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**Agrément
Certificate
No 03/4032**
Second issue*

Designated by Government
to issue
European Technical
Approvals

ANCHOR VERTICA WALL SYSTEM FOR REINFORCED SOIL RETAINING WALLS

Système de renforcement des sols
Bodenvarfestigung

Product



• THIS CERTIFICATE RELATES TO THE ANCHOR VERTICA WALL SYSTEM FOR REINFORCED SOIL RETAINING WALLS.

• The system is based on the use of proprietary dry-jointed concrete block facing units in combination with proprietary polymeric reinforcement. The reinforcement connects directly with the concrete blocks.

• The design and construction of block walls must be in accordance with the conditions set out in the Design Data and Installation parts of this Certificate, and should follow the recommendations given in BS 8006 : 1995.

• The system is distributed by Maccaferri Limited, 7400 The Quorum, Oxford Business Park, North Garsington Road, Oxford OX4 2JZ.

• The concrete block facing units are manufactured under licence by Acheson and Glover Limited, Fivemiletown, Co Tyrone BT75 0SY.

Regulations

1 The Building Regulations 2000 (as amended) (England and Wales)



In the opinion of the BBA, the Anchor Vertica Wall System for Reinforced Soil Retaining Walls is not subject to these Regulations.

2 The Building Standards (Scotland) Regulations 1990 (as amended)



In the opinion of the BBA, the Anchor Vertica Wall System for Reinforced Soil Retaining Walls is not subject to these Regulations.

3 The Building Regulations (Northern Ireland) 2000



In the opinion of the BBA, the Anchor Vertica Wall System for Reinforced Soil Retaining Walls is not subject to these Regulations.

4 Construction (Design and Management) Regulations 1994 (as amended) Construction (Design and Management) Regulations (Northern Ireland) 1995 (as amended)

Information in this Certificate may assist the client, planning supervisor, designer and contractors to address their obligations under these Regulations.

See sections: 6 Delivery to site, handling and storage (6.1) and 8 Practicability of installation (8.1 and 8.2).

5 Description

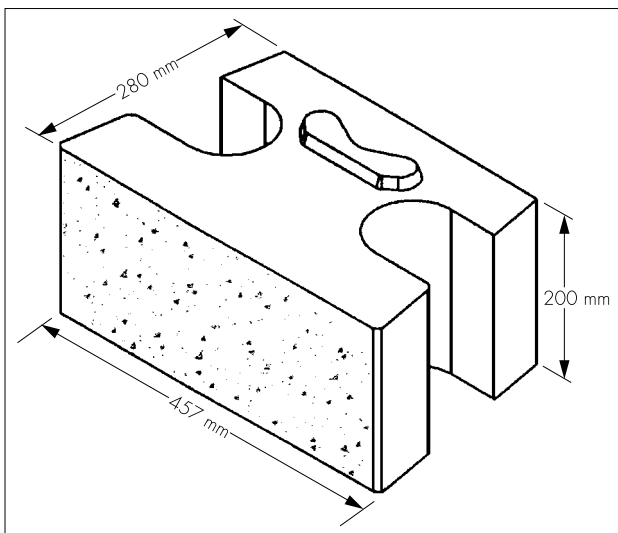
5.1 The system comprises:

- Anchor Vertica concrete block facing units
- Paragrid geogrids.

Anchor Vertica concrete block facing units

5.2 The concrete facing units covered by this Certificate are of a single size and have the normal dimensions 457 mm by 200 mm by 280 mm and nominal weight of 39 kg (see Figure 1). They are available in six standard colours. If special colours are required, the Certificate holder should be contacted. All units are manufactured to the same specification.

Figure 1 Facing units



5.3 All pigments used for the coloration of the concrete blocks comply with BS EN 12878 : 1999.

5.4 Facing units are manufactured in block machines where mechanical vibratory compaction and sizing is used with semi-dry concrete to achieve the specified minimum compressive strength, water absorption and block shape.

5.5 Minimum concrete strength is 30 Nmm^{-2} at 28 days. The concrete mix specification comprises a minimum cement content of 365 kgm^{-3} and a maximum water/cement ratio of 0.5.

5.6 The blocks are cured in a temperature- and humidity-controlled internal environment.

5.7 Factory production control is undertaken throughout all stages of manufacture. Checks include:

- formalised recording of use of correct concrete mix specification
- visual checks on appearance of demoulded units
- dimensional checks
- compressive strength recording at 7 days and 28 days on eight samples taken from each production run.

