The Office of the State Architect Presents:

BIM Training for Project Managers

Introduction to BIM and to TN OSA BIM Goals

Provided by:

Kristine Fallon Associates, Inc.

www.kfa-inc.com

August 13, 2013

Agenda

- Introductions
- What is BIM?
- Why is TN OSA adopting BIM?
- How will BIM benefit projects?

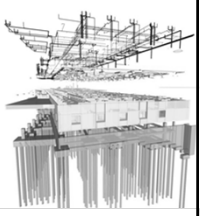
Introductions

Kristine Fallon Associates (KFA)

- KFA provides information technology consulting to the capital facilities industry
- KFA staff are experienced professionals from across the AEC industry
- Clients include:
  - Public agencies
  - Corporate facility groups
  - Design and Construction companies
  - Technology providers
- Current areas of technology focus
  - Building Information Modeling (BIM)
  - Project Collaboration & Management
  - Capital Asset Inventories

KFA BIM Experience

- Consulted to Revit Technology prior to initial product release
- Construction phase MEP coordination
  - > 3 million SF
- GSA Public Buildings Service
  - 3D-4D-BIM Pilot Program
  - Nationwide BIM Services IDIQ Contract
    - BIM Guide for FM
    - BIM Server
    - BIM Checking
- National Institutes of Health
  - BIM Strategy & Implementation Plan
  - Division 1 Language for BIM
- Dept. of Veterans Affairs
  - Existing Condition BIMs > 3 million SF
- BIM Research and Publications
  - U.S. Army Corps of Engineers
  - National Institute of Standards and Technology



Kristine K. Fallon, FAIA

- >25 years' experience in computer applications for design and construction
- 15 years experience managing technology in large AE firms
- Founded Kristine Fallon Associates, Inc. in 1993
- Member of the buildingSMART Alliance Board of Direction
- Member of the Illinois Capital Development Board BIM Committee (2009)
- Member of AIA Technology in Architectural Practice Advisory Group 2004 – 2008 (2007 Chair)
- Author of 2 books and numerous studies and articles
- Contributing author to *The Architect's Handbook of Professional Practice* (13th and 14th Editions)
- Contributing Author to the U.S. National BIM Standard
- Developed and teaches course: *Computer-Integrated Project Delivery* in MPM program at Northwestern

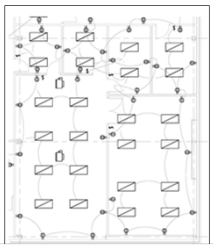
Gregory Williams, AIA, LEED AP

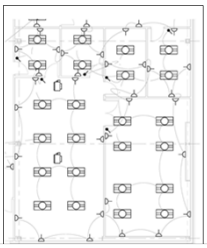
- 10 years of architectural practice experience
- 5 years Building Information Modeling (BIM) experience
- Certified Revit Professional
- KFA projects:
  - University of Illinois BIM Requirements
  - Veteran's Health Administration, VISN 17
    - Managed project to measure and create 2D CAD drawings and BIMs for over 3 million square feet of space
  - COBie Calculator
    - Research project analyzing the cost savings of the COBie approach for Owners, Designers and Contractors

What Is BIM?

BIM Is a Paradigm Shift in Building Representation

- Old: Drawings
  - 2D
  - Symbolic representations

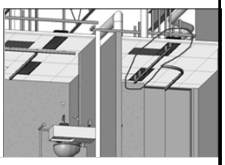




Paradigm Shift

New:

- Model is assembled from “virtual” building elements:
  - Walls, slabs, beams, columns, ducts, pipes, etc.
- Complete (to some level of detail)
- Unambiguous (non-symbolic)
- Machine-interpretable (computable)



BIM Authoring Software

- Creates a graphical and informational building database
- Provides tools for:
  - Selecting/ creating/ editing construction products and assemblies
  - Managing the relationships among building components
  - Maintaining associated data
  - Generating multiple views of the model
    - 3D views
    - 2D drawings
    - Bills of materials
  - Identifying interference conditions
  - Driving fabrication

Graphical / Informational

Sherman_Patient_Tower_012607

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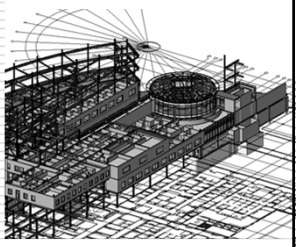
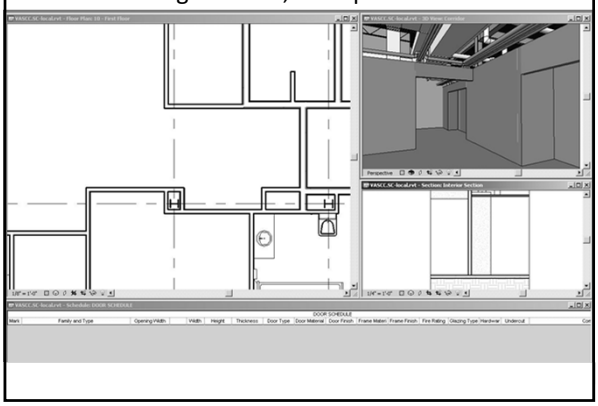
2007-08-09 17:06:17-0400

Part List (Material List, Assembly List, Bolt List, Pegs, Software)

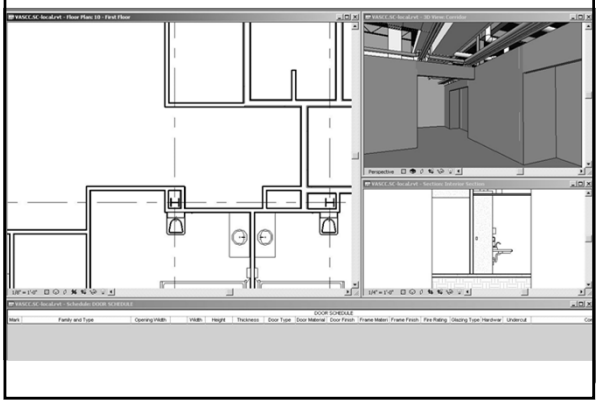
	Qty	Mark (Material)	Size (Link to Material List)	Length (ft-in)	Grade	Unit Wgt (Lbs)	Total Wgt (Lbs)	Function	Holes Per Part (Qty) Size
1	1	**JOIST[1]**	W36x0x3/4	16-1 5-0	A500(B)	442	442	Vertical brace	(4) 1 1/16 (4) 1 1/16
2	1	**a055**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	32	Vertical brace	(5) 13/16
3	1	**a123**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	32	Vertical brace	(5) 13/16
4	1	**a128**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	32	Vertical brace	(5) 13/16
5	1	**a031**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	32	Vertical brace	(5) 13/16 (2) 15/16
6	1	**a032**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	32	Vertical brace	(5) 13/16 (2) 15/16
7	3	**a160**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	97	Vertical brace	(5) 13/16 (2) 15/16
8	2	**a057**	L4x4x1/4	8-10 1-4	A36	65	130	Vertical brace	(5) 13/16
9	1	**a058**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	32	Vertical brace	(5) 13/16
10	1	**a088**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	32	Vertical brace	(5) 13/16
11	2	**a074**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	64	Vertical brace	(4) 13/16
12	4	**a081**	L2-1-2x2-1-2x1-0	8-1 1-0	A36	33	131	Vertical brace	(5) 13/16 (2) 15/16
13	1	**a087**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	32	Vertical brace	(5) 13/16
14	1	**a088**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	32	Vertical brace	(5) 13/16 (2) 15/16
15	9	**a090**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	288	Vertical brace	(5) 13/16 (2) 15/16
16	1	**a091**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	32	Vertical brace	(5) 13/16
17	1	**a092**	L2-1-2x2-1-2x1-0	9-0 15/16	A36	32	32	Vertical brace	(4) 15/16 (2) 13/16
18	1	**a093**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	32	Vertical brace	(4) 13/16
19	1	**a094**	L2-1-2x2-1-2x1-0	7-10 11-10	A36	32	32	Vertical brace	(5) 13/16 (2) 15/16
20	1	**a095**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	32	Vertical brace	(5) 13/16
21	6	**a096**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	191	Vertical brace	(5) 13/16 (2) 15/16
22	1	**a097**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	32	Vertical brace	(5) 13/16
23	6	**a098**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	191	Vertical brace	(5) 13/16
24	2	**a099**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	64	Vertical brace	(5) 13/16 (2) 15/16
25	3	**a100**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	95	Vertical brace	(5) 13/16
26	1	**a101**	L2-1-2x2-1-2x1-0	7-10 11-10	A36	32	32	Vertical brace	(5) 13/16 (2) 15/16
27	1	**a102**	L2-1-2x2-1-2x1-0	7-9 15-10	A36	32	32	Vertical brace	(4) 15/16 (2) 13/16
28	1	**a103**	L2-1-2x2-1-2x1-0	7-10 11-10	A36	32	32	Vertical brace	(5) 13/16 (2) 15/16
29	1	**a104**	L2-1-2x2-1-2x1-0	7-10 3-0	A36	32	32	Vertical brace	(5) 13/16



Single Model, Multiple Views



Single Model, Multiple Views



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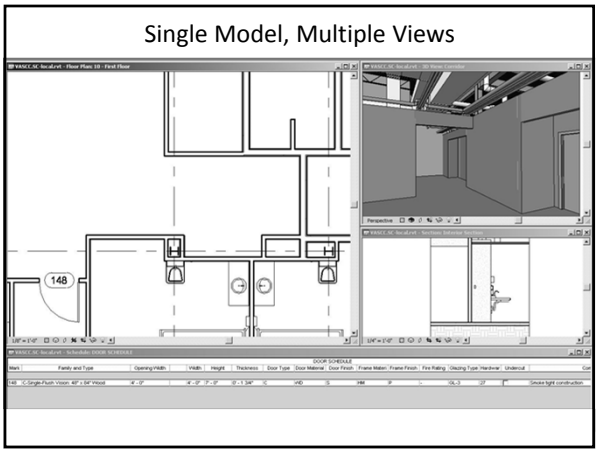

