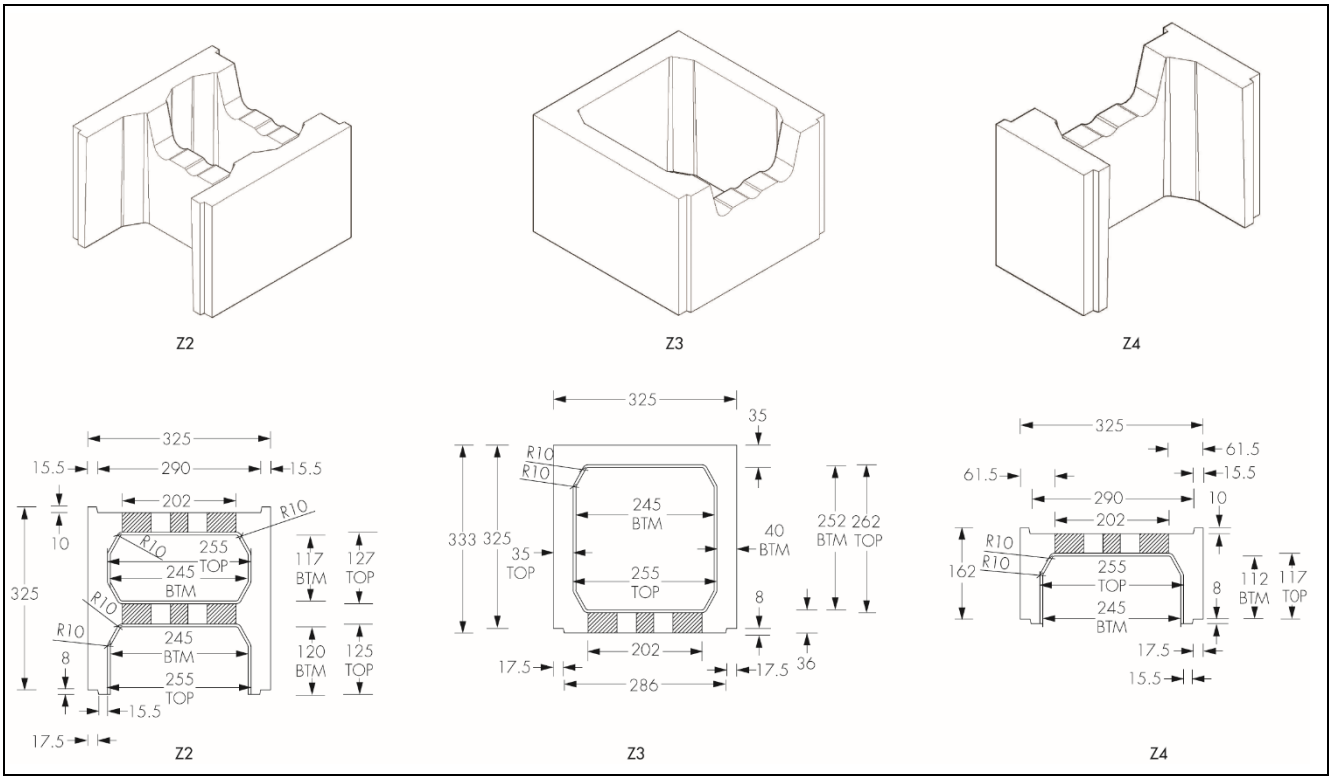


Figure 3 Configurations of Stepoc 325 blocks: full-length standard, full-length plain end and half-length standard. All blocks are 225 mm high (all dimensions in mm)



1.7 The manufacturing tolerances of the blocks in height, length and width are ±2 mm.

1.8 The specification of concrete for the blocks is defined in Table 2 of this Certificate.

1.9 The specification of concrete infill, steel reinforcement and mortar used in conjunction with the Stepoc Concrete Shuttering System, but not manufactured by the Certificate holder, is shown in Table 3 of this Certificate.

Table 3[(1)] Specification of infill concrete and specification of reinforcement used with Stepoc Concrete Shuttering System

Description		**Characteristic**
Concrete infill	Strength class	C32/40
	Minimum cement content	380 kg.m^{-3}
	Cement and combination types	Cement and combination types to suit the design chemical class (DC-Class) up to DC-2 in accordance with Tables A.6 and A.12 of BS 8500 -1 : 2015. See the Durability section of this Certificate. See also section 14 (Durability) of this Certificate
	Maximum w/c ratio	According to Table A.12 of BS 8500-1 : 2015, to suit the DC-Class
	Consistency class	S4 (150 mm) in accordance with BS 8500-1 : 2015
	Aggregate	Maximum aggregate size must be 10 mm; aggregate must comply with BS EN 12620 : 2002
	Admixture / Super-plasticiser	As per manufacturer's instructions and BS EN 934-2 : 2009
	Minimum concrete cover to reinforcement	15, 30 and 40 mm for exposure classes MX1, MX2 and MX3 respectively (refer to Table NA.9 of NA to BS EN 1996-1-1 : 2005
Steel reinforcement		Steel reinforcement H8, H10, H12, H16, H20, H25 and H32 bars to BS 8666: 2005, with a characteristic yield strength (f_{yk}) of 500 N·mm^{-2}. Steel reinforcement should comply with BS 4449 : 2009.
Mortar strength classes		M6 to M12 To be specified by a suitably experienced and qualified engineer (see also sections 4.3, 4.6, 14.1, 14.4, 14.6 and 14.7 of this Certificate).

(1) The standard infill concrete is in accordance with BS EN 206 : 2013, BS 8500-1 : 2015 and BS 8500-2 : 2015, with the addition of a super-plasticiser and reinforced with steel reinforcement. Concrete must be manufactured in plants covered by the Quality Scheme for Ready Mixed Concrete (QSRMC), BSI Kitemark or equivalent quality scheme and placed by personnel with appropriate skill and experience.

1.10 Ancillary items outside the scope of this Certificate include:

- where required, gas barrier membranes with third-party approval
- damp-proof membranes (dpm), with third-party approval
- damp-proof course (dpc), with third-party approval
- sealant for sealing around the reinforcement rebar at position of dpc
- temporary propping or bracing during concreting
- renders, plasterboards and other interior or exterior finishes
- sealant, flexible joint filler and polyethylene backing strip used in movement joint
- waterproofing membrane
- wall ties in accordance with BS EN 845-1 : 2013
- tie-wire to tie the horizontal reinforcement to the vertical reinforcement
- masonry ties, tension straps, hangers and brackets, conforming to BS EN 845-1 : 2013
- lintels, conforming to BS EN 845-2 : 2013
- pipe, used for drainage of retaining wall
- granular and selected fill material, for bedding and backfilling of flexible or rigid drain pipes
- wall insulation
- geotextiles and/or filter membranes with third-party approval
- fixings.

2 Manufacture

2.1 Stepoc blocks are manufactured to harmonised standard EN 15435 : 2008. Stepoc blocks are manufactured to tolerances as defined in section 1.7 of this Certificate, using aggregates which satisfy BS EN 12620 : 2002 and cement to BS EN 197 : 2011.

