Case Study

U.S. Department of Transportation
Federal Highway Administration

NYSDOT KEW GARDENS PROJECT

BIM AS AN AS-BUILT RECORD

This case study covers the overall building information modeling (BIM) for infrastructure approach used in the Kew Gardens Interchange (KGI) project, as well as considerations for model development and positive impacts to the project as a result of BIM use.

BACKGROUND

The New York State Department of Transportation (NYSDOT) used building information modeling (BIM) for the Kew Gardens Interchange (KGI) Reconstruction Project (Figure 1) in Queens, New York, during the third phase of the project.

By making a three-dimensional (3D) computer-aided design and drafting (CADD) model an as-built record, the digital 3D model was refined and updated throughout construction completion. This accurate and complete as-built record (including underground utilities) was created for ongoing maintenance, operations, and asset management purposes during the life cycle of the interchange.

Bernstein Associates Photographers, Tarrytown, NY, used with permission

Figure 1. Section of the Kew Gardens Interchange Project during construction

BIM FOR INFRASTRUCTURE APPROACH

The KGI is the complex intersection of the Grand Central Parkway, the Van Wyck Expressway, the Jackie Robinson Parkway, and the Union Turnpike that serves nearly 600,000 vehicles daily. The NYSDOT is making a number of operational improvements at the interchange to enhance safety and improve traffic flow, with four construction contracts worth almost $700 million and with Phase 1 breaking ground in 2010. Due to the project's complexity, BIM was used as an as-built record, which was used in subsequent phases of the project.

Phase 3 of the KGI was the first design-bid-build (DBB) project to have a NYSDOT BIM requirement and was ongoing as of December 2019. The work was to utilize the three-dimensional (3D) CADD Model, which was to include any existing and installed underground utilities.

The KGI Phase 4 project, which is design-build (DB), also has a BIM requirement. The completed Phase 1 project included widening a portion of the Van Wyck Expressway and rehabilitating the exit ramp from the northbound Van Wyck to westbound Queens Boulevard, four bridges over the Van Wyck, the Van Wyck Bridge over Main Street, and the Queens Boulevard Bridge over the Van Wyck Expressway. This project also included constructing auxiliary lanes on both the northbound and southbound Van Wyck between the Grand Central Parkway and Main Street and provided a dedicated exit lane southbound to Hillside Avenue.

The Phase 2 project constructed a new, wider northbound Van Wyck Expressway viaduct that will carry three travel lanes of traffic once Phase 3 is completed.

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This case study can be found at https://www.fhwa.dot.gov/construction/technologies.cfm.

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In addition, Phase 2 replaced the one-lane entrance ramp connecting the Jackie Robinson Parkway and the Union Turnpike to the northbound Van Wyck Expressway with a new two-lane ramp. A new bridge deck was installed on the eastbound Union Turnpike over the Grand Central Parkway connector ramps, and a new deck and steel girders were installed on the bridge where the Union Turnpike and the Jackie Robinson Parkway merge. Phase 2 illustrates the use of four-dimensional/five-dimensional (4D/5D) models for construction planning, management, and payment.

Phase 3, currently underway as of December 2019, is replacing the existing deteriorated two-lane Van Wyck Expressway southbound viaduct over the Grand Central Parkway with a continuous three-lane viaduct and constructing new exits to the westbound Union Turnpike. The three lanes from the Van Wyck Expressway will also merge with two lanes from the Grand Central Parkway over a longer distance.

MODEL DEVELOPMENT

The NYSDOT began requiring 3D, 4D, and 5D in its DB projects with the Kosciuszko Bridge in 2014, which was a $500 million project that was also the region's first DB project. The project included a modeling requirement in the request for proposals (RFPs)—specifically a 3D model and visualizations in construction for scheduling (4D), project control, payments (5D), and analysis. The 3D model was integrated with 4D and 5D modeling in construction to review and assess actual progress compared to proposed schedule completion. Progress payments were created from the 5D model and a cost-loaded schedule.

Building off of the experiences in the Kosciuszko Bridge project, the KGI Phase 2 project used a 3D model for design development and constructability review. The construction sequence was also modeled to enable comparisons of the proposed and actual construction sequences.

RESULTS

On the KGI project, BIM helped in adhering to the construction schedule and cost and provided a complete and accurate record of work, which resulted in the contractors receiving quicker payments. BIM also substantially improved the accuracy and reliability of quantity workups verifiable by field staff who compared the data against the model. This helped to maintain better control and governance data. BIM adds considerable value to agencies that implement it by helping them deliver a better-coordinated product.

LESSONS LEARNED

BIM requirements were established in the RFPs, which required contractors to use provided models as their baselines for 4D and 5D modeling. The as-built model was required to be updated with any underground utilities encountered during construction. The model from Phase 3 and its updated schedule were provided as supplemental information to the Phase 4 DB project, so that proposers on the Phase 4 DB project would have more accurate information on the current state of the project.

This integration of phases illustrated the importance of maintaining complete and accurate as-built models (including underground utilities), which can then be used in subsequent phases of the project and for maintenance, operations, and asset management throughout the life cycle of the asset.

This case led to a series of actions by the NYSDOT:

- Development of BIM for the implementation plan
- Identification of additional projects for potential BIM applications
- Collaboration with the Federal Highway Administration (FHWA) and with FHWA Planning and Programming to enable the use of all data in the future