BIM Project Execution and Standards Guide
For
Western Michigan University
Facility Management

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NOTE: This document contains abbreviations as referenced above and throughout this document (Example: BIM), full names and the location of these abbreviations can be found in the Section P – Acknowledgements and References and Section Q – Glossary at the end of this document.

SECTION A: BIM PROJECT EXECUTION AND STANDARDS GUIDE OVERVIEW

To successfully implement BIM on a project, Western Michigan University has developed this detailed BIM Project Execution and Standards Guide. This guide defines uses for BIM on the project (e.g. design authoring, cost estimating, and design and construction coordination), along with a detailed design of the process for executing BIM throughout the project lifecycle.

1. Intent

These guidelines are intended to act as standards for BIM development from schematic design to project closeout. Western Michigan University has adopted BIM as a tool for project documentation and development, as-built record documentation, and facility management.

2. Building Information Modeling

BIM is the process that contains all physical features of the project. BIMs shall be created that include all geometry, physical characteristics, and product data needed to describe the design and construction work. Project drawings and schedules required for assessment, review, bidding, and construction shall be extractions from the model. Any exceptions to this rule require advanced approval by the WMU project manager.

3. Model Ownership

Western Michigan University will retain ownership of all documentation throughout the BIM process. Models will be made available to key stakeholders to be used to visualize, coordinate, schedule, and analyze design intent and constructability throughout the project including closeout.

4. External Model Conflict and Clash Detection

BIMs will be imported into external software that checks each model discipline for hard clashes (clashes between elements) and soft clashes (clashes between elements and required clearances).

5. Applicability

The BIM process will be required on all new construction projects and major additions contracted by Western Michigan University on or after the revision date of this document.

6. Historical Phasing of Central Model

Western Michigan University requires the final models to be set to existing phase by the design team after record drawing publishing. WMU will archive the final models, and the most current models will be issued to design and construction teams when available for updating including but are not limited to building remodel, renovation, additions, and retrofits. Each project's updated model(s) will then be archived in addition to the original. This will create a history of models throughout the building lifecycle.

7. Lifecycle Management

Western Michigan University intends to make final deliverable BIMs available for integration into a lifecycle management solution. In order to meet that objective, it is important that the guidelines presented in this document be followed. If there is any question as to the intent of this document, please contact a Western Michigan University project manager.

SECTION B: PROJECT INFORMATION

1. **Project Owner: Western Michigan University**
2. **Project Name:**
3. **Project Location and Address:**
4. **Contract Type / Delivery Method:**
5. **Brief Project Description:**
6. **Project Existing Conditions:**
7. **Additional Project Information:**

PROJECT INFORMATION	NUMBER
WMU Project Number:	
AE Project Number:	
GC/CM Project Number:	
Autodesk Software Version	TBD
Project Scope Definition	See RFP

The project information above to be completed by the WMU project manager, and the remainder of this document to be completed by the project team during the initial BIM kickoff meeting(s).

8. **General Project Schedule:**

Include BIM milestones, pre-design activities, major design reviews, stakeholder reviews, and any other major events which occur during the project lifecycle. **Provide anticipated schedule at the initial BIM kickoff meeting(s).**

PROJECT PHASE / MILESTONE	ESTIMATED START DATE	ESTIMATED COMPLETION DATE	PROJECT STAKEHOLDERS INVOLVED
STUDY/PROGRAMMING			
SCHEMATIC DESIGN			
DESIGN DEVELOPMENT			
CONSTRUCTION DOCUMENTS			
CONSTRUCTION			
OWNER OCCUPANCY/MOVE-IN TRAINING			
CLOSEOUT			
LIFECYCLE			

SECTION C: KEY PROJECT CONTACTS

1. **Outside Contacts for this Project** – ***To be filled out by AE, GC/CM during design and construction.***

Role	Organization	Contact Name	E-Mail	Phone
AE Project Manager				
Design Team BIM Manager				
Discipline Lead ARCH				
Discipline Lead MEP				
Discipline Lead Structure				
Commissioning Authority				
GC/CM Project Manager				
Construction Team BIM Manager				
Site Superintendent				
HVAC BIM Coordinator				
Electrical BIM Coordinator				
Fire Protection BIM Coordinator				
Plumbing BIM Coordinator				
Controls BIM Coordinator				
Structural BIM Coordinator				

2. **WMU Project Contacts** – ***To be filled out by the WMU project team***

Title	Organization	Contact Name	E-Mail	Phone
Project Manager	WMU	TBD		
Commissioning	WMU	DeVon Miller	devon.miller@wmich.edu	269-387-8517
Architecture and Design	WMU	TBD		
Maintenance Services	WMU	Anand Sankey	anand.sankey@wmich.edu	269-387-8579
FM Engineering Electrical	WMU	Daniel Brimmer	daniel.brimmer@wmich.edu	269-387-8520
FM Engineering Mechanical	WMU	John Seelman	john.seelman@wmich.edu	269-387-8539
Facility Records	WMU	Jani J. Hart	jani.hart@wmich.edu	269-387-8562
GIS	WMU	Kevin Agema	kevin.l.agema@wmich.edu	269-387-8014
Construction Administrator	WMU	TBD		

SECTION D: PROJECT GOALS / BIM USES

1. **Major BIM Goals:** To be discussed and completed at the initial BIM kickoff meeting(s).

PRIORITY (HIGH/ MED/ LOW)	GOAL DESCRIPTION	PROJECT PHASE
H	Provide GC/CM a LOD 300 model including Arch, MEP, and Structure for construction	Design
H	Coordinate all disciplines through the design/construction process to reduce RFI's	Construction
M	Improve commissioning process by adding equipment information into BIM process	Construction
H	Deliver an As-Constructed model in Electronic Format	Construction
H	Provide WMU an LOD 500 model containing O&M Manuals, start-up procedures, etc.	Lifecycle

2. **Mandatory Uses of BIM:** To be discussed and completed at the initial BIM kickoff meeting(s).

X	PLAN	X	DESIGN	X	CONSTRUCT	X	OPERATE
	PROGRAMMING		**DESIGN AUTHORING**		**SITE UTILIZATION PLANNING**		**BUILDING MAINTENANCE SCHEDULING**
	SITE ANALYSIS		**DESIGN REVIEWS**		**CONSTRUCTION SYSTEM DESIGN**		**BUILDING SYSTEM ANALYSIS**
			3D COORDINATION		**3D COORDINATION**		**ASSET MANAGEMENT**
			STRUCTURAL ANALYSIS		**DIGITAL FABRICATION**		**SPACE MANAGEMENT / TRACKING**
			LIGHTING ANALYSIS		**3D CONTROL AND PLANNING**		**DISASTER PLANNING**
			ENERGY ANALYSIS		**RECORD MODELING**		**RECORD MODELING**
			MECHANICAL ANALYSIS				
			OTHER ENG. ANALYSIS				
			SUSTAINABLITY (LEED) EVALUATION				
			CODE VALIDATION				
	PHASE PLANNING (4D MODELING)		**PHASE PLANNING (4D MODELING)**		**PHASE PLANNING (4D MODELING)**		**PHASE PLANNING (4D MODELING)**
	COST ESTIMATION		**COST ESTIMATION**		**COST ESTIMATION**		**COST ESTIMATION**
	EXISTING CONDITIONS MODELING		**EXISTING CONDITIONS MODELING**		**EXISTING CONDITIONS MODELING**		**EXISTING CONDITIONS MODELING**

Project scope and objectives should determine the proper application of modeling and weigh all factors including time, cost, and effort vs. net benefit.

