

State of Tennessee Office of the State Architect (TN OSA)

Building Information Modeling Standards (BIMs)

Version 2.1

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1. Introduction

1.1. Mission of the TN OSA BIM Standards

The mission of the State of Tennessee Office of the State Architect (TN OSA) BIM Standards is to utilize consistent *Building Information Modeling* (BIM) technology standards to create building projects with greater long term owner value through a collaborative design, construction and operations process.

1.2. Purpose and Application of the TN OSA BIM Standards

The TN OSA has established these BIM Standards for the consistent development and management of BIM on State designated BIM projects. For projects designated by the State, or State Procurement Agency (SPA) to use BIM, these BIM Standards apply to designers and their consultants, and/or to contractors and their subcontractors, qualified by the State Procurement Agencies (SPAs).

On State projects not designated to use BIM, the designers and/or contractors may voluntarily choose, on their own, to use BIM. The State encourages designers and contractors using BIM on projects, where BIM is not a State requirement, to adopt these BIM Standards. Designers and contractors using BIM on projects, where BIM is not a State requirement, may deliver BIMs, in addition to paper documents, for the aspects of the project for which they have followed these BIM Standards.

The goal of these BIM Standards is to be outcome-based. It is not the intent of the State to prescribe the means, methods or software products by which designers and/or contractors meet these BIM Standards.

This Tennessee (TN) Building Information Modeling Standard (BIMs) encompasses the development of the following BIM project deliverables: See Sections 3.12 and 5.11 for more information on designer and contractor deliverables by project phase.

TN OSA BIMs DELIVERABLES	
BIM / COBie DELIVERABLE*	PROJECT PHASE OF DELIVERY
BIM Execution Plans (See Appendices A and F)	See Sections 3.9 and 5.8
Design BIMs	See Sections 3.12.1.5 and 3.12.1.6
Construction BIMs	Project Close Out
COBie Worksheets	Project Close Out

**Additional BIM requirements, deliverables, and exchanges not required by these BIM Standards may be identified for project delivery by the owner in the BIM Execution Plan (BEP).*

2. General Principles and Definitions

2.1. Ownership and Rights of Data

Refer to SBC-6a Terms and Conditions for Agreement between Owner and Designer Section 6.1 and AIA Document A201 Sections 1.5, 1.7 and 1.8 regarding ownership, digital data use, data transmission and BIM reliance.

BIM and CAD files are not *Contract Documents*. Differences may exist between these files and the corresponding *Contract Documents*. Where discrepancies arise between BIM or CAD files and the *Contract Documents*, the *Contract Documents* shall govern.

2.2. Risk Allocation

Each Project Team member is responsible for any contribution to a BIM or CAD file made by them or by any other Project Team member for whom they are responsible. Each Project Team member shall exercise the same standard of care in their use of BIM and CAD files including the development, exchange, transmission and interoperability of these files. Protocols for such use shall be defined in the BIM Execution Plan (BEP). See Appendices A and F.

No party is entitled to rely on any BIM or CAD file to provide the level of detail required to accurately take off any quantities for any specific project materials or components, unless expressly stated in the BIM Execution Plan (BEP). See Appendices A and F.

2.3. Definitions

- **Asset:** A *BIM Object* such as *Space* or *Equipment* that has *Attributes* associated with it. See Appendices C and D.
- **Asset Category:** A classification of *Assets* organized by their functional and/or systemic relationships. See Appendix D.
- **Attribute:** Properties associated with *BIM Objects* such as *Spaces* and *Equipment*. See Appendices C and D.
- **Building Information Model (BIM):** Digital representation of the physical and functional characteristics of a building.¹
- **BIM - Drawing Equivalency:** For these BIM Standards, this BIM methodology maintains that a drawing at ¼" = 1'-0" or smaller, that is published from a BIM by the designer for inclusion in *Contract Documents*, is a direct representation of that BIM.

¹ The National BIM Standard – United States Version 3

2.3. Definitions (Continued)

- **BIM Execution Plan (BEP):** This plan lays out how BIM will be implemented and which goals or BIM uses will be pursued on the project as a result of the decisions of the *Project Team*.² This is a living document that is updated at key milestones during the project. In most cases, there will be one BEP developed by the design team and a second BEP developed by the contractor. See Appendices A and F for an outline and minimum BEP content.
- **BIM Process Map:** A diagram showing how BIM will be applied on a project including associated activities and information exchanges.³ See Appendix G.
- **BIM Object:** An element, such as a *Space* or a piece of *Equipment* within a BIM, which has properties associated with the object.
- **Construction BIMs:** BIMs generated by the contractor, the contractor's subcontractors, and major suppliers, typically representing a single building system. BIM objects are accurate in terms of size, shape, location, quantity and orientation and may include fabrication, assembly, detailing and non-geometric information. These BIMs are updated throughout the construction phase to include but not limited to addenda, architect's supplemental instructions, change orders and construction change directives. Construction BIMs include facility management data required by the owner per Table E1 and Section 5.1.
- **Construction Operations Building information exchange (COBie):** Format for the exchange of information about building *Assets* such as *Equipment*, products, materials, and *Spaces*.
- **Construction Operations Building information exchange (COBie) Worksheets:** Spreadsheet format of *COBie*.
- **Contract Documents:** See AIA Document A201, Section 1.1.1.
- **Coordination BIM:** Coordinated by the contractor, this composite BIM includes multiple *Design BIMs* and/or *Construction BIMs*, registered spatially, used for the purposes of coordination during construction.

² BIM Handbook, 2008

³ National BIM Standard – United States® Version 3

2.3. Definitions (Continued)

- **Design BIMs:** BIMs produced by the designer and the designer’s consultants, from which construction documents phase drawings are to be published. This BIM is updated during the bidding and negotiation phases to include all changes from addenda, including accepted alternates. Design BIMs are updated throughout the construction phase to include but not limited to addenda, architect’s supplemental instructions, change orders and construction change directives. Design BIMs include facility management data required by the owner per Table E1 and Section 3.1.
- **Equipment – Building Assets** such as conveying systems, plumbing, electrical, fire suppression, HVAC and other installed equipment. See Appendix D, Table D2.
- **Equipment Component:** Each physical instance of a piece of equipment within a BIM having specific *Attributes* associated with it. See Appendix D.
- **Equipment Inventory:** A complete list of the building *Equipment* and their *Attributes*, delivered in *COBie* format. See Appendices D and E.
- **Equipment Type:** A unique *Equipment* object representing a single manufacturer and model number. See Appendix D.
- **Equipment Type ID:** An abbreviation used to identify an *Equipment Type*. This is a BIM parameter that is identical to the *TNID*. See Appendix D.
- **IFC -** The Industry Foundation Class specification is a neutral data format developed and maintained by buildingSMART International used to describe, exchange and share information typically used within the building information modeling and facility management industry sector.
- **Project Team:** The project owner, parties in privity with the owner, and additional parties not in privity with the owner, who are contributing services and/or materials to the project.
- **Shared Parameters File:** A file for Revit that meets the *Asset Attribute* requirements of these BIM Standards. *Project Teams* can use this file to assign TN-required *Asset Attributes* to their Revit objects. This file is configured specifically for use in adding COBie-related parameters and is not meant to replace existing parameters used in preparation of the construction documents.
- **Space:** A space object within a BIM having specific *Attributes* associated with it. See Appendix C.

2.3. Definitions (Continued)

- **Space Inventory:** A complete list of building *Spaces* and their *Attributes*, as specified in Appendices C and E, delivered in *COBie* format.
- **TNID:** An abbreviation used to identify a unique *Asset*. For the TN BIMs, the TNID is a parameter that is identical to the *Asset Type ID*. The TNID is necessary to implement the *TN-Specific Rule Set Model Checker*. See Appendix D.
- **TNNamingSystem:** This is a spreadsheet provided to designers via the OSA website that enables designer's to use custom Type ID's that can be validated using the TN OSA COBie Validator. See Appendix D, *Equipment Naming Standards and Attributes*.
- **TN OSA COBie Validator:** A validation tool provided by the State of Tennessee to assist in verifying that a project's *COBie* file meets the State of Tennessee BIM Standards.
- **TN-Specific Rule Set Model Checker:** A Model Checker for Revit provided by the State of Tennessee to assist designer's, designer's consultants, contractors and subcontractors in verifying that all required *Equipment* names and *Attributes* have been applied as Revit parameters per Appendix D.

3. BIM Requirements for Designers

3.1. Building Information Modeling Scope

The following disciplines must produce *Design BIMs*.

- Architectural - ARCH
- Structural - STR
- Mechanical - MECH
- Plumbing - PLBG
- Electrical - ELEC
- Other specialties required by the SPA or owner
- Civil* - CVL
- Landscape* - LND
- Low Voltage* - LV
- Fire Protection*, ** - FP

NOTE: The discipline abbreviations above are provided for file naming purposes. See *Section 3.12 BIM Deliverables by Phase - Designer*.

*While BIM models are encouraged for this discipline, 3D CAD or dwg formats are acceptable when approved by the SPA or owner and documented in the BEP. While preferred, it is not required that the COBie data be maintained in the *Design BIMs* for this discipline.

**Fire protection elements included in the *Design BIM* shall be sufficient to comply with the *State of Tennessee Standard of Care for Fire Sprinkler System Design*. This shall include mains, branch piping, and heads required to provide preliminary hydraulic calculations associated with most remote zone; size, type, and locations of standpipes and risers; and fire pump and associated piping and required accessories.

The designer and the designer's consultants shall use BIM authoring software to generate BIMs that include the geometry, physical characteristics, and data needed to extract the *Contract Documents* and to produce the required BIM and COBie deliverables.

Unless otherwise indicated in these BIM Standards, the level of development required by the disciplines identified above is at the discretion of the design team. The designers should use their professional judgment in determining the level of development required to provide the normal and contractual information required at each phase in conjunction with these BIM Standards.

The designer and the designer's consultants shall update the *Design BIMs* throughout design and construction in accordance with these BIM Standards. The designer shall make the *Design BIMs* available to the contractor and owner in accordance with these BIM Standards and as described in the *BEP*. See Section 3.8.

For the *Design BIMs*, the space and equipment naming shall be in accordance with Appendices C, D and E of these BIM Standards prior to being provided to the contractor and prior to delivery to the owner.

3.2. Compliance with IFC and COBie

The BIM authoring software shall be compliant with the Industry Foundation Classes (IFC) Coordination View ⁴ and should be able to export to the Construction-Operations Building information exchange (COBie) format, which is based on the IFC Facility Management (FM) Handover View⁵. The major BIM authoring software applications are IFC and COBie compliant. If unsure whether the BIM authoring software meets this requirement or how to export to IFC and COBie formats, contact the BIM authoring software vendor.

3.3. Open Standards and Collaboration

The owner encourages the use of open software standards (e.g., IFC, COBie) and collaboration tools to facilitate interoperability among the *Project Team*.

3.4. Building Number

A campus, department or agency may assign building numbers as required. For STREAM projects that are new construction, an 8-digit Building ID # may be assigned. This number may be provided by the State of Tennessee Project Manager.

3.5. Geo-referencing

The designer and the designer's consultants shall geo-reference BIMs, site plans and associated construction drawings to allow interoperability with existing State of Tennessee Geographic Information Systems (GIS). BIMs, site plans and associated construction drawings shall be registered to the Tennessee State Plane Coordinate System⁷. Coordinates for any site may be requested from Office of Information Resources, GIS Services (OIR GIS). The Tennessee State Plane Coordinates are comprised of:

- The North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88).

The BIMs shall include:

- A marker for the registration point and identify the rotation and origin of rotation from Project North to True North. Geo-referencing shall be maintained throughout the design of the project; and
- A polyline or other BIM-equivalent outline representing the building footprint of the lowest floor of the lowest enclosed area including basement. An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access or storage in an area other than a basement area, is not considered a building's lowest floor. For further clarification see the Federal Emergency Management Agency's (FEMA) definition of lowest floor⁶.

⁴ buildingSMART 2013

⁵ East and Chipman 2011

⁶ FEMA 2012

⁷See Change Log Page 57 Item 31

3.6. Existing Conditions

The designer and the designer's consultants shall model any existing conditions that are needed to describe the design of the project. The designer shall work with the owner to determine the extent of the existing conditions necessary for the design.

Where the owner provides a BIM of the existing conditions, no guarantee is implied as to the accuracy of dimensions or building features shown and users of the models assume full responsibility for verifying the accuracy of such models to the extent that elements represented within the model are visually observable. Where existing conditions provided in a BIM are not visually observable, the designer shall define a strategy to field verify the existing conditions determined necessary for the design.

3.7. Staffing

For each project, the designer shall identify a qualified BIM manager that is capable of managing the BIM deliverables, through the close-out phase, from all disciplines required by Section 3.1 of these BIM Standards. The designer's consultants using BIM shall each identify a BIM coordinator that is capable of managing the BIM deliverables of that specific discipline or firm.

The names, contact information and responsibilities of the BIM manager and the BIM coordinators shall be documented in the *BEP*.

3.8. File Sharing System

The owner shall be provided access to the designer's secure, web-based file sharing system. The files for which the owner is provided access including their associated read/write privileges shall be defined in the *BEP*.

The BIM models for which the owner is provided access including their associated project milestones shall be defined in the *BEP*.

