

# **BIM PROJECT EXECUTION AND STANDARDS GUIDE**

FOR

## **WESTERN MICHIGAN UNIVERSITY**

### **FACILITY MANAGEMENT**

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**SECTION A: BUILDING INFORMATION MODELING PROJECT EXECUTION PLAN OVERVIEW**

To successfully implement Building Information Modeling (BIM) on a project, Western Michigan University has developed this detailed BIM 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 building information model development from schematic design to project closeout. Western Michigan University has adopted building information modeling as a tool for project documentation and development, as-built record documentation, and facility management.

Western Michigan University has made every attempt to provide this standard as complete as possible. However, if there are items not covered in this guide, please contact a Western Michigan University project manager for guidance. Western Michigan University assumes no responsibility for Revit models of existing buildings provided by WMU for renovations and additions.

**2. Building Information Modeling (BIM)**

BIM is the process that contains all physical features of the project. Building Information Models 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.

The term “model” is used in these guidelines as a digital representation of building elements and data used to design, construct, and lifecycle manage a building.

**3. Model Ownership**

Western Michigan University will retain ownership of all documentation throughout the building information modeling process including the Autodesk® Revit® Architecture central file, MEP, and Structure Models (.rvt files), Navisworks® files, and all other associated document types. 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**

Building Information Models will be imported into external software that checks each model discipline (architectural, MEP, and structural) for hard clashes (clashes between elements) and soft clashes (clashes between elements and required clearances)

Conflict and clash detection allows the project team to verify clearance, analyze conflicts/clashes, deliver quality documentation, and coordinate between disciplines to reduce RFI and Change Order submissions.

**5. Applicability**

The Building Information Modeling 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. Lifecycle Management**

Western Michigan University intends to make final deliverable building information models 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 official.

**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. **Existing Conditions:**
7. **Additional Project Information:**

PROJECT INFORMATION	NUMBER
WMU Project Number:	
AE Project Number:	
GC Project Number:	
Autodesk Software Version	
Project Scope Definition	AIA E202 Document

Each Project must complete AIA E202 document to define project Level of Development – LOD.

**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. **See contract documents for official project schedule.**

PROJECT PHASE / MILESTONE	ESTIMATED START DATE	ESTIMATED COMPLETION DATE	PROJECT STAKEHOLDERS INVOLVED
PROGRAMING			
SCHEMATIC DESIGN			
DESIGN DEVELOPMENT			
CONSTRUCTION DOCUMENTS			
CONSTRUCTION			
CLOSEOUT			
LIFECYCLE			

**SECTION C: KEY PROJECT CONTACTS****1. Outside Contacts for this Project**

Role	Organization	Contact Name	E-Mail	Phone
Project Manager				
Project Manger				
Project Manager				
BIM Coordinator				
Discipline Lead ARCH				
Discipline Lead MEP				
Discipline Lead Structure				
Site Superintendent				
Owners Representative				
Commissioning				

**2. WMU Project Contacts**

Title	Organization	Contact Name	E-Mail	Phone
Project Manager	WMU	Doug Lloyd		
Commissioning	WMU	DeVon Miller		
Planning	WMU	David Dakin		
Vice President	WMU	Peter Strazdas		
Construction	WMU	Conn Macomber		
Facilities Management	WMU	Anand Sankey		
Facilities Records	WMU	Jani J. Hart		
OIT	WMU	Erik Dantes		
Construction Administrator	WMU	TBD		

**SECTION D: PROJECT GOALS / BIM USES**

**1. Major BIM Goals & Objectives:**

PRIORITY (HIGH/ MED/ LOW)	GOAL DESCRIPTION	PROJECT PHASE
H	Provide WMU a LOD 300 model including Arch, MEP, and Structure for construction	Construction
H	Coordinate all disciplines through the design/construction process to reduce RFI's	Construction
M	Reference all building components per the Western Michigan University BIM guideline	Lifecycle
H	Improve commissioning process by adding equipment information into BIM process	Lifecycle
H	Improve visualization of design intent using BIM design principles	Design

**2. Mandatory Uses of BIM Models:**

Expected BIM uses for this project include:

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

Project Scope and Objectives should determine the proper application of modeling and weight all factors including time, cost, and effort vs. net benefit.

**3. Western Michigan University BIM Models for Existing Buildings**

WMU will make Revit 2011 .rvt model files available for existing buildings. **WMU** takes no responsibility for the accuracy of these models therefore each should be field verified for accuracy.

**\*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 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, 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
- Must meet BOMA Standards

**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 not limited to:

- Foundations
- Columns, Beams, and Joists
- Column Grid
- Brace Frames and Shear Walls
- Structural Slab
- Specialties
- Miscellaneous Structural Components.

