

UNH T² Center Technical Note

Natural Erosion Prevention Techniques

By Justin Pelletier, UNH T² Project Assistant & UNH Civil Engineering Student

This article discusses ways to prevent erosion by using natural techniques as opposed to modern construction. Natural techniques do not involve the use of steel, concrete, or other synthetic material which are commonly used in construction. Instead, natural techniques make use of living plants and trees as the source of anchoring soil. This helps drier soil areas retain water instead of allowing it to run off. It also helps to remove and evaporate excess water in damp areas to prevent dangerous unstable soil.

Soil Bioengineering

Soil bioengineering is the use of live cut brush layers as an alternative to reinforced or mechanically stabilized earth (MSE). Live cut brush, woody stems, and roots are used to create stable soil, which is quite resistant to erosion.

The live cut stems and branches provide immediate reinforcement. Secondary stabilization is created by rooting, which occurs along the length of buried stems.

Three techniques of soil bioengineering are brush layering, live staking, and live fascines. This article will discuss each technique.

Brush Layering

Brush layering consists of inserting live cut branches or brush between successive layers of compacted soil. This works best in conjunction with the construction of a fill slope. Make branch cuttings one half to two inches in diameter. Leave the

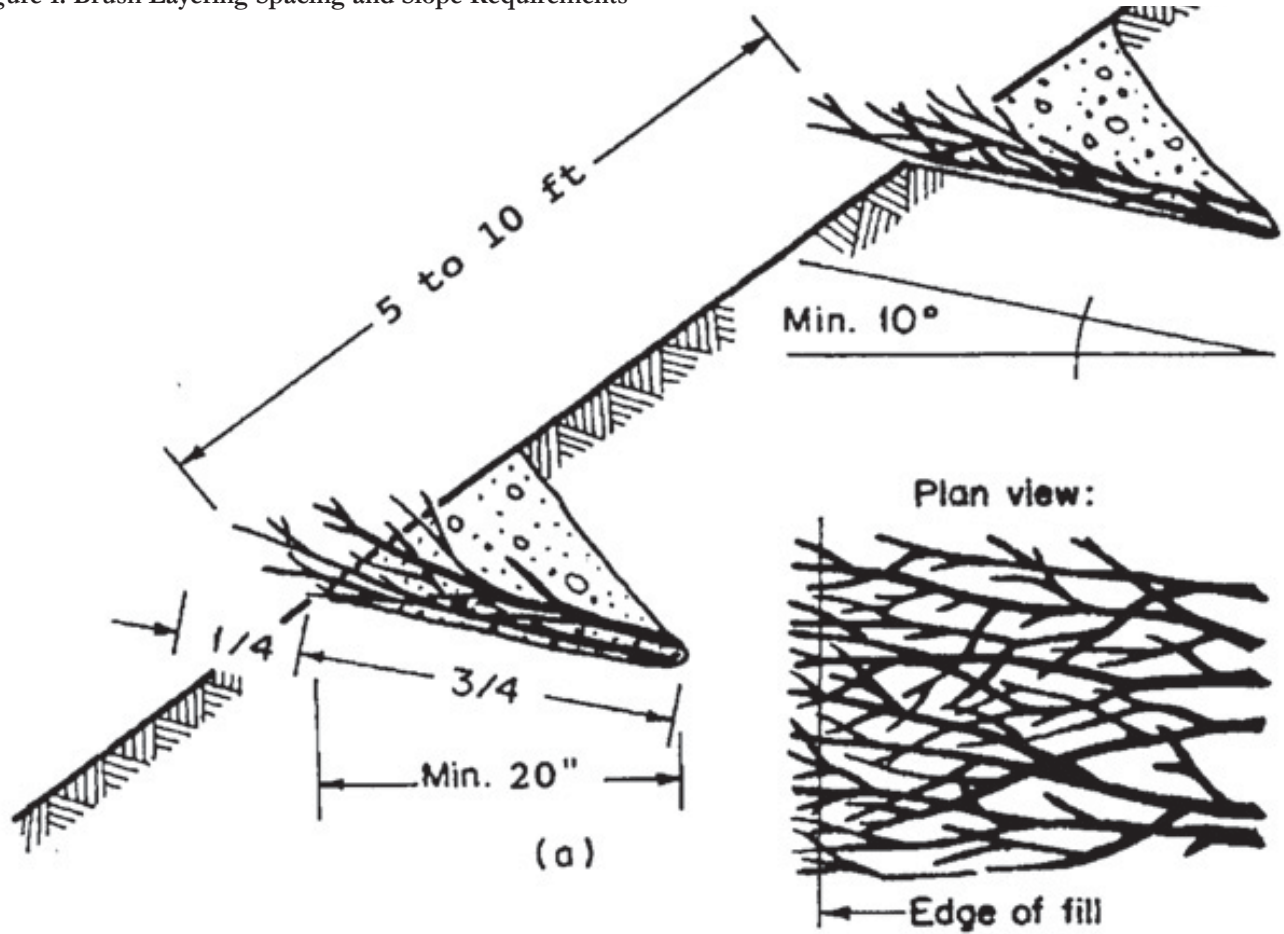
side branches intact for installation.

