BIM Overview

BIM Level of Development

Evolution of the Drawing Process

BIM Workflow
  - Internal
  - Between Consultants

Model Development
  - Programming and Pre-Design
  - Schematic Design
  - Design Development
  - Construction Documents

Case Study

what will be covered...
An OLD process does not work with a NEW tool
"Building Information Modeling, or BIM is a parametric, 3D model that is used to generate plans, sections, elevations, perspectives, details, schedules – all of the necessary components to document the design of a building."
- Mastering Autodesk Revit Architecture 2011

"A Building Information Model serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life cycle from inception onward."
- BuildingSMART Alliance
Multiple views are generated from one model, such as:

- Floor Plans
- Sections
- Elevations
- Details
BIM: Development

Working in Multiple Views
BIM: Information

Not just a Model

It’s a Database
BIM: Types of Data
## 1. BIM: Organizational Data

### Identity Data
- **Assembly Code**: C1020
- **Keynote**
- **Model**
- **Manufacturer**
- **Type Comments**
- **URL**
- **Description**
- **Assembly Description**: Interior Doors
- **Type Mark**: 8
- **Fire Rating**
- **Cost**
- **OmniClass Number**: 23.30.10.00
- **OmniClass Title**: Doors

### Uniformat Classification
- **No classification**
- **B - Shell**
  - **B20 - Exterior Enclosure**
    - **B2030 - Exterior Doors**
      - **B2030100 - Glazed Doors & Entrances**
      - **B2030200 - Solid Exterior Doors**
        - **B2030210 - Exterior Solid Doors - Aluminum**
        - **B2030220 - Exterior Solid Doors - Steel**
        - **B2030230 - Exterior Solid Doors - Wood**

### Text
- **HW Set**
- **Frame Detail - Head**: E4/A691
- **Frame Detail - Jamb**
- **Frame Detail - Sill**

### Materials and Finishes
- **Frame Material**
- **Finish**
- **Door Material**
- **Door Glazing**
- **Frame Glazing**

### Identity Data
- **Door Assembly Type**: H-INT DOUBLE EGRESS
- **Comments**: MAGNETIC DOOR HOLDER
- **Mark**: 1506
- **Workset**: Buildout
- **Edited by**
- **Design Option**: Main Model

### Phasing
- **Phase Created**: New Construction
- **Phase Demolished**: None

### Other
- **Head Height**: 7' 0"
<table>
<thead>
<tr>
<th>Identity Data</th>
<th>Assembly Code</th>
<th>C1020</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Head Height</td>
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</table>
### BIM: Data Standards

**NBIMS**: National Building Information Modeling Standard

**IFC**: The Industry Foundation Classes

**IFD**: Industry Foundation Dictionary
BIM: Authoring Programs

- AUTODESK REVIT
- ARCHICAD
- BENTLEY ARCHITECTURE
- TEKLA (STRUCTURAL)
BIM: Data Standards

Knowledge Databases
- Best Practice Knowledge
- Own Practice

Laws and Regulations
- Building Regulations
- Building Specifications

Briefing
- Functional Requirements
- Estimates
- Conditions
- Requirements

Construction Management
- Scheduling
- Logistics, 4D

Facility Management
- Letting, sale, operations
- Maintenance
- Guaranties

Procurement
- Product databases
- Price databases

CAD Software
- Drawings, calculations
- Architect, engineer...

VRML
- Visualization, 3D models

Simulations
- Comfort
- Ventilation, heating
- Life cycle cost
- Light, sound
- Insulation
- Fire, usage
- Environment
- Life time predictions

Specifications
- Specification sheets
- Classification standards
- Estimates, accounting

Demolition, refurbishment
- Rebuild
- Demolition
- Restoration

*National Building Information Modeling Standard
BIM: INTEROPERABILITY

Construction Industry Trends:

Compared to all Non-Farm related industries the Construction Industry has actually become less productive.

By utilizing a "Complete BIM" the downward trend can potentially be reversed.
According to the National Institute of Standards and Technology, Owners and Operators have the largest interoperability costs of all the stakeholders in the AEC industry.

Owners/Operators bear 68% of the estimated $15.8 billion lost due to inadequate interoperability.

This equates to a loss of over $10.6 billion.

