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Gabion-Faced Reinforced Embankment Case study and Installation Considerations

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MACCAFERRI

TOPICS COVERED

- MSE Wall Definition
- MSE Wall Classification
- Introducing Gabion-Faced Reinforced Embankments
- Case Study
- Installation Process
- Questions

MSE WALL DEFINITION

2.1.1 MSE Walls

MSEW structures are cost-effective alternatives for most applications where reinforced concrete or gravity type walls have traditionally been used to retain soil. These include bridge abutments and wing walls, as well as areas where the right-of-way is restricted, such that an embankment or excavation with stable side slopes cannot be constructed. They are particularly suited to economical construction in steep-sided terrain, in ground subject to slope instability, or in areas where foundation soils are poor.

MSE walls offer significant technical and cost advantages over conventional reinforced concrete retaining structures at sites with poor foundation conditions. In such cases, the elimination of costs for foundation improvements such as piles and pile caps, that may be required for support of conventional structures, have resulted in cost savings of greater than 50 percent on completed projects.

Representative uses of MSE walls for various applications are shown in Figure 2-1.

Temporary MSE wall structures have been especially cost-effective for temporary detours necessary for highway reconstruction projects. Temporary MSE walls are used to support temporary roadway embankments and temporary bridge abutments, as illustrated in Figure 2-2. MSE walls are also used as temporary support of permanent roadway embankments for phased construction, an example is shown in Figure 2-3.

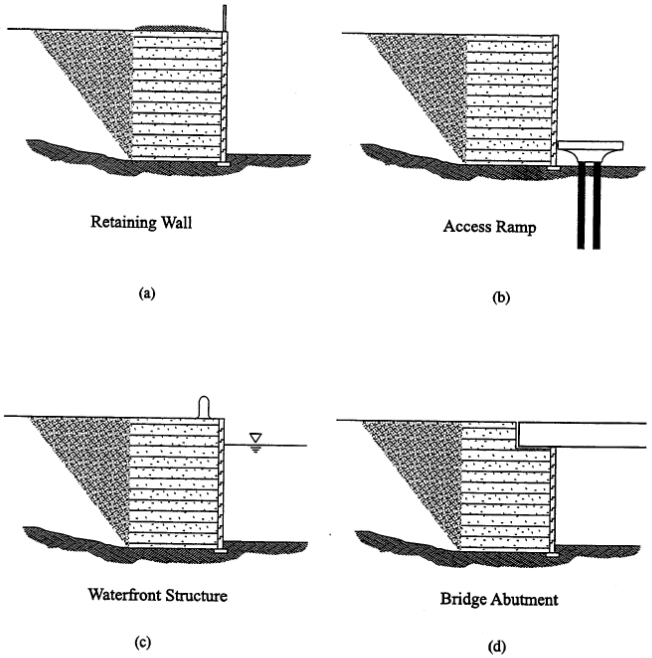


Figure 2-1. Representative MSE wall applications (a) retaining wall; (b) access ramp; (c) waterfront structure; and (d) bridge abutment.

Source: FHWA NHI-10-024, MSE Walls and RSS – Vol I, Page 2-1 and 2-2

MSE WALL ADVANTAGES AND POTENTIAL DISADVANTAGES

2.2.1 Advantages of Mechanically Stabilized Earth (MSE) Walls

MSE walls have many advantages compared with conventional reinforced concrete and concrete gravity retaining walls. MSE walls:

- Use simple and rapid construction procedures and do not require as large of construction equipment.
- Do not require special skills for construction.
- Require less site preparation than other alternatives.
- Need less space in front of the structure for construction operations.
- Reduce right-of-way acquisition.
- Do not need rigid, unyielding foundation support because MSE structures are tolerant to deformations.
- Are cost effective.
- Are technically feasible to heights in excess of 100 ft (30 m).

Pre-manufactured materials, rapid construction, and, competition among different proprietary systems has resulted in a cost reduction relative to traditional types of retaining walls. MSE walls are likely to be more economical than other wall systems for walls higher than about 10 ft (3 m) or where special foundations would be required for a conventional wall.

One of the greatest advantages of MSE walls is their flexibility and capability to tolerate deformations due to poor subsoil foundation conditions. Also, based on observations in seismically active zones, these structures have demonstrated a higher resistance to seismic loading than rigid concrete wall structures.

