



## Galesburg BNSF Railroad Track Sabilization

Compaction grouting was chosen as the repair technique to stabilize soils adjacent to track #4 at the Galesburg BNSF facility. Lincoln Company followed standard industry procedures while conducting the work.

The procedures that Lincoln Company followed resulted in successful soil improvement and included the following:

- Grout mix designed for pumpability
- Low mobility grout with a slump of 0 to 3 inches
- Accurate measurement of grout placement pressures
- Structure and surface elevation monitoring +/- 1/16"
- Accurate measurement of grout volume placed in ground

### Compaction and Injection

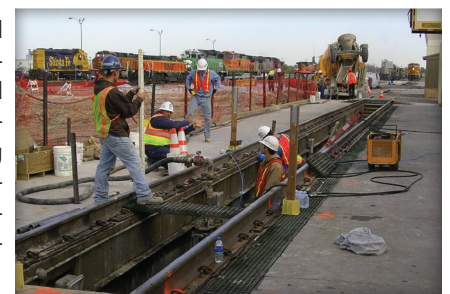
The grout injection pipes were driven to refusal utilizing holes that were core drilled through the reinforced concrete structure. Three rows of grout injection pipes were installed parallel with the alignment of the rail road track and the sheet pile wall retention system. There were six pipes in the first row placed down the center of the maintenance access pit on six feet centers. The grout placement pipes in the second row were offset five feet, parallel to the track alignment, and staggered midway between the first and third rows on six feet centers. The grout placement pipes in the third row were also offset five feet, parallel to rows one, two, and the rail road tracks. All of the pipes were driven to refusal. Refusal depths averaged between seventeen and eighteen feet in row one, eighteen to nineteen feet in row two, and twenty to twenty-three feet in row three.

The high pressure Allentown compaction grout pump was positioned at the north end of the maintenance pit 150'(+/-) from the defined work area. Laser level and string lines were used by Lincoln Company to monitor the pit walls, floor slabs, rail elevation and lateral movement in the sheet pile retaining wall, while River City used optical levels to monitor for track alignment, gauge changes, and elevation control.

The compaction grout material used was a mixture of fine sand, Type I Portland cement and Type C fly ash, and was furnished by Galesburg Builders Supply. The compaction grouting method was controlled and monitored by Lincoln's grouting Superintendent and by the Owners soil testing Technician from Terracon.



*Train over track #4 maintenance pit*



*Pressure and elevation monitoring during injection*

The grout was injected in compliance with a three-fold termination criteria program. The first criterion was volume. A target volume of three cubic feet per two feet injection interval was initially established based on the area of influence of the grout pipe. On secondary holes, the grout volume was unrestricted.

The second termination criterion was injection pressure. Compaction grouting systems are typically capable of applying over 500 psi of injected pressure for 2-inch to 3-inch slump materials at the injection point. Given the nature of the fat clay soil profile and the close proximity to the sheet pile retention system, the termination criteria was established to be between 80 psi to 150 psi maximum at the injection point.

The third termination criterion was surface heave and/or retaining wall movement. Surface movement and wall displacement was anticipated and was expected to range from 1/16" to 1/8" per injection stage. Indication of any movement resulted in the termination of the stage and withdrawal of the pipe to the next stage.

The termination criteria are indicators of onsite conditions. They are routinely adjusted, within limits, as the grouting superintendent and field technical personnel interpret the responses measured in the structure(s).

The process of using compaction grouting to fill voids and densify loose soil zones is a progressive systematic process. The grout placement record for each location provides information as to the soil condition in a treated area. As voids are filled, and as loose soil zones are densified, closure of a treated area occurs. Performance is measured by a reduction in volume of grout placed, an increase in pumping pressure, and may also include an indication of controlled surface movement.

The grouting work performed under and along track #4 followed the pattern of closure expected with this type of ground improvement work. The initial grout placement in row one exhibited easy placement of the target volumes planned with little, if any, back pressure recorded. As the work progressed through the split spaced holes in rows one, two, and three the volume of grout placed varied within expected limits. The placement pressures steadily increased indicating the successful filling and densification of the treated zone. As the grout placement progressed in row three, the volume of grout placed reduced, the pressure increased and lateral movement of the sheeting against the bracing indicated complete void filling and densification of the treated area.



*Train over track #4 maintenance pit*

As the final stage of the last grout pipe injected in row three was in progress, it was observed that the grout placement pressure dropped after two cubic feet of grout were placed. The soils between the sheeting and the concrete platform stem wall had heaved indicating the treated zone was adequately densified and the job completed.

Based on Lincoln Company's experience on similar projects, and our ability to meet the established termination criteria, we are confident that the compaction grouting has increased the density of loosened soils to acceptable levels in the treated areas. It will be important for the Owners and the construction team to continue monitoring the retaining wall for lateral movement. This movement would likely result in the reoccurrence of reduced support for the maintenance pit along Track #4.

### **For more information, please contact:**

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