

# Automating Occupancy: A Smarter Way

Dana De Filippi

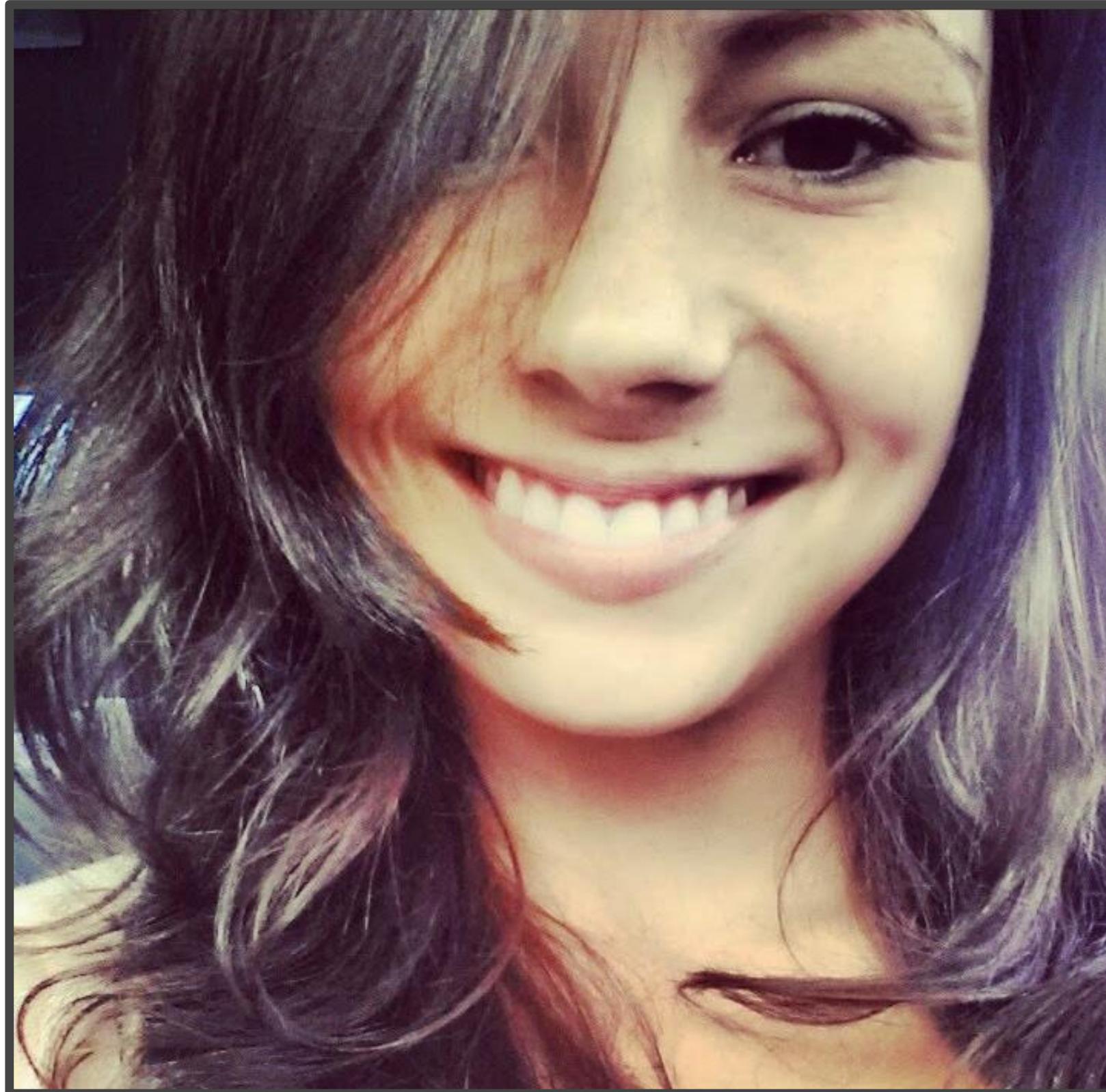
BIM Technologist - SmithGroup

**SMITHGROUP**



@danadefilippi

 **AUTODESK®**  
UNIVERSITY



## About the speaker

### Dana De Filippi

A BIM Technologist at SmithGroup, a national multi-disciplinary firm, in the Washington, DC office. With almost a decade of experience in Base Building Architecture, primarily focused on developing advanced workflows utilizing Revit and Dynamo. An active participant in Washington DC based user groups, serving as an advisor and regular speaker to Revit DC and Dynamo DC.



## About the audience

BIM Managers?

Architects?

Engineers?

Fire Protection Engineers?

Contractors?

Owners?

Other?



## About the audience

Revit Users?

Calculated Occupancy?

Used Key Schedules?

Created Calculated Values / Formulas?

Opened / Ran Dynamo?

Created Dynamo Graphs?



## Disclaimer:

There are many schedules in this presentation.  
The page number of the handout is indicated  
in the top right corner of every slide.



# Objectives

- Review the calculation for number of occupants, area calculation rules.
- Develop an area scheme and associated area plan for life safety.
- Generate area boundaries lines from room boundaries using Dynamo.
- Import function of space data from excel to Revit through Dynamo.
- Generate calculated values in schedules and annotation tag labels.
- Review fixed seats and number of occupants.
- Integrate conditional formatting for ease of user input and visibility.
- Discuss how to deal with future changes.

# A topic near and dear to my heart....

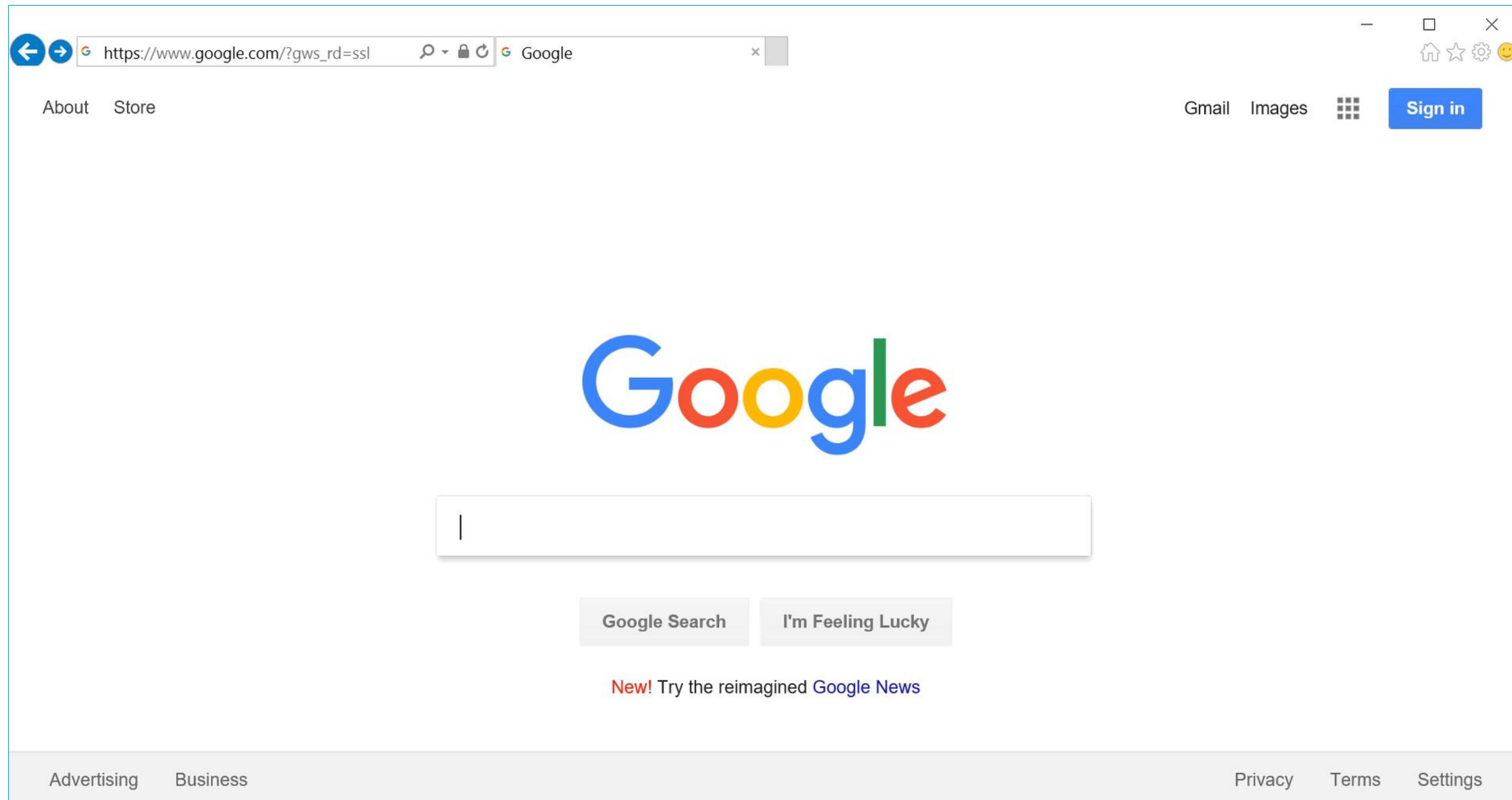
danadefilippi

DECEMBER 5, 2015

- First Dynamo graph EVER was related to Occupancy Calculations
- Over 3 years of Research, Implementation and Support of Revit & Dynamo Occupancy Automation Workflow(s)

December 2015						
S	M	T	W	T	F	S
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2

# “revit occupancy calculations”?



# Why Automate the Number of Occupants?

- Integrated workflow in Revit. No exporting.
- Inability to have key values part of formulas.
- Inability to tag calculated values.
  - Calculated values in tags in Revit 2017 – yay!
  - Multiple code sources, code modifications, etc.
  - Automation of boundary lines from room elements.



First Use of Dynamo (Instagram Post)

# Install Dynamo Packages

The screenshot shows the Revit ribbon at the top with the 'Manage' tab highlighted by a yellow dashed box. Below the ribbon is the Revit interface, specifically the 'Project Location' settings. On the right side of the Revit interface, two items are highlighted with orange dashed boxes: 'Dynamo' and 'Dynamo Player'. Below this, the 'Visual Programming' tab is also highlighted with an orange dashed box.

In short, a Package is a collection of Custom Nodes.

The screenshot of the Dynamo software interface shows the main menu bar with 'File', 'Edit', 'View', 'Packages', 'Settings', and 'Help'. The 'Packages' option is currently selected. The main area contains the Dynamo logo and several links and sections:

- FILES**: New, Custom Node, Open
- RECENT**: LS\_Set Up Function Of Space Key (DYN), LS\_Tag Fire-Smoke Walls (DYN), LS\_Copy Occupant Load Factors (DYN), LS\_Set Up Function Of Space Key (DYN), LegendComponents\_GenericAnnotation
- ASK**: Discussion forum, Dynamo website
- REFERENCE**: Getting Started, Dynamo Primer, Video Tutorials, Dynamo Dictionary
- CODE**: Github repository, Send issues
- SAMPLES**

At the bottom of the interface, there is a 'Backup' section with the text 'Backup location'.

- ARCHI-LAB.NET
- ARCHI-LAB BUMBLEBEE
- CLOCKWORK FOR DYNAMO 2.X

## Number of Occupants

“For areas without fixed seating, the occupant load shall be not less than that number determined by **dividing the floor area under consideration by the occupant load factor assigned to the function of space** as set forth in Table 1004.1.2.”

– International Building Code, Section 1004

$$\frac{\text{AREA}}{\text{OCCUPANT LOAD FACTOR}} = \text{NUMBER OF OCCUPANTS}$$

# AREA



# Why Areas (and not Rooms)?

The screenshot shows the Autodesk Revit ribbon interface with the **Architecture** tab selected. A callout arrow points from the **Room & Area** button in the **Modify** tab to the **Area and Volume Computations** dialog box.

**Area and Volume Computations**

**Computations** (selected)   **Area Schemes**

**Volume Computations**  
Volumes are computed at finish faces.  
 Areas only (faster)  
 Areas and Volumes

**Room Area Computation**  
 At wall finish  
 At wall center  
 At wall core layer  
 At wall core center

**Color Schemes**

**Area and Volume Computations**  
Specifies how areas and volumes are calculated, and creates area schemes.  
  
Volumes are computed at finish faces.  
  
For room areas, you can specify whether they are computed using the wall finish, wall center, wall core layer, or wall core center.

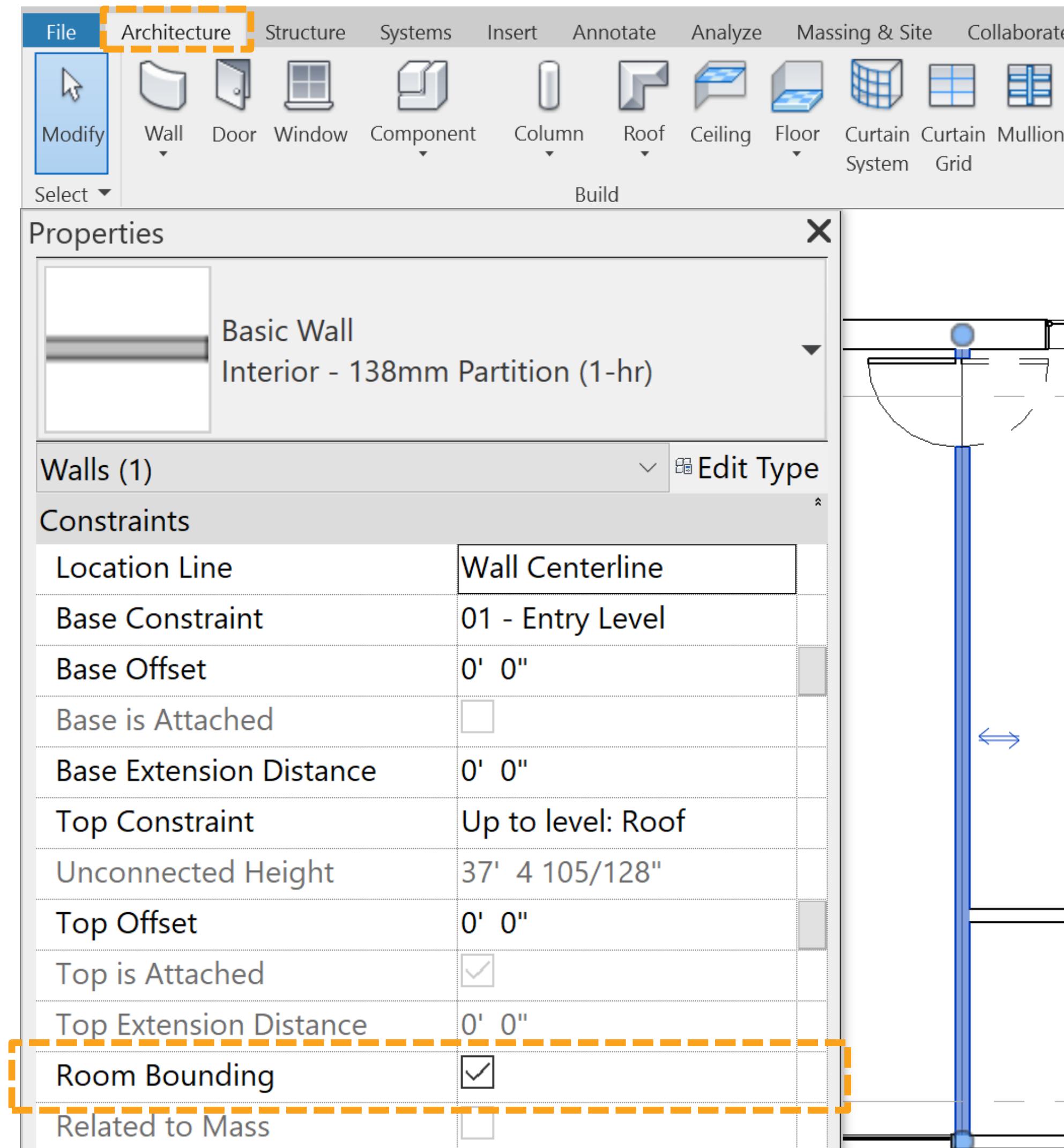
**Press F1 for more help**

**Room Computation is only taken from one face of the wall.**

**Room Area is Computed using Walls, Columns, Room Separation Lines, Etc.**

# Why Areas (and not Rooms)?

The screenshot shows the Revit interface with the **Architecture** tab selected. The **Room & Area** panel is open, showing the **Room Separator** tool, which is highlighted with a yellow dashed box.



**Properties** panel (Basic Wall, Interior - 138mm Partition (1-hr)):

Walls (1)	Edit Type
Constraints	
Location Line	Wall Centerline
Base Constraint	01 - Entry Level
Base Offset	0' 0"
Base is Attached	
Base Extension Distance	0' 0"
Top Constraint	Up to level: Roof
Unconnected Height	37' 4 105/128"
Top Offset	0' 0"
Top is Attached	<input checked="" type="checkbox"/>
Top Extension Distance	0' 0"
Room Bounding	<input checked="" type="checkbox"/>
Related to Mass	<input type="checkbox"/>

**Warning** dialog:

A wall and a room separation line overlap. One of them may be ignored when Revit finds room boundaries. Shorten or delete the room separation line to remove the overlap.

**Room Computation is only taken from one face of the wall.**

**Room Area is Computed using Walls, Columns, Room Separation Lines, Etc.**

**Room Separators that overlap Walls generate warnings.**

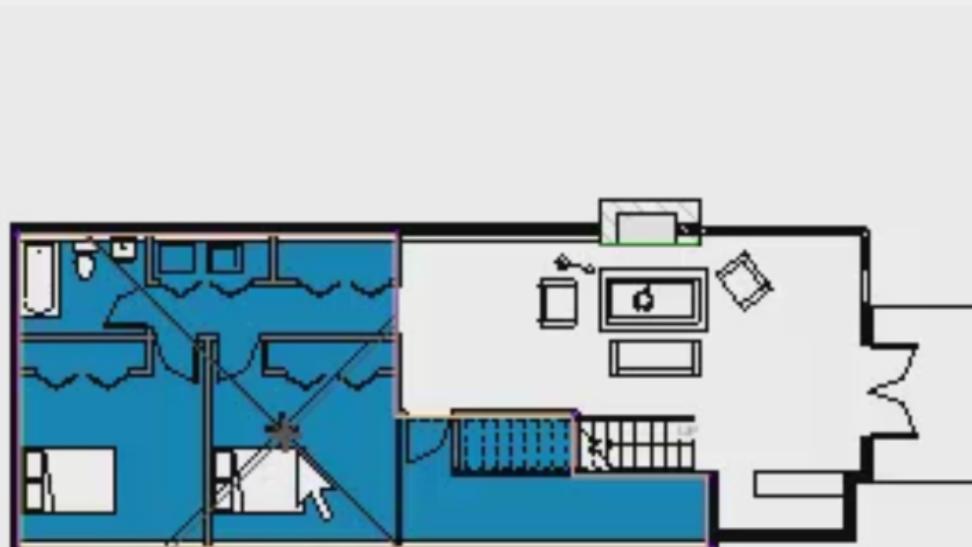
# Why Areas (and not Rooms)?

