

HAPAS

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HAPAS Certificate

16/H247

Product Sheet 2 Issue 3

MACCAFERRI CIVIL ENGINEERING PRODUCTS

MACCAFERRI TERRAMESH SYSTEM

This Product Sheet⁽¹⁾ is issued by the British Board of Agrément (BBA). The Highways Authorities Product Approval Scheme (HAPAS) is supported by National Highways (NH) (acting on behalf of the Overseeing Organisations of the Department for Transport; Transport Scotland; the Welsh Government; and the Department for Infrastructure, Northern Ireland), the Association of Directors of Environment, Economy, Planning and Transport (ADEPT), the Local Government Technical Advisers Group and industry bodies.

(1) Hereinafter referred to as 'Certificate'.

This Certificate relates to the Maccaferri Terramesh System, hexagonal, polymer-coated, galvanized or zinc/aluminium alloy steel mesh units, for use as a reinforcement structure to embankments with slope angles of up to 70° or in the construction of reinforced soil walls with slope angles above 70° and less than 90° in accordance with the *Manual of Contract Documents for Highway Works* (MCHW), Volume 1, Series 600.



The BBA has awarded this Certificate to the company named above for the system described herein. This system has been assessed by the BBA as complying with the requirements of the BBA HAPAS Certification Scheme according to the assessments set out in this Certificate.

On behalf of the British Board of Agrément

Date of Third issue: 3 June 2024
Originally certificated on 11 July 2016

Hardy Giesler
Chief Executive Officer

This BBA HAPAS Certificate is issued under the BBA's accreditation to ISO/IEC 17065 (UKAS accredited Certification Body Number 0113).

Clauses marked † are additional information outside the scope of accreditation.

Readers MUST check the validity and latest issue number of this BBA HAPAS Certificate by referring to the BBA website or contacting the BBA directly.

The Certificate should be read in full as it may be misleading to read clauses in isolation.

Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.

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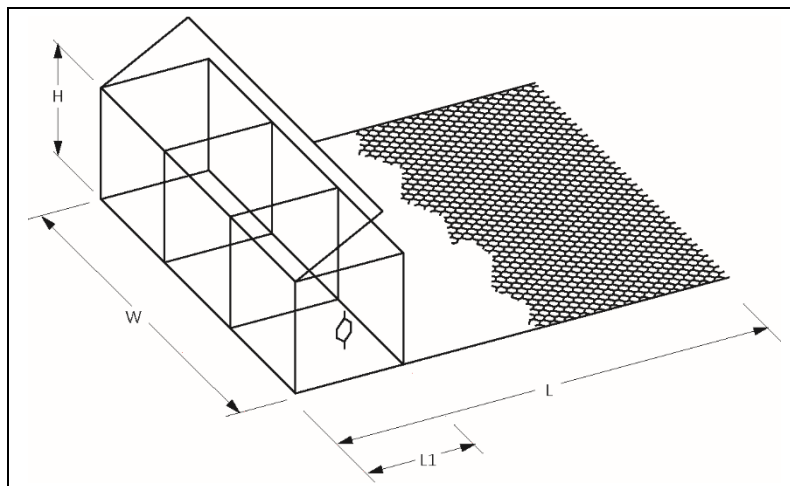
1 Product Description

1.1 The Certificate holder specifies the system under assessment, the Maccaferri Terramesh System, hexagonal, polymer-coated, galvanized or zinc/aluminium alloy steel mesh units, for use as a reinforcement structure to embankments with slope angles of up to 70° or in the construction of reinforced soil walls with slope angles above 70° and less than 90° in accordance with the MCHW⁽¹⁾, Volume 1 *Specification for Highway Works* (SHW), Series 600, BS 8002 : 2015, and BS EN 1997-1 : 2004 and its UK National Annex.

(1) The MCHW is operated by National Highways (NH) (acting on behalf of the Overseeing Organisations of the Department for Transport; Transport Scotland; the Welsh Government; and the Department for Infrastructure, Northern Ireland).

1.2 The Maccaferri Terramesh System consists of polymer-coated, double-twisted, galvanized or zinc/aluminium alloy steel mesh, fabricated into a horizontal soil reinforcement panel faced at one end with a gabion box section. The front and top sections of the gabion are folded from the reinforcement mesh panel. The back and ends are formed separately, and fixed and folded to the horizontal panel during manufacture. Additional separate diaphragm (partition) panels can be fixed on site to the gabion box facing, as required by the design (see Figure 1).

