Microtunneling Technology Benefits Port Authority of New York and New Jersey

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A large percentage of U.S. roadways were built before 1950. In the ensuing decades there have been steady increases in both the number of vehicles that travel these roadways and total travel mileage. As a result, traffic densities in urbanized areas have reached all-time highs. In these areas, traffic disruptions caused by activities such as construction and rehabilitation of highways, accidents, and installation of utilities have major impacts on mobility and on the local economy. The same is true for other transportation facilities, such as airports and railroads.

Problem

Open-cut methods are typically used to install subsurface utilities. However, the disruptions associated with open-cut methods are often unacceptable for public transportation facilities such as major highways, railroad tracks, and aircraft runways.

During the redevelopment and expansion of John F. Kennedy International Airport (JFKIA) in New York, it became necessary to install utilities under existing runways and taxiways. Use of open-cut methods would have caused major disruptions to airport operations, with significant adverse economic consequences for the airport operator and the airlines. The Port Authority of New York and New Jersey (PANYNJ) needed an alternative method for installation of utilities that would cause minimum or no disruptions to airport operations.

Solution

Trenchless technology is an emerging technique for installing conduits beneath roadways, railroads, airport runways, and buildings without open cutting. The technology has been developed and used extensively in Europe and Japan. During the past two decades, government-sponsored research in Japan has assisted the tunneling industry in perfecting the development of small- and large-bore equipment for soft-ground tunneling.

Microtunneling is one of several types of trenchless construction techniques. The technique involves use of a remotely controlled, guided pipe-jacking process that provides continuous support to the excavation face. Microtunneling systems developed in Japan permit pipe casings to be jacked into place safely under a wide variety of subsurface conditions. Casing sizes typically range from 0.9 to 2.4 meters (3 to 8 feet) in diameter, with the casing being made of either steel, reinforced concrete, or fiberglass. Once the casings have been installed, the utilities can be pushed and/or pulled into them.

Microtunneling technology was first applied in the United States in 1983. PANYNJ conducted a literature search, which revealed that as of 1989, 14 U.S. microtunneling projects had been successfully completed. PANYNJ determined that microtunneling was a safe alternative method for installing steel casings with a diameter of 0.9 meter (3 feet) at a depth of 4.6 meters (15 feet) under an active runway at JFKIA.

Application

The subsurface profile at JFKIA typically consists of 3 to 3.7 meters (10 to 12 feet) of hydraulic sand fill overlying 0.9 to 3 meters (3 to 10 feet) of organic material and a minimum of 30.5 meters (100 feet) of medium-density glacial sands. PANYNJ's subsurface investigation along the planned alignment indicated the absence of organic deposits and the presence of groundwater at a depth of approximately 1.5 meters (5 feet). Hence, all jacking operations would be in cohesionless material.

In April 1991, the microtunneling work began while airport operations continued without disruption. Three runway crossings, each 152 meters (500 feet) long, were completed in 18 days (24 hours/day operation). It was essential to verify that the microtunneling activity had not adversely affected the supporting capability of the subsurface soils under the runways. Hence, the spectral analysis shear wave technique, a noninvasive method, was used to determine the density of the soil before and after microtunneling, both along the alignment and outside the zone of influence. Similar assurance for the taxiways, parking apron, and other areas was obtained by measuring crosshole shear wave velocities. Comparison of such measurements ensured that the microtunneling had had a minimal impact on the condition of the subsurface materials.

Benefits

At JFKIA, all estimated direct costs were the same for similar-size microtunneling and open-cut projects. However, microtunneling significantly reduced construction time and caused minimal service disruptions as compared with open-cut techniques. The latter techniques were estimated to have required approximately 42 days, during which airport operations would have been disrupted, whereas the microtunneling installation of conduits took 18 days and resulted in no disruption to airport operations. It may be noted that a runway shutdown at JFKIA is estimated to cost the airport and airlines up to $1,000,000 per day, depending on the number of canceled and diverted flights. Circumventing the runways using open-cut techniques was also considered; however, this approach would have required significant increases in the length of the conduits, resulting in a major adverse impact on both cost and schedule.

Since 1991 PANYNJ has used microtunneling several times to install utilities for various projects at JFKIA, including a water main 404 meters (1,325 feet) in length—a world record in 1994. The technique has also assisted other organizations in designing installations of power and communications cables across railroad tracks with no disruption to operations.

In sum, microtunneling causes minimal disruption to transportation operations and results in significantly reduced construction schedules as compared with traditional methods. The technique causes minimal impacts related to traffic delays, pavement life and maintenance costs, accidents, environmental impacts, and local businesses.

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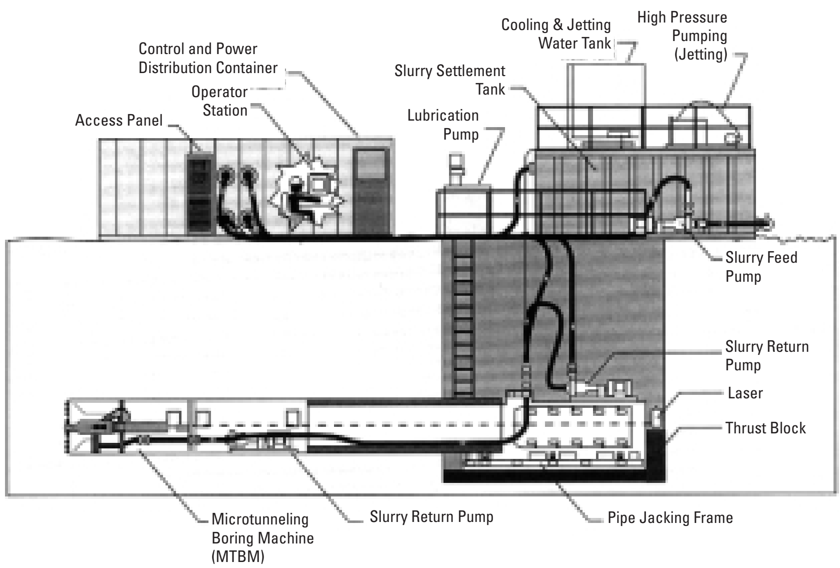

Basic components of a microtunneling system.

NCHRP Synthesis of Highway Practice 242

Trenchless Installation of Conduits Beneath Roadways

This report of the Transportation Research Board provides additional information on microtunneling technology. The report describes the trenchless installation technologies (methods, materials, and equipment) currently employed by state departments of transportation and other agencies to install conduits beneath roadways. The information was obtained from a review of the literature and a survey of transportation agencies. For each technology identified, the range of applications, basis for technique selection, site-specific design factors to be considered, relative costs, common environmental issues, and example specifications are described. In addition, information on emerging technologies and research needs is presented.