BIM-M
Building Information Modeling for Masonry

An Updated Roadmap for Developing and Deploying Building Information Modeling (BIM) for the Masonry Industry

Sponsors

International Masonry Institute (IMI), International Union of Bricklayers and Allied Craftworkers (IUBAC), National Concrete Masonry Association (NCMA), Mason Contractors Association of America (MCAA), The Masonry Society (TMS), and Western States Clay Products Association (WSCPA)

Prepared by

BIM-M Coordinator: David Biggs, PE, SE, Biggs Consulting Engineering
BIM-M Project Managers:
Jeff Elder, SE, Interstate Brick, HC Muddox and Western States Clay Products
Jamie L. Davis, PE, LEED AP, Ryan Biggs | Clark Davis Engineering & Surveying, P.C.
Fred Kinateder, Kinateder Consulting

and

Digital Building Laboratory
Georgia Institute of Technology
Russell Gentry, Project Manager
Charles Eastman, Technical Advisor

April 1, 2015

www.bimformasonry.org

1. INTRODUCTION

This document presents the second generation roadmap for building information modeling for the masonry industry (BIM-M). It follows over two years of masonry industry efforts using the initial roadmap prepared by the Digital Building Laboratory (DBL) at the Georgia Institute of Technology. The initial roadmap was released January 31, 2013 and is available on-line at www.bimformasonry.org. The reader should refer to that document for background information on the BIM-M initiative formation and Phases I and II.

Since beginning, the initiative has been following its mission statement:

> *To unify the masonry industry and all supporting industries through the development and implementation of BIM for masonry software to facilitate smoother workflows and collaboration across all disciplines from owner, architect, engineer, manufacturer, mason, contractor, construction manager, and maintenance professionals.*

BIM-M has been primarily funded by the Sponsors listed on the cover page. Other masonry groups have provided funding and/or technical assistance which is greatly appreciated. These include:

- Brick Industry Association - Brian Trimble
- Cast Stone Institute - Jan Boyer
- Masonry Institute of St. Louis - Darrell McMillian
- Masonry Institute of Michigan - Dan Zechmeister
- Tile Contractors Association of America
- Interstate Brick - Jeff Elder
- Masonry Institute of America - John Chrysler
- Northwest Concrete Masonry Association – Tom Young
- Masonry Association of Florida - Pat McLaughlin
- Concrete Masonry Association of California and Nevada - Kurt Siggard
- North Carolina Mason Contractors Association - Lynn Nash
- New York State Concrete Masonry Association – Nick Carparelli
- New York Structural Masonry Coalition – Nick Carparelli
- Duke Concrete Products – Gary Hukey

The initiative has grown to include masonry interests from both the United States and Canada. It is led by an Executive Committee whose members are listed alphabetically by the sponsoring organizations:

- International Masonry Institute – David Sovinski, Maria Viteri
- International Union of Bricklayers and Allied Craftworkers – James Boland
- Mason Contractors Association of America – Jeff Buczkiewicz, Ed Davenport
- National Concrete Masonry Association – Robert Thomas
- The Masonry Society – Darrell McMillian, Daniel Zechmeister
- Western States Clay Products Association – Jeff Elder
- David Biggs (ex officio), Biggs Consulting Engineering, serves as the BIM-M Coordinator

The primary consultant for BIM-M is the Digital Building Laboratory of Georgia Institute of Technology led by Russell Gentry, Project Manager and Charles Eastman, Technical Advisor. Several projects have included other consultants from the private sector and academia.

As part of the overall evaluation of its efforts, BIM-M engaged many notable experts in the BIM field as external reviewers to critique the Phase II projects and offer recommendations for modifying plans for Phases III and IV. They met at Georgia Institute of Technology for two days in January 2015 with members of the BIM-M Executive Committee and Project Managers and team members from Georgia Tech. BIM-M is grateful to the following individuals for giving their time and talents to the review effort. These include:

Will Ikerd	President, Ikerd Associates and BIM Forum
Richard Robison	Principal, Lord Aeck and Sargent Architects
Tyrone Marshall	Design Applications Manager, Perkins + Will Architects
Michael Palmer	Commercial Wall Specialist, Dow Chemical
Nelson Weeks	BIM Manager, Lord Aeck and Sargent Architects
Jim Barr	Director, Bentley Systems
Michael Gustafson	Industry Strategy Manager, Autodesk
Ben Osborne	BIM Manager, Stan D. Lindsey and Associates
Kevin Torok	Architectural Sales Manager, Georgia Masonry Supply / Oldcastle
Eloisa Amaya	Ikerd Associates
Hans Ehrnrooth	President, Tekla - A Trimble Company

2. BIM-M AND THE ROADMAP PROCESS

In the context of this report, the roadmap represents a series of projects that the masonry industry must undertake to prepare the technical foundation (knowledge into software) for masonry BIM (BIM-M) and to prepare the industry to implement masonry BIM (education). Some of these projects represent stand-alone encapsulated works that can be completed by a sub-contractor to the BIM-M initiative. Other projects require significant input from the masonry industry, and imply the need for a working group drawn from the masonry industry, with financial support from the industry to supervise and support the activity.

