# Comparative Study on Geo-Composite Drain and Conventional Filter Media Used Behind Abutment and Retaining Wall

[1]Amir Rahman, [2]Satish Parihar, [3]Neeraj Aggarwal
[1]M. Tech Student, [2]Professor, [3]M. Tech Student
[1]Civil Engineering Department,
[1]Rama University, Kanpur, India

***Abstract:*** Drainage composite is a subset within the family of geosynthetic material. They are used in environmental, geotechnical and transportation applications. The main objective of drainage composite is to combine the best features of different materials in such a way that specific problems are solved in optimal manner providing optimum performance and minimum cost.

Drainage composite reduces the pore water pressure and thus increases the overall stability of earth retain structures. It is laid behind the wall facia. If in case there is the conventional retaining wall system consisting of the weep holes, the Geo-composite Drain can be used for the dissipation of the water.

***IndexTerms*** **– Drainage composite, water pressure, geotechnical, Geo-composite Drain, hydrostatic**

## I. INTRODUCTION

Drainage composite serves the similar function in reinforced soil wall as mentioned for retaining wall & bridge abutments, but installation and location of the drainage composite is different in reinforced soil wall/slope. Geo-composite Drain drainage composite is laid behind the reinforced walls/slopes as shown in Figure 3 and 3A. It is an effective replacement of chimney drain in reinforced soil systems.

The main function of drainage composite is to drain the water away from the structure. The core part of drainage composite which is made of polymer core networks as watercarrier and the geotextile part checks the passage of fine soil particles into drain and thus avoids the clogging of drainage composite.

Composite drainage performs the following purposes within a civil system (as seen in figure below):

- Drainage – Main / Primary function
- Filtration
- Separation
- Erosion protection

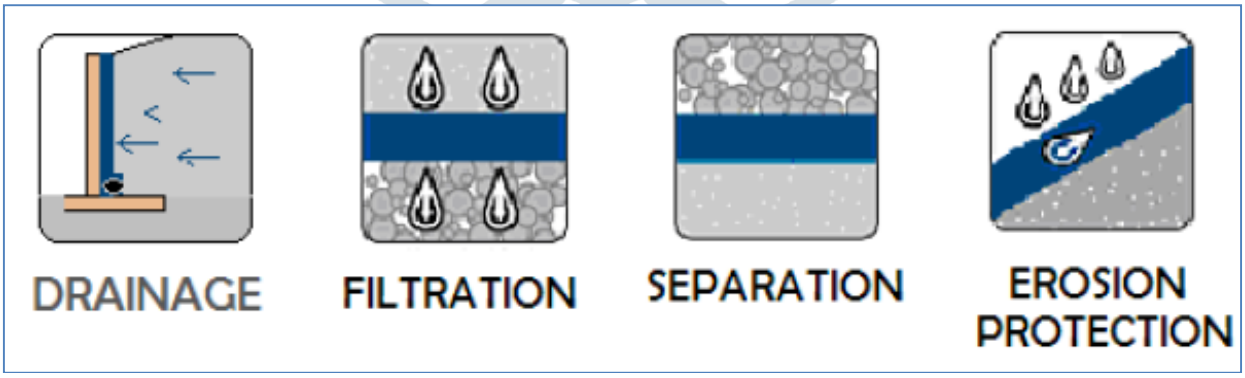


Figure 1: Various Function of Geo-composite Drain

## II. DESIGN CONSIDERATION OF GEO-COMPOSITE DRAIN

Following are the design criteria and design consideration for Geo-composite drain;

### a) Design Criteria

Geo-composite drains when used behind the face of the retaining structure should meet the following criteria;

- **Flow capacity/drainage capacity of the core net:**

The overall flow capacity of Geo-composite drain must be higher than the expected waterflow in structure.

