Specification 310000
MSE RETAINING WALL REQUIREMENTS

1. General

This project requires installation of a mechanically stabilized earth retaining wall system to stabilize ground slopes along a portion of the Gruene Apple Bed and Breakfast Property in Gruene Texas. A concept design with relatively conservative assumptions on several geotechnical properties has been included in these plans and is to be utilized for preparation of bids. To confirm wall design and to facilitate Contractor submittal requirements, the Contractor will need to obtain site specific geotechnical information, report results to the Engineer, and provide a final design prior to installation signed and sealed by a Texas PE.

2. Proposed Wall system

The primary proposed wall system depicted on the plans and details is a mechanically stabilized soil system as provided by Maccaferri, Inc. This wall system is also depicted in cross sections. The typical wall system begins with excavation and installation of gabion baskets that are integrally connected with reinforcing panels of woven wire mesh that extend a sufficient distance into the excavation area such that after layering with structural fill these combine to provide a stable wall system. For this project, on the top of the gabion MSE units the Maccaferri Green TerraMesh system is added for slope protection along a 45 degree slope.

Incorporated into the wall system for this project is a maintenance access ramp with a minimum of 8 ft of width for maintenance equipment. Also, individual gabion units are required in addition to a gabion mattress (“Reno Mattress”) to provide a surface for the maintenance access route to be utilized at a future time.

3. Existing Features to Protect

Existing features shall be protected during installation of the wall system. Any property damaged during construction or as a result of the construction shall be repaired.

- Storm drain: At the center of the drain channel is a storm drain including junction boxes with manholes and an 84 inch diameter corrugated steel drainage culvert. At the end of this storm drain is a concrete impact stilling basin.
- A gabion wall system was installed downstream of the impact stilling basin, extending to the bank of the Guadalupe River.
- A grass lined channel along an existing drainage easement exists between Gruene Road and the Guadalupe River.
- A swimming pool is located west of the proposed MSE retaining wall. A fence extends around most of the pool. Mechanical equipment associated with the pool is located on a concrete pad just outside the fence.
- Trees exist along several portions of the work area. To the extent possible trees shall be protected.
4. Phasing Related to Wall Construction

a. See Section 7 for special phasing of this project.

b. The contractor shall facilitate obtaining geotechnical soil properties within the profile of the MSE wall system well in advance of any submittals or work related to the wall system.

c. The contractor is to report geotechnical values to the Engineer.

d. After approval, the Contractor shall coordinate with the structural engineer and where necessary make modifications to the proposed wall system to complete the wall system within the limits of the concept wall shown on the plans and within the bid amount. The contractor and structural engineer shall coordinate to assure adequate means are specified and utilized during the work to provide safe working conditions, to protect property and equipment, and facilitate efficient installation of the wall system.

e. The Contractor shall submit a wall design coordinated with all relevant project requirements, the contractor’s installation plan, geotechnical data obtained, wall manufacturer’s requirements and industry standards, bearing the seal of a Texas licensed professional engineer.

f. The first 5 layers of the MSE wall system are required to be installed first, beginning at station 10+00. Remaining layers of the MSE system, gabions, and the gabion ‘reno’ mattress will follow.

5. Geotechnical Data Requirement

a. The type of geotechnical information to be obtained by the Contractor shall be coordinated with the Contractors selected structural engineer and the wall system manufacturer. Standard information to obtain will be existing soil description, plastic limit, plasticity index, gradation, soil unit weight, dry weight, water content, presence of a phreatic surface, water table, internal angle of friction, cohesion, bearing strength, and undrained shear strength. Additional soil properties may be helpful or necessary to the Contractor, structural engineer, manufacturer and geotechnical engineer to facilitate wall design and potential reuse of native soils. Cost for obtaining geotechnical information shall be included in the available pay items for this project.

b. A minimum of two soil borings shall be obtained in the immediate area of the proposed wall. The depth of the bores shall be at least 30 feet below the lowest point of excavation to identify any slip plane materials and to fully describe the wall bearing area.

c. All geotechnical data will be provided to the Engineer via the Contractor in the form of a geotechnical data report signed and sealed by a geotechnical engineer.
6. **Submittal Requirement**

a. The following are general design requirements for retaining walls that will be shown on the Contractor’s submittal drawings.

b. Identify and detail any deviations from the concept wall design on plans, cross sections, details, and on technical specifications and any related components.

c. Design calculations for the wall system as proposed, indicating minimum safety factors for overturning, sliding and stability of temporary and permanent slopes. (Typical values are overturning 2.0, sliding 1.5, and temporary construction slopes 1.2, rotation stability analysis, 1.3).

d. Allowable foundation bearing pressure and design approach to comply.

e. As applicable to the submitted wall, internal design requirements for mechanically stabilized earth wall products, to include allowable reinforcement material stress (typically 0.55 FY for steel), safety factor against reinforcement pullout (typically 1.5) and allowable lateral deformation for the interpretation of laboratory pullout tests (typically ¾”). Also include allowable stresses as discussed in AASHTO *Standard Specifications For Highway Bridges* Division 1, Section 5, for tiebacks, inextensible and extensible reinforcement and soil nails when appropriate.

f. Surface loading allowable plus where applicable additional temporary construction loads.

g. Drainage features and other requirements beneath, behind, or through the retaining structure.

h. Backfill requirements for both within and behind the retaining structure.

i. Any other controls, specifications or conditions necessary for the proposed wall system.

j. The wall system must have a design life of at least 50 years.

k. A statement that ground conditions have been surveyed and verified by the contractor to be consistent with the submittal.

l. Installation drawings for the contractor shall be complete with location and elevation information for each wall component and based on the project baseline.

m. If any specialized software used for the submittal, explanation and description of the program shall be provided, including industry acceptance documentation.

The Contractor shall also demonstrate via submittal the method of installation of the proposed wall system, compliance with allowable exposure time, how existing slopes will be protected, protection measures to be employed for working in excavation areas, and any special temporary shoring required to stabilized slopes or infrastructure during the work.
7. **Specifications**

For the following specifications, refer to the plan sheets as shown below.

<table>
<thead>
<tr>
<th>Sheet(s)</th>
<th>Specification</th>
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<tbody>
<tr>
<td>14-27</td>
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</tr>
<tr>
<td>14, 26, 27</td>
<td>313613 - Gabion</td>
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<tr>
<td>14, 26, 27</td>
<td>313619 - Reno Mattress</td>
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<tr>
<td>14-27</td>
<td>323234 - Mechanically Stabilized Earth Retaining Wall System</td>
</tr>
<tr>
<td>14-27</td>
<td>323236 - Gabion for Mechanically Stabilized Earth Retaining Wall System</td>
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</tbody>
</table>

8. **Measurement and Payment**

a. The method of measurement and payment for this item shall be by the percent complete of the lump sum pay item for completed portions of the wall system. Items measured shall be based on a schedule of values supplied by the contractor and coordinated with the Project Inspector for major system components installed and completed in accordance with the following schedule:

   i. Up to 5% of the lump sum bid amount is payable for the wall system upon submittal and acceptance of the site specific geotechnical information obtained by the Contractor’s geotechnical study.

   ii. Up to 15% of the lump sum bid amount is payable upon submittal and approval of the Contractor's submittal of an engineering design signed by a Texas PE for the MSE wall system, fully coordinated with geotechnical data from the site and developed in accordance with the contractor’s work plan for installing the wall system.

   iii. Up to 60% of the lump sum bid price is payable after the first 5 rows of gabions are installed from station 10+00 to the upstream end of the wall system.

   iv. Up to 95% of the lump sum price bid is payable for installation of all remaining wall system components, topsoil, and application of hydromulch on all soil surfaces.

   v. 100% of the pay items is payable upon vegetative establishment on all soil surfaces of the wall system.

b. The bid amount for this item shall be full compensation for all work required to complete this item, inclusive of planning, testing, contracting, studies, design, staging, excavation, removal, hauling, installation, backfill, site repair, site restoration, disposal, materials, labor, equipment, incidentals, and cost of any kind affiliated with completing this work item.
1.0 Description
This work shall consist 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 as determined by the engineer. These specifications are in accordance with ASTM A975 and include gabions as manufactured by Maccaferri Inc or equivalent.