For projects with special information technology (IT) security requirements, the owner may provide a secure, web-based file sharing system for the project.

Any special protocols necessary to access and/or utilize the secure, web-based file sharing system should be documented in the *BEP*.

3.9. BIM Execution Plan (BEP)

The designer and the designer's consultants along with the designer's BIM manager shall develop a *BEP* that identifies the protocols for the development and management of BIMs during the design phases. The *BEP* is a living document, which will be augmented and updated as design progresses. Thus, there are multiple *BEP* milestones as follows.

Appendix A includes the minimum topics that shall be addressed in the designer's *BEP*. Special project types may require additional topics.

3.9.1. Phased BEP Development and Contents

3.9.1.1. Schematic Design Phase (SDP)

Add to the agenda for SDP review meeting the topic: “Discuss BIM Execution Plan”.

During SDP, the designer shall submit for owner review and approval, a *BEP* that, at a minimum, covers the following topics (See Appendix A for detailed information required under each topic):

- Project Information;
- Project designer and designer’s consultants Information; and
- BIM Goals and Objectives
- Roles and Responsibilities
- Collaboration and File Sharing Plan
- Software for Model Authoring
- Planned Models
- Modeling Standards
- Sign-Off

3.9.1.2. Design Development Phase (DDP)

Add to the agenda for DDP Review Meeting the topic: “Discuss BIM Execution Plan”.

During the DDP, the designer shall update and extend the *BEP* and submit it for owner review and approval. The DDP *BEP* shall include all topics included in the SDP *BEP*, with any updates highlighted. It shall also include the following additional topics (See Appendix A for detailed information required under each topic):

- Model Analysis Plan; and
- Project Construction Documents Phase

3.9.1.3. Construction Documents Phase (CDP)

Add to the agenda for CDP review meeting the topic: “Submit BIM Execution Plan, as performed”.

During the CDP, the designer shall update and extend the *BEP* to reflect the BIM execution process as performed then submit it to the owner.

3.10. BIM-Based Analyses

The State of Tennessee BIM Standards recommends BIM for the following analyses described in Sections 3.10.1 through 3.10.3. These BIM Standards require that BIMs be used for the application of Contact, Facility, Floor, *Space* and Type/Component (*Equipment*) names and their *Attributes*. See Appendices C, D and E.

3.10.1. Program Validation

Designers should use BIMs to validate that the design complies with the general requirements of the owner's program.

3.10.2. Energy Analysis

BIMs should be used as the basis for energy modeling and analysis when required. Appendix B of this document provides guidance on preparing a BIM for export for energy analysis.

3.10.3. Clash Detection

The designer and the designer's consultants are required to coordinate their designs. The design team should use the BIMs and automated interference/clash detections to confirm that building system interferences have been identified and resolved within the applicable standard of care so that the occupiable space by these building systems is adequate and that the systems can be integrated while maintaining serviceability and accessibility.

The State of Tennessee provides resources through the OSA website to assist designers and designer's consultants in conducting automated interference/clash detections.

3.10.4. Contact, Facility, Floor and Space - Naming and Attributes

BIMs shall be used as the basis for applying the required Contact, Facility, Floor and *Space Attributes* in accordance with these BIM Standards. *Spaces* shall be named, classified, tagged and assigned *Space Attributes* per Appendix C.

3.10.5. Type/Component (Equipment) Naming and Attributes

BIMs shall be used as the basis for applying the designer-required Type/Component (*Equipment*) naming system and *Attributes* per Appendices D and E of these BIM Standards. See Section 3.10.6 for more information on applying and verifying *Equipment* names and *Attributes*. Any *Attribute* values not required to be provided by the designers may be left blank but the *Attribute* parameter shall be included in the *Design BIM Equipment* object properties.

3.10.6. Equipment Attributes – Applying and Verifying

The TN OSA provides resources available at the TN OSA website to assist designers, designer's consultants and contractors in applying and verifying Type/Component (*Equipment*) names and *Attributes* in accordance with Appendix D.

3.10.6. Equipment Attributes – Applying and Verifying (Continued)

- A *Shared Parameters File* is provided to assist designers and contractors using Autodesk Revit software in applying all required COBie Type/Component (*Equipment*) names and *Attributes* as Revit parameters. Any *Attribute* values not required to be provided by the designers may be left blank but the *Attribute* shall be included in the *Design BIM Object* properties. For example, design engineers are not required to provide the refrigerant type for chillers in their *Design BIM*. However, they are required to apply and maintain an *Attribute* called “RefrigerantType” in their *Design BIM* chiller objects.
- A *TN-Specific Rule Set Model Checker* for Revit is provided to assist designers, designer’s consultants and contractors in verifying that all required *Equipment Attributes* have been applied as Revit parameters per Appendix D. To run these checks, a Type Parameter called *TNID* must be applied to the *Equipment* object properties in the Revit model. The value of the *TNID* Parameter is identical to the *Equipment Type ID* in Appendix D, Table D2 – Column 4 (i.e., For a Chiller, the *Asset Type ID* = CH and the *TNID* = CH).
- The TN OSA COBie Validator is a validation tool provided by the State of Tennessee to assist in verifying that a project’s *COBie* file meets the State of Tennessee BIM Standards.

3.11. BIM Methodology

The following methodology is required for all disciplines creating BIMs.

- a) The designer, the designer’s consultants and the contractor shall geo-reference BIMs, site plans and associated construction drawings to allow interoperability with existing State of Tennessee Geographic Information Systems (GIS). See Section 3.5.
- b) All BIMs shall be geometrically and dimensionally accurate in both 2D and 3D: plan, elevation, and section views. In addition, BIM elements shall be represented by the correct object types in order to provide accurate reporting of building *Assets* and their *Attributes*.
- c) Parametric links shall be maintained within the models to allow the automatic publication of plans, sections, elevations, schedules, and 3D views where used in contract drawings.

3.11. BIM Methodology (Continued)

- d) All drawings shall be direct representations of the BIM in accordance with the *BIM-Drawing Equivalency*. The intent of requiring that drawings not be modified after publication is to preserve the continuity of the BIM model geometry as related to its depiction in the drawings. This continuity is defined as the *BIM - Drawing Equivalency*. The designer shall not modify these documents after publication in a manner as to disassociate the *BIM - Drawing Equivalency*. Typical drawing modifications and enhancements necessary to convey the design intent are acceptable.
- e) Information needed to generate *Contract Documents* shall be graphically and alphanumerically included in and derived from the BIMs. All drawings - plans, sections, and elevations – in addition, schedules and 3D views shall be published from the BIMs *in accordance with the BIM-Drawing Equivalency*.
- f) Unless required by the *BIM-Drawing Equivalency*, details at scales larger than the $\frac{1}{4}'' = 1'-0''$ are not required to be included in the BIMs. For such plans, sections, and elevations, the use of standard Computer Aided Drawing (CAD) details is acceptable provided that the elements shown in model act as the basis for these drawings.
- g) All BIMs shall be organized by discipline and floor. Some models may be delivered in 3D dwg format with no custom objects. See Sections 3.1 and 5.1.
- h) BIMs shall be used to apply and maintain the required *COBie Attribute* parameters and values as required by Appendices C, D and E of these BIM Standards.
- i) Where communications between the designer and contractor result in changes or additions to drawings, schedules or 3D views (e.g., addenda), the *BIMs* shall be updated and the drawings published therefrom in accordance with the *BIM-Drawing Equivalency*.

3.12. BIM Deliverables by Phase - Designer

The following BIM deliverables to the owner are required by the designer and designer's consultants.

Designer - BIM Deliverables and File Standards	
BIM Deliverable	File Type
BIM Execution Plan	. pdf format
Design BIMs	BIMs in .ifc file format / See Section 3.1

Designer - BIM Execution Plan File Naming Convention						
Agent_Deliverable		Project Phase		Building #		File Extension
DES_BEP	_	XX	_	#####	.	pdf

Example: *DES_BEP_DD_19000061.pdf*

Designer - BIM Deliverable File Naming Convention							
Discipline Abbreviation		BIM Type		Project Phase		Building #	File Extension
XXXX	_	DBIM	_	CD's (CDP) or Close Out (CLS)	_	#####	. ifc and dwg

Example: *ARCH_DBIM_CD_19000061.ifc*
LND_DBIM_CLS_19000061.dwg
**MEFP_DBIM_CLS_19000061.ifc*

NOTE: See Section 3.1 for a list of discipline abbreviations to use in the *Design BIM* file name.

NOTE: The required drawings referred to in Section 3.12 are described in the Terms and Conditions for Agreement between Owner and Designer.

*NOTE: Multi-disciplinary Models: Combinations of mechanical, electrical, plumbing and/or fire protection models may be delivered as a single, multi-disciplinary model. When multi-disciplinary models are delivered, the abbreviations below shall be included in the file name.

- Mechanical (M)
- Electrical (E)
- Fire Protection (F)
- Plumbing (P)

3.12.1.1. Program Verification Phase

- Submit *BEP*.

3.12.1.2. Schematic Design Phase (SDP)

- Submit *BEP*.

3.12.1.3. Design Development Phase (DDP)

- Submit *BEP*.
- Submit all required drawings.
 - All drawings required to be provided during the DDP shall be published from the *Design BIMs* in accordance with Section 3 of these BIM Standards.
 - Contact, Facility, Floor, *Space* and Type/Component (*Equipment*) *Attributes* including *Attribute* values shall be applied to the *BIM Objects* in the *Design BIMs*, and be tagged in the drawings, per Appendices C, D and E of these BIM Standards. See Appendix E, Table E1 for the designer-required *Attributes* to be applied to the *Design BIMs*.

3.12.1.4. Early Design Phase Presentation (EDP)

- If an EDP is required, it should adhere to Section 3.11 where applicable. The presentation may be enhanced using other software.

3.12.1.5. Construction Documents Phase (CDP)

- Submit *BEP*.
- Submit all required drawings.
 - All drawings required to be provided during the CDP shall be published from the *Design BIMs* in accordance with Section 3 and Appendices C, D and E of these BIM Standards.
 - Validated Contact, Facility, Floor, *Space* and Type/Component (*Equipment*) *Attributes* including validated *Attribute* values shall be applied to the *BIM Objects* in the *Design BIMs*, and be tagged in the drawings, per Appendices C, D and E of these BIM Standards. See Appendix E, Table E1 for the designer-required *Attributes* to be applied to the *Design BIM*.
 - Submit *Design BIMs* to the owner in accordance with these BIM Standards.

In the *Design BIMs*, any *Equipment Attribute* values not required to be provided by the designers may be left blank but the *Attribute* shall be applied and maintained in the *Design BIM Object* properties per Appendices D and E. See Section 3.10.6 for information on tools provided by TN OSA to assist in the application and verification of *Equipment Attributes*.

3.12.1.6. Bid Phase (BP)

- Submit all required drawings.
 - All revised drawings required during the Bid Phase shall be published from the revised *Design BIMs* in accordance with Section 3 and Appendices C, D and E of these BIM Standards.
 - All revised Contact, Facility, Floor, *Space* and Type/Component (*Equipment*) *Attributes* including *Attribute* values shall be applied to the *BIM Objects* in the *Design BIMs*, and be tagged in the drawings, per Appendices C, D and E of these BIM Standards. See Appendix E, Table E1 for the designer-required *Attributes* to be applied to the revised *Design BIMs*.
- Submit revised *Design BIMs* to the owner in accordance with these BIM Standards.

3.12.1.7. Construction Administration Phase (CA)

- Where any communications with the contractor involve changes or additions to drawings, schedules or 3D views (e.g., addenda), the *Design BIMs* shall be updated and any drawings published therefrom in accordance with the *BIM-Drawing Equivalency*.
- Review shop drawings from the contractor. While these drawings may be published from BIMs, the BIMs may **not** be submitted for review in lieu of 2D drawings.

3.12.1.8. Project Closeout Phase (CLS)

- Review the final *Design BIMs* to verify that they incorporate all changes made by the designer including but not limited to addenda, architect's supplemental instructions, change orders, construction and change directives as formally modified throughout the construction process.
- Confirm that all designer-required Contact, Facility, Floor, *Space* and Type/Component (*Equipment*) *Attributes* including names, values and tags are validated and have been applied to *Design BIMs* per these BIM Standards. See Appendix E, Table E1.
- Submit *the Design BIMs* to the owner in accordance with these BIM Standards.

