



*Volume X
Number 3*

Autumn 2000

BY DESIGN

Global Positioning Systems

Improved Technology Makes Surveying Faster, Easier & More Accurate



For hundreds of years, surveying has been an integral part of mapmaking and boundary determination. It's crucial to government planning, infrastructure development, construction and other applications. While the technology of surveying has evolved through the years, its purpose has never changed; a survey is performed to identify the locations of points on or near the earth. Global Positioning Systems (GPS) often make the task easier. Since 1991, Bolton & Menk, Inc. has used GPS as one of its surveying tools.

What are Global Positioning Systems?

GPS are satellite-based radio systems that provide position, velocity and time information to suitably equipped users anywhere on (or near) the surface of the earth. The system user receives information with a specialized radio receiver that "listens" to radio signals transmitted from satellites. The radio receiver then calculates a position based on that information. In a process known as network adjustment, previously surveyed control points are combined with the new information, by detailed computations, to ensure accurate locations.

How does this method differ from traditional surveying?

Historically, surveyors relied on optical instruments and physical measuring devices (such as tape measures or chains) to identify the location of points on the earth. While these methods can achieve great accuracy, optical and electronic distance measuring instruments require a direct line of site. The second survey or target point, in other words, must be seen from the measuring instrument. Measuring tapes or chains make it necessary for the survey crew to pass through intervening terrain to measure the distance between two points. In very rugged terrain, expensive and difficult surveys are often necessary to accurately measure between relatively close points.

Global Positioning Systems make it much easier to survey without a direct line of site. With one receiver, it is possible to know where a point is within ten meters anywhere in the world. Measurements can be taken in almost any weather conditions and accuracy is not as dependent on the skill of the instrument operator as it is with optical or physical measuring. A few obscure gaps in satellite orbits and shadow interference from buildings and trees are the system's only real weaknesses.

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Kasma Named Burnsville Manager



Mark Kasma

Mark Kasma has been named Manager of BMI's Burnsville Office. He has been with the firm since 1992 and has more than 14 years of civil engineering experience. Mark is a registered professional engineer with a B. S. Degree in Civil Engineering from North Dakota State University. He has extensive experience working with municipalities to develop and to accomplish a wide range of infrastructure projects.



Young Engineer of the Year

David Martini, Minnesota Society of Professional Engineers' Young Engineer of the Year, 2000, joined Bolton & Menk's Mankato Office, Civil Division, in June 2000. Martini is a registered professional engineer and holds a B.S. Degree in Civil Engineering from North Dakota State University. He has more than six years of experience in civil engineering.

The Young Engineer of the Year award is presented to an engineer under the age of 35 who has achieved technically and professionally, and is active in professional, civic and humanitarian activities.

Volume X Editor: Nancy Thorkelson
Number 3 Production: ENVISION: Design that Works, Inc.
Autumn 2000 Saint Peter, Minnesota

Published Quarterly by Bolton and Menk, Inc.

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BY DESIGN

Funding for General Aviation Airports Creates Options for Regional Development

As communities vie for economic development opportunities, airports play an increasingly important role in their ultimate success. Businesses looking for new locations require convenient, dependable transportation op-



A plane takes off from the Fairmont Airport, where recent upgrades have contributed to increased facility usage.

tions to thrive, and airports are increasingly near the top of their wish lists.

Recent action in Congress has made money available to upgrade general aviation airports. AIR-21, the Airports Funding Bill, was passed by Congress and signed by the President. It will increase airport grant entitlement funds for Minnesota from \$8 million to \$16.7 million. Both large and small airports may benefit from this funding increase.

Summary of Airports Funding Bill

- The amount of eligible, dedicated funding for each General Aviation airport will be based upon 20% of the five-year Capital Improvement Plan (CIP). The funding limit is \$150,000 per year. Applicants are eligible for a three-year period, or a total of \$450,000 maximum per facility. Discretionary funds are available for project costs exceeding the dedicated limits.

- Funded agencies are required to update their Airport Layout Plan. Funding is based upon 90% Federal and 10% local; this cost of \$20,000 to \$25,000 should be included in the CIP.

- Projects targeted for the air side of the facility are most likely to be prioritized for funding; revenue-generating projects will not. Mn/DOT standards for pavement construction will be allowed.

- An airport must be in the National Integrated System of Airports for funding eligibility.