**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 not limited to:

- Rain Leader
- Overflow Drain
- Vent
- Waste Water
- Domestic Cold Water
- Domestic Hot Water
- Fire Protection
- Gases
- Fire Alarm System
- Mechanical Ductwork

- Mechanical Equipment
- Electrical Conduit
- Electrical Lighting
- Fire/Smoke Dampers
- Valves with Valve Tags
- Plumbing Equipment and Fixtures
- Electrical Equipment
- Electrical Panels and Schedules
- Specialties
- Equipment clearances for access, service space requirements, gauge reading, valve clearances, and other operational clearances and access panels.

#### 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 mechanical, electrical, and plumbing features for a building including but not limited to:

- Electrical Low Voltage
- Security System
- Energy Management System

#### 5. Model Phases

All model files shall include Revit phases as listed:

- Existing conditions – See Section B for further details of existing conditions
- New construction separated into planned project construction phases

Project Phase	Description
Design	
Construction	
Lifecycle	
Demolition	

#### 6. Design and Construction Model Coordination – Navisworks® Manage - .nwd

Models are to be Navisworks Manage .nwc files. Models will then be converted to .nwd files and made available per the project coordination schedule for design and construction professionals to perform clash detection, scheduling and visualization using Navisworks Manage.

#### 7. Historical Phasing of Central Model

WMU will archive the finished model(s). The most current models will be issued to design and construction teams when available for updating including but not limited to building remodel, renovation, additions, and retrofits. Each projects updated model(s) will then be archived in addition to the original. This will create a history of models throughout the building lifecycle. The most current model is what will be integrated to the WMU lifecycle system.

All final model(s) from each project will be archived to reference historical changes to each building. Models will be archived at each level of development.

**SECTION F: BIM AUTHORIZING AND COLLABORATION SOFTWARE REQUIREMENTS****1. Design Team Software**

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, schedules, simulations, and services required for assessment, review, bidding and construction shall be extractions from this model. The Design Team shall follow the guidelines and requirements detailed in this document for BIM related services. Deliverable requirements are as specified in the Western Michigan University professional services contract (deliverables sections).

Models 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. Drawings and schedules required for assessment, review, bidding and construction shall be extractions from this model. Software shall be capable of interfacing with the design teams 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\*:

- Autodesk® Revit® Architecture
- Autodesk® Revit® MEP
- AutoCAD® MEP
- Autodesk® Revit® Structure
- Autodesk® Civil 3D

**Projects will remain on the same software release throughout the life of the project.**

**3. Coordination Software**

All internal and external model coordination and conflict detection are required to use the following software in its native file format in its current version. All parties including Design, Engineering, Construction, and WMU are required to participate in the BIM coordination process.

- Autodesk® Navisworks® Manage

**Design Team Coordination Requirements**

AE Firms are **required** to perform internal coordination between disciplines to assure quality project delivery for all delivery phases.

**General Contractor and Construction Manager Coordination Requirements**

CM/GC Firms are **required** to coordinate models between disciplines using Navisworks Manage to perform clash detection in order to assure constructability and reduce RFI and change order submissions.

\*Current version is based on the defined version in Section B of this document



#### **4. 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 Western Michigan University for performing model coordination. WMU is not responsible for costs associated with purchasing compatible software or rework to comply with this requirement.

#### **5. Project collaboration tools**

The Design and Construction Team is required to use the Western Michigan University designated collaboration site for all model and document collaboration. Models as well as 2D documentation will be available from this site for download to perform reviews, coordination, estimating, and scheduling.

**Model collaboration platform has yet to be determined.**

**SECTION G: COLLABORATION PROCEDURES**

**1. Collaboration Strategy:**

All BIM collaboration will happen using the Western Michigan University’s designated collaboration site. Project team members will be required to upload information per the BIM project model and document delivery schedule.

**2. BIM Coordination Meeting Procedures:**

MEETING TYPE	PROJECT STAGE	FREQUENCY	PARTICIPANTS	LOCATION
BIM REQUIREMENTS KICK-OFF	PROGRAMMING	ONCE	WMU/AE/CONST	WMU
BIM EXECUTION PLAN DEMONSTRATION	PROGRAMMING	ONCE	RESPONSIBLE PARTY	WMU
DESIGN COORDINATION	DD/SD/CD	BI-WEEKLY	RESPONSIBLE PARTY	WMU
CONSTRUCTABILITY COORDINATION	CONSTRUCTION	BI-WEEKLY	RESPONSIBLE PARTY	WMU
LIFECYCLE BIM PLANNING	CONSTRUCTION	AS-NEEDED	RESPONSIBLE PARTY	WMU

