Scheduling & Estimating Integration

—5D BIM Case Study

CLAYCO

Tomislav Zigo, AIA, CM-BIM, LEED AP+C, Vice President of VDC
Liang Gong, PE, PMP, LEED AP+C, VDC Engineer

AUTODESK. UNIVERSITY

About the speaker

Tomislav Zigo
Vice President, VDC
Clayco inc.
St. Louis, Missouri, United States

Over the past two decades Tomislav has been an advocate of digital technology implementation as a researcher, designer and over past six years as a designer - builder. His experience includes work in the vanguard of BIM methodology implementation on large healthcare, institutional and industrial projects; research work in the field of Building Performance Analysis; optimization and use of mobile and immersive technology and mentorship positions in a number of local and national architectural firms during their transition toward BIM adoption. Currently he leads Clayco's VDC department and teaches at Washington University in St. Louis.

About the speaker

Liang Gong
VDC Estimator/Engineer
Clayco
Chicago, Illinois, United States

Liang works as a VDC Estimator/Engineer at Clayco. Liang works directly with the company's preconstruction/estimating department and VDC to develop accurate detailed project takeoffs and utilizes various programs to assist with other aspects of our business as needed including project management, BIM development and coordination, 3 dimensional detail production and coordination with development of 3D models. Liang reviews and verifies accuracy and completeness of all project documents received and also analyzes and reviews bids, constructability review, and value engineering analysis for all projects received. Liang got his Master of Engineering Management degree from Duke University and Bachelor in Civil Engineering degree from Tianjin University, China.

Contents

- Clayco and its current estimating platforms
- Logistics Tracking: Equipment Sets working with Dynamo
- VICO 5D demo for a healthcare project: Top down method
- VICO 5D demo for a residential project: Bottom up method
- Design versions comparison modes
- One click takeoffs for a structural model
- From Rhino to VICO
- Customized reporting template
- Estimating Platform Integration

VICO

Revit

P6

VSP

Procurement

Cash Flow

Architects

Schedulers

Uniformat

Rhino

Resources

Risks

Dynamo

Monte Carlo Simulation

BIM 360 Glue

BIM 360 Field

Naviswork

Estimators

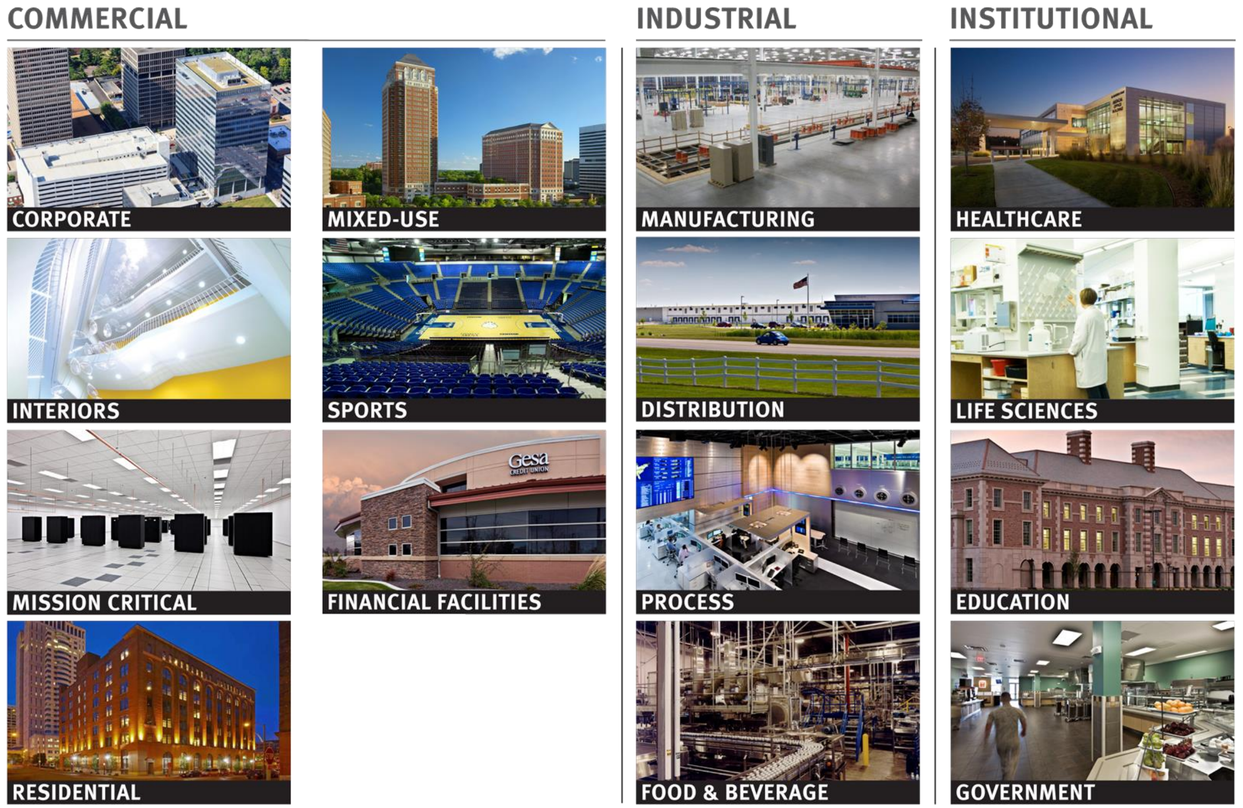
SQL

Python

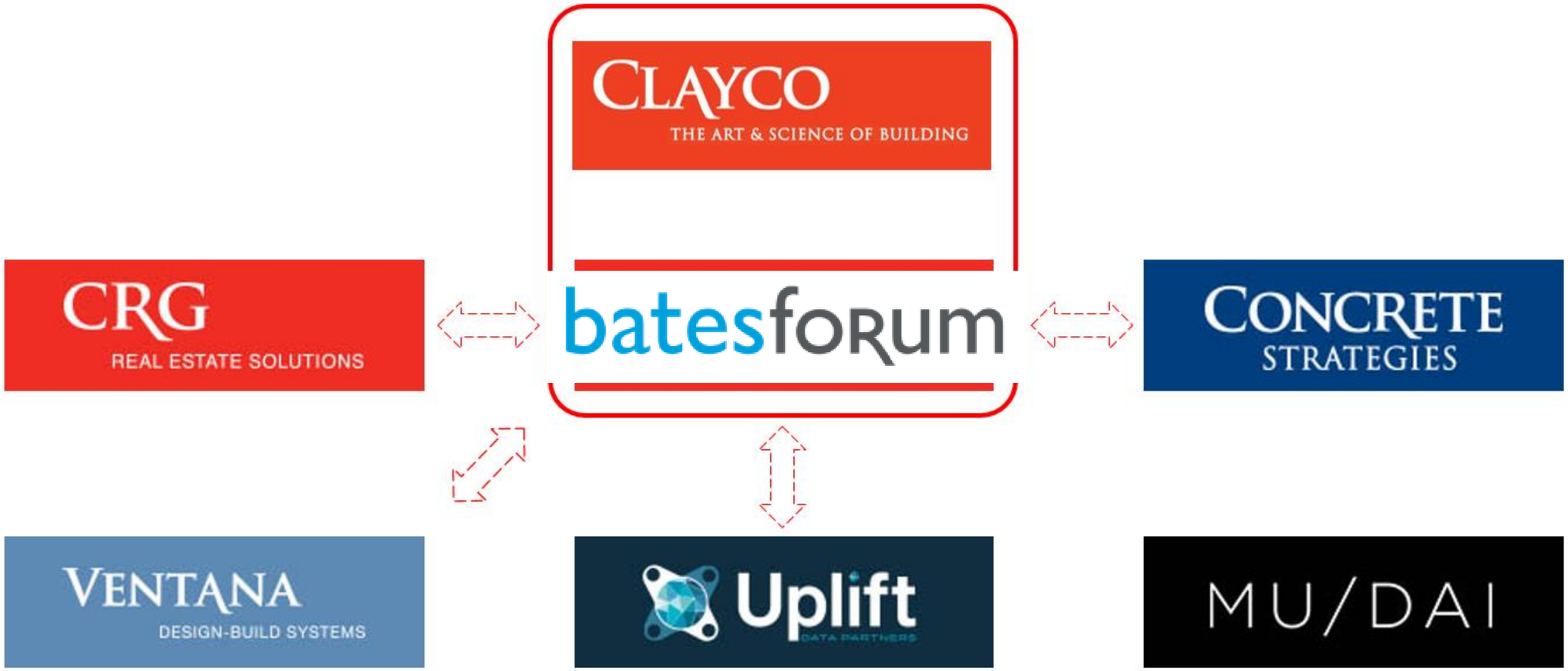
Barcode

Clayco

- Headquartered in Chicago
- Founded in 1984 as a Design-Build Contractor
- Revenue of over $1.5B for 2016, $1.8B in 2017
- ENR top 400 Contractors 2017 Rating #22
- Approximately 1800 employees
- National Diversification of Project Types
- Over 70 LEED Accredited Professionals / 45 LEED Certified Projects



Clayco - Structure

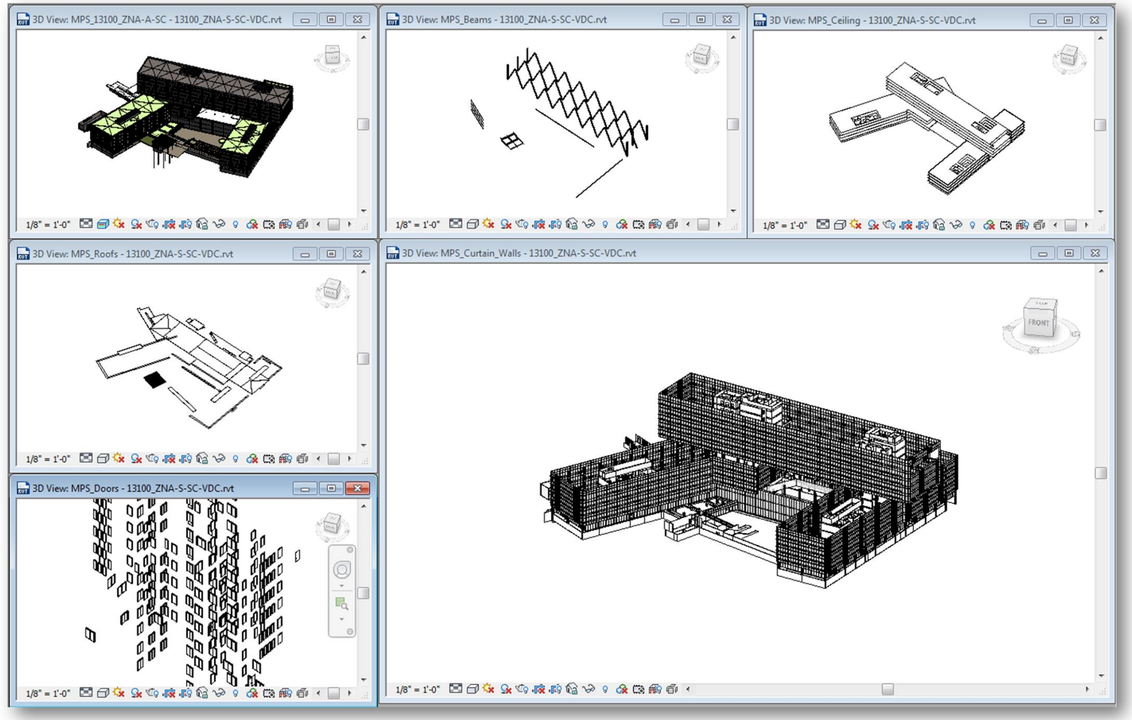


Clayco Approach

- Determine clear objectives
- Recognize main participants
  - Architects / Engineers
  - Pre-Con
  - VDC
- Adopt standards (Uniformat, OmniClass, LOD requirements)
- Identify collaboration nodes (Clayco entities)
- Have the sense of urgency
- Establish transparency
- Sharing results / work product

Feedback Loop

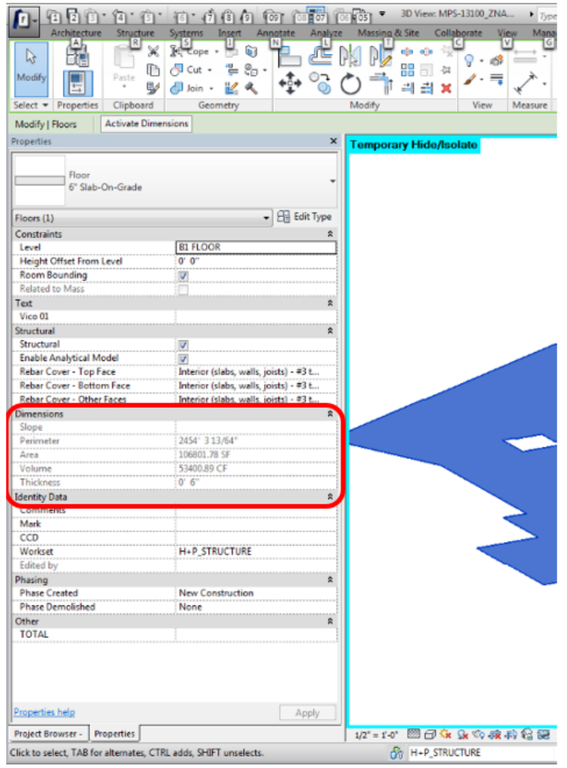
- Design team is working with building assemblies
- Associating family / type with the corresponding assembly code
- Maintaining consistency from project to project..
- Determining which Revit property needs to form the unique identifier
- Develop estimate centric design template
- Accompanied with the content plan development
- Heavy reliance on worksets and filters

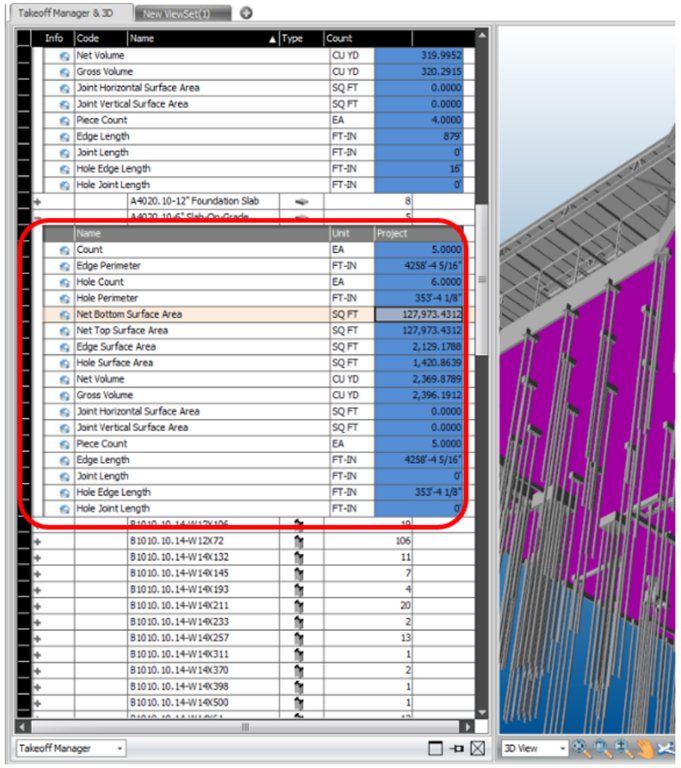


Name	Visibility	Projection/Surface			Cut		Halftone
		Lines	Patterns	Transparen...	Lines	Patterns	
A1020.10-DRIVEN_PILES	☑						☐
A1020.15-BORED_PILES	☑						☐
A1020.80.10-GRADE_BEAMS	☑						☐
B1010.10.23-BEAMS	☑						☐
B1010.20.60-DECKING	☑						☐
A1010.10.21-FOUNDATION	☑						☐
A4020.10-SOG	☑						☐
A1020.70-PILECAPS	☑						☐
B1010.10.11	☑						☐
B1010.10.14-COLUMNS	☑						☐
B1010.10.31-DIAGONAL_B...	☑						☐

Building Trust

- Architect and Engineers can build great models!
- Estimating is an art – form
- Every project is different
- Our templates are not IP (share)
- Trust but verify – twice at least
- Communicate
- Abandon “gotcha” approach
- Be transparent
- No software is perfect





Herding Cats

https://www.youtube.com/watch?v=hx1jdgTs03U “Best Cat Commercials EDS Cat Herders” from YouTube

Laws

Rules

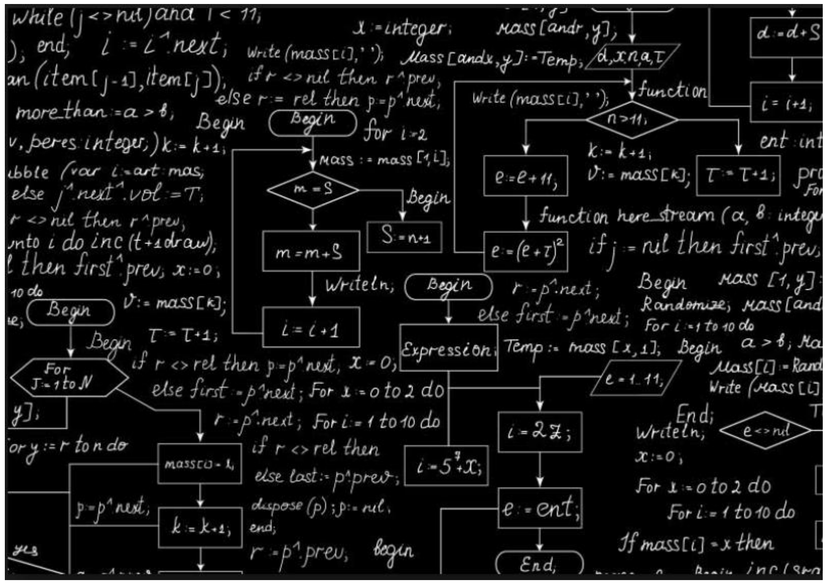
Systems

Automation

Logics

Algorithms

https://www.foodallergy.org/life-with-food-allergies/newly-diagnosed/laws-and-regulations



https://priestlandscomputing.com/algorithms-2/

To *think* as a VDC engineer

Integrate Logistics_Equipment Sets: Asset management

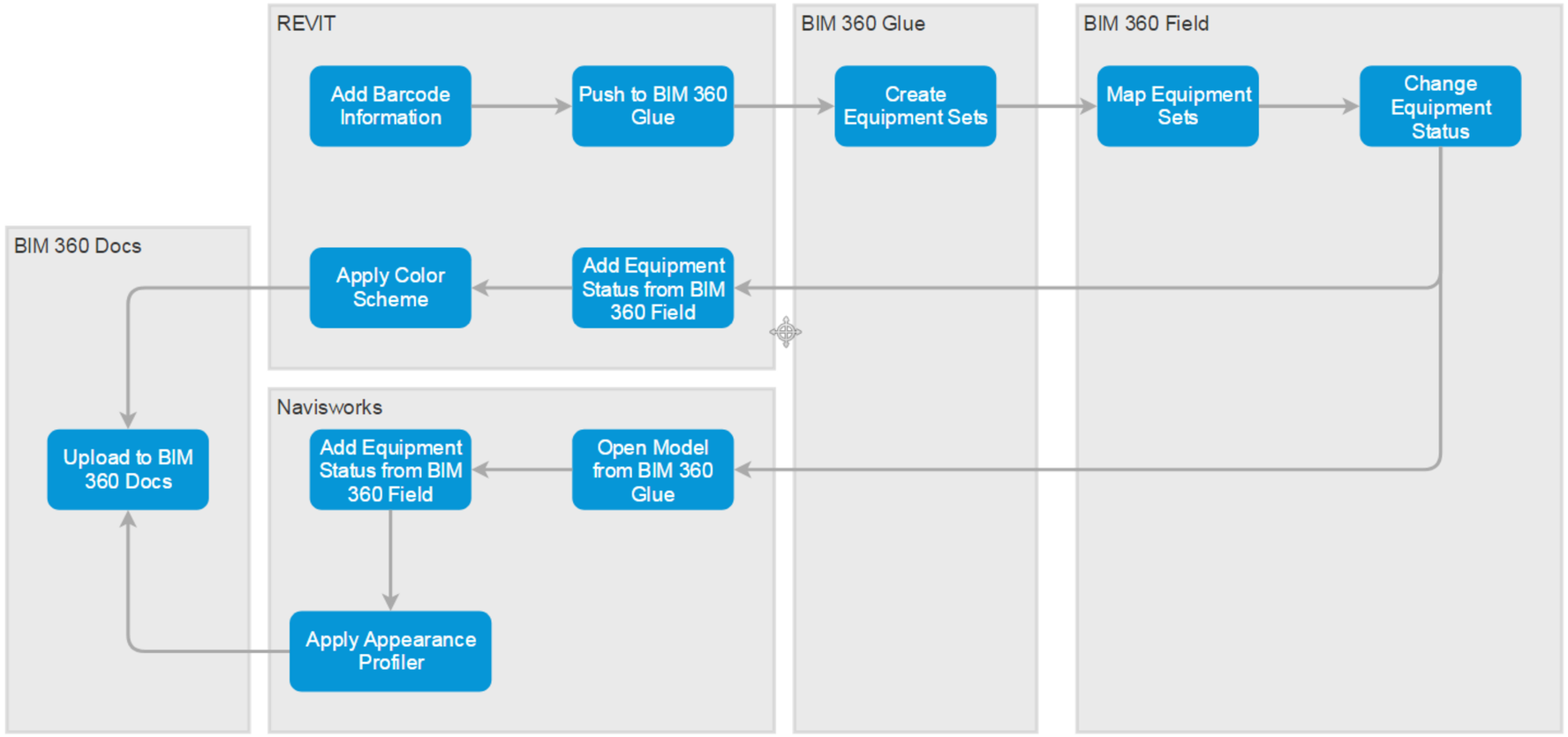
Integrate Logistics_Equipment Sets: Rooms into 5D Process

Question 1: How to search Rooms in Revit?

Question 2: How to stand in center of a room when using “Show in Model”? (Out of a surprise)

Integrate Logistics_Equipment Sets: Rooms into 5D Process

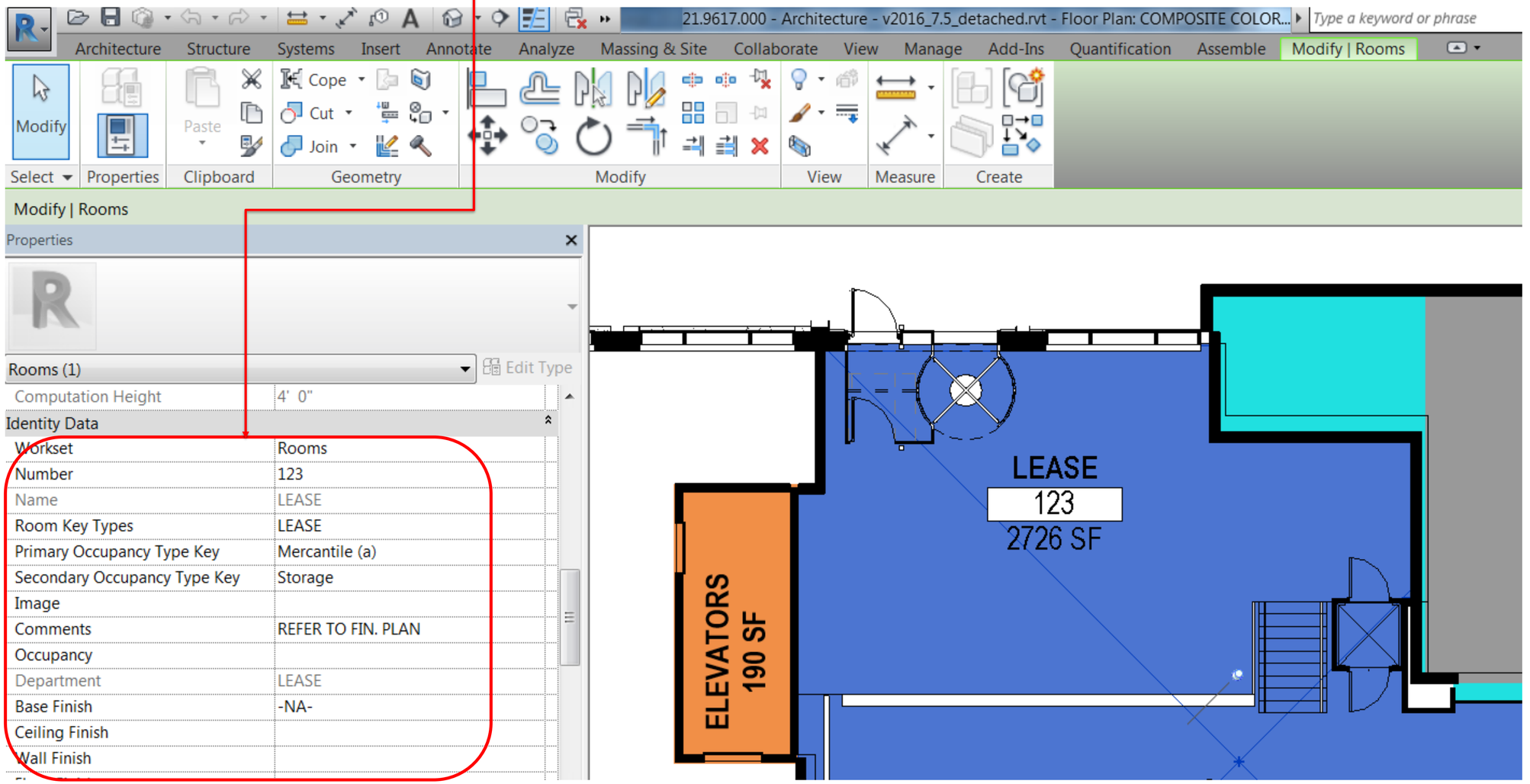
Question 1: How to integrate Barcodes into Revit?



Integrate Logistics_Equipment Sets: Rooms into 5D Process

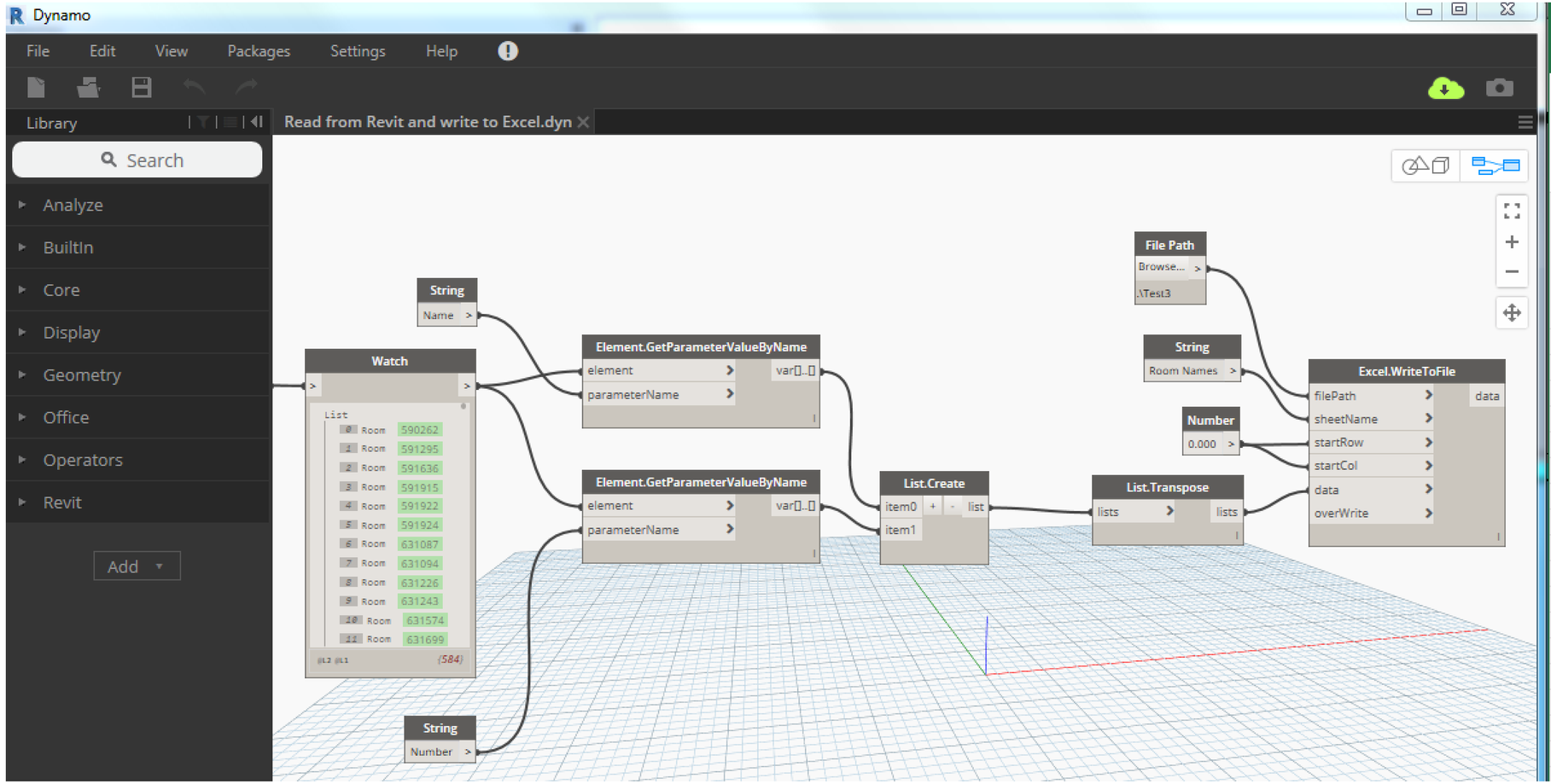
Question 1: How to integrate Barcodes into Revit?

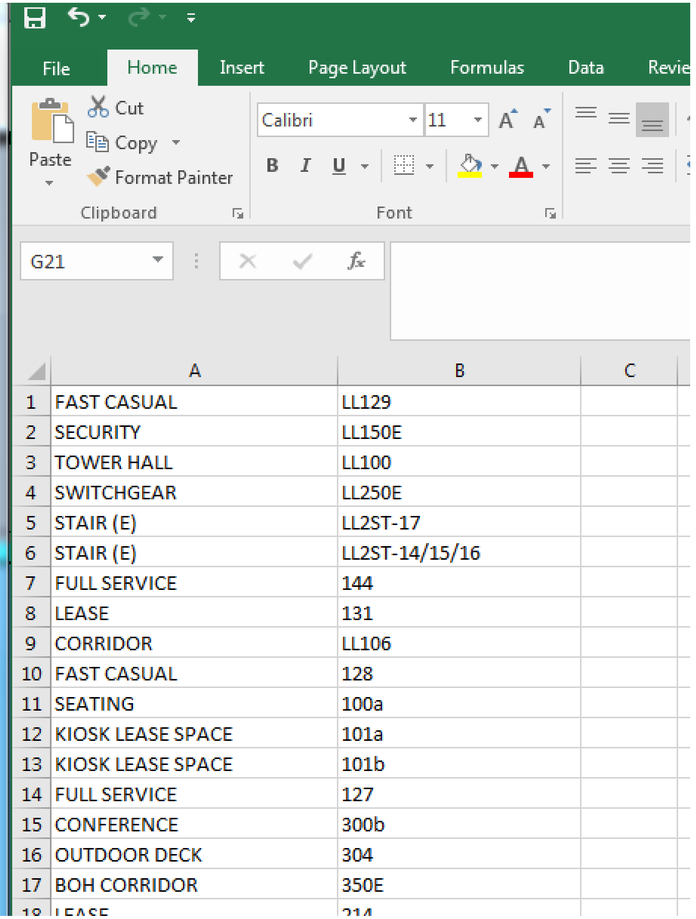
No Barcode information



Integrate Logistics_Equipment Sets: Rooms into 5D Process

Read from Revit and write to Excel – To grasp all the room information

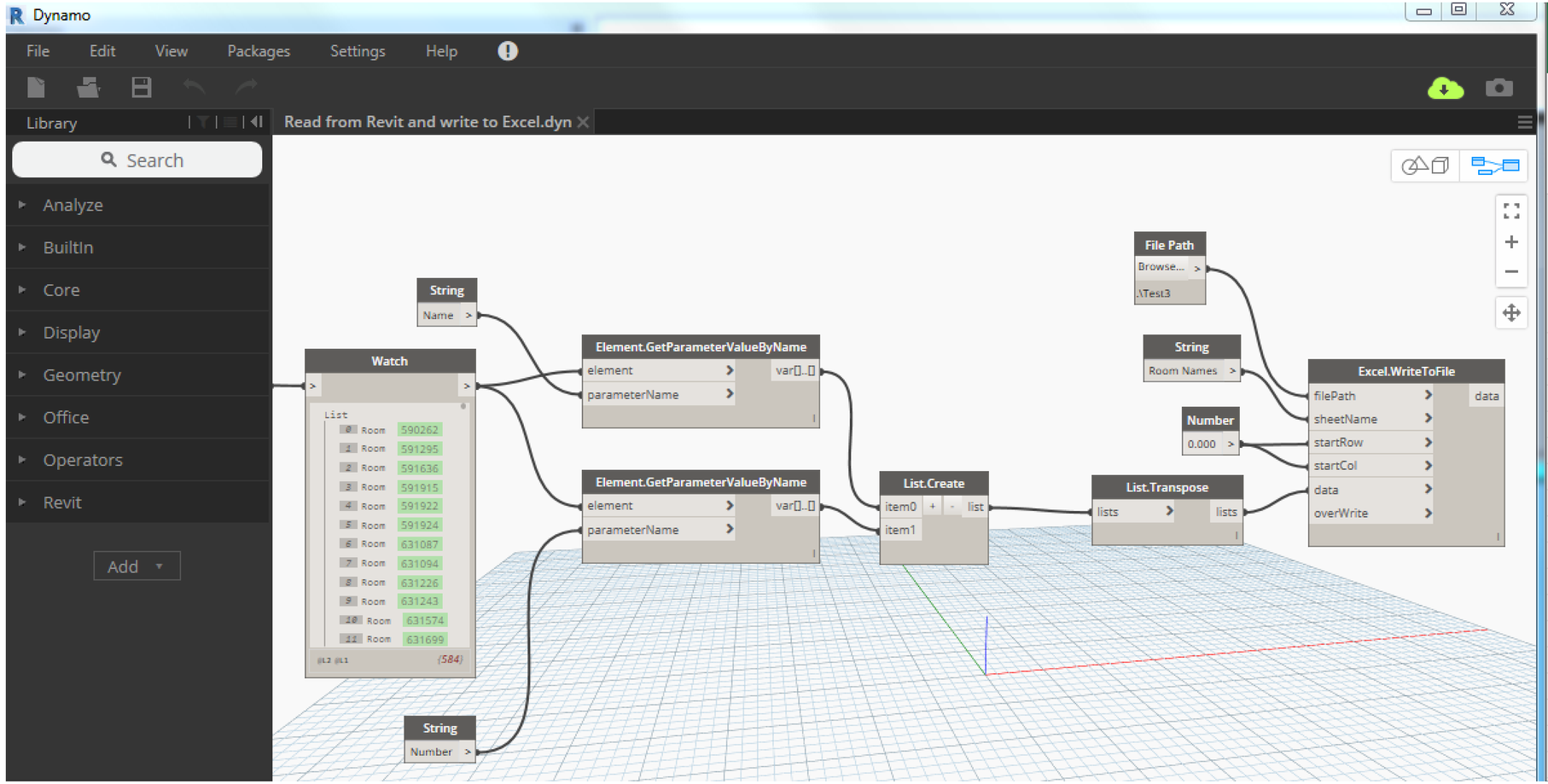


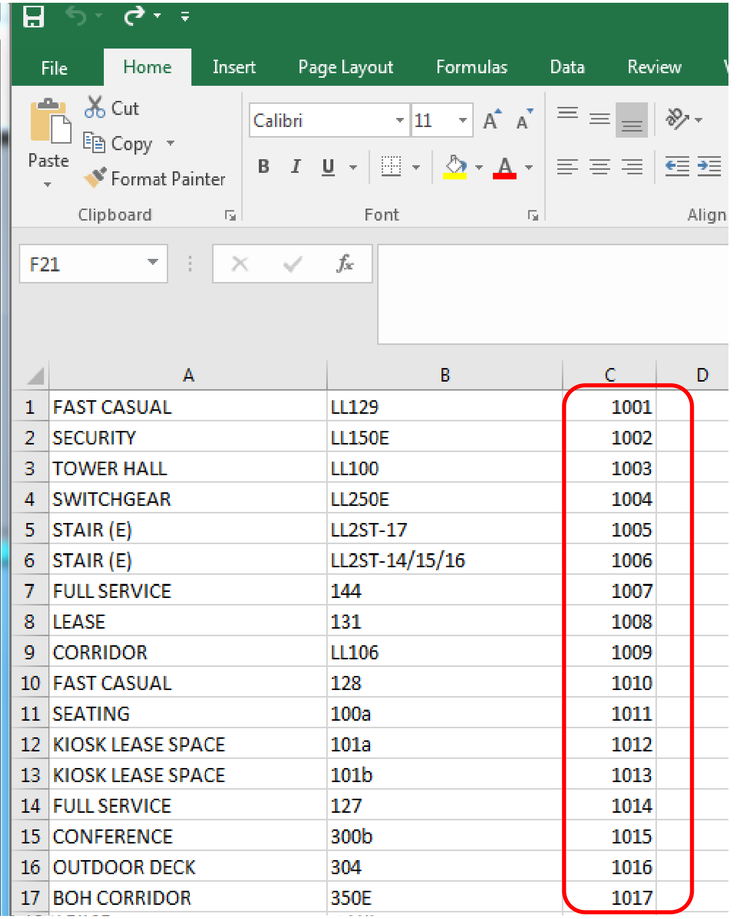


	A	B	C
1	FAST CASUAL	LL129	
2	SECURITY	LL150E	
3	TOWER HALL	LL100	
4	SWITCHGEAR	LL250E	
5	STAIR (E)	LL2ST-17	
6	STAIR (E)	LL2ST-14/15/16	
7	FULL SERVICE	144	
8	LEASE	131	
9	CORRIDOR	LL106	
10	FAST CASUAL	128	
11	SEATING	100a	
12	KIOSK LEASE SPACE	101a	
13	KIOSK LEASE SPACE	101b	
14	FULL SERVICE	127	
15	CONFERENCE	300b	
16	OUTDOOR DECK	304	
17	BOH CORRIDOR	350E	

Integrate Logistics_Equipment Sets: Rooms into 5D Process

Read from Revit and write to Excel – To grasp all the room information

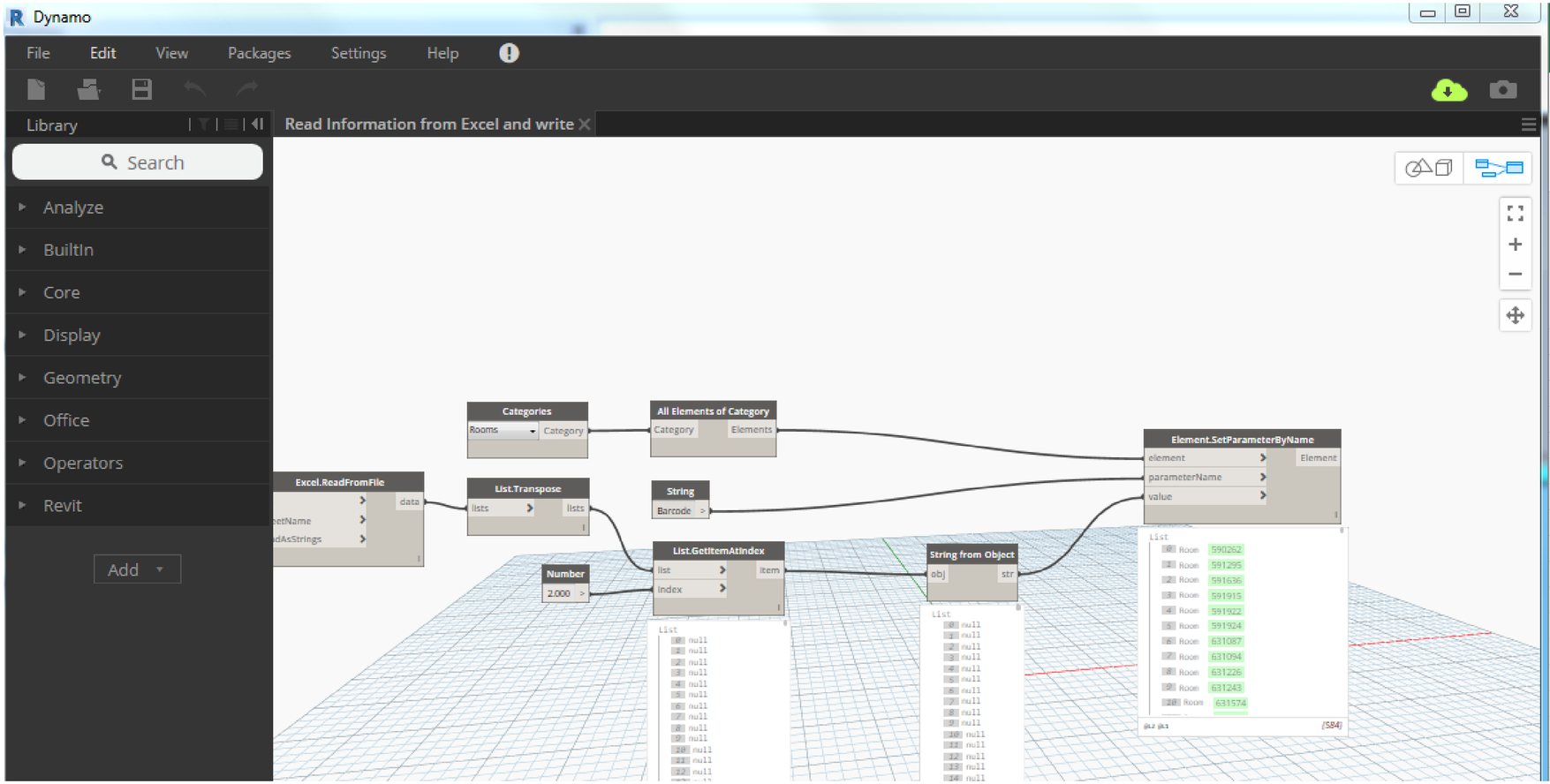


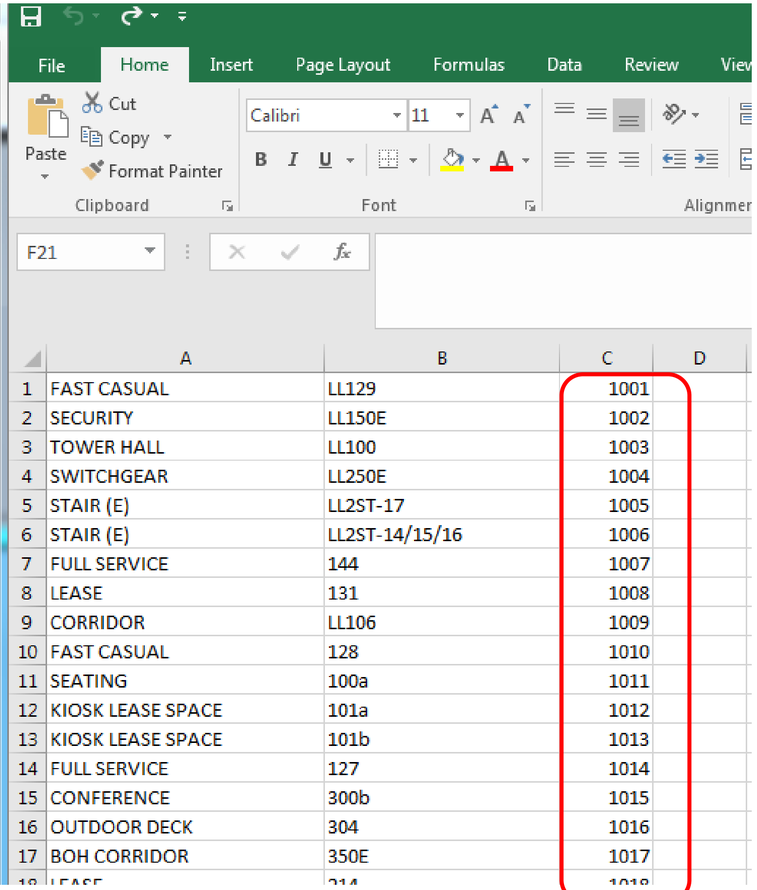


	A	B	C	D
1	FAST CASUAL	LL129	1001	
2	SECURITY	LL150E	1002	
3	TOWER HALL	LL100	1003	
4	SWITCHGEAR	LL250E	1004	
5	STAIR (E)	LL2ST-17	1005	
6	STAIR (E)	LL2ST-14/15/16	1006	
7	FULL SERVICE	144	1007	
8	LEASE	131	1008	
9	CORRIDOR	LL106	1009	
10	FAST CASUAL	128	1010	
11	SEATING	100a	1011	
12	KIOSK LEASE SPACE	101a	1012	
13	KIOSK LEASE SPACE	101b	1013	
14	FULL SERVICE	127	1014	
15	CONFERENCE	300b	1015	
16	OUTDOOR DECK	304	1016	
17	BOH CORRIDOR	350E	1017	