3. **Western Michigan University BIMs for Existing Buildings**

WMU will make Revit model files available for existing buildings. **WMU** takes no responsibility for the accuracy of these models therefore each should be field verified for accuracy. Some of these Revit model files have existing pieces of equipment with critical equipment data and link documents that shall remain intact unless being replaced as part of the construction project. The design team shall model all existing conditions needed to 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.**

Please note: Information from any previous attempts to validate model accuracy will be shared with responsible parties to establish confidence in provided model accuracy.

SECTION E: BUILDING INFORMATION MODELING FILE TYPES

1. Architectural Models – Autodesk® Revit® Architecture .rvt

Models are Revit Architecture project files with Worksets enabled in order to create a central file. The Revit Architecture Model file (.rvt) contains all architectural features for a building including but are not limited to:

- Exterior Wall Systems
- Interior Wall Systems
- Fire Rated Walls
- Architectural Floor Slabs
- Roofing Systems
- Equipment Including Owner Provided Equipment
- Reflected Ceiling Plans
- Vertical Circulation – including elevators, stairs, escalators, ramps and railings
- Doors and Door Frames
- Glazing – Windows, Interior Glazing, Curtain Wall, and Storefront
- Millwork and Casework
- Furniture
- Finishes – Including all room paint codes, flooring codes, and other finish items
- Toilets and Accessories
- Toilet Partitions
- Specialties
- Equipment clearances for access, service space requirements, and other operational clearances and access panels. These clearance zones should be modeled as translucent solids within the object. Clearances should not only extend outwards, but also downwards through the ceilings to ensure good coordination and future maintainability.

2. Structural Model – Autodesk® Revit® Structure .rvt

Models are Revit Structure project files with Worksets enabled in order to create a central file. The Revit Structure Model file (.rvt) contains all structural features for a building including but are not limited to:

- Foundations
- Columns, Beams, and Joists
- Column Grid
- Brace Frames and Shear Walls
- Structural Slab
- Specialties
- Miscellaneous Structural Components (angles for opening, deck bearing, etc.; channels for mechanical units needed for coordination reviews between structural and mechanical; lintels unless considered a major member).

3. Mechanical, Electrical, and Plumbing Model – Autodesk® Revit® MEP .rvt

Models are Revit MEP project files with Worksets enabled in order to create a central file. The Revit MEP Model file (.rvt) contains all mechanical, electrical, and plumbing features for a building including but are not limited to:

- Rain Leader with slope
- Roof Sumps (Roof Drains and Overflow Drains with slope)
- Vent with slope
- Waste Water with slope
- Domestic Cold Water
- Domestic Hot Water

- Gases
- Mechanical Ductwork
- Insulation required for MEP systems
- Duct Fittings
- Hangers
- Manual Volume Dampers and Schedules
- Motorized Dampers and Schedules
- Grilles, Registers & Diffusers
- VAV boxes with access zones and connection points
- Mechanical HVAC equipment including but not limited to AHU's, MUA's, RTU's, FCU's, EF's, Sound Attenuators, Roof curbs and their access zones.
- Backflow Preventers and Schedules
- Supply Fans, Returns Fans, and Exhaust Fans and Schedules
- Humidifiers, Thermostats, Remote Static Pressures Sensors, Humidity Sensors, Carbon Dioxide Sensors and Schedules
- Heating, Cooling and Steam Coils and Schedules
- Steam Traps (all types) and Schedules
- Condensate Receivers and Schedules
- Controls Valves (all types) and Schedules
- Steam PRVs and Schedules
- Meters (all types) and Schedules
- Boilers and Schedules
- Triple Duty Valves (all types) and Schedules
- Relief Valves (all types) and Schedules
- Air Separator (all types) and Schedules
- Expansion Tanks and Schedules
- Side Stream Filters (all types) and Schedules
- Buffer Tanks (all types) and Schedules
- Storage Tanks (all types) and Schedules
- DW Isolation Valves and Schedules
- Condensing Units and Schedules
- Valves with Valve Tags and Schedules
- Fire/Smoke Dampers
- Electrical Conduit (1" and larger)
- Raceways
- Light fixtures with space requirements
- Electrical equipment including but not limited to switch gear, power feeds, transformers, pull stations and junction boxes and their access zones.
- Generator Service Entrances
- Lighting Controls Panels and Schedules
- Major Equipment Service Disconnects and Schedules
- Occupancy Sensors and Schedules
- Lighting Timers and Schedules
- Light Contactors and Schedules
- Variable Speed Drives and Schedules
- Electrical Panels and Schedules
- Specialties

- Equipment clearances for access, service space requirements, gauge reading, valve clearances, and other operational clearances and access panels. These clearance zones should be modeled as invisible solids within the object.

4. Life Safety and Fire Protection – Autodesk® Revit® MEP .rvt

Models are Revit MEP project files with Worksets enabled in order to create a central file. The Revit MEP Model file (.rvt) contains all life safety and fire protection features for a building including but are not limited to:

- Electrical Low Voltage Systems and Devices
  - AV, Telecom, Cable Trays
- Fire protection
  - Sprinkler lines larger than ¾" diameter
  - Sprinkler heads, Fire Protection Pumps
  - Stand pipes, wall hydrants, fire department connections, risers, tamper and flow switches, including valve clearances
- Fire Alarm and Security Systems
  - Input devices
  - Notification devices
  - Associated equipment and access clearances
  - Permanently mounted fixtures
- Energy Management System
  - Building Automation Control Panels and Schedules
- Equipment clearances for access, service space requirements, and other operational clearances and access panels. These clearance zones should be modeled as translucent solids within the object. Clearances should not only extend outwards, but also downwards through the ceilings to ensure good coordination and future maintainability.

SECTION F: BIM AUTHORING SOFTWARE REQUIREMENTS

1. Additional Modeling Requirements

BIMs shall be created that include all geometry, physical characteristics and product data needed to describe the design and construction work to within 5' of building envelope (exception: geothermal piping, wells, auxiliary enclosures and similar out-buildings shall be included in model). All drawings, schedules, simulations, and services required for assessment, review, bidding and construction shall be extractions from this model. Software shall be capable of interfacing with the design team's 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. The design team shall follow the guidelines and requirements detailed in this document for BIM related services.

2. BIM Software Requirements

Authoring Software

The design team is **required** to use parametric BIM authoring software for Western Michigan University projects. All architects, engineers, and specialty consultants are required to use the following design authoring software in its current version as defined in the table below. **Projects will remain on the same software release throughout the life of the project.**

BIM USE	DISCIPLINE (if applicable)	SOFTWARE	VERSION
DESIGN AUTHORING	ARCH	Revit Architecture	TBD
DESIGN AUTHORING	MEP	Revit MEP	TBD
DESIGN AUTHORING	MEP	AutoCAD MEP	TBD
DESIGN AUTHORING	Structure	Revit Structure	TBD

SECTION G: PROJECT DELIVERABLES

1. **Project Deliverable Definitions for each project phase: To be filled out during BIM kickoff meeting(s). Responsible parties for each requirement will be established by the overall project contract and coordination schedule.**

BIM SUBMITTAL ITEM	PHASE	APPROXIMATE DUE DATE	RESPONSIBLE PARTY	FORMAT	NOTES
Design Development drawings for review	Design Development	TBD	AE	PDF	2D drawings will be exported from model. 2D PDF files will be issued for review.
Construction Document drawings for review	Construction Documents	TBD	AE	PDF	2D drawings will be exported from model. 2D PDF files will be issued for review.
Construction Documents for bidding	Construction Documents	TBD	AE	PDF	2D PDF files will be issued for bidding. All 2D documents must use WMU's defined file naming format.
Equipment ID Tagging	Construction	TBD	WMU	EXCEL	Assign TMA ID numbers to all equipment included in Section N before construction phase begins.
Design Intent for Constructability	Construction	TBD	AE	RVT	Design intent BIMs (LOD 300) will be shared to allow all disciplines to develop fabrication BIMs (LOD 400) for construction coordination and fabrication.
Coordination Model for Constructability	Construction	TBD	AE, GC/CM, Subs	NWD	Navisworks Manage will be used to coordinate all disciplines to perform scheduling, clash detection, and visualization.
Submittal and Shop Drawings	Construction	TBD	GC/CM, Subs	PDF	All submittals will be coordinated, reviewed, and uploaded in PDF format to the project collaboration site.
Asset Management/Model Coordination	Construction	TBD	GC/CM, Subs	RVT	All reviewed submittals will be uploaded to the project collaboration site by the GC/CM.
LOD 500 Information Entry	Construction	TBD	GC/CM, Subs	RVT	Enter equipment asset data referenced by the WMU equipment identification number into the defined Revit model parameters.
As-Built Drawings	Closeout	TBD	GC/CM	DWG, PDF	As-built drawings to be submitted to AE for preparations of final 2D record drawings.
Final 2D Record Drawings	Closeout	TBD	AE	DWG, PDF	All record drawings must be submitted as individual sheets in AutoCAD DWG and PDF formats, and the RVT models/file(s). X-refs must be bound.
Record Model	Closeout	TBD	AE	RVT, NWD	The record model will become the WMU LOD 500 deliverable.

