

State of Tennessee



State of Tennessee
Office of the State Architect's
Building Information Modeling (BIM)
Requirements (BIMr)

presented by

Bob Oglesby, AIA, LEED AP
State Architect
Office of the State Architect (OSA)
<http://www.tn.gov/finance/OSA/>

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Role of the State Architect

- Provide operational and technical staff support to the State Building Commission (SBC) which approves funding for all projects associated with improvements to real property
- Responsible for recommending, then developing and implementing SBC supported initiatives, programs and policies like Building Information Modeling (BIM)
- Facilitated through the three **State Procurement Agencies (SPAs)** – DGS's STREAM, TBR and UT

The SBC is interested in:

- Considering any items which may achieve a higher and better use of taxpayer dollars spent on improvements to real property
- Items which create **Greater Owner Value**
 - And
- Will lower the State's Total Cost of Ownership through
 - more efficient and effective design, construction and operational processes
 - the realization of higher performing buildings throughout their entire life cycle
- BIM will help the State achieve this!
 - And
- Improve the productivity of those providing services and products in the Design and Construction industry as well as Operations and Maintenance

Widely Acknowledged Problems

- 30% of projects do not make schedule or budget
 - *Construction Management Association of America (CMAA) Industry Report 2007*
 - Building owners, particularly those represented by CURT, regularly experience project schedule and cost overruns.
 - *Construction Users Round Table (CURT) WP 1202 2004*
- 37% of materials used in the construction industry become waste
 - *Movement for Innovation Industry Reports - Economist Magazine 2002*

Creating Greater Owner Value

- The majority of cost and schedule overruns are due to lack of building systems coordination
- BIM, properly applied, can address these issues:
 - Need accurate 3D model of structure and architecture
 - MEP subcontractors must develop detailed 3D models
 - Subcontractors must fabricate and install from those models

Utilizing Building Information Modeling during Design, Construction and Operations

- 2009 McGraw Hill Construction's report "The Business Value of BIM"

In addition to

- Improved coordination of drawings / documents

The State of TN, like many Owners, say BIM projects have greater value due to:

- Improved collective understanding of design intent
- Improved overall project quality
- Better cost control / predictability of project scope
- Reduced number of RFIs (Requests for Information) and Change Orders
- Reduced conflicts during construction
- Avoiding construction rework / changes
- Faster project delivery
- Providing data useful post construction for Operations and Maintenance

BIM / VDC Related Opportunities for Increasing Productivity:

- *The Construction Industry Institute (CII)*

The linking of BIM / VDC models to intelligent databases and through use of collaboration software helps improve communications, reduces errors and omissions, and reduces project team and construction costs

- The typical building project involves thousands of documents – contracts, budgets, schedules, codes, plans, specifications, cut sheets, shop drawings, fabrication details, warranty information, maintenance data, asset management information, operations procedures, etc.
- Documents which include lots of redundancy and lead to unintentional sharing of inaccurate or out of date information
- Having a common set of real-time information accessible to project owners, project managers, contractors, subcontractors, designers, consultants, and others saves times, improves communication, and reduces errors caused by conflicting information in individual documents or silo applications
- Indirect benefiting contractors so they can more consistently count on construction documents with fewer errors and/or coordination problems

- Use of BIM can also assist the contractor in better managing its workforce and materials
 - Real time project information at the job site can expedite and improve on-site contractor decision making and work sequencing and foster collaborative problem solving and solutions
 - Virtual building models assist contractors and subcontractors to better understand the project scope and costs, and resolving conflicts, etc. before starting construction
 - Assist contractors in better sequencing their labor activities to eliminate down time and coordinate different trade's schedules and work areas so that construction is progressing efficiently and as fast as responsibly possible
 - Assist trades in better pre-packaging the materials needed for each day's work so there is less walking around and more work going on
 - BIM can support improved Supply Chain Management to significantly cut waste related to time, materials and labor and more efficient procurement of materials and supplies (also potentially reducing on-site storage requirements)
 - It can also assist contractors in identifying the best location for materials, supplies and equipment on an on-going basis

3D modeling supports prefabrication and modularization

- Easier access to tools and less materials waste

Which allows for

- Improved quality and precision in fabrication,
- Lower project costs,
- More efficient use of materials,
- Higher labor productivity,
- Fewer job-site environmental impacts,
- Compressed project schedules,
- Increased worker safety,
- Provision of Contractor “as-built” information (versus Designer “record” drawings) which provides more “value added” services and data for Owners

This will all result in Greater Owner Value - shorter schedules, tighter bids and lower costs

OSA BIM Consultant Work

To date:

- Last year, I went around state discussing State's interest in BIM and assessing industry's use and sent out a survey to TN AEC industry representatives assessing their BIM experience
 - 56% using BIM on daily basis
 - 89% would support a State BIM program for use by project team members
- Last summer, OSA hired Kristine Fallon and Associates (KFA) of Chicago as our BIM consultant
- September 2012 - OSA held Town Hall / Webinar – BIM Kickoff
- September 2012 - KFA met with each SPA to gather their initial perspectives
- November 2012 - KFA developed first draft of BIMr
- December 2012 - OSA established a TN AEC industry BIM Working Group – to review and comment on BIMr
- January 2013 - Finalized draft of BIM Requirements

OSA BIM Consultant Work

To date (continued):

- February 2013 - Reviewed and incorporated initial comments from
 - UT, TBR, and STREAM
 - AEC industry attorneys, insurance and surety reps
- March 2013 - Developed Owner's O & M criteria for space and equipment management (based on COBie Guide)
- March 2013 - Reviewed and incorporated additional comments from
 - UT, TBR, and STREAM
- April 22, 2013 - Presented Report on OSA's BIM Requirements to SBC's ESC
- April 23, 2013 - Released BIM Requirements (BIMr) version 1 available on OSA website

OSA BIM Consultant Work

Next steps:

- Will provide BIM pilot project team support
 - SPA identified projects to date: 3 STREAM
 - Contractor volunteered projects to date: 1 UT
- August 13, 2013 - Will conduct training on Design and Construction BIM Usage with State Project Managers and Facilities Managers
- August 14, 2013 - Am offering pre-AIA Convention Workshop - open to AEC industry
 - 8:00 am Arrival and Registration
 - 8:30 am Marlon Blackwell: Using BIM to Create Stellar Design
 - 9:45 am Industry Panel: TN OSA BIM Requirements and Your Business
 - 11:00 am Vendor Panel: Getting Your Firm in the Best Position to Meet the State's New BIM Requirements

OSA BIMr

Mission of BIM Requirements

- To create building projects with greater long term owner value through an enhanced design, construction and operations process.

