

**Flex MSE  
VEGETATED GEOMODULAR MECHANICALLY STABILIZED EARTH  
(VGMSE)**

**PART 1      GENERAL**

**1.01   SUMMARY**

- A. Section Includes – Work shall consist of design, furnishing materials, and construction of Flex MSE Vegetated Geomodular Mechanically Stabilized Earth (VGMSE) retention system. Supply of Geomodular Bag and Interlocking Plate units, geogrids, and pre-construction meeting\* are to be furnished by the supplier of the Flex MSE System.
  - 1. Furnishing structural geogrid reinforcement, and Geomodular Bag and Interlocking Plate units as shown on the construction drawings.
  - 2. Storing, cutting, and placing structural geogrid reinforcement, and Flex MSE Vegetated Geomodular MSE retention system as specified herein and as shown on the construction drawings.
  - 3. Furnishing sealed design calculations and construction drawings for FLEX MSE VG MSE retention system; providing supplier representatives for pre-construction meeting with Contractor and Engineer.
  - 4. Excavation, placement, and compaction of reinforced fill and backfill material as specified herein and as shown on the construction drawings.
- B. Related Sections
  - 1. Section 02200 - Site Preparation
  - 2. Section 02300 – Earthwork
- C. Alternates
  - 1. Geotextile materials will not be considered as an alternative to geogrid materials. Geotextile may be used to provide separation, filtration, or drainage; however, no structural contribution will be attributed to the geotextile.
  - 2. The VGMSE system connector Plates must provide a measured mechanical connection between the geogrid and the Bags. The connection strength between the geogrid and the facing units under a normal stress of 300 lb/ft shall be at least 396 lb/ft at 0.75 in of facing displacement. Connection testing determined by ASTM D6638 (modified).
  - 3. The Engineer shall have absolute authority to reject or accept alternate materials or systems based on the requirements of this Section.

## 1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM)
  - 1. D4354 - Practice for Sampling of Geosynthetics for Testing.
  - 2. D4355 - Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
  - 3. D5321 - Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
  - 4. D6638 (modified) - Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks).
  - 5. D6706 – Standard Test Method for Measuring Geosynthetic Pullout in Soil.
- B. Geosynthetic Research Institute (GRI)
  - 1. GRI-GG4 (b) - Determination of the Long-Term Design Strength of Flexible Geogrids.
- C. Federal Highway Administration (FHWA)
  - 1. FHWA NHI 10-024 & 10-025 - Mechanically Stabilized Earth Walls and Reinforced Soil Slopes (Volumes I & II).
  - 2. FHWA NHI-09-087- Corrosion/Degradation of Soil Reinforcements for Mechanically Stabilized Earth Walls and Reinforced Soil Slopes.
- D. Geosynthetic Accreditation Institute (GAI) - Laboratory Accreditation Program (LAP).
- E. National Transportation Product Evaluation Program (NTPEP).
- F. International Standards Organization (ISO) – 9001:2015.
- G. AASHTO LRFD Bridge Construction Specifications, 4th Edition, with 2020, 2022, and 2023 Interim Revisions.
- H. NCMA Design Manual for Segmental Retaining Walls, 3rd Edition.

## 1.03 MATERIALS

- A. Flex MSE Geomodular Bag - 70% 1000hr UV stabilized, no greater than 3.8oz/yd, J seam, chain stitched, and sewn with UV stabilized PP threads. Supplier to provide current Mill Certificates from an ISO 9001 certified non-woven manufacturer.
- B. Flex MSE Interlocking Plate - 100% Post Consumer Recycled PP spiked connection Plate, with a minimum of 11 spiked connection points, 2 serrated directional geogrid strips, and providing a positive, certified lab-tested connection value to the Geomodular Bag.
- C. Flex MSE Bag Fill Material -  
**Walls, slopes and above high-water line Applications:**
  - Freely draining soils and granular materials cleaned of all debris, roots, branches, stones in excess of US Sieve No.5 (.16”) in diameter and other deleterious materials.

