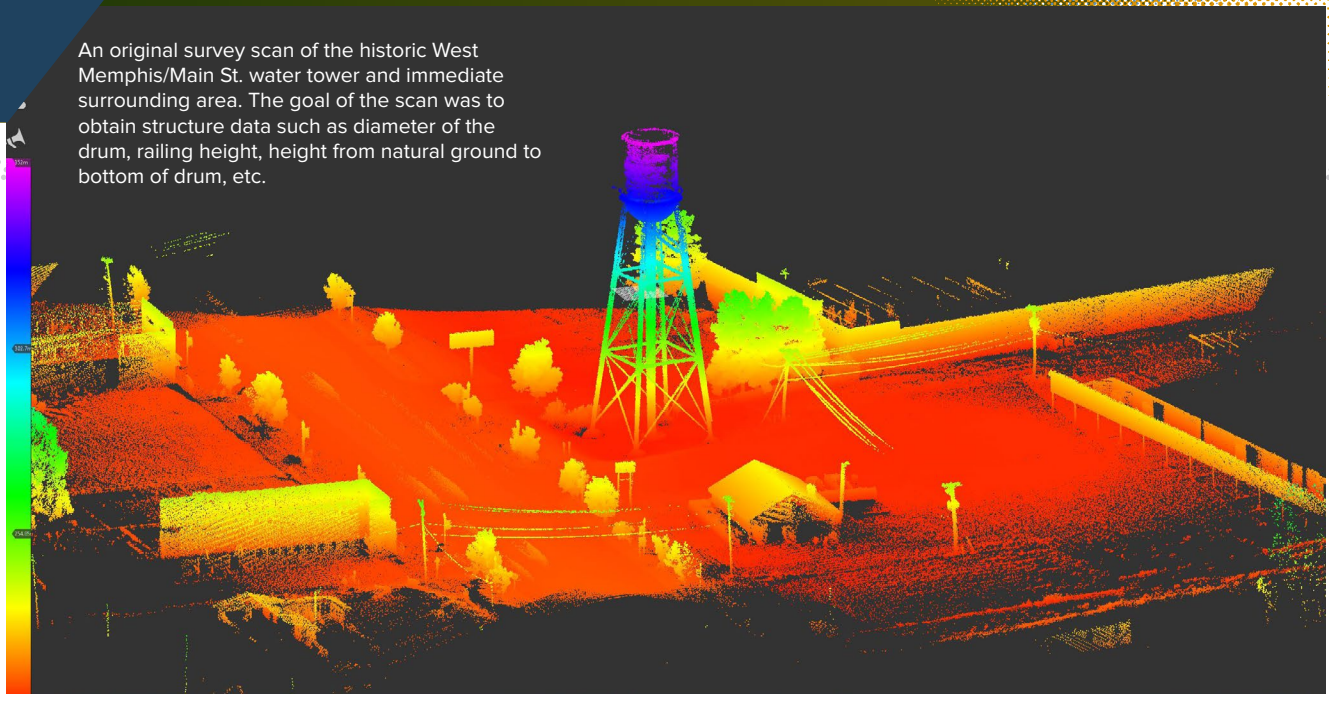
The Sorrell-Smith mobile mapping team after completing a scanning session for Arkansas State Highway & Transportation Department (AHTD). From left to right: Jerrad Burns, Jim Smith and Charlie Patton.

# BRINGING THE GOODS

## MOBILE SCANNING AN INTEGRAL COMPONENT

BY LARRY TROJAK

When Jim Smith, Jerrad Burns and Charlie Patton left the Memphis division of a major construction company in 2015, they took with them the knowledge of how to get even the most complex jobs done and what equipment could best serve them in making that happen. So when they joined West Memphis, Arkansas-based Sorrell Consulting Engineers, one of the capital investments that loomed high on their "dream sheet" was a LiDAR mobile mapping capability. They'd used the solution with their former employer and saw the inherent benefits—including increased productivity, reduced crew size and enhanced safety—it brought to the job site. Today, Jim Smith is a partner in the newly-expanded Sorrell-Smith Engineering



An original survey scan of the historic West Memphis/Main St. water tower and immediate surrounding area. The goal of the scan was to obtain structure data such as diameter of the drum, railing height, height from natural ground to bottom of drum, etc.

