PROGRESSIVE BIOENGINEERING:
The Latest Developments in Non-structural Alternatives for Shoreline Stabilization
If a beach has a base elevation.
Based on Site Specific Criteria

If a beach has a base elevation.

The function a fringe marsh plays.
Based on Site Specific Criteria

If a beach has a base elevation.

The function a fringe marsh plays.

Near shore characteristics like fetch, water depths, sand bars, and location within a given littoral cell.
Bioengineering Strategies

Importance of Fringe Marshes in Coastal Stabilization
Bioengineering Strategies
Importance of Fringe Marshes in Coastal Stabilization

- Woven coir-filled mats used as a growing medium.
- Pre-vegeated to establish prior before installation.
Bioengineering Strategies

Importance of Fringe Marshes in Coastal Stabilization

Fiber Roll Array
Beach Elevation
High Tide
Bioengineering Strategies
Importance of Fringe Marshes in Coastal Stabilization

Fiber Roll Array
High Tide
Bioengineering Strategies

Importance of Fringe Marshes in Coastal Stabilization
Installation & Case Studies

Fringe Marshes
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Fringe Marshes
Bioengineering Strategies

Materials for Stabilizing Coastal Banks

- Coir fiber roll and reinforced fiber roll lifts add stability and protection to the toe of a bank and provides a window of opportunity to establish vegetation.
Bioengineering Strategies
Materials for Stabilizing Coastal Banks

- Robust anchoring systems.
**Bioengineering Strategies**

**Materials for Stabilizing Coastal Banks**

- Erosion control blanketing composed of natural fibers are used to stabilize soils above the fiber rolls allowing time for native salt tolerant plants become established.
Bioengineering Strategies
Materials for Stabilizing Coastal Banks

• Resists degradation from the marine environment.

• Absorbs some of the force of wave energy unlike many hard solutions that deflect the energy of wave action to surrounding areas.

• Materials life-expectancy to stabilize sediments matches the time required to establish native plants.
Bioengineering Strategies
Materials for Stabilizing Coastal Banks

- Establish native plants.
Bioengineering Strategies
Materials for Stabilizing Coastal Banks

- Root Depths of Native Plant Species

2' 2'
4' 4'
6' 6'
8' 8'
10' 10'

Littleblue Stem 2'
Sideoats Grama 4'
Switchgrass 6'
Indiangrass 8'
Big Bluestem 10'
Bayberry
Installation & Case Studies
Installation & Case Studies

Typical Eroding Bank
Installation & Case Studies

Importance of Establishing a Stable Slope

- Utilizing a portion of the upper bank can create a more stable slope angle.
- Adds increased stability and storm damage prevention to the bank.
- Without this step, an investment in bioengineering can be lost due to bank collapses.

(MA CZM Storm Smart Properties Fact Sheet 4)
Installation & Case Studies

Stabilizing toe of bank - Fiber rolls

- Installation begins at the base of the array and proceeds up bank.
- Proper anchoring strategy to hold toe protection in place.
- Synthetic filter fabrics DO NOT ENHANCE success of a bioengineering project.
Installation & Case Studies

Stabilizing toe of bank - Pre-vegetated fiber rolls

- Use of pre-vegetated fiber rolls along top of array.
- Added vegetation to the root matrix.
- Full season of plant growth prior to installation.
Installation & Case Studies

Stabilizing soils above toe protection

- Native salt tolerant grasses are seeded into the bank prior to installation of erosion control blankets.
- The erosion control blankets protect soils from erosion and helps to retain moisture to promote seed germination.
**Installation & Case Studies**

**Sand cover for fiber rolls**

- Sand nourishment protects coir fiber rolls from photo-degradation “Sun Block”.
- Nourishment also functions as sediment source to the adjacent coastal resource areas.
Installation & Case Studies

Native plant species

- Native beach plum and bayberry planted through erosion control blanketing.
- Temporary above ground irrigation for plant establishment.
Installation & Case Studies

Native plant species

• Establishment of native vegetation after two seasons of growth.
Installation & Case Studies

• Condition of fiber roll array following Hurricane Sandy - 11/2012

Waves reached above fiber roll array with no damage.
Installation & Case Studies

• Condition of fiber roll array following named storm Nemo - 2/2013
Installation & Case Studies

• Condition of fiber roll array following named storm Nemo - 2/2013

Waves reached above fiber roll array with no damage.
Installation & Case Studies

• Fiber roll array increased in length by 90’ - 6/2013
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Sand Envelopes