4. The BIM Process for Designers

1. Project awarded
2. Prime: Assign BIM manager.
3. Consultant(s): Assign BIM coordinator.
4. Ascertain the building number(s) and Tennessee State Plane coordinates for the project.
5. Develop, expand and update the *BEP* from SDP through CDP. Refer to *BEP* outline in Appendix A for required content.
6. Set up secure, web-based file sharing system.
7. Finalize program verification.
8. Prepare BIM authoring tool.
 - a. If using Revit
 - i. From the OSA website, download and install all add-ons and/or plugins necessary to export required IFC deliverables.
 - ii. From the OSA website, download the custom TN *Shared Parameters File*. See Section 3.10.6.
 - b. From the OSA website, download the *TN-Specific Rule Set Model Checker* for Revit. If using other authoring software, contact software vendor for support.
9. Develop *Design BIMs*:
 - a. Populate model with *BIM Object* library content updated to contain TN required *Asset* names and *Attributes*. See Appendix E, Table E1 for designer-required Contact, Facility, Floor, *Space* and Type/Component (*Equipment*) *Attributes*.
 - b. The *Model Checker for Revit* may be used to perform validation check on the *Design BIM* to confirm the proper application of *Equipment Attributes*.
10. BIM-based analyses should be performed per Section 3.10 of these BIM Standards.
11. During Construction Documents Phase: (See Section 3.12.1.5)
 - a. Update *Design BIMs* including Contact, Facility, Floor, *Space* and/or Type/Component (*Equipment*) names and *Attributes* to reflect addenda and accepted alternatives.
 - b. Submit *Design BIMs* in accordance with these BIM Standards.. See Section 3.1.
12. During Bidding Phase: (See Section 3.12.1.6)
 - a. Update *Design BIMs* including Contact, Facility, Floor, *Space* and Type/Component (*Equipment*) names and *Attributes* to reflect any required changes to the construction documents including any addenda and/or accepted alternates.
 - b. Submit any revised *Design BIMs* in accordance with these BIM Standards. See Section 3.1.

4. The BIM Process for Designers (Continued)

13. During Construction Administration: (See Section 3.12.1.7)
 - a. Use the *Design BIMs* to produce addenda and other appropriate change documents and provide updated *Design BIMs* to the contractor at intervals and in format(s) agreed upon by the designer and contractor in the *BEP*.
 - b. Review shop drawings from the contractor.
 - c. Review product data provided by the contractor.
 - d. Review the information provided in the contractor's *COBie* document worksheets for conformance to the *Contract Documents*.
14. At Project Closeout: (See Section 3.12.1.8)
 - a. Review *COBie* worksheets for conformance to the *Contract Documents*.
 - b. Review and submit *the Design BIMs* in accordance with these BIM Standards.. See Section 3.1.

5. BIM Requirements for Contractors

5.1. Building Information Modeling Scope

The following trades that shall produce *Construction BIMs*:

- Structural Steel - STRS
- Other Fabrication* - FAB (Optional)
- Mechanical (HVAC) - MECH
- Mechanical (HVAC Pipe) - MECHP
- Plumbing - PLBG
- Electrical - ELEC
- Fire Protection** - FP
- Pneumatic Tube - PT
- Building Automation Systems** - BAS
- Low Voltage** - LV
- Civil** - CVL
- Other trades required by the SPA or owner

NOTE: The discipline abbreviations above are provided for file naming purposes. See *Section 5.11 BIM Deliverables - Contractor*.

*Other Fabrication is optional.

**While *BIM* models are encouraged for this discipline, 3D CAD or dwg formats are acceptable when approved by the SPA or owner and documented in the *BEP*. The *COBie* data for these disciplines is required to be included in the final *COBie* deliverables at project close-out. While preferred, it is not required that the *COBie* data be maintained in the *Construction BIMs* for this discipline.

5.1 Building Information Modeling Scope (Continued)

Design BIMs will be provided by the designer to the contractor in a file format as outlined in the *BEP*.

The BIMs created or modified by the construction team are the *Construction BIMs*. The *Construction BIMs* shall include *Asset* names and *Attributes* per Appendices C, D and E. The nomenclature should be identical to those in the *Design BIMs* provided by the designer in accordance with Appendices C and D, unless there are approved changes.

The level of development required by the disciplines identified above is at the discretion of the contractor. The contractor, the contractor's subcontractors and suppliers should use their professional judgment in determining the level of design required to provide the normal and contractual information required at each phase in conjunction with these BIM Standards.

The contractor, the contractor's subcontractors and suppliers shall use BIM authoring software to develop the required *Construction BIMs* which shall be used in conjunction with the designer-provided *Design BIMs* to allow an accurate BIM context to perform BIM-based coordination. See Section 5.9.1.1.

The contractor, contractor's subcontractors and suppliers shall continuously update and maintain the *Construction BIMs* throughout construction to include but not limited to addenda, architect's supplemental instructions, change orders and construction change directives. During construction, the contractor shall make available to the owner, upon request, up-to-date *Coordination BIMs and/or Construction BIMs* in IFC format.

5.2. Compliance with IFC and COBie

All required trades shall use 3D modeling software. The BIM authoring software shall be compliant with the Industry Foundation Classes (IFC) Coordination View⁴ and should be able to export to the Construction-Operations Building information exchange (*COBie*) format, which is based on the IFC Facility Management (FM) Handover View⁵ above. The major BIM authoring software applications are IFC and *COBie* compliant. If unsure whether the BIM authoring software meets this requirement or how to export to IFC and *COBie* formats, contact the BIM authoring software vendor.

5.3. Open Standards and Collaboration

The owner encourages the use of open software standards (e.g., IFC, *COBie*) and collaboration tools to facilitate interoperability among the *Project Team*.

5.4. Building Number

A campus, department or agency may assign building numbers as required. For STREAM projects that are new construction, an 8-digit Building ID # may be assigned. This number may be provided by the State of Tennessee Project Manager.

5.5. Geo-referencing

The contractor is required to geo-reference all site plans, and *Construction BIMs* to allow interoperability with existing TN GIS. BIMs provided to the contractor from the designer, should already be geo-referenced. See Section 3.5.

5.6. Staffing

The contractor shall identify a qualified BIM manager for each project that is capable of managing the BIM deliverables from all subcontractors and major suppliers during the construction, through the close-out phase of the building project. Each party that is creating a *Construction BIM* shall identify a BIM coordinator. The BIM coordinator is responsible for managing the BIM deliverables of that specific subcontractor or supplier.

The names, contact information, and responsibilities of the BIM manager and the BIM coordinators shall be documented in the *BEP*.

5.7. File Sharing System

The owner may designate a secure, web-based file sharing system for use by the contractor. If the owner does not designate a secure, web-based file sharing system for use by the contractor, then the contractor shall provide a secure, web-based file sharing system. The contractor shall ensure that the secure, web-based file sharing system conforms to any IT or security requirements required by the owner. Any special protocols necessary to access and/or utilize the secure, web-based file sharing system shall be documented in the *BEP*. The contractor shall provide on-site hardware and software to view individual and merged BIMs as well as clash detection results.

The owner shall be provided access to the contractor's secure, web-based file sharing system. The files for which the owner is provided access including their associated read/write privileges shall be defined in the *BEP*. See Section 5.8.

The BIM models and versions for which the owner is provided access shall be defined in the *BEP*. See Section 5.8.

5.8. BIM Execution Plan (BEP)

The contractor and contractor's BIM manager shall develop, with input from all parties providing *Construction BIMs*, *BEP* that identifies the protocols for the development and management of BIMs during the construction phase, as well as the turnover of the BIMs and *COBie* data at project closeout. Appendix F includes the minimum topics that shall be addressed in the *BEP* for construction.

The *BEP* is a living document, which will be augmented and updated as design progresses. Thus, there are multiple *BEP* milestones as follows. Each *BEP* milestone submission requires a sign-off from all team members with BIM and/or *COBie* responsibility.

5.8.1. Phased BEP Development and Contents

5.8.1.1. Mobilization

During mobilization, the contractor shall submit for owner review and approval, a *BEP* that, at a minimum, covers the following topics (See Appendix F for detailed information required under each topic):

- Project Information;
- Project Construction Team Information;
- BIM Goals and Objectives;
- Roles and Responsibilities;
- Software for Model Authoring;
- Modeling Standards and Content;
- Construction Phase Analyses;
- BIM Kickoff Meeting date, location and agenda; and
- Sign-Off.

5.8.1.2. Following BIM Kickoff Meeting, before Coordination

Following BIM kickoff meeting, the contractor shall update and extend the *BEP* and submit for owner review and approval. This *BEP* shall include all topics included above, with any updates highlighted. It shall also include the following additional topics (See Appendix F for detailed information required under each topic):

- Collaboration and File Sharing Plan;
- BIM Coordination;
- BIM Coordination Meetings;
- *COBie* Coordination; and
- *COBie* Coordination Meetings.

5.8.1.3. Substantial Completion

At substantial completion the contractor shall update and extend the *BEP* and submit for owner review and approval. This *BEP* shall include all topics included above, with any updates highlighted. It shall also include the following additional topics (See Appendix F for detailed information required under each topic):

- BIM Deliverables

5.9. BIM-Based Analyses

5.9.1.1. Coordination

- The schedule and the detailed protocols of the BIM-based coordination process shall be included in the *BIM Execution Plan*.
- BIMs should be used to identify and resolve spatial interferences between building systems and products prior to fabrication and field installation. The contractor should determine any additional building elements, temporary structures, etc. required for coordination.
- The contractor shall include clearances for maintenance and other access, code clearances, and other required clearances in the interference checking.
- On a periodic basis, the contractor shall schedule and manage on-site coordination meetings to resolve interferences. The contractor shall publish and make available reports identifying the statuses of the interferences and the coordination progress.

5.9.1.2. Fabrication and Installation

- Coordinated *Construction BIMs* shall be used to fabricate building components and systems for at least those trades required by Section 5.1 of these BIM Standards to produce BIMs.

5.9.1.3. 4D BIM

The contractor and subcontractors should use *Construction BIMs* for additional analyses including:

- Logistical planning and layout and
- 4D scheduling, where 4D scheduling is a 3D geometric model linked to a schedule.

5.9.1.4. Contact, Facility, Floor and Space - Naming and Applying Attributes

- The contractor shall maintain the Contact, Facility, Floor names and *Attributes* including *Space* types, classifications, tags, names and *Attributes* that were developed in the *Design BIM* in accordance with these BIM Standards.

5.9.1.5. Equipment Naming and Applying Attributes

- The contractor shall maintain the Type/Component (*Equipment*) classifications, types, tags, names and *Attributes* that were developed in the *Design BIM* in accordance with Appendix D.
- The contractor shall add any Type/Component (*Equipment*) objects that were not modeled by the designer, but are required per Appendices D and E. Where *Equipment* objects are created by the contractor, the contractor shall maintain the classifications, tags, names and *Attributes* in accordance with Appendix D. See Sections 3.10.5 and 3.10.6 on applying and verifying *Equipment* names and *Attributes*.
- The contractor shall add any additional Contact *Attributes* to the *Construction BIMs* as required per Appendix E.

5.10. BIM Methodology

Section 3.11 describes the required BIM methodology for all disciplines and trades creating BIM deliverables.

5.11. BIM Deliverables - Contractor

All BIM deliverables required by the contractor shall be submitted at project closeout.

Contractor - BIM / COBie Deliverables and File Standards	
BIM Deliverable	File Type
BIM Execution Plan	.pdf format
Construction BIMs	BIMs in .ifc file format / See Section 5.1
COBie Worksheets	COBie format / .xls or .xlsx file type

Designer - BIM Execution Plan File Naming Convention					
Agent_Deliverable		Project Phase		Building #	File Extension
CNTR_BEP	_	XX	_	#####	.pdf

Example: *CNTR_BEP_CD_19000061.pdf*

Contractor - BIM Deliverable File Naming Convention					
Discipline Abbreviation		BIM Type		Building #	File Extension
XXXX	_	CBIM	_	#####	.ifc and .dwg

5.11. BIM Deliverables – Contractor (Continued)

Example Name: *ELEC_CBIM_19000061.ifc*

NOTE: See Section 5.1 for a list of discipline and trade abbreviations to use in the *Construction BIM* file name.

Contractor - COBie Worksheet File Naming Convention						
Document Type		Project Title		Building #		File Extension
COBie	_	XXXXXXXXXX	_	#####	.	.xls or .xlsx

Example Name: *COBie_TN State Museum_19000061.xls*

5.11.1. Deliverables: BEP

The *BEP* shall be updated and submitted to the owner for review at project phases in accordance with these BIM Standards. The final *BEP* shall be delivered at project closeout.

5.11.2. Deliverables: Construction BIMs

- Submit to the owner, the updated, coordinated *Construction BIMs* for at least the disciplines required by Section 5.1 of these BIM Standards.
 - Updated, coordinated Construction BIMs reflect changes to the building that include but are not limited to addenda, architect’s supplemental instructions, change orders, construction and change directives as formally modified throughout the construction process.
- Submit a complete, validated *Asset Inventory* in *COBie* format.
 - *Construction BIMs* shall include the Type/Component (*Equipment*) names, *Attributes* and values applied to the *BIM Object* properties by the contractor, subcontractors and/or other trades per Appendices D and E.
 - *Construction BIMs* shall include the Contact *Attributes* and values applied to the BIM object properties by the contractor, subcontractors and/or other trades per Appendix E.
 - Site and landscape models shall be provided with any custom (ARX) objects converted to native AutoCAD objects.

5.11.3. Deliverables: COBie Worksheets

- Submit a complete, validated *Asset Inventory* in COBie format.
 - The *Space Inventory* and *Equipment Inventory* shall be published from the *Construction BIMs* into the COBie format for delivery to the owner. See Appendix E for information regarding COBie worksheet formatting and naming conventions.
 - The contractor shall use the *TN OSA COBie Validator* to check that the *Space Inventory* and *Equipment Inventory* in the COBie Worksheets are complete, error-free and in accordance these BIM Standards before submitting to the owner.

