

**Second Avenue Subway  
72<sup>nd</sup> St. Station Cavern Mining Contract (C-26007)  
Summary Report of August 21, 2012 Incident at Ancillary No. 2**

***Background***

The SSK Constructors Joint Venture (Schiavone Construction Company, J. F. Shea Construction, and Kiewit Corporation) was awarded a contract on October 1, 2010 to mine and/or excavate the cavern, tunnels, ancillary buildings, and entrances for the 72<sup>nd</sup> Street Station for the Second Avenue Subway. In January 2011, SSK began blasting operations for the 72<sup>nd</sup> Street Station and a total of 1,129 blasts have been performed for this phase of the work.

The scope of this contract includes the excavation of a shaft of approximately 74 feet by 74 feet at the surface using drill and blast construction at the site for the Ancillary 2 Building (see figure below). This site will ultimately be an entrance to the subway below and a ventilation facility for the station.



The construction contract is being managed by Parsons Brinckerhoff under a Consultant Construction Management (CCM) contract with MTA Capital Construction (MTACC). The Designer of Record for the Second Avenue Subway Project is a joint venture of AECOM and ARUP (AAJV).

***FDNY Blasting Requirements (Chapter 33 of the NYC Fire Code)***

The New York City Fire Department (FDNY), which regulates all blasting operations in New York City, has stringent regulations regarding permits, qualified personnel, and procedures for blasting operations. Pursuant to these regulations, blasting must be performed under the personal supervision of a blaster holding an FDNY Certificate of Fitness for blasting operations. The blaster is responsible for ensuring compliance with all applicable laws, rules, regulations, permit conditions and blasting procedures. Only a blaster with the appropriate FDNY Certificate of Fitness can initiate a blast.

FDNY regulations on the storage of explosives mandate that they must be under the personal supervision of a magazine keeper holding a Certificate of Fitness for explosive storage. The Magazine Keeper works for the contractor. Each truck delivering explosives must have two drivers at all times who are licensed to handle explosives. The magazine keeper is responsible for opening and closing the truck carrying the explosives and for safeguarding and securing the explosives from unauthorized access. Once the truck is secured, the truck must be within visual contact at all times by one of the licensed drivers.

***Approved Blast Plan for Ancillary 2 Shaft***

The blasting protocol to be followed for the excavation of the shaft at Ancillary 2 was based on a general blast plan (approved by AAJV on July 22, 2011) and an individual blast plan (approved by AAJV on April 4, 2012). The individual blast plan identified 14 areas within the shaft with typical sections for each area. Within each of the typical sections, the plan detailed the number of drill holes, the timing delay and the firing times. This plan detailed three variations that could be used depending on vibration results of the previous blast. An explosive loading guide was also provided for hole depths of 6 – 12 feet which were to be drilled vertically.

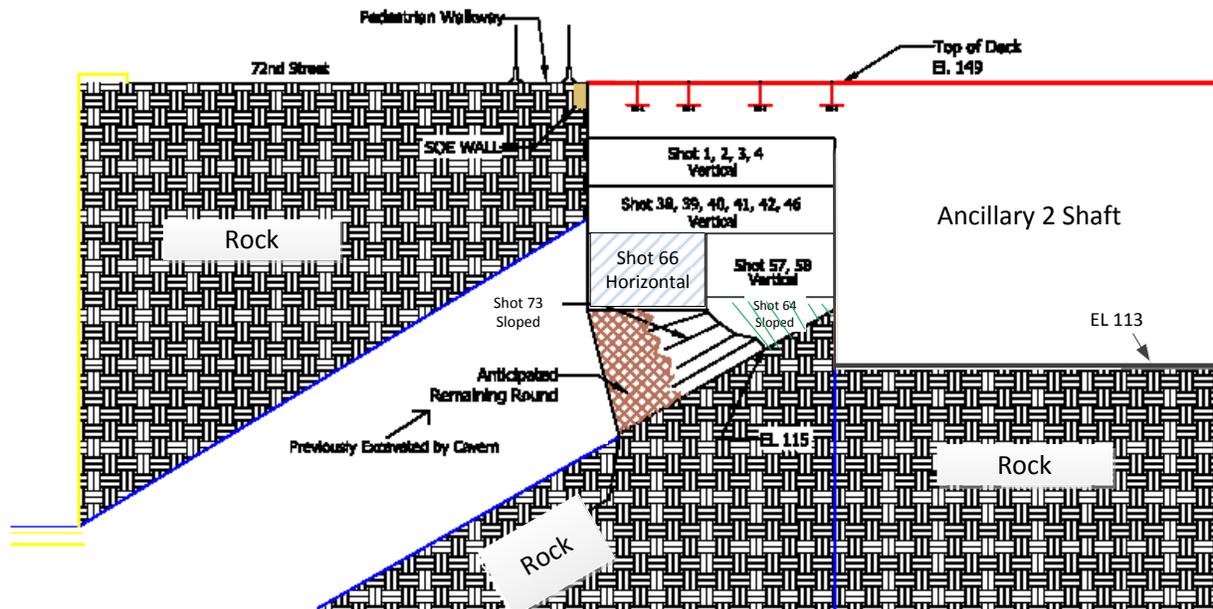
Blasting at this specific location began on April 4, 2012 and 73 blasts have been completed to date. The excavation, which started at the surface, has reached a depth of approximately 35 feet. As the blasting proceeded, blast holes were drilled vertically into rock and the horizontal force of the blast pushed the rock fragments laterally rather than upwards towards the surface.

