

Detection of Voids, Soft Grout and Tendon Corrosion in Post Tensioning Ducts

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Agenda

- Problem
- Testing Internal & External PT Ducts
 - Process
 - Limitations
 - Accuracy
- Repair Options
 - QA of Repairs

Why Are PT Ducts Filled With Grout?

- Prevents Water and Chlorides from getting to the Strands
- Passivate/Protect the Steel Tensioning Strands
- Bond Transfers Loads to the Structure

Problems

- Voids/Air Pockets in Grout-Expose PT Tendons to Corrosion
 - Bleed Water Voids –re-absorption of bleed water
 - Improper Venting
 - Grout Leaks / Pump Air
- Soft Grout- Corrosion due to pH and Grout Variations
 - Excessive Water in Grout Mix
 - Poor Mix Design
 - Segregation

Testing for Voids and Soft Grout in PT Ducts



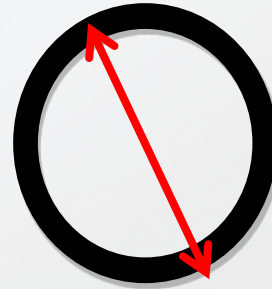
Internal PT Ducts



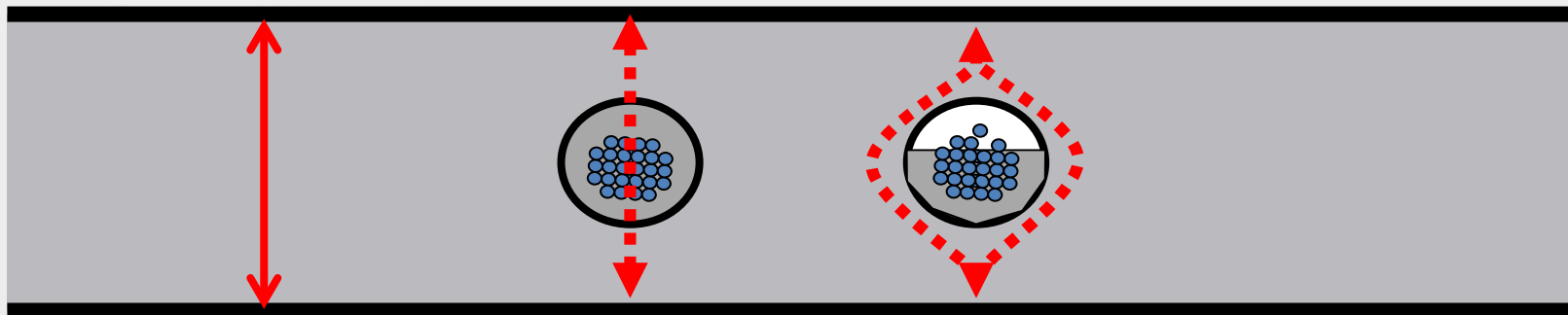
External PT Ducts

Impact- Echo Testing for Voids & Soft Grout

External Tendon Ducts



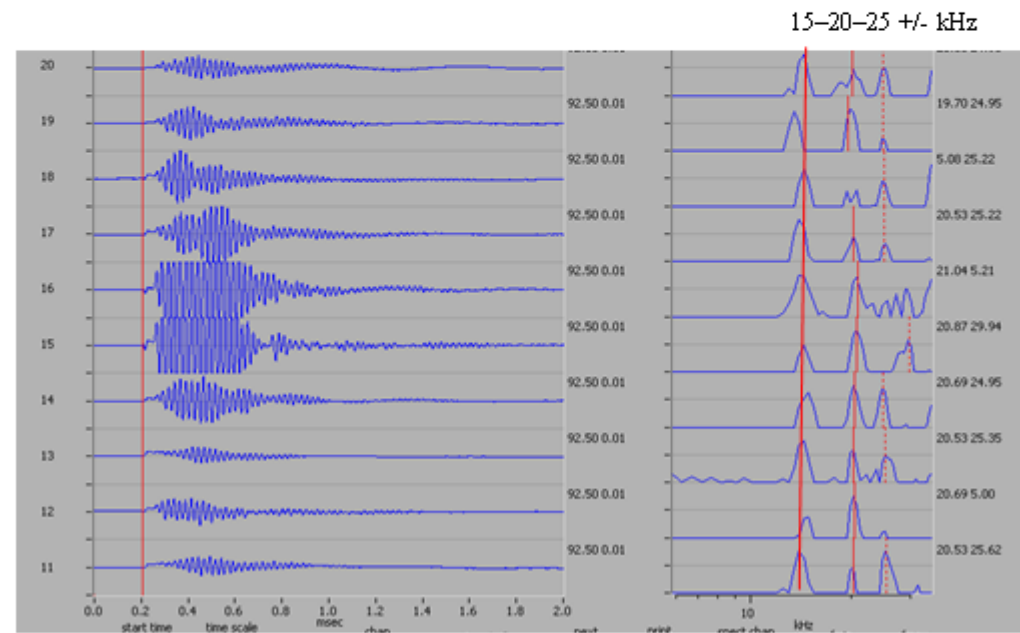
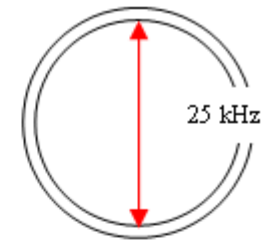
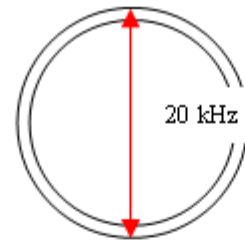
Internal Tendon Ducts



