

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C127-04, Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.
  - .2 ASTM D698-00ae1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>(600 kN-m/m<sup>3  - .3 ASTM D1557-02e1, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>(2,700 kN-m/m<sup>3  - .4 ASTM D4253-00, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.</sup></sup>

### **1.2 DEFINITIONS**

- .1 Corrected maximum dry density is defined as:
  - .1  $D = (F1 \times D1) + (0.9 \times D2 \times F2)$
  - .2 Where: D = corrected maximum dry density kg/m<sup>3</sup>.
    - .1 F1 = fraction (decimal) of total field sample passing 19mm sieve
    - .2 F2 = fraction (decimal) of total field sample retained on 19mm sieve (equal to 1.00 - F1)
    - .3 D1 = maximum dry density, kg/m<sup>3</sup> of material passing mm sieve determined in accordance with Method A C of ASTM D698.
    - .4 D2 = bulk density, kg/m<sup>3</sup>, of material retained on 4.75 mm sieve, equal to 1000G where G is bulk specific gravity (dry basis) of material when tested to ASTM C127.
  - .3 For free draining aggregates, determine D1 (maximum dry density) to ASTM D4253, dry method when directed by Departmental Representative.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not Used.

## **Part 3 Execution**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International
  - .1 ASTM D4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 Submittal Procedures.
- .2 Samples:
  - .1 Allow continual sampling by Departmental Representative during production.
  - .2 Provide Departmental Representative with access to source and processed material for sampling.
  - .3 Supply new or clean sample bags or containers according appropriate to aggregate materials.
  - .4 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Transportation and Handling: handle and transport aggregates to avoid segregation, contamination and degradation.
- .3 Storage: store washed materials or materials excavated from underwater 24 hours minimum to allow free water to drain and for materials to attain uniform water content.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Granular Base Course:
  - .1 Crushed stone or gravel consisting of hard, durable particles free from clay lumps, cementation, organic material, frozen material, or other deleterious materials.

- .2      Gradation to be within limits specified when tested to ASTM C136 and ASTM C117 giving smooth curve without sharp breaks when plotted on semi-log charts.
- | Sieve Designation | % Passing |
|-------------------|-----------|
| 20 000            | 100       |
| 10 000            | 68 - 86   |
| 5 000             | 40 - 68   |
| 1 250             | 20 - 45   |
| 315               | 5 - 19    |
| 80                | 2 - 10    |
- .3      Submit sieve analysis of granular material from qualified laboratory.
- .2      A qualified material testing laboratory approved by the Departmental Representative will perform the sieve analysis of the submitted samples.
- .3      The aggregate should be crushed and have a minimum CBR of 60.
- .4      The coarse fraction of the aggregate should have a percent wear by the Los Angeles abrasion test of not more than 50.
- .5      The material passing the 0.4 mm sieve should have a plasticity index of 6 or less.
- .6      The material retained on the 5 mm sieve should have a minimum 60 percent by dry mass with at least two fractured faces.
- .7      Granular base should be placed in lifts not exceeding 150 mm in compacted thickness with each lift being uniformly compacted to a minimum of 100 percent of Standard Proctor density (ASTM D698).
- .8      Flat and elongated particles of coarse aggregate: to ASTM D4791.
- .1      Greatest dimension to exceed 5 times least dimension.
- .9      Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
- .1      Screenings produced in crushing of quarried rock, boulders, gravel or slag.
- .10      Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
- .1      Crushed rock.
- .2      Gravel and crushed gravel composed of naturally formed particles of stone.

### **Part 3      Execution**

#### **3.1      EXAMINATION**

- .1      Verification of Conditions: verify that conditions are acceptable for topsoil stripping.
- .1      Visually inspect substrate in presence of Departmental Representative.
- .2      Inform Departmental Representative of unacceptable conditions immediately upon discovery.

#### **3.2      PREPARATION**

- .1      Aggregate source preparation:

- .1 Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials.
  - .2 Where clearing is required, leave screen of trees between cleared area and roadways as directed.
  - .3 Clear, grub and strip area ahead of quarrying or excavating operation sufficient to prevent contamination of aggregate by deleterious materials.
  - .4 When excavation is completed dress sides of excavation to nominal 1.5:1 slope, and provide drains or ditches as required to prevent surface standing water. Trim off and dress slopes of waste material piles and leave site in neat condition.
  - .5 Provide silt fence or other means to prevent contamination of existing watercourse or natural wetland features.
- .2 Stockpiling:
- .1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Departmental Representative. Do not stockpile on completed pavement surfaces.
  - .2 Stockpile aggregates in sufficient quantities to meet project schedules.
  - .3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.
  - .4 Except where stockpiled on acceptably stabilized areas, provide compacted sand base not less than 300 mm in depth to prevent contamination of aggregate. Stockpile aggregates on ground but do not incorporate bottom 300 mm of pile into Work.
  - .5 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
  - .6 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Departmental Representative within 48 hours of rejection.
  - .7 Uniformly spot dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
  - .8 Do not cone piles or spill material over edges of piles.
  - .9 Do not use conveying stackers.
  - .10 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.
- .4 Leave any unused aggregates in neat compact stockpiles as directed by Departmental Representative.

