Article 146

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Coconut Rolls as a Technique for Natural Streambank Stabilization

Eroding streambanks are a ubiquitous problem along urban streams. Traditional solutions have involved hard engineering methods such as rip-rap, channelization, and retaining walls to secure the banks. It was reasoned that only hard material could withstand the enormous erosional energy that occurs during large storm events. Unfortunately, hard engineering techniques are often detrimental to the streamside ecosystem and may be less than satisfactory in controlling erosion.

Natural alternatives to streambank stabilization have their weak points as well; for example, willow stakes planted directly into an eroding bank may not withstand large storms. However, there is a fairly new method on the market for controlling erosion by the use of rolls made of natural coconut fiber.

A key design issue for streambank stabilization is how to physically protect the bank from erosion until the vegetation has become fully established. One solution is to use rolls of coconut fiber (also known as coir rolls) along the toe of the bank. The coconut roll acts as a flexible but resistant foundation for streambank plantings (Figure 1). Fiber rolls are initially plugged with native hydrophytic plants and then laid along the toe of the bank where they retain water and nutrients. The coir rolls eventually degrade but give plants enough time to form a dense network of intertwining roots that holds the bank (Figure 2, A and B).

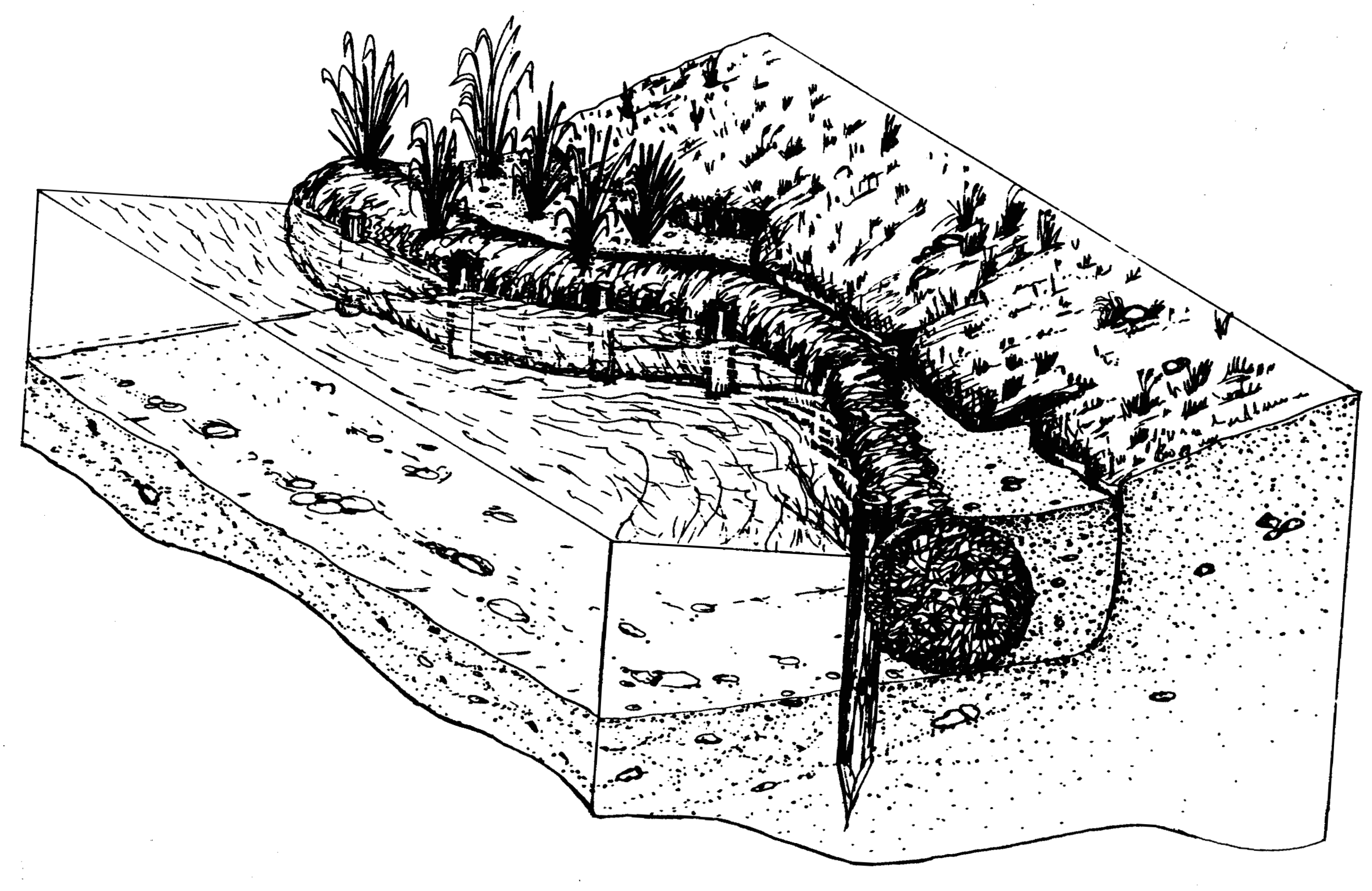

Figure 1: Placement of Coconut Roll Along Toe of Bank ***(drawing courtesy of Bestmann Green)***