It is important to remember that the term BIM represents both an object, a "building information model", and a process, "building information modeling". Therefore, the roadmap describes activities that focus on "objects" and "processes". The "object" activities will develop technical details and specifications describing how masonry will be represented in CAD and BIM computer software – and how this information will be preserved and transferred as building projects go from the planning to design to construction phases. The "process" activities will investigate how stakeholders in the masonry industry currently handle information regarding masonry and will describe new BIM-enabled workflows in the design and construction phases of a project. The majority of the process-related BIM-M projects are focused on masonry contractors and masons (bricklayers), because most of our other stakeholders (i.e., architects, engineers, and materials suppliers) are already using software as part of their business workflows.

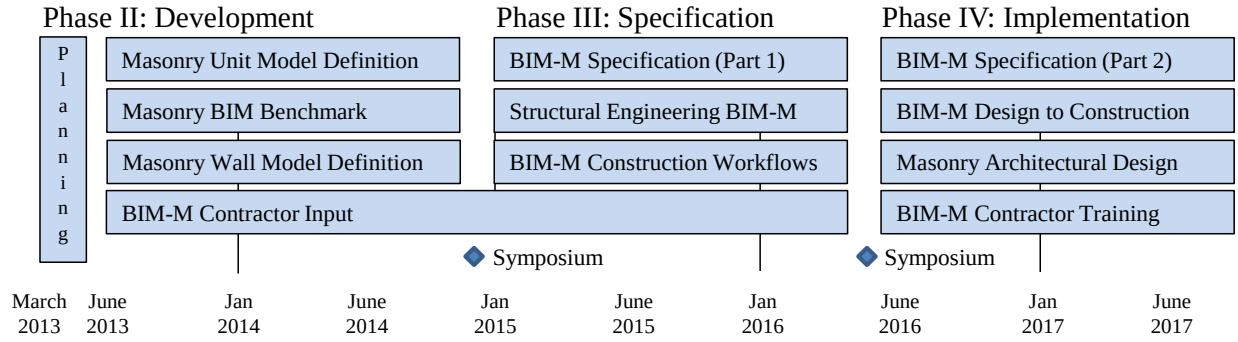
The update to the roadmap is organized into the following sections:

- An updated timeline representing our vision for the development and implementation of masonry BIM based upon the progress of the past couple years is presented. The initial timeline from January 31, 2013 provided an overall view of the BIM-M initiative in three phases. With this update, we are signaling the end of Phase II and beginning the final two phases (Phases III and IV).
- A summary of Phase II results (listed as short bulleted items)
- Specific projects that are part of the updated timeline are presented. The projects that represent Phase IV in the timeline are described in lesser detail, as it is likely that they will be modified based on outcomes of the Phase III projects.

This document does not address the cost of implementing the updated roadmap. The Executive Committee will be identifying financial and technical resources for Phase III during the upcoming planning period.

3. PHASES AND TIMELINE

The initial roadmap proposed three phases of work on masonry BIM, Phase II - Development, Phase III - Specification, and Phase IV - Implementation. A copy of the original timeline and projects as envisioned in the 2013 Roadmap is given below.