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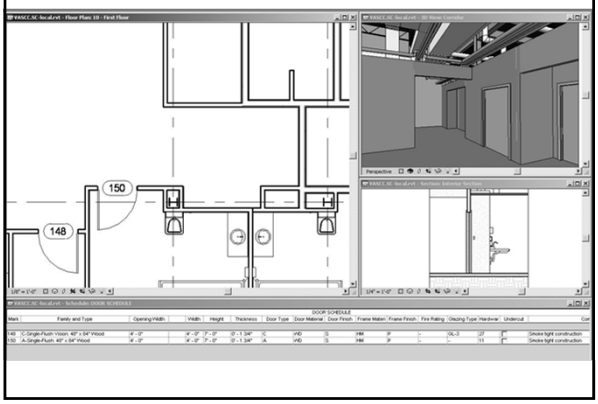

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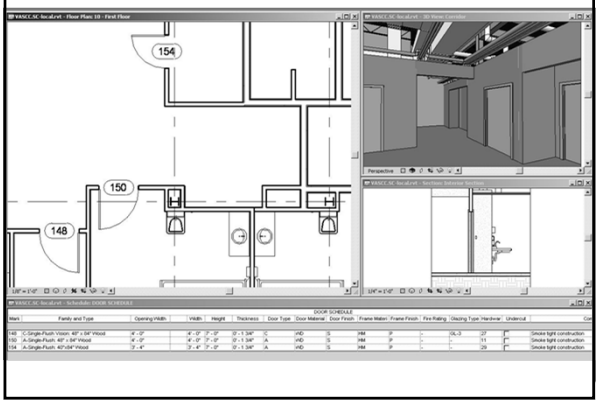
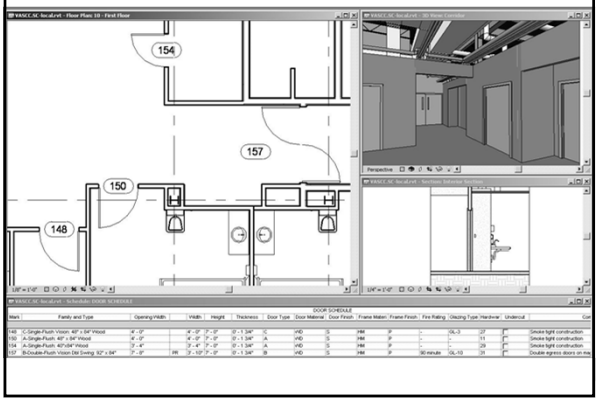
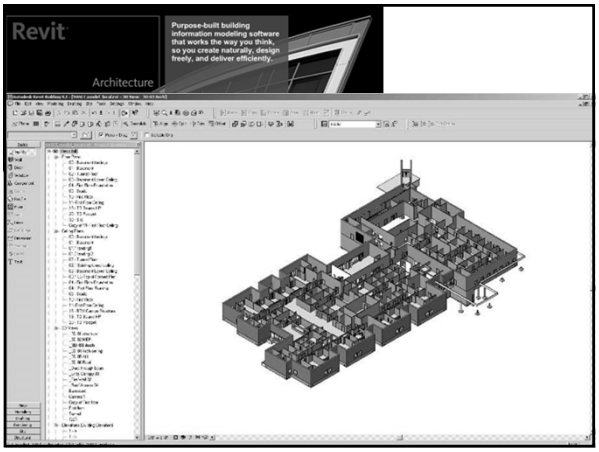
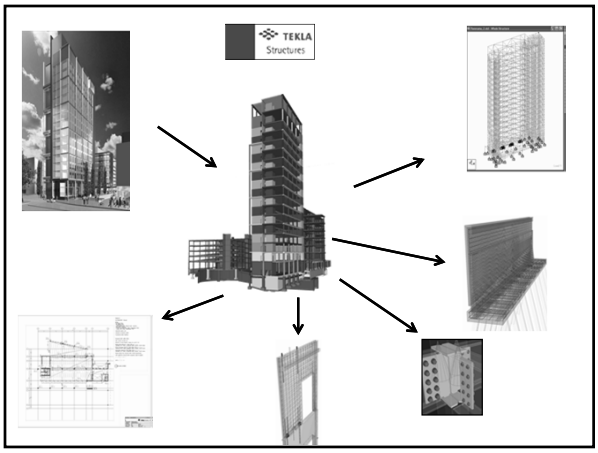


Single Model, Multiple Views



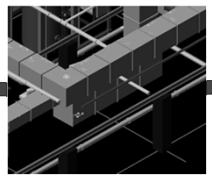
BIM Software Embodies Domain Expertise

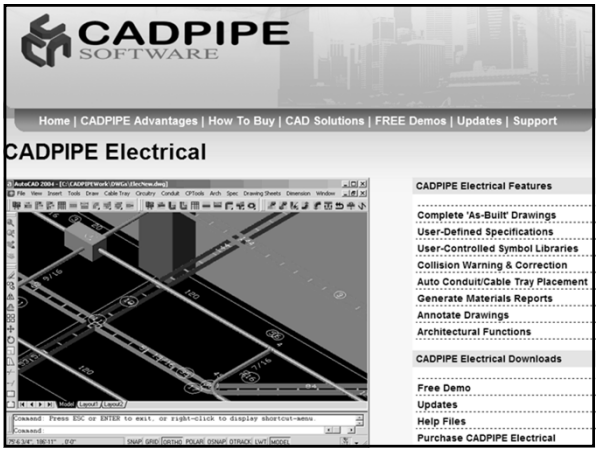


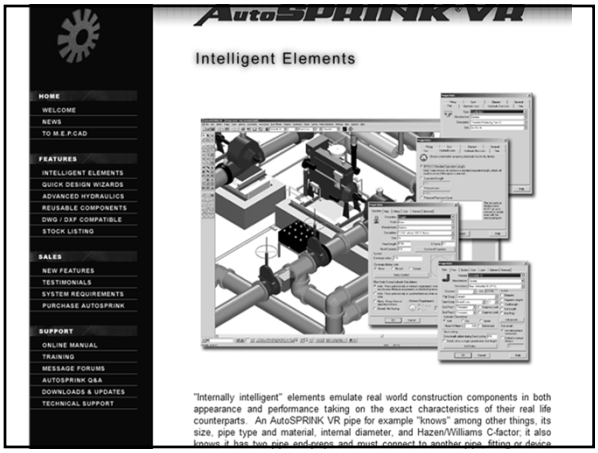


Ductwork, Plumbing

- CADPIPE
- QuickPen

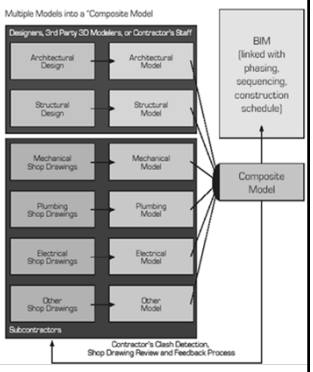
Estimating ⟵  ⟶ Fabrication





Multiple BIMs

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

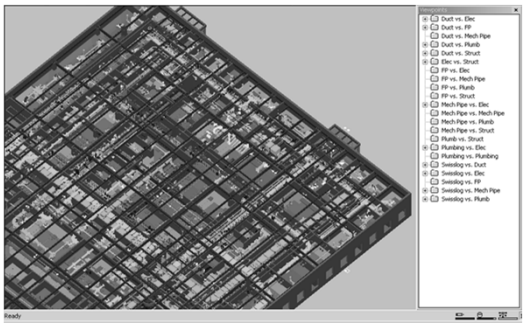


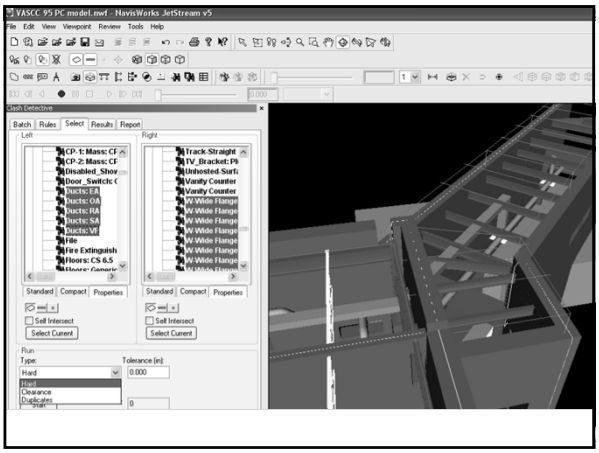
AGC: Contractors' Guide to BIM

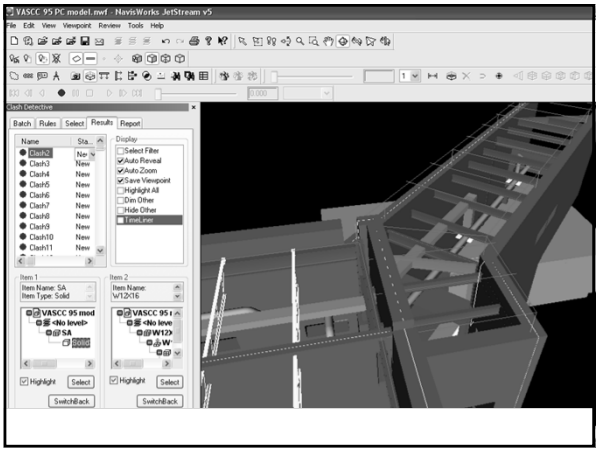
Interoperability

Building Information Modeling requires use of and data interchange among many different software products

Interoperability: Composite Model







Interoperability

This simple example requires a software product for interference checking to analyze 3D models created with 2 different BIM software products for spatial conflicts.