$$\text{Thickness} = \text{Velocity} / 2 \times \text{Frequency}$$



External PT Duct Testing Data



Testing Internal PT Ducts



GPR to Locate PT Duct



Impact-Echo Testing for Voids



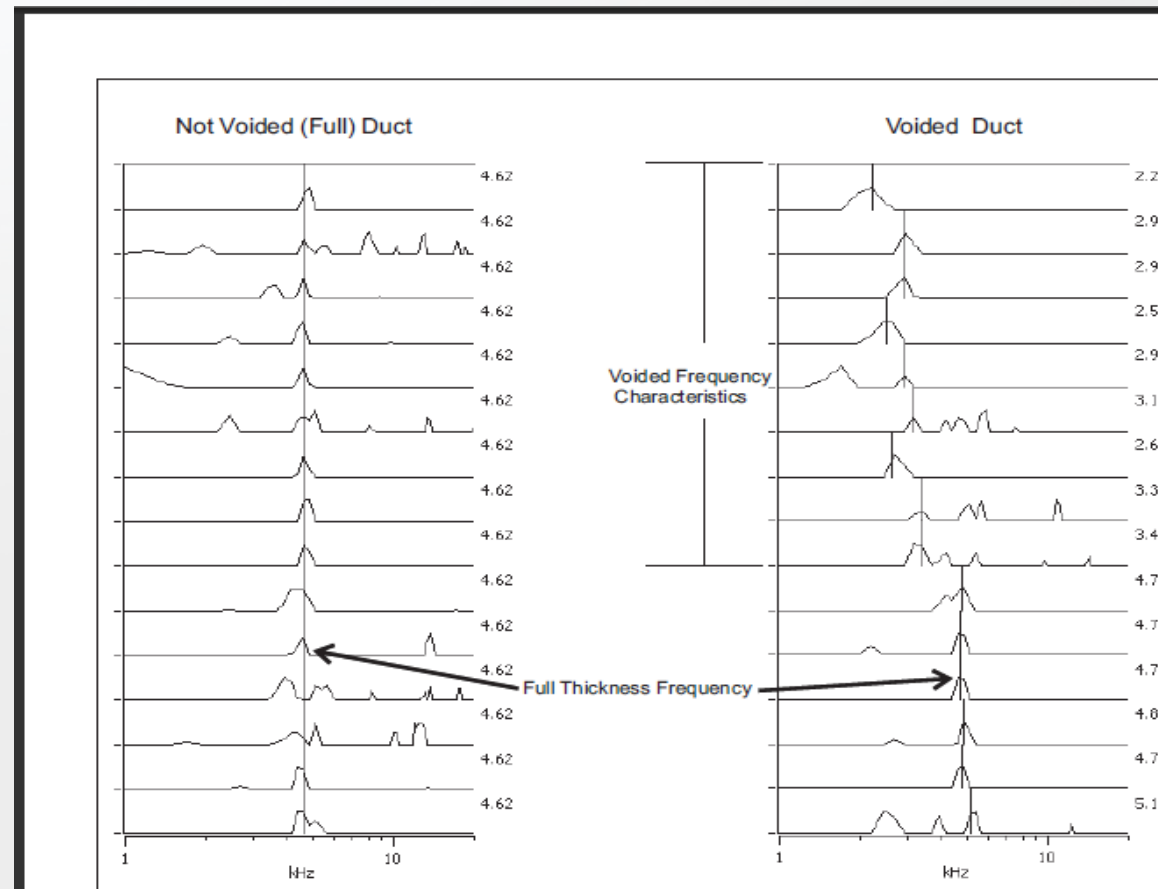
Evaluate Anomalous Impact-Echo Data



Document Internal PT Duct Conditions

Sonic / Ultrasonic Non-Destructive Testing for Full and Voided PT Tensioning Ducts