Figure 1 Maccaferri Terramesh composition



1.3 The hexagonal mesh is manufactured from steel wire in accordance with BS EN 10218-1 : 2012 and BS EN 10218-2 : 2012.

1.4 The hexagonal double twisted mesh wire is protected with PVC⁽¹⁾, Maccaferri PA6⁽²⁾ or PoliMac⁽³⁾⁽⁴⁾ polymer-coating onto galvanized or Zn/Al alloy galvanized wire.

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

(2) Maccaferri PA6 is an environmentally safe, extruded polyamide coating applied to galvanized mild steel wire to provide increased resistance against mechanical damage, low friction coefficients, long term strength and elasticity, improved adhesion to wire, low liquid penetration for corrosion process, and improved performance in cold temperature. The properties of the PA6 coating are in accordance with BS EN 10245-5.

(3) Maccaferri PoliMac is an environmentally safe extruded polymer specifically developed with an additional masterbatch, to provide increased resistance to abrasion and to mechanical damage, an improved performance in cold and hot temperatures, and a better performance to UV radiation. The properties of the PoliMac coating are in accordance with BS EN 10245-1 : 2011.

(4) PoliMac is a registered trademark.

1.5 Nominal dimensions of standard panels are given in Table 1.

Table 1 Standard sizes of the Maccaferri Terramesh System units

L = length (m)	W = width (m)	L1 = stone filled front section depth (m)	H = height (m)
3	2 or 3 ⁽¹⁾	1.0, 0.8	0.5, 0.8, 1.0
4	2 or 3 ⁽¹⁾	1.0, 0.8	0.5, 0.8, 1.0
5	2 or 3 ⁽¹⁾	1.0, 0.8	0.5, 0.8, 1.0
6	2 or 3 ⁽¹⁾	1.0, 0.8	0.5, 0.8, 1.0

(1) Provided with 2 diaphragms.

Wire mesh

1.6 The base steel wire is coated with zinc or zinc-aluminium alloy in accordance with BS EN 10244-2 : 2009. The metallic coating is classified Class A, for PVC and PoliMac coated wire with nominal thickness of 0.5 mm, and minimum Class E for PA6 coated wire with nominal thickness of 0.4 mm. Wire specifications are given in Table 2.

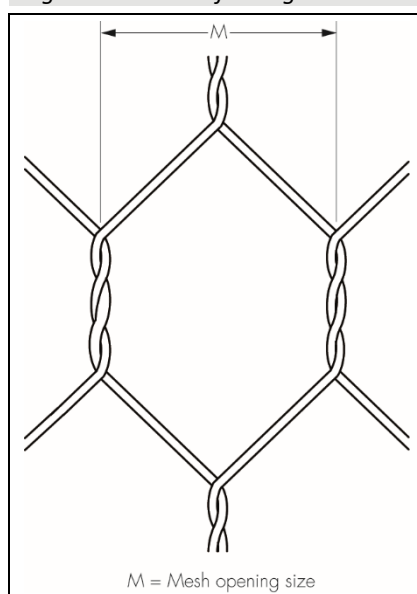
Table 2 Wire specification

Wire type	Nominal diameter			Core tolerance $\pm$ (mm)	Mesh opening size M ⁽¹⁾ (mm)	Minimum Zn or Zn-Al coating Class A (gr·m ⁻²)	Minimum Zn-Al coating Class E (gr·m ⁻²)
	Overall diameter PVC or PoliMac coated wire (mm)	Overall diameter PA6 coated wire (mm)	Core diameter (mm)				
Mesh wire	3.7	3.5	2.7 ⁽¹⁾	0.06	80	245	60
Edge and selvedge	4.4	4.2	3.4	0.07	80	265	60
Lacing	3.2	3.0	2.2	0.06	80	230	60

(1) Manufacturing reference: 8 x 10 mesh type.

1.7 The wire is woven into a hexagonal pattern mesh (see Figure 2) with double-twist joints; larger diameter wire is introduced along the edge and selvedge.

Figure 2 Details of hexagonal mesh



1.8 To form the individual unit panels the mesh is cut, during manufacture, to the required dimensions and the selvedge wire is positioned and mechanically fixed to the panel. The rear panel is fixed to the main panel. Diaphragm panels are provided loose, packed with the folded unit for delivery.

1.9 Site assembly of Maccaferri Terramesh units is carried out using either lacing wire (see Table 2) or stainless steel rings. Stainless steel rings are manufactured from 3 mm diameter stainless steel wire with a minimum tensile strength of 1550 MPa. The pull-apart strength of the lacing rings is a minimum of 2.0 kN.

