TENDER SPECIFICATION

FOR SUPPLY OF DRAINAGE COMPOSITE

(SEPARATION, FILTRATION AND DRAINAGE APPLICATION)

PART 1 - GENERAL

1.1 Scope of work

.1 This specification covers the requirements for the manufacture, fabrication, supply, and installation of the Drainage Composite to the material specifications stated herein, as per the bill of quantity and schedule of supplies enclosed. The Drainage Composite and its individual components shall meet or exceed the requirements of this specification. The manufacture, handling, storage, and installation shall be performed in accordance with the procedures provided in this specification.

.2 The CONTRACTOR shall provide all labor, materials, tools, equipment, and perform all operations necessary to furnish, deploy, and install the Drainage Composite in the areas indicated on the Drawings or as required by the ENGINEER, the OWNER or his representative.

1.2 References

.1	ASTM D4491-20e1	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
.2	ASTM D4751-20b	Standard Test Methods for Determining Apparent Opening Size of a Geotextile
.3	ASTM D4873-17	Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
.4	ASTM D7005-16	Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites1
.5	ASTM D7931-18	Standard Guide for Specifying Drainage Geocomposites
.6	EN ISO9863-1:2016	Geosynthetics — determination of thickness at specified pressures - part 1: single layers
.7	EN ISO 12236 :2006	Geosynthetics — Static puncture test (CBR test)
.8	EN ISO 10319:2015	Geosynthetics — Wide - width tensile test.
.9	EN ISO 12958-1	Geotextiles and geotextile-related products — Determination of water flow capacity in their plane — Part 1: Index test
.10	EN ISO 12958-2	Geotextiles and geotextile - related products — Determination of water flow capacity in their plane — Part 2: Performance test
.11	ISO 18228-4:2021	Design using geosynthetics — Part 4: Drainage *(in press)*

1.3 Qualifications

.1 The CONTRACTOR shall have demonstrated experience in the installation of Drainage Composites, have installation staff trained by the MANUFACTURER, or work under the guidance of a representative approved by the MANUFACTURER.

.2 The CONTRACTOR shall be trained and experienced in field handling, storing, deploying, and installing geosynthetic materials. Alternatively, CONTRACTOR shall engage an experienced Subcontractor who shall meet the experience requirements.

1.4 Quality Assurance

.1 The quality management system of the MANUFACTURER shall conform to the requirements of ISO 9001:2015

.2 The In-house Laboratory performing Manufacturing Quality Control shall hold a valid GAI-LAP Accreditation, as well as a ISO/IEC 17025:2017 Accreditation from NABL for the tests performed in Manufacturing Quality Control.

.3 The Drainage Composite shall hold a valid CE-Marking certificate.

.4 The MANUFACTURER shall issue a report stating minimum average roll values and results of the test conducted on samples from the rolls delivered to the project at the time of shipment is made. The number of samples tested should be at least one sample per production lot, and at least one sample every 10,000 m². The following properties must be declared:

- Weight of the Drainage Composite.
- Thickness of the Drainage Composite.
- Tensile properties of the Drainage Composite.
- CBR puncture strength of the Drainage Composite.
- In-plane Water flow capacity of the Drainage Composite at 100 and 200 kPa, between rigid boundaries and after 6 minutes seating time.

.5 The ENGINEER, the OWNER or his representative may visit the facility where the product is manufactured and review the quality control procedure as well as the storage and handling conditions at the plant, at their expense.

.6 Indigenously manufactured drainage composites should be preferred, considering advantages of shorter delivery periods, no inventory pile-up and cost being unaffected by fluctuation of exchange rate of foreign currency.

.7 A representative of the OWNER or the ENGINEER shall observe and document the unloading, storage, deployment, and installation of the Drainage Composite.

.8 If required by a Construction Quality Assurance (CQA) Plan, then OWNER or ENGINEER shall obtain samples of the Drainage Composite for conformance testing at the sampling rate defined by the CQA Plan. Each sample shall be at least 600 mm long, taken across full width of the Drainage Composite roll for each type of material furnished for Project.

a. When applicable, third party sampling, testing and related expenses will be covered by the owner.

b. Care must be given to put back the packaging in a way that will not expose the rolls to the weather after sampling.

1.5 Warranty

.1 Installation shall be warranted against defects in workmanship for a period of 1 year from the date that the installation is deemed complete.

1.6 Submittals

.1 The CONTRACTOR shall submit to the ENGINEER for approval data from the MANUFACTURER indicating that the properties of the proposed Drainage Composite conform to the requirements of this Specification.

