

Geofabrics

JOURNAL

EROSION CONTROL • GEOGRIDS • GEOMEMBRANES • GEOTEXTILES

Reprinted from Volume 2 • Number 1 • February 1996
A supplement to Canadian Environmental Protection & Canadian Heavy Equipment Guide.



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Cellular confinement employed at Cootes Paradise

A cross-disciplinary team of engineers and landscape architects opted for a revolutionary cellular confinement system with polymeric tendons to rehabilitate a 1.5H:1V slope in a Hamilton, Ontario, conservation area.

Ontario's transit authority, GO Transit, was expanding its commuter rail lines, necessitating track improvements between Toronto and Hamilton. The owner of that section of track, CP Rail, constructed a twin track beside an existing track including a new railway bridge over the DesJardins Canal. The canal connects Lake Ontario's Burlington Bay and Cootes Paradise, a designated conservation area owned by the Royal Botanical Gardens. Cootes Paradise is a shallow lake of roughly 650 acres and is part of the Spencer Creek Watershed. Royal Botanical Gardens has slowly been winning the battle to restore the area as a cattail marsh.

"Most of it is less than a meter deep," Royal Botanical Gardens Plant Biologist Justice Benkhysen said. "Perhaps 10 or 15 percent is covered with emergent plants. That percentage was almost 100 percent circa 1920."

Several hundred thousand canoeists, skiers, ice skaters and hikers enjoy the area free of charge each year, and festivals are held on adjacent grounds.

Bridge construction meant disturbing area

Construction of the new bridge involved cutting a road into the side of an existing slope to give the construction crews access. Once construction of the bridge was completed, the contractor, Diamond Stone Bridge, was responsible for reinstating the slope to its original condition. The real challenge was preventing the topsoil required to establish vegetation from sliding into the canal. Another concern was the difficult site access once the project was completed. Consultant John Kristof wanted to avoid expensive remedial work.

"Looking at the steepness of the slope, we knew we'd have to go with some type of system that was appropriate and was proven," said Kristof, a landscape architect with Ecoplans, a multi-disciplinary environmental consulting firm that has won awards for a similar project in the Town of Oakville, Ontario. Ecoplans is a division of McCormick Rankin, the transportation consulting firm hired by CP rail to administer the project. McCormick Rankin does most of its work in Ontario, but a division of the firm, McCormick Rankin International, does work abroad, including the United States and Australia.

"We considered a bioengineering approach, where aggressive growing species like poplars, willows and dogwoods would be transplanted, Kristof said. "But the timing was wrong. It was mid-summer and the plant material would die. It's generally better to transplant during the dormant periods through late autumn and early spring."

Kristof contacted InterSol Engineering, Inc., Presto's consultant and Canadian technical representative, to determine if the Presto Geoweb Cellular Confinement System would be applicable. Jamie Walls of InterSol analyzed the slope using WebCover, a software pro-

gram developed in cooperation with Presto Geosystems.

"What WebCover allows us to do is analyze the stability of the Geoweb® system and give the client the safest, most cost-effective solution. It's not just a stand alone product anymore. It's an engineered system," said Andrew Lister, Technical Representative for InterSol Engineering and Presto.

Technology used in Desert Storm

Presto Geosystems pioneered cellular confinement technology, a combination of a honey-comb-like polyethylene structure and engineered infill materials, in cooperation with the Army Corps of engi-

The contract for bridge construction began in September of 1994, and work on the slope took place in the spring of 1995, concluding in May. The budget for the bridge at DesJardins Canal was roughly \$2 million, a very small percentage of which was for slope rehabilitation.

Bioengineering still a possibility

A bioengineering approach is still possible within the Geoweb system. Saplings can be inserted in the individual cells, helping to anchor the system in place and adding to the biodiversity of the site. This is a technique that Ecoplans has incorporated before, most recently in the Mountainview Road bridge approach project in Georgetown, Ontario.

topsoil using a track backhoe with an extended dipper. The backhoe bucket was used to lightly compact the topsoil infill.

"It was too late in the season for hydroseeding," Waters said. "The intent is to hydroseed in the spring. In the meantime, a lot of native vegetation has spread to the area and is growing on its own."

Unseeded system survives 100-year rainfall event

Even without hydroseeding, the cellular confinement system stood up to a 100-year rainfall event in the fall of 1995.

"I remember the day well," said Wayne Christian, Weather Specialist with Environment Canada's Hamilton Weather Office. "It was a result of Hurricane Opal.



A cellular confinement system with polymeric tendons is used to rehabilitate this 1.5H:1V slope.

neers in the late '70s. Cellular confinement systems strengthen structural infill by increasing its shear strength and stiffness. The Geoweb system was used extensively to construct sand roads for use by rubber tired vehicles during Operation Desert Storm, and has been successfully employed in other road stabilization, slope protection, channel protection, load support and earth retention projects worldwide.

The preliminary design utilized 4-inch, large cell Geoweb material with three polymeric tendons per section. These tendons have an ultimate strength of 600 pounds. A combination of 3/8-inch diameter by 24-inch long and 3/4-inch diameter by 36-inch long J-pins were used to anchor the system to the slope.

"We tied loops in the tendons and fastened them to 24-inch long, half-inch diameter J-pins at the top of the slope. Without the tendons we would have had to increase both the diameter of the J-pins and density of the stakes. It was easier and more cost effective to insert tendons and transfer the load up to the top of the slope," Lister said.

Actual installation of the system was relatively simple, according to Resident Engineer Mark Waters of McCormick Rankin.

"We got a lot of help through Andy Lister at InterSol," Waters said. "They assisted with the design input, specifications and details. And they were on site to help the contractor with the Geoweb system. One thing that made cellular confinement an attractive option is the simplicity. We've done bio-engineered slopes before, and they require a more specialized Installer. With assistance from InterSol, we were able to install this system ourselves. This is a system that a general contractor can install."

Silty clay material was brought in, placed and compacted with a sheep's foot drum compactor to restore the slope's original profile. The only compacting required was provided by the weight of the backhoe and a sheep's foot drum compactor. The Geoweb was expanded into place, anchored, and the adjoining sections were mechanically fastened together using a manual industrial stapler. The system was infilled with unscreened

On December 5th we recorded 91 millimetres of rain. That's about 3 1/2 inches. In my last 20 years working for Environment Canada I remember hearing about a rainfall like that once in the 1970s. I'd say that rain is a once in 35- to 100-year event. Within 30 miles of Hamilton they received 116 millimetres."

"There were substantial rainfall problems throughout the corridor," Waters said. "Other areas of the slope didn't stand up as well to these conditions as that very steep slope with the Geoweb system."

"The Geoweb system offers the benefit of a natural, living appearance with excellent stability through sound design," Dan Senf of Presto Geosystems said. "We take special pride in seeing the system used to preserve wildlife areas like Cootes Paradise."

"These bodies of water used to be very polluted, not only by eroded materials but by other sources as well," Hamilton Regional Conservation Authority John Quinn said. "An excellent job is being done to restore the entire area to the cattail marsh it once was."