6. The BIM Process for Contractors

The following description includes the recommended process for the development of and the management of BIMs by contractors.

1. As early as feasible after project award, the contractor assigns a BIM Manager and documents this in the *BEP*.
2. Each subcontractor or vendor with BIM and/or *COBie* responsibility assigns a BIM Coordinator and documents this in the *BEP*.
3. The BIM Manager works with the BIM Coordinators to review the software to be used and verify that the software meets the requirements of these BIM Standards.
4. The BIM Manager reviews their company's modeling standards to align them with owner requirements and deliverables.
5. The contractor selects file sharing system(s).
6. Contractor develops the *BEP*. This plan is updated throughout the project and submitted for review at the milestones indicated in these BIM Standards.
7. Contractor conducts a BIM kickoff meeting.
8. Contractor sets up the secure, web-based file sharing system(s).
9. The construction team develops the *Construction BIMs*.
10. Prior to fabrication and installation, the construction team identifies and resolves spatial conflicts between building systems and products.
11. During construction, the construction team:
 - a. Fabricates and builds from the coordinated *Construction BIMs*.
 - b. Updates the coordinated *Construction BIMs*. See Section 5.11.2.
 - c. Extracts all coordination drawings from the coordinated *Construction BIMs*.
 - d. Uses the coordinated *Construction BIMs* as the basis for generating any shop drawings.
 - e. Updates and maintains the *Asset* inventories in *COBie* format.
 - i. Captures *Asset Attributes* during product data submittals.
 - ii. Performs preliminary *COBie* validation tests to identify an effective software, data and methodology workflow.
12. At project closeout,
 - a. Submit to the owner, the final *Construction BIMs* organized by discipline and floor in IFC format. Certain BIMs, as identified in Section 5.1, may be delivered in 3D dwg format with no custom objects.
 - b. Review the information provided in the *COBie* document worksheets for conformance to the *Contract Documents*.
 - c. Provide to the owner, the final, complete and validated *Asset Inventory* in *COBie* format.

References

buildingSMART (2013). "Coordination View Version 2.0" < <http://www.buildingsmart-tech.org/specifications/ifc-view-definition/coordination-view-v2.0>> (June 10, 2018).

East, B. and Carrasquillo-Mangual, M. (2012). "The COBie Guide" <https://www.nibs.org/page/bsa_cobieguide?> (June 10, 2018).

East, B. and Chipman, T. (2011). "Facilities Management Handover." <http://buildingsmartalliance.org/docs/BSADOC_COBIE/index.htm > (Nov. 27, 2012).

(FEMA) Federal Emergency Management Agency (2012). "Lowest Floor." <https://www.fema.gov/media-library-data/1478090503191-375956f5cfdca82b6344181cf19541c8/07_lowest_floor_guide_508_oct2016.pdf> (June 10, 2018).

(OCCS)OCCS Development Committee Secretariat (2012). "OmniClass Table 13 – Spaces by Function" Release Date: 2012-05-16 < <http://www.omniclass.org>> (June 10, 2018)

(NCES) U.S. Department of Education, National Center for Education Statistics. (2006). *Postsecondary Education Facilities Inventory and Classification Manual (FICM)*, 2006 Edition (NCES 2006-160). U.S. Department of Education. Washington, DC.

(NIBS) National Institute of Building Sciences "Chapter 4.4 Design to Building Energy Analysis" National BIM Standard- United States Version 2. <http://www.nationalbimstandard.org/nbims-us-v2/pdf/NBIMS-US2_c4.4.pdf> (Feb. 21, 2013).

Appendices

Appendix A – BIM Execution Plan Outline - Designers

The following outline indicates the minimum information to be included in a BEP on State of Tennessee projects. Additional information may be included in the BEP as deemed appropriate by the owner, designer and contractor or as otherwise required by these BIM Standards.

Project Information

- Identify project name, SBC number, location (address & geo-reference)
- Identify owner
- Identify effective date or revision date of plan

Project Designer and Designer's Consultants Information

- Designer firm
 - Discipline
 - Firm name
 - Firm address
 - BIM Manager name
 - BIM Manager contact information
- All Consultants
 - Firm name
 - Firm address
 - BIM coordinator name
 - BIM coordinator contact information

BIM Goals and Objectives

- List owner's intended goals or end uses of the model
- List the Designer's and the Designer's Consultants use of the models during the project

Roles and Responsibilities

- Briefly describe each organization's responsibility for:
 - Model creation
 - Model quality
 - Model analysis
 - Model management
- Describe the roles of the BIM manager and BIM coordinators

Collaboration Plan

- Describe the collaboration and file sharing system(s) you will use to exchange, merge and visualize models
- Describe the schedule and format of model updates, COBie data updates, and interference checks
- Describe tools and process to be used for interference checking
- Describe the process for executing BIM-based model coordination and clash detection
- Describe process to be used to generate drawings from coordinated models
- Identify owner-accessible files, milestones and read/write privileges

Software for Model Authoring

- Identify all software products to be used for model creation and the software version

Planned Models

- Identify model name and phase of delivery
- Detail contents of each model by phase – components and properties
- Identify authoring company
- Identify authoring tool(s)
- Identify analysis tools to be used and their modeling
- Identify file formats required

Modeling Standards

- Common coordinate system
 - Units
 - File origin (X,Y,Z)
 - Geolocation
- Model partitions
- Naming
 - Files
 - Building level designators
 - Building area designators
 - Discipline designators
 - Layers (if applicable)
 - Properties required for:
 - Owner-requested analyses
 - Designer and the Designer’s Consultants-initiated analyses
 - Units and values for properties (e.g.- cubic feet per minute, space use codes from The Postsecondary Education Facilities Inventory and Classification Manual (FICM))
- Level of precision and dimensioning
- Any exclusions from models

Model Analysis Plan

- For each project phase, define:
 - Each analysis that will be performed
 - Software to be used
 - Model(s) to be analyzed
 - File format required
 - Responsible team member(s) for
 - Performing the analysis
 - Producing the analysis model(s)
 - Clash detection
 - Software to be used
 - Model(s) to be analyzed
 - File formats acceptable
 - Any object enablers required
 - Responsible team member(s) for
 - Performing the check
 - Producing the clash detection model(s)
 - Process for resolving clashes

Project Deliverables

- Identify electronic models, drawings, renderings, analyses and reports to be delivered
- Identify all types and attributes to be included in the Design BIMs for Contractor’s final COBie deliverables
- Describe process to be used to extract all deliverables from coordinated models
- Describe quality assurance and quality control measures to be implemented
- For Design-Assist projects only, address model sharing and the transition of model responsibilities to the Design-Assist contractor

Sign-Off

- Authorized signature from the Designer and the Designer’s Consultants indicating agreement to comply with this *BEP*.

Appendix B – Tips for Preparing a BIM for Export for Energy Analysis

The following are general tips on preparing a BIM for export for use in external energy analysis software programs. gbXML and IFC are two formats currently supported for energy analysis. Refer to your particular BIM software application's help or resource manual for "how-to" information related to these tips.

- Only include in the data exported for energy analysis the building elements necessary for energy analysis. This includes exterior walls, windows, doors, floors, ceilings, roofs, and volumetric heating and cooling zones. Make sure these elements are defined accurately: for example, do not use generic exterior walls for the analysis; the anticipated exterior wall construction should be used instead.
- Area calculations for zones should be set to calculate both area *AND* volume.
- All zones should be contained by bounding elements (wall, floor, ceiling, or roof). One hundred percent of the building volume should be contained within identified zones. Define the sliver space tolerance (if this option is available).
- Overall, keep the geometry of the energy model simple. A complex model may produce errors and will not yield a more accurate analysis.

Related Reference Documents

The following list of documents and/or websites provide additional information on best practices, tips, and data requirements for preparing BIMs for energy analysis.

- GSA BIM Guide: 05 - BIM Guide for Energy Performance Version 2.1 – June 2015
<http://www.gsa.gov/bim>
- ERDC-CERL TR-11-41 Early Design Energy Analysis Using Building Information Modeling Technology:
<https://apps.dtic.mil/dtic/tr/fulltext/u2/a552789.pdf>
- IFC MVD Definition Diagram: Concept Design to Building Energy Analysis (BEA)–Exchange Requirements Model diagram
http://www.blis-project.org/IAI-MVD/Snapshots/GSA-003_ERM_%28BEA%29_Design_to_BuildingEnergyAnalysis.pdf
- Mastering Autodesk Revit Architecture 2018 – Autodesk Authorized Publisher

Appendix C – State of Tennessee Office of the State Architect (TN OSA) Space Naming and Attribute Standards

The table below lists the required *Attributes* of a *Space Inventory* and maps these *Attributes* to their appropriate locations in a *COBie* file. BIM-authoring software may provide *Attributes* that map to these *COBie* locations. If so, the built-in *Attributes* can be used; otherwise, these *Attributes* will need to be added. Ultimately, it is necessary to ensure this information appears in the correct location in the *COBie* file.

GENERAL ATTRIBUTES		COBie WORKSHEET LOCATION		
Placement Requirement	Attribute	Sheet	Column	Comments
Once Per Project	Building Name	Facility	Name	Owner’s Building Number
Once Per Project	Facility Identification	Facility	ProjectName	Project Title
Once Per Project	Region Code	Facility	SiteName	Optional. May be used to indicate campus or office complex
Each Floor	Floor Identification	Floor	Name	Floor Level
Each Space	Room Designator 1	Space	Name	Owner’s Space naming standard. See below for format.
Each Space	FICM Use Code	Space	Category	For UT and TBR projects only. (See Note 1.)
Each Space	OmniClass Table 13 Code	Space	Category	STREAM only. (See Note 2.)
Each Space	Unique Space ID	Space	ExtIdentifier	Unique ID that should be generated by BIM-authoring software.
Each Space	Net Assignable Area (sf)	Space	NetArea	In SF (For UT and TBR, see FICM)

Floor Name Format

The floor name shall be provided per the owner’s requirements as indicated in the designer’s contract drawings. See Appendix E, Table E2, Floor Name and Description.

Space Name Format

The *Space* name shall be the room number of that *Space*. For example, Room 1223 shall have a *Space* Name of 1223.

Zones

The use of the zones on the project, and therefore the Zone worksheet, is at the discretion of the State of Tennessee Project Manager, in conjunction with the *Project Team*, and based on the project’s scope. Additional guidance on the *COBie Worksheets* can be found in *The COBie Guide*⁸.

⁸ East and Carrasquillo-Mangual, 2012

Space Category

For Higher Education projects, the *Space* category shall be entered a FICM Use Code. See listing of FICM Use Codes in Appendix C.

For space classification of higher education projects, reference the U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, Postsecondary Education Facilities Inventory and Classification Manual ⁹.

For State of Tennessee Real Estate Asset Management Division (STREAM) projects, space classification is based on OmniClass Table 13 - Spaces by Function ¹⁰. OmniClass Table 13 provides high-level categories for spatial functions as well as the ability to provide very detailed functional classification by adding additional digits. For example, 13-11 21 00 is the classification for Meeting Spaces. Optionally, these can be further broken down:

- a. 13-11 21 11 Meeting Room
- b. 13-11 21 17 Conference Room
- c. 13-11 21 27 Community Room
- d. 13-11 21 41 Interview Room

⁹ (NCES) U.S. Department of Education, National Center for Education Statistics, 2006

¹⁰ (OCCS)OCCS Development Committee Secretariat, 2012

FICM USE CODES	
100 Classroom Facilities	110 Classroom Facilities
115 Classroom Service	200 Laboratories
210 Class Laboratory	215 Class Laboratory Service
220 Open Laboratory	225 Open Laboratory Service
250 Research/non-class Laboratory	255 Research/non-class Laboratory Service
300 Office Facilities	310 Office
315 Office Service	350 Conference Room
355 Conference Room Service	400 Study Facilities
410 Study Room	420 Stack
430 Open-Stack Study Room	440 Processing Room
455 Study Service	500 Special Use Facilities
510 Armory	515 Armory Service
520 Athletic or Physical Education	523 Athletic Facilities Spectator Seating
525 Athletic or Physical Education Service	530 Media Production
535 Media Production Service	540 Clinic
545 Clinic Service	550 Demonstration
555 Demonstration Service	560 Field Building
570 Animal Facilities	575 Animal Facilities Service
580 Greenhouse	585 Greenhouse Service
590 Other (All Purpose)	600 General Use Facilities
610 Assembly	615 Assembly Service
620 Exhibition	625 Exhibition Service
630 Food Facility	635 Food Facility Service
640 Day Care	645 Day Care Service
650 Lounge	655 Lounge Service
660 Merchandising	665 Merchandising Service
670 Recreation	675 Recreation Service
680 Meeting Room	685 Meeting Room Service
700 Support Facilities	710 Central Computer or Telecommunications
715 Central Computer or Telecommunications Service	720 Shop
725 Shop Service	730 Central Storage
735 Central Storage Service	740 Vehicle Storage
745 Vehicle Storage Service	750 Central Service
755 Central Service Support	760 Hazardous Materials Storage
770 Hazardous Waste Storage	775 Hazardous Waste Service
780 Unit Storage	800 Health Care Facilities
810 Patient Bedroom	815 Patient Bedroom Service
820 Patient Bath	830 Nurse Station
835 Nurse Station Service	840 Surgery
845 Surgery Service	850 Treatment/Examination Clinic
855 Treatment/Examination Clinic Service	860 Diagnostic Service Laboratory

