

An MEP Engineer's Guide to Dynamo

Andrew Duncan

Associate | BIM Development Manager
@AGDunc

Andrei Capraru

Mechanical Engineer

Class summary

People often associate Dynamo software with designing complex parametric geometry; but Dynamo software is not just a tool for creating funky shapes, it's a whiz at processing all kinds of data. This class will demonstrate various examples of how Dynamo software has been applied to common MEP (mechanical, electrical, and plumbing) engineering tasks to make them more efficient or more accurate. We will cover linking Revit Space naming utility information to Revit software families, using Dynamo software as an engine for MEP calculations, using Dynamo software to give you visual feedback on how hard equipment is being asked to work in your design, and using Microsoft Excel as a source of data for much of the above. You also needn't worry if you are completely new to Dynamo software (most MEP folk will be), as we will cover enough basics to get you going before we dive into the advanced stuff.

Key learning objectives

At the end of this class, you will:

- Know enough about Dynamo to get started on your own scripts
- Learn how to pull data from Excel into Revit via Dynamo to inform calculations
- Learn how to use Dynamo as an engine for performing MEP calculations such as determining heating loads or flow rates
- Learn how to link Revit Space information to Revit families for use in calculations

A little info about me ...

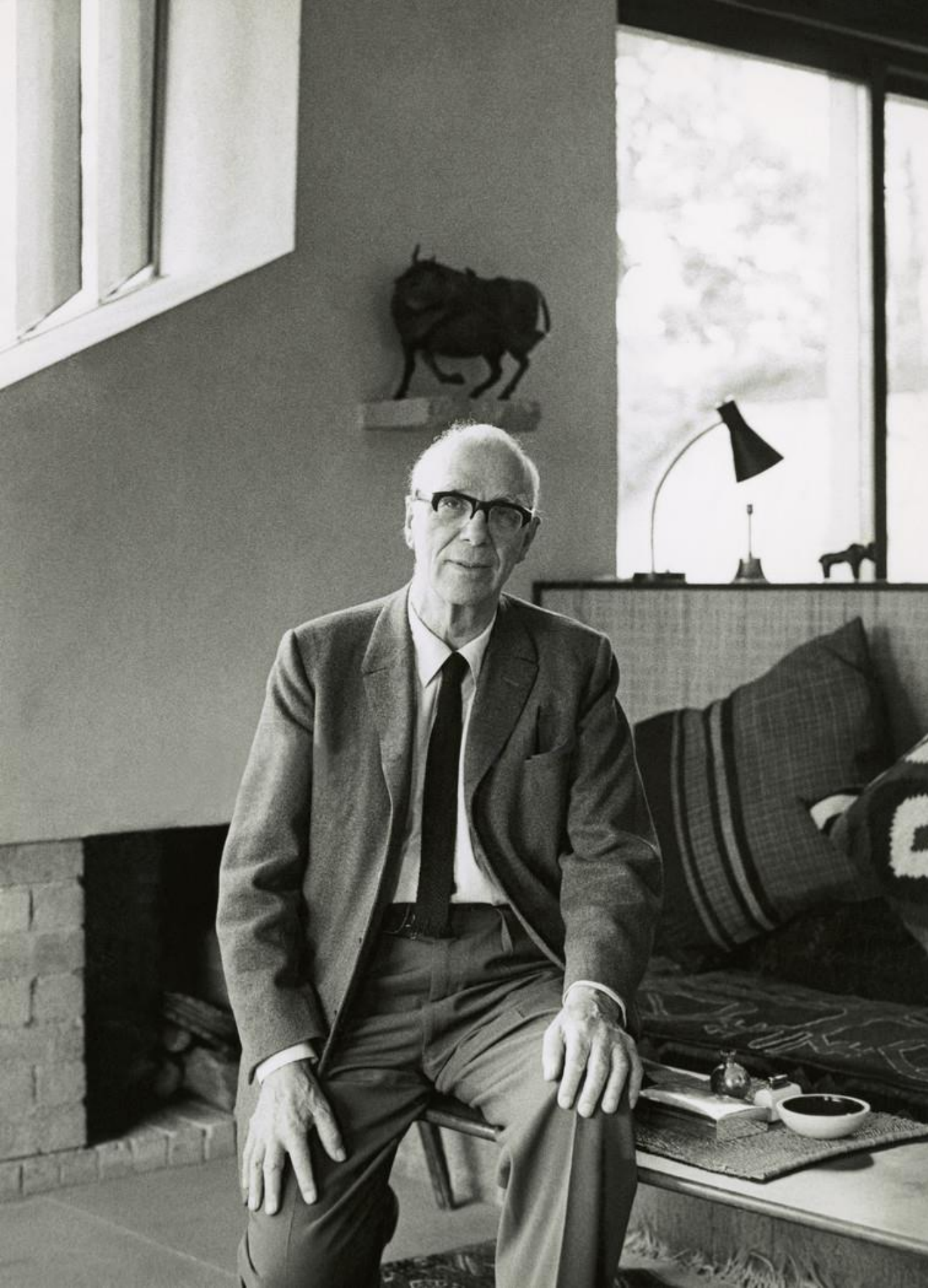
- Joined Arup in 2005
- BIM Development Manager, based in London
- MEP by background (mainly M)
- IEng professionally qualified Engineer
- Recently finished an MSc in *BIM and Integrated Design*
- 2 x Autodesk Revit Gunslinger
- ... General technology nerd



A little info about me ...

- Joined Arup in 2011
- Mechanical Engineer, based in London
- Experience on mission critical, healthcare, commercial and custodial projects.
- BIM Project of the Year for UK Government Project (HMYOI Cookham Wood)
- Specialised in implementation of BIM as a design tool for engineers.





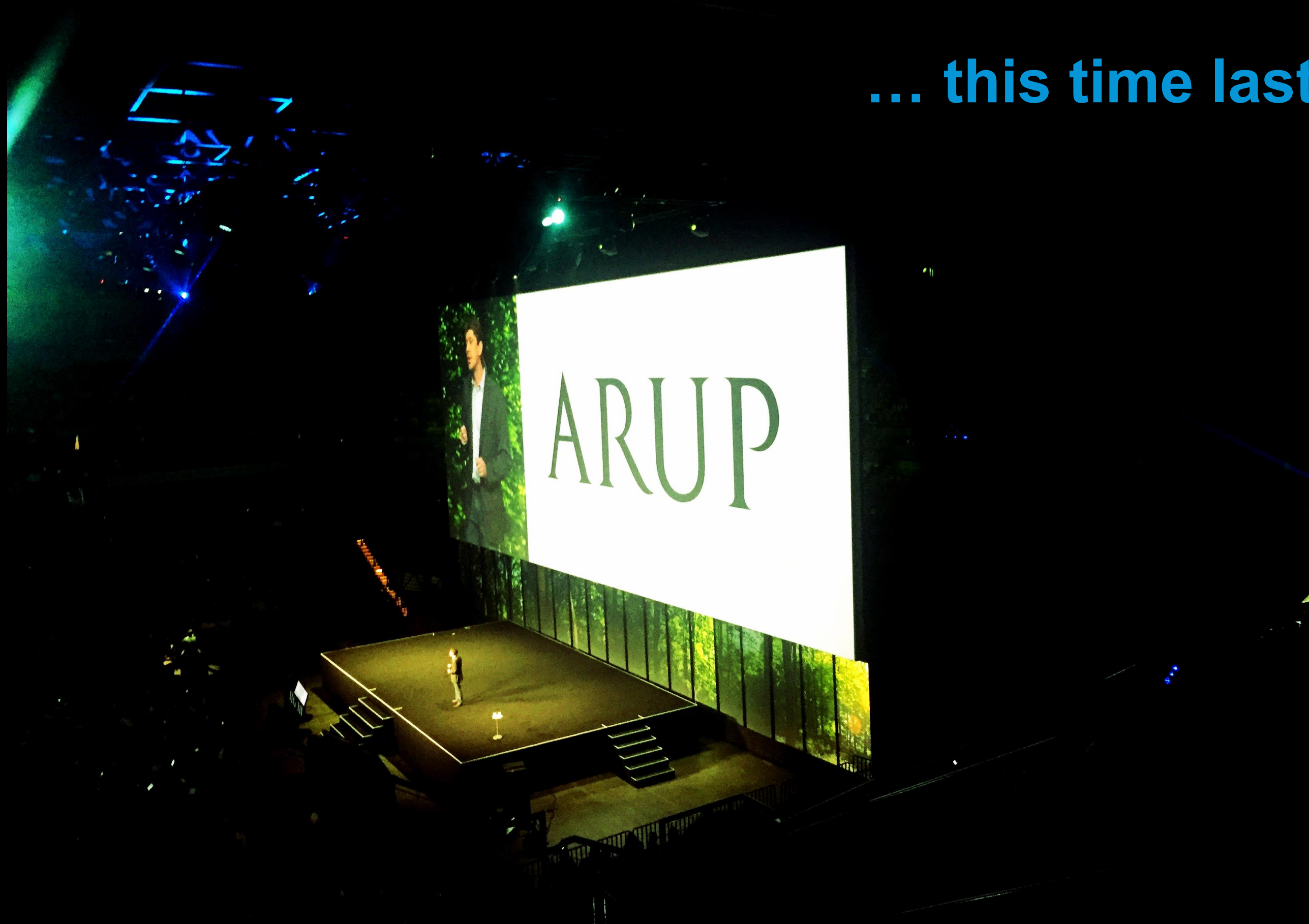
Arup's creative spark and intellectual independence has been there from the very beginning. These shared values, like the firm's name, are essentially derived from the beliefs and convictions of the firm's founder, the engineer and philosopher, Sir Ove Arup.

ARUP

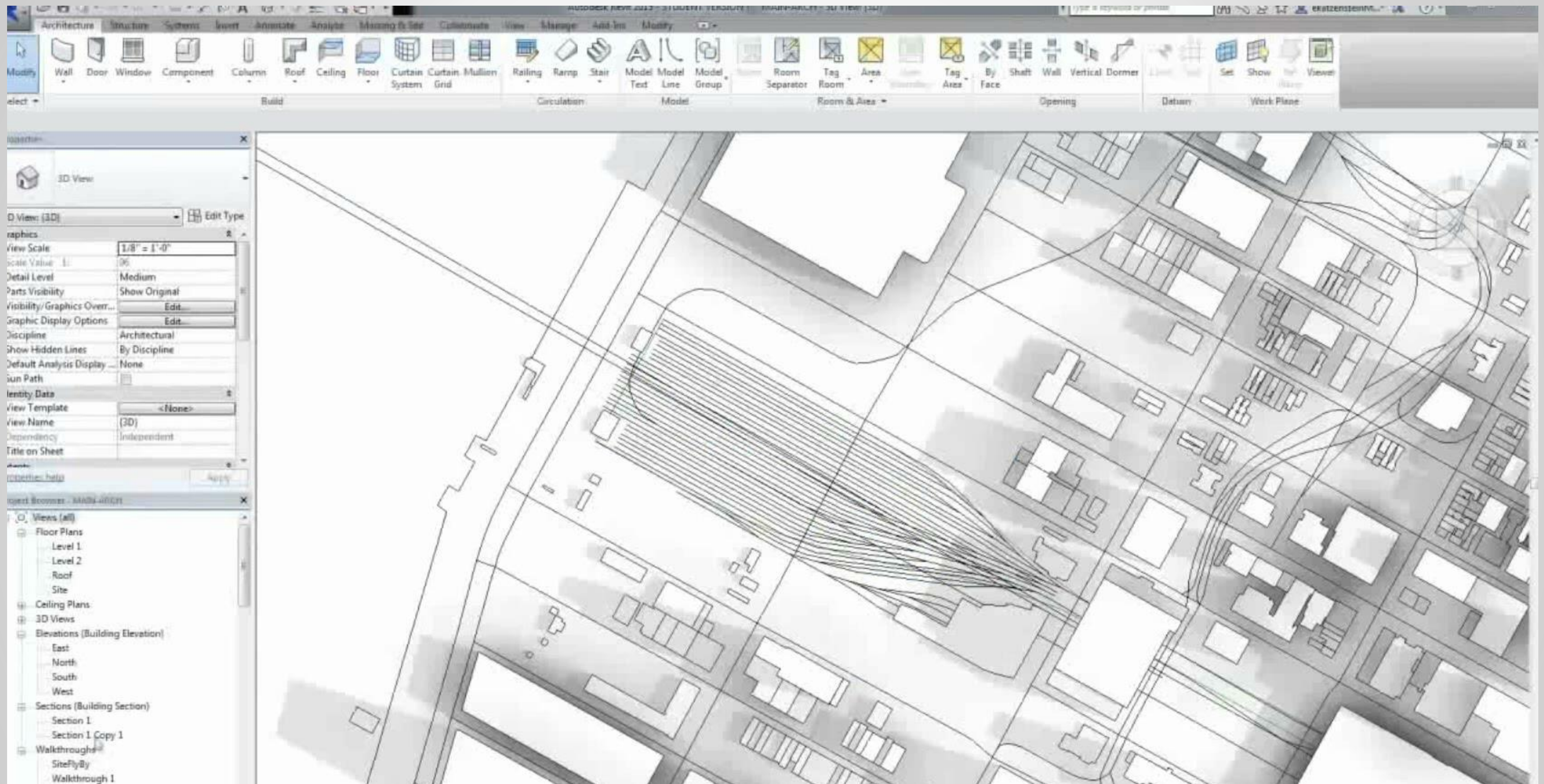


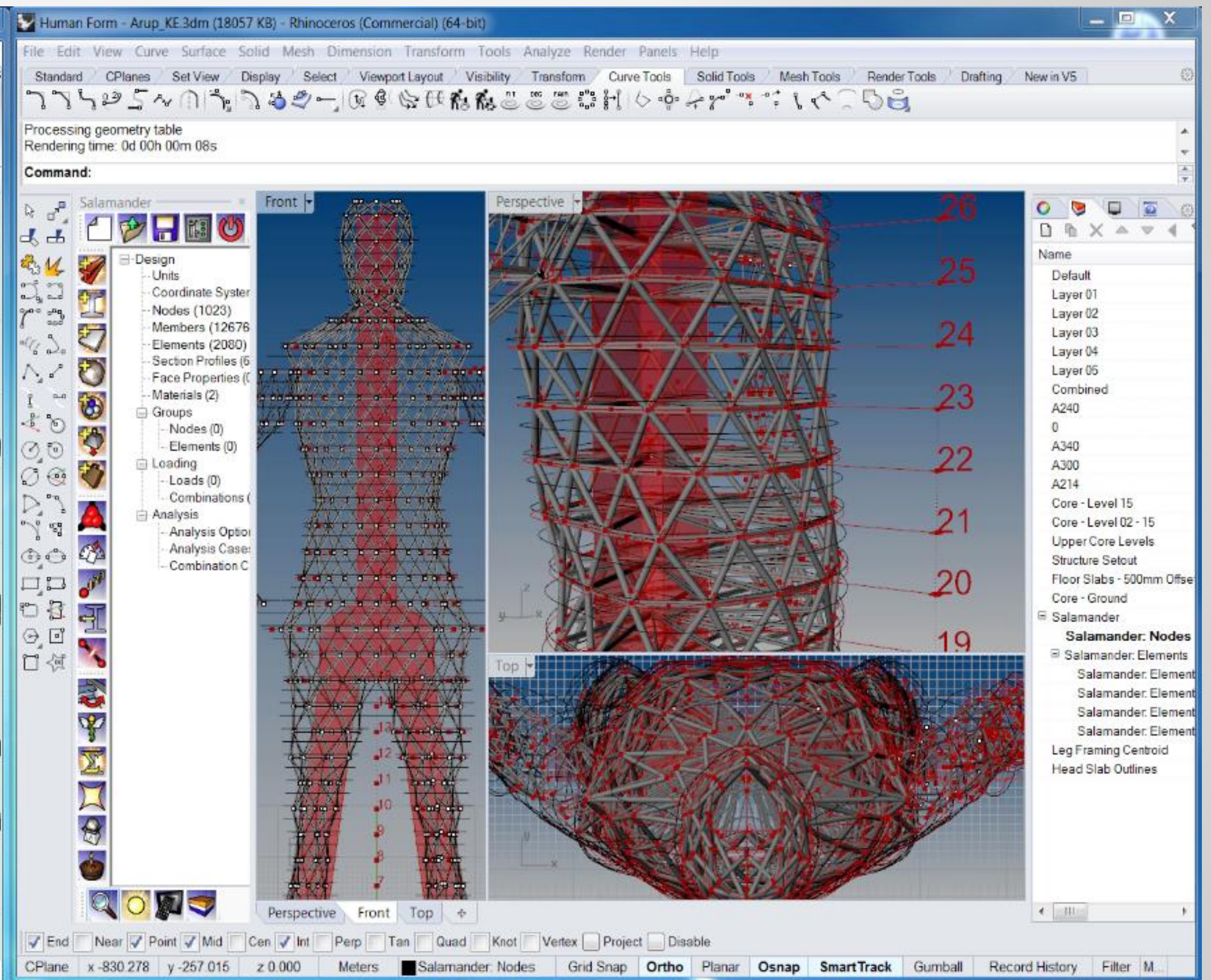
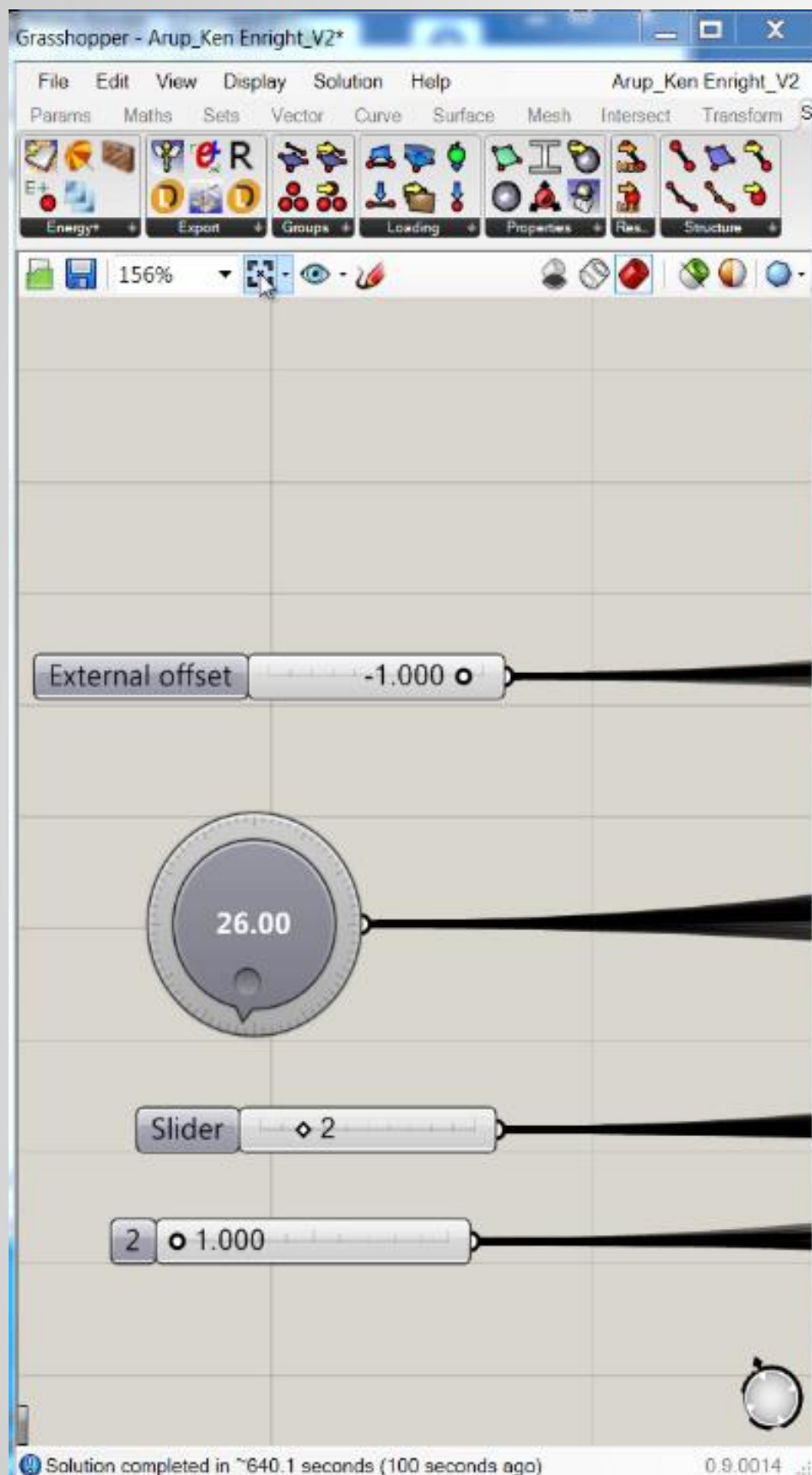


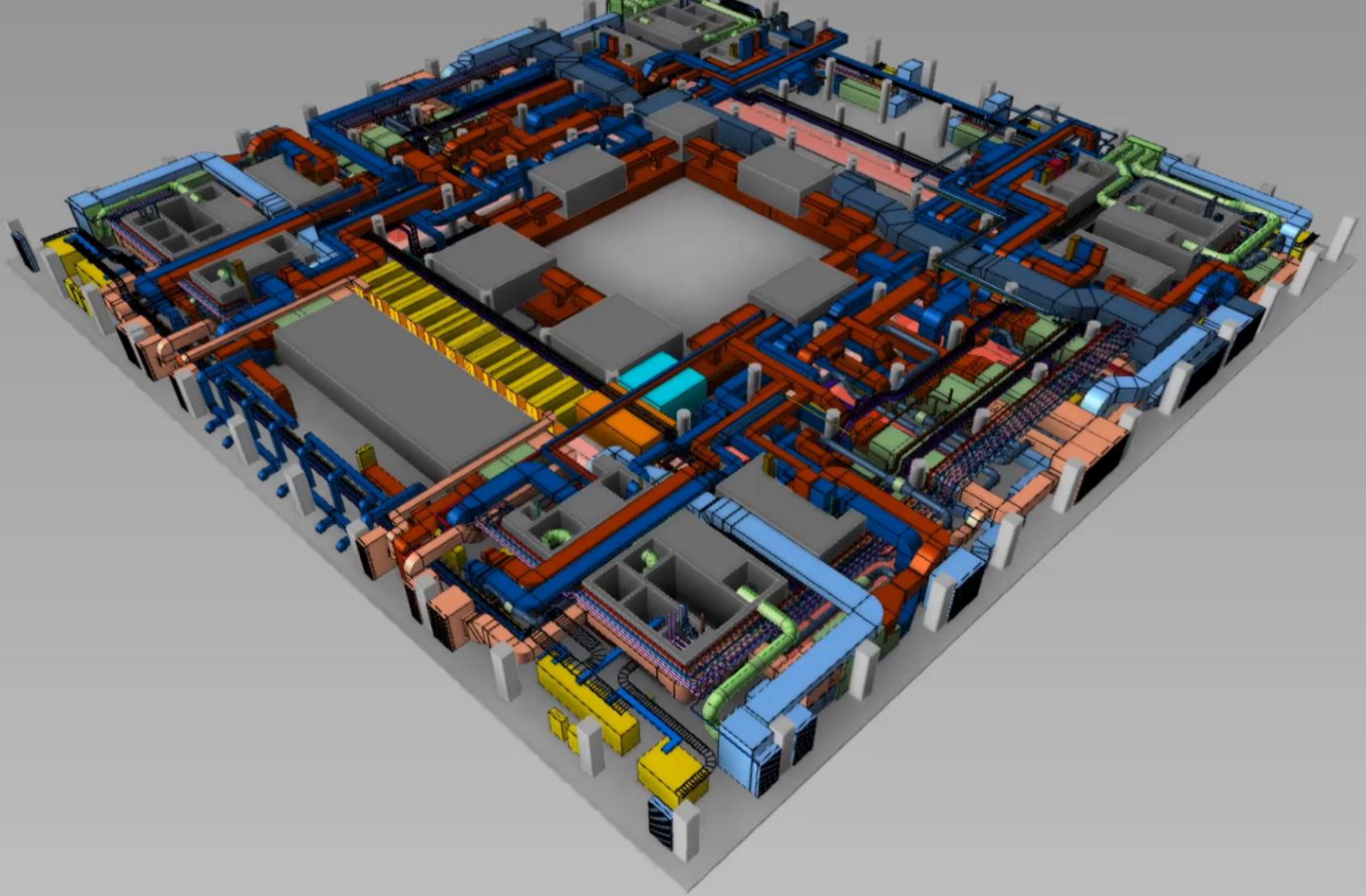
... this time last year

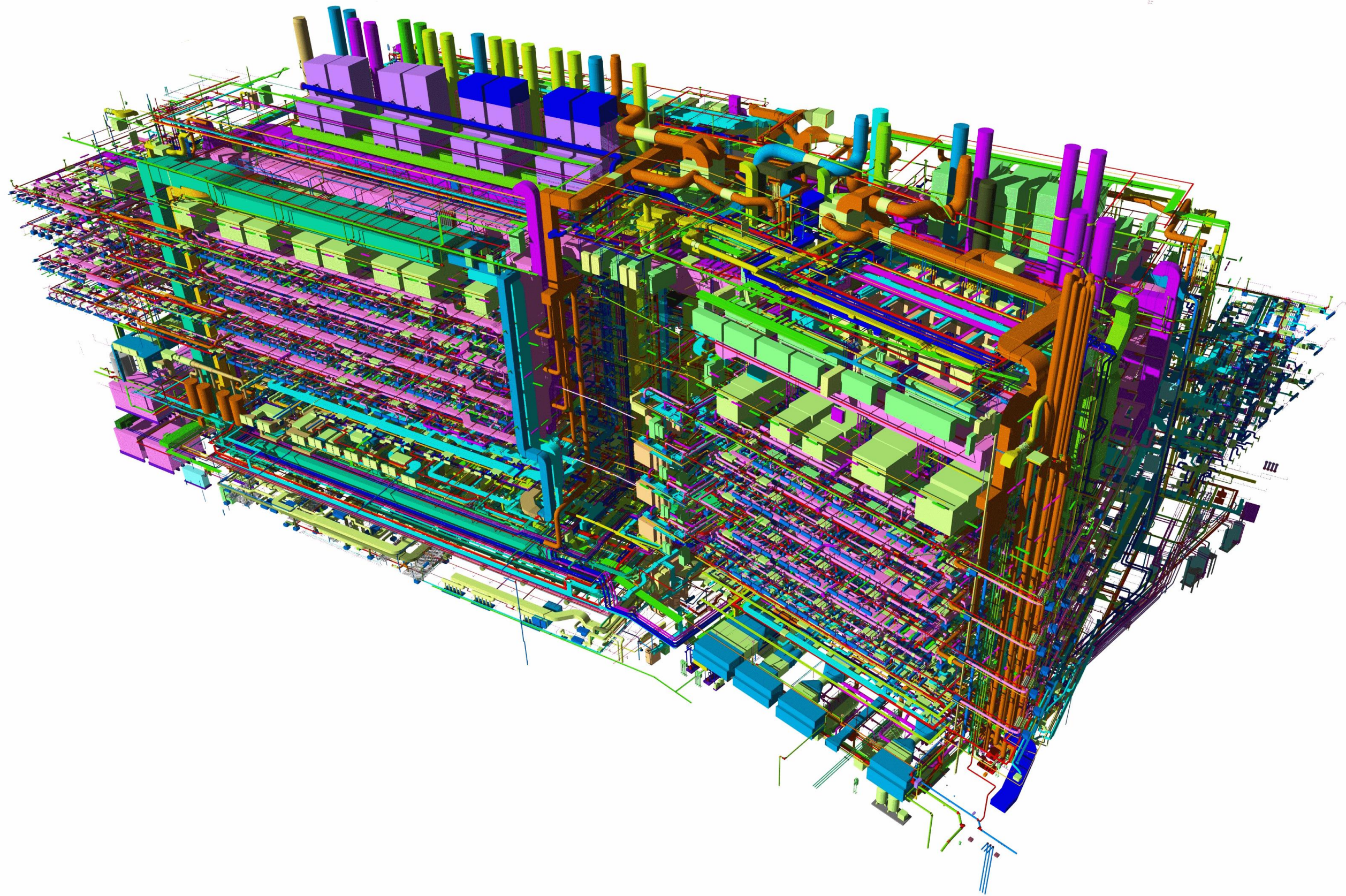


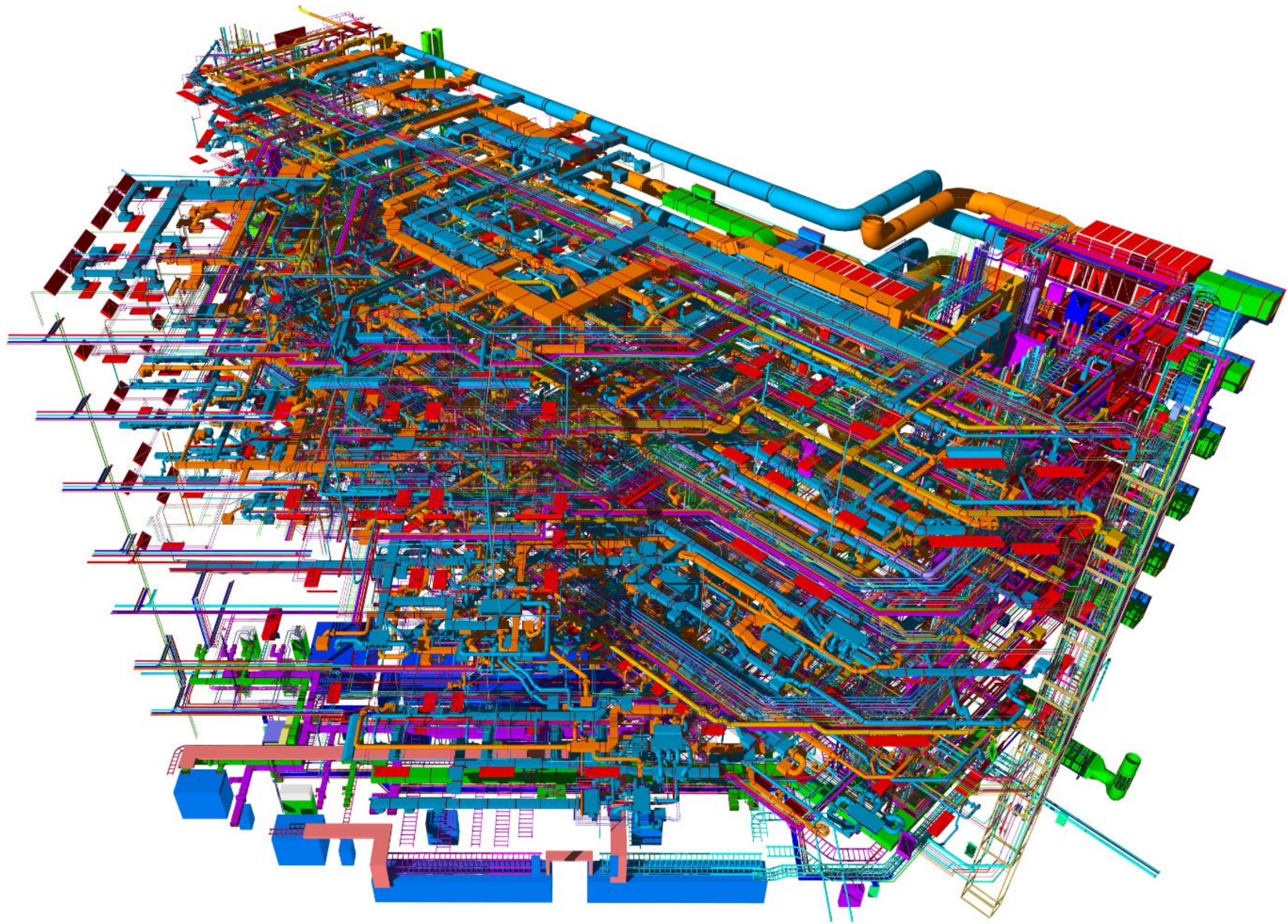
What is Dynamo and How does it work?



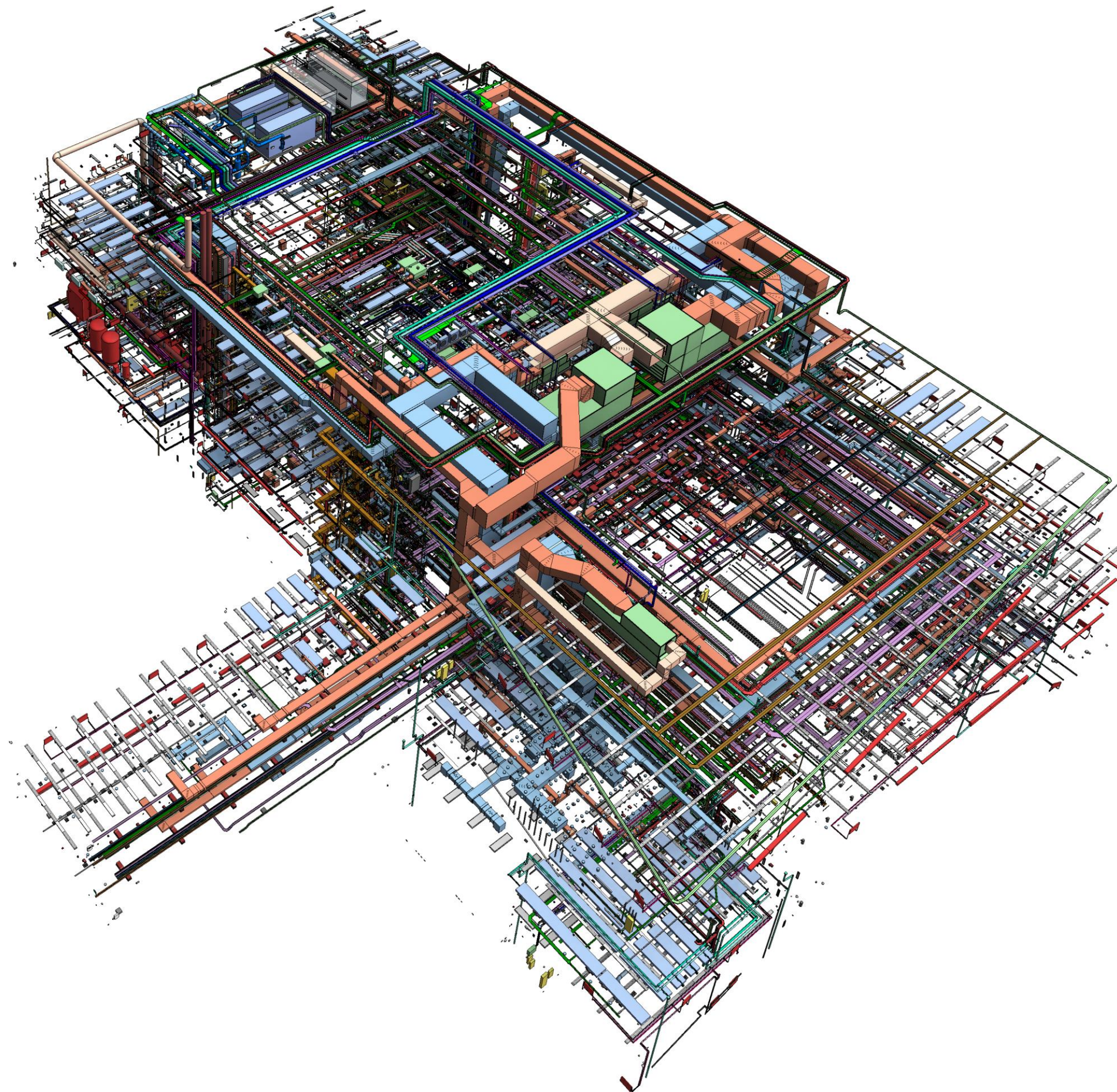




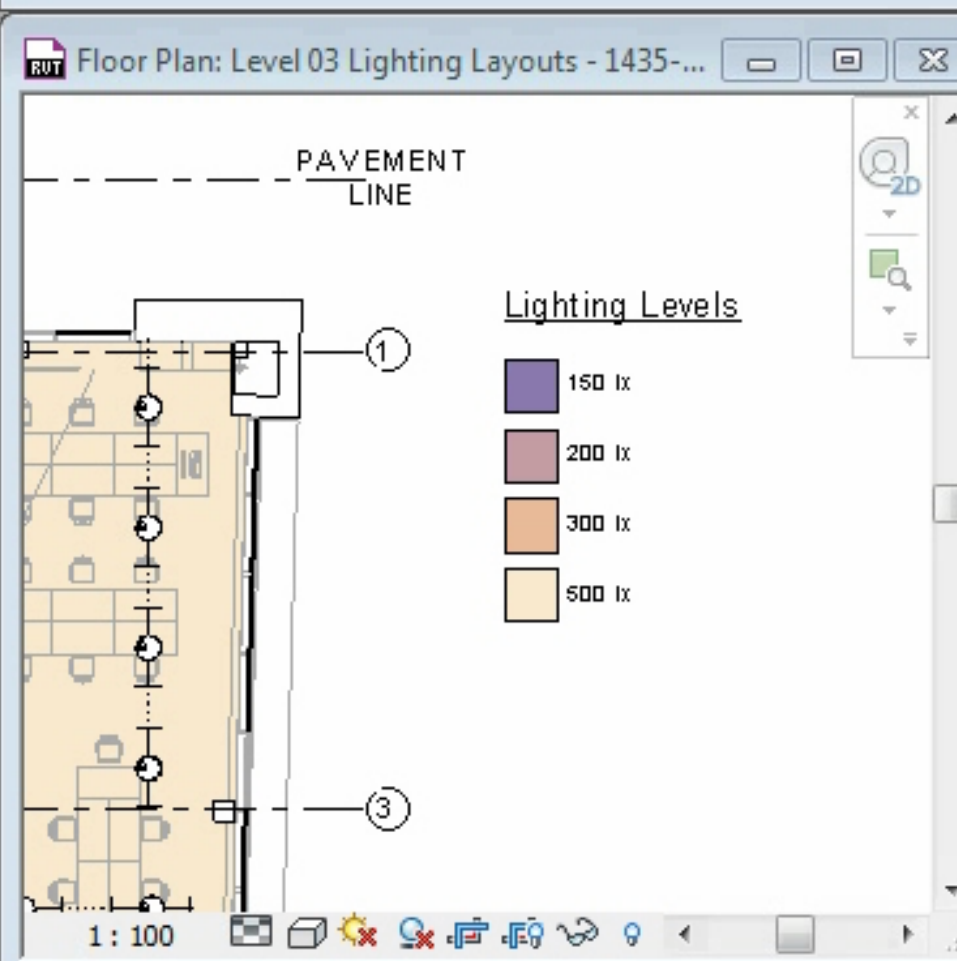
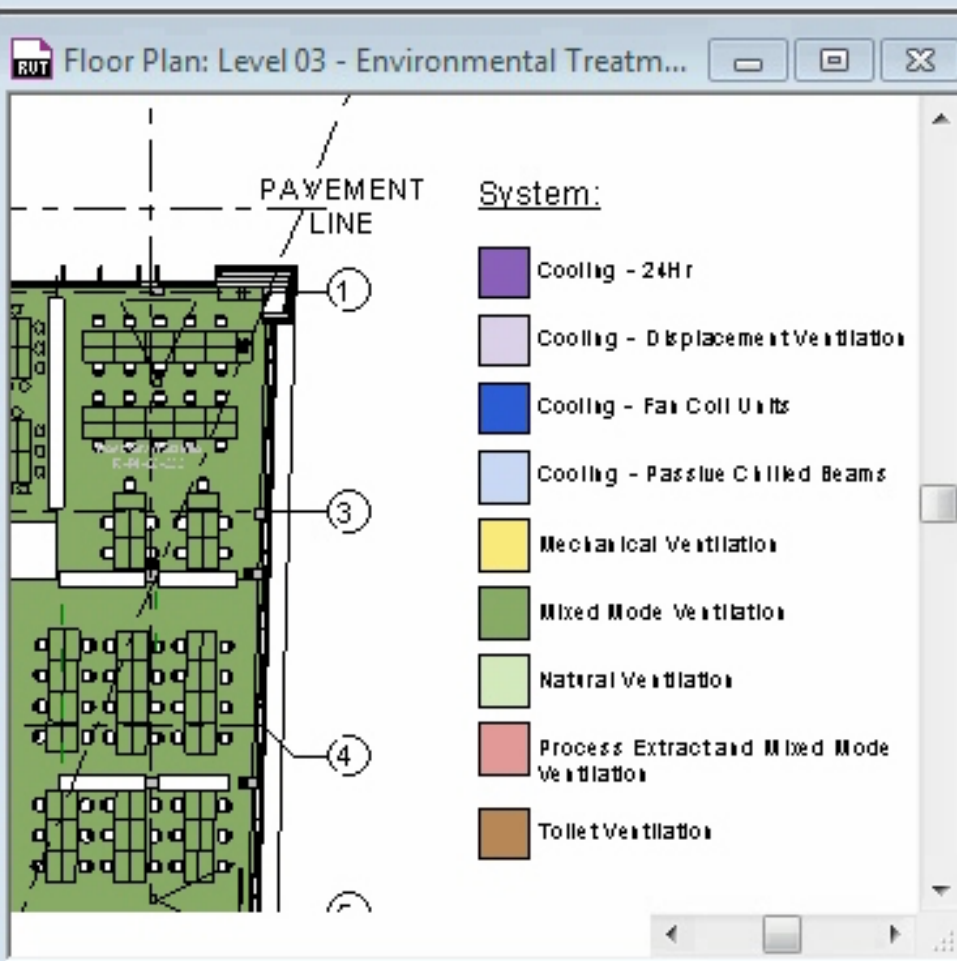
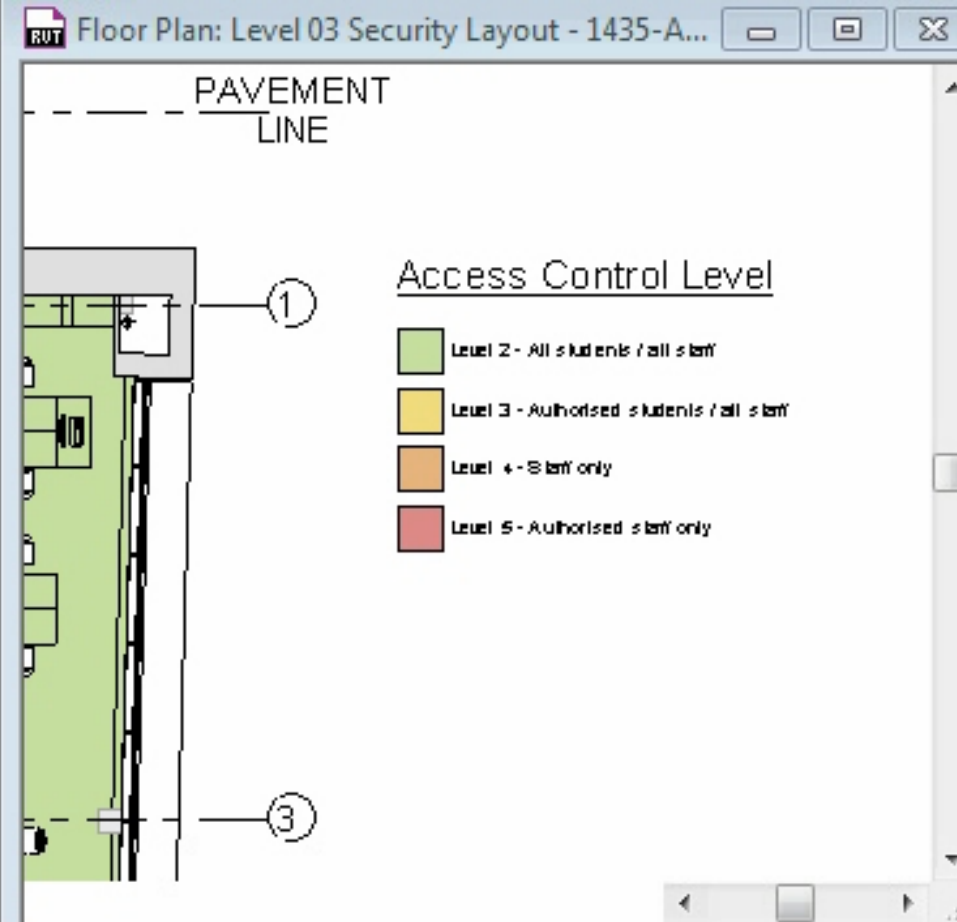
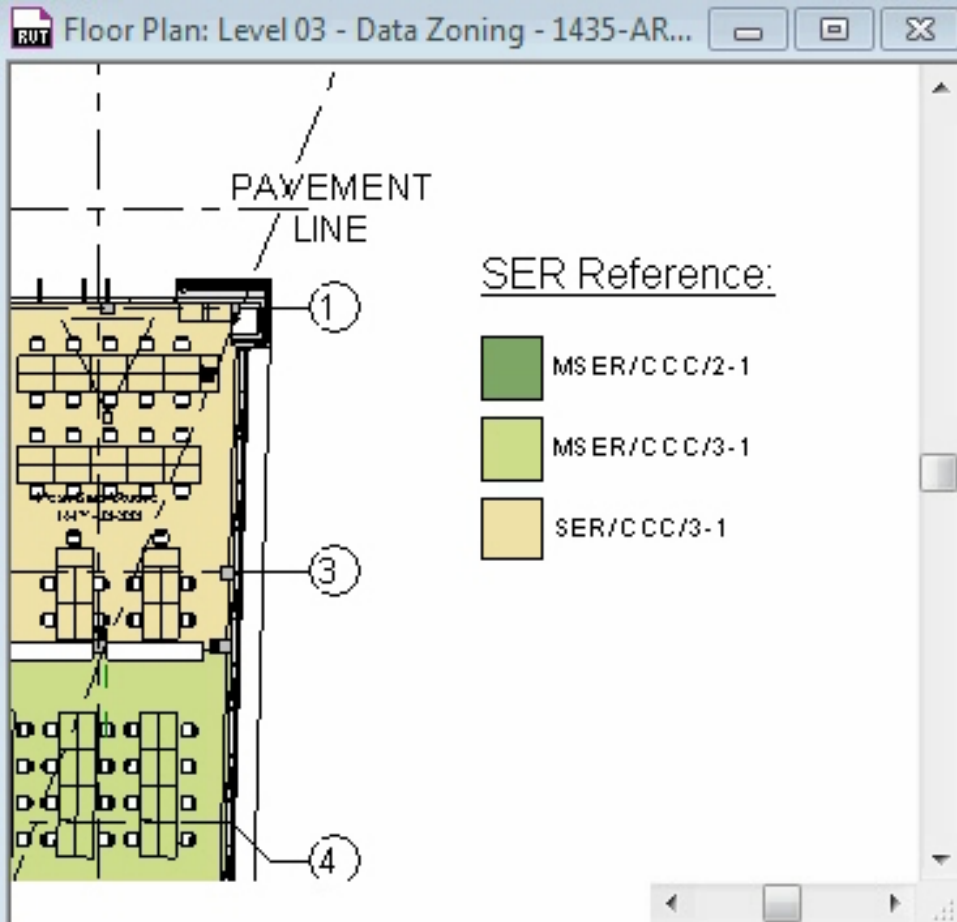




