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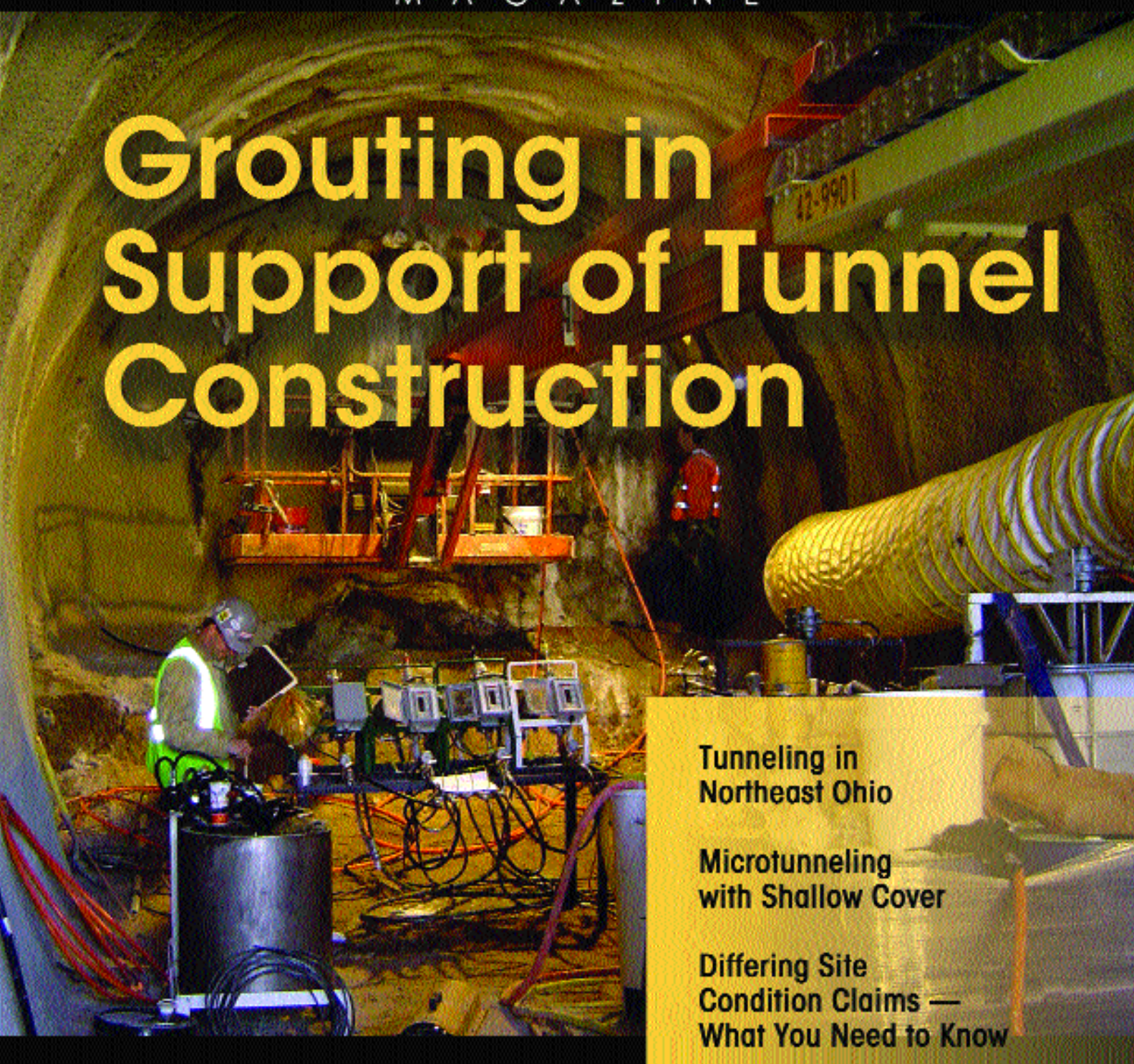

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Grouting for the Baumgartner Tunnel in St. Louis

By James W. Rush

St. Louis, the "Gateway to the West," is in the midst of a large capital program to improve its entire wastewater collection and treatment systems. Under the auspices of the Metropolitan St. Louis Sewer District (MSD), the $3.7 billion Capital Improvement and Replacement Plan is already under way, marking the largest and most expensive capital program MSD has ever undertaken.

MSD was formed in 1954 and started operation and maintenance activities in 1956 in an area roughly comprised of St. Louis City and the portion of St. Louis County east of Interstate 270. Most of the remainder of St. Louis County was annexed to the District in 1977.

MSD's responsibilities include the interception, collection and treatment of wastewater, as well as stormwater management. Currently, MSD serves a population of approximately 1.4 million with more than 400,000 accounts.

