

BIM AND ALL THAT JAZZ

RENOVATING AN OLD BUILDING CAN BE COSTLY, COMPLEX AND FULL OF SURPRISES. STUART CADGE EXPLAINS HOW AN HISTORIC AMERICAN SCHOOL BENEFITTED FROM BOTH BIM AND SLAM TECHNOLOGIES

Look beyond the brief of any historical surveying project and the stories behind the buildings and locations are often fascinating. The Attucks school renovation project in the heart of Kansas City in the US is one such example. Built in 1905 and designed by local architect Charles A Smith, the Attucks building has colonial revival influences and special significance, thanks to its role in the educational history of the African-American community.

Smith designed the building to be symmetrical, but by 1922, it was so overcrowded that he was commissioned to design a two-storey wing connected to the east façade of the school. This changed the floor plans and capacity of the school hugely, but Smith still paid close attention to the architectural details of the new build to ensure the additional wing was aesthetically in keeping with the old.

Developing and retrofitting buildings like this is incredibly difficult, particularly if not enough attention is paid to the condition of their infrastructure. Despite the documenting of the history of the Attucks school in national and state registers, the likelihood of existing unforeseen structural conditions is high – particularly as it is a building that has been added to and developed over the years.

For the renovation, civil engineering firm BHC Rhodes was asked to provide a 3D Revit building information model (BIM) of the building. This would enable the firm to anticipate obstacles early on in the project, save time and money with the subsequent renovation, and reduce the overall delivery time for the project, too.

Luckily for the Attucks project, the 'Statement of Significance' document in the national historic places register offered a fantastic starting point for identifying materials. BIM modelling would result in better consideration of alternative materials, equipment and technology, ultimately ensuring a more informed decision-making process. However, it quickly became clear that the Attucks project presented some

unique challenges. There were several hazards in mapping such an old building, even before any changes were made to it, with visible deterioration in the wood floors, collapsing ceilings and asbestos present. BHC Rhodes therefore decided that as few staff as possible should be in the building and they should spend the least time possible surveying it.

Technology needed

The surveying of the Attucks project therefore needed to be as quick as possible, without compromising on accuracy. Staff knew they would need to enter the building, navigate the site safely, mount uneven surfaces, climb stairs and go where trolley-based scanners could not. They would have to scan quickly and accurately, and leave if necessary without having to carry or manoeuvre heavy kit.

Since other LiDAR technology can be costly and require long periods of time on site, including photographically documenting it and potentially returning later to iron out any queries, BHC Rhodes chose the GeoSLAM ZEB-REVO, a handheld, lightweight, mobile mapping scanner that uses 3D simultaneous localisation and mapping (SLAM) technology (see Box on page 34) to record more than 40,000 measurement points per second. Intended primarily for indoor mobile mapping, the ZEB-REVO has been designed with multi-level environments in mind, allowing three-dimensional loops using stairways, all without the need for GPS. As well as scanning to BIM, it is used for generating footprints, estate agency requirements, and mapping heritage buildings and industrial plants.

The BHC Rhodes team needed minimal training to use the ZEB-REVO, so they could 'pick up and go', reducing the overall time needed for the survey. Indeed, they scanned the entire building in just 4.5 hours.

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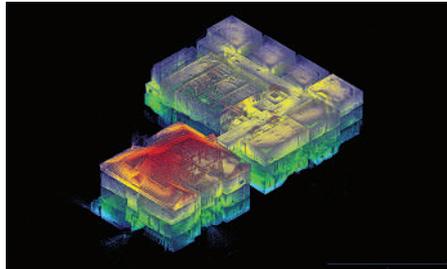
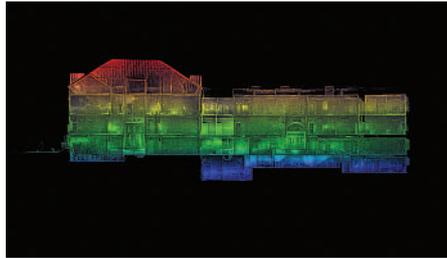
Trimble



The original Attucks school building dates from 1905 and was designed by local architect Charles A Smith



The GeoSLAM ZEB-REVO handheld mobile mapping unit, which was used to scan the entire school building in just 4.5 hours



The complete 3D scan of the building is made from four separate scans and more than 160 million data points



The 3D point data was used to build a level 200 BIM model in Recap and Revit 2014

WHAT IS SLAM?

Simultaneous Localisation And Mapping (SLAM) technology uses data from a moving LiDAR sensor and an inertial measurement unit (IMU) for rapid and accurate 3D acquisition of complex environments. The IMU is used to estimate an initial position and create a point cloud from which 'Surfels' are extracted to represent the unique shapes in the point cloud. The trajectory is then calculated for the next sweep of data using the IMU and 'Surfels' are extracted again in the same way. The two sets of Surfels are then used to match the point clouds together and subsequently correct and smooth the trajectory estimation. A final point cloud is created based on the new smoothed best estimate trajectory.

Using a combination of the data from the ZEB-REVO and other technology, BHC Rhodes modelled the building to document the basic architectural and structural components of its interior and exterior, two weeks faster than originally expected. Cyclone 9.1.4 provided the ability to register the datasets to a common coordinate system and export to Autodesk ReCap as a .pts file. The data was then divided into 10GB files for efficient use in ReCap and Revit 2014, where a level 200 BIM model was created.

Plans for the future

Kansas City's Jazz District Redevelopment Corporation (JDRC) is using the BIM model to look at the Attucks school's structural integrity and its use of space, as it is considering turning it into a community performing arts centre with adjoining office spaces. In keeping with the African-American heritage of the building, this would contribute to the 18th and Vine Historic District in the city, which earned the name 'Jazz District' between 1920 to 1940 when it became the centre of jazz.

A fine legacy to be a part of – but the hard work is not over. There is no funding available for the project and the school's historic status means dealing with the Landmarks Commission, which protects and ensures the integrity of buildings that reflect the city's historic, cultural, aesthetic and architectural heritage. This covers all exterior alterations to buildings and any new construction in the district because of its historical designation, of which Attucks School is a prime example.

For any plans to be approved on the site of the Attucks School, the commission needs substantial drawings that convey materials, full dimension drawings, floor plans, site drawings and elevations, as well as an explanation of what part of the existing building will remain, explain the rehabilitation techniques, and convey the information graphically and in writing.

What the JDRC can be sure of is that the BIM modelling of the existing building is exceptional. When funding does eventually become available, the site can be transformed into a community centre that celebrates the history of the city and its people, as well as ensuring the original features of the Attucks School remain intact.

THERE WERE SEVERAL HAZARDS IN MAPPING SUCH AN OLD BUILDING, WITH VISIBLE DETERIORATION IN THE WOOD FLOORS, COLLAPSING CEILINGS AND ASBESTOS PRESENT

Stuart Cadge is sales and marketing coordinator at GeoSLAM (www.geoslam.com)