One Model to Rule Them All: Using Revit to Produce Multiple Analytical Energy Models

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Class summary

This class will present techniques for using Revit to rapidly produce analytical geometry models for use in various energy modeling programs and Autodesk Simulation CFD

Key learning objectives

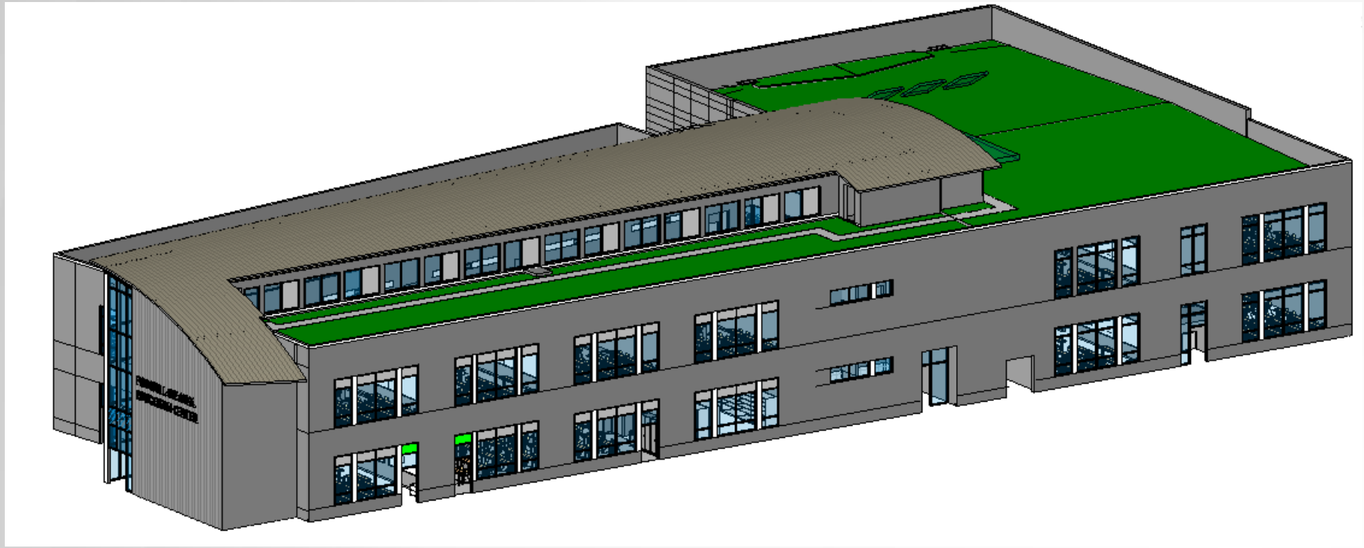
At the end of this class, you will have:

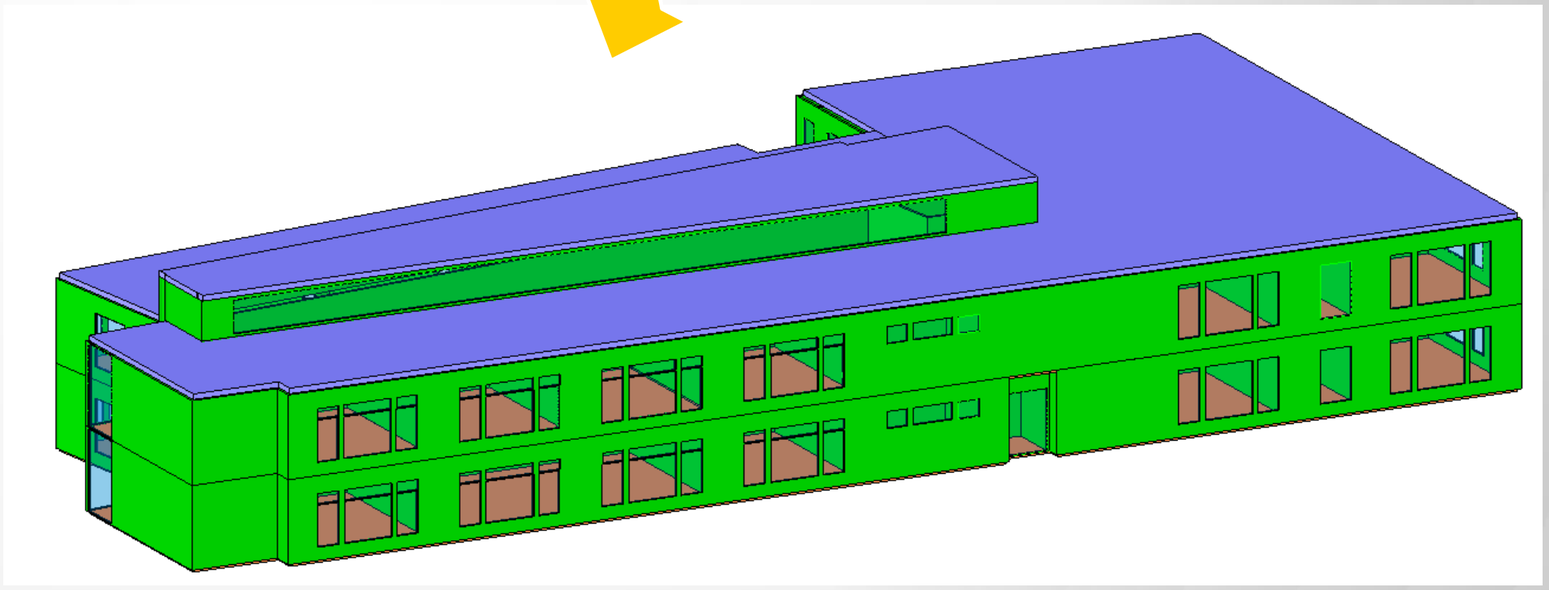
- Learned how to use the Revit software workflow for rapidly building an analytical model from an architectural model
- Learned how to use Revit software and the Green Building Studio service to export to multiple energy analysis programs
- Learned how to use Revit software to quickly import a full lighting design into an energy model
- Learned how to use Revit software to create CFD boundary condition geometry

Why?

Rapid Creation of Analytical Model Geometry

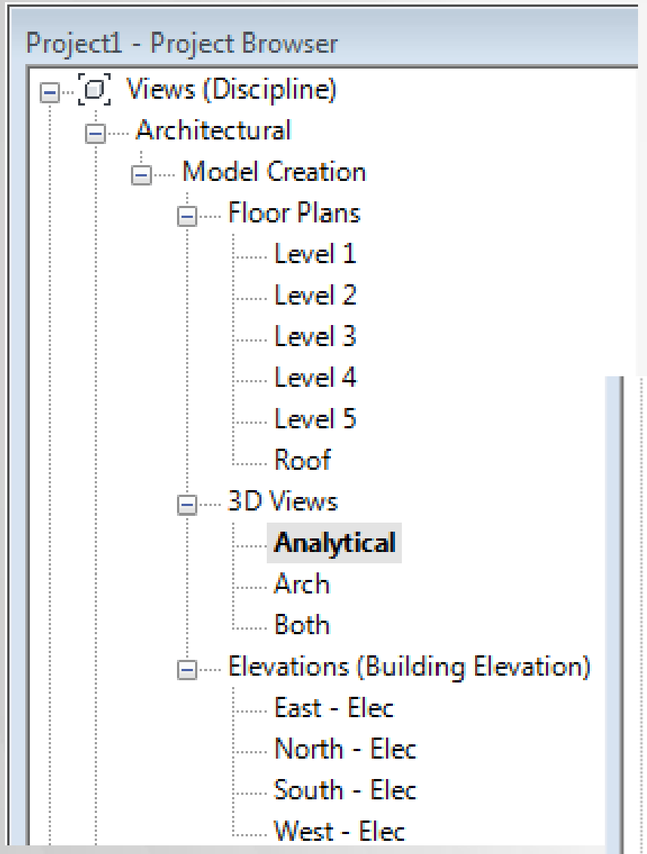
Creating Analytical Model from Detailed Model

