Operating in a BIM Environment

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Build, Adapt, Change

“We have always done it that way.”
The 7 most expensive words in business
Disruptive Innovations:
…change the way we do business.

BIM is a disruptive Technology
BIM is expanding within the Construction industry worldwide. It is changing the way we design, procure materials, fabricate and construct buildings.

Stratasys Direct Manufacturing
3D printed car bodies
Eden Prairie, MN

Car Manufactures are becoming mobility service companies
**Mass Customization**

Computational Design - Adaptive Wall Covering:
Image source [www.grasshopper3d.com/photo/interference-wave00003](http://www.grasshopper3d.com/photo/interference-wave00003)

**Digital Fabrication**

Santiago Calatrava’s St. Nickolas Church at Ground Zero (2mm Pentelic Marble)
Santiago Calatrava’s Florida Polytechnic University

MG McGrath Sheet Metal, Maplewood, MN – digital fabrication

**Digital Fabrication**

Herzog & DeMuron’s Walker Art Center, Minneapolis

Frank Ghery’s Weisman Museum, University of Minnesota

MG McGrath Sheet Metal, Maplewood, MN – digital fabrication
**Digital Fabrication**

MG McGrath Sheet Metal, Maplewood, MN– digital fabrication

**BIM for Masonry**

IMI
IUBAC
Georgia Tech
MCAA
NCMA
WSCPA
CSI
BIA

**BIM-M – raising the bar**

BIM Masonry tools for building stakeholders.

Owners
Architects
Engineers
Manufacturers & Suppliers
Craftworkers
Mason Contractor
General Contractors

**BIM-M – Today**

BIM-M Masonry Wall Project
Jamie Davis, PE

BIM-M Best Practices Guide
Morgan Wiese -Integrus Architecture

BIM-M Benchmark Projects
Russell Gentry & Franca Trubiano
Operating in a BIM Environment

“Build it before you build it.”

Mark Swanson

- Stay current with technology.
- Discover new ways that BIM can help us.
- Participate and interact with the project team EARLIER in a project.

WHAT IS BIM?

Building Information Modeling (BIM) is a process involving the generation and management of digital representations of physical and functional characteristics of places.

BIM is just a tool: for coordinating construction projects
Operating in a BIM Environment

Plan the Work
Work the Plan

BIM is just a tool:
There is no one size fits all

BIM allows the contractors to:
- Collaborate with design team.
- Visualize the work.
- Quantify the work.
- Schedule the work.
- Clash Detection.

BIM
Where is the industry?

2014
82% of U.S.
contractors
using BIM

Why do General Contractors use it?

BIM Implementation Levels

Making the Business Case for BIM

BIM Required for Team Formation
Contractors in nine of the world's top construction markets using BIM report that building information modeling (BIM) helps them to improve productivity, efficiency, quality and safety on their projects, as well as their own competitiveness.

**Why do Contractors use it?**

- Identify and resolve design clashes before construction.
- Decrease number of RFIs.
- Accelerate Project Schedules.
- Improve productivity, efficiency, quality and safety.

**Project Delivery Methods**

- 1. Design-Bid-Build
- 2. Construction Manager at Risk
- 3. Design/Build
- 4. Integrated Project Delivery (IPD)

**Basic types of BIM models**

- Architectural
- Structural
- Mechanical
- Electrical
- Plumbing
- Energy
- Trades

Images from Autodesk, IMI
**BIM: Software**

**AutoDesk:**
- REVIT
- Navisworks
- Recap
- 360 Glue
- 360 Field

- Tradesmen’s (3D)
- CAD BLOX
- Timberline
- Primavera
- Innovaya
- SketchUp
- Rhino
- Bentley
- Tekla

**BIM: Silos**

**Reviewing a BIM Collaboration Model: FREE Software**

- Enhance communication
- Measure
- Mark up and annotate

[usa.autodesk.com/design-review/download](usa.autodesk.com/design-review/download)

