AS11047: Dynamo Hero 2

Using Revit Scripting to Optimize Real-World Projects

Michael Hudson & Thorsten Strathaus

Associate Director — @MikeHudsonArchi

BIM Coordinator — @TStrathaus

@FlanLawArch

Class summary

This class will present how real-life architectural projects have used Dynamo Studio software to accelerate complex Building Information Modelling (BIM) challenges within Revit and Navisworks software. It shall demonstrate how PythonScript has been used to facilitate API access where no components have been published.

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This class will present how real-life architectural projects have used Dynamo Studio software to accelerate complex Building Information Modelling (BIM) challenges within Revit and Navisworks software. It shall demonstrate how PythonScript has been used to facilitate API access where no components have been published.

Key learning objectives

At the end of this class, you will be able to:

- Discover more time-efficient approaches to repetitive design tasks
- Discover the principles of the Dynamo visual programming interface
- Discover the principles of DesignScript and PythonScript
- Learn how to set up simple list management strategies for managing Clash results in Navisworks

About your speakers

Michael Hudson

BArch DipArch MArch ARB RIBA

- Associate Director
- Chartered Architect
- BIM Consultant
- University Lecturer
- BIM software since 2003
- Parametric Conceptual Design since 2007

Thorsten Strathaus

Dipl. Ing. Architektur

- BIM Coordinator
- Background in Architecture & Engineering
- 15+ years experience with Autodesk products
- 10+ years experience in parametric design and multi-objective optimisation

Flanagan Lawrence

- Design Architect
- London, UK
- 90 Employees
- RIBA Awarded
- WAF 2012/14/15
- BD 2014
- AJ Small Projects 2014

Flanagan Lawrence

- Design Architect
- Revit since 2012
- Masterplans
- Acoustic/Theatre Design
- Residential/Mixed Use
- Office

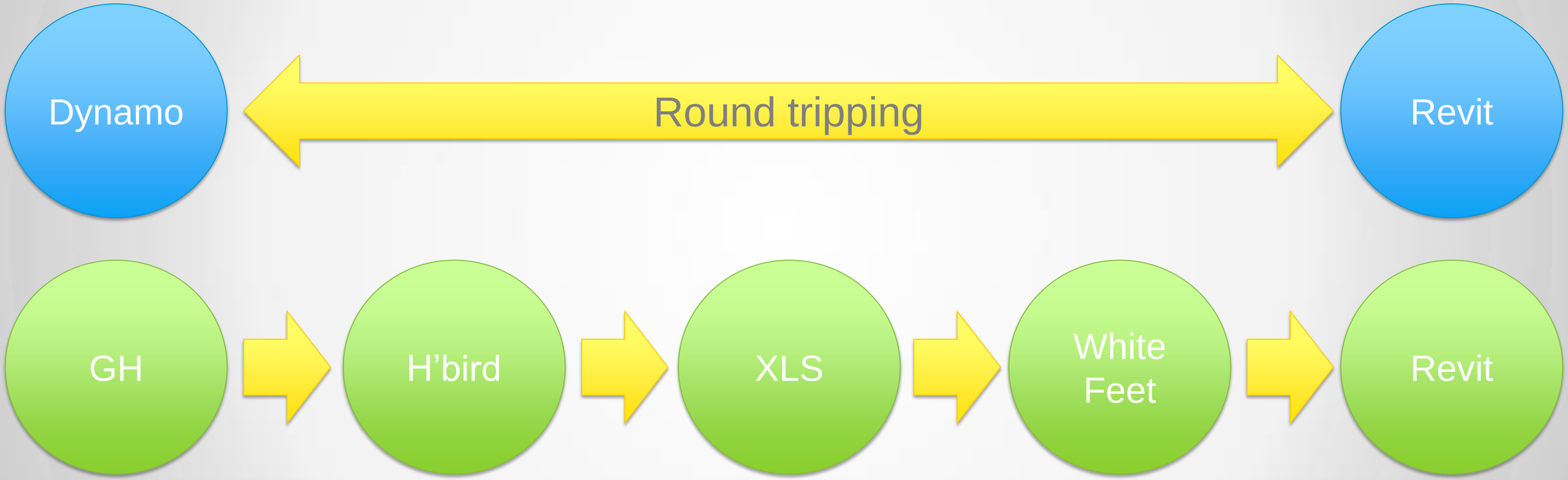
Flanagan Lawrence

- Flanagan Lawrence Group
- Interior Design
- BIM Consultancy
- Visualisation
- Site Delivery/CMT

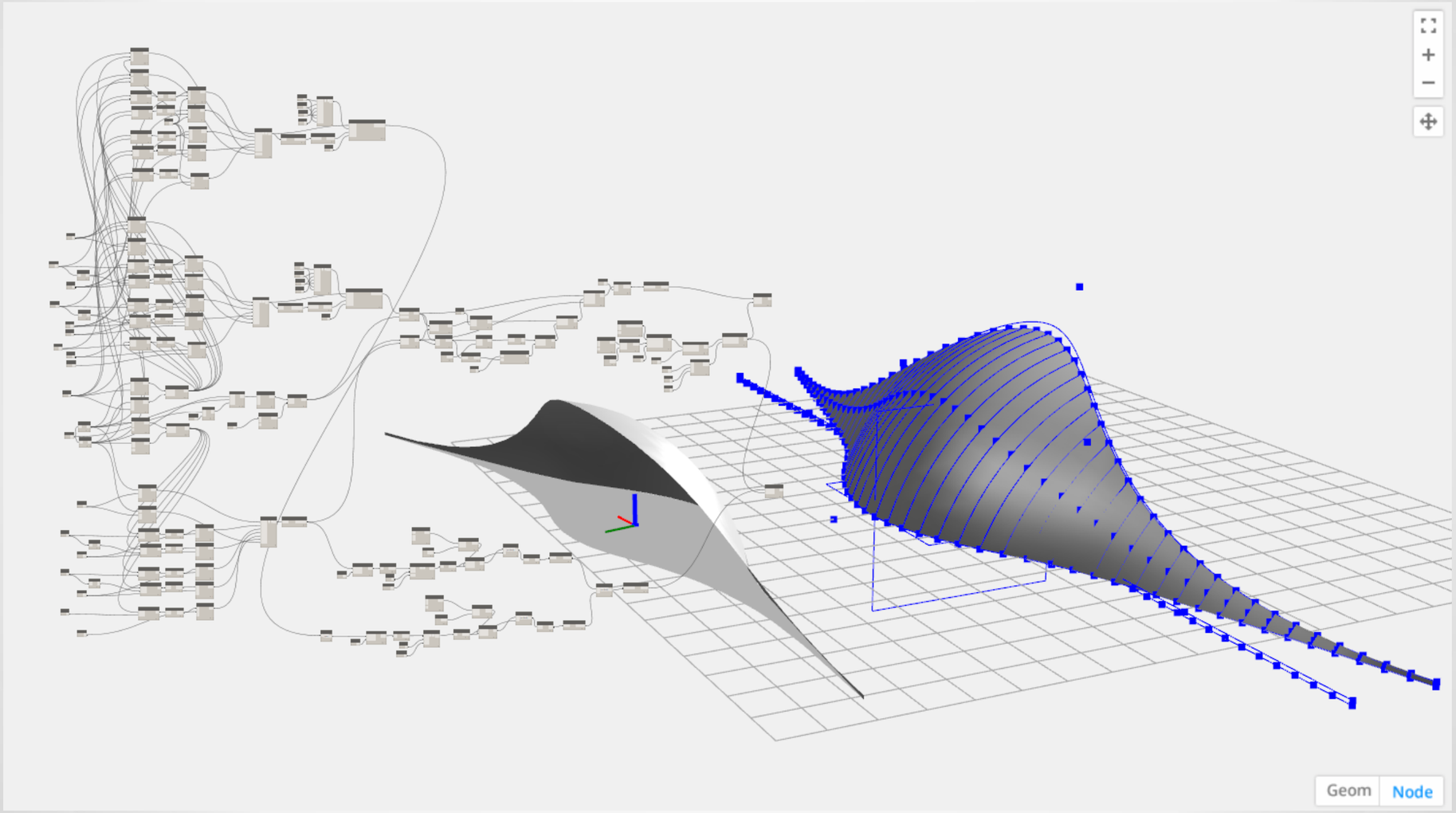
Previously….


NOW! THE BOOK YOU ASKED FOR!
TOWER ACTION SERIES
DYNAMO
THE GREATEST THUNDER AGENT OF THEM ALL!
APPROVED BY THE COMICS CODE AUTHORITY
25¢
AUG.
No. 1

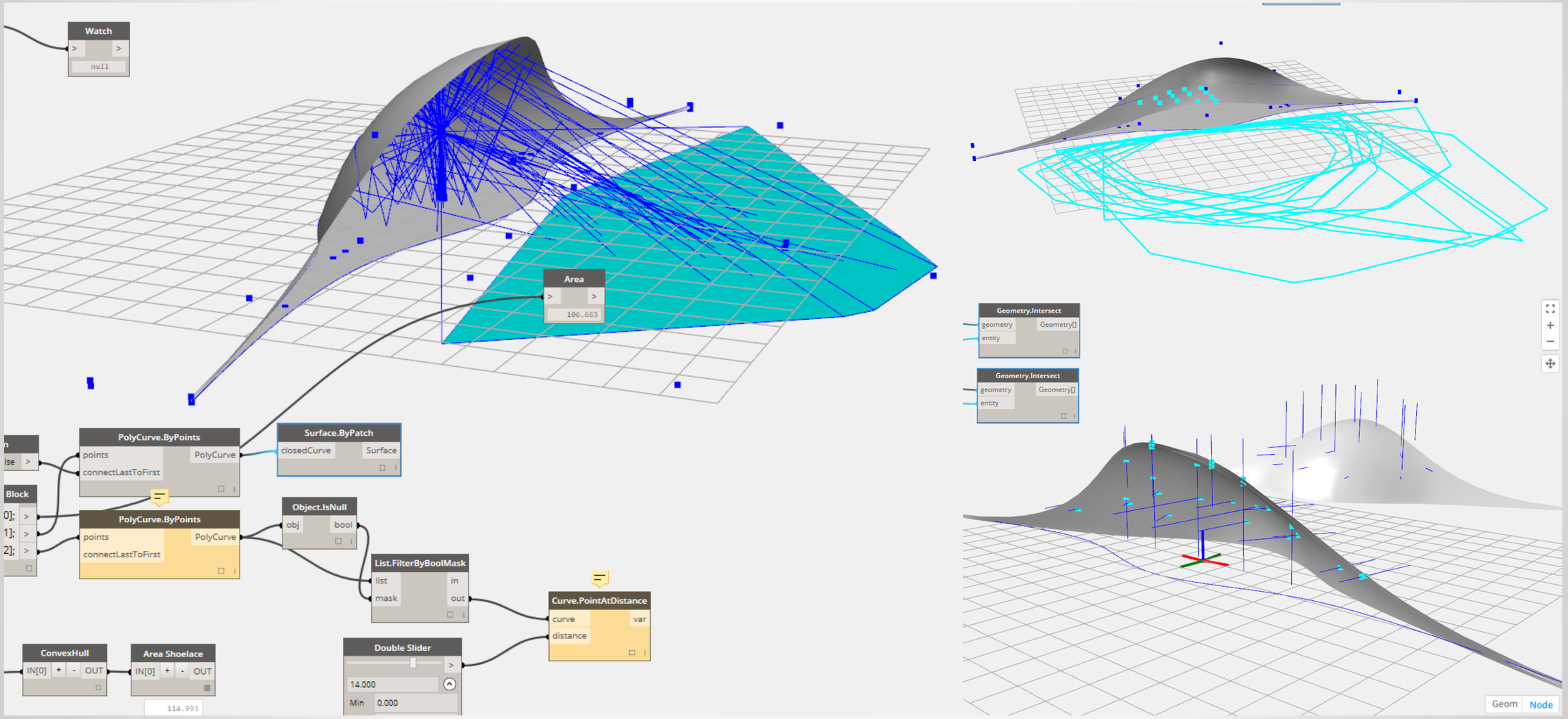
Back in 2013…



We used Dynamo for Geometry



Acoustic Simulation & Optimisation



And Fabrication

Dynamo Hero 2: The Sequel?

More Superheroes….

Copyright: LEGO Group

More Superheroes + Bigger Challenges

Original Image Copyright: CBS Corporation

More Superheroes + Bigger Challenges = Chaos

What Powers Should Dynamo Possess?

Accessibility

Connectivity

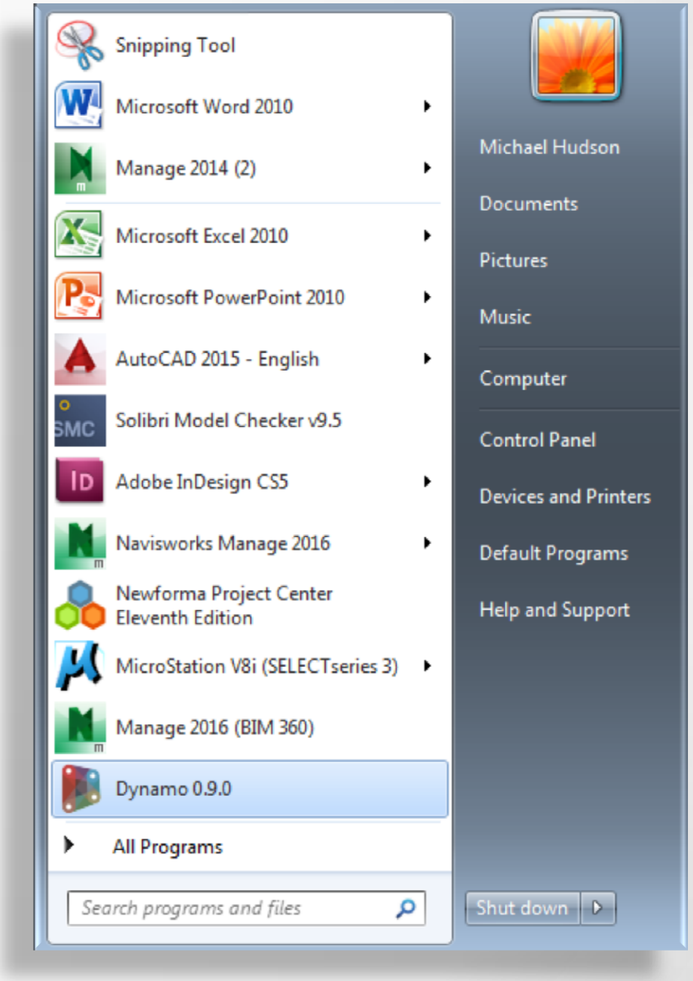
Teleportation

Time-travel

Accessibility

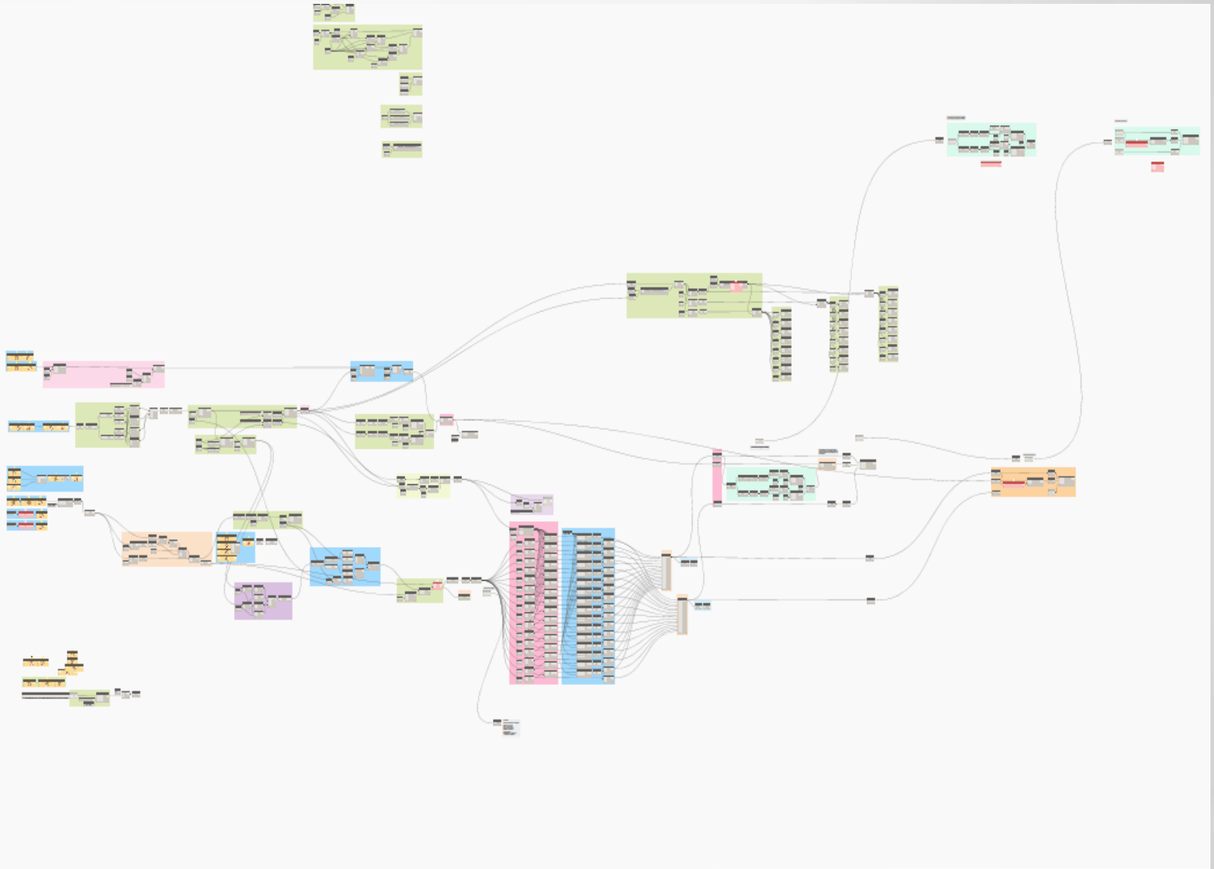
Accessibility

- Standalone or Integrated



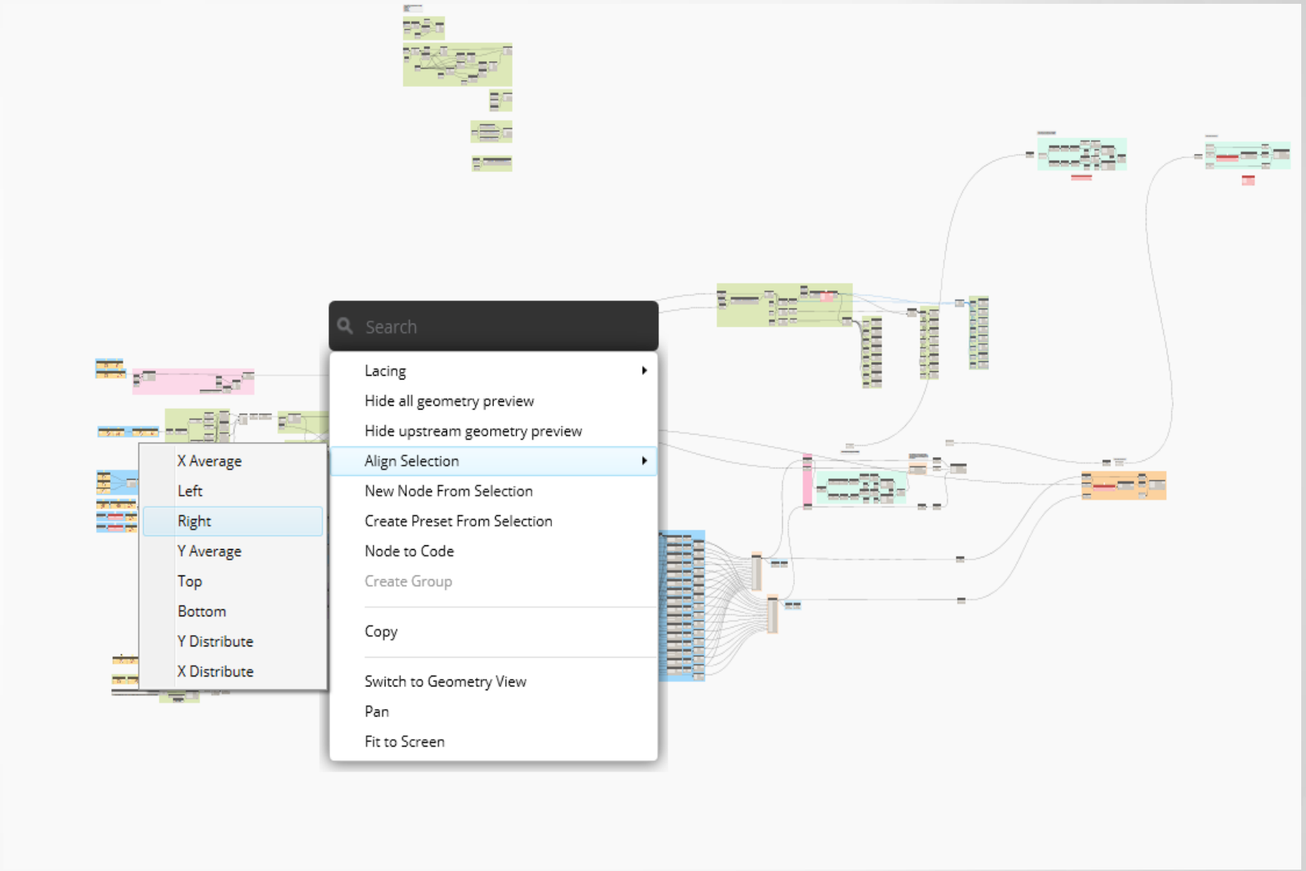
Accessibility

- Standalone or Integrated
- Grouping

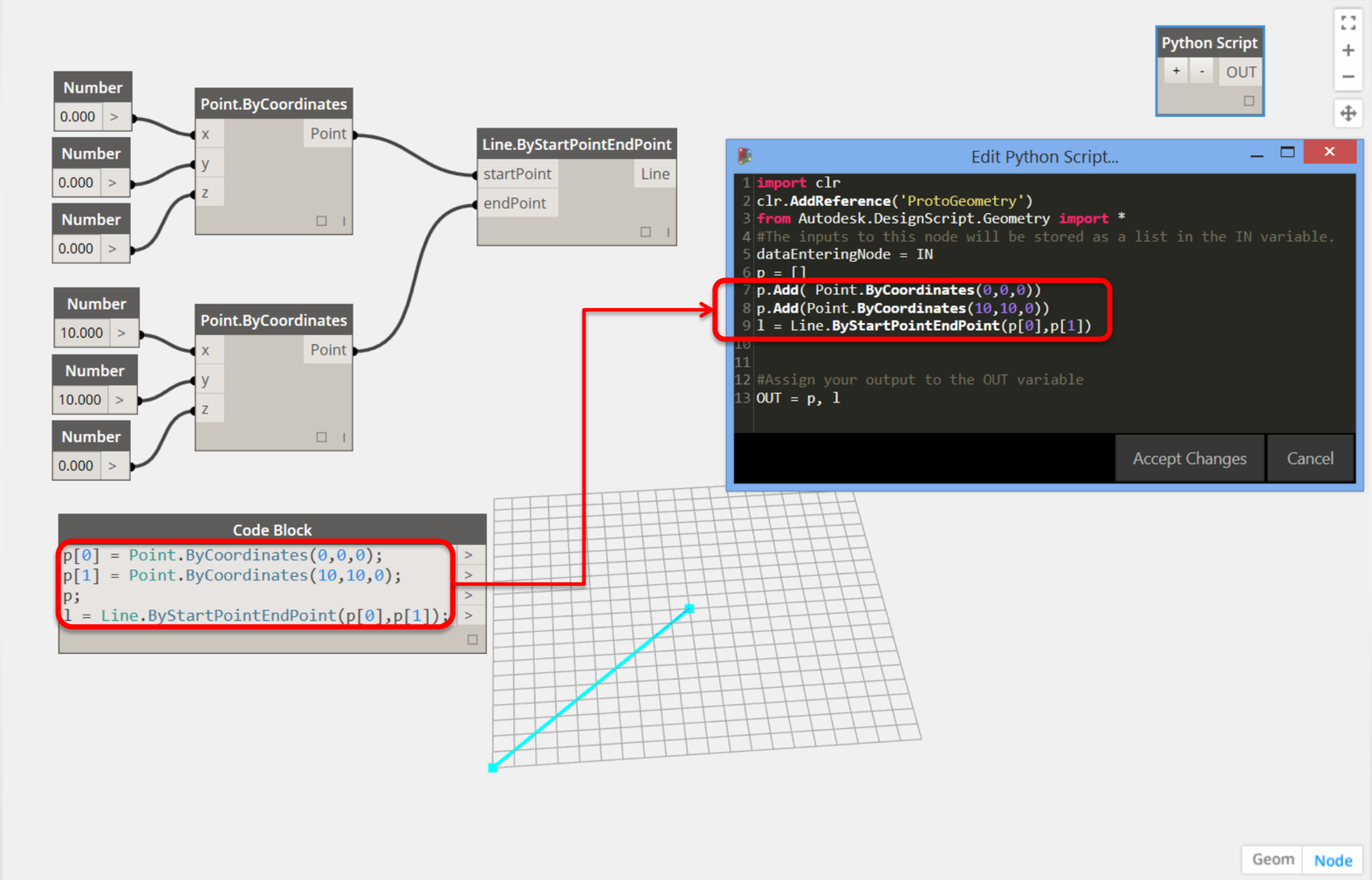


Accessibility

- Standalone or Integrated
- Grouping
- Canvas Operations

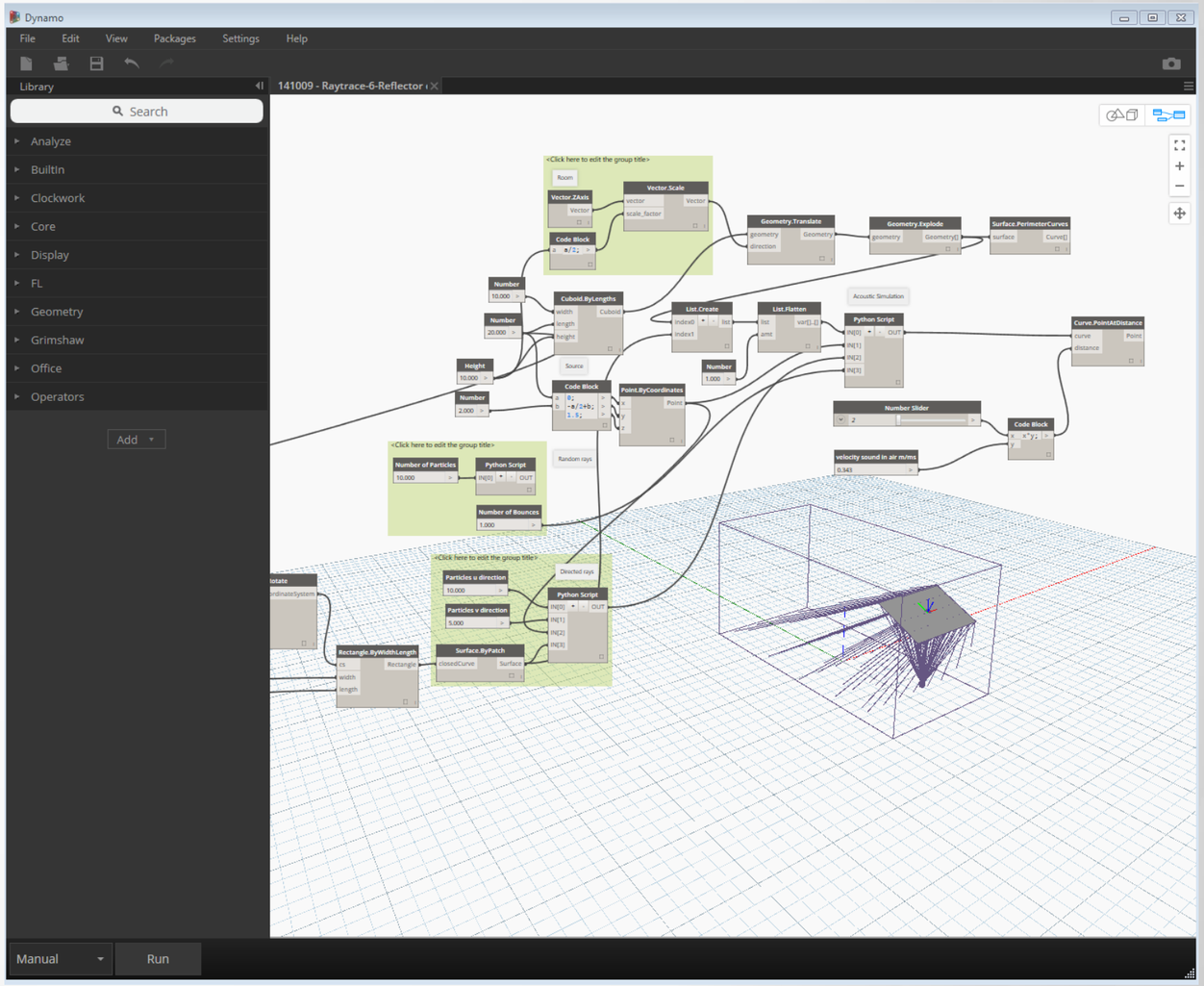


PythonScript



Accessibility

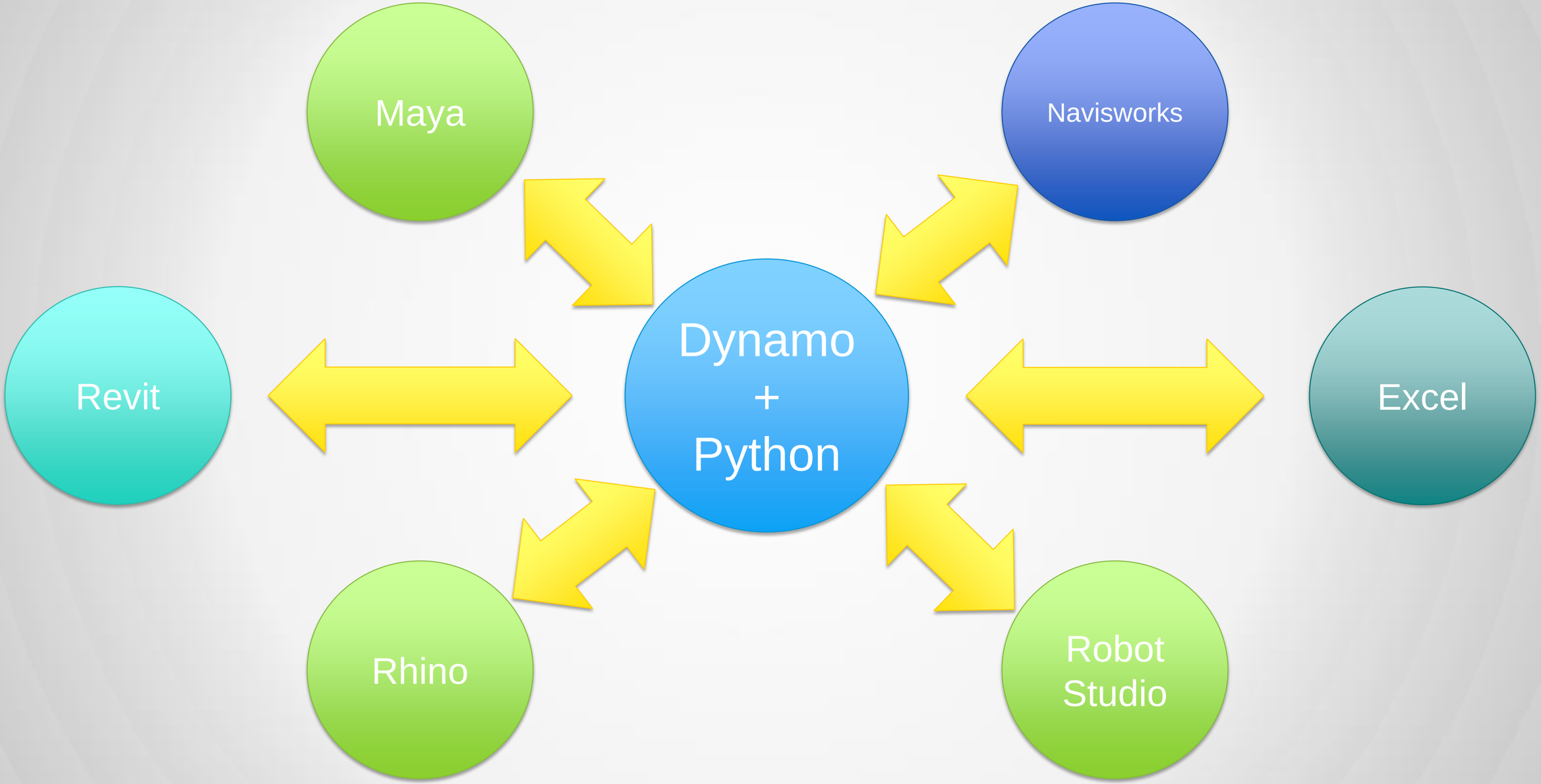
- Standalone or Integrated
- Grouping
- Canvas Operations
- Code Blocks (DesignScript)
- IronPythonShell
- Zero Touch Import
- DynamoBIM.com
- DynamoPackages.com
- GitHub.com
- Dynamoreach.com



