DESIGN Proposal

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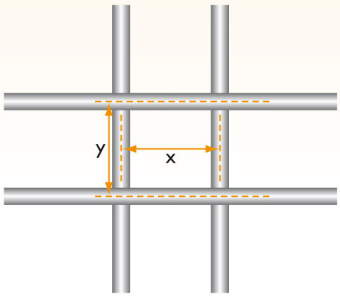
Project	**51 Briarswood** Biddulph
Client	Louise Hughes-Jones
Design Date	01-07-14
Design reference	15061
Issue	1

CLIENT INFORMATION

Contact	Louise Hughes-Jones
Telephone	07917152017
Email Address	

SPECIFIED MESH



BI-AXIAL
WELDED MESH

Nominal dimension (x)
Gabions (75mm) Mattresses (75mm)

Nominal dimension (y)
Gabions (75mm) Mattresses (75mm)

Project example

Gabion 39 System, Bi-Axial Welded Mesh (Stepped Face)
This example illustrates a mass gravity gabion wall, designed and supplied by Enviromesh, utilising the Gabion 39 System for a new factory development in Bradford. The wall was up to 5.0m high and supplied with gabions such that all exposed face panels had a 5mm wire diameter to achieve a high level of aesthetics.

Industry leading specialists for all your gabion requirements

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Project

51 Briarswood
Biddulph

Documentation enclosed :

IF ANY OF THE DOCUMENTS LISTED ABOVE ARE NOT INCLUDED, PLEASE CONTACT :

Telephone : 0845 136 0101
Email : design@enviromeshgabions.co.uk

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Conditions Relating to this Design Proposal

The following design proposal has been prepared by Cerana Limited trading as Enviromesh.

Copyright

Design charges

This design proposal has been provided free of charge based on information provided by the client/contractor. Any substantial re designs required due to changes from the clients/contractors initial design brief may be subject to a charge at the discretion of Enviromesh. In certain circumstances this charge may be refundable against the material supply price upon receipt of order. The same charge will apply to clients/contractors requiring as built drawings, whose responsibility it is to provide the necessary information to Enviromesh for us to compile.

Design limitations

Whilst every care has been undertaken in the preparation of this proposal, it is the client's/contractor's responsibility to satisfy themselves that any design parameters used within this document are representative of the conditions prevailing on site. Enviromesh **MUST** be notified immediately of any such variations and certainly prior to construction in order that the design proposal may be re-evaluated if required.

Where the design requires a maximum cut angle into existing slopes, this is a requirement of the design. In the case where local soil conditions would render the cut unstable to work under, a reduced cut angle may be required for temporary stability or alternatively temporary support works will be required. Enviromesh do not undertake temporary support design, this is the responsibility of others.

It should be noted that no design liability is accepted by Enviromesh unless prior written confirmation is obtained.

Prior to ordering materials, the client must ensure that Enviromesh are provided with the latest contract drawings for review. If Enviromesh are not provided with this information, then any claims resulting from variation will not be accepted.

It should be noted that materials offered by Enviromesh, but sourced elsewhere will invalidate this design proposal.

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Site supervision

Enviromesh do not undertake site supervision, but advice and guidance on the correct assembly of gabion and mattress products can be obtained via the contact details outlined above. Site visits relating to contractual and construction issues will be at the discretion of Enviromesh.

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Design Brief

Enviromesh were approached by Louise Hughes-Jones to produce a detailed design for a proposed Gabion retaining wall at a site located in Biddulph. Enviromesh were subsequently provided with information to advise a gabion wall design proposal.

Gabion Wall Specification

It is considered that a Galfan coated wall would be the most applicable style of wall. The gabion design calculations contained within this design proposal have been based EC7 methodology.

The foundation/sub base to the proposed gabion wall should be 300 mm deep layer of 6F2 to provide a level base for the wall. The sub base should extend 300 mm behind the first course of the proposed wall. The sub base material should be pitched at an angle of 6 degrees from the horizontal and be compacted in situ ready for construction of the gabion wall.

Back fill to the gabion wall should be Class 6N material and should be placed in layers not exceeding 300 mm immediately behind the proposed wall (with a geotextile separator separating the back fill to the rear of the gabion cage) and be suitably compacted.

Where any soft areas are found beneath the proposed gabion wall these should be excavated out and replaced with compacted 6F2 fill.