Consultants, LLC (2SEC), Burns and Patton are once again working alongside him, and some of the more challenging aspects of their survey function are being addressed through the use of a Topcon IP-S3 mobile mapping system. It's a new location with the same great results.

## Continuity in Mind

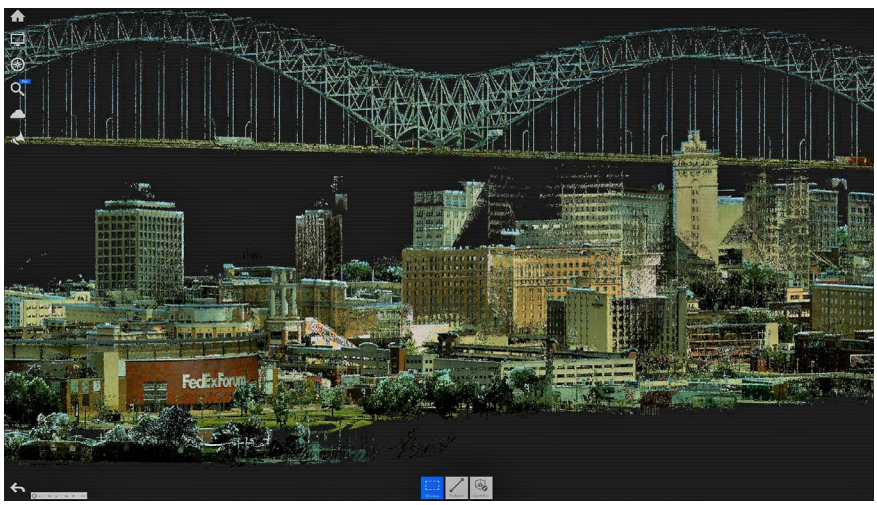
Already a successful engineering practice with nearly a quarter century of service to its clients, Sorrell Consulting Engineers was rocked in 2014 when its founder James "Dennis" Sorrell passed away unexpectedly. Jim Smith, P.E., was contacted and agreed to join as a partner in an effort to continue moving the business forward. According to Jerrad Burns C.D., Sorrell-Smith's LiDAR/Civil Engineering Technician, since the formation of the new business, the entire staff has worked together to expand the breadth of services the engineering firm offers.

"Sorrell traditionally focused its efforts on boundary survey, ALTA work, commercial site design, and municipal water & sewer projects," Burns said. "When Jim came on board and later when Charlie and I joined 2SEC, we brought with us a lot of expertise with survey in a construction-focused setting, and the type of work we've landed reflects that. Some of our current projects include work on a Union-Pacific rail line extension, a number of bridge projects on I-40, site improvements to a major greyhound race track, design for hotels and warehouses and more."

