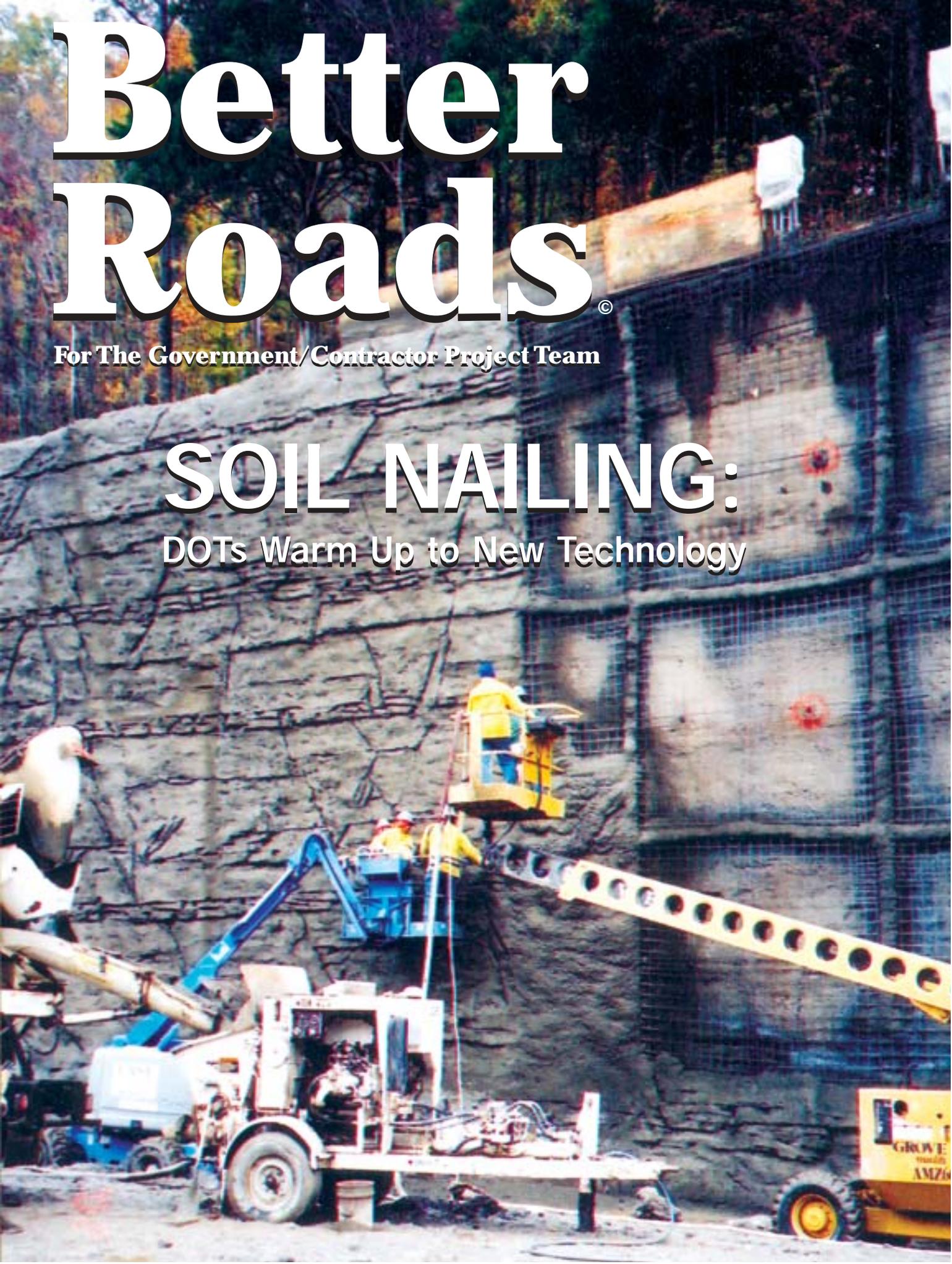


Better Roads[®]

For The Government/Contractor Project Team

SOIL NAILING: DOTs Warm Up to New Technology



by Sara McGray

Soil Nailing: DOTs Warm Up to New Technology

Soil and rock nailing is a relatively new construction technique first used in Europe to stabilize and construct tunnels. In North America, it is quickly becoming a popular method of soil and rock retention, slope stabilization, and shoring.



