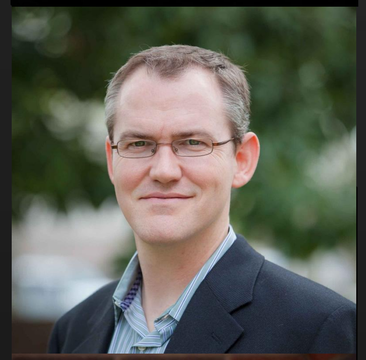
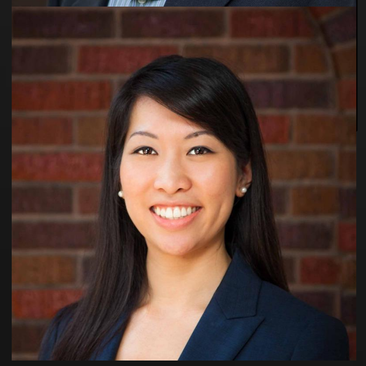
Rapid-Fire Autodesk Revit Data Extraction: Best Practices in Construction Data Extraction

James McKenzie, Director-Center For Excellence, Swinerton Incorporated
Trent Miskelly, VP of Development, Assemble Systems
Wendy Titus, Territory Manager, Assemble Systems





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Class Summary

- Revit Data Structure
- Collaboration using BIM
- Revit Data Extraction
- Downstream Uses of Building Information

Revit Data Mgmt.

Data Mapping

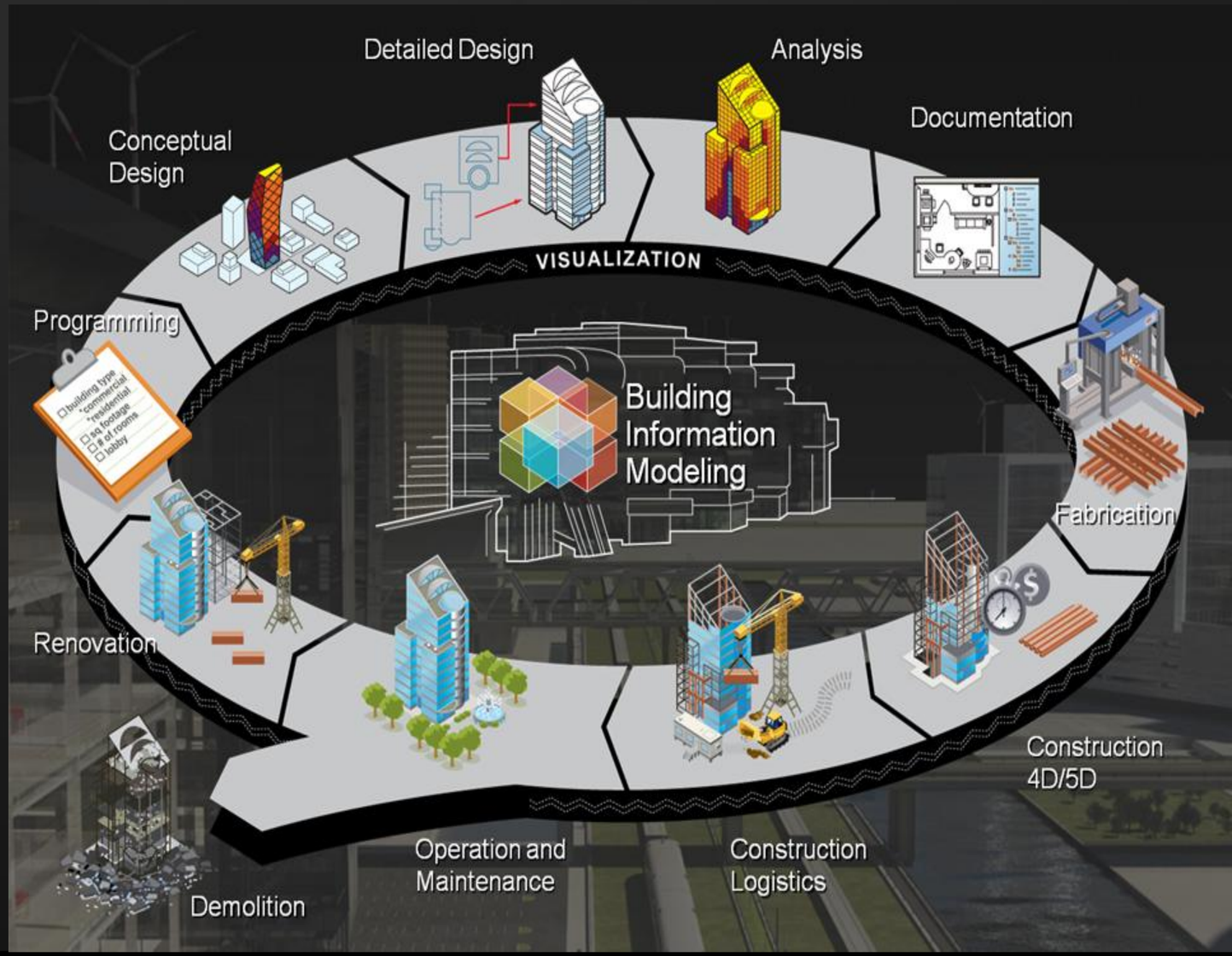
Learning Objectives

External Databases

Delivery Process Affects BIM

Need for Rapid Data Extraction

- Revit “hidden” data
- What do we have?
- Speed of Business



Revit Data Management-Its All About the Data

- How is data entered ?
- Does data sit in a silo ?
- Analyze where there are data “overlaps”
- Examine what data is not electronic & whether it can digitized
- Where is data stored ? Multiple locations ?
- Evaluate how data is transmitted and in what format

Revit Modeling Success=Planning + Continuous Collaboration and Feedback

Revit Morphology

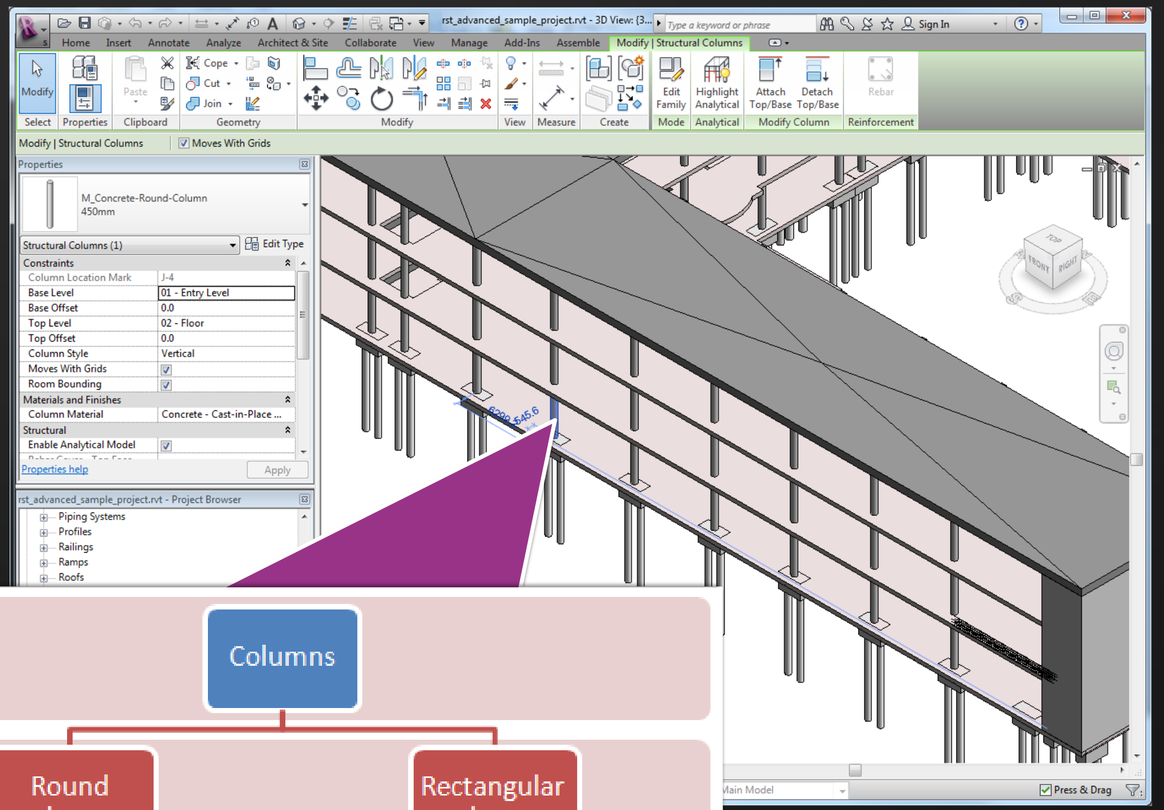
- Single, unified representation of the building (full description not just a 3D model)
- Generates all necessary documentation
- Modeling instead of drawing using building components such as walls, windows, floors, ceilings, etc.
- Revit recognizes form (geometry) and behavior of building components
- Object based
- Parametric relationships
- Objects, parameters and values

