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BIM and the Building Envelope

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BUILDING INFORMATION MODELING (BIM) will fundamentally and historically change the perspective of return on investment (ROI) in the building envelope (BE) industry before 2015. Such a bold claim is based on the belief that BIM is a process that acts as an enabling catalyst to two major building industry drivers that especially dominate the facade industry: 1) virtual design and construction (VDC); and 2) lean construction.

The BIM process has the potential to make significant changes in the highly specialized arena of curtain wall design, engineering, fabrication, installation and maintenance. The BIM opportunity and challenges for contractors, glaziers, glazing system suppliers and the consultants they use is to understand what the new BIM process is and how BIM changes their businesses today and in the years to come. They then must choose the best path to transform their firms, staff and corporate thinking into a BIM delivery process at all levels of the company. Many will find that the greatest hurdles to a BIM transition are the psychology of changing a corporate culture and not with the technology of installing a new software tool.

BIM obviously has a very graphic-rich 3D interface for the building objects that facilitate an intuitive understanding of the information the database contains. The models also aid in the automated generation of 2D sections of the building envelope plan views of the perimeters. As a relational database of building objects, they can generate parts lists from 3D unit assemblies, integrated façade elevations, and digitally link to engineering analysis models of BE systems. For example, these models can link to analytical applications for thermal analysis at mullion glass interfaces.

The types of information the BIM process can manage include many building envelope aspects beyond the 3D model: wind loads, wind tunnel tests, structural live load movement requirements, material finishes, glass type, interlayer type, allowable deflection on framing systems, thermal information, curtain wall profiles, test criteria, drift and earthquake requirements, sound transmission, sealant types, and field inspection data. An example of this data-rich use of BIM can be seen in the unitized glass curtain wall model shown in **FIGURE 1** that records and organizes vast amounts of field data on glass conditions following a hurricane near the 20-story building. The BIM was developed by Raymond L. Goodson Jr., Inc. (RLG), BIM consultants that specialize in building envelopes. Vertical Solutions was the curtain wall consultant on the project.

This example illustrates RLG's development and implementation of BIM to store and analyze field-recorded glass and curtain wall data in an intuitive model that owners can understand. As field data was recorded on the project, the BIM was updated, which in return, automatically updated all of the parts list, 2D and 3D images, as well as the quantity take off list of the glass conditions.

The first major driver of the BIM process in the building envelope industry is virtual design and construction (VDC), which is the process of using BIM to evaluate and analyze projects from design to construction. VDC will be rapidly increasing in 2010 and beyond as contractors adopt BIM, as indicated in the McGraw Hill *SmartMarket Report on Building Information Modeling (BIM)*. Contractors are beginning to look for building envelope models to contain content far beyond generic facade systems. This higher level of modeling can include connections, backer rods, sealant, flashing and vapor barriers. These are items that traditional envelope designers and detailers would address with general notes, 2D typical details and schedules. However, some subcontractors and BIM-BE consultants are modeling this construction level content.

A major goal of this level of modeling in VDC is to enable constructability analysis by providing dimensionally accurate 3D models. These models will help in identifying scope gap between the building envelope trades, material incompatibility, construction tolerance issues between materials, and other aspects of material transitions at joints (see **FIGURE 2**).

