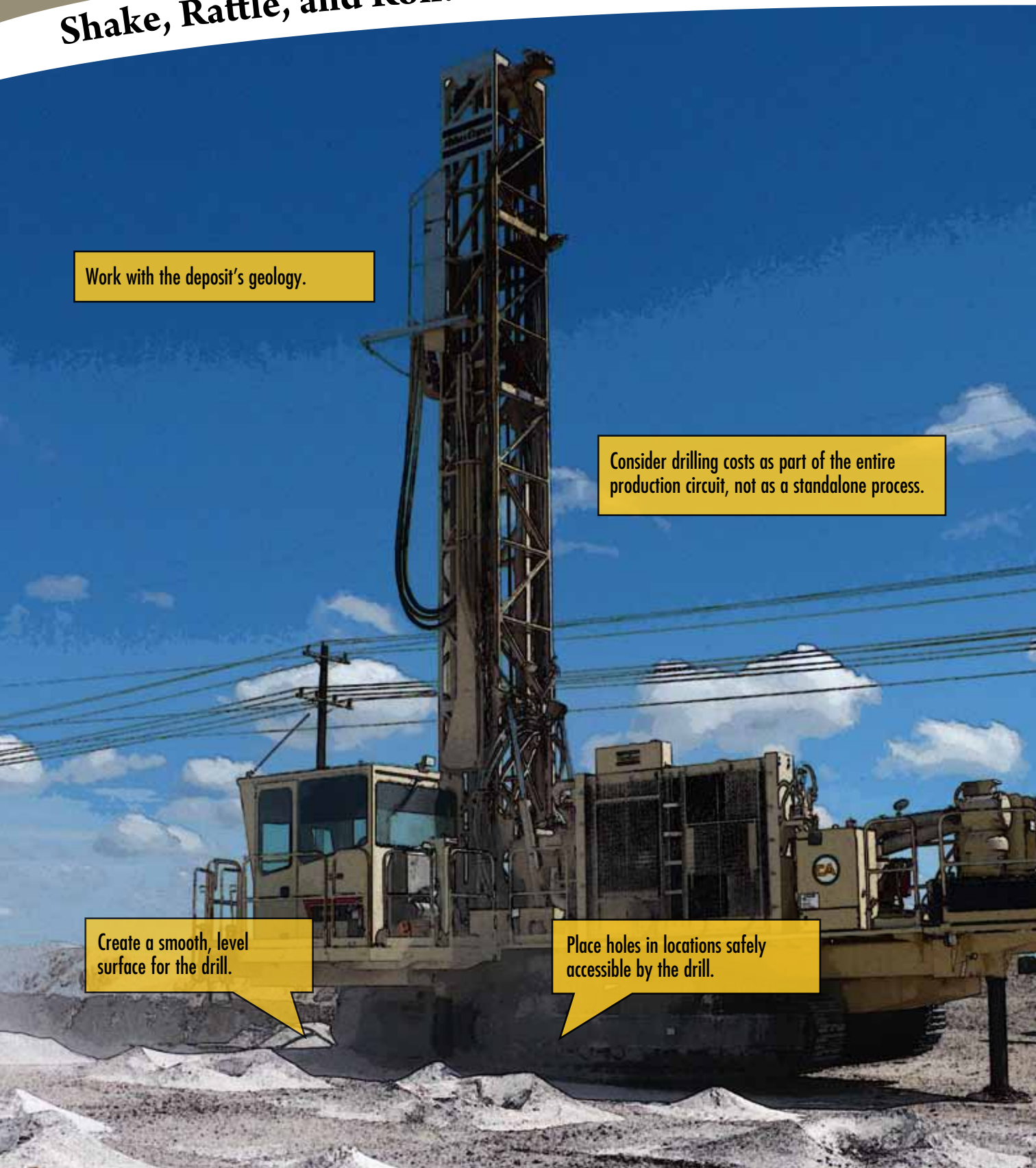
AGGREGATES MANAGER
Your guide to profitable production
PULL-OUT GUIDE
by Therese Dunphy, Editor-in-Chief

OPERATIONS ILLUSTRATED

Shake, Rattle, and Roll: Understanding Drill Feedback



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Quality Comes Before Quantity

In today's economic environment, a plant superintendent needs to understand his or her operation better than ever. "It's a game-changing era," says Bill Hissem, senior applications engineer with Sandvik Mining and Construction. "In this upside-down economy, you can no longer make money on volume."

Instead, it's important to recognize how each unit throughout the production chain operates and how it impacts other parts of the process. "They need to understand every nuance of their operation to a degree they've never had to before, and it all starts with the drill," Hissem adds.

One of the biggest mistakes operators make is to not approach their drilling and blasting program properly, adds Pat Garven president and CEO of Finndrill. "Drilling and blasting is approximately 25 percent of the production cost, but it impacts the other 75 percent," he explains. "Anybody can do inexpensive drilling, but you still have to process the material. People who ignore that, especially today, are making a mistake."