ARUP



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0 0 0 1 0 1 0
1 1 1 0 1 0 1
1 0 1 1 1 1 1
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0 0 0 0 0 1 0
0 0 0 0 0 1 0



Properties

Floor Plan: Level 03 Lighting La... Edit Type

Graphics

View Scale	1 : 100
Scale Value 1:	100
Display Model	Normal
Detail Level	Medium
Visibility/Graphics ...	Edit...
Visual Style	Hidden Line
Graphic Display Opt...	Edit...
Underlay	None
Underlay Orientation	Plan
Orientation	Project North
Wall Join Display	Clean all wall joins
Discipline	Coordination
Color Scheme Loca...	Background
Color Scheme	Target Lighting Levels
System Color Sche...	Edit...
Analysis Display Style	None
Sub-Discipline	E - Lighting
Sun Path	☐

Identity Data

View Name	Level 03 Lighting La...
Dependency	Primary
Title on Sheet	
Referencing Sheet	ARP-E-P1-02-GA-203
Referencing Detail	A
Default View Templ...	Sheet View - Leve...
Workset	View "Floor Plan: ...
Edited by	
Arup Discipline	Electrical

Extents

Crop View	☒
Crop Region Visible	☐
Annotation Crop	☐

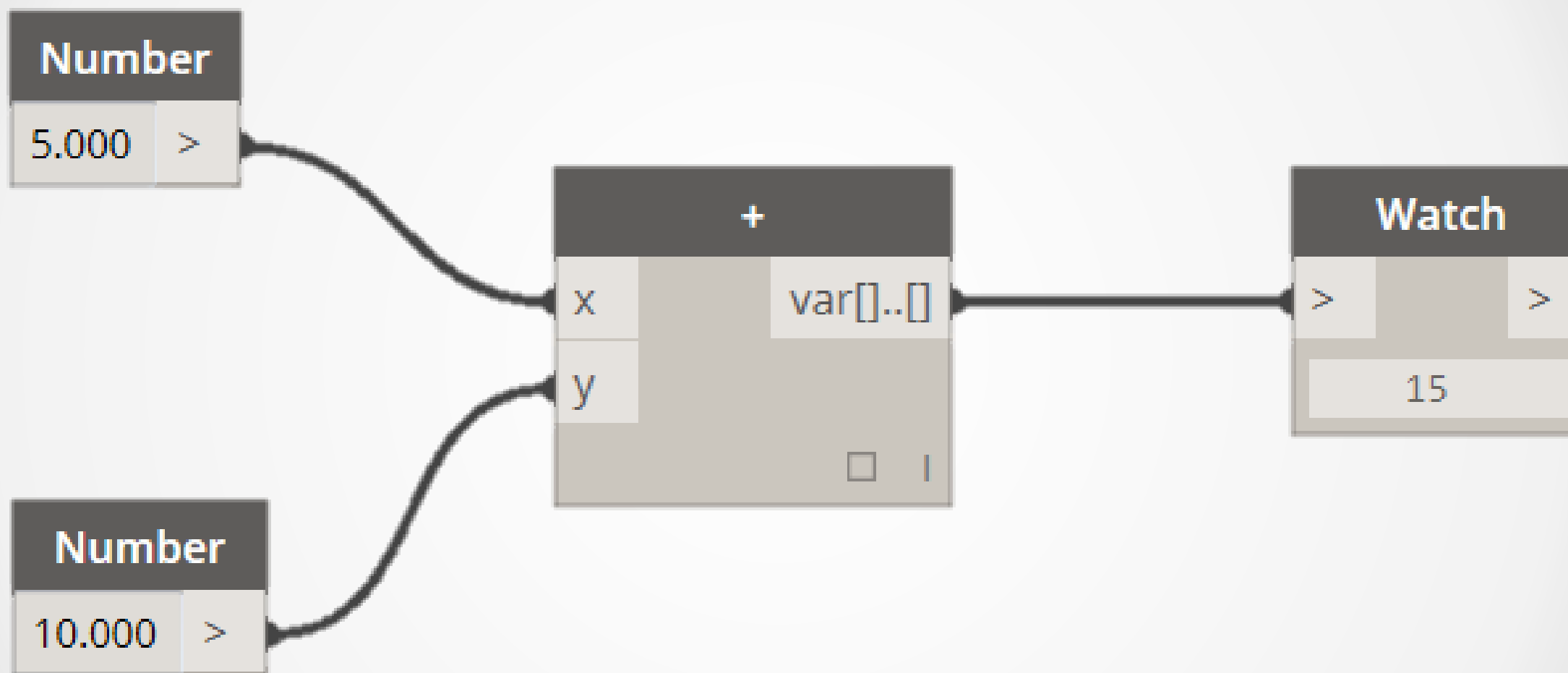
Properties help Apply

1 1 0 1 1 1 0
0 0 1 0 1 0 1
0 0 1 0 1 0 1
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1 0 1 0 0 0 0
0 1 0 1 1 1 1
1 1 1 1 0 1 0
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1 0 1 0 0 0 0
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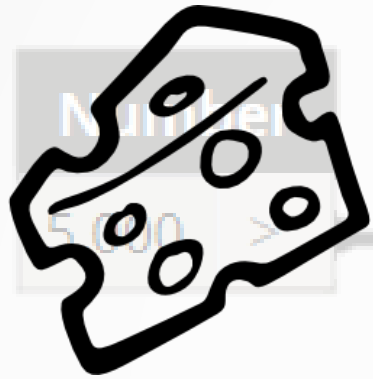
Efficiency Quality Reduced Risk

*“Reduce the effort to do the usual / necessary and
increase the time to be creative”*

Tristram Carfrae Global BIM strategy



Ingredients



Cooking



Finished Meal



Inputs

Function

Outputs/Result

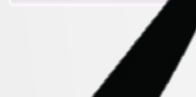
Lists the air flow types (i.e. Supply, Return etc.) to be retrieved from each space. The values returned are then be divided by the number of Air Terminals of each type within each space.



Revit API Snippet

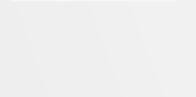


Selects all Air Terminals within the model



Revit API Snippet

Lists the instances of Air Terminals in the entire model grouped by air terminal type



Revit API Snippet



Today's Menu...

Starter

**Populate a Model with Data
from Excel**

Main

Use that data for Calculations

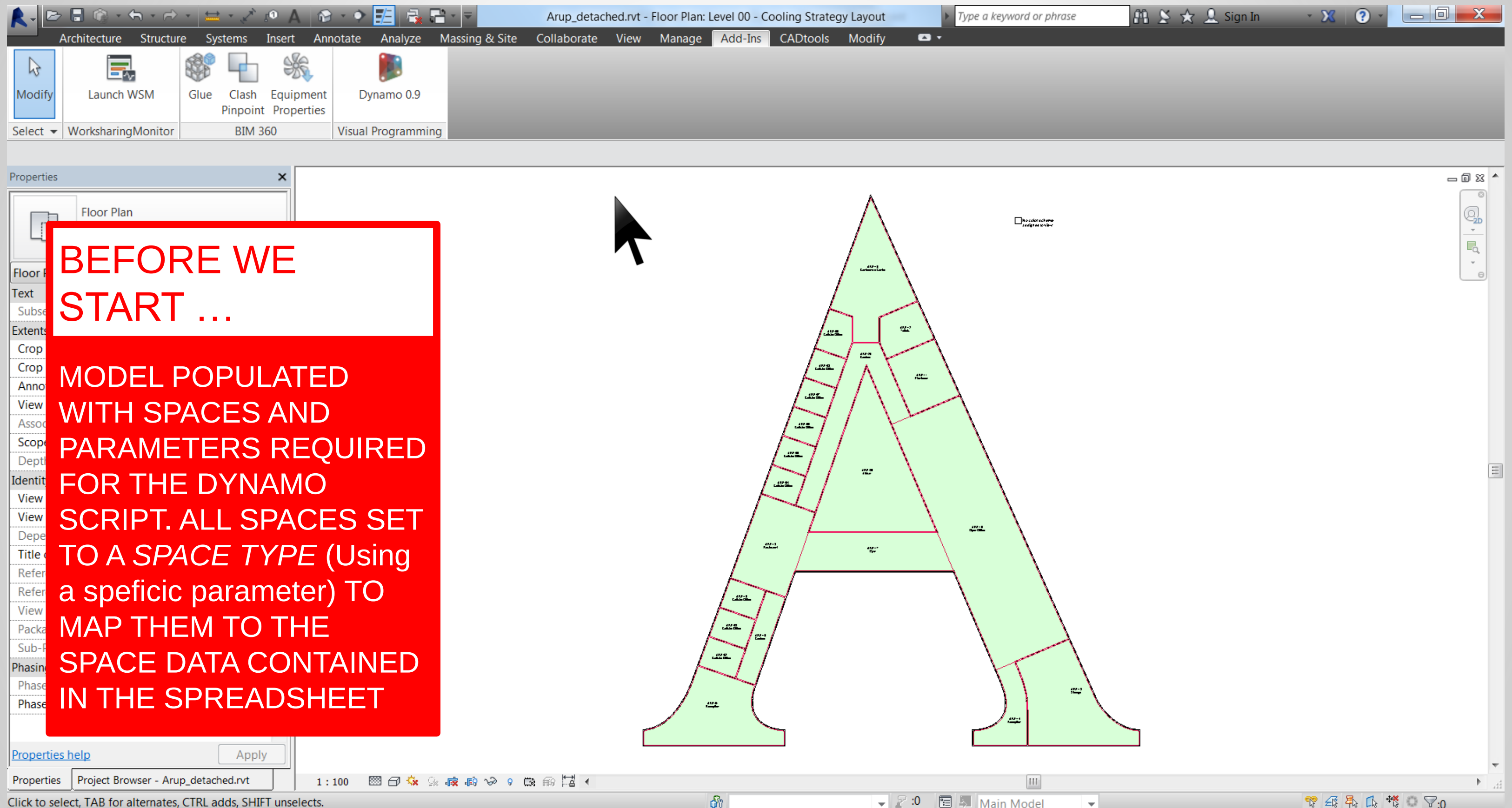
Dessert

**Link the *Space* calculations to
Families for further analysis**



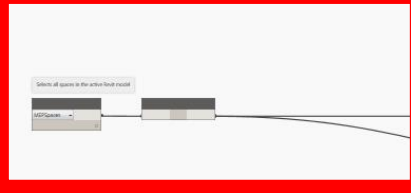


Pushing Excel data into Revit *Spaces* using Dynamo

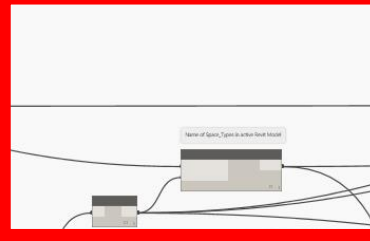




SELECT
SPACES IN
REVIT MODEL



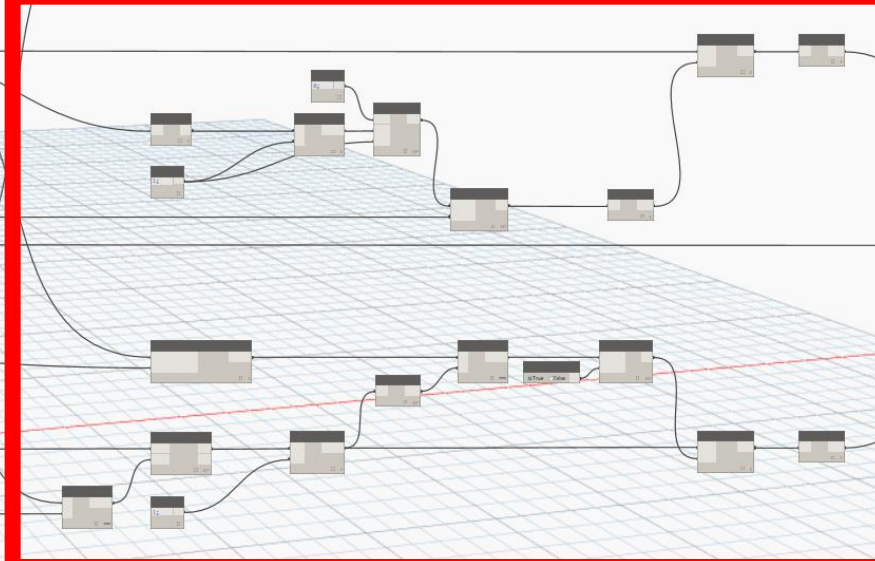
READ
DATA
FROM
REVIT



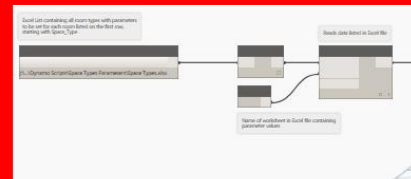
COMPARE *SPACE
TYPES* IN EXCEL
AGAINST SPACE
TYPES IN REVIT



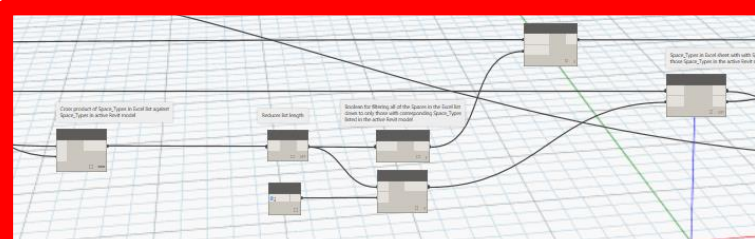
FORMATS ALL OF THE
DATA IN FOR SPACE
TYPES FOUND TO BE
PRESENT IN BOTH REVIT
AND IN EXCEL INTO THE
NECESSARY STRUCTURE
TO UPDATE THE REVIT
MODEL



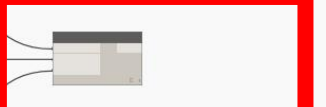
SELECT
SPREAD-
SHEET AND
READ DATA
FROM
EXCEL



COMPARE *SPACE
TYPES* IN EXCEL
AGAINST SPACE
TYPES IN REVIT



UPDATES
THE
SPACE
PARAMS IN
REVIT
MODEL



Dynamo

File Edit View Packages Settings Help

Space Types_FINAL_cleaned.dj

Library

Properties

Spaces (1)

Electrical - Loads

Plumbing

Mechanical

Space_Mechanical_Cooling_Required	☒
Space_Mechanical_Cooling_Type	
Space_Mechanical_Cooling_Type_Termi...	
Space_Mechanical_Heating_Required	☒
Space_Mechanical_Heating_Type	
Space_Mechanical_Heating_Type_Termi...	
Space_Mechanical_Humidity_Design	
Space_Mechanical_Humidity_Tolerance	
Space_Mechanical_Outlets_Gas_Compre...	
Space_Mechanical_Outlets_Gas_Compre...	☒
Space_Mechanical_Outlets_Gas_Industri...	
Space_Mechanical_Outlets_Gas_Industri...	☒
Space_Mechanical_Outlets_Gas_Medical...	
Space_Mechanical_Outlets_Gas_Medical...	☒
Space_Mechanical_Outlets_Gas_Natural_...	
Space_Mechanical_Outlets_Gas_Natural_...	☒
Space_Mechanical_System_Resilience_Re...	
Space_Mechanical_System_Resilience_Ty...	☒
Space_Mechanical_Temperature_Overhe...	
Space_Mechanical_Temperature_Overhe...	
Space_Mechanical_Temperature_Overhe...	
Space_Mechanical_Temperature_Summ...	
Space_Mechanical_Temperature_Summ...	
Space_Mechanical_Temperature_Winter...	
Space_Mechanical_Ventilation_Extract_T...	
Space_Mechanical_Ventilation_Required	☒
Space_Mechanical_Ventilation_Specialist...	☒
Space_Mechanical_Ventilation_Specialist...	
Space_Mechanical_Ventilation_Supply_T...	
Space_Mechanical_Ventilation_Type	

Mechanical - Flow

Mechanical - Loads

Dimensions

[Properties help](#)

Apply

Project Browser - Arup_andrei.capraru.rvt

Properties

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

Workset1 (Not Editable)

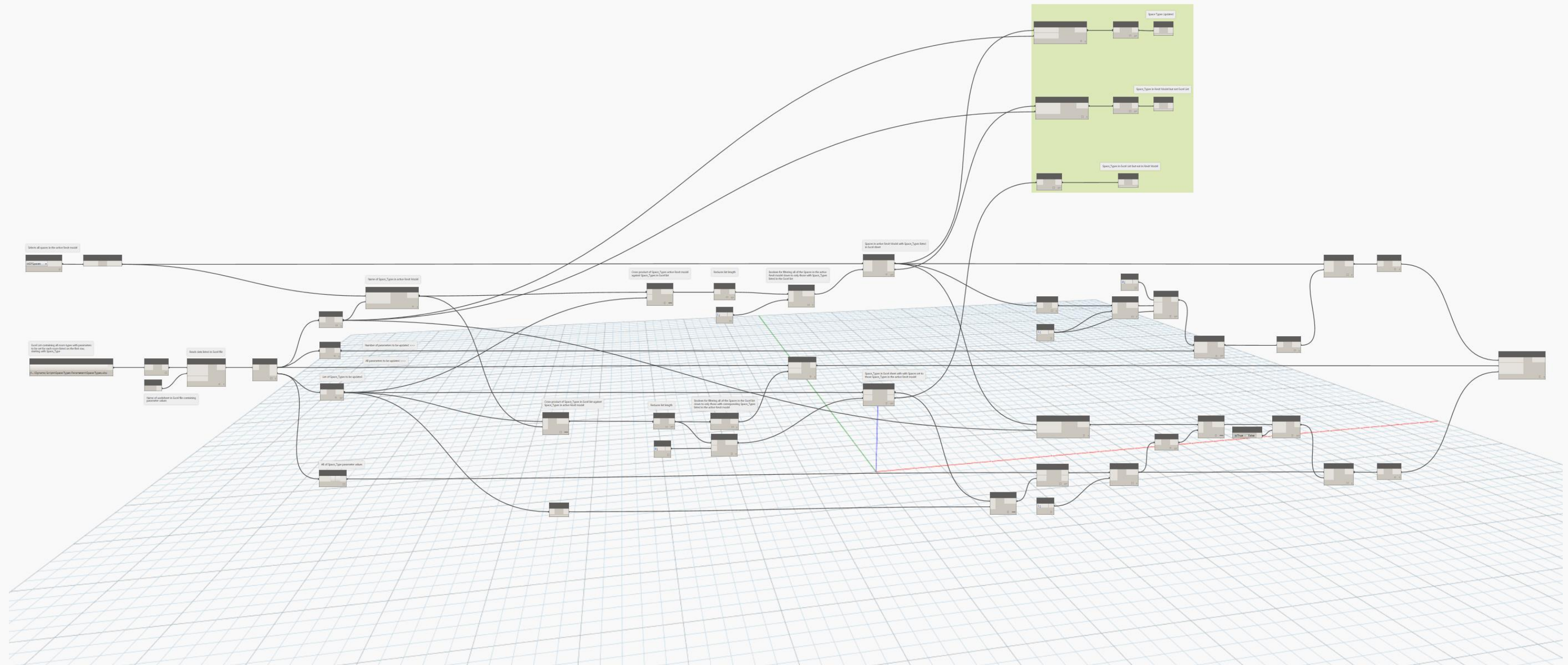
Main Model

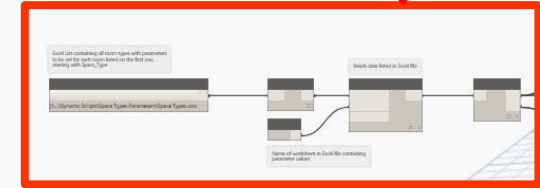
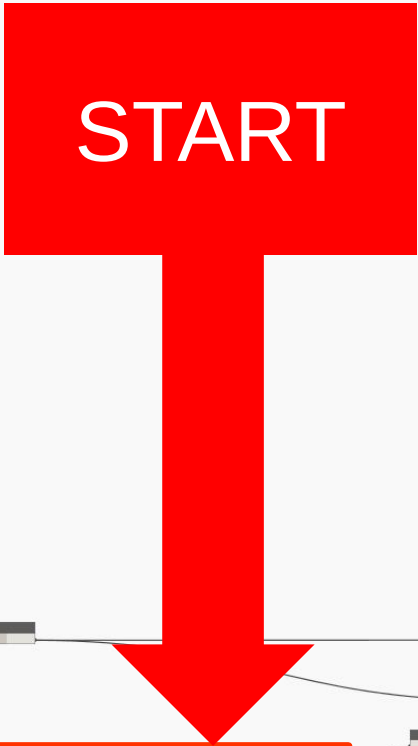
Architecture Structure Systems Insert Annotate Analyze Massing & Site Collaborate View Manage Add-Ins CADtools

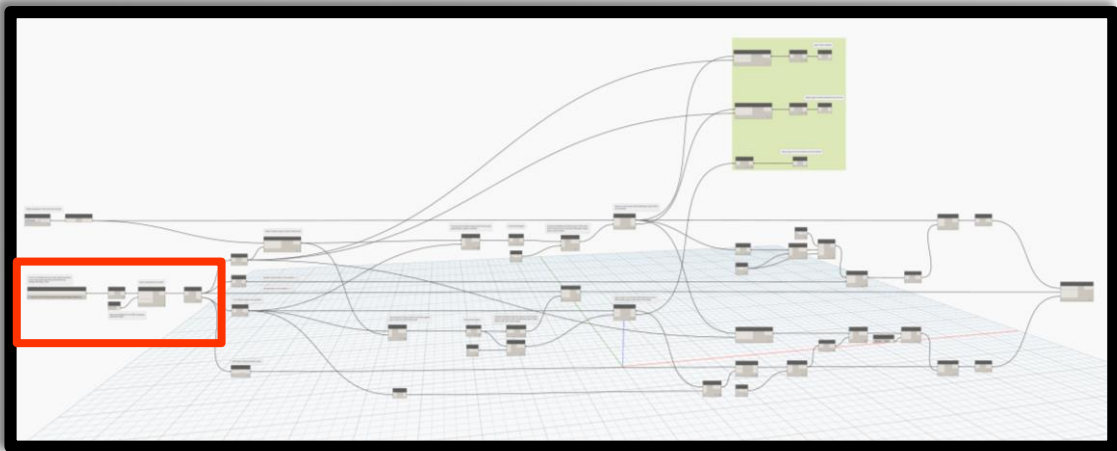
Modify | Spaces

Heating Strategy

☐ No cooling system





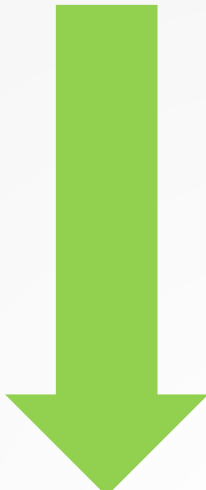


Excel List containing all room types with parameters to be set for each room listed on the first row, starting with Space_Type

File Path

Browse... >

J:\...\Dynamo Scripts\Space Types Parameters\Space Types.xlsx



File.FromPath

path file

String

Output >

Name of worksheet in Excel file containing parameter values

Reads data listed in Excel file

Excel.ReadFromFile

file sheetName readAsStrings

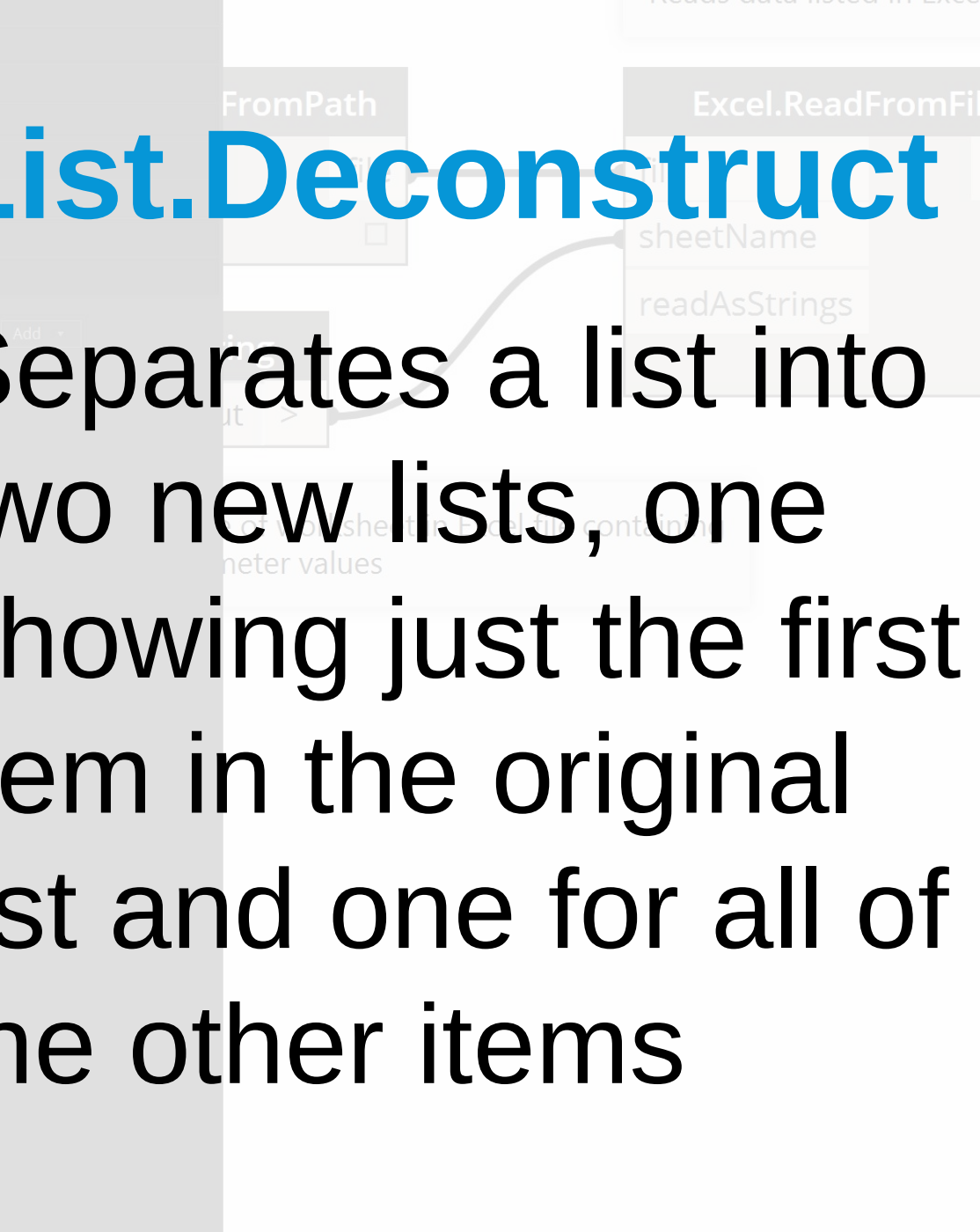
data

List.Deconstruct

list first rest



LISTS

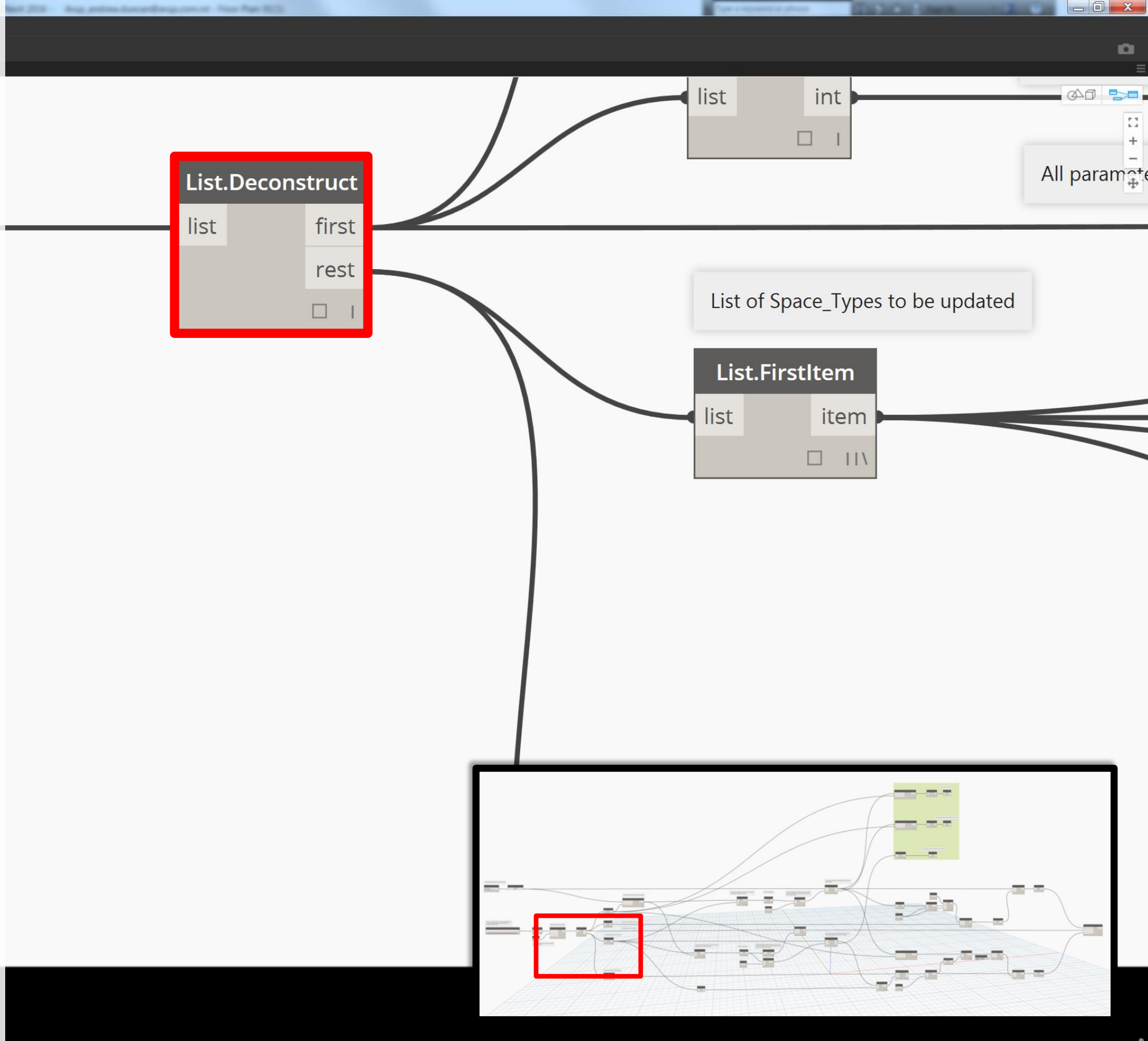


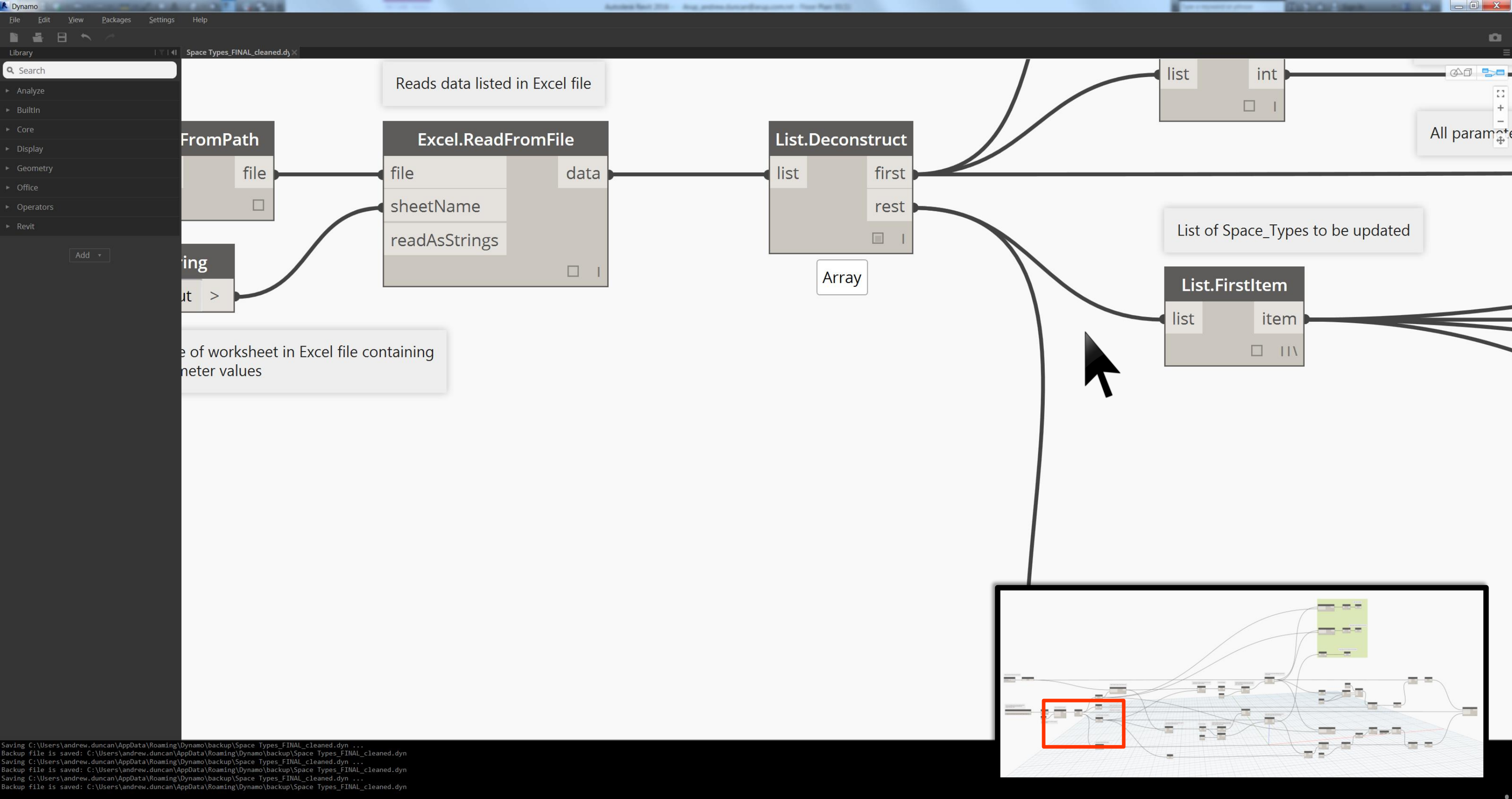
The background image shows a screenshot of the Dynamo software interface. On the left is a library pane with categories like Analyze, BuiltIn, Core, Display, Geometry, Office, Operators, and Revit. The main workspace contains two nodes: 'FromPath' and 'Excel.ReadFromFile'. The 'Excel.ReadFromFile' node has inputs for 'filePath' and 'sheetName', and an output for 'data'. A blue line connects the 'data' output of the 'Excel.ReadFromFile' node to the input of the 'List.Deconstruct' node. The 'List.Deconstruct' node has two outputs, each leading to a 'Print' node. The text 'List.Deconstruct' is overlaid in large blue font, and the description 'Separates a list into two new lists, one showing just the first item in the original list and one for all of the other items' is overlaid in large black font.

List.Deconstruct

Separates a list into two new lists, one showing just the first item in the original list and one for all of the other items

Separates a list into two new lists, one showing just the first item in the original list and one for all of the other items





Dynamo

File Edit View Packages Settings Help

Library

Search

Analyze

Builtin

Core

Display

Geometry

Office

Operators

Revit

Add

FromPath

file

Excel.ReadFromFile

file

sheetName

readAsStrings

data

Reads data listed in Excel file

List.Deconstruct

list

first

rest

List

[0] List

[0] Space_Type

[1] Design Heating Load

[2] Design Cooling Load

[3] Specified Return Airflow

[4] Specified Exhaust Airflow

[5] Specified Supply Airflow

[6] Space_Mechanical_Cooling

[7] Space_Mechanical_Heating

[8] Space_Mechanical_Ventilat

[9] Space_Mechanical_Fresh Ai

[10] Number of People

[11] Space_Occupancy_HVAC_Nor

[12] null

[13] null

[14] null

List of Space_Types to be updated

List.FirstItem

list

item

All parameters

Number of worksheet in Excel file containing parameter values

Saving C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space_Types_FINAL_cleaned.dyn ...
Backup file is saved: C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space_Types_FINAL_cleaned.dyn ...
Saving C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space_Types_FINAL_cleaned.dyn ...
Backup file is saved: C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space_Types_FINAL_cleaned.dyn ...
Saving C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space_Types_FINAL_cleaned.dyn ...
Backup file is saved: C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space_Types_FINAL_cleaned.dyn ...