*The study also revealed that an inordinate amount of time is spent locating and verifying specific facility and project information from previous activities.
2 BIM: LEVEL OF DEVELOPMENT
COMMON QUESTIONS:

How detailed should my model be?

How much information should I include in my model?

Who is responsible for modeling “X”?

Should this be considered an additional service?
LEVEL OF DEVELOPMENT: Building Information Modeling Protocol Exhibit
MODEL ELEMENT:
Component, System or Assembly within a BIM

MODEL ELEMENT AUTHOR:
Party responsible for model elements (Architect, Contractor, Mechanical, Etc....)

MODEL USER:
Individual or Entity allowed to use the model for Analysis, Estimating, or Scheduling.
LEVEL OF DEVELOPMENT:

Describes the completeness to which a Model Element is developed.

LOD: 100 Conceptual Geometry
LOD: 200 Approximate Geometry
LOD: 300 Precise Geometry
LOD: 400 Fabrication
LOD: 500 “As-Built”

“Schematic Design”
“Design Development”
“Construction Documents”
“Construction Model”
LEVEL OF DEVELOPMENT: LOD: 100 (Schematic Design)

CONCEPTUAL GEOMETRY:
Overall Building Massing Indicative of Area
Height
Volume
Location
Orientation.

MODEL ELEMENT AUTHOR(S):
Architect

APPLICATIONS:
Early Visualization - Massing
Site Analysis
Environmental Impact - Solar Design
LEVEL OF DEVELOPMENT:
LOD: 200 (Design Development)

APPROXIMATE GEOMETRY:
Generalized Systems
Assemblies with Approximate Quantities
Size
Shape
Location
Orientation.

MODEL ELEMENT AUTHOR(S):
Architect
Consultants

APPLICATIONS:
Visualization - Materiality
Coordination with multiple disciplines
LEVEL OF DEVELOPMENT:
LOD: 300 (Construction Documents)

SPECIFIC GEOMETRY:
Specific Assemblies
Accurate in Terms of Size
Shape
Location
Quantity
Orientation

MODEL ELEMENT AUTHOR(S):
Architect
Consultants

APPLICATIONS:
Construction Documents
LEVEL OF DEVELOPMENT:
LOD: 400 (Construction Model)

FABRICATION MODEL:
Specific Assemblies
Accurate in Terms of Size
Shape
Location
Quantity
Orientation
Complete Fabrication

MODEL ELEMENT AUTHOR(S):
Contractor
Sub-Contractors

APPLICATIONS:
Detailed Visualization
Reduction of Conflicts
Direct to Fabrication
Construction Scheduling
LEVEL OF DEVELOPMENT:
LOD: 500 (As-Built Model)

AS-BUILT MODEL:
Constructed Assemblies
Actual and Accurate in Terms of Size
Shape
Location
Quantity
Orientation.

MODEL ELEMENT AUTHOR(S):
Contractor
Sub-Contractors

APPLICATIONS:
Equipment maintenance and procurement
Locating MEP and related services
§ 4.3 Model Element Table

Identify (1) the LOD required for each Model Element at the end of each phase, and (2) the Model Element Author (MEA) responsible for developing the Model Element to the LOD identified.

Insert abbreviations for each MEA identified in the table below, such as “A – Architect,” or “C – Contractor.”

NOTE: LODs must be adapted for the unique characteristics of each Project.

<table>
<thead>
<tr>
<th>Model Element</th>
<th>LOD</th>
<th>MEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>B20 Exterior Enclosure</td>
<td>100</td>
<td>A</td>
</tr>
<tr>
<td>B2010 Exterior Walls</td>
<td>100</td>
<td>A</td>
</tr>
<tr>
<td>B2020 Exterior Windows</td>
<td>100</td>
<td>A</td>
</tr>
<tr>
<td>B2030 Exterior Doors</td>
<td>100</td>
<td>A</td>
</tr>
<tr>
<td>B30 Roofing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B3010 Roof Coverings</td>
<td>100</td>
<td>A</td>
</tr>
<tr>
<td>B3020 Roof Openings</td>
<td>100</td>
<td>A</td>
</tr>
<tr>
<td>C INTERIORS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C10 Interior Construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1010 Partitions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1020 Interior Doors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1030 Fittings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C20 Stairs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C2010 Stair Construction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
WHAT TYPES OF INFORMATION SHOULD BE INCLUDED IN A LOD 300 EXTERIOR WALL?

