Iowa Department of Transportation

MINUTES
OF
IOWA D.O.T. SPECIFICATION COMMITTEE MEETING

February 12, 2009

Members Present:	John Adam	Statewide Operations Bureau
	Jim Berger	Office of Materials
	Roger Bierbaum	Office of Contracts
	Bruce Kuehl	District 6 - District Construction
	Doug McDonald	District 1 - Marshalltown RCE
	Gary Novey	Office of Bridges & Structures
	Charlie Purcell	Office of Local Systems
	Tom Reis, Chair	Specifications Section
	John Smythe	Office of Construction
Members Not Present:	Troy Jerman	Office of Traffic & Safety
	Mike Kennerly	Office of Design
	Dan Redmond	District 4 - District Materials
Advisory Members Present:	Lisa Rold	FHWA
Others Present:	Donna Buchwald	Office of Local Systems
	Daniel Harness	Office of Design
	John Heggen	District 1 - District Materials
	Mark Masteller	Office of Design

Tom Reis, Specifications Engineer, opened the meeting. The following items were discussed in accordance with the agenda dated February 6, 2009:

1. Article 2413.03, C, 2, Class HPC-O High Performance Concrete.

The Office of Construction requested a change to clarify the requirements of the finishing machine for bridge floors.

2. Article 2506.02, D, Admixtures.

The Office of Materials requested changes to eliminate the air entrainment limit.

3. Section 2601, Erosion Control.

The Office of Design requested changes to update terminology; and add Turf Reinforced Mats and compost.

4. Article 2602.03, Construction.

The Office of Design requested changes to add an option for use of compost as a filter sock medium.

5. Article 4111.03, Quality.

The Office of Materials requested a change to absolute strength for mortar.

6. Article 4117.03, Quality.

The Office of Materials requested a change to absolute strength for mortar.

7. Section 4169, Erosion Control Materials.

The Office of Design requested changes to update terminology; and add Turf Reinforced Mats and compost.

8. DS-011XX, Fabric Formed Concrete Structure Revetment.

The Office of Bridges and Structures requested changes to DS-01083 to eliminate shop drawings, to add sizes to Table B - Articulating Block Mat Properties, and to change the concrete grout mix.

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: John Smythe / Wayne A. Sunday	**Office:** Construction	**Item 1**
Submittal Date: January 27, 2009	**Proposed Effective Date:** October 2009	
Article No.: 2413.03, C, 2 **Title:** Class HPC-O High Performance Concrete	**Other:**	

Specification Committee Action: Deferred.

Deferred: X	**Not Approved:**	**Approved Date:**	**Effective Date:**

Specification Committee Approved Text:

Comments: Office of Construction noted this may have been carried over from the old latex modified concrete requirements for bridge deck overlays. The Office of Bridges asked what is required for dense mix. They noted since a vibrating screed is used, the Contractor would need to get as close to the curb as possible. The Office of Construction asked to defer the item until they have a chance to look into the requirements further.

Specification Section Recommended Text:

2413.03, C, 2, Class HPC-O High Performance Concrete.

Replace the first paragraph:

The finishing machine shall meet the requirements of Article 2412.06 ~~and be capable of finishing the surface to within 1 foot (0.3 m) of the edges of the area being placed~~.

Comments:

Member's Requested Change (Redline/Strikeout):

2. Class HPC-O High Performance Concrete.
The finishing machine shall meet the requirements of Article 2412.06. ~~and be capable of finishing the surface to within 1 foot (0.3 m) of the edges of the area being placed.~~

Reason for Revision: Specification Article 2412.06 does not have a stated requirement for the finishing machine to be capable of finishing the surface to within 1 foot (0.3 m) of the edges of the area being placed. Also drum type finishing machines are not typically capable of finishing much closer than 1 1/2 feet to the edges. Regardless of the finishing machine used, Contractors will operate the finishing machine as close to the edges of the area being placed to minimize the area of hand finishing that must be done.

County or City Input Needed (X one)			**Yes**	**No**	
Comments:					
Industry Input Needed (X one)			**Yes**	**No**	
Industry Notified:	**Yes**	**No**	**Industry Concurrence:**	**Yes**	**No**
Comments:					

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Jim Berger	**Office:** Materials	**Item 2**
Submittal Date: 2008.12.04	**Proposed Effective Date:** October 2009	
Article No.: 2506.02, D **Title:** Admixtures (Flowable Mortar)	**Other:**	

Specification Committee Action: Approved as is.

Deferred:	**Not Approved:**	**Approved Date:** 2/12/09	**Effective Date:** 10/20/09

Specification Committee Approved Text: See Specification Section Recommended Text.

Comments: None.

Specification Section Recommended Text:

2506.02, D, Admixtures.

Replace the article:

Air entraining and water reducing admixtures may be added ~~at a rate not to exceed 2 fluid ounces per cubic yard (75 mL/m^3)~~ to increase the fluidity of flowable mortar.

Comments:

Member's Requested Change (Redline/Strikeout):

D. Admixtures.

Air entraining and water reducing admixtures may be added ~~at a rate not to exceed 2 fluid ounces per cubic yard (75 mL/m^3)~~ to increase the fluidity of flowable mortar.

Reason for Revision:

County or City Input Needed (X one)	**Yes**	**No**

Comments:

Industry Input Needed (X one)			**Yes** Sent to IRMCA	**No**	
Industry Notified:	**Yes** X	**No**	**Industry Concurrence:**	**Yes** X	**No**

Comments: There is no need to limit the air entrainment to aid in fluidity. Several mixes have been already placed on primary projects with air entrainment and water reducers to improve the placement. It has become common practice in some areas to use both admixtures in flowable mixes. Several ready mix producers have also noted the positive effects on other non primary projects.

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Mike Kennerly / Ole Skaar	**Office:** Design	**Item 3**
Submittal Date: January 30, 2009	**Proposed Effective Date:** October 2009	
Section No.: 2601 **Title:** Erosion Control	**Other:**	

Specification Committee Action: Approved with changes as noted.

Deferred:	**Not Approved:**	**Approved Date:** 2/12/09	**Effective Date:** 10/20/09

Specification Committee Approved Text:

See Specification Section Recommended Text.

Replace Article 2106.06, B with:

B. Highly erosive soils or sloped embankments with drainage onto the area shall have the compost incorporated by mixing it into the top soil a minimum of 2 inches (50 mm) to prevent the compost from washing off the slope.

Comments: The Office of Design explained they have been experimenting with turf reinforcement mats (TRM) for several years. TRMs are effective in areas where higher flows are expected. They also noted local agencies have been using compost for several years. The Department has used it in a few locations on I-235 and the Avenue of the Saints. TRM may be used as the top mat or can be incorporated into the underlying soil.

District 6 asked if "incorporated" is defined. The Office of Design noted the intent of "incorporated" is to mix the compost into the top couple inches of soil. The Specifications Section asked if this needs to be clarified in the specifications. The Committee agreed to add language to clarify, in this case, "incorporate" means to mix into the top 2 inches (50 mm) as a minimum.

District 6 noted the waterings have been reduced in number and quantity of water. The Office of Design explained this was done to make the specifications more realistic with what is actually being done. They noted in some situations, more watering may be necessary.

The Office of Construction noted there may be some difficulty related to hydraulic seeding concerning the 1/4 inch (6 mm) specified for seed mixed into the compost. This will be difficult to measure. They suggested implementing some type of range. The Office of Design explained the intent is that a majority of the compost be placed before spreading seed. If seed is mixed throughout the compost layer, the seed at the bottom part of the compost layer may not germinate. The Committee decided to leave the language as is.

Specification Section Recommended Text:

2601.03, G, Hydraulic Seeder.

Replace the title and article:

G. Hydraulic Seeder and Mulcher.
Hydraulic seeding equipment shall include a pump rated at not less than 100 gallons (350 L) per minute. Inoculant, seed, and fertilizer may be applied in a single operation, unless otherwise stated in the contract documents. Hydraulic mulch shall be applied as a separate operation unless stated otherwise in the contract documents. The equipment shall have a suitable working pressure and a nozzle adapted to the type of work. Supply tanks shall have a means of mechanical agitation. Tanks shall be calibrated and provided with a calibration stick

or other approved device to indicate the volume used or remaining in the tank.

2601.03, R, Silt Fence Machine.

Add new article:

R. Silt Fence Machine.
The machine shall slice-in and place silt fence at a minimum depth of 12 inches (300 mm).

2601.04, K, Spring Overseeding.

Renumber the article

2601.04, ~~K~~L, Spring Overseeding.

2601.04, K, Pneumatic Seeding.

Add new article:

K. Pneumatic Seeding.
Includes furnishing and applying compost to a depth of 1 inch (25 mm) on all designated disturbed areas. Compost shall be applied with a pneumatic (air blower) system with sufficient hose to reach 300 feet (100 m). Driving on the soil to apply the compost will not be allowed. Seed shall be applied with the top 1/4 inch (6 mm) of compost material. Fertilizer shall be incorporated into the full depth of compost material. Seedbed preparation shall be in accordance with Article 2601.04, J.

2601.04, L, Native Grass Seeding and Wetland Grass Seeding.

Renumber the article

2601.04, ~~L~~M, Native Grass Seeding and Wetland Grass Seeding.

Replace the Native Grasses table:

SEEDS COMMON NAMES, SCIENTIFIC NAMES, PLS			
Common Name	**Scientific Name**	**PLS (per ac)**	**PLS (per ha)**
NATIVE GRASSES & WILDFLOWERS: All seed, except Grain Rye, shall be certified as Source Identified Class (Yellow Tag) Source G0-Iowa.			
~~Annual~~ Grain Rye~~grass~~	~~Lolium perenne, var. italicum~~ Secale cereale	~~45~~ 22.5 lbs.	~~50~~ 25 kg
Canada Wild Rye	Elymus canadensis	12 lbs.	13 kg
Switchgrass ~~- Blackwell, NE, 28, Pathfinder, or Cave-in-Rock~~	Panicum virgatum	2 lbs.	2.2 kg
Big Bluestem ~~- Kaw, Roundtree, or Champ~~	Andropogon gerardi	8 lbs.	9 kg
Indiangrass ~~- NE, 54, Otto, or Holt~~	Sorghastrum nutans	8 lbs.	9 kg
Little Bluestem ~~- Blaze, Aldous, or Camper~~	~~Andropogon scoparius~~ Schizachyrium scoparium	4 lbs.	4.5 kg
~~Sideoats Grama - Butte, or Trailway~~ Side-oats grama	Bouteloua curtipendula	3 lbs.	3.4 kg
Blue Grama	Bouteloua gracilis	3 lbs.	3.4 kg
Purple Prairie Clover	~~Petalostemum purpureum~~ Dalea purpurea	4 oz.	280 g

Blackeyed Susan	Rudbeckia hirta	4 oz.	280 g
Prairie Blazing Star	Liatris pycnostachya	4 oz.	280 g
~~Purple Coneflower~~ Butterfly weed	~~Echinacea purpurea~~ Asclepias tuberosa	4 oz.	280 g
~~Plains Coreopsis~~ Wild bergamot	~~Coreopsis tinctoria~~ Monarda fistulosa	4 oz.	280 g
~~Grayhead Prairie~~ Gray-headed coneflower	Ratibida pinnata	4 oz.	280 g
New England Aster	~~Aster novae-angliae~~ Symphyotrichum novae-angliae	2 oz.	140 g

2601.04, M, Wildflower Seeding.

Renumber the article.

2601.04, ~~M~~N, Wildflower Seeding.

2601.04, N, Mowing.

Renumber the article.

2601.04, ~~N~~O, Mowing.