FileEditViewPackagesSettingsHelp

Library

Search

Analyze

Builtin

Core

Display

Geometry

Office

Operators

Revit

Add

FromPath

file

Excel.ReadFromFile

file

sheetName

readAsStrings

data

List.Deconstruct

list

first

rest

List.FirstItem

list

item

int

All parameters

List of Space_Types to be updated

Reads data listed in Excel file

Path of worksheet in Excel file containing parameter values

List

[0] List

[0] Space_Type

[1] Design Heating Load

[2] Design Cooling Load

[3] Specified Return Airflow

[4] Specified Exhaust Airflow

[5] Specified Supply Airflow

[6] Space_Mechanical_Cooling

[7] Space_Mechanical_Heating

[8] Space_Mechanical_Ventilat

[9] Space_Mechanical_Fresh Ai

[10] Number of People

[11] Space_Occupancy_HVAC_Nor

[12] null

Space Types_FINAL_cleaned.dj

Space Types.xlsx - Excel

FILEHOMEINSERTPAGE LAYOUTFORMULASDATAREVIEWVIEWDEVELOPERPOWERPIVOT

CutCopyFormat Painter

Clipboard

Calibri11

Font

General

Alignment

Number

Conditional Formatting

Table

NormalBadGoodNeutralCalculation

Check CellExplanatory T...InputLinked CellNote

Styles

InsertDelete Format

Cells

AutoSum

Fill

Clear

Editing

Sort & Find & Filter

Select

D15

	A	B	C	D	E	F	
1	Space_Type	Design Heating Load	Design Cooling Load	Specified Return Airflow	Specified Exhaust Airflow	Specified Supply Airflow	Space_Mecha
2	Atrium	968752	861113	2472	2119	1766	
3	Cellular Office	861113	753474	2119	1766	1413	
4	Conference Cen	1076391	1184030	4238	4591	5297	
5	Corridor	753474	645835	1766	1413	1059	
6	Gym	645835	538196	1413	1059	706	
7	Open Office	538196	430556	1059	706	353	

Autodesk Uni

Autodesk

FileEditViewPackagesSettingsHelp

Library

Search

Analyze

BuiltIn

Core

Display

Geometry

Office

Operators

Revit

Add

Space Types_FINAL_cleaned.dyn

FromPath

file

Excel.ReadFromFile

file

sheetName

readAsStrings

ing

ut >

...e of worksheet in Excel file containing
...meter values

Reads data listed in Excel file

List.Deconstruct

list

first

rest

[25] null

[26] null

[27] null

[28] null

[29] null

[30] null

[1] List

[0] List

[0] Atrium

[1] 968751.939

[2] 861112.835

[3] 2472.027

[4] 2118.880

[5] 1765.733

[6] 80.000

[7] 120.000

[8] 1.000

list

int

All parameters

List.FirstItem

list

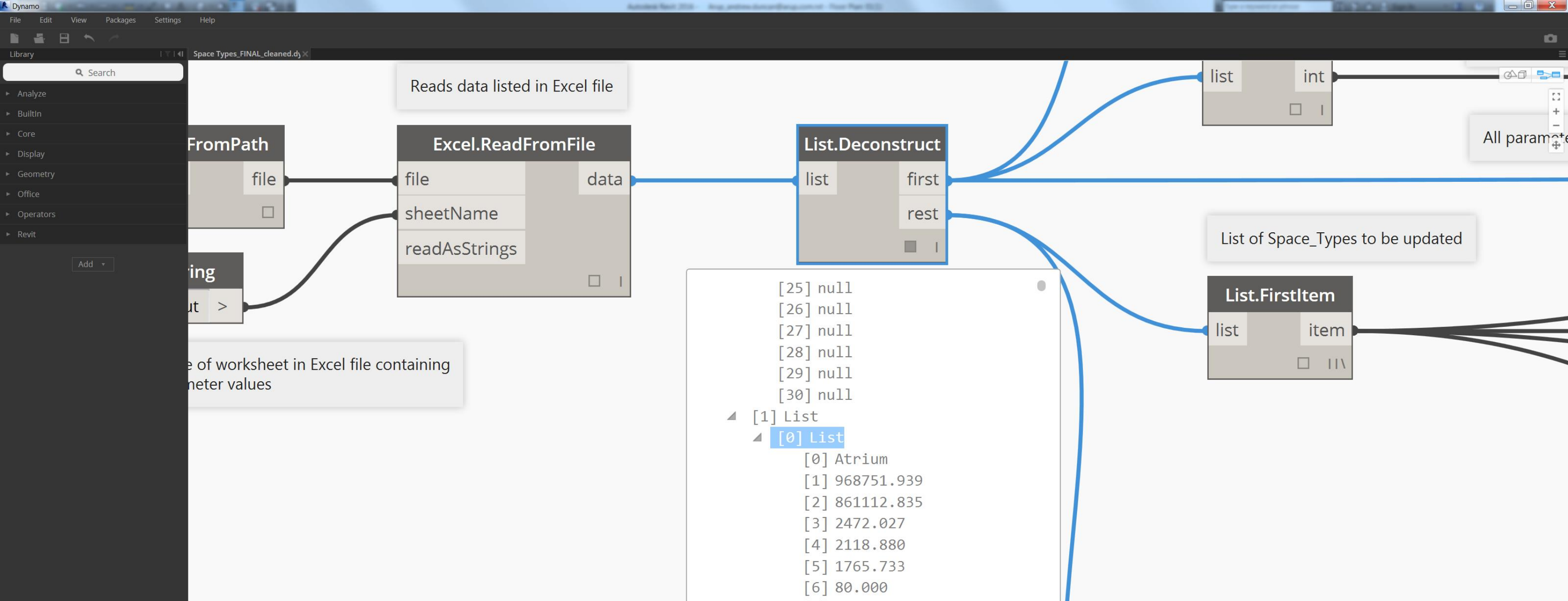
item

List of Space_Types to be updated

Saving C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space Types_FINAL_cleaned.dyn ...
Backup file is saved: C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space Types_FINAL_cleaned.dyn ...
Saving C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space Types_FINAL_cleaned.dyn ...
Backup file is saved: C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space Types_FINAL_cleaned.dyn ...
Saving C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space Types_FINAL_cleaned.dyn ...
Backup file is saved: C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space Types_FINAL_cleaned.dyn ...

ManualRun

21:43
25/11/2015



Space Types.xlsx - Excel

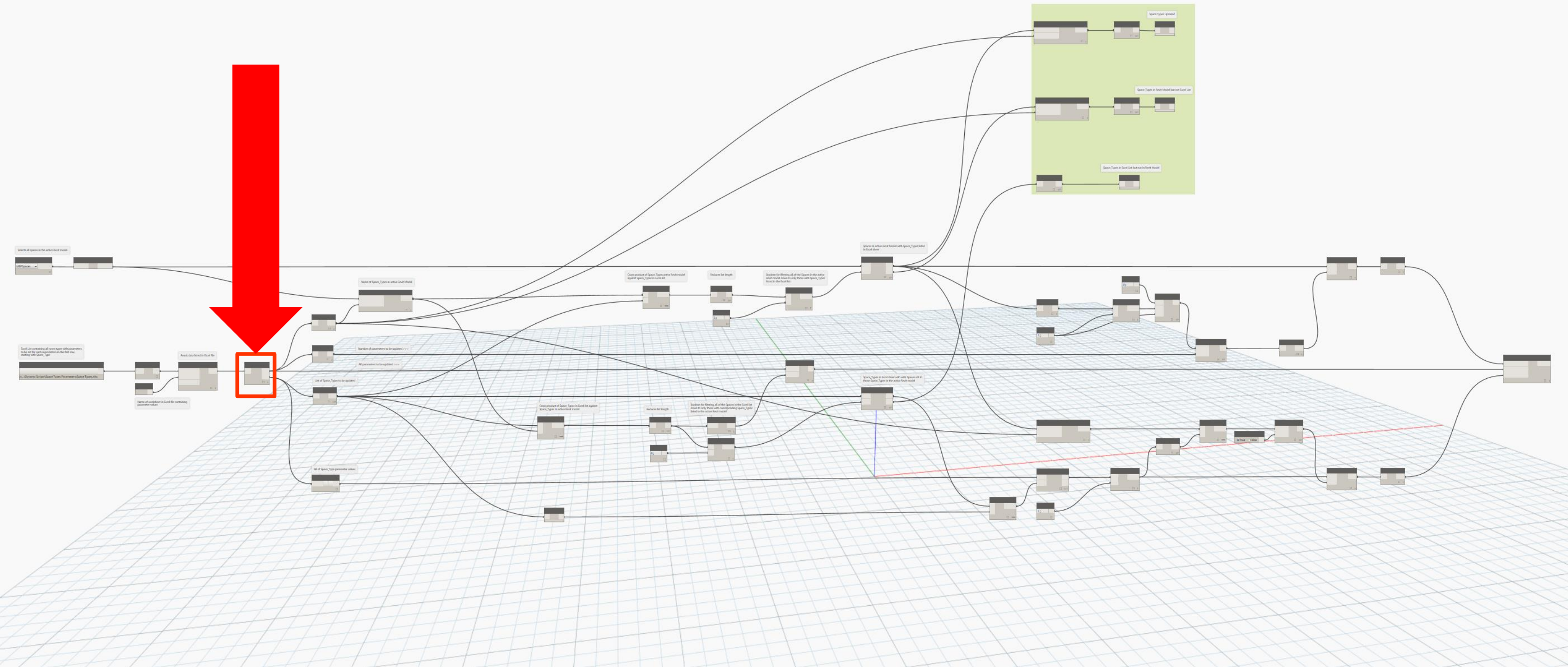
Andrew Duncan

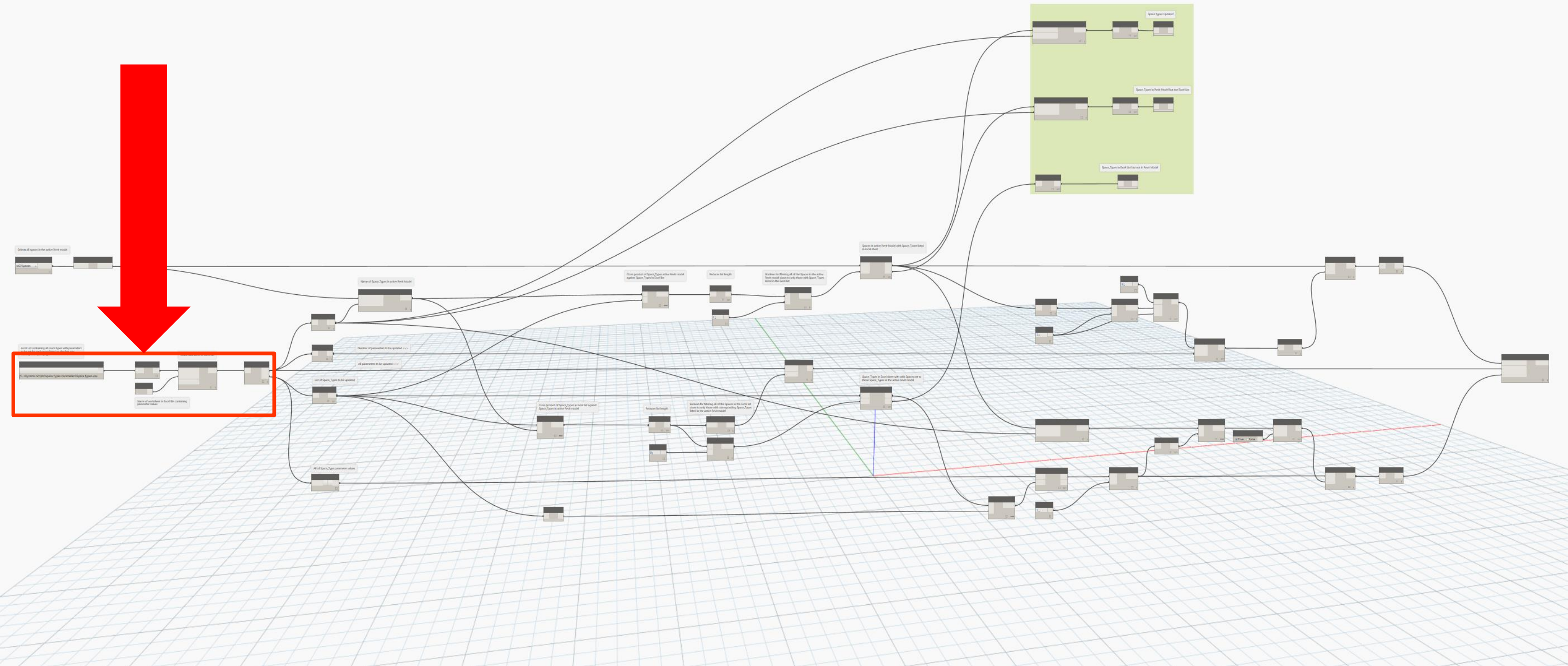
	A	B	C	D	E	F	
1	Space_Type	Design Heating Load	Design Cooling Load	Specified Return Airflow	Specified Exhaust Airflow	Specified Supply Airflow	Space_Mecha
2	Atrium	968752	861113	2472	2119	1766	
3	Cellular Office	861113	753474	2119	1766	1413	
4	Conference Cen	1076391	1184030	4238	4591	5297	
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6	Gym	645835	538196	1413	1059	706	
7	Open Office	538196	430556	1059	706	353	

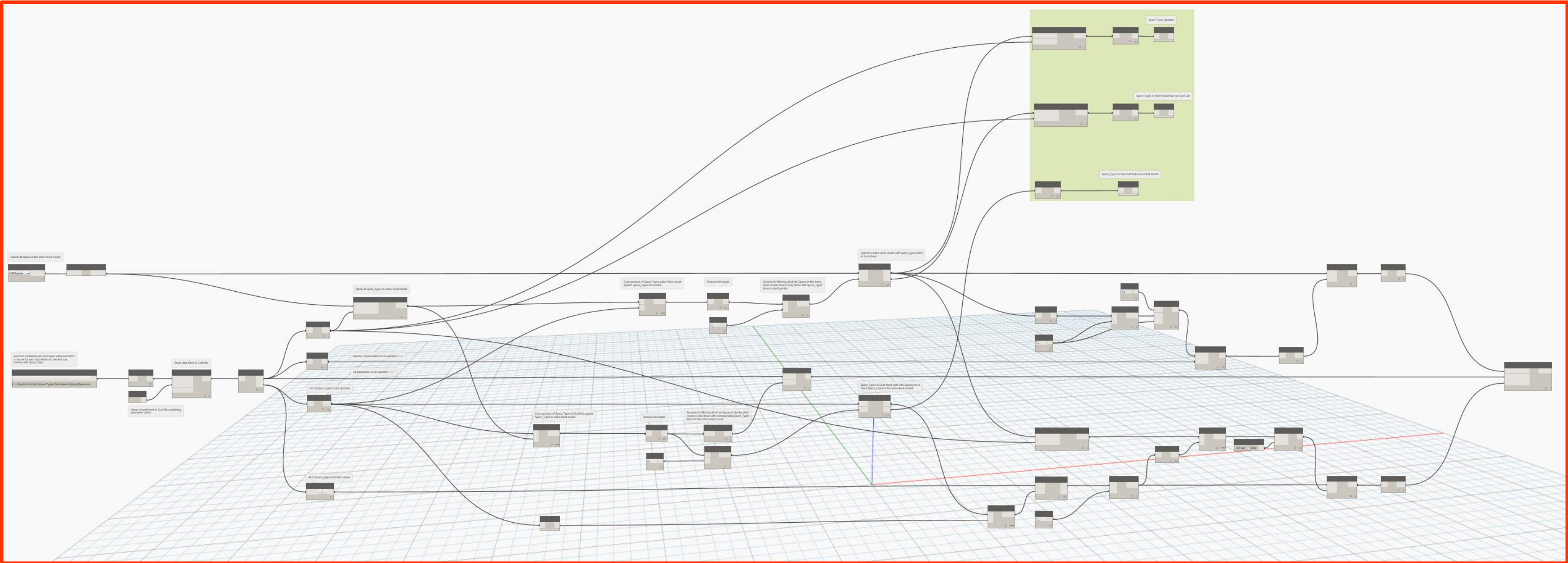
Manual Run

Saving C:\Users\andrew.duncan\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\... Backup file is saved: C:\Users\andrew.duncan\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\...

**Why is this so
important?**







Data passes through the **WHOLE** graph in **LISTS**...

FileEditViewPackagesSettingsHelp

Library

Search

Analyze

BuiltIn

Core

Display

Geometry

Office

Operators

Revit

Add

Space Types_FINAL_cleaned.dyn

Reads data listed in Excel file

FromPath

file

Excel.ReadFromFile

file

sheetName

readAsStrings

data

ing

ut >

e of worksheet in Excel file containing
meter values

Dynamo

FileEditViewPackagesSettingsHelp

Library

Search

List

List.Create

Range

Sequence

AddItemToEnd

AddItemToFront

AllIndicesOf

Chop

Clean

Combinations

ContainsItem

Count

Cycle

Deconstruct

DiagonalLeft

DiagonalRight

Save C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space Types_Data_Population.dyn ...

Backup file is saved: C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space Types_Data_Population.dyn

Save C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space Types_Data_Population.dyn ...

Backup file is saved: C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space Types_Data_Population.dyn

Save C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space Types_Data_Population.dyn ...

Backup file is saved: C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space Types_Data_Population.dyn

Manual

Run

All param...

Dynamo

File Edit View Packages Settings Help

Library

Search

Analyze

Builtin

Core

Display

Geometry

Office

Operators

Revit

Add

FromPath

file

Excel.ReadFromFile

file

sheetName

readAsStrings

data

Reads data listed in Excel file

List.Deconstruct

list

first

rest

List of Space_Types to be updated

List.FirstItem

list

item

All parameters

Index of worksheet in Excel file containing parameter values

List

- [0] List
 - [0] Space_Type
 - [1] Design Heating Load
 - [2] Design Cooling Load
 - [3] Specified Return Airflow
 - [4] Specified Exhaust Airflow
 - [5] Specified Supply Airflow
 - [6] Space_Mechanical_Cooling
 - [7] Space_Mechanical_Heating
 - [8] Space_Mechanical_Ventilat
 - [9] Space_Mechanical_Fresh Ai
 - [10] Number of People
 - [11] Space_Occupancy_HVAC_Nor
 - [12] null
 - [13] null
 - [14] null

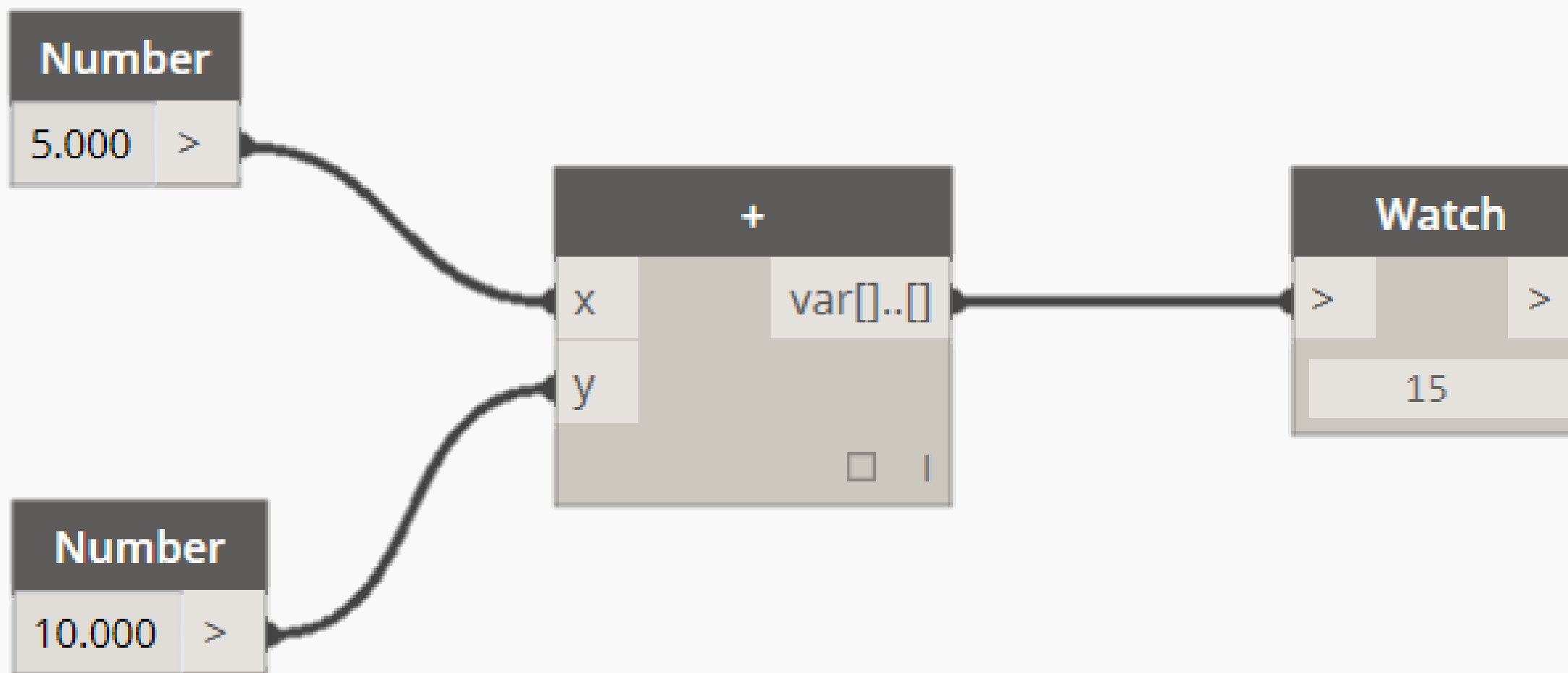
Saving C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space_Types_FINAL_cleaned.dyn ...
Backup file is saved: C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space_Types_FINAL_cleaned.dyn ...
Saving C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space_Types_FINAL_cleaned.dyn ...
Backup file is saved: C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space_Types_FINAL_cleaned.dyn ...
Saving C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space_Types_FINAL_cleaned.dyn ...
Backup file is saved: C:\Users\andrew.duncan\AppData\Roaming\Dynamo\backup\Space_Types_FINAL_cleaned.dyn ...

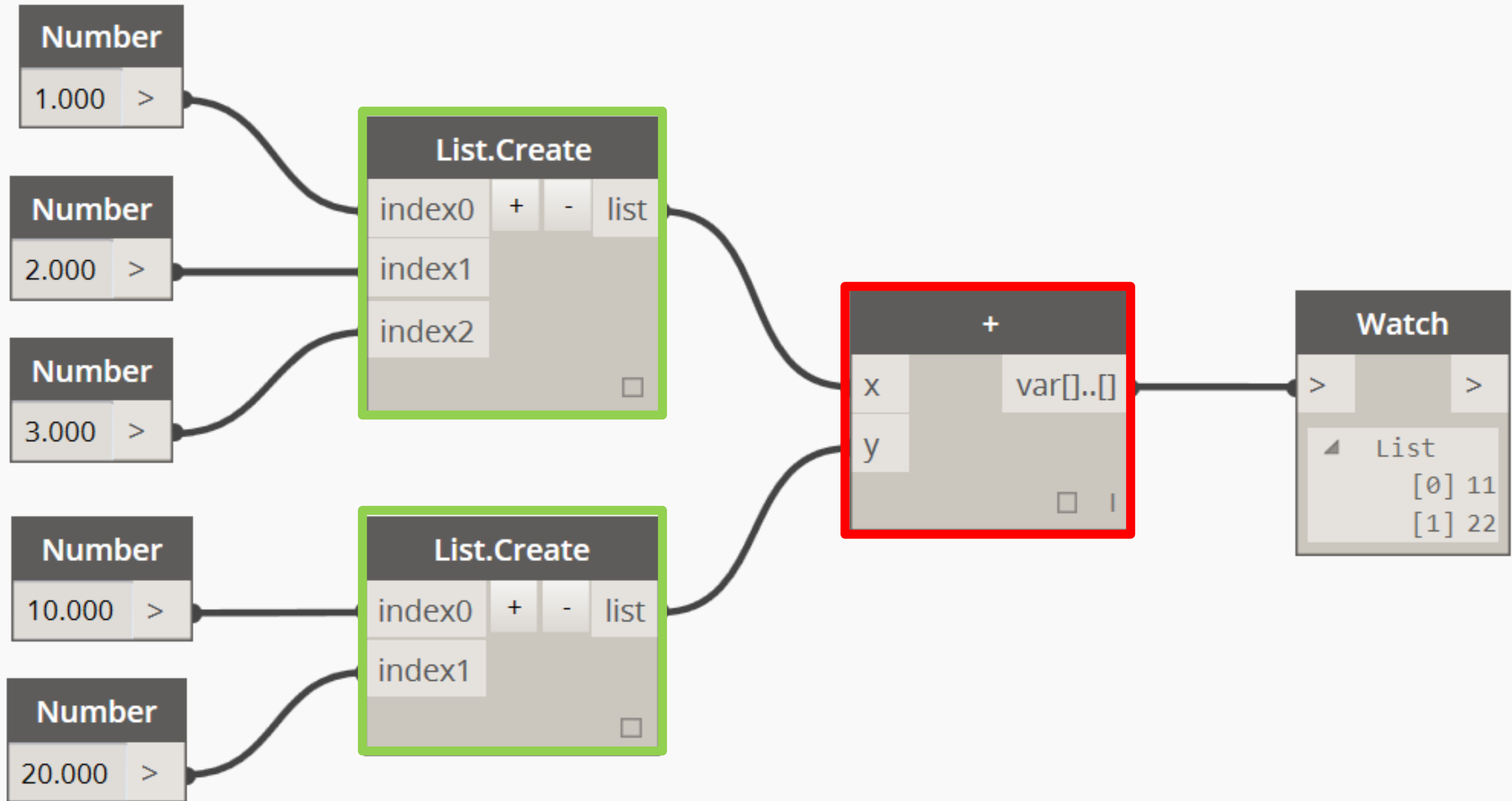
Gets the first item in a list, in this instance the *Space Type*

So why are there multiple items in the list?

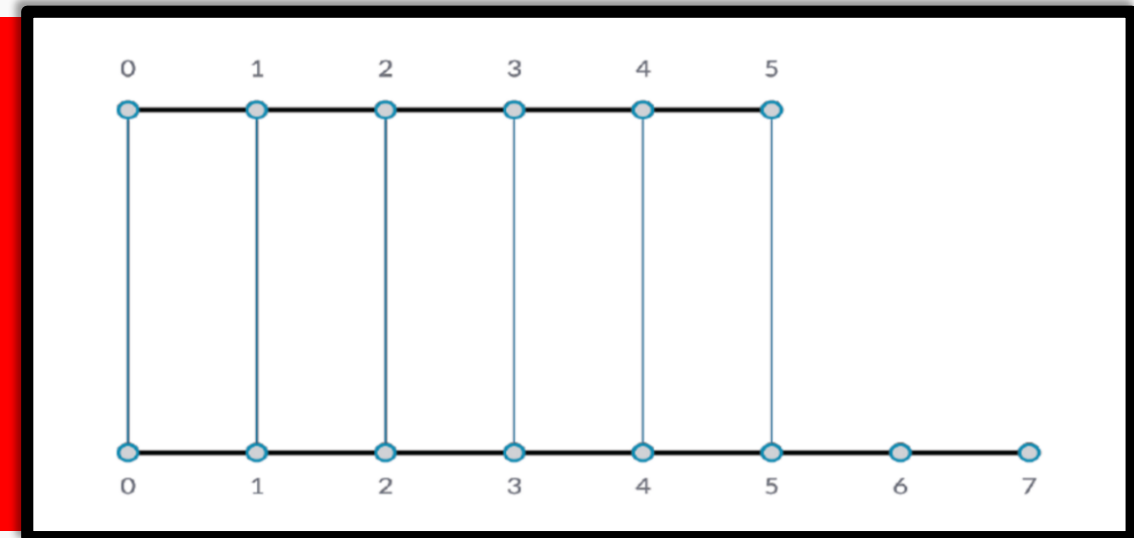


LACING

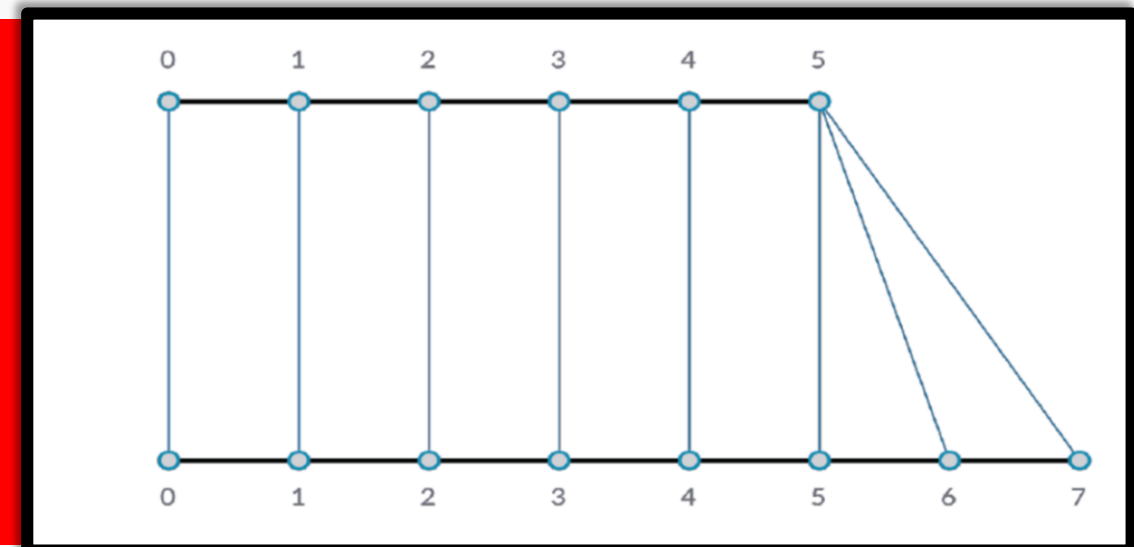




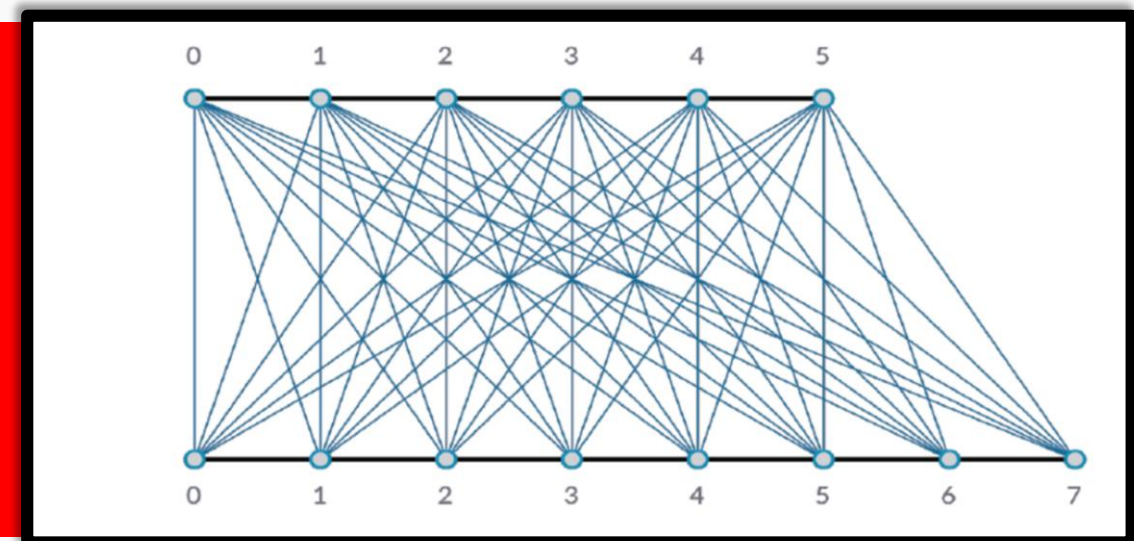
Shortest



Longest



Cross Product



Number
1.000 >

Number
2.000 >

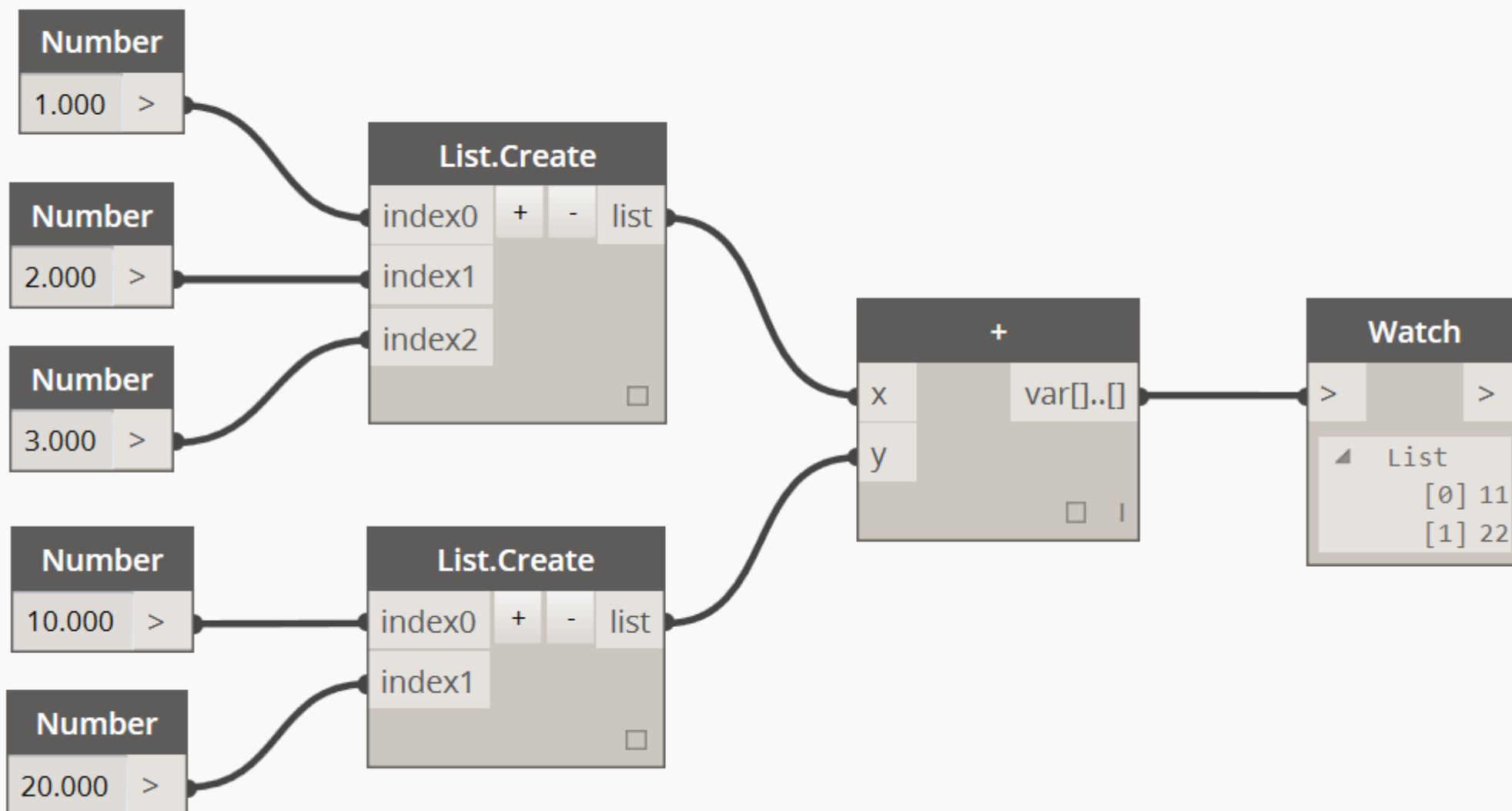
Number
3.000 >

Number
10.000 >

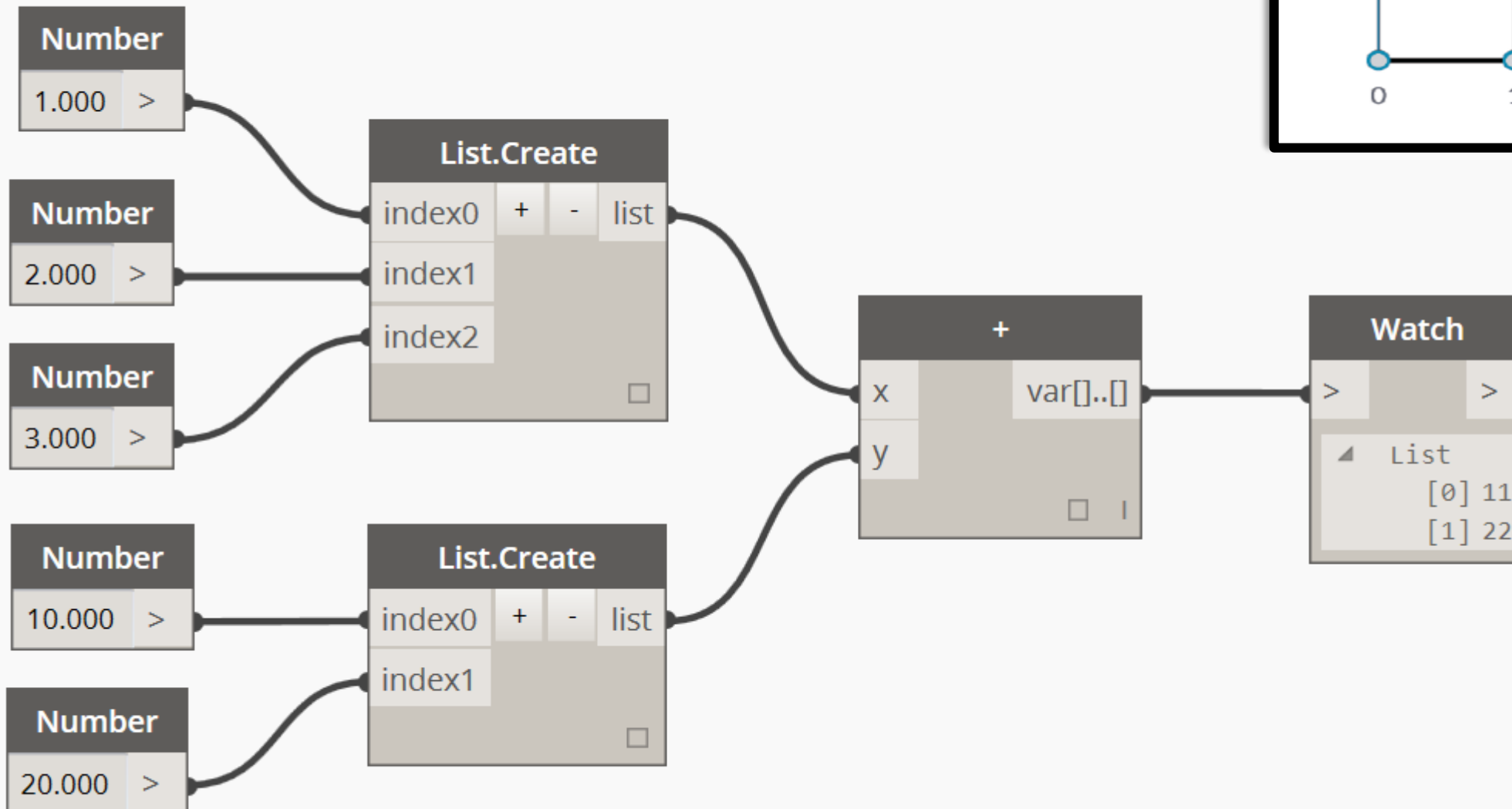
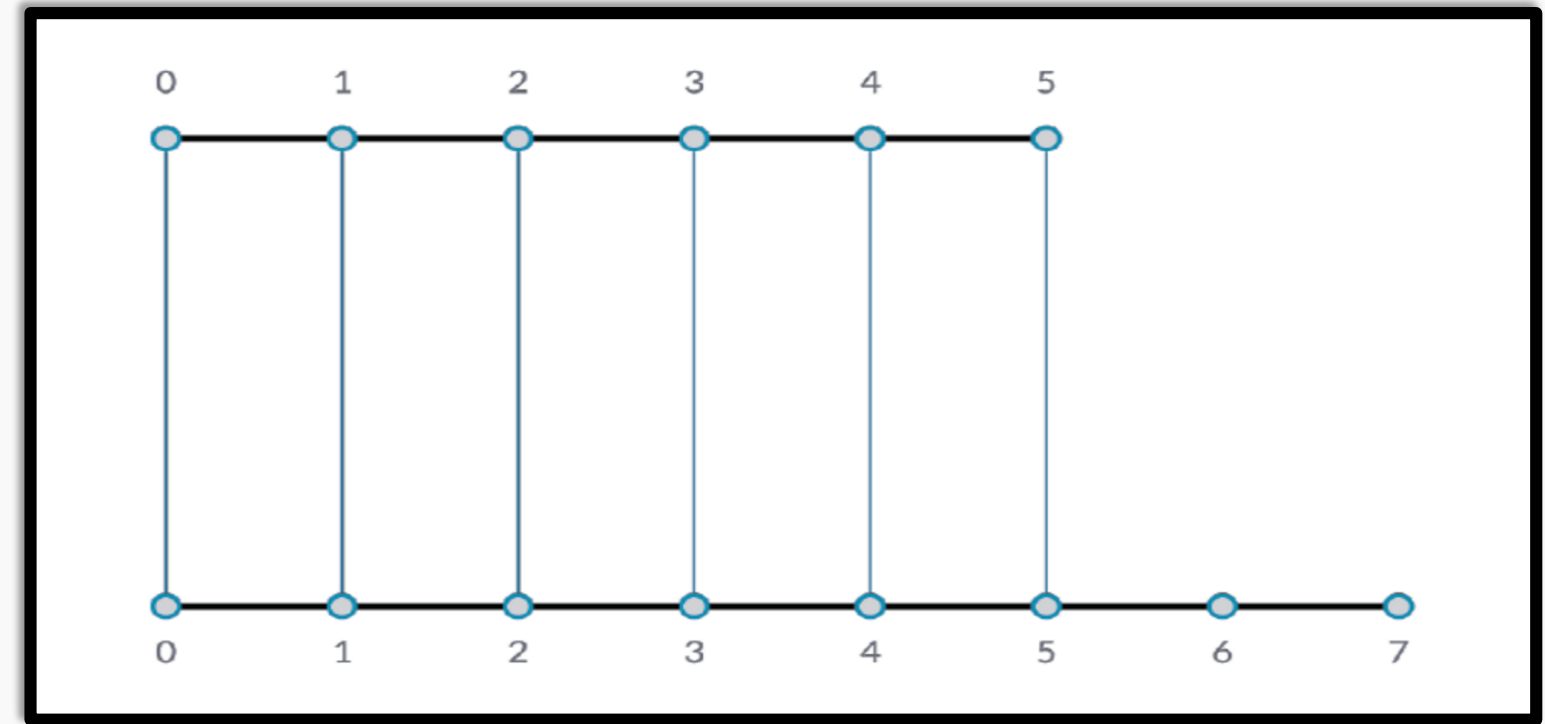
Number
20.000 >