SECTION H: LEVEL OF DEVELOPMENT

1. LOD

The following outlines Western Michigan University's definition of LOD for BIM deliverables.

- **LOD 100 –** The model equivalent of conceptual design, the model would consist of overall building massing and the downstream users are authorized to perform whole building types of analysis (volume, building orientation, cost per square foot, etc.)
- **LOD 200 –** Model that includes basic elements including windows walls and doors. This level of modeling is for visualization and basic energy analysis and is similar to the schematic design or design development. It consists of generalized systems or assemblies with approximate quantities, size, shape, location, and orientation.
- **LOD 300 –** Model elements are suitable for construction and are the equivalent of traditional construction documents and shop drawings. This model level would be suitable for analysis and simulation of detailed elements and systems.
- **LOD 400 –** Model level of development considered suitable for fabrication and assembly. This model will include all as-constructed details for Western Michigan University's use to manage the facility. This is the equivalent of as-built drawings in the traditional construction process.
- **LOD 500 –** WMU – level of development – LOD for project delivery includes Revit model(s) that represent the project as it has been constructed. WMU LOD 500 models are also focused on facility management by identifying key building equipment and space information and including it in the Revit model(s). This includes TMA equipment ID numbers and the key equipment information outlined in Section N – Building Information Model Requirements – Lifecycle BIM.

SECTION I: MODEL STRUCTURE

1. File Naming Structure

All Revit Central files will be named in accordance to Western Michigan University's naming convention. Examples are shown in the table below.

FILE NAMES FOR MODELS SHOULD BE FORMATTED AS:	
ARCHITECTURAL MODEL	Building#_Arch_WMUProjectNumber.Description_Rev#_YYYY MM DD
CIVIL MODEL	Building#_Civil_WMUProjectNumber.Description_Rev#_YYYY MM DD
MEP MODEL	Building#_MEP_WMUProjectNumber.Description_Rev#_YYYY MM DD
Food Service MODEL	Building#_FoodService_WMUProjectNumber.Description_Rev#_YYYY MM DD
Fire Protection MODEL	Building#_FireProtection_WMUProjectNumber.Description_Rev#_YYYY MM DD
Fire Alarm MODEL	Building#_FireAlm_WMUProjectNumber.Description_Rev#_YYYY MM DD
STRUCTURAL MODEL	Building#_Structure_WMUProjectNumber.Description_Rev#_YYYY MM DD
ENERGY MODEL	Building#_Energy_WMUProjectNumber.Description_Rev#_YYYY MM DD
CONSTRUCTION MODEL	Building#_Const_WMUProjectNumber.Description_Rev#_YYYY MM DD
COORDINATION MODEL	Building#_Coordination_WMUProjectNumber.Description_Rev#_YYYY MM DD
LIFECYCLE MODEL	Building#_Lifecycle_WMUProjectNumber.Description_Rev#_YYYY MM DD

2. Model Structure:

Model will be separated into disciplines as defined in Section F for design and construction coordination by all project participants throughout the design and construction process.

3. Model Units:

Imperial measurement system will be used for all modeling.

4. GIS Coordinates

All models should be created using true north coordinates vs. project north. Firms are required to verify building true north coordinates. Western Michigan University will make every effort to assist in this process.

5. Model Accuracy and Tolerances:

Models should include all appropriate dimensioning as needed for design intent, analysis, and construction.

PHASE	DISCIPLINE	TOLERANCE
EXISTING CONDITIONS	ARCH, STRUCT, MEP	ACCURATE TO +/- (1/8") OF DESIGN INTENT SIZE ACCURATE TO +/- (2") OF DESIGN INTENT LOCATION
DESIGN DOCUMENTS	CIVIL, ARCH, STRUCT, MEP	ACCURATE TO +/- (1/8") OF DESIGN INTENT SIZE ACCURATE TO +/- (2") OF DESIGN INTENT LOCATION
SHOP DRAWINGS	SUBS	ACCURATE TO +/- (1/16") OF ACTUAL SIZE ACCURATE TO +/- (1") OF ACTUAL LOCATION
AS-BUILT	CIVIL, ARCH, STRUCT, MEP	ACCURATE TO +/- (1/16") OF ACTUAL SIZE ACCURATE TO +/- (2") OF ACTUAL LOCATION

SECTION J: BIM ORGANIZATION ROLES

The owner and project team roles may vary from project to project depending on the BIM experience and proficiency of that project's design and construction teams. The following is an overview.

1. Western Michigan University

The primary role of WMU is to monitor the BIM process in all stages of design, construction into operations and to ensure that WMU's BIM Project Execution and Standards Guide is adhered to throughout design, construction, commissioning and closeout.

Some of WMU's responsibilities include but are not limited to the following:

a. Review, evaluate, and comment on the BPEP that has been developed with the design team, the general contractor or construction manager to be project specific to ensure it meets with the WMU BIM Project Execution and Standards Guide.
b. Conduct BIM kickoff meetings: WMU will participate in a BIM project kickoff meeting at the start of the project with the entire design team including major consultants, which shall be led by the design team BIM manager. A second meeting will be held once a GC or CM has been selected and shall include the design team, which shall be led by the design team BIM manager. A third meeting (**if required**) will be held with the entire construction team and include the design team, which shall be led by the construction team BIM manager.
c. WMU will provide project team with a shared parameter file for Revit, as well as an excel spreadsheet with equipment tag number identification.
d. WMU will attend the construction coordination clash detection meetings and review clash detection reports to ensure compliance with the WMU BPEP.
e. WMU will test Revit files to ensure room and equipment information are successfully transferred from Revit into WMU's CMMS test database. Any errors or omissions encountered, the Revit file(s) will be returned to the appropriate party for resolution.

2. Design Team BIM Manager

Individual assigned by the design team to serve as the main point of contact between the design team, construction team, and WMU for all BIM related issues. Responsibilities include but are not limited to the following:

a. Attends BIM kickoff meeting(s).
b. Ensures development and compliance with the approved WMU BPEP.
c. Responsible for the development, coordination, publication, and verification that all necessary configurations and standards required for seamless integration of design and construction modeling information has been implemented.
d. Assembles composite design model for coordination meetings.
e. Ensures that BIMs are used appropriately to test design requirements/criteria for functionality.
f. Determines the project BIM geo-reference point(s), and assures all technical discipline models are properly referenced.
g. Primary interface between the design and construction teams and WMU for BIM data and file transfers as required at each design phase or otherwise.
h. Assures that the BIM design deliverables specified and/or required by the contract and the WMU BPEP are provided in accordance with the formats specified.
i. Attends construction coordination/clash detection meetings.
j. Coordinates with the construction team BIM manager to assure the creation of proper BIM final deliverables.