Purpose and Application of the BIM Requirements

- For the consistent development and management of BIM on State building projects.
- They may be used voluntarily by Designers, and/or Contractors, working on State projects who choose on their own to use BIM and agree to do so according to the State's standards.
- They also apply to all projects designated to use BIM, and their Designers and Consultants, and/or to their Contractors and Subcontractors, as specified and selected by any of the three State Procurement Agencies (SPAs):
 - State of Tennessee Real Estate Asset Management (STREAM),
 - The University of Tennessee (UT), and
 - The Tennessee Board of Regents (TBR).

OSA BIMr

BIM General Principles:

- These BIM Requirements do not change the contractual relationship between the parties or shift the risks between those parties.
- All parties to any contract relating to the Project shall contain flow down clauses requiring all other parties to those contracts to comply with these BIM Requirements
- Nothing in the BIM Requirements modify, amend, suspend or abrogate any obligation of the Designer to the Owner or the Owner to the Contractor relating to the constructability of the Project's design.

OSA BIMr

Ownership and Rights of Data

- The Owner shall have ownership of and rights to all BIMs, electronic CAD files, and building data developed during the Project.

Risk Allocation

- Each non-Owner party shall be responsible for any contribution that it makes to a BIM or that arises from that party's access to a BIM.

Such responsibility includes any contribution or access to a BIM by a Project Team member in contract with that party and of a lower tier than that party.

TN OSA BIM Requirements
Overview
For
Designers & Contractors

TN OSA Approach

- All of a designated BIM project's team members must use BIM
- Supporting Open (non-proprietary) Standards
 - No requirement to use a specific software product
 - All BIMs to be delivered in Industry Foundation Classes (IFC) format
 - All Space and Equipment Inventories to be delivered in Construction to Building information exchange (COBie) format
- All major drawings must be extracted from the BIM
- BIMs must be the basis for:
 - Area and volume calculations
 - Energy analysis
 - Interference checking
 - Space and equipment inventories
- Design and Construction teams must use collaboration technology to share models and other project information

BIM Requirements for Designers

Acceptable BIM Software for Designers

Autodesk Revit

Autodesk Revit Architecture

Autodesk Revit Structure

Autodesk Revit MEP

Autodesk AutoCAD

Architecture

Autodesk AutoCAD MEP

Autodesk AutoCAD Civil 3D

Bentley Architecture

Bentley AECOsim

Bentley Inroads

Graphisoft ArchiCAD

Graphisoft ArchiCAD MEP

Tekla Structures

Digital Project: Designer

Nemetschek Vectorworks

Other products will be considered if requested

Required BIM Uses

- At each design submission, the BIMs shall be provided in IFC format
 - Conformed Bid BIMs (includes all changes from Addenda and accepted alternates) also required in native (original) format
- All plans, sections, and elevation drawings and CAD files at $\frac{1}{4}'' = 1'-0'$ or smaller scale, as well as schedules and 3D views, shall be extracted from the BIMs
- BIMs shall be used to perform all area and volume calculations
- BIMs shall be used as the basis for energy analysis
- BIMs shall be used to identify and resolve spatial conflicts between building systems
- BIMs shall be used to produce space and equipment inventories

Reasons for Requirements

- IFC-format BIMs can be merged, visualized and checked for interferences using free software
 - Conformed Bid BIMs in native format can be updated by Contractor to reflect As-Built conditions
- Drawings and schedule extraction from the BIMs ensures:
 - Drawings are coordinated
 - Building systems coordination effort is reflected in the drawings
 - Schedules are accurate
- Calculating areas and volumes from BIMs is quicker and more accurate
- Using BIMs as the basis for energy analysis reduces time required to get a result and allows for more iterations and optimization
- BIM-based interference checking eliminates the majority of field problems
- Space and equipment inventories from BIMs are more accurate and useful to Owners

Other Significant Requirements

- Geo-referencing
- Staffing
 - BIM Manager
 - BIM Coordinators
- BIM Execution Plan

