

MINNEAPOLIS AIRPORT

MINNEAPOLIS - USA

Real time monitoring of the airport hangers protected by compensation grouting during tunnel mining.

Real-time monitoring, consolidation and compensation grouting were performed to successfully protect two airport hangers from excessive settlement during tunnel mining by Earth Pressure Balance Tunnel Boring Machine (EPB – TBM).

During the mining of the South Bound Tunnel considerable difficulties were encountered when the TBM encountered a mixed face condition as it made a transition from sand stone, through a limestone cap into fine sands. Based from the experience gained from the construction of the South Bound Tunnel it was decided to undertake a grouting program prior to and during North Bound Tunnel Mining to protect the airport hangers directly above the mixed face condition from excessive settlement or damage.

A real-time monitoring system consisting of two automated theodolites under computer control and 75 prisms were installed. Complete surveys of critical walls within the two hangers were available at the monitoring computer every 15 minutes. The data were displayed on a plan view via contour lines, instantaneous values at each prism and colour-coded alarms. The system also allowed the time history of individual and groups of monitoring points to be displayed. Consolidation grouting was performed via sleeve-pipe grouting with microfine cement grouts. The grout injection process was controlled and monitored by a real-time computerized system. Vertical and battered holes were drilled from surface to allow treatment of mixed face and a five-foot wide zone above the tunnel. Six lines of holes with rows every five feet were drilled along the tunnel alignment.



Battered holes were required to reach locations underneath the office space within the hangers.

Compensation grouting was performed via battered sleeve pipes installed to target the spread footings underneath the building walls. During tunnel mining it was possible to control excessive settlement by injecting grout to compensate for the ground losses. The compensation grouting process involved two phases.

Prior to tunnelling, a preconditioning grouting program was performed to ensure that subsequent grout injection would cause immediate ground reaction. During this phase regular cement based grout was injected with the computerized control/monitoring system until ground movements of 1 to 2 mm were monitored. During tunnelling, real-time building monitoring data were analysed to control which pipes would be injected. The injection process was controlled and monitored by a real-time computerized system and injection continued until control of the rate and magnitude of the settlement were achieved.

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| CLIENT: | OBAYASHI JOHSON JV |
| DURATION OF WORKS : | 3 MONTHS |
| WORKS DONE : | |
| <ul style="list-style-type: none">• Installation of an automatic monitoring system including:<ul style="list-style-type: none">- 1 automated monitoring total station.- 50 targets.• Real time monitoring, alarms and reporting. | |