INTRODUCTION:
This document has been prepared to assist Engineers in specifying gabion works for their Clients or strictly in accordance with the Specification for Highway Works. Also included is an assessment of durability and design life of Maccaferri PVC coated galvanised gabions.

“Gabions are to have BBA Certification recommending a design life of XYZ, and are to be manufactured in an ISO9001 Certified factory. Current conformance certificates for the facility and the specific gabion production run are to be provided by the gabion material supplier. The supplier is to furnish test results from an independent UK based laboratory proving the product meets the project specification.”

CLIENTS INDIVIDUAL SPECIFICATION
Gabions can be supplied in a variety of different specifications and sizes, however, economy dictates that there is a degree of standardisation.

Specifications should include the following points:
1. The mesh size (80mm would be a typical figure for gabions)
2. The diameter of the main wire (and overall diameter if PVC coating)
3. The type of protective coating (galvanised only or with an additional PVC coating)
4. Sizes of units

Typical Specifications for gabions are:

A. Galvanised Gabions
All mesh shall be manufactured from steel wire complying with BSEN 10218-2 and BSEN 10223-3 and zinc or Galfan galvanised to BSEN 10244-2 Table 3 CLASS A (245g/m2 minimum for 2.7mm dia. wire), prior to weaving of the mesh. Mesh opening shall be hexagonal in shape to BSEN10223-3 (Figs 1 & 2); nominal size 80mm and joints shall be flexible and consist of one and a half full turns of wire.

The mesh wire shall be 2.7mm diameter and all edges shall be reinforced during manufacture with a heavier selvedge wire not less than 3.4mm diameter. Partition panels of the same mesh specification shall be fixed during manufacture at 1 metre centres on units greater than 1.5m in length. Lacing wire for assembling the units shall be 2.2mm diameter and to the same specification.

B. PVC Coated Galvanised Gabions
Maccaferri gabions have a British Board of Agrément Certificate 95/3141 detailing a life expectancy of 120 years.
All mesh shall be manufactured from steel wire complying with BSEN 10218-2 and BSEN 10223-3 and galvanised to BSEN 10244-2 Table 3 CLASS A (245g/m2 minimum for 2.7mm dia. wire) and a heat bonded coating of grey PVC, or other non-flammable polymer, 0.5mm (nominal) thick, all prior to weaving of the mesh. Flammable HDPE or other polymer coatings that sustain combustion when the ignition source is removed shall not be permitted. Mesh openings shall be hexagonal in shape to BSEN 10223-3 (Figs 1 & 2); nominal size 80mm and joints shall be flexible and consist of one and a half turns of wire.

The mesh wire shall be 2.7mm core diameter, 3.7mm overall diameter. All edges shall be reinforced during manufacture with a heavier selvedge wire not less than 3.4mm diameter, 4.4mm overall diameter. Partition panels of the same mesh specification shall be fixed during manufacture at 1 metre centres on units greater than 1.5m in length. Lacing wire for assembling the units shall be to the specification as the mesh wire, of 2.2mm core diameter, 3.2mm overall diameter.

C. Stone filling
Stone filling shall conform to BS5390 for hardness, crushing strength and resistance to weathering. The material shall be well graded, the maximum size shall not exceed two thirds of the minimum dimension of the gabion compartment or 200mm whichever is smaller and the minimum size of fill shall be not less than the size of the mesh opening.

D. Assembly of Box Gabions
• Gabions shall be assembled in accordance with the manufactures instructions.
• The tops of the corners must be level and join together by twisting together the selvedge wire projecting from the edge of the panels.
• The four corners of the gabion boxes shall be laced first, followed by the edges of internal diaphragms to the sides. Lacing shall be a continuous operation for approximately one metre.
• Lacing shall commence at the top of the gabion by twisting the end of the lacing wire around the selvedge and then passing around the two edges being joined with alternate double and single loops at every mesh.
• The binding wire shall be securely tied off at the bottom and all cut ends turned to the inside of the gabion on completion.
E. Construction of Box Gabions

- Gabion units shall be assembled in accordance with the position and adjoining units securely laced together with alternate single and double loops at 100mm centres before they are tensioned and filled.
- Before filling, the gabions must be stretched by an appropriate method and held under tension during filling. On multi-layer structures the empty gabions shall be securely laced along all edges to adjacent filled gabions whilst under tension.
- Filling shall be carried out in layers only whilst gabion boxes are under tension.
- Internal bracing wires shall be fixed at 330mm centres in 1m deep units at a ratio of 4 per square metre on all visible faces of the structure. For 0.5m deep units bracing wires shall be similarly fixed at half height level.
- All visible faces shall be hand packed to ensure a good finished appearance.
- Gabions shall be sufficiently overfilled to allow for consolidation and minimise distortion. Lids shall be stretched tight over filling and wired down securely through each mesh along all edges, ends and diaphragms.
- The overall tolerance for the finished structure shall not exceed ± 75mm both horizontally and vertically from the specified alignment.

