HIGHWAY STAR

Ditch lining system offers solution to failed riprap drainage channel on overpass

By Kit Jones

To control storm water runoff along highways and overpasses, riprap has been the go-to material for decades in many parts of the country. Conventional wisdom and experience has taught engineers and contractors that it is cheap, plentiful and reliable.

Over time, many riprap applications have proven to be less-than-permanent solutions. Heavy runoff often causes rocks and stone to wash away, especially along steep grades. Replacing washed out riprap and repairing any resulting damage often can cost as much or more than the initial job. Furthermore, with today's high fuel prices, new riprap is more expensive to transport and put in place than ever before.

One highway overpass in Columbia County, Wis., stands out as an example of the shortcomings of riprap. The material originally was specified for two steep drainage outfall channels on the overpass to control storm water runoff and slope erosion.

"We'd been battling a slope erosion problem at this particular overpass for quite some time," said Tom Lorfeld, P.E., and Columbia County highway commissioner. "Quite frankly, we were getting tired of repairing the riprap channel every time we had a heavy rainstorm. Not only is it a time-consuming task, but it's very labor-intensive."

Each time a repair was made, the county would have to reclaim as much of the failed stone material as possible, re-excavate the original channel and then refill it with the old material. According to Lorfeld, restoring the channel using a combination of manual and backhoe riprap placement would take his crew up to two days.

Recognizing that the same problem would eventually repeat itself, however, county and Wisconsin Department of Transportation engineers opted for a new approach: a channel replacement system from SmartDitch.

A New Approach

The channel replacement system consists of a modular, trapezoidal channel liner made from high-density polyethylene and is available in a variety of sizes. It is manufactured and shipped in 10-ft sections. Laid in an excavated channel, the downstream end of each section overlaps onto the upstream end of the next. The sections are connected with self-tapping coated steel screws. Stainless steel "cable anchors" then are driven into the ground with a driving rod or impact hammer to hold the entire channel in place. The steel cables then are pulled tight and secured with cable locks.

The liner sections incorporate a corrugated design that helps regulate the flow of water from flat to steep grades so that drainage and flow patterns are maintained. SmartDitch has an engineered Manning's Coefficient of .022 for engineered designs. The ribs also add strength to the liner. The material is UV resistant and, once in place, the liner is virtually maintenance free. According to the company, SmartDitch has a projected minimum service life of 20 years.

The system offers distinct advantages over riprap in runoff applications. "You can't just lay down rock in a creek bed or flow channel," said Michael Desvernine, national sales manager for SmartDitch. "You need a variety of rock sizes that must be carefully secured and placed to ensure you get the correct flow control results.

Riprap was used for steep drainage outfalls on a highway overpass.

A channel-lining system was installed after the riprap failed multiple times.

You also cannot rely on riprap for high-velocity flow areas, because it will be displaced over time and then you'll be looking at maintenance and reapplication issues.

"A channel lined with riprap would require 2.6 times the cross-sectional flow area to equal the flow in a SmartDitch system," Desvernine added. "You also would need an additional 1.5 to 3 ft of over-excavation to properly install riprap, and that creates a larger footprint and additional waste soil."

Mark Maederer, Penda's staff civil engineer, said that the maximum slope of an installation depends on soil types and the stability of the slope on which the product is installed. Slopes greater than 4:1 (horizontal to vertical) should be installed with additional anchoring. A minimum slope of 0.5% is recommended to prevent ponding.

Installation Process

The Colombia County overpass job consisted of two 24-in.-wide channels—one 110 ft long and one 45 ft long. The longer channel's slope was approximately 3:1, while the shorter channel's was 5:1. A county highway maintenance crew first removed the failed riprap, and then excavated both ditches. The old riprap was relocated to the bottom of the slope to help with water displacement and drainage.

All of the 24-in. SmartDitch channel sections were delivered on a pallet to the site by a single truck. The sections were light enough to be hand carried and placed into the excavated trenches. Bulkhead sections were placed at the top of each trench to tie into the existing outfall drainage pipe. Once all segments were screwed together, the entire channel was secured with tensioned steel cables and anchored to the ground. A layer of 30-mil polyethylene sheeting was laid along both outside edges of the channel to prevent water from seeping under the liner before vegetation was reestablished. Finally, the slope was dressed and seeded. The entire job was completed in only two days.

"This channel lining system was much easier to install than riprap," Lorfeld said. "Because the channel sections were so light, it also was a lot safer to handle."

A Permanent Solution

According to Lorfeld, routine inspections conducted by the county since the installation have been positive. "We've have record rainfall in the months of April and June," he said. "The channel lining system has held up perfectly, and we've detected no signs of slope erosion." In fact, one of Lorfeld's maintenance workers may have said it best when the overpass was inspected after a recent downpour: "I think we've fixed that problem permanently." SWS

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