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HAPAS Certificate

17/H263

Product Sheet 1

ANCHOR RETAINING WALL SYSTEMS

LANDMARK RETAINING WALL SYSTEM FOR REINFORCED SOIL RETAINING WALLS AND BRIDGE ABUTMENTS

This HAPAS Certificate Product Sheet⁽¹⁾ is issued by the British Board of Agrément (BBA), supported by Highways England (HE) (acting on behalf of the Overseeing Organisations of the Department for Transport; Transport Scotland; the Welsh Assembly Government and the Department for Regional Development, Northern Ireland), the Association of Directors of Environment, Economy, Planning and Transport (ADEPT), the Local Government Technical Advisers Group and industry bodies. HAPAS Certificates are normally each subject to a review every three years.

(1) Hereinafter referred to as 'Certificate'.

This Certificate relates to the Landmark Retaining Wall System⁽¹⁾ for Reinforced Soil Retaining Walls and Bridge Abutments, comprising modular concrete block facing units, Enkagrid PRO geogrids, PVC lock bars and compacted fill. The system is used for the construction of reinforced soil and retaining walls and bridge abutments up to a maximum height of 10 metres, where the slope of the ground above the top of the wall does not increase soil pressure.

(1) Landmark Retaining Wall System is a registered trademark.

CERTIFICATION INCLUDES:

- factors relating to compliance with HAPAS requirements
- 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 — the method of connection between the geogrids and concrete block facing units has been assessed, and long-term connection strength values have been determined for various wall heights and concrete block/geogrid combinations. The interface shear capacity between adjacent concrete block facing units and the layers of geogrid reinforcement is satisfactory (see section 7).

Design strength of geogrids — the short- and long-term tensile strength of the geogrids, resistance to installation damage, weathering and environmental effects, and soil/geogrid interaction are satisfactory (see sections 6 and 7).

Durability — the system will have adequate durability for its intended use as a retaining wall or bridge abutment (see section 9).

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: 30 May 2017

Handwritten signature of Brian Chamberlain in black ink.

Brian Chamberlain
Head of Technical Excellence

Handwritten signature of Claire Curtis-Thomas in black ink.

Claire Curtis-Thomas
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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Requirements

In the opinion of the BBA, the Landmark Retaining Wall System for Reinforced Soil Retaining Wall and Bridge Abutments when designed and installed in accordance with the provisions of this Certificate, will meet the requirements of all UK Highway Authorities for the design and construction of reinforced soil-retaining walls and bridge abutments.

Regulations

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: 1 *Description* (1.2) and 3 *Delivery and site handling* (3.1 and 3.4) of this Certificate.

Additional Information

CE marking

The Certificate holder has taken the responsibility of CE marking the modular concrete block facing units in accordance with harmonised European Standard BS EN 771-3 : 2011. The supplier of the geogrids has taken the responsibility of CE marking the geogrids in accordance with harmonised European Standard BS EN 13251 : 2016.