Integrate Logistics_Equipment Sets: Rooms into 5D Process

Read from Excel and write to Revit – Write Barcodes back to Revit

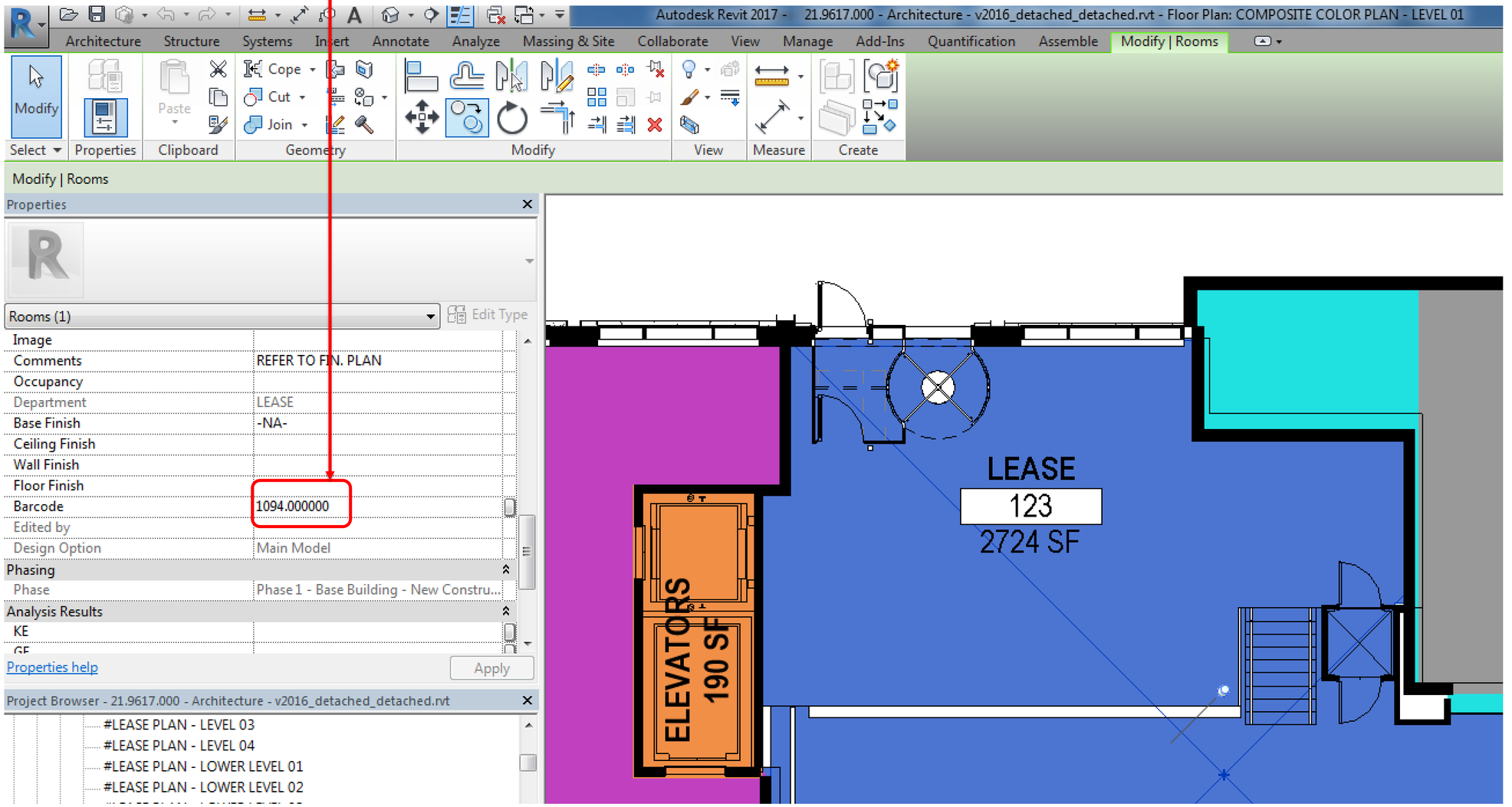




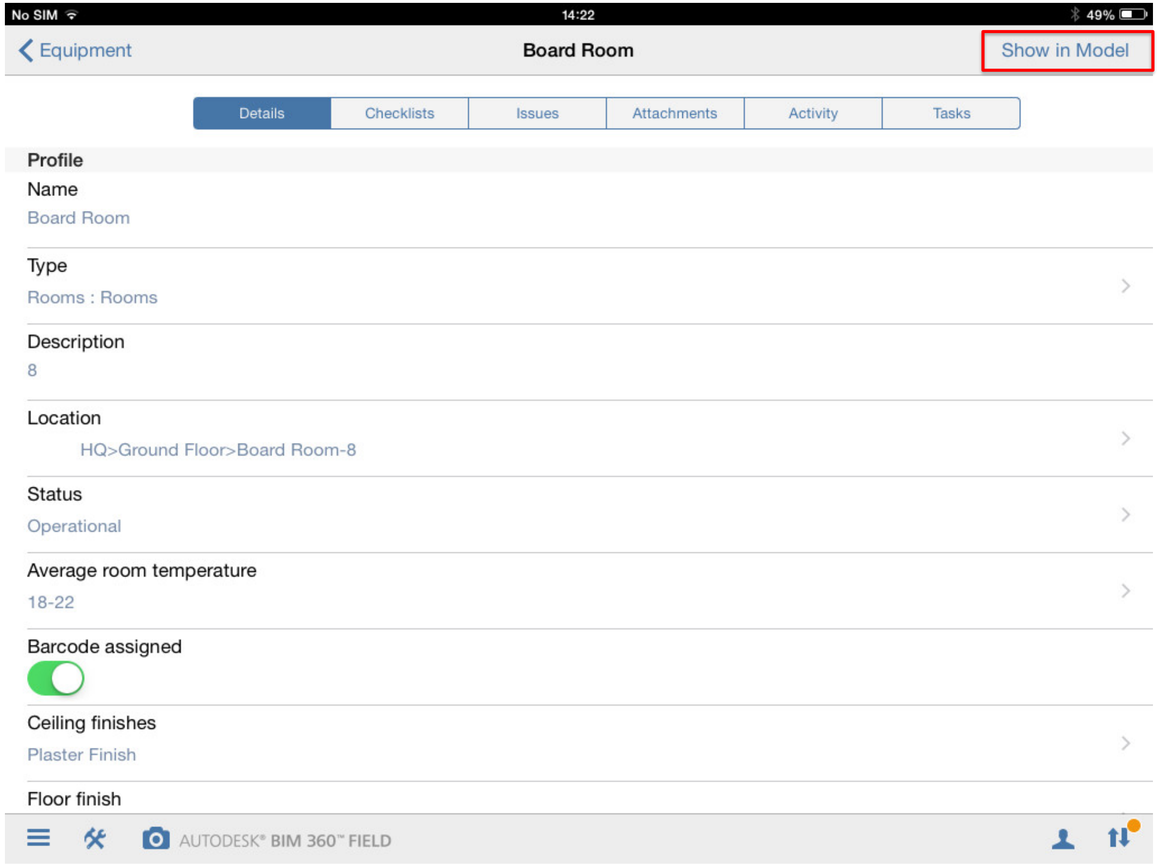
	A	B	C	D
1	FAST CASUAL	LL129	1001	
2	SECURITY	LL150E	1002	
3	TOWER HALL	LL100	1003	
4	SWITCHGEAR	LL250E	1004	
5	STAIR (E)	LL2ST-17	1005	
6	STAIR (E)	LL2ST-14/15/16	1006	
7	FULL SERVICE	144	1007	
8	LEASE	131	1008	
9	CORRIDOR	LL106	1009	
10	FAST CASUAL	128	1010	
11	SEATING	100a	1011	
12	KIOSK LEASE SPACE	101a	1012	
13	KIOSK LEASE SPACE	101b	1013	
14	FULL SERVICE	127	1014	
15	CONFERENCE	300b	1015	
16	OUTDOOR DECK	304	1016	
17	BOH CORRIDOR	350E	1017	

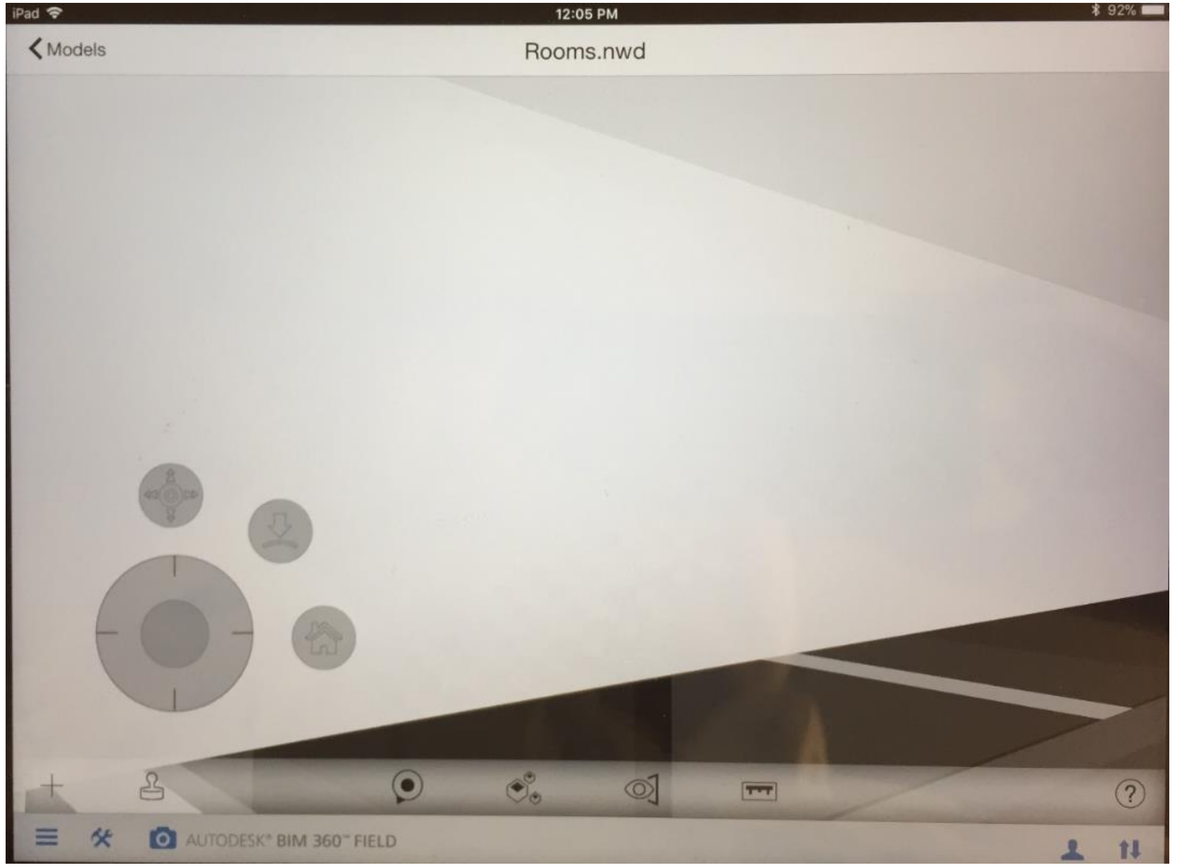
Integrate Logistics_Equipment Sets: Rooms into 5D Process

Barcode Added



Question 2: How to stand in center of a room when using “Show in Model”?



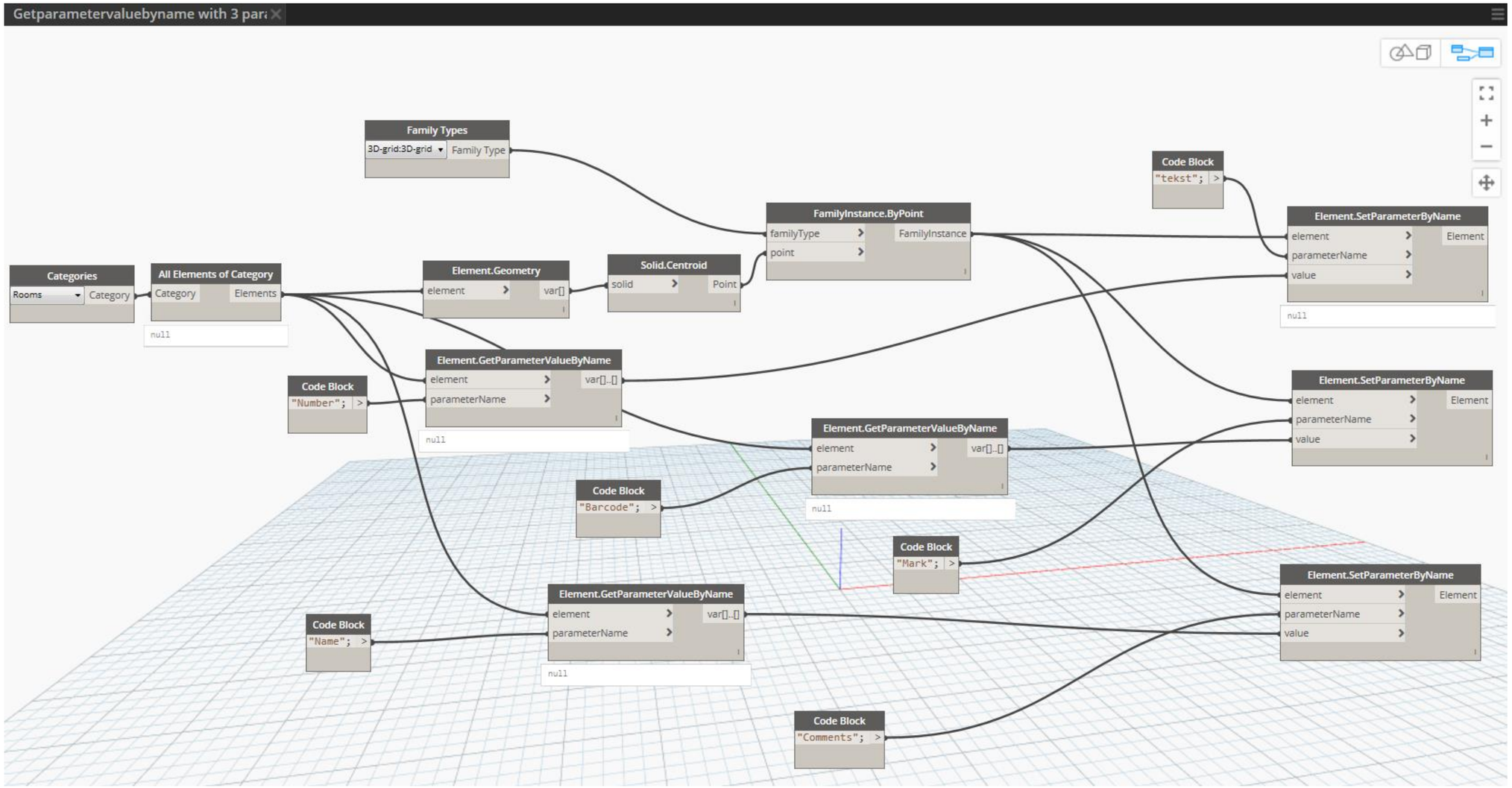


Where is the room?

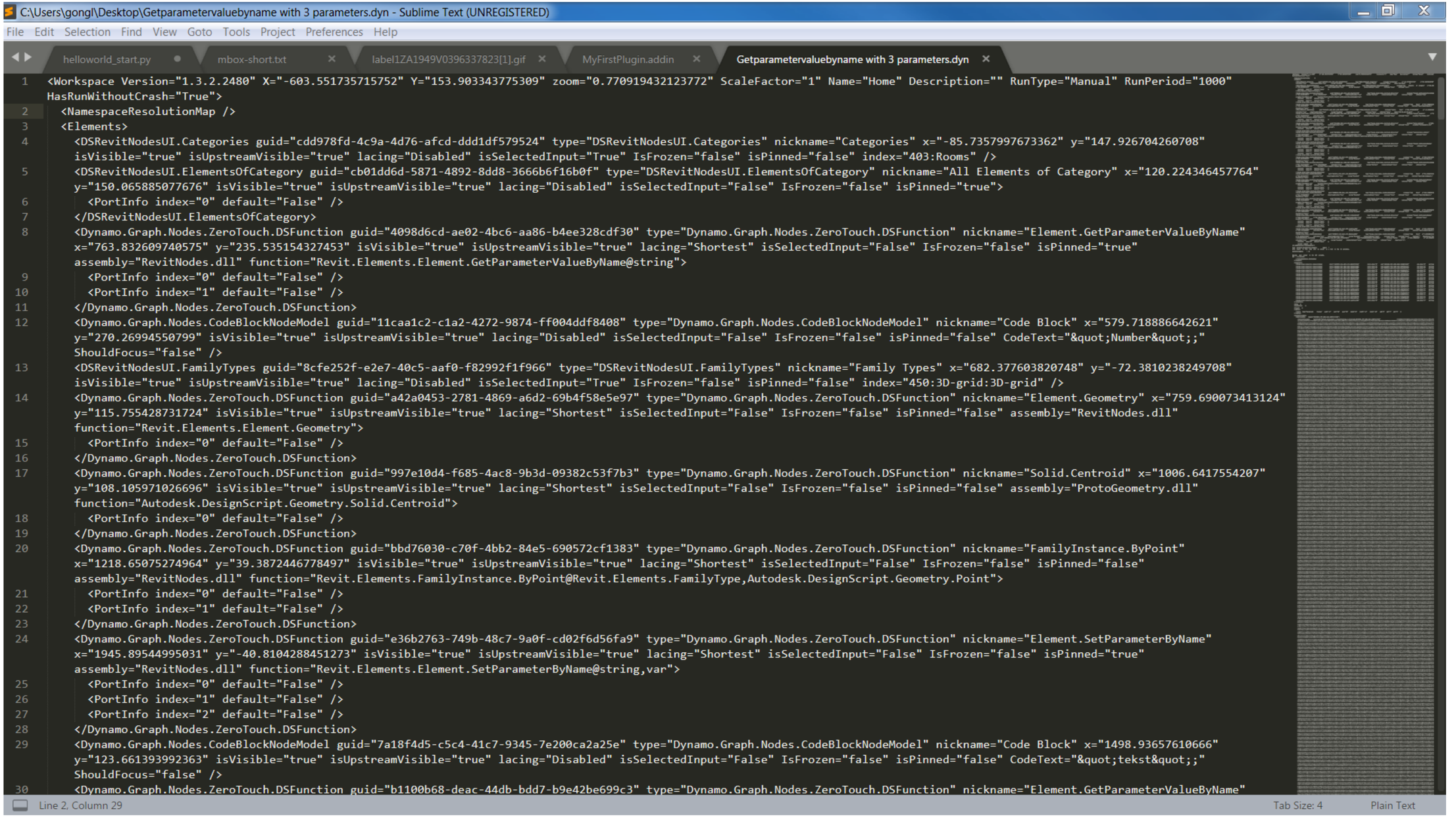
The room is hidden by a wall or floor

Room name, room number and barcode are transferred to the associated **3D tag** and then to 360 Field by expanding scripts.

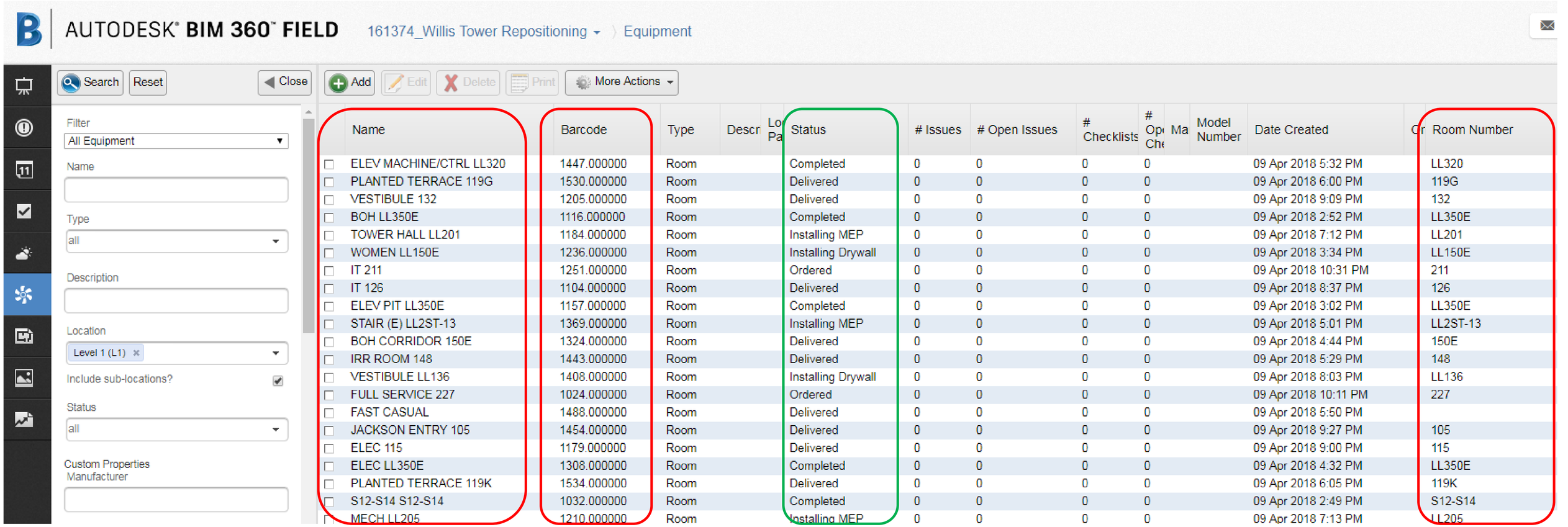
Solution



Have a deeper look at the logics behind



Integrate Logistics_Equipment Sets: Rooms into 5D Process



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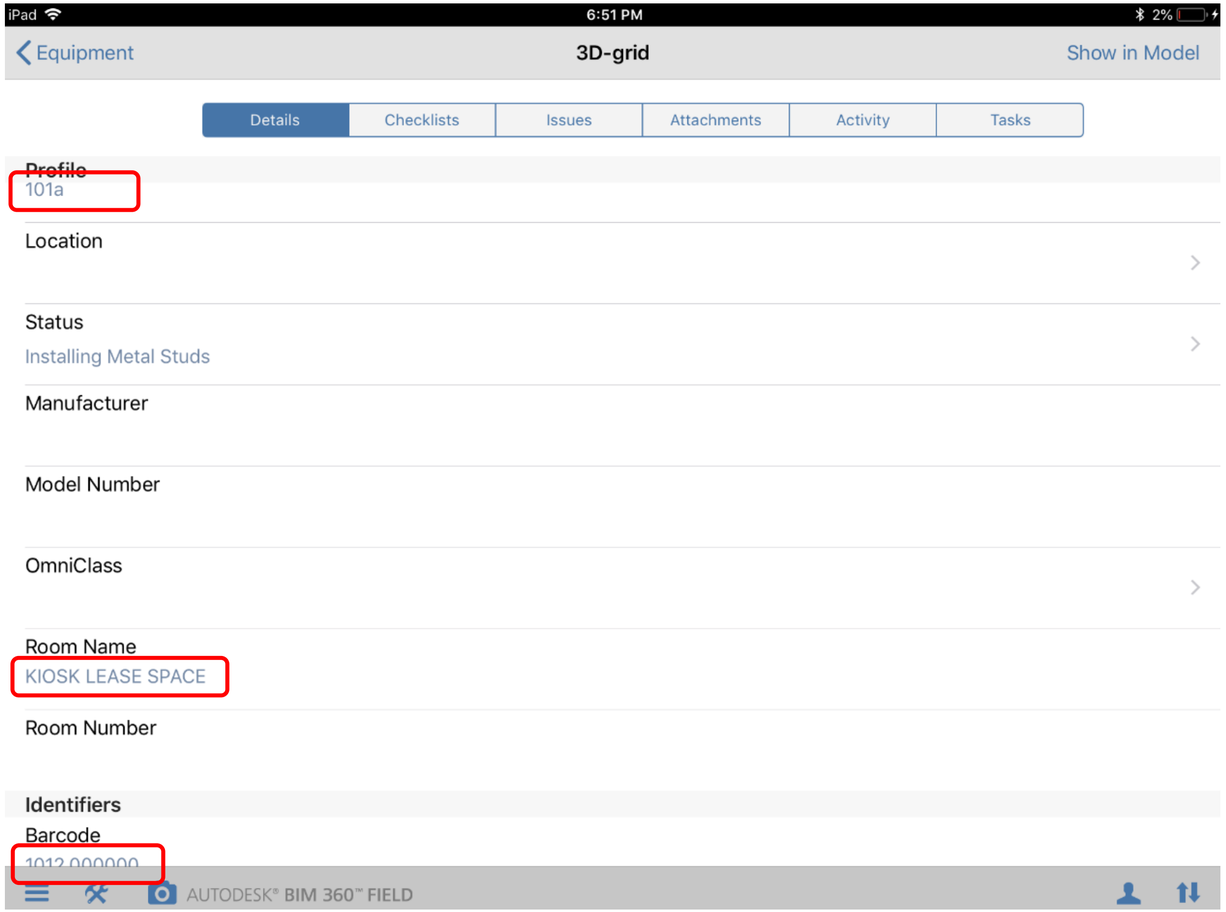
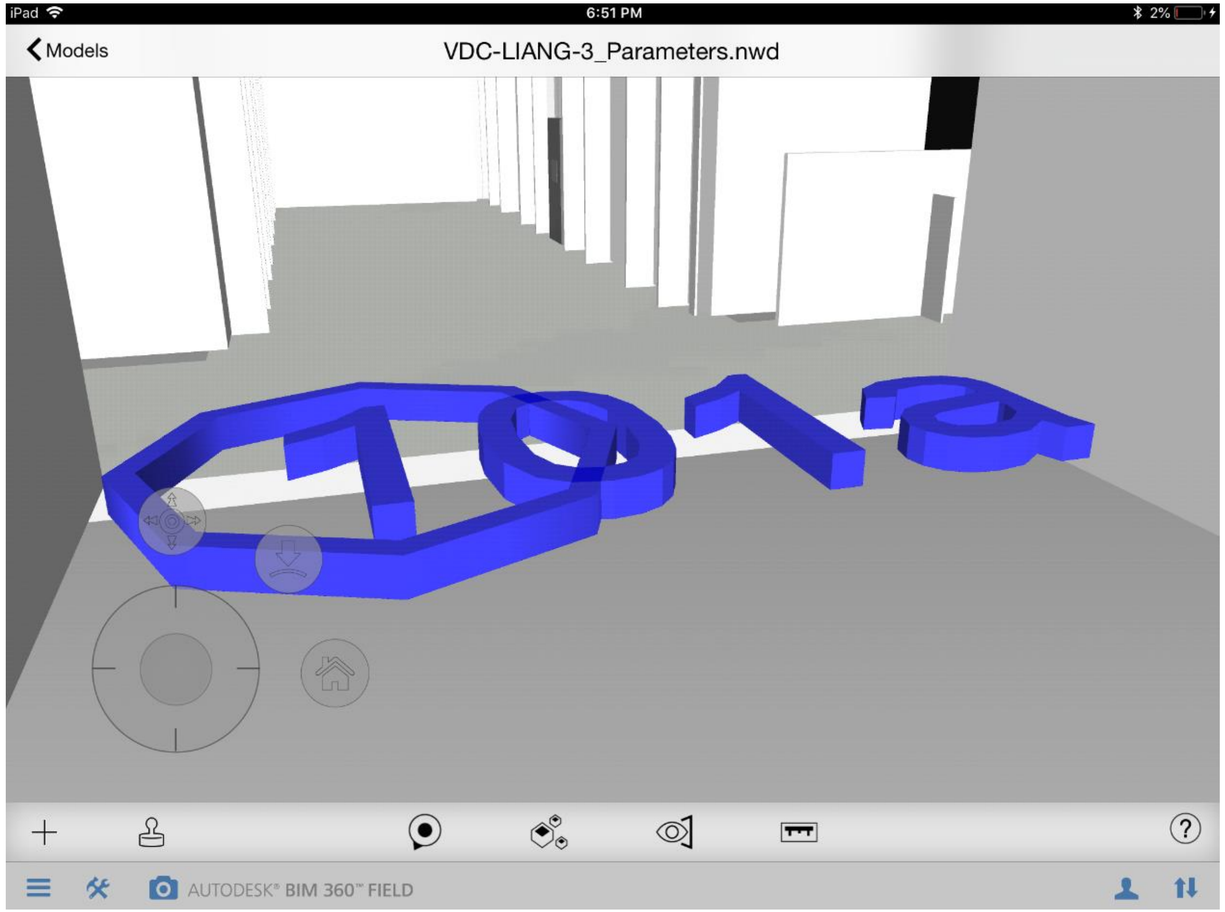
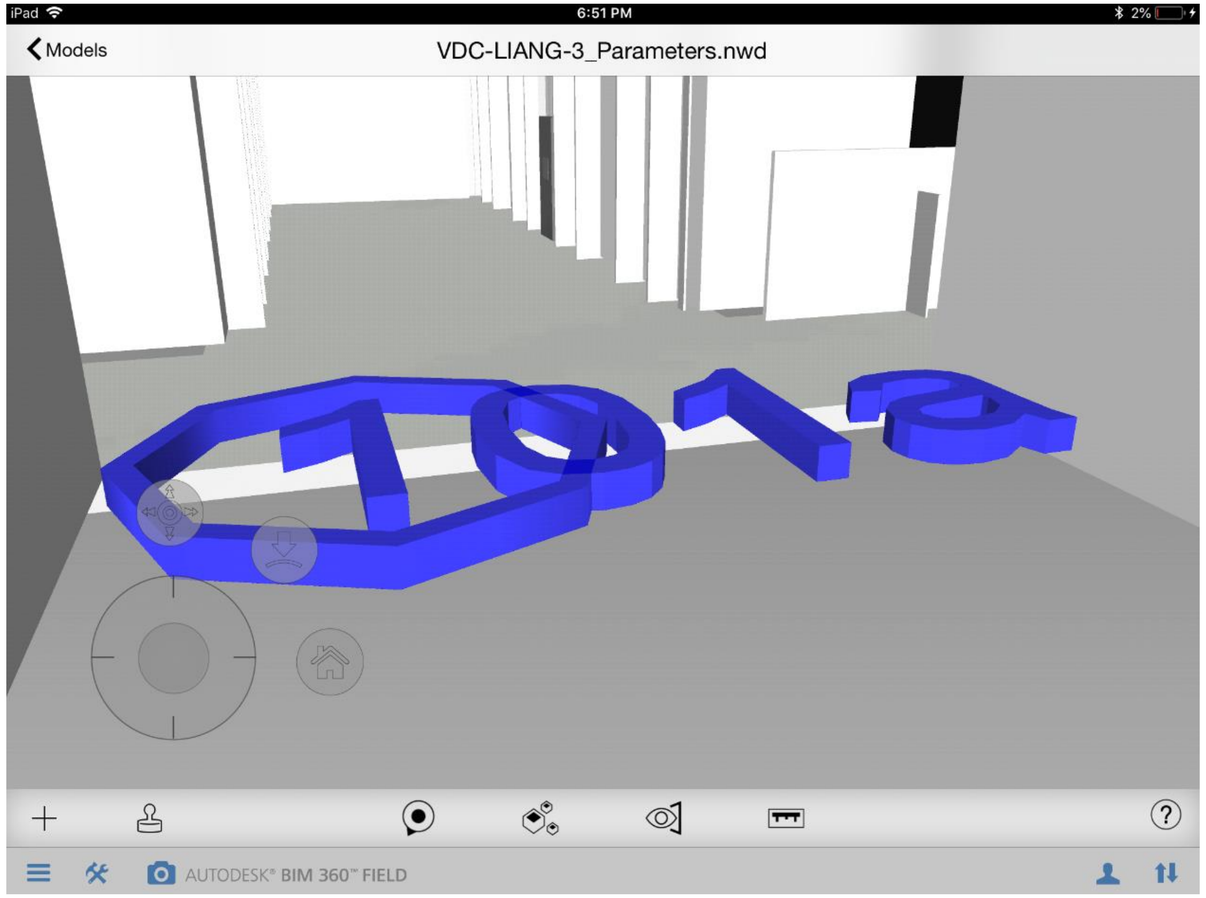




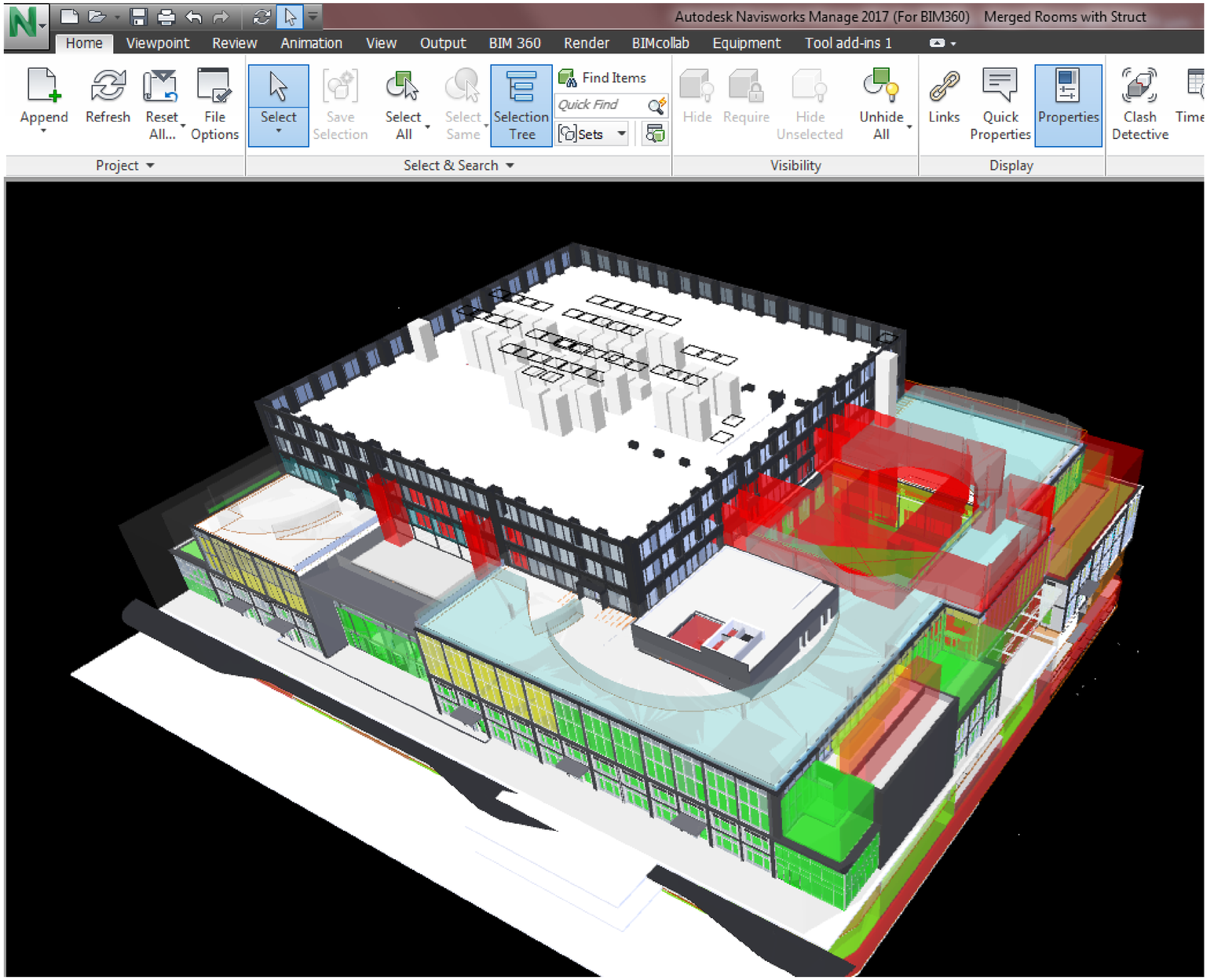
Question 2: How to stand in center of a room when using “Show in Model”?

