

Want It Supersized? A Workflow-Oriented Discussion for Large-Scale Projects in Autodesk® Revit®

Lindsey DuBosar – Buro Happold Consulting Engineers

MP3751

For some, the ideal workflow for an Autodesk® Revit® software project is instinctively driven by past experience and perhaps even by other program dynamics and functions. However, for projects that exceed 500,000 square feet, finding an appropriate workflow that works for all design team parties is critical to the success of the project. This class will dive into some of the trials and tribulations that were experienced on several supersized projects. We will explore appropriate model setup, copying and monitoring of fixtures, collaboration and communication between trades, and other issues as we attempt to answer the question, "When should we do the work?" You will leave this class with a better grasp of some of the largest issues that exist on a supersized architectural endeavor that is executed in Autodesk® Revit®.

Learning Objectives

At the end of this class, you will be able to:

- Learn how choosing the appropriate workflow before the project start will save time and money in later phases.
- Understand some of the limitations of modern design tools.
- Learn how to be proactive in BIM model management of super-sized projects to ensure a smooth daily design work.
- Learn how workflow can influence the coordination between disciplines of the project.

About the Speaker

Lindsey has over 5 years experience in the architectural and building environments industry. She has a BS and M. Arch from Northeastern University, and also studied in Rome, Italy for architectural analysis and design. She initially worked as a BIM Consultant, Designer and Job Captain for several architectural firms in Connecticut, Boston and New York. She currently works for Buro Happold Consulting Engineers as a BIM Coordinator on several high profile projects such as Yale University New Residential Colleges, Columbia University Business School, Columbia University Graduate School of Architecture, Planning and Preservation, and various others. Her role entails the management of all BIM models, coordination between design teams, and managing project modeling workflows. Her software exposure includes Revit® Architecture/MEP, Navisworks®, Glue 360®, AutoCAD®, and 3dStudio Max®. Lindsey has the ability to deliver projects to the highest quality and within budget.

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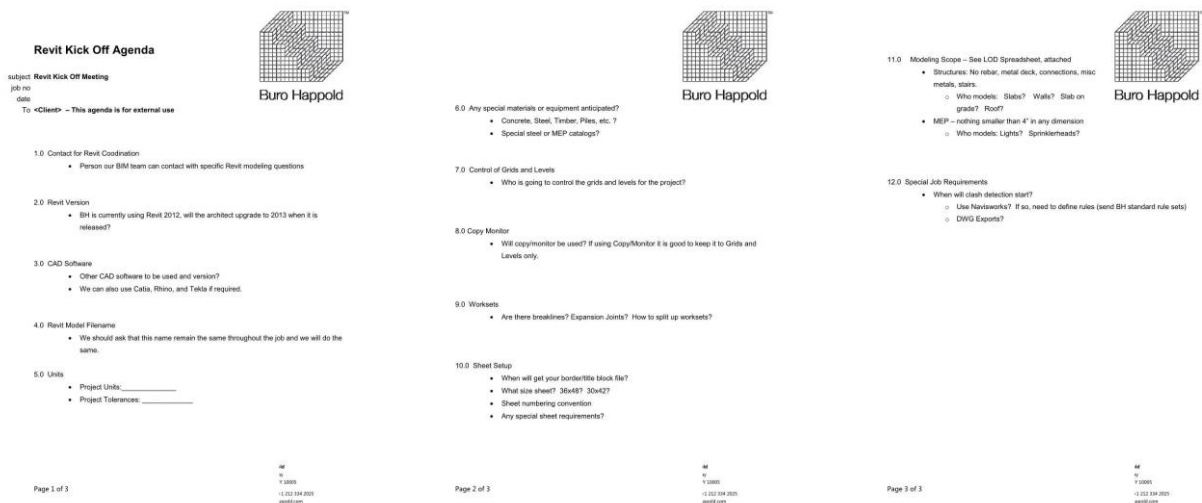
Introduction

Having an effective workflow can make or break any project.

It is difficult to accomplish an efficient process that allows team members to produce a quality, coordinated model. Each member of the design team calculates BIM decisions very differently from one another, simply because they all have different priorities.

However, at the end of the day, producing a model that operates both efficiently and effectively, is in everyone's best interest.

Project BIM Kickoff Meeting



CONTACT FOR REVIT COORDINATION: BIM contacts in each office, Direct discipline contacts, etc.

SOFTWARE: What version of Revit will be used as well as other/ if any alternative software?

REVIT MODEL STANDARDS: Project standards, BIM/REVIT standards used by each consultant (view and workset naming, break lines, expansion joints). Filenames are to remain the same throughout life of the project. How will the project be broken up?

PROJECT UNITS: Metric or Imperial

ANTICIPATED SPECIALTY MATERIALS: What specialty equipment or materials are needed?

CONTROL OF LEVELS AND GRIDS / COPY/MONITOR: Who will have control of the levels and grids? Will copy/monitor be used? If yes, on what? Refrain from copy/monitor elements and recreating when possible.

WORKSETS: Worksets remain extremely important, especially in conjunction with visibility/graphics overrides. Educate all the project team on what lives in each workset.

SHEET SETUP: Streamline drawing production by adjusting sheet preferences in the start. Be proactive about using revision schedules in title blocks.