Note:

Shot= Blast Number

Vertical/ horizontal/diagonal  
=direction of drill hole

### Section View Escalator Excavation Sequence Prior to Shot #73



SSK's method to contain the force of the blast within the work site was through the use of steel plate decking supported by steel girders, approximately 34 feet above the blast location.

#### ***August 21<sup>st</sup> Blast (Shot 73)***

The August 21<sup>st</sup> blast (shot 73) was not consistent with the approved plan.

The drill holes for this blast, and two prior blasts which went off without incident, were not drilled vertically as required under the approved plans (shots #64 and #66). The CCM should have recognized that these three blasts did not meet the requirements of the approved plans and the blasts should not have been allowed to proceed. MTACC's engineer (AAJV) confirmed that the use of angled or horizontal drilling was not contemplated in the approved plans.

If SSK wanted to proceed with this type of drilling, they should have submitted an individual blast plan using sloped or horizontal drilled blast holes for review and approval by MTACC's

engineer (AAJV). Once this plan was approved by AAJV, SSK may have been required to conduct test blasts prior to starting full production blasting with the use of horizontally or vertically drilled blast holes.

In reviewing the post blast data from the August 21<sup>st</sup> blast, the following factors contributed to the release of fly rock:

1. Improper blast timing sequence causing excessive blast force.
2. Orientation of the drilled holes, which were inclined (i.e. angled) rather than vertical.
3. Use of 10-12 foot long blast holes which may have not been drilled properly (i.e. in parallel).
4. Sloped condition of the rock and inadequate rock cover.
5. Failure of the decking system to contain the fly rock.

The unanticipated focus of blast energy upwards, rather than horizontally caused the shifting of two sections of the steel deck plates. This resulted in the release of rock, smoke and dust from the shaft into the 72<sup>nd</sup> Street road surface and the surrounding public area. The steel decking system that SSK used to prevent fly rock from exiting the shaft, did not consider the uplift pressure caused by the use of non-vertically drilled blast holes. Furthermore, the steel plates were not fully anchored to the steel girders and concrete support wall.

No injuries were reported. The property located at 260 East 72<sup>nd</sup> Street, to the south of the blast, sustained damage to three windows on the street level commercial property and two windows above street level (one on the second and one on the third floor).

Immediately after the blast, MTACC ordered SSK to halt all construction work and MTACC initiated an investigation of the blast and safety review of the work area. The safety review revealed a number of safety deficiencies which have all been corrected by the contractor. SSK was allowed to resume non-blasting work on August 27<sup>th</sup>.

### ***Corrective Actions***

The corrective actions highlighted below will be implemented by each of the organizations responsible for the safe performance of the contract work at the 72<sup>nd</sup> Street construction site. These measures must be in place before any blasting activities can be resumed.

#### ***SSK***

- The license for the Blaster-In-Charge has been suspended and a new licensed blaster will be utilized.

- A superintendent will check that the blast area has been prepared in accordance with the approved plan and sign the pre-blast checklist. This will include checking all drilled holes in their final state for diameter, depth, orientation; and provide a completed checklist to the CCM prior to proceeding with any blast operation.
- A second licensed blaster will be required for each blast to verify that the blast has been prepared in accordance with the approved plan.
- The blast plan must be documented with each individual blast.
- The steel decking system must be supported by design drawings and calculations demonstrating its ability to withstand uplift pressure.
- For all blast events in ancillary and entrance shafts, a minimum of a double layer of overlapping blast mats must be used over the blast area.

### *CCM*

- Reorganize and strengthen the CCM's ability to inspect and monitor blasting activities.
- All inspection personnel monitoring blasting activities have been retrained.
- Any deviation from the approved blast plan must be in writing and approved by the Engineer.
- No blasting will be allowed to commence until all documents for the blasting operation are in place, reviewed and approved.
- Inspectors will ensure that all pre-blasting operations proceed in accordance with the approved Individual Blast Plans. This includes the inspection and verification that documentation received from the Contractor's Superintendent confirms all the holes are drilled and loaded in conformance to the approved blast plan.

### *MTACC*

- An independent consultant (Thacher Associates/Total Safety Consulting, LLC) has been retained to provide technical expertise and monitor compliance with applicable safety standards relating to blasting.
- MTACC program management and quality assurance oversight will target future reviews to confirm all blasting operations are conducted in accordance with the revised protocols/requirements.

### ***Resumption of Blasting***

- New blasting protocols have been established and are in place.
- All managerial changes needed to resume blasting safely have been made.
- SSK will be permitted to resume blasting first in the cavern, then in the shaft.