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<th>Description</th>
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</tbody>
</table>
1. **INTRODUCTION**

1.1. **MISSION OF THE UNIVERSITY BIM STANDARDS**

The mission of the University of Tennessee Knoxville (University) Building Information Modeling (BIM) standards is to utilize BIM technology for the purposes of Capital Project Planning, Facilities Management and Campus Administration and Services-related throughout the University of Tennessee.

These standards are an amendment to the requirements outlined by the State of Tennessee Office of the Architect (OSA) BIM Standards (https://www.tn.gov/osa.html) and identify specific BIM needs to fit the University’s goals. Project Teams should follow OSA’s latest standards for complete information on requirements, or clarification of definitions and responsibilities.

1.2. **PURPOSE AND APPLICATION OF UNIVERSITY BIM STANDARDS**

The University has adopted BIM as a tool for project documentation and development, as-built record documentation, and facility management. These guidelines are intended to act as standards for BIM development from schematic design to project closeout. These guidelines will assist with the establishment of protocols for the development, use, transmission, and exchange of digital data, defining expectations of Level of Development for Model Elements at various milestones of the project. These standards encompass the development of the following key BIM Project Deliverables:

<table>
<thead>
<tr>
<th>BIM DELIVERABLE</th>
<th>PROJECT PHASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIM Execution Plans</td>
<td>Updated at the end of each phase</td>
</tr>
<tr>
<td>Design BIMs</td>
<td>End of Construction Documents Phase</td>
</tr>
<tr>
<td>Record BIMs (Design BIMs and Construction BIMs)</td>
<td>Project Closeout</td>
</tr>
<tr>
<td>Construction Drawings</td>
<td>Per Designer Manual’s Requirements</td>
</tr>
</tbody>
</table>

The University has made every attempt to provide these standards as complete as possible. However, if there are items not covered in this guide, please contact the University’s Facilities Services Project Manager for guidance.

1.3. **PROJECT BIM GOALS AND OBJECTIVES**

The University’s major BIM goals and objectives for each project are listed below.

<table>
<thead>
<tr>
<th>GOAL DESCRIPTION</th>
<th>PROJECT PHASE</th>
<th>RESPONSIBLE PARTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide the University a LOD 350 model including ARCH, MEP and Structure for Construction</td>
<td>Construction</td>
<td>CM/GC</td>
</tr>
</tbody>
</table>
2. OBLIGATIONS TO USE BIM AND GENERAL PRINCIPALS

The following definitions of ownership and Level of Developments are specific to University projects.

2.1. OWNERSHIP AND RIGHTS OF DATA

It is important to the University to own, reuse, and properly manage building data throughout the facility lifecycle. The goal of the BIM process is to develop deliverables in support of the owner, and for utilization in facility management. University will retain ownership of all documentation created throughout the BIM process including Revit, DWG files, BIM Models and facility data developed for the project. The University may make use of this data following any deliverable. The University will release the Design and Construction Teams of any liabilities related to the model.

2.2. LEVEL OF DEVELOPMENT

The BIMForum’s Level of Development (LOD) Specifications will serve as the framework for defining the progression of the model components. The LOD defines the relevant model element geometry to be included along with minimum parameters to facilitate the ongoing use of the BIM. The information below is referenced from the BIMForum’s LOD Specification Version 2019. The Design and Construct Teams are expected to progress their models to the appropriate LOD as defined below. This defines both the geometry and non-graphic information to be included in the Record Construction BIM and Conformed Design Intent BIM.

- **LOD 100 – Conceptual Model:**

  The Model Element may be graphically represented in the Model with a symbol or other generic representation, but does not satisfy the requirements for LOD 200. Information related to the Model Element (i.e. cost per square foot, tonnage of HVAC, etc.) can be derived from other Model Elements.

  The Model would consist of overall building massing representative of area, height, volume, location and orientation that may be modeled in three dimensions.

- **LOD 200 – Approximate Model:**
Model Elements are modeled as generalized systems or assemblies with approximate quantities, size, shape, location, and orientation. Additional information may also be attached to Model Elements.

Model includes basic elements such as windows and doors. This level of modeling is for visualization and basic energy analysis and is similar to the schematic design or design development.

- **LOD 300 – Precise:**

  Model Elements are graphically represented within the Model as a specific system, object or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.

  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 350 – University’s Model Delivery:**

  Model Elements are modeled as detailed assemblies that accurately represent specific systems, objects, or assemblies in terms of quantity, size, shape, orientation, and interfaces with other building systems with the detail necessary for cross-trade coordination and construction layout. Non-graphic information may also be attached to the Model Element.

  The Model represents the project as it has been constructed and focus on facility management by identifying key building equipment and space information and including it in the Model. This includes ARCHIBUS equipment ID numbers and key equipment information outlined in Section 6.5.

  - All models must contain the required space and equipment information outlines in Sections 6.4 and 6.5
  - Data entry should be completed as soon as the equipment is installed and should not be held until the end of the project.
  - All record drawings and documentation at the time of turnover must be provided in native file format. Elements included in the model must be detailed in both the 2D and 3D documentation for internal University use.
  - All record drawings must be submitted in AutoCAD DWG, PDF and BIM in its native file format.

While the BIM Forum LOD Specification defines the minimum geometric requirements, Appendices B and C outline required components that will enable the University to link the Record BIMs with ARCHIBUS system for the facility lifecycle maintenance and operation requirements.

