

**DRAFT**

**BUILDING INFORMATION MODELING  
(BIM)  
GUIDELINES and STANDARDS for  
ARCHITECTS and ENGINEERS**

**July 1, 2012**

**Division of Facilities Development  
Department of Administration**



**State of Wisconsin**

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## Purposes and Uses

The BIM Guidelines and Standards previously issued July 1, 2009 have been updated to establish portfolio baseline requirements for consistent model development and management across state agencies and the UW System. This applies to Architects and Engineers (AE) selected by the Wisconsin Department of Administration, Division of Facilities Development for projects advertised on or after July 1, 2012.

*Required on all construction (new and addition/alteration) with total project funding of \$5M or greater,  
Required on all new construction with total project funding of \$2.5M or greater,  
Required on all addition/alteration construction with total project funding of \$2.5M or greater that  
includes new addition costs of 50% or more of total,  
Encouraged but not required on all other projects.*

This guide focuses on BIM authoring software uses and deliverables of value to the DFD and consistent with current technology and methods.

- Existing conditions modeling
- Cost analysis of early design options
- Design authoring
- 2D and 3D visualization
- Energy analysis of early design options
- Structural analysis
- Mechanical analysis
- Energy modeling to optimize the selected design
- Spatial Validation for conformance with the project program
- Spatial conflict checking of design
- Spatial awareness (links to GIS)
- Coordinated Construction Documents
- Record modeling

Additional BIM authoring software requirements, deliverables and exchanges may be identified to meet project delivery processes or operational requirements. These may be included at time of advertisement for services or developed during project execution.

DFD welcomes your input and advice in the implementation of BIM. Please contribute your feedback or direct questions to DFD BIM Program Manager at DFD Call Center 608-266-1485 (phone) 608-261-7070 (fax) or email: [DOADSFAdminServices@wisconsin.gov](mailto:DOADSFAdminServices@wisconsin.gov) .

## 1. Requirements

### 1.1. Architects and Structural Engineers

AE shall use BIM Authoring Software. Building information models shall be created that include all geometry, physical characteristics and data needed to describe the design and construction work. A/E shall follow the guidelines and requirements detailed in this document for BIM related services.

### 1.2. Mechanical, Electrical, and Plumbing Engineers:

These engineers should use BIM Authoring Software but may use 3D object-oriented software. Models shall be created that include all geometry, physical characteristics and data needed to describe the design and construction work. Software shall be capable of interfacing with the Architects and Structural Engineers BIM authored software. Model the building and

infrastructure systems to a level that allows the team to verify clearances, analyze conflicts clashes and properly coordinate the work with other aspects of the project. Engineers shall follow the guidelines and requirements detailed in this document for BIM related services.

### 1.3. Civil Engineers, Fire Protection and Specialty Consultants:

These consultants including but not limited to Food Service Planning, Medical Planning, Library Planning, Audiovisual/Communications, Exhibit Design, Safety and Security Planning, and Interior Design shall use 3D object oriented software or BIM Authoring software. Models shall be created that include all geometry, physical characteristics and data needed to describe the design and construction work. Software shall be capable of interfacing with the Architects' BIM authored software. Model the site and other building components to a level that allows the team to verify clearances, analyze conflicts/clashes and properly coordinate the work with other aspects of the project. Engineers and consultants shall follow the guidelines and requirements detailed in this document for BIM related services.

### 1.4. Accepted Software

DFD accepts object oriented software applications that comply with current industry interoperability standards. Architectural, Structural, and MEP BIM Authoring Software shall at a minimum comply with the Industry Foundation Classes, IFC2x3 coordination view. All software should be capable of data exchange with coordination and collaboration software.

Currently pre-accepted software includes:

Authoring and Design Software (architecture and structure)

- ArchiCAD, Bentley Architecture, Digital Project, Revit Architecture, Revit Structure, Tekla, Vectorworks

Authoring (MEP,FP, Specialty consultants)

- ArchiCAD MEP, AutoCAD MEP, Revit MEP, AutoCAD Architecture

Design (civil)

- Bentley Inroads, AutoDesk Civil 3D

Coordination (spatial conflict checking)

- BIMSight, NavisWorks, Solibri Model Checker

Model Checking Utilities (spatial validation and IFC)

- Solibri, BIMSight, Navisworks

Energy analysis and modeling

- DOE2, EcoDesigner, Ecotect, EnergyPlus, eQuest, Green Building Studio, Trane/Trace, Vasari

DFD will consider other software subject to their capabilities and benefits to the project.