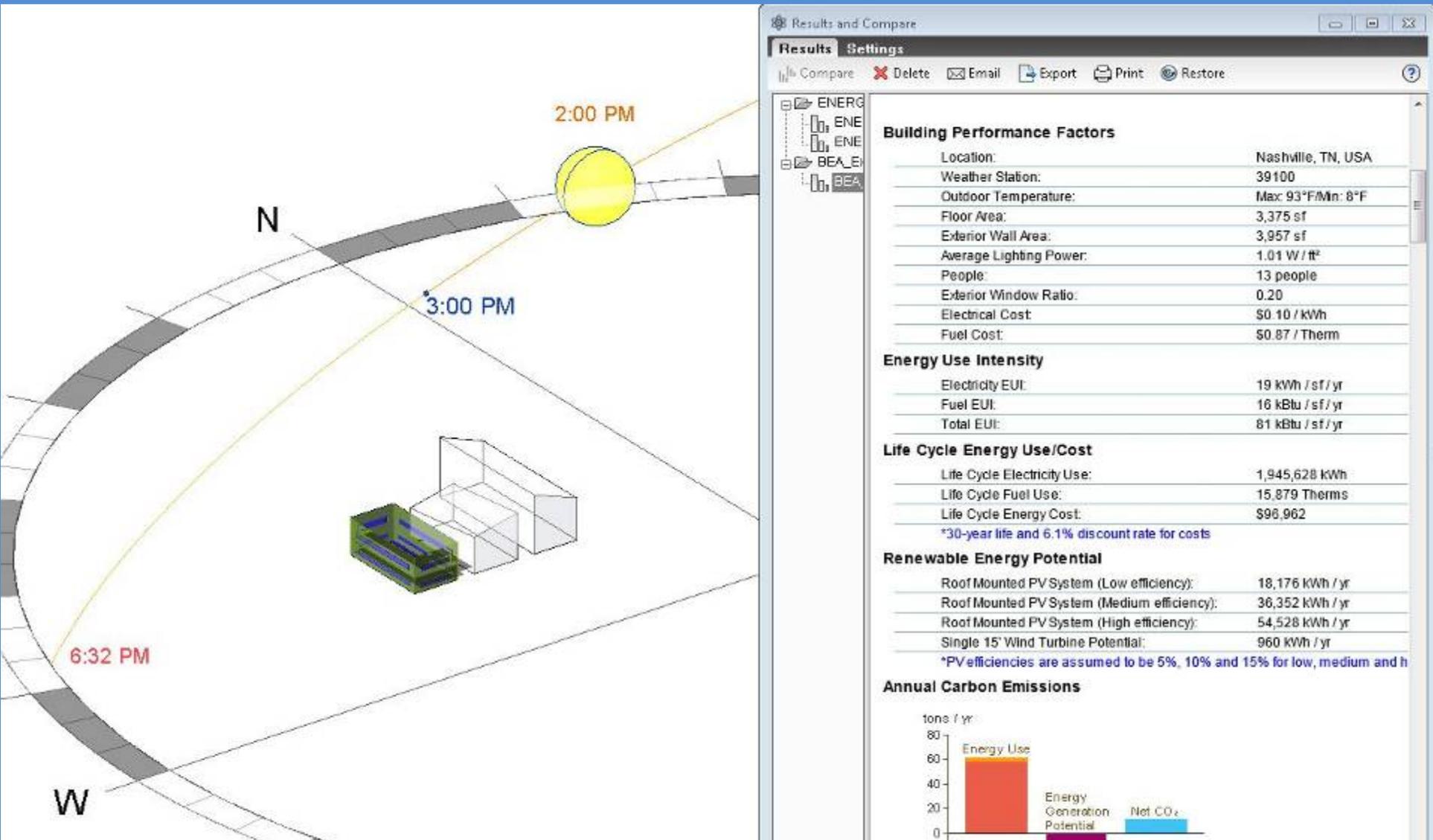
BIM Execution Plan - Designers

- Project Information
- Project Designer's and Designer's Consultants' Contact Information
- BIM Goals and Objectives
- Roles and Responsibilities
- Collaboration Plan
- All Software to be Used for Model Authoring
- Planned Models
- Modeling Standards
- Model Analysis Plan
- Project Deliverables
- Sign-Off

BIM Requirements: Pre-Design / Programming & Schematic Design

Pre-Design/Programming	BIM is not required, but encouraged.
Schematic Design	Massing BIM indicating siting and orientation.
	Submit space inventory in COBie format (COBie worksheets: Contact, Facility, Floor, and Space only).
	Drawings and 3D views shall be extracted from the BIMs.