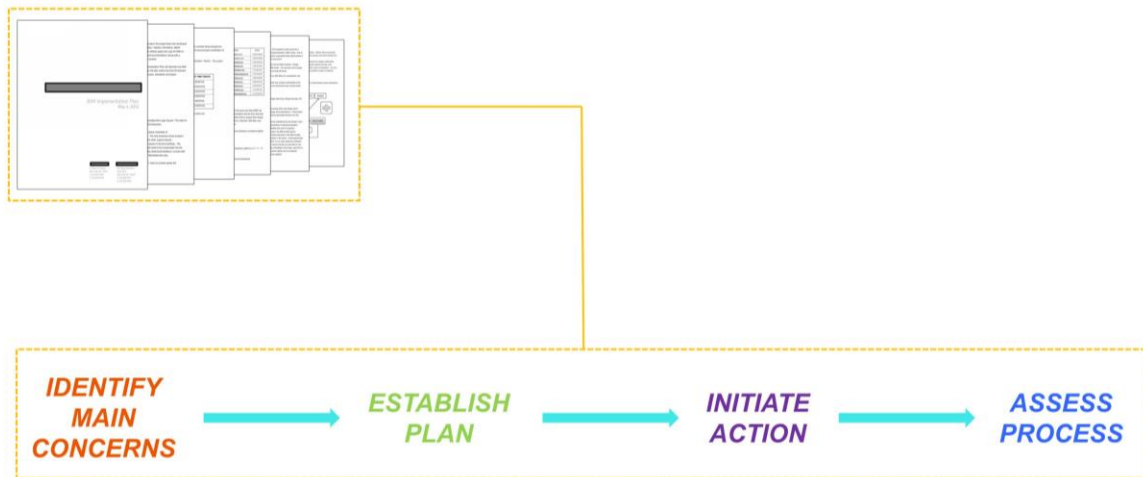
MODELING SCOPE: Set proper expectations for the design team by outlining the scope of the model to be completed for each project phase.

SPECIAL JOB REQUIREMENTS: DWG, DWF exports, Layer Conventions

COORDINATION: How often will models be exchanged, Method of exchange (FTP, Model Server, E-mail), Purging & Auditing of models before uploading

CLASH DETECTION: In Revit? In Navisworks? In Glue 360

BIM Execution Plan



INTRODUCTION: Lists project team & respective roles, Defines base goals of the document (ie: Design Authoring, Design Coordination, Clash Detection & Documentation).

PROJECT INFORMATION: Project Owner, Name & Location, Brief project description, Project schedule, Phases & Milestones, Key Contacts

PROJECT GOALS: Major BIM Goals, integration of other design tools, BIM usage (for meetings, coordination, clash detection, documentation, structural analysis), Technology Workflow, Data Flow Details (AutoCAD to Revit, etc.)

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BIM MODEL AUTHORING: Architectural Models (where file resides, worksets, auditing/purging), Engineering Models (Services included in each model), Collaboration Guidelines between disciplines, Standards (Naming Conventions, Loadable Families, Browser Organization, Worksets, External Linking Procedures), Model Administration & Support, Model Maintenance (responsibilities), Non-Revit format Integration.

DIGITAL TECHNOLOGY: Hardware Specifications, Softwares to be Utilized

SCOPE: Architectural, Structural, MEP

DELIVERABLES: File Types Expected, Concept Design Phase..., Schematic Design Phase..., Design Development Phase..., Construction Document Phase...

NAVISWORKS (CLASH SOFTWARE): Revit Exports, Clash Detection Protocol (Clash Types), Proposed Clashes, Internal Clash Responsibilities, Color Coding Strategy, Navisworks Coordination & Review Process

LOD Document / Schedule – What Processes need to be completed by which phase of the project?

Buro Happold Modeling Scope Matrix

AIA BIM Protocol Exhibit
(Document E202-2008)

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Buro Happold Modeling Scope Matrix

Element (ASTM Uniformat II Classification)			Level of Detail (LOD) and Model Component Author (MCA)							
			100% Schematic Design	30% Design Development	50% Construction Documents	70% Construction Phase	80% Construction Phase	90% Construction Phase	100% Construction Phase	
A SUBSTRUCTURE			LOD 100 MCA	LOD 200 MCA	LOD 300 MCA	LOD 400 MCA	LOD 500 MCA	LOD 600 MCA	LOD 700 MCA	
A01 General	A0100	Grids (lines and bubbles)	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Levels (slab elevations)	100 ARC	200 ARC	300 ARC	400 ARC	500 ARC	600 ARC	700 ARC	TC
A10 Foundations	A1010	Pier Footings	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Wall Footings	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Pile (bents and elevations)	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Mat/Raft foundations	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Piers	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Driven Piers	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Drilled Piers	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Slab on Grade (non-structural)	100 ARC	200 ARC	300 ARC	400 ARC	500 ARC	600 ARC	700 ARC	TC
		Structural Slab on Grade	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Below slab on grade gravel, vapor barrier	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
A20 Basement Construction	A2010	Basement Excavation	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Basement Walls (including openings)	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Basement Walls Insulation, drainage mat	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Basement Walls, top of wall curbs	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Basement Walls, top of wall curbs	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
B SHELL	B10 Superstructure	Floor and Roof Construction	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Concrete Framed Slabs	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Metal Deck Slab (model as representative thickness)	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
	B1012	Concrete Reinforcement	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC
		Concrete Reinforcement	100 STR	200 STR	300 STR	400 STR	500 STR	600 STR	700 STR	TC

Buro Happold Modeling Scope Matrix

BH User Notes:

The content in G5-083 is shown for example only - it is expected that each project team will validate and adjust the content to align with the particular needs of the project and capabilities of the team members. The Level of Detail by Phase entries shown here are the minimum that would satisfy the phase descriptions in the AIA/AIACC IPD Guide*.

