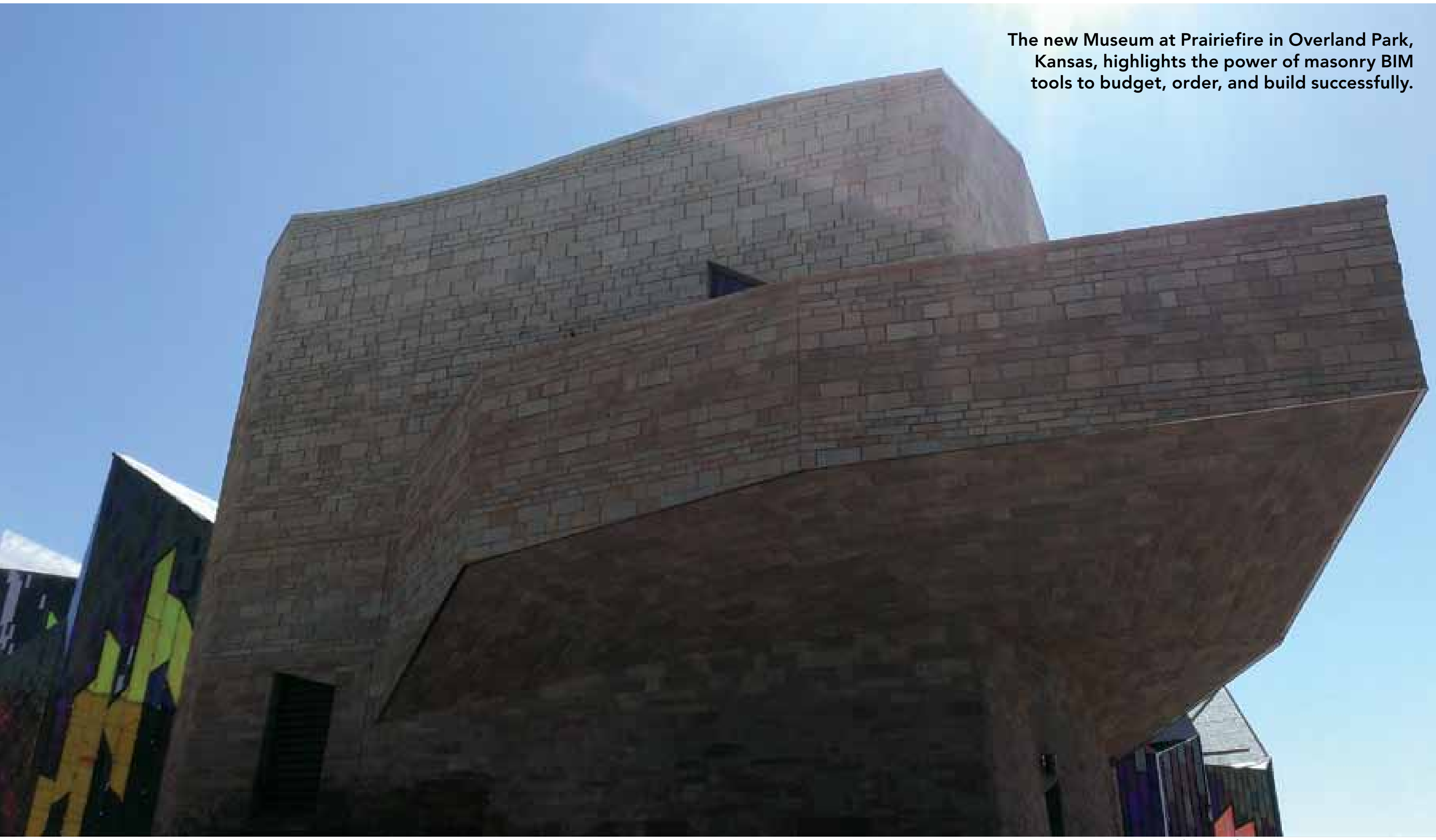

The new Museum at Prairiefire in Overland Park, Kansas, highlights the power of masonry BIM tools to budget, order, and build successfully.

Photo courtesy of Oldcastle® Architectural

BIM Comes to Masonry

The time-honored trade gets closer to meaningful Building Information Management

Sponsored by Oldcastle® Architectural | *By Tom Cuneio, ME*

Of all the acronyms in the design and construction industry today, BIM (Building Information Management) has to be one of the most recognized. Many in the industry are enthralled by all the brightly colored visions of projects still on the drawing board, the opportunity to immediately grasp the overall impact of a proposed modification in one system, and the intense record-keeping capability that translates to far easier repairs and renovations afforded by such advanced modeling capabilities. And with good reason. BIM stands to revolutionize the design and construction process, strengthening the traditional three-sided paradigm of success—project quality, cost, and schedule. Masonry, however, has largely been left behind in the race to BIMify the industry. This article will discuss the masonry situation in terms of existing and emerging BIM and other modeling capabilities, as well as challenges and benefits of a modeling system for masonry. Also provided will be real life examples of masonry projects that have enjoyed the benefits of modeling.

A TRADITIONAL TRADE—ADVANCED TECHNIQUES

The masonry trade is an extreme blend of old and new technology. Consider the situation in undeveloped countries such as Malawi, a small country in South East Africa. Roofs in this village are primarily constructed by lashing sticks together into a crude frame and then covering the frame with bundles of grass to provide minimal shelter from sun and rain. The homes are primarily constructed with mud brick. These bricks are dug from the native soil on site and then baked in a wood-fired oven,

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Learning Objectives
After reading this article, you should be able to:

1. Articulate the benefits of BIM to project cost, schedule, and quality.
2. Discuss the challenges that masonry faces in terms of meaningful modeling.
3. Explain the advantages that architects stand to gain as BIM for masonry is implemented.
4. Describe what architects can do now in using modeling to the fullest when specifying masonry products.