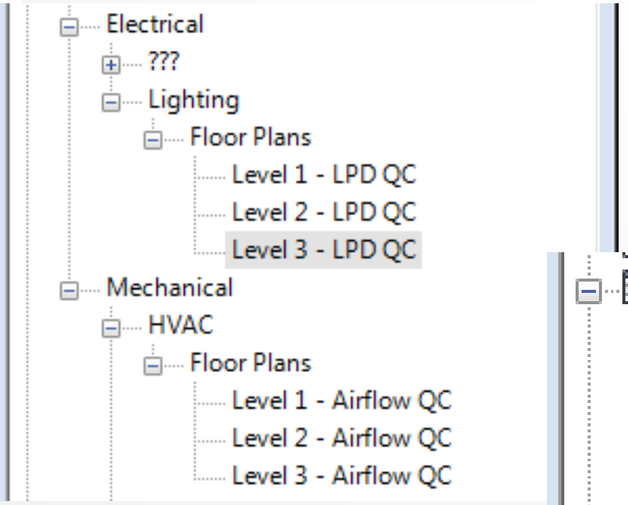


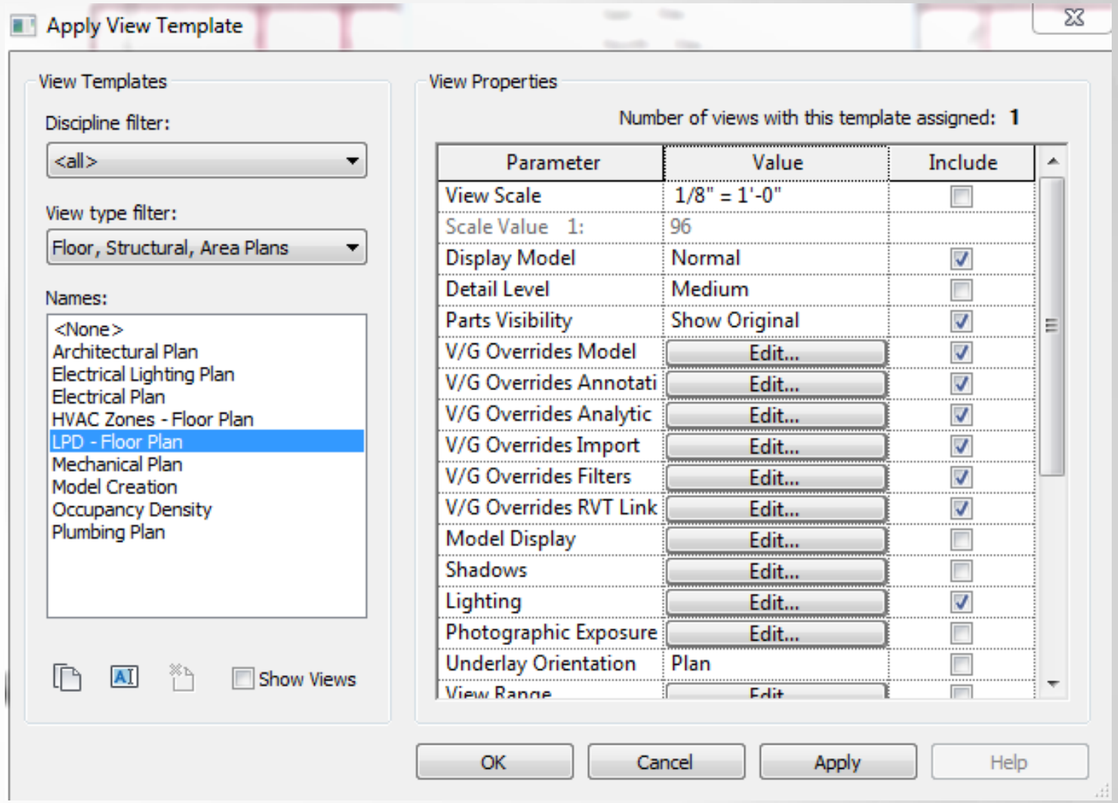


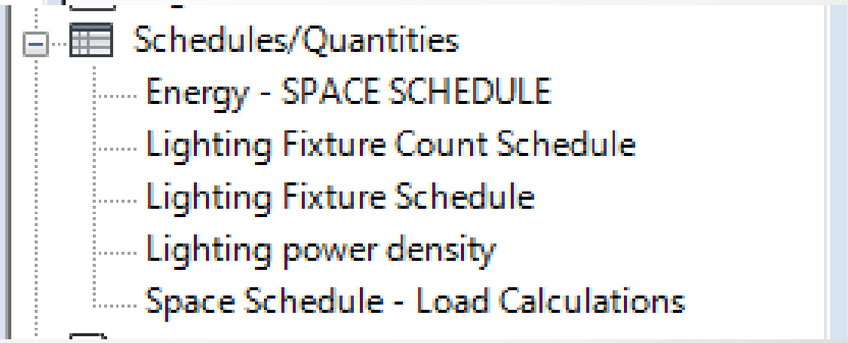
Project Template File

Commonly used views and schedules

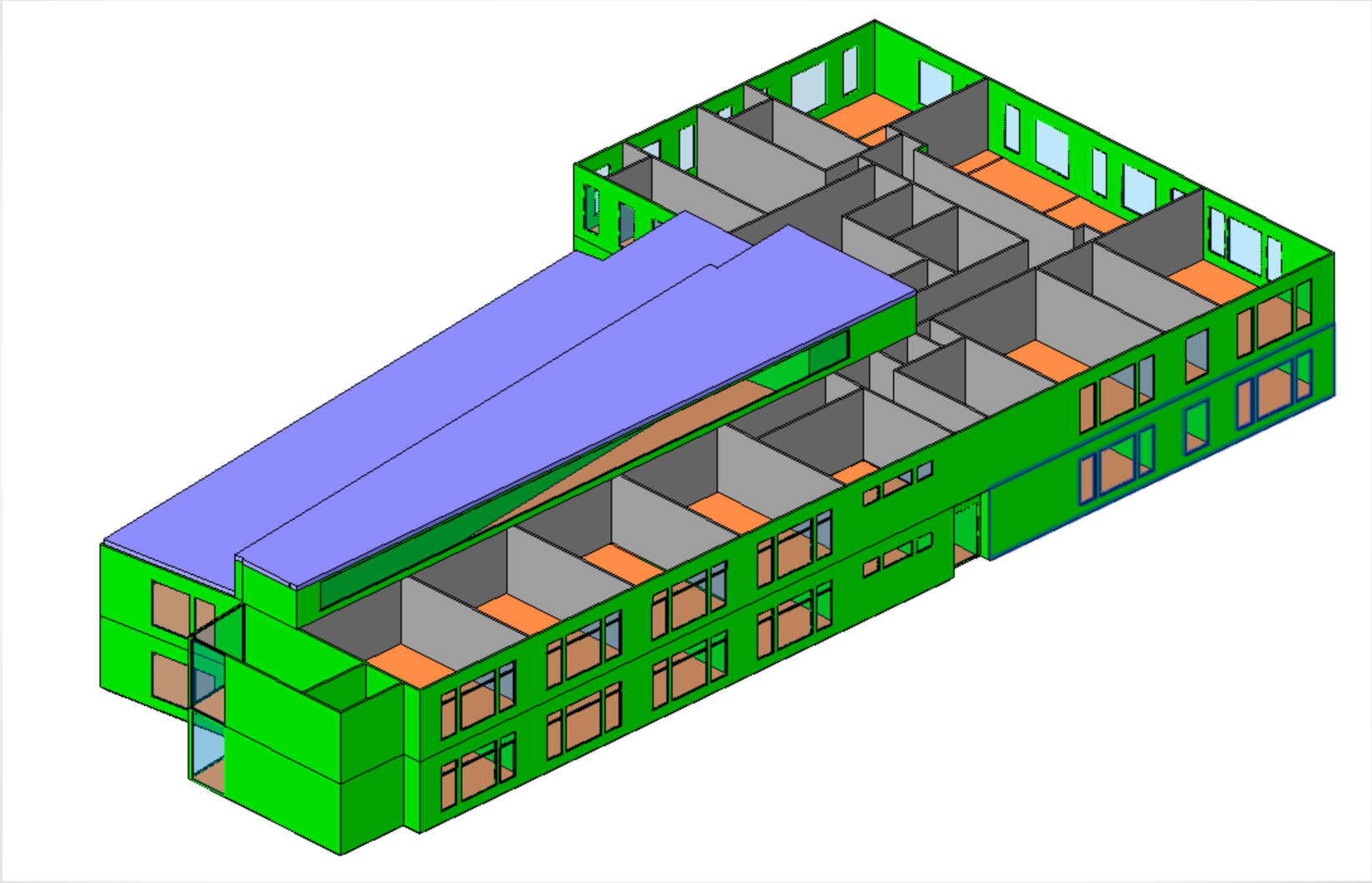




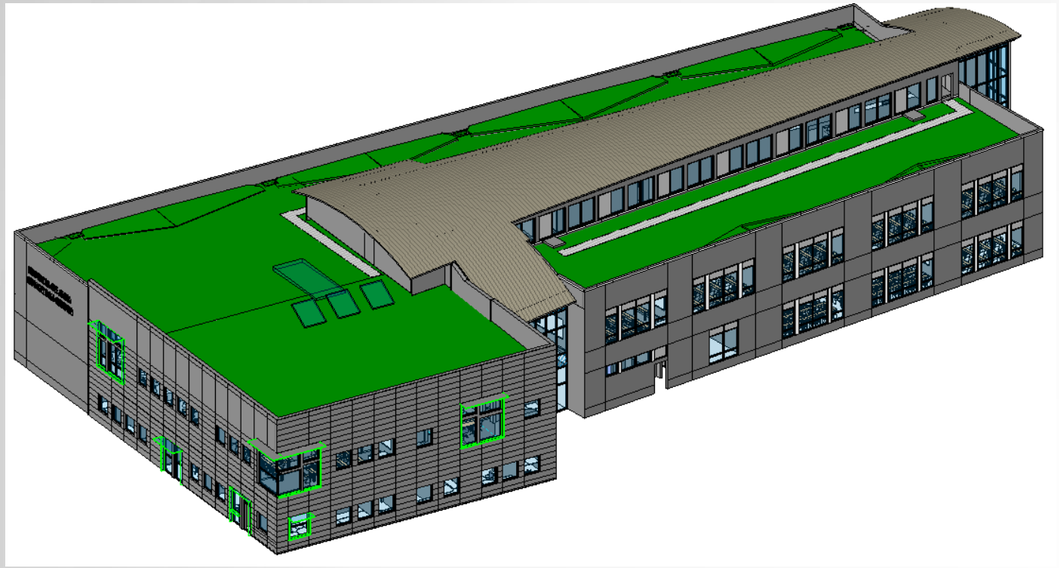


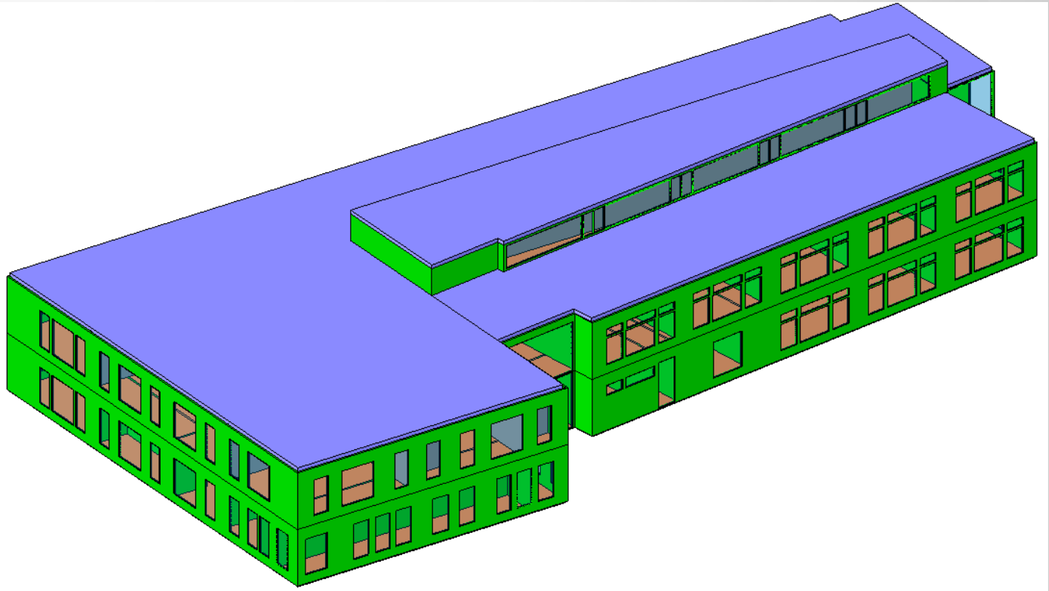


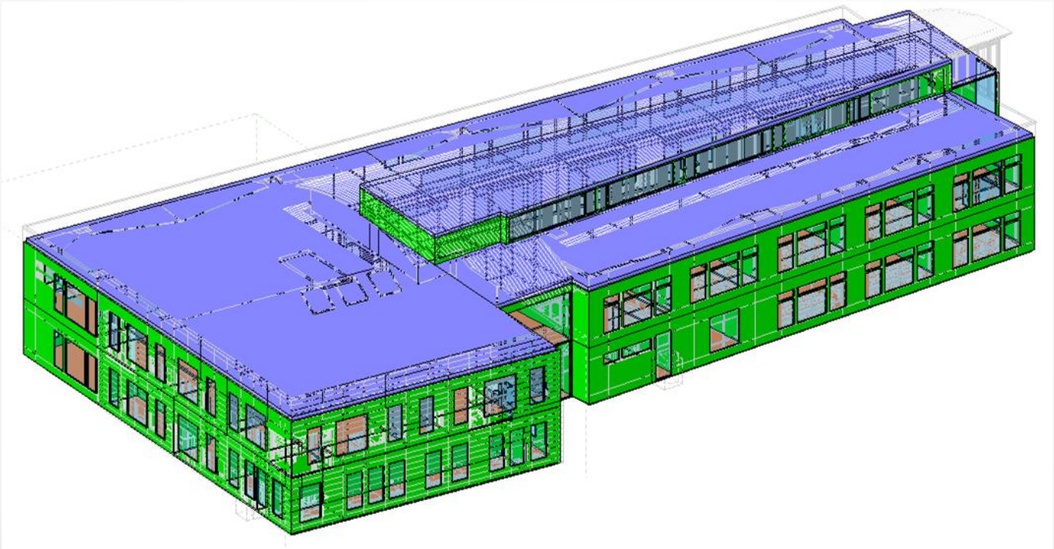
Envelope Families



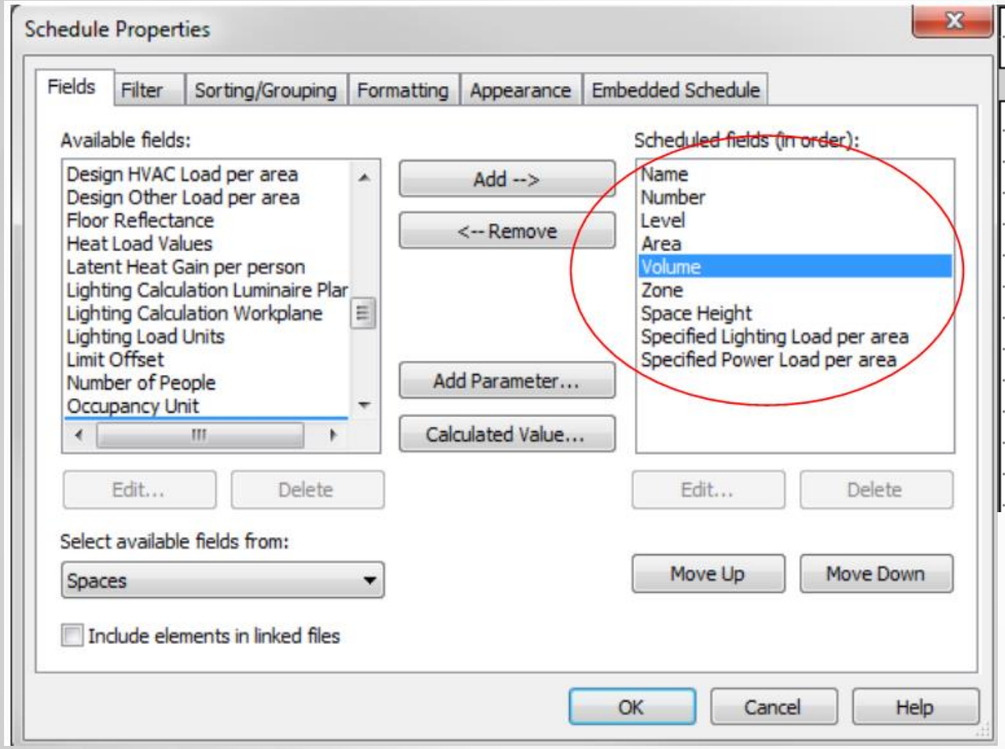
Predefined Views







Predefined Schedules



Energy - SPACE SCHEDULE

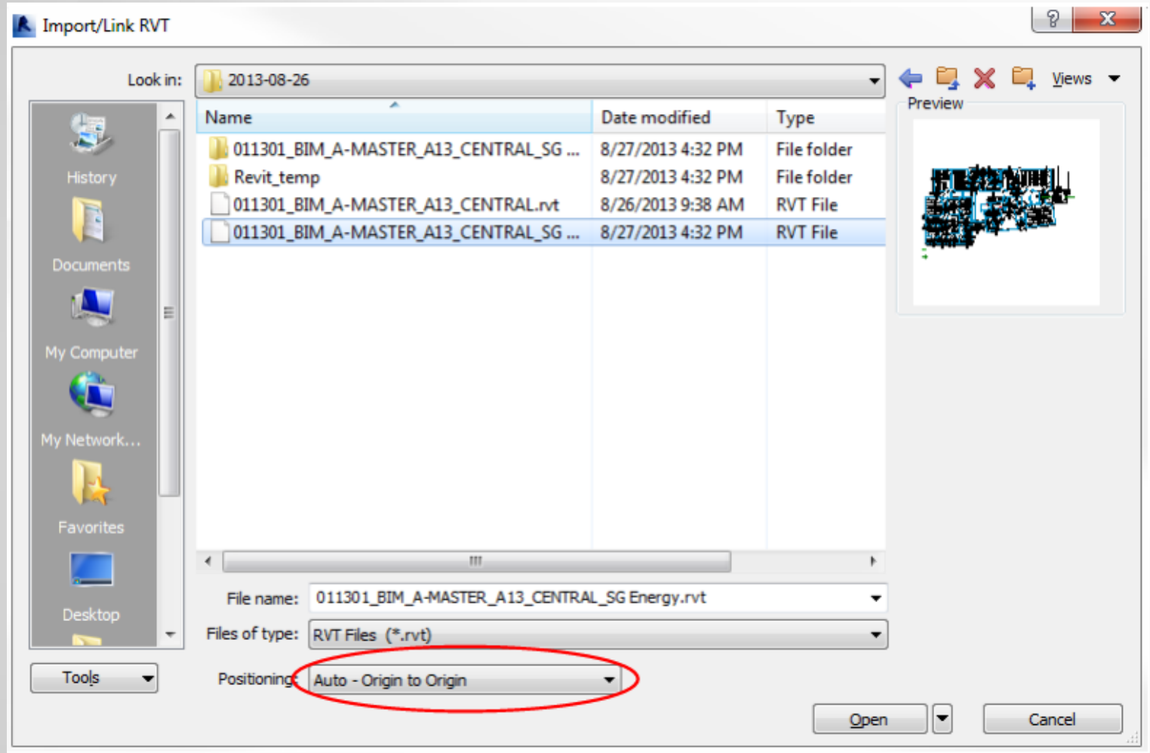
Name	Number	Zone	Level	Area	Volume	Space Height	Specified Lighting Load	Specified Power
WOMEN	114	1-WOMEN 114	Level 1	628 SF	9101.61 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
STORE	107C	1-STORE 107C	Level 1	150 SF	2172.48 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
STORAGE	113	1-STORAGE 113	Level 1	188 SF	2719.01 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
STORAGE	108	1-STORAGE 108	Level 1	905 SF	13121.59 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
STAIR 2	132	1-STAIR 2 132	Level 1	459 SF	6648.30 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
STAIR 1-1	140-1	1-STAIR 1-1 140-1	Level 1	464 SF	6722.79 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
SOUTH VEST	131	1-SOUTH VEST 131	Level 1	216 SF	3131.93 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
SECURITY	115D	1-SECURITY 115D	Level 1	201 SF	2911.28 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
RESTRM	115A	1-RESTRM 115A	Level 1	119 SF	1725.51 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
PARTNERING	115	1-PARTNERING AREA 115	Level 1	2490 SF	36101.05 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
OFFICE	126B	1-OFFICE 126B	Level 1	322 SF	4673.83 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
OFFICE	115K	1-OFFICE 115K	Level 1	510 SF	7393.87 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
OFF	111A	1-OFF 111A	Level 1	172 SF	2490.13 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²

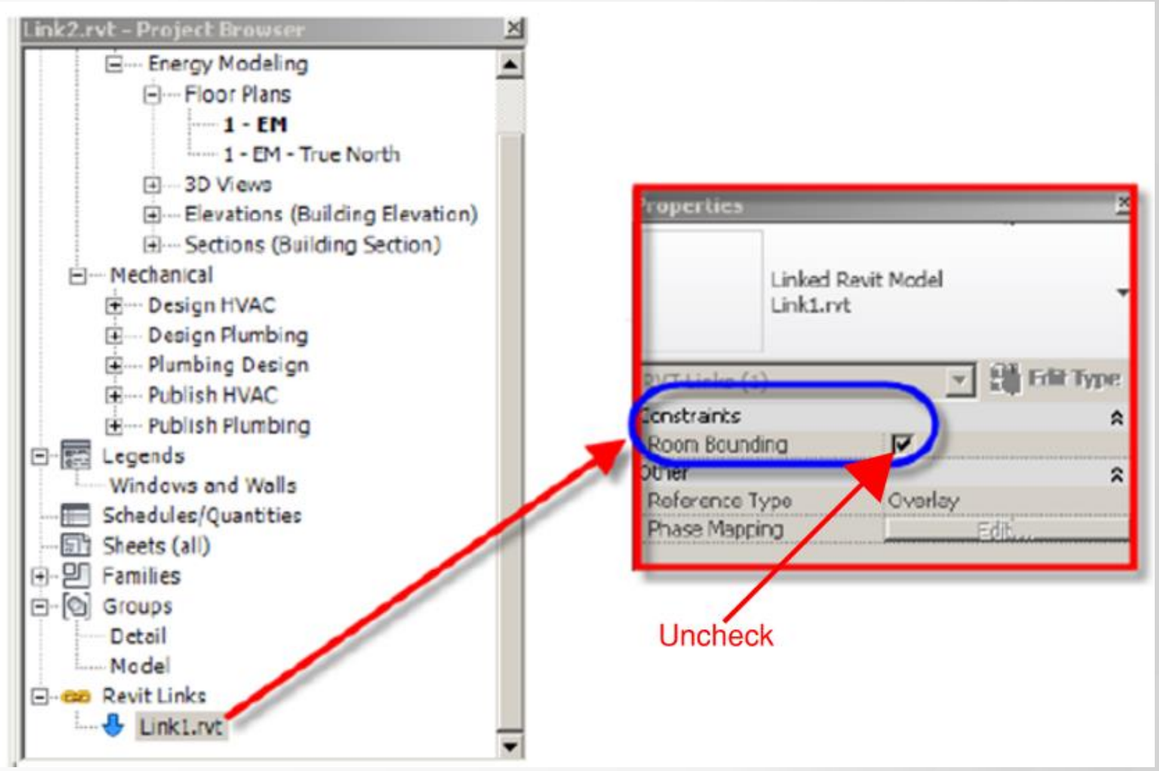
Creating Analytical Geometry for Energy Modeling

General Modeling Rules

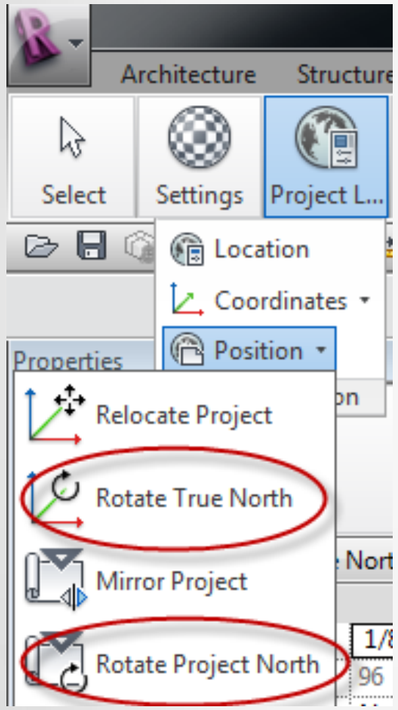
- Keep it simple!
  - Rectangular zoning
  - No doors (unless more than 10% of wall area)
  - Don’t model columns, shafts, non-bounding elements
- Align surfaces (ignore small offsets)
- Don’t use design options (use separate models)
- Use native families (in-place families don’t export)

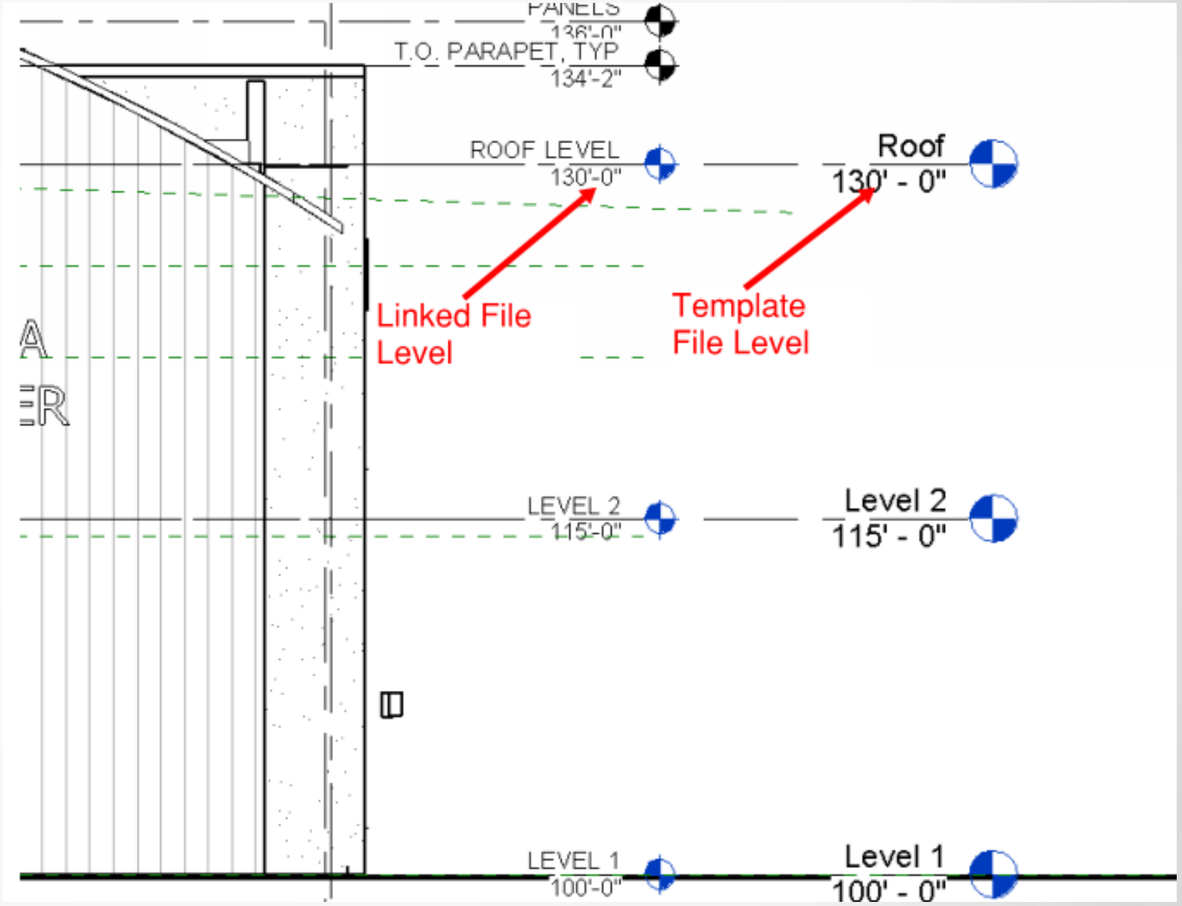
Step 1 – Link Architectural Model



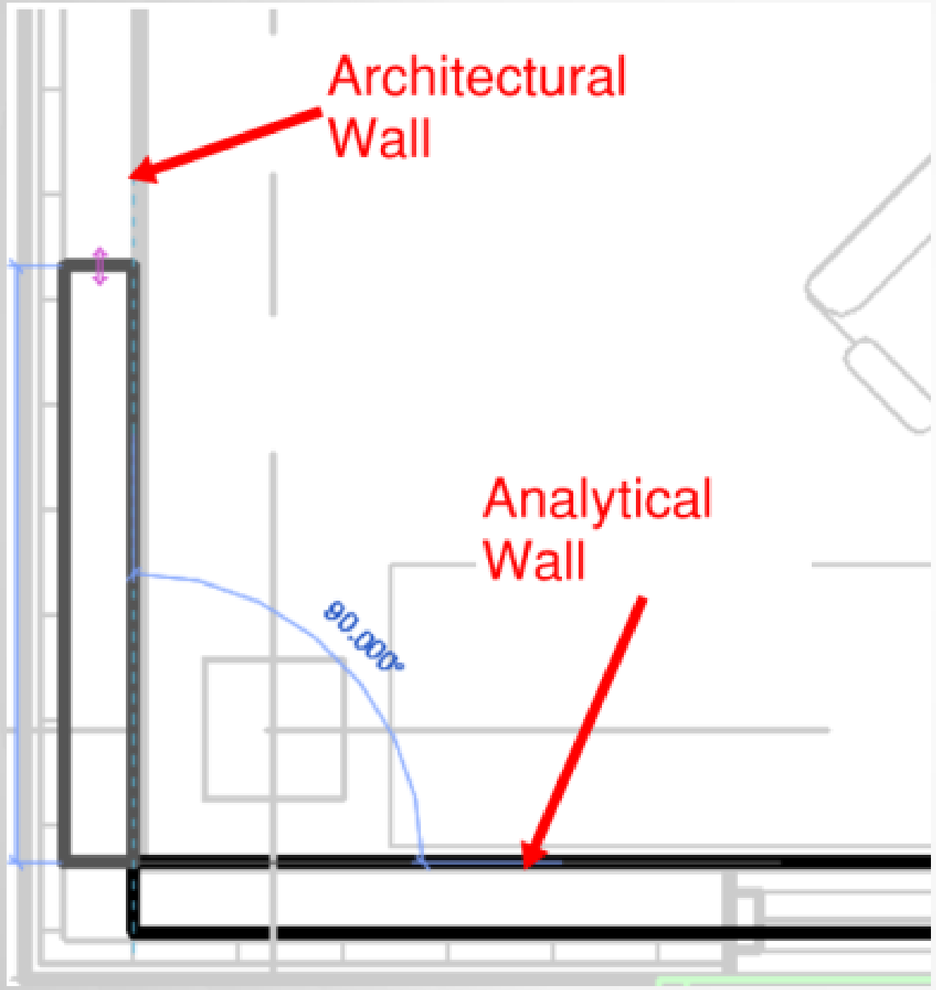


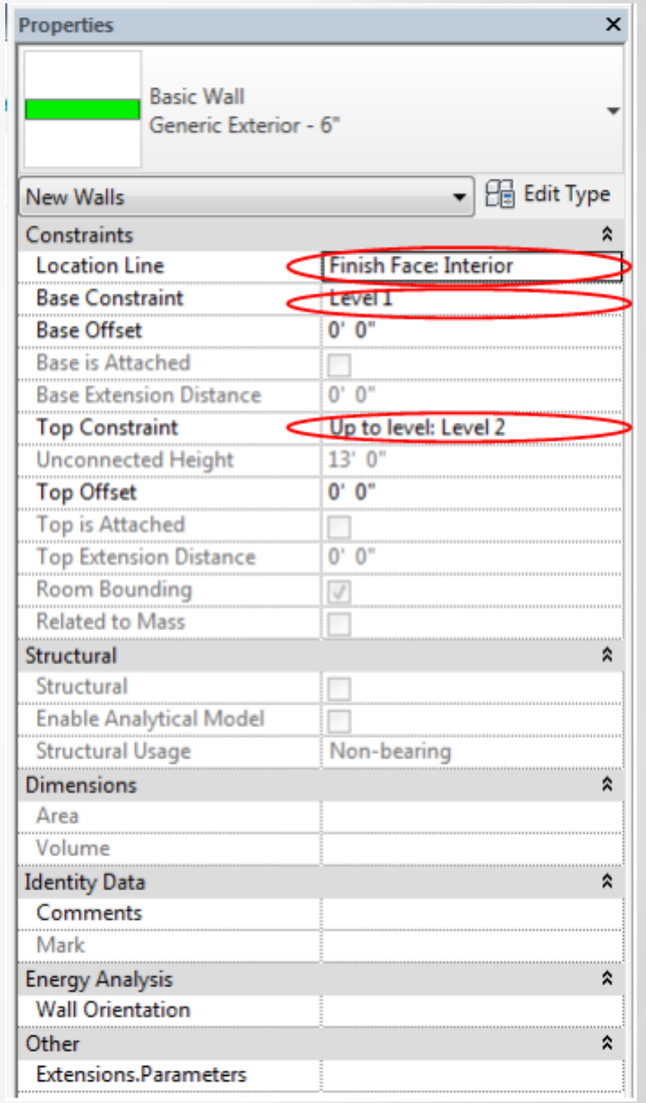
Steps 2 and 3 – Set Orientation and Align Levels



