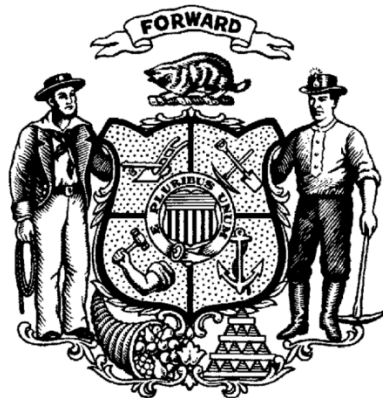


(Revised 9/12)

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

July 1, 2009

**Division of Facilities Development
Department of Administration**



State of Wisconsin

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Building Information Modeling (BIM) Guidelines and Standards for Architects and Engineers

This BIM Guideline and Standard applies to DFD A/E selections advertised on or after July 1, 2009 for the following projects:

- *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.*

DFD welcomes your input and advice in the implementation of BIM. Please contribute to our feedback forum at: DOADSFAdminServices@wisconsin.gov

1. Requirements

- 1.1. Architects and Structural Engineers shall use BIM Authoring software (see section 1.4). Building information models shall be created that include all geometry, physical characteristics and product data needed to describe the design and construction work. All drawings and schedules required for assessment, review, bidding and construction shall be extractions from this model. A/E shall follow the guidelines and requirements detailed in this document for BIM related services. Deliverable requirements are as specified in the *A/E Policy and Procedure Manual*.
- 1.2. Mechanical, Electrical, Plumbing, Fire Protection, and Civil engineers shall use BIM Authoring software or discipline specialty 3D software. Models shall be created that include all geometry, physical characteristics and product data needed to describe the design and construction work. Drawings and schedules required for assessment, review, bidding and construction shall be extractions from this model. Software shall be capable of interfacing with the Architects and Structural Engineers BIM authored software. In all cases, model building and infrastructure systems to a level that allows the team to verify clearances, analyze conflicts/clashes and properly coordinate the work with all other aspects of the project. A/E shall follow the guidelines and requirements detailed in this document for BIM related services. Deliverable requirements are as specified in the *A/E Policy and Procedure Manual*.
- 1.3. Specialty Consultants including but not limited to: Food Service Planning, Medical Planning, Library Planning, Audiovisual/Communications, Exhibit Design, Safety and Security Planning, Interior Design shall use BIM Authoring software or discipline specialty 3D software. Models shall be created that include all geometry, physical characteristics and product data needed to describe the design and construction work. Drawings and schedules required for assessment, review, bidding and construction shall be extractions from this model. Software shall be capable of interfacing with the Architects' BIM authored software. In all cases, model components to a level that allows the team to verify clearances, analyze conflicts/clashes and properly coordinate the work with all other aspects of the project. Deliverable requirements are as specified in the *A/E Policy and Procedure Manual*.
- 1.4. BIM Authoring Software
A/E's required or using BIM shall use one or a combination of the following ***BIM Authoring*** software for DFD projects.
 - AutoDesk Revit Architecture, Structure and MEP

- Bentley Architecture
- Graphisoft ArchiCAD
- Nemetschek AllPlan
- Tekla Structures

DFD will consider other software products subject to their capabilities, features and benefits to the State. Note: other BIM tools may be used for analysis, specialty design, and other project needs.

1.5. IFC compliance

BIM Authoring software shall be compliant with the latest release of the Industry Foundation Classes (IFC) as certified by the buildingSMART Alliance.

1.6. Open Standards for Interoperability

The State has adopted open standards for data exchange. A/E is encouraged to use products based on or using open standards for greatest interoperability between consultants and DFD.

1.7. Geo-referenced model

A/E shall geo-reference site plans and building models to Wisconsin State GIS WTM83, NAD83 (1991) coordinate system and USGS datum.

1.8. Project collaboration tools

A/E is encouraged to use electronic project collaboration tools such as document management and file sharing sites, reviewing tools, project communication websites, web meetings, and video conferencing.

2. Process

2.1. Model quality

A/E shall establish and use in-house modeling quality control guidelines and exchange protocols. This may include but not limited to:

- Use of element and component objects that embed the best practices of the firm.
- Maintenance of parametric linkages within the model at all times.
- Do not use disconnected 2D files. Extract all drawing views from your model.
- Use correct object definitions for modeling: i.e. use a table object for a table – do not “fudge it” with slab commands. It may *look right* but will not *be right* for scheduling, analysis or interoperability with other software.
- Practice efficient and accurate modeling, i.e. eliminate object overlap, correctly close wall intersections, etc. The model needs to *look right* and *be right*. Inaccurately modeled items WILL become a problem.
- Creation and adherence to A/E’s own in-house standards.
- Creation and use of BIM planning procedures.
- Use industry accepted or DFD defined nomenclature for objects and spaces.
- Use appropriate and interoperable viewing, checking, and output file formats.
- Use of model checking tools to confirm the validity and accuracy of files and adherence to modeling standards before submission.
- Use of Open Standards and IFC compliant software.
- Where intelligent objects are not available, these items may be modeled as a “concept object” conforming closely in length, width, height and properly located.