3. Construction Team BIM Manager

Individual assigned to serve as the main point of contact for the GC/CM and appropriate contractors (construction team) for BIM related issues. Responsibilities include but are not limited to the following:

a. Attends BIM kickoff meeting(s).
b. Ensures development and compliance with the approved WMU BPEP.
c. Overall responsibility for the construction team BIMs coordinating creation and information developed during construction.
d. Acts as the main point of contact for BIM and related issues between the construction and design teams, WMU and others as required.
e. Coordinates construction sequencing and scheduling activities, and assures they are integrated with the construction team BIMs.
f. Schedules, coordinates, and facilitates use of composite trade models in construction coordination/clash detection meetings with design and construction teams, and WMU, and provides detection reports by the identification and resolution of all hard and soft collisions.
g. Communicates with design team, coordinates the data extraction sets required by the construction trades and ensures that these requests are met.
h. Coordinates with the design team to facilitate design changes in the field have been documented and are updated in the BIMs in a timely manner.
i. Prior to approval and installation, work with lead fabrication modelers to integrate 3D fabrication models with the updated design model to ensure compliance with design intent.
j. Coordinates update of as-constructed conditions in the as-built BIM deliverable.
k. Coordinates with design and construction teams, commissioning authority to ensure lifecycle BIM requirement is complete.

4. BIM Coordinator

All major design technical disciplines/trades shall assign an individual to the role of BIM coordinator to coordinate their work with the entire design and construction teams. Responsibilities include but are not limited to the following:

a. Attend BIM kickoff meeting.
b. Coordinate technical discipline BIM development, standards, data requirements, etc. as required with the design and construction teams BIM manager's.
c. Lead the technical requirements needed for BIM documentation and analysis for their discipline/trade.
d. Coordinate clash detection and resolution activities.

e. Coordinate trade items into the BIMs.

5. Commissioning Authority/CxA

Third party firm assigned by Western Michigan University to serve as the main point of contact between the design and construction teams, and WMU for all BIM related issues. Responsibilities include but are not limited to the following:

a. Attends BIM kickoff meeting(s).
b. Attends construction coordination/clash detection meetings.
c. CxA will provide commissioning record (e.g., checklists, functional test results, etc.) to construction team for integration in the as-built BIM deliverable.

SECTION K: BIM RESPONSIBILITIES

1. Design Team Responsibilities

The design team will manage and update the BIMs through the end of the construction phase, incorporating all updates and/or revisions to the BIMs as necessary to reflect design changes initiated by RFI, bulletins, or coordination with existing conditions.

a. At the end of the design phase, the design team shall share the updated design intent BIMs with the construction team for construction coordination. The design team shall be an active participant in the construction collaboration process as defined in Section L-4.
b. At substantial completion, the construction team will share the as-built BIMs with the design team, who shall then be responsible for the final preparations and delivery as defined in Section G.
c. Within four (4) weeks of substantial completion (or from the date the as-builts are received from the Contractor, whichever is later), the design team will transmit the record BIM and other closeout documentation to Western Michigan University in accordance with the Agreement for Professional Services.

2. Construction Team Responsibilities

a. At the end of the design phase, the construction team will begin developing the fabrication models for construction coordination as defined in Section L-4.
b. Prior to substantial completion, the construction team will incorporate the following updates and/or revisions into the as-built BIM:
    - Assure all updates and/or revisions to the BIMs as necessary to reflect the (as-built) information obtained from the “red-line” (as-built) drawings.
    - Incorporate final updates to material/equipment data and properties where installations differ from the basis of design (BOD).
    - Incorporation or linking of certain closeout documents to the BIMs (refer to Section N).
c. All BIM updates by the construction team shall be complete at substantial completion at which time the BIMs and as-built drawings shall be shared with the design team.

3. Commissioning Authority/CxA Responsibilities

a. At substantial completion, the commissioning authority/CxA will perform an as-built BIM QA/QC review on WMU’s behalf:
    - Review, evaluate, and comment on the BPEP that has been developed with the design team, the general contractor or construction manager to be project specific to ensure it meets with the WMU BIM Project Execution Plan and Standards Guide.
    - Study all discipline specific BIMs to assure accuracy of the as-constructed conditions.
    - Provide a list of deficiencies and suggested solutions for each model, as well as a meeting to discuss findings with the design and construction teams and WMU.

SECTION L: COLLABORATION SOFTWARE REQUIREMENTS AND PROCEDURES

1. Coordination Software

All internal and external model coordination and conflict detection are required to use Autodesk® Navisworks® Manage software in its native file format as outlined in Section F. All parties are **required** to participate in the BIM coordination process. BIMs are to be (.nwc) files and converted to (.nwd) files, and then made available per the project coordination schedule for design and construction professionals to perform clash detection, scheduling and visualization. **Note:** Navisworks file set (.nwf) for linking Navisworks files (.nwc) together and making views in the (.nwf). Then should be exported to the (.nwd).

2. Open Architecture for Interoperability

Subcontractors are **required** to use products that offer interoperability with Autodesk products outlined in Section F when creating fabrication models. Information must be made available to the design and construction teams as well as WMU for performing model coordination. WMU is not responsible for costs associated with purchasing compatible software or rework to comply with this requirement.

3. Project Collaboration Tools

The design and construction teams are **required** to use the GC/CM firm's designated collaboration site for all model and document collaboration. BIMs as well as 2D documentation will be available from this site for download to perform reviews, coordination, estimating, and scheduling.

4. Collaboration Strategy:

a. **Clash Detection Process –** Clash detection analysis is done to check for interferences between the designs of one or many models. To reduce change orders during construction, clash detection should be performed early and continue throughout the completion of the model as scheduled in Section L-6 of this document. For clash detection to work properly the project's models need to have a common reference point and they must be compatible with the clash detection tool.

b. **Clash Detection Coordination Plan –** In addition to the extensive coordination that takes place during the design of the project, it is invaluable to have the 3D MEP/Structure coordination process take place prior to the start of construction. During the 3D MEP coordination process the work of all trades is analyzed and any potential installation conflicts are identified and addressed. A well-executed 3D MEP effort will have a significant positive impact on the satisfaction of the overall project budget and the project schedule.

- It is the design/construction teams' responsibility to conduct and manage an adequate and thorough clash detection process so that all major interferences between building components will have been detected and resolved before construction. It shall be the goal of the design/construction teams to reduce the number of changes during construction due to major building interferences to zero before construction starts.
- The design/construction teams' BIM managers shall assemble a federated BIM from all the BIMs of each design discipline for the purpose of performing a visual check of the building design for spatial and system coordination. Vertical shafts should also be reviewed to ensure that adequate space has been allocated for all of the vertical systems and that all of the shafts line up floor to floor. Prior to each scheduled coordination meeting, an updated clash report shall be issued by the construction team BIM to the project team.
- Coordination software as defined in Section L-1 shall be used for assembling the various design BIMs to electronically identify, collectively coordinate resolutions, and track and publish interferences reports

between all disciplines. The technical disciplines shall be responsible for updating their BIMs to reflect the coordinated resolution.

- The project team shall review the federated BIM and the clash reports in coordination meetings on an as-needed basis throughout the pre-construction phase until all spatial and system coordination issues have been resolved.
- During the construction phase, the accuracy of fabrication models shall be verified and approved, prior to submittal and fabrication. Fabrication contractors shall submit their BIMs to the construction team BIM manager for integration and clash detection / coordination and resolution. Shop drawings shall be produced directly from the construction BIMs. Whenever possible the construction team shall use the construction BIMs to fabricate or preassemble their systems.
- **Internal Clash Resolution** – The design team and subcontractors who are responsible for multiple scopes of work are expected to coordinate the clashes between those scopes prior to providing those BIMs to the construction team BIM manager for spatial and system coordination.
- Spatial Coordination: Verification and tracking of resolved conflicts of all trade coordination issues which could result in change orders or field conflicts shall be provided to WMU during milestone dates, and should be fully resolved before construction starts.

c. **Process Outline –** Please refer to Section L-6 of this document. The "DUE DATE or START DATE" to be revised by the project team.