Technical Specification

1 Description

1.1 The Landmark Retaining Wall System for Reinforced Soil Retaining Walls and Bridge Abutments comprises:

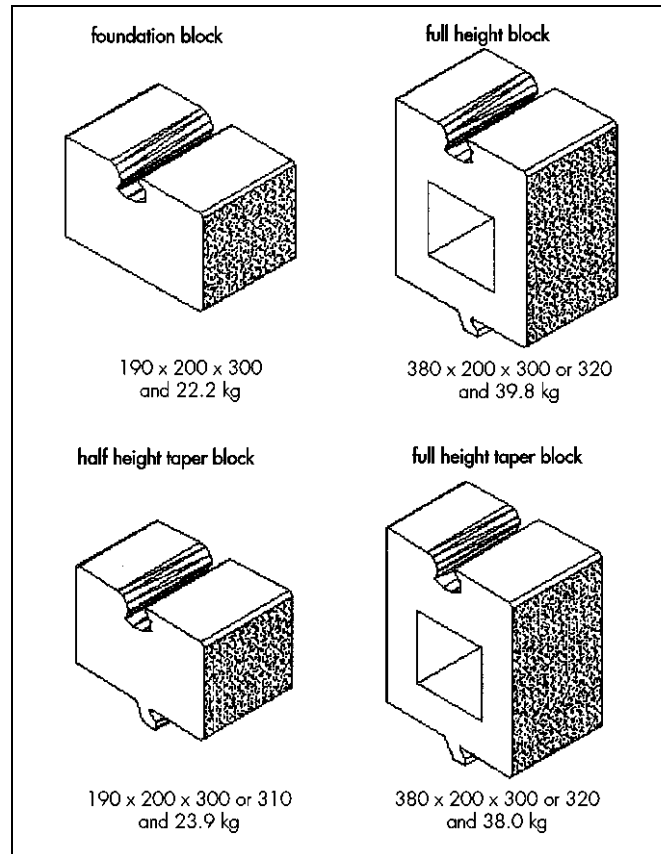
- Landmark modular concrete block facing units
- Enkagrid PRO geogrids⁽¹⁾
- PVC lock bars
- granular material — placed behind the concrete block facing units
- compacted fill material.

(1) The subject of BBA Certificate 14/H211, Product Sheet 1.

Concrete block facing units

1.2 The Landmark modular concrete block concrete facing units are available in four different types and have the nominal dimensions and weights shown in Figure 1. All except the foundation blocks have a lower locating lock flange, and all types have a receiving channel in the top.

Figure 1 Landmark modular concrete block facing units



1.3 The blocks are made with a split concrete finish and are available in natural grey as standard. If other colours are required, the Certificate holder should be contacted. All pigments used for the coloration of the concrete blocks comply with BS EN 12878 : 2014.

1.4 The blocks are manufactured from concrete with a minimum 28-day compressive strength of 40 N·mm⁻², and satisfy the requirements of the Overseeing Organisations for durability of class XF2 exposure in accordance with BS 8500-1 : 2015.

1.5 The blocks conform to BS EN 771-3 : 2011 and have the essential characteristics given in Table 1 as declared by the manufacturer.

Table 1 Landmark concrete blocks — essential characteristics in accordance with BS EN 771-3 : 2011

Characteristic	Manufacturer's Declaration of Performance value
Dimensional tolerance	Category D2
Compressive strength (N·mm ⁻²)	>40
Reaction to fire	A1
Gross dry density (kg·m ⁻³)	2300 - 2350
Water absorption (%)	<6
Durability	Adequate for purpose

Geogrids

1.6 The following grades of Enkagrid PRO geogrids⁽¹⁾ have been assessed by the BBA for use with the system:

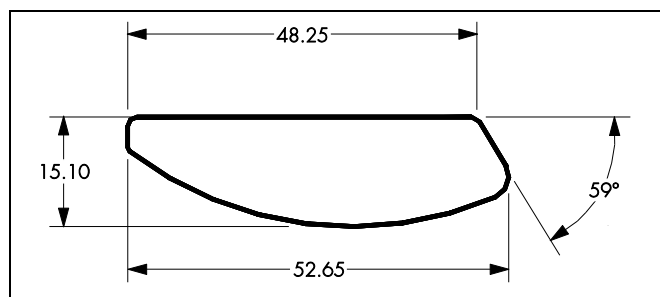
- Enkagrid PRO 40
- Enkagrid PRO 60
- Enkagrid PRO 90.

(1) The subject of BBA Certificate 14/H211, Product Sheet 1.

PVC lock bars

1.7 The PVC lock bars have the profile shown in Figure 2, and are supplied in 1 m lengths.

Figure 2 Lock bar (all dimensions in millimetres)



Granular material

1.8 The material placed immediately behind the concrete block facing units must be a minimum of 300 mm wide well graded, angular, granular material with a maximum particle size of 20 mm and without fines, in accordance with Clause 6.10.4.4 of BS 8006-1 : 2010.