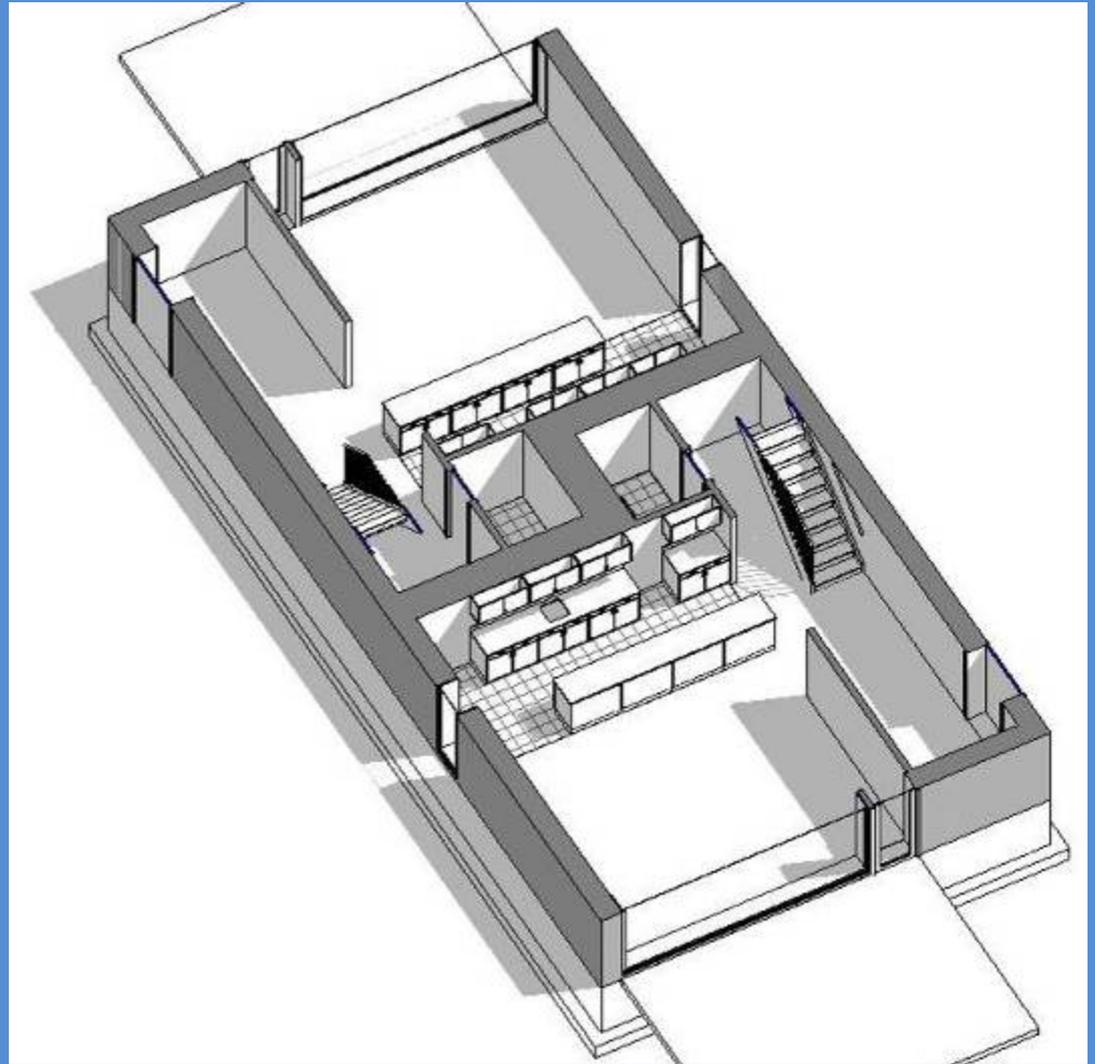
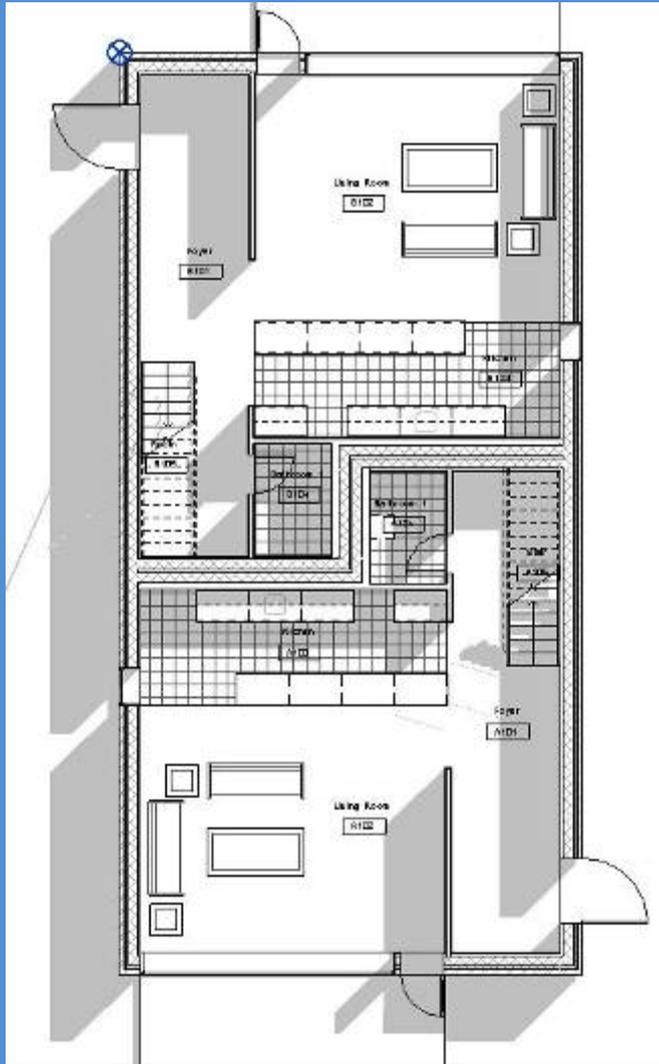
BIM Use: Pre-Design / Programming & Schematic Design



BIM Deliverable Requirements – Early Design Stage

Early Design Stage Presentation (or Early Design Review)	BIM in IFC format and if applicable, a site model in IFC or 3D .DWG format, with any custom (ARX) objects converted to native AutoCAD objects.
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BIM Output – Early Design



BIM Deliverable Requirements – Design Development

Design Development	BIM partitioned by discipline and floor in IFC format only. If applicable, a site model in IFC or 3D .DWG format, with any custom (ARX) objects converted to native AutoCAD objects.
	BIM-based energy analysis reports
	Interference report
	Submit space and equipment inventories in COBie format (COBie worksheets: Contact, Facility, Floor, Space, Zone, Type, System, and Attribute).
	All ¼" = 1'-0" or smaller scale drawings - Plans, Sections, and Elevations – in addition to Schedules and 3D views shall be extracted from the BIMs.