2601.05, A, Stabilizing Crop Seed Mixture.

Replace the table following the third paragraph:

Spring -- March 1 to May 20		
Oat	2 bu. per acre	(75 kg/ha)
~~Winter~~ Grain Rye	1 bu. per acre	(63 kg/ha)
Red Clover	5 lbs. per acre	(6 kg/ha)
Timothy	5 lbs. per acre	(6 kg/ha)
Summer -- May 21 to July 20		
Oat	3 bu. per acre	(108 kg/ha)
~~Annual~~ Grain Rye	~~35 lbs.~~ 2 bu. per acre	(~~39~~ 126 kg/ha)
Red Clover	5 lbs. per acre	(6 kg/ha)
Timothy	5 lbs. per acre	(6 kg/ha)
Fall -- July 21 to September 30		
Oat	2 bu. per acre	(72 kg/ha)
~~Winter~~ Grain Rye	2 bu. per acre	(126 kg/ha)
Red Clover	5 lbs. per acre	(6 kg/ha)
Timothy	5 lbs. per acre	(6 kg/ha)

2601.06, Mulching.

Renumber and **replace** article:

2601.~~06~~07, Mulching.

A. Time of Mulching and Fertilizer.
All areas requiring mulch shall be mulched as soon as seed is sown and final rolling completed.

B. Application of Mulch.

1. Straw Mulch.
Mulch shall be evenly and uniformly distributed and anchored into the soil. The application rate for reasonably dry material shall be approximately 1 1/2 tons per acre (3.5 Mg/ha) of dry cereal straw, native grass straw, ~~2 tons per acre (4.5 Mg/ha) of~~

~~wood excelsior, or 2 tons per acre (4.5 Mg/ha) of prairie hay,~~ or other approved material, depending on the type of material furnished. All accessible mulched areas shall have mulch consolidated into the soil with a mulch stabilizer, and slope areas shall be tucked on the contour. Crawler type or dual wheel tractors shall be used for the mulching operation. Equipment shall be operated in a manner to minimize displacement of the soil and disturbance of the design cross section.

2. Hydraulic Mulches
Hydraulic mulches shall be applied at no less than the manufacturer's recommended minimum rate using standard hydraulic mulching equipment.

2601.06, Composting.

Add new article:

2601.06 Composting.
Compost may be used as a top dress application or as an incorporated soil amendment.

A. Top dress applications may be used for urban seeding or on soils that are highly erosive or sloped soils to prevent surface or rill erosion and to provide organic material and nutrients needed for vegetative establishment. Areas top dressed with compost shall have little or no drainage onto the area.

B. Highly erosive or sloped soils with drainage onto the area shall have the compost incorporated to prevent the compost from washing off the slope.

Renumber Articles 2601.07 to 2601.09 as **2601.08 to 2601.10**.

2601.~~07~~08 RESEEDING, REFERTILIZING, AND REMULCHING.
2601.~~08~~09 SODDING.
2601.~~09~~10 CONSTRUCTING AND RESHAPING INTERCEPTING DITCHES AND FLUMES.

2601.10, Special Ditch Control and Slope Protection.

Renumber article and **replace** title:

2601.~~10~~11, Special Ditch Control, Turf Reinforcement Mat, and Slope Protection.
This work shall include the following:

A. Special ditch control wood excelsior mat or other material specified shall include shaping of channels on all ditches, furnishing and applying seed and fertilizer, mulch, ditch control material, and water, all in accordance with the contract documents.

B. Turf Reinforcement Mat (TRM) shall include shaping of channel, ditches or slopes, furnishing and applying seed and fertilizer, furnishing and applying a minimum of 1 inch of soil suitable for the establishment of vegetation on the TRM, furnishing and applying special ditch control wood excelsior mat on the soil fill and watering, all in accordance with the contract documents.

~~B~~C. Special ditch control over sod shall include furnishing and applying jute mesh or other the specified material, including staples, over the sodded areas.

~~C~~D. Slope protection wood excelsior mat or other material specified shall include furnishing and applying of the specified material on the slopes designated by the Engineer.

Materials shall meet the requirements of Article 4169.10.

The Engineer will designate the areas for each type of work.

2601.11, Preparation of Area to be Treated with Special Ditch Control and Slope Protection.

Renumber article and **replace** title:

2601.~~11~~12, Preparation of Area to be Treated with Turf Reinforcement Mat, Special Ditch Control, and Slope Protection.

Replace fourth paragraph:

Preparation ~~of the ditches for special ditch control~~ and placement of the ditch control or TRM material shall be coordinated with the seedbed preparation, seeding, including sticking agent, and inoculant, fertilizing, and mulching of the adjacent area of right-of-way.

2601.12, Seeding for Special Ditch Control and Slope Protection.

Renumber article

2601.~~12~~13, Seeding for Special Ditch Control and Slope Protection.

Replace the table in Article 2601.12, A:

DITCHES OUTSIDE SHOULDER Fescue, ~~or~~ Fawn ~~Birdsfoot Trefoil (Empire)~~ Fescue Creeping Red Ryegrass (Perennial)	 70% 10% 20%
MEDIAN DITCHES Fescue, Fawn Birdsfoot Trefoil (Empire) Ryegrass (Perennial)	 77% 3% 20%

2601.14, Mulch for Special Ditch Control and Slope Protection.

Delete the title and article.

2601.15, Application of Special Ditch Control Materials on Seeded Areas.

Replace the title:

2601.15. Application of Special Ditch Control and Turf Reinforcement Mat Materials on Seeded Areas.

2601.15, B, Other Materials.

Replace the title and the article:

B. ~~Other Materials~~ Turf Reinforcement Mat.

~~When other materials are specified, the details for installation will be specified in the contract documents.~~ TRM shall be placed on channel or slope after shaping and shall be applied following the manufacturer's instructions and in accordance with the contract documents.

2601.17, Finishing Adjacent to Special Ditch Control Areas.

Replace the title:

2601.17. Finishing Adjacent to Special Ditch Control and Turf Reinforcement Areas.

2601.19. Watering of Special Ditch Control and Slope Protection.

Replace the title and article:

2601.19. Watering of Special Ditch Control, Turf Reinforcement Mat, and Slope Protection.
The Contractor shall provide watering equipment and an approved water supply before special ditch control, TRM, or slope protection work is started. Following placement of the materials as specified, the area shall be watered not later than the day following placement. Three additional waterings shall be applied at approximately 1 week intervals at the discretion of the Engineer and subject to local weather conditions.

All waterings shall be sufficient to saturate thoroughly the seedbed to a depth of approximately ~~3~~ 2 inches (~~75~~ 50 mm). Each watering may require a maximum of ~~100~~ 50 gallons of water per square (~~40~~ 20 L of water per square meter), and the water shall be applied as a spray or dispersion to prevent damage to the seedbed. Each watering shall be completed within a 4 hour period, and more than one application for each watering may be necessary to provide adequate saturation without runoff.

2601.21, Method of Measurement.

Replace the first indented paragraph:
The Engineer will compute in acres to the nearest 0.1 acre (hectares to the nearest 0.1 hectare) the surface areas of Overseeding and Fertilizing, Seeding and Fertilizing, Pneumatic Seeding, Mulching, Compost, Native Grass Seeding, Wetland Grass Seeding, Wildflower Seeding, Stabilizing Crop Seeding and Fertilizing, Seeding Special Areas, and Crownvetch Seeding.

Replace the fourth indented paragraph:
The Engineer will measure the area of Special Ditch Control, Turf Reinforcement Mat, and Slope Protection in squares of 100 square feet (square meters to the nearest 0.1 m). Measurement of actual area covered will be used, but will not exceed an area based on the actual measured length and design width. Materials used for anchor slots, junction slots, check slots, terminal folds, lap joints, mulch, and seed and fertilizer for Special Ditch Control shall be incidental.

2601.22, Basis of Payment.

Replace the first sentence of the first indented paragraph:
For the number of acres to the nearest 0.1 acre (hectares to the nearest 0.1 hectare) of Overseeding and Fertilizing, Seeding and Fertilizing, Pneumatic Seeding, Mulching, Compost, Native Grass Seeding, Wetland Grass Seeding, Wildflower Seeding, Stabilizing Crop Seeding and Fertilizing, and Crownvetch Seeding, the Contractor will be paid the contract unit price per acre (hectare).

Add as the ninth indented paragraph:
For the number of squares (square meters) of Turf Reinforcement Mat the Contractor will be paid the contract unit price per square (square meter). This payment shall be full compensation for the Turf Reinforcement Mat, preparation and materials including shaping channels, ditches and slopes, soil fill, seed and fertilizing, wood excelsior mat and watering.

Comments:

Member's Requested Change: **(Do not use 'Track Changes', or 'Mark-Up'. Use Strikeout and Highlight.)**

2601.03 EQUIPMENT.

G. Hydraulic Seeder and Mulcher.
Hydraulic seeding equipment shall include a pump rated at not less than 100 gallons (350 L) per minute. Inoculant, seed, and fertilizer may be applied in a single operation, unless otherwise stated in the contract documents. Hydraulic mulch shall be applied as a separate operation unless otherwise stated in the contract document. The equipment shall have a suitable working pressure and a nozzle adapted to the type of work. Supply tanks shall have a means of mechanical agitation. Tanks shall be calibrated and provided with a calibration stick or other approved device to indicate the volume used or remaining in the tank.

R. Silt Fence Machine.

The machine shall slice in and place silt fence at a minimum 12 inch depth.

2601.04 add the pneumatic seeding somewhere after URBAN SEEDING.

Pneumatic Seeding.

Includes furnishing and applying compost to a 1 inch depth on all designated disturbed areas. The compost shall be applied with a pneumatic (air blower) system with sufficient hose to reach 300 feet. Driving on the soil to apply the compost will not be allowed. The seed shall be applied with the top ¼ inch of compost material. The fertilizer shall be incorporated with the full 1 inch of compost material. Seedbed preparation shall be in accordance with 2601.04 J. Urban Seeding.

2601.04, L.