- **The total discharge is calculated by the following mathematical expression:**

$$Q = k\ H\ N_f / N_d$$

Where, k= permeability of backfill soil
H= height of the wall
$N_f$ and $N_d$ = no. of the flow lines and the Equipotential lines

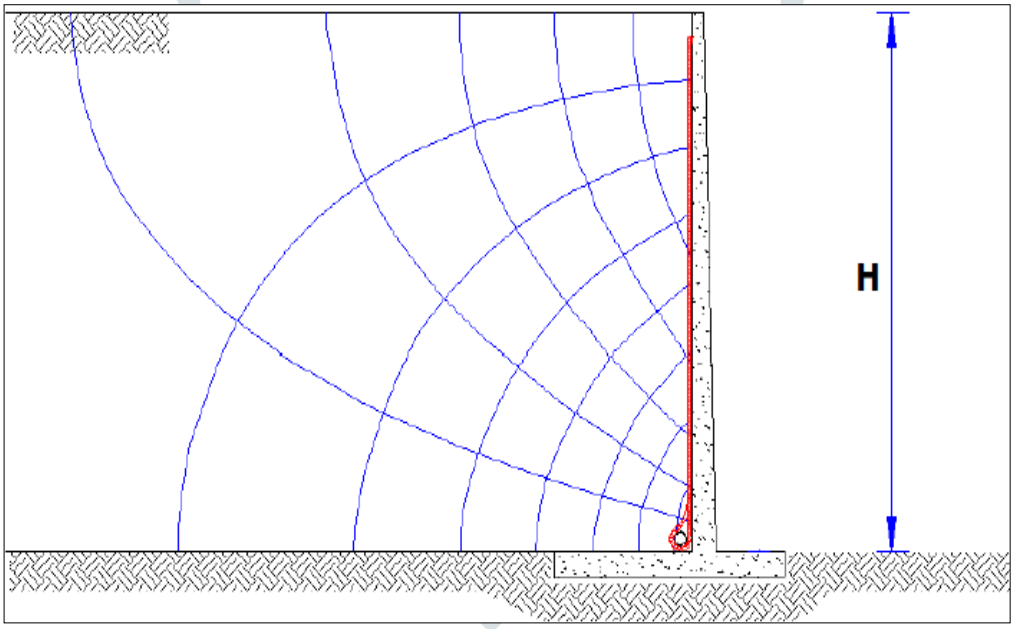


Figure 2: Discharge calculation in the retaining from backfill soil

The Geo-composite drain is then selected as per the above determined flow capacity with the suitable factor of safety (in the range of 1.5 to 2).Suitable reduction factors shall be incorporated in the Geo-composite drain flow capacity for creep, chemical and the biological degradation and the installation damage. The flow net for this project has been plotted with help of slide software.

### b) Filtration Criteria (Refer the Fhwa-Hi-95-038)

The geotextile filter part of the drainage composite must follow the necessary specifications of the obvious scale of the opening and the permeability of the site land.

Apparent Opening size of the Geotextile should be such that it should not get clogged due to soil particles.

- The calculations show that the proposed Geo-composite drain satisfies all the criterion of being a good filter media. Its suitability is also verified considering the flow net developed behind the retaining wall and replacement of chimney drain in reinforced soil structure.
- From the given input drawing P&P Km 136+200 to 156+600 the maximum height of retaining wall has been considered as 16m for a conservative design.
- As per RDSO GE-01 and IRC-78:2014-Appendix V the recommended soils are GP, GW and SW. Based on the less permeability criteria SW has been selected over GP and GW soils.
- Based on the given classification, Permeability of backfill material properties has been assumed. Reference used for permeability of soil is Table No. 8.1- Typical values of the coefficient of permeability, Pg. No. 136 of Arora K. R. (2004), Soil Mechanics & Foundation Engineering, Standard Publisher,6th addition, Delhi, India.

## III. SITE PREPARATION

The retaining wall need to be constructed as per construction drawings. Refer the figure & photograph given below.

The surface on which the Geo-composite Drain is to be installed shall be free from any oil/grease or any sharp objects/edges. Half perforated PVC pipe at the bottom of Geo-composite is provided for water collection so Provision of Weep holes for retaining wall is optional.


Figure 3: Retaining Wall before Geo-composite Drain Installation

## IV. FIXING OF GEO-COMPOSITE DRAIN TO STRUCTURE

- The Geo-composite Drain roll shall be opened up to the required length on flat ground as per below photograph.

Figure 4: Geo-composite Drain Roll

- Accordingly, the length and width of Geo-composite Drain shall be measured. Geo-composite Drain roll shall be cut based on the height of retaining wall. Geo-composite Drain shall be laid in machine direction

i.e. roll direction has to be in the direction of height of wall. Refer the below given photographs. Geo-composite Drain shall be positioned with geotextile in contact with backfill material.

Figure 5: Cutting & Laying of Geo-composite Drain

- Before laying the Geo-composite Drain, perforated PVC pipe shall be wrapped with Geo-composite Drain as per the detailed sequence of the figures 1 to 4 as shown in the photos below.