Categories of BIM Software

- BIM platforms
- BIM tools
- BIM servers

BIM Platforms

- Provide tools for developing and managing a primary building model
- Generate data for multiple uses
- Support drawing generation
- Provide interfaces with BIM and other tools

BIM Tools

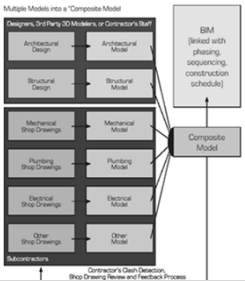
- Analyze a model
  - Structural
  - Energy
  - Cost
  - Interferences
  - …
- Simulate building use/performance
  - Blast
  - Circulation
  - Emergency egress
- Sometimes add or modify model information

BIM Servers

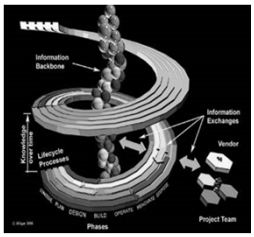
- **Emerging category**
- Provide tools for merging multiple BIMs
- Provide tools for selecting and updating subsets of information from the merged BIMs
- Provide access controls and versioning at the object level

BIM Today and Tomorrow

BIM Reality



BIM Promise



Source: Alan Edgar for NIBS NBIMS

Why Is TN OSA Adopting BIM?

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 **S**tate **P**rocurement **A**gencies (**SPA**s) – 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 **G**reater **O**wner **V**alue
  - 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

OSA BIM/VDC Goals

- Develop and Standardize Owner BIM/VDC Building Lifecycle Requirements, Standards, Guidelines, Deliverables
  - Encourage the use of open (IFC-compliant) BIM authoring software for the creation of Construction Operations Building information Exchange (COBie) deliverables
  - Employ BIM collaboration/integration technology and protocols
- Modify Contract/Manual Requirements For Designers, Engineers and Contractors accordingly
- Take an experience-based approach to adopting cutting-edge, but not bleeding-edge, technology, processes, protocols and standards
- Implement, Train, Support and Evaluate BIM Projects
- Develop Team Education Program and BIM/VDC Implementation Plan, Budget and Schedule

TN OSA BIM Requirements

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 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).

•They may also be voluntarily used 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.

BIM/VDC-Related Opportunities

by The Construction Industry Institute (CII)

Linking of BIM/VDC models to intelligent databases and use of collaboration software improves communication, 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.
- Document redundancy leads to unintentional sharing of inaccurate or out of date information
- Having a common set of current 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
- Contractors benefit because they can more consistently count on construction documents with fewer errors and/or coordination problems

Construction Phase BIM:

- Allows contractors and subcontractors to better understand the project scope and costs, and to resolve spatial conflicts before starting construction
- Supports better sequencing of labor activities to eliminate down time and coordinate different trades' schedules and work areas so that construction is progressing efficiently and as fast as responsibly possible
- Assists trades in better pre-packaging the materials needed for each day's work so there is less walking around and more work going on
- Improves Supply Chain Management and assists in more efficient procurement of materials and supplies (also potentially reducing on-site storage requirements)
- Assists contractors in identifying the best location for materials, supplies and equipment on an on-going basis
- Supports prefabrication and modularization

BIM at Turnover

- Contractor "as-built" information (versus Designer "record" drawings)
  - More accurate
  - More timely

End Result – Greater Owner Value:

- Shorter schedules
- Tighter bids
- Lower costs

How BIM Benefits Projects

BIM Represents a Paradigm Shift in Project Control

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*

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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

Why?

Automated Drawing Coordination
+ Clash Detection Tools
=
Fewer Field Problems
+ Less Rework

Case Study: Design Phase BIM Pilot

- Does BIM create a better set of construction documents?
  - 70,000 sq. ft. hospital addition
  - Design/ build delivery
  - BIM effort:
    - Initiated by the GC
    - Ran in parallel with 2D CAD approach
      - GC's AE consultants worked in 2D
      - KFA shadowed CD development in BIM

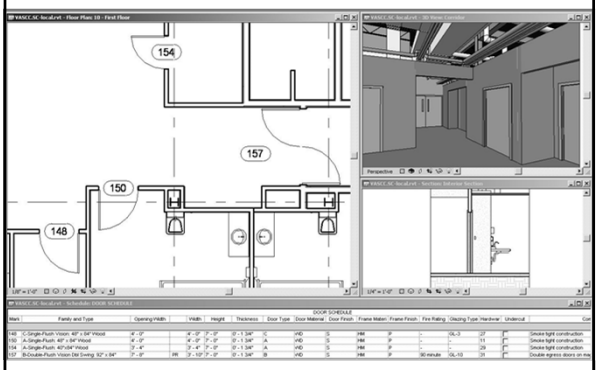
Issues Identified Through BIM

- At 100% CDs, 22 remaining coordination and constructability issues
  - "Wheel Toilet Room D10 on Sheet A1.11.11 indicates that the west wall is Type 3B. The3B wall type extends to the bottom of deck. A large return-air duct bisects the wall overhead."
  - "Lower Level ceiling clarification - Section 2 sheet A3.12 shows horizontal 6" bridging with a 1" plywood deck 1'-6" above the finished ceiling tagged as lay in. This causes a conflict with the 90"x72" OA duct above the corridor, not enough plenum space to accommodate the OA, the RA and SA ductwork below, piping and the first floor structural framing."
  - "A long section of SA duct on the Main Level between and parallel to E –F and perpendicular to 7-8 doesn't have any diffusers or branch lines coming off of it."
  - "The wall between Therapy Room D7 & Kitchen D6 is dimensioned on Sheet A1.11.10 to both faces of the wall. Because of the wall thickness, the provided dimensions are not possible. Please clarify which dimension to hold."
  - "New elevation dimensions of the AHU and plan drawings do not match the schedule. Schedule does not appear to have been updated."

BIM Pilot Conclusions

- BIM use by the design team WOULD improve the construction documents
  - Modelers immediately see
    - Misalignment of structure and architecture
    - Nonalignment of waste stacks from floor to floor
    - Ducts bisected by walls to deck
    - Misplacement of lighting and other fixtures
  - Automated coordination of all model views
    - Plans
    - Sections
    - Elevations
    - Schedules

Automated Drawing Coordination



Construction Phase BIM

Widely Acknowledged Problems

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What Contractors Say

- 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

Image source: Mechanical Inc.

Sherman Hospital

Elgin, Illinois

- 645,000 S.F. New Campus (255 beds)
- 6 Story Patient Tower
- 2 Story Diagnostic &Treatment Center
- Cancer Center
- Emergency Department
- 2D Design

BIM-Based MEP Coordination

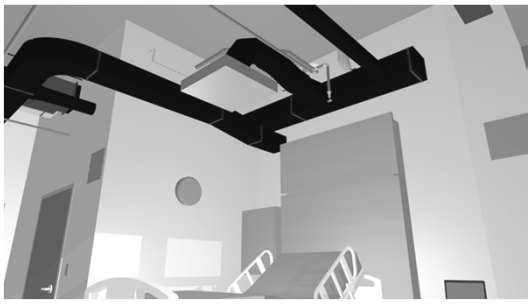
- Building modeled by KFA based on contract drawings and 2D CAD files
  - Architectural
  - Structural
- Subcontractors modeled individual systems
  - HVAC duct
  - HVAC pipe
  - Plumbing
  - Electrical
  - Fire Protection
  - Pneumatic Tube
- KFA integrated individual models in Navisworks for coordination

BIM Results

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

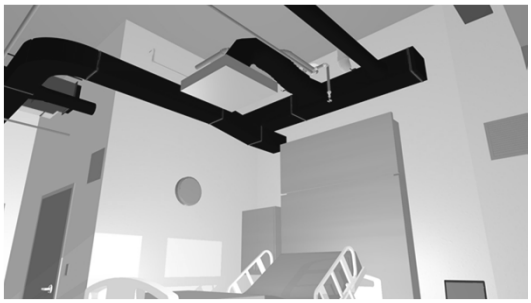
Build to the Model

Build to the Model



Build to the Model

Build to the Model

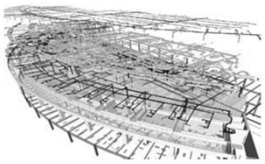


McGraw-Hill CONSTRUCTION ENR

Not for the Faint of Heart, Expecting a Win By Taking on BIM

04/29/2009
By Tom Sawyer

One lesson learned from the Walsh Group's construction- management assignment on a 650,000-sq-ft hospital in Elgin, Ill.—a project Walsh took over as mass excavation and steel procurement were under way—is that a lack of team experience with building information modeling should not be an inhibiting factor on a complex construction project.



Despite a rocky start and an opening scheduled for early 2010, Sherman Hospital is on time and on budget. "This is a BIM success story," says Dan Klancnik, virtual construction manager for Chicago-based Walsh, who readily admits not all of them turn out that way. Success was achieved even though most of the individuals from Walsh and none of the subcontractors had BIM project experience, with the exception of BIM consultant Steven Cook from Kristine Fallon Associates Inc., Chicago. "For most of the people working for Walsh, it was their first BIM project," Klancnik says.

BIM Strategies

- Make the impossible possible

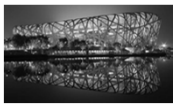
- Project delivery strategy

- Get a better building

- Life cycle strategy

Make the Impossible Possible

- Form generation
- Custom programming
- Iterative analyses
- Custom Fabrication



- Requires high level of technology skills in project team

BIM Requirements: Project Delivery

- What
  - Use BIM
  - Perform 3D interference checks
  - Generate all drawings from the coordinated model
  - Build to the model
- How
  - Require both lead designer and general contractor to produce a BIM Execution Plan for approval

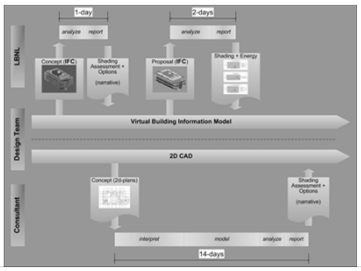
BIM Requirements for Better Buildings

Define "Better"

- Identify appropriate BIM uses
  - Visualization for more satisfied occupants
  - Energy analysis or broader sustainability assessment
  - Programmatic compliance (area calculations)
- Require iterative analyses during design
- Use automated checking of BIM models for conformance to design targets as appropriate

Iterative BIM-based Analyses

Fair Oaks Clinic:



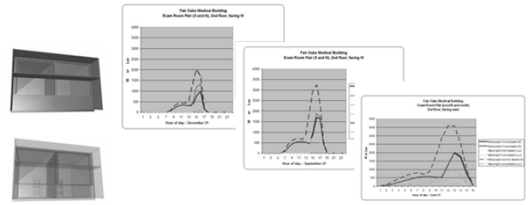
- Solar penetration analysis

Anshen + Allen

Energy Efficiency

Fair Oaks Clinic

– *Shading and Daylight*



© 2005 source: Vladimir Bazjanac, Lawrence Berkeley National Laboratory

Computable Building Description

- In the past, every analysis or review required hours or even days of a person's time to comb through the documents and analyze the content
- This typically requires the time of someone with significant experience and knowledge of building codes and standards to review projects for compliance

BIM Requirements for Computability

- BIM creates a computable building description, but thought must be given to including in the BIM the specific information required for each analysis
- BIM standards are required:
  - Not just formats or file naming
  - Objects required
  - Properties (attributes) to be included
  - Terminology
- TN OSA BIM Requirements supply such standards for Spaces and Equipment

TN OSA BIM Requirements

DISCIPLINE / SYSTEM	ASSET TYPE	TYPE ID	COMPONENT NAMING STANDARD	ATTRIBUTE	TYPE OR COMPONENT ATTRIBUTE?	SPECIFIED BY THE LEAD 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

BIM Requirements

- What
  - Use BIM
  - Follow object, property and naming standards
  - Use BIM data as input to analyses
- How
  - Require lead designer to document analyses, related modeling requirements and responsible parties in a BIM Execution Plan

What's the Business Case for BIM Information Handover?

