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**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS**

**"Specification for Geocomposite drain to be used behind
Bridge Abutment/Retaining wall"**

Specification No. RDSO/2018/GE: IRS-0006

**March 2019
Geo-technical Engineering Directorate,
Research Designs and Standards Organisation
Manak Nagar, Lucknow – 11**



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Annexure-1**Specification of Geocomposite Drain to be used behind Bridge Abutment/ Retaining Wall for Railway Bridge****(For height up to 10 m)****(A) Properties of Geocomposite Drain (Vertical)**

The Geocomposite Drain (or Drainage Composite) consisting of a geonet core sandwiched between non-woven geotextile filters on both sides, to be used behind Bridge Abutment/Retaining Wall of Height up to 10m, shall have following properties, when tested as per the latest edition of the test method indicated therein:

Sl. No.	Property	Test Method	Proposed value
I	Composite Drain (Non-woven geotextile on both sides)		
1	Tensile Strength	ASTM D4595-2017	20 KN/m in both MD & CD ($\pm 10\%$)
2	In-plane Water Flow (For $i=1$, Rigid/Soft Contacts) At 100 kPa (To be tested in lab)	ASTM D4716-2014	1.5 lit/m.sec.
3	Static Puncture Resistance CBR(*)	ASTM D 6241-2014	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)
II	Core		
1	Material	-	HDPE/Polypropylene/ Polyethylene or combination thereof
III	Filter (Non-woven Geotextile)		
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 ² .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. for drainage behind bridge abutment/retaining wall) at minimum 3 locations, with minimum 3 year's experience at one of the location, with supporting documents as an evidence for satisfactory performance.
- (iv) To ensure proper quality assurance and reproducibility of the product, following stipulations are as under:
 - 1. The manufacturer of Geocomposite 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

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each product to determine if any changes have been made since the last assessment or surveillance. The significance of changes shall be assessed.

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 1.5 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 100 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., 1.5 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 (Vertical)

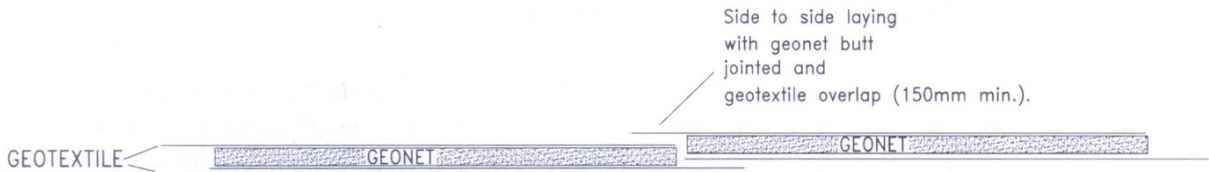
- (i) The Geocomposite drain shall be provided in wraps with a protective covering. A tag or other method of identification shall be attached to each wrapped package indicating the following:
 - (a) Manufacturer or Supplier Name
 - (b) Product Name and Style
 - (c) Roll Identification Number
 - (d) Lot or Batch Number
- (ii) Rolls of Geocomposite drain should not be dragged on the ground and they must be lifted off the ground before moving them.
- (iii) Geocomposite 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°C etc.
- (v) When Geo-composite drains are assembled on site, the assembly area shall be clean and dry.
- (vi) Geocomposite 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

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any exposed edge shall be protected from the ingress of soil by wrapping with a minimum overlap of 150mm or other measures.

Geocomposite jointing and overlap



- (vii) Care must be taken to ensure that large stones are not allowed in the soil & large projections abutment surface to damage the surface of the geotextile filter.
- (viii) In case of use behind Bridge Abutment or Retaining Wall, slotted pipe can be provided for horizontal drainage at bottom, by placing Geonet inside slot and both layers of geotextile to be wrapped around the slotted pipe & pasted at the overlap with suitable tape. Or perforated pipe can be provided for horizontal drainage at bottom, by placing Geonet is terminated at the top of perforated pipe and both layers of geotextile to be wrapped around the perforated pipe & pasted at the overlap with suitable tape.
- (ix) A diagram showing GeoComposite Drain behind bridge abutment is enclosed as Annexure-A