2.2.3 Potential Disadvantages

The following general potential disadvantages may be associated with all reinforced soil structures, and are dependent upon local and project conditions:

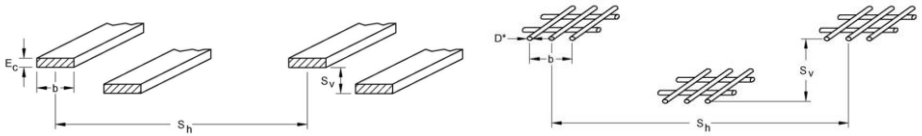
- Require a relatively large space (e.g., excavation if in a cut) behind the wall or slope face to install required reinforcement.
- MSE walls require the use of select granular fill. (At some sites, the cost of importing suitable fill material may render the system uneconomical.) Reinforced fill requirements for RSS are typically less restrictive.
- The design of soil-reinforced systems often requires a shared design responsibility between material suppliers and owners.

Source: FHWA NHI-10-024, MSE Walls and RSS – Vol I, Page 2-6 and 2-7

TYPES OF SYSTEMS

Reinforcement Geometry

- **Linear unidirectional**. Strips, including smooth or ribbed steel strips, or coated geosynthetic strips over a load-carrying fiber.
- **Composite unidirectional**. Grids or bar mats characterized by grid spacing greater than 6 in. (150 mm).
- **Planar bi-directional**. Continuous sheets of geosynthetics, welded wire mesh, and woven wire mesh. The mesh is characterized by element spacing of less than 6 in. (150 mm).



Reinforcement Material

Reinforcement Material Distinction can be made between the characteristics of metallic and nonmetallic reinforcements:

- **Metallic reinforcements**. Typically of mild steel. The steel is usually galvanized.
- **Nonmetallic reinforcements**. Generally polymeric materials consisting of polyester or polyethylene.

Figure 17 , Metallic Reinforcement (Inextensible). Left: metallic grid. Right: Ribbed Strips.

Source: FDOT MSEW INSPECTOR'S HANDBOOK

ParaWeb®

Reinforcement Extensibility

Reinforcement Extensibility There are two classes of extensibility relative to the soil's extensibility:

- **Inextensible**. The deformation of the reinforcement at failure is much less than the deformability of the soil. Steel strip and bar mat reinforcements are inextensible.
- **Extensible**. The deformation of the reinforcement at failure is comparable to or even greater than the deformability of the soil. Geogrid, geotextile, and woven steel wire mesh reinforcements are extensible.

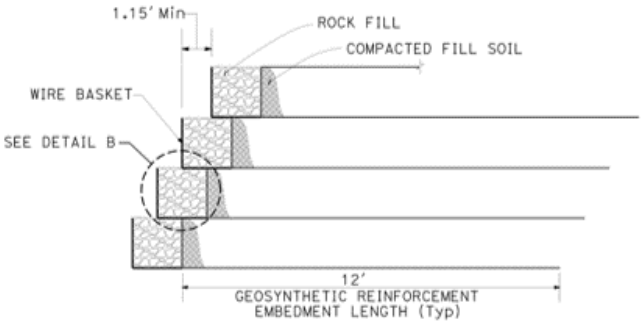
Source: FHWA NHI-10-024, MSE Walls and RSS – Vol I, Page 2-11

FACING SYSTEMS

Segmental precast concrete panels

Dry cast modular block wall (MBW) units

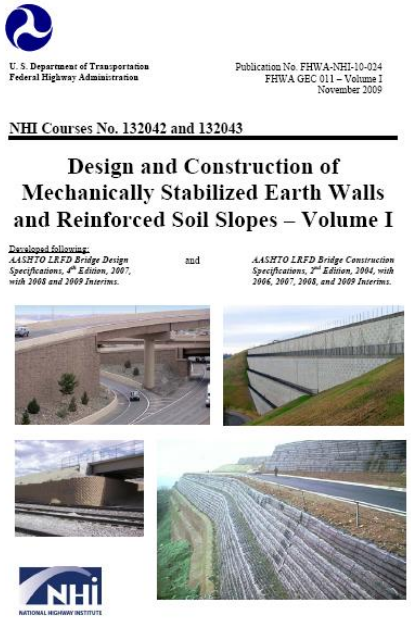
Gabion Facing



Weldel Wire Mesh (WWM)