Paragrid geogrids

5.8 The geogrids approved for use with the wall system are types 30/15, 50/15 and 80/15, and are covered by BBA Roads and Bridges Certificate No 98/R098.

Fill

5.9 The designer should specify the relevant properties of the fill material deemed acceptable for the purposes of the design. Materials should meet the requirements of the Manual of Contract Documents for Highway Works (MCHW), Volumes 1 and 2, May 2001. The recommendations given in BS 8006 : 1995 should also be considered.

6 Delivery to site, handling and storage

Facing units

6.1 The facing units are delivered to site on shrink-wrapped pallets. The shrink wrap is hand-marked with the date of production and labelled to show the product name, manufacturer's logo and the BBA logo. Pallets should not be stacked more than two high.

6.2 To prevent damage, care should be taken in transit and handling. During prolonged periods of storage on site the units should remain covered on pallets.

Paragrid geogrids

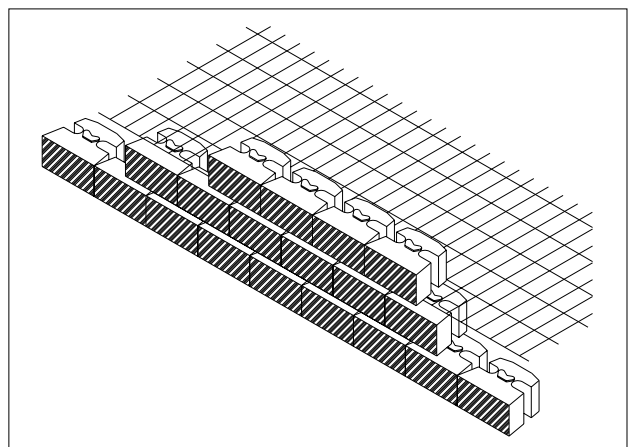
6.3 Paragrid geogrids should be delivered, handled and stored in line with the requirements of BBA Roads and Bridges Certificate No 98/R098.

Design Data

7 General

7.1 The Anchor Vertica Wall System for Reinforced Soil Retaining Walls is satisfactory for use in providing reinforced soil retaining walls. Walls up to a maximum height of 8 m are covered by this Certificate. Structural stability is achieved through the frictional interaction and interlock of the soil particles with the geogrid and by the frictional connection of the geogrid to the facing units (see Figure 2).

Figure 2 Typical wall construction



10 Mechanical properties

Long-term connection strength (T_{conn})

10.1 A value for the long-term connection strength of the wall system (see Table 1) has been derived by performing a series of short-term tests in line with the National Concrete Masonry Association *Design Manual for Segmental Retaining Walls* (Second Edition, 1997). From the results of these tests, a connection efficiency, expressed as a percentage, has been applied to values of characteristic long-term strength (P_c) for a 60-year and a 120-year life. The values of the P_c have been derived from long-term creep rupture testing at 20°C. For ultimate limit state, for a 60-year and 120-year design life, P_c is 64% and 60% respectively of the ultimate tensile strength (P_{ult}).

Table 1 Long-term connection strength, T_{conn}

Geogrid grade	P_c (kNm ⁻¹)	T_{conn} (kNm ⁻¹)	
60-year life			
30/15	19	0.0–1.8 m	5.6
		1.9–3.5 m	7.5
		3.6–7.0 m	8.3
		7.1–8.7 m	9.1
50/15	32	0.0–1.8 m	5.3
		1.9–3.5 m	5.7
		3.6–7.0 m	10.2
		7.1–8.0 m	10.3
80/15	51	0.0–1.8 m	7.2
		1.9–3.5 m	11.3
		3.6–5.2 m	13.0
		5.3–7.0 m	15.2
		7.1–8.0 m	15.9
120-year life			
30/15	18	0.0–1.8 m	5.3
		1.9–3.5 m	7.1
		3.6–7.0 m	7.8
		7.1–8.0 m	8.6
50/15	30	0.0–1.8 m	5.0
		1.9–3.5 m	5.3
		3.6–7.0 m	9.5
		7.1–8.0 m	9.6
80/15	48	0.0–1.8 m	6.7
		1.9–3.5 m	10.7
		3.6–5.2 m	12.2
		5.3–7.0 m	14.3
		7.1–8.0 m	15.0

Design strength of Anchor Vertical wall system

10.2 To evaluate the overall design strength of the wall system, it is necessary to consider both the design strength of the grid (T_{Dgrid}) and the design strength of the connection (T_{Dconn}).

