2016 Honorable Mention

Mexico City Deep Sewer Rehabilitation with Shotcrete

By Raúl Armando Bracamontes Jiménez

Mexico City's deep drainage system is a complex underground network composed of a series of tunnels designed to convey sewage and storm water to discharge and treatment facilities. The system covers almost 125 miles (200 km) of tunnels. Construction on this deep drainage system began in 1967, with its first phase concluding in 1975.

Fig. 1: Initial conditions—note deterioration at the top of the drainage tunnel

Fig. 2: Surface prepared and supplemental reinforcement in place ready to cover with shotcrete

Evaluation of two of the interceptor lines found significant damage to this concrete tunnel primarily in the top quadrant of the tunnels. Exposure to corrosive gases from the sewage and storm water contributed to this damage. The two interceptor lines were 16 ft (5 m) in diameter and had 11 access "ports," which totaled 11 miles (18 km) in length. Additional problems included thinning of the walls of the channel from chemical attack and corrosion from the reinforcing steel.

The repair process started with hydrodemolition to remove the damaged concrete, then preparing the remaining concrete surface, placement of a corrosion inhibitor on the existing reinforcing steel, placing a new layer of supplemental steel reinforcement, and applying a 6 in. (150 mm) thick shotcrete layer to reinforce the existing drainage sections in the upper middle of the tunnel.

For the placement of the shotcrete, we had a concrete pump at the ground surface to pump concrete from the surface up to 4900 ft (1500 m) below ground to a second pump that discharged to the final shotcrete delivery hose and nozzle. We opted for a robotic application to increase

Fig. 3: Shotcrete equipment in position within the tunnel

Fig. 4: Shotcreting operation

Fig. 5: Final job

productivity and placed an average of 210 yd^3 (160 m^3) of shotcrete daily.

In the below-ground locations, we used a Putzmeister Spraymobil PM400 with a diesel engine. The repairs were performed before the start of the rainy season and we worked 24 hours a day. Once the rains began, the tunnels would be flooded, regardless of equipment or materials. The ease of use and deployment of the shotcrete process, as well as proper surface preparation, allowed us to complete the job with a successful and durable application before the rains began.

***Raúl Armando Bracamontes Jiménez**, Ing., graduated from ITESO University (Instituto de Estudios Superiores de Occidente) in 1994 with a degree in civil engineering and has been working in the concrete industry ever since. Currently the owner of ADRA Ingeniería S.A. de C.V. since 2005, he is fluent in Spanish and English with multiple publications and courses given on shotcrete on his résumé. He is an ACI Certified Wet-Mix Nozzleman and Approved Examiner. Bracamontes is a member of Instituto Mexicano del Cemento y del Concreto (IMCYC), Colegio de Ingenieros Civiles de León (CICL), and the American Shotcrete Association.*

HONORABLE MENTION

Project Name
Mexico City Deep Sewer Repair

Project Location
Mexico City, Mexico

Shotcrete Contractor
ADRA Ingeniería S.A. de C.V.

General Contractor
Ingenieros Civiles Asociados

Architect/Engineer
Raul Bracamontes

Material Supplier/Manufacturer
Putzmeister Shotcrete Technology*— Cemex Cemento

Project Owner
Ingenieros Civiles Asociados

*Corporate Member of the American Shotcrete Association