WISCONSIN CONSTRUCTION SPECIFICATION

21. STRUCTURAL MEASURES FOR STREAMBANK AND SHORELINES

1. SCOPE

The work shall consist of furnishing and installing structural treatments to stabilize and protect eroding banks of streams or constructed channels, and shorelines of lakes, reservoirs, or estuaries.

2. TREATMENTS

Treatment measures shall be installed in the locations shown on the construction drawings. Several treatments may be installed in combination to achieve the desired conditions.

a. Tree Revetment - A tree revetment is constructed from freshly cut, well branched whole trees (except rootwads) that are cabled together and anchored by earth anchors, which are buried in the bank. Freshly cut or soaked wood are less buoyant.

   i. Lay the cabled trees along the bank with the basal ends pointed upstream and oriented parallel to the bank.

   ii. Overlap the trees 1/3 to 1/2 their length in a shingle fashion to ensure continuous protection to the bank starting at the downstream end.

   iii. Use trees that have a trunk diameter of 8 inches or larger. The best type is those that have a brushy top and durable wood, such as red or white pine, hemlock, cedar, oak, hard maple, or beech.

   iv. Attach the trunks by cables to anchors set in the bank. Secure the trees with a 3/16-inch cable or larger and earth anchors every 4 to 6 feet. Wrap the anchor cable around the basal end of the inside tree and around the outside tree top and bring the cable back onto itself and clamp it using an approved mechanical device. Trees should be secured as tightly to the streambank with cable and earth anchors as possible. If necessary, holes should be drilled approximately one foot from the base of the tree. Drill hole should be at least twice the diameter of the cable. On larger trees and streams subject to ice flow, extra anchors may be required. The trees are thus secured tightly to the bank with cable and earth anchors as the drawings indicate. Pilings can be used in lieu of earth anchors in the bank if they can be driven well below the point of maximum bed scour.

   v. Install other vegetative plantings or soil bioengineering systems within and above structures to restore stability and establish a vegetative community as shown on the construction drawings.

   vi. Placement of tree revetments shall be accomplished during low water periods.

b. Log, Rootwad and Boulder Revetments - These revetments are systems composed of non-coniferous tree species logs, rootwads, and boulders selectively placed in and on streambanks or shorelines.

   i. Root wad revetments shall be in sound condition and free from extensive decay. Logs over 12 inches in diameter that are crooked and have an irregular surface should be used.

   ii. Root wads of 6 to 12 feet in diameter should be used in typical streambank treatments, though smaller root fans may be used where they provide adequate coverage to a shorter streambank. A length of bole (or trunk) 6 to 12 feet in length is left attached to the root fan, creating the "root wad." Remaining trunks of 12 inches or greater in diameter are cut into lengths of 10 to 20 feet to form header and/or footer logs as needed. The length of the logs is set based on the desired spacing between root wads.

   iii. Boulders should be as large as possible, but at a minimum 1½ times the log diameter. The boulders shall have an irregular surface.

   iv. Install a footer log at the toe of the eroding bank by excavating trenches or driving them into the bank to stabilize the slope and provide a stable foundation for the rootwad.

   v. Place the footer log to the expected scour depth at a slight angle off parallel to the bank.

   vi. Use boulders to anchor the footer log against flotation. If boulders are not available, logs can be pinned into gravel and rubble substrate with 3/4-inch rebar 54 inches or longer. Anchor rebars to provide maximum pull-out resistance. Cable and anchors may also be used in combination with boulders and rebar.

   vii. Drive or trench and place rootwads into the bank so that the tree's primary brace roots are flush with the bank.

   viii. Backfill and combine vegetative plantings or soil bioengineering systems behind and above rootwad. They can include live stakes and dormant post plantings in the openings of the revetment below stream-forming flow stage, live stakes, bare root, or other upland methods at the top of the bank.

c. Dormant Post Plantings - Dormant post plantings form a permeable revetment that is constructed from rootable vegetative material placed in a square or triangular pattern.

   i. Preparation of Materials

      1) Harvesting

         a) Materials should be harvested when the plants are dormant.
         b) Live, healthy materials shall be obtained from specified sources or sources approved by the Technician (local or native source preferred).

c) Select a plant species appropriate to the site conditions, such as willows and poplars.
d) The materials shall be taken from vigorous, undamaged, disease and insect free stock.
e) All cuts must be clean with no splits. The cutting tools should be appropriately sized for the material being cut.
f) Cut live posts approximately 7 to 9 feet long and 3 to 5 inches in diameter. Taper the basal end of the post for easier insertion into the ground. The materials must have side branches cleanly removed with the bark intact. The cutting length shall be long enough to reach the lowest water table at the site during the growing season.