2.0 Materials

2.1 Woven Mesh Gabions

2.1.1 Wire (Zinc Coated):
All tests on the wire must be performed prior to manufacturing the mesh.
- **Tensile strength**: both the wire used for the manufacture of gabions and the lacing wire, shall have a maximum tensile strength of 75,000 psi (515 MPa), in accordance with ASTM A641/A641M.
- **Elongation**: the test must be carried out on a sample at least 12 in. (30 cm) long. Elongation shall not be less than 12%, in accordance with ASTM A370.
- **Zinc coating**: minimum quantities of zinc according to ASTM A641/A641M, Class III soft temper coating.
- **Adhesion of zinc coating**: the adhesion of the zinc coating to the wire shall be such that, when the wire is wrapped six turns around a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with the bare fingers, in accordance with ASTM A641/A641M.

2.1.2 PVC (Polyvinyl Chloride) Coating
- **Specific gravity**: 81-84 pcf (1.30-1.35 kg/dm3,) in accordance with ASTM D792, Table 1;
- **Hardness**: between 50 and 60 Shore D, according to ASTM D 2240;
- **Tensile strength**: not less than 2,985 psi (20.6 MPa), according to ASTM D412;
- **Modulus of elasticity**: not less than 2,700 psi (18.6 MPa), according to ASTM D412;
- **Abrasion resistance**: the percentage of the weight loss shall be less than 12%, according to ASTM D1242.
- **Heat Aging Test**: prior to UV and abrasion degradation, the PVC polymer coating shall have a projected durability life of 60 years when tested in accordance with UL 746B.

The accelerated aging tests are:
- **Salt spray test**: test period 3,000 hours, test method ASTM B117;
- **Exposure to UV rays**: test period 3,000 hours at 145°F (63°C), test method ASTM D1499 and ASTM G152;
- **Brittleness temperature**: no higher than 15°F (-9°C), or lower temperature when specified by the purchaser, when tested in accordance with ASTM D746.

The properties after aging tests shall be as follows:
- Appearance of coated mesh: no cracking, stripping or air bubbles, and no appreciable variation in color;
- Specific gravity: variations shall not exceed 6%;
- Hardness: variations shall not exceed 10%;
- Tensile strength: variations shall not exceed 25%;
- Modulus of elasticity: variations shall not exceed 25%;
- Abrasion resistance: variations shall not exceed 10%;
- Brittleness temperature: shall not exceed + 64°F (+18°C).

2.1.3 Galvanized and PVC coated wire mesh gabions (8 x 10 mesh type):
- PVC coating thickness: Nominal – 0.02 in. (0.5 mm), Minimum – 0.015 in. (0.38 mm)
• Mesh Wire: Diameter – 0.106 in. (2.70 mm) internal, 0.146 in. (3.70 mm) external
• Selvedge Wire: Diameter – 0.134 in. (3.40 mm) internal, 0.174 in. (4.40 mm) external
• Mesh Opening: Nominal Dimension D = 3.25 in. (83 mm), as per Fig. 1.

2.1.4 Galvanized and PVC coated lacing wire and internal stiffeners:
• PVC coating thickness: Nominal – 0.02 in. (0.5 mm), Minimum – 0.015 in. (0.38 mm)
• Lacing wire: Diameter – 0.087 in. (2.20 mm) internal, 0.127 in. (3.20 mm) external
• Cross Tie/Stiffener wire: Diameter – 0.087 in. (2.20 mm) internal, 0.127 in. (3.20 mm) external
• Preformed Stiffener: Diameter – 0.134 in. (3.4 mm) internal, 0.174 in. (4.4 mm) external

2.1.5 Steel Mesh properties
• Mesh Tensile Strength: shall have a minimum strength of 2900 lb/ft (42.3 kN/m) when tested in accordance with ASTM A975 section 13.1.1.
• Punch Test Resistance: shall have a minimum resistance of 5300 lb (23.6 kN/m) when tested in accordance with ASTM A975 section 13.1.4.
• Connection to selvedges: shall have a minimum resistance of 1200 lb/ft (17.5 kN/m) when tested in accordance with ASTM A975.

2.1.6 Spenax Fasteners (Overlapping Fasteners):
Stainless Steel overlapping fasteners may be used in lieu of, or to complement, lacing wire for basket assembly and installation.

• High tensile fasteners shall have a nominal spacing of 4 in. (100 mm) not to exceed 6 in (150 mm) for all assembly and installation. This is based on a 1,200 lb/ft (17.5 kN/m) pull apart resistance for galvanized mesh with this spacing (ASTM A975 section 13.1.2).
• Fasteners used for assembly and installation of the units on the field shall be tested for compliance with the ASTM A975 section 13.1.2.2 Pull-Apart Resistance. Producer or supplier of the wire mesh shall provide certification no later than 15 days prior of starting construction.
• When tested in accordance with section 13.1.2.1, the average maximum resistance of the fasteners from the field shall not be lower than 90% of the resistance provided in the certification.
• Stainless Steel Fasteners: Diameter = 0.120 in. (3.05 mm), according to ASTM A313/A313M, Type 302, Class I.
• Tensile strength: 222,000 to 253,000 psi (1530-1744 MPA) in accordance with ASTM A764(2001).
• Proper installation of rings: A properly formed Spenax fastener shall have a nominal overlap of one (1) in. after closure (Fig. 2).

2.2 Tolerances
• Wire: Zinc coating, in accordance with ASTM A641/A641M, Class III soft temper coating.
• Gabions: ± 5 % on the length, width, and height.
• Mesh opening: Tolerances on the hexagonal, double twisted wire mesh opening shall not exceed ± 10% on the nominal dimension D values (see Fig.1):

![Fig. 1](image_url)

<table>
<thead>
<tr>
<th>Mesh Type</th>
<th>Nominal Dimension D</th>
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<td>8 x 10</td>
<td>3.25 in. (83 mm)</td>
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</table>

![Fig. 2](image_url)

Close

Normal overlap of 1 in. (25 mm) after closure

Open

0.75 in. (19 mm)
1.75 in. (44 mm)
2.3 Standard Unit Size

<table>
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<tr>
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<tr>
<td>4.5 (1.4)</td>
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</table>

All sizes and dimensions are nominal. Tolerances of ±5% of the width, and length height, of the gabions shall be permitted.

2.4 Fabrication
Gabions shall be manufactured and shipped with all components mechanically connected at the production facility. The front, base, back and lid of the gabions shall be woven into a single unit. The ends and diaphragm(s) shall be factory connected to the base. All perimeter edges of the mesh forming the basket and top, or lid, shall be selvedged with wire having a larger diameter. The gabion is divided into cells by means of diaphragms positioned at approximately 3 ft (1 m) centers. The diaphragms shall be secured in position to the base so that no additional lacing is necessary at the jobsite. See Figure 3.

