



Standard Practice for Assembly and Placement of Double-Twisted Wire Mesh Gabions and Revet Mattresses¹

This standard is issued under the fixed designation D 7014; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers standard practice for assembly, placement and filling of double-twisted wire mesh gabions and revet mattresses used for various erosion control, soil retention or freestanding structures. The product size, type and alignment must be determined by the user. Gabions and Revet Mattresses shall be installed in accordance with project plans and specifications when available.

1.2 This standard is expressed in SI (metric) units. American (inch-pound) units are provided in parenthesis for information purposes.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

A 975 Specification for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire With Polyvinyl Chloride (PVC) Coating)

D 6711 Practice For Specifying Rock to Fill Gabions, Revet Mattresses, and Gabions Mattresses

2.2 AASHTO Standard:

AASHTO M288 Geotextile Specification for Highway Application³

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

¹ This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.25.05 on Gabions and Mattresses.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001.

3.1.1 *gabion, n*—a wire mesh container of variable sizes, uniformly partitioned into internal cells, interconnected with other similar units, and filled with stone at the project site to form flexible, permeable, monolithic structures such as retaining walls, sea walls, channel linings, revetments and weirs for erosion control projects.

3.1.2 *revet mattress, n*—a double-twisted wire mesh container uniformly partitioned into internal cells with relatively small height in relation to other dimensions, having smaller mesh openings than the mesh used for gabions: revet mattresses are generally used for river bank protection and channel linings.

3.1.3 *double-twisted wire mesh, n*—a non raveling mesh made by twisting continuous pairs of wires through three one half ($\frac{1}{2}$) turns (commonly called double-twisted) which are then interconnected to adjacent wires to form hexagonal-shaped openings.

3.1.4 *selvedge wire, n*—a terminal wire used to edge the wire mesh perpendicular to the double twist by mechanically wrapping the mesh wires around it at least 2.5 times or by inserting it through the twists and folding one mesh length.

3.1.5 *edge wire, n*—a terminal wire used to edge the wire mesh parallel to the double twist by continuously weaving it into the wire mesh.

3.1.6 *lacing wire, n*—for gabions and revet mattresses, a metallic coated steel wire or metallic coated steel wire with PVC coating used to assemble and interconnect empty units, to close and secure stone filled units and for internal stiffeners.

3.1.7 *fastener, n*—an alternate connector to lacing wire, used for binding operations for gabions and revet mattresses.

3.1.8 *stiffener, n*—for gabions, a length of metallic coated steel wire or metallic coated steel wire with PVC coating used for support of facing by connecting the front panel to the back panel of a gabion (stiffener formed at the project site using wire having the same diameter as for the lacing wire) or across the corners of a gabion cell (pre-formed stiffener as specified in Specification A 975).

4. Significance and Use

4.1 Gabions and Revet Mattresses, as described in Specification A 975, are used to achieve soil stability and prevent soil erosion and are also used as retaining wall structures to resist

movements due to gravity. Their ability to function properly depends on correct design and installation. This standard practice describes the proper installation of gabions and revet mattresses to ensure the products function as intended by the manufacturers.

4.2 This practice offers a set of instructions for performing one or more specific operations and does not replace professional judgment. Not all aspects of this practice may be applicable in all situations. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects.

5. Material Delivery

5.1 Gabions and revet mattresses are manufactured with all components mechanically connected at the production facility with the exception of the mattress lid, which is produced separately from the base, as per Specification A 975. All gabions and revet mattresses are supplied in the collapsed form, either folded and bundled or rolled, for shipping. The bundles are banded together at the factory for shipping and handling. Revet mattress bases and lids may be packed in separate bundles. Lacing wire is shipped in coils having a diameter approximately 0.60 m (2 ft). Fasteners are shipped in boxes. Preformed stiffeners are shipped in bundles.

5.2 All gabions and revet mattresses shall be labeled to show their dimensions, the number of pieces, and the manufacturer's color code if applicable.

6. Assembly

6.1 *Gabions*—The folded units shall be taken out from the bundle and placed on a hard, flat surface. Gabions shall be

opened, unfolded and pressed out to their original shape (Fig. 1). Front, back and end panels shall be lifted to a vertical position to form an open box shape (Fig. 2). Panels shall be fastened together with the projecting heavier gauge selvedge wire by firmly wrapping the selvedge wire around the selvedge or edge wire of the intersecting panel or the back panel (Fig. 3). Inner diaphragm panels shall be lifted into a vertical position and secured in the same manner. All edges of the diaphragms and end panels shall be tied or fastened to the front and back of the gabion as specified in Section 7.

6.2 *Revet Mattresses*—The folded units shall be taken out from the bundle and placed on a hard, flat surface. Revet mattresses shall be opened, unfolded and pressed out to their original shape. Front, back and end panels shall be lifted to a vertical position to form an open box shape (Fig. 4). End flaps shall be folded and/or overlapped, as appropriate. All edges of the diaphragms and end panels shall be tied or fastened to the front and back of the mattress, as specified in Section 7.

