

BY HARRY O. WARD, PE

Veteran Lessons on Machine Control

I made the acquaintance of Louis Spahn through the World of Concrete conference this year. Spahn's longevity in the construction business intrigued me, so I thought I would share some of the lessons he has learned over the years.

Spahn began his career in the U.S. Army in 1966 as a combat engineer. After three years in Vietnam, he returned home and entered the operating engineers' union in New York. As an engineer, he gravitated toward Agtek software, which he has been running since 1983. His in-depth use of this early construction software attracted the attention of Agtek, so he became one of the software's beta testers.

It wasn't long before Agtek's owner, John W. Fletcher, asked Spahn to join the company. Spahn worked for Agtek for six years and, during that time, he helped to usher GPS technology into the construction industry. Now Spahn is back in production as a project specialist for Las Vegas Paving Corp., one of the largest contractors in the country. His current position entails estimating, model building and project troubleshooting.

Spahn stressed two important points during our conversation. The first was how important it is to cross-train your staff, and the second was how important staking still is on the construction site.

Cross-training the Staff

"One of the pitfalls in construction technology is that different crews have different skill levels, different equipment and different interfaces," Spahn said, also noting work cultures may differ from site to site.

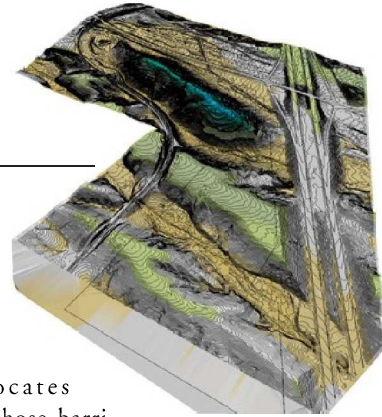
For example, many construction sites in Las Vegas have a union-based work culture. Unions often create a work atmosphere founded on division and specialization of labor, but this approach can actually hinder site production. Even though each person knows his job well, there may not be much

communication or cross-training between disciplines and job functions.

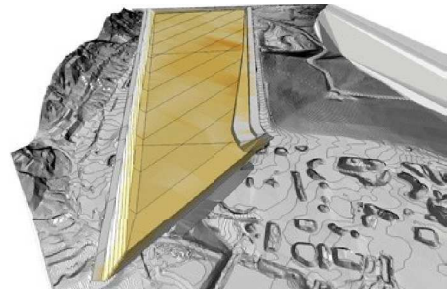
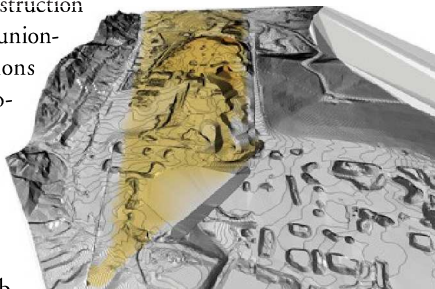
Spahn advocates breaking down those barriers through cross-training. "Any training that can help span staff functions, expand the capabilities and usage of equipment, show the pitfalls and how to avoid them, as well as passing on tips and tricks would only help improve production," he said.

Spahn said construction staff and management should familiarize themselves with the educational tools and venues available from the equipment manufacturers. One such venue is Trimble Dimensions, a conference that showcases new technologies and offers training classes, lectures and industry insight to users. And both Topcon and Leica Geosystems offer hands-on "Technology Roadshows" and "Field Days," respectively, at dealer locations throughout the country.

Spahn said all staff members should be educated in potential pitfalls caused by job conditions or technical equipment limitations. For example, he noted it would help to build the skills of all crew members by educating them



Louis Spahn uses Agtek software to help him develop surfaces. Agtek's 3D detail of a rock quarry project makes it easy to see what will be cut and what will be filled during the bidding site visit.



The proposed interim design of a site, left, and the results of data preparation are shown.

about the issue of multipath on GPS. If everyone is aware of the problems caused by multipath, then staff members can use their equipment's technical abilities to improve accuracies.