2.5 Rock
The rock for gabions 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. Gabion rocks shall range between 4 in. (0.10 m) and 8 in. (0.20 m). The range in sizes shall allow for a variation of 5% oversize and/or 5% undersize rock, provided it is not placed on the gabion exposed surface. The size shall be such that a minimum of three layers of rock must be achieved when filling the gabions.
3.0 Construction Requirements

3.1 Assembly
Gabions are supplied folded flat and packed in bundles. The units are assembled individually by erecting the sides, ends, and diaphragms, ensuring that all panels are in the correct position, and the tops of all sides are aligned. The four corners shall be connected first, followed by the internal diaphragms to the outside walls. All connections should use lacing wire or fasteners as previously described in Section 2.1.4 and Section 2.1.6.

The procedure for using lacing wire consists of cutting a sufficient length of wire, and first looping and/or twisting to secure the lacing wire to the wire mesh. Proceed to lace with alternating double and single loops through every mesh opening approximately every 6 in. (150 mm), pulling each loop tight and finally securing the end of the lacing wire to the wire mesh by looping and/or twisting.

The use of fasteners shall be in accordance with the manufacturer’s recommendations as specified in Section 2.1.6.

3.2 Installation
After initial assembly, the gabions are carried to their final position and are securely joined together along the vertical and top edges of their contact surfaces using the same connecting procedure(s) described in Section 3.1. Whenever a structure requires more than one layer, the upper empty baskets shall also be connected to the top of the lower layer along the front and back edges of the contact surface using the same connecting procedure(s) described in Section 3.1.

3.3 Filling
Gabions shall be filled with rock as specified in Section 2.4. During the filling operation some manual stone placement is required to minimize voids. The exposed faces of vertical structures may be carefully hand placed to give a neat, flat, and compact appearance. Care shall be taken when placing fill material to ensure that the sheathing on the PVC coated baskets is not damaged.

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-foot (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. Behind gabion walls, compact the backfill material simultaneously to the same level as the filled gabions.

3.4 Internal Connecting Wires
MacTie preformed stiffeners or lacing wire can be used as internal connecting wires when a structure requires more than one layer of gabions to be stacked on top of each other. Internal Connecting Wires with lacing wire shall connect the exposed face of a cell to the opposite side of the cell. Internal Connecting Preformed stiffeners shall connect the exposed face of a cell to the adjacent side of the cell. Preformed stiffeners are installed at 45° to the face/side of the unit, extending an equal distance along each side to be braced (approximately 1 ft. (300 mm)). An exposed face is any side of a gabion cell that will be exposed or unsupported after the structure is completed.

3.4.1 3 Feet (1 m) High Gabions
3 feet (1 m) high gabions shall be filled in three layers, 1 foot (300 mm) at a time. Connecting wires/bracings shall be installed after the placement of each layer, that is, at 1 foot (300 mm) high and 2 feet (600 mm) high.

3.4.2 1.5 Feet (0.5 m) High Gabions
1.5 feet (0.5 m) high gabions do not require connecting wires/bracings unless the baskets are used to build vertical structures. In some cases, these units shall be filled in two layers, 9 in. (230 mm) at a time. Connecting wires shall be installed after the placement of the first layer, which is at 9 in. (230 mm) high.

3.5 Lid Closing
Once the gabion baskets are completely full, the lids will be pulled tight until the lid meets the perimeter edges of the basket. A tool such as a lid closer can be used. The lid must then be tightly
laced and/or fastened along all edges, ends and tops of diaphragm(s) in the same manner as described in Section 3.1.

3.6 Mesh cutting and folding
Where shown on the drawings or otherwise directed by the engineer, the gabions shall be cut, folded and fastened together to suit site conditions. The mesh must be cleanly cut and surplus mesh either folded back or overlapped so that it can be securely fastened together with lacing wire or fasteners in the manner described in Section 3.1. Any reshaped gabions shall be assembled, installed, filled and closed as specified in the previous sections.

4.0 Method of Measurement and Basis of Payment

4.1 Measurement and Basis of Payment for this item shall be based on the percent complete of the lump sum pay item for all completed and accepted portions of the gabion work required for the project. Gabions measured for this item do not include gabion boxes installed as a part of the MSE wall.

4.2 The bid amount for this item shall be full compensation for all work required to complete this item, inclusive of all staging, excavation, removal, hauling, installation, backfill, site repair, site restoration, disposal, materials, labor, equipment, incidentals, and cost of any kind affiliated with completing this work item.
Specification 313619 RENO MATTRESS
GALVANIZED & PVC COATED

1.0 Description
This work shall consist of furnishing, assembling, and filling woven wire mesh Reno mattresses
with rock as specified in the contract to the dimensions, lines and grades shown on the plans, or as
determined by the engineer. These specifications are in accordance with ASTM A975 and include
Reno mattresses as manufactured by Maccaferri, Inc. or equivalent.

2.0 Materials
2.1 Woven Mesh Reno Mattresses

2.1.1 Wire (Zinc Coated):
All tests on the wire mesh must be performed prior to manufacturing the mesh.
- Tensile strength: both the wire used for the manufacture of gabions and the lacing wire, shall
  have a maximum tensile strength of 75,000 psi (515 MPa), in accordance with ASTM
  A641/A641M.
- Elongation: the test must be carried out on a sample at least 12 in. (30 cm) long. Elongation
  shall not be less than 12%, in accordance with ASTM A370.
- Zinc coating: minimum quantities of zinc according to ASTM A641/A641M, Class III soft
  temper coating.
- Adhesion of zinc coating: the adhesion of the zinc coating to the wire shall be such that,
  when the wire is wrapped six turns around a mandrel having four times the diameter of the
  wire, it does not flake or crack when rubbing it with the bare fingers, in accordance with ASTM
  A641/A641M.

2.1.2 PVC (Polyvinyl Chloride) Coating
- Specific gravity: 81-84 pcf (1.30-1.35 kg/dm3) in accordance with ASTM D792-00, Table 1;
- Hardness: between 50 and 60 Shore D, according to ASTM D 2240-04;
- Tensile strength: not less than 2,985 psi (20.6 MPa), according to ASTM D412-98a;
- Modulus of elasticity: not less than 2,700 psi (18.6 MPa), according to ASTM D412-98a;
- Abrasion resistance: the percentage of the weight loss shall be less than 12%, according to
  ASTM D1242-95a.
- Heat aging test: prior to UV and Abrasion degradation, the PVC polymer coating shall have
  a projected durability life of 60 years when tested in accordance with UL 746B.

The accelerated aging tests are:
- Salt spray test: test period 3,000 hours, test method ASTM B117;
- Exposure to UV rays: test period 3,000 hours at 145°F (63°C), test method ASTM D1499
  and ASTM G152;
- Britleness temperature: no higher than 15°F (-9°C), or lower temperature when specified by
  the purchaser, when tested in accordance with ASTM D746.

