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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

PRODUCT SCOPE AND SUMMARY OF CERTIFICATE

This Certificate relates to LME Welded Mesh Gabion Boxes and Mattresses, containers formed from a welded square or rectangular mesh of galvanized or Galvan-coated steel wire additionally PVC-coated, where required, for use in temporary and long-term earth retention, soil reinforcement, river training, erosion control, fascia system, free standing wall and rainscreen applications.

AGRÉMENT 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 5).

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 7).



The BBA has awarded this Agrément 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: 12 October 2010

Originally certified on 25 March 2005

Handwritten signature of Brian Chamberlain in black ink.

Brian Chamberlain

Head of Approvals — Engineering

Handwritten signature of Greg Cooper in black ink.

Greg Cooper

Chief Executive

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

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

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Regulations

In the opinion of the BBA, LME Welded Mesh Gabion Boxes and Mattresses, if used in accordance with the provisions of this Certificate, will meet or contribute to meeting the relevant requirements of the following Building Regulations:



The Building Regulations 2010 (England and Wales)

In the opinion of the BBA, LME Welded Mesh Gabion Boxes and Mattresses are not subject to these regulations.



The Building (Scotland) Regulations 2004 (as amended)

In the opinion of the BBA, LME Welded Mesh Gabion Boxes and Mattresses are not subject to these regulations.



The Building Regulations (Northern Ireland) 2000 (as amended)

In the opinion of the BBA, LME Welded Mesh Gabion Boxes and Mattresses are not subject to these regulations.

Construction (Design and Management) Regulations 2007

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

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

See sections: *2 Delivery and site handling (2.1 and 2.4) and 9 Procedure (9.10 to 9.12 and 9.21) of this Certificate.*

Non-regulatory Information

NHBC Standards 2010

In the opinion of the BBA, the use of LME Welded Mesh Gabion Boxes and Mattresses, in relation to this Certificate, is not subject to the requirements of these Standards.

General

This Certificate relates to LME Welded Mesh Gabion Boxes and Mattresses for use in earth retention, soil reinforcement systems, river training, erosion control, fascia systems, free standing walls and rainscreen applications.

This Certificate does not cover the use of gabions and mattresses within the foundation zone of a building.

Construction of the system is usually carried out by civil engineering or building contractors who must ensure that the installation of the system is in accordance with the Certificate holder's instructions and information given in this Certificate.

The gabions are marketed in the UK by Cerana Ltd (trading as Enviromesh), Garner Street Business Park, Etruria, Stoke-on-Trent, Staffordshire ST4 7BH. Tel: 0845 1360101; Fax: 0845 1360202; e-mail: enquiries@enviromeshsolutions.com; website: www.enviromeshsolutions.com.

Technical Specification

1 Description

1.1 LME Welded Mesh Gabion Boxes and Mattresses are rectangular cages made up 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' together and/or linked with a locking pin, and filled with selected granular material (stone) (see sections 3.3 and 3.7). The nominal dimensions of standard gabions and mattresses are given in Table 1.

Figure 1 LME Welded Mesh

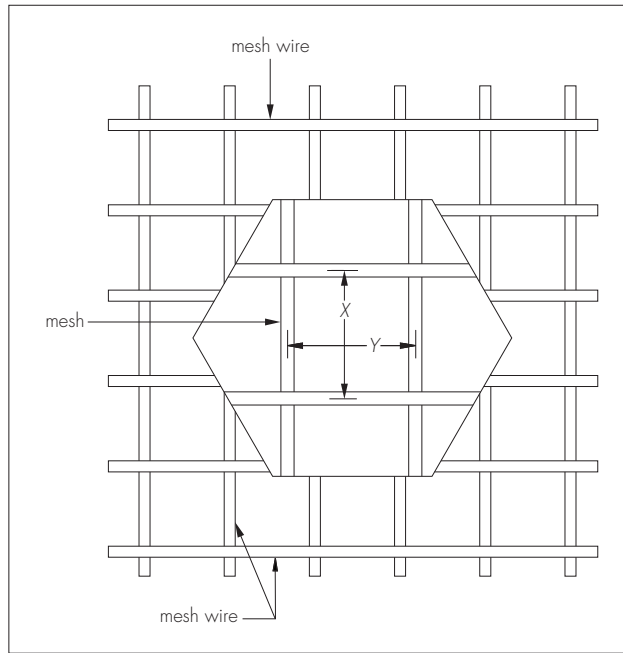


Table 1 Nominal sizes of standard gabion boxes and mattresses

Gabion			Mattress		
Length (m)	Width (m)	Depth (m)	Length (m)	Width (m)	Depth (mm)
1	0.5 or 1	0.5 or 1	3	1 or 2	150, 225 or 300
1.5	0.5 or 1	0.5 or 1	4	1 or 2	150, 225 or 300
2	0.5 or 1	0.5 or 1	5	1 or 2	150, 225 or 300
3	0.5 or 1	0.5 or 1	6	1 or 2	150, 225 or 300
4	0.5 or 1	0.5 or 1			

