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The BIM Uses Guide defines the way BIM can be used on projects.

GETTING STARTED

Getting Started with Building Information Modeling (BIM) on a project can be overwhelming – there seem to be an endless amount of technical terms, acronyms, and software programs. The UCMC BIM Subcommittee created the following set of resources to support Harvard stakeholders, whether the language of BIM populates your everyday conversations or this is your first time learning about BIM.

Beginners may find it helpful to start with the Introduction to BIM and progress sequentially to the BIM Uses Guide. Others may start with the BIM Procurement Guide, flip back to the BIM Uses Guide, and then jump to the BIM Execution Plan Template.

<table>
<thead>
<tr>
<th>“What is BIM?”</th>
<th>“How can I use BIM on my project?”</th>
<th>“Should I use BIM on my project?”</th>
<th>“How can I select a BIM-enabled team?”</th>
<th>“How do I implement BIM on my project?”</th>
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INTRODUCTION TO BIM  BIM USES GUIDE  BIM DECISION MATRIX  BIM PROCUREMENT GUIDE  BIM EXECUTION PLAN TEMPLATE

Addresses questions including:
- What is BIM?
- Why should I use BIM?
- Does BIM cost more?
- Take longer?

Explain the different ways project stakeholders use BIM. Future documents reference the BIM Uses Guide.

Helps Harvard stakeholders determine if a project can benefit from BIM, and if so, what specific BIM Uses are best suited for that project.* Includes BIM Decision Matrix instructions

Includes:
- Sample RFP language
- BIM-capability evaluation methods
- Procurement Best Practices

* Includes Guide to BIM Execution Planning

A standardized framework for teams to plan, document, and implement BIM on a project.
1. **EXISTING CONDITIONS**

1.01 **Surrounding Area**
Laser scanning accurately records the surface geometry of the surrounding environment. This data can be converted to a BIM, providing documentation of the surrounding project area. The results provide improved modeling and site-related analysis (i.e. sun path, wind, etc.) as well as contextual understanding for design and construction logistics planning. Another (less accurate) method of documenting surrounding areas is photogrammetric surveying, which provides measurements from photographs.

1.02 **Existing Buildings**
Laser scanning, combined with conventional surveying methods, produces an accurate virtual model of the existing building. The resulting documentation looks like a photograph, but is actually made up of millions of points—each with its own coordinate. These points, referred to as a ‘point cloud’ can be converted to a BIM, providing an accurate baseline for documentation and coordination. Costly field issues associated with inaccurate as-built documentation can be eliminated with the precise nature of a laser scan.
Laser scanning should be considered for:

- 1.02.1 Building Exterior
- 1.02.2 Building Interior
- 1.02.3 Building Systems

1.03 **Geo-Tech**
Information from borings and geotechnical reports can be extrapolated into a BIM to plan soil removal and subsurface work. BIMs include:

- 1.03.1 Environmental Pre-Characterization
- 1.03.2 Subsurface

1.04 **Site and Topography**
Site surveys or laser scanning can document surface conditions. Benefits of this can include an improved contextual understanding for design and construction logistics planning, allowing the team to design and fabricate around topographical obstacles, avoiding costly changes.
The following elements can be included in the BIM for document planning and coordination:

- 1.04.1 Surface Materials
- 1.04.2 Site Utilities
- 1.04.3 Major Plantings
2. **PROGRAM AND SPACE VALIDATION**

Area and program information is extracted from the BIM in order to track developments in space allocation as the design develops. This allows the tracking of design decisions on rentable area, gross area, and usable area. BOMA calculations and diagrams can be generated directly from the BIM. Different applications can include:

2.01 Program

2.02 BOMA (Building Owners and Managers Assoc.)

3. **DESIGN AUTHORING**

The BIM is the environment for developing the design for:

3.01 Architecture

3.02 Interiors

3.03 HVAC

3.04 Structure

3.05 Telephone/Data

3.06 Plumbing

3.07 Lighting

3.08 Fire Protection

3.09 Electrical/Fire Alarm

4. **DIGITAL MOCK-UP**

Detailed modeling of specific areas and assemblies can improve understanding of and coordination between design details. This can facilitate discussion with consultants, contractors, and subcontractors resulting in optimized and constructible details. The following systems should be considered:

4.01 Foundations

4.02 Façade

4.02.1 Curtain wall Assembly

4.02.2 Parapet

4.02.3 Mechanical Spaces

4.02.4 Material Interfaces

4.03 Mechanical

4.03.1 Mechanical Spaces

4.03.2 Material Interfaces

4.03.3 Shafts
4.03.4 Plenum

4.04 Quantity Comparison

4.05 Finishes

4.06 FFE

4.07 Elevator

5. DESIGN OPTIONS

5.01 Visualization
Multiple versions of a design can be modeled for comparison through renderings, drawings, and other imagery. Visualizations of each option allow for more informed decision-making by owners, users, or potential tenants.

5.02 Quantity Comparison
Separate quantity takeoffs can be extracted for cost comparisons between design options, providing accurate cost breakdowns to support decision-making.

6. DESIGN COMMUNICATION

6.01 Still Images
Images can be exported from the BIM to provide visualization of the design intent. Accurate materials and lighting can create photo-realistic imagery to preview the visual impact of the finishes. Still images come in several of the following forms:

6.01.1 Renderings
6.01.2 Rendered Drawings
6.01.3 Imagery

6.02 Animations
The BIM can be used to create various animations: walk-throughs, fly-throughs, and step-by-step sequences of detailed assemblies and processes.

6.03 3D Print
A 3D printer constructs a scale physical model from a digital model, such as a BIM. The model can be created from materials such as acrylic, epoxy, starch, and powder. 3D printing is an efficient process for generating a physical representation from a digital design, providing a tactile way to experience the design.

6.04 Promotional Materials
Images, animations, and other assets can be created within the BIM to support promotional materials, including signage, slides, tear sheets, and videos.

6.05 Tenant Guidelines
7. DESIGN DOCUMENTS

7.01 OPR/BOD

7.02 Documents

2D design documents are created within the BIM and can improve coordination between the various disciplines, leading to reductions in cost. Types of documents include: plans, exterior elevations, interior elevations, building sections, schedules, and legends.

7.02.1 SD
7.02.2 DD
7.02.3 CD

7.03 Details

Details can be created within the BIM using combinations of 2D and 3D documentation. At minimum, details should be comprised of 2D drafting over 3D model geometry. 2D drafting over live views of 3D geometry assures more accurate coordination than importing 2D details into the BIM. Details fully modeled in 3D allow for the most accurate coordination and quantity extraction.

7.03.1 Details - SD
7.03.2 Details - DD
7.03.3 Details – CD

7.04 Specifications

Specifications can be linked to the BIM, enabling an update to the specifications manual each time a change is made in the BIM. If components are synced, designing and altering will not cause errors. Integration between specifications and the BIM can create a unified project with consistent information.

8. DESIGN ANALYSIS

8.01 Architectural

The following analyses can be performed by leveraging geometry or data from the BIM, enabling iterative review of design:

8.01.1 Materials
8.01.2 Day lighting
8.01.3 Code Validation
8.01.4 Acoustical
8.01.5 ADA
8.01.6 Egress

8.02 Sustainability/Evaluation

8.02.1 LEED Documentation
8.02.2 Daylighting
8.02.3 Documentation for LEED credits can be developed using views from the BIM.
8.02.4 Utility Int. Analysis

8.03 Energy Model
Due to timing of analysis and potential model clean-up, energy analysis is often performed separate from the BIM. There are opportunities to leverage some architectural geometry and data, preventing the engineer from developing a separate model.

9. **ENGINEERING ANALYSIS**

9.01 Structural Analysis
Structural design options, overall building structure, and individual detailed connections can be analyzed and tested, which can result in a structure optimized for cost and performance.

9.02 Energy Analysis
The following loads can be calculated using spatial and envelope data from the BIM:

9.03 Mechanical Analysis

9.04 Lighting Analysis

9.05 Envelope
Using geometry and data from the BIM, the envelope can be analyzed at the levels of system, assembly, and material interfaces. Since the enclosure is a high-risk element, the envelope analysis is a critical component of a project. Envelope analyses include:

- **9.05.1 Thermal**
- **9.05.2 Thermal-Air Infiltration**
- **9.05.3 Hydrothermal (Condensation)**
- **9.05.4 Structural**
- **9.05.5 Fire**
- **9.05.6 Water-Proofing**

9.06 Wind
Wind studies can leverage geometry from the BIM, resulting in quicker turnaround of and more opportunities for analysis.