Before

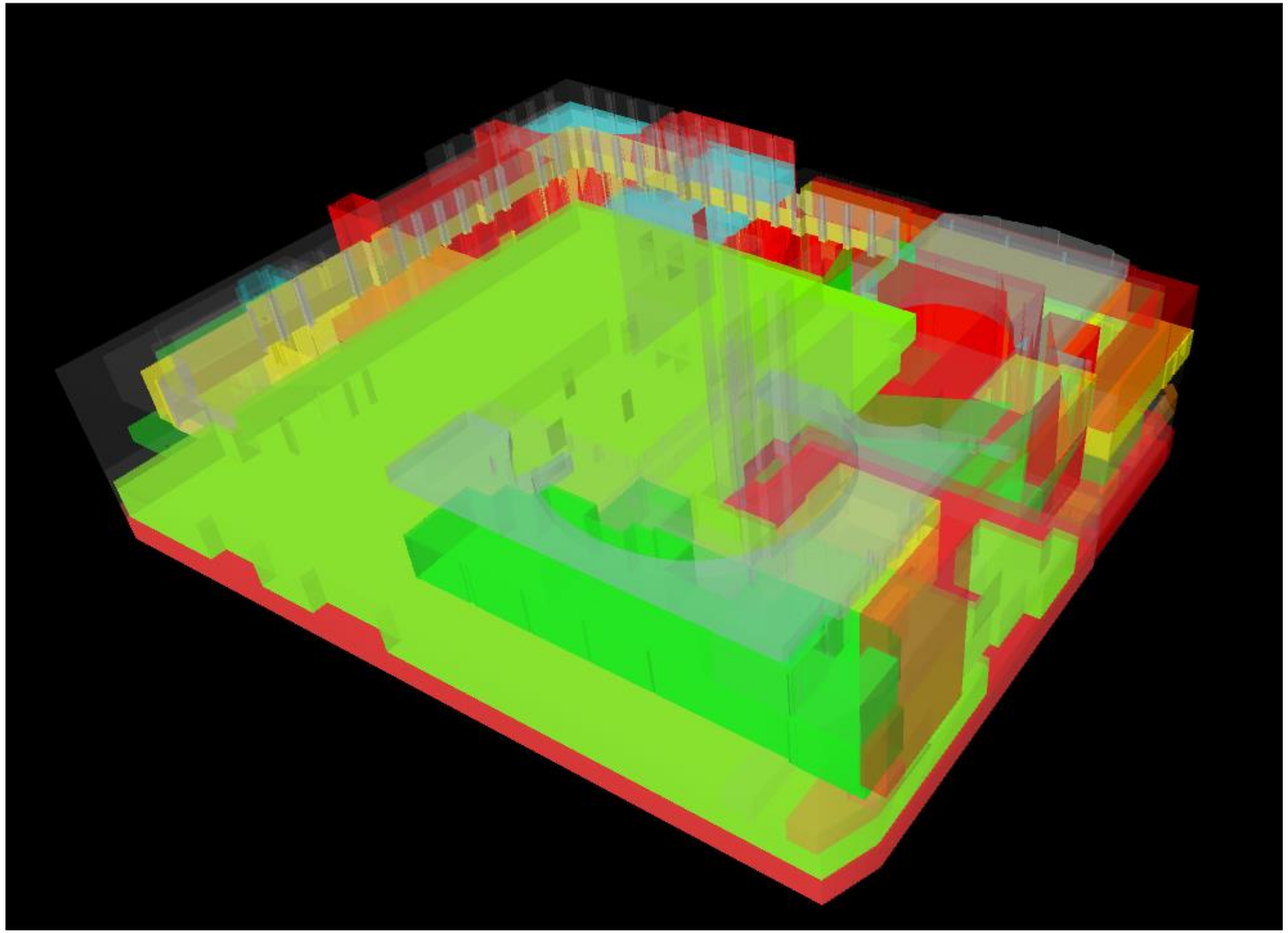
After



Integrate Logistics_Equipment Sets: Rooms into 5D Process

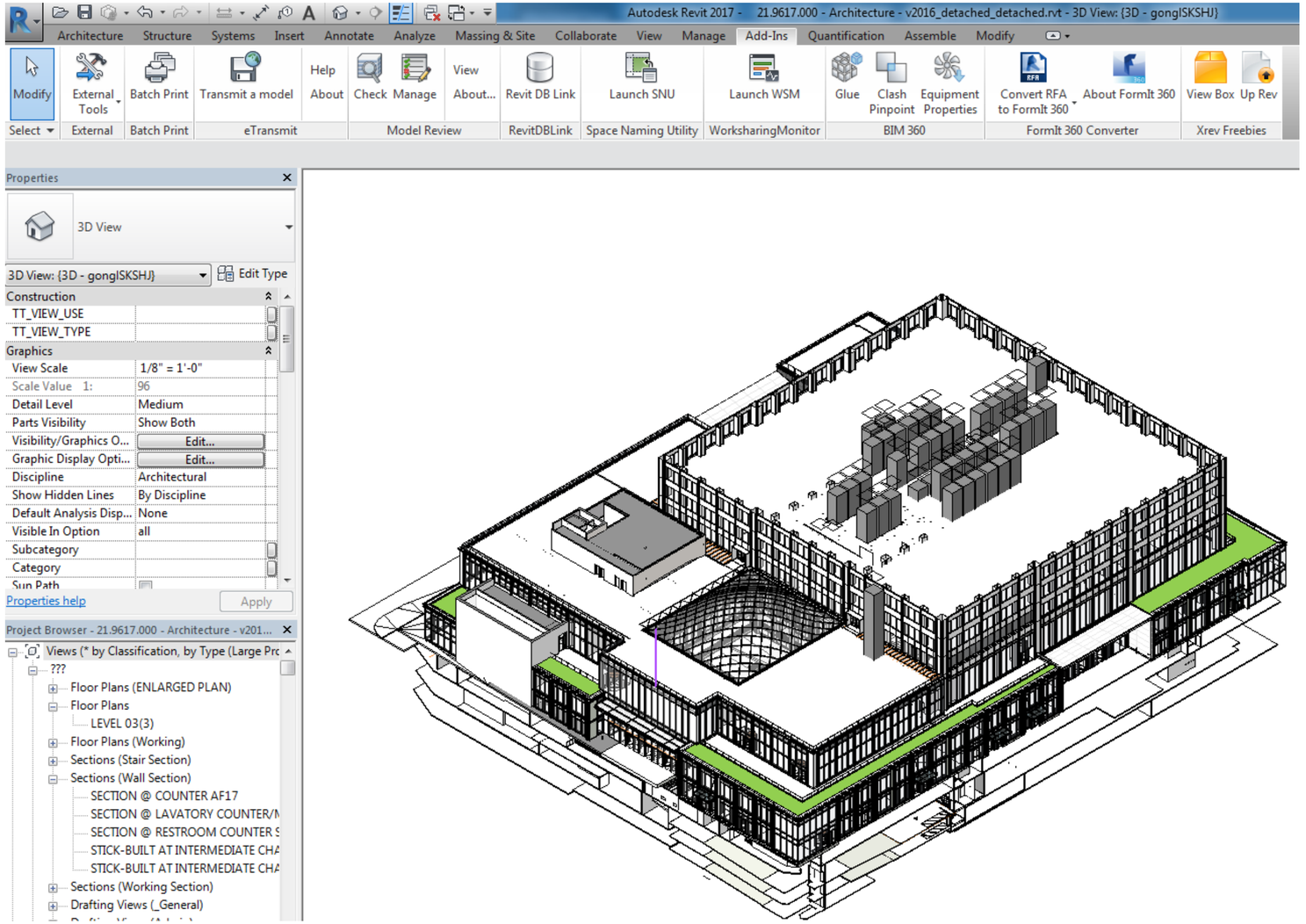


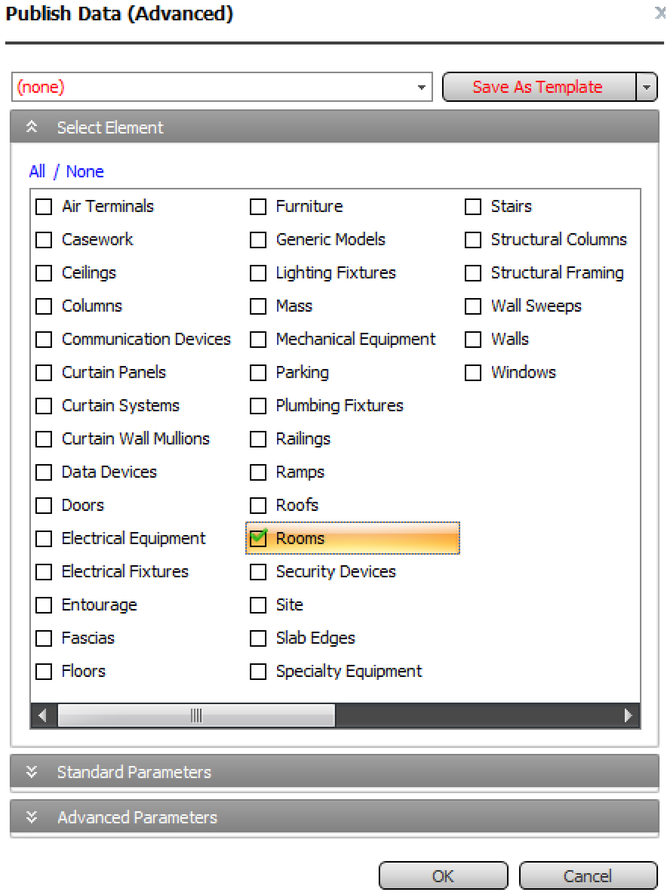
Integrate Logistics_Equipment Sets: Rooms into 5D Process

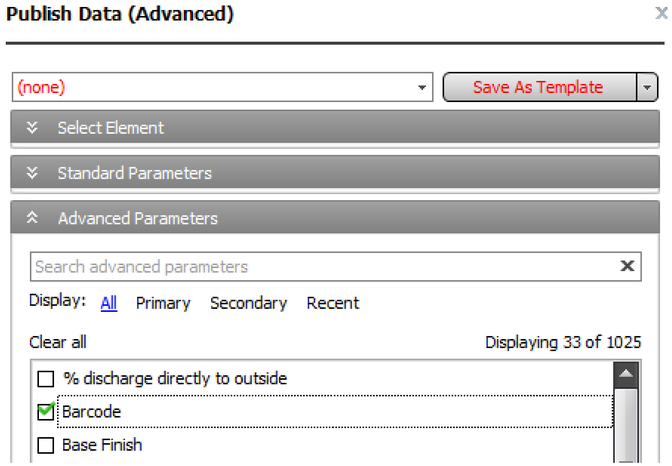


Selector		
BIM 360: Status equals "Planning"		80
BIM 360: Status equals "Ordered"		50
BIM 360: Status equals "Installing MEP"		50
BIM 360: Status equals "Installing Drywall"		50
BIM 360: Status equals "Completed"		50

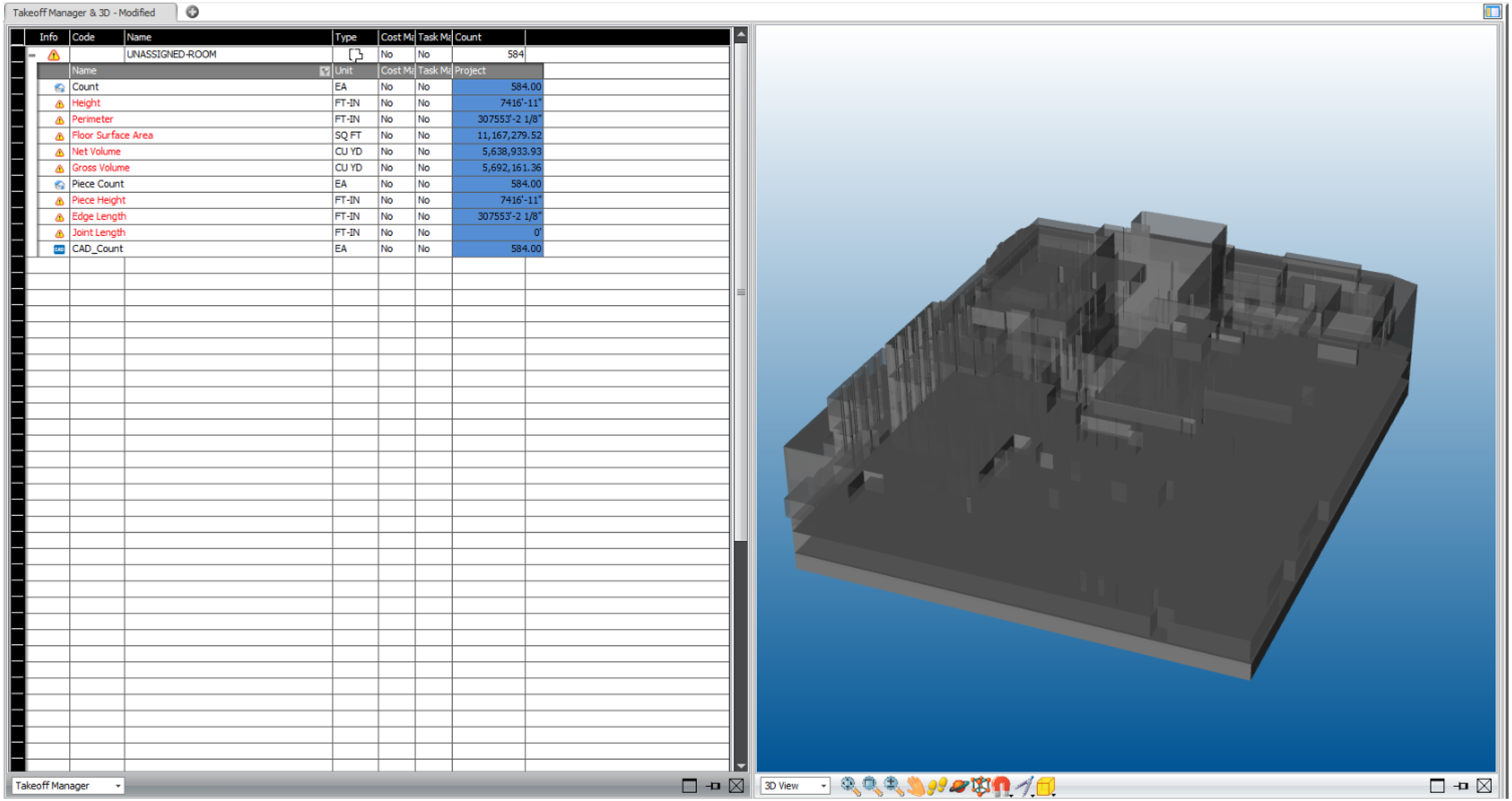
Integrate Logistics_Equipment Sets: Rooms into 5D Process







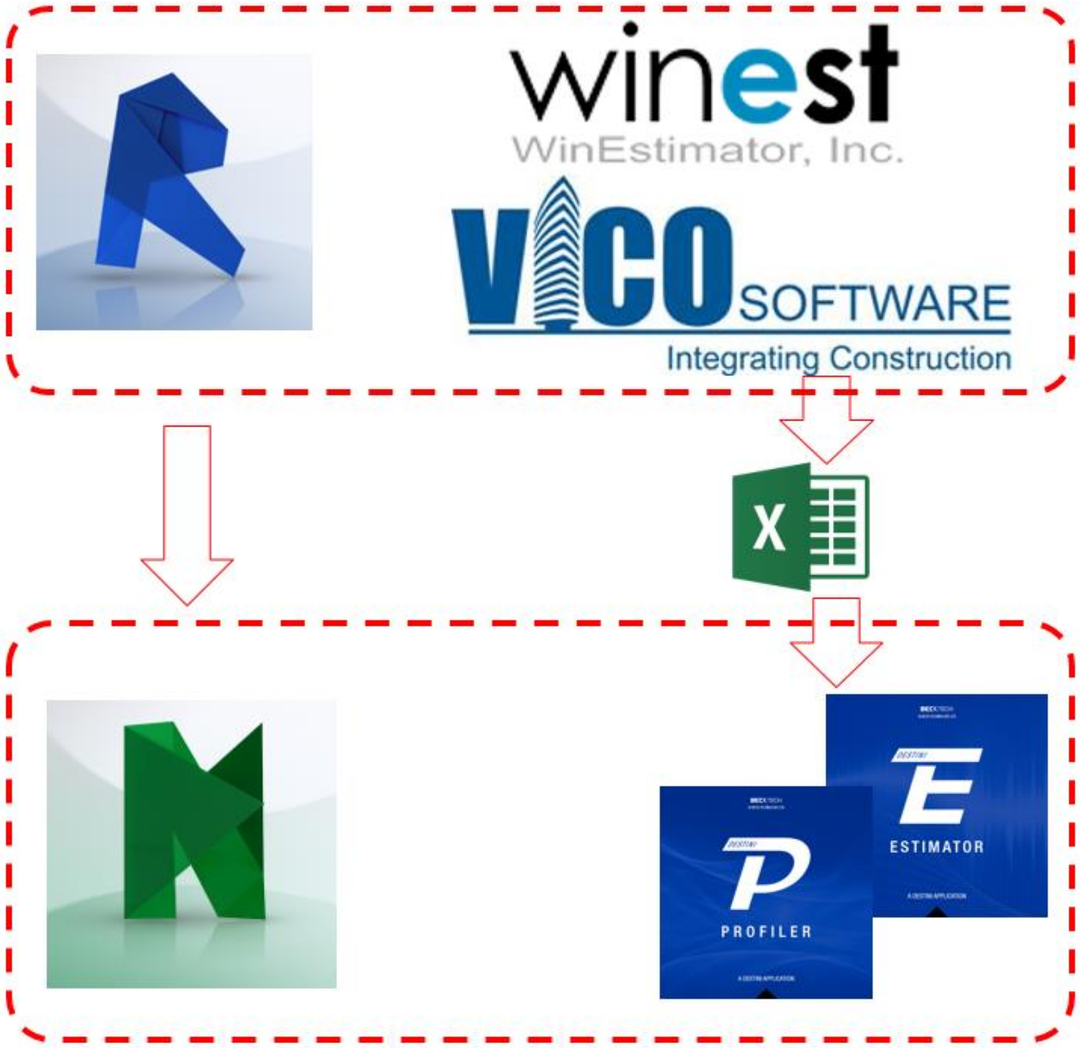
Integrate Logistics_Equipment Sets: Rooms into 5D Process



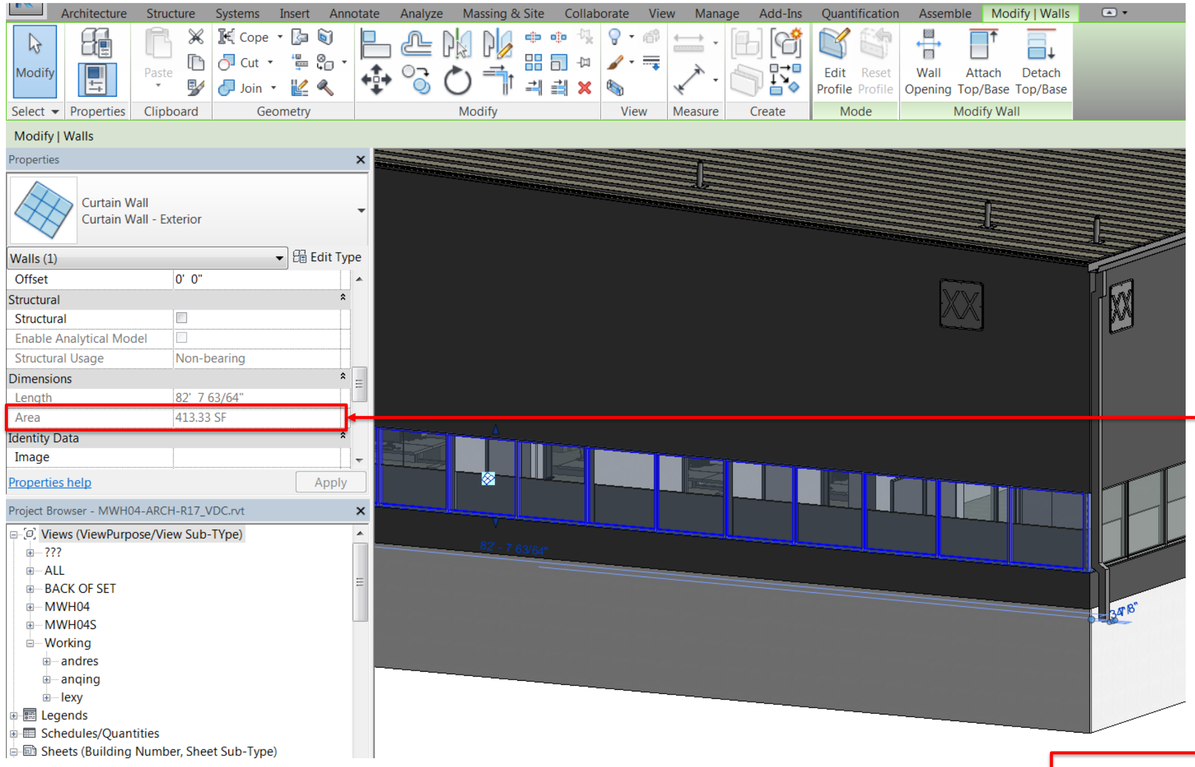
Current Platforms

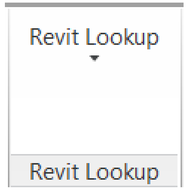
- AUTODESK – TRIMBLE
- AUTODESK – BECK
- ORACLE – P6

- Same modeling practice
- Similar take – off logic
- Different levels of integration
- Very capable – different process logic
- Different learning curve
- Race to full cloud integration…



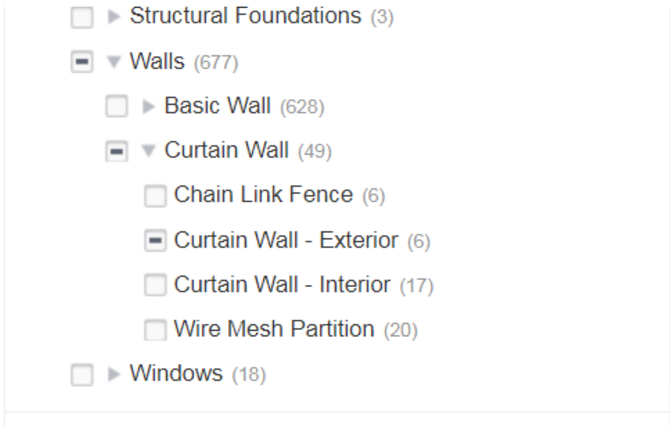
Why SqFt is Different?

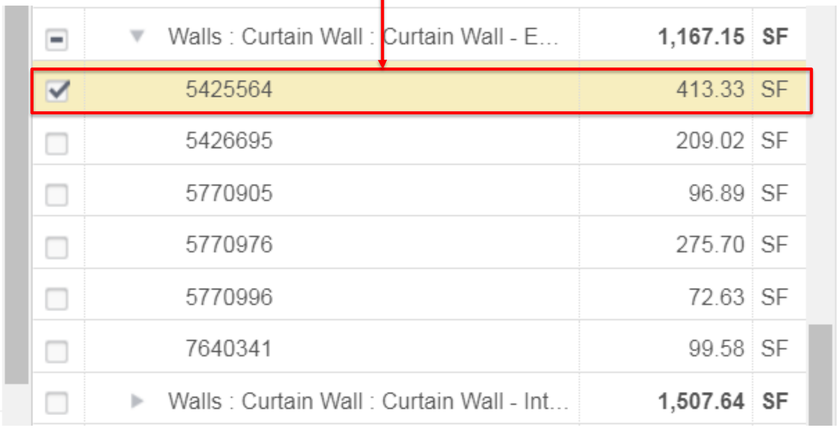


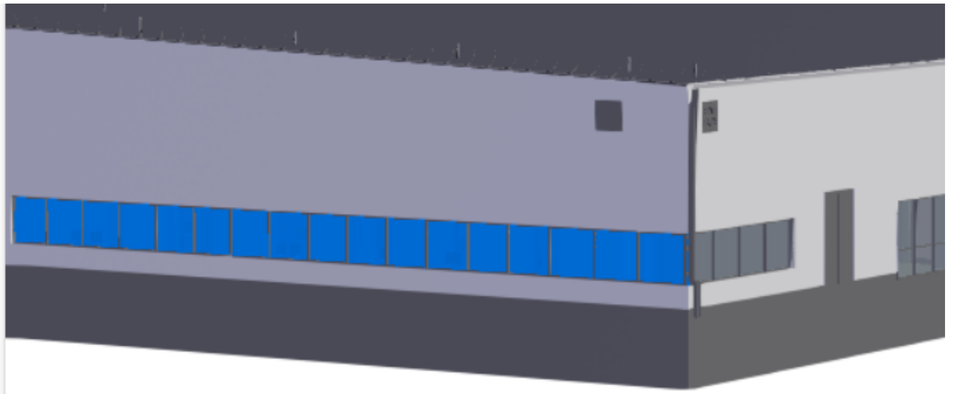


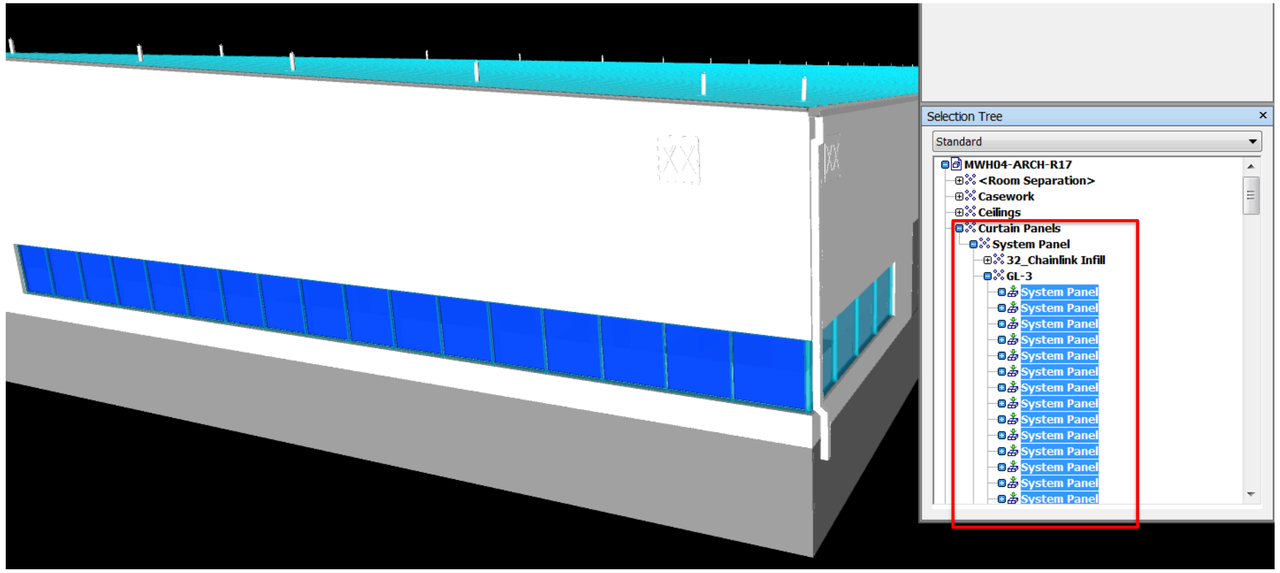
Revit

Assemble



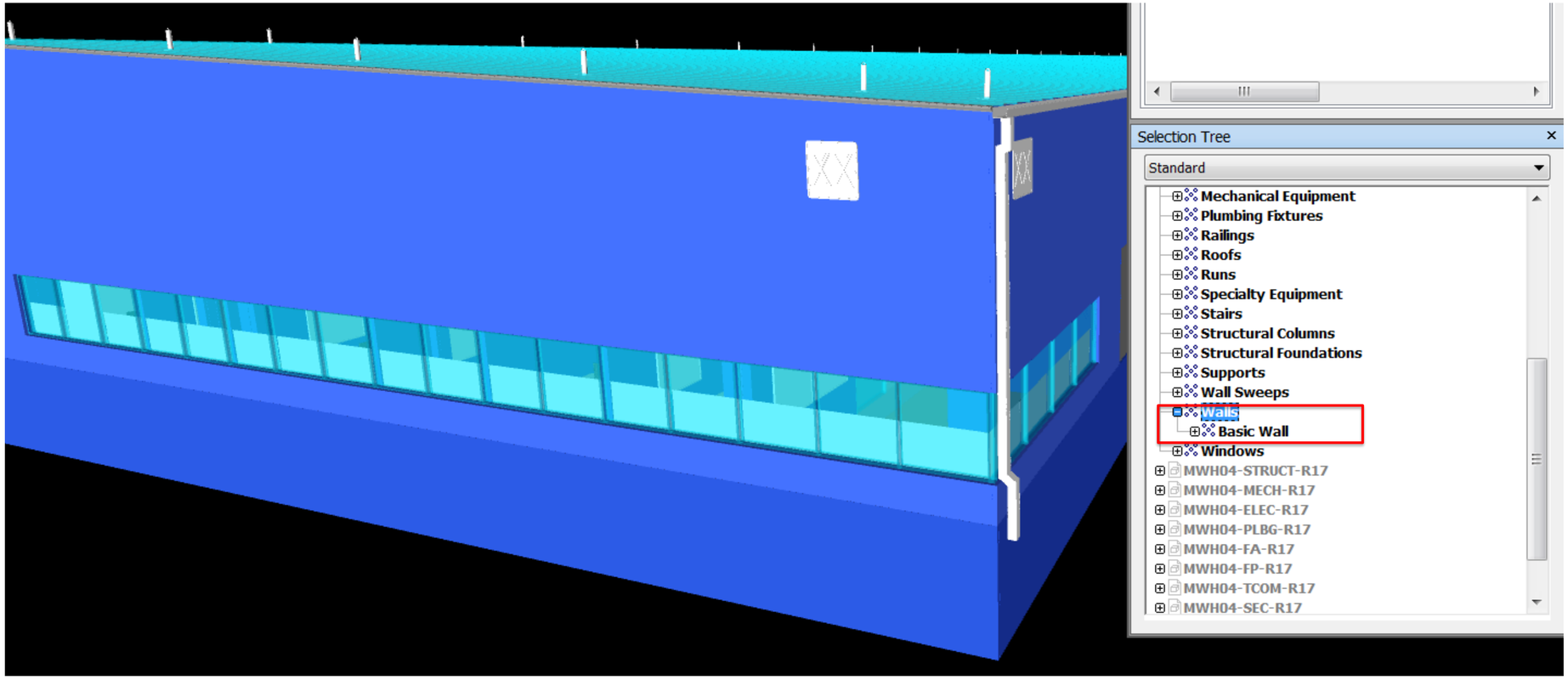






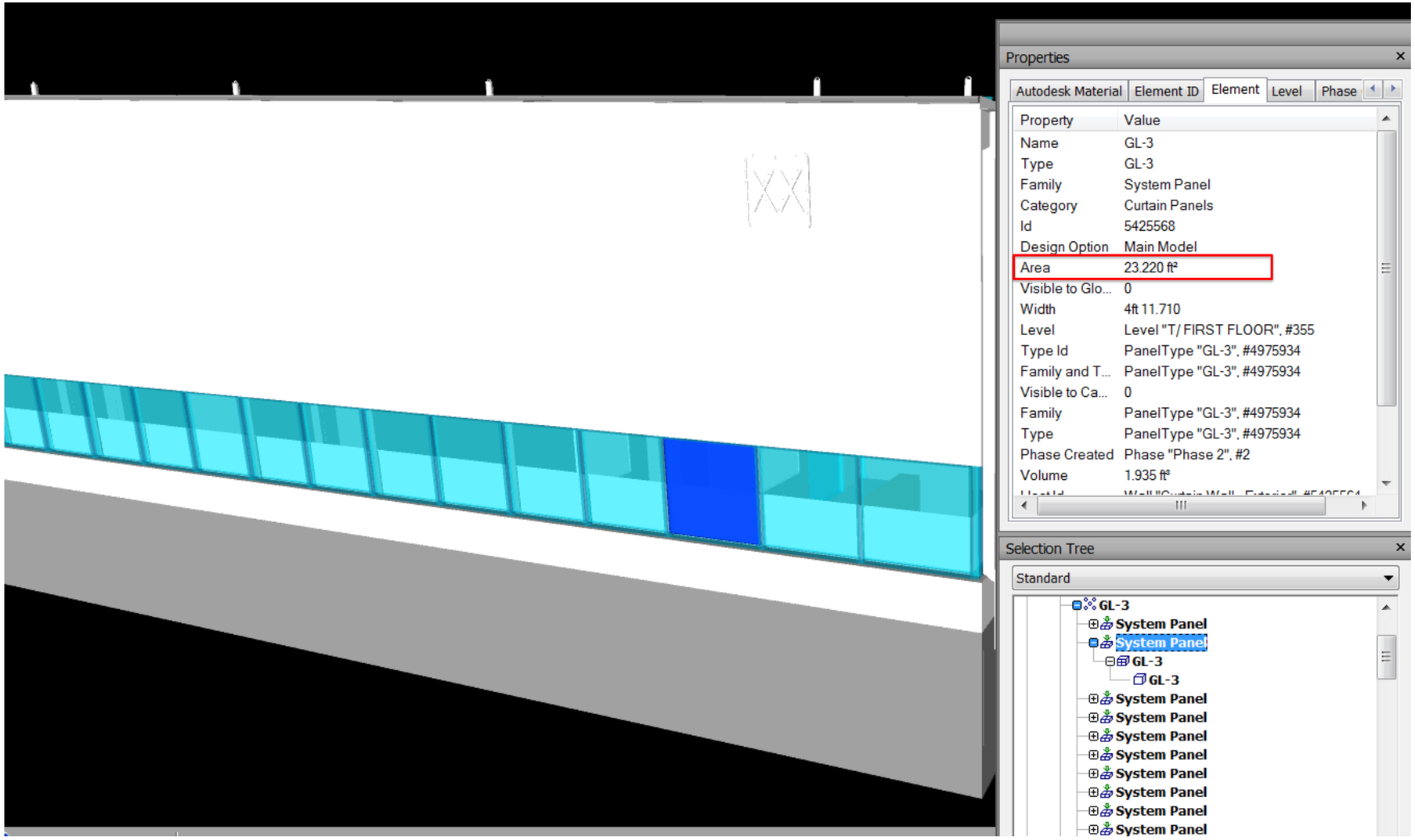
From Revit to Naviswork

The curtain wall instances are hosts to other instances where their geometries have been usurped. Because there is no geometry, the curtain walls will not exist in the NWC.



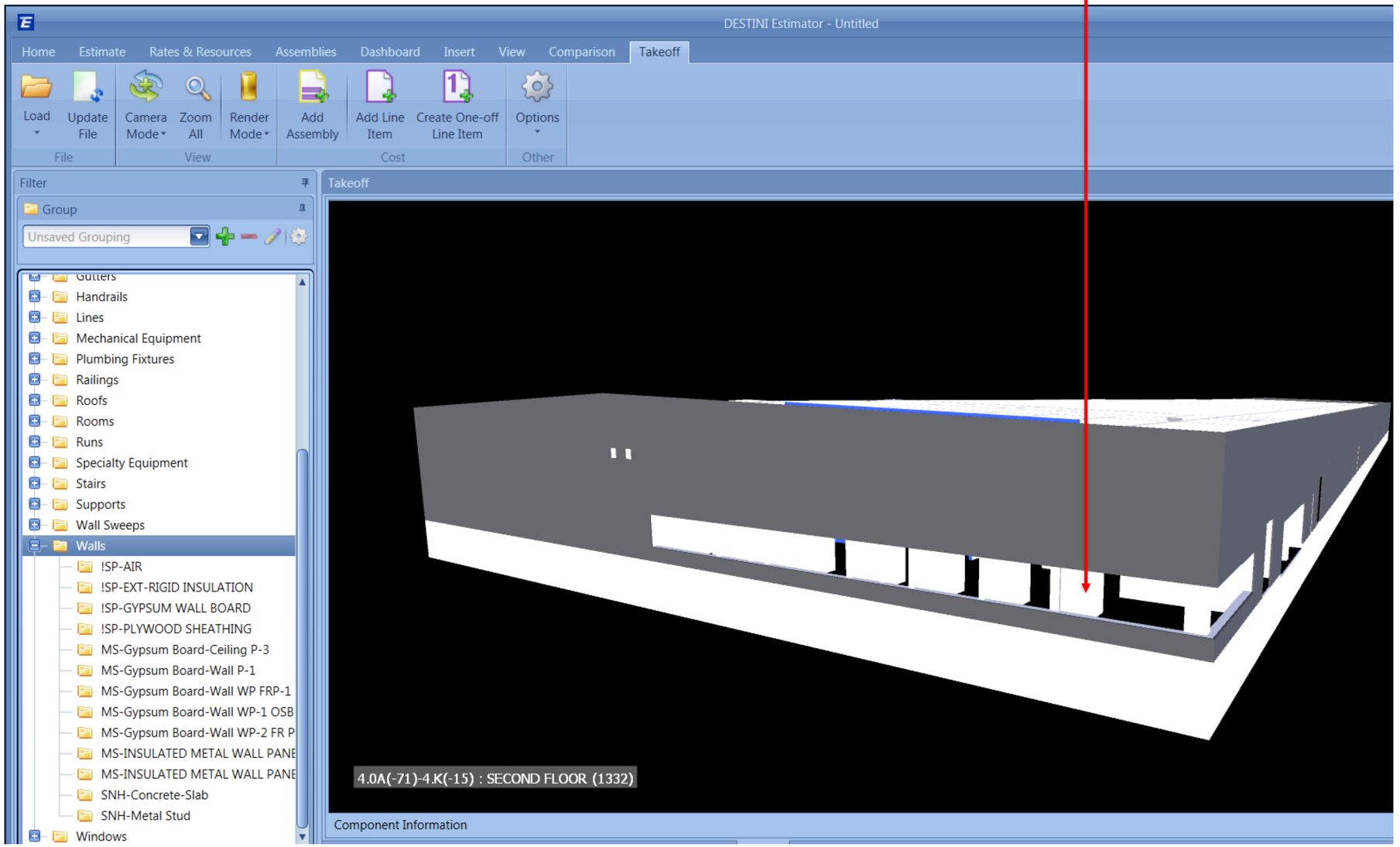
Add all curtain panels together

19.83+21.66*11+21.67*2+23.22+22.56+23.63=370.84 < 413.33

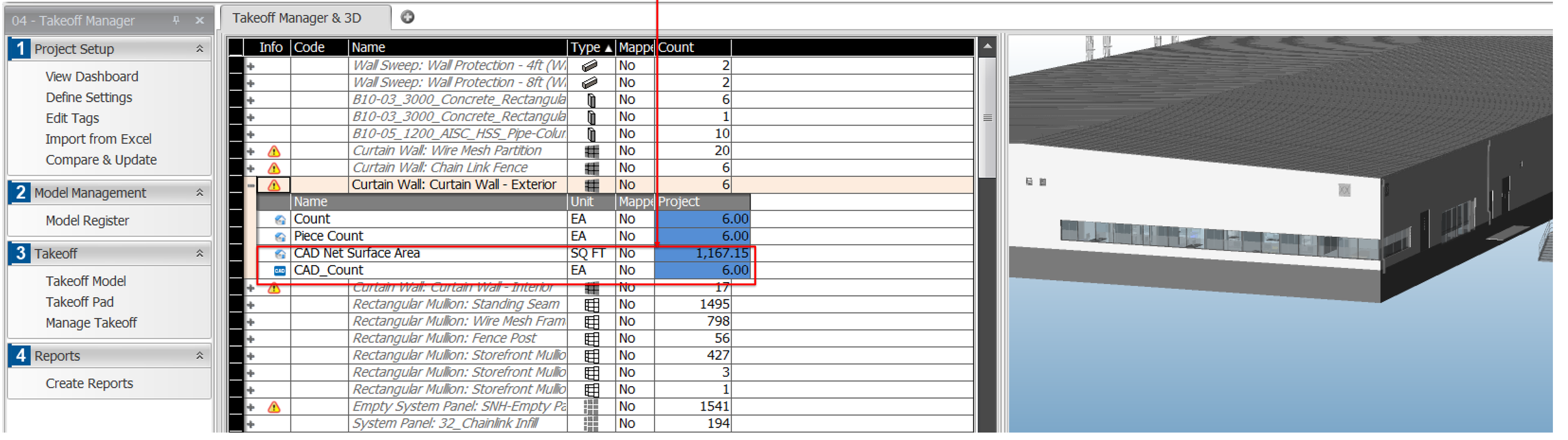


From Naviswork to DEstimator

The curtain wall are not even shown under Walls



VICO


04 - Takeoff Manager
1 Project Setup
View Dashboard
Define Settings
Edit Tags
Import from Excel
Compare & Update
2 Model Management
Model Register
3 Takeoff
Takeoff Model
Takeoff Pad
Manage Takeoff
4 Reports
Create Reports
Takeoff Manager & 3D
Info
Code
Name
Type
Mappe
Count
Wall Sweep: Wall Protection - 4ft (W
Wall Sweep: Wall Protection - 8ft (W
B10-03_3000_Concrete_Rectangula
B10-03_3000_Concrete_Rectangula
B10-05_1200_AISC_HSS_Pipe-Colur
Curtain Wall: Wire Mesh Partition
Curtain Wall: Chain Link Fence
Curtain Wall: Curtain Wall - Exterior
Name
Unit
Mappe
Project
Count
EA
6.00
Piece Count
EA
6.00
CAD Net Surface Area
SQ FT
1,167.15
CAD_Count
EA
6.00
Curtain Wall: Curtain Wall - Interior
Rectangular Mullion: Standing Seam
Rectangular Mullion: Wire Mesh Fram
Rectangular Mullion: Fence Post
Rectangular Mullion: Storefront Mullio
Rectangular Mullion: Storefront Mullio
Rectangular Mullion: Storefront Mullio
Empty System Panel: SNH-Empty Pa
System Panel: 32_Chainlink Infill

File | Architecture | Structure | Systems | Insert | Annotate | Analyze | Massing & Site | Collaborate | View | Manage | Add-Ins | Modify | Walls

Modify | Select | Properties | Paste | Clipboard | Cope | Cut | Join | Geometry | Modify | View | Measure | Create | Edit Profile | Reset Profile | Mode | Wall Opening | Attach Top/Base | Detach Top/Base | Modify Wall | Filter | Save | Load | Edit | Selection

Modify | Walls | Activate Dimensions

Properties

Curtain Wall
Curtain Wall - Exterior

Walls (6) | Edit Type

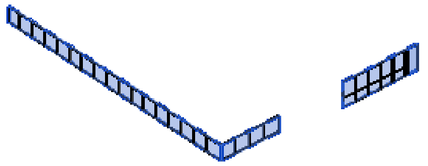
Constraints	
Base Constraint	T/ FIRST FLOOR
Base Offset	
Base is Attached	☐
Top Constraint	Unconnected
Unconnected Height	
Top Offset	-0' 6"
Top is Attached	☐
Room Bounding	☑
Related to Mass	☐
Materials and Finishes	
Material Color	
Vertical Grid	

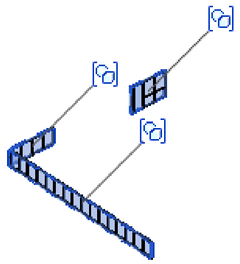
Properties help | Apply

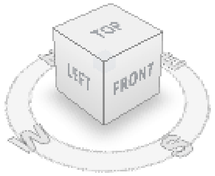
Project Browser - 1708739 MWH04-ARCH-R17_VDC.rvt

- Structural Beam Systems
- Structural Columns
- Structural Foundations
- Structural Loads
- Walls
  - Basic Wall
  - Curtain Wall
    - Chain Link Fence
    - Curtain Wall - Exterior
    - Curtain Wall - Interior
    - Wire Mesh Partition
  - Stacked Wall
    - EXT-BRICK ON CMU-STL STUD
- Windows
- Groups
- Revit Links
  - MWH05-ARCH-R17.rvt
  - MWH0405-ELEC-R17.rvt

Temporary Hide/Isolate

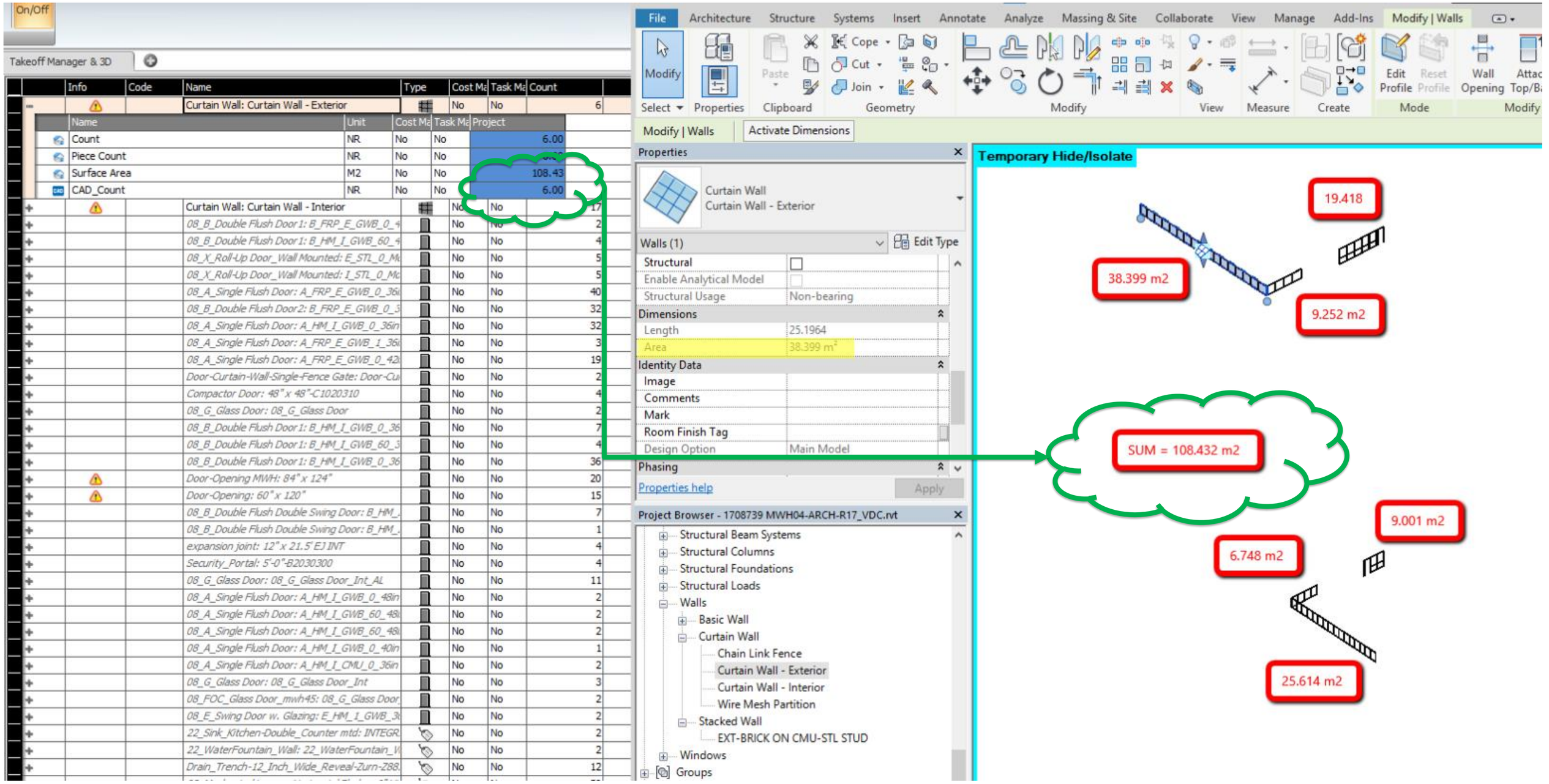






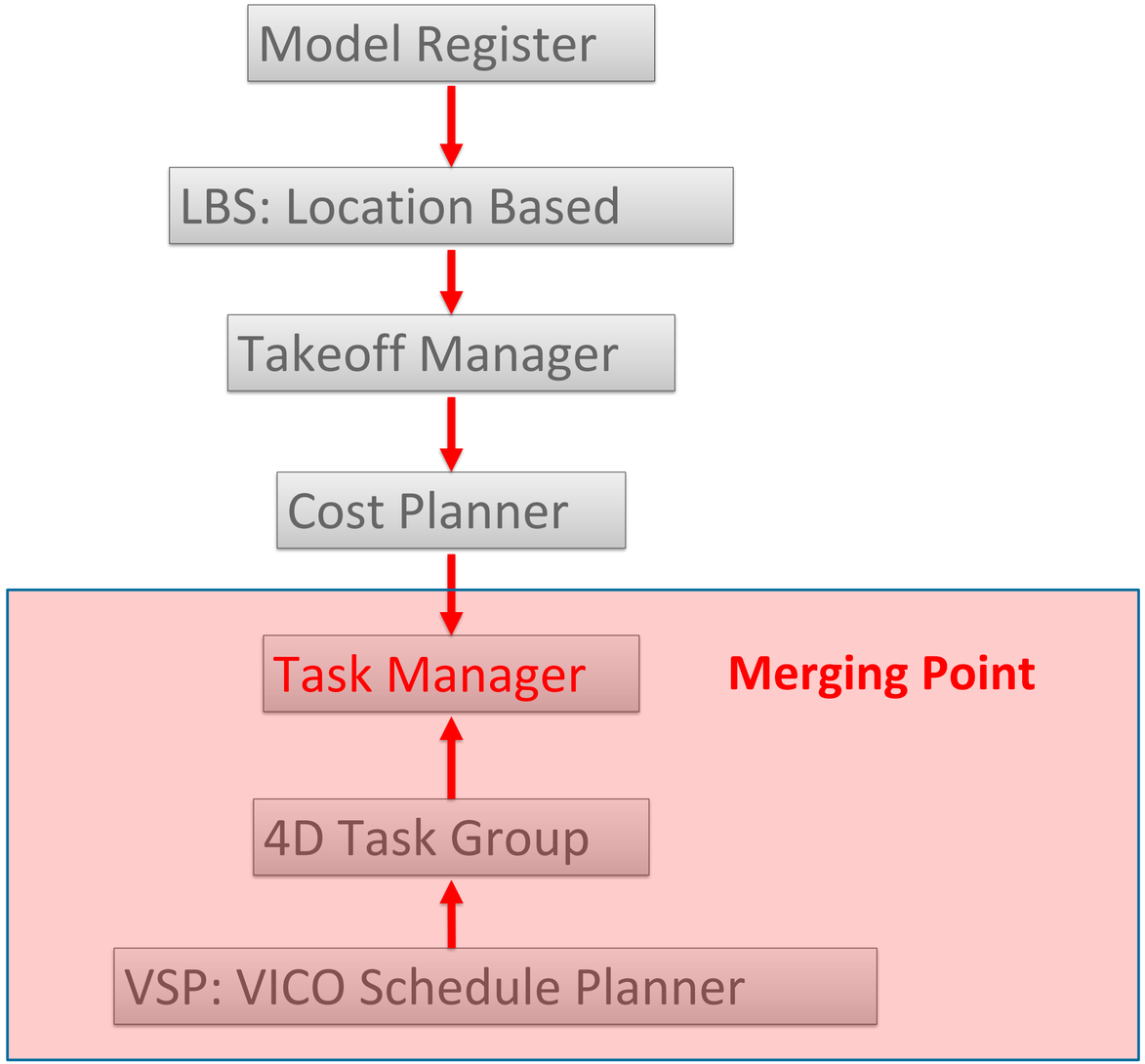
1/8" = 1'-0"