Information Provided

This proposal has been prepared upon indicative information provided by the client. All proposals should be checked prior to construction.

A full Geotechnical Investigation report has not been forwarded to Enviromesh to advise this design. Design parameters have been based upon moderately conservative values that might be expected at the site. Design soil parameters should be checked prior to construction.

In the absence of a geotechnical investigation report it is considered that this gabion wall design proposal and any subsequent quotation should be treated as preliminary and may be subject to change upon receipt of full site information including a geotechnical investigation report.

The bearing pressures calculated for the proposed Gabion Walls are detailed in the calculations section of this design proposal and confirmation of adequate safe allowable bearing capacity for the founding soils/foundations should be sought prior to construction. If the safe allowable bearing capacity for the founding soils are not adequate then the design MUST be re-evaluated.

NOTES:

1. Gabion Wall design must be read in conjunction with the accompanying design proposal if provided.

2. All Gabion mesh is to be BBA certified as supplied by:-

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Garner Street Business Park, Etruria, Stoke-on-Trent ST4 7BH
tel 0845 136 0101 fax 0845 136 0202
email enquiries@enviromeshgabions.co.uk
web http://www.enviromeshgabions.co.uk.

3. Mesh Wire to have a tensile strength in the range of 540 to 770 N/sqmm

4. Gabion Retaining Wall units to comprise of Galfan coated wire mesh (95% zinc 5% Aluminium) in accordance with BS EN 10244-2: 2009 (Class A).
Gabion mesh panels to be constructed from 75 mm x 75 mm square mesh in 3mm diameter wire. Factory assembled joints to be clipped/C rings at maximum 225mm spacing.

5. Gabion construction and installation must be in strict accordance with the Enviromesh's installation instructions.

6. Gabion units to be constructed using internal windlass ties.

7. Gabion units to site assembled with lacing wire and/or 'C' clips.

8. Lengths and levels stated on this drawing are based on theoretical basket dimensions, there may be a gain/loss in levels or lengths which may require on site modification to suit specific lengths and levels.

9. Gabion sizes to be provided upon receipt of material order.

10. Gabion fill to be Class 6G having a density of 16kN/cu m.

11. Backfill to gabion walling to be class 6N compacted in layers not exceeding 300 mm.
Density 18kN/cum PhF35 degrees

12. Gabions to be founded on minimum of 300mm of Class 6F2 material. Any local soft areas in the foundations shall be excavated out and replaced with compacted granular material (eg. 6F2).
Density 18kN/cum PhF35 degrees.