Sonic/ultrasonic Data



Bore Scope Images



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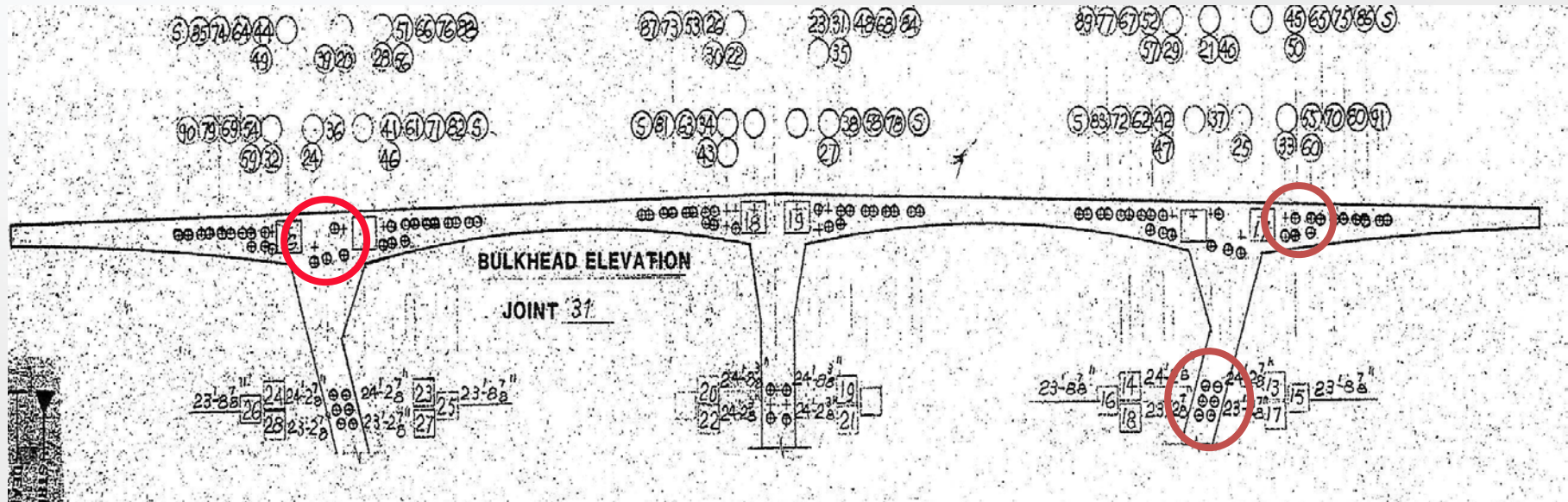
Soft Grout



Limitations – Internal Ducts

- Ducts over Piers or Diaphragms (Duct burial depth versus concrete thickness)
- Asphalt or debonded Wearing Surfaces
- Multiple Ducts (Ducts behind Ducts or Ducts Touching), Cannot Distinguish which Duct is Voided
- Irregular Surfaces





Ducts over webs



Ducts over ducts



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Accuracy of Sonic / Ultrasonic Impact – Echo to Identify Voided PT Ducts