Main fill material

1.9 The main fill material must comply with the requirements set out in BS 8006-1 : 2010 and the *Manual of Contract Documents for Highway Works* (MCHW), Volume 1 *Specification for Highway Works*.

2 Manufacture

2.1 The concrete block facing units are manufactured to an agreed specification by the Certificate holder's nominated supplier. The concrete mix is placed in moulds and hydraulically pressed to get the initial base block shape. Once pressed, the blocks are cured before being split to give the final face finish.

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 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 being operated by the manufacturer are being maintained.

2.3 The geogrids are manufactured by Bonar B.V. from extruded high tenacity polyester (PET) bars. See BBA HAPAS Certificate 14/H211, Product Sheet 1.

2.4 The PVC lock bars are manufactured by extrusion to one agreed specification by the Certificate holder's nominated supplier, and are accepted against Certificates of Conformity.

3 Delivery and site handling

Concrete block facing units

3.1 The concrete block facing units are delivered to site shrink-wrapped on pallets and secured with plastic straps. Each pallet contains forty-five full-height blocks, or sixty half-height blocks. Pallets should not be stacked more than two high.

3.2 The pallets are labelled with a printed cover sheet including the product name, date of production, the Certificate holder's name/logo, and BBA HAPAS Certificate 17/H263.

3.3 To prevent damage, care should be taken in transit and handling. Should the lock flange of a block be damaged in excess of a length of 25 mm, the block should be discarded. During prolonged periods of storage on site, the units should remain covered on pallets.

Geogrids

3.4 The geogrids are delivered, handled and stored, in accordance with BBA HAPAS Certificate 14/H211, Product Sheet 1.

PVC lock bars

3.5 The PVC lock bars are delivered to site in cardboard boxes, labelled with the date of production and product code.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the Landmark Retaining Wall System for Reinforced Soil Retaining Walls and Bridge Abutments.

Design Considerations

4 General

4.1 When designed and installed in accordance with this Certificate, the Landmark Retaining Wall System for Reinforced Soil Retaining Walls and Bridge Abutments is satisfactory for the construction of reinforced soil-retaining walls and bridge abutments up to a maximum height of 10 metres, where the slope of the ground above the top of the wall does not increase soil pressure. Walls not complying with these requirements require special consideration and are outside the scope of this Certificate.

4.2 Prior to the commencement of the work, the designer must satisfy the design approval and certification procedures of the relevant Highway Authority.

4.3 In addition to the factors included in section 6 of this Certificate, attention must also be made in design to consider:

- site preparation
- fill material properties
- the specification for placing and compaction of the fill material
- drainage behind the wall
- protection of the geogrid against damage during installation.

4.4 The BBA has not assessed the wall structure for supporting parapet loading caused by vehicle collisions at the top of the facing units.

4.5 Reinforced soil structures constructed using the system should be used with suitable barriers, to protect the structure against potential damage from vehicle impact, vehicle fires and unauthorised access.

4.6 It is considered that 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 8006-1 : 2010, Table 18, can be achieved. However, due consideration should be given to Notes 1 and 2 under Table 18 of BS 8006-1 : 2010 and where critical, the BBA considers that a 76 mm tolerance as mentioned in NCMA guide "Segmental Retaining Walls Best Practices Guide" should be achievable.

4.7 Particular attention should be made to changes in direction of walls where overlapping of the geogrids may occur. BS 8006-1 : 2010 also gives guidance on typical layout plans for the geogrids (reinforcing elements) in bridge abutments.

4.8 Where the wall height is not gradually reduced to zero over the length of the wall, the design must include end restraint. This can be achieved by means of a short section of wall constructed at 90 degrees to the main wall.

5 Practicability of installation

The system is designed to be installed by trained contractors in accordance with the Certificate holder's design specifications and construction drawings (see the *Installation* part of this Certificate).

6 Design

Methodology

6.1 Reinforced soil-retaining walls and bridge abutments constructed using the Landmark Retaining Wall System for Reinforced Soil Retaining Walls and Bridge Abutments must be designed in accordance with BS 8006-1 : 2010 and the MCHW, Volume 1.