See "Level of Detail Descriptions" tab for descriptions of LOD 100 - 500.

This is based on the AIAE202 contract exhibit available from Orin.

Model Content	Level of Detail (LOD) Descriptions				
	100	200	300	400	500
Design & Coordination (function / form / behavior)	Non-geometric data or line work, areas, volumes, etc.	Generic elements shown in three dimensions - maximum size - purpose	Specific elements confirmed 3D Object Geometry - dimensions - capacities - connections	Shop drawing fabrication As built	As built
Authorized uses	4D Scheduling	Time scaled, ordered appearance of major activities	Time scaled, ordered appearance of detailed assemblies	Fabrication and assembly detail including construction means and methods (cranes, man-lifts, shoring, etc.)	Record costs
Cost Estimating	Conceptual cost allowance. Example: \$/sf of floor area, \$/hospital bed, \$/parking stall, etc. assumptions on future content	Estimated cost based on measurement of generic element. E.g., generic interior wall.	Estimated cost based on measurement of specific assembly. E.g., specific wall type.	Committed purchase price of specific assembly at Buyout.	Record costs
Program Compliance	Gross departmental areas	Specific room requirements	FF&E, casework, utility connections	shop drawings	as-built
Sustainable Materials	LEED strategies	Approximate quantities of materials by LEED categories	Precise quantities of materials with percentages of recycled/local purchased materials	Specific manufacturer selections	purchase documentation
Environmental: Lighting, Energy use, air movement Analysis/Simulation	Strategy and performance criteria based on volumes and areas	Conceptual design based on geometry and assumed system types	Approximate simulation based on specific building assemblies and engineered systems	Precise simulation based on specific manufacturer and detailed system components	Commissioning and reporting of measured performance
Other uses may be identified and developed					
Existing and circulation code compliance					
Etc.					

Level of Detail (LOD) Descriptions

What's At Stake? Small vs Large

TIME: Supersize projects require a greater time commitment, thus needing a higher level of coordination and a well thought out work flow to streamline production.

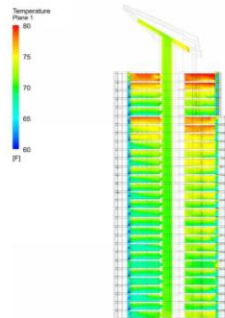
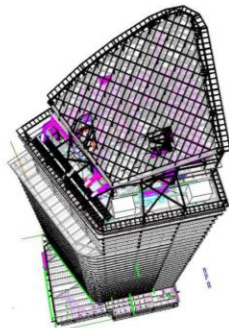
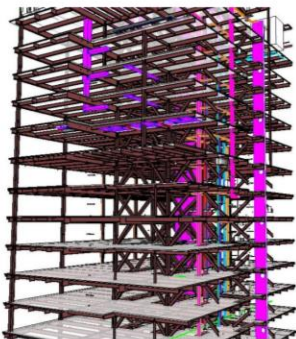
MONEY: Time is money! BIM on any project is a financial commitment. The bigger the project, the more complex models get, and the more money needed to maintain them.



Large Scale Project **SPLIT BY DISCIPLINE / SUB-DISCIPLINE** (Architectural, Mechanical, Electrical, Plumbing, Fire Protection and Structural)

Approximately 850,000 SF

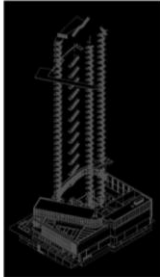
USES: Visualization; Meta Data; Coordination; Document Production; Energy Modeling



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Large Scale Project **SPLIT BY DISCIPLINE / SUB-DISCIPLINE** (Architectural, Mechanical, Electrical, Plumbing, Fire Protection and Structural)

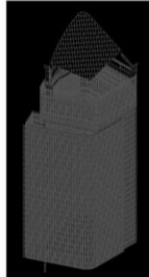
8 Revit Models



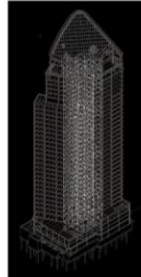
Architectural Revit Model



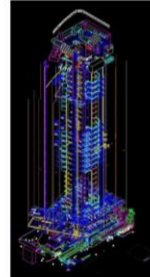
Architectural Revit Model



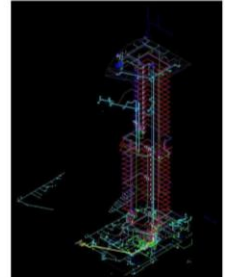
Architectural Revit Model



Structural Revit Model



Mechanical Revit Model



Plumbing Revit Model

ARCHITECTURAL MODEL (229 MB, 57 MB, 214MB)