1.2 The mesh is available in standard sizes⁽¹⁾ of 50 mm by 50 mm, 75 mm by 75 mm, 100 mm by 50 mm or 100 mm 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 10218-2 : 1997 with an ultimate strength of between 540 N·mm⁻² and 770 N·mm⁻². The wire can be heavily galvanized or Galfan-coated with a minimum coating 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 in accordance with BS EN 10245-1 : 2001 and BS EN 10245-2 : 2001 (see Table 2 of this Certificate).

Table 2 General specification of wires used in gabions and mattresses

Core wire diameter (mm)	Minimum coating weight (g·m ⁻²)	
	HDG ⁽¹⁾	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.

1.4 The span wires and spiral wires are to BS EN 10218-2 : 1997 and available in sizes of 2.2 mm, 2.5 mm, 3 mm, 4 mm 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 : 2001 and BS EN 10245-2 : 2001.

1.5 Welded joints have a strength of at least 75% of the minimum tensile strength of the wire. 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 flatpack 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 9.1.2).

1.7 Quality control is carried out on raw materials, during production process and finished products.

2 Delivery and site handling

2.1 Generally, the gabions and mattresses are delivered to site on pallets in bundles of 40.

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

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

2.4 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

3 General

Gabion boxes

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

3.2 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.

3.3 The stone infill to the gabions is normally sized between 100 mm and 200 mm and is of hard, durable stone such as quarried or naturally occurring rounded stone.

3.4 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

3.5 The design of the mattress structures should be based on the principles of hydraulic engineering and, where applicable, mass earth-retaining structures.

3.6 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.

3.7 The stone infill to the mattresses is normally sized between 75 mm 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.

3.8 Mattresses can be constructed to form curved sections by either cutting and folding units or by overlapping adjacent mattresses.

4 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.

5 Structural performance

5.1 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 and BS 6031 : 2009.

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

5.3 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.

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

5.5 The mesh specification should be chosen to achieve the required design life (see section 7).

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

5.7 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.

5.8 Where cohesive materials, eg clay, are 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.

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

6 Maintenance and repair

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

7 Durability

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

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

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

7.4 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 to 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

7.5 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.

7.6 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.

Installation

8 General

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

9 Procedure

In-situ filled gabion boxes

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

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

9.3 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 2 Details of gabion construction

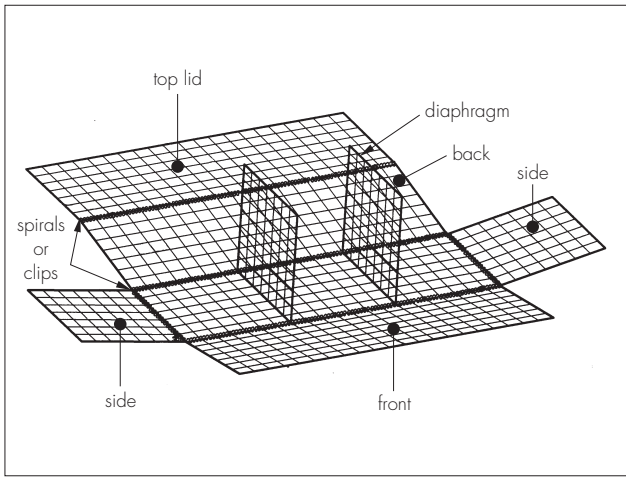
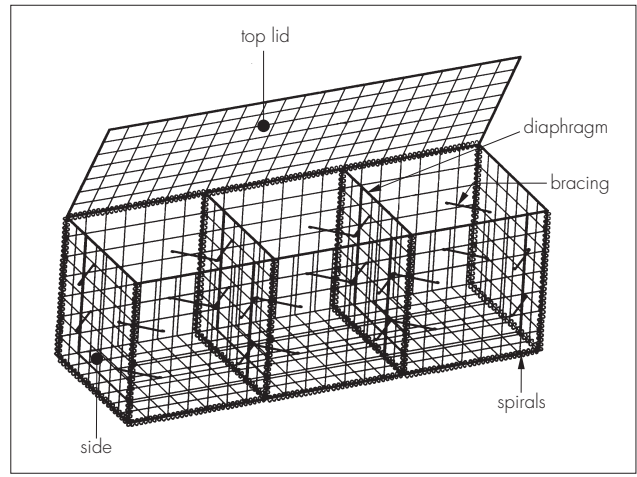
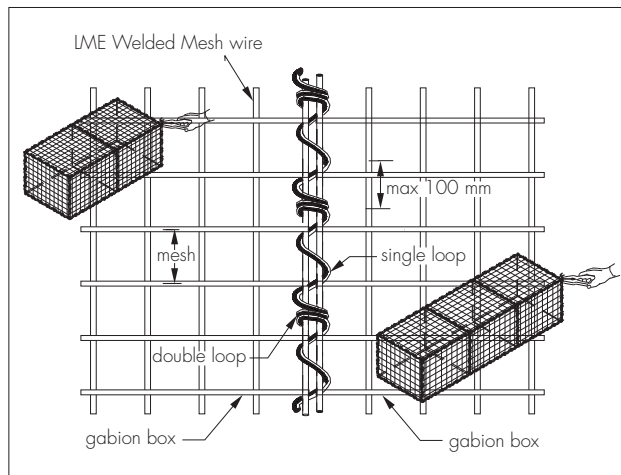


