

HAPAS

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HAPAS Certificate

17/H259

Product Sheet 1

LINK MIDDLE EAST (LME) EARTH RETENTION AND PROTECTION SYSTEMS

LME WOVEN HEXAGONAL MESH GABIONS

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 LME Woven Hexagonal Mesh Gabions, cages formed from PVC-U coated galvanized wire for use in retaining wall applications.

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

Structural performance — the products, when used correctly in a fully-designed application, will have adequate strength to resist the anticipated loads (see section 6).

Durability — when used in accordance with the requirements of this Certificate, the gabion structure may be considered to have a life expectancy in excess of 60 years (see section 8).

The BBA has awarded this Certificate to the company named above for the products described herein. These products 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: 23 February 2017

Brian Chamberlain
Head of Technical Excellence

Originally subject of Certificate 99/R117 issued on 1 November 1999

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

The Highways Technical Advisory Committee has agreed with the British Board of Agrément the aspects of performance to be used by the BBA in assessing LME Woven Hexagonal Mesh Gabions.

In the opinion of the BBA, LME Woven Hexagonal Mesh Gabions, when manufactured and installed in accordance with the provisions of this Certificate and the Department of the Environment, Transport and the Regions, Highways England (DETR, HE) *Standard HD22 Ground Investigations and Earthworks Procedure for Geotechnical Certification*, is suitable for use in embankments with an effective slope angle of up to 70°.

The design, materials specification and construction methods adopted must be in accordance with the DETR, HE Advice Note HA 68/94 and/or BS 8006-1 : 2010, IAN 124/11 and the *Manual of Contract Documents for Highway Works* (MCHW)⁽²⁾, Volume 1 *Specification for Highway Works* (SHW).

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

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

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: 3 *Delivery and site handling* (3.1 and 3.4) and 11 *Procedure* (11.14) of this Certificate.

Technical Specification

1 Description

1.1 LME Woven Hexagonal Mesh Gabions are cages formed from hexagonal galvanized woven steel wire mesh, laced together and filled with selected granular material (stone) (see section 4.2).

1.2 The hexagonal steel wire mesh is protected with PVC-U⁽¹⁾ polymer coating onto galvanized Zinc or Galfan (95Zn+5Al) coated wire.

(1) PVC-U coating in accordance with BS EN 10245-2 : 2011.

1.3 The nominal dimensions⁽¹⁾ of standard gabions are:

- height (m) 0.50 or 1.0
- length (m) 1.0, 1.5, 2.0, 3.0, 4.0 or 5.0
- depth (m) 1.0 or 2.0.

(1) Tolerances on sizes are in accordance with BS EN 10223-3 : 2013.

1.4 Details of mesh dimensions, the wire used for the range of standard mesh/wire combinations and the associated lacing wire required for on-site fabrication are given in Table 1 and Figure 1.

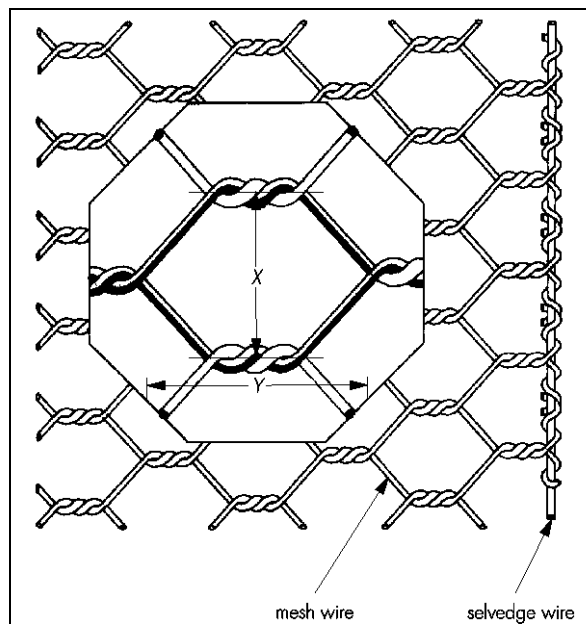
Table 1 Standard mesh and wire sizes

| Mesh dimension ⁽¹⁾ X x Y (mm) | Wire diameter ⁽²⁾ (mm) | | | | | |
|---|-----------------------------------|-----|-----------------------|-----|-----------------------|-----|
| | Mesh | | Selvedge | | Lacing | |
| | Galvanized/ Galfan | PVC | Galvanized/ Galfan | PVC | Galvanized/ Galfan | PVC |
| 60 x 80 | 2.0 | 3.0 | 2.4 | 3.4 | 2.2 | 3.2 |
| 60 x 80 | 2.2 | 3.2 | 2.7 | 3.7 | 2.4 | 3.4 |
| 60 x 80, 80 x 100 | 2.4 | 3.4 | 3.0 | 4.0 | — | — |
| 60 x 80, 80 x 100, 100 x 120 | 2.7 | 3.7 | 3.4 | 4.4 | — | — |
| 80 x 100, 100 x 120 | 3.0 | 4.0 | 3.9 | 4.9 | — | — |
| 100 x 120 | 3.4 | 4.4 | 4.4 | 5.4 | — | — |

(1) See Figure 1.