The properties after aging tests shall be as follows:

Appearance of coated mesh: no cracking, stripping or air bubbles, and no appreciable variation in
color;
- Specific Gravity: variations shall not exceed 6%;
- Hardness: variations shall not exceed 10%;
- Tensile strength: variations shall not exceed 25%;
- Modulus of elasticity: variations shall not exceed 25%;
- Abrasion resistance: variations shall not exceed 10%;
- Britleness temperature: shall not exceed +64°F (+18°C);
2.1.3  Galvanized and PVC coated wire mesh Reno mattresses (6 x 8 mesh type):

- PVC coating thickness: Nominal – 0.02 in. (0.5 mm), Minimum – 0.015 in. (0.38 mm)
- Mesh Wire: Diameter – 0.087 in. (2.20 mm) internal, 0.127 in. (3.20 mm) external
- Selvedge Wire: Diameter – 0.134 in. (3.40 mm) internal, 0.174 in. (4.40 mm) external
- Mesh Opening: Nominal Dimension D 2.5 in. as per Fig.1.

2.1.4  Galvanized and PVC coated lacing wire:

- PVC coating thickness: Nominal – 0.02 in. (0.5 mm), Minimum – 0.015 in. (0.38 mm)
- Lacing wire: Diameter – 0.087 in. (2.20 mm) internal, 0.127 in. (3.20 mm) external
- Stiffener wire: Diameter - 0.087 in. (2.20 mm) internal, 0.127 in. (3.20 mm) external

2.1.5  Steel Mesh Properties

Mesh Tensile Strength shall have a minimum strength of 2300 lb/ft (33.6 kN/m) when tested in accordance with ASTM A975 section 13.1.1

Punch Test Resistance shall have a minimum resistance of 4000 lb (17.8 kN) when tested in accordance with ASTM A975 section 13.1.4

Connection to selvedges shall have a minimum resistance of 700 lb/ft (10.2 kN/m) when tested in accordance with ASTM A975.

2.1.6  Spenax Fasteners (Overlapping Fasteners):

Stainless Steel overlapping fasteners may be used in lieu of, or to complement, lacing wire for basket assembly and installation.

- High tensile fasteners shall have a nominal spacing of 4 in. (100 mm) not to exceed 6 in (150 mm) for all assembly and installation. This is based on a 1,200 lb/ft (17.5 kN/m) pull apart resistance for galvanized mesh with this spacing (ASTM A975 section 13.1.2).
- Fasteners used for assembly and installation of the units on the field shall be tested for compliance with the ASTM A975 section 13.1.2.2 Pull-Apart Resistance. Producer or supplier of the wire mesh shall provide certification no later than 15 days prior of starting construction.
- When tested in accordance with section 13.1.2.1, the average maximum resistance of the fasteners from the field shall not be lower than 90% of the resistance provided in the certification.

- Stainless Steel Fasteners: Diameter = 0.120 in. (3.05 mm), according to ASTM A313/A313M, Type 302, Class I.
- Tensile strength: 222,000 to 253,000 psi (1530-1744 MPA) in accordance with ASTM A764(2001).
- Proper installation of rings: A properly formed Spenax fastener shall have a nominal overlap of one (1) in. after closure (Fig. 2).

2.2  Tolerances

- Wire: Zinc coating, in accordance with ASTM A641/A641M, Class III soft temper coating.
- Reno mattress sizes: ±5% on the length, width, and 10% on the height.
- Mesh opening: Tolerances on the hexagonal, double twisted wire mesh opening shall not exceed ±10% on the nominal dimension D values (see Fig.1):

![Fig. 1: Mesh Type vs Nominal Dimension D](image1)

![Fig. 2: Spenax Fastener](image2)
2.3 **Standard Unit Size**

<table>
<thead>
<tr>
<th>L=Length ft (m)</th>
<th>W=Width ft (m)</th>
<th>H=Height in (mm)</th>
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<td>6 (150)</td>
<td>3</td>
</tr>
<tr>
<td>12 (3.6)</td>
<td>6 (1.8)</td>
<td>6 (150)</td>
<td>4</td>
</tr>
<tr>
<td>9 (2.7)</td>
<td>6 (1.8)</td>
<td>9 (230)</td>
<td>3</td>
</tr>
<tr>
<td>12 (3.6)</td>
<td>6 (1.8)</td>
<td>9 (230)</td>
<td>4</td>
</tr>
<tr>
<td>12 (3.6)</td>
<td>6 (1.8)</td>
<td>12 (300)</td>
<td>4</td>
</tr>
</tbody>
</table>

**Fabrication**

Reno mattresses shall be manufactured with all components mechanically connected at the production facility with the exception of the mattress lid, which is produced separately from the base. The ends and diaphragm(s) shall be formed in conjunction with the base. The lid shall be a separate piece made of the same type mesh as the basket. All perimeter edges of the mesh forming the basket and top, or lid, shall be selvedged with wire having a larger diameter. The Reno mattress is uniformly partitioned into internal cells. The diaphragms shall be secured in position to the base so that no additional tying is necessary at the jobsite.

2.5 **Rock**

The rock for Reno mattresses 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. Mattress rocks shall range between 3 in. (0.08 m) and 5 in. (0.13 m) for units of 9 in. (0.23 m) and 6 in. (0.15) and between 4 in. (0.1 m) and 8 in. (0.20 m) for units of 12 in. (0.30 m). The range in sizes may allow for a variation of 5% oversize and/or 5% undersize rock, provided it is not placed on the gabion exposed surface. The size shall be such that a minimum of two layers of rock must be
achieved when filling the mattress.

3.0 Construction Requirements

3.1 Assembly
Reno mattresses are supplied folded flat and packed in bundles. The units shall be assembled individually by erecting the sides, ends, and diaphragms ensuring that all panels are in the correct position. All connections should be accomplished using lacing wire or fasteners as previously described in Section 2.1.4 and Section 2.1.6.

The procedure for using lacing wire consists of cutting a sufficient length of wire, and first looping and/or twisting to secure the lacing wire to the wire mesh. Proceed to lace with alternating double and single loops through every mesh opening approximately every 6 in. (150 mm) pulling each loop tight and finally securing the end of the lacing wire to the wire mesh by looping and/or twisting. The use of fasteners shall be in accordance with the manufacturer’s recommendations as specified in Section 2.1.6.

3.2 Installation
After assembly, the Reno mattresses are carried to their final position and are securely joined together along the vertical and top edges of their contact surfaces using the same connecting procedure(s) described in Section 3.1.

3.3 Filling
Mattresses shall be filled with rock as specified in Section 2.5. During the filling operation some manual stone placement is required to minimize voids. It is also recommended to slightly overfill the baskets by 1 in. (25 mm) to allow for settlement and so that the rock is tightly confined by the Reno mattress lid, thereby minimizing any movement of the rock under hydraulic load. Care shall be taken when placing fill material to ensure that the sheathing on the PVC coated baskets is not damaged.

The mattress sections on this project are intended at a later date to be utilized for an access road. Accordingly the contractor shall take extra measures to fill mattress sections consistently and evenly to facilitate maintenance equipment use.

3.4 Lid Closing
Once the Reno mattresses are completely full, the lids will be pulled tight until the lid meets the perimeter edges of the basket. A tool like a lid closer can be used. The lid must then be tightly laced and/or fastened along all edges, ends and tops of diaphragm(s) in the same manner as described in Section 3.1.

3.5 Mesh cutting and folding
It will be necessary to cut mattress sections to fit the available space at the access maintenance ramp. At these locations and other places where required, the mattress mesh shall be cut, folded and fastened together to suit existing site conditions. The mesh must be cleanly cut and the surplus mesh folded back and neatly wired to an adjacent mattress face. The cut edges of the mesh shall be securely fastened together with lacing wire or fasteners in the manner described in Section 3.1. Any reshaped mattress shall be assembled, installed, filled and closed as specified in the previous sections.