### 1.5. Open Standards for Software Interoperability

The Wisconsin Department of Administration, Division of Facilities Development has adopted open standards for data exchange. The A/E is encouraged to use products based on or using open standards for greatest interoperability between consultants and DFD.

## 2. Process

### 2.1. Model quality

AE shall follow these model quality guidelines:

- 2.1.1. General: Building Information Models and Site Models shall consist of objects and elements that represent the actual dimensions and data needed to describe the design and

construction of the project. They shall also include the modeling of spaces, volumes and zones as well as required clearances and access zones for equipment.

- 2.1.2. AE's In-house standards: Use of element and component objects that embed the best practices of the firm.
- 2.1.3. Parametrics: Maintain parametric linkages within the model at all times.
- 2.1.4. View generation: All plans, building and wall sections, interior and exterior elevations, and all schedules shall be direct extractions from the model. Details should have their base elements extracted from the model unless the AE or DFD have standard details or diagrams.
- 2.1.5. Objects Classification: Use correct object and spatial classifications for modeling. For example use the table tool for creating a table not the slab tool.
- 2.1.6. Object and property naming: Use industry accepted or DFD defined nomenclature for objects and spaces.
- 2.1.7. Accurate modeling: Practice efficient and accurate modeling, i.e. eliminate object overlap, correctly close wall intersections, extend walls to deck if they will intersect in actual construction, etc. The model needs to *look right* and *be right*.
- 2.1.8. Communication: Use appropriate and interoperable viewing and checking file formats.
- 2.1.9. Validation: Use model checking tools to confirm adherence to the accurate translation of file formats before submission.
- 2.1.10. Off-the-shelf objects: Manufacturer supplied objects must adhere to IFC standards.
- 2.1.11. Concept objects: Where intelligent objects are not available, these may be modeled as a "concept object" conforming closely in length, width, height and properly located.

## 2.2. Level of Development

The Level of Development (LOD) describes the completeness to which a model elements representing components, systems or assemblies are developed at progressive project phases. This development includes geometric and non-geometric data.

The LOD also communicates model exchange expectations among team members. As project requirements will vary so will the progression of model development. The AE team should define the required levels according to the projects specific needs as part of their BIM Execution Plan. In general models should be developed to a level that can generate the required BIM deliverables for that phase of the design process.

- 2.2.1 The level required for the review documents is that which is suitable for the generation of traditional two dimensional review drawings and IFC format model files.
- 2.2.2 The level required at bidding document issue is that which is suitable for the generation of traditional two dimensional construction drawings.
- 2.2.3 The level required for the record documents is that which is suitable for the generation of traditional two dimensional record drawings and model files.

## 2.3. BIM Execution Planning

DFD supports the development and application of the National Building Information Modeling Standards (NBIMSv2) Section 5.3 as a best practice guide. The essential elements that are required content for the BIM Execution Plan submittal include:

- Section E: Organizational Roles/Staffing
- Section F: BIM Process Design
- Section G: BIM Information Exchanges
- Section J: Quality Control
- Section K: Technological Infrastructure Needs

The section letter, title and content is required, the format of the submittal may be that provided in the NBIMSv2 or the A/E may use their choice of format. The content and submittal of the BIM Execution Plan Section shall be as follows:

2.3.1. BIM Execution Team Structure

Section E: Organizational Roles/Staffing

(exclude estimated work hours and location columns of Item 2)

- *Submit with screening submittal material for projects over 5M.*
- *Submit with letter of interest for others.*

2.3.2. BIM Execution Team Process

Section F: BIM Process Design, Item 1 only

Section J: Quality Control, Item 1 only

- *Submit with Fee Rate Sheet at Interview, and Present BIM Execution Plan during Interview time for projects over 5M.*
- *Submit and discuss at kick-off meeting for others.*

2.3.3. BIM Execution Plan

Section F: BIM Process Design Item 2

(for BIM uses stated above)

Section G: BIM Information Exchanges

(modify as needed for BIM uses stated above)

Section J: Quality Control, Item 2

Section K: Technological Infrastructure Needs

- *Submit with fee proposal.*

NBIMSv2 and Section 5 Practice Documents can be found at

<http://www.nationalbimstandard.org/>. Use Section 5.3 BIM Project Execution Planning Guide.

A URL (<http://bim.psu.edu/>) linking to the standard guide and templates is located in the middle of page three

2.4. **Work Effort and Compensation Schedule**

DFD may negotiate fee allocation up to the stated BIM work effort. This allocation will be based on A/E's BIM capabilities, scope of the project, project delivery requirements and the accepted BIM execution plan.

