

LONG-HOLE DRILLING IN ADVANCE OF TUNNEL PENETRATION

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STATE OF THE ART

Increasing attention is being given to the drilling of horizontal exploratory holes ahead of tunnel excavation so that geological conditions ahead of the advancing face can be known and proper methods and procedures can be set up to handle the excavation, support, and safety of the tunnel. When initial tunnel investigations are inadequate, the need for long-hole drilling is greater for dependable predictions of ground conditions to be encountered during excavation. Even with the best geologic exploration, pinpointing unusual hazardous conditions is difficult. Some conditions that may not show up in initial exploration are fault zones, squeezing or swelling ground, running ground, water, and gas. In addition, proper ground support procedures and methods may not be possible to establish.

At present long-hole drilling is done through the tunnel face or from a cut-out in the side or back of the tunnel. In a tunnel being driven by drilling and blasting, long-hole drilling can be performed from the jumbo during the drill cycle, or it can be done on weekends or on days that the tunnel is not being worked. Both of these methods contain undesirable aspects. Drilling from the jumbo cannot be done far enough ahead of the tunnel face to allow time to properly analyze the conditions to be encountered. Drilling on weekends is expensive, requiring extra backup crews and overtime payments, and cannot be done far enough to stay ahead of tunnel excavation during the ensuing week.

In mechanical driven tunnels, long-hole drilling is done when the mole is not advancing or is done on weekends. The footage drilled during mole shutdown or on weekends is not so effective because of the rapid advance in a mechanically bored tunnel.

Drilling from a niche cut in the side or back of the tunnel can continue independent of the tunnel advance. In a mole-bored tunnel, it is extremely difficult with the present state of the art to keep ahead of tunnel advance and maintain accuracy of hole alignment.

Present methods for drilling long holes in tunnels include

1. Percussion machines, which use jointed steel and take sludge samples;
2. Rotary-percussion machines, which use a diamond drill type of flush jointed rods and take sludge samples; and
3. Diamond drills, which use flush jointed rods and take either sludge sample or core or both.

FUTURE RESEARCH

Faster Drilling

Increased ground penetration with reasonable accuracy by either core drill or plug drilling is important so that tunnel progress is not delayed and yet information is available in enough time to make proper decisions.

Smaller Drills

A smaller drill is needed that could be set up close to the tunnel rib and would not require excessive extra excavation.

Geophysical Methods

Tunnel engineers are failing to take full advantage of geophysical methods. They can be used in drilling long holes from the tunnel face, side wall advance drilling, or drilling holes from the surface. The correlation of geophysical methods from surface and underground holes can be of great help in determining ground conditions ahead of tunnel advance.

Long-Hole Drilling From Moles

Manufacturers of moles should design their machines to allow a center hole so that drilling can go ahead as a separate operation from mole advance. The advantage of the center hole is that the long hole can be drilled a great distance ahead of tunnel advance and the drilling will not interfere with tunnel advance. The long hole could be used for grouting a bad ground area ahead of mole penetration.