Laser-guided stringless paving

Once operators have gone through the learning curve, they never want to go back to stringline.

by Karl Soar

The G21 controller works on a technology called CAN-Bus. The way I like to describe CAN-Bus to customers is that it's like "Internet for machines." It's a communications method that allows all the different sensors on the machine, plus engine components and circuits, to communicate with each other over one common cable network. Much like PCs in an office can share printers and exchange information with each other, CAN-Bus allows a machine to do that. The information that can be exchanged on CAN-Bus is anything from engine and oil temperature and pressure to 3D position data and hydraulic control signals.

Our 3D control system for stringless paving is built around CAN-Bus technology and we've been working on this together with GOMACO since 1999. We defined a message system which allows our machine computer and software to share the CAN-Bus network on GOMACO machines and send out our steering and grade commands to the G21 controller, which then talks to the valves in a similar way as it would to a stringline sensor.

The advantage of a CAN-Bus is that it is extremely fault tolerant. For example, if there is any electrical interference on or around the machine, CAN-Bus itself is not affected by that. It's a voltage differential system and if there are any changes in the background voltage of the machine, such as when operators crank the starter or adjust engine revs, the CAN-Bus messages are not affected by that.

It's also extremely fast. The CAN-Bus messaging system that we use together with GOMACO runs at 125 kilobits – very fast compared to older serial communication methods which also aren't as flexible or reconfigurable as CAN-Bus. The key advantages are robustness and speed.

Another advantage of the G21 controller is the large program space it has available. It's allowed GOMACO and Leica to develop a new feature which we call mixed-mode paving configuration. It's particularly useful on airport projects where contractors have to pave pilot lanes.

It also allows scab-on paving. When a contractor is scabbing-on to the side of an existing slab, they can run lock-to-grade on that side of the paver and 3D control on the opposite side so they're able to smoothly connect to the existing concrete. It's a neat little feature.

Design errors can be spotted before you start paving

The beauty of the "software version" of virtual stringlines is that you can be sitting in a nice, warm office with a cup of coffee just clicking through a CAD program and you can spot any design errors before you even take that model out to the machine. You can overlay existing features and compare the model to your subgrade.

Imagine a contractor paving an airport runway... the subgrade has been put in and it's an inch or so high. They have to go in and trim that to spec with their trimmer. One thing the contractor can do first is a grid-level survey where they take spot heights and form a rectangular pattern to build up a surface model of their existing subgrade. From that, they can work out the amount of material and know how it relates to the theoretical design level for the subgrade.

They can instantly work out how much volume of material they're going to take off with their trimmer. The contractor can use that very same model that they've used for trimming, dial in the thickness of the slab they want to pave, put it into the computer on the paver and go pave it. They don't need to generate another model, assuming that their concrete is a constant thickness slab design. They might have an 18-inch (457 mm) slab, so just dial in 18-inch (457 mm) offset, upwards from subgrade level, and there's your finished concrete level to go pave with.

Above: A total station tracks the progress of a 9500 trimmer.
Below: A stringless GP-4000 slipforming a 24-inch (610mm) thick slab for an airport project.
Right: Slipforming a barrier wall with the Leica 3D stringless guidance system.

The preferred alternative is even better, but does require owners, designers and contractors to cooperate. It's now 2006, and pretty much everything is designed in CAD, so why not use it as it is? Where's the benefit in taking a good electronic design, plotting it onto paper, reading or scaling-off the design, manually surveying and staking it out and introduce all those possibilities for errors?

Just get the top-of-concrete levels and slab positions from the designers directly in an electronic file. Double-check it first, of course, but then put it straight into the Leica system. Dial in that 18-inch (457 mm) offset as a negative number (i.e. a "cut") and go trim the subgrade perfect

relative to top-of-concrete. Move the Leica system onto the paver, reset the offset to zero, and off you go. Imagine how much time, money, effort and material that can save you over a sizeable project!

Where has my stringline gone?

Operators ask, "Where has my stringline gone? I've got nothing to check against." As time progresses, contractors are going to realize that's not something they need to worry about anymore.

The fear that the machine is going to go in the wrong place is taken care of by our system in connection with the G21. The secret to all that apparently complex communication is the CAN-Bus. We use our robotic total stations for position, and slope sensors for orientation of the machine, to figure out how much height, steer and crossfall adjustment it needs, plus how much draft and mainfall to provide.

We just hook the slope sensors up to the GOMACO machine, installing them on the GOMACO mounting brackets, and connect one cable allowing the G21, our Leica system and our slope sensors to talk on the same network. It's a fast and super-reliable technology.

The fear the customer has that the Leica system doesn't somehow integrate with their processes and doesn't integrate well with the machine, that it's some kind of bolt-on effort, is really not the case at all.

It's pure plug and play technology. In fact, we call it "Plug & Pave!" That's exactly what it is, because as soon as we fire up our computer and are on the CAN-Bus, we recognize the G21, the G21 recognizes us, and you're ready to go pave.

If the contractor needs to go to one of the mixed-mode paving options, paving left or right grade, it's just a case of them selecting the appropriate mode on the G21, restarting the G21, running that new mode and away they go. It's really just press a button and flip a switch.

Learning how to operate the system takes 10 to 15 minutes

It's complete rubbish for anyone to say the average operator won't be able to handle this system, that it's too complicated for them. Why would GOMACO be the market leader if their products were too complicated for people to use? And why would Leica be the world's leading surveying equipment manufacturer if no one could switch on our total stations? You just have to have a team of guys that are willing to go through the learning curve, because there is a learning curve involved.

As far as training the machine operator... it takes us no more than 10 to 15 minutes to get the operator up to speed on what needs to be done. You used to pave in dual-grade left or dual-grade right – now press that button one more time and the Leica mode comes up.

On our Leica system, there's only three or four buttons the operator really needs to know. Those are start, stop and offsets so he can change the position and attitude of the machine on the fly if he needs to adjust for concrete variances.

Once our system is up, measuring, and sending steer and grade commands to the G21, the operator just has to remember to put the G21 into the Leica mode before he goes to pave and everything is the same as it would be on string. All he has to do is occasionally glance an eye over the Leica computer to see that everything looks sensible.

Remember, if there's an issue, a red warning light flashes on our system and the machine stops. The operator has to take a quick look at the diagnostics on the G21 and it displays something like "Leica stopped tracking, reset Leica." It won't let him start paving again until the diagnosis is dealt with.

It is a new way to pave, but our customers get comfortable with it very quickly. Once they've gone through that learning curve, the world is their oyster and they never want to go back to stringline.

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