SEEDS COMMON NAMES, SCIENTIFIC NAMES, PLS			
Common Name	**Scientific Name**	**PLS (per ac)**	**PLS (per ha)**
~~**NATIVE GRASSES:**~~ **NATIVE GRASSES & WILDFLOWERS:** All seed, except Grain Rye, shall be certified as Source Identified Class (Yellow Tag) Source G0-Iowa.			
~~Annual~~ Grain Rye~~grass~~	~~Lolium perenne, var. italicum~~ Secale cereale	~~45~~ 22.5 lbs.	~~50~~ 25 kg
Canada Wild Rye wildrye	Elymus canadensis	12 lbs.	13 kg
Switchgrass ~~- Blackwell, NE, 28, Pathfinder, or Cave-in-Rock~~	Panicum virgatum	2 lbs.	2.2 kg
Big Bluestem - Kaw, Roundtree, or Champ	Andropogon gerardi	8 lbs.	9 kg
Indiangrass ~~- NE, 54, Otto, or Holt~~	Sorghastrum nutans	8 lbs.	9 kg
Little ~~Bluestem - Blaze, Aldous, or Camper~~ bluestem	~~Andropogon scoparius~~ Schizachyrium scoparium	4 lbs.	4.5 kg
~~Sideoats Grama - Butte, or Trailway~~ Side-oats grama	Bouteloua curtipendula	3 lbs.	3.4 kg
Blue Grama	Bouteloua gracilis	3 lbs.	3.4 kg

Purple ~~Prairieclover~~ prairie clover	~~Petalostemum purpureum~~ Dalea purpurea	4 oz.	280 g
~~Blackeyed Susan~~ Black-eyed susan	Rudbeckia hirta	4 oz.	280 g
Prairie ~~Blazing Star~~ blazing star	Liatris pycnostachya	4 oz.	280 g
~~Purple Coneflower~~ Butterfly weed	~~Echinacea purpurea~~ Asclepias tuberosa	4 oz.	280 g
~~Plains Coreopsis~~ Wild bergamot	~~Coreopsis tinctoria~~ Monarda fistulosa	4 oz.	280 g
~~Grayhead Prairie~~ Gray-headed coneflower	Ratibida pinnata	4 oz.	280 g
New England ~~Aster~~ aster	~~Aster novae-angliae~~ Symphyotrichum novae-angliae	2 oz.	140 g

2601.05, A:

Spring -- March 1 to May 20

Oat	2 bu. per acre (75 kg/ha)
~~Winter~~ Grain Rye	1 bu. per acre (63 kg/ha)
Red Clover	5 lbs. per acre (6 kg/ha)
Timothy	5 lbs. per acre (6 kg/ha)

Summer -- May 21 to July 20

Oat	3 bu. per acre (108 kg/ha)
~~Annual~~ Grain Rye	~~35 lbs.~~ 2 bu. per acre (~~39~~ 126 kg/ha)
Red Clover	5 lbs. per acre (6 kg/ha)
Timothy	5 lbs. per acre (6 kg/ha)

Fall -- July 21 to September 30

Oat	2 bu. per acre (72 kg/ha)
~~Winter~~ Grain Rye	2 bu. per acre (126 kg/ha)
Red Clover	5 lbs. per acre (6 kg/ha)
Timothy	5 lbs. per acre (6 kg/ha)

…..add this before Mulching

Composting
Compost may be used as a topdress application or as an incorporated soil amendment.

A. Topdress applications may be used for urban seeding or on soils that are highly erosive or sloped soils to prevent surface or rill erosion and to provide organic material and nutrients needed for vegetative establishment. Areas topdressed with compost shall have little or no drainage onto the area.

B. Highly erosive or sloped soils with drainage onto the area shall have the compost incorporated to prevent the compost from washing off the slope.

2601.06:

A. Time of Mulching and Fertilizer.
All areas requiring mulch shall be mulched as soon as seed is sown and final rolling completed.

B. Application of Mulch.
1.) Straw Mulch
Mulch shall be evenly and uniformly distributed and anchored into the soil. The application rate for

reasonably dry material shall be approximately 1 1/2 tons per acre (3.5 Mg/ha) of dry cereal straw or native grass straw, ~~2 tons per acre (4.5 Mg/ha) of wood excelsior, or 2 tons per acre (4.5 Mg/ha) of prairie hay,~~ or other approved material, depending on the type of material furnished. All accessible mulched areas shall have mulch consolidated into the soil with a mulch stabilizer, and slope areas shall be tucked on the contour. Crawler type or dual wheel tractors shall be used for the mulching operation. Equipment shall be operated in a manner to minimize displacement of the soil and disturbance of the design cross section.

2.) Hydraulic Mulches

1) All hydraulic mulches shall be applied at the manufacturer's recommended rate (min.) using standard hydraulic mulching equipment.

2601.10:

2601.10 SPECIAL DITCH CONTROL, TURF REINFORCEMENT MAT (TRM) AND SLOPE PROTECTION.

This work shall include the following:

A. Special ditch control wood excelsior mat or other material specified shall include shaping of channels on all ditches, furnishing and applying seed and fertilizer, mulch, ditch control material, and water, all in accordance with the contract documents.

B. Turf Reinforcement Mat (TRM) shall include shaping of channel, ditches or slopes, furnishing and applying seed and fertilizer, furnishing and applying a minimum of 1 inch of soil suitable for the establishment of vegetation on the TRM, furnishing and applying special ditch control wood excelsior mat on the soil fill and watering, all in accordance with the contract documents.

C.~~B.~~ Special ditch control over sod shall include furnishing and applying ~~jute mesh or other~~ the specified material, including staples, over the sodded areas.

D.~~C.~~ Slope protection wood excelsior mat or other material specified shall include furnishing and applying of the specified material on the slopes designated by the Engineer.

Materials shall meet the requirements of Article 4169.10.

The Engineer will designate the areas for each type of work.

2601.11:

2601.11 PREPARATION OF AREA TO BE TREATED WITH TURF REINFORCEMENT MAT (TRM), SPECIAL DITCH CONTROL AND SLOPE PROTECTION.

The ditch channel shall be shaped in the same manner as preparing a ditch for sod as provided in Article 2601.08, A.

During ditch shaping operations, a seedbed shall be provided with a friable soil condition on the surface. Slope areas to be protected with ditch control material shall be prepared as preparing a seedbed for seeding as provided in Article 2601.04, A, except the depth shall be not less than 3/4 inch (20 mm).

All material 1 1/2 inches (40 mm) in diameter or greater, including clods, rocks, and other debris, which will prevent contact of the ditch control material with the seedbed, shall be removed.

Preparation ~~of the ditches for special ditch control~~ and placement of the ditch control or turf reinforcement mat material shall be coordinated with the seedbed preparation, seeding, including sticking agent, and inoculant, fertilizing, and mulching of the adjacent area of right-of-way.

Areas to be protected with slope protection materials shall be prepared as preparing a seedbed for seeding, as provided in Article 2601.04, A.

2601.12, A:

A. Special Ditch Control in Depressed Medians and Other Ditch Areas.
Ditches and depressed medians shall be seeded at a rate of 5 pounds per 1,000 square feet (2.5 kg per 100 m^2) as directed by the Engineer, using the following seed mixture:

DITCHES OUTSIDE SHOULDER	
Fescue, ~~or~~ Fawn	70%
~~Birdsfoot Trefoil (Empire)~~ *Fescue	10%
Creeping Red Ryegrass (Perennial)	20%
MEDIAN DITCHES	
Fescue, Fawn	77%
Birdsfoot Trefoil (Empire)	3%
Ryegrass (Perennial)	20%

~~**2601.14 MULCH FOR SPECIAL DITCH CONTROL AND SLOPE PROTECTION.**~~
~~Mulch shall be placed as follows:~~

~~**A. Special Ditch Control.**~~
~~Prior to placement of the specified ditch control material, mulch shall be placed. The application rate shall be 25 pounds per 1,000 square feet (12 kg per 100 m^2). Mulch will not be required for special ditch control (wood excelsior mat).~~

~~**B. Slope Protection.**~~
~~The method of mulch installation for slope protection shall be as shown in the contract documents. The application rate for mulch shall be as specified in Article 2601.06, B. Mulch will not be required for slope protection (wood excelsior mat).~~

2601.15 APPLICATION OF SPECIAL DITCH CONTROL AND TURF REINFORCEMENT MAT (TRM) MATERIALS ON SEEDED AREAS.

The areas of special ditch control will be designated by the Engineer. The ditch channel shall be shaped as provided in Article 2601.08, A. The provisions of Articles 2601.12, 2601.13, 2601.17, and 2601.19 shall apply. See the contract documents for details for installation of the material.

A. Wood Excelsior Mat.
Check slots on ditch channels must be spaced so that one check slot occurs within each 50 foot (15 m) increment on slopes of more than 4%.

Wood excelsior mat shall be applied without tension and in the direction of the flow of water. Where more than one strip is required, the lap joint shall be lapped not less than 3 inches (75 mm). The anchor slot on the top edge of the wood excelsior mat shall be buried from 6 inches to 12 inches (150

mm to 300 mm), as designated by the Engineer.

On junction slots, the upslope end of each strip of wood excelsior mat shall be buried 6 inches (150 mm), with the soil firmly tamped. Ends of the wood excelsior mat shall overlap at least 12 inches (300 mm) and shall be stapled, with the upgrade section on top.

The terminal fold at the bottom end of the wood excelsior mat shall be stapled.

~~Wire staples shall be driven without objectionable bending. The s~~Staples shall ~~be No. 11 gauge (3.06 mm diameter) wire, meeting~~ meet the requirements of Article 4169.10, A ~~B~~. Staples shall be spaced as shown in the contract documents.

~~B. Jute Mesh.~~

~~Before fertilizer, seed, mulch, and jute mesh are applied to the area specified, all check slots shall be installed. They shall be installed at right angles to the direction of water flow, using jute mesh approximately 48 inches (1.3 m) wide, by placing a tight fold from 6 inches to 12 inches (150 mm to 300 mm) vertically into the soil, as designated by the Engineer. The jute mesh shall be tamped and stapled into place.~~

~~Check slots on ditch channels shall be spaced so that one check slot occurs within each 50 foot (15 m) increment on slopes of 4% or less. On slopes of more than 4 %, there shall be one check slot and additional check slots, as determined by the Engineer, so that there is a check slot in each increment of 25 feet (7.5 m) or less.~~

~~Jute mesh shall be applied without tension and in the direction of the flow of water. When more than one strip is required, the lap joint shall be lapped not less than 3 inches (75 mm).~~

~~The anchor slot on the top edge of the jute mesh shall be buried from 6 inches to 12 inches (150 mm to 300 mm), as designated by the Engineer.~~

~~On junction slots, the upslope end of each strip of jute mesh shall be buried 6 inches to 12 inches (150 mm to 300 mm), as designated by the Engineer, with the soil firmly tamped. Ends of the jute mesh shall overlap at least 12 inches (300 mm) with the end folded under approximately 4 inches (100 mm) and stapled, with the upgrade section on top. Rolls of jute mesh containing splices that are not securely sewn by machine shall be separated and junction slots installed.~~

~~The terminal fold at the bottom end of the jute mesh shall be folded under approximately 4 inches and stapled.~~

~~For all anchor slots, junction slots, check slots, and terminal folds, suitable U-shaped staples shall be used. Wire staples shall be driven without objectionable bending. The staples shall be No. 11 gauge (3.06 mm diameter) wire meeting the requirements of Article 4169.10, B. For some soil conditions, No. 13 gauge (2.32 mm diameter) wire staples meeting the requirements of Article 4169.10, B will be accepted. Staples shall be spaced as shown in the contract documents.~~

~~C~~B. ~~Other Materials.~~ Turf Reinforcement Mat (TRM)

~~When other materials are specified, the details for installation will be specified in the contract documents.~~ Turf reinforcement mat shall be placed on channel or slope after shaping and shall be applied following the manufacturer's instructions and in accordance with the contract documents.

C. Other Materials.

When other materials are specified, the details for installation will be specified in the contract documents.

2601.17 Finishing Adjacent to Special Ditch Control and Turf Reinforcement (TRM) areas

2601.19 WATERING OF SPECIAL DITCH CONTROL, TURF REINFORCEMENT MAT (TRM) AND SLOPE PROTECTION.
The Contractor shall provide watering equipment and an approved water supply before special ditch control, turf reinforcement mat or slope protection work is started. Following placement of the materials as specified, the area shall be watered not later than the day following placement. Three additional waterings shall be applied at approximately 1 week intervals at the discretion of the Engineer and subject to local weather conditions.

All waterings shall be sufficient to saturate thoroughly the seedbed to a depth of approximately ~~3~~ 2 inches (~~75~~ 50 mm). Each watering may require a maximum of ~~100~~ 50 gallons of water per square (~~40~~ 20 L of water per square meter), and the water shall be applied as a spray or dispersion to prevent damage to the seedbed. Each watering shall be completed within a 4 hour period, and more than one application for each watering may be necessary to provide adequate saturation without runoff.