4.0 Method of Measurement and Basis of Payment

4.1 Measurement and Basis of Payment for this item shall be based on the percent complete of the lump sum pay item for all completed and accepted portions of the reno mattress work. Reno Mattress construction measurement will not include adjoining gabions or other MSE wall components.

4.2 The bid amount for this item shall be full compensation for all work required to complete this item, inclusive of staging, excavation, removal, hauling, installation, backfill, site repair, site restoration, disposal, materials, labor, equipment, incidentals, and cost of any kind affiliated with completing this work item.
Specification 323234
Mechanically Stabilized Earth Retaining Wall System
(Green Terramesh System®)

1.0 Description
This work shall consist of furnishing, assembling, and back filling woven wire mesh soil reinforcement units used in Mechanical Stabilized Earth (MSE) structures, as specified in the contract documents in conformity with the dimensions, lines and grades shown on the plans, or as determined by the engineer. These specifications are in accordance with ASTM A975-97 and include Green Terramesh® manufactured by Maccaferri Inc. or equivalent.

2.0 Materials
2.1 Woven Mesh
2.1.1 Wire (Zinc Coated):
All tests on the mesh and lacing wire must be performed prior to manufacturing the mesh.
- **Tensile strength:** both the wire used for the manufacture of Green Terramesh® and the lacing wire, shall have a maximum tensile strength of 75,000 psi (517 MPa), in accordance with ASTM A641/A641M-03.
- **Elongation:** the test must be carried out on a sample at least 12 in. (30 cm) long. Elongation shall not be less than 12%, in accordance with ASTM A370-97a.
- **Zinc coating:** minimum quantities of zinc according to ASTM A641/A641M-03, Class III soft temper coating.
- **Adhesion of zinc coating:** the adhesion of the zinc coating to the wire shall be such that, when the wire is wrapped six turns around a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with the bare fingers, in accordance with ASTM A641/A641M-03.

2.1.2 PVC (Polyvinyl Chloride) Coating
- **Specific density:** 81-84 pcf (1.30–1.35 kg/dm³) in accordance with ASTM D792-00;
- **Hardness:** between 50 and 60 Shore D, according to ASTM D2240-04;
- **Tensile strength:** not less than 2,985 psi (20.6 MPa), according to ASTM D412-98a;
- **Modulus of elasticity:** not less than 2,700 psi (18.6 MPa), according to ASTM D412-98a;
- **Abrasion resistance:** the percentage of the weight loss shall be less than 12%, according to ASTM D1242-95a;
- **Heat aging test:** prior to UV and Abrasion degradation, the PVC polymer coating shall have a projected durability life of 60 years when tested in accordance with UL 746B.

The accelerated aging tests are:
- **Salt spray test:** test period 3,000 hours, test method ASTM B117-97;
- **Exposure to UV rays:** test period 3,000 hours at 145°F (63°C), test method ASTM D1499-99 and ASTM G152-00;
- **Brittleness temperature:** no higher than 15°F (- 9°C), or lower temperature when specified by the purchaser, when tested in accordance with ASTM D746-04.

The properties after aging tests shall be as follows:
- **Appearance of coated mesh:** no cracking, stripping or air bubbles, and no appreciable variation in color;
- **Specific gravity:** variations shall not exceed 6%;
- **Hardness:** variations shall not exceed 10%;
- **Tensile strength:** variations shall not exceed 25%;
- **Modulus of elasticity:** variations shall not exceed 25%;
- **Abrasion resistance:** variations shall not exceed 10%;
- **Brittleness temperature:** shall not exceed + 64°F (+18°C).

2.1.3 Galvanized and PVC coated wire mesh (8 x 10 mesh type):
- **PVC coating thickness:** Nominal – 0.02 in (0.5 mm), Minimum – 0.015 in (0.38 mm);
- **Mesh wire:** Diameter – 0.106 in (2.70 mm) internal, 0.146 in (3.70 mm) external;
- **Selvedge and reinforcement steel wire:** Diameter – 0.134 in (3.40 mm) internal, 0.174 in (4.40 mm) external. (Note: the reinforced steel wire is not galvanized);
- **Mesh opening:** Nominal Dimension D = 3.25 in. (83 mm), as per Fig. 1.
2.1.4 Steel Wire for Welded Back Panel:
- **Wire diameter:** Nominal 0.309 in (7.85 mm) Size W8 in accordance with ASTM A82-97a;
- **Mesh openings:** 5.9 in. x 6.38 in. (150 x 162 mm);
- **Tensile strength:** 75 ksi (515 MPa) in accordance with ASTM A82-97a Table 2;
- **Bending:** in accordance with ASTM A82-97a Table 3;
- **Welding:** minimum of 2625 lbs (11 660 N) in accordance with ASTM A185-97.

2.1.5 Reinforcing Steel Brackets:
- **Wire diameter:** Nominal 0.309 in. (7.85 mm) Size W8 in accordance with ASTM A82-97a;
- **Tensile strength:** 80 ksi (550 MPa) in accordance with ASTM A82-97a Table 1.

2.1.6 Galvanized and PVC coated lacing wire:
- **Lacing wire:** Diameter – 0.087 in (2.20 mm) internal, 0.127 in (3.20 mm) external.

2.1.7 Steel Mesh Properties
- **Mesh Tensile Strength** shall have a minimum strength of 2900 lb/ft (42.3 kN/m) when tested in accordance with ASTM A975 section 13.1.1
- **Punch Test Resistance** shall have a minimum resistance of 5300 lb (23.6 kN) when tested in accordance with ASTM A975 section 13.1.4
- **Connection to selvedges** shall have a minimum resistance of 1200 lb/ft (17.5 kN/m) when tested in accordance with ASTM A975

2.1.8 Spenax Fasteners (Overlapping Fasteners):
Overlapping stainless steel fasteners may be used in lieu of, or to complement, lacing wire for basket assembly and installation. The spacing of the fasteners during all phases of assembly and installation shall be in accordance with spacing based on 1,200 lb/ft (17.5 kN/m) pull apart resistance for PVC coated mesh when tested in accordance with ASTM A975 section 13.1.2 and with a nominal spacing of 4 in. (100 mm), and not to exceed 6 in. (150 mm).
- **Stainless steel fasteners:** Diameter: 0.120 in (3.05 mm), according to ASTM A313/A313M-98, Type 302, Class I.
- **Tensile strength:** 222,000 to 253,000 psi (1530-1744 MPa) in accordance with ASTM A313/A313M-98.
- **Proper installation of rings:** A properly formed Spenax fastener shall have a nominal overlap of 1 in. after closure (Fig. 2).

2.1.9 Erosion Control Blanket:
For “Water” type, a geosynthetic ECB is attached to the inside facing. For “Soil” type, a biodegradable coir fiber ECB is attached to the inside facing.

2.2 Tolerances
- **Wire:** Zinc coating, in accordance with ASTM A641/A641M-03, Class III soft temper coating.
- **Green Terramesh unit:** ± 5 % on the length, width, and height.
- **Mesh opening:** Tolerances on the hexagonal, double twisted wire mesh opening shall not exceed ± 10% on the nominal dimension D values (see Fig.1).