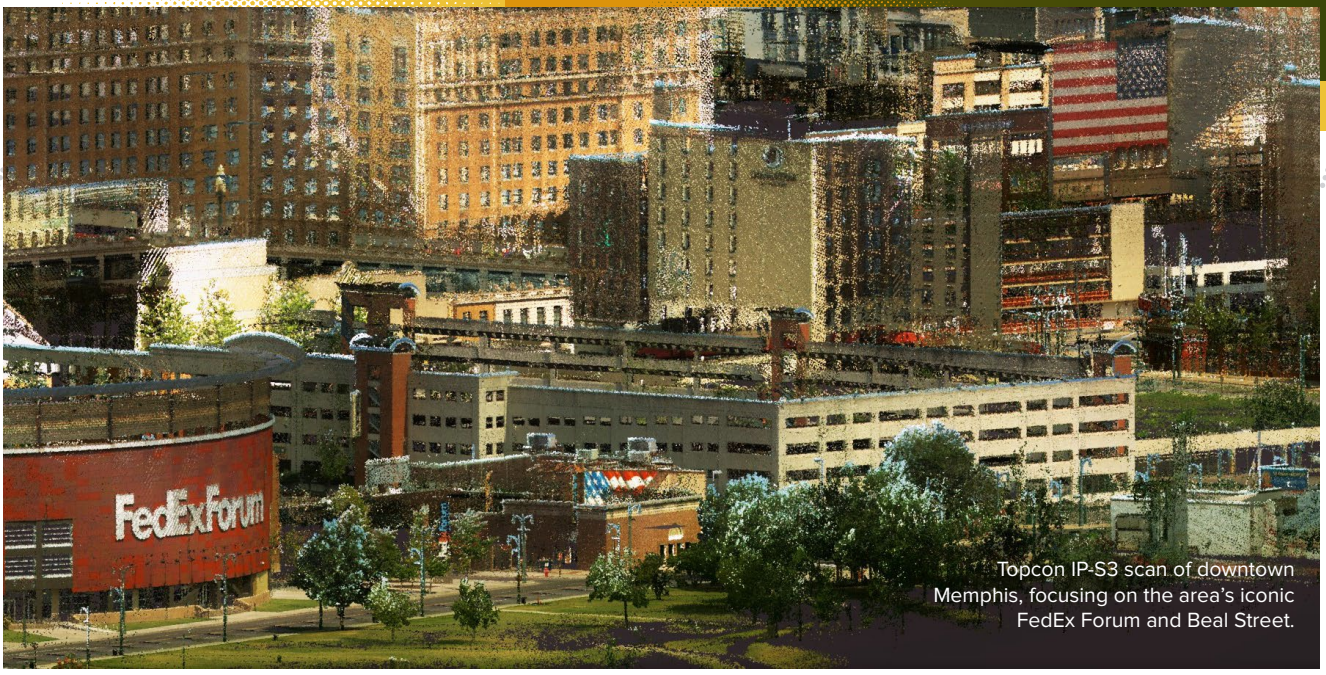
Also important to note in the evolution of Sorrell-Smith is a relationship the firm has established with local and regional contractors, companies with which the group had worked closely in the past. "It was just natural for those contractors to use our services and for us to recommend them whenever possible," said Burns. "This has helped us build some very solid and complementary relationships."

## When I'm 64

That mutually-beneficial attitude recently resulted in 2SEC landing a subcontract with local firm Crisp Construction. That project called for all




Sorrell-Smith's scan of downtown Memphis as viewed in Autodesk Recap. The scan was taken both for future in-house construction design projects and to use the data gathered for GIS purposes.

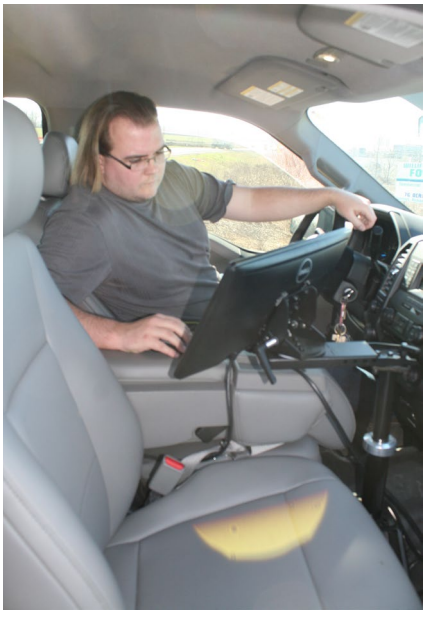



Topcon IP-S3 scan of downtown Memphis, focusing on the area's iconic FedEx Forum and Beal Street.

the grade calculations and construction layout work for a six-mile reconstruction project on Highway 64, a major east-west thoroughfare in eastern Arkansas. According to Burns, the job was similar to one that they'd done with their previous company, which helped direct their approach to handling it.

