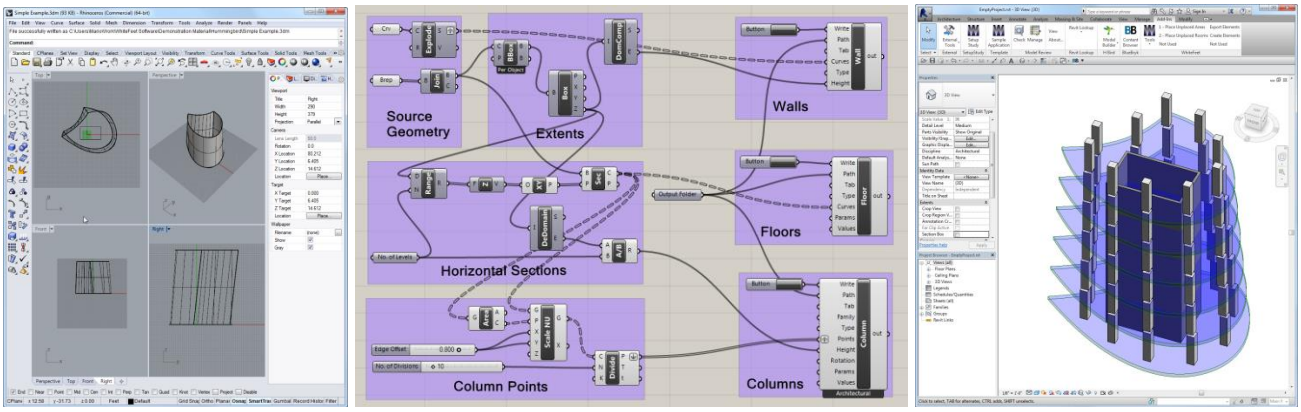
Hummingbird – Rhino-Grasshopper User Guide

Mario Guttman
Revised 2019-04-29
Based on Rhino 6 and Revit Version 2020

The *Hummingbird* solution includes a set of components for Rhino-Grasshopper and an add-in for Revit called *ModelBuilder*.

This document describes the Rhino-Grasshopper components. A separate document *Hummingbird - Revit Addin.pdf* describes the Revit add-in. This document includes more detail about the .CSV file with is used to transfer output between the Rhino-Grasshopper and Revit environments.



Using Rhino Geometry to Create Native Revit Objects

I. Overview

Hummingbird is used to create native Revit objects based on data that is generated from Rhino-Grasshopper. The Grasshopper components write to a .CSV text file that can be read by the Revit add-in Model Builder, which builds the Revit objects. The text file can be viewed in a Hummingbird CSV-Viewer (or Excel) for study and editing data if necessary, however this is not normally required.

The Rhino-Grasshopper components also include an Input tool, which can be used to read CSV data that has been created in Revit or another source. This data is used to create Rhino geometry or data input to other Grasshopper components.

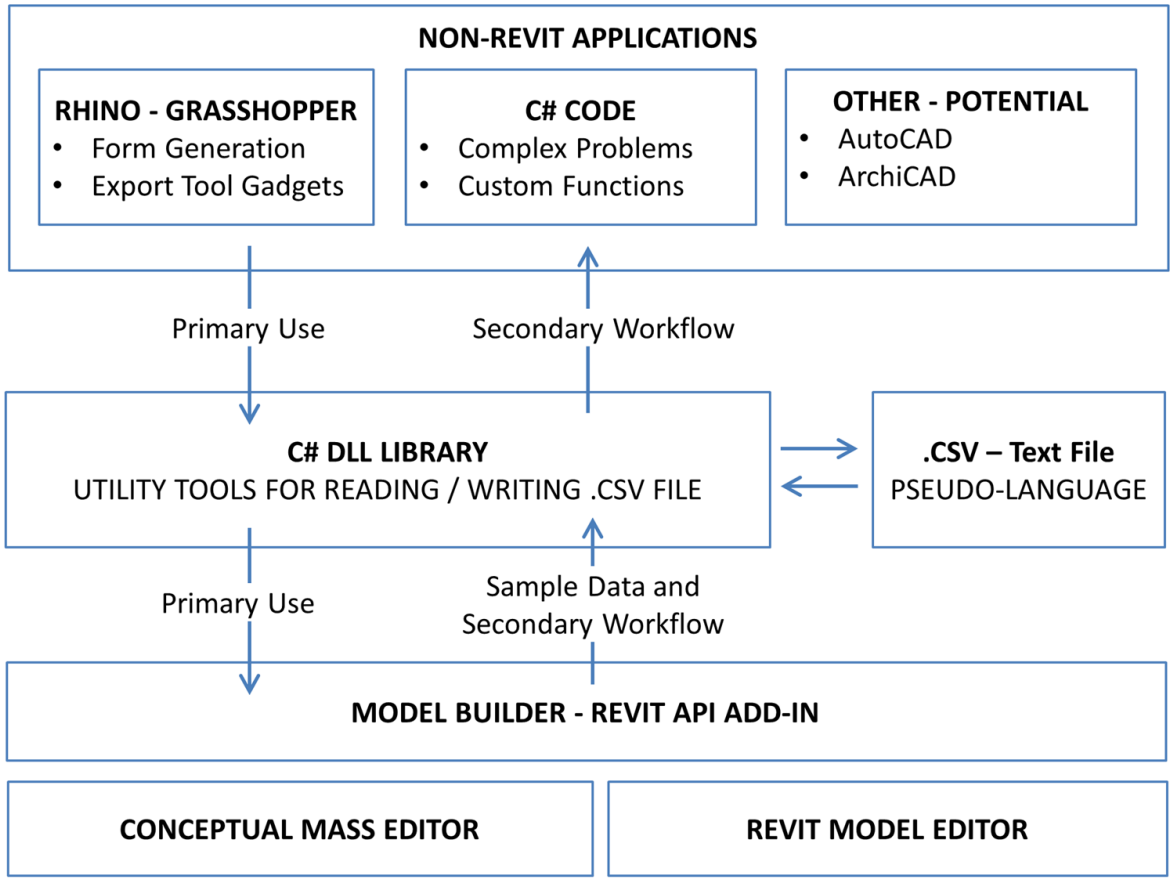
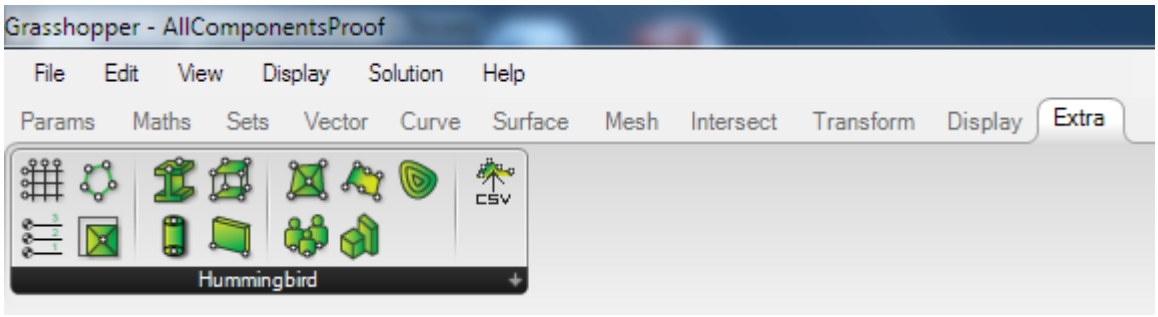


Diagram of the Workflow and Data Model

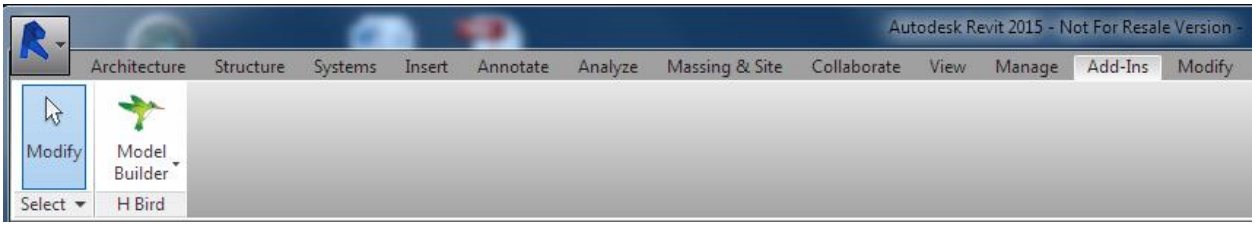
With Rhino 5 the Grasshopper add-in must be installed. See this site for more information on how to get it: http://www.grasshopper3d.com/ . With Rhino 6 this is included automatically.

The Hummingbird installation adds the components to the *Extra* tab in Grasshopper.



The Hummingbird Components are installed to the Extra Tab in Grasshopper

The Revit ModelBuilder add-in is installed to the *Add-Ins* tab in Revit.

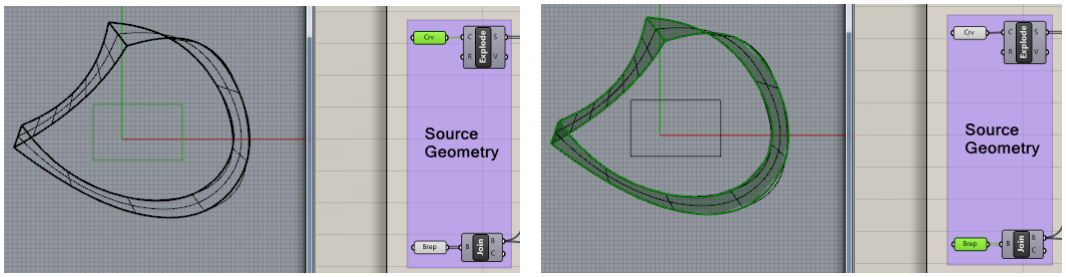


The ModelBuilder is installed to the Add-Ins Tab in Revit

Example Project

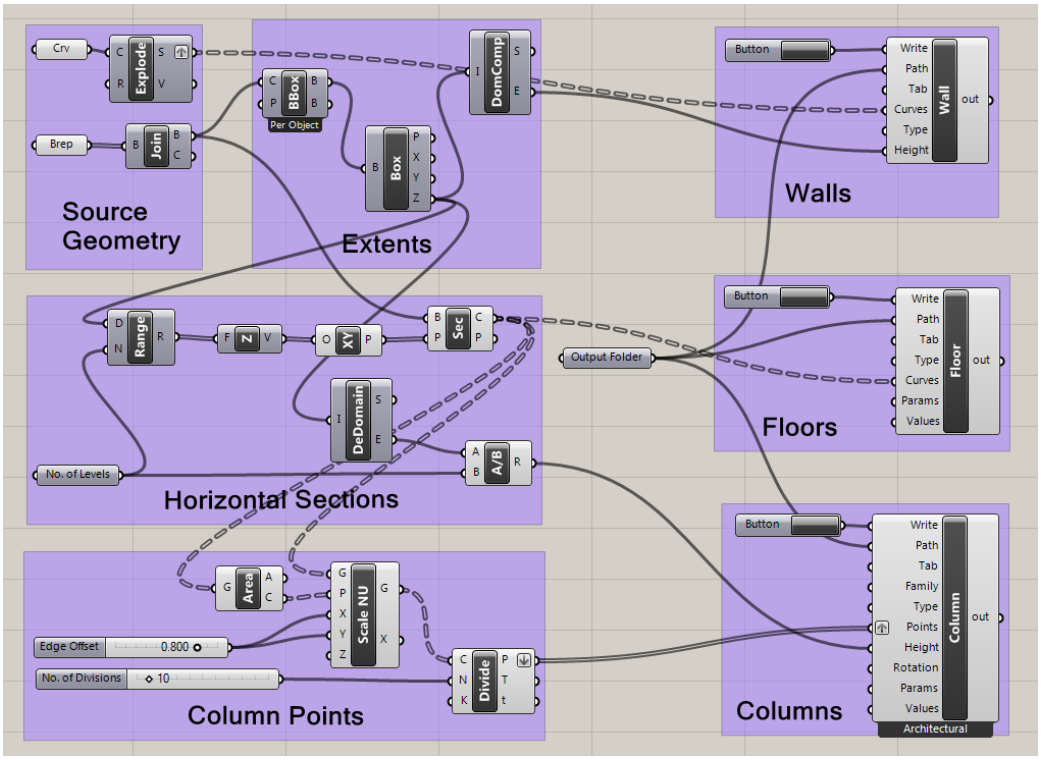
Project is named “Simple Example.3dm” and “Simple Example.gh”.

A. Geometry in Rhino

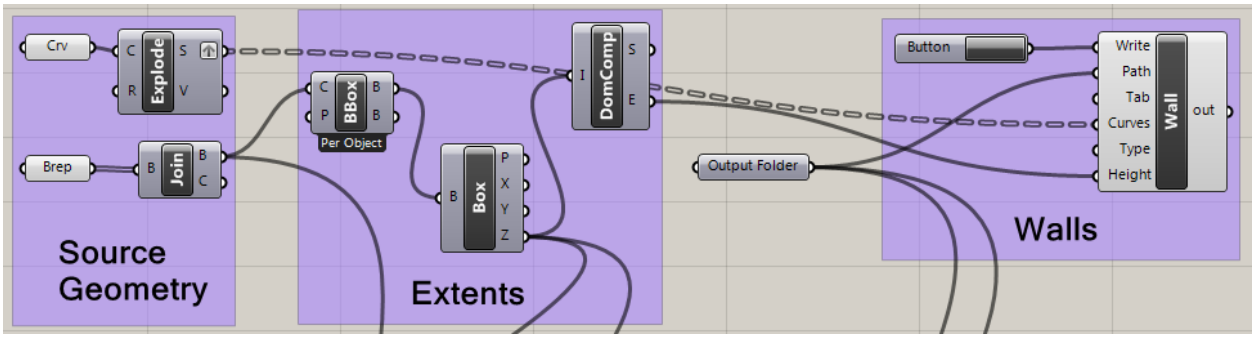


A simple rectangle and lofted surface in Rhino.