6.2 In accordance with BS 8006-1 : 2010, Annex B, the required design life for permanent walls and bridge abutments is 120 years.

6.3 The design must consider the following issues relating to the performance of the geogrids and concrete block facing units:

- the long-term design strength and post construction creep strain for the geogrids
- the length of embedment of the geogrids
- the connection strength between the geogrid and concrete block facing units
- the interface shear capacity of the blocks between layers of geogrid reinforcement
- interface shear capacity between adjacent rows of blocks
- the connection strength between the blocks and geogrid layers at each layer of geogrid
- the tensile strength of the geogrids
- the embedment and resistance to sliding and pull out of the geogrids from the fill material.

Design strength of geogrids (ultimate limit state)

6.4 The designer must carry out design checks to ensure that the geogrids have adequate long-term tensile strength at each layer of reinforcement, to satisfy ultimate limit state design criteria as defined in BS 8006-1 : 2010 + A1 : 2016. Short- and long-term tensile strength values and material reduction factors for use in the design of the geogrids are given in BBA HAPAS Certificate 14/H211, Product Sheet 1.

Design strength of geogrids (serviceability limit state)

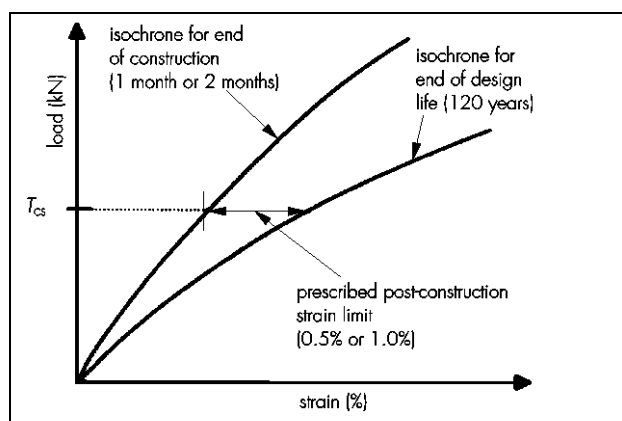
6.5 The serviceability limit state design strength of the geogrid ($T_{D(SLS)}$) should be taken as T_{CS}/f_m , where:

T_{CS} is the tensile load in the reinforcement which induces the prescribed limit value of post-construction strain in the geogrid

f_m is the partial material factor.

6.6 The prescribed post-construction strain limit and the tensile load that would create the prescribed post-construction strain (T_{CS}) are illustrated in Figure 3.

Figure 3 Definition of T_{cs}



6.7 The prescribed maximum allowable post-construction creep strains allowed by BS 8006-1 : 2010 for the serviceability limit state of reinforced soil-retaining walls and bridge abutments are shown in Table 2.

Table 2 Serviceability limits on post-construction internal strain for bridge abutments and retaining walls

Structure	Strain (%)	Design period for the purposes of determining limiting strain
Bridge abutments and retaining walls with permanent structural loading	0.5	2 months to 120 years
Retaining walls with no applied structural loading, ie transient live loadings only	1.0	1 month to 120 years

6.8 Post-construction strain can be related to the average load in the reinforcement. The average serviceability limit state design load (T_{avj}) that the geogrid must resist is calculated in accordance with BS 8006-1 : 2010. The average load in the j^{th} level (T_{avj}) is related to the maximum load in the reinforcement (T_j) by a factor k such that $T_{avj} = T_j/k$. The factor k has a minimum value of unity and generally falls in the range of 1.0 to 2.0. Where the distribution of tensile load along the loaded length of the reinforcement is not proven by field measurements, the factor k should be taken as unity. In all cases $T_{avj} \leq T_{D(SLS)}$.

6.9 Isochronous curves, design values for T_{cs} and reduction factors for determination of $T_{D(SLS)}$ are given in sections 7.2 to 7.4.