"The size of the project dictates that it can be handled one of two ways," said Burns. "Obviously, we could allocate several crews to tackle the survey along the six-mile route; which would be very time-consuming and draw our resources away from serving our other clients and their projects. When we faced a similar situation a few years back, we opted to replace the manual survey effort with one that employed mobile mapping and it was a huge success on so many levels. It was so impactful, in fact, that we knew we wanted that capability when we came to 2SEC."

In March 2016, led by Jim Smith and working through the Earl Dudley group in Birmingham, Alabama, Sorrell-Smith purchased a Topcon IP-S3 mobile mapping system which it currently has at work on the Highway 64 project as well as on other survey-intensive jobs the firm has undertaken.



**Above:** Jerrad Burns monitors raw data collection using Topcon Mobile Master Field software.

Sorrell-Smith's Charlie Patton and Jerrad Burns prepare the Topcon IP-S3 for a scanning session.


**Right:** Sorrell-Smith's mobile mapping system in operation near a UP rail line in West Memphis, Ark.


A processed visual scan of a local elementary & high school. Sorrell-Smith used the scan as part of a presentation to students for a successful career day event.

"We are only in the early phases of the highway job," said Burns. "But so far we've used the IP-S3 to obtain our original data—essentially taking the existing centerline and edge of pavement grades to get the existing profile. From that point, we create a smoother surface that we convert into the model that will power the Topcon 3D machine control systems in Crisp Contractors' machines. We will also use the mapper during the final survey to obtain the cross sections needed for earthwork calculations. Based on past practice, we know what this technology will be giving us as we move forward: among other benefits, the ability for one man to get in a single LiDAR session what two full crews would generally need a week to get—and in a much safer working environment."

## Loaded Pickup

Smaller yet more powerful than its predecessor, the Topcon IP-S3 which 2SEC has embraced gathers high density, ultra-precise, point cloud data and combines it with high resolution panoramas. Using a positioning system that integrates an Inertial Measurement Unit (IMU), GNSS receiver (GPS and GLONASS) and a vehicle odometer, the IP-S3 provides precise positioning and attitude—all from the back of the company's Ford F-150 pickup. A rotating LiDAR sensor captures the environment at a rate of 700,000 pulses per second. During each rotation, 32 internal lasers cover the full 360 degrees around the system, each from a slightly different viewing angle. Doing so, not only minimizes gaps in the point cloud which can arise from obstacles or dead-angles, it also eliminates the need to install multiple scanners.

On the railroad extension project referenced above, 2SEC used the IP-S3 to determine the clearance heights of area power lines; the location of relevant signage (x/y/z for stop signs, rail crossing signs, road signs, business signs that are within the right of way, etc.); existing topo; curb around railroad intersections; clearance and drape line of trees; coordinates for important markings such as stop bars, and rail crossing markings; and more.

"This was a very thorough session in which we also scanned and documented the top and bottom of the slope of the rail line's road bed—we tried to get as much as possible," said Burns. "We learned early on using this technology that it is best to go well beyond the basic needs of your scan. There's nothing worse than having the client change their mind about a need or a location and finding yourself without that info because you didn't take the five extra minutes to scan. A good rule to live by is: 'Better to have more data than not enough.' We are also fortunate to be a subscriber to Earl Dudley's iNET CORS network which already has an impressive presence in Alabama, Georgia, and Tennessee, and which we've been helping expand here into eastern Arkansas. Now instead of setting up a base station prior to a scanning session, we simply log onto iNET, tell it to start recording at one second intervals from RTK data, and start driving."