Follow these steps when installing brush layers:

- Starting at the toe of the slope, excavate benches horizontally, on the contour, or angled slightly down the slope, if needed to aid drainage. Construct the bench two to three feet wide.
- Slope the surface of the bench so that the outside edge is higher than the inside.
- Place live branch cuttings on the bench in a crisscross or overlapping configuration.
- Align the branch growing tips toward the outside of the bench. Place backfill on top of the branches and compact it to eliminate air spaces. Make sure the brush tips extend slightly beyond the fill to filter sediment.
- Backfill each lower bench with the soil obtained from excavating the bench above.
- Space the brushlayer rows three to five feet apart, depending on the slope angle and stability. *See figure 1.*
- Seeding is best accomplished between brushlayer rows when a mulch is used. Place long straw or similar mulching material between rows on 3:1 or flatter slopes. Use jute mesh or similar material in addition to the mulch on slopes steeper than 3:1.

Use brush layering on relatively uncomplicated upland site conditions, and uncomplicated shoreline sites with low velocities and wave heights, or to control erosion on moderate, dry land slopes.

Figure 1: Brush Layering Spacing and Slope Requirements



Brush Layering Installation Guidelines

Slope	Slope distance between benches		Maximum slope length (ft)
	Wet slopes (ft)	Dry Slopes (ft)	
2:1 to 2.5:1	3	3	15
2.5:1 to 3:1	3	4	15
3.5:1 to 4:1	4	5	20

Live Staking

Live staking is another technique used to reduce erosion on vulnerable slopes. Live staking involves the insertion and tamping of live but dormant vegetative cuttings into the ground. If done correctly, the live stake will root and grow. Utilize the following guidelines when selecting the stakes to be used in your project:

- Cuttings are usually a half to one and a half inches in diameter and two to three feet long.
- Take cuttings from vigorous, undamaged, disease and insect free stock. Make sure the stock is either native or adapted to the planting site.
- Materials must have side branches cleanly removed and bark intact.

- Cut the basal ends at an angle for easy insertion into the soil. Cut the top to make it square. Plant stakes with the butt ends into the ground. Make sure buds are oriented up.
- Install the materials the same day they are prepared. They must not dry out. Store materials in water or in a cool, shaded, and wet environment.
- Cut and install plants when they are dormant; that is, prior to bud swell and leaf emergence in the spring and after leaves have turned color and fallen off in the fall. Periodic pruning or replanting may be required.

When installing live stakes, follow these steps:

- Tamp the live stake into the ground at right angles to the slope face.
- Install live stakes two to three feet apart using triangular spacing. Place stakes with two to four stakes per square yard.
- Make sure the buds are oriented up.
- Install four fifths of the length of the live stake into the ground and pack the soil firmly around it after installation.
- Remove and replaced stakes that split during installation.
- An iron bar can be used to make a pilot hole in firm soil. Drive the live stake into the ground with a dead blow hammer (hammer head filled with shot or sand).
- Bare slopes may be seeded and mulched.

Figure 2 illustrates what a stake should look like at the time of installation. It also depicts the spacing between stakes and other appropriate uses of live stakes.

Live Fascine

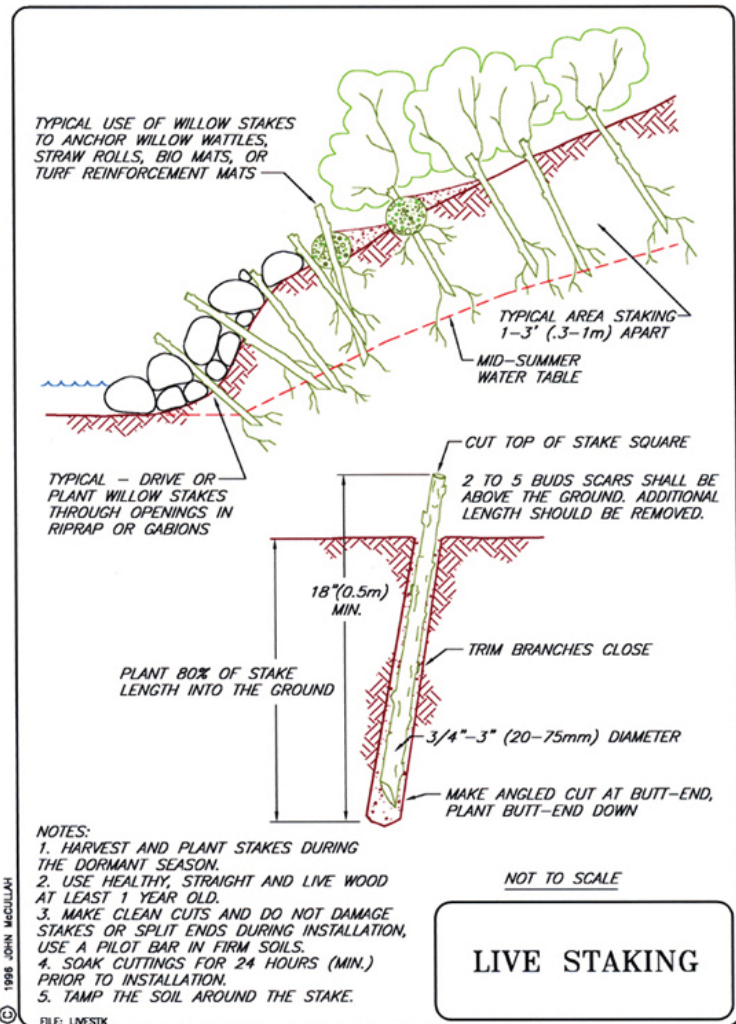
Live fascines, or wattles, are long bundles of live dormant branch cuttings bound together into a long, cylindrical structure. Live fascines are inexpensive to construct and install, and offer immediate protection from surface erosion when securely anchored. They are a very effective soil stabilization technique once roots are established. The installed fascines re-