2.2 The blocks are extrusion-cast using conventional concrete moulding techniques.

2.3 Extruded blocks are kiln-cured for a minimum of 24 hours; the blocks are then palletised and shrink-wrapped.

2.4 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained

2.5 The management system of Anderton Concrete Products Ltd has been assessed by the BSI and registered as meeting the requirements of BS EN ISO 9001 : 2015 (certificate FM559191).

3 Delivery and site handling

3.1 The blocks are supplied in banded cubes on pallets which can be handled by forklift trucks or mechanical grabs. The blocks should be stored on dry, level ground and must be carefully unloaded and stacked; particular attention must be paid to blocks being used for facings without an additional finish, to preserve the arises and avoid face damage.

3.2 Good site practice should be observed to prevent damage to the components.

3.3 Stepoc blocks must be protected on building sites from saturation by rain, snow and rising damp, both when they are stacked on site before use and whilst walls are being built. If necessary, blocks should be covered.

3.4 The dry density of the blocks in accordance with BS EN 772-13 : 2000 is 2000 kg.m^{-3}. The mass of each block, number of blocks per pack and mass per pack are given in Table 4.

Table 4 Mass of each Stepoc block, number of blocks per pack and mass per pack

Type of Stepoc block	Mass of each block (kg)	No. of blocks per pack	Mass per pack of blocks kg
200 (L2)	17.3	40	692.0
200 (L3)	16.9	40	676.0
200 (L4)	8.4	80	672.0
256 (V2)	19.9	32	636.8
256(V3)	19.9	32	636.8
256(V5)	7.5	96	720.0
256(V6)	7.6	96	729.6
325 (Z2)	19.9	24	477.6
325(Z3)	19.9	24	477.6
325(Z4)	9.8	48	470.4

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the Stepoc Concrete Shuttering System.

Design Considerations

4 Use

4.1 Stepoc concrete blocks are satisfactory for use in internal and external loadbearing, non-loadbearing and retaining walls subjected to vertical and orthogonal horizontal loadings.

4.2 Walls must be designed and constructed in accordance with BS EN 1996-1-1 : 2005, BS EN 1996-1-2 : 2005, BS EN 1996-2 : 2006 and BS EN 1996-3 : 2006 and their UK National Annexes, and PD 6697 : 2010.

4.3 A suitably experienced and qualified engineer should perform a site-specific assessment and design to ensure that:

- based on the geotechnical report, the appropriate cement type and quantity is used for the blocks, infill concrete and mortar in accordance with BRE Special Digest 1 : 2005 to resist the Design Sulfate (DS) classes of DS1 to DS3, and DC classes of DC-1 to DC2 as specified in Tables 2 and 3 of this Certificate
- appropriate damp proofing and watertightness measures are considered where the blocks are used below the ground level or in the construction of basements, swimming pools or retaining walls
- appropriate mortars, which are used as a level medium, (designation O, S and M) corresponding to different exposure classes (MX1, MX2 and MX3) are used for bedding the first course of blocks on the surface of the foundation or supporting structure (see the Durability section of this Certificate)
- appropriate corrosion protection systems for ties, tension straps, brackets and hangers conforming to BS EN 845-1 : 2013 in relation to exposure classes (MX1, MX2 and MX3) are used (see the Durability section of this Certificate)
- to prevent saturation of the soil behind the retaining wall, appropriate solutions (such as sealing the soil surface, deploying a drainage system within the soil, providing weep-holes where it is not possible to discharge the drains beyond the end of the wall, etc.) are considered. Weep holes are formed prior to the infill concrete in the wall being poured and a pipe placed through
- the passage of water through the wall is controlled as necessary, for aesthetic or other reasons, such as aggressive ground water. If necessary, the earth face of the wall should be treated using appropriate sealing techniques
- adequate temporary props at free ends and corners to support Stepoc concrete block walls against wind or accidental loading during construction works are provided. The wall should be considered as a temporary structure until the infill concrete has reached its design strength
- the detailing of movement joints to accommodate the anticipated ground movements both reversible and irreversible, without damage to the wall is adequate. In external walls, movement joints should be designed to allow any water to flow off without causing harm to the Stepoc concrete blocks or penetrating into the building
- consideration is given to shrinkage of the wall, the wall components, and any applied finishes due to moisture and thermal variations, which should be mitigated against by the provision of movement joints
- consideration is be given to the position of holes for services. These should preferably be cast into the wall during construction rather than cored out post-construction
- where the concrete infill may be subjected to freezing whilst wet, air entrainment is used
- where required, lateral restraint is provided at wall-floor junctions in accordance with the requirements of BS EN 8103-1: 2011 and the *NHBC Standards 2021*
- the wall is not loaded (or a retaining wall is not backfilled, and compaction is not commenced) until the concrete has reached its sufficient design strength to resist the structural actions
- the adequacy of overall stability (outside the scope of this Certificate) of the wall against sliding and overturning, is sufficient.

4.4 Where Stepoc concrete blocks are used for retaining walls, a soil investigation report must be obtained; this report must include the characteristic soil properties including level of surface water and its sulphate content (SO_4 $mg.l^{-1}$), position of services, etc.

4.5 The foundation and load-bearing capacity of the ground are outside the scope of this Certificate. Continuity must be maintained between the wall and foundation reinforcement to ensure the adequacy of transferring the shear and bending moment, as applicable, and prevent sliding of the wall. There must be adequate overlap between the wall and foundation reinforcement (for required length of overlap, see section 6.5 of this Certificate).

4.6 The requirements of the national Building Regulations in respect of provision of lateral restraint at wall, floor and roof junction levels and horizontal and vertical tying, when applicable, must be taken into account according to building classes (consequence classes).

4.7 Party walls and double-skin Stepoc concrete blocks are outside the scope of this Certificate.

5 Practicability of installation

The system is designed to be installed by competent general builder, or a contractor, experienced with this type of system.

6 Strength and stability

6.1 A suitably qualified and experienced engineer must undertake the structural design of the wall to the relevant standards, taking into account the following considerations:

- the variable actions (imposed, surcharge, snow and wind load in accordance with BS EN 1991-1-1 : 2002, BS EN 1991-1-3 : 2003, BS EN 1991-1-4 : 2005 and their UK National Annexes). Actions during execution and accidental action also must be taken into account in accordance with BS EN 1991-1-6 : 2005 and BS EN 1991-1-7 : 2006, and their UK National Annexes
- the permanent actions in accordance with BS EN 1991-1-1 : 2002 and BS EN 1997-1 : 2004 and their UK National Annexes. When calculating the lateral pressure from backfill, the level of surface water, angle of friction of backfill, angle of friction between the soil and the wall, and density of backfill must also be taken into account
- the calculated design bending moment (M_{Ed}) and shear force (V_{Ed}) applied to the wall using equation 6.10 or the less favourable equations 6.10a and 6.10b of BS EN 1990 : 2002 and its UK National Annex
- the calculated design bending moment resistance (M_{Rd}) of reinforced Stepoc wall using equations 6.23 and 6.25a[(1)(3)], or 6.23 and 6.25b[(1)(2)(3)], of BS EN 1996-1-1 : 2005 for the bending moment resistance of the wall

(1) Equation 6.25a limits the design bending moment resistance based on Stepoc concrete blocks category I . Stepoc concrete blocks are categorised as Group 1 when the concrete infill is in place, with the masonry executed under a Class 1 level of execution control
(2) Stepoc concrete blocks are categorised as Group 2 without concrete infill, with the masonry executed under a Class 1 level of execution control
(3) For calculation of bending moment of the wall, an alternative design approach, accounting for the masonry outer shell and the inner concrete core of the wall in the compressive stress block, can also be adopted by a suitably qualified and experienced engineer.