COBie Calculator

Acknowledgements

- The COBie Calculator project was conducted under a Cooperative Research and Development Agreement between the National Institute of Building Sciences and the U.S. Army, Corps of Engineers, Engineer Research and Development Center. Point of contacts for this project were Mr. Deke Smith of NIBS and Dr. Bill East of ERDC.
- Work was performed by Kristine Fallon Associates, Inc.
- Authors: Kristine Fallon, Omobolawa Fadojutimi, Gregory Williams, Naila Crawford, Danielle Gran
- Study authors wish to acknowledge The Chicago Transit Authority and the University of Chicago for providing project data for analysis.

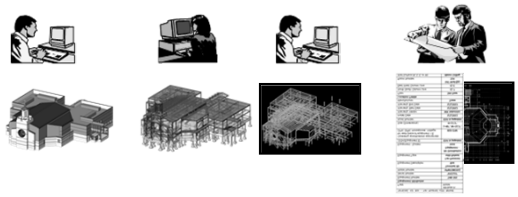
COBie Calculator

- Create a tool to calculate savings from use of:
  - Technology:
    - Computable building information
    - Standard data format: COBie
  - Coverage: Managed Assets
    - Space
    - Equipment
  - Lifecycle stages
    - Planning
    - Design
    - Construction
    - Turnover

What is COBie?

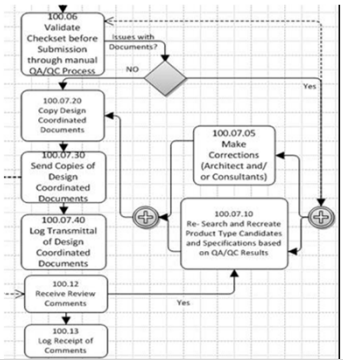
- **C**onstruction **O**perations **B**uilding **i**nformation **e**xchange
- COBie is based on the IFC Model View Definition for Facilities Management Handover
- COBie's focus is on delivering building information for facilities management, not geometric modeling
  - **Spaces**
  - **Equipment**
  - **Products**

COBie Life Cycle Data Flow



Architectural Model: Spaces and Equipment Placement + Consultant Model: Equipment Specifications + Construction Model: Product Data, O&Ms > Facility Management System : Space/Equipment Inventory, Maintenance and Replacement History

Understand the Business Processes



Create a Cost Model

- Defined 210 variables associated with the tasks in the business process model
- **Only costs associated with specification, documentation and fulfillment of managed asset requirements (space and maintained equipment)**
- **Only costs incurred by Owner, Architect (A/E) and Contractor**

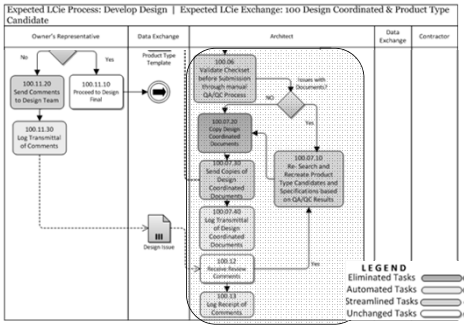
Apply Current Costs

Current Process			
100.01	Receive Design Schematic Approval Document from Owner		
100.02.10	**Produce Design Coordinated Documents**		
25	Avg. Number of Plan Drawings in Design Coordinated Drawings		
0.00	Avg QTO Time for Equipment Components (hours / plan drawing)		
0.17	Avg QTO Time for Spaces in building (hours / plan drawing)		
80%	Percentage of Time Spent by Licensed Professional Architect		
20%	Percentage of Time Spent by Architect Drafter		
$103.93	Licensed Professional Architect Rate ($ / hour)	$549.95	
$70.70	Architect Drafter Rate ($ / hour)	$88.35	
	SubTotal		$638.32
100.02.20	**Produce Detailed Specification / Product Type Template**		
50	Number of Equipment (product) Types (Types / project)		
2	Avg. Time Spent Developing Detailed Equipment (products) Type Template (hours / product)		
$103.93	Specifier	$10,998.90	
	SubTotal		$10,998.90
100.03	**Search for Product Type Candidates**		
50	Number of Equipment (product) Types (Types / project)		
1	Avg. Time Searching for Product Literature for Candidates (Hours/product)		
$103.93	Licensed Professional Architect Rate ($ / hour)	$5,499.45	
	SubTotal		$5,499.45

Identify Cost Reduction Opportunities

- SEARCHING savings
  - Automated comparison of product data to specifications
- VALIDATION savings
  - Automated checking
- REFORMATTING savings
  - Adoption of a single, open standard data format
- RECREATING savings
  - Fewer revision cycles
  - Minimize rework
- COPYING savings
  - Reliance on electronic documents and data
- HANDLING savings
  - Managed project collaboration and management systems

Identify Where Savings Occur



Cost Reduction Factors Applied

Expected Process			
100.01 Receive Design Schematic Approval Document from Owner			
100.02.10 Produce Design Coordinated Documents			
25	Avg. Number of Plan Drawings in Design Coordinated Drawings		
0.05	Avg QTO Time for Equipment Components (hours / plan drawing)		
0.02	Avg QTO Time for Spaces in building (hours / plan drawing)		
60%	Percentage of Time Spent by Licensed Professional Architect		
20%	Percentage of Time Spent by Architect Drafter		
$109.99	Licensed Professional Architect Rate ($ / hour	$54.99	
$76.70	Architect Drafter Rate ($ / hour)	$8.84	
	SubTotal		$63.83
100.02.20 Produce Detailed Specification / Product Type Template			
50	Number of Equipment (product) Types (Types / project)		
1	Avg. Time Spent Developing Detailed Equipment (products) Type Template (hours / product)		
$109.99	Specifier	$3,299.67	
	SubTotal		$3,299.67
100.03 Search for Product Type Candidates			
50	Number of Equipment (product) Types (Types / project)		
0.10	Avg. Time Searching for Product Literature for Candidates (Hours/product)		
$109.99	Licensed Professional Architect Rate ($ / hour	$549.95	
	SubTotal		$549.95

Project Phase	Current Process	COBie Process	Savings	% Savings
LCie 01 - Facility Criteria	$0.00	$0.00	$0.00	0%
LCie 02 - Design Specification	$0.00	$0.00	$0.00	0%
LCie 03 - Feasibility Study	$10.00	$10.00	$0.00	0%
LCie 04 - Project Definition	$0.00	$0.00	$0.00	0%
LCie 05 - Space Program	$510.00	$10.00	$500.00	98%
LCie 06 - Product Program	$890.00	$30.00	$860.00	97%
LCie 07 - Request for Proposal	$80.00	$80.00	$0.00	0%
LCie 08 - Design Early	$11,800.00	$300.00	$11,500.00	97%
LCie 09 - Design Schematic	$31,800.00	$1,500.00	$30,300.00	95%
LCie 10 -Design Coordinated	$68,000.00	$7,600.00	$60,400.00	89%
LCie 11 - Design Final	$28,200.00	$1,900.00	$26,300.00	93%
LCie 12 - Request for Proposal	$20.00	$10.00	$10.00	50%
LCie 13 - Inquiry Issue	$100.00	$100.00	$0.00	0%
LCie 14 - Pre-Construction Plan	$0.00	$0.00	$0.00	0%
LCie 15 - Inquiry Issue (RFI)	$26,000.00	$26,000.00	$0.00	0%
LCie 16 - Product Type Selection	$0.00	$0.00	$0.00	0%
LCie 17 - System Layout	$0.00	$0.00	$0.00	0%
LCie 18 - Submittal Package	$84,700.00	$3,100.00	$81,600.00	96%
LCie 19 - Submittal Issue	$61,400.00	$500.00	$60,900.00	99%
LCie 20 - Purchase Order	$0.00	$0.00	$0.00	0%
LCie 21 - Product Installation	$12,900.00	$0.00	$12,900.00	100%
LCie 22 - Start-Up	$0.00	$0.00	$0.00	0%
LCie 23 - Product Inspection	$326,800.00	$13,100.00	$313,700.00	96%
LCie 24 - Punchlist Issue	$0.00	$0.00	$0.00	0%
LCie 25 - Turnover Package	$15,400.00	$300.00	$15,100.00	98%
Total	**$669,000.00**	**$55,000.00**	**$614,000.00**	**92%**

Can TN Achieve These Savings?

Requirements

- Mfrs. provide product data in COBie format
- BIM authoring tools both import and export COBie data
- FM systems import COBie data
- Software exists:
  - To check the COBie data for Completeness and Conformance to the specification
  - To automate comparison of the contents of two COBie files:
    - Specification
    - Contractor's product data submittals
- Project managed in a project collaboration system with automated workflow and audit trail; paper eliminated

Reality

- Not yet - TN designers and contractors will need to create this data
- COBie export capabilities are good
- ARCHIBUS does
- Automated checks for conformance to TN OSA requirements are under development
- Semi-automated comparison exists
- TN BIMr requires use of a project collaboration system

But Wait – There's More!