The screenshot shows the Revit interface with the **Architecture** tab selected. The **Area** tool in the **Room & Area** panel is highlighted with a dashed orange box.

**Project Browser - rac\_advanced\_sa...**

- Views (all)
  - Floor Plans
  - Ceiling Plans
  - 3D Views
  - Elevations (Building Elevation)
  - Sections (Building Section)
  - Sections (Wall Section)
  - Detail Views (Detail)
  - Renderings
  - Drafting Views (Detail)
  - Walkthroughs
  - Area Plans (Gross Building)
  - Area Plans (Life Safety)
    - 01 - Entry Level**
  - Legends
- Schedules/Quantities (all)
- Sheets (all)
- Families
- Groups
- Revit Links

**Area Plan**  
Creates an area defined by walls and boundary lines.  
Open an area plan view, and click in the view to place the area.  
If you place an area inside area boundaries, it expands to the extents of the boundaries. Define area boundaries with the Area Boundary Line tool.  
You can also place an area in a free space or one that is not entirely bounded, and then define area boundaries later.



Press F1 for more help

**Room Computation is only taken from one face of the wall.**

**Room Area is Computed using Walls, Columns, Room Separation Lines, Etc.**

**Room Separators that overlap Walls generate warnings.**

**Life Safety Areas may encompass many Rooms (ex: Residential Units).**

**Life Safety Elements are housed in a safe place within the Area Scheme.**

# Area Schemes

The screenshot illustrates the Revit interface for creating area schemes. The ribbon shows the **Architecture** tab selected. In the **Modify** panel, the **Room & Area** button is highlighted with a dashed orange box. A callout arrow points from this button to the **Area Schemes** tab in the **Area and Volume Computations** dialog. Another callout arrow points from the **Area Schemes** tab to the detailed description in the help panel.

**Area and Volume Computations**

**Computations** **Area Schemes**

	Name	Description
1	Gross Building	Total Constructed Area of a Building
2	Rentable	Area Measurements Based on the Standard Method for Measuring Fl
3	Life Safety	Life Safety Area Measurements

**New**

**Delete**

**OK** **Cancel** **Help**

**Area and Volume Computations**

Specifies how areas and volumes are calculated, and creates area schemes.

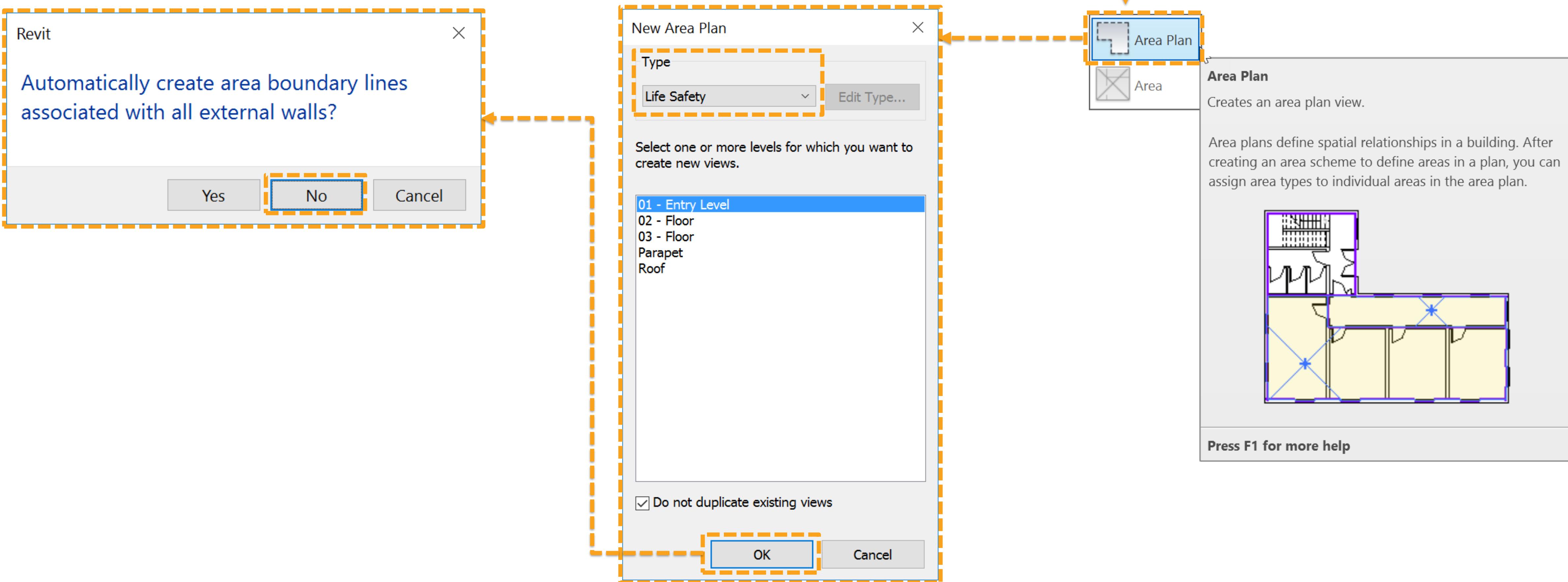
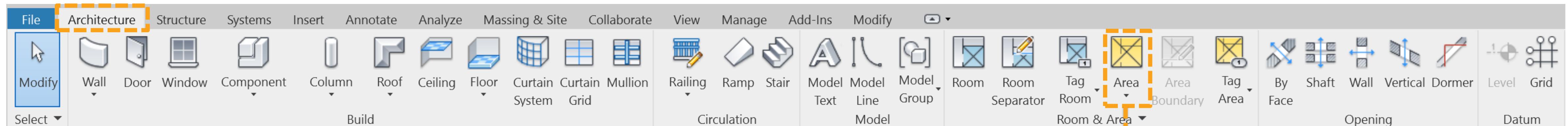
Volumes are computed at finish faces.

For room areas, you can specify whether they are computed using the wall finish, wall center, wall core layer, or wall core center.

Press F1 for more help

OOTB Revit Architectural Template contains Gross Building and Rentable Schemes  
New Area Schemes can be created for each variation of Area Calculations

# Area Plans



# Area Type Rules

Rules are determined by one type of space bordering another space.

The following table shows area measurement rules. To find the appropriate measurement rule, find the selected Area Type and the corresponding Bordering Area Type.

<http://help.autodesk.com/view/RVT/2017/ENU/?guid=GUID-B4AC3088-DBA8-4EB0-BA8F-CAF8EC1EBF9D>

## Gross Building Area Scheme Types

Gross Building Area Scheme Types		
Area Type Selected	Bordering Area Type	Measurement Rule
Gross Building Area		
Gross Building Area	None	Area Boundary measured to the outside surface of building.
Gross Building Area	Exterior Area	Area Boundary measured from outside surface of building.
Exterior Area		
Exterior Area	Exterior Area	Area Boundary measured from wall centerline.
Exterior Area	Gross Building Area	Area Boundary measured from outside surface of building.

If you select the **Apply Area Rules** option, Revit automatically changes the wall boundary position when you change the area type. (See [About Area Types](#).) For example, office area is measured at the wall centerline, while exterior area is measured to the exterior wall face. By applying area rules, the area boundary position updates in accordance with area type changes.

<http://help.autodesk.com/view/RVT/2017/ENU/?guid=GUID-0AB09044-22FC-4116-8845-0D558BA129C1>

# Gross vs. Net Area Calculation Rules

**"The gross floor area technique applied to a building only allows the deduction of the plan area of the exterior walls, vent shafts and interior courts from the plan area of the building.**

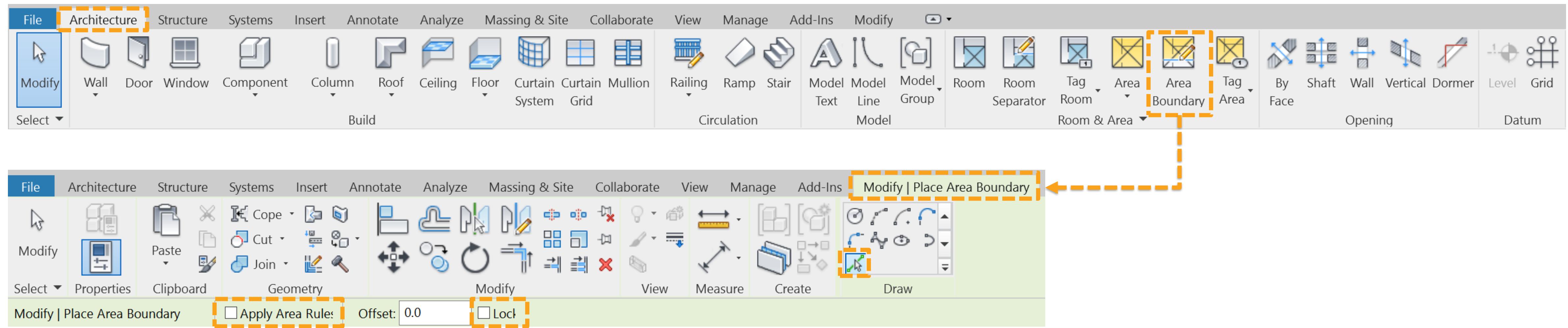
The net floor area permits the exclusion of certain spaces that would be included in the gross floor area. The net floor area is intended to apply to the actual occupied floor areas. The area used for permanent building components, such as shafts, fixed equipment, thicknesses of walls, corridors, stairways, toilet rooms, mechanical rooms and closets, is not included in net floor area."

– 2015 International Building Code Commentary, Means of Egress

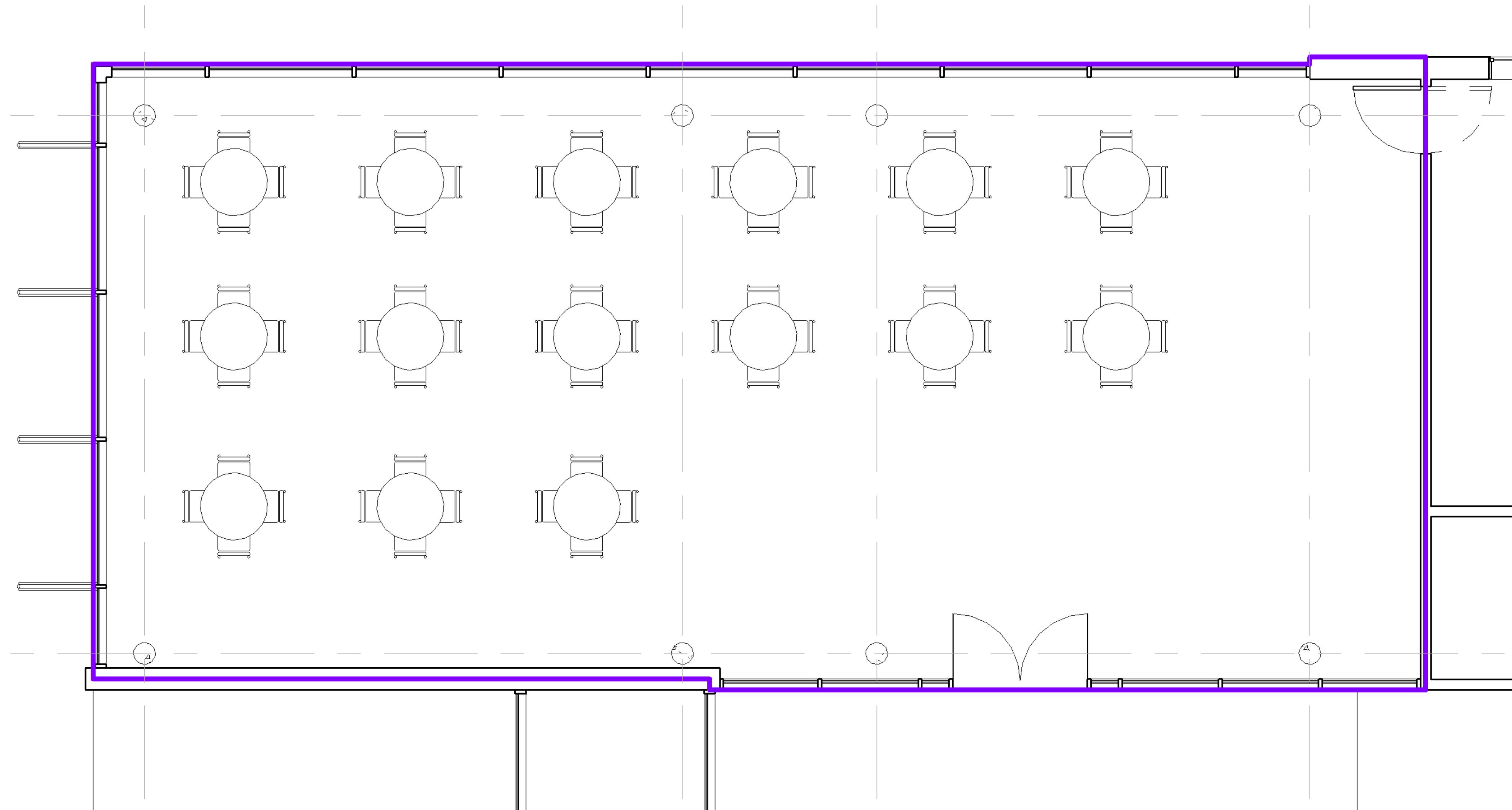
**TABLE 1004.1.2**  
**MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT**

FUNCTION OF SPACE	OCCUPANT LOAD FACTOR <sup>a</sup>
Assembly	
Gaming floors (keno, slots, etc.)	11 gross
Exhibit gallery and museum	30 net
Assembly with fixed seats	See Section 1004.4
Assembly without fixed seats	
Concentrated (not fixed)	7 net

