BRIERLEY ASSOCIATES
Creating Space Underground

In Depth
Spring, 2021

Microtunneling in the Tropics

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As I toured the entry pit area again, watching the microtunnel machine moving subtly forward, the mid-day heat and humidity were nearly debilitating. Knowing conditions for the microtunnel crew working down in the pit and tunnel entrance were certainly more uncomfortable than my own didn't make me feel much better. Surgical masks worn full time were a field requirement as a measure against Covid spread, and they made every breath harder. We were installing a microtunnel in Acajutla, El Salvador and it was Thanksgiving Day 2020. As the only American on the project site working alongside Europeans from at least a dozen countries and Latinos from most of Central America, I knew there was not going to be a turkey that night for dinner. But later back at the hotel a delicious, fresh seafood pasta with avocado, tropical fruits, tres leches cake and coconut water did ease that burden.

Rock face cliff in the vicinity of the microtunnel.

The project goal was to install a 24-inch (61-centimeter) diameter high pressure gas line and fiber optic communication line from offshore back to shore as part of a built-from-scratch marine LNG receiving terminal and shoreside gas-fired power plant, moving El Salvador towards a future mix of greener energy. Brierley Associates was retained by the project Owner and reviewed several tunneling methodologies including HDD and Direct Pipe before recommending a microtunnel approach to allow interventions, if required. Brierley provided geotechnical and geological design inputs, prepared summary documents on the anticipated geology,

Microtunnel Entry Pit Area

Cuttings piles showing mix of sand piles (separated by gravel), with fines separated out in background.

reviewed and commented on Contractor provided design documentation, and now in the final step was onsite as Owner Representative to oversee the microtunnel construction.

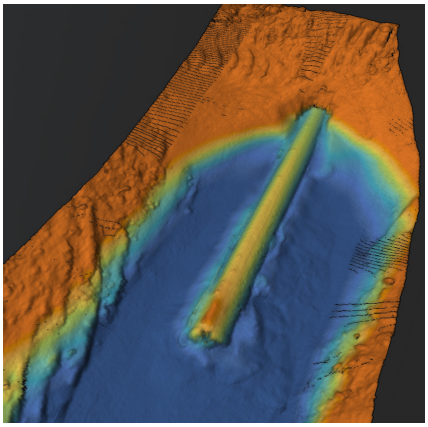
Challenges to deliver the gas and fiber optic lines beneath the protected surf zone and a 15-meter cliff face were compounded by a volcanic debris avalanche deposit consisting of hard basalt rock fragments and blocks from 2.5 centimeters to 3 meters diameter, strewn randomly through weakly cemented sandy volcanic ash.

The deposit was likely laid down during a single volcanic eruption that occurred up to 57,000 years ago and traveled at least 40 km from the source within the crater of the Santa Ana Volcano.

To accomplish this mission reinforced concrete jacking pipe (RCJP) joints, each about 2.85 meters long and 2.12 meters diameter, were installed as a casing pipe and served as the conduit to pull the gas and fiber optic lines through from landside to offshore. The entry pit was a solid concrete structure 9.4 meters deep, 12 meters long and 7 meters wide. The exit pit was a dredged hollow about 5 meters deep within the seafloor, over 550 meters from the entry pit. Four curves in the design route made maintaining the microtunnel line and grade more challenging. Making the successful installation would be a world-class achievement.

The Microtunneling Contractor, a multinational Italian firm working for large Dutch marine General Contractor, excavated the microtunnel using an AVN closed slurry MTBM system manufactured by Herrenknecht. A total of 188 individual pipe joints, including five Intermediate Jacking Stations (IJS), were installed.

Tunneling commenced on November 17, 2020. As the days of Thanksgiving edged into December and towards the Christmas holidays, crews worked 24/7 to try to get the microtunnel completed as quickly as possible - it represents the critical path for the power plant to come online in late 2021. By December 10th finishing the tunnel before Christmas appeared to be an unlikely scenario due to lower tunneling advancement rates during the initial start-up phase. However, after that date the MTBM, the slurry pump mix and the hard-working crews putting in two 12-hour shifts in the muggy conditions began to tame the geology. In turn, the ground conditions began to cooperate.



Multibeam echosounder record of MTBM and first couple reinforced concrete jacking pipe (RCJP) dead center within exit pit.

Production increased significantly and reached a maximum of 36.8 meters of installed tunnel in a 24-hour day on December 13th, and thereafter rarely dropped below 25 meters production per day.

During the day shift on December 19th the MTBM squeezed into the exit pit over 550 meters from the entry pit, and high-quality marine survey equipment towed from a local vessel confirmed that it had hit its mark almost perfectly, within just millimeters of the design location.

Shortly thereafter, I wrapped up my onsite responsibilities and boarded a plane for home in time to spend Christmas with my spouse and children. I reflected on how lucky I am to be a part of the Brierley Family, able to work on a world class microtunnel project in a geologic and physiographic setting not often encountered, and in a part of the world seldom explored.

Light at the end of the microtunnel, morning of December 20, 2020