Connection strength between the geogrids and concrete block facing units

6.10 The design connection strength between the geogrids and concrete block facing units (T_{Dconn}) should be determined for the ULS, and checks should be made to ensure that it is not exceeded by the design load (T_j) at each level, ie $T_j \leq T_{Dconn}$. Particular care should be taken during the design of bridge abutments to ensure that adequate reinforcement is provided and that adequate connection strengths are achieved at the top of the wall and in front of bank seats.

6.11 The design connection strength (T_{Dconn}) is determined using the formula $T_{Dconn} = T_{conn}/f_m f_n$ where:

T_{conn} is the long-term connection strength derived from testing (see section 7)

f_m is the material safety factor for the geogrid (see section 7)

f_n is the partial factor for ramification of failure in accordance with BS 8006-1 : 2010, Table 9.

6.12 The load factors used in determining the design loads should be to BS 8006-1 : 2010 for all designs using the wall system.

Length of embedment of geogrids

6.13 The designer must carry out design checks to ensure that the geogrids have sufficient length of embedment within the fill material to prevent pull out of the geogrid. Short- and long-term tensile strength values and material reduction factors for use in the design are given in BBA HAPAS Certificate 14/H211, Product Sheet 1.

Interface shear capacity between concrete block facing units

6.14 The system has adequate interface shear capacity when designed and installed in accordance with this Certificate.

Specification of fill material

6.15 The designer should specify the relevant properties of the fill material for the reinforced soil structure deemed acceptable for the purposes of the design. Acceptable materials should meet the requirements of BS 8006-1 : 2010 and the MCHW, Volume 1, Series 600.

7 Mechanical properties

Long-term tensile strength of geogrids

7.1 Short- and long-term strength values and reduction factors required for design of the geogrids are given in BBA HAPAS Certificate 14/H211, Product Sheet 1. These include:

- characteristic short-term tensile strengths (T_{char})
- long-term creep rupture strengths (T_{CR})
- reduction factors for installation damage (RF_{ID}), weathering (RF_W) and environmental degradation (RF_{CH})
- factors of safety for extrapolation of data (f_s).

Soil/geogrid interaction

7.2 Soil/geogrid interaction coefficients for use in design are given in BBA HAPAS Certificate 14/H211, Product Sheet 1.

Post-construction strain in geogrids

7.3 Values for T_{CS} may be estimated from the appropriate isochronous curves. A typical set of isochronous curves for the EnkaGrid PRO Geogrid product range is shown in Figure 4. Values of T_{CS} for EnkaGrid PRO 40, EnkaGrid PRO 60 and EnkaGrid PRO 90 are given in Table 3.