B. Processing in Grasshopper



1. Rectangle for Walls

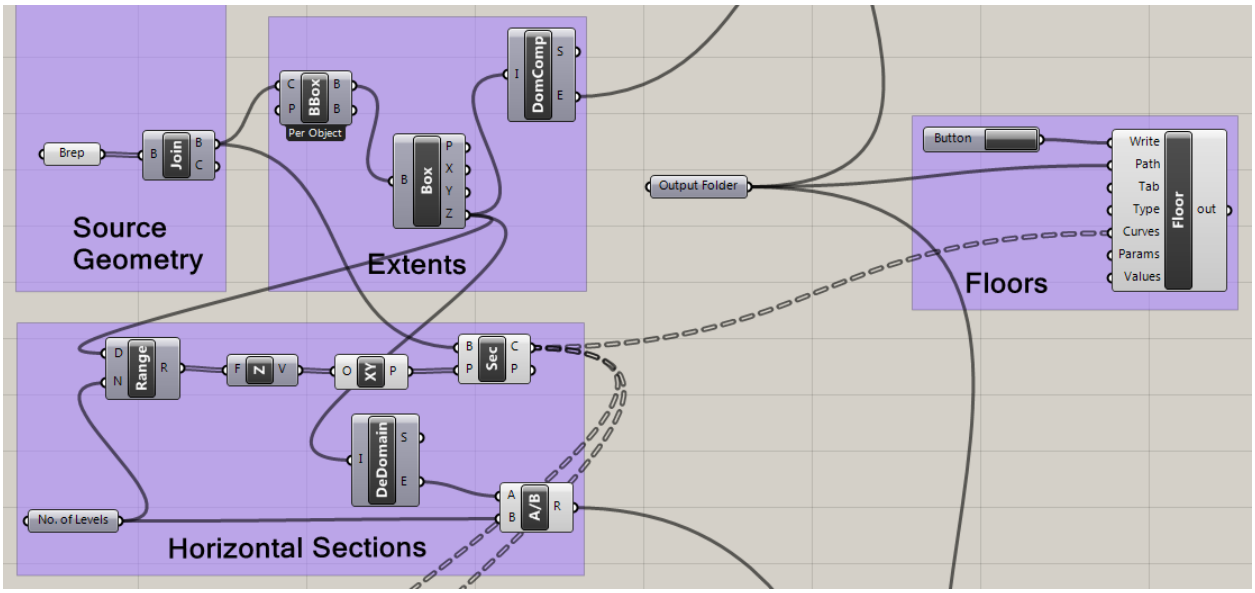


The rectangle is a *Closed Polyline Curve* in Rhino. The Explode component in Grasshopper extracts the four component lines:

The lofted surface is in two parts, which are joined by the *Join* component in Grasshopper. This geometry is used by all three output types. In the Walls case a *Bounding Box* component is used to determine their extents, which are used to set the wall height.

	A	B	C	D	E	F	G	H
1	RowId	ElementId	Action	Object	Value01	Value02	Value03	Value04
2	0		Set	WallHeight	46.2			
3	1		Add	Wall	-6.30000000, -4.60000000, 0.00000000	13.30000000, -4.60000000, 0.00000000		
4	2		Add	Wall	13.30000000, -4.60000000, 0.00000000	13.30000000, 7.70000000, 0.00000000		
5	3		Add	Wall	13.30000000, 7.70000000, 0.00000000	-6.30000000, 7.70000000, 0.00000000		
6	4		Add	Wall	-6.30000000, 7.70000000, 0.00000000	-6.30000000, -4.60000000, 0.00000000		

2. Horizontal Sections for Floors

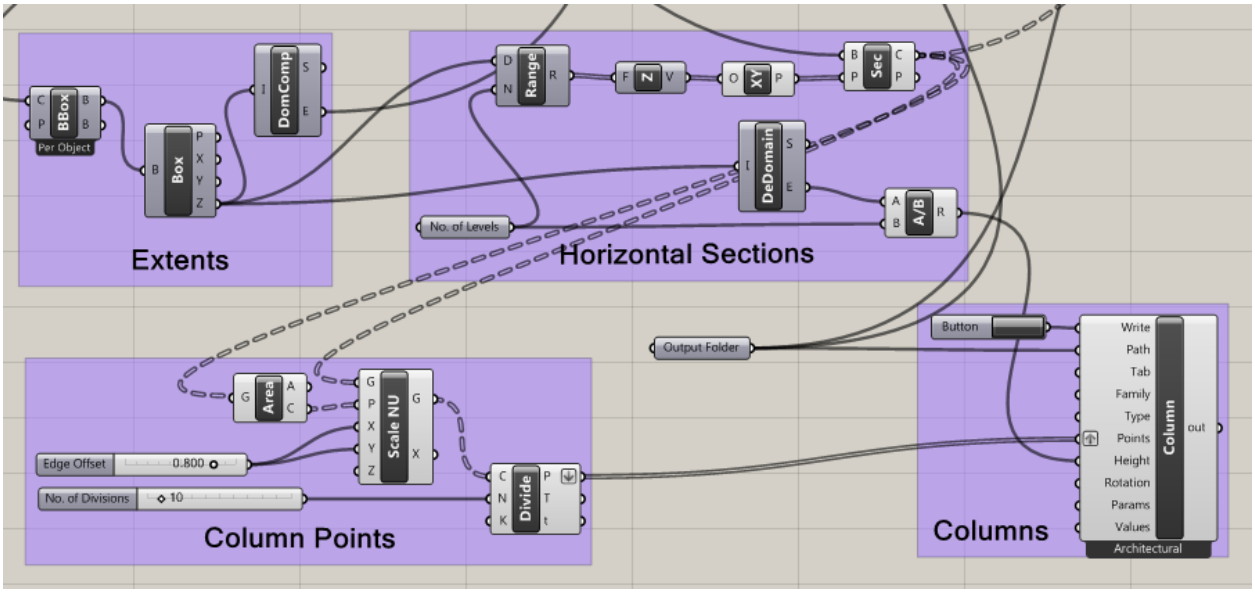


A *Section* component is used to slice the form, providing the curves for the Floors component.

Note that the number of sections is based on a range that uses the same bounding box created for the wall heights.

	A	B	C	D	E	F	G	H
1	RowId	ElementId	Action	Object	Value01	Value02	Value03	Value04
2	0		Draw	CurveArray				
3	0.1		Use	Points	1.10000000, 20.60000000, 0.00000000	5.93527203, 22.07902438, 0.00000000	17.60632427, 24.27895456, 0.00000000	26.94484028, 10.65213876, 0.00000000
4	0.2		Use	Points	29.75214683, -5.35844326, 0.00000000	19.10955328, -18.04198107, 0.00000000	2.66700992, -17.26695008, 0.00000000	-11.30197047, -10.66587638, 0.00000000
5	0.3		Use	Points	-19.66559871, -4.88719403, 0.00000000	-23.70000000, -1.80000000, 0.00000000		
6	0.4		Draw	NurbSpline				
7	0.5		Use	Points	-23.70000000, -1.80000000, 0.00000000	-22.27760480, -1.02340492, 0.00000000	-19.46341586, 0.60226159, 0.00000000	-15.41831504, 3.24562116, 0.00000000
8	0.6		Use	Points	-11.56645761, 6.11957595, 0.00000000	-7.89876269, 9.28864069, 0.00000000	-4.50636918, 12.75261802, 0.00000000	-1.48895988, 16.46478803, 0.00000000
9	0.7		Use	Points	0.29467642, 19.19612512, 0.00000000	1.10000000, 20.60000000, 0.00000000		
10	0.8		Draw	NurbSpline				
11	0.9		Add	Floor				
12	1		Draw	CurveArray				
13	1.1		Use	Points	0.30000000, 21.64000000, 9.24000000	5.11978573, 22.74958679, 9.24000000	16.43365835, 24.07265501, 9.24000000	25.87148901, 11.05512649, 9.24000000
14	1.2		Use	Points	29.21314171, -4.81286930, 9.24000000	18.53213057, -17.25831741, 9.24000000	2.30918579, -16.54126846, 9.24000000	-11.52946350, -10.11710781, 9.24000000
15	1.3		Use	Points	-19.57562508, -4.06665498, 9.24000000	-23.36000000, -0.82000000, 9.24000000		
16	1.4		Draw	NurbSpline				
17	1.5		Use	Points	-23.36000000, -0.82000000, 9.24000000	-21.94529668, -0.08854642, 9.24000000	-19.14936234, 1.46016794, 9.24000000	-15.15390851, 4.03997198, 9.24000000
18	1.6		Use	Points	-11.39009054, 6.90772543, 9.24000000	-7.86987256, 10.12759661, 9.24000000	-4.70434130, 13.66077229, 9.24000000	-1.96274188, 17.46240628, 9.24000000
19	1.7		Use	Points	-0.39705609, 20.22525827, 9.24000000	0.30000000, 21.64000000, 9.24000000		
20	1.8		Draw	NurbSpline				
21	1.9		Add	Floor				

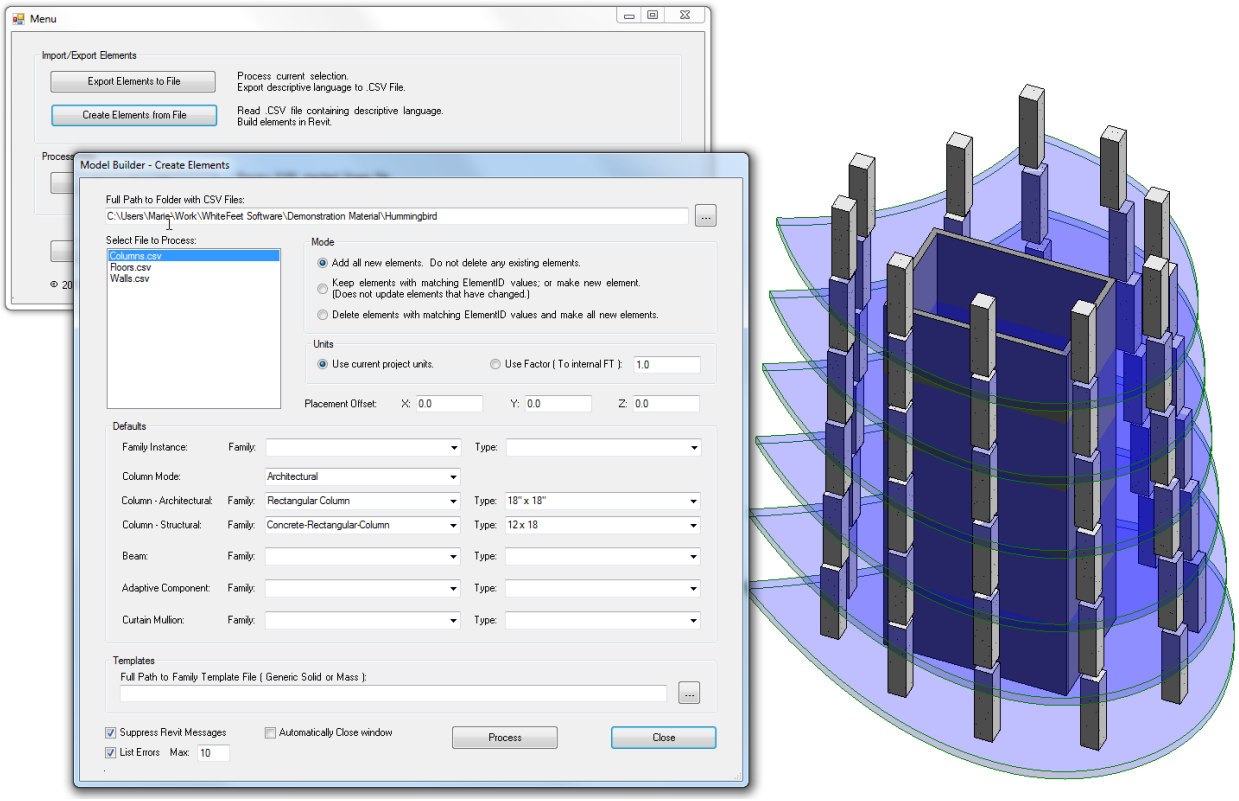
3. Horizontal Sections for Column Points



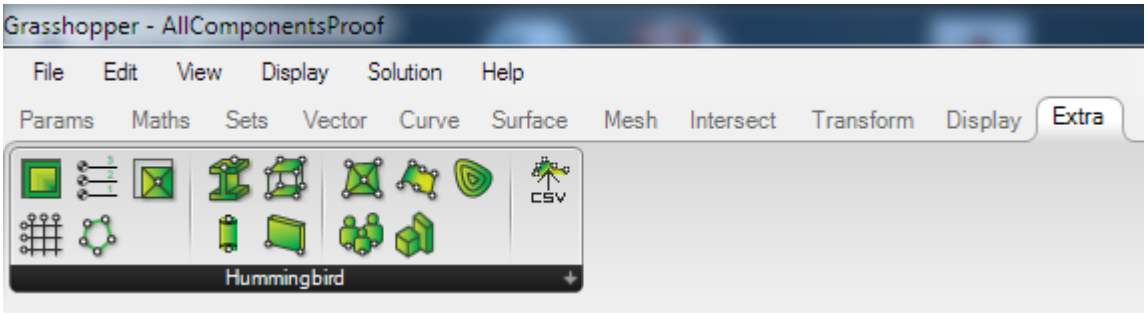
The horizontal sections are also used to generate points for the bottom and top points of the columns.

	A	B	C	D	E	F	G	H
1	RowId	ElementId	Action	Object	Value01	Value02	Value03	Value04
2	0		Set	ColumnHeight	9.24			
3	1		Add	Column	2.23743547, 16.75336754, 0.00000000			
4	2		Add	Column	13.31980872, 17.76893609, 0.00000000			
5	3		Add	Column	21.23751892, 10.26118036, 0.00000000			
6	4		Add	Column	23.82998577, -0.57974519, 0.00000000			
7	5		Add	Column	18.99236818, -10.39891804, 0.00000000			
8	6		Add	Column	8.46715919, -13.48864577, 0.00000000			
9	7		Add	Column	-2.36348482, -10.62224656, 0.00000000			
10	8		Add	Column	-12.15337488, -5.08178026, 0.00000000			
11	9		Add	Column	-13.67513037, 1.13144226, 0.00000000			
12	10		Add	Column	-4.75425853, 7.97453318, 0.00000000			
13	11		Add	Column	1.49212127, 17.69738268, 9.24000000			
14	12		Add	Column	12.46047920, 17.98080670, 9.24000000			
15	13		Add	Column	20.31128313, 10.55697326, 9.24000000			

C. Objects in Revit

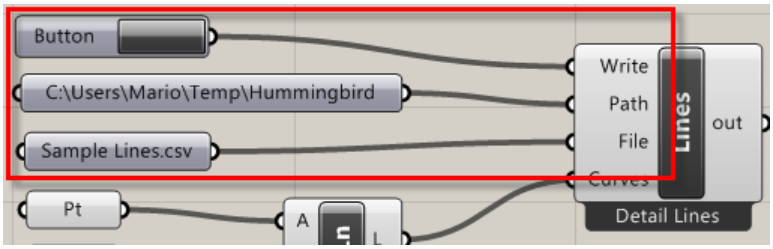


II. Grasshopper Component Reference



The Hummingbird Components are installed to the Extra Tab in Grasshopper

The Revit Creation components are used to create a .CSV file. The Input component is used to create Rhino geometry from a .CSV file. They all have the same three connectors at the top:



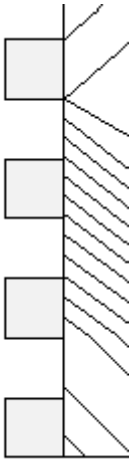
- **Write**: A binary input that is typically connected to a Toggle or a Button. When true is causes the file to be written.
- **Path**: The full path to an existing folder where the files will be written/read.
- **File**: (Optional) the name of the .CSV file to be created/read. If omitted the name of the component will be used.

