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**Agrément Certificate**

**05/4215**

Product Sheet 1

## LINK MIDDLE EAST (LME) EARTH RETENTION AND PROTECTION SYSTEMS

### LME WELDED MESH GABION BOXES AND MATTRESSES

This Agrément Certificate Product Sheet<sup>(1)</sup> relates to LME Welded Mesh Gabion Boxes and Mattresses, containers formed from a welded square or rectangular mesh of galvanized or Galfan-coated steel wire, additionally PVC-coated, where required, for use in temporary and long-term earth retention, river training, erosion control, fascia cladding system, free-standing wall and rainscreen applications.

(1) Hereinafter referred to as 'Certificate'.

#### CERTIFICATION INCLUDES:

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



#### KEY FACTORS ASSESSED

**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 dry, land-retaining applications, the powder-coated mesh may be considered to have a life expectancy of 120 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 Second issue: 6 April 2017

Originally certificated on 25 March 2005

Brian Chamberlain  
Head of Technical Excellence

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](http://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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## Regulations

In the opinion of the BBA, the use of LME Welded Mesh Gabion Boxes and Mattresses is not subject to the national Building 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 3.2) and 11 *Procedure* (11.10 to 11.12 and 11.21) of this Certificate.

## Technical Specification

### 1 Description

1.1 LME Welded Mesh Gabion Boxes and Mattresses are rectangular cages made from flat panels of steel wire mesh, welded into squares or rectangles (see Figure 1). Panels, gabions or mattresses are laced, 'C' clipped or 'helicalled' (ie laced with spiral wires) together and/or linked with a locking pin, and filled with selected granular material (stone) (see sections 4.3 and 4.7). The nominal dimensions of standard gabions and mattresses are given in Table 1.

Figure 1 LME Welded Mesh

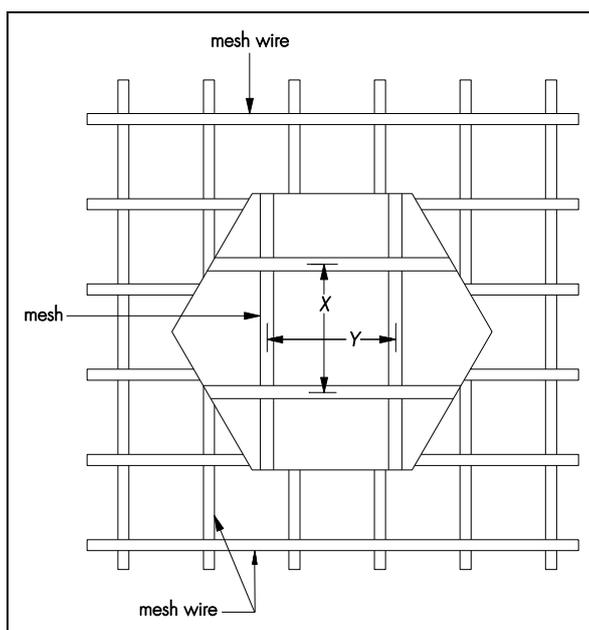


Table 1 Nominal dimension<sup>(1)</sup>

| Product  | Length (m)           | Width (m)     | Depth (m)                 |
|----------|----------------------|---------------|---------------------------|
| Gabion   | 1, 1.5, 2, 3, 4 or 5 | 0.5, 1 or 1.5 | 0.5, 0.7 or 1             |
| Mattress | 2, 3, 4, 5 or 6      | 1 or 2        | 150, 225, 250, 300 or 500 |

(1) Mesh tolerances in accordance with BS EN 10223-8 : 2013.

1.2 The mesh is available in standard sizes<sup>(1)</sup> of 50 by 50 mm, 75 by 75 mm, 100 by 50 mm, and 100 by 100 mm, or in multiples of these sizes, as gabion flat packs, individual flat panels or in rolls.

(1) X by Y sizes shown in Figure 1.

