

County Keeps Surveying Costs Under Control

GPS/GIS technology makes road and bridge maintenance more efficient.

By Richard Storm

Here in the Loess Hills of Northwest Iowa, the Woodbury County engineering department has its hands full.

We've got the Missouri River on our western border adjacent to Nebraska and South Dakota to the Northwest. And we've got some 1,400 miles of county roads to maintain, along with 315 bridges and a few thousand culverts and associated structures.

Our mission: to provide county residents and taxpayers with a network of good secondary roads in the most reasonable, cost-effective manner possible. With almost a \$6-million annual budget and 40 employees, nine of whom are engineers or technicians responsible for planning, inspection, design, and GIS, we're always looking for ways to improve our efficiency.

One time-consuming task that we've successfully streamlined is the surveying and construction staking required for

road maintenance and bridge replacement projects. Woodbury County has more bridges than most Iowa counties—we average about four bridge replacements a year plus trying to rebuild several more through our bridge maintenance program control—and it's especially important to be efficient in this task. Since we've recently embarked on a bridge replacement effort to add to our normal duties of road maintenance, upgrading box culverts, and resurfacing roads, this improvement has been particularly valuable.

In our quest for efficient surveying we've moved through three levels of technology in the past ten years. With each technology advance we've improved performance and efficiency. In fact, in the past ten years we estimate we've improved our surveying efficiency 20 times over. Ten years ago it took a four-person crew more than five days to do the surveying for an average-size bridge replacement. This survey tech-

nology utilizes plane survey with differential leveling along with profile leveling including: transit, steel tape, level, and paper field book. Eight years ago, using new electronic total station technology, we cut the job to 7.5 man days. Today—with the latest GPS technology advance, an affordable new centimeter-accurate, single-frequency RTK GPS receiver—we've been able to complete that same job using one person in usually less than a day and a half.

From Total Stations to GPS

For all our projects, we survey the site and prepare drawings, a site plan, and cross sections, which are used to produce plans. From these plans the project goes to bid and eventual letting. During the past eight years, we typically used a total station for this survey work. Because our surveying is based on sighting a prism and entering the data into a collector, surveying with the total station requires a three- or four-person field team. Our department is relatively small and our technicians perform many different tasks including survey, construction inspection, and auditing of completed projects. Our survey crew includes three employees who can also work as inspectors. That versatility gives us added impetus to find ways to limit how many people we need on a survey crew. We were always looking for GPS equipment that produces survey-grade results, but up to now survey-grade GPS has been too costly. We attend seminars where there are vendors with the latest technology, but equipment costs for GPS survey grade, often in the upper \$40,000s, have made the cost too high for us. But we've kept our eyes open, thinking that if prices dropped to a level



Only one field technician is required to collect real-time, centimeter-accurate survey points for a bridge replacement project.

we could afford, our productivity could increase by collecting the information and getting the project out the door faster.

In the spring 2007, with the help of our local Magellan dealer, the Sidwell Company (www.sidwellco.com), we found a totally new centimeter-accurate GPS receiver solution. It has just been introduced by Magellan Navigation, Inc. (<http://pro.magellangps.com/en/>). It not only cost about half what a comparable dual-frequency system costs, but we've found it does the job much faster and better than the total station we've been using.

We can now send just one technician (or two when safety is a concern) into the field for a day or, at most, a day and a half, and he'll come back with much better data in about a fifth of the time it took using a total station. The product we found is the Magellan ProMark 3 RTK. It uniquely uses a GNSS processing solution that employs two satellite systems (GPS + SBAS) to outperform conventional single-frequency RTK receivers to deliver real-time centimeter accuracy in a lightweight handheld system. It gives us the accuracy we need at a price around \$15,000, which is quite a bit lower than the dual-frequency survey systems that also deliver centimeter accuracy, and outperforms other single-frequency systems with initialization times on par with more costly systems.

Easy to Set Up, Easy to Use

It's remarkably easy to use and we get everything we got with the total station and much more. The ProMark3 RTK is easy to set up. Though the system can be operated in several different ways, including wirelessly receiving real-time RTK corrections in areas where a real-time network system is operational and paired with a data-enabled cell phone, we use the system as a base and rover connected by two license-free radios that are powered right from the GPS receiver. In our terrain, the radios work well to about a mile and a half, which is more than adequate for our needs. New



Ten years ago it took a four-person crew five days to do a bridge replacement survey. Today, it takes one person one day to complete the same task.

license-free radios still in development should increase our range to completely eliminate the need for static occupations in our three-mile grid reference network. After establishing a control point with static post-processed information, we just set up a base on the control and use the RTK rover to grab points. The system is particularly well-suited to our open sky and the short baseline surveys we need to do. We also just set up the base and survey if we don't need to accurately tie to control monuments.

Because we can insert the aerial photos into the ProMark3 RTK as an overlay using the FAST Survey software tools, the surveyor in the field has the advantage of seeing an overall picture of the site and its surroundings. For example, in the area around a proposed bridge replacement project, he can look into deeper ravines that are being scoured by water and locate smaller structures, such as culverts, that may be failing.

Among other benefits, our contour information is dramatically improved. With the RTK rover unit, we can just follow a contour line, an edge, and the centerline of the road, taking points in

seconds. In fact, with the ProMark3 RTK, which is relatively lightweight, allowing all-day on-the-go-use, we can log up 500 to 600 points in a day, more than twice as many points as we can with a total station. All these points and their identifying characteristics, which are within a tenth of a foot in elevation, are uploaded into the engineering design software. We get much better data into our CAD system, and that gives our designer a much more accurate picture of the topography.

GIS Capability

The ProMark3 RTK also doubles as a mobile mapping system, combining full GIS data collection and navigation software. Because of its GIS capabilities our ProMark3 also helps us in building our GIS inventory database. Building this county-wide database continues to be a huge project for us, and the ProMark3

RTK is an important tool for collecting and recording our county-wide sign inventory. As we replace signs, we record all the other signs in the area. To facilitate this and avoid duplication, the sign repair crew carries a laptop into the field running the open-source uDig GIS (<http://udig.refractions.net/>), and at a job site they review the signage on the laptop's large screen that has already been captured in the GIS system. We collect and record sign attributes, such as type of sign, post size, and replacement date. Back at the office this GIS data is transferred into our ArcView GIS (www.esri.com) program and then reflected on the field laptop.

It's no secret that road maintenance costs are on the rise and that local governments are under pressure to find every savings they possibly can. Our new Magellan system is a relatively small piece of the puzzle, but the savings add up over time, and there's no compromise in road and bridge safety. For the taxpayers of this county, that's moving in the right direction.



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