<i>DFD Project Phases</i>	<i>Description of A/E BIM work effort</i>	<i>Traditional work effort</i>	<i>BIM work effort</i>
3.1 Pre-design	Confirms program, budget and schedule at a high level	In below	5%
3.2 Preliminary Design: Peer review	Defines the optimum design solution meeting program requirements and demonstrates adherence to budget, schedule, energy, sustainability and code requirements.	10%	20% 25% total
3.3 Preliminary Design	Facility design is fully developed, coordinated and validated. Cost and Schedule established with high level of precision.	25% 35% total	25% 50% total
3.4 Final Design	Detailed design is fully annotated and graphically clarified for accurate bidding, scheduling and construction purposes.	40% 75% total	25% 75% total

3.5 Bidding	Above plus inclusion of review into model(s)	5% 80% total	5% 80% total
3.5 Construction Issue	Above plus inclusion of addendum, value engineering, and negotiations into model(s)	In above	In above
3.6 Construction	Include construction contract changes into model(s)	20% 100% total	20% 100% total
3.7 Closeout	Record documents, change orders and other appropriate close-out submittals incorporated into Record model(s)	In above	In above

### 3. Objectives, Applications and Deliverables

#### 3.1. Pre-Design

3.1.1. AE is encouraged to use electronic programming and planning tools that integrate into their BIM Authoring software to capture early cost, schedule and program information during this phase.

#### 3.1.2. Topographic and Property Line Surveying

Detailed requirements of what is to be included in surveying deliverables is managed by DFD staff in consultation with the AE on a project-by-project basis. Surveys shall be provided in electronic format and minimally include 3D topographic information including paving and retaining walls.

Topographic and property surveys shall be tied to the State’s GIS WTM83, NAD83 (1991) coordinate system and USGS datum. The surveyor shall provide electronic files that clearly define the project site and include accurate x/y/z coordinates on all survey items. The file(s) shall be in a format that allows for importing directly into the State’s GIS system. Survey points must ‘land’ within the State’s GiS datum within the margin for error that is normal in the industry.

#### 3.1.3. Geo-referenced model

AE shall link the building and site models to the geo-referenced survey and/or geo-reference it to Wisconsin State GIS WTM83, NAD83 (1991) coordinate system and USGS datum.

#### 3.1.4. Existing conditions

A/E shall model all existing conditions needed explain the extent of the construction work for alterations and additions projects. The extent of modeling beyond the affected areas and the level information to be included will be determined based on project needs. These requirements may be stated in the project’s advertisement for services, the program and discussed during the project kickoff meeting.

#### 3.2. Preliminary Design: Peer Review

##### 3.2.1. General

Building information modeling shall be used in this phase to support the creation and communication of an optimal design solution that meets the owner’s functional and aesthetic requirements. The BIM deliverables must also demonstrate that the design is on track to satisfy the owner’s sustainability, codes, operational, technical, constructability, cost and schedule requirements. AE may use any tools or methods to begin the design process but shall use BIM or 3D model(s) to complete the deliverable requirements of this



section. All information used to describe the schematic design and other deliverables shall be graphically or alphanumerically included in and derived from these models.

3.2.2. Visualization

Models shall be at a level of development to support two and three dimensional illustration of the organizational and spatial relationships of the proposed facility. AE’s are encouraged to use interactive 3D tools when appropriate.

3.2.3. Comparative energy analysis

AE shall use early energy analysis tools typically integrated within the BIM authoring software to develop comparative energy analysis of early design options being considered. Modeling parameters shall be based on local climate data and actual site conditions. Results should demonstrate how various architectural variables such as orientation, massing, form, sun controls, materials, wall construction, natural ventilation, area of glass, day-lighting and other factors were used to optimize the design.

3.2.4. Program and Space Validation

AE shall use the BIM Authoring software or other analysis tools to compare and validate stated program requirements with the actual design solution. The following shall be developed automatically from the building information model:

- Assignable Areas (ASF) and Non-assignable Areas (NaSF) measured to inside face of wall objects.
- Gross Area (GSF) measured to the outside face of wall objects.

3.2.5. Comparative Cost Analysis

AE shall extract quantity information using BIM authoring software and other BIM integrated tools to support comparative cost analysis of early options studied. Results should demonstrate how various cost parameters such as building perimeter, square foot zones by cost type, exterior envelop area, construction type, envelop materials, and/or others were used to optimize the design.

3.2.6. Spatial Conflict Checking

AE shall use automated conflict checking software to validate spatial needs and relationships of major systems and spaces such as major mechanical equipment or vertical shafts are not conflicting or using the same space.