TABLE CONTINUED ON NEXT PAGE

FICM USE CODES	
865 Diagnostic Service Laboratory Support	870 Central Supplies
880 Public Waiting	890 Staff On-Call Facility
895 Staff On-Call Facility Service	900 Residential Facilities
910 Sleep/Study Without Toilet or Bath	919 Toilet or Bath
920 Sleep/Study With Toilet or Bath	935 Sleep/Study Service
950 Apartment	955 Apartment Service
970 House	000 Unclassified Facilities
050 Inactive Area	060 Alteration or Conversion Area
070 Unfinished Area	WWW Circulation Area
W01 Bridge/Tunnel	W02 Elevator
W03 Escalator	W04 Loading Dock
W05 Lobby	W06 Public Corridor
W07 Stairway	XXX Building Service Area
X01 Custodial Supply Closet	X02 Janitor Room
X03 Public Rest Room	X04 Trash Room
YYY Mechanical Area	Y01 Central Utility Plant
Y02 Fuel Room	Y03 Shaft
Y04 Utility/Mechanical Space	AAA01 Arenas - Open Air
AAA02 Baseball Fields	AAA03 Basketball Courts
AAA04 Bleachers	AAA05 Circuit Training Courses
AAA06 Climbing Walls	AAA07 Dugouts
AAA08 Field Light Poles	AAA09 Grass Playing Fields
AAA10 Hard Playing Surfaces	AAA11 Press Boxes
AAA12 Rope Course Elements	AAA13 Running Tracks
AAA14 Scoreboards	AAA15 Shooting Ranges
AAA16 Ski Lifts	AAA17 Softball Fields
AAA18 Stadiums	AAA19 Swimming Pools – Open Air
AAA20 Synthetic Fields	AAA21 Tennis Courts
AAA22 Volleyball Courts	AAA23 Other Miscellaneous and Not Defined Athletic – Outdoor
END OF TABLE	

For STREAM projects, the *Space* category shall be entered as an OmniClass Table 13 code. See listing of OmniClass Table 13 codes in Appendix C.

OmniClass Table 13	
13-11 00 00 Space Planning Types	13-11 11 00 Planned Work Space
13-11 13 00 Planned Building Service Space	13-11 15 00 Planned Amenity/Support Space
13-11 17 00 Planned Circulation Space	13-11 19 00 Planned Parking Space
13-13 00 00 Void Areas	13-13 11 00 Light Well
13-13 13 00 Air Shaft	13-13 15 00 Occupant Void Area
13-15 00 00 Wall Spaces	13-15 11 00 Exterior Wall Space
13-15 13 00 Interior Wall Space	13-17 00 00 Encroachment Spaces
13-17 11 00 Interior Encroachment	13-17 13 00 Perimeter Encroachment
13-21 00 00 Parking Spaces	13-21 11 00 Exterior Parking Spaces
13-21 13 00 Interior Parking Spaces	13-23 00 00 Facility Service Spaces
13-23 11 00 Vertical Penetration	13-23 12 00 Horizontal Infrastructure/Service Space, Non-Occupied
13-23 13 00 Control Room	13-23 15 00 Loading Dock
13-23 17 00 Restroom	13-23 19 00 Utility Equipment Room
13-23 21 00 Waste and Recycling Spaces	13-23 23 00 Building Service Support Spaces
13-23 25 00 Equipment Platform	13-23 27 00 Interstitial Space
13-23 29 00 Unimproved Shell	13-23 31 00 Alteration or Conversion Space
13-25 00 00 Circulation Spaces	13-25 11 00 Primary Circulation Spaces
13-25 13 00 Transitional Circulation Spaces	13-25 15 00 Connector
13-25 17 00 External Circulation Spaces	13-25 19 00 Secondary Circulation Spaces
13-25 21 00 Restricted Spaces	13-25 23 00 Refuge Spaces
13-31 00 00 Education and Training Spaces	13-31 11 00 Breakout Space
13-31 13 00 Lecture and Classroom Spaces	13-31 15 00 Class Laboratories
13-31 17 00 Training Spaces	13-31 19 00 Study Spaces
13-33 00 00 Recreation Spaces	13-33 11 00 Athletic Recreation Spaces
13-33 13 00 Swimming Pools	13-33 15 00 Non-Athletic Recreation Spaces
13-33 17 00 Wellness Spaces	13-35 00 00 Government Spaces
13-35 11 00 Judicial Spaces	13-35 13 00 Legislative Spaces
13-35 15 00 Military Spaces	13-37 00 00 Artistic Spaces
13-37 11 00 Performance Spaces	13-37 13 00 Display Spaces
13-37 15 00 Creative Spaces	13-41 00 00 Museum Spaces
TABLE CONTINUED ON NEXT PAGE	

OmniClass Table 13	
13-41 11 00 Museum Gallery	13-45 00 00 Library Spaces
13-45 11 00 Library	13-47 00 00 Spiritual Spaces
13-47 11 00 Worship spaces	13-47 13 00 Ceremonial Spaces
13-47 15 00 Procession Spaces	13-47 17 00 Death Spaces
13-49 00 00 Environmentally Controlled Spaces	13-49 11 00 Anechoic Chamber
13-49 13 00 Hazard Containment	13-49 15 00 Clean Room
13-49 17 00 Temperature and Pressure Chamber	13-49 19 00 Data Center
13-49 21 00 Controlled Space Support	13-49 23 00 Miscellaneous Environmentally Controlled Spaces
13-51 00 00 Healthcare Spaces	13-51 11 00 General Examination Spaces
13-51 14 00 Inpatient Care Spaces	13-51 17 00 Multi-Medical Service Support Spaces
13-51 21 00 Diagnostic Imaging Spaces	13-51 24 00 Diagnostic Imaging Support Spaces
13-51 27 00 Radiation Diagnostic and Therapy Spaces	13-51 31 00 Heart and Lung Diagnostic and Treatment Spaces
13-51 34 00 General Diagnostic Procedure and Treatment Spaces	13-51 37 00 Eye and Ear Healthcare Spaces
13-51 41 00 Endoscopy/Gastroenterology Spaces	13-51 44 00 Surgical Spaces
13-51 47 00 Clinical Laboratory Spaces	13-51 51 00 Clinical Laboratory Support Spaces
13-51 54 00 Pharmacy Spaces	13-51 57 00 Medical Services Logistic Spaces
13-51 61 00 Rehabilitation Spaces	13-51 64 00 Dental Spaces
13-51 67 00 Medical Research and Development Spaces	13-53 00 00 Laboratory Spaces
13-53 11 00 Chemistry Laboratories	13-53 13 00 Biosciences Laboratories
13-53 15 00 Physical Sciences Laboratories	13-53 17 00 Astronomy Laboratories
13-53 19 00 Earth and Environmental Sciences Laboratories	13-53 21 00 Forensics Laboratories
13-53 23 00 Psychology Laboratories	13-53 25 00 Bench Laboratories
13-53 27 00 Dry Laboratories	13-53 29 00 Integration Laboratories
13-53 31 00 Wet Laboratories	13-53 33 00 Laboratory Storage Spaces
13-53 35 00 Laboratory Support Spaces	13-55 00 00 Commerce Activity Spaces
13-55 11 00 Office Spaces	13-55 13 00 Banking Spaces
13-55 15 00 Trading Spaces	13-55 17 00 Demonstration Spaces
13-55 19 00 Sales Spaces	13-55 21 00 Commercial Service and Repair Spaces
13-55 23 00 Commercial Support Spaces	13-55 27 00 Hotel, Motel, Hostel, and Dormitory Service Spaces
13-55 29 00 Commerce Activity Support Areas	13-57 00 00 Service Activity Spaces
TABLE CONTINUED ON NEXT PAGE	

OmniClass Table 13	
13-57 11 00 Grooming Activity Spaces	13-57 13 00 Food Service
13-57 15 00 Child Care Spaces	13-57 17 00 Resting Spaces
13-57 21 00 Laundry/Dry Cleaning Space	13-57 23 00 Smoking Space
13-59 00 00 Production, Fabrication, and Maintenance Spaces	13-59 11 00 Material Handling Area
13-59 13 00 Batching Space	13-59 15 00 Production Process
13-59 17 00 Printing and Reproduction Spaces	13-59 19 00 Quality Control and Test Spaces
13-59 21 00 Production Service and Repair Spaces	13-59 23 00 Production and In-Process Storage Spaces
13-59 25 00 Production Support Spaces	13-59 29 00 Greenhouse Spaces
13-61 00 00 Protective Spaces	13-61 11 00 Animal Securing Spaces
13-61 13 00 Detention Spaces	13-61 15 00 Spaces for Protection from the Elements
13-61 17 00 Spaces for Protection from Violence	13-63 00 00 Storage Spaces
13-63 11 00 Warehouse Spaces	13-63 13 00 Non-Warehouse Storage Spaces
13-63 15 00 Moveable Storage Spaces	13-63 17 00 Environmentally Controlled Storage Spaces
13-63 19 00 Specialty Storage Spaces	13-65 00 00 Private Residential Spaces
13-65 11 00 On-call Room	13-65 13 00 Bathroom
13-65 15 00 Mud Room	13-65 17 00 Laundry Room
13-65 19 00 Bedroom	13-65 21 00 Nursery
13-65 23 00 Kitchen	13-67 00 00 Alternate Workplace
13-67 11 00 Customer Site	13-67 13 00 Home Office
13-67 15 00 Rent-An-Office	13-67 17 00 No Fixed Location
13-67 19 00 Supplier Site	13-69 00 00 Building Associated Spaces
13-69 11 00 Roof	13-69 13 00 Roof Terrace
13-69 15 00 Penthouse	13-69 17 00 Antenna Farm
13-69 19 00 Heliport	13-69 21 00 Balcony
13-69 23 00 Deck	13-69 25 00 Pedestrian Travel Spaces
END OF TABLE	

Appendix D – State of Tennessee Office of the State Architect (TN OSA) Asset Naming and Attribute Requirements

Asset Types

Equipment is defined by Types, with each Type representing a single manufacturer and model number. Each Type must be unique. Every piece of *Equipment* is of one Type. All pieces of *Equipment* of the same Type must have the same:

- Manufacturer
- ModelNumber
- Category
- AssetType
- WarrantyGuarantorParts
- WarrantyDurationParts
- WarrantyDurationUnit
- All other *Attributes* designated as “TYPE” (Tables D1, D2 and E1). All Type names must follow the type naming format.

Type Naming Standard Format

Building #	-	TypeID	Type Count
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Building #: The building number, See Section 3.4.

Type ID: Abbreviation found in Column 4 of Table D2 and used to identify the kind of *Equipment*.

Type Count: The number used to distinguish different products of the same Type ID. For example, air handling units (AHU) from different manufacturers.

Example: All air handling units from manufacturer X with model number Y in building 1900006 would be Type:

1900006-AHU1

All air handling units from manufacturer A with model number B in building 1900006 would be Type:

1900006-AHU2

See the *Tables D1 and D2* for a full listing of suggested Type IDs and required *Attributes*.

Components

Each physical instance of a Type within a project is considered a Component. For example, the same roof top unit may recur many times. In this case, each individual roof top unit is a Component. The values of “COMPONENT” *Attributes* may vary between Components of the same Type. Each component must have a unique name.

Component Naming Standard Format

Equipment Category	-	Type Name	-	Floor Name	-	Sequence #
--------------------	---	-----------	---	------------	---	------------

Equipment Category: This is the abbreviation for the *Equipment* category. See Table D2. This table identifies 7 *Equipment* categories: HVAC, PLBG, ELEC, FSUP, CNVSY, ARCH and SITE.

Type Name: This is the name of the Type. See Appendix C, *Type Naming Standard Format*.

Floor: The owner’s required floor name as provided by the designer in the contract drawings. See Appendix C, *Floor Name Format*.

Sequence #: A unique, preferably sequential number for each Component of a Type on the identified floor

Example: The first instance of Type 1900006-AHU1 on the 12th floor would be Component:

HVAC-1900006-AHU1-12-1

NOTE: Although it is desirable that Component Sequence Numbers to be consecutive, designers and/or contractors are **not** required to renumber Components when there are changes. Contractors shall maintain designer’s numbering for all Components that were included in the *Design BIM* in accordance with these BIM Standards. Added Components shall continue the existing sequence.

Component Tag Standard Format

When tagging Components on the contract drawings, an abbreviated version of the Component name is used.

TypeID	Type Count	-	Sequence #
--------	------------	---	------------

A component named HVAC-1900006-AHU1-12-1 would be tagged in the contract drawings as:

AHU1-1

Component Tag Standard Format (Continued)

NOTE: The component tag shall be mapped or otherwise populated into the component’s *Description* field. See Appendix E, Table E2, Component (Column 1) and Description (Column 3).

Equipment Inventory

The *Equipment Attributes* that are required in the *Equipment Inventory* are categorized as Group A, Group B and Group C. The *Attributes* required by Group A and Group B are indicated in Table D1.

For Group C *Attributes*, see Table D2, Column 6. In Table D1, the *Equipment Type Attribute* named **Category** shall be provided as an OmniClass Number from Table D2 column 3. Table D2 maps the Type Description in column 1 to the corresponding Table 23 OmniClass Number in column 3.