(2) To BS EN 10218-2 : 2012, tolerances class T1.

Figure 1 Details of gabion mesh



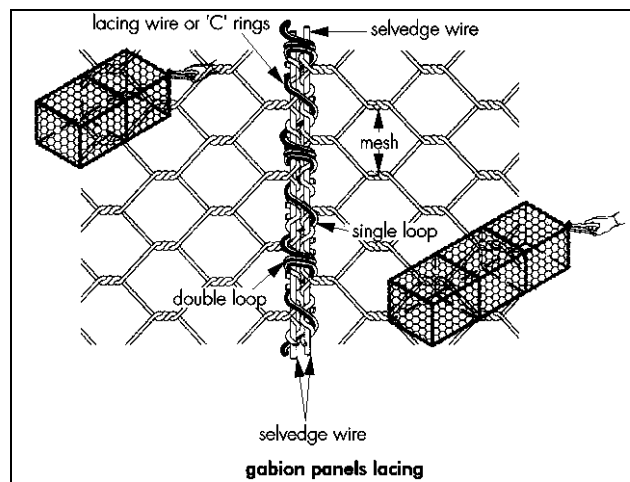
1.5 The wire used for the mesh is generally to BS EN 10218-1 : 2012, BS EN 10218-2 : 2012 and BS EN 10223-3 : 2013, with an ultimate tensile strength in the range of 350 to 550 N·mm⁻², and with a minimum elongation at fracture of 8% on a gauge length of 250 mm, and is drawn from rods complying with BS EN 16120-1 : 2011 and BS EN 16120-2 : 2011. The base steel wire is galvanized in accordance with BS EN 10244-2 : 2009 (Tables 1 and 2, Class A) prior to being PVC-U coated in accordance with BS EN 10245-1 : 2011 and BS EN 10245-2 : 2011. The minimum coating thickness for the various diameters is given in Table 2. Different specifications are used for the selvedge wire, mesh and lacing coil (see Tables 1 and 2 and Figure 2).

Table 2 Specifications for wire diameter, tolerances and coating mass

| Nominal core wire diameter (mm) | Minimum overall diameter of PVC-coated wire ⁽¹⁾ (mm) | Tolerance on core diameter (t_1) (\pm mm) | Minimum mass of zinc/Galfan coating ($\text{g}\cdot\text{m}^{-2}$) |
|---------------------------------|---|--|--|
| 2.0 | 3.0 | 0.05 | 215 |
| 2.2 | 3.2 | 0.06 | 230 |
| 2.4 | 3.4 | 0.06 | 230 |
| 2.7 | 3.7 | 0.06 | 245 |
| 3.0 | 4.0 | 0.07 | 255 |
| 3.4 | 4.4 | 0.07 | 265 |
| 3.9 | 4.9 | 0.07 | 275 |

(1) Including PVC coating.

Figure 2 Details of gabion construction



1.5 Steel lifting frames, with the appropriate number of slings/chains attached, are available and must be used to install pre-filled gabions (see section 10.14).

2 Manufacture

2.1 Galvanized wire and PVC-U coated wire are manufactured by the Certificate holder or bought in to the specification defined by Link Middle East.

2.2 Factory production control includes checking the Mill Certificate against the agreed specification, visual and dimensional checks on the incoming wire coil, checks on the thickness of the zinc coating and thickness of the plastic coating as appropriate, and dimensional checks on the woven mesh.

2.3 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.

2.4 The products are manufactured by the Certificate holder and marketed in the UK by Cerana Ltd (trading as Enviromesh), with the registered address at 83 Ducie Street, Manchester, M1 2JQ, and the trading office at Garner Street Business Park, Etruria, Stoke-on-Trent, Staffordshire, ST4 7BH, tel: 0845 1360101, email: enquiries@enviromeshgabions.co.uk, website: www.enviromeshgabions.co.uk

3 Delivery and site handling

3.1 The products are delivered to site in bales of one or more bundles, with each bundle consisting of 1 to 45 gabion boxes weighing up to a maximum of 1000 kg. The bundles of boxes are strapped together to form a bale, which has a maximum height of 2 m and maximum weight of between 2.5 and 3.5 tonnes.