5. BIM Coordination Meeting Procedures:

MEETING TYPE	PROJECT STAGE	FREQUENCY	PARTICIPANTS	LOCATION
BIM REQUIREMENTS KICK-OFF	PROGRAMMING/PRE-CONSTRUCTION	AS-NEEDED	WMU/AE/CONST/CxA	WMU
DESIGN COORDINATION	SD/DD/CD	AS-NEEDED	RESPONSIBLE PARTY	TBD
CONSTRUCTABILITY COORDINATION	CONSTRUCTION	AS-NEEDED	RESPONSIBLE PARTY	TBD
LIFECYCLE BIM PLANNING	CONSTRUCTION	AS-NEEDED	RESPONSIBLE PARTY	TBD

6. Model & Document Delivery Schedule of Information Exchange for Review, Coordination, Submission and Approval: Frequency and date to be determined by project team. Files to be uploaded to the GC/CM Collaboration site.

INFORMATION EXCHANGE	FILE SENDER	FILE RECEIVER	ONE-TIME or FREQUENCY	DUE DATE or START DATE	MODEL FILE	MODEL SOFTWARE	FILE TYPE	2D FILE TYPE*
DESIGN INTENT	AE	COLLABORATION SITE	WEEKLY	TBD	ARCH	REVIT, AutoCAD	.RVT, .NWC, .DWG, .DWF	.PDF
COORDINATED DRAWINGS	AE	COLLABORATION SITE	AS REQUIRED	TBD	PLBG. & MECH. PIPING	REVIT, AutoCAD	.NWC, .DWG	.PDF
COORDINATED DRAWINGS	AE	COLLABORATION SITE	AS REQUIRED	TBD	HVAC	REVIT, AutoCAD	.NWC, .DWG	.PDF

COORDINATED DRAWINGS	AE	COLLABORATION SITE	AS REQUIRED	TBD	ELEC.	REVIT, AutoCAD	.NWC, .DWG	.PDF
COORDINATED DRAWINGS	AE	COLLABORATION SITE	AS REQUIRED	TBD	STRUCT	REVIT, AutoCAD	.NWC, .DWG	.PDF
COORDINATED DRAWINGS	AE	COLLABORATION SITE	AS REQUIRED	TBD	IT	REVIT, AutoCAD	.RVT, .DWG	.PDF
COORDINATED DRAWINGS	AE	COLLABORATION SITE	AS REQUIRED	TBD	A/V	REVIT, AutoCAD	.RVT, .DWG	.PDF
COORDINATED DRAWINGS	AE	COLLABORATION SITE	AS REQUIRED	TBD	FP	REVIT, AutoCAD	.RVT, .DWG	.PDF
SUBMITTALS	GC/CM, Subs	COLLABORATION SITE	AS REQUIRED	TBD	N/A	N/A	.PDF	.PDF
COORDINATION	AE, GC/CM, Subs	COLLABORATION SITE	AS REQUIRED	TBD	CONST	NAVISWORKS	.NWD	.PDF
AS-BUILT MODEL	GC/CM	AE, CxA, WMU	AS REQUIRED	CLOSEOUT	ALL	REVIT, NAVISWORKS, AutoCAD	.RVT, .NWF, .NWC, .NWD, .DWG, .DWF	.PDF

SECTION M: QUALITY CONTROL

1. Overall Strategy for Quality Control:

The BIM process has been put in place to improve coordination of the design/construction process as well as deliver improved information for the Facilities Management Department. Western Michigan University requires the following quality control process.

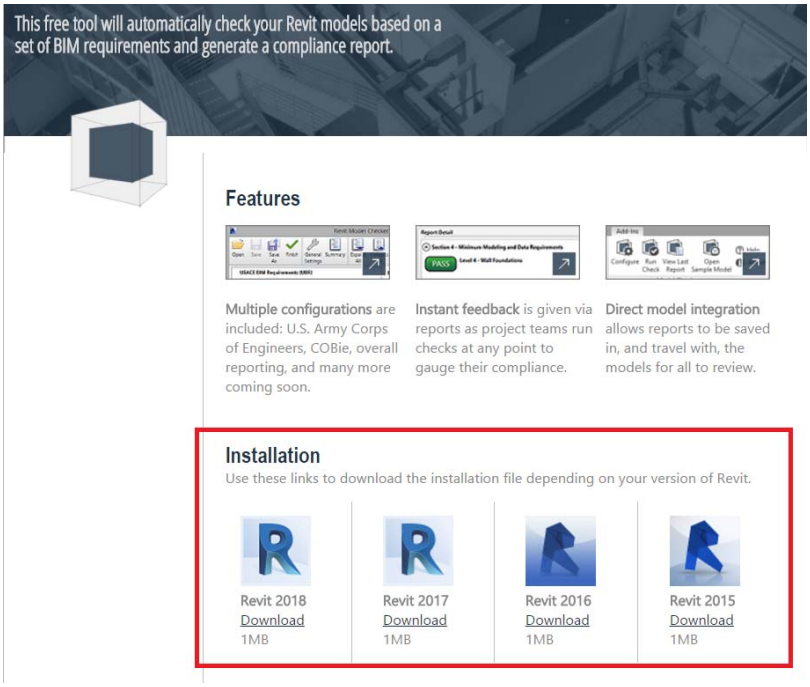
2. Quality Control Checks:

The following checks should be performed to assure quality. Required files/documents will be uploaded to the GC/CM designated collaboration site per the schedule requirements.

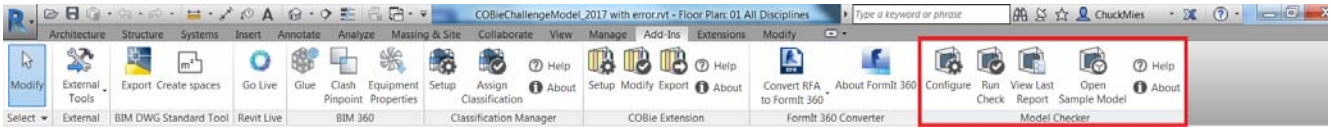
CHECKS	DEFINITION	RESPONSIBLE PARTY	SOFTWARE PROGRAM(S)	PHASE
DESIGN INTENT MODEL FOR LOD 300	Submit design intent model including Arch, MEP, and Structure for construction.	AE	Revit, Navisworks Manage	Construction
COORDINATION	Coordinate all disciplines including Arch, MEP, and Structure to reduce construction RFI's and change orders.	AE, GC/CM, Subs, WMU, CxA	Revit, Navisworks Manage	Project Review
STANDARDS CHECK	Ensure that the BIM and AEC Standards have been followed.	AE	Revit	Project Review
MODEL INTEGRITY CHECKS	External model coordination should be performed between disciplines including clash detection and visualization.	AE, GC/CM, Subs	Navisworks Manage	Project Review
QUALITY CONTROL CHECKS	Validate equipment information parameters	GC/CM	Revit Model Checker	End of Construction
AS-BUILT MODEL FOR LOD 500	Submit record model including required information defined by Model parameters included in Section N	AE, GC/CM, CxA	Revit, Navisworks Manage	End of Construction

