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GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS

**“Specification for Geo-composite drain to be used at the base of  
the Embankment” for Railway Formation**

**Specification No. RDSO/2018/GE: IRS-0004 Part-II**

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## Annexure-1

### Specification of Geocomposite Drain to be used at base of the Embankment

#### (A) Properties of Geocomposite Drain (Horizontal)

In case of embankments over weak/fine grained sub-soils (which are mostly soft clays) and having water table at higher level, it is a good practice to provide a "separator-cum-drainage layer" of sand at the ground level to provide adequate drainage path for the water coming from sub-soil (reducing excess pore water pressure in embankment and thereby increasing its' stability) and to prevent fouling of subgrade by the fine grained subsoil.

For reducing the thickness of "drainage-cum-separator layer of sand" at the base of embankment, Geo-composite Drain (or Drainage Composite) consisting of a geonet core sandwiched between non-woven geotextile filters on both sides can be laid with cross slope of 1 in 30. Such geo-composite drain is sandwiched between two sand layers of thickness 75mm each.

The specification of geo-composite Drain shall be as listed below when tested as per the latest edition of the test method indicated therein. These specification are for embankments of height up to 8m when laid over weak/fine grained sub-soils.

Sl. No.	Property	Test Method	Value
<b>(I) Composite Drain (Non-woven geotextile on both sides)</b>			
1	Tensile Strength	ASTM D4595-2017	20 KN/m in both MD & CD ( $\pm 10\%$ )
2	In-plane Water Flow (Min.) (For $i=1.0$ , Soft/Soft Contacts) At 200 kPa (To be tested in lab)	ASTM D4716 -2014	0.45 lit/m.sec.
3	Static Puncture Resistance CBR(*)	ASTM D6241-2014	3000 N
4	Ultraviolet Stability Requirement after 500 Hours of exposure (*) Retained breaking strength in Strip Tensile Test	ASTM D4355-2018	Not less than 70% (After unwrapping, the Geocomposite should be installed and covered within a maximum of 14 days)
5	Minimum retained Ultimate Tensile Strength(*)	EN:12447-2001 and EN ISO: 13438-2004	50% (tested as per Clause B.4 of EN: 13250-2016, for 100 year service life)
6	Resistance to Installation damage {% retained of In-plane Water Flow (Min.) (For $i=1.0$ , Soft/Soft Contacts) At 200 kPa (To be tested in lab)}	ASTM- D5818-2018	90%
<b>(II) Core</b>			
1	Material	-	HDPE/Polypropylene/ Polyethylene or combination thereof
<b>(III) Filter (Non-woven Geotextile)</b>			
1	Material	-	Polypropylene/Polyamide/Polyethylene, Polyester or combination thereof
2	Type/Structure	-	Non-woven Needle Punched & Mechanically or Thermally bonded type or equivalent
3	Permeability (Perpendicular to Plane)	ASTM D4491-2016	70 lit./m <sup>2</sup> .s (Min.)
4	Apparent Opening Size	ASTM D4751-2016	150 Micron (Max.)
5	Puncture Strength – CBR (*)	ASTM D6241 – 2014	1400 N
6	Ultraviolet Stability Requirement after 500 Hours of exposure (*) Retained breaking strength in Strip Tensile Test	ASTM D4355-2018	Not less than 70% (After unwrapping, the Geocomposite should be installed and covered within a maximum of 14 days)

- MD: Machine Direction (Longitudinal to the roll)
- CD: Transverse Direction i.e., 90° to MD, (Across the roll width)

\* Is Minimum Average Roll Value (MARV), which is derived statistically as average value minus two standard deviations.