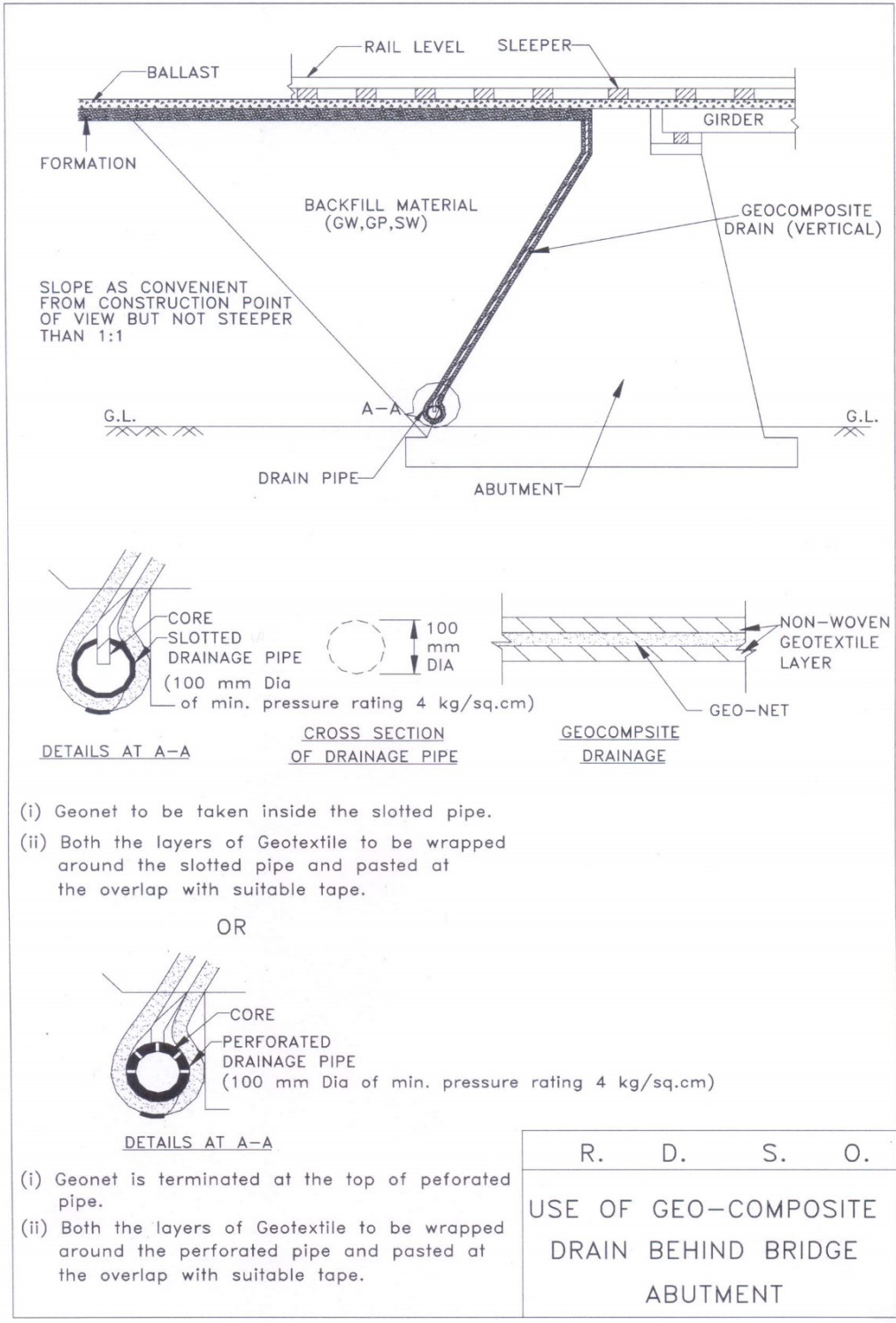
C) Measurement for Payment of Geo-composite Drain (Vertical)

The Geocomposite 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



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Feedback Performa for Laying/Installation Of Geocomposite Drain Used Behind Bridge Abutment/Retaining Wall

1. **Section/Division/Railway**
 - Axle load
 - GMT of the section
 - Last Deep screening done
 - Sectional speed

2. **General Details of site** where Geocomposite drain used:
 - Bridge details-
 - Number & Type
 - Span
 - Total length etc
 - Height of abutment/Retaining wall
 - Cross-sectional details etc

3. **Track Structure details**

4. **Backfill material used** behind Bridge abutment as per Sketch 1 of Para 6.4.2 of Guidelines for Earthwork in Railway Projects (GE: G-1, July 2003).

5. **Details of Geocomposite Drain used:**
 - Date of installation
 - Cost (per sq. meter)
 - Properties, test method and values of Geocomposite Drain used as per specification no. RDSO/2018/GE: IRS-0006

6. **Details- After installation of Geocomposite Drain:**
 - Chainage/TP wise TGI Values after installation of Geocomposite Drain
 - Frequency of Machine Tamping/ Manual track attentions at Bridge approach
 - Speed Restrictions
 - Settlement (if any) at Bridge approach after installation
 - Track Parameters (gauge, unevenness, x-level, twist and alignment etc.).

7. **Special Maintenance efforts** during summers & monsoons, along with brief description, after installation of Geocomposite drain.

8. Overall comment on the **drainage and effectiveness** of the system with Geocomposite drain in place, problem encountered (if any) after its installation.

9. Any **sign of instability** in abutment/retaining wall (like crack etc.) due to excess pore water pressure with accumulation of water/ improper drainage behind bridge abutment.

10. Results of the in-situ **pore water pressure measurement** before and after monsoon with piezometers installed just ahead of Geocomposite behind abutment/retaining wall, within the backfill material.

11. Any problem during **laying/installation** of Geocomposite Drain.

12. Any other remarks (other than those prescribed above).

Signature of Railway Official:
Name:
Designation:

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