Connectivity

Connectivity

Connectivity



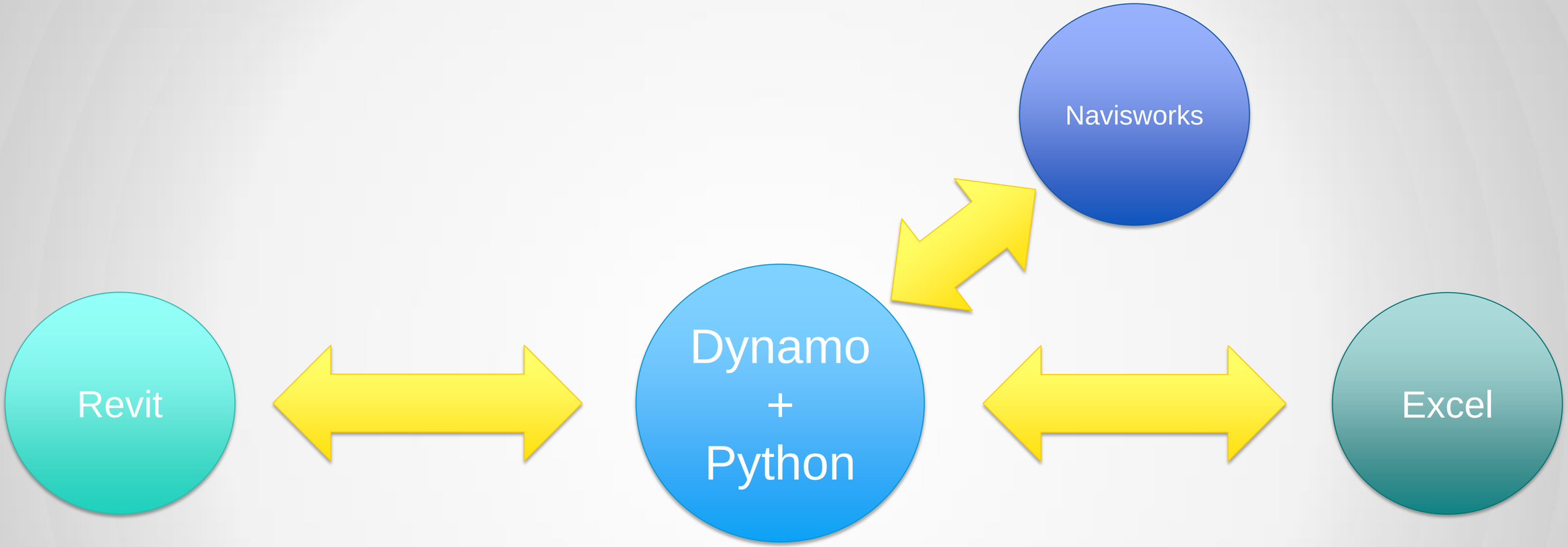
API Access

Edit Python Script...

```python
#Dimitar Venkov, BBtoSect

import clr
clr.AddReference('RevitAPI')
from Autodesk.Revit.DB import *

clr.AddReference("RevitNodes")
import Revit
clr.ImportExtensions(Revit.GeometryConversion)
clr.ImportExtensions(Revit.Elements)

clr.AddReference("RevitServices")
import RevitServices
from RevitServices.Persistence import DocumentManager
from RevitServices.Transactions import TransactionManager

BB = IN[0]
ClashName = IN[1]
offset = float(IN[2])

doc = DocumentManager.Instance.CurrentDBDocument
view = doc.ActiveView
try:
    TransactionManager.Instance.EnsureInTransaction(doc)

```

Python Node by Dimitar Venkov

Connectivity - Dynaworks



Alto Apartments

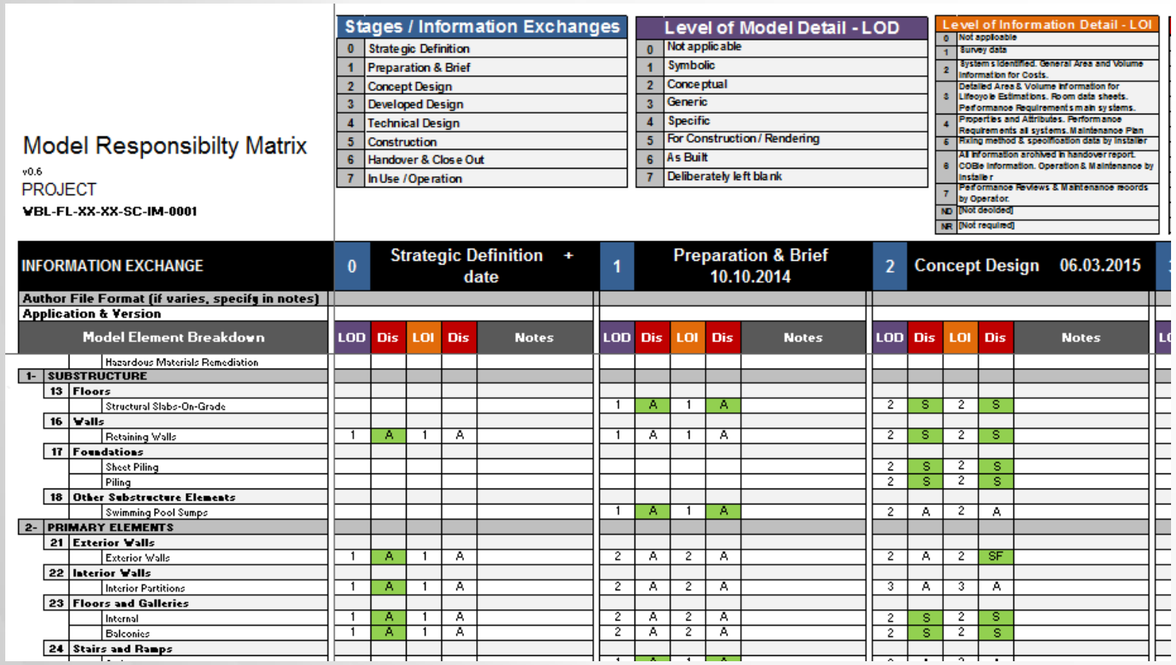
- £1 Billion Masterplan
- £95 Million Mixed Use Phase
- 310 Private + 52 Affordable Units
- Energy Centre
- Architect & Interior Designer
- Information Manager/BIM consultant

Alto Apartments

- UK BIM Level 2
  (EIR, BEP & MRM)
- Multidisciplinary Approach (IPD)
- Bi-weekly Model Federations
- Up to 60 Models (Mostly Revit)

Alto Apartments

- Auditable Collaboration
- LOD Deliverables (PAS 1192-2)
- Agreed Resolution Timetables



Model Responsibilty Matrix

v0.6

PROJECT

VBL-FL-XX-XX-SC-IM-0001

Stages / Information Exchanges	
0	Strategic Definition
1	Preparation & Brief
2	Concept Design
3	Developed Design
4	Technical Design
5	Construction
6	Handover & Close Out
7	In Use / Operation

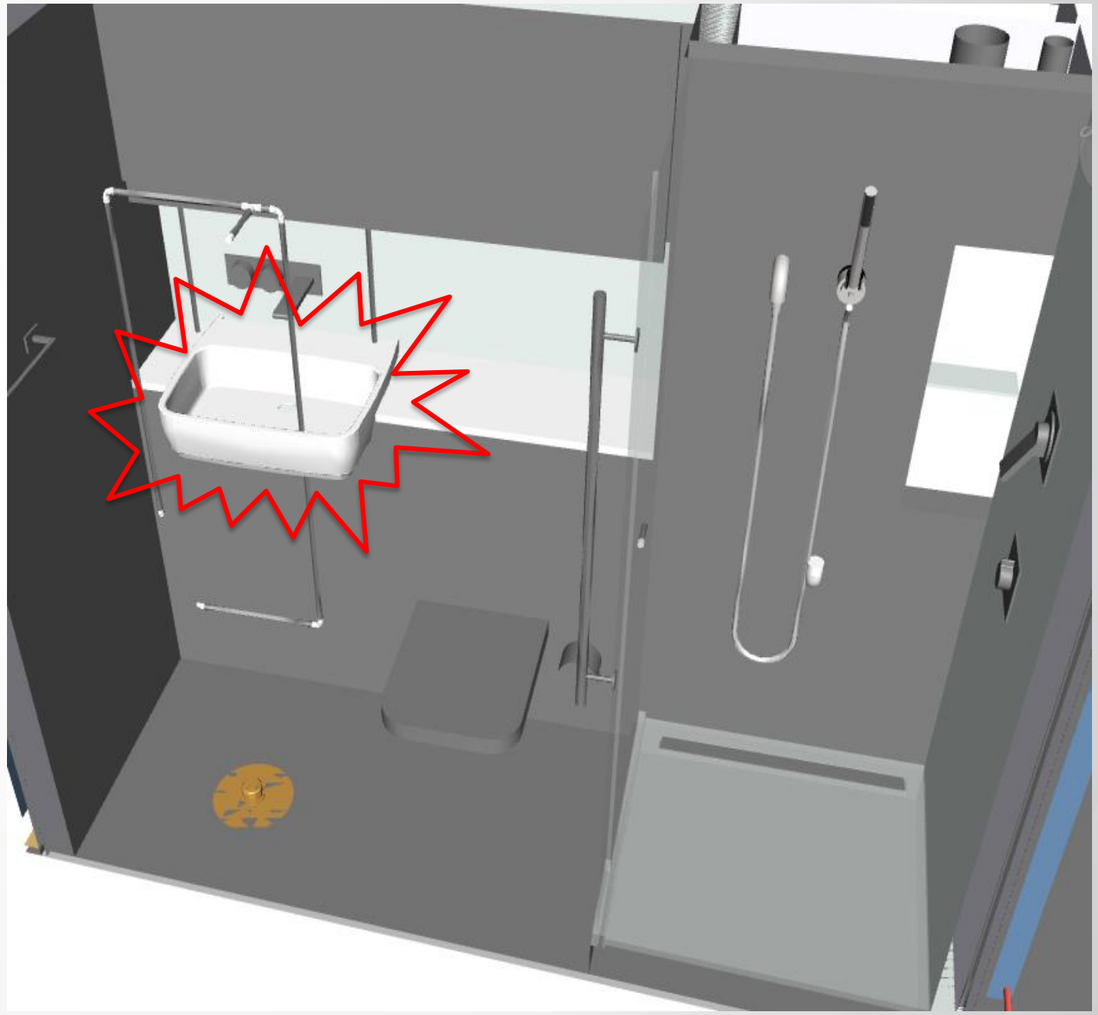
Level of Model Detail - LOD	
0	Not applicable
1	Symbolic
2	Conceptual
3	Generic
4	Specific
5	For Construction / Rendering
6	As Built
7	Deliberately left blank

Level of Information Detail - LOI	
0	Not applicable
1	Survey data
2	System s identified. General Area and Volume information for Costs.
3	Detailed Area & Volume information for Lifecycle Estimations. Room data sheets. Performance Requirements main sy stems.
4	Properties and Attributes. Performance Requirements all systems. Maintenance Plan
5	Fixing method & specification data by Installer
6	All information archived in handover report. COBie information. Operation & Maintenance by installe r
7	Performance Reviews & Maintenance records by Operator.
ND	[Not decided]
NR	[Not required]

INFORMATION EXCHANGE	0	Strategic Definition + date				1	Preparation & Brief 10.10.2014				2	Concept Design 06.03.2015			
Author File Format (if varies, specify in notes)															
Application & Version															
Model Element Breakdown	LOD	Dis	LOI	Dis	Notes	LOD	Dis	LOI	Dis	Notes	LOD	Dis	LOI	Dis	Notes
Hazardous Materials Remediation															
1- SUBSTRUCTURE															
13 Floors															
Structural Slabs-On-Grade						1	A	1	A		2	S	2	S	
16 Walls															
Retaining Walls	1	A	1	A		1	A	1	A		2	S	2	S	
17 Foundations															
Sheet Piling											2	S	2	S	
Piling											2	S	2	S	
18 Other Substructure Elements															
Swimming Pool Sumps						1	A	1	A		2	A	2	A	
2- PRIMARY ELEMENTS															
21 Exterior Walls															
Exterior Walls	1	A	1	A		2	A	2	A		2	A	2	SF	
22 Interior Walls															
Interior Partitions	1	A	1	A		2	A	2	A		3	A	3	A	
23 Floors and Galleries															
Internal	1	A	1	A		2	A	2	A		2	S	2	S	
Balconies	1	A	1	A		2	A	2	A		2	S	2	S	
24 Stairs and Ramps															

Alto Apartments

- Auditable Collaboration
- LOD Deliverables (PAS 1192-2)
- Agreed Resolution Timetables



Model Responsibilty Matrix

v0.6

PROJECT

WBL-FL-XX-XX-SC-IM-0001

Stages / Information Exchanges	
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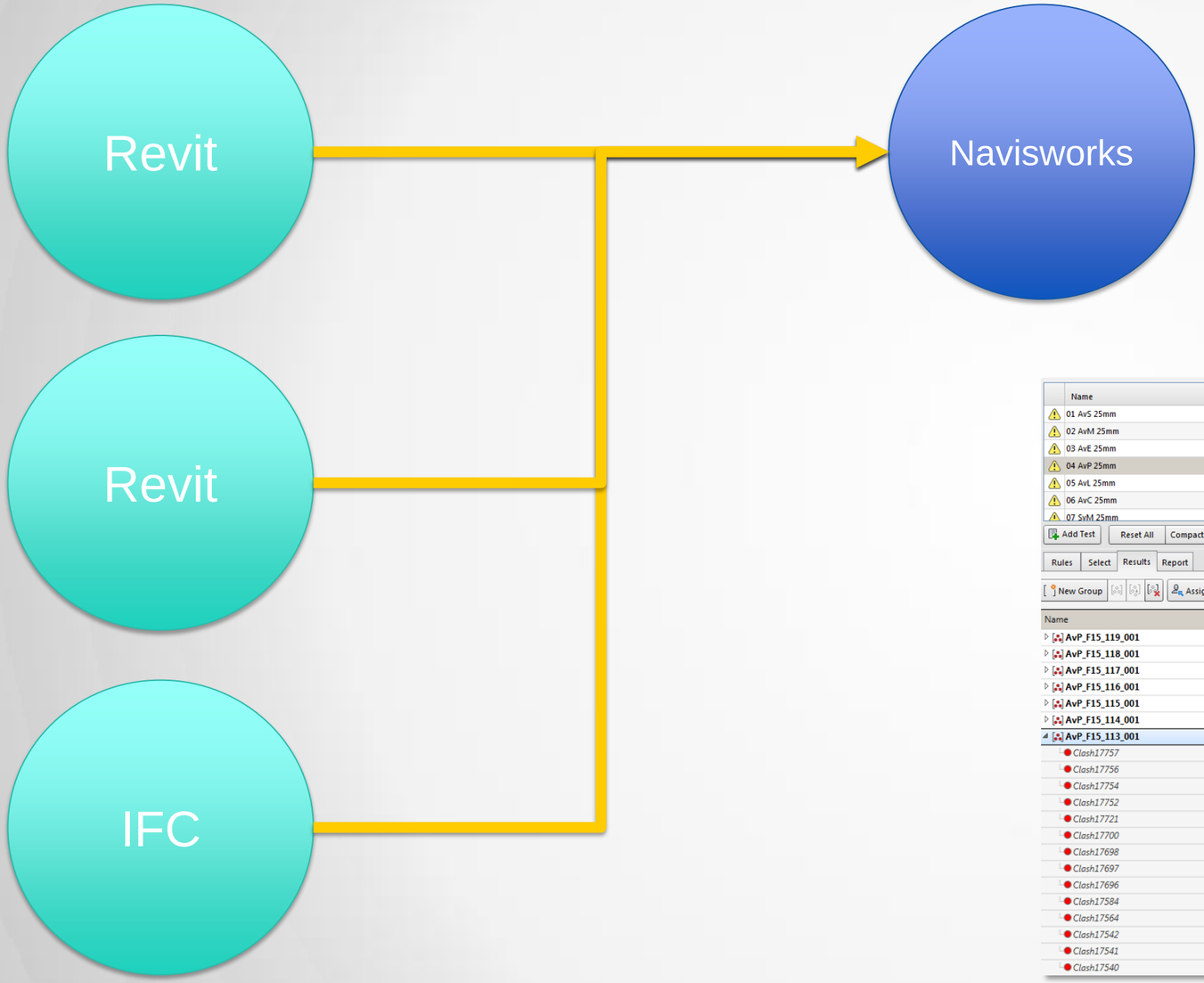
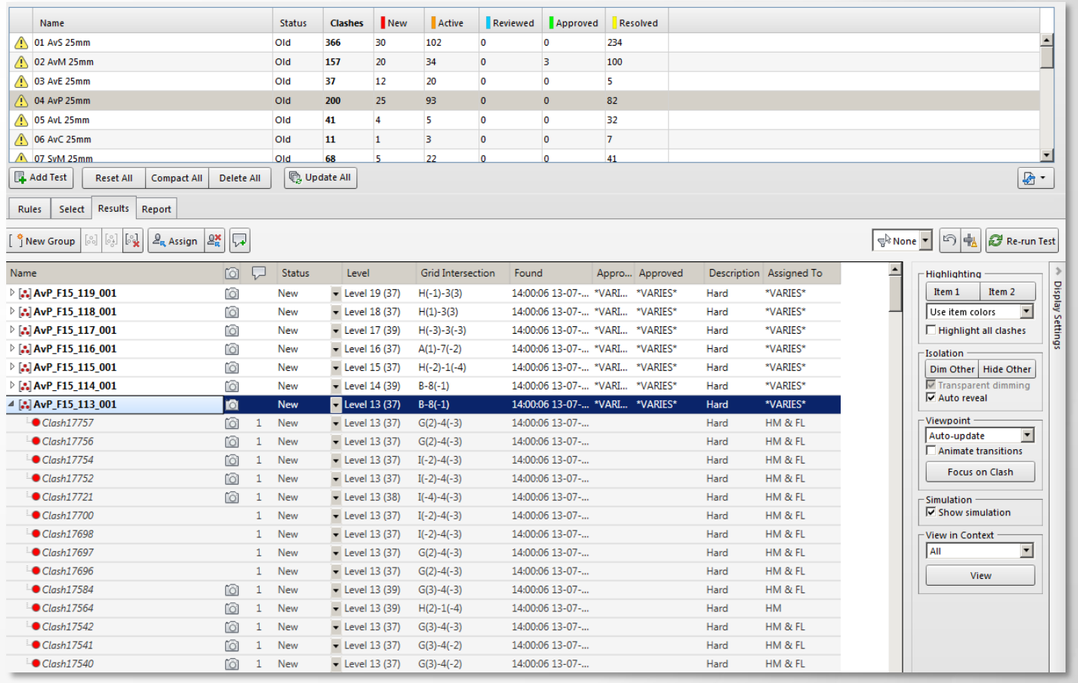
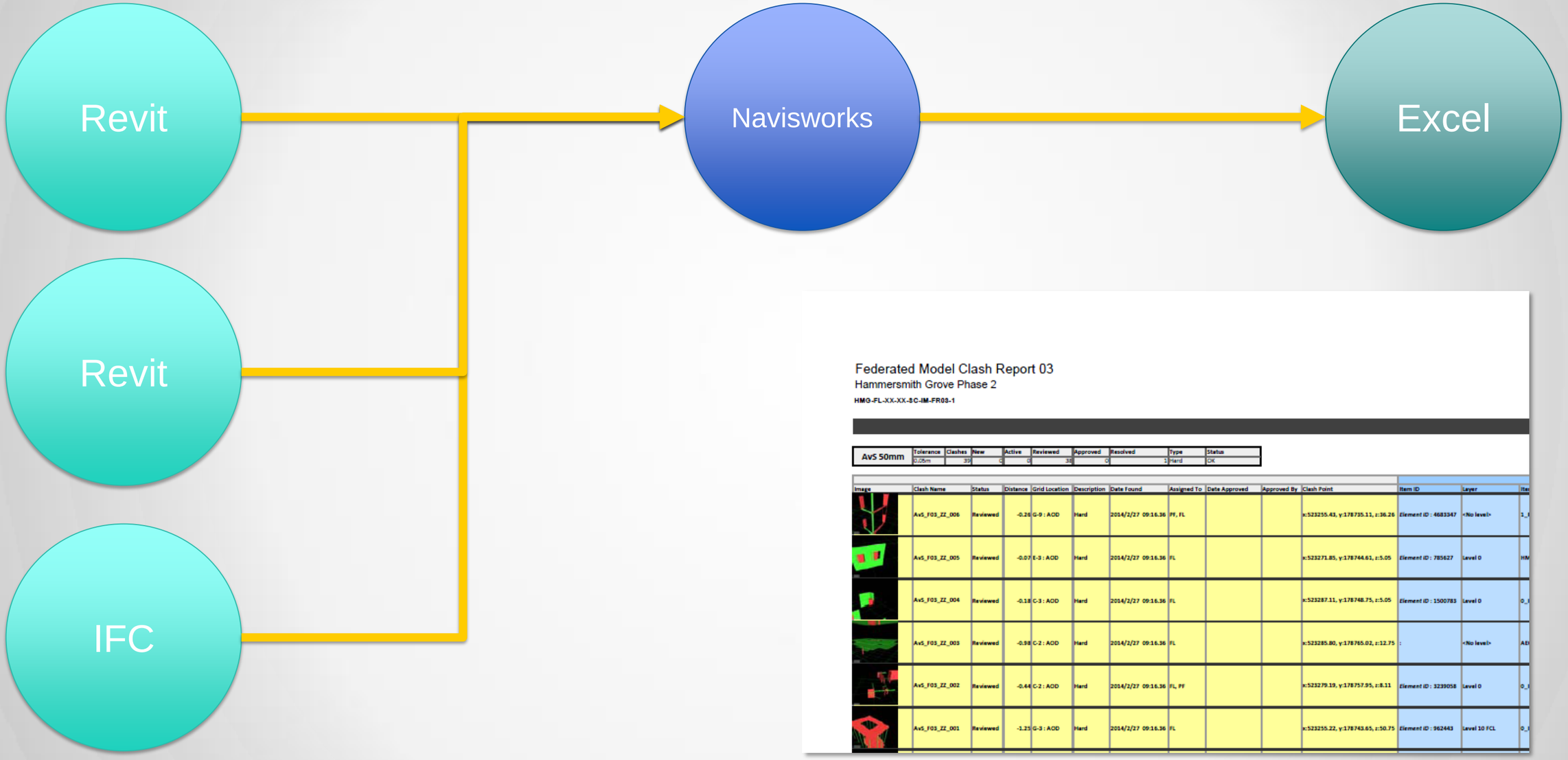
22 Interior Walls															
Interior Partitions	1	A	1	A		2	A	2	A		3	A	3	A	
23 Floors and Galleries															
Internal	1	A	1	A		2	A	2	A		2	S	2	S	
Balconies	1	A	1	A		2	A	2	A		2	S	2	S	
24 Stairs and Ramps															

Navisworks Clash Reports





Navisworks Clash Reports

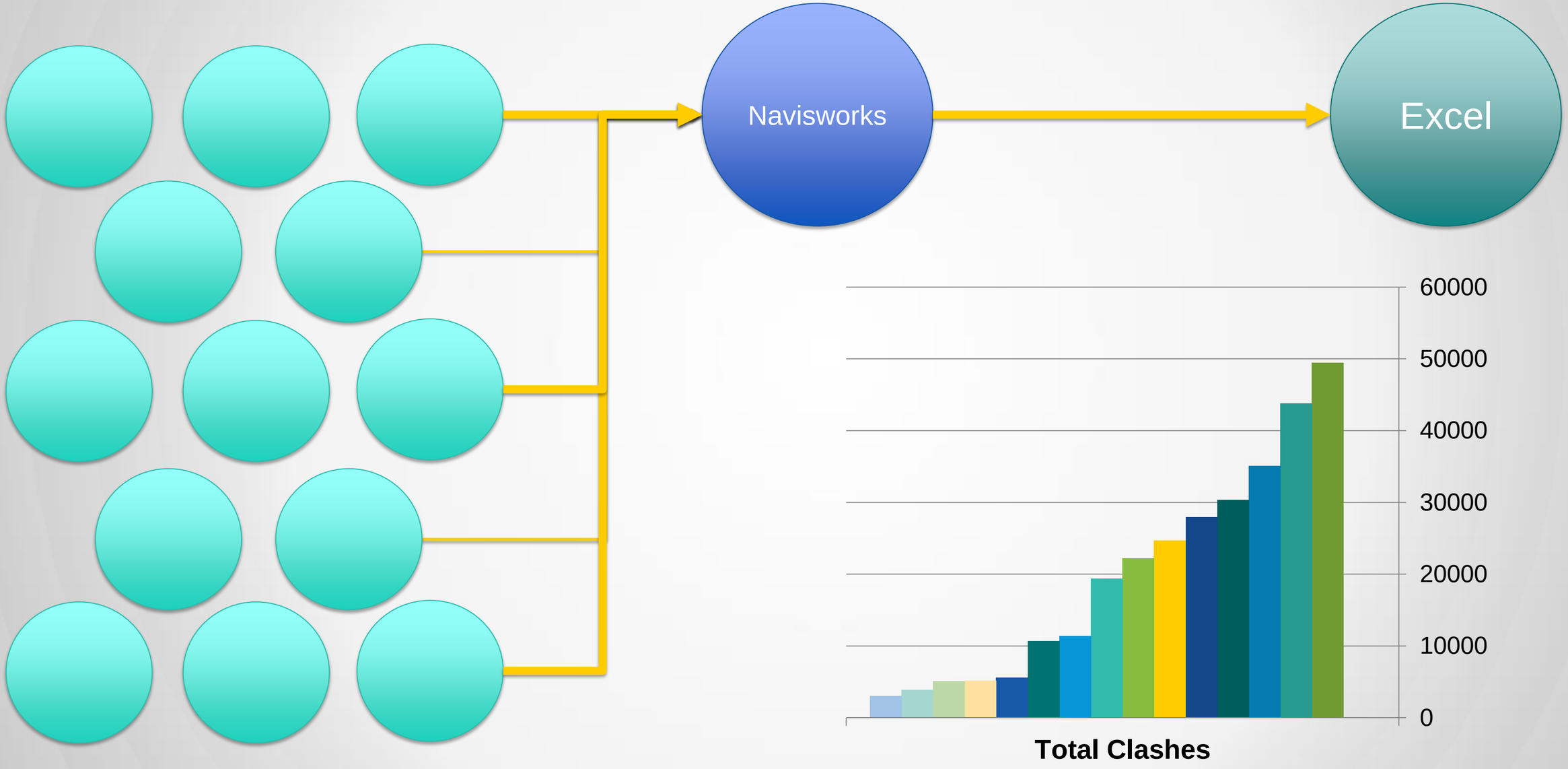


Federated Model Clash Report 03
Hammersmith Grove Phase 2
HMG-FL-XX-XX-SC-IM-FR03-1

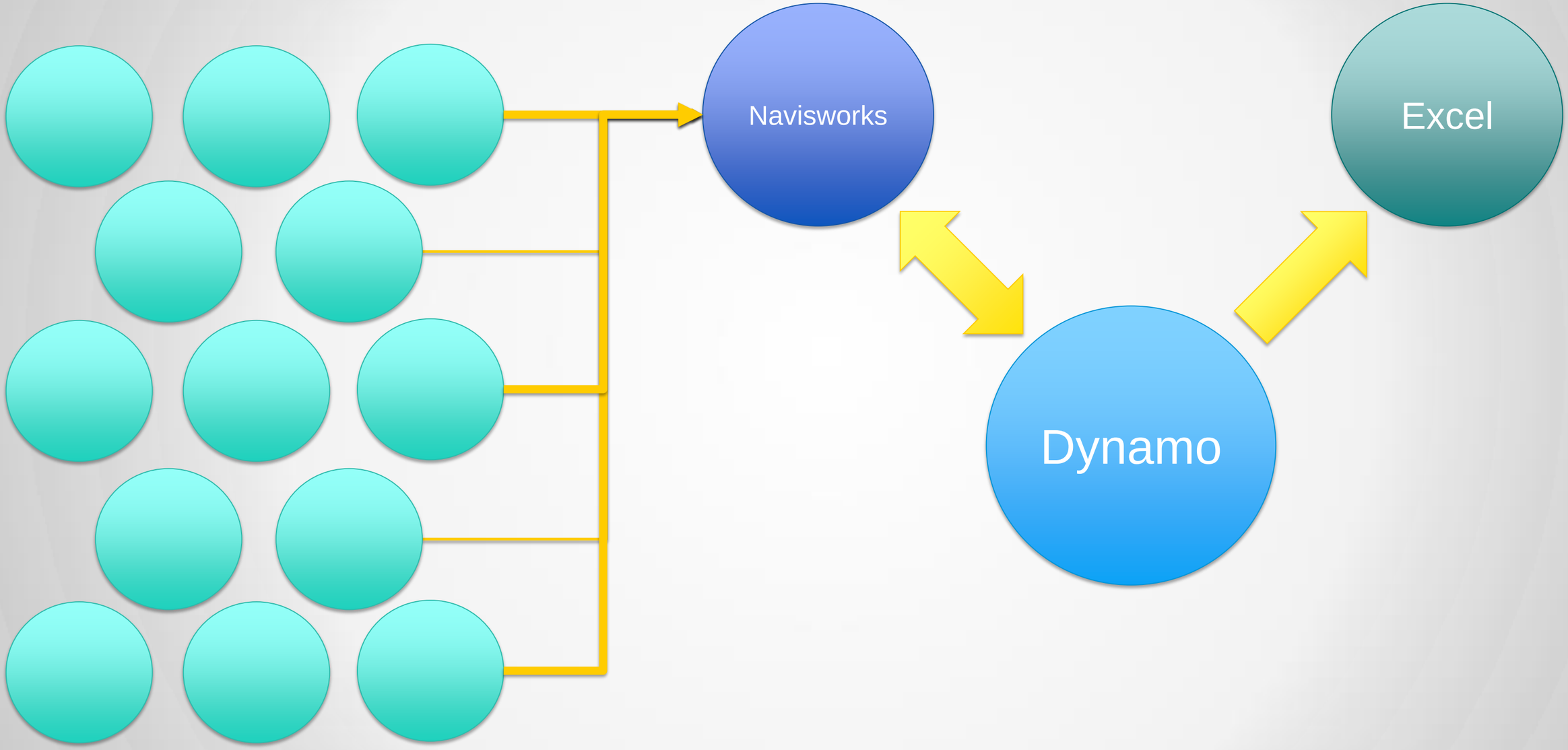
	Tolerance	Clashes	New	Active	Reviewed	Approved	Resolved	Type	Status
AvS 50mm	0.05m	39	0	0	38	0	1	Hard	OK

Image	Clash Name	Status	Distance	Grid Location	Description	Date Found	Assigned To	Date Approved	Approved By	Clash Point	Item ID	Layer
	AvS_F03_ZZ_006	Reviewed	-0.26	G-9 : AOD	Hard	2014/2/27 09:16:36	PF, FL			x:523255.43, y:178735.11, z:36.26	Element ID : 4683347	<No level>
	AvS_F03_ZZ_005	Reviewed	-0.07	E-3 : AOD	Hard	2014/2/27 09:16:36	FL			x:523271.85, y:178744.61, z:5.05	Element ID : 785627	Level 0
	AvS_F03_ZZ_004	Reviewed	-0.18	C-3 : AOD	Hard	2014/2/27 09:16:36	FL			x:523287.11, y:178748.75, z:5.05	Element ID : 1500783	Level 0
	AvS_F03_ZZ_003	Reviewed	-0.98	C-2 : AOD	Hard	2014/2/27 09:16:36	FL			x:523285.80, y:178765.02, z:12.75	:	<No level>
	AvS_F03_ZZ_002	Reviewed	-0.44	C-2 : AOD	Hard	2014/2/27 09:16:36	FL, PF			x:523279.19, y:178757.95, z:8.11	Element ID : 3239058	Level 0
	AvS_F03_ZZ_001	Reviewed	-1.25	G-3 : AOD	Hard	2014/2/27 09:16:36	FL			x:523255.22, y:178743.65, z:50.75	Element ID : 962443	Level 10 FCL