Figure 4 Isochronous curves — EnkaGrid PRO Geogrids

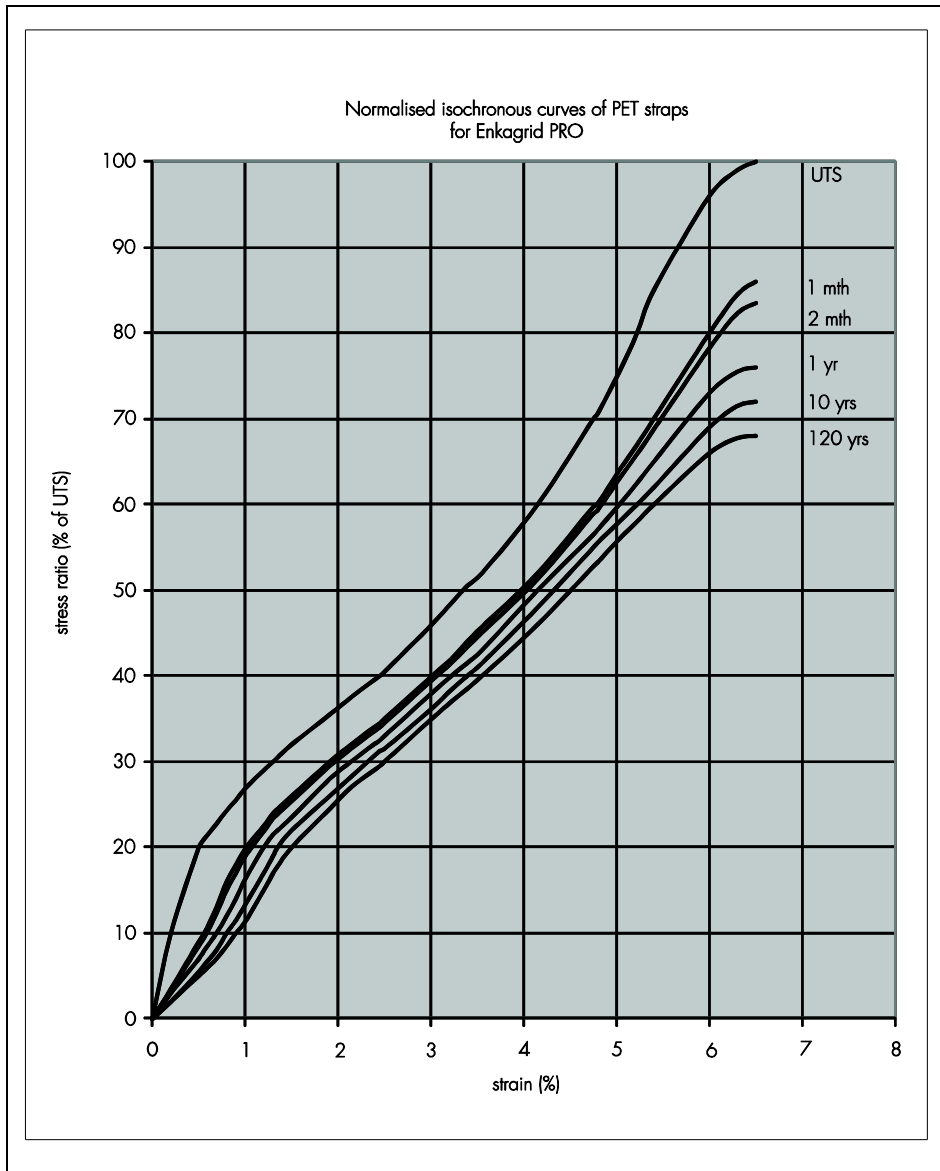


Table 3 Tensile load (T_{CS}) inducing prescribed post-construction strain limits

Geogrid grade	T_{CS} ($\text{kN}\cdot\text{m}^{-1}$) prescribed post construction strain limits	
	0.5%	1.0%
EnkaGrid PRO 40	23.0	26.7
EnkaGrid PRO 60	36.8	42.7
EnkaGrid PRO 90	54.6	63.3

Connection strength between the geogrids and concrete block facing units

7.4 Long-term connection strength values (T_{conn}) for the system have been derived from short-term tests in accordance with the National Concrete Masonry Association *Design Manual for Segmental Retaining Walls (Second edition 2002)* and ASTM D6638 : 2007. Connection efficiencies determined from these tests have been applied to the long-term creep rupture strength (T_{CR}) values for the geogrids approved for use with the system, to determine the relevant long-term connection strengths (T_{conn}). The results are shown in Table 4 and can be used to determine the design connection strength (T_{Dconn}) as set out in section 6.

Table 4 Long-term connection strength for EnkaGrid Pro geogrids (T_{conn})⁽¹⁾

Geogrid grade	T_{CR} (kN·m ⁻¹)	Height of wall above geogrid layer (m)	T_{conn} (kN·m ⁻¹)
EnkaGrid PRO 40	27.2	0.0 to 6.0	19.7
		6.1 to 10.0	18.1
EnkaGrid PRO 60	43.5	0 to 3.0	32.7
		3.1 to 10.0	41.2
EnkaGrid PRO 90	64.6	0 to 3.0	50.1
		3.1 to 10.0	50.3

(1) For a design life of 120 years and at a design temperature of 20°C.

7.5 The reduction factors and factors of safety shown in Table 5 should be used to determine the material factor (f_m) required for calculation of the ultimate limit state design connection strength (T_{Dconn}), where $f_m = RF_{ID} \times RF_W \times RF_{CH} \times f_s$.