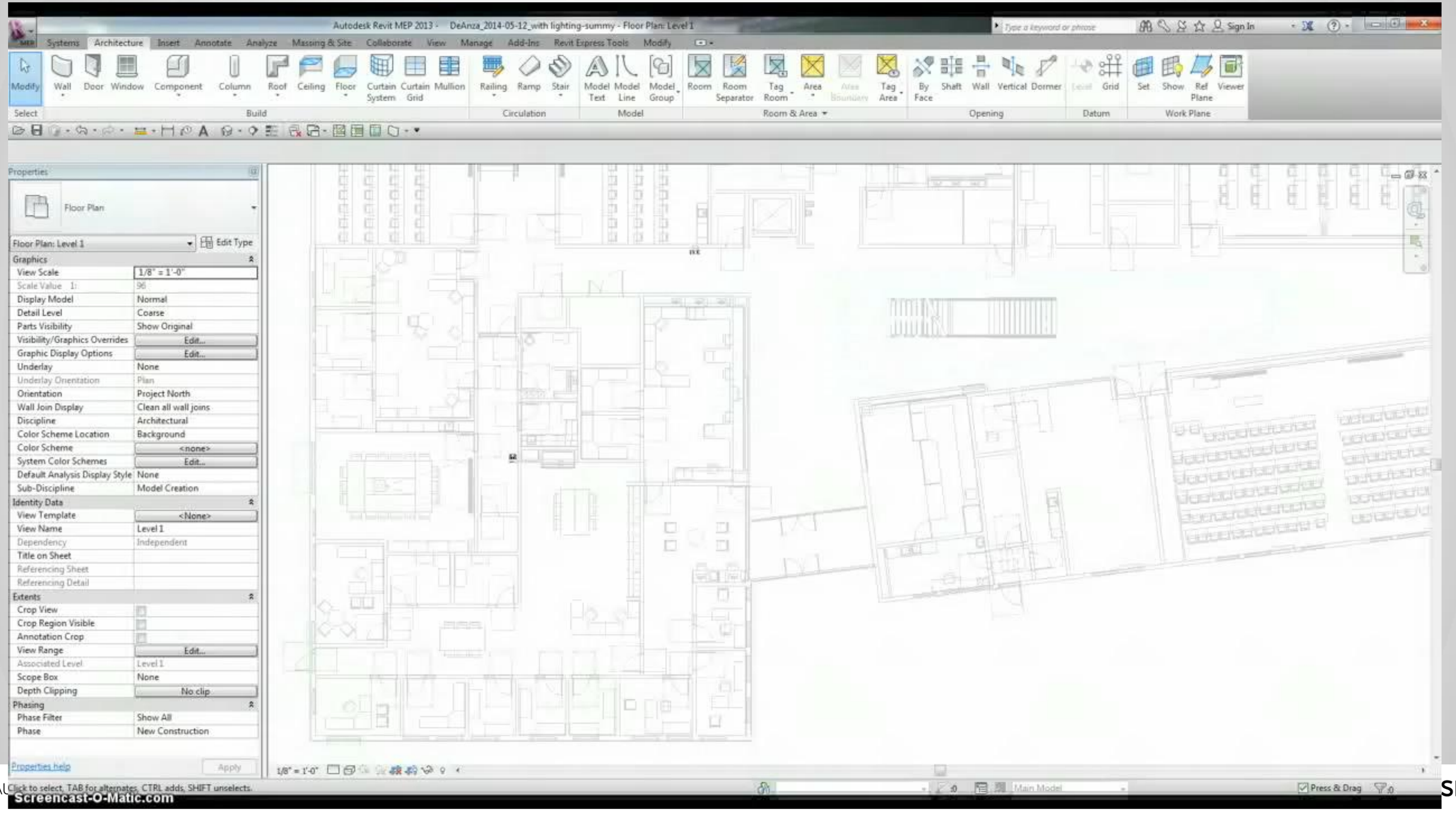


Step 4 – Draw Exterior Walls and Floors

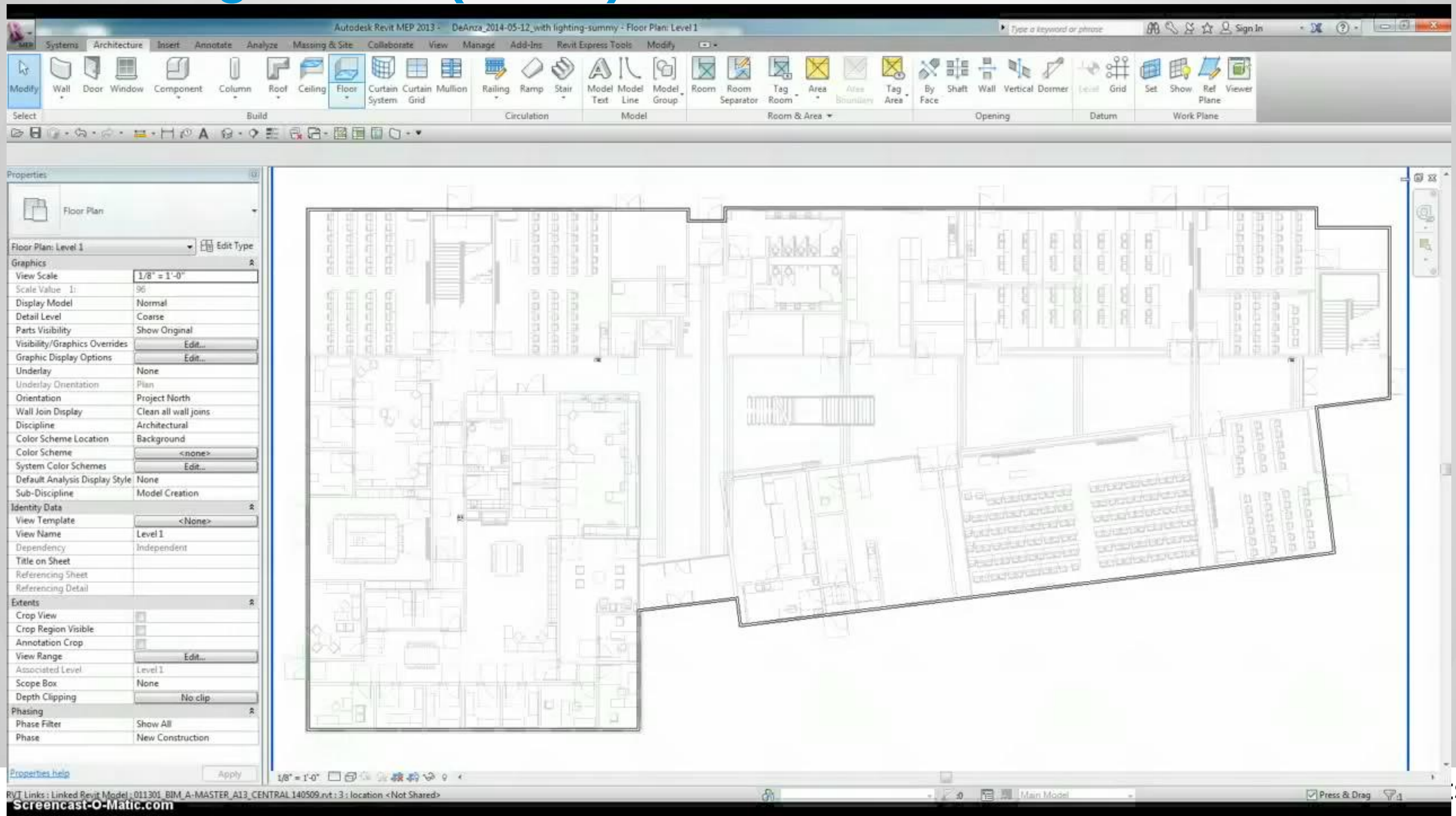




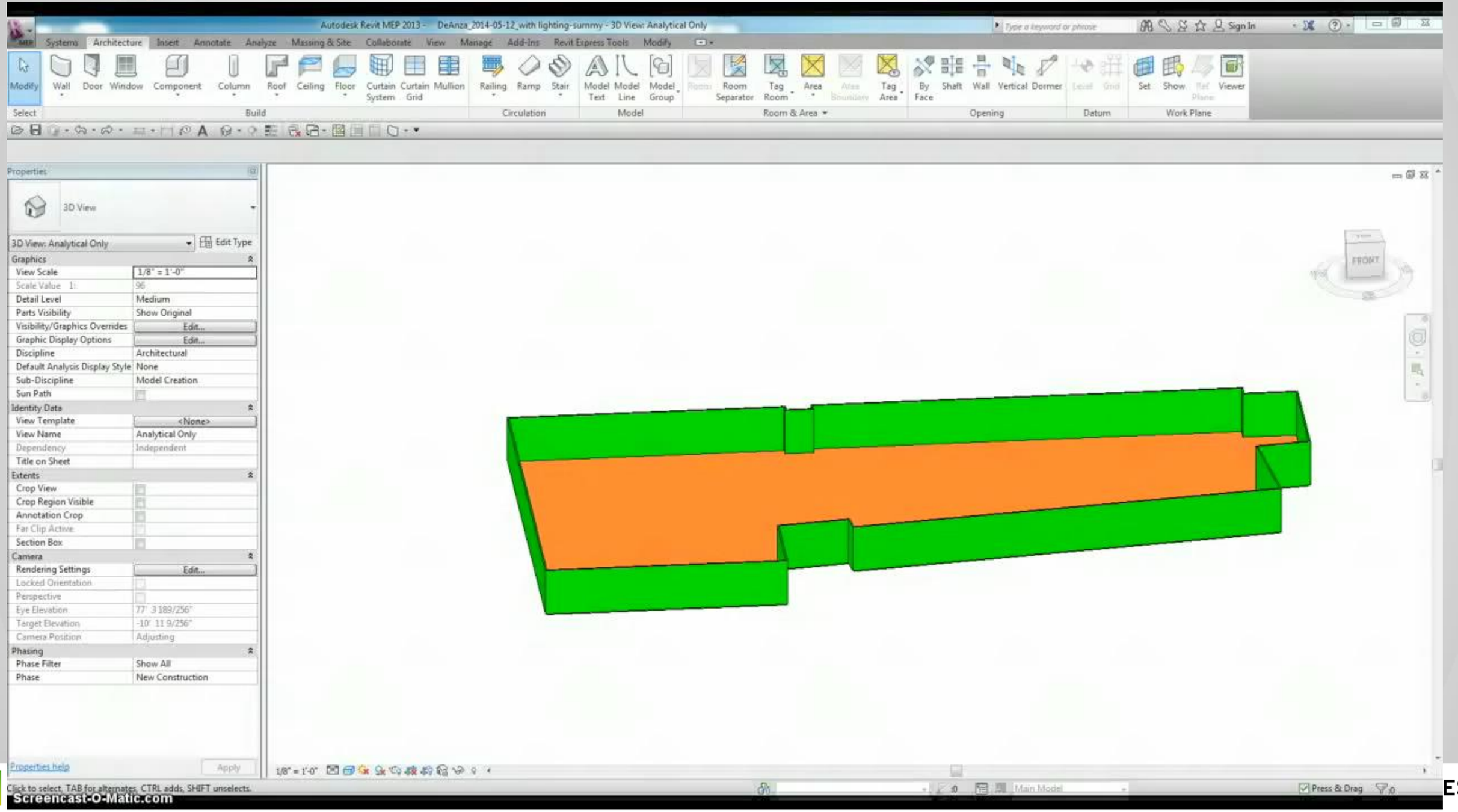
Drawing Walls (video)



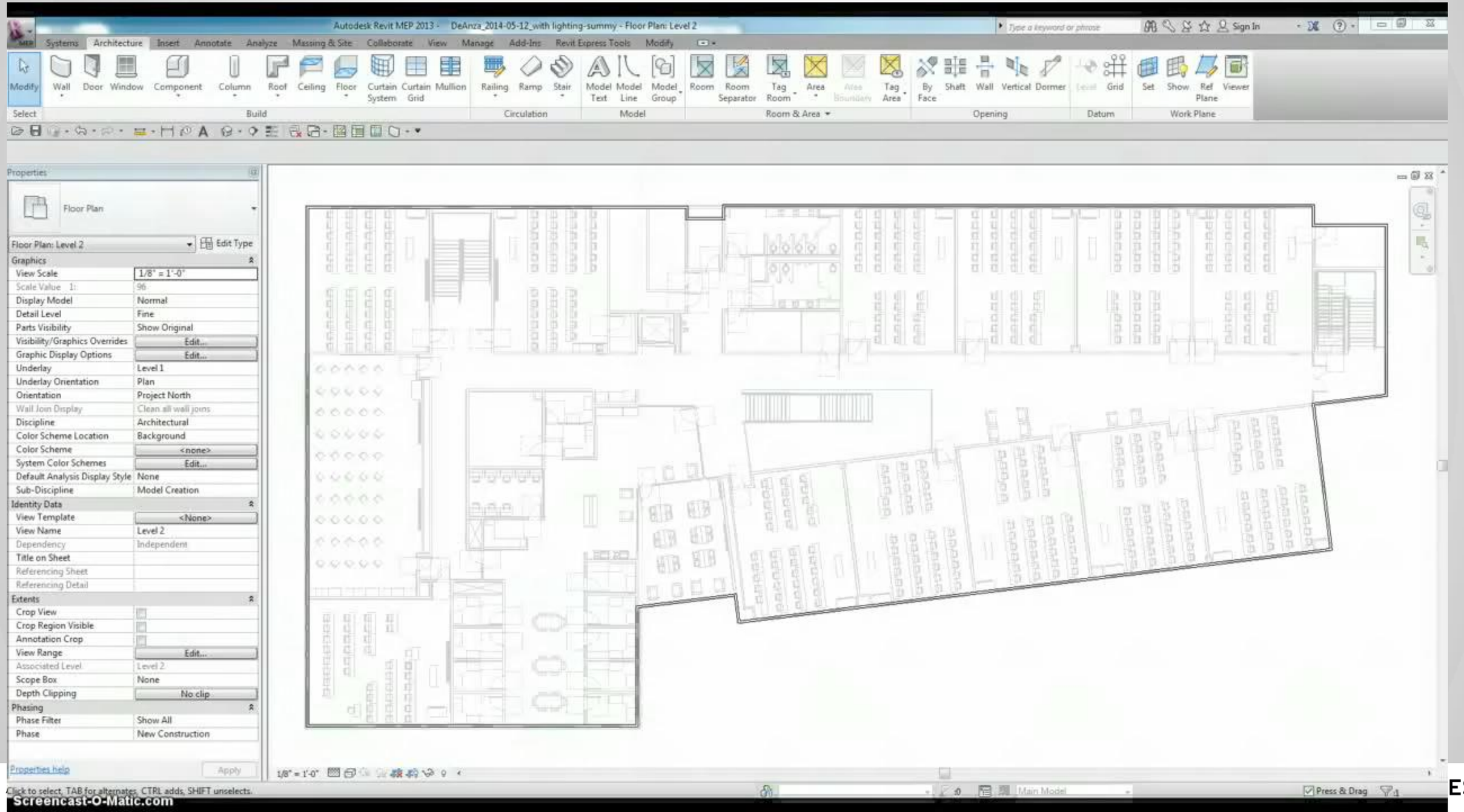
Drawing Floors (video)



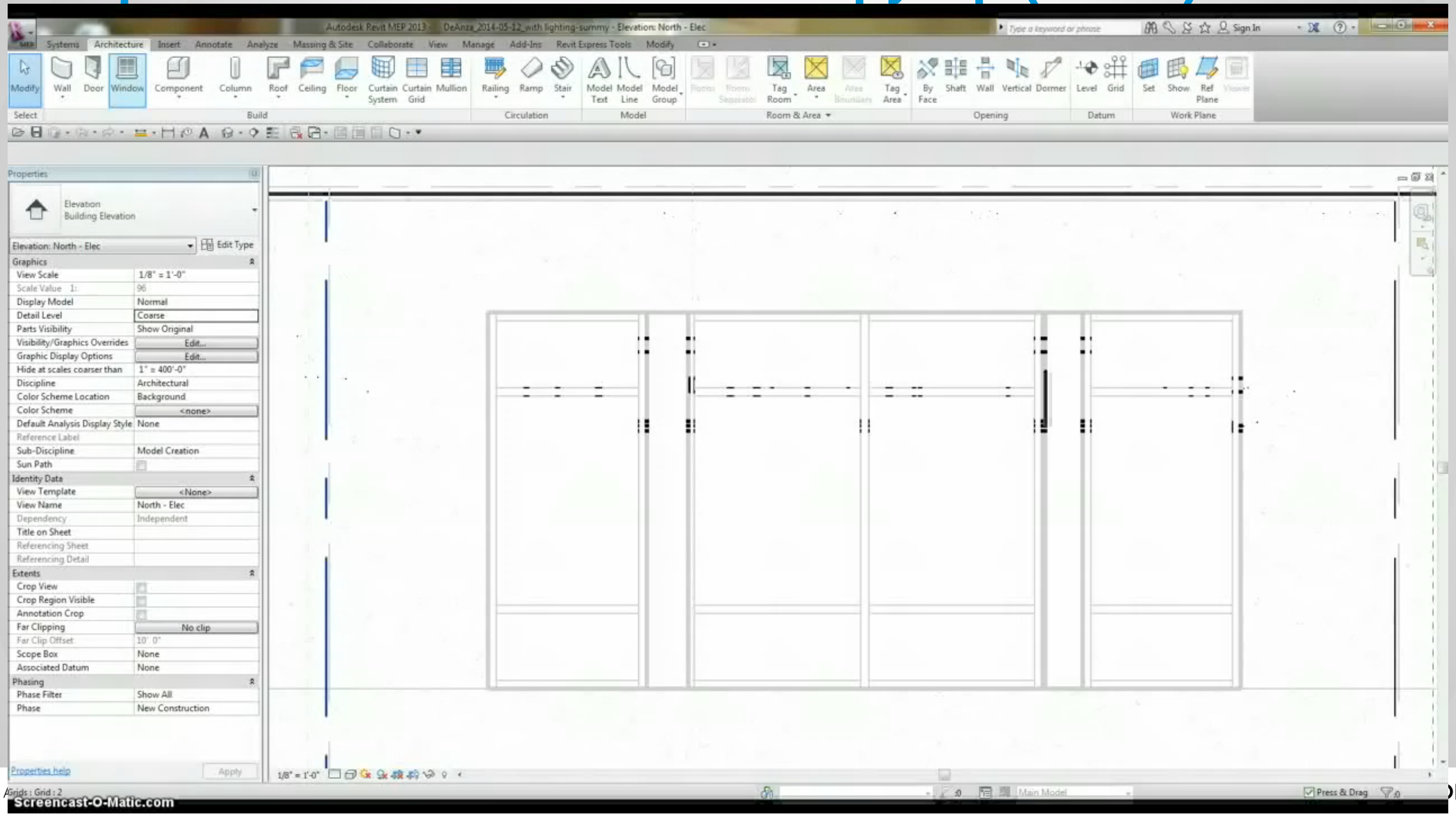
Copy and Paste Walls and Floors (video)



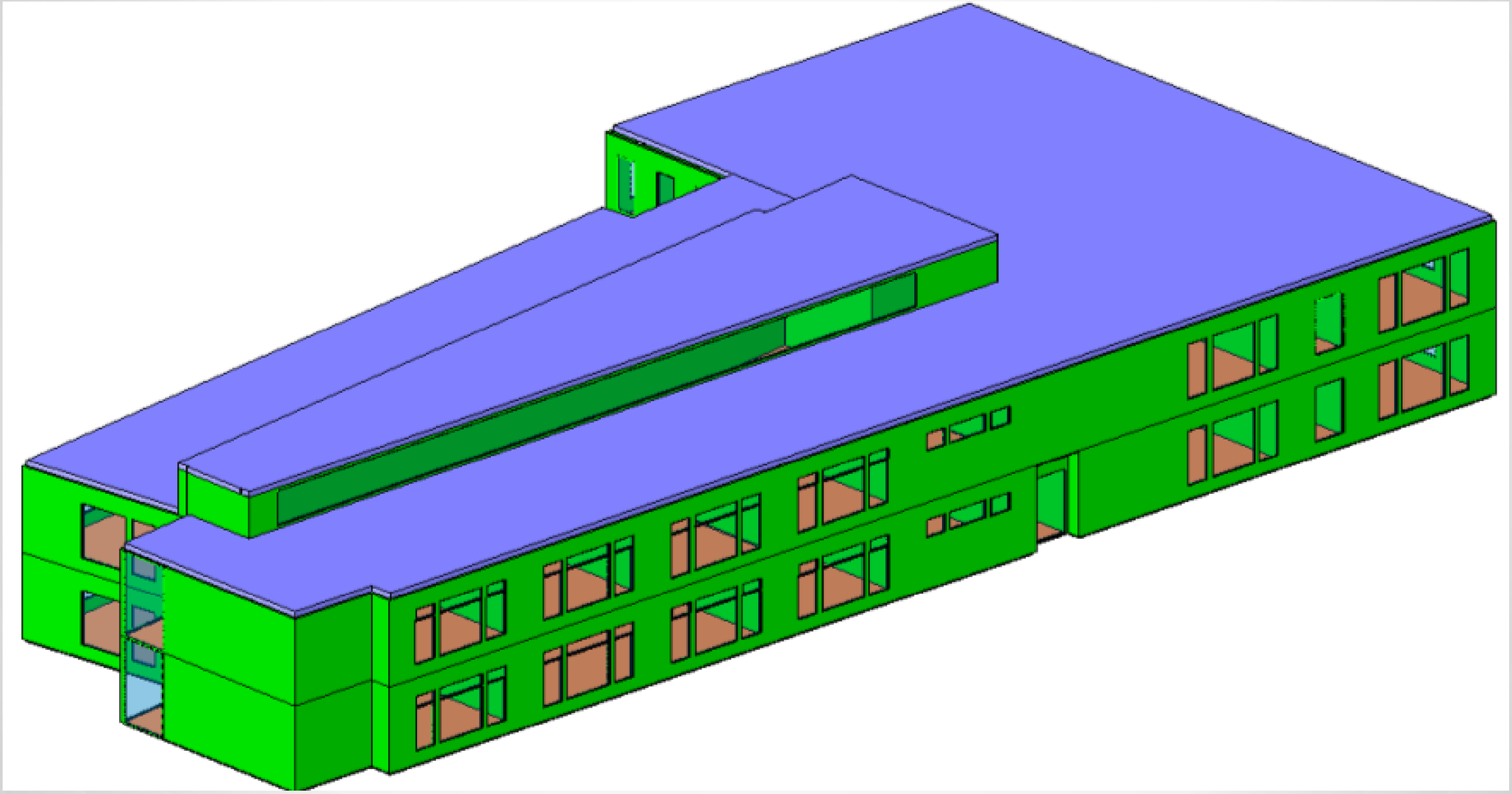
Drawing Roofs (video)



Step 5 – Draw Windows and Copy Up (video)

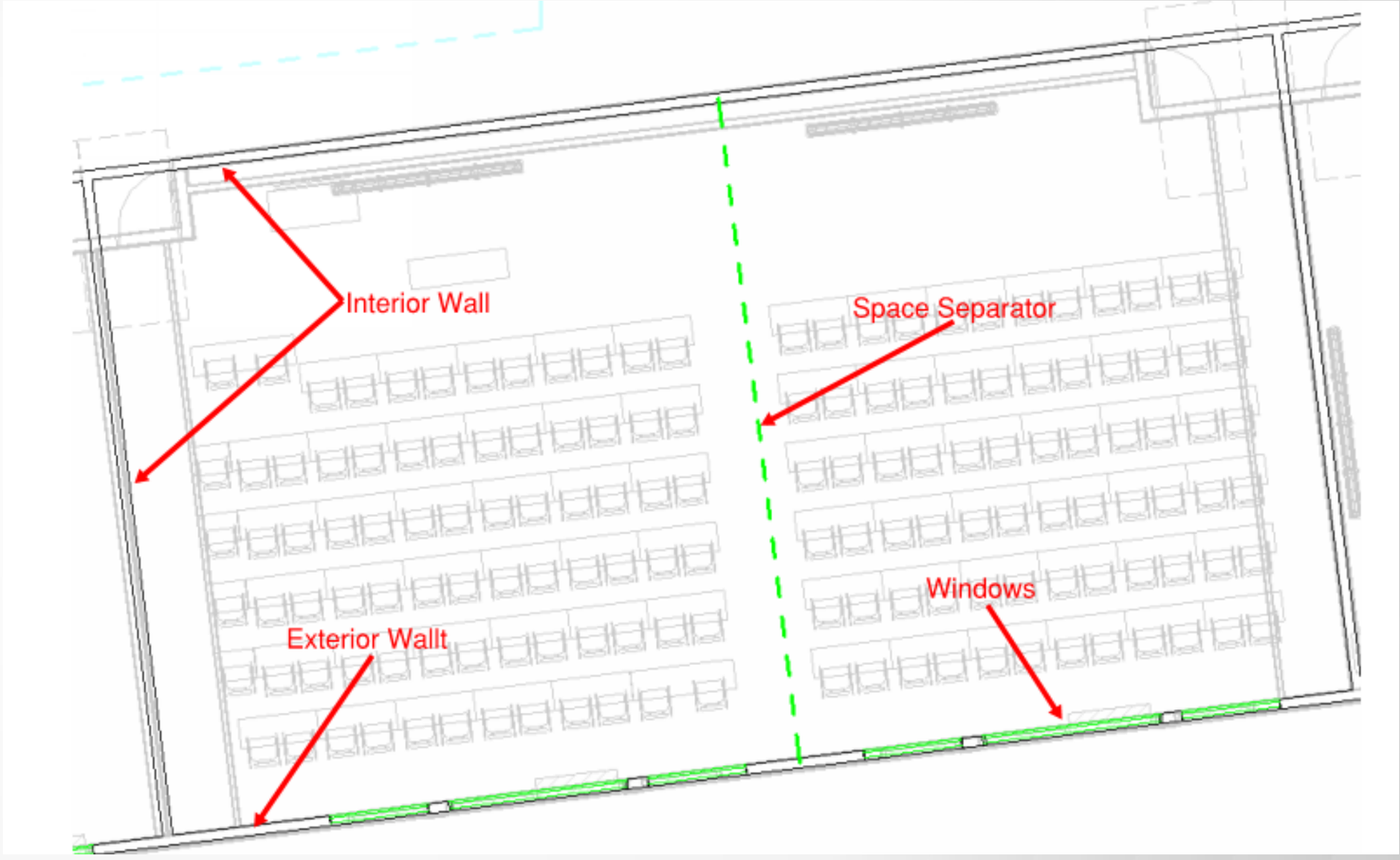


Progress So Far



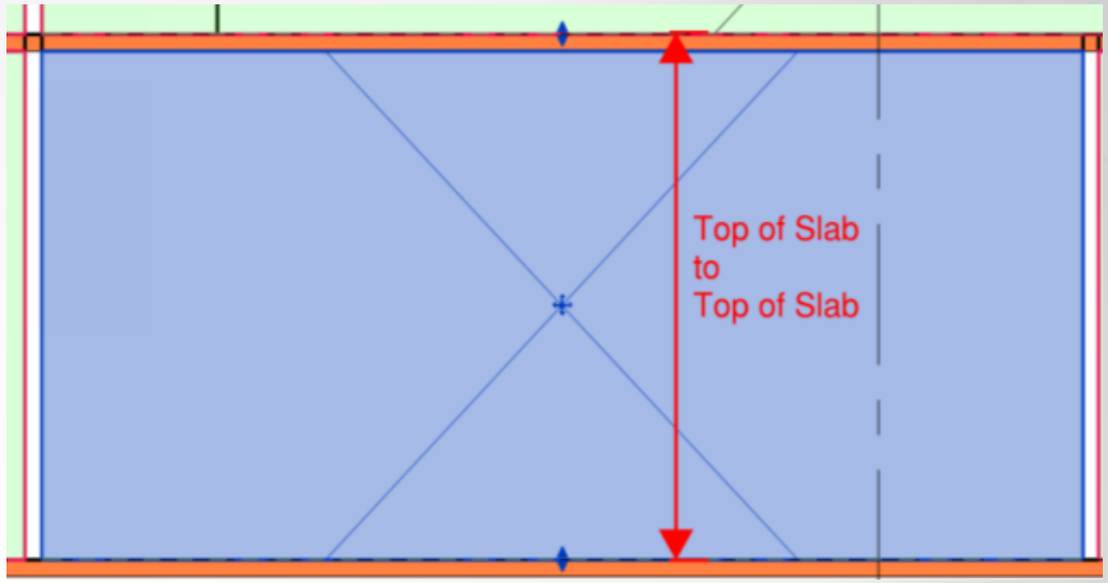
Step 6 – Zoning the Model

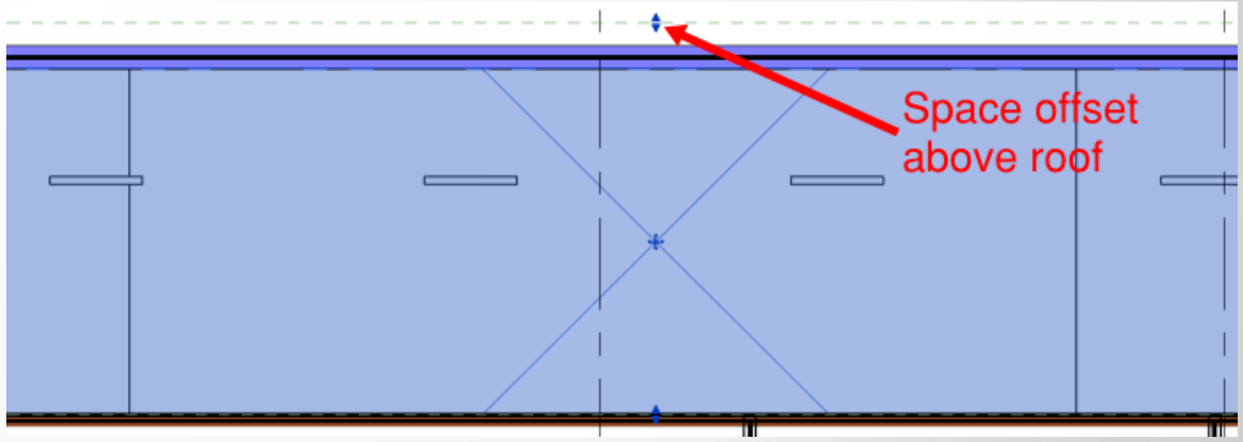
- Use walls and space separators to define thermal zones
- Use the “Place Spaces Automatically” tool



