Geosynthetic spins 'web' of success

Twelve years after installation, polyethylene cellular confinement system holds Wisconsin highway's base course in place as rest of road is prepared for reconstruction

edited by Larry Flynn

The polyethylene geosynthetic material is installed in 1984. Aluminum stretcher frames, used to expand the material, are removed after the material is infilled.

Wisconsin winters are notorious for the damage they can cause to roads. An example of winter's influence was seen on Highway E, a winding, two-lane asphalt road that serves commuters between Little Chute and Oneida. Once called the worst stretch of road in Outagamie County, it was plagued by cracking and heaving during the winter months. Similar problems occur elsewhere in the region where sub-base sand silt pockets enclosed in the state's thick clays become highly saturated and freeze.

The speed limit on a half-mile stretch of Highway E had to be reduced from its normal 55 mph to 15 mph during the winter months. "Heaving could start as early as November and be a problem through March," said Mike Marsden, Outagamie County Highway Commissioner. "We could tell when the frost was out of the ground in the spring because the road would flatten out. We'd put up flashing barriers and advance warning signs. It was really difficult to plow snow in the area."

Little did Marsden know that he'd find a solution to the heaving problem in his own county. The corporate offices of Presto Products Company and the Geosystems group are located in Appleton, Wis. Presto Products Company helped pioneer cellular confinement technology in cooperation with the Army Corps of Engineers in the late '70s. The company's Presto Geoweb Cellular Con-

Defining a geosynthetic: Type and functions

The first use of fabrics in reinforcing roads was attempted by the South Carolina Highway Department in 1926. A heavy cotton fabric was placed on a primed earth base, hot asphalt was applied to the fabric, and a thin layer of sand was put on the asphalt. The department published the results of this work in 1935, describing eight separate field experiments. Until the fabric deteriorated, the results showed that the roads were in good condition and that the fabric reduced cracking, raveling and localized road failures. This project was certainly the forerunner of the separation and reinforcement functions of geosynthetic materials as we know them today.

In all, geosynthetics, perform five major functions: separation, reinforcement, filtration, drainage and moisture barrier. There are six families of geosynthetics: geotextiles, geogrids, geonets, geomembranes, geocomposites and "geo-others."

- **Geotextiles** form the largest group of geosynthetics. They are indeed textiles in the traditional sense, but consist of synthetic fibers rather than natural ones, such as cotton, wool or silk. Geotextiles are porous to water flow across their manufactured plane and also within their plane, but to a widely varying degree.
- **Geogrids** represent a small but rapidly growing segment of the geosynthetics area. Rather than being a woven, nonwoven or knit textile (or textile-like) fabric, geogrids are plastics formed into a very open, gridlike configuration, i.e., they have large apertures. Often they are stretched in one or two directions for improved physical properties. By themselves, there are at least 25 application areas, and they function in two ways: reinforcement and separation.
- **Geonets** constitute another specialized segment of the geosynthetics area. They are usually formed by a continuous extrusion of polymeric ribs at acute angles to one another. When the ribs are opened, relatively large apertures are formed in a netlike configuration. Their design function is completely within the drainage area where they have been used to convey fluids of all types.
- **Geomembranes** represent the second largest group of geosynthetics, and in dollar volume their sales are essentially equal to that of geotextiles. They are impervious thin sheets of rubber or plastic material used primarily for linings and covers of liquid- or solid-storage facilities. Thus, their primary function always is as a liquid or vapor barrier. The range of applications, however, is very wide.
- **Geocomposites** consist of geotextile and geogrid; or geogrid and geomembrane; or geotextile, geogrid, and geomembrane; or any one of these three materials with another material (e.g., deformed plastic sheets, steel cables, or steel anchors). Major functions of this creative effort encompass the entire range of five functions listed for geosynthetics discussed.
- Geo-Others is a general area of geosynthetics that has exhibited such innovation that many systems defy categorization. For want of a better phrase, geo-others describes items, such as threaded soil masses, polymeric anchors, and encapsulated soil cells. As with geocomposites, their primary function is produce-dependent and can be any of the five major functions of geosynthetics. •

The above information war excerpted from the book Designing With Geosynthetics, *Second Edition, by Robert hf. Koemer, Ph.D., P.E. Copyright 1990 by Prentice Hall, Englewood Cliffs, N.J.*

finement System is designed to strengthen structural fill by increasing its shear strength and stiffness.

The system originally was developed for building roads across insufficiently supported grounds, such as beach sands. The system was used to build sand roads for rubber-tired vehicles during the Persion Gulf War.

"Our first project with Outagamie County was at the county landfill site," said Gary Bach, product manager. "We used the system to construct an access road into one of the landfill cells. That application was a success and led us to the Highway E project." To combat Highway E's washboarding pavement, the county worked with the company in 1984 to produce a cross-section design of the road. Presto staff were on site during installation.

The system is an expandable honeycomb-like structure made of high-density polyethylene. The system is designed to produce a stiff base with high flexural strength. According to the company, under load, the system generates powerful lateral confinement forces and high soil-to-cell wall friction. It is to provide a bridging action and improve the long-term load deformation performance of common granular fill materials.

On Highway E, an 8-in. deep system was installed in the problem area. The asphalt pavement was removed and stored for recycling and final topping after reconstruction. The silty clay subbase was cut down 18 in. below the water table level and covered with a geotextile. Next, a 6- to 8-in. layer of 3½-in. to 4½-in. clean crushed stone was added. The system was expanded, positioned and secured at the edges with granular fill. It was then infilled with sand and topped with a 15-in. base course of crushed stone. The completed area was then compacted with a vibratory roller and was immediately ready for traffic.

"Because of our soil conditions, we always use a 15-in. base course on all of our roads, Marsden said. "We probably could have gotten by with less, but we decided not to. If we hadn't used the confinement system, we probably would have reworked the subgrade and added 2 ft of base course. Even though we had fill material available just 6 miles away, it was less expensive to complete the renovation project with the Geoweb material than without it."

Unpaved, the road performed well throughout the following winter, and was surfaced with the recycled asphalt in the summer of 1985.

The system was installed in Highway E in 1984. Now, more than 10 years later, the road still is level and holding up well under all weather conditions. The highway is scheduled to be rebuilt in 1997. The county will widen the highway, fill some valleys, improve sight distance and flatten curves.

"We're not going to touch the section of the road that has the confinement system in it," Marsden said. "The road will be widened, but we won't alter the alignment or the system. We're very pleased with the way it has solved the problems for us on Highway E." •

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