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116359000_Core.rvt	11/7/2012 6:20 PM	Autodesk Revit Pr...	57,312 KB
116359000_Shell_SF.rvt	11/7/2012 6:21 PM	Autodesk Revit Pr...	214,612 KB

STRUCTURAL MODEL (200 MB)

028513-PlanD-STR-CENTRAL.rvt	11/9/2012 6:37 PM	Autodesk Revit Pr...	200,368 KB
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MEP/FP MODEL (35 MB, 67MB, 77MB, 69MB)

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Project D P Model_2012_CENTRAL.rvt	11/8/2012 2:33 PM	Autodesk Revit Pr...	69,432 KB

Large Scale Project **SPLIT BY DISCIPLINE / SUB-DISCIPLINE** (Architectural, Mechanical, Electrical, Plumbing, Fire Protection, Telecom, Security and Structural)

Approximately 470,000 SF

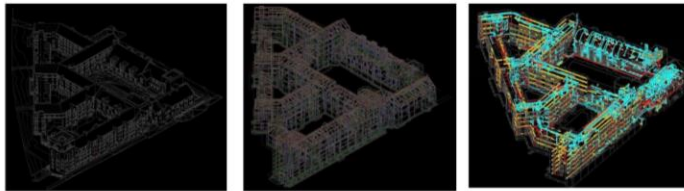
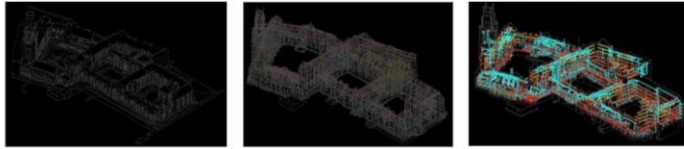
USES: Visualization; Meta Data; Coordination; Document Production



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Large Scale Project **SPLIT BY DISCIPLINE / SUB-DISCIPLINE** (Architectural, Mechanical, Electrical, Plumbing, Fire Protection, Telecom, Security and Structural)

20 Revit Models



ARCHITECTURAL MODEL

(9 MB, 665 MB, 137 MB, 26 MB, 576 MB, 126 MB)

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Yale_North.rvt	5/17/2012 3:57 PM	Autodesk Revit Pr...	665,112 KB
Yale_North_Interior.rvt	2/22/2012 10:05 AM	Autodesk Revit Pr...	137,488 KB
Yale_Site.rvt	3/12/2012 2:48 PM	Autodesk Revit Pr...	25,600 KB
Yale_South.rvt	5/22/2012 5:22 PM	Autodesk Revit Pr...	576,352 KB
Yale_South_Interior.rvt	2/22/2012 10:23 AM	Autodesk Revit Pr...	125,552 KB

STRUCTURAL MODEL (94 MB, 92 MB)

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MEP/FP/S/T/C MODEL

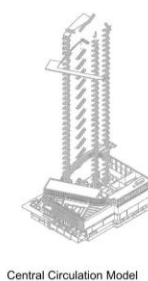
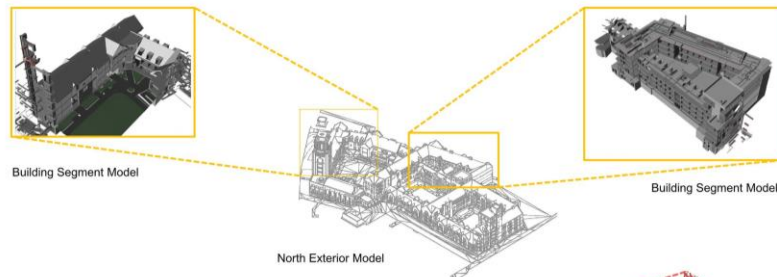
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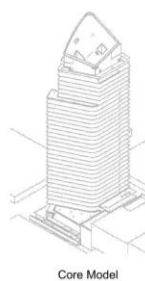
Model Splitting

Architecture

Floor By Floor
Building Segments
Core & Shell
Exterior & Interior
Furniture
Rendering Families



