Trimble MEP
CASE STUDY

U.S. Engineering

Fab to Field Robotic Workflow Facilitates Speedy Hospital Construction

Soon after the former St. John's Mercy Regional Medical Center in Joplin, Mo. was destroyed on May 22, 2011 by an EF-5 tornado, Mercy, the sixth largest Catholic health care system in the U.S., looked to fast-track the construction of a new hospital to serve the community.

Mercy initiated plans to build the new $335 million Mercy Hospital Joplin with a design-to-construction-to-commissioning goal of just three years. The owner and its general contractor, McCarthy, made the decision early in the design phase to bring in the major MEP partners in a design-assist role, or modified integrated project delivery (IPD).

As part of the team, U.S. Engineering was contracted to handle the mechanical and plumbing design, fabrication and installation of the entire project. Given the tight schedule, size and scope of the job, and the survey-accuracy positioning required for every component, U.S. Engineering knew it would have to draw all of its technology expertise to keep the project on track. They've stayed on schedule and much more. Since project go-ahead in December 2011, the company has established one of the industry's most efficient, accurate and repeatable design-to-fabrication-to-installation workflows ever put in place on a hospital project.

Design to Fabrication

The new 875,000-square-foot Mercy Hospital Joplin, designed to withstand a powerful tornado, will include beds for surgical, critical care, women's/children's services (labor, delivery, recovery and postpartum rooms), behavioral health and rehab. The bottom three floors of the structure will include hospital space along with a seven-story patient tower and a four-story clinic tower rising above the hospital space.

The facility also incorporates heavy duty mechanical, plumbing

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Jeff Kiblen, U.S. Engineering, Project Manager

and electrical systems. A new 30,000-square-foot central utility plant (CUP) will house emergency equipment and generators located away from the hospital with a strengthened exterior. Utility service access to the CUP from the hospital will be via a 450-foot underground tunnel.

The hospital mechanical and plumbing systems include the necessary components for fuel storage, air supply and return, chilled water, condenser water, HVAC and plumbing as well as piping for the tunnel between the hospital and the CUP.

For example, the CUP system includes 3 steam boilers and boiler feed pumps fed by a high pressure 12-inch steam main. The CUP chilled water system includes three 2000 ton chillers and three chilled water pumps with 24-inch supply and return mains from the chillers to the tunnel and chilled water return main from pumps to chillers. The CUP also includes three cooling towers and three condenser water pumps connected by a 30-inch underground main.

To bid on the project, the owner and the general contractor mandated that all subcontractors had to have 3D coordination capabilities for prequalification. Due to the fast-track nature of the project the project team's goal was to use the detailed 3D model, which would include all MEP elements, to issue construction documents and facilitate a speedier start to fabrication concurrent to contract documents.

Jeff Kiblen, U.S. Engineering's project manager of fabrication/3D coordination oversight for the mechanical and plumbing systems on the project, recalls, "We came on board in December 2011, and we were putting in deep

underground by March 2012. Most projects of this scope and scale would require six weeks to complete drawings, issue documents and finish detailing. Because of the modified IPD methodology, we had to be exponentially faster."

Tech Support

The Mercy Hospital Joplin project broke ground in January 2012. Once the foundation and structural steel had been installed on the site and the first floor deck pour was complete, U.S. Engineering began installing the hangers and sleeves for the piping and sheet metal components that would be routed overhead.

Kiblen recalls, "This was our biggest challenge on the project. On any given day, we'd need to locate hundreds of

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The pace of the project design, fabrication and installation drove the need for more robotic total stations, and U.S. Engineering's interest in the Trimble rental program. Through the program, the firm was able to rent two more identical robotic total stations.

For the hospital projects, the team used three Trimble RTS773 Robotic Total Station connected to the Windows 7 Trimble Field Tablet and two Trimble RTS655 Robotic Total Station connected to Nomad handheld units. Due to size of project and potential Wi-Fi issues onsite, connectivity using the Trimble robotic total station unit's integrated radio frequency communication capability instead of Wi-Fi, ensured no loss of signal.

"The military grade radio has made a huge difference in connectivity and communication throughout the project," says Kiblen.

Point to Point Precision

Once design of the mechanical and plumbing systems was coordinated and approved, U.S. Engineering used Trimble Point Creator for CAD and Revit (TPC) to create 2D and 3D field points within Revit.

"This was the first time that we had used TPC to this magnitude. One great advantage of the tool is the ability to break systems up into more manageable sizes," says Kiblen. "For instance, the mechanical systems might be broken up as 3rd floor patient tower exhaust, return and supply air."

Once the team was ready to move into the field, the points were exported to a Trimble Field Link for MEP robotic total station to layout the floor penetrations and hanger support embeds.

"Overall, it took us 2-3 weeks to complete each floor including setting units, triangulating and then positioning," says Kiblen. "On average, the field layout person can routinely layout between 40-50 points an hour in good conditions."

To-date, U.S. Engineering has completed the design of the mechanical and plumbing systems and located in excess of 78,000 points for sleeves, embeds, floor penetrations, drains and hanger supports. The points located on the 1st and 2nd floor of the hospital main building exceeded 38,000 points. The 3rd Floor, which is common to both towers, had roughly 10,000 points. The six-story Patient Tower added another 22,000 points and the three-story Clinic Tower another 8,000 points. U.S. Engineering has also used the Trimble Point Creator for CAD and Revit & Trimble Field Link for MEP connection to verify as-constructed conditions with the architectural floor plan.

In terms of accuracy, U.S. Engineering is also very satisfied. Kiblen says, "Any inaccuracy especially with sleeve layouts in walls for plumbing would have created significant fit problems. We needed to be within .25-inch or .5-inch because of the density of ceiling spaces, and tight coordination with all the other systems. Thus far, we've realized incredible accuracy thanks to our 3D model-to-field workflow."

U.S. Engineering is currently installing all systems through the 5th floor of the hospital.

The building exterior will be complete in November 2013 and the CUP operational by January 2014—just two years after construction start with the main structure expected to open in early 2015.

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