Update on PTI Grouting Specifications

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PTI Grouting Specification

Background

- 2001: Original Specification
- 2003: 2nd Edition
- 2012: 3rd Edition
- Recent Issues
Post-Tensioning Grouting

Key Issues

- High Chlorides
- Grout Segregation/Instability
- Bleed
- Workmanship/Construction Practice
Ensuring Grout Quality

Qualification (Laboratory) Testing

Material & Personnel Certifications and Submittals

Production Testing (QC/QA)

Grout Quality
Qualification Testing

Materials

- **Cement**
  - Blaine Value between 300 and 380 m²/kg
- **Mineral Additives**
  - Densified silica fume shall not be used
- **Admixtures**
- **Aggregates**
- **Water**
  - Potable Water / ASTM C1602
  - Verify chloride content: <500ppm
Performance Criteria

- Workability
  - Setting Time
  - Pumpability & Fluidity
    - Combined sections; use ASTM C939 Modified for both thixotropic and non-thixotropic
    - Efflux time:

- Strength
- Permeability
- Volume Change
Performance Criteria

- Bleed
  - Wick Induced Bleed Test
    - ASTM C940 Modified to use a 1 Meter tube
Wick Induced Bleed Test

New Test Procedure

Old Test Procedure

Height: \( \approx 440 \text{ mm} \)
Diameter: \( \approx 66 \text{ mm} \)

Height: \( = 1 \text{ m} \)
Diameter: \( = 80 \text{ mm} \)
Performance Criteria

- Bleed
  - Wick Induced Bleed Test
    - ASTM C940 Modified to use a 1 Meter tube
  - Schupack Pressure Bleed Test (ASTM C1741)
    - New test pressure and bleed limit for vertical grouting applications (x > 20 ft)
Performance Criteria

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- **Corrosion Resistance**
  - Revised Accelerated Corrosion Test

- **Wet Density**
  - Establish range for maximum & minimum water dosage
Performance Criteria

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- **Corrosion Resistance**
  - Accelerated Corrosion Test updated

- **Wet Density**
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- **Inclined Tube**
Inclined Tube Test

- Includes effects of pressure (deep tendon profile) and strand (filter effect)
- Sized to be representative of the real environment in the duct
Inclined Tube Test
Euronorm EN 445 – “Grout for prestressing tendons – Test methods”, Section 4.4

Prepare and Inject Grout in accordance with Grouting Method Statement

Two Specimens – 5 m Long x 80 mm

12 Strands Each

Grout Each Specimen

Record Air, Water, Segregation at Top at Four Time Intervals (30 min, 1h, 3h, and 24 hour)

Regrout 2nd Specimen after 30 min

Bleed Limit < 0.3%
Qualification Testing

Performance (contd.)

Performance Criteria

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- **Inclined Tube**

- **Trial Batches & Mock-ups**
Performance Criteria

- Trial Batches
- Field Mock-up

> Dissect the test specimen & examine for bleed pockets, soft grout, segregation, or corrosion
Certifications and Submittals

Materials Certifications/ Submittals
- Chloride ion levels of all constituents;
- Shelf life/expiration of admixtures
- Annual Audit of manufacturer’s QC program

Written Grouting Procedures

Personnel
- Carried out by experienced staff and operators
  - ASBI Certified Grouting Technician, or
  - PTI Level 2 Bonded PT Field Specialist (recommended)
- Performed under the control of person skilled in all aspects of grouting
  - Name & furnish proof of experience

Record of Grouting
Minimum Testing per Day:

- 1 - Pressure Bleed Test
- 2 - Wet Density (Mud Balance) Tests
- 1 - Strength Test
- 2 - Fluidity Tests (Flow Cone)
  - One at mixer; one at duct outlet
  - Repeat every 2 hours of grouting
- 1 - Volume Change Test**

** If expansive admixture used
Storage of Materials
- Store per Manufacturer’s recommendations

Flushing
- Removed all references to flushing – Do Not Flush

Grout Injection Equipment
- Use of Recirculation “T” to control pressures

Grouting Operations
- Pumping rate slow enough to avoid air entrapment and segregation; 5 – 15 m/min
- Removed holding pressure for one minute
- Do not elevate pressure
  - Normal 10 – 50 psi;
  - Maximum: 75 psi (thixotropic)
  - Maximum: 1 MPa (145 psi) (non-thixotropic)
Ensuring Grout Quality
Chloride Provisions

- Test more frequently -- at least once per project and a minimum of every 40,000 lbs. of the material
- Independently tested on the trial batch
- Use potable water with <500ppm Cl⁻
- Cl⁻ ≤ 0.08% by weight of the mixed grout
- Provide written certification of Chloride Ion levels of all constituents
- Annual Audit of manufacturer’s QC program
Grout Segregation/Instability Provisions

- Inclined Tube Test
- Modified Wick Induced Bleed Test
- Perform qualifying performance tests whenever any of the materials sources has changed
- Compatibility of admixtures and other constituents
- Test as a system (specific constituents, mixing equipment, pumping pressures and temperature ranges)
- Limits on Cement Blaine Value
- Control Pressure and pumping rate
- Examine field mock-up for bleed, soft grout etc.
- Store per Manufacturer’s recommendations
Bleed Provisions

- Inclined Tube Test
- Modified Wick Induced Bleed Test
- Do Not Flush
- Field Mock-up - examine for bleed pockets
- Wet Density range for maximum & minimum water
- New test pressure and bleed limit for vertical grouting
Personnel Qualifications

- Carried out by workers trained and experienced for the task
- Under the control of a skilled person
- Recommended certifications:
  - ASBI Grouting Certification
  - PTI Bonded PT Field Specialist
PT Grouting
Recommended Action

- Adopt PTI spec. or similar provisions in individual DOT specifications
- Revise AASHTO Grouting Specification
- Consider requiring certification of grouting and inspection personnel
Questions?