**END OF SECTION**

## **1.1 REFERENCES**

- .1 AASHTO Standards
  - .1 T88 - Particle Size Analysis of Soils
  - .2 T90 - Determining the Plastic Limit and Plasticity Index of Soils
  - .3 T99 - The Moisture-Density Relations of Soils Using a 5.5lb (2.5 kg) Rammer and a 12in (305 mm) Drop
  - .4 Standard Specifications for Highway Bridges
- .2 American Society for Testing and Materials (ASTM)
  - .1 D 1248-05, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
  - .2 D 4101-11 Standard Specification for Propylene Plastic Injection and Extrusion Materials.
  - .3 D 4218-96 (R2008) Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
  - .4 D 4354-99 (2009) - Practice for Sampling of Geosynthetics for Testing
  - .5 D 4873-02 (2009) - Guide for Identification, Storage, and Handling of Geotextiles
  - .6 D 5262-07 - Standard Test Method for Evaluating the Unconfined Tension Creep Behaviour of Geosynthetics.
  - .7 D 6637-10 - Standard Test Method for Determining the Tensile Properties of Geogrids by the Single Rib or Multi-Rib Tensile Method
- .3 National Concrete Masonry Association (NCMA) - Design Manual for Segmental Retaining Walls, Second Edition, 1997.
- .4 Geosynthetic Research Institute (GRI):
  - .1 GRI GG1 - Geogrid Tensile Strength.
  - .2 GRI GG2 - Geogrid Junction Strength.
  - .3 GRI-GG4(b) - Determination of the Long-Term Design Strength of Flexible Geogrids
  - .4 GRI-GG5 - Test Method for Geogrid Pullout
- .5 Federal Highway Administration (FHWA)
  - .1 FHWA SA-96-071 - Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines
  - .2 FHWA SA-96-072 - Corrosion/Degradation of Soil Reinforcements for Mechanically Stabilized Earth Walls and Reinforced Soil Slopes
- .6 Geosynthetic Accreditation Institute (GAI) - Laboratory Accreditation Program (LAP).

## **1.2 DEFINITIONS**

- .1 Minimum Average Roll Value (MARV): Property value calculated as typical minus two standard deviations. Statistically, it yields a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported.

## **1.3 SUBMITTALS**

- .1 Submit the following:
  - .1 Certification: The contractor shall provide to the Department Representative a certificate stating the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns and other pertinent information to fully describe the geosynthetic. The Certification shall state that the furnished geosynthetic meets MARV requirements of the

specification as evaluated under the Manufacturer's quality control program. The Certification shall be attested to by a person having legal authority to bind the Manufacturer.

.2 Samples: One 3 m length from full roll width of geogrid material at least 2 weeks prior to commencing work.

#### **1.4 DELIVERY AND STORAGE**

- .1 During delivery and storage, protect geogrids from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.
- .2 Geosynthetic labeling, shipment, and storage shall follow ASTM D 4873. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number.
- .3 Wrap each geosynthetic roll with a material that will protect the geosynthetic from damage due to shipment, water, sunlight, and contaminants.
- .4 During storage, geosynthetic rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, excess temperatures, and any other environmental conditions that may damage the physical property values of the geosynthetic.

#### **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Contract requirements.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

### **Part 2 Products**

#### **2.1 DESCRIPTION**

- .1 Open grid polymer geosynthetic having uniaxial orientation, free of striations, roughness, pinholes, blisters, undispersed raw materials or any sign of contamination by foreign matter. The geosynthetic shall be manufactured with fibers consisting of long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins or polyesters. They shall form a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.

#### **2.2 APPROVED MATERIALS**

- .1 Tensile Strength at ultimate 50 kN/m
- .2 Biaxial grid
- .3 Product weight – 220 g/m<sup>2</sup> minimum
- .4 Approved products, alternatives will be considered:
  - .1 Stratagrid 200 by Strata Systems Inc.
  - .2 Tensar UX1500HS by Tensar International Corporation.
  - .3 Tencate Miragrid 5XT by Tencate Geosynthetics North America.
  - .4 Fortrac by HUESKER Inc.

## **2.3 QUALITY CONTROL**

- .1 Manufacturing Quality Control: Testing shall be performed at a laboratory accredited by GAI-LAP for tests required for the geosynthetic, at frequency meeting or exceeding ASTM D 4354.
- .2 Ultraviolet Stability shall be verified by an independent laboratory on the geosynthetic or a geosynthetic of similar construction and yarn type.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Foundation soil shall be excavated to the line and grades as directed by the Department Representative. Over-excavated areas shall be filled with compacted backfill material as per project specifications or as directed by the Department Representative.
- .2 As a minimum, foundation soil shall be proof rolled prior to backfill and geosynthetic placement.