Figure 3 Assembled gabion



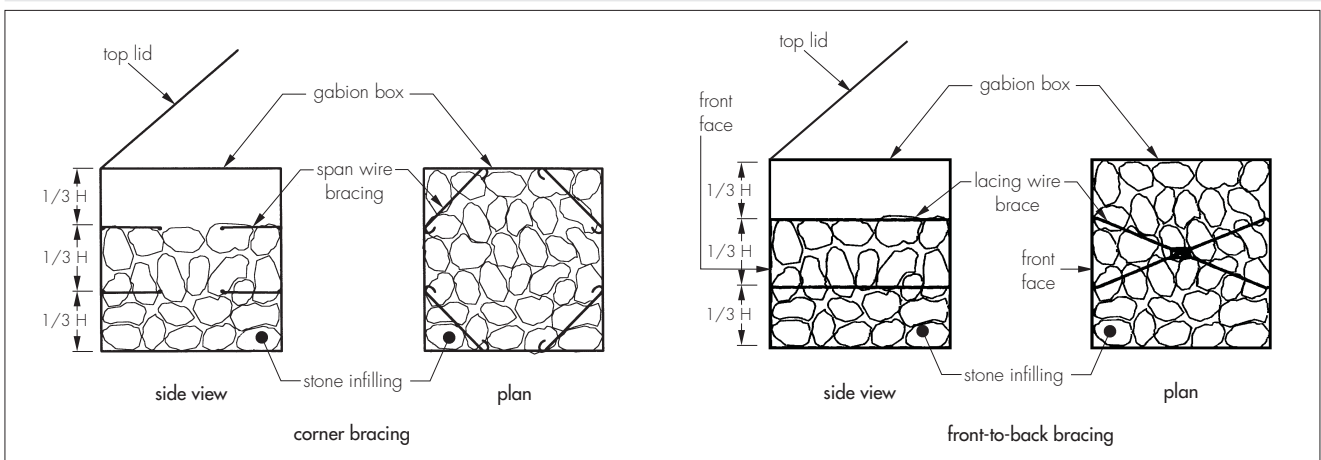
9.4 A number of empty gabion boxes may be placed in position on a flat surface and secured together with spirals, 'C' clips or lacing wire, starting from the top corner in a continuous operation using alternate single and double twists at a maximum spacing of 100 mm (see Figure 4).

Figure 4 Details of lacing



9.5 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



9.6 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.

9.7 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 again braced. Filling may then be completed (see Figure 6).

9.8 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 9.4 (see Figure 7).