VICO added all curtain walls together under one TOI



5D Top-down

5D Bottom-up



CLAYCO

THE ART & SCIENCE OF BUILDING

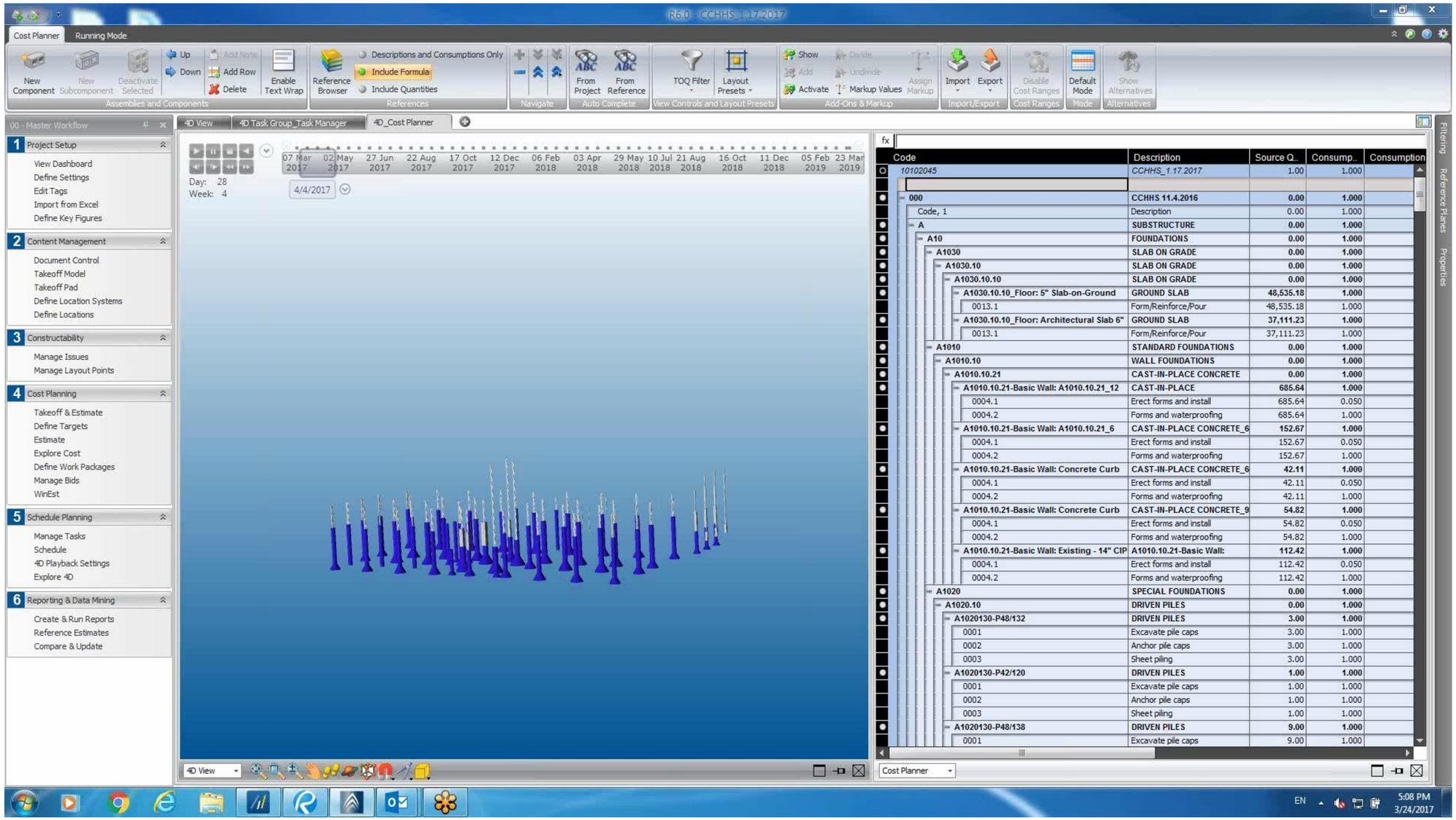
5D Top-down

Cook County and the Cook County Health and Hospital Systems have hired Clayco, Inc., as the developer and design/builder to program, design and construct the new nine (9) story, 282,000 square foot Central Campus Health Center (“Center’).

The new Center will be constructed with a structural steel braced frame erected upon a belled caisson foundation. It will feature stand-alone MEP systems with air cooled rooftop units and hot water VAV reheat The exterior will be enclosed by a combination of curtain wall and unitized GFRC panels.

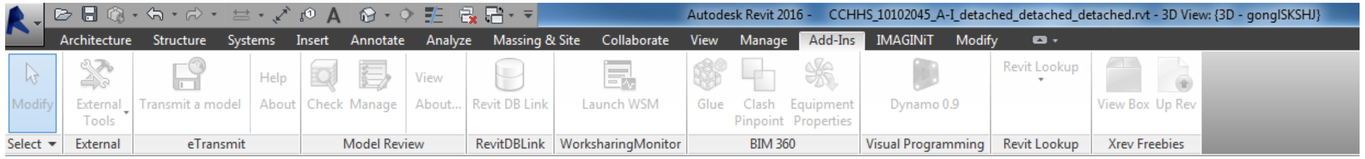
The project is targeting LEED Silver Certification. It has an approximate budget of $108.5 million and a 3rd quarter of 2018 completion date.

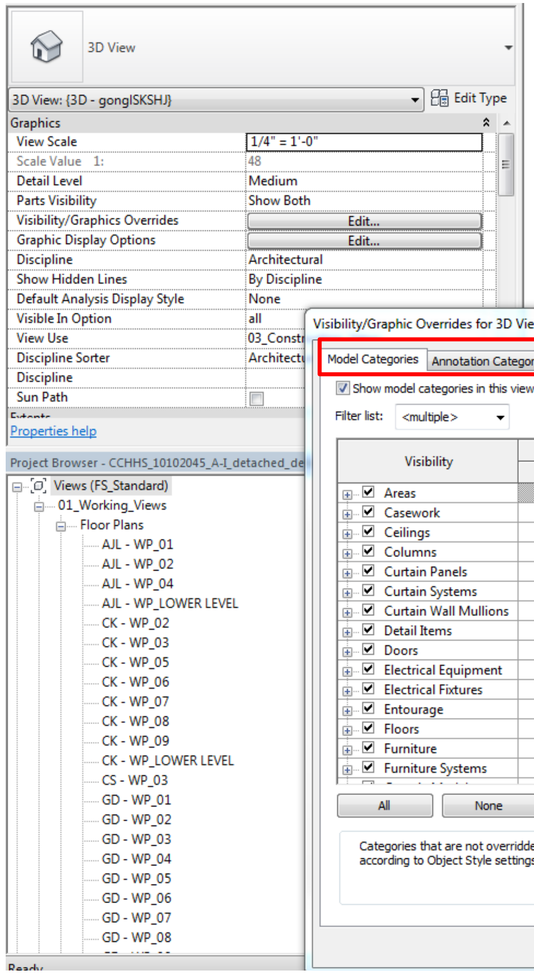
5D Top-down: Explore 5D

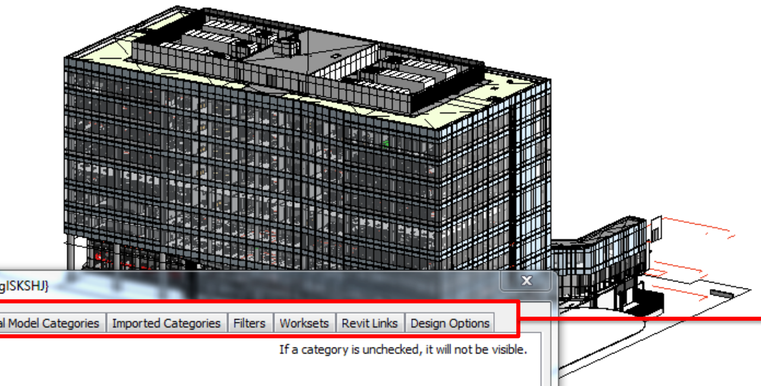


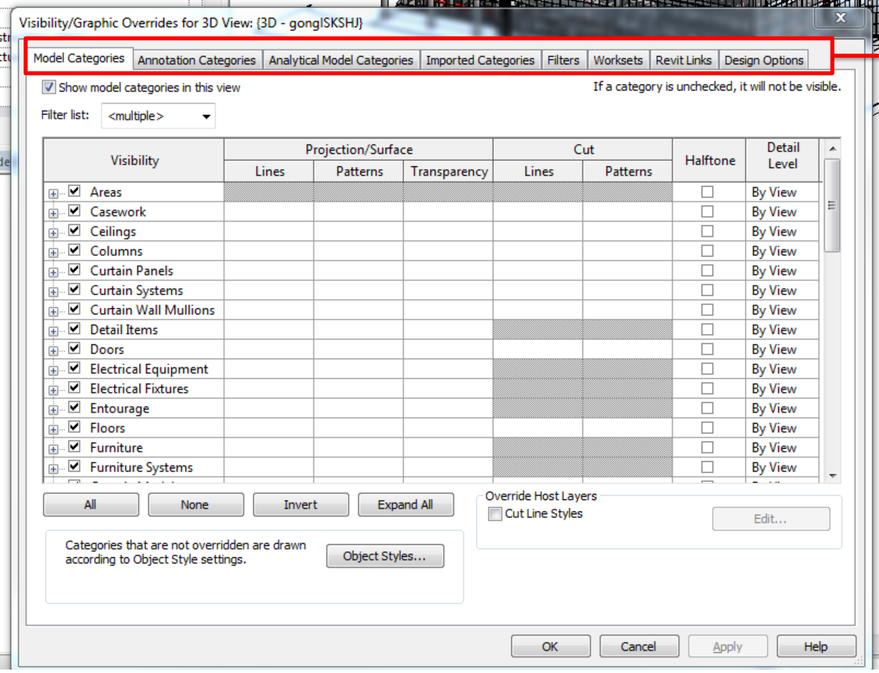
See attached video

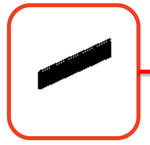
5D Top-down: Revit Export











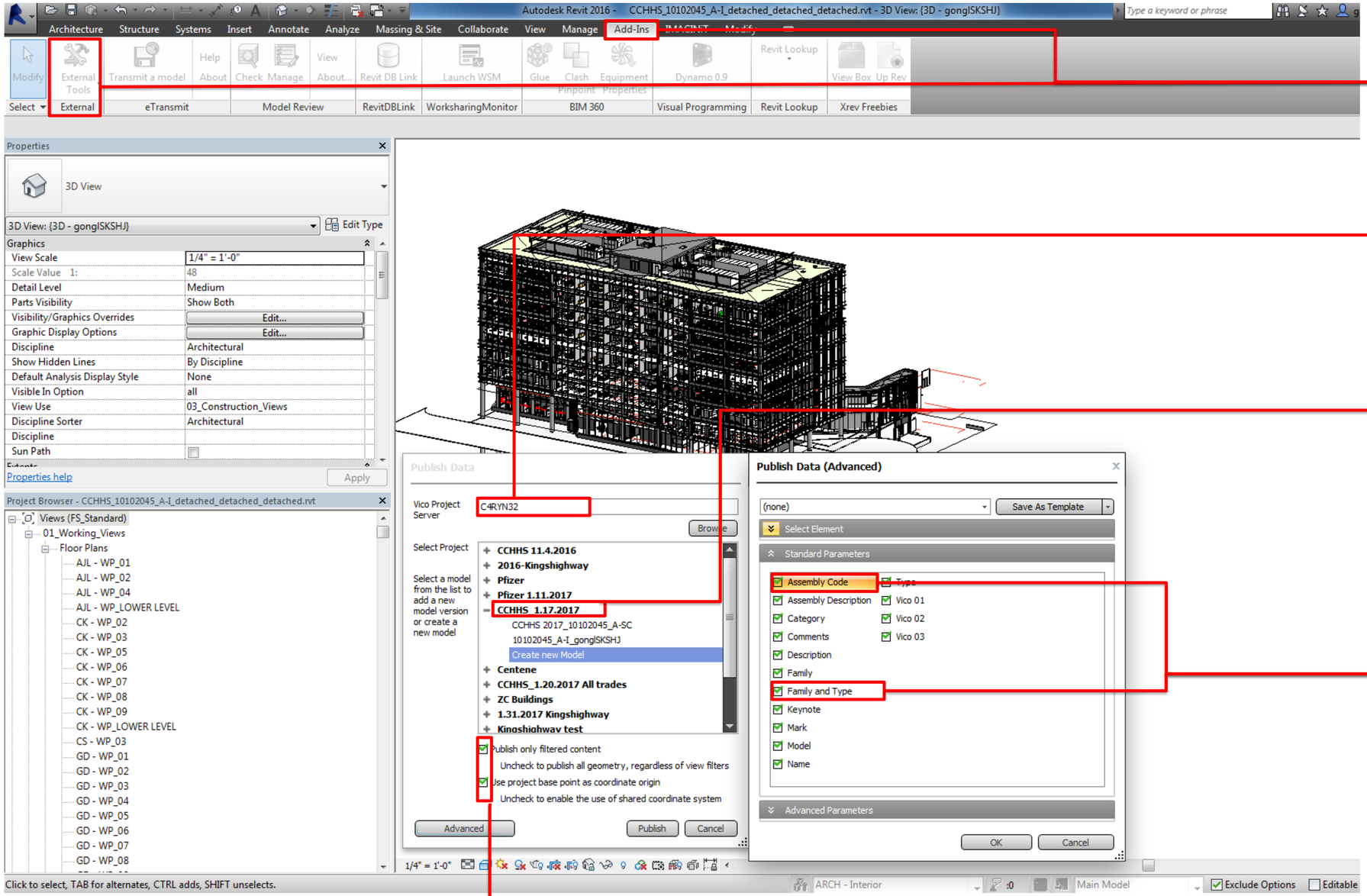
Make sure no **floating objects** are presented in view.

Check **Visibility Overrides** in Revit.

Only visible objects will be exported into VICO.

Shortcut: VV

5D Top-down: Revit Export



VICO Add-in is located at Revit – Add-ins – External Tools – Publish to VICO office

Export to the estimator's computer name.

Set up new project CCHHS in VICO. CCHHS will be listed on the projects in the Publish Data window.

Make sure **Assembly codes** and **Family and Type** are checked. The structure of VICO is based on Uniformat Elemental Classification. Attached please find the Uniformat file.

Make sure these are checked.

5D Top-down: Revit Export

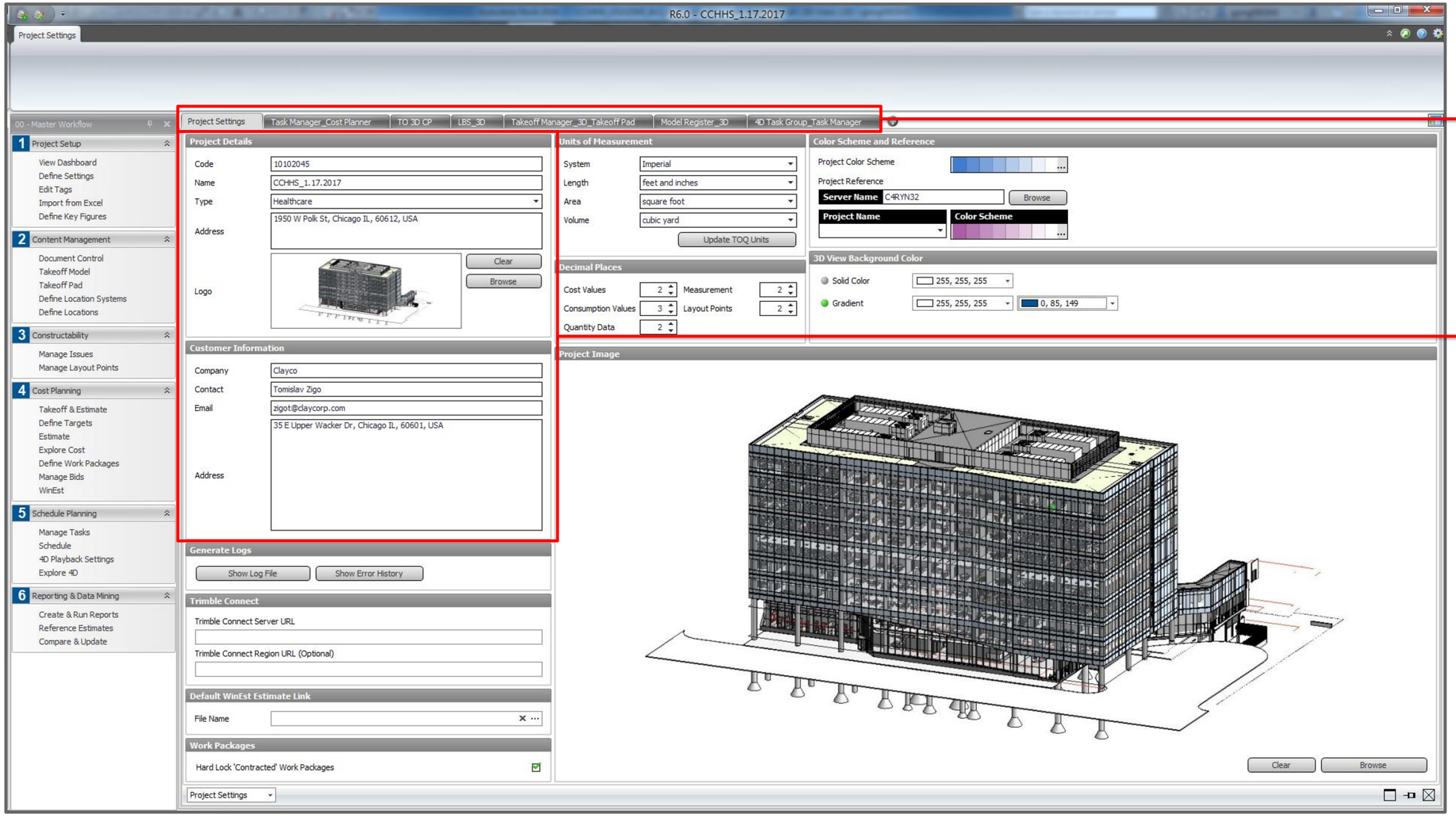
UNIFORMAT

UNIFORMAT II ELEMENTAL CLASSIFICATION FOR BUILDIONG SPECIFICATIONS, COST ESTIMATING, AND COST ANALYSIS

ASTM Uniformat II Classification for Building Elements (E1557-97)

Level 1 Major Group Elements	Level 2 Group Elements	Level 3 Individual Elements
A SUBSTRUCTURE	A10 Foundations	A1010 Standard Foundations A1020 Special Foundations A1030 Slab on Grade
	A20 Basement Construction	A2010 Basement Excavation A2020 Basement Walls
B SHELL	B10 Superstructure	B1010 Floor Construction B1020 Roof Construction
	B20 Exterior Enclosure	B2010 Exterior Walls B2020 Exterior Windows B2030 Exterior Doors
	B30 Roofing	B3010 Roof Coverings B3020 Roof Openings
C INTERIORS	C10 Interior Construction	C1010 Partitions C1020 Interior Doors C1030 Fittings
	C20 Stairs	C2010 Stair Construction C2020 Stair Finishes
	C30 Interior Finishes	C3010 Wall Finishes C3020 Floor Finishes C3030 Ceiling Finishes
D SERVICES	D10 Conveying	D1010 Elevators & Lifts D1020 Escalators & Moving Walks D1090 Other Conveying Systems
	D20 Plumbing	D2010 Plumbing Fixtures D2020 Domestic Water Distribution D2030 Sanitary Waste D2040 Rain Water Drainage D2090 Other Plumbing Systems
	D30 HVAC	D3010 Energy Supply D3020 Heat Generating Systems D3030 Cooling Generating Systems D3040 Distribution Systems D3050 Terminal & Package Units D3060 Controls & Instrumentation D3070 Systems Testing & Balancing D3090 Other HVAC Systems & Equipment
	D40 Fire Protection	D4010 Sprinklers D4020 Standpipes D4030 Fire Protection Specialties

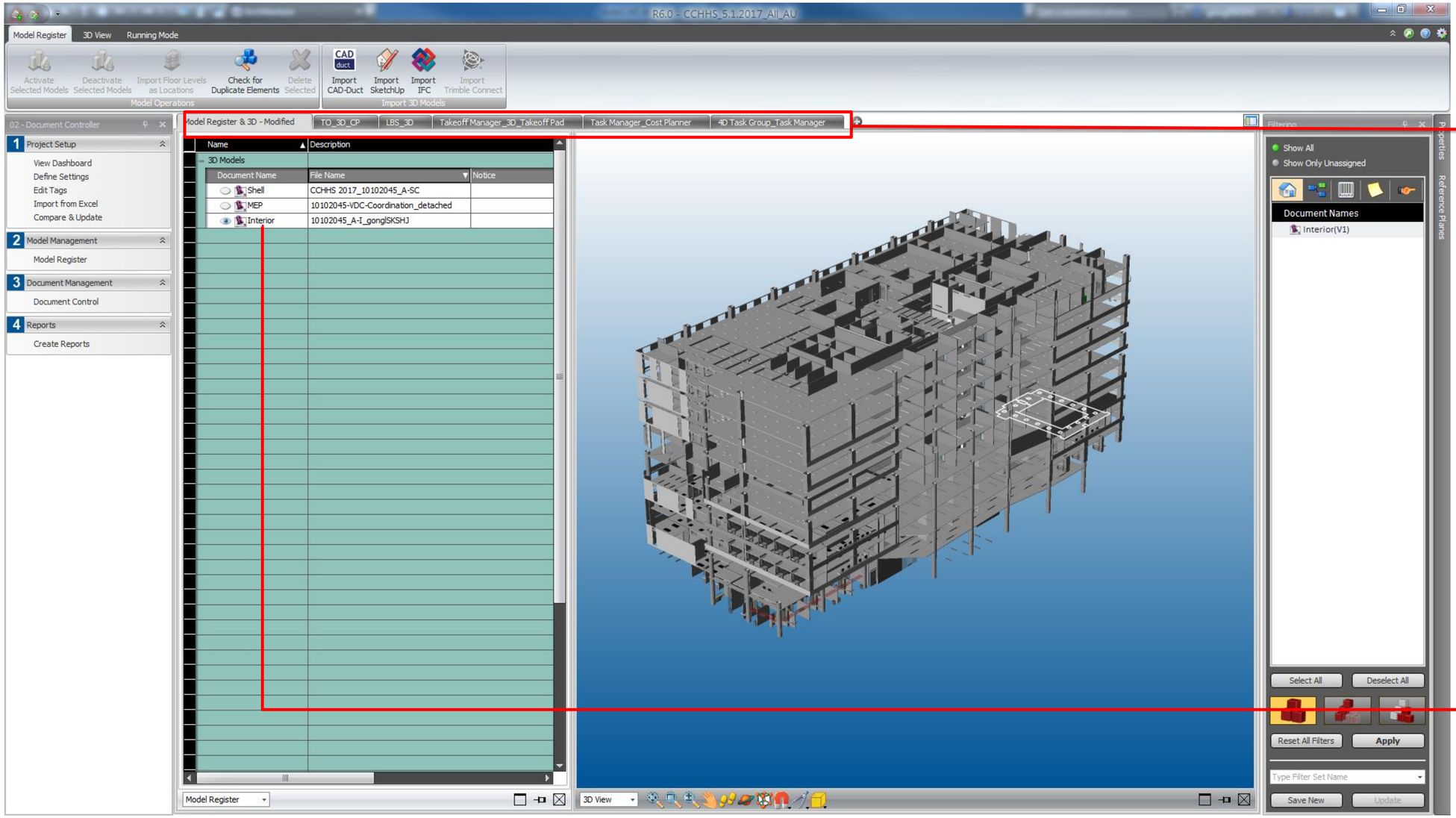
5D Top-down: Project Settings



Customized combined window views

Project basic information

5D Top-down: Model Register

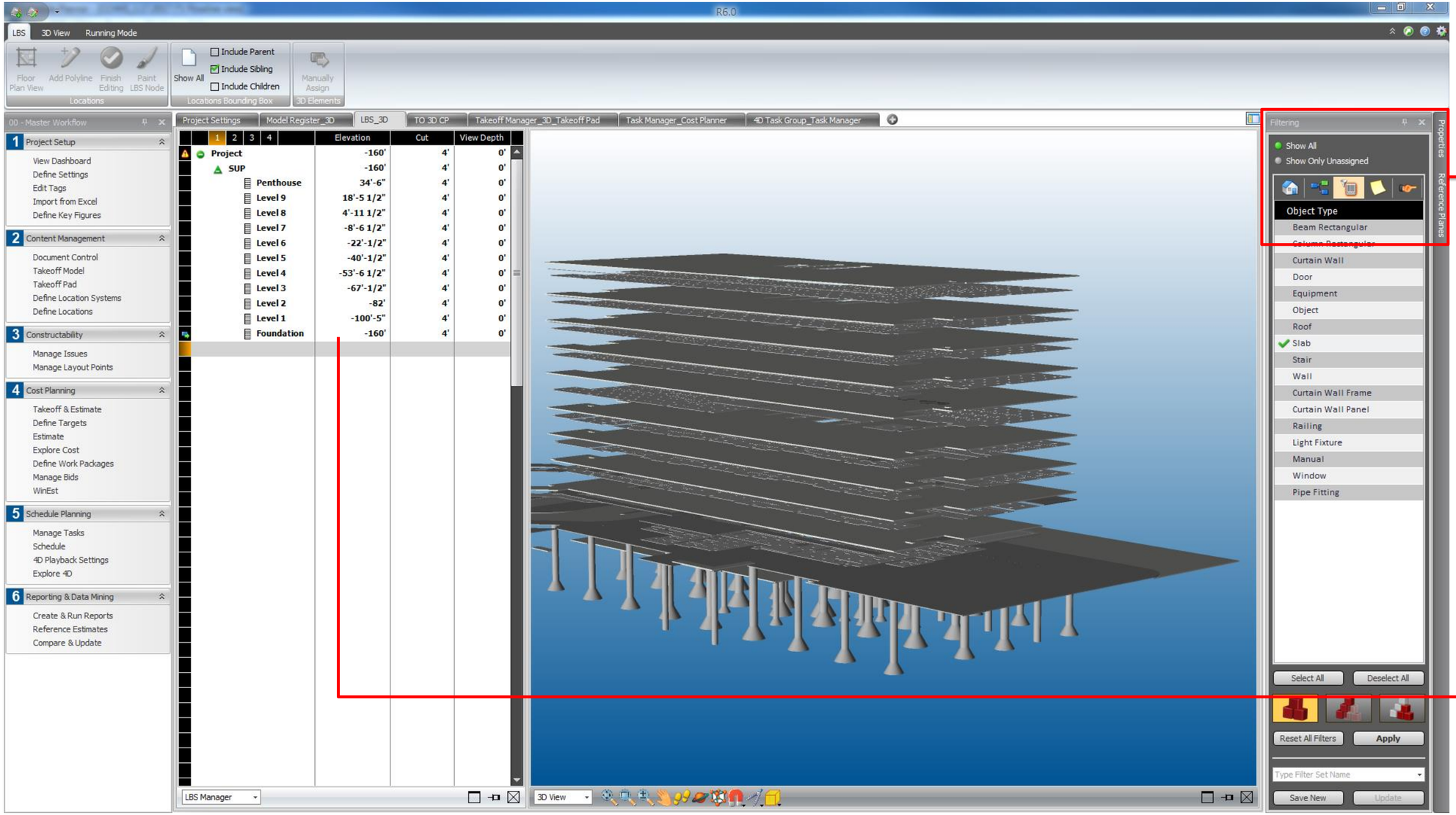


Suggested customized combined window views: Model Register_3D, LBS Manager_3D, Takeoff Manager_3D View_Cost Planner, Takeoff Manager_3D View_Takeoff Pad, Task Manager_Cost Planner, 4D Task Group_Task Manager.

Revit exported model (Shell, interior, MEP, etc.) will be listed here. Select the model for takeoff and right click to activate. Only selected model will be shown in the 3D View.

5D Top-down: LBS (Location Based Schedule Manager)_3D View Vertically

The divided zones in this module will facilitate categorizing the following takeoffs and scheduling based on locations.

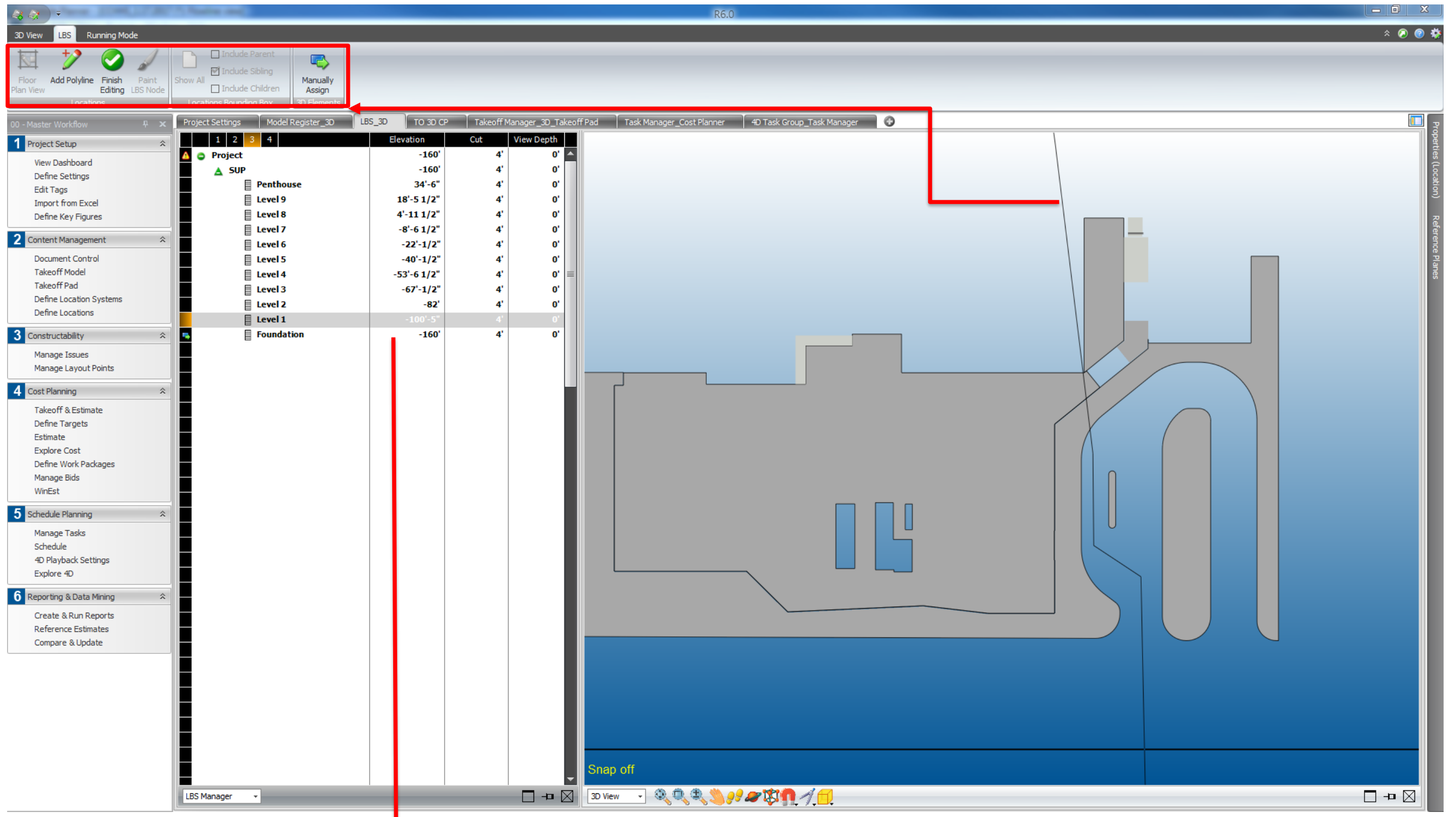


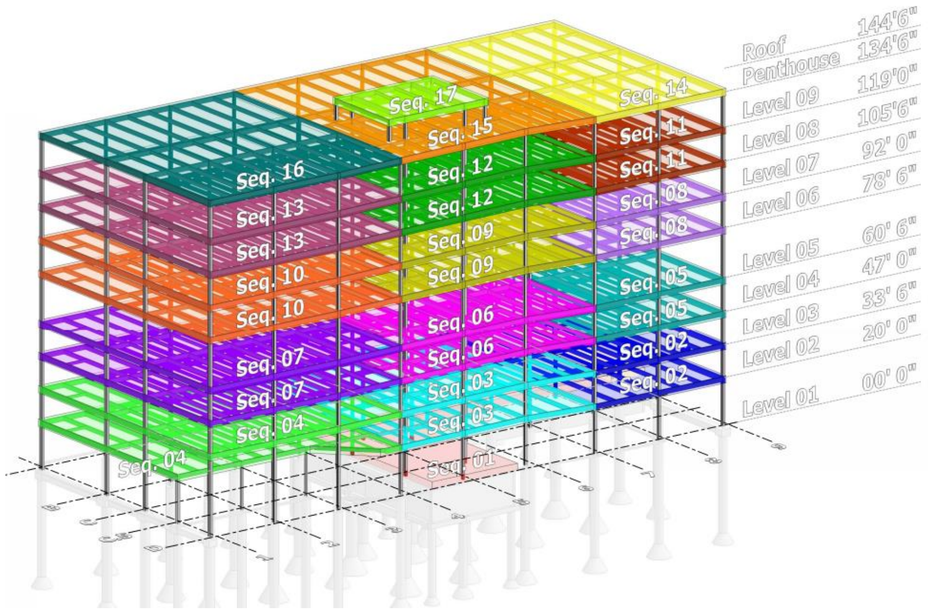
Filtering: filter the types to be shown exclusively in 3D view. Properties: click on object to see its quantities information

Right click on each level: 1) Define level Z value from 3D model 2) Manually assign 3D elements

5D Top-down: LBS (Location Based Schedule Manager)_3D View Horizontally

The divided zones in this module will facilitate categorizing the following takeoffs and scheduling based on locations.

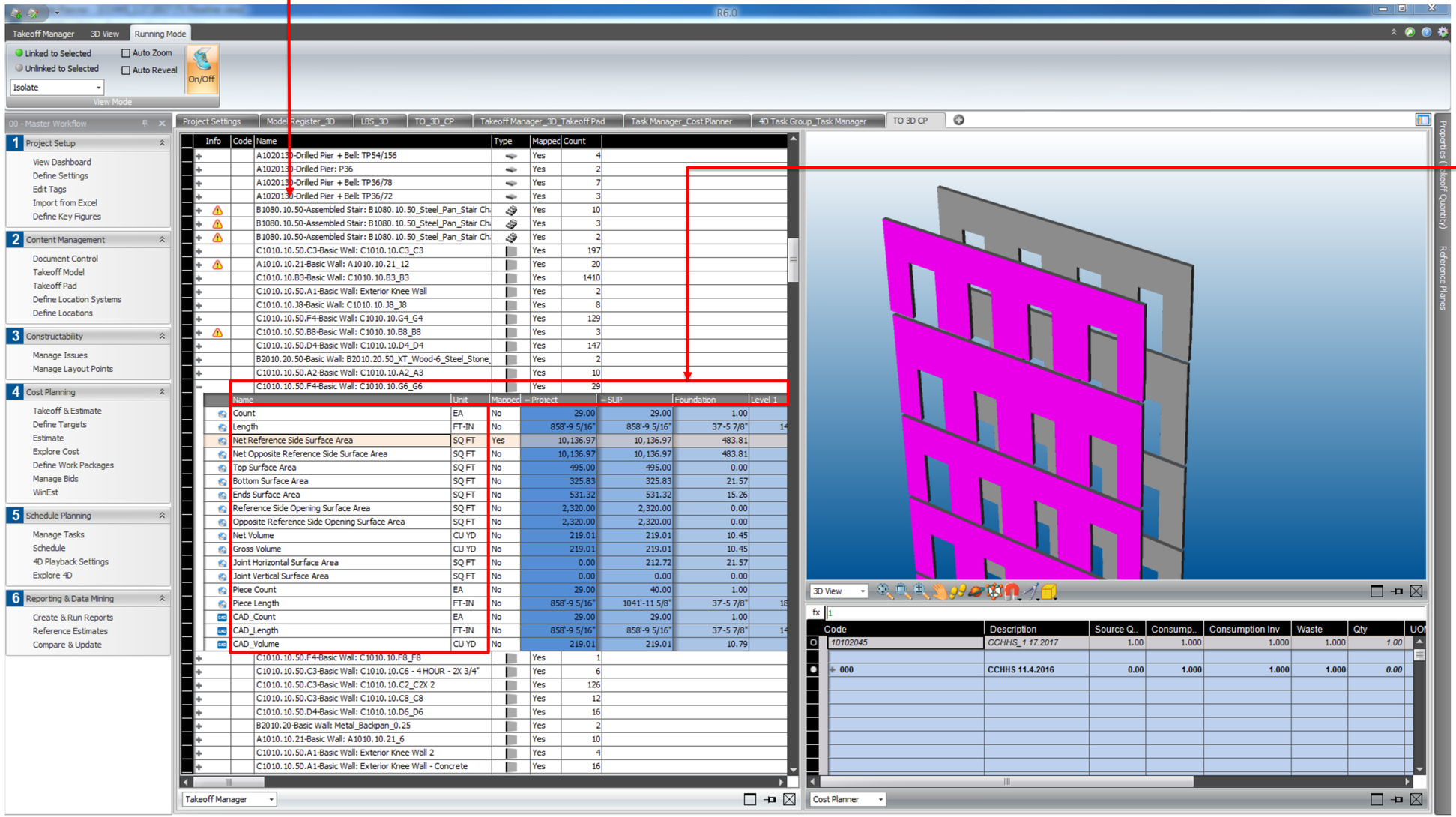




Right click on each level to access Floor Plan View.
In Floor Plan View, Polylines can be drawn to divide zones based on project's needs.