index1

index0 + - list



Shortest



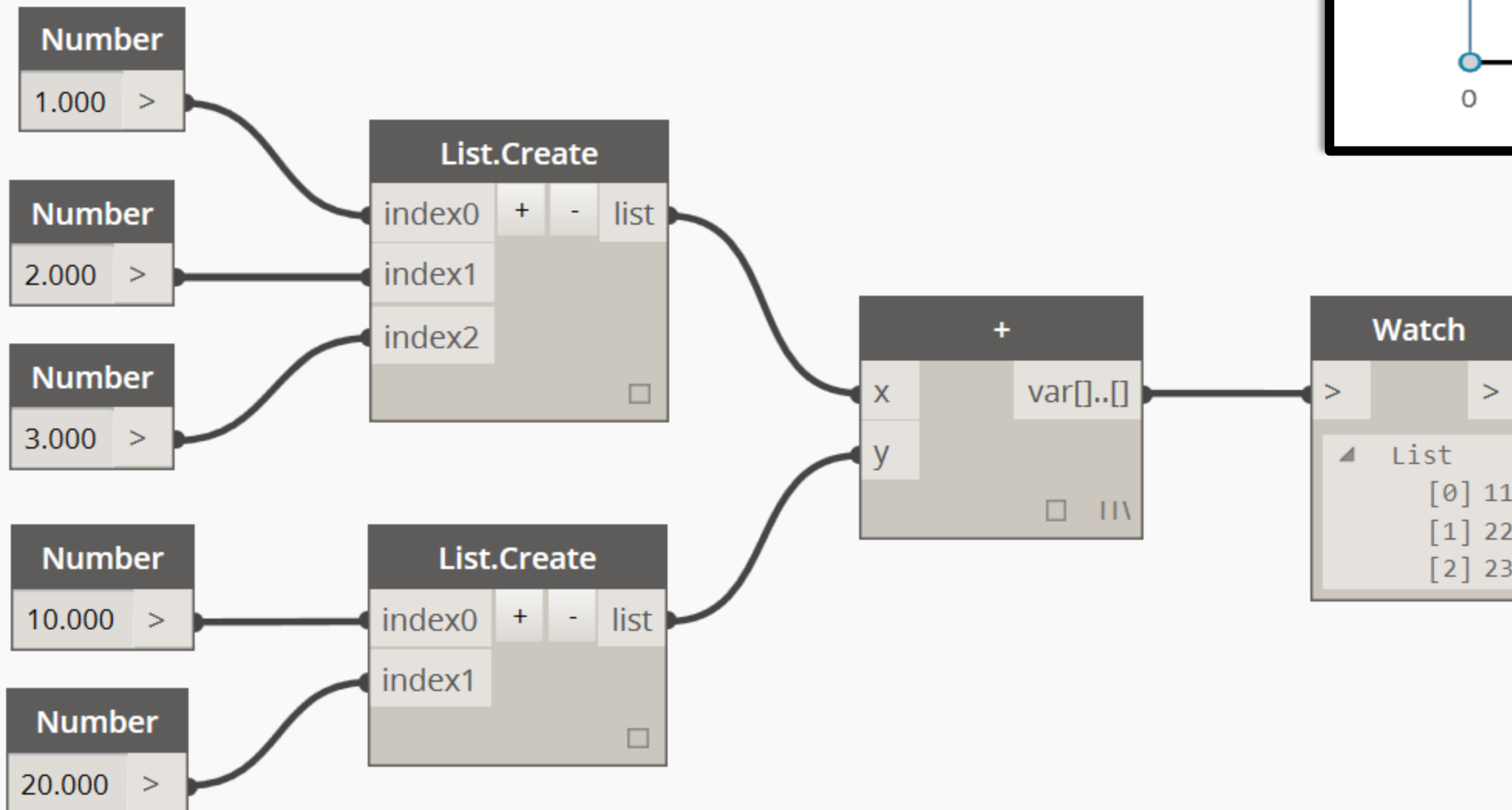
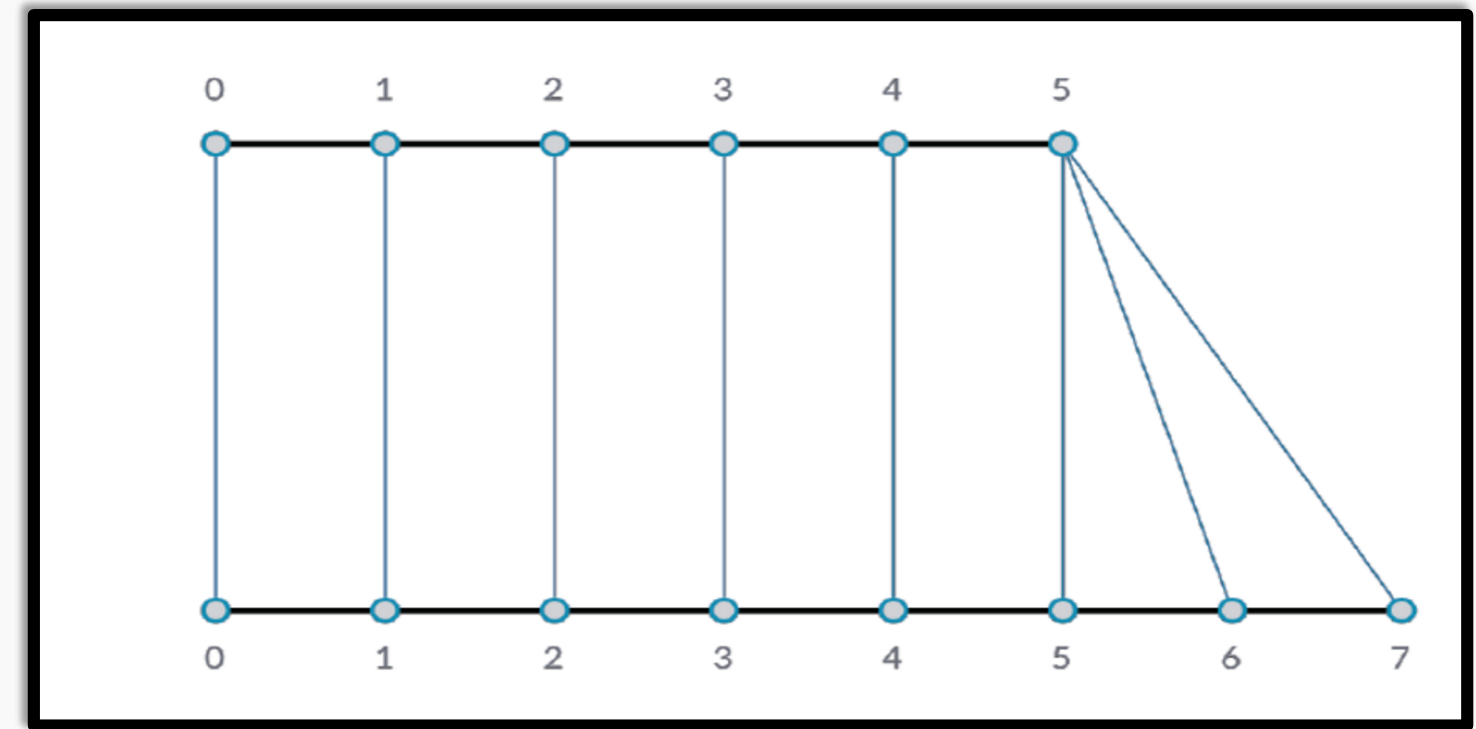
List

$$1 + 10 = 11$$

$$2 + 20 = 22$$

3 discarded

Longest



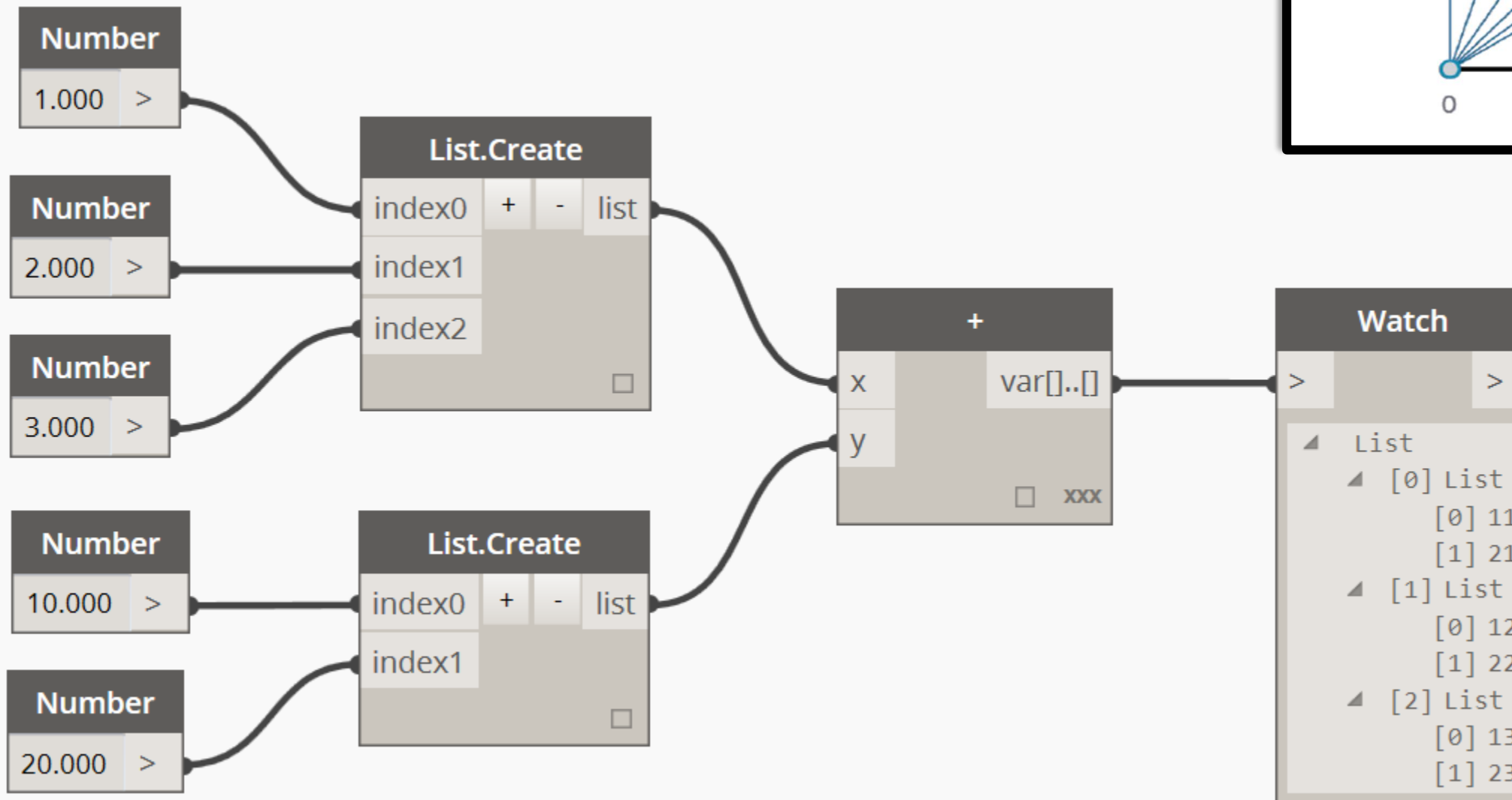
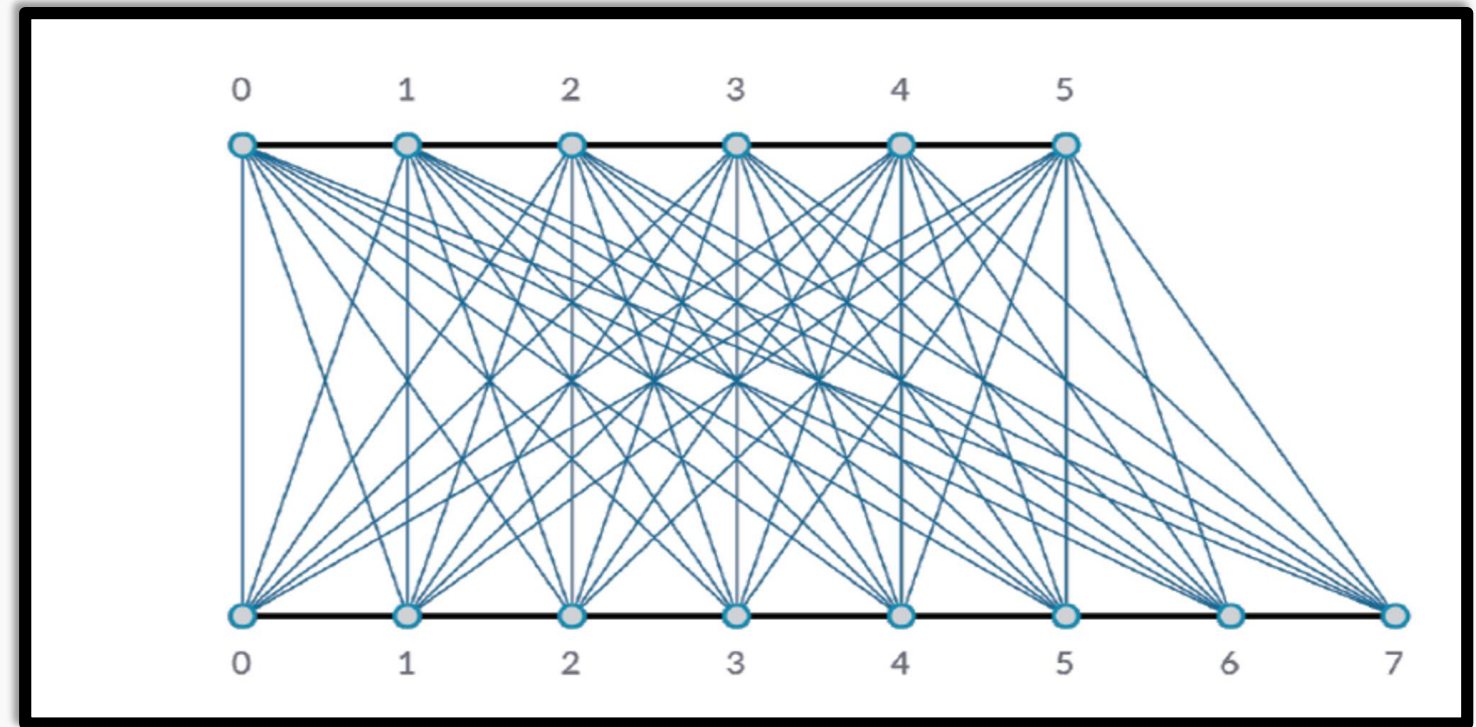
List

$$1 + 10 = 11$$

$$2 + 20 = 22$$

$$3 + 20 = 23$$

Cross Product



List

(0) List

$$1 + 10 = 11$$

$$1 + 20 = 21$$

(1) List

$$2 + 10 = 12$$

$$2 + 20 = 22$$

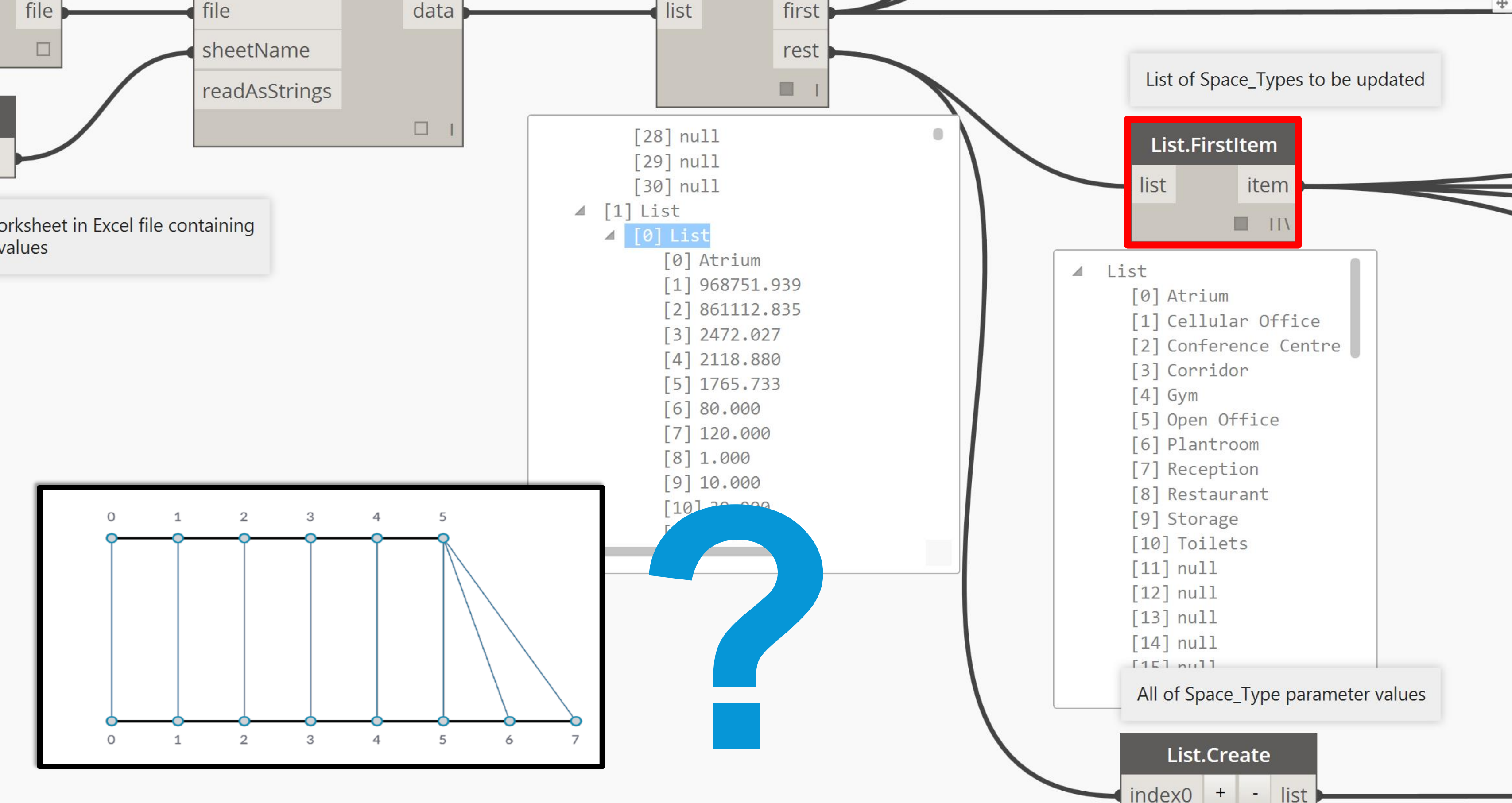
(2) List

$$3 + 10 = 13$$

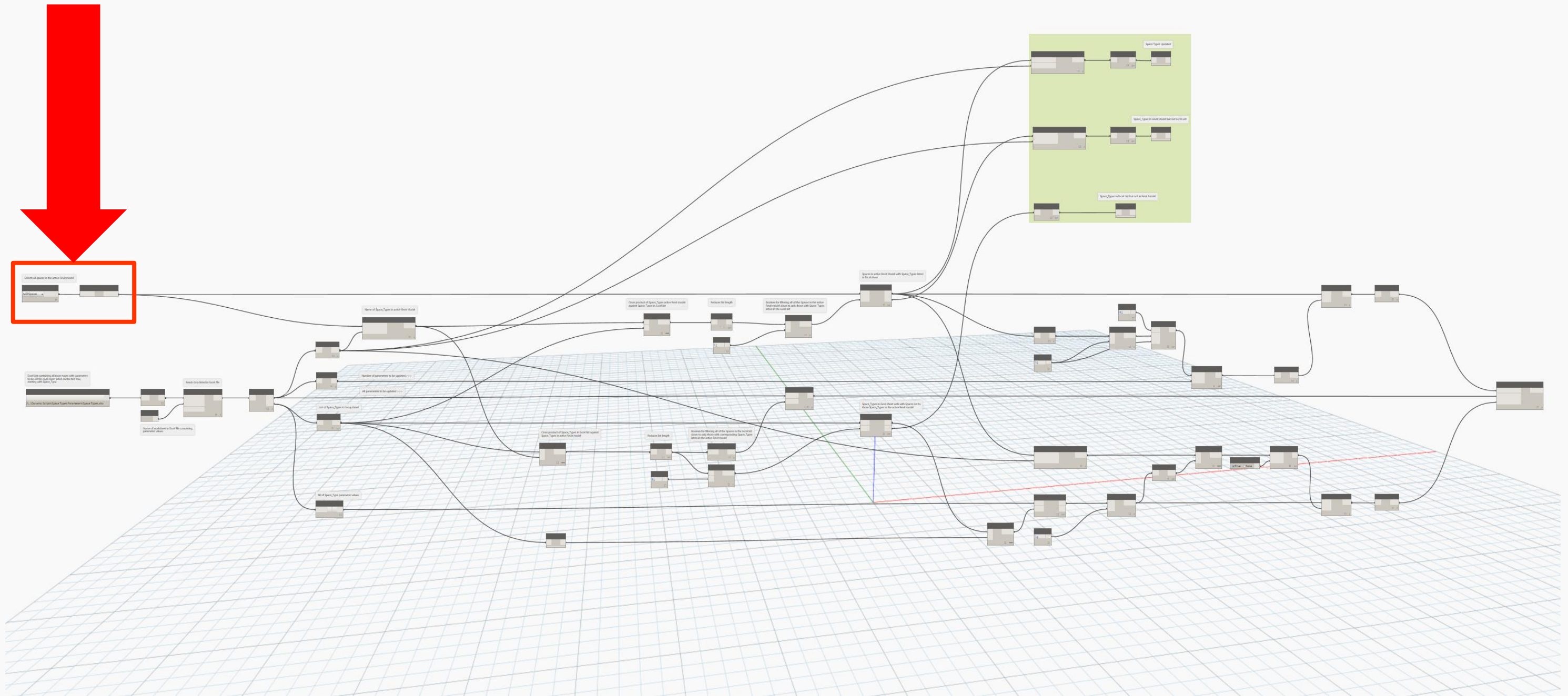
$$3 + 20 = 23$$

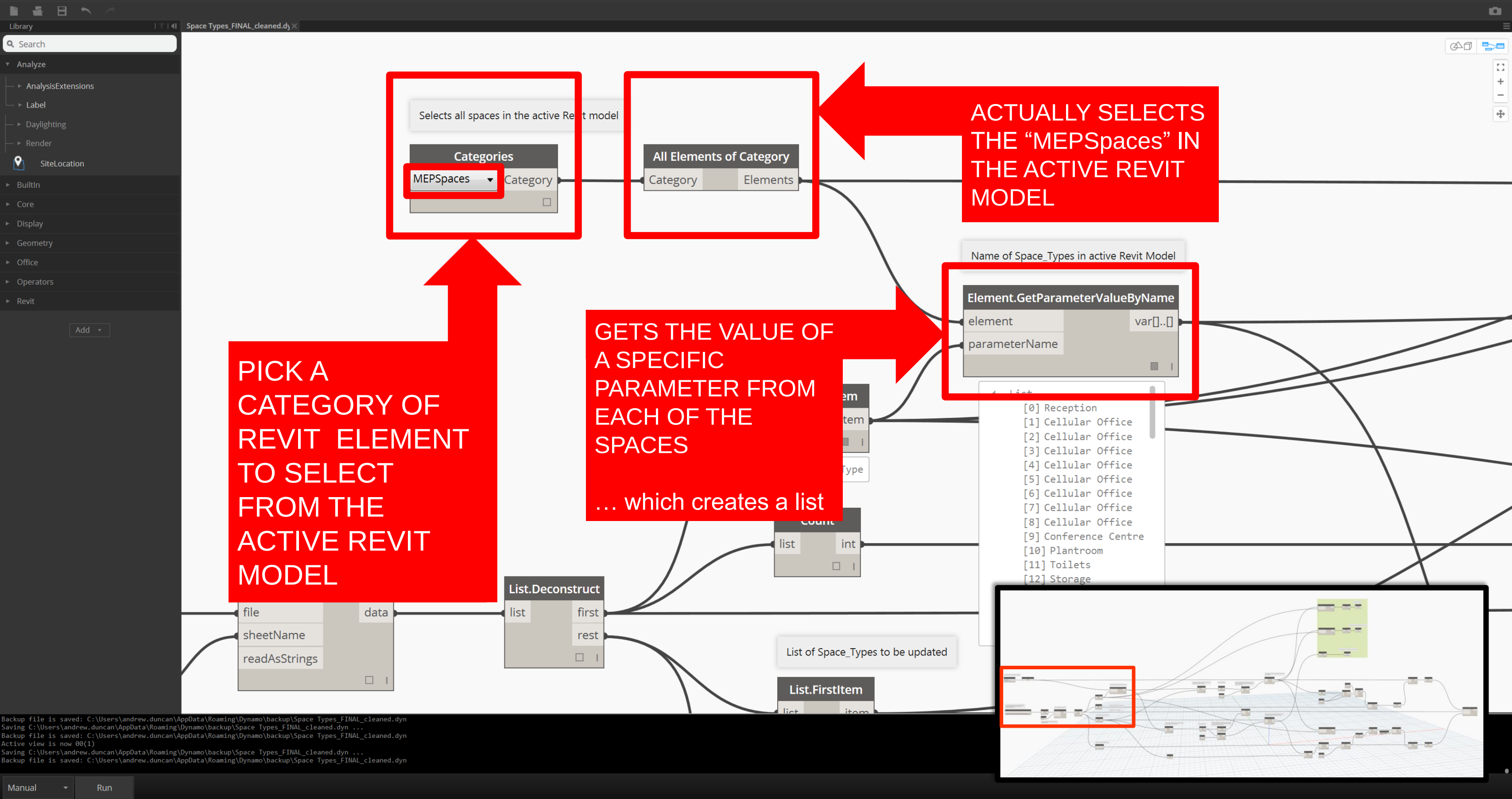
Does that make sense?

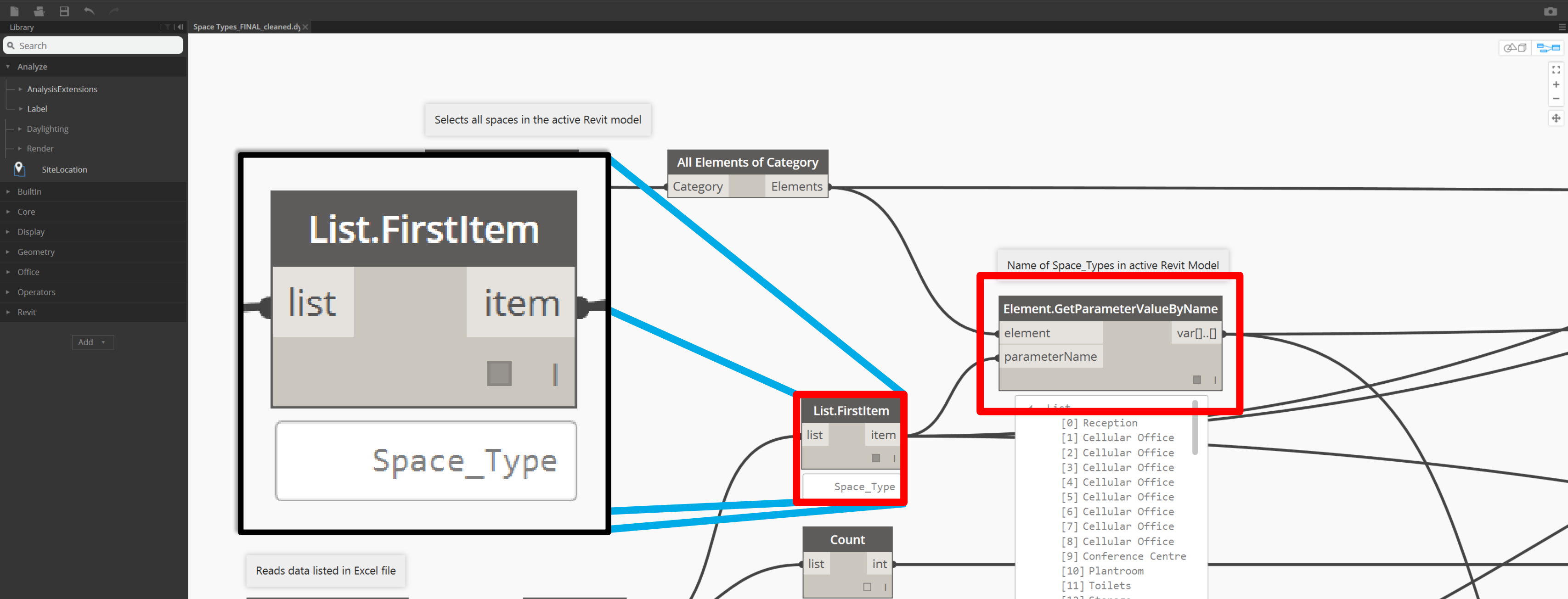
Good, but one of the best ways of working out which to *Lacing* method to use is trial and error (a lot of the time anyway)...



**We've talked a lot
about data, but what
about the model?**







Space Types.xlsx - Excel

	A	B	C	D	E	F	
1	Space_Type	Design Heating Load	Design Cooling Load	Specified Return Airflow	Specified Exhaust Airflow	Specified Supply Airflow	Space_Mecha
2	Atrium	968752	861113	2472	2119	1766	
3	Cellular Office	861113	753474	2119	1766	1413	
4	Conference Cen	1076391	1184030	4238	4591	5297	
5	Corridor	753474	645835	1766	1413	1059	
6	Gym	645835	538196	1413	1059	706	
7	Open Office	538196	430556	1059	706	353	

COUNTS THE NUMBER OF EACH SPACE TYPE PRESENT IN THE MODEL

CountTrue

list int

11\

[2] 1
[3] 2
[4] 1
[5] 21
[6] 1
[7] 2
[8] 1
[9] 1
[10] 1
[11] 0
[12] 0
[13] 0
[14] 0
[15] 0
[16] 0
[17] 0
[18] 0
[19] 0

ADDS UP THE SUM TOTAL OF SPACES WITH SPACE TYPES PRESENT IN THE MODEL FOR USE LATER IN THE SCRIPT

Math.Sum

values sum

1

>

x var[..]
y

1

List

[0] true
[1] true
[2] true
[3] true
[4] true
[5] true
[6] true
[7] true
[8] true
[9] true
[10] true
[11] false
[12] false
[13] false
[14] false
[15] false
[16] false

FILTERS THE ORIGINAL LIST TO ONLY THOSE SPACE TYPES PRESENT IN THE MODEL

List.FilterByBoolMask

list in
mask out

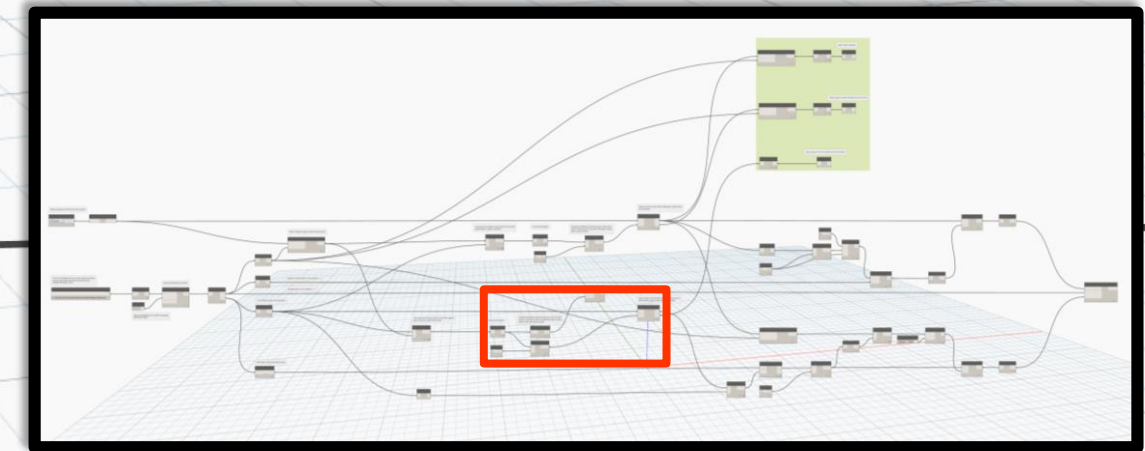
11\

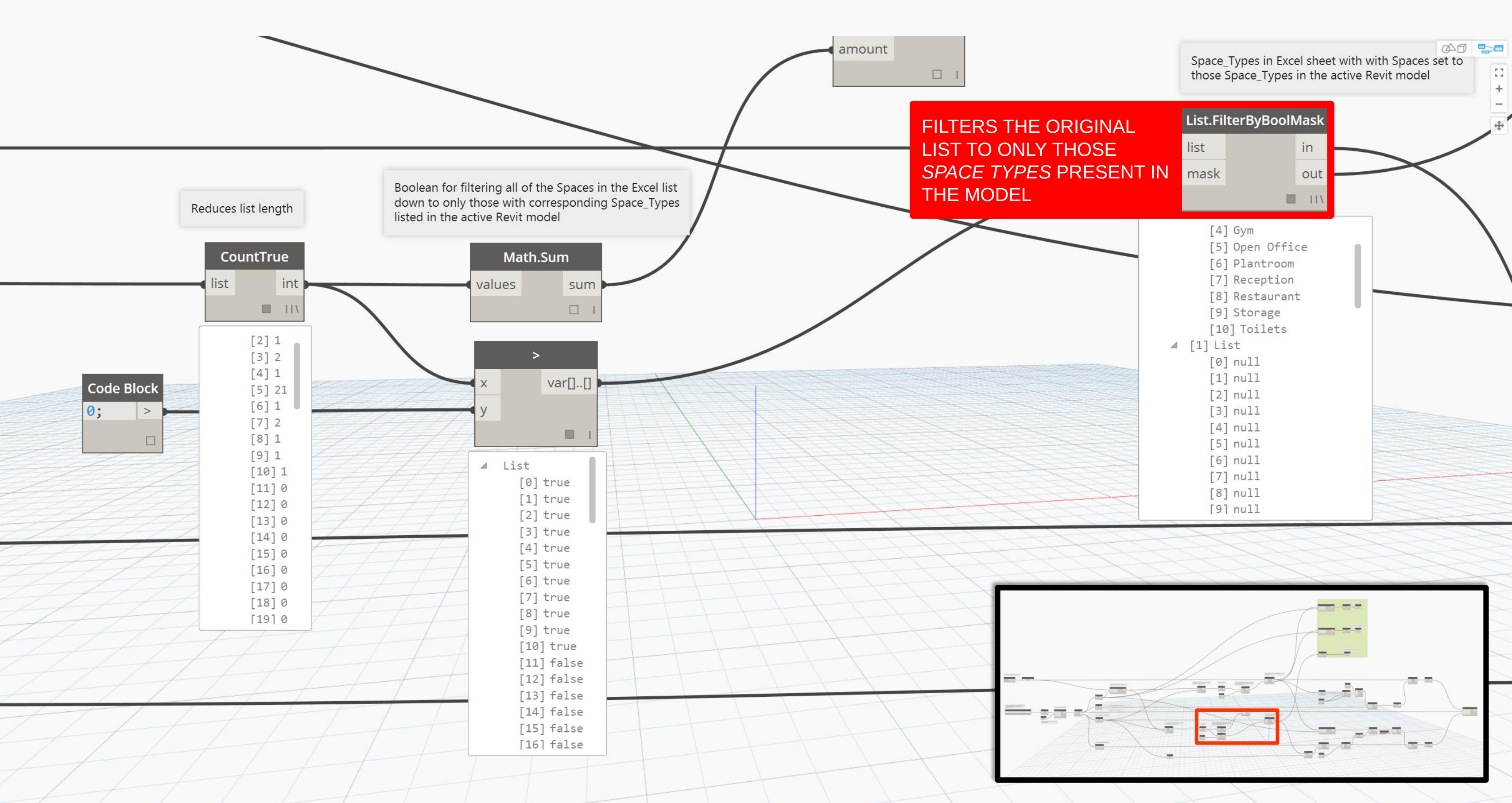
[4] Gym
[5] Open Office
[6] Plantroom
[7] Reception
[8] Restaurant
[9] Storage
[10] Toilets
[1] List
[0] null
[1] null
[2] null
[3] null
[4] null
[5] null
[6] null
[7] null
[8] null
[9] null

Code Block

0; >

1





Reduces list length

Boolean for filtering all of the Spaces in the Excel list down to only those with corresponding Space_Types listed in the active Revit model

FILTERS THE ORIGINAL LIST TO ONLY THOSE SPACE TYPES PRESENT IN THE MODEL

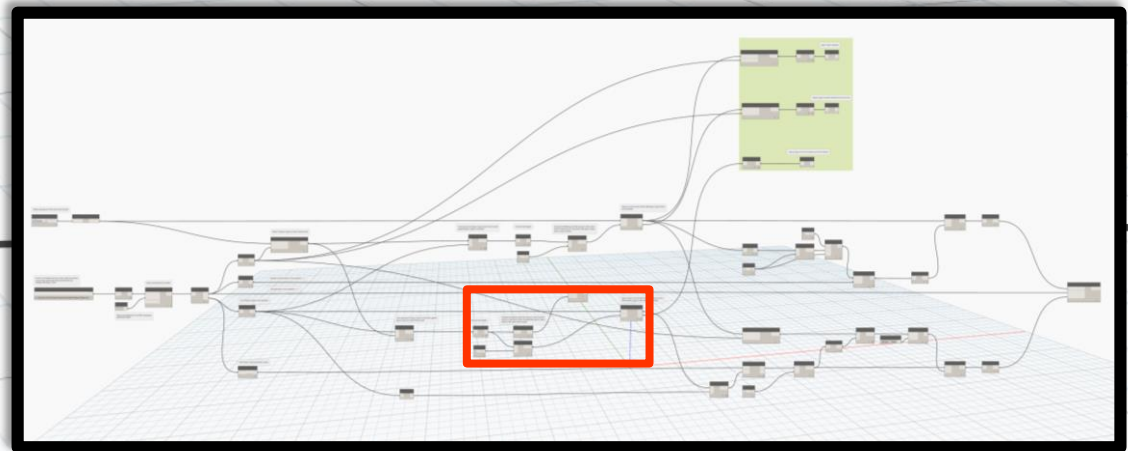
Space_Types in Excel sheet with with Spaces set to those Space_Types in the active Revit model

