

## Construction Specification 465—Soil Bioengineering Plantings

### 1. SCOPE

The work shall consist of furnishing and installing or planting live plant materials on streambanks and eroding slopes to stabilize the bank and control erosion.

### 2. MATERIALS

All materials furnished shall meet the following requirements unless otherwise specified in section 8 of this specification:

General - Plant materials shall be live, viable woody vegetation free of insects and diseases. The plants shall consist of the species which will root, such as *Salix* species (willow), *Cornus* species (dogwood), *alnus* species (alder), or as specified on the drawings or in section 8 of this specification. The plant materials shall be from commercial sources or shall be harvested from existing local stands as specified in section 8 of this specification.

Root systems and limbs shall be kept intact and undamaged. Pruning cuts or cuts for live unrooted cuttings shall be smooth as not to damage the remaining bark of the plant.

*Fascine bundles* shall be prepared from live, shrubby material. Fascine bundles may vary in length. Diameter of branches used in the fascines shall not be more than 1½ inches in diameter. Stems shall be placed in the same direction and overlapped to create a shingled effect. When compressed firmly and tied, each bundle shall be 4 to 8 inches in diameter.

Fascines shall be tied in a manner that gathers all branches on a 12 to 24 inch center with a minimum of two wraps of natural undyed bailing twine by a non-slipping knot.

*Live stakes* shall be living, woody plant cuttings with side branches removed and the bark intact. They shall be prepared from 1/2 inch to 2 inch diameter stock and cut into lengths that will reach sustainable soil moisture when installed, generally 2 to 5 feet. The basal or butt ends shall be cleanly cut at an angle to facilitate easy insertion into the soil. The top shall be cut square or blunt. Pilot holes may be required depending on soil conditions.

*Brushmattress* is a combination of live stakes, live fascines and mattress branch cover. All woody species shall be live and of good quality that will root readily from the stem. The stem length for the mattress portion shall be 5 to 6 feet in length.

*Wire* for securing the brushmattress shall be single strand #16 gauge (non galvanized) wire capable of field use for at least 2 years.

*Dead Stout Stakes* shall be cut to a minimum length of 24 inches from untreated 2 x 4 inch lumber. Each length shall be cut diagonally across the 4 inch face, to produce two dead stout stakes. The diagonal cut shall begin and end 1/8 to 1/4 inch from the edge of the piece so the finished stake has a 1/8 to 1/4 inch tip. Only sound lumber shall be used.

*Vegetated Geogrids* will consist of live plant materials or cuttings between wrapped soil lifts. The wrapped geogrids will be of woven bristle natural coir (coconut fiber) #700 for the outer wrap and stitched coconut blanket #30 for the inner wrap.

### **3. HARVESTING INDIGENOUS SPECIES**

When specified in the plans or Section 8 of this specification, the plant materials shall be harvested from existing stands of living woody vegetation. The harvested plant materials shall be one of the species and determined suitable by the engineer.

Harvesting shall be done so there will be minimal disturbance to the site. The materials shall be cut with chainsaws, brush axes, loppers, pruners or other devices that will provide a smooth cut without damage to the bark of the cutting or the remaining plant. Cuts shall be made at an angle of approximately 45 degrees, 6 to 8 inches above the ground, to assist rapid regenerate. Remnant materials from the harvesting operation shall be chipped, or placed in piles for wildlife cover.

Live cuttings shall be securely bundled at the collection site with branches and limbs kept intact and transported in enclosed or covered vehicles. Cuttings shall be stored out of direct sunlight, in a cool shaded location, sprayed with water and covered with a wet tarp.

Cuttings should be installed within 24 hours of harvest. Live cuttings that cannot be installed within 24 hours shall be placed in storage at 40°F to 50°F. Cuttings shall be refrigerated, if the air temperature is above 50°F. Prior to installation the cutting shall be placed (cut ends) in water for 24 hours to allow for uptake of water by the cutting.

### **4. PLANT MATERIALS FROM COMMERCIAL SOURCES**

Plant material from commercial sources shall be harvested just before shipment to the site or harvested no earlier than two months before planting and put in refrigerated storage at 40°F to 50°F. When shipped, plants shall be transported in enclosed or covered vehicles and scheduled to arrive on site within 24 hours. The plants shall be bundled and packed to prevent damage to the bark, limbs, or root systems. All bare root plants shall be treated with a root gel to prevent drying.

Plant materials should be planted the day they arrive on site. Plants that cannot be planted the day of arrival shall be stored onsite and protected from wind, direct sunlight, drying out or other damage. Cuttings shall be stored to protect them from them from drying out by keeping them in a cool place and damp. Cuttings or unrooted stock not planted within two days after arrival on the site shall be discarded unless refrigerated at 40°F to 50°F.

Discarded materials shall be replaced from commercial sources at the Contractor's expense.

### **5. TIMING OF PREPARATION, INSTALLATION, AND PLANTING**

All planting of woody vegetation shall be accomplished during the dormant season between October 1 and May 15.

Installation of plant materials should begin concurrently with the earth moving operations and should be completed no later than 10 days after the slope has been prepared. When the planting is delayed beyond 10 days, the slope shall be protected from erosion by mulching with straw at the rate of 2 tons per acre or installing erosion control blankets.

