

RUNWAY CONSTRUCTION TAKES OFF



Spaceport America Conceptual Images URS/Foster + Partners

Machine control equipment boosts grading and paving at Spaceport America.

BY DANIEL C. BROWN

In a remote desert area 35 miles southwest of Truth or Consequences, N.M., a showcase for space tourism is beginning to taking shape. Spaceport America, the world's first purpose-built commercial spaceport, is designed to launch and land specialized aircraft into suborbital space. The \$198 million project, financed by the state of New Mexico and Dona Ana and Sierra counties, will also serve as the headquarters for Virgin Galactic, billionaire Sir Richard Branson's space enterprise.

Thanks to some space-age machine control equipment from Leica Geosystems for the grading and paving, David Montoya Construction of Alameda, N.M., is on pace to wrap up construction of Spaceport's \$27-million runway in July—nearly two months ahead of schedule. This is Montoya's first project using Leica Geosystems' machine control products.

“Machine controls are the reason we’ll beat the schedule,” says David Guerra, superintendent for Montoya.

Model Approach to Grading

In September 2009, Montoya began grading the 10,000-foot concrete runway and two attached taxiways, carving them from the red sandy clay of southern New Mexico.

Montoya attacked the site with an all-Caterpillar fleet, including 12 Model 623 scrapers, two D9 dozers, and three motor graders—two 140H units and one 14H grader. Two of the motor graders, a 140H and the 14H, were controlled by Leica PowerGrade 3D GPS systems, and Montoya set up a Leica PowerBox as the base station for the site.

Leica’s on-site service representative, Anthony Cerisano, built a digital terrain model (DTM) for the runway. The DTM is entered into computers onboard the motor graders, and satellites send signals to both the base station and receivers onboard the motor graders. Through radio communications, the base station corrects the signals sent directly to the graders. A computer onboard each grader discerns the position difference between the DTM and the grader blade and controls the blade accordingly.

Using this technology, crews excavated 300,000 cubic yards of excess soil from the runway site. Next, Montoya removed an even 1-foot layer of soil from the runway and bladed it to the side.

“Then we scarified the bottom foot of the subgrade, added water and used two Caterpillar graders to mix the subgrade to 11 percent moisture,” says Guerra. “We compacted that with two single-drum Caterpillar rollers. Once we achieved the desired density on that layer, we bladed the 1 foot of material back onto the grade and repeated the process.”

Guerra says the Leica PowerGrade 3D GPS systems saved time compared to using stakes. “With the blades, we have doubled our production, easily,” he says. “We don’t have to set out blue-tops. The operator has full control of his elevation; he can use a higher gear to finish the subgrade.”

For trimming the subgrade, Montoya used a Gomaco 9500 trimmer, working 16 feet wide. A Leica PaveSmart 3D system, based on a robotic total station, automatically controlled the trimmer’s elevation.



A Leica PowerGrade 3D GPS system controls a Caterpillar 140H motor grader. The system doubled production on the 10,000-foot runway at Spaceport America in New Mexico.

“The machine control that really, really saves time is the Leica robotic total station on the trimmer,” Guerra says. “I can increase my production by 300 percent on the trimmer, compared to motor graders. We figure that a good finish blade operator can do 2,000 to 3,000 square yards per day. It takes multiple passes. But with the trimmer, you do one pass, and it’s finished. You can finish 10,000 to 11,000 square yards per eight-hour shift, cutting 2 inches deep.”

Staying in Control of Paving

Once the subgrade was complete and trimmed, Montoya used Leica’s PaveSmart 3D system with two Leica TCP 1201+ robotic total stations to control a new Guntert & Zimmerman S850 paver to first place a 6-inch layer of soil cement. After that was laid and trimmed, paving began.

In a similar manner to the GPS system, Leica’s PaveSmart 3D bases its guidance on a DTM that is entered into a computer onboard the paver. The paver also has two prisms, mounted above the machine, to receive signals from the two robotic total stations set up on tripods ahead of the paver. The prisms on the paver have a relation to four points on the slipform concrete paver’s pan, which extrudes concrete for the runway.



The all-new paving spread for Spaceport America consists of a placer-spreader, at left, followed by the paver and a texture-cure machine.

When setting up the two total stations, a technician back-sights each of them to three known control points. That fixes the location of the total stations relative to the runway's DTM. The total stations can then "see" two prisms on the paver and communicate to the paver—by FreeWave radio—the paver's precise location. The onboard computer then processes the differences between the

If he had been using stringline, Guerra says he would have used one stringline for the placer-spreader and another one for the paver. Both stringlines are time-consuming to set up.

"I'd say that machine control saves us at least 50 percent of the time it takes to use stringline," says Guerra.

While paving, Montoya used four robotic total stations to control the paver, but only two are active at one time. Two stations are set 500 feet ahead of the paver, one on each side of the paving lane. Those two control the paver while the next two wait 1,000 feet ahead for the paver to catch up. When the paver passes the first two stations, the second two take over, and the first two stations are then leapfrogged out ahead. That way the paver never stops, says Cerisano, Leica's on-site service representative.

To control the paver, Montoya uses two workers. The paver operator reads the paver's computer to check elevation and steering, and the main quality control worker handles placement of the robotic total stations and supervises the operation. Guerra says he is getting accuracies of plus or minus 0.005 foot on the concrete slab.

"We've been paving about 2,300 cubic yards of concrete per seven-hour day," says Guerra, though he added he thought they'd be able to pave up to 3,000 cubic yards per day once some problems with the concrete batch plant were fixed.

Guerra says crews pave every other 33.3-foot lane to start with, then come back and fill in the lanes between those first paved. After each lane is paved, crews saw-cut the centerline and cut transverse joints at 15-foot intervals down the slab. Dowel bars are placed for load transfer on 15-inch centers in both the transverse and longitudinal directions. Because the G&Z paver does not have a dowel bar inserter, dowels are set ahead of the paver in baskets nailed to the asphalt base.



Two prisms, attached to each side of the Guntert & Zimmerman S850 paver, receive signals from the two robotic total stations set up on tripods ahead of the paver.

actual paver location and the DTM. Knowing those differences, the computer controls the paver pan location automatically.

Leica's PaveSmart 3D system also controlled the Gomaco 9500 for handling the trimming chores after two DD-130 Ingersoll Rand rollers compacted the soil cement. The trimmer placed the grade to within plus or minus 0.5 inch.

Another way Montoya used Leica's PaveSmart 3D was to control the steering on the Guntert & Zimmerman PS 1200 placer spreader.

That GPS system works the same way that the one controlling the motor graders does. A Leica PowerBox onboard the placer processes satellite signals, discerns the difference between the placer's actual location and the DTM and steers the machine accordingly. The GPS system steers the right front leg of the placer, and the other legs are a slave to the right front one. The placer-spreader's operator controls the machine's elevation by conventional controls.

No Strings Attached

Because of the machine control systems, Montoya eliminated the labor normally spent performing a detailed survey of a runway and setting up stringlines for paving. Typically, a concrete paver is controlled by two stringlines set at precise locations on each side of the lane being paved.

Geared for a Smooth Ride

Guerra says he bought the Leica machine control equipment, including six TCP 1201 robotic total stations, because he wanted a system that was independent of the paver and simple to use. The total stations, their tripods and the required radios and batteries are easy to move on and off of the project, he says.

"Leica equipment is ... really accurate, and we have received excellent technical support from the company," Guerra says.

Most space tourists will not know that machine control systems helped build Spaceport America. But they'll certainly appreciate the smoothness of the runway after an out-of-this-world experience. **SP**

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