7. Fastening Procedure

7.1 All gabions and revet mattresses must be fastened as specified in 7.2 and 7.3 at each step of construction. Initial assembly, tying of adjacent units along the contacting edges, tying of the lid to sides, tying of lid to top of diaphragms, and re-tying of cut gabions or revet mattresses.

7.2 When using tie wire, cut a piece of wire approximately 1.5 times the length of the edge to be tied. The maximum length of the edge to be tied at one time shall not exceed 1 m (or 3 ft). Longer edges shall be joined by several lengths of wire. Tie wires shall be secured around the selvedge wire or heavier edge wire, where present, by looping and twisting the lacing wire around itself. Proceed tying with alternate double and single loops. Double loops shall be made at intervals not

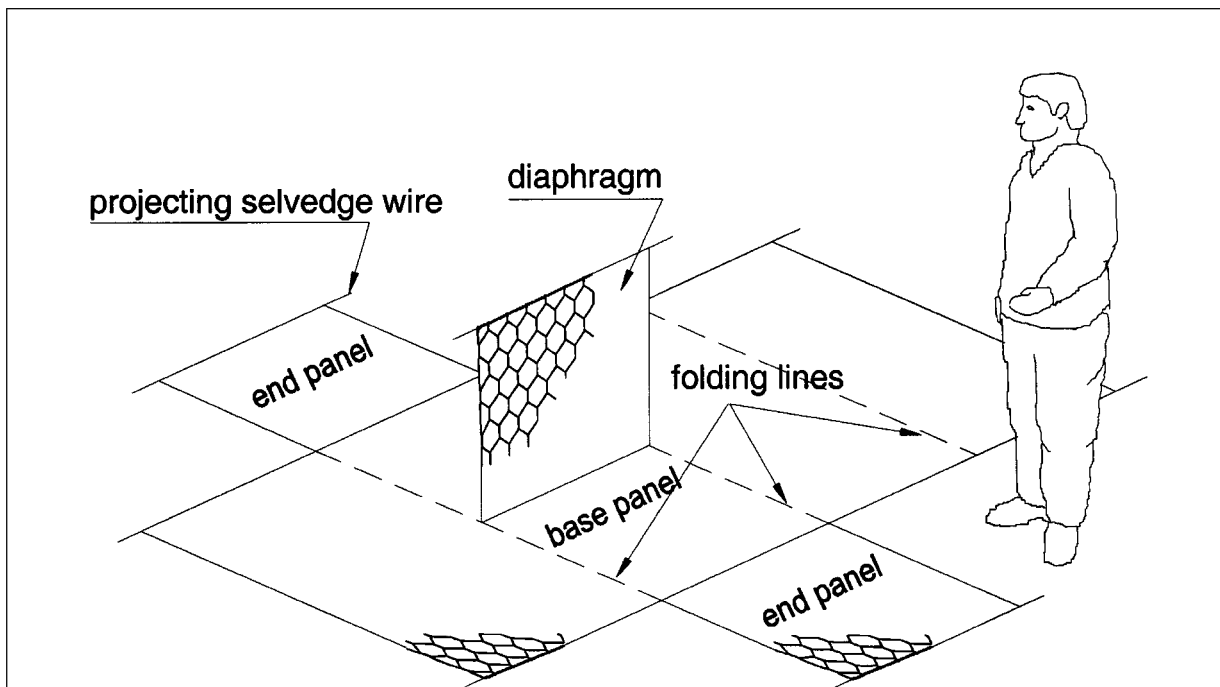


FIG. 1 Assembly—Gabions

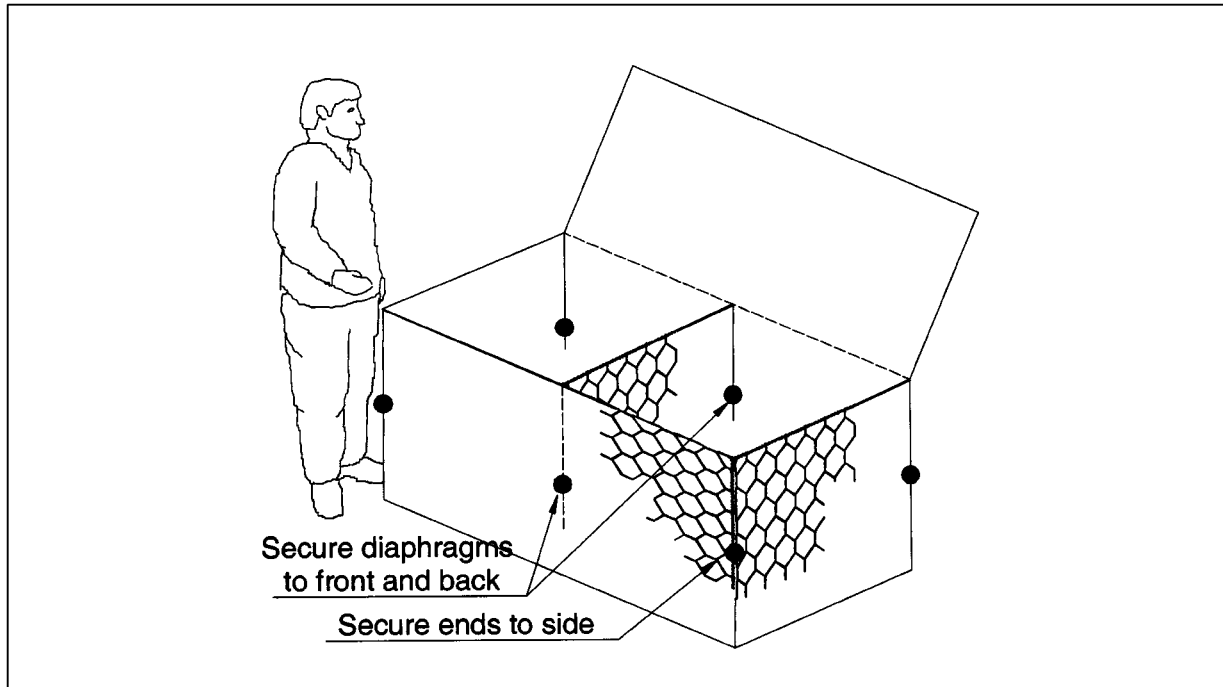


FIG. 2 Assembly—Gabions

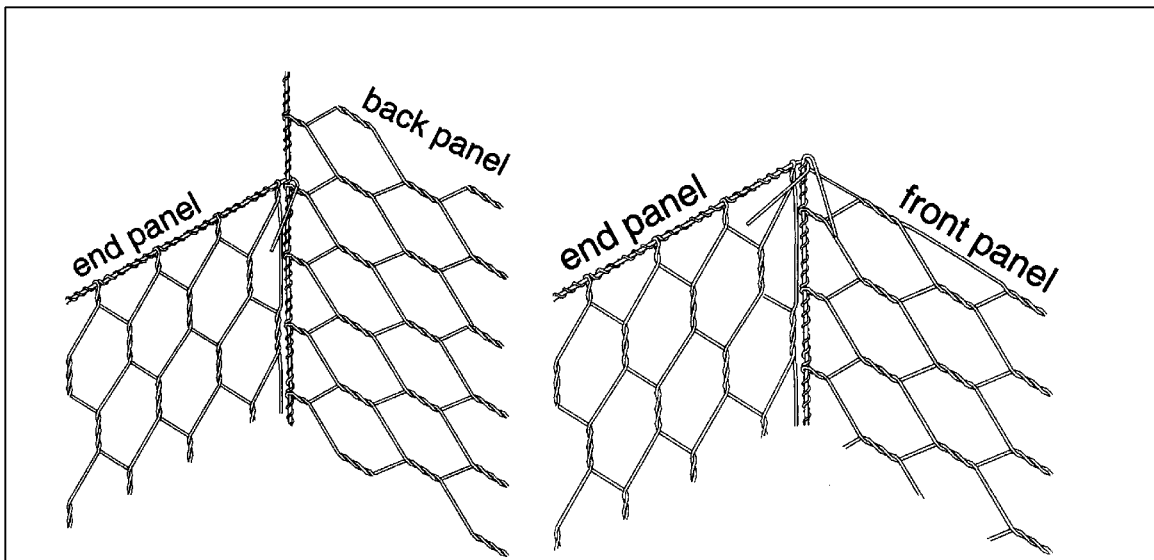


FIG. 3 Assembly—Gabions—Selvedge Connection End and Front Panel to Back Panel

greater than 0.10 m to 0.15 m (4 in to 6 in) (Fig. 5). The basket pieces should be pulled tightly together during the tying operation. The other end of the tie wire shall be secured again by looping and twisting the wire around itself. When using tie wire to assemble the units, pliers may be used to create tight joints. Care should be taken to avoid damaging the wire coating. Minimum requirements for panel to panel joint strength using tie wire shall be as specified in Specification A 975.