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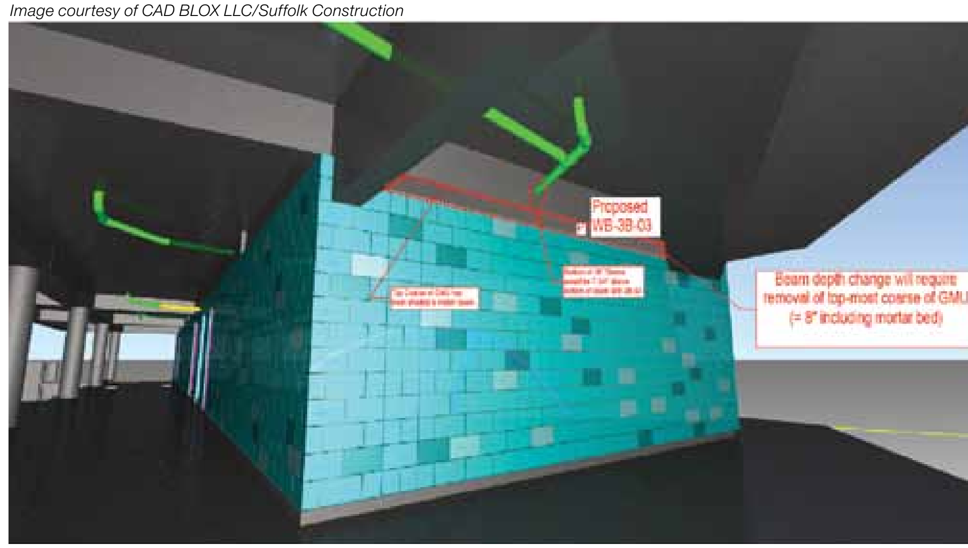
also on site, to remove some of the moisture. The end product is a brick that is only slightly stronger than a dirt clod. They are laid in running bond using mud as mortar. They dig a small hole on the site and periodically wet the hole to dig "mortar" for laying the brick. No cement or other additive is used.

Dimensional tolerance? Unit compressive strength? Type S or Type N? f'n? These are nowhere to be found. On the other hand, these dwellings illustrate the simple beauty of masonry and the ancient roots of the trade. These structures are surprisingly sound. They have high thermal mass, are termite proof, require no transportation of materials, are 100 percent recyclable, are locally mined and manufactured. In fact they surpass even our best efforts at being "green" and sustainable. One man can mine, manufacture, deliver, and install all the necessary components to build these structures—a remarkable feat.

Since its inception thousands of years ago, masonry has in many ways not changed. It is still practiced today in exactly the same form that it began so long ago. Even at its most basic state, masonry is still a very effective means of providing shelter and security for people all over the world. At the other end of the spectrum is masonry in the U.S. In addition to cost, aesthetics, and durability, our projects must meet standards for energy performance and sustainability, and they must be technology friendly. Those involved with masonry products today may likely spend their time with high-end computer hardware, the latest in software developments, intricate algorithms and analytical methods. The push is on to develop something that has never occurred to those builders of mud huts but could prove invaluable in today's world demanding complex projects—3D models of masonry buildings to advance the art of BIM for masonry.

Image courtesy of CAD BLOX LLC/Suffolk Construction



Detailed masonry models are providing meaningful data in the BIM environment.

BUILDING INFORMATION MANAGEMENT (BIM)—WHAT IS IT?

As most architects know, BIM is a process that involves the generation and management of digital representations of physical and functional characteristics of places. Building Information Models (BIMs) constitute files, which may incorporate proprietary data and formats. These files are exchanged or networked to facilitate decision-making about a project and its design. BIM extends the format to 3D, incorporating the three primary spatial dimensions of width, height, and depth with other dimensions, such as time and cost, taking the information to a fourth and fifth dimension. BIM is object oriented, and in order to understand BIM, an understanding of the object being modeled is necessary. Unlike CAD, which represents elements with lines that define its geometry, BIM creates smart objects that contain several levels of information, or parametric data, including geometry, material properties, color and texture, cost, source and distribution information, and manufacturer. Each element in the BIM model "knows" how it relates to other objects and to the design in general.

Designs are represented as combinations of objects, or assemblies that can be simple or very complex, and can be analyzed as systems or according to cost. Because BIM defines objects as parameters and in relation to other objects, if an object is changed or modified, related objects will automatically change as will the associated cost estimates as well as material tracking, ordering, and many other attributes.

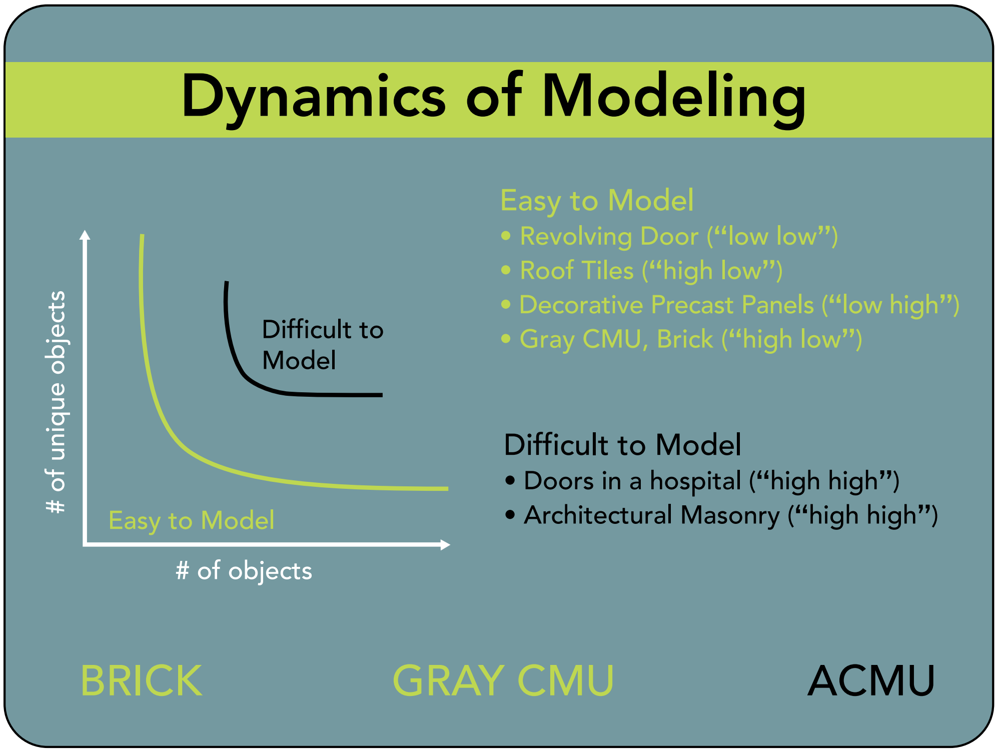
Because each member of the design team from architects and engineers to contractors and owners adds discipline-specific data to the single shared model, information losses are reduced and a more detailed database is created about a complex structure. Use of BIM, then, extends beyond the initial planning and design phase of the project, to have value throughout the building life cycle, and to support such project stages as construction management, project management, facility operation, and beyond. Early adopters are enthusiastic and confident that the use of BIM will enhance a variety of functions including improved visualization and productivity; better coordination of construction documents; increased information about specific materials and quantities for estimating and bidding; dramatic savings in overall project schedule and costs. BIM advocates also point out that most of the data needed for building energy performance analysis exists and that building energy simulation is feasible from an accuracy, time, and cost standpoint.

