U.S. Department of Transportation
Federal Highway Administration

Priority, Market-Ready Technologies and Innovations

Global Positioning System (GPS) Surveying

Problem: Surveying land areas for highway infrastructures is time- and labor-intensive

There are considerable costs associated with conventional surveying technology. Methods are time-consuming and often require multiple trips to the same site to gather data and to ensure the collected data is accurate. In addition, workers must be trained to operate conventional surveying equipment properly. Weather also can delay data collection and highway surveys; crews are not always able to work under certain weather conditions, such as snow, rain, or extreme temperatures.

The Federal Highway Administration (FHWA) recognizes the importance of increasing survey accuracy while reducing labor costs and improving efficiency—addressing this problem is one of the Agency's top priorities.

Putting It in Perspective

- It takes many days to survey small sections of road using traditional techniques.
- Complete road inventories may take years.

Solution: GPS increases survey accuracy, improves productivity, and reduces costs

Over the past 5 years, studies across the United States have shown that GPS technology increases the productivity of conventional survey crews, reduces data collection time, improves survey accuracy, and allows crews to work under a broad range of weather conditions. Moreover, less expertise is required to operate a GPS surveying unit than is needed to operate conventional surveying technologies.

What is GPS?
GPS is a space-based, radio-navigation system that provides worldwide, all-weather, three-dimensional position, velocity, navigation, and time data to both civilian and military users. Potential uses for GPS within the highway community are diverse and range from providing traveler information to mapping (GPS technology can be integrated easily with Geographic Information Systems).

How does it work?
GPS can provide a very accurate digital map of the highway infrastructure. The technology operates on the principle of triangulation—if the difference from an observer to three known points can be measured, the position of the observer can be calculated. The system includes at least 24 satellites in orbit 19,320 kilometers (12,000 miles) above the earth and inclined at 55°. These satellites continuously broadcast their position, a timing signal, and other information. By combining the measurements from four different satellites, users with receivers can determine their 3-dimensional position, currently within 4–20 meters (13–66 feet).

Successful Applications: Research indicates improved survey accuracy and reduced costs

The Utah Department of Transportation found that one person operating GPS equipment is generally twice as fast as a conventional survey crew, and a GPS system with two units is potentially four times faster than crews using conventional surveying technologies. Other advantages of GPS technology include the ability to use the technology across long distances with minimal setups. After a GPS system is placed, roving can be performed within a radius of 10 kilometers (6 miles) of the stationary base unit. Using conventional technologies, the base unit would have to be moved every 183 meters (600 feet). In one study, GPS equipment recorded 5,511 topographic points in 30 person-hours, while a similar project using conventional technologies covered only 1,500 topographic points in 120 person-hours.

Utah, Michigan, and North Carolina are the lead States of the American Association of State Highway and Transportation Officials' Technology Implementation Group (TIG) initiative to champion GPS for surveying applications. Plans include hands-on demonstration workshops and training programs for agencies that plan to apply GPS to surveying efforts. The GPS TIG group also is considering developing national standards and protocols for GPS programs.

Benefits

Compared to conventional surveying technology, GPS:

- Is faster.
- Requires less labor.
- Requires less training.
- Is more accurate.

Additional Resources

Additional information on GPS surveying technology is available at **www.aashtotig.org**

For more information, contact:

John McCracken, FHWA Office of Research, Development, and Technology
Phone: 202–493–3422
E-mail: john.mccracken@fhwa.dot.gov

Charlie Brown, North Carolina DOT
E-mail: charliebrown@dot.state.nc.us

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