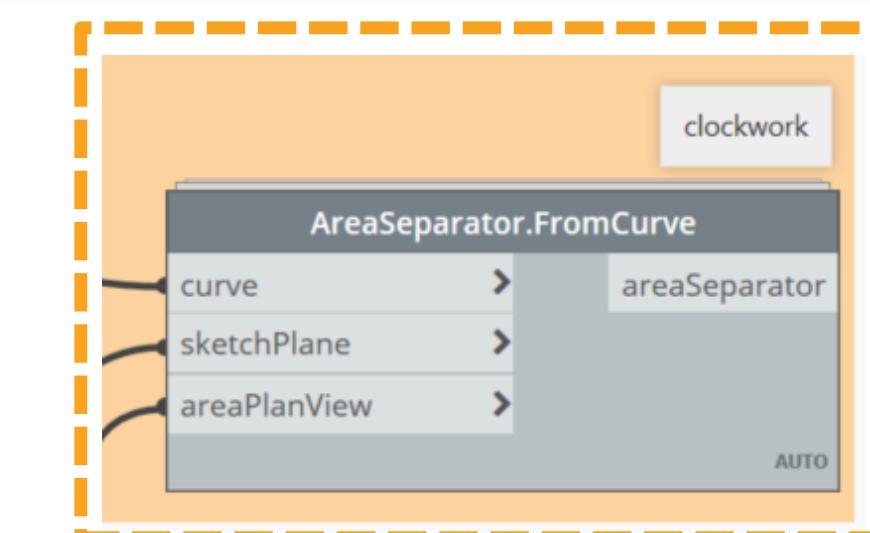
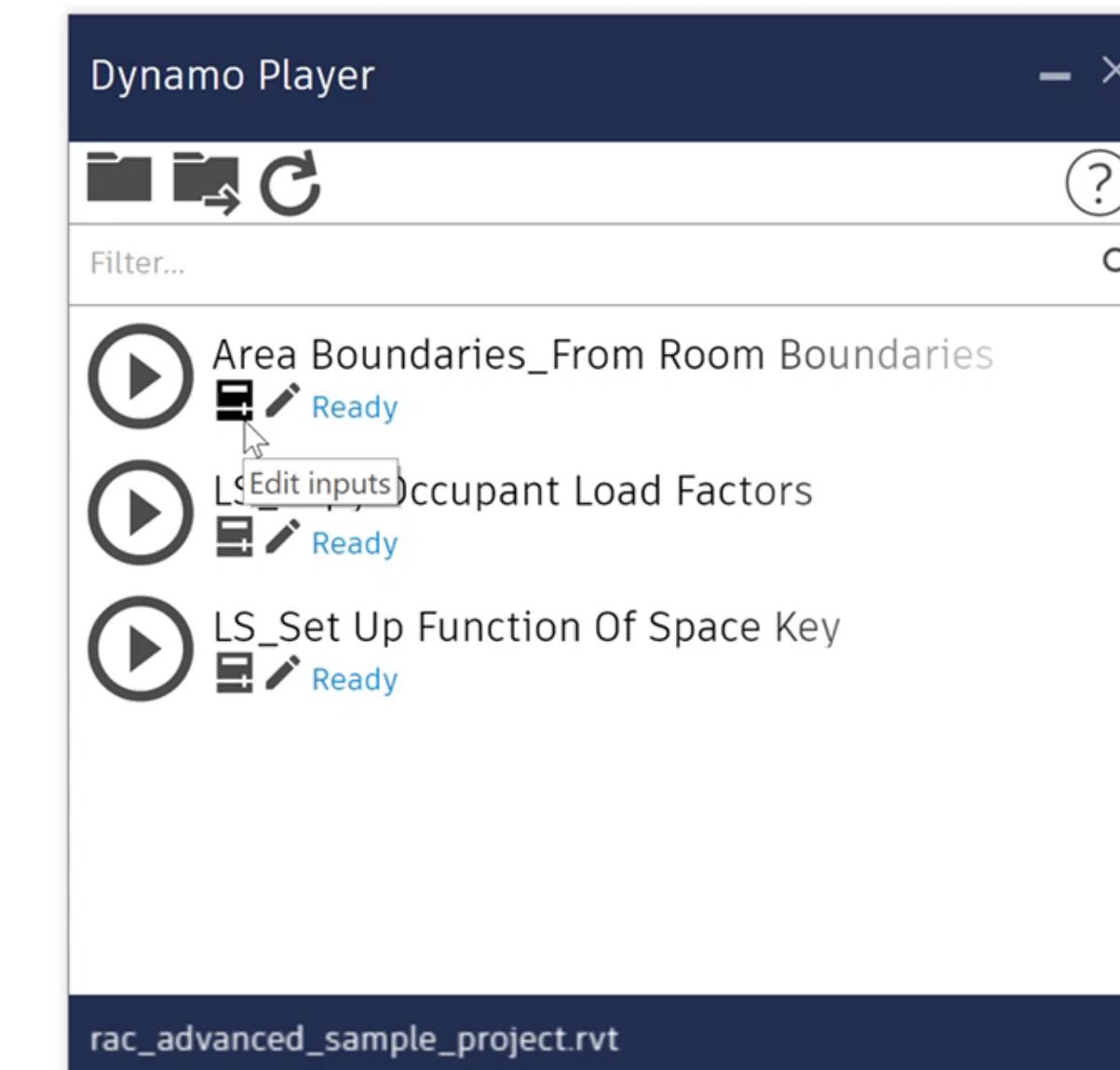
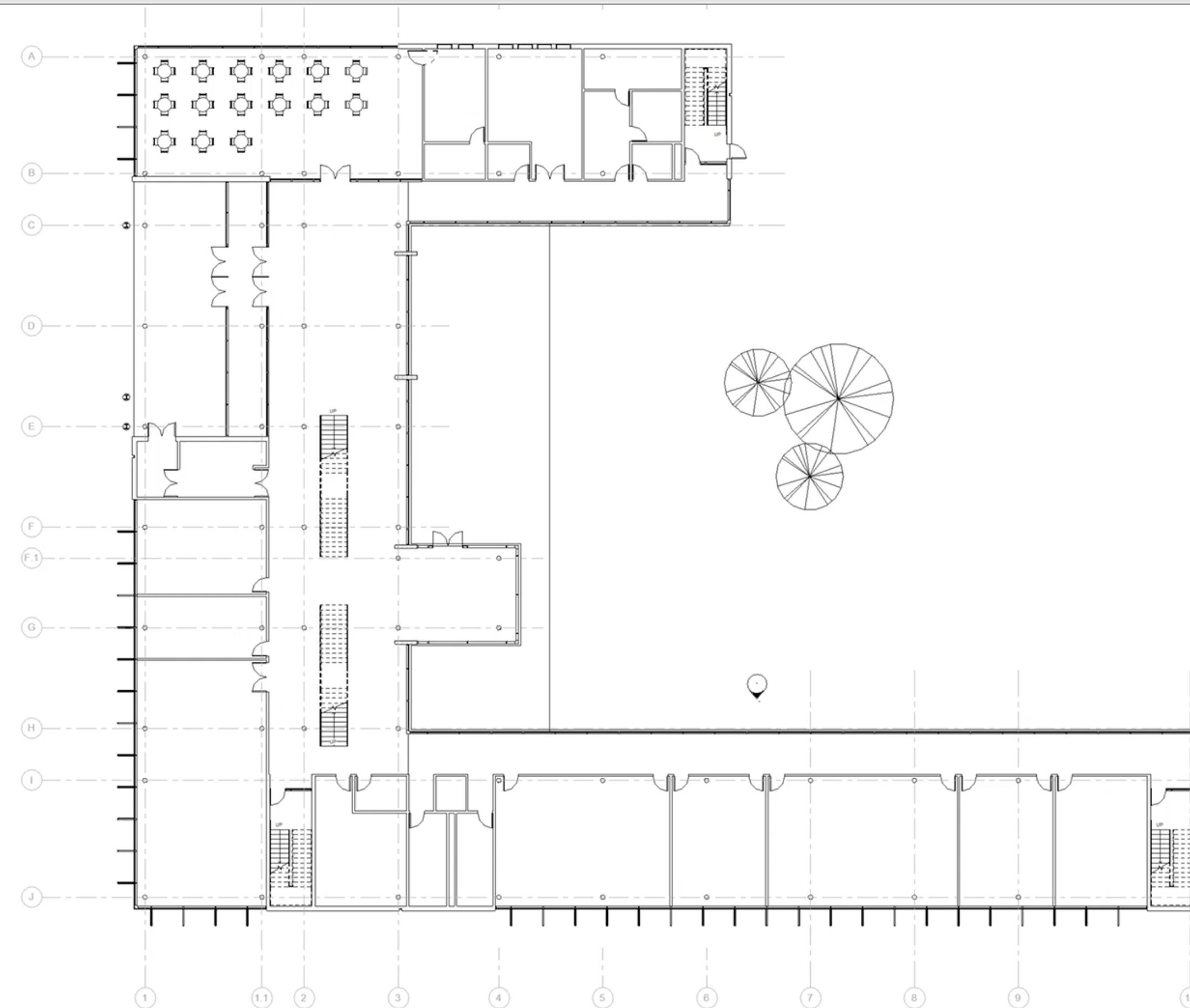
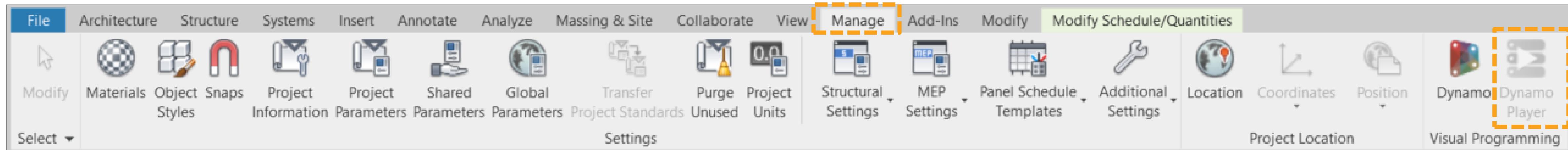
# Area Boundaries



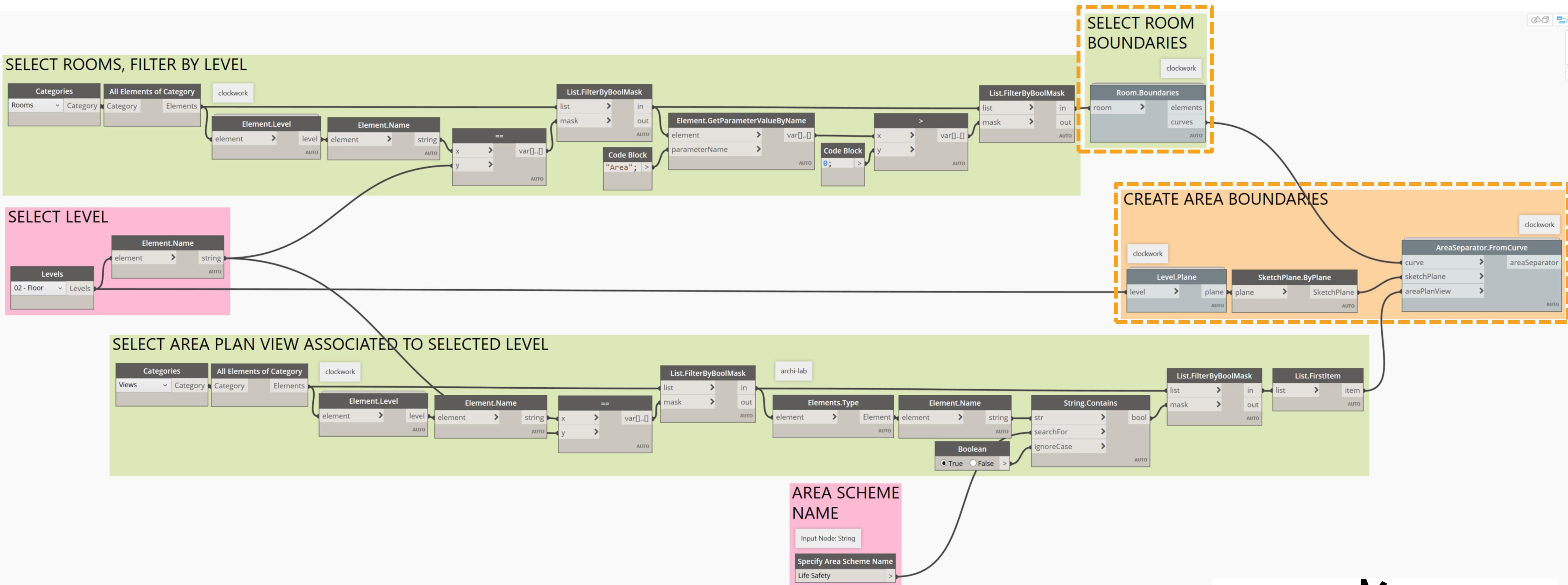
# Area Boundaries



# Area Boundaries & Dynamo



# Area Boundaries & Dynamo



# Areas

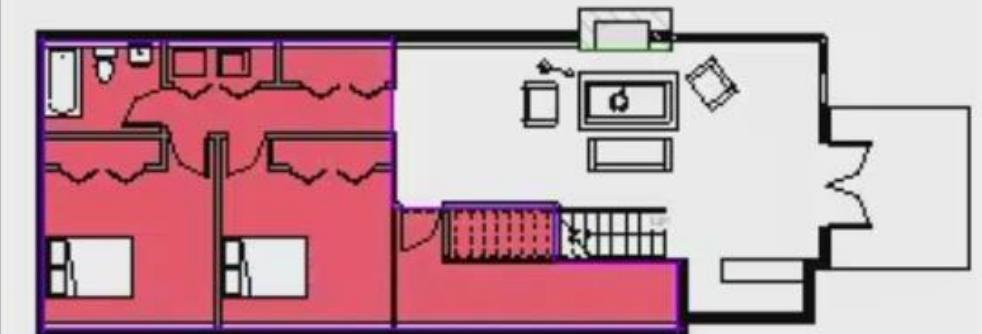


The screenshot shows the Revit ribbon with the Modify tab selected. The 'Modify | Place Area' button is highlighted with a dashed orange box. A callout box points from this button to a detailed description of the 'Area' tool.

**Area**  
Creates an area defined by walls and boundary lines.

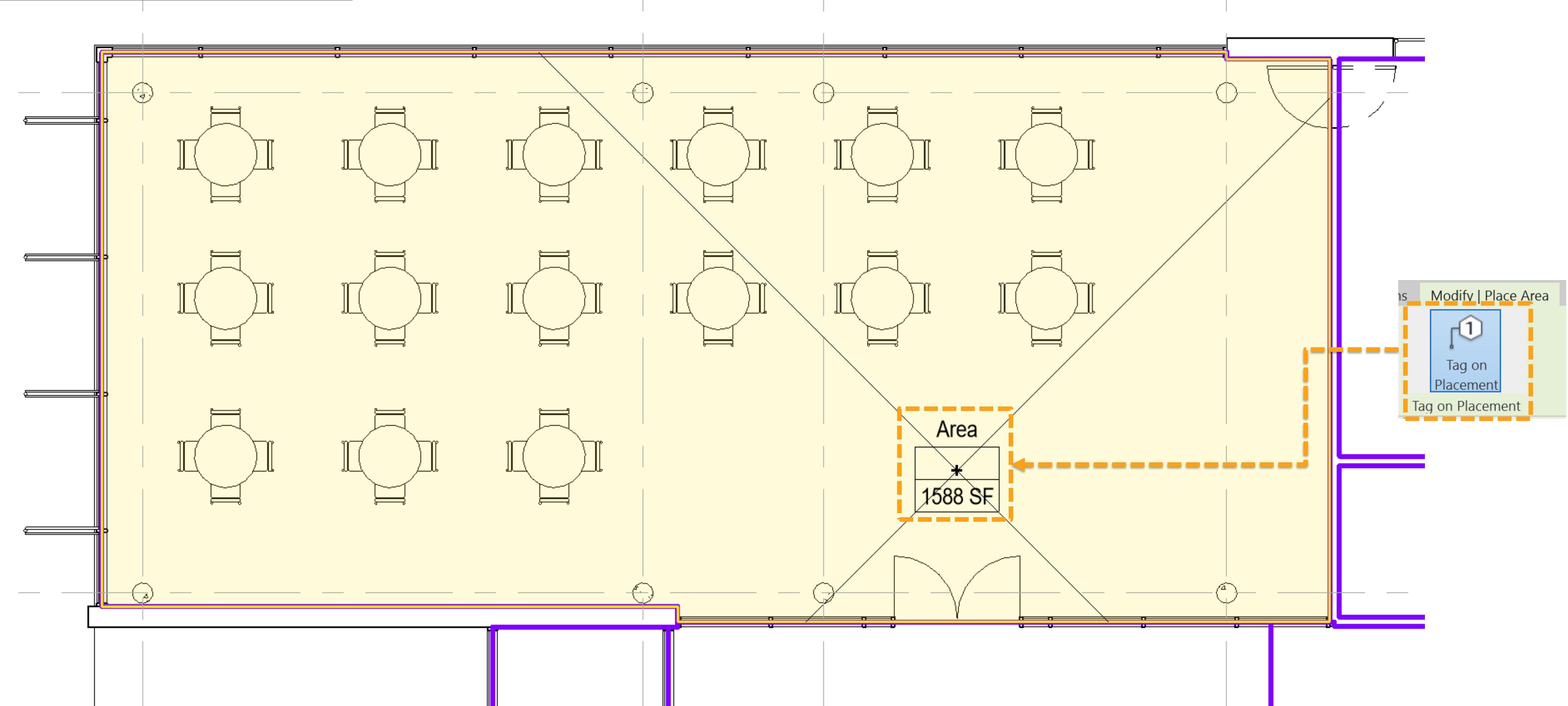
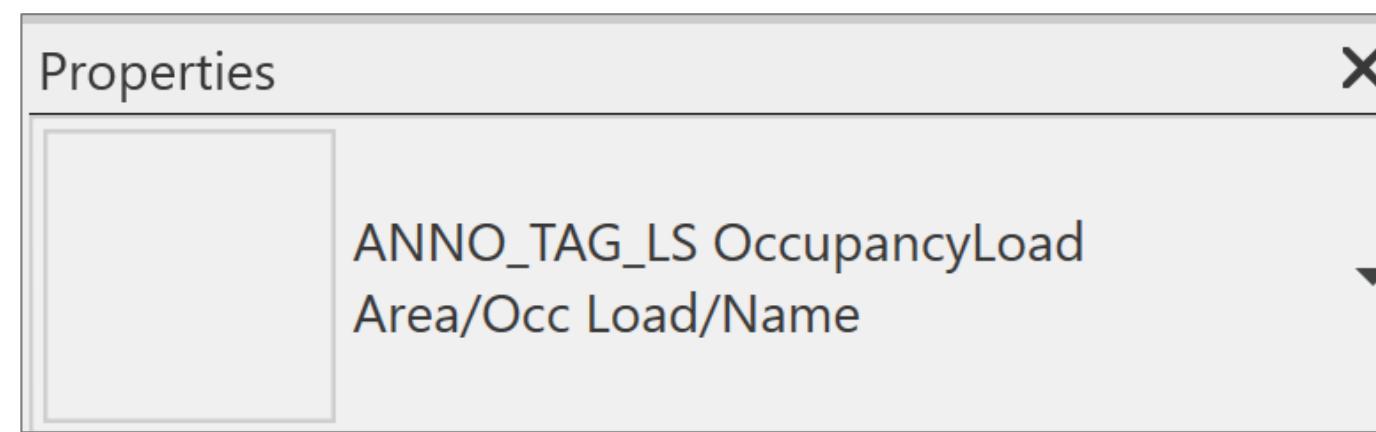
Open an area plan view, and click in the view to place the area. If you place an area inside area boundaries, it expands to the extents of the boundaries. Define area boundaries with the Area Boundary Line tool.

You can also place an area in a free space or one that is not entirely bounded, and then define area boundaries later.



Press F1 for more help

# Areas



# Areas

**Area and Volume Computations**

**Computations Area Schemes**

	Name	Description
1	Gross Building	Total Constructed Area of a Building
2	Rentable	Area Measurements Based on the Standard Method for Measuring Fl
3	Life Safety	Life Safety Area Measurements

New Delete

OK Cancel Help

Each area scheme has its own distinct set of plans, boundaries, and areas. Area boundaries and areas will only be visible in the plans which reference the area scheme. Ex: life safety area boundaries and areas will only be visible in life safety area plans (not floor plans, gross building area plans, etc.)

If the Area Scheme is deleted all of the associated elements will be deleted also.

**New Area Plan**

Type: Life Safety Edit Type...

Select one or more levels for which you want to create new views.

