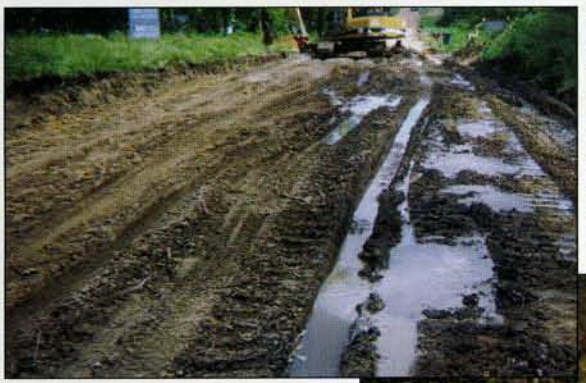
Geoweb carries the load

Cellular confinement system stabilizes poor soil base

"One area that many counties struggle with in road construction is poor soils," says Tom Byle, maintenance and local road construction engineer for the Kent County Road Commission, Kent County, Mich. "Many country roads in America were built over muck, swamps or other similar, inadequate soils. Most counties cannot justify the expense of the standard peat-removal treatment, digging the peat out and replacing it with sand. Many counties end up leaving the road gravel or, if the road is blacktop, shimming the settlements with blacktop until its thickness is literally measured in feet."

Paved surfaces that are built over weak soils can experience subsoil movement and base deterioration, which causes deflections, rutting and cracking in the asphalt surface. One way to combat this problem is to stabilize the weak base and increase the load capacity of those soils. The Geosystems® Group of Presto Products Co., Appleton, Wis., provides a product, the Geoweb® Cellular Confinement System, which is designed to help stabilize road bases for paving.



These two photos show the before and after appearance of 108th Street in Caledonia Township, Mich. The wet, swampy soil (above) gave way to a 200-foot (61-m) mud wave while crews were trying to cut the subgrade. Once the base had been stabilized (at right), the road was paved with asphalt and, four years later, remains smooth and free from deflections, cracks or rutting.

Cellular confinement comprises base

The Geoweb cellular confinement system is an expandable, honeycomb-like structure made of high-density polyethylene. The three-dimensional network of interconnected, perforated cells are filled with select infill materials, such as aggregates, topsoil, crushed limestone, concrete or a combination of these materials. For structural infills, native soils can be used as long as the fraction of fines, such as silt and clay particles, does not exceed 10 percent and the plasticity index of the material is less than 6 percent. The maximum size of aggregate that can be used to fill the cells depends on the cell depth and radius, neither of which should the aggregate exceed. The chosen aggregate must also be able to stay inside the cell when acted

upon by the forces of gravity and fluids.

The Geoweb system confines the base material within its cell walls, decreasing the rate of the infill material's lateral movement and creating passive resistance between adjacent-filled cells. By adding cohesion to cohesionless material, the Geoweb system strengthens the structural fill used in load support applications. The product helps create a stiff base and acts as a semi-rigid slab by distributing loads laterally and cutting down on subgrade contact pressures.

According to Presto Products Co., by using confined versus unconfined aggregate, the material thickness can be reduced by 50 percent. In addition, when aggregate is confined within cellular walls, the subgrade materials may withstand more than 10 times the number of cyclic load applications before accumulating the amount of deflection that an unconfined aggregate experiences, according to the manufacturer. "The Geoweb helps maintain integrity of the pavement base material to the point where it degrades much slower — at the rate of 12 to 15 times slower," says Dan Senf, Presto Products marketing manager. "It can extend the life of the pavement from four to six years to 50 to 60 years."

The Geoweb sections come in various sizes, cell sizes and cell depths. A standard section measures 8 feet (2.4 m) wide by 20 feet (6.1 m) long, with special section lengths ranging from 2 feet (0.6 m) to 30 feet (9.1 m). Larger cell sections are 8 feet (2.4 m) wide by 40 feet (12.2 m) long, with special section lengths ranging from 4 feet (1.2 m) to 60 feet (18.2 m). The standard cell size is 9.6 inches (244 mm) by 8 inches (200 mm), with larger cells measuring 19.2 inches (488 mm) by 16 inches (400 mm). The cell depths for both cell sizes are 3 inches (75 mm), 4 inches (100 mm), 6 inches (150 mm) and 8 inches (200 mm). Cell depth and size is determined by the specific application and details of the base that is being stabilized.