3. Quality Control Software

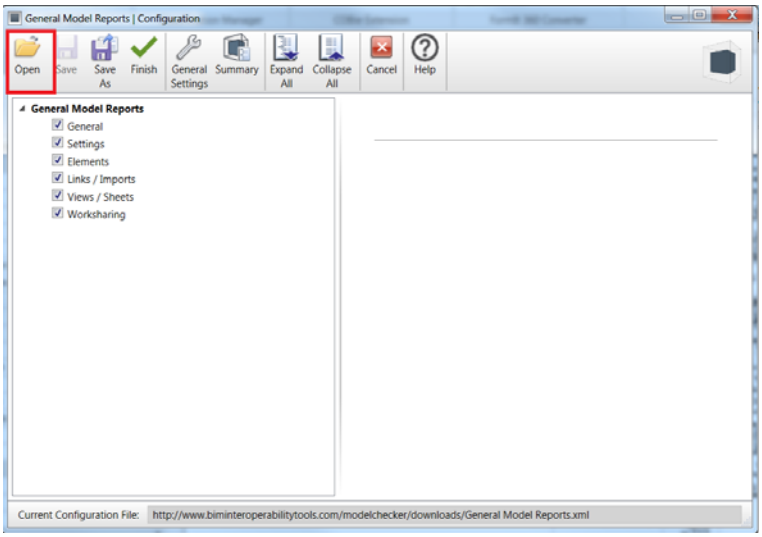
Autodesk and CADD Microsystems developed a sample configuration called "Western Michigan University Revit Model Checks" as a QC tool for WMU BIM projects. The Autodesk® Revit® Western Michigan University Model Checker shall be used by all parties to validate equipment information parameters before submitting Revit files to WMU for testing with their WebTMA interface test database. To download, start here and download the appropriate plug-in as outlined in Section F-2 at: http://www.biminteroperabilitytools.com.



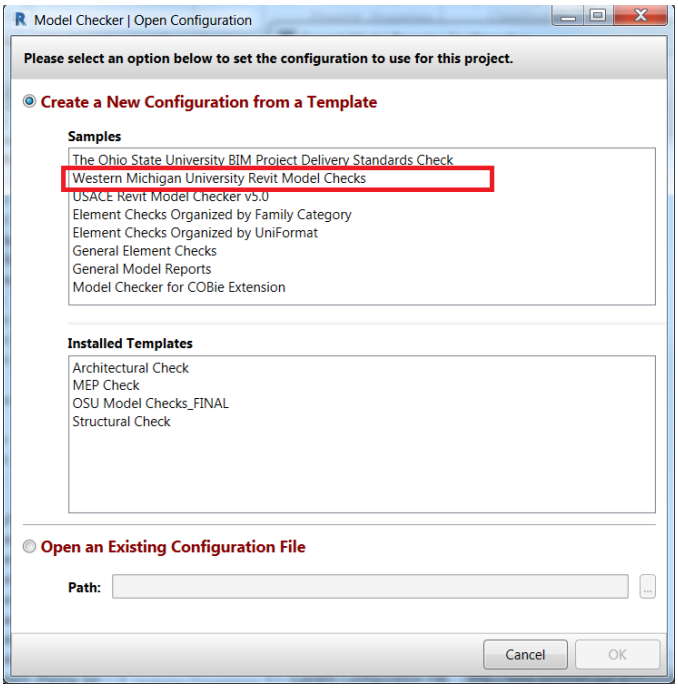
After that is installed, you should see the extension available under the Add-ins tab in Revit like this:



Select "Configure" and you will get a dialog box like this:



Select “Open”, and then you will see the “Western Michigan University Revit Model Checks” as shown below:



After that you should be all set to go with using the Western Michigan University Revit Model Checks.

SECTION N: BUILDING INFORMATION MODEL REQUIREMENTS – LIFECYCLE BIM

The following is a summary of the items required for BIM document information. These basic guidelines have been established to create a custom plan for each individual project. The intent is for the project team to review and adapt this list for projects of all sizes, and assure consistent outcomes regardless of the complexity of the systems. BIM information attachment for any project may include each of the following items.

In addition to the specifics listed below, it is assumed that all data provided for each system will include the **date of installation**, **warranty duration**, and **installer contact information**. For the sake of brevity these are considered universal requirements, and are not included in each section. Please note, WMU will provide the BIM-TMA shared parameters file in (.txt) format to the BIM Manager(s) and Coordinator(s) noted in Section J. Also, when linking documents (i.e., O&M's, submittals, cut sheets, etc.) BIM Manager(s) and/or Coordinator(s) shall use: https://www.fm.wmich.edu/ap/filefinder/search/FILENAME, where 'FILENAME' is the name of the document in WMU's Naming Convention being linked for each piece of equipment/system.

1. **SPACE IDENTIFICATION –** Rooms (To be completed by AE during design phase)
   - Room - ID NUMBER, USE, TYPE
   - Size - SQUARE FEET, VOLUME
   - Finishes – FLOORING, BASE, PAINT, WALL COVERINGS, CEILING TYPE AND INFORMATION
   - Window Coverings – DESCRIPTION, O&M, SUBMITTAL
   - Appliances – DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, COMPONENT INFORMATION, CUT SHEETS/O&M WHERE APPLICABLE, EACH LOCATION
   - Furniture – COMPONENT INFORMATION, CUT SHEETS/O&M WHERE APPLICABLE, EACH LOCATION

2. **CONVEYANCE SYSTEMS** – DESCRIPTION, O&M
   - Elevators – Package Units
   - ADA Lifts – Package Units
   - Dock Lifts and Levelers
   - Escalators – Package Units

3. **AIR DISTRIBUTION SYSTEMS**

   Air Handling Package – Package Air Handling Units; WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, WMU_FILTER TYPE, WMU_FILTER SIZE, WMU_FILTER QUANTITY, O&M, SUBMITTAL
   - Supply Fans – REFER TO FANS
   - Return Fans – REFER TO FANS
   - Coils – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M, SUBMITTAL
   - Humidifier – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M, SUBMITTAL

   Rooftop Unit Package – REFER TO AIR HANDLING PACKAGE

   Fan Coil Unit Package – REFER TO AIR HANDLING PACKAGE

   Fan Powered Box Package – REFER TO AIR HANDLING PACKAGE

   Heat Pump Unit Package – REFER TO AIR HANDLING PACKAGE

   Unit Ventilator Package – REFER TO AIR HANDLING PACKAGE

   Air Terminal Unit Package – REFER TO AIR HANDLING PACKAGE

   Outside Air Supply Systems, Heat/Energy Recovery Units – REFER TO AIR HANDLING PACKAGE
   - Fans – REFER TO FANS
   - Enthalpy/Desiccant Wheel – WMU-TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M
     - Motor – WMU_MOTOR ID, WMU_MOTOR DESCRIPTION, WMU_MOTOR RPM, WMU_MOTOR HP, WMU_MOTOR MODEL #, WMU_MOTOR SERIAL #, WMU_MOTOR MANUFACTURER, WMU_MOTOR

AMPERAGE, WMU_MOTOR VOLTAGE, WMU_MOTOR FRAME, WMU_MOTOR PHASE, WMU_MOTOR BEARING/COUPLING SIZE

Emergency Fire System AHU Interaction – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, SEQUENCE OF OPERATION, GRAPHICAL SYSTEM RISER REPRESENTATION

- Smoke Purge Fan – REFER TO FANS
- Fire Dampers – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M, SUBMITTAL
- Smoke Dampers – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M, SUBMITTAL

4. **KITCHEN/LAB EXHAUST SYSTEMS**
   Hood Package – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, O&M, SUBMITTAL
   - Fans – REFER TO FANS

5. **FANS** – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, WMU_BELT NAME, WMU_BELT SIZE, WMU_BELT QUANTITY, O&M, SUBMITTAL
   - Motor – WMU_MOTOR ID, WMU_MOTOR DESCRIPTION, WMU_MOTOR RPM, WMU_MOTOR HP, WMU_MOTOR MODEL #, WMU_MOTOR SERIAL #, WMU_MOTOR MANUFACTURER, WMU_MOTOR AMPERAGE, WMU_MOTOR VOLTAGE, WMU_MOTOR FRAME, WMU_MOTOR PHASE, WMU_MOTOR BEARING/COUPLING SIZE

