

BLIND SHAFT DEVELOPMENT

SDI breaks new ground in shaft development and ground stabilization

BY STEVE FISCOR, EDITOR-IN-CHIEF

Advancements in shaft development techniques are reducing completion times and costs for coal mine operators. Shafts serve multiple purposes for underground mining. They are primarily used for ventilation and transporting men and materials. Other uses include production shafts to get coal to the surface, and smaller diameter shafts have found niche uses for utility conduits, dewatering systems, degasification, and emergency escape-ways.

One of the more popular shaft development methods, blind shaft development, uses reverse circulation technology. Shaft Drillers International (SDI) leads the way with the use of blind shaft development and, over the course of the last 25 years, the company has gained a considerable amount of experience.

Through a series of recent acquisitions SDI broadened its capabilities to include geotechnical reinforcement. In 2006, Scott Kiger and Charlie Riggs, natives of the western Pennsylvania coalfields, purchased SDI through their own geotechnical firm, Coastal Drilling East. At that time SDI was a holding company for North American Drillers and Zeni Drilling. Today, SDI is the holding company for North American Drillers, Zeni Drilling, and Coastal Drilling East.

The acquisition gave SDI access to a group of geotechnical engineers and working together they have been able to enhance the services that SDI can provide. As an example, the geotechnical division of Coastal Drilling East performs pre-grouting for shaft installation and they also have a well-plugging division, which has become even more important to longwall coal miners.

SDI considers itself a geotechnical construction company—one that is uniquely positioned to deliver both large and small diameter shafts with the appropriate ground treatment and stabilization to minimize surface and strata risk. They are routinely drilling shafts as large as 20-ft in diameter with depths approaching



Shaft drilling operations are conducted from the surface with only a few miners.

2,000 ft deep. Through its experience in the coalfields, the company also has a keen understanding of the new regulatory demands that underground mine operators face.

Blind Boring Techniques

Blind shaft drilling offers several advantages over conventional shaft sinking techniques. The process is highly automated. Using only a three- or four-man crew, all of the work is performed on the surface. No one enters the shaft during development. Similarly, SDI does not need access to the headings underground. Depending on the geological conditions encountered, the drilling process normally advances at much quicker rates than a conventional shaft sinking operation.

SDI developed large diameter drilling capabilities in the Appalachian coalfields and has perfected its techniques over time. Theoretically, the technology has no limit as far as depth. “As far as the shaft development business and this particular method, SDI has been successfully completing these projects in the U.S. since the 1980s,” said Tim Bruner, project manager—shaft

construction, SDI. “We accomplish this drilling in advance of mining by drilling down into a virgin seam of coal, removing all of the cuttings, and installing the liner. When the coal miners reach the shaft, they have the ventilation they need.”

The shaft drilling rig has a rotary table connected to a reamer body (or cutting tool) by a heavy doubled walled rod or “drill string.” The rotary table provides the torque or turning action for the reamer. To create up flow, the shaft is filled with water which is maintained at a constant level throughout the entire shaft development. The water fills both the shaft and the hollow drill string creating two independent columns of water.

Compressed air is injected into the water column of the drill string displacing the fluids and creating a much lighter column. The heavier water column inside the shaft pushes down and across the development face (bottom of the shaft). The water is then forced through a small opening called a “pick-up” on the reamer body, which displaces the lighter water column in the drill string. The displacement of the lighter drill string fluid results in an upward flow or “reverse cir-



The reamer body for the shaft drilling system is lowered into the hole.

culcation.” The volume of fluids being displaced, typically 2,000 to 3,000 gpm, creates a tremendous vacuum at the pick-up point that literally sucks the cuttings from the face.

The reverse circulation is maintained by providing a constant level of water in the shaft, which provides both a downward pressure for flow and the added benefit of concentric outward pressure on the shaft wall. Concentric pressure reduces the potential for surrounding strata to shift or move and, in turn, increases overall stability.

“We pioneered this blind drilling technique for the mining sector,” Bruner said.

“SDI continues to make improvements. We design and build all of our own cutting heads. We strive to make those more efficient and there have been serious advancements in the individual cutters that we use.”

Once fully developed, the shafts are typically lined prior to dewatering. Depending on application—and to maximize efficiency—the final liner is available in steel, concrete or composite material. “Most mines prefer the steel liners, which have multiple advantages,” Bruner said. “There are no water rings and the liner is guaranteed water tight. Any project up to 15-ft diameter is lined

with steel. The cost of the steel becomes prohibitive for larger diameter shafts. Larger shafts are usually concrete lined.”

Shaft development rates are a function of diameter and ground conditions. For 8- to 10.5-ft diameter shafts, which is the vast majority of what SDI does, they can complete a 500- to 800- ft shaft in four to six months. For 12- to 15-ft diameter shafts, the development rate would be between five and seven months.