5D Top-down: Takeoff Manager_3D View_Cost Planner

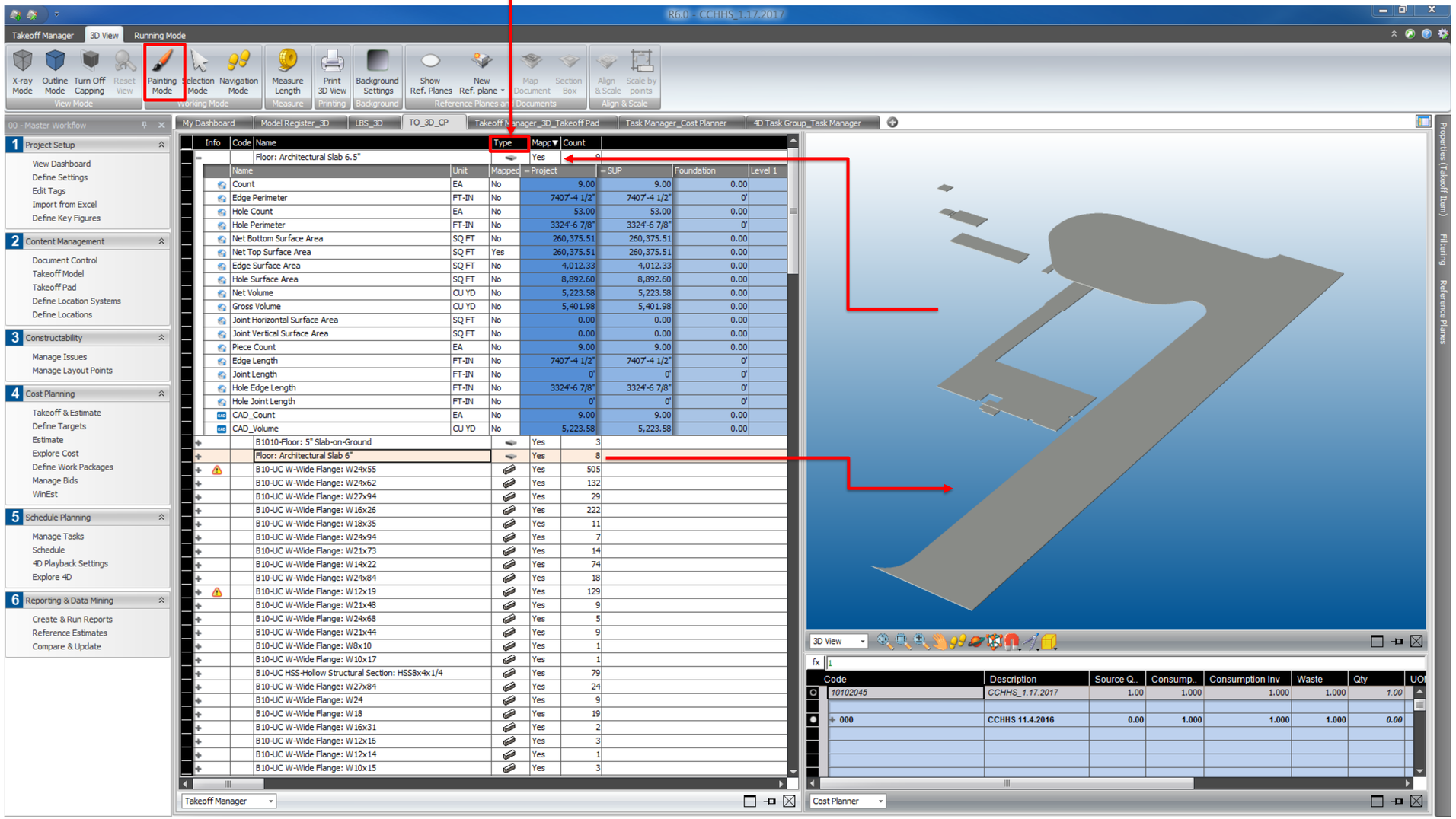
TOIs (Takeoff Items) are organized by **assembly codes** and **family and types**. That is why these two parameters must be exported from Revit.



Quantity parameters are calculated under TOI. Data are divided by zones defined in previous LBS Manager. Click on Net Reference Surface Area, the corresponding area will be highlighted in pink in the 3D View.

5D Top-down: Takeoff Manager_3D View_Cost Planner

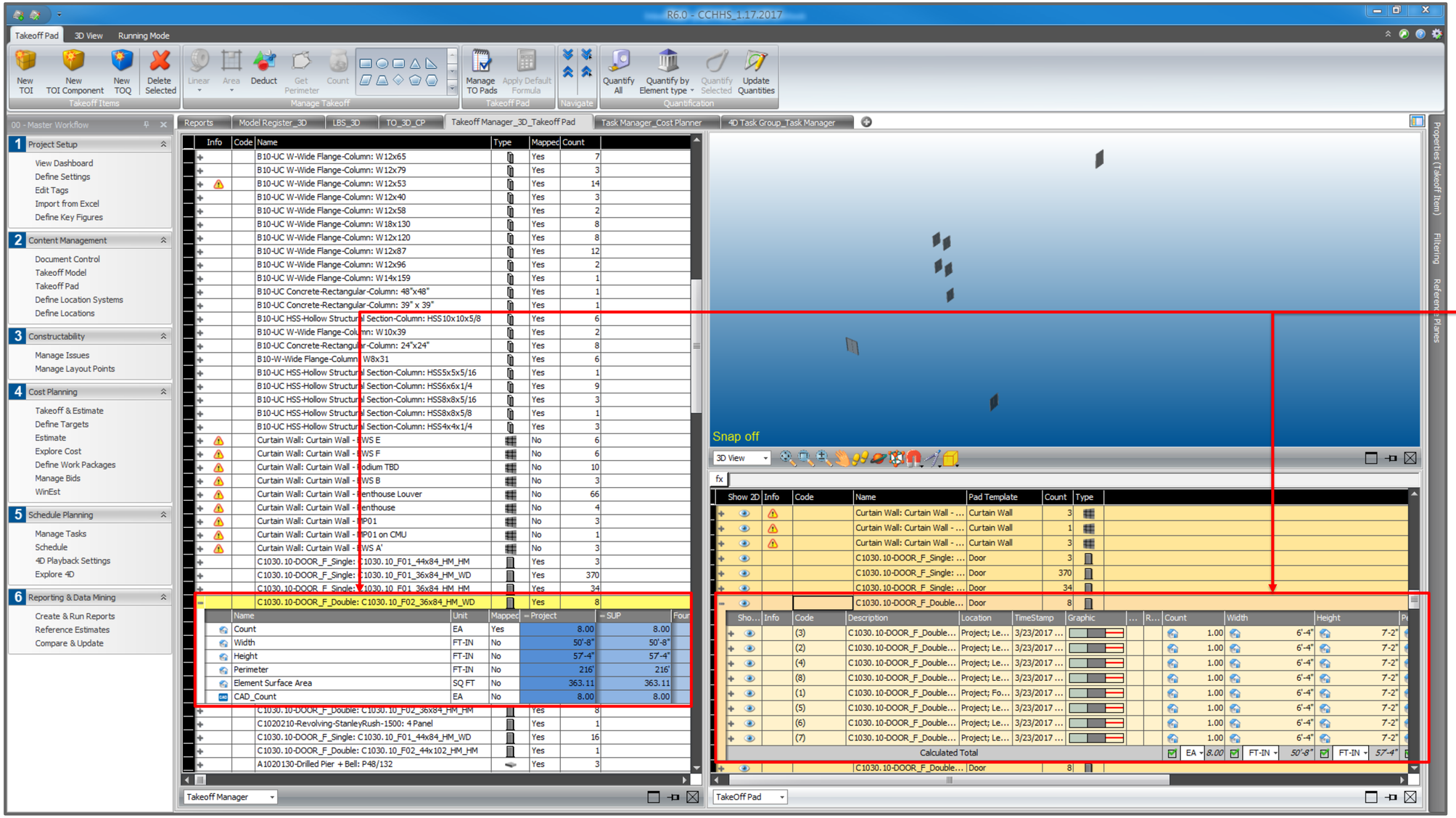
TOIs types include Beam Rectangular, Column Rectangular, Curtain Wall, Curtain Wall Frame, Curtain Wall Panel, Door, Equipment, Light Fixture, Object, Pipe Fitting, Railing, Roof, Slab, Stair, Wall and Window.



Painting Mode allows to allocate (add and deduct) the Takeoff Quantities to different Takeoff Items. New TOI can be created by right click in the Takeoff Manager.

5D Top-down: Takeoff Manager_3D_Takeoff Pad

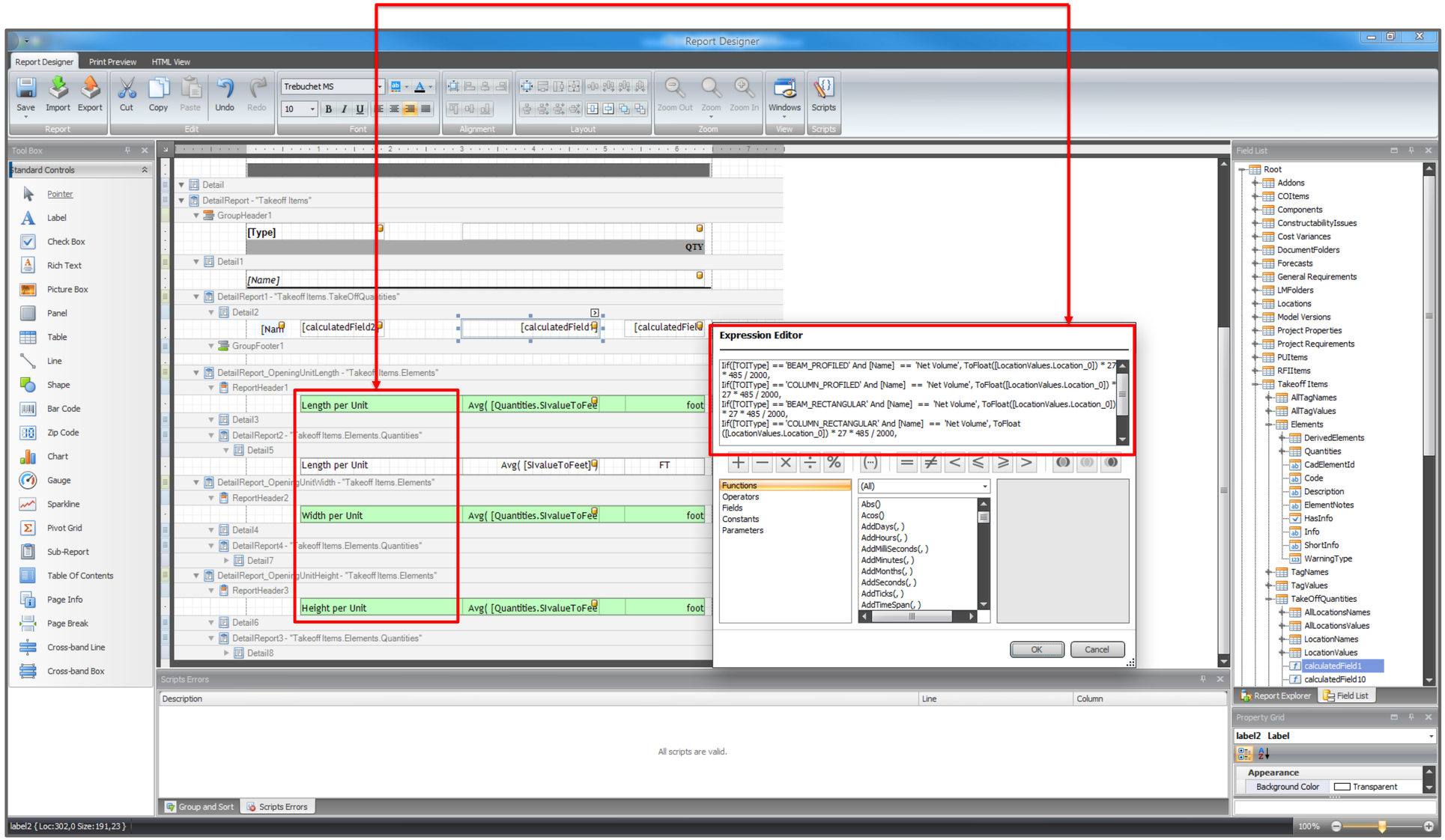
Takeoff Pad is a breakdown of TOI in Takeoff Manager



Take the HM door TOI as an example, the total Width and Height in Takeoff Pad equals to the Width and Height in Takeoff Manager

5D Top-down: Creating Takeoff Report

Please see the attached customized Clayco quantity takeoff report template. Besides the TOQ in Takeoff Manager, customized TOQ can be created in Expression Editor.

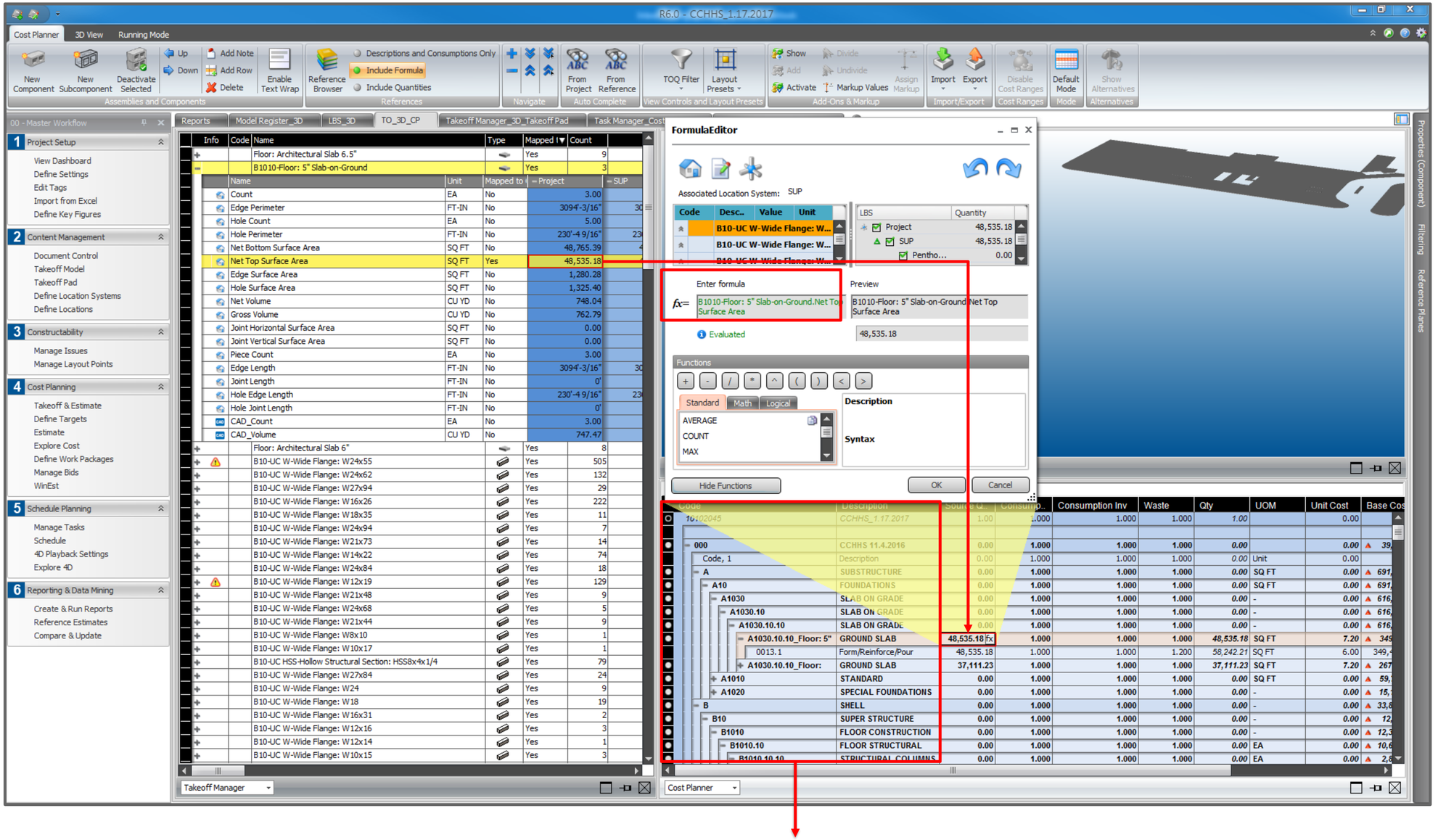


5D Top-down: Creating Takeoff Report

CCHHS Takeoffs

Code 1	Code 2	Code 3	Code 4	Code 5	Code 6	Code 7	Description	Unit	Quantities
#1000							Alternatives		
	C						INTERIORS		
		C10					Interior Construction		
			C1010				Fixed Partitions		
				C1010.10			INTERIOR FIXED PARTITIONS		
					C1010.10.50		METAL STUD FRAMING		
						C1010.10.50.C3-C1010.10.C3_C3	METAL STUD FRAMING_C3	SQ FT	44,547.42
						C1010.10.50.D4-C1010.10.D4_D4	METAL STUD FRAMING_D4	SQ FT	6,555.29
						C1010.10.B3-Basic Wall: C1010.10.B3_B3	METAL STUD FRAMING_B3	FT-IN	1,289.87
						C1010.10.B6-Basic Wall: C1010.10.B2_B6	METAL STUD FRAMING_B6	SQ FT	1,969.32
						C1010.10.50.F4-C1010.10.F4_F4	METAL STUD FRAMING_F4	SQ FT	49,076.60
						C1010.10.50.A2-C1010.10.A2_A2	METAL STUD FRAMING_A2	SQ FT	1,654.24
						C1010.10.50.A2-Basic Wall: Exterior Column	Column Wrap	SQ FT	1,440.04
						C1010.10.50.A1-Exterior Knee Wall	FURRING STUD	SQ FT	1,909.69
						C1010.10.A3-Basic Wall: Column Cover Walls	FURRING STUD	SQ FT	298.09
					C1010.10.J8		CMU		
						C1010.10.J8-C1010.10.J8_J8	CMU_J8	SQ FT	6,480.75
			C1030				INTERIOR DOORS		
				C1030.10			INTERIOR SWING DOORS		
					C1030.10-C1030.10_F01_44x84_HM_HM		SWING DOOR_44x84_HM_HM	EA	3.00
					C1030.10-C1030.10_F01_36x84_HM_HM		SWING DOOR_36x84_HM_HM	EA	6.00
					C1030.10-C1030.10_F02_36x84_HM_HM		SWING DOOR_36x84_HM_HM	EA	34.00
					C1030.10-C1030.10_F01_36x84_HM_WD		SWING DOOR_36x84_HM_WD	EA	12.00
					C1020210-4 Panel		REVOLVER	EA	1.00
					C1030.10-C1030.10_F02_44x102_HM_HM		SWING DOOR_44x102_HM_HM	EA	1.00

5D Top-down: Takeoff Manager_3D View_Cost Planner

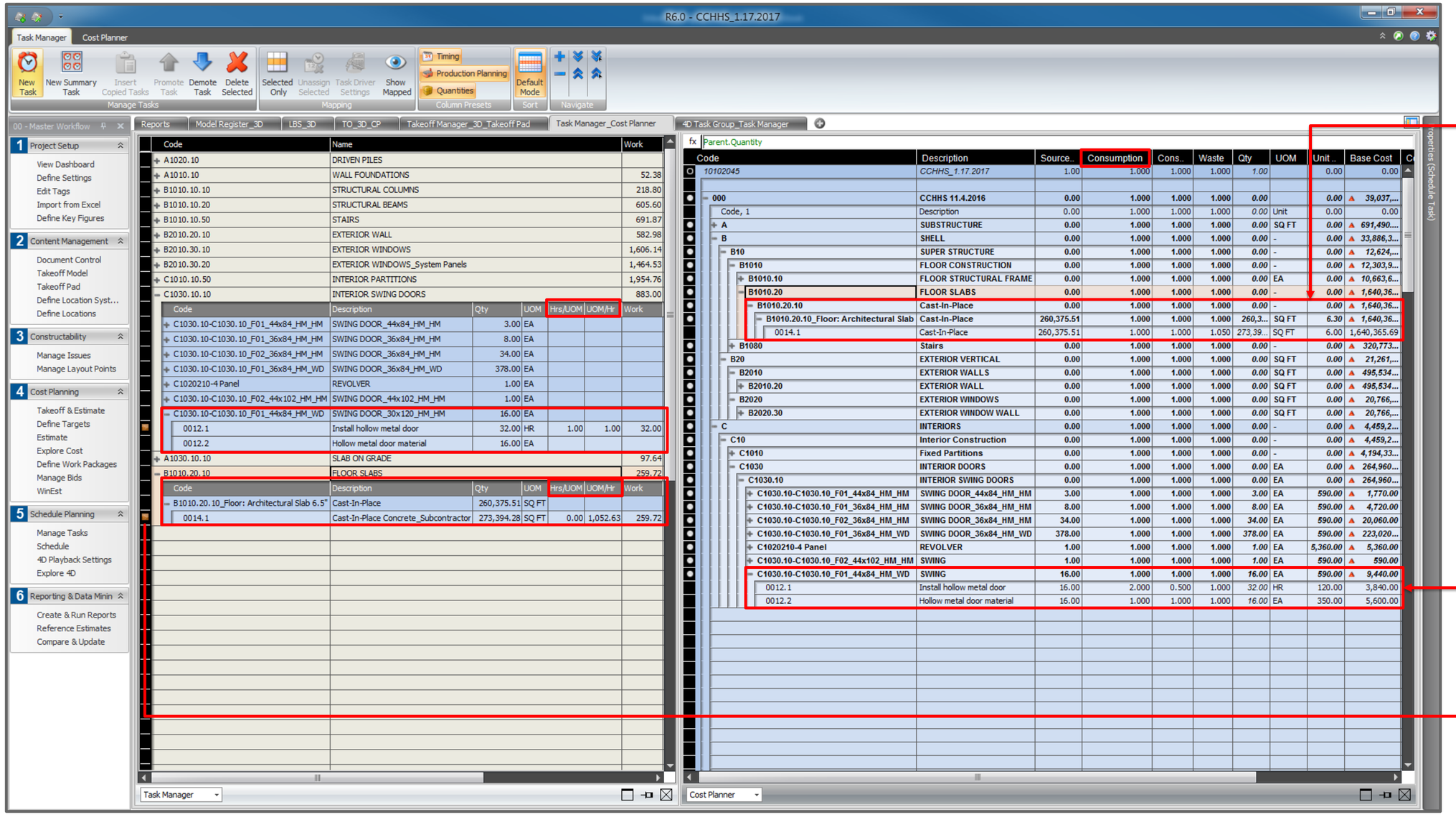


Map TOIs from Takeoff Manager to Cost Planner by dragging the TOQ and dropping to the Source Qty. The mapping routine will be shown in the formulas under Source Qty.

The estimates structure in Cost Planner is organized by **Assembly codes** in Uniformat Elemental Classification. Attached please find the Uniformat file.

5D Top-down: Task Manager_Cost Planner

Task Manager provides the interface for defining Tasks and for mapping cost assemblies and components (labor, material, and equipment) to these Tasks using drag-and-drop.

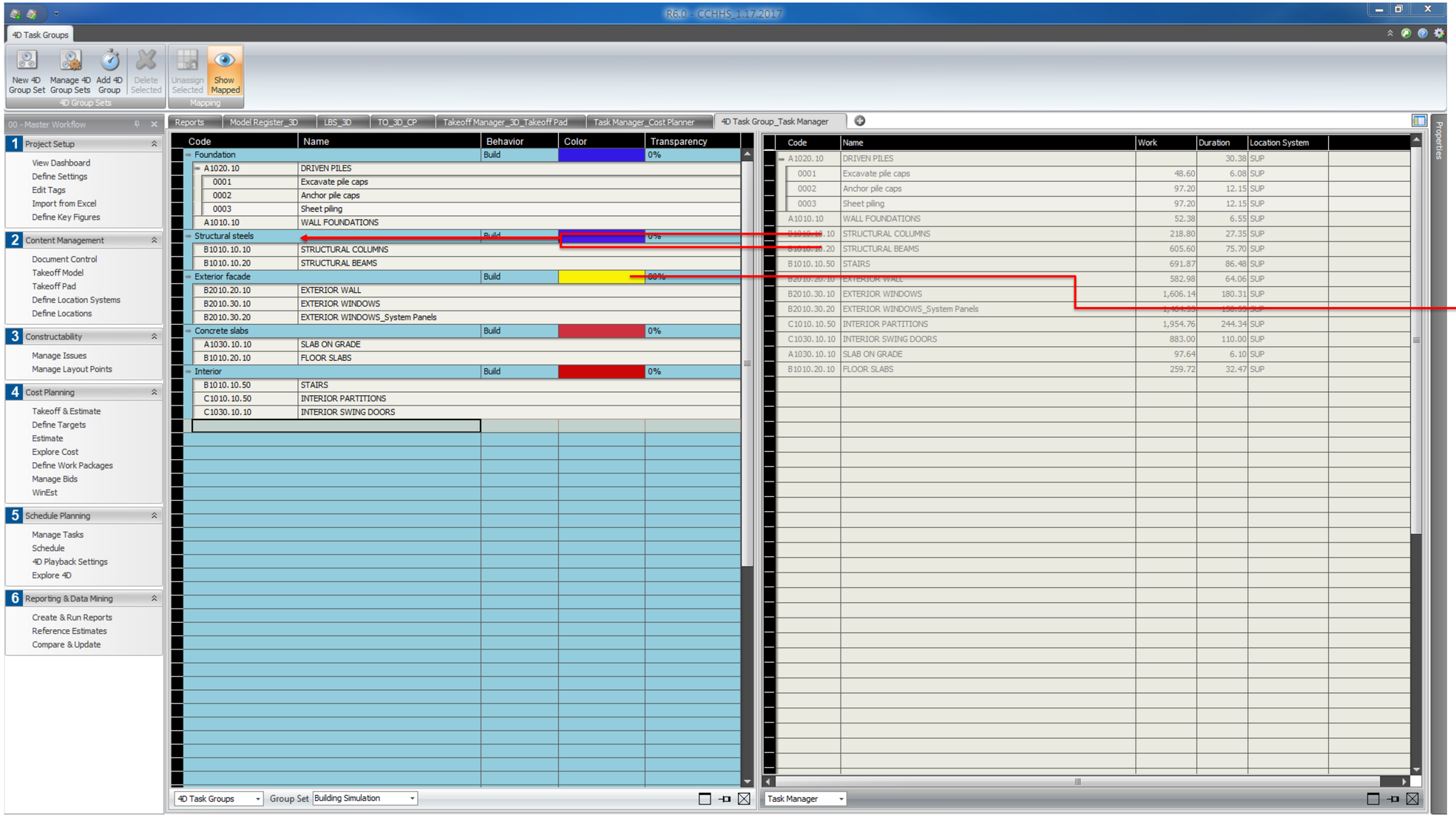


Tasks can be added by
1) a single task by subcontractor Or
2) self-performing labor work and material supplied

Task Drivers
are defined by adding hours/unit (consumption rate) or units/hour to cost component

5D Top-down: 4D Task Group_Task Manager

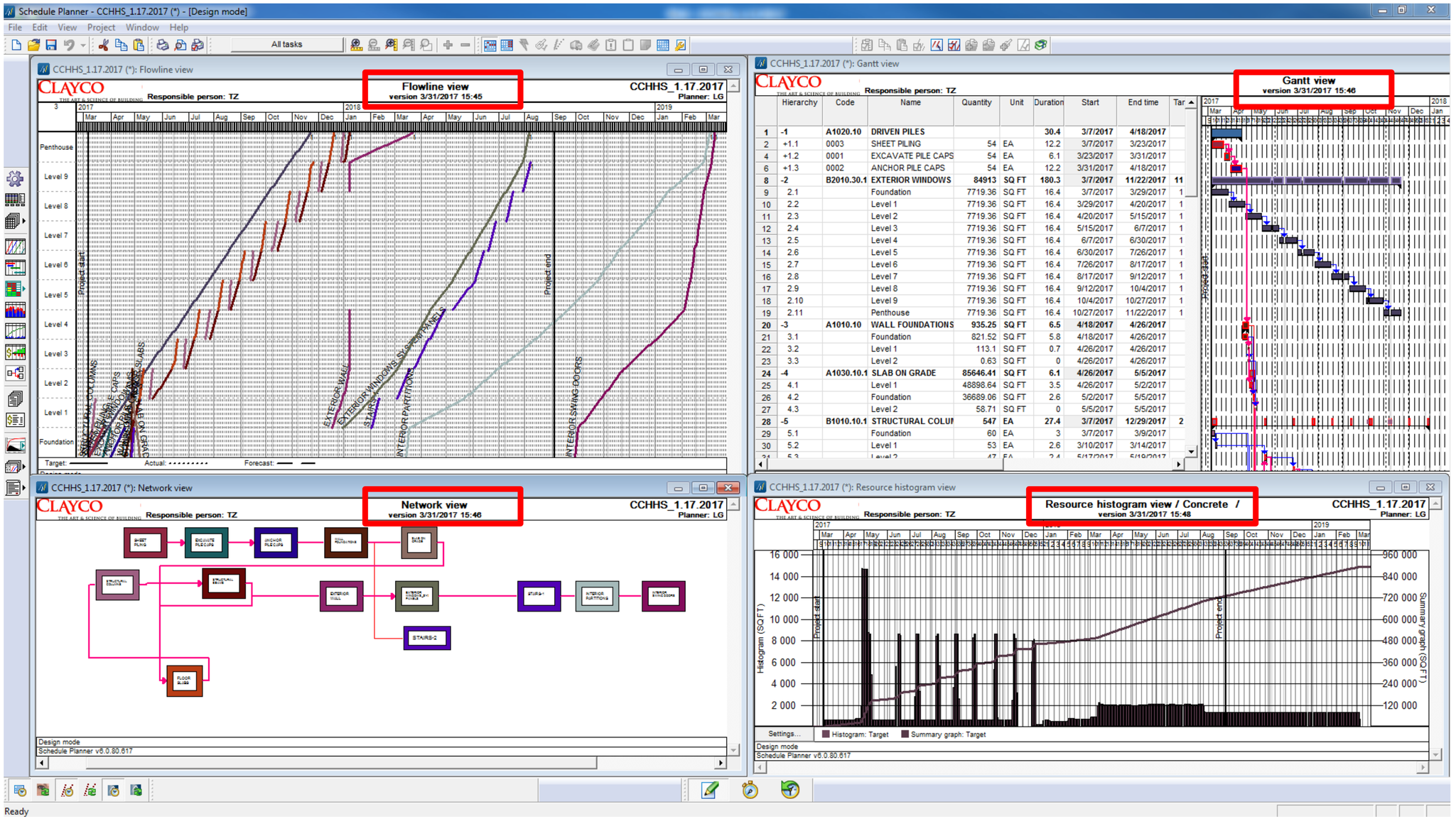
4D Task Group allows to create a movie for different task groups. Map the tasks from Task Manager to 4D Task Group by dragging and dropping under each subcontracting category. Pick the colors to represent each of the major task categories for that Sub.



Define colors to present different tasks in the following 4D schedule simulation.

5D Top-down: Schedule Planner

Views to define task sequence: Network View → Flowline View → Gantt View → Resource View



CLAYCO

THE ART & SCIENCE OF BUILDING

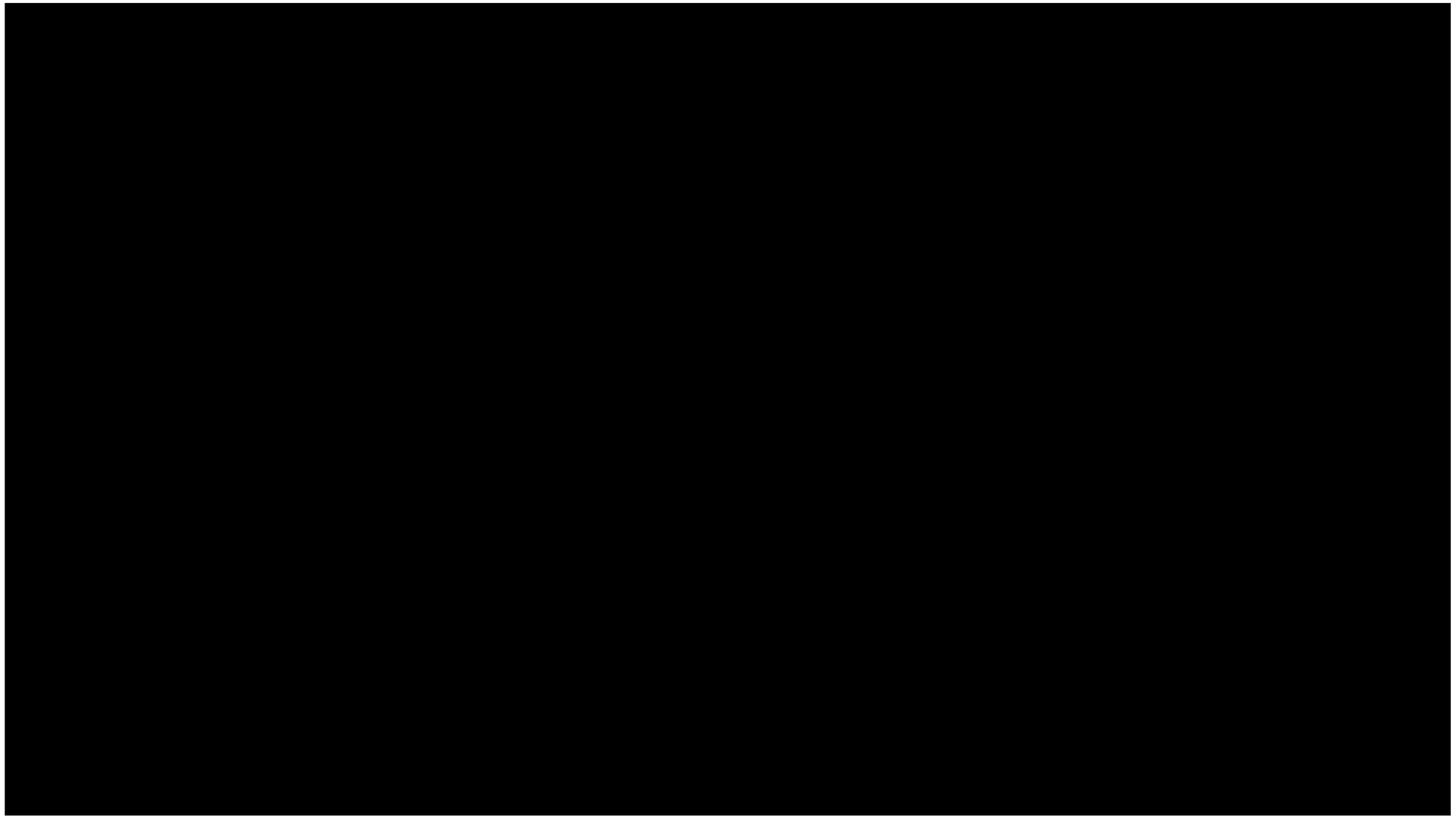
5D Bottom-up

100 Kingshighway will be a 36-story, luxury apartment tower overlooking Forest Park.

Once complete, tower will be tallest residential building in the city of St. Louis. Along with the building's size, another striking feature will be the project's incredible modernist exterior, designed by Studio Gang. The large expanses of glass facade are intended to give the building's residents a range of natural lighting and sweeping views of the park and city. Clayco's subsidiary, Ventana was selected to design, manufacture, and install the exterior window systems.

The base of the tower will be a mix of retail space, apartment amenity space, and parking. The parking garage will have a 185-vehicle capacity. Concrete Strategies is providing the reinforced concrete structure. The tower itself will contain 316 apartment units. The project broke ground in the Spring of 2018.

5D Bottom-up: Workflow_ Explore 5D

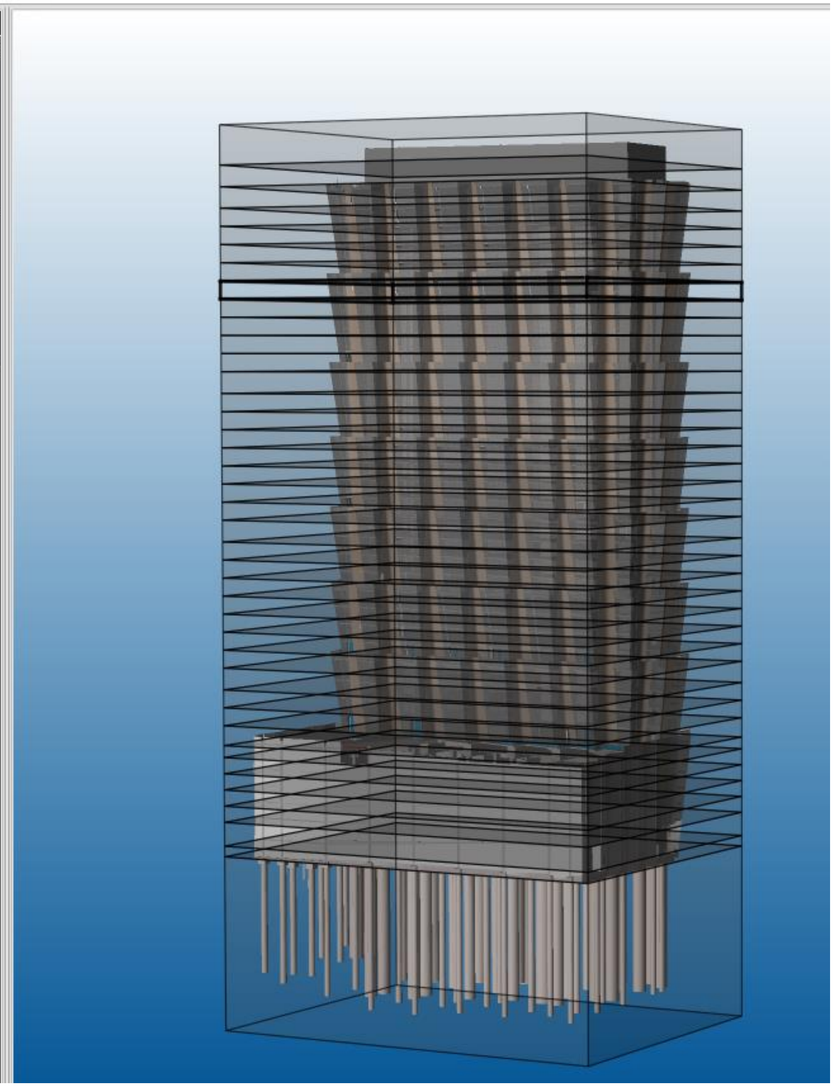


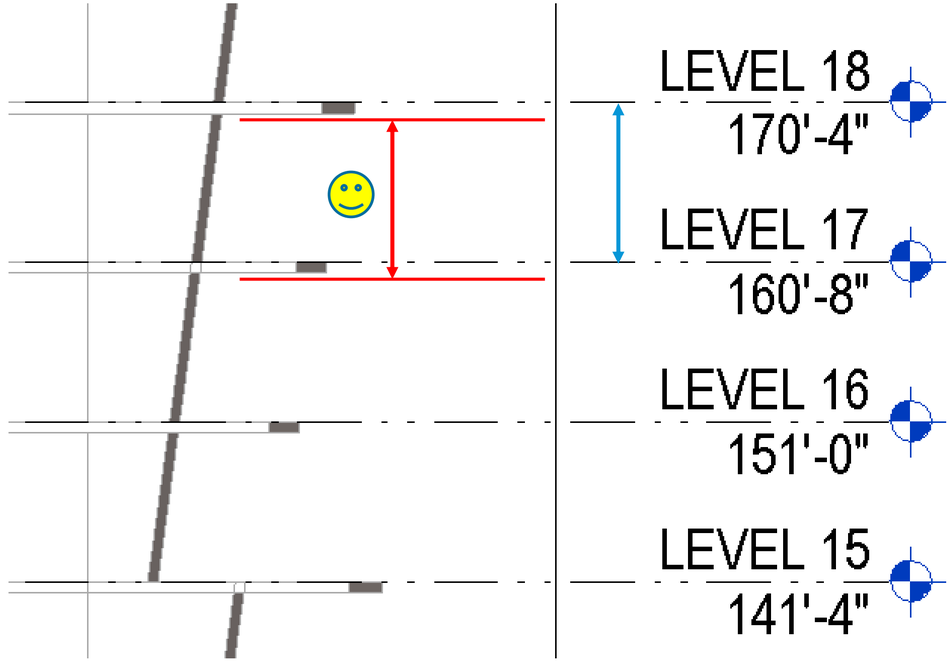
See attached video

5D Bottom-up: LBS Slicing Floors

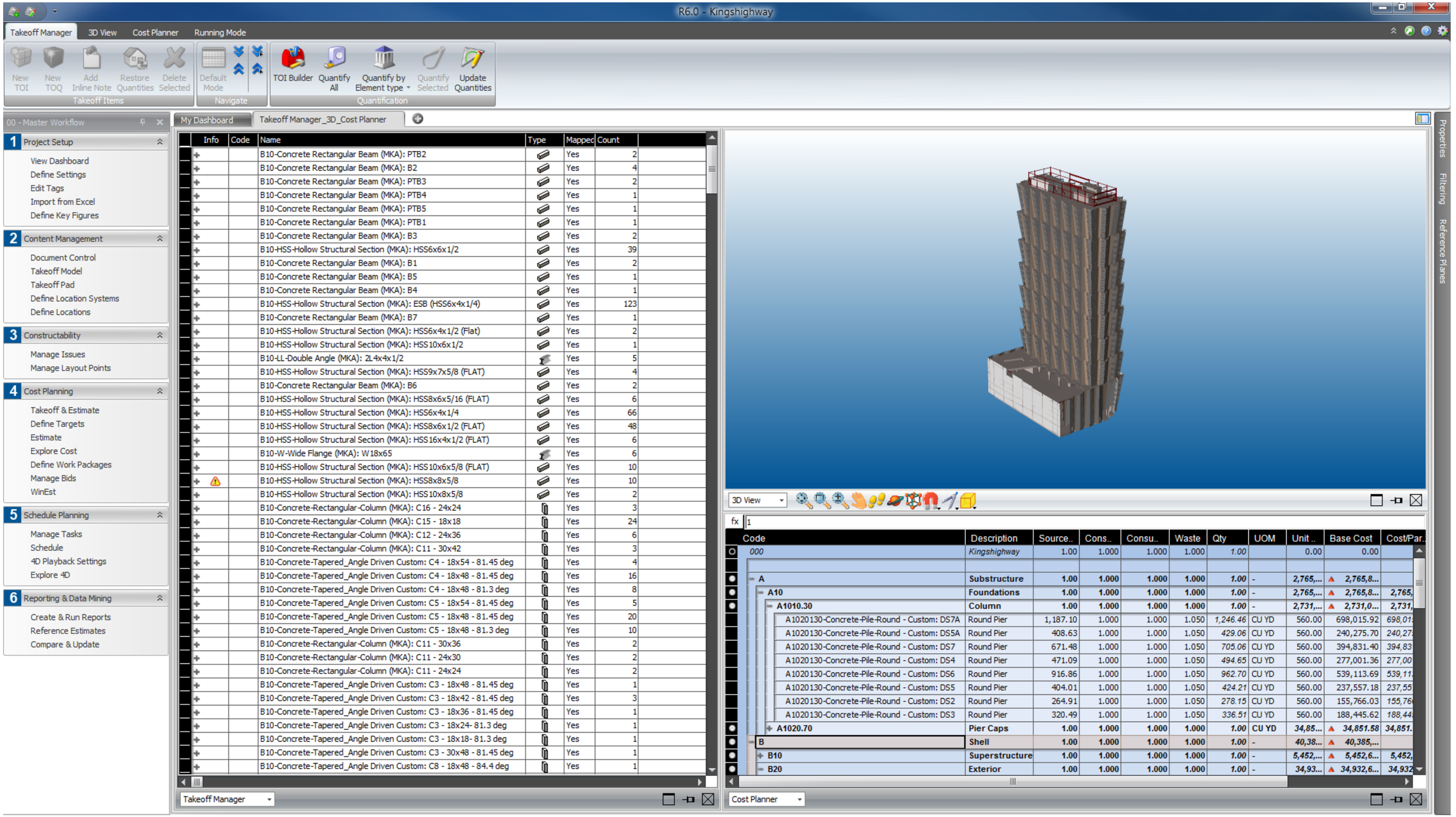
My Dashboard | Takeoff Manager_3D_Cost Planner | LBS_3D

