A bnp media Publication
AUGUST/SEPTEMBER 2011 | WWW.SITEPREPMAG.COM
VOLUME 5 | ISSUE 6

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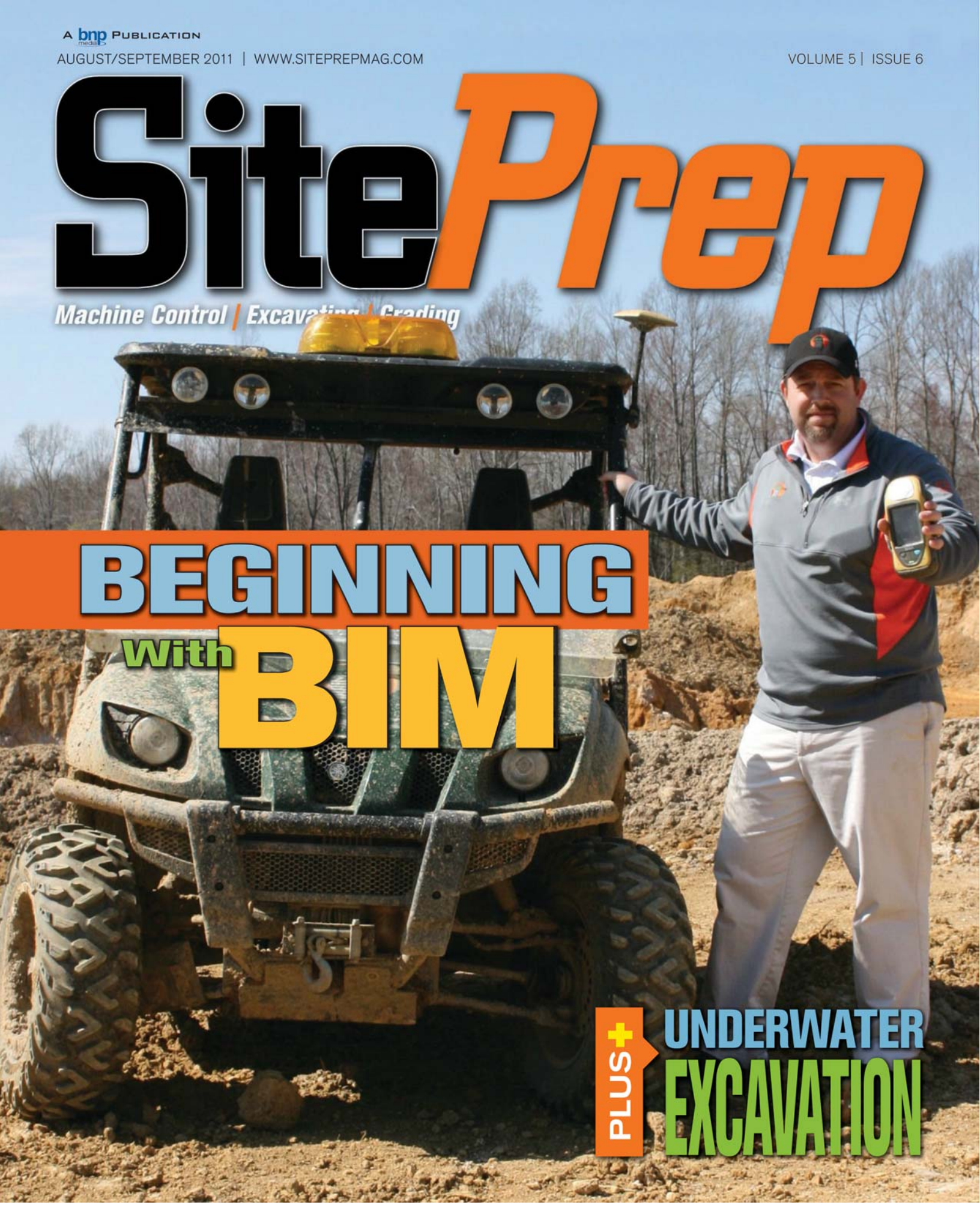

