

Design of Initial Support Required for Excavation of Underground Cavern and Shaft from Numerical Analysis

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ABSTRACT

Excavation of underground cavern and shaft was proposed for the construction of a ventilation facility in an urban area. A shaft connects the street-level air plenum to an underground cavern, which extends down approximately 46 m below the street surface. At the project site, the rock mass was relatively strong and well-defined joint sets were present. A kinematic block stability analysis was first performed to estimate the required reinforcement system. Then a 3-D discontinuum numerical analysis was conducted to evaluate the capacity of the initial support and the overall stability of the required excavation, followed by a 3-D continuum numerical analysis to complement the calculated result. This paper illustrates the application of detailed numerical analyses to the design of the required initial support system for the stability of underground hard rock mining at a relatively shallow depth.

1. INTRODUCTION

The Long Island Rail Road (LIRR) provides passenger service from 10 branch lines on Long Island through the Amtrak tunnels under the East River to the west side of Manhattan into Penn Station in New York City, NY. The East Side Access (ESA) Project will enable the LIRR to provide direct service to the east side of Manhattan. As part of the ESA project, the construction of a ventilation facility was proposed on East 55th Street. The facility consists of a traction power substation and tunnel ventilation plant beneath East 55th Street on the west side of Park Avenue in New York City. The construction of the street-level air plenum was planned to be performed using cut-and-cover methods to approximately 9.1 m (30 ft) below the stress surface. A 12.2 m (40 ft)

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