Another area where staff could benefit from additional training is 3D modeling of surface data. "A lot of people are learning how to build 3D models these days, but many are flawed," Spahn said. "Better training, better education and a more rounded understanding of the model and how it fits into the scheme of things would benefit everyone. Training on the critical importance of using breakline data in the models is needed."

I agree with him completely. Too many people are developing poor models from contours and point data. This produces a model with too much ambiguity in the TIN mesh. Breaklines force the TIN to act properly—or at least the way the modeler intended.

Stakeout for Machine Control

My conversation with Spahn also reminded me that a project's success is directly related to the ability to communicate the data to the field. Spahn believes there is a strong connection between developing data and physically staking it out on site. I was impressed by the forethought and attention he pays to construction layout.

In some cases, contractors are using automatic machine guidance where the machinery reads proposed data from 3D models, compares it to what the GPS reads on the machine, and then the robotically controlled hydraulics move the blade to displace the material in question. Spahn estimates an inarguable production increase of at least 30% can be expected for automatic systems.

But in the majority of cases, contractors are not using equipment embedded with automatic control and must still use stakes or stringline. Although this stakeout data is often collected using GPS technology, it is still communicated through the use of stakes.

"A good rule for stakeout is that you should stake what you want, where you want it and when you want it," Spahn said. "Because if you set stakes too soon, they get knocked down; if you set them too late, the machinery is kept waiting."

What Spahn has tapped into is the ability to improve deadlines and profits on a project where stakeout is still the primary method of communication. "Rather than stake the ground, provide staking that works for the equipment being used," he said.

For example, he pointed out that on a golf course project, the rough grading contours are usually staked in nonlinear patterns. This requires a lot of machine movement to follow those stakes. Instead, Spahn said, "On a golf course construction project, set the stakes in straight lines. This is how the equipment naturally moves, so why not set stakes to coincide with the equipment's drive path? This resulted in improved production of 3-to-1 over what was being done in the past on this project. We can now perform our rough grading in one month where it would have taken three."

WHAT IS MULTIPATH?

Multipath is a phenomena that occurs when the signal to the GPS antenna is blocked, perhaps by a building, terrain or even the technician's body. The signal is bounced or is forced to go around objects, thereby lengthening the travel time and distance to the receiver. GPS signals work by computing the travel time from the satellite to the receiver, so if the travel time is distorted, the related computations are more dubious.

A rule of thumb is that if you do not have a direct line of sight to the satellite, then multipathing can be an issue. However, even a direct line of sight does not guarantee a multipath free signal.

Velocity filtering is a mechanism within the equipment that provides signal corrections at the receiver to solve multipath problems.

As another example of how to improve stakeout, Spahn recalled a road project where the normal staking was down the centerline with the anticipation that a standard scraper would be used. However, when extra-wide pan scrapers were brought on site, he moved the stakes to the sides of the road shoulders, both left and right. This created a pattern for the scrapers so that the loaded vehicles dropped material as they came down the sides of the road. The center was now clear so the returning, unloaded equipment could use the middle of the road. This improved pattern increased the speed of material transport.

"Try setting stakes wider than normal to allow for large equipment such as scrapers," Spahn added. "Often the scraper tries to move around the stakes and, in doing so, time is lost." Once again, setting the stakes based on the equipment being served increases efficiency. Spahn also pointed out that improving how stakes are set can save time and there is absolutely no cost associated with these tricks.

In summary, train the staff, cross-train the staff and take advantage of any educational opportunities that may exist. Plus, pay close attention to the communication of information from the office to the field. If you do this, you should begin to see production increases. Keep these tips in mind, and if anyone wants to share other methods for speeding up production, please contact me. **SP**

Harry O. Ward, PE, is a registered professional engineer, a state licensed contractor and certified in machine control. He is president of Harken-Reidar, a new infrastructure solutions company. He has been a member of the engineering faculty at George Mason University since 1997. He can be reached at hward@harken-reidar.com.