Geosynthetic Facing

INTRODUCING GABION-FACED MSE WALL

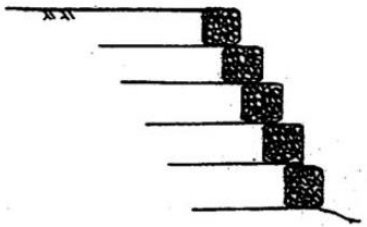

U. S. Department of Transportation
Federal Highway Administration

Publication No. FHWA-NHI-10-024
FHWA GEC 011 – Volume I
November 2009

NHI Courses No. 132042 and 132043

Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes – Volume I

Developed following:
AASHTO LRFD Bridge Design Specifications, 4th Edition, 2007, with 2008 and 2009 Interims. and *AASHTO LRFD Bridge Construction Specifications, 2nd Edition, 2004, with 2006, 2007, 2008, and 2009 Interims.*



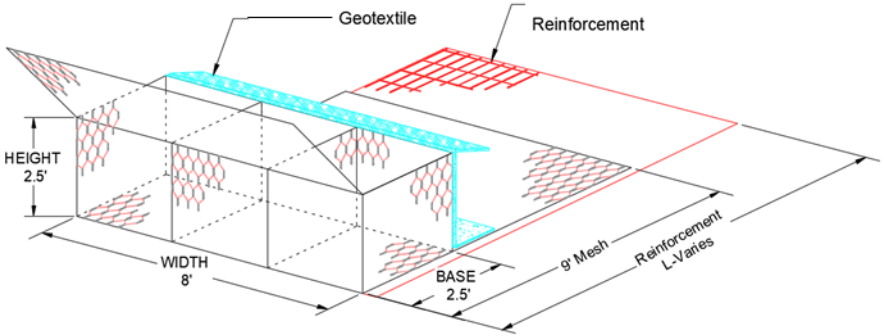
Gabion-Facing

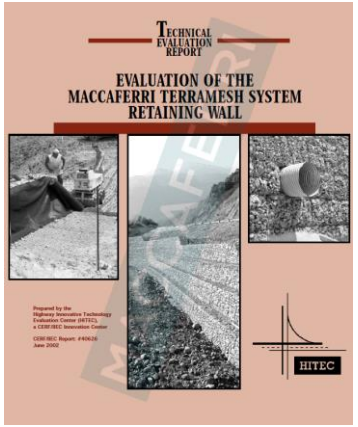
- **Gabion Facing**. Gabions (rock-filled wire baskets) can be used as MSE wall or RSS facing with reinforcing elements consisting of welded wire mesh, welded bar-mats, geogrids, geotextiles or the double-twisted woven mesh placed between or integrally manufactured with the gabion baskets. For example, this facing system is used by Maccaferri for their Terramesh® wall system.

Source: FHWA NHI-10-024, MSE Walls and RSS – Vol I, Page 2-15

INTRODUCING GABION-FACED MSE WALL

- **Terramesh® System** is a reinforced soil system with **gabion facia** and double twist wire mesh reinforcement
- Durability: **up to 75 years** as certified by **HITEC** evaluation report