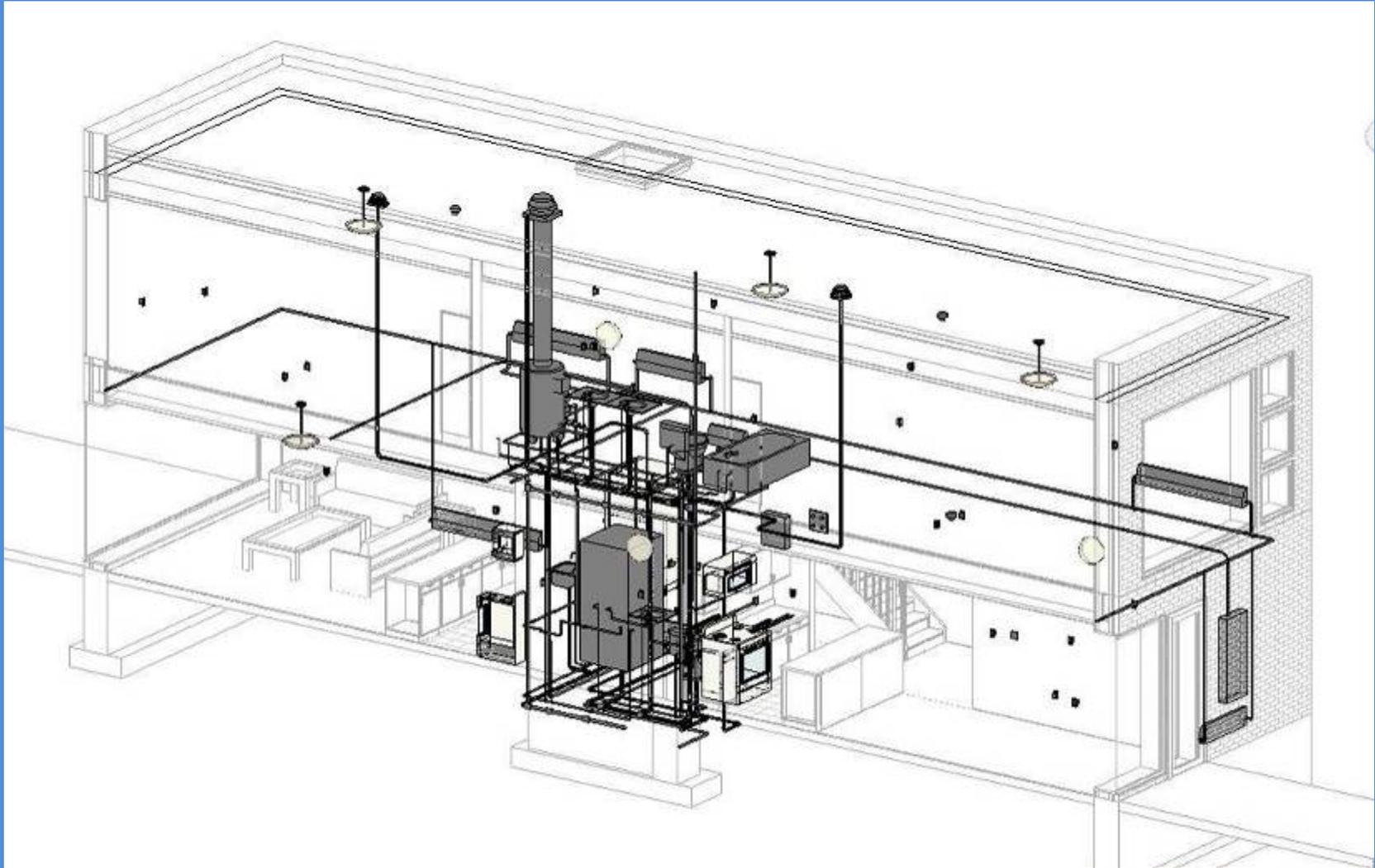
Section Derived from BIM – Design Development



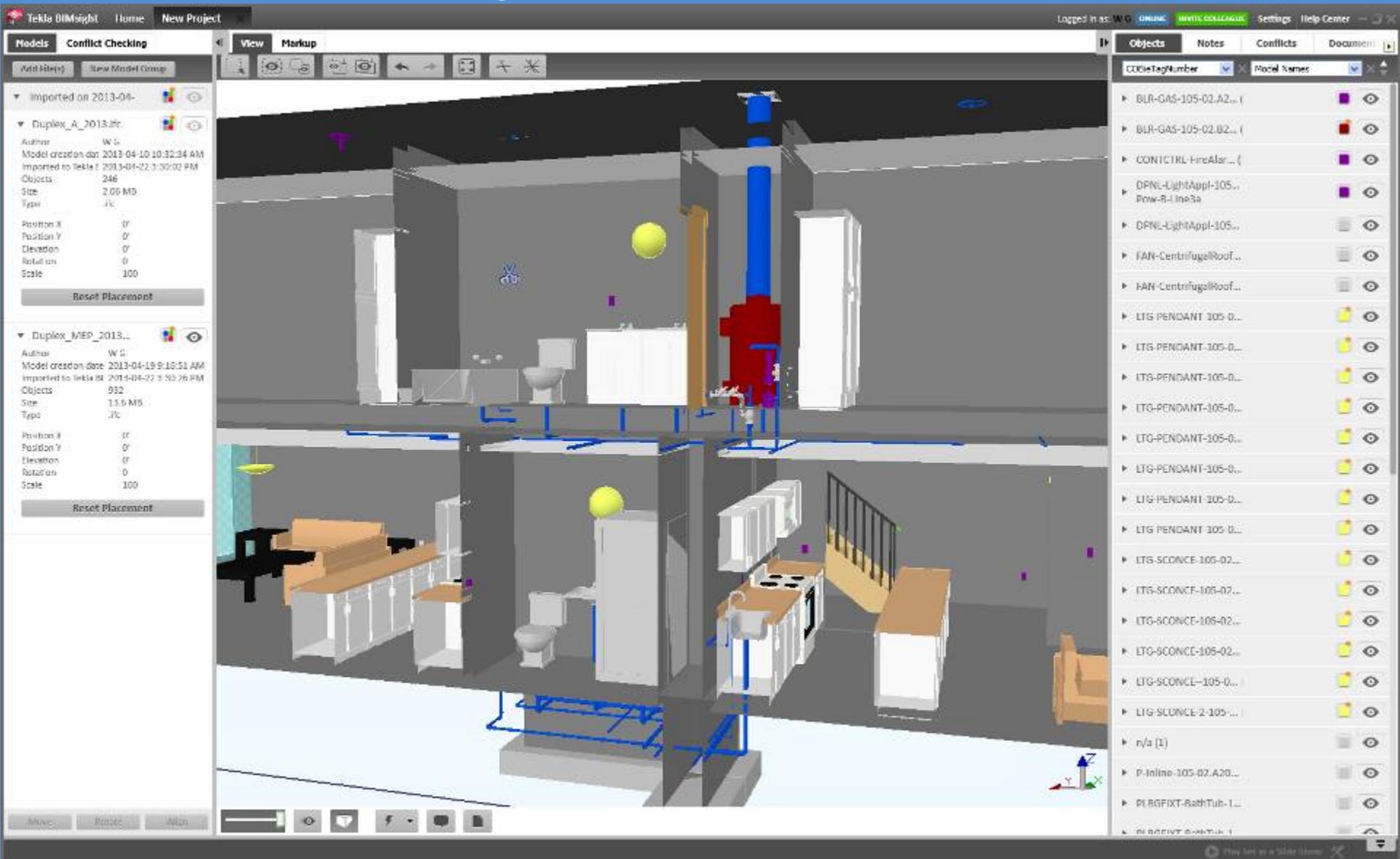
BIM Deliverable Requirements – Construction Documents