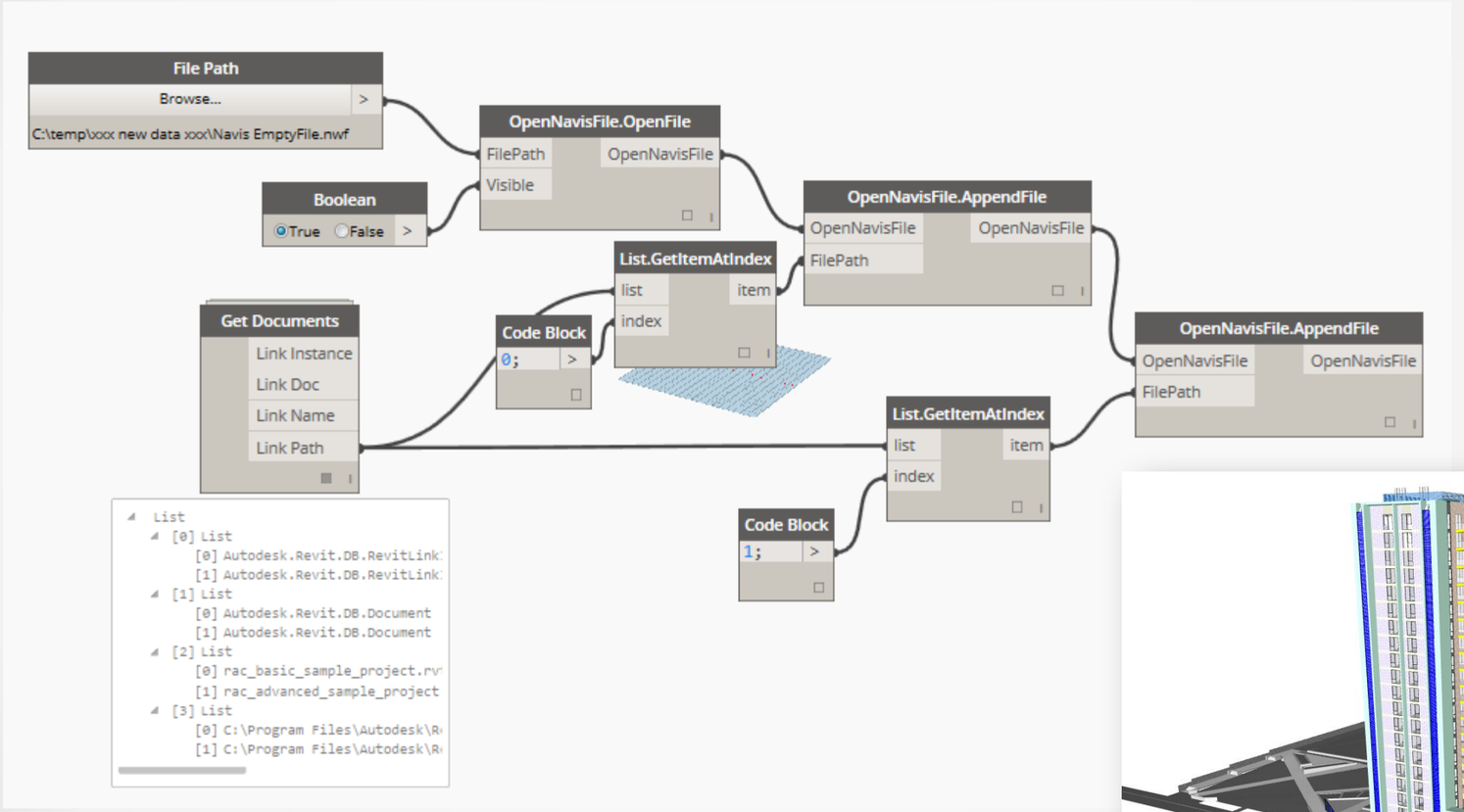
Navisworks Clash Reports



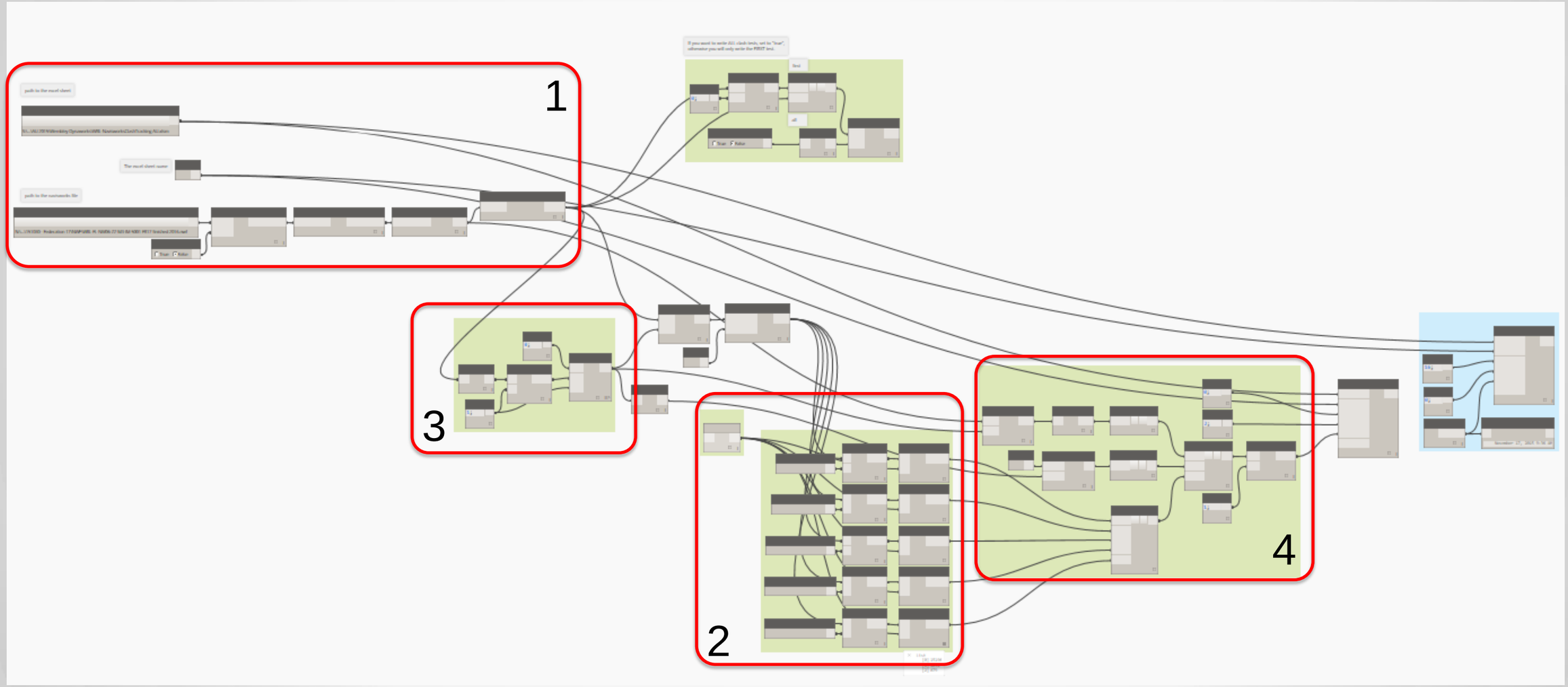
Dynaworks



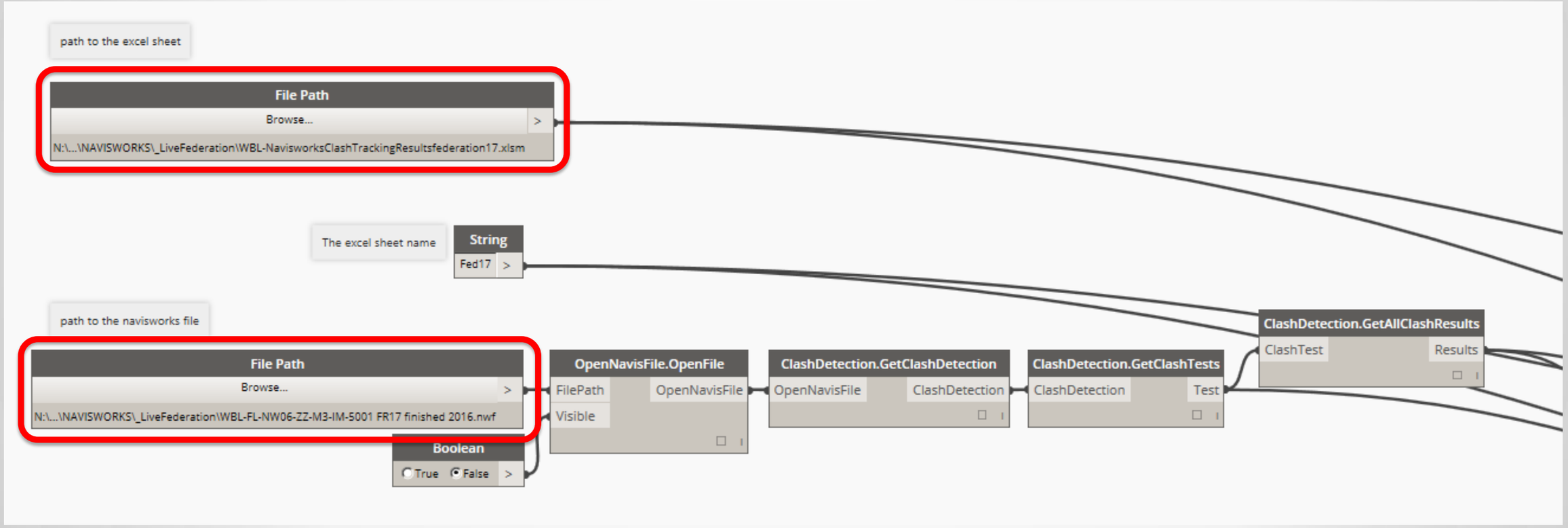
Dynaworks Batch Importer



Dynaworks - 60,000 clashes, 60 Nodes, 6 Minutes



1. Getting started



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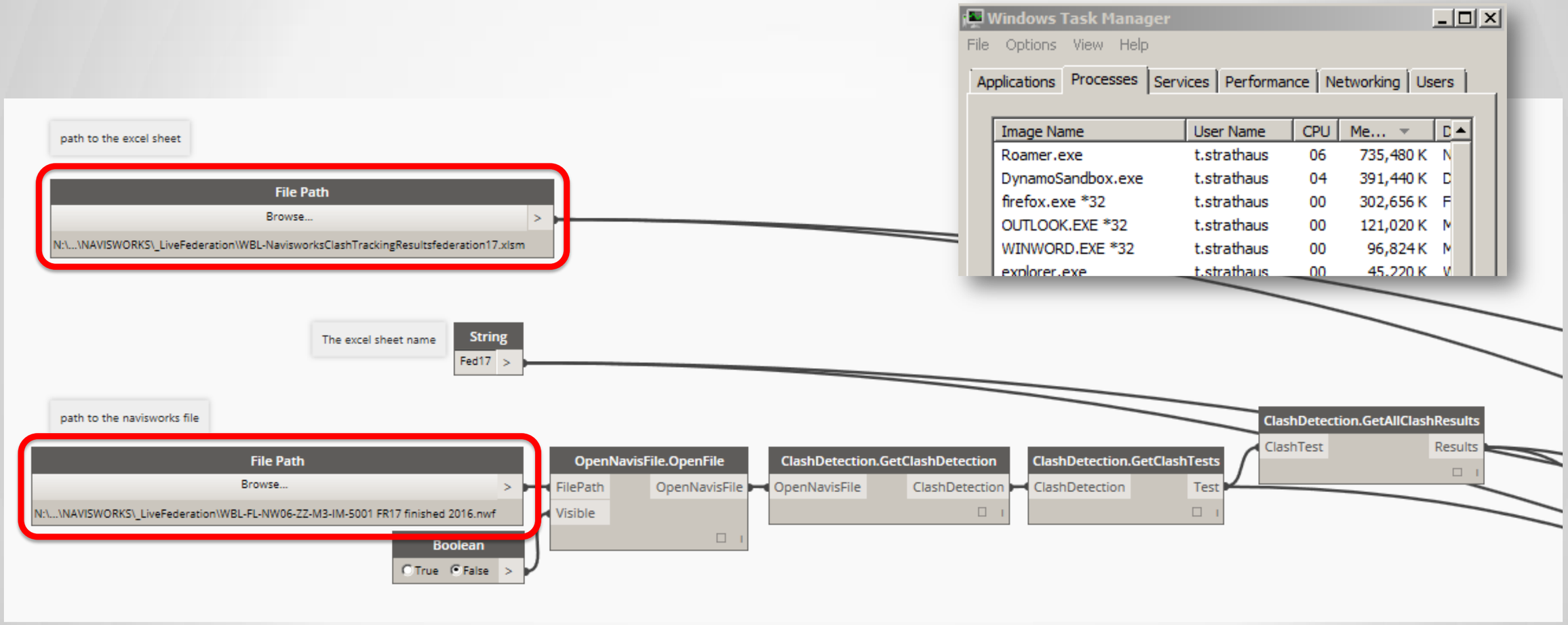
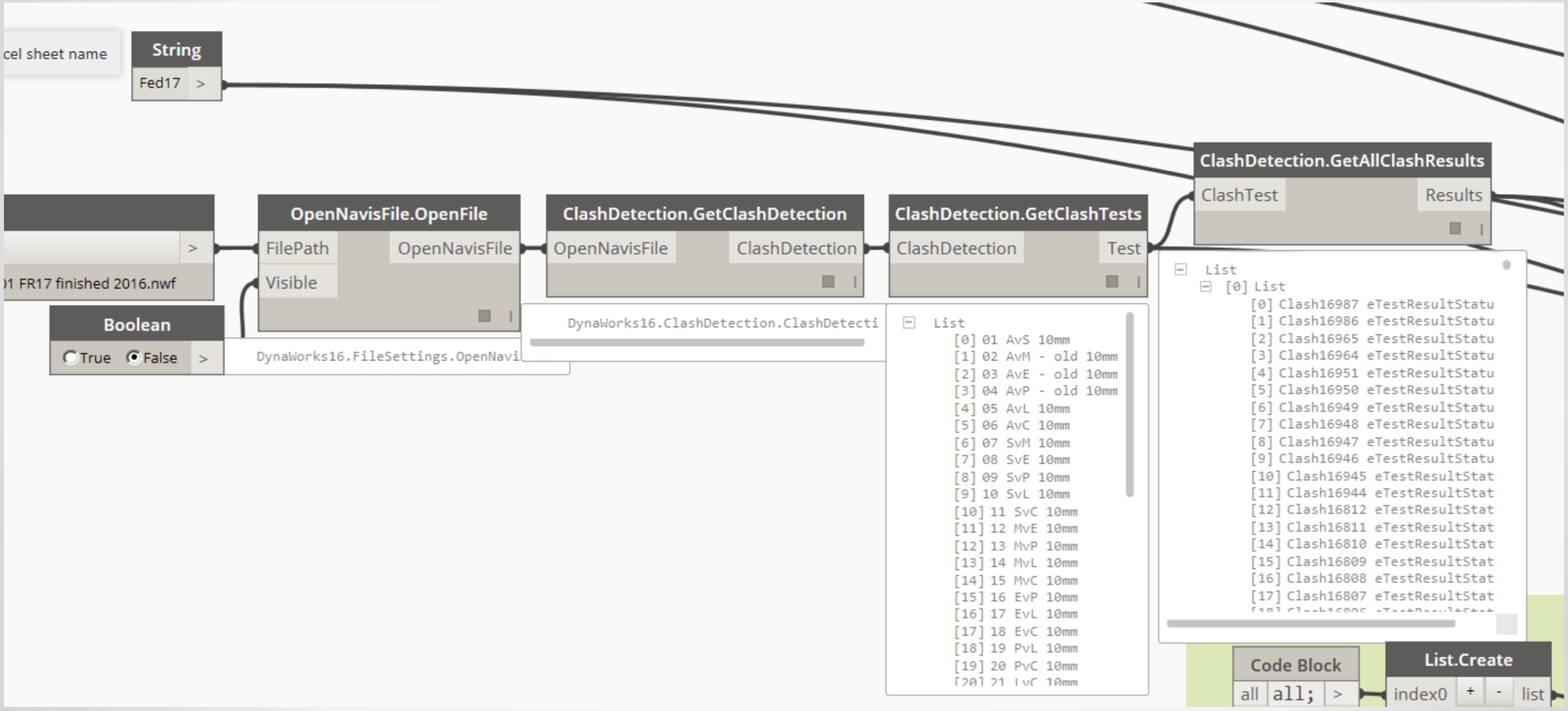


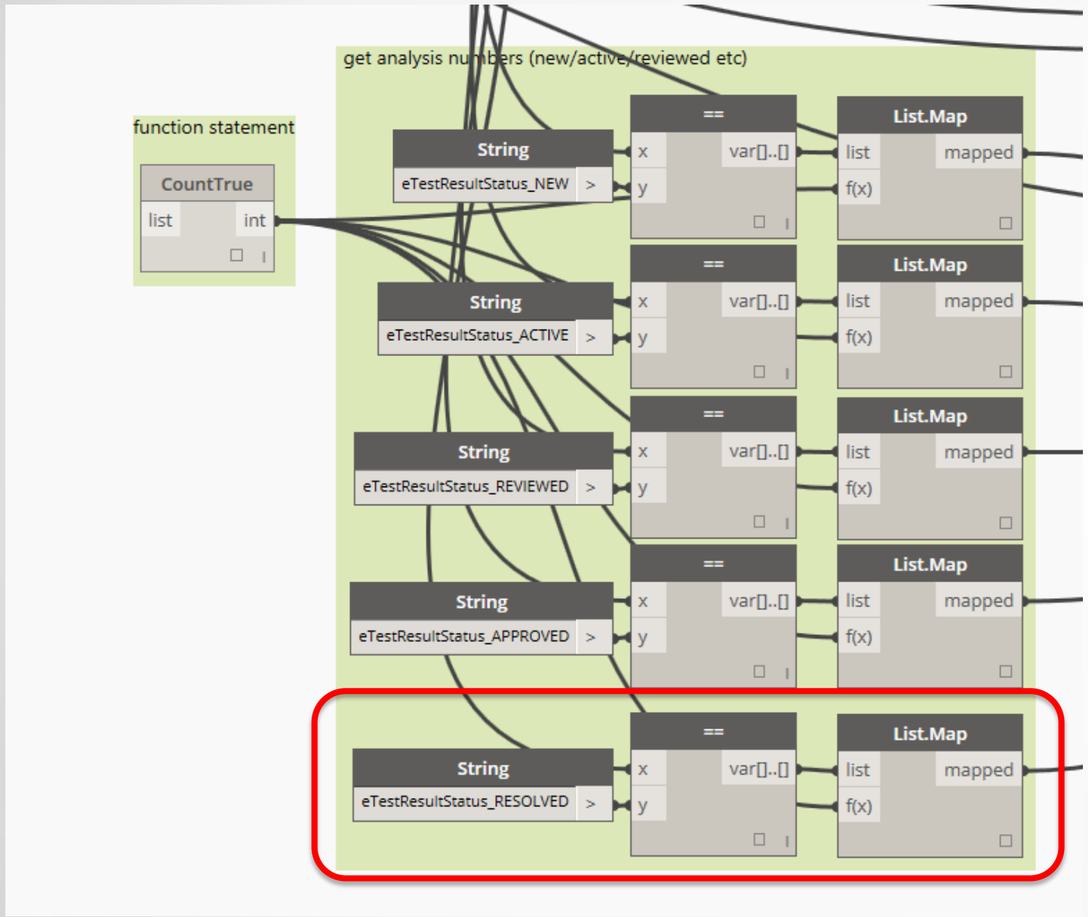
1. Reading data from Navisworks

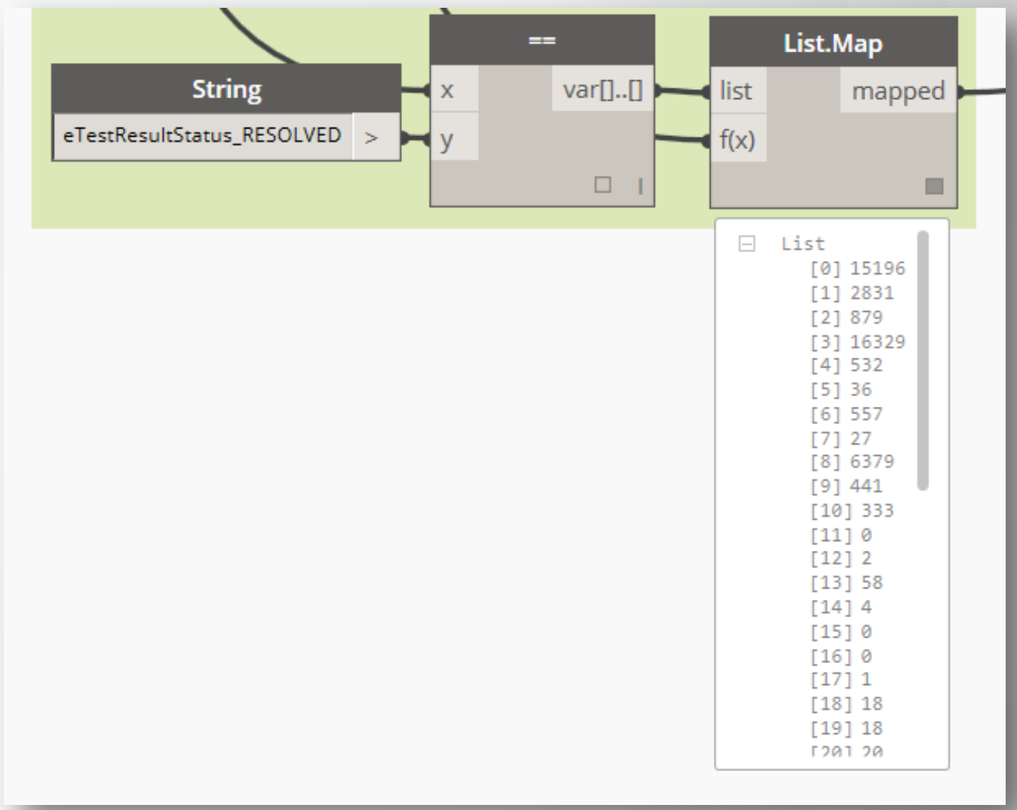


2. Getting Clashes by Status

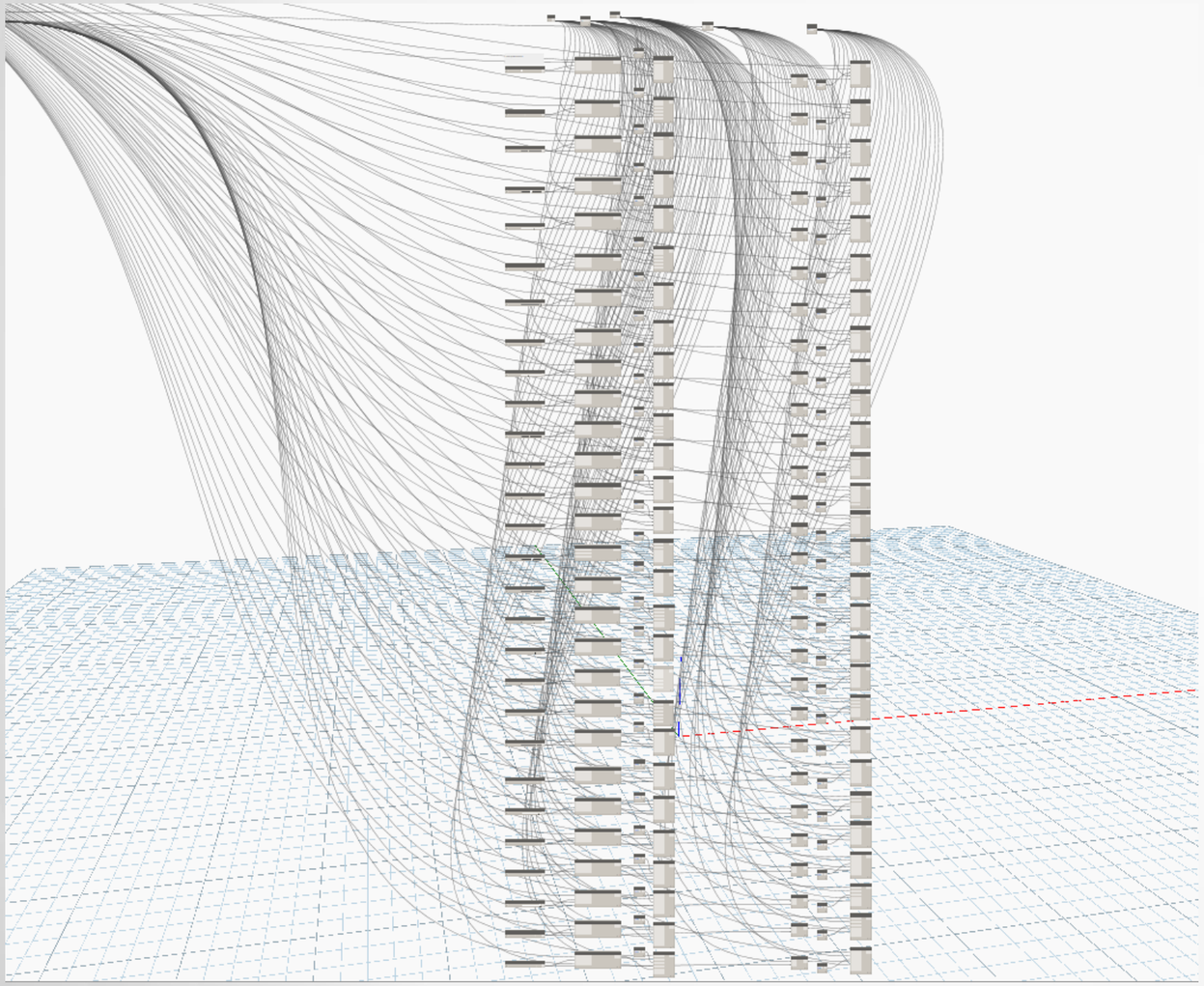
Status	Clashes	New	Active	Reviewed	Approved	Resolved
Old	**404**	38	126	0	0	240
Old	**160**	1	41	0	0	118
Old	**39**	1	30	0	0	8
Old	**203**	6	114	0	0	83
Old	**48**	4	10	0	0	34
Old	**14**	2	3	0	1	8
Old	**77**	2	28	0	1	46
Old	**9**	3	1	0	1	4
Old	**168**	24	70	0	0	74

2. Getting Clashes by Status



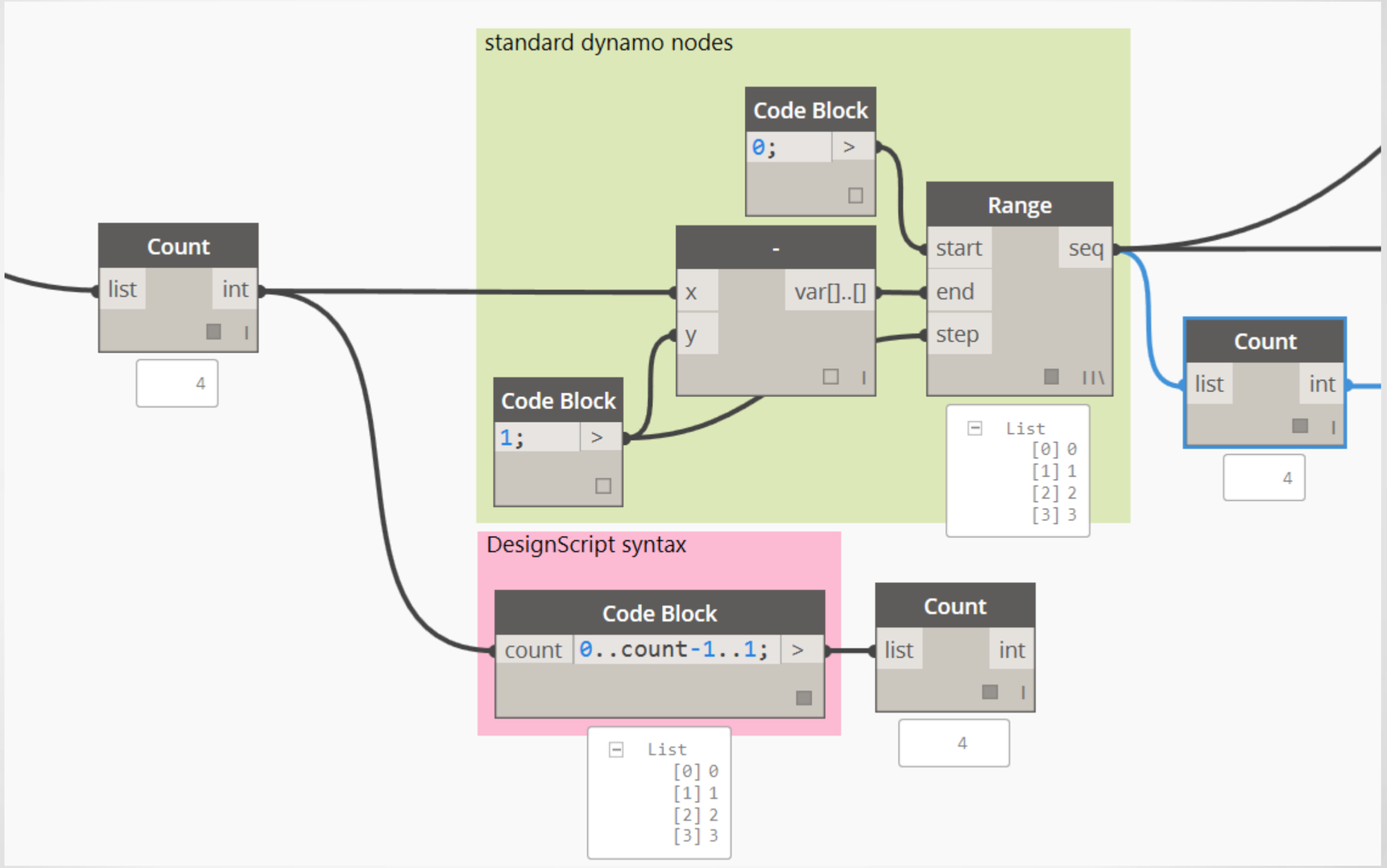


3. Repetitive Nodes – List Management

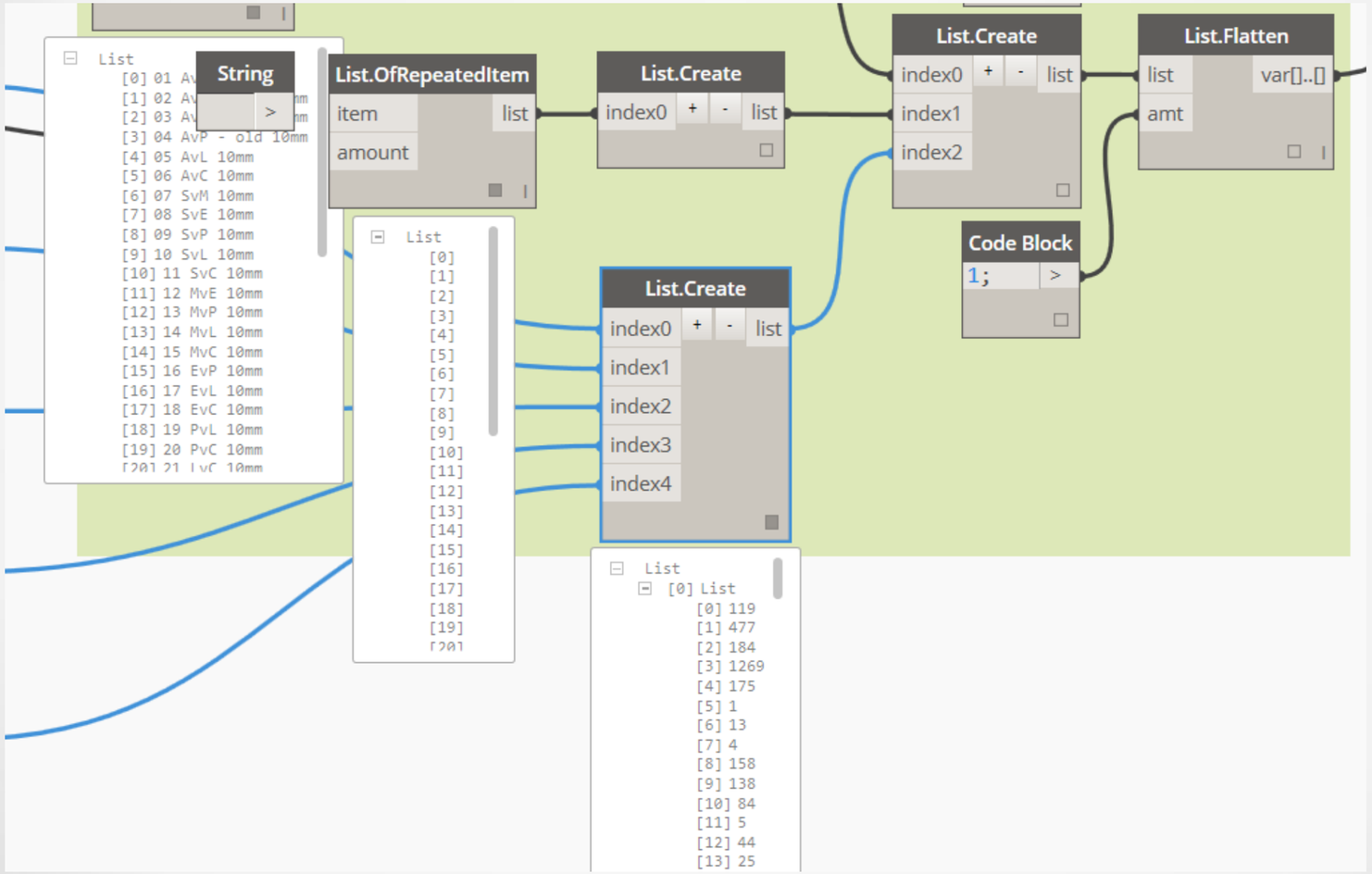


50 AvP 0-fire rated Part. Wall 10mm
51 AvP Facade 10mm
52 AvP Pods 10mm
53 AvP ZZ 10mm
54 AvP Dura Grating 10mm

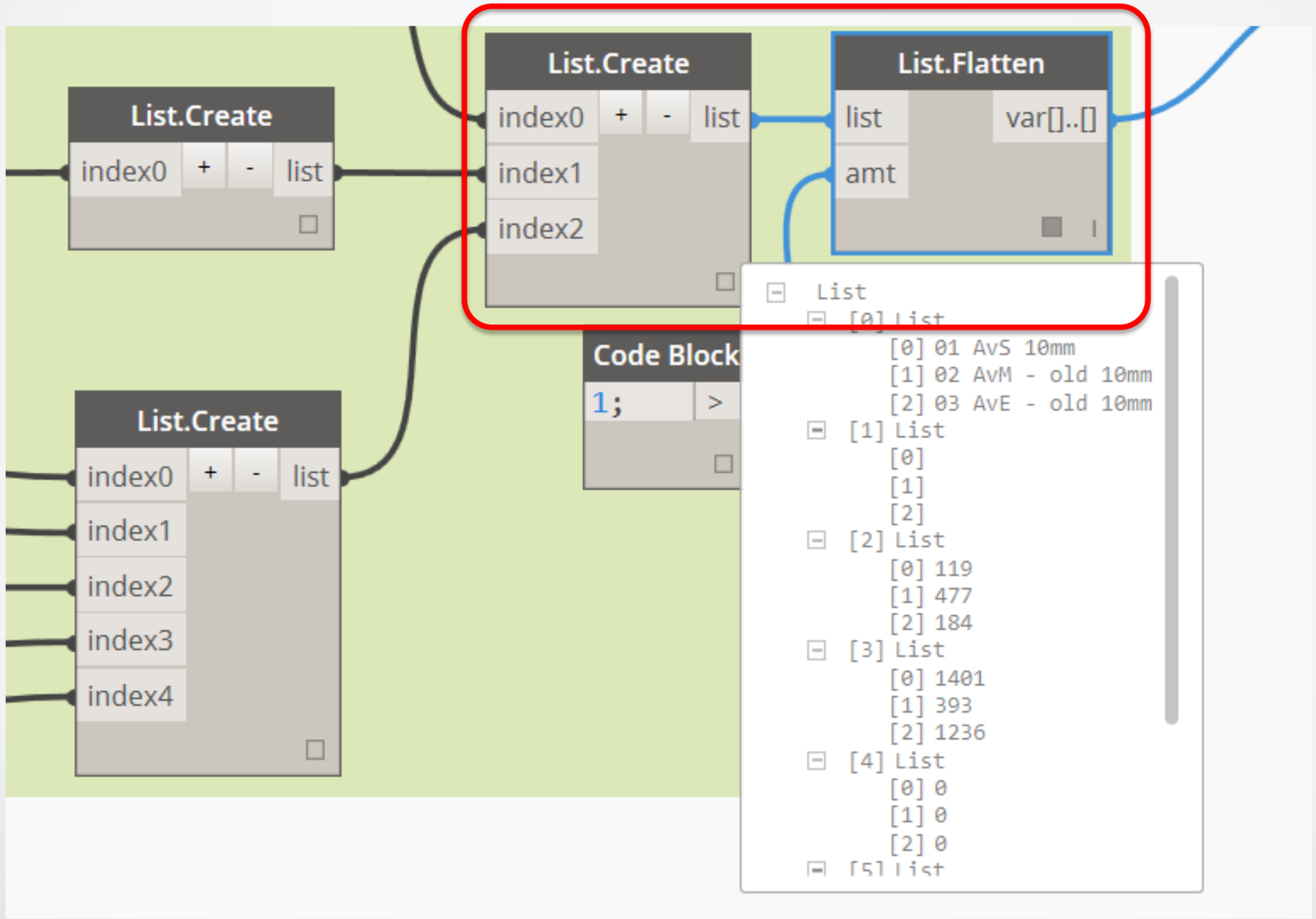
3. Ranges – Standard Nodes vs. DesignScript



