Grouted Post-Tensioning – State of the Practice

T-9 Technical Committee for Bridge Preservation

William R. (Randy) Cox, P.E.
Manager
American Segmental Bridge Institute
Purpose of Grout

- Corrosion Protection
- Bond
Durability and Post-Tensioning

• Extremely durable when properly constructed
  – Crack control
  – Multiple levels of protection

• The grout is last level of protection for the strand

moisture, Cl⁻, CO₂

duct
grout
concrete
strand
Guide Specification for Grouted Post-Tensioning
Post-Tensioning System Tendon Protection Levels (PLs)

• Based on *fib* Bulletin 33, Durability of post-tensioning tendons

• Define in Contract Documents based on the project location, particular environmental conditions, and durability / design life requirements

• Once selected, all performance requirements of a particular PL should be consistent
Post-Tensioning System Tendon Protection Levels (PLs)

PL-1A – Defined as a Duct with Grout Providing Durable Corrosion Protection

PL-1B – Defined as PL-1A Plus Engineered Grout and Permanent Grout Cap

PL-2 – Defined as PL-1B Plus an Envelope, Enclosing the Tensile Element Bundle Over Its Full Length, and Providing a Permanent Leak Tight Barrier

PL-3 – Defined as PL-2 Plus Electrical Isolation of Tendon, or Encapsulation to be Monitorable or Inspectable at Any Time
Protection Level 1A

- Taped Duct Connections
- Galvanized Metal Duct
- Reusable Temporary Grout Caps
Protection Level 2

- Corrugated Plastic Duct
- Inspection Port
- Air Tight Intermediate Grout Port
- Air Tight Connection Between Duct and Anchorage Trumpet
- Permanent Grout Cap
- Grout Inlet
- Grout Vent
Personnel Qualifications

- **Direct Supervisor**
  - PTI Level 2 Bonded PT Field Specialist

- **Foreman of Installation and Stressing Crew**
  - PTI Level 2 Bonded PT Field Specialist

- **Foreman of Grouting Crew**
  - PTI Level 2 Bonded PT Field Specialist
  - ASBI Certified Grouting Technician

- **Crew (at Least 25%)**
  - PTI Level 1 Bonded PT – Field Installation
Specification for Grouting of Post-Tensioned Structures
Construction Requirements

• Pre-Grouting

• Post-Grouting
  – Internal Inspection
    • Grout Cap, Behind Wedge Plate, High Points
  – External Visual Inspection: Anchorage and Vent Protection
Summary of Specification for Grouting of PT Structures including Addendum No. 1

- Chlorides: Field testing for acid-soluble chloride ion (Cl\(^-\)) on the mixed grout once per project and minimum every 40,000 lbs.
- Cement variability: Blaine value 300 to 400 m\(^2\)/kg.
- Bleed / segregation: Inclined tube test.
- Constituent materials: Range also given for the Class C (prepackaged grouts).
- Construction procedures: No tendon flushing; grout testing also at outlet; lower pressure.
- Soft grout potential: No aggregates and inert fillers for Classes A, B, and C grouts.
- Corrosion: No additional sulfates
Enhancements under Development
Specification for Grouting of PT Structures

• Robustness – 10% - 15% additional water
• Shelflife/Storage Requirements
• Bag Requirements
• Alternate Cements
• Sulfate Limits
• Checklists for Grouting
Conclusions

• Specs for Grouted PT are available
• Cementitious Grout – over 60 years of experience
  – Inorganic
  – High pH
  – Enhanced Properties
  – Structural Design Advantages
  – Specification Improvements Ongoing
Thank you!

38800 Country Club Drive
Farmington Hills, MI 48331
248.848.3180
FAX: 248.848.3181
www.post-tensioning.org

142 Cimarron Park Loop, Suite F
Buda, TX 78610
512.523.8214
FAX: 512.523.8213
www.asbi-assoc.org