1 2 3	Elevation	Cut	View Depth
Project	-94'-2 1/8"	4'	0'
Roof	370'-2"	4'	0'
Level 37	358'-8"	4'	0'
Level 36	347'-4"	4'	0'
Level 35	337'-8"	4'	0'
Level 34	328'	4'	0'
Level 33	318'-4"	4'	0'
Level 32	308'-8"	4'	0'
Level 31	299'	4'	0'
Level 30	289'-4"	4'	0'
Level 29	279'-8"	4'	0'
Level 28	270'	4'	0'
Level 27	260'-4"	4'	0'
Level 26	248'-8"	4'	0'
Level 25	239'	4'	0'
Level 24	229'-4"	4'	0'
Level 23	219'-8"	4'	0'
Level 22	210'	4'	0'
Level 21	200'-4"	4'	0'
Level 20	190'-8"	4'	0'
Level 19	181'	4'	0'
Level 18	169'-4"	4'	0'
Level 17	159'-8"	4'	0'
Level 16	150'	4'	0'
Level 15	140'-4"	4'	0'
Level 14	130'-8"	4'	0'
Level 13	121'	4'	0'
LEVEL 12	111'-4"	4'	0'
LEVEL 11	101'-8"	4'	0'
LEVEL 10	90'	4'	0'
LEVEL 9	80'-4"	4'	0'
LEVEL 8	70'-8"	4'	0'
LEVEL 7	60'	4'	0'
LEVEL 6	53'-7"	4'	0'
LEVEL 5	44'-10"	4'	0'
LEVEL 4	36'-1"	4'	0'
LEVEL 3	27'-4"	4'	0'
LEVEL 2	18'-7"	4'	0'
LEVEL 1.5	5'-9"	4'	0'
LEVEL 1	0'	4'	0'
Foundation	-94'-2 1/8"	4'	0'



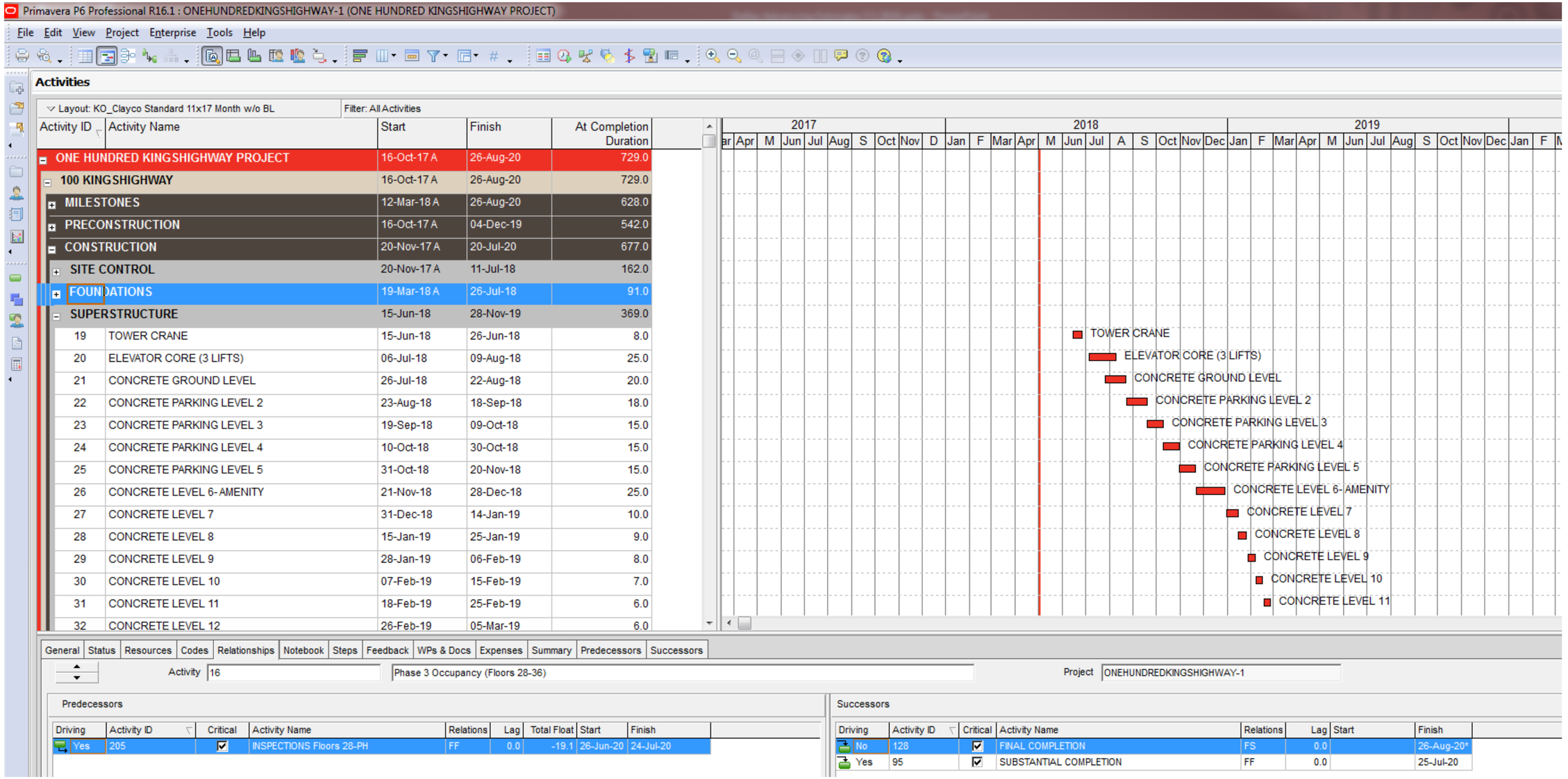


5D Bottom-up: Takeoffs and Costs



5D Bottom-up: Export P6 Schedule into XML File

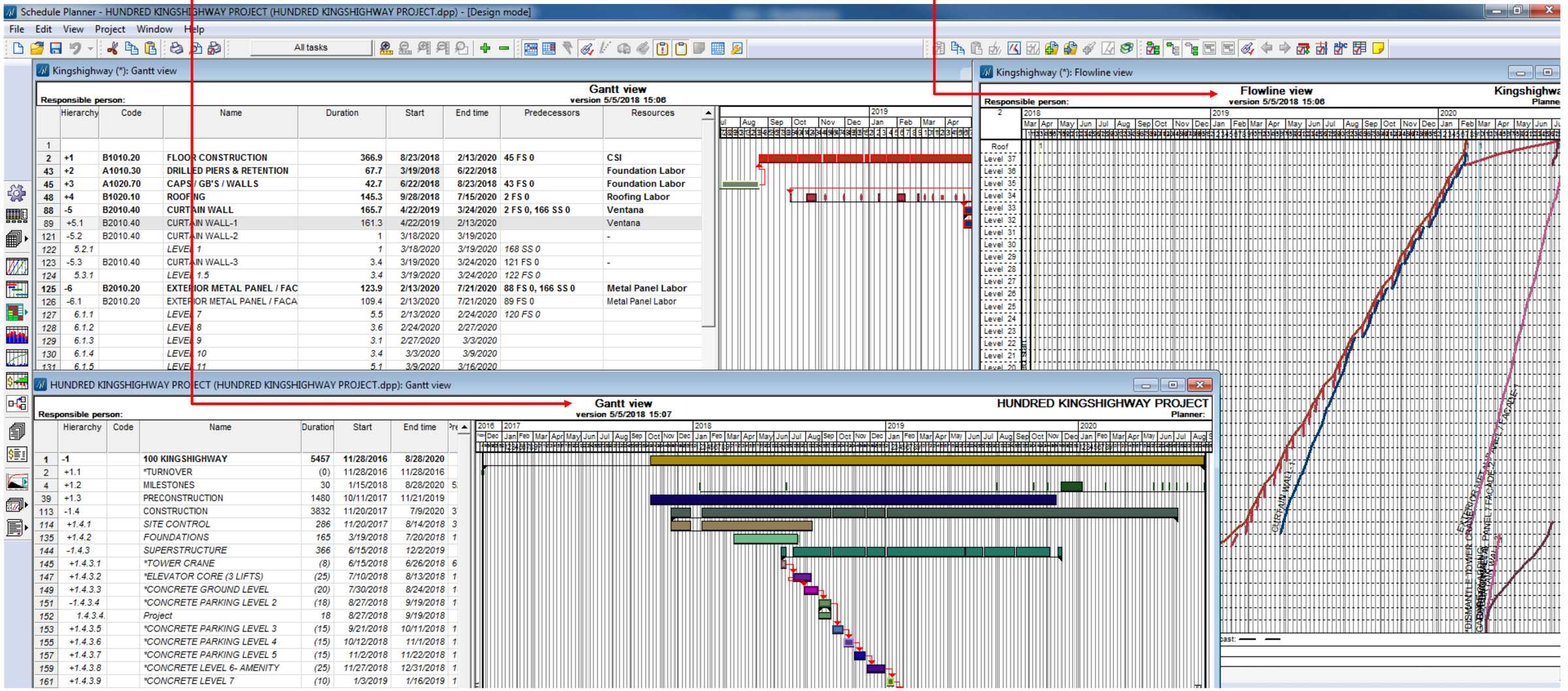
Schedule was originally built up by scheduler in P6



5D Bottom-up: Import XML into VSP and Map it to the existing project

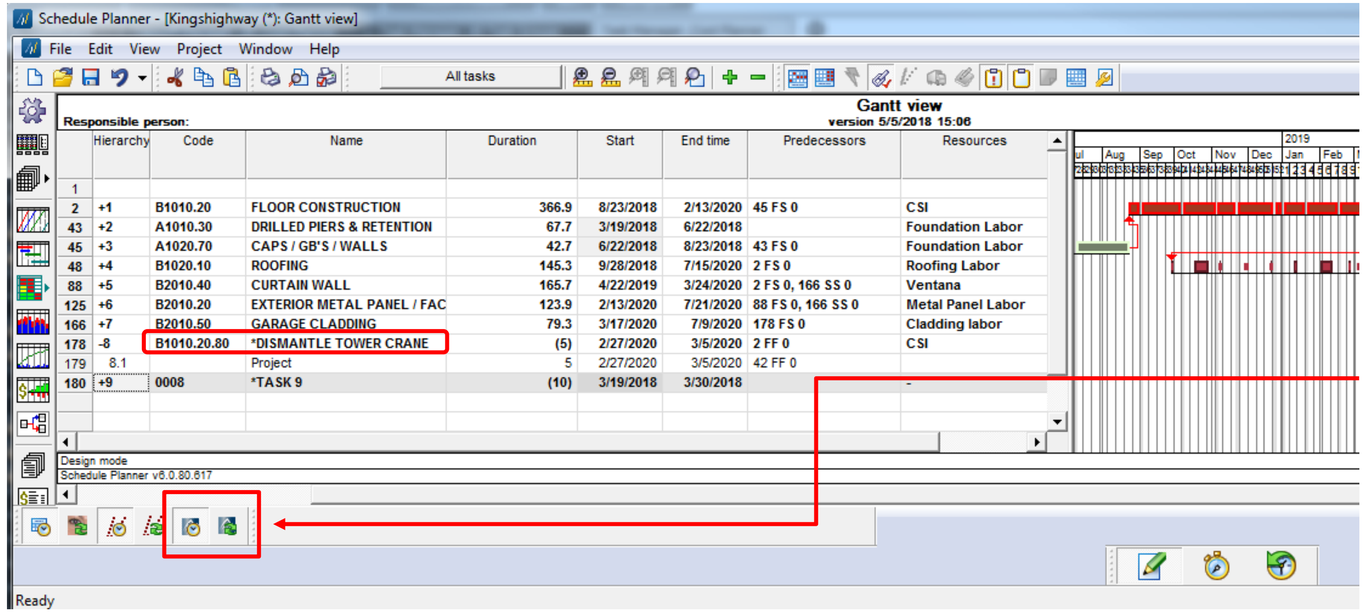
Imported original XML schedule

VICO project DPP schedule



5D Bottom-up: Costs and Tasks

Merging Point: Task Manager



Synchronize VSP Schedule with VICO Office

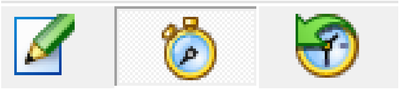
Map cost assemblies and components (labor, material, and equipment) to Tasks using drag-and-drop

My Dashboard | Takeoff Manager_3D_Cost Planner | Task Manager_4D Task Groups | Task Manager_Cost Planner

Code	Name	Work	Duration
B1010.20	Floor Construction	2,935.59	366.95
A1010.30	DRILLED PIERS & RETENTION	541.87	67.73
A1020.70	CAPS / GB'S / WALLS	341.68	42.71
B1020.10	ROOFING	1,162.35	145.29
B2010.40	CURTAIN WALL	1,325.54	165.69
C-AGM_...	Glass 117,64... SQ FT 0.01 100.00	1,176.49	
K-AGM_...	Glass 14,905.11 SQ FT 0.01 100.00	149.05	
B2010.20	EXTERIOR METAL PANEL / FACADE	991.10	123.89
B2010-B...	Metal Panels 78,546.47 SQ FT 0.01 80.00	981.83	
B2010-B...	Metal Panels 741.46 SQ FT 0.01 80.00	9.27	
B2010.50	GARAGE CLADDING	634.13	79.27
B2010-B...	8" Masonry 13,989.11 SQ FT 0.02 50.00	279.78	
KH-AGM...	Parking Screen 566.24 SQ FT 0.02 50.00	11.32	
KH-AGM...	Parking Screen 17,151.11 SQ FT 0.02 50.00	343.02	
B1010.20.80	Dismantle Tower Crane		5.00
0008	Task 9		10.00

Code	Description	Sour..	Cons..	Consum..	Waste	Qty	UOM	Unit Cost	Base Cost	Cost/Par..
000	Kingshighway	1.00	1.000	1.000	1.000	1.00		0.00	0.00	N/A
A	Substructure	1.00	1.000	1.000	1.000	1.00	-	2,765,858...	2,765,8...	N/A
B	Shell	1.00	1.000	1.000	1.000	1.00	-	40,385,32...	40,385,...	N/A
B10	Superstructure	1.00	1.000	1.000	1.000	1.00	-	5,452,671...	5,452,6...	5,452,671....
B20	Exterior Enclosure	1.00	1.000	1.000	1.000	1.00	-	34,932,65...	34,932,6...	34,932,651...
B2010.40	Fabricated Exterior	1.00	1.000	1.000	1.000	1.00	-	19,585,00...	19,585,...	19,585,003...
C-AGM_Glass 8p: C-AGM_Glass 8p	Glass	117,64...	1.000	1.000	1.000	117,64...	SQ FT	150.00	17,647,339...	17,647,339...
K-AGM_Glass 8p-OP: K-AGM_Glass 8p-OP	Glass	14,905...	1.000	1.000	1.000	14,905...	SQ FT	130.00	1,937,664.62	1,937,664....
B2010.20	Panels	1.00	1.000	1.000	1.000	1.00	-	12,671,23...	12,671,...	12,671,238...
B2010-Basic Wall: Metal Panel_6"	Metal Panels	78,546...	1.000	1.000	1.000	78,54...	SQ FT	160.00	12,567,434...	12,567,434...
B2010-Basic Wall: Metal Panel_2"	Metal Panels	741.46	1.000	1.000	1.000	741.46	SQ FT	140.00	103,803.94	103,803.94 /
B2010.50	Mansory at Garage	0.00	1.000	1.000	1.000	0.00	SQ FT	0.00	2,676,4...	2,676,408....
B2010-Basic Wall: Generic - 8" Masonry	8" Masonry	13,989...	1.000	1.000	1.000	13,989...	SQ FT	90.00	1,259,019.99	0.00 / SQ...
KH-AGM_Metal Parking Screen 16P:	Parking Screen	566.24	1.000	1.000	1.000	566.24	SQ FT	80.00	45,299.36	0.00 / SQ...
KH-AGM_Metal Parking Screen: KH-AGM_Metal	Parking Screen	17,151...	1.000	1.000	1.000	17,151...	SQ FT	80.00	1,372,088.98	0.00 / SQ...

5D Bottom-up: Control Mode vs Planning Mode (Actual vs Scheduled vs Forecast)



Schedule Planner - [Kingshighway (*): Gantt view]

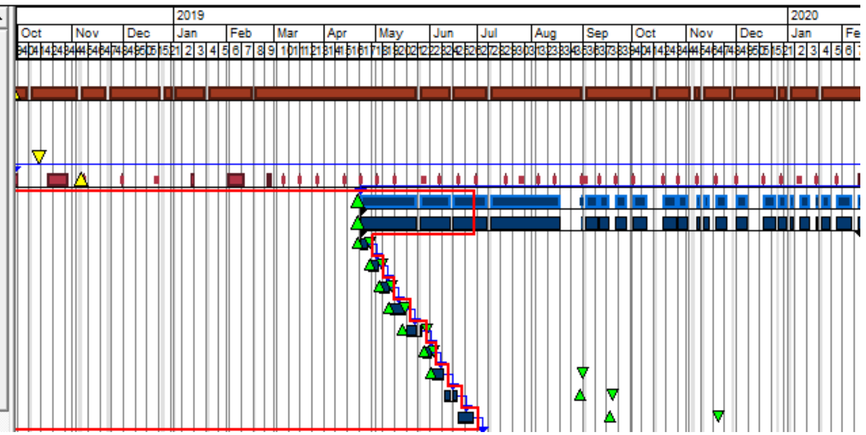
File Edit View Project Window Help

All tasks

Gantt view
version 5/3/2018 10:23

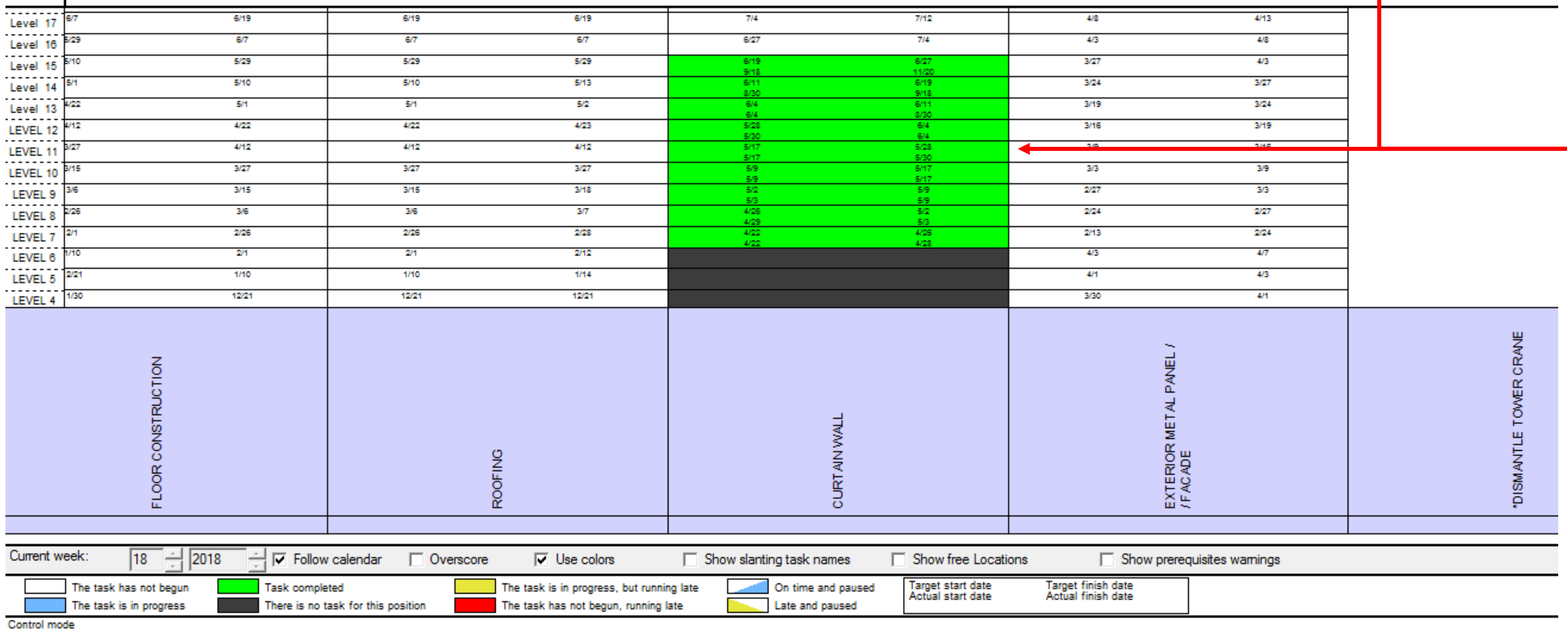
Responsible person:

	Hierarchy	Code	Name	Duration	Current duration	Start	Current start time	End time	Current end time	Date of the latest actual	Latest actual	Suspension days	Predecessors	Reso
1														
2	+1	B1010.20	FLOOR CONSTRUCTION	366.9	0	8/23/2018	9/27/2018	2/13/2020	3/24/2020				45 FS 0	-
43	-2	A1010.30	DRILLED PIERS & RETENTION	67.7	0	3/19/2018	5/3/2018	6/22/2018	8/10/2018					-
44	2.1		Foundation	67.7		3/19/2018		6/22/2018						
45	+3	A1020.70	CAPS / GB'S / WALLS	42.7	0	6/22/2018	8/10/2018	8/23/2018	10/12/2018				43 FS 0	-
48	+4	B1020.10	ROOFING	145.3	0	9/28/2018	11/7/2018	7/15/2020	8/20/2020				2 FS 0	-
88	-5	B2010.40	CURTAIN WALL	165.7	0	4/22/2019	4/22/2019	3/24/2020	5/7/2020				2 FS 0, 166 SS 0	-
89	-5.1	B2010.40	CURTAIN WALL-1	161.3		4/22/2019		2/13/2020						-
90	5.1.1		*LEVEL 7*	*3.7*		*4/22/2019*		*4/26/2019*		*4/28/2019*	*100%*	*0*	*16 FS 0*	
91	5.1.2		*LEVEL 8*	*4.4*		*4/26/2019*		*5/2/2019*		*5/3/2019*	*100%*	*0*		
92	5.1.3		*LEVEL 9*	*4.9*		*5/2/2019*		*5/9/2019*		*5/9/2019*	*100%*	*0*		
93	5.1.4		*LEVEL 10*	*6.4*		*5/9/2019*		*5/17/2019*		*5/17/2019*	*100%*	*0*		
94	5.1.5		*LEVEL 11*	*6*		*5/17/2019*		*5/28/2019*		*5/30/2019*	*100%*	*0*		
95	5.1.6		*LEVEL 12*	*4.4*		*5/28/2019*		*6/4/2019*		*6/4/2019*	*100%*	*0*		
96	5.1.7		*Level 13*	*4.8*		*6/4/2019*		*6/11/2019*		*8/30/2019*	*100%*	*0*		
97	5.1.8		*Level 14*	*5.2*		*6/11/2019*		*6/19/2019*		*9/18/2019*	*100%*	*0*		
98	5.1.9		*Level 15*	*6.4*		*6/19/2019*		*6/27/2019*		*11/20/2019*	*100%*	*0*		



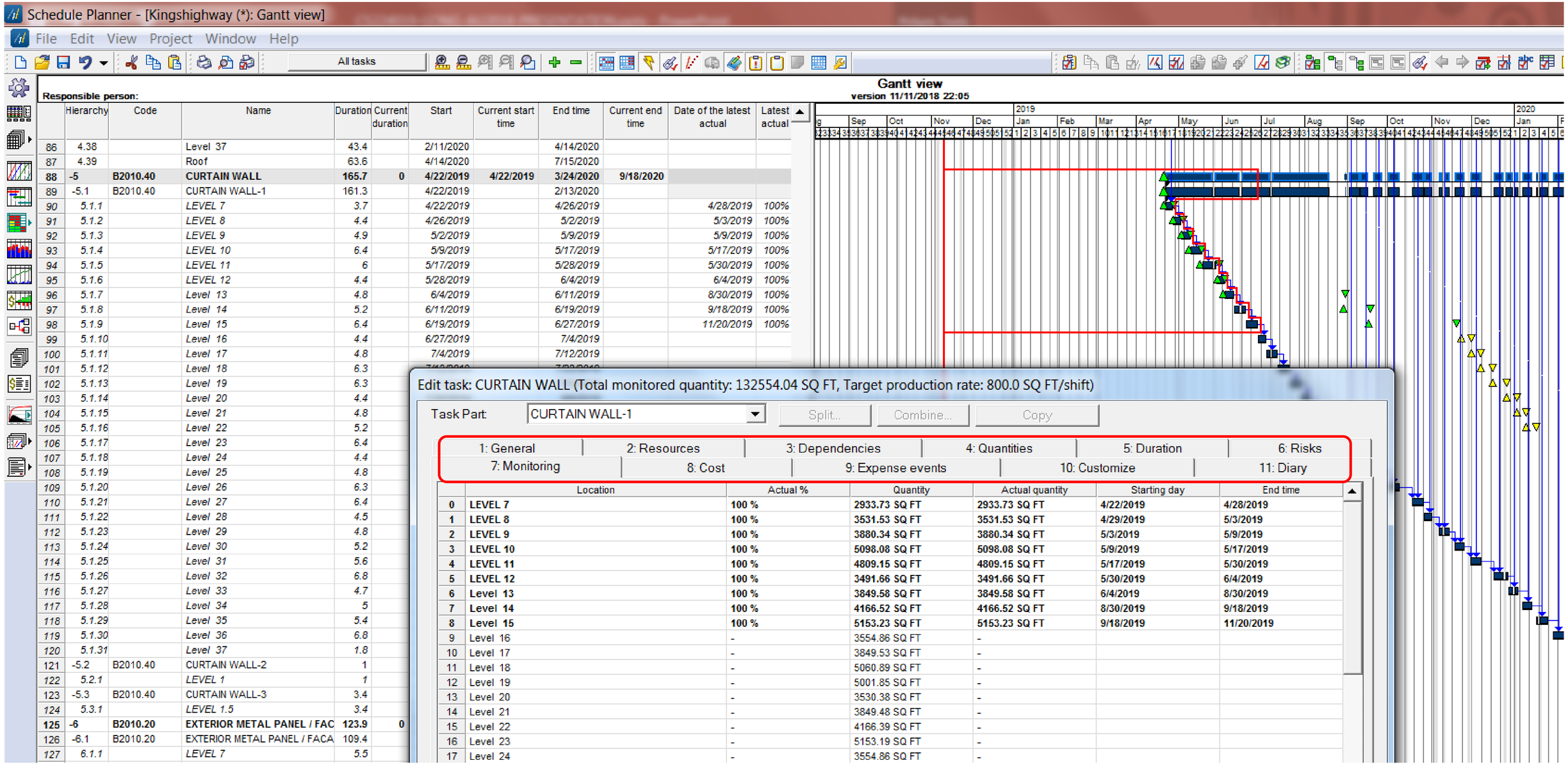
Task status
version 5/3/2018 10:33

Responsible person:



Input actual start and finish date of a task:
Level 7 to Level 15 curtainwall installation has been finished

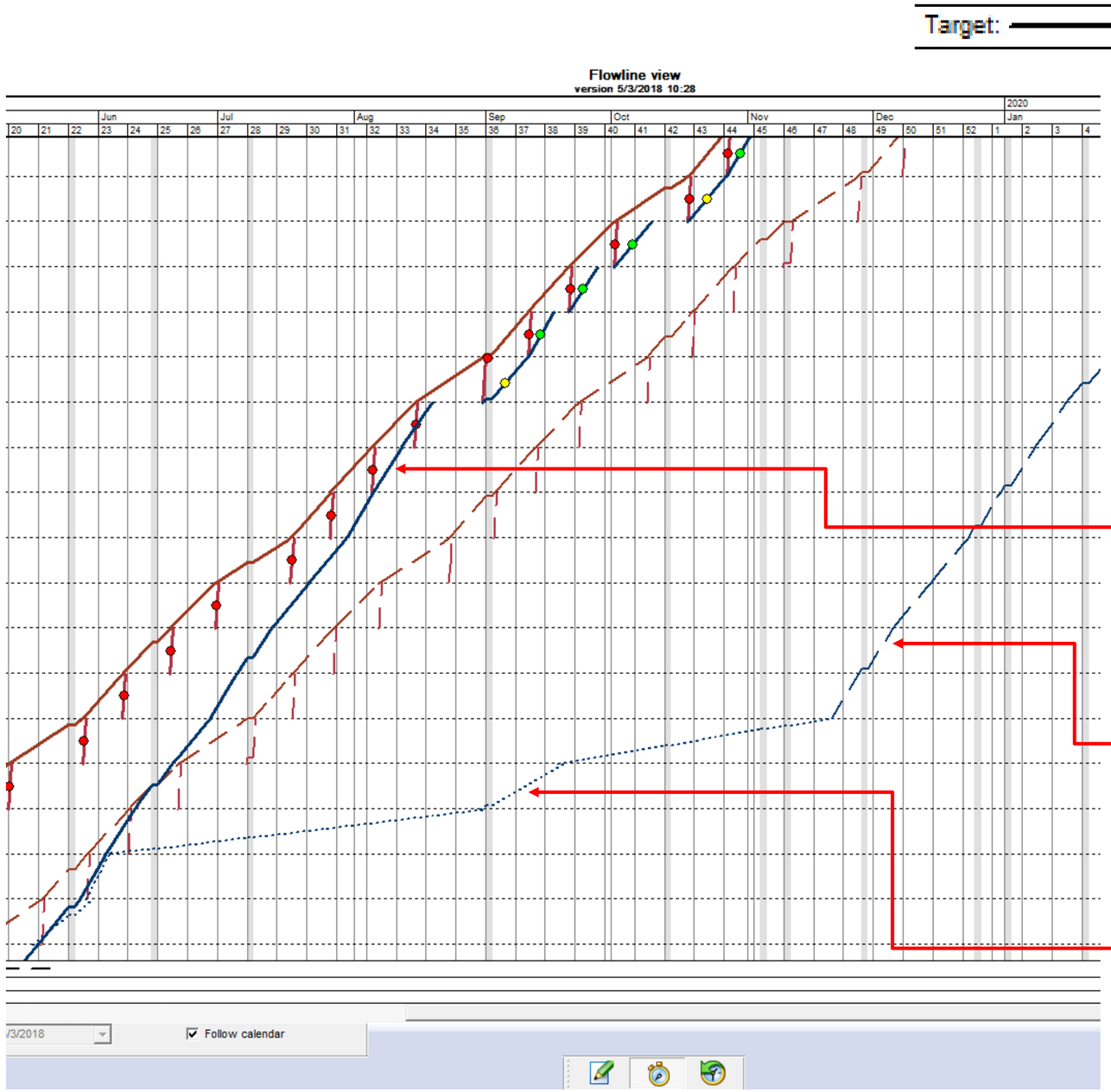
5D Bottom-up: Control Mode vs Planning Mode (Actual vs Scheduled vs Forecast)



	Hierarchy	Code	Name	Duration	Current duration	Start	Current start time	End time	Current end time	Date of the latest actual	Latest actual
86	4.38		Level 37	43.4		2/11/2020		4/14/2020			
87	4.39		Roof	63.6		4/14/2020		7/15/2020			
88	-5	B2010.40	CURTAIN WALL	165.7	0	4/22/2019	4/22/2019	3/24/2020	9/18/2020		
89	-5.1	B2010.40	CURTAIN WALL-1	161.3		4/22/2019		2/13/2020			
90	5.1.1		LEVEL 7	3.7		4/22/2019		4/26/2019		4/28/2019	100%
91	5.1.2		LEVEL 8	4.4		4/26/2019		5/2/2019		5/3/2019	100%
92	5.1.3		LEVEL 9	4.9		5/2/2019		5/9/2019		5/9/2019	100%
93	5.1.4		LEVEL 10	6.4		5/9/2019		5/17/2019		5/17/2019	100%
94	5.1.5		LEVEL 11	6		5/17/2019		5/28/2019		5/30/2019	100%
95	5.1.6		LEVEL 12	4.4		5/28/2019		6/4/2019		6/4/2019	100%
96	5.1.7		Level 13	4.8		6/4/2019		6/11/2019		8/30/2019	100%
97	5.1.8		Level 14	5.2		6/11/2019		6/19/2019		9/18/2019	100%
98	5.1.9		Level 15	6.4		6/19/2019		6/27/2019		11/20/2019	100%
99	5.1.10		Level 16	4.4		6/27/2019		7/4/2019			
100	5.1.11		Level 17	4.8		7/4/2019		7/12/2019			
101	5.1.12		Level 18	6.3							
102	5.1.13		Level 19	6.3							
103	5.1.14		Level 20	4.4							
104	5.1.15		Level 21	4.8							
105	5.1.16		Level 22	5.2							
106	5.1.17		Level 23	6.4							
107	5.1.18		Level 24	4.4							
108	5.1.19		Level 25	4.8							
109	5.1.20		Level 26	6.3							
110	5.1.21		Level 27	6.4							
111	5.1.22		Level 28	4.5							
112	5.1.23		Level 29	4.8							
113	5.1.24		Level 30	5.2							
114	5.1.25		Level 31	5.6							
115	5.1.26		Level 32	6.8							
116	5.1.27		Level 33	4.7							
117	5.1.28		Level 34	5							
118	5.1.29		Level 35	5.4							
119	5.1.30		Level 36	6.8							
120	5.1.31		Level 37	1.8							
121	-5.2	B2010.40	CURTAIN WALL-2	1							
122	5.2.1		LEVEL 1	1							
123	-5.3	B2010.40	CURTAIN WALL-3	3.4							
124	5.3.1		LEVEL 1.5	3.4							
125	-6	B2010.20	EXTERIOR METAL PANEL / FAC	123.9	0						
126	-6.1	B2010.20	EXTERIOR METAL PANEL / FACA	109.4							
127	6.1.1		LEVEL 7	5.5							

	Location	Actual %	Quantity	Actual quantity	Starting day	End time
0	LEVEL 7	100 %	2933.73 SQ FT	2933.73 SQ FT	4/22/2019	4/28/2019
1	LEVEL 8	100 %	3531.53 SQ FT	3531.53 SQ FT	4/29/2019	5/3/2019
2	LEVEL 9	100 %	3880.34 SQ FT	3880.34 SQ FT	5/3/2019	5/9/2019
3	LEVEL 10	100 %	5098.08 SQ FT	5098.08 SQ FT	5/9/2019	5/17/2019
4	LEVEL 11	100 %	4809.15 SQ FT	4809.15 SQ FT	5/17/2019	5/30/2019
5	LEVEL 12	100 %	3491.66 SQ FT	3491.66 SQ FT	5/30/2019	6/4/2019
6	Level 13	100 %	3849.58 SQ FT	3849.58 SQ FT	6/4/2019	8/30/2019
7	Level 14	100 %	4166.52 SQ FT	4166.52 SQ FT	8/30/2019	9/18/2019
8	Level 15	100 %	5153.23 SQ FT	5153.23 SQ FT	9/18/2019	11/20/2019
9	Level 16	-	3554.86 SQ FT	-		
10	Level 17	-	3849.53 SQ FT	-		
11	Level 18	-	5060.89 SQ FT	-		
12	Level 19	-	5001.85 SQ FT	-		
13	Level 20	-	3530.38 SQ FT	-		
14	Level 21	-	3849.48 SQ FT	-		
15	Level 22	-	4166.39 SQ FT	-		
16	Level 23	-	5153.19 SQ FT	-		
17	Level 24	-	3554.86 SQ FT	-		

5D Bottom-up: Control Mode vs Planning Mode (Actual vs Target vs Forecast)

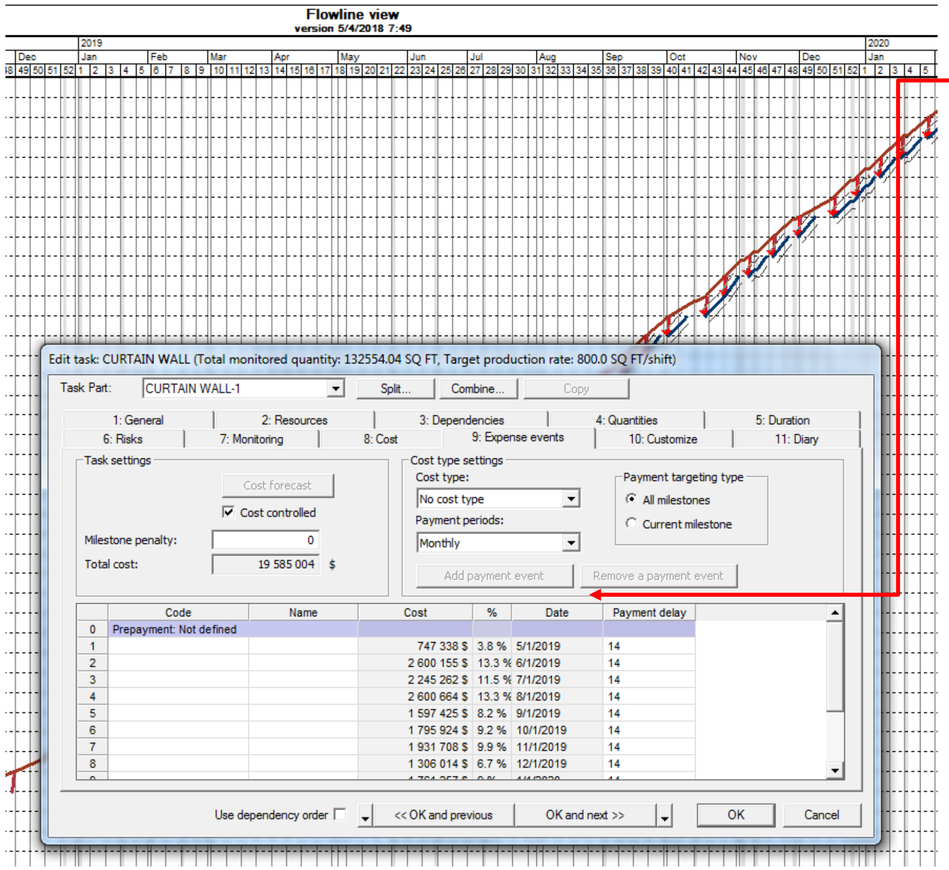


Target: enables the planned schedule which we are targeting

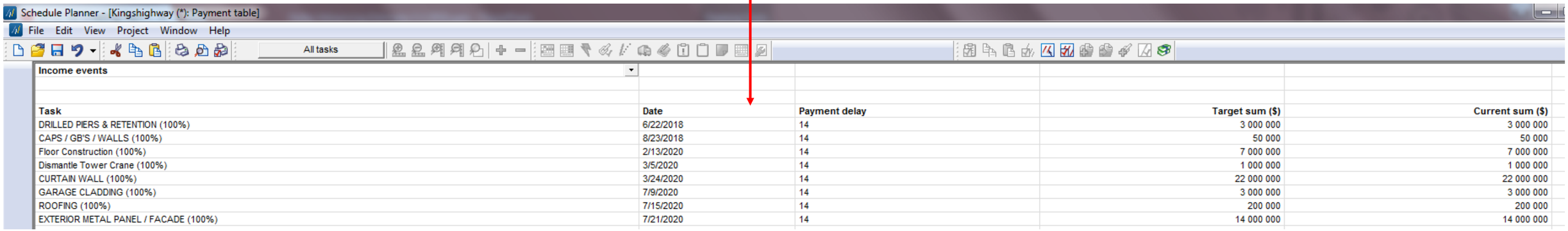
Forecast: takes all actualized data to generate a comparative model

Actual: a reflection of the current plan including all detailed tasks

5D Bottom-up: Expense and Income

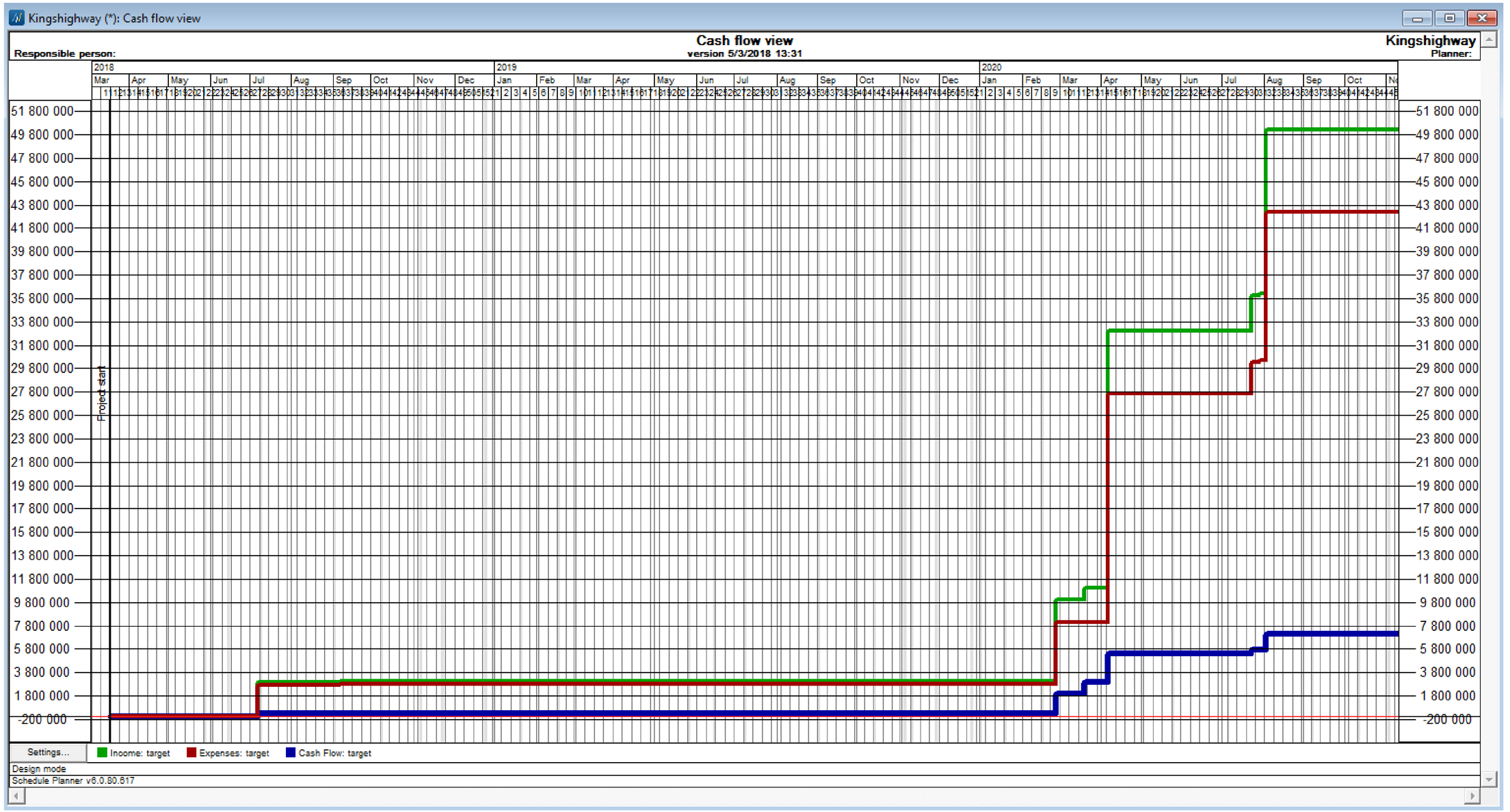


- Define **payments to subcontractors** under Expense Events.
- Define **income from owner** under Income Events.
- Provides a basis for accurately forecasting and controlling the net cash for a project.
- Provides a firm link to completion of locations progressively through a project.