**3. Model & Document Delivery Schedule of Information Exchange for Review, Coordination, Submission and Approval:**

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 FIRM	COLLABORATION SITE	BI-WEEKLY	Thursday 5:00pm	ARCH	REVIT	.NWC/.DWF	.PDF
MEP COORDINATION	MEP CONSULTANT	COLLABORATION SITE	BI-WEEKLY	Thursday 5:00PM	MEP	REVIT	.NWC/.DWF	.PDF
MEP COORDINATION	MEP CONSULTANT	COLLABORATION SITE	BI-WEEKLY	Thursday 5:00PM	MEP	AUTOCAD MEP	.DWG/.DWF	.PDF
STRUCTURE COORDINATION	STRUCTURE CONSULTANT	COLLABORATION SITE	BI-WEEKLY	Thursday 5:00PM	STRUC	REVIT	.NWC/.DWF	.PDF
RECORD MODEL	AE FIRM	WMU	CONSTRUCTION	AS-NEEDED	ALL	REVIT	RVT	.PDF
COORDINATION*	CM/GC	COLLABORATION SITE	BI-WEEKLY	FRIDAY 12:00PM	CONS T	NAVISWORKS	.NWD	.PDF
BID DISTRIBUTION	CONSTRUCTION	COLLABORATION SITE	BID	BID	CONS T	REVIT	.NWC	.PDF
SHOP DRAWINGS	CONSTRUCTION	COLLABORATION SITE	AS REQUIRED	CONST	ARCH	REVIT	.RVT	.PDF
SHOP DRAWINGS	CONSTRUCTION	COLLABORATION SITE	AS REQUIRED	CONST	MEP	REVIT/AC MEP	.RVT/.DWG	.PDF
SHOP DRAWINGS	CONSTRUCTION	COLLABORATION SITE	AS REQUIRED	CONST	STRUC	REVIT	.RVT	.PDF
SUBMITTALS	CONSTRUCTION	COLLABORATION SITE	AS REQUIRED	CONST	NA	NA	.PDF	.PDF

\*In addition to the BIM model file types, documents will be issued in 2D in both AutoCAD DWG and PDF.

General Contractors and Construction Managers are **required** to coordinate models between disciplines to perform clash detection in order to reduce RFI and change order submissions using Navisworks Manage.

**SECTION H: FILE NAMING CONVENTION ISSUE 04****1. General**

The purpose of this guideline is to provide guidelines and direction for standardizing electronic file information into retrievable formats. Building Information Management Systems require unique file names to function properly and allow searches to find the information the requestor desires. These guidelines/standards will be the first step in developing our Building Information Management Systems (BIM).

This guideline should be followed by all personal in the Facility Management Department and anyone providing services, documents or work for the University. Deviations from this guideline shall require approval in writing from the Facilities Management Associate Vice President and Document Management Team.

**Applicability: As of March 24, 2010 this is now the standard for all files on the Facility Management file server.**

*This document will be updated regularly as we implement our document consolidation process.*

**2. File Naming Convention**

The following are the new file naming conventions for all files on the Facility Management computer system. The intent of this naming convention is to give each file on our computer network a unique name that can be utilized to retrieve files and information from our computer network utilizing our File Finder Tool.

**2.1 File Name Structure**

To ensure the File Finder search tool will be able to sort our documents, the following file name format needs to be followed. The underscore ( \_ ) is used in the file name to separate the section fields. The file names shall consist of five distinct sections delineated by the following format:

**Field 1** **Field 2** **Field 3** **Field 4** **Field 5.xxxx**

**Field 1:** This field should be the Location on campus the file is related to or addressing, such as *building number*. If it is not a building related file then it may relate to the *site* around the buildings such as a *parking lot number*, *utilities* on campus, *landscaping* or it may be an project or *administrative* file or *study*. See Field 1 in Table 2.1.

**Field 2:** This field should provide Sub-location information such as *floor #*, type of utility, *CSI specification section* (old or new system), type of document (ie *study*, *form*, *budget*, *letter*, *email*, etc).

**Field 3:** This field has two parts the Project number followed by the file title description. The Project Number is not necessary, but will help keep packages together and should be followed by a ***period*** and the file/title description. The file description can contain the *title of the document*, subject of the email or description of the file. This is a description of the file contents and in case of our renaming the archived files, be the old file name. This field could also contain the drawing package title also, such as 50% CD if available.

**Field 4:** This *Sub-Description* field should contain the information like the *drawing sheet number* from the title block, the *document number*, the *purchase order number*, *contract number*, *revision number*, *shop drawing version*, *change order number*, or the *time of the email*.

**Field 5:** This should contain the date of the contents of the file, such as the issued date current revision date of the document. The date format should be a four digit year, two digit month, two digit day (yyyy mm dd). The numbers can have spaces, dashes or no spaces in the date. Entering only a year, or year and month, are acceptable. The purpose of the date in this format sorts the files for the File Finder tool by most important first.

Working files are defined as files used on a daily recurring basis, such as a cad drawing in progress or specification document being developed would not have a field 5 (date) unless it needs to be saved for record or

milestone reasons. Therefore if you are developing a document and are not done with it you would enter only a year in the title until you issued it for comments or use. Also you may enter “master” in field 4, to distinguish a file as the master version.

## 2.2 Field Name Conventions

The following table is intended to be a matrix of standard nomenclature to use in the various fields identified. If there is no applicable data for a field, leave the field empty and place two underscores (\_\_) in the file name (see the examples in table 2.2).