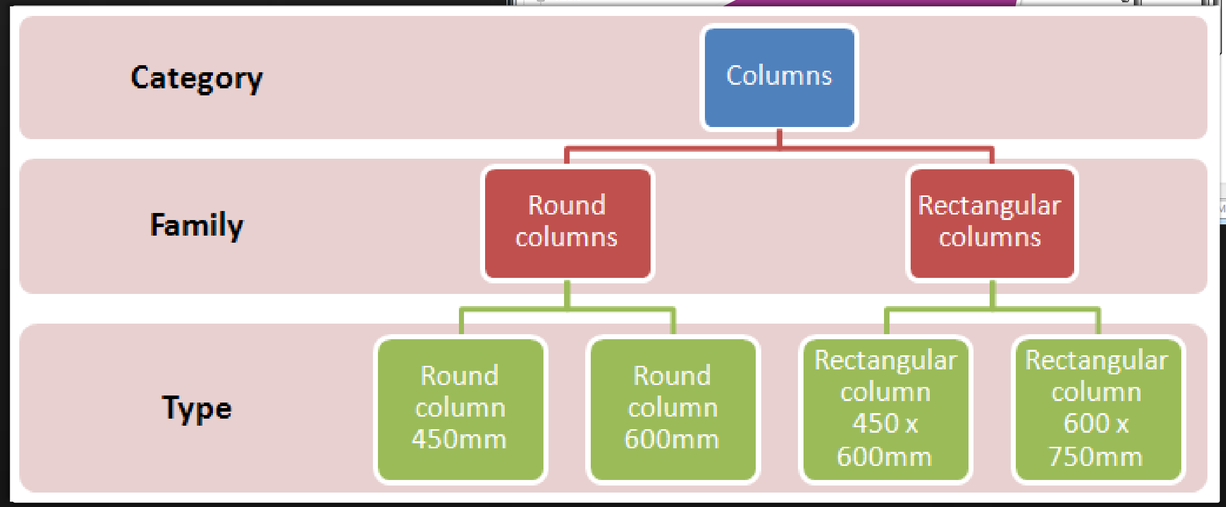
Revit Data Structure

Revit Hierarchy

- Category
  - Family
    - Type
      - Instance

- Parameters
  - Family
  - Type
  - Instance

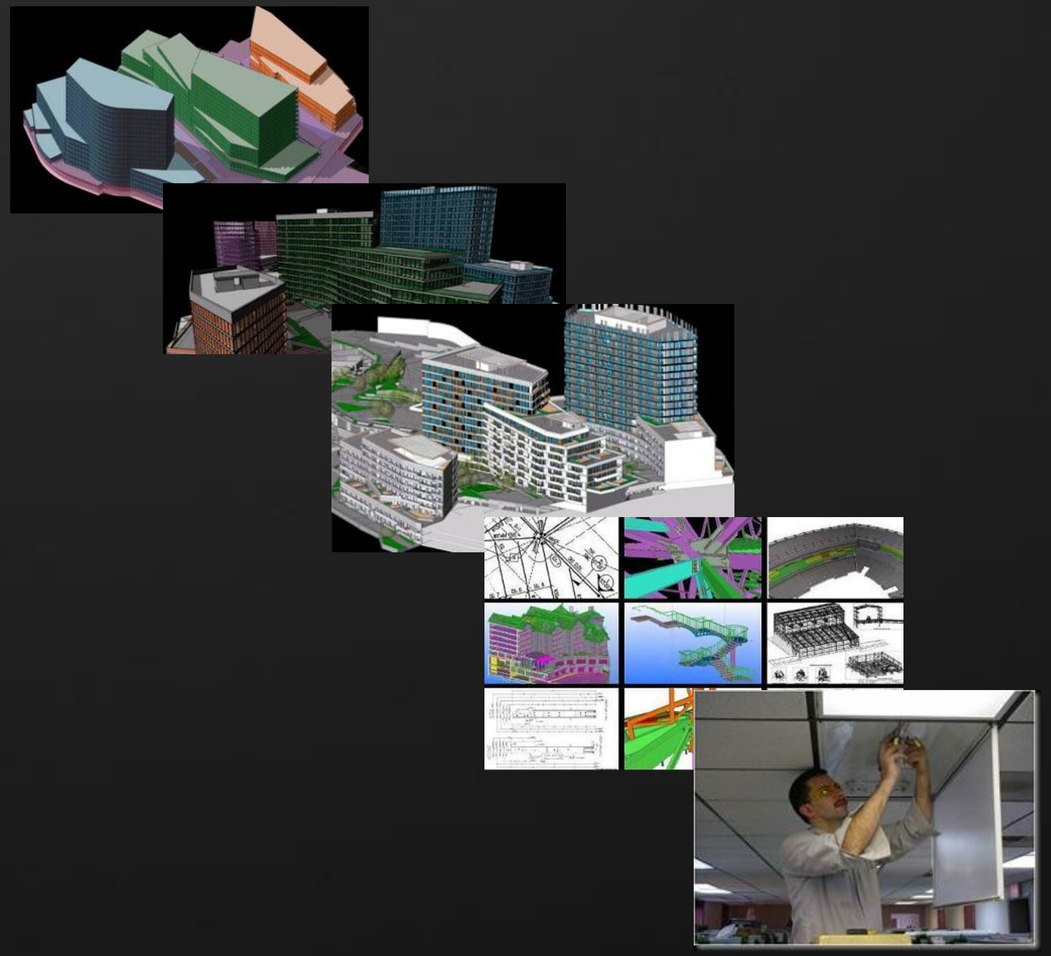




Level of Detail

- LOD 100: Conceptual
- LOD 200: Approximate Geometry
- LOD 300: Precise Geometry
- LOD 400: Fabrication
- LOD 500: As-built

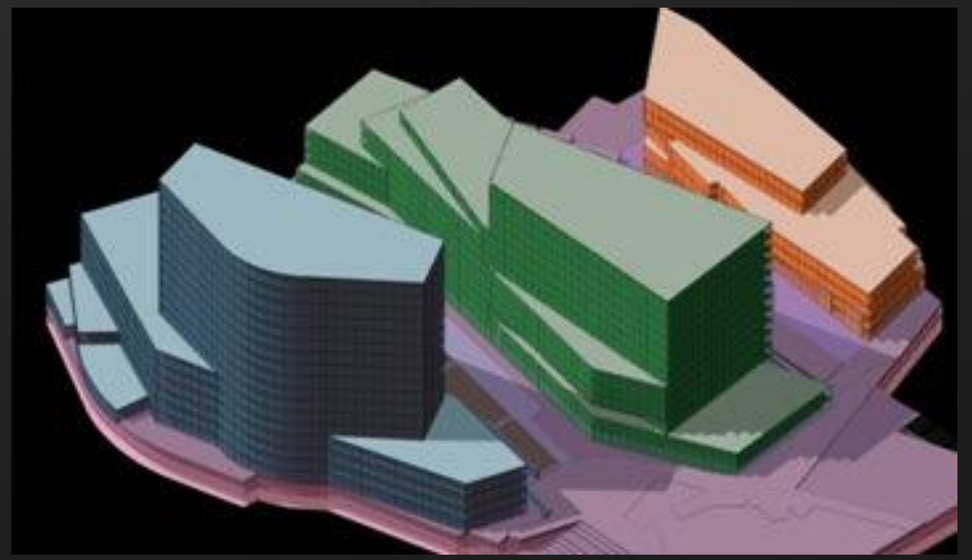
Modeled elements will need to be at least ***LOD 300*** *if used for construction*



Levels of Detail

- LOD 100

  Model Elements indicative of area, height, volume, location, and orientation may be modeled in three dimensions or represented by other data. (ie., a pump would be a cube)

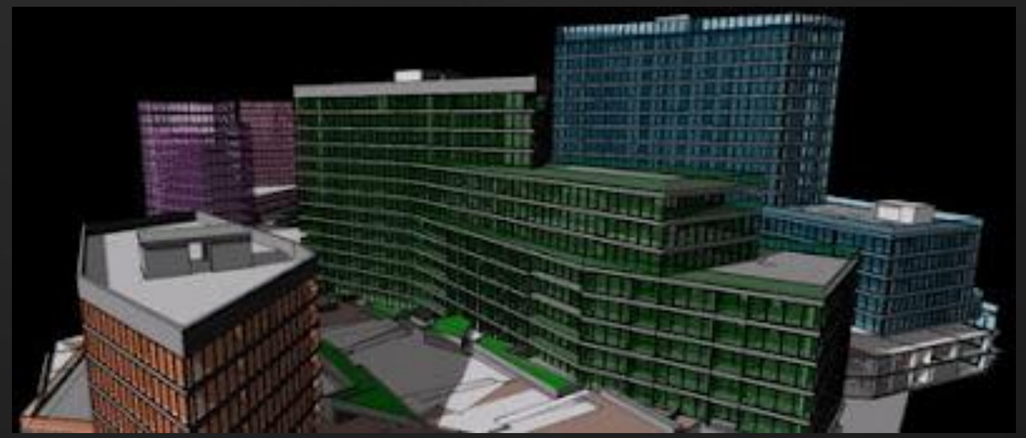


- Uses
  - *Total project duration*
  - *Phasing of major elements*
  - *Conceptual cost allowance ($/sf of floor area)*
  - *Cost assumptions on future content*

Levels of Detail

- LOD 200

  Model Elements are modeled as generalized systems or assemblies with approximate quantities, size, shape, location, and orientation. Non-geometric information may also be attached to Model Elements. (ie., a pump would be a generic pump of approximate size.)



- Uses
  - *Time-scaled, ordered activities*
  - *Estimated cost based on generic elements*

Levels of Detail

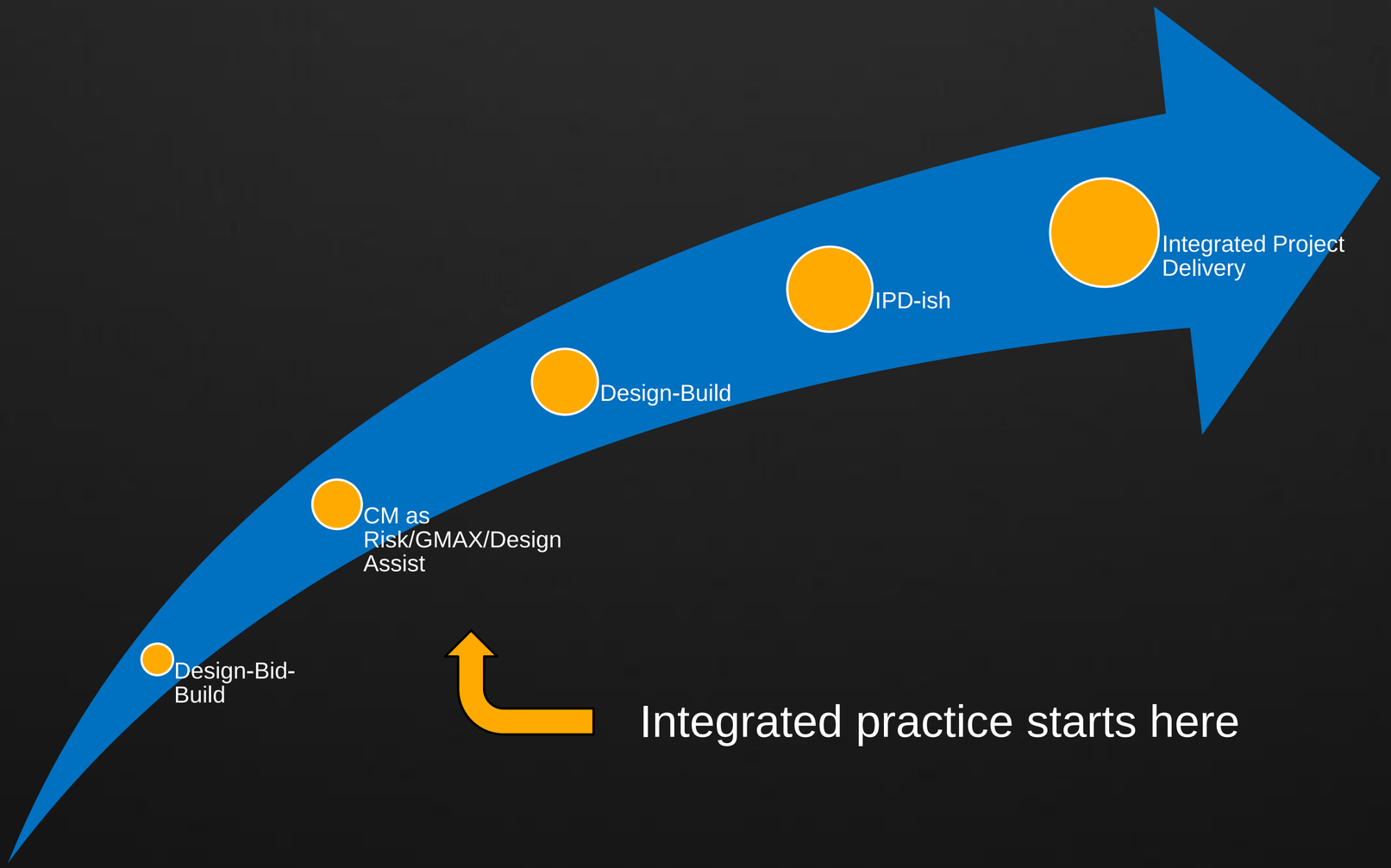
- LOD 300

  Model Elements are modeled as specific assemblies accurate in terms of quantity, size, shape, location, and orientation. Non-geometric information may also be attached to Model Elements. Accurate to contract documents. (ie., a pump would be a generic pump of accurate size complete with connections and clearances for a complete system.)