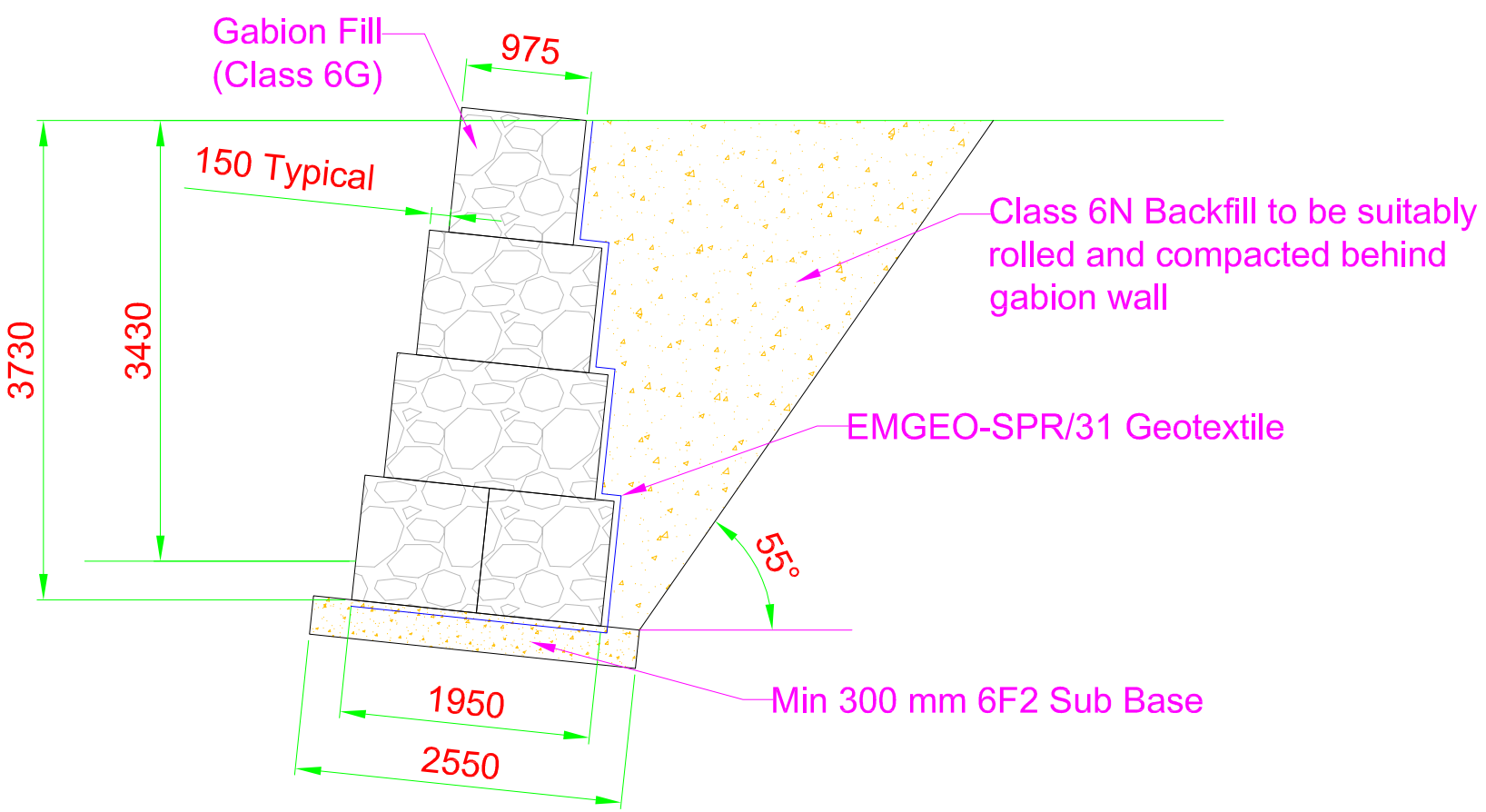
13. Geotextile to be placed behind and below walling - EMGEO-SPR/31 Geotextile.

14. Site soils in the shown section must have a minimum effective angle of shearing resistance of the following:

Retained soil - 26 degrees

15. Site soils in the shown section are assumed to have a density of 19 kN/cum and a cohesion of 0 kN/sqm.

16. The shown section has been designed with a surcharge behind the wall of not greater than 10 kN.



Due care and attention has been taken in the preparation of the design of the gabion structures and is based on the information received. It is the contactor/clients responsibility to ensure that the details provided encompass all aspects of the required works and the limits of construction and levels shown on the drawing are correct prior to placing of material orders. Enviromesh does not accept liability for errors or omissions once an order is placed.Where further amendments are required due to additional requirements or variation in the structure line and/or levels, the design time will be chargeable.

DRAWN: MM	SCALE: NOT TO SCALE	PROJECT TITLE: 51 Briarswood, Biddulph. Gabion Design Proposal	ENVIROMESH
REVISIONS:	DATE:		
		PROJECT NUMBER: 15061-01	DATE: 01-07-2014

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The following design analysis is based on BS EN 1997, two design combinations are considered for Design Approach 1, Design Approach 2 is not applicable in the UK.

The following partial factors are used in the designs:-

ACTIONS		SET	
		A1	A2
PERMANENT	Unfavourable	1.35	1.00
	Favourable	1.00	1.00
VARIABLE	Unfavourable	1.50	1.30

For parapet loadings and wind loadings determined from other codes they are considered as unfavourable permanent loadings

SOIL PARAMETERS	SET	
	M1	M2
ANGLE OF SHEARING RESISTANCE	1.00	1.25
WEIGHT DESNSITY	1.00	1.00

DESIGN APPROACH 1: COMBINATION 1-----FACTORS A1,M1,R1

DESIGN APPROACH 1: COMBINATION 2-----FACTORS A2,M2,R1

Factor R1 is unity for both combinations.

This design proposal is based exclusively on the materials sourced from Enviromesh and installed in accordance with the manufacturer's instructions. Whilst every care has been taken in producing this design proposal, it is the customers's responsibility to satisfy himself that the design, analysis and specifications are correct. No responsibility is accepted by Cerana Limited for the accuracy of the design and specifications included in this proposal.

