PROJECT PROFILE

GEOTECHNICAL ENGINEERING FOR LIGHT RAIL TRANSIT SYSTEM

D'Appolonia provided geotechnical engineering consulting services, prepared designs and provided construction management services over a ten-year period for the construction of a light rail transit (LRT) system connecting metropolitan and south suburban Pittsburgh, PA. The LRT system included both above-ground and below-ground components with the below-ground (subway) segments located in downtown Pittsburgh and suburban commercial districts.

Braced excavation for construction of the Gateway Center subway station in Pittsburgh.

The project scope of work included construction of a subway requiring deep excavations in the central business district of Pittsburgh under two major streets with adjacent high-rise structures. Design considerations for this portion of the system included protection of large buildings adjacent to 40-foot-deep excavations, control of ground water in the sand and gravel soils that were recharged by the nearby Monongahela and Allegheny Rivers, and maintenance of busy Pittsburgh street traffic during construction.

The LRT system also included construction of twin-tube tunnels in rock (18 feet in diameter and 2,500 feet in length) under the main business district of Mount Lebanon, PA located to the south of Pittsburgh. Construction of these tunnels was an extremely sensitive issue in that they passed within 50 to 100 feet of many buildings with historic significance and the tunnels were only 200 feet in elevation above abandoned coal mine workings. D'Appolonia conducted an extensive subsurface exploration study to define and characterize the subsurface stratigraphy and the effects of surface and subsurface constraints on these tunnels.

A preliminary study of tunneling and support alternatives was undertaken to evaluate the feasibility of using tunnel boring machines, road headers or drill and blast techniques for rock excavation. A similar study was performed to evaluate rock bolts, shotcrete and steel mesh, steel sets or combinations thereof for initial support. The possibility of mixed-face conditions near the portals, the possible presence of methane gas, and the influence of tunneling operations on sensitive structures above the tunnel were important considerations in selecting alternatives .

Subsurface exploration studies carried out for the LRT project included soil and rock sampling using vertical and inclined boreholes to identify stratigraphy and the orientation and frequency of discontinuities, borehole camera surveys to detect subsidence of the abandoned mine workings below the tunnels, borehole geophysical exploration to define subsurface stratigraphy, seismic cross hole testing to characterize rock mass behavior, and in-situ permeability tests. Geotechnical and analytical laboratory testing was performed to determine the strength of intact rock and rock discontinuities for tunnel support requirements, soil strength for stability considerations near the tunnel portals, and ground water chemistry. Also, an extensive instrumentation program for monitoring ground movements and vibrations was implemented.

Soldier pile and concrete lagging retaining wall along LRT above-ground alignment.