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Roads and Bridges
Agrément Certificate
12/R149
Product Sheet 1

REDI-ROCK MODULAR BLOCK SYSTEM

REDI-ROCK RETAINING WALL AND FREE STANDING WALL SYSTEMS

The Highways Agency requirements to which this Certificate is subject are detailed on page 2

PRODUCT SCOPE AND SUMMARY OF CERTIFICATE

This Certificate relates to the Redi-Rock Retaining Wall and Free Standing Wall Systems, non-reinforced concrete modular blocks for use in constructing retaining and free standing walls founded on granular or concrete foundations.

AGRÉMENT CERTIFICATION INCLUDES:

- factors relating to compliance with Highways Agency requirements where applicable
- factors relating to compliance with Regulations 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

Mechanical properties — key areas evaluated include:

- design strength of the concrete wall system including safety factors (see section 7)
- connection strength (see section 7).

Durability — the wall system, with concrete modular blocks classified as XF2 to BS 8500-1 : 2006, can achieve a design life greater than 120 years (see section 9).



The BBA has awarded this Agrément Certificate to the company named above for the systems described herein. These systems have been assessed by the BBA as being fit for their intended use provided they are installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 28 March 2012

Brian Chamberlain
Head of Approvals — Engineering

Greg Cooper
Chief Executive

The BBA is a UKAS accredited certification body — Number 113. The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk

Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.

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Highways Agency Requirements

All proposals for adopting the systems shall comply with current HA design and certification procedures and relevant Design Data shall be submitted in accordance with the requirements of section 5 of this Certificate.

The design, materials specification and construction methods adopted must be in accordance with HA Technical Standard BD 70/03 (DMRB 2.1.5) and *Manual of Contract Documents for Highway Works (MCHW)*⁽¹⁾, Volumes 1 and 2, August 1998 (as amended).

(1) The MCHW is operated by the Overseeing Organisations: the Highways Agency (HA), Transport Scotland, the Welsh Assembly Government and The Department for Regional Development (Northern Ireland).

Regulations

Construction (Design and Management) Regulations 2007

Construction (Design and Management) Regulations (Northern Ireland) 2007

Information in this Certificate may assist the client, CDM co-ordinator, designer and contractors to address their obligations under these Regulations.

See sections: 1 *Description* (1.1) and 3 *Delivery and site handling* (3.1) of this Certificate.

Technical Specification

1 Description

1.1 The Redi-Rock Retaining Wall and Free Standing Wall Systems comprise plain concrete interlocking blocks with a simulated limestone or cobblestone finish, for use when constructing retaining or free standing walls. The blocks are manufactured with the dimensions and finishes indicated in Tables 1 and 2 and Figure 1.

Table 1 Block dimensions (retaining wall blocks)

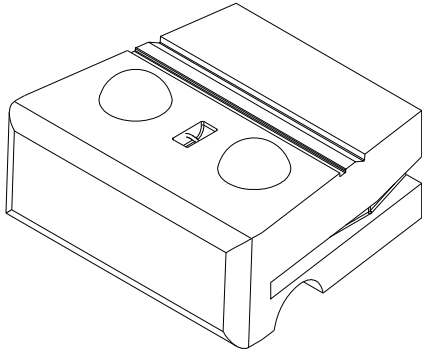
Description	Height (mm)	Depth (mm)	Width (mm)	Setback (mm)	Weight (kg)
Top	330/457	710/1040	1170	41/238/422	555
Half top	330/457	710/1040	585	41/238/422	268
Middle	457	710/1040/1520	1170	41/238/422	739/1066/1492
Half middle	457	710/1040/1520	585	41/238/422	347/472/604
Bottom	457	710/1040/1520	1170	41/238/422	802/1126/1551
Half bottom	457	710/1040/1520	585	41/238/422	375/501/632
Planters	457	1040/1520	1170	422	916
Half planters	457	1040/1520	585	422	404

Table 2 Block dimensions (free standing wall blocks)