Construction Documents	BIM partitioned by discipline and floor in IFC format only. If required, a site model in IFC or 3D .DWG format, with any custom (ARX) objects converted to native AutoCAD objects.
	BIM-based energy analysis reports
	Interference Report
	Submit space and equipment inventories in COBie format (COBie worksheets: Contact, Facility, Floor, Space, Zone, Type, Component, System, and Attribute).
	All ¼" = 1'-0" or smaller scale drawings - Plans, Sections, and Elevations – in addition to Schedules and 3D views shall be extracted from the BIMs.

MEP BIM – Construction Documents



Merged BIMs in IFC Format



BIM Deliverable Requirements – Bid

Bid	<p>Submit separate Conformed Bid BIMs for each floor and discipline, in native and IFC file formats. If required, a site model in native and 3D .DWG formats, with any custom (ARX) objects converted to native AutoCAD objects.</p>
	<p>Extract all Conformed Construction Drawings at ¼" = 1'-0" scale or smaller from the Conformed Bid BIMs.</p>
	<p>Submit updated space and equipment inventories in COBie format to include changes from Addenda and accepted alternates.</p> <p>(COBie worksheets: Contact, Facility, Floor, Space, Zone, Type, Component, System, and Attribute).</p>

Space Information Required

Field Name	Description
BuildingName	Owner's Building Number
FacilityIdentification	Treasury Risk Management Number
RegionCode	Optional: Campus or Complex
FloorIdentification	Floor Level
RoomDesignator1	Per Owner's Standard
RoomDesignator2	Optional: Room "Nickname"
FICMUseCode	For UT and TBR
GSASpaceCode	For STREAM
UniqueSpaceID	GUID assigned by software
GrossAreaSquareFoot	Gross Area in SF
NetAssignableAreaSquareFeet	Net Area in SF

Equipment Requirements

- Equipment objects shall be named, classified, and assigned attributes per the OSA requirements
- The equipment inventory shall be extracted into the COBie format

BIM Deliverable Requirements – Project Closeout

Project Closeout	Review the As-Built BIMs as developed by the Contractor for conformance to the original design as formally modified throughout the Construction process.
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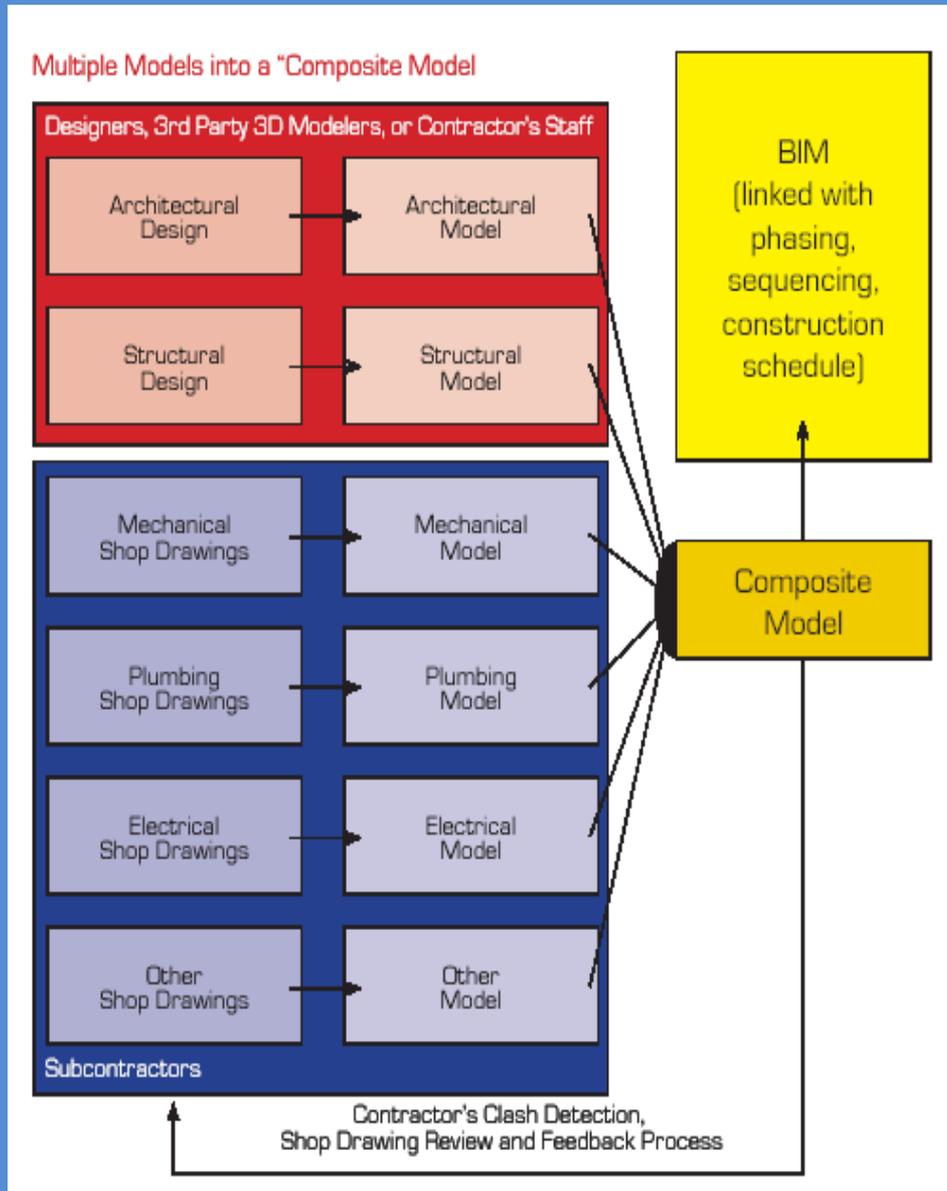
BIM Requirements for Contractors