Each section is connected to another section to prevent movement during the infilling operation. Heavy-duty metal staples from a pneumatic stapler are used to connect units. The Geoweb cellular confinement system is anchored into the ground by stakes that bear against the top of the cell wall or against tendons passing through the cell.

The sections also come in two cell types: perforated and nonperforated. The perforations along the cell walls allow water to move from cell to cell, reducing unwanted ponding and providing lateral drainage. They also help in preventing a shear plane from developing between the infill and cell walls.

Geoweb provides stable bases in Michigan

"There are specific benefits for using the Geoweb system with asphalt pavements," says Geoweb distributor John Price, owner of Price and Co., Grand Rapids, Mich. "First of all, it supplies a maximum load distribution, or stress relief, from the asphalt surface to the subgrade with the least amount of thickness. Second, when used on soft subgrades, or with utilities, the Geoweb provides a stiffer base for the pavement."

When used with geotextiles, the cellular confinement system should turn a swampy strip of land into a stable, paved road. For example, Kent County used this technique on the largest project they have constructed — Reeds Lake Blvd. in East Grand Rapids. "In two areas, totaling 1,900 feet (48 m), this stretch of road is literally floating on 30 to 35 feet (9 to 11 m) of wet, soft muck," explains Byle.

"The road is built over swamp land and floods every spring. The water would rise (in the swamp) when the snow melted and it would go right over the road. We ended up closing the road every year at that time. Since we've done the project, though, we have not had to close the road. And the asphalt that was placed over it looks pretty good. There is no cracking on it."

Byle used geotextile, cellular confinement, plastic pipe and lightweight slag on this project. The biggest challenge for Kent County was constructing the culvert that provides the inlet to Reeds Lake. The culvert, located in an area where the muck was over 30 feet (9 m) deep, required three 36-inch (914-mm) smooth, lined plastic pipes. Removing the old culverts destroyed what there was of the existing road bed. The geotextiles were used to keep the culverts from sinking into the muck by tying them back into the existing road bed. The Geoweb cellular confinement system was used to spread the load and stiffen the road bed over the culverts.

Another project took place in Grand Rapids Township, on Leffingwell Ave., from Knapp Ave. to 3 Mile Road. Byle explains that 450 feet (137 m) of this road was in a muck swamp. The crews stripped off the original asphalt and found that the gravel underneath had been placed directly on the muck and at a thickness of less than 6 inches (150 mm). "Running the dozer literally caused eruptions of soft muck up through the gravel," says Byle. "So, we decided to modify our original design and place the cellular confinement system full width across the road bed to stiffen grade and spread the live load."

Crews lay down geotextile and Geoweb cellular confinement sections. Once the Geoweb is placed, slag aggregate is added to fill and cover the cells.

Kent County then took this same technique and applied it to one of the worst road conditions imaginable — a subgrade that, once cut, produced a 200-foot (61-m) long mud wave. The project, which was constructed on 108th Street in Caledonia Township, involved grading, stabilizing and paving the road. An initial solution was to stabilize the grade with geotextile, add underdrain, and cover with lightweight oversize slag. As the dozer operator spread the slag, however, the wave shifted and the underdrain came up through the slag behind the dozer.

Kent County decided to again use the Geoweb cellular confinement system — several 8-foot (2.4-m) by 20-foot (6.1-m) sections of it. The cells were filled and then covered with 2.25 feet (0.69 m) of #4 slag aggregate. Another layer of synthetic geotextile was laid, then covered with 6 inches (150 mm) of 22A slag aggregate. Asphalt was then placed on top of everything. When the project was completed, 2.5 feet (0.8 m) of materials had been added between the top of the subgrade and the bottom of the first lift of asphalt.

"The roadway shows no sign of distress at all," says Byle. "One fact to keep in mind with this type of construction, though, is that settlement is not eliminated. Settlement will occur; but hopefully it will be kept uniform — or, in other words, controlled settlement."

Price adds another suggestion: "The gravel being used needs to go between the bottom of the asphalt and the top of the Geoweb, so that when the asphalt gets hot, it doesn't melt over the Geoweb and get cut through — like a cookie cutter."

Making sure the application of the materials is done correctly is important. To assist with the planning of the project, Presto's Geosystems provides the SPECMaker™ Specification Development Tool. The SPECMaker software system develops complete material and construction specs for the Geoweb cellular confinement system. The program writes a project description based on what materials are available and what design has been provided. The software allows the user to specify the type of application — such as load support on a roadway — performance criteria, cell depth, cell type, anchoring system and infill material selection. ▮

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