1.10 An ancillary item used with the system is the Maccaferri Pneumatic Tool.

2 Requirements

Requirements for the system are outlined in the BBA HAPAS Certification Scheme and Technical Specifications Documents, and have been established from the following specification documents:

- The MCHW⁽¹⁾, Volume 1, *Specification for Highway Works* (SHW), Series 600
- BS 8006-1 : 2010
- CD 622
- BS EN 10218-1 : 2012
- BS EN 10218-2 : 2012
- BS EN 10223-3 : 2013
- BS EN 10244-2 : 2009
- BS EN 10245-2 : 2011
- BS EN 10245-5 : 2011
- BS EN 14475 : 2006
- BS EN ISO 16120-1 : 2017
- BS EN ISO 16120-2 : 2017
- CG 300 *Technical Approval of Highway Structures*
- CD 350 *The Design of Highway Structures*
- UKTA-0836-22/0022 Terramesh System, Green Terramesh, Mineral Terramesh, Duna System 90/90, Duna System 90/70, Duna System 90/60, Duna System 60/60 and Duna System 80/80, MAC-SYSTEM, MAC-GREEN, MAC_MINERAL, LINER.

(1) The MCHW is operated by National Highways (NH) (acting on behalf of the Overseeing Organisations of the Department for Transport; Transport Scotland; the Welsh Government; and the Department for Infrastructure, Northern Ireland).

3 Summary of Product Assessment

The system was assessed on the basis of the following characteristics in accordance with HAPAS requirements.

3.1 Tensile strength and elongation of the steel wire

Table 3 Tensile strength and elongation for steel wire used for the Maccaferri Terramesh System

Product assessed	Assessment method	Requirement	Outcome
Steel wire	Tensile strength and elongation to BS EN 10223-3 : 2013 drawn from rods complying to BS EN ISO 16120-1 : 2017 and BS EN ISO 16120-2 : 2017	Minimum strength Minimum elongation at rupture	350 to 550 N·mm ² 8%

3.2 Tensile strength (T_B) of the Maccaferri Terramesh System

Table 4 Short-term tensile strength (T_B) for the Maccaferri Terramesh System

System assessed	Assessment method	Requirement	Outcome
Maccaferri Terramesh System	Tensile strength to BS EN 10223-3 : 2013	$\geq 50 \text{ kN}\cdot\text{m}^{-1}$	Pass

3.3 Installation damage

Table 5 Partial material safety factor — mechanical installation damage (f_{m21}) for the Maccaferri Terramesh System

System assessed	Assessment method	Requirement	Outcome
Maccaferri Terramesh System	Installation damage to BS 8006-1 : 1995, Annex D	Silts and clays maximum particle size < 0.06 mm	1.00
		Sands maximum particle size < 2 mm	1.00
		Sandy gravels maximum particle size < 9.5 mm	1.05
		Coarse gravels maximum particle size < 38 mm	1.15
		Crushed stones maximum particle size < 200 mm	1.22

3.4 Pull-out resistance

Table 6 Typical values of coefficients relating to pull-out resistance for the Maccaferri Terramesh System

System assessed	Assessment method	Requirement	Outcome
Maccaferri Terramesh System	Pull-out resistance to BS EN 13738 : 2004	Silty sand	$\phi [^\circ] = 25$ $a'^{(1)} = 0.5$ μ $= a' \tan \phi = 0.233$
		Sand	$\phi [^\circ] = 34$ $a'^{(1)} = 0.65$ μ $= a' \tan \phi = 0.438$
		Gravel	$\phi [^\circ] = 38$ $a'^{(1)} = 0.9$ μ $= a' \tan \phi = 0.703$

(1) Average a' value of interaction factor determined from tests.

Note: These values may be used in the equation above to establish the pull-out resistance for a particular situation, but the resistances generated may deviate by $\pm 30\%$ of the value established by testing.

3.5 Resistance to weathering

3.5.1 Some localised damage may occur to the polymer coating during installation, and in exposed areas this may lead to corrosion of the mesh. Site evidence and test data indicate that such damage will not spread 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 external facing mesh is not used in the design of the structure as a whole indicate that this local damage will not affect the integrity of the structure.

3.5.2 The system will permit the growth of vegetation which will contribute to the integrity of the structure and to maintaining a natural appearance.

3.5.3 The polymer protection and galvanized or zinc/aluminium alloy coated steel wire will not be affected by the chemicals normally encountered in earth-retaining structures.