![Fig. 1](image1.png)

<table>
<thead>
<tr>
<th>Mesh Type</th>
<th>Nominal Dimension D</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 x 10</td>
<td>3.25 in. (83 mm)</td>
</tr>
</tbody>
</table>

![Fig. 2](image2.png)
2.3 Standard Unit Size

<table>
<thead>
<tr>
<th>L=Length ft</th>
<th>W=Width ft</th>
<th>H=Height ft</th>
<th>Slope angle</th>
</tr>
</thead>
<tbody>
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<td>6.5</td>
<td>2.3</td>
<td>60°</td>
</tr>
<tr>
<td>12</td>
<td>6.5</td>
<td>2.3</td>
<td>60°</td>
</tr>
<tr>
<td>9</td>
<td>6.5</td>
<td>2.3</td>
<td>45°</td>
</tr>
<tr>
<td>15</td>
<td>6.5</td>
<td>2.3</td>
<td>45°</td>
</tr>
</tbody>
</table>

2.4 Fabrication

Green Terramesh® shall be manufactured and shipped preassembled at the production facility. The external face, reinforcing panel, and top return shall be woven into a single unit. Horizontal reinforcing steel rods shall be placed in the double twist of the front face of the unit, spaced approximately every 6 in (162 mm). The welded wire panel shall be factory connected to the base unit. Reinforcing steel brackets and erosion control blanket shall be furnished unattached within the packaged units. See Figure 3. The erosion control blanket shall be a geosynthetic material for Water type Green Terramesh®.

2.5 Topsoil

Topsoil should be sandy clay or clay like sand, with 3% to 20% of organic material. The soil should be fertile and friable and should come from 8 in. to 12 in. (200 mm to 300 mm) depths in the field. Topsoil should be free from wood and stones larger than 2 in. (50 mm) in maximum dimension. Placement is made to the specified thickness and profile into the face of the unit prior to the placement of the structural backfill. Apply and incorporate dry 13-13-13 fertilizer granules at the rate of 1 oz per SY of topsoil. Also place sufficient topsoil on the top sections of the wall system upon completion and grade to drain.

2.6 Structural Backfill

Mechanically stabilized earth structures shall be made of a good quality, free draining, granular and/or selected fill. The recommended soil gradation is in the range of 0.001 in. to 0.75 in. (0.02 mm to 19 mm), or as indicated by AASHTO T-27 and FHWA Demo 82. Soils outside of this range may be suitable, providing approval is given by a geotechnical engineer.
3.0 Construction Requirements

3.1 Assembly
Green Terramesh® units are pre-assembled during manufacturing and are supplied folded flat and packed in bundles. Each bundle is labeled with a tag reporting the sizes of the units. When the units are unfolded, they will have one or two shipping folds, which must be removed. This can be achieved by placing the fold over a 2 in. x 4 in. (50 mm x 100 mm) board and walking along the sides.

The procedure for using lacing wire consists of cutting a sufficient length of wire (± 3 ft) (± 1 m), 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 6 in. (150 mm), pulling each loop tight and finally securing the end of the lacing wire to the wire mesh by looping and/or twisting.

The use of fasteners shall be in accordance with the manufacturer’s recommendations as specified in Section 2.1.8.

3.2 Installation
Prior to installing the assembled units, the foundation on which the Green Terramesh® units are to be placed shall be cut or filled and graded to the lines and grades shown on the construction drawings. Surface irregularities, loose material, and vegetation shall be removed during the preparation of the foundation.

Units are carried to and placed in their final position and the facing units raised. Adjoining units must be securely joined together using the procedure(s) described in Sections 2.1.6 and 2.1.8, along the vertical facing and top edges of their contact surfaces. Adjacent units should be connected along the reinforcing panel every 3 ft (1 m) to avoid movement during backfilling. Whenever a structure requires more than one layer of units, the upper unit shall also be connected to the top of the lower layer via the welded panels using the procedure(s) described in Sections 2.1.6 and 2.1.8. Unroll and place the Erosion Control Blanket (ECB) over the steel welded panels with a minimum overlap of 4 in. (100 mm) at the top and bottom. The blanket should be secured using lacing wire or steel fasteners every 3 ft (1 meter).

Connect the reinforcing steel brackets to the top of the welded wire panel and the reinforcing steel wire in the anchor panel. (Make a small cut to the ECB if necessary.) The bottom hook of the reinforcing steel bracket can be closed with an overlapping fastener. This ensures that the hook does not come unfastened. The units placed on the last row (uppermost course) at the top of the structure should have a return of 6.56 ft (2 m) long.

3.3 Vegetative Soil Placement
Prior to placing vegetative soil, ensure that the blanket overlap is located correctly. Vegetative soil shall be placed on the ECB and at the back of the facing element; 18-24 in. (457-610 mm) thickness minimum is required. The soil should be lightly compacted by foot or small machine compactor.

3.4 Placement of the Structural Backfill
The arches mesh panel should be unfolded, the shipping folds flattened out, and pulled tight to minimize future creepage. The granular backfill specified by the engineer shall be installed in maximum lifts of approximately 1 ft (300 mm). Placement and compaction is to proceed parallel to the slope face, ensuring that construction engineer does not come into contact with the mesh panel or within 3 ft (1 m) of the rear of the face element. The homogeneity of the backfill and the level of compaction required shall be verified.

3.5 Mesh Cutting and Folding
Where shown on the drawings or otherwise directed by the engineer, the Green Terramesh® shall be cut, folded and fastened together to suit existing site conditions. The mesh must be cleanly cut and surplus mesh either folded back or overlapped so that it can be securely fastened together with lacing wire or fasteners in the manner described in Section 3.1. Any reshaped Green Terramesh® shall be subject to all the aforementioned specifications in the previous sections.

4.0 Hydroseeding
Sufficiently wet and Apply hydromulch to all soil exposed sections of the wall system upon completion. Apply sufficient water, at least twice a week for 30 days after seeding in a manner that does not damage growing plants.
Specification 323236 Gabions for MSE Wall System
(Terramesh® System, Galvanized & PVC Coated)

1.0 Description
This work shall consist of furnishing, assembling, and filling woven wire mesh soil reinforcement units used in Mechanical Stabilized Earth (MSE) structures, as specified in the contract documents in conformity with the dimensions, lines and grades shown on the plans, or as determined by the engineer. These specifications are in accordance with ASTM A975 and include Terramesh® System manufactured by Maccaferri, Inc. or equivalent.

2.0 Materials
2.1 Woven Mesh
2.1.1 Wire (Zinc Coated):
All tests on the wire must be performed prior to manufacturing the mesh.
- **Tensile strength**: the wire used for the manufacturing of Terramesh® System and the lacing wire shall have a maximum tensile strength of 75,000psi (515 MPa), in accordance with ASTM A641/A641M.
- **Elongation**: the test must be carried out on a sample at least 12 in (30 cm) long. Elongation shall not be less than 12%, in accordance with ASTM A370.
- **Zinc coating**: minimum quantities of zinc according to ASTM A641/A641M, Class III soft temper coating.
- **Adhesion of zinc coating**: the adhesion of the zinc coating to the wire shall be such that, when the wire is wrapped six turns around a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with the bare fingers, in accordance with ASTM A641/A641M.

2.1.2 PVC (Polyvinyl Chloride) Coating
- **Specific density**: 81-84 pcf (1.30-1.35 kg/dm³) in accordance with ASTM D792;
- **Hardness**: between 50 and 60 Shore D, according to ASTM D2240;
- **Tensile strength**: not less than 2,985 psi (20.6 MPa), according to ASTM D412;
- **Modulus of elasticity**: not less than 2,700 psi (18.6 MPa), according to ASTM D412;
- **Abrasion resistance**: the percentage of the weight loss shall be less than 12%, according to ASTM D1242.
- **Heat aging test**: prior to UV and Abrasion degradation, the PVC polymer coating shall have a projected durability life of 60 years when tested in accordance with UL 746B.