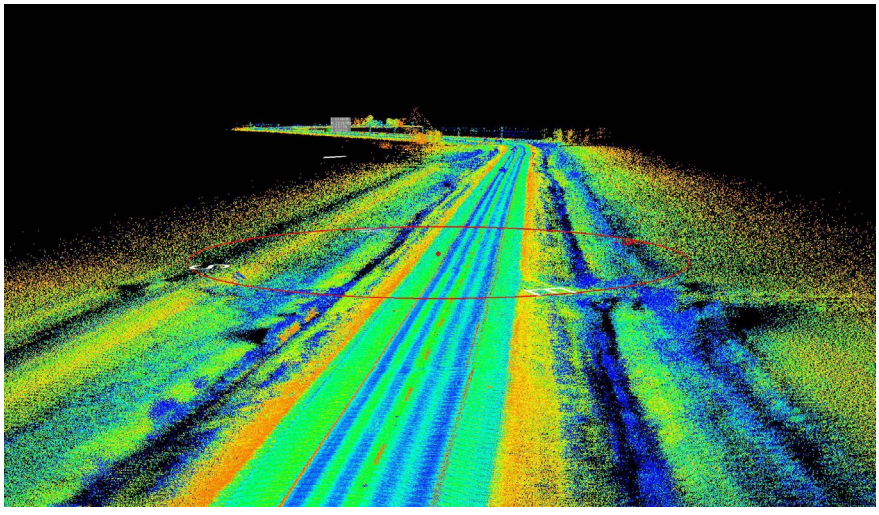
## Smooth Flow

With the necessary targets scanned using Topcon Mobile Master Field, the IP-S3's proprietary scanning software, data is transferred to a solid state drive and brought into Sorrell-Smith's office for post-processing. Once there, it is imported into Mobile Master Office (MMO) as a TPS file to optimize the data and export individual scans.

"We use that TPS file along with the RAW scan from the IP-S3 to align the trajectory. Once the TPS has been matched with the LiDAR data, the images are stitched together, at which point we bring in our ground control points and do a SLAM (Simultaneous Localization And Mapping) correction algorithm. From there we export into the Virtual Geomatics (VG) for orientation; essentially the goal is to match targets that have been shot by our field surveyors. VG is also used to create a topo as well as to drape lines for conversion into shape files to export to CAD."

At that point, using either AutoCAD or Carlson Civil 3D, Burns said they import the VG-generated shape files that have been laid over the data and convert them to profile lines. Also handled is the task of bringing in any hard break lines, importing ASCII point files, and creating TIN surfaces from the VG data.

"I take those hard break lines or profile lines and convert them into 3D poly lines—in an LN3 format—and create a TIN for model usage," said Burns. "While all this post-processing is taking place, Charlie Patton, our head surveyor, goes to the job site, creates job control and sets up a GC3 calibration file using either Topcon Pocket 3D or MAGNET Field. Once the model has been QA'd/QC'd, I incorporate Charlie's job control and join them together. At this point, we are ready for field check, then, with that verified, we are ready to make it a deliverable to our client."



Raw Lidar scan data for an AHTD project being processed through Topcon Mobile Master Office.

## Taking Flight

The current lineup at 2SEC includes three members of the original company: Rick Sorrell, design/drafting; Jesse Thweatt, survey/inspection, and office administrator Michele Miller. The staff has been bolstered with the addition of Jim Smith, Jerrad Burns and Charlie Patton, as well as by Michael Caster, also a survey/inspector.

"Based on the workload we've undertaken—and the reputation we've developed over the last couple years—we have every reason to believe that we will be staffing up even further, particularly on the survey side of things," said Burns. "But we also know that technology has been key in helping us get to where we are now. So we've been looking at additional moves to keep that momentum going, including the use of unmanned aerial vehicles or drones. Much like the success we've had with our mobile scanning efforts, we can see that solution taking us to the next level in areas such as bridge inspection, massive-acre surveys, mining, inventories, and so on. In fact, we've already been talking with Topcon about the options available to us in that area. We have an outstanding group in place here at Sorrell-Smith Engineering Consultants, we've made some outstanding progress to this point and, as cliché as it sounds, we are genuinely excited for what's in store for us as we move forward." ■

**Larry Trojak** of Minnesota-based Trojak Communications, is a freelance marketing content specialist. He writes extensively for the geopositioning, utility, aggregate processing, recycling, construction, and demolition markets.