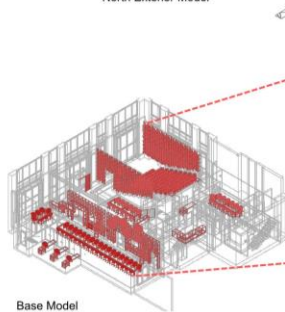
Central Circulation Model



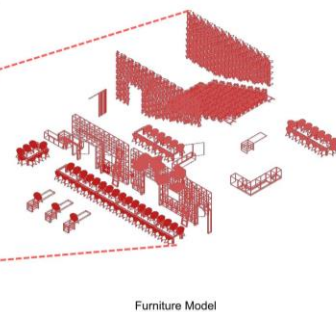
Core Model



Shell Model



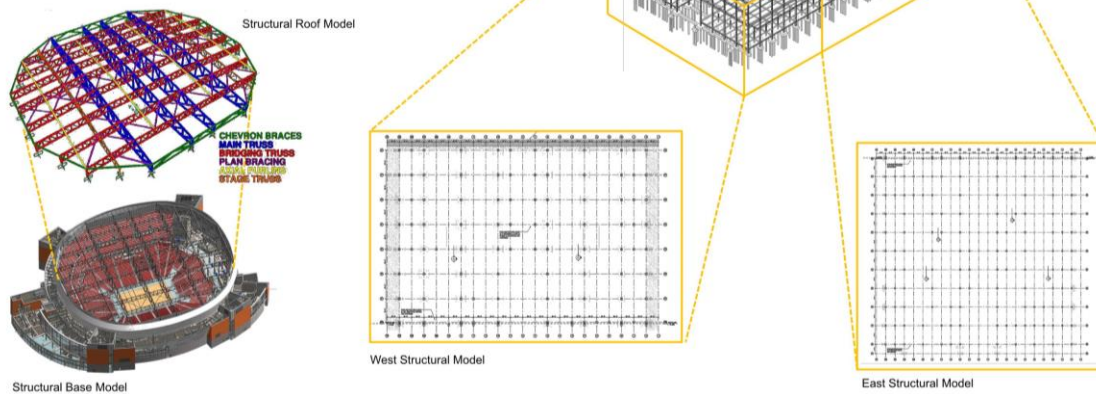
Base Model



Furniture Model

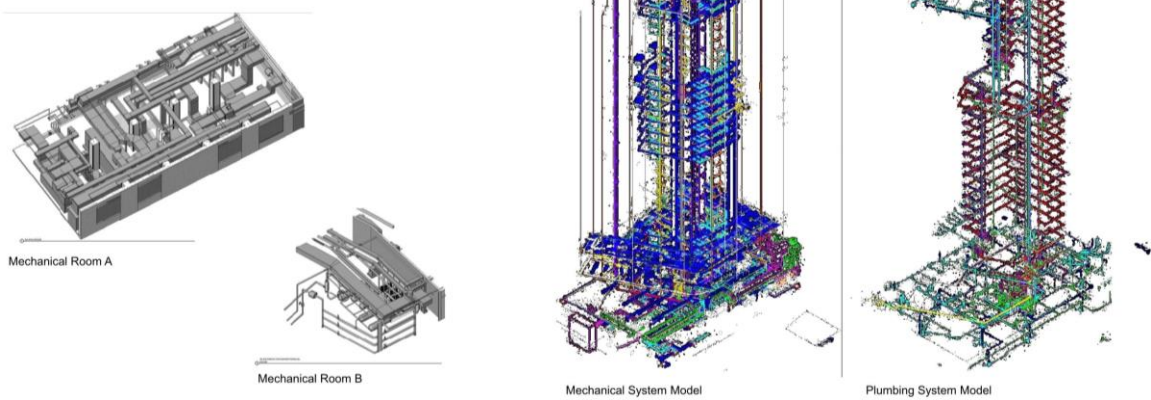
Structures

Building Segment (North vs. South, Expansion Joints)
Base & Roof
Subsurface & Above Ground (Vertical Joints)



MEP

System Type
Mechanical Rooms
Service Distribution



Model Management

Roles and Responsibilities – One or Many?

PROJECT LEADER: Discusses what platform is to be used for the project and identifies concrete deliverables from that platform.

JOB LEADER: Makes sure project deliverables are produced correctly and with sufficient technical rigor.

MODELLER/DRAFTER: Responsible for the input of geometric and analytical model information.

PROJECT INTEGRATOR: BIM super user that operates on multidisciplinary projects, combining superior BIM modelling skills with a keen understanding of building structures and building systems.

DATASET CONTROLLER: Responsible for ensuring their team implements the project's BIM standards and processes for their dataset/trade.

FINISHER: Responsible for cleaning up all drawings, checking the accuracy and consistency of line weights, and the administration of the production process.

...need a project integrator?

PROJECT INTEGRATOR

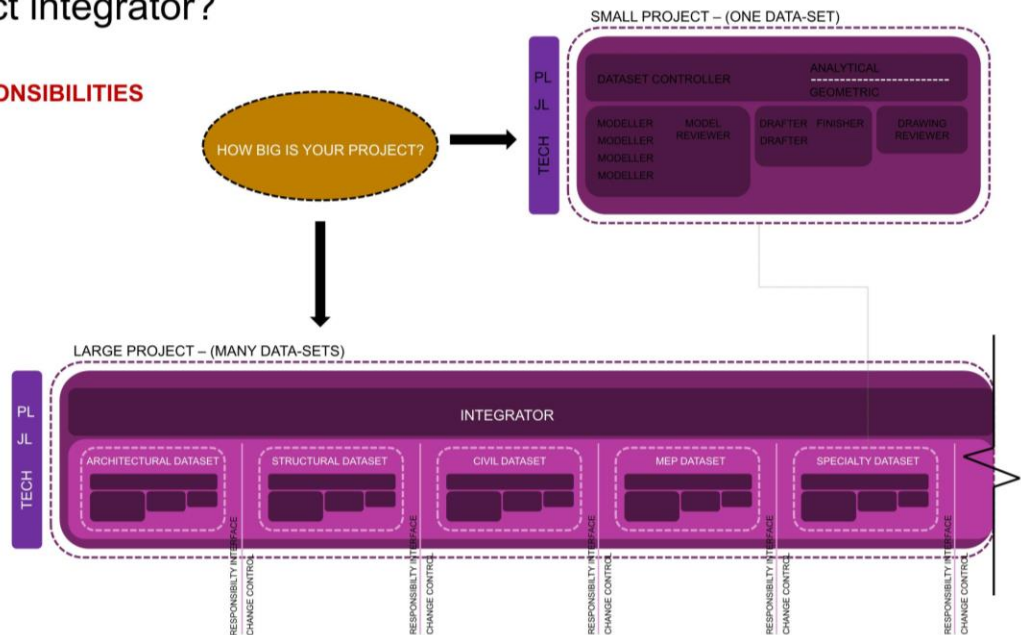
Involved from project start through CA phase