7.3 When steel wire ring fasteners are used, the use of either a mechanical or a pneumatic fastening tool is required. Rings shall be installed at the top and the bottom connections of the end and center diaphragms and then a maximum nominal spacing of 0.15 m (6 in.) along all edges shall be used (Fig. 5). Ring fasteners can be galvanized, stainless steel or Zinc-5 % aluminum-mischmetal alloy coated, depending on the type of wire specified in A 975, section 6.3. Minimum requirements for the panel to panel joint strength using ring fasteners, as well

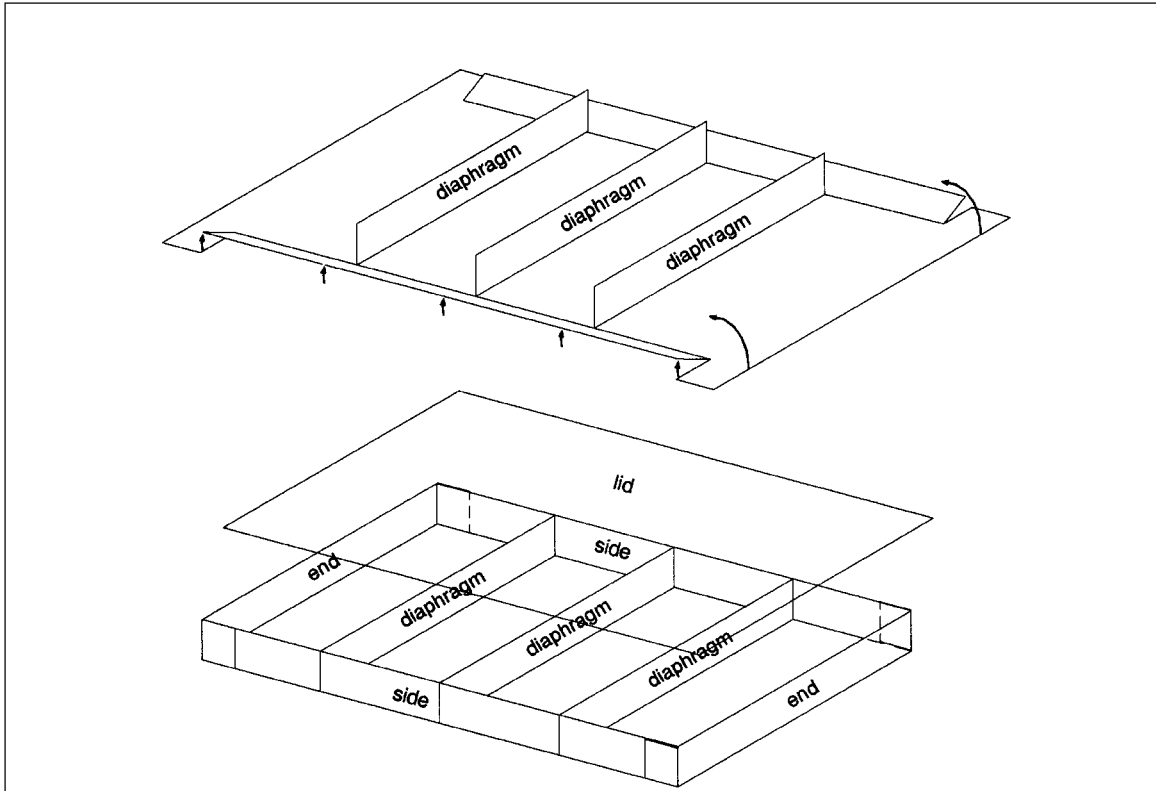


FIG. 4 Assembly—Revet Mattresses

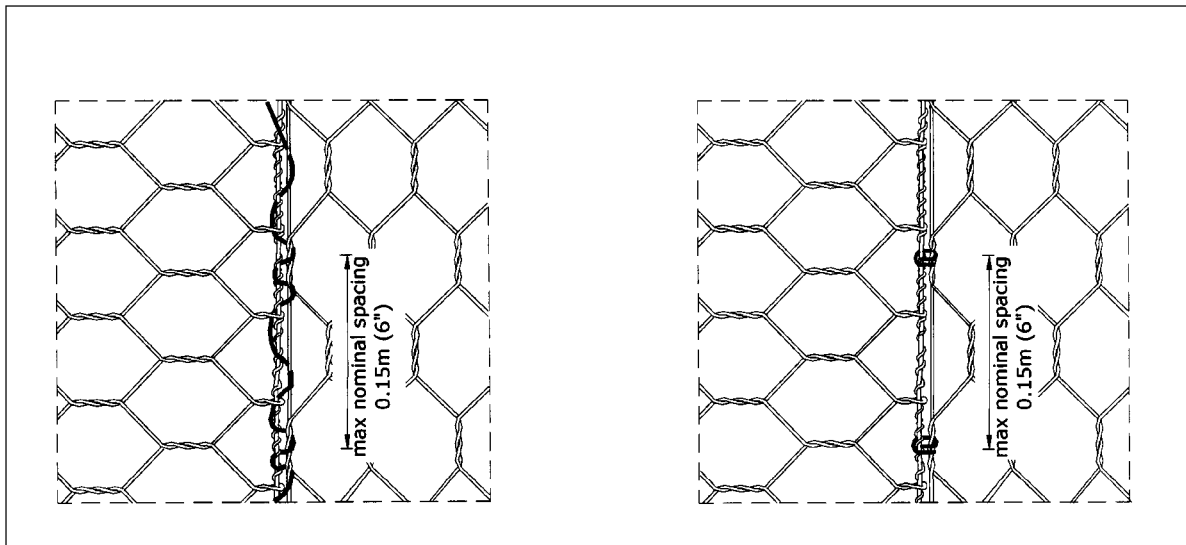


FIG. 5 Fastening Procedure—Connection Using Lacing Wire or Ring Fasteners

as the mechanical and physical characteristics of the ring fasteners shall be as specified in Specification A 975, section 7.2.