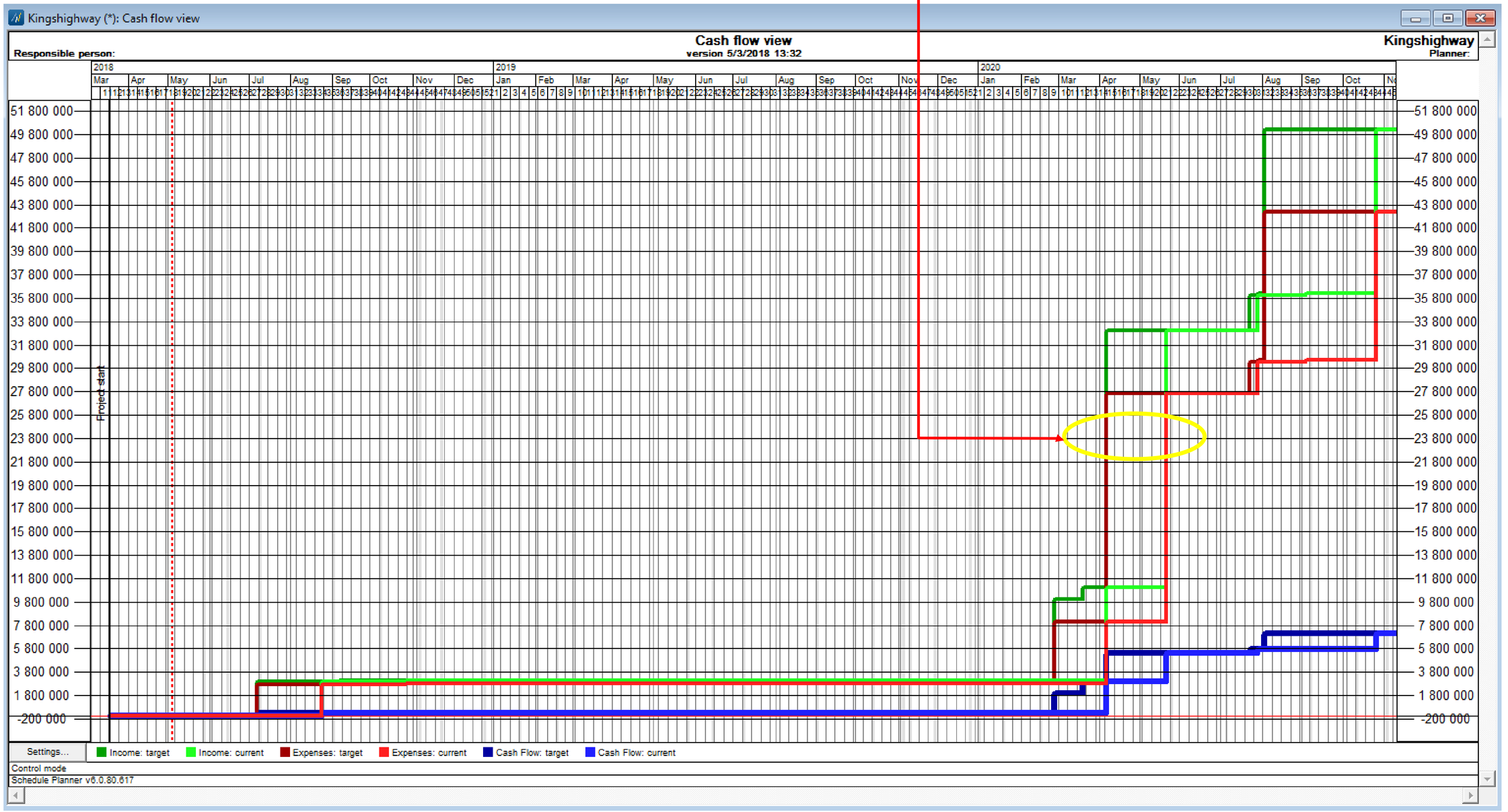
Task	Date	Payment delay	Target sum ($)	Current sum ($)
DRILLED PIERS & RETENTION (100%)	6/22/2018	14	3 000 000	3 000 000
CAPS / GB'S / WALLS (100%)	8/23/2018	14	50 000	50 000
Floor Construction (100%)	2/13/2020	14	7 000 000	7 000 000
Dismantle Tower Crane (100%)	3/5/2020	14	1 000 000	1 000 000
CURTAIN WALL (100%)	3/24/2020	14	22 000 000	22 000 000
GARAGE CLADDING (100%)	7/9/2020	14	3 000 000	3 000 000
ROOFING (100%)	7/15/2020	14	200 000	200 000
EXTERIOR METAL PANEL / FACADE (100%)	7/21/2020	14	14 000 000	14 000 000

5D Bottom-up: Cash Flow _ Target

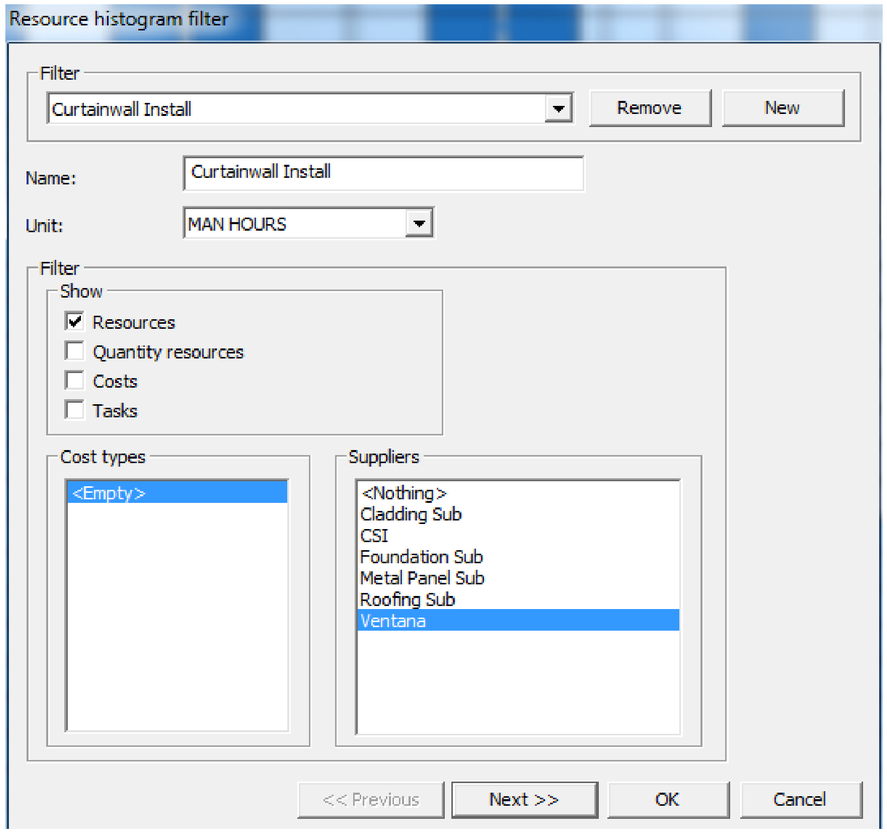


5D Bottom-up: Cash Flow _ Target vs Current

Curtainwall installation is delayed



5D Bottom-up: Resource Histogram

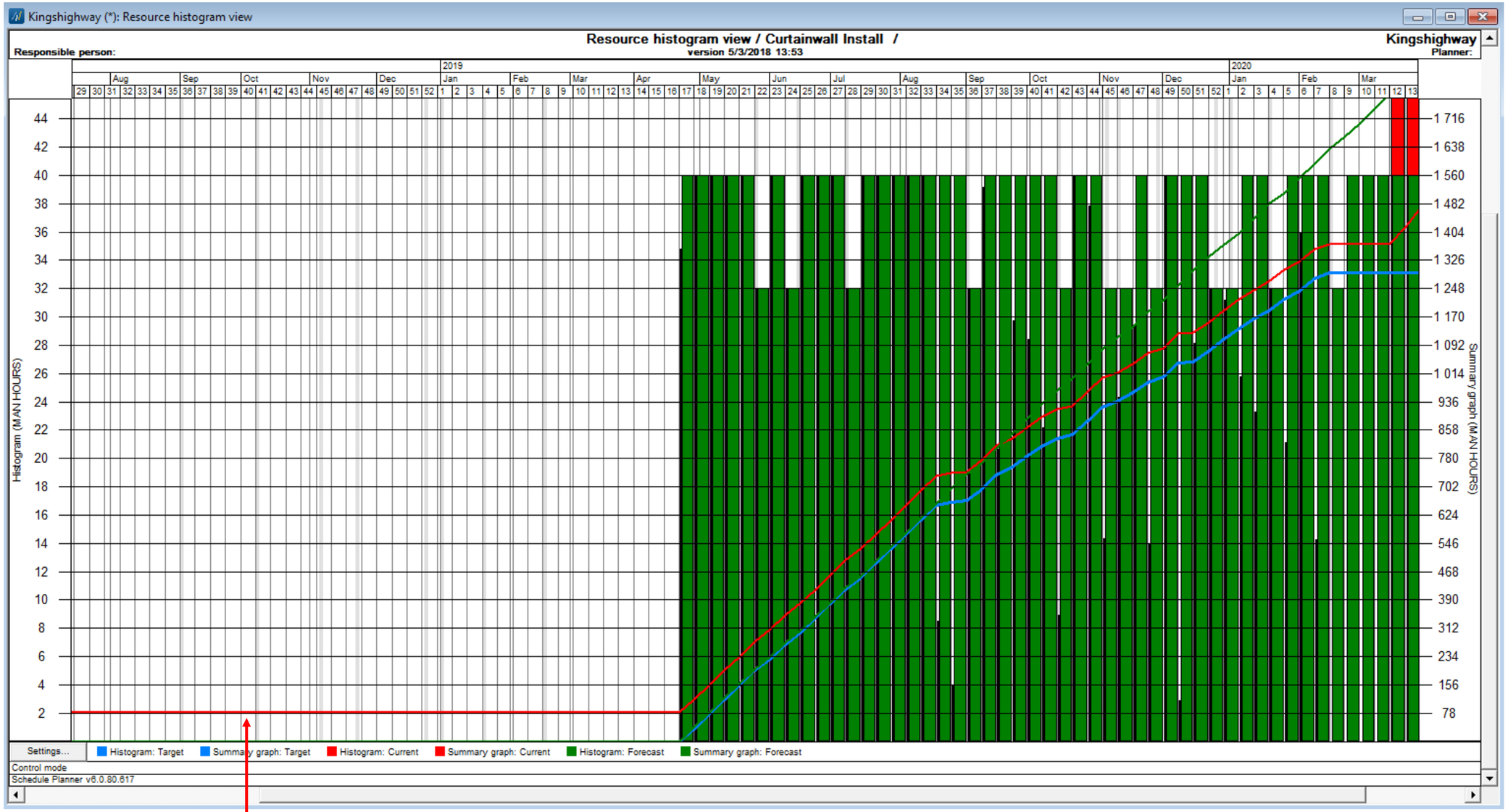


- Resource Histogram allows using historical actualized data to trend resource quantities, resource hours, quantities and cost in the future.

- Resource Histogram allows us to determine the potential risks of resource or quantity over or underage

5D Bottom-up: Resource Histogram

Number of hours needed by week



Total number of hours

Curve line: **Accumulative** number of hours

5D Bottom-up: Risks

Risks

1. Starting Risk
2. Duration Risk
3. Resource Beginning Risk
4. Resource Come Back Delay
5. Production Factor Risk

Risk management includes planning continuous work, using buffers and being proactive to prevent delays

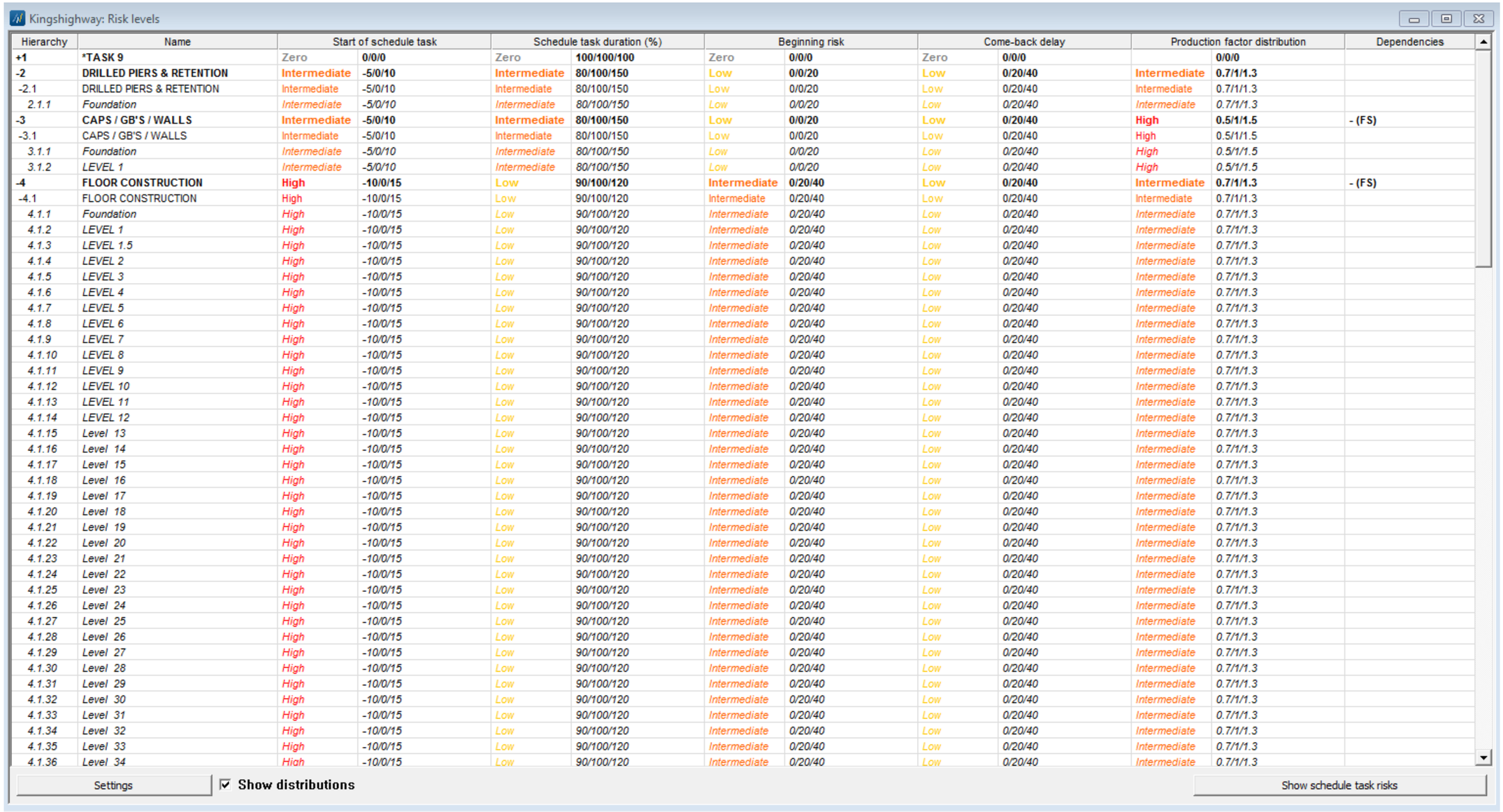
5D Bottom-up: Risk Simulation

Risk Simulation is used to validate the reliability of a schedule and to optimize the schedule to find the optimal trade offs between cost and time under conditions of uncertainty

- Monte Carlo Risk Simulation is a tool to model and identify problem in the schedule
- Results can be used to alert the GC to make proactive decisions
- Monte Carlo Risk Simulation provides a probability calculation to access each of the 5 risk categories

5D Bottom-up: Risk Simulation

Monte Carlo Risk Simulation: How to assign risk levels (variabilities) to tasks (variables)

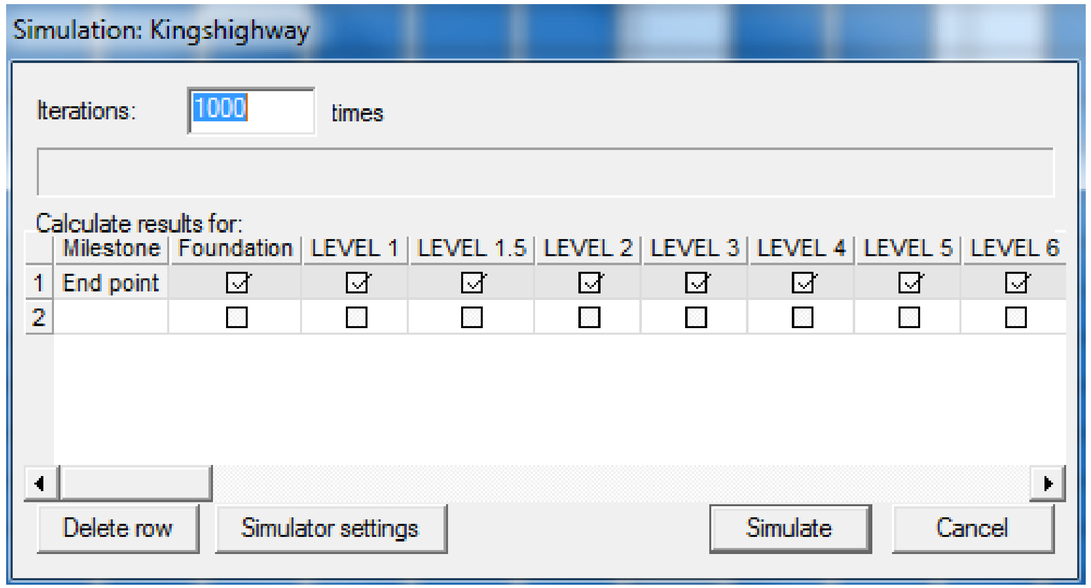


Kingshighway: Risk levels

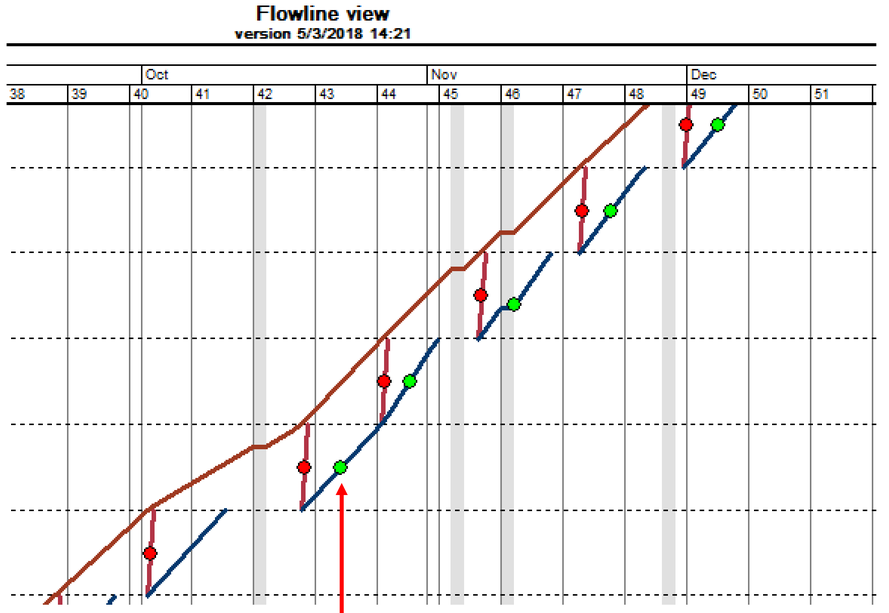
Hierarchy	Name	Start of schedule task		Schedule task duration (%)		Beginning risk		Come-back delay		Production factor distribution		Dependencies
+1	*TASK 9	Zero	0/0/0	Zero	100/100/100	Zero	0/0/0	Zero	0/0/0		0/0/0	
-2	DRILLED PIERS & RETENTION	Intermediate	-5/0/10	Intermediate	80/100/150	Low	0/0/20	Low	0/20/40	Intermediate	0.7/1/1.3	
-2.1	DRILLED PIERS & RETENTION	Intermediate	-5/0/10	Intermediate	80/100/150	Low	0/0/20	Low	0/20/40	Intermediate	0.7/1/1.3	
2.1.1	*Foundation*	*Intermediate*	*-5/0/10*	*Intermediate*	*80/100/150*	*Low*	*0/0/20*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
-3	CAPS / GB'S / WALLS	Intermediate	-5/0/10	Intermediate	80/100/150	Low	0/0/20	Low	0/20/40	High	0.5/1/1.5	- (FS)
-3.1	CAPS / GB'S / WALLS	Intermediate	-5/0/10	Intermediate	80/100/150	Low	0/0/20	Low	0/20/40	High	0.5/1/1.5	
3.1.1	*Foundation*	*Intermediate*	*-5/0/10*	*Intermediate*	*80/100/150*	*Low*	*0/0/20*	*Low*	*0/20/40*	*High*	*0.5/1/1.5*	
3.1.2	*LEVEL 1*	*Intermediate*	*-5/0/10*	*Intermediate*	*80/100/150*	*Low*	*0/0/20*	*Low*	*0/20/40*	*High*	*0.5/1/1.5*	
-4	FLOOR CONSTRUCTION	High	-10/0/15	Low	90/100/120	Intermediate	0/20/40	Low	0/20/40	Intermediate	0.7/1/1.3	- (FS)
-4.1	FLOOR CONSTRUCTION	High	-10/0/15	Low	90/100/120	Intermediate	0/20/40	Low	0/20/40	Intermediate	0.7/1/1.3	
4.1.1	*Foundation*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.2	*LEVEL 1*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.3	*LEVEL 1.5*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.4	*LEVEL 2*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.5	*LEVEL 3*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.6	*LEVEL 4*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.7	*LEVEL 5*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.8	*LEVEL 6*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.9	*LEVEL 7*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.10	*LEVEL 8*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.11	*LEVEL 9*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.12	*LEVEL 10*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.13	*LEVEL 11*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.14	*LEVEL 12*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.15	*Level 13*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.16	*Level 14*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.17	*Level 15*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.18	*Level 16*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.19	*Level 17*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.20	*Level 18*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.21	*Level 19*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.22	*Level 20*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.23	*Level 21*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.24	*Level 22*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.25	*Level 23*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.26	*Level 24*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.27	*Level 25*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.28	*Level 26*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.29	*Level 27*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.30	*Level 28*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.31	*Level 29*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.32	*Level 30*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.33	*Level 31*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.34	*Level 32*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.35	*Level 33*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	
4.1.36	*Level 34*	*High*	*-10/0/15*	*Low*	*90/100/120*	*Intermediate*	*0/20/40*	*Low*	*0/20/40*	*Intermediate*	*0.7/1/1.3*	

Settings | Show distributions | Show schedule task risks

5D Bottom-up: Risk Simulation



Define Iterations

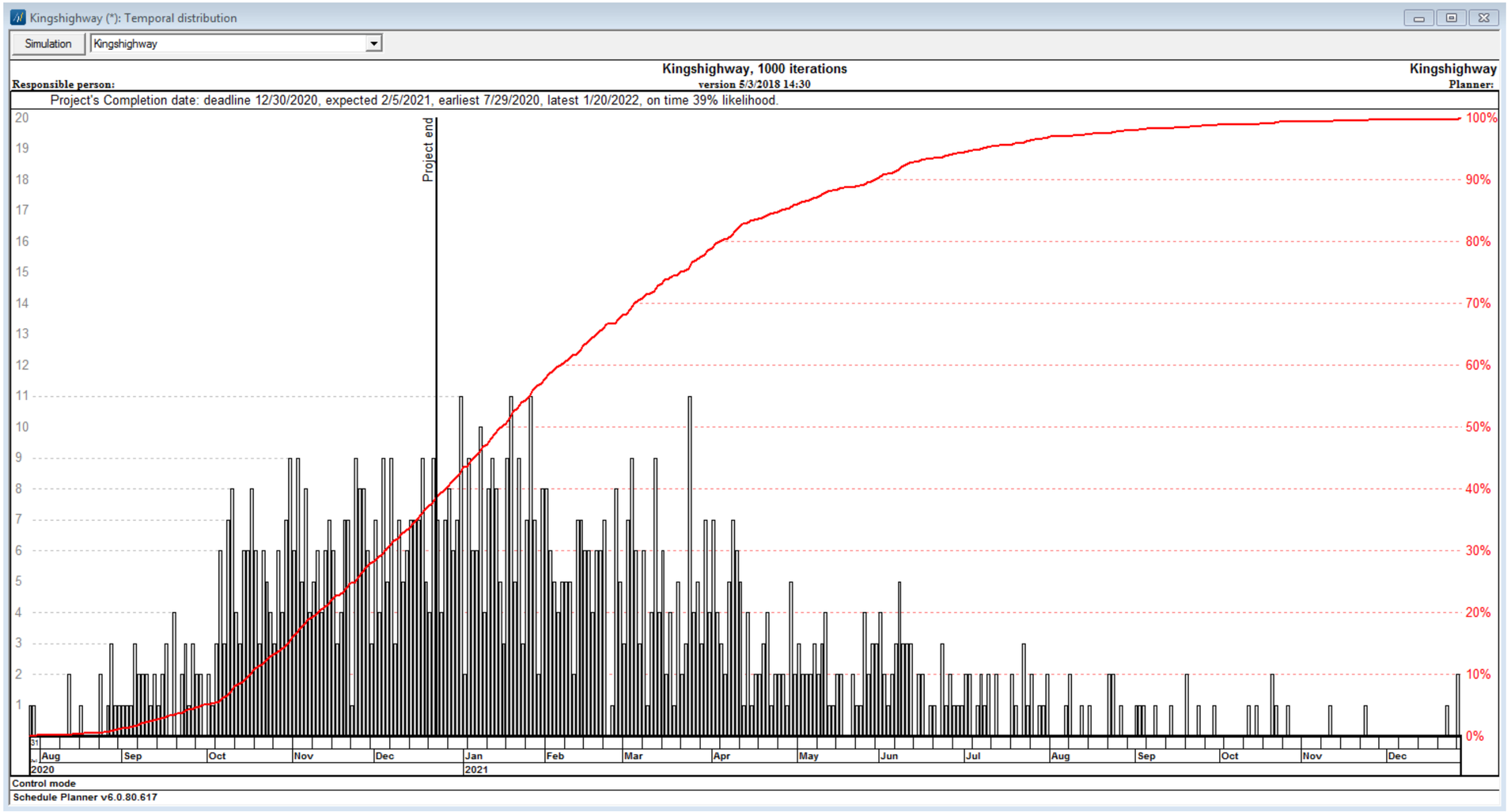


30%
Install curtainwall

Percentage of risk that location can occur

5D Bottom-up: Risk Simulation_Temporal Distribution

Verticals: Probability of completion at a specific day
Curve: Probability of completion before a specific day (accumulatively)



Conclusion: Very Risky. Need to introduce buffer to optimize schedule

5D Bottom-up: Risks

Actions:

- We use the probability values to assess the schedules areas of most risks
- By using this data we can determine how we can use our optimization tools
- We can add buffer, change resource amounts, make tasks ASAP, combine tasks and split tasks

5D Bottom-up: Logistics-Procurement Tasks: Bill of Quantities

Questions

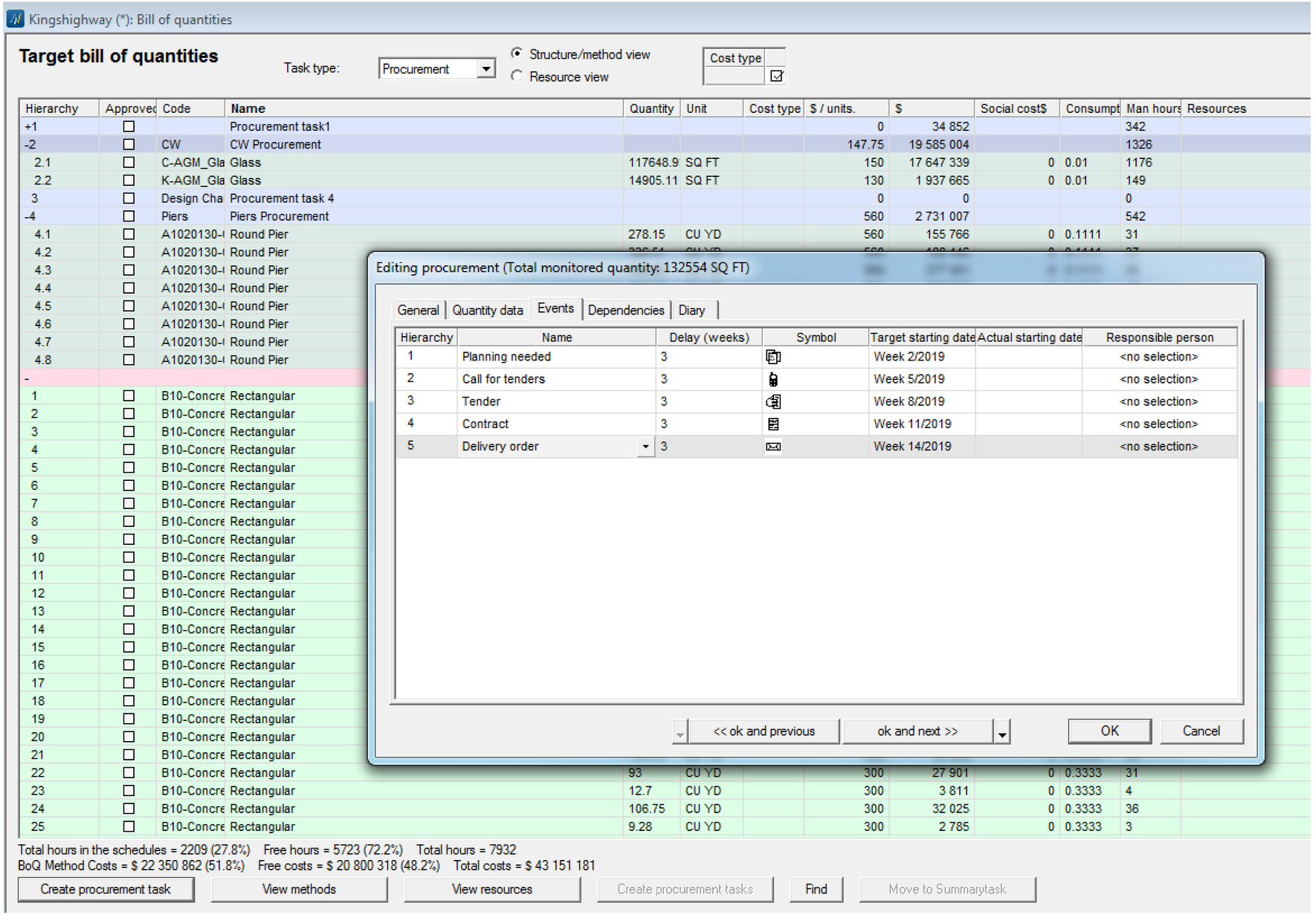
Why do we plan logistics?
When to deliver materials?
How many deliveries are required?
Time and resources needed for receiving and hauling?
What is the lead time before production can start?

What are procurement tasks?

A procurement task is composed of the organization of materials or subcontractor work packages that are able to be ordered from a supplier. The following must be finished before a task can commence:

- Design
- Planning accurate task schedule
- Document and Call for tender
- Bid evaluation
- Contract
- Deliver order

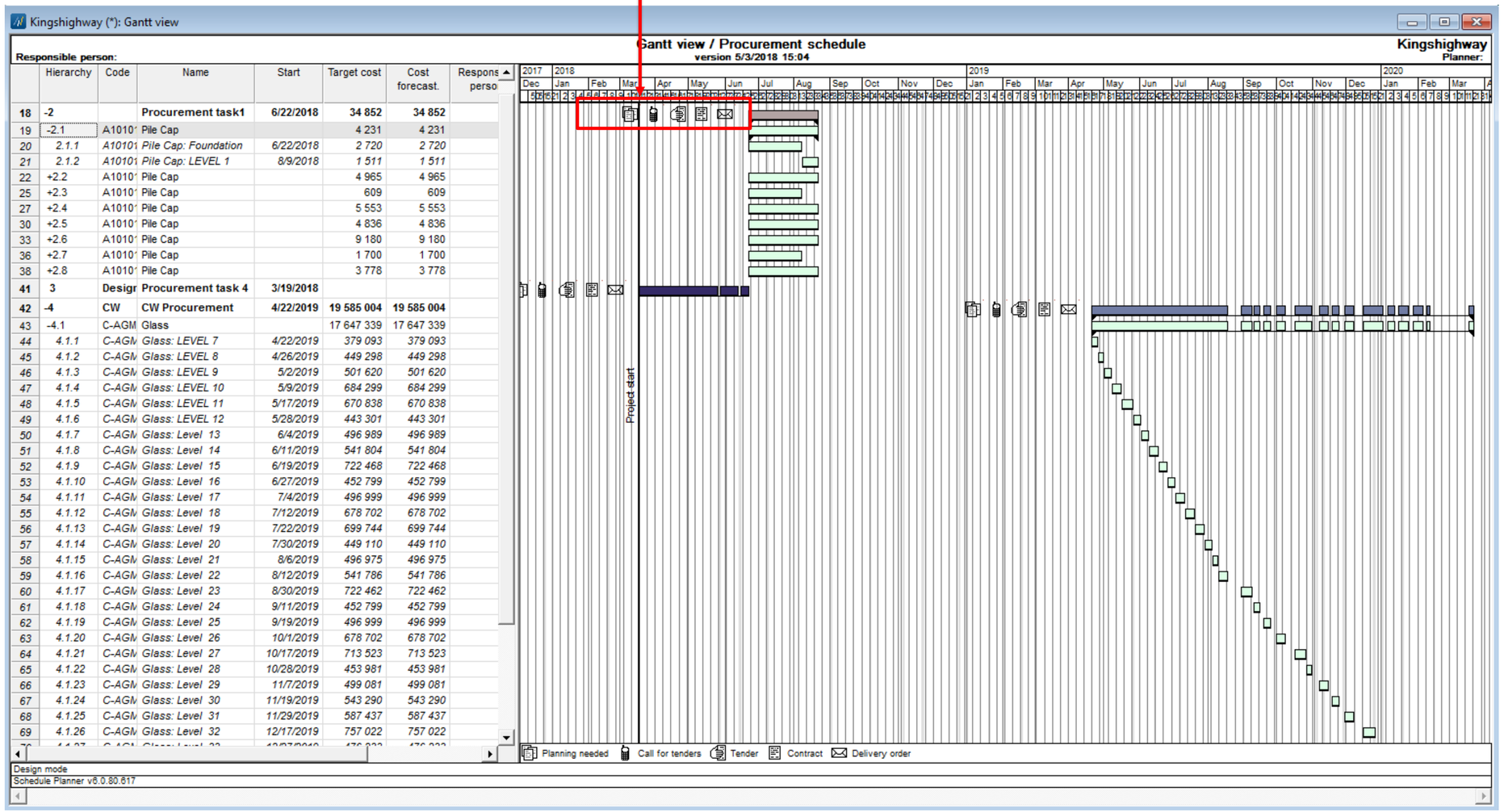
5D Bottom-up: Logistics-Procurement Tasks: Bill of Quantities



- Pull the procurement tasks to scheduled activities
- Calculate durations for Just In Time Delivery

5D Bottom-up: Logistics-Procurement Tasks: Bill of Quantities

Drag and drop icons to suit the schedules as required to be completed

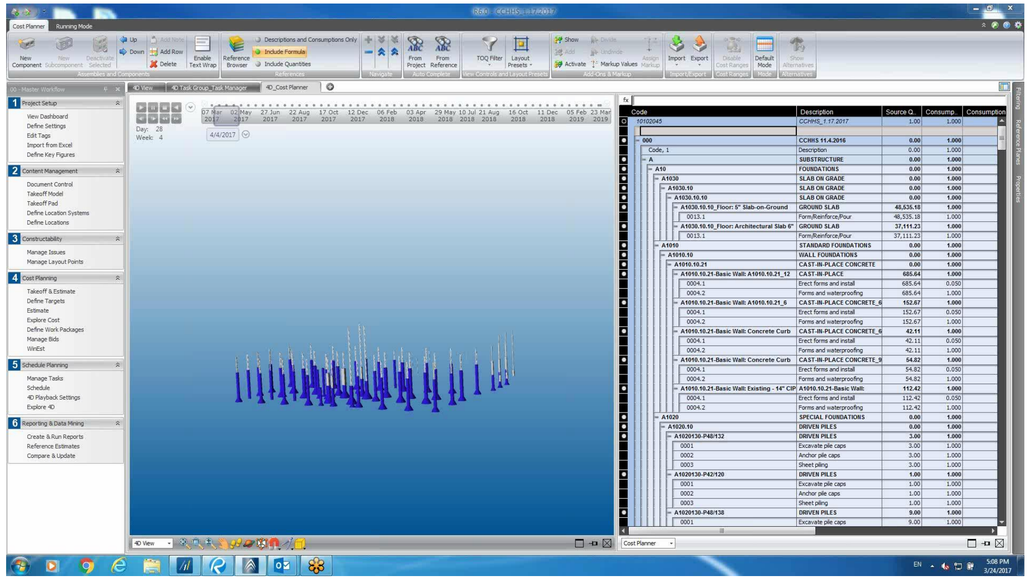


	Hierarchy	Code	Name	Start	Target cost	Cost forecast.	Respons perso
18	-2		Procurement task1	6/22/2018	34 852	34 852	
19	-2.1	A1010	Pile Cap		4 231	4 231	
20	2.1.1	A10101	Pile Cap: Foundation	6/22/2018	2 720	2 720	
21	2.1.2	A10101	Pile Cap: LEVEL 1	8/9/2018	1 511	1 511	
22	+2.2	A1010	Pile Cap		4 965	4 965	
25	+2.3	A1010	Pile Cap		609	609	
27	+2.4	A1010	Pile Cap		5 553	5 553	
30	+2.5	A1010	Pile Cap		4 836	4 836	
33	+2.6	A1010	Pile Cap		9 180	9 180	
36	+2.7	A1010	Pile Cap		1 700	1 700	
38	+2.8	A1010	Pile Cap		3 778	3 778	
41	3	Desigr	Procurement task 4	3/19/2018			
42	-4	CW	CW Procurement	4/22/2019	19 585 004	19 585 004	
43	-4.1	C-AGM	Glass		17 647 339	17 647 339	
44	4.1.1	C-AGM	Glass: LEVEL 7	4/22/2019	379 093	379 093	
45	4.1.2	C-AGM	Glass: LEVEL 8	4/26/2019	449 298	449 298	
46	4.1.3	C-AGM	Glass: LEVEL 9	5/2/2019	501 620	501 620	
47	4.1.4	C-AGM	Glass: LEVEL 10	5/9/2019	684 299	684 299	
48	4.1.5	C-AGM	Glass: LEVEL 11	5/17/2019	670 838	670 838	
49	4.1.6	C-AGM	Glass: LEVEL 12	5/28/2019	443 301	443 301	
50	4.1.7	C-AGM	Glass: Level 13	6/4/2019	496 989	496 989	
51	4.1.8	C-AGM	Glass: Level 14	6/11/2019	541 804	541 804	
52	4.1.9	C-AGM	Glass: Level 15	6/19/2019	722 468	722 468	
53	4.1.10	C-AGM	Glass: Level 16	6/27/2019	452 799	452 799	
54	4.1.11	C-AGM	Glass: Level 17	7/4/2019	496 999	496 999	
55	4.1.12	C-AGM	Glass: Level 18	7/12/2019	678 702	678 702	
56	4.1.13	C-AGM	Glass: Level 19	7/22/2019	699 744	699 744	
57	4.1.14	C-AGM	Glass: Level 20	7/30/2019	449 110	449 110	
58	4.1.15	C-AGM	Glass: Level 21	8/6/2019	496 975	496 975	
59	4.1.16	C-AGM	Glass: Level 22	8/12/2019	541 786	541 786	
60	4.1.17	C-AGM	Glass: Level 23	8/30/2019	722 462	722 462	
61	4.1.18	C-AGM	Glass: Level 24	9/11/2019	452 799	452 799	
62	4.1.19	C-AGM	Glass: Level 25	9/19/2019	496 999	496 999	
63	4.1.20	C-AGM	Glass: Level 26	10/1/2019	678 702	678 702	
64	4.1.21	C-AGM	Glass: Level 27	10/17/2019	713 523	713 523	
65	4.1.22	C-AGM	Glass: Level 28	10/28/2019	453 981	453 981	
66	4.1.23	C-AGM	Glass: Level 29	11/7/2019	499 081	499 081	
67	4.1.24	C-AGM	Glass: Level 30	11/19/2019	543 290	543 290	
68	4.1.25	C-AGM	Glass: Level 31	11/29/2019	587 437	587 437	
69	4.1.26	C-AGM	Glass: Level 32	12/17/2019	757 022	757 022	

- Procurement milestones are used to identify time considerations to begin a task 
- VSP pulls milestones to the commencement of the task

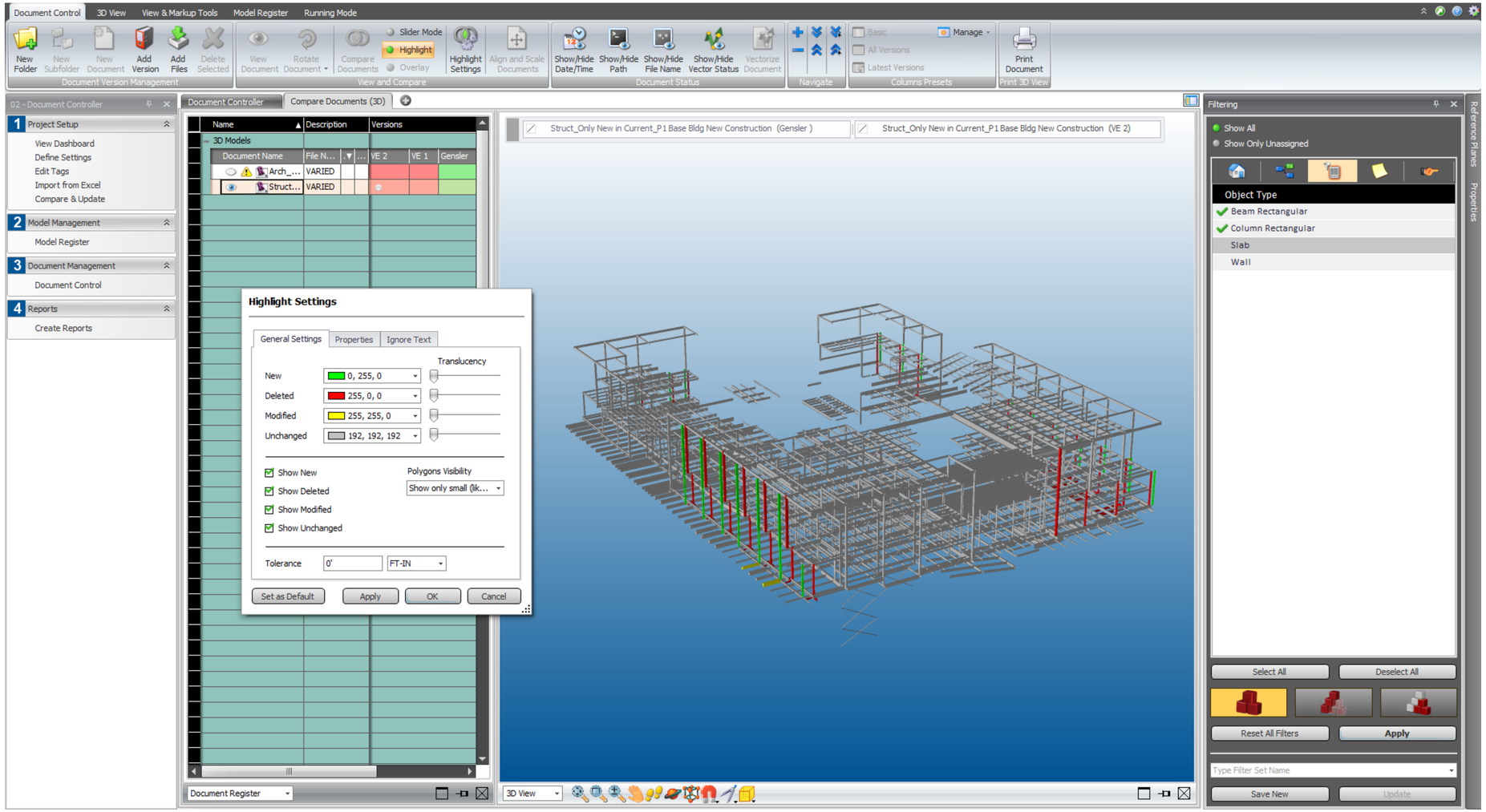
4D & 5D integration

- Location Based **Schedule Manager** facilitates categorizing takeoffs, estimates and scheduling based on 3D locations.
- **Cost Planner** sets up estimates with formulas under Source Qty by mapping TOIs from Takeoff Manager.
- **Task Manager** lays out tasks by mapping cost assemblies and components (labor, material, and equipment) from Cost Planner.
- **Task Groups** allows to create 4D animations by mapping the tasks from Task Manager.
- **Schedule Planner** defines task sequence with Network View, Flowline View and Gantt View.



