

Project Summary

Organization:

Fitzpatrick Engineering Group, PLLC

Solution:

Structural Engineering

Location:

Cornelius, North Carolina,
United States

Project Objective:

- Perform structural design for a two-story, 65,000-square-foot, steel-framed building designed for a future floor.
- Provide an Autodesk Revit 2012 model deliverable to the owner upon project close-out.
- Share structural design model data with steel fabricator to jumpstart detailing and shop drawing production.

Products used:

AECOSim Building Designer, RAM Structural System, Structural Synchronizer, ISM Revit plug-in

Fast Facts

- FEG collaborated seamlessly with an integrated project delivery team that included the design team, contractor, and major subcontractors.
- Using AECOSim Building Designer's parametric cells enabled tighter coordination between models and plans, and helped optimized scheduling.

ROI

- RAM Structural System's analysis of proprietary SidePlate connections allowed FEG to provide a USD 15,000 savings in direct material costs for steel.
- Fillet welds in the SidePlate connections required less field inspection and testing, saving an additional USD 13,000.

Fitzpatrick Engineering Group Uses Bentley BIM Software for Major Structural Design Project

Software Ensures High-quality Data for Steel Fabricators; Helps Save on Material Costs on USD 18 Million Rehabilitation Center

Owner Requirements Drive the Need for Interoperability

Located in North Carolina, U.S.A., Fitzpatrick Engineering Group (FEG) specializes in structural engineering solutions for commercial, institutional, and healthcare buildings. The firm was selected by a major healthcare provider in the southeastern United States to be part of an integrated project delivery team for an USD 18 million rehabilitation center.

As a long-time Bentley user and an early adopter and advocate of building information modeling (BIM), FEG was committed to using their preferred BIM applications – Bentley's AECOSim Building Designer® and RAM Structural System® – to provide structural design for the 65,000-square-foot, steel-framed building. Using Bentley's integrated and interoperable software enabled FEG to not only easily meet the owner's requirements for a Revit deliverable, and provide the steel fabricator with the most accurate and complete information possible, but also to achieve a USD 28,000 savings in direct material costs and field inspection costs.

FEG conducted an internal study comparing the information exported from leading BIM platforms into structural detailing software applications, and confirmed that AECOSim Building Designer was the clear winner.

AECOSim Building Designer Provides the Most Accurate and Complete Structural Data

The rehabilitation center was the owner's first foray into integrated project delivery, in which the design team, contractor, and major subcontractors were on board from the start of the project in late 2011. As one of two main requirements, the owner requested a Revit model deliverable from all design disciplines for use in facility management, as their previous pilot projects had demonstrated that BIM

reduced changes and produced measurable savings before and during construction, as well as for ongoing operations. In addition, the owner also required FEG to share the design model data with the fabricator.

Sharing structural model information with downstream members of the construction team, including fabricators, was not new to the FEG. However, the owner's requirement for a Revit deliverable did require FEG to closely examine the accuracy and completeness of data exports from both applications. A thorough internal review concluded that AECOSim Building Designer was clearly able to export the most accurate and complete structural data.

Integrated Structural Modeling Tools

The solution to providing both the Revit model deliverable and high-quality steel fabrication data, without having to re-enter data, was to implement Bentley's Integrated Structural Modeling (ISM) tools. FEG determined that its structural engineers could use AECOSim Building Designer in conjunction with Bentley's Structural Synchronizer® and ISM Revit plug-in®. Structural Synchronizer could provide a shared, dynamic repository for all structural content, including change management visualization and revision history. AECOSim Building Designer could use Structural Synchronizer to communicate with the database, while the ISM Revit plug-in could transfer data to Revit.

"We could work in our preferred BIM application, confident that we would be able to send reliable information to the fabricator and deliver a Revit model through electronic means without having to manage two models separately," Fitzpatrick said.

FEG started the project with two Bentley products: RAM Structural System, which allowed analysis and design using a single model and Structural Modeler, a BIM application that enabled engineers to easily explore design alternatives with flexible interdisciplinary coordination and interoperability. When a new release of AECOSim Building Designer became available, FEG phased out its use of Structural Modeler in order to leverage the new modeling features in AECOSim Building Designer.

“The robust features of AECOsim Building Designer and Bentley’s continued commitment to interoperability have allowed Fitzpatrick Engineering Group to move beyond the traditional ‘beams and columns’ of BIM and set itself apart as an industry leader while collaborating in mixed environments.”