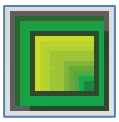
Existing .CSV files with the same name are overwritten without any warning.

Many components include inputs for **Parameter Name** and **Parameter Value**.

These are always optional. If provided, the names should be a list of existing parameter names that will be set for each instance created. The values should be a tree of values to use with the parameters. The dimensions of the tree should correspond to the number of parameters and the number of instances to be created.

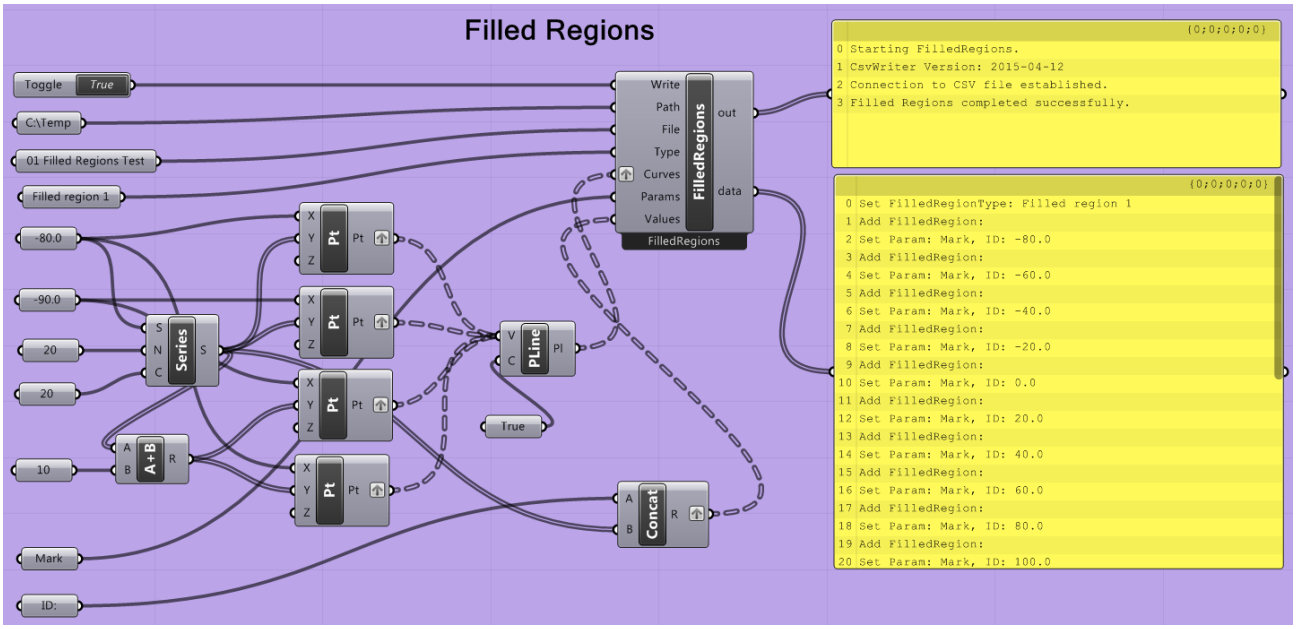
A. Basic Revit Elements



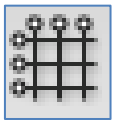


Filled Regions:

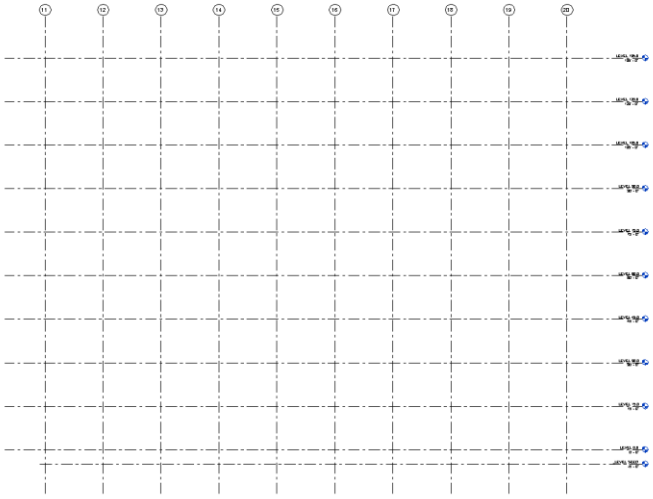
Filled regions are useful as a way of representing a bounded area in Revit. They can include holes and islands in the holes.



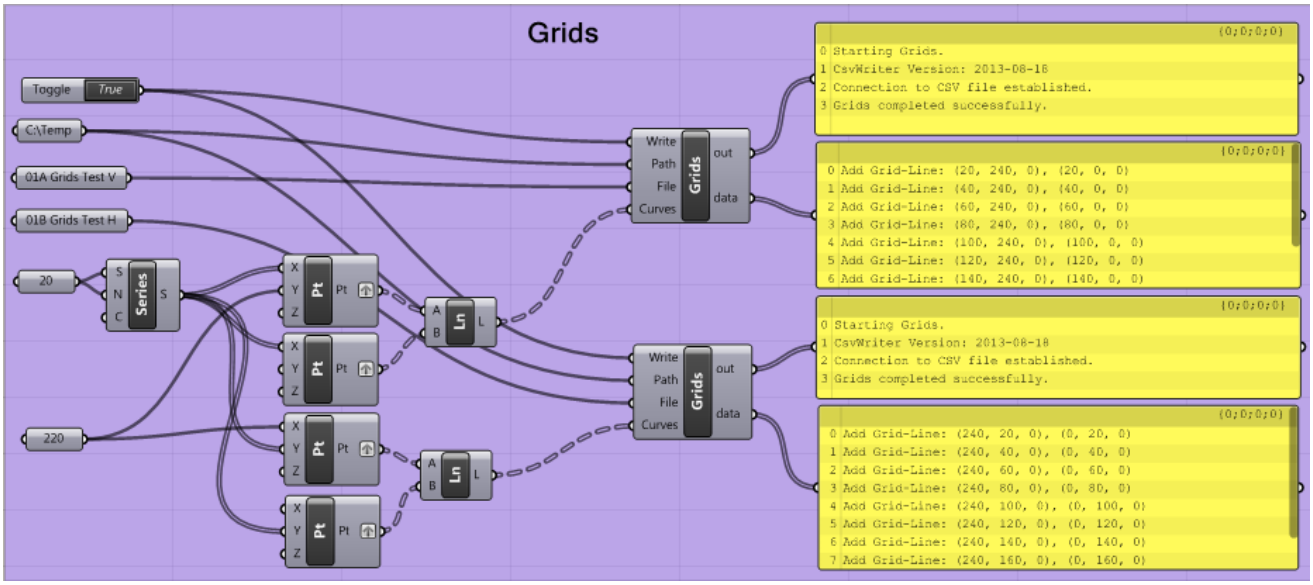
RowId	ElementId	Action	Object	Value01	Value02	Value03
0		Set	FilledRegionType	Filled region 1		
1.0		Draw	CurveArray			
1.1		Draw	Line	-80.00000000, -80.00000000, 0.00000000	-90.00000000, -80.00000000, 0.00000000	
1.2		Draw	Line	-90.00000000, -80.00000000, 0.00000000	-90.00000000, -70.00000000, 0.00000000	
1.3		Draw	Line	-90.00000000, -70.00000000, 0.00000000	-80.00000000, -70.00000000, 0.00000000	
1.4		Draw	Line	-80.00000000, -70.00000000, 0.00000000	-80.00000000, -80.00000000, 0.00000000	
1.5	69439	Add	FilledRegion			
2		Modify	ParameterSet	Mark	ID: -80.0	
3.0		Draw	CurveArray			
3.1		Draw	Line	-80.00000000, -60.00000000, 0.00000000	-90.00000000, -60.00000000, 0.00000000	
3.2		Draw	Line	-90.00000000, -60.00000000, 0.00000000	-90.00000000, -50.00000000, 0.00000000	
3.3		Draw	Line	-90.00000000, -50.00000000, 0.00000000	-80.00000000, -50.00000000, 0.00000000	
3.4		Draw	Line	-80.00000000, -50.00000000, 0.00000000	-80.00000000, -60.00000000, 0.00000000	
3.5	69448	Add	FilledRegion			



Grids:

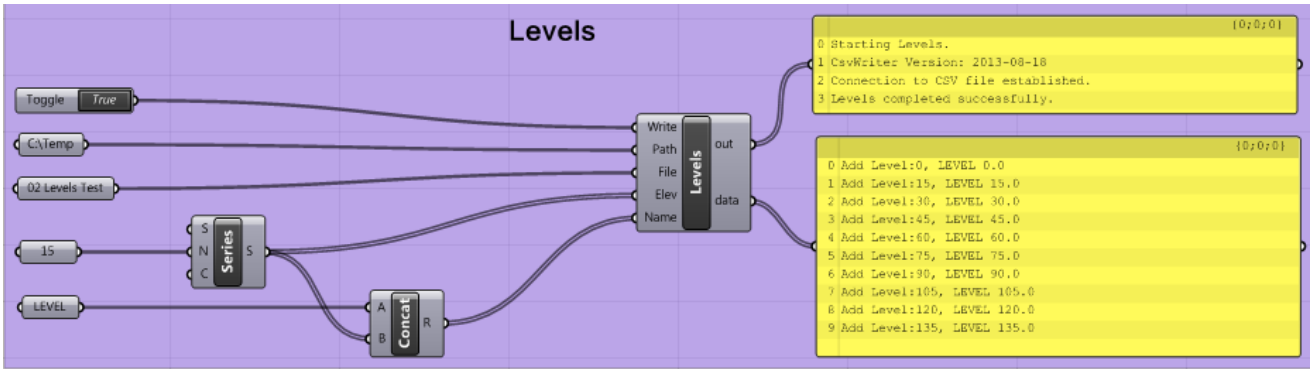


Native Revit Grids and Levels are built from Rhino data, seen in an elevation view in Revit.



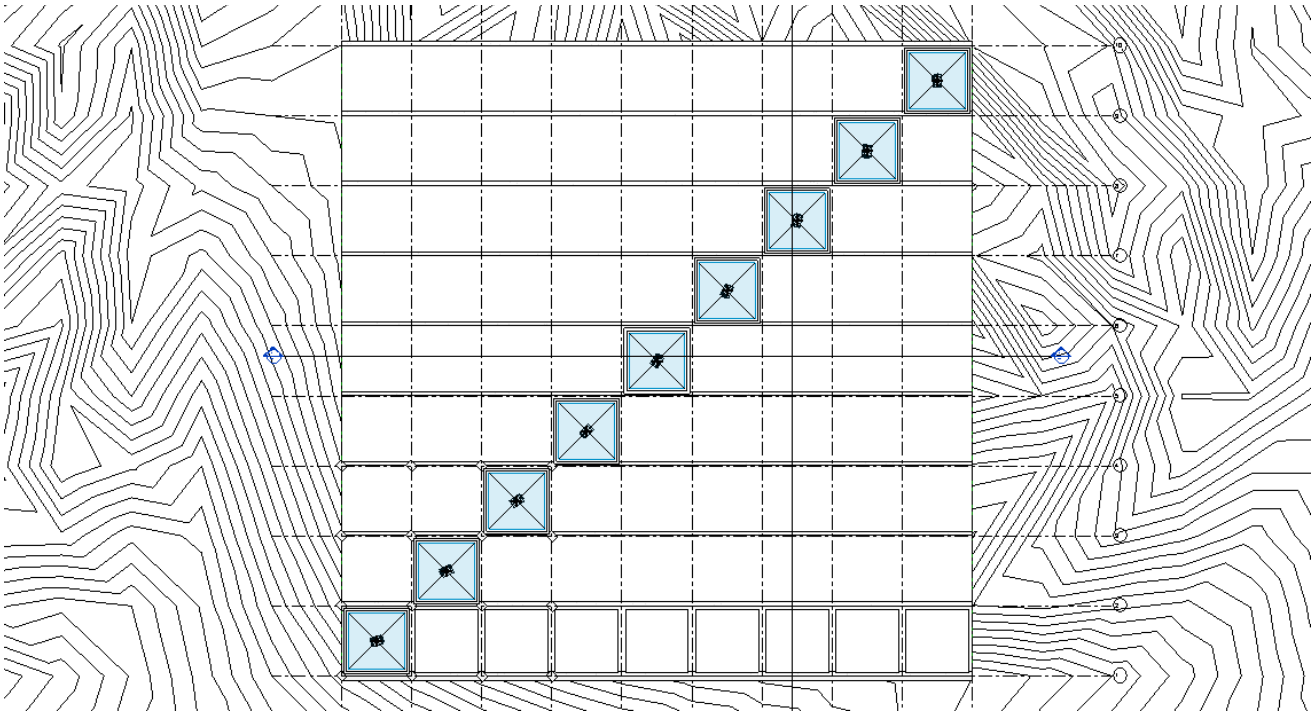
RowId	ElementId	Action	Object	Value01	Value02	Value03
0		Add	Grid	20.00000000, 240.00000000, 0.00000000	20.00000000, 0.00000000, 0.00000000	
1		Add	Grid	40.00000000, 240.00000000, 0.00000000	40.00000000, 0.00000000, 0.00000000	
2		Add	Grid	60.00000000, 240.00000000, 0.00000000	60.00000000, 0.00000000, 0.00000000	
3		Add	Grid	80.00000000, 240.00000000, 0.00000000	80.00000000, 0.00000000, 0.00000000	
4		Add	Grid	100.00000000, 240.00000000, 0.00000000	100.00000000, 0.00000000, 0.00000000	
5		Add	Grid	120.00000000, 240.00000000, 0.00000000	120.00000000, 0.00000000, 0.00000000	
6		Add	Grid	140.00000000, 240.00000000, 0.00000000	140.00000000, 0.00000000, 0.00000000	
7		Add	Grid	160.00000000, 240.00000000, 0.00000000	160.00000000, 0.00000000, 0.00000000	
8		Add	Grid	180.00000000, 240.00000000, 0.00000000	180.00000000, 0.00000000, 0.00000000	
9		Add	Grid	200.00000000, 240.00000000, 0.00000000	200.00000000, 0.00000000, 0.00000000	

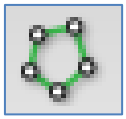
Levels:



RowId	ElementId	Action	Object	Value01	Value02	Value03
0		Add	Level	0.00000000	LEVEL 0.0	
1		Add	Level	15.00000000	LEVEL 15.0	
2		Add	Level	30.00000000	LEVEL 30.0	
3		Add	Level	45.00000000	LEVEL 45.0	
4		Add	Level	60.00000000	LEVEL 60.0	
5		Add	Level	75.00000000	LEVEL 75.0	
6		Add	Level	90.00000000	LEVEL 90.0	
7		Add	Level	105.00000000	LEVEL 105.0	
8		Add	Level	120.00000000	LEVEL 120.0	
9		Add	Level	135.00000000	LEVEL 135.0	

