Soilmec Hydromill Shatters Slurry-Wall Records

Photo courtesy Trevi S.p.A.
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By excavating a slurry-trench panel 100 meters deeper than ever before, an Italian contractor hopes to grab a bigger share of the market for repairing leaking dam foundations. Trevi S.p.A. engineers claim the 250-m-deep trial wall, recently excavated near the company's Cesena, Italy, headquarters, sets the stage for the potential increased use of deep remedial cutoffs at troubled reservoirs.

Trevi's aim for the trial on its new Soilmec Tiger SC-200 Hydromill is "to push the limits of this technology," explains Maurizio Siepi, who manages the firm's technology department. The difference between the hydromill and a standard machine, he adds, is the "difference between Formula One cars and the cars that you find at car dealers."

For the experimental excavation work, the Trevi team and Soilmec S.p.A., its equipment-manufacturing subsidiary, chose to stabilize a site that contained calcareous marl, says Siepi. "We knew from the beginning [the trial] was going to take weeks because it was a prototype and we had to test everything," Siepi explains. Starting in August, the team completed one 3.2-m-long, 1.5-m-wide, 250-m-deep wall panel in early November and will cast the concrete this month, he adds.

Like similar trenching machines, the Tiger lowers into the ground a frame that carries counter-rotating cutters to excavate wall slots. As the cutters descend, a thixotropic slurry, such as bentonite, is circulated in the trench, helping to support the sides and remove spoil. When the excavation is complete, concrete is tremied into the bottom of the trench, displacing the slurry and forming the wall.

Among other challenges, the Italians had to keep the cutterhead vertical despite the depth. "We were very close to the accuracy [limits] of the instrumentation," says Siepi. Because of the ground conditions, the cutterhead deviated 60 centimeters off course about 100 m down, he reports. "We were able to recover the deviation at the bottom," he adds.

The engineers also encountered power losses along the long hoses, each weighing 60 tonnes, and maintaining hydraulic seal. "At high depths, all these problems are magnified," notes Siepi. Specialists from Bologna University advised the drilling team on geology, while staff from Marche Polytechnic University, Ancona, helped with the concrete-mix design. Turin University experts provided guidance on monitoring and instrumentation.

The wall trial marks another advance for the slurry-wall technology. First developed in Europe during the 1950s, slurry walls initially were excavated with "rope grabs," or clamshells operated by a cable, hung from tripod rigs, according to a recent review from the U.S. Society on Dams (USSD). To deal with harder rock and greater depth, hydraulically operated grabs were developed. For a project in Schuttdorf, Austria, in 1994, contractor A. Porr A.G., Vienna, claims to have built Europe's deepest wall, at 104 m, using a grab.

Following the development of the reverse-circulation drilling technique in Japan, trench-cutting machines took off in Europe, according to USSD. In 1984, German contractor Bauer A.G., Schrobenhausen, used one of the first trench cutters to build a 40-m-deep wall in sandstone at the country's Brombach reservoir. In 2006, the company claimed to have reached a 116 m depth for a cutoff wall at the Perimbonka hydro dam, Quebec, Canada.

In the mid-1980s, before being acquired by Trevi, the contractor Rodio S.p.A. used a milling machine to drill a 100-m-deep wall in sandy, gravely soil for a demonstration trial near Milan. Early this summer, Rodio claimed another, deeper success, testing Soilmec's S-135 rig down to 150 m.

But Trevi has yet to go anywhere near that deep on a commercial contract. In an equal partnership with Paris-based Soletanche Bachy S.A., the group's biggest-ever contract for a cutoff wall is now well advanced on the Wolf Creek Dam foundation remediation project in Russell County, Ky. The contract, signed in 2008 with the Army Corps of Engineers for $341.4 million, calls for a 1.2-km-long, up to 84-m-deep cutoff wall, including slurry walls and secant piles (ENR 2/27/12).

While the big leap in wall depths excites Trevi engineers, its reception by dam designers likely will be restrained. "There is no doubt that what they are suggesting is new," says Tim Hill, the Cambridge, U.K.-based head of hydraulic structures at the design firm Mott MacDonald. But the technology's newness "tests the way the dam

industry works, because we are very conservative," he notes.

Hill acknowledges the scarcity of alternatives to concrete walls for plugging leaks in soluble rock-dam foundations. "People have tried grouting, but that has had very limited success," he says. "I am excited that it's new, but somebody has to stick their toes in the water first."

While there is demand for deeper walls, Siepi agrees that, "at the moment, there are few projects where the capability of this rig will be required." He adds, "There are serious projects to build something like that, although at this time I cannot disclose where [those projects are]."