- Uses
  - *Time-scaled, ordered assemblies*
  - *Estimated cost based on specific assemblies (i.e., specific wall type)*

Collaboration Using BIM

BIM Usage Spectrum by Project Delivery Method



Design Intent vs. Construction Models

- Level of Detail
- From Generic Objects to well-defined objects
- Scale

Importance of a BIM Execution Plan

- Define BIM Goals & Uses
- Design Project Process & Responsibilities
- Develop Model Requirements
- Implement Quality Control

Minimum Modeling Matrix (M3)

US Army Corps of Engineers.

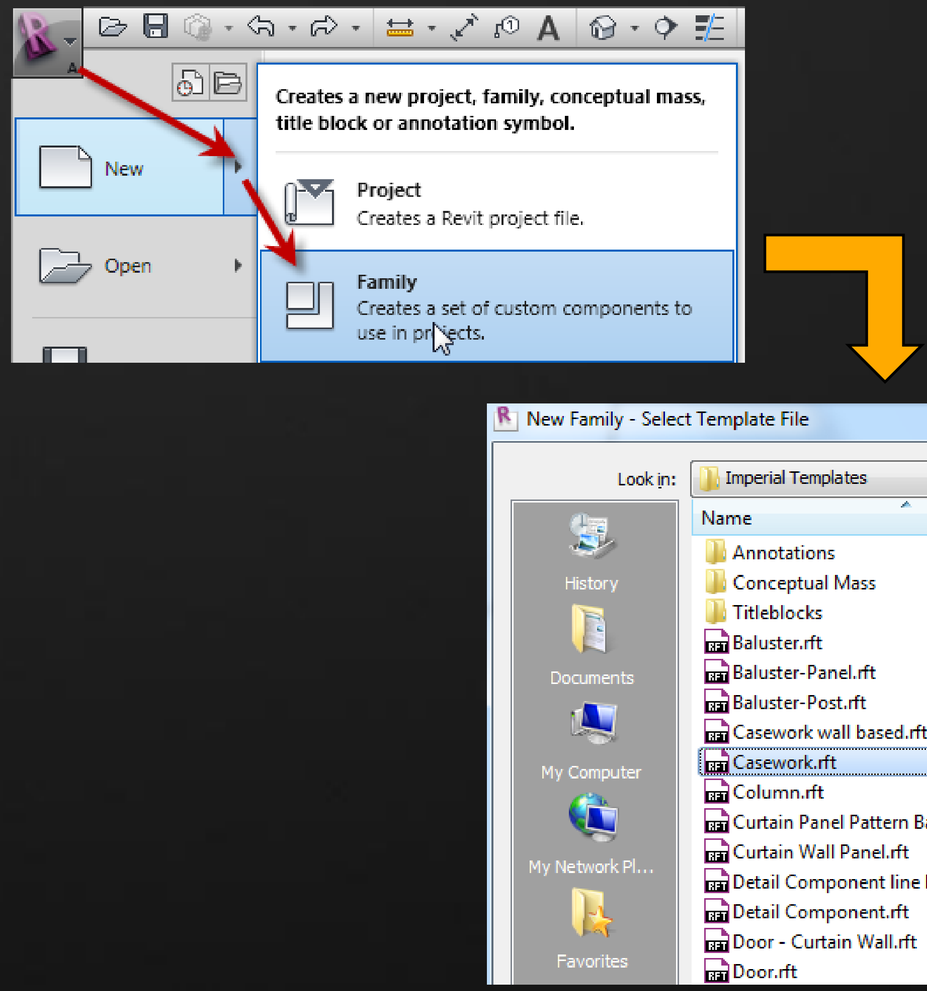
Document Release: 20120913

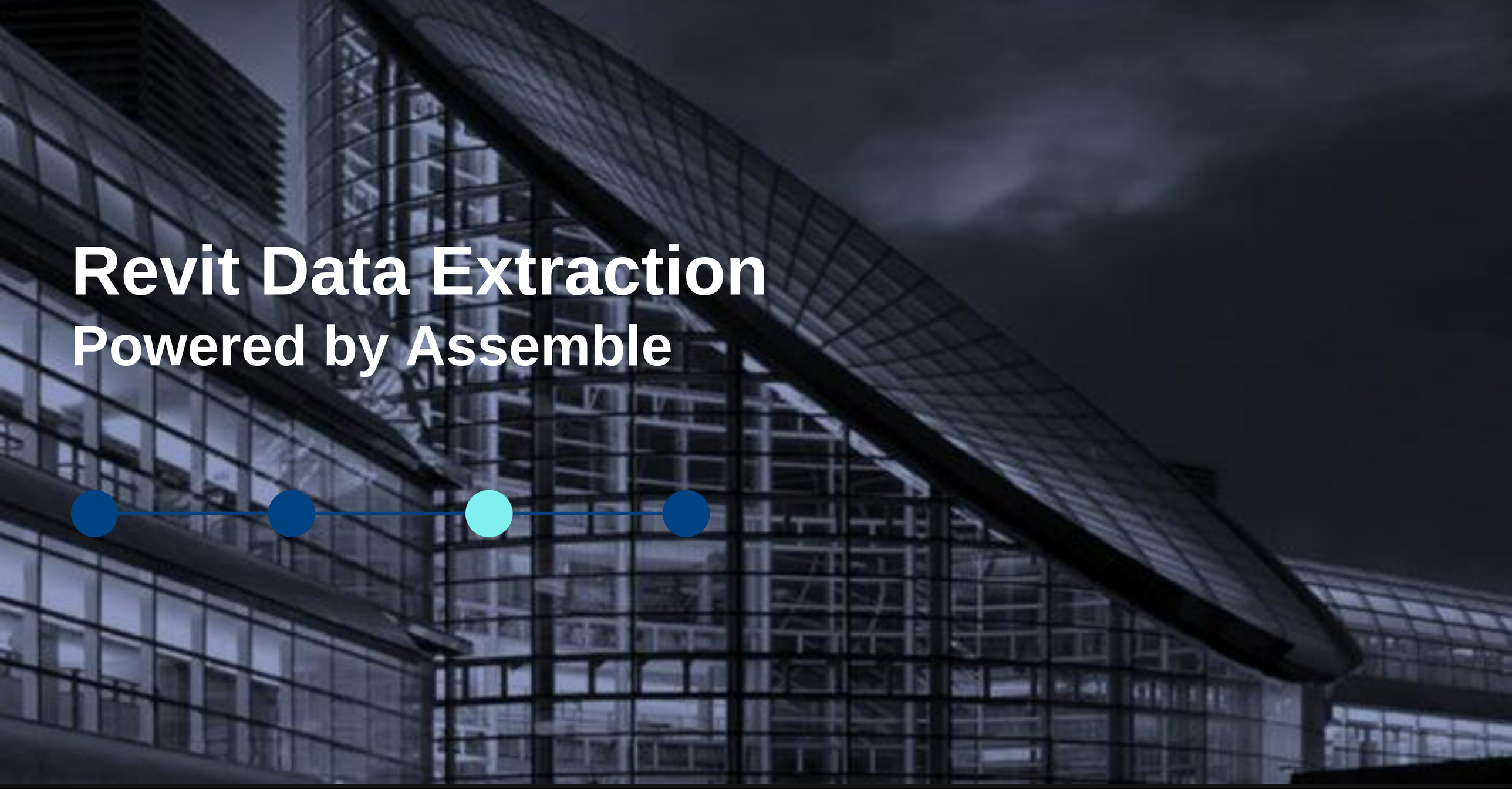
							DESIGN MODEL (CONSTRUCTION DOCUMENTS)	RECORD MODEL (AS-BUILTS)	FOR AGENCY OR CONTRACTOR INTERNAL USE. NOT A CONTRACTUAL REQUIREMENT.	
Level	Element ID	OmniClass ID	UniFormat ID	MasterFormat ID	Included in Facility or Site? (change to NO if NOT part of project scope	LOD	GRADE (CD)	GRADE (AB)	Primary Discipline (This will allow design team to identify discipline specific areas of content)	Notes
Level 1	SUBSTRUCTURE	21-01 00 00	A		Yes	•	•	•	Structural	
Level 2	Foundations	21-01 10	A10		Yes	•	•	•	Structural	
Level 3	Standard Foundations	21-01 10	A1010		Yes	•	•	•	Structural	
Level 4	Wall Foundations	21-01 10 10	A1010.10		Yes	300	A	A+	Structural	
Level 4	Column Foundations	21-01 10 10 10	A1010.30		Yes	300	A	A+	Structural	
Level 4	Standard Foundation Supplementary Components	21-01 10 10 30	A1010.90		Yes	200	C	C+	Structural	
Level 3	Special Foundations	21-01 10 20	A1020	31 60 00	Yes	•	•	•	Structural	
Level 4	Driven Piles	21-01 10 20 10	A1020.10	31 62 00	Yes	300	A	A+	Structural	
Level 4	Bored Piles	21-01 10 20 15	A1020.15	31 63 00	Yes	300	A	A+	Structural	
Level 4	Caissons	21-01 10 20 20	A1020.20	31 64 00	Yes	300	A	A+	Structural	
Level 4	Special Foundation Walls	21-01 10 20 30	A1020.30	31 66 16	Yes	300	A	A+	Structural	
Level 4	Foundation Anchors	21-01 10 20 40	A1020.40	31 68 00	Yes	100	C	C+	Structural	
Level 4	Underpinning	21-01 10 20 50	A1020.50	31 48 00	Yes	100	C	C+	Structural	
Level 4	Raft Foundations	21-01 10 20 60	A1020.60	03 71 00	Yes	300	A	A+	Structural	
Level 4	Pile Caps	21-01 10 20 70	A1020.70		Yes	300	A	A+	Structural	
Level 4	Grade Bea									
Level 2	Subgrade									
Level 3	Walls for S									
Level 4	Subgrade									
Level 4	Subgrade									
Level 4	Subgrade									
Level 2	Slabs on G									
Level 3	Standard S									
Level 3	Structural									
Level 3	Slab Trenc									