Figure 6 Sequential filling of gabions

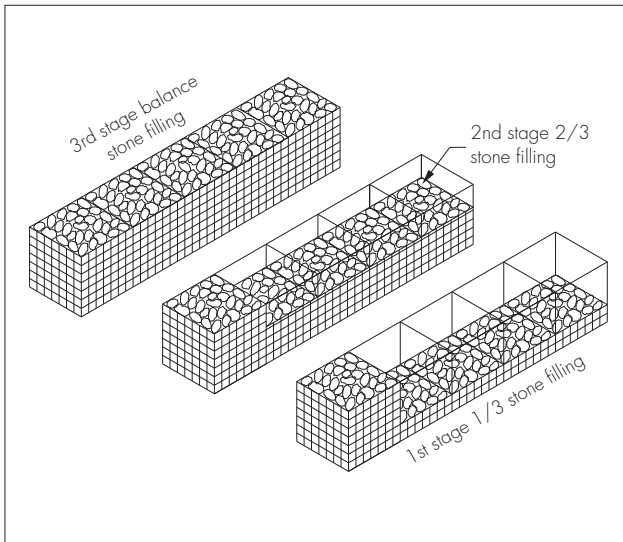
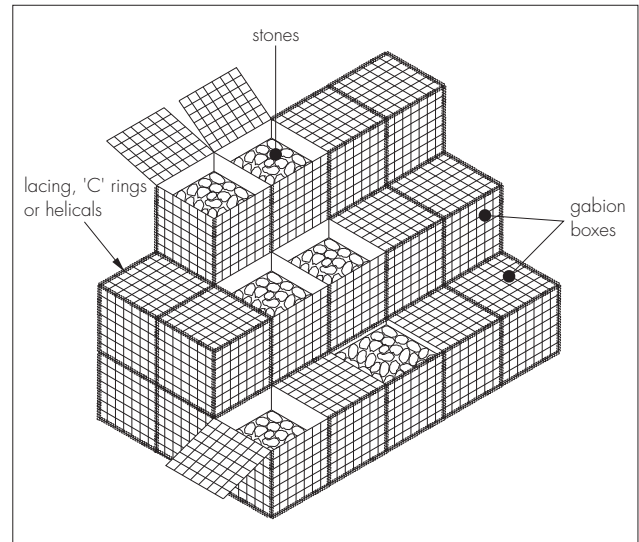


Figure 7 Jointing adjacent gabion boxes

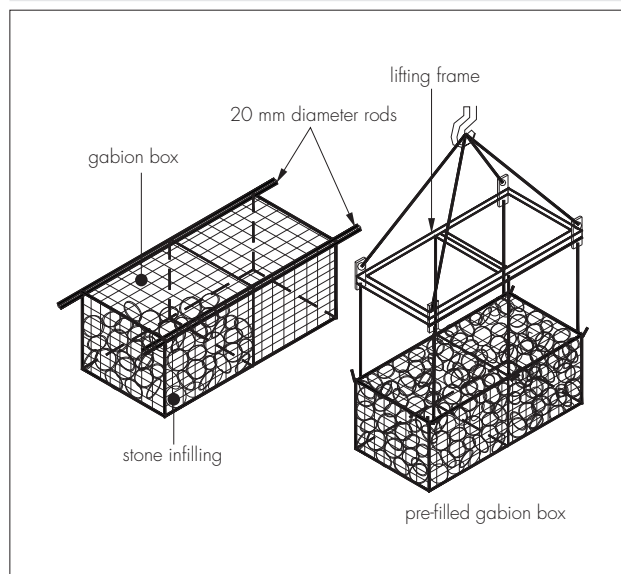


Pre-filled gabion boxes

9.9 Gabion boxes are constructed as described in sections 9.1 to 9.3 and 9.5, but with spirals, 'C' rings and span wires. However, it is advantageous to construct a slightly oversize frame to maintain the box shape whilst filling.

9.10 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 Figure 8).

Figure 8 Filling and lifting gabion boxes



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

9.12 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

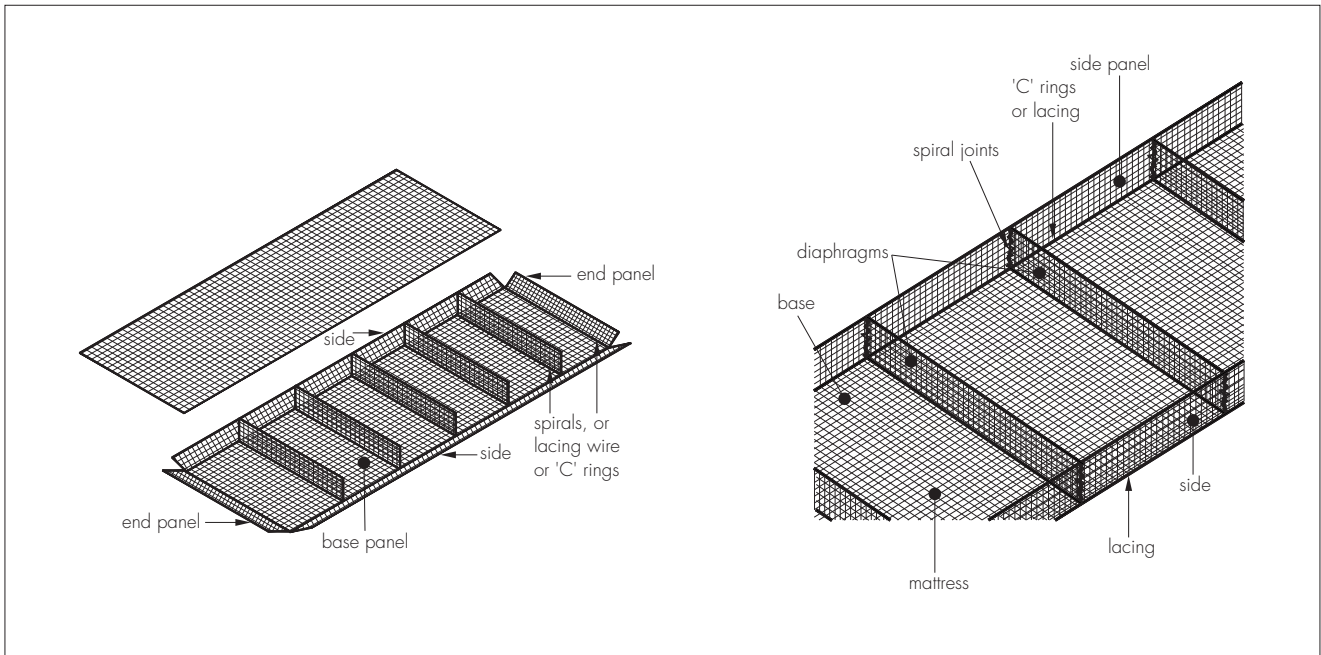
9.13 Mattresses are laid and assembled on a hard surface (see Figure 9).