BEGINNING With BIM

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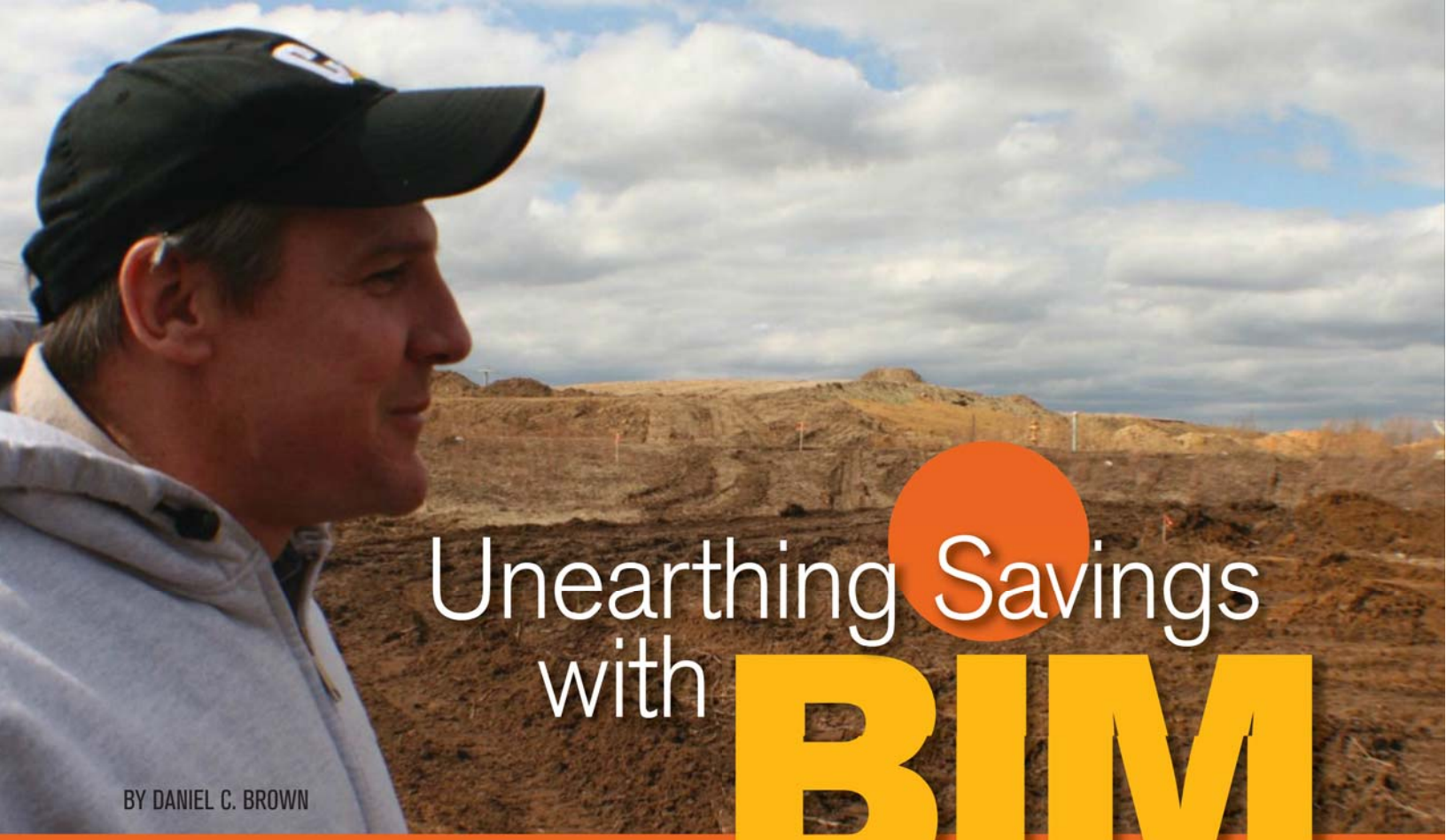


Unearthing Savings with BIM

BY DANIEL C. BROWN

Maryland site development starts with 3D modeling, integrated project delivery.