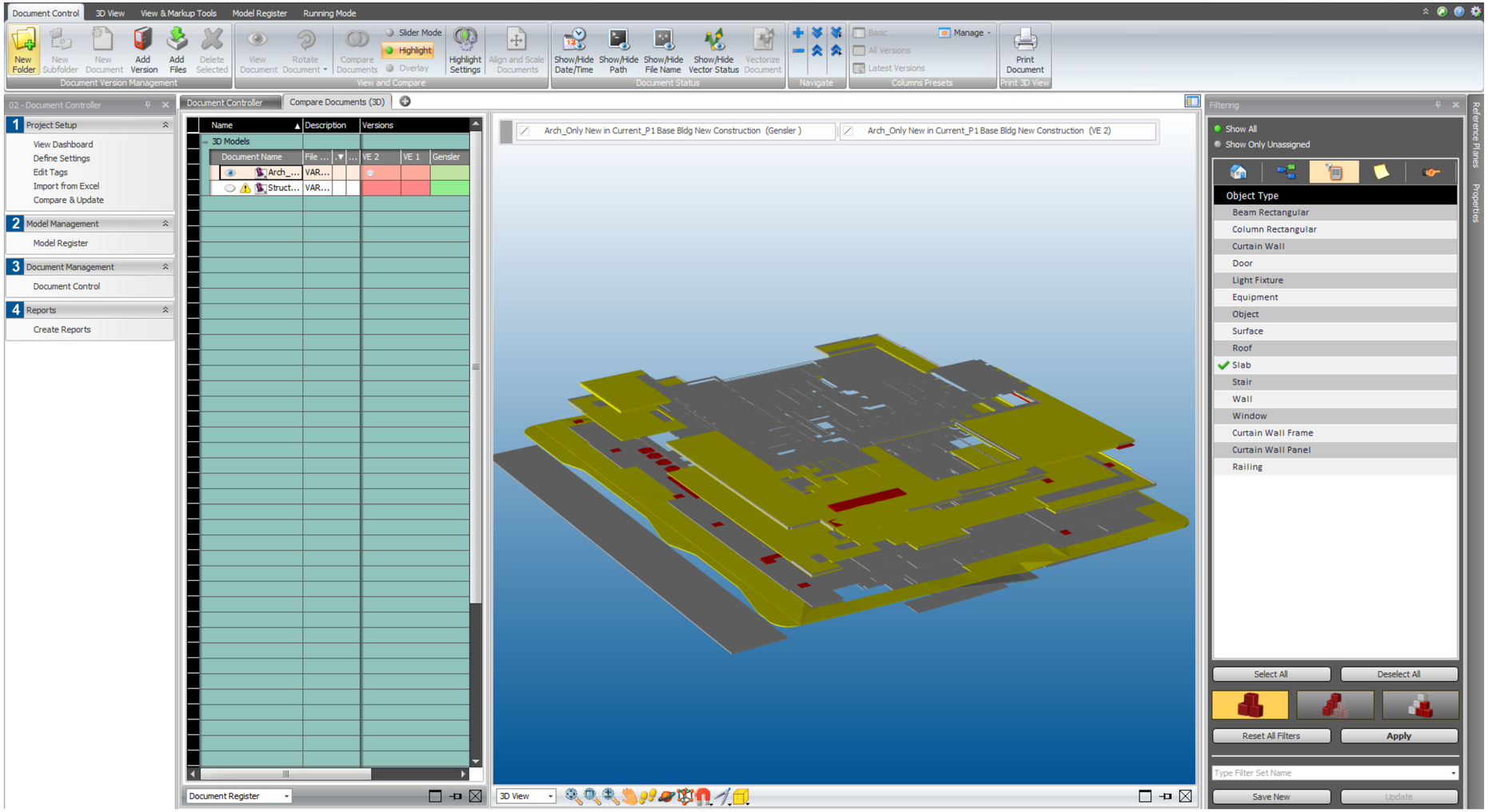
5D integration (Animation on left side and Cost Planner on right side)
See attached video for animation

Comparing Alternatives (Highlight Mode)



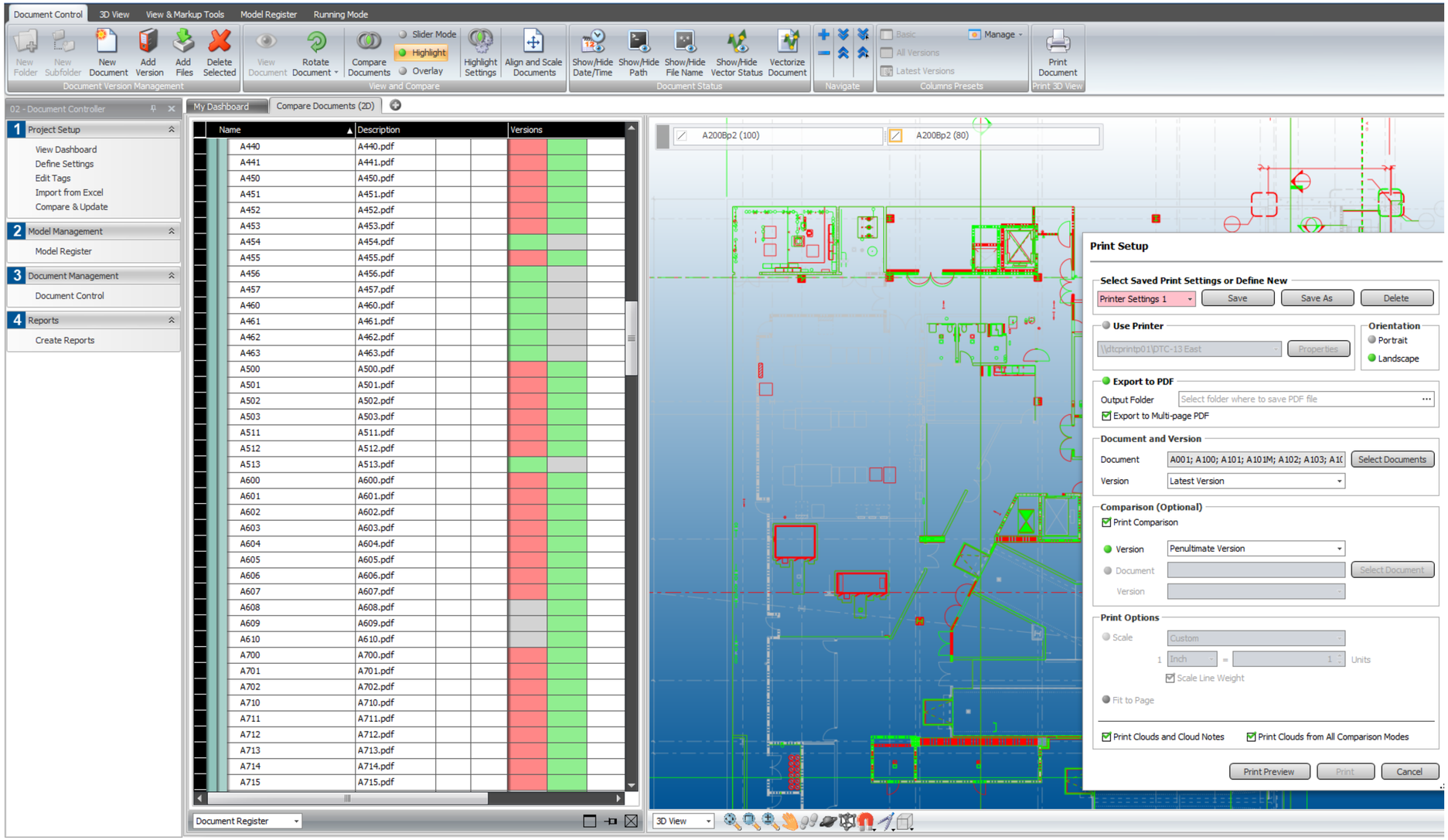
Structures_Design Versions Comparison

Comparing Alternatives (Highlight Mode)



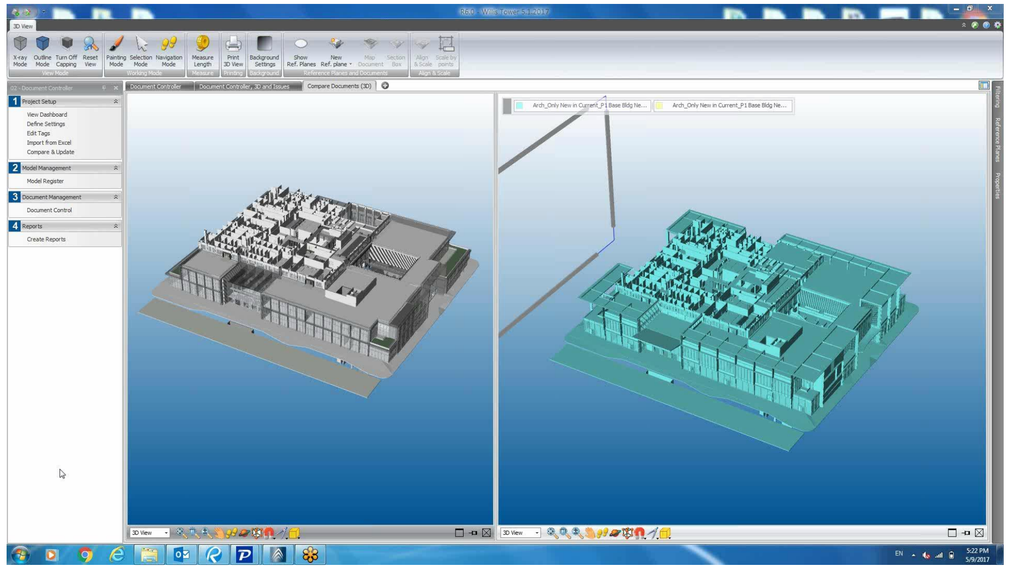
Architectures_Design Versions Comparison

Comparing Alternatives (Highlight Mode_2D)

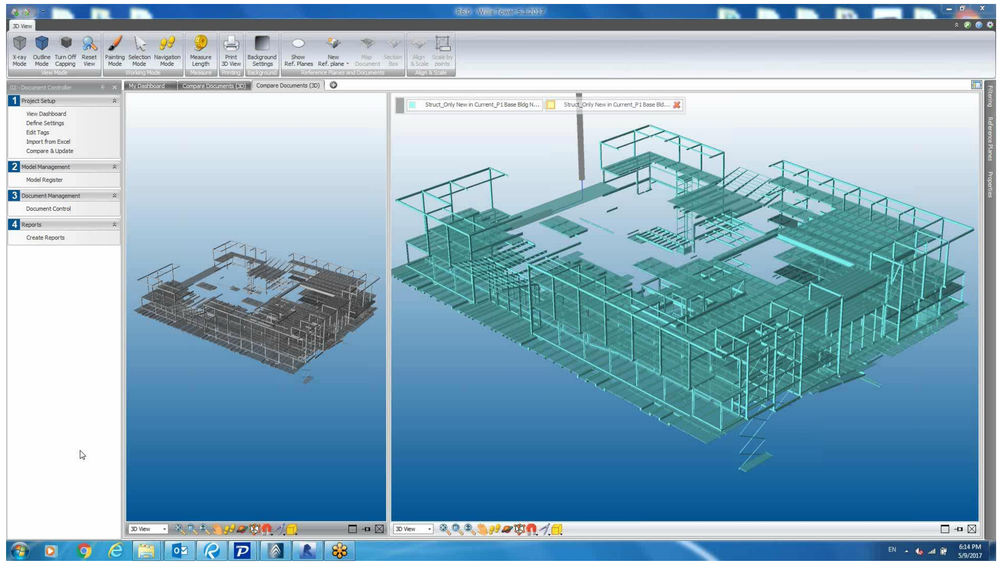


Create batch report in few seconds

Comparing Alternatives (Sliding Mode)



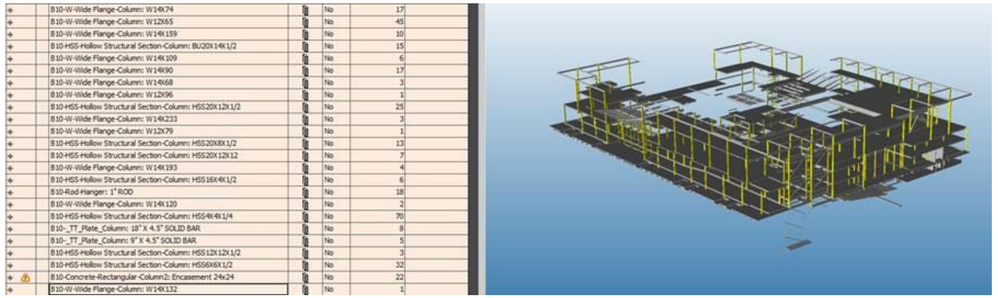
Architectures_Design Versions Comparison

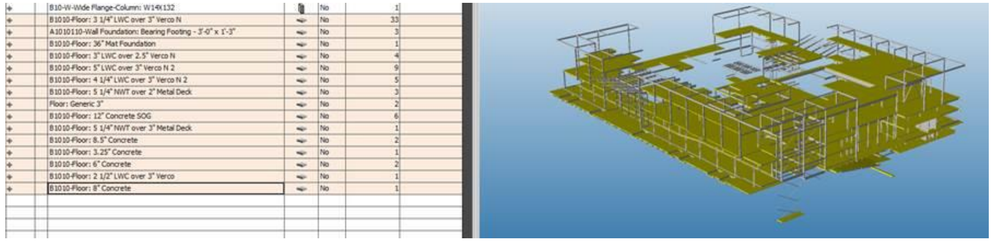


Structures_Design Versions Comparison

Fast Takeoffs_Podium Structural Model

Takeoff Objects	Quantities	Units
Beams_New Construction	2,881	ton
Columns_New Construction	304	ton
Slabs_New Construction	226,072	sqft





VE Structural model Takeoffs Willis Tower

File | Home | Insert | Page Layout | Formulas | Data | Review | View | Developer | Add-Ins | BLUEBEAM | Team | Tell me what you

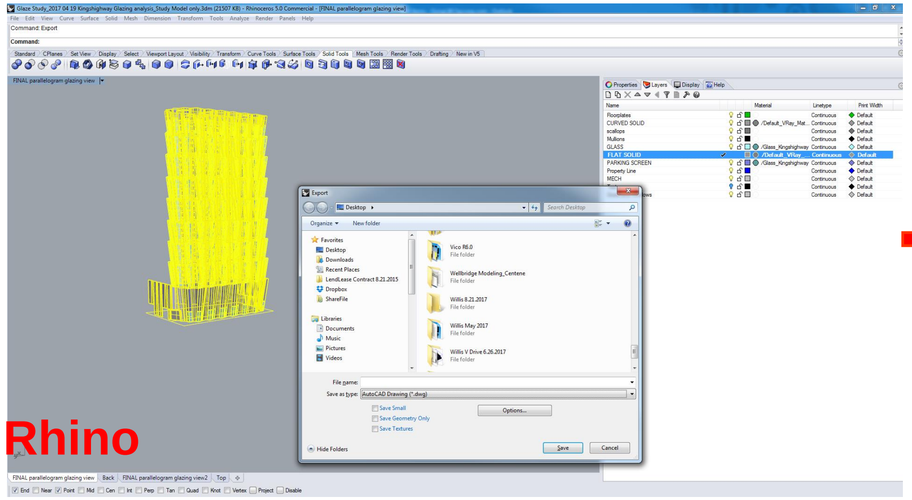
Cut | Copy | Format Painter | Paste | Calibri | 11 | Wrap Text | General | Merge & Center | Conditional Formatting | Format as Table | Normal | Calculation

Clipboard | Font | Alignment | Number

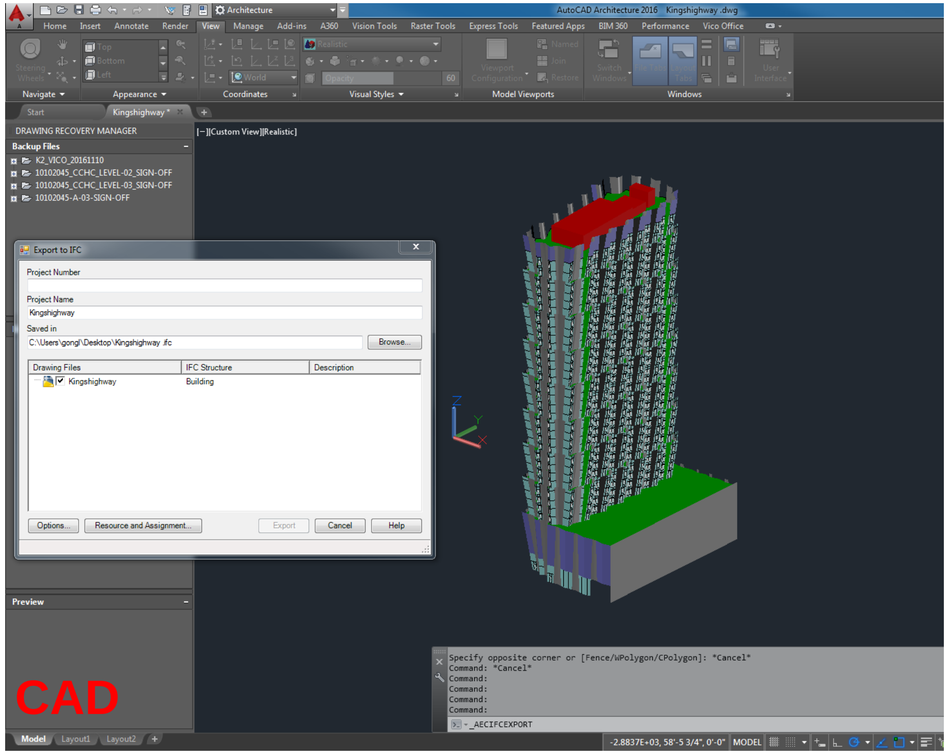
N13

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**Willis Tower 5.3.2017**												
2													
3	BEAM_RECTANGULAR			**2,880.44**									
5									QTY				
6	*B10-_TT_Tapered_Plate: 27" x 4.5 - 6" x 4.5"" SOLID BAR TAPERED*												
9		Length		214'-13/16"					feet and inches				
11		Weight		27.24					Tons				
13	*B10-_TT_Tapered_Plate_30: 30" x 4.5" - 6" X 4.5" SOLID BAR TAPERED*												
16		Length		215'-1 9/16"					feet and inches				
18		Weight		30.31					Tons				
20	*B10-_TT-Plate Girder: BG*												
23		Length		45'					feet and inches				
25		Weight		5.11					Tons				
27	*B10-_TT-Plate Girder: PG 1*												
30		Length		417'-6"					feet and inches				
32		Weight		90.42					Tons				
34	*B10-_TT-Plate Girder: PG 2*												
37		Length		105'					feet and inches				
39		Weight		27.89					Tons				
41	*B10-_TT-Plate Girder: PG 3*												
44		Length		60'-4 15/16"					feet and inches				
46		Weight		8.05					Tons				
48	*B10-_TT-Plate Girder: PG 4*												
51		Length		200'					feet and inches				
53		Weight		68.29					Tons				
55	*B10-Concrete-Rectangular Beam: Encased Beam1*												
58		Length		77'-4 1/2"					feet and inches				
60		Weight		88.72					Tons				
62	*B10-Concrete-Rectangular Beam: Encased Beam2*												
65		Length		463'-1/16"					feet and inches				

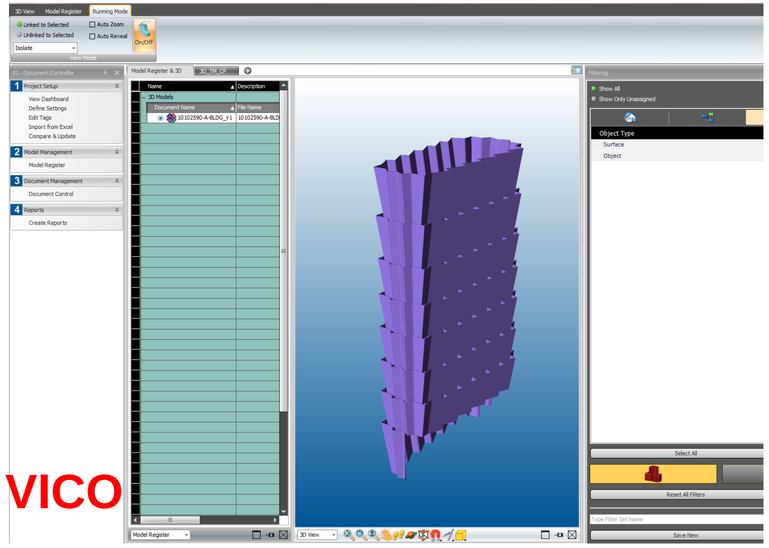
Rhino Model imported to VICO



Rhino converting to CAD

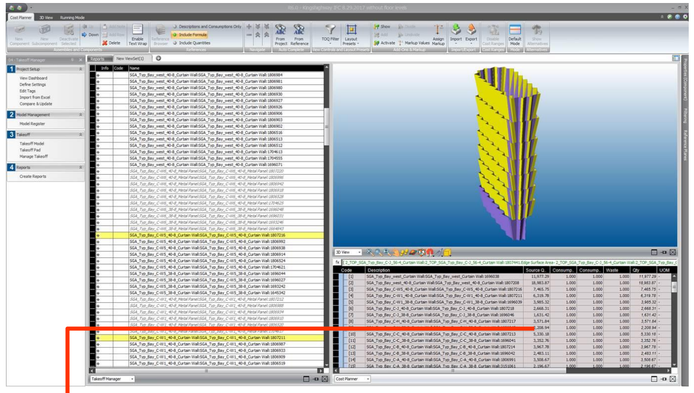


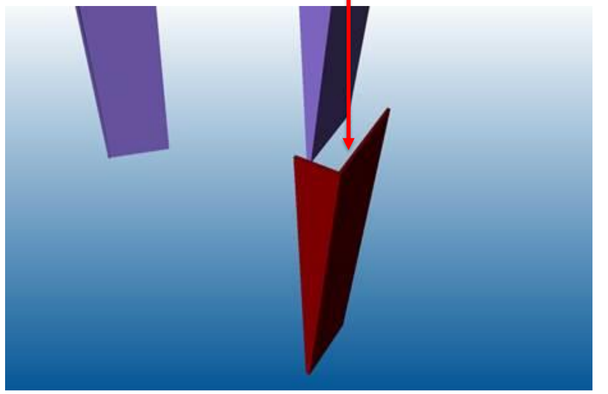
CAD converting to IFC and then IFC Importing to VICO



Rhino Model Converted to VICO

Type: Roof





Total curtainwall area on tower is 121,805 sqft.

Use formula to define quantities as desired

FormulaEditor

Associated Location System: -

Code	Description/Quantity	Value	Unit
	SGA_Typ_Bay_west_Metal Panel:SGA_Typ_Bay_west_Metal Panel:1298685		
	SGA_Typ_Bay_west_Curtain Wall:SGA_Typ_Bay_west_Curtain Wall:1300345		
	SGA_Typ_Bay_west_Metal Panel:SGA_Typ_Bay_west_Metal Panel:1300346		
	SGA_Typ_Bay_west_Metal Panel:SGA_Typ_Bay_west_Metal Panel:1300347		
	SGA_Typ_Bay_west_Curtain Wall:SGA_Typ_Bay_west_Curtain Wall:1300348		
	SGA_Typ_Bay_west_Curtain Wall:SGA_Typ_Bay_west_Curtain Wall:1629978		
	SGA_Typ_Bay_C-W1_38-8_Curtain Wall:SGA_Typ_Bay_C-W1_38-8_Curtain Wall:1630025		
	SGA_Typ_Bay_C-W1_38-8_Metal Panel:SGA_Typ_Bay_C-W1_38-8_Metal Panel:1631655		
	SGA_Typ_Bay_C-C_38-8_Curtain Wall:SGA_Typ_Bay_C-C_38-8_Curtain Wall:1633121		
	SGA_Typ_Bay_C-B_38-8_Curtain Wall:SGA_Typ_Bay_C-B_38-8_Curtain Wall:1634578		
	SGA_Typ_Bay_C-W5_38-8_Curtain Wall:SGA_Typ_Bay_C-W5_38-8_Curtain Wall:1645342		
	SGA_Typ_Bay_C-H_38-8_Curtain Wall:SGA_Typ_Bay_C-H_38-8_Curtain Wall:1649325		
	SGA_Typ_Bay_C-J_38-8_Curtain Wall:SGA_Typ_Bay_C-J_38-8_Curtain Wall:1649326		
	SGA_Typ_Bay_C-C_38-8_Metal Panel:SGA_Typ_Bay_C-C_38-8_Metal Panel:1659128		

LBS	Quantity
Project	18,983.87

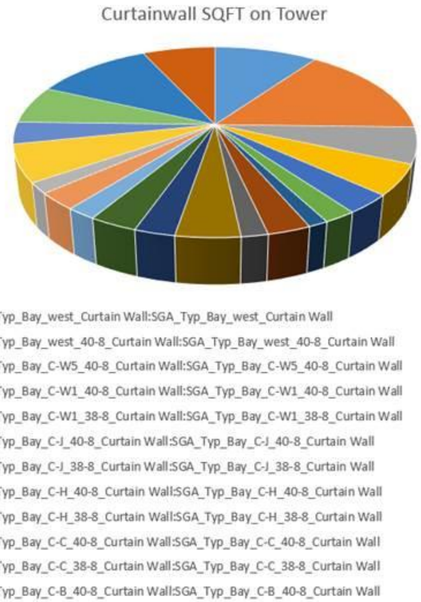
Enter formula

fx= (SGA_Typ_Bay_west_40-8_Curtain Wall:SGA_Typ_Bay_west_40-8_Curtain Wall:1807208.Edge Surface Area- SGA_Typ_Bay_west_40-8_Curtain Wall:SGA_Typ_Bay_west_40-8_Curtain Wall:1807208.Two_Edge_Surface*(SGA_Typ_Bay_west_40-8_Curtain Wall:SGA_Typ_Bay_west_40-8_Curtain Wall:1807208.Count-1))/2

Preview

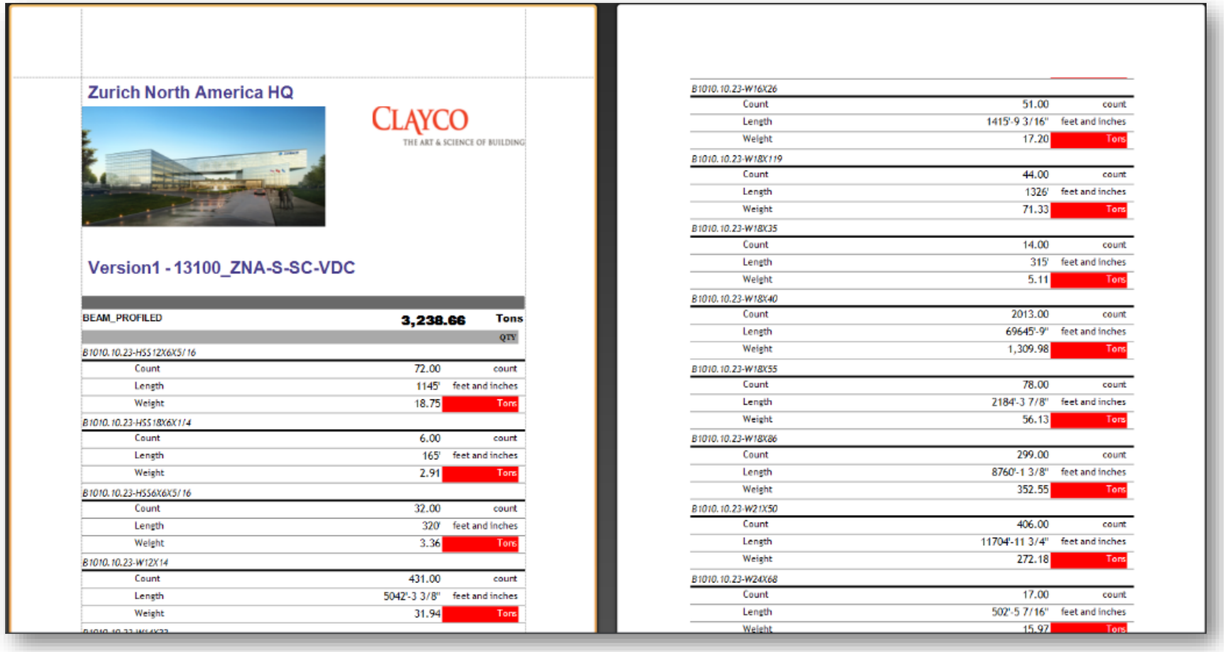
((SGA_Typ_Bay_west_40-8_Curtain Wall:SGA_Typ_Bay_west_40-8_Curtain Wall:1807208.Edge Surface Area-(SGA_Typ_Bay_west_40-8_Curtain Wall:SGA_Typ_Bay_west_40-8_Curtain Wall:1807208.Two_Edge_Surface* (SGA_Typ_Bay_west_40-8_Curtain Wall:SGA_Typ_Bay_west_40-8_Curtain Wall:1807208.Count-1.000000000000))/2.000000000000)

	Curtainwall Modules	SQFT
[1]	SGA_Typ_Bay_west_Curtain Wall:SGA_Typ_Bay_west_Curtain Wall	11,977.29
[2]	SGA_Typ_Bay_west_40-8_Curtain Wall:SGA_Typ_Bay_west_40-8_Curtain Wall	18,983.87
[3]	SGA_Typ_Bay_C-W5_40-8_Curtain Wall:SGA_Typ_Bay_C-W5_40-8_Curtain Wall	7,465.75
[4]	SGA_Typ_Bay_C-W1_40-8_Curtain Wall:SGA_Typ_Bay_C-W1_40-8_Curtain Wall	6,319.78
[5]	SGA_Typ_Bay_C-W1_38-8_Curtain Wall:SGA_Typ_Bay_C-W1_38-8_Curtain Wall	3,985.32
[6]	SGA_Typ_Bay_C-J_40-8_Curtain Wall:SGA_Typ_Bay_C-J_40-8_Curtain Wall	2,668.31
[7]	SGA_Typ_Bay_C-J_38-8_Curtain Wall:SGA_Typ_Bay_C-J_38-8_Curtain Wall	1,631.42
[8]	SGA_Typ_Bay_C-H_40-8_Curtain Wall:SGA_Typ_Bay_C-H_40-8_Curtain Wall	3,571.84
[9]	SGA_Typ_Bay_C-H_38-8_Curtain Wall:SGA_Typ_Bay_C-H_38-8_Curtain Wall	2,208.94
[10]	SGA_Typ_Bay_C-C_40-8_Curtain Wall:SGA_Typ_Bay_C-C_40-8_Curtain Wall	5,330.18
[11]	SGA_Typ_Bay_C-C_38-8_Curtain Wall:SGA_Typ_Bay_C-C_38-8_Curtain Wall	3,352.76
[12]	SGA_Typ_Bay_C-B_40-8_Curtain Wall:SGA_Typ_Bay_C-B_40-8_Curtain Wall	3,967.78
[13]	SGA_Typ_Bay_C-B_38-8_Curtain Wall:SGA_Typ_Bay_C-B_38-8_Curtain Wall	2,483.11
[14]	SGA_Typ_Bay_C-A_40-8_Curtain Wall:SGA_Typ_Bay_C-A_40-8_Curtain Wall	3,508.67
[15]	SGA_Typ_Bay_C-A_38-8_Curtain Wall:SGA_Typ_Bay_C-A_38-8_Curtain Wall	2,196.67
[16]	3_SGA_Typ_Bay_west_51-10_Curtain Wall:3_SGA_Typ_Bay_west_51-10_Curtain Wall	7,703.25
[17]	3_SGA_Typ_Bay_C-W5_51-10_Curtain Wall:3_SGA_Typ_Bay_C-W5_51-10_Curtain Wall	4,522.49
[18]	3_SGA_Typ_Bay_C-J_51-10_Curtain Wall:3_SGA_Typ_Bay_C-J_51-10_Curtain Wall	7,829.81
[19]	2_TOP_SGA_Typ_Bay_west_56-4_Curtain Wall:2_TOP_SGA_Typ_Bay_west_56-4_Curtain Wall	13,639.70
[20]	2_TOP_SGA_Typ_Bay_C-J_56-4_Curtain Wall:2_TOP_SGA_Typ_Bay_C-J_56-4_Curtain Wall	8,457.75
TOTAL		121,804.68



Reporting

- Construction grade quantities
  - Steel
  - Concrete
  - Partitions
  - Finishes
- Comparison report
  - Unified models database
  - Quantity reporting
  - Associated cost reporting
  - Visual verification
- Quantity push to estimating platform



Zurich North America HQ

CLAYCO
THE ART & SCIENCE OF BUILDING

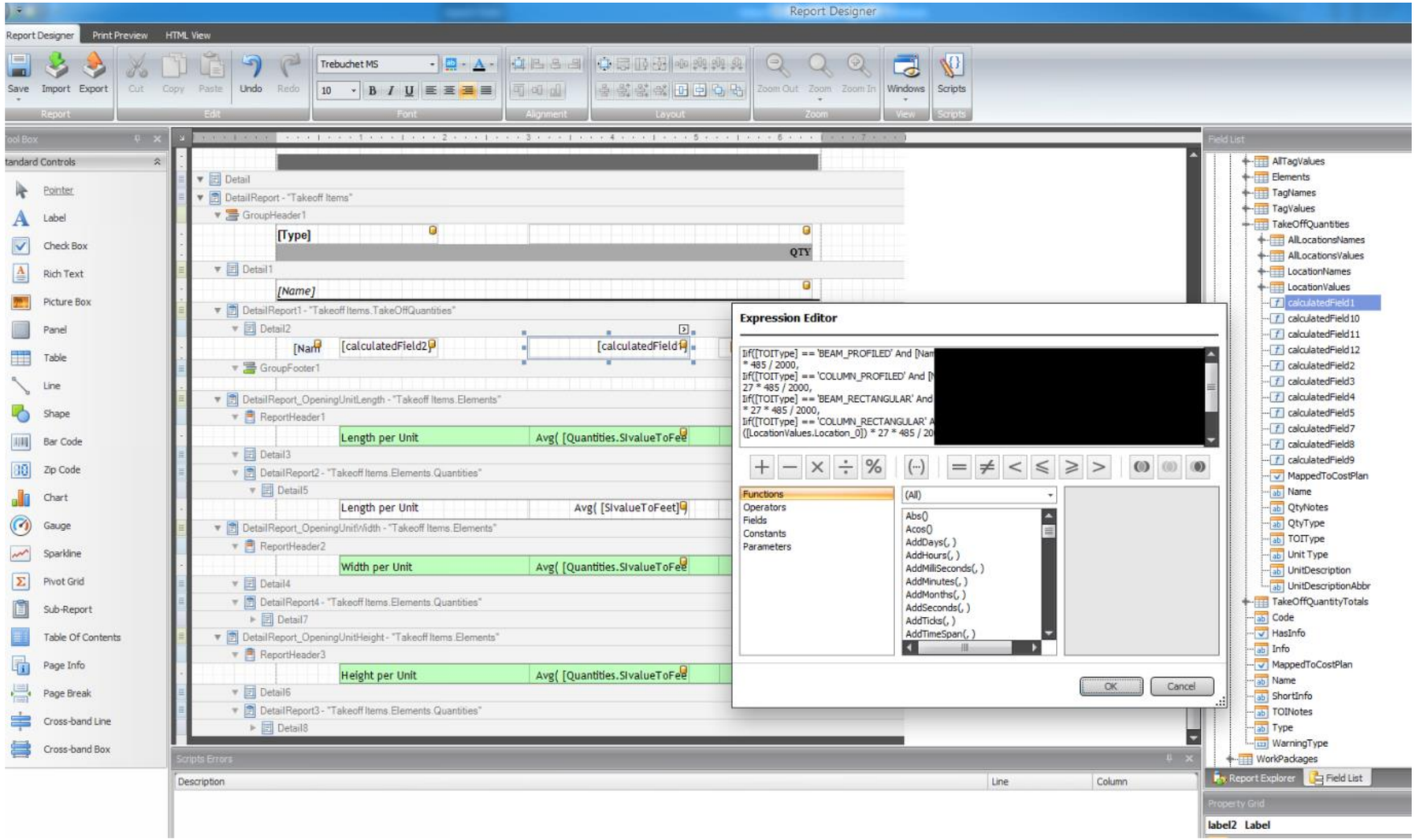
Version1 - 13100_ZNA-S-SC-VDC

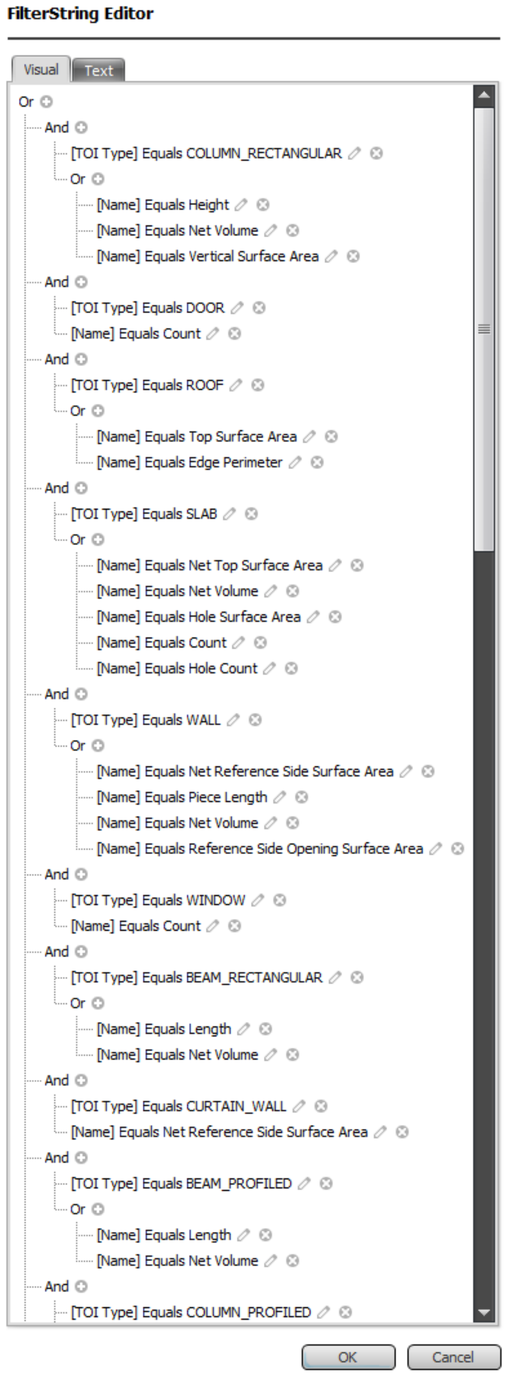
BEAM_PROFILED	3,238.66	Tons
		QTY
B1010.10.23-HSS12X6X5/16		
Count	72.00	count
Length	1145'	feet and inches
Weight	18.75	Tons
B1010.10.23-HSS18X6X1/4		
Count	6.00	count
Length	165'	feet and inches
Weight	2.91	Tons
B1010.10.23-HSS6X6X5/16		
Count	32.00	count
Length	320'	feet and inches
Weight	3.36	Tons
B1010.10.23-W12X14		
Count	431.00	count
Length	5042'-3 3/8"	feet and inches
Weight	31.94	Tons

B1010.10.23-W16X26		
Count	51.00	count
Length	1415'-9 3/16"	feet and inches
Weight	17.20	Tons
B1010.10.23-W18X119		
Count	44.00	count
Length	1326'	feet and inches
Weight	71.33	Tons
B1010.10.23-W18X35		
Count	14.00	count
Length	315'	feet and inches
Weight	5.11	Tons
B1010.10.23-W18X40		
Count	2013.00	count
Length	69645'-9"	feet and inches
Weight	1,309.98	Tons
B1010.10.23-W18X55		
Count	78.00	count
Length	2184'-3 7/8"	feet and inches
Weight	56.13	Tons
B1010.10.23-W18X86		
Count	299.00	count
Length	8760'-1 3/8"	feet and inches
Weight	352.55	Tons
B1010.10.23-W21X50		
Count	406.00	count
Length	11704'-11 3/4"	feet and inches
Weight	272.18	Tons
B1010.10.23-W24X68		
Count	17.00	count
Length	502'-5 7/16"	feet and inches
Weight	15.97	Tons

		QTY
B1010.10.23-HSS12X6X5/16		
Count	72.00	count
Length	1145'	feet and inches
Weight	18.75	Tons

Customizing Report Items





Scheduling & Estimating Platform Integration

- Ability to create Master assemblies
- No more corrupted Excel Formulas
- Estimates according to industry standards
  - Masterformat 95, 2004
  - Uniformat 2010
- Historical Cost modeling
- Support for the unlimited WBS and Locations
- P6 development

Q & A

Thank You!

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