3.6 Reuse and recyclability

The polymer-coated galvanized or zinc/aluminium coated steel wire can be recycled.

3.7 Durability

3.7.1 The system may be used in soils normally encountered in civil engineering practice.

3.7.2 Evidence from tests show that the polymer-coated wire has good resistance to chemical corrosion, biodegradation, temperature effects and ultraviolet exposure.

3.7.3 In the opinion of the BBA, when used and installed in accordance with this Certificate, the system units may be considered to have a service life of 120 years.

4 Summary of Process Assessment

Manufacturing process and quality control	Complies with HAPAS requirements
Delivery and site handling	Complies with HAPAS requirements

4.1 Manufacture

4.1.1 The BBA has undertaken the following tasks for the assessment of system manufacture and has established that the manufacture complies with BBA HAPAS Certification Scheme requirements:

- the BBA has recorded and evaluated the manufacturer's documentation of the methods adopted for quality control procedures and product testing against HAPAS requirements
- the BBA has assessed the quality control operated over batches of incoming materials and formulations against HAPAS Requirements
- the BBA has evaluated the process for management of non-conforming work
- the BBA has audited the production process and verified that it is in accordance with the documented process
- the BBA has checked that equipment has been properly tested and calibrated.

4.1.2 The system units are manufactured, controlled and delivered to an agreed specification that includes requirements for incoming raw materials, method of production and process control, inspection and testing of the finished system, and packaging and delivery to site.

4.1.3 Galvanized or zinc/aluminium alloy PVC, PoliMac or PA6 coated steel wires are manufactured by the Certificate holder or bought in to the specification defined by the Certificate holder. Certificates of conformity and/or mill certificates are supplied with each batch of bought-in wire.

4.1.4 The system units are manufactured, controlled and delivered to an agreed specification that includes requirements for incoming raw materials, method of production and process control, inspection and testing of the finished system, and packaging and delivery to site.

4.1.5 The BBA has undertaken to review the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

† 4.1.6 The management system of the manufacturer has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2015 by CERTICOM/Slovak Republic (Certificate CM5620718/1). The management system of Maccaferri Ltd has also been certified by SGS UK for geotechnical design and supplying of retaining structures, erosion protection works, highway and bio-engineering systems (Certificate GB01/52789).

4.2 Delivery and site handling

† 4.2.1 The Certificate holder states that the system units are delivered to site in bundles weighing from 600 to 700 kg, depending on unit size and mesh specification.

4.2.2 To achieve the performance described in this Certificate, delivery and site handling must be performed in accordance with the Certificate holder's instructions and this Certificate, including:

- a label bearing the BBA logo incorporating the number of this Certificate, the Certificate holder's name, batch number and product code is attached to each bundle
- all bundles must be handled with due care to avoid damage to the polymer coating. Individual panels can be manhandled, but the weight of individual units varies between 20 and 75 kg, and therefore the appropriate number of people required to lift the units must be assessed to satisfy manual lifting requirements
- the flat-pack units may be stored outdoors, but away from site traffic to avoid the risk of accidental damage, and should remain packaged until required
- lacing wire is supplied in 25 kg coils.

4.3 Design

† 4.3.1 The Maccaferri Terramesh System is satisfactory for use as a reinforcement structure to embankments with slope angles up to 70°. The system is also satisfactory for use in the construction of reinforced soil walls with slope angle above 70° and less than 90°, at the discretion of the Technical Approval Authority (TAA), where CG 300 *Technical Approval of Highway Structures* is appropriate.

† 4.3.2 For reinforced embankment projects in the UK, when designs are carried out by, or on behalf of, the Certificate holder, they must be in accordance with the procedures given in BS 8006-1 : 2010.

4.3.3 Structural stability is achieved through frictional interaction and mechanical interlocking of soil particles with the system.

† 4.3.4 The system may be used in combination with soil types having an effective angle of shearing resistance in the range of 25 to 50°, and where the design is in accordance with the procedures given in BS 8006-1 : 2010.

4.3.5 The system may also be used in combination with Linear Composites Paragrid, Paradrain or Paralink reinforcement geogrids (the subject of BBA Certificates 16/H249 and 03/4065) or other types of Maccaferri reinforcement geogrids, but this was not assessed by the BBA and is outside the scope of this Certificate.

4.3.6 The system may also be used in combination with soil nailing or other ground anchor systems. This combination was not assessed by the BBA and it is outside the scope of this Certificate.