Table 2.1

Field 1		Field 2		Field 3		Field 4		Field 5	
Location (10 Characters)	Sub-Location (12 Characters)	Project No.	Description (100 Characters)	Doc Revision (25 Characters)	Date (yyyy mm dd) (25 Characters)				
Bldg #, KPH bldg#, 0060 kln	Admin, Form; Sched, Scope; Bid, RFP, RFQ, Proposal; Budget, Contract; CSI # Spec Section or Division; Email, Letter, Transmittal, Memo, MtgMin, Workorder; Floor # (ie: 03, 02, MZ, 01, UL, ML, LL, GF, B0, B1, B2, Operating, Turf); Standards, Guidelines; Site, Streets, Parking; ShopDwg, RFI, Photos, O&M, Punchlist, Testing (Reports); Signage; Sprinkler, Plantings; System: Elect, Mech, Arch, Struct, Lndscp, Civil, Equip, Cover, Plumb, Utilitiy, FlrPln, Survey, Tunnel, Steam, N Gas, StmSwr, SanSwr, TCom, Water, FireAlm, Stormwater, Chwtr; Record, Prop Record.	09013; RXXXX.	Sheet Title; Package Title; Old File name; Subject; File Description; Email Subject; Shop drawing title;	Sht # or Dwg #; Time (Military format) (1345); Rev #, Req # PO #, CO#, Contract #, Doc # RFI#; Review, Approved, Approved as Noted, Rejected.	2009 11 19 2008 2006 10				
Admin									
Concepts									
Landscape									
Maps									
Master Plan									
Site									
Study									
Utilites									
<b>DIRECTORY</b>									

### 2.3 Examples

The following are examples of files following this naming scheme.

**Table 2.2**

File Name	File Description
149_Arch_R10093.Architectural Revit Model_LOD 500_2013 09 23.rvt	Zhang Legacy Collections Center Architectural Revit Model, dated Sept. 23, 2013.
149_Const_R10093.Joist Bridging and Bracing_LOD 400_2013 08 01.nwc	Zhang Legacy Collections Center Joist Bridging and Bracing Navisworks Construction Model, dated Aug. 1, 2013.
149_Const_R10093.Joist Fabrication Model_LOD 400_2013 08 01.dwg	Zhang Legacy Collections Center Joist Bridging and Bracing AutoCAD Construction Drawing, dated Aug. 1, 2013.
149_Lifecycle_R10093.Electrical Model_LOD 500_2013 09 27.rvt	Zhang Legacy Collections Center Electrical Revit Model, dated Sept. 27, 2013.
149_Lifecycle_R10093.Fire Protection Model_LOD 500_2013 09 20.rvt	Zhang Legacy Collections Center Fire Protection Revit Model, dated Sept. 20, 2013.
149_Lifecycle_R10093.HVAC Controls Model_LOD 500_2013 08 01.rvt	Zhang Legacy Collections Center HVAC Controls Revit Model, dated Aug. 1, 2013.
149_Lifecylce_R10093.HVAC Duct Pipe Plumbing Model_LOD 500_2013 09 20.rvt	Zhang Legacy Collections Center HVAC Ductwork, Piping, and Plumbing Revit Model, dated Sept. 20, 2013.
149_Structure_R10093.Structural Engineer Model_LOD 300_2013 08 01.rvt	Zhang Legacy Collections Center Structural Engineer Model, dated Aug. 1, 2013.
149_Const_R10093.Architectural Revit Model_LOD 500_2013 08 01.dwf	Zhang Legacy Collections Center Architectural Autodesk Review Construction Model, dated Aug. 1, 2013.
149_Lifecycle_R10093.Federated Navisworks Model__2013 08 01.nwd	Zhang Legacy Collections Center Federated Model, dated Aug. 1, 2013.
149_Bid Package 1_R10093.Electrical Details_E501_2012 07 18.pdf	Scanned Bid Package 1 Electrical Details Drawing E501 for Zhang Legacy Collections Center, dated July 18, 2012.
149_As-Builts_R10093.First Floor HVAC Plan_M111_2014 03 26.dwg	As-Built AutoCAD First Floor HVAC Plan Drawing M111 for Zhang Legacy Collections Center, dated March 26, 2014.
<b>Note: A field can be empty, maintain the underscore format.</b>	

### 3. QUESTIONS

Questions, comments, mistakes that identified in the use of this process should be directed to the FM Document Management Committee.

Committee members are: Jani J. Hart, Erik Dantes, DeVon Miller, Dan List, Doug Lloyd, Steve Macomber, and George Wilson.

**SECTION I: QUALITY CONTROL**

**1. Overall Strategy for Quality Control:**

The building information modeling process is suited to improve coordination of the design/construction process as well as deliver improved information for facility management. 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 Western Michigan University designated collaboration site per the schedule requirements.