2.2. Work Effort and Compensation Schedule

DFD will consider fee allocation within the stated BIM work effort limits. This decision will be based on A/E's BIM capabilities, scope of the project and adherence to work effort descriptions. The following chart compares DFD project phases with alternative project phase naming conventions proposed by the American Institute of Architects.

DFD Project Phases	Alternative Project Phases	Description of A/E BIM work effort	Traditional work effort	BIM work effort
Pre-design <i>(agency work but confirmed by A/E during pre-contract phase)</i>	Conceptualization	Confirms program, budget and schedule at a high level	0	0
Peer review	Criteria Design	Defines the optimum design solution meeting program, budget and schedule.	10% 10% total	15% 15% total
Preliminary Design	Detailed Design	Facility design is fully developed, coordinated and validated. Cost and Schedule established with high level of precision.	25% 35% total	30% 45% total
Final Design (100% review)	Implementation Documents: Review	Detailed design is fully annotated and graphically clarified for accurate bidding, scheduling and construction purposes.	40% 75% total	30% 75% total
Bid set	Implementation Documents: Bidding	Above plus inclusion of review into model(s)	In above	In above
Bidding	Buyout	Clarify document intent	5% 80% total	5% 80% total
Construction Issue	Implementation Documents: Construction	Above plus inclusion of addendum into model(s)	In above	In above
Construction	Construction	Maintain Implementation model(s)	20% 100%	20% 100%
Closeout	Closeout	Record documents, change orders and other appropriate close-out submittals incorporated into the model(s)	In above	In above

2.3. Model Submittal

With submittal of closeout documentation, the A/E shall submit the final model(s) in native application's format and validated IFC. Any future changes to, or extractions from the model(s) will be the responsibility of the party making the changes.

A/E shall make all submittals per *A/E Policy and Procedure Manual*.

3. Objectives and Application

3.1. Pre-Design (Conceptualization) Phase

3.1.1. A/E 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 A/E on a project-by-project basis. Surveys shall be provided in electronic format and minimally include 3D topographic information including paving and retaining walls. The file(s) shall be in a format that allows for importing into the A/E's BIM Authoring software.

All land surveys must be tied to the State's GIS WTM83, NAD83 (1991) coordinate system and USGS datum. The surveyor must provide electronic files that clearly define the project site and include accurate x/y/z coordinates on all survey items. The file(s) must 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.

3.2. Schematic or Peer Review milestone (Criteria Design)

3.2.1. A/E may use any method to begin the design process but shall be using a BIM authored or 3D model(s) by completion of this phase. All information needed to describe the schematic design shall be graphically or alphanumerically included in and derived from these models. DFD expects AE to use analysis tools, static images and interactive 3D to describe the design concepts.

Deliverables are required as stated in section 4I of the *A/E Policy and Procedure Manual* and as noted below.

3.2.2. 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 program or discussed during the project kickoff meeting.

3.2.3. Comparative Cost Analysis

A/E shall extract quantity information using BIM Authoring Software and other BIM integrated tools to support comparative costs analysis of options studied, Analysis and options may include: building perimeter, square foot zones by cost type, exterior envelop area, construction type, envelop materials, and/or others appropriate to the project. Outputs shall be converted to spreadsheets and submitted as part of the design solution justification at end of this phase.

3.2.4. Comparative energy and sustainability analysis

A/E shall use early energy modeling tools integrated with the BIM Authoring software to develop comparative energy analysis. Variables shall include orientation, massing, form, sun controls, wall construction, natural ventilation, area of glass, daylighting and other factors appropriate to decision making. Modeling parameters shall be based on local

climate data and actual site conditions. Output format shall clearly communicate and be appropriate to project needs and submitted as part of the design solution justification at the end of this phase.

3.2.5. Program and Space Validation

A/E 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.

Outputs shall be converted to the standard Space Tabulation format per *A/E Policy and Procedure Manual* and submitted as part of the design solution justification at the end of this phase.

3.2.6. Conflict Checking

A/E is encouraged to use automated conflict checking software for this phase of the work.