† 4.3.7 The designer should specify the relevant properties of a fill material deemed 'acceptable' for the purpose of the design. 'Acceptable' materials must meet the requirements of the MCHW, Volume 1, *Specification for Highway Works* (SHW), Series 600 (supplemented by BS 8006-1 : 2010 as appropriate).

Mechanical properties

4.3.8 The design tensile strength of the reinforcement (T_D), reinforcement base strength (T_B) and partial material factor (f_m) is calculated in accordance with the methodology set out in BS 8006-1 : 2010.

Design tensile strength of the reinforcement (T_D)

4.3.9 The design tensile strength of the reinforcement (T_D) that the reinforcement can be relied upon to deliver at the end of the design life and at the design temperature can be calculated from the equation:

$$T_D = \frac{T_B}{f_m}$$

where f_m is the partial factor for the reinforcement.

Partial Material factor (f_m)

† 4.3.10 In establishing the design tensile strength of the system and ensuring that during the life of the embankment the reinforcement will not fail in tension, the BBA recommends that, in line with the method given in BS 8006-1 : 2010, a set of partial safety factors should be applied to the base strength (T_B) value:

$$f_m = f_{m11} \times f_{m12} \times f_{m21} \times f_{m22}$$

Manufacture (f_{m11}) and extrapolation (f_{m12}) of data — partial safety factor (f_m)

4.3.11 To allow for variation in manufacture and system dimensions and to account for extrapolation of data, the value for the factor f_m is calculated from the equation stated in section 4.3.10 and is given in Table 7:

$$f_{m11} = 1.04 \text{ and } f_{m12} = 1.0$$

Table 7 Partial material safety factor — manufacture and extrapolation of data

Design life (years)	Safety factor (f_m)
120	1.04

Installation damage — partial safety factor (f_{m21})

4.3.12 To allow for loss of strength owing to mechanical damage that may be sustained during installation, the appropriate value for f_{m21} may be selected from Table 8. The partial safety factors given for site damage assume that well-graded material is used (coefficient of uniformity > 5) and with a minimum compacted depth of 150 mm. For soils not covered by Table 8, appropriate values of f_{m21} may be determined from site specific trials.

Table 8 Partial material safety factor — mechanical installation damage (f_{m21})

Fill material	Maximum particle size (mm)	Safety factor (f_{m21})
Silts and clays	< 0.06	1.00
Sands	< 2	1.00
Sandy gravels	< 9.5	1.05
Coarse gravels	< 38	1.15
Crushed stones	< 200	1.22

Environmental effects — partial safety factor (f_{m22})

4.3.13 To account for environmental conditions, the appropriate value for f_{m22} may be selected from Table 9. For soils with pH values outside the range quoted, consideration should be given to an increased value for f_{m22} .

Table 9 Partial material safety factor — environmental effects

Soil pH level (pH)	Safety factor (f_{m22})
3-13	1.05

Fill/Maccaferri Terramesh System interaction

Bond strength

4.3.14 The partial factor for reinforcement pull-out resistance (f_p) in granular soils, ignoring cohesion is calculated in accordance with the methodology set out in BS 8006-1 : 2010.

$$F_{po} = 2\sigma_v\mu LB / f_p f_n$$

where:

- F_{po} is the ultimate pull-out resistance
- σ_v is the total ultimate vertical applied pressure
- μ is the coefficient of soil/reinforcement friction
- L is the length of the reinforcement in the resistant zone
- B is the width of the reinforcement
- f_p is the partial factor for pull-out resistance (see BS 8006-1 : 2010, Table 11)
- f_n is the partial factor for economic ramification of failure (see BS 8006-1 : 2010, Table 9).

Note:

$$\mu = a' \times \tan \phi'$$

where:

- a' is the interaction coefficient relating soil/reinforcement bond angle with $\tan \phi'$
- ϕ' is the internal friction angle of the structural soil.

4.3.15 The characteristics of the fill materials used for determination of the interaction factors shown in Table 6 are given in Table 10.

Table 10 Characteristics of tested fill materials

Fill material	Bulk unit weight (kN·m ³)	Moisture content (%)	Sieve analysis (mm) (D50)
Silty sand	14.5	8	0.14
Sand	16.7	2	0.56
Gravel	16.9	< 1	3.22

† 4.3.16 For soils not covered by Table 6, appropriate values of a' may be determined from site-specific tests to BS EN 13738 : 2004.