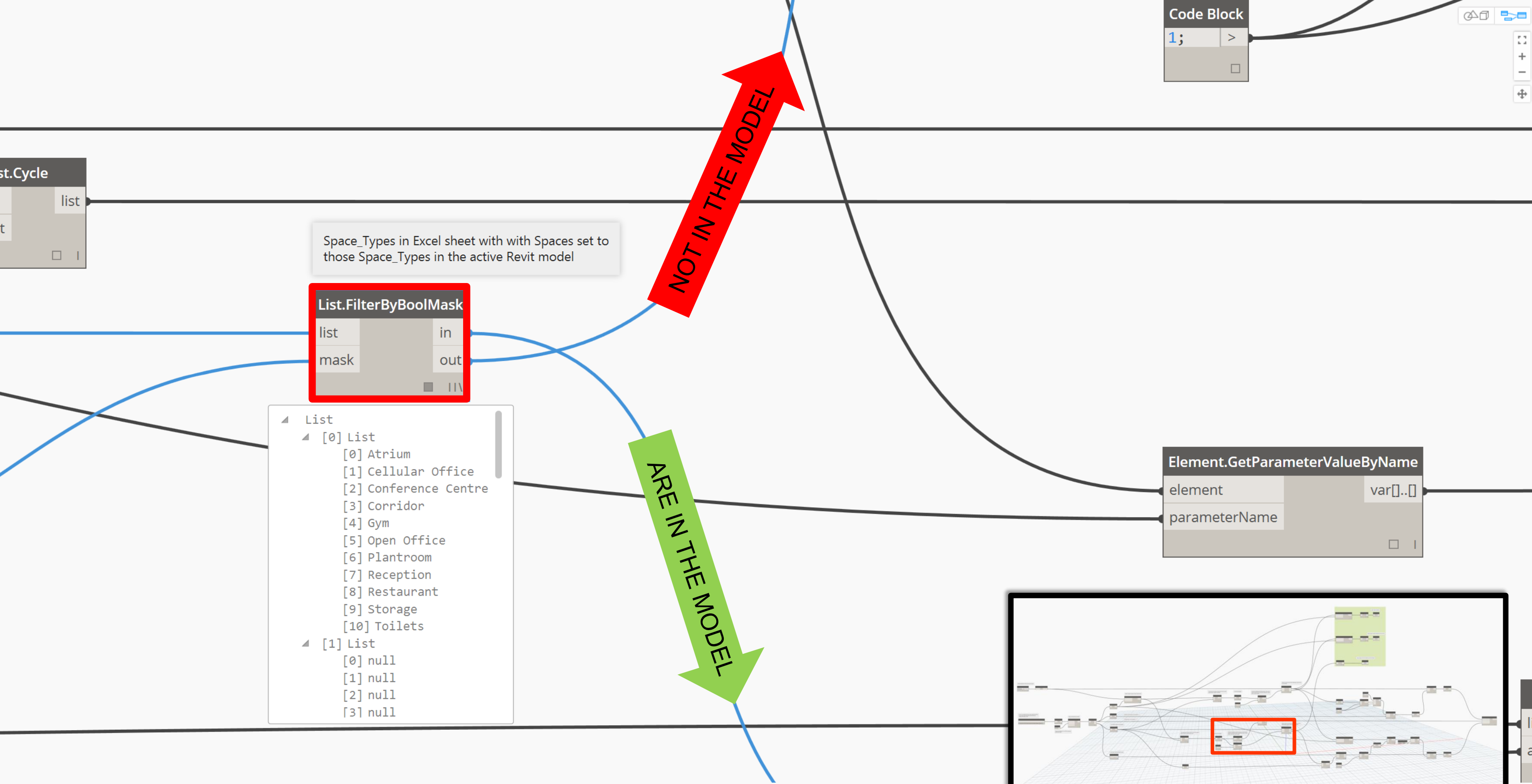
List.FilterByBoolMask

list	in
mask	out

- [4] Gym
- [5] Open Office
- [6] Plantroom
- [7] Reception
- [8] Restaurant
- [9] Storage
- [10] Toilets
- ▲ [1] List
 - [0] null
 - [1] null
 - [2] null
 - [3] null
 - [4] null
 - [5] null
 - [6] null
 - [7] null
 - [8] null
 - [9] null

- ▲ List
- [0] true
 - [1] true
 - [2] true
 - [3] true
 - [4] true
 - [5] true
 - [6] true
 - [7] true
 - [8] true
 - [9] true
 - [10] true
 - [11] false
 - [12] false
 - [13] false
 - [14] false
 - [15] false
 - [16] false





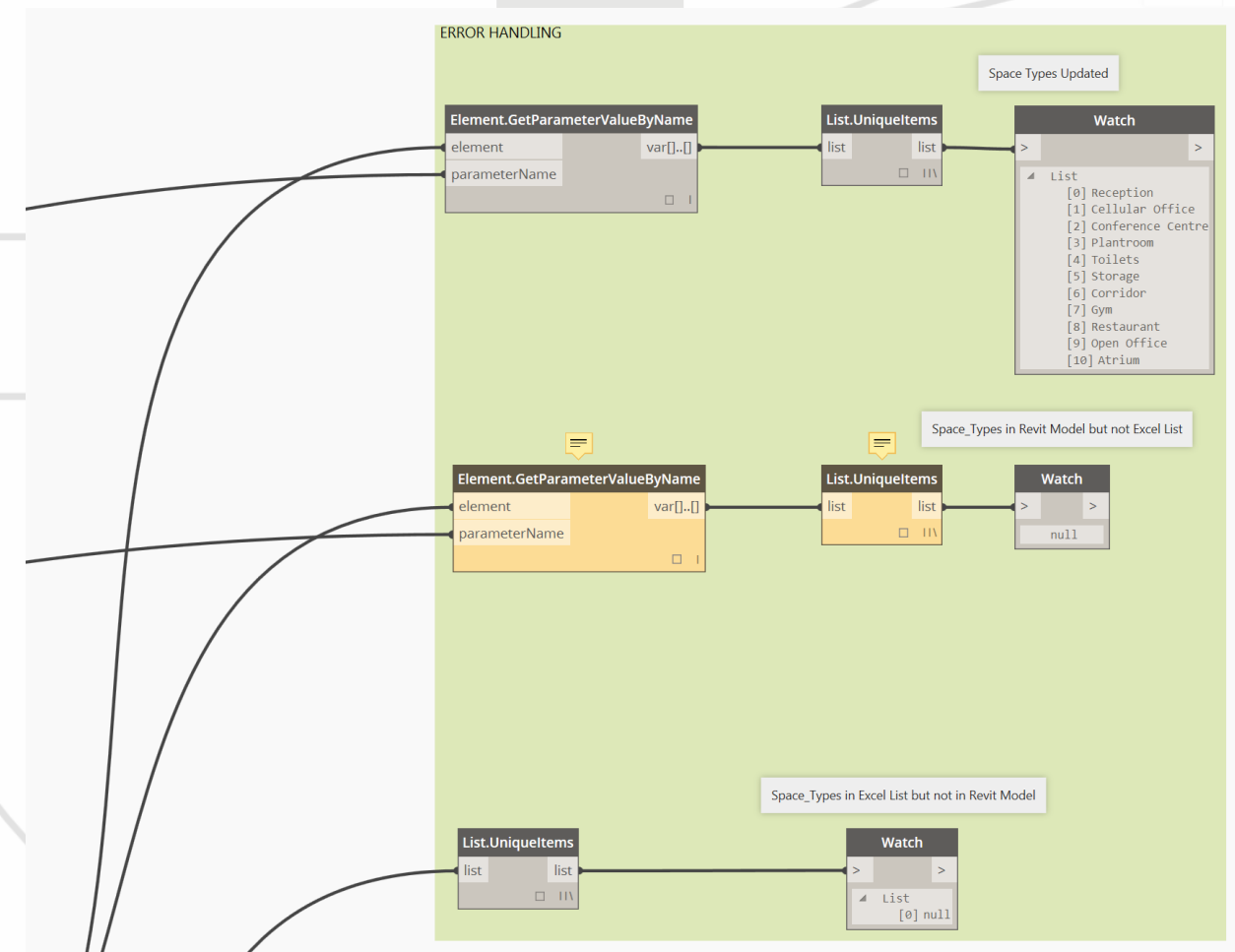
st.Cycle
list

Space_Types in Excel sheet with with Spaces set to those Space_Types in the active Revit model

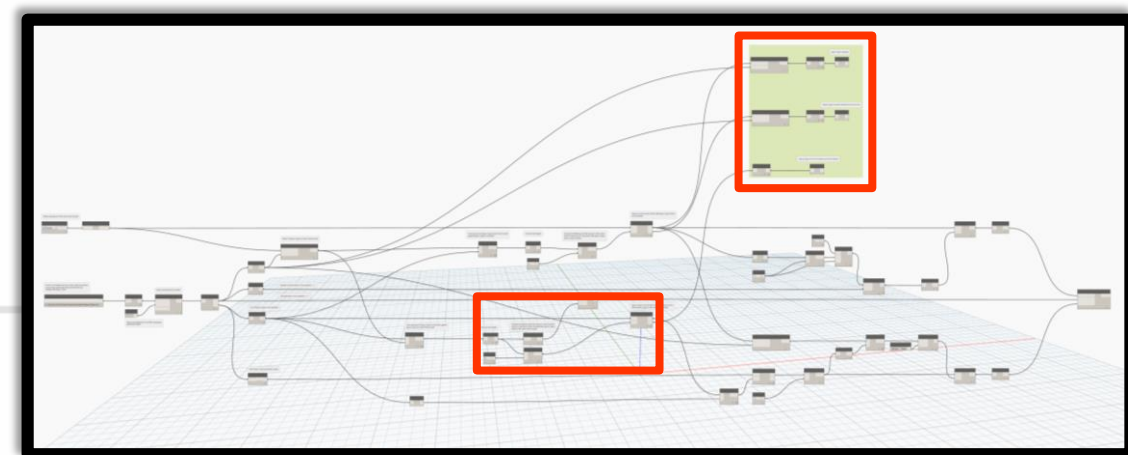
List.FilterByBoolMask
list in
mask out

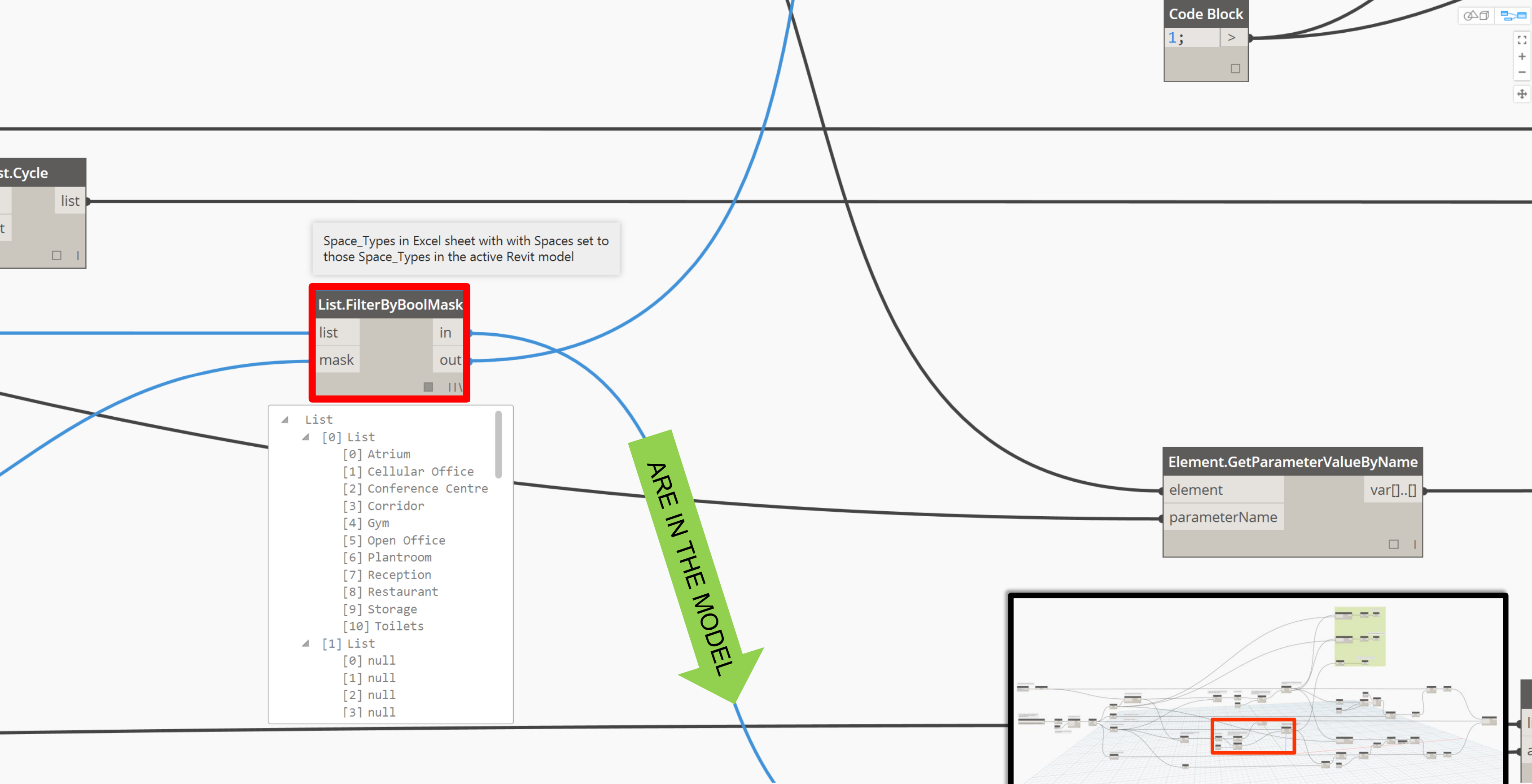
- List
 - [0] List
 - [0] Atrium
 - [1] Cellular Office
 - [2] Conference Centre
 - [3] Corridor
 - [4] Gym
 - [5] Open Office
 - [6] Plantroom
 - [7] Reception
 - [8] Restaurant
 - [9] Storage
 - [10] Toilets
 - [1] List
 - [0] null
 - [1] null
 - [2] null
 - [3] null

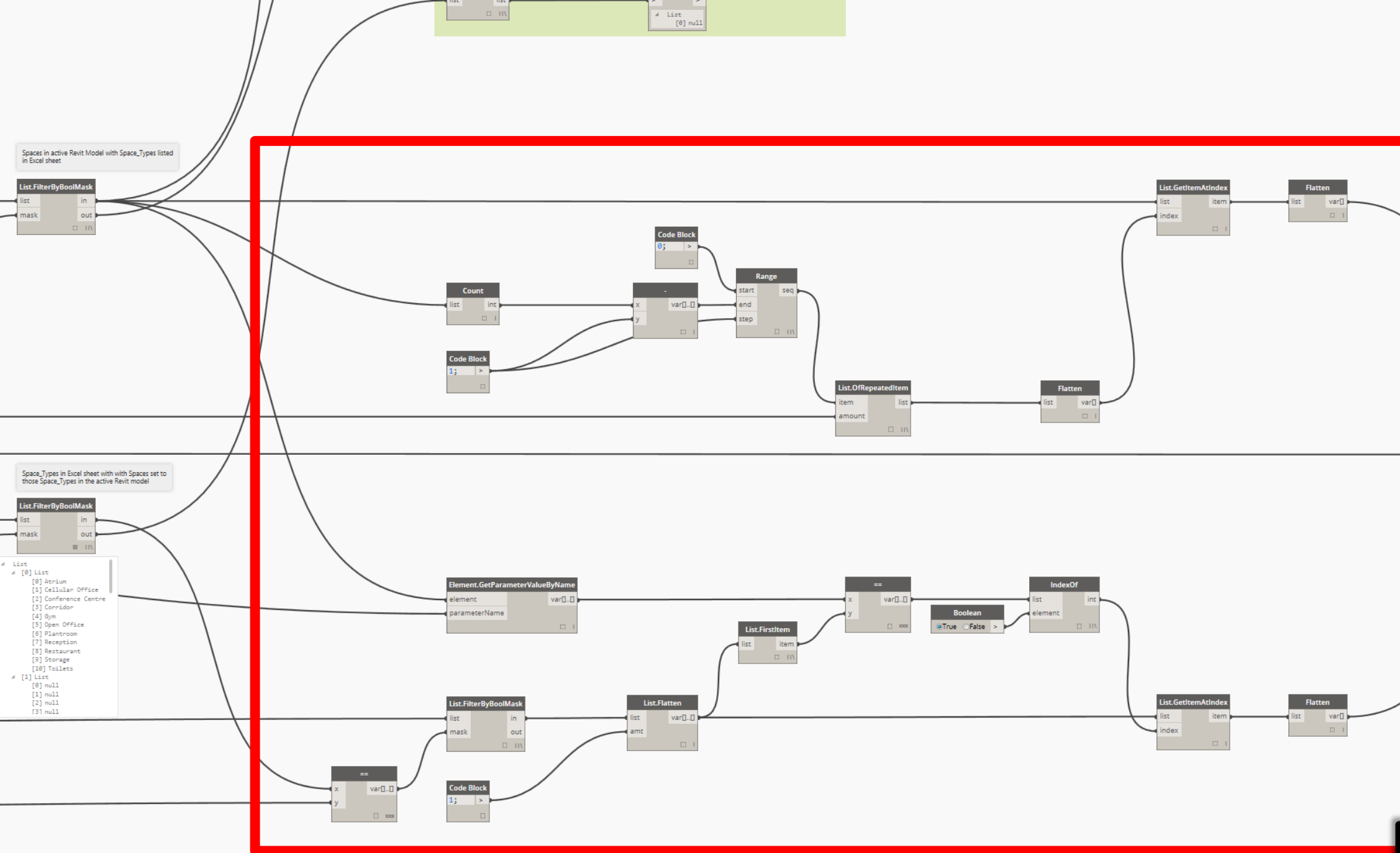
NOT IN THE MODEL



Element.GetParameterValueByName
element
parameterName
var[]..[]

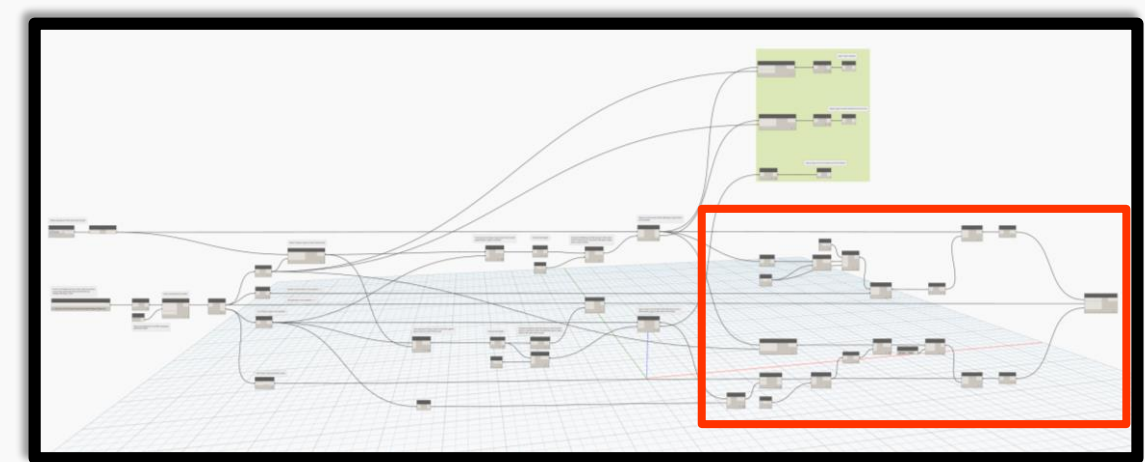
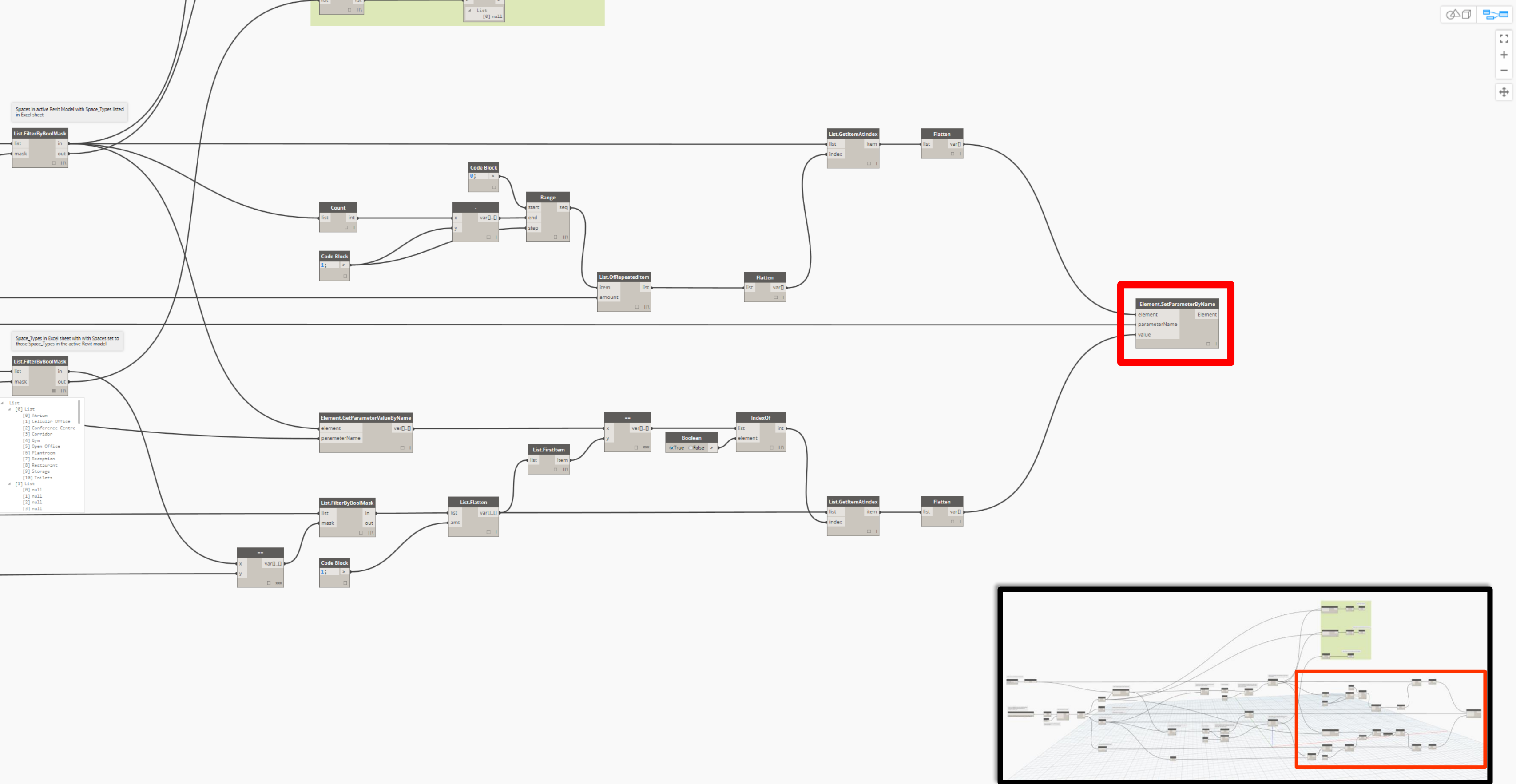


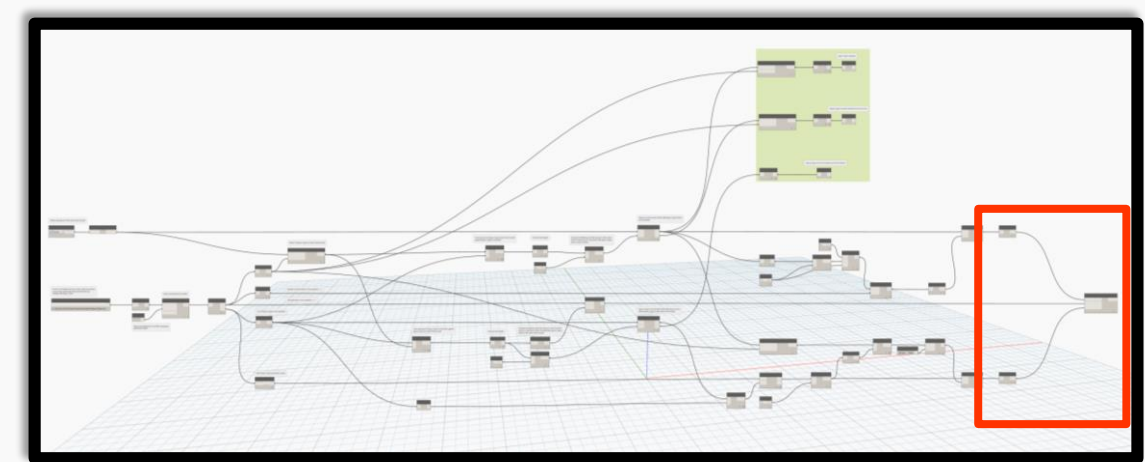


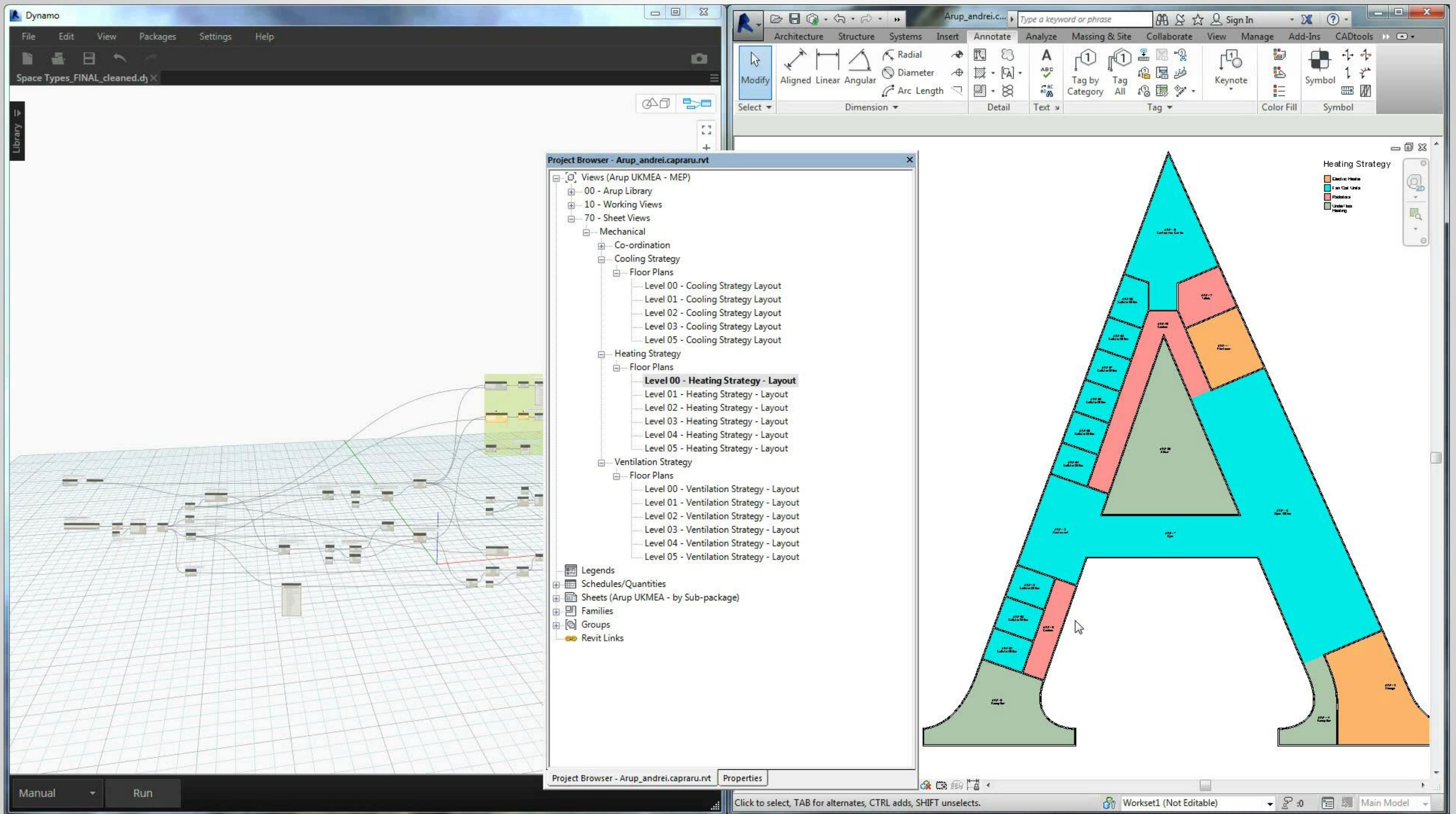


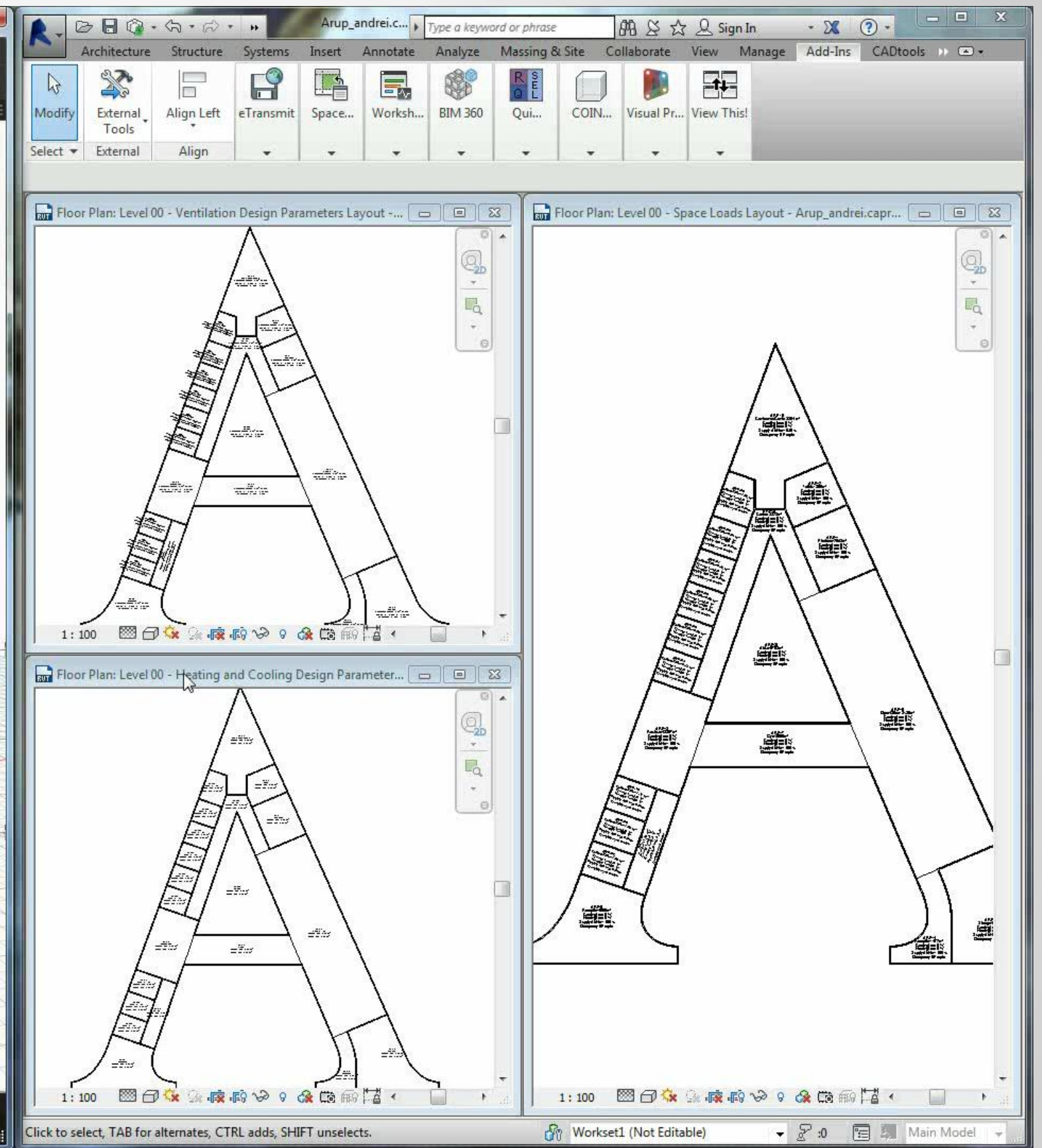
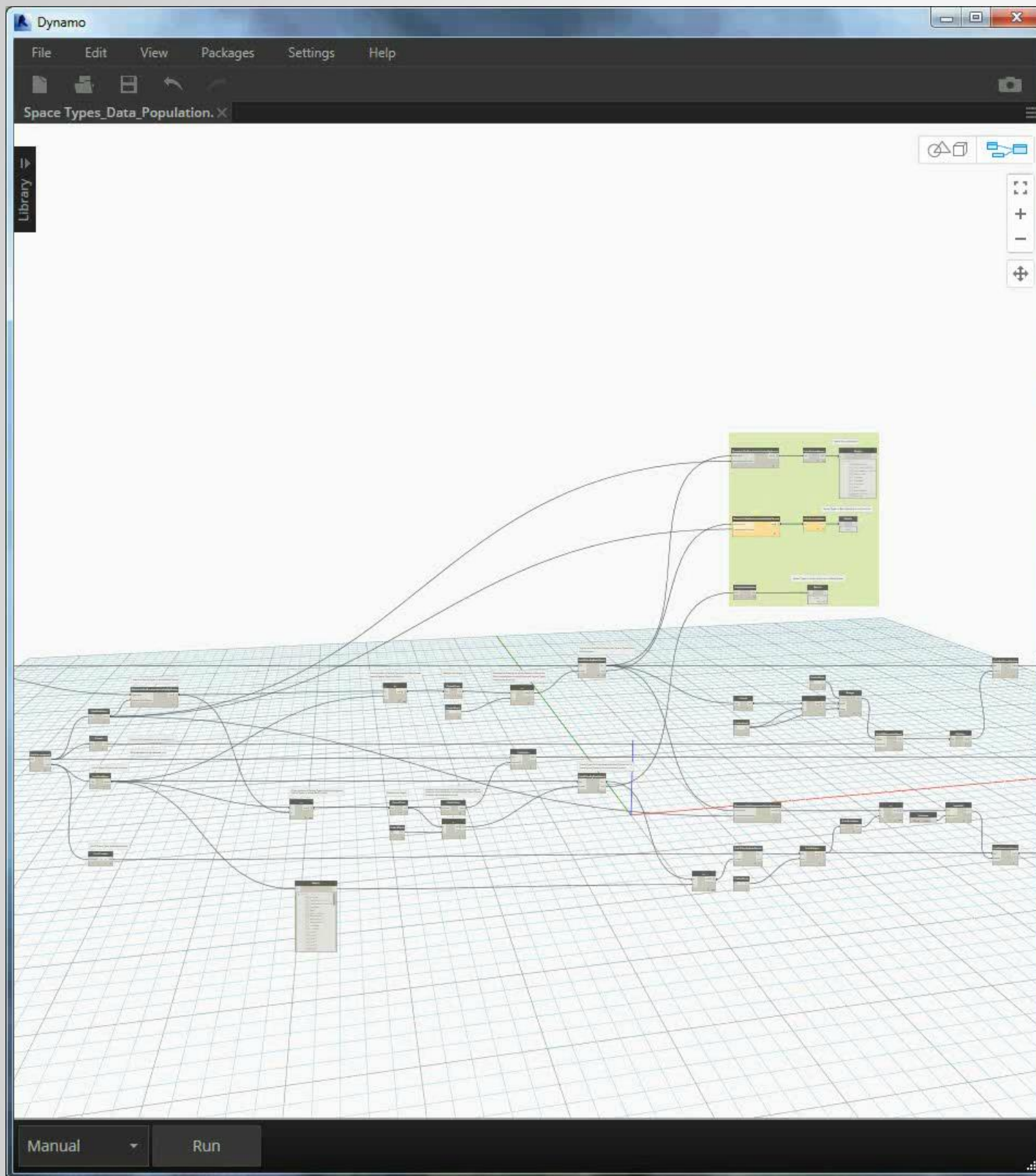
RESTRUCTURING
THE LIST DATA IN
ORDER TO
PREPARE THE
PARAMETER
VALUES BEING
PUSHED INTO THE
SPACES
THEMSELVES











Using *Space* parameters to inform calculations using Dynamo



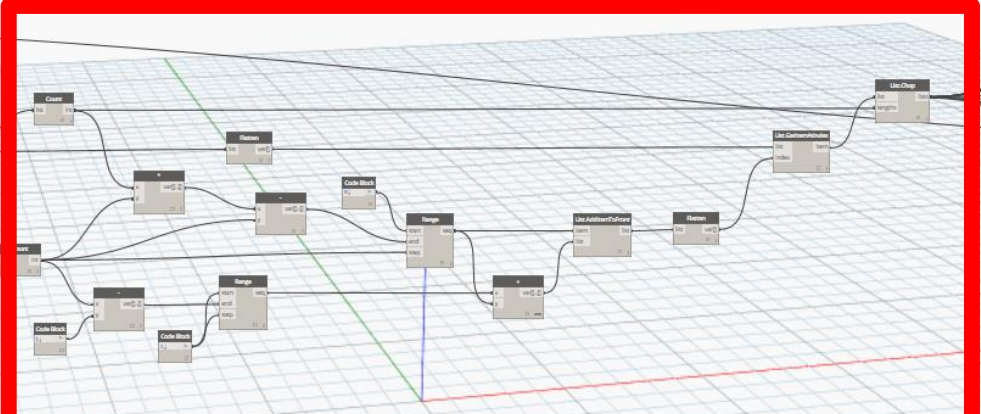
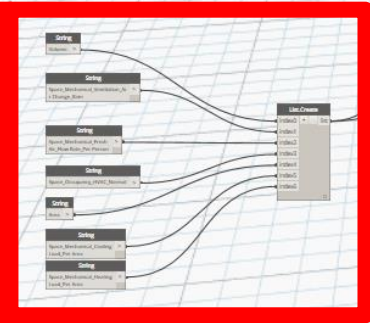
SELECT THE SPACES IN THE MODEL



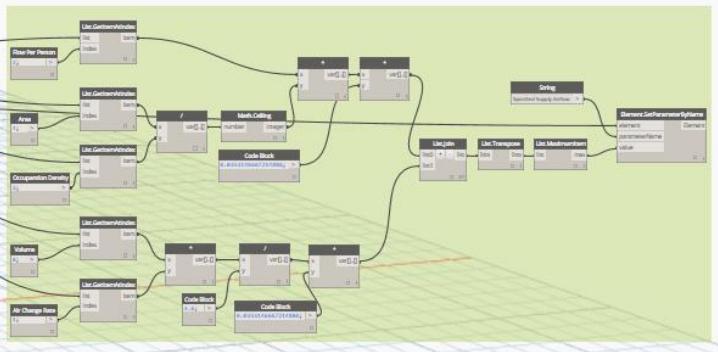
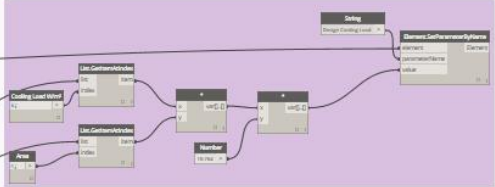
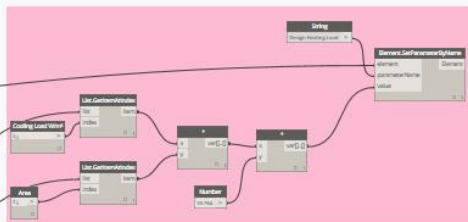
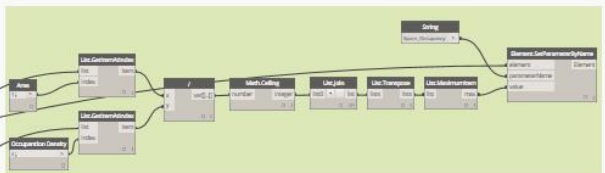
GET THE PARAMETER VALUES



