Second Nature

BIM has been part of the relationship between a Michigan structural engineer and steel fabricator for several years, and their projects reap the benefits.

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Douglas Steel

WE CONSTANTLY HEAR—AND SAY—THAT BUILDINGS are being designed at a more accelerated rate than ever before, and that fast-track projects are no longer an option but the norm. And that's true. But it's been true for years now.

As we all know, the daily design routine has constantly evolved—from hand-drawn documents to analytical tools and CAD programs, for example—to keep up with this ever-increasing pace. One of the newer tools, of course, is building information modeling (BIM) technology. While not everyone is using BIM, most in the design industry have at least a basic understanding of what it is.

To some, BIM means only "3D modeling," while to others it invokes a complete building model shared between construction team members, with "smart" parametric attributes that hold all of a building's components' information—structural, M/E/P, etc. This latter interpretation is more beneficial. While a 3D model is useful for coordination and space allocation, a BIM model holds this information *plus* all of the structural parametric information for a building. These parametrics, when shared among the various building team members, can result in significant time savings.

BIM and Hospitals

Perhaps nowhere is BIM more important than with hospital projects. An example: Beaumont Hospital, Troy, located in southeast Michigan, is currently undergoing an expansion that encompasses five new buildings as well as additions to four existing buildings. Some of the new work includes a 575-ft-long pedestrian bridge, a vertical bed tower

Harley Ellis Devereaux

Beaumont Hospital, Troy's campus is currently undergoing an expansion that will house a total of nine new buildings or additions to existing buildings.

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expansion, an emergency center expansion, a critical-care tower addition, a powerhouse expansion, and a new ambulatory care center (ACC). Altogether, new construction on the campus comprises approximately 1,000,000 sq. ft—all designed using BIM technology.

While this expansion project encompasses several facilities, we'll focus on one: the ACC. This slab-on-grade, three-story, 130,000-sq.-ft building is connected to an adjacent medical office building (also part of the expansion) and the pedestrian bridge via a large atrium. The east wall of the ACC has a rolling spline façade with irregular column spacing in one direction; continuous ribbon windows wrap the building's exterior. Total steel for the job is 1,100 tons.

We evaluated concrete and steel structural framing systems early in the design stage. The main criteria were to maintain program flexibility for future renovations using a 32-ft by 32-ft grid and within vibration restrictions of 8,000 micro in./sec. While a design using both steel and concrete would have met these requirements, cost and schedule were the deciding factors in our eventual selection of a steel frame for the ACC; the steel was able to be released prior to the interiors being designed and signed off on.

The building's framing system is constructed with composite steel beams, and lateral resistance is provided by moment frames in the longitudinal direction and braces in the transverse direction. The braced frames were located strategically near shafts and configured around doorways and corridors. To maintain schedule—and even accelerate it in some cases—BIM played a major role in the project.