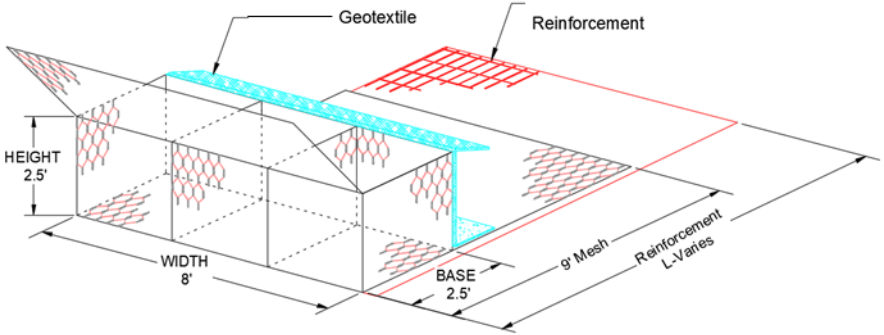


GABION-FACED MSE WALL - COMPONENTS

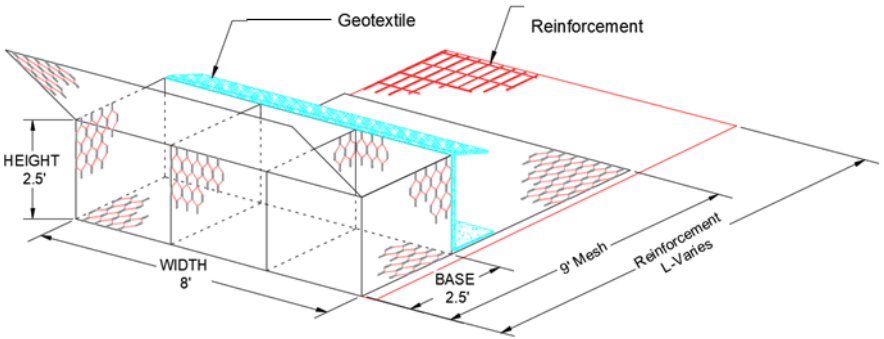
DT wire mesh unit

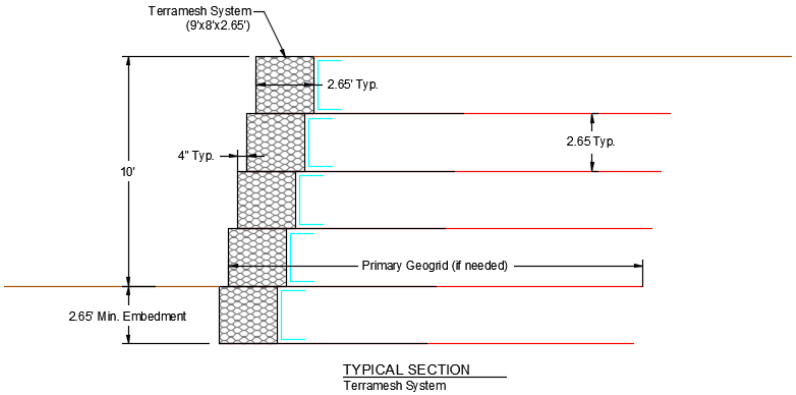
4” to 8” rock (100 mm – 200 mm)

