MANHATTAN TUNNELS EXCAVATION

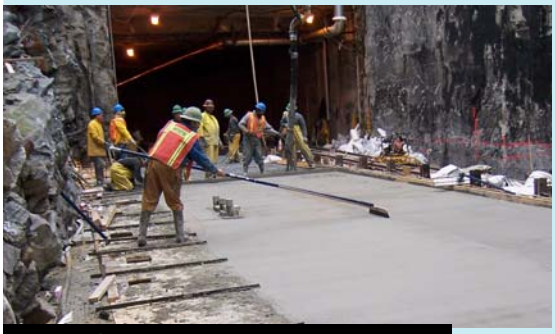
In July 2006, the joint venture of Dragados USA, a unit of Madrid-based ACS Group, and Judlau Contracting of College Point, NY, were awarded the contract for the Manhattan tunnels, a four-year, $428 million tunneling contract.

Pre-Excavation

Before the arrival of the TBMs, the 63rd Street tunnel at the existing bellmouth (opening) in Queens was reframed. For additional support, a concrete invert (floor) was created at the entrance to the Bellmouth.

Rail tracks were installed in the existing tunnel and two TBM assembly chambers, beneath E. 63rd Street and Second Avenue in Manhattan, were mined out of bedrock.

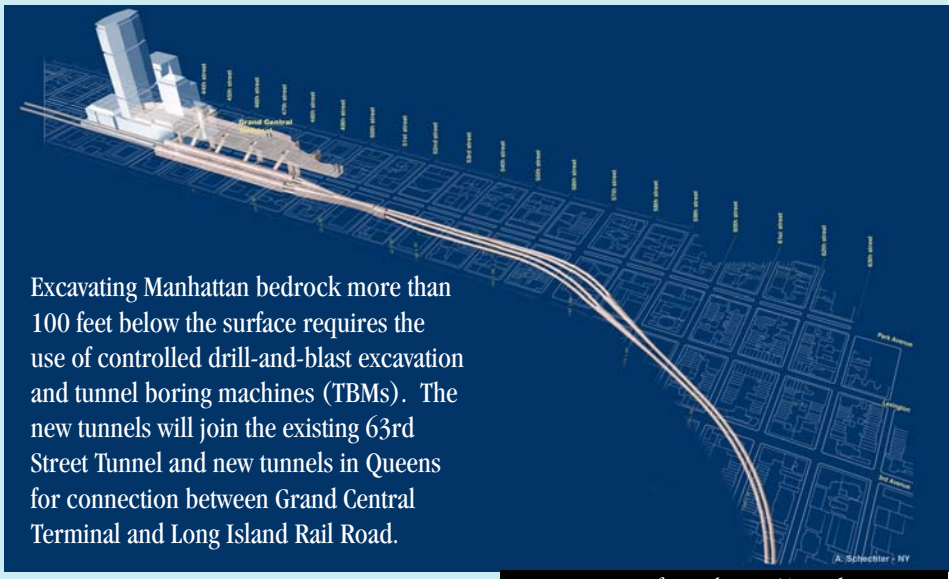
Two TBMs were factory-tested as part of this contract. The first TBM, on its arrival in Queens, was taken into the bellmouth in parts, with some pieces weighing approximately 34,000 lbs. It is now fully assembled with a diameter of 22 feet. The second TBM is currently being assembled in the second assembly chamber.



Laying Concrete Invert

A small locomotive is being used to transport the muck, workers, TBM components and construction materials along narrow gauge rail between the Queens bellmouth and the Manhattan assembly chambers.

A conveyor belt system is now in place extending from the assembly chambers, through the existing tunnel into Queens, and over Northern Boulevard to where the excavated rock material (muck) from the tunnels will be initially deposited in Sunnyside Yard.



Excavating Manhattan bedrock more than 100 feet below the surface requires the use of controlled drill-and-blast excavation and tunnel boring machines (TBMs). The new tunnels will join the existing 63rd Street Tunnel and new tunnels in Queens for connection between Grand Central Terminal and Long Island Rail Road.

Isometric View of Manhattan Tunnels

Pre-construction building surveys are on-going and comprehensive monitoring programs have been established to ensure that vibration, settlement, and tilt levels remain within established thresholds. Community outreach includes e-mail notification, meetings and mailings to keep the residents and businesses apprised of the construction schedule and anticipated effects.

Excavation

Excavation of the Manhattan tunnels by the TBMs will be at a depth of about 140 feet below street level entirely in Manhattan schist. The new tunnels will curve from 63rd Street and Second Avenue to Park Avenue around 57th Street, continuing beneath Park Avenue past Grand Central Terminal (where a new terminal will be constructed under a later contract) to 37th Street and Park Avenue, to allow room for train storage. The TBMs will make multiple tunnel drives. Both TBMs are expected to reach 37th Street in early Spring 2008. Approach tunnels, cross-passages and chambers will also be excavated using controlled drill-and-blast.

Post-Excavation

At the end of tunneling operations, the TBMs will be backed out of the tunnels and disassembled. Cast-in-Place (CIP) lining, concrete arches, and mechanical and electrical systems will be installed in the tunnels.

Tunnel Boring Machine

FUN FACTS

- Manhattan schist is a metamorphic rock formed over 450 million years ago and has an intact strength generally two to three times greater than concrete. The strength of this rock has made possible New York City's famous skyline.
- The conveyor system is comprised of seven linked belts that run 2.2 miles to remove muck.
- The combined volume of rock and soil removed from TBM tunneling and controlled drill-and-blast excavation in Manhattan and Queens, if poured into an Olympic-sized swimming pool, would fill it 400 times.