That said, some industries are more BIM-compatible than others. In terms of structural building materials, the main focus has been on incorporating steel and reinforced concrete into BIM software. For years, structural steel and cast-in-place concrete have had software with 3D capabilities and substantial design information that has made it easy for BIM software developers to build on. Likewise, several BIM tools have been developed for wood and cold-formed steel. Why not masonry? Arguably, the reasons stem principally from the intricacy of masonry products themselves and the endless possibilities to combine these products into complex arrays.

THE BIM-MASONRY CHALLENGE

One of the reasons masonry has not been included in BIM software is the sheer complexity of the material.

For starters there is the problem of managing the large number of units possible in a commercial masonry project. A block job may have several hundred thousand units and a large brick job can have more than a million units. Each unit has a unique location and orientation in the model, making unit model building a huge labor task. A variety of bond patterns are available to arrange the units in the building and sometimes several patterns are combined. Beyond this, many options exist for material and several are typically combined in a single job. There may be natural stone, manufactured stone, clay brick, concrete masonry, and within each option there can be many colors and textures, making the models even more complex. If that weren't enough of a challenge, an additional layer of complexity is added by shape variation. Consider a very simple case of a wall of 8816 standard concrete masonry units all in the same color and texture. Within that product there may be 75 percent solid units, bond beam units, open end units, double open end units, solid bottom units and on and



on it goes. Finally, additional layers such as making the job ground face or adding bullnose corners compound the problem. One can easily appreciate how much information must be tracked in a quality masonry model to get useful data. Each of the layers of complexity described above impact cost, so unless they can be tracked in the model, accurate cost data cannot be generated.

The dynamics of modeling are such that it is relatively easy to model materials that represent a small number of dissimilar objects regardless of complexity. Consider a revolving door which likely has only a few instances. It is also not difficult to model a very large number of homogeneous items as is the case for hundreds of thousands of roof tiles. But for masonry models which have both large number and great variation, the task becomes exponentially complex—especially for architectural masonry.

Challenges abound in incorporating masonry into BIM, and there are no easy answers, and no short cuts, just as there is little value in a model unless it is high quality and can take into account the complex layers of data required. It is not difficult for BIM designers to generate data, even for masonry. The real challenge for modeling masonry is quality data. While a stretcher—a basic unit in the field of a wall—may have a given cost, a corner unit of the same material can be three or four times as expensive in some architectural applications. Accurately accounting for these variations in product is essential to generate useful Quantity Takeoff (QTO) data for masonry.

THE LANDSCAPE TODAY

Analytical models do exist, however, to assist in the design and installation of architectural masonry products. A few proprietary services offer a host of advantages in reducing time, cost, and potential problems in building complicated masonry jobs. The landscape is also changing as masonry industry stakeholders join forces to collaborate on creating and implementing new generation BIM-M, or BIM for Masonry.

Current Software Modeling Tools

Post-bid commercial software modeling programs do exist to assist in the ordering and installation of architectural masonry products. The models help the project team understand the products, order them accurately, resolve design issues related to CMU, layout bond patterns, stage complex orders, and increase productivity in the field. Further, the software enables practitioners to troubleshoot unusual design conditions such as an atypical bond pattern, bullnoses, score patterns, multiple textures, cove bases, arches, radius walls, or all of the above. The most successful technologies build models one unit at a time, as is done in the field—an approach that allows effective handling of the complexity of glazed CMU, ground face CMU, stone veneer, or other types of prefinished masonry units. Multiple colors, multiple textures, and intricate bond patterns can be modeled as well. Coded models facilitate an understanding of how precisely to build difficult conditions, with 3D layout drawings showing all conditions in the model to increase productivity in the field. "The take off detail is invaluable of course," says Rick Riley of Hoffman Cortes Masonry, about this type of model. "The shop drawings save time and material in the field. They are like having a set of instructions on the wall. The foreman can give a copy to the b'layers on the wall and not worry about what is being set."

It is important to point out, however, that the complexity of this type of quality modeling is primarily a post-bid activity. Design time masonry modeling is still in development but is an achievable ambition which the industry is actively pursuing.

BIM-M

BIM-M, or BIM for Masonry, is in the works, with several funding organizations blazing the trail. The Mason Contractors Association of America (MCAA), the National Concrete Manufacturer's Association (NCMA), the International Union of Bricklayers and Allied Craftworkers (BAC), Western States Clay Products Association, the International Masonry Institute (IMI), and The Masonry Society (TMS) are recommending that software developers include masonry in BIM software. Working with the Georgia Institute of Technology, the group has completed a roadmap to achieve that goal and is now working on realizing their vision, all with the help of industry individuals including masonry contractors, material suppliers, structural engineers, architects, and general contractors. Their rationale: If masonry is not included in BIM software as steel and precast concrete are, masonry may appear to be difficult to work with, and find itself in a bad position competitively.

Phase 2, which involves creating a digital library of masonry units and accessories in a common format, is currently ongoing. In subsequent phases, the group will prepare proposals for software vendors to include more masonry capabilities into their products and, ultimately, implement new software for the masonry industry. These efforts are slated to begin in 2015 and 2016, respectively. A first-generation BIM(-M) software for masonry is anticipated sometime in 2017 or 2018, with industry watchers maintaining it will have a significant impact on the way masonry buildings are designed, constructed, and maintained.