ASSHTO M288 Class 3 Geotextile



CLASSIFICATION





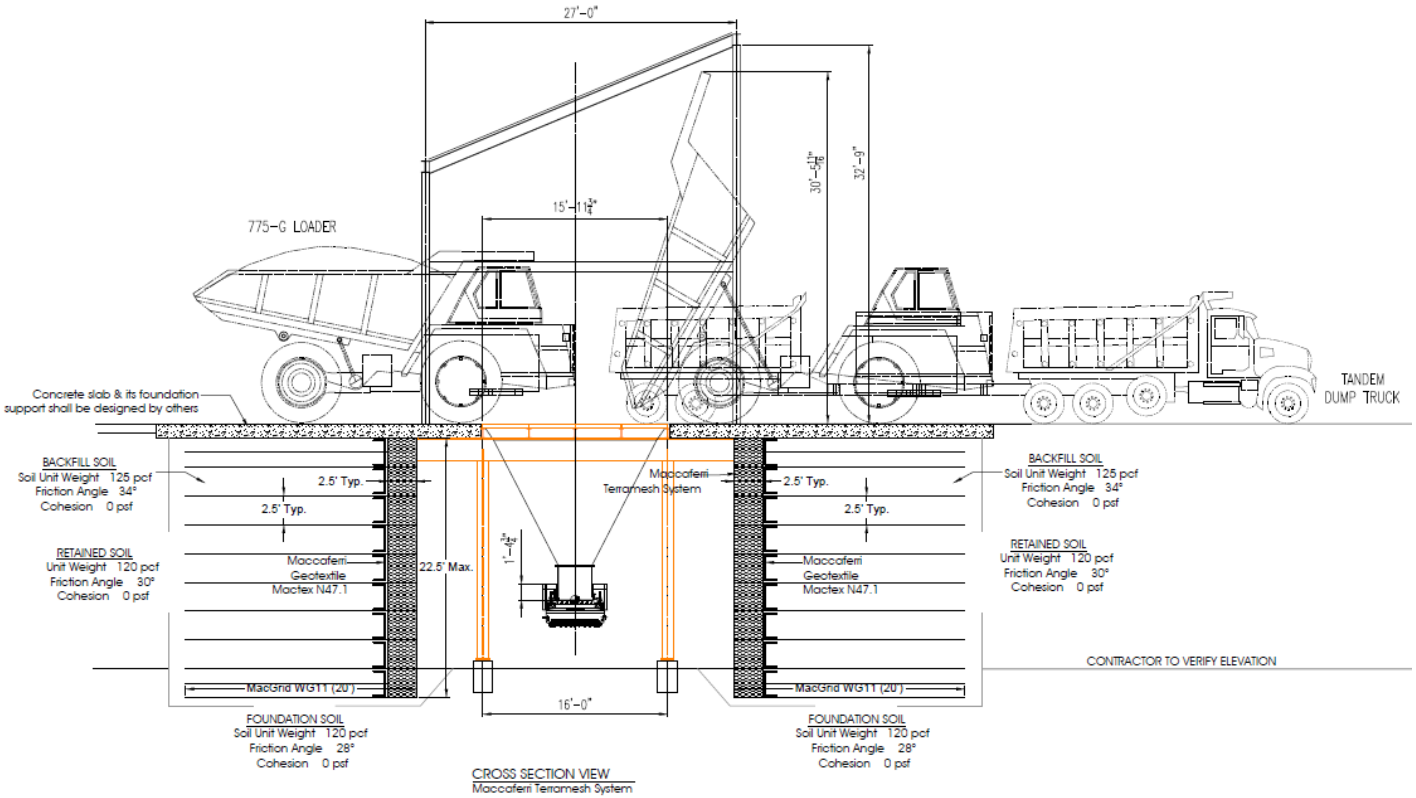
Reinforcement Geometry	**PLANAR BI-DIRECTIONAL (DT MESH)**
Reinforcement Material	**METALLIC REINFORCEMENT (DT MESH) + POLYMER COATING**
Reinforcement Extensibility	**EXTENSIBLE REINFORCEMENT**
Facing System	**GABION FACING**

MATERIAL SENT TO THE JOBSITE

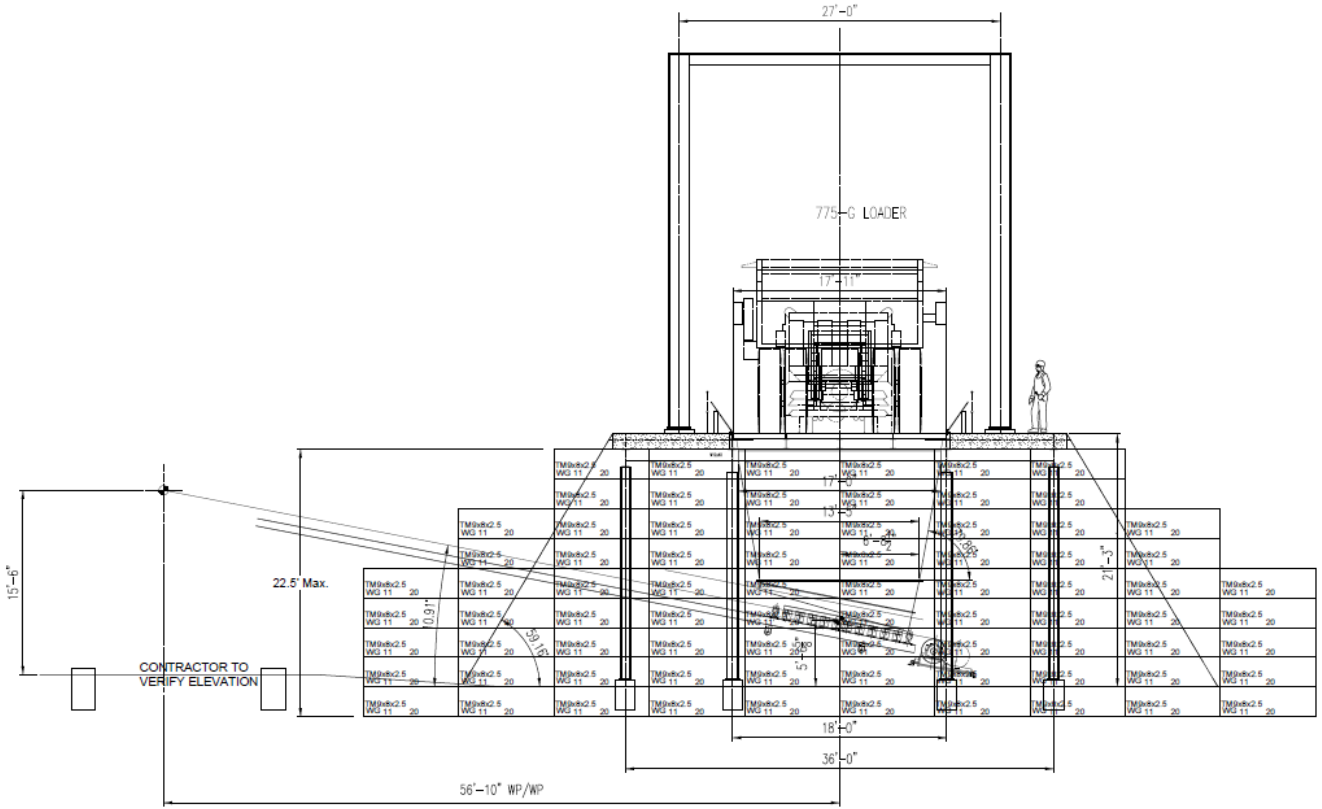
Terramesh® System is a pre-fabricated unit