If you would like more information or assistance with updating a Capital Improvement Plan, contact Ron Roetzel, 952-890-0509 or via e-mail: ronro@bolton-menk.com.

Directional Drilling in City of Lake Crystal Facilitates New Development

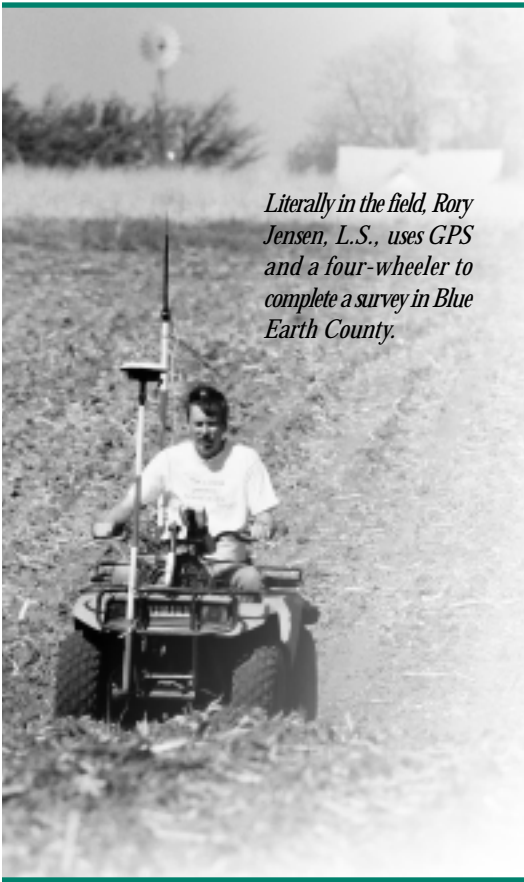
The City of Lake Crystal put plans for development of a new subdivision on hold for several years. Two geographical barriers were the cause: Crystal Lake and Minnesota Trunk Highway 60 stood between previous and future developments. Open trenching was impossible because of concrete highway pavement, and drilling under the highway was not economical because of Mn/DOT regulations.

Directional drilling made the improvements feasible. The Minnesota Department of Health granted permission to extend the watermain, the Minnesota Pollution Control Agency granted permission to install the forcemain, and licenses were obtained from the Minnesota Department of Natural Resources for the right to cross under Crystal Lake.

The project was completed this spring. Installation of two pipes required six days: three for a twelve-inch watermain, and three for an eight-inch forcemain. On day one, a 1525 foot pipe was fused together; on day two, drilling was done; and on day three, pipes were pulled through the bored opening. The contractor used three employees to monitor drilling during the process: one in a fiberglass boat, one near the shore in waders, and one operating the drilling rig.

The project, which also included a large regional lift station, wetland permitting and replacement, grading and other improvements, made possible a new forty-three lot subdivision, which is phase one of a larger development plan.





Literally in the field, Rory Jensen, L.S., uses GPS and a four-wheeler to complete a survey in Blue Earth County.

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How is GPS making a difference for cities and counties?

When Bolton & Menk began using GPS in 1991, signals were received in the field from four satellites and calculations completed later in the office. A known point was used to figure corrections, and adjustments were made on the other three points accordingly. While the process was somewhat cumbersome, GPS made it possible for the first time to accurately measure distances up to thirty miles. Advancements in GPS technology have continued to streamline the surveying process and improve services. Corrections are now made immediately in the field and broadcast to other points in real time, which makes field calculations accurate at a distance of up to seven miles. GPS contributes to the operation of a Geographic Information System (GIS),

software that creates "intelligent" maps and information data bases for planning, zoning, and infrastructure maintenance for cities and counties.

Bolton & Menk's GPS manager, Peter Blethen, L.S., says the systems will continue to improve surveying and in turn, the ability of clients to access and use important information. "A portable receiver and four-wheeler now make it possible for us to do five hundred acres of topographic mapping in two days — a process that took two and a half weeks in the past." Through GPS methods, surveys and infrastructure data can be more easily tied to a state or national coordinate system, allowing clients to better manage community-wide facilities and plan cost-effective improvements.

As GPS technology grows more accessible and user-friendly, these systems will become an increasingly important tool for the full range of surveying services required by both the public and private sectors.

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FIRST CLASS MAIL
U.S. POSTAGE
PAID
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Permit No. 110