THE POWER OF BIM

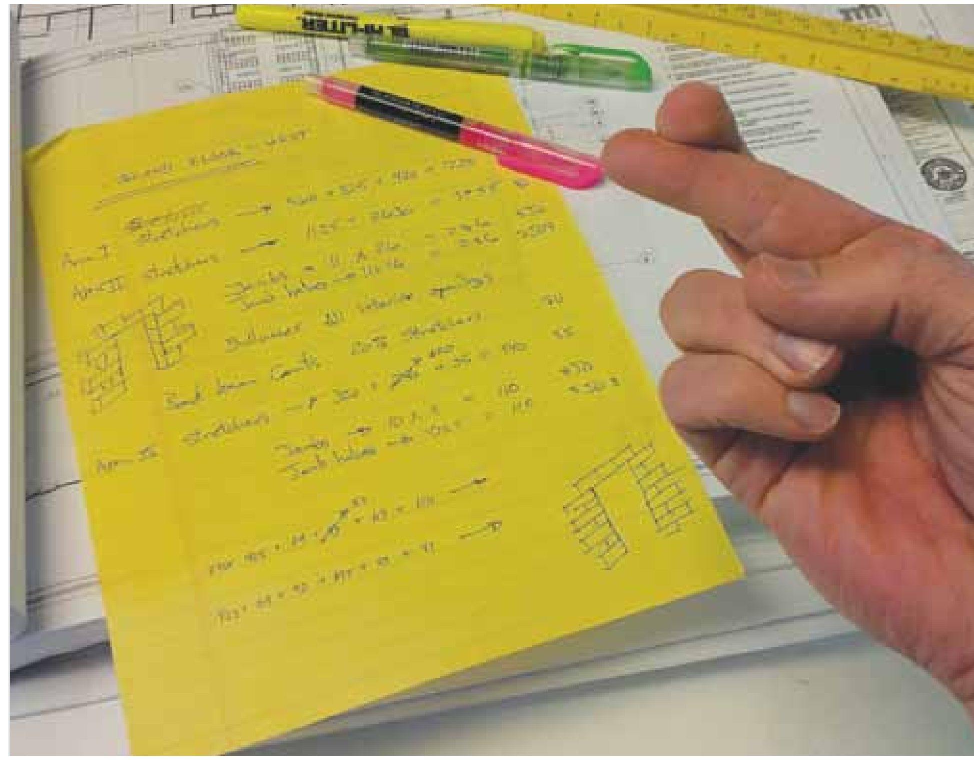
BIM has been dubbed a "game changer," and as such opens the door to many advantages over conventional "longhand" techniques that have been part of the construction process for centuries. While many architects will probably never work on a project with the staggering convolution of a Disney Concert Hall, most will work on projects that require sophisticated detailing. In these instances, which include most projects in today's development portfolios, BIM can simplify an architect's job in many ways.

Reduce or Eliminate Errors

Computerized models have great potential to reduce human error and if an effective planning effort has been made by each discipline and is carefully reviewed and shared, BIM has the potential to avoid or at least reduce mistakes. Orders can be extracted directly from a quality BIM model, providing an exact representation of unit types, colors, textures, and quantities. With confirmation of the accuracy of the model, the exact product order can be delivered, eliminating the usual waste factor in sizeable orders. Further, because the software can break down and provide a better understanding of the construction project, there is a smoother implementation by contractors and subcontractors.

Clash detection. Integral to BIM modeling, clash detection is possible because each discipline—structural, MEP engineering, environmental engineering, etc.—has created an independent model which is then integrated in a single multilevel model. Clash detection identifies where the separate models have incompatible parameters, or an out-of-order time sequence that might cause design changes, higher materials costs, and the accompanying cascade of schedule and budget overruns. In the past, clash detection was performed on site as opposed to in the design phase when constructability issues can be resolved before construction begins, saving vast sums of money and time and producing a better building.

Quantity takeoff. A key part of any project, take off and estimating has been a tedious, time-consuming task. In the masonry field, the traditional method has been to cost out a project longhand, and then add a margin to the bid based upon the complexity of the job to cover all the intricacies that hand calculations cannot account for. For complicated architectural jobs this margin can be as high as 25 to 30 percent to cover unforeseen conditions. Yet BIM modeling can substantially decrease the time and effort involved, and derive a more accurate result. Field experience is full of case studies that have followed the cost of contractors' mistakes in estimating and ordering. In 2011, for example, designers of a Chicago Public School specified 67,000 ground face units, and subsequently followed two paths: the contractor's cost numbers and ordering methods and a modeling program to determine the same issues. While the modeling effort provided what in hindsight was an accurate cost figure and ordering scheme, the designers went with the contractor's decisions, and ended up requiring 12 add orders, additional mold set up fees and freight costs, and experiencing significant delays and color variation problems.



Traditional QTO technology is to cost out the job longhand, and add 25 percent.

Benefits Realized

While prefabrication reduces field labor cost and time and increases accuracy in good quality construction, it requires highly reliable models to be successful. BIM models can achieve this level of accuracy via specifications, finishes, sequences, and a three-dimensional visual for each building component. Provided that BIM relates to fabricators' software, building elements can be manufactured according to precise specifications and delivered to the jobsite on time, in many cases curtailing costly and time-consuming field cutting. Since architectural masonry typically involves a manufacturer-applied design treatment to various faces and edges, like ground face or bullnose, it is essentially a very large prefabrication problem that is ideally suited to a BIM solution.

Optimizing Products

Synthesizing information from a number of disciplines, BIM has the capability to identify unique products, optimized for individual customers or projects, and for a faster, more efficient construction process in order to create better buildings with less effort. Masonry manufacturers typically have tremendous flexibility to produce exactly the right specialized unit to resolve just about any design condition but if these unique products are not located and accounted for during the QTO process, those units will never appear on the jobsite. This is another area where a BIM solution controls both the cost of masonry projects as well as the final aesthetic of the installation.

