

Floor Plan

DOTS v 1.0

Design Optimization Tool Set

Grasshopper Plugin for Architecture and Urban design / planning

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- **Approximate geometric Configurations in Architecture & Urban Planning**
- **Embedded (in-built) Optimization / AI algorithms**
- **Alternatives that respond to domain specific constraints**

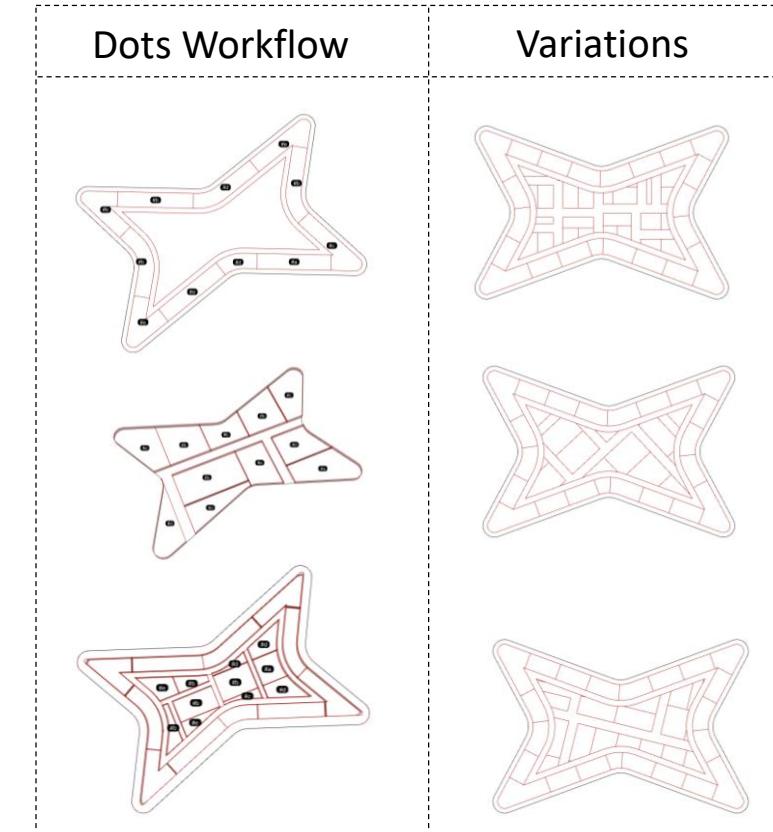
Approximations



Geometric configs or collection of shapes are not always smooth or sharp

Using DOTS components

- Dots' components are meant to be used in combination.
- By joining the Dots, various geometric configurations can be achieved.
- Appropriate optimization algorithms are in-built.
- It will *try* to maximize the possibility of achieving input-constraints.

