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Project Case Study: Smart site design

RAPID PROTOTYPING HELPS IDENTIFY THE MOST COST-EFFECTIVE LAYOUT SOLUTION FOR LAND DEVELOPMENT.

By Tess Gadwa

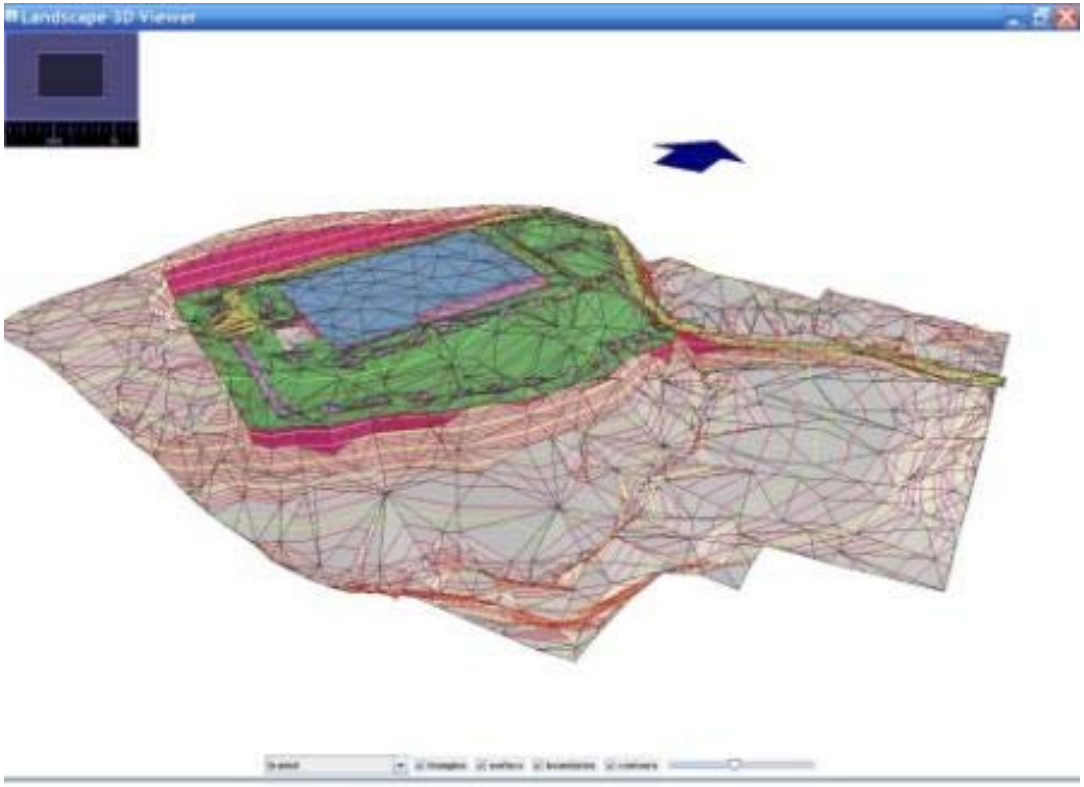
Rapid prototyping helps identify the most cost-effective layout solution for land development.

Project
Retail development, Limerick, Pa.
Civil engineer
MESH Consulting, Eagleville, Pa.

Product application
Web-based software allows engineers to quickly analyze layout options that optimize site-development costs.

When land developers call in value engineers, they usually do not expect to hear good news. A 30-acre wholesale retail site in Limerick, Pa., proved the exception. Using site-optimization technology, value engineers at MESH Consulting identified $1.1 million in savings on a $3 million to $4 million site-development budget by eliminating a costly underground stormwater management system. The project belonged to The Provco Group, a Philadelphia company specializing in real estate and venture financing.

The site had already been through several horizontal layout iterations by the time a large national civil engineering firm recommended that Provco contact MESH. Numerous environmental constraints including wetlands, a flood plain zone, and steep slopes made it difficult to place a 120,000-square-foot building, 590 parking spaces, and one fueling station in a cost-effective layout. Initially, the client simply asked for a cost estimate on its existing horizontal layout. MESH told Provco that with SITEOPS site-optimization technology it could improve the current design and save the client money.



A 3-D view generated by the SITEOPS software shows the optimized layout and grading of the site that allows space for an above ground basin to the left of the building and parking area.

MESH Consulting, a SITEOPS Certified Provider, specializes in applying cutting-edge technology and extensive construction and engineering experience to the most stubborn engineering problems. "At the early stages of a project, the developer typically has a big void in their pro forma, and that's the site cost estimate. That's the scenario we get called in on," explained Steve Thomas, P.E., managing partner of MESH. "You're being asked by your client to give a soup-to-nuts construction budget based on only a horizontal layout overlaid onto the existing grades. Without at least a rough design, this task can become a guessing game."

Provco requested a cost estimate for the original horizontal layout. MESH put together a rough engineered design and

added up the costs for clearing, erosion control, earthwork, site work, stormwater drainage system, sanitary sewer system, water distribution system, lighting, landscaping, and off-site road improvements. MESH estimated the cost at $4.4 million for the existing horizontal layout. This was too steep for the client's budget.