In its traditional sense, most construction professionals think of Building Information Modeling (BIM) as pertaining to modeling of the actual vertical structure.

But in reality, BIM goes far beyond the building. In fact, a construction team in Maryland is using both BIM and integrated project delivery to achieve savings during site development.

St. Charles is a 9,100-acre master-planned community in northern Charles County, Md. The project developer, American Community Properties Trust (ACPT), has entitlements to build 24,730 housing units in a total of five villages. Approximately 13,400 residential units have been built to date, with about 55 percent of those units consisting of single-family homes, 25 percent townhouses and 20 percent apartments. The project is using BIM to forego the use of a general contractor, provide earthwork estimates and perform progress reports.

"The civil engineering community looks at BIM as if it is only a vertical buildings concept," says Frank Duduk, partner at SmartSite, the construction manager for the project. "And we do not see it that way at all."

Mark MacFarland, vice president of land development for St. Charles Community, says the project is saving 15 percent by using these techniques. And the key to the savings at every step is the BIM model.

Construction manager SmartSite, located in La Plata, Md., hands off the 2D plans to MESH Consulting of Limerick, Pa., for creation of the 3D model. Steve Thomas, P.E., a partner at MESH Consulting, says his firm gets involved early—when the design and approval process is about three-quarters complete. MESH uses a combination of different software packages to complete the model.

"In addition to Trimble's Terramodel, we use Carlson Software's Takeoff and AutoCAD Civil 3D to create the model," Thomas says.

SmartSite then uses the model to break work into bid packages, lets them for bidding, manages construction and makes progress payments to contractors. SmartSite takes separate-phase bids from contractors at the same time as the firm gets lump-sum bids from general contractors.

An Alternative to a GC

One of the ways the project is realizing savings is by not using a general contractor, MacFarland says.

"Instead of hiring a general contractor, we hire a dirt contrac-

ABOVE: Steve Thomas, P.E., a partner at MESH Consulting, checks on the progress at St. Charles Community, a 9,100-acre master-planned community in northern Charles County, Md. MESH created a 3D model of the project.

tor, and someone to do the sewer system, and someone to do the water system, and so forth," he says. "We are taking bids from contractors in each category and using the 3D model—especially on the dirt side—to give us accurate quantities throughout the bidding and construction process, minimize double-handling of dirt and reduce the risk of quantity mistakes by the contractors. We really get the best price possible."

MacFarland says they've used this approach on two projects in the community so far, a 117-unit single family home project and a 75-townhouse project. "On both of those projects, our integrated approach produced a total cost of about 15 percent below the GC bids," he says.

Plus, MacFarland says this method gave them a better way to control costs. "I think change orders were under 2 percent for both projects," he says.

MacFarland says they continue to see savings at St. Charles using this approach. In late February, SmartSite took bids for a new neighborhood called Glen Eagles. The lowest general contractor's bid was just less than $3 million. "When we compared that to our integrated approach bids, the total—with comparable scopes—was about $2.65 million," MacFarland says.

Finding Savings Inside the Model

Another benefit of the BIM modeling process is that it gives contractors some assurance that the earthwork quantities they're given at bidding time are accurate. SmartSite's Duduk says the process produces fewer risks for the contractor and subsequently results in lower bids.