The Judy Company uses a Schwing trailer-mounted concrete pump with line system to apply shotcrete. Decorative landscape rock artisans are brought in to achieve a more realistic aged rock look on a shotcrete surface in Kentucky. This process must take place immediately after the shotcrete is sprayed onto the excavated wall.

Soil nailing provides project owners and departments of transportation economic benefits and a rapid means of retaining wall and retention support system construction. Two very different projects proved the advantages of soil nailing over conventional retaining-wall construction for DOTs in Kentucky and Iowa.

Ken Abud, business development manager for The Judy Company, Kansas City, says that soil nailing projects generally follow the same basic procedure. Geotechnical engineers design the soil nailing project, taking into account soil compatibility and strength requirements of the grout and shotcrete. The technique, appropriate in many cohesive soils or fragmented rock, is top-down construction.

A bench is excavated ranging between 4 and 6 feet in height. Holes are drilled into the excavated face typically measuring 6 to 8 inches in diameter in soil and 3 to 4 inches in rock. Typically, holes are angled at 15 degrees below horizontal. The hole is pumped full of ready-mixed grout soon after drilling to ensure the hole remains open. Nails, generally continuously threaded steel bars, are long enough to penetrate the failure plane of the excavation, and are inserted immediately following grouting. The nails are equipped with centralizers to ensure central placement in the grouted hole. The concept is to stabilize the soil by creating a grouted mass that the surrounding soil will act upon in friction. The grout also provides corrosion protection for the nail. Once the grout sets, the protruding nails are fitted with a steel plate to transfer forces from the wall to the nail. Horizontal and vertical drain strips are then installed onto the



A retaining wall in Kentucky was stained after curing to create a more natural look.

facing to control seepage and eliminate hydrostatic pressure buildup.

Reinforcing steel is applied and the face is shotcreted. For temporary walls, as in shoring or behind a cast-in-place concrete finish, the surface can be left rough or lightly troweled. For permanent walls, the shotcrete can be hand troweled or even sculptured and stained to blend into the natural surroundings depending on the desired look.

Because of the potential that the soil will collapse after being excavated, a soil nailing contractor only cuts as long a bench as crews can complete in a 24-hour period. "You cut only what can be finished in a day, shotcrete and everything," Abud says. "On any given job, the pump is almost continually working, so it must be reliable. It is the key to making the technique work, maintaining productivity, and staying on schedule and budget."

On site

Soil nailing has several applications, and the Judy Company has been contracted for a range of projects across the nation. The company recently completed an 8,500-square foot wall in Pike County, Kentucky as a subcontractor. The original plans required a cast-in-place wall in front of the shotcrete shoring. As an alternative, the company proposed a soil-nailed and shotcreted wall sculpted and stained to look like adjacent highway cuts. The proposal was accepted and Boulderscape, Capistrano Beach, California was contracted to place and sculpt the shotcrete.



A cutter attachment on a skid steer is used to create the second bench.



Holes are drilled into the excavated face typically measuring 6 to 8 inches in diameter in soil, and 3 to 4 inches in rock.



Reinforcing steel is applied and the face is shotcreted. Behind cast-in-place concrete finish, shotcrete can be left rough or lightly troweled.

Technology

A Des Moines project is a true testimony to soil nailing as a successful soil retention technique.



Judy Company crews hand screed the recently shotcreted wall in Des Moines.

Working from a manlift, the shotcrete was placed with a Schwing concrete pump. Sculptors from another manlift carved the shotcrete from the top down using hand trowels and brushes, emulating natural rock formations in the area. After curing, the wall was stained, making the finished product look like a natural cut.

At the same time, the contractor was finishing a massive, 63,000-square foot soil nailing project on I-235 in Des Moines as specified by the Iowa DOT.

Crews finished over 1,500 square feet a day.

Judy Company President Pat Carr says the Des Moines project is a true testimony to soil nailing as a successful soil retention technique. "Using top-down construction and this technology, the highway could be constructed in the minimum right-of-way. Soil nailing allowed excavation very close to city streets and utilities and eliminated detours during construction," he says. **BR**

Sara McGray represents SAGA in Minneapolis.



The first bench of the Des Moines retaining wall project is completed. Soil contractors only cut as long a bench as crews can complete in a 24-hour period, to prevent collapse.



About 63,000 feet of retaining wall was constructed off I-235 in Des Moines using the soil-nailing method. Upon completion, the walls were covered with pre-cast panels.

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