**Reviewing a BIM Collaboration Model: FREE Software**

- Bluebook
- VU 360
- PDF reader
- Area take offs
- Mark up and annotate

Reviewing a BIM Model

Communicating with the design team with PDFs

Reviewing a BIM Collaboration Model: FREE Software

Autodesk Navisworks Freedom
Download free Navisworks 3D viewer

Features
Free* viewer for easy opening of .NWD and 3D DWF files

Enables viewing of model hierarchy, object properties, and embedded review data, including viewpoints, animations, redlines, and comments
Supports real-time display of materials and lighting

http://usa.autodesk.com/support/viewers/

Reviewing a BIM Collaboration Model: Design Team Collaborate

Autodesk® A360 enables project teams to efficiently work together in one central workspace.

2D and 3D model view.
Supports over 100 file formats.

http://usa.autodesk.com/support/viewers/
Reviewing a BIM Collaboration Model: Construction Team Collaborate

BIM 360™ Glue®
BIM 360 Field

BIM coordination and collaboration is a cloud-based BIM coordination service.

Sketchup 3D Warehouse loaded with free IMI Masonry detail content.

IMI Masonry Details are Sketchup details

IMIweb.org

MASONRY SUB CONTRACTOR
BIM Software Solutions

Trimble Sketchup (FREE)
Trimble Sketchup Pro ($590)

- BIM Execution Plan
- Level of Detail (LOD)

Expectations – Questions to ask
- Owner Goals
- Project Team Goals
- BIM Execution Plan
- Defined Levels of Development

BIM: LEVEL OF DETAIL (LOD)

- LOD 100
- LOD 400

AIA G202 (2013)
Building Information Modeling Protocol Form
Current REVIT Software
LOD 100-200

Level of Development - LOD for Masonry

BIM-M – raising the bar

Current REVIT wall section
Courtesy IMI

Figure 2: Virtual mock-up of load-bearing masonry construction with structural elements highlighted.
Courtesy of Lena Klein and Russell Gentry, Georgia Tech Digital Building Laboratory.

BIM –M Recommended LOD for Masonry is
350

BIM-M
LOD 350: Bond Beams, vertical bar-grouted cells, control joints

Figure 2: Virtual mock-up of load-bearing masonry construction with structural elements highlighted. Courtesy of Lena Klein and Russell Gentry, Georgia Tech Digital Building Laboratory.

BIM-M
LOD 300: Coursing, Insulation, Wythes modeled independently
BIM-M
LOD 350: Bond Beams, vertical bar-grouted cells, control joints

Level of Development- LOD for Masonry

BIM-M
LOD 400: Flashing, weeps, control joint material, horiz. reinforce

Level of Development- LOD for Masonry
BIM Objects: Where do we go?

BIM Objects

USS Minneapolis  
Cruiser 1934
Ship Bell at Minneapolis Convention Center
BIM Objects

USS Minneapolis  Cruiser  1934
Built in Philadelphia Naval Shipyard

BIM-M – content

BIM List – easy access to masonry library in REVIT
BIM-M – Best Practices

BIM-M – M.U.D. Masonry Unit Database

BIM: Design 3D Visualization

CLASH DETECTION
Sample Collisions

- Early detection of conflicts and constructability issues before they materialize in the field.
BIM: Quantification & Estimating

- Quantify materials and estimate the work based on the conditions the project is built.

BIM: 4D Schedule Visualization

- Scheduling sequence that everyone can see.

Construction Schedule: Steel

18 months

Structural Steel Lead times

Construction Schedule: CMU

14 months
Area of 4D Construction Sequence

4D BIM scheduling
• Scheduling sequence that everyone can see.