2601.21 METHOD OF MEASUREMENT.
The various items of work involving erosion control will be determined on satisfactory completion as follows:

The Engineer will compute in acres to the nearest 0.1 acre (hectares to the nearest 0.1 hectare) the surface areas of Overseeding and Fertilizing, Seeding and Fertilizing, Pneumatic Seeding, Mulching, Compost, Native Grass Seeding, Wetland Grass Seeding, Wildflower Seeding, Stabilizing Crop Seeding and Fertilizing, Seeding Special Areas, and Crownvetch Seeding.

The Engineer will measure in squares of 100 square feet (square meters to the nearest 0.1 m) the surface areas of Sodding.

Debris picked up and removed, in accordance with Article 2601.04, A, will be measured in cubic yards (cubic meters) by cross sectional measurement or in the hauling units, at the option of the Engineer.

The Engineer will measure the area of Special Ditch Control, Turf Reinforcement Mat (TRM) and Slope Protection in squares of 100 square feet (square meters to the nearest 0.1 m). Measurement of actual area covered will be used, but will not exceed an area based on the actual measured length and design width. Materials used for anchor slots, junction slots, check slots, terminal folds, lap joints, mulch, and seed and fertilizer for Special Ditch Control shall be incidental.

Watering will be measured for payment by counting loads from a transporting tank of known volume or by metering.

Mobilization for watering will be paid for by count for each mobilization. Mobilization for the initial watering required at installation of the plant material will not be measured for payment.

Mowing described in Article 2601.04, N, will be measured in acres to the nearest 0.1 acre (hectares to the nearest 0.1 hectare) of surface area.

2601.22 BASIS OF PAYMENT.
Payment will be made for the various items of work involved in erosion control as follows:

For the number of acres to the nearest 0.1 acre (hectares to the nearest 0.1 hectare) of Overseeding

and Fertilizing, Seeding and Fertilizing, Pneumatic Seeding, Mulching,

Compost, Native Grass Seeding, Wetland Grass Seeding, Wildflower Seeding, Stabilizing Crop Seeding and Fertilizing, and Crownvetch Seeding, the Contractor will be paid the contract unit price per acre (hectare). This payment shall be full compensation for preparing the area and furnishing and applying each material.

For the number of acres to the nearest 0.1 acre (hectares to the nearest 0.1 hectare) of Seeding Special Area, the Contractor will be paid the contract unit price per acre (hectare). This payment shall be full compensation for preparing the area and furnishing and applying the seed and fertilizer as specified.

For sowing special seed ordered by the Engineer but not provided for in the contract documents, the Contractor will be paid the delivered cost of the seed plus 10% of the contract unit price for Seeding and Fertilizing.

For the number of squares (square meters) of Sodding, the Contractor will be paid the contract unit price per square (square meter). This payment shall be full compensation for preparing the sodbed, furnishing, placing, and finishing the sod, and fertilizing. This payment shall also be compensation for repair of adjacent areas disturbed by the sodding operation.

For the number of squares (square meters) of staking of sod flumes, slopes, and ditch channels, the Contractor will be paid 25% of the contract unit price for Sodding in addition to payment for Sodding.

For the quantity of mulch furnished and placed, the Contractor will be paid the predetermined contract unit price per acre (hectare).

Debris pickup for grading work shall be in accordance with Article 2102.03. Debris pickup of additional boulders resulting from Stabilized Crop Seeding and Fertilizing will be paid for as described in Article 2102.14 for Class 12 boulders, or if there is no Class 12 item, the Contractor will be paid at the rate of 10 times the contract unit price for Class 10 excavation. For the number of cubic yards (cubic meters) of debris picked up and removed in conjunction with other work, the Contractor will be paid 25% of the contract unit price for Stabilizing Crop Seeding or Seeding and Fertilizing, as applicable.

For the number of squares (square meters) of Special Ditch Control over Sod, Wood Excelsior Mat or other material, as specified, the Contractor will be paid the contract unit price per square (square meter). This payment shall be full compensation for the special ditch control preparation and materials, including reshaping intercepting ditches and flumes, seed, fertilizer, stapling, mulch, and in areas where special ditch control is specified, for construction of intercepting ditches and flumes.

For the number of squares (square meters) of Turf Reinforcement Mat (TRM), the contractor will be paid the contract unit price per square (square meter). This payment shall be full compensation for the Turf Reinforcement Mat, preparation and materials including shaping channels, ditches and slopes, soil fill, seed and fertilizing, wood excelsior mat and watering.

For the number of squares (square meters) of Slope Protection with Wood Excelsior Mat or other material, as specified, the Contractor will be paid the contract unit price per square (square meter). This payment shall be full compensation for the slope protection materials in addition to the amount paid for seed and fertilizer.

When a large area is to be watered, the contract documents will include an item for watering. For the quantity of water applied to sod, Article 2601.08, E, and to special ditch control and slope protection, Article 2601.19, the Contractor will be paid the contract unit price per 1,000 gallons (kiloliter). When an

item for watering is not included, the cost of watering shall be included in the amount paid for the item to be watered.

Mobilization for watering will be paid for by count for each required watering at the pre-determined price of $350.00 each.

For the number of acres to the nearest 0.1 acre (hectares to the nearest 0.1 hectare) of mowing, as described in Article 2601.04, the Contractor will be paid the contract unit price per acre (hectare).

Payment for these items shall be full compensation for furnishing all materials, equipment, tools, and labor necessary to complete the work according to the contract documents. It includes removal of rock and other debris from the area, filling gullies and washes, preparing the seedbed or sodbed, furnishing and placing sod and staking sod, furnishing and placing seed including any treatment required, furnishing and placing fertilizer and mulch, tucking the mulched areas, furnishing and placing wood excelsior mat ~~or jute mesh~~, and furnishing water and other care during the care period.

Payment will not be allowed for any area seeded until all seeding of the area permitted by the season is completed, including crown vetch seeding in the spring, and until the Special Ditch Control, Slope Protection, fertilizer and mulch are placed.

Payment will not be allowed for the Special Ditch Control and Sod until the watering, as specified, has been completed. Special Ditch Control and Sod areas which are damaged by weather or other causes before the specified initial watering has been completed shall be replaced or repaired, at the discretion of the Engineer, at the Contractor's expense.

Areas of completed work which are damaged by weather or other causes during the care period and which are repaired at the direction of the Engineer will be paid for at the contract unit prices for the respective types of work involved. Should the repair work not be done with reasonable promptness, payment for repair will be limited to the work described at the time of notification.

Furnishing of extra length stakes or staples when directed by the Engineer will be paid for as extra work in accordance with Article 1109.03, B.

When suitable soil for filling holes, gullies, or washes is not available adjacent to the area to be filled or when soil must be removed, necessary loading and hauling directed by the Engineer will be paid for as extra work in accordance with Article 1109.03, B.

Reason for Revision: Updating terminology

County or City Input Needed (X one)			**Yes**	**No** X	
Comments:					
Industry Input Needed (X one)			**Yes**	**No**	
Industry Notified:	**Yes** X	**No**	**Industry Concurrence:**	**Yes** X	**No**
Comments:					

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Mike Kennerly / Ole Skaar	**Office:** Design	**Item 4**
Submittal Date: January 30, 2009	**Proposed Effective Date:** October 2009	
Article No.: 2602.03 **Title:** Construction (Water Pollution Control (Soil Erosion)).	**Other:**	

Specification Committee Action: Approved with changes as noted.

Deferred:	**Not Approved:**	**Approved Date:** 2/12/09	**Effective Date:** 10/20/09

Specification Committee Approved Text:

2602.03, Construction.

Add as third sentence of second paragraph:

Unless specified otherwise, compost shall be used as a filter medium in filter socks, filter berms, or filter blankets for sediment control.

Comments: The Office of Construction noted that using "specified" indicates compost is required rather than an option. The Office of Design explained that for most situations, compost would be the preferred option. They added the designer should be making the decision as to what should be in the filter sock. The Office of Contract suggested rewording the sentence as:

Compost shall be used as a filter medium in filter socks, filter berms, or filter blankets for sediment control unless specified otherwise.

The Committee agreed with this change.

Specification Section Recommended Text:

2602.03, Construction.

Add as third sentence of second paragraph:

Compost may be used if specified as a filter medium in filter socks, filter berms, or filter blankets for sediment control.

Comments:

Member's Requested Change: **(Do not use 'Track Changes', or 'Mark-Up'. Use Strikeout and Highlight.)**

Add to Section 2602

Compost may be used if specified as a filter medium in filter socks, filter berms or filter blankets for sediment control.

Reason for Revision: Updating terminology

County or City Input Needed (X one)	**Yes**	**No** X
Comments:		
Industry Input Needed (X one)	**Yes**	**No**

Industry Notified:	**Yes** X	**No**	**Industry Concurrence:**	**Yes** X	**No**
Comments:					

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Jim Berger	**Office: Materials**	**Item 5**
Submittal Date: 2009.01.21	**Proposed Effective Date:** October 2009	
Article No.: 4111.03 **Title:** Quality (Class L Fine Agg. for PCC)	**Other:**	

Specification Committee Action: Approved as is.

Deferred:	**Not Approved:**	**Approved Date:** 2/12/09	**Effective Date:** 10/20/09

Specification Committee Approved Text: See Specification Section Recommended Text.

Comments: None.

Specification Section Recommended Text:

4111.03, Quality.

Replace the second row of Table 4111.03:

Mortar Strength	~~1.3~~ 5,200 psi (35.9 MPa) (minimum)	Iowa DOT Materials Laboratory Test Method 212

Comments:

Member's Requested Change (Redline/Strikeout):

Section 4111, Class L Fine Aggregate for Portland Cement Concrete

Change: Mortar Strength ratio from 1.3 to Mortar Strength of 5,200 psi.

SECTION 4111, CLASS L FINE AGGREGATE FOR PORTLAND CEMENT CONCRETE

4111.03 QUALITY.

Table 4111.03

Fine Aggregate Quality	Test Limits	Test Method
Shale and Coal	2.0% (maximum)	Materials I.M. 344
Mortar Strength	~~1.3 (minimum)~~ 5,200 psi (minimum)	Iowa DOT Materials Laboratory Test Method 212

Reason for Revision:

This is to make this spec parallel with changes in 4110. With the increasing strength of cements, the relative difference between the sample and the standard has caused an increasing number of fine aggregates to fail the mortar strength ratio test. Going to the "absolute" strength of the sample will resolve this problem. The value of 5,200 psi is based on historic values of the standard strength and a ratio of 1.3 between standard and sample.

County or City Input Needed (X one)			**Yes**	**No** X	
Comments:					
Industry Input Needed (X one)			**Yes**	**No** X	
Industry Notified:	**Yes**	**No** X	**Industry Concurrence:**	**Yes**	**No**
Comments: Not a change in specification, but a reinterpretation of test data to resolve problems with the method.					

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Jim Berger	**Office: Materials**	**Item 6**
Submittal Date: 2009.01.21	**Proposed Effective Date:** October 2009	
Article No.: 4117.03 **Title:** Quality (Class V Aggregate for PCC)	**Other:**	

Specification Committee Action: Approved as is.

Deferred:	**Not Approved:**	**Approved Date:** 2/12/09	**Effective Date:** 10/20/09

Specification Committee Approved Text: See Specification Section Recommended Text.

Comments: None.

Specification Section Recommended Text:

4117.03, Quality.