According to

AIA E202

LOD 300 - SPECIFIC GEOMETRY:
Specific Assemblies that are Accurate in Terms of Size, Shape, Location, Quantity, and Orientation.
SUPPLEMENT THE AIA E202 WITH ANOTHER MORE DETAILED GUIDE

VA OBJECT/ELEMENT MATRIX
LEVEL OF DEVELOPMENT: VA Object Element Table

BIM OBJECT/ ELEMENT MATRIX:

Developed by the Department of Veterans Affairs as part of VA BIM Guide.

It depicts Building Information Typologies/Types, when they are relevant, and to what level of development (LOD) throughout a building lifecycle.

It is an expansion of the E-202 to support a greater level of understanding of BIM information use.

Highly Detailed list of various requirements as they relate to a BIM’s Level of Development.

* Free downloadable Excel file from VA website
LEVEL OF DEVELOPMENT: VA Object Element Table

INFORMATION TYPES:

Information Categories include Functional and performance characteristics that may extend across current OmniClass Tables

- Building Program & Project Meta Data
- Physical Properties of BIM Objects & Elements
- GeoSpatial and Spatial Location of Objects & Elements
- Manufacturer Specific Information Requirements
- Specifications
- Estimating
- Value Engineering Requirements (BIM Use Case)
- Energy Analysis Requirements (BIM Use Case)
- Sustainable Material LEED or Other Requirements
- Project Environmental & Site Conditions
- Program/Space Compliance or Validation
- Code Compliance/ Occupant Safety Requirements
- Phases Time Sequencing & Schedule Requirements
- Construction Logistics & Sequencing
- Building Commissioning Requirements
- Facilities/Asset Management (Organization Specific Standards)
- Note/Remarks
LEVEL OF DEVELOPMENT:
VA Object Element Table

Data Comparison
Exterior Walls

AIA E-202

<table>
<thead>
<tr>
<th>B SHELL</th>
<th>B10 Superstructure</th>
<th>B1010 Floor Construction</th>
<th>B1020 Roof Construction</th>
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<tbody>
<tr>
<td>B20</td>
<td>Exterior Enclosure</td>
<td>B2010 Exterior Walls</td>
<td>B2020 Exterior Windows</td>
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<td>B2030 Exterior Doors</td>
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<td>B30</td>
<td>Roofing</td>
<td>B3010 Roof Coverings</td>
<td>B3020 Roof Openings</td>
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</table>

VA Object Element Matrix
**Physical Properties of BIM Objects & Elements**

<table>
<thead>
<tr>
<th>Overall Length</th>
<th>Overall Width</th>
<th>Overall Height</th>
<th>Overall Area</th>
<th>Overall Volume</th>
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<tbody>
<tr>
<td>44' 0&quot;</td>
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<td></td>
<td>880.00 SF</td>
<td>898.33 CF</td>
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**Dimensions**

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<th>Value</th>
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<tr>
<td>Length</td>
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<tr>
<td>Area</td>
<td>880.00 SF</td>
</tr>
<tr>
<td>Volume</td>
<td>898.33 CF</td>
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<tr>
<td>Width</td>
<td>1' 0 1/4&quot;</td>
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**Unconnected Height**: 20' 0"

---

**EXTERIOR WALL**: LOD 100

---

**LEVEL OF DEVELOPMENT**: VA Object Element Table
### Manufacturer Specific Information Requirements

<table>
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<tr>
<th>Costing Requirements</th>
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#### Sustainable Material LEED or Other Requirements

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<thead>
<tr>
<th>LEED Items per Quantity Values</th>
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<tr>
<td>LEED Items per Quantity Values</td>
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#### Program/Space Compliance or Validation

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### Exterior Wall: LOD 200

- **Identity Data**
  - Keynote
  - Model
  - Manufacturer
  - Type Comments
  - URL
  - Description
  - Assembly Description
  - Exterior Wall Construction

- **Properties**
  - Basic Wall
  - Extender - EPS on MIl Stud

- **Parameters**
  - Value
    - Wrapping at Ends
    - Wrapping at Joints
    - Wrapping at Stubs
    - Wrapping at Joints
    - Wrapping at Studs
    - Wrapping at Joints
    - Wrapping at Studs