The rough design included a large subsurface stormwater storage system beneath the parking lot. "For that particular site, it was a last resort," said MESH Managing Partner Steve Narducci. "There really was no room for above ground stormwater management, but we told the client that SITEOPS had the capability to quickly look at alternate layouts and rough designs."

SITEOPS, developed by BLUERIDGE Analytics, is web-based site-planning software that applies findings from predictive analytics—a subfield of artificial intelligence—to real-world problems of land development. More than just a CAD drawing tool, SITEOPS uses a sophisticated optimization engine that analyzes billions of layout, grading, and stormwater drainage alternatives to determine the most cost-effective solution for a project. It also generates takeoff cost estimates, based on user-supplied criteria, for every proposed solution.

SITEOPS users upload a DWG file with the site's topography and property line to the web server. The building footprint, along with optional site information layers such as geotechnical data, can be imported with the DWG file or added from the SITEOPS web application. Site constraints and cost properties are reviewed and revised as needed. Cost and constraint templates can be defined for clients and municipalities.

Civil engineers use the application's real-time simulator to see the effects of simple layout changes. For example, what happens when the orientation of parking spaces or the location of a truck drive is changed?

Next, the user submits the project for optimization. An engineer may choose to keep the layout fixed and only optimize plans for grading or stormwater drainage or, like MESH did, they may use layout optimization to see whether shifting the arrangement of site elements could save money.

Within 24 hours, the SITEOPS server returns three to five cost-optimized preliminary site designs (in DWG format) containing 30 layers of information, each with its own takeoff cost report in XLS format. The server is able to analyze the layout for the most cost-effective location of the building footprint; generate the optimal finished floor elevation; generate basic stormwater drainage plans; auto-draw parking lots, curbing, truck drives, and retaining walls; and produce an optimized grading plan, including the proposed finish and sub grades.

Cost reports contain a detailed breakdown of site development costs with categories such as clearing, topsoil removal, grading cut, fill, import and export, retaining walls, seeding, concrete and asphalt paving, sidewalks, curbs, and storm structures and piping. Users may run unlimited optimizations for a single project to tweak the design and experiment with different scenarios. This rapid prototyping capability was what MESH found most valuable.

After MESH submitted the project for optimization, SITEOPS provided a new layout solution that moved the building footprint closer to the center of the site to make room for an above ground stormwater management basin. Eliminating the underground system saved $1.1 million in site development costs.

Thomas estimated that the firm spent one-half day on a site visit, four hours to enter cost and constraint data into SITEOPS, and eight hours to determine post-optimization calculations and CAD cleanup. He believes that an engineer not using SITEOPS might have arrived at the same design eventually, but he added, "From a time standpoint, you couldn’t do it the conventional way that quickly."

He emphasized that, for engineers, the time and cost required to investigate multiple design alternatives often precludes their exploration. "[Before SITEOPS], we didn’t have a means to say quickly if this would have worked," he said. "If it was a 50-50 chance, we wouldn’t even go down that route."
Skill, judgment, and experience are still necessary to use the tool effectively, he stressed. For example, the project specification called for a customer fueling station in the main parking lot. To simplify the first round of optimization, MESH engineers left the fueling station out of the initial layout submitted to SITEOPS and added it back in during the post-optimization calculation and cleanup process. Also, MESH calculated its own rough design and cost numbers for erosion control, water, sanitary, landscaping, lighting, and off-site road improvements.

"SITEOPS coupled with an engineer’s experience is a much more powerful CAD tool than what was previously available," said Thomas. "It’s the rapid answer to the ’what if’ questions that makes it unique. An engineer could say, ’Let’s try to slide this around,’ but without a tool like SITEOPS, it’s going to take time. And to developers, time is money."

MESH is able to use its expertise as a SITEOPS Certified Provider to deliver new service offerings to clients seeking site assessment and design, feasibility analysis, value engineering, and quality reviews. SITEOPS has become a market differentiator as well as a tool to increase internal efficiency—and clients are paying attention to the impact on their bottom line.

Both managing partners at MESH see a great value in using SITEOPS to make the hypothetical possible. They note that even small changes can have surprisingly large effects. For instance, on another project, they found that moving a supermarket layout (building and parking) by 100 feet saved $120,000 in sitework costs.

Previously there was no way for an engineer to examine every possible permutation of a site's design. Now, engineers can quickly answer those "what if" questions. "Say you're wondering what would happen to the overall grading of a site if you changed a 5-percent driveway grade to 7 percent," speculated Thomas. "Well, now you have a tool that can accurately answer that question without going through the long process of redrafting a grading plan and running the earthwork calculations. Instead, you just modify the driveway slope parameter in SITEOPS and run a new optimized grading plan."

This comes as welcome news for customers facing a competitive leasing and financing environment coupled with rising construction costs for fuel and materials. SITEOPS is also good news for engineers looking for more creative freedom in their design work, as well as a tool that will aid them in designing the best site possible.

"I don't think you're ever going to take the human element out of design," Thomas said. "But you can take out a lot of the tedious tasks."

Tess Gadwa is communications manager for BLUERIDGE Analytics. To learn more about SITEOPS and the SITEOPS Certified Engineer program, visit the company's website at www.siteops.com.