Chapter 2: Shoreline Stabilization

Presentation for the

Upper Mississippi River Basin EMP Workshop

by

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Outline

Chapter Overview

- Resource Problem
- Design Methodology

Design Details

- Shoreline Stabilization Techniques
- Lessons Learned

Questions/Input

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Resource Problem

Increased Shoreline Erosion

- Exposure to erosive forces from wind driven wave action, river currents, and ice action
- Loss of aquatic vegetation
- More open water

Result

- Degraded habitat in the navigation pools

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Design Methodology

Existing Information

- EM 1601
- Shore Protection Manual

One size does not fit all

- Gradations
- Material Costs

Philosophy

- Diversity
- Minimize rock size and thickness
- Larger gradations improved fish habitat

Design Methodology Stabilization Techniques

Riprap

- High Degree of Precision

Biotechnical

- Combines live vegetation and structural material

Vegetative Stabilization

- Inexpensive

Other Biotechnical Methods

- Synthetic Reinforcement Grid
- Willow mats or rolls

Design Methodology Stabilization Techniques

Technique Selection

- 20% riprap, 40% biotechnical, 40% vegetative



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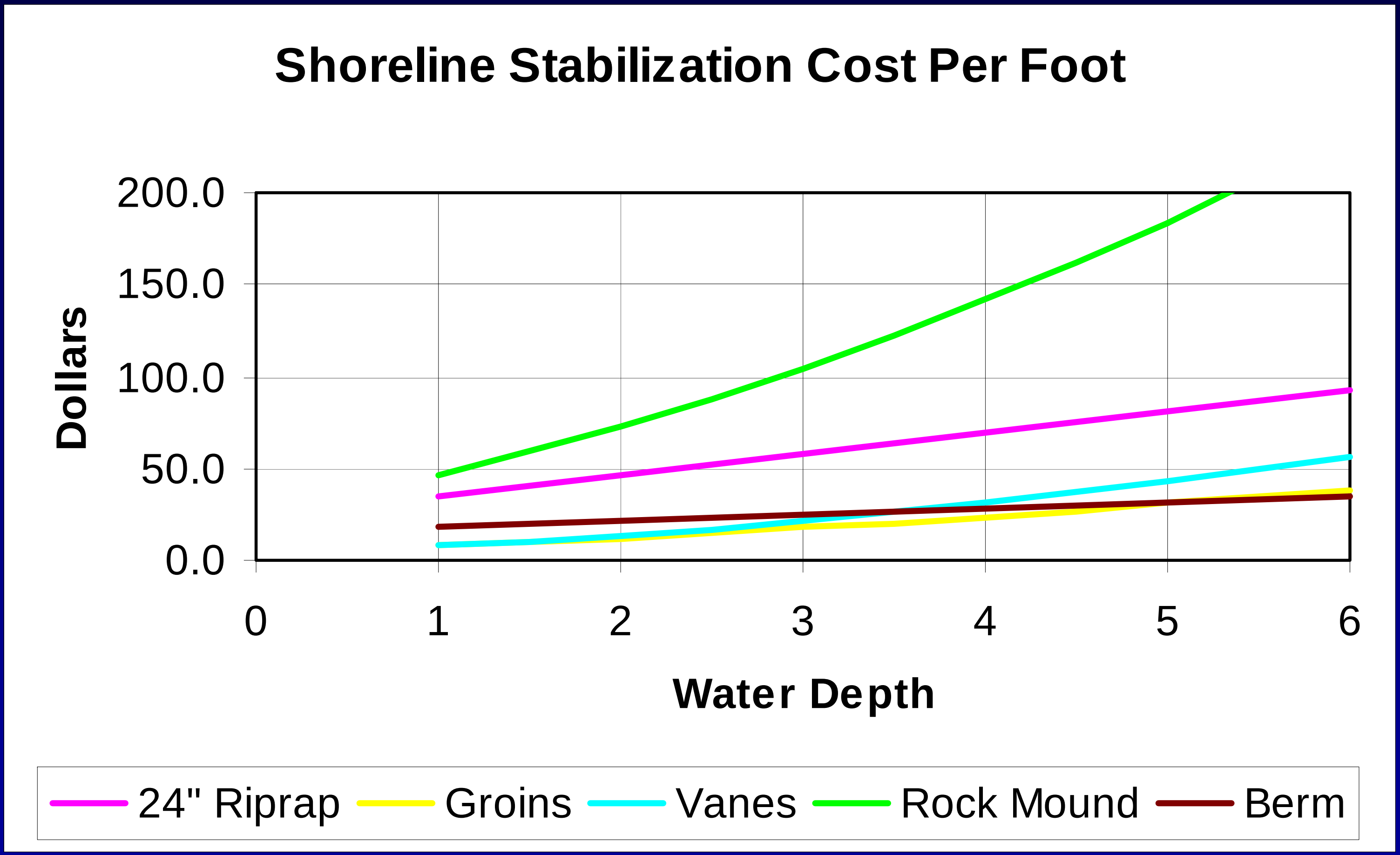
Design Methodology
Cost – MVP Data