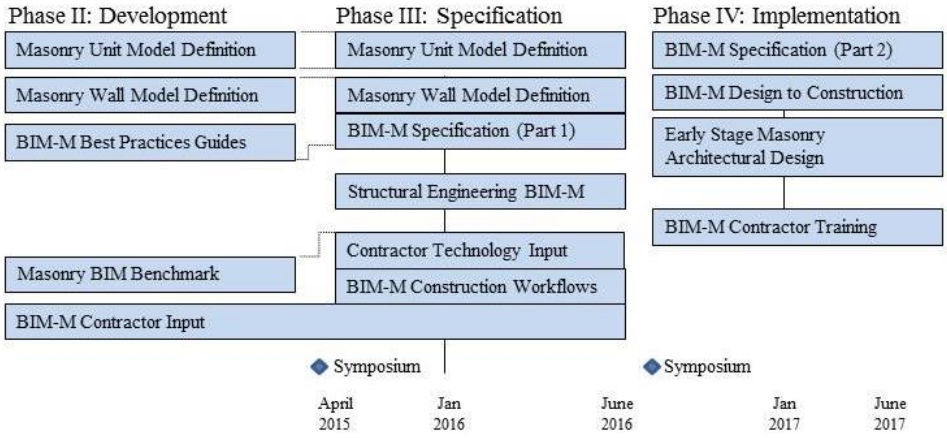
As we reach the end of Phase II, we have chosen to assess our progress and modify our goals for Phase III based upon lessons learned. This ongoing assessment includes the BIM-M Symposium in St. Louis on April 9-10, 2015 where all projects will be reviewed and working groups will meet. We will present this draft of the update at the BIM-M Symposium. Members of the Executive Board and our key contributors from Phase II will be on hand to consider the feedback, and we will finalize the update of the Roadmap subsequent to the St. Louis meeting.

In Phase III, many of the projects from Phase II will continue as either stand-alone projects or as an activity integrated within other projects. The flagship project for Phase III is the BIM-M Specification, which will produce detailed requirements for BIM for masonry software in the design, engineering, and construction phases. Additional projects will focus on the integration of

structural engineering into BIM-M and on continuing the development of BIM-M in the construction phase.

In Phase IV of the roadmap, the primary focus will be bringing **Generation 1 BIM for Masonry** to fruition. Projects will include the implementation of BIM-M from the earliest stages of architectural design to the details of masonry BIM in the construction phase. Phase IV will also focus on contractor training. The software specification will be continuously revised in conjunction with our commercial software partners, leading to the further development and implementation of masonry BIM.

An updated view of the timeline and projects, based on the progress made in Phase II, is shown below. The projects have been repositioned and grouped to show how Phase II projects are leading directly into Phase III. Where Phase III projects are grouped, for example the Masonry Wall Model Definition is grouped with the BIM-M Specification, it is implied that this is a single project, but with the potential for sub-projects given the broad scope of the activity. In Phase III the contractor activities are grouped, but we see three separate efforts for mason contractors and masons in Phase III: Contractor Technology Input - identification and implementation of information technologies to support masonry construction; Construction Workflows - identification of best-practices for masonry construction with an emphasis on activities that use BIM or other information technology and; Contractor Input - ongoing interaction with mason contractors to determine their needs for better software and IT workflows. In addition to the grouping, linkages between Phase III projects are denoted.



The proposed timeline for Phases III and IV begins in April 2015 after the Symposium and runs until the end of 2017. Including the Phase I roadmap, the BIM-M efforts for **Generation 1** will represent roughly five years (2012 – 2017) of activity by the masonry industry. BIM-M has been, and continues to be, an ambitious endeavor. We do not control the schedules of software companies and thus the time they require for BIM-M implementation may vary significantly.

The software industry is aware of our efforts regarding masonry BIM. Some developers have attended BIM-M meetings and webinars, and served as external reviewers. It is still not clear at this point whether the software suppliers will implement masonry BIM at no cost to the masonry industry. We anticipate an outcome, where much of BIM-M is implemented gradually by the software industry, but that certain masonry-specific functionality (for example, wall scheduling,

bracing analysis, structural analysis of walls) may require seed funding from the industry for software modifications or the development of third-part software as add-ins or plug-ins to commercial software.

What is **Generation 1 BIM-M**? We need **Generation 1** because BIM technology is constantly evolving. **Generation 1** is defined as the conceptual termination of the BIM-M Initiative's initial efforts to make masonry more accessible to designers, masons, contractors, manufacturers, and owners using BIM. Success will be determined by the availability of masonry specific tools and processes that place the masonry industry on a level with competing materials. Some aspirations for what Generation 1 will include are:

- Masonry unit database accessible to all BIM users.
- Masonry wall definitions for Level of Development (LOD) with standard details.
- BIM software upgrades that achieve LOD 350 or greater for design.
- BIM software that allows contractors to achieve LOD 400 or greater for construction purposes and can detect clashes with specific masonry features (bond beams, grouted cells, shelf angles, etc.)
- BIM software upgrades that will operate with other masonry specific software.
- New and/or improved design tools (software upgrades, add-ins, plugs-ins) using Autodesk Revit that provide for modularity, early project pricing, masonry detailing.
- New and/or improved tools (software upgrades, apps for mobile devices, hardware specific for field use) for contractors to improve project efficiency and utilize developing BIM tools.
- The beginning of development of new software specific to construction by third-part vendors.