The accelerated aging tests are:
- **Salt spray test**: test period 3,000 hours, test method ASTM B117;
- **Exposure to UV rays**: test period 3,000 hours at 145°F (63°C), test method ASTM D1499 and ASTM G152;
- **Brittleness temperature**: no higher than 15°F (- 9°C), or lower temperature when specified by the purchaser, when tested in accordance with ASTM D746.

The properties after aging tests shall be as follows:
- **Appearance of coated mesh**: no cracking, stripping or air bubbles, and no appreciable variation in color;
- **Specific Gravity**: variations shall not exceed 6%;
- **Hardness**: variations shall not exceed 10%;
- **Tensile strength**: variations shall not exceed 25%;
- **Modulus of elasticity**: variations shall not exceed 25%;
- **Abrasion resistance**: variations shall not exceed 10%;
- **Brittleness temperature**: shall not exceed + 64°F (+18°C).

2.1.3 Galvanized and PVC coated wire mesh (8 x 10 mesh type):
- **PVC coating thickness**: Nominal – 0.02 in (0.5 mm), Minimum – 0.015 in (0.38 mm)
- **Mesh Wire**: Diameter – 0.106 in (2.70 mm) internal, 0.146 in (3.70 mm) external
- **Selvedge Wire**: Diameter – 0.134 in (3.40 mm) internal, 0.174 in (4.40 mm) external
- **Mesh Opening**: Nominal Dimension D = 3.25 in (83 mm), as per Fig. 1.
2.1.4 Galvanized and PVC coated lacing wire and internal connecting wires.
(Connecting wires are used in Terramesh® System on exterior of structure):
- PVC coating thickness: Nominal – 0.02 in (0.5 mm), Minimum – 0.015 in (0.38 mm)
- Lacing wire: Diameter – 0.087 in (2.20 mm) internal, 0.127 in (3.20 mm) external
- Cross Tie/Stiffener wire: Diameter - 0.087 in (2.20 mm) internal, 0.127 in (3.20 mm) external
- Preformed Stiffener: Diameter – 0.134 in (3.4 mm) internal, 0.174 in (4.4 mm) external

2.1.5 Steel Mesh Properties
- Mesh Tensile Strength shall have a minimum strength of 2900 lb/ft (42.3 kN/m) when tested in accordance with ASTM A975 section 13.1.1
- Punch Test Resistance shall have a minimum resistance of 5300 lb (23.6 kN) when tested in accordance with ASTM A975 section 13.1.4
- Connection to selvedges shall have a minimum resistance of 1200 lb/ft (17.5 kN/m) when tested in accordance with ASTM A975.

2.1.6 Spenax Fasteners (Overlapping Fasteners):
Stainless Steel overlapping fasteners may be used in lieu of, or to complement, lacing wire for basket assembly and installation.
- High tensile fasteners shall have a nominal spacing of 4 in. (100 mm) not to exceed 6 in (150 mm) for all assembly and installation. This is based on a 1,200 lb/ft (17.5 kN/m) pull apart resistance for galvanized mesh with this spacing (ASTM A975 section 13.1.2).
- Fasteners used for assembly and installation of the units on the field shall be tested for compliance with the ASTM A975 section 13.1.2.2 Pull-Apart Resistance. Producer or supplier of the wire mesh shall provide certification no later than 15 days prior of starting construction.
- When tested in accordance with section 13.1.2.1, the average maximum resistance of the fasteners from the field shall not be lower than 90% of the resistance provided in the certification.
- Stainless Steel Fasteners: Diameter = 0.120 in. (3.05 mm), according to ASTM A313/A313M, Type 302, Class I.
- Tensile strength: 222,000 to 253,000 psi (1530-1744 MPA) in accordance with ASTM A764(2001).
- Proper installation of rings: A properly formed Spenax fastener shall have a nominal overlap of one (1) in. after closure (Fig. 2).

2.2 Tolerances
Wire: Zinc coating, in accordance with ASTM A641/A641M, Class III soft temper coating.
Terramesh unit: ± 5 % on the length, width, and height.
Mesh opening: Tolerances on the hexagonal, double twisted wire mesh opening shall not exceed ± 10% on the nominal dimension D values (see Fig.1):
2.3 Standard Unit Size

Table of sizes for Terramesh® System

<table>
<thead>
<tr>
<th>L=Length ft (m)</th>
<th>W=Width ft (m)</th>
<th>H=Height ft (m)</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>18 (5.5)</td>
<td>6 (1.8)</td>
<td>2.6 (0.80)</td>
</tr>
</tbody>
</table>

2.4 Fabrication
Terramesh® System shall be manufactured with all components mechanically connected at the production facility. The external face, reinforcing panel, and lid of the Terramesh® shall be woven into a single unit. The ends, back, and diaphragm shall be factory connected to the base. All perimeter edges of the mesh forming the basket shall be selvedged with wire having a larger diameter.

The facing element of a Terramesh® unit is divided into two cells by means of a diaphragm positioned at approximately 3-ft (1 m) centers. The diaphragm shall be secured in position to the base so that no additional lacing is necessary at the job-site.
2.5 Rock
Rock for the facing 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 2.6 feet (0.80 m) high Terramesh® units and a minimum of two layers for the 1.5 feet (0.50 m) high units.

2.6 Structural Backfill
Mechanically stabilized earth structures shall be made of a good quality, free draining, granular and/or selected fill. The recommended soil gradation is in the range of 0.00072 in (0.02 mm) to 0.75 in (19 mm), or as indicated by AASHTO T-27 and FHWA Demo 82. Soils outside of this range may be suitable, providing approval is given by a geotechnical engineer.

3.0 Construction Requirements

3.1 Assembly
Terramesh® System units are supplied folded flat and packed in bundles. The facing section of the units are assembled individually by erecting the sides, back, ends, and diaphragm, ensuring that all panels are in the correct position, and the tops of all sides are aligned. The four corners of the basket shall be connected first, followed by the internal diaphragm to the outside walls. All connections shall be made using lacing wire or ring fasteners as previously described in Section 2.1.4 and Section 2.1.6.

The procedure for using lacing wire consists of cutting a sufficient length of wire, and first looping and/or twisting to secure the lacing wire to the wire mesh. Proceed to lace with alternating double and single loops through every mesh opening approximately every 6 in (150 mm) pulling each loop tight and finally securing the end of the lacing wire to the wire mesh by looping and/or twisting.

The use of ring fasteners shall be in accordance with the manufacturer’s recommendations as specified in Section 2.1.6.

Following assembly of the facing section the reinforcing panel shall be unfolded to the required length and the shipping folds removed. Folds can be removed by placing the fold over a 2 in x 4 in (50 mm x 100 mm) board and walking along the sides.

3.2 Installation
Prior to installing the assembled units, the foundation on which the Terramesh® units are to be placed shall be cut or filled and graded to the lines and grades shown on the construction drawings. Surface irregularities, loose material, and vegetation shall be removed during the preparation of the foundation. The Terramesh® units are carried to their final position and connected with the adjoining empty units along the vertical and top edges of their contact surfaces using the same connecting procedure(s) described in Section 3.1. Whenever a structure requires more than one layer of units, the upper layer shall be connected to the top of the lower layer along the front and back edges of the contact surface using the same connecting procedure(s) described in Section 3.1.

