MORETRENCH

Ground Freezing

The Deep Freeze at the "Big Dig" Box Jacking

It doesn't get any tougher than this.

The Central Artery/Tunnel Project and new Interstate 90 extension project in downtown Boston, Massachusetts (a.k.a, "the Big Dig") entailed construction of three tunnels, nearly 80 feet wide and 38 feet high, beneath active train tracks transporting 300 commuter trains to South Station, daily. The boxes were to be advanced by tunnel jacking techniques, but of unprecedented size.

One of the many technical challenges faced by construction contractors on the world's largest transportation project was how to stabilize the unsupported vertical face during "tunnel jacking" operations. Tunnel jacking involved pushing a concrete box 78 feet wide, 38 feet high and up to 350 long through saturated, "historic" fill overlaying soft clay. Supporting existing infrastructure residing atop the tunnel sites was critical during this component of the program.

Flexible and Solid.

Ground freezing was selected for use at the tunnel jacking sites because operating transportation systems could continue to run uninterrupted throughout the 19-month project. Inserted from above, closed end freeze pipes were drilled into the earth amidst the train tracks. Mobile refrigeration plants were connected to the series of pipes and circulated chilled calcium chloride brine. The resultant cooling converted in-situ pore water into ice. The ice acted as a bonding agent and increased the strength of the ground.

The operating ground freezing system stabilized the ground and rail lines during construction of three tunnels comprising the Interstate 90 Extension.

Chilled calcium chloride brine was circulated through more than 2,000 freeze pipes.

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Ground Freezing (continued)

The Deep Freeze at the "Big Dig"

The ground freezing technique was particularly suited for this project because the "Big Dig" site was at one time, hundreds of years ago, underwater. Old wharves, jetties, and abandoned buildings were a part of the site's geology. Ground freezing's effectiveness is unaltered in these unpredictable, man-made ground conditions. Additionally, once removed, the ground freezing technique causes no lasting environmental impact. Freezing also provided the greatest degree of assurance that the ground was stabilized.

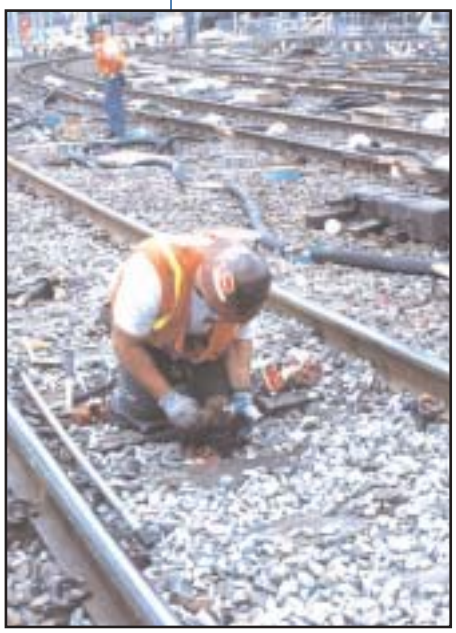
Three massive concrete boxes were jacked under these portions of the rail lines.

*freeze*WALL began each tunnel site stabilization by using computer models to determine the appropriate pipe locations inside the railroad right of way. The locations were critical, as the presence of each switch and underground utility required adjusting. Pipe spacing had to be evaluated, sometimes requiring additional pipes.

The calcium chloride brine was circulated through the freeze pipes four months prior to actual tunnel jacking. Monitoring of ground temperatures at over 400 points ensured adequate stabilization of the ground. The method allowed *freeze*WALL to freeze a block of soil that the tunnel box was driven through. Pipes were disconnected and cut off as the shield progressed.

Going Strong, Freezing Long Gone.

All three tunnels are now complete. All of the tunnel jacking operations were conducted without delays to train schedules and without any uncontrolled loss of ground or seepage. Traffic is expected to begin flowing through the tunnels in December, 2002.



Freeze pipes were installed between the tracks and piped to refrigeration units.

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