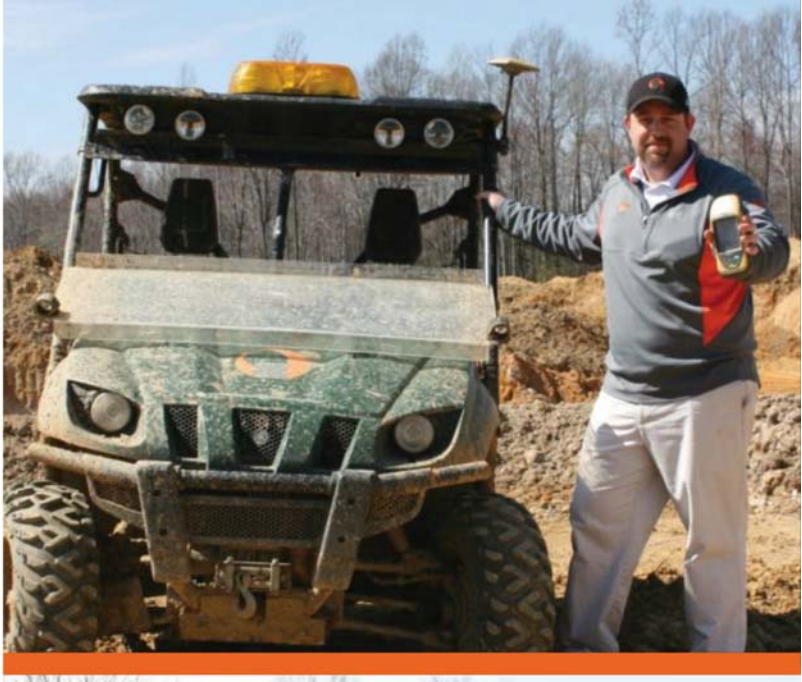
"We commission MESH Consulting to split the model into scopes of work in a highly detailed manner," Duduk says. "That way the information is at a construction level of accuracy, it is at a survey level of accuracy, and it is at a budget level of accuracy."

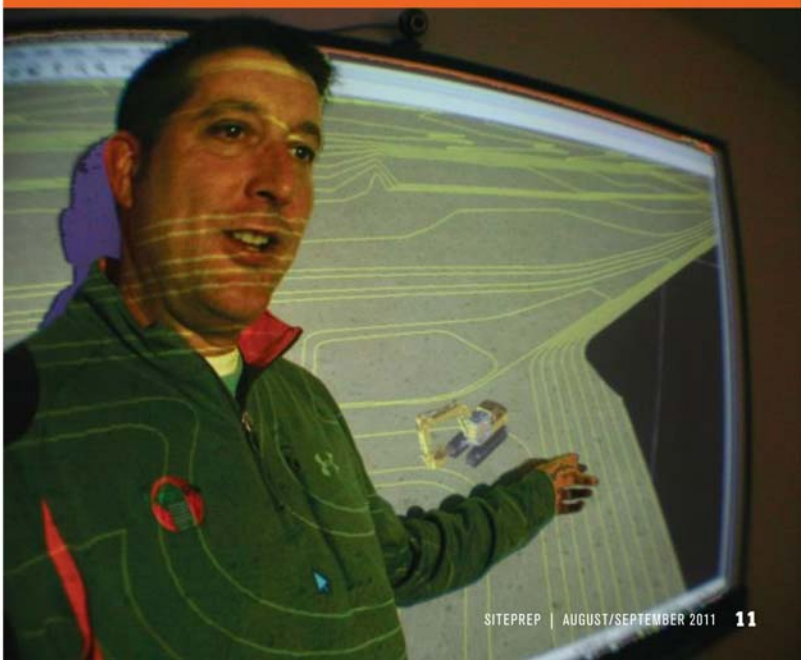
MESH first creates what Thomas calls the value engineering/estimating model. It provides quantity information and is used to look at ways to save money, such as in earthmoving.

"It does not have the detailing necessary for construction, but it has plenty of detail for accurate take-off quantities," Thomas says. "We report those quantities to Frank Duduk at SmartSite and go back and forth with him through some value engineering ideas and exercises."

Thomas says the value engineering/estimating model includes four different surfaces: existing (based on existing contours), the interim grade, the structural surface and the final lot grade.

"The original engineer designs the final lot grades based on a fictitious house footprint," he says. "Then they come up with





TOP: Frank Duduk, partner at construction manager SmartSite, uses a Topcon GRS-1 rover to conduct topo checks on the St. Charles project. MIDDLE: Pablo Aparicio, GPS technician for SmartSite, collects points at the St. Charles development. BOTTOM: SmartSite partner Pat Hobbs shows the machine's location on MESH's 3D model during a grading simulation.

some finished grades for that house footprint and determine where they need to leave the lot grades to balance the basement spoils following house construction. This process results in the interim grading plan." The interim surface is the grade that the developer needs to leave the site prior to home construction.