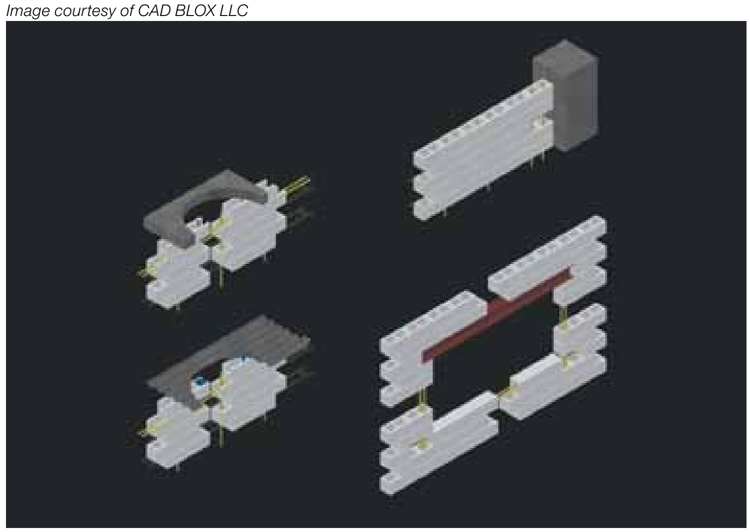
Continues at ce.architecturalrecord.com

Tom Cuneio *is a mechanical engineer who developed CAD BLOX 10 years ago to provide a reliable modeling method for complex masonry projects.*

Powerful Information Record

Information about a building project that is collected and created during its lifecycle provides an unprecedented data resource that can help owners and managers improve operational effectiveness throughout the service life of the building, and beyond. As this flow of information is cyclical—data collected by continuous measurement of various parameters—it becomes a database for future renovation and a QTO for repairs and building maintenance. Further, performance data of this depth can help determine the efficacy of designs and predictive models. In some cases, the information is critical in addressing unforeseen situations. One example is the experience of the Triumph Foods Packing Plant in St. Joseph, Missouri. Architects had called for 60,000 pieces of glazed block which was being installed as the plant suffered an explosion in 2005. Portions of the block turned to rubble. Instead of spending weeks or months in the reordering process determining what product was in the walls that were lost, the owners consulted the model that had been formulated for accurate QTO during the ordering process, which enabled them to retrieve the precise information on the size, color, character, and cost of the block that had been initially specified. The reordering process was completed in less than an hour, a dramatic reduction in time and effort versus conventional methods.

Image courtesy of CAD BLOX LLC



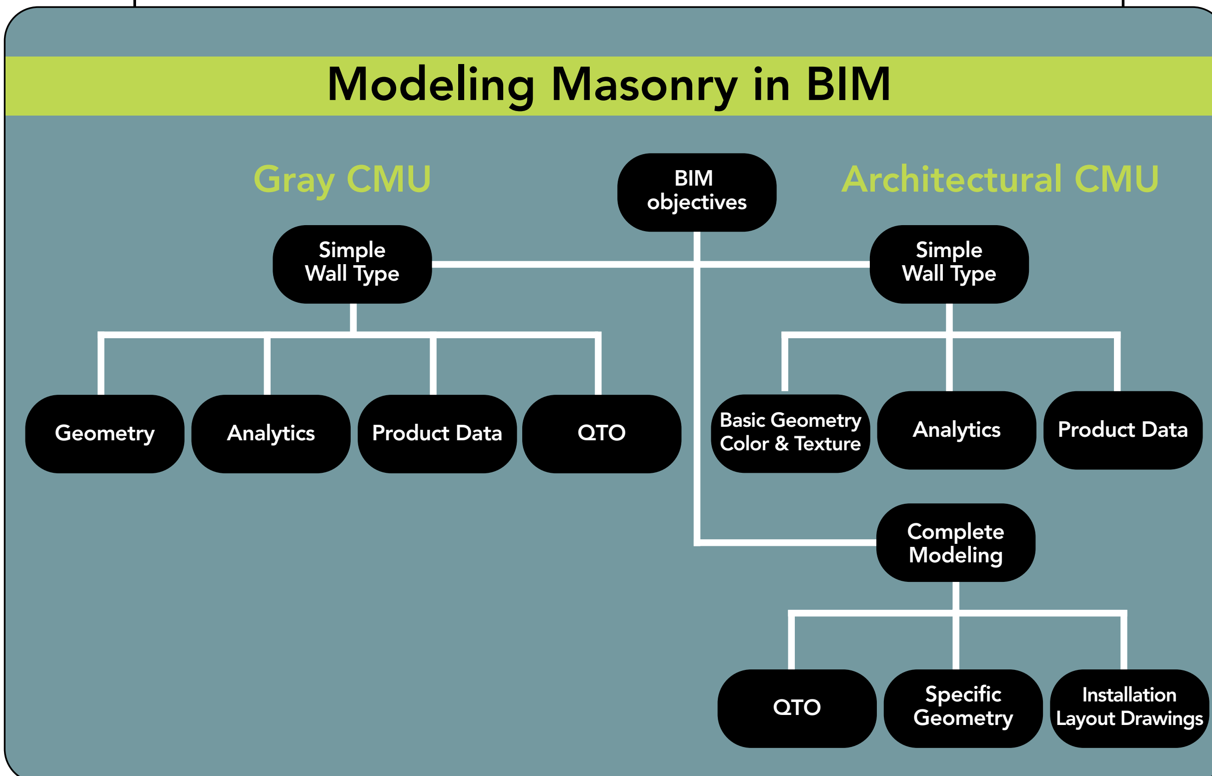
In addition to the units themselves, masonry walls encompass a host of supporting hardware.

Current Design Options

Typically, BIM modeling for masonry occurs on a post-bid basis rather than in the design phase, yet the latter is where it could be most valuable. The design advantages are multifold: The 3D model provides the benefit of visualization of the project that will facilitate a more accurate design with fewer errors and omissions, the ability to visualize bond patterns, exchange products and see the cost impact, and properly locate and size openings in the bond pattern to eliminate field cutting. With 4D modeling during the design phase, construction sequences can be visualized to develop a phasing sequence to be incorporated into the construction documents.

HOW MASONRY FITS IN

How masonry fits in to BIM and other types of modeling depends on how you define "masonry." Generally, there is brick and gray CMU, which are comparatively simple, straightforward products, and there is architectural CMU, which refers to more complex units that come in hundreds of faces, glazings, colors, shapes, sizes, and finishes. Brick and gray CMU are relatively easy to model, while architectural masonry is a more complex exercise. The accompanying table sets forth the richer, more robust BIM output for architectural masonry versus gray CMU.