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Based on BS EN 1997 the following are considered in design:-

Analysis of soil forces is determined on Coulumbs Wedge Analysis having a critical failure wedge of 45 degrees + (factored soil friction angles)/2 in determining the value. of the Co-efficient of Active Thrust.

No consideration is given to passive pressure in front of the structure.

The stability of each course is checked for Overturning, Sliding, Bearing and Eccentricity.

The effective angle at the rear of the wall for each course is taken as the plane between the intersection of the retained soil and with the wall and the heel of the gabion course to the horizontal.

For Sliding check at course interfaces the friction value is taken as 35 degrees.

UDL'S and Line loads are considered as variable unfavourable actions.
Horizontal loads are considered as permanent unfavourable actions.
Direct vertical load on the gabion structure itself is a favourable action.
Soil forces are considered permanent unfavourable actions.

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DESIGN DATA INPUT
Gabion Details

Gabion Fill	Class 6G
Gabion Density	16 kN/cum
Cut angle to existing soil or zone of backfill	55 degrees
Geotextile requirements	to the rear and below the gabion structure

Gabion Section

Wall inclination 6 deg

Course	Offset	Unit width	Unit height
4	0.45	0.975	0.975
3	0.3	1.35	0.975
2	0.15	1.65	0.975
1	0	1.95	0.975

Gabion Specification

Gabion System	39 Welded mesh
Corosion protection	GALFAN
Wire Diameters;	SPEC 333

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DESIGN DATA INPUT

Geometry of slopes

Downstand from top of gabion to start of slope 0 m

Foundation level below ground level 0.3 m

Grade	Slope in degrees	Horizontal Slope Length
Crest grade 1	0	10
Crest grade 1	0	
Toe grade 1		
Toe grade 2	0	1

Loadings

Load Type	Load Intensity	Start	End
UDL	10	0	9
UDL			
Line load			
Line load			

Load Type	Load Intensity	Height above top of wall
Horizontal		
Vertical		considered central to top gabion

Soil Data

Soil type	Density	phi	cohesion
Retained Soil	19	26	
Backfill Soil	18	35	
Subgrade Soil	19	26	0
Foundation Soil	18	35	0

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Table of Results Design Approach 1 Combination 1

Course	Ka	Pa	Total Mo	Total Mr	Fo	N	T	Fs	e	e max	Bearing
4	0.26	3.03	2.54	11.51	4.54	18.53	2.65	18.85	0	0.16	19.13
3	0.34	15.82	16.36	47.22	2.89	51.28	12.87	4.93	0.07	0.22	42.61
2	0.35	36.65	46.9	108.48	2.31	92.82	29.53	3.4	0.16	0.27	69.95
1	0.35	66.11	100.48	203.76	2.03	144.33	53.02	2.6	0.25	0.32	100.84

Table of Results Design Approach 1 Combination 2

Course	Ka	Pa	Total Mo	Total Mr	Fo	N	T	Fs	e	e max	Bearing
4	0.33	2.79	2.52	11.13	4.42	18.17	7.66	2.31	0.01	0.16	19.17
3	0.4	13.88	15.94	44.16	2.77	48.99	23.65	1.95	0.1	0.22	42.52
2	0.41	32	45.3	99.73	2.2	87.39	45.2	1.79	0.2	0.27	70.15
1	0.41	57.57	96.45	185.02	1.92	134.43	73.07	1.58	0.31	0.32	102.02

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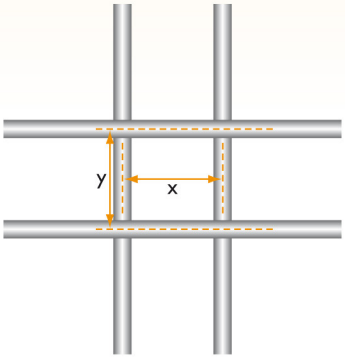
GABION DESIGN SPECIFICATION : BIAXIAL WELED MESH
3.00mm WIRE DIAMETER - GALFAN COATED



SPECIFIED MESH BI-AXIAL WELDED

Nominal dimensions (x) and (y) : Gabions, 75mm Mattresses, 75mm

Gabions to be manufactured and/or supplied by Enviromesh, Garner Street Business Park, Etruria Stoke-on-Trent, Staffordshire Tel 0845 136 0101, Fax 0845 136 0202 having BBA certification as detailed below.