- **LOD 400 – Fabrication:**

  The Model Element is graphically represented within the Model as a specific system, object, or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be
attached to the Model Element. This Model level of development is considered suitable for fabrication and assembly.

- **LOD 500**

Model Elements are modeled as constructed assemblies actual and precisely representing size, shape, location, quantity, and orientation, including As-Built conditions. The Model represent the project as it has been constructed and focus on facility management by identifying key building equipment and space information and including it in the Model. This includes ARCHIBUS equipment ID numbers and key equipment information outlined in Section 6.5.

- All models must contain the required space and equipment information outlines in Sections 6.4 and 6.5
- Data entry should be completed as soon as the equipment is installed and should not be held until the end of the project.
- All record drawings and documentation at the time of turnover must be provided in native file format. Elements included in the model must be detailed in both the 2D and 3D documentation for internal University use. Elements must be marked or tagged and visual in both the 2D and 3D documentation.
- All record drawings must be submitted in AutoCAD DWG, PDF and BIM in its native file format.

While the BIM Forum LOD Specification defines the minimum geometric requirements, Appendices B and C outline required components that will enable the University to link the Record BIMs with ARCHIBUS system for the facility lifecycle maintenance and operation requirements.

### 3. BIM REQUIREMENTS FOR THE UNIVERSITY

The University will provide the following information (where available) to the Project Teams in support of the development and delivery of BIM according to these guides and standards.

- Provide verification that the Design Team’s BIM is developed in accordance to the University’s BIM Standards throughout the Design phase to ensure the Construction Team will receive an acceptable product to being their BIM work.
- Provide relevant project data as required by the BIM project execution plan.
- Models of existing facilities will be made accessible by the University along with other models, drawings and specifications of past projects for renovation, additions, and use in connecting to adjacent facilities.
- The University’s Space Coordinator will coordinate information regarding floor level and elevation naming conventions outlined in the “Room Numbering and Floor/Level Conventions” section in the [2020 Design Guidelines and Preferences](#) out with Design and Construction Teams.

#### 3.1. UNIVERSITY OF TENNESSEE BIM MANAGER

The University will identify a BIM Manager for each project who will serve as the main point of contact between the Design Team, Construction Team, and the University for all BIM related issues. The University’s BIM Manager responsibilities include:
- Collaborate with the Design and Construction teams to develop the BIM Execution Plan.
- Serve as liaison between all design and construction team members to the University for all BIM-related activities.
- Provide specific BIM Use Cases that identify unique project needs.
- Provide oversight and direction to all project team members so they are able to perform their work in accordance with the required deliverables outlined in this document.
- Provide final approval of the project’s BIM Execution Plan.
- Distribute BIM project documentation to project teams as outlined in Section 8.1
- Coordinate and participate with model reviews.
4. **BIM FILES**

4.1. **MODEL NAMING**

Design and Construction Teams are responsible for documenting the model naming for their final BIM deliverables following the naming convention below.

<table>
<thead>
<tr>
<th>MODEL NAMING CONVENTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUILDING NUMBER</td>
</tr>
<tr>
<td>----------------</td>
</tr>
</tbody>
</table>

- Building Number: Official eight-digit building number. This building number will be provided to the Design and Construction Teams by the University’s Project Manager.
- Model Author: Standard model author abbreviations as listed below. Model author abbreviations shall not be edited but can be removed or added with the approval of the University as needed per project:

<table>
<thead>
<tr>
<th>ABBREVIATION</th>
<th>MODEL AUTHOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARCH</td>
<td>Architect</td>
</tr>
<tr>
<td>STRCE</td>
<td>Structural Engineer</td>
</tr>
<tr>
<td>PLMBE</td>
<td>Plumbing Engineer</td>
</tr>
<tr>
<td>HVAECE</td>
<td>HVAC Engineer</td>
</tr>
<tr>
<td>FRPTE</td>
<td>Fire Protection Engineer</td>
</tr>
<tr>
<td>ELCTE</td>
<td>Electrical Engineer</td>
</tr>
<tr>
<td>LOWVE</td>
<td>Low Voltage Engineer</td>
</tr>
<tr>
<td>CNTRM</td>
<td>Construction Manager</td>
</tr>
<tr>
<td>GNRLC</td>
<td>General Contractor</td>
</tr>
<tr>
<td>STRCTC</td>
<td>Structural Contractor</td>
</tr>
<tr>
<td>DSNGB</td>
<td>Design Builder</td>
</tr>
<tr>
<td>PLMBC</td>
<td>Plumbing Contractor</td>
</tr>
<tr>
<td>HVACC</td>
<td>HVAC Contractor</td>
</tr>
<tr>
<td>FRPTC</td>
<td>Fire Protection Contractor</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

- Date: Date format should be a four-digit year, two-digit month and two-digit day. Example:

<table>
<thead>
<tr>
<th>BUILDING NUMBER</th>
<th>MODEL AUTHOR</th>
<th>DATE</th>
<th>FILE EXTENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>50110100</td>
<td>ARCH</td>
<td>20170928</td>
<td>.RVT</td>
</tr>
</tbody>
</table>

4.2. **ARCHITECTURE MODELS**

Architecture models constructed using Revit should not be delivered as central files. Models should be detached from the central file, worksets discarded, and delivered as fully contained files not attached to other models. Custom families should be delivered to the University attached to the models or as a separate file to be reloaded.
The architectural model file shall contain all architectural features for a building including but not limited to:

- Grid lines that are labeled and visible.
- Floor plans named according to the University’s Room Numbering and Floor/Level Conventions.
- Building Elevation Plans
- Exterior Wall Systems
- Interior Wall Systems including landscape furniture
- Fire Rated Walls colored coded per the following guidelines:

<table>
<thead>
<tr>
<th>WALL RATING</th>
<th>COLOR</th>
<th>RGB Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Hour</td>
<td>Yellow</td>
<td>255/255/0</td>
</tr>
<tr>
<td>1.5-Hour</td>
<td>Orange</td>
<td>255/128/0</td>
</tr>
<tr>
<td>2-Hour</td>
<td>Red</td>
<td>255/255/0</td>
</tr>
</tbody>
</table>

- Architectural Floor Slabs
- Roofing Systems
- Ceiling Plans
- Circulation including elevators, stairs, escalators and railings.
  - The room boundary of open stairs between two levels should be split between levels.
  - Room boundaries for multiple elevators in one open shaft should be equally split between the elevator cars.
- Room boundaries and tags per the University’s Room Numbering and Floor/Level Conventions.
- Doors
- Windows, interior glazing, curtain walls and storefront.
- Classroom furniture
- Millwork and casework
- All plumbing fixtures
- Toilet partitions

4.3. **STRUCTURAL MODELS**

Structural models constructed using Revit should not be delivered as central files. Models should be detached from the central file, worksets discarded, and delivered as fully contained files not attached to other models. Custom families should be delivered to the University attached to the models or as a separate file to be reloaded.

The structural model file shall contain all architectural features for a building including but not limited to:

- Foundations
- Columns, beams and joists
- Column grids
- Brace frames and shear walls
- Structural slab
- Specialties
• Miscellaneous structural components.

4.4. MECHANICAL, ELECTRICAL AND PLUMBING MODELS

Mechanical, electrical and plumbing models constructed using Revit should not be delivered as central files. Models should be detached from the central file, worksets discarded, and delivered as fully contained files not attached to other models. Custom families should be delivered to the University attached to the models or as a separate file to be reloaded.

The mechanical model file shall contain all architectural features for a building including but not limited to:

• Mechanical equipment following the requirements outlined in Appendix B.
• Rain Leader
• Overflow Drain
• Vent
• Waste Water
• Domestic Cold Water
• Domestic Hot Water
• Fire Protection
• Gases
• Fire Alarm System
• Mechanical Ductwork
• Electrical Conduit
• Electrical Lighting
• Fire/Smoke Dampers
• Valves
• Plumbing Equipment and Fixtures
• Electrical Equipment
• Electrical Panels and Schedules
• Specialties

5. BIM REQUIREMENTS FOR DESIGNERS

5.1. BIM STANDARDS FOR DESIGNERS

OSA’s standards should be reviewed for information regarding disciplines that are required to produce BIM, model accuracy specifications and BIM deliverables at each design phase deliverable.

5.2. BIM SOFTWARE

All BIM project participants are required to have their own software licenses and computers capable of running the needed software to perform their portion of work. The software and version used shall be identified in the BIM Execution Plan. Projects shall remain on the same software release throughout the life of the project if possible. Updates to a new software release should be discussed a project milestone. BIM-related files used by the Design Team will be shared through a common project site managed by the Design Team.
Design firms are required to perform internal coordination between disciplines to ensure quality project delivery.

5.3. **GENERATE SPACE INVENTORY**

Space information shall be collected for use in the University’s Space Management System following these guidelines:

- Outside covered circulation areas of ten net square feet or greater shall be tracked and identified by name and room number, even if those spaces are not listed in the program.
- Spatial data shall be generated, and associated with bounding elements (walls, doors, windows, floors, columns, ceilings).
- The Net Square Footage (NSF) shall be modeled for each functional space. BIM Spaces shall be represented and broken down into area types (Example: Public Corridor, Mechanical, Office Staff, Classroom, etc.) as defined in Appendix A of the UT Physical Facilities Inventory 2017 document. A physical space may contain several areas that are treated individually (lobby, partitions, cubicles, entrance areas). If two areas have different functional space classifications, even though they are within the same physical space, they shall be modeled as two separate spaces. For example, a work area such as a built-in reception desk within an entrance or lobby shall be modeled as separate non-overlapping spaces. These spaces might also be grouped into a Zone, for visualization and analysis purposes (e.g., for thermal simulation calculations). Space/area schedules and diagrams must be dynamically updated from the model geometry.
- Review University’s Room Numbering and Floor/Level Conventions for all floor levels and room number assignments. All room numbers shall be approved by University’s Space Coordinator.

Refer to Appendix A for a list of parameters shall be associated with space elements. Attributes marked with an ‘X’ in the ‘BIM’ column should be populated by the Design or Construction Teams as appropriate.

5.4. **GENERATE EQUIPMENT INVENTORIES**

Each BIM equipment object shall contain geometric data and a set of attributes. Equipment attribute data shall have the ability to be extracted from the project BIM’s deliverable and linked to our ARCHIBUS database. Refer to Appendix B for a list of attribute data that shall be provided for each piece of equipment as it is relevant to the project by the Design Team and populated by the Construction Teams as appropriate.