Most of these goals will be achieved by commercial third-party groups with BIM-M serving as the champion and possibly seeding the development.

What is beyond **Generation 1**? Depending upon the decision of the sponsors, BIM-M may sunset after the completion of **Generation 1**. However, BIM-M development will likely continue in some form. Whether that effort will be guided by the masonry industry and BIM-M has yet to be determined. However, the move to open BIM standards and IFCs (Industry Foundation Classes) will be left for future generations of software development.

4. PROJECTS AND TASKS

The updated roadmap has been broken into the final two phases (III and IV) with multiple projects. The projects are described below. Phase IV – Implementation is described in somewhat less detail, as we expect that those projects will be revised to reflect the findings of the projects in Phase III.

Phase	Project
Phase III - Specification	1. Masonry Unit Model Definition - continued from Phase II 2. Benchmark – continued from Phase II (to be completed June 2015) 3. Masonry Wall Model Definition - continued from Phase II in conjunction with Project 3. 4. BIM-M Contractor Input - continued from Phase II 5. BIM-M Contractor Technology Input 6. BIM-M Software Specification (Part 1) 7. Structural Engineering and BIM-M 8. BIM-M Construction Workflows
Phase IV - Implementation	9. BIM-M Software Specification (Part 2) 10. BIM-M: Design Phase to Construction Phase 11. BIM-M Contractor Training 12. Early-Stage Masonry Architectural Design

Responsibility for leading and completing the projects has not been fully assigned at this time, as this is the role of the BIM-M Executive Committee. The assignments for the Phase III projects will be developed following the April 2015 Symposium.

THE PROJECTS SPECIFIC TO PHASE III INCLUDE:

1. Masonry Unit Model Definition – continued from Phase II

Over the course of the last two years, the BIM-M Masonry Unit Working Group, led by Jeff Elder, developed a spreadsheet to represent the majority of data parameters and specification information to be used by BIM software developers in the design, purchasing, shop drawing and sustainability of clay, CMU and cast stone. This data set was based upon geometric and material attributes provided by numerous manufacturers. Georgia Tech has developed an SQL database of masonry units, primarily in the CMU and clay industry segments.

At a January 2015 meeting, the external review team noted significant progress towards the creation of masonry units in BIM, but felt that additional work was necessary. The BIM software companies made a request for "standard named" masonry units which could be used in BIM software, while the industry continued to work on means for representing custom units and accessories in BIM software.

The data set is being used by Georgia Tech DBL to develop a mockup of a "back-end" web portal to access information regarding masonry units. The mock-up will be presented at the 2015 Symposium. In addition, Georgia Tech will be presenting a script that demonstrates the reading of masonry units from the database with subsequent instantiation in Revit. The short-term goal is to implement a functioning masonry unit database in 2015 that can be added to and modified as needed by individual manufacturers. In the long-term, there is a need for masonry manufacturers to consider the business processes and implications of an industry wide data model, and how such a model should be implemented and hosted.

To complete the database, there is also a need to include natural stone (cut stone) and manufactured stone and their endless array of patterns and colors, wet cast and dry cast cement

products, and dry cast calcium silicates. The question of whether and how the MUD represents masonry accessories also needs to be addressed in Phase III.

Project Tasks

1. Develop a naming protocol for masonry units. Invite the various organizations to offer suggestions. These include:
    a. CMU: NCMA
    b. Clay units: BIA and WSCPA
    c. Cast stone: Cast Stone Institute
    d. Manufactured stone: NCMA
    e. Natural stone: Marble Institute of America, Indiana Limestone Institute, Building Stone Institute, others
    f. Calcium Silicate – Arriscraft
2. Determine how the database represents masonry items with variable dimensions (for example, a cast stone unit with a given cross-section geometry but any length within a given range).
3. Survey stone suppliers to determine all of the information that should be included in the model definitions.
4. Determine the best manner for input into the database (for example, custom spreadsheets).
5. Host face-to-face working group meeting for stakeholder input.
6. Demonstrate input of masonry unit data into CAD and BIM software from the database.
7. Revise data structure based on stakeholder feedback to demonstration database.
8. Publish final specification for data structure.
9. Review the work of third-party vendor in creating masonry database.

Participants

The project will be led by Georgia Tech and staffed for 18 months with participation by masonry organizations and the working group. The effort will need to be coordinated with the Construction Specifications Institute (CSI) for compatibility with CSI OmniClass and IFCs and IFDs and ASTM Uniformat II (standard database formats developed for use in BIM, quantity take offs, and cost estimating).