- **Structural Usage**
  - Non-bearing

- **Dimensions**
  - Length
  - Width
  - Height
  - Area
  - Volume
  - E98.33 CF
**LEVEL OF DEVELOPMENT:**
VA Object Element Table

**EXTERIOR WALL:** LOD 300

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<td>Mark</td>
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**LEVEL OF DEVELOPMENT:**
VA Object Element Table

**EXTERIOR WALL:** LOD 400
**LEVEL OF DEVELOPMENT:**
VA Object Element Table

**EXTERIOR WALL:** LOD 500

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<thead>
<tr>
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<th>GeoSpatial and Spatial Location of Objects &amp;</th>
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<td><strong>Costing Requirements</strong></td>
<td>Installed Cost</td>
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<td>Cost Over-Run</td>
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<td><strong>Sustainable Material LEED or Other Requirements</strong></td>
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<td>Maintenance</td>
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## 2 LEVEL OF DEVELOPMENT: VA Object Element Table

### DATA ACCUMULATION

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<td><strong>Conceptual Unit Cost</strong></td>
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<td><strong>Retail Cost</strong></td>
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<tr>
<td><strong>Costing Requirements</strong></td>
<td><strong>Installed Cost</strong></td>
</tr>
<tr>
<td><strong>Costing Requirements</strong></td>
<td><strong>Cost Over-Run</strong></td>
</tr>
</tbody>
</table>
LEVEL OF DEVELOPMENT: MODEL ELEMENT TABLE

PM CONSIDERATIONS:

Make sure the entire project team is involved in filling out the Model Element Table.

Work with the owner to determine the actual needs in terms of LOD.

The higher the LOD, the higher the cost (300+)
3 EVOLUTION
OF THE DRAWING PROCESS
Evolution of the Drawing Process
Drafting to BIM

Hand Drafting  →  Computer Aided Drafting  →  Building Information Modeling
3 Evolution of the Drawing Process
Drafting to BIM

File Structure

**CAD**

- Model File
- Sheet File
- Sheet

**BIM**

- Model
- View
- Sheet
Evolution of the Drawing Process
Drafting to BIM

Building Up vs. Cleaning Up

CAD

BIM
Evolution of the Drawing Process
Drafting to BIM

Traditional Process

Struct. ➔ Arch. ➔ MEP

Drawing Set

Contractor / Owner
Evolution of the Drawing Process
Drafting to BIM

BIM Process

Arch. -> BIM -> MEP -> Drawing Set -> Contractor / Owner

Struct.
BIM is a widely used tool, but it’s not our only tool in our toolbox.
Evolution of the Drawing Process

BIM working with other tools

BIM and CAD

Site Plan

Details
Evolution of the Drawing Process
BIM working with other tools

BIM and Presentation Oriented Programs

Sketch Up

3D Studio Max
3. Evolution of the Drawing Process
BIM working with other tools

BIM and Database Programs

Microsoft Access
Evolution of the Drawing Process
BIM working with other tools

BIM and Energy Modeling

Sun Path Study

Sun Exposure Study
Example Project
Fine tuning the curtain wall system and lobby space
Evolution of the Drawing Process
Capabilities for 3D

Visualizing how things come together
Evolution of the Drawing Process
Capabilities for 3D

Visualizing the quality of space
Evolution of the Drawing Process
Capabilities for 3D

Comparing Options

Column VS. No Column
4 BIM: WORKFLOW
PM: Considerations

Staffing:

Most experienced modelers should be assigned at the start of the project. This person will work directly with the Architect/Engineer to develop the model.

This is an opportunity to share and strengthen the intellectual resources of your team by allowing the more experienced Architects to mentor and provide technical guidance while the modeler shares and teaches Architect about BIM software and other digital tools.
BIM Workflow
Internal: Staffing

Legend:
- SDCD
- Project Phase
- DD
- Modeler II
  (Most experienced Revit users on Team)
  works with PA/PM/PE on initial development of model.
- Modeler I
  (Less experienced Revit users on Team)
  works on setting up views, detailing, etc…
- Information Manager
  No Revit Experience Req.
  (PM/PA/PE)
  Responsible for Keynote database and specifications.
BIM Workflow
The Team Work Environment

Working out of “one” file
How far to take the model?