Replace Table 4117.03-2:

Table 4117.03-2

Fine Aggregate Quality	Test Limits	Test Method
Shale and Coal	2.0% (maximum)	Materials I.M. 344
Mortar Strength~~[a]~~	~~1.5~~ 6,000 psi (41.4 MPa) (minimum)	Iowa DOT Materials Laboratory Test Method 212
~~Fineness Modulus~~	~~2.75 (minimum)~~	~~Materials I.M. 302~~
~~[a] An annual mortar strength test result of 1.5 or greater is required for continued approval of a source with a fineness modulus less than 2.75.~~		

Comments:

Member's Requested Change (Redline/Strikeout):

Section 4117. Class V Aggregate for Portland Cement Concrete

Change: Mortar Strength ratio from 1.5 to Mortar Strength of 6,000 psi.
Delete: Reference to Fineness Modulus.

Section 4117. Class V Aggregate for Portland Cement Concrete

4110.03 QUALITY.

Table 4117.03-2

Fine Aggregate Quality	Test Limits	Test Method
Shale and Coal	2.0% (maximum)	Materials I.M. 344
Mortar Strength~~[a]~~	~~1.5 (minimum)~~ 6,000 psi (minimum)	Iowa DOT Materials Laboratory Test Method 212
~~Fineness Modulus~~	~~2.75 (minimum)~~	~~Materials I.M. 302~~

	~~(a) An annual mortar strength test result of 1.5 or greater is required for continued approval of a source with a fineness modulus less than 2.75.~~	

Reason for Revision:

This is to make this spec parallel with changes in 4110. With the increasing strength of cements, the relative difference between the sample and the standard has caused an increasing number of fine aggregates to fail the mortar strength ratio test. Going to the "absolute" strength of the sample will resolve this problem. The value of 6,000 psi is based on historic values of the standard strength and a ratio of 1.5 between standard and sample. Fineness modulus will be established by source, with a drop of 0.2 requiring a new mortar strength test. Details will be included with source approval information in Materials IM 409.

County or City Input Needed (X one)			**Yes**	**No** X	
Comments:					
Industry Input Needed (X one)			**Yes**	**No** X	
Industry Notified:	**Yes**	**No** X	**Industry Concurrence:**	**Yes**	**No**

Comments: Not a change in specification, but a reinterpretation of test data to resolve problems with the method.

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Mike Kennerly / Ole Skaar	**Office:** Design	**Item 7**
Submittal Date: January 30, 2009	**Proposed Effective Date:** October 2009	
Section No.: 4169 **Title:** Erosion Control Materials.	**Other:**	

Specification Committee Action: Approved as is.

Deferred:	**Not Approved:**	**Approved Date:** 2/12/09	**Effective Date:** 10/20/09

Specification Committee Approved Text: See Specification Section Recommended Text.

Comments: District 6 Construction asked what the acceptance criteria would be for the proposed changes. Design explained that compost suppliers will provide test results as well as certifications. Members of the Office of Design and Office of Location and Environment have inspected some of the facilities and have developed a list of approved sources.

The question was asked if there are certified mulch sources available. The Office of Design indicated they believe there is. They also noted the requirements they are proposing are already being applied to projects in the form of plan notes. District 6 asked if suppliers can provide certifications. The Office of Design noted they can.

Specification Section Recommended Text:

4169.08, Mulch.

Replace article:

A. Straw Mulch.
Material used as mulch may consist of dry cereal straw or native grass straw ~~threshed or unthreshed prairie hay, threshed cereal straw, wood excelsior, wood cellulose, or other material, as specified~~. All material used as mulch shall be free from noxious weeds and shall be Certified Noxious Weed Seed Free Mulch as certified by the Iowa Crop Improvement Association or adjacent states Crop Improvement Associations. ~~The Contractor shall furnish a list of the number of bales and corresponding ticket from an approved scale for the mulch material to be used on the project.~~

B. Hydraulic Mulches.

1. Wood Cellulose Fiber.
~~Wood excelsior shall be composed of wood fibers, a minimum of 8 inches (200 mm) long, based on an average of 100 fibers, and approximately 0.024 inch (600 µm) thick and 0.031 inch (800 µm) wide. The fibers shall be cut from green wood and shall be reasonably free of seeds or other viable plant material. Wood excelsior shall be baled and the weight (mass) determined. The weight (mass) of the material shall be furnished by the manufacturer and shall be used for determining the rate of application.~~

a. Material used as wood cellulose fiber mulch shall be a natural or cooked cellulose fiber processed from whole wood chips, or a combination of (50%-50%) cellulose fiber produced from whole wood chips and recycled fiber from sawdust, recycled paper, chipboard, or corrugated cardboard.

b. The wood cellulose fiber mulch shall contain a colloidal polysaccharide tackefier

adhered to the fiber to prevent separation during shipment and avoid chemical coagglomeration during mixing.

c. The mulch material shall form a homogeneous slurry of fibers, tackefier, and water that can be applied with standard hydraulic mulching equipment and be dyed green to facilitate visual metering during application.

d. The wood cellulose fiber mulch material shall contain no growth or germination inhibiting factors, and have a minimum pH of 4.8.

2. Bonded Fiber Matrix (BFM).

a. Material used as a bonded fiber matrix shall be long-strand wood fibers held together by organic tackefiers and bonding agents that, when dry, become insoluble and non-dispersible.

b. The mulch upon curing (24 - 48 hours) shall form a continuous, 100% coverage, flexible, absorbent, erosion-resistant blanket that encourages seed germination.

c. The mulch shall be manufactured to be applied with standard hydraulic mulching equipment and shall be dyed green to facilitate visual metering during application.

d. The bonded fiber matrix mulch shall contain no growth or germination inhibiting factors.

e. Physical Properties:

1. Fibers: Virgin wood, greater than 88% by volume.

2. Organic Material: Greater than 96% by volume.

3. Tackefier: 8 - 10%.

4. pH: 4.8 minimum.

5. Moisture Content: 12% ±3%.

6. Minimum Water Holding Capacity: 1.2 gallons per pound (10 L/kg).

3. Mechanically-Bonded Fiber Matrix (MBFM).

a. The material used as a mechanically-bonded fiber matrix shall be long-strand wood fibers and crimped, interlocking synthetic fibers.

b. The mulch upon curing (2 hours) shall form a continuous, 100% coverage, flexible, absorbent, porous, erosion-resistant blanket that encourages seed germination.

c. The mulch shall be manufactured to be applied with standard hydraulic mulching equipment and shall be dyed green to facilitate visual metering during application.

d. The mechanically-bonded fiber matrix mulch shall contain no growth or germination inhibiting factors.

e. Physical Properties:

1. Virgin Wood Fibers: 73% minimum.

2. Crimped, Interlocking Synthetic Fibers: 5% ±1%

3. Tackefier: 10% ±1%.

4. Moisture Content: 12% ±3%.

5. Minimum Water-Holding Capacity: 1.2 gallons per pound (10 L/kg).

6. pH: 4.8 minimum.

4169.09, Compost.

Add new article:

4169.09. Compost.

Compost shall be an organic substance produced by the biological and biochemical decomposition of source-separated compostable materials separated at the point of waste generation. Organic substances may include, but are not limited to:

- Leaf and yard trimmings.
- Food scraps.
- Food processing residues.
- Manure and/or other agricultural residuals.
- Forest residues and bark.
- Soiled and/or unrecyclable paper and biosolids.

Compost shall contain no visible admixture of refuse or other physical contaminants nor any material toxic to plant growth. Compost shall meet the additional requirements below. All physical requirements shall be in accordance with the United States Composting Council, "Testing Methods for the Examination of Composting and Compost" (TMECC).

A. Minimum organic material shall be 30% (dry weight (mass) basis) as determined by loss on ignition.

B. Moisture content shall be 30% - 60%. Organic material shall be loose and friable and not dusty.

C. Soluble salts shall be less than 5.0 ds/m.

D. Stability: Carbon dioxide evolution rate shall be less than 8 in accordance with TMECC 5.08-B. Growth screening: Emergence shall be a minimum of 80% for all compost to be vegetated.

E. pH: 6.0 - 8.0.

F. Fecal Coliform shall be in accordance with TMECC 07.01-B.

G. Heavy Metals shall be in accordance with TMECC 04.06 and TMECC 04.13-B.

H. Particle size shall be in accordance with the following:

- **Pneumatic Seeding (Urban):** 100% shall pass the 1/2 inch (12.5 mm) screen.
- **Pneumatic or Mechanical Seeding (Rural):** 100% shall pass the 1 inch (25 mm) screen, 80% to 90% shall pass the 3/4 inch (19 mm) screen, and 70% to 80% shall pass the 1/2 inch (12.5 mm) screen.
- **Filter Sock, Filter Berm, and Filter Blanket:** 100% shall pass the 2 inch (50

mm) screen, 70% to 90% shall pass the 1 inch (25 mm) screen, and 50% to 70% shall pass the 1/2 inch (12.5 mm) screen.

4169.09, Stakes for Holding Sod.

Renumber article:

4169.~~09~~10, Stakes for Holding Sod.

4169.10, Special Ditch Control and Slope Protection.

Renumber and **rename** article:

4169.~~10~~11, Special Ditch Control, Turf Reinforced Mat, and Slope Protection.

Add new article:

E. Turf Reinforcement Mat.

Type 1 Turf Reinforcement Mat (TRM) shall be constructed of a web of mechanically or melt-bonded polymer netting, or monofilaments fibers that are entangled to form a strong and dimensionally stable mat. Bonding methods shall include polymer welding, thermal or polymer fusion, or the placement of synthetic fibers between two high-strength, biaxially-oriented nets, mechanically bound by parallel stitching with polyolefin thread. Products may contain a degradable component.

Type 2 & 3 TRM shall be constructed of a web of mechanically or melt-bonded polymer netting, or monofilaments, or fibers that are entangled to form a strong and dimensionally stable mat. Non-woven bonding methods shall include polymer welding, thermal or polymer fusion, or the placement of fibers between two high-strength, biaxially oriented nets, mechanically bound by parallel stitching with polyolefin thread. Components shall be 100% synthetic and resistant to biological, chemical, and ultraviolet degradation.

Type 4 TRM shall be a high performance/survivability TRM that is composed of monofilament yarns woven into a resilient uniform configuration. The mat shall have a matrix that exhibits very high interlock and reinforcement capacities with both soil and root systems and demonstrate a high tensile modulus. TRMs manufactured from discontinuous or loosely held together by stitched or glued, netting, or composites will not be allowed in this category. Components shall be 100% synthetic and resistant to biological, chemical, and ultraviolet degradation. This category shall be used when field conditions exist with high loading and/or high survivability requirements.

Minimum material property and performance requirements shall be as in the following table:

Property	**Property**	**Test Method**	**Type 1**	**Type 2**	**Type 3**	**Type 4**
Material	Thickness,	ASTM D 6525	0.25 in (6.25 mm)	0.25 in (6.25 mm)	0.25 in (6.25 mm)	0.25 in (6.25 mm)
Material	Tensile Strength[a, b]	ASTM D 6818	125 lb/ft (186 kg/m)	240 lb/ft (357 kg/m)	750 lb/ft (1116 kg/m)	3000 lb/ft (4465 kg/m)
Material	UV Resistance	ASTM D 4355	80% @ 500 hrs	80% @ 1000 hrs	80% @ 1000 hrs	90% @ 3000 hrs
Performance	Maximum Shear Stress (Channel Applications)[c]	ASTM D 6460	7-9 lb/ft^2 (1.4-1.8 kg/m^2)	10-11 lb/ft^2 (2.0-2.3 kg/m^2)	12-14 lb/ft^2 (2.5-2.9 kg/m^2)	15-16 lb/ft^2 (3.1-3.3 kg/m^2)
Performance	Maximum Slope Gradient (Slope	N/A	1:1 (H:V) or flatter	1:1 (H:V) or flatter	1:1 (H:V) or greater	1:1 (H:V) or greater

	Applications)					

a. Minimum Average Roll Values, machine direction only.
b. Tensile Strength of structural components retained after exposure.
c. Maximum shear stress that fully-vegetated TRM can sustain without physical damage or excess erosion (1/2 inch (12.5 mm) soil loss) during a 30 minute flow event in large scale testing. Acceptable large scale testing protocol includes ASTM D 6460 or independent testing conducted by the Texas Transportation Institute, Colorado State University, Utah State University, or other approved testing facility. Bench scale testing is not acceptable.