Design Details

Design Criteria

Rock Slope	1V:1.5H – 3H
Height above Average Water Surface Elevation (feet)	1 – 5
Thickness (inches)	18 - 36

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Design Details

Lessons Learned

Project	Year Constructed	Lesson Learned
Weaver Bottoms	1986	The 30" layer of rock (no filter fabric) placed at a 1V:2H slope on these islands has held up for almost 20 years.
Lake Onalaska	1989	Portions of the 18" layer of rock (w filter fabric) placed at a 1V:3H slope were severely damaged by ice action during winter freeze-thaw expansion and spring break up. Subsequent maintenance involved placing additional rock over the damaged rock at a 1V: 4H slope. This has also been damaged by ice, however the rock thickness is adequate to prevent exposure of the underlying granular material.

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Design Details

Case Studies

Site	Rock Slope	T (in)	Height above Normal Pool (feet)	10-YR FL Height (feet)	Geo-textile	Project Length (Feet)	Year
Betsey Slough	1V:2.5H	30	4.0	8.5	No		
Billy's Slough	1V:1.5H	32	3.0	12.0	No		
Dakota	1V:2H	32	2.5	5.0	No		

Rock Revetments

Design Criteria

Rock Slope	1V:1.5H – 3H
Height above Average Water Surface Elevation (feet)	1 – 5
Thickness (inches)	18 - 36

Rock Revetments

Uses

- New Construction and Existing Shoreline
- Improves shear strength of shoreline

Lessons Learned

- 18 inch thickness placed at 1V : 3H is stable
- 1V : 4H should be used if ice action is expected

Case Studies

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Rock Groins

Design Criteria

Top Width (feet)	2 – 5
Rock Slope	1V:1.5H – 2H
Height above Average Water Surface Elevation (feet)	1.5 – 2
Groin Length (feet)	30 – 40
Groin Spacing (feet)	120 – 240
Ratio of Groin Spacing to Groin Length	4 – 6
Key-in (feet)	5 – 10

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Rock Groins

Uses

- Mainly New Construction
  - ✓ Wave Action and Littoral Drift are the Dominant Processes

Lessons Learned

- If ice action is anticipated, end slope should be 1V:5H
- If little scalloping observed, vegetation alone could have been used

Case Studies

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Rock Vanes

Design Criteria

Top Width (feet)	3 – 5
Rock Slope	1V:1.5H – 3H
Height above Average WSE (feet)	1.5 – 2
Top Elevation Slope	10 – 12%
Length	30 – 45
Hook Length (J-Hook vanes only)	30 – 45
Angle (θ)	40 – 55
Spacing Ratio (Length to Spacing)	1:3 - 4

Rock Vanes

Rock Vanes

Uses

- New Construction and Existing Shoreline
  - ✓ Adjacent to moving current
  - ✓ More economical than groins in deeper water

Lessons Learned

- Stabilized bank, but reshaping is still occurring.

Case Studies

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Offshore Rock Mounds

Design Criteria

Top Width (feet)	3 – 5
Rock Slope	1V:1.5H – 3H
Height above Average WSE (feet)	1.5 – 2

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Offshore Rock Mounds

Uses

- Shoreline with shallow nearshore bathymetry
- Low shorelines or marsh area
- Shorelines with heavy wood debris

Lessons Learned

- Design top elevations need to account for settling
- Settling has continued over time

Case Studies

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Rock-Log Structures

Design Criteria

Minimum Rock Cover Needed (feet)	Typical Bottom Elev Required and Elevation of Tree Trunk
2.0' if 15' of tree is covered by rock 1.5' if 20' of tree is covered by rock	628.0 to 628.5 = Bottom 630.0 to 630.5 = Tree Trunk

Chevrons

Chevrons

Uses

- Allow better control of flow splits between the main and side channels
- Scour holes on the downstream side improve habitat diversity
- Wide reaches of the river, where a typical dike is not feasible

Lessons Learned

- Better if several are used in a series
- Bank revetment is typically needed on the near bank of the structures

Berms and Vegetation

Design Criteria

Berm Width (feet)	25 – 40
Slope to Top Elevation	1V:3H or flatter
Height above Average Water Surface Elevation (feet)	1.5 – 3

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Berms and Vegetation

Uses

- New Construction and Existing Shoreline
  - ✓ Offshore velocities <3 fps, wind fetch < 0.5 mile
  - ✓ Ice action and boat wave minimal

Lessons Learned

- Low elevation berms placed along the shoreline will naturally colonize
- Vegetation is not adequate if the shoreline is exposed to sustained wave and ice action.
- 20 – 30 ft berms have been stable

Case Studies

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Loafing Habitat

Design Criteria

Height above summer pool (inches)	2 – 12
Length (feet)	25 - 60
Tree Species	Black Locust, White Oak
Location	Sheltered Areas

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Questions