Email enquiries@enviromeshgabions.co.uk Web http://www.enviromeshgabions.co.uk

The certification, materials, manufacture, assembly and installation of the above-mentioned product shall comply with all of the following criteria:

Certification

All gabion materials and accessories must be certified in accordance with **British Board of Agrément (BBA)** requirements. This is for current General Building Regulation's where the gabions are considered to have a life expectancy of up to 70 years in a mild environment. Evidence of current BBA certification and relevant certificates of conformity with respectto wire strength, weld strength and coating weights used in the manufacture of the mesh fabric and wire products are to be issued upon request.

Materials

The wire used in the manufacture of the gabions and installation accessories shall comply with the following:

Mesh Fabric
The mesh fabric shall be formed by electrically welding at each and every intersection, hard drawn steel line and cross wires into a dimensionally stable bi-axial square metric mesh of size **75mm x 75mm.**

The weld strength shall be **75%** of the minimum ultimate tensile strength of the wire.

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The nominal wire diameter shall be **3.0mm** for the base, ends, diaphragms and lid on the uppermost gabion all within the tolerances specified in BS EN 10218-2:1997 and shall have a tensile strength that falls within a range of **540-770 N/mm²**
Tensile strengths of less than 540 N/mm2 that can result in increased deformation of filled units as well as reduction in weld strength shall not be permitted.

Lacing Wire
The lacing wire used for site assembly shall be of a nominal **2.2mm** wire diameter in accordance with BS EN 10218-2:1997 and shall have a tensile strength that falls within a range of **380 to 550 N/mm²**.

Helical Binders *(where specified)*
Full height helical binders for the vertical joints for gabion installation and assembly shall be of a nominal **3.0mm** wire diameter in accordance with BS EN 10218-2:1997 and shall have a tensile strength that falls within a range of **600 to 800 N/mm²**.

Pre Formed Corner Bracing Ties *(where specified)*
Pre formed corner bracing ties are to be formed from a nominal **3.0mm** wire diameter in accordance with BS EN 10218-2:1997 and shall have a tensile strength that falls within a range of **350 to 550 N/mm²**.

Corrosion Resistance
All wire used in the mesh fabric or accessories shall be Galfan coated (95% Zinc / 5% Al) in accordance with BS EN 10244-2: 2009 (Class A).

Manufacture

Unit Formation
The gabion is to be formed from mesh panels such that the front, rear, ends and diaphragm panels are connected to the base panel with either stainless steel **CL35 clips** or **Galfan coated CL50 'C' rings** at a maximum spacing of **225mm** for all joints. This process must be undertaken in a factory controlled environment. The lid may be supplied loose or fixed in the same manner to the rear or face panel. Diaphragm (partitioning panels) spacing's should not exceed 1.050m on units orientated as stretchers and 1.5m orientated as headers.

Should units be required to be prefilled and lifted as opposed to filling in situ, additional clips, rings and mesh panels may be required. In such circumstances the manufacturer must be consulted prior to supply to ensure product is suitable for application.

Gabion Sizes
It should be noted that it is industry standard for gabions to be quoted as overall nominal sizes. The actual gabion sizing is dependant upon the physical mesh configuration. Clarification should always be sought from the manufacturer in relation to gabion sizing.

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Assembley and Installation

Note Please also refer to manufacturer's installation instructions which are available upon request in either electronic or hard copy format.

Jointing

Gabions are supplied with lacing wire as standard for jointing adjacent units whilst empty as well as for internal windlass ties. Lacing is to be continuous along all joints both vertically and horizontally using alternate single and double twists at a maximum spacing of 100mm ensuring that it forms a tight joint. Start or termination of lacing is formed by three turns ensuring the free end is turned into the unit.

Where helical binders are requested for use on verticals joints, the top and bottom helical turn should be rotated through 90 degrees to prevent movement. All horizontal joints are to be laced as described above unless specially requested.

If CL50 'C' rings are to be used for final jointing as an alternative to lacing or helical binders then these must be installed at every other mesh opening to achieve the required joint strength along all vertical and horizontal courses.