3.2 The products should be stored in the open, but away from site traffic to avoid the risk of accidental damage, and should remain packaged until required.

3.3 A label bearing the BBA Certificate number, Certificate holder's name, batch number and product code is attached to each bundle.

3.4 Gloves must be worn and bundles should be handled with due care to avoid damage to the coatings. Individual cages can be manhandled.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on LME Woven Hexagonal Mesh Gabions.

Design Considerations

4 General

4.1 LME Woven Hexagonal Mesh Gabions comply with the requirements of the MCHW, Volume 1, clause 626, and therefore are satisfactory for use as described in the *Requirements* section of this Certificate.

4.2 Selected granular material (as detailed in the MCHW, Volume 1, Series 600, Table 6/1, Class 6G) must be used to fill the gabions. The fill material should be of hard durable stone such as quarried or naturally-occurring rounded stone. The maximum and minimum particle size must comply with the MCHW, Volume 1, Clause 626.5.

4.3 The design of gabion structures should be based on the principle of mass earth-retaining walls.

4.4 The density of filled mattresses should be taken as 60% of the density of the solid material. A higher value may be appropriate in certain circumstances but this will be the responsibility of the consulting engineer, who must ensure that the design value is achieved on site.

4.5 Gabion walls can be constructed with a minimum radius of curvature of 25 m on plan without modification of the gabion structure.

4.6 Placing the external layer of stone by hand can give a better appearance to the completed wall without affecting the strength of the gabion structure.

5 Practicability of installation

The products are designed to be installed by a competent civil engineering or building contractor experienced with these types of products, and are installed easily under normal site conditions.

6 Structural performance

6.1 The design of the gabion structures should be carried out by a suitably-qualified engineer.

6.2 The mesh has adequate strength to resist all loads associated with handling and positioning. Care must be taken when installing pre-filled gabions (see sections 11.12 to 11.14).

6.3 Correctly laced gabions will remain in position and adequately sustain the load associated with placing the stone infill.

6.4 Gabion walls are permeable and will not permit hydrostatic pressure to build up behind the wall. Gabion structures are not normally designed to withstand hydrostatic pressure.

6.5 Where cohesive material, such as clay, is retained, water movement may cause it to exude into the gabion structure and block the passage of water. To reduce the risk of a build-up of hydrostatic pressure in these conditions, it may be necessary to provide additional granular layers behind the gabion structure to allow water to drain away.

6.6 The lifting frames and slings must have adequate strength for lifting and positioning the gabions.

7 Maintenance and repair

Routine maintenance is not normally required. However, any damage to the PVC-U mesh coating and exposing of the steel can be repaired by securing additional or replacement mesh as required.

8 Durability

8.1 The life of a gabion structure is dependent on the quality of the mesh, the durability of the stone and, in the longer term, the stability of the consolidated mass of the infill material.

8.2 The PVC-U coated galvanized steel wire will not be affected by the chemicals normally encountered in earth-retaining structures.

8.3 Some local damage may occur to the PVC-U coating during installation and in exposed areas, and may lead to corrosion of the mesh. Site evidence and test data indicate that such damage will remain local and will not cause sequential corrosion underneath the intact adjacent area of mesh. The design of the wire mesh, and the fact that the strength of the mesh is not taken into account in the design of the structure as a whole, indicate that this local damage will not affect the integrity of the structure.

8.4 A gabion wall is a mass earth-retaining structure, and settlement may occur under the action of its self-weight. The movement associated with this will gradually increase the density of the structure and cause a reduction in the volume of voids. Additional settlement may occur when gabions are founded on weak soils.

8.5 Gabion walls will permit the growth of vegetation which will contribute to the integrity of the structure and to maintaining a natural appearance.

8.6 The design life of a gabion structure constructed in accordance with this Certificate, with suitable stone infill and adequate maintenance (see section 7), will be in excess of the 60 years required by HE.

9 Reuse and recyclability

The products are manufactured from PVC-U coated galvanized or galfan wire, which can be recycled.

Installation

10 General

Installation of LME Woven Hexagonal Mesh Gabions must be in accordance with this Certificate and the Certificate holder's installation instructions.