10. **DESIGN COORDINATION**

10.01 Clash Detection
Software analyzes the BIM for physical interferences (clashes) between building systems and components, then, clashes are manually sorted and reported. Clash detection during design can result in increased coordination of design intent, setting the stage for construction coordination.

10.02 Clearance Checking
Clearance checking is a type of clash detection that analyzes code or access clearance conflicts. This can be accomplished by modeling clearance zones or by changing clash settings to clearance.

Figure 11. Transparent red volume indicates clearance zone required for mechanical maintenance
10.03 Clash Resolution
Conflicts found during clash detection need to be resolved within the design BIM authoring platform. Virtually solving the issue ahead of time can avoid costly errors and revisions in the field.

11. CONSTRUCTION COORDINATION

11.01 Clash Detection
Software analyzes the BIM for physical interferences (clashes) between building systems and components, then, clashes are manually sorted and reported. Construction-level clash detection can result in a reduction of: field conflicts, RFIs, and change orders. Coordination with off-site prefabricated components can be improved.

11.02 Clearance Checking
Clearance checking is a type of clash detection that analyzes code or access clearance conflicts. This can be accomplished by modeling clearance zones or by changing clash settings to clearance.

11.03 Clash Resolution
Conflicts found during clash detection need to be resolved within the fabrication BIM authoring platform in order to be incorporated into shop drawings. Virtually solving the issue ahead of time can avoid costly errors and revisions as well as schedule and occupancy delays.

11.04 Coordination Sign-Off
After construction coordination is complete, a set of 2D and 3D coordination drawings can be created within the BIM for construction team sign-off and design team submittal review.

12. SCHEDULING

12.01 Phasing
12.01.1 Project Phasing
Representative masses in the BIM are linked to the summary project schedule for visualization and preliminary planning. This improves understanding of phasing and can allow for comparison of different strategies.

12.01.2 Detailed Phasing
Detailed phasing focuses on a specific detail, process, or period of time, such as curtainwall assembly or slurry walls/foundations. Components in digital mock-ups are linked to a construction sequence in order to visualize multi-trade installation. This identifies critical phases of the installation sequence of complex details.

12.02 Schedule
12.02.1 Project Schedule
Individual objects in the BIM are linked to the master schedule for visualization and schedule simulation. Visualizations can include milestone snapshots and animations.

12.02.2 3-Week Look-Ahead
Snapshots can be extracted from the schedule-linked BIM in weekly intervals. This can reduce deviations from the original schedule, create visual milestones for the field staff, and verify that the project is on schedule.
12.02.3 Sequenced Logistics
Modeled logistics objects are organized by the construction schedule to produce visualizations of site planning.

13. QUANTITY EXTRACTION
Quantity extractions from the BIM can be used to support cost engineering and procurement activities. Quantities can be provided in spreadsheet format as well as in Advanced Bill of Materials. Consider extracting the following quantities:

13.01 Foundations
13.02 Structure
13.03 Exterior Enclosure
13.04 Roof
13.05 Interior Construction
13.06 Finishes
13.07 Stairs/Elevators
13.08 Mechanical
13.09 Electrical/Fire Alarm
13.10 Fire Protection
13.11 Site
13.12 Plumbing

14. LOGISTICS PLANNING
Detailed logistics objects are modeled in the BIM and organized by the construction schedule. The model can provide fast, accurate quantities for logistics objects; simulation of construction phasing; and a single, coordinated source for logistics documentation. This can provide more accurate planning and study of logistics as well as clearer, more detailed planning presentations.
14.01 Traffic
The model can be used to design, simulate, and present traffic planning. Turning radius and wheel paths can be accurately calculated and documented allowing for a more detailed understanding of space allocation and vehicle access on the site.

14.01.1 Truck Routes/Queue
14.01.2 Lane Closures
14.01.3 Deliveries

14.02 Parking
The model can be used to analyze temporary parking options for the site and the public. Including parking spaces in the model allows for fast and accurate space counts, simulation of multiple design options, and a single file location for multiple parking allocations during different phases of design.

