TxDOT
PT/Grout Issues

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PT/Grouting Issues

- Chlorides in Grout
- Soft/segregated grout
- Installation/Inspection issues
- Going forward – Design Issues
Chlorides in Grout

5 bents, 5 tendons per bent, 14-19 strands per tendon
Testing Program

- Optical petrography
  - Significant segregation of “A” material
  - Many large air voids
  - Excess moisture present
  - “A” material weak and brittle
  - “B” material appeared normal in strength
### Scanning Electron Energy Dispersive Spectroscopy/ X-ray Fluorescence/ Ion Chromatography

<table>
<thead>
<tr>
<th>“A” material</th>
<th>“B” Material</th>
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</thead>
<tbody>
<tr>
<td>• High levels of Chlorides &gt; 21000 ppm</td>
<td>• Normal hydration</td>
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<tr>
<td>• High Na and K levels</td>
<td>• Cl levels exceed specs (&gt;800 ppm)</td>
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<tr>
<td>• Relatively low Ca levels</td>
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Unused grout (dry): approx 1300 ppm of Cl

2nd lot: very low Cl
Contributing factors

- Grout storage
  - Too long (up to 9 months, past shelf life)
  - Too hot (>120F)
- Mixing/pumping issues
- Several blow-outs reported
- Inconsistent procedures
- “Burping” tendons
- Pumping pressure/speed
Resolution

- Papers and testimony by Bernd Iseke and Paul Lambert (European corrosion experts)
- Good (“B”) grout presence was verified
- All tendons bore-scoped
- “A” material removed and vacuum grouted
- Conservative design (per code) helped
- Long Term testing paid by supplier (ongoing)
National Issue

• “What starts in Texas changes the world”
• FHWA memo dated 11/23/2011
• ASTM C150: no limits on Cl content in cement
• Most suppliers weren’t testing their cement sources (they are now!)
• Suspect grout produced from 2002 to 2010 – 16M lbs of grout that went to 38 states
Secondary Issues

• Grout segregation
  – Mixing/pumping practices
  – Trapped water in system
  – Pumping pressure
  – Burping
Grout Segregation w/o Chlorides
Marble Falls Segmental Bridge

• Diff grout mnfr/grouter
• “gelatinous” grout in top portion
• Segregated
• High concentrations of Na, K, S
• Confined to cap region – did not extend into ducts
Going Forward: Nov 6, 2011 Memo

- Test all grout when on the job – physical and chemical testing
- Watch grout storage: conditions and time
- Restrict pumping pressure/speed
- Disallow burping
- Post-grouting inspection
- 2014 Specs will require PTI certification for all PT operations
Post-grouting inspection
Will TxDOT use PT?

52 years old
$9M in 1959
$50+M maintenance costs
Will be replaced with segmental bridge ~ 2020
Will TxDOT use PT?
PT Design

- If ECR is used on the bridge, use Severe Exposure criteria for PT designs
- Plastic ducts are required per Item 426
- Try to use standard tendon sizes/hardware
- Give plenty of room for jacks,…
- Watch stressing sequences
- New PTI Guide Spec coming soon
Common Tendon Sizes

- Mnfr A: 0.5” x 12, 19, 27, 31, 37 strands
  0.6” x 12, 19, 22, 31, 37 strands
- Mnfr B: 0.5” x 9, 12, 15, 27, 37 strands
  0.6” x 9, 12, 15, 19, 27, 37 strands
- Mnfr C: 0.6” x 12, 13, 19, 22, 25, 27, 31, 37 strands

USE 0.6” x 19
PT Detailing

Simple tendon profile

Complex Tendon Profile

Staged stressing
PT Detailing

• Locate tendons using cg steel
• Give force @ crit location after friction losses
• BRG is working on a PT Standard
  – Will show vent locations,… sim to FDOT
• Show other info (assumed long-term losses) in “Design Notes” on the plans
• Payment – base on force after friction
• Pour-backs
Pour-Backs
Future Specs for PT (2014?)

- Item 426 will be for PT only
- Prestressing will go in 424
- PTI Multi-strand Certification will be required for all operations/installation
- PTI/ASBI Certifications required for grouting