- the design shear resistance of reinforced Stepoc walls must be assessed using equations 6.33 V_{Rd1}[(1)] and 6.34 of BS EN 1996-1-1 : 2005 when the contribution of any shear reinforcement is ignored.

(1) For reinforced masonry walls containing vertical reinforcement, V_{Rd} (design shear resistance) must be calculated using equations 6.33 to 6.35 and Annex J of BS EN 1996-1-1 : 2005.

- the area of required steel reinforcement must be determined so that the design bending moment and shear resistance of the wall are greater than the design value of applied bending and design value of shear load applied on the wall, as shown below:
  $M_{Rd} > M_{Ed}$
  $V_{Rd1} > V_{Ed}$
- the ratio of the height to effective depth of reinforced Stepoc wall must be limited to 18[(1)] (refer to Table 5.2 of BS EN 1996-1-1 : 2005), when the Stepoc concrete blocks are used for a cantilever wall, to ensure that the deflection of the wall at Serviceability Limit State (SLS) remains within the acceptable limit

(1) For free-standing walls not forming part of a building and subjected predominantly to wind loads, the ratio may be increased by 30%, provided such walls have no applied finish which may be damaged by deflections.

- to avoid unacceptably large cracks under serviceability loading conditions, the appropriate cover to steel reinforcement (see the Durability section of this Certificate) and sufficient ductility of the wall by limiting the ratio of the d/x to 0.4 (where d is the effective depth and x is the depth of the neutral axis before redistribution of moment), must be utilised. The influence on all aspects of a design from any redistribution of moments in accordance with BS EN 1992-1-1 : 2004 must be taken into account

- the spacing of vertical and horizontal steel reinforcement must be in accordance with Table 5 of this Certificate
- the maximum effective depth of Stepoc blocks when used in retaining walls is based on achieving the minimum cover requirements for the defined exposure class (eg 40 mm for exposure class MX3)
- the maximum effective depth of Stepoc blocks when used in walls must not exceed the values shown in Figure 4 of this Certificate
- the characteristic compressive strength (f_k) and the design compressive strength (f_d) of Stepoc concrete blocks are shown in Table 6 of this Certificate
- for cantilever walls with lateral restraint provided only at the support, the clear distance from the end of the cantilever to the face of the support, lr, should not exceed $25b_c$ or $100b_c^2\ d^{-1}$ (refer to equations 5.15 and 5.16 of BS EN 1996-1-1 : 2005) where b_c is the width of the compression face of the support and d is the effective depth of the wall
- the maximum height of the retaining wall must be designed in accordance with BS EN 1996-1-1 : 2005 and its UK National Annex based on site specific requirements. For example, the maximum height (1) of a retaining wall constructed with single skin Stepoc 200, 256 and 325 blocks based on the following assumptions must not exceed 1.80, 2.70 and 3.30 m respectively:

  (1) the assumptions for the maximum heights mentioned above are:
  — surcharge = 5 kPa
  — diameter of horizontal bars is 12 mm
  — diameter of vertical bars is 16 mm for Stepoc 200 and 20 mm for Stepoc 256 and 325
  — characteristic yield strength of reinforcement (f_{yk}) equals 500 $N.mm^{-2}$
  — partial factor for material (γ_s) equals 1.15
  — vertical spacing of reinforcement as per Table 5 of this Certificate
  — for the effective depth of the Stepoc concrete blocks, see Figure 4 of this Certificate
  — bulk unit weight of the soil (Y_b) is assumed to be 20 $kN.m^{-3}$
  — it is assumed there is no hydraulic pressure behind the wall due to the presence of a drain
  — the height of back fill equals the height of the wall
  — f_k and f_d of each Stepoc blocks are as defined in Table 6 of this Certificate
  — Exposure class is MX3 as shown in Figure 4

- the maximum height of wall which may be constructed using single skin Stepoc blocks 200, 256 and 325, where the wall is only vertically loaded without any lateral loads, is 5.4, 6.9 and 8.78 m, respectively (refer to clauses 5.5.2.1 and 5.5.14 of BS EN 1996-1-1 : 2005 for slenderness of reinforced masonry wall – must be limited to 27(1))

(1) Effective thickness(t_{ef}) /Effective height (h_{ef}) <27

- the clear distance between adjacent parallel reinforcing steel satisfies the requirements of Clauses 8.2.7(2) and (3) of BS EN 1996-1-1 : 2005 (the clear distance should not be less than the maximum size of the aggregate plus 5 mm, the bar diameter or 10 mm, whichever is the greater, and the spacing of tension reinforcement should not exceed 600 mm)
- movement joints must be provided in accordance with clause 2.3.4 of BS EN 1996-2: 2006 and its UK National Annex
- the requirements of BS EN 1996-1-2 : 2005 and its UK National Annex in relation to fire are to be taken into account ie apply the appropriate reduction factor for the load combinations 6.10, 6.10a, 6.10b to BS EN 1990 and the design values of the mechanical properties (material strength and deformation). See also section 9 of this Certificate
- the requirement for the prevention of disproportionate collapse as applicable.

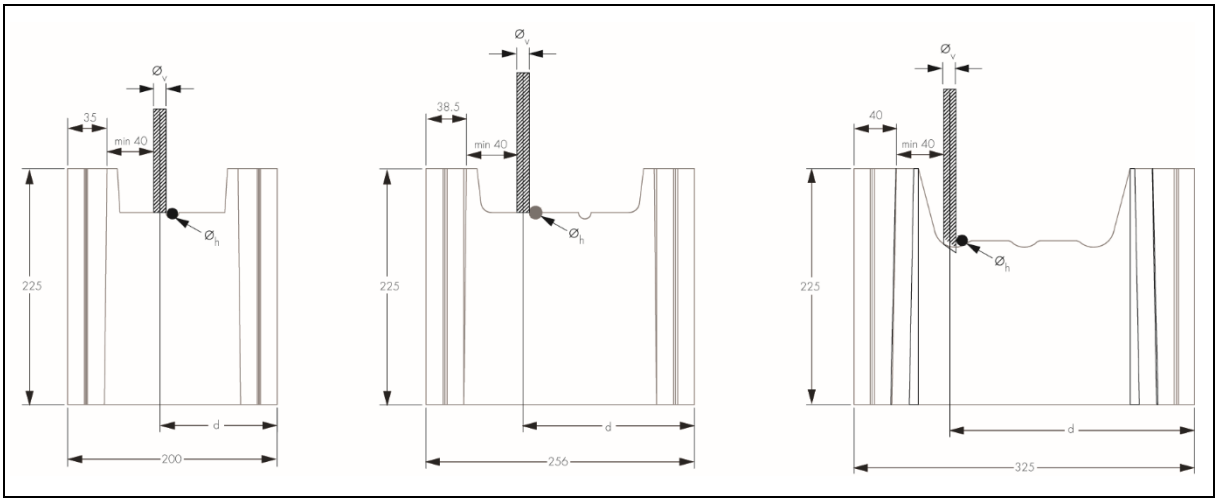
6.2 For low-rise buildings, the design of masonry walls should be in accordance with BS 8103-2 : 2013.

