



# Deep Foundations

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## Ground Freezing Successes in Taiwan



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# DFI 2022 Outstanding Project Award Winner: Mosul Dam

The Mosul Dam Rehabilitation Project by Trevi



Over the last two decades, DFI has recognized superior work performed by its members on projects related to their geotechnical, deep excavation and deep foundation aspects. This year's Outstanding Project Award is the Mosul Dam Rehabilitation Project, in Iraq, submitted by Trevi. The award is being presented at DFI's 47th Annual Conference on Deep Foundations in National Harbor, Maryland, October 4-7.

The Mosul Dam on the Tigris River dates back to the 1980s and is the largest in Iraq at 113 m (371 ft) tall and 3.65 km (2.3 mi) long. Even during the construction phase engineers were aware of the foundation's weak rock, mainly marls and limestones, and contractors encountered cavities during excavation. Due to political and schedule pressures, the work continued. Despite extensive grouting efforts, water seepages started immediately after commissioning the dam.

Fast forward to March 2016, Trevi took over the contract to perform maintenance grouting, along with training the owner's personnel and rehabilitating the bottom outlet tunnels through electromechanical work and diving operations.

The works included a double grout curtain line along the dam's axis, from both the grouting gallery and the crest (between spillway and fuse plug), and a single grout curtain line along the eastern side of the spillway (from grout lines on the crest to river). Trevi used diesel crawler-mounted Soilmec SM-16 and electric crawler-mounted Soilmec SM-5E units to drill the crest and grouting gallery, respectively. Making operations more difficult, from the grouting gallery the boreholes were drilled from the ramps, which had up to a 42% grade.

As part of the project, Trevi developed the T-Grout system (T stands for Trevi). This is a computer-automated web application that allowed the remote management of grouting activities from a control room. It allowed the calculation of the effective grouting pressure at any stage by taking into account the water table level, the head losses discounted along the injection pipeline and the specific gravity of the grout mix.

From 2016 to 2019, Trevi completed about 403,000 linear meters (1,322,178 lft) of grouted boreholes, injecting about 41,000 m<sup>3</sup> (53,626 cu yd) of grout — equivalent to 26,700 tons of solids — into the ground.

Trevi also created courses on modern equipment and techniques as part of its remit to engage and train the owner's personnel. This included both theoretical classes and field activities, organized by profession so that Iraqi engineers, geologists, drilling and grouting operators, mechanics, electricians and IT specialists acquired the competence, and confidence, to continue with the dam's operations after Trevi completed its contract.

One final challenge worth mentioning is that Trevi carried out all of this work at the dam, a mere 13 km (8 mi) away from the armed conflict against ISIS. Fortunately, the presence of the Coalition Forces, together with the Italian Army, guaranteed the required security of the project area. Notwithstanding the strict security procedures, the works proceeded expeditiously with no delays. The workforce numbered more than 700 and the project logged 8 million man-hours worked without accidents.