† 4.3.17 For routine design purposes, the coefficient of skin friction, a' , of the system may be assumed to be 0.6 for compacted frictional fill ($\phi \geq 30^\circ$). This is a conservative value. Where more precise values are required, for use in design, tests to BS EN 13738 : 2004 may be carried out using the appropriate soil and the Maccaferri Terramesh System reinforcement mesh.

Direct sliding

4.3.18 When used in steep slopes, defined as from 45 to 70° from the horizontal, designed to (permitted within BS 8006-1 : 2010, Clause 7.4.4.2), the direct sliding resistance of the system may be established from the value $f_{ds} \tan \phi'$ where f_{ds} is a direct sliding coefficient and determined as follows:

$$f_{ds} = \alpha_s a' + (1 - \alpha_s)$$

where:

- α_s is the proportion of plane sliding area that is solid, 0.091 for the Maccaferri Terramesh System reinforcement mesh
- a' is taken from Table 6 of this Certificate or established from site specific tests to BS EN 13738 : 2004. (Note: a' is referred to as f_{st}).

† 4.3.19 The designer should specify the relevant properties of the fill material for the reinforced soil structure deemed acceptable for the purposes of the design. Acceptable materials should meet the requirements of BS 8006-1 : 2010 and the MCHW, Volume 1 *Specification for Highway Works* (SHW), Series 600.

4.4 Installation

4.4.1 The Certificate holder's instructions for installation of the system were confirmed as meeting the BBA HAPAS Certification Scheme requirements.

4.4.2 Installation of the Maccaferri Terramesh System must be carried out in accordance with this Certificate and the Certificate holder's installation instructions.

4.4.3 Provided the appropriate reduction factor for mechanical damage has been included at the design stage to allow for the installation methods employed and the type of fill permitted, the system can be readily installed following appropriate construction drawings.

4.4.4 Prior to and during installation, particular care must be taken to ensure that:

- site preparation and embankment construction are as detailed in sections 4.4.7 and 4.4.8
- fill properties satisfy the design specification
- drainage is adequate at all stages of construction, as required by the contract documents
- the system is protected against damage from site traffic and installation equipment
- the stability of existing structures is not affected.

4.4.5 Care must be exercised to ensure that the system is laid with the longitudinal direction of the reinforcement mesh panel, parallel to the direction of principal stress.

4.4.6 The system is designed to be installed by a competent general builder, or contractor, experienced with this type of system, and are installed under normal site conditions.

4.4.7 Preparation

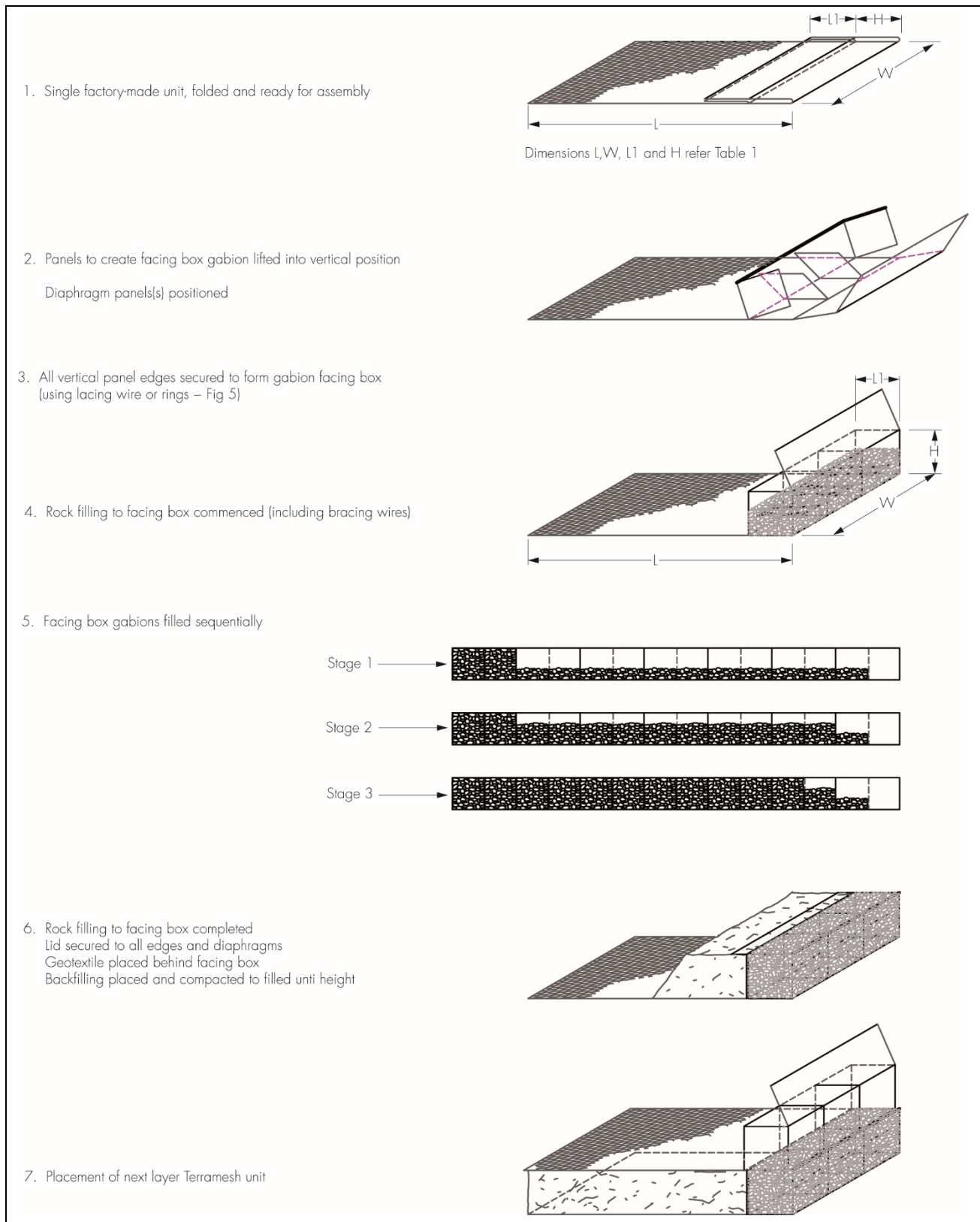
The gabion formation is prepared by levelling and compacting the subgrade in accordance with the MCHW, Volume 1 *Specification for Highway Works* (SHW), Series 600. The surface must be free of surface irregularities, loose material, organic or frozen matter and any other obstacles that may damage the polymer-coated wire mesh.