4. Re-Mapping …


String
List.OfRepeatedItem
item
amount
list
List.Create
index0
index1
index2
index3
index4
+
-
List.Flatten
var[]..[]
amt
Code Block
1;
[0] 01 Av
[1] 02 Av
[2] 03 Av
[3] 04 AvP - old 10mm
[4] 05 AvL 10mm
[5] 06 AvC 10mm
[6] 07 SvM 10mm
[7] 08 SvE 10mm
[8] 09 SvP 10mm
[9] 10 SvL 10mm
[10] 11 SvC 10mm
[11] 12 MvE 10mm
[12] 13 MvP 10mm
[13] 14 MvL 10mm
[14] 15 MvC 10mm
[15] 16 EvP 10mm
[16] 17 EvL 10mm
[17] 18 EvC 10mm
[18] 19 PvL 10mm
[19] 20 PvC 10mm
[0] List
[0] 119
[1] 477
[2] 184
[3] 1269
[4] 175
[5] 1
[6] 13
[7] 4
[8] 158
[9] 138
[10] 84
[11] 5
[12] 44
[13] 25

Flattening Lists of Lists into Excel format

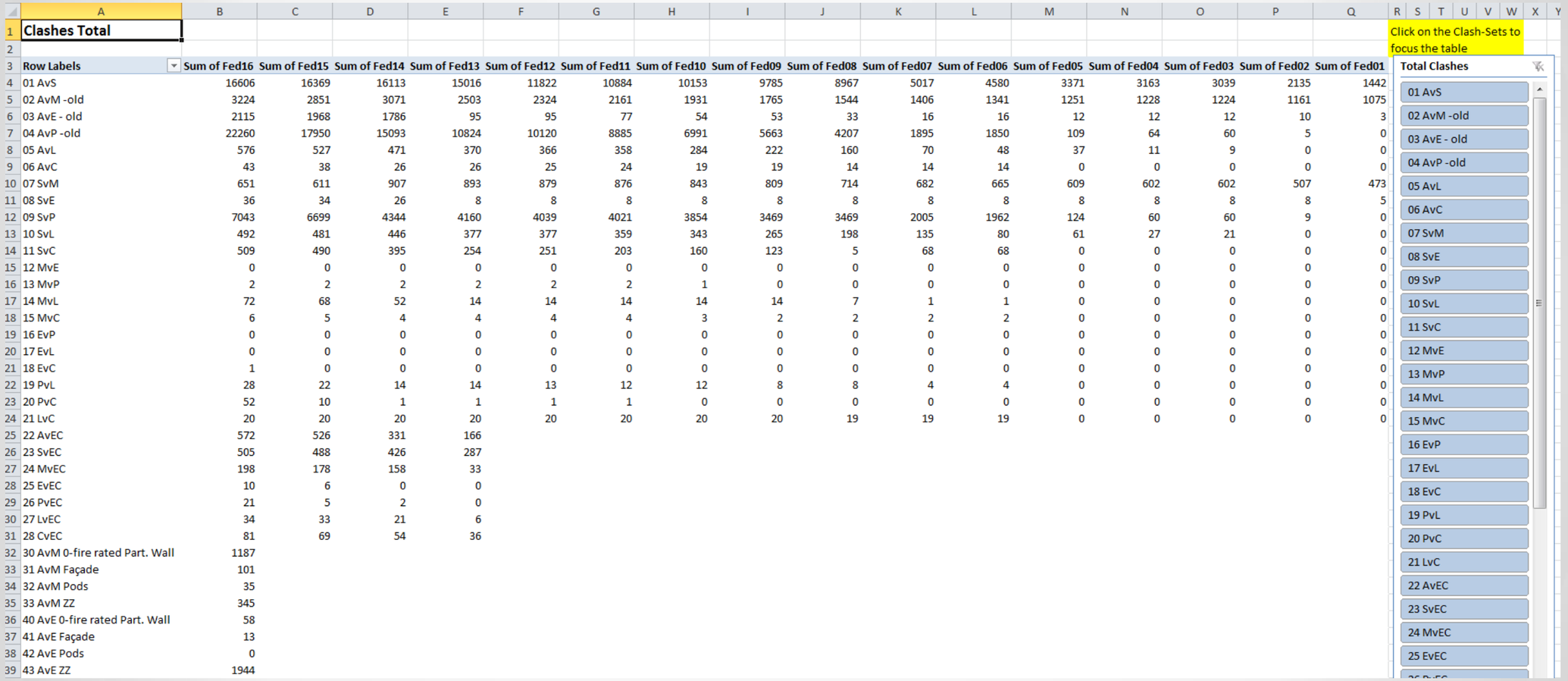


Data Transfer

	A	B	C	D	E	F	G	H	
1	Clashtest		01 AvS 10mm	2 AvM - old 10mm	03 AvE - old 10mm	04 AvP - old 10mm	05 AvL 10mm	06 AvC 10mm	07 Sv
2									
3	New		119	477	184	1269	175	1	
4	Active		1401	393	1236	5925	43	5	
5	Reviewed		0	0	0	0	0	0	
6	Approved		1235	0	0	0	0	8	
7	Resolved		15196	2831	879			36	
8									
9									
10	Unresolved New+Active		1520	870	1420			6	
11	Total		17951	3701	2299			50	
12									
13	CLEAR CELLS								
14									
15									
16	last data exchange								
17	16/11/2015 12:41								
18									
19									
20									
21									
22									

```
List
  [0] List
      [0] 01 AvS 10mm
      [1] 02 AvM - old 10mm
      [2] 03 AvE - old 10mm
  [1] List
      [0]
      [1]
      [2]
  [2] List
      [0] 119
      [1] 477
      [2] 184
  [3] List
      [0] 1401
      [1] 393
      [2] 1236
  [4] List
      [0] 0
      [1] 0
      [2] 0
  [5] List
```

Data table



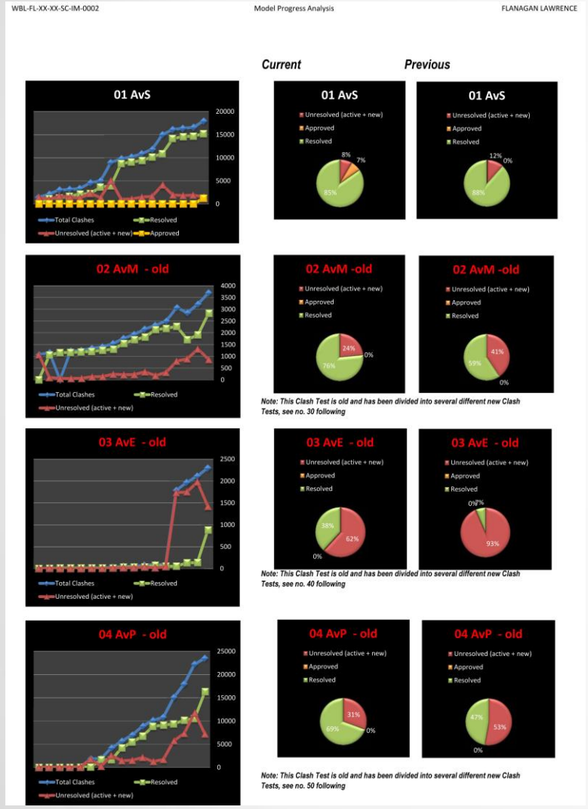
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	**Clashes Total**																
2																	
3	**Row Labels**	**Sum of Fed16**	**Sum of Fed15**	**Sum of Fed14**	**Sum of Fed13**	**Sum of Fed12**	**Sum of Fed11**	**Sum of Fed10**	**Sum of Fed09**	**Sum of Fed08**	**Sum of Fed07**	**Sum of Fed06**	**Sum of Fed05**	**Sum of Fed04**	**Sum of Fed03**	**Sum of Fed02**	**Sum of Fed01**
4	01 AvS	16606	16369	16113	15016	11822	10884	10153	9785	8967	5017	4580	3371	3163	3039	2135	1442
5	02 AvM -old	3224	2851	3071	2503	2324	2161	1931	1765	1544	1406	1341	1251	1228	1224	1161	1075
6	03 AvE - old	2115	1968	1786	95	95	77	54	53	33	16	16	12	12	12	10	3
7	04 AvP -old	22260	17950	15093	10824	10120	8885	6991	5663	4207	1895	1850	109	64	60	5	0
8	05 AvL	576	527	471	370	366	358	284	222	160	70	48	37	11	9	0	0
9	06 AvC	43	38	26	26	25	24	19	19	14	14	14	0	0	0	0	0
10	07 SvM	651	611	907	893	879	876	843	809	714	682	665	609	602	602	507	473
11	08 SvE	36	34	26	8	8	8	8	8	8	8	8	8	8	8	8	5
12	09 SvP	7043	6699	4344	4160	4039	4021	3854	3469	3469	2005	1962	124	60	60	9	0
13	10 SvL	492	481	446	377	377	359	343	265	198	135	80	61	27	21	0	0
14	11 SvC	509	490	395	254	251	203	160	123	5	68	68	0	0	0	0	0
15	12 MvE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	13 MvP	2	2	2	2	2	2	1	0	0	0	0	0	0	0	0	0
17	14 MvL	72	68	52	14	14	14	14	14	7	1	1	0	0	0	0	0
18	15 MvC	6	5	4	4	4	4	3	2	2	2	2	0	0	0	0	0
19	16 EvP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	17 EvL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	18 EvC	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	19 PvL	28	22	14	14	13	12	12	8	8	4	4	0	0	0	0	0
23	20 PvC	52	10	1	1	1	1	0	0	0	0	0	0	0	0	0	0
24	21 LvC	20	20	20	20	20	20	20	20	19	19	19	0	0	0	0	0
25	22 AvEC	572	526	331	166												
26	23 SvEC	505	488	426	287												
27	24 MvEC	198	178	158	33												
28	25 EvEC	10	6	0	0												
29	26 PvEC	21	5	2	0												
30	27 LvEC	34	33	21	6												
31	28 CvEC	81	69	54	36												
32	30 AvM 0-fire rated Part. Wall	1187															
33	31 AvM Façade	101															
34	32 AvM Pods	35															
35	33 AvM ZZ	345															
36	40 AvE 0-fire rated Part. Wall	58															
37	41 AvE Façade	13															
38	42 AvE Pods	0															
39	43 AvE ZZ	1944															

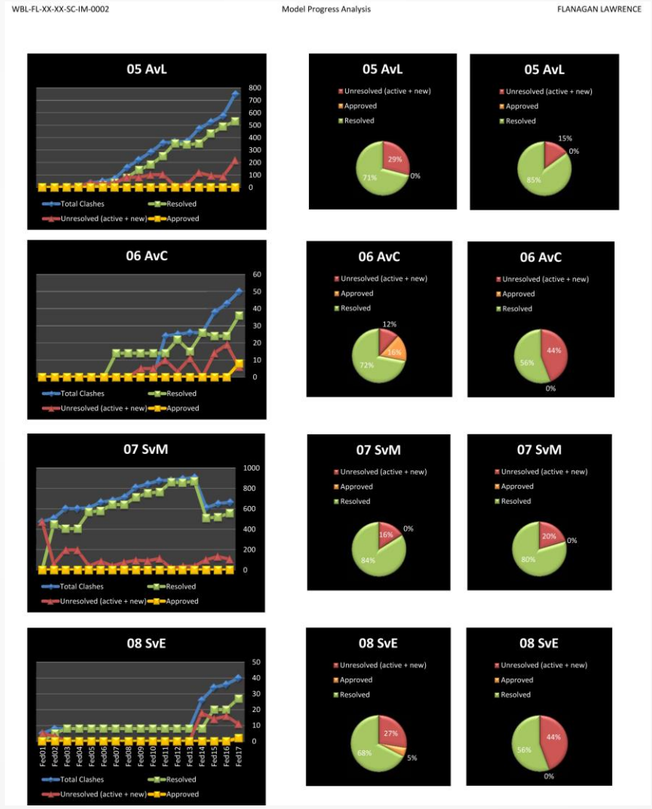
Click on the Clash-Sets to focus the table

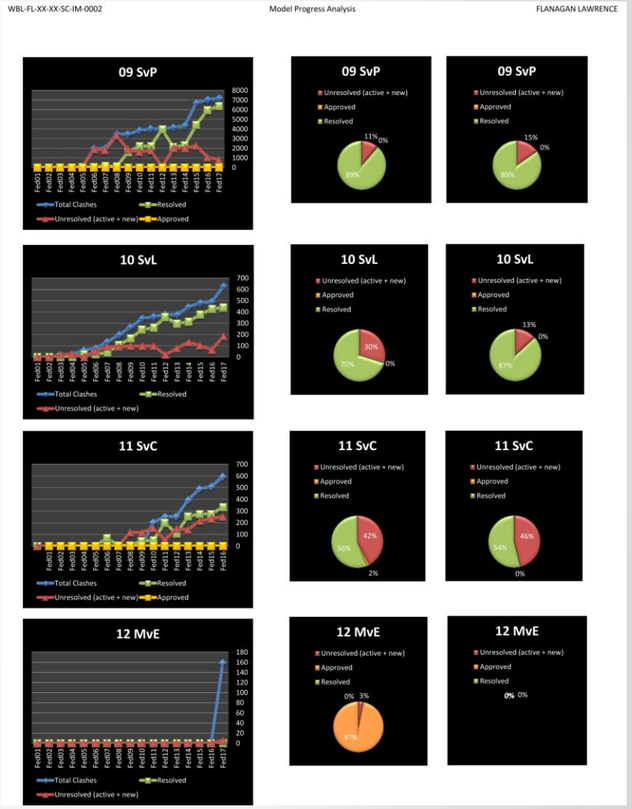
Total Clashes

- 01 AvS
- 02 AvM -old
- 03 AvE - old
- 04 AvP -old
- 05 AvL
- 06 AvC
- 07 SvM
- 08 SvE
- 09 SvP
- 10 SvL
- 11 SvC
- 12 MvE
- 13 MvP
- 14 MvL
- 15 MvC
- 16 EvP
- 17 EvL
- 18 EvC
- 19 PvL
- 20 PvC
- 21 LvC
- 22 AvEC
- 23 SvEC
- 24 MvEC
- 25 EvEC

Automated Tracker

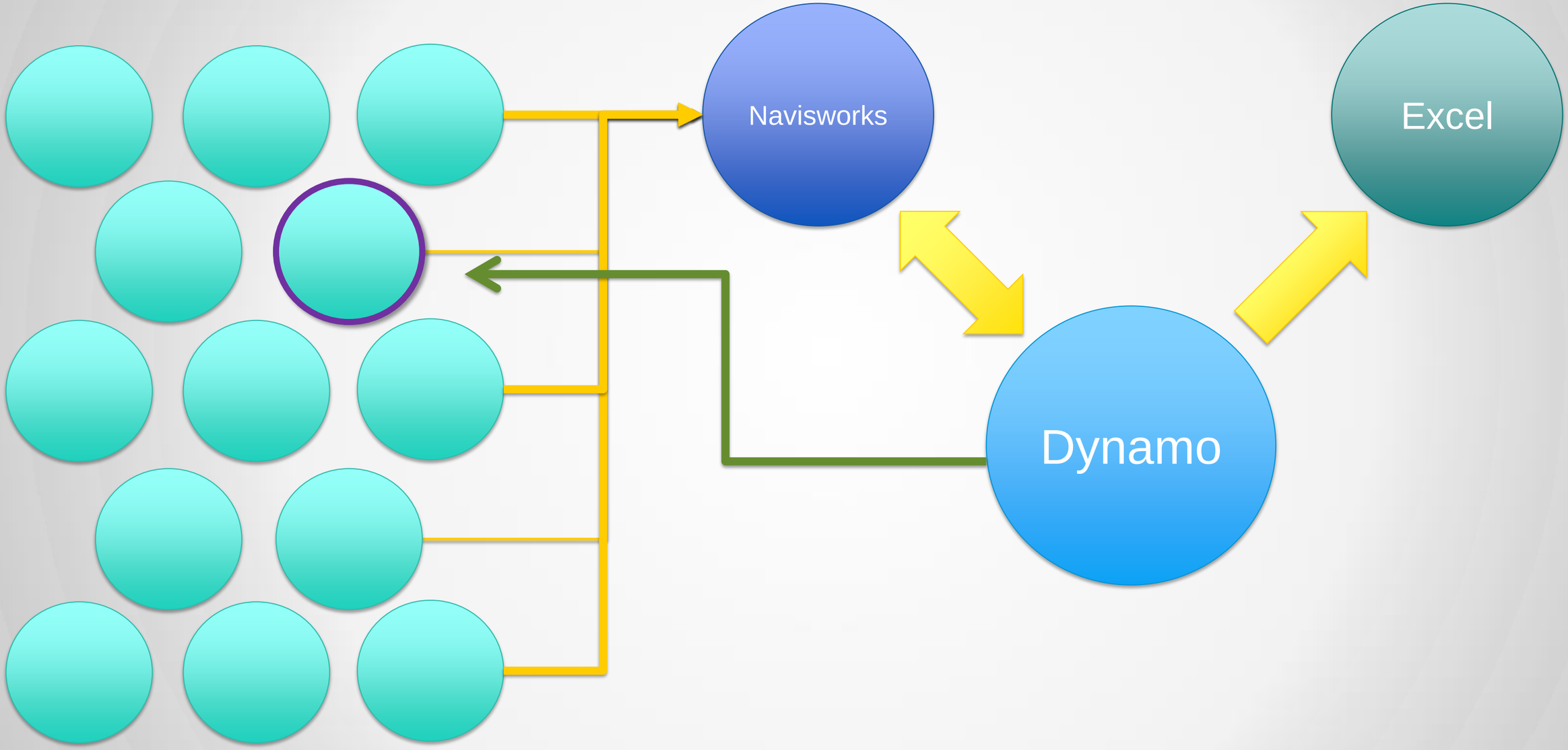




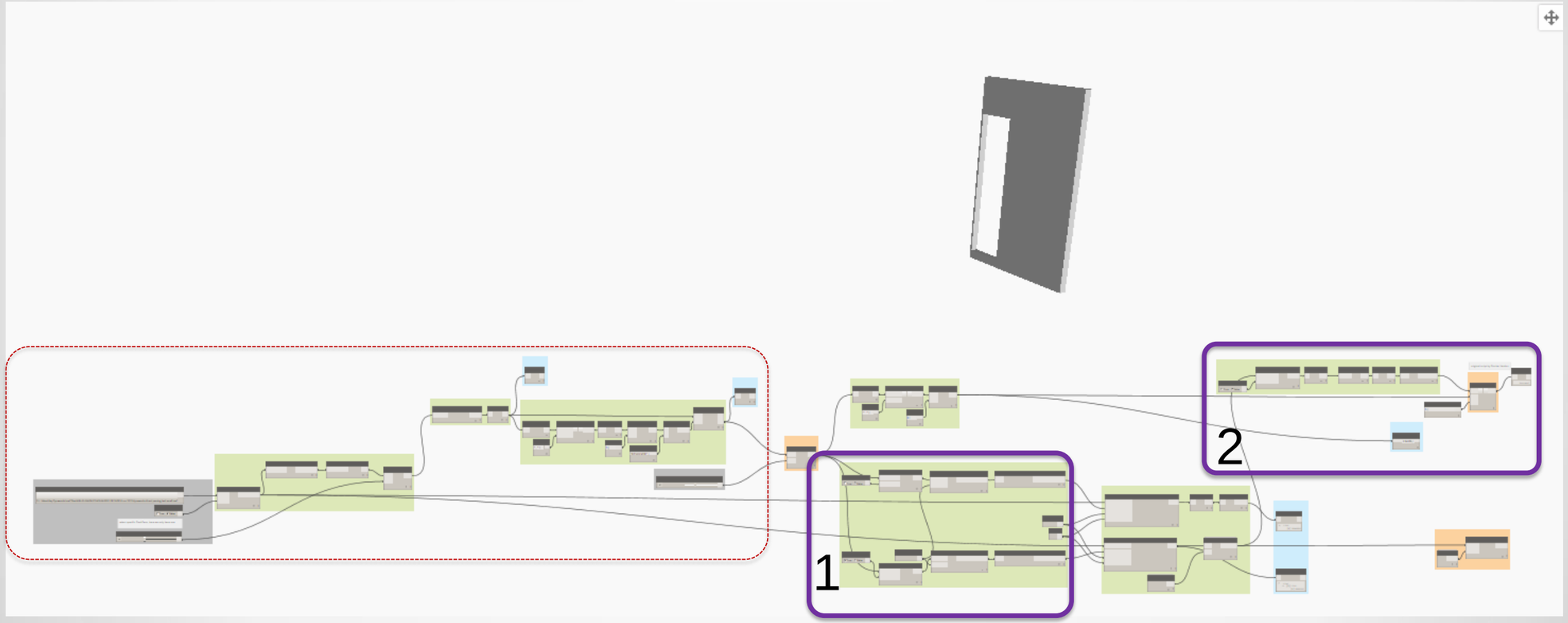


Teleportation

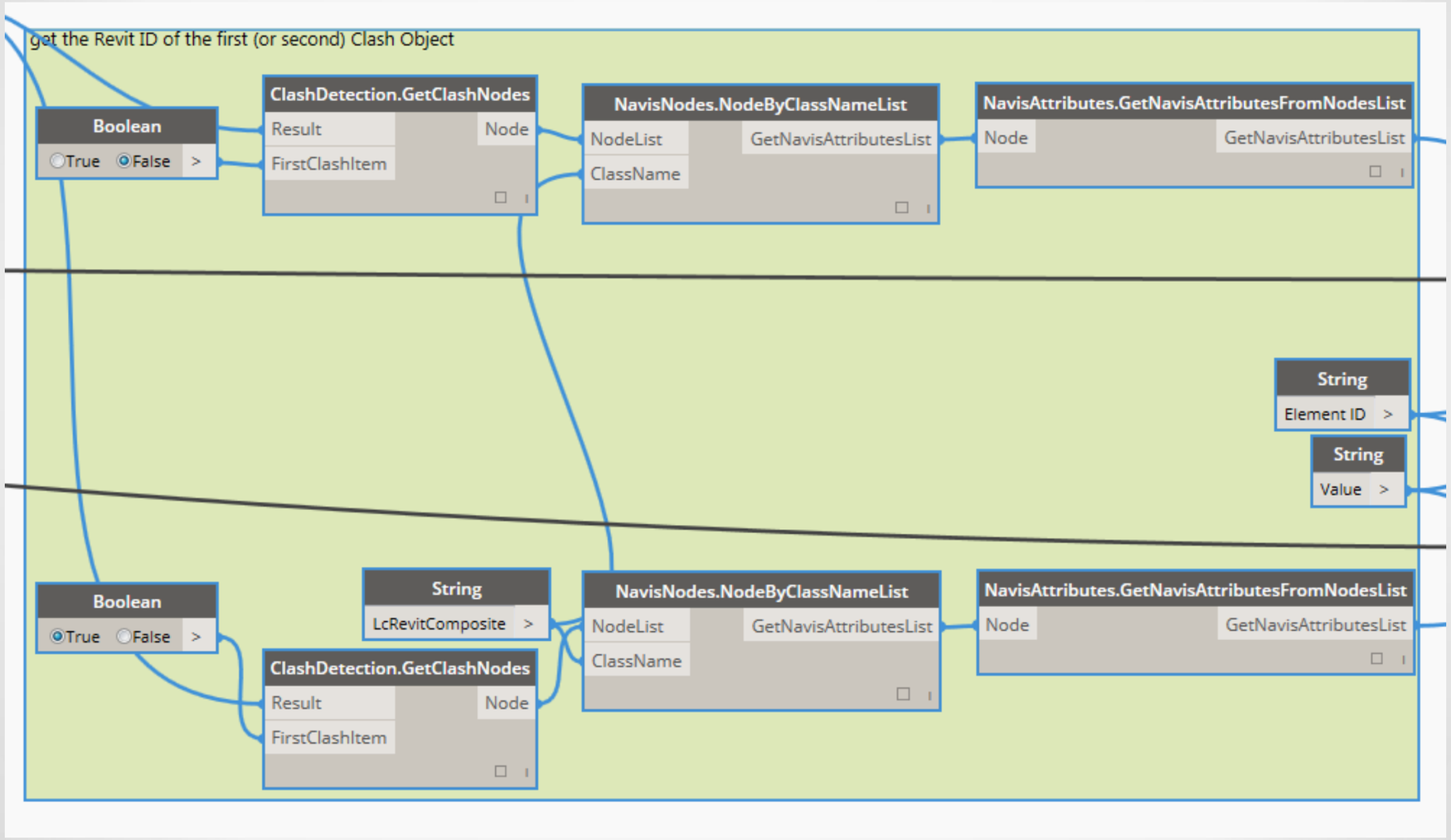
Dynaworks – Clash Solving



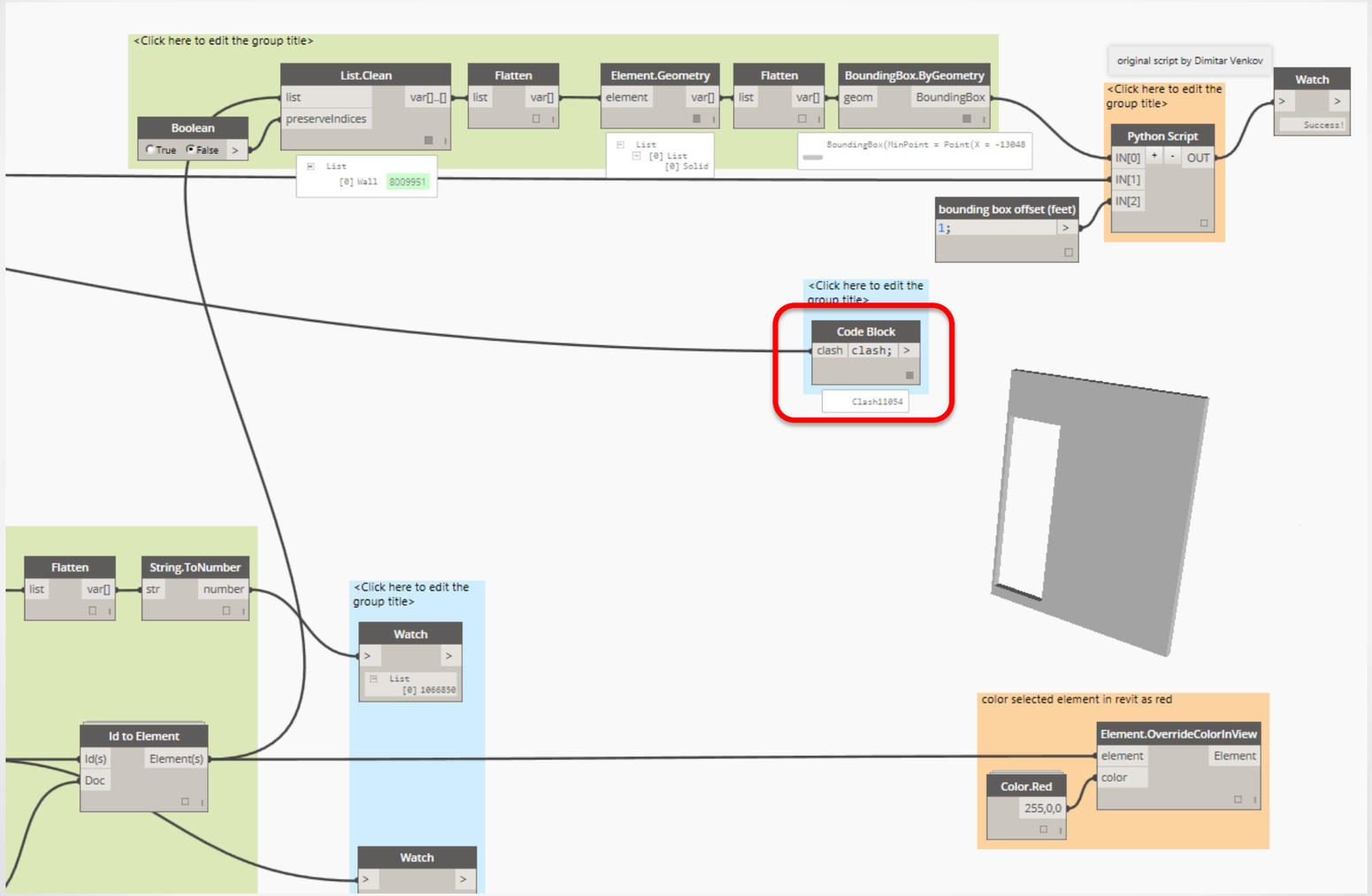
Revit Auto-Section Box



1. Getting Data from Item 1 and 2



Revit Auto-Section Box

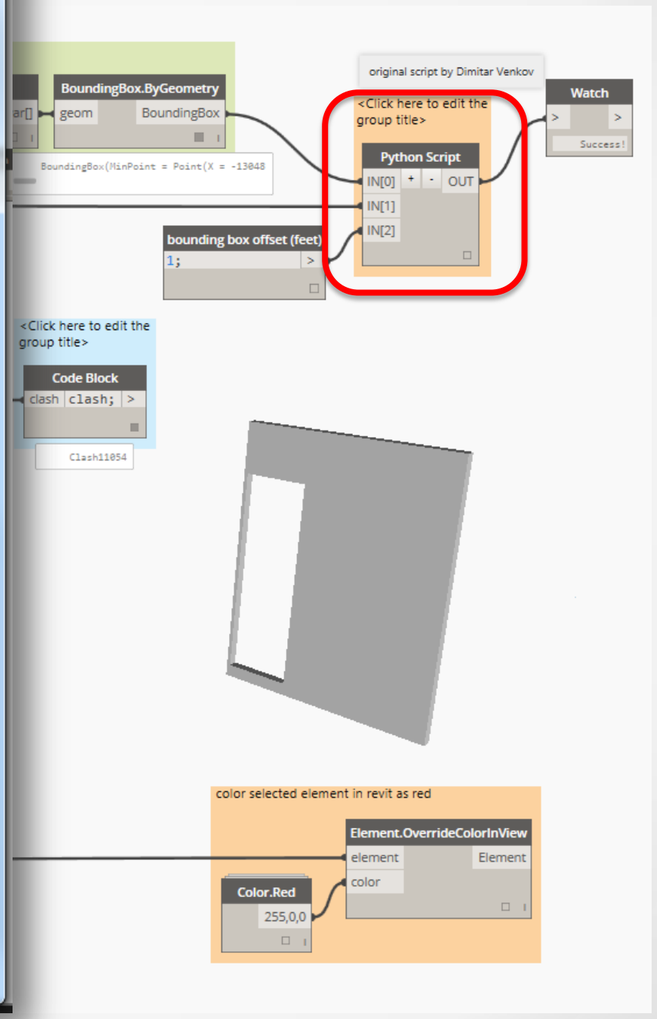


Python API Access

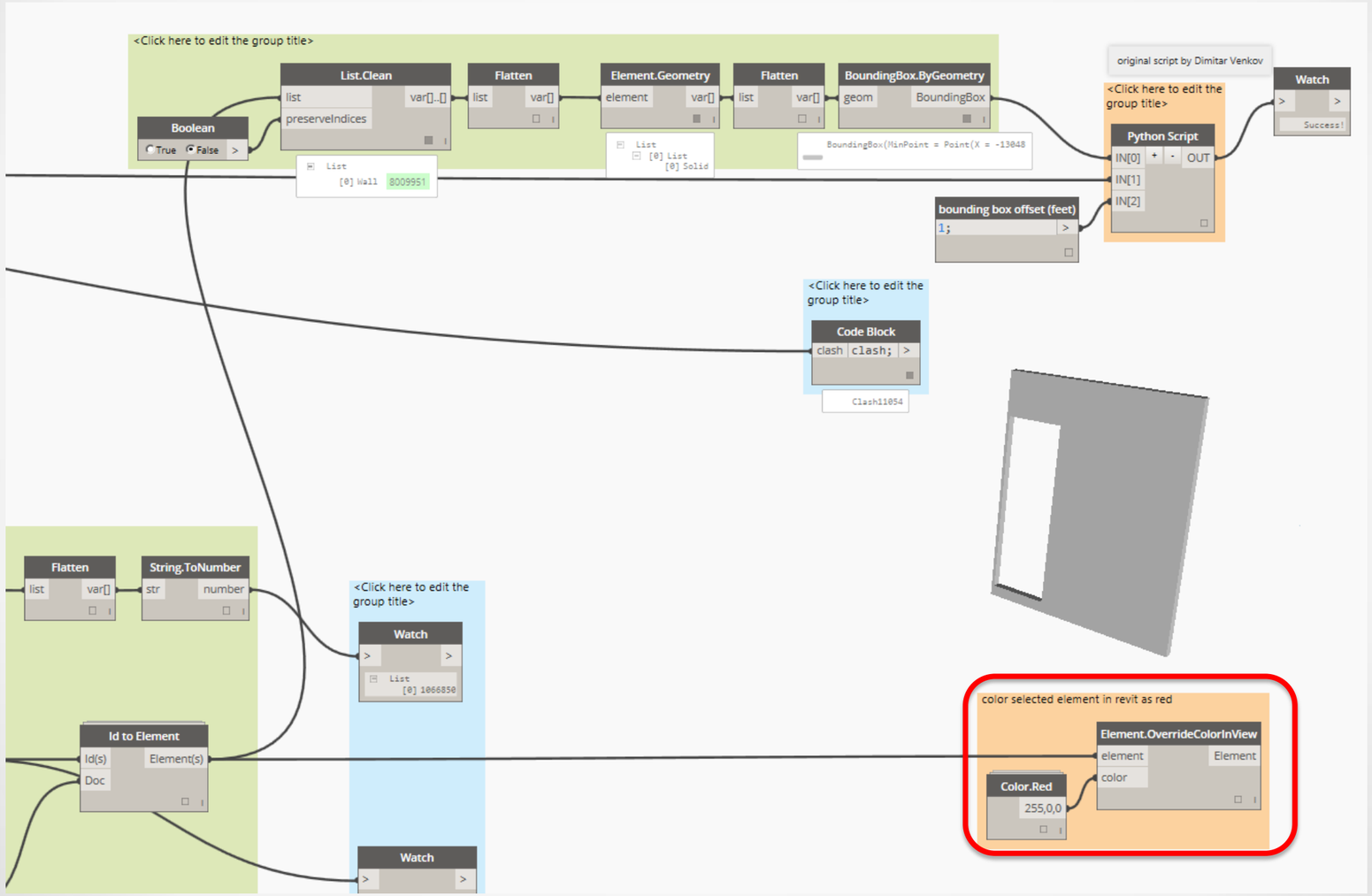
Edit Python Script...

```python
#Dimitar Venkov, BBtoSect

import clr
clr.AddReference('RevitAPI')
from Autodesk.Revit.DB import *

clr.AddReference("RevitNodes")
import Revit
clr.ImportExtensions(Revit.GeometryConversion)
clr.ImportExtensions(Revit.Elements)

clr.AddReference("RevitServices")
import RevitServices
from RevitServices.Persistence import DocumentManager
from RevitServices.Transactions import TransactionManager

BB = IN[0]
ClashName = IN[1]
offset = float(IN[2])

doc = DocumentManager.Instance.CurrentDBDocument
view = doc.ActiveView
try:
    TransactionManager.Instance.EnsureInTransaction(doc)

# get boundigbox min & max
    newmax = UnwrapElement(BB.MaxPoint).ToRevitType()
    newmin = UnwrapElement(BB.MinPoint).ToRevitType()
    newbboxOffset = BoundingBoxXYZ()

# getting X, Y & Z for min/max of the bounding box
    bboxMinX = newmin.X
    bboxMinY = newmin.Y
    bboxMinZ = newmin.Z
    bboxMaxX = newmax.X
    bboxMaxY = newmax.Y
    bboxMaxZ = newmax.Z

# offsetting the bounding box
    newbboxOffset.Min = XYZ((bboxMinX - offset), (bboxMinY - offset), (bboxMinZ - offset))
    newbboxOffset.Max = XYZ((bboxMaxX + offset), (bboxMaxY + offset), (bboxMaxZ + offset))

# creating sectionbox with offsetted boundingbox min/max + set viewname to clashname
    z = view.SetSectionBox(newbboxOffset)
    view.Name = ClashName
    TransactionManager.Instance.TransactionTaskDone()

    OUT = "Success!"
except:
    OUT = "Failed!"
```