1.3 The wire used in the meshes is generally to BS EN 10218-1 : 2012, BS EN 10218-2 : 2012 and BS EN 10223-8 : 2013, with an ultimate strength of between 540 and 770 N·mm<sup>-2</sup>. The metallic coating thickness of wire in accordance with BS EN 10244-2 : 2009 (Table 1 or 2, Class A), or galvanized or Galfan-coated with an additional 0.25 mm thick organic-polymer-powder coating thickness in accordance with BS EN 10245-1 : 2011 and BS EN 10245-2 : 2011 (see Table 2 of this Certificate).

*Table 2 General specification of wires used in gabions and mattresses*

| Core wire diameter<br>(mm) | Minimum coating weight (g·m <sup>-2</sup> ) |        |
|----------------------------|---|--------|
|                            | HDG <sup>(1)</sup>                          | Galfan |
| 2.2                        | 230   | 230    |
| 2.5                        | 245   | 245    |
| 2.7                        | 245   | 245    |
| 3.0                        | 255   | 255    |
| 3.5                        | 265   | 265    |
| 3.8                        | 275   | 275    |
| 4.0                        | 275   | 275    |
| 4.5                        | 280   | 280    |
| 5.0                        | 280   | 280    |

(1) Hot-dip galvanized zinc.

1.4 The span wires and spiral wires are to BS EN 10218-2 : 2012 and BS EN 10223-8 : 2013, available in sizes of 2.2, 2.5, 3, 4 or 5 mm diameter, and galvanized or Galfan-coated to BS EN 10244-2 : 2009 (Table 1 or 2, Class A). An additional nominal thickness may be applied: 0.5 mm for organic-polymer coating or 0.25 mm for powder coating, in accordance with BS EN 10245-1 : 2011 and BS EN 10245-2 : 2011.

1.5 The average shear strength of four welds selected at random from one panel must not be less than 75% of the breaking load of the wire (maximum force during tensile test) and no single weld should be below 50%, in accordance with BS EN 10223-8 : 2013. The mesh is cut to the required length. For gabions, the end panels and diaphragms are connected to the base panel with stainless steel or Galfan-coated clips (one clip at each third mesh opening) or spiral wires. The units are available as either factory-jointed panels in flat pack form, or loose panels with joining clips or spiral wires separately.

1.6 Steel lifting frames, with the appropriate number of slings/chains attached, are available and must be used to install pre-filled gabions (see section 11.12).

## 2 Manufacture

2.1 The products are manufactured from steel wire, which is drawn to the required sizes by the Certificate holder from mild steel wire rods, bought in to the Certificate holder's specification. The drawn wire is then galvanized or Galfan coated, coated with organic-polymer powder (where required), and welded by electric resistance welding equipment.

2.2 The boxes and mattresses are assembled and folded to form a bundle.

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 office 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 136 0101, email: enquiries@enviromeshgabions.co.uk, website: www.enviromeshgabions.co.uk

### 3 Delivery and site handling

- 3.1 The gabions and mattresses are normally delivered to site on pallets, in bundles of 40.
- 3.2 The spirals and other fixings are supplied in bundles or packed on pallets.
- 3.3 The products should be stored away from site traffic to avoid the risk of accidental damage, and should remain packaged until required.
- 3.4 Each bundle carries a label bearing the Certificate holder's name, batch number, product code and the number of this Certificate.
- 3.5 Bundles must 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 Welded Mesh Gabion Boxes and Mattresses.

## Design Considerations

### 4 General

#### Gabion boxes

- 4.1 The design of gabion structures should be based on the principle of mass earth-retaining walls.
- 4.2 In general, the density of filled gabions 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.
- 4.3 The stone infill to the gabions is normally sized between 100 and 200 mm and is of hard, durable stone, such as quarried or naturally-occurring rounded stone.
- 4.4 Gabion walls can be constructed with a minimum radius of curvature of 25 m on plan without modification of the gabion structure. Factory-modified gabions are available with differing front and back panels to allow a tighter radius.