5.5. **BIM DELIVERABLES BY PHASE**

The Design Team shall follow OSA’s standards for executing the appropriate deliverables at each phase of the design process. The following are University clarifications on BIM deliverables:

- Author the BIM Execution Plan for the design phase of a project. Review OSA’s standards for requirements of the BIM Execution Plan. The following
- **Design BIM:** The Design Team will be required to submit their Design BIM at LOD 300 for each project discipline to the University as part of their construction documents package. This model will be made available to the construction teams.
- All BIM updates by the Design Team will be delivered to the Construction Team as a Design BIM at LOD 300 as defined by the BIMForum’s LOD Specification Version 2019.
- Design BIM should include all required model parameters listed in Appendices B and C when delivered to the Construction Team.
- **Record BIM:** By the end of Closeout, the Designer shall provide the Designer’s Record BIM at LOD 300 that reflects changes cause by Addenda, modifications, and observed changes recorded by the contractors.
- **Construction Drawings/Record Drawings:** By the end of Construction Phase, the designer shall provide Construction Documents as outlined by the Designer’s Manual.

At the project’s completion, final digital project documentation will be submitted to University by both the Design and Construction teams. This includes the following items that will ultimately become the University's As-Maintained and Archived BIMs. Deliverable requirements for both teams include:

<table>
<thead>
<tr>
<th>DELIVERABLE</th>
<th>RESPONSIBLE PARTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIM Execution Plan</td>
<td>AE/CM/GC Firm</td>
</tr>
<tr>
<td>Design BIM (LOD 300)</td>
<td>AE Firm</td>
</tr>
<tr>
<td>Record BIMs (Native File Format) (LOD 500)</td>
<td>CM/GC Firm</td>
</tr>
<tr>
<td>Final 2D As-Built Drawings (PDF and DWG)</td>
<td>CM/GC Firm</td>
</tr>
<tr>
<td>Operations and Maintenance Manuals</td>
<td>CM/GC Firm</td>
</tr>
<tr>
<td>Equipment ID Tagging</td>
<td>CM/GC Firm</td>
</tr>
</tbody>
</table>

### 5.6. QUALITY CONTROL

The Construction and Design Teams will be responsible for verifying that the model meets the requirements described in University’s Project Execution Plan and Standard Guides. The following checks should be performed to assure quality.

<table>
<thead>
<tr>
<th>CHECKS</th>
<th>DEFINITION</th>
<th>RESPONSIBLE PARTY</th>
<th>SOFTWARE PROGRAMS</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Check</td>
<td>Review of all 3D design intent</td>
<td>AE Firm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Check</td>
<td>Review of all 2D design intent (Review of drawings)</td>
<td>AE Firm</td>
<td>PDF</td>
<td></td>
</tr>
<tr>
<td>Coordination</td>
<td>Coordinate all disciplines including Arch, MEP and Structure to reduce construction RFI's and change orders</td>
<td>AE/CM/GC/UT/ Subs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Record Model</td>
<td>Submit Record Model including required information defined by Model parameters included in Sections 6.4. and 6.4.</td>
<td>CM/GC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Checks</td>
<td>Ensure University's Standard Guides document have been followed</td>
<td>AE/ CM/GC /UT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model Integrity Checks</td>
<td>Ensure that the project room and equipment information has no undefined, incorrectly defined or duplicated elements</td>
<td>AE/ CM/GC /UT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>----------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model Integrity Checks</td>
<td>External model coordination should be performed between disciplines including clash detection and visualization</td>
<td>CM/GC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.7. CLASH DETECTION

Clash detection allows the project team to verify clearance, analyze conflicts, deliver quality documentation, and coordinate between disciplines to reduce RFI and Change Order submittals.

- It is the Design/Construction Teams responsibility to conduct and manage a Clash Detection process so that all major interferences between building components will have been detected and resolved before construction. The Design Team will be responsible for Clash Detection during the Design Phase. The Construction Team will be responsible for Clash Detection during the Construction Phase.

- The Design/Construction Teams BIM Managers shall assemble a composite BIM from all of the BIMs of each design discipline for the purpose of performing a visual check of the building design for spatial and system coordination. An updated clash report will be issued by the Design/Construction Teams BIM Manager to the project team at project milestones.

- Coordination software shall be used for assembling the various design BIMs to electronically identify, collectively coordinate resolutions, and track and publish interference reports between all disciplines.

- The Project Team shall review the model and the Clash Reports in coordination meetings on a regular as-needed basis until relevant 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.

5.8. GEOREFERENCING

The Designer and the Designer’s Consultants are required to geo-reference BIMs, site plans and associated construction drawings. The project geographical locations shall be set using Tennessee State Plane coordinates. The following datum should be used: North American Data 1983 (NAD83) HARN for horizontal control and North American Datum (NAVD) 1988 for vertical control.

5.9. EXISTING CONDITIONS
For renovations and/or additions projects, the University will provide BIM (where available) of existing campus buildings that have been converted from 2D to 3D. Each of these models will state that “no guarantee is implied as to the accuracy of dimensions or building features shown and users of the models assume full responsibility for verifying its accuracy.”