2. BIM-M Benchmark – continued from Phase II (to be completed June 2015)

The original intent of the BIM Benchmark project was to focus on software capabilities and to understand the role of software in the masonry industry at all project phases. The Phase II project from Georgia Tech extended this scope to focus not only on software, but also on BIM processes, that is, how masonry stakeholders use BIM or other tools. The primary goal was to develop a vision for "future state" processes that can take advantage of the **Generation 1 BIM-M** software. The original proposal called for the analysis of three project types: brick/CMU, structural masonry, and complex masonry. Georgia Tech completed seven building case studies of a number of building types. An additional building case study, Huntsman Hall at the University of Pennsylvania, is ongoing. The Benchmark Project focused on three areas:

Task 1 - Framework Development
Task 2 - Process Documentation
Task 3 - Process Model Evaluation

Case studies are being developed that describe:

- Current state processes for schematic design, design development, contracting, planning, and execution of masonry using traditional methods of project documentation and delivery (non-BIM)
- Current state processes for schematic design, design development, contracting, planning, and execution of masonry using BIM tools available today.
- Future state processes for schematic design, design development, contracting, planning, and execution of masonry using BIM-M tools envisioned, but not yet implemented.

Excerpts from these case studies will be posted to the BIM-M web-site giving descriptions and examples of each of the processes, and value proposition for BIM-based strategies on different project types and in different phases. We will also summarize this information into recommendations and opportunities for future implementations and validation of BIM-based processes for the masonry industry.

The Benchmark Project is essentially complete, but the documentation from the case studies must be vetted with the design and construction teams that provided the case-study materials. This must take place before the case-study presentations can be used publically by BIM-M. In addition, a series of lessons-learned from each project should be compiled and forwarded to the teams involved in the specification process. Finally, the case-study information should be made available to the contractor working groups, as many of the processes identified during the Benchmark have implications for masonry construction – and might be for the nucleus of a best-practices approach to use of construction IT in mason contracting.

3. Masonry Wall Model Definition - continued from Phase II

This project is at the core of masonry BIM. Because masonry BIM is a computational model of masonry construction, and masonry walls are the fundamental assembly in masonry construction, it is critical that the data representation of the masonry wall support all of the functionality that is envisioned for BIM-M. Currently, it is simply not computationally practical for BIM software to track individual masonry units in an entire building. Therefore, the masonry BIM data structure must include the definition of wall types, and must provide the means to map these wall types onto regular and irregular regions on wall surfaces.

Begun in Phase II, this project will continue to develop requirements for the digital representation of masonry walls in BIM systems. This will lead to the development of masonry families, through which a set of masonry units (extracted from the data structure defined in the masonry unit project) are arrayed according to established rules to take a generic wall in BIM and represent it as a fully-described masonry wall. It is anticipated that these walls will be represented in different levels of detail depending on the needs of the BIM user. For example, in early stages of design and on large-scale buildings, walls will be represented as regions without populated masonry units (wireframe mode). As more detail is required, these regions will be populated as masonry units represented as 2-D polygons, and finally as full 3-D photorealistic rending with masonry units modeled as solids. In addition, the wall definition must include the propagation of masonry units in various bonding pattern with modular coordination of masonry veneer and backup systems.

Project Tasks Continuing from Phase II

1. Identify rules that define the relationships between objects. These will be the parametric rules that control bonding patterns and the relationship between veneer and backup bonding and coursing. These rules will determine how bonding patterns react to the placement of door and window openings, to the placement of floors and roof systems, and how the bonding systems will react to the region boundaries in which a given masonry family is mapped.
2. Define strategies for regions to adapt to modularity of the masonry systems embedded in them. Evaluating a "smart wallpaper" concept and aggregations of masonry. Develop an interface that allows for the importing of masonry units (from the masonry unit database) into a wall definition.
3. Develop interface requirements for the input of wall types (denoted a "wall definition module") to be implemented in BIM.
4. Work with software vendors to prototype/validate initial data structure for masonry wall definitions.
5. Publish a draft specification for wall data model.

New Project Tasks for Phase III

6. Review the work of consultants (Integrus Architecture and CTC) to model masonry in Autodesk Revit. Solicit feedback from other Revit users. Develop and publish a *Best Practices Guide for Modeling of Masonry using Autodesk Revit* in cooperation with TMS. The Guide has a three-fold purpose including informing users on how current Revit tools may be used to model masonry, to define what collaboration and modelling tools are lacking, and to create a wish-list of modelling tools that would be helpful to the industry.
7. To develop a competition for college students to use the *Best Practices Guide* and provide feedback that could be used in future updates.
8. To cooperate with the BIM Forum to further advance BIM-M in the construction industry.
9. Evaluate Tradesmen's software for use by designers. This software was developed for contractors but has features that could be valuable to designers including cost estimating, evaluating aesthetics by varying units, checking dimensions for modularity of units, and more.