Then Thomas says they add the actual builder's footprint, which is a significantly smaller house, and balance the lots again. This results in a revised interim grade surface based on the new home footprint.

The structural surface is the subgrade of the roads, the right-of-way and—for this particular project—a level 2 feet above the basement floor elevation for all lots. By viewing the four surfaces in 3D and using various software surface tools, the construction manager is assured that structural material is being placed everywhere to at least 2 feet above the basement floor—and at the same time, the lots will drain.

"One of the advantages to doing this in 3D is that it is easier to cross-reference, manipulate and calculate different material volumes with the four surfaces," Thomas says.

The next step is to identify the areas where the site contractor will not need to strip the topsoil (nonstructural material). This is a potential value engineering change that can save money. "For example, if a lot requires a 3 foot fill to reach the interim grade, we look at the basement floor elevation, and if it is at least 2 feet below existing grade within the entire building set-back area, the lot does not need to be stripped," Thomas says. "This is because when they build the basement, they will dig down through the nonstructural material to the structural material below.

"Ultimately what this whole exercise is aimed at doing is identifying opportunities to save money, not only upfront but also potential opportunities during construction. You are not going to be able to find all of the opportunities prior to construction because of some of the unforeseen conditions that come up during construction, such as material suitability and material depths."

Adjustments Made Easy

The 3D BIM model provided the information that helped Sandy Excavating of Waldorf, Md., win the earthwork contract for Glen Eagles Parcel E at St. Charles.

"I think the 3D model is great," says Bill Sandy, president of Sandy Excavating. "It shows you what is actual. With a lot of the old equipment that we used prior to modeling and Topcon's 3D Office, there were a lot of variables that could play a part in it. The model takes all the variables out of the picture."

The model also helped find savings during work in the parcel. ACPT set up a GPS network for St. Charles that reaches everyone working on the development within an 18-mile radius. A Topcon GRS-1 rover is issued to every manager in the supply chain—from owner to engineers and site work contractors—so everyone on the team can check the progress of construction against the model.

"For example, if an earthwork contractor feels like they have reached a subgrade for a road, they will use their GRS-1 to quickly topo the road," Duduk says. "They wirelessly transmit the points directly to me. We compare those points against the model, which is going to tell us whether or not the quality of the work is there—whether or not it meets plus or minus two-tenths of a foot, which is their contract tolerance.

"Then I am going to compare that, the same points we just collected, to the last time they worked in that area, which is compared to the model. The quantities performed provide the cost. That will give me a progress report. Using those same points compared to the last ones, will tell me time. I can then extrapolate the comparisons between those and tell right away whether we are performing on schedule or not."

Duduk says this approach was used on Parcel E.

"After the trees come down, we topo the entire existing grade," he says. "We call that a new existing DTM (digital terrain model). MESH will calculate the new existing DTM based on points that our GPS tech collects in the field."

A topo of Parcel E revealed the site was 3 inches lower than the original engineer's plans showed.

"For Parcel E, the elevations averaged lower than originally thought, so it resulted in less cuts and less exports, which saved the owners approximately $90,000," Duduk says.

Despite that fact, Parcel E still had an excess of about 60,000 cubic yards of earth on it. By consulting the model built for the adjoining parcel F and C2 and using some value engineering on the adjacent site, SmartSite and MESH determined the excess could be moved across the street to offset the material shortage found in Parcel F and Parcel C2.

Thomas credits Duduk with seeing the potential for material management in the 3D modeling process.

"Instead of just building one model for the contractor at the end of the day, let's get involved upfront," Thomas says. "We can build a value engineering/estimating model, update that once the project design is finalized and issued, take progress topos throughout the project and constantly reference it back to that model so that you know where you are during construction." SP

Daniel C. Brown is the owner of TechniComm, a communications business based in Des Plaines, Ill. He specializes in construction and engineering topics.