Responsibilities include:

- Structural and MEP Geometric Modeling
- Running 'clash detection' reports and resolving the conflicts by communicating with internal and external team members
- Reviewing shop drawings for coordination issues
- Site visits to ensure construction accuracy in accordance with shop drawings
- Production administration (preparing of issue sheets, etc.)

...need a project integrator?

BIM ROLES AND RESPONSIBILITIES



...need a project integrator?

INTERNAL VS. EXTERNAL

INTERNAL: Do you have enough resource for a full-time integrator (time, budget and personnel)?
Does that person have the knowledge base and experience necessary?

PROS:

- Control over all models
- Project information accessible 24/7

CONS:

- Dedicated resources available
- Full responsibility

EXTERNAL: Does the budget permit?
Does the client require an external integrator?

PROS:

- Releases large amount of responsibility
- Allows for resources to be allocated elsewhere

CONS:

- Can strain project budget
- Relies on outside party scheduling

Project Model Set-Up

Linked file Cleanup



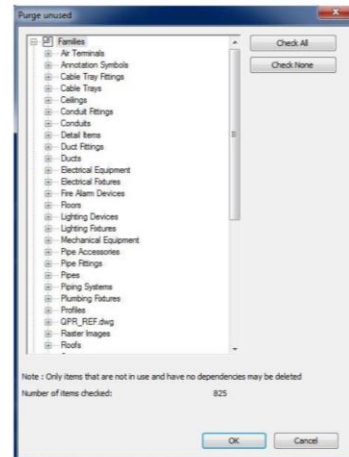
Projects Browser



Manage Tab

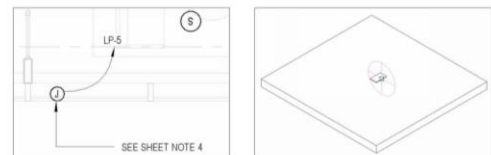
Clear unnecessary views, legends, schedules and sheets out of all linked models

Purge all unnecessary model elements and families



Default Purge Menu

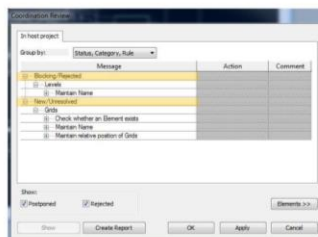
Copy/Monitoring – pros/cons, alternatives



J-BOX ELECTRICAL CONNECTOR

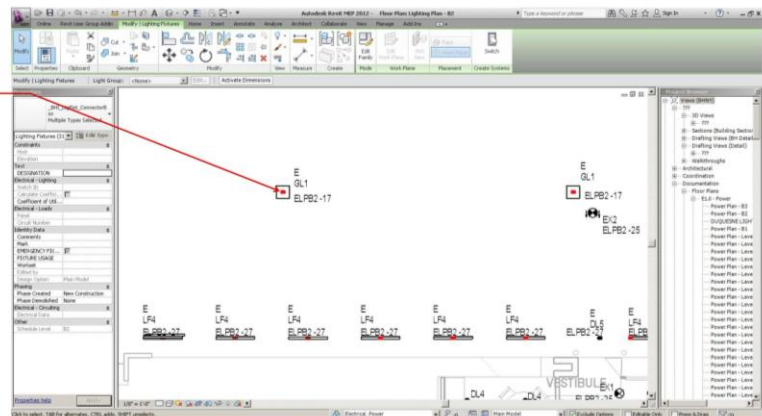


COPY/MONITOR TOOL BAR



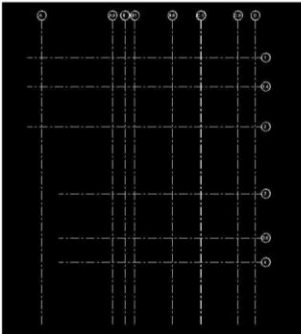
COORDINATION REVIEW DIALOG BOX

ELECTRICAL CONNECTOR

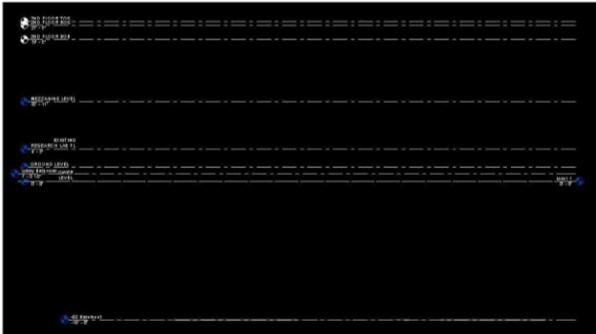


Copy/Monitoring

RECOMMENDATIONS:

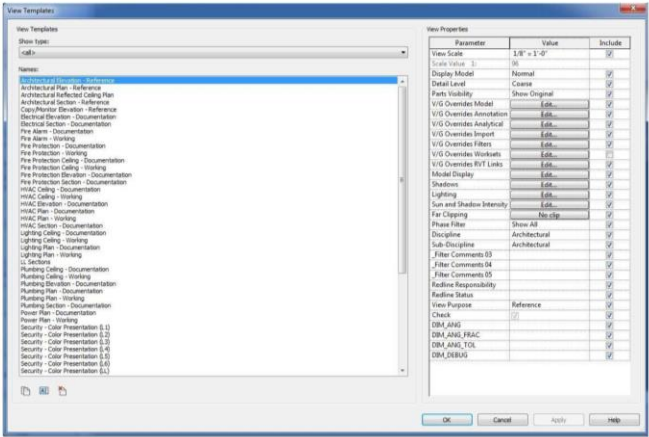


Grids



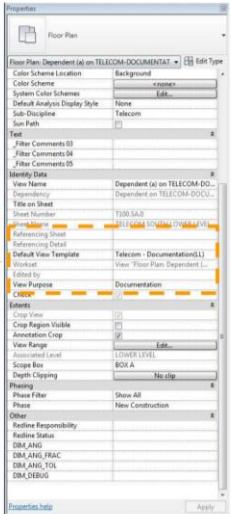
Levels

View Templates



VIEW TEMPLATE DIALOG BOX

Referencing Sheet	
Referencing Detail	Telecom - Documentation(LL)
Workset	View "Floor Plan Dependent (...)
Edited by	
View Purpose	Documentation



DEFAULT VIEW TEMPLATE

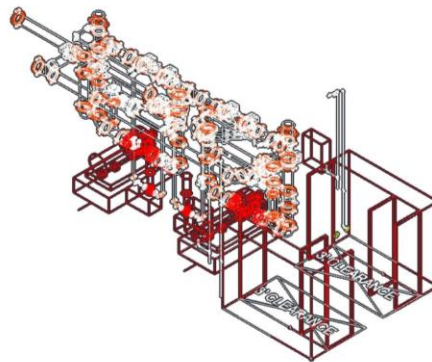
Modeling Smart

Family Best Practice

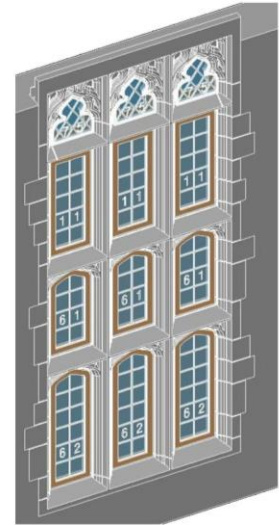
Use Smart Parameters
Geometry (Less is More!)
Beware of Manufacturer Direct
Families, over detailed bolts,
equipment and casement.



Chair Family



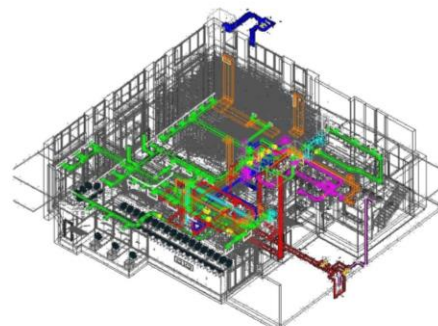
Fire Pump Family



Complex Window Family

Daily Workflows / Best Practices

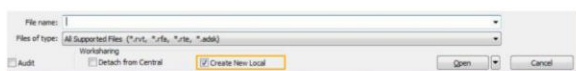
New local
Save, sync, relinquish
Wireframe
Work Sharing Monitor
Lync (Communication is key!)
Reboot daily
Consider creating new central files



Wireframe Graphic Mode



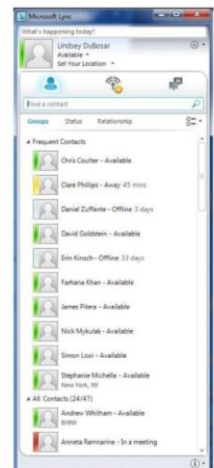
Synchronize with Central



Create New Local Option



Worksharing Monitor for Revit 2012



Lync Communicator

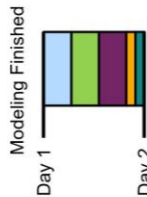
Deadline Preparations

Deliverables, Printing (Dedicated Machine)

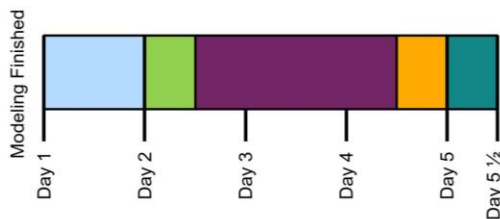
LEGEND

- Print Check Set
- Adjust Errors Found
- Plot Final Sheets
- Compare Final Plot with Issue Sheet
- Upload Final Deliverables
- Drawing Cleanup (Irregular Match Lines)

TYPICAL SMALL-SCALE PROJECT (10,000SF)



TYPICAL SUPERSIZED PROJECT (450,000SF)



TYPICAL SUPERSIZED PROJECT [IRREGULAR MATCHLINES] (450,000SF)