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**Note:**

- (i) The adherence to above listed specification should be checked by testing the samples at IIT/ NIT/ other NABL accredited lab.
- (ii) Manufacturing of Geosynthetics shall be in accordance with the manufacturer's QAP for quality control.
- (iii) The product being supplied by the manufacturer should have been successfully used for similar application (i.e., Geo-composite Drain at base of the Embankment) at minimum 3 locations, with minimum 3 year's experience at one of the location, with supporting documents as a evidence for satisfactory performance.
- (iv) To ensure proper quality assurance and reproducibility of the product, following stipulations are as under:
  1. The manufacturer of the Geo-composite Drain should have ISO: 9001/CE Certification for the product being supplied. The manufacturer of Geo-synthetics should have a well-documented Quality Assurance Procedure (QAP)/Factory Production Control (FPC) Manual, covering every specific product produced on specific production site, which shall be referred/stipulated in the ISO: 9001/CE Certification. The QAP/FPC Manual shall consist of a permanent internal production control system to ensure that product being manufactured conforms to the requisite properties and it addresses following items:
    - (a) Produce design requirement and criteria.
    - (b) Acceptance criteria of raw/incoming material and procedures to ensure that these are met.
    - (c) Relevant features of the plant and production process; giving frequency of inspections, checks & tests, together with values/criteria required on equipment and action(s) to be taken when control values or criteria are not obtained.
    - (d) Tests on finished products – Size of the samples and frequency of sampling with results obtained.
    - (e) Details of alternative tests and procedures, if any, and their correlation with reference tests.
    - (f) Calibration of equipment having influence on test results.
    - (g) Records to be maintained for various inspections, checks and tests carried out during factory production.
    - (h) Assessment of results of various inspections, checks and tests carried out during factory production; where possible and applicable.
    - (i) System of traceability and control of designs, incoming materials and use of materials.
    - (j) Corrective action for non-conforming materials and finished products.
    - (k) Training, job description and responsibility of the personnel involved in the manufacturing process.
  2. Any subsequent changes in raw materials, manufacturing procedures or the control scheme that effects the properties of a product shall be recorded/revised in the QAP/FPC Manual and certified by the ISO: 9001/CE Certification.
  3. Surveillance of QAP/FPC Manual shall be undertaken at least once per year. The surveillance shall include a review of the test plan(s) and production processes for each product to determine if any changes have been made since the last assessment or surveillance. The significance of changes shall be assessed.

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4. Records of all in-house test results, as per QAP/FPC Manual, shall be shown to the purchaser; whenever requested by the purchaser.
5. Geo-composite Drain shall be manufactured by thermal bonding of filter and core. Melt temperature of the bonding materials must be compatible so that the properties of each material are retained. Adhesion of filter & core using glue/adhesive tape shall not be permitted particularly for this application.
6. In-plane water flow as per item I(2) of Specification is 0.45 lit/m.sec which is to be tested in lab. For calculating the value of short term flow creep factor is taken as 1.3. Manufactures have to give the test certificate indicating the value of creep factor for their product tested accordingly to ASTM D7931-2018. The value of creep factor of the product should be less than or equal to 1.3 for 100 years design life under 200 kPa pressure. In case the creep factor of a product is greater than 1.3 then in-plane water flow to be tested in lab i.e., 0.45 lit/m.sec as mentioned in specification at I(2) should be increased proportionally.
7. Geocomposite drain consisting of cuspated core shall not be used.

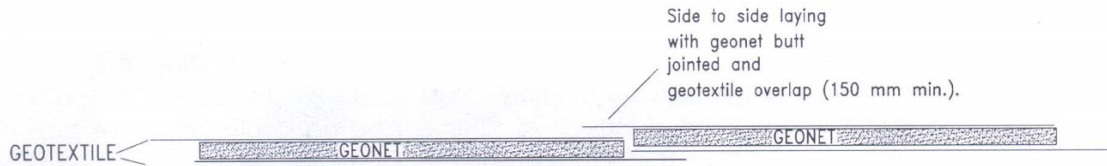
**(B) Packing, Handling and Installation of Geo-composite Drains (Horizontal)**

- (i) The Geo-composite drain shall be provided in wraps with a protective covering. A tag or other method of identification shall be attached to each wrapped package indicating the following:
  - (a) Manufacturer or Supplier Name
  - (b) Product Name and Style
  - (c) Roll Identification Number
  - (d) Lot or Batch Number
- (ii) Rolls of Geo-composite drain should not be dragged on the ground and they must be lifted off the ground before moving them.
- (iii) Geo-composite drain should be adequately protected from Ultraviolet (UV) exposure during storage at site. The protective wrapping, in which the Geo-composite drain come wrapped from factory, should be kept on till their installation. After unwrapping, the Geo-composite drain should be installed and covered within a maximum of 14 days.
- (iv) If stored outside, they should be elevated from the ground surface and adequately covered to protect them from site construction damage, precipitation, UV radiation, chemicals that are strong acids/bases, flames including welding sparks, temperatures in excess of 71<sup>0</sup>C etc.
- (v) When Geo-composite drains are assembled on site, the assembly area shall be clean and dry.
- (vi) Geo-composite drains shall be capable of being connected longitudinally or laterally into pipe systems or chambers for outflow purpose. Joint parallel to the direction of flow and any exposed edge shall be protected from the ingress of soil by wrapping with a minimum overlap of 150mm or other measures.