SPECIAL CHALLENGES FOR ARCHITECTURAL MASONRY

As has been mentioned, when it comes to BIM, masonry is in a class of its own. Challenges notwithstanding, the masonry field can benefit from advanced BIM modeling in a number of ways.

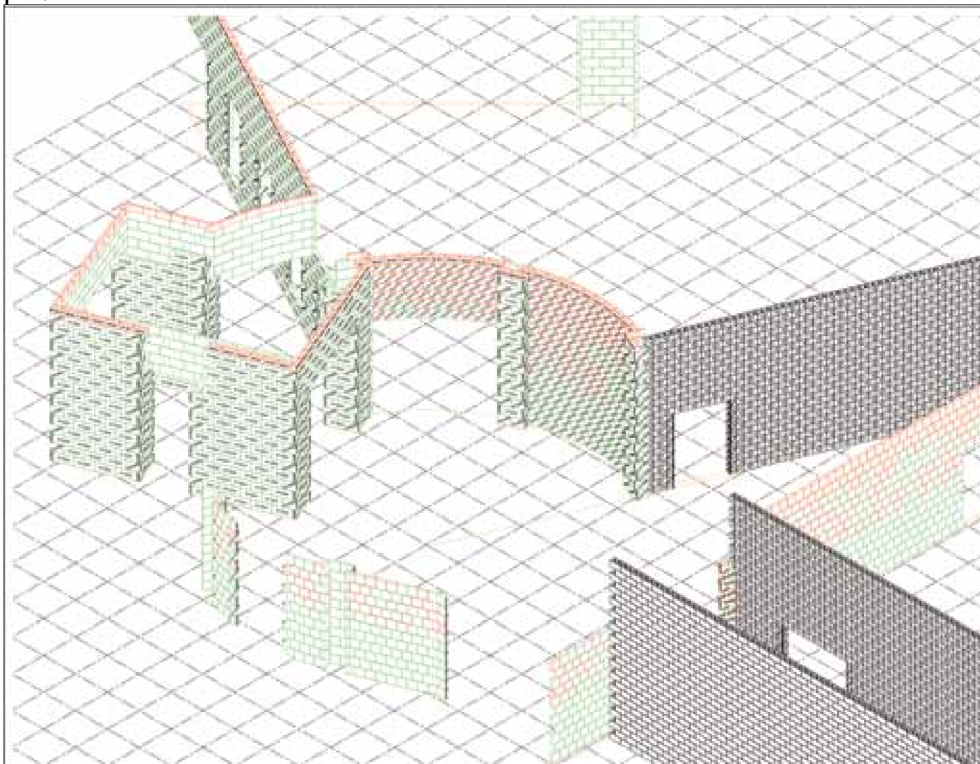
Getting Finished Faces Right

In a masonry project, one of the highest priorities is receiving the correct units that reflect the design intent. Often, the approach is to order lesser amounts and add on if in the field it is deemed that more or different units are needed. However, short ordering, as it is known, comes with its own set of problems. Mold set ups and freight costs can add up quickly, and there is also the disadvantage of possible color variations, job delays, loss of productivity, and wasted resources. If a specialized corner unit is required, for example, that condition is on hold until a proper unit can be delivered, which can upset the schedule of all related work. For masonry, it really pays to get things right the first time around.

Product Limitation

Model builders with a close relationship with manufacturers enable selection of the proper units from the manufacturer's line. If a custom unit is required to handle a condition, the required shop drawings for the plant are produced. Too, models can often help in laying out conditions using less expensive methods, and can help prevent those small add orders for a product that wasn't initially thought to be needed.

Image courtesy of CAD BLOX LLC



BIM can model—and help resolove—the complex geometry of a masonry project.

Design Preservation

Modeling can help with resolving the geometry problems within the overall building shell. In fact, some architectural masonry projects are so complex that their geometry cannot be resolved without an analytical tool. Case in point is St. Mary's Academy, a school project in New Orleans, which involved such complicated geometry that constuctibility and cost issues threatened to jeopardize the project. The design involved more than 140,000 glazed CMUs; more than 100 unique shapes further multiplied by multiple color, score patters and bonding methods to be shipped in various quantities—or more accurately put, 350 unique items. Because of the intended single wythe wall construction, the design was compared to a 140,000-piece 3D puzzle with a photo on each side. When the architects presented the design to contractors, a unanimous vote of "impossible to build" was returned. The only alternative was to build two 4-inch walls to separate the complexity—an approach that was cost prohibitive and not desired by the architects who stood behind their design. Detailed masonry modeling during the design phase, however, salvaged the design, and resulted in precise identification, ordering, and installation of each masonry unit. The technology was used to control costs and preserve the design intent.

Special Attention to Correct Installation

Many times 3D layout drawings take the guess work out of building with architectural CMU. The unit codes in the drawings match the codes on the pallets facilitating accuracy and cost effectiveness in the field. Drawings can show, for example how to start the bond so the order will work for all openings, corners, etc. "Using 3D layout drawings from a BIM model makes my life easier—a time-saving service for us all the way around," says Charlie Adams, masonry foreman, D&D Masonry. The value of this productivity boost has even been seen in relatively uncomplicated gray CMU.

There is such a diversity of masonry elements that even the most well versed architects or field personnel may not be familiar with every type of unit. Consider an 8JOTX X=8 glazed unit, for example—a unit that not everyone may recognize. In a practical sense, drawings coded to match the packing slips on the block order can simplify efforts in the field. Modeling software can put a picture with the codes for instant recognition that help boosts productivity.

Modeling can help streamline the staging of a masonry job.

Staging Complex Orders

Once the model has been produced, project team members can isolate portions of the building for changes if necessary, or produce sub orders based on job staging requirements, increasing the effectiveness of deliveries and ensuring that products arrive on time in the sequence required. If the product is damaged, lost or needs to be changed, models can help rectify the situation, with the pertinent information easily obtained for better field management. A proper masonry model allows for each truck to be loaded with the proper blend of units based on installers work flow.