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
1							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	
2							Not in Model	Not in Model	Not in Model	Not in Model	Not in Model	Not in Model	Not in Model	Not in Model	Not in Model	Not in Model	Not in Model	Not in Model	Not in Model	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Dimensional Tolerance	Count	Dimensional Tolerance	Dimensional Tolerance	Count	Dimensional Tolerance	
3							O	O	O	O	O	O	O	O	O	O	O	O	O	S	S	S	S	A	A	A	A	A	A	S	S	S	S	A	A	A	A	A	A	A	A	A	
4					Constrained by		Code/Covenance Requirements	Business Plan	Site Selection	Survey E.C Natural & Manmaid	Program	Performance Spec	Design Concept	System Capacity Requirements	Budget Cost & Schedule	Proforma	Arrange Financing	Preliminary Zoning Review	Land Acquisition	Foundation Bearing Elements	Caissons and Piles	Slab on Grade	Foundation Walls	Pads Pits & Trenches	Dock Pits	Floor Plates Definition	Floor to Floor Height Definition	Concept Elevation Design	Primary Structural Framing	Miscellaneous Framing - Arch	Miscellaneous Framing - Mech	Floor Decks	Roof Decks	Exterior Walls	Windows, Glass & Glazing	Exterior Doors	Flat Roofing	Sloped Roofing	Skylights	Interior Walls	Interior Doors	Interior Specialties	Interior Stairs		
5					Design & Engineer		A0100	A0101	A0102	A0103	A0104	A0105	A0106	A0107	A0108	A0109	A0110	A0111	A0112	A1010	A1020	A1030	A2020	A4010	A4020	B0101	B0102	B0103	B1010	B1010	B1010	B1020	B1030	B2010	B2020	B2030	B3010	B3020	B3030	C1010	C1020	C1030	C2010		
6		$0.00	1	Not in Model	O	Code/Covenance Requirements	A0100																																						
7		$0.00	2	Not in Model	O	Business Plan	A0101																																						
8		$0.00	3	Not in Model	O	Site Selection	A0102	X																																				
9		$0.00	4	Not in Model	O	Survey E.C Natural & Manmaid	A0103		X																																			
10		$0.00	5	Not in Model	O	Program	A0104	X																																				
11		$0.00	6	Not in Model	O	Performance Spec	A0105				X																																	
12		$0.00	7	Not in Model	O	Design Concept	A0106	X		X	X	X																																
13		$0.00	8	Not in Model	O	System Capacity Requirements	A0107	X	X			X	X	X																															

Leverage Revit Family Templates

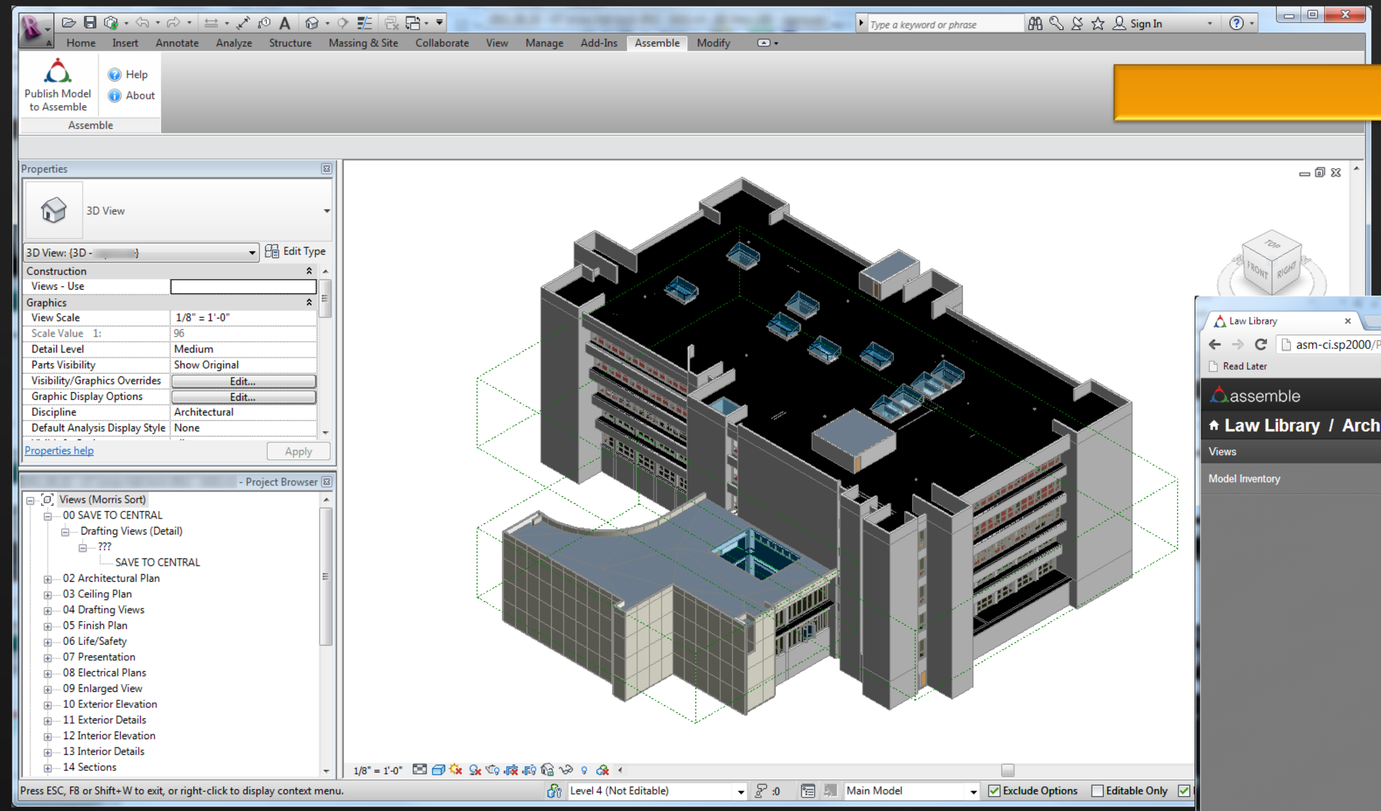
- Configured to Execution Plan requirements
- Eases QA\QC process
- Streamlines 4D & 5D downstream integration