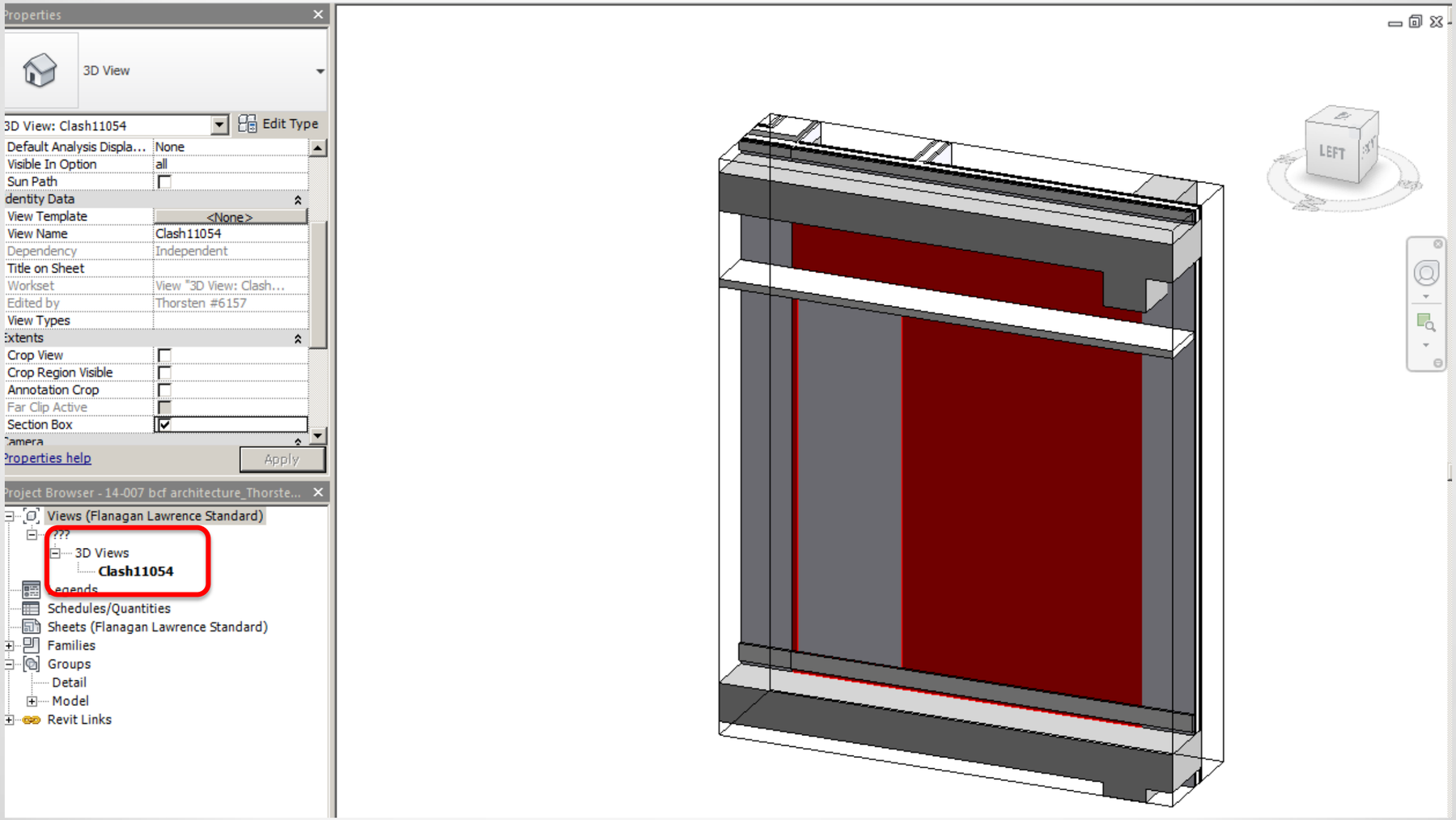
Accept Changes | Cancel



Override Colour of Element to Highlight

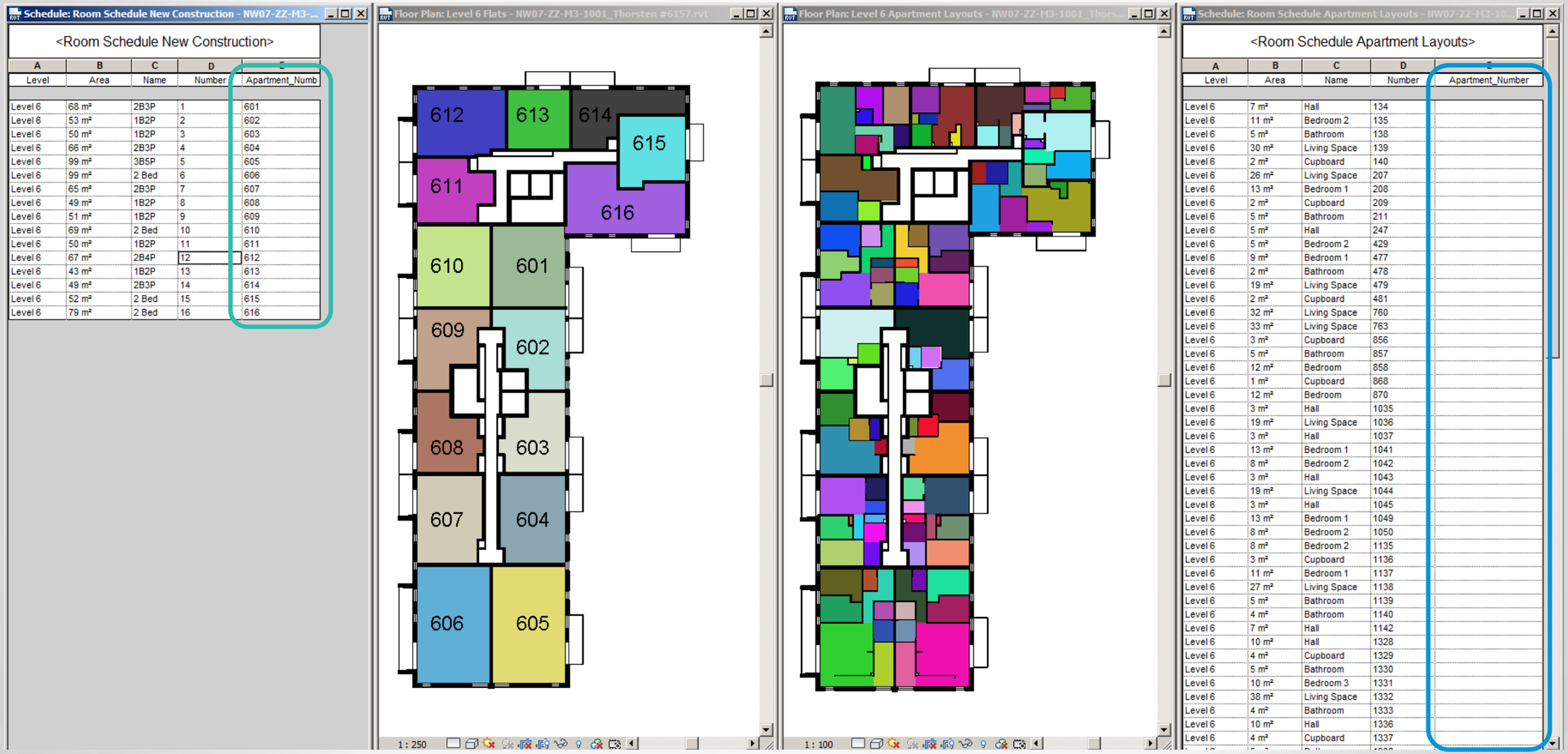


View Generated in Revit



Time Travel

Can a Room be Room Aware?



Schedule: Room Schedule New Construction - NW07-ZZ-M3-...

<Room Schedule New Construction>

A	B	C	D	E
Level	Area	Name	Number	Apartment_Numb
Level 6	68 m²	2B3P	1	601
Level 6	53 m²	1B2P	2	602
Level 6	50 m²	1B2P	3	603
Level 6	66 m²	2B3P	4	604
Level 6	99 m²	3B5P	5	605
Level 6	99 m²	2 Bed	6	606
Level 6	65 m²	2B3P	7	607
Level 6	49 m²	1B2P	8	608
Level 6	51 m²	1B2P	9	609
Level 6	69 m²	2 Bed	10	610
Level 6	50 m²	1B2P	11	611
Level 6	67 m²	2B4P	12	612
Level 6	43 m²	1B2P	13	613
Level 6	49 m²	2B3P	14	614
Level 6	52 m²	2 Bed	15	615
Level 6	79 m²	2 Bed	16	616

Floor Plan: Level 6 Flats - NW07-ZZ-M3-1001_Thorsten #6157.rvt

612 613 614 615 611 616 610 601 609 602 608 603 607 604 606 605

1 : 250

Floor Plan: Level 6 Apartment Layouts - NW07-ZZ-M3-1001_Thors...

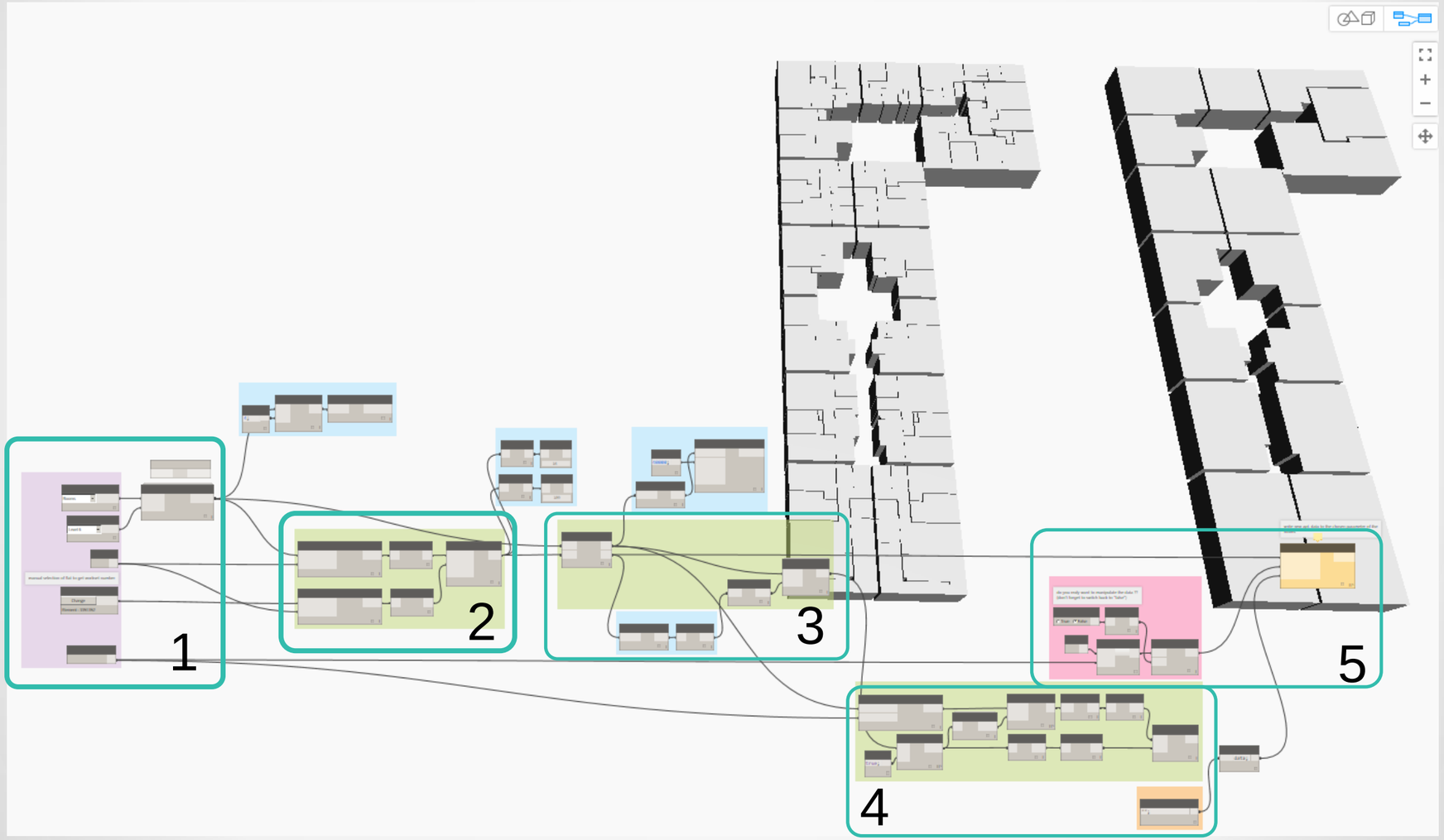
1 : 100

Schedule: Room Schedule Apartment Layouts - NW07-ZZ-M3-10...

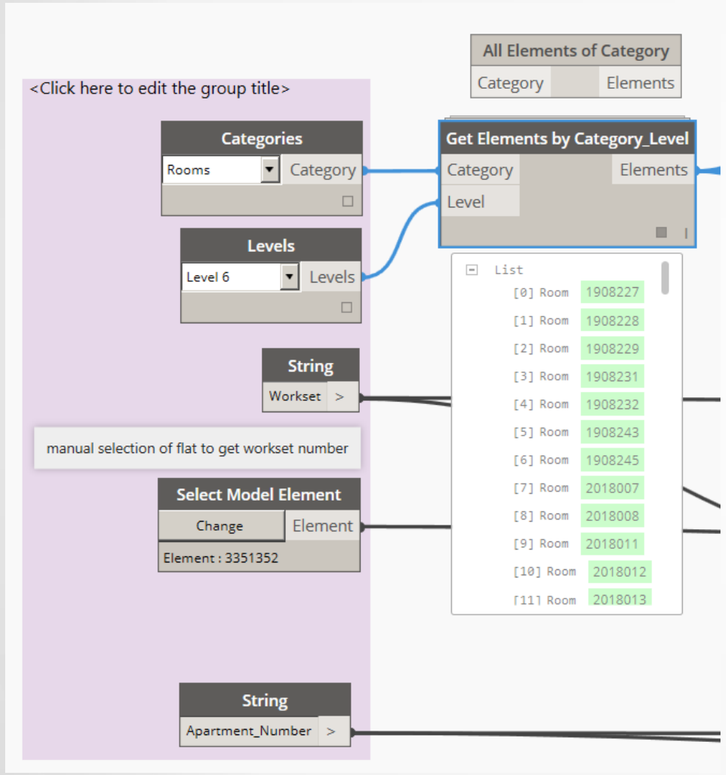
<Room Schedule Apartment Layouts>

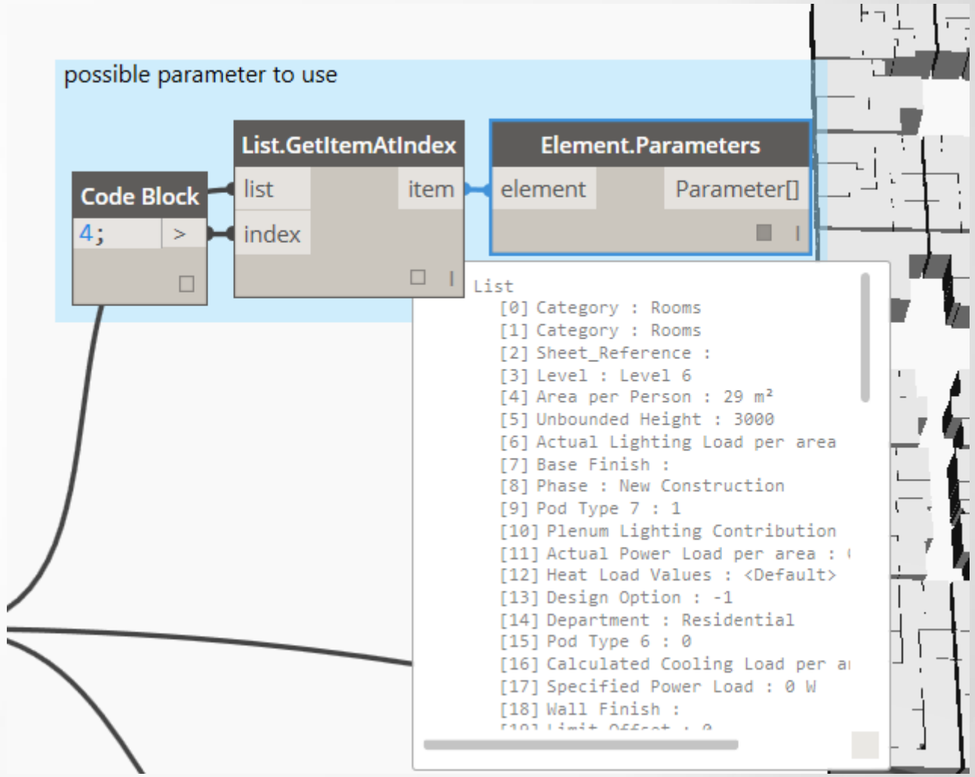
A	B	C	D	E
Level	Area	Name	Number	Apartment_Number
Level 6	7 m²	Hall	134	
Level 6	11 m²	Bedroom 2	135	
Level 6	5 m²	Bathroom	138	
Level 6	30 m²	Living Space	139	
Level 6	2 m²	Cupboard	140	
Level 6	26 m²	Living Space	207	
Level 6	13 m²	Bedroom 1	208	
Level 6	2 m²	Cupboard	209	
Level 6	5 m²	Bathroom	211	
Level 6	5 m²	Hall	247	
Level 6	5 m²	Bedroom 2	429	
Level 6	9 m²	Bedroom 1	477	
Level 6	2 m²	Bathroom	478	
Level 6	19 m²	Living Space	479	
Level 6	2 m²	Cupboard	481	
Level 6	32 m²	Living Space	760	
Level 6	33 m²	Living Space	763	
Level 6	3 m²	Cupboard	856	
Level 6	5 m²	Bathroom	857	
Level 6	12 m²	Bedroom	858	
Level 6	1 m²	Cupboard	868	
Level 6	12 m²	Bedroom	870	
Level 6	3 m²	Hall	1035	
Level 6	19 m²	Living Space	1036	
Level 6	3 m²	Hall	1037	
Level 6	13 m²	Bedroom 1	1041	
Level 6	8 m²	Bedroom 2	1042	
Level 6	3 m²	Hall	1043	
Level 6	19 m²	Living Space	1044	
Level 6	3 m²	Hall	1045	
Level 6	13 m²	Bedroom 1	1049	
Level 6	8 m²	Bedroom 2	1050	
Level 6	8 m²	Bedroom 2	1135	
Level 6	3 m²	Cupboard	1136	
Level 6	11 m²	Bedroom 1	1137	
Level 6	27 m²	Living Space	1138	
Level 6	5 m²	Bathroom	1139	
Level 6	4 m²	Bathroom	1140	
Level 6	7 m²	Hall	1142	
Level 6	10 m²	Hall	1328	
Level 6	4 m²	Cupboard	1329	
Level 6	5 m²	Bathroom	1330	
Level 6	10 m²	Bedroom 3	1331	
Level 6	38 m²	Living Space	1332	
Level 6	4 m²	Bathroom	1333	
Level 6	10 m²	Hall	1336	
Level 6	4 m²	Cupboard	1337	

Example Level

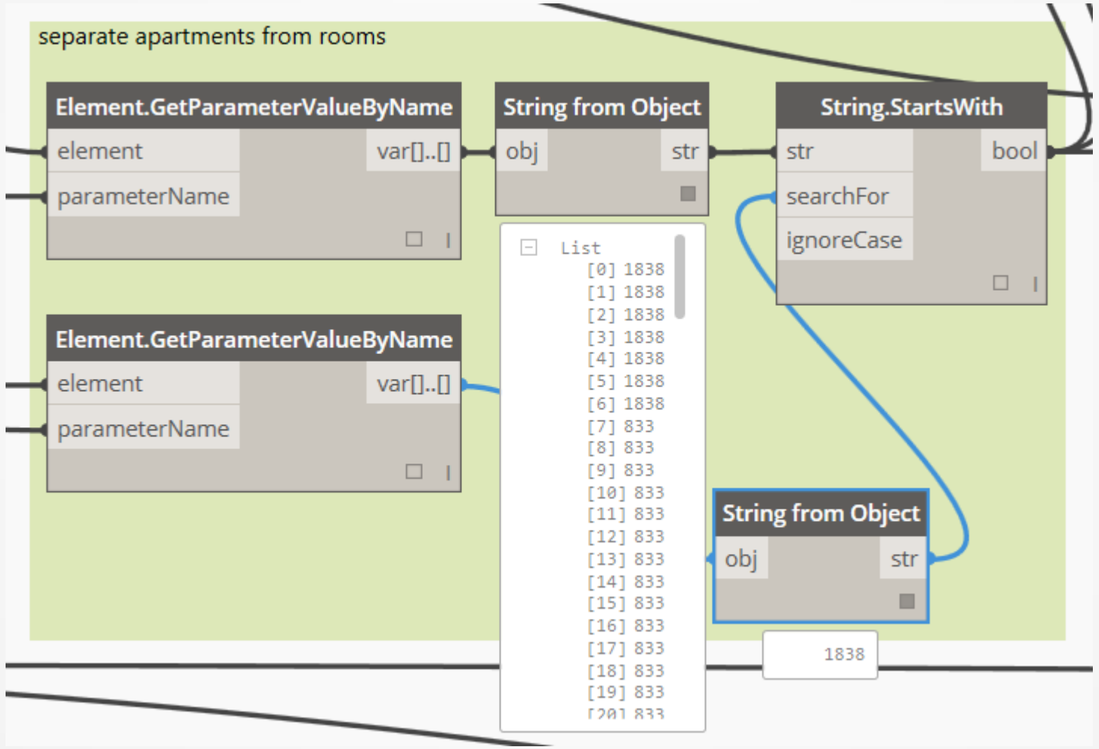


1. First Finding the Rooms

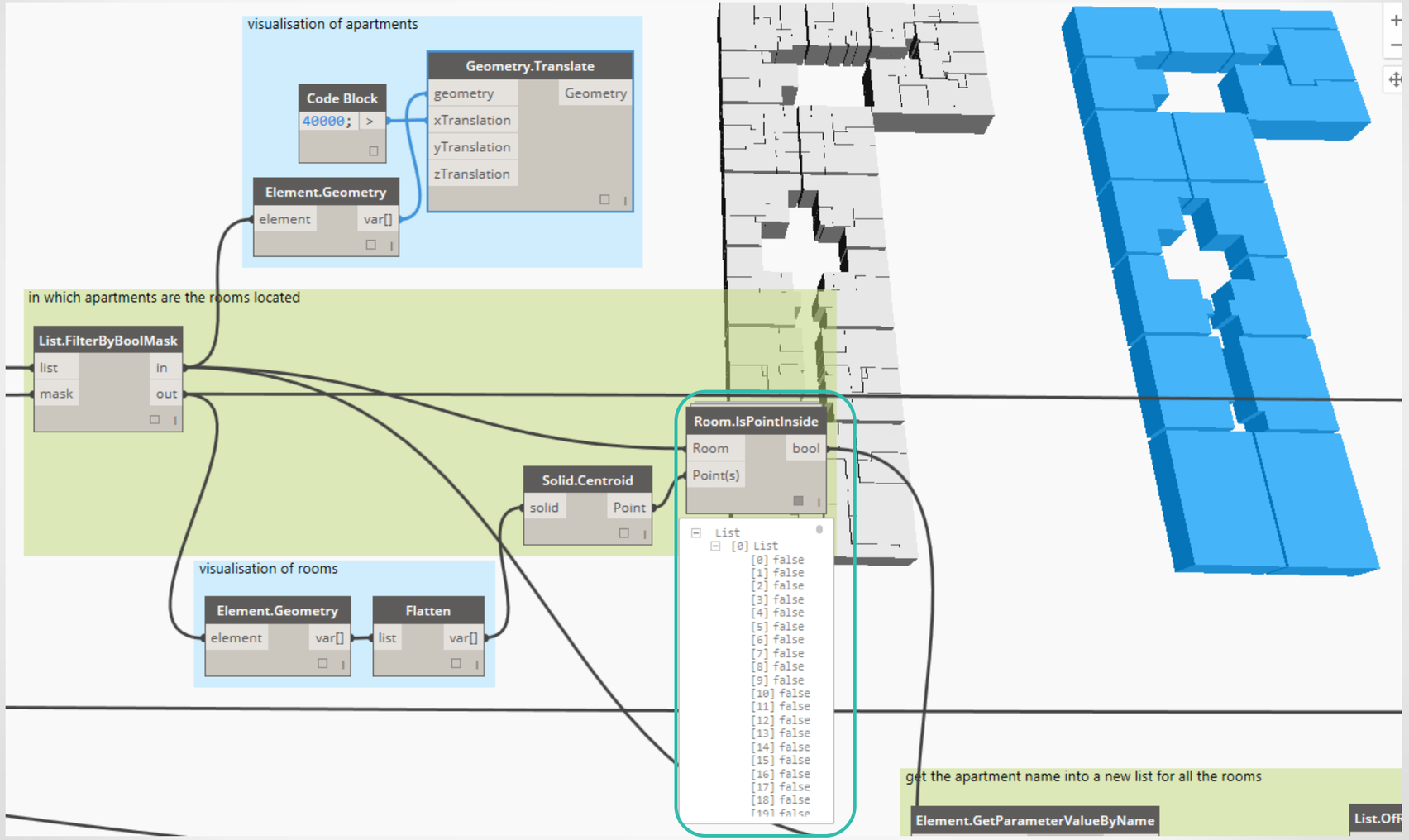




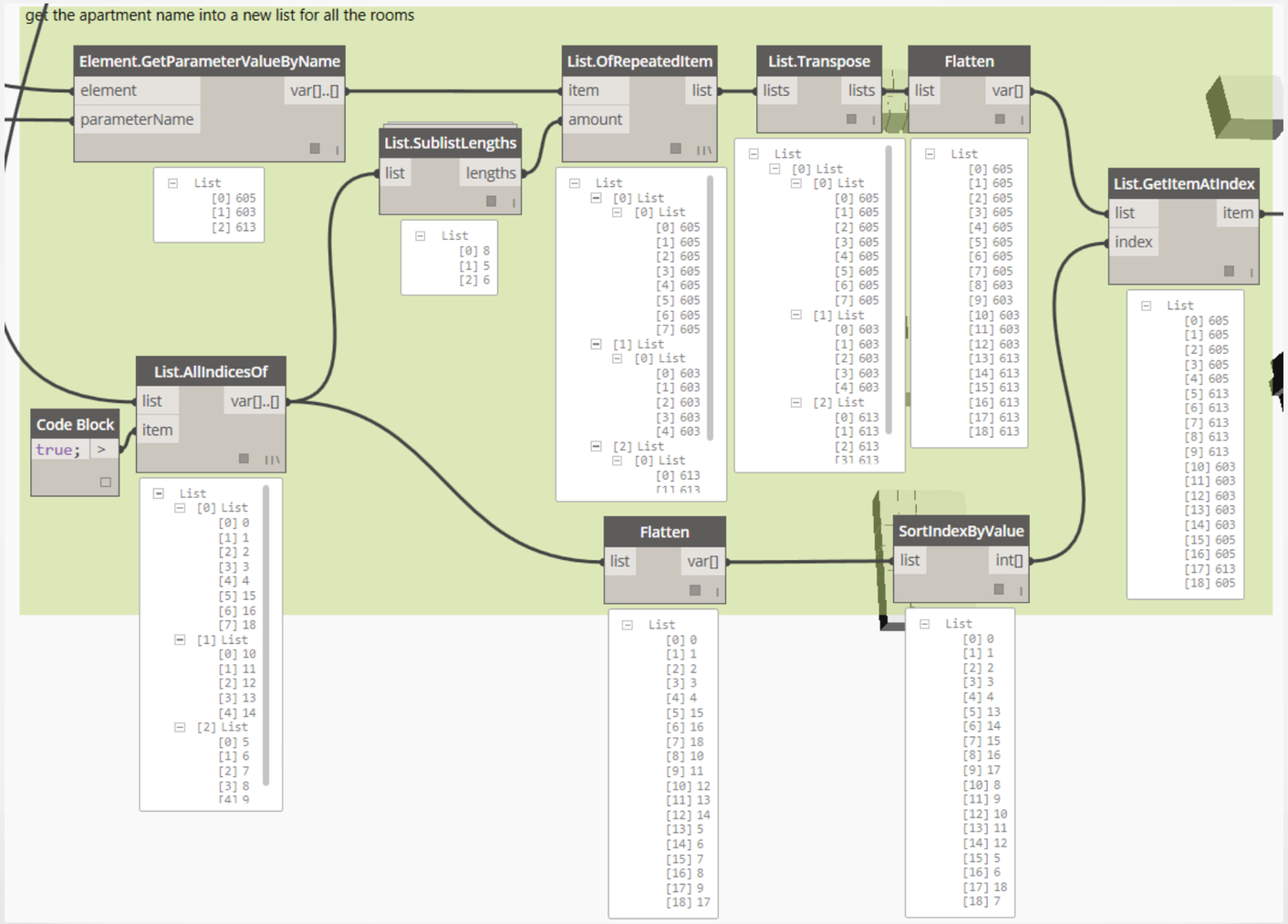
2. Sorting by Worksets



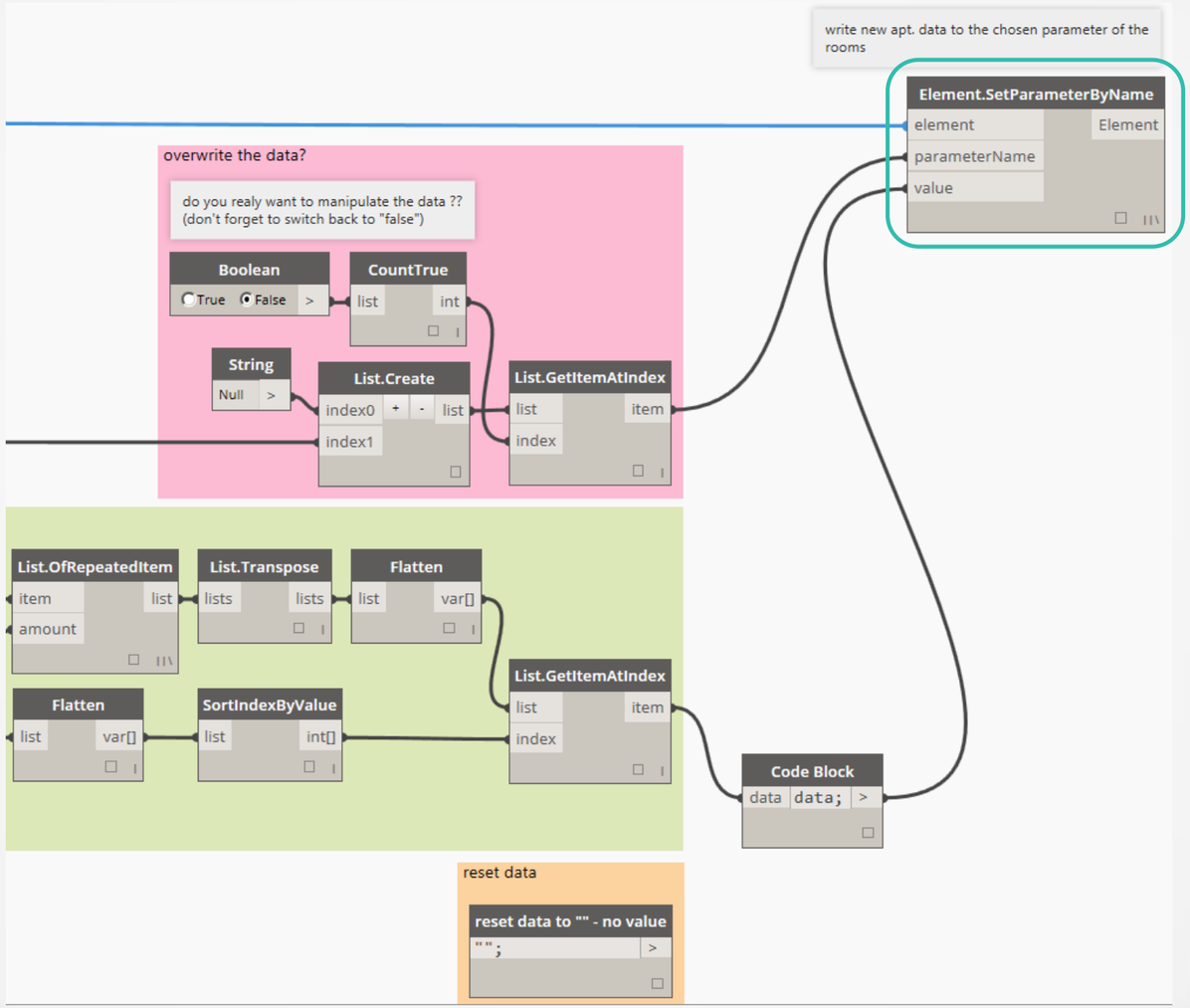
3. Check if Room is inside Room



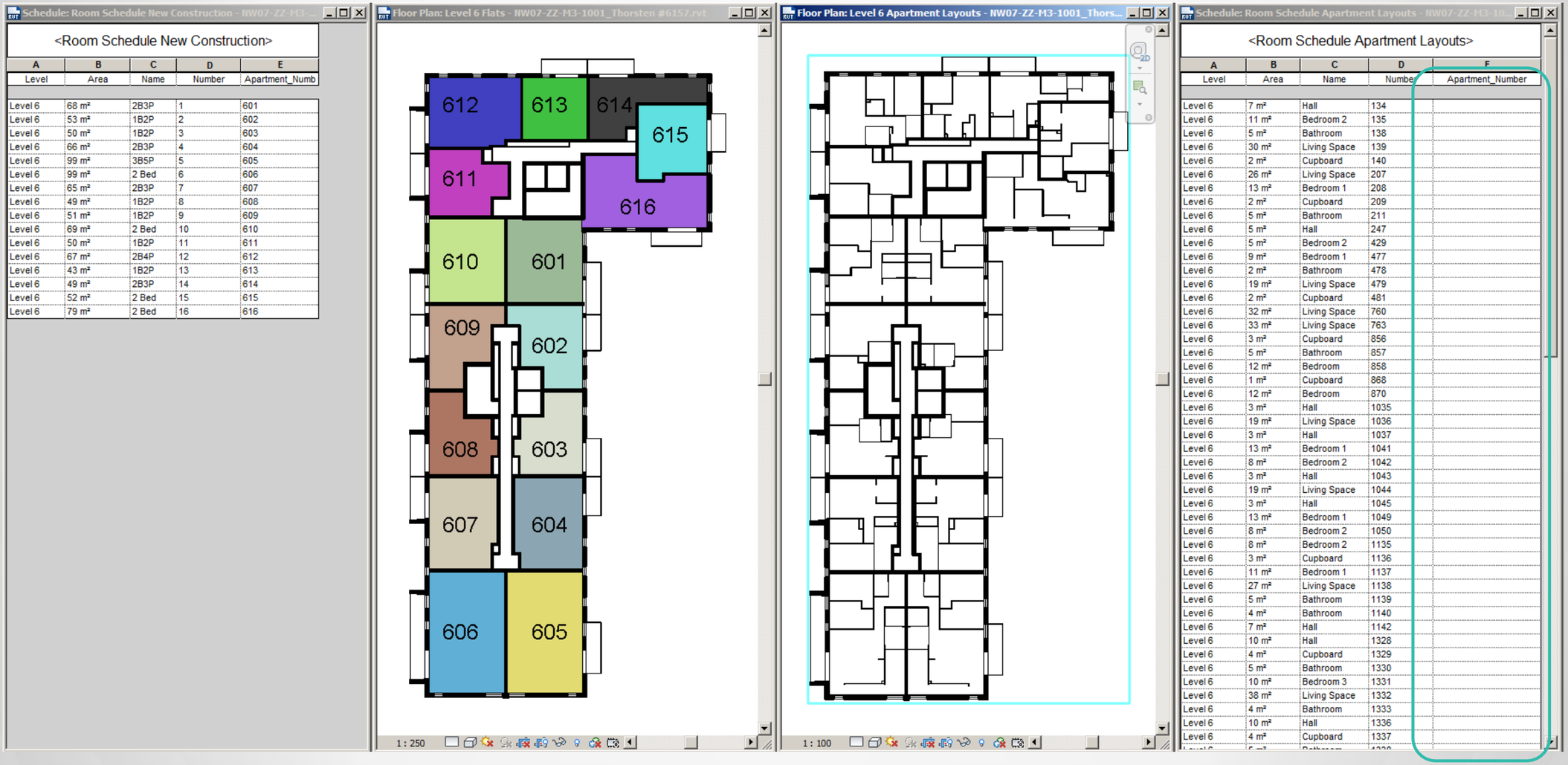
4. Re-mapping


get the apartment name into a new list for all the rooms
Element.GetParameterValueByName
element
parameterName
var[]..[]
List.SublistLengths
list
lengths
List.OfRepeatedItem
item
amount
list
List.Transpose
lists
lists
Flatten
list
var[]
List.GetItemAtIndex
list
index
item
List.AllIndicesOf
list
item
var[]..[]
Code Block
true;
Flatten
list
var[]
SortIndexByValue
list
int[]

5. Write Apartment Data to Room



Apartment Location Migrated to Rooms



Schedule: Room Schedule New Construction - NW07-ZZ-M3-...

