Healthy Dose of Reality

LASER SCANNING OPERATES AS CRITICAL TOOL IN HOSPITAL CONSTRUCTION

A modern hospital is a complex, demanding type of construction. The walls, floors and ceilings are dense with services including HVAC, water, drains, plumbing vents, medical gas, electric power and emergency electric power. There are very long corridors of perfectly aligned doors. Floor flatness and levelness are critical for some pieces of medical technology. Floor slope is crucial to sanitary drainage in patient bathrooms and showers. Ceilings contain structural support for heavy, boom-mounted equipment. And to make it all more exacting, new hospital buildings are often built to connect floor-by-floor with existing buildings.

For projects of that complexity and precision, BIM has become essential. Ten years ago, the proponents of BIM were still voices crying in the wilderness. Now, BIM is the central communication tool of design, and a required capability for any contractor or trade working on a major project.

Of course, the model is only really effective if it accurately reflects conditions in the real world. Coordinating BIM with the real world — the as-built world — used to be a challenge. Now, laser scanning has improved to a level where it is fast and easy to capture a space precisely and bring that data into BIM. The laser scan data can be displayed much like a 3D model, and can be overlaid on the designed model, joining and comparing the real and virtual worlds, with a wealth of beneficial uses.

Several recent hospital projects offer striking examples of contractors getting creative with the laser scanning and finding more ways that it can save time and money, offer greater client benefit, and improve the quality of the work, especially in the highly demanding healthcare sector. They're even using it to win projects in the first place.

ONE TECHNOLOGY, MANY SITUATIONS

McCarthy Building Companies, a member of multiple AGC chapters, recently completed a major, multi-phase project at the CHRISTUS Spohn Hospital Corpus Christi-Shoreline campus, including a new 400,000-square-foot, 10-story patient tower, a new 23,000-square-foot, central utility plant, renovations of existing operating rooms, and build-out of shell spaces into a 27-bed medical/surgical unit, an imaging facility and specialized operating rooms.

In the shell spaces, the as-built conditions were minimal — existing ductwork overhead, and sanitary pipes and vents running vertically from upper floors — but they had to be coordinated in the design. They scanned the space using their Faro Focus3D X scanner to get precise locations of all the existing installations and uploaded that scan to BIM 360 Glue, the platform McCarthy uses to upload the different trades' 3D models.
The scanner records millions of points — each a three-dimensional coordinate and a color — of every surface that is visible in a nearly 360º sphere. This mass of coordinates is referred to as a point-cloud. When displayed on the computer as a 3D model, the point cloud information is so dense that it almost looks like a photograph. It can be overlaid on the designer's 3D model to compare realities.

“We were noticing that some of the pipes were outside of the new walls we were constructing,” recalls Preston Cope, project director on the CHRISTUS Spohn project. “We found quite a few instances of a pipe that wasn’t where the drawing said it was.” They gave the scan to the design team to rework the wall configurations and minimize relocations. “Otherwise, we would have found that stuff when we started construction, and there would have been delays.”

In the renovation phases, pre-construction scanning also served them well, but the conditions of the capture were trickier. The operating rooms were still active during the design phase, so access was very limited. McCarthy’s team coordinated with the nursing staff to go in at downtimes. “We would stick the scanner above the ceiling to scan certain areas that we were concerned about. It’s a longer process because you’ve got more visual obstructions to prevent the laser scanner from seeing as much.”

SCANNING FOR THE FUTURE

During construction, in areas such as operating rooms where the walls were congested with specialized electrical and plumbing, they scanned before closing up the walls and ceiling. “As medical equipment ages or new equipment becomes available, hospitals have a high likelihood of wanting to renovate or retrofit,” explains Cope. “The first thing they need is an understanding of what they have in the walls. We give them that information, along with our coordinated BIM models, and they have a really good idea of exactly what’s in the wall and — because it’s all dimensionable — where it is in the wall.”

Cope adds that this information is not just for the distant future. Medical technology is changing quickly, and during the lag between initial design and construction, hospital projects change their equipment orders. Cope says there have been instances where they’ve “done renovation before we finished construction” and the as-built wall scans were crucial tools. “The laser scanner was a tool for us to verify that the trades we had coordinated were actually installed in the right spot.”

McCarthy scanned their floor-decks both before and after concrete pouring. Pre-pour scans recorded the layout of rebar and double-checked the locations of electrical and plumbing sleeves. The latter was particularly important because the decks were post-tensioned slabs that could not be cored afterwards and could only be drilled in locations that were approved by the engineers.