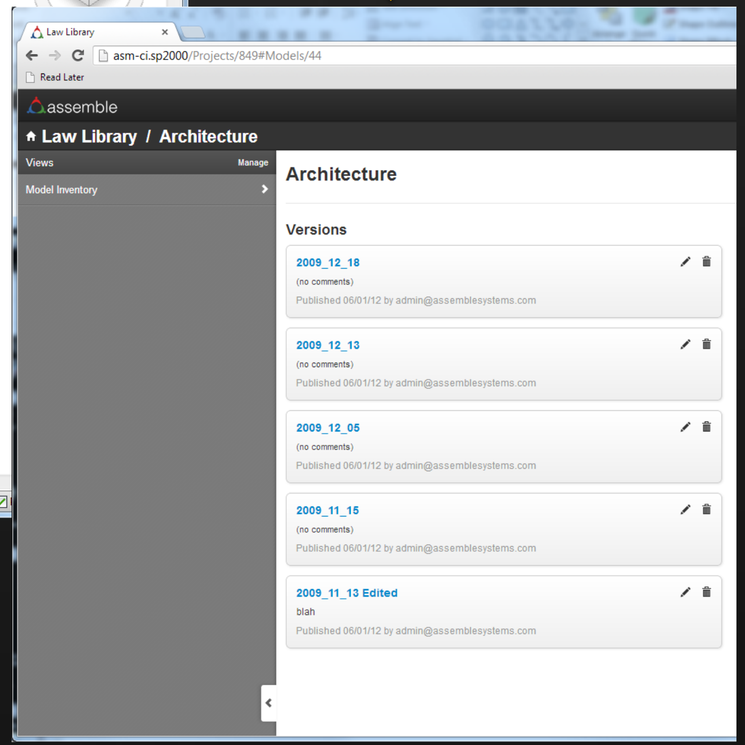


Revit Data Extraction
Powered by Assemble

Publishing Models and Revisions

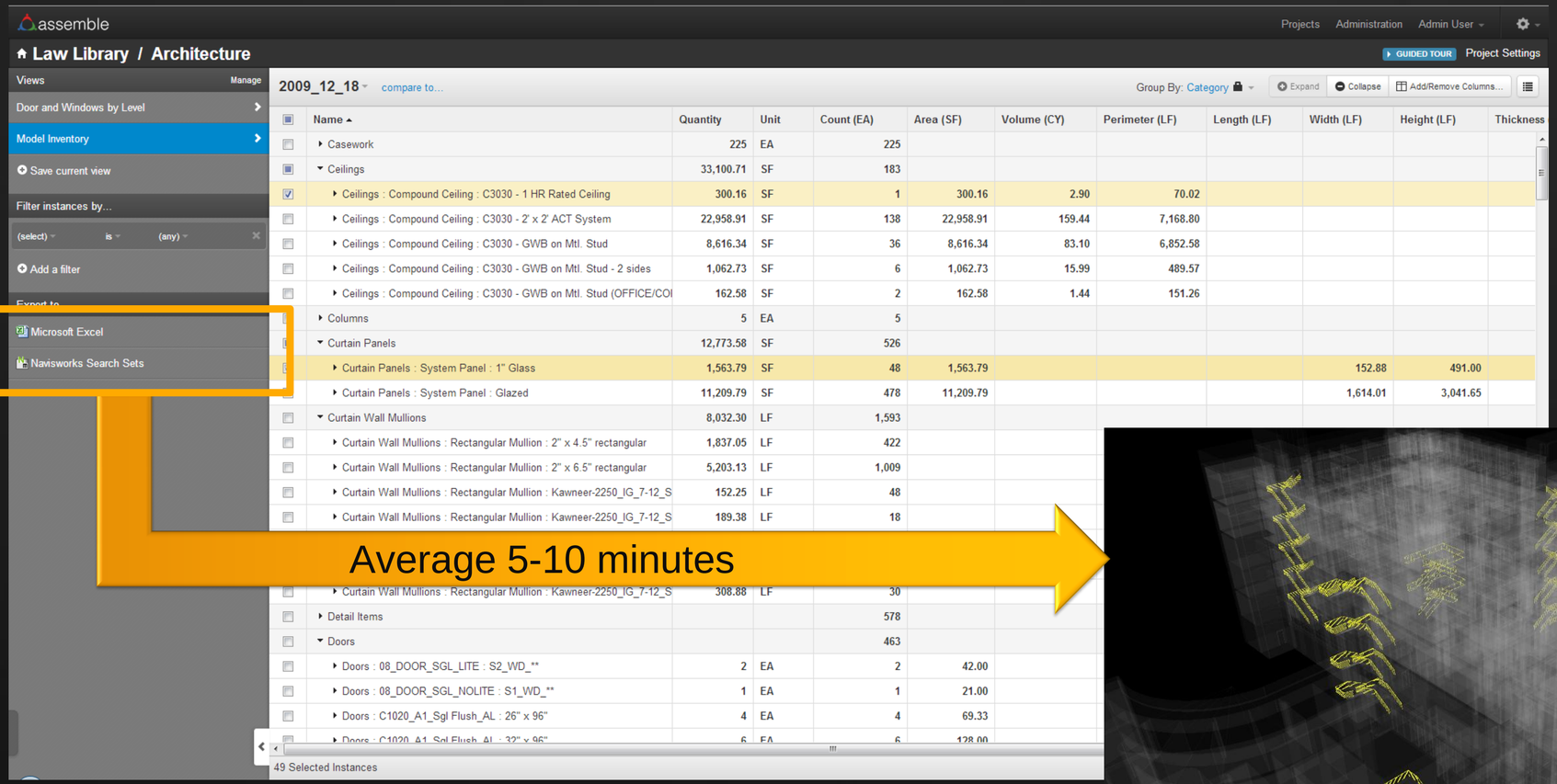


Complete inventory of 100MB model in 5 minutes

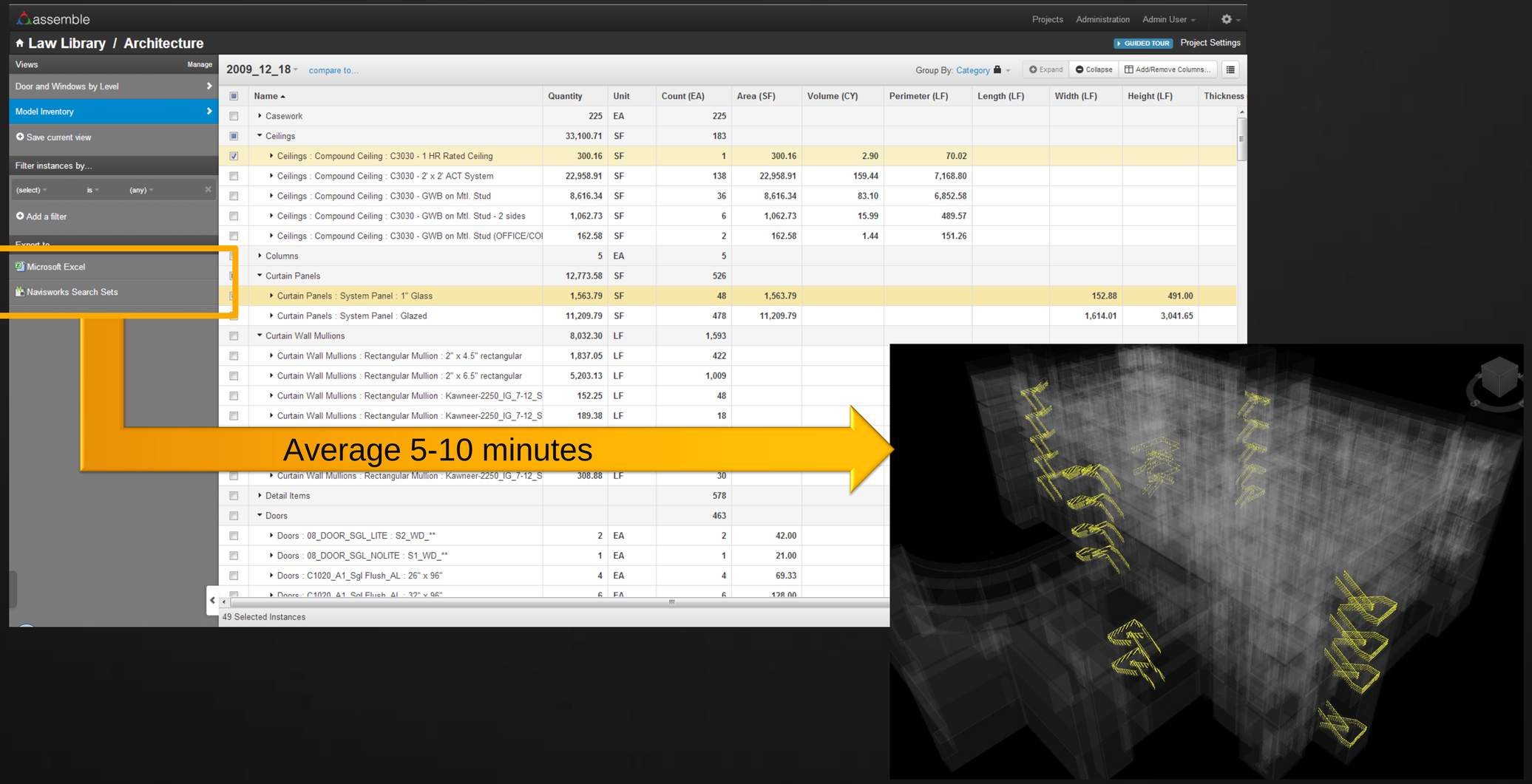


Opening model and Publishing to Assemble takes about 10 minutes. Assemble tracks each version for side-by-side comparisons.

Leveraging Model Inventories

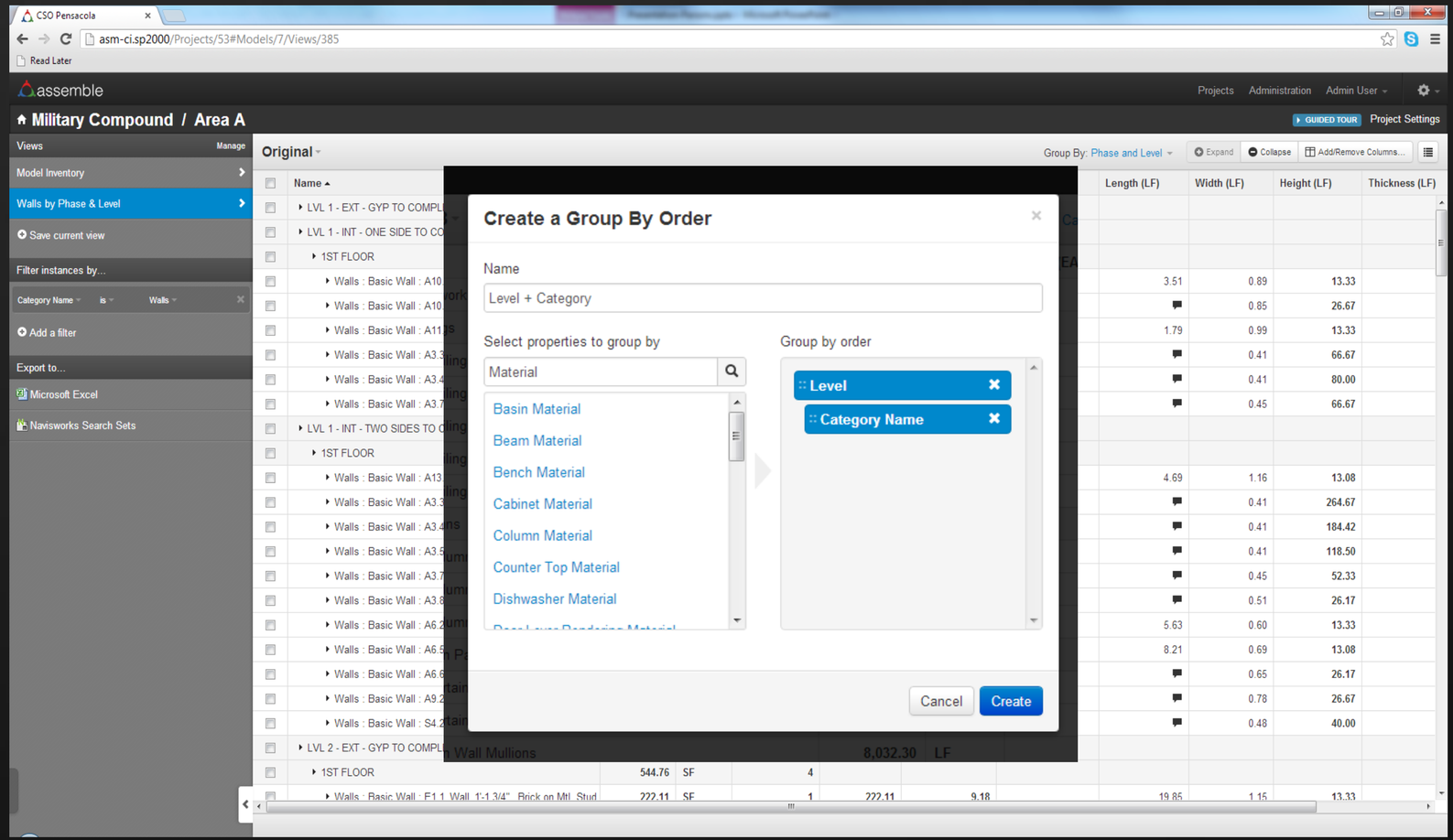


Components can be quickly isolated into specific studies or complete model takeoffs can be compiled. Navisworks Search Sets are created representing each item in the model for easy visualization.