- Partial utilization of BIM: ‘Disconnect’ model from drawings in CDs
- Use of a BIM through CDs
- Full utilization of BIM: Use of a BIM through Life Cycle of Building
4 BIM Workflow
Internal

What to plan for when setting deadlines

Suggested Schedule for CAD Projects

Suggested Schedule for BIM Projects
BIM Workflow
Between Design Professionals

Setting Deadlines with adequate time to catch changes
When linking models…

- Establish Coordinate system so all models align
- Set up linkable views for each discipline to use
- Set any imported CAD line work to black
- Organize links on separate worksets/ layers
- Adjust any visibility and graphic settings as needed
Controlling the graphics from a linked model

Structural Grid

Architectural Grid
Opportunities for Design Collaboration: Lighting Studies

Equinox at Noon

Summer Solstice at Noon

Winter Solstice at Noon
BREAK
5 BIM: MODEL DEVELOPMENT
5.1 PROGRAMMING
MODEL DEVELOPMENT: PROGRAMMING

A Building Information Model can be started as early as programming.

Programmatic Information furnished by the owner can be inputted into a BIM.

This information can be used as a reference throughout the entire project and it can be referenced at any time.

Excel Spreadsheet

BIM
MODEL DEVELOPMENT: PROGRAMMING

Rooms: Define a space within a model

Rooms will store all of the programmatic data and will be the primary tool used at this phase in the project.
5 MODEL DEVELOPMENT: PROGRAMMING

PROGRAM/SPACE COMPLIANCE & VALIDATION:

Types of information that can be included in a room:

Space name
Space number
Space description

Departmental requirements
Required sf
Required quantities
Required equipment
Required furniture
Required built-ins
Required finishes

Ceiling heights
Sound transmission resistance

Etc.... (Data can be customized to meet your needs)
5 MODEL DEVELOPMENT: PROGRAMMING

PROGRAM/SPACE VALIDATION:

Scheduled can be used as a tool for validation to ensure that the needs have been met.

<table>
<thead>
<tr>
<th>Room Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Office</td>
</tr>
<tr>
<td>Reception</td>
</tr>
<tr>
<td>Conference</td>
</tr>
</tbody>
</table>

OWNERS REVIT REQ. ➔ Update Revit model to meet owner’s programmatic requirements.
MODEL DEVELOPMENT: PROGRAMMING

VISUALIZE DATA:

Color legends can be developed based on an established criteria. (Revit)

Common criteria types include color by department/ name
MODEL DEVELOPMENT: PROGRAMMING

PM CONSIDERATIONS:

BIM can be a powerful tool during the earliest stages of a project.

Information gathered from this effort will be embedded within the model throughout all phases of the project. This will help to ensure that all of the programmatic requirements have been met.

Less experienced users can work at this stage as no actual geometry is created.
5.2 SCHEMATIC DESIGN
Conceptual Massing:
Quickly Generate massing models within your BIM authoring tool
Model Development: Schematic Design

Conceptual Massing:
Unlike most programs, the parametric nature of BIM allows for the quick and accurate quantification of your conceptual massing.

As the form is modified the schedule is automatically updated!
5 MODEL DEVELOPMENT: SCHEMATIC DESIGN

Conceptual Energy Modeling:
The conceptual massing can be exported to a gbxml or other format for early energy analysis.

- Green Building Studio
- Ecotect
- Project Vasari
Presentation Tool:
Most BIM Authoring program have options for rendering your model for presentations.
**5 MODEL DEVELOPMENT: SCHEMATIC DESIGN**

**Project Drawings:**
Views can be preset so as you model; floor plans, elevations, sections, etc will be generated and updated automatically.
PM: Considerations

Staffing:

Most experienced modelers should be assigned at the start of the project.

This person will work directly with the Architect/Engineer to develop the model.