CREATE A LIST OF THE PARAMETERS WE WANT FROM THESE SPACES

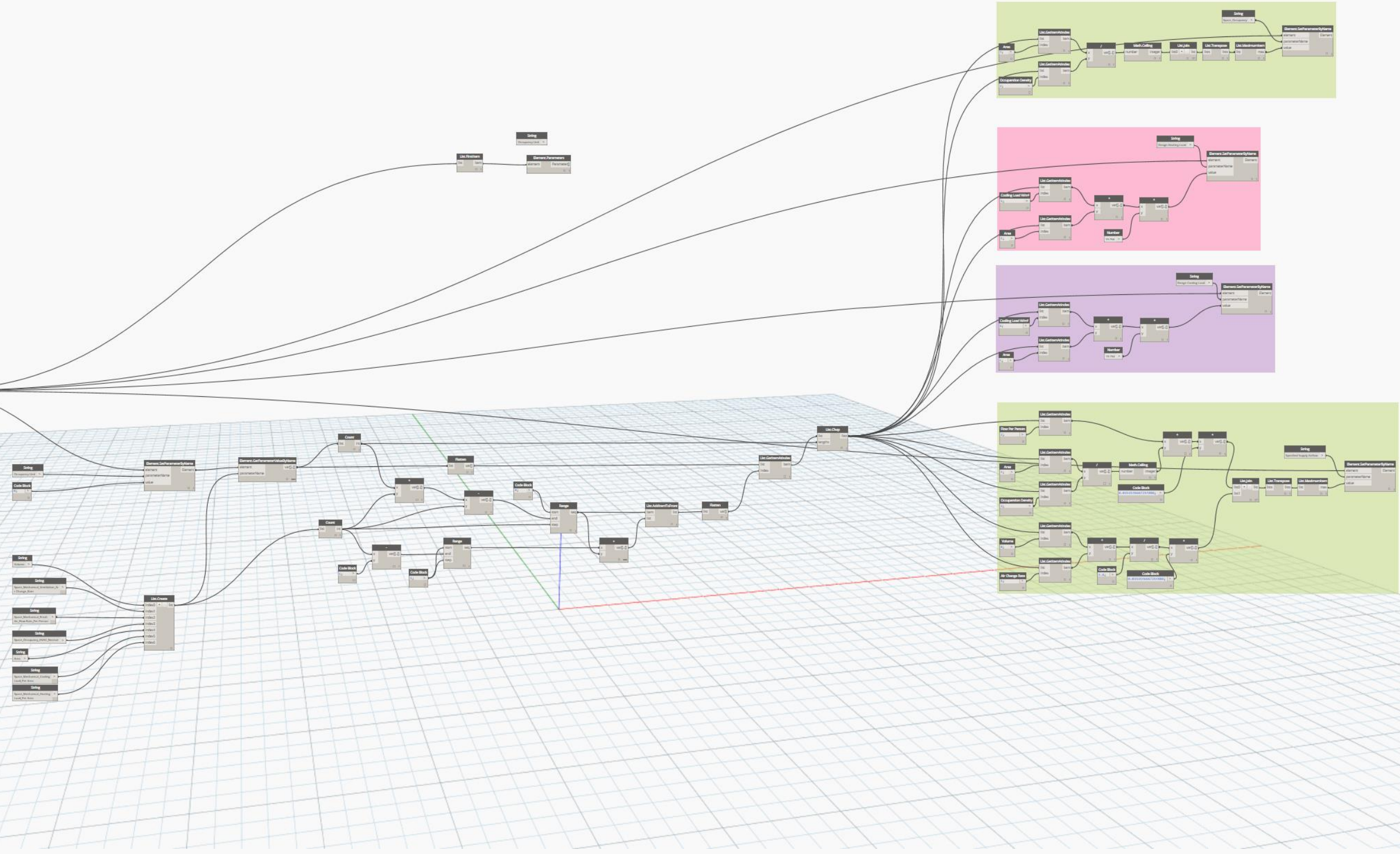


RE-ORDER THE LISTS CONTAINING THE PARAMETER VALUES FOR USE IN CALCULATIONS

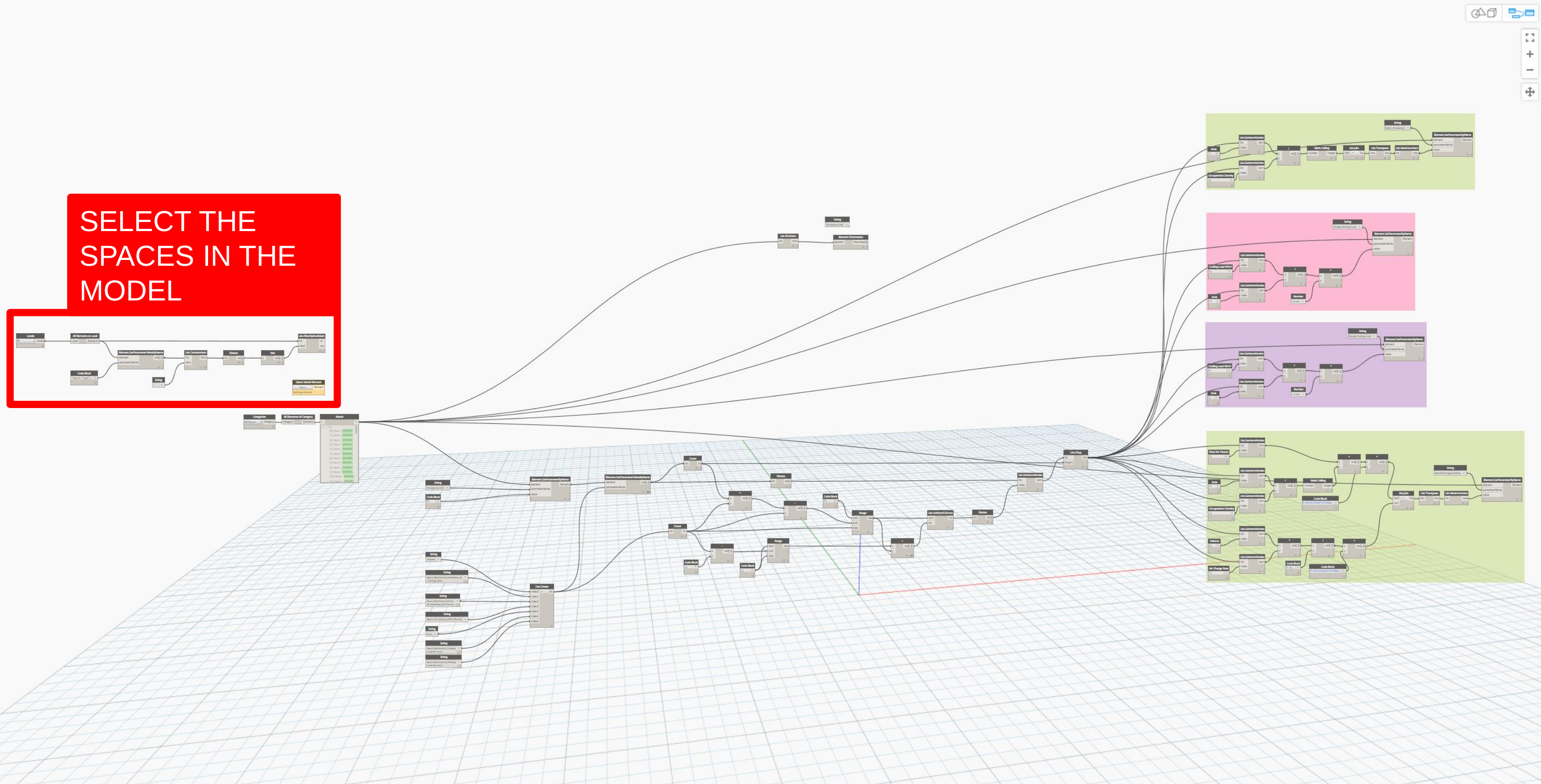
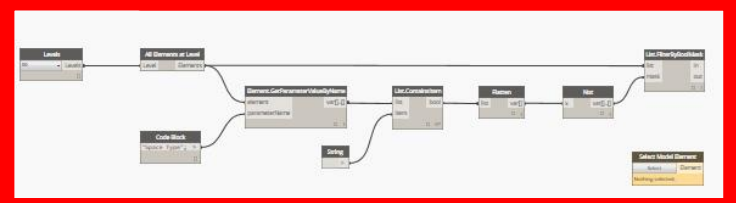


USE PARAMETER VALUES FOR CALCULATIONS, AND SET NEW PARAMETER VALUES

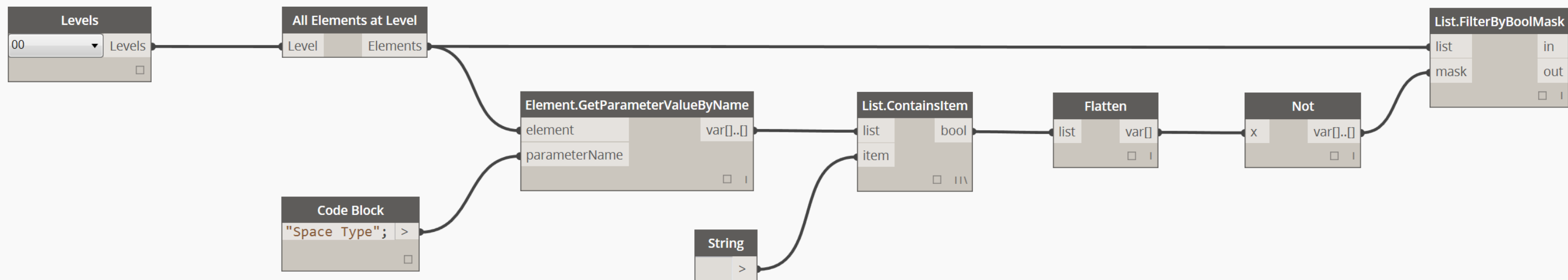
SELECT THE SPACES IN THE MODEL



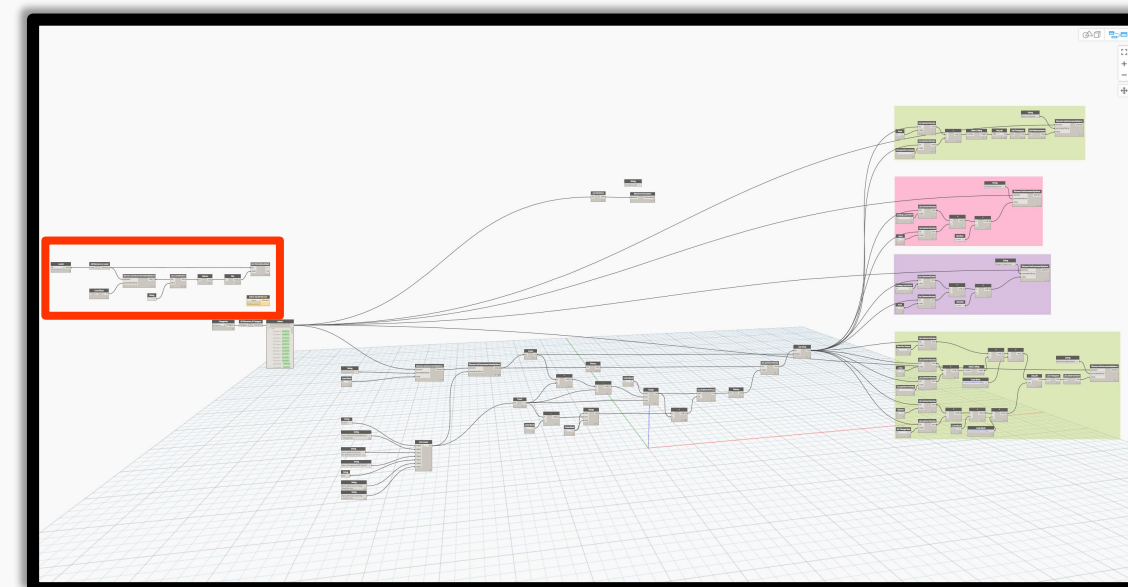
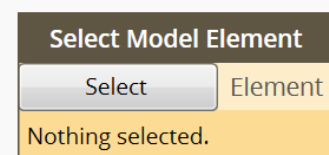
SELECT THE SPACES IN THE MODEL



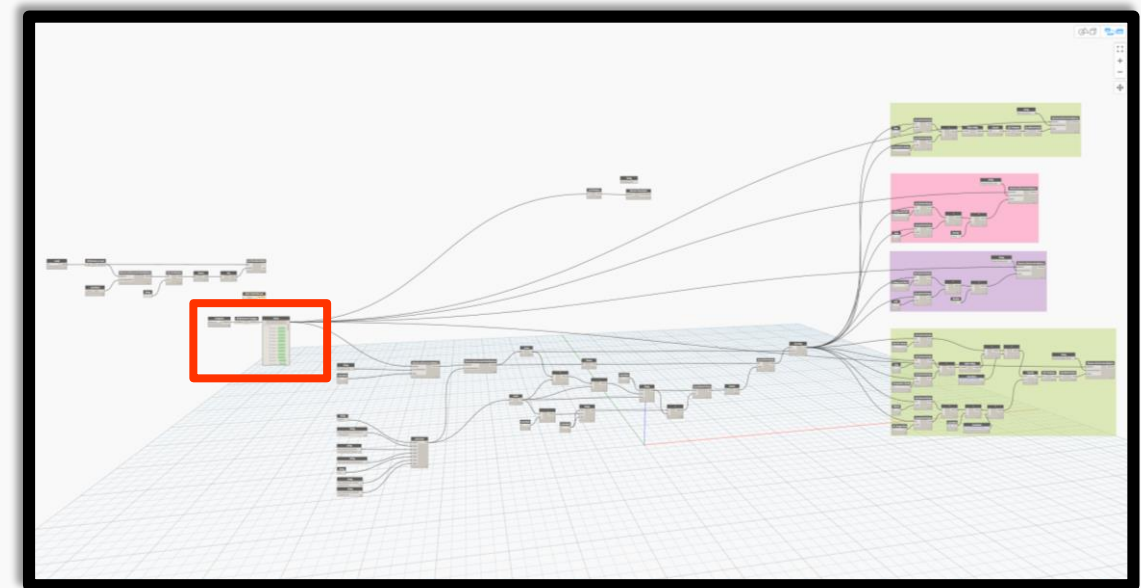
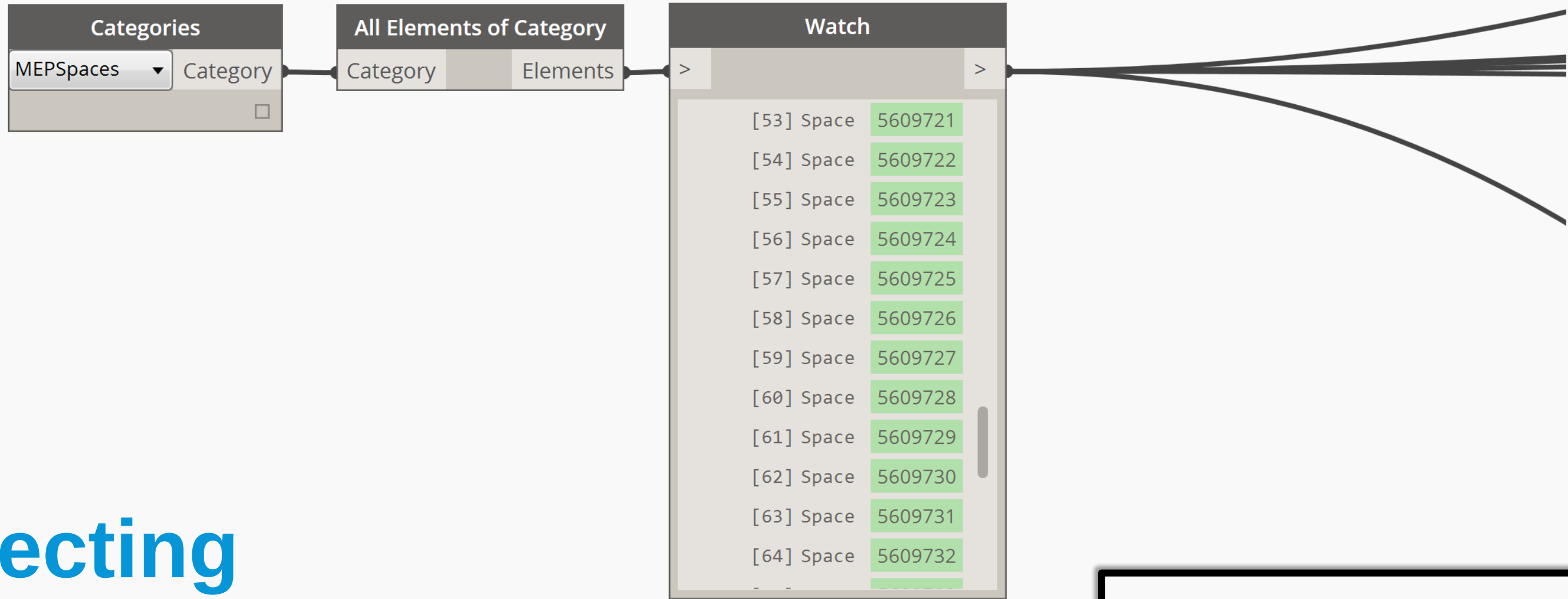
Select Only Spaces for a Given Level



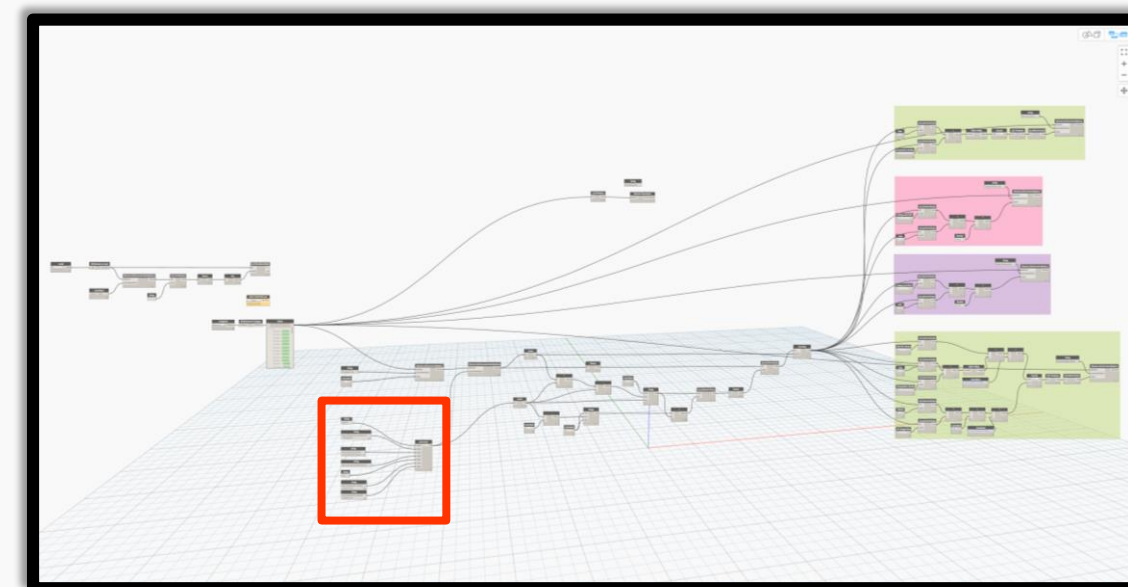
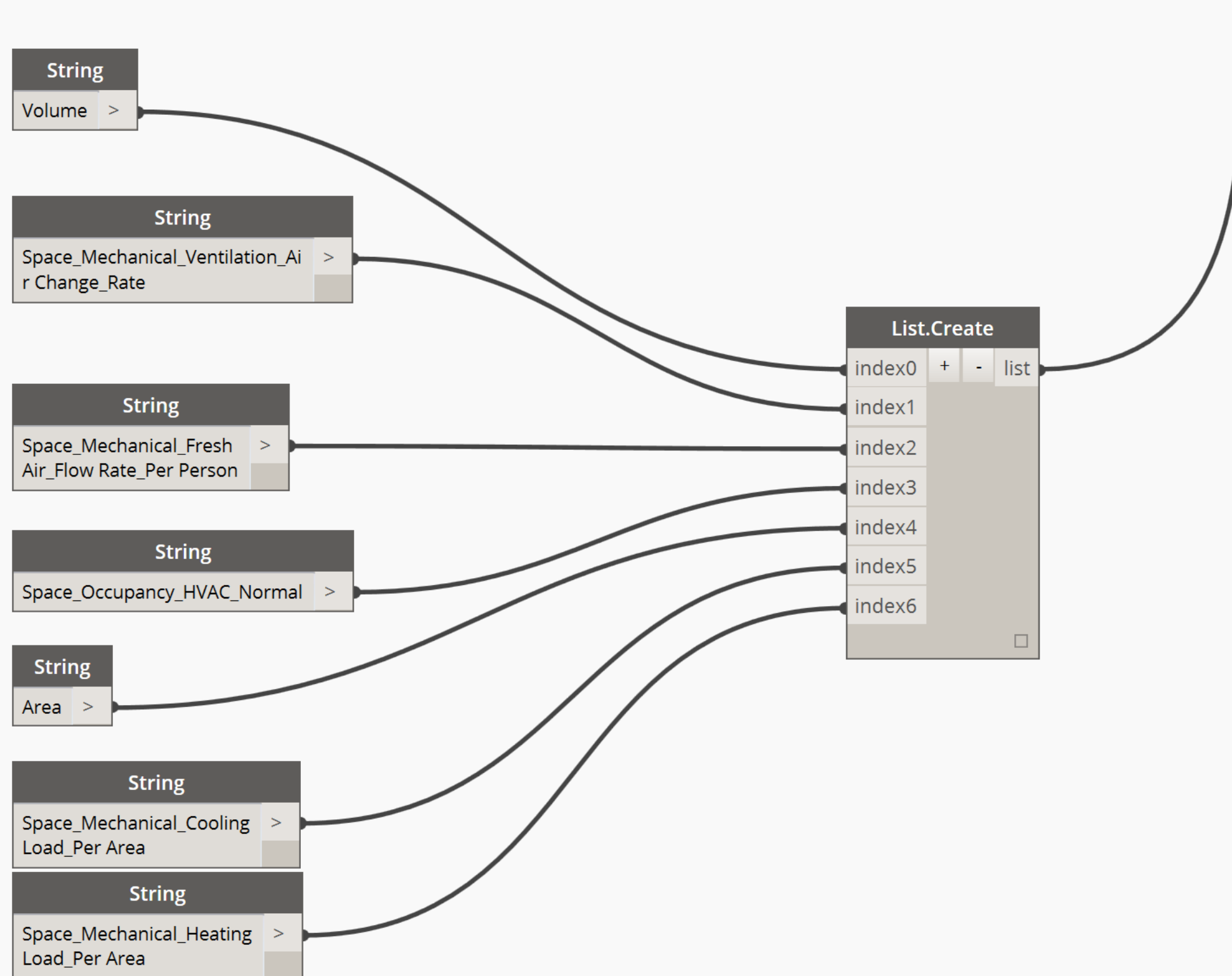
Select Only a Single Space



Selecting Elements in the model using Dynamo







String
Volume >

String
Space_Mechanical_Ventilation_Air
Change_Rate >

String
Space_Mechanical_Fresh
Air_Flow_Rate_Per_Person >

String
Space_Occupancy_HVAC_Normal >

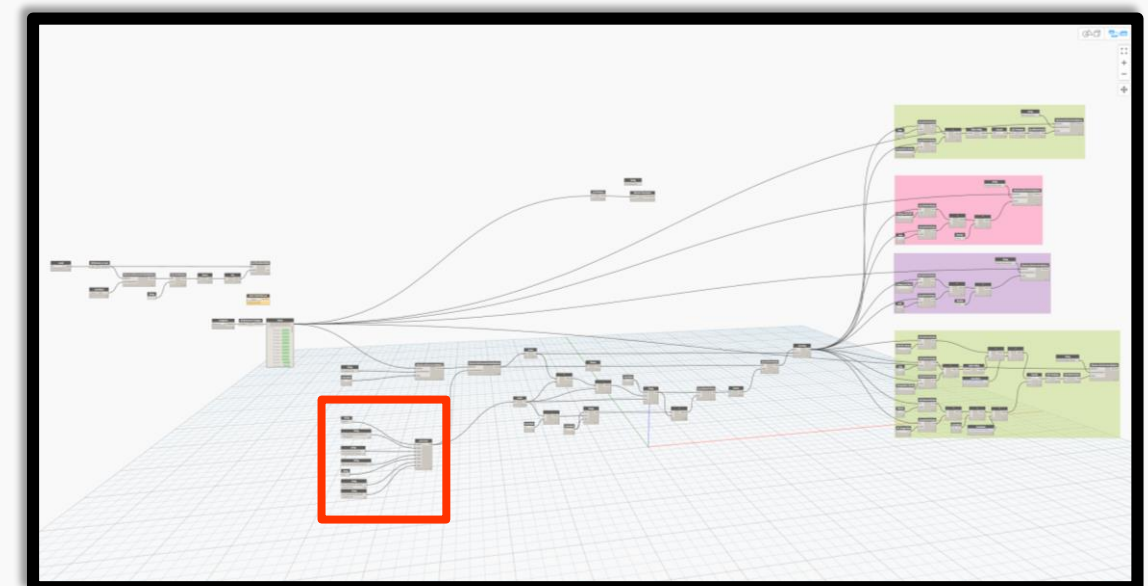
String
Area >

String
Space_Mechanical_Cooling
Load_Per_Area >

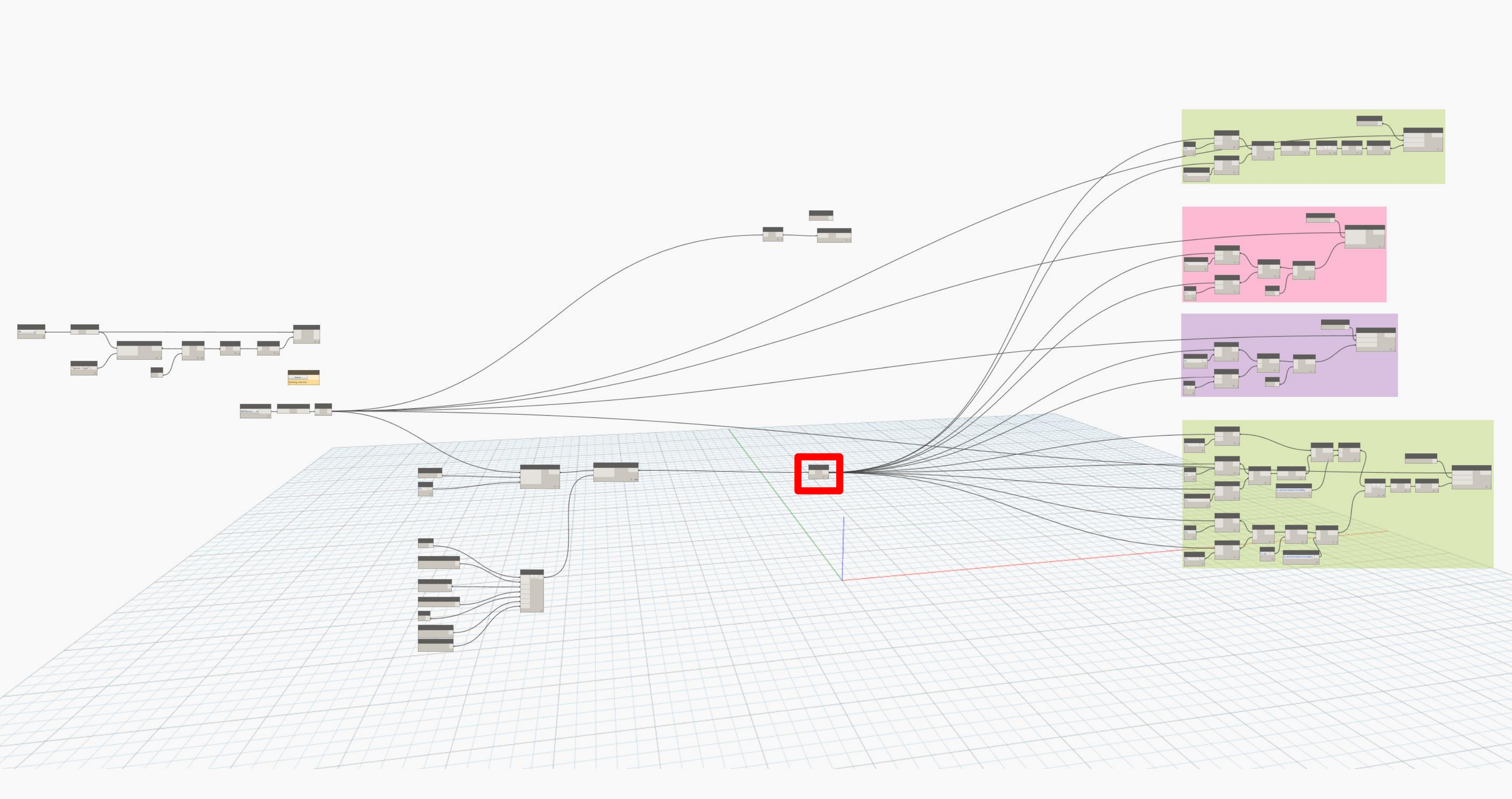
String
Space_Mechanical_Heating
Load_Per_Area >

List.Create
index0 + - list
index1
index2
index3
index4
index5
index6

List
[0] Volume
[1] Space_Mechanical_Ventilation_Air
Change_Rate
[2] Space_Mechanical_Fresh Air_Flow
Rate_Per_Person
[3] Space_Occupancy_HVAC_Normal
[4] Area
[5] Space_Mechanical_Cooling Load_Per
Area
[6] Space_Mechanical_Heating Load_Per
Area



GET THE
PARAMETER
VALUES



List.Transpose

Rearranges the list structure **FROM** the parameter values from each space **TO** groups of like parameter values

List

[0] Volume

[1] Space_Mechanical_Ventilation_A

[2] Space_Mechanical_Fresh Air_Flow

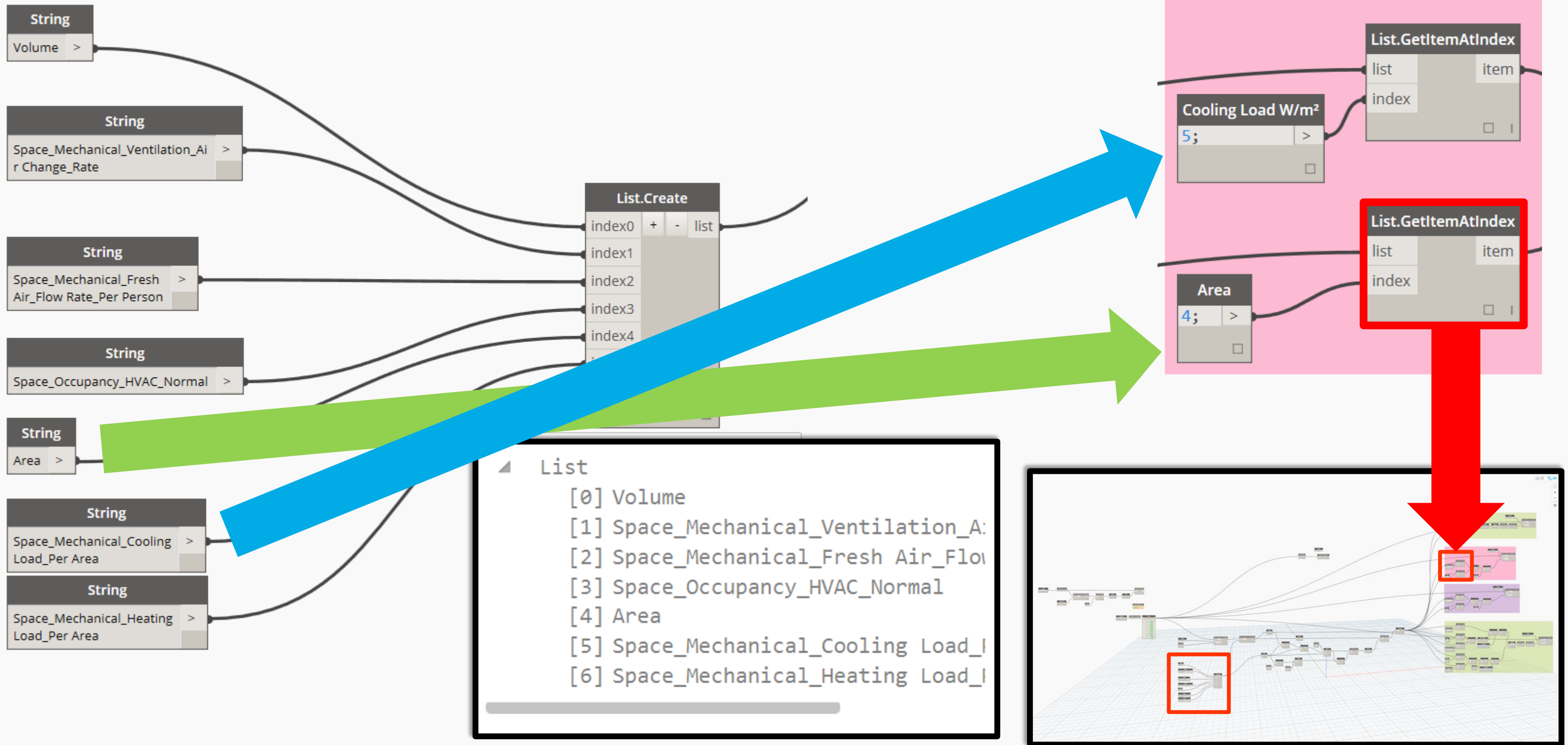
[3] Space_Occupancy_HVAC_Normal

[4] Area

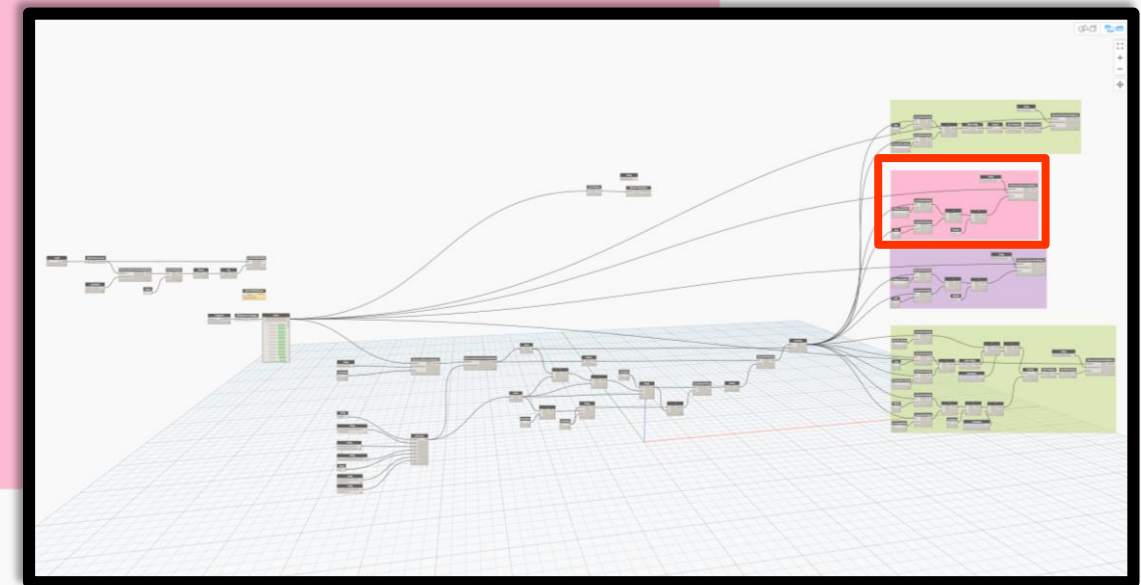
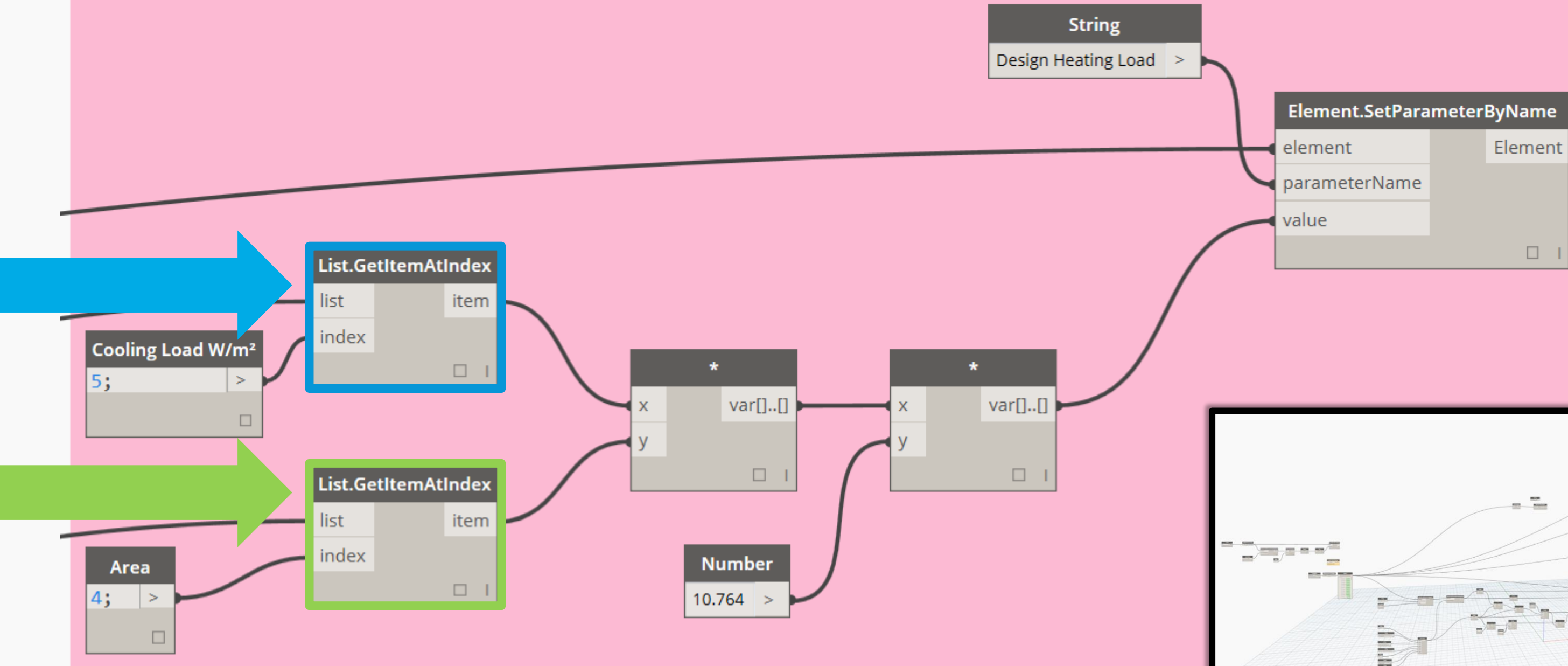
[5] Space_Mechanical_Cooling Load_

[6] Space_Mechanical_Heating Load_

◀ [2] List



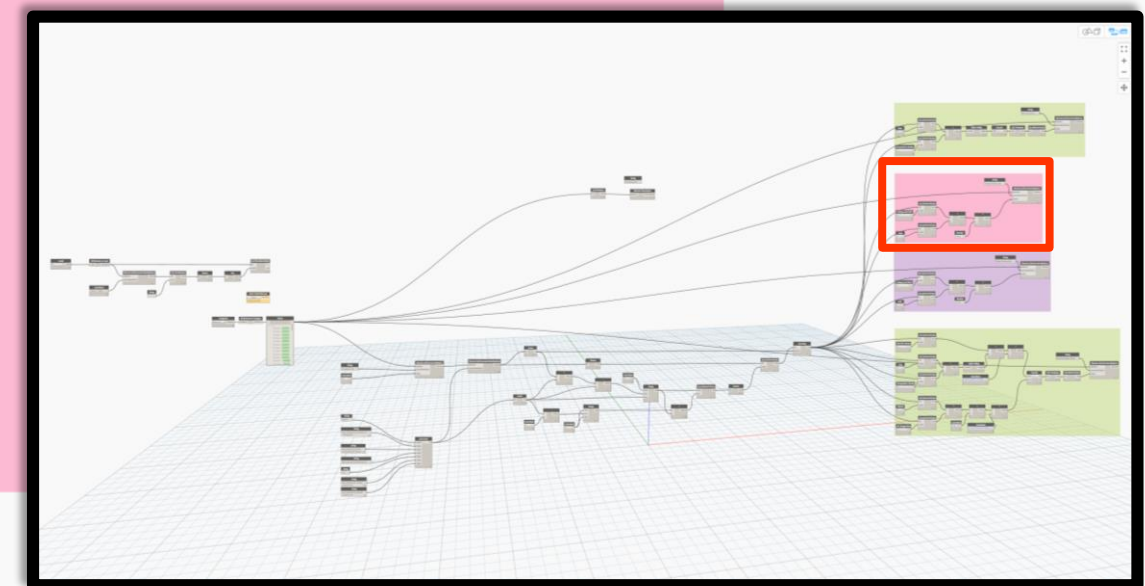
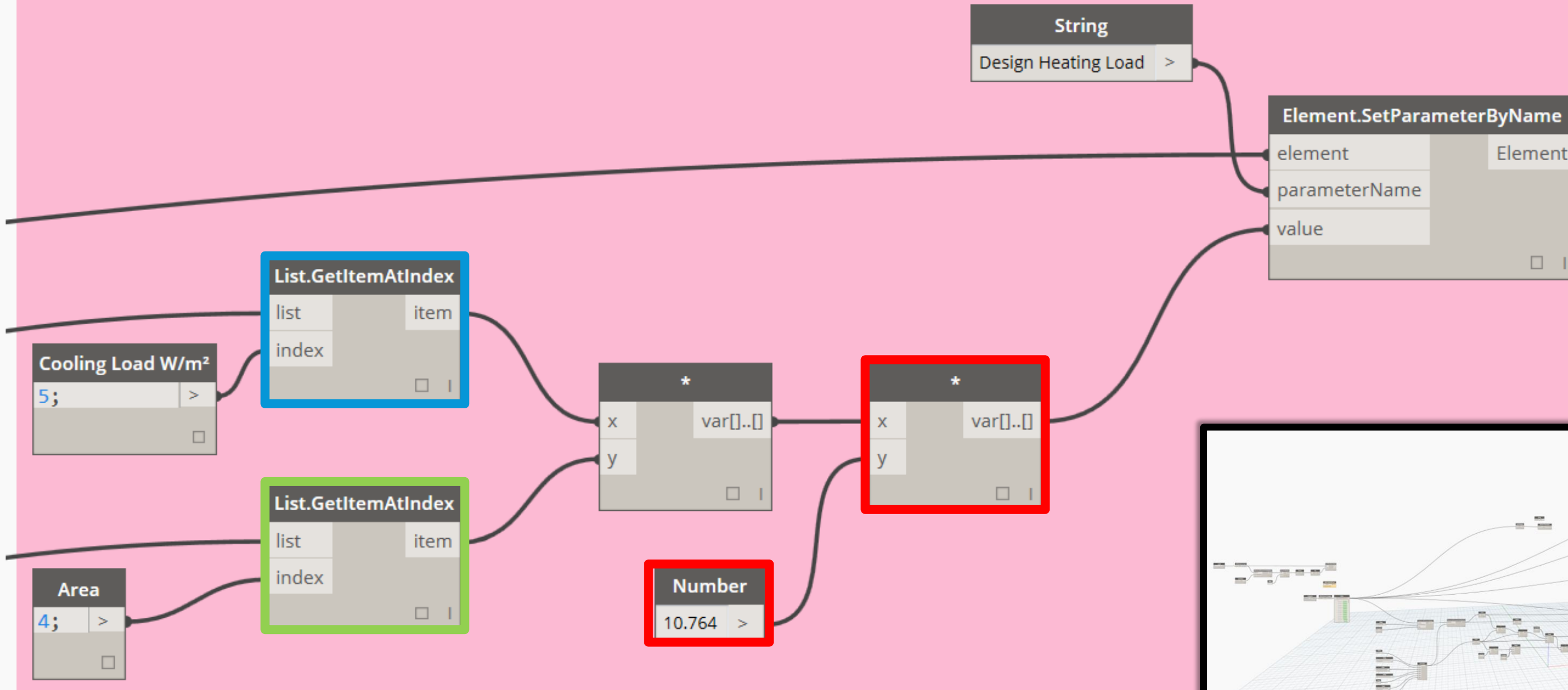
HEATING CALCULATIONS