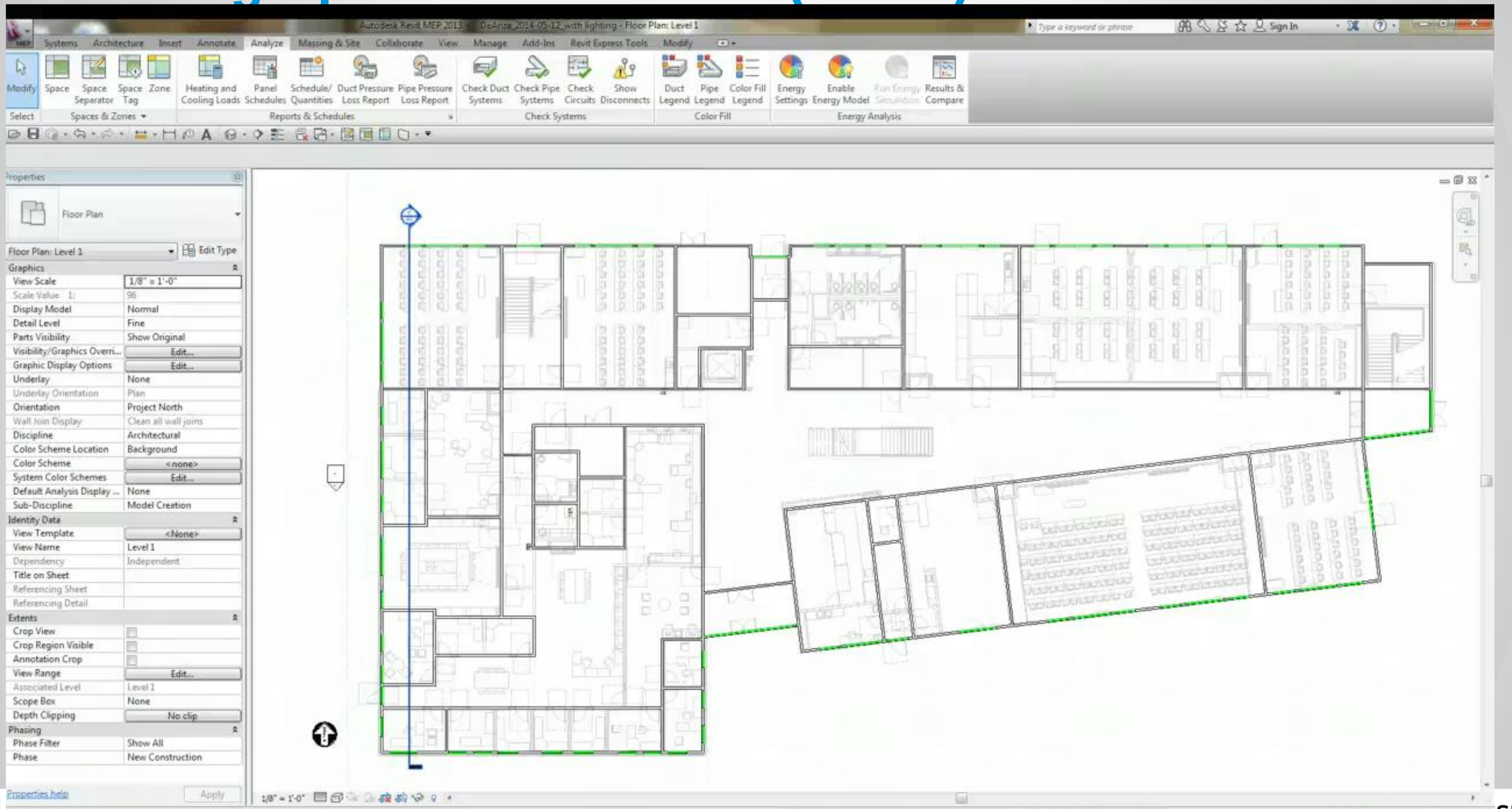
Zoning Tips

- Create one HVAC zone for every Space
- Make sure space limits go from floor-to-floor
- For top floor spaces, use a limit offset





Creating Spaces and Zones (video)



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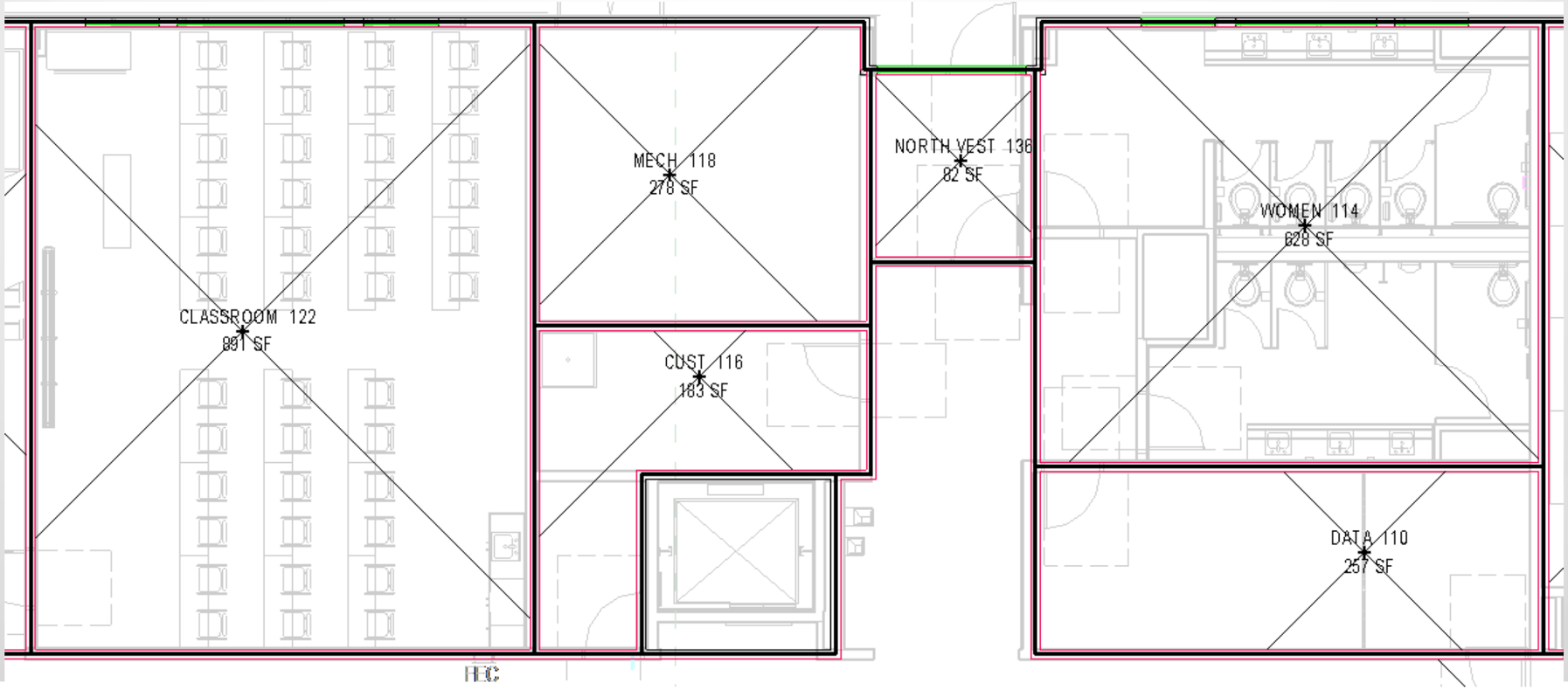
Step 8 – Space and Zone Naming

- Name = Occupancy type
- eQUEST uses the Zone name
- Trace uses the Space name
- IES-VE uses a combination of space name and number

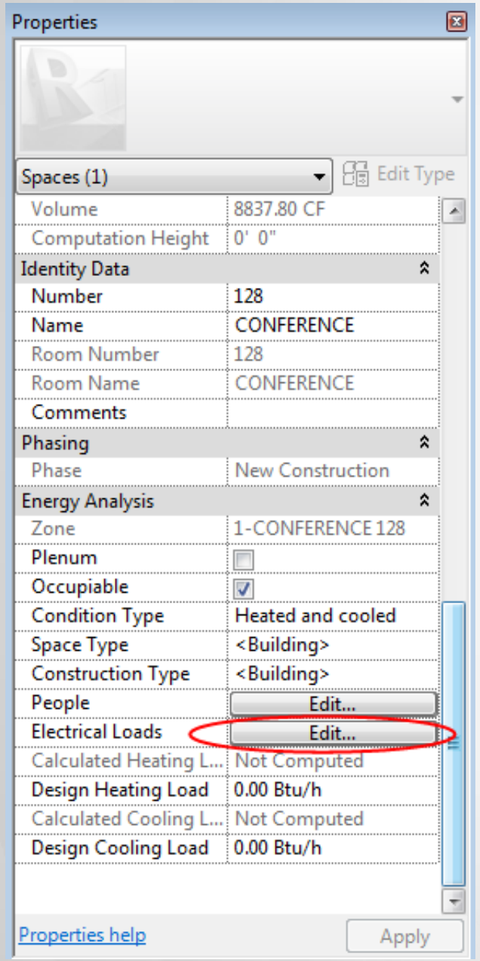


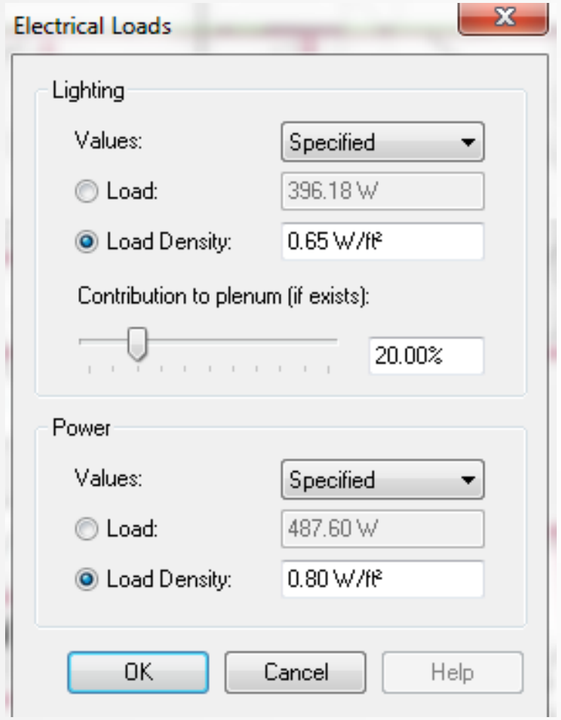
Naming Tools

- Space Naming Utility (grabs names from arch model)
- Custom Tools – Create Zones

Energy - SPACE SCHEDULE										
Room: Name	Room: Numb	Name	Number	Zone	Level	Area	Volume	Space Height	Specified Lightin	Specified Power
WOMEN	114	WOMEN	114	1-WOMEN 114	Level 1	628 SF	9101.61 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
STORE	107C	STORE	107C	1-STORE 107C	Level 1	150 SF	2172.48 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
STORAGE	113	STORAGE	113	1-STORAGE 113	Level 1	188 SF	2719.01 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
STORAGE	108	STORAGE	108	1-STORAGE 108	Level 1	905 SF	13121.59 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
STAIR 3	131	STAIR 2	132	1-STAIR 2 132	Level 1	459 SF	6648.30 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
STAIR 1	140	STAIR 1-1	140-1	1-STAIR 1-1 140-1	Level 1	464 SF	6722.79 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
SOUTH VES	132	SOUTH VEST	131	1-SOUTH VEST 131	Level 1	216 SF	3131.93 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
SECURITY	115D	SECURITY	115D	1-SECURITY 115D	Level 1	201 SF	2911.28 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²
RESTRM	115A	RESTRM	115A	1-RESTRM 115A	Level 1	119 SF	1725.51 CF	14' - 6"	0.65 W/ft²	0.80 W/ft²

Step 9 - Load Parameters in Revit



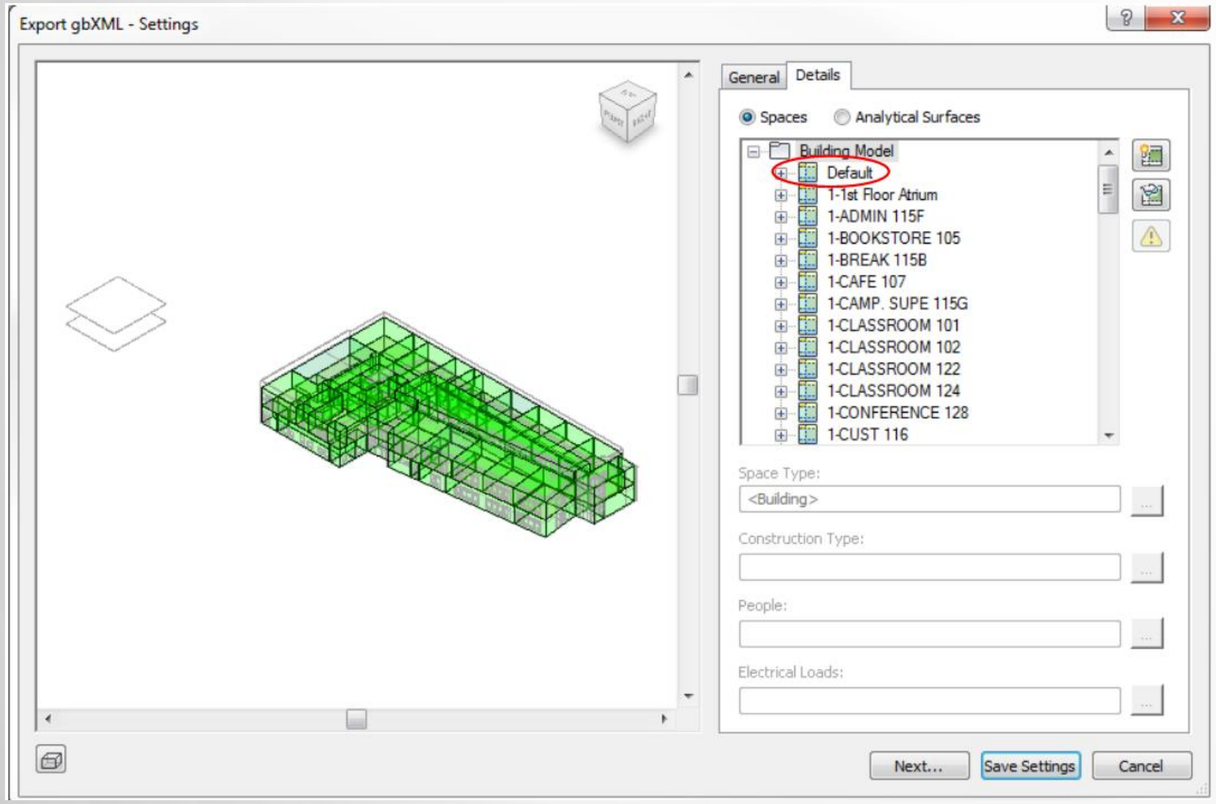


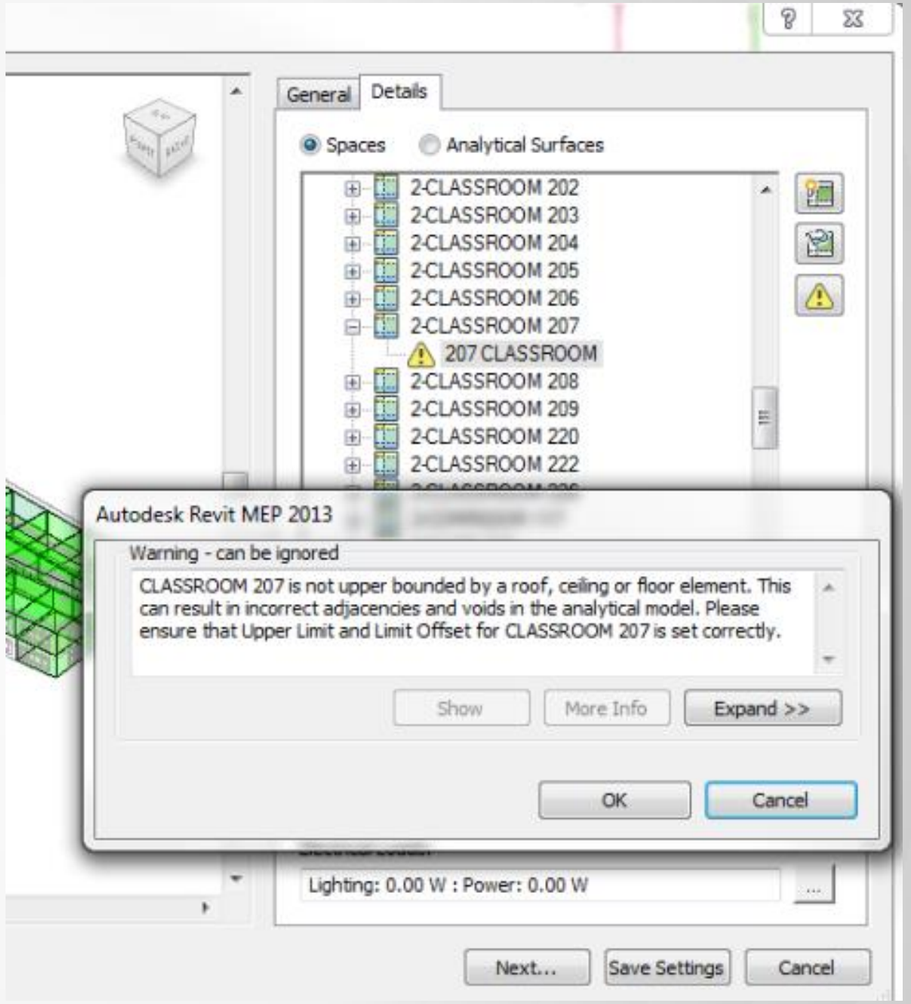
Energy - SPACE Load Schedule		
Name	Specified Lighting Load per area	Specified Power Load per area
1st Floor Atrium	0.65 W/ft²	0.10 W/ft²
2nd Floor Atrium	0.65 W/ft²	0.01 W/ft²
ADMIN	0.65 W/ft²	0.80 W/ft²
ASSESS CENTER	0.65 W/ft²	0.80 W/ft²
BOOKSTORE	0.65 W/ft²	0.50 W/ft²
BREAK	0.65 W/ft²	1.00 W/ft²
CAFE	0.65 W/ft²	5.00 W/ft²
CAMP. SUPE	0.65 W/ft²	0.20 W/ft²
CLASSROOM	0.65 W/ft²	0.80 W/ft²
CLASSROOM	0.65 W/ft²	0.80 W/ft²
CLASSROOM	0.65 W/ft²	0.80 W/ft²

Step 10 – QCing the Analytical Model

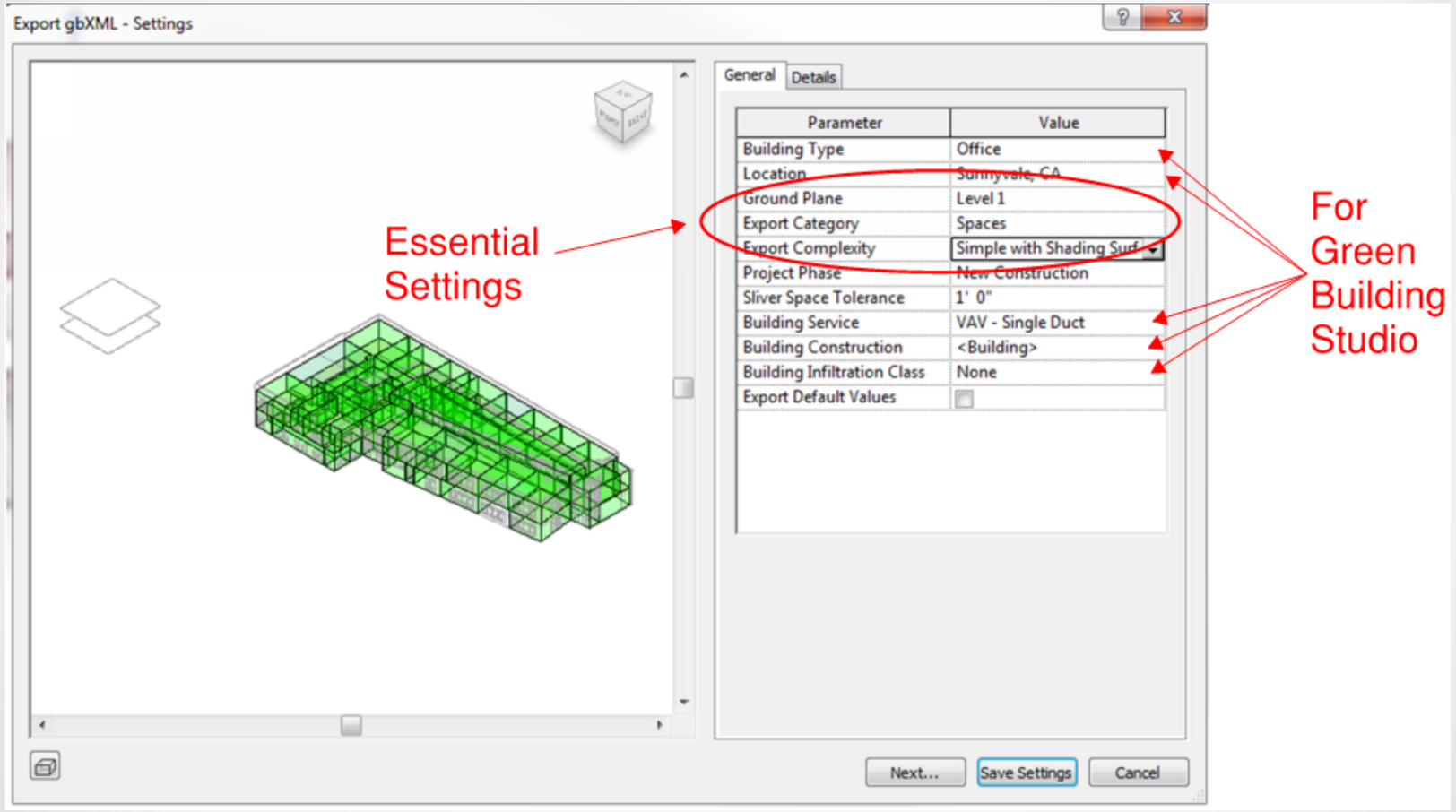
Energy - SPACE SCHEDULE

Name	Number	Zone	Level	Area	Volume	Space Height	Occupia
BOOKSTORE	105	Default	Level 1	775 SF	11236.36 CF	14' - 6"	☑
WOMEN	114	1-WOMEN 114	Level 1	628 SF	9101.61 CF	14' - 6"	☑
STORE	107C	1-STORE 107C	Level 1	150 SF	2172.48 CF	14' - 6"	☑
STORAGE	113	1-STORAGE 113	Level 1	188 SF	2719.01 CF	14' - 6"	☑