8. Foundation Preparation

8.1 The foundation on which the gabions are to be placed shall be level, and graded to the elevations as shown on the project construction drawings. The foundation for gabions and

revet mattress shall be level, smooth, and free of surface irregularities, loose material, and vegetation. Appropriate measures shall be taken for filtering and drainage of the foundation, (geotextile or graded aggregate filters, drain pipes, etc.). Geotextiles required to be installed behind or underneath gabion or revet mattress structures shall comply with the requirements in AASHTO M288 for subsurface drainage applications.

9. Installation and Filling

9.1 *Gabions*—After the foundation has been prepared, the pre-assembled gabions shall be placed in position empty, and shall be tied or fastened to adjacent gabions along all containing edges in order to form a continuously connected, monolithic structural unit. All connections shall be in accordance with Section 7. Gabions shall be placed front to front and back to back in order to expedite the stone filling and lid lacing operations (Fig. 6). Rock sizes shall be in accordance with Practice D 6711. Rocks shall be placed in 0.30 m (1 ft) lifts for 0.91 m (3 ft) or 1 m high gabions, and 0.23 m (9 in) lifts for 0.46 m (1.5 ft) or 0.50 m high gabions. The fill layer shall never be more than 0.30 m (1 ft) higher than any adjoining cell (Fig. 7). Care shall be taken when placing the stone to ensure that the PVC coating on gabions is not damaged. After a layer of rock has been placed in the cell, sufficient hand manipulation of the rock shall be performed to minimize voids and achieve a maximum density of rock in the gabion. The rock in exposed vertical faces shall be hand placed to reduce voids on the outer face. Stiffeners or internal cross ties shall be installed as indicated (Figs. 8 and 9), connecting the front and back faces of any supported or exposed face at the vertical third points for a gabion 0.91 m (3 ft) or 1 m high, as the cell is being filled. Gabion units installed at the wall ends, having two exposed sides, shall also include a set of cross ties installed perpendicularly to the lateral exposed face. For 0.3 m (1 ft) or 0.46 m (1.5 ft) high baskets when used as revetment, stiffeners or internal cross ties are not required. When more than one vertical layer of gabions is installed, units shall be overfilled to approximately 0.025 m (1 in) to 0.04 m (1.5 in) to allow for natural settlement. The top surface shall be smoothly leveled, minimizing voids. Ensure that diaphragm tops are accessible for connecting.

9.2 *Revet Mattresses*—The pre-assembled revet mattresses shall be placed in position empty and shall be tied or fastened to adjacent revet mattresses along all contacting edges in order

to form a continuously connected monolithic structural unit. On slopes, the mattress shall be laid with the width perpendicular to the slope, except for very small channels. Mattresses shall be placed and securely attached while empty. All connections shall be in accordance with Section 7. Where mattresses are to be placed on steep slopes (1.5 Horizontal to 1 Vertical or steeper), the unit may be secured by anchoring systems (hardwood pegs, galvanized pipes, steel bars, etc.) driven into the ground just below the upper end panel. Diameter, location and the length of the anchoring system shall be established by the engineer based on the slope, mesh opening and strength, mattress height or as specified in the project specifications. Rock sizes shall be in accordance with Practice D 6711. Mattresses can be filled by any suitable appropriate size machine, such as a backhoe, crane, etc. Care shall be taken when placing the stone to ensure that the PVC coating on mattresses is not damaged. Sufficient hand manipulation of the rock shall be performed to minimize voids and result in a maximum density of rock in the mattress. Filling shall be done unit by unit, but several units shall be ready for filling at any one time. Ensure that the diaphragm tops are accessible for wiring. Securely attach the lids to the ends of the mattresses and then securely attach them to the sides and diaphragms, using alternate double and single loops, or steel wire ring fasteners. Adjacent lids can be securely attached in one operation. In cases where a number of adjacent bases are to be covered simultaneously, rolls of mesh can be used in place of unit size lids.