To improve the outcome of a blast, quality should take precedence over speed and quantity of production. It may also entail evaluating how the site interacts with the driller. For example, if site management prioritizes production quantities and the driller's compensation is based on that issue, he is incentivized to produce volume with no qualifications. If, however, the driller serves in a consultative capacity, he may be able to make recommendations on how to improve product quality and optimize drilling and blasting through the design. "Most clients are focused on profit," Garven says. "If you can show them a more profitable, easier way to do things, they're pretty open-minded."

Smart investments include consideration of the hole size, layout and design of the hole pattern, quality of explosives, and operator training. Money spent upfront can be recouped in more efficient processing of the muckpile. "You can shoot a 7- to 10-yard bucket size pattern," Garven says, "but if the guy has a 5-yard bucket, he can't load it." In addition, oversize material can tear up tires and create havoc in the maintenance department, while it also increases amp draw at the crusher and drives up energy costs. Garven recommends that all processing equipment — including loaders, trucks, and crushers — be taken into account when designing the drilling and blasting program.

"The operator must try to find ways to minimize his costs while maximizing his revenue at the end of the process stream," Hissem reiterates. "No one can afford the luxury of looking at each unit operational step in isolation and assume they'll get the optimum profitability at the end. What they do upstream impacts what happens downstream."

1 Properly prepare the bench

Uneven terrain introduces error. Before bringing in the drill, create a clear level surface. If the bench resembles a moonscape, the driller will have a difficult time setting up evenly and drilling a straight hole. Although minimal surface preparation may seem to yield cost savings, lost blasting efficiency and accuracy may quickly offset the cost of proper preparation.

4 Work with good geology

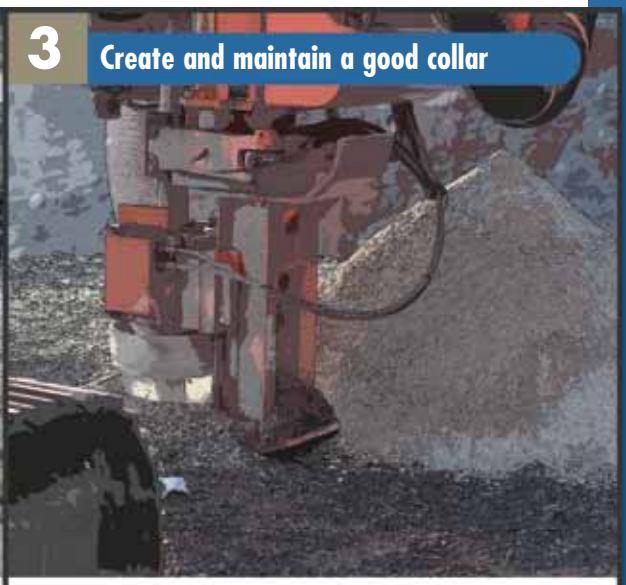
If you have good geologic conditions where the rock is laminated and has a horizontal bedding structure, such as many limestone deposits throughout the Midwest, plan your shots to take advantage of the line between partings of material. The rock is likely to cut easily and smoothly.

Optimizing Crusher Capacity

2 Consider the locations of the holes

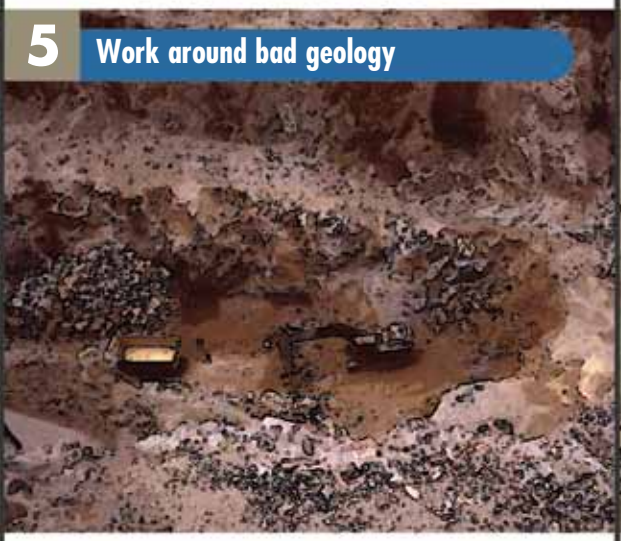
If holes are placed close to the highwall or the crestline, the operator may be hesitant to put himself or the drill in a position where he feels unsafe. Safety concerns — whether real or perceived — should be taken into consideration when laying out the shot. If the feet of the drill can't be placed in the desired location, the shot pattern will not be properly executed.

3 Create and maintain a good collar



Many drillers say that one of the top factors in achieving a straight hole is won or lost when collaring the hole at the ground contact surface. If the center of the hole is not straight, the hole will deviate. In that case, the driller must readjust the drill string alignment with the hole to minimize lateral stresses that will cause the drill to deviate.

5 Work around bad geology



If you encounter an air pocket, or vug, in the deposit, pay close attention to the path of the drill. If the drill is center to the face, re-collar the hole and continue. If the drill is off center or to the side of the hole, the wall of the vug may push against the bit and the drill can become wedged in the hole.

