Coir Fibers Help Strengthen Environmentally-Friendly Golf Course Stream Restoration Project

RoLanka International, Inc. 2004

Stabilizing nearly two miles of streambanks and slopes wasn't the only challenge Garden Management Consultants, Inc., faced when tackling a stream restoration project on a Georgia golf course. The landscape design and construction firm also had to contend with record rainfalls and heavy stream flows. It was a fitting test of the company's confidence in the value of soil bioengineering practices as a better, long-term solution to solving erosion problems than conventional engineering materials, like rock or concrete. In this case, the company met the challenges by combining soil-reinforcing coir and synthetic materials with more than 100,000 plugs, shrubs and other plant materials.

It was the largest stream restoration project ever undertaken by the company, which is based in Gainesville, Ga. The firm is owned by Claudia Hodges, a landscape planner and designer, and her husband, Bart, who directs the construction work. They specialize in building and rehabilitating water features, like streams, falls and ponds for parks and golf courses. The seven-month long project, part of a larger project to improve drainage and other course features, was completed in October, 2003. The work centered around three streams – Peavine Creek, its south fork and Lullwater Creek – which flow through the Druid Hills Golf Club's course in suburban Atlanta. Built in 1912, this 6,800-yard private course, lined with stately oaks, is one of the oldest in Georgia.

The streams come into play on just about every one of the course's 18 holes. However, the streams, which drain a watershed consisting mostly of impervious roof, sidewalk and street surfaces, converge on the course at the lowest point of the watershed. "This resulted in a huge amount of runoff," says Bart. "Almost any rain event can bring the stream up and out of its banks within 15 to 20 minutes." He speaks from experience. "During the project we were hit with the area's heaviest rainfalls in more than 100 years," Bart says. "We stopped counting the times our work was under water less than half way through the project. By that time the number had reached 30. We got a real quick test of which erosion control practices worked and which didn't." Over the years, erosion and sedimentation had changed the nature of the stream. "Following major storm events, low areas on the course would flood and remain out of play for days," says Randy Delaney, the club's general manager. "That affected our revenues and it was unsettling to our members to have a hole closed for several days after a heavy rain."

A Soft Alternative to Hard Walls

One purpose of the restoration project was to improve the appearance of the stream, which had been re-routed over the years. He reports the entire stream had been lined with riprap at one point or another and several areas, some as long as about 200 yards, were covered with shotcrete. In other areas, rock or poured concrete walls, up to about 6 ft. high and 200 ft. long, had been constructed to support adjacent tees or storm drains. These structures had proved less than ideal for controlling erosion. "Every wall had been rebuilt at some time," Bart says. "Also, we found many areas where riprap had failed to prevent streambank washouts and more riprap had been added. People were surprised at just how much riprap had been installed over time in an attempt to control erosion." Garden Management Consultants proposed a more natural, permanent fix – using turf reinforcement mats (TRM), made of coir and/or synthetic materials to build reinforced soil structures, and coir rolls combined with turf reinforcement mats to stabilize streambanks until vegetative canopies and root systems could establish to hold the soil in place permanently. "A lot of people who aren't familiar with soil bioengineering have a hard time believing that these materials offer a less-expensive, more environmentally-friendly alternative to concrete and riprap in controlling erosion," Bart says. He and his crews used TRMs to build fabric-encapsulated soil lifts, creating the earth structures. In all, they built eight of these structures. Most replaced existing rock or poured concrete walls that protected stream banks or were used elsewhere to support tees or a cart path.

Depending on the application, they used one of three different types of TRMs, manufactured by RoLanka International, Inc., to build the structures. They began construction by first anchoring part of the unrolled TRM onto the wall foundation, using rebar or wood stakes. Then, they added and compacted soil on top of this fabric to a depth of 12 in. Next, they wrapped the remaining fabric over the front of this soil lift to cover the layer and anchored this top fabric to the soil layer. They formed a second fabric encapsulated lift on top of the first, setting it back about two to six inches, and repeated this process until reaching the desired height of the structure. Vegetation, either sod or plants, were then installed on the face and top of the structure to complete the reinforced earth wall.

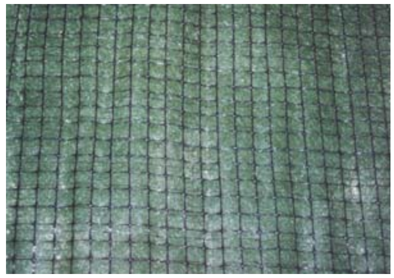
A Trio of Mats

One of the TRMs was 3DTRM-PP, a permanent, 100 percent synthetic product, made of a green polyolefin fiber layer sewn between two high-strength polypropylene geo-grids and reinforced with a polypropylene net. Depending on type of vegetation, the green color offered an attractive look to a site until the vegetation became established.

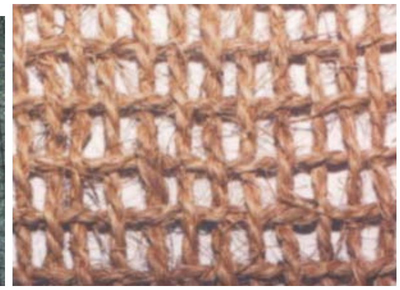
The second product, 3DTRM-CC, was also provided permanent soil reinforcement. It's similar to the first TRM, except for the inner fiber layer. Instead of a synthetic material, it's made of natural coir, a 100 percent organic brown mattress fiber from processed coconut husks that features a high wet tensile strength and natural-resistance to rot, molds and moisture. This composite TRM offers more flexibility and higher water holding capacity than a synthetic mat, supports seed germination and seedling growth and it's easy to walk on. Both products exceed industry standards for 100 percent synthetic and composite TRMs in terms of tensile strength and elongation for improved performance during the critical unvegetated stage. Each is recommended for flow velocities up to 30 ft./sec. and shear stresses up to 8 lb./sq. ft.