5.10. STAFFING

The Designer shall identify a Design BIM Manager for each project. Individual assigned by the Design Team to serve as the main point of contact between the Design Team, Construction Team, and the University for all BIM related issues. The responsibilities below do not supersede the overall chain of command that exists on a project. The identification of BIM project-specific leadership roles will be outlined in the BIM Project Execution Plan as described in OSA’s standards. Responsibilities include the following:

- Author the BIM Execution Plan for the design phase of a project.
- Advise and support the University’s Facilities Services Project Manager, serving as the technical resource for all BIM-related issues.
- Provide oversight to the design BIM use cases.
- Ensures development and compliance with University’s BIM Guides and Standards.
- Responsible for the development, coordination, publication, and verification that necessary configurations and standards required for seamless integration of design and construction modeling information has been implemented.
- Assembles the design model for coordination meetings.
- Facilitates use of the design models in design coordination/clash detection meetings and provides detection reports by the identification and resolution of collisions.
- Ensures that BIMs are used appropriately to test design requirements/criteria for functionality.
- Assumes responsibility for the proper classification of all spaces in the model according to the requirements listed in Appendices B and C to ensure direction downstream use for facility management.
- Schedules, coordinates, and facilitates BIM technical meetings between the Design Team and the University during the Design phase.
- The Design BIM Manager and discipline-specific BIM Managers are required to coordinate their LOD 300 building components, assemblies and systems.
- Determines the project BIM geo-reference point(s), and assures all technical discipline models are properly referenced.
- Primary interface between the Design and Construction Teams and the University for BIM data and file transfers as required at each design phase.
- Coordinates with the Construction Team BIM Manager to assure the creation of proper BIM final deliverables.
- Monitors compliance with the University’s Standards and Guides documents and related BIM Level of Development (LOD) requirements.

5.11. BIM EXECUTION PLAN

At the initiation of the project, the University’s Facilities Services Project Manager will collaborate with the project’s primary architect and engineer to identify the Design BIM Manager and other key individuals. These key individuals will be responsible to document the collaborative design and construction workflows that will meet the University’s project
delivery requirements. The Design BIM Manager shall submit their BIM Execution Plan to the university within 60 days after contract has been signed. If the Construction Team was not under contract at this stage, they shall review and update the BIM Execution Plan as appropriate with information about the Construction Phase within 60 days after contract has been signed. The requirements of the BIM Execution Plan are outlined by OSA’s standards.

6. BIM REQUIREMENTS FOR CONSTRUCTION

6.1. BIM STANDARDS FOR CONSTRUCTION

OSA’s standards should be reviewed for information regarding disciplines that are required to produce BIM, model accuracy specifications and BIM deliverables at each design phase deliverable.

6.2. OPEN STANDARDS AND COLLABORATION

The University encourages the use of open standards and collaboration tools to facilitate interoperability between the University, members of the Design Team, the Design Team and the Construction Team, and any other consultant involved in the BIM process.

During the construction phase, the Construction Team will maintain a record construction BIM which will be used by the Design and Construction Teams to review and compare any changes, deviations, additions or corrections to the BIM’s as implemented during the construction process. The Construction Team will lead model review meetings focused on providing a 3D review of the model and where project team members will have the opportunity to ask questions and address concerns. The amount of model review meetings will be at the discretion of the University’s Facilities Services Project Manager. Also, the Record Construction BIM model should be made available for on-going review by the University project team members.

Design and Construction teams shall outline what software will be used and how they intend to collaborate and share models to support the project’s BIM Uses and develop the required deliverables.

6.3. BIM USES

The Construction Team and University shall identify project specific BIM uses based on the project scope and objective. These uses will be outlined in the BIM Execution Plan as explained in OSA’s standards.

6.4. BIM SOFTWARE

All BIM project participants are required to have their own software licenses and computers capable of running the needed software to perform their portion of work. The Construction Team should use commercially available software that provides interoperability between the difference software applications used within a project. The software and version used shall be identified in the BIM Execution Plan. Projects shall remain on the same software release
throughout the life of the project if possible. Updates to a new software release should be discussed at project milestone.

6.5. BIM DELIVERABLES

The University’s Facilities Services Project Manager will collaborate with the Construction BIM Managers to document when key deliverables will be submitted to the University. The Construction Team will assure all updates and/or revisions to the BIMs as necessary reflect the As-Built information. Overall responsibilities of the Construction Team include:

- **Record Construction BIM:** The Construction Team will be responsible for submitting a record construction model which will become the University’s deliverable for use during the maintenance and operations of the facility. The model’s progression to the approximate LOD will be achieved in accordance with the BIMForum 2019 LOD Specifications definitions outlined in Section 2.3.1.
- **Equipment ID Tagging:** The Contractor shall tag equipment following section 6.5.3.
- **Final Record Drawings:** The Construction Team shall deliver final As-Built drawings in PDF format to the University.
- **Operations and Maintenance Manuals:** The Construction Team shall deliver PDF copies of the O&M manuals. This will include manufacturer’s documents including cut sheets, installation instructions, and recommended maintenance tasks, test data and reports. An electronic format of the O&M manuals shall be submitted along with the paper copies in PDF format.
- Incorporate final updates to material/equipment data and properties where installations differ from the basis of design included in the Design Teams BIMs.
- At substantial completion, the Construction Team will transmit the BIMs to the Design Team who will then incorporate updates and/or revisions causes by Addenda, modifications, and observed changes recorded by the contractors into the Record BIM.