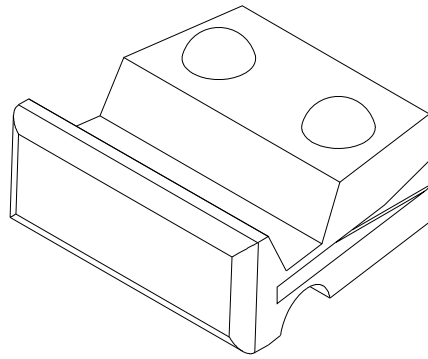
Description	Height (mm)	Depth (mm)	Width (mm)	Weight (kg)
Top ⁽¹⁾	457	610	1170	579
Half top ⁽¹⁾	457	610	585	339
Top ⁽²⁾	457	610	1170	651
Top garden ⁽¹⁾	457	610	1170	518
Half top garden ⁽¹⁾	457	610	585	257
Top garden ⁽²⁾	457	610	1170	496
Middle ⁽¹⁾	457	610	1170	693
Half middle ⁽¹⁾	457	610	585	346
Middle ⁽²⁾	457	610	1170	665
Bottom ⁽¹⁾	457	610	1170	703
Half bottom ⁽¹⁾	457	610	585	372
Bottom ⁽²⁾	457	610	1170	720

(1) Straight block.

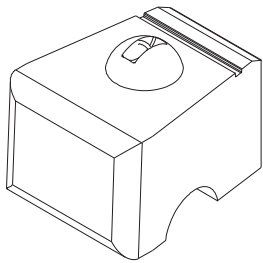
(2) Curved block.