2) Storage - If materials are not installed within a day of harvest, the cuttings must be stored in a dark, moist and cool environment until planting. For the best chance of success, plant the material within 5 to 7 days after harvest.

a) Short Term: Cuttings to be planted within 5 to 7 days shall not be allowed to dry out.
b) Long Term: The temperature should be maintained between 34 and 40 degrees Fahrenheit. Cuttings can be stored for several months if the above conditions are maintained. If cuttings are stored at higher temperatures, a fungicide should be applied to prevent damage caused by pathogens and saprophytes.

3) Pre-plant Soaking of Cuttings

Prior to planting, all cuttings shall be soaked for a minimum of 24 hours. Only the portion of the cutting that will be below ground needs to be soaked. Soaking the entire cutting is not detrimental. Soaking can be accomplished in a garbage can, stream, pond, lake or any body of water that is deep enough as long as the cuttings are protected from the sun and wind exposure.

ii. Installation

1) Install posts into the eroding bank at or just above the normal waterline. Make sure posts are installed vertically. Two to three buds should be placed above the ground.

2) Insert 1/2 to 2/3 of the length of post below the ground line. At least the bottom 12 inches of the post should be set into a saturated soil layer.

3) Avoid excessive damage to the bark of the posts.

4) Place two or more rows of posts spaced 2 to 4 feet apart using square or triangular spacing.

5) Supplement the installation with appropriate soil bioengineering systems or, where appropriate, rooted plants.

d. Coconut Fiber Rolls - Coconut fiber rolls are cylindrical structures composed of coconut fibers bound together with woven twine. The twine can be biodegradable or synthetic. This material is manufactured in various diameters (6, 8, 12, 16, 18, 20 inches), densities (5, 7, 9 pounds/cubic foot), and lengths.

   i. The diameter, density, and materials shall be those specified in the design or construction drawings.

   ii. The minimum manufactured product life expectancy shall be 60 months.

   iii. Excavate a shallow trench at the planned location of the fiber roll to a depth 1/4 the diameter of the roll.

   iv. Place the coconut fiber roll in the trench. (Submerge the log 1/2 to 2/3 of its diameter)

   v. Anchoring options:

      1) Dead stout stake and twine or rope – The dead stout stakes nominal dimension shall be 2” x 2” x 4’. Drive dead stout stakes between the binding twine and coconut fiber. Stakes should be placed on both sides of the roll on 2 to 4 feet centers depending upon anticipated velocities/wave action. The tops of the stakes should not extend above the top of the fiber roll. Notch the outside of the stakes on either side of the fiber roll and secure with 16-gauge wire.

      2) Duck bill or other mechanical anchors - Install the mechanical anchors according to the manufacturer’s recommendations.

   vi. Backfill behind the fiber roll with soil, if required.

e. Jacks or Jack Fields - Jacks are individual structures made of wood, concrete, or steel. The jacks are placed in rows parallel to the eroding bank and function by trapping debris and sediment.

   i. Grade the jack shelf to the slope shown on the construction drawings.

   ii. Place the jacks on a shelf 14 feet wide for one line or on two shelves, each 14 feet wide, for a double jack row.

   iii. Space jacks closely together with a maximum of one jack dimension between them to provide an almost continuous line of revetment.

   iv. Anchor the jacks in place by a cable strung through and tied to the center of the jacks with cable clamps. The cable should be tied to a buried anchor or pilings, thereby securing all the jacks as a unit.

   v. Bury anchors or drive mechanical anchors to the depth as shown on the construction drawings or determined by the technician.

vi. Attach an anchored 3/8-inch diameter wire cable to one leg of each jack to prevent rotation and improve stability.

viii. Supplement the installation with appropriate soil bioengineering systems or, where appropriate, rooted plants.

f. Additional NRCS specifications that may be applicable:

i. Wisconsin Construction Specification 9, Loose Rock Rip Rap.
ii. Wisconsin Construction Specification 17, Wire Mesh Gabions and Mattresses.
iii. Wisconsin Construction Specification 18, Sack or Tubular Gabion.
iv. Wisconsin Construction Specification 20, Soil Bioengineering.

3. SITE EROSION CONTROL

Practices shall be installed, or the work performed in such a manner that will minimize site erosion, and the production of sediment. They include but are not limited to project staging, diversions, waterways, seeding, mulching, sediment basins, in-channel sediment control, and silt fence.