The third TRM used on the project was BioND-TRM 100. It is woven from machine twisted bristle coir twine, reinforced with two UV-stabilized polypropylene strands. The coir fiber biodegrades in four to six years and the synthetic mat structure continues to provide permanent support for the soil and plant roots. It's designed for fabric encapsulated soil layers in wetland areas and, unlike most TRMs, features a woven structure with moveable intersecting points to prevent entrapment of wildlife. "We used a lot of this product," Bart says. "Unlike the other two TRMS, we could cut openings into the fabric for planting root balls and secured the fabric back around the base of the plant after planting. "Not only are these walls more aesthetically-pleasing, they cost about 40 percent less than a concrete or rock wall."

3DTRM-CC



3DTRM-PP



BioND-TRM 100

<u>Protecting Streambanks</u>

Bart and his crew used RoLanka's BioD-Roll coir rolls to stabilize the toe of streambank slopes. Made from coir fiber densely packed into tubular coir outer netting, the product is available in various sizes. In this case, 12-in. diameter, 10-ft. long rolls were installed along more than 7,000 linear feet of streambanks. With a design life of about five years, these logs resist the erosive force of stream flows to provide initial structural stability for the streambanks. Also, they are a growth medium. Over time, sediment will be deposited around the rolls to support riparian vegetation, planted in and around the coir rolls (logs), which will provide permanent erosion control.

In some cases, the TRMS were anchored to the coir rolls and used to stabilize the banks above the logs, before installing plants. Towards the end of the project, the TRMS protected bare areas above the logs over the winter until sod could be installed the following spring. "Once the logs filled with water, they became fairly heavy, providing a good base for tying the TRMs," Bart says. "They also prevented the mat from being undercut by the stream."

In many areas, smaller perennials, including ferns and cardinal flowers, were planted directly into the logs. In others, sod was installed directly on top of the logs. "Although the logs are pretty stiff, they were flexible enough to bend around most of the contours in the stream," Bart says. "Sometimes, instead of reshaping all of a bank, we were able to push the logs into undercuts to provide an anchor for the TRMs before filling in behind the logs. The logs acted like shock absorbers to prevent damage to the TRMs from the impact of some fairly heavy debris in the flowing stream."

Flexible Solutions

All exposed areas next to the stream were covered with a geotextile to protect them temporarily when the crew wasn't working on them. Elsewhere, disturbed ground was stabilized after planting with RoLanka StrawMats, which are stitched straw blankets designed for temporary use on moderate slopes; and more durable, higher performance BioD-Mat woven from bristle coir twine designed for steep slopes.

The wide range of available coir and composite materials proved valuable. "We come up against a variety of situations throughout the project," Bart says. "The combination of materials allowed us to use them in a variety of ways, other than textbook applications, to solve different problems." Sediment control during the project included the use of such conventional practices as silt fence and sediment ponds as well as more innovative approaches. In some cases, polyacrylamide flocculent blocks were placed in drainage channels to remove sediment. Crews also built check dams, made of large river rock, to slow stream flows and collect sediment for removal. After the project was completed, these dams were broken down and the rocks left in place, enhancing the natural look of the stream.

Prior to working in the streams, the crew installed RoLanka BioD-Pillow, a 2-in. thick mattress of coir encased in a woven bristle coir blanket, across shallow areas downstream of the work site to collect sediment. Once the earthwork was completed, the sediment was removed and the coir mattresses were placed on the streambank to degrade naturally. These sediment control practices proved very effective. "Sediment levels in the stream were monitored after every rain event during the project," Bart says. "The water in the stream leaving the property course was consistently cleaner than the streams as they entered the golf course. The soil bioengineering practices continue to minimize the amount of sediment in the stream. Fish species are now being observed that haven't been seen this far upstream in almost 20 years."

Other features of the golf course renovation projection include a wetland which was created as part of drainage improvement. It covers several acres where the three streams meet, which once were part of a fairway. "This wetland captures and holds runoff, releasing it slowly to reduce flooding," Delaney explains. "Now it solves a drainage problem while giving golfers a hazard to shoot over. Several bird species, including kingfishers and blue herons, have taken up residence, adding to the appeal of the course."

Passing the tests

The stream restoration work has met performance expectations. Since the project was completed, it has been tested by half a dozen or so major storms that have dumped as much as several inches of rain in a few hours. "We had to make some minor revisions in a few areas, but the erosion control features have done what they are supposed to do," says Delaney. He is also a member of the board of directors of the Peavine Watershed Alliance, a citizens group which has followed the project with interest. That group is also pleased with the effectiveness of the project's erosion and sediment control techniques, he reports. Bart sees increased use of soil bioengineering and other environmentally-friendly practices in future golf course renovation projects. "It offers a better way than previous hard armor techniques to improve and protect riparian areas," he concludes.