3D Laser Scanning Boosts BIM

by Geoff Jacobs

There's a lot of buzz about BIM – Building Information Modeling – and what its rapid adoption means to surveying, design, and construction professionals. BIM allows the generation and management of physical and functional properties of a building by digital representation. The surveying and mapping firm Woolpert was recently involved in a large BIM project that took advantage of current advances in field data capture and office processing based on Leica Geosystems laser scanners and point cloud software. These advances significantly improved the efficiency of applying 3D laser scanning for the creation of accurate, intelligent 3D models – the foundation of BIM.

The Woolpert team and the architecture and construction firm Beck Group were contracted by the United States General Services Administration (GSA) to provide accurate BIM deliverables for federal buildings in Atlanta, Georgia. The two firms had previously teamed up for a similar project at the same campus as part of a pilot "scan-to-BIM" study that GSA had sponsored. For this second project with five

Operating the Leica ScanStation via tablet.

buildings – two 30-floor buildings and one each of six, nine, and ten floors dating back to the 1920's – GSA had a fixed budget allocated for data capture and BIM creation. To meet the budget constraints and an ambitious schedule, and to try to exceed client expectations, both Woolpert and The Beck Group turned to innovations based on Leica Geosystems laser scanning tools.

Woolpert's final deliverables to The Beck Group were registered, geo-referenced point clouds. The end client (GSA) required Autodesk®Revit® BIM models of each building, with separate models for interior, structural, façade, as well as site models. Separate BIM models enabled the client to keep each Revit file below 100MB. In total, Beck had to deliver BIM models covering 420,000m² (502,000yd²) of building area. So, both in field and office work this was a large project and it entailed significant office time to create the models.

Field Innovations

For the new project, Woolpert used their two new, compact, and versatile Leica ScanStation C10's. Woolpert developed an innovative field approach for their ScanStation C10's that enabled them to beat the efficiency of their prior approach and exceed client expectations.

Woolpert placed each of two ScanStation C10's on rolling tripods and used a wireless tablet controller to execute field scanning and photo capture. The rolling tripod reduced the time for set up, tear down and moving of the scanner from station to station. It also eliminated powering off and re-booting each ScanStation C10 between setups. A crew of three operated both 3D laser scanners simultaneously.

Eliminating scanner setup, tear-down, and powering off/on between stations saved five minutes per setup, resulting in a time reduction of 36 percent. With more than 400 setups, the net savings were significant.

Using a wireless tablet with a larger display to control scanning, photo capture, and target acquisition provided high visibility for scan quality monitoring and better zooming resolution for critical aiming at targets. In addition, operators were free to roam while scanning and were able to record targets with the tablet while walking to the next location.

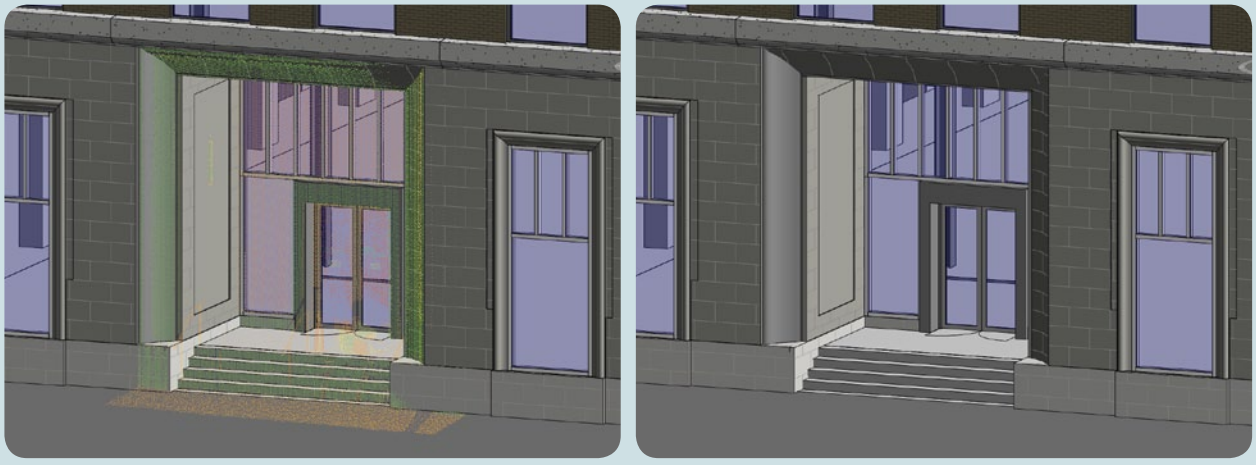
Comparing field efficiency of the new approach to pilot project metrics, the overall average time per scan was reduced by 23 percent.

Office Innovations

There were also two innovations on the office side of the project – one by Woolpert related to monitoring field capture progress and the other by The Beck Group for speeding up the processing of registered scans into intelligent 3D BIM models.

The buildings were secure government offices in Atlanta, more than 1,000km (700mi) from Woolpert's main laser scanning administration office in Dallas, Texas. The Beck Group office was in Atlanta. To improve internal communications and client interaction during the two-week scanning portion of the project, Woolpert integrated Leica TruViews directly into AutoCAD® drawings of the buildings. TruViews – lightweight file sets that enable intuitive, panoramic viewing of scans and photos over the web – enabled internal, client, and partner staff to easily monitor scanning progress and ensure that areas being scanned were the right ones, thus avoiding return trips to the site. Users could also measure from scan images, pan/zoom, mark-up, and even link images to other content.

In the early stage of creating Revit models, The Beck Group staff modeled based on old drawings and CAD files. To ensure accurate "as-is" model geometry, BIM



Model buildings in 3D from the point cloud using Leica CloudWorx for Revit.

models and registered point clouds were overlaid in Navisworks® and compared. The BIM model was adjusted as needed and then re-checked in Navisworks. However, simply opening large point clouds within Navisworks took a long time and the process was not as exact as being able to create the BIM model directly from point clouds.

Beck looked for an alternative solution to increase production of as-built models. When Leica CloudWorx for Revit first became available in January 2012, Beck's staff was eager to try it out for this project. Leica CloudWorx plug-ins enable users to work efficiently with point cloud data directly within CAD (e.g. AutoCAD) and VR (Virtual Reality) applications. They have been very popular ever since they were first introduced in 2001. Today, there are eight different Leica CloudWorx plug-in's for specific CAD and VR applications. Leica CloudWorx for Revit is the latest addition to the Leica CloudWorx family.

One immediate benefit was Beck's ability to open registered scan files directly from CloudWorx' Cyclone database and project file structure without any data conversion steps. However, Beck also found some limitations in this first release version that prevented them from using it the way they needed to – which was to create BIM models directly from point clouds.

Beck's BIM Manager, Jason Waddell, worked directly with Leica Geosystems Product Manager, David Langley, providing input about their initial findings. This resulted in a second version of Leica CloudWorx for Revit that did everything Beck expected.

Beck could now readily manage very large point cloud files and quickly manipulate scans – even high density areas – for efficient 3D viewing. He was also able to quickly slice and crop point cloud areas of interest directly. Furthermore, the new version allowed him to perform fast, accurate elevation & plan sectioning, set levels & work-planes, and directly place doors, light fixtures, and even model piping from point clouds (in Revit MEP).

Ultimately Beck was able to eliminate the previous workflow steps of loading and viewing point clouds and models in Navisworks and/or Revit. Overall, using Leica CloudWorx for Revit enabled Beck to increase office productivity for creating accurate BIM models based on laser scan data by about 50 percent – significant savings for a large project like this.

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