More recently, Bruner said he has seen the business change mainly due to regulatory requirements being placed on the industry these days. “We have seen more activity with the larger diameter shafts due to the additional ventilation required underground,” Bruner said. “We have also completed several secondary escapeway projects which were required as part of the company’s emergency response plans.”

By law, the Mine Safety and Health Administration (MSHA) requires every mine to have an Emergency Response Plan (ERP) in place. “We can help with ERPs,” Bruner said. “SDI has equipment that’s available on a moment’s notice to go and work with mine rescue projects. We are being retained by several coal companies in the eastern coalfields as a signatory rescue contractor of choice.” If something should happen, a major collapse, inundation, entrapment, etc., SDI would be contacted immediately to come to the site and put down an emergency borehole to either give trapped miners breathable air or drill a hole big enough to rescue the miners once they are located.

Timing is an important consideration for a blind shaft drilling project. “Obviously SDI is able to complete these projects well ahead of mining, potentially avoiding delays and congestion underground,” said Bruner.

Raise Bore Drilling

SDI is committed to expanding its capabilities in order to control costs, increase efficiencies, and reduce construction schedules for its customers. “We’re always looking for ways to go larger and deeper,” Bruner said. “Our raise bore capabilities are offering the mines a few more options to meet production demands.”

Raise bore shaft development requires access to the bottom of the shaft in order to connect the reamer head to the drill rod as well as to remove the cuttings. SDI is developing shafts using raise bore technology, which produces faster advance



Charlie Riggs (left) and Scott Kiger, owners/managers of SDI.

rates and requires fewer excavation personnel.

"We're providing surface and underground setup with the raise bore division," said Bruner. "The disturbance to surrounding rock is minimized and we're able to limit the interruptions to traffic and services."

Geotechnical Engineering

With the previously mentioned acquisitions, SDI has realized synergies in

ground stabilization technologies and other capabilities, such as well plugging. Coastal Drilling East originally started as a civil firm. Through its association with SDI, however, it has discovered new opportunities in the coal business.

"Coastal's geotechnical division is a specialty geotechnical construction company, which means we deal with all types of ground improvement, such as pre-grouting work for shafts, grouting of

poor soil, water leaks into the mine, etc." said Dean Dibert, project manager-geotechnical construction, SDI. "In development, we get into all types of earth retention work, shoring systems, foundation work for crushers and conveyor systems. For difficult ground conditions, we offer solutions to help the mines with anything from ground improvement to foundation support."

Fundamental to any underground development is the ability to control the subsurface strata in which the excavation will occur. With the majority of shaft developments requiring some type of pre-grout program, SDI is uniquely positioned to self-perform both ground stabilization and shaft development which delivers optimum efficiencies and the greatest alleviation of risk for our clients.

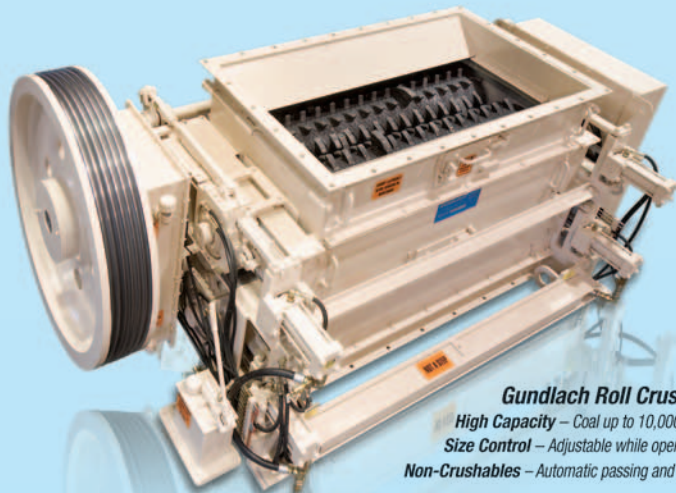
"SDI possesses the knowledge, technology, and equipment to deal with strata-related risks, providing our clients with 100% accountability," Dibert said. "Other contractors might have to go to a third party, which can be time-consuming."

"Coastal also has a well-plugging division," said Dibert. "Obviously the wells have to be plugged before the longwall can pass through these areas. Right now mines are spending significant resources on locating and plugging gas wells."

SDI's technical capacity to find abandoned wells is well documented throughout north central West Virginia and southwestern Pennsylvania. The company has specialized equipment and fishing tool knowledge. It has rigs rated for 225,000 lb and 5,000 ft, and personnel trained in pipe recovery and milling methods.

Completing the work ahead of development has always been a big selling point for SDI. "We're striving to become a true turn-key company when it comes to underground access and geotechnical ground construction solutions," Bruner said. "Industry leaders use SDI's scheduling expertise to implement annual and long-term planning that bring efficiencies to capital spending budgets. Working with one contractor, we have the ability to see the shaft project from the coping section through to final development." Whether it's development work or emergency services, SDI will be able to help coal operators meet their needs and operate more efficiently.

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