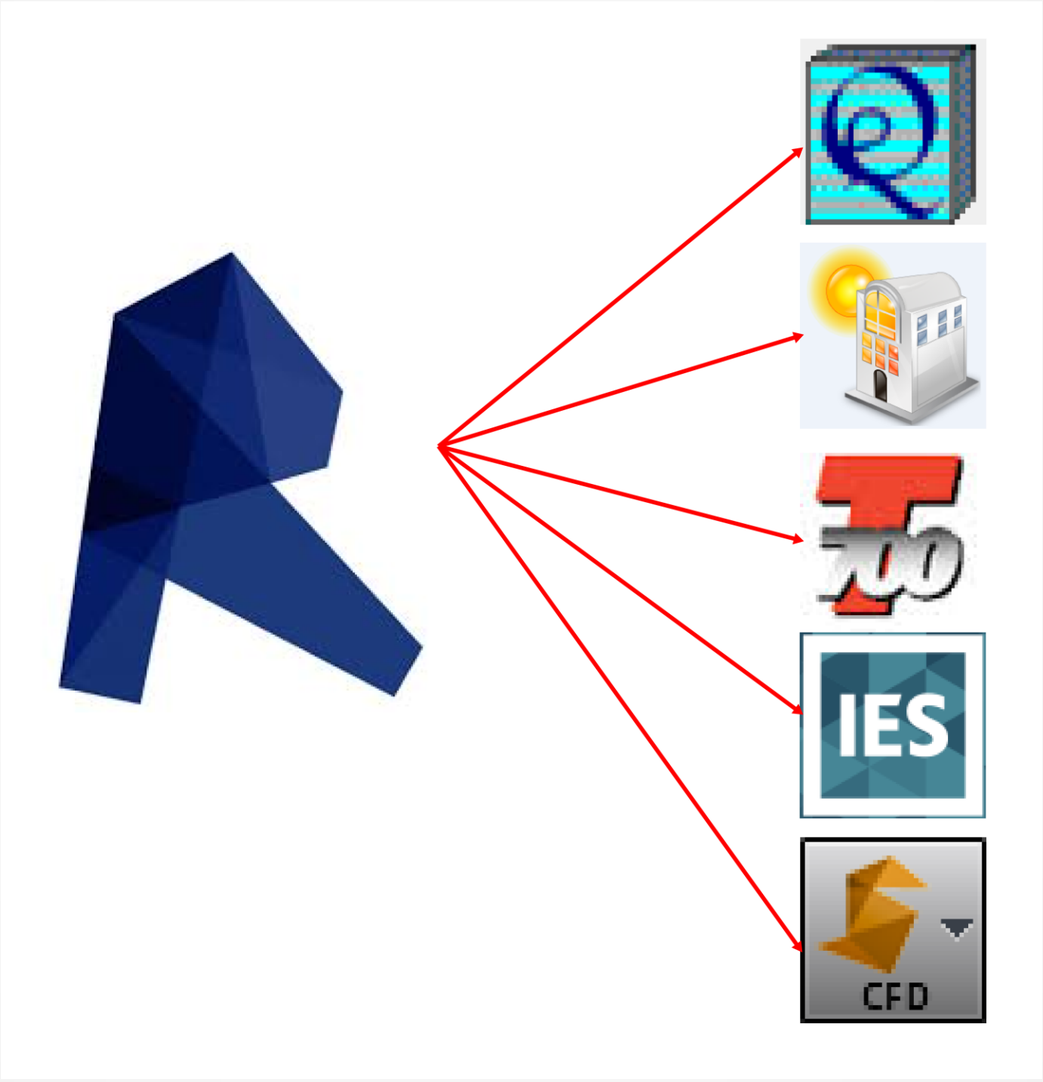




Step 11 – Export gbXML

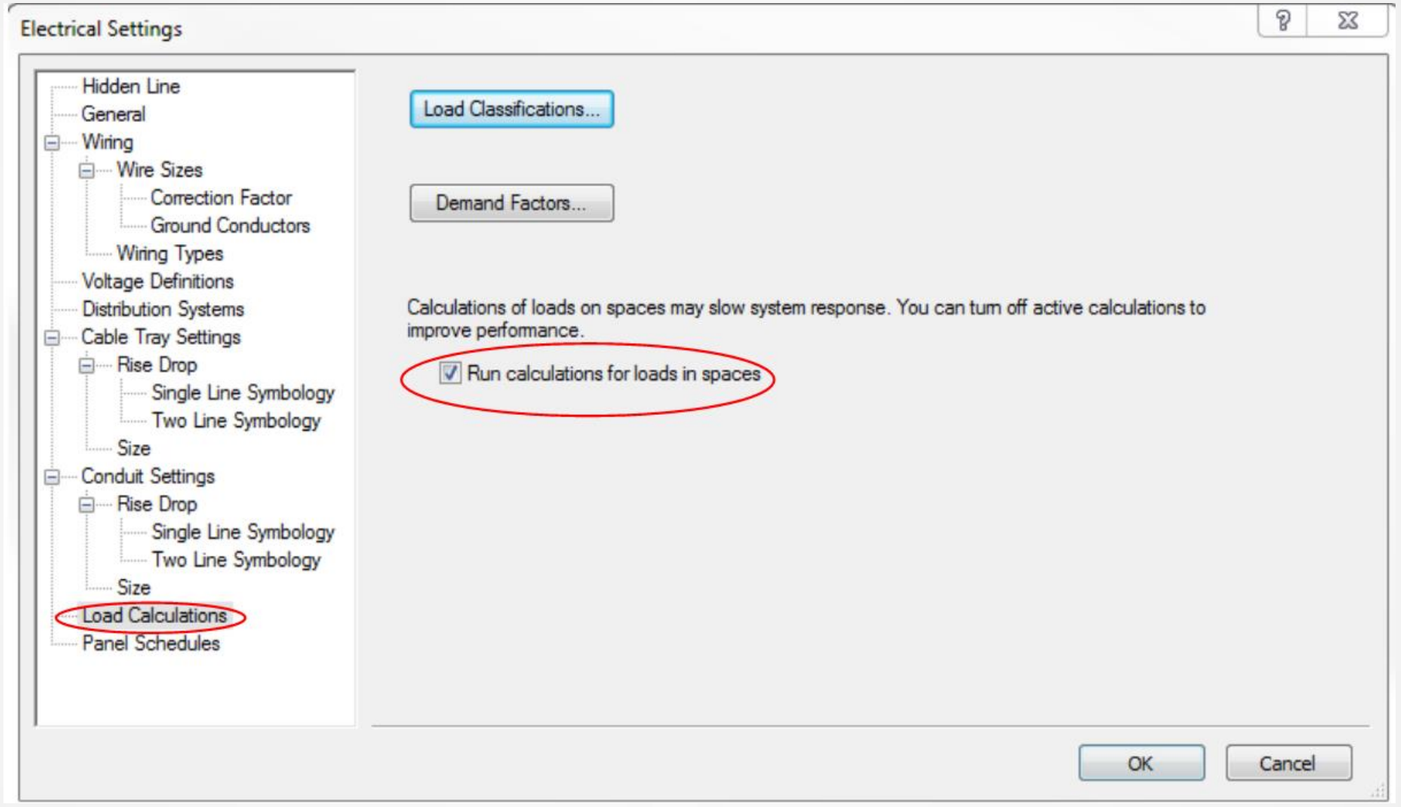


You’re Done!

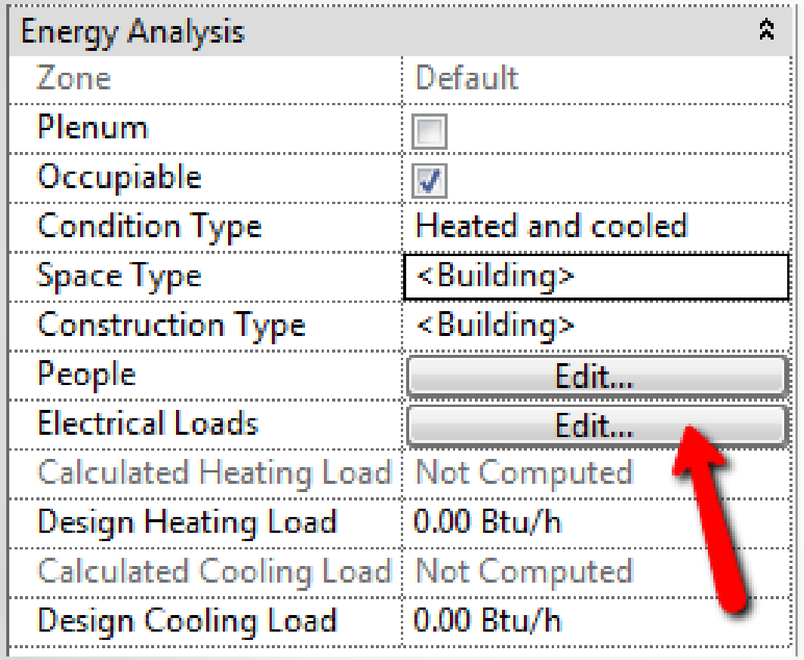


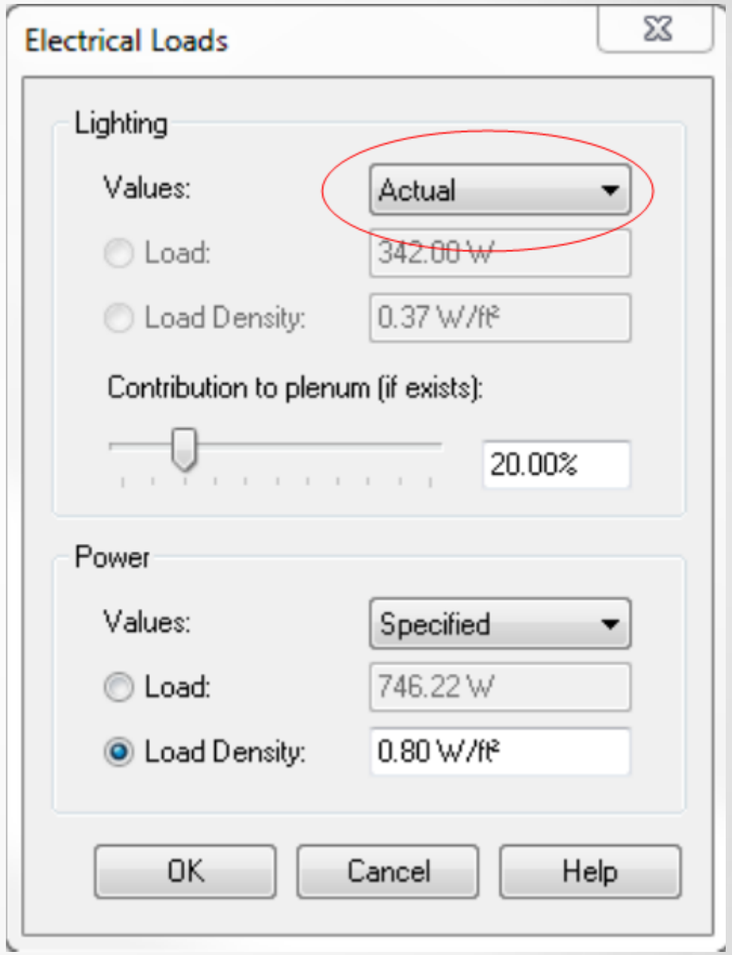
Importing a Revit Lighting Design into Analytical Model

Electrical Settings

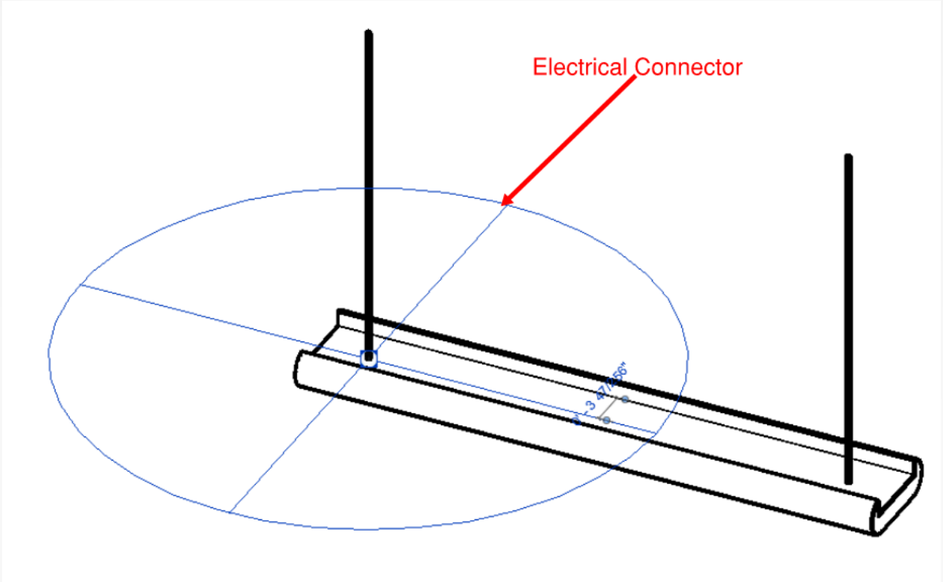


Space Settings





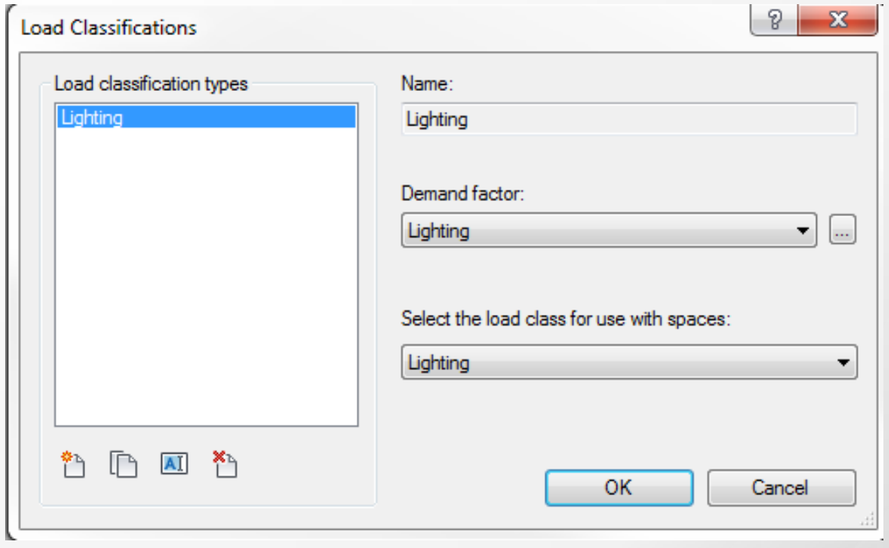
Electrical Connector and Load Classification



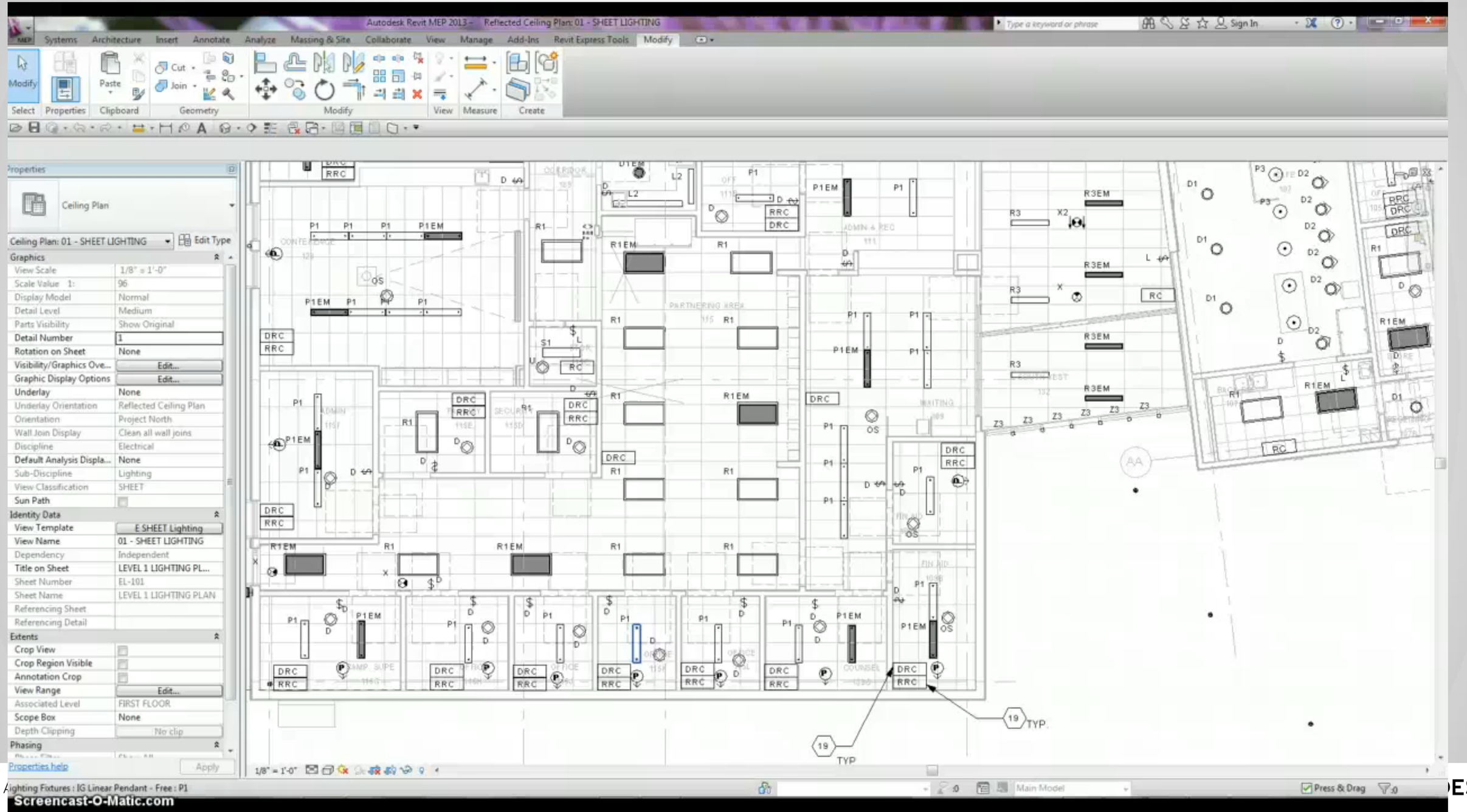
Properties

Connector Element (1) | Edit Type

Electrical - Loads	
System Type	Power - Balanced
Number of Poles	1
Power Factor State	Lagging
Load Classification	Lighting
Load Sub-Classification...	
Voltage	120.00 V
Apparent Load	57.00 VA
Power Factor	1.000000
Identity Data	
Utility	
Connector Description	



Copy and Paste Fixtures (video)



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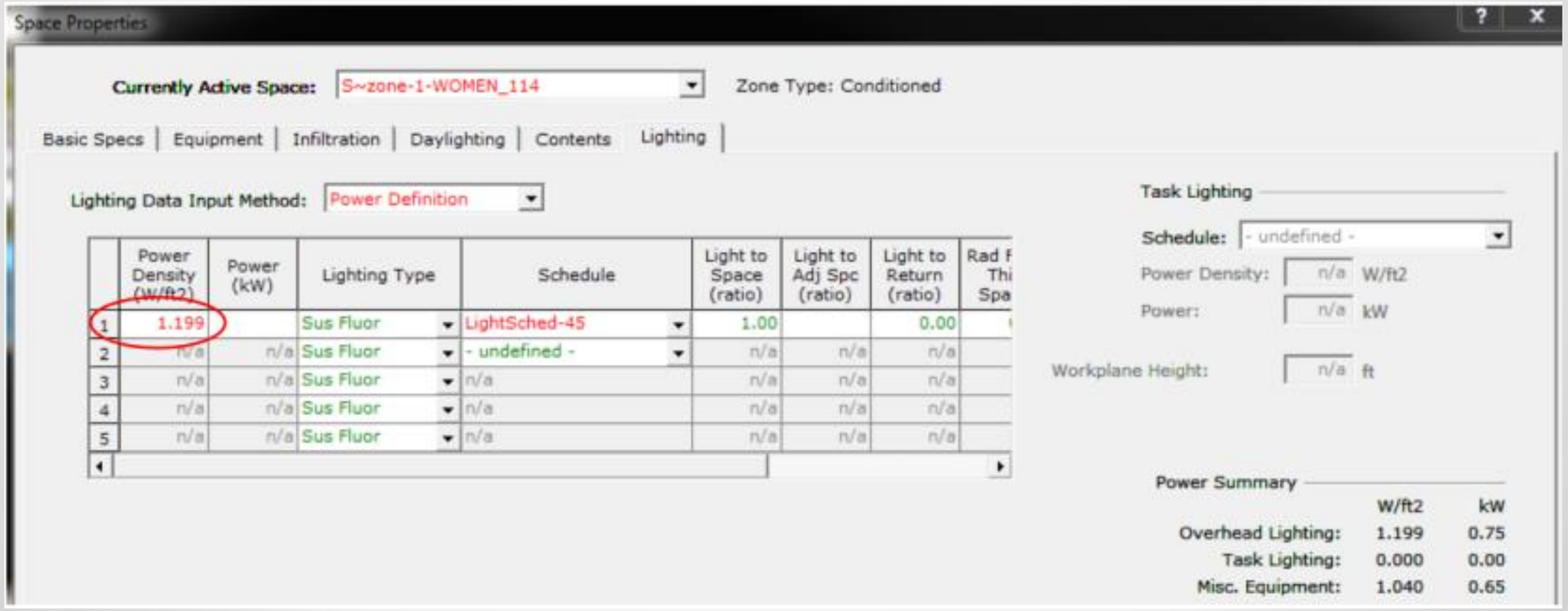
General Rules and Tips

- Fixtures Must Touch Space
- Fixtures only Visible in Electrical Discipline
- Actual lighting power exports through gbXML
  - But not to IES-VE ☹

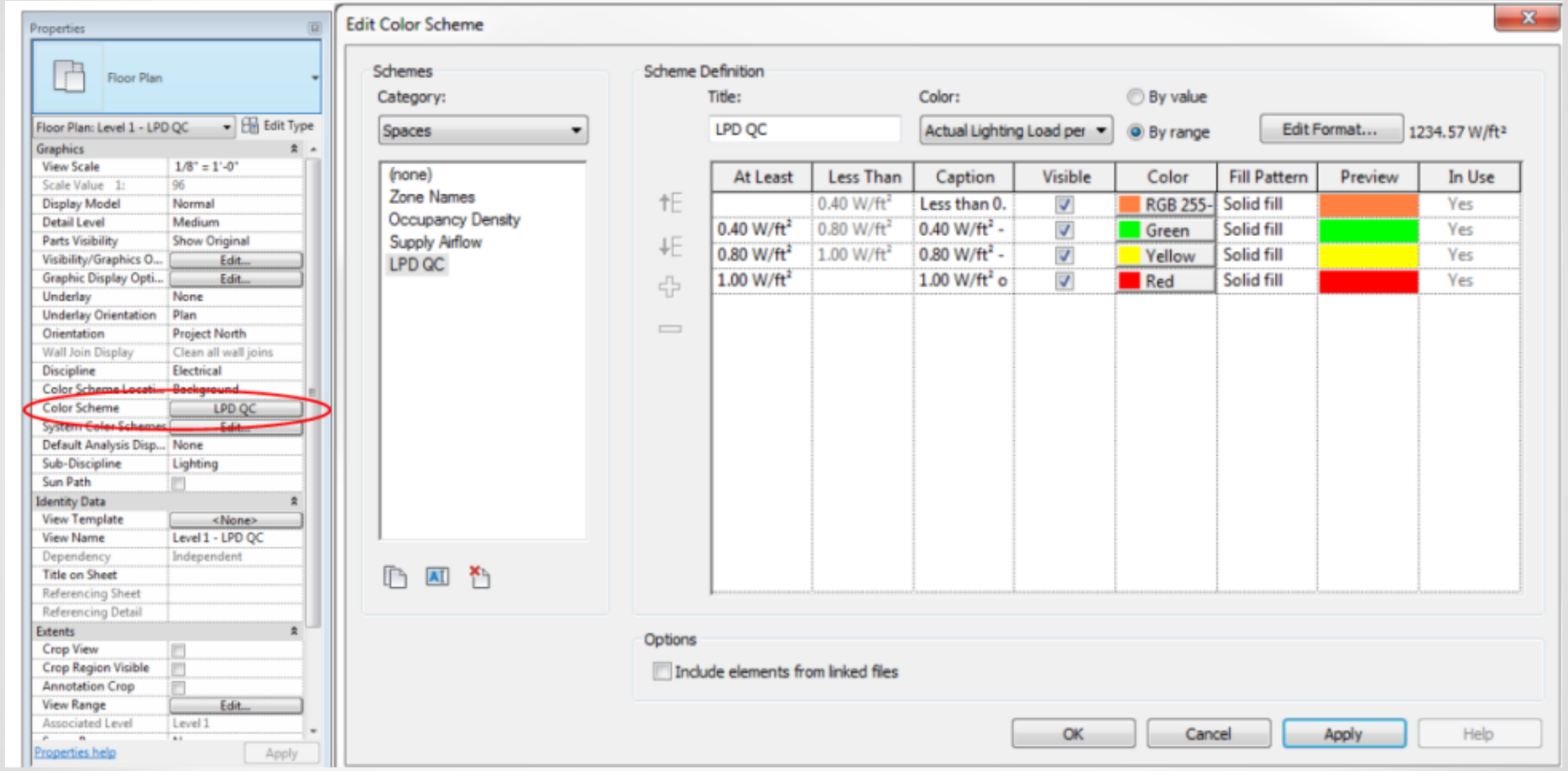


QCing the Lighting Design with Schedules

Lighting Fixture Count Sche	
Type Mark	Count
A1	36
B1EM	6
B2	21
B2EM	6
D1	10
D1EM	14
D2	8
L2	2
L3EM	22
P1	85
P1EM	27
P3	5
R1	113
R1EM	54
R2	7
R3	41
R3EM	27
S1	23
S1EM	8
W1	4
Z3	14
Z5	1
Z6	3

Lighting Fixture Schedule		
Type	Apparent Load	Space: Name
1		
Z6 ext sconce	26.00 W	
Z6 ext sconce	26.00 W	
Z6 ext sconce	26.00 W	
3		
22		
B1EM	37.00 W	1st Floor Atrium
B1EM	37.00 W	1st Floor Atrium
2		
R3	18.00 W	1st Floor Atrium
R3	18.00 W	1st Floor Atrium
R3	18.00 W	1st Floor Atrium
R3	18.00 W	1st Floor Atrium
R3	18.00 W	1st Floor Atrium
R3	18.00 W	1st Floor Atrium
R3	18.00 W	1st Floor Atrium
R3	18.00 W	1st Floor Atrium
R3	18.00 W	1st Floor Atrium
R3	18.00 W	1st Floor Atrium
R3	18.00 W	1st Floor Atrium