11 Procedure

In-situ filled gabion boxes

11.1 Gabion boxes are opened and folded on a hard surface, pressing out any unwanted creases.

11.2 Front and rear sides, ends and diaphragms are lifted into position to form a box shape (see Figure 3a).

11.3 Top corners are secured with thick selvedge wire.

11.4 The edges are laced together, starting from the top corner, in a continuous operation using alternate single and double twists at intervals of one mesh length. The ends of the lacing wire are secured at each corner with triple loops and turned into the gabions (see Figure 3b). Individual ties of lacing wire must not be used.

11.5 The initial layer of gabions should be placed on a flat surface.

11.6 A number of empty gabion boxes may be placed in position and secured together with lacing wire or 'C' rings using the method described in section 11.4.

11.7 The end gabion is partly filled with suitable stone to form an end anchor, and bracing wires are fixed at 500 mm intervals to prevent the front side from bulging (see Figure 3c). The gabions are tensioned by applying a load to the end remote from the anchor gabion, ensuring that the load is distributed over the whole area of the last gabion (see Figure 3d).

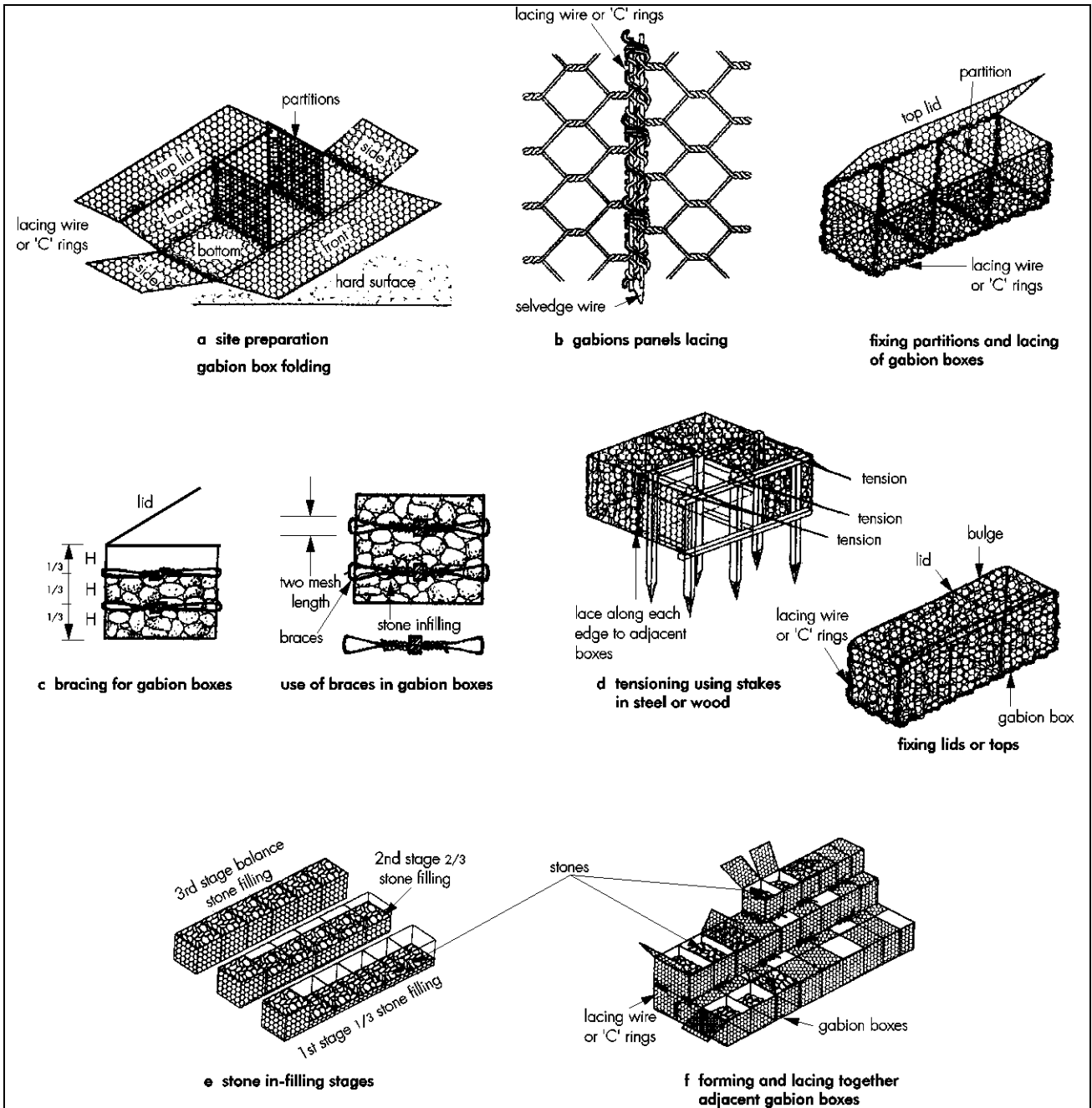
11.8 One-metre high gabions should be filled to one-third height, braced, filled to two-thirds height and braced again. A 0.5 m-high gabion requires only one row of bracing at 250 mm height. The gabion is overfilled by approximately 50 mm to 75 mm to allow for settlement of the infill owing to self-weight.