MSD's current boundaries cover 525 sq miles and encompass all of St. Louis City and approximately 90 percent of St. Louis County, which includes 92 municipalities. MSD currently operates eight treatment facilities, treating an average of 291 million gallons of sewage per day, and is responsible for operating and maintaining 9,630 miles of sewers. MSD has 311 miles of sewers predating 1890, and another 524 miles of sewers more than 80 years old.

The District's duties include the interception, collection and treatment of wastewater, sanitary sewer maintenance, stormwater sewer maintenance, floodwater control, pump station operation and maintenance, monitoring of industrial waste, issuance of pretreatment discharge permits, engineering design and specification, rehabilitation of sewer lines, plan review and approval and the issuance of connection permits.

Part of the overall Capital Improvement and Replacement Plan included the construction of a new wastewater treatment plant and the elimination of a treatment lagoon that did not have adequate capacity for current or future flows. In order to transport existing flows from the old treatment lagoon to the new facility, MSD needed to construct an interceptor sewer.

The tunnel – the Baumgartner Tunnel – involved the construction of a 200-ft deep, 12-ft diameter interceptor sewer through rock.

The tunnel stretches for more than 20,000 ft, connecting the outdated lagoon with the new Meramec Wastewater Treatment Plant located near the confluence of the Meramec and Mississippi rivers.

In addition to conveying flows from the lagoon to the new treatment plant, the tunnel was designed to pick up flows from Mattese Creek and other watersheds along the course of its alignment. The tunnel is planned to extend another 5,000 ft to allow MSD to eliminate two additional plants – the Fenton and Grand Glaize wastewater treatment plants.

Frontier-Kemper, Evansville, Ind., was contracted to construct the tunnel for MSD. In addition to the tunnel, Frontier-Kemper was required to construct three access shafts, approximately 30 ft in diameter and five drop shafts, 6 to 10 ft in diameter. Inside the 12-ft diameter tunnel, crews placed 96-in. diameter carrier pipe.

The ground conditions proved to be difficult for the contractors. "That was our biggest challenge in constructing the tunnel," said Jim Nickerson, project manager for Frontier-Kemper. "The ground conditions consisted of a shaley claystone that required a surface grouting program (completed by Hayward Baker, Odenton, Md.) to grout a curtain around the tunnel excavation prior to mining."

To bore the tunnel, the contractor chose a Wirth TBM capable of installing rock bolts and probe drilling. About 4,000 ft of the tunnel alignment did not require support, while the remainder rock bolts on 5-ft centers.

The carrier pipe was 96-in. ID reinforced concrete pipe with a T-Lok liner. The pipe, supplied by Independent Concrete Pipe of St. Louis, came in 12-ft lengths and was hauled into the tunnel. Once installed, Pacific International Grout was subcontracted to grout the annulus using cellular grout supplied by Cellular Concrete LLC, Allentown, Pa.

The fact that the tunnel was a deep tunnel with limited access meant that the concrete had to pumped long distances, including one stretch of 12,000 ft.

"This type of grouting was rarely used in the 1980s but is now fairly typical for linings that are not cast-in-place," said Patrick Stevens of Pacific International Grout. "The advantage of cellular concrete is that it can be pumped long distances; it allows the elimination of access shafts."

Pacific International Grout used Mearlcrete Liquid Concentrate supplied by Cellular Concrete LLC, Allentown, Pa. When mixed with cementitious materials, Mearlcrete creates concrete in which air is the aggregate where the air voids are uniformly distributed as small, homogeneous, non-interconnected cells.

The air content may be varied to produce densities from 20 pcf to 120 pcf with compressive strengths from 20 psi to more than 2,500 psi. The air cells are introduced into the cement slurry by means of a separately generated stable, microbubbled, aqueous foam.

The Mearlcrete Liquid Concentrate is used at the jobsite by mixing it with Portland cement, with or without fine aggregate such as flyash or sand, with the impregnated aqueous foam. When the cement paste surrounding each air void or cell hardens, the foam is stabilized and cellular concrete is created.

Advantages of cellular concrete include:

- Low cost
- Easily pumpable
- High slump
- Positive fill
- Lightweight
- Insulating
- Can be designed for almost any psi
- Environmentally friendly
- Rapid installation
- Non-corrosive
- Freeze-thaw resistance
- Shock absorbing
- Requires less bulkheading

Because of the versatility of cellular concrete, it is being used in a variety of applications including annular fill and back fill; abandoned mines; consolidating poor ground; load reductions; bridge approaches and more. New innovations, such as pervious cellular concrete, increase the versatility of the product and broaden the scope of possible applications.

James W. Rush is editor of *TBM*.