GABIONS FOR RETAINING WALLS AND EROSION CONTROL

GEOFABRICS GEOBOX GABION BASKET

INSTALLATION GUIDE

Geofabrics® Geobox™ gabion is manufactured from a double-twisted steel wire mesh which is interconnected with similar units to form flexible, permeable and monolithic structures such as mass gravity retaining walls, channel linings, revetments and weirs for hydraulic and erosion control projects.

IMPORTANT INFORMATION

RESPONSIBILITIES

The Contractor is fully responsible for carrying out the works in accordance with the construction design documents, technical specifications, and contract documents (which are not provided to Geofabrics). To support the contractor, Geofabrics has included recommendations in this guide; however, these do not absolve the contractor from adhering to all applicable safety regulations and procedures.

Geofabrics accepts no liability for any inaccuracies or omissions in the execution of the works, nor for any resulting consequences.

It is the responsibility of both the contractor and the client to ensure that all site personnel involved in the work have access to this guide and are familiar with its contents.

MATERIALS REQUIREMENTS BEFORE STARTING

This work consists of furnishing, assembling and filling woven wire mesh gabions with rock as specified in the contract to the dimensions, lines and grades shown on the plans, or determined by the engineer.

GABIONS

Gabions are manufactured with all components mechanically connected at the production facility. Units are delivered to site folded and compressed in bundles weighting approximately 800 kg, and measuring approximately 2 x 1 m in plan and 0.5 m in height; type and size determine the number of units per bundle.

LACING WIRE

Lacing wire is supplied in coils and is used to assemble and interconnect the units, and for facing support. Refer to Table 1 for the correct lacing wire to match the gabion coating.

GABION	LACING WIRE
Zn-Al Gabion	Zn-Al lacing wire
Zn-Al/PVC Gabions	Zn-Al/PVC lacing wire

Table 1 - Lacing wire type

RING FASTENERS

To increase the installation productivity, steel ring fasteners are used to connect units and to close and secure filled gabions (Fig 1).

Fig. 1 - Fastening Rings

The rings comply with EN 10223-3 and are supplied in box (1600 rings/box); these rings are available Zn/Al coated for use with the corresponding type of material, or stainless steel for use with polymer coated mesh. The indicative quantity of rings depends on the size of the gabion units (Table 2).

GABIONS	RINGS
H = 1 m with diaphragms	30-40 /m³
H = 1 m without diaphragms	30-40 /m³
H = 0.5 m	40-60 /m³

Table 2 – Suggested number of rings

GABION ROCK

Rocks should be hard, angular to round, durable and of such quality that they do not lose their integrity on exposure to water or weathering during the life of the structure. Rocks range between 100 mm and 200 mm for 8 x 10 wire mesh gabions. The range in sizes may allow for a variation of 5% oversize and/or 5% undersize rock, provided it is not placed on the exposed surface. In all cases, the oversize rock must not be larger than 250 mm and the undersize rock shall not be smaller than 50mm.

GEOTEXTILE

Bidim non-woven geotextile to be placed at the soil-gabion interface for separation and filtration purposes. Ensure that the correct type, grade and quantity is delivered to the site.

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TOOLS

To aid the lacing and bracing operations, the use of pliers to achieve tight joints is recommended. Care needs to be taken to avoid damaging to the wire coating. The teeth of the pliers should be ground to a smooth finish. Do not use fencing pliers as they damage the polymer coating.

Care must be taken when using crowbars for closing the lids as this also damages the coating. Specialist lid closing tools can be supplied (Fig 2).

Fig. 2 – Lid closing tool

Pneumatic lacing tool shown in Fig 3 is suitable for lacing with Zn-Al or stainless-steel rings. Pneumatic lacing tool is to be connected to an air compressor using an air pipe (max 10 mm and max length 30 m).

The air compressor regulator should be set at 100 to 105 psi (690 to 720 kPa). Never operate above 115 psi (795 kPa). A 15 CFM air compressor is capable of a minimum delivery of 10 CFM with an air tank capacity of at least 48 litres.

Fig. 3 – Pneumatic lacing tool

REQUIRED MACHINERY FOR INSTALLATION

Gabions – The individual units can be transported by a minimum of two workers. Unloading from trucks is to be carried out with mechanical equipment (telehandler etc.) The rock filling of the gabions is to be carried out with the help of an excavator of a mass and arm length to suit the construction site configuration.

Backfilling – Backfill soil should be transported by trucks and unloaded with the help of an excavator. The choice of the machinery is left to the contractor as it depends on the condition of access to the site and the volume of soil fill. It is strictly prohibited to use the heavyweight machinery close to the facing (within 1 m from the facing).

Compaction – Vibratory rollers of adequate dimensions are to be used for compaction of the filling material. For uniformly distributed fine sand, it is suggested using non vibrating rollers. For the compaction of the backfill soil close to the facing, within a minimum width of 1 m, lightweight handheld compaction devices, such as vibratory plate compactors and small vibratory rollers shall be used.