Participants
The project will include masonry information developed by the masonry industry volunteers of the TMS BIM-M Committee and participation by Georgia Tech as part of Project 6-Specifications.

4. BIM-M Contractor Input –Phase III continued from Phase II

It has been clearly determined that mason contractors and masons will benefit from BIM-M. In this project, we propose that mason contractors explore in greater detail the potential benefits of BIM and document their current work processes and their use of software in current practice. Input from general contractors will be solicited as well, to identify areas where general contractors desire interaction with masonry construction in their BIM models – for example, in coordination of masonry with mechanical and other building systems (clash detection). There are perceptions that the mason contractors are the "least digital" of the stakeholders in the masonry industry, and the BIM-M initiative needs to better understand the needs of mason contractors in this second phase of the process. This project will lead to the development of BIM implementation and training strategies for mason contractors, and the development of training materials for their use.

Project Tasks

1. The Contractor Input Working Group (CIWG) will continue to solicit input with on-line surveys as needed.
2. Identify best practices of BIM use in other non-masonry subcontractor areas.
   Best practices to be presented in the Phase II report, and partial results at the BIM-M 2015 Symposium.
3. CIWG Project Manager to attend/participate at future BIM Forum conventions to interact with mason contractors, general contractors and CMs.
4. Meet with mason contractors at previously-established venues (MCAA, IMI, TMS meetings and others).
5. Prepare detailed "scenarios of use (SOU)" in the areas of safety, planning, material procurement, quantity take off, cost estimating, wall bracing, etc. that can be used to gage the potential for BIM implementation in these areas.
6. Key SOU will be identified and developed per Task 5, and based on Phase II and III input collected. The SOU development process will include, but not be limited to the following:
   - Develop needs/wish list for software and applications providers outlining requirements that incorporate information obtained from mason contractors, general contractors and other subcontractors currently using BIM.
   - Maintain communications with DBL, Tradesmen's and other identified software/app providers to discuss current and future potential for accomplishing the above needs/wish list.
   - Provide input into Project 5 - Contractor Technology Input.
7. Present these "scenarios of use" to mason contractors and validate/revise.
   Input for SOU validation will be collected via online surveys, email discussion, conference calls, etc. Results will be presented in a Phase III report. The Phase III report will also gage the expected level of response by mason contractors based on location, market niche, size, etc.

8. Prepare a detailed report for use by the initiative and by mason contractors. Make recommendations for subsequent project on Masonry Construction Workflows.
   Project Manager will submit the Project 4, Tasks 1-7 final report at the end of Phase III. This report will provide an overall summary of the contractor input project and will include mason contractor feedback, as needed, regarding workflows generated by the Phase II, Benchmark Project, and the Phase III, BIM-M Construction Workflows Project.
9. Issue RFPs to software vendors to develop new digital tools.
10. Develop an educational program of courses, seminars, and webinars to introduce the BIM concept to masons and contractors. Before there is BIM-M software for masons, the masonry industry must prepare and be technologically trained to use digital tools. (This is a continuation of Task 8 from Phase II).

Project Participants
Tasks 1-9 of this project continue to be led by the masonry industry through the CIWG and with interaction by DBL. The education aspect (Task 10) of the project will be developed through an invited RFP process with individuals and educational institutions. The major masonry organizations will implement training developed as part of this project.

5. BIM-M Technology Input
The use of BIM for design and construction has led to the development of new technology or the modification of existing technology from other industries and applied to building construction. Examples include 3-D laser scanning, robotics, tablets and kiosks on-site for information dissemination, and more.

The goal of this project is to evaluate how technology can be used in the masonry industry, with or without interaction with BIM models, to make masonry contractor more efficient. Some potential examples that a technology working group could evaluate include, but are not limited to:

- Mobile Apps – Update the existing BIM-M Mobile Apps seminar periodically. Created in Phase II, this seminar includes currently available apps that could be useful to mason contractors. Offer suggestions for apps to be included in future updates of the seminar and recommend the development of new masonry-specific apps that BIM-M could fund and promote.
- Tools – The working group could evaluate and recommend the use of hardware (tablets, smart phones, readers, kiosks, hands-free computers, etc.) that could improve the efficiency of the mason and mason contractor in any stage of a BIM project.
- Equipment – Evaluate robotic devices or aids working in tandem with masons that interact with BIM software to improve construction quality and efficiency.
- Software – Evaluate and recommend existing or new software that may improve mason proficiency for training, skills development, project operations and management, etc.