9.3 *Non-rectangular Shapes and Special Adaptation*—Where a complete gabion or revet mattress cannot be installed because of space limitations, the basket unit shall be cut, folded or overlapped, and securely connected as specified in Section 7 to suit existing site conditions. Gabion and revet mattresses can conform to bends up to a radius of 18 m to 21 m (60 ft to 70 ft) without alterations. The units shall be securely

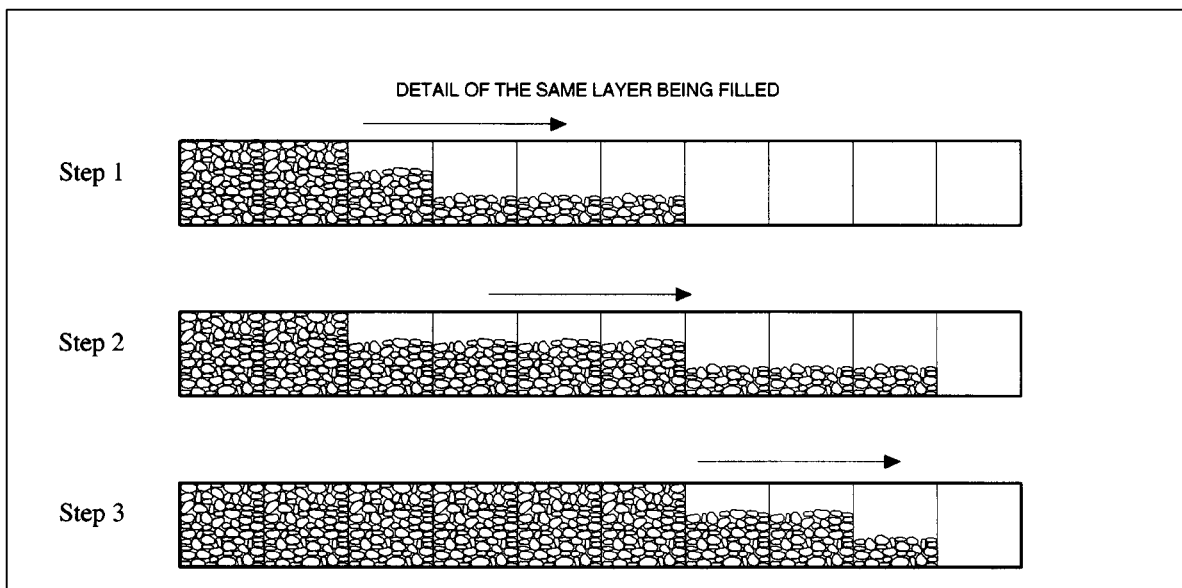


FIG. 6 Installation and Filling—Gabions

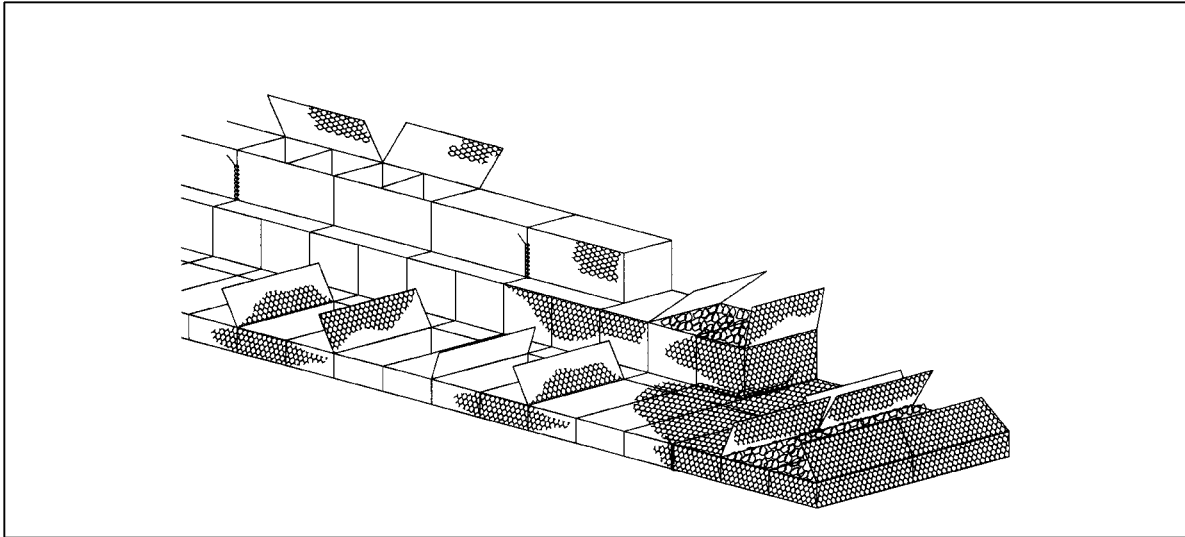


FIG. 7 Installation and Filling—Gabions

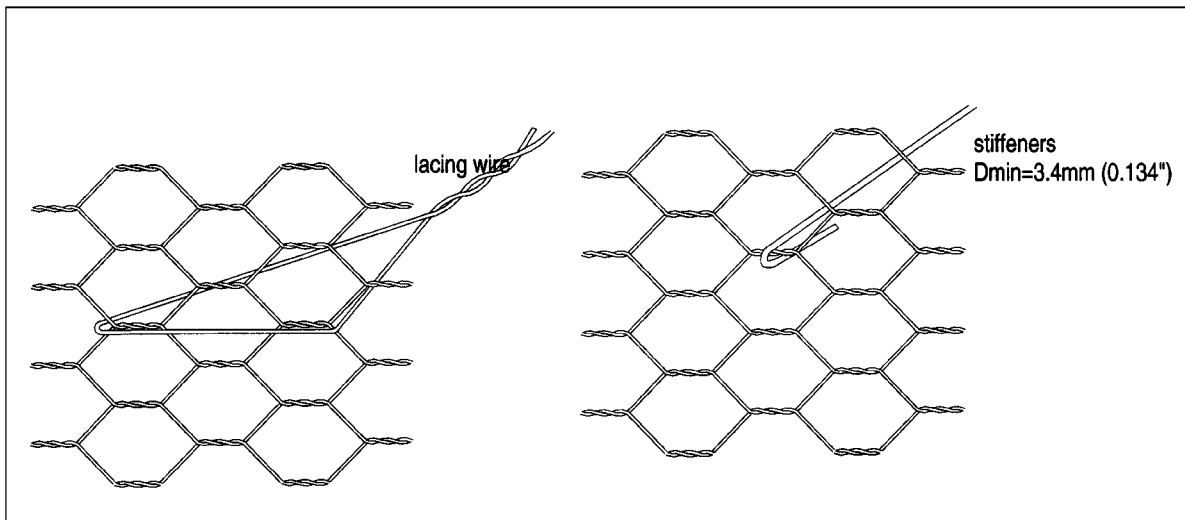


FIG. 8 Installation and Filling—Gabions—Cross Ties

connected as specified in Section 7, and shall be placed to the required curvature for filling. Gabions may be cut to form curves or bevels. All modified gabions shall form a closed cell when completed. Excess mesh wire shall be cut off or tightly and neatly tied down. Care shall be taken that all projecting wires are turned inward or cut off.

10. Closing

10.1 *Gabions*—After the rock has been leveled and voids have been minimized, fold the lid down and pull edges of the panels together. It should require a light stretching using an appropriate closing tool or lid closer in order to bring the two gabion pieces together. Care shall be taken that the mesh is not deformed or the coating on the wire damaged. The projecting selvedge wire of the lid shall be wrapped two complete turns

around the selvedge wire or edge wire on the sides. The lid shall be tightly tied along all edges, ends, and tops of diaphragms as specified in Section 7. Adjacent lids may be tied or attached simultaneously. All projecting sharp ends of wire shall be turned in on the completed gabion structure.

10.2 *Revet Mattresses*—After the rock has been leveled and the voids minimized, the lid shall be placed and tied or fastened along all edges, ends, and tops of diaphragms in the manner as specified in Section 7 (Figs. 10 and 11). Adjacent lids may be attached simultaneously. All projecting ends shall be turned in on the completed revet mattress structure.

11. Keywords

11.1 erosion control; gabions; lacing wire; lid closer; pre-formed cross ties; revet mattresses; ring fasteners; stiffeners