CHECKS	DEFINITION	RESPONSIBLE PARTY	SOFTWARE PROGRAM(S)	FREQUENCY
VISUAL CHECK	Review of all 3D design intent.	AE Firm	Revit Navisworks	Project Review
VISUAL CHECK	Review of all 2D design intent.	AE Firm	PDF/DWF	Project Review
COORDINATION	Coordinate all disciplines including Arch, MEP, and Structure to reduce construction RFI's and change orders.	AE/CM/GC/ WMU/Subs	Revit Navisworks Manage	Project Review
RECORD MODEL FOR LOD 500	Submit record model including required information defined by Model parameters included in Section N	CM/GC WMU	Revit	Start of Construction
STANDARDS CHECK	Ensure that the BIM and AEC Standards have been followed.	AE Firm	Revit	Project Review
MODEL INTEGRITY CHECKS	External model coordination should be performed between disciplines including clash detection and visualization.	AE Firm	Navisworks Manage	Project Review

**3. Model Accuracy and Tolerances:**

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

PHASE	DISCIPLINE	TOLERANCE
DESIGN DOCUMENTS	ARCH	ACCURATE TO +/- .25" OF ACTUAL SIZE AND LOCATION
SHOP DRAWINGS	MECH CONTRACTOR	ACCURATE TO +/- 1" OF ACTUAL SIZE AND LOCATION

**SECTION J: TECHNOLOGY INFRASTRUCTURE REQUIREMENTS****1. Software:**

All project participants are required to have the following software in order to participate in the WMU BIM design and construction process. BIM software use is as follows:

BIM USE	DISCIPLINE (if applicable)	SOFTWARE	VERSION
DESIGN AUTHORIZING	ARCH	Revit Architecture	2014
DESIGN AUTHORIZING	MEP	Revit MEP	2014
DESIGN AUTHORIZING	MEP	AutoCAD MEP	2014
DESIGN AUTHORIZING	Structure	Revit Structure	2014
DESIGN AUTHORIZING	Civil	Civil 3D	2014
COORDINATION	Construction	Navisworks Manage	2014
FACILITY MANAGEMENT	Handover	To be determined*	

\*Provided by WMU

**2. Computers / Hardware:**

All project participants are required to have the necessary hardware in order to participate in the BIM design and construction process. Hardware required is as follows:

BIM USE	HARDWARE	OWNER OF HARDWARE	SPECIFICATIONS
All Phases	Responsibility of Design/Construction Firms	Design/Construction Firm	Autodesk minimum required specifications



## SECTION K: MODEL STRUCTURE

### 1. File Naming Structure

All Revit Central files will be named using the following instructions.

FILE NAMES FOR MODELS SHOULD BE FORMATTED AS:	
ARCHITECTURAL MODEL	Building#_Arch_WMUProjectNumber.Description_Rev#_YYYYMMDD
CIVIL MODEL	Building#_Civil_WMUProjectNumber.Description_Rev#_YYYYMMDD
MEP MODEL	Building#_MEP_WMUProjectNumber.Description_Rev#_YYYYMMDD
STRUCTURAL MODEL	Building#_Structure_WMUProjectNumber.Description_Rev#_YYYYMMDD
ENERGY MODEL	Building#_Energy_WMUProjectNumber.Description_Rev#_YYYYMMDD
CONSTRUCTION MODEL	Building#_Const_WMUProjectNumber.Description_Rev#_YYYYMMDD
COORDINATION MODEL	Building#_Coordination_WMUProjectNumber.Description_Rev#_YYYYMMDD
LIFECYCLE MODEL	Building#_Lifecycle_WMUProjectNumber.Description_Rev#_YYYYMMDD

### 2. Model Structure:

Model will be separated by the following disciplines for design and construction coordination by all project participants throughout the design and construction process.

- **Architectural**
- **Mechanical, Electrical, Plumbing – MEP**
- **Structure**
- **Civil**

### 3. Measurement and Coordinate Systems:

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 Units

Design setup for managing large models is at the discretion of the AE Firm. Due to large file sizes of BIM models, model units should be created in a logical manner determined by project scope.

## SECTION L: PROJECT DELIVERABLES

### 1. Project Deliverable Definitions for each project phase.

\* To be performed by WMU.

BIM SUBMITTAL ITEM	STAGE	APPROXIMATE DUE DATE	FORMAT	NOTES
Complete E202 Checklist	Programming		PDF	WMU and design team will complete AIA E202 checklist to define LOD – Level of Development.
Schematic Design Model for review	Schematic Design		RVT	The current Revit Model .rvt will be uploaded to the Western Michigan University collaboration site at the conclusion of the SD phase.
Design Development Model for review	Design Development		RVT	The current Revit Model .rvt will be uploaded to the Western Michigan University collaboration site at the conclusion of the DD phase.
Construction Documents for bidding	Construction Documents		PDF	2D PDF files will be issued for bidding. All 2D documents must use WMU's defined file naming format.
Coordination Model for Constructability	Construction		NWD	Navisworks Manage will be used to coordinate all disciplines to perform scheduling, clash detection, and visualization.
Record Model	Construction & Closeout		RVT	The record model will become the WMU LOD 500 deliverable.
Equipment ID Tagging	Construction		RVT	Assign TMA ID numbers to all equipment included in Section N before construction phase begins.
Submittal and Shop Drawings	Construction		PDF	All submittals will be coordinated, reviewed, and uploaded in PDF format to the Western Michigan University Collaboration Site.
Asset Management/Model Coordination	Construction		RVT	All reviewed submittals will be uploaded to the WMU document vault by the CM/GC using the WMU file naming convention Issue 04 outlined in Section H.
LOD 500 Information Entry	Construction		RVT	Enter equipment asset data referenced by the WMU TMA identification number into The defined Revit model parameters.
Facilities Management	Construction		RVT	Final LOD 500 model(s) to include information required in Section N – Building Information Model Requirements – Lifecycle BIM.
Final 2D As-Built Drawings	Closeout		DWG PDF	Final 2D drawings will be output from the Revit® model and provided in Autocad DWG as well as PDF in full sets.

