Concrete Rehabilitation and Technology

Facilities Engineering Seminar, October 26, 2017

Gary Ledford, P.E.
Concrete Rehabilitation

- Traditional chip and re-cast
- Hydrodemolition
- Shotcrete
- Pile Repair
- Passive Cathodic Protection – Spray-on zinc, Embedded anodes
Concrete Technology

Elastomeric Concrete
Concrete Mix Design
Strengthening with Concrete Replacement
Strengthening with Graphic Epoxy Composite Mats
Fully understand the cause for rehabilitation

Field samples
Underwater inspections
Corrosion or Mechanical Damage?
Added CFRP strips to replace lost prestress
CFRP Strips in service since 1998
Damaged Piles
Pinned the pile to the cap - 1995
Bullous Bow Damage
Pneumatically Applied Concrete - Shotcrete
10 Years Later
Cargo Pier Repairs – Passive Cathodic Protection
Cast-in-Place Option
Less than ideal results
Lessons Learned:

Plan on quantities increasing by at least 25%.
Delays due to additional quantities shall not be grounds for change orders.
Unit prices shall include all costs including extended general conditions.
Repairs on an Active Berth

Underside of rail beam
Lessons Learned:

Coordinate with the berth operator and develop a plan.
Include the plan as a schedule constraint with the repair bid documents.
Flame Sprayed Zinc
Concrete Technology

Elastomeric Concrete – Joint Repair

Concrete Mix Design
Strengthening by increasing the deck thickness

Strengthening with Graphic Epoxy Composite Mats (CFRP)
Deck Joint Repair
Elastomeric Concrete

Neoprene Seal
Concrete Mix Design

Goal: Highly impermeable concrete

Maximum water to cementitious ratio:
CIP – 0.37       Precast-prestressed – 0.34
Minimum Quantity Cementitious Material: 675 lbs/CY
Type II Portland Cement
Option 1:
25% Fly Ash, 10% Microsilica, 4.5 gal/CY Calcium Nitrite
Option 2:
50% Slag (GGBFS), 4.5 gal/CY Calcium Nitrite
Concrete Mix Design

Water-reducing admixture
High range water reducers and retarders
Air entrainment: 1% to 3%

Breaks – between 8,000 to 11,000 PSI
Design: 5,000 to 6,000 PSI

Minimum cover: 4 inches for CIP
Option 1 Mix – fog surface during troweling
7 days continuous wet cure under blankets, followed by curing compound for 21 days
Concrete Mix Design

Option 1 Mix – 1991

Option 2 Mix - 2008

Latest modification to the Marine Concrete Mix Design:

Crystalline Waterproofing Additive
7 lbs per CY
Absolutely no water added to the truck once it leaves the batch plant.

Concrete Preconstruction Conference held at the Concrete Supplier’s Yard
Contractor, Concrete Supplier, Admixture Technical Representatives, Owner, EOR
Concrete Batch Plant QCP, demonstration batches
Concrete Placement Plan
Cargo Berth Deck Strengthening

Hydrodemolition – remove 4 to 6 inches of topping
Exposed top of precast prestressed 15” hollow-core deck units
Constant monitoring and adjustment
New topping 6 to 9” thick, negative moment reinforcement
Started concrete placement at 4:00 am
No initial shrinkage cracking.
After 2 years – random or crazed hairline cracks.
Cruise Pier Deck Strengthening

Mobile Passenger Boarding Bridges – CT5 & CT10
Specialty DB Contractors – Performance Specification
Strengthened two 4 foot wide planks
Field tests and samples for lab tests
Thank You

Questions?