FIBER REINFORCED MATRIX (FRM)

SCDOT Designation: SC-M-815-4 (11/08)

1.0 Fiber Reinforced Matrix (FRM)

This supplemental specification replaces sections 815.1.1.6 815.2.11, 815.4.16, 815.5, and 815.6 for Flexible Growth Matrix (FGM) in the *South Carolina Department of Transportation Standard Specifications for Highway Construction*, 2007 Edition.

1.1 Description

Use Fiber Reinforced Matrix (FRM) as an allowable mulch for erosion control and vegetation establishment as outlined in *Supplemental Specification for Seeding SCDOT Designation SC-M-810*. Do not use FRM as a channel liner or for areas receiving concentrated flow. Install FRM in the following situations:

- As a Type A Temporary Erosion Control Blanket. (Refer to the current *SCDOT Rolled Erosion Control Products (RECP) Specification.*)
- On slopes up to 2H:1V with slope lengths less than 75 feet for permanent cover applications.
- On slopes up to 1H:1V with slope lengths less than 50 feet for temporary cover applications.
- For permanent cover applications on slopes 1:1 or greater at a rate of 4,500 pounds per acre as directed by the RCE when the proper installation of a TRM is not practicable due to site constraints.
- As an infill for SCDOT approved infill TRMs for permanent cover applications on slopes greater than 2H:1V.
- As an infill for SCDOT approved infill TRMs for channel applications.
- In environmentally sensitive wetlands and other wildlife areas not compatible for products containing netting.
- When the site requires strong mechanical and chemical bonds to withstand greater surface flow and/or severe slopes.
- When the minimum required functional longevity of soil protection is 12 months.
- When the site requires immediate erosion protection and there is a risk of impending weather.
- When fast vegetation establishment is required.
- When a high factor of design safety is required.

1.2 Materials

Provide a Fiber Reinforced Matrix (FRM) composed of a hydraulically applied matrix composed of organic defibrated fibers, cross-linked insoluble hydro-colloidal tackifiers, and reinforcing natural and / or synthetic fibers. Provide a FRM that is a flexible erosion control matrix and forms a lofty, interlocking matrix which creates air space and water absorbing cavities that improves seed germination, reduces the impact of raindrop energy, and minimizes soil loss. Do not use materials composed of paper, cellulose fiber, or a mixture of paper, cellulose, and other materials. Provide an FRM composed of:

- Long strand, non-toxic fibers.
- Thermally processed fibers heated to an appropriate temperature for sterilization purposes.
- Crimped, interlocking natural or synthetic fibers.
- Performance enhancing additives.
- Water insoluble cross-linked hydro-colloidal tackifiers and activators.

Furnish a FRM that requires no curing period and when applied forms an intimate bond with the soil surface to create a continuous, porous, absorbent, and erosion resistant matrix that allows rapid germination

and accelerated plant growth. Do not use materials listed or used for Hydraulic Mulch (HM), Stabilized Mulch Matrix (SMM), or Bonded Fiber Matrix (BFM) applications.

Seed, lime, and fertilizer may be added to the FRM mixture according to the current requirements of **Section 810**, *Seeding Specifications*. Furnish FRM components pre-packaged by the manufacturer to assure material performance and compliance with the minimum physical requirements of Table 1 when applied at a rate of 3,500 pounds per acre. Under no circumstances will field mixing of additives or components be accepted.

Table 1: Minimum FRM Performance and Physical Requirements

Property		Required Value
Thermally Processed Fiber by Weight		75% ± 10%
Crimped Interlocking Fibers		5% ± 2%
Cross-linked Hydro-Colloidal Polymer Tackifiers and Activators		10% ± 2%
Moisture Content		10% ± 3%
Organic Matter		90% minimum
Color		Colored to contrast application area, shall not stain concrete or painted surfaces.
FRM Property	**Test Method**	**Required Value**
Physical		
Mass Per Unit Area	ASTM D6566*	11.0 oz/yd^2 minimum
Thickness	ASTM D6525*	0.15 inch minimum
Ground Cover	ASTM D6567*	97% minimum
Water Holding Capacity	ASTM D7367	1400 % minimum
Flexural Rigidity (wet)	ASTM D6575*	5 oz-yd maximum
Endurance		
Functional Longevity	Observed	Minimum of 12 months
Performance		
Cover Factor	SCDOT Approved Large Scale Testing	0.01 maximum
% Effectiveness	SCDOT Approved Large Scale Testing	99% minimum
Cure time	SCDOT Approved Large Scale Testing	98% Effective 2 hours after application
Vegetation Establishment	ASTM D7322*	500% minimum

* ASTM test methods developed for Rolled Erosion Control Products (RECPs) that have been modified to accommodate Hydraulic Erosion Control Products (HECPs).

Provide FRM from a manufacturer listed on the most recent edition of *SCDOT Qualified Products List 66* and provide documentation of testing at an approved independent laboratory demonstrating performance based on reduced water runoff, reduced soil loss, and enhanced plant germination.

1.2.1 Quality Assurance

Before installation of FRM, provide the following information from the manufacturer:

- Written quality control program conforming to the requirements of subsection 1.2.2 *Quality Control*.

- Documentation of field and/or laboratory testing that quantifies the performance of the product conforming to the requirements of subsection 1.2.2 *Quality Control*.