6.3 To achieve structural stability of the Stepoc concrete wall during the construction, the maximum height for each pour must not exceed the values shown in Table 7 of this Certificate. In addition, the wall using the blocks must be braced sufficiently (eg bracing during the concrete pour must be at free ends and corners) to resist the loads imparted on the system by the wet concrete, wind load and other construction loads until the infill concrete has reached its sufficient design strength (based on reduced strength parameters in its temporary state).

Table 5 Vertical and horizontal spacing of the steel reinforcement for single Stepoc blocks

Stepoc concrete block	Spacing of vertical steel reinforcement (mm)	Spacing of horizontal steel reinforcement (mm)
200	200	225
256	133	
325	162.5	

Figure 4 The effective depth (d)[(1)(2)] measured from the compressive face of the wall of the Stepoc concrete blocks 200, 256 and 325 for exposure class MX3 (minimum cover to vertical reinforcement for exposure class MX3 is 40 mm) – all dimensions in mm



(1) Vertical reinforcement position shown is the primary set out factor
(2) The position of grooves and of horizontal reinforcement in the blocks is for guidance only

Table 6 Characteristic compressive strength (f_k) and the design compressive strength (f_d) of masonry including Stepoc blocks

Stepoc concrete block	Characteristic compressive strength (when concrete infill is in place) (f_k) ($N.mm^{-2}$)	γ_M[(2)]	Design compressive strength (f_d) $f_d = f_k / \gamma_M$ ($N.mm^{-2}$)
Stepoc 200	7.79[(1)]	2.0 [(2)]	7.79/2 = 3.895
Stepoc 256	9.92[(1)]		9.92/2 = 4.960
Stepoc 325	9.37[(1)]		9.37/2 = 4.685

(1) From test report in accordance with BS EN 1052-1 : 1999 (no mortar)
(2) γ_M equals 2.0 for reinforced masonry made with units of categories I (refer to Table NA.1 of NA to BS EN 1996-1-1 : 2005)

Table 7 Maximum heights for each concrete pour to maintain the stability of wall[(1)]

Stepoc	Maximum course of blocks	Maximum height of wall for stability (m)
200	8	1.80
256	10	2.25
325	10	2.25

(1) To avoid segregation of the concrete and excessive fines bleed, the concrete should not be discharged at a height of more than 1.5 metres.

6.4 Wall ties and spacing must be in accordance with BS EN 1996-1-1 : 2005, BS EN 1996-2: 2006 and BS EN 1996-3 : 2006 and their respective UK National Annexes, and PD 6697: 2010.

6.5 The length of overlap for tension or compression reinforcement bars must be in accordance with the relevant clause of BS EN 1996-1-1 : 2005, as summarised below:

- for straight anchorage or bars in accordance with equation 8.1 of clause 8.2.5.1(4)
- the anchorage length in tension may be reduced by a factor of 0.7 for bars ended by hooks, bends and loops.

6.6 An appropriate padstone or spreader may be required beneath a concentrated load.

7 Hygrothermal performance

7.1 The thermal conductivity of the Stepoc blocks has been declared as 1 $W.m^{-1}.K^{-1}$, based on the tabulated values given in BS EN 1745 : 2012.

7.2 The water vapour resistance (μ) for the block is $5^{(1)}/15^{(2)}$, in accordance with BS EN 1745 : 2012.

(1) The diffusion behaviour is into a building block.
(2) The diffusion behaviour is out of the building block.

8 Sound insulation

8.1 Separating walls with a concrete core density greater than 2200 $kg{\cdot}m^{-3}$ and full length of 200, 256 and 325 mm Stepoc blocks will achieve a mass per unit area for the core of 440, 560 and 580 $kg.m^{-2}$ respectively. The wall can satisfy the requirements of wall Type 1 in *Approved Document E* for England and Wales and *Technical Booklet G* for Northern Ireland, and wall types A and B in the *Technical Handbook* (Scotland).

8.2 Internal walls and flanking separating walls in new dwellings, and rooms for residential purposes, should have a minimum mass per unit area, excluding finishes, in excess of 120 $kg{\cdot}m^{-2}$.

8.3 Separating walls in dwellings and rooms for residential purposes are generally subject to pre-completion testing in accordance with relevant regulations and guidance.

9 Behaviour in relation to fire

9.1 The Stepoc blocks, infill concrete and reinforcement have a reaction to fire classification of A1 in accordance with the provisions of EC Decision 96/603/EC (as amended) without the need for testing, on the basis of its listing in that Decision. They are not subject to any restriction on building height or proximity to boundaries as defined in the national Building Regulations.

9.2 The nominal cover to reinforcement should be appropriate to the exposure classes in accordance with BS EN 1996-1-1 : 2004 (see the Durability section of this Certificate) or fire resistance requirements of BS EN 1992-1-2 : 2004 and their UK National Annexes, whichever is the greater.

9.3 The requirements of BS EN 1996-1-2 : 2005 and its UK National Annex in relation to resistance to fire must be taken into account, including reduction of the design value of mechanical properties (material strength and stiffness) and including the appropriate reduction factor for load combinations 6.10, 6.10a and 6.10b of BS EN 1990 : 2002.

9.4 Walls must have a minimum thickness requirement to satisfy the fire resistance requirements of national Building Regulations. Tabulated data for minimum thickness of masonry wall are given in BS EN 1996-1-2 : 2005.

9.5 Any supporting part of a structure, or stiffening, must have at least the same fire resistance as the structure being supported.

9.6 The fire performance and suitability of wall ties and anchors for a specific construction should be confirmed with the manufacturer of those products.

9.7 The fire resistance of Stepoc masonry walls may be increased by the application of a layer of a suitable surface finish, for example:

- gypsum premixed plaster in accordance with BS EN 13279-1 : 2008
- plaster type LW or T in accordance with BS EN 998-1 : 2016
- gypsum plasterboard.

10 Use below the dpc

10.1 Stepoc blocks are resistant to the freeze-thaw conditions likely to occur below the ground level and are suitable for use in situations up to and including MX3 (see the Durability section of this Certificate) as defined in BS EN 1996-2 : 2006, Annex A, Table A1 and its UK National Annex.

10.2 Stepoc concrete blocks and infill concrete can be used in Design Sulfate Classes DS1, DS2 and DS3 of soil or groundwater as defined in BRE Special Digest 1 : 2005 *Concrete in aggressive ground, Part C Assessing the aggressive chemical environment*, provided the appropriate sulphate-resistant cement is used (see also the Durability section of this Certificate). However, the Certificate holder's advice should be obtained.

10.3 When Stepoc blocks filled with concrete infill are used for basement or retaining wall construction, particular consideration must be given to requirements of BS 8102 : 2009. Care must be taken to ensure that all detailing and jointing methods comply with the manufacturer's instructions.