### **3.2 INSTALLATION**

- .1 Lay geosynthetic at the proper elevation and orientation as shown on the reviewed shop drawings or as directed by the Department Representative. Correct orientation of the geosynthetic shall be verified by Contractor. Retain geosynthetic in position in accordance with manufacturer's written recommendations.
- .2 Temporarily secure geosynthetic in-place with staples, pins, sand bags or backfill as required by fill properties, fill placement procedure or weather condition, or as directed by the Department Representative.
- .3 Primary geosynthetic may **not** be overlapped or connected mechanically to form splices in the primary strength direction. Single panel lengths are required in the primary strength direction. Overlap each successive strip of geogrid 600 mm over previously laid strip at right angles to the primary strength direction.
- .4 Backfill material shall be placed in lifts and compacted as directed under project specifications. Backfill shall be placed, spread and compacted in such a manner as to minimize the development of wrinkles in and/or movement of the geosynthetic. A minimum fill thickness of 150 mm is required prior to the operation of tracked vehicles over the geosynthetic.
- .5 Turning of tracked vehicles should be kept to minimum to prevent tracks from displacing the fill and damaging the geosynthetic. Rubber tired equipment may pass over the geosynthetic reinforcement at low speeds, less than 16 km/hr. Sudden braking and sharp turns shall be avoided. Any geosynthetic damaged during installation shall be replaced by the Contractor at no additional cost to the Departmental Representative.
- .6 After installation, cover with one lift of material within 24 hours of placement.
- .7 Replace damaged or deteriorated geogrid to approval of Department Representative.

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**3.3 PROTECTION**

- .1 No vehicles permitted directly on geogrid.

**END OF SECTION**



## **Part 1 General**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM D 4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
  - .2 ASTM D 4595, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
  - .3 ASTM D 4716, Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
  - .4 ASTM D 4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-4.2-M88, Textile Test Methods.
  - .2 CAN/CGSB-148.1, Methods of Testing Geotextiles and Geomembranes.
    - .1 No.2-M85, Mass per Unit Area.
    - .2 No.3-M85, Thickness of Geotextiles.
    - .3 No.7.3-92, Grab Tensile Test for Geotextiles.
    - .4 No.6.1-93, Bursting Strength of Geotextiles Under No Compressive Load.
- .3 Canadian Standards Association (CSA)
  - .1 CAN/CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel.
  - .2 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

### **1.2 MILL CERTIFICATES**

- .1 Submit to Department Representative copies of mill test data and certificate at least 4 weeks prior to start of work.

### **1.3 DELIVERY AND STORAGE**

- .1 During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

## **Part 2 Products**

### **2.1 MATERIAL**

- .1 Geotextile: non-woven synthetic fibre fabric, supplied in rolls.
  - .1 Width: 4.6 m minimum.
  - .2 Length: 91 m minimum.
  - .3 Seams: lapped in accordance with manufacturer's recommendations
- .2 Physical properties – Non-woven:
  - .1 Tensile strength and elongation (in any principal direction): to ASTM D 4595.
    - .1 Tensile strength: minimum 900 N, wet condition.
    - .2 Elongation at break: maximum 50%
    - .3 Mullen burst strength to CAN/CGSB – 4.2, Method 1.1, minimum 2,619 kPa, wet conditions.
  - .2 Acceptable Material: Propex “Non-Woven” geotextile No. 4553 or an approved equivalent.
- .3 Geotextile: woven synthetic fibre fabric supplied in rolls.
  - .1 Width: 5.49 m minimum
  - .2 Length: 76.2 m minimum
  - .3 Seams: Lapped in accordance with manufacturer's recommendations.
- .4 Physical Properties – Woven:
  - .1 Tensile strength and elongation (in any principal direction):
    - .1 Elongation at break: 15% minimum.
    - .2 Mullen burst strength: to CAN/CGSB – 4.2, Method 11.1, Minimum 4,130 kPa, wet conditions.
  - .2 Acceptable Material: Propex “Woven” geotextile No. 2006 on an approved equivalent.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Place geotextile material of the type as indicated on the drawings as per manufacturer's instructions.
- .2 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.
- .3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.

- .4 Join successive strips of geotextile by sewing longitudinal joint (if required) at the place of manufacture and overlapping and pinning joints perpendicular to roadway centreline in accordance with manufacturer's recommendations.
- .5 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.
- .6 After installation, cover with overlying layer within 4 h of placement.
- .7 Replace damaged or deteriorated geotextile to approval of Department Representative.

### **3.2 PROTECTION**

- .1 Do not permit the passage of any vehicle directly on geotextile at any time.

**END OF SECTION**