Underwater Pile Repair and Protection of Marine Structures

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Objectives

• What is Pile Encapsulation?
• Why Do Piles Fail?
• Pile Jacket Installation
• Future Trends

Marine Infrastructure Overview

Bridges
Wharfs
Piers
Jetties
Dolphins
Transmission Towers
Sea Walls
Marine Applications

Concrete

Wood

Steel

Deterioration in Marine Environments

- Marine organisms
- Chemical attack
- Corrosion
- Mechanical damage
- Freezing and thawing damage
- Salt scaling

Repair Zones for Typical Pile Repair

- Total Zone:
  - Corrosion
  - Biological/chemical attack
  - Mechanical damage
- Splash Zone:
  - Corrosion
  - Biological/chemical attack
  - Mechanical damage
- Marine:
  - Mechanical damage
- File Caps:
  - Corrosion
  - Mechanical damage
Prior to Pile Encapsulation Systems

Complete replacement – or – Repair in place

In-place repairs were made using the same materials used in original construction

Drawbacks to this type of repair:

- Subject to same issues that caused deterioration
- Unending repair cycle
- Costs:
  - Cofferdams are often required to dewater the repair area
  - Lengthy repair times
  - Loss of structure function during repair

Composite Systems for Pile Encapsulation

System to Repair and Protect damaged and deteriorated piles

Provides an “in-place” repair

- No dewatering
- No loss of service

Impervious repair:

- Suffocates the splash zone
- Improves resistance
- Chemical
- Biological
- Freeze thaw

Proven technology for over 40 years

Advantages of Pile Encapsulation

Components are Underwater & Marine Grade

- Effective above and below waterline
- Effective in salt water, fresh water, and brackish water
- Jacket and fillers can be placed and cure underwater
- No dewatering required
- Environmentally safe to marine life
- Cost effective!
Advantages of Pile Encapsulation

Benefits to contractors, owners & engineers:

- User-friendly; can be modified in field; maintenance-free
- Jackets are manufactured per project needs
- Epoxy is both pourable and pumpable; fills all voids
- Epoxy grout bonds tenaciously to jacket
- Complete barrier system protects against additional corrosion and deterioration
- Restores structural integrity
- No need to shut down structure during installation

Components of a Jacketing System

Stay in Place Form
- Fiberglass jacket

Filler
- High-strength grouting materials
- Marine epoxy grout
- Underwater cementitious grout

Accessories
- Forming hardware
- Temporary bottom seals
- Pumping ports
- Stainless steel screws

Made from fiberglass fabric and polymer resin

Shape and size made per project

Jackets are 1/8” to 1/2” thick

Integral tongue & groove joint

Spacers added to maintain annulus

Bottom Seal

Self-tapping screws
**Type of Filler Material**

Depends on Section Loss

- **Less than 25%**: Epoxy grout
- **Greater than 25%**: Epoxy & cement grout

**What About Complete Pile Section Loss?**

- Jackets may still provide solution
- Engineer-of-record to determine

- Additional repair material may be appropriate
  - Rebar cage (wood or concrete piles)
  - Welded steel plates (steel piles)

**Surface Preparation**

Clean existing surface from loose debris

Prepare surface:

- **Concrete**: Mechanically, remove unsound concrete to the damaged area
- **Steel**: Prepare surface by high-pressure water jetting or other mechanical means up to specification
- **Fiberglass Jacket**: Fiberglass surfaces must be sound, clean, and free of all contaminants

**Means & Methods**

- Mechanical Sandblast
- Water Blasting
- Abrasive

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Installation Procedure

- Gun epoxy into T&B joint
- Place jacket around pile
- Close jacket Position 18"-24" beyond repair area
- Mark bilateral bearing Mark nerves to secure T&B joint

Installation Procedure

- Bottom seal Install epoxy grout
- All-epoxy systems Fill joint with epoxy grout
- Epoxy/cement system Fill remainder with epoxy grout
- Top seal Apply epoxy mortar

Installation Details

- Grout Port
- Bell Joint
- Jacket formwork
Future Trends with Jacketing Systems

Stay in Place Forms
Strengthening Applications
Passive Cathodic Protection Systems
Active Cathodic Protection Systems

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Thank You!

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