COBie Calculator measures savings during the project process. Information handed over in a computable form also reduces the costs of ongoing operations and maintenance

Opportunity for Savings

$15.8 billion spent on
39 billion SF or $0.40/SF =

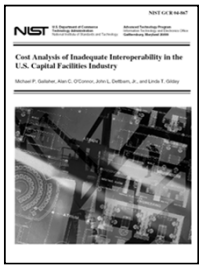
annual cost of inadequate interoperability

- August 2004 study published by U.S. National Institute of Standards and Technology

Opportunity for Savings

"Of these costs, two-thirds are borne by owners and operators, which incur most of these costs during ongoing facility operation and maintenance (O&M)."

- O&M spent $4.8B or $0.12/SF (2002) verifying documentation; $613M or $0.02/SF to transfer to useful format
- Wasting money looking for, validating and/or recreating facility information that should be readily available



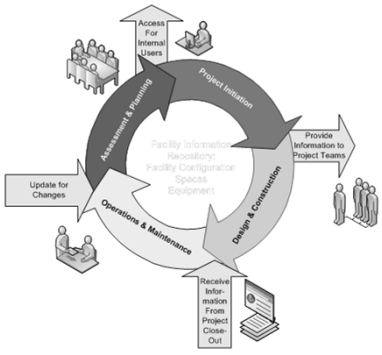
Facilities Handover Research Conclusions

- Lack of standard approaches costs U.S. industry at least $15.8 billion per year
- Information handover requirements must be driven by the long-term needs of the Owner
- Common life cycle information strategy for the whole portfolio reduces development costs
- Structure information packages to support downstream processes
- Create project information handover plan before information is created
- Implementation must be managed

TN OSA BIM Approach

- Require BIM deliverables to support:
  - Space management
  - Operations and maintenance
- Create common BIM requirements for all SPAs
- Require COBie-format deliverables, consumable by FM software, including ARCHIBUS
- Establish standard data sets and naming for space and equipment
- Require BIM Execution Plans
- Prepare TN PMs to manage BIM projects

Life Cycle Facility Information Management



Project Types Suitable for BIM

- New construction
- Additions
- Gut renovations
- New projects in buildings already in BIM
- Major upgrades to building systems
- High churn space
- High-performance building projects with energy analysis requirements

Discussion

The Office of the State Architect Presents:

BIM Training for Project Managers

Review of TN OSA BIM Requirements,
PM Responsibilities, KFA's Support Role

Provided by:

Kristine Fallon Associates, Inc.

www.kfa-inc.com

August 13, 2013

TN OSA BIM Requirements Overview

TN OSA Approach

- All of a BIM project's team members must use BIM
- Open Standards
  - No requirement to use a specific software product
  - As-Built BIMs to be delivered in IFC format
  - Space and Equipment Inventories to be delivered in COBie format
    - Design
    - Construction
- Major drawings must be extracted from the BIM
  - Design
  - Construction
- 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

Software Requirements

- BIM authoring software:
  - 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

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 also required in native format
- All plans, sections, and elevation drawings and CAD files at ¼" = 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

Designer's COBie Worksheets

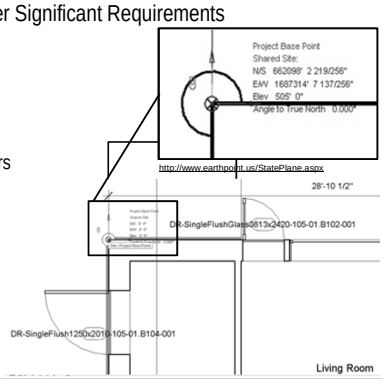
- Contact
- Facility
- Floor
- Space
- Zone
- Type
- Component
- System
- Attribute

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

Other Significant Requirements

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



Office of the State Architect

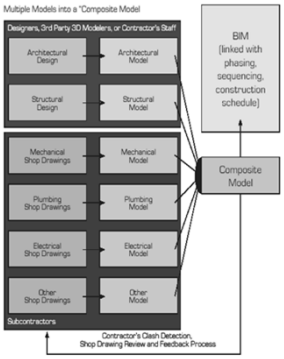
BIM Requirements for Contractors

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

Composite Model:

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



AGC: Contractors' Guide to BIM

Software Requirements

- BIM software:
  - 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

- Contractor and the Contractor's subcontractors and suppliers shall use BIM authoring The 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"

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

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 Equipment Inventories in COBie Format?

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

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.

TN Project Manager Responsibilities

Overview

- Designate disciplines and trades required to use BIM
- Verify that Project Team has:
  - Understanding of BIM requirements
  - Qualified BIM Manager
  - Necessary tools, standards, and procedures in place
- At each project milestone check BIM deliverables using:
  - Tekla BIMsight
  - COBie Validation Tool

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Tekla BIMsight

Tekla BIMsight is a free BIM tool that will allow TN PMs to:

- View Building Information Models (BIMs) to assess project progress
- Mark-up BIMs as a part of a design review
- Run interference checks if they suspect building systems have not been well-coordinated

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COBie Validation Tool

- Customized to check COBie files based on TN OSA's BIM Requirements
- Validation is specific to project phase
- Check that COBie file is properly formatted
- Check that mandatory data are included
- Check that TN naming conventions are followed
- For Construction Closeout only:
  - Check that all required documents are listed in the COBie spreadsheet
  - Check that all documents listed have been provided

Pre-Planning

Task	What to Look For
Designate Design Disciplines Required to Produce BIM	•All building systems will be modeled
Designate Construction Trades Required to Produce BIM	•All building systems will be modeled

6.1. Trades Required to Produce BIMs
The Owner or the Owner's Representative has indicated in the list below the trades that shall produce BIMs:

- ☐ Structural Steel Fabrication
- ☐ Mechanical - HVAC
- ☐ Mechanical - HVAC Pipe
- ☐ Plumbing
- ☐ Electrical
- ☐ Fire Protection
- ☐ Fire Sprinkler
- ☐ Pneumatic Tube
- ☐ Building Automation Systems
- ☐ Communications
- ☐ Civil (3D geometry)
- ☐ Landscape (3D geometry)
- ☐ Other:_____

3.1. Disciplines Required to Produce BIMs
The Owner has indicated in the list below the disciplines that shall produce BIMs:

- ☐ Architectural
- ☐ Structural
- ☐ Mechanical
- ☐ Plumbing
- ☐ Electrical
- ☐ Civil (3D geometry)
- ☐ Landscape (3D geometry)
- ☐ Communications
- ☐ Fire Protection
- ☐ Other:_____
- ☐ Other:_____

Design Project Startup

Task	What to Look For
Review Resume of BIM Manager	•The proposed BIM Manager has professional qualifications, BIM knowledge, and previous experience in a BIM management role
Review Proposed Web-Based Collaboration System	•The Owner is able to access all content • The Web-Based Collaboration System supports automated versioning of files and provides access to previous versions

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Calendar

3/12/2009 8:00 AM MEP Coordination Meeting
3/19/2009 8:00 AM MEP Coordination Meeting
3/26/2009 8:00 AM MEP Coordination Meeting
4/2/2009 8:00 AM MEP Coordination Meeting
4/9/2009 8:00 AM MEP Coordination Meeting

Add new event

New Documents

Type	Name	Modified	Modified By	Version	File Size	Check In Comment
	L3K3ND3DPRESSURE	3/11/2009 10:39 AM	Jonathan Kennen	9.0	7193 KB	rotated medgas tees
	L3H3ND3DPRESSURE	3/11/2009 10:15 AM	Jonathan Kennen	14.0	7209 KB	
	L3S3DPSPE	3/11/2009 10:07 AM	Peter Rozelle	4.0	7115 KB	
	L1J3ND3DPRESSURE	3/11/2009 10:05 AM	Jonathan Kennen	11.0	7207 KB	Rotated Tees in medgas
	L3KS3DPSPE	3/11/2009 9:59 AM	Peter Rozelle	22.0	2331 KB	
	L2S3DPSPE	3/11/2009 9:55 AM	Peter Rozelle	14.0	4409 KB	
	L2W3D	3/11/2009 9:42 AM	Andrew Karstaedt	16.0	764 KB	
	L3W3D	3/11/2009 9:30 AM	Andrew Karstaedt	2.0	746 KB	
	L3N3DGRAVITY	3/10/2009 7:16 PM	Jonathan Kennen	3.0	9729 KB	
	CR_KFA_L3_20090310 NEW	3/10/2009 6:26 PM	Ryan Schultz	1.0	1549 KB	"Composite (L3KF3D.nwd) version 6.0. Elec (L3TC3D.dwg) version 9.0. FP (L3WW3D.dwg) version 1.0. Duct (L3S3DDUCT) version 2.0. HVAC Pipe (L3S3DPSPE) version 3.0. Plumb-SAN (L3N3DGRAVITY) version 2.0. Plumb-DomH2O (L3N3DPRESSURE) version 3.0. Ptube (L3SL3D.dwg) version 1.0. "
	L3KF3D	3/10/2009 6:26 PM	Ryan Schultz	6.0	9017 KB	"Composite (L3KF3D.nwd) version 6.0. Elec (L3TC3D.dwg) version 9.0. FP (L3WW3D.dwg) version 1.0. Duct (L3S3DDUCT) version 2.0. HVAC Pipe (L3S3DPSPE) version 3.0. Plumb-SAN (L3N3DGRAVITY) version 2.0. Plumb-DomH2O (L3N3DPRESSURE) version 3.0. Ptube (L3SL3D.dwg) version 1.0. "
	CR_KFA_L2_20090310 NEW	3/10/2009 6:23 PM	Ryan Schultz	1.0	558 KB	"Composite (L2KF3D.nwd) version 28.0. Elec (L2TC3D.dwg) version 16.0. FP (L2WW3D.dwg) version 15.0. Duct (L2S3DDUCT) version 11.0. HVAC Pipe (L2HS3DPSPE) version 12.0. Plumb-SAN (L2N3DGRAVITY) version 3.0. Plumb-DomH2O (L2JN3DPRESSURE) version 5.0. Ptube (L2SL3D.dwg) version 1.0. "
	L2KF3D	3/10/2009 6:23 PM	Ryan Schultz	28.0	9493 KB	"Composite (L2KF3D.nwd) version 28.0. Elec (L2TC3D.dwg) version 16.0. FP (L2WW3D.dwg) version 15.0. Duct (L2S3DDUCT) version 11.0. HVAC Pipe (L2HS3DPSPE) version 12.0. Plumb-SAN (L2N3DGRAVITY) version 3.0. Plumb-DomH2O (L2JN3DPRESSURE) version 5.0. Ptube (L2SL3D.dwg) version 1.0. "