3.3 Filling of the Facing Section
The facing section shall be filled with rock as specified in Section 2.4. During the filling operation some manual stone placement is required to minimize voids. For vertical or near vertical structures the exterior of the basket may be carefully hand placed to give a neat, flat, and compact appearance. Care shall be taken when placing fill material to ensure that the sheathing on the PVC coated baskets is not damaged. 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.
3.4 Internal Connecting Wires
Mac Tie preformed stiffeners or lacing wire can be used as internal connecting wires when a structure requires more than one layer of Terramesh® to be stacked on top of each other. Internal Connecting Wires with lacing wire shall connect the exposed face of a cell to the opposite side of the cell. Internal Connecting performed stiffeners shall connect the exposed face of a cell to the adjacent side of the cell. Preformed stiffeners are installed at 45° to the face (side of the unit), extending an equal distance along each side to be braced (approximately 1 ft (300 mm)). An exposed face is any side of Terramesh® that will be exposed or unsupported after the structure is completed.

3.4.1 2.6 Feet (0.80 m) High Terramesh® System
2.6 ft (0.80 m) high Terramesh® System shall be filled in three layers, 11 in (280 mm) at a time. Connecting wires shall be installed after the placement of each layer, that is, at 11 in (280 mm) high and 22 in (560 mm) high.

3.4.2 2.1 Feet (0.65 m) High Terramesh® System
2.1 ft (0.65 m) high Terramesh® System shall be filled in three layers, 9 in (230 mm) at a time. Connecting wires shall be installed after the placement of each layer, that is, at 9 ft (230 mm) high and 18 in (460 mm) high.

3.4.3 1.5 Feet (0.50 m) High Terramesh® System
1.5 ft (0.50 m) high Terramesh® System does not require connecting wires unless the baskets are used to build vertical structures. In some cases, these units shall be filled in two layers, 9 in (230 mm) at a time. Connecting wires shall be installed after the placement of the first layer, which is at 9 in (230 mm) high.

3.5 Placement of the Structural Backfill
The anchor mesh panel should be unfolded, the shipping folds flattened out, and pulled tight to minimize further creepage. Prior to starting this operation, a geotextile filter shall be placed at the facing section and backfill interface. The characteristics of the geotextile shall be as specified by the engineer. The geotextile should have a 12 in (300 mm) return at both top and bottom. The granular backfill specified by the engineer shall be installed in lifts of approximately 8 in (200 mm), and dumped in the middle section of the anchor mesh panel. Compacting is to precede parallel to the wall, ensuring that the compacting machine does not come in contact with the mesh panel or within 3 ft (1 m) of the rear of the face section. The homogeneity of the backfill and the level of compaction required shall be verified.

3.6 Lid Closing
Once the baskets are completely full, the lids shall be pulled tight until the lid meets the perimeter edges of the basket. A tool like a lid closer can be used. The lid must then be tightly laced and/or fastened along all edges, ends, and tops of diaphragm(s) in the same manner as described in Section 3.1.

3.7 Mesh Cutting and Folding
Where shown on the drawings or otherwise directed by the engineer, the Terramesh® System may be cut, folded and fastened together to suit existing site conditions. The mesh must be cleanly cut and surplus mesh either folded back or overlapped so that it can be securely fastened together with lacing wire or fasteners in the manner described in Section 3.1. Any reshaped Terramesh® System shall be assembled, installed, filled and closed as specified in the previous sections.

4.0 Method of Measurement and Basis of Payment
This item will not be measured separately for payment. It shall be considered fully subsidiary, inclusive of all labor, materials, incidentals, work, and cost of any kind to the lump sum bid for the MSE retaining wall system, Item 323234.
GEOTECHNICAL STUDY
PROPOSED STREET RECONSTRUCTION
GRUENE ROAD, PHASE "A"
NEW BRAUNFELS, TEXAS

THE SCHULTZ GROUP
New Braunfels, Texas
PLAN OF BORINGS
PROPOSED STREET RECONSTRUCTION
GRUENE ROAD, PHASE "A"
NEW BRAUNFELS, TEXAS

FUGRO SOUTH, INC.

PLATE 2
# LOG OF BORING NO. 6
GRUENE ROAD, PHASE A
NEW BRAUNFELS, TEXAS

**TYPE:** Flight Auger

**LOCATION:** See Plate 2

<table>
<thead>
<tr>
<th>DEPTH, ft</th>
<th>SYMBOL</th>
<th>SAMPLES</th>
<th>BLOWS PER FOOT OR REC (RQD), %</th>
<th>STRATUM DESCRIPTION</th>
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<tbody>
<tr>
<td>6.0</td>
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<td></td>
<td>1&quot; ASPHALT</td>
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<td>6.0 to 6.5</td>
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<td>6&quot; FILL: aggregate base</td>
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<td>-hard below 2'</td>
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<td></td>
<td></td>
<td>-with calcareous deposits, 4' to 6'</td>
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<tr>
<td>10.0</td>
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**Note:** No free groundwater was observed.

**Completion Depth:** 10.0 ft

**Date:** 01-28-02

**Project No.:** 1003-0790

**FUGRO SOUTH, INC**

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<tr>
<th>Layer Elev./Depth</th>
<th>WATER CONTENT</th>
<th>LIQUID LIMIT</th>
<th>PLASTIC LIMIT</th>
<th>PLASTICITY INDEX (PI)</th>
<th>PASSING NO. 200 SIEVE, %</th>
<th>UNIT DRY WEIGHT, gd</th>
<th>UNDRAINED SHEAR STRENGTH, kPa</th>
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<td>4.5+ (P)</td>
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LOG OF BORING NO. 7
GRUENE ROAD, PHASE A
NEW BRAUNFELS, TEXAS

TYPE: Flight Auger
LOCATION: See Plate 2

DEPTH, ft

STRATUM DESCRIPTION

0.1 0.7
- 8
14 44 16 28

WATER CONTENT, %
LIQUID LIMIT, %
PLASTIC LIMIT, %
PLASTICITY INDEX, %
PASSING NO. 200 SIEVE, %
UNIT DRY WEIGHT, psf
UNDRAINED SHEAR STRENGTH, ksf

Layer Elev./Depth

1" ASPHALT
6" FILL: aggregate base
CLAY (CL), light gray to tan, lean, hard, with gravel
-tan below 2'

50/10"

50/7"

ref/6"

50/6"

- with calcareous deposits below 8'

9.5

Note: No free groundwater was observed.

COMPLETION DEPTH: 9.5 ft
DATE: 01-28-02
PROJECT NO. 1003-0790

FUGRO SOUTH, INC

PLATE 9
LOG OF BORING NO. 8  
GRUENE ROAD, PHASE A  
NEW BRAUNFELS, TEXAS

**TYPE:** Flight Auger  
**LOCATION:** See Plate 2

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<th>SYMBOL</th>
<th>SAMPLES BLOWS PER FOOT OR RECORD, %</th>
<th>STRATUM DESCRIPTION</th>
<th>Layer Elev./Depth</th>
<th>WATER CONTENT, %</th>
<th>LIQUID LIMIT, %</th>
<th>PLASTIC LIMIT, %</th>
<th>PLASTICITY INDEX, %</th>
<th>PASSING NO. 200 SIEVE, %</th>
<th>UNIT DRY WEIGHT, psi</th>
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**COMPLETION DEPTH:** 8.9 ft

**DATE:** 01-28-02  
**PROJECT NO.:** 1003-0790

Note: No free groundwater was observed.