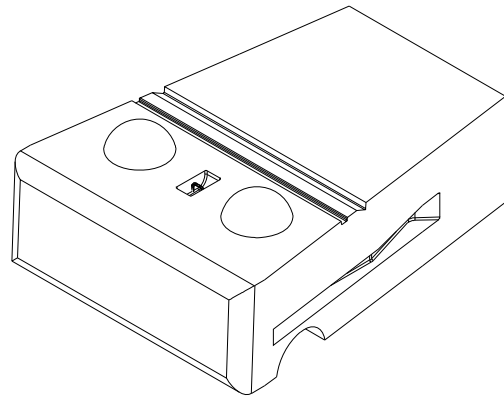
1040 middle retaining wall block



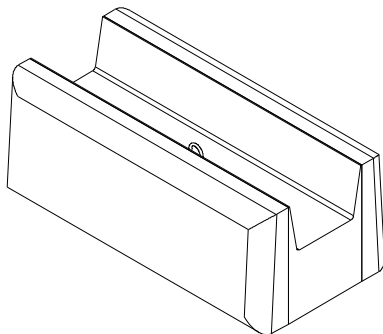
1040 planter retaining wall block



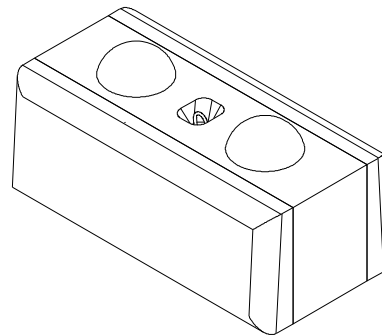
710 half middle retaining wall block



1520 middle retaining wall block



top garden free standing wall block



middle free standing wall block



limestone finish

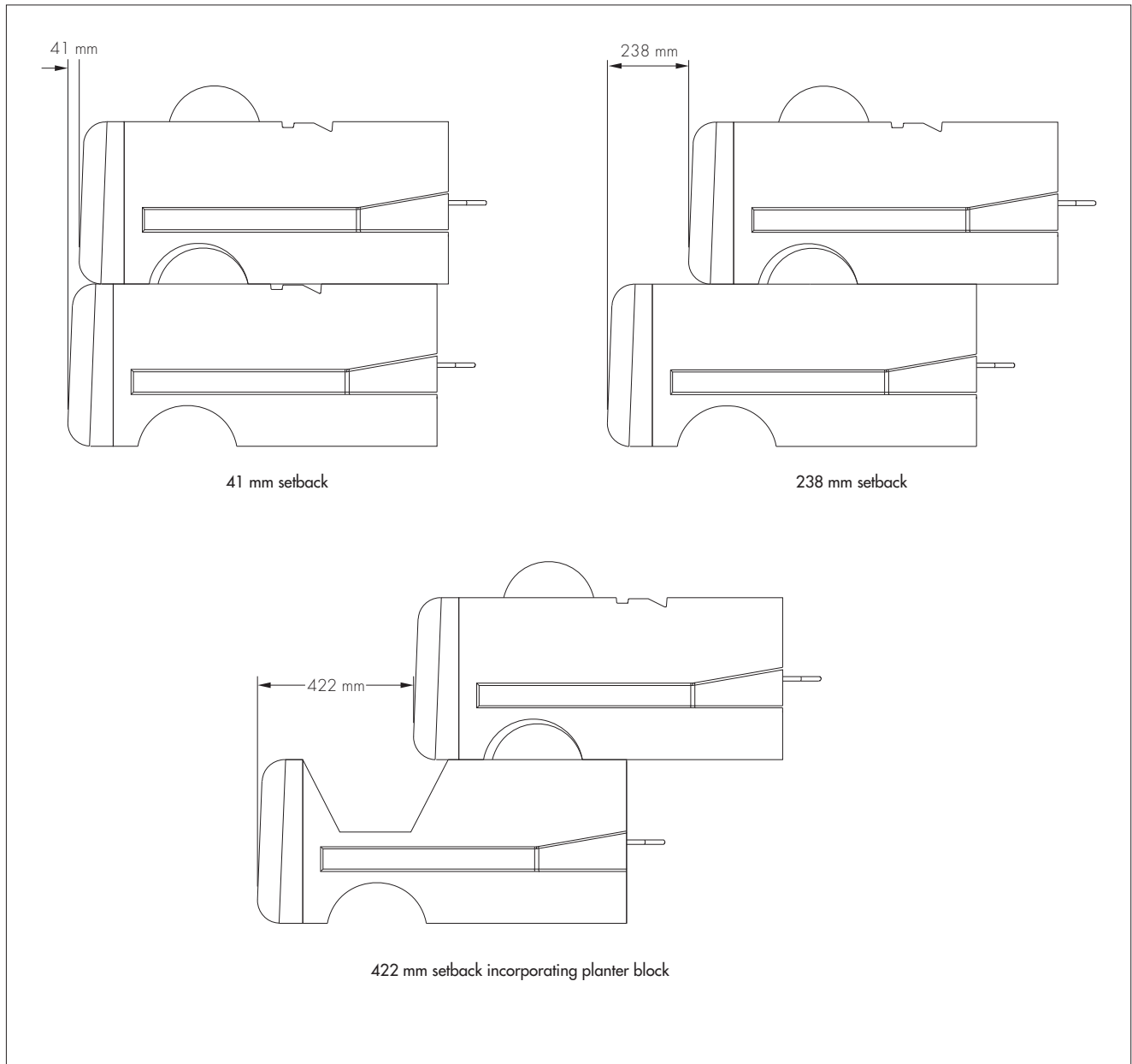


cobblestone finish

1.2 The interlocking mechanism is formed between two domes on the top surface of the block and a half circular recess along the bottom surface of the block as shown in Figure 1.

1.3 Retaining wall blocks are designed to incorporate a setback when stacked upon each other to aid stabilisation in a retaining wall system (see Figure 2). This setback is achieved by staggering the alignment of the interlocking mechanism. A 41 mm setback block will give a 5 degree batter to the front face when stacked horizontally upon each other.

Figure 2 Retaining wall block setback detail



1.4 The free standing wall blocks are designed to sit flush on top of each other via connection with the interlocking mechanism.

1.5 During the casting process, lifting points are incorporated on the top of the blocks.

1.6 The minimum concrete strength of the blocks is $40 \text{ N}\cdot\text{mm}^{-2}$ at 28 days. The concrete mix specification comprises a minimum cement content of $380 \text{ kg}\cdot\text{m}^{-3}$ and a maximum water/cement ratio of 0.4. The concrete satisfies the requirements of BS 8500-1 : 2006, exposure class XF2.

1.7 Corner blocks are available to form internal and external, right-hand or left-hand diversions.

1.8 Example wall details are shown in Figures 3 and 4.

Figure 3 Example of retaining wall detail

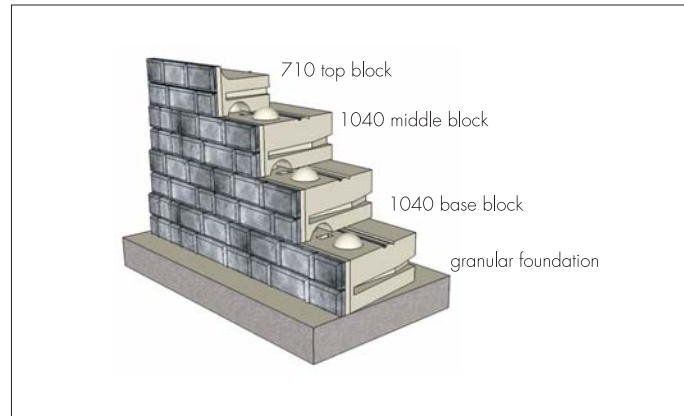
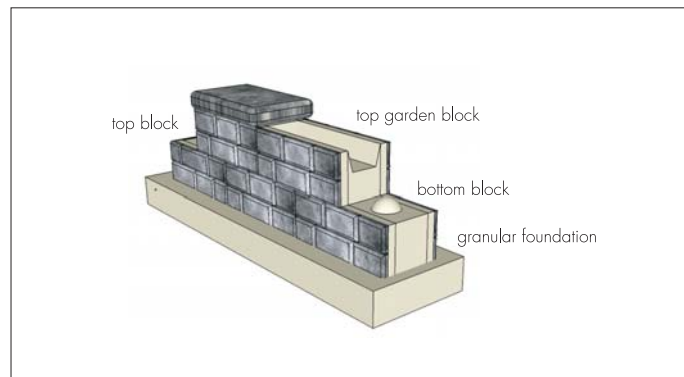