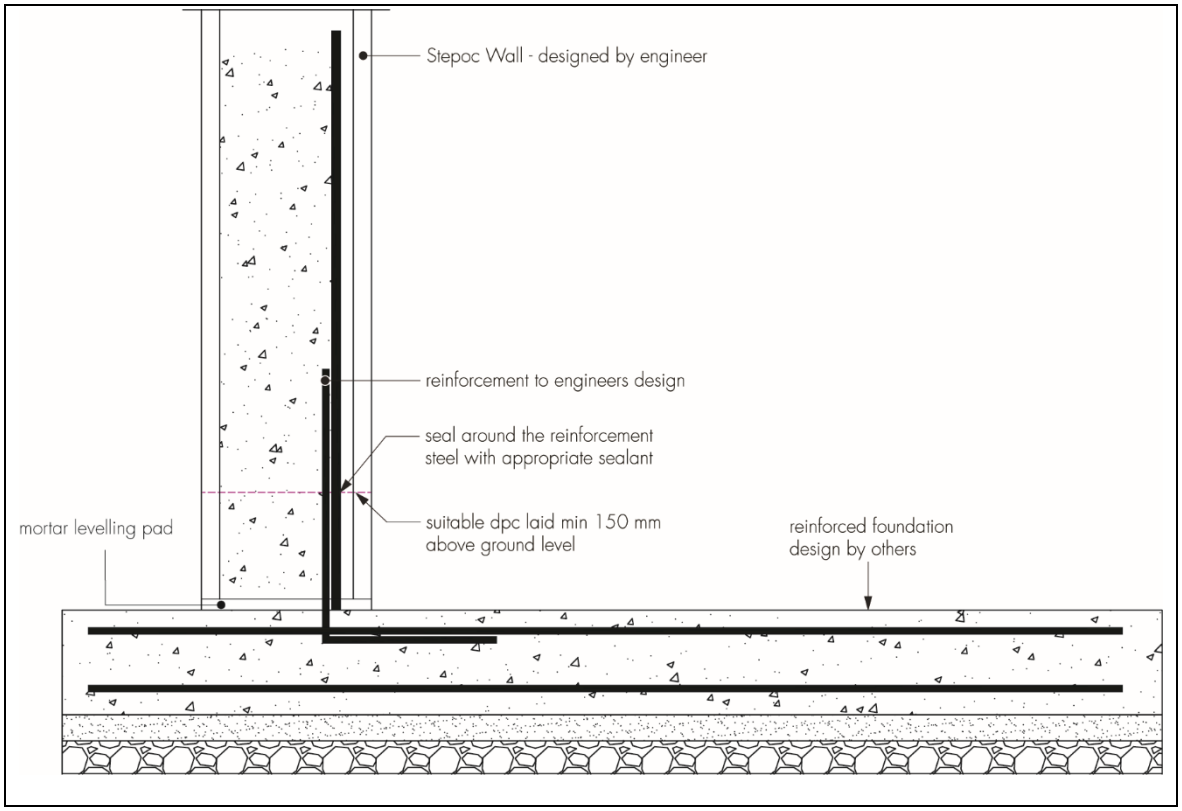
10.4 In unusual soil and/or groundwater conditions (eg soils contaminated by industrial waste or highly acidic soils) where there is a risk of chemical attack in the retaining wall, expert advice should be obtained.

10.5 Any waterproofing must be carried out in line with a specialist contractor's guidance and be suitable for the type of construction (eg retaining wall).

10.6 Any waterproofing solutions must be designed in accordance with requirements of BS 8102 : 2009 and, if applicable, in accordance with *NHBC Standards 2021*, Chapter 5.4 by a suitably experienced and qualified engineer or waterproofing design specialist with the relevant experience.

10.7 The dpc, where required, must be positioned the same as a masonry wall ie at least 150 mm above the ground level or paths adjoining the home. Around the reinforcement rebars, at the position of the dpc, must be sealed by appropriate sealant (see Figure 5).

Figure 5 dpc detail for Stepoc concrete wall



11 Resistance to moisture

11.1 Walls built from the blocks should be designed and constructed in accordance with the national Building Regulations.

11.2 Resistance to rain ingress is provided by the external finishes (not covered by this Certificate). Care should be taken to ensure that the design and construction complies with the Certificate holder's installation procedures.

12 Movement

12.1 The maximum declared moisture movement of the blocks may be taken as a nominal value of 0.52 $mm \cdot m^{-1}$ in accordance with BS EN 772-14 : 2002.

12.2 Consideration should be given to movement joints in external walls containing openings. The blockwork above and below the opening may need to be reinforced to restrain movement.

13 Maintenance

The Stepoc concrete blocks, concrete and steel have adequate durability and will not require maintenance (see section 14).

14 Durability

14.1 Stepoc concrete blocks are suitable for use in exposure class XF2 (moderate water saturation and structure exposed to freezing and airborne de-icing agents) in accordance with BS 8500-1 : 2019 or BS EN 1992-1-1 : 2004. To resist chemical attacks, the cement and combination types for the blocks, concrete infill and mortar for the first course must be suitable for the DC-2 class in accordance with Table A.12 of BS 8500-1 : 2015.

14.2 Stepoc concrete blocks are made with dense aggregate conforming to BS EN 12620 : 2002 and are suitable for work below or near external ground level for exposure classes MX2.1, MX2.2, MX3.1 and MX3.2 (refer to Table 15 of PD 6697 : 2010 and Table A.1 of BS EN 1996-2 : 2006).

14.3 Walls constructed with Stepoc concrete blocks 200, 256 and 325 have a service life of 50 years for exposure conditions MX1, MX2 and MX3, provided that the 15, 30 and 40 mm cover to steel reinforcement (for exposure classes MX1, MX2 and MX3 respectively) is provided for in the design (see also section 6 of this Certificate). For the minimum cover required for exposure classes MX1, MX2 and MX3, refer to NA to BS EN 1996-1-1 : 2005, BS EN 1996-2 : 2006 and PD 6697 : 2010.

14.4 The nominal cover to reinforcement must be as mentioned in section 14.3 of this Certificate or the cover required for fire resistance in accordance with BS EN 1992-1-2 : 2004 and its UK National Annexes, whichever is the greater.

14.5 Where there is a risk of sulphate attack in the soil or groundwater, the appropriate sulphate-resistant cement based on a soil investigation report must be used for the blocks, concrete infill and mortar used for laying the first course of blocks (see also Tables 2 and 3 of this Certificate)

14.6 The mortar used below the first course of blocks must be M6 or M12 designation (in accordance with Table NA.2 of NA to BS EN 1996-1-1 : 2005 and Table 1 of BS EN 998-2: 2016) for laying the first course of blocks, to resist against freeze thaw (see Table 15 of PD 6697 : 2010). However, where a movement joint is provided, a weaker mortar designation may be acceptable to accommodate movement due to settlement, temperature and moisture changes.

14.7 The specification of mortar (designation P(1), M(2) or S(3) for different exposure classes must be in accordance with Annex B of BS EN 1996-2 : 2006 which is summarised below:

(1) P - for use in masonry subjected to passive exposure
(2) M - for use in masonry subjected to moderate exposure
(3) S - for use in masonry subjected to severe exposure.

14.8 Corrosion protection systems for ties, tension straps, brackets and hangers must conform to BS EN 845- 1 in relation to exposure classes MX1, MX2 and MX3 as defined in Table C.1 of BS EN 1996-2 : 2006.