Comments:

Member's Requested Change: (Do not use 'Track Changes', or 'Mark-Up'. Use Strikeout and Highlight.)

Change 4169.08

A. Straw Mulch

Material used as mulch may consist of dry cereal straw or native grass straw. ~~threshed or unthreshed prairie hay, threshed cereal straw, wood excelsior, wood cellulose, or other material, as specified.~~ All material used as mulch shall be free from noxious weeds and shall be Certified Noxious Weed Seed Free Mulch as certified by the Iowa Crop Improvement Association or adjacent states Crop Improvement Associations. ~~The Contractor shall furnish a list of the number of bales and corresponding ticket from an approved scale for the mulch material to be used on the project.~~

B. Hydraulic Mulches

1. Wood Cellulose Fiber:

~~Wood excelsior shall be composed of wood fibers, a minimum of 8 inches (200 mm) long, based on an average of 100 fibers, and approximately 0.024 inch (600 µm) thick and 0.031 inch (800 µm) wide. The fibers shall be cut from green wood and shall be reasonably free of seeds or other viable plant material. Wood excelsior shall be baled and the weight (mass) determined. The weight (mass) of the material shall be furnished by the manufacturer and shall be used for determining the rate of application.~~

a. Material used as wood cellulose fiber mulch shall be a natural or cooked cellulose fiber processed from whole wood chips, or a combination of (50%-50%) cellulose fiber produced from whole wood chips and recycled fiber from sawdust, recycled paper, chipboard or corrugated cardboard.
b. The wood cellulose fiber mulch shall contain a colloidal polysaccharide tackefier adhered to the fiber to prevent separation during shipment and avoid chemical coagglomeration during mixing.
c. The mulch material shall form a homogeneous slurry of fibers, tackefier and water that can be applied with standard hydraulic mulching equipment and be dyed green to facilitate visual metering during application.
d. The wood cellulose fiber mulch material shall contain no growth or germination inhibiting factors, and have a minimum pH of 4.8.

2. Bonded Fiber Matrix (BFM):

a. Material used as a bonded fiber matrix shall be long-strand wood fibers held together by organic tackefiers and bonding agents that, when dry, become insoluble and non-dispersible.
b. The mulch upon curing (24-48 hours) shall form a continuous, 100% coverage, flexible, absorbent, erosion-resistant blanket that encourages seed germination.
c. The mulch shall be manufactured to be applied with standard hydraulic mulching equipment and shall be dyed green to facilitate visual metering during application.
d. The bonded fiber matrix mulch shall contain no growth or germination inhibiting factors.
e. Physical Properties:
1. Fibers: Virgin wood, greater than 88% by volume.
2. Organic Material: Greater than 96% by volume.
3. Tackefier: 8-10%.
4. pH: 4.8 minimum.
5. Moisture Content: 12% ±3%.

6. Water-Holding Capacity (min.): 1.2 gal. per lb.

3. Mechanically-Bonded Fiber Matrix (MBFM):
a. The material used as a mechanically-bonded fiber matrix shall be long-strand wood fibers and crimped, interlocking synthetic fibers.
b. The mulch upon curing (2 hours) shall form a continuous, 100% coverage, flexible, absorbent, porous, erosion-resistant blanket that encourages seed germination.
c. The mulch shall be manufactured to be applied with standard hydraulic mulching equipment and shall be dyed green to facilitate visual metering during application.
d. The mechanically-bonded fiber matrix mulch shall contain no growth or germination inhibiting factors.
e. Physical Properties:
1. Virgin Wood Fibers: 73% minimum.
2. Crimped, Interlocking Synthetic Fibers: 5% ± 1%.
3. Tackefier:10% ± 1%.
4. Moisture Content: 12% ±3%.
5. Water-Holding Capacity (min.): 1.2 gal/lb.
6. pH: 4.8 minimum.

Add to Section 4169

Compost
Compost shall be an organic substance produced by the biological and biochemical decomposition of source-separated compostable materials separated at the point of waste generation that may include but are not limited to leaf and yard trimmings, food scraps, food processing residues, manure and/or other agricultural residuals, forest residues and bark and soiled and/or unrecyclable paper and biosolids. Compost shall contain no visible admixture of refuse or other physical contaminents nor any material toxic to plant growth. Compost shall meet the following additional specifications, and all physical requirements shall be in accordance with the United States Composting Council, "Testing Methods for the Examination of Composting and Compost" (TMECC).

A. Minimum organic material shall be 30% (dry weight basis) as determined by loss on ignition.
B. Moisture content shall be 30%-60% and it shall be loose and friable and not dusty.
C. Soluble salts shall be less than 5.0 ds/m.
D. Stability – Carbon dioxide evolution rate less than 8 – TMECC 5.08-B. Growth screening: Minimum 80% emergence for all compost to be vegetated.
E. pH shall be between 6.0 – 8.0.
F. Fecal Coliform: Pass in accordance with TMECC 07.01-B.
G. Heavy Metals: Pass in accordance with TMECC 04.06 and TMECC 04.13-B.
H. Particle size:

Pneumatic Seeding (Urban) – 100% passing the ½ inch screen.
Pneumatic or Mechanical Seeding (Rural) – 70% -80% passing the ½ inch screen.
80% -90% passing the ¾ inch screen. -
100% passing the 1 inch screen.
Filter Sock, Filter Berm, and Filter Blanket -50%-70% passing the ½ inch screen.
-70%-90% passing the 1 inch screen
-100% passing the 2 inch screen.

~~**4169.09**~~ **4169.10 Stakes For Holding Sod.**

~~**4169.10**~~ **4169.11 SPECIAL DITCH CONTROL, TURF REINFORCED MAT (TRM) AND SLOPE PROTECTION**
Add

E. TURF REINFORCEMENT MAT

TRM Type 1: Use a TRM that is constructed of a web of mechanically or melt-bonded polymer netting, or monofilaments fibers that are entangled to form a strong and dimensionally stable mat. Bonding methods include polymer welding, thermal or polymer fusion, or the placement of synthetic fibers between two high-strength, biaxially-oriented nets, mechanically bound by parallel stitching with polyolefin thread. Products may contain a degradable component.

TRM Type 2 & 3: Use a TRM that is constructed of a web of mechanically or melt-bonded polymer netting, or monofilaments, or fibers that are entangled to form a strong and dimensionally stable mat. Non-woven bonding methods include polymer welding, thermal or polymer fusion, or the placement of fibers between two high-strength, biaxially oriented nets, mechanically bound by parallel stitching with polyolefin thread. Use only components that are 100% synthetic and resistant to biological, chemical, and ultraviolet degradation.

TRM Type 4: Use a high performance/survivability TRM that is composed of monofilament yarns woven into a resilient uniform configuration. Use a mat that has a matrix that exhibits very high interlock and reinforcement capacities with both soil and root systems and demonstrate a high tensile modulus. TRMs manufactured from discontinuous or loosely held together by stitched or glued, netting, or composites are not allowed in this category. Use only components that are 100% synthetic and resistant to biological, chemical, and ultraviolet degradation. Use this category when field conditions exist with high loading and/or high survivability requirements.

PROPERTIES AND PERFORMANCE: Meet the minimum material and performance requirements contained in the following table:

Property	Property	Test Method	Type 1	Type 2	Type 3	Type 4
Material	Thickness,	ASTM D6525	0.25 in	0.25 in	0.25 in	0.25 in
Material	Tensile Strength 1, 2	ASTM D6818	125 lb/ft	240 lb/ft	750 lb/ft	3000 lb/ft
Material	UV Resistance	ASTM D4355	80% @ 500 hrs	80% @ 1000 hrs	80% @ 1000 hrs	90% @ 3000 hrs
Performance	Maximum Shear Stress (Channel Applications) 3	ASTM D6460	7-9 lb/ft^2	10-11 lb/ft^2	12-14 lb/ft^2	15-16 lb/ft^2
Performance	Maximum Slope Gradient (Slope Applications)	N/A	1:1 (H:V) or flatter	1:1 (H:V) or flatter	1:1 (H:V) or greater	1:1 (H:V) or greater

1. Minimum Average Roll Values, machine direction only.
2. Tensile Strength of structural components retained after exposure.
3. Maximum shear stress that fully-vegetated TRM can sustain without physical damage or excess erosion (0.5 in soil loss) during a 30-minute flow event in large scale testing. Acceptable large scale testing protocol includes ASTM D6460 or independent testing conducted by the Texas Transportation Institute, Colorado State University, Utah State University, or other approved testing facility. Bench scale testing is not acceptable.

Reason for Revision: Updating terminology

County or City Input Needed (X one)			**Yes**	**No** X	
Comments:					
Industry Input Needed (X one)			**Yes**	**No**	
Industry Notified:	**Yes** X	**No**	**Industry Concurrence:**	**Yes** X	**No**
Comments:					

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Gary Novey	**Office:** Bridges and Structures	**Item 8**
Submittal Date: Dec 10, 2008	**Proposed Effective Date:** March 2009	
Article No.: DS-01083 **Title:** Fabric Formed Concrete Structure Revetment	**Other:**	

Specification Committee Action: Approved with changes as noted.			
Deferred:	**Not Approved:**	**Approved Date:** 2/12/09	**Effective Date:** 5/19/09
Specification Committee Approved Text: See attached Draft DS.			
Comments: The Office of Bridges and Structures stated there are other changes related to cold weather protection they had intended to include. They passed out copies of their proposed changes. The Specifications Section noted the language is similar to existing language in the Standard Specifications. They will look into possibly referencing existing specifications for cold weather protection.			
Specification Section Recommended Text: See attached Draft DS.			
Comments:			

Member's Requested Change: **(Do not use 'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.)**

See attached Draft DS

Reason for Revision: Additional modifications to changes approved in June 2008 meeting. Additional changes include additional sizes to Table B- Articulating Block Mat Properties and changes to the concrete grout mix.

County or City Input Needed (X one)			**Yes**	**No**	
Comments:					
Industry Input Needed (X one)			**Yes**	**No**	
Industry Notified:	**Yes**	**No**	**Industry Concurrence:**	**Yes**	**No**
Comments:					

DRAFT DS-01XXX
(Replaces DS-01083)

Iowa Department of Transportation

DEVELOPMENTAL SPECIFICATIONS
FOR
FABRIC FORMED CONCRETE STRUCTURE REVETMENT

Effective Date
May 19, 2009

THE STANDARD SPECIFICATIONS, SERIES OF 2001, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

01XXX.01 DESCRIPTION.
This work consists of constructing fabric formed concrete revetment as shown on the plans. The revetment is normally used adjacent to bridge substructure units to protect the substructure from excessive scour.

The fabric formed revetment shall consist of specially woven, double-layer synthetic forms filled with a pumpable, fine aggregate concrete grout in such a way as to form a stable revetment of required thickness, weight (mass), and configuration.

The configuration of fabric formed revetment ~~on this project~~ shall be 'Articulating Block Mat' with reinforced polyester cable, and/or 'Armor Units' with or without reinforced ~~with~~ polyester cable in accordance with the contract documents.

01XXX.02 MATERIALS.