duce the overall slope into a series of smaller slopes by acting as mini-dam structures that hold fill soil on the face of a stream bank. Typical wattles along a stream embankment are shown in Figure 3.

Install live fascines as follows:

- Prepare the live fascine bundles and live stakes immediately before installation. Do not allow the bundles to dry out.
- Beginning at the base of the slope, dig a trench on the contour just large enough to contain the live fascine. The trench will be 12” to 18” in width depending on the angle of the slope to be treated. The depth will be six to eight inches depending on the individual bundle’s final size.
- Drive the dead stout stakes directly through

Figure 2: Live Stake Spacing and Stake Size Requirements.



the live fascine every two to three feet along the length. Use extra stakes connections or bundle overlaps. Leave the top of the stakes flush with the installed bundle.

- Live stakes are generally installed on the downslope side of the bundle. Drive the live stakes below and against the bundle between the previously installed dead stout stakes. Allow the live stakes to protrude two to three inches above the top of the live fascine. Place moist soil along the sides of the live fascine. Leave the top of the fascine so it is slightly visible when installation is complete.
- Repeat these steps at intervals on the contour or at an angle up the face of the bank to reach the top of the slope. Place one or two rows over the top of the slope if possible.
- Place long straw or similar mulching material between rows on 2.5:1 or flatter slopes. Place jute mesh or similar material on slopes steeper than 2.5:1 in addition to the mulch. The slope may be seeded before mulching.

Consider the following guidelines when installing live fascines:

- Cuttings tied together to form live fascine bundles vary in length from five to thirty feet, depending on site conditions and limitations in handling.
- Make completed bundles six to eight inches in diameter with all of the growing tips oriented in the same direction. Stagger the cuttings in the bundles so that the tops are evenly distributed throughout the length of the fascine.
- Fascines may be secured with live stakes or dead stout stakes. Make sure live stakes used to anchor the fascines are 2.5 feet long in cut slopes

and three feet long in fill slopes.

- Make sure the dead stout stakes used to secure the live fascines are 2.5 feet long, untreated 2 x 4 lumber. Cut each length again diagonally across the four inch face to make two stakes from each length. Use untreated twine for tying the bundles.
- The best planting times are in late fall at the onset of plant dormancy or in early spring before growth begins. Periodic pruning or replanting may be required.

Contact the Natural Resources Conservation Service (NRCS) or the Soil and Water Conservation District (SWCD) in your county for more info.

References:

Brush Layering Fact Sheet. St. Paul, MN: United States Department of Agriculture: Natural Resources Conservation Service, 1994.
 Ervin, Mark. *Ohio Stream Management Guide: Live Fascines.* Columbus, OH: Ohio Department of Natural Resources.
 Federal Interagency Stream Restoration Working Group. *Stream Corridor Restoration: Principles, Processes, and Practices.* FISRWG, 1998.
 Gray, Donald H., and Robbin B. Sotir. *Biotechnical Stabilization of Steepened Slopes.* Washington, DC: Transportation Research Board, 1995.
 Lewis, Lisa. "Curbing Roadside Erosion." *Conservation Magazine* 2002.
 Live Fascine Fact Sheet. St. Paul, MN: United States Department of Agriculture: Natural Resources Conservation Service, 1994.
 Live Stakes Fact Sheet. St. Paul, MN: United States Department of Agriculture: Natural Resources Conservation Service, 1994.
 Live Staking with Willow Cuttings. Berkeley, CA: Urban Creeks Council of California, 2002.

Figure 3: Typical Wattles Along a Stream Embankment