14.9 Ancillary components and their fixings must be corrosion resistant for the environment in which they are to be used.

14.10 When Stepoc blocks are used in retaining walls or below the dpc, and where a site investigation indicates the possibility of soil contamination eg sulphates or volatile organic compounds (VOCs), a membrane with appropriate third-party approval may be used to resist against moisture and/or chemical ingress.

15 Re-use and recyclability

The Stepoc concrete blocks and steel reinforced concrete used for infill can be recycled.

Installation

16 General

16.1 Installation of Stepoc concrete blocks must be carried out strictly in accordance with the provisions detailed in this Certificate. Technical advice should be sought from the Certificate holder for particular installations, as required.

16.2 The level of supervision during installation of the Stepoc blocks must be sufficient to ensure the quality of work described in BS EN 1996-2 : 2006, BS 8000-3 : 2001 and BS 8000-0 : 2014. All reinforced masonry should be undertaken per Class 1 of execution control to BS EN 1996-2 : 2006.

17 Preparation

The system requires that the foundation is level, smooth finished and within a tolerance of ±10 mm, over lengths of 5 m in any direction. Any out-of-tolerances must be made good prior to placement of the blocks.

18 Procedure

Foundations

18.1 When casting the foundation, vertical reinforcing bars must be positioned at appropriate centres for each block type, with the frequency to be determined by a suitably qualified and experienced engineer.

18.2 The foundations should be laid as level as is practicable to avoid excessive mortar bedding (maximum 20 mm) on the first course, which is laid and bedded using normal bricklaying techniques.

18.3 The ends of the block should engage the nib of the adjacent block, ensuring the blocks are level in both directions.

Setting out

18.4 Where the length of a wall is not equal to a Stepoc module, full length blocks will not be able to be used, but the blocks can be cut to suit. In addition, the blocks are dry-laid, so the tolerances of the blocks must be taken into account.

18.5 Setting out is commenced from the ends of walls and/or movement joints, working towards central positions. At the finishing points, the blocks from the opposing starting points are butted up to each other (there is no male/male or female/female connector). Some cutting of third/half-length blocks and/or temporary formwork may also be required.

18.6 The blocks are stacked dry to a third or half running bond, as appropriate to the block size.

18.7 The vertical faces of the blocks are checked for plumb on completion of alternate courses. At openings, plain ends are used and cut to suit. Alternatively, temporary formwork may be used.

18.8 The horizontal bars should be laid inside the line of the vertical bars, towards the centre of the block away from the exposed faces.

18.9 The horizontal reinforcement is tied to the vertical reinforcement using a tie wire.

18.10 To keep the bars in position, they are tied to each other at every third or fourth course, and at the laps (if needed for the length of the required overlap). See also section 6.5 of this Certificate.

18.11 The first layer of the vertical reinforcement is connected to the starter bars from the foundation.

18.12 Corner and end details should be constructed first, and any cut blocks incorporated towards the centre of the walling section (see Figures 6, 7 and 8 of the Certificate for construction detail).

Concrete pour

18.13 The blocks are filled by a concrete pump and, if possible, a reducer nozzle, to reduce the flow of concrete.

18.14 The method of transportation and placing of the concrete must not incur an additional risk to the stability of the wall. Therefore, the concrete must be discharged as near to vertically as practicable, to prevent lateral loading on the wall.

18.15 Mechanical vibration must not be used due to the fluid nature of the poured concrete. Attention is required to ensure voids do not occur within the wet concrete around formed openings and congested areas of reinforcement.

Pour heights

18.16 There is a maximum height for each pour so that stability is not lost in the dry-laid blocks as they are filled. For the maximum build height of walls for pouring concrete using each Stepoc block (single skin), see Table 7 of this Certificate. Particular attention should be given to the flow-rate of concrete; care is necessary to maintain alignment during concrete filling.

18.17 Temporary propping at free ends and corners during the filling process must be used (with guidance from the Certificate holder).

18.18 The corner pieces have a notch cut out of the side wall on site. This is to allow the horizontal reinforcement to continue around the corner and continuity of concrete infill.

18.19 To allow initial setting, 24 hours should elapse between pours of concrete. Concrete should finish 50 to 75 mm below the top of the block to provide a key for subsequent courses, with the vertical bars finishing high enough above the concrete to provide the required lap.