6. **BUILDING AUTOMATION, MONITORING, SPACE CONTROL** – DESCRIPTION, O&M, SUBMITTAL
   - Thermostat and Remote Sensor, Remote Static Pressure Sensor, Humidity/Dew Point and Carbon Dioxide Sensor, Occupancy Sensor, Controller, Control Panel

7. **HEATING FUNCTIONS**
   Steam Delivery and Condensate Return – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M, SUBMITTAL
   - Coil, Pumping Trap, Receiver, Meter

   Heat Exchanger/Converter – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, O&M, SUBMITTAL

   Cabinet and/or Suspended Unit Heaters – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTUER, WMU_MODEL #, O&M, SUBMITTAL
   - Unit Heater, Cabinet Unit Heater, Gas Fired Unit

8. **COOLING FUNCTIONS**
   Chiller – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, O&M, SUBMITTAL

   Cooling Tower – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, O&M, SUBMITTAL
   - Fan Gear Box – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #
     - Motor – WMU_MOTOR ID, WMU_MOTOR DESCRIPTION, WMU_MOTOR RPM, WMU_MOTOR HP, WMU_MOTOR MODEL #, WMU_MOTOR SERIAL #, WMU_MOTOR MANUFACTURER, WMU_MOTOR AMPERAGE, WMU_MODEL VOLTAGE, WMU_MOTOR FRAME, WMU_MOTOR PHASE, WMU_MOTOR BEARING/COUPLING SIZE

   Refrigeration Equipment – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, O&M, SUBMITTAL
   - Compressors
     - Motor – WMU_MOTOR ID, WMU_MOTOR DESCRIPTION, WMU_MOTOR RPM, WMU_MOTOR HP, WMU_MOTOR MODEL #, WMU_MOTOR SERIAL #, WMU_MOTOR MANUFACTURER, WMU_MOTOR

AMPERAGE, WMU_MOTOR VOLTAGE, WMU_MOTOR FRAME, WMU_MOTOR PHASE, WMU_MOTOR BEARING/COUPLING SIZE

- Split Systems and Package (Leibert type) AC Units
  - Sensors – REFER TO BUILDING AUTOMATION, MONITORING, SPACE CONTROL
  - Condensation pumps – REFER TO WATER DISTRIBUTION
- Chilled Beams, Condensing Units, Ice Machine, Water Cooler, Drinking Fountain, Domestic Refrigerator, Ice Cream Freezer, Ice Cream Machine, Juice Machine, Laboratory Equipment, Window Shaker, Pass Thru/Reach-in Refrigerator, Walk-in/Reach-In Freezer, Walk-in/Reach-in Cooler

9. PLUMBING SYSTEMS

Domestic Plumbing

- Meters – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M, SUBMITTAL
- Booster/Circulation Pumps – REFER TO WATER DISTRIBUTION
- Water Heater – REFER TO HEAT EXCHANGER/CONVERTER

Plumbing Fixtures – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M, SUBMITTAL

Sanitary System

- Sump Pumps – REFER TO WATER DISTRIBUTION
- Acid Treatment – COMPONENT INFORMATION
- Manholes – COMPONENT INFORMATION, CUT SHEETS EACH LOCATION

Storm System

- Roof Sumps – COMPONENT INFORMATION, CUT SHEETS WHERE APPLICABLE, EACH LOCATION
- Sump Pumps – REFER TO WATER DISTRIBUTION

10. WATER DISTRIBUTION

- Pumps – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, O&M, SUBMITTAL
  - Motor – WMU_MOTOR ID, WMU_MOTOR DESCRIPTION, WMU_MOTOR RPM, WMU_MOTOR HP, WMU_MOTOR MODEL #, WMU_MOTOR SERIAL #, WMU_MOTOR MANUFACTURER, WMU_MOTOR AMPERAGE, WMU_MOTOR VOLTAGE, WMU_MOTOR FRAME, WMU_MOTOR PHASE, WMU_MOTOR BEARING/COUPLING SIZE

11. WATER EQUIPMENT – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, CERTIFICATION, O&M, SUBMITTAL

- Water Softener, Domestic Water Filter, Reverse Osmosis, Back Flow Preventer

12. HVAC WATER TREATMENT – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M, SUBMITTAL

- Side Stream Filter, Chemical Feeder, Air Separator, Flow Preventer, Centrifugal Separator

13. VALVE – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M, SUBMITTAL

- Control Valve, Balance Valve, Pressure Reducing Valve, Relief Valve, Triple Duty Valve

14. TANK – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M, SUBMITTAL

- Expansion Tank, Storage Tank, Air Troll

15. SPECIALTY EQUIPMENT – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M, SUBMITTAL

- Elevator Oil Interceptor, Oil Separator

16. ARCHITECTURAL

Building Envelope Systems

- Roof System – DESCRIPTION, WMU_MANUFACTURER, TYPE AND MATERIAL INFORMATION, GREEN ROOF DETAILS, SUBMITTAL
- Exterior Doors – DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, GLASS DETAILS, REVOLVING/MOTORIZED DETAILS, HARDWARE SET, SEALANT, SUBMITTAL
- Exterior Finishes – (METAL PANELS, STONE, BRICK, MANUFACTURED PANELS)
- Windows – DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, REFLECTION, COLOR, GRADE, SEALANT, SUBMITTAL
- Skylights – DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, REFLECTION, COLOR, GRADE, SEALANT, SUBMITTAL
- Access Doors and Hatches, Ladders – DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, HARDWARE SET, SUBMITTAL

17. BUILDING COMPRESSED GAS SYSTEMS

Natural Gas System - METERS, REGULATORS/PRV's, SAFETIES, WMU_MANUFACTURER, WMU_MODEL #, SUBMITTAL

Compressed Air Systems

- Air Compressors – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, WMU_BELT NAME, WMU_BELT SIZE, WMU_BELT QUANTITY, O&M, SUBMITTAL
- Air Dryers – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, O&M, CAPACITY, SUBMITTAL
- Storage tanks – REFER TO TANK

Lab Gas Systems – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #L, WMU_SERIAL #, O&M, SUBMITTAL

- Regulator stations, Monitoring and Alarm Systems, Vacuum Pumps

18. ELECTRICAL

Electrical Distribution System – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M, SUBMITTAL

- Transformers, Switch Gear, Panel Boards, Major Equipment Service Disconnects

Emergency Electric Generation – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, O&M, SUBMITTAL

- Emergency Generator, Transfer Switch, Emergency Lighting Components
- Service Entrance – DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, O&M

Lighting Systems

- Fixtures – DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, WMU_BULB TYPE, WMU_BULB QUANTITY, WMU_BALLAST TYPE, WMU_BALLAST QUANTITY, CIRCUIT NUMBER, O&M, SUBMITTAL
- Controls – REFER TO BUILDING AUTOMATION, MONITORING, SPACE CONTROL
- Occupancy Sensors – REFER TO BUILDING AUTOMATION, MONITORING, SPACE CONTROL
- Timers – DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M, SUBMITTAL
- Light Contactor – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, O&M, SUBMITTAL

Motor Controls – WMU_TAG #, WMU_TYPE DESC, WMU_SUBTYPE DESC, DESCRIPTION, WMU_LOCATION, WMU_MANUFACTURER, WMU_MODEL #, WMU_SERIAL #, O&M, SUBMITTAL

- Variable Speed Drive, Motor Control Center, Motor Control Panel

SECTION O: MODEL COLOR CODING & FORMULA GUIDELINE

The following systems color coding should be followed when creating Building Information Models. This color coding is intended to improve the overall visualization of the Revit models.