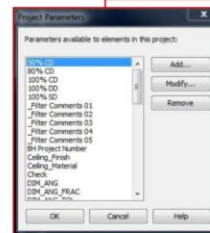
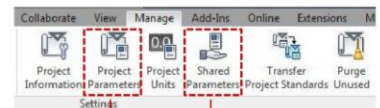


Sheet management, Printing model, Project-wide shared parameters

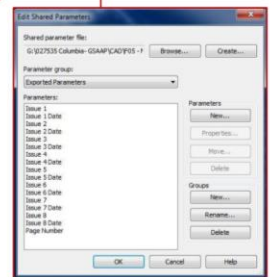
Other	
File Path	
Drawn By	Author
Redline Responsibility	
Redline Status	
EXPORT_NAME	
Discipline Type	TELE-DATA
Sheet Type	T-100 Partial Plans
Discipline Order	12.000000
100% SD	☒
100% CD	☒
80% CD	☒
100% CD	☒
Guide Grid	Guide Grid 1

Shared Parameters – to Dedicated Printing Model Sheet List

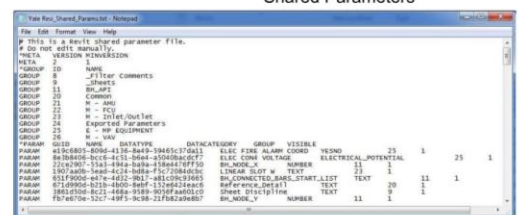
Discipline Type	Discipline Order	Sheet Type	Sheet Number	Sheet Name
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GENERAL INFORMATION	2	10.000 GENERAL	10.000	10.000 GENERAL
GENERAL INFORMATION	3	10.000 GENERAL	10.000	10.000 GENERAL
GENERAL INFORMATION	4	10.000 GENERAL	10.000	10.000 GENERAL
GENERAL INFORMATION	5	10.000 GENERAL	10.000	10.000 GENERAL
GENERAL INFORMATION	6	10.000 GENERAL	10.000	10.000 GENERAL
GENERAL INFORMATION	7	10.000 GENERAL	10.000	10.000 GENERAL
GENERAL INFORMATION	8	10.000 GENERAL	10.000	10.000 GENERAL
GENERAL INFORMATION	9	10.000 GENERAL	10.000	10.000 GENERAL
GENERAL INFORMATION	10	10.000 GENERAL	10.000	10.000 GENERAL
GENERAL INFORMATION	11	10.000 GENERAL	10.000	10.000 GENERAL
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GENERAL INFORMATION	18	10.000 GENERAL	10.000	10.000 GENERAL
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GENERAL INFORMATION	85	10.000 GENERAL	10.000	10.000 GENERAL
GENERAL INFORMATION	86	10.000 GENERAL	10.000	10.000 GENERAL
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GENERAL INFORMATION	98	10.000 GENERAL	10.000	10.000 GENERAL
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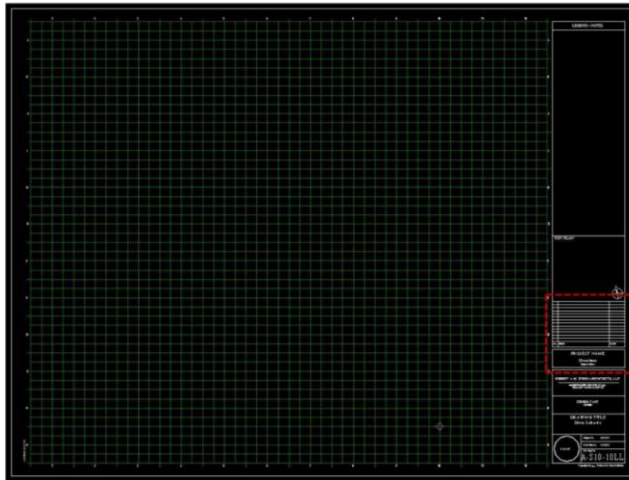
Project Parameters



Shared Parameters



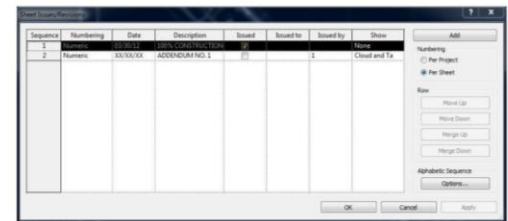
Title blocks and Revision Schedules



Project Title block



Embedded Revision Schedule



Revision Menu

Hardware Recommendations

Where To Put Your Money...

RECOMMENDATIONS:

- Windows 7 64 bit Operating System
- Pentium®, Xeon® CPU
- Minimum 16GB RAM for 64 bit
- 1 GB Graphics Card
- Dedicated Machine for Production

Conclusion

Design an internal and external plan for BIM standards throughout the entire life cycle of the project (BIM Execution Plan).

Assign a member/members of the project team to hold responsibility for the maintenance of all project models and day to day model management.

Split models appropriately to make daily work as easy as possible.

Educate project team members of BIM best practices (modeling smart).

Invest budget wisely (appropriate hardware)

Prepare an execution plan for deadlines at the beginning of the project.

A solid plan will help streamline all processes and minimize effort, time and money spent.