Internal Bracing

Internal bracing is formed by creating a continuous windlass tie between the face and rear of the exposed cells within the structure. On 1m high units, two internal windlass bracings are required at third widths and at each third height of the gabion. For 0.5m high units one internal windlass bracing is required at mid height. In all cases the windlass tie is to span two or three mesh openings on the front and rear cells to spread the load. The exposed end gabions to the wall should also be braced in both directions to prevent end face deformation.

Where pre formed corner bracing ties are used instead of lacing wire to restrain the face, 4 corner ties are to be used on 1m high units placed at one third and two third lifts and 2 corner ties on 0.5m high units placed centrally on the face cell. In both cases, this is also required to the rear cell. Corner ties are positioned front to side panels and rear to side panels and tied back onto themselves accordingly.For pre filled units, it is necessary to brace each cell in both directions.

Geo-textile Separators

Where a geo-textile separator between the rear of the gabion and backfill is to be used, refer to the engineers design proposal and specification.

Foundations, Wall Inclination, Face Configuration, Drainage and Backfilling

Reference to the engineers design proposal must be made with respect to foundation requirements, wall inclination, face configuration (stepped, flush or combination thereof), drainage and backfilling requirements. Any soft areas in the sub grade should be excavated and replaced with a granular material to the engineer's requirements.

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Filling

Units are to be filled with a hard, durable, non-frost susceptible rock, stone or clean crushed concrete as specified by design. The grading of the fill is to be 100 to 150mm or 100 to 200mm (6G). Where dual fills of the same grading are specified a separation panel is optional. Where the secondary fill grading is less than the mesh aperture size, it is necessary for the fills to be separated using pre-cut correx panels or geo-textile that is inserted into the gabion on site. If this is the case then this will require the fitting of an additional longitudinal diaphragm set back from the face. In such instances it is important to refer to the engineers design proposal with respect to additional drainage that may be required. It is also important to note that cohesive fills are **not** to be used as a secondary fill within gabions.

The units shall be filled in layers not exceeding 340mm, if large voids are present then the stone must be re-orientated to minimise voids. Where specified the gabions are to have a hand placed front face.

The units shall be filled such that the mesh lid bears down onto the gabion filling material. It may be beneficial to blind the top of the filled unit with a 20 to 50mm aggregate.

Filling should be staged so that no adjacent cells have more than a third difference in the level of filling for 1m high units or half height in the case of 0.5m units
To assist in maintaining face alignment and reduce deformation, the use of external formwork i.e. timber or scaffold tubes can be tied onto the external face of the structure at third heights and then removed upon completion.

Where the bottom unit has an extended base that would ordinarily act as the lid to another gabion, these are to be either removed with a cutting device on site or more simply backfilled and buried.

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Needle Punched Non-Woven Geotextile
EMGEO/SPR31

The above-mentioned product shall comply with the following properties:

	Test Method	Value	Tolerance
Mechanical Properties			
Tensile Strength MD	EN ISO 10319	17.8kN/m	-2.3kN/m
Tensile Strength CD	EN ISO 10319	17.8kN/m	-2.3kN/m
Elongation MD	EN ISO 10319	50.0%	±11.5%
Elongation CD	EN ISO 10319	55.0%	±12.7%
Static Puncture Resistance CBR	EN ISO 12236	3.10kN	-0.62kN
Dynamic Perforation Resistance - cone drop	EN ISO 13433	13.0mm	+3.3mm
Protection efficiency	EN ISO 14574	275.0N	-55.00N
Hydraulic Properties			
Water permeability normal to the plane	EN ISO 11	$80x10^{-3}$m/s	$-24x10^{-3}$m/s
Water flow normal to the plane (*)	EN ISO 11	$80 l/m^2.s$	$-24 l^2$m.s
Water flow capacity in the plane 20kPa	EN ISO 12958	$7x10^{-6}m^2/s$	-10% log g
Characteristic opening size (AOS)	EN ISO 12956	70.0μm	±21.0μm
Physical Properties			
Thickness under 2kPa (*)	EN ISO 9863-1	2.20mm	±0.44mm
Weight (*)	EN ISO 9864	$250g/m^2$	$\pm 25.0g/m^2$
Composition	100% polypropylene non-woven geotextile		
Durability	Predicted to be durable for a minimum of 25 years in natural soil with 4 < pH < 9 and soil temperatures		

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Risk Assessment (RASS) Document

GABION & MATTRESS INSTALLATIONS

This document is a guide only to the potential hazards/risks associated when working with gabions and mattresses. The following list is certainly not exhaustive and should not be used as a substitute for undertaking a complete independent risk assessment (site specific) prior to the installation of product. It should be noted that the word **gabion** in this document refers to any steel wire mesh cage filled with stone or granular materials.