.2 At least 15 days prior to installation, the CONTRACTOR shall submit to the ENGINEER quality control test results from the MANUFACTURER for the rolls produced specifically for the project and certification that the material meets the requirements of this Specification.

.3 At least 15 days prior to installation, the CONTRACTOR shall submit to the ENGINEER:

- Drawings showing the Drainage Composite sheet layout and direction of overlap.
- Description of proposed method of deployment and provisions for holding the Drainage Composite temporarily in place until permanently secured.

.4 The MANUFACTURER shall submit the proof of supply and satisfactory performance for a quantity of at least 10,000 square meters, on projects located in India.

.5 The CONTRACTOR shall provide all the above-requested documents without exception.

PART 2 - MATERIALS

2.1 General Requirements

.1 The Drainage Composite consists of:

c. A triplanar geonet acting as a drainage core, comprised of three sets of parallel overlaid ribs integrally connected to form a shape made of high-density polyethylene formulated to resist the chemical environment typically prevailing in soils.

d. Two geotextiles made by needle-punching polypropylene staple fibers to form a nonwoven fabric. Additional thermal or chemical treatments may be performed on the non-woven after needle-punching. The geotextiles shall be non-biodegradable, resist to commonly encountered soil chemicals, mildew and insects, and stabilized to resist solar radiation during their installation.

.2 The geotextiles are heat-bonded on each side of the drainage core to prevent soil particles from entering in the drainage core. The assembled product is ready to deploy without additional assembly required onsite between the three layers. On-site assembly of independent layers does not procure an equivalent performance and is not permitted.

2.2 Properties of the biplanar composite

.1 The triplanar geocomposite and its two main constituents are controlled during manufacturing.

.2 The triplanar geonet shall meet or exceed the values provided in Table 2.2-1. Properties shall be measured before assembly to the geotextiles.

Table 2.2–1 : properties of the triplanar geonet serving as a drainage core.

CHARACTERISTIC	STANDARD	UNIT	VALUE	TOLERANCE
Mass per unit area	EN ISO 9864	g/m^2	800	Typical
Thickness at 2 kPa	EN ISO 9863-1	mm	6.0	Typical
In-plane flow capacity (Note 1) - 100 kPa - 200 kPa	EN ISO 12958-1	l/(m.s)	 2.5 2.2	Typical

Note 1: In-plane flow capacity is measured in longitudinal direction, between rigid boundaries, with a hydraulic gradient of 1.0 and a seating time of 6 minutes. The In-plane flow capacity may vary with the testing laboratory, boundary conditions, compressive load, hydraulic gradient, seating time, and test temperature. The proposed values reflect the properties of the product measured in accordance with the conditions described in the ISO test method.

.3 The geotextiles shall meet or exceed the values provided in Table 2.2-2. Properties shall be measured before assembly to the drainage core.

Table 2.2–2 : properties of the geotextiles serving as filters.

CHARACTERISTIC	STANDARD	UNIT	VALUE	TOLERANCE
Characteristic opening size O_{95}	ASTM D 4751	mm	0.150	Maximum
Flow Rate (50 mm water head)	ASTM D 4491	$l/m^2/s$	70	Minimum
Static puncture resistance	EN ISO 12236	N	1400	Minimum
Retained properties after UV exposure	ASTM D4355	%	70%	Minimum

.4 The properties of the assembled drainage composite shall meet or exceed the values provided in Table 2.2-3. Properties shall be measured on the manufactured product, with the geotextiles laminated on the drainage core.

Table 2.2–3 : properties of the assembled drainage geocomposite.

CHARACTERISTIC	STANDARD	UNIT	VALUE	TOLERANCE
Roll width	--	Meters	4.0	± 0.05
Roll length	--	Meters	25	± 1.0
Thickness at 2 kPa	EN 9863-1	mm	6.5	Typical
Mass per unit area	EN ISO 9864	g/m2	1050	Typical
Static puncture resistance	EN ISO 12236	N	3000	Minimum
Tensile strength MD/CMD(Note 1)	EN ISO 10319	kN/m	22/18	Minimum
Peel resistance	ASTM D7005	N/m	174	Minimum
Index in-plane flow capacity (Note 2) - 100 kPa, R/R - 200 kPa, R/R	ISO 12958-1	l/(m.s)	 1.8 1.7	Typical
Design in-plane flow capacity(Note 3) - 100 kPa, R/S, 100 hours - 200 kPa, S/S, 100 hours	ISO 12958-2	l/(m.s)	 1.5 0.9	Typical
RF_{CR}(Note 4) - 100 kPa, 100 years - 200 kPa, 100 years	Note 4	Unitless	 1.10 1.12	Typical
RF_{GI}(Note 4) - 100 kPa, 100 years - 200 kPa, 100 years	Note 4	Unitless	 1.0 – 1.4 1.0 – 1.5	Typical