The Equipment Type Attribute named **Category** shall include the Table 23 OmniClass Number followed by the OmniClass Title. As an example, the Type Attribute named **Category** for a chiller would be: **23.33.21.00: Chiller**.

TABLE D1 - STATE OF TENNESSEE - EQUIPMENT ATTRIBUTE GROUPS		
ATTRIBUTE GROUP	ATTRIBUTE	TYPE/COMPONENT ATTRIBUTE
A	Name	Type/Component
A	CreatedBy	Type/Component
A	CreatedOn	Type/Component
A	Description****	Type/Component
A	Category*	Type
A	AssetType	Type
A	WarrantyGuarantorParts	Type
A	WarrantyDurationParts	Type
A	WarrantyDurationUnit	Type
A	Manufacturer	Type
A	ModelNumber	Type
A	SpecificationSection	Type
A	TagNumber	Component
A	SerialNumber	Component
A	InstallationDate	Component
A	Space	Component
A	SpatialPlacement **	Component
A	WarrantyStartDate	Component
B	Current	Type
B	Voltage	Type
C	See Table D2, Column 6***	See Table D2, Column 6**
<p>* The Type Attribute in Group A named Category, shall be entered as the Table 23 OmniClass Number provided in Table D2 Column 3.</p> <p>**The values that can be used for the “SpatialPlacement” attribute shall include, but not be limited to AboveCeiling, InSpace, InWall, OnRoof, OnSite, or UnderFloor.</p> <p>*** All Group C Attributes indicated in column 6 of Table D2 are Type Attributes unless denoted by (CA) indicating the attribute is a Component Attribute.</p> <p>****See Appendix E, Table E2 for information relating to the Type Description and the Component Description.</p>		
END OF TABLE		

Equipment Naming Standards and Attributes

Table D2 includes the minimum equipment types and *Attributes* required by these BIM Standards. Additional equipment and attributes may be required by the owner or SPA. The extent of equipment and attributes to be included in the project scope should be coordinated at the start of the project and documented in the *BEP and in the TNNamingSystem spreadsheet*.

While the Type ID indicated in Table D2, Column 4 is recommended, designers may use their own Type ID naming system. When an alternative Type ID naming system is implemented, it shall be documented in the *TNNamingSystem spreadsheet* provided on the TN OSA website. This spreadsheet shall be imported into the *TN OSA COBie Validator* and the *Design BIMs* shall be validated prior to hand off to the contractor. If the Type ID naming system provided in table D2 is implemented by the designer, the *TNNamingSystem spreadsheet* does **not** have to be imported into the default *TN OSA COBie Validator*. The OSA website provides guidance on how to import the *TNNamingSystem spreadsheet* into the *TN OSA COBie Validator*.

It is the responsibility of the designer to apply and maintain the *Attribute* parameters for all required *Attributes* in their *Design BIM*. See Section 3.10.6 and Appendix E, Table E1. It is the responsibility of the contractor to apply and maintain the *Attribute* parameters for all required *Attributes* in their *Construction BIMs*. See Section 5.9.1.5 and Appendix E, Table E1. CADD Microsystems has developed a *TN-Specific Rule Set Model Checker*. The rule set checks that all required TN *Attributes* have been applied as Revit parameters, based on the Type ID. If a designer or contractor wants to run these checks, a type parameter called *TNID* needs to be included on all *COBie Equipment* in the Revit model. The value of the *TNID* parameter is the same as the Type ID for that kind of *Equipment*.

NOTE: For equipment not listed in Table D2, refer to the most current OmniClass Table 23 for the OmniClass Title and OmniClass Number.

TABLE D2 - STATE OF TENNESSEE - STANDARD REQUIRED EQUIPMENT - ASSET MAPPING AND ATTRIBUTES					
1	2	3	4	5	6
ASSET DESCRIPTION	OmniClass TITLE	TABLE 23 OmniClass #	TYPE ID	ATTRIBUTE GROUP (See Table D1)	GROUP C ATTRIBUTES *
EQUIPMENT CATEGORY: HVAC					
CHILLERS	Chillers	23.33.21.00	CH	A , B	Power, Capacity, ChillerType, RefrigerantType, VariableSpeedDrive
BOILERS	Commercial Boilers	23.33.11.00	BLR	A , B	FullLoadFuelConsumption, ThermalEfficiency, FuelType
AIR HANDLING UNITS	Air Handling Units	23.33.25.00	AHU	A , B	CoilFlow, CoilCapacity, HeatingCoilType
FAN COIL UNITS	HVAC Fan Coil Units	23.33.33.00	FCU	A , B	TotalCapacity, CoolingCoilDeltaP, FanMotorHorsepower, Phase, HeatingCoilType
EVAPORATOR UNITS (INDOOR UNITS)	Refrigerant Condensing Units	23.33.37.00	EU	A, B	FanMotorHorsepower, Phase, CoilType, ExpansionDevice
FANS	Air Circulators	23.33.31.00	FAN	A , B	FanMotorHorsepower
AIR TERMINAL UNITS	HVAC Air Terminals	23.33.41.00	ATU	A , B	AirFlow-Minimum, HeatType
HEAT PUMPS (PACKAGED/SPLIT)	Heat Pumps	23.33.17.00	HP	A , B	Capacity, RefrigerantType
CONDENSER UNITS (OUTDOOR UNITS)	HVAC Condenser Units	23.33 43 00	CU	A, B	Cooling Capacity, RefrigerantType

TABLE CONTINUED ON NEXT PAGE

TABLE D2 - STATE OF TENNESSEE - STANDARD REQUIRED EQUIPMENT - ASSET MAPPING AND ATTRIBUTES					
1	2	3	4	5	6
ASSET DESCRIPTION	OmniClass TITLE	TABLE 23 OmniClass #	TYPE ID	ATTRIBUTE GROUP (See Table D1)	GROUP C ATTRIBUTES *
EQUIPMENT CATEGORY: HVAC					
COMPUTER ROOM AIR CONDITIONING UNIT	Air Conditioning Equipment	23.33 39 00	CRAC	A, B	Capacity, RefrigerantType, Phase
COOLING TOWERS	Cooling Towers	23.33 23 00	CLGTWR	A, B	Capacity, Power
HEAT EXCHANGERS	Heat Exchangers	23.27 23 00	HX	A, B	CoolingType, PipeType
COMPRESSORS	Compressors	23.27 21 00	COMPR	A, B	Capacity, RefrigerantType,
PUMPS	Pumps	23.27.17.00	HVP	A, B	PumpMotorHorsepower
ROOFTOP PACKAGED UNITS	HVAC Specific Products and Equipment	23.33.00.00	RTU	A, B	Capacity, RefrigerantType
EXHAUST HOODS (KITCHEN/LAB)	Air Circulators	23.33.31.00	EXH	A, B	FanMotorHorsepower, Phase, FanSpeed
EQUIPMENT CATEGORY: PLBG					
WATER HEATERS	Hot Water Heaters	23.31 29 00	WH	A, B	Capacity, FullLoadFuelConsumption, FuelType
PLUMBING PUMPS	Pumps	23.27.17.00	PLP	A, B	
EQUIPMENT CATEGORY: FSUP					
FIRE SUPPRESSION PUMPS	Pumps	23.27.17.00	FSUPP	A, B	
EQUIPMENT CATEGORY: ELEC					
GENERATORS	Electrical Generators	23.35.11.00	GEN	A, B	FuelType, AirPermit
UNINTERRUPTED POWER SUPPLY	Power Conditioning Equipment	23.35.23.00	UPS	A, B	Power
TRANSFORMERS	Transformers	23.35.13.00	XFMR	A, B	Phase, StepType, CoreType, InstrumentType
EQUIPMENT CATEGORY: CNVSYS					
ELEVATORS	Vertical Transportation Equipment	23.23.11.00	ELEV	A, B	Capacity
CRANES	Materials Handling	23.23.17.00	CRANE	A, B	
EQUIPMENT CATEGORY: ARCH					
DOORS**	Doors	23.17.11.00	DR	A	FireLabelClass, FireLabelRating
EQUIPMENT CATEGORY: SITE					
ELECTRIC METER	Electrical Utility Equipment	23-39 23 00	EM	A, B	MeterType
GAS METER	Natural Gas Utility Equipment	23-39 25 00	GM	A	MeterType
WATER METER	Water Utility Equipment	23-39 27 00	WM	A	MeterType,
SITE WATER PUMPS	Pumps	23.27.17.00	SWP	A, B	Power
SITE FIRE SUPPRESSION PUMPS	Pumps	23.27.17.00	SFSUPP	A, B	Power
WATER SUPPLY WELL PUMPS	Pumps	23.27.17.00	WSWP	A, B	Power
SEWER PUMPS	Pumps	23.27.17.00	SWRP	A, B	RatedFlow, ControllerType
FUEL DISTRIBUTION PUMPS	Pumps	23.27.17.00	FDP	A, B	Service, Power, Phase
FUEL DISTRIBUTION TANKS/CONTAINMENTS	Tanks and Storage Structures	23.27.29.00	FDTNK	A	Capacity, FuelType
<p>* All Additional Attributes indicated in column 6 of Table D2 are Type Attributes unless denoted by (C) indicating the attribute is a Component Attribute. ** All scheduled doors require COBie data including overhead doors, revolving doors, fire-rated doors, and fire shutters.</p>					
END OF TABLE					

Appendix E – COBie Documents and Formatting

Table E1 indicates the parameter values that are to be provided in the BIMs by the designer and the contractor. The table indicates the BIMs in which these values are to be provided and also indicates the project stage in which this data should be added and/or updated in the *Design BIMs* or the *Construction BIMs*.

Table E1 - Legend

- D:** *Attribute* value required from designer
- U/D:** *Attribute* value to be updated by designer
- C:** *Attribute* value required from contractor
- U/C:** *Attribute* value to be updated by contractor

The *Equipment Inventory* and all required Type and Component *Attributes* shall be submitted in COBie format. A blank COBie template can be found at:

https://www.nibs.org/page/bsa_cobietemplate.

Table E2 indicates the worksheets found in a COBie workbook that are required by the State of TN. The Zone worksheet is optional.

- Contact
- Facility
- Floor
- Space
- Zone*
- Type
- Component
- System
- Document**
- Attribute

Table E2 lists the TN-required COBie Worksheets and the information that shall be provided in each Worksheet for an *Asset Inventory*.

Additional guidance on the COBie Worksheets can be found in The COBie Guide (East and Carrasquillo-Mangual 2012).

*The use of the zones on the project, and therefore the Zone worksheet, is not required by these BIM Standards. It is at the discretion of the State of Tennessee Project Manager, in conjunction with the *Project Team*, and based on the project's scope.

**While the Document worksheet is required by the contractor as part of the COBie documentation, it is not included in Table E1 as this information may not typically be maintained within the BIM model.

TABLE E1 - STATE OF TENNESSEE - DESIGNER AND CONTRACTOR REQUIRED BIM ATTRIBUTE VALUES FOR COBie DOCUMENTATION BY PROJECT STAGE						
COBie WORKSHEET	REQUIRED ATTRIBUTES*	BIM TYPE WHERE ATTRIBUTE VALUES ARE PROVIDED	PROJECT STAGE WHEN ATTRIBUTE VALUES ARE PROVIDED OR UPDATED			
			DESIGN DEVELOPMENT	CONSTRUCTION DOCUMENTS PHASE	CONTRACTOR APPROVED SUBMITTALS	CONTRACTOR INSTALLATION
FACILITY	Name	Design BIMs	D	U/D		
	CreatedBy	Design BIMs	D	U/D		
	CreatedOn	Design BIMs	D	U/D		
	Category	Design BIMs	D	U/D		
	ProjectName	Design BIMs	D	U/D		
	SiteName	Design BIMs	D	U/D		
	LinearUnits	Design BIMs	D	U/D		
	AreaUnits	Design BIMs	D	U/D		
	VolumeUnits	Design BIMs	D	U/D		
	CurrencyUnit	Design BIMs	D	U/D		
	AreaMeasurement	Design BIMs	D	U/D		
Description	Design BIMs	D	U/D			
FLOOR	Name	Design BIMs	D	U/D		
	CreatedBy	Design BIMs	D	U/D		
	CreatedOn	Design BIM	D	U/D		
	Category	Design BIMs	D	U/D		
	Elevation	Design BIMs	D	U/D		
	Height	Design BIMs	D	U/D		
SPACE	Name	Design BIMs	D	U/D		
	CreatedBy	Design BIMs	D	U/D		
	CreatedOn	Design BIMs	D	U/D		
	Category	Design BIMs	D	U/D		
	FloorName	Design BIMs	D	U/D		
	Description	Design BIMs	D	U/D		
	GrossArea	Design BIMs	D	U/D		
NetArea	Design BIMs	D	U/D			
CONTACT	Email	Design BIMs / Construction BIMs	D	U/D	C	U/C
	CreatedBy	Design BIMs / Construction BIMs	D	U/D	C	U/C
	CreatedOn	Design BIMs / Construction BIMs	D	U/D	C	U/C
	Category	Design BIMs / Construction BIMs	D	U/D	C	U/C
	Phone	Design BIMs / Construction BIMs	D	U/D	C	U/C
	Company	Design BIMs / Construction BIMs	D	U/D	C	U/C
TYPE / COMPONENT **	Name (Type and Component)	Design BIMs / Construction BIMs	D	U/D	C	U/C
	CreatedBy (Type and Component)	Construction BIMs			C	U/C
	CreatedOn (Type and Component)	Construction BIMs			C	U/C
	Category (Type)	Construction BIMs			C	U/C
	Description (Type and Component)	Construction BIMs			C	U/C
	AssetType (Type)	Construction BIMs			C	U/C
	Warranty Guarantor Parts (Type)	Construction BIMs			C	U/C
	Warranty Duration Parts (Type)	Construction BIMs			C	U/C
	Warranty Duration Unit (Type)	Construction BIMs			C	U/C
	Manufacturer (Type)	Construction BIMs			C	U/C
	ModelNumber (Type)	Construction BIMs			C	U/C
	All Type Attributes from Table D2 Column 6	Construction BIMs			C	U/C
	All Component Attributes from Table D2 Column 6	Construction BIMs				C
	TagNumber (Component)	Construction BIMs				C
	SerialNumber (Component)	Construction BIMs				C
	InstallationDate (Component)	Construction BIMs				C
SpatialPlacement	Constructions BIMs				C	
SpecificationSection	Construction BIMs				C	

*See Table E2, Column 3 for Attribute Descriptions

For all Equipment other than Doors, designers are required to provide the Name Attribute (Type and Component) in the Design BIM. **Designers are required to provide all Attributes for Doors. See Tables D1 and D2.