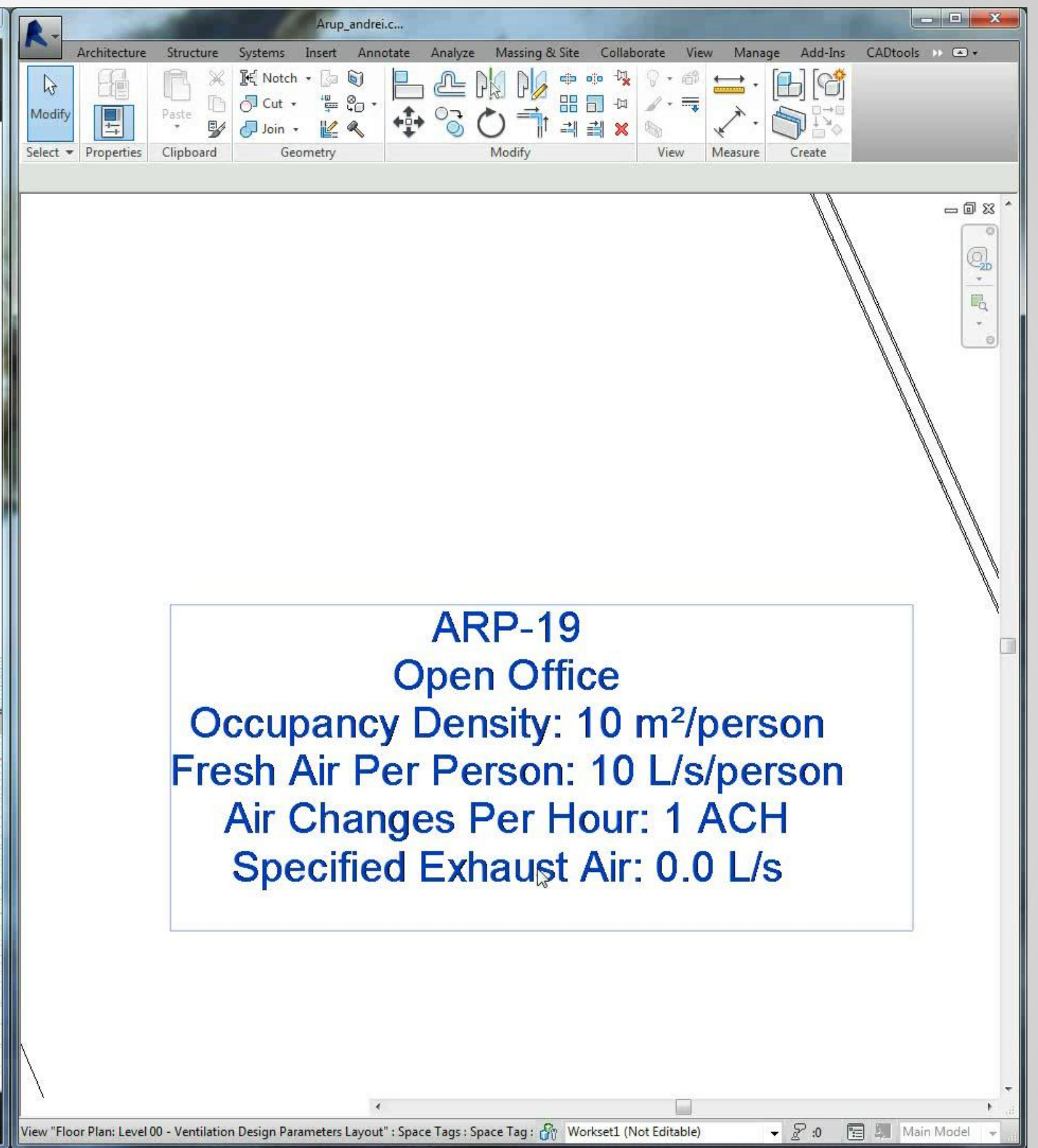
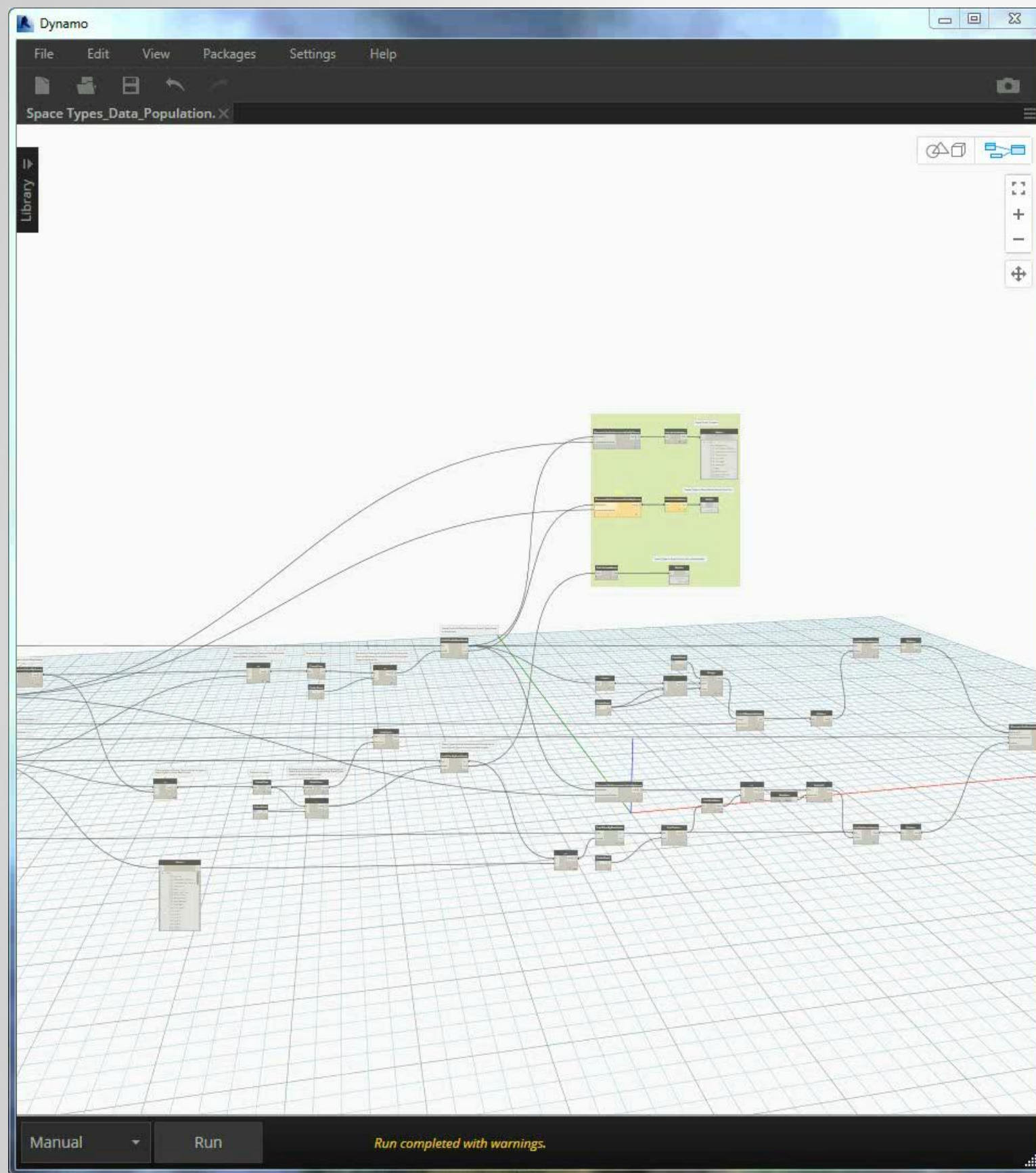


Cooling Load W/m^2 x Area

x 10.764?

HEATING CALCULATIONS

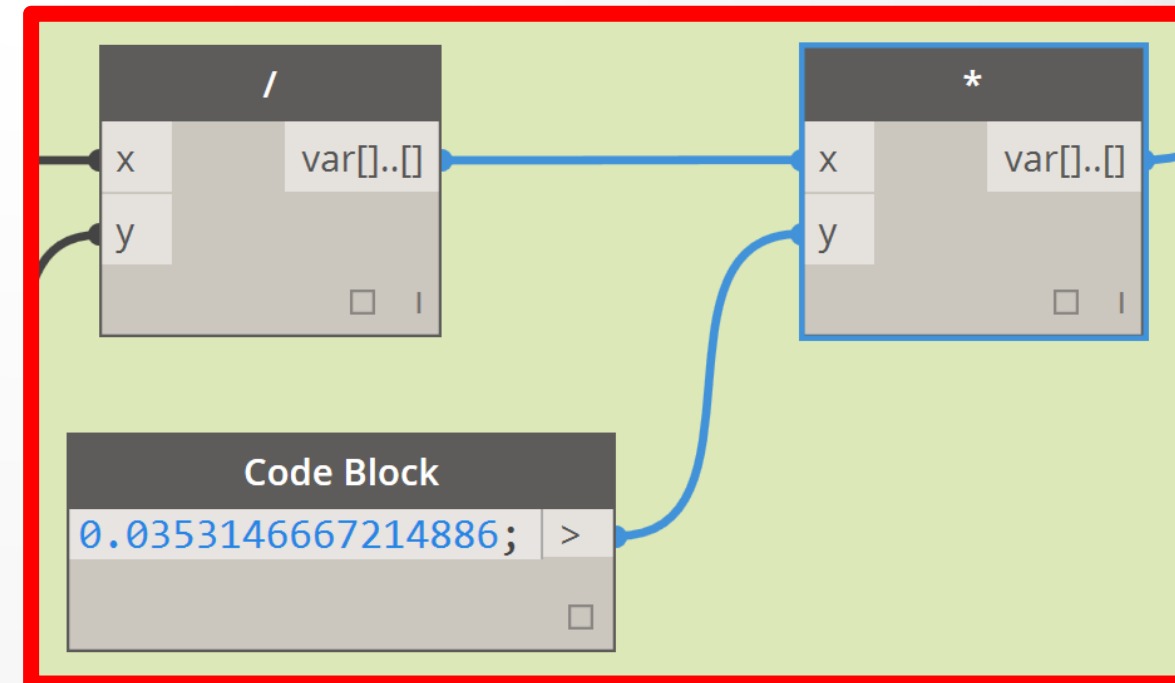
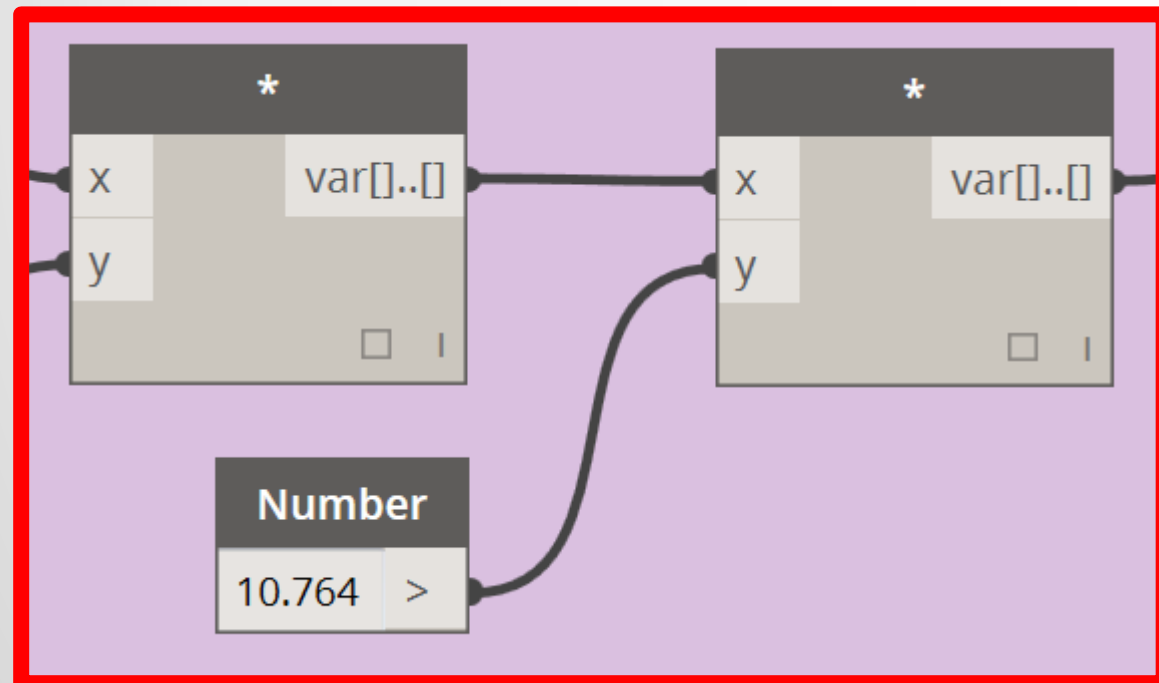


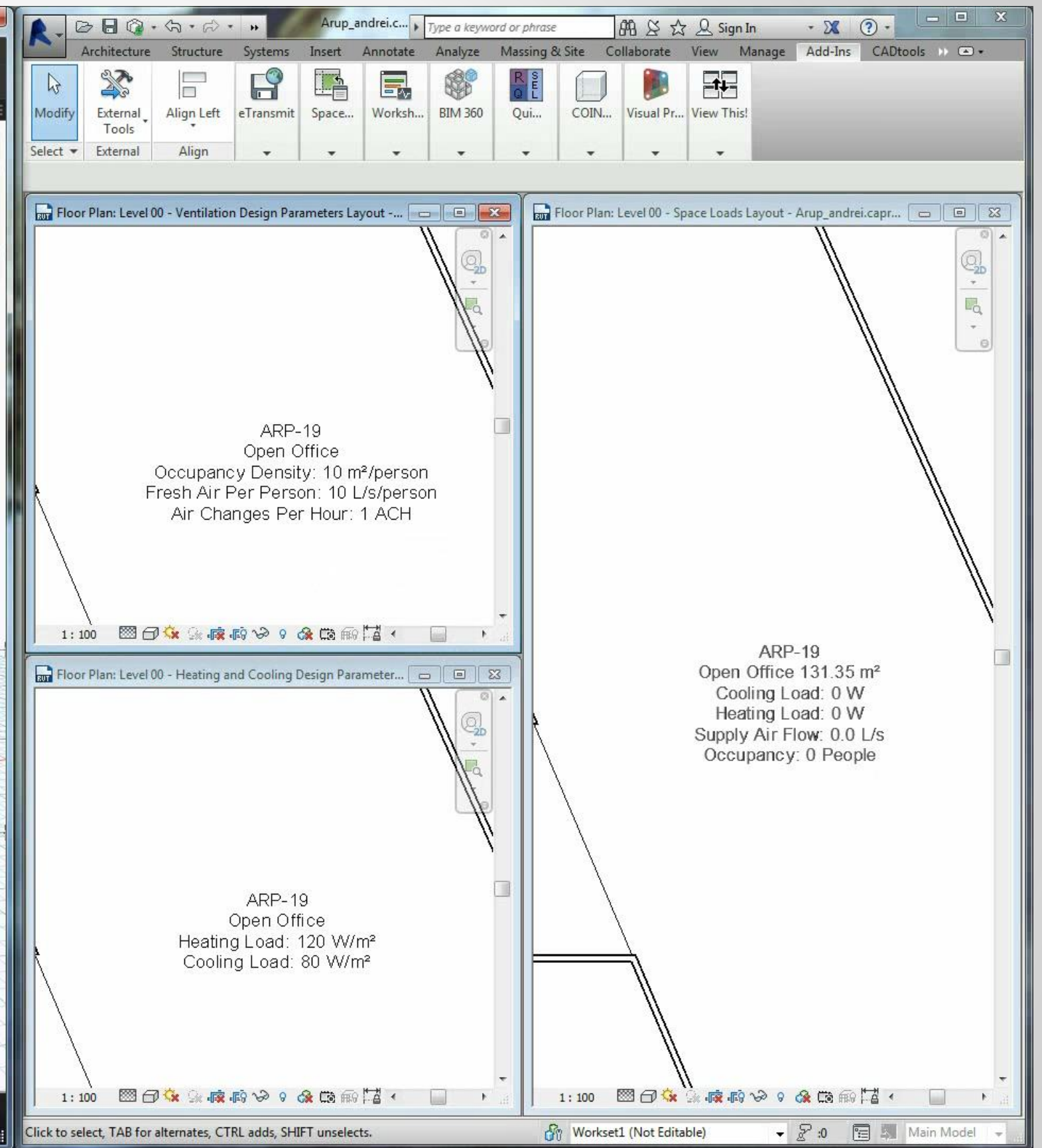
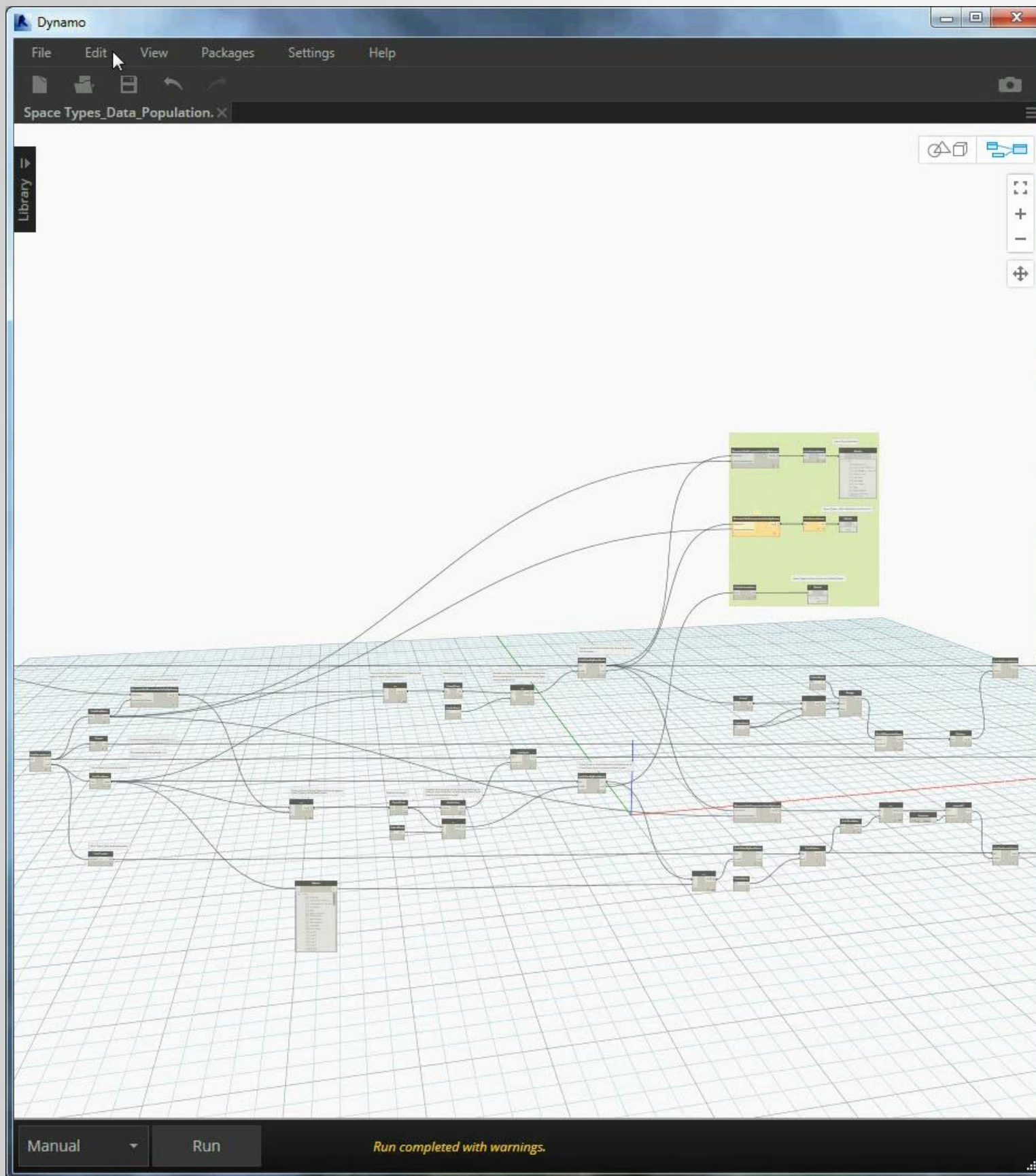


ARP-19
Open Office
Occupancy Density: 10 m²/person
Fresh Air Per Person: 10 L/s/person
Air Changes Per Hour: 1 ACH
Specified Exhaust Air: 0.0 L/s

TIP:

Use Code Block instead of Number for greater accuracy when required





Autodesk Revit 2015 - Dynamo Heating_NEW.rvt - Floor Plan: Level 0

Architecture Structure Systems Insert Annotate Analyze Massing & Site Collaborate View Manage Add-Ins Tools4Revit T4R: Wood Framing T4R: Smart MEP CASE CADtools Revit Express Tools NBS RF Tools

Modify External Tools Batch Print Transmit a model Help About Check Manage View Revit DB Link Launch SNU Launch WSM Glue Clash Pinpoint Equipment Properties Auto Section Box Toggle Section Box Dynamo 0.8.0 Unifi Upload family Batch Export Dynamo 0.8

Select External Batch Print eTransmit Model Review RevitDBLink Space Naming Utility WorksharingMonitor BIM 360 COINS Section Box Dynamo Version Unifi Toolbar Visual Programming

Properties

Floor Plan
10 - Wo CS - All Services with Actual Fixtures - Layout

Floor Plan: Level 0 Edit Type

Graphics

View Scale	1 : 100
Scale Value 1:	100
Display Model	Normal
Detail Level	Fine
Parts Visibility	Show Original
Visibility/Graphics Overrides	Edit...
Graphic Display Options	Edit...
Underlay	None
Underlay Orientation	Plan
Orientation	Project North
Wall Join Display	Clean all wall joins
Discipline	Mechanical
Show Hidden Lines	By Discipline
Color Scheme Location	Background
Color Scheme	<none>
System Color Schemes	Edit...
Default Analysis Display Style	None
Sun Path	☐

Extents

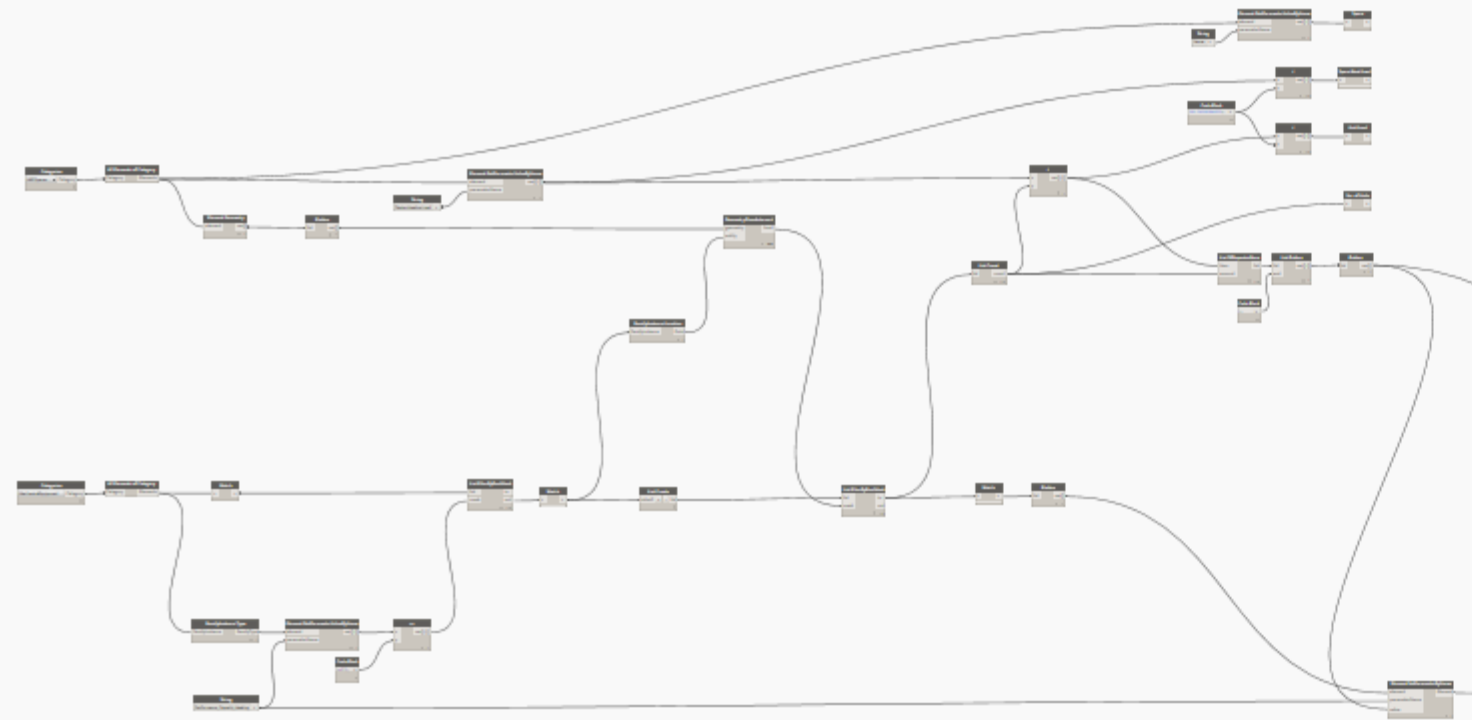
Crop View	☐
Crop Region Visible	☐
Annotation Crop	☐
View Range	Edit...
Associated Level	Level 0

Properties help Apply

Project Browser - Dynamo Heating_NEW.rvt Properties

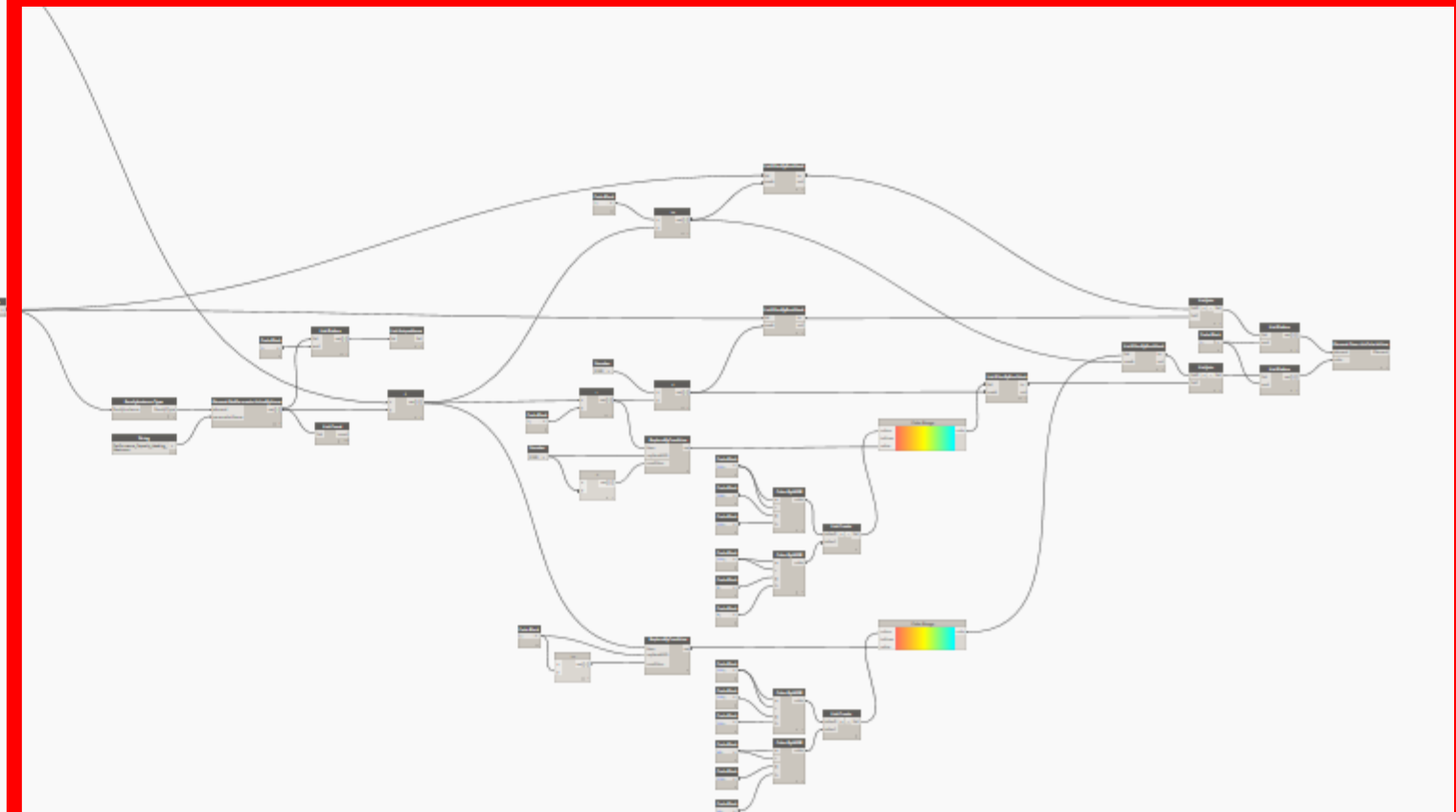
Click to select. TAB for alternates. CTRL adds. SHIFT unselects.

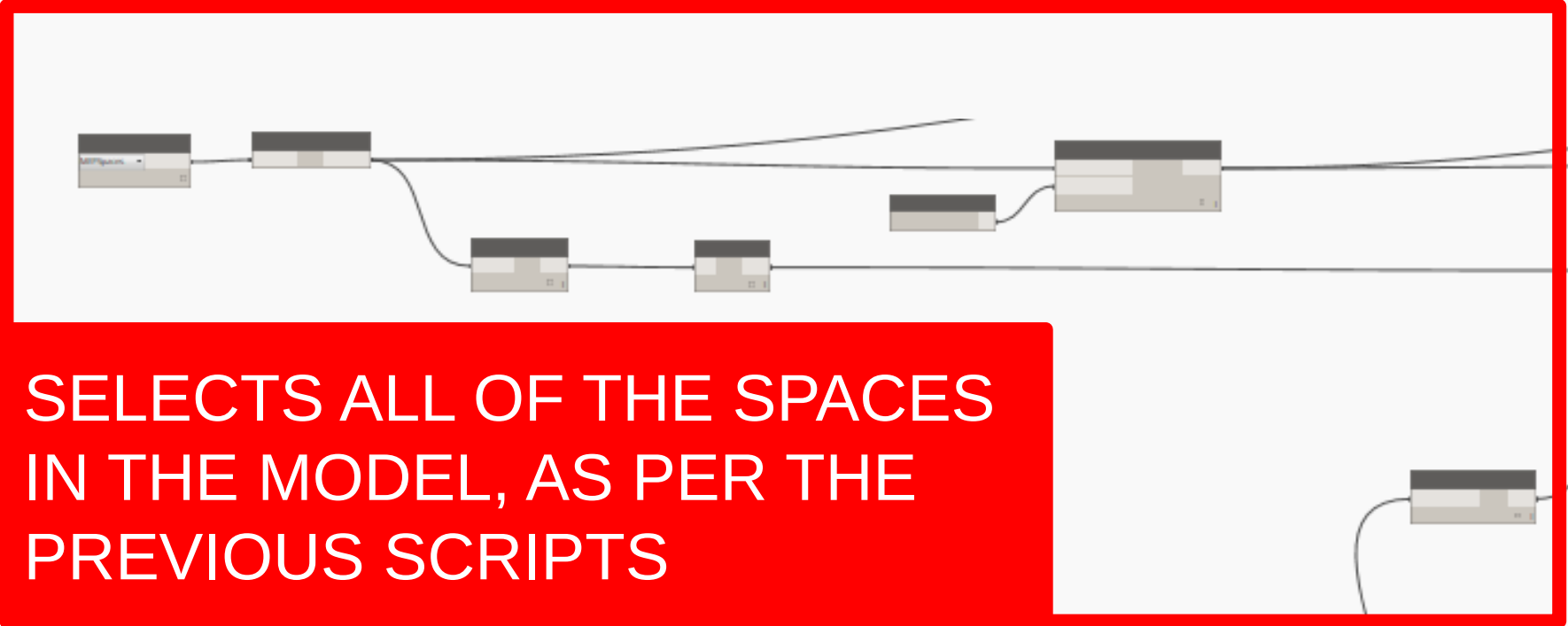
Linking *Space* parameters to *Family* Parameters



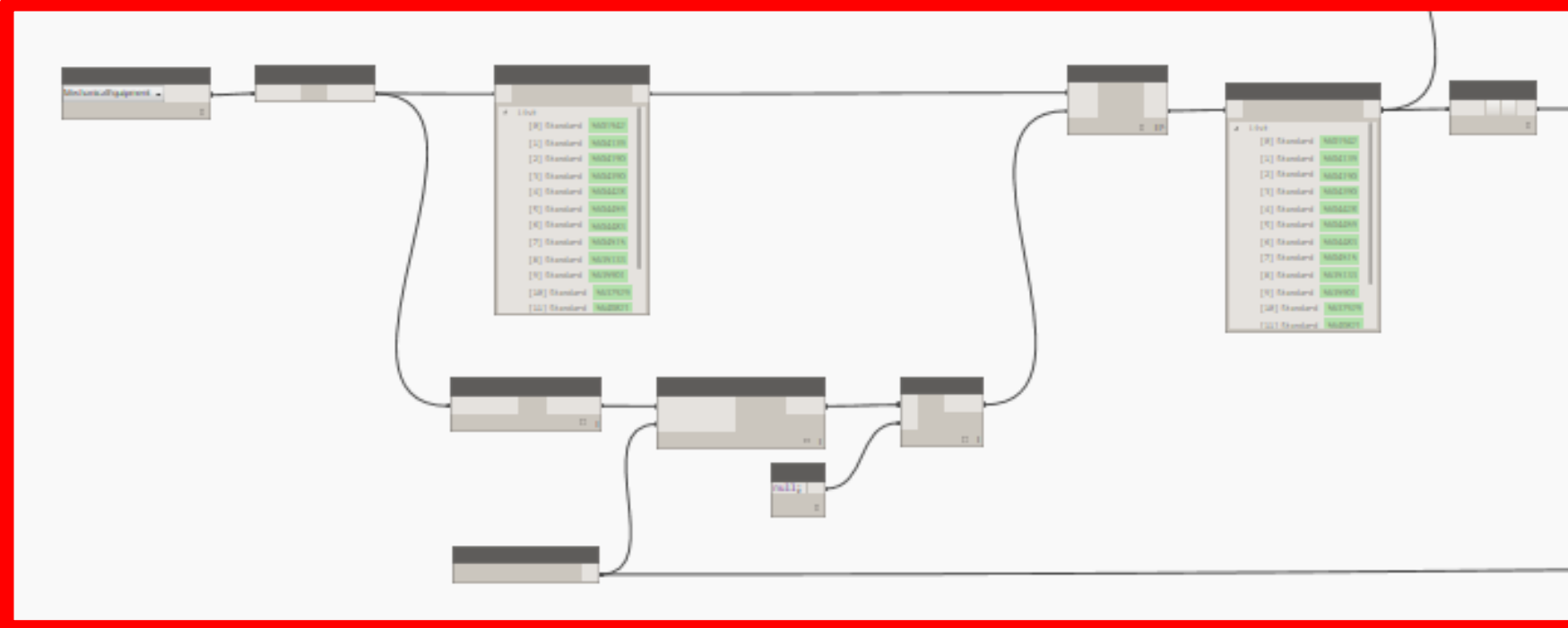
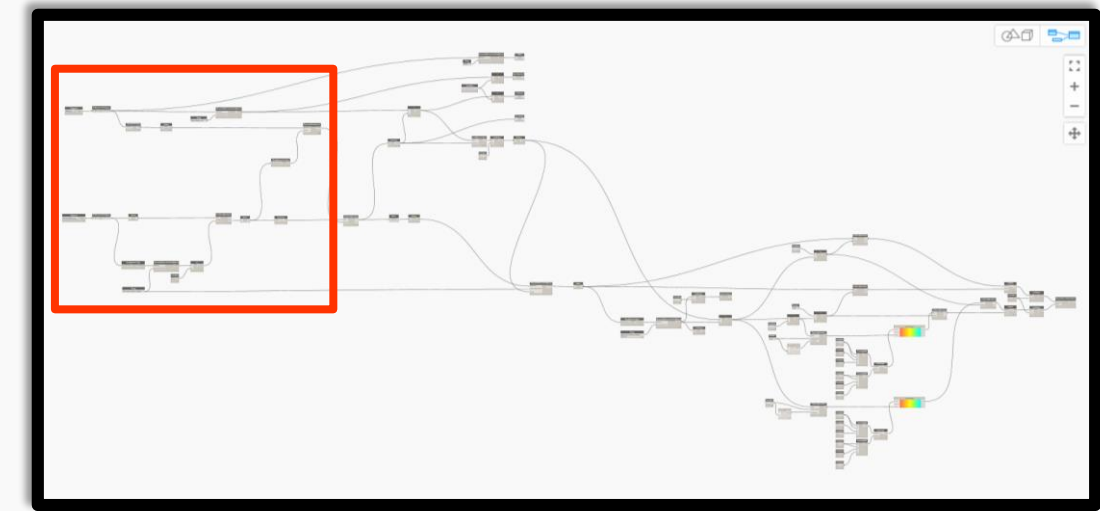
DIVIDE THE HEATING LOAD OF A SPACE
OVER THE NUMBER OF PIECES OF
EQUIPMENT IN THAT SPACE ABLE TO
PROVIDE HEATING

COLOURS IN THE HEATING EQUIPMENT
BASED ON HOW HARD IT IS WORKING
ACCORDING TO ITS MAXIMUM
CAPACITY





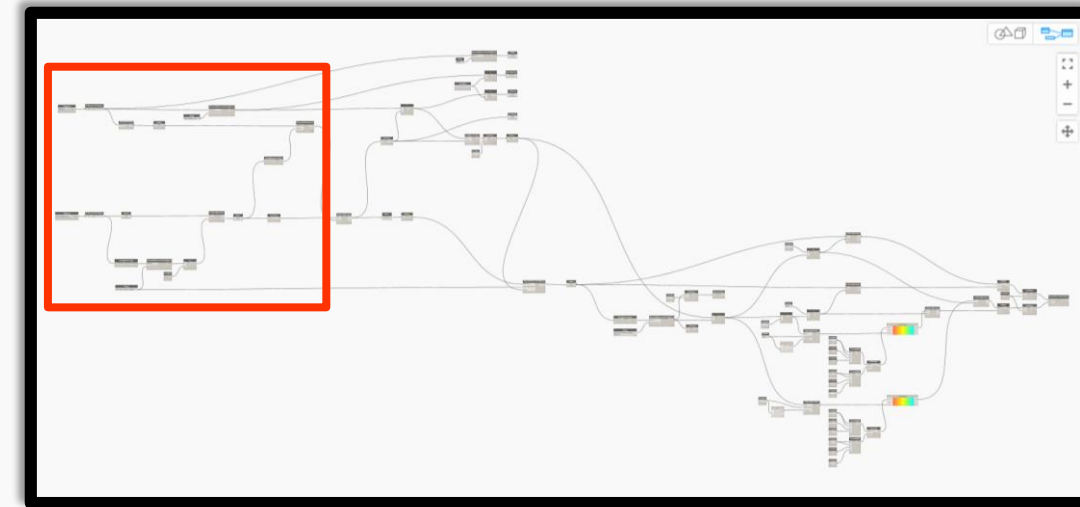
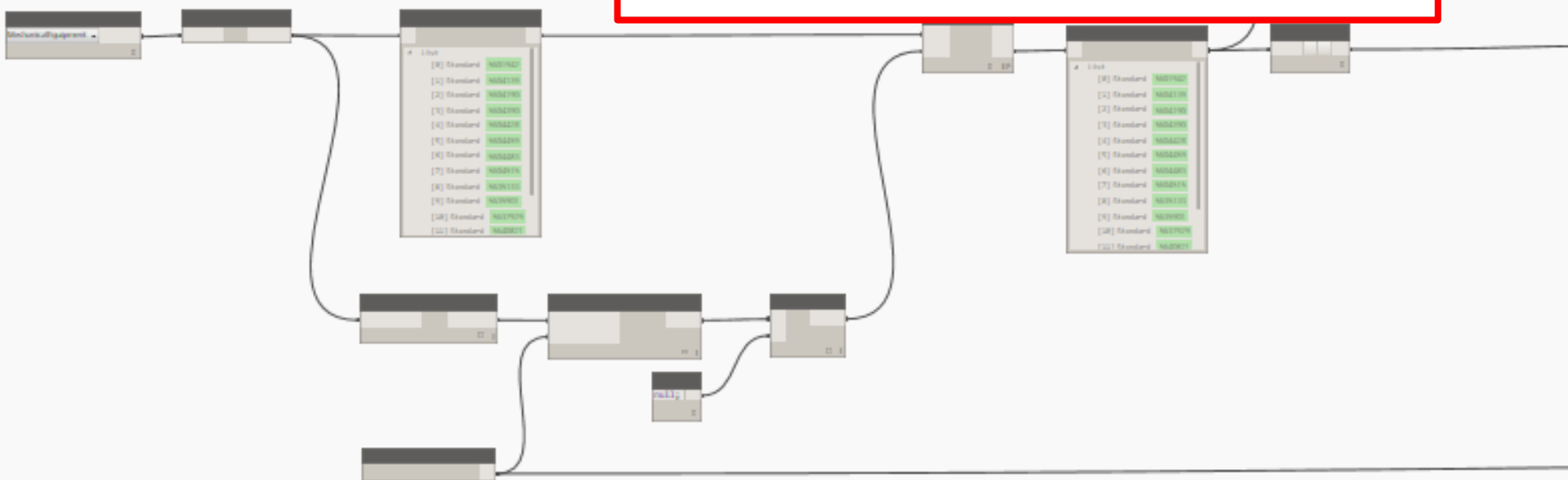
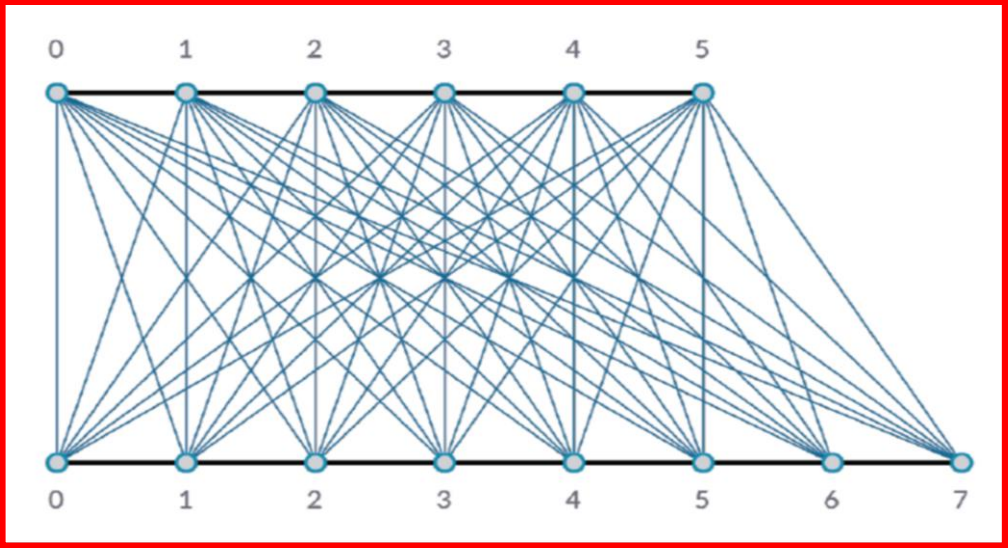
SELECTS ALL OF THE SPACES
IN THE MODEL, AS PER THE
PREVIOUS SCRIPTS