- Soils contaminated with calcium chloride as well as toxic materials and petroleum products shall be removed.
- Properties should include:
  - o Approximate Organic Content: 30% by total mixed volume.
  - o Granular Content smaller than No.5 sieve and larger than No.60 sieve in: 70% by volume.
  - o Total fines (passing the #200 sieve) of mixed Bag medium: Less than 12% by mass.
  - o Percolations shall be such that no standing water is visible 60 minutes after at least 10 minutes of moderate to heavy rain or irrigation.
- Organic additive materials must be a viable commercial compost product tested for nutritional content. Flex MSE Bag Fill properties are to be confirmed with an up-to-date combined sieve and nutritional analysis.
- Thoroughly mix all constituents of the Flex MSE Bag Fill material.

**Tidal or rapid drawdown applications:**

- Clean granular material with coefficient of uniformity ranging from 1 to 4 with material size ranging from ¾" in gravel to US Sieve No.20.

- D. Structural Geogrid - All geogrid material shall have a valid NTPEP REGEO evaluation report. The geogrid shall be manufactured with fibers consisting of long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins or polyesters. They shall form a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.

The geogrid shall be sufficiently labeled for easy identification in the field, this includes labels on the rolls and in the roll core indicating original manufacturer, style name, roll size, and tracking roll number. The material must also be labeled on the material itself for easy identification once the roll has been unwrapped and unrolled.

1.  $T_{ULT}$  shall be the minimum average roll value (MARV) ultimate tensile strength as tested per ASTM D6637, Method B. **Testing by ASTM D6637, Method A (single rib) is not allowed in the determination of wide width tensile strength or Long-Term Design Strength (LTDS).**  $T_L$  or LTDS, are determined per AASHTO, FHWA, GRI, and NCMA guidelines where  $LTDS = T_{ULT} / (RF_{CR} \times RF_{ID} \times RF_D)$ .  $RF_{CR} = 1.45$ ;  $RF_D = 1.15$ ;  $RF_{ID} = 1.05$  (Sand);  $RF_{ID} = 1.10$  (Sandy Gravel);  $RF_{ID} = 1.25$  (Gravel).

Property	Geosynthetic Reinforcement		
	Type 1	Type 2	Type 3
Allowable LTDS – (kN/m)			
Coefficient of Interaction $C_i$			
Coefficient of Direct Sliding - $C_{Ds}$			

Calculation of the allowable reinforcement tension shall use the following method:  
Allowable reinforcement Tension:

The allowable reinforcement tension,  $T_a$ , at the end of the service life shall consider the time-temperature creep characteristics of the reinforcement, environmental degradation, construction induced damage and an overall factor of safety.

$$T_a = \frac{T_{ult}}{RF_D \times RF_{ID} \times RF_{CR} \times FS_{UNC}}$$

**where:**

$T_{ult}$  = Ultimate (or yield tensile strength) from wide width tensile strength tests (ASTM D4595 or ASTM D6637).

$RF_D$  = Durability reduction factor is dependent on the susceptibility of the geosynthetic to be attacked by any microorganisms, chemicals, thermal oxidation, hydrolysis and stress cracking and can vary partially from 1.1 to 2.0.

$RF_{ID}$  = Installation damage reduction factor that can range from 1.05 to 3.0, depending on backfill gradation and product mass per unit weight.

$RF_{CR}$  = Creep reduction factor is the ratio of the ultimate strength ( $T_{ult}$ ) to the creep limit strength obtained from laboratory creep tests for each product, and can typically vary from 1.5 to 5.0.

$FS_{UNC}$  = Overall factor of safety or load factor to account for uncertainties in the geometry of the structure, fill properties, reinforcement properties, and externally applied loads, and shall be no less than 1.5.

In no case shall the product  $RF_D \times RF_{ID} \times RF_{CR}$  be less than 2.0.