At the project’s completion, final digital project documentation will be submitted to the University by both the Design and Construction teams. This includes the following items that will ultimately become the University’s As-Maintained and Archived BIMs. Deliverable requirements are outlined in Section 4 and include:

<table>
<thead>
<tr>
<th>DELIVERABLE</th>
<th>RESPONSIBLE PARTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIM Execution Plan</td>
<td>AE/CM/GC Firm</td>
</tr>
<tr>
<td>Design BIM (LOD 300)</td>
<td>AE Firm</td>
</tr>
<tr>
<td>Record BIMs (Native File Format)</td>
<td>CM/GC Firm</td>
</tr>
<tr>
<td>Final 2D As-Built Drawings (PDF and DWG)</td>
<td>CM/GC Firm</td>
</tr>
<tr>
<td>Operations and Maintenance Manuals</td>
<td>CM/GC Firm</td>
</tr>
<tr>
<td>Equipment ID Tagging</td>
<td>CM/GC Firm</td>
</tr>
</tbody>
</table>

6.5.1. SPACE NAMING

The Contractor shall maintain the space object names, classifications, and designations that were developed during the design of the building.

6.5.2. EQUIPMENT NAMING

The Construction Team shall maintain the equipment object types and attributes that were developed during the design of the building.
Equipment objects shall be created, named, classified, and assigned attributes per the requirements in Appendix C or as required by the University. The Construction Team shall add any equipment objects that were not modeled by the Designer, but are required for the University’s Facility Management. The Construction Team shall add equipment attribute data not available during design.

6.5.3. EQUIPMENT TAGGING

Modeled equipment shall receive a barcode so maintenance activities associated with that piece of equipment for it can be tracked. This will generally apply to building system equipment that is permanently attached to the building. Equipment that already has an IRIS asset tag should not be re-tagged; the IRIS barcode can be used to identify the equipment.

Barcode tags should be affixed at a location on the equipment where they will be readily visible and easy to find. Sufficient space in front of the tag should be provided so that it can be easily scanned. Tags should be affixed using an adhesive. The tag should not be placed where it will cover existing labels or where it is likely to be damaged.

Tags should follow the proposed design as shown below:

6.6. QUALITY CONTROL

The Construction Team and Design Teams will be responsible for verifying that the model meets the requirements described in University’s Project Execution Plan and Standard Guides. The Construction Team shall review quality control requirements listed in Section 4.7.

6.7. CLASH DETECTION

Clash detection allows the project team to verify clearance, analyze conflicts, deliver quality documentation, and coordinate between disciplines to reduce RFI and Change Order submittals. The Construction Team shall review clash detection requirements listed in Section 4.8.

6.8. GEOREFERENCING
The Designer and the Designer’s Consultants are required to geo-reference BIMs, site plans and associated construction drawings. The project geographical locations shall be set using Tennessee State Plane coordinates. The following datum should be used: North American Data 1983 (NAD83) HARN for horizontal control and North American Datum (NAVD) 1988 for vertical control.

6.9. STAFFING

The Construction Team shall identify a Construction BIM Manager for each project. Individual assigned by the Construction Team to serve as the main point of contact between the Design Team, Construction Team, and the University for all BIM related issues. The responsibilities below do not supersede the overall chain of command that exists on a project. The identification of BIM project-specific leadership roles will be outlined in the BIM Project Execution Plan. Responsibilities include the following:

- Author BIM Execution Plan in collaboration with the Design BIM Manager. If Construction BIM Manager is not part of the team during the design phase, provide updates for the construction phase once the Construction team has been assigned.
- Provide oversight to the construction BIM use cases as defined in Section 5.5.
- Ensures development and compliance with the University’s BIM Guides and Standards.
- Overall responsibility for the Construction Teams BIMs coordinating creation and information developed during construction.
- Acts as the main point of contact for BIM and related issues between the Construction Team, subcontractors, the University, the Design Team and others as required.
- Facilitates use of composite BIM models in construction coordination/clash detection meetings and provides detection reports by the identification and resolution of significant collisions.
- Communicates with the Design Team, coordinates the data extraction sets required by the construction trades and ensures that these requests are met.
- Assumes responsibility for the proper classification of all equipment in the model to ensure direction downstream use for facility management.
- 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.
- Prior to approval and installation, works to integrate 3D fabrication models with the updated design model to ensure compliance with design intent.
- Coordinates update of as-constructed conditions in the Record (As-Built) BIM deliverable.
- Schedules, coordinates, and facilitates BIM technical meetings between the Construction Team and the University during the Construction phase.

6.10. BIM EXECUTION PLAN

At the initiation of the construction phase, the University Facility Services’ Project Manager will collaborate with the GM/CM to update the BIM Execution Plan finalized during the Design Phase with information that identifies the protocols for the development and management of BIMs during the construction phase. The Construction BIM Manager shall submit their BIM Execution Plan to the university within 60 days after contract has been signed. The requirements of the BIM Execution Plan are outlined in OSA’s standards.
### APPENDIX A. SPACE MANAGEMENT INFORMATION