QCing the Lighting Design with Color Schemes

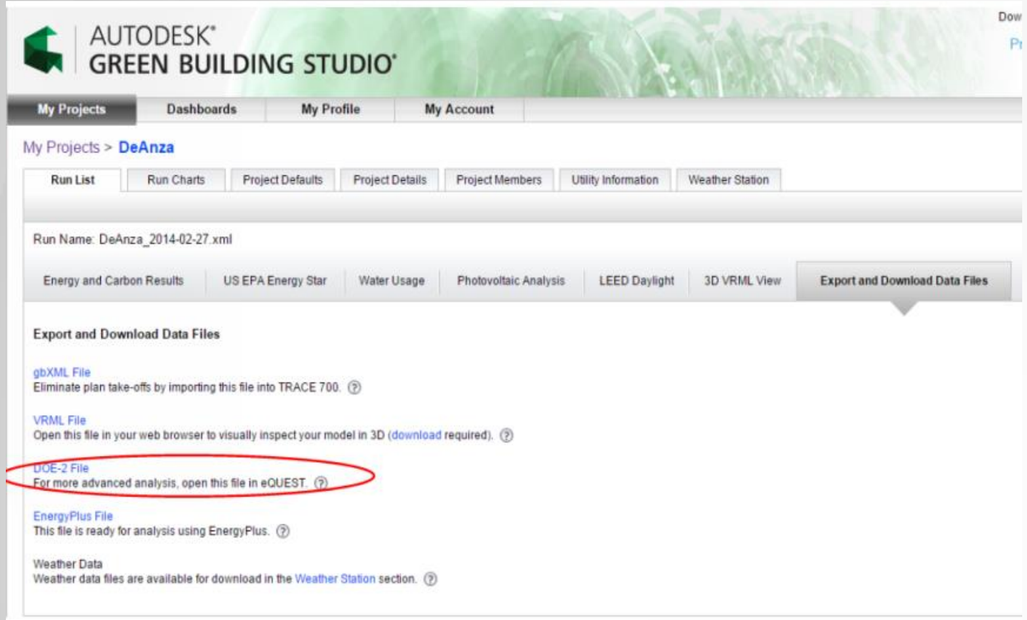


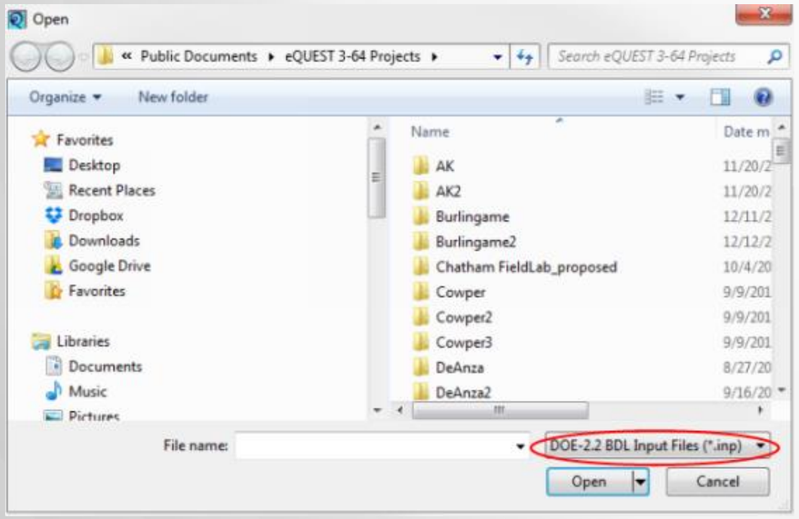
QCing the Lighting Design with Color Schemes

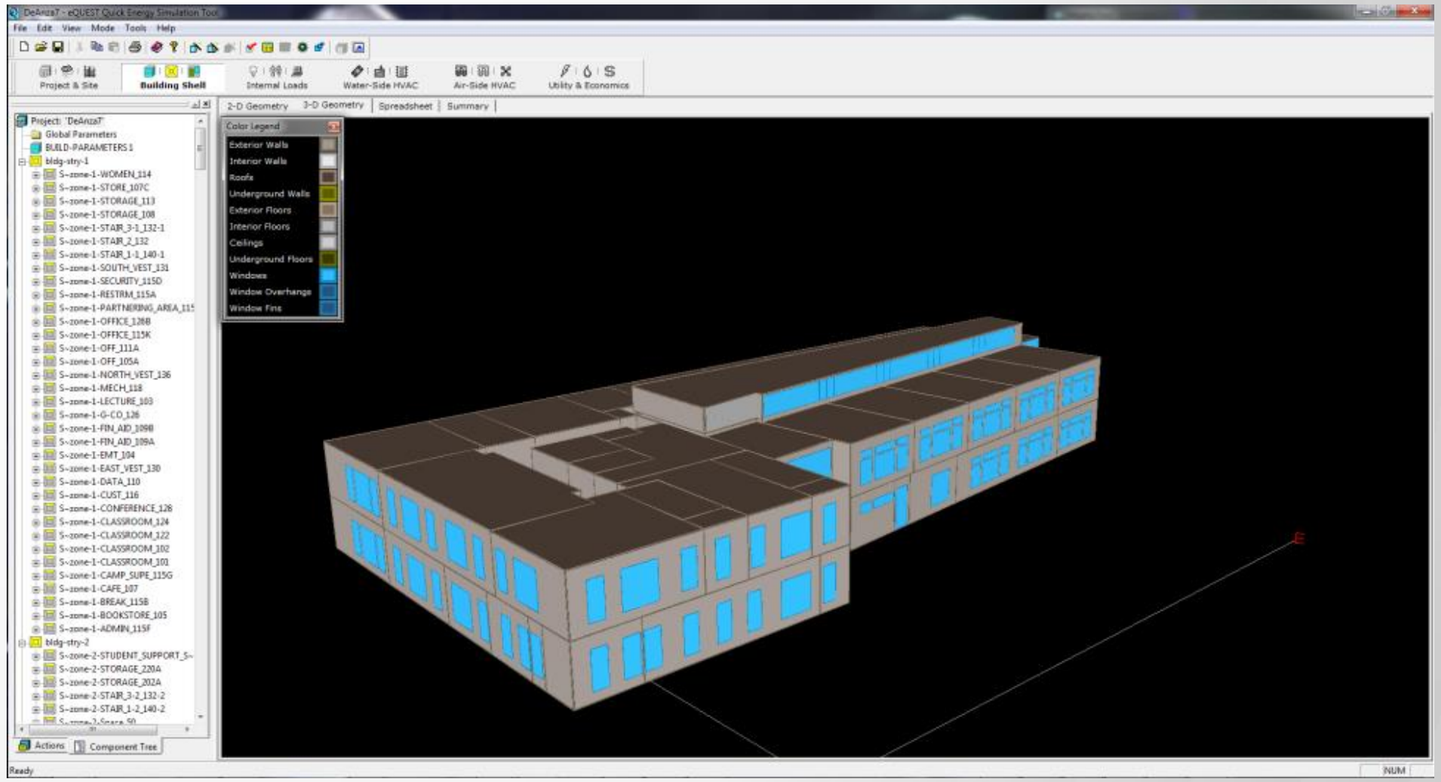
Importing the Analytical Model into Simulation Software

Importing to eQUEST via Green Building Studio

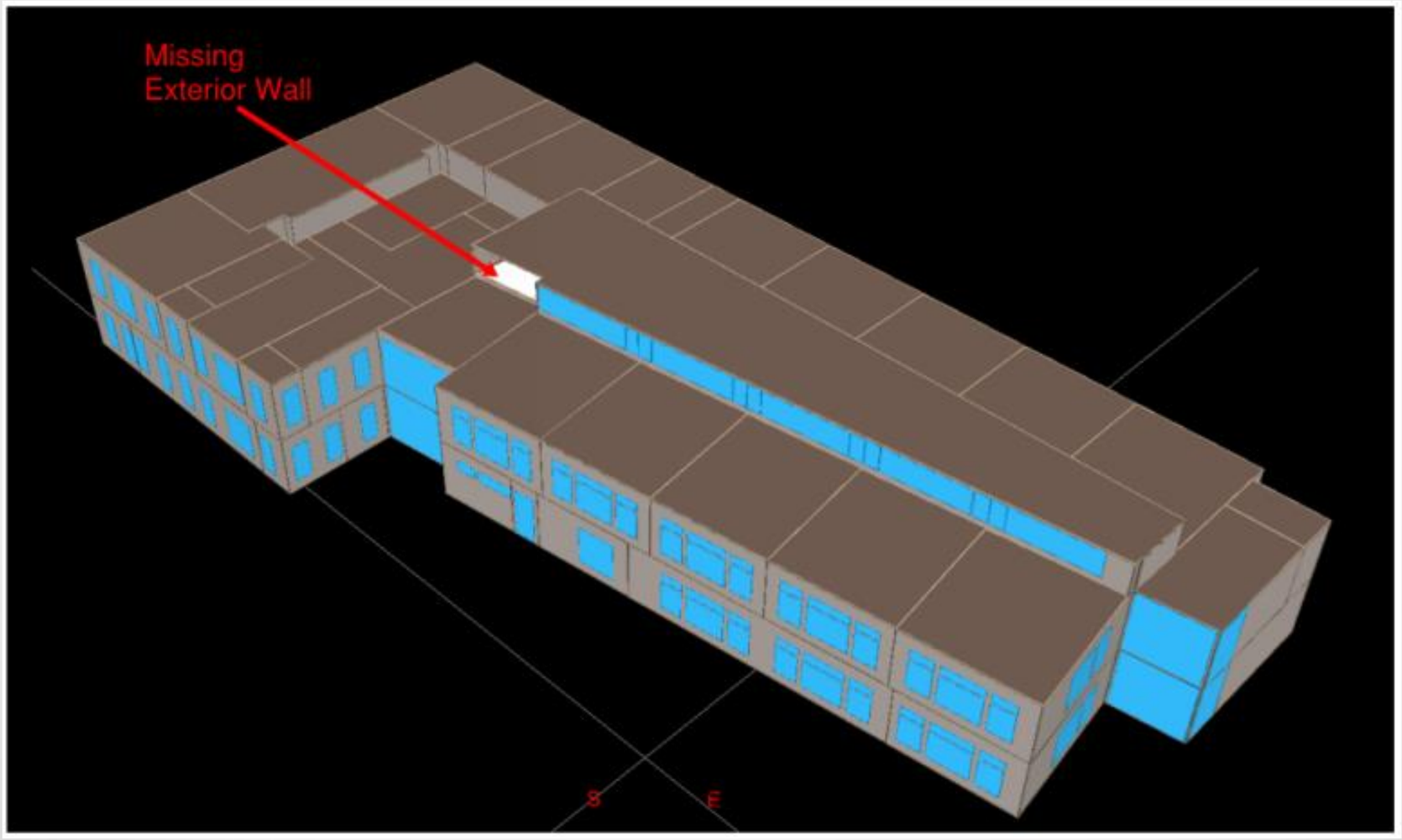
https://gbs.autodesk.com/



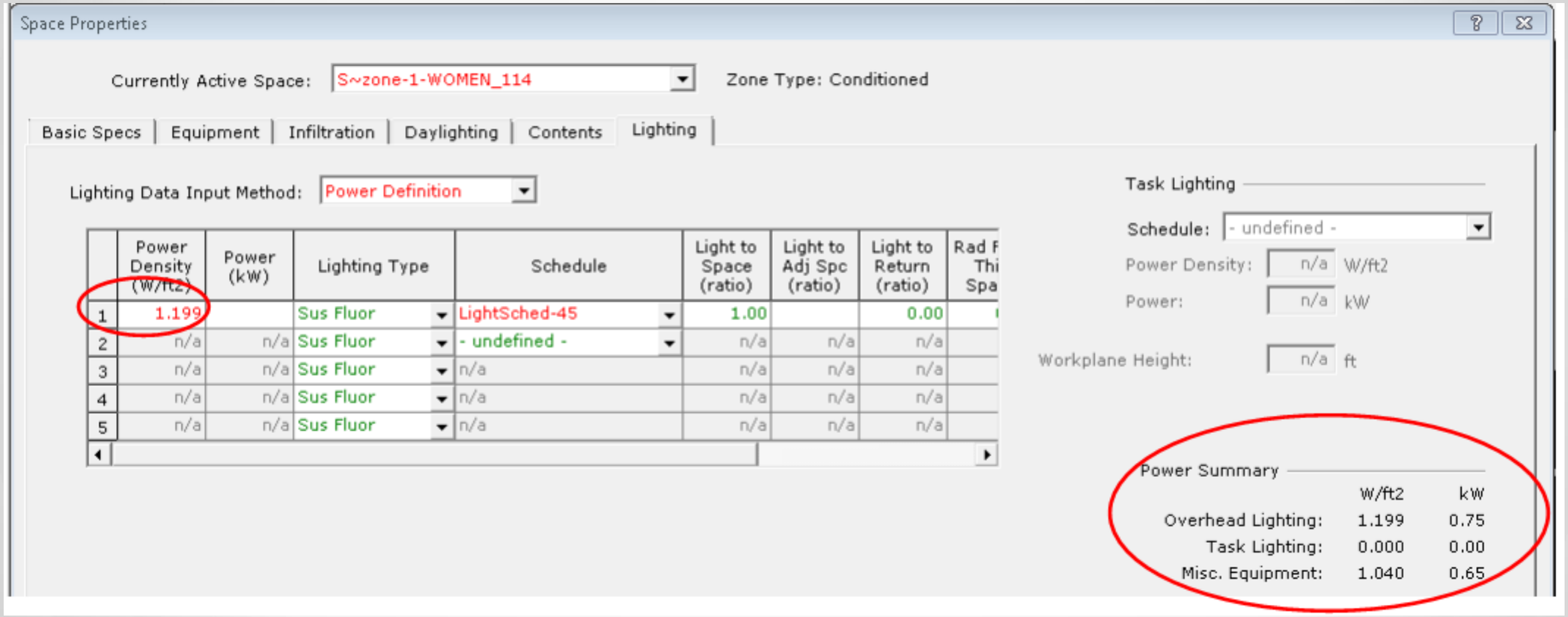




Importing to eQUEST via Green Building Studio

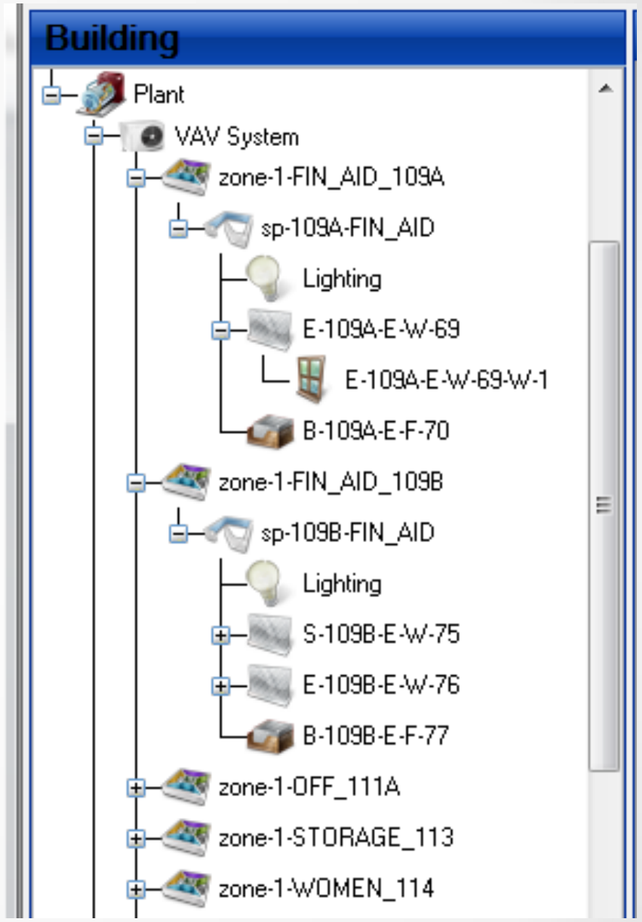


Importing to eQUEST via Green Building Studio



Importing to EnergyPro

- Much easier than eQUEST for compliance
- Import gbXML directly
  - Including load parameters and actual lighting wattage
- Use fixture count schedule for compliance documentation



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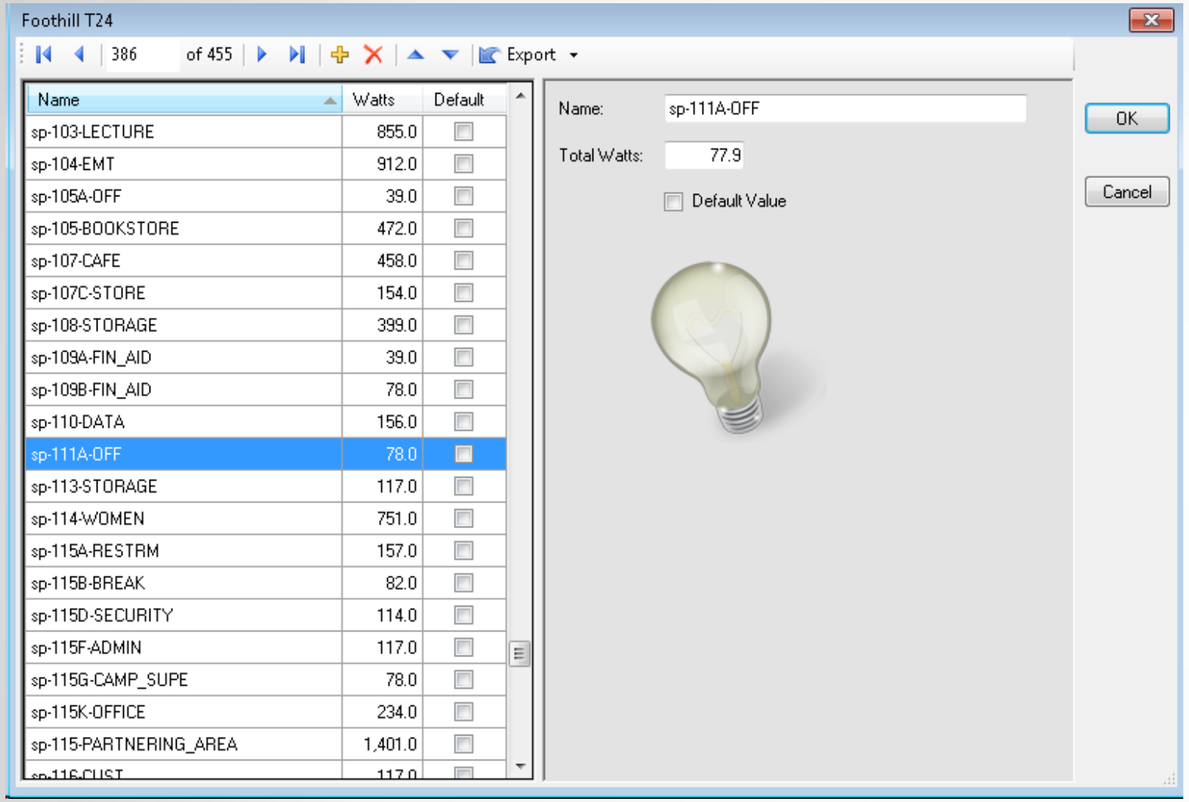
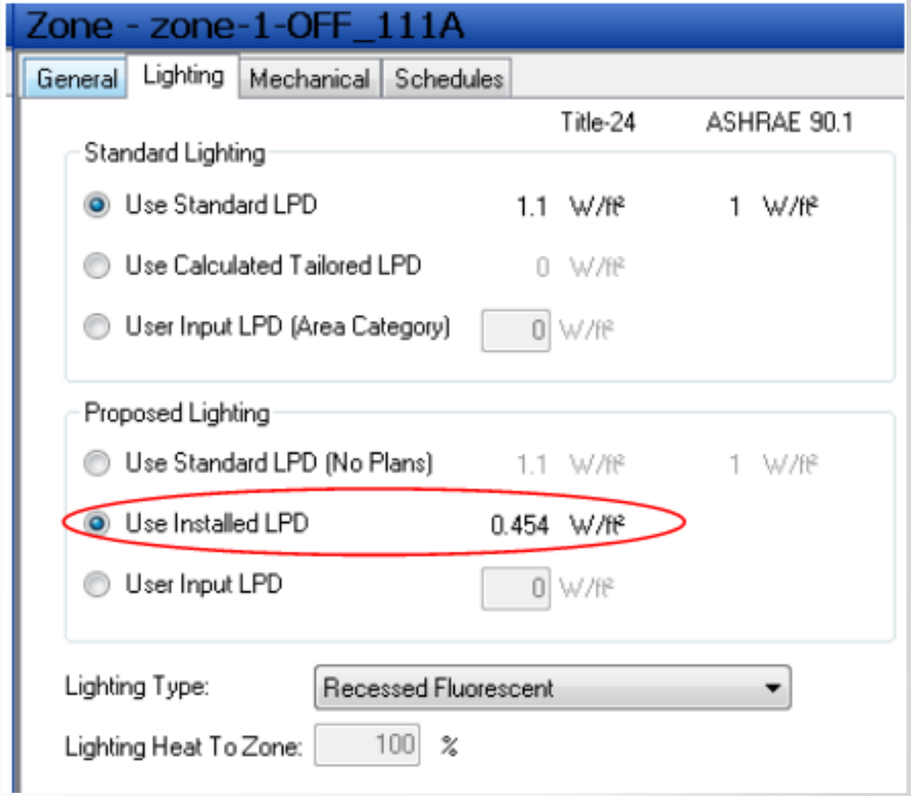
R3	41
R3EM	27
S1	23
S1EM	8
W1	4
Z3	14
Z5	1
Z6	3

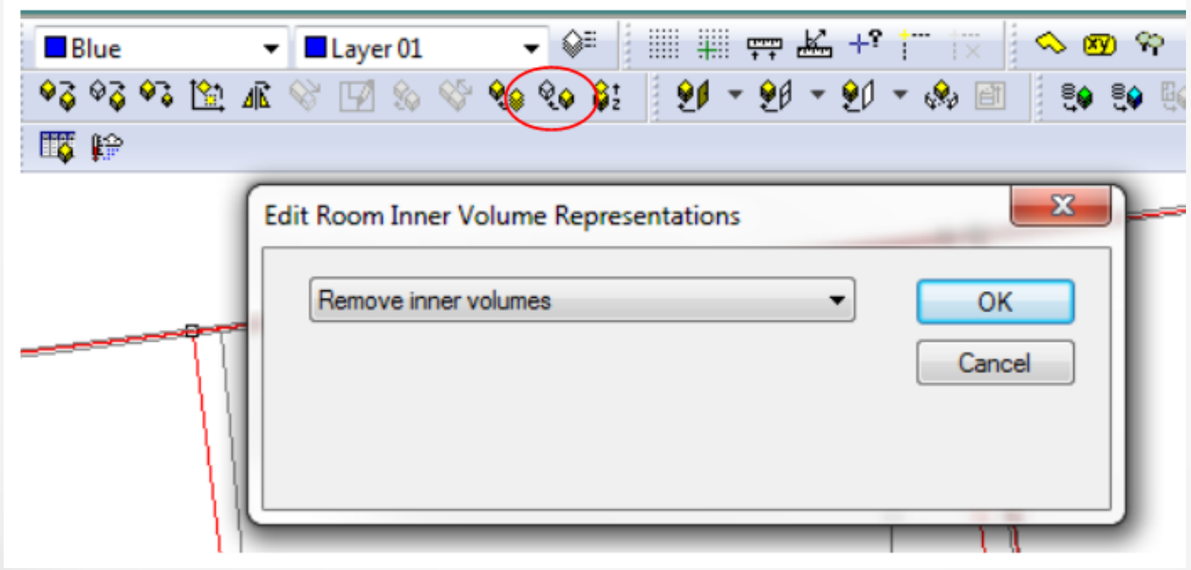
Importing to EnergyPro



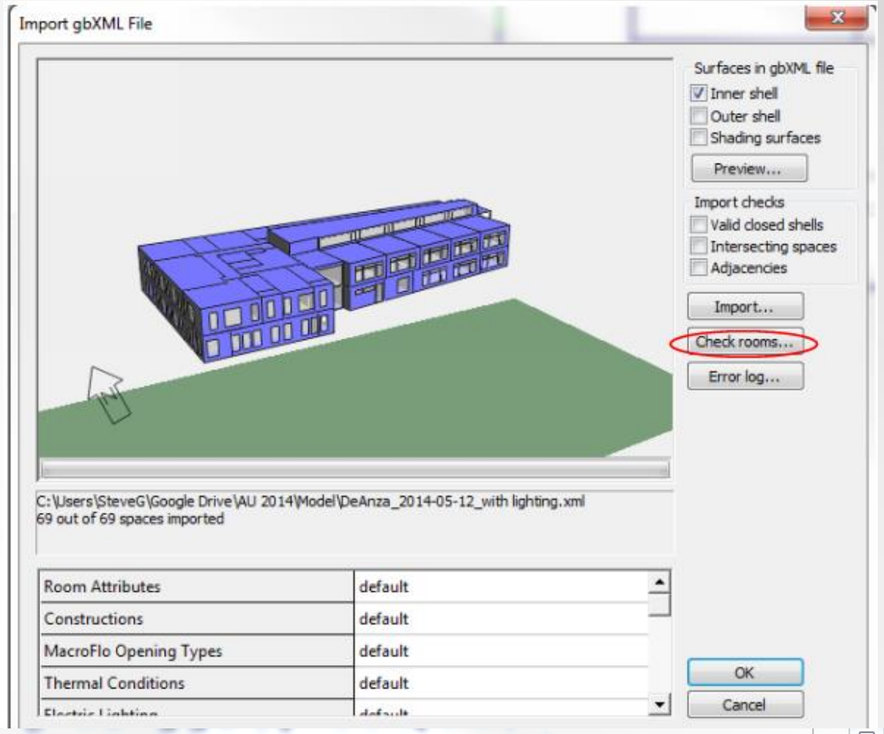


Importing to IES-VE

- Import gbXML directly
- Remember to remove inner volumes
- Load parameters don’t import