Systems Color Coding Guideline		
Revit Component:	**Color**	**Formula R/G/B**
Rain Leader	Magenta	255/000/128
Overflow Drain	Light Magenta	255/085/170
Vent	Light Brown	230/115/000
Waste Water	Dark Brown	128/064/000
Compressed Air	Blue	000/064/128
Lab Gases	Purple	128/090/128
Chilled Water	Green	000/064/000
Chilled Return	Light Green	00/185/000
Natural Gas	Brown	255/255/00
Heated Water	Dark Orange	179/089/000
Heated Water Return	Light Orange	250/160/107
Domestic Soft Water	Light Blue	066/066/255
Domestic Cold Water	Dark Blue	000/000/100
Domestic Hot Water	Red	255/000/000
Fire Protection		
Outdoor Air Ductwork	Yellow	255/255/125
Supply Air Ductwork	Blue	170/255/255
Return Air Ductwork	Pink	255/170/255
Exhaust Air Ductwork	Orange	255/213/170
Electrical Light Switches	Green	000/255/000
Refrigeration Equipment		
Refrigerant Piping		
Mechanical Equipment		
Electrical Conduit		
Electrical Lighting	Yellow	204/204/102
Ceiling Devices		
Fire/Smoke Dampers	Red	255/128/000
Valves and Valve Tags		
Plumbing Equipment		
Plumbing Fixtures		
Electrical Panel Schedules		
Equipment Clearances		
VAV Box	Pink	255/128/128
Diffuser		
Air Handling Unit		
Exhaust Hoods		

Compressors		
Chillers		
Louvers		
Condensate	Magenta	255/000/140
Steam	Orange	255/155/000

SECTION P: ACKNOWLEDGEMENTS AND REFERENCES

1. **Resources and References for Review**
   - **a.** NBIMS National BIM Standard
     https://www.nationalbimstandard.org
   - **b.** Indiana University, University Architect's Office
     http://www.iu.edu/~vpcpf/consultant-contractor/standards/bim-standards.shtml
   - **c.** University of South Florida, Administrative-Services
     www.usf.edu/administrative-services/facilities/documents/design-construction/guide-bim-plan.docx
   - **d.** Florida International University, Facilities
     facilities.fiu.edu/documents/forms_standards/fiu_bim_standard_120814.pdf
   - **e.** Pennsylvania State University, Computer Integrated Construction (CIC) Research Program
     http://bim.psu.edu/Project/resources

SECTION Q: GLOSSARY

TERM	DEFINITION
3D/4D/5D	Descriptions of BIM implementation with increasing 'richness' of associated information.
AE	**Architect and/or Engineer** – Collective acronym for professions working in the creation/maintenance of the built environment.
AEC	**Architectural, Engineering, and Construction Division CAD Standard** -
As-Built BIM	Design Intent Models that have been updated throughout the construction process. These changes and updates have been communicated from the GC/CM to the Designer through comments, annotations and mark-ups from the As-Built Documents or red lines.
As-Constructed BIM	The updated Contractor BIMs which represent what was installed in the field.
BIM	**Building Information Modeling – Process** – A collection of defined model uses, workflows, and modeling methods used to achieve specific, repeatable, and reliable information results from the model. Modeling methods affect the quality of the information generated from the model.
BIM Authoring Tools / Software	The software or tool used to create the models. (Design application such as Autodesk® Revit®)
BIMs	**Building Information Model(s) – Product** – An object-based digital representation of the physical and functional characteristics of a facility. The Building Information Model or Models serves as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its lifecycle from inception onward.
BMP	**Best Management Practice** – Is a method or technique that has consistently shown results superior to those achieved with other means, and that is used as a benchmark. In addition, a "best" practice can evolve to become better as improvements are discovered.
BOD	**Basis of Design** – The design parameters and subsequent design systems and materials incorporated into the project model(s). The BOD is owner provided functional requirements for the facility with expectations of use and operation. It may include project and design goals, budgets, limitations, schedules, owner directives and supporting information.

BPEP	**BIM Project Execution Plan** – Written plan to integrate the BIM tasks and information with all stakeholders and processes.
CAD	**Computer-Aided Design** – (Also known as 2D Drawings) A geometric/symbol based computer drawing system that replicated hand drawing techniques. The production of CAD documents are to be completely derived from the BIMs.
CD	Construction Documents
Clash Detection	Process of identifying conflicts and issues using 3D collaboration and coordination software tools.
CM	**Construction Management** – Professional service that uses specialized, project management techniques to oversee the planning, design, and construction of a project, from its beginning to its end. The purpose of CM is to control a project's time, cost and quality.
CMMS	**Computerized Maintenance Management Systems** – A software package that maintains a computer database of information about an organization's maintenance operations, enabling the facility manager to track the status of maintenance work on their assets and the associated cost and manpower related to that work.
CxA	**Commissioning Authority/Agent –** The leader of the commissioning team and is responsible for planning, organizing, and facilitating the completion of the commissioning process on behalf of the owner.
Construction Team	A group of professionals working together for a common goal in utilizing techniques and industry involved in the assembly and erection of structures.
DD	Design Development
Design Team	A group of design professionals working together for a common goal or purpose. It is made up of different individuals with different skills or talents. It may consist of architects, engineers, artists, etc.
DWG	DWG is a binary file format used for storing two and three dimensional design data and metadata. It is the native format for several CAD packages.
Fabrication	The act or process of manufacturing, to make, build, or construct in reference to building systems or components. Usually means off site fabrication done within a controlled environment resulting in improved accuracy and efficiencies.
Federated Model	An aggregation of Models in a single database.
FM	**Facility Management** – The Facilities Management Department of Western Michigan University is a unit of the Office of Business and Finance. Facilities Management provides all facility services to campus customers in a professional manner that exemplifies positive customer services and stewardship.
GC	**General Contractor** – A manager, and possibly a tradesman, employed by the client that is responsible for the overall coordination of a project.
Geo-reference	To associate something with locations in physical space. The term is commonly used in geographic information systems to describe the process of association to spatial locations. Establishes control points, coordinate system and other projection parameters.
GIS	**Geographic Information System** – The Engineering Division at Western Michigan University uses a geographic information system to visualize, question, analyze, interpret and understand data to reveal relationships, patterns and trends.
GSF	**Gross Area Square Feet** – The sum of all areas on all floors of a building included within the outside faces of its exterior walls. Includes: exterior covered areas, and all vertical penetration areas, for circulation and shaft areas that connect one floor to another. Note: GSF calculations do not include space that is open to below.
HVAC	**Heating, Ventilation, and Air Conditioning** – The system used to provide heating and cooling services to a building.
Information model	Another name or reference to the Building Information Model.
LEED	**Leadership in Energy and Environmental Design** – Is a green building certification program that recognizes best-in-class building strategies and practices. To receive LEED certification, building projects satisfy prerequisites and earn points to achieve different levels of certification.

LOD	**Level of Development** – Scales applied to provide common understanding of information requirements at different stages of a project (A scale developed by the American Institute of Architects).
MEP	**Mechanical, Electrical, and Plumbing** – The professional engineers designing the building systems for Mechanical, Electrical and Plumbing disciplines.
NBIMS	National Building Information Modeling Standard – United States, Version 2 (NBIMS-US v2)
O&M	**Operations & Maintenance** – Encompasses a broad spectrum of services required to assure that the built environment will perform the functions for which a facility was designed and constructed.
PM	**Project Manager** – Individual in overall charge of the planning and execution of a particular project.
QA	Quality Assurance
QC	Quality Control
Record BIM	The updated BIMs that come from the architect that includes the contractors As-Constructed BIMs.
RFI	**Request for Information** – The process of requesting additional information, directive or clarification from the architect or client.
RFP	Request for Proposal
RFQ	Request for Qualifications
SD	Schematic Design