Figure 4 Example of free standing wall detail



2 Manufacture

2.1 The blocks are manufactured from architectural-grade precast concrete.

2.2 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 non-conformities
- 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.

2.3 The product/system is manufactured and marketed/distributed in UK and Ireland by:

- CPM Group Ltd, CPM House, Heath Mill Road, Wombourne, Wolverhampton WV5 8AP. Telephone; 01902 356220, Fax; 01902 356221, e-mail; sales@cpm-group.com, website; www.cpm-group.com
- Moore Concrete Products Ltd, Caherty house, 41 Woodside Road, Ballymena, Co Antrim BT42 4QH. Telephone; +44 028 2565 2566, Fax; +44 028 2565 8480, e-mail; info@moore-concrete.com, website; www.moore-concrete.com

2.4 The management system of Moore Concrete Products Limited and CPM Group Limited have been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2008 by BSI (Certificates Certificate No FM 53305 and FS 571714 respectively).

3 Delivery and site handling

3.1 Blocks are delivered to site to a maximum weight of 1.8 tonnes.

3.2 Checks must be carried out by the installer on the material upon delivery to ensure correct unit types have been received.

3.3 The contractor/installer must prevent excessive mud, wet cement and similar materials from coming in contact with the units.

3.4 To avoid damage, care should be taken in transit and handling. Damaged materials must not be incorporated into the project. During prolonged periods of storage on site, the blocks should remain covered on pallets.

Assessment and Technical Investigations

The following gives a summary of the assessment and technical investigations carried out on the Redi-Rock Retaining Wall and Free Standing Wall Systems.

Design Considerations

4 General

4.1 The Redi-Rock Retaining Wall and Free Standing Wall Systems should be designed by a suitably qualified engineer.

4.2 Correctly designed free standing and retaining walls can be used up to 2.3 m (5 courses) and 5 m high respectively. Walls more than this height are outside the scope of the certificate.

4.3 Depending on soil parameters, a concrete foundation may be required.

4.4 The BBA has not assessed this system for supporting parapet loading caused by vehicle collision at the top of the wall. When applicable, this aspect of a design would require separate consideration and approval by the Highways Agency.

4.5 Prior to commencement of the work, the designer must satisfy the Highways Agency technical approval requirements.

4.6 Where appropriate to specific projects, the designer should provide the main contractor with:

- working drawings
- calculations
- specification for fill material
- acceptable moisture content of fill material at time of placement
- sequence of placing fill material
- tolerance on the position of finished line of the wall.

5 Practicability of installation

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

6 Design

6.1 Retaining wall systems constructed using the Redi-Rock blocks shall be designed to resist the loads determined in accordance to BS EN 1997-1 : 2004.

6.2 To evaluate the overall design strength of the wall system, it is necessary to consider the design strength of the connection between the dome and the corresponding recess of the concrete blocks. Shear tests were carried out on the concrete dome and the characteristic ultimate shear resistance per dome is 70 kN. A material factor of 1.5 in accordance to BS EN 1992-1 : 2004 should be applied to the characteristic ultimate shear resistance to give the ultimate resistance of 46.6 kN.

6.3 Redi-Rock provides a design service which adopts the following methodology to check the suitability of a Redi-Rock wall structure:

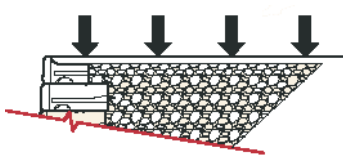
- site survey
- determine characteristic weight of material values for wall, retained and founding soil
- calculate characteristic values of actions for unfavourable and favourable conditions
- calculate design values of above actions
- design against overturning of overall wall structure
- design against sliding of overall wall
- design against bearing failure
- check the overturning and sliding between foundation and the base block
- check subsequent blocks for overturning and shear resistance

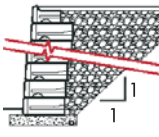
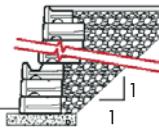
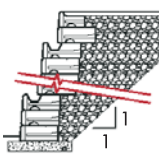
6.4 Example criteria required to achieve a 5 m retaining wall is shown in Table 3.