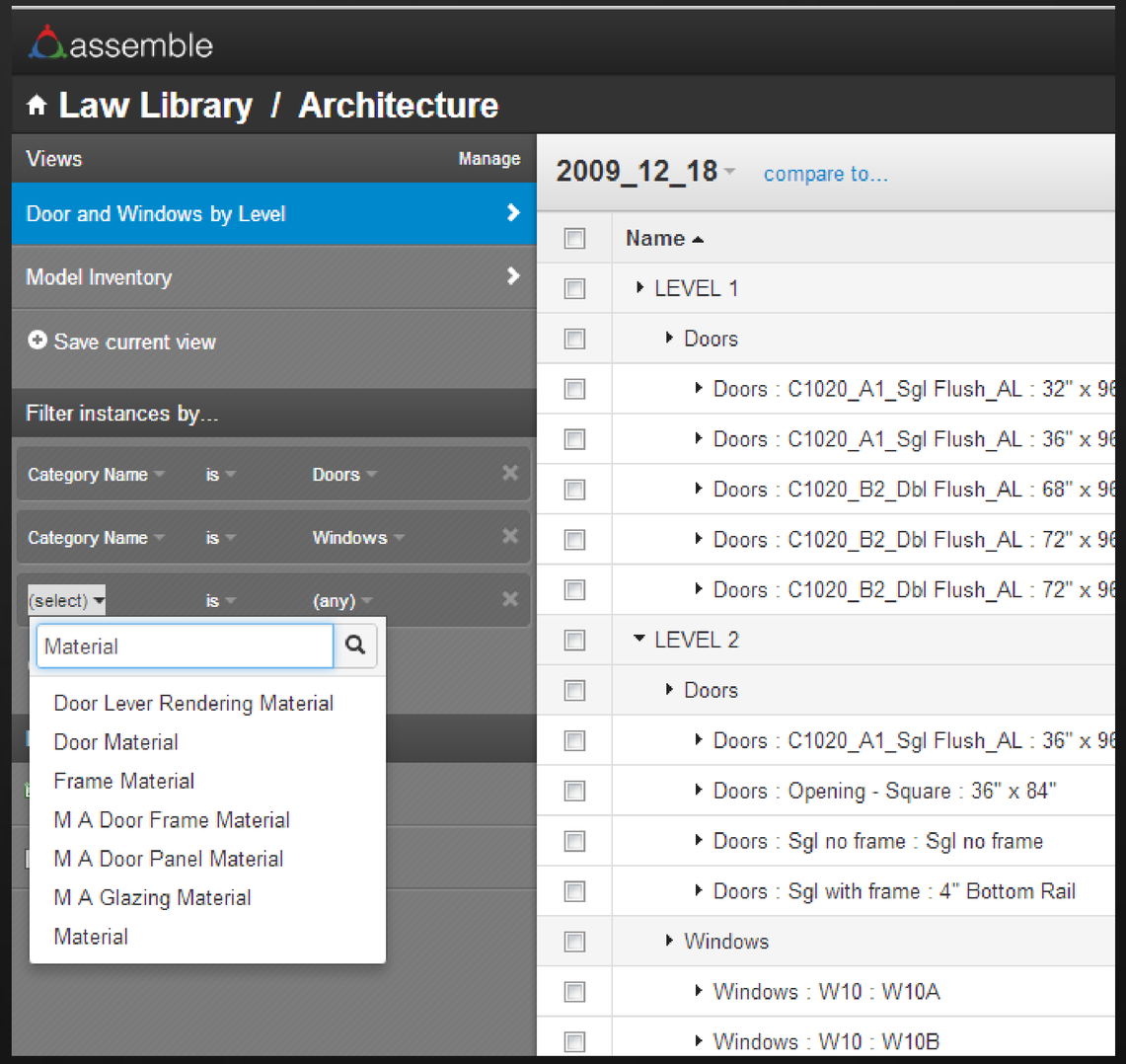
Making Sense of your Building Information

- Group by ANY property
  - Built-in or User-defined
- Examples
  - By Level & Category
  - By Room & Space
  - By MEP System
  - By Work Breakdown
    - *Assembly Code*
    - *Keynote*
    - *Omniclass*

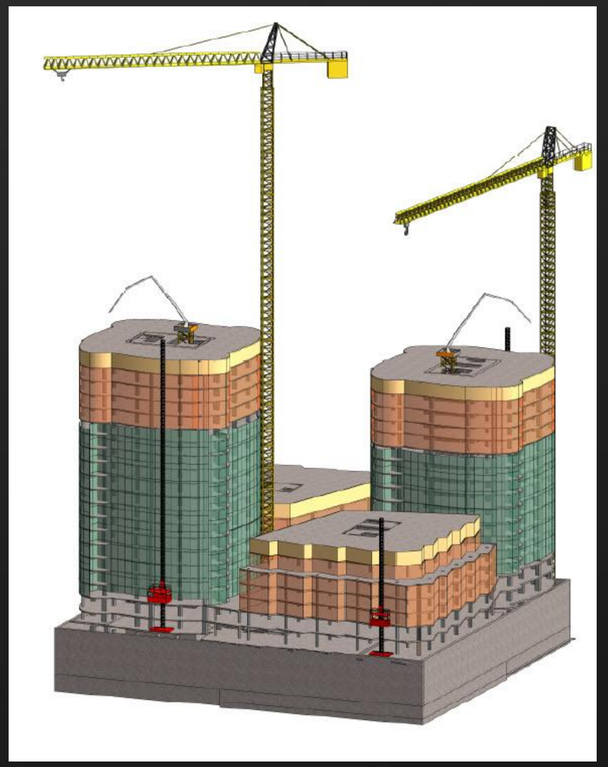


Using Smart Filters to Focus and Collaborate

- Focus on specific studies of your project
- Filter on any property, including Quantities and Text
- Create custom views you can reference for future revisions
- Quality Check your models
- Create custom reports you can share with other stakeholder
- Produce search sets that simplify clash detection and coordination



Visually Comparing Model Versions

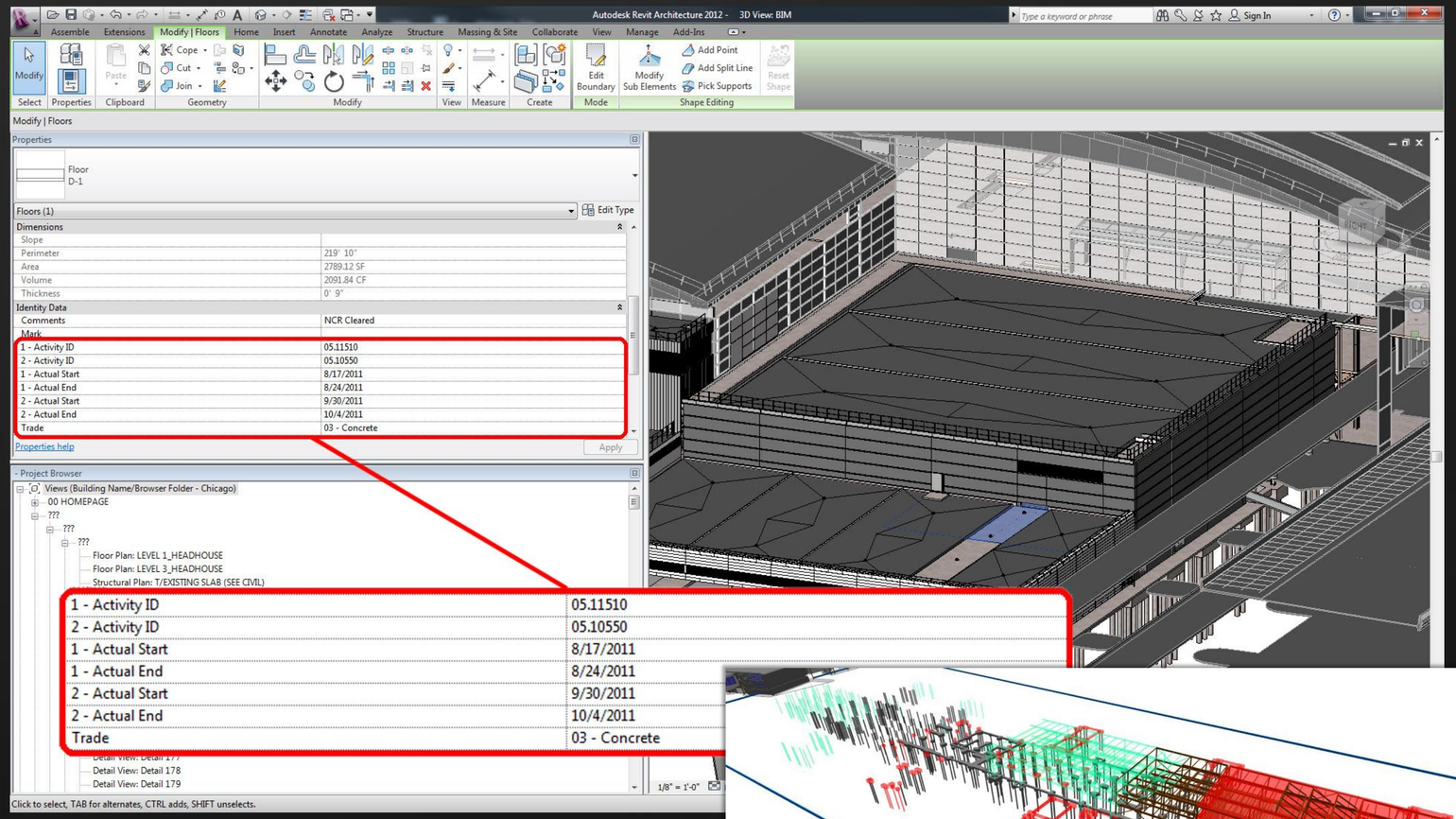


Overlaying Versions to Reveal Changes

Benefits of Rapid Data Extraction

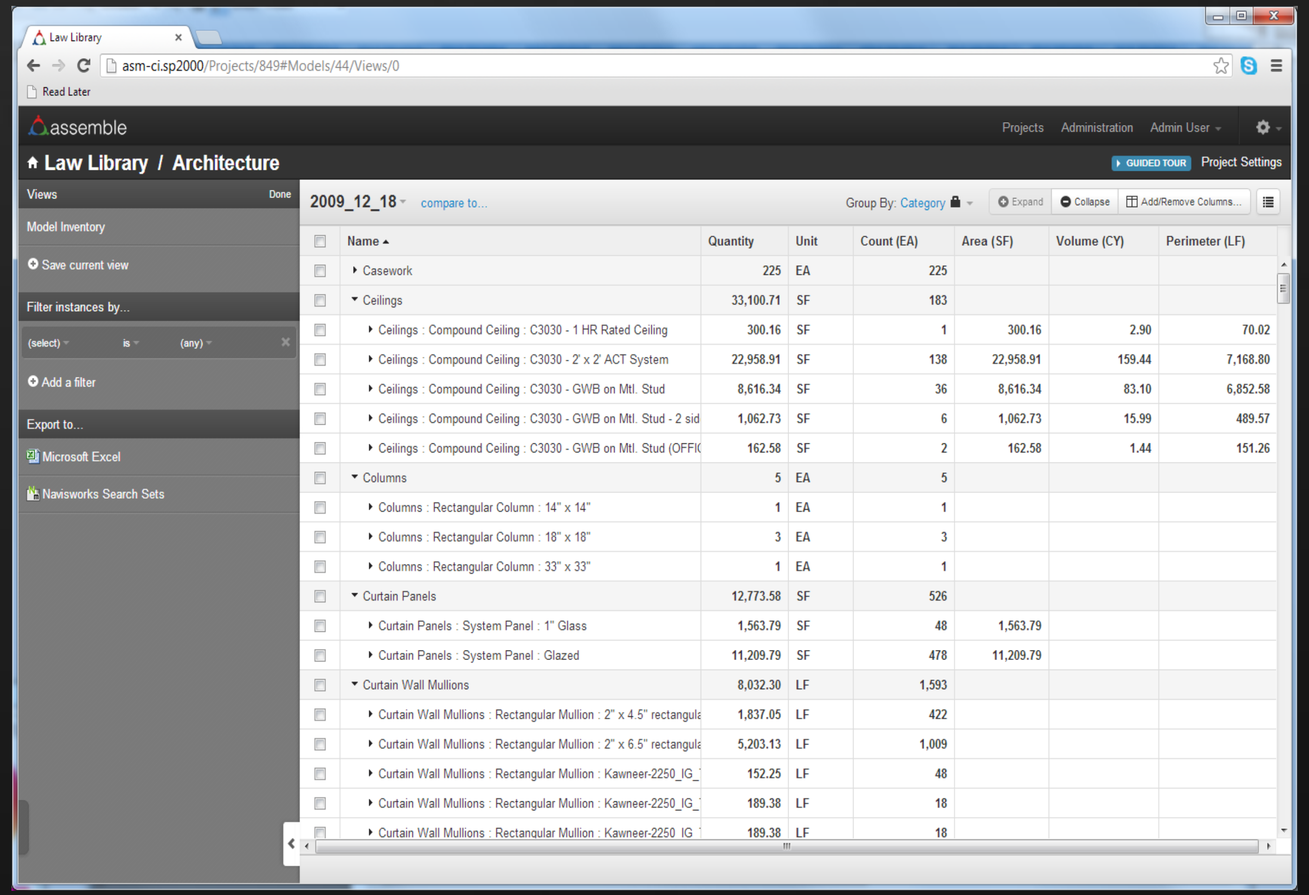
Taking Advantage of Revit Shared Parameters