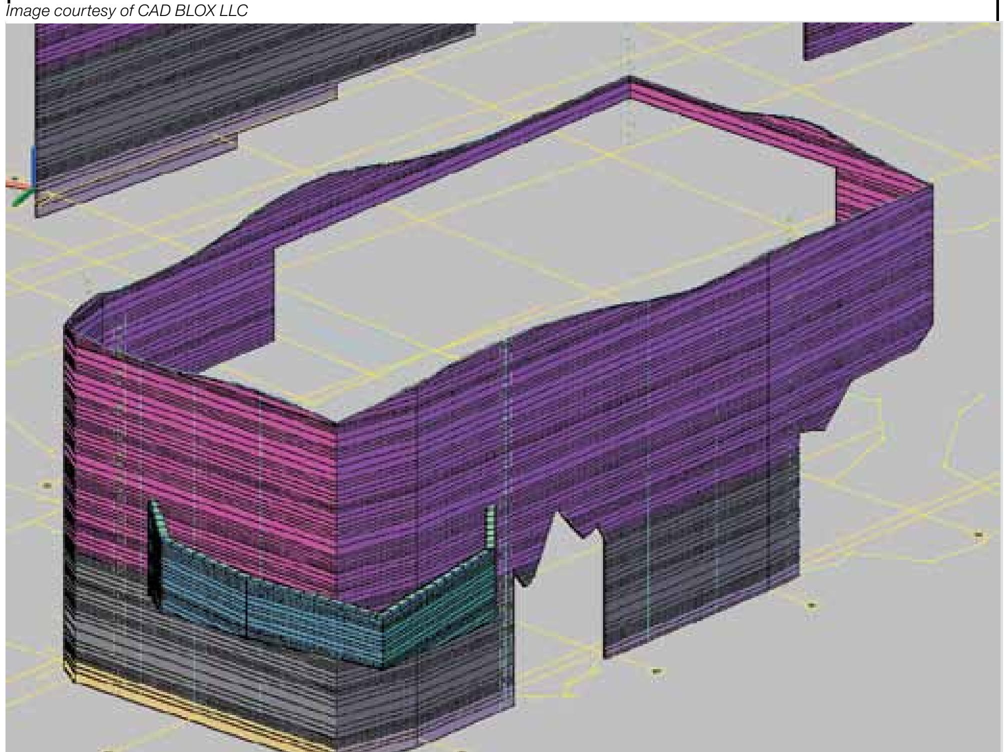
Resolving Complexity

Complex designs specifying architectural masonry can easily involve a hundred different shapes with many in small quantities. Modeling can be helpful in several ways to reduce problems associated with complicated design elements. The new Miami Science Museum, currently under construction, provides an example of implementing the state of the art in masonry BIM tools to control the cost and the aesthetic of architectural masonry. Third-party BIM masonry modeling allowed the architect, manufacturer, and other trades to collaborate on some very specific details that would otherwise have been left to chance in the field. The architectural team of the visually striking, three-story, 250,000-square-foot Miami Science Museum, specified more than 17,000 masonry units in their world class design. The architecture of the museum was characterized by highly unusual angles in the glazed block structure, and designers did not want to sacrifice the integrity of their design by improper bonding or unnecessary field cutting and needed to assess the effects of small changes in the masonry profile on other systems in this high-profile project. As a result, a separately prepared masonry model was pulled into to the full BIM project, for a comprehensive living picture of all building systems—concrete, piping, electrical, etc. Clash detection was performed, and the BIM model accommodated changes in the masonry environment to resolve issues and promote trouble-free installation. “The masonry scope for the Frost Museum of Science project includes an exposed glazed masonry unit installation on two buildings, which both span five levels in height, with custom angled/

shaped units and multiple transitions from full units to veneers, and back—all of which needed to be coordinated with the adjacent and supporting structure. For Suffolk and Formrite Construction, incorporating the masonry scope of work into the BIM coordination process was a must," says Alan Barroso, assistant project manager for Suffolk.

Modeling can be enormously helpful in the design stage and on some projects, custom analytical tools may prove more useful than BIM. Such was the case with a particularly challenging masonry layout for the Museum at Prairiefire in Overland Park, Kansas. Verner Johnson Inc. designed the building using a complex blend of stone veneer products that did not lend itself to standard BIM masonry modeling techniques. The intent was to create a gradient of color and texture moving vertically up the wall. To accomplish this effect over the 46-foot-high cavity wall, 32 separate horizontal zones were established each containing a unique mix of material, color and texture with variable blends. Five colors of Cordova Stone (formerly Prairie Stone) and four colors of natural limestone in two different textures were used to compose the blend with each band varying proportions of product. In addition to the variation of product and color, unit height varied and unit lengths were randomly mixed. As is apparent in the model of one of two structures, the veneer envelope was also uniquely shaped. All these variables converged to present a very challenging modeling proposition.

Image courtesy of CAD BLOX LLC



A hybrid model preserved the integrity of design at the Museum at Prairiefire and freed the masons to practice their craft cost effectively.

Due to the number of variables and the desire for a random effect in the distribution of stone lengths, it was not realistic to create an exact stone model with individual unit placement. While it was possible to build such a model, the drawings and order produced by such a model would be far to constraining to use for construction. Instead, a custom modeling approach was devised that enabled flexibility in the unit placement while preserving the accuracy of unit counts to produce an accurate order. This also allowed the mason, D&D Masonry of Kansas City, Missouri, the freedom to blend the product in an efficient way with proper proportions for each band coming directly from the model. This hybrid modeling solution preserved the integrity of the order, was specific enough to yield useful data for each band, yet freed the masons to practice their craft in a cost-effective manner, a situation that underscores the current paradigm of using the latest technology to facilitate the ancient craft of masonry.

Another interesting aspect of this project was the timing of the modeling. Analytical modeling was deployed privately prior to bid by the winning contractor, which allowed for an accurate bidding process as well as early interaction with the architect to manage the complexity of the design from the standpoint of cost. The ability to have an accurate picture of cost as well as a basic strategy for construction provided very useful feedback for budgeting and the impact of design changes to the stone. The information generated from the model provided a basis for controlling costs by adapting the masonry materials and layout while still preserving the design intent. The Museum at Prairiefire illustrates how the use of BIM masonry modeling techniques can help preserve a complex masonry design through the bidding and construction process to make creative designs affordable and buildable realities.