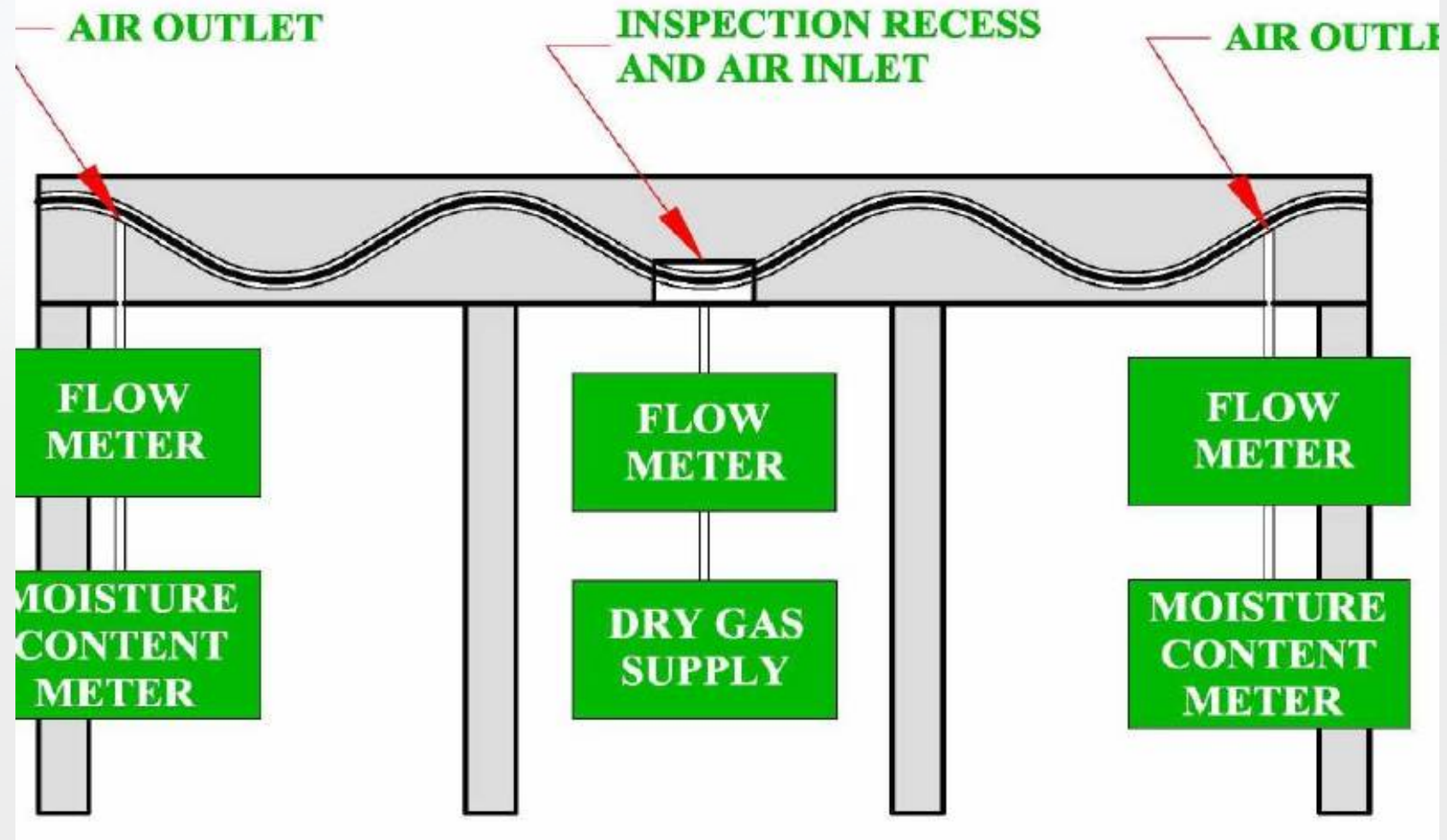
- **Sonic / Ultrasonic impact -echo data indicate full ducts** **98+ %**
- **Sonic / Ultrasonic impact-echo data indicating voids** **95%**
- **Sonic / Ultrasonic impact echo data uncertain** **60%**