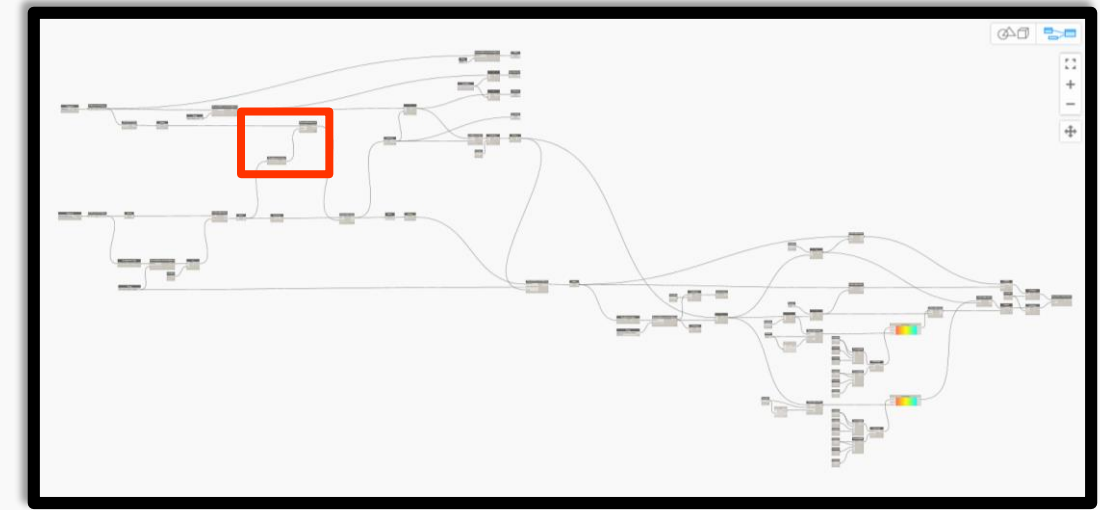
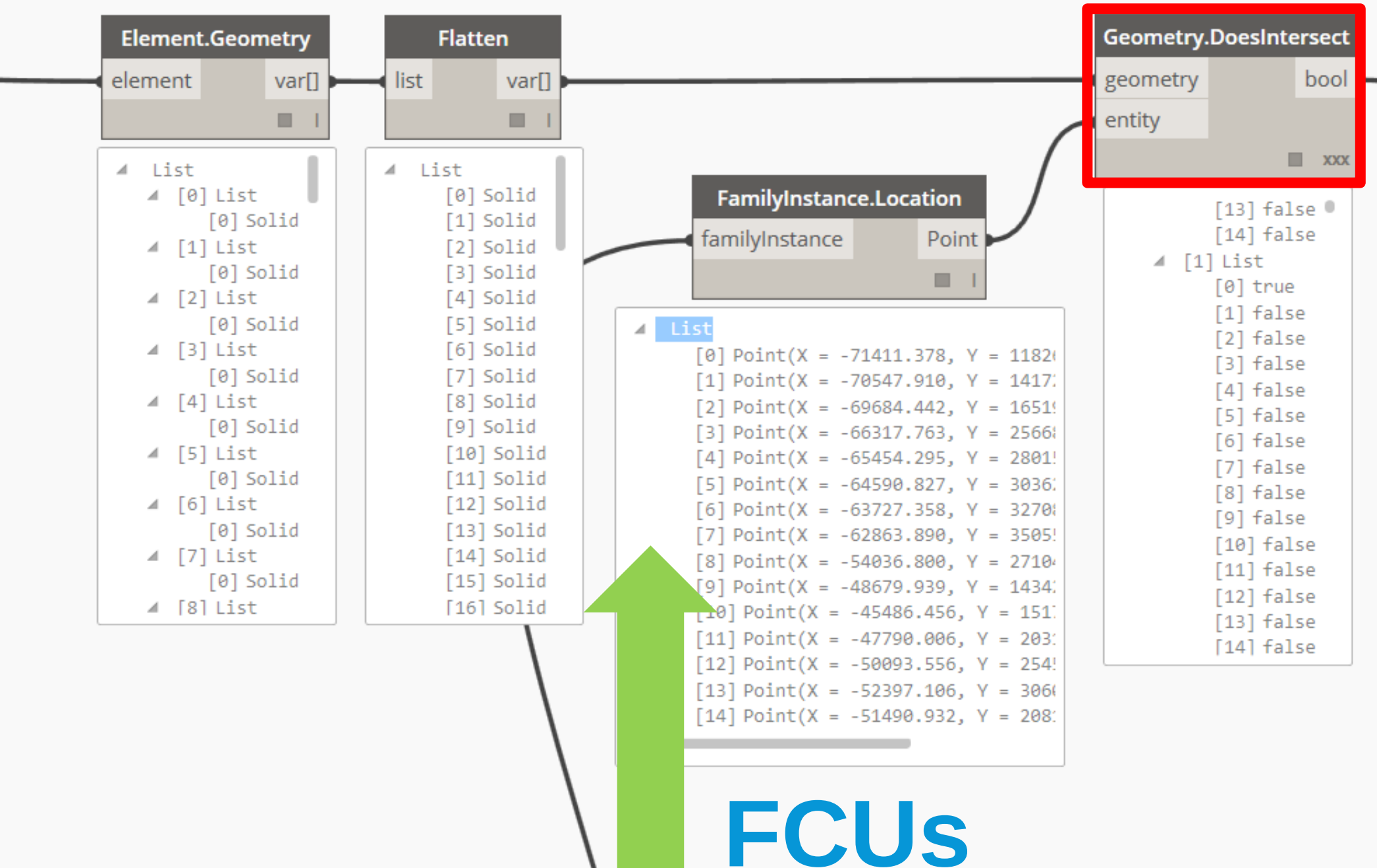
SELECT THE FAN COIL UNITS,
BASED ON THEM BEING
MECHANICAL EQUIPMENT AND
THAT THEY CONTAIN THE
PARAMETER
“Performance_Capacity_Heating”



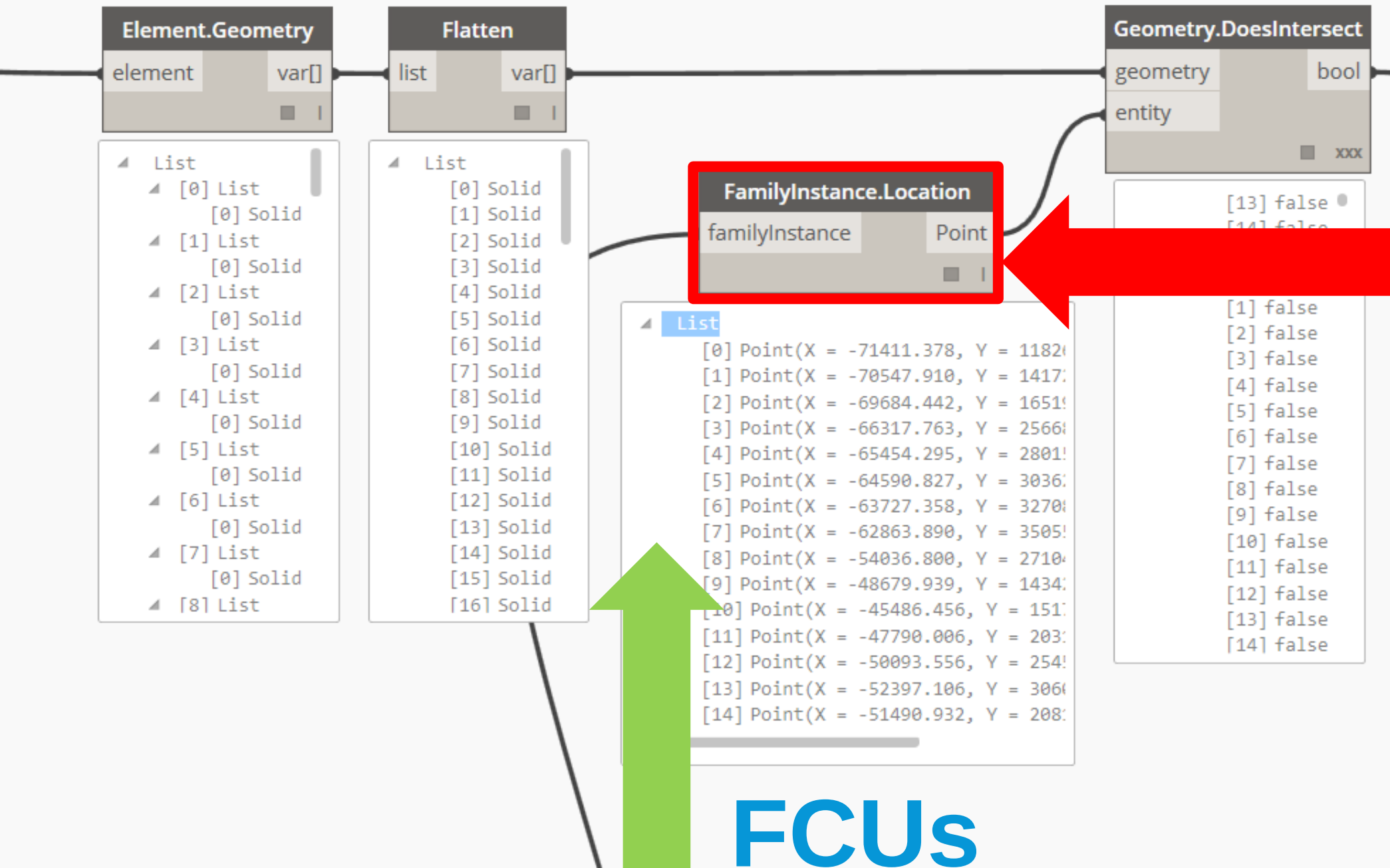
WHICH FCUs ARE IN WHICH SPACES?



SPACES



SPACES



WHAT'S WRONG WITH THIS?

This only give the center point of a family, which may not be in a space (as the family may be in a void above the space)

Select Model Elements

Select Elements

Elements : 5590732 5590762

Element.Geometry

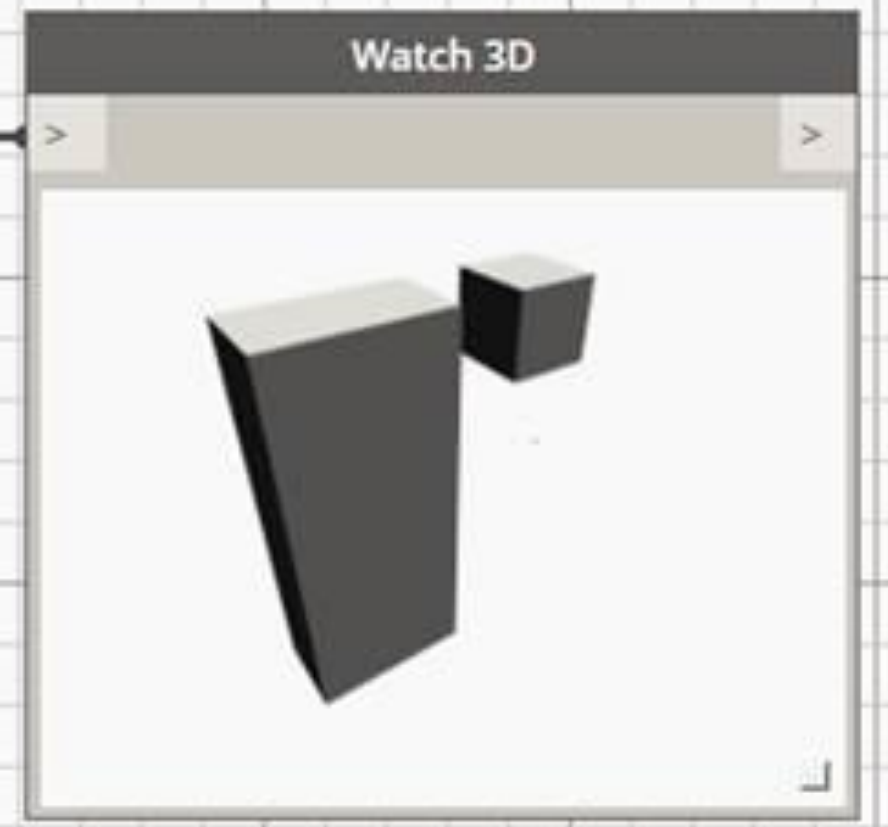
element var[]

Element.BoundingBox

element BoundingBox

BoundingBox.ToCuboid

boundingBox Cuboid



Select Model Elements

Select Elements

Elements : 5590732 5590762

Element.Geometry

element var



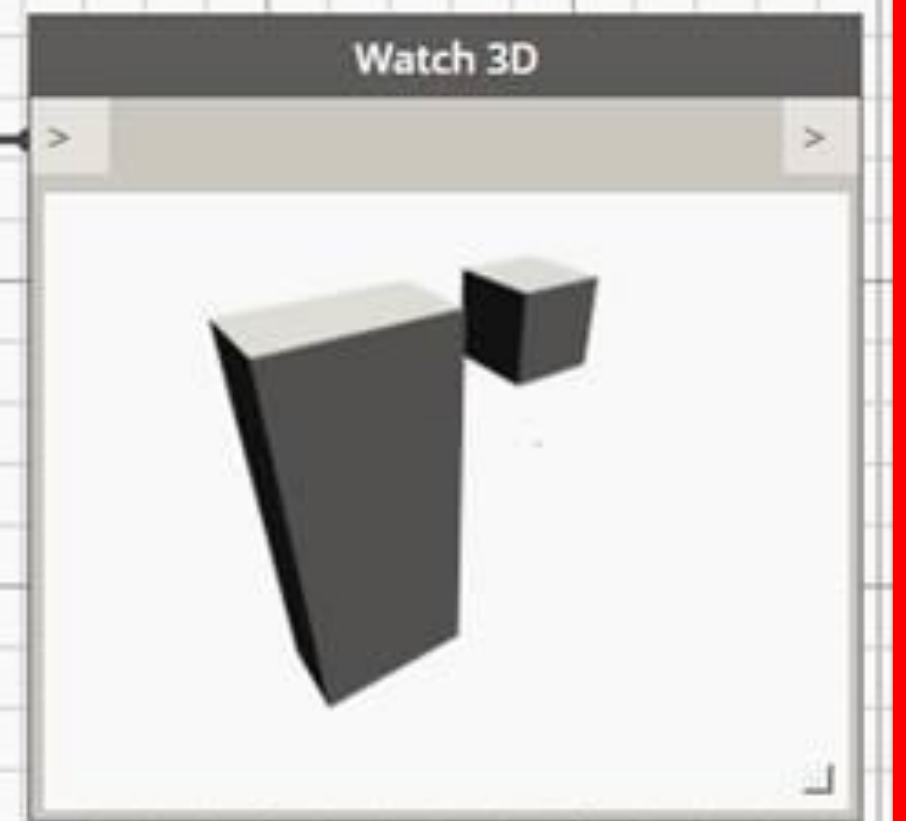
WHY IS
THIS SO
DIFFERENT

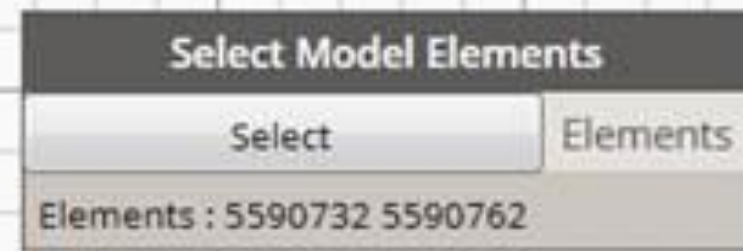
Element.BoundingBox

element BoundingBox

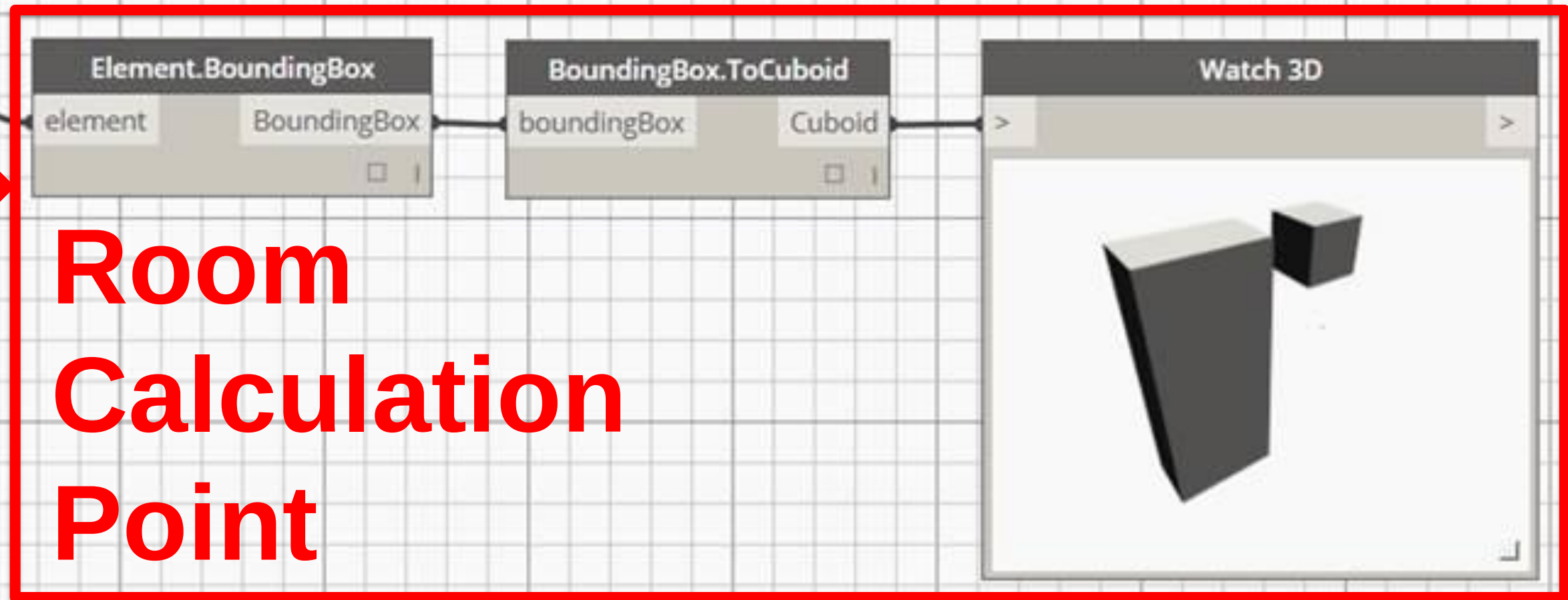
BoundingBox.ToCuboid

boundingBox Cuboid

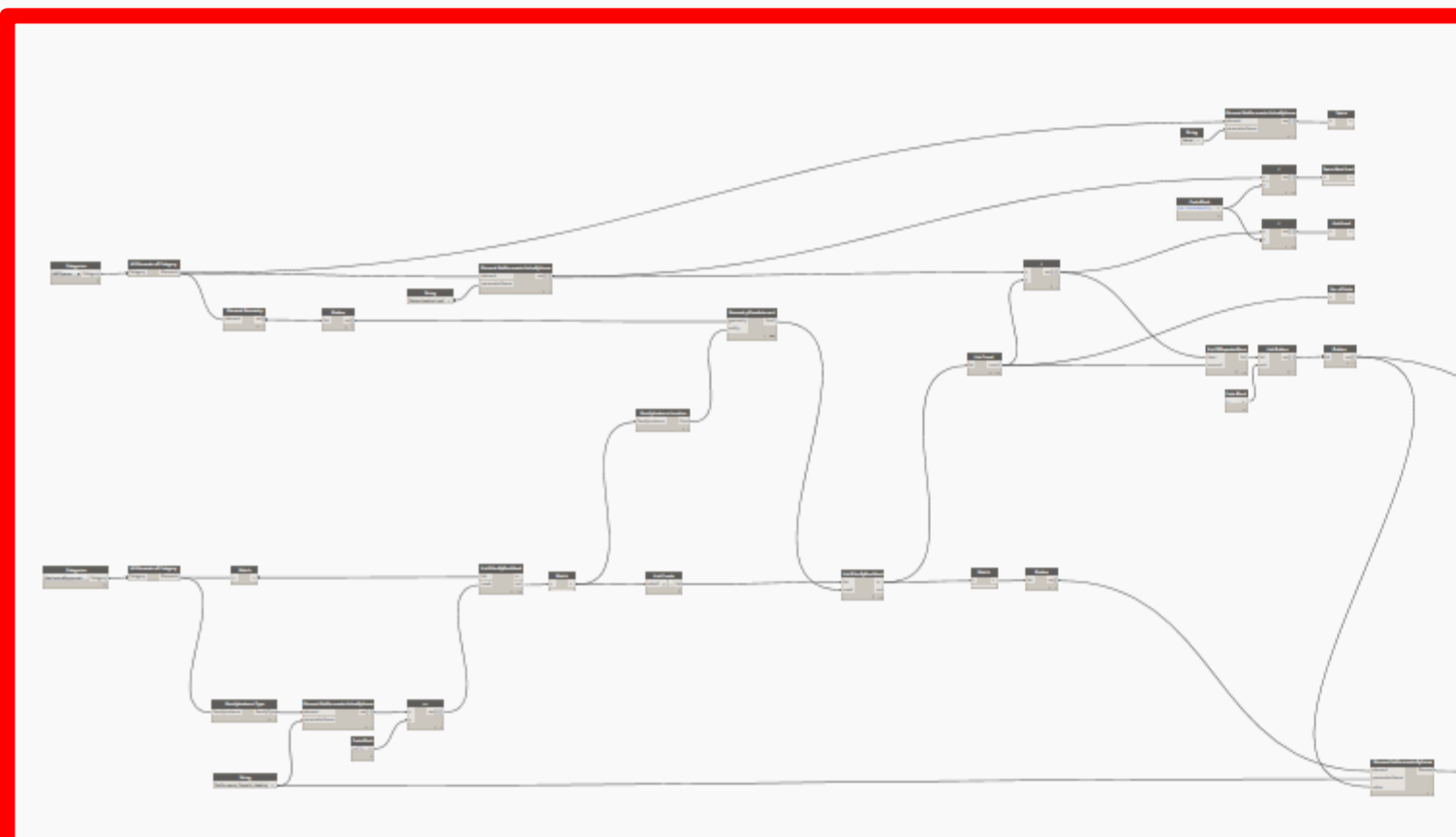




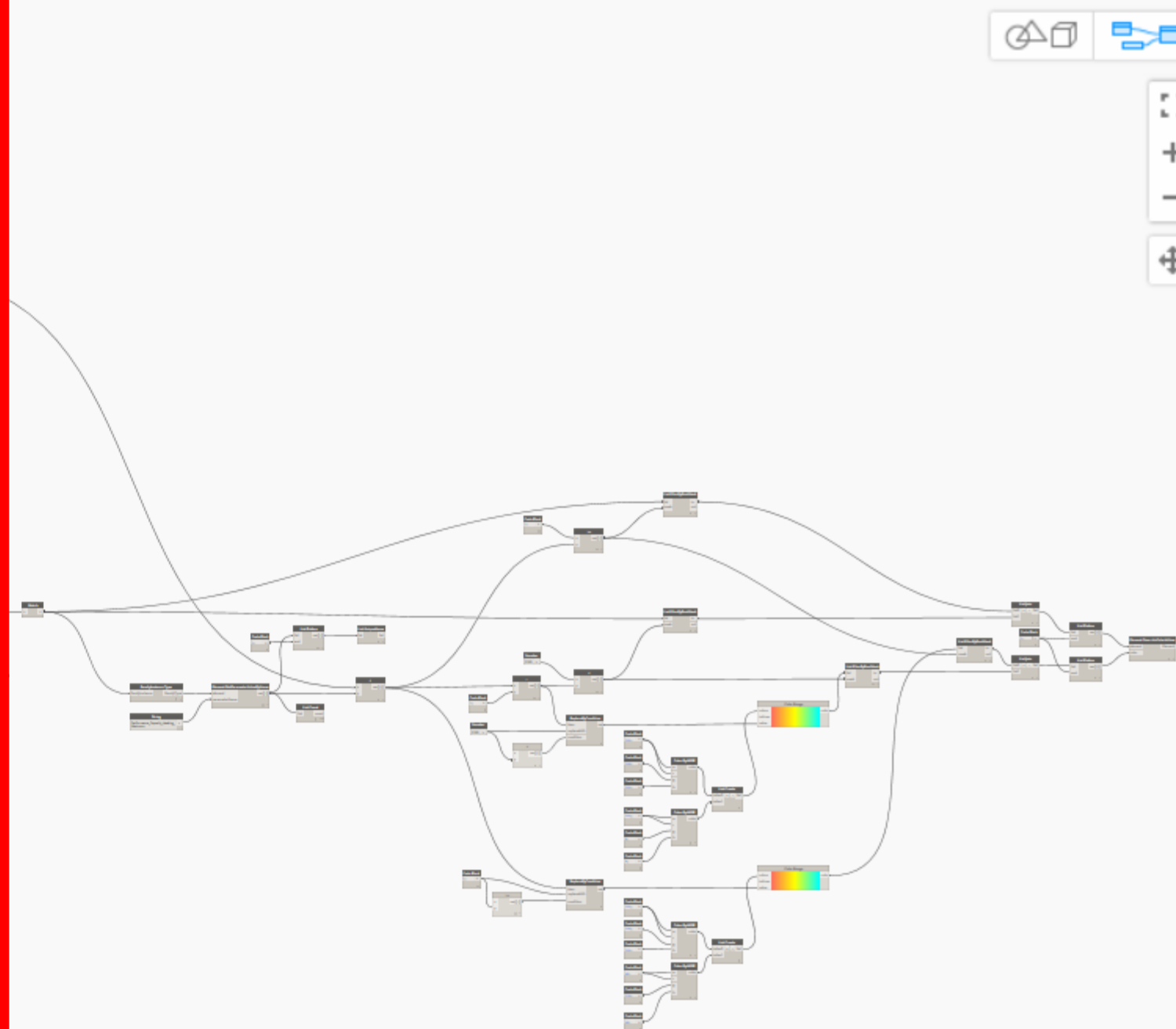
WHY IS
THIS SO
DIFFERENT



Room
Calculation
Point



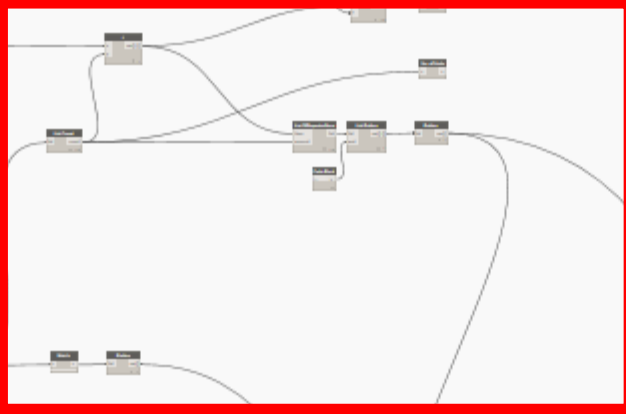
DIVIDE THE HEATING LOAD OF A SPACE
OVER THE NUMBER OF PIECES OF
EQUIPMENT IN THAT SPACE ABLE TO
PROVIDE HEATING



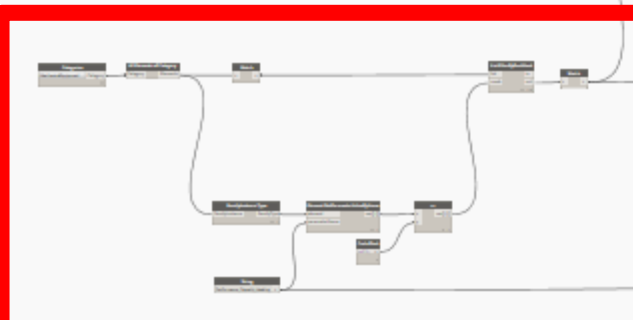
SELECT THE SPACES IN THE MODEL GET THEIR HEATING LOADS



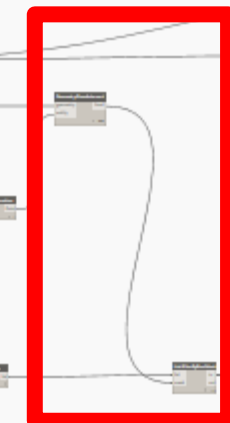
DIVIDE THE SPACE HEATING LOADS BETWEEN THE FCUs IN A GIVEN SPACE



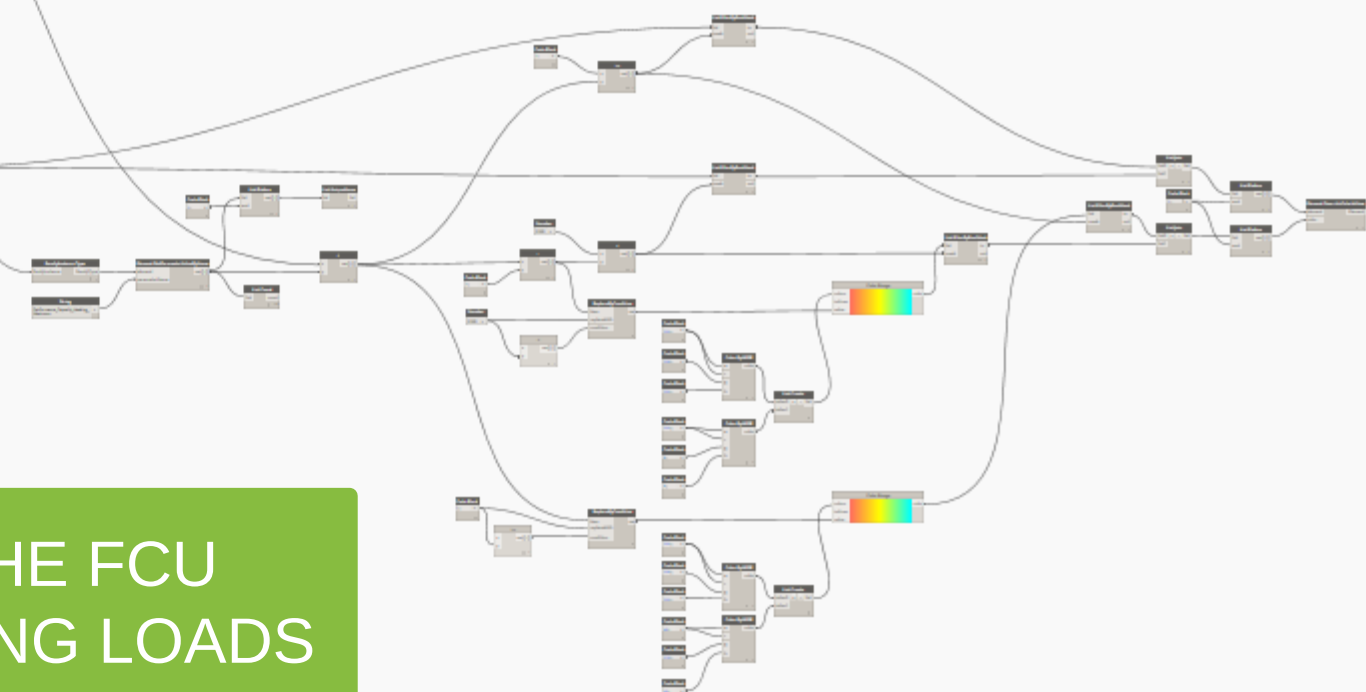
SELECT THE FCUs IN THE MODEL



DETERMINES WHICH FCUs ARE IN EACH OF THE SPACES



SET THE FCU HEATING LOADS



Autodesk Revit 2015 - Dynamo Heating_NEW.rvt - Floor Plan: Level 0

Architecture Structure Systems Insert Annotate Analyze Massing & Site Collaborate View Manage Add-Ins Tools4Revit T4R: Wood Framing T4R: Smart MEP CASE CADtools Revit Express Tools NBS RF Tools

Modify External Tools Batch Print Transmit a model Help Check Manage View Revit DB Link Launch SNU Launch WSM Glue Clash Pinpoint Equipment Properties Auto Section Box Toggle Section Box Dynamo 0.8.0 Unifi Upload family Batch Export Dynamo 0.8

Select External Batch Print eTransmit Model Review RevitDBLink Space Naming Utility WorksharingMonitor BIM 360 COINS Section Box Dynamo Version Unifi Toolbar Visual Programming

Properties

Floor Plan
10 - Wo CS - All Services with Actual Fixtures - Layout

Floor Plan: Level 0 Edit Type

Graphics

View Scale	1 : 100
Scale Value 1:	100
Display Model	Normal
Detail Level	Fine
Parts Visibility	Show Original
Visibility/Graphics Overrides	Edit...
Graphic Display Options	Edit...
Underlay	None
Underlay Orientation	Plan
Orientation	Project North
Wall Join Display	Clean all wall joins
Discipline	Mechanical
Show Hidden Lines	By Discipline
Color Scheme Location	Background
Color Scheme	<none>
System Color Schemes	Edit...
Default Analysis Display Style	None
Sun Path	☐

Extents

Crop View	☐
Crop Region Visible	☐
Annotation Crop	☐
View Range	Edit...

Associated Level: Level 0

Properties help Apply

Project Browser - Dynamo Heating_NEW.rvt Properties

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

The diagram illustrates a mechanical, electrical, and plumbing (MEP) floor plan for Level 0. It features several green rectangular equipment units, each labeled with heating (H) and cooling (C) loads in kilowatts (kW). The units are connected by a network of pipes, with specific pipe diameters (ø54) indicated. The plan includes a central 'Open Office' area with a heating load of 95.0 kW and a cooling load of 0.0 kW. Other rooms and equipment are labeled with their respective H and C loads, such as 'H: 19.0 kW C: 0.0 kW' and 'H: 10.0 kW C: 0.0 kW'. The diagram is overlaid on a floor plan showing walls, doors, and furniture.

Automating calculations within *Families* using formulas

See my other class, [ES11064 - Creating Smarter Revit MEP Families](#)

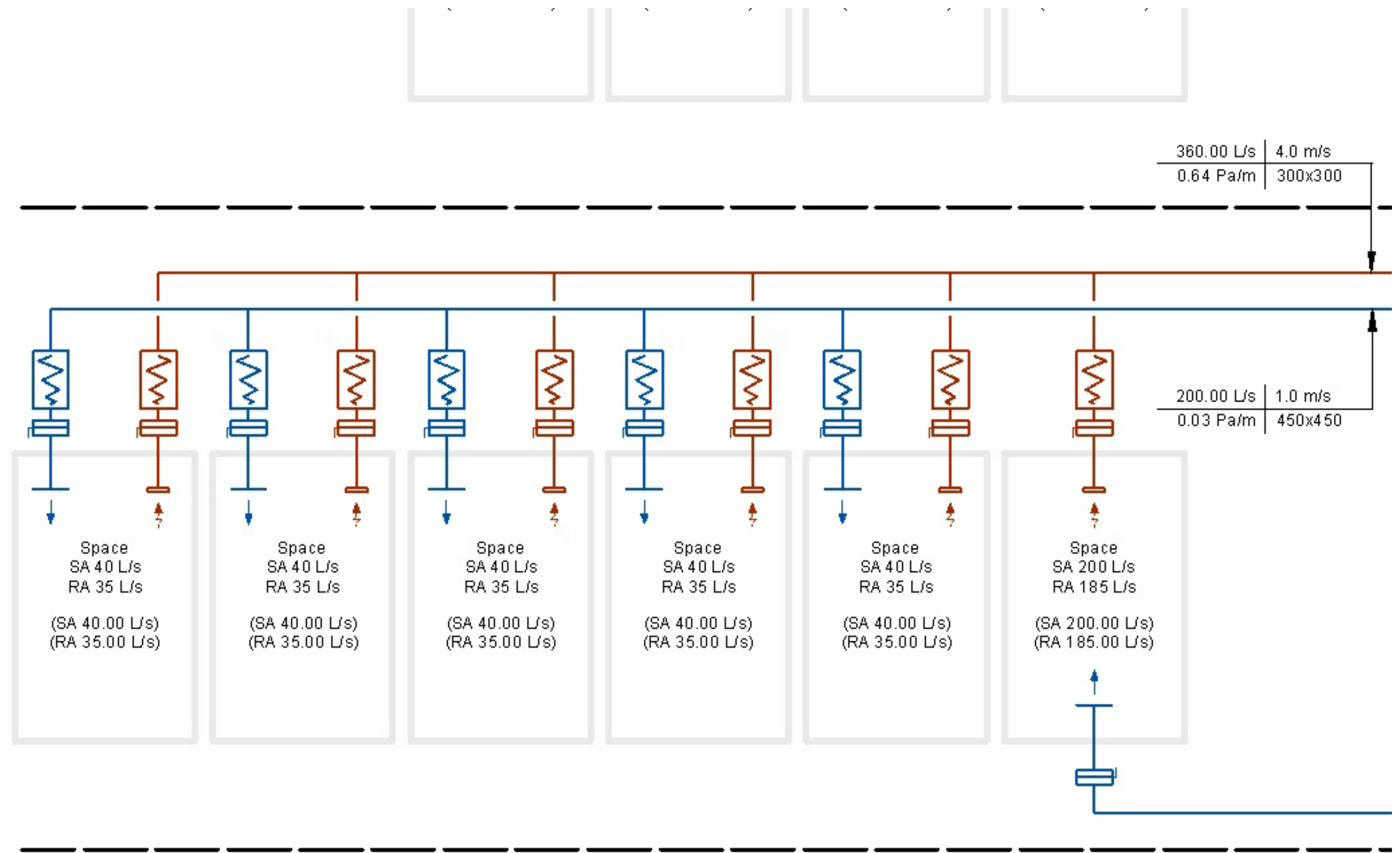
TIP: Don't model pipe sizes anymore, just model everything at largest anticipated pipe size (e.g. approximately 50Ø for a FCU system) and let Revit do the pipe sizing for you. This will save you loads of time.

Efficiency Quality Reduced Risk

*“Reduce the effort to do the usual / necessary and
increase the time to be creative”*

Tristram Carfrae Global BIM strategy

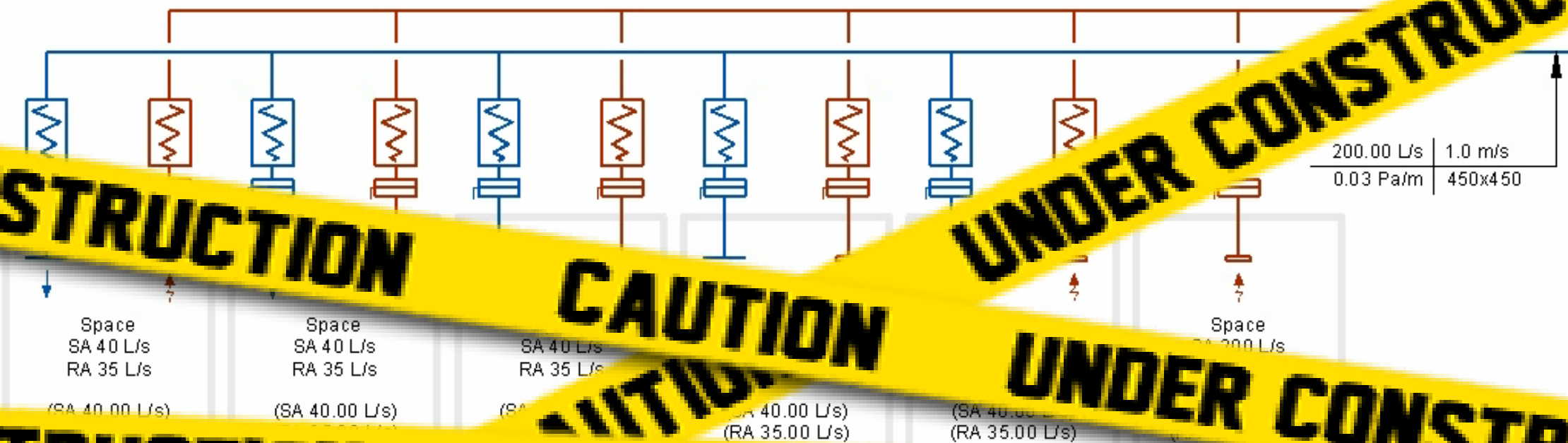
... and as an added bonus (come back next year for more)



UNDER CONSTRUCTION

CAUTION

COMING SOON



That's your lot ... Thank you very much for attending!



- Via the Survey Stations, email or mobile device
- AU 2015 passes given out each day!
- Best to do it right after the session
- Instructors see results in real-time