- 01 - Entry Level
- 02 - Floor
- 03 - Floor
- Parapet
- Roof

Do not duplicate existing OK

**New Schedule**

Filter list: <show all>

Category:

- Analytical Spaces
- Analytical Surfaces
- Analytical Wall Foundations
- Analytical Walls
- Areas (Gross Building)
- Areas (Life Safety) **(highlighted)**
- Areas (Rentable)
- Assemblies
- Cable Tray Fittings
- Cable Tray Runs
- Cable Trays
- Casework
- Ceilings
- Columns

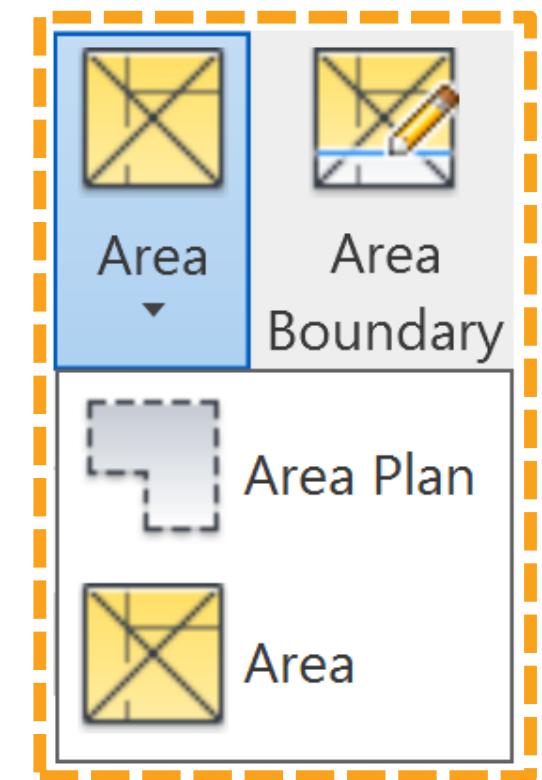
Name: Area Schedule (Life Safety)

Schedule building components  
 Schedule keys

Key name:

Phase:

OK Cancel Help



# Areas

<LS Area Schedule>									
A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level									
Area	(none)					1,588 SF		<input checked="" type="checkbox"/>	

User  
Driven  
Input

Dynamo  
Driven  
Input

Key  
Schedule  
Values

Calculated  
Value  
(Formula)

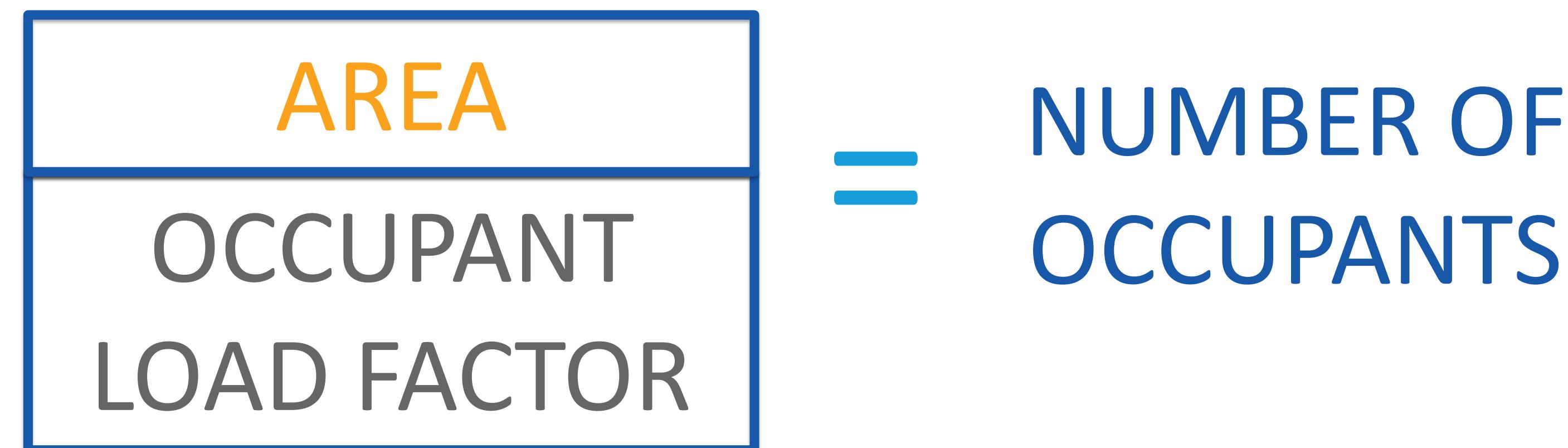
# OCCUPANT LOAD FACTOR



## Number of Occupants

“For areas without fixed seating, the occupant load shall be not less than that number determined by **dividing the floor area under consideration by the occupant load factor assigned to the function of space** as set forth in Table 1004.1.2.”

– International Building Code, Section 1004

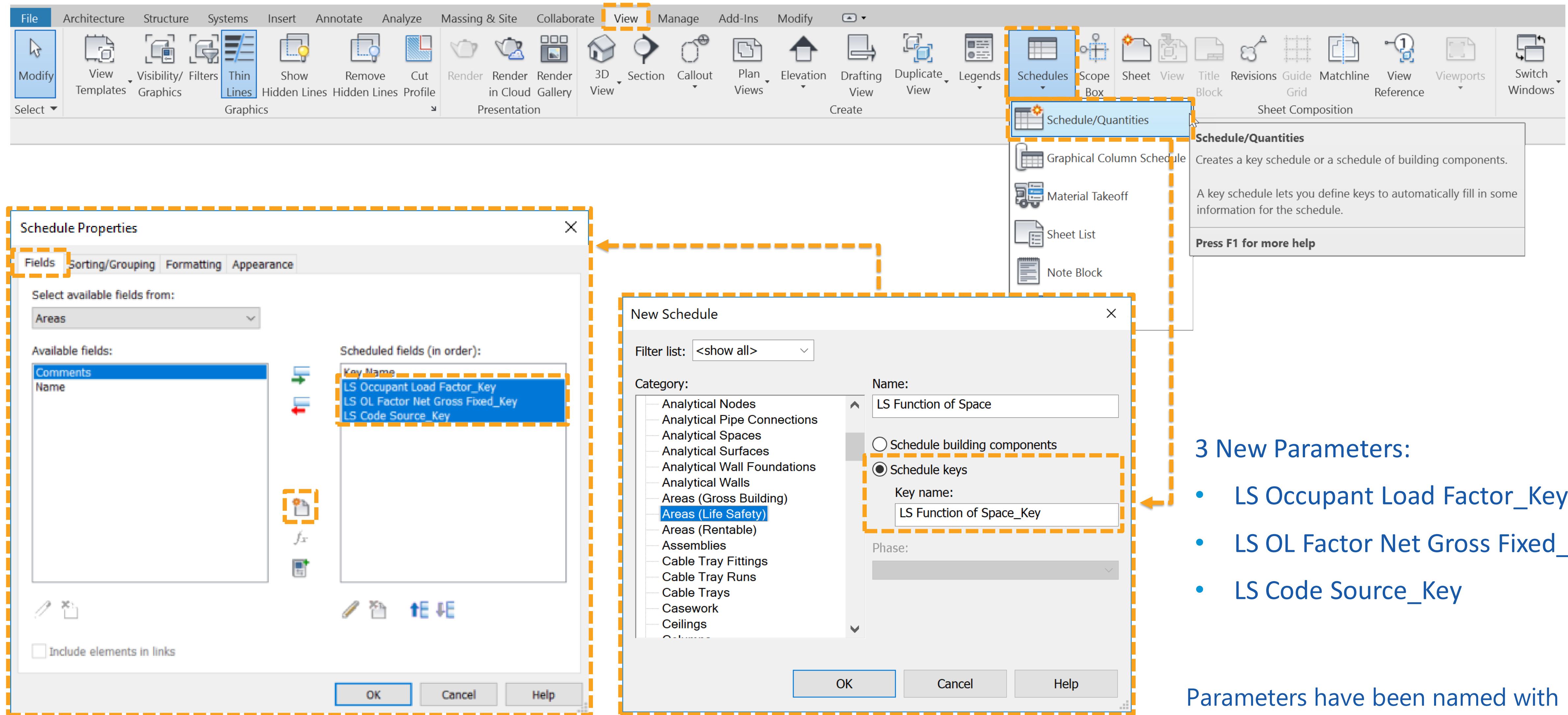


# Occupant Load Factor

**TABLE 1004.1.2**  
**MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT**

FUNCTION OF SPACE	OCCUPANT LOAD FACTOR <sup>a</sup>
Accessory storage areas, mechanical equipment room	300 gross
Agricultural building	300 gross
Aircraft hangars	500 gross
Airport terminal	
Baggage claim	20 gross
Baggage handling	300 gross
Concourse	100 gross
Waiting areas	15 gross
Assembly	
Gaming floors (keno, slots, etc.)	11 gross
Exhibit gallery and museum	30 net
Assembly with fixed seats	See Section 1004.4
Assembly without fixed seats	
Concentrated —not fixed)	7 net

# Area Schedule of Keys



## 3 New Parameters:

- LS Occupant Load Factor\_Key
- LS OL Factor Net Gross Fixed\_Key
- LS Code Source\_Key

Parameters have been named with  
“\_Key” to indicate where it is derived.

# Area Schedule – Function of Space Keys

The screenshot shows the Revit ribbon with the 'Modify' tab selected, indicated by a yellow dashed box around its title. The 'Modify' tab contains several icons for modifying schedules and quantities. Below the ribbon is a schedule table with four columns labeled A, B, C, and D. Column A contains 'LS Function of Space\_Key'. Column B contains 'LS Occupant Load Factor\_Key'. Column C contains 'LS OL Factor Net Gross Fixed\_Key'. Column D contains 'LS Code Source\_Key'. The table also includes rows for 'ACCESSORY STORAGE AREAS, MECHANICAL EQUIPMENT ROOM', '300', 'GROSS', and 'IBC 2012'.

<LS Function of Space Keys>			
A	B	C	D
Properties	Parameters	Columns	Rows
Titles & Headers			
LS Function of Space_Key	LS Occupant Load Factor_Key	LS OL Factor Net Gross Fixed_Key	LS Code Source_Key
ACCESSORY STORAGE AREAS, MECHANICAL EQUIPMENT ROOM	300	GROSS	IBC 2012

# Areas & Function of Space

<LS Area Schedule>									
A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level									
Area	(none)				1,588 SF		<input checked="" type="checkbox"/>		
					1,588 SF				
					1,588 SF				

User  
Driven  
Input

Dynamo  
Driven  
Input

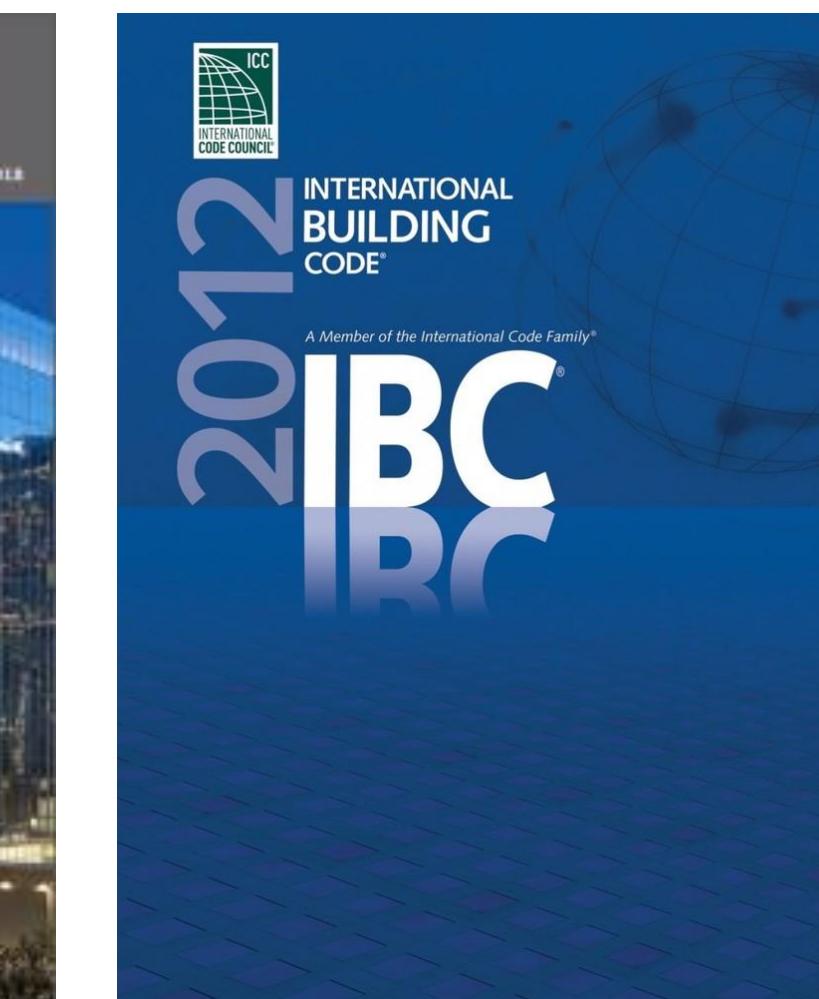
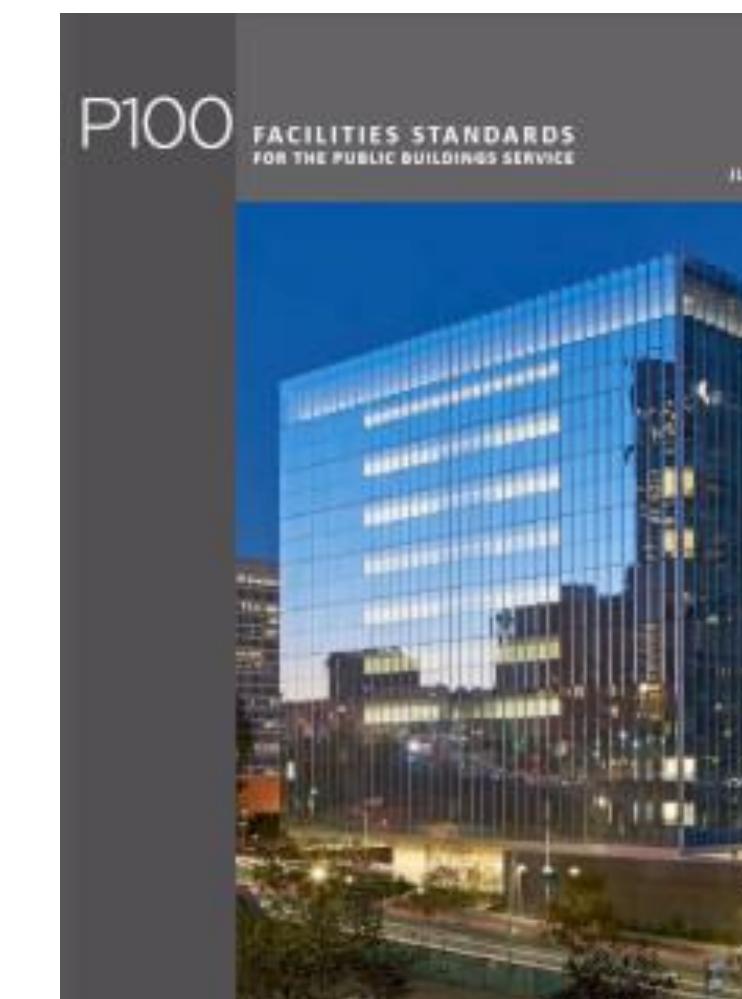
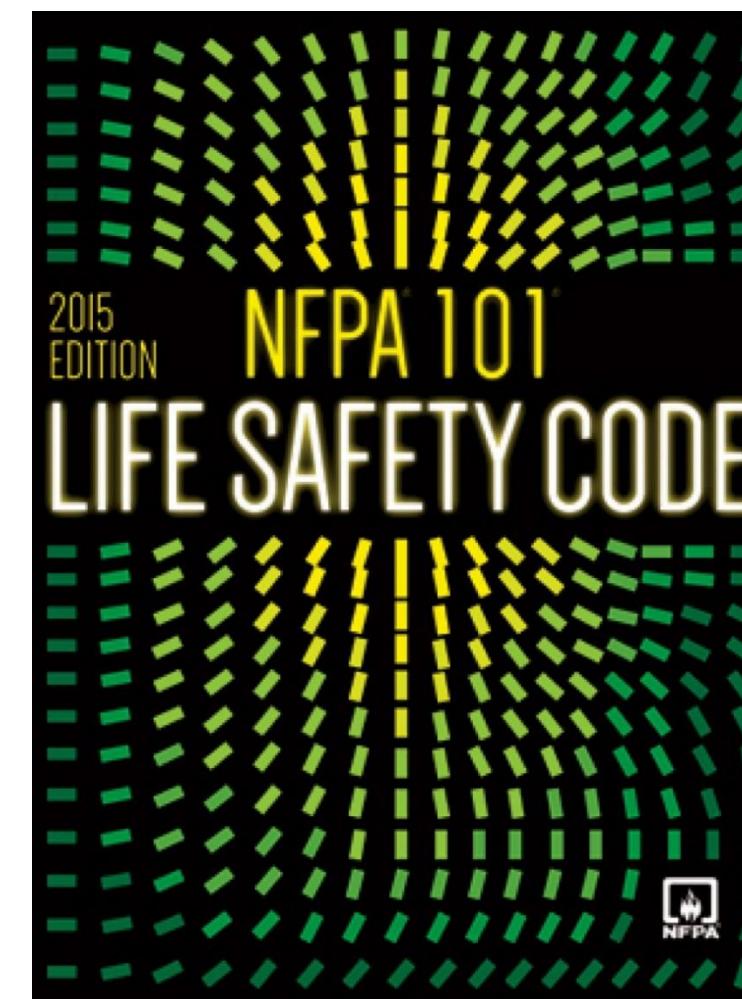
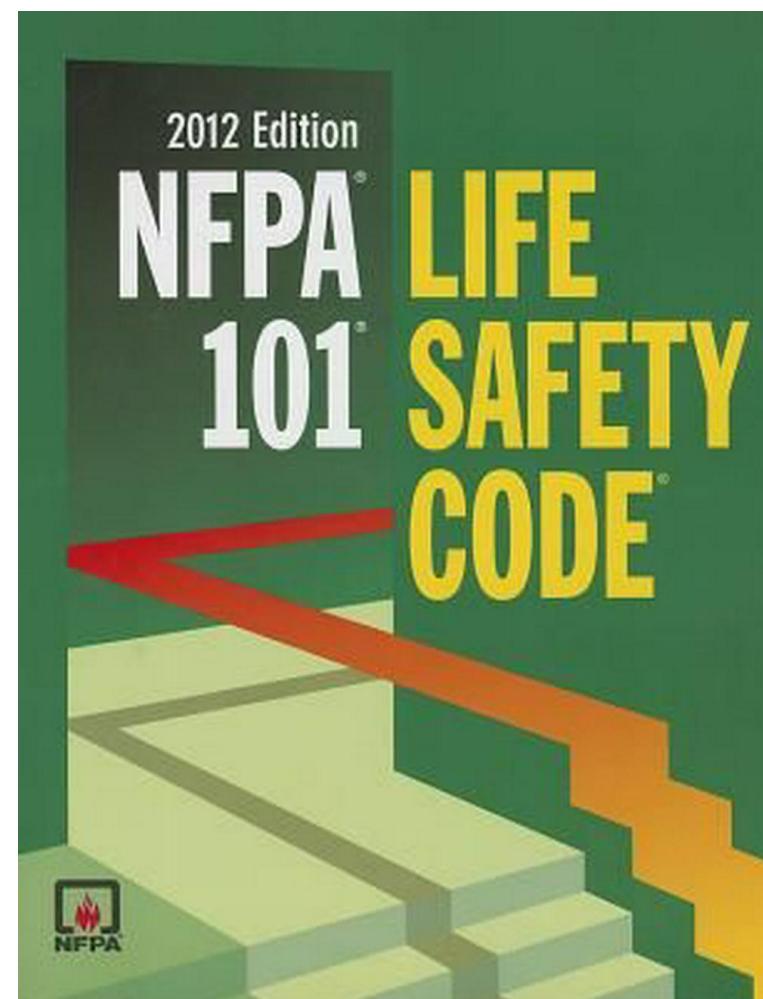
Key  
Schedule  
Values

Calculated  
Value  
(Formula)

# Various Code Sources & Versions

When it comes to codes there are various – sources, versions or code years, etc.