Post-pour the scanner checked floor flatness and levelness. The data display commonly called a heat-map shows floor elevation as a series of colors that make it easy to spot flatness and levelness problems quickly. Cope sees this as a significant step up over traditional manual methods of verifying floor flatness and floor levelness, going beyond the minimum information to prove compliance with the spec and providing detailed information about the floor condition. The software also helps McCarthy figure out the most cost-effective choice between filling and grinding to level a problem floor.

A key step in this system of coordinating 3D models is for the design team to hand off their model to the trades at the most efficient point in the design process. In this fast-developing field, that is still a matter of judgment. “It’s something that everyone is getting a lot better at,” Cope observes.

ALL IN

Turner Construction, a member of multiple AGC chapters, has embraced 3D scanning (among other technologies) enthusiastically, and made use of it in many phases of construction. The recently completed Shorb Tower at Methodist University Hospital (MUH) in Memphis, Tennessee, a $275-million, nine-story 450,000-squarefoot patient tower, provides numerous examples.

Turner deployed a state-of-the art scanner to dramatically speed up the workflow in floor flatness measurements. The tower had 70 patient bathrooms, each about 8 feet by 8 feet, consisting of a toilet, sink and shower, with no partitions or curbs in the floors. The entire floor had to slope consistently into the shower drain. Most available scanning equipment would take six to 10 minutes per scan, and each bathroom was scanned twice to cover the entire floor. Turner brought in the newly released Leica RTC 360 scanner that captured each scan in 24 seconds, less than a minute for each bathroom, cutting the whole operation from several days down to a few hours.

They produced a heat map of each bath-room. A properly sloped floor would have a sort of bullseye effect centered on the lowest point: the drain. Gary Chapman, regional virtual design and construction manager for the Midsouth Region for Turner, describes the heat map as “the most beneficial form of communication to show the deviation of the installation. We just hand those off to the construction team as 2D PDFs, and they’ll take them into the bathrooms.”

In the MUH tower, they were scanning hardened concrete, but Chapman has also scanned wet pours of sealant in real time. He captures a scan, takes it back to the computer in the trailer, runs the heat map, then tells the crew how to adjust the slab. “Typically, in our workflows,” Chapman relates, “I just have a handheld laser pointer, and I communicate with the guys finishing the concrete by shining the laser pointer where I want them to bring it up or down.” He adds that one of the newer scanning set-ups can actually use the scanner’s own laser to point out trouble spots in a similar fashion, automatically.

Turner also dealt with a renovation challenge similar to one McCarthy faced in Corpus Christi, Texas, not having pre-construction access to live operating rooms. The Turner team was able to scan in the seven-foot interstitial space between floors to document as-built condition. Then they were able to coordinate with the design team and the hospital. “We could go back to the owner and say ‘this pipe here that’s labeled nitrogen gas is going to be impacted by our construction. We need to come up with a method or procedure to relocate these utilities to minimize/eliminate any downtime to the active facility.’”

SAFETY AND SALES
Chapman is fired up about the scanner’s potential for increasing safety. On a recent high-rise project in downtown Nashville, concrete balconies had been poured with block-outs for handrails but getting the exact location of the block-outs on an open-ended balcony was a high-risk task. “Instead of having a guy go out there on a hundred of these balconies, tied off 375 feet up in the air, with these super high winds … we just have the scanner inside the fence, and in 24 seconds we have a perfect as-built that we can give to the handrail designer, with exact dimensions to within about a 16th of an inch.”

“We’ve seen a tremendous value,” Chapman continues. “We’re using our laser scanning in our interviews with our clients. We’ll have a scan of the proposed area of work and our model, and we show them, if we win this job, this is our plan. These are the challenges, and this is how we’re going to overcome them. It’s a really powerful tool to set us apart, to show that we’re all in.”

“We use it in our pre-con process tremendously, for any area that we’re retrofitting or any existing space. It’s just best practice we scan that area. We’re using laser scanning almost daily, somewhere.”
Cope also expects more uses for scanning in the future. “As we’re faced with issues that come up, we’re going to continue to find ways to use laser scanning and have it evolve for us. It’s certainly at a point now where you can find a lot of value in it, being able to take three-dimensional information, utilize it in the virtual world, and apply it to real construction. It seems like a very reasonable investment for the amount of gain we’re getting from it. I think it’s pretty fantastic.”

Steve Miller, CDT