#### Mattresses

- 4.5 The design of the mattress structures should be based on the principles of hydraulic engineering and, where applicable, mass earth-retaining structures.
- 4.6 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.
- 4.7 The stone infill to the mattresses is normally sized between 75 and 150 mm. The size will depend on the use of the product and the mesh size. In hydraulic structures, the nominal size of the stone should be 1.5 times the mesh size. To ensure adequate protection to the underlying soil, the stone size and grading should be chosen to ensure more than one layer within the mattress depth. The fill must be of hard, durable stone such as quarried or naturally-occurring rounded stone.
- 4.8 Mattresses can be constructed to form curved sections by either cutting and folding units or by overlapping adjacent mattresses.

### 5 Practicability of installation

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

## 6 Structural performance

6.1 The design of the gabion box and mattress structures should be carried out by a suitably-qualified engineer and should be in accordance with BS EN 1997-1 : 2004, BS 6031 : 2009 and BS 8002 : 2015.

6.2 The magnitude and distribution of the earth pressures and earth resistance should be calculated in accordance with current design philosophy.

6.3 As in other earth-retaining structures, it is necessary to determine a suitable factor of safety against the principal modes of failure for parameters of:

- overall stability
- overturning
- shearing pressure
- sliding
- internal stability.

6.4 Watercourse linings, weirs and other hydraulic structures may require special consideration with regard to scour, uplift, wave action and seepage.

6.5 The mesh specification should be chosen to achieve the required design life (see section 8).

6.6 If installed in accordance with this Certificate, the mesh has adequate strength to resist the loads associated with handling, positioning and filling.

6.7 Gabions and mattresses are permeable and, in general, will not permit hydrostatic pressure to build up. Gabion earth-retaining structures are not normally designed to withstand hydrostatic pressure.

6.8 Where cohesive material, eg 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.

6.9 Gabions and mattresses have adequate strength to permit pre-filling and placing by crane when designed in accordance with the Certificate holder's instructions.

## 7 Maintenance and repair

Routine maintenance is not normally required. However, damaged exposed mesh can be repaired by securing additional or replacement mesh as required.

## 8 Durability

8.1 The specification for a particular installation must be chosen to achieve the required design life.

8.2 The life of a gabion structure is dependent on the specification of the mesh wire and the durability of the stone and, in the longer term, the stability of the consolidated mass of the infill material and the conditions of exposure encountered during its design life.

8.3 The galvanized or Galfan-coated and organic-polymer powder-coated galvanized steel wire is resistant to the chemicals normally encountered in earth-retaining structures.

8.4 Some local damage may occur to the powder coating and galvanized or Galfan-coated wire during installation and in exposed areas. Evidence from installations indicates that such damage will remain local and will not affect the integrity of the structure. Therefore, when used in dry land retaining walls, the powder-coated mesh may be considered to have a life expectancy of 120 years. The life expectancy of the non-powder-coated wire products may be estimated from the predicted loss of coating, based on exposure conditions. The Galfan coating has better corrosion prevention than pure galvanizing, and may be considered to give an increased design life compared with conventional galvanized wire in the same exposure conditions (see Table 3).

Table 3 Expected deterioration of wire coating

| Exposure conditions | Wire diameter (mm) | Galvanized wire           |               | Galfan-coated wire          |               |
|---------------------|--------------------|---------------------------|---------------|-----------------------------|---------------|
|                     |                    | Corrosion of zinc (years) | Total (years) | Corrosion of Galfan (years) | Total (years) |
| Severe              | 3.0                | 4.6                       | >5            | 5.2                         | <6            |
|                     | 4.0                | 4.6                       | <6            | 5.2                         | >6            |
|                     | 5.0                | 4.6                       | >6            | 5.2                         | >10           |
| Mild                | 3.0                | 46                        | >50           | 50                          | >70           |
|                     | 4.0                | 46                        | >50           | 50                          | >80           |
|                     | 5.0                | 46                        | >50           | 50                          | >80           |

8.5 In severe conditions (including use in sea water), under aggressive conditions (eg polluted environments) or where the anticipated exposure conditions are uncertain, organic-polymer-powder coated mesh should be used to ensure an optimum design life.

8.6 The life expectancy of products used in river erosion and coastal protection schemes will also be affected by the scouring effects of fast-flowing water.

## 9 Reuse and recyclability

The products are made from steel wire which is galvanized or Galfan-coated and additionally polymer-coated, which can be recycled.