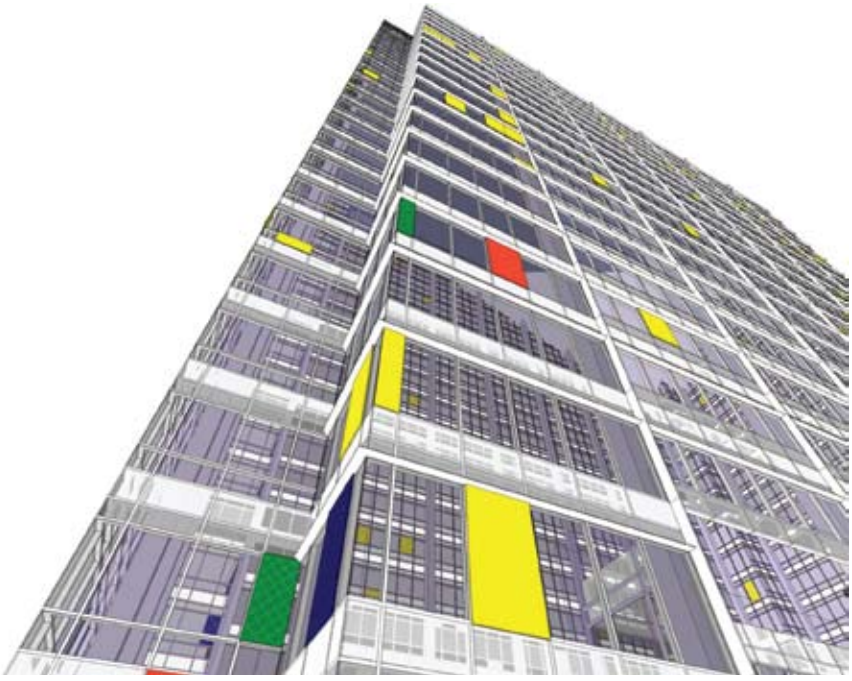

Figure 1. A building information model of a unitized glass curtain wall system on a 20-story building.

On this BE-VDC process, each trade was required to only model items that they installed. The VDC process allowed the team to define "scope gap" early in the construction process and plan solutions that would avoid installation delays. This model also aids the third-party water proofing reviewer of the building envelope to walk through the facade during their review.

Other benefits of BIM-BE are coordination of structural supporting steel and embeds with the building envelope systems. Some opponents of this level of modeling argue that it takes too much effort and time to model the building envelope at a construction level of detail. This is easily dismissed when the cost of modeling is compared with the cost of contractor call backs or litigation related to building envelope failures. Those who have experienced virtual mockups of facades are reporting that the return is worth the time and effort invested.

The second driver towards BIM in the building envelope industry is lean construction. Unitized curtain walls already builds on many of the lean construction methods of reduced waste in time, material, field labor, and trade coordination with on site materials. The BIM process expands these benefits by allowing teams to "measure twice (in the model with 3D fit up) and cut once (in the shop)".

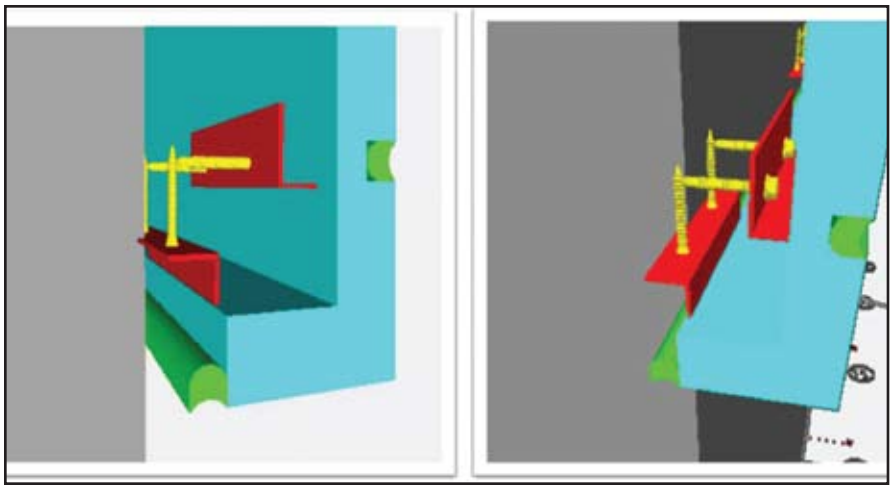

Figure 2 A (left) & B (right). A metal panel connected to architectural concrete where the design detail included wood blocking attached to the concrete for the metal panel to screw into (see fasteners in yellow). These are part of a building envelope BIM assembled by RLG.

The BIM process also provides the opportunity to discover fabrication and fit-up issues virtually in the model before they are built. Additionally, the BIM process can greatly enhance the execution of just-in-time (JIT) delivery of unitized systems from the factory to the job site by linking scheduling information in 4D BIM. A BIM enabled production and project planning with JIT can also increase inventory turns and reduce the amount of working capital required to operate the fabrication. Additionally, BIM enabled planning of erection and installation sequences that optimizes where the different trades operate within the building in the schedule of construction can allow for fewer workers on site with faster installation and safer jobs.

The construction industry's change to BIM is now happening faster than many realize with a rapid expanse in design, construction and institutional owners. Curtain wall companies will have to provide committed competent BIM services to compete and survive on projects of any significance within the next five years. This necessity will be the result of the two BIM drivers previously discussed: VDC and lean construction. An emerging third driver of sustainable design will also propel the building envelope industry into BIM in the years to come.

The building envelope industry of 2015 will look dramatically different in terms of BIM than it does today. Additionally, BIM requirements will be ubiquitous on requests for proposals for new work related to the building envelope in the near future. The most significant ROI for BIM as it relates to facades is that the firms that adopt BIM will be relevant while their non-BIM competitors will fall behind in the rapidly evolving building industry. ■

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