Working with gabions

IMPORTANT

All Personal Protective Equipment (PPE) is to be worn at all times when handling and installing gabions. Current manual handling operations regulations to be followed at all times.

- Protective gloves against injury to hands
- Protective eye wear against injury to sight
- Protective toe cap footwear against injury to feet
- Protective hard hat against injury to the head
- High visibility clothing

Understanding the risks

The following table highlights some of the risks and hazards that may be presented to personnel working on gabion or mattress installations - together with an analysis of possible consequences and an overview of measures that can help to minimise associated risks.

Hazard or Risk	Consequence	Control measure
Unpacking of gabions	Personal injury from cutting banding.	Full PPE. Other operatives to stand clear whilst cutting banding.
Stability of excavated soil faces	Collapse of cut soil face and loose materials falling down cut face.	Full PPE. Identify soil types prior to work commencing and grade soil type to indicate risk of an accident occurring. or provide temporary netting or support to prevent materials falling from height.

continued on next page

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Hazard or Risk	Consequence	Control measure
Working on embankments	Falls	Full PPE. Provide fencing to all leading edges and check stability of embankments continually.
Handling of lacing wire, helicals and corner ties.	Cuts and abrasions to head, eyes and body.	Full PPE. Ensure other people are not in the working area whilst tying is taking place. Ends of wire to be bent over to avoid sharp protruding wire poking into eyes.
Handling of gabions	Strains and cuts.	Full PPE. Use mechanical or multiple man power to lift.
Moving heavy stone in confined spaces	Pinching of fingers and hands between pieces of stone infill. Falling rocks from plant.	Full PPE. Only one person to work within a gabion basket at any time and all other personnel to stand clear during mechanical filling operations.
Overspill of heavy stone	Crushing, bruising, cuts and abrasions.	Full PPE. Stone to be placed by machine and not dropped from height.
Modification and cutting of gabions on site	Off cuts causing trip and slipping hazards and open wire sharp ends leading to falls, cuts, abrasions and bruising.	Full PPE. Off cuts to be disposed of correctly and the working area kept free debris. Where off cuts are to be re-used they should be stored tidily in a suitable area.
Fixing of gabions to structures involving power tools	Electric shock can occur if tools are used in wet conditions or tools are in a poor state of repair.	Full PPE. Use only 110v power tools for drilling etc. Ensure cables are kept neat and are covered and/or secured to prevent trips etc. Ensure suitable edge protection is implemented. Competent trained personnel to use power tool equipment only.
Working at heights above 2.0m	Personal injury.	Full PPE. Climbing up wall faces is not permissible. Where possible make suitable access around the side or rear of the wall. Where possible always work from the rear of the wall and provide suitable handrails to leading edge. If working from the face, provide a working platform or scaffolding as necessary. Wear safety harnesses where required.

continued on next page

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Hazard or Risk	Consequence	Control measure
Pre-fill and lifting of gabions	Overloading and exceeding operating capacity of lifting appliance, lifting tackle and frames. Serious/fatal injury.	Full PPE. Ensure all plant is fit for purpose and certified and that only trained operators use plant. Provide adequate surfaces to work off and ensure all operatives / personnel are at a safe distance whilst lifting is in process. A banks man should direct the plant operator at all times.
Use of portable compressed	Injury to fingers, strains and tripping leading to personal injury.	Full PPE. Ensure equipment is in working order and operatives are trained in the use of the equipment.
Use of portable power tools	Electric shock can occur if tools are used in wet conditions or tools are in a poor state of repair. Fire could occur when using electrical equipment near flammable vapours.	Full PPE. Carry out weekly checks and monthly formal inspections. Ensure all tools are 110v only and that all leads, casings etc. are in a good order. Do not use equipment in damp conditions without adequate protection to generators and tools. Refuelling generators etc. only to be carried out when works have ceased and risk of fire from hot parts have gone.
Working with gabions in water	Drowning.	Full PPE and wet gear. Always work in pairs and ensure site personnel are aware of operations being carried out. Operations to be undertaken in a safe depth of water otherwise qualified divers are required.