THE COST OF INACCURATE ORDERS

Any architect that has kept track of how much it costs to miss a masonry order, can attest to the fact that dollars mount up quickly. Architectural masonry does not come cheap and it does not take too much extra block at the end of a job to drain profits. Working with architectural masonry can be extremely complex, requiring considerable time to scrutinize the accuracy of plans. An efficient BIM modeling process sets out a blueprint that can be checked against a visual reference for every block in the building—3D drawings can be quickly reviewed to confirm accuracy. Trouble spots can be sorted out, and orders placed more quickly, which translates to on-site deliveries of block sooner than with conventional efforts. Bonding pattern and locations of field cuts can be reviewed prior to installation, assuring greater confidence in the final placement. These services are currently available and have proven to be a very effective means of eliminating such costs.

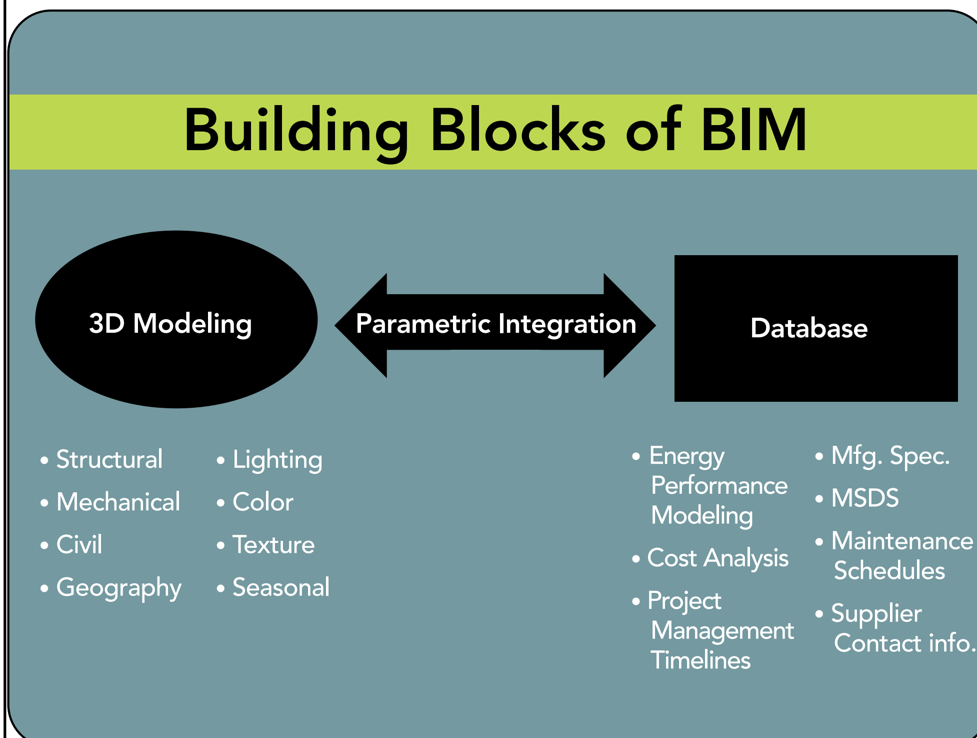
WHAT ARCHITECTS CAN DO TODAY

Modeling technology for architectural masonry is rapidly evolving. A few programs currently exist, and the industry is quickly moving toward BIM for Masonry. Based on the proven effectiveness of these models it behooves architects to keep abreast of what is happening and to continue to educate themselves on developing possibilities and what various manufacturers have to offer. It is important to note that it is not necessary to wait to land a BIM job. There is no need to put off realizing the benefits of a modeling system until expert status has been achieved. Modeling technologies can simply be written into the specifications for a project, which can ensure that installers are working with proper orders and provide installation drawings or models for review.

TOWARD THE FUTURE OF MASONRY

Masonry has been used for more than 10,000 years from pyramids to domes to arches and walls. Designers have specified architectural masonry for centuries, and throughout it has always been—and will always be—an excellent choice to bring distinction to the built environment through a range of colors, textures, patterns, and shapes. Granted, there are challenges with using architectural masonry products—complex geometries, large numbers of diverse units, different bond patterns, the constructability of such details as corbels and quoins, etc. Yet current modeling technology is having a dramatic impact on reducing these challenges and the technology is improving every day. Architects can help themselves by requiring modeling services in the design phase—an action that will greatly increase chances of success with architectural masonry.

ONLINE PORTION



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ONLINE PORTION

QUIZ—FOR REFERENCE ONLY

1. The main focus has been on incorporating which structural materials into BIM software?
a. Steel and glass
b. Glass and reinforced concrete
c. Wood and glass
d. Steel and reinforced concrete

2. The dynamics of modeling are such that it is relatively difficult to model materials that represent a small number of dissimilar, or complex objects.
a. True
b. False

3. What is the real challenge for modeling masonry?
a. Quality data
b. Scheduling information
c. Contractor issues
d. Design specifics

4. Existing masonry software is primarily for:
a. design.
b. post-bid activities.
c. BIM.
d. installation.

5. In the past, clash detection was performed:
a. on site.
b. during design.
c. on CAD.
d. It wasn't performed.

6. Which are relatively easy to model?
a. Natural stone and brick
b. Brick and gray CMU
c. Gray CMU and architectural masonry
d. Veneer and brick

7. In the masonry field, the traditional method of QTO was to cost out a project longhand, and:
a. submit with drawings.
b. contact the contractor for verification.
c. add a margin.
d. calibrate with historical data.

8. Since architectural masonry typically involves a manufacturer-applied design treatment to various faces and edges, what kind of problem does it pose that is ideally suited to a BIM solution?
a. Design
b. Construction
c. Prefabrication
d. Installation

9. Typically, BIM modeling occurs on a post-bid basis, but could be most valuable in:
a. design.
b. prefabrication.
c. estimating .
d. records.

10. Short ordering can result in:
a. more mold setups.
b. increased freight costs.
c. color variations.
d. All of the above

ANSWER KEY:

1. d
2. b
3. a
4. b
5. a
6. b
7. c
8. c
9. a
10. d