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## Geocomposite jointing and overlap



- (vii) Care must be taken to ensure that large stones are not allowed in sub soil & subgrade soil to damage the surface of the geotextile filter.
- (viii) The water coming from the Geo-Composite Drain can be disposed off by providing side drain along the embankment.
- (ix) A diagram showing Use of Geo-Composite Drain in bank over soft subsoil is enclosed as Annexure-A

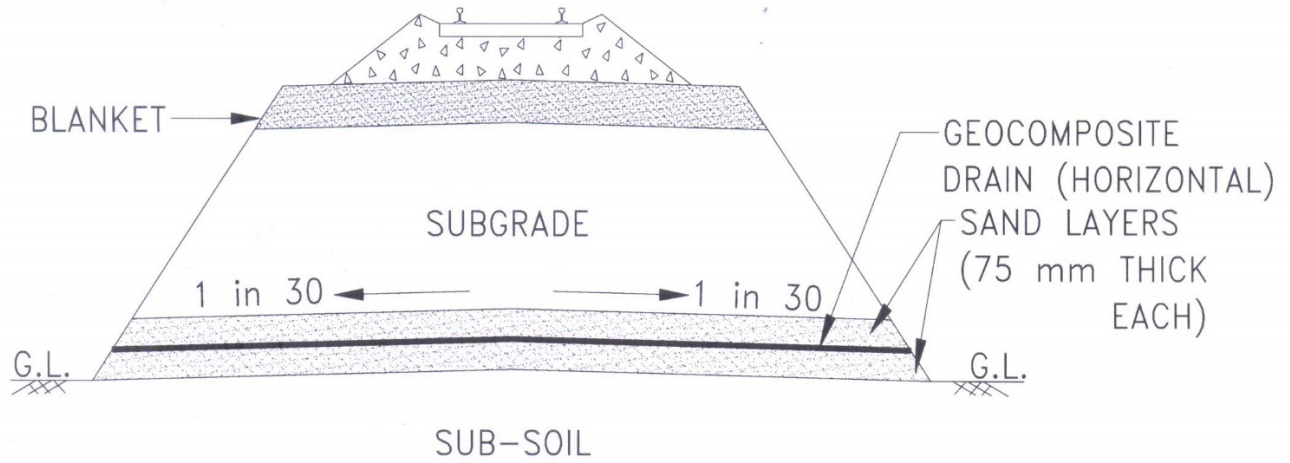
### **(C) Measurement for Payment of Geo-composite Drain (Horizontal)**

The Geo-composite drain shall be measured in square metres, with no allowance for overlapping at transverse & longitudinal joints. The contract unit rate for the accepted quantities of Geo-composite drain shall be in full compensation for furnishing, preparing, hauling and placing Geo-composite drain including all labour, freight, tools, equipment and incidentals to complete the work as per specifications.

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Annexure-A



**Use of Geo-Composite Drain in bank over soft subsoil**

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**Feedback Performa of Track for laying of Geocomposite Drain to be used at the base of the Embankment**

1. **Station/ Section/Division/Railway**
  - Axle load
  - GMT of the section
  - Last Deep screening done
  - Sectional speed before & after laying
2. Application for which Geocomposite Drain used: Geocomposite Drain in embankment over soft subsoil.
3. Track Structure details
4. **Embankment formation details** including
  - Cross-section
  - Sand layers details used
  - Type of sub soil/subgrade soil etc
5. **Details of the section** like
  - Problem faced,
  - Ground improvement required or not,
  - Any ground improvement done(if any please specify the method).
6. **Details of Geocomposite Drain used:**
  - Date of laying
  - Total length of Geocomposite Drain laid in the section
  - Cost (per sq. meter)
  - Properties, Test method and values of Geocomposite Drain used as per specification no. RDSO/2018/GE: IRS-0004 Part-II
7. **Details-before and after laying of Geocomposite Drain:**
  - Chainage/TP wise TGI Values of previous 3 years and after laying of Geocomposite Drain
  - Frequency of Machine Tamping/ Manual track attentions
  - Speed Restrictions
  - Track Parameters (gauge, unevenness, x-level, twist and alignment etc.).
8. Special maintenance efforts during summers & monsoons, along with brief description after laying of Geocomposite Drain.
9. Overall comment on the **drainage and effectiveness** of the system with Geocomposite Drain in place, problem encountered (if any) after its installation.
10. Results of the in-situ **pore water pressure measurement** before and after monsoon with piezometers installed just below the ground level in subsoil (Longitudinal along the alignment @500m c/c and vertically @3m c/c).
11. Status after using Geocomposite Drain in detail.
12. Improvement in drainage through side drain provided for the purpose.
13. Any improvement in soft subsoil properties (N value & Cu value and Ev2 value) before and after laying of Geocomposite Drain.
14. Any problem during laying of Geocomposite Drain.
15. Any other remarks (other than those prescribed above).

**Signature of Railway Official:**

**Name:**

**Designation:**

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