This is an opportunity to share and strengthen the intellectual resources of your team by allowing the more experienced Architects to mentor and provide technical guidance while the modeler shares and teaches Architect about BIM software and other digital tools.
5.3 DESIGN DEVELOPMENT
5  
MODEL DEVELOPMENT: 
DESIGN DEVELOPMENT

Concept to Reality:
The Conceptual surface can be converted into “real” objects such as walls, floors, roofs, etc…
Concept to reality
Adding content
Assemblies are created
5 MODEL DEVELOPMENT:
WORKING IN MULTIPLE VIEWS
5 MODEL DEVELOPMENT: WORKING IN MULTIPLE VIEWS
MODEL DEVELOPMENT: WORKING IN MULTIPLE VIEWS

Working in Multiple Views
MODEL DEVELOPMENT:
WORKING IN MULTIPLE VIEWS

Working in Multiple Views
MODEL DEVELOPMENT: Cutting Views on the Fly for Coordination

Moving a Column
MODEL DEVELOPMENT: Cutting Views on the Fly for Coordination

Moving a Wall
MODEL DEVELOPMENT:
Cutting Views on the Fly for Coordination

Establishing Edge Distances

5"
Establishing Edge Distances
MODEL DEVELOPMENT:
Evaluating and Communicating a Change

New Top of Steel Heights
5 MODEL DEVELOPMENT: Evaluating and Communicating a Change

New Top of Steel Heights
MODEL DEVELOPMENT:
Evaluating and Communicating a Change

New Top of Steel Heights
MODEL DEVELOPMENT:
Evaluating and Communicating a Change

New Top of Steel Heights
LIVE DEMONSTRATION
5.4 CONSTRUCTION DOCUMENTS
Experienced Modeler has developed a majority of the model.
Less experienced users can be added to the team to complete the construction documents.

These users will generate any additional plans, sections, elevations and callouts needed to complete the construction documents.
Annotation symbols such as section marks, elevation tags, and callout bubble are used to generate the actual views within the project.
Annotation symbols such as section marks, elevation tags, and callout bubble are used to generate the actual views within the project.
Process of checking to ensure that callouts are coordinated is no longer necessary. Views within Revit are tied directly to the callout symbol. If the view moves, it is automatically updated.
Model Development: Construction Documents

Keynoting Options

Reference Keynotes
Keynoting Options

Sheet Keynotes

5 MODEL DEVELOPMENT: CONSTRUCTION DOCUMENTS
5 MODEL DEVELOPMENT: CONSTRUCTION DOCUMENTS

Keynoting Options

Text Notes
Managing Keynotes

<table>
<thead>
<tr>
<th>Key Value</th>
<th>Keynote Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>06000</td>
<td>Division 06 - Wood and Plastics</td>
</tr>
<tr>
<td>07000</td>
<td>Division 07 - Thermal and Moisture Protection</td>
</tr>
<tr>
<td>07200</td>
<td>Thermal Protection</td>
</tr>
<tr>
<td>07210.A1</td>
<td>R-11 Batt Insulation</td>
</tr>
<tr>
<td>07210.A2</td>
<td>R-13 Batt Insulation</td>
</tr>
<tr>
<td>07210.A3</td>
<td>R-15 Batt Insulation</td>
</tr>
<tr>
<td>07210.A4</td>
<td>R-19 Batt Insulation</td>
</tr>
<tr>
<td>07210.A5</td>
<td>R-21 Batt Insulation</td>
</tr>
<tr>
<td>07210.A6</td>
<td>R-22 Batt Insulation</td>
</tr>
<tr>
<td>07210.A7</td>
<td>R-25 Batt Insulation</td>
</tr>
<tr>
<td>07210.A8</td>
<td>R-30 Batt Insulation</td>
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<tr>
<td>07210.A9</td>
<td>R-38 Batt Insulation</td>
</tr>
<tr>
<td>07210.A10</td>
<td>Batt Insulation</td>
</tr>
<tr>
<td>07210.B1</td>
<td>13mm Rigid Insulation</td>
</tr>
<tr>
<td>07210.B2</td>
<td>25mm Rigid Insulation</td>
</tr>
<tr>
<td>07210.B3</td>
<td>38mm Rigid Insulation</td>
</tr>
<tr>
<td>07210.B4</td>
<td>50mm Rigid Insulation</td>
</tr>
<tr>
<td>07210.B5</td>
<td>63mm Rigid Insulation</td>
</tr>
<tr>
<td>07210.B6</td>
<td>75mm Rigid Insulation</td>
</tr>
<tr>
<td>07210.C1</td>
<td>25mm Microlite</td>
</tr>
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</table>