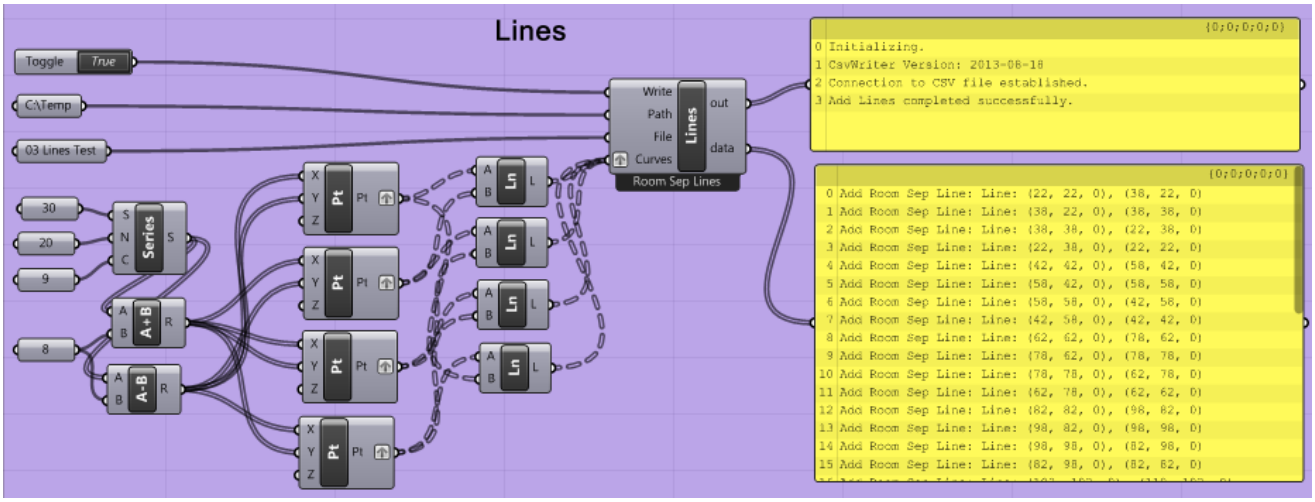
Columns, beams, floors, walls, room separation lines, rooms, and family insertions over a topography surface, all created in Revit from Rhino geometry.





Lines:

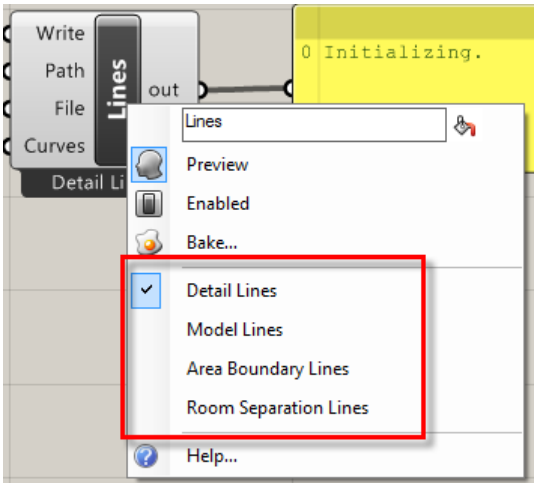
The **Lines** component processes Rhino curves into lines in Revit.

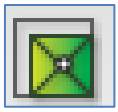


RowId	ElementId	Action	Object	Value01	Value02	Value03
0		Add	RoomSeparationLine	22.00000000, 22.00000000, 0.00000000	38.00000000, 22.00000000, 0.00000000	
1		Add	RoomSeparationLine	38.00000000, 22.00000000, 0.00000000	38.00000000, 38.00000000, 0.00000000	
2		Add	RoomSeparationLine	38.00000000, 38.00000000, 0.00000000	22.00000000, 38.00000000, 0.00000000	
3		Add	RoomSeparationLine	22.00000000, 38.00000000, 0.00000000	22.00000000, 22.00000000, 0.00000000	
4		Add	RoomSeparationLine	42.00000000, 42.00000000, 0.00000000	58.00000000, 42.00000000, 0.00000000	
5		Add	RoomSeparationLine	58.00000000, 42.00000000, 0.00000000	58.00000000, 58.00000000, 0.00000000	
6		Add	RoomSeparationLine	58.00000000, 58.00000000, 0.00000000	42.00000000, 58.00000000, 0.00000000	
7		Add	RoomSeparationLine	42.00000000, 58.00000000, 0.00000000	42.00000000, 42.00000000, 0.00000000	

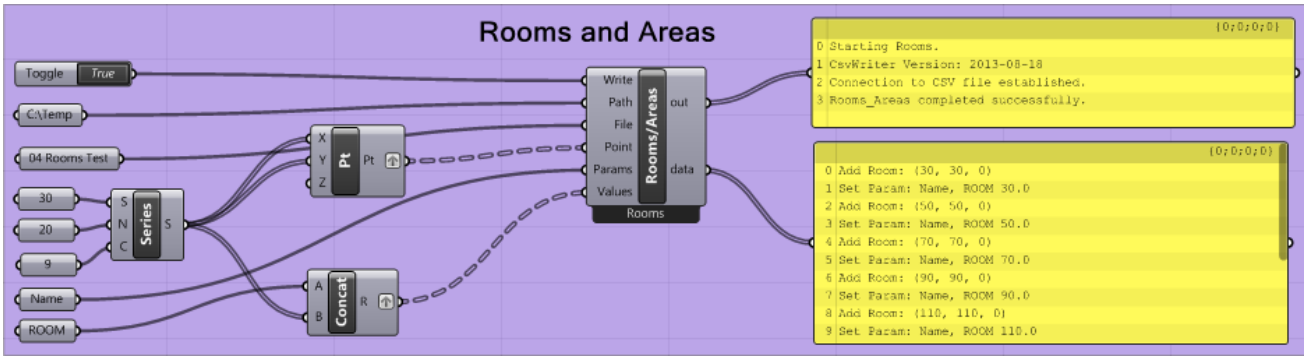
The Curves connection accepts a list of Rhino curves.

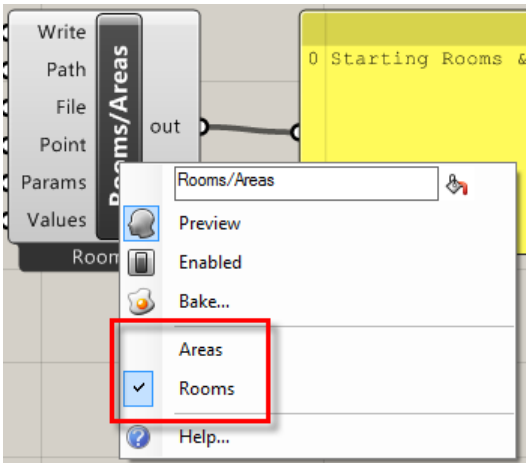
The component can create four different kinds of Revit lines: **Detail Lines**, **Model Lines**, **Area Boundary Lines**, and **Room Separation Lines**. By right-clicking on the component the output can be switched between these.

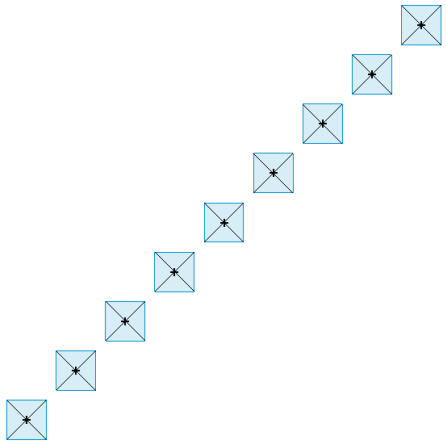




Rooms and Areas:



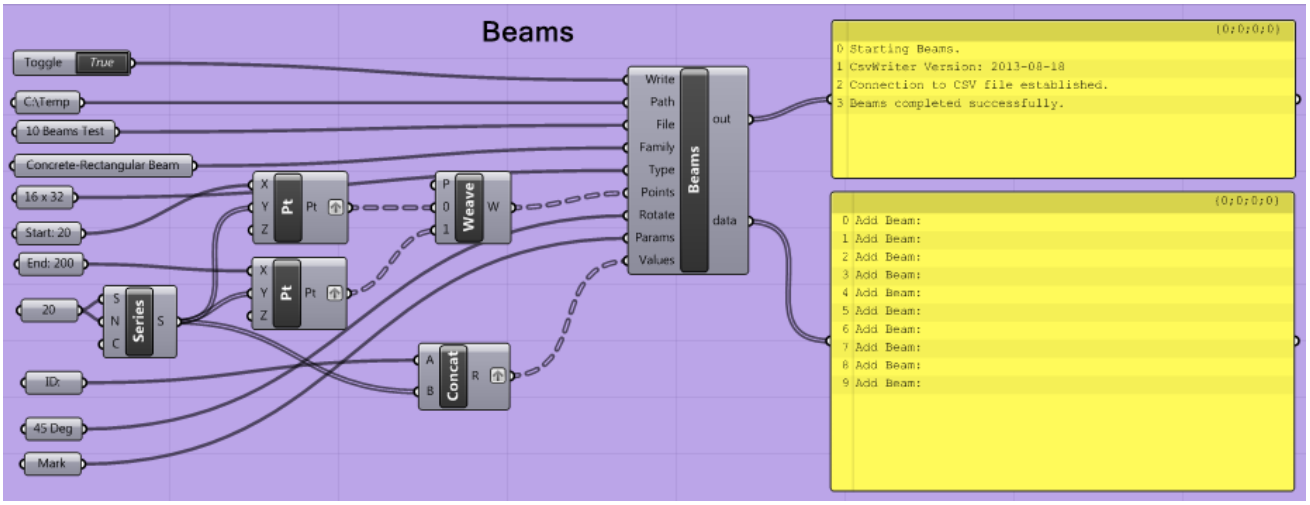




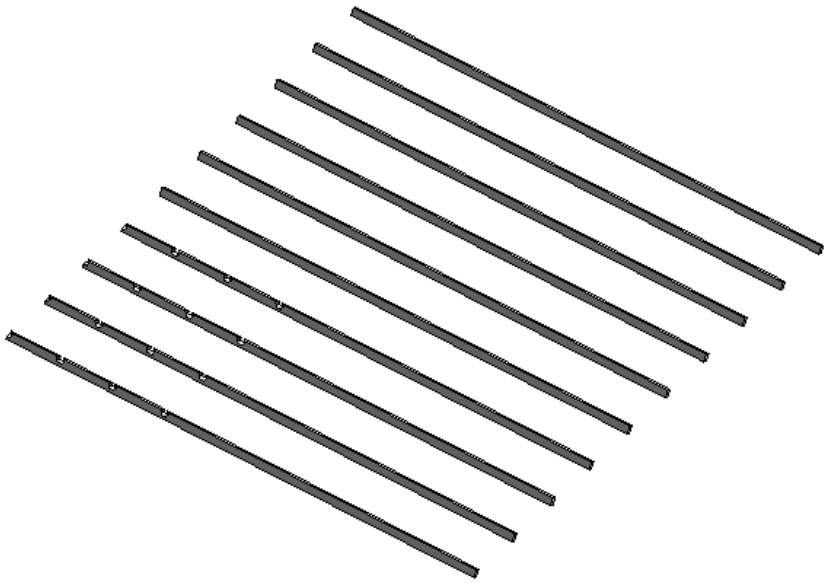
RowId	ElementId	Action	Object	Value01	Value02	Value03
0		Add	Room	30.00000000, 30.00000000, 0.00000000		
1		Modify	ParameterSet	Name	ROOM 30.0	
2		Add	Room	50.00000000, 50.00000000, 0.00000000		
3		Modify	ParameterSet	Name	ROOM 50.0	
4		Add	Room	70.00000000, 70.00000000, 0.00000000		
5		Modify	ParameterSet	Name	ROOM 70.0	
6		Add	Room	90.00000000, 90.00000000, 0.00000000		
7		Modify	ParameterSet	Name	ROOM 90.0	

B. Simple Revit Forms

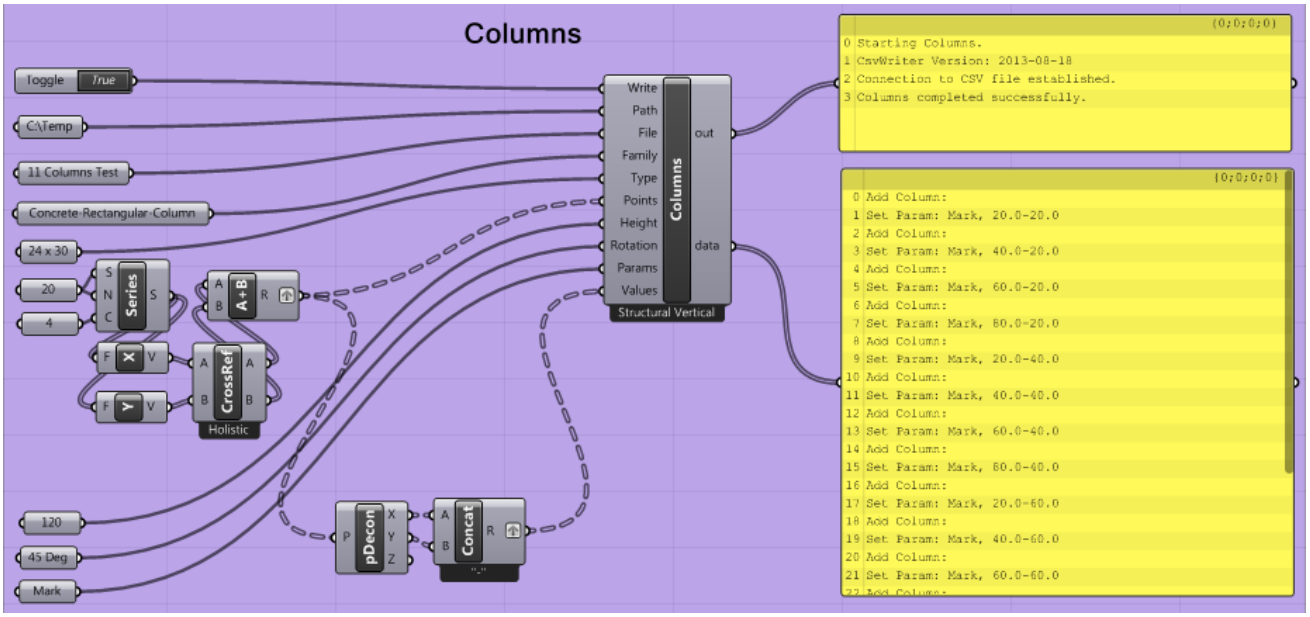
Beams:

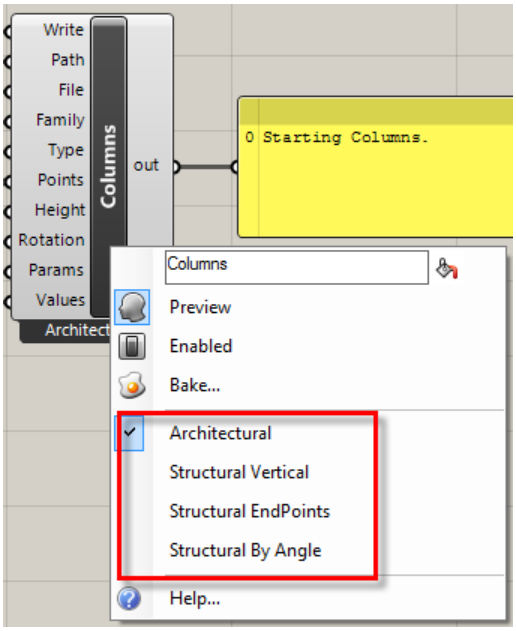


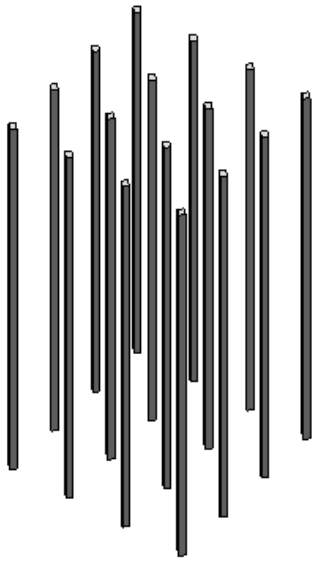
RowId	ElementId	Action	Object	Value01	Value02	Value03
0		Set	BeamType	Concrete-Rectangular Beam	16 x 32	
1		Set	BeamRotation	45.00000000		
2		Add	Beam	20.00000000, 20.00000000, 0.00000000	200.00000000, 20.00000000, 0.00000000	
3		Modify	ParameterSet	Mark	ID: 20.0	
4		Add	Beam	20.00000000, 40.00000000, 0.00000000	200.00000000, 40.00000000, 0.00000000	
5		Modify	ParameterSet	Mark	ID: 40.0	
6		Add	Beam	20.00000000, 60.00000000, 0.00000000	200.00000000, 60.00000000, 0.00000000	
7		Modify	ParameterSet	Mark	ID: 60.0	



Columns:

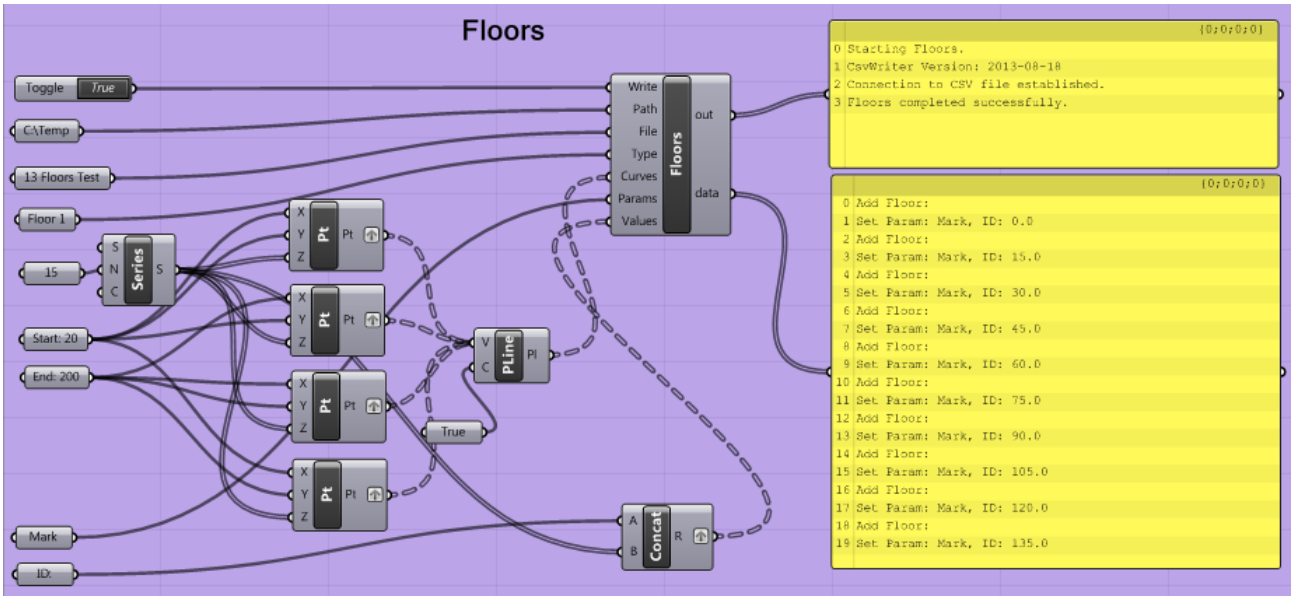




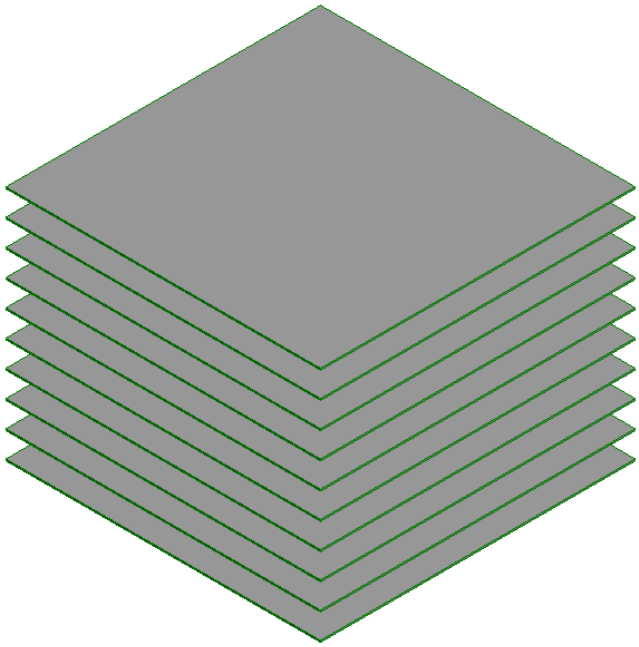


RowId	ElementId	Action	Object	Value01	Value02	Value03
0		Set	ColumnMode	StructuralVertical	Concrete-Rectangular-Column	24 x 30
1		Set	ColumnRotation	45.00000000		
2		Set	ColumnHeight	120.00000000		
3		Add	Column	20.00000000, 20.00000000, 0.00000000		
4		Modify	ParameterSet	Mark	20.0-20.0	
5		Add	Column	40.00000000, 20.00000000, 0.00000000		
6		Modify	ParameterSet	Mark	40.0-20.0	

Floors:

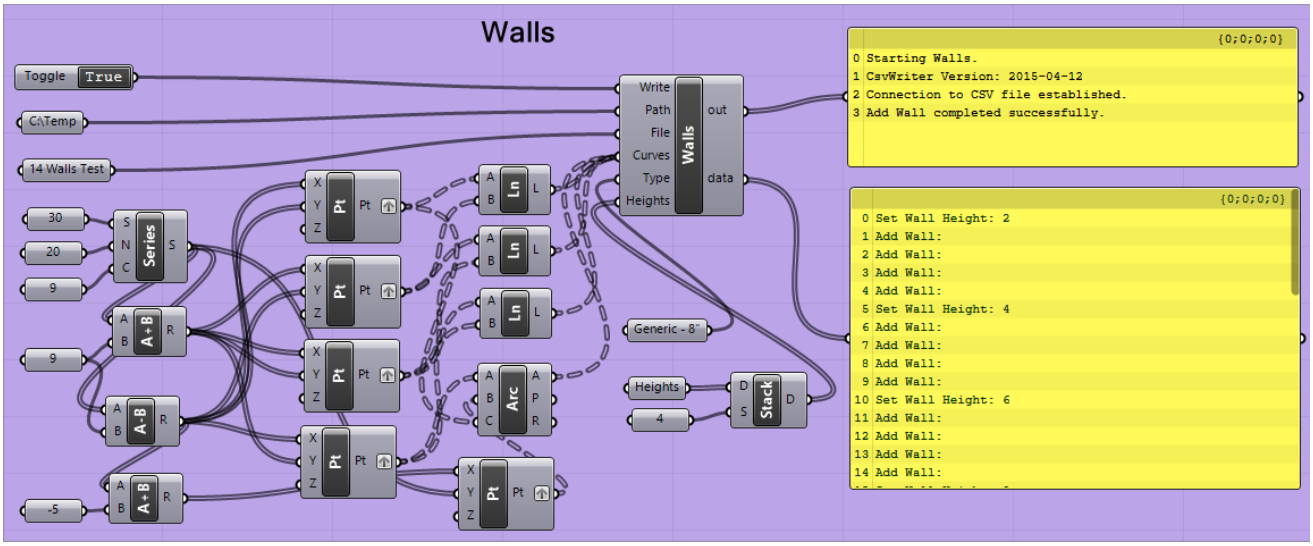


RowId	ElementId	Action	Object	Value01	Value02	Value03
0		Set	FloorType	Floor 1		
1.0		Draw	CurveArray			
1.1		Draw	Line	20.00000000, 20.00000000, 0.00000000	200.00000000, 20.00000000, 0.00000000	
1.2		Draw	Line	200.00000000, 20.00000000, 0.00000000	200.00000000, 200.00000000, 0.00000000	
1.3		Draw	Line	200.00000000, 200.00000000, 0.00000000	20.00000000, 200.00000000, 0.00000000	
1.4		Draw	Line	20.00000000, 200.00000000, 0.00000000	20.00000000, 20.00000000, 0.00000000	
1.5		Add	Floor			

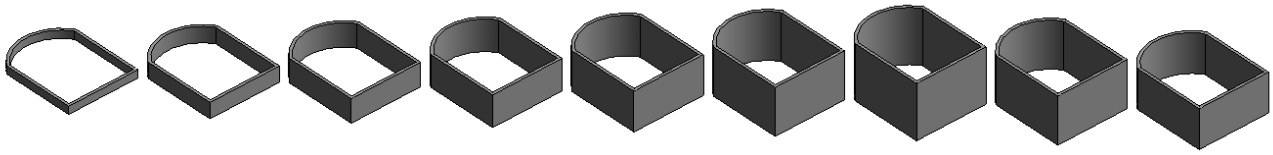


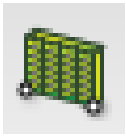
Walls:

The **Heights** value may be a single value or a list of varying wall heights.



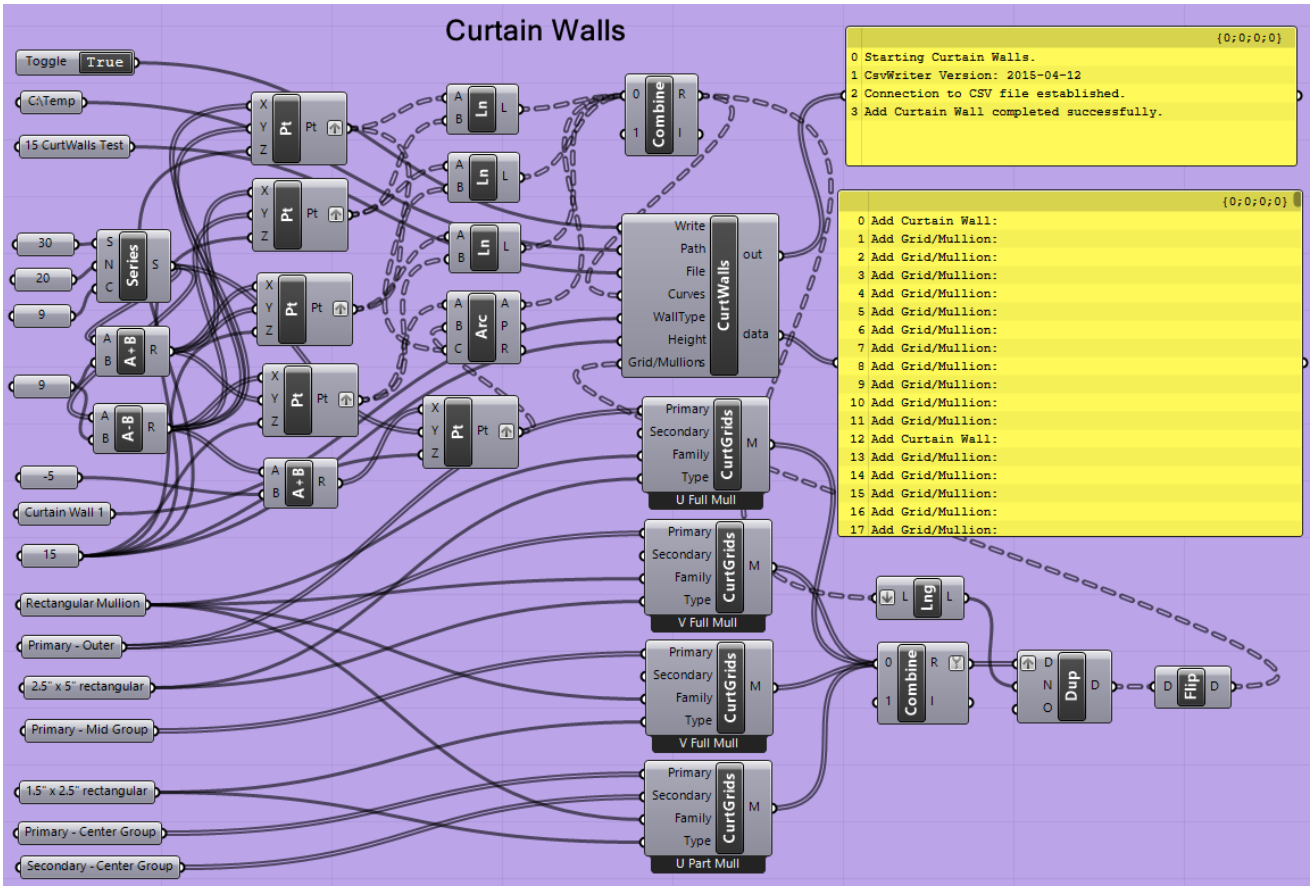
RowId	ElementId	Action	Object	Value01	Value02	Value03
0		Set	WallType	Generic - 8"		
1		Set	WallHeight	2		
2		Add	Wall	21.00000000, 21.00000000, 0.00000000	39.00000000, 21.00000000, 0.00000000	
3		Add	Wall	39.00000000, 21.00000000, 0.00000000	39.00000000, 39.00000000, 0.00000000	
4		Add	Wall	39.00000000, 39.00000000, 0.00000000	21.00000000, 39.00000000, 0.00000000	
5		Add	Wall	21.00000000, 39.00000000, 0.00000000	21.00000000, 21.00000000, 0.00000000	16.00000000, 30.00000000, 0.00000000
6		Set	WallHeight	4		
7		Add	Wall	41.00000000, 41.00000000, 0.00000000	59.00000000, 41.00000000, 0.00000000	
8		Add	Wall	59.00000000, 41.00000000, 0.00000000	59.00000000, 59.00000000, 0.00000000	
9		Add	Wall	59.00000000, 59.00000000, 0.00000000	41.00000000, 59.00000000, 0.00000000	
10		Add	Wall	41.00000000, 59.00000000, 0.00000000	41.00000000, 41.00000000, 0.00000000	36.00000000, 50.00000000, 0.00000000



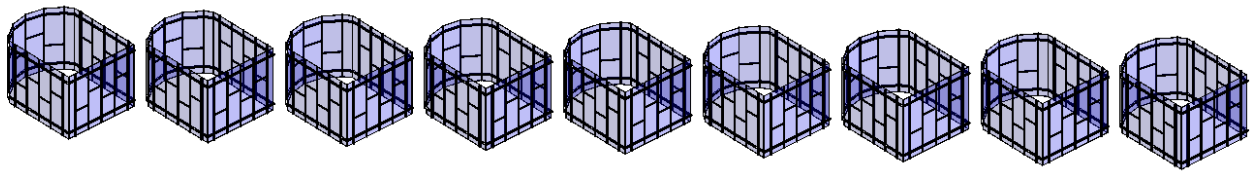


Curtain Walls:

The mullions are optional. Grids without a mullion may also be used. It is not possible to add a mullion to the perimeter.