Note 1: MD: longitudinal direction; CMD: Transverse direction

Note 2: Index in-plane flow capacity is measured in longitudinal direction, between rigid boundaries (R/R), with a hydraulic gradient of 1.0 and a seating time of 6 minutes. The in-plane flow capacity may vary with the testing laboratory, boundary conditions, compressive load, hydraulic gradient, seating time, and test temperature. The proposed values reflect the properties of the product measured in accordance with the conditions described in the ISO test method.

Note 3: Design in-plane flow capacity is measured in longitudinal direction, between Sand/Sand boundaries (S/S) or Rigid/Sand boundaries (R/S), with a hydraulic gradient of 1.0 and a seating time of 100 hours. The specified value reflects an average flow capacity across the roll width. It may vary with the testing laboratory, boundary conditions, compressive load, hydraulic gradient, seating time, and test temperature. The proposed values reflect the properties of the product measured in accordance with the conditions described in the ISO test method.

Note 4: RF_{CR}: Reduction factor for creep; RF_{GI}: Reduction factor for long-term geotextile intrusion, determined using ISO 18228-4 and/or ASTM D7931. RF_{GI} depends on the actual boundary conditions. The Reduction factors must be determined using a representative sample coming from the same plant and using similar raw materials. Example of determination of RF_{CR} and RF_{GI} are available in "TFI Technical Note 2021-03 – Revision 1, February 2021"

2.3 Transportation, Storage and Handling

.1 General guidance established in ASTM D4873-16 should be followed for transportation, storage and handling of the Drainage Composite.

.2 Packaging and Identification

a. Cover each roll with an opaque wrapping material for protection from damage due to shipment, water, sunlight, or contaminants while being stored or handled in accordance with this guide.

b. Each roll must be identified with a durable, gummed label, or equivalent, clearly readable on the roll packaging. Roll identification should include the name of the MANUFACTURER, product designation / style number, and the unique roll number. Identification should also include the width and length of the roll.

.3 Receiving and Storing at the job site

a. While unloading or transferring the geocomposite from one location to another, prevent damage to the wrapping and to the geocomposite itself. If practicable, use forklift trucks fitted with poles that can be inserted into the cores of rolls. The poles must be at least two thirds the length of the rolls to avoid breaking the cores and possibly damaging the geosynthetic. Slings may be used to carry relatively rigid rolls, provided that the slings do not cause damage to the rolls. Do not drag the rolls as damage may result.

b. Geocomposites, when possible, should be stored elevated of the ground and covered to ensure adequate protection from the following:

- Precipitation (because geocomposite roll goods saturation may lead to handling difficulties),
- Ultraviolet radiation,
- Undesirable chemicals for any extended period of time,
- Flames, including welding sparks,
- Temperatures in excess of 71°C and below 0°C, and
- Any other environmental condition that may affect the properties of the composite.

.4 On-Site Handling

a. While transferring geocomposites from one location to another, prevent damage to the wrapping and to the geocomposite itself. Follow the cautions specified in the previous section.

b. Before unrolling a roll of geocomposite at the job site, verify its identification. While unrolling the geocomposite, inspect for damage or defects.

c. Follow all applicable site or project specifications and recommendations from the MANUFACTURER for handling and installation.

d. Correct any damage that occurs during storage or installation as directed by the project specifications and the ENGINEER in charge of installation.

2.4 Quality Control & testing

.1 Should third party testing of the Drainage Composite be required, tests must be conducted according to the test methods identified herein.

.2 Should third-party testing be requested on the geotextile and the drainage core before lamination, the corresponding samples must be requested at the time the product is ordered, to permit sampling during production, before lamination. The OWNER may request to have the sampling witnessed by a representative he will designate, at his cost. Testing the core and the geotextile properties after production will not be considered valid tests.

.3 Any direct or indirect costs associated to third party testing will be covered by the owner.

PART 3 - INSTALLATION

3.1 Site Preparation

.1 The site shall be prepared by clearing, grubbing, and excavation or filling the area to the design grade. This includes removal of topsoil and vegetation.

.2 Prior to deploying any Drainage Composite, the CONTRACTOR shall carefully inspect the surface on which the material will be placed and verify that the material may be placed without adverse impact.

3.2 Approval of the subgrade

.1 CONTRACTOR shall certify in writing that the surface on which the Drainage Composite will be installed is acceptable. The certificate of acceptance shall be given to ENGINEER prior to commencement of installation of the Drainage Composite in the area under consideration.