The units are sent to the jobsite ready to be installed!

CASE STUDY IN NEBRASKA – PROJECT PLANS



CASE STUDY IN NEBRASKA – PROJECT PLANS



CASE STUDY IN NEBRASKA – MATERIAL RECEIVED IN THE JOBSITE

Terramesh® System Units

Primary Geogrid

Non-Woven Geotextile

UNLOAD UNITS FROM THE BUNDLE

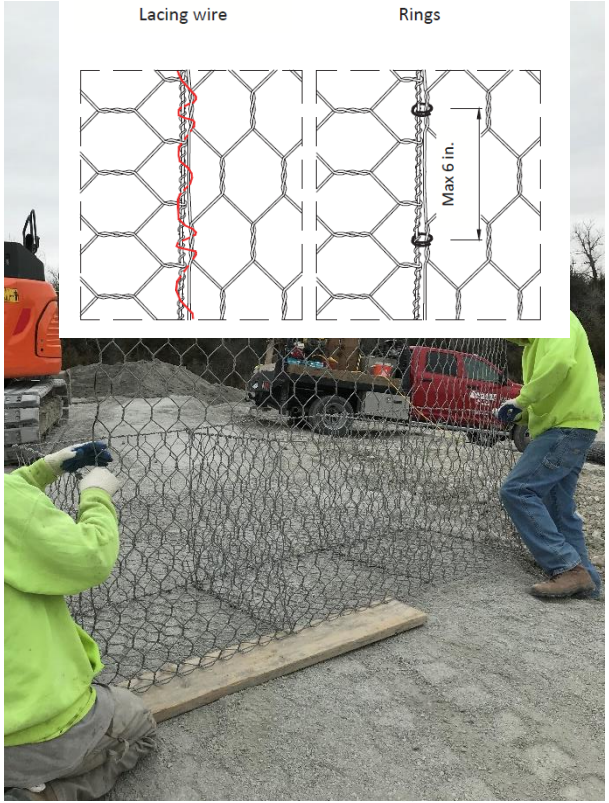
CUT GEOGRID TO REQUIRED LENGTH (CHECK DRAWINGS)

CUT GEOTEXTILE

3 rolls of 5’x300’

UNIT ASSEMBLY

UNIT ASSEMBLY



ASSEMBLED UNIT

GEOGRID PLACEMENT

UNIT PLACEMENT ON TOP OF THE GEOGRID

UNIT CONNECTION WITH ADJACENT UNITS

UNIT CONNECTION WITH ADJACENT UNITS

Fig. 10 – Placing of rings by pneumatic lacing gun to connect two adjacent wire mesh tails