<Room Schedule New Construction>

A	B	C	D	E
Level	Area	Name	Number	Apartment_Numb
Level 6	68 m²	2B3P	1	601
Level 6	53 m²	1B2P	2	602
Level 6	50 m²	1B2P	3	603
Level 6	66 m²	2B3P	4	604
Level 6	99 m²	3B5P	5	605
Level 6	99 m²	2 Bed	6	606
Level 6	65 m²	2B3P	7	607
Level 6	49 m²	1B2P	8	608
Level 6	51 m²	1B2P	9	609
Level 6	69 m²	2 Bed	10	610
Level 6	50 m²	1B2P	11	611
Level 6	67 m²	2B4P	12	612
Level 6	43 m²	1B2P	13	613
Level 6	49 m²	2B3P	14	614
Level 6	52 m²	2 Bed	15	615
Level 6	79 m²	2 Bed	16	616

Floor Plan: Level 6 Flats - NW07-ZZ-M3-1001_Thorsten #6157.rvt

612 613 614 615 611 616 610 601 609 602 608 603 607 604 606 605

1 : 250

Floor Plan: Level 6 Apartment Layouts - NW07-ZZ-M3-1001_Thors...

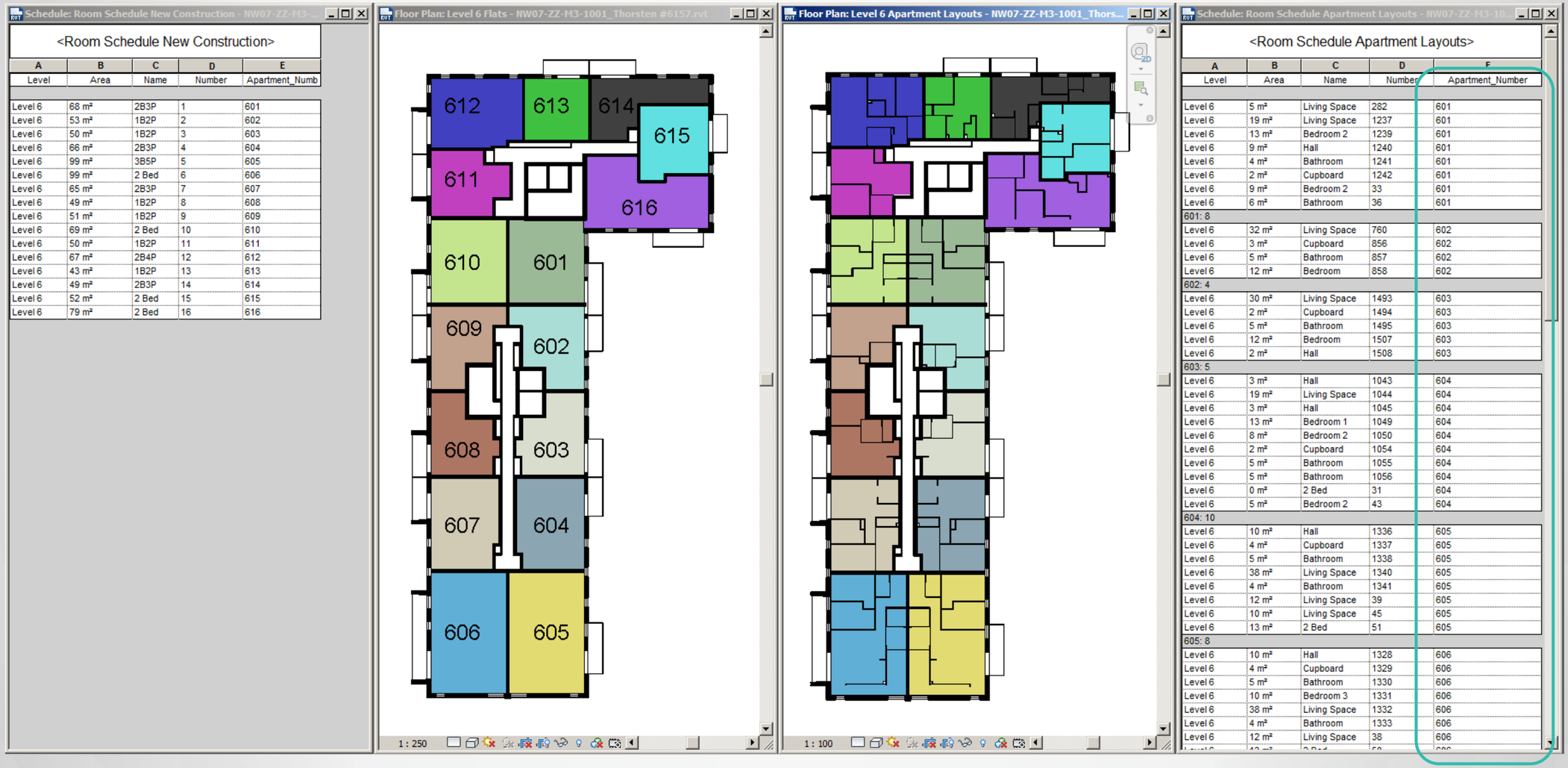
1 : 100

Schedule: Room Schedule Apartment Layouts - NW07-ZZ-M3-10...

<Room Schedule Apartment Layouts>

A	B	C	D	F
Level	Area	Name	Number	Apartment_Number
Level 6	7 m²	Hall	134	
Level 6	11 m²	Bedroom 2	135	
Level 6	5 m²	Bathroom	138	
Level 6	30 m²	Living Space	139	
Level 6	2 m²	Cupboard	140	
Level 6	26 m²	Living Space	207	
Level 6	13 m²	Bedroom 1	208	
Level 6	2 m²	Cupboard	209	
Level 6	5 m²	Bathroom	211	
Level 6	5 m²	Hall	247	
Level 6	5 m²	Bedroom 2	429	
Level 6	9 m²	Bedroom 1	477	
Level 6	2 m²	Bathroom	478	
Level 6	19 m²	Living Space	479	
Level 6	2 m²	Cupboard	481	
Level 6	32 m²	Living Space	760	
Level 6	33 m²	Living Space	763	
Level 6	3 m²	Cupboard	856	
Level 6	5 m²	Bathroom	857	
Level 6	12 m²	Bedroom	858	
Level 6	1 m²	Cupboard	868	
Level 6	12 m²	Bedroom	870	
Level 6	3 m²	Hall	1035	
Level 6	19 m²	Living Space	1036	
Level 6	3 m²	Hall	1037	
Level 6	13 m²	Bedroom 1	1041	
Level 6	8 m²	Bedroom 2	1042	
Level 6	3 m²	Hall	1043	
Level 6	19 m²	Living Space	1044	
Level 6	3 m²	Hall	1045	
Level 6	13 m²	Bedroom 1	1049	
Level 6	8 m²	Bedroom 2	1050	
Level 6	8 m²	Bedroom 2	1135	
Level 6	3 m²	Cupboard	1136	
Level 6	11 m²	Bedroom 1	1137	
Level 6	27 m²	Living Space	1138	
Level 6	5 m²	Bathroom	1139	
Level 6	4 m²	Bathroom	1140	
Level 6	7 m²	Hall	1142	
Level 6	10 m²	Hall	1328	
Level 6	4 m²	Cupboard	1329	
Level 6	5 m²	Bathroom	1330	
Level 6	10 m²	Bedroom 3	1331	
Level 6	38 m²	Living Space	1332	
Level 6	4 m²	Bathroom	1333	
Level 6	10 m²	Hall	1336	
Level 6	4 m²	Cupboard	1337	

Apartment Location Migrated to Rooms



Schedule: Room Schedule New Construction - NW07-ZZ-M3-...

<Room Schedule New Construction>

A	B	C	D	E
Level	Area	Name	Number	Apartment_Numb
Level 6	68 m²	2B3P	1	601
Level 6	53 m²	1B2P	2	602
Level 6	50 m²	1B2P	3	603
Level 6	66 m²	2B3P	4	604
Level 6	99 m²	3B5P	5	605
Level 6	99 m²	2 Bed	6	606
Level 6	65 m²	2B3P	7	607
Level 6	49 m²	1B2P	8	608
Level 6	51 m²	1B2P	9	609
Level 6	69 m²	2 Bed	10	610
Level 6	50 m²	1B2P	11	611
Level 6	67 m²	2B4P	12	612
Level 6	43 m²	1B2P	13	613
Level 6	49 m²	2B3P	14	614
Level 6	52 m²	2 Bed	15	615
Level 6	79 m²	2 Bed	16	616

Floor Plan: Level 6 Flats - NW07-ZZ-M3-1001_Thorsten #6157.rvt

612 613 614 615 611 616 610 601 609 602 608 603 607 604 606 605

1 : 250

Floor Plan: Level 6 Apartment Layouts - NW07-ZZ-M3-1001_Thors...

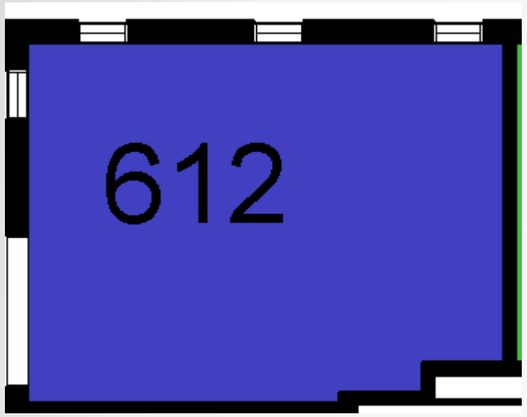
1 : 100

Schedule: Room Schedule Apartment Layouts - NW07-ZZ-M3-10...

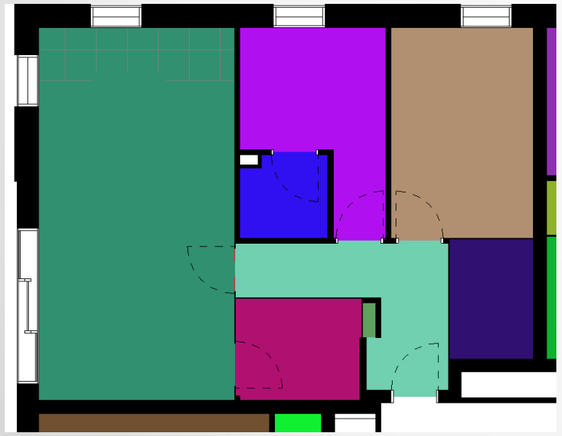
<Room Schedule Apartment Layouts>

A	B	C	D	E
Level	Area	Name	Number	Apartment_Number
Level 6	5 m²	Living Space	282	601
Level 6	19 m²	Living Space	1237	601
Level 6	13 m²	Bedroom 2	1239	601
Level 6	9 m²	Hall	1240	601
Level 6	4 m²	Bathroom	1241	601
Level 6	2 m²	Cupboard	1242	601
Level 6	9 m²	Bedroom 2	33	601
Level 6	6 m²	Bathroom	36	601
601: 8				
Level 6	32 m²	Living Space	760	602
Level 6	3 m²	Cupboard	856	602
Level 6	5 m²	Bathroom	857	602
Level 6	12 m²	Bedroom	858	602
602: 4				
Level 6	30 m²	Living Space	1493	603
Level 6	2 m²	Cupboard	1494	603
Level 6	5 m²	Bathroom	1495	603
Level 6	12 m²	Bedroom	1507	603
Level 6	2 m²	Hall	1508	603
603: 5				
Level 6	3 m²	Hall	1043	604
Level 6	19 m²	Living Space	1044	604
Level 6	3 m²	Hall	1045	604
Level 6	13 m²	Bedroom 1	1049	604
Level 6	8 m²	Bedroom 2	1050	604
Level 6	2 m²	Cupboard	1054	604
Level 6	5 m²	Bathroom	1055	604
Level 6	5 m²	Bathroom	1056	604
Level 6	0 m²	2 Bed	31	604
Level 6	5 m²	Bedroom 2	43	604
604: 10				
Level 6	10 m²	Hall	1336	605
Level 6	4 m²	Cupboard	1337	605
Level 6	5 m²	Bathroom	1338	605
Level 6	38 m²	Living Space	1340	605
Level 6	4 m²	Bathroom	1341	605
Level 6	12 m²	Living Space	39	605
Level 6	10 m²	Living Space	45	605
Level 6	13 m²	2 Bed	51	605
605: 8				
Level 6	10 m²	Hall	1328	606
Level 6	4 m²	Cupboard	1329	606
Level 6	5 m²	Bathroom	1330	606
Level 6	10 m²	Bedroom 3	1331	606
Level 6	38 m²	Living Space	1332	606
Level 6	4 m²	Bathroom	1333	606
Level 6	12 m²	Living Space	38	606

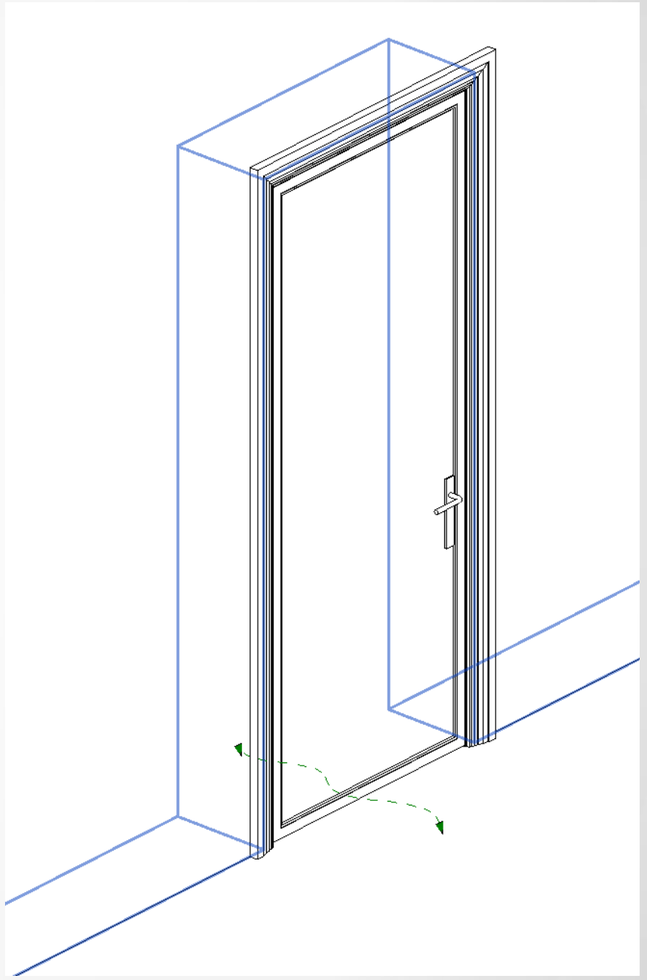
Phase Independent Door Schedules



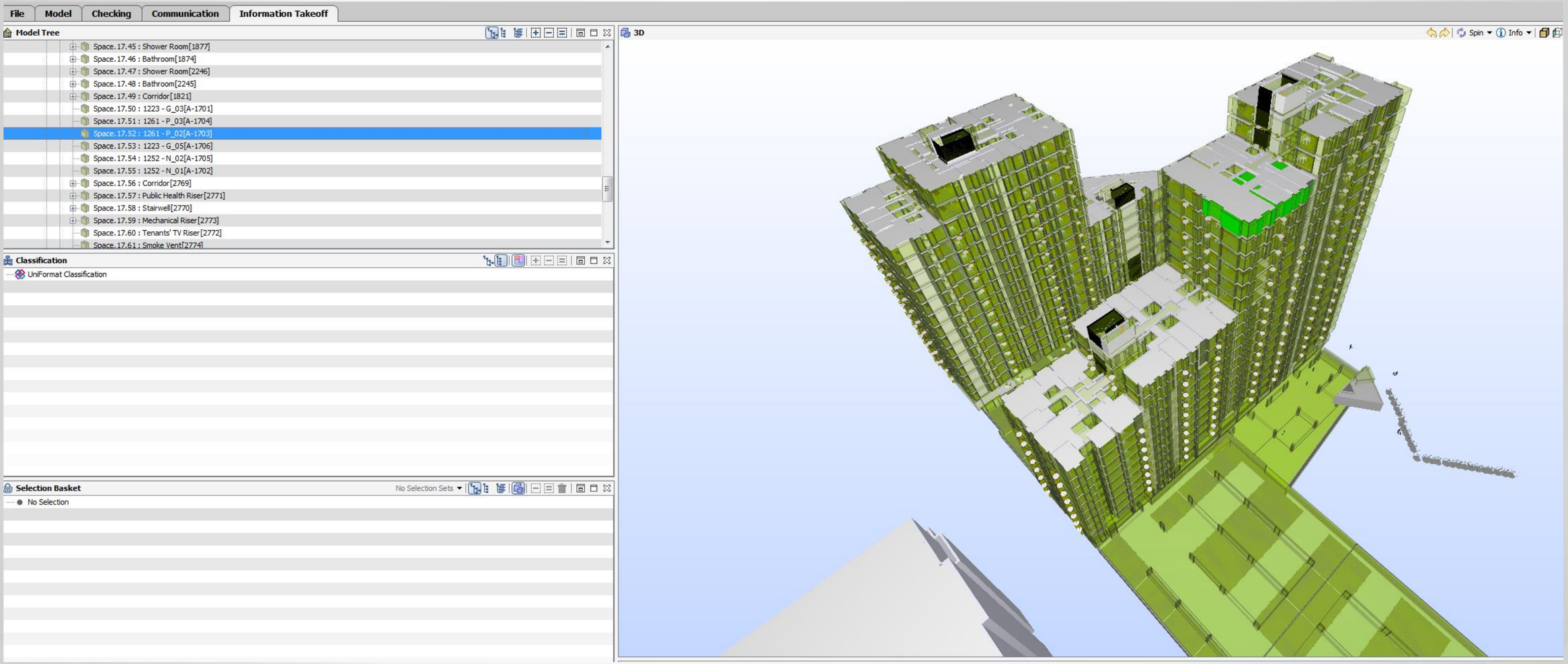
Number (From Apartment)