3.2.7. Planning Tools

A/E is encouraged to use electronic programming and planning tools that integrate into BIM Authoring software to continue project development at this phase.

3.3. Preliminary Design (Detailed Design) Phase

3.3.1. General

A/E shall continue development of their Building Information Model (or 3D Models for Consulting Engineers and Specialty Consultants) created in the “criteria phase”. 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 “detailed design” shall be graphically or alphanumerically included in and derived from these models only, except for the Specifications.

Deliverables shall be as stated in the *A/E Policy and Procedure Manual*.

3.3.2. Architectural Systems

Model the following architectural elements to a level that defines the design intent and accurately represents the design solution.

- Architectural Site plan (also see Civil Engineering section below)
 - Paving, grades, sidewalks, curbs, gutters, site amenities and other elements typically included on enlarged scale site drawings in vicinity of building.
- Existing conditions to the extent required by 3.2.2.
- Demolished items to the extent required by 3.2.2.
- New interior and exterior walls including:
 - Doors, windows, openings,
 - Veneers, insulation and other vertical elements thicker than ½” (may be part of a composite element or assembly)
 - Interior and exterior soffits, overhangs, sun control elements
 - Parapets, screening elements

- Architectural precast
- Floor, ceiling and roof systems including:
 - Appropriate structural items listed below if not provided by the structural engineer and integrated into the architectural model for coordination and document generation.
 - Insulation, ceiling systems, floor tiles and other horizontal elements ½” or thicker (may be part of a composite element or assembly)
 - Roof, floor and ceiling slopes, if needed, shall be modeled
- Elevators, stairs, ramps including railing systems
- Casework, shelving, fireplaces and other interior architectural elements
- Furnishings, fixtures and equipment if not provided by others and integrated into the architectural model for coordination and document generation.
 - Furniture
 - Specialty equipment (food service, medical, etc)
 - Model mechanical, electrical and plumbing items that require architectural space (toilets/sinks/etc), require color/finish selection (louvers, diffusers, etc.) or affect 3D visualization (lighting fixtures) unless provided by engineers.
- Clearance zones for access, door swings, service space requirements, gauge reading, and other operational clearance must be modeled as part of all equipment and checked for conflicts with other elements.
- These items may be modeled at A/E option:
 - Exterior and interior wall trim
 - Sheet metal or other thin elements
 - Hardware
 - Finishes unless stated above

3.3.3. Structural Engineering

Model the following structural elements:

- Foundations such as:
 - Spread Foundations
 - Caisson Foundations
 - Pile Foundations
 - Mat Foundations
 - Load-bearing Wall Foundations
- Framing such as:
 - Steel Columns (with correct shape and size)
 - Steel Floor C-Joists
 - Open Web Joists (include webs for visual purposes, but need not be accurate)
 - Joist Girders (Model webs for visual purposes, but need not be accurate)
 - Steel Beams (with correct shape and size)
 - Precast Concrete Elements (Hollow Core Plank may be modeled as a slab)
 - Cast-In-Place Concrete Elements (Chamfers and embeds may or may not be modeled)
 - Floors including overall extents and openings (Cast-In-Place, Precast, Wood)
 - Model overall thickness of wood floor systems (framing members need not be modeled)
 - Wood Posts/Column
 - TJI Joists
 - Wood Trusses (include webs for visual purposes, but need not be accurate)

- Solid Wood or Laminated Beams
- Wall Types including openings
 - Load Bearing Walls (Masonry, Concrete, Cold-Formed Steel, Wood)
 - Model overall thickness of Cold-Formed Steel and Wood Stud walls (individual members may be modeled at A/E option)
 - Structural Foundation Walls including brick ledges
- These items may be modeled at A/E option:
 - Steel reinforcing in concrete
 - Embeds in concrete
 - Connection steel (gusset plates, bolts, clip angles, etc.)
 - Miscellaneous Steel
 - angles for openings, deck bearing, etc.
 - channels for mechanical units
 - lintels (unless considered a major member)
 - Miscellaneous Wood
 - king studs
 - headers (unless considered a major member)

3.3.4.HVAC Systems

Model the following HVAC elements:

- Equipment
 - Fans, VAV's, compressors, etc.
- Distribution
 - Supply, return, exhaust, relief and outside air ductwork modeled to outside face dimension or duct insulation (whichever is greater)
 - Duct Joints
 - Diffusers, grilles, louvers, hoods, radiant panels, perimeter units, wall units
- Pipes sized at and over 2" OD, include any insulation in model
- Clearance zones for access, door swings, service space requirements, gauge reading, and other operational clearance must be modeled as part of the HVAC equipment and checked for conflicts with other elements.
- Exclusions
 - Pipe Fittings and connections

3.3.5.Electrical systems

Model the following electrical elements

- Power
 - Interior and exterior transformers and other equipment
 - Main and distribution panels and switchgear including access clearances
 - Feeders and conduit over 2"OD
 - Outlets, switches, junction boxes
- Lighting
 - Permanently mounted lighting fixtures (moveable, plug-in fixtures need not be modeled as part of the electrical package)
- Clearance zones for access, door swings, service space requirements, gauge reading, valve clearances and other operational clearance must be modeled as part of the electrical equipment for collision checking.