SMALL LAYER TO STOP POSSIBLE GEOGRID MOVEMENT

GEOTEXTILE INSTALLATION

RECOMMENDED FRAME IN THE UNIT FACING

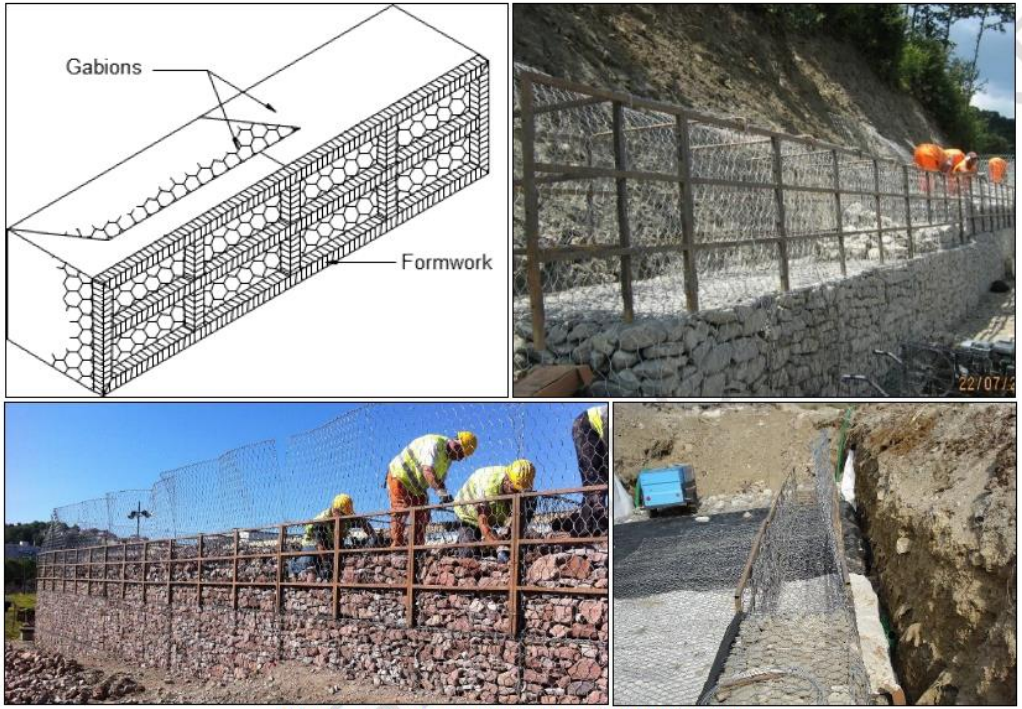


Fig. 16 – Use of a steel frame to avoid gabion bulging

ROCK INSTALLATION

ROCK INSTALLATION

Rock

Rock used in the gabion fascia section of a Terramesh unit shall be hard, angular to round, durable and of such quality that they shall not disintegrate on exposure to water or weathering during the life of the structure. The rocks shall range between 4 in (100 mm) and 8 in (200 mm). Each range of sizes may allow for a variation of 5% oversize rock by number of particles, or 5% undersize rock by number of particles, or both. The size of any oversize rock shall allow for the placement of minimum of three layers of rock must be achieved when filling the 2.5 feet (0.76 m) high Terramesh units.