.2 Special care shall be taken to avoid desiccation cracking or freezing of the soil surface. The soil surface shall be maintained in the required condition throughout the course of geocomposite installation.

3.3 Laying of the Drainage Composite

.1 The Drainage Composite shall not be placed, joined, or repaired during periods of precipitation, excessively high winds, or in ponding water.

.2 The Drainage Composite shall be kept clean prior to and during installation, until backfilled by the cover soil.

.3 The drainage geocomposite must be backfilled as soon as possible: if possible, on the day of installation, and at most within 7 calendar days after removal of the packaging.

a. Preventive measures must be taken to prevent wind uplift should backfilling not be possible on the day of installation.

b. The ENGINEER must confirm that the product is suitable for backfilling considering environmental conditions prevailing on the site and formulation of the product should backfilling not possible within 7 days.

.4 The Drainage Composite shall be laid smooth without wrinkles or folds.

.5 The machine direction must be oriented in the following direction:

a. For installation in road structures, the longitudinal direction must follow the slope of the subgrade in a direction perpendicular to the direction of traffic.

b. For installation on slopes, the longitudinal direction must be parallel to the direction of the slope.

c. For installation on walls, the longitudinal direction must be vertical.

d. Any deviation to the above recommendations, or condition not addressed herein, must be approved by the ENGINEER.

.6 Overlap between adjacent rolls shall be as directed by the ENGINEER, the minimum overlap shall be 300 mm. The same process shall be followed for all roll ends.

.7 On curves, the Drainage Composite may be cut to conform to the curves. The fold or overlap shall be in the cross direction of construction and held in place by pins. Overlap requirements indicated above apply to cut pieces of the drainage composite.

.8 Junctions with collectors, when applicable, shall be as designed by the ENGINEER. The Drainage Geocomposite must not be exposed directly to the sun for a duration exceeding one week. When connecting to a ditch, a gravel backfill must be installed to cover it.

.9 When planning cuts and overlaps, the CONTRACTOR must make sure that overlaps will be shingled in the direction that backfilling will occur, and that the drainage core will not be in direct contact with any soil, above or below the Drainage Composite, and on its edges.

.10 Prior to placing the backfill material as per the project requirements, the installed Drainage Composite shall be inspected and approved by the ENGINEER. Any damages shall be repaired by covering the damaged location with a patch made from the same Drainage Composite, which extends an amount equal to the required overlap beyond the damaged area, as directed by the ENGINEER. Any accumulation of fine particles on the surface of the geotextile may affect the long-term flow perpendicular to the geotextile and may require the replacement of the geotextile, as directed by the ENGINEER.

3.4 Placing and Compacting the backfill

.1 The backfill (e.g., the subgrade course for roadway applications) shall be free of matter that could damage or clog the Drainage Composite.

.2 The backfill shall be placed by end dumping onto the Drainage Composite from the edge of the Drainage Composite. Trucks shall not drive directly on the drainage composite.

.3 Movement of construction equipment directly over the Drainage Composite shall not be permitted. In case a truck would accidentally drive on the Drainage Composite, the trafficked region must be replaced by a new panel of Drainage Geocomposite, or a patch added on top as specified by the ENGINEER.

.4 The first lift thickness shall be 250 to 300 mm. Compaction of the first lift shall consist of a minimum of 2 passes with the compaction equipment specified by the ENGINEER. Further backfilled material may be installed as directed by the ENGINEER.

.5 Sudden breaking and sharp turning of construction equipment shall be avoided over the laid Drainage Composite, even when covered by the first layer of the backfill soil.

.6 Any ruts occurring during construction shall be filled with additional subgrade material and compacted to the specified density.

PART 4 - APPROVED MANUFACTURERS

4.1 List of Approved Manufacturers

.1 The following is a list of pre-approved supplier of drainage composites

Techfab (India) Industries Ltd.

712 Embassy Centre,

Nariman Point, Mumbai – 400 021

Phone: 022 – 2287 6224/6225

Fax: 022 – 2287 6218

PART 5 - DELIVERY

5.1 Delivery

.1 Delivery of Drainage Composite shall be done according to the delivery schedule.

PART 6 - PAYMENT

6.1 Method of Measurement

.1 The Drainage Composite will be measured by Square Meter of material received at the owner's / contractor's store.

6.2 Basis of Payment

.1 Payment for the supply of the Drainage Composite shall be made at the contract unit price per Square Meter, which shall be full compensation for the cost of materials, transportation, duties and taxes.

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