#### 1.04 SUBMITTALS

- A. The Contractor shall submit 1 set of detailed design calculations, construction drawings, and shop drawings for approval at least 30 days prior to the beginning of construction with the Flex MSE VGMSE Retention System. The calculations and drawings shall be prepared and sealed by a Professional Engineer, licensed in the region. Upon approval, the Engineer will make available 1 set of the drawings to the Contractor. The Contractor shall obtain the approved drawings prior to commencing construction.
- B. Submit geogrid, Flex MSE VGMSE Geomodular Bag and Interlocking Plate unit samples.
- C. At least 30 days prior to the start of the Flex MSE VGMSE Retention System construction, the Contractor shall submit their official Installer Certificate, Manufacturer's installation instructions, and product data sheets for the geogrid soil reinforcement and Geomodular Bags, to meet the requirements set forth in the respective material specifications.
- D. The Contractor shall submit Flex MSE VGMSE Bag fill material sieve and soil nutritional analysis a minimum of 30 days prior to construction.
- E. The Contractor shall provide to the Owner's Engineer with the VGMSE and Geogrid Manufacturers' current ISO 9001 certificates a minimum of 30 days prior to construction.

- F. The connection strength between the geogrid and the facing units under a normal stress of 300 lb/ft shall be at least 396 lb/ft at 0.75 in of facing displacement. Connection testing determined by ASTM D6638 (modified).
- G. Within 30 days of completing construction of the Flex MSE VGMSE works, the Contractor shall submit as-built drawings that confirm the geometries and materials installation conform to the locations shown on the construction drawings.

## **1.05 QUALITY ASSURANCE**

- A. Qualifications - The VGMSE system meets all of these qualifications:
  - 1. The geogrid reinforcement, Geomodular Bag and Interlocking Plate components must comply with these specifications.
  - 2. The VGMSE system manufacturer provides:
    - a. Valid ISO 9001 certificate
    - b. Mill Certificates for the Bag material and Plate resin
    - c. Type III Environmental Product Declaration
    - d. Record of all national and regional certifications
  - 3. Manufacturer shall have experience in the supply of at least 500 VGMSE projects worldwide.
- B. The design shall be stamped and signed by a registered Professional Engineer in the region, who shall demonstrate a minimum Errors and Omissions insurance coverage as required for the project by furnishing the Engineer with a current certificate of insurance.

## **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Storage and Protection
  - 1. Prevent excessive mud, wet concrete, epoxy, or other deleterious materials from coming in contact with and affixing to the geogrid materials.
  - 2. Prevent any ecotoxic, acid, or alkaline materials from coming in contact with the VGMSE system.
  - 3. Store at temperatures above -20 degrees F.
  - 4. All geotextile materials to be palletized, covered and or wrapped for transport and while on site.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Approved VGMSE Supplier: Flex MSE [info@flexmse.com](mailto:info@flexmse.com)
- B. All suppliers of the VGMSE or their representative must request, in writing 15 days prior to the bid date, to be placed on the approved supplier list.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. The Contractor shall check the geogrid, Geomodular Bag and Interlocking Plate units upon delivery to verify that the proper material has been received. The geogrid, Geomodular Bag and Interlocking Plate units shall be inspected by the Contractor to be free of flaws or damage occurring during manufacturing, shipping, or handling.

### 3.02 VGMSE INSTALLATION

- A. See Flex MSE Installation Guidelines and Installation and Geogrid Installation CADs for details.