Design strength T_{Dgrid}

10.3 T_{Dgrid} should be calculated for both the ultimate and serviceability limit states. For ultimate limit state, for a 60-year design life P_c is 64% of P_{ult} and for a 120-year design life, 60% of P_{ult} . Further information can be found in BBA Roads and Bridges Certificate No 98/R098.

7.2 Design of the wall system should be in accordance with the recommendations of BS 8006 : 1995. The design should be undertaken by a suitably qualified engineer, taking into account all the required partial-material and load factors.

7.3 The BBA has not assessed this system for supporting parapet loading caused by vehicle collision at the top of the facing units. When applicable this aspect of a design would require separate consideration.

7.4 Where appropriate, the system should be protected against horizontal impact loads caused by possible vehicle collision with the lower facing units of the wall.

8 Practicability of installation

8.1 The system is installed easily, provided all requirements of section 12 are complied with.

8.2 Before and during installation, particular care should be taken to ensure:

- site preparation and wall construction is as detailed in section 12
- fill properties satisfy the design specification
- drainage is adequate at all stages of construction as required by the contract in the appropriate documents
- geogrids are protected against damage by site traffic and installation equipment
- the stability of existing structures is not affected.

8.3 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.

8.4 Where accurate cutting of facing units is required on site, disc cutting techniques should be employed.

9 Design considerations

General

9.1 Reinforced soil structures incorporating the wall system shall be designed in accordance with BS 8006 : 1995.

9.2 Adequate consideration shall be given to the provision of drainage to the wall.

9.3 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 can be achieved. However, where the alignment of the vertical face is critical, consideration may be given to providing a brickwork skin, or similar, to the facing units.

9.4 The design of the retaining wall as a whole unit must ensure that the facing units can provide adequate anchorage to the geogrids and provide local support to the soil between the layers of geogrid.

Design strength T_{Dconn}

10.4 For the ultimate limit state, the connection design strength should be calculated by using:

$$T_{Dconn} = \frac{T_{conn}}{f_m f_n}$$

10.5 For all designs involving the use of the wall system the value of the partial factor for ramification of failure, f_n , should be in accordance with BS 8006 : 1995.

10.6 The values of the partial material factor, f_m , sub-components should be taken from Table 2.

Table 2 Partial Material Factor, f_m , sub-component factors for evaluating T_{Dconn}

Partial Material Factor component	Value
f_m 11	1.00
f_m 121	1.05
f_m 122	1.00
f_m 212	1.00 ⁽¹⁾
f_m 22	1.05 ⁽²⁾

- (1) Short-term installation damage effects are deemed to have been taken into account through the method of deriving the value, T_{conn} .
- (2) A value of 1.05 applies to soils with a pH value in the range 2.0 to 9.5 as in BBA Certificate No 98/R098.

10.7 The design load the connection must resist (T_i) is to be calculated using prescribed load factors recommended in BS 8006 : 1995. For all designs including the wall system the minimum value of load factor is to be 1.5. In all cases T_i must be $\leq T_{Dconn}$.

11 Durability

In the opinion of the BBA, when used and installed in accordance with this Certificate, the wall system results in a reinforced soil structure that can achieve a design life of 120 years.

Installation

12 Procedures

12.1 Detailed information on installation can be found in the Certificate holder's installation instructions.

12.2 Anchor Vertica blocks are laid on a levelling pad which may be composed of either good compactable material (MCHW1, 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 Anchor Vertica 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.

12.3 A maximum of four courses of facing units may be laid before inserting a geogrid.

12.4 Backfilling 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 (MCHW1, 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.

12.5 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 50 mm of the face of the lower concrete facing units.

