Geotextile Performance

There has been a rapid increase in the use of geotextiles, or "geotechnical fabrics," in the last 10 years. This development has led to the need for a better understanding of the performance and benefits associated with this relatively new class of artificial material in civil engineering.

While most geotextile applications have been made on empirically derived data and increasingly available experience, one recent research activity made use of an instrumented performance test of geotextiles in conventional railroad track[1]. By making use of actual measured data, the researchers involved were able to evaluate the various benefits, and their associated mechanisms, that have been claimed for geotextiles in railroad track applications

Claimed benefits

Geotechnical fabrics have been attributed with four basic operational functions and their associated benefits[2]: *separation, filtration, reinforcement* (both vertical and lateral), and *drainage in the plane of the fabric.*

Separation enables the fabric to pass water while retaining fines, thus stopping subgrade intrusion and/or pumping. Filtration retains soil particles of differing sizes and composition, for instance separating silts and clays. Reinforcement is the characteristic of increasing the "strength" of the track structure. This can be accomplished vertically through membrane support or laterally by restraining the tendencies of the ballast and/or subballast to displace transversely. Drainage is provided by the fabric's ability to improve the internal lateral transport of the moisture in the subgrade.

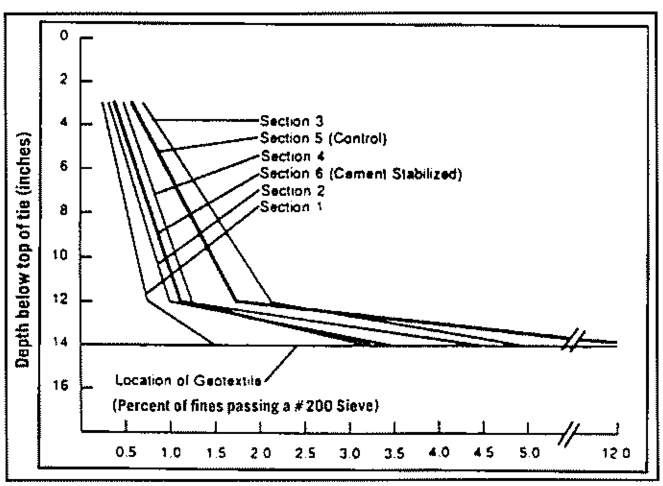

Figure 1 — Percentage of fines passing a #200 sieve versus sampling depth in test sections 1-6.

Some claims disproven

Analysis of the test site data, as presented in Reference 1, revealed that while significant effects in filtration and separation were noted in the test sections, no subgrade reinforcement or subgrade moisture transport below the ballast/subgrade interface was evident.

The test report noted that the "real success" of the geotextiles investigated was in the area of filtration/separation. This agrees quite closely with earlier published reports (see Reference 2) which stated that the primary benefits of geotechnical fabrics are expected from material separation, preventing subgrade intrusion and/or subballast fines pumping, and the like.

Figure 1 presents some of the test data. It compares the amount of fines above the fabric with the fines at the ballast/soil interface at the control section. At this point, it should be noted that the test site consisted of four fabric sections, a control site with no fabric and a cement stabilized stretch for comparison. As Figure 1 clearly shows, the amount of fines at the ballast/soil interface of the control section was significantly higher than the amount of fines above the geotechnical fabric in *all* of the four fabric test sites.

For the evaluation of geotextiles in track reinforcement, subgrade pressures and deformation under load, as measured by pressure transducers and extensometers, were compared between the control (no fabric) and the fabric test sections. Researchers, however, saw no significant differences between the test section types. For the evaluation of subgrade moisture transport, soil moisture measurements and pore water pressure readings were compared. And again, no significant differences were observed between the control and fabric test sites.

Permeability critical

An additional finding of this test site came about from a track failure that occurred at one of the geotextile locations. This site had a low permeability fabric that apparently clogged under the accumulation of time and traffic. As a result a clay slurry formed. With the accumulation of clay fines underneath the fabric that were not allowed to pass through, the slurry, in turn, had a very low shear strength. Consequently, the track structure failed, and excessive settlement occurred.

Loss of permeability of the geotechnical fabric with time and traffic has already been documented, as can be seen in Figure 2[3]. As long as sufficient fabric permeability remains, this does not pose a significant problem. It must be cautioned, however, that clogging of the fabric can be more harmful than not installing a geotextile at all.[1] In fact, it has been concluded[2] that the geotechnical fabric property most important for successful long-term fabric performance in track is clogging resistance. As a result of this requirement, the test results[1] point out that filtration should not be 100 percent efficient. Rather, the fabric should permit the passing of some of the clayey fines to prevent the buildup of clogging particles.

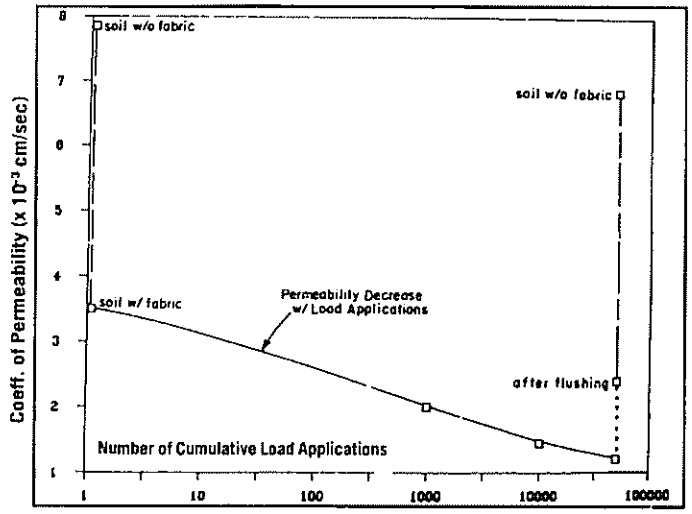

Figure 2 — Coefficient of equivalent permeability versus number of repeated load cycles.

References:

1. Chrismer, S. M. and Richardson, G., "In Track Performance Test of Geotextiles at Caldwell, Texas," Association of American Railroads Report R-611, December, 1985
2. Haliburton, T. Allan, "Use of Geotechnical Fabric in Railroad Operations," Association of American Railroads Report R-456, August, 1980.
3. Chrismer, S. M., et. al., "Performance Tests for Geotextiles in Railroad Track," Association of American Railroads Report R-607, September 1985.