



NORTH CAROLINA
Department of Transportation



A BUMP IN THE ROAD

What is NCDOT doing about settling bridge approach slabs?

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What is NCDOT doing?

- Working on the issue from 2 sides
 - Design/Construction
 - Revising Approach Fill Details for the 2018 Standard Specs and Roadway Drawings
 - Encouraging MSE Abutments with End Bents on Spread Footings – U-2525C, GRS Pilot Project
 - Maintenance
 - Slab Jacking
 - Embankment Stabilization
 - Ask the right questions
 - “More of an art than a science”

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It is confusing!

- Fluid Cementitious Grout vs. Low Mobility Grout vs. Expanding Polyurethane Foam
- Mud Jacking vs. Deep Injection vs. Permeation Grouting vs. Compaction Grouting
- Fluidity vs. Slump
- Hydrophobic vs. Hydro-Insensitive vs. Hydrophilic
- 2 Part Foam vs. 1 Part Foam with/without a Catalyst

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What has Geotech done?

- Research – What has NCDOT done? What are the options? What are other state DOTs doing?
- Written or Revised Material Specs for Grout (Types 4 & 5) and Foam (Types 1, 2 & 3)


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Hydro-Insensitivity

GTP-9

**TEST PROCEDURE FOR HYDRO-
INSENSITIVITY OF HIGH DENSITY
POLYURETHANE GROUT – PANEL TEST**



GEOTECHNICAL TEST PROCEDURE
GTP-9
Revision #1
AUGUST 2015

Department of
TransportationOffice of
Technical ServicesGeotechnical Engineering
Bureau

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NCFI – Mount Airy, NC



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What has Geotech done?

- Research – What has NCDOT done? What are the options? What are other state DOTs doing?
- Written or Revised Material Specs for Grout (Types 4 & 5) and Foam (Types 1, 2 & 3)
- Created APLs for Grout & Foam and Work Codes for Contractor Prequalification
- Written Spec for Slab Jacking (Bids mud jacking vs. lifting slabs with foam)
- Completed Construction of 2 Compaction Grouting Pilot Projects

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Compaction Grouting

"The design and application of compaction grouting is always site-specific, considering the entire above and below-ground conditions."

Compaction Grouting Delivery Methods

Installation of grout pipe:

- Drill or drive casing
- Location very important
- Record ground information from casing installation

Initiation of grouting:

- Typically bottom up but can be top down
- Grout quality important
- Pressure and/or volume of grout is usually limited
- Slow, multiple stage injection

Continuation of grouting:

- On site backing used and control
- Grout quality important
- Pressure, grout quantity and indication of these are controlling factors
- Separating of slab injection joints very important

Improvement Conditions

Typically grout is 1,500 psi (or higher) and is required to maintain den-sification. Limited densification can be achieved with less overburden. This means one can raise from conventional methods, such as backfill and foundation beds. When densification is the primary intent, a replacement ratio and pressure volume is applied to each stage of compaction grouting. This ratio is determined based on the existing density, the soil density range, and the amount of displacement necessary to affect the improvement.

Replacement Ratio (RR) = Treatment Volume / 3 to 20% (typical)

Experience has proven that treatment spacing should not exceed 4 to 10 ft. From this, a compaction grouting volume can be calculated. The maximum pressure volume permits fraction and ground loss and compensation for soil stress in the treatment area. Vertical stages are usually set at 2 to 3-ft intervals; tighter grid spacing will generally lead to better results.

Quality Control/Quality Assurance

Quality control includes pre- and post-grouting inspection and documentation of the work activity, testing to ensure proper site design and injection rates, and verification of ground improvement where applicable. Ground improvement can be assessed by Standard Penetration Testing, Cone Penetration Testing, or other suitable methods. Once resulting of important grouting parameters has been utilized on suitable projects.

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Low Mobility Grout (Type 5)



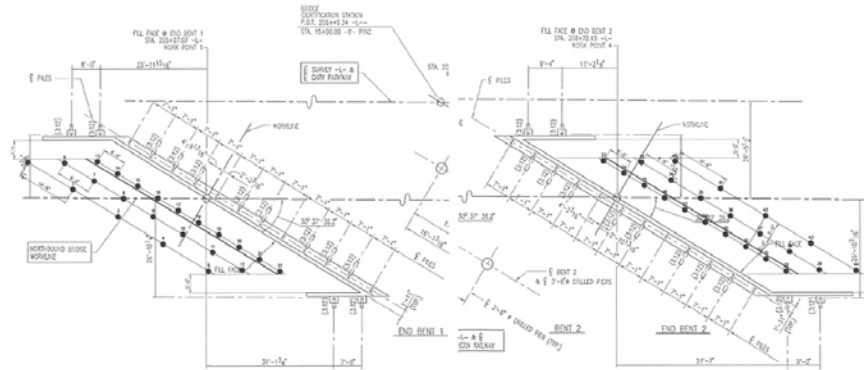
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Cary Parkway Bridges



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Cary Pkwy Bridges



Volumetric Concrete Mixer



Casing



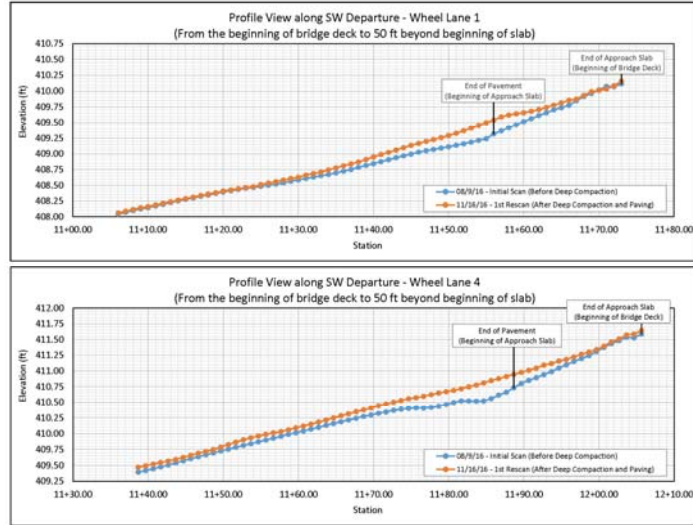
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Compaction Grouting



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LiDAR Scans



Monitoring For Movement



Damage Can Occur



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Slow and Steady Wins the Race



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What Now?



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Lessons Learned

- Does not seem to be a single cause
- Use the right tool
- Borings are strongly recommended for embankment stabilization
- Grout logs are extremely valuable to compaction grouting
- Maybe it is time for a different philosophy/mindset/paradigm?

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Questions?