So what do you do: Build one code into your template? All codes? No codes?



# Area Schedule – Function of Space Keys

The screenshot shows the Revit ribbon with the **Manage** tab selected (highlighted with a yellow dashed box). Below the ribbon, a table titled **<LS Function of Space Keys>** is displayed with four columns (A, B, C, D) containing the following text:

A	B	C	D
LS Function of Space_Key	LS Occupant Load Factor_Key	LS OL Factor Net Gross Fixed_Key	LS Code Source_Key

To the right of the table, a **Dynamo Player** window is open, also highlighted with a yellow dashed box. The window lists three items:

- Area Boundaries\_From Room Boundaries (Ready)
- LS\_Copy Occupant Load Factors (Ready)
- LS\_Set Up Function Of Space Key (Ready)

The bottom of the window shows the file path: **rac\_advanced\_sample\_project.rvt**.

# Function of Space & Dynamo

	A	B	C	D	E	F
1	LS Function of Space	LS Occupant Load Factor	LS OLF Gross-Net-Fixed	Code Source		
2	Accessory Mechanical and Storage Areas	300		gsf	IBC 2018, Table 1004	
3	Assembly Use - Commercial Kitchens	100		gsf	NFPA 101, Table 7.3.1.2	
4	Assembly Use - Concentrated	7		nsf	NFPA 101, Table 7.3.1.2	
5	Assembly Use - Exercise Rooms with Equipment	50		gsf	NFPA 101, Table 7.3.1.2	
6	Assembly Use - Exercise Rooms without Equipment	15		gsf	NFPA 101, Table 7.3.1.2	
7	Assembly Use - Exhibits Galleries and Museums	30		nsf	IBC 2018, Table 1004	
8	Assembly Use - Fixed Seating	0		Fixed	NFPA 101, Table 7.3.1.2	
9	Assembly Use - Library Reading Rooms	50		nsf	NFPA 101, Table 7.3.1.2	
10	Assembly Use - Library Stack Areas	100		gsf	NFPA 101, Table 7.3.1.2	
11	Assembly Use - Locker Rooms	50		gsf	IBC 2018, Table 1004	
12	Assembly Use - Stages and Platforms	15		nsf	NFPA 101, Table 7.3.1.2	
13	Assembly Use - Standing Space	3		nsf	NFPA 101, Table 7.3.1.2	
14	Assembly Use - Unconcentrated	15		nsf	NFPA 101, Table 7.3.1.2	
15	Business Use - Concentrated	50		gsf	NFPA 101, Table 7.3.1.2	
16	Business Use - General	100		gsf	NFPA 101, Table 7.3.1.2	
17	Educational Use - Classrooms	20		nsf	NFPA 101, Table 7.3.1.2	
18	Educational Use - Shops and Laboratories	50		nsf	NFPA 101, Table 7.3.1.2	
19	Health Care Use - Inpatient Sleeping	120		gsf	NFPA 101, Table 7.3.1.2	
20	Health Care Use - Inpatient Treatment	240		gsf	NFPA 101, Table 7.3.1.2	
21	Health Care Use - Outpatient/Ambulatory Care	100		gsf	NFPA 101, Table 7.3.1.2	
22	Industrial Use	100		gsf	NFPA 101, Table 7.3.1.2	
23	Mercantile Use - Sales Area on Floors Above Street Floor	60		gsf	NFPA 101, Table 7.3.1.2	
24	Mercantile Use - Sales Area on or Below Street Floor	30		gsf	NFPA 101, Table 7.3.1.2	
25	Mercantile Use - Sales Area on Two or More Street Floors	40		gsf	NFPA 101, Table 7.3.1.2	
26	Mercantile Use - Storage, Stock, and Shipping Areas	300		gsf	NFPA 101, Table 7.3.1.2	
27	Parking Garage	200		gsf	IBC 2018, Table 1004	
28	Unoccupied	0		N/A	N/A	



IBC 2012

IBC 2015

IBC 2018

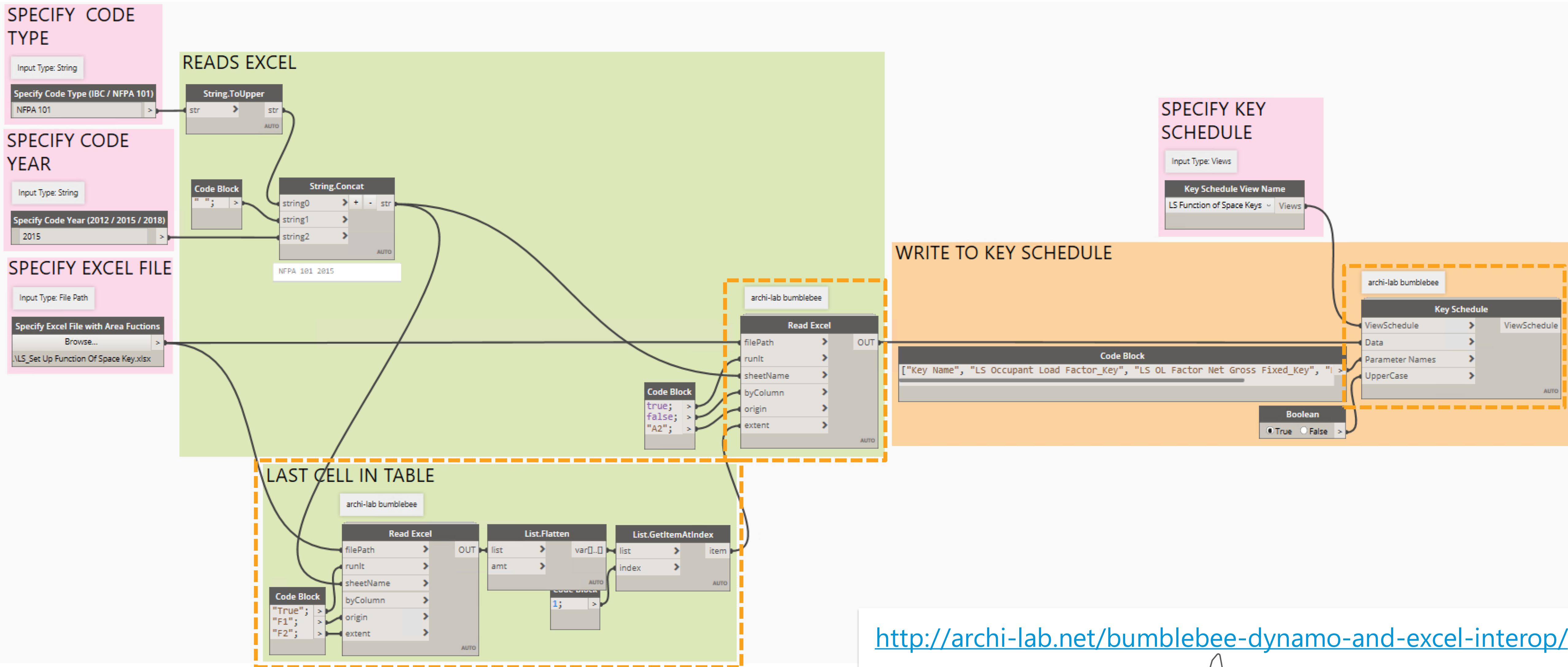
NFPA 101 2012

NFPA 101 2015

NFPA 101 2018



# Function of Space & Dynamo



<http://archi-lab.net/bumblebee-dynamo-and-excel-interop/>

# Areas & Function of Space

<LS Area Schedule>									
A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level									
Area	(none)				1,588 SF	<input checked="" type="checkbox"/>	1,588 SF	1,588 SF	

User  
Driven  
Input

Dynamo  
Driven  
Input

Key  
Schedule  
Values

Calculated  
Value  
(Formula)

# Areas

<LS Area Schedule>									
A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level									
Area	ACCESSORY MECHANICAL AND	IBC 2018, TABLE 1004	300.0		GSF	1,588 SF		<input checked="" type="checkbox"/>	

User  
Driven  
Input

Dynamo  
Driven  
Input

Key  
Schedule  
Values

Calculated  
Value  
(Formula)

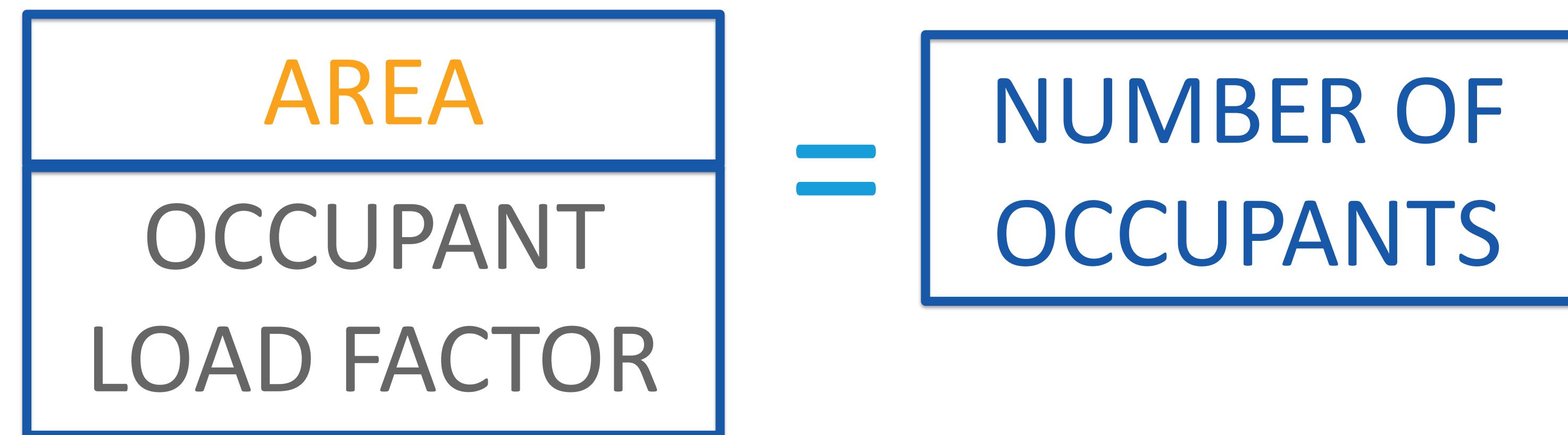
# NUMBER OF OCCUPANTS



## Number of Occupants

“For areas without fixed seating, the occupant load shall be not less than that number determined by **dividing the floor area under consideration by the occupant load factor assigned to the function of space** as set forth in Table 1004.1.2.”

– International Building Code, Section 1004



## Number of Occupants

roundup 
$$\left( \frac{\text{AREA /1sf}}{\text{OCCUPANT LOAD FACTOR}} \right) = \text{NUMBER OF OCCUPANTS} \right)$$

Area (or square feet) needs to be converted to a number.

The number of occupants must be an integer (or a whole number; we cannot have part of a person), therefore, we round up the value.

# Number of Occupants

A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level									
Area	ACCESSORY MECHANICAL AND	IBC 2018, TABLE 1004	300.0		GSF	1,588 SF			

Schedule Properties

Fields Filter Sorting/Grouping Formatting Appearance

Select available fields from:

Areas

Available fields:

- Area Type
- Comments
- Count
- IfcGUID
- Image
- Number
- Perimeter

Scheduled fields (in order):

- Level
- Name
- LS Occupancy Class Name
- LS Occupancy Class Abbreviation
- LS Function of Space\_Key
- LS Code Source\_Key
- LS Occupant Load Factor\_Key
- LS Occupant Load Factor
- LS OL Factor Net Gross Fixed\_Key
- Area
- Occupant Load
- LS Fixed Occupant Load
- LS Fixed Occupant Load Override

OK Cancel Help

Include elements in links

Calculated Value

Name: Occupant Load

Formula Percentage

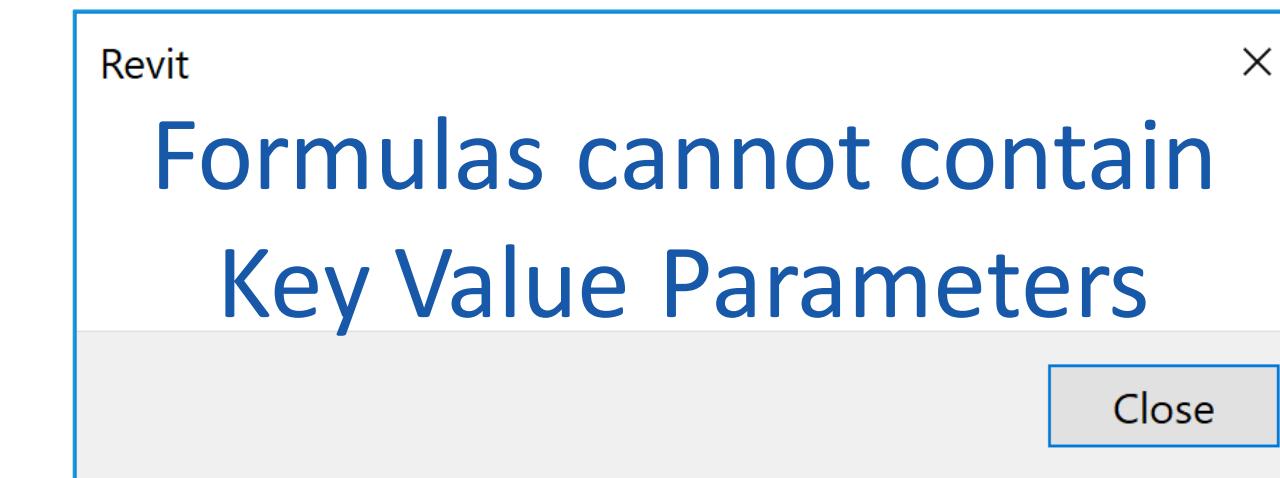
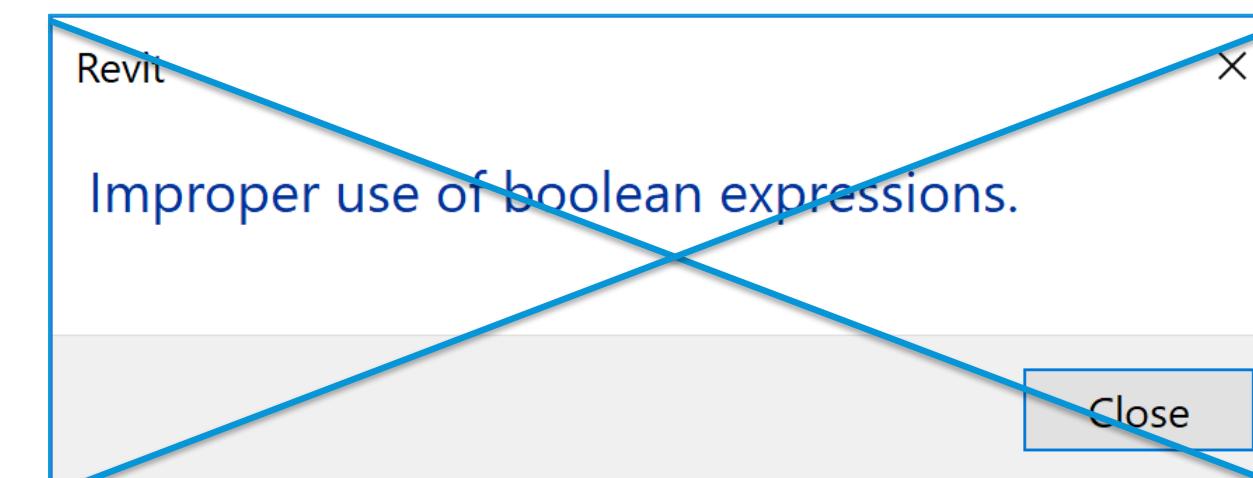
Discipline: Common

Type: Number

Formula: roundup((Area/1sf)/LS Occupant Load Factor\_Key)

OK Cancel Help

roundup((Area/1sf)/LS Occupant Load Factor\_Key)



# Number of Occupants

**<LS Area Schedule>**

A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level	ASSEMBLY USE - CONCENTRATED	NFPA 101, TABLE 7.3.1, 7.0		NSF		1,648 SF			
Area									

Schedule Properties

Fields Filter Sorting/Grouping Formatting Appearance

Select available fields from:

Areas

Available fields:

- Area Type
- Comments
- Count
- IfcGUID
- Image
- Number
- Perimeter

Scheduled fields (in order):

- Level
- Name
- LS Occupancy Class Name
- LS Occupancy Class Abbreviation
- LS Function of Space\_Key
- LS Code Source\_Key
- LS Occupant Load Factor\_Key
- LS Occupant Load Factor
- LS OL Factor Net Gross Fixed\_Key
- Area
- Occupant Load
- LS Fixed Occupant Load
- LS Fixed Occupant Load Override

**Calculated Value**

Name: Occupant Load

Formula Percentage

Discipline: Common

Type: Number

Formula: `roundup((Area/1sf)/LS Occupant Load Factor)`

OK Cancel Help

**roundup((Area/1sf)/LS Occupant Load Factor)**

Include elements in links

OK Cancel Help

# Occupant Load Factor & Dynamo

Screenshot of the Revit ribbon interface showing the "Modify Schedule/Quantities" tab selected. The "Dynamo" icon in the Visual Programming group is highlighted with a dashed orange box.