INSTALLATION

FOUNDATION PREPARATION

The foundation on which gabions are to be placed should be levelled, and graded to the elevations as shown on the project construction drawings (Fig 4).

The foundation for gabions is to be smooth, and free from surface irregularities, loose material and vegetation, in accordance with the project specifications.

To ease the construction of battered walls the foundation should be sloped at a maximum of 6 degrees.

The foundation should be compacted to the engineer's specification to ensure uniform bearing capacity and minimize differential settlements. When founding on a rock, a concrete levelling pad and dowel anchors are recommended.

Fig. 4 – Prepared foundation

SETTING OUT

Points marked should be start of the wall, end of wall and any internal/ external angle changes or steps. Points required to be marked out must be at the front of the toe wall i.e. front base of wall at top of foundation level.

FLATTENING THE UNITS

Workers should ensure to have a safe open and level area adequate for opening the units. Each individual basket will be removed from the bundle; unfold the gabion flat on the ground and stretch the unit to remove all factory folds.

Fig. 5 – Flattening gabion

ASSEMBLY

Connect the back and the front panels of the gabion to the end panels and centre diaphragms. The top corner of the end panels and centre diaphragms have an extended selvedge wire extending approx. 100 mm out from the corner edge. Raise the end panels and the diaphragms to a vertical position and wrap the selvedge wire around the edge wire of the top and back panels.

Note: it is essential that the top corners meet (Fig 6).

Fig. 6 – Raising panels into position

Connect the edges of the diaphragms to the gabion by using lacing wire or rings (Fig 7). The procedure for using lacing wire consists of cutting a sufficient length of wire, and first looping and/or twisting the lacing wire to the wire mesh. Proceed to lace with alternating double and single loops through every mesh opening approximately every 150 mm pulling each loop tight and finally securing the end of the lacing wire to the wire mesh by looping and/or twisting (Fig 8). The use of pliers is normally recommended to aid assembly and wiring of the units using the binding wire supplied with the gabions.

Higher installation productivity rates can be achieved when fastening with steel rings. Rings must be installed at the top and the bottom connections of the end and centre diaphragms and then a maximum spacing of 200 mm along all edges shall be used (Fig 8).

Fig. 7 – Connecting diaphragm

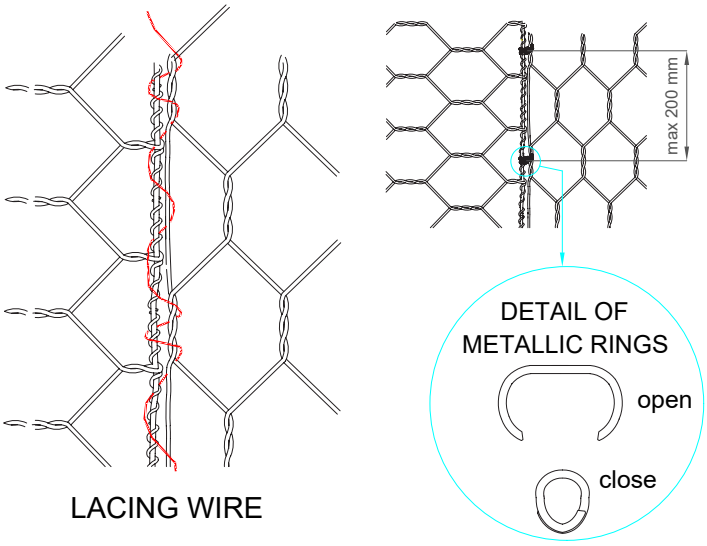


Fig. 8 – Lacing methodology

PLACING THE UNITS

After the foundation has been prepared, the pre-assembled gabions are placed in their proper location to form the structure. Gabions should be connected together using the lacing procedure described above and aligned before filling the baskets with rock.

Note 1: All gabion units to be laced to each other on all contact surfaces. Each layer gabion must be securely laced to the gabion layer below.

Note 2: During the installation procedure, it is of fundamental importance to assure that the gabion's layout and the orientation/ positioning of their lids allow an easy access to the worker or the frontal loader for the filling procedure to improve the installation productivity (Fig 9).

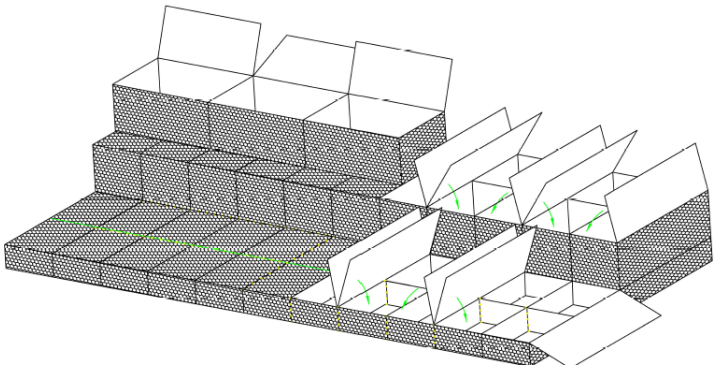


Fig 9 – Gabion orientation

FILLING AND BRACING THE GABIONS

Rocks for gabions may be produced by any suitable quarrying method, that yields the required sizes within the gradation limits chosen. Fill each gabion in 1/3 layers, inserting cross bracing between layers. Use at least four cross bracing wires per square metre of the front face, positioned at 1/3 and 2/3 the depth for 1 m high gabions, and at 0.25 m for 0.5 m units (Fig 10).