Project Tasks

1. Create a BIM-M Technology Working Group (TWG) by soliciting members of masons, mason contractors, vendors and suppliers whose primary focus is to evaluate and recommend technology improvements for the masonry industry that are directly related to BIM-M. Encourage member attendance and participation at BIM-M meetings, symposiums, webinars and seminars.
2. Evaluate technology that could improve construction quality and efficiency.
3. Evaluate technology that could improve mason proficiency for training, skills development, project operations and management, etc.
4. Coordinate with the BIM-M Contractor Input Work Group (CIWG) by attending CIWG meetings and communicating on a regular basis. The CIWG's mission is to identify masonry issues related to improving mason contractor workflows. The TWG is to examine technological options to solve these issues.
5. Meet with CIWG and mason contractors at previously-established venues (MCAA, IMI, TMS meetings, World of Masonry, BIM-M 2015 Symposium, and others) as needed.
6. Cooperate with other BIM-M committees and work groups to advance the interests of BIM-M.
7. Present a quarterly report (March, June, September, and December) that can be provided to the Executive Committee on the progress and needs of the committee.

Project Participants

This project will be staffed by volunteers who will compose the TWG. Third-party vendors will be solicited by RFPs to implement recommended projects that are recommended by the TWG and the Executive Committee.

6. BIM-M Software Specification (Part 1) – Phase III

This project is the continuation of Project 3-Masonry Wall Model Definition by Georgia Tech DBL. Using information from Project 3 and the other Phase II projects, Georgia Tech DBL will create a written software specification for masonry BIM.

The software specification will be shared with key software vendors and stakeholders in the AEC industry for their review and comment. The specification will detail masonry wall functionality within BIM from the architectural, structural, building envelope (including energy) and contractor viewpoints and will illustrate the data structures necessary to represent masonry construction with the detail required to support the proposed BIM-M functionality.

The specification will show how BIM for masonry will import and use digital masonry units defined in Project 1, and will build on and formalize the masonry wall definitions also established in Project 3. BIM software vendors will be asked to identify areas where they will, at no cost to the industry, adapt their software to meet the requirements of BIM-M and to identify areas where the masonry industry will need to collaborate and fund masonry-specific extensions to BIM software.

RFPs will be developed for solicitation of developers to produce stand-alone software, add-ins, and plug-ins that could benefit the masonry industry.

7. Structural Engineering and BIM-M – Phase III

In a conventional design workflow, structural engineers take building data in the form of plans and elevations from the architect, and assess the initial architectural design ideas for gravity and lateral loads. The engineer uses manual or computational analysis to design the walls, and returns information to the architect on the extent of walls (for in-plane and out-of-plane loads), reinforcing requirements, control joint locations, etc. In a BIM-enabled masonry workflow, structural engineers receive a BIM model from the architects with potential wall locations identified. Structural engineers will be able to select walls that are to be load bearing (for gravity loads), resistant for lateral loads (shear walls) and non load-bearing walls and partitions.

This project will establish the workflow for BIM integration between architects and structural engineers. The information exchanges needed to transfer wall information from the architect to the structural engineer and from structural engineering BIM directly to structural analysis will be established. This project will build on the previous Masonry Wall Model Definition project. The Georgia Tech DBL will develop an RFP for this project, and interested parties in the educational and software development community will be solicited for proposals. The project will build on prior work sponsored by the IMI and NCMA to implement masonry wall structural analysis software in Bentley RAM. The project will also survey existing stand-alone masonry wall software to assess its potential interactivity with BIM-M.

Project Tasks

1. Solicit sub consultant firms to evaluate existing whole-building masonry software (Bentley, RISA, etc.) for interoperability with Autodesk Revit. Determine needs for bi-directional data transmission. Publish "white paper" on strengths and weaknesses of software.
2. Solicit sub consultant firms to evaluate stand-alone masonry-specific software (RAM Elements Masonry Module, NCMA Structural Masonry Design System, and others) for interaction with Autodesk Revit and other BIM authoring software. Publish "white paper" on strengths and weaknesses with software.
3. Recommend the development of add-ins, plugs-ins and new software that could make masonry analysis and design more BIM efficient.
4. Evaluate Tradesmen's software for ability to model structural masonry designs for locating grouted cells, bond beams, reinforcement, and other structural elements.