Responsible parties for each requirement will be established by the overall project contract and coordination schedule.

**SECTION M: DELIVERY STRATEGY & LOD – LEVEL OF DEVELOPMENT****1. Delivery and Contracting Strategy for the project:**

The intent of the building information modeling process is to improve project visualization, coordination, construction, and hand over to facility management process. All models will be made available to the WMU as well as the design and construction project participants throughout the design, construction, and hand over process.

**2. Team Selection Procedure:**

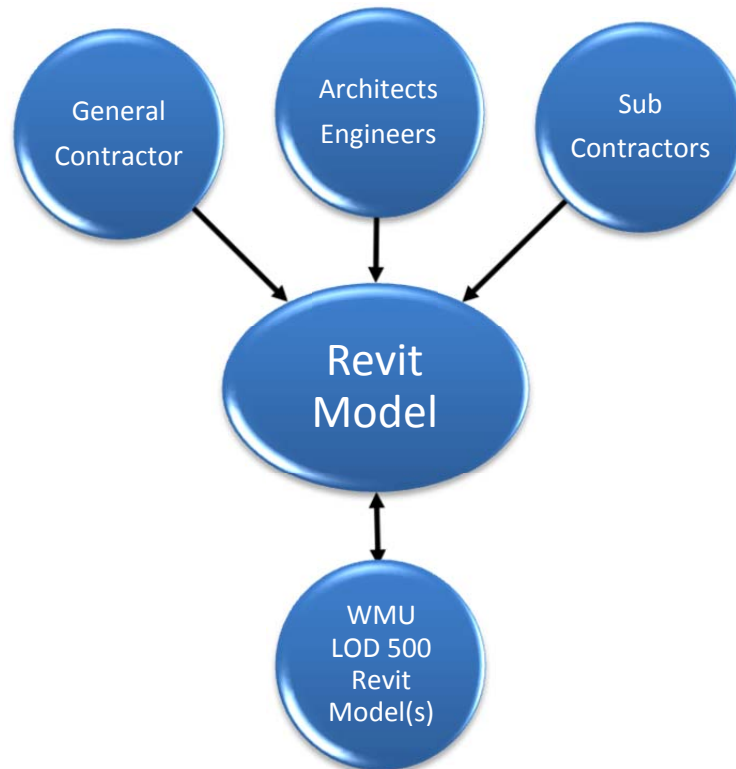
Team members will not be selected entirely on their ability to participate in the BIM process. However those firms that do not have the capacity or capability will be required to partner with a firm that can provide the required BIM deliverable.

**3. Western Michigan University LOD – Level of Development**

The following outlines Western Michigan University's definition of Level of Development – LOD for building information model – BIM deliverables. As defined by the AIA document E202 – 2008.

- **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 Model Delivery** – 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.
  - All Revit models must contain the required equipment data outlined in Section N: Building Information Model Requirements – Lifecycle BIM. **To accomplish this, WMU will provide project participant with WMU specific Revit Template files that will schedule WMU required equipment information parameters within each WMU Revit Model(s).**
  - The data in Section N, required by WMU, will be entered by each awarded contractor into the specific Revit Model Parameters **Data entry should be completed as soon as the equipment is installed and/or upon startup. Data entry should not be held until the end of the project.**

- All as-built record drawings and documentation at the time of turnover must be provided in Revit. Elements included in the model must be detailed in both the 2D and 3D documentation for internal WMU use. Elements must be clearly marked or tagged and visual in both the 2D and 3D documentation.
- All record drawings must be submitted in AutoCAD DWG, a full set of PDF files, and the Revit RVT models/file(s)



## SECTION N: BUILDING INFORMATION MODEL REQUIREMENTS – LIFECYCLE BIM

The following is a summary of the items requires 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.