14.03 Site Planning
Staging and storage zones can be modeled and located in relation to equipment zones (e.g. crane radius) and other logistics objects (e.g. turning radius, truck routes). This can enable more detailed understanding and planning of the site.

14.03.1 Staging and Storage
14.03.2 Equipment Zones
14.03.3 Environmental Controls

The following environmental control plans can be analyzed and developed in the model:

14.03.4 ICRA
14.03.5 Erosion Control

15. SAFETY

15.01 Internal Safety Measures
A complete safety plan can be developed in the BIM, which can result in better communication of requirements and a safer site. Components of a safety plan include:

15.01.1 Controlled Access Zones
15.01.2 Floor Penetration Protection
15.01.3 Guard Rail/Perimeter Protection

15.02 Public Safety Measures
Visuals can be extracted from the BIM to inform the public, communicate upcoming work, and allow stakeholders to interact with the job site. The public safety measures can include:

15.02.1 Pedestrian Protection and Routes
15.02.2 Emergency Routes

16. CONSTRUCTION LAYOUT
Geometry from the BIM is exported to total station for an accurate, coordinated construction layout. This can increase efficiency in the layout of systems, and reduce overall margin of error. Systems to layout can include:
16.01 Partitions

16.02 Mechanical
   16.02.1 Hangers
   16.02.2 Curbs

16.03 Structure
   16.03.1 Foundations
   16.03.2 Slabs and Slab Edge
   16.03.3 Structural Steel
   16.03.4 Verification

17. SHOP DRAWINGS & SUBMITTALS

Geometry and data from the BIM can be exported to fabrication software. Required geometry is detailed for shop drawings and can be sent to computer numerical control (CNC) equipment for prefabrication, and erected efficiently on site. This can result in time and cost savings and a reduced margin of error. Potential systems to consider:

17.01 Formwork/Foundations

17.02 Steel

17.03 Façade
   17.03.1 Curtain wall
   17.03.2 Metal Panel

17.04 Mechanical

17.05 Plumbing

17.06 Fire Protection

17.07 Electrical/Fire Alarm

17.08 Casework/Millwork

17.09 Elevator

17.10 Design Features

17.11 Wood Framing

18. FIELD SUPPLEMENTS

18.01 3D Print

A 3D printer constructs a scale physical model from a digital model such as a BIM. The model can be created from acrylic, epoxy, starch, powder, and other materials. 3D printing is an efficient process for generating a physical representation of a complex detail, providing a tactile way to understand the assembly.

18.02 Drawings

Drawings are extracted from the BIM depicting additional details, dimensions, and other information needed for construction (supplementing the CDs). On-site efficiency can be maximized by quickly supplying the information to subcontractors.
18.03 Renderings

Photo-realistic imagery of special conditions, finished details, and spaces are printed large scale from the BIM and displayed on site. This can reduce rework by increasing understanding of design intent by subcontractors.

19. Turnover/Record BIM

The finished BIM is considered the Record BIM for turnover to the owner. See Appendix regarding the standard turnover. BIM elements can contain information for facilities management, including:

19.01 Warranty Data
19.02 Maintenance Data
19.03 Asset Data
19.04 Performance Data

20. Facilities Management

The Turnover/Record BIM can integrate with automated building controls, property management training, maintenance records, and work orders. The following features should be discussed:

20.01 CMMS Integration
20.02 BAS Integration
20.03 Controls Integration
20.04 Work Orders Integration
20.05 Mobile Solutions
20.06 Asset Tracking
20.07 Asset Management
20.08 Disaster Planning
20.09 Space Mgmt. & Tracking
**BIM USE TIMEFRAMES**

Although teams should determine the appropriate timeframe for a BIM Use on a specific project, there are some general rules of thumb for BIM Use timeframes:

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<thead>
<tr>
<th>Activity</th>
<th>Design</th>
<th>Preconstruction</th>
<th>Construction</th>
<th>Operations</th>
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<tbody>
<tr>
<td>Existing Conditions</td>
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<td>Program &amp; Space Validation</td>
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<td>Facilities Management Implementation</td>
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