Table 3 Example criteria for a 5 m retaining wall⁽¹⁾⁽²⁾

Load condition

- no back slope
- 12 kPa live load surcharge



Scheme drawings	Wall Height (m)	Minimum cover to foundation (mm)	Foundation thickness (mm)
 0 planters	3.66	300	300
 1 planter	4.57	300	300
 2 planters	5.03	450	300

- (1) Soil properties:
- crushed stone with $\phi = 40^\circ$ over native soil with $\phi = 34^\circ$.
- (2) Non reinforced walls with 1040 mm wide blocks and crushed stone backfill and granular foundation.
- (3) Information extracted from Redi-Rock design charts.

6.5 Granular material with an assumed $\phi = 30^\circ$ is used in the foundation to achieve 2.3 m (5 courses) for free standing wall constructions.

6.6 Adequate consideration shall be given to the provision of drainage to the wall in accordance with Highways Agency requirements.

6.7 With correct design and workmanship and by following the recommendations of this Certificate, normally accepted tolerances of line and level for the construction of retaining walls, as defined in BS 8006 : 1995, Table 23, can be achieved.

7 Mechanical properties

Tests have shown that blocks used in the Redi-Rock Retaining Wall and Free Standing Wall Systems have a sufficient strength and interlocking mechanism to be used as part of a retaining or free standing wall structure.

8 Maintenance

8.1 Blocks may become soiled in time, the rate depending on the finish chosen, degree of exposure, level of atmospheric pollution and the design and detailing of the wall. The appearance may be restored by use of a powerwash.

8.2 Walls should be checked periodically to ensure there are no signs of cracks or fatigue.

9 Durability

9.1 In the opinion of the BBA, when used and installed in accordance with this Certificate, the wall system can achieve a design life greater than 120 years. This is based on the assumption that the exposure environment for the concrete is classified as XF2 in accordance with BS 8500-1 : 2006.

9.2 Where concrete wall units are to be embedded in potentially aggressive soils, the guidance given in BRE Special Digest 1 : 2005 *Concrete in aggressive ground* should be followed.

10 General

10.1 The execution of Redi-Rock Retaining Wall Systems should be carried out in accordance to the manufacturer's installation manual.

10.2 It is important that the first course of concrete block units is laid accurately to the correct line and level to avoid compounding errors in alignment as the wall is built.

10.3 To lay the gravity retaining wall, the foundation should be made with compacted crushed stone or graded granular fill, to provide a safe bearing pressure of $250 \text{ kN}\cdot\text{m}^{-2}$.

11 Procedure

Retaining wall structure

11.1 Detailed information on installation of the Redi-Rock Retaining Wall Systems can be found in the Certificate holder's Installation Guide.

11.2 The blocks are laid on a levelling pad composed of either well-graded, good compactable material or a suitable concrete foundation (not less than RC40 in accordance with BS 8500-2 : 2006) laid to the correct level for the first course with the aesthetic surface facing out and the front edges tight together. The first course of the wall units are laid and checked for level and alignment. The blocks should be in full contact with the foundation pad.

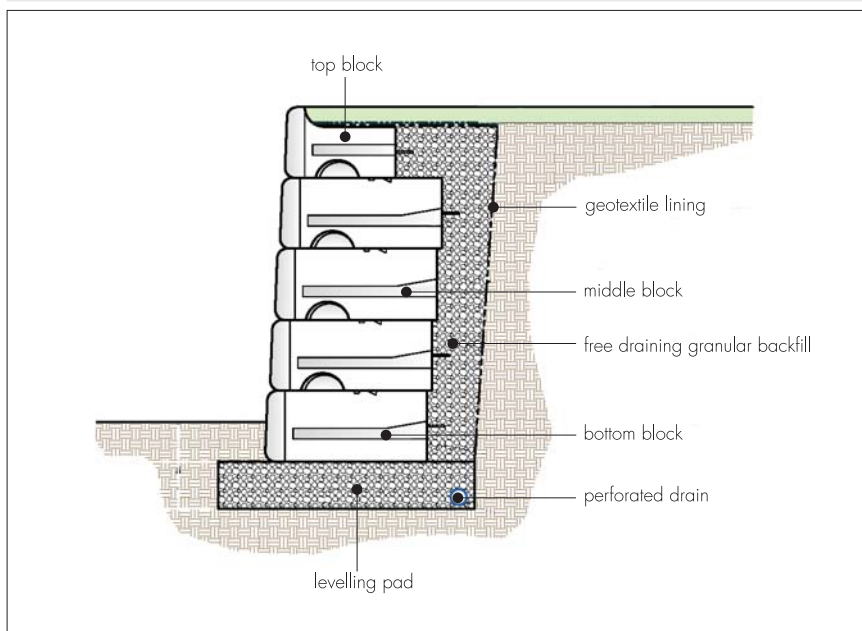
11.3 The next course of wall units are installed in an offset position from the seams of blocks below. The blocks are placed fully forward so the dome and corresponding recess are engaged.