9.14 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 9.3.

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

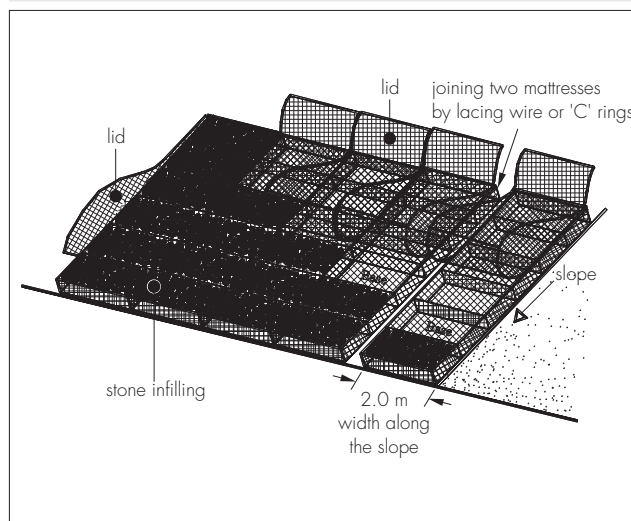
9.16 Fill is placed into each compartment, working from the base of the slope upwards, until each cell is filled completely.

Figure 9 Details of mattress assembly



9.17 The lid is secured along each edge and diaphragm using spiral wires or tie wire or 'C' rings as specified (see Figure 10).

Figure 10 Mattress placed and filled



Pre-filled mattresses

9.18 The mattress is assembled as described in section 9.14, but using spiral or tie wires with alternate single and double twists at a maximum spacing of 100 mm.

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

9.20 After filling, the unit must be properly secured using the method described in section 9.3.

9.21 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.

10 Investigations

10.1 The manufacturing process of the gabions and mattresses was examined, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

10.2 An assessment of data was made to determine:

- dimensional accuracy
- tensile strength
- quantity of Galvan coating
- quantity 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.

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

Bibliography

BS 6031 : 2009 *Code of practice for earthworks*

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

BS EN 10218-2 : 1997 *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 : 2001 *Steel wire and wire products — Organic coatings — General rules*

BS EN 10245-2 : 2001 *Steel wire and wire products — Organic coatings on steel wire — PVC finished wire*

11 Conditions

11.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is granted only to the company, firm or person named on the front page — no other company, firm or person may hold or claim any entitlement to this Certificate
- 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.

11.2 Publications and documents referred to in this Certificate are those that the BBA deems to be relevant at the date of issue or re-issue of this Certificate and include any: Act of Parliament; Statutory Instrument; Directive; Regulation; British, European or International Standard; Code of Practice; manufacturers' instructions; or any other publication or document similar or related to the aforementioned.

11.3 This Certificate will remain valid for an unlimited period provided that the product/system and the manufacture and/or fabrication including all related and relevant 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.

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

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- individual installations of the product/system, including the nature, design, methods and workmanship of or related to the installation
- the actual works in which the product/system is installed, used and maintained, including the nature, design, methods and workmanship of such works.

11.5 Any information relating to the manufacture, supply, installation, use and maintenance 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 and maintained. It does 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; 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. 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 manufacture, supply, installation, use and maintenance of this product/system.

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