Project Participants

This project will be staffed by the TMS BIM-M Committee to develop RFPs and review results of contracts with input by Georgia Tech DBL.

8. BIM-M Construction Workflows – Phase III

This Phase III project will follow from the work of the Mason Contractor Input Working Group (CIWG) as well as Project 2- Benchmark. In this project, formal construction workflows for the use of BIM-M will be formulated and shared with the mason contractors. In this context, a workflow is a flowchart that documents the structure, format, and flow of information from the moment it arrives to the mason contractor (from the general contractor or construction manager) all the way through the masonry construction process. The workflows will detail how the BIM-M software will be implemented with mason contractors, and how BIM authoring platforms will

be queried for use with other software systems that utilize BIM data (clash detection, project planning, cost estimation, staging and wall bracing, as examples). The workflows will act as a formal mediator between the mason contractor and the software vendors, that is, mason contractors will agree that their practices are properly depicted in the workflows and that they consume and produce information in the manner described in these workflows, and the software vendors will agree to structure and process the BIM information in the manner depicted in the workflows.

The intent is to ensure that mason contractors are comfortable with the information flows that are to be implemented in BIM-M and to ensure software vendors that mason contractors are aware of the ways that the BIM-M software will produce and use masonry-specific data. The Executive Committee and the Georgia Tech DBL will establish RFPs for this project, with the workflows to be delivered in a detailed format for use by the software vendors as they implement masonry BIM for mason contractors.

THE PROJECTS SPECIFIC TO PHASE IV INCLUDE:

9. BIM-M Software Specification (Part 2) – Phase IV

This project will kick-off Phase IV of the masonry BIM initiative – and will continue to manage the relationship between the BIM-M initiative and software vendors. At this point, it is included as an umbrella project for the continued participation in the BIM-M project by the Georgia Tech Digital Building Laboratory. The project will assess areas where BIM-M is meeting the goals set forth in the software specification and focus resources in underdeveloped areas. It will also document BIM-M and see to its implementation as part of the National BIM Standard. It will develop an industry structure for ongoing maintenance of BIM-M in the years following Phase IV. This project will reflect back on the entire BIM-M roadmap, identifying areas where the goals of the initiative have been met, and areas for future development.

10. BIM-M: Design Phase to Construction Phase – Phase IV

This project will document and formalize the transition of a BIM model from a masonry "design" BIM model, used primarily by architects and engineers during the contract document phases of a project, to a "construction" model that is used by general and mason contractors, and construction managers during the construction phase. This project is expected to benefit from an industry-wide effort to establish multiple levels of BIM information that become more and more detailed as a given project progresses. These levels of BIM specificity are outlined in the current American Institute of Architects (AIA) E202-2008, BIM Protocol – but as yet do not contain references to the details of masonry construction. The project will focus on specific needs for masonry BIM such as automated production of shop drawings, production of fabrication drawings for cut and cast stone, etc.

11. BIM-M Contractor Training – Phase IV

This project will follow from the BIM-M Contractor Input project in Phases II and III of the initiative. At this point in time, we anticipate that the BIM-M software will be becoming commercially available and that mason contractors are on the way towards integrating BIM software tools into their construction practices as a standard operating procedure. This project will develop training courses and webinars to assist contractors in deploying BIM-M. The

training courses will demonstrate how BIM interacts with specialized software used by mason contractors and how it is used in typical mason contractor tasks such as quantity take-off, cost estimating, procurement, and project scheduling. The training will have a specific components for office staff (estimators, detailers), for field superintendents, for project managers, and for masons.

12. Early-Stage Masonry Architectural Design – Phase IV

The early development of BIM for masonry in Phases II and III of the initiative will focus on the modeling and representation of the most widely used masonry units and systems. This makes the most sense as it will dictate that the earliest releases of BIM-M will have the greatest impact on the industry. One important goal of the initiative is to serve innovation in design in masonry, and BIM tools that support design innovation need to be developed. This proposed final project in the BIM-M initiative will close the loop, circling back to the needs of architects as they propose creative use of masonry, including the use of custom masonry units, non-planar walls, new types of load-bearing masonry, prefabricated masonry systems, etc. This project will develop strategies for parametric modeling of masonry in complex building forms, and will develop rules for integrated rules for the transition of complex form-making models, used by architects in the early stages of design, into BIM-M models. The project will also extend BIM-M wall rules, developed in Project 3 to work with novel ideas for masonry construction. The project will advance the ties between BIM-M and existing detail libraries provided by masonry industry associations, and will describe the functionality of tools for preliminary analysis of masonry for energy use, quantity take-offs, clash-detection, cost, etc.