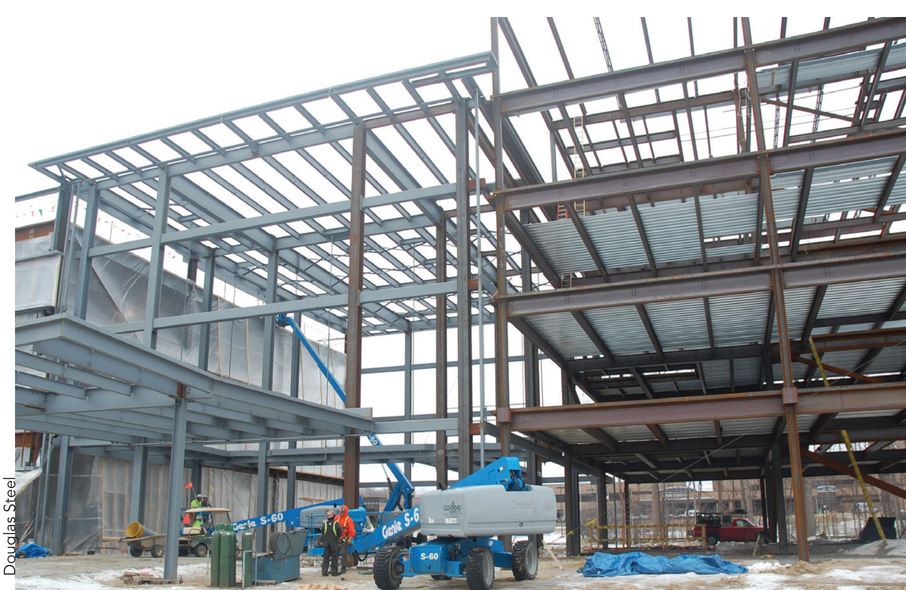
Phases

We modeled the building in phases. The first phase was primarily beams, columns, and foundations. We leveraged available technology, electronically transferring our Revit Structure model into our analytical program, RAM Structural System. After completing our engineering of the gravity and lateral members, we round-tripped the design. The interoperability between the two programs allowed the engineers to transfer all of the beam and column design information back and forth with the push of a button. Specifically, Douglas Steel translated the RAM files to CIS/2 then imported the CIS/2 file into SDS/2. In the end, we were able to import all of the beam reactions, camber, shear studs, bracing, and sizes without marking up a single drawing.

Once phase one was engineered and documented, we handed the model over to the project's steel fabricator, who was able to use our model for two important purposes: creating an advance bill of material order for the mill and starting the fabricator's model. The BIM process, executed properly, eliminates concerns over potential discrepancies between the model and printed dimensions since the documents *and* the analytical model were both created from the BIM model; thus the coordination was automatic.

As BIM allowed the shop drawing process to start sooner, the steel was ordered earlier, fabricated earlier, and available for delivery earlier. While the fabricator was detailing the main structural members and preparing to receive steel from the mill, phase two of the modeling was started. This phase comprised all exterior framing components—namely the kickers, struts, vertical supports, and horizontal headers—and miscellaneous interior steel framing members. Thanks to the BIM process, when coordinating with the mechanical engineers, we were able to visually inspect the model to ensure that the kickers did not interrupt the duct runs or other building systems.

Once the building was well under construction, final mechanical equipment selections were made. To facilitate the installation of the equipment and coordinate with the trades that had already been installed, the design team modeled the Unitstrut or open-slotted channel framing and equipment drops.



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The structural connection information from the fabricator's model also proved beneficial. When reviewing the building system equipment drawings—specifically, all of the hanging loads—we verified that the beams and their connections had adequate capacity to support the equipment. This readily available information from the fabricator proved to be an immense time-saver. The engineer did not need to go to the field and count bolts or measure a welded connection. Rather, the information was already available and only a few clicks away.

During a post-evaluation of the project and its design process, it was clear why BIM was such a crucial element. We were able to leverage the model to expedite the shop drawing and detailing processes, reduce some of the fabricator's set-up time, and minimize coordination time. MSC

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BIM the Norm

Douglas Steel and Harley Ellis Devereaux have been operating as a team on projects for more than three decades. In fact, one of our first projects together using model transfer and BIM technology was a previous expansion to William Beaumont Hospital in 1995.

During almost all of our projects, we share our ideas and preliminary designs with Douglas for feedback on cost and constructability. We validate this effort when our documents go out to bid and the structural proposals come in within budget.

Douglas Steel was instrumental in developing the electronic shop drawing process between our companies. Their staff came to our office for "real" training. (Anyone who implements a new system or program knows what I mean by "real" training.) This is a sign of true partnering, rather than a design team and a separate fabrication team.

BIM technology has come a long way since our first BIM project together. The BIM environment is no longer a buzz word or an additional service. Rather—for us, at least—it has become the normal way of doing business and forming efficient teams between design and fabrication.