## Installation

### 10 General

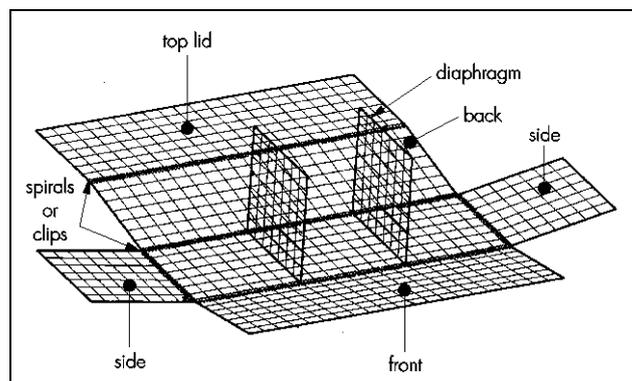
Installation of LME Welded Mesh Gabion Boxes and Mattresses must be in accordance with this Certificate and the Certificate holder's installation instructions.

### 11 Procedure

#### In-situ filled gabion boxes

11.1 Gabion boxes are laid and assembled on a hard surface (see Figure 2).

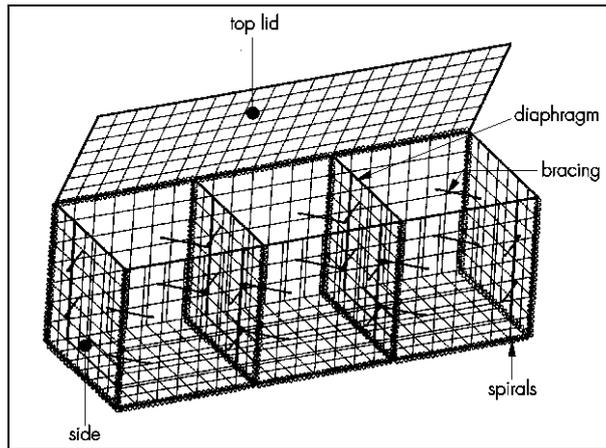
Figure 2 Details of gabion construction



11.2 Front and rear sides, ends and diaphragms are lifted into position to form a box shape.

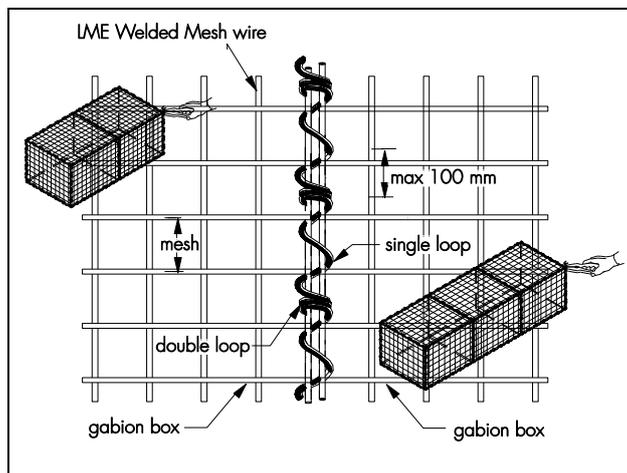
11.3 Top corners are secured and edges are joined together, using the appropriate spiral wires, starting from the top corner in a continuous operation. Lacing wire and 'C' clips can also be used (see Figure 3).