The "LS Area Schedule" table is displayed below the ribbon:

A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level									
Area	ASSEMBLY USE - CONCENTRAT	NFPA 101, TABLE 7.3.1	7.0	NSF		1,588 SF	<input checked="" type="checkbox"/>		
						1,588 SF		1,588 SF	

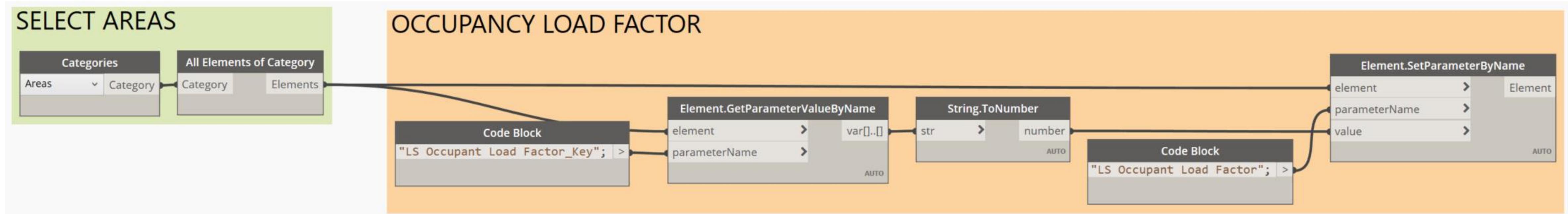
A "Dynamo Player" window is open in the bottom-left corner, showing three available scripts:

- Area Boundaries\_From Room Boundaries (Ready)
- LS\_Copy Occupant Load Factors (Ready)
- Run script Up Function Of Space Key (Ready)

The file path "rac\_advanced\_sample\_project.rvt" is visible at the bottom of the window.

# Occupant Load Factor & Dynamo

<b>&lt;LS Area Schedule&gt;</b>									
A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level									
Area	ASSEMBLY USE - CONCENTRAT	NFPA 101, TABLE 7.3.1	7.0	7	NSF	1,588 SF	227	0	0



# FIXED SEATING



## Number of Occupants

"For areas having fixed seats and aisles, the occupant load shall be determined by the number of fixed seats installed therein."

– International Building Code, Section 1004

FIXED SEAT  
COUNT

=

NUMBER OF  
OCCUPANTS

# Fixed Occupants

**<LS Area Schedule>**

A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level	ASSEMBLY USE - FIXED SEATING	NFPA 101, TABLE 7.3.1.0.0		0	FIXED	1,588 SF	250	<input checked="" type="checkbox"/>	250

Schedule Properties

Fields Filter Sorting/Grouping Formatting Appearance

Select available fields from:

Areas

Available fields:

- Area Type
- Comments
- Count
- IfcGUID
- Image
- Number
- Perimeter

Scheduled fields (in order):

- Level
- Name
- LS Occupancy Class Name
- LS Occupancy Class Abbreviation
- LS Function of Space\_Key
- LS Code Source\_Key
- LS Occupant Load Factor\_Key
- LS Occupant Load Factor
- LS OL Factor Net Gross Fixed\_Key
- Area
- Occupant Load
- LS Fixed Occupant Load
- LS Fixed Occupant Load Override

**Calculated Value**

Name: Occupant Load

Discipline: Common

Type: Number

Formula: `roundup(if(LS Fixed Occupant Load, LS Fixed Occupant Load Override, (Area / 1 SF) / LS Occupant Load Factor))`

OK Cancel Help

**roundup(if(LS Fixed Occupant Load,  
LS Fixed Occupant Load Override,  
(Area / 1 SF) / LS Occupant Load Factor))**

# Fixed Occupants & Dynamo

Screenshot of the Revit interface showing the "Modify Schedule/Quantities" tab selected. The "Dynamo" icon in the ribbon is highlighted with a dashed orange box.

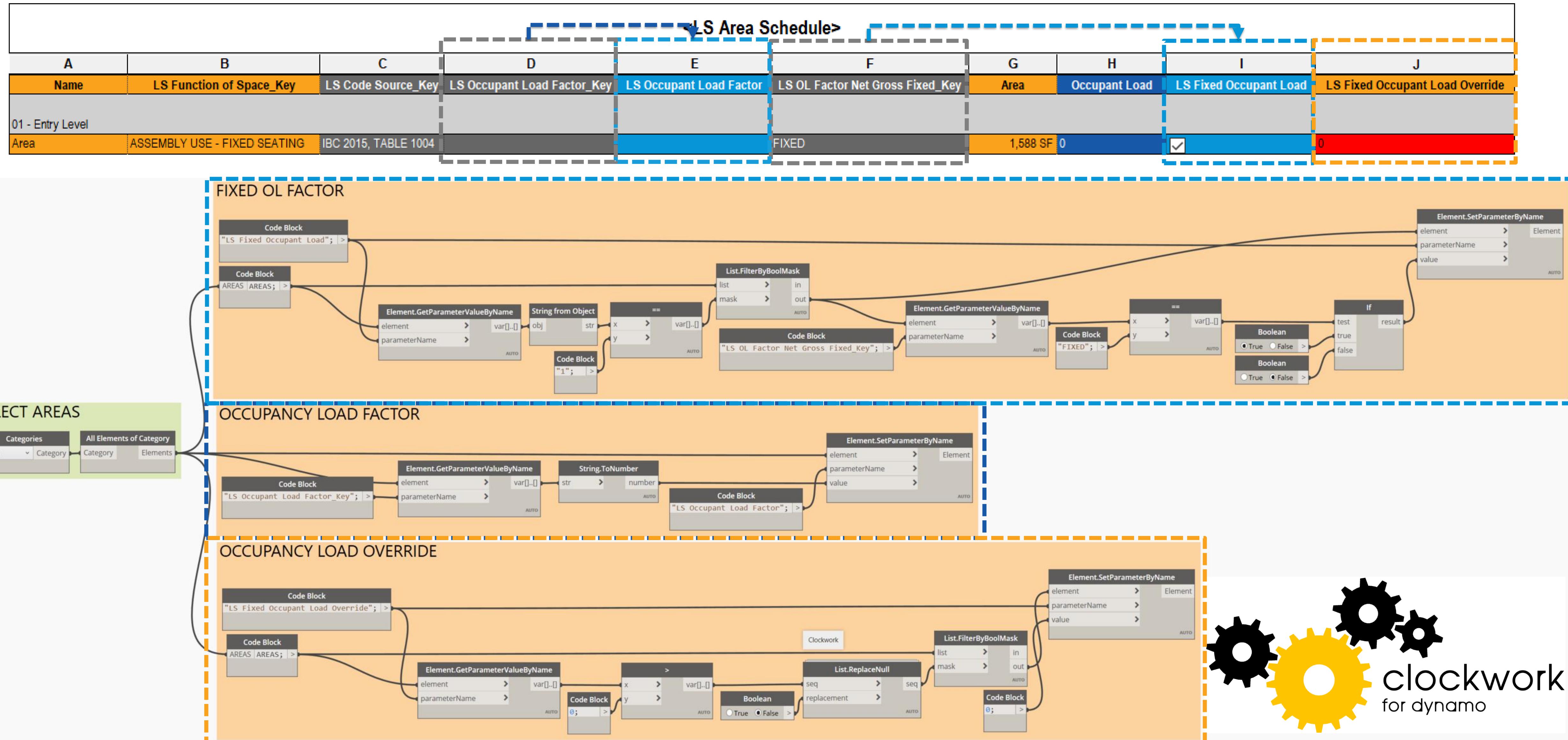
The main window displays the "<LS Area Schedule>" table:

A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level									
Area	ASSEMBLY USE - CONCENTRAT	NFPA 101, TABLE 7.3.1.7.0		7	NSF	1,588 SF	227		0
						1,588 SF			1,588 SF

The "Dynamo Player" panel is open at the bottom left, showing three available nodes:

- Area Boundaries\_From Room Boundaries (Ready)
- LS\_Copy Occupant Load Factors (Ready)
- LS\_Set Up Function Of Space Key (Ready)

# Fixed Occupants & Dynamo



# Fixed Occupants & Conditional Formatting

**<LS Area Schedule>**

A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level									
Area	ASSEMBLY USE - FIXED SEATING	IBC 2015, TABLE 1004		FIXED	1,588 SF	0	<input checked="" type="checkbox"/>	0	0

**Schedule Properties**

Fields: **LS Fixed Occupant Load Override**

Formatting tab selected.

Fields:

- Level
- Name
- LS Occupancy Class Name
- LS Occupancy Class Abbreviation
- LS Function of Space\_Key
- LS Code Source\_Key
- LS Occupant Load Factor\_Key
- LS Occupant Load Factor
- LS OL Factor Net Gross Fixed\_Key
- Area
- Occupant Load
- LS Fixed Occupant Load**
- LS Fixed Occupant Load Override**

Condition:

Condition

Field: LS Fixed Occupant Load  
Test: Equal To  
Value: 0  
and  
10000

Conditions to Use:

LS Fixed Occupant Load Override == 0  
and LS Fixed Occupant Load == Yes

Background Color: Red

OK Cancel Help

**User Driven Input**

**Dynamo Driven Input**

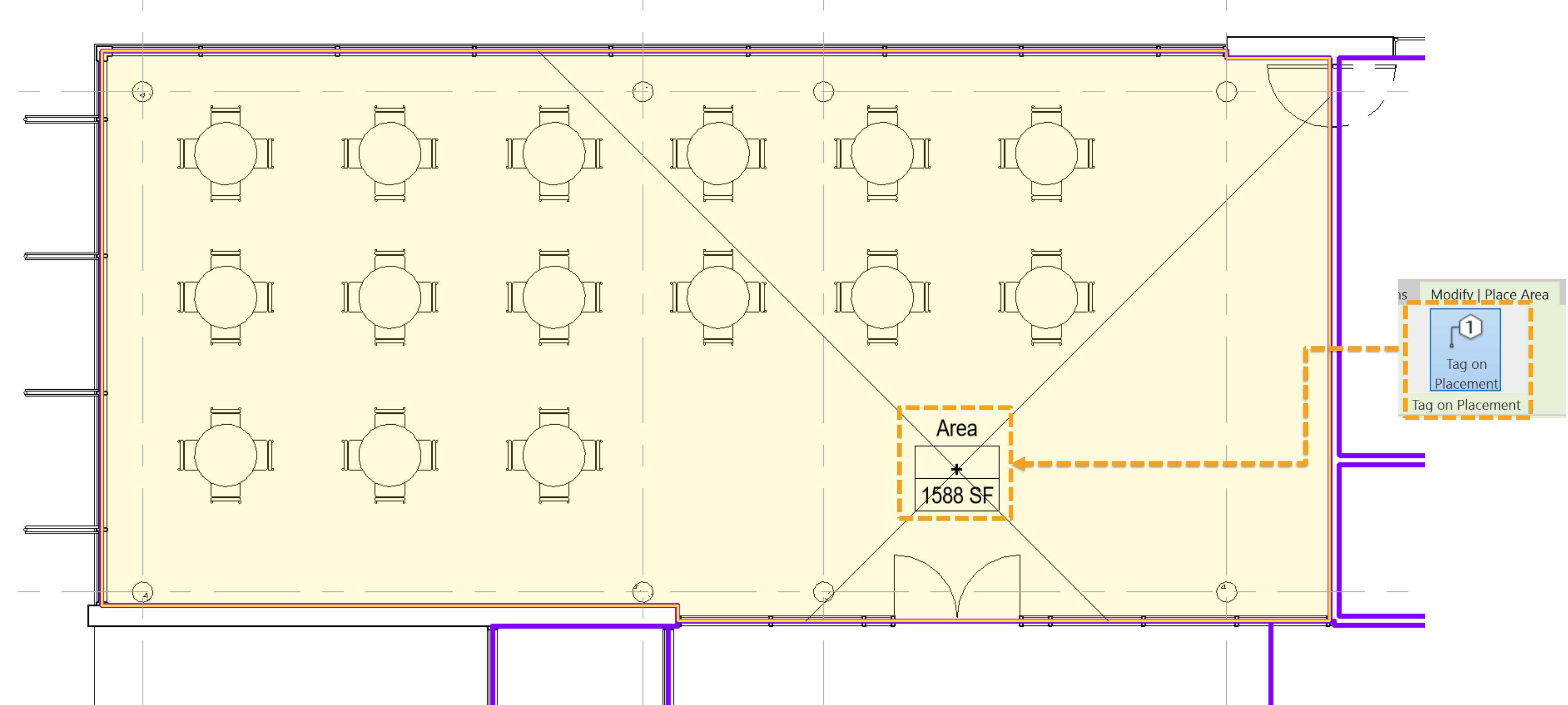
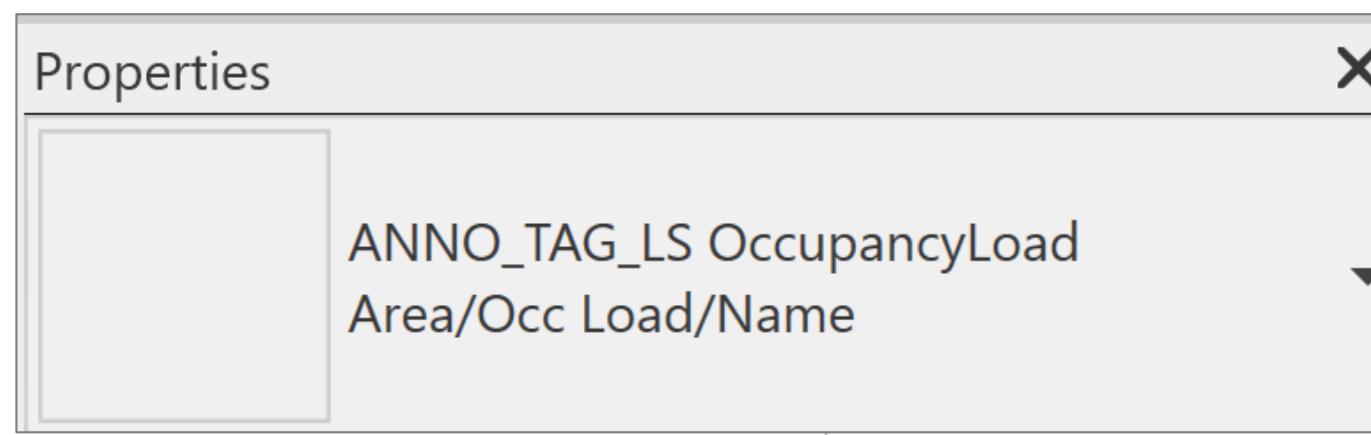
**Key Schedule Values**