A. Fabric Forms.

1. Manufacturers and Products.
Acceptable manufacturers and products are listed in Materials I.M. 496.01.~~as follows:~~ The fabric forms supplied shall meet the details and specifications of these ~~above named~~ products as modified by this specification.

~~**a.** Donnelly Fabricators, Inc., 970 Henry Terrace, Lawrenceville, GA 30045, telephone 770.339.0108. Products: Texicon™ Articulating Block Mat, Texicon™ Concrete Bags.~~
~~**b.** Hydrotex Synthetics, Inc., 74 Perimeter Center East, Suite 7420, Atlanta, GA 30346-1803, telephone 800.225.0023. Products: Hydrotex™ Articulating Block Mat, Hydrocast™ Armor Units.~~
~~**c.** Armorform, Inc., P.O. Box 710, Jefferson, GA 30549, telephone 706.367.4661. Products: Armorform™ Articulating Block Mat, Armorform™ Armor Bags.~~
~~**d.** Approved equal to the above named products.~~

2. Fabric and Cables.
Fabric forms shall be fabricated to conform to the dimensions shown in the contract documents. ~~When the plan indicates a finished dimension, t~~The fabric form dimension shall be adjusted to provide the finished dimension shown following filling with concrete grout including allowances for form material in anchor, terminal, or toe trenches as applicable. See Article 01XXX.02, C, for the requirements for concrete grout for the fabric formed concrete revetment ~~(concrete grout)~~.

The fabric forms shall be composed of synthetic yarns formed into a woven fabric. Yarns used in the manufacture of the fabric shall be composed of nylon and/or polyester. Forms shall be woven with a minimum of 50% textured yarns by weight (mass) to improve adhesion to the concrete grout and to improve filtration. Each layer of fabric shall conform to the physical, mechanical, and hydraulic requirements referenced herein. The fabric forms shall be free of defects or flaws that significantly affect their physical, mechanical, or hydraulic properties.

Fabric used to fabricate the fabric forms shall meet or exceed the values shown for the properties shown in the following table:

Table A - Fabric Form Minimum Property Requirements

Property	Test Method	Units	Armor Unit	Articulating Block Mat
Composition of Yarns			Nylon or Polyester	Nylon or Polyester
Mass Per Unit Area (double-layer)	ASTM D 5261	oz/yd^2 (g/m^2)	14 (470)	12 (403)
Thickness	ASTM D 5199	mils (mm)	28 (0.7)	25 (0.6)
Mill Width		in (m)	76 (1.92)	76 (1.92)
Wide-Width Strip Tensile Strength -Machine	ASTM D 4595	lbf/in (kN/m)	190 (33.2)	140 (24.5)
- Cross	ASTM D 4595	lbf/in (kN/m)	140 (24.5)	110 (19.3)
Elongation at Break - Machine	ASTM D 4595	%	20	20
- Cross	ASTM D 4595	%	30	30
Trapezoidal Tear Strength - Machine	ASTM D 4533	lbf (N)	180 (800)	150 (665)
- Cross	ASTM D 4533	lbf (N)	115 (510)	100 (445)
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Std. Sieve (mm)	60 (0.250)	40 (0.425)
Flow Rate	ASTM D 4491	gal/min/ft^2 (l/min/m^2)	50 (2035)	90 (3665)

Notes:

1. Conformance of fabric to specification property requirements shall be based on ASTM D 4759.
2. All numerical values represent minimum average roll values (i.e., average of test results from any sample roll in a lot shall meet or exceed the minimum values). Lots shall be sampled according to ASTM D 4354.

Mill widths of fabric shall be a minimum of 76 inches (1.92 m). Each selvage edge of the top and bottom layers of fabric shall be reinforced for a width of not less than 1.35 inches (35 mm) by adding a minimum of 6 warp yarns to each selvage construction. Mill width rolls shall be cut to the length required, and the double-layer fabric separately joined, bottom layer to bottom layer and top layer to top layer, by means of sewing thread, to form multiple mill width panels with sewn seams on not less than 72 inch (1.82 m) centers.

All factory-sewn seams shall be downward facing upon completion of the revetment. All seams sewn in the factory shall be not less than 90 ~~lbf/in~~ pound-force per inch (15.7 kN/m) when tested in accordance with ASTM D 4884. All sewn seams and zipper attachments shall be made using a double line of U.S. Federal Standard Type 401 stitch. All stitches shall be sewn simultaneously and be parallel to each other, spaced between 0.25 inches to 0.75 inches (6 mm to 9 mm) apart. Each row of stitching shall consist of 4 to 7 stitches per inch (~~per~~ 25.4 mm). Thread used for

seaming shall be nylon and/or polyester. Field sewing ~~shall~~ will be permitted only to join the factory assembled fabric form panels together.

Cables, when required, shall be constructed of high tenacity, low elongation, and continuous filament polyester fibers. Cable shall have a core construction comprised of parallel fibers contained within an outer jacket or cover. The weight (mass) of the parallel core shall be between 65% to 75% of the total weight (mass) of the cable.

Cable nominal size and rated breaking strength shall be as specified in the following sections for the type and size of fabric formed revetment. Cable splices shall be made with aluminum compression fittings selected so that the resultant cable splice from use of a single fitting shall provide a minimum of 80% of the rated breaking strength of the cable. A minimum of two fittings per splice, separated by a minimum of 6 inches (153 mm) of cable overlap, shall be used at each splice. Upon completion of the revetment all fittings shall be encased by concrete grout within the fabric form.

a. Articulating Block Mat.

Fabric forms shall consist of double-layer woven fabric joined together by narrow perimeters of interwoven fabric into a matrix of rectangular compartments that form a concrete articulating block mat. Cords shall connect the two layers of fabric at the center of each compartment. The cords shall be interwoven in two sets of four cords each, one set for the upper layer and one set for the bottom layer. Each cord shall have a minimum breaking strength of 160 lbf (710 N) when tested in accordance with ASTM D 2256.

Fabric form compartments shall be offset one-half a compartment length, in the mill width direction, to form a bonded concrete block pattern. The mill width direction for articulating block mat shall be the flow direction shown on the plans unless otherwise noted.
Fabric form compartments shall each have four grout ducts, two on each side parallel to the mill width direction, to allow passage of the concrete grout between adjacent compartments. Two additional grout ducts, one on each side perpendicular to the mill width direction, is permissible. The concrete grout filled, cross sectional area of each grout duct shall be no more than 10% of the maximum filled cross sectional area of the block transverse to the duct.

Grout stops shall be installed at predetermined mill width intervals to regulate the distance of lateral flow of concrete grout. The grout stop material shall be nonwoven filter fabric. The grab tensile strength of the filter fabric shall be not less than 90 ~~lbf/in~~ pound-force per inch (400 N) when tested in accordance with ASTM D 4632.

Cables shall be installed between the two layers of fabric and through the compartments in a manner that provides for longitudinal and lateral binding of the finished articulating block mat. Two revetment cables perpendicular to mill width direction shall pass through each compartment. One revetment cable parallel to the mill width direction shall pass through the approximate center of each compartment.

The cables shall enter and exit the compartments through opposing grout ducts. As an alternate, cable ducts may be provided for insertion of revetment cables between compartments. The diameter of each cable duct shall be 1.0 inch (25.4 mm) maximum.

All cables, within each compartment shall be completely embedded in the concrete grout.

Articulating block mat nominal finished dimensions and properties for the specified size shall be per the following table:

Table B - Articulating Block Mat Properties

Size	4 inch (100 mm)	6 inch (150 mm)	8 inch (200 mm)	10 inch (250 mm)	12 inch (300 mm)
Average Thickness, inches (mm)	4.0 (100)	6.0 (150)	8.0 (200)	10.0 (250)	12.0 (300)

Mass Per Unit Area, lb/ft^2 (kg/m^2)	45 (220)	68 (330)	90 (440)	113 (550)	135 (661)
Mass per Block, lb (kg)	88 (39.8)	188 (85.2)	325 (148)	563 (255)	844 (382)
Nominal Block Dimensions, inches (mm) [C]	20x14 (508x356)	20x20 (508x508)	20x26 (508x660)	30x24 (762x610)	30x30 (762x762)
Cable Nominal Diameter, inches (mm)	0.250 (6.35)	0.312 (7.94)	0.312 (7.94)[B]	0.375 (9.53) [D]	0.375 (9.53) [D]
Cable Average Breaking Strength, lbf (kN)	3700 (16.47)	4500 (20.03)	4500 (20.03)[B]	7,000 (31.15) [D]	7,000 (31.15) [D]
Concrete Coverage[A], ft^2/yd^3 (m^2/m^3)	75 (9.1)	50 (6.1)	38 (4.6)	30 (3.6)	25 (3.0)

[A] For information only.
[B] When the contract documents require 0.375 inches (9.53 mm) cable, the Average Breaking Strength shall be 7000 lbf (31.15 kN).
[C] Mill width direction x perpendicular to mill width direction.
[D] When the contract documents require 0.440 inches (11.20 mm) cable, the Average Breaking Strength shall be 10,000 lbf (44.50kN).

b. Armor Units/Concrete Bags.

Fabric forms shall consist of two layers of woven fabric sewn together. When filled with concrete grout they shall form a concrete Armor Unit (concrete bag).
Self-sealing filling valves, suitable for use with an injection pipe at the end of a pump hose for concrete grout, shall be installed at predetermined locations.

When Armor Units are specified, the fabric forms shall be similar to the typical unreinforced bags produced by the manufacturers specified above.

When Armor Units Reinforced are specified, the following modifications to the typical unreinforced bag shall be made:

1) The fabric form shall be continuous along its length. The intent is to provide a continuous width and thickness of fabric formed concrete along the substructure unit being protected. ~~If the Armor Unit is placed around the circumference of a pier, the unit shall be continuous around the pier.~~

2) Grout stops shall be installed as required to regulate the distance of flow of concrete grout. The grout stop material shall be nonwoven filter fabric. The grab tensile strength of the filter fabric shall be not less than 90 ~~lbf/in~~ pound-force per inch (400 N) when tested in accordance with ASTM D 4632.

3) Longitudinal cables shall be spaced evenly across the cross section of the Armor Unit. The number of longitudinal cables required are shown in the following table:

Table C - Armor Unit Properties

Size - Width Unfilled Fabric Form in (m)	**No. Longitudinal Cables[B]**	**Filled Thickness in (mm) Volume of Concrete[A] ft^3/ft (m^3/m)**	**Filled Thickness in (mm) Volume of Concrete[A] ft^3/ft (m^3/m)**
24 (0.61)	2	6 (15) 0.8 (0.07)	9 (23) 1.1 (0.10)
36 (0.91)	2	6 (15) 1.3 (0.12)	9 (23) 1.8 (0.17)
48 (1.22)	3	9 (23) 2.6 (0.24)	12 (30) 3.2 (0.30)
60 (1.52)	4	9 (23) 3.3 (0.31)	12 (30) 4.2 (0.39)
72 (1.83)	5	9 (23) 4.1 (0.38)	12 (30) 5.2 (0.48)

84 (2.13)	6	9 (23) 4.8 (0.45)	12 (30) 6.5 (0.60)
96 (2.44)	7	12 (30) 7.2 (0.67)	15 (38) 8.8 (0.82)
108 (2.74)	8	12 (30) 8.2 (0.76)	15 (38) 10.0 (0.93)

(A) For information only.

(B) For Reinforced Armor Units

Longitudinal cables shall be spliced at joints.

Cables shall be nominally 0.250 inches (6.35 mm) in diameter and their rated average breaking strength shall be not less than 3700 ~~lbf~~ pound-force (16.47 kN). Cords shall connect the cables to the fabric form as required to position the cables near the center of the finished armor thickness.