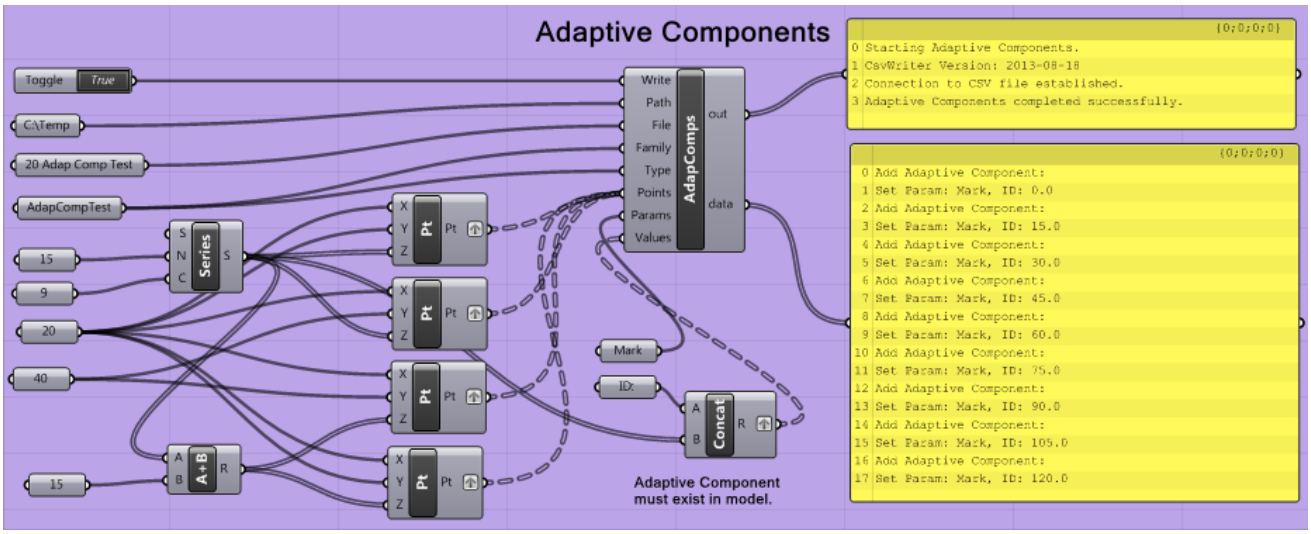
RowId	ElementIc	Action	Object	Value01	Value02	Value03
0		Set	WallType	Curtain Wall 1		
1		Set	WallHeight	15		
2	79754	Add	Wall	21.00000000, 21.00000000, 15.00000000	39.00000000, 21.00000000, 15.00000000	
3		Set	MullionType	Rectangular Mullion	2.5" x 5" rectangular	
4		Modify	MullionUAdd	0.1		
5		Modify	MullionUAdd	0.9		
6		Modify	MullionVAdd	0.1		
7		Modify	MullionVAdd	0.9		
8		Set	MullionType	Rectangular Mullion	1.5" x 2.5" rectangular	
9		Modify	MullionVAdd	0.3		
10		Modify	MullionVAdd	0.5		
11		Modify	MullionVAdd	0.7		
12		Modify	MullionUAdd	0.4	0.2	
13		Modify	MullionUAdd	0.6	0.4	
14		Modify	MullionUAdd	0.4	0.6	
15		Modify	MullionUAdd	0.6	0.8	
16	79978	Add	Wall	39.00000000, 21.00000000, 15.00000000	39.00000000, 39.00000000, 15.00000000	
17		Set	MullionType	Rectangular Mullion	2.5" x 5" rectangular	
18		Modify	MullionUAdd	0.1		
19		Modify	MullionUAdd	0.9		
20		Modify	MullionVAdd	0.1		
21		Modify	MullionVAdd	0.9		
22		Set	MullionType	Rectangular Mullion	1.5" x 2.5" rectangular	
23		Modify	MullionVAdd	0.3		
24		Modify	MullionVAdd	0.5		
25		Modify	MullionVAdd	0.7		
26		Modify	MullionUAdd	0.4	0.2	
27		Modify	MullionUAdd	0.6	0.4	
28		Modify	MullionUAdd	0.4	0.6	
29		Modify	MullionUAdd	0.6	0.8	
30	80181	Add	Wall	39.00000000, 39.00000000, 15.00000000	21.00000000, 39.00000000, 15.00000000	
31		Set	MullionType	Rectangular Mullion	2.5" x 5" rectangular	
32		Modify	MullionUAdd	0.1		
33		Modify	MullionUAdd	0.9		
34		Modify	MullionVAdd	0.1		
35		Modify	MullionVAdd	0.9		
36		Set	MullionType	Rectangular Mullion	1.5" x 2.5" rectangular	
37		Modify	MullionVAdd	0.3		
38		Modify	MullionVAdd	0.5		
39		Modify	MullionVAdd	0.7		
40		Modify	MullionUAdd	0.4	0.2	
41		Modify	MullionUAdd	0.6	0.4	
42		Modify	MullionUAdd	0.4	0.6	
43		Modify	MullionUAdd	0.6	0.8	
44	80382	Add	Wall	21.00000000, 39.00000000, 15.00000000	21.00000000, 21.00000000, 15.00000000	16.00000000, 30.00000000, 15.00000000



C. Complex Revit Forms

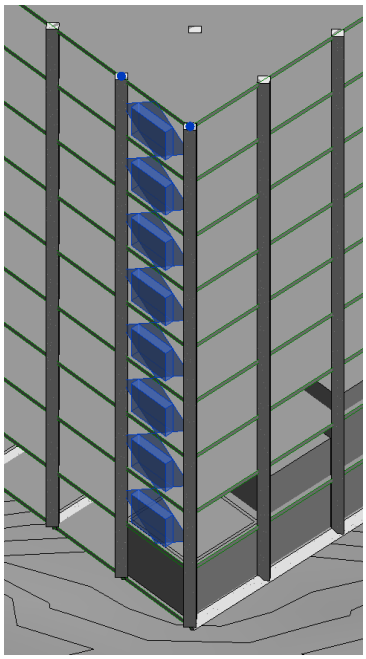
Adaptive Components:

The **AdapComps** component is used to place an existing adaptive component in Revit and adjust its control points. The correct number of control points must match between the Grasshopper output and the Revit family, and the points must be in the correct order.

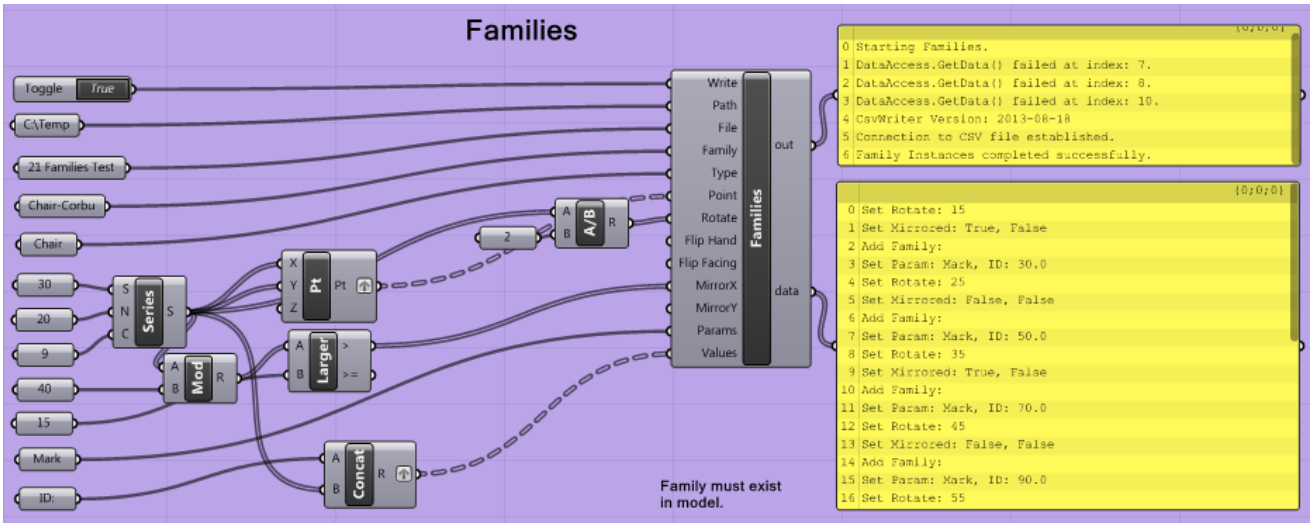


Action	Object	Value01	Value02	Value03	Value04
Set	AdaptiveComponentType	AdapCompTest	AdapCompTest		
Add	AdaptiveComponent	20.00000000, 20.00000000, 0.00000000	20.00000000, 40.00000000, 0.00000000	20.00000000, 40.00000000, 15.00000000	20.00000000, 20
Modify	ParameterSet	Mark	ID: 0.0		
Add	AdaptiveComponent	20.00000000, 20.00000000, 15.00000000	20.00000000, 40.00000000, 15.00000000	20.00000000, 40.00000000, 30.00000000	20.00000000, 20
Modify	ParameterSet	Mark	ID: 15.0		
Add	AdaptiveComponent	20.00000000, 20.00000000, 30.00000000	20.00000000, 40.00000000, 30.00000000	20.00000000, 40.00000000, 45.00000000	20.00000000, 20
Modify	ParameterSet	Mark	ID: 30.0		

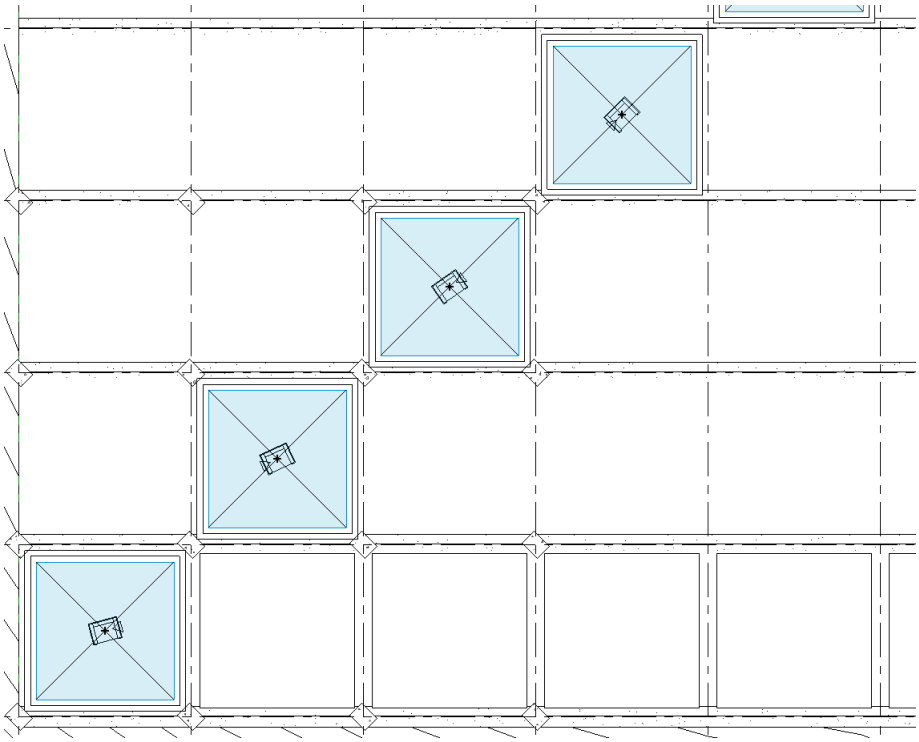
The **Family** and **Type** values are optional. If they are provided, they will be specified in the .CSV file. If not, they will be inferred from the default setting in the ModelBuilder addin in Revit. In either case, the family and type must already exist.