### **6. INSTALLATION**

**Live stakes** shall be installed in the configuration, spacing, and areas shown on the drawings. The cuttings shall be tamped into the ground at right angles to the slope to a

minimum depth of 18 inches for a firm hold. Where soils are soft and 24 inch stakes are not solid (i.e., if they can be moved by hand) 36 inch stakes shall be used. Where soils are so compacted or frozen that 24 inch stakes cannot be tamped into the ground without splitting, pilot holes shall be drilled using an auger or reinforcing rod. Pilot holes shall be narrower in diameter than the live stakes.

**Fascine** trenches shall be spaced as shown on the drawings. Trenches shall be dug on the horizontal contour to a depth of 3/4 the diameter of the bundle. Beginning at the bottom of the slope and proceeding upward, the live fascine bundle shall be placed in the prepared trench with ends of the bundles overlapping at least 12 inches. Dead stout stakes shall be driven directly through the fascine bundles every 3 feet along the length or as needed to secure the fascine in the trench. Where bundles overlap, an additional stake shall be used at the midpoint of the overlap. The fascine bundle shall be covered immediately with soil and tamped. Installers shall walk on the fascine as work progresses to further work soil into the bundles. It is important to achieve the maximum plant material to soil contact to insure successful root emergence. Ten to twenty percent of the bundle shall be left exposed when construction is completed. Live stakes shall be tamped into the ground beneath the live fascine bundle, in between the previously placed dead stakes.

**Brushmattress** - Beginning at the base of the slope, a trench shall be dug on the contour to a depth of 3/4 the diameter of the live fascine bundle. The upslope side of the trench shall be graded to provide a smooth transition from the bottom of the trench to the upslope bank. A live fascine shall be placed in the trench in a manner as previously specified in Section 6. The basal ends of the brush shall be placed under the live fascine. The branches shall lie smoothly against the bank above, perpendicular to the live fascine. The brush shall be placed as shown on the drawings or to a more or less solid layer which shall be 4 to 8 inches thick when compressed and tied down. Dead stout stakes shall be driven to a firm hold on a grid of 4 foot centers each way encompassing the entire brush layer. They shall extend beyond the sides and from just above the fascine to within 1 foot of the top of the mattress. The brushmattress shall be securely tied down between the stakes with #16 wire. Ties shall be at right angles to the brush and also diagonally between the stakes. Ties shall be placed in such a manner as to compress the brushmattress. This may be accomplished by tying the wire tightly and then driving the stakes nearly to ground level. Live stakes shall be driven between the dead stakes. The brushmattress shall be partially covered with soil to encourage rooting.

**Brush Layering** - Spacing of trenches shall be as shown on the drawings. Hand trenching shall start at the bottom of the slope. Trenches shall be dug 24 to 36 inches into the slope, on contour, sloping downward into the slope from the face of the bank 10 to 20 degrees from horizontal. Brush shall be placed with basal ends inward and in a crisscrossed manner to the thickness shown on the drawings or be 4 inches thick in cut slopes and 6 inches thick in fill slopes. Thickness shall be measured after compression by the fill or covering soil. No less than 6 inches or more than 18 inches of the tips shall extend beyond the slope face. The brush layers shall be backfilled with soil immediately following placement and the soil compacted firmly. Backfilling may be accomplished by hand or with machinery.

**Vegetated geogrids** incorporate brush layers with natural or synthetic geotextile materials wrapped around each soil lift. Starting at the bottom of the slope, the bank shall be excavated to a depth of 2 feet. Live brush shall be placed horizontally, on the contour, in a

crisscross manner. The brush shall be 5 feet in length and placed at the rate of 5 stems per linear foot. The basal ends of the cuttings shall be placed against the back of the excavation. No more than 6 inches of plant material shall extend beyond the surface of the slope. Twelve inch high batter boards are temporarily placed 12 inches back from the surface of the slope. Geotextile is then placed over the soil, brush and draped over the batter boards. The geotextile shall extend from the back of the excavated trench to the surface of the slope. Excavated material shall be placed on the geotextile to a depth of 12 inches and compacted. The geotextile shall then be wrapped around the soil layer and anchored with dead stout stakes. Two to three inches of soil and live brush shall be placed horizontally on the geotextile in a crisscrossed manner at the density specified for the first layer. The above procedure shall continue until the number of lifts shown on the drawings is completed. The final wrap is secured to the bank with dead stout stakes and live stakes.

## **7. PLANTING ROOTED STOCK**

Bare Rooted Cuttings, Seedlings or Trees shall be dipped in a root gel just prior to planting. Holes for plants shall be made by a planting bar or shovel in the prepared slope. The holes shall be of sufficient size to permit placing the plant without bending the root. Plants shall be placed in the holes to the same depth as they were originally growing.

Rooted cuttings or seedlings shall be planted on approximately 5 foot centers in rows or randomly along the contour of the slope. Rows shall be 5 feet apart and plants shall be staggered from row to row. Random planting and use of multiple species will contribute to a more natural appearance.

Holes made with a shovel shall be filled with excavated soil and pressed firmly around the roots up to the ground surface. Holes made with a planting bar may be closed with the planting bar firming the soil at the bottom of the hole first and then firming the soil at the top. All spaces within one foot of the plant shall be filled with soil and compacted assure not air spaces remain.

Any plant materials damaged during installation or determined to be unsuitable by the engineer shall be removed and replaced at the Contractor's expense.

## **8. SPECIFIC DETAILS**