INSTALLATION

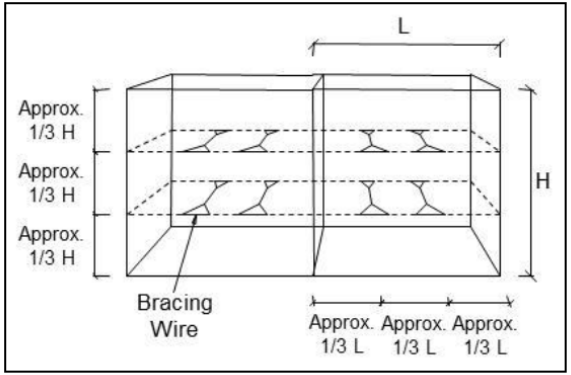


Fig. 17 – Bracing layout

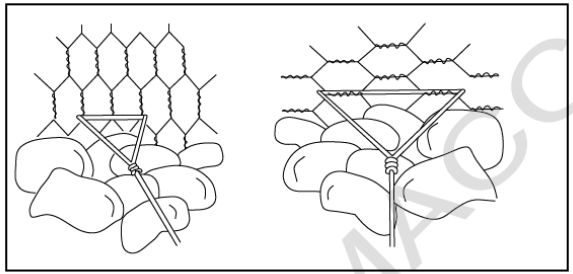


Fig. 18 – Detail on the mesh openings (minimum 2) to be braced

FILLING OPERATION DETAIL

The cells shall be filled in stages so that local deformation may be avoided. That is, at no time shall any cell be filled to a depth exceeding 1-ft (0.30 m) higher than the adjoining cell. It is also recommended to slightly overfill the baskets by 1 to 2 in (25 to 50 mm) to allow for settlement of the rock. See Fig. 5.

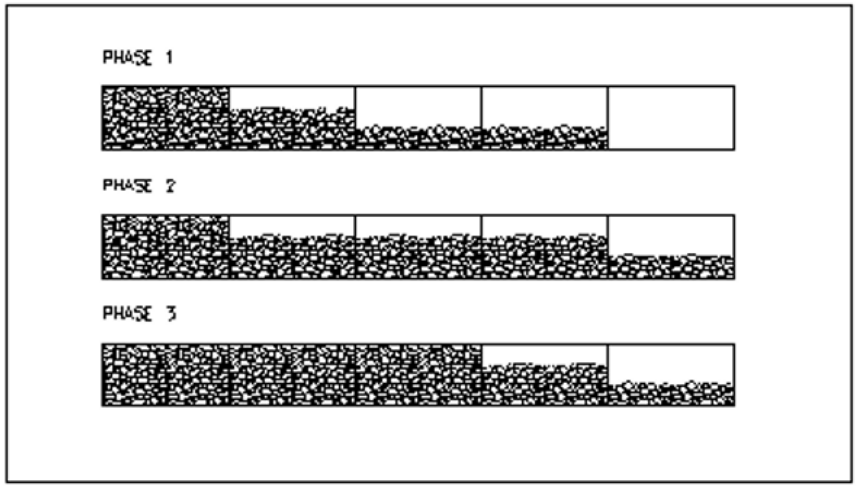


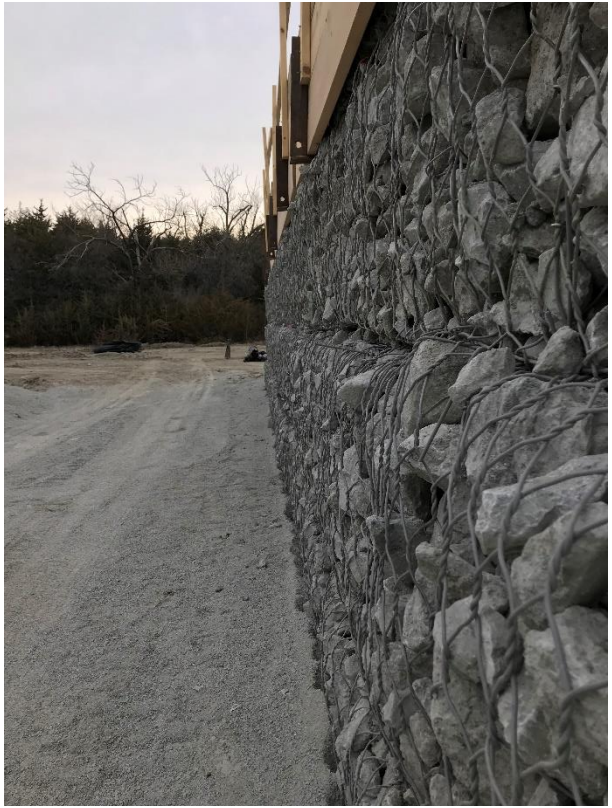
Fig. 5

BACKFILLING OPERATIONS

BACKFILLING OPERATIONS

CLOSING OPERATIONS

READY FOR NEXT LAYER



READY FOR NEXT LAYER

Thank you!! Questions???

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