Procedure

† 4.4.8 The Certificate holder's instructions advise the following:

4.4.8.1 The system units are unfolded and the base mesh section is placed over the hard flat surface. Any creases not required for forming the box are pressed out and the installation procedure is commenced (see Figure 3).

Figure 3 Installation sequence



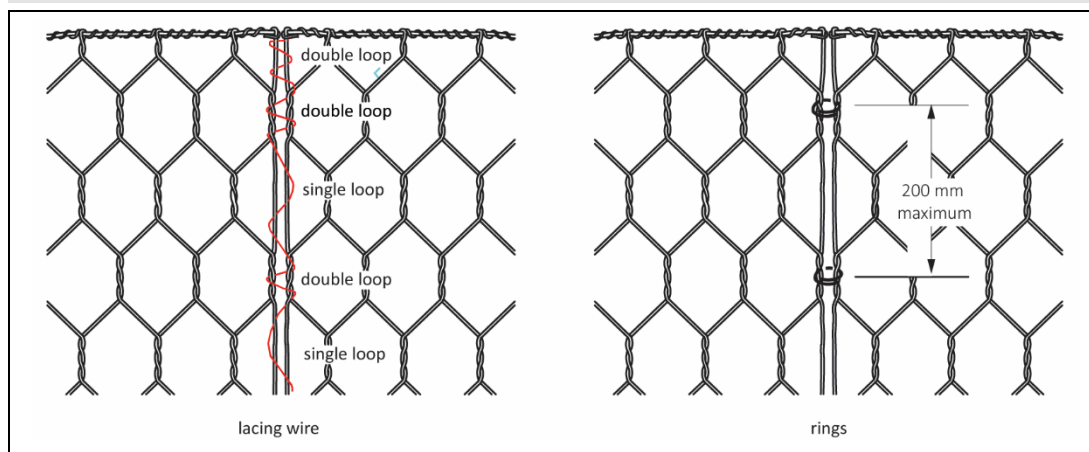
4.4.8.2 The front and rear sides, ends and diaphragm are lifted into position to form the shape of the facing box gabion.

4.4.8.3 The top corners are secured with the thick selvedge wire.

4.4.8.4 The external-facing gabion cage is assembled by wiring up the vertical faces of the front, rear, sides and diaphragm.

4.4.8.5 Vertical panel edges are joined together, either using the appropriate lacing wire starting from the top edge in a continuous operation using alternate single and double twists, or using rings applied using the Maccaferri Pneumatic Tool (see Figure 4). Individual ties of lacing wire must not be used.