Figure 3 Assembled gabion



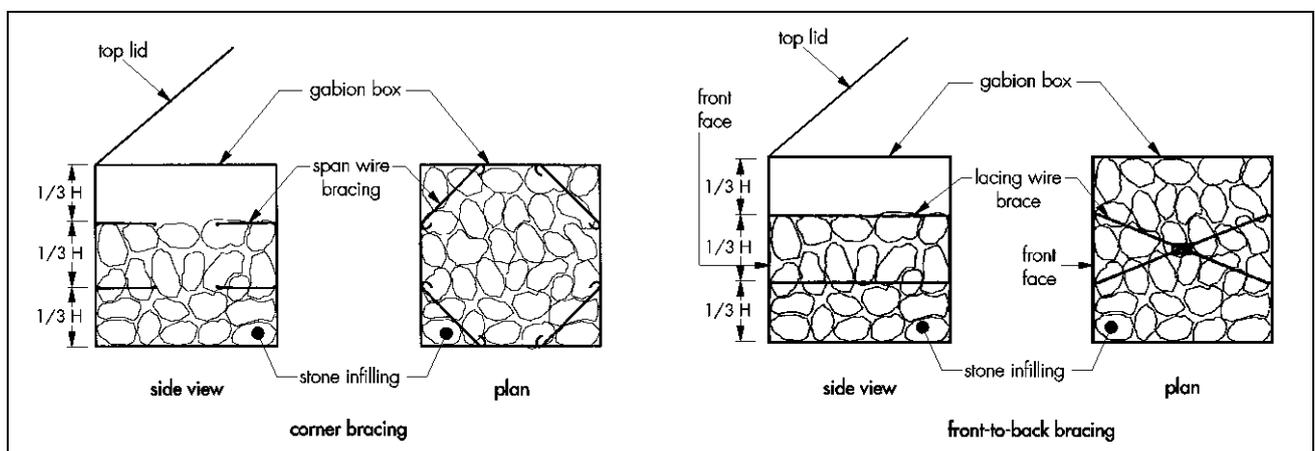
11.4 A number of empty gabion boxes may be placed in position on a flat surface and secured together with spirals, 'C' clips or lacing wire, starting from the top corner in a continuous operation using alternate single and double twists at a maximum spacing of 100 mm (see Figure 4).

Figure 4 Details of lacing



11.5 One-metre high gabions should be filled to one-third height and braced at all corners with span wires, or braced from front to back with lacing wire, then filled to two-thirds height and braced again at each corner or front to back. A half-metre high gabion only requires one layer of bracing at half-height (ie 250 mm) (see Figure 5).

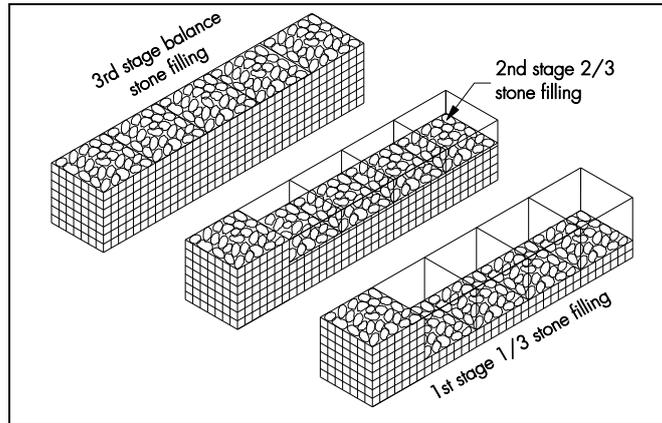
Figure 5 Bracing in metre-high gabion boxes



11.6 The gabion boxes are filled with suitable stone such that the mesh lid bears down on the stone. If large voids are present, these should be infilled with small stones.

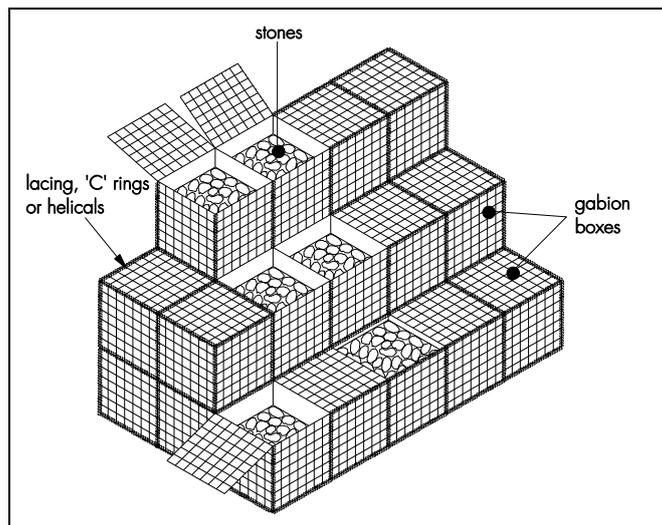
11.7 Gabion boxes forming the exposed face of a structure should be filled to one-third height, braced in accordance with Figure 5, filled to two-thirds height and braced again. Filling may then be completed (see Figure 6).