Two Ways to Start

1. Project Designed in BIM
 - Maintain all or portions of the Conformed Bid BIMs
 - Cause the trade contractors to create Construction BIMs for building systems
2. No Design BIM
 - Provide the Architectural and Structural Proxy BIMs, for coordination purposes only
 - Create or cause the trade contractors to create Construction BIMs for other building systems

Federated Model:

- Designers, GC or 3rd party provides base building model
- Subcontractors model own systems



AGC: Contractors' Guide to BIM

Software Requirements

- BIM software:
 - Any software used by various trades and fabricators as long as it meets the following:
 - Must export models in IFC format
 - Must support the IFC Coordination View
 - Must export space and equipment inventories to the COBie format
- Collaboration software:
 - May be provided by the Owner
 - Must be web-based
 - Must provide real-time access to project team
 - Must support versioning of BIM files
 - Must provide access-controlled folders for the team members
 - Must conform to any Owner IT or security requirements

Construction BIMs

- The Contractor and the Contractor's subcontractors and suppliers shall use BIM authoring software to update the Conformed Bid BIMs or generate new Construction BIMs that include all of the geometry and clearances needed to perform trade coordination.
- Construction BIMs shall be continuously updated and maintained to reflect current as-built conditions
- Construction BIMs shall include the facility management information required by the Owner
 - Maintain Space inventory provided by Designer
 - Create equipment inventory showing "actuals"

Designer / Contractor Equipment Data Responsibilities

General Attributes	COBie Worksheet Location				
ATTRIBUTE	SHEET	COLUMN	ASSOCIATION	SPECIFIED BY THE DESIGNER	PRODUCT DATA PROVIDED BY THE CONTRACTOR
TagNumber	Component	TagNumber	-		X
SerialNumber	Component	SerialNumber	-		X
WarrantyStartDate	Component	WarrantyStartDate	-		X
SpecificationSection	Attribute	-	Type	X	X
Type	Type	Name	-	X	X
WarrantyDurationLabor	Type	WarrantyDurationLabor	-		X
WarrantyDurationParts	Type	WarrantyDurationParts	-		X
Manufacturer	Type	Manufacturer	-		X
ModelNumber	Type	ModelNumber	-		X

Required BIM Uses

- Generate equipment inventories
- Identify and resolve spatial interferences between trades and building systems prior to fabrication and field installation
- Coordinated Construction BIMs shall be used:
 - As the basis for Shop Drawings for those trades using BIM
 - To generate Coordination Drawings for those trades using BIM
 - To fabricate building components and systems for those trades using BIM
 - To install building components and systems for those trades using BIM
 - To produce equipment inventories which shall be delivered in COBie format
- As-Built Drawings shall be extracted from the Coordinated Construction BIMs.

Why the Emphasis on Coordinated Construction BIMs?

Before BIM:

- 30% of projects do not make schedule or budget
 - - CMAA Industry Report 2007
- Building owners, particularly those represented by CURT, regularly experience project schedule and cost overruns.
 - - CURT WP 1202 2004
- 37% of materials used in the construction industry become waste
 - - Movement for Innovation Industry Reports and Economist Magazine 2002

After BIM:

- Corrected upwards of 300 critical conflicts in model
- 25% MEP construction schedule reduction
- ZERO field coordination change orders
- No work stoppages (550 workers) due to coordination issues
- Increased off-site fabrication
- Improved Quality
- Improved Safety
- Decreased material waste

Staffing Requirements

- BIM Manager: identified by the Contractor to manage BIM coordination and deliverables from all Subcontractors and Major Suppliers during construction
- BIM Coordinator: manages the BIM deliverables of the specific subcontractor or supplier. Required for each party creating a Construction BIM.

BIM Execution Plan - Contractors

- Project Information
- Project Construction Team Contact Information
- BIM Goals and Objectives
- Roles and Responsibilities
- Collaboration Plan
- Kickoff Meeting
- BIM Coordination Process
- BIM Coordination Meetings
- Software for Model Authoring
- Modeling Standards and Content of Models
- Other Construction Phase Analyses
- BIM Deliverables
- Sign-Off

Milestone	Deliverables
Coordination Phase	Shop Drawings shall be extracted from the coordinated Construction BIMs.
	Coordination Drawings shall be extracted from the coordinated Construction BIMs.
Closeout Phase	As-Built BIMs partitioned by discipline and floor in IFC format. Site and landscape information may be submitted in IFC or 3D .DWG file format, with all custom objects converted to native 3D AutoCAD objects.
	As-Built Drawings shall be extracted from the As-Built BIMs.
	Submit updated space and equipment inventories in COBie format (COBie Worksheets: Contact, Facility, Floor, Space, Zone, Type, Component, System, Document, and Attribute).