IES-VE – Geometry Validation



bimimport Report

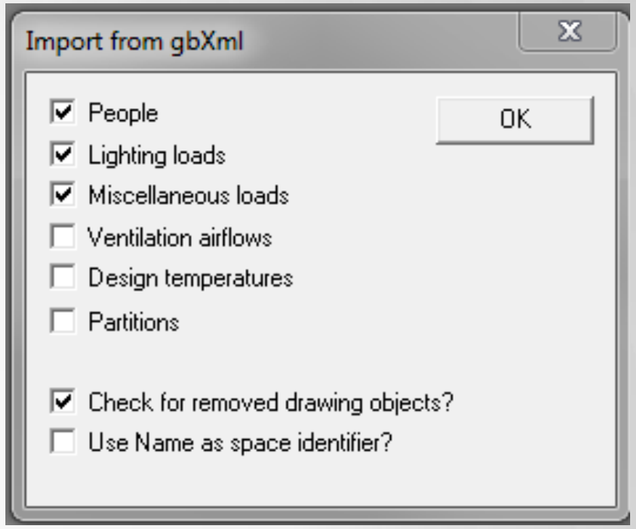
File Edit

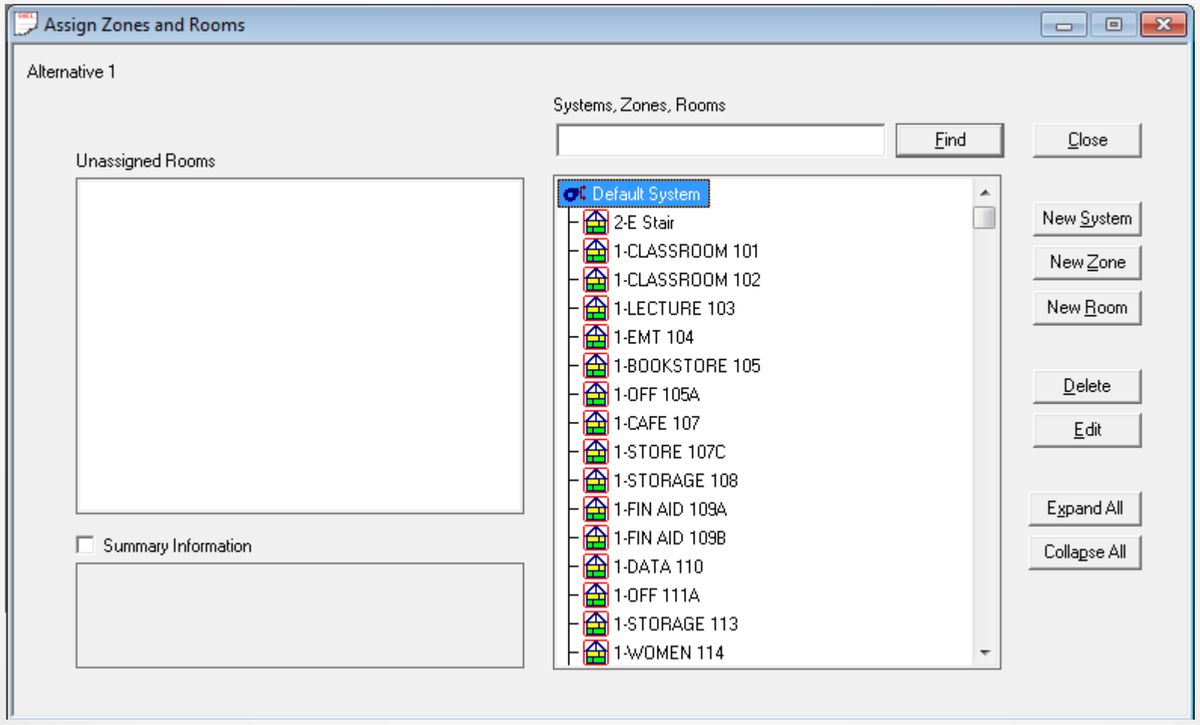
BIM Source package:
Adjacency Separation Distance (m): 0.100

Room (space)			Raw (space boundaries in file)						Processed (space boundaries after tidy)						Other issues			
BIM ID	Imported ID	Name	Bounded	Unmatched edges [1]	Missing area (m^2) [2]	Missing area ratio	Floor area (m^2) [3]	Volume (m^3)	Bounded	Unmatched edges [1]	Missing area (m^2) [2]	Missing area ratio	Floor area (m^2) [3]	Volume (m^3)	Corrections made	Intersections OK	Adjacencies OK	Adjacency issues
00802682	00802682	sp-50-E_Stair	×	16	0.233	0.001	0.000	209.985	×	16	0.000	0.000	43.843	210.294		•	•	
00799895	00799895	sp-101-CLASSROOM	×	8	171.873	0.502	0.000	261.934	✓	0	0.000	0.000	83.117	392.902	1 outer ceiling surface(s) reversed	•	•	
00799110	00799110	sp-102-CLASSROOM	×	12	178.532	0.507	0.000	272.083	×	6	0.000	0.000	86.397	408.124	1 outer ceiling surface(s) reversed	•	•	
00799893	00799893	sp-103-LECTURE	×	14	382.837	0.592	0.000	583.443	×	10	0.000	0.000	187.044	875.164	4 outer ceiling surface(s) reversed	•	•	

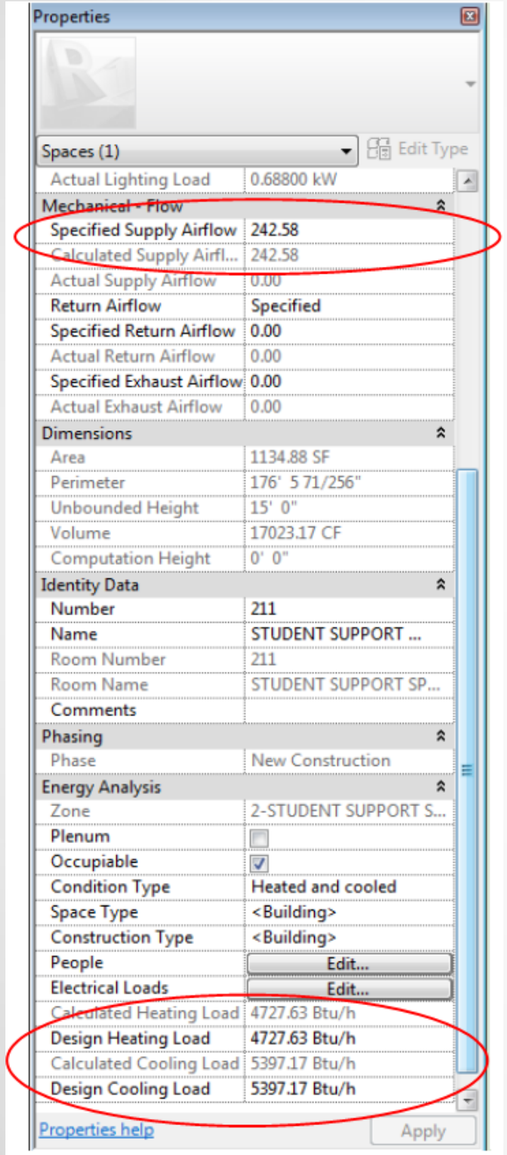
Importing to Trane Trace

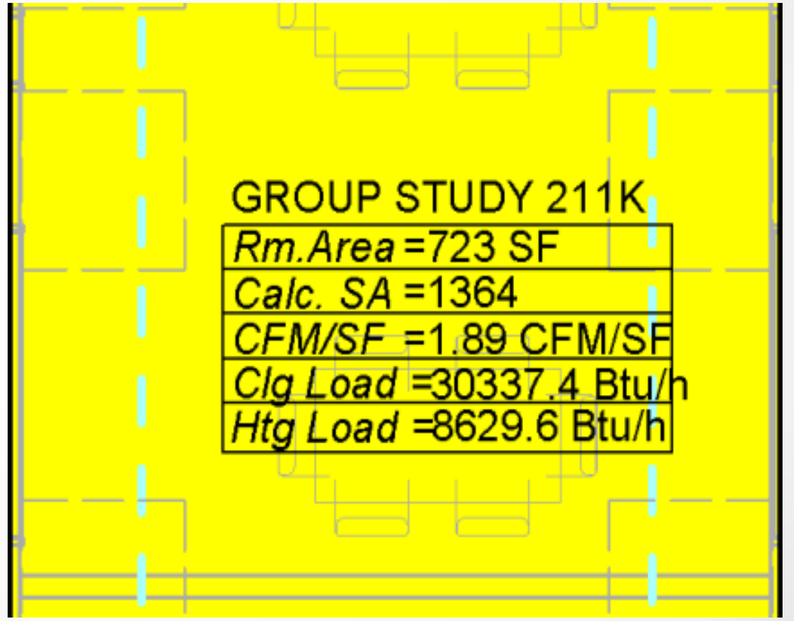
- Import gbXML directly
- Chose load parameters



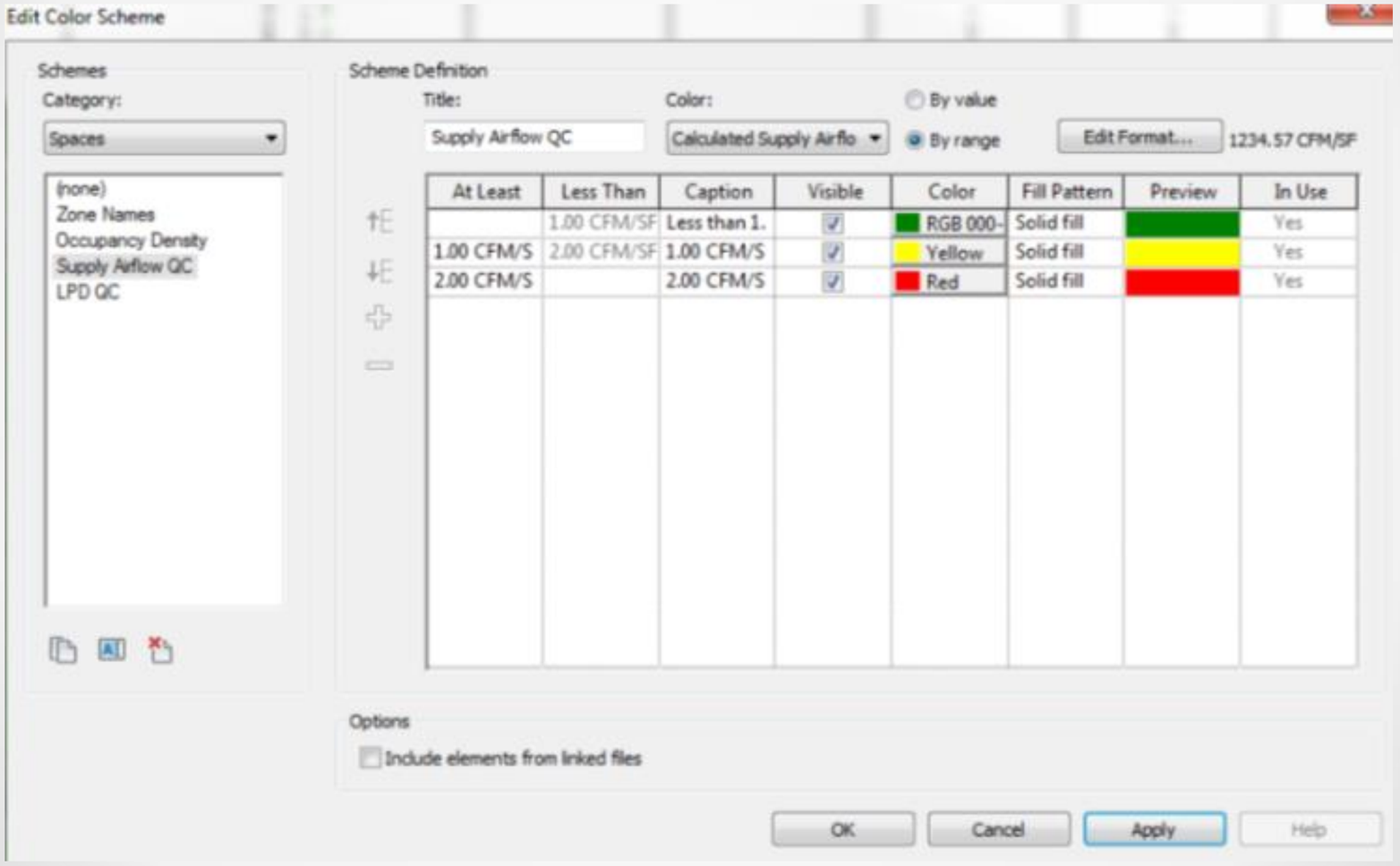


Import Load Calc from Trace Back into Revit





QCing Load Calc Using Color Schemes



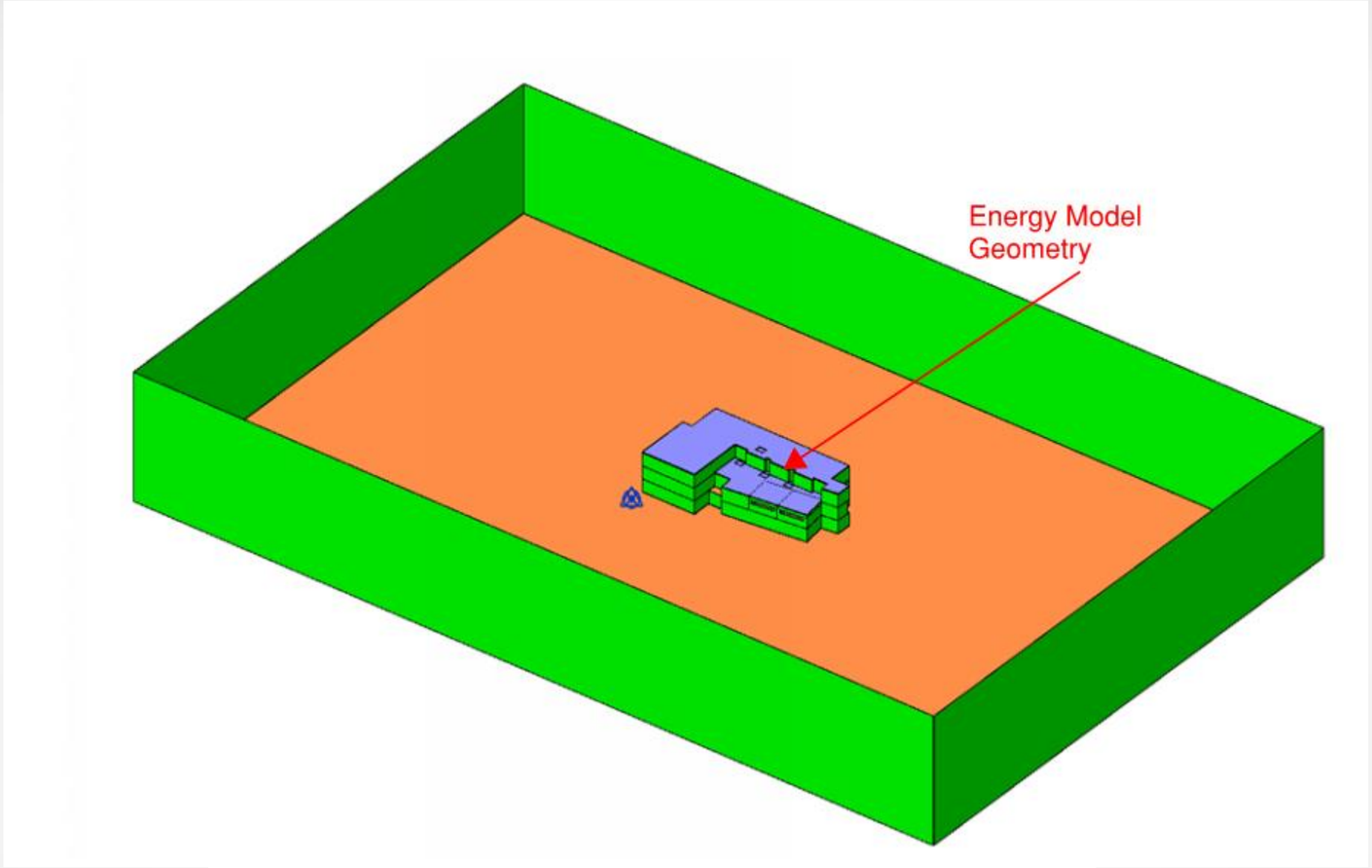
QCing Load Calc Using Color Schemes

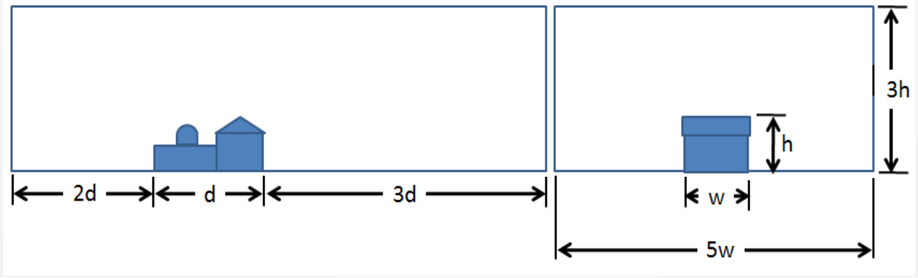
Using Revit to Create CFD Geometry and Boundary Conditions for Autodesk Simulation CFD

General Rules

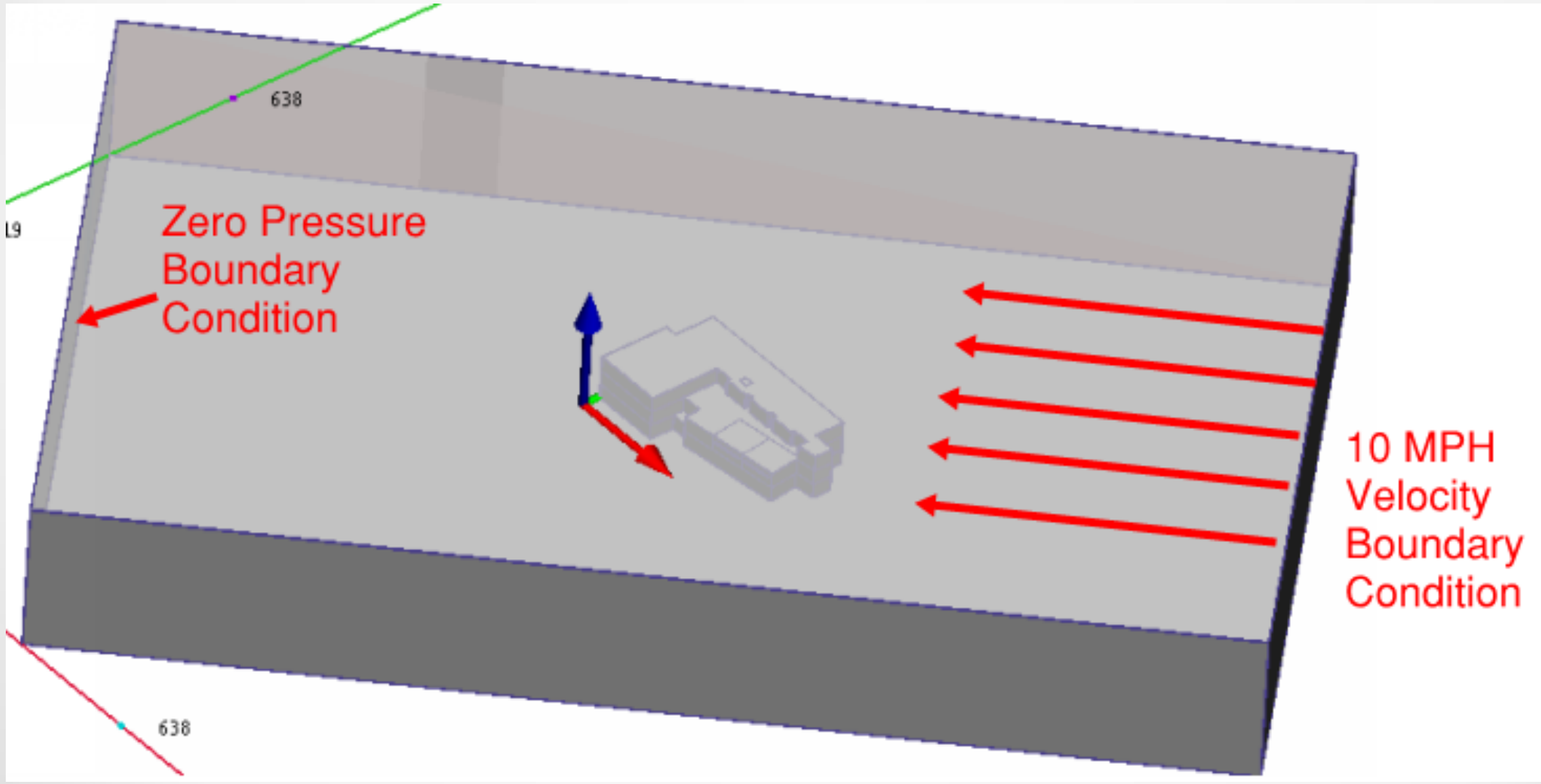
- Export from 3D view (using Revit plugin)
  - Only visible elements will export
- Keep it simple
  - Align walls
  - Avoid gaps
- Each Revit component results in independent boundary surface
- Create exterior volumes using walls roofs, and floors