11.4 A perforated drainpipe is laid behind the base course of blocks, surrounded by a minimum of 150 mm of pipe gravel.

11.5 Suitable backfill of a maximum diameter of 75 mm, followed by selected granular drainage fill with a maximum diameter of 20 mm in a minimum depth of 300 mm are placed behind the blocks up to the top level of the wall. Both the backfill and the granular fill are compacted to a 95% standard proctor density within 2% of its optimum moisture content.

11.6 The general construction procedure is repeated until the required level for the top unit is reached. Construction tolerance at the wall face is 2 degrees vertically and 25 mm in 3 m horizontally. A typical cross-section of a retaining wall is shown in Figure 5.

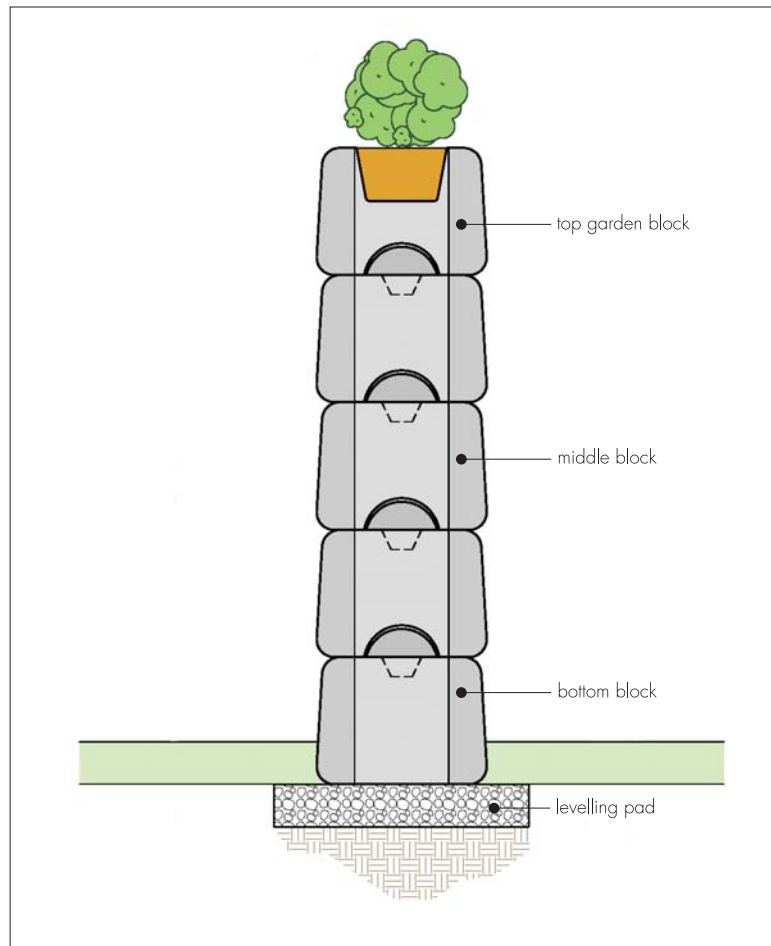
Figure 5 Typical construction



Free standing wall structure

11.7 Blocks, designed to be used in a free standing wall system are stacked on top of each other on a compacted base founded a minimum of 150 mm below the finished ground level (see Figure 6).

Figure 6 Typical construction



11.8 Depending on intended shape, straight, curved or a combination of both blocks are used.

11.9 Free standing blocks can be installed on a gravity retaining wall to meet clients demand and special project specification.