TN OSA
Construction to Operations Building information exchange
(COBie)
Requirements

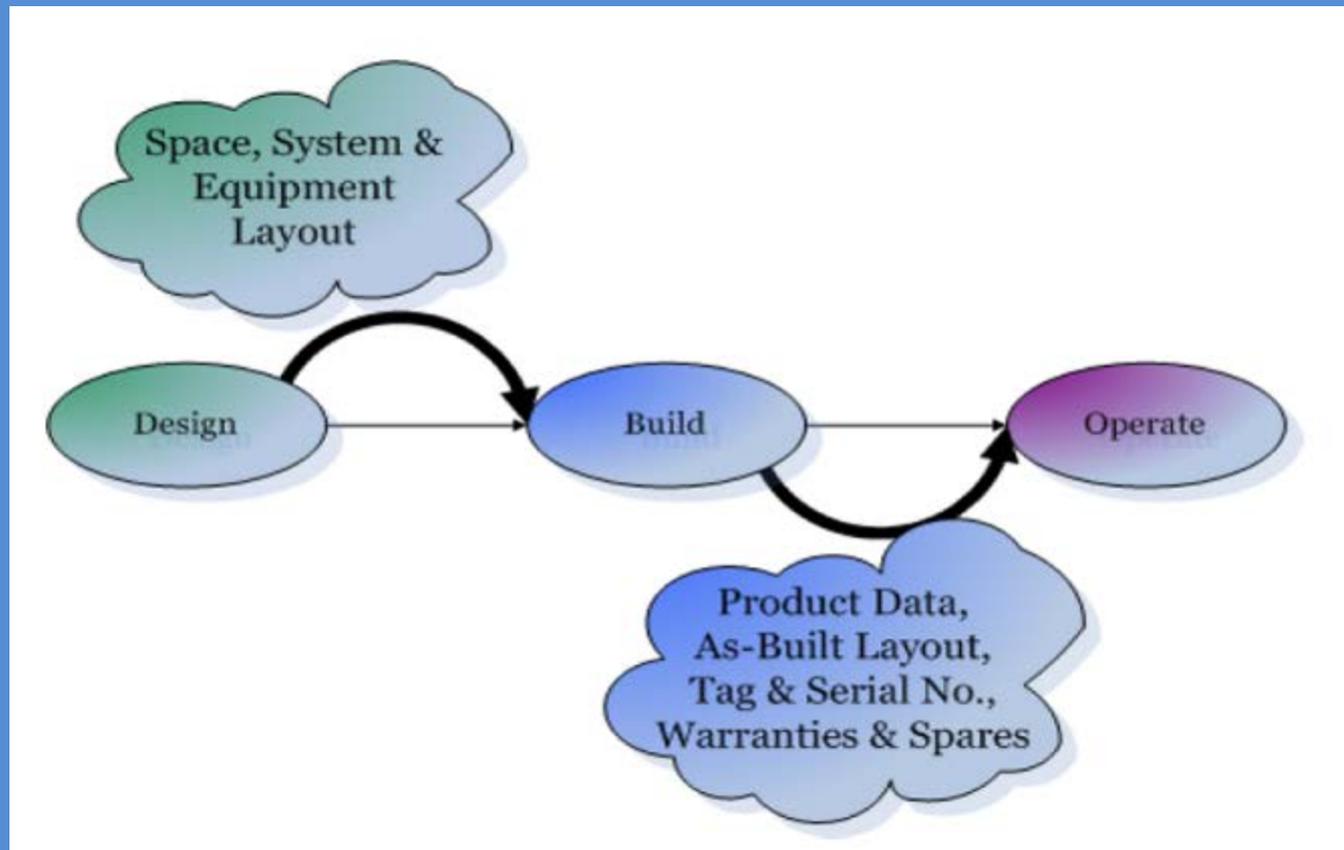
Why Is TN OSA Requiring COBie?

- Computable asset inventory:
 - Direct transfer to Facility Management system
 - Can be checked for completeness and compliance with software
- Delivered faster
- Savings in paper handling, shipping, reproduction and storage
- COBie is an open standard broadly supported by BIM Facility Management software



COBie Phased Delivery

- Phased delivery of project documentation
- Capture the information when it is created



Source: ERDC

COBie Worksheets

COBie Worksheets

- Contact
- Facility
- Floor
- Space
- Zone
- Type
- Component
- System
- Assembly
- Spare
- Resource
- Job
- Impact
- Document
- Attribute
- Coordinate
- Connection
- Issue

TN-Required COBie Worksheets

- Contact
- Facility
- Floor
- Space
- Zone
- Type
- Component
- System
- ~~• Assembly~~
- ~~• Spare~~
- ~~• Resource~~
- ~~• Job~~
- ~~• Impact~~
- Document
- Attribute
- ~~• Coordinate~~
- ~~• Connection~~
- ~~• Issue~~

Designer's COBie Worksheets

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

Contractor's COBie Worksheets

- Contact
- Facility (from design)
- Floor (from design)
- Space (from design)
- Zone
- Type (manufacturer, model, warranty information)
- Component (serial number, installation date, warranty start date)
- System
- Document
- Attribute

DISCIPLINE / SYSTEM	ASSET TYPE	TYPE ID	COMPONENT NAMING STANDARD	ATTRIBUTE	TYPE OR COMPONENT ATTRIBUTE?	SPECIFIED BY THE DESIGNER	PRODUCT DATA PROVIDED BY THE CONTRACTOR
ELECTRICAL	LIGHT FIXTURES	LTG	LTG-TypeXX-Room#-No.	Lamp type	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
				Electrical Panel Name	TYPE		X
				Electrical Panel Circuit	TYPE		X
	DISTRIBUTION PANEL	DPNL	DPNL-TypeXX-Room#-No.	Phase	TYPE	X	X
				Number of Wires	TYPE	X	X
				Number of Poles	TYPE	X	X
				Main Bus Current	TYPE	X	X
				Predominant Load Type	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
				Electrical Panel Name	TYPE		X
				Electrical Panel Circuit	TYPE		X
	SWITCHGEAR	SWGR	SWGR-TypeXX-Room#-No.	Short Circuit Interrupting Rating	TYPE	X	X
				Enclosure Rating	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
Electrical Panel Name				TYPE		X	
Electrical Panel Circuit	TYPE		X				

Why Require COBie?



as seen at Fort Lewis in 2009

Questions & Answers