- 6" DEEP HAND DUG LOCK-IN TRENCH, PER MANUFACTURER INSTRUCTIONS
- EROSION CONTROL BLANKET (ECB) ON BANK
- 20° DIAMETER FIBER ROLLS INSTALLED AT 15.1 SLOPE APPROX. TOP FIBER ROLLS TO BE LOW-DENSITY (#7) AND PLUGGED WITH AMERICAN BEACHGRASS & QUACK GRASS @ 12" OC
- COMPATIBLE SEDIMENT TO PROVIDE AVERAGE COVER OF 4-6" OF COVER OVER PRE-VEGETATED FIBER ROLLS
- PAIRED DBBB DUCKBILL ANCHORS ATTACHED TO CABLES, ANCHORS SPACED 2.5" +/- 0" ACROSS FACE OF FIBER ROLLS INTO UNDISTURBED SOIL
- BOTTOM FIBER ROLLS TO BE HIGH-DENSITY (#9) AND COVERED WITH LAYER OF EROSION CONTROL MESH
- SAND FILLED ENVELOPE CONSTRUCTED OF SINGLE LAYER OF BIODEGRADABLE JUTE-BURLAP AND TWO LAYERS OF 900-GRAM COIR FABRIC
- 900-GRAM 100% BIODEGRADABLE COIR FABRIC

FIBER ROLL SECTION, TYPICAL

DETAIL PROVIDED BY WILKINSON ECOLOGICAL DESIGN, SPECIALISTS IN COASTAL STABILIZATION CONSTRUCTION

Scale: 3/8" = 1'
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Sand Envelopes

COIR ENVELOPE SECTION TYP.

Scale: 1/4" = 1'

DETAIL PROVIDED BY WILKINSON ECOLOGICAL DESIGN, SPECIALISTS IN COASTAL STABILIZATION CONSTRUCTION
Evolution of Bioengineering
Sand Envelopes
Evolution of Bioengineering

Reinforced Fiber Roll Lift

U.S. Patent No. 10,125,462

1. FIBER ROLL REINFORCED LIFT SECTION, TYPICAL

SOIL LIFTS CONSISTING OF A SINGLE LAYER OF C-700 COIR NETTING AND MESH COMPAREABLE TO THE CASING OF FIBER ROLLS

6"X6" ANCHOR POSTS SPACED 5' O.C.

SB65 DUCKBILL ANCHORS ATTACHED TO 42" CABLES. ANCHORS SPACED 2.5' +/- OC ACROSS FACE OF FIBER ROLLS

SAND NOURISHMENT PLACED OVER HIGH-DENSITY FIBER ROLLS AT GREATER DEPTH TO PROVIDE SPECIFIED VOLUME OF SAND NOURISHMENT

BOTTOM FIBER ROLLS TO BE HIGH-DENSITY (#9) AND COVERED WITH LAYER OF EROSION CONTROL MESH AND C-700 COIR NETTING

20" DIAMETER FIBER ROLLS INSTALLED AT 1:5:1 SLOPE APPROX. TOP FIBER ROLLS TO BE LOW-DENSITY (#7) AND PLUGGED WITH AMERICAN BEACHGRASS & QUACK GRASS @ 12" OC

EXISTING GRADE

PROPOSED GRADE

1:5:1 TYP
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Reinforced Fiber Roll Lift
U.S. Patent No. 10,125,462

20" diameter fiber rolls installed at 1:5:1 slope approx. top fiber rolls to be low-density (#7) and plugged with American beachgrass & quack grass @ 12" OC compatible sediment to provide average cover of 4-6" of cover over pre-vegetated fiber rolls.

Proposed grade

Soil lifts consisting of a single layer of C-700 cori netting and mesh comparable to the casing of fiber rolls.

2" untreated hardwood stakes to secure cori fabric.

DBBB duckbill anchors attached to 42" cables, anchors spaced 15" +/- OC across face of fiber rolls.

Paired DBBB duckbill anchors embedded 42" into sediment pillows fastened to steel aircraft cables with four anchors per pillow.

1.5' x 30' reinforcing untreated hardwood stakes.

Bottom fiber rolls to be high-density (#9) and covered with layer of erosion control mesh and C-700 cori netting.

Remains of sand nourishment placed over high-density fiber rolls at greater depth to provide specified volume of sand nourishment.

Bottom fiber rolls to be covered with layer of erosion control mesh and C-700 cori netting.

4'-5" thick, 3'-4" wide salt marsh pillows made of 700 gram cori blanket envelope filled with mixed loose cori fiber and compost.

Native maritime grasses (refer to plant specifications).

Fiber reinforced lift and cori salt marsh pillow section, typical.

Detail provided by Wilkinson Ecological Design, Specialists in Coastal Stabilization Construction.

U.S. Patent No. 10,125,462

Scale: 1/4" = 1'
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Reinforced Fiber Roll Lift

U.S. Patent No. 10,125,462

FIBER ROLL REINFORCED LIFT SECTION, TYPICAL

Scale: 2" = 1'
Installation & Case Studies

Reinforced Fiber Roll Lift
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