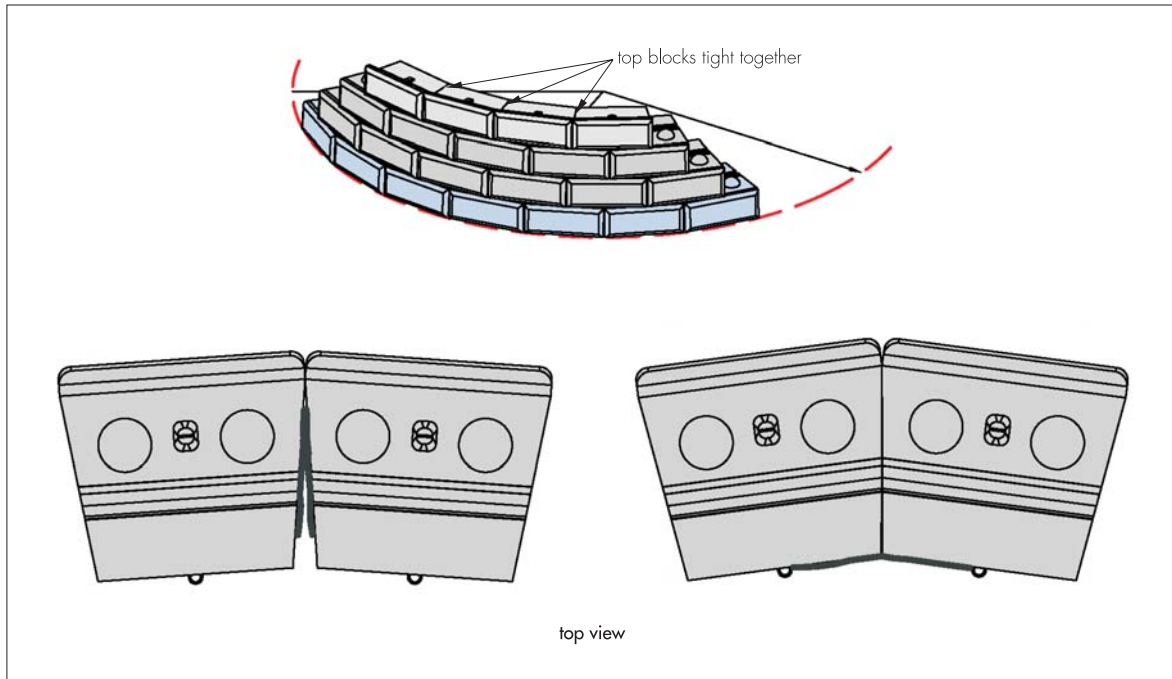
11.10 Coping stone is grouted to free standing wall systems with a minimum of two beads of construction adhesive. Mortar cement may also be used if desired.

Curved wall

11.11 For retaining wall structures, blocks can be laid at varying radii as the edges are tapered⁽¹⁾ (see Figure 7). Due to the set-back of the retaining wall blocks, the radius of curve will decrease as the height of the wall increases.

