

# MANHATTAN TUNNELS AND STRUCTURES EXCAVATION

In July 2006, the joint venture of Dragados USA, a unit of Madrid-based ACS Group, and Judlau Contracting of College Point, NY, was awarded the contract for the Manhattan tunnels, a four-year, \$428 million tunneling contract. A second contract was awarded to the same joint venture in February of 2008 for a contract value of \$500 million. That contract is for the excavation of the caverns for the new station.

## Pre-Excavation

Before the start of any excavation, the existing 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.

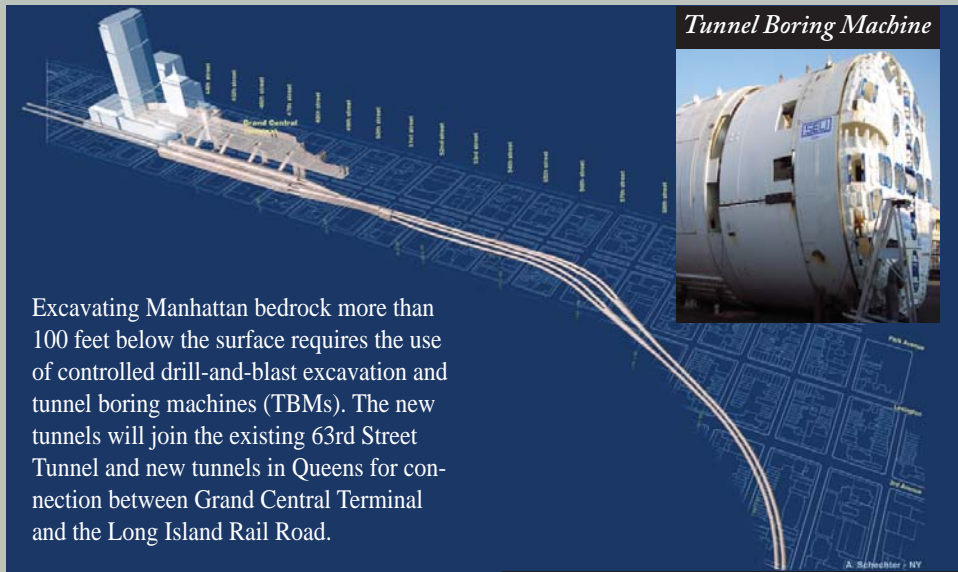
Rail tracks were installed in the existing tunnel and two tunnel boring machine assembly chambers, beneath E. 63rd Street and Second Avenue in Manhattan, were mined out of bedrock.

Two tunnel boring machines, TBMs, were taken into the bellmouth in parts, with some pieces weighing approximately 34,000 lbs. Once fully assembled, the diameter measured at 22 feet.

Locomotives are being used to transport the muck, workers, equipment and construction materials between the Queens bellmouth and the work areas in Manhattan.

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

Pre-construction building surveys have been completed and comprehensive monitoring programs remain in place to ensure that vibration, settlement, and tilt levels remain within established thresholds. Community outreach includes e-mail notifications,



Tunnel Boring Machine

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 the Long Island Rail Road.

Isometric View of Manhattan Tunnels

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 is at a depth of approximately 90-140 feet below street level entirely in Manhattan Schist. The new tunnels 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 is being excavated) to 37th Street and Park Avenue to allow room for train storage.

The TBMs will make a total of 8 tunnel drives. Both TBMs will complete all of their runs in 1st Quarter of 2011. Approach tunnels, cross-passages, shafts and chambers are currently excavated using a combination of methods that include controlled drill-and-blast, roadheader machines and hoe rams.

## 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. Exca-

vation of the station caverns, cross passages and associated shafts and chambers will continue until 2012.

The new Long Island Rail Road (LIRR) and East Side Access (ESA) station at Grand Central Terminal will consist of two mined caverns directly under the existing subway and MetroNorth tracks. Each of the LIRR's eight platform tracks will accommodate 12-car trains. The new concourse level, of approximately 350,000 sq. ft will extend north to south from 48th Street to the main hall of the current terminal at 42nd Street and provide extensive facilities and passenger amenities.

## 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 from the tunnels.
- The combined volume of rock and soil removed from TBM tunneling and controlled drill-and-blast excavation both in Manhattan and Queens would fill 400 Olympic-sized swimming pools.