### 1. SPACE IDENTIFICATION - Rooms

- Room - ID NUMBER, USE, DEPARTMENT
- Size - SQUARE FEET, VOLUME
- Finishes – FLOORING, BASE, PAINT, WALL COVERINGS, CEILING TYPE AND INFORMATION
- Window Coverings - WMU\_MANUFACTURER, O&M

### 2. CONVEYANCE SYSTEMS

- Elevators – Package Units; WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, PARTS CATALOG, O&M, SUBMITTAL
  - Motors - 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
  - Pumps - WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE SESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, PUMP CURVE, GPM, 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
  - Controls- DRAWINGS, SEQUENCE OF OPERATION, LOGIC PROGRAMMING
- ADA Lifts – Package Units; WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, PARTS CATALOG, O&M, SUBMITTAL
- Dock Lifts and Levelers – Package Units; WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, PARTS CATALOG, O&M, SUBMITTAL
- Escalators – Package Units; WMU\_Tag #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, PARTS CATALOG, O&M, SUBMITTAL

### 3. LIFE SAFETY/ SECURITY SYSTEMS

#### Fire Safety Systems

- Fire Alarm - WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, O&M, SUBMITTAL
- Components - STROBE, SENSOR, HORN, PULL STATION AND OTHER FEATURES; CUT SHEET FOR EACH LOCATION
- Fire Suppression - SYSTEM RISER DIAGRAM, SHUT OFF VALVE LOCATIONS

- Pumps - WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, PUMP CURVE, GPM, 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
- Backflow Preventer - WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M, SUBMITTAL
- Tamper Prevention - WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M

Security Systems

- Card Access - COMPONENT INFORMATION, CUT SHEETS OR O&M WHERE APPLICABLE, EACH LOCATION
- Cameras - COMPONENT INFORMATION, CUT SHEETS OR O&M WHERE APPLICABLE, EACH LOCATION
- Motion Sensors - COMPONENT INFORMATION, CUT SHEET/O&M WHERE APPLICABLE, EACH LOCATION
- Motorized openers - COMPONENT INFORMATION, CUT SHEET/O&M WHERE APPLICABLE, EACH LOCATION, O&M, PROGRAMMING AND SETUP INFORMATION

**4. OFFICE/CLASSROOM TECHNOLOGY**Office Technology

- Smart boards - COMPONENT INFORMATION, CUT SHEETS OR O&M WHERE APPLICABLE, EACH LOCATION
- Projectors - COMPONENT INFORMATION, CUT SHEETS OR O&M WHERE APPLICABLE, EACH LOCATION
- Screens - COMPONENT INFORMATION, CUT SHEETS OR O&M WHERE APPLICABLE, EACH LOCATION
- TV/Sound systems - COMPONENT INFORMATION FOR RECEIVERS, SPEAKERS, AMPLIFIERS, DVD, OVERHEAD CAMERAS, CUT SHEETS OR O&M WHERE APPLICABLE, EACH LOCATION

Classroom Technology

- Projectors - COMPONENT INFORMATION, CUT SHEETS OR O&M WHERE APPLICABLE, EACH LOCATION
- Screens - COMPONENT INFORMATION, CUT SHEETS OR O&M WHERE APPLICABLE, EACH LOCATION
- TV/Sound systems - COMPONENT INFORMATION FOR RECEIVERS, SPEAKERS, AMPLIFIERS, DVD, OVERHEAD CAMERAS, CUT SHEETS OR O&M WHERE APPLICABLE, EACH LOCATION
- Multi-System Interaction - PRODUCT AND SYSTEM PROGRAMMING FILES AND PRODUCT INFORMATION FOR ALL INTERACTIVE CARTS AND PODIUMS DESIGNED TO MERGE MULTIPLE INPUTS.

**5. INFORMATION TECHNOLOGY SYSTEMS**

Unknown Categories– WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, O&M

**6. 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, SEQUENCE OF OPERATION, O&M, SUBMITTAL

- Supply 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, FAN CURVE
  - **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

- Return 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, FAN\_CURVE
  - **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



**Exhaust 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, SHEAVE NUMBERS, SEQUENCE OF OPERATION, 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

**Outside Air Supply Systems, Heat Recovery Units** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M, SUBMITTAL

- **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, FAN CURVE
- **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** – 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, FAN CURVE, 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
- **Fire Dampers** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M, SUBMITTAL, MOTOR INFORMATION AT EACH LOCATION

7. **KITCHEN EXHAUST SYSTEMS** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, O&M, SUBMITTAL

- **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, SHEAVE NUMBERS, FAN CURVE
- **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

8. **LAB EXHAUST SYSTEMS** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, O&M, SUBMITTAL

- **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, SHEAVE NUMBERS, FAN CURVE

- **Motor** – WMU\_MOTOR ID, WMU\_WM\_U\_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

#### 9. BUILDING AUTOMATION, MONITORING, SPACE CONTROL

- **Thermostat and remote Sensors** – WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, UNIT(S) CONTROLLED, SPACES CONTROLLED AT EACH LOCATION.
- **Remote Static pressure sensors** – WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, UNIT(S) CONTROLLED, SEQUENCE OF OPERATION OR SPACE/EQUIPMENT CONTROLLED, AT EACH LOCATION.