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Management Systems (MSYS) Document

Introduction

It should be noted that the word gabion in this document refers to any steel wire mesh cage filled with stone or granular materials.

The performance of gabion structures is dependent not only on the quality of the manufactured gabion materials, but also on the quality of assembly and installation of the system on site.

The design and manufacturer's recommendations for construction and installation must be followed to ensure the long-term performance of the structure. In the event of uncertainty, always request a site visit by the manufacturer's representative prior to the onset of installation.

In the event that site assembly instructions have not been previously issued, please contact the above telephone number and an electronic version will be forwarded. If other problems arise then please contact the designer and or manufacturer as required.

Problems associated with gabion structures are normally related to the installation process providing the design requirements have been followed. Typically, the causes of potential problems are usually attributable to one of the following factors:

- Failure to observe correct assembly and erection procedures.
- Incorrect grading of rock fills.
- Poor filling of units.

The following management system is designed to ensure a good quality of construction as well as to maximize the performance of gabion structures.

Construction inspection

Material deliveries

Gabions
Ensure that the material specification and unit sizes delivered to site are correct. Also ensure that all specified fixing systems are as per the items quoted for.

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Rock Fill
Check that the rock fill is to the correct grading (normally 100-200mm) and that it is a hard, durable and an irregular shaped stone or as previously specified by design. The rock/stone should also be checked to ensure that it will achieve the correct design density. It is normally acceptable to have 6% by weight of rock fill less than the 100mm minimum dimension.

To improve filling of gabion units, the maximum size grading of 200mm can be reduced to 150mm.

Gabions that have had mesh damaged in transportation or during storage on site should not be used.

During construction and on completion of works

A visual inspection should be made to check the following, both during the construction phase as well as on completion.

- The required inclination of the wall is correct.
- The overall line and level is acceptable and that there are no large voids or facial deformations present on the exposed faces.
- All joints are tight and correctly formed.
- No damage has occurred to the mesh fabric or its coatings during the construction period. Any areas where mesh has been damaged must be patched by overlaying with a secondary mesh piece such that it can be wired to areas of adjacent sound mesh.
- Any deformations should be corrected immediately as it becomes very difficult to correct faults as construction progresses.

Post construction

Periodic inspection should be carried out to ensure the performance of the structure and that no external damage has occurred to the mesh fabric which would affect the walls integrity.

If the wall is in a river, lake or coastal environment, the structure should be additionally inspected after severe weather or flood occurrences.

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Programme for inspection

Inspection requirements

The inspection process should take place at the end of construction and at 1 year intervals for the first 5 years, and every 5 year intervals thereafter.

Damage to the mesh fabric

If there has been a failure of one or more mesh wires, the area must be patched (see during construction and on completion of works).

Settlements

Where settlements have occurred, the cause should be investigated (it will usually be due to localized poor construction, foundation preparation or backfilling). In severe cases, the affected area should be taken down and reconstructed, reinstating the foundation if this is found to be the cause.

Where settlements are minor, these should be monitored on a six monthly basis to check if it is an initial settlement problem or a long-term issue.

Initial settlements generally stabilize and do not cause further problems. Long-term settlements must be investigated as to the cause and remedial action taken. Where mattress toe protection is used to prevent undermining, settlements can occur if the depth of scour is too great.

Normally the apron length of the mattress is 1.5 to 2 times the anticipated depth of scour, however in highly erodible soils this may need to increase.
It is therefore necessary where settlements have occurred on mattress apron protection schemes to check if the scour has exceeded the recommendations for the mattress length.

Excessive deformation

Excessive localized deformation of gabions is usually as a result of poor internal windlass tie / pre formed corner tie installation or failure of these options. Should the deformation be visually acceptable, then no remedial measures are required, otherwise the affected units should be opened, emptied and repacked.
Where excessive deformation has occurred over a length, the causes are generally settlement or movement of the wall. This will require further investigation and more regular inspection to ascertain if it is an ongoing problem.

Where problems occur during or after construction, advice should be sought from a suitably qualified and competent engineer.

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Design Document Record Sheet

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Date	Project Reference	Conditions	Design Brief	Drawing Number	Design Computations	Design Specifications	Risk Assessment (RASS)	Management Systems (MSYS)
01-07-14	15061-01	Y	Y	15061-01	Y	Y	Y	Y