To/From Room Data



Rooms to IFCSpace

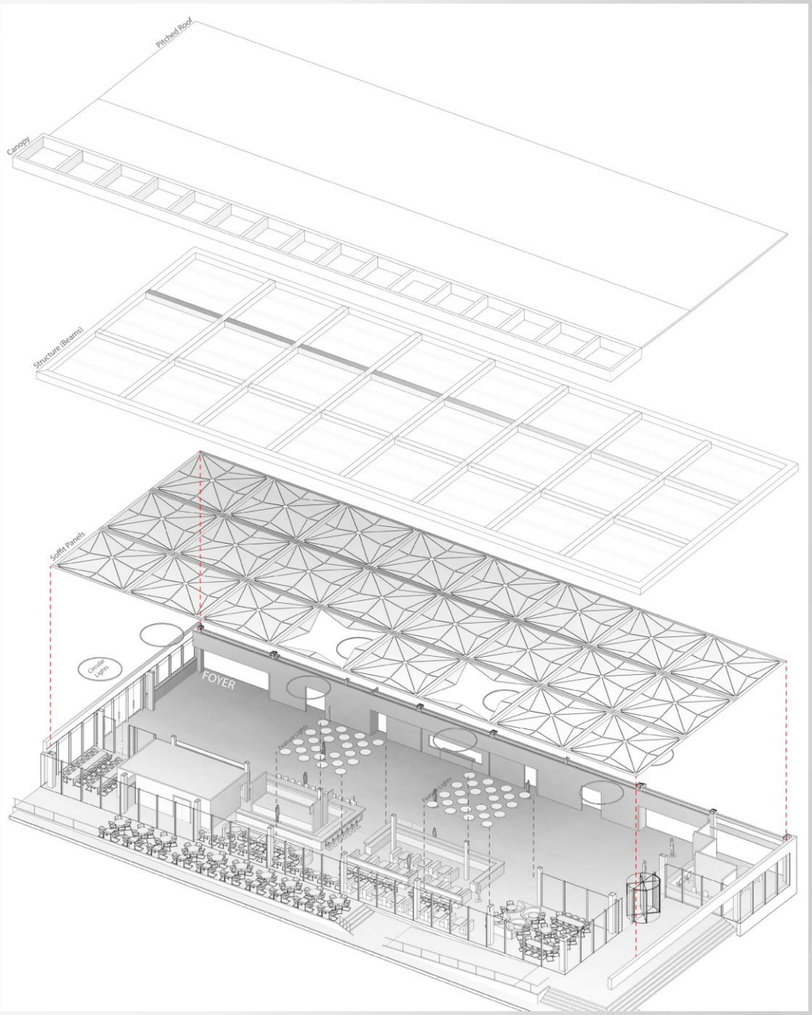


The Final Battle

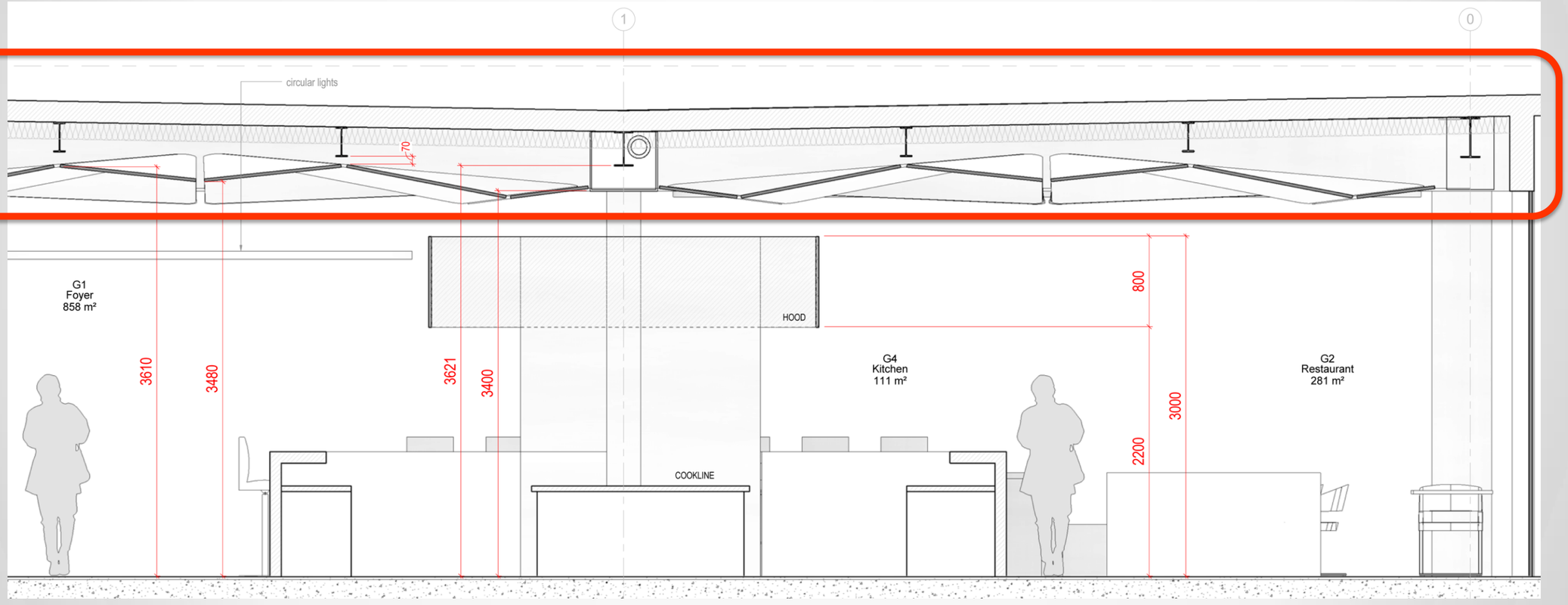
Acoustic Design

Wembley Theatre

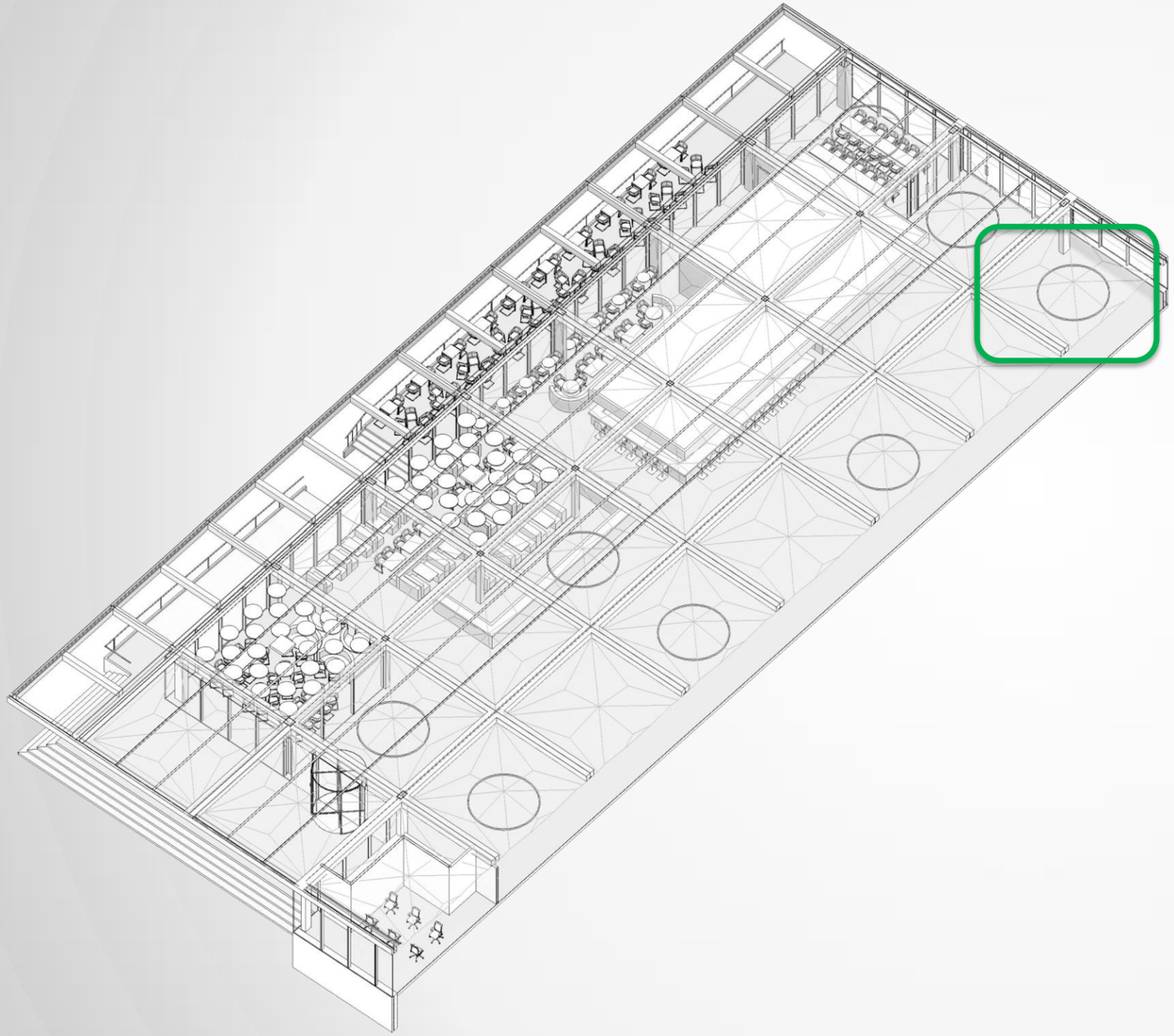
Foyer Ceiling



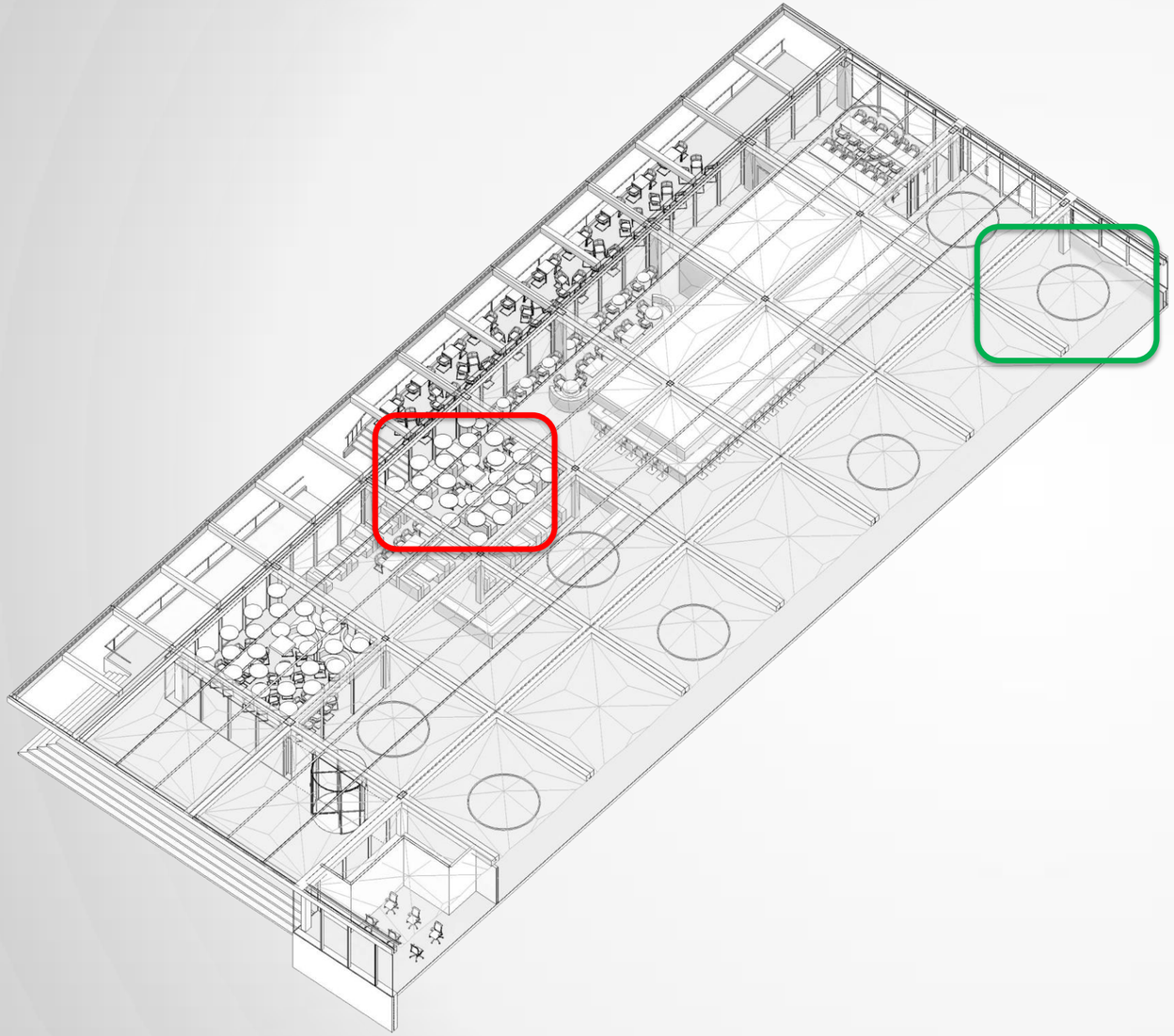
Limited Ceiling Void



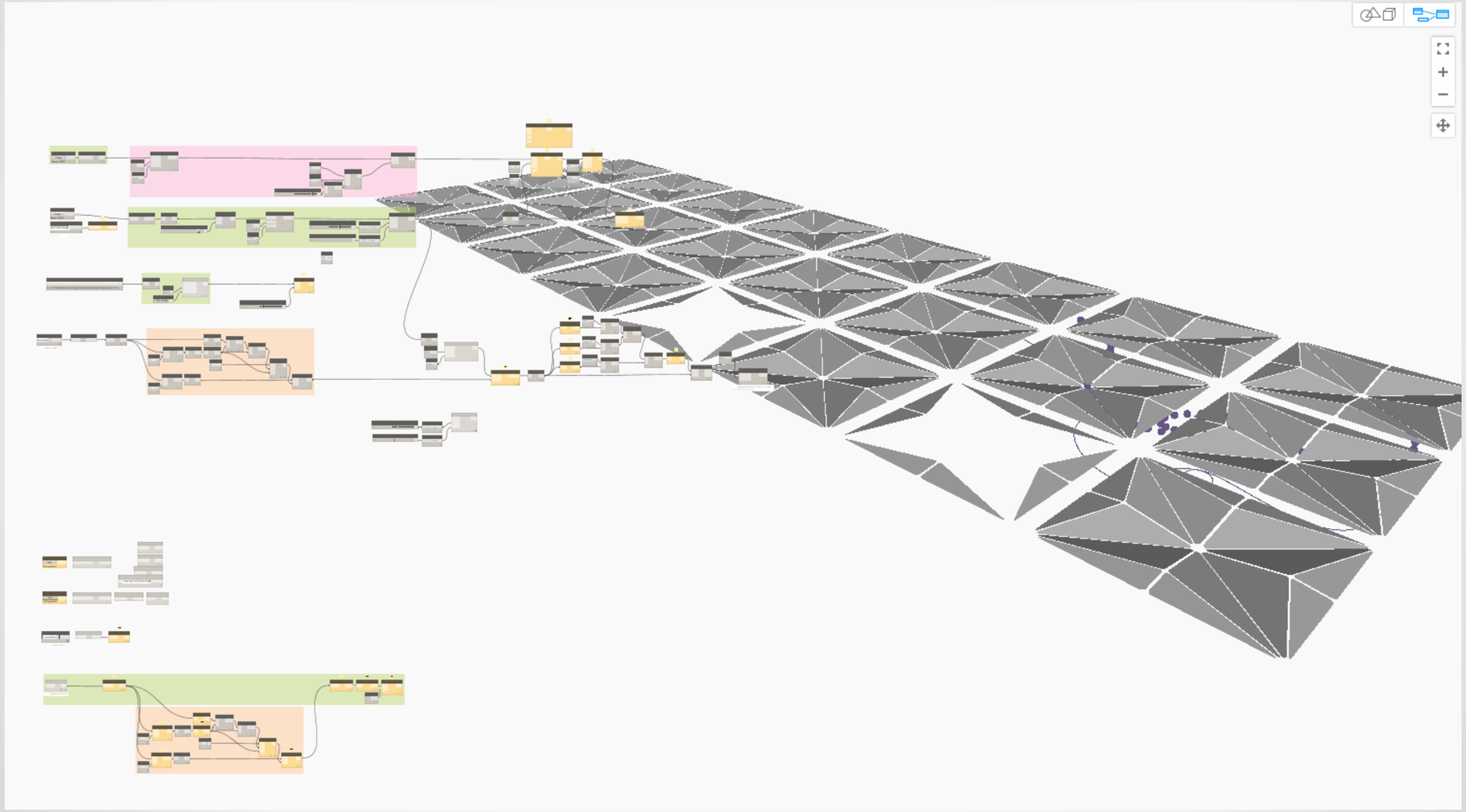
Multi-use Space



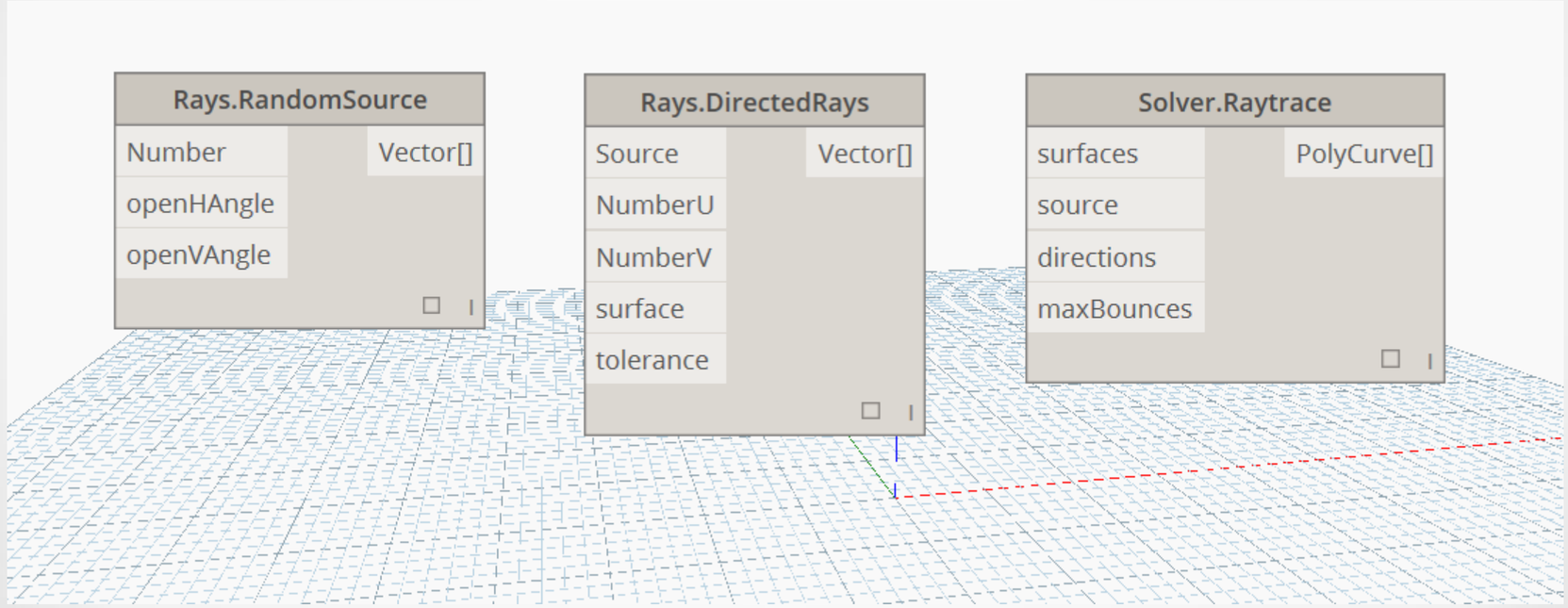
Multi-use Space



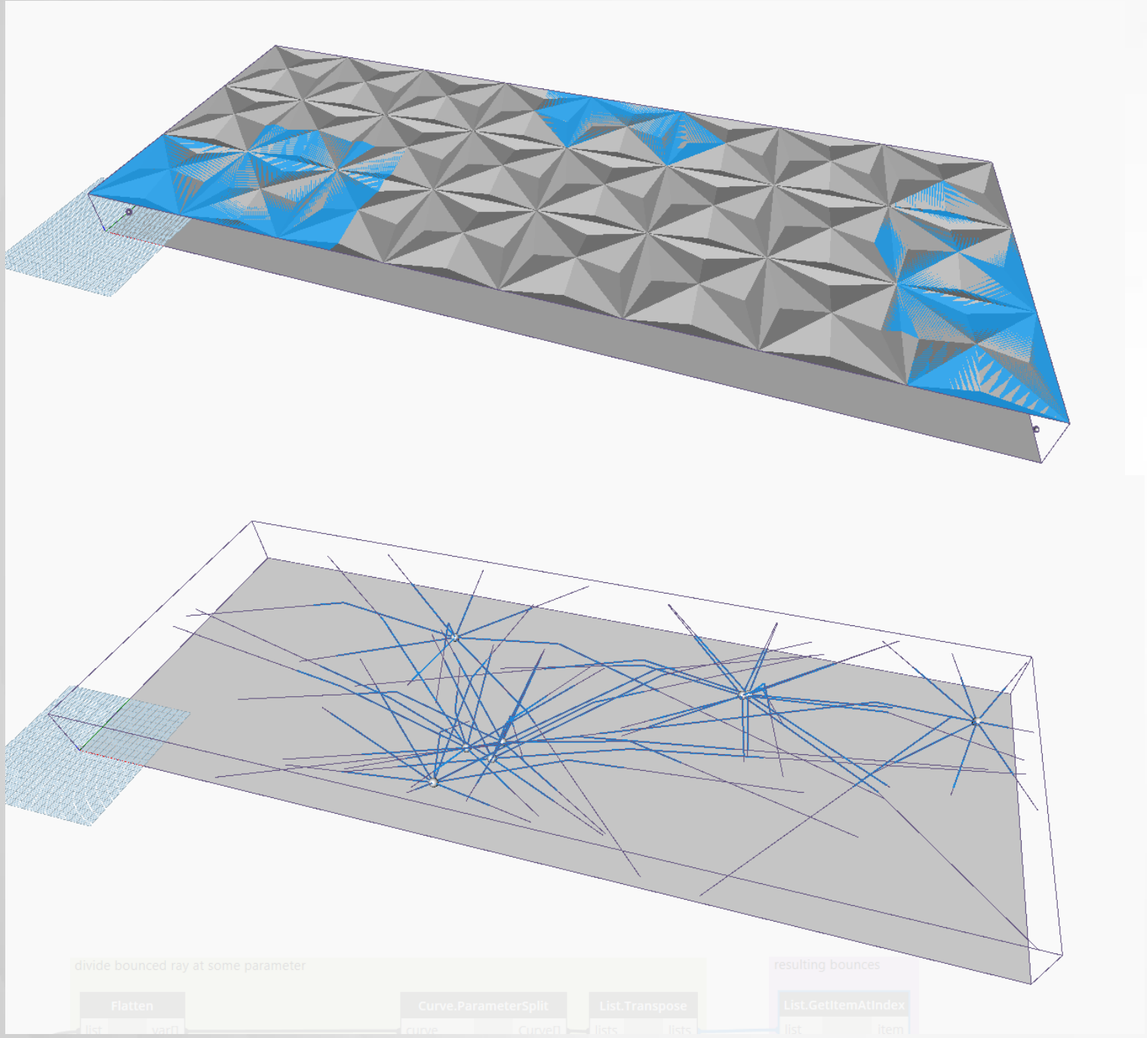
Ceiling Graph

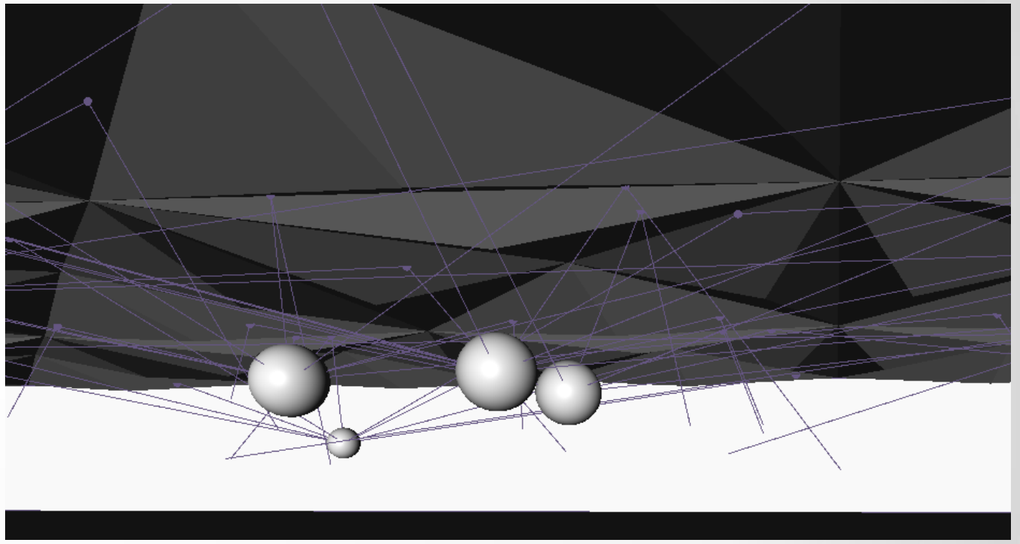


Acustamo


Rays.RandomSource
Number
Vector[]
openHAngle
openVAngle
Rays.DirectedRays
Source
Vector[]
NumberU
NumberV
surface
tolerance
Solver.Raytrace
surfaces
PolyCurve[]
source
directions
maxBounces