#### 10. HEATING FUNCTIONS

##### Steam Delivery and Condensate Return

- **Coils** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, O&M, SUBMITTAL
- **Pumping traps, Receivers** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, O&M, SUBMITTAL
- **Spence type PRV's** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, O&M, SUBMITTAL

##### Heating Water Distribution

- **Pumps** - WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, PUMP CURVE, 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
- **Heat Exchangers** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, PUMP CURVE, O&M, SUBMITTAL
- **Fin Tubes and Radiant Panels** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, PUMP CURVE, O&M, SUBMITTAL

Cabinet and/or Suspended Unit Heaters

- **Unit Heaters** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, BTU's, SEQUENCE OF OPERATION, O&M, SUBMITTAL
- **Cabinet Unit Heaters** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, BTU's, SEQUENCE OF OPERATION, O&M, SUBMITTAL
- **Gas fired units** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, O&M, SUBMITTAL
- **Remote sensors** – WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M

**11. COOLING FUNCTIONS**

Chillers and Refrigeration Systems – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, UNIT(S), SPACES CONTROLLED, AT EACH LOCATION, STEAM ABSORPTION UNITS, ELECTRIC CHILLERS, O&M, SUBMITTAL

- **Cooling Towers** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, CONDENSER MOTORS, SUMPS, DRAINS, CONDITION DIRECT EXPANSION REFRIGERATION, 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
- **Chilled water pumps** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, PUMP CURVE, 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
- **Split Systems and Package (Leibert type) AC Units** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, CAPACITY in BTU, O&M, SUBMITTAL
  - Sensors – WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, O&M
  - Condensation pumps – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, O&M

**12. PLUMBING SYSTEMS**Domestic Plumbing

- **Meters** – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, O&M, SUBMITTAL

- Back flow Preventers – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, CERTIFICATION, O&M, SUBMITTAL
- Booster/Circulation Pumps – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, DESIGN CRITERIA, SEQUENCE OF OPERATION, 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
- Water Softeners - WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, O&M, SUBMITTAL
- Heaters and Heat Exchangers - WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, O&M, SUBMITTAL
- Pressure Relief Valves – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, CUT SHEETS AT EACH LOCATION, O&M, SUBMITTAL
- Expansion Tanks - WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, CUT SHEETS AT EACH LOCATION, O&M, SUBMITTAL

Sanitary System

- Sump Pumps – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, PUMP CURVE, 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
- 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 – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, SEQUENCE OF OPERATION, PUMP CURVE, 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

**13. ARCHITECTURAL**Building Envelope Systems

- Roof System – WMU\_MANUFACTURER, TYPE AND MATERIAL INFORMATION, GREEN ROOF DETAILS, SUBMITTAL
- Exterior Doors – WMU\_MANUFACTURER, WMU\_MODEL #, GLASS DETAILS, REVOLVING/MOTORIZED DETAILS, SEALANT, SUBMITTAL
- Exterior Finishes – (METAL PANELS, STONE, BRICK, MANUFACTURED PANELS)
- Windows – WMU\_MANUFACTURER, WMU\_MODEL #, REFLECTION, COLOR, GRADE, SEALANT, SUBMITTAL
- Skylights – WMU\_MANUFACTURER, WMU\_MODEL #, REFLECTION, COLOR, GRADE, SEALANT, SUBMITTAL
- Access Doors and Hatches, Ladders – WMU\_MANUFACTURER, WMU\_MODEL #, SUBMITTAL

**14. 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 #, SEQUENCE OF OPERATION, O&M, CAPACITY, SUBMITTAL

- Storage tanks – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, CUT SHEETS AT EACH LOCATION, O&M

#### Lab Gas Systems

- Regulator stations – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M
- Monitoring and Alarm Systems – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M
- Vacuum Pumps – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M

**15. ELECTRICAL**Electrical Distribution System

- Transformers – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M, SUBMITTAL
- Switch Gear – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M, SUBMITTAL
- Panels – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M, SUBMITTAL
- Major Equipment Service Disconnects – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M, SUBMITTAL

Emergency Electric Generation

- Service Entrance – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M
- Emergency Generators – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M, PARTS LISTS, SERVICE HISTORY, SUBMITTAL
- Transfer Switches - WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M, SUBMITTAL
- Emergency Lighting Components – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, DESCRIPTION, WMU\_LOCATION, WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M, SUBMITTAL

Lighting Systems

- Fixtures – WMU\_TAG #, WMU\_TYPE DESC, WMU\_SUBTYPE DESC, 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 – WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M, SUBMITTAL
- Occupancy Sensors – WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M, SUBMITTAL
- Timers – WMU\_MANUFACTURER, WMU\_MODEL #, WMU\_SERIAL #, O&M, SUBMITTAL

**SECTION O: BUILDING INFORMATION MODEL REQUIREMENTS – LIFECYCLE BIM**

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 models.

<b>Systems Color Coding Guideline</b>		
<b>Revit Component:</b>	<b>Color</b>	<b>Formula R/G/B</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