11.9 The mesh lid is folded down, stretched into position and secured to the front, sides and diaphragms.

11.10 The remaining row of gabions may be filled sequentially as shown in Figure 3e.

11.11 It is essential that each gabion box is properly secured to adjacent gabion boxes above, below and on each side (see Figure 3f).

Figure 3 Installation — in-situ



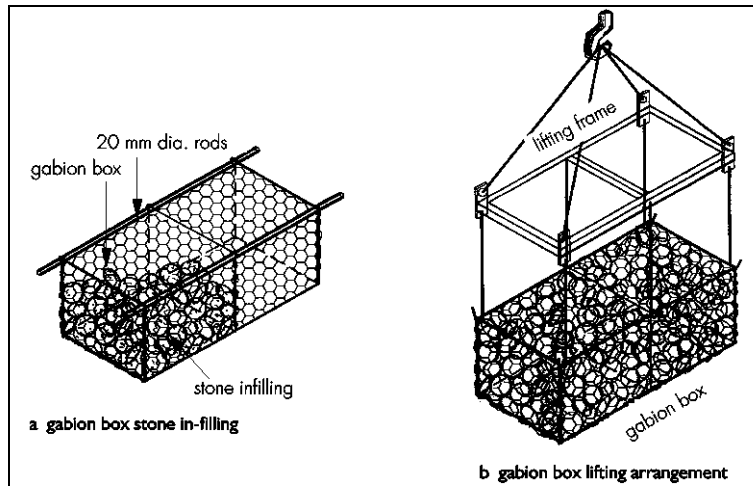
Pre-filled gabion boxes

11.12 Gabion boxes are constructed as described in sections 11.1 to 11.4, 11.8 and 11.9. However, it is advantageous to construct a slightly oversize frame within which the empty unit can be stretched taut (see Figure 4a).

11.13 After filling, the horizontal top edges are stiffened, if required, using reinforcing bars, typically 20 mm in diameter, to maintain shape during lifting. Bars should be removed after placement (see Figure 4b).

11.14 Purpose-made lifting frames and slings must be used for lifting filled units which weigh up to 1.8 tonnes per cubic metre.

Figure 4 Installation — pre-filled



Technical Investigations

12 Investigations

12.1 An assessment of data was carried out to determine:

- dimensional accuracy
- tensile strength
- quality of galvanized/galfan coating
- the effect of tolerances
- strength of wire, mesh and filled gabions
- quality of materials
- quality of organic coating
- ease of assembly
- compliance with HE specification, clause 626
- design procedures
- strength of the lifting frame
- durability
- effect of site damage.

12.2 Site visits were carried out to assess the practicability, ease of handling and installation under various site conditions.

12.3 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.

Bibliography

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

BS EN 16120-1 : 2011 *Non-alloy steel rod for conversion to wire — General requirements*

BS EN 16120-2 : 2011 *Non-alloy steel rod for conversion to wire— Specific requirements for general purpose wire rod*

BS EN 10218-1:2012 *Steel wire and wire products- General- Test Methods*

BS EN 10218-2 : 2012 *Steel wire and wire products — General — Wire dimensions and tolerances*

BS EN 10223-3 : 2013 *Steel wire and wire products for fences — Hexagonal steel wire netting for engineering purposes*

BS EN 10244-2 : 2009 *Steel wire and wire products — Non-ferrous metallic coatings on steel wire — Zinc or zinc alloy coatings*

BS EN 10245-1 : 2011 *Steel wire and wire products — Organic coatings — General rules*

BS EN 10245-2 : 2011 *Steel wire and wire products — Organic coatings on steel wire — PVC finished wire*

HA 68/94 *Design Manual for Roads and Bridges Volume 4 : Geotechnics and Drainage, Section 1 : Earthworks, Part 4 : Design Methods for the Reinforcement of Highway Slopes by Reinforced Soil and Soil Nailing Techniques*

IAN 124/11 *Use of Eurocodes for the design of highway structures*

Manual of Contract Documents for Highway Works, Volume 1 *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 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.

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
- 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.

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.