External Flow Models – Geometry in Revit

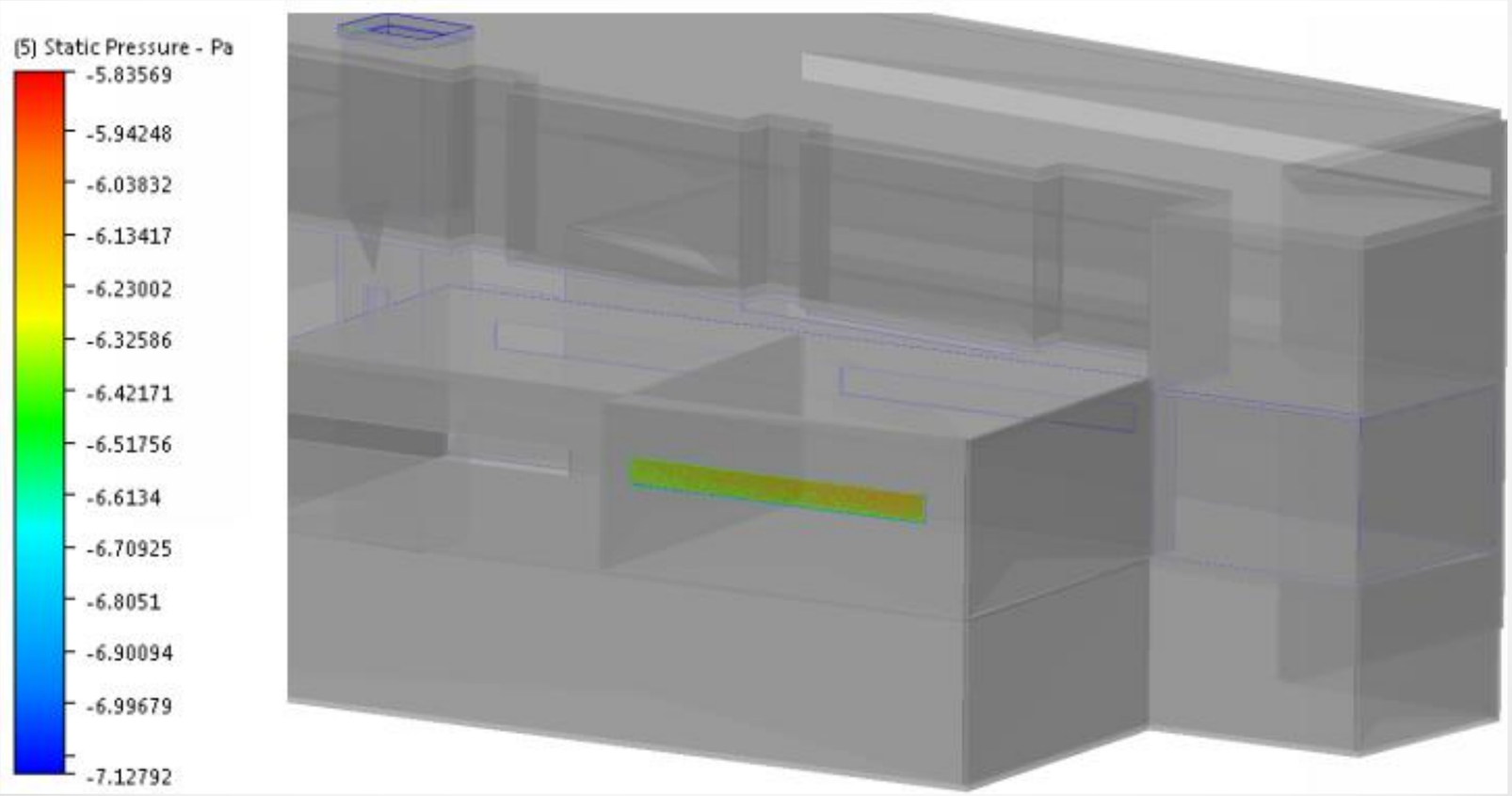




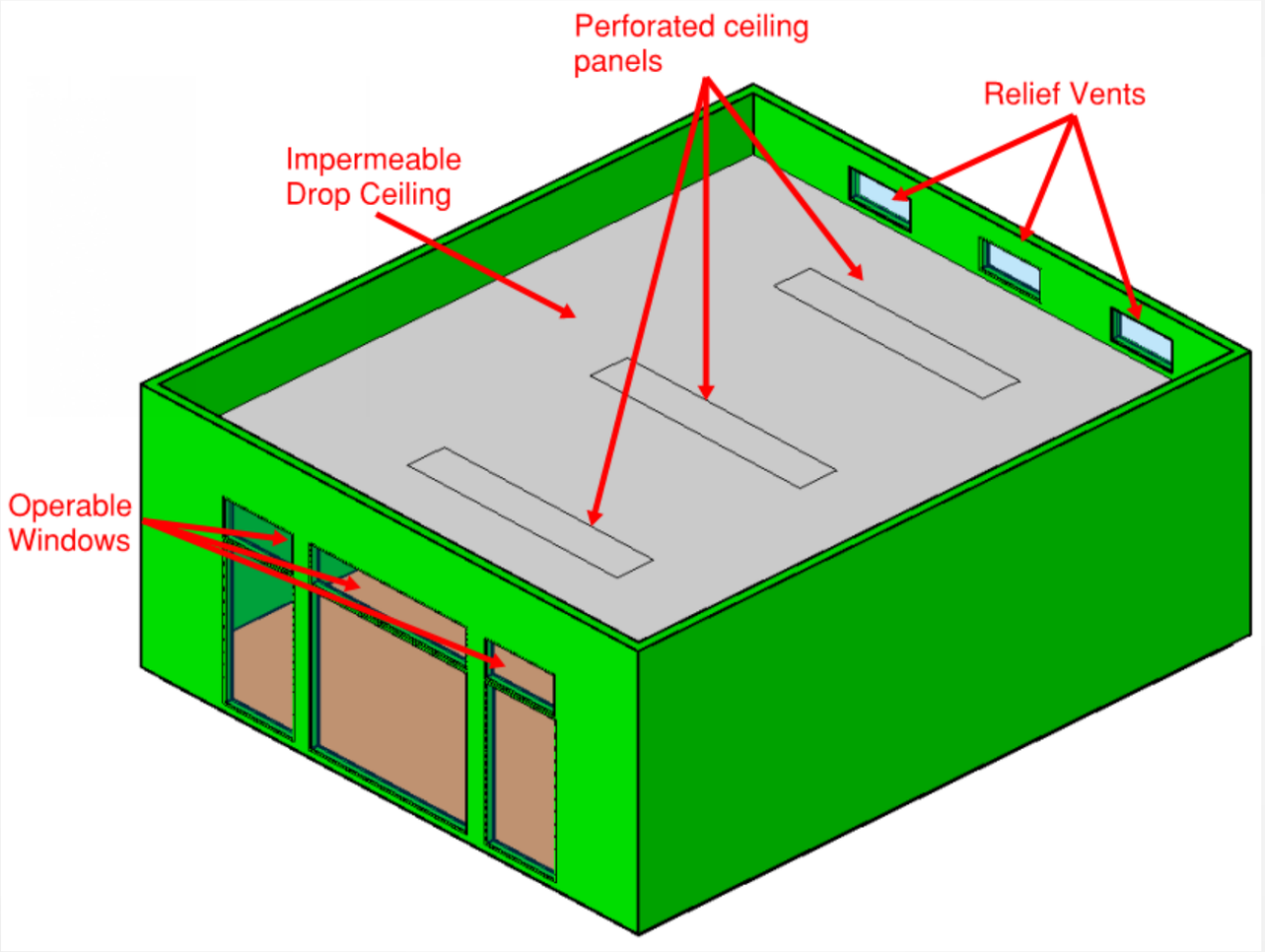
External Flow Models – Boundary Conditions in Simulation CFD



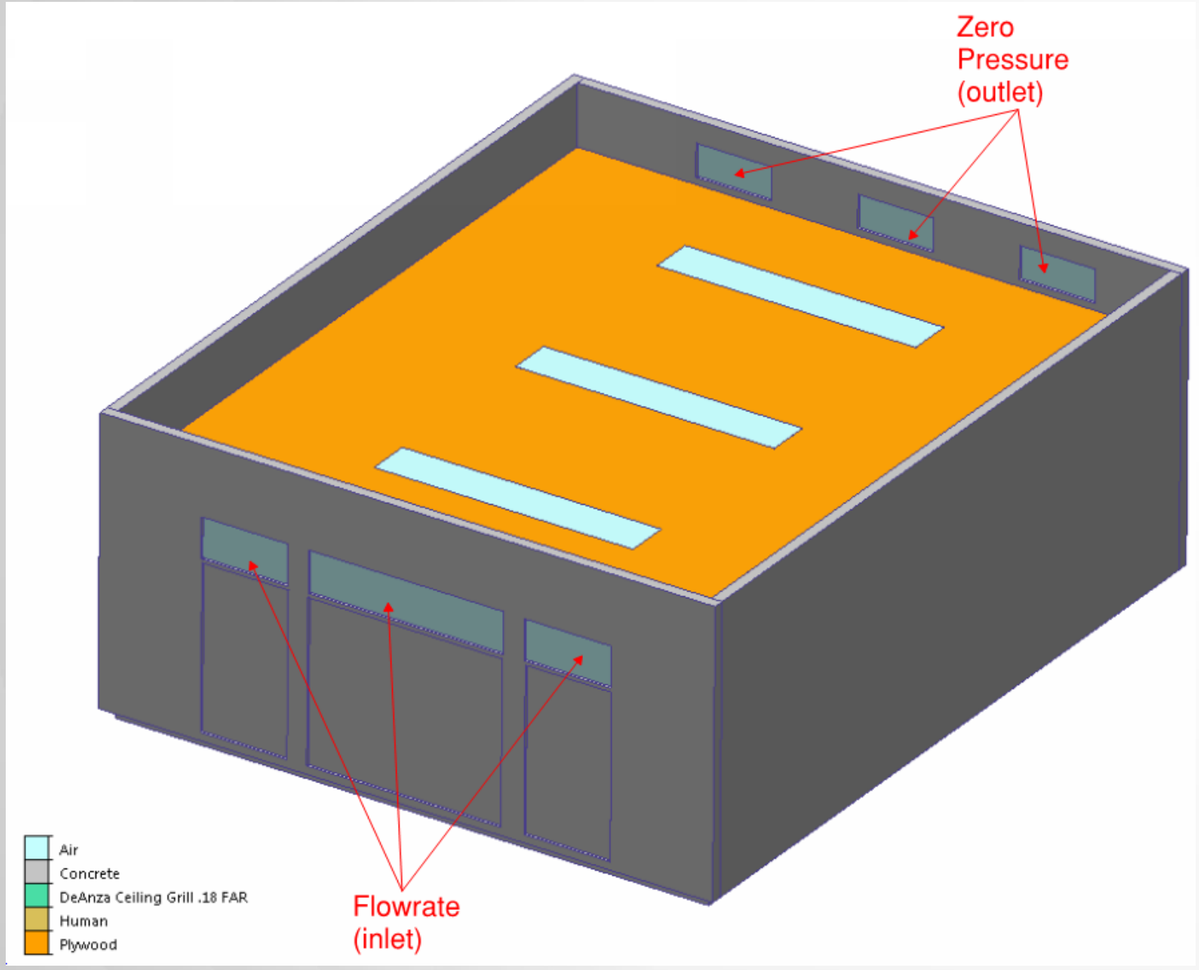
External Flow Models - Results

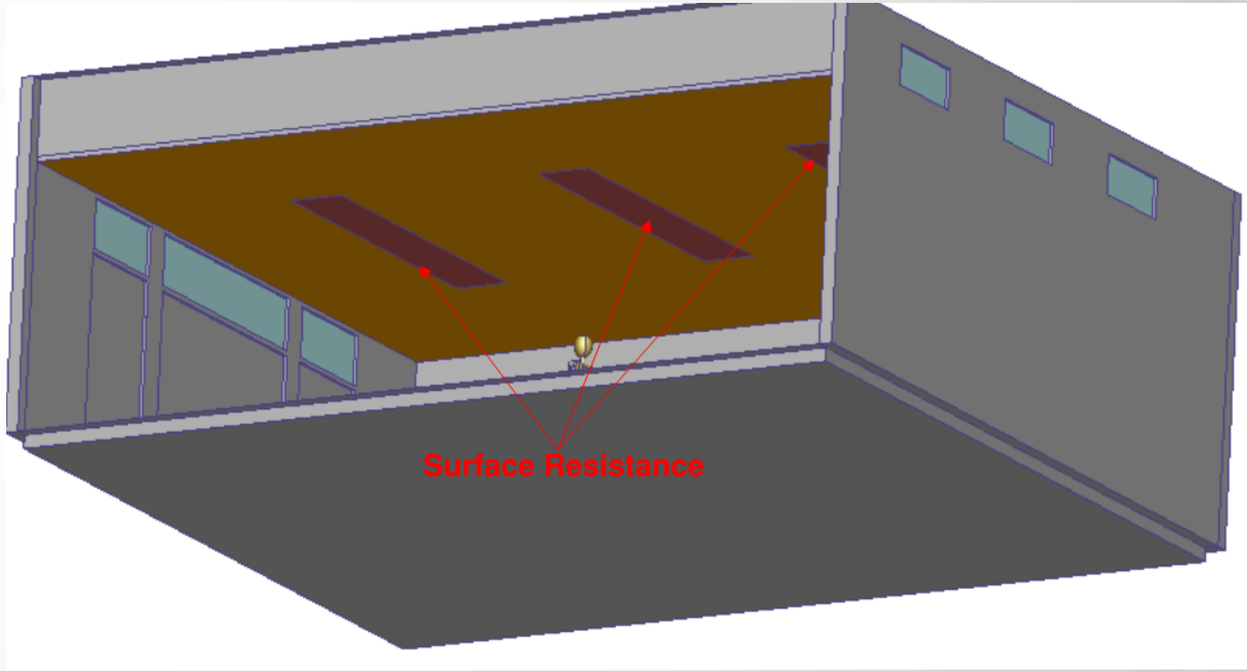


Internal Flow Models – Boundary Conditions in Revit

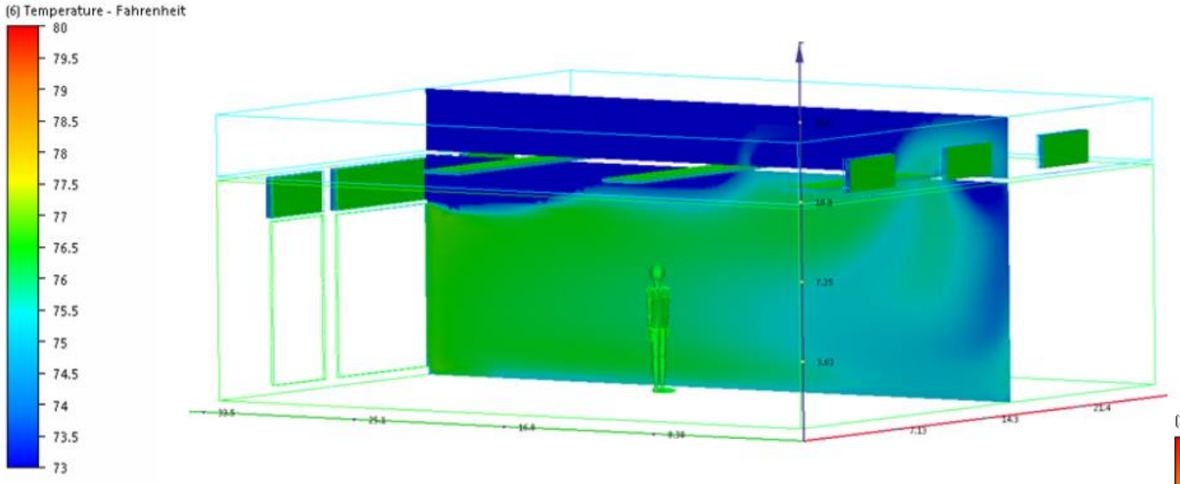


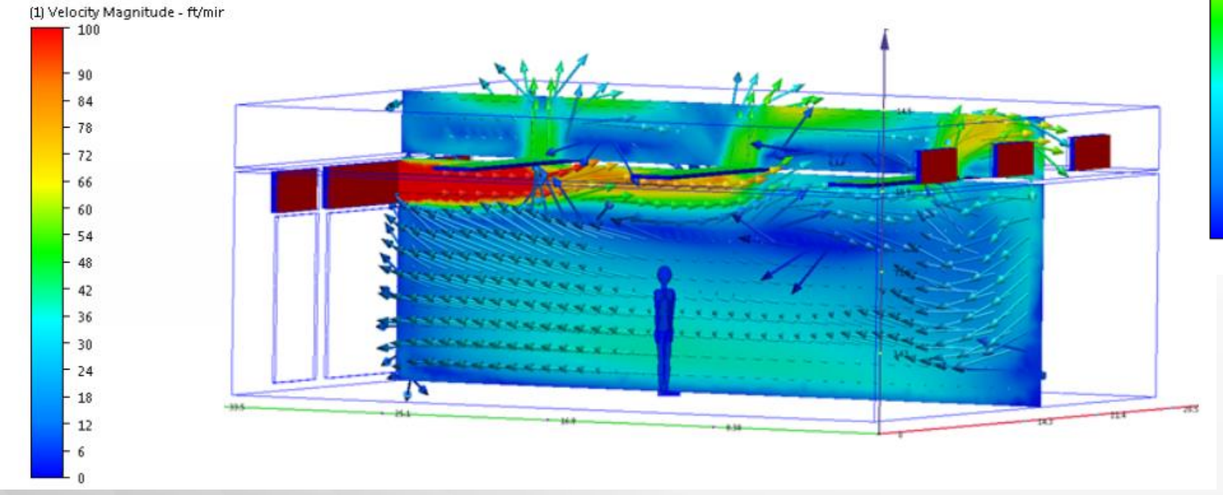
Internal Flow Models – Apply Boundary Conditions in Simulation CFD

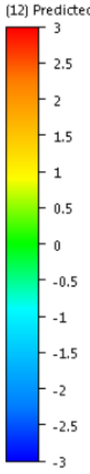


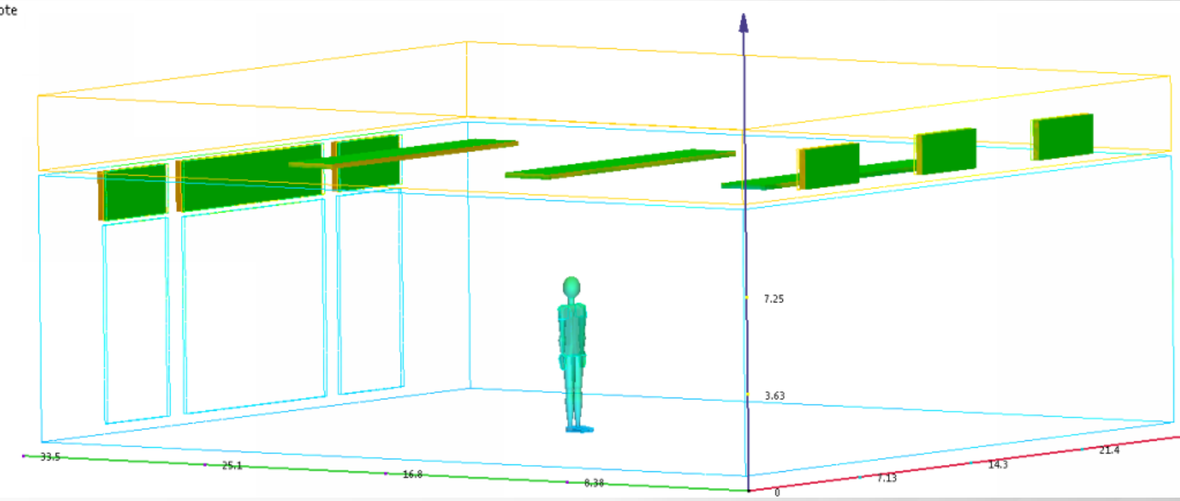


Internal Flow Models - Results









Thank You!!

Questions?

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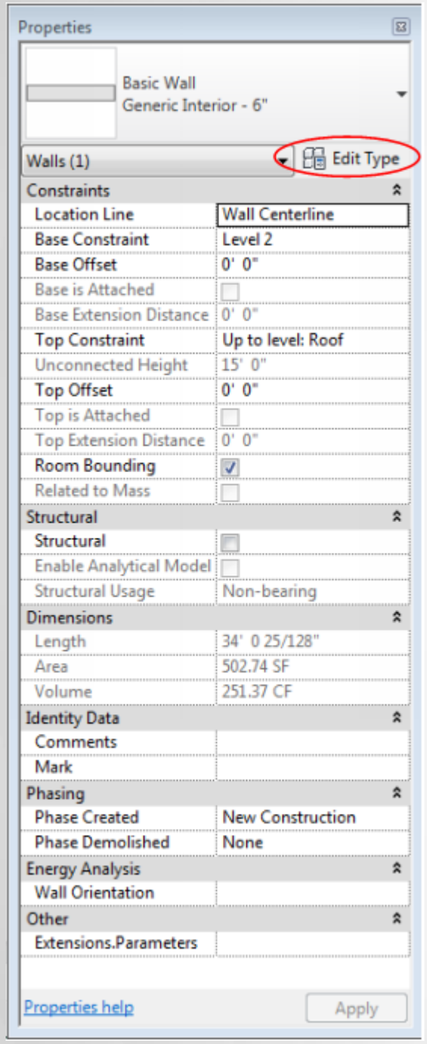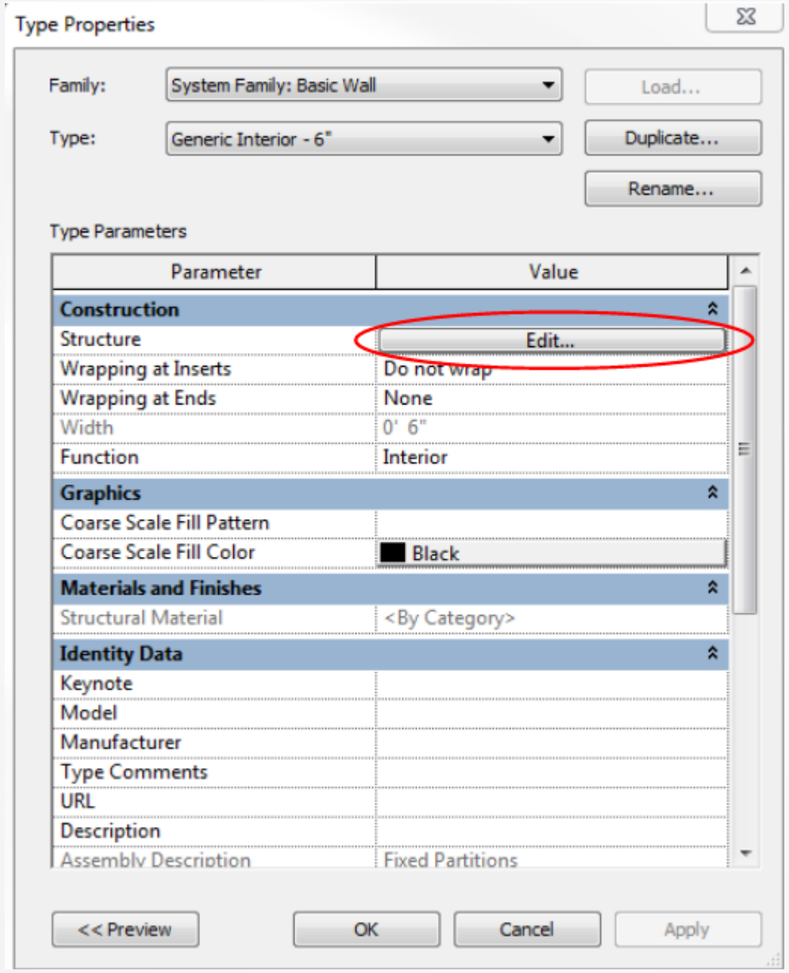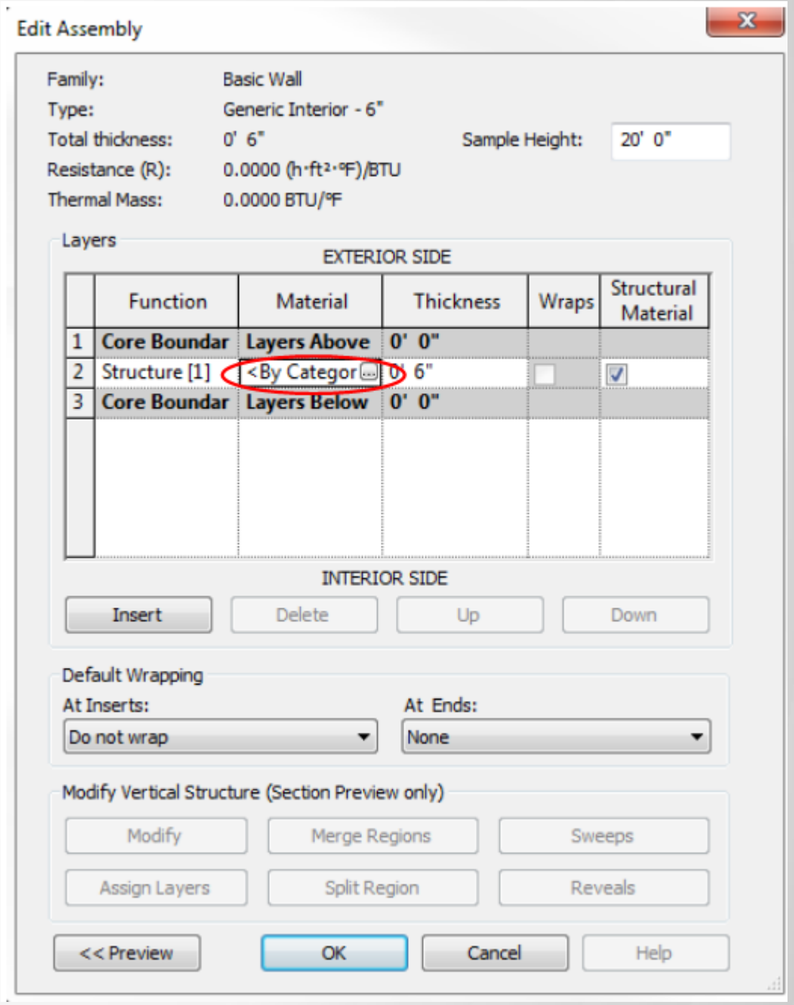
Envelope Families