CMU LOAD BEARING WALLS
STEEL ROOF JOISTS
STEEL FRAME
STEEL STUD BACKUP WALLS

GENERAL CONTRACTOR BIM PROCESS
BIM turns into VDC
VDC = VIRTUAL DESIGN AND CONSTRUCTION

GENERAL CONTRACTOR BIM / VDC PROCESS:
MORTENSON CONSTRUCTION
MASONRY SUBCONTRACTOR
VDC USES:

1. Site Logistic Planning (site utilization)
2. Phase Planning (visual sequencing)
3. Virtual Mockups (constructability)
5. Digital Fabrication (prefab)

BIM: Site Logistics & Staging

General Contractor BIM Process

• Virtual Mockups – Trades input and coordination
• Leverage the Design Model
• Put separate design models together in Navisworks
• Run a Clash Detection on Collaboration Model
• On-going Virtual Coordination meetings with team to identify and clear design clashes.
• Glue 360 – push back up to cloud and distribute.

VDC PROCESS:
VIRTUAL MOCKUPS

• Communication Tool
• Constructability
• Who has what and when?
• Sequencing
• How are all systems working together?
VDC PROCESS: VIRTUAL MOCKUPS

VIRTUAL MOCKUPS

VDC PROCESS: INTEGRATED WORK PLAN (IWP)

- Go through each step of the wall construction.
- Field use drawings.
- Right of Reliance – dimensioning from models.

VDC PROCESS: INTEGRATED WORK PLAN (IWP)

- IDENTIFYING MASONRY WALLS.
VDC PROCESS: CLASH DETECTION WITH BOND BEAMS

• IDENTIFYING STRUCTURAL MASONRY.

Masonry Sub-Contractor BIM Applications

• GC- Power Construction
• Mason Sub-Contractor Richards and Weyer

Masonry Sub-Contractor BIM Applications

• 1,500 + Sleeves in masonry walls
• Trades shared BIM model info and space
Masonry Sub-Contractor BIM Applications

1,500 + Sleeves in masonry walls
Trades shared BIM model info and space

CASE STUDY: UW Maple & Terry Halls

MASONRY SUB CONTRACTOR
BIM Workflow Process

R&D MASONRY, Marysville, WA

- Request CAD floor plans for the background.
- SKETCHUP: Create walls and relevant materials and input into the model.
- Put items on layers that make sense so they can be turned on and off as needed.
- Make scenes, sections and views that can be easily transferred to the 2D drawing.
- The RDM Mock Up Shops are linked to the model.
- Convert to a 2D plan program (in this case Sketchup Layout).
- Export to PDF for submittal or printing.
- Export to DWG for sharing with Revit/Navisworks.

CASE STUDY: UW Maple & Terry Halls
BIM Workflow Process: Pattern Layouts
CASE STUDY: UW Maple & Terry Halls
BIM Workflow Process: Shop Drawings

CASE STUDY: UW Maple & Terry Halls Seattle, WA

CASE STUDY: State Route 167 Sound Wall
BIM Workflow Process: Virtual Mockups

CASE STUDY: S.R. 167 Sound Wall
CASE STUDY: S.R. 167 Sound Wall
BIM Workflow Process: Wall Elevations

CASE STUDY: S.R. 167 Sound Wall
BIM Workflow Process: Rebar Layout

CASE STUDY: S.R. 167 Sound Wall
BIM Workflow Process: Masonry Units

CASE STUDY: S.R. 167 Sound Wall
BIM Process: Masonry Unit Layout
New Technology

- Reality Capture
- Robotics
- Augmented Reality
- 3D Printing

REALITY CAPTURE: LASER SCANNING

- LASER SCANNING
  - STATIONARY – TOTAL STATION / LIECA
  - AERIAL DRONES
  - MOBILE MAPPING

POINT CLOUDS

Robotics
BIM Software: Augmented Reality

NEW FABRICATION APPLICATIONS: 3D PRINTING

FABRICATION APPLICATIONS
3D PRINTING: QUAKE COLUMN

http://www.wired.com/2014/10/architects-create-3-d-printed-column-survives-earthquakes/

- Stay current with technology.
- Innovate: Discover new ways that BIM can help us.
- Participate and interact with the project team EARLIER in a project.
• Build it before you build it.

• Build, Adapt, Change, and keep changing…