The table below lists the required attributes that shall be associated with space elements. All attributes should be included in the model, but only those marked with an ‘X’ should be populated by the Design or Construction Teams as appropriate.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ARCHIBUS DATABASE FIELD</th>
<th>RESOURCES</th>
<th>BIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Name</td>
<td>utk_name</td>
<td>Provided by the University</td>
<td>x</td>
</tr>
<tr>
<td>Building Code</td>
<td>utk_bl_id</td>
<td>Provided by the University</td>
<td>x</td>
</tr>
<tr>
<td>Floor Code</td>
<td>utk_fl_id</td>
<td>Room Numbering and Floor/Level Conventions</td>
<td>x</td>
</tr>
<tr>
<td>Floor Name</td>
<td>utk_fl.name</td>
<td>Basement Floor (Floor B) Mezzanine Floor (Floor M) First Floor (Floor 1) Second Floor (Floor 2), etc.</td>
<td>x</td>
</tr>
<tr>
<td>Room Number</td>
<td>utk_rm_id</td>
<td>Room Numbering and Floor/Level Conventions</td>
<td>x</td>
</tr>
<tr>
<td>Building Area</td>
<td>utk_Area_gross_int</td>
<td>Gross Interior Footage (GSF)</td>
<td>x</td>
</tr>
<tr>
<td>Room Area</td>
<td>utk_area</td>
<td>Net Square Footage (NSF)</td>
<td>x</td>
</tr>
<tr>
<td>Room Standard</td>
<td>utk_rm_std</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Room Category</td>
<td>utk_rm_cat</td>
<td>See Appendix C</td>
<td>x</td>
</tr>
<tr>
<td>Room Use</td>
<td>utk_rm_use</td>
<td>See Appendix C</td>
<td></td>
</tr>
<tr>
<td>Area Type</td>
<td>utk_rm_type</td>
<td>See Appendix C</td>
<td>x</td>
</tr>
<tr>
<td>Number of Workspaces</td>
<td>utk_cap_em</td>
<td></td>
<td></td>
</tr>
<tr>
<td>College ID</td>
<td>utk_dv_id</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Department Code</td>
<td>utk_dp_id</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Room Name</td>
<td>utk_name</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Department</td>
<td>utk_name</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupant</td>
<td>utk_em_id</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupancy Count</td>
<td>utk_Count_em</td>
<td>Seat count occupancy</td>
<td>x</td>
</tr>
<tr>
<td>Door Number</td>
<td>utk_rm_id_door</td>
<td>Room number based on signage</td>
<td>x</td>
</tr>
<tr>
<td>Room Height</td>
<td>utk_rm_height</td>
<td>Use main room height measurement</td>
<td>x</td>
</tr>
<tr>
<td>Room Width</td>
<td>utk_rm_width</td>
<td>Use longest width measurement</td>
<td>x</td>
</tr>
<tr>
<td>Room Length</td>
<td>utk_rm_length</td>
<td>Use longest length measurement</td>
<td>x</td>
</tr>
<tr>
<td>Funding</td>
<td>utk_fc_ic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Card Access</td>
<td>utk_has_card</td>
<td>Y or N option field</td>
<td>x</td>
</tr>
<tr>
<td>Key Shop ID</td>
<td>utk_keyshopid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Room Notes – Departments</td>
<td>utk_note_dept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Room Notes – Facilities</td>
<td>utk_note_ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responsible Cost Center</td>
<td>utk_dp_id</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Requestable</td>
<td>utk_requestable</td>
<td>Y or N option field</td>
<td></td>
</tr>
</tbody>
</table>
# APPENDIX B. BIM EQUIPMENT OBJECTS

Each BIM equipment object shall contain geometric data and a set of attributes. Equipment attribute data shall have the ability to be extracted from the project BIM’s deliverable and linked to our ARCHIBUS database.

Equipment components shall have a unique equipment code named as followings:

<table>
<thead>
<tr>
<th>Equipment Standard (eq_std)</th>
<th>Building ID (bl_id).Floor(fl_id).Room Number (rm_id).</th>
<th>Sequential Number</th>
</tr>
</thead>
</table>

Example: WFTN-1610UA.01.104 -BFS-0001 (Water Fountain Bottle Filling Station #1 at Room 104, in the First Floor of 1610 University Avenue Building).