**Calculated Value (Formula)**

# AREA TAGS



# Area Tag



## Area Tag

Area

250
1588 SF



NAME

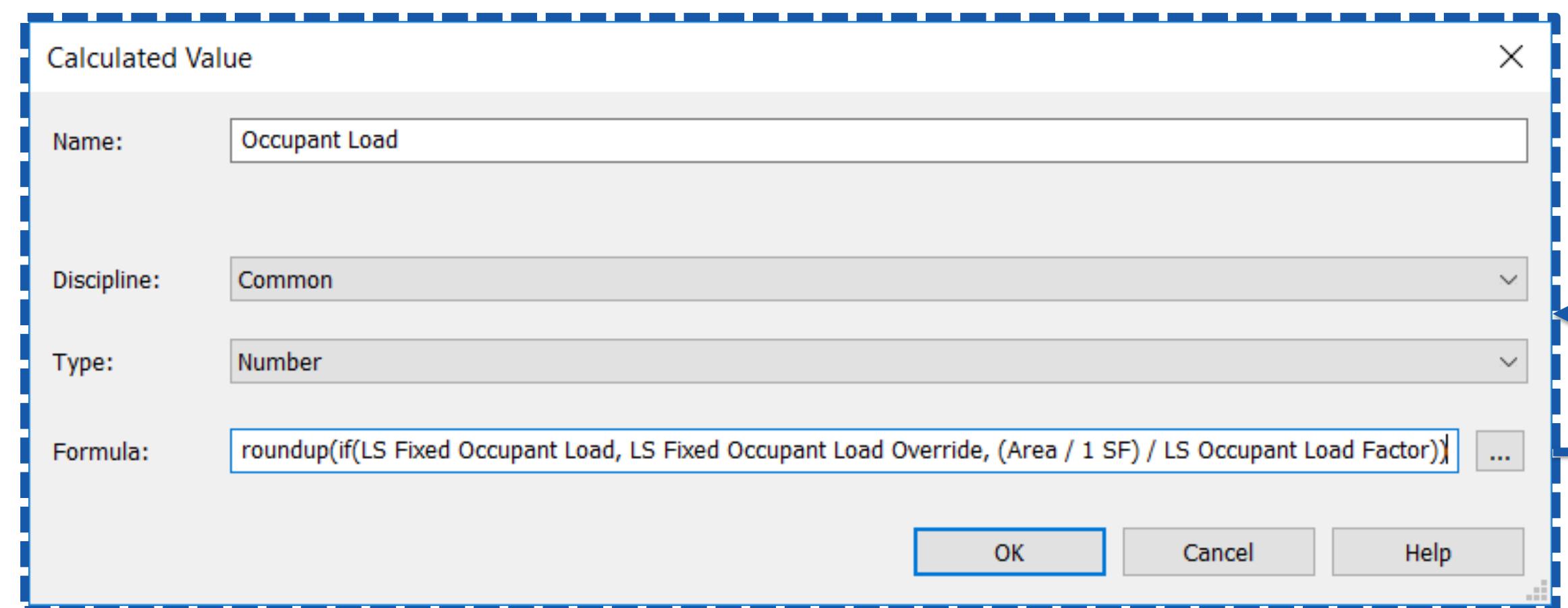
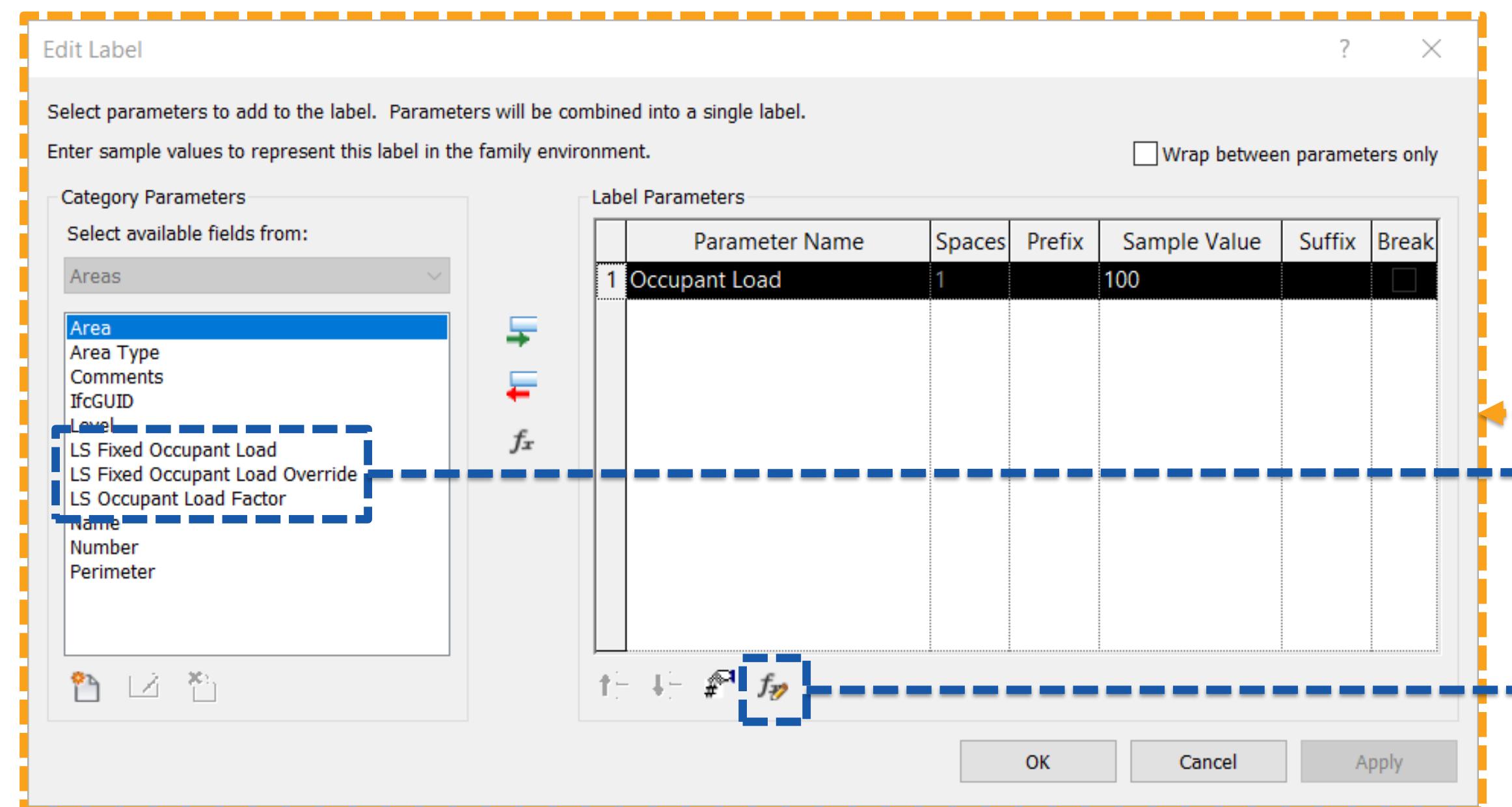
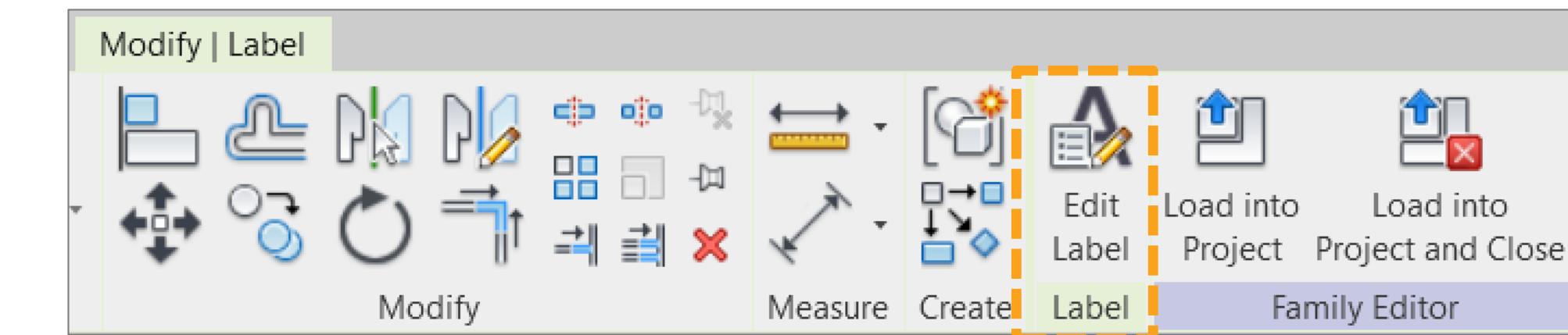
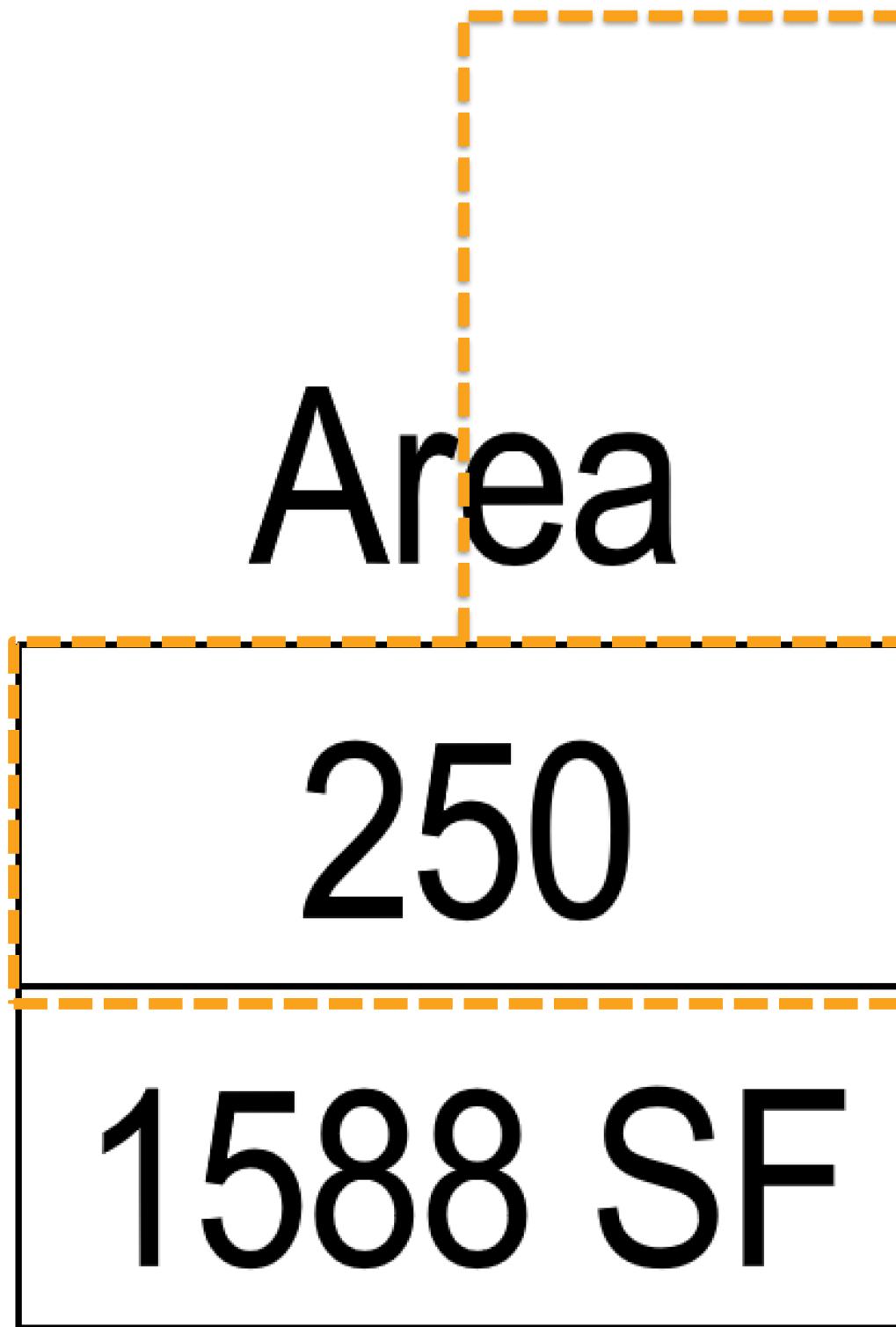


NUMBER OF OCCUPANTS



AREA

# Area Tag



Must be Shared parameters

roundup(if(LS Fixed Occupant Load,  
LS Fixed Occupant Load Override,  
(Area / 1 SF) / LS Occupant Load Factor))

# THE WORKFLOW IN ACTION

The background features a large, abstract blue shape that resembles a stylized mountain or a series of overlapping layers. This shape is composed of numerous thin, light-blue lines that create a sense of depth and motion. In the foreground, there is a dark blue triangular area with white internal lines forming a mesh or grid pattern, similar to a solar panel or a technical diagram.

Autodesk Revit 2019 - rac\_advanced\_sample\_project.rvt - Area Plan (Life Safety): 01 - Entry Level

Type a keyword or phrase

File Architecture Structure Systems Insert Annotate Analyze Massing & Site Collaborate View Manage Add-Ins Modify CTC IMAGINiT SmithGroup Revolution Design Ideate Software

Modify Wall Door Window Component Column Roof Ceiling Floor Curtain Mullion System Grid Railing Ramp Stair Model Text Line Model Group Room Room Separator Tag Room Area Area Boundary Tag Area By Face Shaft Wall Vertical Dormer Level Grid Set Show Ref Plane Datum Work Plane

Select Build Circulation Model Room & Area Opening Datum Work Plane

Project Browser - rac\_advanced\_sample\_project.rvt X LS Area Schedule X 01 - Entry Level X

Views (all)  
Floor Plans  
Ceiling Plans  
3D Views  
Elevations (Building Elevation)  
Sections (Building Section)  
Sections (Wall Section)  
Detail Views (Detail)  
Renderings  
Drafting Views (Detail)  
Walkthroughs  
Area Plans (Gross Building)  
Area Plans (Life Safety)  
01 - Entry Level  
Legends  
Schedules/Quantities (all)  
Area Schedule (Gross Building)  
Door Schedule  
Furniture Schedule  
Hardware Schedule  
Landscape Schedule  
LS Area Schedule  
LS Function of Space Keys  
Mass Floor Schedule  
Parking Schedule  
Room Finish Schedule  
Sheets (all)  
A1 - Floor Plan  
A2 - Sections  
Families  
Groups  
Revit Links

Properties X Area Plan Life Safety

Area Plan: 01 - Entry Level Edit Type

Graphics View Scale Custom  
Scale Value 1: 100  
Display Model Normal  
Detail Level Coarse  
Parts Visibility Show Original  
Visibility/Graphics Ov... Edit...  
Graphic Display Opti... Edit...  
Orientation By Scope Box  
Wall Join Display Clean all wall joins  
Discipline Architectural  
Show Hidden Lines By Discipline  
Color Scheme Location Background  
Color Scheme <none>  
System Color Schemes Edit...  
Default Analysis Disp... None  
Sun Path   
Underlay Range: Base Level None  
Range: Top Level Unbounded  
Underlay Orientation Look down  
Extents Crop View   
Crop Region Visible   
Properties help Apply

LS Area Schedule <LS Area Schedule>

A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override

LS Function of Space Keys <LS Function of Space Keys>

A	B	C	D
LS Function of Space_Key	LS Occupant Load Factor_Key	LS OL Factor Net Gross Fixed_Key	LS Code Source_Key

01 - Entry Level X

Dynamo Player

- Area Boundaries\_From Room Boundaries Ready
- LS\_Copy Occupant Load Factors Ready
- LS\_Set Up Function Of Space Key Ready

rac\_advanced\_sample\_project.rvt

1 : 100 Main Model

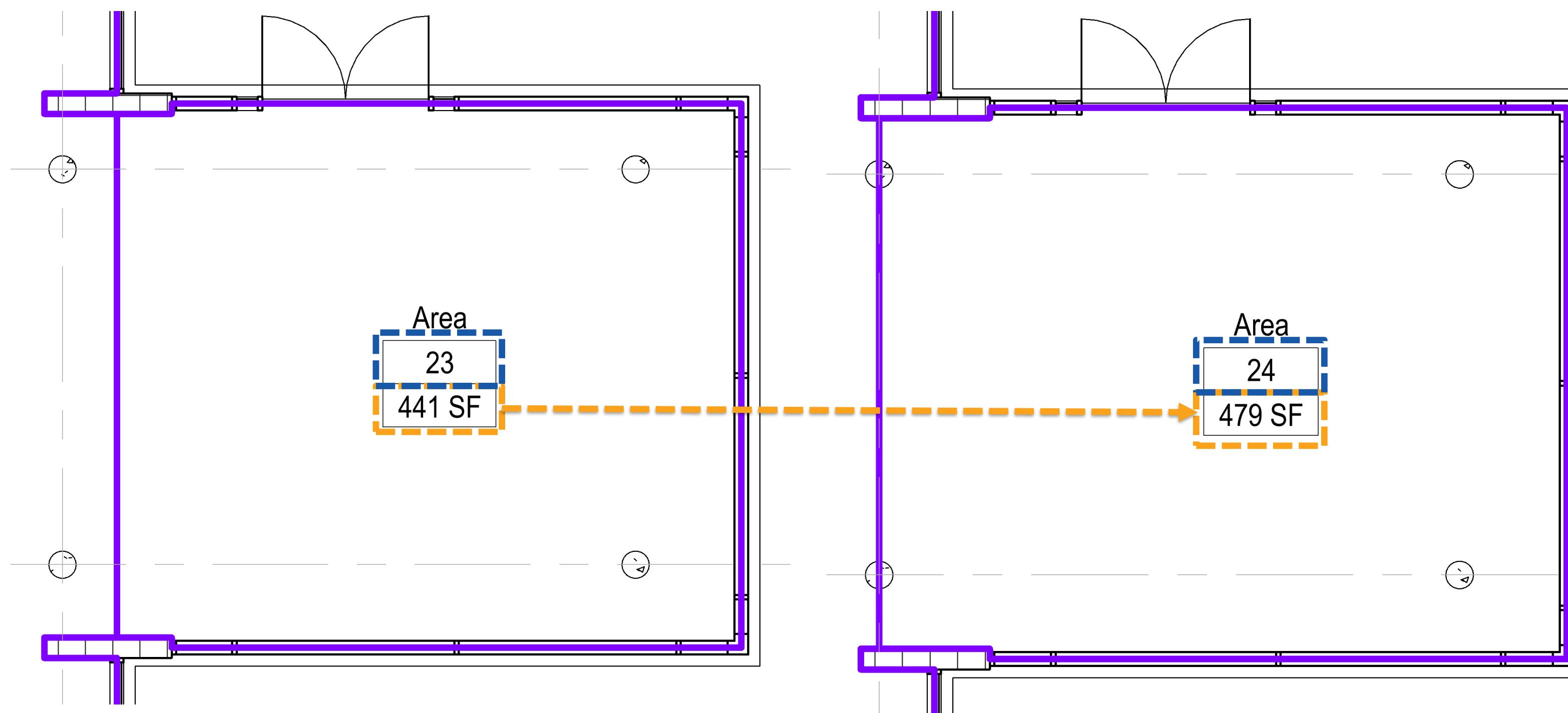
Click to select, TAB for alternates, CTRL adds, SHIFT unselects.