- Naming Conventions
  - Used for QA\QC
- Classification Systems
  - Used for Cost and Schedule
  - UniFormat (Assembly Code)
  - MasterFormat (Keynote)
  - Omniclass
- Scheduling
  - Activity Codes
  - Actual Start
  - Actual Complete



Working with the Revit API

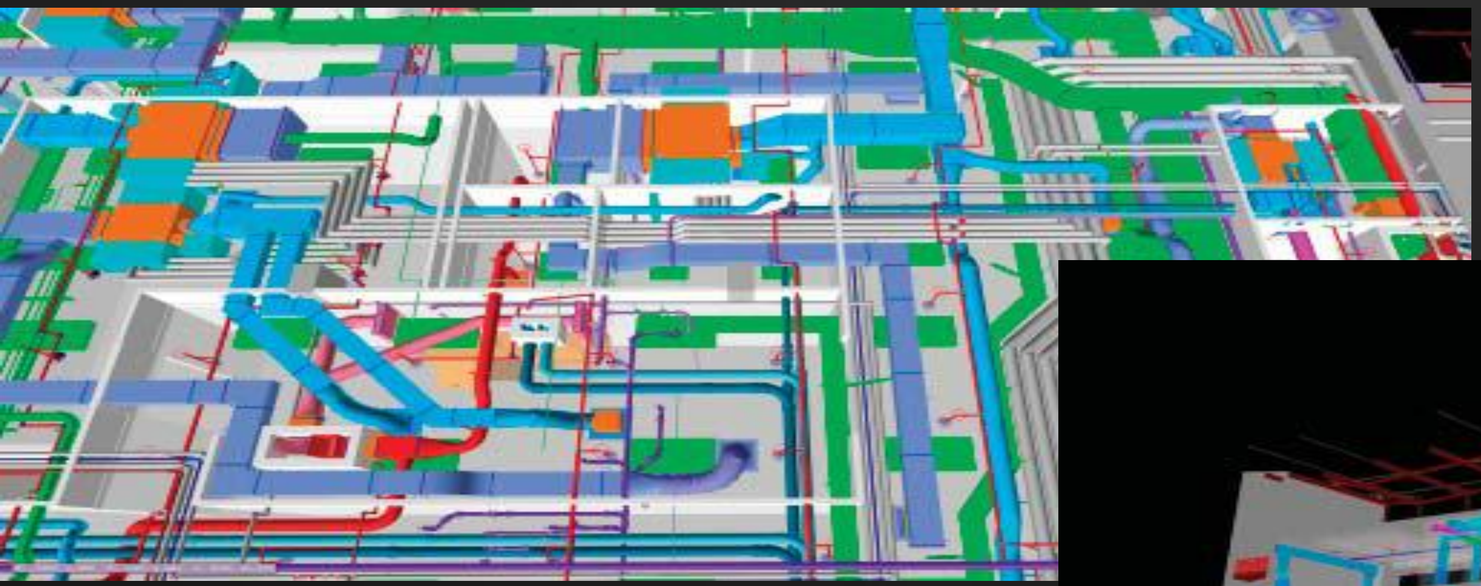
- Easy to learn, hard to master
- Why?
  - *Not thoroughly documented*
  - *Documentation for what parameters exist for each category is non-existent*
  - *Dozens of project units*
- Our approach is heuristic
- Our approach is comprehensive
  - Includes built-in parameters
  - Includes user-defined parameters

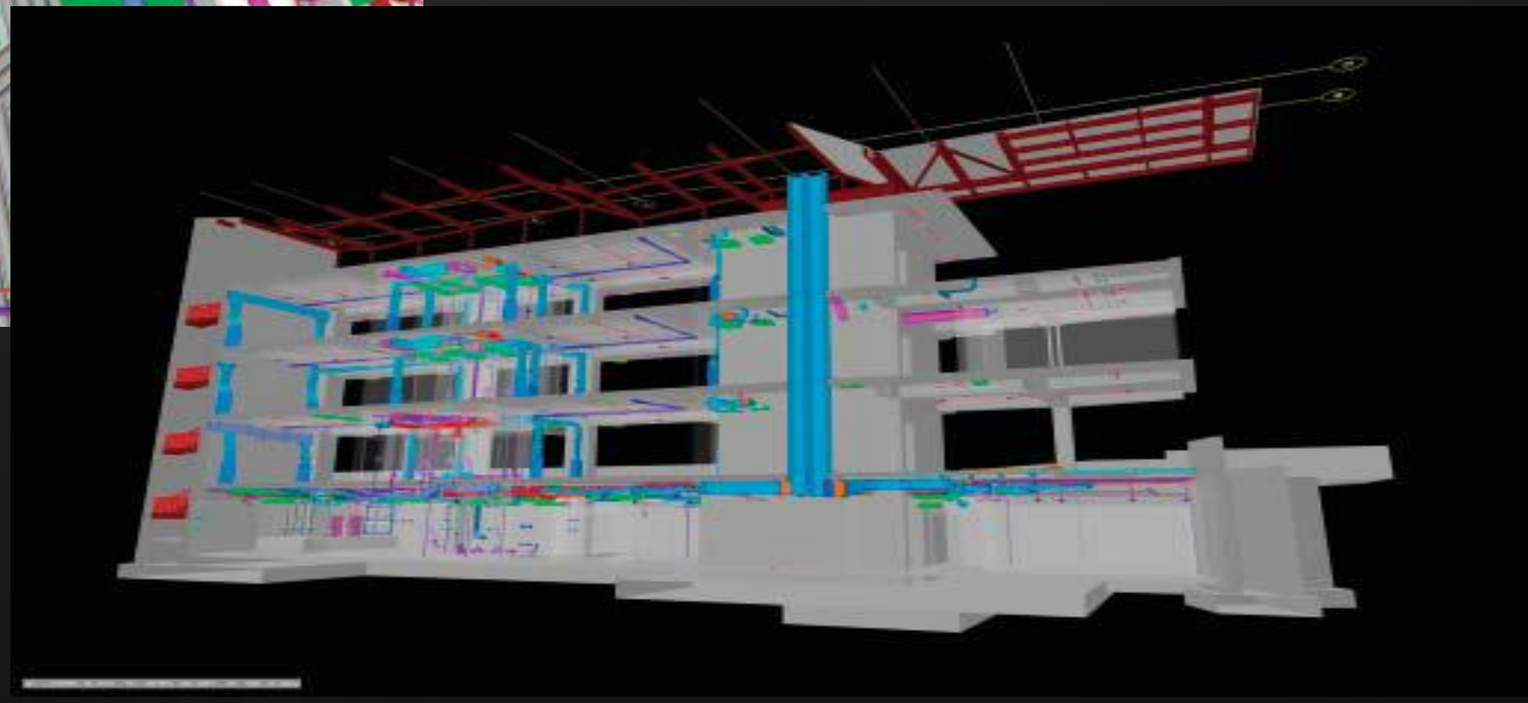


Downstream Uses

Model QA/QC

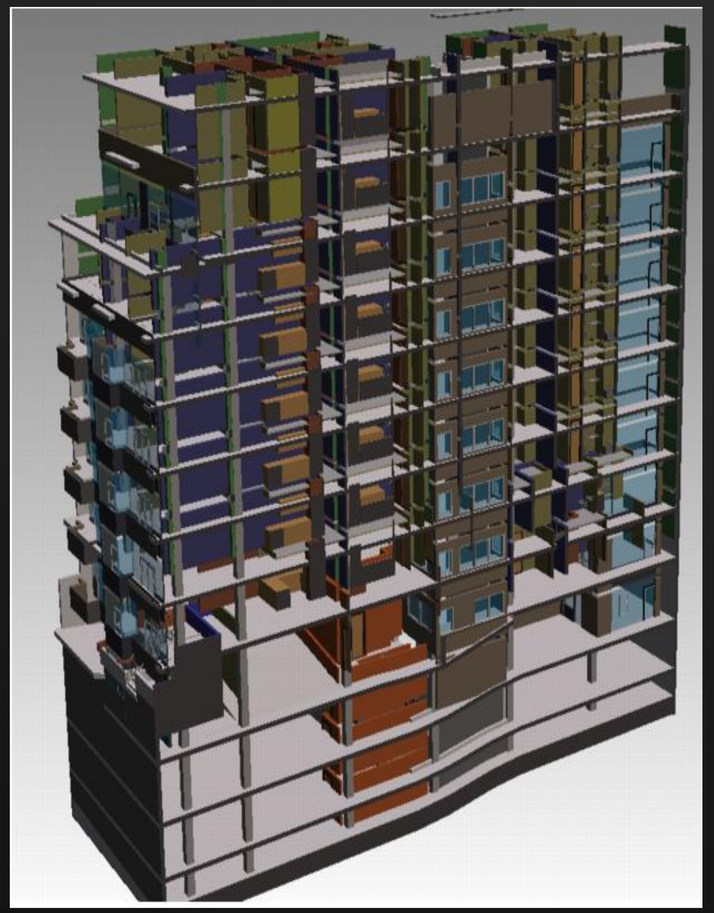
Clash Detection, Constructability and Coordination