Figure 6 Construction detail for Stepoc blocks 200

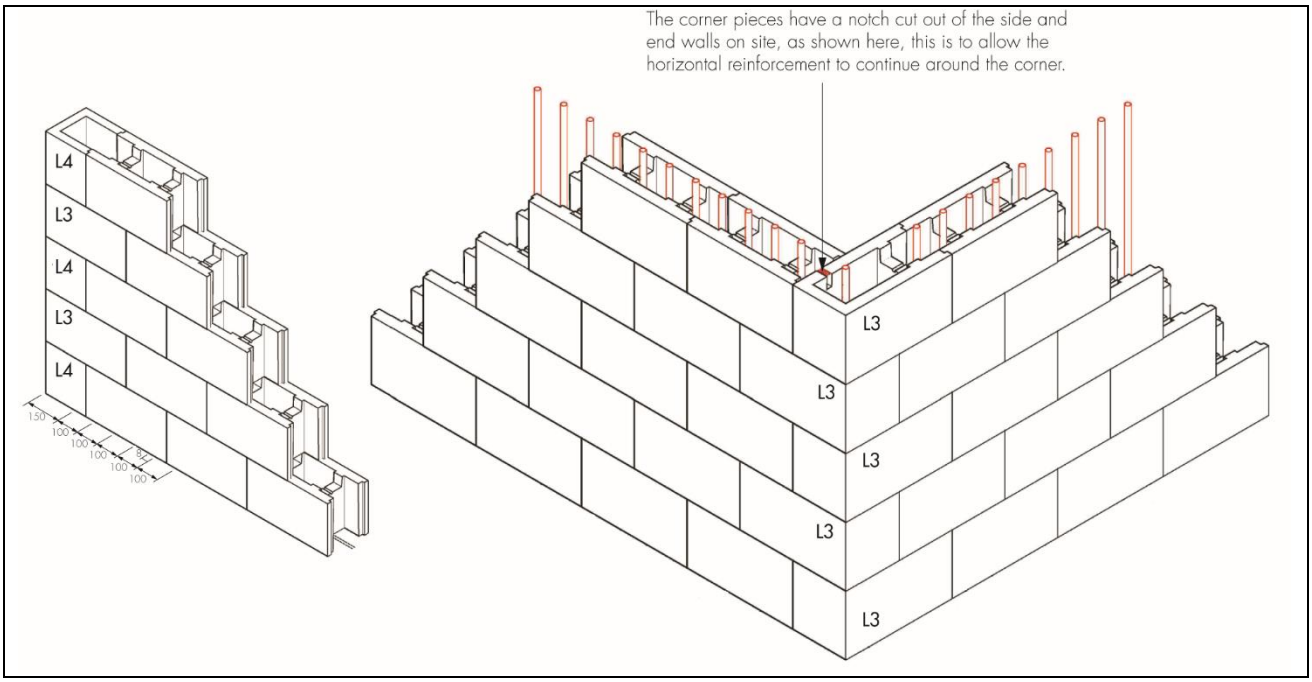


Figure 7 Construction detail for Stepoc blocks 256

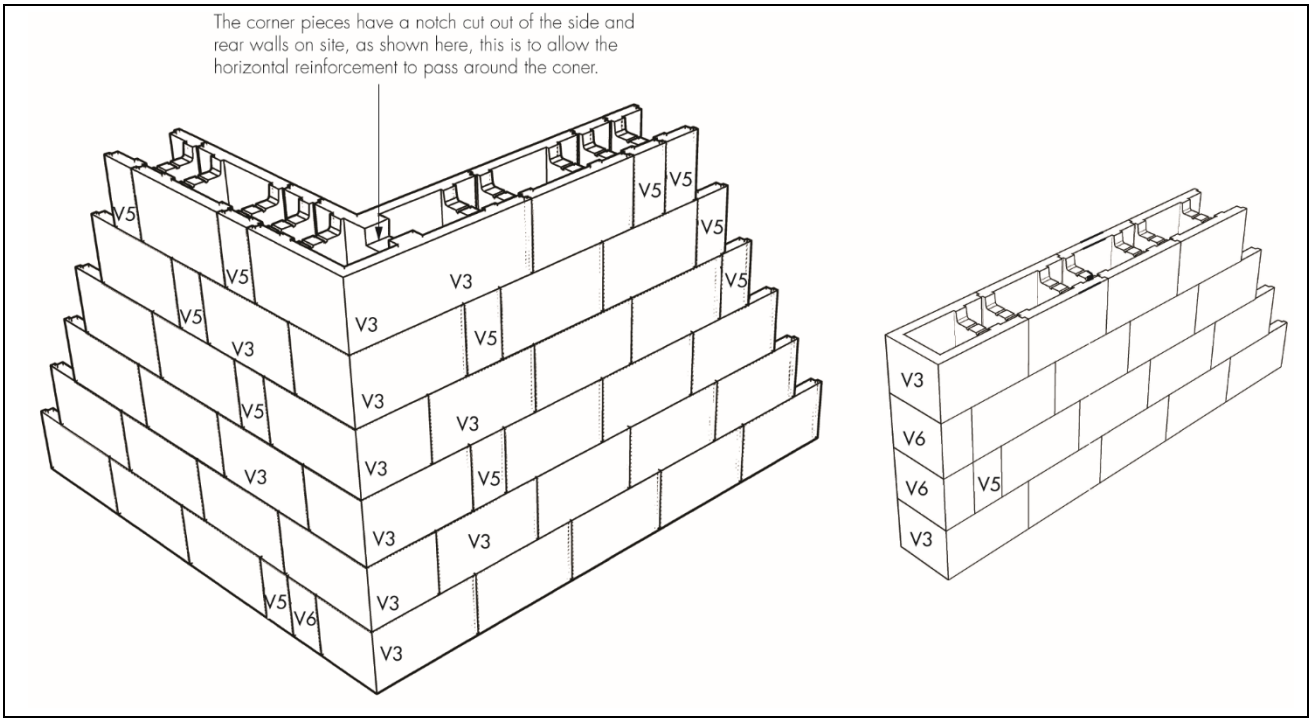
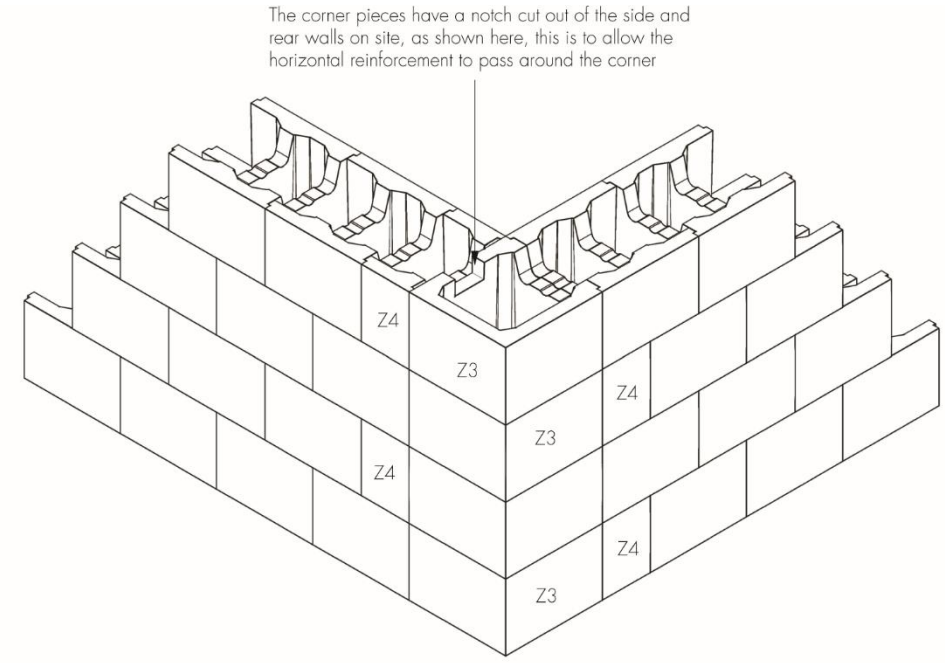


Figure 8 Construction detail for Stepoc blocks 325



Radius walls

18.20 Radius walls(1) are constructed using the blocks with full-, half- or third-length units, or a combination of any of them. Tight radius walls can be constructed (for example, Roman-end style swimming pool detail); however, such walls will require the vertical joint to be opened and filled with mortar or expanded foam prior to the Stepoc being filled with concrete (see Figure 9 for example of a radius wall). These walls must also be designed by a suitably experienced/ qualified engineer (see also section 4.3 of this Certificate).

(1) Depending on the radius of the curve, the setting-out dimensions for the vertical bars are adjusted. For further guidance, contact the Certificate holder.