TABLE CONTINUED ON NEXT PAGE

TABLE E1 - STATE OF TENNESSEE - DESIGNER AND CONTRACTOR REQUIRED BIM ATTRIBUTE VALUES FOR COBie DOCUMENTATION BY PROJECT STAGE						
COBie WORKSHEET	REQUIRED ATTRIBUTES*	BIM TYPE WHERE ATTRIBUTE VALUES ARE PROVIDED	PROJECT STAGE WHEN ATTRIBUTE VALUES ARE PROVIDED			
			DESIGN DEVELOPMENT	CONSTRUCTION DOCUMENTS PHASE	CONTRACTOR APPROVED SUBMITTALS	CONTRACTOR INSTALLATION
SYSTEM	Name	Construction BIMs			C	U/C
	CreatedBy	Construction BIMs			C	U/C
	CreatedOn	Construction BIMs			C	U/C
	Category	Construction BIMs			C	U/C
	ComponentNames	Construction BIMs			C	U/C
ATTRIBUTE	Name	Construction BIMs			C	U/C
	CreatedBy	Construction BIMs			C	U/C
	CreatedOn	Construction BIMs			C	U/C
	Category	Construction BIMs			C	U/C
	SheetName	Construction BIMs			C	U/C
	RowName	Construction BIMs			C	U/C
	Value	Construction BIMs			C	U/C
Unit	Construction BIMs			C	U/C	
*See Table E2, Column 3 for Attribute Descriptions						
END OF TABLE						

TABLE E2 - STATE OF TENNESSEE - REQUIRED COBie WORKSHEETS AND ATTRIBUTES		
1	2	3
COBie WORKSHEET	WORKSHEET COLUMN (ATTRIBUTE)	DESCRIPTION
Contact	Email	One row for each discipline or organization that provides COBie information, including manufacturers and guarantors
	CreatedBy	Entered as an email that is listed in the Email column on the Contact worksheet
	CreatedOn	Date/time entered in ISO 8601 format, YYYY-MM-DDTHH:mm:ss (e.g. 2018-03-18T17:02:59)
	Category	Use OmniClass Table 34 Organizational Roles
	Company	The name of the company for the Email
	Phone	The telephone number for the Email.
Facility	Name	The Owner's Building Number (See Sections 3.4 and 5.4)
	CreatedBy	Entered as an email which must occur on the Contact worksheet
	CreatedOn	Date/time entered in ISO 8601 format, YYYY-MM-DDTHH:mm:ss (e.g. 2018-03-18T17:02:59)
	Category	Use OmniClass Table 11 Construction Entities by Function
	ProjectName	The Project Title
	SiteName	The name of the Site
	LinearUnits	The associated linear unit of measurement applied to all COBie information other than that found in the Attribute worksheet
	AreaUnits	The associated area unit of measurement applied to all COBie information other than that found in the Attribute worksheet
	VolumeUnits	The associated volume unit of measurement applied to all COBie information other than that found in the Attribute worksheet
	CurrencyUnit	The associated currency applied to all COBie information other than that found in the Attribute worksheet
	AreaMeasurement	The measurement method used to calculate areas. (e.g. BOMA, Standard Revit Area, etc.)
	Description	A general description of the facility
Floor	Name	One row for each vertical level to include foundations, floors, roofs, and site per the owner's requirements as indicated in the designer's contract drawings.
	CreatedBy	Entered as an email which must occur on the Contact worksheet
	CreatedOn	Date/time entered in ISO 8601 format, YYYY-MM-DDTHH:mm:ss (e.g. 2018-03-18T17:02:59)
	Category	Typical terms are: Floor, Roof, or Site. Value must occur in the FloorType column on the PickLists worksheet.
	Elevation	Elevation at the top of the floor structure
	Height	Distance between top of floor structure to bottom of structure above
TABLE CONTINUED ON NEXT PAGE		

TABLE E2 - STATE OF TENNESSEE - REQUIRED COBie WORKSHEETS AND ATTRIBUTES		
1	2	3
COBie WORKSHEET	WORKSHEET COLUMN (ATTRIBUTE)	DESCRIPTION
Space	Name	One row per functional space, per room. Multiple spaces in a room are possible
	CreatedBy	Entered as an email which must occur on the Contact worksheet
	CreatedOn	Date/time entered in ISO 8601 format, YYYY-MM-DDTHH:mm:ss (e.g. 2018-03-18T17:02:59)
	Category	Use FICM or OmniClass Table 13 Spaces by Function.
	FloorName	Must be a name listed on the Floor worksheet
	Description	The description of the space
	GrossArea/Net Area*	The total space area, See Facility > AreaMeasurement for information regarding GrossArea and NetArea measurement standard
Zone (Optional)*	Name	The name of the zone, There should be one row for each COBie.Space and COBie.Zone pairing.
	CreatedBy	Entered as an email which must occur on the Contact worksheet
	CreatedOn	Date/time entered in ISO 8601 format, YYYY-MM-DDTHH:mm:ss (e.g. 2018-03-18T17:02:59)
	Category	A classification for the identified Zone. Typical values are: Circulation Zone, Lighting Zone, Fire Alarm Zone, Historical Preservation Zone, Occupancy Zone, or Ventilation Zone. Value must occur in the ZoneType column on the PickLists worksheet
	SpaceNames	Entered as a Name that must occur on the Space worksheet
Type	Name	One row for each owner required equipment Type.
	CreatedBy	Entered as an email which must occur on the Contact worksheet
	CreatedOn	Date/time entered in ISO 8601 format, YYYY-MM-DDTHH:mm:ss (e.g. 2018-03-18T17:02:59)
	Category	Use OmniClass Table 23 Products (See Table D2, Column 3).
	Description	A general description of the asset type
	AssetType	Indicate if Type is “moveable” or “fixed”.
	Manufacturer	Entered as an email which must occur on the Contact worksheet
	ModelNumber	The model number of the installed product
	WarrantyGuarantorParts	Entered as an email which must occur on the Contact worksheet
	WarrantyDurationParts	The length of the warranty period for replacement parts
	WarrantyDurationUnit	The unit of measure for the durations listed in WarrantyDurationParts and WarrantyDurationLabor (e.g. year, month, etc.)
<p>*The use of the zones on the project, and therefore the Zone worksheet, is at the discretion of the State of Tennessee Project Manager, in conjunction with the Project Team, and based on the project’s scope. **COBie requirements for Gross Area and Net Area should be determined at the beginning of the project and documented in the BEP.</p>		
TABLE CONTINUED ON NEXT PAGE		

TABLE E2 - STATE OF TENNESSEE - REQUIRED COBie WORKSHEETS AND ATTRIBUTES		
1	2	3
COBie WORKSHEET	WORKSHEET COLUMN (ATTRIBUTE)	DESCRIPTION
Component	Name	One row for each individually scheduled product or each instance of tagged equipment
	CreatedBy	Entered as an email which must occur on the Contact worksheet
	CreatedOn	Date/time entered in ISO 8601 format, YYYY-MM-DDTHH:mm:ss (e.g. 2018-03-18T17:02:59)
	TypeName	Must be a Type name listed on the Type worksheet
	Space	Must be a Space name listed on the Space worksheet
	Description	This is the abbreviated component name as tagged in the contract drawings. See Appendix C, Component Tag Standard Format.
	SerialNumber	The serial number of the installed equipment, if applicable
	InstallationDate	The date the equipment was installed entered in ISO 8601 format, YYYY-MM-DDTHH:mm:ss (e.g. 2018-03-18T17:02:59)
	WarrantyStartDate	The start date of the equipment’s warranty entered in ISO 8601 format, YYYY-MM-DDTHH:mm:ss (e.g. 2018-03-18T17:02:59)
	TagNumber	The name for the equipment as listed on the equipment’s tag
System	Name	The name of the system, There should be one row for each COBie.Component and COBie.System pairing.
	CreatedBy	Entered as an email which must occur on the Contact worksheet
	CreatedOn	Date/time entered in ISO 8601 format, YYYY-MM-DDTHH:mm:ss (e.g. 2018-03-18T17:02:59)
	Category	Use OmniClass Table 21 Elements.
	ComponentNames	Must be a Component name listed on the Component worksheet
Document (See Appendix E, Table E3)	Name	One row for each deliverable document related to Types and Components. See Appendix E, Table E3 for the naming convention
	CreatedBy	Entered as an email which must occur on the Contact worksheet
	CreatedOn	Date/time entered in ISO 8601 format, YYYY-MM-DDTHH:mm:ss (e.g. 2018-03-18T17:02:59)
	Category	Applicable values are listed in the Document Type column in the Document Naming Convention Table E3 in Appendix E. Value must occur in the DocumentType column on the PickLists worksheet.
	ApprovalBy	Allowed values listed in the ApprovalBy column on the PickLists worksheet. Standard values are Owner Approval, Contractor Certified, and Information Only
	Stage	Allowed values listed in the StageType column on the PickLists worksheet. See COBie template, PickLists worksheet for standard values.
	SheetName	Documents may be associated with Types, Components, Systems, or other COBie worksheets. Enter the appropriate worksheet for the document.
	RowName	This value must occur in the Name column on the worksheet listed in the SheetName field.
	Directory	The full path name to the file, but not including the file name
File	The name of the file, as listed in the Name field, with the file extension (e.g. PD-101-AHU0001.PDF)	

TABLE CONTINUED ON NEXT PAGE

TABLE E2 - STATE OF TENNESSEE - REQUIRED COBie WORKSHEETS AND ATTRIBUTES		
1	2	3
COBie WORKSHEET	WORKSHEET COLUMN (ATTRIBUTE)	DESCRIPTION
Attribute	Name	One row for each required Type or Component Attribute that is not included on another COBie worksheet. See Appendix D
	CreatedBy	Entered as an email which must occur on the Contact worksheet
	CreatedOn	Date/time entered in ISO 8601 format, YYYY-MM-DDTHH:mm:ss (e.g. 2018-03-18T17:02:59)
	Category	Value must occur in the StageType column on the PickLists worksheet
	SheetName	Attributes may be associated with Space, Types, Components, or other COBie worksheets. Enter the appropriate worksheet for the attribute.
	RowName	This value must occur in the Name column on the worksheet listed in the SheetName field.
	Value	This is the Attribute value. For example, a pump’s FlowRate may be 30 gallons per minute. The value would be 30.
	Unit	This is the unit of the Attribute value. For example, a pump’s FlowRate may be 30 gallons per minute. The unit would be gpm. Some attribute units are provided by the designer and some are provided by the Contractor. See Appendix D
END OF TABLE		

In reference to the *COBie Worksheet* tab titled *Document*, Table E3 identifies the document types related to managed *Assets* that should be listed in the Document Worksheet in the *COBie* deliverable.

Document Naming Convention:

TABLE E3 - STATE OF TENNESSEE - COBie DOCUMENT NAMING CONVENTION		
DOCUMENT TYPE	DOCUMENT CODE	DOCUMENT NAMING CONVENTION
Cut Sheet	CS	CS–Type Name
Manufacturer Certificates	MC	MC–Type Name
Manufacturer Installation Instructions	MII	MII–Type Name
Material Safety Data Sheet	MSDS	MSDS–Type Name
Manufacturer Test Reports	MTR	MTR–Type Name
Operations & Maintenance Data	OM	OM–Type Name
Product Certificates	PC	PC–Type Name
Product Data	PD	PD–Type Name
Spare Parts List	SP	SP–Type Name
Material Warranty	MW	MW–Type Name
Field Test Reports	FTR	FTR–Component Name–Description of document (optional)
Start-up Reports	SR	SR–Component Name–Description of document (optional)
Test & Balance Reports	TAB	TAB–Description of document
END OF TABLE		

Document Naming Convention (Continued)

As an example, assume there is an HVAC system with multiple air handling units of Type AHU0001 in building 1900006.