6 Exercise care around karst

In some portions of the country, glacial activity left non-uniform rock formations with an irregular subsurface. The operator must be sensitive to the drill's feedback and proceed slowly with the minimum amount of feed and percussion pressure on the drill bit to re-establish a collar condition where the drill contacts the sloped hard material.

OUR EXPERTS

Bill Hissem is the senior applications engineer for Sandvik Mining and Construction LLC in North America. He has a bachelor's degree in mining engineering from the Colorado School of Mines and has worked in numerous mine operations in the western United States. He joined Tamrock in 1983 and now assists Sandvik customers in mining, quarrying, and construction sectors. He is a member of SME, ISEE, and is currently on the board of National Stone, Sand & Gravel Association's Manufacturers and Services Division.

Pat Garven is president and CEO of Finndrill , a company he founded in 1994 with Jussi Kivisto. Previously, he spent 22 years in the drilling industry, including 10 years at Tamrock. He is a member of SME and ISEE and attended the Milwaukee School of Engineering. He can be contacted at 414-940-8981.

Voices of Experience

Bill Hissem

A high-quality driller is a bit like a superior marksman, says Bill Hissem, senior product engineer, Sandvik Mining & Construction. "It's a bit like shooting a gun, except that instead of having one target, a driller has two targets he needs to intersect. He has a target painted on the ground at the top of the hole, and he's got a theoretical target at the bottom of the hole. A good driller is a marksman who is able to intercept two targets with one shot," he explains. "The quality of the result is always relative to the quality of the driller."

Part of a driller's challenge is that he can't see most of what is happening with the drilling process. "Once you collar a hole, the majority of the action — and your success or failure — lies with what you cannot see," Hissem says. Instead of relying on sight, a driller relies on secondary sensory feedback, such as sound and vibration, as well as the size of material coming out of the hole and the velocity of drilling.

The importance of this feedback is often relative to the deposit's composition. At one end of the spectrum, a perfect deposit performs like a well-behaved child where the drilling process goes according to plan. "The robins are singing in the air. It's 72 degrees Farenheit, low humidity," Hissem jokes. "Life is good."

These conditions are common in a large number of operations, particularly in limestone deposits throughout the Midwest where the rock is beautifully bedded and horizontally oriented. "If you're lucky enough to have that, you want to shoot to a bench height where the bottom of the bench lines up with the parting of one section of the limestone and the other. It will cut just like a laser beam," he says. "It's a cake walk."

At the other end of the spectrum, the rock behaves very badly and does nothing you want it to do. "It fights you every step of the way," Hissem says. "It's expensive, and your production is down."

These problems can occur in deposits that have irregularly shaped beds. For example, when the drill hits an angled rock surface, the bit wants to deflect in the direction of the rock. At that point, the ability of the drill operator to negotiate the intricacies of the rock will determine the success of the hole. Other drilling challenges include voids in the deposit and karst. In these conditions, drill feedback and sensory perception once again come into play. "If the driller is good, he'll perceive very quickly that he's coming into contact with the rock," Hissem says, "and essentially has to re-collar the hole."

Pat Garven

Obtaining a sound understanding of the deposit's geology is the first step toward a successful drilling and blasting program, says Pat Garven, president and CEO of Finndrill. "What is the geology like? Is there underground water? Are there caves and crevices?" he says. "Once you've done your homework and know what you have, determine what you're going to do."

Based on the geology, decisions can be made about the blast pattern. In this process, accuracy is critical. Garven says he prefers to use laser measurements: "Measuring tapes have served their purpose for many years, but it's not an accurate way to do it." A tape generally measures 5 to 10 percent deeper than the face. Accurate laser height measurment aids not only in achieving a clean, straight, loadable hole, but also reduces the cost of blasting agents and ground vibration. "Quarries that were at one time rural quarries are now urban quarries," Garven notes. "When you start putting more explosives in the ground, you'll break rock where it's too deep in the floor. When you drill too deep, you're not only shaking the neighbors, you've also damaged the bench for the next shot."

When a deposit offers challenging conditions, it's important to log and communicate those concerns to all parties involved. Garven says that his drillers keep a four-part log: one copy goes into the company's permanent file, one copy goes to the customer, one copy goes to the blaster, and the driller keeps the final copy. The log may note that hole A-7 has a void at 10 feet or that a group of holes is soft on the top. "All notable differences are logged," he says. That way, all parties are aware of varying rock conditions. The blaster can load the hole appropriately, while the operator can plan ahead for future production decisions.

If voids are noted, such decisions must be made. If the void is fairly small, Garven says that he may use a different bit to work through the rock. "The bit has a lot to do with how you go through material," he explains. For example, a retract bit may guide the drill through different cracks and strata, while the design of its top allows it to cut its way out of the hole. If the void is large, such as a cave, options include drilling around it or drilling to it, removing the rock above it, and exposing the void before moving on.

At the end of the day, the driller must focus on the grid of the hole design. "It's very important to make sure the grid is the same on the bottom as it is on top," Garven says, "because that's where everything starts moving."