Keynote Text: 75mm Rigid Insulation
### Managing Keynotes

<table>
<thead>
<tr>
<th>Division</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>00</td>
<td>Procurement and Contracting Requirements</td>
</tr>
<tr>
<td>01</td>
<td>General Requirements</td>
</tr>
<tr>
<td>01 50 00</td>
<td>Temporary Facilities and Controls</td>
</tr>
<tr>
<td>01 53 00</td>
<td>Temporary Construction</td>
</tr>
<tr>
<td>01 53 00.A1</td>
<td>Temporary Dustproof Partition</td>
</tr>
<tr>
<td>01 53 00.A2</td>
<td>Temporary Protective Floor Cover</td>
</tr>
<tr>
<td>01 53 00.A3</td>
<td>Temporary Protective Passageway</td>
</tr>
<tr>
<td>01 53 00.A4</td>
<td>Temporary Protective Wall Cover</td>
</tr>
<tr>
<td>01 53 00.A5</td>
<td>&quot;Temporary Shoring, Bracing And Support&quot;</td>
</tr>
<tr>
<td>01 53 00.A6</td>
<td>Temporary Weatherproof Closure</td>
</tr>
<tr>
<td>02</td>
<td>Existing Conditions</td>
</tr>
<tr>
<td>02 40 00</td>
<td>Demolition and Structure Moving</td>
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<tr>
<td>02 41 00</td>
<td>Demolition</td>
</tr>
<tr>
<td>02 41 00.A1</td>
<td>Remove Existing Below Grade Construction</td>
</tr>
<tr>
<td>02 41 00.A2</td>
<td>Remove Demolition Materials From Site</td>
</tr>
<tr>
<td>02 41 00.A3</td>
<td>Remove Demolition Materials To Owner's</td>
</tr>
<tr>
<td>02 41 00.A4</td>
<td>Remove Existing Construction</td>
</tr>
<tr>
<td>02 41 00.A5</td>
<td>Existing Building To Be Removed</td>
</tr>
<tr>
<td>02 41 00.A6</td>
<td>Salvage Item, Return To Owner</td>
</tr>
<tr>
<td>02 41 00.A7</td>
<td>Salvage Item, Re-Use In New Work</td>
</tr>
<tr>
<td>02 41 00.B1</td>
<td>Disconnect And Seal Existing Utilities</td>
</tr>
<tr>
<td>02 41 00.B2</td>
<td>Maintain Existing Utilities In Service</td>
</tr>
<tr>
<td>02 41 00.C1</td>
<td>Topsoil Stockpile Area</td>
</tr>
<tr>
<td>02 41 00.C2</td>
<td>Asphalt Paving To Be Removed</td>
</tr>
<tr>
<td>02 41 00.C3</td>
<td>Concrete Walk To Be Removed</td>
</tr>
<tr>
<td>02 41 00.C4</td>
<td>Fence To Be Removed</td>
</tr>
<tr>
<td>02 41 00.C5</td>
<td>Concrete To Be Removed</td>
</tr>
<tr>
<td>02 41 00.C6</td>
<td>Concrete Porch To Be Removed</td>
</tr>
<tr>
<td>02 41 00.C7</td>
<td>Brick Masonry To Be Removed</td>
</tr>
<tr>
<td>02 41 00.C8</td>
<td>CMU's To Be Removed</td>
</tr>
<tr>
<td>02 41 00.C9</td>
<td>Stone Veneer To Be Removed</td>
</tr>
</tbody>
</table>
Generating Specifications

Keynotes generated from default list.

Schedule of notes used in project can be used to develop an outline specification.

<table>
<thead>
<tr>
<th>Keynote Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Value</td>
</tr>
<tr>
<td>03410.C1</td>
</tr>
<tr>
<td>04220.A1</td>
</tr>
<tr>
<td>08110.A2</td>
</tr>
<tr>
<td>07210.B6</td>
</tr>
<tr>
<td>07220.A2</td>
</tr>
<tr>
<td>07620.B1</td>
</tr>
</tbody>
</table>

All project keynotes can be reviewed in a single place.
Generating Specifications

Information Manager

Develops keynotes to be used within the project.