# DEALING WITH CHANGES



# Scenario 1 – SF / Area Boundaries Changes

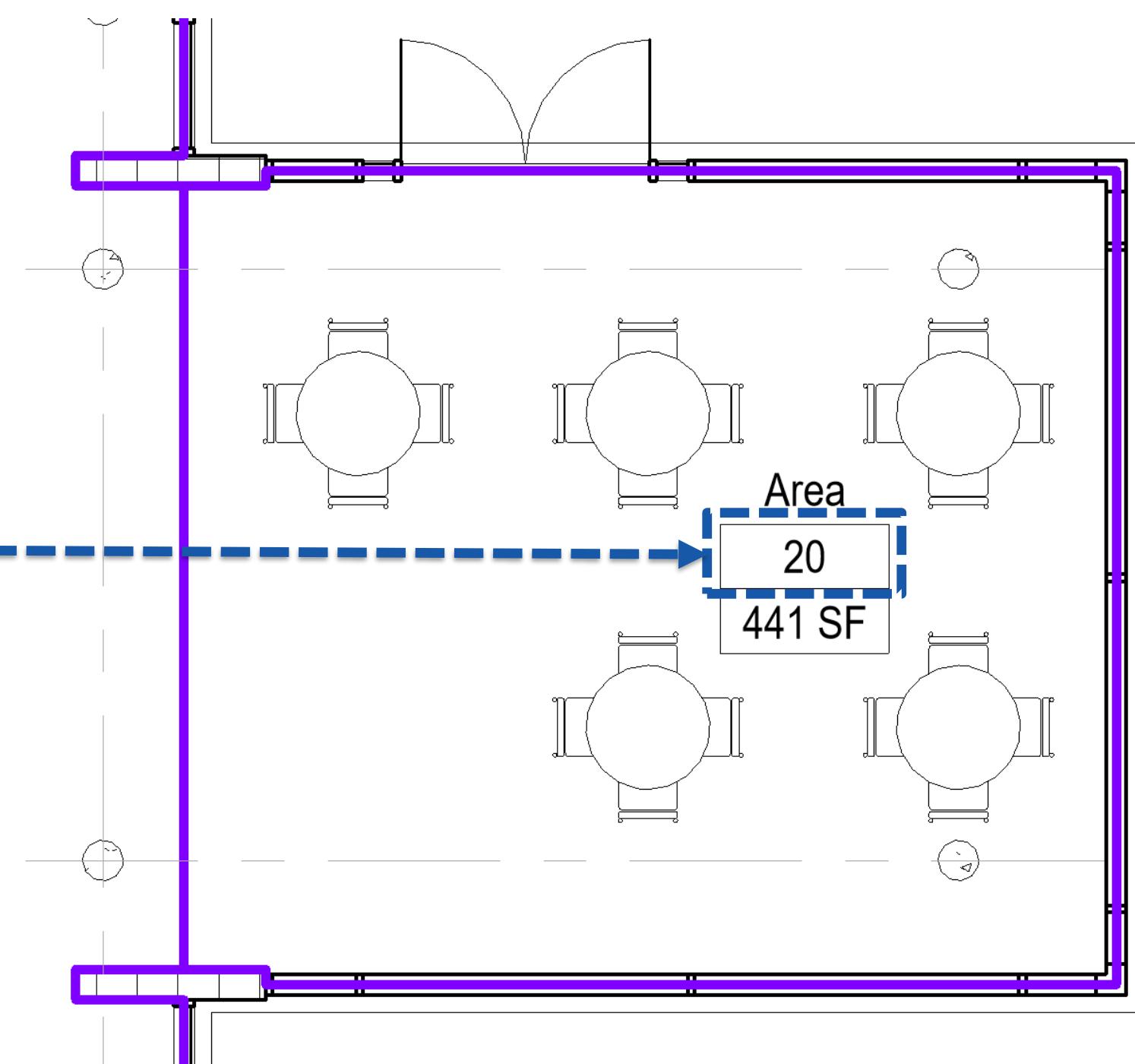
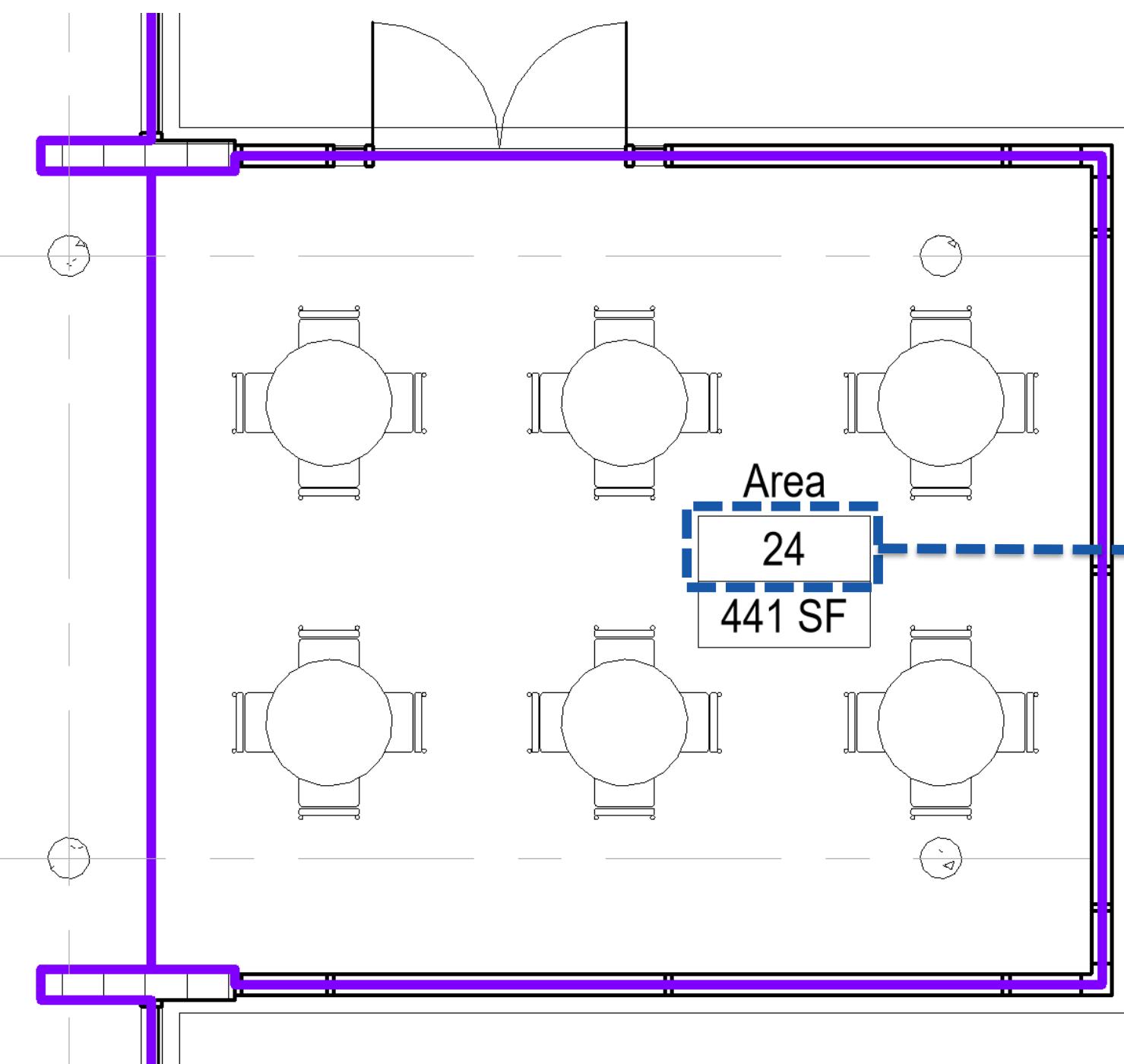
<LS Area Schedule>									
A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level									
Area	ASSEMBLY USE - CONCENTRATED	IBC 2015, TABLE 1004	7.0	20	NSF	441 SF	23	0	0
Area	ASSEMBLY USE - CONCENTRATED	IBC 2015, TABLE 1004	7.0	20	NSF	479 SF	24	0	0



roundup(if(LS Fixed Occupant Load,  
LS Fixed Occupant Load Override,  
(Area / 1 SF) / LS Occupant Load Factor))

## Scenario 2 – “LS Fixed Occupant Load Overide” Changes

<LS Area Schedule>									
A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level									
Area	ASSEMBLY USE - FIXED SEATING	IBC 2015, TABLE 1004		FIXED		441 SF	24	<input checked="" type="checkbox"/>	24
Area	ASSEMBLY USE - FIXED SEATING	IBC 2015, TABLE 1004		FIXED		441 SF	20	<input checked="" type="checkbox"/>	20



roundup(if(LS Fixed Occupant Load,  
LS Fixed Occupant Load Override,  
(Area / 1 SF) / LS Occupant Load Factor))

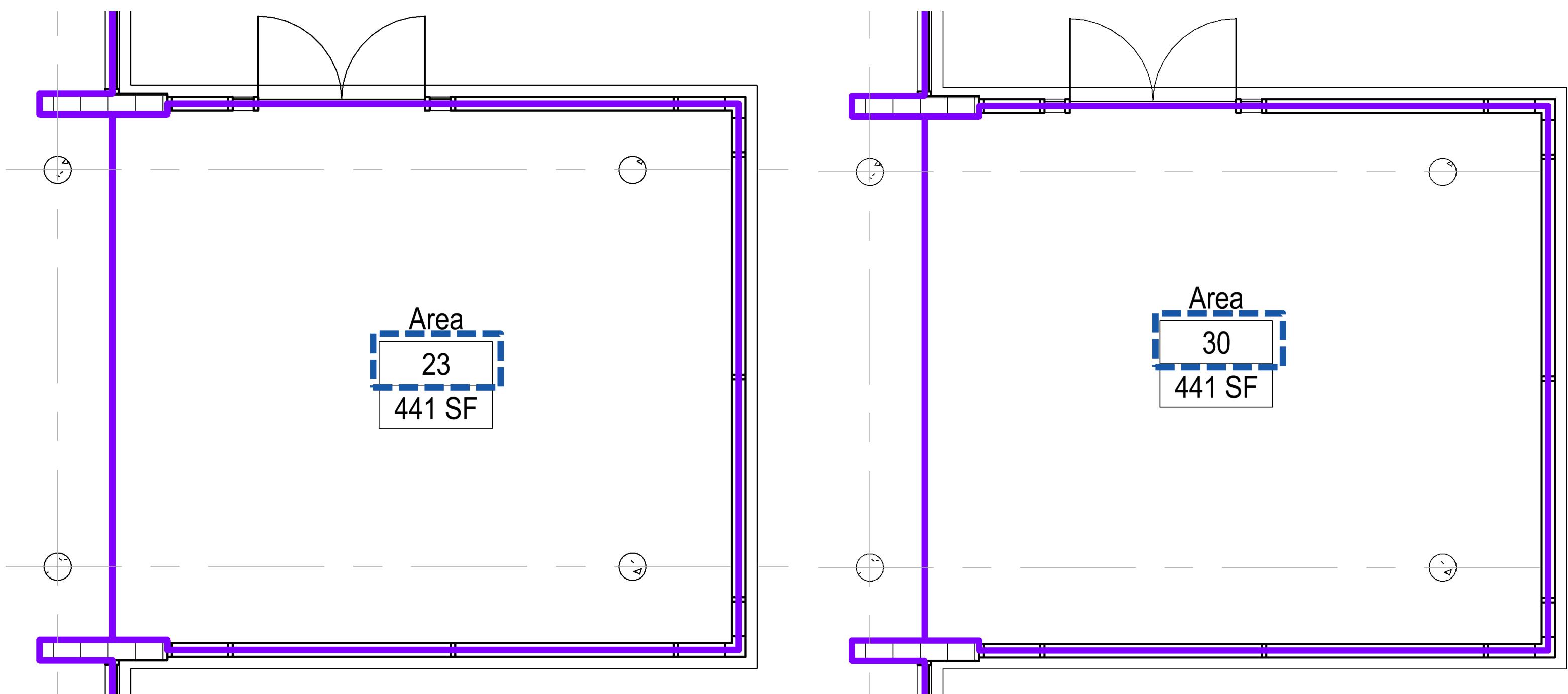
## Scenario 3 – “LS Function of Space” Changes

<LS Function of Space Keys>			
A	B	C	D
LS Function of Space_Key	LS Occupant Load Factor_Key	LS OL Factor Net Gross Fixed_Key	LS Code Source_Key
ACCESSORY MECHANICAL AND STORAGE AREAS	300.0	GSF	IBC 2015, TABLE 1004
ASSEMBLY USE - COMMERCIAL KITCHENS	200.0	GSF	IBC 2015, TABLE 1004
ASSEMBLY USE - CONCENTRATED	7.0	NSF	IBC 2015, TABLE 1004
ASSEMBLY USE - EXERCISE ROOMS	50.0	GSF	IBC 2015, TABLE 1004
ASSEMBLY USE - EXHIBITS GALLERIES AND MUSEUMS	30.0	NSF	IBC 2015, TABLE 1004
ASSEMBLY USE - FIXED SEATING		FIXED	IBC 2015, TABLE 1004
ASSEMBLY USE - LIBRARY READING ROOMS	50.0	NSF	IBC 2015, TABLE 1004
ASSEMBLY USE - LIBRARY STACK AREAS	100.0	GSF	IBC 2015, TABLE 1004
ASSEMBLY USE - STAGES AND PLATFORMS	15.0	NSF	IBC 2015, TABLE 1004
ASSEMBLY USE - STANDING SPACE	5.0	NSF	IBC 2015, TABLE 1004
ASSEMBLY USE - UNCONCENTRATED	15.0	NSF	IBC 2015, TABLE 1004

# Scenario 3 – “LS Function of Space” Changes

**<LS Area Schedule>**

A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level									
Area	ASSEMBLY USE - CONCENTRATED	IBC 2015, TABLE 1004	7.0	7	NSF	441 SF	64	0	0
Area	ASSEMBLY USE - CONCENTRATED	IBC 2015, TABLE 1004	15	7	NSF	441 SF	64	0	0
Area	ASSEMBLY USE - CONCENTRA	IBC 2015, TABLE 1004	15	15	NSF	441 SF	30	0	0

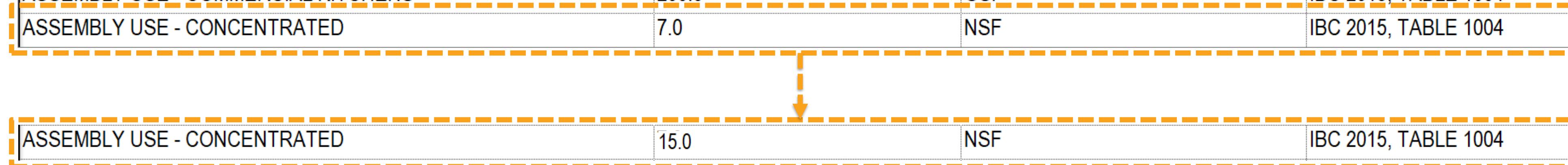


**Dynamo Player**

- Area Boundaries\_From Room Boundaries Ready
- LS\_Copy Occupant Load Factors Ready
- LS\_Set Up Function Of Space Key Ready

rac\_advanced\_sample\_project.rvt

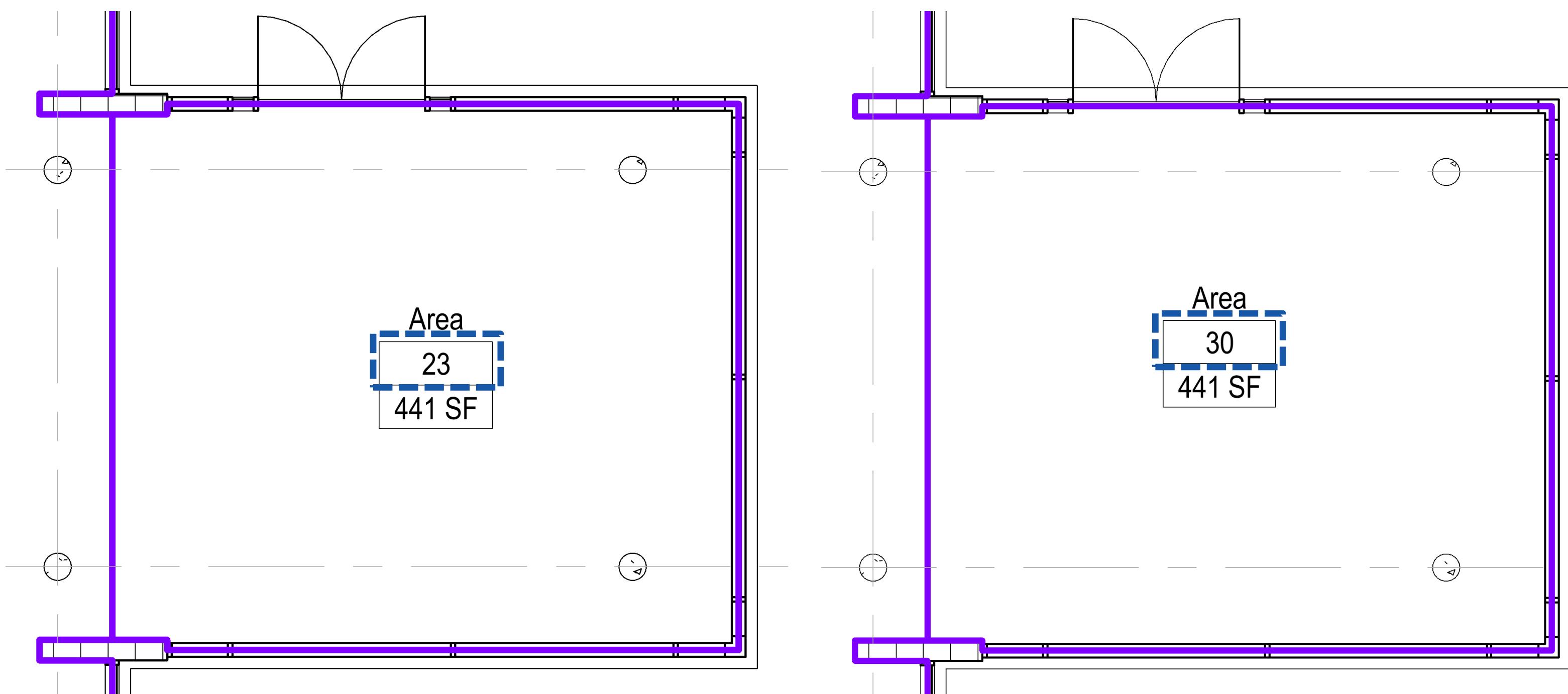
## Scenario 4 – “LS Occupant Load Factor\_Key” Changes

<LS Function of Space Keys>			
A	B	C	D
LS Function of Space_Key	LS Occupant Load Factor_Key	LS OL Factor Net Gross Fixed_Key	LS Code Source_Key
ACCESSORY MECHANICAL AND STORAGE AREAS	300.0	GSF	IBC 2015, TABLE 1004
ASSEMBLY USE - COMMERCIAL KITCHENS	200.0	GSF	IBC 2015, TABLE 1004
ASSEMBLY USE - CONCENTRATED	7.0	NSF	IBC 2015, TABLE 1004
			
ASSEMBLY USE - CONCENTRATED	15.0	NSF	IBC 2015, TABLE 1004

## Scenario 4 – “LS Occupant Load Factor\_Key” Changes

**<LS Area Schedule>**

A	B	C	D	E	F	G	H	I	J
Name	LS Function of Space_Key	LS Code Source_Key	LS Occupant Load Factor_Key	LS Occupant Load Factor	LS OL Factor Net Gross Fixed_Key	Area	Occupant Load	LS Fixed Occupant Load	LS Fixed Occupant Load Override
01 - Entry Level									
Area	ASSEMBLY USE - CONCENTRATED	IBC 2015, TABLE 1004	7.0	7	NSF	441 SF	64	0	0
Area	ASSEMBLY USE - CONCENTRATED	IBC 2015, TABLE 1004	15	7	NSF	441 SF	64	0	0
Area	ASSEMBLY USE - CONCENTRA	IBC 2015, TABLE 1004	15	15	NSF	441 SF	30	0	0



**Dynamo Player**

- Area Boundaries\_From Room Boundaries Ready
- LS\_Copy Occupant Load Factors Ready
- LS\_Set Up Function Of Space Key Ready

rac\_advanced\_sample\_project.rvt

# OCCUPANCY? AUTOMATED!



# What do I need to make this work in my Model?

- Area Scheme – “Life Safety”
- Area Schedules (Insert Views from File – Area Scheme Names must match exactly)
  - LS Area Schedule
  - LS Function of Space Keys
- Dynamo Packages
  - archi-lab.net (Konrad K Sobon)
  - archi-lab BumbleBee (Konrad K Sobon)
  - Clockwork for Dynamo 2.x (Andreas Dieckmann)
- Dynamo Scripts
  - Area Boundaries\_From Room Boundaries
  - LS\_Set Up Function of Space (and accompanying Excel File with Code Data)
  - LS\_Copy Occupant Load Factors
- Area Tag containing Calculated Value

# What do I need to make this work in my Model?

[https://drive.google.com/open?id=1QQo1xs9HHhIYyvSy1dNRI\\_yz\\_BXXqqhP](https://drive.google.com/open?id=1QQo1xs9HHhIYyvSy1dNRI_yz_BXXqqhP)

# QUESTIONS?

Don't forget the survey!

... I love comments 😊



Make anything<sup>TM</sup>

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