University of California,
San Diego Housing & Dining
Administration Building

5D Estimating

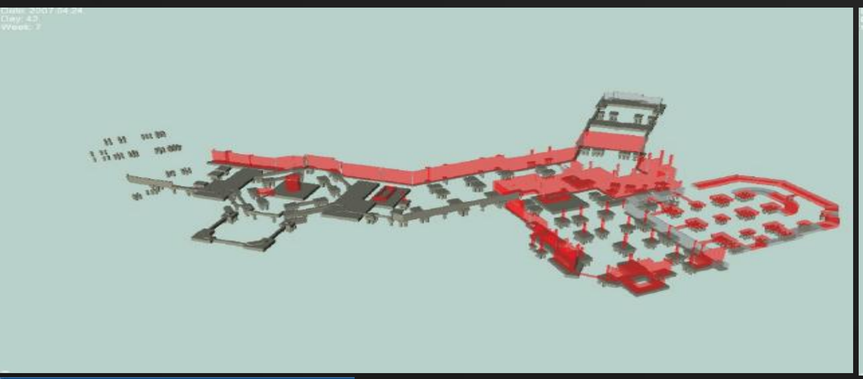


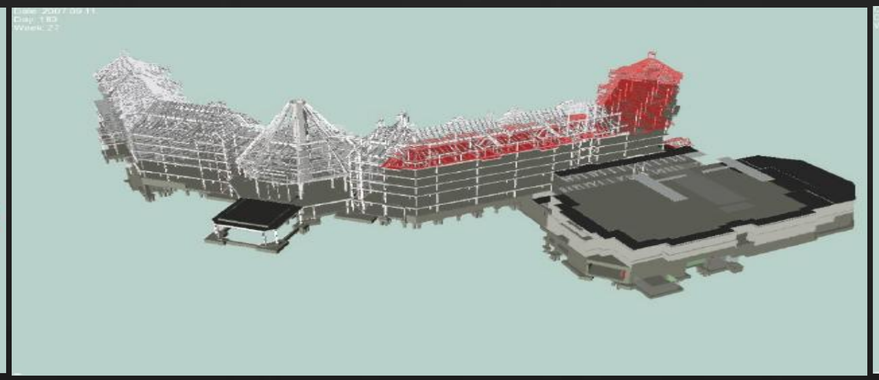
Concrete Estimate

Structures and Quantities | Recipes | Methods | Resources

Code	Specification	Quantity Unit	USD/Unit	USD	Hours
B	**SHELL**			**102 301 675.92**	
B10	**SUPERSTRUCTURE**			**74 544 833.01**	
B1010	**Structure**			**26 124 737.36**	
B1010 B1010.2101	**Prcst Beam 30ft**	**197 997.94 cf**	**44.97**	**8 904 660.35**	**0.00**
03410.00 1002	**Precast Beams 30ft Span (PreCast Structure)**	**7 333.25 cy**	**1 214.29**	**8 904 660.35**	**0.00**
3 03410.0002	Precast Beams 30ft Span (PreCast Structure)	10 476.07 cy	850.00	8 904 660.35	
B1010 B1010.2110	**Precast Column**	**290 589.09 cf**	**59.26**	**17 220 077.00**	**0.00**
03410.00 1008	**Precast Columns 12ft (PreCast Structure)**	**10 762.55 cy**	**1 600.00**	**17 220 077.00**	**0.00**
3 03410.0008	Precast Columns 12ft (PreCast Structure)	16 557.77 cy	1 040.00	17 220 077.00	
B1020	**Floor Decks**			**48 420 095.65**	
B1020 B1020.1200	**Slab on Deck-Cmposit**	**1 291 023.30 cf**	**37.51**	**48 420 095.65**	**0.00**
03210.92 1001	**Concrete Reinforcing (Slab on Composite Deck)**	**71 006 281.50 lb**	**0.55**	**39 053 454.83**	**0.00**
3 03210.9201	Concrete Reinforcing (Slab on Composite Deck)	35 503.14 ton	1 100.00	39 053 454.83	
03310.00 1017	**3500 psi Concrete Material (Slab on Compsite Deck)**	**47 815.63 cy**	**72.00**	**3 442 725.36**	**0.00**
2 03310.0017	3500 psi Concrete Material (Slab on Composite Deck)	47 815.63 cy	72.00	3 442 725.36	
03315.00 1024	**Place SOD w/Pumped Concrete (Slab on Compsite Deck)**	**47 815.63 cy**	**20.50**	**980 220.41**	**0.00**
3 03315.0024	Place SOD w/Pumped Concrete (Slab on Composite Deck)	47 815.63 cy	20.50	980 220.41	
03315.00 1025	**Finish Slab on Deck (Slab on Compsite Deck)**	**1 936 534.50 sf**	**0.65**	**1 258 747.43**	**0.00**
3 03315.0025	Finish Slab on Deck (Slab on Composite Deck)	1 936 534.50 sf	0.65	1 258 747.43	
05310.72 1010	**Composite Deck 20 Ga 2.0in (Slab on Compsite Deck)**	**1 936 534.50 sf**	**1.75**	**3 388 935.38**	**0.00**
3 05310.7210	Composite Deck 20 Ga 2.0in (Slab on Composite Deck)	1 936 534.50 sf	1.75	3 388 935.38	

4D Scheduling, Sequencing, and Phasing



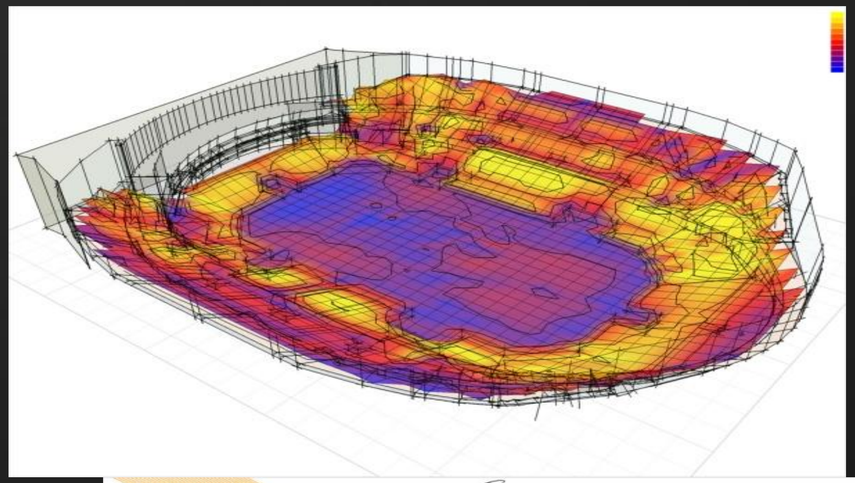


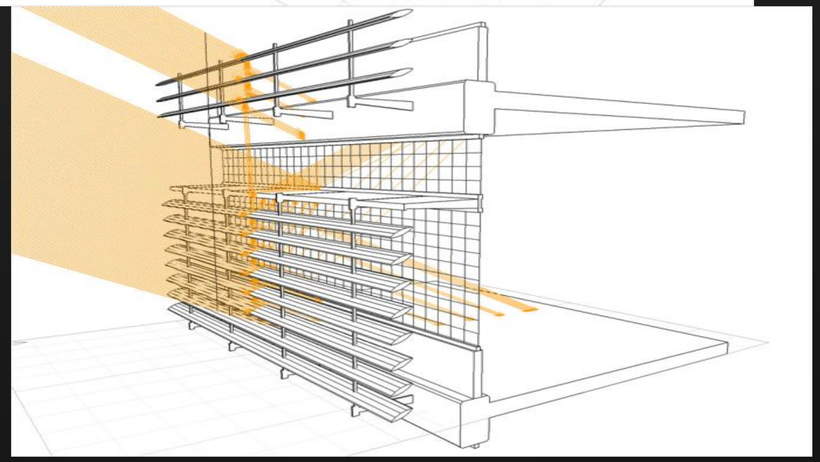
SWINERTON BUILDERS

Historical Trend Analysis

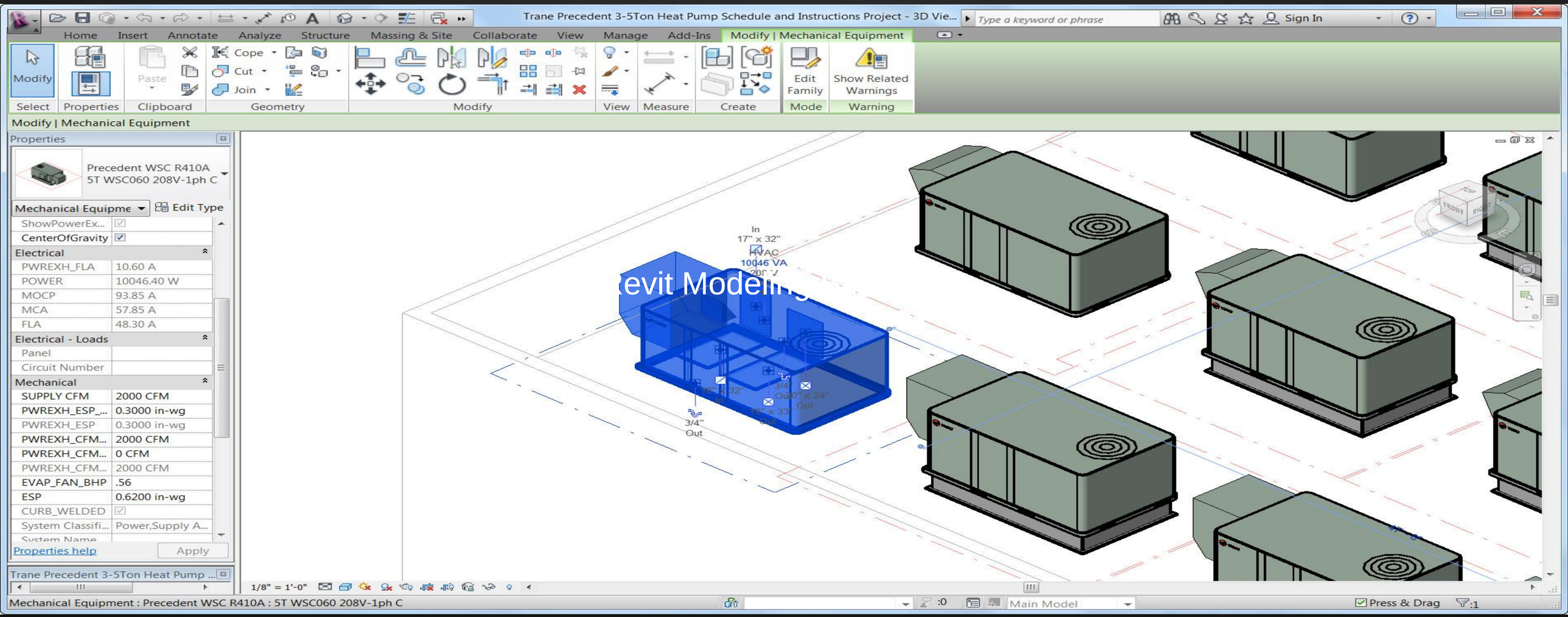
Energy Modeling & Analysis

- Energy analysis can be performed on a 3D model during conceptual design
- Design changes can be made early in order to optimize energy usage
- Architect and MEP engineer work collaboratively early in the design process rather than later
- Energy analysis is now a science
- Different building systems and loads impact each other and overall building performance.
- Building design and energy analysis data can now be linked





6D BIM-Operations



Conclusion and Summary

Thank you