FMT Tunnel Fresh Air Duct Rehabilitation
Using Wet Process Shotcrete
Tunnel Typical Section

Location of Repairs
Design

Spalling due to minimal cover and corrosion
Repair Contracts

- Three Contracts C=$20M
- Wet process pneumatically applied mortar
  - Reduced dust, rebound, and waste
  - Pre-mixed before the nozzle
  - Allows for thicker lifts
Concrete Soffit Repairs

Repair Detail

- Pneumatically applied mortar (see specifications)
- 4x4 WO.9xW0.9 WELDED WIRE FABRIC (GALV.) WITH ANCHOR BOLTS
- Roughen surface of sound concrete
- REMOVAL
- 6" MAX
- EXISTING REINFORCEMENT CLEAN AND PRIME

Repair Requirements

- Required Min Cover = 2"
- < 2" locations built up to provide 2" cover
  - Edges tapered 1:1
- Hydro-demo only
  - no saw cutting or sandblasting
  - 6” deep or 3” behind rebar
  - 30 lbs chipping hammer
- Microsilica enhanced polypropylene fiber reinforced mortar
- 28 day strength = 7,500 psi
- Welded wire fabric

Additional Cover as Required
• **Shotcrete Placement**
  - Rotary pump
  - Nozzle pressure = 50-85 psi
  - Nozzle 3-4 feet from surface
  - Perpendicular strike
  - Placed in layers to prevent sag
    - Less than 4” thick
    - Water maintained at minimum

• **Nozzleman Requirements**
  - Three projects in last 10 yrs on highway structures
  - ACI certification in wet process
    - Horizontal and vertical
  - Certifications due at time of bid
  - Test panels
    - completed and approved prior to production placement
    - Required test panels to be completed every 100 CF of placement
Nozzleman Horizontal Test Panel
Nozzleman vertical test panel
Construction Access
Repair Preparation
Unexpected Utility Challenge

- 13kV ducts exposed during concrete removal
  - Entire duct concrete cover in poor condition
  - Duct heavily corroded and breached in locations
  - Safety concerns - Live cables exposed
  - Ducts feed vent fans
Shotcrete Placement
Acceptable repairs?
• Total quantity
  • CF
• Total Cost
Summary of Project

3 Construction Contracts

- **Contract 1**
  - Bid Date – July 29, 2010
  - Low Bid - $7.5M
  - Contractor – Coastal Gunite Construction
  - SB Bores

- **Contract 2**
  - Bid Date – December 20, 2010
  - Low Bid - $5.5M
  - Contractor – Eastern Waterproofing & Restoration Co.
  - NB Bores

- **Contract 3**
  - Bid Date – January 23, 2014
  - Low Bid - $20M
  - Contractor – Coastal Gunite Construction
  - NB & SB Bores

Total Shotcrete Placed = 58k CF
Key Requirements for Success

• Contractor Qualifications
  • Sufficient evidence using wet process for vertical and overhead
  • Prefer tunnel experience but may limit contractor pool
  • Require at time of bid

• Shotcrete Process
  • Use hydro-milling, and limited light hammer chipping
  • Utilize the wet process
  • Do not accept dry process as an equal

• Nozzleman Certifications
  • Each nozzleman must be ACI certified
  • Owner must verify certs using ACI database (ensure not expired)
  • Require certs at time of bid
  • Require each nozzleman to properly shoot vertical and overhead test panels

• Owner Inspections
  • Detail oriented
  • Sound everything
  • Enforce corrective action requirements