The following attribute data shall be provided for each piece of equipment as it is relevant to the project.
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ARCHIBUS DATABASE FIELD</th>
<th>OPTIONS</th>
<th>RESOURCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Code</td>
<td>utk_eq_id</td>
<td>Concatenation of bl_id_reg &amp; &quot;.&quot; &amp; eq_std &amp; &quot;.&quot; &amp; &lt;sequential number&gt;</td>
<td>Room Numbering and Floor/Level Conventions</td>
</tr>
<tr>
<td>Building Code</td>
<td>utk_bl_id</td>
<td>Provided by the University</td>
<td>Room Numbering and Floor/Level Conventions</td>
</tr>
<tr>
<td>Floor Code</td>
<td>utk_fl_id</td>
<td></td>
<td>Room Numbering and Floor/Level Conventions</td>
</tr>
<tr>
<td>Room Number</td>
<td>utk_rm_id</td>
<td></td>
<td>Room Numbering and Floor/Level Conventions</td>
</tr>
<tr>
<td>Equipment Standard</td>
<td>utk_eq_std</td>
<td>See Appendix D</td>
<td></td>
</tr>
<tr>
<td>Equipment Category</td>
<td>utk_eq_cat</td>
<td>See Appendix D</td>
<td></td>
</tr>
<tr>
<td>Manufacturer</td>
<td>utk_mfr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UT Tag #</td>
<td>utk_iris_tag_numer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model #</td>
<td>utk_modelno</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serial #</td>
<td>utk_num_serial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment Status</td>
<td>utk_status</td>
<td>in = In Service</td>
<td>Defaults to &quot;in&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>out = Out of Service</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>rep=In Repair</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>stor = In Storage</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>salv = Salvaged</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>sold = Sold</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>miss = Missing</td>
<td></td>
</tr>
<tr>
<td>CSI Classification</td>
<td>utk_csi_id</td>
<td>See CSI Classification Codes</td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>ARCHIBUS DATABASE FIELD</td>
<td>OPTIONS</td>
<td>RESOURCES</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------</td>
<td>----------------------------------------------</td>
<td>-----------------------------</td>
</tr>
</tbody>
</table>
| Criticality               | utk_criticality         | 1 = None
                                          2 = Very Low
                                          3 = Low
                                          4 = Low to Moderate
                                          5 = Moderate
                                          6 = Moderate to High
                                          7 = High
                                          8 = Very High
                                          9 = Hazard with warning
                                         10 = Hazard without warning | Defaults to "1"                  |
| Equipment Condition       | utk_condition           | New
                                          Good
                                          Fair
                                          Poor                                           | Defaults to “New”                |
<p>| Years Life of Expectancy  | utk_qty_life_expect     |                                             |                             |
| Isolation Transformer     | utk_isolation_transformer|                                             |                             |
| VFD Size                  | utk_vfd_size            |                                             |                             |
| VFD Brand                 | utk_vfd_brand           |                                             |                             |
| RPM                       | utk_rpm                 |                                             |                             |
| Voltage                   | utk_voltage             |                                             |                             |
| Enclosure                 | utk_enclosure           |                                             |                             |
| Mounting                  | utk_mouting             |                                             |                             |
| HP (Horsepower)           | utk_hp                  |                                             |                             |
| PH (Phase)                | utk_ph                  |                                             |                             |
| AMPS                      | utk_amps                |                                             |                             |
| Duty                      | utk_duty                |                                             |                             |
| Motor ID                  | utk_motor_id            |                                             |                             |
| Frame                     | utk_frame               |                                             |                             |</p>
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ARCHIBUS DATABASE FIELD</th>
<th>OPTIONS</th>
<th>RESOURCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendor</td>
<td>utk_war_vendor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact Info</td>
<td>utk_contact_info</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warranty Description</td>
<td>utk_description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expiration Date</td>
<td>utk_date_expiration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warranty Code</td>
<td>utk_warranty_id</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### APPENDIX C. ROOM CATEGORIES, USE AND AREA TYPE

A description of these area type codes can be found in the document below:
*Appendix A of the UT Physical Facilities Inventory 2017 document.*

<table>
<thead>
<tr>
<th>ROOM CATEGORY</th>
<th>DESCRIPTION</th>
<th>AREA TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.000</td>
<td>Unclassified Areas</td>
<td>50</td>
<td>Unclassified--Inactive, Avail.</td>
</tr>
<tr>
<td>01.000</td>
<td>Unclassified Areas</td>
<td>60</td>
<td>Unclassified--Alteration, Conversion</td>
</tr>
<tr>
<td>01.000</td>
<td>Unclassified Areas</td>
<td>70</td>
<td>Unclassified--Unfinished, New</td>
</tr>
<tr>
<td>01.000</td>
<td>Unclassified Areas</td>
<td>80</td>
<td>Unclassified--Inactive, Renovation Required</td>
</tr>
<tr>
<td>01.100</td>
<td>Classroom Facilities</td>
<td>10</td>
<td>Classroom</td>
</tr>
<tr>
<td>01.100</td>
<td>Classroom Facilities</td>
<td>10.2</td>
<td>Classroom, Special Purpose</td>
</tr>
<tr>
<td>01.100</td>
<td>Classroom Facilities</td>
<td>10.3</td>
<td>Class Auditorium, General</td>
</tr>
<tr>
<td>01.100</td>
<td>Classroom Facilities</td>
<td>10.4</td>
<td>Class Auditorium, Special</td>
</tr>
<tr>
<td>01.100</td>
<td>Classroom Facilities</td>
<td>10.6</td>
<td>Classroom, Seminar</td>
</tr>
<tr>
<td>01.100</td>
<td>Classroom Facilities</td>
<td>15</td>
<td>Classroom Service</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>10</td>
<td>Laboratory, Class</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>10.1</td>
<td>Laboratory-DRY, Class</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>10.2</td>
<td>Laboratory-WET, Class</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>10.4</td>
<td>Laboratory, Class-Photo Darkroom</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>15</td>
<td>Laboratory Service, Class</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>15.4</td>
<td>Laboratory Svc, Class-Photo Darkroom</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>20</td>
<td>Laboratory, Open</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>20.4</td>
<td>Laboratory, Open-Photo Darkroom</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>25</td>
<td>Laboratory Service, Open</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>25.4</td>
<td>Laboratory Svc, Open-Photo Darkroom</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>50</td>
<td>Laboratory, Research/Non-Class</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>50.1</td>
<td>Laboratory-DRY, Research/Non-Class</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>50.2</td>
<td>Laboratory-WET, Research/Non-Class</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>55</td>
<td>Laboratory Svc,Research/Non-Class</td>
</tr>
<tr>
<td>01.200</td>
<td>Laboratory Facilities</td>
<td>55.1</td>
<td>Laboratory Svc,Research /NC-Glasswash</td>
</tr>
<tr>
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# APPENDIX D. EQUIPMENT CATEGORIES AND STANDARDS

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