Ensure that each package of FRM bears complete identification including, but not limited to, the following:

- Manufacturer's name and location,
- Manufacturer's telephone number and fax number,
- Manufacturer's e-mail address and web address,
- FRM name, model, and/or serial number, and
- FRM physical composition.

FRM is listed on the most recent edition of *SCDOT Qualified Product List 66* prior to being accepted for use. Prior to inclusion on *SCDOT Qualified Products List 66*, FRM must meet the physical and performance criteria outlined in this specification.

1.2.2 Quality Control

Before installation of FRM, provide the following information from the manufacturer:

- Written description of the manufacturer's quality control program of field and/or laboratory testing that quantifies the performance of the product. Performance testing must take place at a laboratory accredited to perform tests required for the product tested.
- Instructions on the proper installation and maintenance of the FRM.
- Certification of the testing requirements upon request.

Provide verification of conformance with manufacturer's published specifications (i.e. the certification) which at a minimum identify the following:

- Independent qualified test facility name and location,
- Manufacturer,
- Product ID,
- Test ID, and
- Test date.

1.3 Construction Requirements

1.3.1 Installation

Use FRM with components pre-packaged by the manufacturer to assure material performance. Do not field mix materials, performance enhancing additives, or components such as polyacrylamides or tackifiers.

Examine substrates and conditions before applying materials. Do not proceed with installation until unsatisfactory conditions are corrected. Apply FRM to geotechnically stable slopes that are constructed to divert runoff water away from the face of the slope, eliminating damage to the slope face caused by the surface flow from above the slope.

Use personnel or subcontractors certified and trained by the manufacturer in the proper procedures for mixing and application of FRM. Strictly comply with the manufacturer's mixing recommendations and installation instructions. Use approved hydraulic seeding/mulching machines with appropriate nozzles for FRM applications. Apply FRM from opposing directions to the soil surface in successive layers, reducing the "shadow effect" to achieve maximum coverage of all exposed soil. FRM does not require a cure time and is effective immediately; therefore, FRM may be applied immediately before, during, or after a "typical" rainfall event. Avoid installing FRM during high intensity rainfall events. Install FRM materials at the general application rates of Table 2.

Table 2: FRM Installation Requirements

Condition	Max Continuous Slope Length (ft)	Temporary Cover by Mulch (no seed) Application Rate (lbs/acre)	Temporary Cover by Seeding Application Rate (lbs/acre)	Permanent Cover Application Rate (lbs/acre)
4:1 Slope	100	2,500	1,500	2,500
3:1 Slope	85	3,000	1,800	3,000
2:1 Slope	75	3,500	2,000	3,500
1:1 Slope	50	4,000	2,500	NA**
Below TRM	NA	NA	NA	1,500
TRM Infill*	NA	NA	NA	3,500

*Use SCDOT Approved TRM for Infill Applications.

** FRM may be used for permanent cover applications on slopes 1:1 or greater at a rate of 4,500 pounds per acre as directed by the RCE when the proper TRM installation is not practicable due to site constraints.

1.3.2 Delivery Storage and Handling

Use FRM with components pre-packaged by the manufacturer to assure material performance. Have materials and products delivered in UV and weather resistant factory labeled packages. Store and handle FRM in strict compliance with the manufacturer's instructions and recommendations. Protect FRM from damage from weather, excessive temperatures, and construction operations. Clean all spills promptly.

1.3.3 Inspection and Maintenance

Prepare a FRM maintenance plan that includes the following:

- Reapplication of FRM as directed by RCE to disturbed areas that require continued erosion control.
- Maintenance of equipment to provide uniform application rates.
- Rinsing all FRM mixing and application equipment thoroughly with water to avoid formation of residues and appropriate discharge of rinse water.

Degradation of FRM can be expected to occur as a result of mechanical degradation, chemical degradation, biological hydrolysis, sunlight, salt, and temperature. Where necessary, reapply FRM in accordance with the manufacturer's instructions. Reapplication is not required unless FRM treated soils are disturbed or turbidity or water quality shows the need for an additional application. If FRM treated soils are left undisturbed, the necessity of reapplication will be determined by the RCE. The Department will not pay for the reapplication of FRM within 12 months of the initial application unless the reapplication is approved by the RCE.

1.3.4 Acceptance

Obtain RCE acceptance and approval of FRM installations. When requested by the RCE, ensure that a manufacturer's representative is on-site to oversee and approve the initial FRM installation. Obtain a letter from the manufacturer approving the installation when requested by the RCE.

1.4 Measurement

The quantity for the pay item Fiber Reinforced Matrix (FRM) is the surface area covered by the FRM applied at the recommended rate and is measured by the one-acre (acre) unit of FRM in-place, complete, and accepted. The installation of FRM may require written acceptance by the manufacturer's representative before acceptance for payment.

1.5 Payment

Payment for Fiber Reinforced Matrix (FRM) is full compensation for installing FRM as specified or directed by the RCE and includes furnishing, applying, and maintaining the FRM including testing and documentation of Quality Control and Quality Assurance programs and all other materials, labor, equipment, tools, supplies, transportation, and incidentals necessary to fulfill the requirements of the pay item in accordance with the Plans, the Specifications, and other terms of the Contract.

Table 3: Bid Item Number

Bid Item Number	Description	Units
8151020	Fiber Reinforced Matrix (FRM)	acre