A

B

Figure 2: Vegetation Establishment on Coir Rolls: Mystic River, Medford, MA October 1993 (A) and October, 1994 (B)

The prescription for the use of coconut rolls for streambank stabilization depends on the size of the stream, the slope of the eroding banks, and the expected stream velocity. Best results have been obtained in low-order streams, with graded or ungraded bank slopes of 3:1 or 4:1 (horizontal:vertical) and stream velocities between 2.5 and 7 ft/s. As with most bioengineering techniques, the use of coconut rolls requires full or partial sun for the plants to grow.

Typically, each project is designed by an interdisciplinary team of hydrologists, wetland experts, or landscape architects. In some cases, the existing eroded bank must be graded to achieve the more gentle side-slopes required for bioengineering (3:1). Seeded coconut logs, about 20 ft in length, are anchored along the toe of the bank and secured with stakes. Areas above the log may be stabilized by mats of coconut fiber or jute. Trees, shrubs and ground cover are then planted in the bank, using hydroseed, containers, or live stakes.

Coconut rolls have been utilized to stabilize eroding stream banks in Little Cedar Creek, a small stream draining a highly urban (60% impervious cover) watershed near Allentown, Pennsylvania. The stream experienced extensive bank erosion due to uncontrolled stormwater runoff from the upstream watershed. The stream, which at one time supported brown trout, had lost much stream habitat.

The City of Allentown first used rock armoring to keep the banks from eroding further. This costly approach was abandoned by the City after it was found that it created downstream bank erosion problems. After public meetings were held, coconut rolls were used as an alternative on approximately 1,400 linear feet of stream channel (both banks). The coconut rolls were installed and planted over a two-month period, and City officials have been pleased with the results. Over half of the native plant species have persisted (Table 1) and many other volunteer species colonized the site after two growing seasons. No visible erosion near the treatment area was observed, and anecdotal reports were made of improvements in the fish community.

Coconut logs were also used to stabilize the eroding banks of a small urban stream in Yonkers, New York. Once again, the streambanks were highly eroded due to stormwater runoff from upstream development. The eroding stream banks were cleared of woody vegetation, and the steeply sloping banks were graded to achieve a gentle slope. The toe of the streambank was protected by an anchored coconut roll, and mats of coconut were used to protect the upper bank from erosion. Sixteen species of native trees, shrubs, and ground cover were planted in the newly reshaped bank. Most of the planted vegetation survived and an equal number of volunteer species colonized the stream bank. Reports indicate that the vegetated streambank continues to prevent erosion, despite numerous sub-bankfull, bankfull, and over-bank floods.

The experience so far with coconut logs indicates that they can be a very effective method to repair

streambank erosion on small streams, with gentle, unwooded slopes. Best results are achieved when native plant species are used and the plantings are carefully maintained during the first few months. The cost of the coconut log approach is about $10/linear foot for materials; a four-person crew can plant from 200 to 300 ft/day *(Note: Cost can increase by an additional $9/ linear foot if extensive regrading of the bank is needed; for a general cost comparison.)*

Several interesting questions remain about coconut logs. For example, at what stream size should coconut logs be replaced by a layer of stone at the base of the streambank? Can shade-tolerant plant species grow fast and dense enough to allow coconut logs (or other bioengineering techniques) to be used in flood plains that have a dense tree canopy? And lastly, what will the streamside plant community be like after a decade or more of woody plant succession—will it still be dense enough to provide erosion control benefits?

—JMC

Reference

Greechan, H., S. Hoeger, and P. Summerfield 1993. *County Pioneers Stream Bank Stabilization Method*. Public Works 124 98.

Table 1: Vegetation Establishment on Coconut Rolls at Two Sites Over Four Years (S. Hoeger, pers. comm.)

Variables	Trexler Park Allentown, PA (1991-1994)	Tibbetts Brook Yonkers, NY (1991-1994)
No. species planted	27	16
No. original spp. surviving	16	11
No. new species	29	15
Total increase in diversity	60%	61%