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

Design Project Startup

Task	What to Look For
Review BIM Execution Plan	•The BIM Execution Plan covers all topics and includes all disciplines required to produce BIMs •All disciplines are required to upload BIM revisions to the collaboration site •The modeling standards include all sub-topics and are consistent across all disciplines •The model naming identifies the contents of each model file and indicates models will be segmented by discipline and floor •The model naming indicates that model revisions will be managed by the collaboration system versioning rather than dates

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Modeling Standard Contents

- **Common Coordinate System**
  - **Units, File Origin (X, Y, Z), Geo-location**
- **Model Partitions**
- **Naming**
  - **Files**
  - **Building Level Designators**
  - **Discipline Designators**
  - **Layers (if applicable)**
  - **Properties Required for COBie Deliverables, Owner-requested Analyses, and Designer and the Designer's Consultants-initiated Analyses**
  - **Units and Values for Properties**
- **Level of Precision and Dimensioning**
- **Any Exclusions from Models**

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Naming Tips

Design BIMs: IFC Files and Native Format Files						
Structure:	Level	Area	-	Discipline	-	User Defined
Example:	L1	A	-	A	-	UUUU

Composite Models – Individual Levels and Areas				
Structure:	Level	Area	-	Discipline
Example:	L1	A	-	COMP

Composite Models – Individual Levels and Areas			
Structure:	Level	-	Discipline
Example:	LALL	-	COMP

BIM Review Comment Files									
Structure:	Level	-	Discipline	-	Phase	-	Reviewer Initials	-	Date
Example:	LALL	-	TNPM	-	DD	-	GW	-	20130814

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Design Project Startup

Task	What to Look For
Review BIM Execution Plan Cont.	•The description of generating drawings clearly shows that drawings will be derived from the models and will not be altered after extraction •The software products used for model authoring are IFC and COBie compliant •The model analysis plan indicates the model will be used for space area calculations, energy analysis (if required), building system coordination, and space and equipment inventories in COBie format •The project deliverables section describes how deliverables will be extracted from the coordinated models and includes all BIM requirements •The project team describes an acceptable level of quality control •All parties providing BIM deliverables have signed

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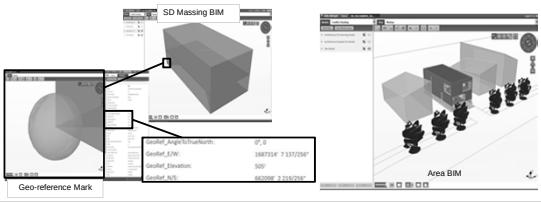
Schematic Design Phase

Task	What to Look For
Review BIM Deliverable	•The massing BIM is in IFC format and contains a geo-reference mark with annotation
Review/Validate the COBie Deliverable Using Automated Tools	•Contact, Facility, Floor, and Space worksheets are provided and valid



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Design Development Phase

Task	What to Look For
Review BIM Deliverables	•The BIM is partitioned by floor and discipline in IFC format and contains a geo-reference mark and annotation. The site model may be in IFC or 3D DWG format •The polyline of the FEMA building footprint is present
Spot Check that Drawings are Being Exported from the Models	•The information shown in the drawings is seen in the model
Spot Check that Areas are Being Calculated from the Models	•Area calculations in the model match those on the drawings
Review/Validate the COBie Deliverable Using Automated Tools	•Contact, Facility, Floor, and Space, Zone, Type, Component, System, and Attribute worksheets are provided and valid
Review Interference Report	•All interferences are resolved or adequately annotated
Review Energy Analysis report	•Verify that Energy Analysis input came from the Design BIMs

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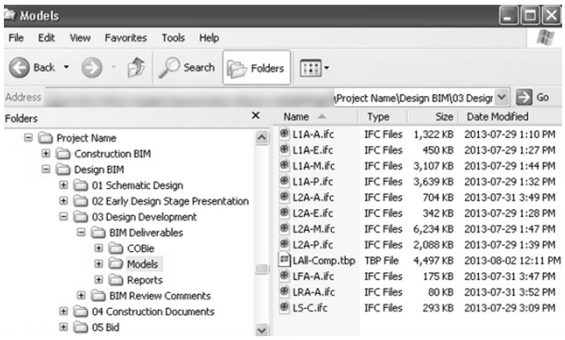

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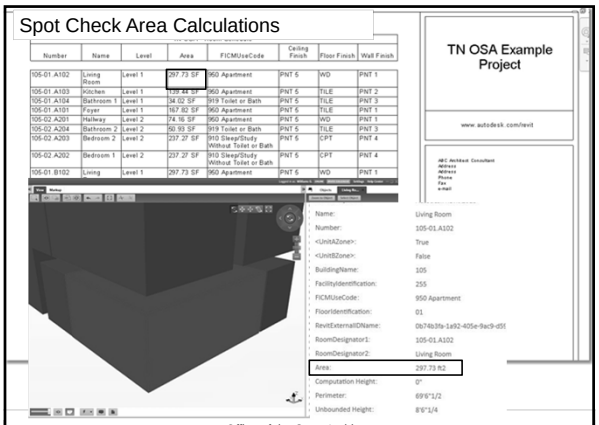
Spot Check Area Calculations



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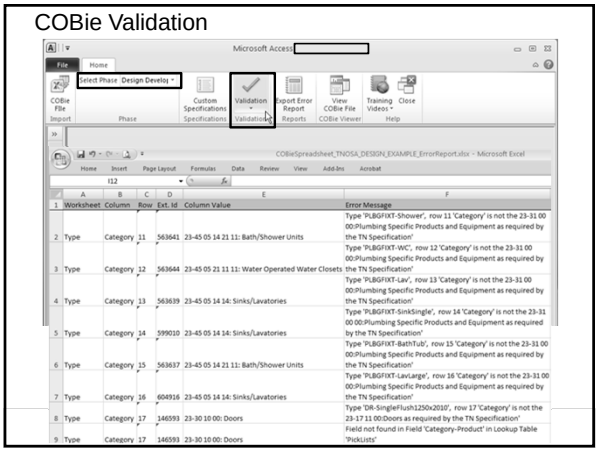
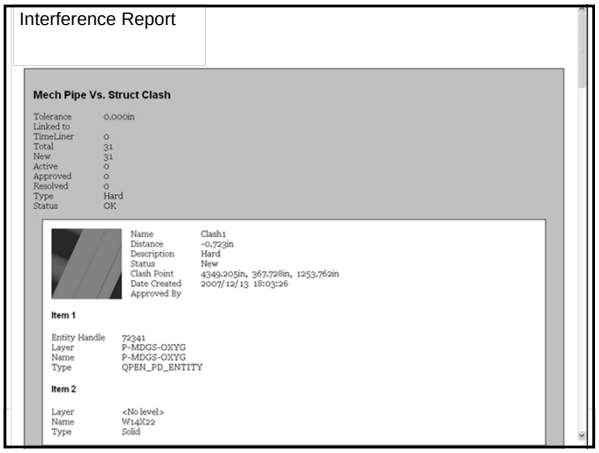
COBie Validation



Interference Report



Energy Analysis Report

AUTODESK.

100-000_TNOSA_ExampleProject_A_SDMassing
100-000_TNOSA_ExampleProject_A_SDMassing Analysis (1)
Analyzed at 9/2/2013 8:34:56 AM
Version 2014.2.30.1781(D06.2.2-44e4)

Revit Energy Analysis Result

Building Performance Factors

Location:	Nashville, TN, USA
Weather Station:	39100
Outdoor Temperature:	Max: 93°F/Min: 8°F
Floor Area:	3,375 sf
Exterior Wall Area:	3,957 sf
Average Lighting Power:	1.01 W / ft²
People:	11 people
Exterior Window Ratio:	0.20
Electrical Cost:	$0.10 / kWh
Fuel Cost:	$0.87 / Therm

Energy Use Intensity

Electricity EUI:	17 kWh / sf / yr
Fuel EUI:	17 kBtu / sf / yr
Total EUI:	77 kBtu / sf / yr

Life Cycle Energy Use/Cost

Life Cycle Electricity Use:	1,768,484 kWh
Life Cycle Fuel Use:	17,651 Therms

Construction Documents Phase

Task	What to Look For
Review BIM Deliverables	•The BIM is partitioned by floor and discipline in IFC format and contains a geo-reference mark and annotation. The site model may be in IFC or 3D DWG format •The polyline of the FEMA building footprint is present
Spot Check that Drawings are Being Exported from the Models	•The information shown in the drawings is seen in the model
Spot Check that Areas are Being Calculated from the Models	•The area calculations in the model match those on the drawings
Review/Validate the COBie Deliverable Using Automated Tools	•Contact, Facility, Floor, and Space, Zone, Type, Component, System, and Attribute worksheets are provided and valid
Review Interference Report	•All interferences have been resolved
Review Energy Analysis report	•Verify that the Energy Analysis input came from the Design BIMs

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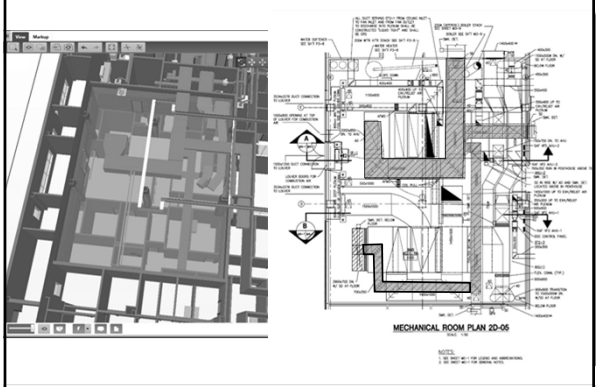