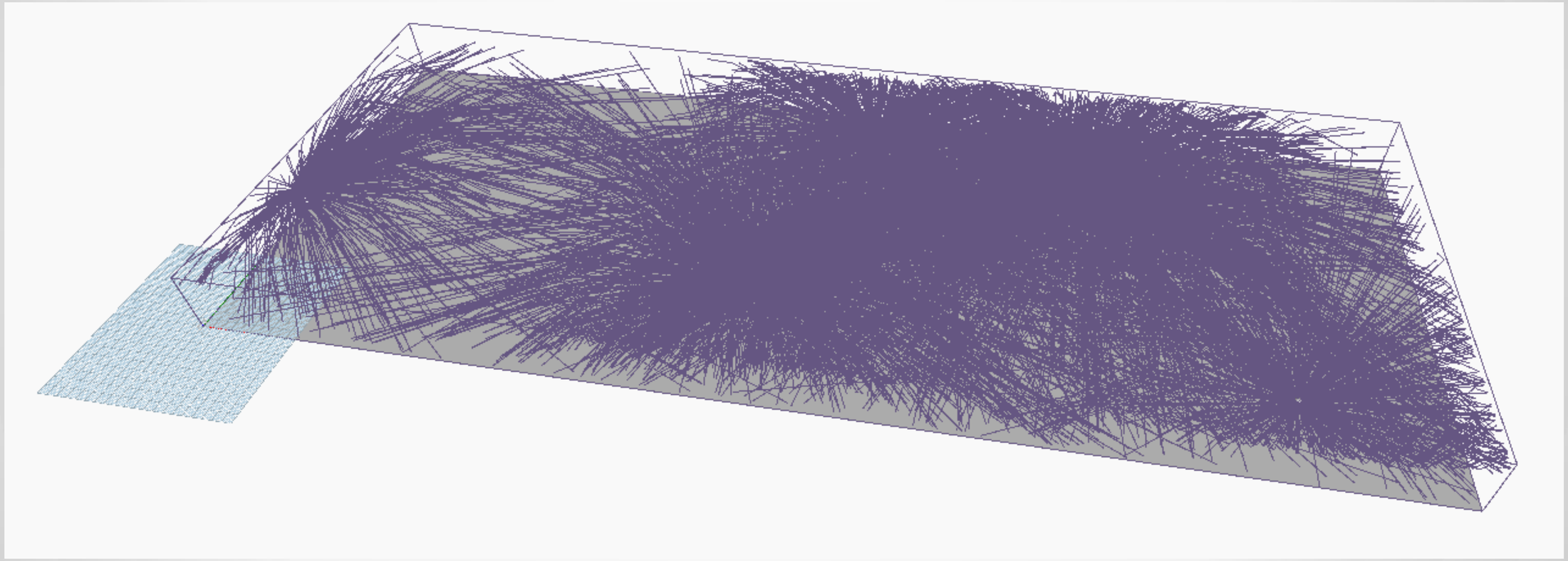
Multiple Sources



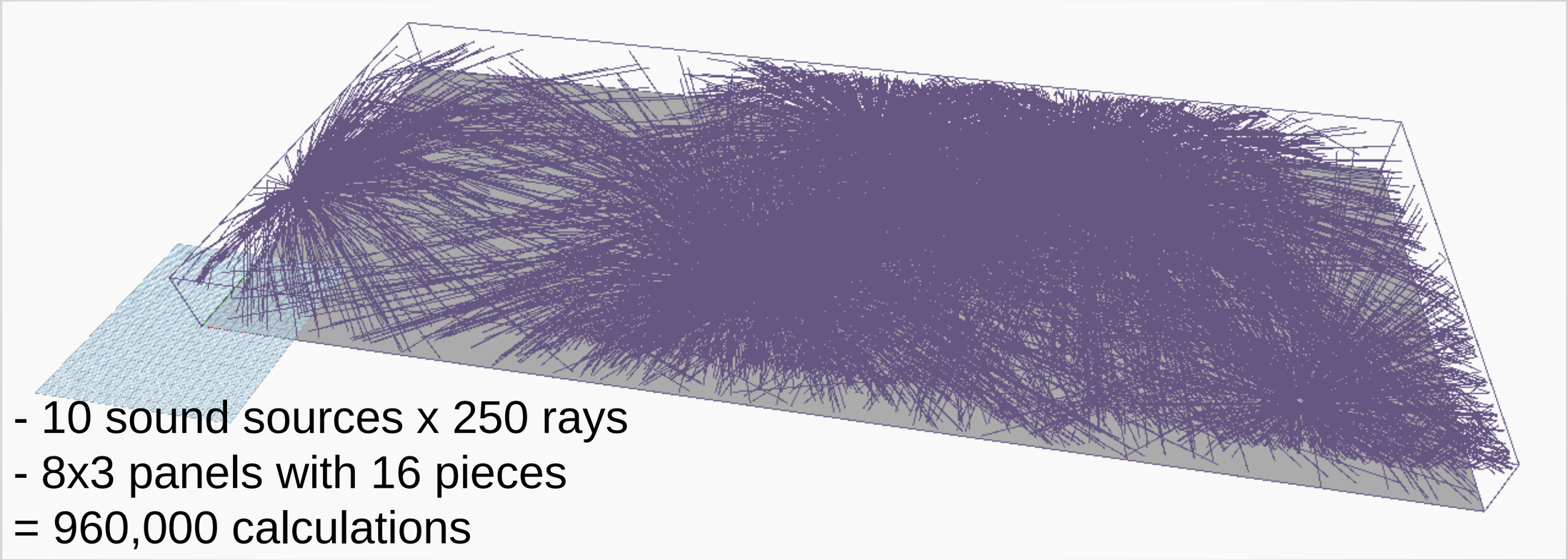


Test setup
5 sound sources x 25 rays

10 Sources = 6 hours

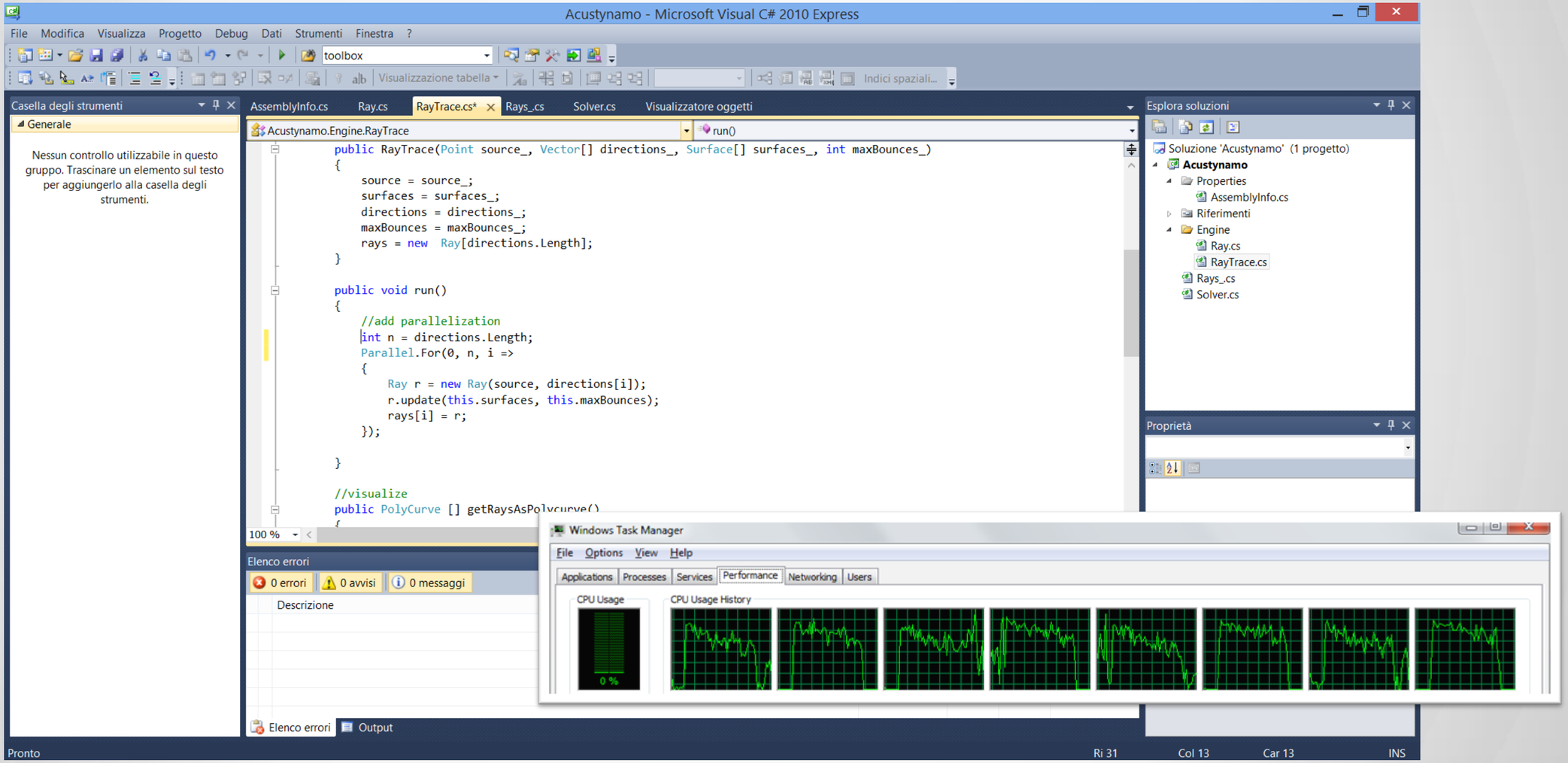


10 Sources = 6 hours

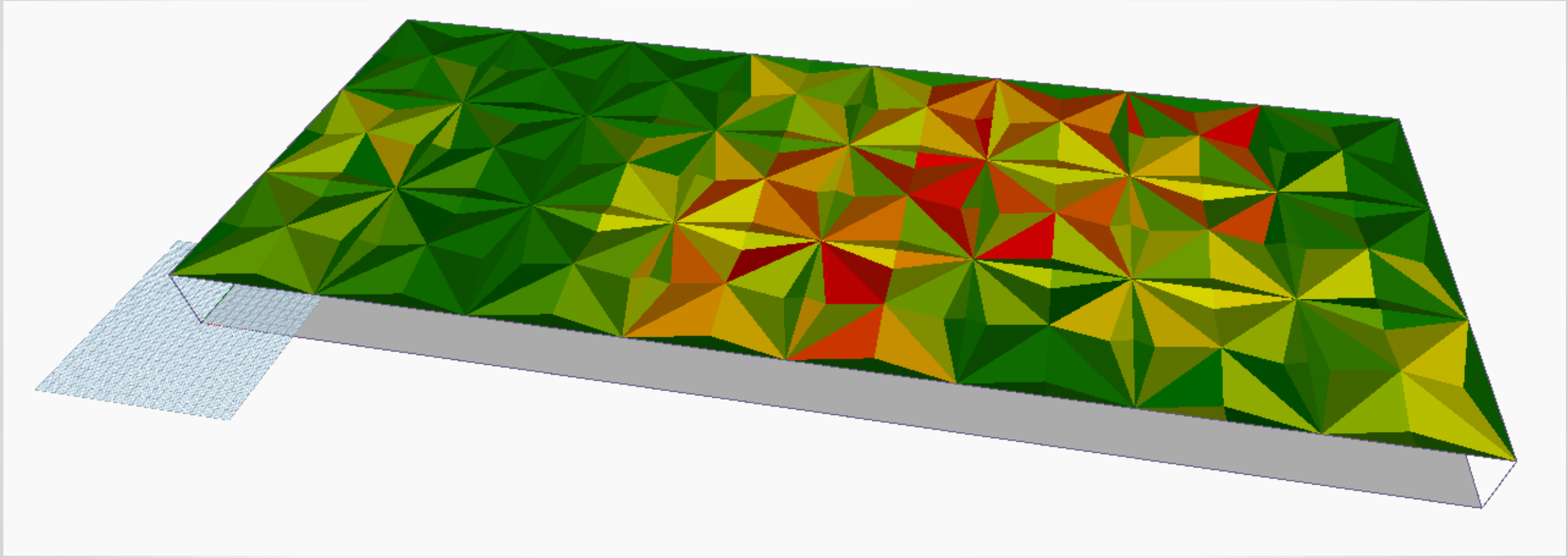


- 10 sound sources x 250 rays
- 8x3 panels with 16 pieces
= 960,000 calculations

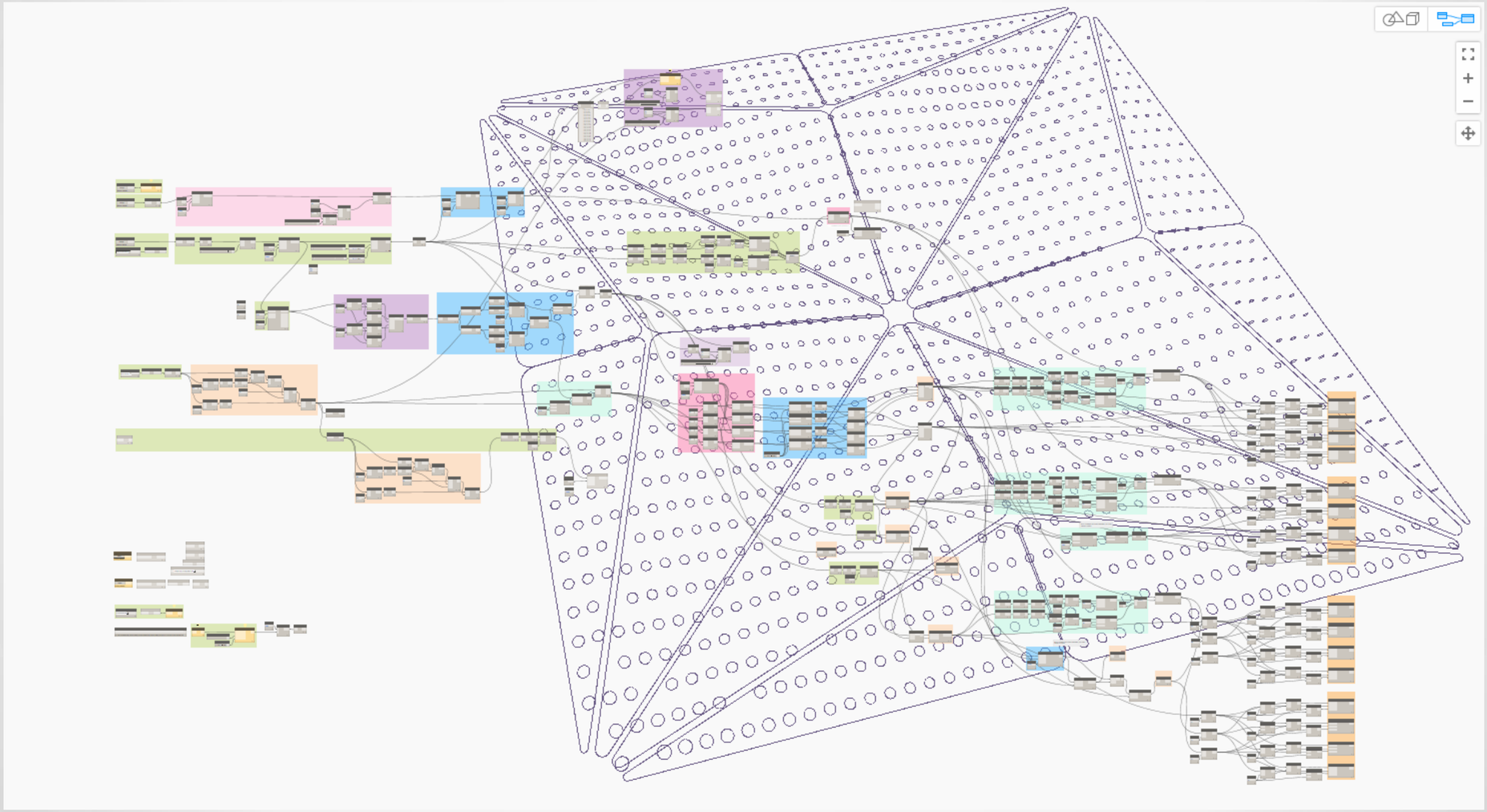
C# Multithreading



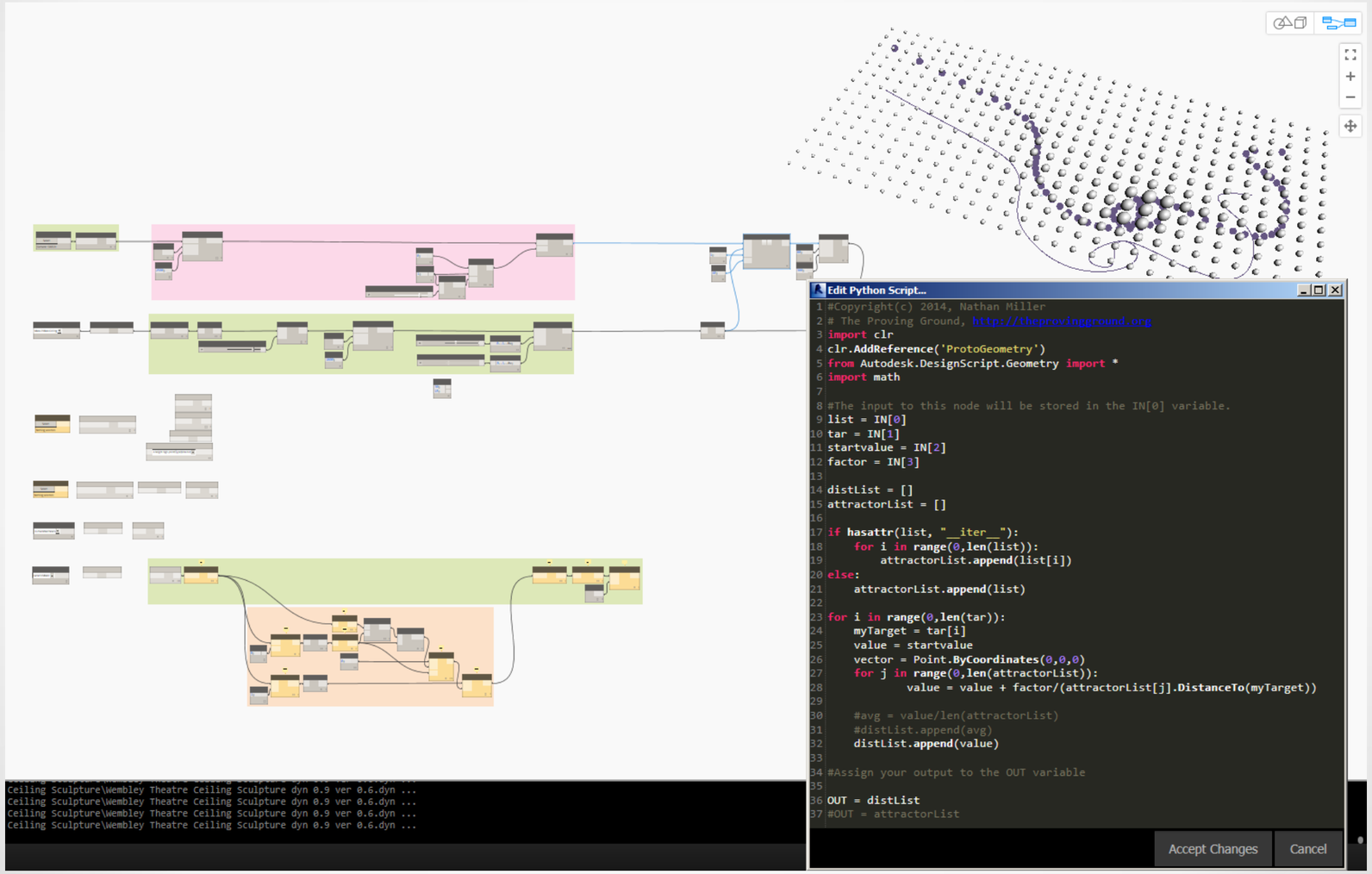
Analysis Result



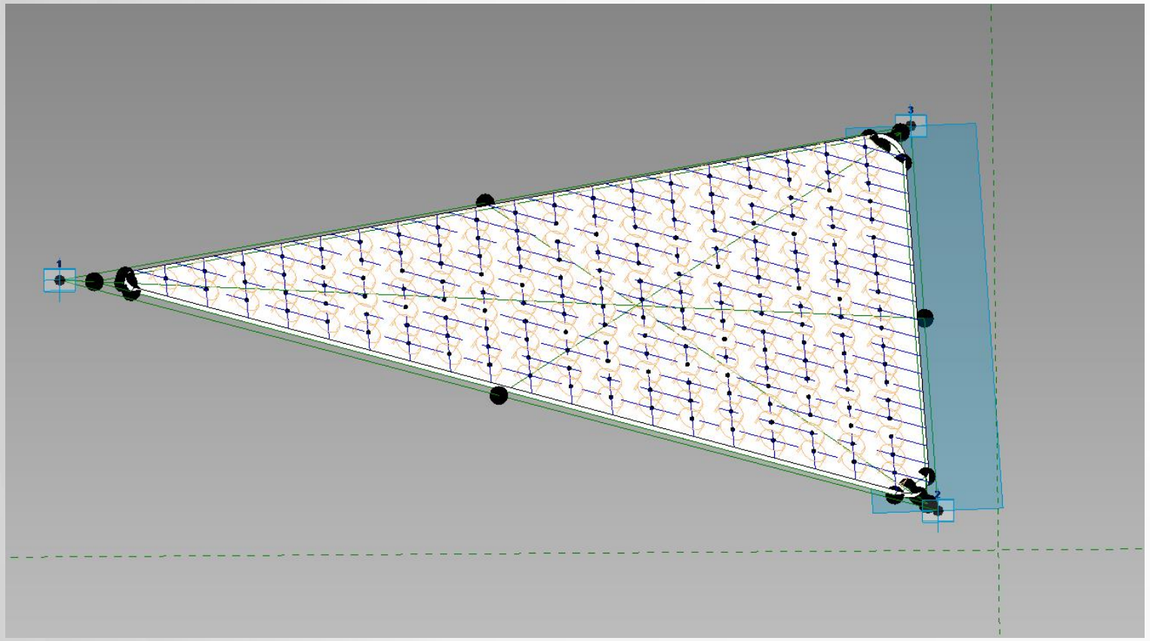
Perforations

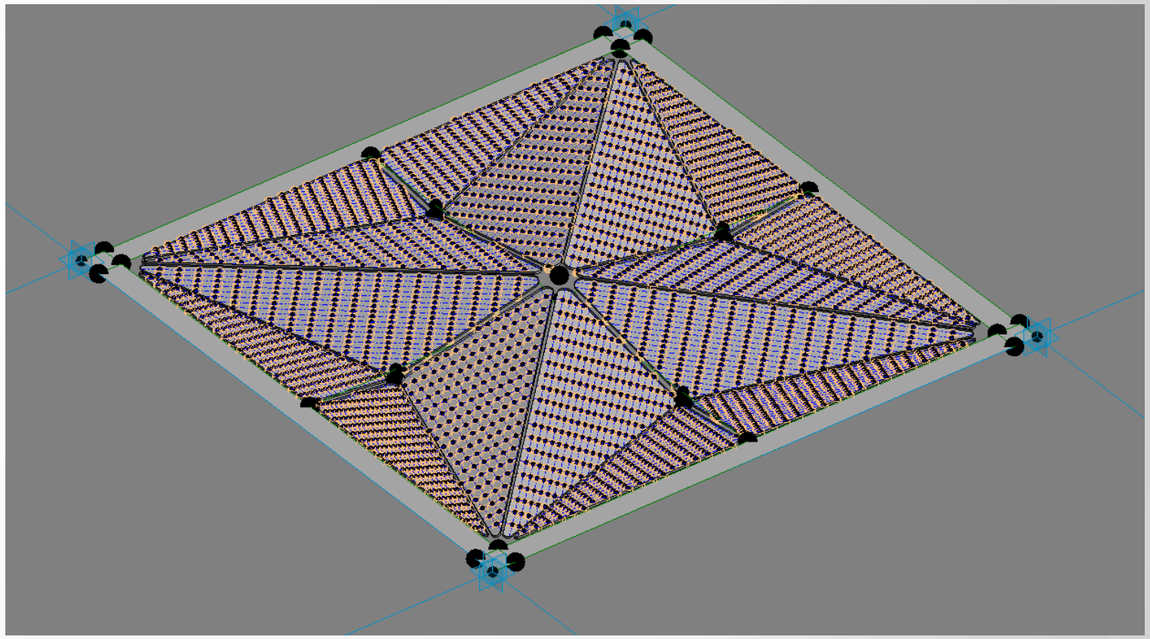


Attractor

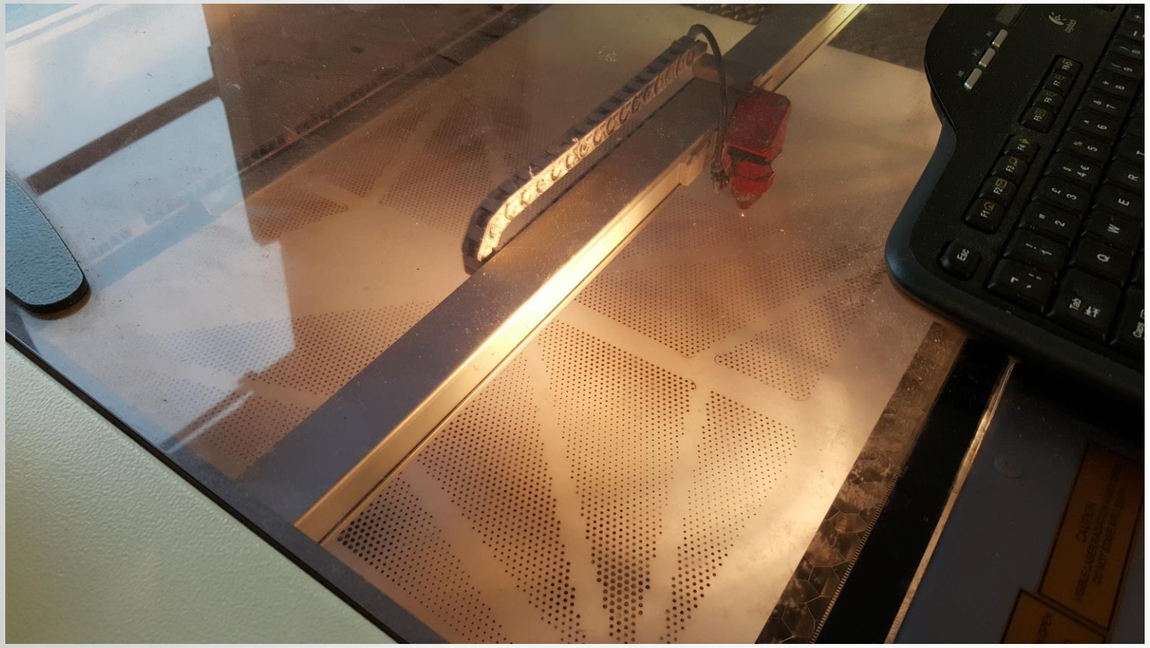

Edit Python Script...
#Copyright(c) 2014, Nathan Miller
# The Proving Ground, http://theprovingground.org
import clr
clr.AddReference('ProtoGeometry')
from Autodesk.DesignScript.Geometry import *
import math
#The input to this node will be stored in the IN[0] variable.
list = IN[0]
tar = IN[1]
startvalue = IN[2]
factor = IN[3]
distList = []
attractorList = []
if hasattr(list, "__iter__"):
for i in range(0,len(list)):
attractorList.append(list[i])
else:
attractorList.append(list)
for i in range(0,len(tar)):
myTarget = tar[i]
value = startvalue
vector = Point.ByCoordinates(0,0,0)
for j in range(0,len(attractorList)):
value = value + factor/(attractorList[j].DistanceTo(myTarget))
#avg = value/len(attractorList)
#distList.append(avg)
distList.append(value)
#Assign your output to the OUT variable
OUT = distList
#OUT = attractorList
Accept Changes
Cancel
Ceiling Sculpture\Wembley Theatre Ceiling Sculpture dyn 0.9 ver 0.6.dyn ...
Ceiling Sculpture\Wembley Theatre Ceiling Sculpture dyn 0.9 ver 0.6.dyn ...
Ceiling Sculpture\Wembley Theatre Ceiling Sculpture dyn 0.9 ver 0.6.dyn ...
Ceiling Sculpture\Wembley Theatre Ceiling Sculpture dyn 0.9 ver 0.6.dyn ...

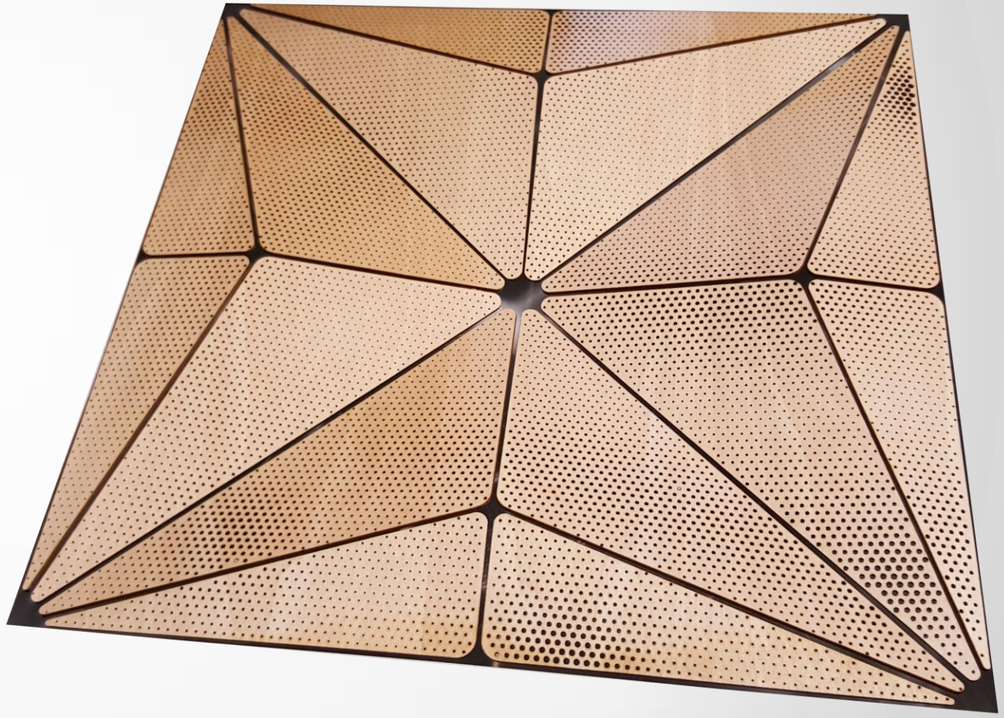
Revit Adaptive Panels





Scale Mock-ups

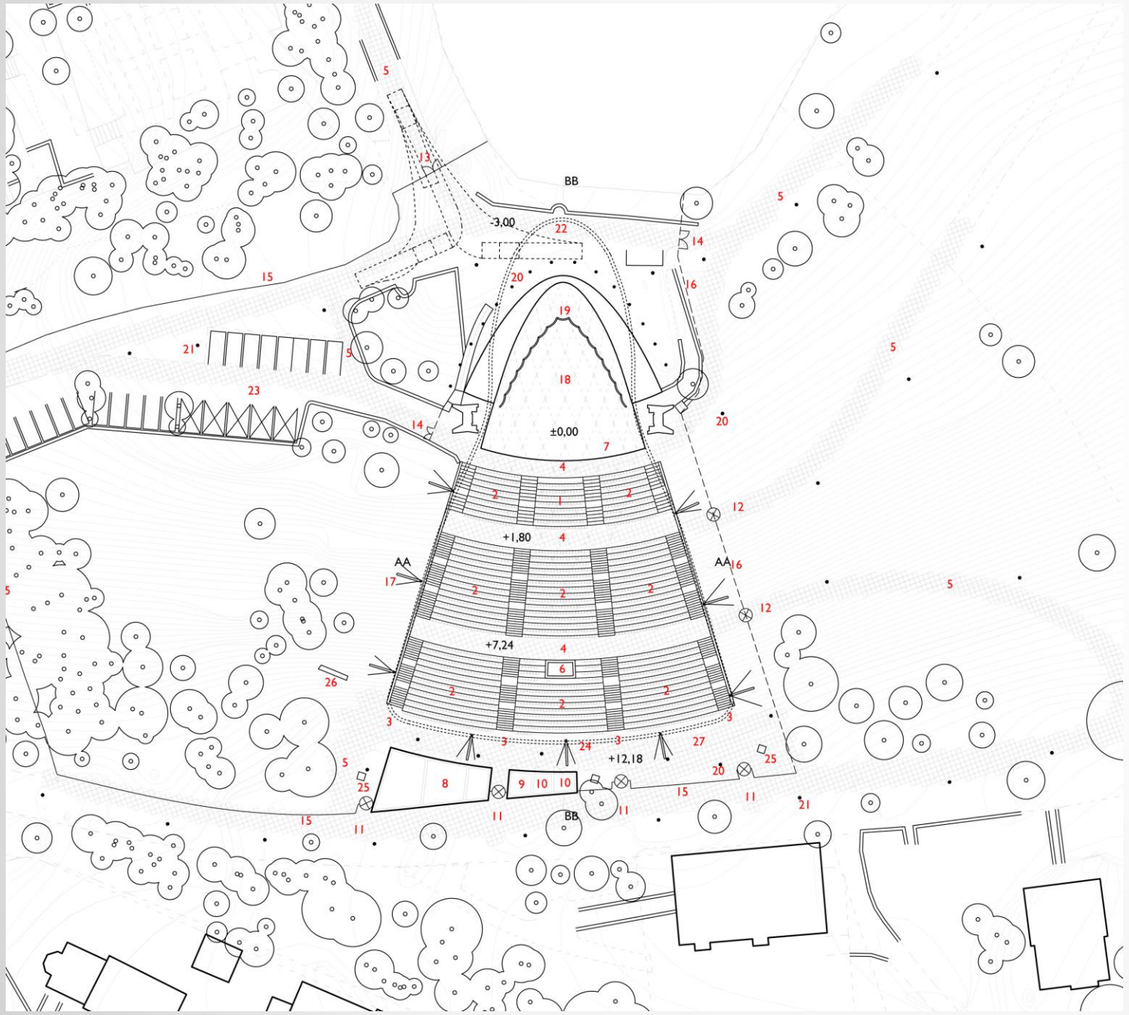


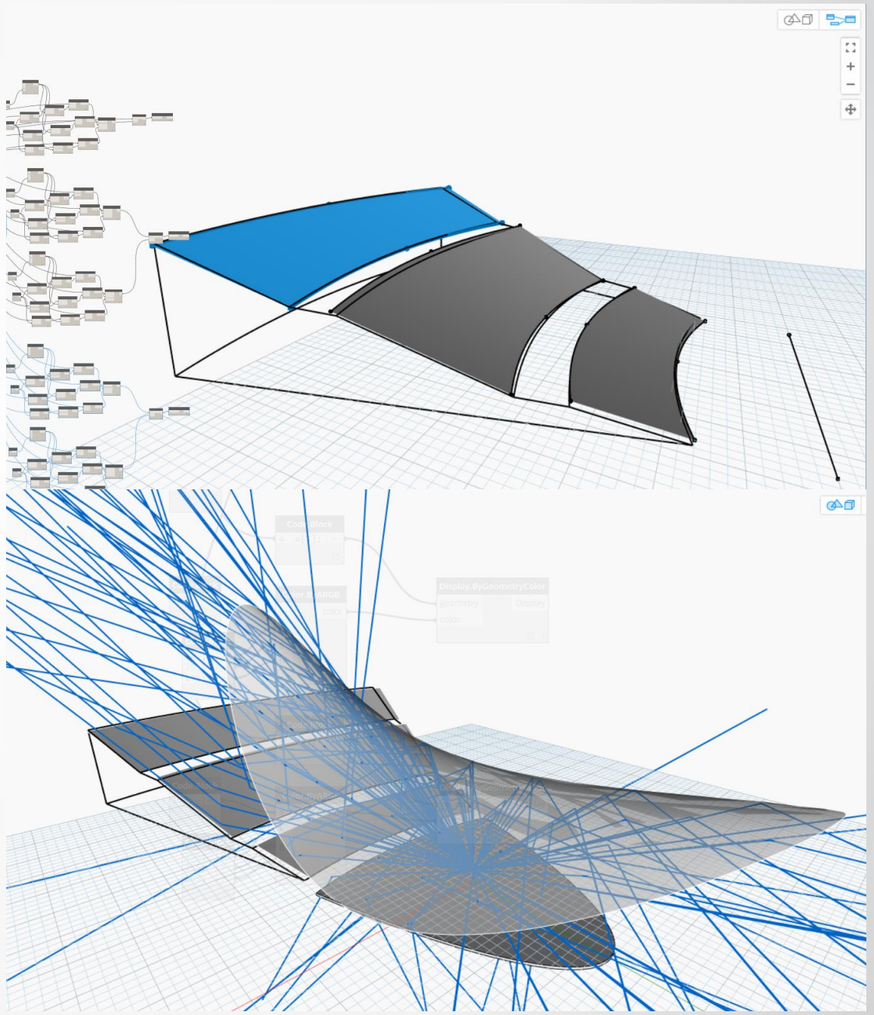


Dynamo Hero 3?

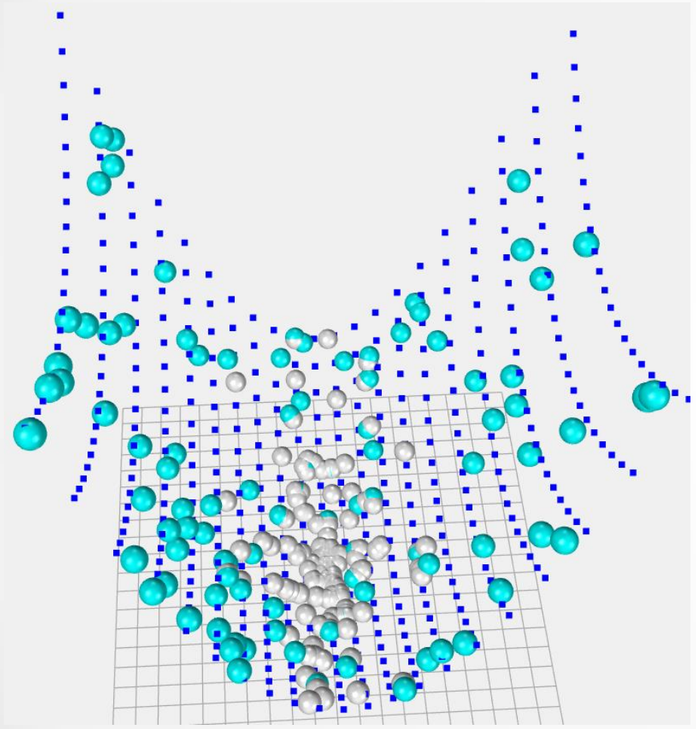
Poland

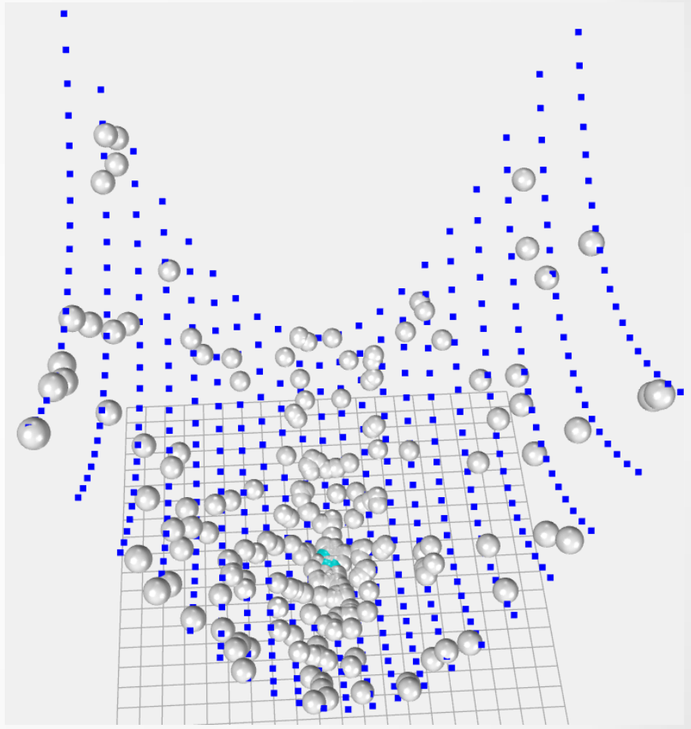
Form Optimisation



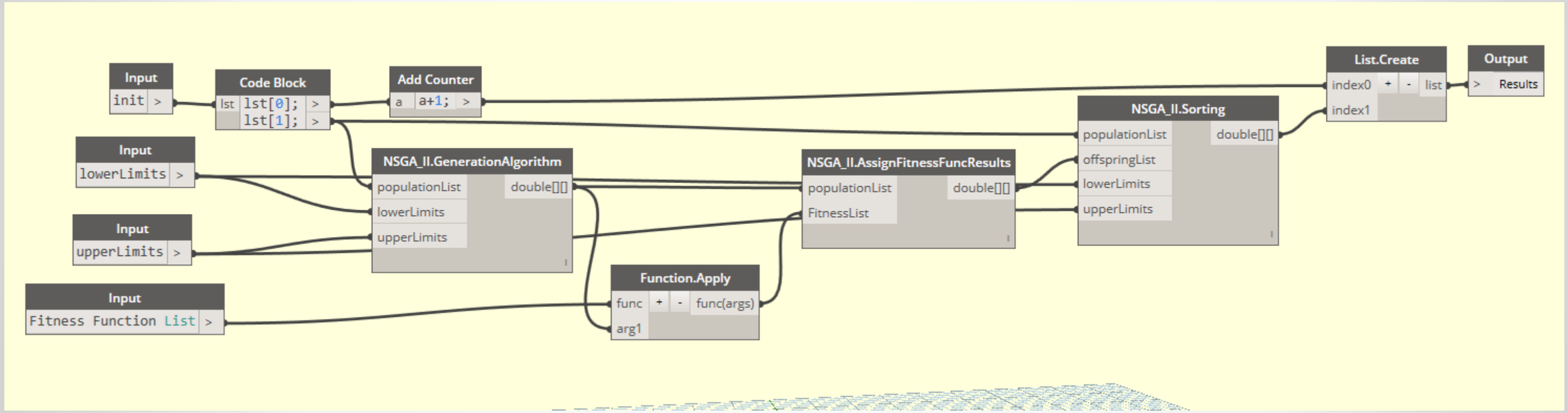


Optimo

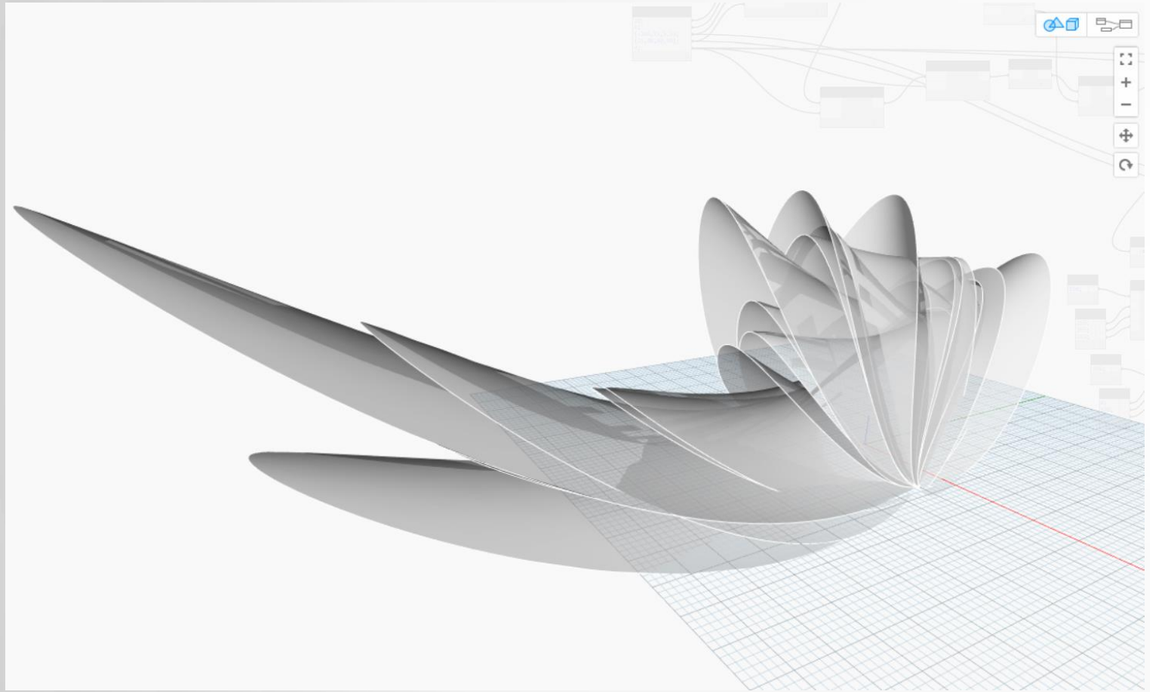


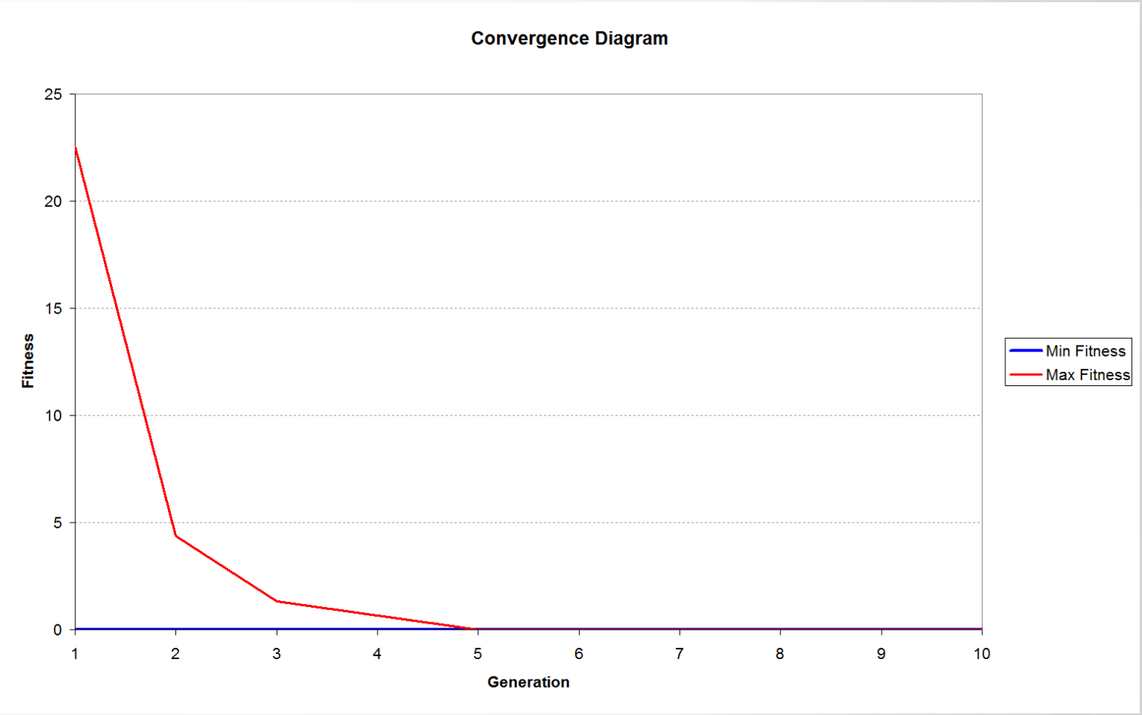


Optimo Node

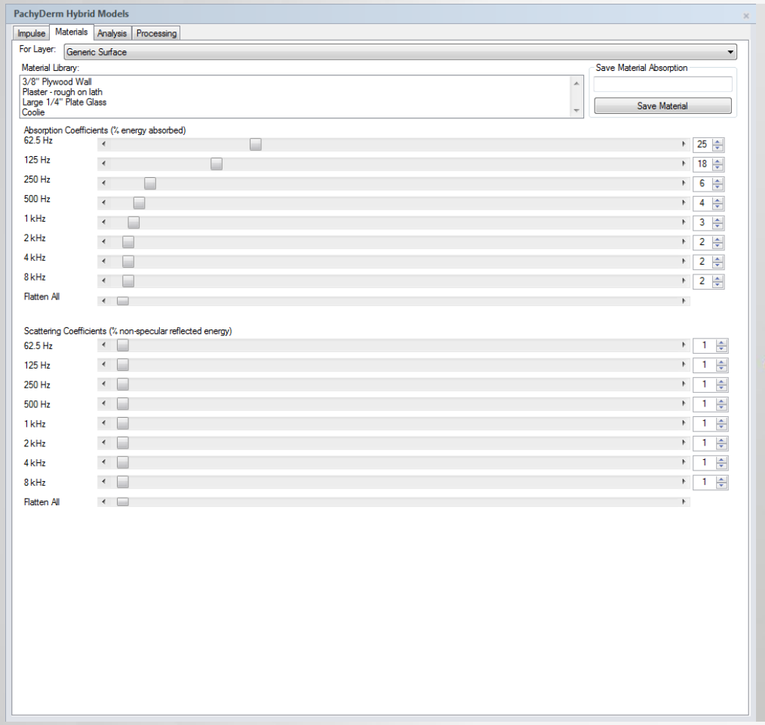

Input
init >
Code Block
lst lst[0]; >
lst[1]; >
Add Counter
a a+1; >
List.Create
index0 + - list
index1
Output
> Results
Input
lowerLimits >
NSGA_II.GenerationAlgorithm
populationList double[][]
lowerLimits
upperLimits
NSGA_II.AssignFitnessFuncResults
populationList double[][]
FitnessList
NSGA_II.Sorting
populationList double[][]
offspringList
lowerLimits
upperLimits
Input
upperLimits >
Function.Apply
func + - func(args)
arg1
Input
Fitness Function List >

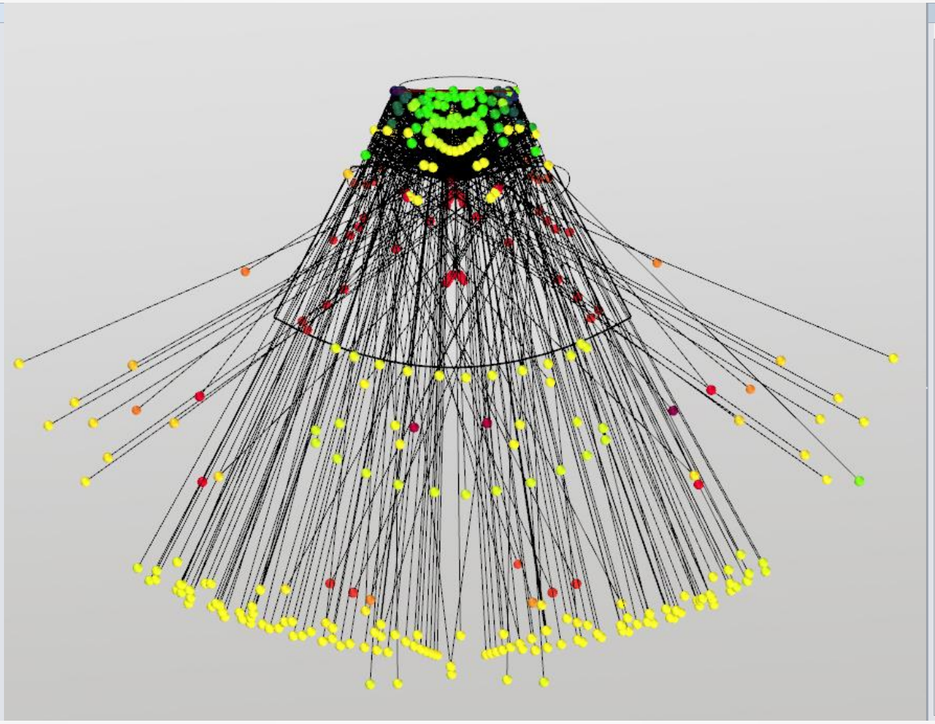
Iterations

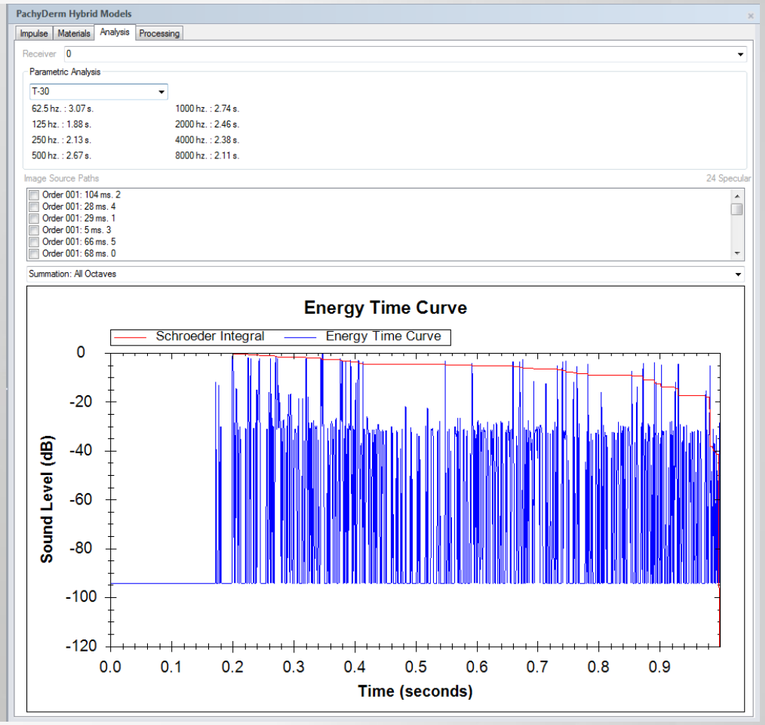



Convergence Diagram
25
20
15
10
5
0
Fitness
1
2
3
4
5
6
7
8
9
10
Generation
Min Fitness
Max Fitness

Acoustamo + Pachyderm







Materials

Frequencies

Timeline

Conclusion

- Coders are the new member of the AEC team
- Dynamo is a powerful tool to access data
- Let your CPU handle repetitive tasks
- PythonScript allows access to many programs

Conclusion

- Coders are the new member of the AEC team
- Dynamo is a powerful tool to access your data
- Let your CPU handle repetitive tasks
- PythonScript allows access to many programs
- You too could be a DYNAMO HERO!

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- AU 2016 passes awarded daily!
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- Give instructors feedback in real-time.