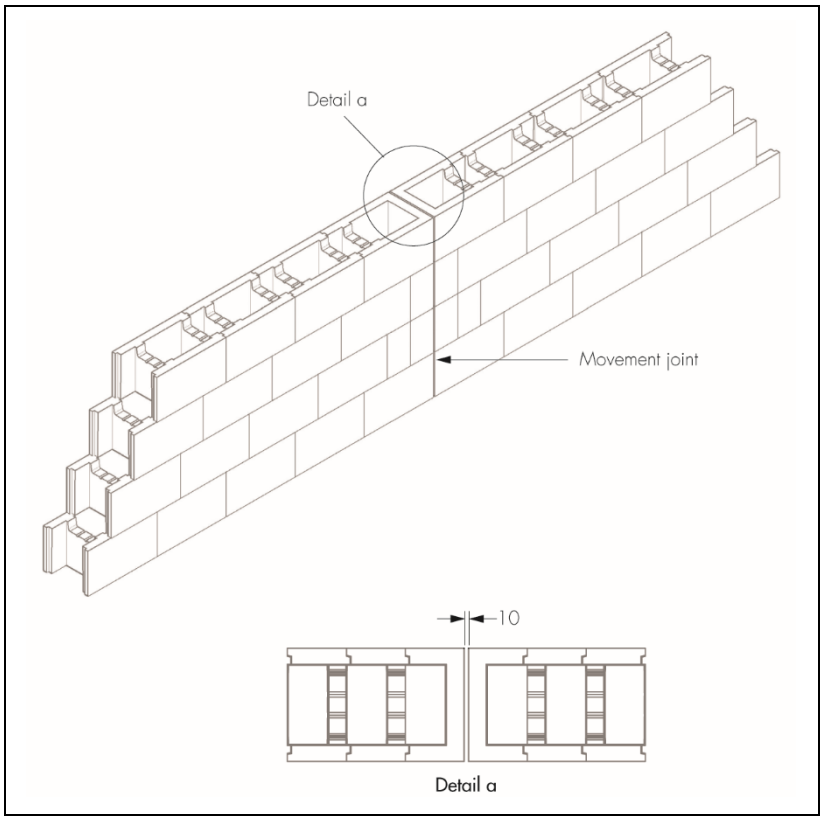
Figure 9 Example of radius wall

Movement joints

18.21 Movement joints must be provided and are recommended at maximum 20 m centres but are subject to a suitably experienced/qualified engineer and the Certificate holder's instructions, along with the recommendations in this Certificate (see Figure 10). The movement joint is built using a standard terminal end detail with a 10 mm gap.

18.22 The full width and height of the joint in the wall is filled with flexible joint filler, with a sealant on the outside edge or edges.

Figure 10 Movement joint detail



Changes in height

18.23 Changes in height should be staged so that they are a full block height (that is, 225 mm). Where the required height of the wall is not a multiple of 225 mm, there are three options:

- Raise the finished wall height to that of a full module
- Use temporary shuttering to form a concrete base, to raise the wall to the required height so that a Stepoc module can be used
- Build the wall to the nearest Stepoc module below the required height, and then use temporary shuttering to raise the final wall height.

Note: when walls are raised using temporary shuttering, structural continuity must be maintained to suit the requirements of the design.

Backfill soil and drainage – retaining walls

18.24 Drainage at the rear of basement/retaining walls must be designed by a suitably experienced/qualified engineer.

Waterproofing

18.25 Where a habitable room is being constructed, waterproofing must be incorporated following the recommended guidance of a waterproofing design specialist (see also section 10.6).

Wall ties

18.26 Wall ties are coursed-in with the Stepoc wall by nicking the top of the Stepoc block using an angle grinder to cut the block, and then placing the wall tie into the nick. Alternative methods of wall ties can be used, including drill and screw, and dovetail slots.

Junctions with existing structures

18.27 Where the Stepoc meets an existing wall, it can be started as a terminal end, with wall ties connecting to the existing wall as a typical movement joint detail**.** Alternatively, the Stepoc blocks can be butted up to the existing wall using full length and one-third length standard blocks (trimmed to suit), with holes drilled into the existing wall to allow horizontal bars to form a key (where possible).

Services

18.28 Design information must include all necessary details relating to the proposed underground services. Drain pipes passing through or under the building may require flexible connections or other means of accommodating differential movement. Where pipes penetrate walls, they should be provided with flexible joints or be sited in an opening formed by lintels.

Good practice guide

18.29 The following good practice should be taken into account throughout the installation process:

- cube compressive strength and slump tests for concrete infill carried out
- limitation of consistency class for concrete (as per Table 2)
- concrete not to be poured below 5°C
- maximum temperature at which the concrete should be placed is 30°C and decreasing
- concrete not to be poured during rainfall.

19 Finishing

19.1 Stepoc concrete blocks have a grey, 'paint quality' block finish, which is typically covered with paint, plaster or render. Where the appearance is not of primary importance, the blocks can be left fair-faced. Rendering and plastering, if required, must be carried out in accordance with BS EN 13914-1 : 2016 and BS EN 13914-2 : 2016.

19.2 The Certificate holder should be consulted regarding suitable finishes and low water-vapour-permeability renders. The moisture condition of the wall should be considered before the finishes are applied.

20 Chasing

20.1 The maximum depth of horizontal and vertical chases allowed without calculation of their effect on the structural resistance of the wall is given in clauses 8.6.1 to 8.6.3 of BS EN 1996-1-1 : 2005, and tables NA.11 and NA.12 of its UK National Annex.

20.2. The depth of the chase must be limited to the thickness of the shell.

21 Fixings

Fixings must be selected and installed in accordance with the fixing manufacturer's instructions, paying particular attention to drilling depth, drill bit diameter, minimum spacing and minimum edge distance.

Technical Investigations

22 Tests

An assessment was made of existing test data for the blocks, to determine:

- drying shrinkage/moisture movement in accordance with BS EN 772-14 : 2002
- flexural strength of shells
- net and gross dry density
- compressive strength test in accordance with BS EN 1052-1 : 1999
- normalised compressive strength in accordance with BS EN 772-1 : 2011.

23 Investigations

23.1 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

23.2 A wall constructed with the blocks was inspected to assess the practicability of installation and site storage.

23.3 An assessment was made to evaluate the water vapour permeability of the blocks.

23.4 An examination was made of existing data relating to the structural properties, durability and behaviour in relation to fire of the Stepoc Concrete Shuttering System.

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BS EN 1992-1-2 : 2004 *Eurocode 2 – Design of concrete structures — General rules*
NA to BS EN 1992-1-2 : 2004 UK National Annex to *Eurocode 2 — Design of concrete structures — General rules — Structural fire design*

BS EN 1996-1-1: 2005 + A1 : 2012 *Eurocode 6 : Design of masonry structures — General rules for reinforced and unreinforced masonry structures*
NA to BS EN 1996-1-1: 2005 + A1 : 2012 UK National Annex to *Eurocode 6: Design of masonry structures — General rules for reinforced and unreinforced masonry structures*

BS EN 1996-1-2 : 2005 *Eurocode 6 : Design of masonry structures — General rules — Structural fire design*
NA to BS EN 1996-1-2 : 2005 UK National Annex to *Eurocode 6: Design of masonry structures — General rules — Structural fire design*

BS EN 1996-2 :2006 *Eurocode 6 — Design of masonry structures — Part 2: Design considerations, selection of materials and execution of masonry*
NA to BS EN 1996-2 :2006 UK National Annex to *Eurocode 6 — Design of masonry structures — General rules — Structural fire design*

BS EN 1996-3 : 2006 *Eurocode 6 : Design of masonry structures — Simplified calculation methods for unreinforced masonry structures*

NA + A1 : 2014 to BS EN 1996-3 : 2006 UK National Annex to *Eurocode 6: Design of masonry structures — Simplified calculation methods for unreinforced masonry structures*

BS EN 1997-1 : 2004 + A1 : 2013 *Eurocode 7: Geotechnical design — Part 1: General rules*
NA + A1 : 2014 to BS EN 1997-1 : 2004 + A1 : 2013 *Eurocode 7: Geotechnical design — Part 1: General rules*

BS EN 10088-1 : 2014 *Stainless steels — List of stainless steels*

BS EN 13279-1 : 2008 *Gypsum binders and gypsum plasters Part 1: Definitions and requirements*

BS EN ISO 9001 : 2015 *Quality management systems — Requirements*

PD 6697 : 2010 *Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2*

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