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Bidding Phase

Task	What to Look For
Review Conformed Bid BIMs	•The conformed bid BIMs, delivered in IFC and native formats partitioned by floor and discipline, reflect addenda and accepted alternates
Review Conformed COBie File	•The COBie file reflects changes in the conformed bid BIMs and is in conformance with TN's BIM standards

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Pre-Construction

Task	What to Look For
Provide Conformed Bid BIMs in IFC and Native Format, as well as COBie Spreadsheet, to Contractor	•All Conformed Bid BIMs and COBie spreadsheet have been delivered to the Contractor
Review Resume of BIM Manager	•The proposed BIM Manager has professional qualifications, BIM knowledge, and previous experience in a BIM management role
Review Proposed Web-Based Collaboration System	•The Owner is able to access all content • The collaboration site supports automated versioning of files and provides access to previous versions •The collaboration site provides all trades with access to all models while preventing changes to one trade's model(s) by another trade

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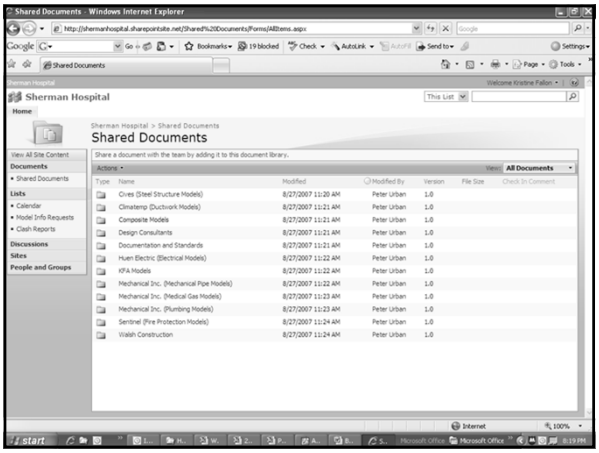

BIM Execution Plan- Contractors

- 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

Pre-Construction

Task	What to Look For
Review BIM Execution Plan	•The BIM Execution Plan covers all topics and includes all trades required to produce BIMs with each trade having a designated BIM Coordinator •The construction team is modeling the entire building with all trades being required to share models via the collaboration site •A computer with software capable of viewing merged models will be provided onsite •The modeling standards include all sub-topics, are consistent across all disciplines, and require geo-referencing of all BIMs •The model naming indicates the contents of each model file and that models will be segmented by discipline and floor •The model naming indicates that model revisions will be managed by the collaboration system versioning rather than dates •The kickoff meeting attendees, location, date, and agenda, including all topics, are provided

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Pre-Construction

Task	What to Look For
Review BIM Execution Plan Cont.	The description of the processes for using BIMs during construction coordination include: •The reference model(s) to be used by all trades • The technique to be used for modeling clearances •Partitioning of model for purposes of coordination •Sequence of coordination •Responsibility of trades to upload models to collaboration system •Schedule for uploads •List of interference checks to be performed, typically each system against each other system (structural vs. plumbing, structural vs. duct, structural vs. electrical, duct vs. plumbing, etc.) •Responsibility for performing interference checks •Process and schedule for reviewing interferences, assigning responsibility for resolution, and tracking interference resolution •Process for signing off on a Coordination BIM •Requirement to build to signed off Coordination BIM •Requirement to generate all shop and coordination drawings from signed off Coordination BIM

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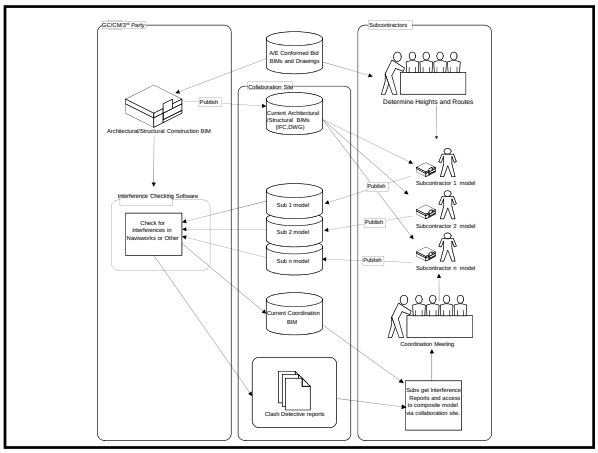

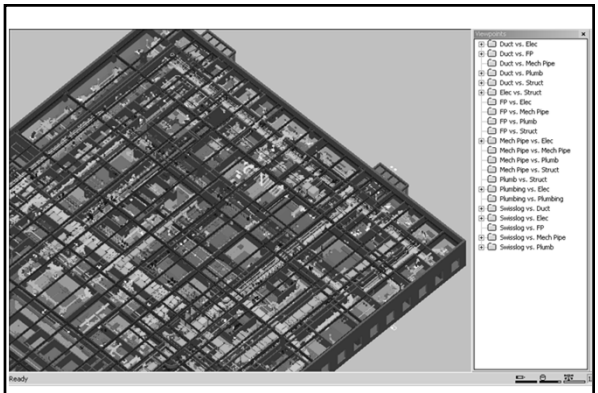

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Pre-Construction

Task	What to Look For
Review BIM Execution Plan Cont.	•The software products used for model authoring are IFC and COBie compliant •Other construction-phase analyses are identified and include the software to be used, BIMs to be analyzed, and responsible team members •The process and responsibility for insuring all building configuration changes are incorporated into the Construction BIM •The project deliverable section describes how each deliverable will be produced and delivered from the Coordinated Construction models. These deliverables include As-Built BIMs partitioned by floor in IFC format, site and landscape model in IFC or 3D DWG format, As-Built drawings extracted from As-Built BIMs, COBie spreadsheet, and all documents listed in COBie spreadsheet •The project team describes an acceptable level of quality control •All parties providing BIM deliverables have signed
Attend BIM Kickoff Meeting	

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Coordination Phase

Task	What to Look For
Verify Shop Drawings are Being Extracted from Coordinated BIMs	•The information shown in the Shop Drawings is seen in the model(s)
Verify Coordination Drawings are Being Extracted from Coordinated BIMs	•The information shown in the drawings is seen in the model(s)

Construction Phase

Task	What to Look For
Verify Construction BIMs are Being Maintained to Reflect Field Changes or Change Orders	•Approved building configuration changes have been modeled in the Construction BIMs
Spot Check that Equipment Inventory and Documents are Maintained in COBie Format	•Don't wait until closeout to find out whether the contractor is capable of producing a COBie spreadsheet

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COBie File: Type Worksheet

Name	CreatedBy	CreatedOn	Category	Description	AssetType	Manufacturer	ModelNumber	WarrantyGuarantorParts	WarrantyDurationParts	WarrantyGuarantorLabor	WarrantyDurationLabor	WarrantyDurationUnit	NominalLength	NominalWidth	NominalHeight
BLR-GAS	gwilliams@kfa-inc.com	2013-04-21T15:57:40	23-75 10 11 14: Hot Water Heat Generators	Gas Boiler	Fixed	sales@Weil-McLain.com	5004B	sales@Weil-McLain.com	1	sales@Weil-McLain.com	1	year	3.47	2.91	3.17

Project Closeout Phase

Task	What to Look For
Receive As-Built BIMs in IFC Format (Site may be in 3D DWG)	•All As-Built BIMs have been delivered
Verify Separate BIMs for each Floor and Discipline	•As-Built BIMs have been partitioned by floor and discipline in IFC format. The site model may be in IFC or 3D DWG format
Verify As-Built Drawings are Extracted from As-Built BIMs	•The information shown in the As-Built drawings is seen in the As-Built BIMs
Deliver As-Built BIMs to Designer to Review for Conformance to Design Intent	•All As-Built BIMs have been delivered partitioned by floor and discipline in IFC format
Verify that As-Built BIMs have been Reviewed by Designer for Conformance to Design Intent	
Receive and Validate COBie Deliverable Using Automated Tools	•The Contact, Facility, Floor, Space, Zone, Type, Component, System, Document, & Attribute Worksheets are provided, including all listed documents

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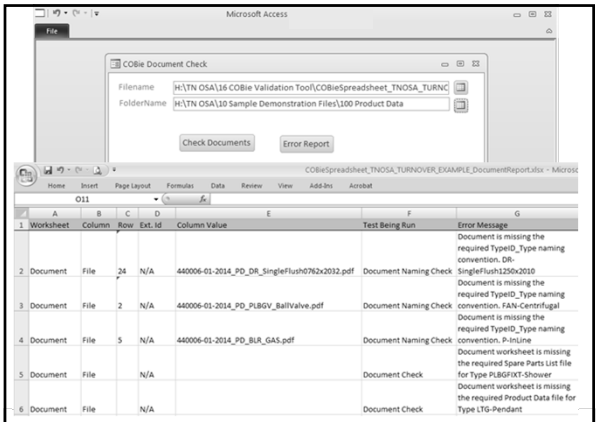

	A	B	C	D	E	F	G
1	Worksheet	Column	Row	Ext. Id	Column Value	Test Being Run	Error Message
2	Document	File	24	N/A	440006-01-2014_PD_DR_SingleFlush0762x2032.pdf	Document Naming Check	Document is missing the required TypeID_Type naming convention. DR-SingleFlush1250x2010
3	Document	File	2	N/A	440006-01-2014_PD_PLBGV_BallValve.pdf	Document Naming Check	Document is missing the required TypeID_Type naming convention. FAN-Centrifugal
4	Document	File	5	N/A	440006-01-2014_PD_BLR_GAS.pdf	Document Naming Check	Document is missing the required TypeID_Type naming convention. P-InLine
5	Document	File		N/A		Document Check	Document worksheet is missing the required Spare Parts List file for Type PLBGFIXT-Shower
6	Document	File		N/A		Document Check	Document worksheet is missing the required Product Data file for Type LTG-Pendant