Table 5 Reduction factors for determination of T_{Dconn}

Reduction factor	Value and conditions of use/limitations
RF_{ID}	A value of 1.00 can be used for all grades of geogrid, as short-term installation damage at the point of connection is already taken into account during the full scale connection strength tests
RF_W, RF_{CH}, f_s	As set out in BBA HAPAS Certificate 14/H211 PS1, according to geogrid specification selected and conditions of use ⁽¹⁾

(1) pH levels within and immediately behind the wall are assumed to be the same as those in the main fill material.

Soil/geogrid interaction

7.6 Soil/geogrid interaction coefficients for use in design are given in BBA HAPAS Certificate 14/H211, Product Sheet 1.

8 Maintenance

The exposed faces of the concrete block facing units may require periodic maintenance to remove dirt build-up, mould and moss growth. All other components of the system are confined within the wall and/or fill, and do not require maintenance.

9 Durability

9.1 When designed and installed in accordance with this Certificate, the system will have adequate durability for the required 120-year design life of a retaining wall and bridge abutment if the requirements of BS EN 206 : 2013 have been considered appropriately.

9.2 Where the blocks are to be embedded in potentially aggressive soils, the guidance given in BS 8500-1 : 2015 and BRE Special Digest 1 : 2005 should be followed.

10 Reuse and recyclability

The concrete facing units can be crushed and reused as aggregate. The fill material can also be reused.

Installation

11 General

Installation of the Landmark Retaining Wall System for Reinforced Soil Retaining Walls and Bridge Abutments should be in accordance with BS 8006-1 : 2010 and BS EN 14475 : 2006. Detailed information on installation can be found in the Certificate holder's Installation Guide.

12 Procedure

12.1 Landmark blocks are laid on a levelling pad which may be composed of either good compactable material (MCHW Volume 1, Type 1) or a suitable concrete foundation (C25/20 or as specified) laid to the correct level for the first course of facing units. Where a concrete foundation is used, a base course of Landmark blocks can be laid by placing on a mortar bed to achieve the required accuracy in line and level. The tops of each unit should be brushed clean prior to the placement of the next course. The foundation stratum and the underlying formation below the system must be checked appropriately.

12.2 The maximum vertical spacing between geogrid layers should be 760 mm.

12.3 Backfill material should be placed up to the top level of the layer that requires reinforcement and compacted back to the extent of the geogrid reinforcement or as shown on the construction drawings. Heavy plant exceeding one tonne should not be allowed within two metres of the face of the wall (MCHW, Volume 1, Clause 622.7). A vibrating plate compactor of less than one tonne must carry out compaction within this zone. Frequent checks must be made to the alignment of the face to ensure that any disturbance from the compaction process is promptly corrected.

12.4 A suitable length of geogrid is cut from the roll. The geogrid should be placed with the machine direction perpendicular to the wall face and within 25 mm of the face of the lower concrete facing units.

12.5 The connection between the geogrids and concrete block facing units is achieved by the PVC lock bar and lock flange at the bottom of each concrete facing block, which pushes the geogrid into the channel on the top of each block and firmly holds the geogrid in place.

Figure 5 Method of connecting geogrid to concrete block facing units



12.6 The reinforcement is placed on top of the channels formed in the top of the units. The lock bar should be installed flat side up, with the angled side to the back of the units, shown by an arrow printed on the lock bar.