Armor Units nominal finished dimensions and properties for the specified size shall be per Table C above.

B. Delivery.

Fabric forms shall be kept dry and wrapped such that they are protected from the elements during shipping and storage. If stored outdoors, they shall be elevated and protected with a waterproof cover that is opaque to ultraviolet light. The fabric forms shall be labeled as per ASTM D 4873.

~~The Contractor shall submit layout and/or shop drawings a minimum of 2 weeks prior to installation. These drawings shall include the dimensions of the fabric form panels, location and type of field seams, and field splicing requirements.~~

The Contractor shall submit a manufacturer's certificate that the supplied fabric forms meet the criteria of these specifications, as measured in full accordance with the referenced test methods and standards. The certificates shall include the following information about each fabric form delivered:

- Manufacturer's name and current address
- Full product name
- Style and product code number
- Composition of yarns
- Manufacturer's certification statement

C. Concrete Grout for Fabric Formed Concrete Revetment.

Materials for concrete grout for the fabric formed concrete revetment (concrete grout) shall meet the requirements of the following:

Item	Standard Specification Section
Portland Cement	4101
Fine Aggregate	4110, 4111, or 4112
Water	4102
Admixtures	4103
Fly Ash	4108

Concrete grout shall consist of a mixture of Portland cement, fine aggregate, water, admixtures, and fly ash so proportioned and mixed as to provide a pumpable slurry. ~~Pozzolan and g~~Grout fluidizer may be used at the Contractor's option.

Consistency of concrete grout delivered to the concrete pump shall be proportioned and mixed as to have an efflux time of ~~9~~ 8 to 12 seconds when passed through the 0.75 inch (19 mm) orifice of the standard flow cone that is described in ASTM C 939.

Concrete grout shall have an air content of not less than 5% nor more than ~~8~~ 10% of the volume of the grout. The mix shall obtain a compressive strength of 2000 ~~psi~~ pounds per square inch (13,750 kPa) at 28 days when tested in conformance with Materials I.M. 315.

~~Mix proportions shall be similar to that for Concrete Grout for Revetment or Gabion per Article 2507.02, B, of the Standard Specifications.~~ The Contractor shall be responsible for supplying a mix design to the Engineer that meets the above requirements. The Contractor shall submit ~~the samples of fine aggregate, cement, and fly ash~~ intended mix design for use to the Engineer before the work begins. The Contractor shall produce a 1 cubic yard (1 m^3) test batch prior to utilizing the intended mix design. The Engineer will validate consistency and air content of the test batch. Previously approved mix designs with a history of strength and flow may be utilized without a test batch subject to approval of the Engineer. After the mix has been designated, it shall not be changed without approval of the Engineer.

A mix utilizing at least 800 pounds (365 kg) of cementitious material with a required substitution of at least 25% but no more than 35% type C fly ash may be used without strength testing before placement. Efflux time and air content by unit weight determination will be measured by the project Engineer prior to placement and at least once every 4 hours until the placement is complete.

01XXX.03 CONSTRUCTION.

A. Equipment.

Mixing and pumping equipment used in preparation and handling of the concrete grout shall be approved by the Engineer. Proportioning and mixing equipment shall meet requirements of Articles 2001.20 and 2001.21 of the Standard Specifications. Sufficient mixing capacity of mixers shall be provided to permit the intended pour to be placed without interruption. All oil or other rust inhibitors shall be removed from the mixing drums, stirring mechanisms, and other portions of the equipment in contact with the grout before the mixers are used. The pumping equipment shall have a variable flow rate to provide enough pressure for pumping without breaking the fabric.

B. Site Preparation.

Areas on which fabric forms are to be placed shall be constructed to the lines, grades, contours, and dimensions shown on the plans. All obstructions such as roots and projecting stones shall be removed. Where such areas are below the allowable grades, they shall be brought to grade by placing compacted layers of select material. The thickness of layers and the amount of compaction shall be as specified by the Engineer. Where required by the contract documents, soft and otherwise unsuitable subgrade soils shall be identified, excavated, and replaced with select materials in accordance with the Standard Specifications.

Excavation and preparation of aprons as well as anchor, terminal, or toe trenches shall be done in accordance with the lines, grades, contours, and dimensions shown on the plans. Immediately prior to placing the fabric forms, the Engineer will inspect the prepared area, and no forms shall be placed until the area has been approved.

C. Fabric Form Placement.

Engineering fabric shall be placed on the graded surface approved by the Engineer when required by the contract documents. Fabric forms shall be placed over the engineering fabric, when required, and within the limits shown on the plans. The fabric forms shall be anchored as required to prevent displacement during curing of grout. Anchorages requiring connection to the structure and not shown on the plans require approval by the Engineer prior to use.

Where fabric formed concrete is placed adjacent to a substructure unit, the fabric forms shall be placed so that the filled fabric formed revetment shall be flush with the substructure unit. Placement of the fabric forms prior to filling shall consider the contraction of the fabric form during filling.

All field seams shall be made using two lines of U.S. Federal Standard Type 101 stitches. Thread

used for seaming shall be nylon and/or polyester. All sewn seams shall be downward facing. Zipper seams shall be permitted unless noted otherwise in the contract documents. The finished strength of the field seams shall comply with manufacturer's recommendations.

All cables crossing a field seam shall be spliced in conformance with the Article DS-01XXX.02, A, 2, above. Upon completion of the revetment all splice fittings shall be encased by concrete grout within the fabric form.

Where fabric formed concrete units/mats lap on top of previously installed units, 6 mils (150 µm) polyethylene sheeting shall be placed on top of the underlying unit to prevent bonding prior to placement of the engineering fabric and fabric forms for the succeeding layer.

Immediately prior to filling with the concrete grout, the Engineer will inspect the assembled fabric forms, and no concrete grout shall be pumped until the fabric seams have been approved. At no time shall the unfilled fabric forms be exposed to ultraviolet light (including direct sunlight) for a period exceeding 5 calendar days.

1. Articulating Block Mat.
Adjacent fabric form panels shall be joined before filling with concrete grout by field sewing or zippering the two bottom layers of fabric together and the two top layers of fabric together. Lap joints shall only be used at locations shown in the contract documents.

2. Armor Units.
Typical unreinforced Armor Units shall be joined together following placement of concrete grout as shown in the contract documents.

Reinforced Armor Units shall be joined before filling with concrete grout by field sewing or zippering the two bottom layers of fabric together and the two top layers of fabric together to form a continuous unit.

D. Proportioning and Mixing Concrete Grout.
All materials shall be accurately measured by volume or weight (mass) as they are fed into the mixer. The quantity of water shall be such as to produce a grout having a pumpable consistency. Time of mixing shall be not less than 1 minute. If agitated continuously, the grout may be held in the mixer or agitator for a period not exceeding 2 1/2 hours in temperatures below 70°F (21°C) and for a period not exceeding 2 hours at higher temperatures. If there is a lapse in a pumping operation, the grout shall be recirculated through the pump or through the mixer drum (or agitator) and pump.

E. Concrete Grout Placement.
Concrete grout shall be pumped in such a way that excessive pressure on the fabric forms and cold joints are avoided. A cold joint is defined as one in which the pumping of the concrete grout into a given form is discontinued or interrupted for an interval of 45 or more minutes.

After the concrete grout has set, all anchor, terminal, and toe trenches shall be backfilled and compacted, as specified by the Engineer.

Foot traffic on the filled form shall be restricted to an absolute minimum for 1 hour after filling.

If a fabric formed concrete unit/mat is to bear on previously installed units, the lower units ~~must~~ shall be allotted a minimum of 4 hours of cure time before beginning installation of a succeeding, vertically adjacent course of fabric formed unit(s). Abutting fabric formed concrete units/mats may be installed immediately after placement of the preceding unit(s).

The freshly pumped fabric formed concrete shall not be washed (sprayed) under pressure with water in an effort to clean or remove spills from its surface. The cement film that bleeds through the top layer of the fabric form shall be maintained through curing on finished surfaces exposed to sunlight.

Should the film be removed in these areas, the film shall be repaired by spreading a thin layer of a water-cement paste over the effected area.

1. Articulating Block Mat.
Following the placement of the fabric forms, small slits shall be cut in the top layer of the fabric form to allow the insertion of the filling pipe at the end of the concrete grout pump hose. These slits shall be of the minimum length to allow proper insertion of the filling pipe. Concrete grout shall be pumped between the top and bottom layers of fabric, filling the forms to the recommended thickness and configuration. Holes in the fabric forms left by the removal of the filling pipe shall be temporarily closed by inserting a piece of nonwoven fabric or similar material. The nonwoven fabric shall be removed when the concrete grout is no longer fluid and the grout surface at the hole shall be cleaned and smoothed by hand.

2. Armor Units.
Following the placement of the fabric form, the filling pipe at the end of the concrete grout pump hose shall be inserted through the self-sealing filling valve. Concrete grout shall be pumped between the top and bottom layers of fabric, filling the forms to the recommended thickness and configuration.

When the contract documents require joining of adjacent Armor Units by inserting reinforcement bar dowels or staples into the Armor Units, the dowels or staples shall be inserted into the filled unit(s) not less than 0.5 hour and not more than 1 hour after filling of the unit, unless directed otherwise by the Engineer. When the contract documents require joining of vertically adjacent Armor Units, reinforcing dowels shall be driven into the lower unit in the time frames specified in this paragraph. The vertically adjacent fabric form shall then be placed over the reinforcing dowels. The dowels shall be forced through the bottom layer of the vertically adjacent fabric form prior to filling that form.

F. Cold Weather Protection.
Concrete grout shall not be placed in forms laying on frozen ground.

Grout filled fabric formed concrete less than 48 hours old shall be protected as follows:

Night Temperature Forecast	Type of Protection
32°F to 25°F (0°C to -4°C)	One layer of burlap or a 3/4 inch (19 mm) layer of soil.
Below 25°F (-4°C)	Three layers of burlap or equivalent commercial insulating material, or a 1 1/2 inch (38 mm) layer of soil.

Protection shall completely cover the fabric formed concrete to the water line on the finished fabric formed concrete surface. Protection of fabric formed concrete below water is not required.

01XXX.04 METHOD OF MEASUREMENT.

A. Fabric Formed Concrete Revetment.
The quantity of Fabric Formed Concrete Revetment of the type specified, in square yards (square meters), will be the quantity shown in the contract documents ~~for each installation to the nearest 0.1 foot (0.1 m)~~.

B. Engineering Fabric.
The quantity of Engineering Fabric will be measured in accordance with Article 2507.04 of the Standard Specifications.

C. Concrete Grout.
The quantity of Concrete Grout for Fabric Formed Concrete Revetment will be measured in accordance with Article 2507.04 of the Standard Specifications.

01XXX.05 BASIS OF PAYMENT.

A. Fabric Formed Concrete Revetment.
The Contractor will be paid the contract unit price for Fabric Formed Concrete Revetment of the type specified per square yards (square meters). This payment shall be full compensation for all work, including furnishing the forms and all equipment, tools, and labor necessary to place the forms ready for filling with grout and any required work following filling. The work includes but is not limited to joining field seams, cable splices, plastic for lap areas, reinforcing bars to join Armor Units.

Unless otherwise noted in the contract documents, this payment shall also be full compensation for any bank shaping, excavation, and backfilling necessary to complete the work in conformance with the contract documents.

B. Engineering Fabric.
The Contractor will be paid for the Engineering Fabric in accordance with Article 2507.05 of the Standard Specifications.

C. Concrete Grout.
The Contractor will be paid for the Concrete Grout for Fabric Formed Concrete Revetment in accordance with Article 2507.05 of the Standard Specifications.