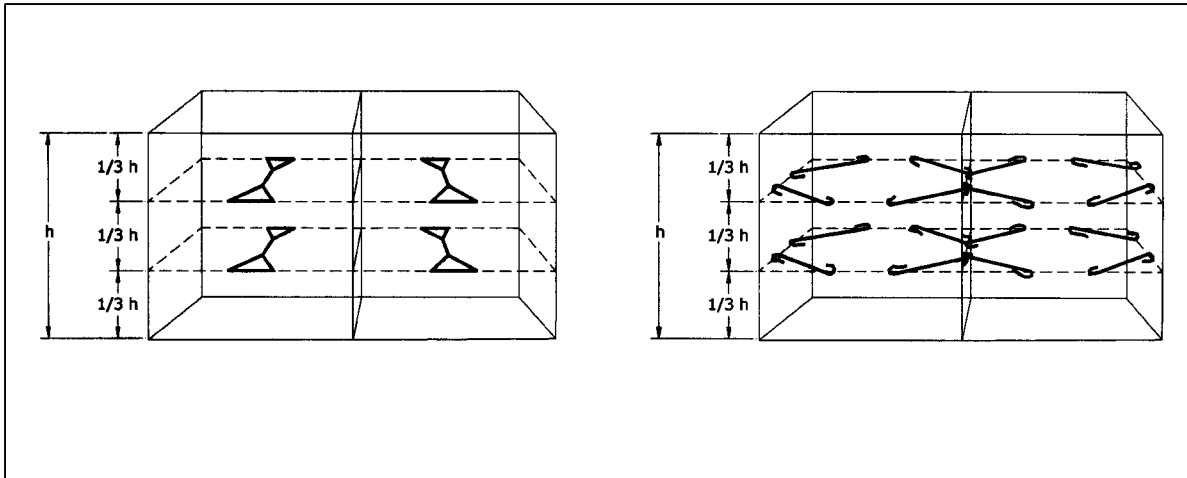


FIG. 9 Installation and Filling—Gabions—Cross Ties

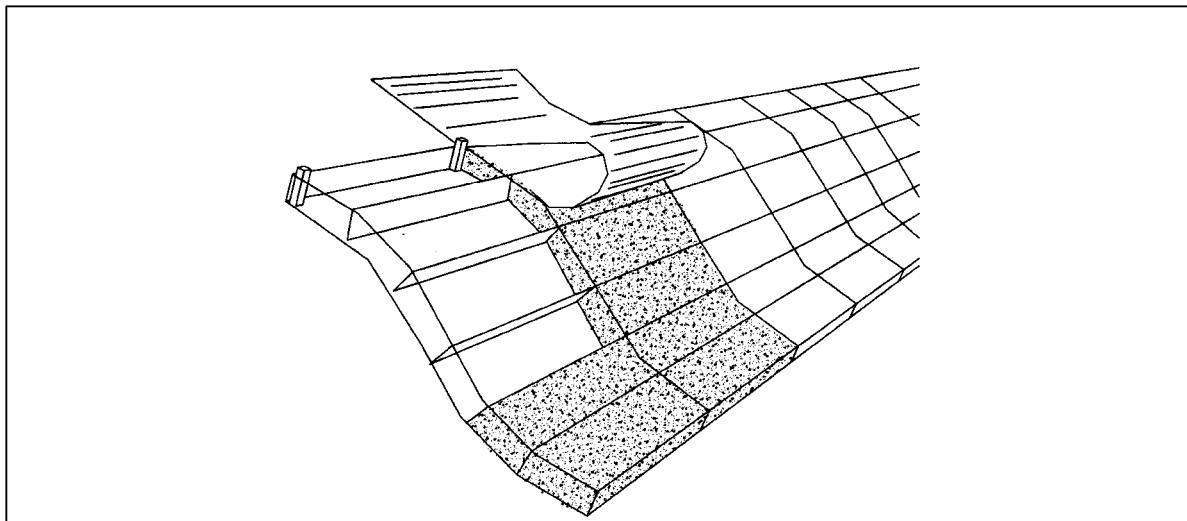


FIG. 10 Installation and Filling—Revet Mattresses—Lid Parallel to the Bank

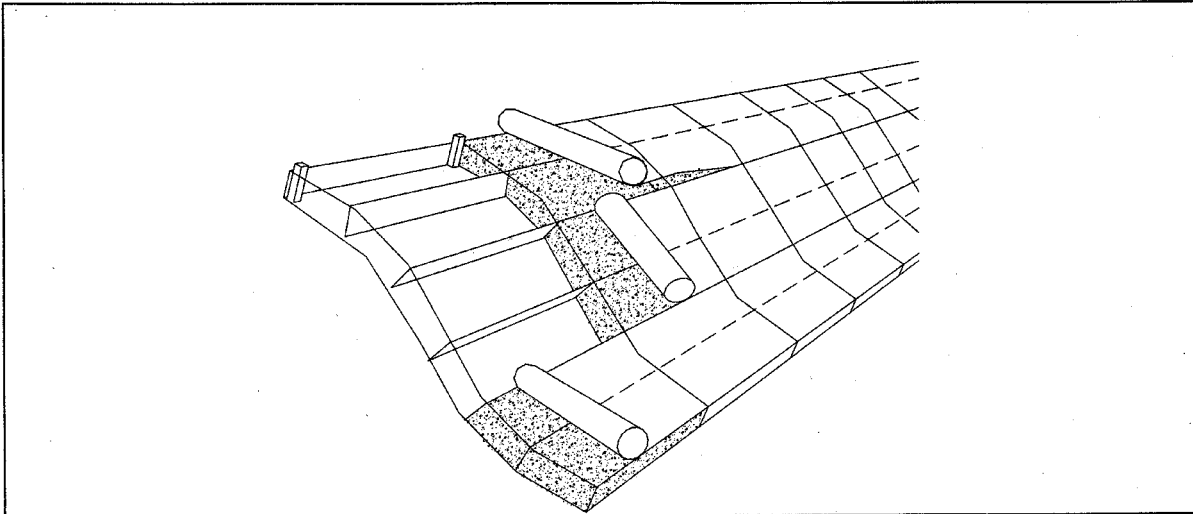


FIG. 11 Installation and Filling—Revet Mattresses—Lid Perpendicular to the Bank

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