Figure 6: Sequence of fixing perforated pipe

- The pipes shown in Photograph 26 shall be replaced with half perforated PVC pipes shown in Photograph 27. 10 mm diameter perforations are given in triangular grid at a spacing of 75 mm c / c.

- Around the half-perforated PVC pipe, one of the geotextiles of the Geo-composite Drain shall be opened in such a manner that it completely wraps the perforated PVC pipe (Ref Photograph 26 step 2). Once the pipe is completely wrapped then, a tape shall be pasted on the geotextile to prevent any unwrapping (Ref Photograph 26 step 3). While wrapping the Geo-composite Drain around pipe, care shall be taken that the draining core is in direct contact with pipe for ensuring proper flow of water through it. The Geo-composite Drain with pipe shall be placed as per the levels/locations shown in the drawings. Proper care shall be taken so that Geo-composite Drain will remain in the position during the period of construction.

Figure 7: Half Perforated Pipe

- At the joint of the two geotextiles around the perforated pipes, 100mm overlap shall be ensured. To hold entire assembly stitching is done with the help of binding wire (Photograph 28).

Figure 81: Perforated Pipe is hold by stitching with Binding Wire

- If the overlap edges of Geotextile are available, then the Geo-composite Drain is provided with the butt joint (Ref Fig 2). If there are no extending edges, then an overlap of 100 mm shall be provided at the junction of 2 rolls and shall be sealed with tape.

## V. MATERIAL SPECIFICATION AND TESTING

Recently, Ministry of State Road Transport and Highway (MoRTH) for highway, roads and bridges projects, The Research Design & Standards Organization (RDSO) for rail projects, issued specifications for the application of Geo-Composite Drain which are given below;

1. Material when received at site, shall be checked in third party laboratory IIT/NIT/other NABL accredited laboratory.
2. 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 years' experience at one of the locations, with supporting documents as an evidence for satisfactory performance.
3. To insure that the commodity is adequately quality controlled and reproducible, the following stipulations are as follows;
   a. The manufacturer of Geo-composite drain The substance to be shipped will have ISO:9001 / CE certification. Which certification is referred / stipulated in ISO: 9001 / CE. The QAP / FPC manual consists of a permanent internal control scheme for output to ensure that the commodity being manufactured confirms the properties needed and discusses the following items;

      i. Produce design requirement and criteria.
      ii. Acceptance criteria of raw/incoming material and producers to ensure that these are met.
      iii. Relevant features of the plant and production process; giving frequency of inspections, checks & tests, together with values/criteria required on equipment.
      iv. Check on finished goods- Sample size and sample frequency with collected results.
      v. Details of alternative tests and procedures, if any, and their correlation with reference tests.
      vi. Calibration of equipment having influence on test results.
      vii. Records to be maintained for various inspections, checks and tests carried out during factory production; where possible and applicable.
      viii. Corrective action for non-confirming materials and finished products.
      ix. Training job description and responsibility of the personnel involved in the manufacturing process.

   b. Monitoring of the QAP / EPC Manual shall be done at least once a year. Tracking shall require a summary of the evaluation plan(s) and manufacturing cycle for each component to determine whether any adjustments have occurred after the previous appraisal or tracking. The significance of changes shall be assessed.
   c. Records with all in-house check findings shall be shown to the purchaser as per the QAP / FPC manual; whenever the purchaser so orders.
   d. Geo-composite drain is provided by means of thermal filter and core bonding. The bonding material's melting temperature must be consistent so as to preserve the properties of each substance. Specially for this use, adhesion of filter & core using glue / adhesive tape shall not be permitted.

## VI. CONCLUSION

Based on the report, it is clear that Geo-composite drain is an alternative to 600mm thick conventional hand packed boulder or graded aggregate filter media. The observations & conclusions are summarized below:

1. The process of installation of Geo-composite drain is very simple, fast and economical.
2. Composite drainage successfully reduces hydrostatic pressure by storing and conveying groundwater for discharge to a drain outlet.
3. Weep holes into the structure will become optional as water will be discharged through perforated pipe.
4. The core part of drainage composite which is made of polymer core networks with high compressive strength act as water carrier and the geo-textile part prevent the passage of fine soil particles into drain and thus avoids the clogging of drainage composite and thus ensures the required in plane flow capacity and proper functioning.

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