The Innovative Use of Compaction Grouting for Ground Improvement and Structure Rehabilitation

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Compaction grouting, otherwise known as Low Mobility Grouting (LMG) is the injection of low slump cementitious grout into weak or soft soil layers throughout a weak soil profile in a primary/secondary pattern in order to **densify the soils for the purpose of increasing bearing capacity, decreasing settlement potential or general ground improvement.**
1. **(Step 1)** Hole is drilled or casing is driven to bottom of proposed treatment zone.

2. **(Step 2)** Compaction grout is then pumped through the casing until one of several refusal criteria have been reached.

3. **(Step 3)** Casing is lifted to the next stage and Steps 1 & 2 are repeated.
• Precise treatment
• **Fast installation**
• Can be performed in very **tight access and low headroom**
• No waste spoil disposal
• Wide applications range
• **Non-destructive** and adaptable to existing foundations
• **Cost effective** alternative to removal and replacement or piling
• Time tested and proven
• Site batching allows for necessary adjustments on the fly to maximize results
IDEAL GROUT MAKE-UP

• Aggregate:
  • 100 % passing 3/8”
  • 15-25% passing #200
  • Rounded pea gravel helps
• 10-20% cement by volume
• Slump is very important – typically less than 2” or 3” for pre-treatment and around 1” for underpinning and piles
QA/QC

- Grout logs for every hole at every one ft stage during production
- Pre-production test program can evaluate improvement
- Pre and Post SPT’s
- CPT’s
- Primary/Secondary nature of the method “notices” improvement between primary and secondary holes
  - Higher pressures
  - Lower grout takes
Karst Related (nature caused)

Culvert/Tunnel/Utility Collapse (man caused)
Emergency Sinkhole Stabilization and Repair Typically Consists of Two Components:

• Backfilling the sinkhole from surface with a flowable fill material often from a ready-mix plant, or material produced with on-site batchers
• Deep compaction grouting into the throat of the sinkhole in order to choke it off so that the flow fill can begin to fill it up
• Once the sinkhole is stabilized, a pattern of compaction grouting can be performed around the sinkhole in overburden soils in order to find and densify and loosened soils and or voids that may not have yet collapsed or propagated to the surface
ROADWAY EMBANKMENT STABILIZATION

Soft soils on fill side of roadway settle over time
Utility Backfill Settlement Treatment and Ground Loss in Tunneling
SETTLEMENT REDUCTION FROM FILL LOADS
BRIDGE APPROACH MITIGATION
RR SUBGRADE TREATMENT
BEARING CAPACITY IMPROVEMENT OF EXISTING STRUCTURES
HISTORIC STRUCTURE STABILIZATION
US HWY 12- COOPER CREEK BRIDGE APPROACH SETTLEMENT MITIGATION WHITE SULPHUR SPRINGS, MT

- Bridge was replaced several years ago
- Approaches started settling immediately afterwards
- Approaches were repaved several times
- Subsequent borings showed loose abutment fill from 10 – 25 ft bgs
• Compaction grouting is being used to densify the soft zones on both approaches to reduce or eliminate additional future settlement
• SPT's are being used to verify densification
• Roadway surface will be milled and repaved following grouting
COAL MINE COLLAPSE MITIGATION
NORTON, VA
MSE Wall Rotated Outward and Settled Immediately After Completion of Construction
Re-Densification of Softened Wall Backfill Material Following Wall Movement

Bearing Capacity Improvement For Wall Load – Original Wall Did Not Bear on Bedrock

MSE Wall Was Stabilized In-Place With Soil Nails
Purpose of the Grouting

› At top of wall
  • Once the wall had been stabilized, compaction grouting was used to densify softened and voided zones that were created as a result of the slope/wall movement in order to reduce future settlement potential of the roadway surface in the following years (decreasing future maintenance costs)

› At base of the wall
  • Compaction grouting was used to increase the bearing capacity of the soil under the wall face and wall backfill within approximately 4 ft of the wall face in order to prevent additional wall settlement and potentially resulting rotation leading to further pavement distress thereby decreasing future maintenance costs
CASING INSTALLATION
COMPACATION GROUTING
WHILE MONITORING INJECTION PRESSURES, QUANTITIES, AND GROUND MOVEMENT
CASING INSTALLATION FOR IMPROVEMENT BELOW EXISTING MSE WALL