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KFA's Role

Training, Support, Continuous Improvement

Office of the State Architect

KFA's Role

Provide assistance to additional BIM projects and additional services to OSA, SPAs and BIM project teams to promote success

- **Assist SPA/Owner with BIM-related consultant/contractor selection criteria**
- **Review Contract Documents for incorporation of BIM requirements**
- **Prepare for and attend BIM Kickoff**
- **Other onsite visits**
- **Assist PM in reviewing BEP (read, comment, review resubmission)**
- **Provide direction on BIM templates**
- **Assist PM in BIM design review**
- **Assist PM in performing COBie validation**
  - **Develop custom error reporting**
- **Call into project meetings**
- **Write monthly BIM Progress Report**
- **Conduct Design Phase Lessons Learned exercise**
- **Additional BIM training/services as required by SPAs or OSA**

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Discussion

Office of the State Architect

The Office of the State Architect Presents:

BIM Training for Project Managers

BIM Tools that Make the PM's Job Easier

Provided by:

Kristine Fallon Associates, Inc.

www.kfa-inc.com

August 13, 2013

Summary

- Tekla BIMsight
  - Overview
  - Getting Organized
    - Folder Structure
    - Naming Standards
  - Getting to Work
    - Setting Up a Composite Model
    - Performing Reviews

Tekla BIMsight

Tekla BIMsight is a free BIM tool that will allow TN PMs to:

- View Building Information Models (BIMs) to assess project progress
- Mark-up BIMs as a part of a design review
- Run interference checks if they suspect building system have not been well-coordinated

Getting Organized: Folder Structure

Before downloading files from the online collaboration system, prepare a location for the files.

Folder Structure:

Project Name
- **Design BIM**
  - **01 Schematic Design**
    - BIM Deliverables
      - COBie
      - Models
      - Reports
    - BIM Review Comments
  - **02 Early Design Stage Presentation**
    - BIM Deliverables
      - Models
    - BIM Review Comments
  - **03 Design Development**
    - BIM Deliverables
      - COBie
      - Models
      - Reports
    - BIM Review Comments
  - **04 Construction Documents**
    - BIM Deliverables
      - COBie
      - Models
      - Reports
    - BIM Review Comments
  - **05 Bid**
    - BIM Deliverables
      - COBie
      - Models
        - IFC
        - Native
      - Reports
    - BIM Review Comments

Getting Organized: Naming Standards

Design BIMs: IFC Files (and Native format files)

Structure:	Level	Area	-	Discipline	-	User Defined
Example:	L1	A	-	A	-	UUUU

Composite Models: Individual levels and areas

Structure:	Level	Area	-	Discipline
Example:	L1	A	-	COMP

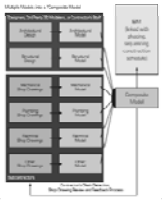
Composite Models: All levels and areas

Structure:	Level	-	Discipline
Example:	LALL	-	COMP

BIM Review Comment Files

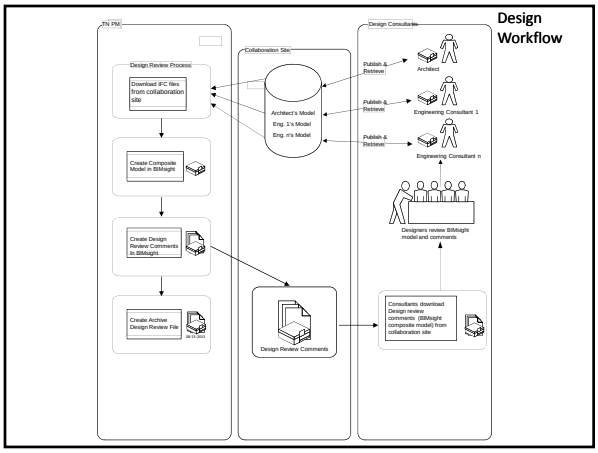
Structure:	Level	-	Discipline	-	Phase	-	Reviewer Initials	-	Date
Example:	LALL	-	TNPM	-	DD	-	GW	-	20130814

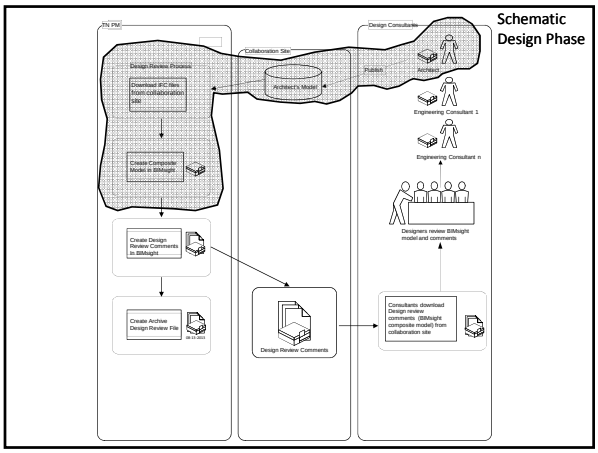
Getting to Work: Setting Up the Tekla BIMsight Composite Model



Demonstration

Getting to Work: Performing Reviews



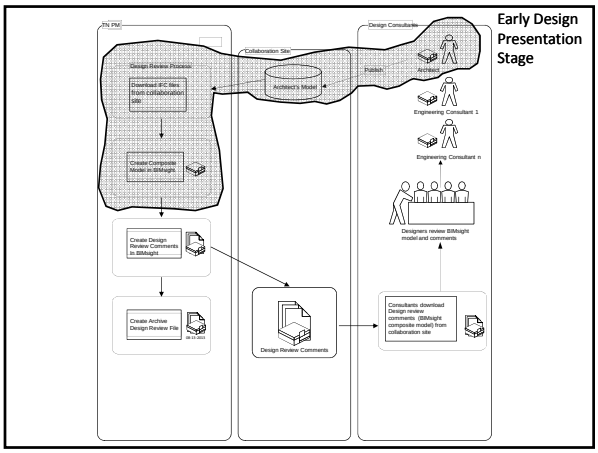


Schematic Design Phase

Task	What to Look For
Review BIM Deliverable	•The massing BIM is in IFC format and contains a geo-reference mark with annotation •Spot check that area calculations and drawings are extractions from the BIM

Tekla BIMsight Tools/Processes Discussed:
•Models Tab •Navigation Tools •Objects Tab •View Tab •Creating Views •Saving

Demonstration

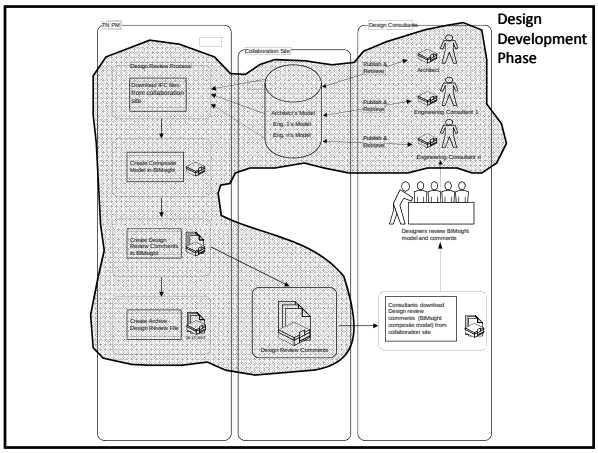


Early Design Stage

Task	What to Look For
Review BIM Deliverable	•BIM is in IFC format and site model in IFC or 3D .DWG

Tekla BIMsight Tools/Processes Discussed:
•Models Tab •Navigation Tools •Objects Tab •View Tab •Creating Views •Saving

Demonstration

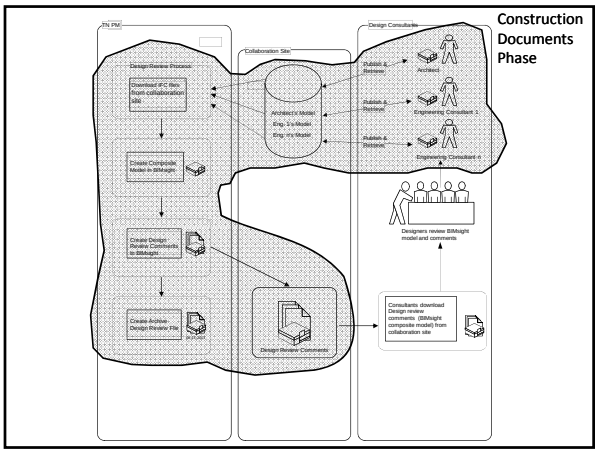


Design Development Phase

Task	What to Look For
Review BIM Deliverables	•The BIM is partitioned by floor and discipline in IFC format and contains a geo-reference mark and annotation. The site model may be in IFC or 3D DWG format •The polyline of the FEMA building footprint is present
Spot Check that Drawings are Being Exported from the Models	•The information shown in the drawings is seen in the model
Spot Check that Areas are Being Calculated from the Models	•Do the area calculations in the model match those on the drawings

Tekla BIMsight Tools/Processes Discussed:	
•Models Tab •Navigation Tools •Objects Tab •View Tab •Markup Tab	•Notes Tab •Documents Tab •Saving the DD Review TBP file •Saving an archived copy of the DD Review

Demonstration



Construction Documents Phase

Task	What to Look For
Review BIM Deliverables	•The BIM is partitioned by floor and discipline in IFC format and contains a geo-reference mark and annotation. The site model may be in IFC or 3D DWG format •The polyline of the FEMA building footprint is present
Spot Check that Drawings are Being Exported from the Models	•The information shown in the drawings is seen in the model
Spot Check that Areas are Being Calculated from the Models	•Do the area calculations in the model match those on the drawings

Tekla BIMsight Tools/Processes Discussed:	
•Conflict Checking Tab •Conflicts Tab •Other Visibility tools	•Saving the CD Review TBP file •Saving an archived copy of the CD Review TBP file

Demonstration

TN OSA Tekla BIMsight Training Videos

- Training videos created specifically for TN PMs will be available on the OSA website soon
- Contact the TN OSA to find out how to access the videos.

Discussion/Q&A