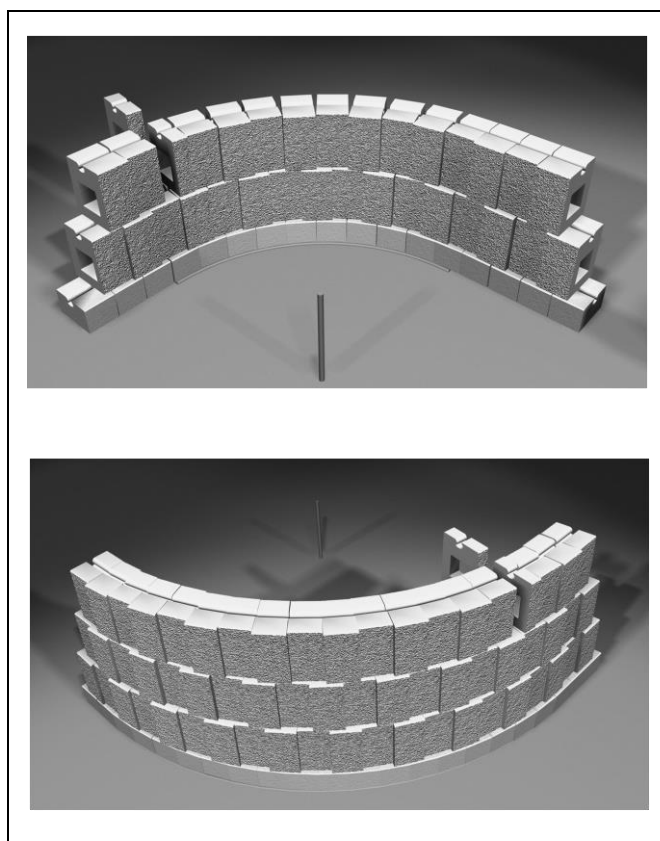
12.7 Plant machinery should not be allowed to run directly over geogrids and at least 150 mm of fill should be placed over them to avoid damage from traffic.

12.8 Backfill material should be placed as described in section 12.3, and further courses of blocks and geogrids added in an identical manner until the required level for a coping unit is reached.

Corners and curves

12.9 External curves with a minimum radius of 2.75 m and internal curves with a minimum radius of 1.8 m can be formed using tapered blocks (see Figure 6). It should be noted that the setback of the block will cause the radius of each course to gradually increase/decrease and affect the running bond of the wall. To maintain proper running bond, partial units should be used, as necessary. It should also be noted, that with decreasing radii, the lockbar may require cutting into smaller lengths.

Figure 6 Internal and external curves



12.10 External corners of 90° can be formed using special corner units available from the Certificate holder (outside the scope of this Certificate). Further guidance can be found in the Certificate holder's Installation Instructions.

Technical Investigations

13 Tests

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

13.2 An assessment was made of test data to determine:

- the compressive strength and gross dry density of concrete block facing units
- system durability
- performance of the retaining wall system under fire test conditions
- the connection strength between the geogrids and facing units
- interface shear capacity between the blocks.

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

13.4 Dimensional check tests were carried out on facing units.

Bibliography

BRE Special Digest 1 : 2005 *Concrete in aggressive ground*

BS 8006-1 : 2010 + A1 : 2016 *Code of practice for strengthened/reinforced soils and other fills*

BS 8500-1 : 2015 + A1 : 2016 *Concrete — Complementary British Standard to BS EN 206 — Method of specifying and guidance for the specifier*

BS EN 206 : 2013 + A1 : 2016 *Concrete — Specification, performance, production and conformity*

BS EN 771-3 : 2011 *Specification for masonry units — Aggregate concrete masonry units (Dense and lightweight aggregates)*

BS EN 12878 : 2014 *Pigments for the colouring of building materials based on cement and/or lime — Specifications and methods of test*

BS EN 13251 : 2016 *Geotextiles and geotextile-related products — Characteristics required for use in earthworks, foundations and retaining structures*

BS EN 14475 : 2006 *Execution of special geotechnical works — Reinforced fill*

ASTM D6638 : 2007 *Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks)*

Manual of Contract Documents for Highway Works, Volume 1 *Specification for Highway Works*, Series 600

NCMA guide “Segmental Retaining Walls Best Practices Guide”

National Concrete Masonry Association Design Manual for Segmental Retaining Walls (Second edition 2002).

14 Conditions

14.1 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 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.

14.2 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.

14.3 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.

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

14.5 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
- actual 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.

14.6 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.