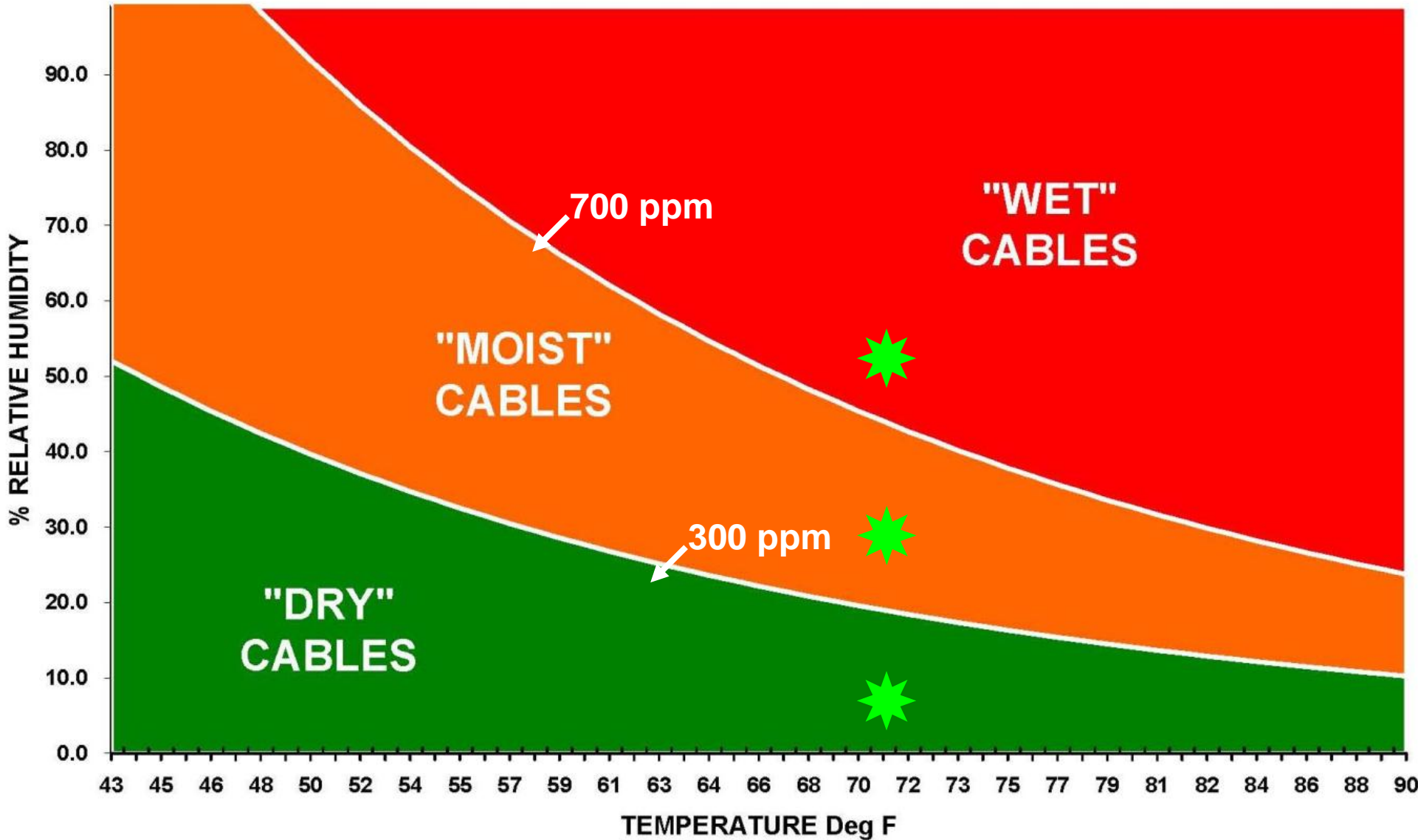
PT Corrosion Evaluation

- Test for risk of corrosion in bonded and unbonded PT tendons

PT Corrosion Evaluation



PT Corrosion Evaluation Grading Chart





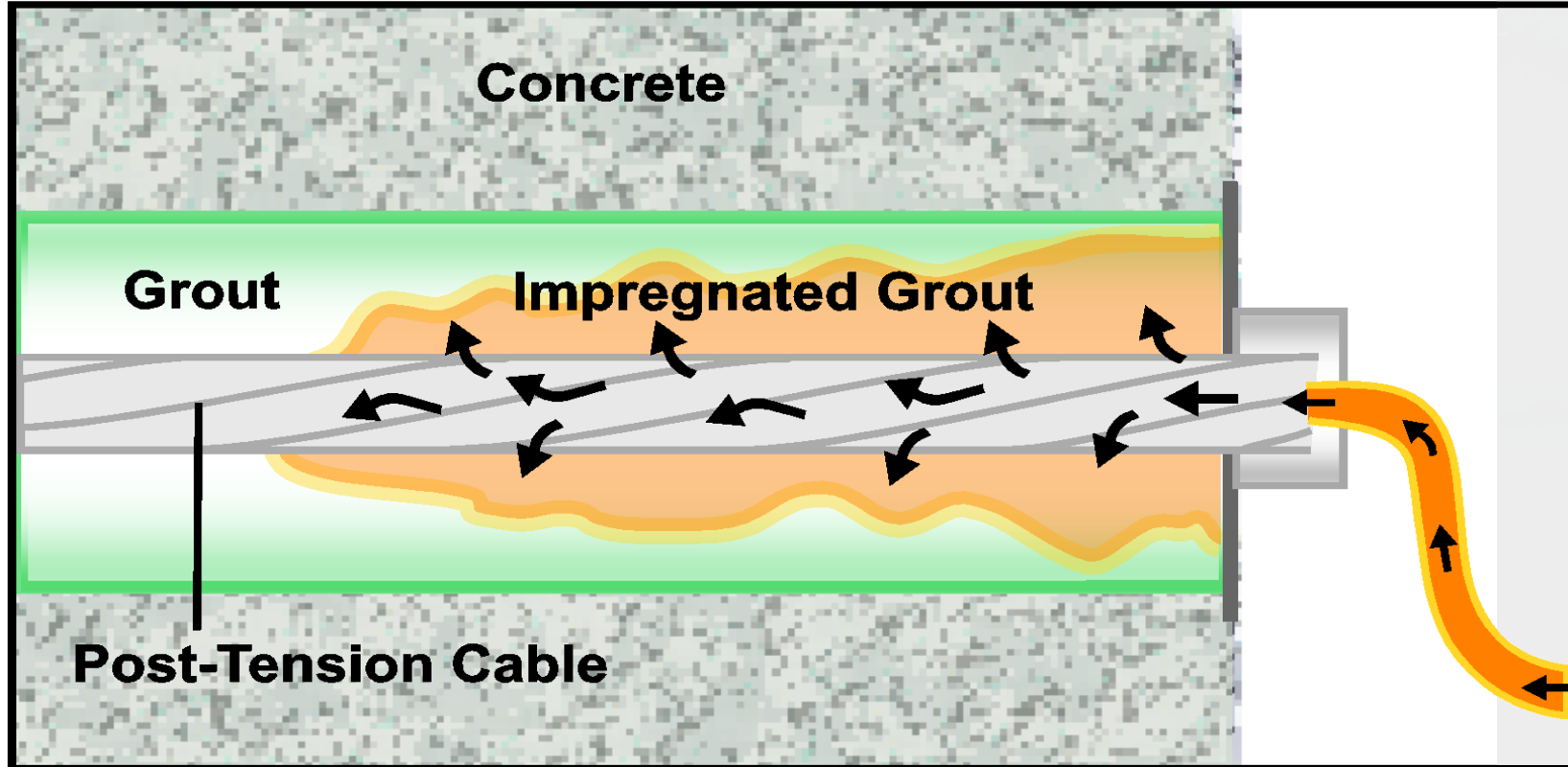
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Options to Repair / Preserve

- Voids
 - Grouting
 - Impregnation
- Soft Grout
 - Drying
 - Impregnation

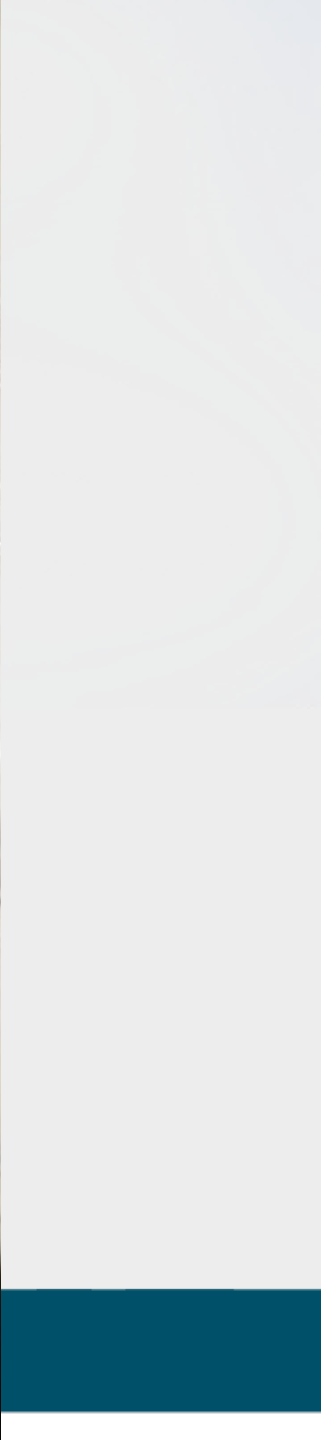






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QA of Grout Repairs

If the volume of grout used to fill voids is considerably less than expected, Impact-echo testing can be used to determine where voids are unfilled

SUMMARY

- Over 20 Years of PT Duct Testing Experience
 - Segmental
 - Cast in Place, and
 - Precast Bridges
- Testing Confirms Condition and Provides Results to Prepare Repair Bid Documents
 - Location of Voids
 - Approximate Volume of Voids
 - Location of Corrosion and Severity
- Grouting Defects and Corrosion can be Mitigated

QUESTIONS??