Figure 4 Typical Mesh joint lacing pattern



4.4.8.6 The initial layer of pre-assembled units is placed empty on the flat, prepared formation surface (see section 4.4.7) and wired or fastened to adjacent units along all the containing edges, in order to form a continuously connected, monolithic structural unit. The horizontal reinforcement panels (behind the gabion facing box) do not need to be joined together.

4.4.8.7 The gabion box facing is lightly tensioned (parallel to the wall alignment) using a cable winch/tirfor or similar, to hold the faces taut during the filling operation and assist in alignment. The units are laced to the course below (if present).

4.4.8.8 The gabion box facing is filled in the identical manner to standard gabions.

4.4.8.9 The stone infill to the gabion facing section is normally sized between 100 and 200 mm. The fill must comprise hard, durable stone as quarried or naturally occurring rounded stone (class 6G in accordance with the MCHW, Volume 1, Table 6/1).

4.4.8.10 One-metre-high gabion facing cages are filled to one-third height, braced, filled to two-thirds height and braced again. A half-metre high unit requires only one row of bracing at 250 mm height. The gabion is overfilled by approximately 30 to 50 mm to allow for natural settlement of the infill.

4.4.8.11 After filling, the cage mesh lid is folded down, stretched into position and laced to the front and side panels and the top of the diaphragm panel(s).

4.4.8.12 The full length of gabion facing must be filled sequentially (as shown in Figure 3), and the lids laced down. A strip of non-woven geotextile is placed against the rear side of the gabion facing cages, before the reinforced block backfill is commenced, to provide a separation layer.

4.4.8.13 Placement and compaction of the backfill must be carried out in accordance with BS EN 14475 : 2006 Section 8.5.4, and the MCHW, Volume 1 SHW, Series 600.

4.4.8.14 The design-specified fill is initially placed to a minimum depth of 150 mm, with particular care being taken to ensure that the polymer-coated reinforcing mesh panels are adequately covered before compaction or trafficking.

4.4.8.15 The fill must be fully compacted, in layers, to satisfy the design specification requirements. Thickness of compaction layers depends on the type of fill and compaction equipment employed, which must be determined according to the MCHW, Volume 1 SHW, Series 600, Clause 612.

4.5 Maintenance

Routine maintenance is not normally required, however, should the exposed mesh be damaged, additional or replacement panels can readily be fixed to the structure.

5 Fulfilment of Requirements

5.1 The conclusion of this BBA assessment is that the Maccaferri Terramesh System, when used in accordance with the provisions of this Certificate, complies with the BBA HAPAS Certification Scheme requirements.

5.2 In order for the system to continue to meet Scheme requirements, it must be installed, used and maintained as per the Certificate holder's instructions and as detailed in this Certificate.

6 Validity of Certificate

Continuing validity of this Certificate is dependent on the following factors:

- continuing compliance with system or process requirements, as described in the HAPAS Scheme document, and the specification documents referred to therein
- ongoing BBA surveillance of factory production control, to verify that the specifications and quality control being operated by the manufacturer are being maintained
- acceptable results from long-term exposure monitoring
- acceptable data to confirm durability
- formal triennial Review of the Certificate, and Reissue for required technical or non-technical updates
- compliance with ongoing Certificate obligations by the Certificate holder and manufacturer(s).

† 7 Additional 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.

UKCA marking

The Certificate holder has taken the responsibility of UKCA marking the system in accordance with UKAD 200026-00-0102.

8 Bibliography

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

BS 8006-1 : 1995 *Code of practice for strengthened/reinforced soils and other fills*

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

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

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 mesh products for civil 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 on steel wire — General rules*

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

BS EN 10245-5 : 2011 *Steel wire and wire products — Organic coatings of steel wire — Polyamide coated wire*

BS EN 13738 : 2004 *Geotextiles and geotextile-related products — Determination of pull-out resistance in soil*

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

BS EN ISO 9001 : 2015 *Quality management systems — Requirements*

BS EN ISO 16120-1 : 2017 *Non-alloy steel wire rod for conversion to wire — General requirements*

BS EN ISO 16120-2 : 2017 *Non-alloy steel wire rod for conversion to wire — Specific requirements for general-purpose wire rod*

CG 300: *Technical Approval of Highway Structures*

CD 350: *The Design of Highway Structures*

CD 622 *Managing geotechnical risk*

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

9 Conditions of Certification

9.1 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 or 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.

9.2 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.

9.3 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.

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

9.5 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 UKCA marking and CE marking.

9.6 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.

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