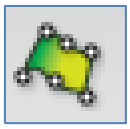


Families:

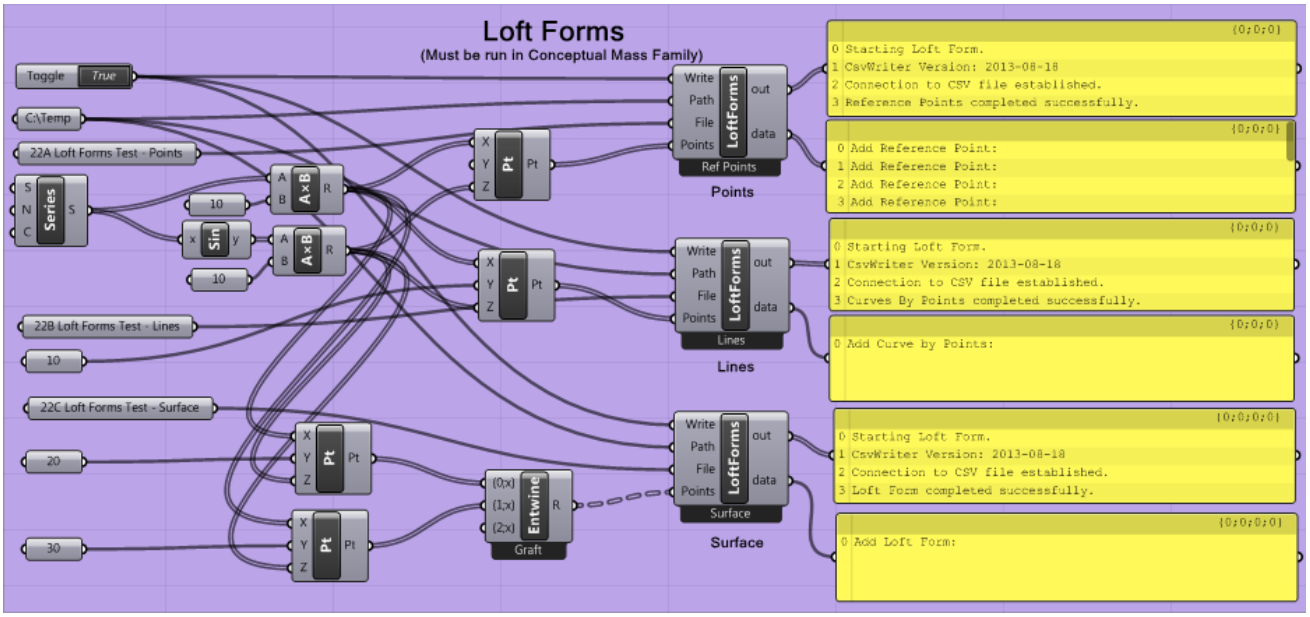


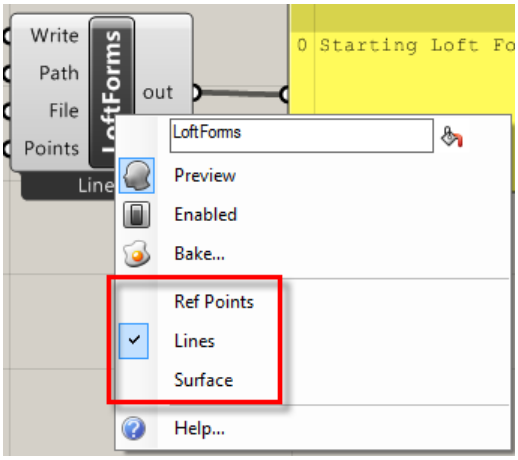
RowId	ElementId	Action	Object	Value01	Value02	Value03
0		Set	FamilyType	Chair-Corbu	Chair	
1		Set	FamilyRotation	15		
2		Set	FamilyMirrored	True	False	
3	69012	Add	FamilyInstance	30.00000000, 30.00000000, 0.00000000		
4		Modify	ParameterSet	Mark	ID: 30.0	
5		Set	FamilyRotation	25		
6		Set	FamilyMirrored	False	False	
7	69014	Add	FamilyInstance	50.00000000, 50.00000000, 0.00000000		
8		Modify	ParameterSet	Mark	ID: 50.0	





Loft Forms:

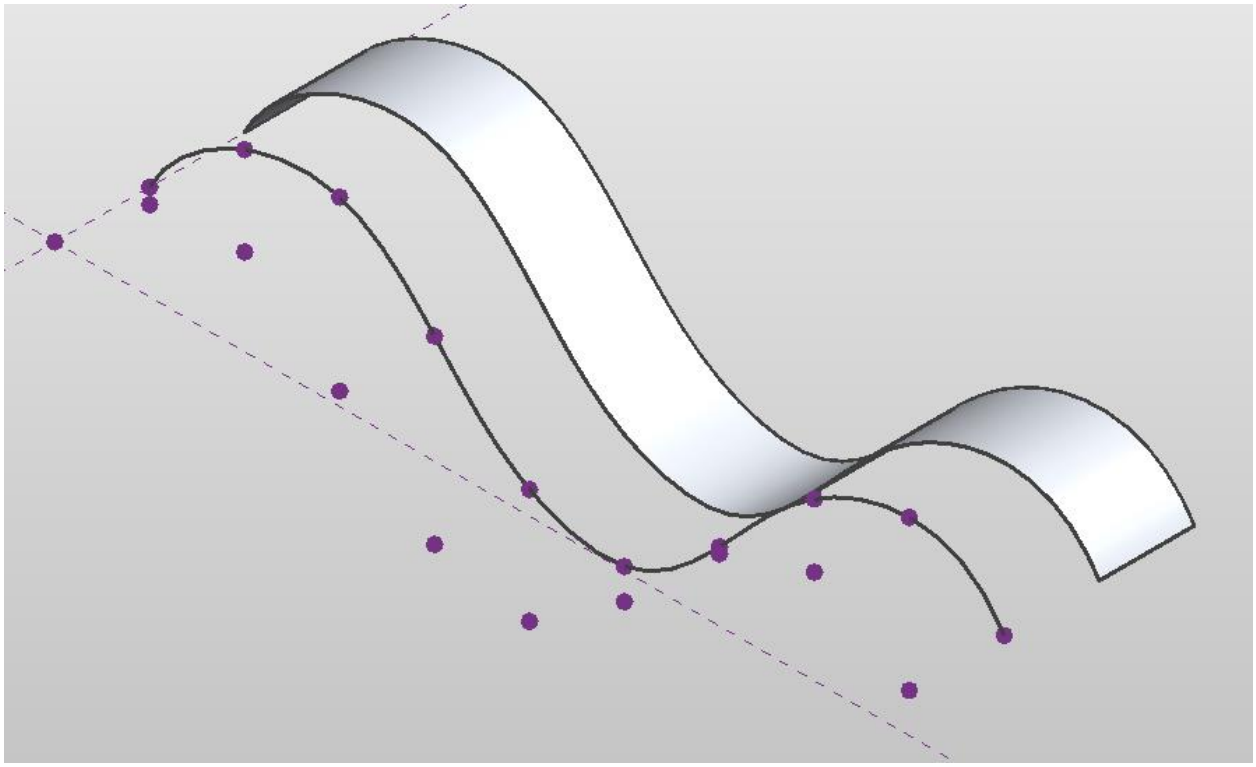




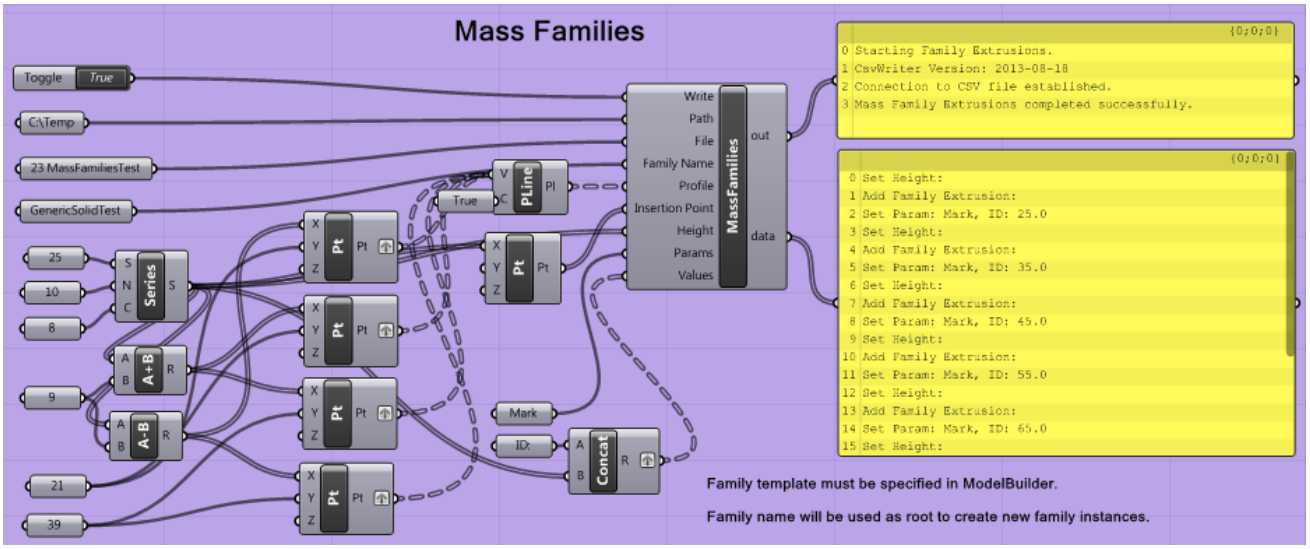
Action	Object	Value01	Value02	Value03	Value04
Add	ReferencePoint	0.00000000, 0.00000000, 0.00000000			
Add	ReferencePoint	10.00000000, 0.00000000, 8.41470985			
Add	ReferencePoint	20.00000000, 0.00000000, 9.09297427			
Add	ReferencePoint	30.00000000, 0.00000000, 1.41120008			
Add	ReferencePoint	40.00000000, 0.00000000, -7.56802495			
Add	ReferencePoint	50.00000000, 0.00000000, -9.58924275			
Add	ReferencePoint	60.00000000, 0.00000000, -2.79415498			
Add	ReferencePoint	70.00000000, 0.00000000, 6.56986599			

Action	Object	Value01	Value02	Value03	Value04
Use	Points	0.00000000, 10.00000000, 0.00000000	10.00000000, 10.00000000, 8.41470985	20.00000000, 10.00000000, 9.09297427	30.00000000, 10.0000000
Use	Points	40.00000000, 10.00000000, -7.56802495	50.00000000, 10.00000000, -9.58924275	60.00000000, 10.00000000, -2.79415498	70.00000000, 10.0000000
Use	Points	80.00000000, 10.00000000, 9.89358247	90.00000000, 10.00000000, 4.12118485		
Add	CurveByPoints				

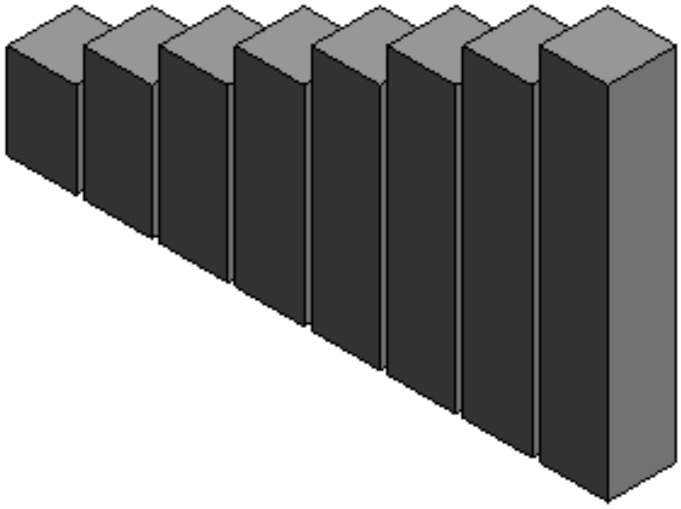
Action	Object	Value01	Value02	Value03	Value04
Model	ReferenceArray				
Use	Points	0.00000000, 20.00000000, 0.00000000	10.00000000, 20.00000000, 8.41470985	20.00000000, 20.00000000, 9.09297427	30.00000000, 20.000000
Use	Points	40.00000000, 20.00000000, -7.56802495	50.00000000, 20.00000000, -9.58924275	60.00000000, 20.00000000, -2.79415498	70.00000000, 20.000000
Use	Points	80.00000000, 20.00000000, 9.89358247	90.00000000, 20.00000000, 4.12118485		
Model	ReferenceArray				
Use	Points	0.00000000, 30.00000000, 0.00000000	10.00000000, 30.00000000, 8.41470985	20.00000000, 30.00000000, 9.09297427	30.00000000, 30.000000
Use	Points	40.00000000, 30.00000000, -7.56802495	50.00000000, 30.00000000, -9.58924275	60.00000000, 30.00000000, -2.79415498	70.00000000, 30.000000
Use	Points	80.00000000, 30.00000000, 9.89358247	90.00000000, 30.00000000, 4.12118485		
Add	LoftForm				



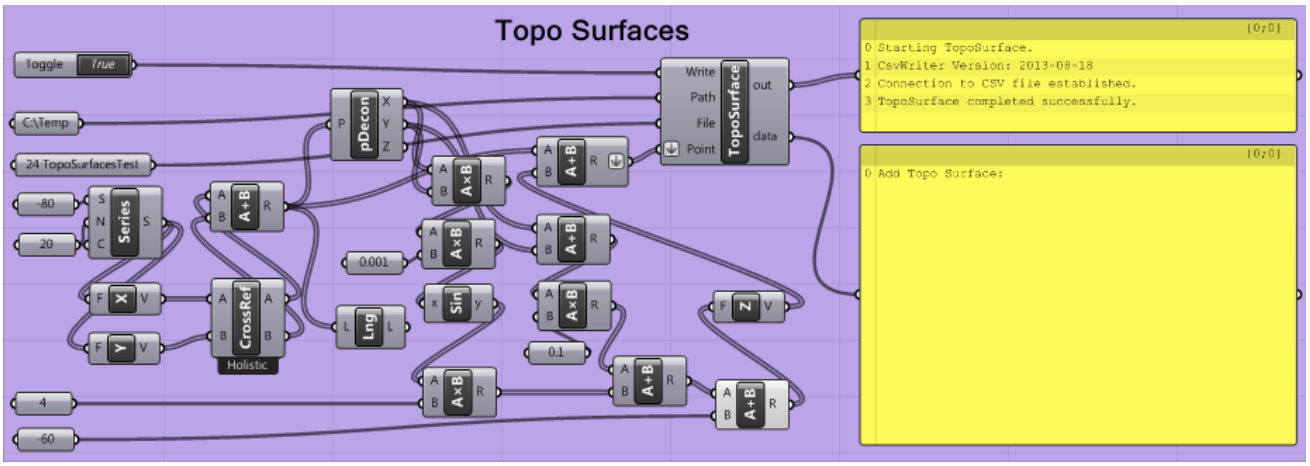
Mass Families:



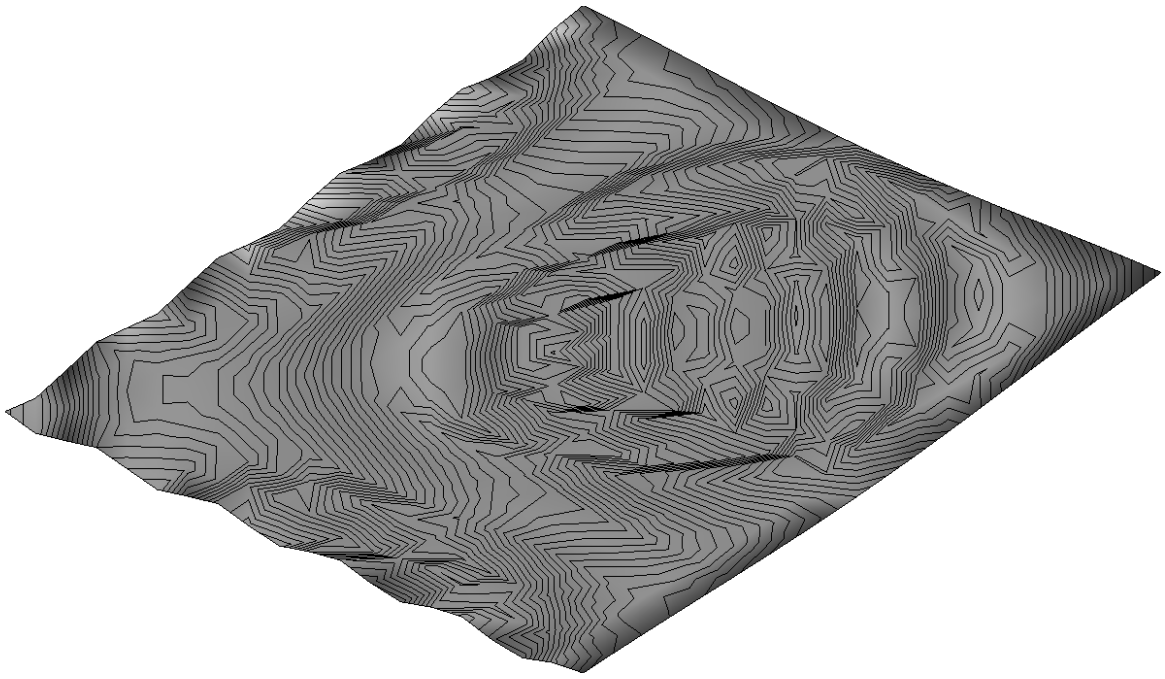
RowId	ElementId	Action	Object	Value01	Value02	Value03
0		Set	FamilyExtrusionHeight	25.00000000		
1.0		Draw	CurveArray			
1.1		Draw	Line	16.00000000, 21.00000000, 0.00000000	34.00000000, 21.00000000, 0.00000000	
1.2		Draw	Line	34.00000000, 21.00000000, 0.00000000	34.00000000, 39.00000000, 0.00000000	
1.3		Draw	Line	34.00000000, 39.00000000, 0.00000000	16.00000000, 39.00000000, 0.00000000	
1.4		Draw	Line	16.00000000, 39.00000000, 0.00000000	16.00000000, 21.00000000, 0.00000000	
1.5		Add	FamilyExtrusion	GenericSolidTest	25.00000000, 0.00000000, 0.00000000	
2		Modify	ParameterSet	Mark	ID: 25.0	



Topographic Surfaces:



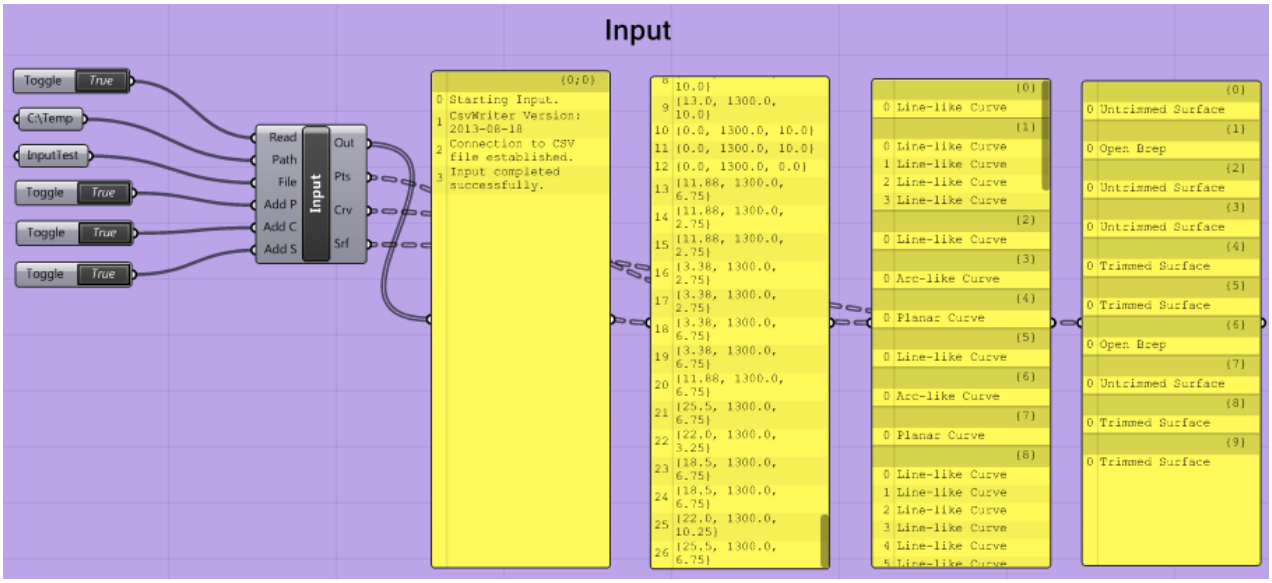
Action	Object	Value01	Value02	Value03	Value04
Use	Points	-80.00000000, -80.00000000, -75.53380318	-60.00000000, -80.00000000, -77.98465844	-40.00000000, -80.00000000, -72.23349657	-20.00000000, -80.0000000
Use	Points	0.00000000, -80.00000000, -68.00000000	20.00000000, -80.00000000, -69.99829441	40.00000000, -80.00000000, -63.76650343	60.00000000, -80.0000000
Use	Points	80.00000000, -80.00000000, -60.46619682	100.00000000, -80.00000000, -61.95743299	120.00000000, -80.00000000, -55.30269288	140.00000000, -80.000000
Use	Points	160.00000000, -80.00000000, -52.92603930	180.00000000, -80.00000000, -53.86263111	200.00000000, -80.00000000, -46.84838673	220.00000000, -80.000000
Use	Points	240.00000000, -80.00000000, -45.37325972	260.00000000, -80.00000000, -45.71518094	280.00000000, -80.00000000, -38.40977727	300.00000000, -80.000000
Use	Points	-80.00000000, 300.00000000, -34.37768655	-60.00000000, 300.00000000, -32.99605101	-40.00000000, 300.00000000, -31.85370833	-20.00000000, 300.0000000
Use	Points	0.00000000, 300.00000000, -30.00000000	20.00000000, 300.00000000, -29.11766199	40.00000000, 300.00000000, -28.14629167	60.00000000, 300.0000000
Use	Points	80.00000000, 300.00000000, -25.62231345	100.00000000, 300.00000000, -23.95212650	120.00000000, 300.00000000, -21.96711541	140.00000000, 300.0000000
Use	Points	160.00000000, 300.00000000, -17.07301865	180.00000000, 300.00000000, -14.23515620	200.00000000, 300.00000000, -11.21924248	220.00000000, 300.0000000
Use	Points	240.00000000, 300.00000000, -4.98470655	260.00000000, 300.00000000, -1.94408618	280.00000000, 300.00000000, 0.93276128	300.00000000, 300.0000000
Add	TopographySurface				



D. Rhino Geometry

There is one component that is fundamentally different from the others; instead of using Rhino geometry to write to a .CSV file, it uses a .CSV file to create Rhino data and geometry.

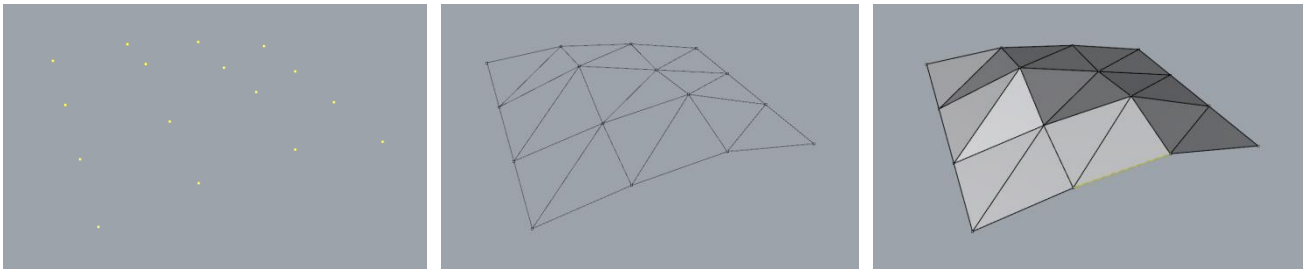
Input:



There are two kinds of output:

- The “Add P” (points), “Add C” (curves), and “Add S” (surfaces) toggles control which, if any, geometry to create directly in Rhino.
- The outputs “Pts” (points), “Crv” (curves), and “”Srf” (surfaces) output data in tree structures for use with other Grasshopper componetns.

Use	Points	0, 400, 0	10, 400, 2	20, 400, 3	30, 400, 2
Use	Points	0, 410, 1	10, 410, 3	20, 410, 5	30, 410, 1
Use	Points	0, 420, 2	10, 420, 5	20, 420, 3	30, 420, 0
Use	Points	0, 430, 3	10, 430, 4	20, 430, 2	30, 430, -1
Add	TopographySurface				



A single .CSV file, in this example a Topography Surface, creates points, lines, and surfaces.

III. Installation

All of the Rhino-Grasshopper elements and the Revit add-in are installed automatically by the GrasshopperSetup.msi file. Double-click this file to run it. The file can also be used to repair or uninstall Hummingbird. It can also be uninstalled from the Windows Control Panel.

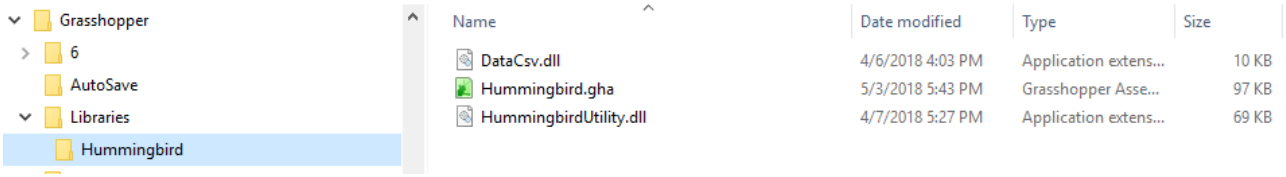
If a manual setup is required for some reason the following elements are necessary:

A. Rhino – Grasshopper Setup

The files are installed under the folder: (Note: the same folder is used for Rhino 5 and 6.)

C:\Users\<UserName>\AppData\Roaming\Grasshopper\Libraries\Hummingbird

The folder contains:



B. Revit Setup

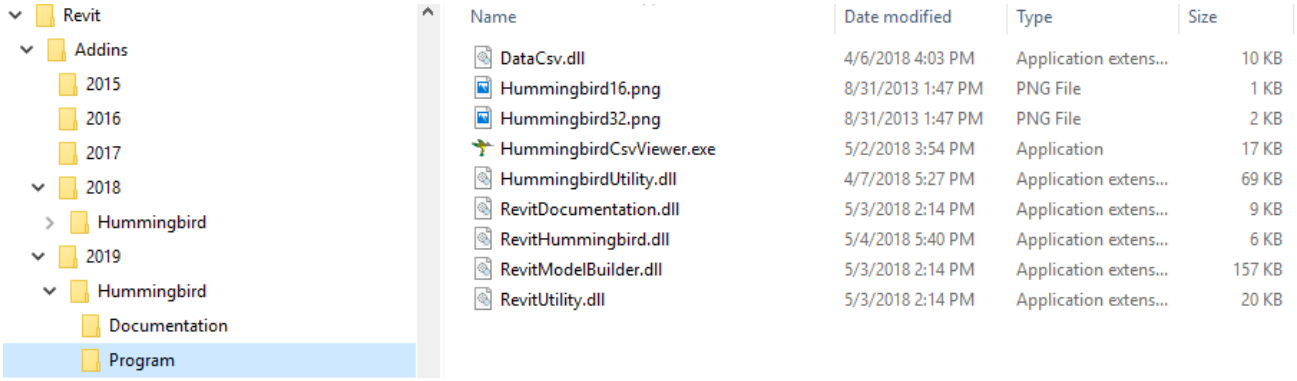
The files are installed under the folders:

C:\Users\<UserName>\AppData\Roaming\Autodesk\Revit\Addins\2018\Hummingbird

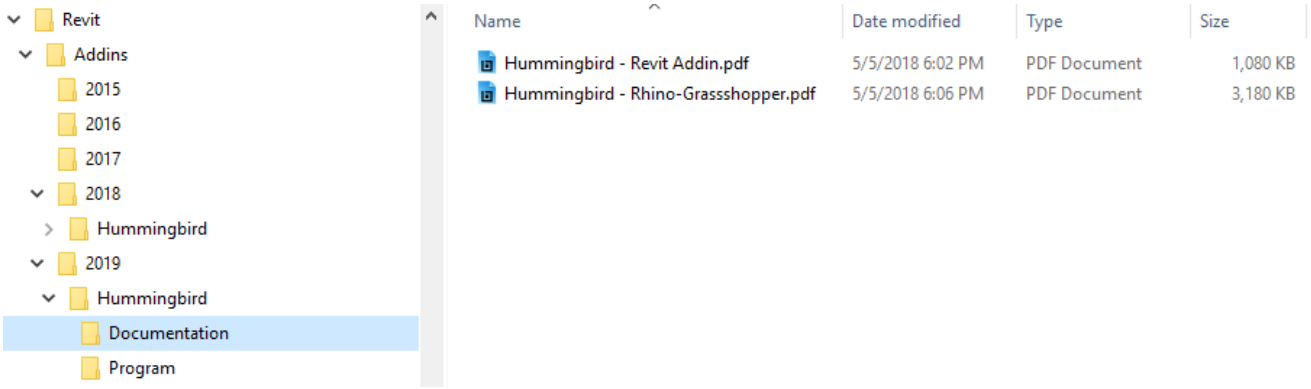
C:\Users\<UserName>\AppData\Roaming\Autodesk\Revit\Addins\2019\Hummingbird

There are two subfolders:

- **Program** (2019 version shown) contains the files:



- **Documentation** contains:



Other files may be placed here and will display when the Documentation command is run from Revit.

An Addin file named “WhiteFeet.Hummingbird.addin” is placed in the folder(s):

C:\Users\<UserName>\AppData\Roaming\Autodesk\Revit\Addins\2014
C:\Users\<UserName>\AppData\Roaming\Autodesk\Revit\Addins\2015

The file consists of:

Hummingbird.addin

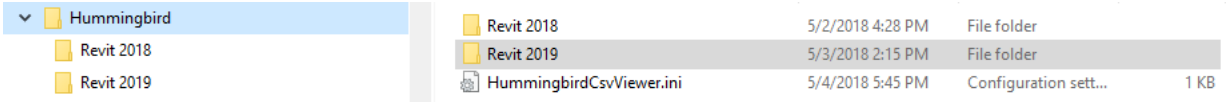
```
<?xml version="1.0" encoding="utf-8"?>
<RevitAddIns>

  <AddIn Type="Application">
    <Name>Hummingbird</Name>
    <Assembly>Hummingbird\Program\RevitHummingbird.dll</Assembly>
    <AddInId>93BC2D26-39A7-4AA0-A6BA-5387F8C31395</AddInId>
    <FullClassName>RevitHummingbird.Application</FullClassName>
    <VendorId>ADSK</VendorId>
    <VendorDescription>Autodesk, Inc, www.autodesk.com</VendorDescription>
  </AddIn>

</RevitAddIns>
```

The program also creates a set of folders under:

C:\Users\<UserName>\AppData\Roaming\Hummingbird



These are used to store settings from the Revit addin and the CSV file viewer as a convenience so that the menus restore to their last configuration when they are re-opened. These files may be deleted without harm.