

• Mapping

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perpendicular to the earth. The plumb bob is held against a frame that parallels the surface being measured. Although it's mostly been replaced by computerized equipment, it's one of the many tools used by civil engineers.

Civil engineering can include a variety of tasks, such as drawing up blueprints, designing municipal sewage systems or laying out a new subdivision, as well as dealing with clients, the community and various regulatory agencies. Anything that needs to be done to a piece of land before the construction crews and contractors come in usually falls under the umbrella of civil engineering.

"There's really not a typical week," Jerry Ott said.

They have designed water towers for Trafalgar and New Whiteland, mapped out a water line expansion for Franklin, helped upgrade sewer systems, as well as drawn up the

blueprints for retail spaces, subdivisions and government buildings.

"Cities and towns are the foundation of a lot of the work I've done," Jerry said. "I did a lot of work for Franklin under Mayor Blankenship before they hired a full time engineer."

Brad's love is land surveying. He takes an empty plot of land, such as acreage for a subdivision, and uses a variety of instruments to plot out a blueprint.

Brad, who is the president of the company, uses a computer program



Brad Ott and his Robotic Total System.

called AutoCAD to put his calculations on paper. All the contractors that work in the subdivision use the blueprints, whether they are paving the roads or pouring foundations.

"We have to figure out what's there and what they want. We look at grade, land features," Jerry Ott said.

Legal issues

The Otts have to take local laws into account, such as property setbacks, easements or flood plain rules, to lay out where a subdivision's roads and property lines will be. Brad must make sure the developer is prepared to discuss his design with local government officials, who will want to make sure the plans are up to code.

Jerry said just about every building project has legal issues involved. A large road project, for example, may have eminent domain issues. A town's new sewer system may include working with the Indiana Department of Environment Management to make sure the system will meet clean water regulations. For any government-sponsored projects, civil engineers also play a role in preparing the required Environmental Impact Statement.

"There are approval agencies at federal, state and local levels," Brad Ott said.

"We have to help out in a quasi-legal manner, but we are not attorneys," Jerry Ott said.

Government regulations have changed a lot during Jerry's 30-year career.

Jerry remembered the 1970s, when the federal Clean Water Act went into effect and he helped the city of Greenwood overhaul its sewer system. The city eliminated two wastewater

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From plumb bobs to GPS

Surveying — the science and art of determining or establishing the relative positions of points above, on, or beneath the surface of the earth — has been around since 1400 B.C., when the Egyptians first used it to accurately divide land into plots for the purpose of taxation.

Later, the Greeks developed the science of geometry and were using it for precise land division. They are credited with developing the first piece of surveying equipment, a dioptra, which is a lens used to visually measure distances, and the plumb bob, a lead weight hung on a line to help the surveyor determine a vertical line as a reference point.

Greeks also created standardized procedures for conducting surveys.

The history of the field is what appeals to Brad Ott, president of Main Street Consulting, Land Surveying and Engineering in Franklin.

"I like the history, rethinking the old surveyors' steps. It feels good to be able to follow through with what they'd done," he said.

He said he still carries a plumb bob on his belt for sentimental reasons. Plumb bobs are still used in the construction industry, but modern, computerized equipment has replaced them in the surveyor's tool box.

Thomas Jefferson

On large projects, surveyors must take the curvature of the Earth into account when making their maps.



is credited with the first plan to lay out the United States and the public land system in 1802, Ott said.

That was the beginning of the industrial revolution and the importance of "exact boundaries" and the demand for public improvements such as railroads, canals, roads brought surveying into a prominent position, according to Purdue University.

More accurate instruments were invented. The "spirit level" replaced the plumb bob and the sciences of geodetic and plane surveying were developed.

Geodetic is the science of determining the shortest lines between two points on a curved surface, such as the earth.

Today, it is used when surveying large areas, usually more than 300 square feet. Plane surveying, which pertains to flat surfaces, is used to survey smaller areas, such as a subdivision or new industrial park.

"Jefferson was smart enough to follow the curve of the earth," Ott said.

Indiana, along with much of what was considered the "West" back then, was laid out in 36-square mile townships. The central point, or the fixed point from which the township lines were drawn, was in Paoli.

They used 4-inch, 3-foot tall wooden posts to mark the boundaries, but after they began to rot away, surveyors used rocks to mark the section and township lines.

"They originally did it with compasses and chains that were 66 feet long," said Jerry Ott, Brad's father and also a civil engineer. "That's how they

measured through wild lands. They blazed a trail, there were no roads, and set the stone."

Geographical features and politics have changed today's townships, Jerry Ott said. They are no longer perfect squares, but they once were.

Today, surveying affects just about everything in our daily lives. Surveyors used their skills to map the earth above and below the sea, prepare navigational maps for land, air or sea, establish boundaries of public and private lands, develop databases for natural resource management and to develop engineering data for bridge construction, roads, buildings and land development, according to Purdue University.

The Otts said another significant change in the field is equipment.

"Thank God for computers," Jerry Ott said.

In the past, calculations would have to be done on a basic calculator, which cost \$800 when it first came out and blueprints were drawn by hand. Now, a program called AutoCAD will do them.

The plumb bob has been replaced by the robotic total system. It can be programmed, carried to the survey site and set up on its tripod. It creates a reference point from a prism, also set by the surveyor, and makes the measurements according to the section coordinates of the plot of land being surveyed.

The next new tool for surveyors might be global positioning systems, which Brad expects to see more and more of.

"We'll probably buy one in the next five years," he said.

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