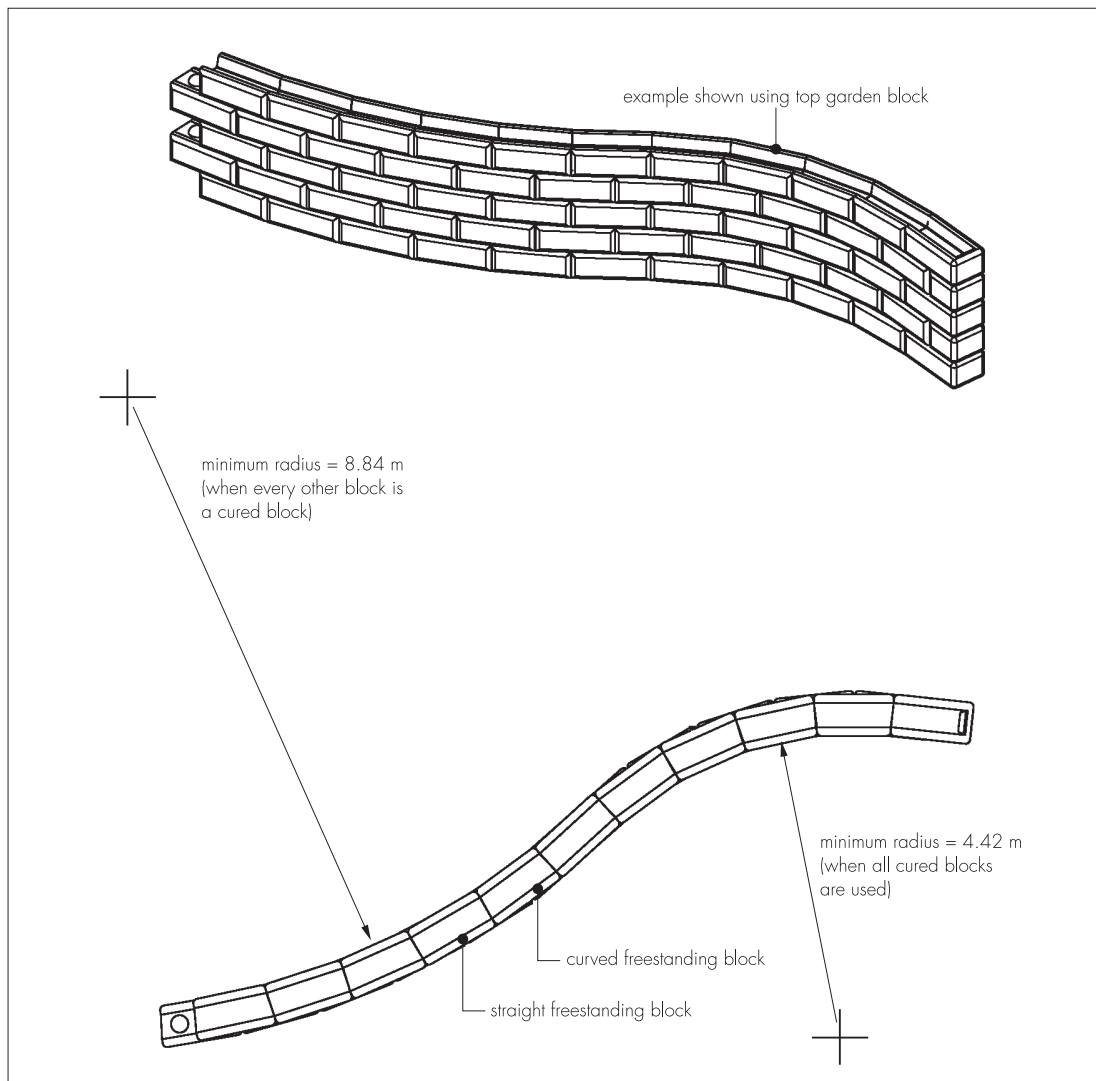
(1) For details of permissible radii achievable for both internal and external curves, and for more information relating to the construction of curved walls, the advice of the Certificate holder should be sought.

Figure 7 Curved retaining wall detail



11.12 For free standing wall structures, the appropriate blocks are selected and laid accordingly. A combination of straight and curved blocks can be used, with a minimum outside radius of 8.8 m when curved and straight blocks are laid alternately. A minimum outside radius of 4.4 m can be achieved when using all curved blocks (see Figure 8).

Figure 8 Curved free standing wall detail



12 Investigations

12.1 The manufacturing process for the concrete modular block was examined, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

12.2 An examination was made of test data relating to:

- strength of concrete block
- durability
- performance of the retaining wall system under simulation of longitudinal settlement
- interface shear capacity between the blocks.

12.3 An assessment was made of the method of installation to assess the practicability and ease of construction of the system.

12.4 Design methods including partial material factors were assessed in relation to the requirements of BS EN 1997-1 : 2004.

12.5 Dimensional checks were carried out on block units.

Bibliography

BS 8006 : 1995 *Code of practice for strengthened/reinforced soils and other fills*

BS 8500-1 : 2006 *Concrete — Complementary British Standard to BS EN 206-1 — Method of specifying and guidance for the specifier*

BS 8500-2 : 2006 *Concrete — Complementary British Standard to BS EN 206-1 — Specification for constituent materials and concrete*

BS EN 1997-1 : 2004 *Eurocode 7 : Geotechnical design — General rules*

BS EN ISO 9001 : 2008 *Quality management systems — Requirements*

BRE special Digest 1 : 2005 *Concrete in aggressive ground : Part 1 : Assessing the aggressive chemical environment*

Manual of Contract Documents for Highway Works, Volume 1 *Specification for Highway Works, August 1998 (as amended)*

Manual of Contract Documents for Highway Works, Volume 2 *Notes for Guidance on the Specification for Highway Works, August 1998 (as amended)*

13 Conditions

13.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page — no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

13.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

13.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate
- remain in accordance with the requirements of the Highways Agency.

13.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

13.5 In issuing this Certificate, the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- individual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

13.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.