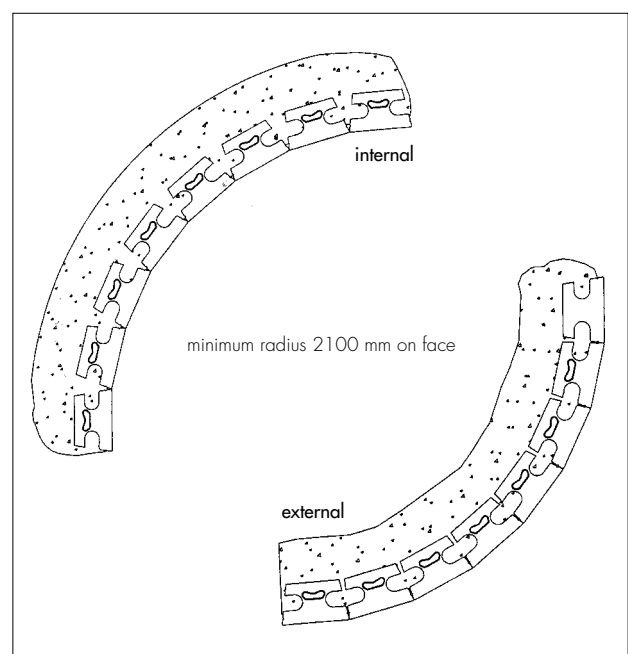
12.6 The next course of concrete facing units should be installed to secure the geogrid in place and it should be pulled taut and the back edge pinned to keep it from wrinkling. Plant should not be allowed to run directly over geogrids and at least 150 mm of fill should be placed over them to avoid damage from traffic.

12.7 Backfilling should be placed as described in section 12.4 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

12.8 Internal and external corners (to a minimum radius of 2100 mm on the face) can be formed using any standard blocks as shown in Figure 3.

Figure 3 Internal and external curves



12.9 External corners of 90° can be formed using special corner units available from the Certificate holder (not covered by this assessment). Further guidance can be found in the Certificate holder's installation instructions.

Technical Investigations

The following is a summary of the technical investigations carried out on the Anchor Vertica Wall System for Reinforced Soil Retaining Walls.

13 Investigations

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

13.2 An examination was made of test data relating to:

- compressive strength of concrete block facing units
- durability
- performance of the retaining wall system under fire test conditions
- the connection strength between the geogrids and facing units.

13.3 Visits were made to installations in progress to assess the practicability and ease of construction of the system.

13.4 Proposed design methods were assessed in relation to the requirements of BS 8006 : 1995 and the National Concrete Masonry Association *Design Manual for Segmental Retaining Walls* (Second Edition — 1997) National Concrete Masonry Association, Herndon, Virginia, USA.

Bibliography

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

BS EN 12878 : 1999 *Pigments for the colouring of building materials based on cement and/or lime — Specifications and methods of test*

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)

Conditions of Certification

14 Conditions

14.1 This Certificate:

- (a) relates only to the product that is described, installed, used and maintained as set out in this Certificate;
- (b) is granted only to the company, firm or person identified on the front cover — no other company, firm or person may hold or claim any entitlement to this Certificate;
- (c) is valid only within the UK;
- (d) has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective;
- (e) is copyright of the BBA;
- (f) is subject to English law.

14.2 References in this Certificate to any Act of Parliament, Regulation made thereunder, Directive or Regulation of the European Union, Statutory Instrument, Code of Practice, British Standard, manufacturers' instructions or similar publication, are references to such publication in the form in which it was current at the date of this Certificate.

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

- (a) are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA;

(b) continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine; and

(c) are reviewed by the BBA as and when it considers appropriate.

14.4 In granting this Certificate, the BBA is not responsible for:

- (a) the presence or absence of any patent or similar rights subsisting in the product or any other product;
- (b) the right of the Certificate holder to market, supply, install or maintain the product; and
- (c) the nature or standard of individual installations of the product or any maintenance thereto, including methods and workmanship.

14.5 Any recommendations relating to the use or installation of this product which are contained or referred to in this Certificate are the minimum standards required to be met when the product is used. They do not purport in any way to restate the requirements of the Health & Safety at Work etc Act 1974, or of any other statutory, common law or other duty which may exist at the date of this Certificate or in the future; nor is conformity with such recommendations to be taken as satisfying the requirements of the 1974 Act or of any present or future statutory, common law or other duty of care. In granting this Certificate, the BBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the installation and use of this product.



In the opinion of the British Board of Agrément, the Anchor Vertica Wall System for Reinforced Soil Retaining Walls is fit for its intended use provided it is installed, used and maintained as set out in this Certificate. Certificate No 03/4032 is accordingly awarded to Anchor Retaining Wall Systems Incorporated.

On behalf of the British Board of Agrément

A handwritten signature in black ink, appearing to read 'P. C. Newson', is written over a light grey background.

Date of Second issue: 28th July 2004

Chief Executive

**Original Certificate issued on 26th June 2003. This amended version includes reference to revised values of long-term connection strength and new Conditions of Certification.*

Electronic Copy

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For technical or additional information,
contact the Certificate holder (see
front page).
For information about the Agrément
Certificate, including validity and
scope, tel: Hotline 01923 665400,
or check the BBA website.