*Figure 6 Sequential filling of gabions*



11.8 It is essential that each gabion box is properly secured to adjacent gabion boxes above, below and on each side, using the lacing wires, 'C' rings or helicals, as described in section 11.4 (see Figure 7).

*Figure 7 Jointing adjacent gabion boxes*



### **Pre-filled gabion boxes**

11.9 Gabion boxes are constructed as described in sections 11.1 to 11.3 and 11.5, but with spirals, 'C' rings and span wires. For factory pre-assembled units, when using 'C' rings, one is to be placed every mesh opening for prefill and lifting applications. However, it is advantageous to construct a slightly oversized frame to maintain the box shape whilst filling.

11.10 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 Figures 8 and 9).

Figure 8 Filling and lifting gabion boxes from the lid

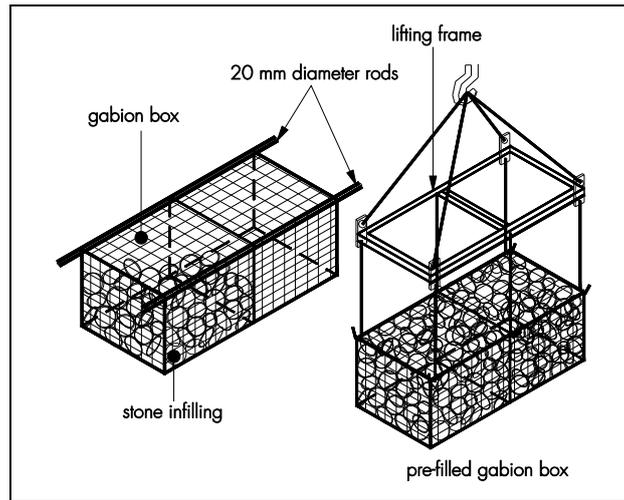


Figure 9 Safe lifting of prefilled gabions from the base



11.11 Purpose-made lifting frames and slings must be used for lifting filled units which weigh up to 1.8 tonnes per cubic metre (see Figures 10 and 11).

*Figure 10 Lifting strops and/or chains looped centrally around rebar*



*Figure 11 Gabion filled and braced as normal, with lifting strop/chain vertical*