<table>
<thead>
<tr>
<th>Key Value</th>
<th>Keynote Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>03410.C1</td>
<td>1500 x 200mm Precast Concrete Hollow Core Slab</td>
</tr>
<tr>
<td>04220.A1</td>
<td>200x200x400mm CMU - 2 Core</td>
</tr>
<tr>
<td>06110.A2</td>
<td>Wood Blocking As Required</td>
</tr>
<tr>
<td>07210.B6</td>
<td>75mm Rigid Insulation</td>
</tr>
<tr>
<td>07220.A2</td>
<td>Tapered Rigid Insulation</td>
</tr>
<tr>
<td>07620.B1</td>
<td>Parapet Cap Flashing</td>
</tr>
</tbody>
</table>
5.5 COORDINATION
Traditional Coordination Process
Coordination
Coordination
MODEL DEVELOPMENT: CONSTRUCTION DOCUMENTS

Clash Detection

Mechanical Model

Navisworks

Structural Model
Clash Detection
5 MODEL DEVELOPMENT: CONSTRUCTION DOCUMENTS

Clash Detection

IFC File format

Tekla BIMsight
Coordination Meetings

Agenda:
Load models
Add tolerances (Fire Proofing)
Add Access clearances
Any other additional restrictions/geometry that should be accounted for.

Run Clash Detection
Review results
Each consultant receives list of clashes that need to be resolved.

Repeat meeting as needed. (Virtual weekly meeting via Go-To-Meeting)??
5.6 QA/QC PROCESS
QA/QC Process

PM does not need to know how to use the software to review drawings:

Process of exporting to dwg at the end of the day/week/when needed
(batch Export)

Markup tools:

Autodesk Design Review
Blue Beam
Etc....
Digital Review Process

Drawings can be exported as DWF files for use in various mark-up/ review tools.
Digital Review Process

There are many mark-up/review programs that are available for free.
Digital Review Process

Most review tools are easy to use and will allow you to digitally “red-line” a drawing.
Digital Review Process

Most review tools are easy to use and will allow you to digitally “red-line” a drawing.
Digital Review Process

When exporting from a BIM, all of the associated data is saved within the DWF.
Model Development: Construction Documents

Review drawings from virtually anywhere!
Digital Review Process

Changes can be reloaded directly into BIM for team to address.
Digital Review Process
5 MODEL DEVELOPMENT: CONSTRUCTION DOCUMENTS

Digital Review Process

Digital redline can be archived if needed.
CASE STUDY:
PROTOTYPE PROJECT X
Project X

Prototype Project

This project was selected due to the fact that less design decisions were required so that inefficiencies could be filtered out to focus largely on the new tool “Revit”
Case Study
The new fee structure

Project X

Total Hours Per Phase

1st Revit Project: 1259 Hours

- Highly Experienced Team (AutoCAD): 773 Hours
- Minimally Experienced (Revit) Team: 694 Hours

Project: AutoCAD
Team Experience (1-10): 10
Team Size: 3-4

Project: 1st Revit Project
Team Experience (1-10): 0
Team Size: 3-4

Project: 2nd Revit Project
Team Experience (1-10): 4
Team Size: 3-4
Case Study
The new fee structure

Project X

Traditional Fee Distribution

Current Fee’s do Not reflect effort!

<table>
<thead>
<tr>
<th>Hours</th>
<th>SD</th>
<th>DD</th>
<th>CD</th>
<th>BN</th>
<th>CA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Phase</td>
<td>10%</td>
<td>20%</td>
<td>45%</td>
<td>5%</td>
<td>20%</td>
</tr>
</tbody>
</table>

What happens when a Revit project is put on hold before the CD phase?
Case Study
The new fee structure

Project X

Proposed Fee Distribution

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD</td>
<td>25%</td>
</tr>
<tr>
<td>DD</td>
<td>45%</td>
</tr>
<tr>
<td>CD</td>
<td>15%</td>
</tr>
<tr>
<td>BN</td>
<td>5%</td>
</tr>
<tr>
<td>CA</td>
<td>10%</td>
</tr>
</tbody>
</table>

CAD Project

BIM Project
Case Study
The new fee structure

Evolution toward a new design process

1. Paradigm Shift moving to BIM

PD: Pre-design
SD: Schematic design
DD: Design development
CD: Construction documentation
PR: Procurement
CA: Construction Administration
OP: Operation

1. Ability to impact cost and functional capabilities
2. Cost of design changes
3. Traditional design process
4. Preferred design process

Graphic courtesy of Patrick MacLeamy AIA / HOK
QUESTIONS ?