F. HIGHWAYS AGENCY; SPECIFICATION FOR HIGHWAYS WORK

The Highways Agency “Specification for Highways Works” published by HMSO covers gabions in Clause 626 States:

1. Gabions shall be in accordance with Clause 626 of the Specification for Highways Works

2. Gabions shall be sufficiently overfilled to allow for consolidation and minimise distortion. Lids shall be stretched tight over filling and wired down securely through each mesh along all edges, ends and diaphragms.

3. All visible faces shall be hand packed to ensure a good finished appearance.

4. Internal bracing wires shall be fixed at 330mm centres in 1m deep units at a ratio of 4 per square metre on all visible faces of the structure. For 0.5m deep units bracing wires shall be similarly fixed at half height level.

5. All visible faces shall be hand packed to ensure a good finished appearance.

6. Mechanical equipment may only be used for filling gabion units where the Engineer is satisfied that the results are equivalent to filling by hand.

G. Additional Requirements to Clause 626 to be included in Appendix 6/10

Note: It is important that this section is completed in addition to stating: - ‘Gabions shall be in accordance with Clause 626 of the Specification for Highways Works’

<table>
<thead>
<tr>
<th>Appendix 6/10</th>
<th>Example of Maccaferri Gabions</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>References to Drawings showing locations and details including:</td>
</tr>
<tr>
<td>b</td>
<td>Additional requirements and type of mesh [626.1 and 3]</td>
</tr>
<tr>
<td>c</td>
<td>Core dia. And its BS for mesh if different from 626.3 (i)</td>
</tr>
<tr>
<td>d</td>
<td>Properties of plastic geomesh, if permitted [626.3 (ii)]</td>
</tr>
<tr>
<td>e</td>
<td>Size of mesh openings and gradings of fill [626.5]</td>
</tr>
</tbody>
</table>

NB: Although not part of the Specification for Highway Works, the specifier may consider it prudent to include a specification statement regarding the use of flameable polymer coatings on gabions. There are products that sustain burning when the ignition source is removed. This is clearly undesirable for highway structures.

Therefore consideration should be given to an appendix inclusion such as:

“Gabions are to have BBA Certification recommending a design life of 120 years, and are to be manufactured in an ISO9001 Certified factory. Current conformance certificates for the facility and the specific gabion production run are to be provided by the gabion material supplier. Flammable HDPE or other polymer coatings that sustain combustion when the ignition source is removed shall not be permitted on any highway works.

Independent UK based laboratory testing to confirm conformance to the specification above may be requested by the project engineer and be provided at the material suppliers expense.”
DURABILITY OF PVC COATED MACCAFERRI GABIONS AND RENO MATTRESSES

Maccaferri Ltd has been supplying PVC coated galvanised gabions for more than 40 years and has more than 100 years of experience with woven mesh gabions. Maccaferri is the world’s largest manufacturer and supplier of gabions, Reno mattresses and rockfall netting with 23 factories on 4 continents. Our PVC coated units have been supplied to locations from the Equator to the Artic and Antarctic circles, applications ranging from tidal structures to walls on dry land.

Extracts for a typical specification for PVC coated mesh may include the following requirements:

A. **The thickness of the PVC coating**, 0.5mm, has been designed to resist mechanical damage during transportation and construction.

B. **Bonding to wire core.** After immersion of a length of the coated wire in a 1% solution of potassium permanganate for a continuous period of 50 hours at an ambient temperature, the maximum penetration between the coating and the wire core from a square cut end shall be 10mm (0.394in). The PVC coating is extruded onto wire heavily galvanised to BSEN10244-2 CLASS A providing a very good bond between the coating and the wire core.

   No special treatment, therefore, is given to the cut ends of mesh, the PVC coating being extruded onto the wire before weaving into the mesh.

C. **Resistance to corrosion of the PVC.** After immersion of a length of the coated wire, excluding the ends, in a concentrated solution of sodium chloride for a continuous period of 60 hours at an ambient temperature, there shall be no loss of weight.

   The mix formulated for the PVC was chosen to combat the deleterious effect of UV radiation and, although the PVC gets slightly harder on exposure, it does not break down.

<table>
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<tr>
<th>Life Expectancy</th>
<th>Example and Comments</th>
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</thead>
</table>
| 120 years       | Dry land retaining wall  
See British Board of Agreement Certificate No 95/3141 detailing a life expectancy of 120 years. |
| 60 years +      | Saline Estuary  
A tidal Defence at Brough on Humber subjected to alternate wetting and drying and overtopping at high tide was stated to be as good as new when tested 30 years after construction. |
| 30+++           | Tidal Revetment Dawlish Warren  
Constructed in 1971 to protect its sand dunes when inspected in 1998 there would appear to be no reason why it should not last at least another 30 years. |
| 25 years without maintenance | River Wall with heavy bed load  
In South Wales, rolling stone abraded the PVC coating near bed level – maintenance was done by tying new mesh in affected areas. |
| 2 years          | Temporary jetty  
Subject to heavy wave action and shingle continuously thrown against structure. |

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