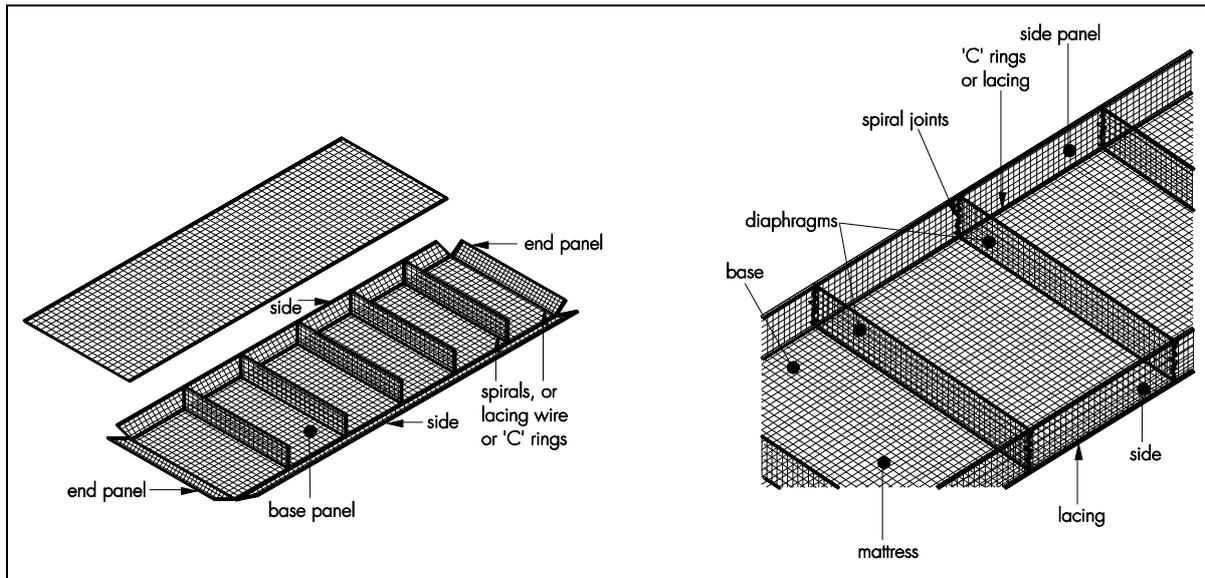


11.12 The Certificate holder can supply drawings showing construction details for the lifting frame needed to place pre-filled gabions. The specification for the required load can be obtained from the Certificate holder.

#### **In-situ filled mattresses**

11.13 Mattresses are laid and assembled on a hard surface (see Figure 12).

Figure 12 Details of mattress assembly



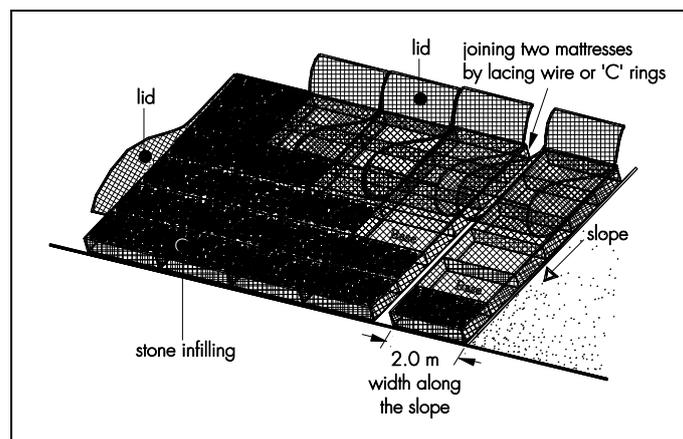
11.14 Ends, side panels and diaphragms are lifted into position and the ends and diaphragms are secured to the side panels using the method indicated in section 11.3.

11.15 The unit is placed in its final position and secured to adjacent mattresses, ensuring that diaphragms, ends and sides are taut.

11.16 Fill is placed into each compartment, working from the base of the slope upwards, until each cell is filled completely.

11.17 The lid is secured along each edge and diaphragm using spiral wires or tie wire or 'C' rings as specified (see Figure 13).

Figure 13 Mattress placed and filled



### Pre-filled mattresses

11.18 The mattress is assembled as described in section 11.14, but using spiral or tie wires with alternate single and double twists at a maximum spacing of 100 mm.

11.19 Additional support should be provided under the lid using steel bars, typically 20 mm in diameter.

11.20 After filling, the unit must be properly secured using the method described in section 11.3. The alternative method of lifting from the base, as described in sections 11.10 and 11.11 must also be implemented for the safe handling of pre-filled mattresses.

11.21 Purpose-made lifting frames and slings must be used with suitable attachments to enable the filled mattresses to be safely placed in position. Filled mattresses weigh up to 1.8 tonnes per cubic metre.

## Technical Investigations

### 12 Investigations

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

12.2 An assessment of data was made to determine:

- dimensional accuracy
- tensile strength
- quality of Galfan coating
- quality of galvanized coating
- effect of tolerances
- strength of wire, mesh and filled gabions
- quality of materials
- quality of plastic coating
- ease of assembly
- design procedures
- strength of the lifting frame
- effect of site damage
- durability
- shearing potential of gabion structures.

12.3 Site visits were carried out to assess the practicability, ease of handling and installation under various sites.

## Bibliography

BS 6031 : 2009 *Code of practice for earthworks*

BS 8002 : 2015 *Code of practice for earth retaining structures*

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

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

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*

BS EN 10223-8 : 2013 *Steel wire and wire products for fencing and netting- Part 8: welded mesh gabion products*

### 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.