Steven Schaefer Associates, Inc.
Consulting Structural Engineers

# NEW SCHOOL TOOL SMOOTHES OLD SCHOOL UPGRADE

How Building Information Modeling Eased the Unique Challenges of Replacing and Integrating Structures

All school construction projects introduce design challenges, but perhaps not quite as complex as those posed by the addition and remodeling currently underway at Butler High School in Vandalia, Ohio. Because it involved sandwiching a new structure between two existing older ones, the project presented unique structural engineering hurdles as well.

Picture a 227,900-square-foot school complex consisting of an original 1957 structure with several additions adjoined over the years. Imagine removing the central structure and replacing it with a new one. Now make the combination work like one, modern high school. Even if you were working with a set of Legos, you wouldn't just demolish the central structure and start building another in its place. The old building not only has to come down safely, the new one needs to go up smoothly, with school in session. When completed, the new central structure has to communicate seamlessly with both existing sides.

It's certainly easy to understand how client-designer and client-contractor communication errors might arise and multiply under such conditions. With so many people working on such a complex project, the opportunities for conflict and error can multiply. However, with the help of Building Information Modeling (BIM), the design team responsible for the Butler High School challenge was able to streamline the communication and design process in an effort to eliminate incidents of error. BIM enables a design team to provide a more coordinated design, which can ultimately reduce the cost of installing electrical, plumbing, and mechanical systems.

**Old School Meets New School**

Structural engineers Kate Stanton, E.I., and Jeff Bolchalk, P.E., managed part of the complex challenge for Steven Schaefer Associates. Together they designed all the structural elements of the new building replacement and integrated them with the existing buildings on either side.

Architects and structural engineers understand that there are always challenges when new construction adjoins an existing structure. In the case of the Butler High School, however, Kate and Jeff had to deal with two structural interfaces, one on each side. All three buildings—two old and one new—will not only communicate but integrate seamlessly as one school.

The team had to make sure not to load the existing school structure with any expansion loads from the new structure. To make matters worse, the original buildings did not account for snow drift loads. Inserting a new building between two others presented double the foundation undermining issues normally encountered as well. The architect's signature design feature also proved challenging. The slim, cantilevered roof profile, suggesting a plane wing—a nod to the Butler High School Aviators—is an atypical roof design that covers the dining room, a state-of-the-art media center, and an atrium.

Inside the new school design, the Schaefer team incorporated multiple structural framing systems in order to meet architectural floor height restrictions, mechanical room-vibration issues, as well as fireproofing demands.

*In its 110,000-square-feet of new space, the remodeled Butler High School will contain many new classrooms, including science, music, business, computer, and special education rooms, a wood shop, media center, dining facilities, and administrative offices.*
*Rendering of the front entrance, Courtesy of SHP Leading Design*

**Revit Joins the Team**

Helping Kate and Jeff manage these challenges within a BIM framework was Detailer Bryan Tenhundfeld, also of Steven Schaefer Associates. It was Tenhundfeld who worked with the architect and the other professionals involved using Autodesk Revit, a 3D object-based design software for BIM.

Working with Revit, all team members were able to view architectural, mechanical, and structural components of the building in a three-dimensional model. The coordination effort required to match roof slopes, avoid placing a beam in the way of mechanical ductwork, or other conflicts between disciplines was greatly reduced. Structural and mechanical designers, for example, always have to make sure that their work does not interfere with each other. But on the Butler High School project, the challenges were magnified. The designers of the new structure were working with the existing features of the old building. On top of that, new construction would have to take place with the existing mechanicals—heat, electric, plumbing, fire protection—operating.

Early in the process, BIM helped the design team explore design concepts and forms. They were able to achieve the architect's vision more accurately throughout the design development and construction documentation phases using BIM to avoid interference with each others' design elements. No one had to manually update another's drawings to avoid walls interfering with mechanical ductwork, for example. When one member of the design team made a change, other team members saw notification of the change through Revit's tracking when they downloaded the latest model.

Overall, Revit allows for easier visual communication and sharing of changes. While still on the phone with project team members, the design can be changed, uploaded, and viewed by other team members in a matter of minutes. No more faxes or hard copies need to be exchanged. It takes just a few minutes to see how someone's proposed change affects the overall design.

**Everyone Wins with BIM**

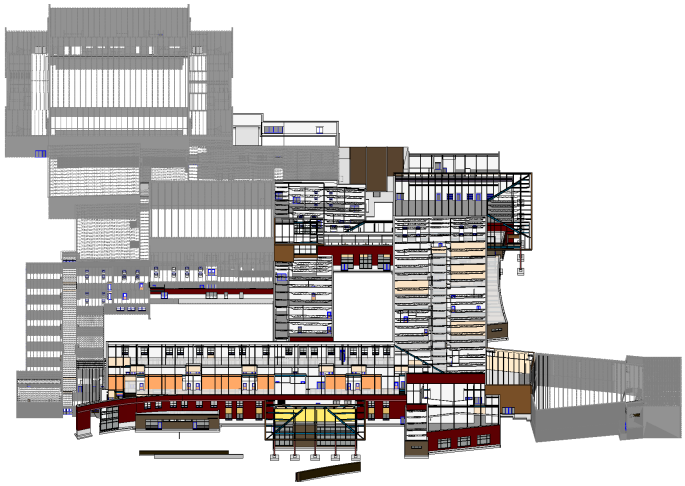
Now with the Butler High School structural design complete and construction underway, a look back demonstrates that BIM helped everyone involved meet the complex layers of building code requirements, satisfy all of the design demands, and help better communicate with the other trades. The old way of construction was to stop when there was interference between trades and come up with a solution that could include someone redoing work already completed. With BIM, these potential interferences are resolved in the design phase. Owners can occupy their building faster, because the contractors can work more efficiently with less time lost during construction.

**Can BIM Reduce Costs?**

Steven Schaefer Associates has been using BIM for three years. We find that the more complex the challenge, the more BIM can do to reduce time, errors, and costs. A complex challenge like the Butler High School building replacement was perfect for BIM.

BIM facilitated communication between the design team members and helped make the design phase run smoothly. Without BIM our structural engineer would need to copy exterior walls designed by the architect into our model in order to coordinate the type, size, and placement. With BIM the architect models the exterior wall and links that model to the structural model, which shows the foundation wall and footing. No copying is required, no elements are modeled twice, and no discipline is responsible for modeling another's element. When the individual models are linked, each team member can see the collaborative model.

See the complete article, "Can BIM Be Profitable?"



*"By utilizing BIM the design team is able to address many conflicts before the documents are published. This saves the design team from possible extensive rework caused by finding these conflicts in the field during construction. It also saves the owner from potentially expensive change orders."* Aaron Buirley, Architect, SHP Leading Design