3.3.6.Plumbing and Fire Protection

Model the following plumbing and fire protection elements

- Waste and Vent
 - Piping sized at and over 2" OD, include any insulation in model
 - Roof and floor drains, leaders, sumps, grease interceptors, tanks, water treatments and other major items.
- Supply
 - Piping sized at and over 2" OD, include any insulation in model
- Fixtures: sinks, toilet fixtures, water tanks, floor sinks
- Fire protections
 - Sprinkler lines over 2"OD
 - Sprinkler heads,
 - Stand pipes, wall hydrants, fire department connections, risers, including valve clearances
- Clearance zones for access, service space requirements, gauge reading, valve clearances and other operational clearance must be modeled as part of the plumbing and fire protections system and checked for conflicts with other elements.

3.3.7.Specialty Consultants

Model the following specialty consultant elements to correct size and location.

- Equipment provided or specified by said consultants
- Rough-in connections points for power, data, communications, water service and waste, gas, steam, or other needed utilities.
- Extent of specialty consultant modeling shall be coordinated with the prime A/E.
- Clearance zones for access, doors swings, service space requirements, controls, gauge reading, and other operational clearance must be modeled as part of the equipment and checked for conflicts with other elements.

3.3.8.Civil Engineering

Model the following civil engineering elements::

- Topography – 3D terrain of all sitework as designed, including retaining walls. This model should include the site and surrounding areas that contribute to the site's drainage system or otherwise impact on the site. In most cases this will require that adjacent roadways be modeled.
- Landscaping elements: planting areas, such as raised planting beds and berms, parking islands, pools/ponds/other water features, terraces and other items not included elsewhere in the model.
- Stormwater management structures, pump stations, fueling systems, manholes and other major items that impact on the overall project understanding or which may become project design constraints.

All items must be geo-referenced such that all elements can be viewed as an overlay in the building information model or the State's GIS system correctly positioned in the correct location, at all times.

The A/E is encouraged to model the following items:

- Existing site conditions (other than topography listed in 3.1.2).
- Utilities – underground and overhead (except as described above).
- Sediment and erosion controls
- Trees and shrubs
- Paving, curbs, gutters, striping
- Site amenities or structures

3.3.9. Energy modeling

Provide energy modeling and reporting per current *A/E Policy and Procedure Manual*. A/E is encouraged to use the BIM model and tools which can use the model data for this analysis, rather than manually creating the data.

3.3.10. Conflict checking

A/E shall use conflict checking software to resolve clashes between all 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.

Submit the report generated by the checking software showing conflicts have been resolved.

3.3.11. Program and Space Validation

A/E shall use the methodology described in 3.2.6 above to reconfirm program.

3.3.12. Other analysis and checking tools

A/E is encouraged to analyze the design using software that interacts with the model in order to refine daylighting, natural ventilation, acoustics, code issues and design issues.

3.3.13. Quantity Take-off and Cost Control

A/E is encouraged to use quantity take-off features of the BIM and 3D tools coupled with unit costs to assist in construction cost control.

3.4. Final Design Construction Documents (Implementation Documents) Phase

A/E shall continue development of the BIM (or 3D Models for Consulting Engineers and Specialty Consultants) created in the “detailed design 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 describe the “implementation documents” shall be graphically or alphanumerically included in and derived from these models only. Specifications are not required to be linked in BIM.

Deliverables shall be as stated in the *A/E Policy and Procedure Manual*.

3.5. Bidding (Buyout) Phase

A/E shall update the models with all addendum, accepted alternates and/or value enhancement proposals. Republish documents and deliverable files as stated in the *A/E Policy and Procedure Manual*.

3.6. Construction Phase

A/E is expected to continuously maintain and update the model(s) with changes made during construction.

3.7. A/E Contract Close-out

A/E shall update their respective models with contractor recorded changes. Republish record documents. Also submit full model with all needed objects and reference drawings, in original authored software and in IFC format. Submit all per *A/E Policy and Procedure Manual*.

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