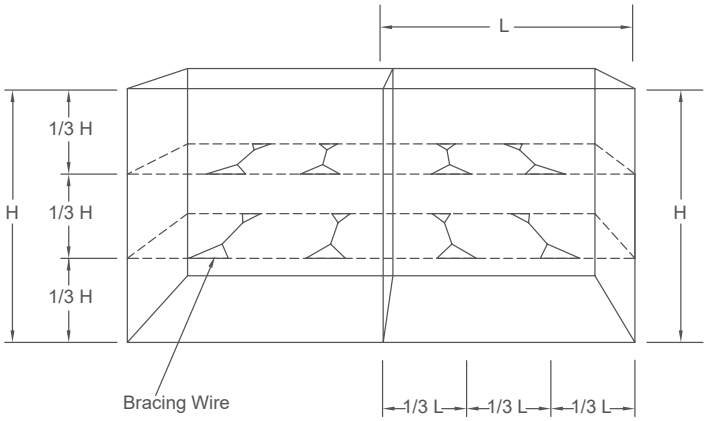


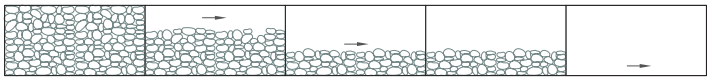
Fig. 10 – Gabion bracing

Each brace requires 2 full turns of binding wire (approx. 2.3–2.7 m for 1m wide, 3.3–3.7 m for 1.5m units) or preformed braces. Loop the wire through two mesh openings front and back, and twist in the centre. Tension by twisting with pliers or a stone until the front face aligns. (Fig 11)

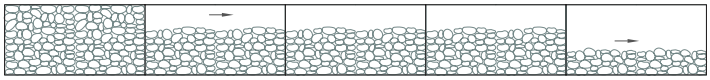
Fig. 11 – Installing bracing wire

When installing multiple gabions in a row, fill all cells (except the last) to 1/3 height, brace, then fill to 2/3, brace again, and finally fill to the top. The cells are filled in stages so that local deformation may be avoided. At no time, should any cell be filled to a depth exceeding 0.3 m higher than the adjoining cell (Fig 12). Care must be taken when placing the stone to assure that the wire coating will not be damaged.

PHASE 1



PHASE 2



PHASE 3

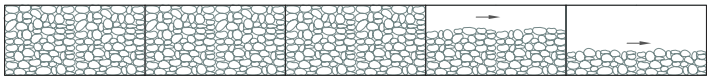


Fig. 12 – Filling of cells with stone

During the filling operation some manual stone placement is required to minimise voids. The exposed faces of vertical structures may be carefully hand placed to give a neat, flat, and compact appearance (Fig 13). Overfill gabions by 25–50 mm to allow for settlement, keeping the diaphragm edge visible for lid lacing.

Fig. 13 – Hand stacking stone in front face

CLOSING

Fold the lid down, pull the edges of the panels to be connected where necessary using appropriate tool as a lid closer. The lids must be tightly laced along all edges, ends and diaphragms in the same manner as described for assembling . Adjacent lids may be securely attached simultaneously (Fig 14). All end wires should then be turned in.

Fig. 14 – Lid closing

BACKFILLING

Compaction of backfill must be done simultaneously with every row of gabions laid. Care must be taken not to damage the geotextile when placing and compacting the backfill. Heavy compaction equipment (>1500 kg) must not come within 1.0 m of the gabion basket: small handheld compaction equipment may be used adjacent to the gabion basket.

TOLERANCES

Care should be taken to ensure that predicted construction and design life deformations will meet specified tolerances. For gabions structures reference can be made on the standard EN 14475 “Execution of special geotechnical works” (table C.9), considering the limits specified for reinforced soil structures having gabion baskets as facing elements (Table 3).

	TOLERANCE
Alignment	± 100 mm
Longitudinal differential settlement	2 %
Compressibility	5 %

Table 3: Construction tolerances

INSTALLATION PRODUCTIVITY

The installation productivity is dependent on volume, geometry and access to working area.

By making reference to a typical 5 men working team (1 foreman, 1 backhoe loader operator, 3 workers) operating 8 hours a day, the following rates can be assumed for gabions with only 1 side facing (including the stone filling):

GABIONS HEIGHT (M)	UNITS	CREW	AVERAGE PRODUCTIVITY PER CREW	
			MINIMUM UNIT DAY CREW	MAXIMUM UNIT DAY CREW
1	m^3	5	40	50
0.5	m^3	5	30	40