

viewpoint

Army Drawn to Customer-friendly Design Program

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By JoAnne Castagna

After the bombing campaign ceased in Kosovo in 1999, the U.S. Army Corps of Engineers was called upon to design and build Camp Bondsteel and Camp Monteith in Kosovo from the ground up. David Rackmales, a structural engineer in the Corps' New York District found himself working in a tent in the dead of winter in Kosovo designing the camps with a team of project managers and engineers. "We were working very closely in an intense, energized environment," said Rackmales.



Castagna

Rackmales had the same feeling recently while taking part in a Building Information Modeling (BIM) workshop at the New York District facilitated by Bentley Systems, a computer design software firm and the Corps primary vendor for BIM.

BIM is a collaborative approach to designing that involves integrating the various disciplines to build a structure in a computerized virtual environment. The process allows the design team to work effectively, particularly when identifying potential problems before they arise during construction. BIM teams work side-by-side focusing on a single design project. The designs are completed at a rapid, intense pace and generally much sooner than it would normally take if they worked individually at their respective workstations, which can be in different geographical areas in the country. Each member is equipped with a state-of-the-art desktop computer, which is networked, and contains BIM 3-dimensional modeling software with discipline-specific files for various design disciplines and a master file. The buildings they're working on are projected on a large screen, enabling them to virtually 'walk through' during the design process. "There's an old adage for designers that says, 'build it on paper first,'" says Rackmales. "Now that we are in the 21st Century we are building things virtually in a 3D environment, that is, we're building it in electrons first."

The team, which has more than twenty years of experience using two-dimensional (2D) CAD for creating 2D construction plans, includes structural engineers, architects, mechanical engineers and electrical engineers that were anxious to learn the new BIM processes. They also have considerable experience with engineering analysis software but the BIM software was completely new to them.

The major benefit of using BIM is the cost savings to the Corps and customers.

"The real serious money and scheduling savings with BIM comes during construction. When we build something virtually beforehand with BIM, we've already resolved 99.999% of any construction issues," said Rackmales. "This seriously reduces the number of requests for information from the field offices during construction. Information requests can result in construction modifications, emergency redesigns, and work slowdowns which can cost us and our customer considerable money."

The New York District team used BIM on a current design project involving three buildings for the U.S. Military Academy at West Point, N.Y. While designing these buildings, the following benefits of using BIM became more recognizable as the BIM Workshop progressed:

1. It's a Living Design

A BIM model is not just a computer model made up of lines and points, like a typical CAD model. In a BIM model, the lines, points and other objects all contain design information that can be used and modified over the lifetime of the building, that is, from initial concept design through construction and ultimately facility operations and maintenance.

For example, a drawing of a steel beam in a CAD design may just be a collection of lines and points, but in a BIM model in addition to those lines and points this beam will have information linked to the beam's cross-sectional dimensions, weight per unit length and other engineering properties. This beam may also have information on its material make-up, pricing information and possibly its manufacturer.

In the case of an entire building, the BIM model stores this and more information for every single element of the project, all of which can be "extracted" to generate plans, elevations, sections, schedules, material quantities and cost estimates.

2. Seeing in 3D

Not only do BIM models have information behind them, but they also allow for more detail than 2D drawings. One of the buildings the BIM team designed included a staircase leading to a door. They viewed the staircase in both 2D and 3D. In 2D, the staircase looks like it's leading to a door, but in 3D, it was discovered that it really led right into a wall. The team's architect and structural engineer were able to readily resolve this conflict that otherwise may not have been discovered until late into project construction.

3. Team effort

Rackmales said, "We're working as a team, sharing our discipline-specific BIM files, through a master file, building virtually together. We can see each other's work and spot problems and correct them right away. Any designer can point out that something either doesn't look right or needs some clarification from a different design discipline. We'll then investigate the issue as a team."

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While designing one of the West Point buildings the team's mechanical engineer realized that the ceiling height was higher than it had to be and quickly coordinated with one of the team's architects to address this issue. "The customer would have been heating more room area than necessary and paying for it," said Rackmales.

The team also made adjustments to the building heights. During the workshop, the team realized that the conceptual design plans, created prior the BIM workshop, conflicted with building height requirements, almost leading each team member to design their part of the building at different heights!

The team also optimized the size of garage doors for the buildings. They realized that different sized doors were shown in the conceptual design plans for all of the buildings and agreed to use one size for all. "BIM made our job easier because we were able to design one best-fitting garage door frame instead of several different ones, which would have added cost and confusion to those performing the construction," says Rackmales. "The more building elements we reduce from unique to repetitive, the more we reduce any potential confusion during construction and right away we've eliminated a possible request for information or worse, a claim."

Working as a BIM team for three weeks, they completed the same amount of design work that would normally take about three months or longer. After the workshop, the team created the design plans in less than a week, which typically takes a month and requires extensive collaboration with team members from various locations.

The Corps' headquarters is implementing BIM Corps-wide. Several Corps districts have used BIM successfully on their civil works and military projects. The Corps also maintains an ever-increasing repository of collected BIM designs, providing Corps districts the tools to efficiently adapt any project to meet its customer's demands.

Rackmales found his district's BIM Workshop experience to be very rewarding and his team just as tight as the one in Kosovo, "It was the ultimate team building experience. Our team came out of the workshop as a well-oiled BIM Machine!"

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