ABSTRACT

Lee, Sang-Ho., Ph.D., Purdue University, August, 2005. Experimental investigation and probabilistic modeling of soil filtration using geotextiles. Major Professor: Philippe L. Bourdeau.

The doctoral research is a study of soil filtration by geotextile fabrics, with the ultimate objective of improving design and long-term performance of underdrain systems in highways.

The experimental investigation was conducted in the laboratory using the best available techniques, Flexible Wall Gradient Ratio Test and Rapid Retention Test, in order to assess soil-filter compatibility and monitor geotextile clogging, for a range of materials and testing conditions. Field information was also collected and samples from highway reconstruction project were examined for their long-term performance. The main findings from these experiments relate to the influence of such factors as silt and clay amounts present in the subgrade and its state of compaction. Controlling parameters of the geotextile effectiveness are its opening size, thickness and manufacturing style. Based on these empirical results and information already available from the literature, new design and installation guidelines including filter selection criteria are proposed for non-woven geotextile filters in highway underdrain systems.

Another important part of the study is an attempt to modeling numerically the filtration process in the soil at the vicinity of the geotextile fabric and in the geotextile itself. Because in such models, input information that is needed for characterizing the soil grain size distribution and filter pore structure is of statistical nature, the formulation is necessarily probabilistic. Two separate algorithms were developed and programmed in a spreadsheet software environment. The first one simulates the self-filtration process taking place within the soil in the vicinity of the geotextile fabric while the other addresses filtration within the geotextile. Both are based on the concept of multi-layered sieve which is proposed herein as an analogy for the actual mechanisms. In spite of simplification and limitation inherent to the modeling technique, consistency of computed example cases with observed filtration behavior suggests the proposed methodology has potential for future development as a simulation tool.