The naming convention for System level reports will be:

Document Code – Description of the document
System example: TAB-HVACSupplyLevel3

The naming convention for Type level reports will be:

Document Code – Type Name
Type example: PD-1900006-AHU0001

The naming convention for Component level reports will be:

Document Code – Component Name – Description of the document

SR-HVAC-1900006-AHU0001-12-001-TraneUnitStartUp
Or: SR-HVAC-1900006-AHU0001-12-001

Appendix F – BIM Execution Plan Outline – Contractors

The following outline indicates the minimum information to be included in a BEP on State of Tennessee projects. Additional information may be included in the BEP as deemed appropriate by the owner, designer and contractor or as otherwise required by these BIM Standards.

Project Information

- Identify project name, SBC number, location (address & geo-reference)
- Identify owner
- Identify effective date or revision date of plan

Project Construction Team Information

- Contractor firm
 - Firm name
 - Firm address
 - BIM manager name
 - BIM manager contact information
- subcontractors and Major Suppliers
 - Firm name
 - Firm address
 - BIM coordinator name
 - BIM coordinator contact information

BIM Goals and Objectives

- Identify owner's intended goals or end uses of the BIM
- Identify Contractor, subcontractors, and major suppliers uses of the BIMs during the project
- Organization responsible for each Construction BIM
- List of Construction BIMs to be delivered

Roles and Responsibilities

- Briefly describe each organization's responsibility for:
 - BIM creation
 - BIM quality
 - BIM analyses
 - BIM management
- Identify BIM software product and version to be used by each organization
- Describe the roles of the BIM Manager and the BIM Coordinators

Software for Model Authoring

- Identify all software products to be used for BIM creation/updating and the software version
- Identify all object enablers to be used for viewing BIMs
- Identify all software products to be used for BIM Coordination and interference reporting
- Identify software products that will be used to perform quality control on BIMs

Modeling Standards and Content

- Common coordinate system
 - Units
 - File origin (X,Y,Z)
 - Geolocation
- Modeling partitions
- File versioning
- Naming
 - Files
 - Building level designators
 - Building area designators
 - Discipline designators
 - Layers (if applicable)
 - Properties required for:
 - COBie deliverables
 - Owner-requested analyses
 - Construction-initiated analyses
 - Units and values for properties (e.g.- cubic feet per minute, space use codes from FICM)
- Level of precision and dimensioning
- Objects to be modeled per discipline or trade
- BIMs shall include clearances for access, maintenance, and code requirements
- Object properties to be included
- Equipment tags
- Any exclusions from the Construction BIMs

Construction Phase Analyses,

- Each analysis that will be performed:
 - Software to be used
 - BIM(s) to be analyzed
 - File format required
 - Responsible team member(s) for
 - Performing the analysis
 - Producing the required BIM(s)

BIM Kickoff Meeting

- Identify the required and optional attendees
- Identify the meeting location and date
- Identify the agenda of the kickoff meeting.
 - Sample agenda could include:
 - BIM expectations
 - Project goals
 - BIM coordination process
 - BIM coordination meetings
 - COBie data capture process
 - COBie coordination meetings
 - Other BIM analyses such as 4D Scheduling
 - Discuss BIM Execution Plan
 - Discuss modeling standards
 - Discuss model content
 - COBie deliverables and requirements
 - BIM deliverables
 - Discuss any software limitations that may affect deliverables

Collaboration Plan

- Describe the collaboration and file sharing system(s) to be used to exchange, merge, identify interferences and visualize BIMs
- Describe the collaboration and file sharing system to be used for data aggregation from and assigning data responsibility to team members
- Describe the method to be used to capture required equipment attributes as data during Submittals and Installation
- Describe the system(s) to be used to exchange other electronic documents such as meeting minutes, meeting agendas, and interference reports
- Describe the hardware and software to be provided for onsite viewing of Coordination BIMs
- Identify owner-accessible files, versions and read/write privileges

BIM Coordination

- Describe the roles and responsibilities of required Project Team members for BIM coordination
- Describe the schedule for or frequency of model updates and interference checks
- Describe tools to be used for BIM coordination
- Define the clashes to be run (e.g. HVAC vs. Structure)
- Describe the process to identify and resolve interferences
- Describe the process for tracking action items from the meeting.
- Describe the process for tracking changes to the Coordination BIMs
- Describe the process to be used to generate related shop drawings and coordination drawings from the coordinated Construction BIMs

BIM Coordination Meetings

- Identify the frequency of meetings
- Identify the required and optional attendees
- Identify the locations of the meetings

COBie Coordination

- Describe the roles and responsibilities of required Project Team members for COBie data capture
- Discuss the tool(s) to be used to aggregate the data from multiple parties
- Describe the method for capturing required equipment Attributes, as defined in Appendices D during product submittals
- Describe the method for frequency of QA/QC of COBie data

COBie Coordination Meetings

- Identify the frequency of meetings
- Identify the required and optional attendees
- Identify the locations of the meetings

BIM Deliverables

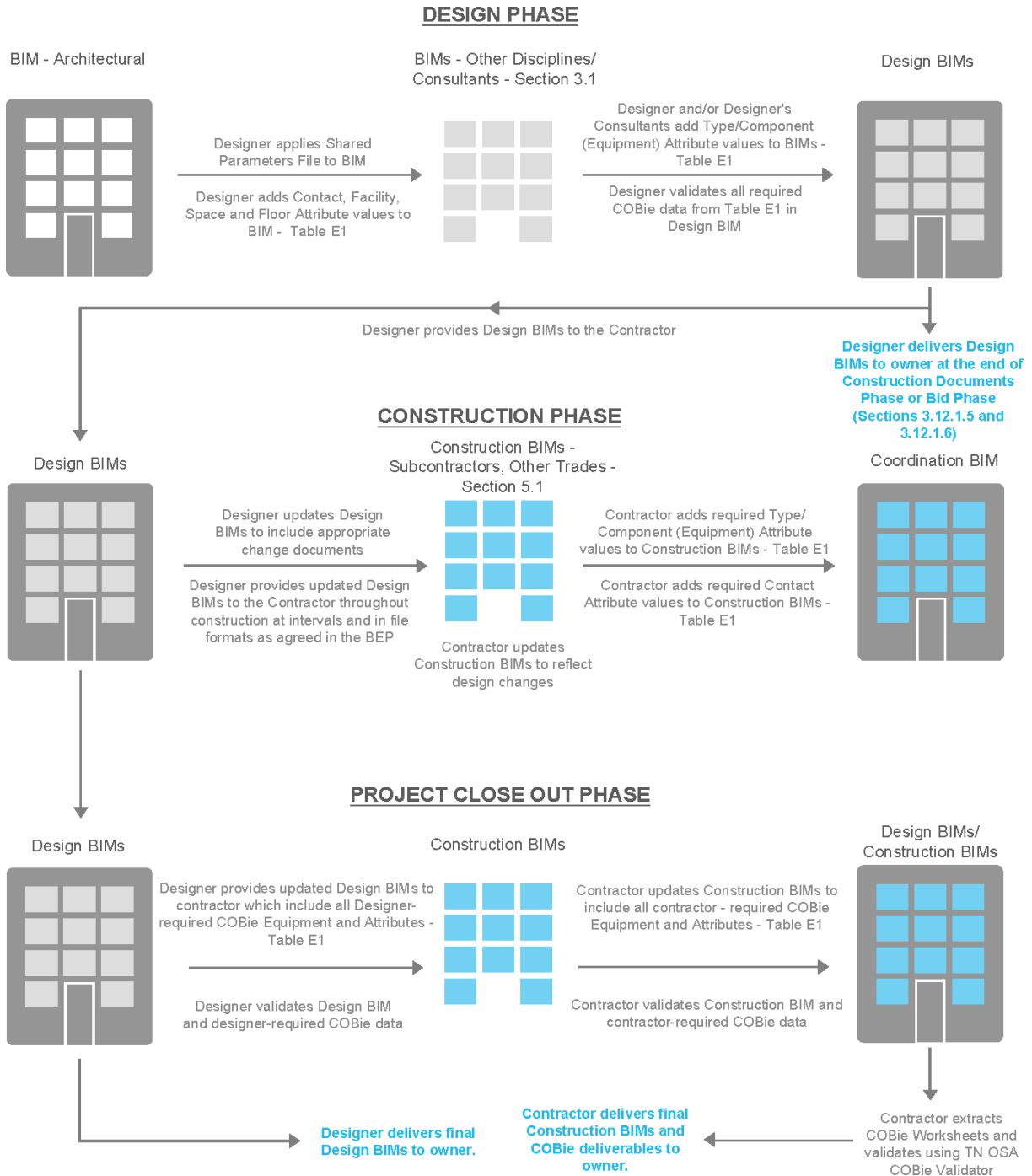
- Identify electronic models, drawings, analyses, data and reports, to be delivered
- Identify all types and attributes to be included in the COBie deliverables
- Describe technique for merging COBie data produced by multiple parties
- Describe process to be used to extract all BIM and drawing deliverables from the coordinated, Construction BIMs
- Identify the file formats for all deliverables
- Describe process to be used to aggregate and deliver COBie documents
- Describe quality assurance and quality control measures to be implemented

Sign-Off

- Authorized signature from the Contractor, Subcontractors, and Major Suppliers indicating agreement to comply with this BIM Execution Plan

Appendix G – BIM Process Map

The *BIM Process Map* below illustrates a general progression of BIM model development and how BIM will be applied on a project including associated activities and information exchanges from project design through project close out. See Sections 3.12 and 5.11 for more information regarding designer and contractor BIM deliverables by project phase.



Appendix H – Change Log

1. Section 1: Clarified that these BIM Standards are meant to be outcome based.
2. Section 2: Clarified definitions.
3. Section 3: Clarified material and addressed concerns raised from the Industry and pilot teams.
4. Section 4: Updated to capture and reflect changes made in Section 3.
5. Section 5: Clarified material and addressed concerns raised from pilot teams.
6. Section 6: Updated to capture and reflect changes made in Section 5.
7. Appendix A: Clarified the clash detection reporting requirement for designers.
8. Appendix B: No changes.
9. Appendix C: Updated to include requirement that higher education projects use an un-altered form of FICM for classifying spaces. Included naming for floors. Shortened the included OmniClass Table 13 list.
10. Appendix D: Updated attribute requirements based on feedback from industry, STREAM, JLL, and pilot teams.
11. Appendix E: New. Created to address request for a brief COBie primer.
12. Appendix F: New. Contains the document naming standards and requirements that were originally included in Appendix D.
13. Appendix G: Renamed; this was the old Appendix E. Updated to include additional feedback from pilot teams.

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14. Section 1: Removed Section 1.3 Incremental BIM Adoption
15. Section 2: Removed Section 2 Obligation to Use BIM and General Principles
16. Section 2: Moved Section 2.1.7 to Section 2.2 Risk Allocation
17. Section 2: Revised/Added Definitions
18. Section 3: Revised Building Number requirement, Section 3.4, Clarified Existing Conditions, Section 3.6
19. Section 3: Added Section 3.11 BIM Methodology to consolidate previous Section 3.10 Well-Structured BIM
20. Section 3: Revised Section 3.12 BIM Deliverables by Phase - designer
21. Section 4: Revised Section 4 to align with Section 3.12 revisions
22. Section 5: Removed Architectural and Structural Proxy BIMs (Section 5.1), Revised Building Number requirements (Section 5.4), Added Reference to Section 3.11 BIM Methodology
23. Section 5: Revised BIM Deliverable – contractor (Section 5.11)
24. Section 6: Revised Section 6 to align with Section 5.11 revisions
25. Appendix D: Specified an Abbreviated Component Tag format
26. Appendix D: Added Table D1, Attribute Groups to simplify table D2

27. Appendix D: Table D2, Consolidated Equipment Naming Standards and Attribute Table including OmniClass 23 mapping and Attribute Groups, Table D1 reference
28. Appendix E: Added Table E1 to clarify BIM Attribute/Parameter Values by responsibility, BIM Type and Project Stage.
29. Appendix E: Moved COBie Field Requirements from Appendix F to Appendix E.
30. Appendix G: Added BIM Process Map to clarify how BIM will be applied on projects including associated activities and information exchanges.

31. BIMs Section 3.5. Geo-referencing – Updated the requirements for expressing units when using the Tennessee State Plane Coordinate System

SECTION 1. Tenn. Code Ann. § 66-6-102, is amended by deleting the section and substituting:

*The plane coordinate values for a point on the earth's surface, used to express the geographic position or location of such point, must consist of two (2) distances expressed in United States survey feet and decimals of a foot when using the Tennessee Coordinate System of 1927, expressed in either United States survey feet and decimals of a foot or meters and decimals of a meter when using the Tennessee Coordinate System of 1983, and **expressed in either International feet and decimals of a foot or meters and decimals of a meter when using the Tennessee State Plane Coordinate System.** One (1) of these distances, to be known as the "East X-coordinate," must give the distance east of the Y axis; the other, to be known as the "North Y-coordinate," must give the distance north of the X axis. The Y axis of any zone must be parallel with the central meridian of that zone. The X axis of any zone must be at right angles to the central meridian of that zone.*