***BIM DELIVERABLES: Submit after Preliminary Design: Peer Review is approved:***

- *A coordinated model in validated IFC format (open and check the file in an IFC viewer). This model shall include all schematic level architectural, structural and MEP design. Include civil when appropriate.*
- *A “clean” spatial conflict checking report in the software’s standard output format*

3.3. Preliminary Design

3.3.1. General

AE shall continue development of their Building Information Models (or 3D Models for Consulting Engineers and Specialty Consultants) created in the Preliminary: Peer review. Parametric links shall be maintained within the models to enable automatic generation of all plans, sections, elevations, custom details and schedules as well as 3D views. All



information needed to describe the design shall be graphically or alphanumerically included in and derived from these models only, except for the specifications.

### 3.3.2. Visualization

AE shall continue to use the model for visually testing functionality, aesthetics, constructability and other factors. DFD is open to innovation and encourages the AE to find efficiencies and uses for BIM to enhance communication for the project. Integrate BIM into progress meetings and use for all graphic design review submittals.

### 3.3.3. Energy modeling

Provide energy modeling and reporting per current *AE Policy and Procedure Manual*. AE shall use the BIM model and tools which can use the model data for this analysis, rather than manually re-creating the data.

### 3.3.4. Program and Space Validation

AE shall use the methodology described in 3.2.5 above to reconfirm program and generate Design Report space tabulations.

### 3.3.5. Cost Estimating

AE shall use BIM quantity data in support of other cost estimating tools and methods.

### 3.3.6. Conflict checking

AE shall use conflict checking software to resolve clashes between disciplines and specialties included on the project. Hard clashes between the various elements and soft clashes between an element and a required clearance shall be identified and resolved prior to submittal.

### 3.3.7. Other analysis and checking tools

AE is encouraged to use BIM and associated tools as appropriate to analyze and develop sustainability, day-lighting, life cycle costing, scheduling and phasing and other design reports.

#### *BIM DELIVERABLES: Submit with Preliminary Review Documents:*

- *A fully coordinated model in validated IFC format. This model shall include all preliminary level architectural, structural and MEP design. Include civil when appropriate.*
- *A “clean” spatial conflict checking report in the software’s standard output format*

## 3.4. Final Design

### 3.4.1. General

AE shall continue development of the BIM (or 3D Models for Consulting Engineers and Specialty Consultants) created in the Preliminary phase. Maintain parametric links within the respective models to enable automatic generation of all plans, sections, elevations, custom details, schedules and 3D views. All information needed to create the construction documents shall be graphically or alphanumerically included in and derived from these models only. Exceptions are the AE’s standard details, diagrams and specifications.

### 3.4.2. Cost Estimating

AE shall use BIM quantity data in support of other cost estimating tools and methods.

### 3.4.3. Conflict checking

AE shall use conflict checking software to resolve clashes between disciplines and specialties included on the project. Hard clashes between the various elements and soft clashes between an element and a required clearance shall be identified and resolved prior to submittal.

***BIM DELIVERABLES: Submit with Final Review Documents:***

- A single fully coordinated model in validated IFC format. This model shall include completed architectural, structural and MEP design. Include civil when appropriate.
- A “clean” spatial conflict checking report in the software’s standard output format.

### 3.5. Bidding

AE shall update the models with all addendum, accepted alternates and/or value enhancement proposals.

***BIM DELIVERABLES: After bidding is complete submit with Construction Documents:***

*At the completion of the bidding phase BIM files shall be cleaned of extraneous objects, layers, stories, abandoned designs and other content or data not part of the final construction documents.*

*Submit:*

- *Native files: A separate model for each discipline in native application’s format with any referenced documents bound to the BIM.*
- *IFC files: A validated IFC for each disciplines’ model and, a single fully coordinated model in validated IFC format.*
- *Submit a “clean” spatial conflict checking report in the software’s standard output format if changes have been made to any of the models.*

### 3.6. Construction

AE shall continuously maintain and update the model(s) with changes made during construction.

### 3.7. Close-out

AE shall update their respective models with contractor recorded changes.

***BIM DELIVERABLES: Submit with Record Documents***

*BIM files shall be cleaned of extraneous objects, layers, stories, abandoned designs and other content or data not part of the construction or record documents. Submit:*

- *Native files: A separate model for each discipline in native application’s format with any referenced documents bound to the BIM.*
- *IFC files: A validated IFC for each disciplines model, and a single fully coordinated model in validated IFC format.*

### 3.8. Native file format model submittals

Any changes to, or extractions from the construction or record model(s) submittals will be the responsibility of the party making the changes.