Protecting the NJ Coast Using Large Stone Seawalls

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Overview

- Project Description
- Design Overview
- Seawall Construction
- Deepwater Stabilization Construction
- Lessons Learned
Project Locations

[Map showing locations of Townsends Inlet and Hereford Inlet along the Atlantic Ocean coast]
Project Information

- Townsends Inlet
- Hereford Inlet
- Residential / commercial buildings
- Existing undersized seawalls
  - Damage
  - Failed sections
Pre-Conditions - Avalon
Pre-Conditions - Hereford
Pre-Conditions - Hereford
Pre-Condition - Hereford
Pre-Condition - Hereford
Design Basis
Seawall

• Based on set of historical storms
• Design forcing parameters based on Modeling
  – wave
  – water level
  – currents at each inlet
  – 50-yr return period equivalent
Design Criteria - Seawall

- SPM and CEM guidance
- Armor stone evaluated based on structural stability
  - <5% damage (stone displacement)
  - Hudson equation; double layer armor
- Crest height
  - Allowable wave overtopping w/ no damage
- Toe scour
  - Potential wave
  - Current-induced scour
Avalon Seawall
Avalon Seawall Structure

- 3,000 ft rubble seawall
- New construction “over” existing
- 4-6 / 6-10 ton capstone
- 700-1,400 lb corestone
- Marine mattress
- Sand infill
Avalon Seawall

• Two rounds of bids
  – Round 1: $25 M
  – Round 2: $13 M
Avalon Seawall “VE”

- Toe scour design and structural feature modification
- Build with existing seawall in place
Avalon VE: Revised Toe Scour Design

• Original Design Conservative wide berm; -15 ft depth
  – *Moderate to severe* scour potential
  – Scour based on vertical wall empirical relationships

• Revised design; no berm; - 12 ft depth
  – Low to moderate scour potential based on historical evidence
  – Consider sloping face, Reduce depth by 30%
Avalon VE: Revised Toe Scour Structure

• Change structural feature
  – Marine mattress scour apron
  – Reduce
    • Cost
    • excavation depth
    • Overall structure footprint
Avalon VE: Leave Existing

- Eliminate removal effort and risk
- Sand infill
Sand Infill Design
Original

Placement Detail
Geotextile between new seawall & existing bulkhead
N.T.S.

Note:
Gap between new stone/marine mattress and bulkhead shown for clarity only.
Sand Infill Design
Revised

TYPICAL DETAIL - STONE AND SAND FILL
N.T.S.
Avalon original - $25M
Avalon VE: $13M
Hereford Seawall
Hereford Seawall Structure

- Consists of three schemes
  - 1,200 ft Deepwater stabilization
  - 2,400 ft New rubble seawall 3 – 5 T capstone
  - 5000 ft Rehab of existing seawall 2 T capstone
- 600 – 1000 lb corestone
- Marine mattress
Hereford Seawall
Multiple Projects

- Rehabilitation
- Deepwater stabilization
- New Section
Hereford Seawall Rehabilitation Detail

Typical Section
STA. 24+70 to STA. 35+03.47
Hereford Seawall
Deepwater Stabilization Detail

TYPICAL SECTION - DEEPWATER STABILIZATION OF EXISTING SEAWALL
STL 36+10.75 TO STL 42+20
Hereford Seawall
New Seawall Detail

TYPICAL SECTION
STA. 44+82.89 TO STA. 56+00 @ 3°18' TO SURVEY BASELINE
Marine Mattress Description

- Polyethylene geogrid basket
- Lined with geotextile
- Approximately 6-ft by 20-ft
- Overlap flap
Marine Mattress Detail
Marine Mattress Construction
Marine Mattress Construction
Marine Mattress Placement
Marine Mattress Advantages

- Instant Filter: Eliminate material quantity
- Flexible: conforms to under shape
- Stable placement in moving water
- Serves as scour apron
- Provides stable work area
- Provides cushion to work on
Seawall Construction Sequence
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Seawall Construction Sequence
Seawall Construction Sequence
Seawall Construction Sequence
Seawall Construction Sequence
Seawall Finished Product
Avalon Seawall Action
Hereford Deepwater Stabilization
Deepwater Stabilization
Design Basis
Deepwater Stabilization

- Geotechnical slope stability
- Current erosion
Deepwater Stabilization

TYPICAL SECTION - DEEPWATER STABILIZATION OF EXISTING SEAWALL
STA. 36+10.75 TO STA. 42+20
Deepwater Stabilization
Mattress Placement
Deepwater Stabilization
Mattress Placement
Deepwater Stabilization
Mattress Placement
Deepwater Stabilization
Mattress Placement
Lessons Learned

• VE can lead to significant savings

• Consider practical site characteristics
  – Toe scour history
  – Existing groins withstood ’62 storm
  – VE attributed existing failures to poor filter gradation, not scour
Lessons Learned

- Drawing representation
  - Square stones – not available in large quantity
  - Proximity to bulkhead
Lessons Learned

• Use “Anchor” Toe Stone or Key-in Toe
  – Difficult to build with low resistance of outer stones
  – Marine mattress prohibits “embedding toe in sand”
Lessons Learned

- Evaluate single layer on existing flat surface
  - Difficult to achieve required interlock to ensure stable layer
  - Use concrete for raising existing cap
Lessons Learned
Tolerance / Interlock

• Vary under-layer thickness

• Provide Contractor clear explanation

• **Spec language:** “The stones shall be closely fitted and interlocked……. All stone will be in close contact to assure no independent movement or sliding”

• Require test sections
  – Complete FIRST
  – Instill team approach
Lack of Interlock / Tolerance
Lack of Interlock / Tolerance
Lack of Interlock / Tolerance
Lessons Learned

- Consider Best Value Procurement: Stone setter is key in product
- Stone shape / availability
  - “Inter-layer” interlock
  - “Intra-layer” interlock
  - Tolerance
High Points

- Avalon Overall Quality
- Contractor innovation – sonar imaging
- Design Involvement in Construction
Proposed Cross Section
Seawall Finished Product