—Douglas G. Fitzpatrick,
P.E., President, Fitzpatrick
Engineering Group

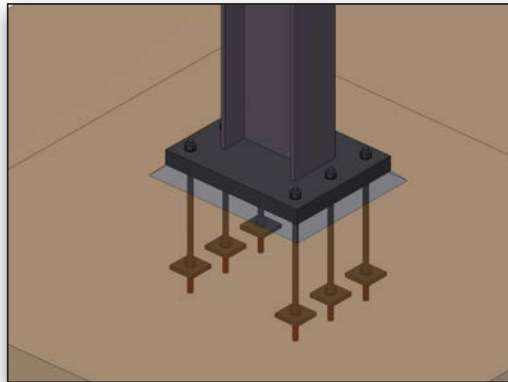
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Parametric Cells Help Enhance Coordination Between Models and Plans

Using the latest version of AECOsim Building Designer, FEG was able to use dimension-driven parametric modeling to create and manipulate complex structural assemblies. Parametric modeling technology enabled the creation of parametric cells for common structural components in the project including the proprietary SidePlate connection and baseplates with anchor bolts. “Parametric cells have allowed us to add more meaningful content into our models and provide tighter coordination between our models and plans,” explained Fitzpatrick.



Parametric modeling with AECOsim Building Designer provided an immediate visual feedback to ensure model accuracy.

Parametric cells not only provide the designers with a visual check as they are placing the element, but also yield benefits with plan annotations and scheduling. Because they are linked to the original element, any associated data for an element can be placed as an annotation on the plans, and as the design continues to evolve, the annotations are automatically updated. Similarly, an entire group or subset of data for a component can be easily exported to a spreadsheet and reformatted into a schedule to meet corporate standards.

FEG created parametric cells for the SidePlate connections that included all of the plate components as well as the welds. As the connection component was placed, the engineer received immediate visual feedback. If the parameters entered were correct, the cell would fit snugly around the column and beams for that condition. If column flanges extended beyond the side plates, or if the cover plates were not snug to the beam flanges, the user could take action to correct the problem rather than dealing with an RFI during construction. Column base plate parametric cells were created that included anchor bolts, nuts, washers, embedment depths, and a non-plotting clearance lug at the bottom of the anchor bolt. If this (red) lug was visible

from the underside of the foundations, FEG knew the footings were too shallow or the bolts too long for that condition, and the anchor bolts would not have the proper concrete cover. Anchor bolt layouts could be visually compared against the column profile for clearances during modeling as well.

The base plates and anchor bolt layouts were included on the extracted foundation plan, offering another opportunity to ensure consistency. The engineering team created spread footing parametric cells to allow them to consistently model footing sizes, reinforcing quantities and elevations. It also ensured enforcement of FEG’s corporate designs. Beam web openings, necessary for proper coordination and interference detection, were created and scheduled as well. Annotations were placed on drawings for each of these parametric elements, closing the loop on accurate coordination between the model and plans and enforcing corporate standards for labeling each of the elements. The risk associated with transferring red marks the old way was eliminated, and consistency between FEG’s model and drawings was ensured.

“By creating parametric content with AECOsim Building Designer, we were able to provide an immediate visual confirmation of modeling accuracy during element placement,” Fitzpatrick said. “The user was able to see the new content in full context of the model and could tell if the assigned parameters fit the current condition. This visual confirmation provided the first level of conformance and error checking.”

RAM’s SidePlate Analysis Helps Save Material Costs

Using RAM Structural System to analyze the proprietary SidePlate connection technology allowed FEG to provide a USD 15,000 savings in direct material steel costs on the project. Although the SidePlate connection was conceived for high-seismic applications, it has demonstrated savings in lower seismic regions as well – not only in terms of direct material costs but also in field inspection costs. Traditional seismic connections require continuous inspection of full penetration welds, whereas SidePlate connections are all fillet welds allowing for periodic inspection and less field testing. The inspection and testing cost reduction was anticipated to save an additional USD 13,000.

This project demonstrates that mega-sized firms working on mega-sized projects are not the only ones using Bentley’s building applications to solve unique challenges, work and thrive in a mixed BIM environment, gain sustainable drawing production efficiencies, and deliver more consistent drawings using the powerful set of tools in AECOsim Building Designer. Bentley’s innovative products have allowed this small firm to surpass industry standards and set itself apart as a leader by developing an advanced solution to today’s BIM workflow.