### 3.03 VEGETATION

- A. Vegetation is performed according to the project's vegetation plans. Vegetation is achieved through single or combined methods during and/or after construction. Thoroughly water the installation prior to any vegetation method. For Live Planting or Brush Layering refer to Contract Documents and manufacturer CADs for plant lists, spacing, and placement instructions. Vegetation on the facing or top of the wall or slope shall be under 6.5 ft in mature height. Vegetation will meet establishment guidelines within the projects specified establishment time period.
  - 1. Hydroseed with a High Performance Flexible Growth medium, with installation precedence at the prescribed wall or slope face angle. On face angles steeper than 4V:1H, select seed varieties with mature heights under 24 in. 100% coverage with the mulch product must be achieved. Seed mixtures shall be purchased from accredited sources with guaranteed standard germination rates. Seed quality and mix shall be submitted to the Owner's representative prior to application.
  - 2. Live plant according to the Flex MSE Live Planting CAD. Do not cut Bags positioned below the Normal High Water Mark.
  - 3. Brush layering with containerized or rooted plants by positioning the root ball between or behind the Bags (see Flex MSE Brush Layering CAD).
  - 4. Brush Layering with live stakes by punching the stake/branch directly into the Bags or in between the Bags (see Flex MSE Brush Layering CAD).



**Bowman**  
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**Cascade**  
GEOSYNTHETICS

## LOCATIONS & CONTACT INFO

### ASP ENTERPRISES

aspent.com  
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### BOWMAN CONSTRUCTION SUPPLY

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**Denver, CO** 303.696.8960  
**Colorado Springs, CO** 719.257.7840  
**Loveland, CO** 970.535.0863

**Des Moines, IA**  
515.289.1271

**Portland, OR**  
971.339.1020

## SOLUTIONS WE SUPPLY

### GEOSYNTHETICS

Filter Fabrics

Stabilization Fabrics

Geogrids

- Road Grids
- Wall Grids
- Slope Stabilization

Specialty Fabrics

Composite Geomembranes

- GCLs, PVC, HDPE, LLDPE, EPDM, Granular Bentonite

### SEDIMENT CONTROL

Inlet Protection

- Grated Inlet, Curb Inlet, Area Inlet Protection

Ditch Checks

- Triangle Silt Dike
- GeoRidge

Perimeter Protection

- High and Low-Porosity Silt Fence, Straw Wattles, Silt Socks
- Safety Fence

Flocculants & Water Treatment

- Polymer-Based & Natural Flocculants

Sediment Basin Skimmers

Dewatering Bags

Trackout Control

- FODS
- Rumble Grates

Turbidity Curtains

### EROSION CONTROL

Basic Hydraulically Applied Mulches

- Wood
- Paper
- Blends
- Straw

High-Performance Hydraulically

Applied Products

- BFM
- FGM
- Additives & Tackifiers

Temporary Erosion Control Blankets

- Coir & Jute Mat/Nettings
- Short-Term ECBs
- Extended-Term ECBs

Permanent Erosion Control Blankets

- Turf Reinforcement Mats
- HP-TRMs
- Anchor Reinforced Vegetation System

Structural BMPs

- Transition Mats
- Geoweb Cellular Confinement
- Composite Vegetated Armor System
- Flex MSE Vegetated Wall System
- Articulated Concrete Block
- Gabions
- Grout-Filled Geotextile Mats

Vegetation Establishment

- Native Seed & Turf Seed
- Fertilizers
- Organic Soil Additives
- Stratavault Soil Cells

### STORMWATER MANAGEMENT

Water Quality

- Inlet Filter Boxes
- Pre-Treatment Chamber
- Nutrient Separating Baffle Boxes
- High-Flow Biofiltration Media
- Hydrodynamic Separators
- Stratavault

Water Quantity

- Modular Underground Storage Systems
- Chamber Detention Systems

Drainage

- HDPE Swale Liner
- Pipe & Fittings
- Drainage Composites
- Strip Drain

Inlet Structures

- PVC
- Drain Basins, In-Line Drains
- Landscape

Permeable Pavers

- Permeable Articulating Concrete Block
- Grass Pavers
- Gravel Pavers
- Concrete Pavers

### SPECIALTY

Natural & Synthetic Coir Fiber Logs

Vegetated Reinforced Soil Slopes

Soil Anchors

Root Barrier System

AquaBlok

Muscle Wall

We are full line distributors of construction materials for all project types. Contact us for assistance with a project. From specification and development to installation and completion, we're here to help with all of your site solution needs.

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