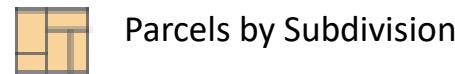


Components

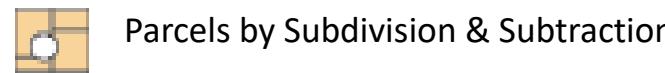
DOTS

Simple Partitions

Intended for Urban plans



Parcels by Subdivision



Parcels by Subdivision & Subtraction



Parcels From Internal Polyline



Parcels from Curve Skeleton



Parcel Selector

simple

Alternative usage

Massing / Typology

Intended for Urban plans



Extrude Block



Staggered Massing



Urban Massing from setbacks,
street-types & FSR



Courtyard Massing



Staggered Courtyard Massing
- Interpolated



Staggered Courtyard Massing
- Normal

Constrained Partitions

Intended for Floor plans



Subdivision Algorithm



Subdivision of a Curve



Circulation

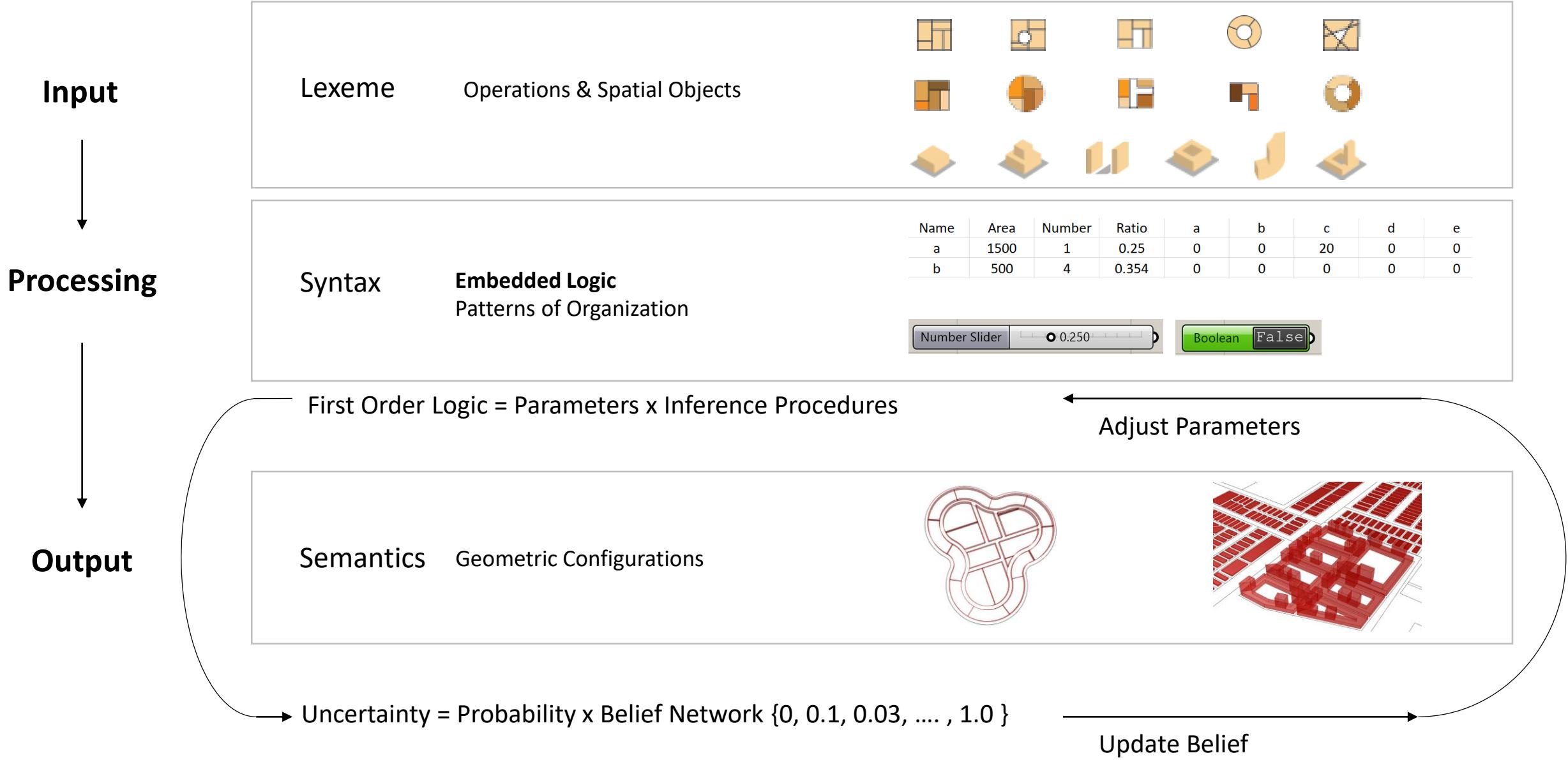


Occupy the plane



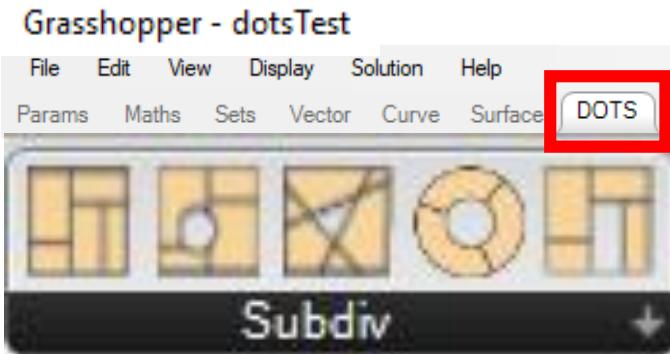
Occupying Periphery

Software Design



Fundamental Components for *Partitions* of a region (urban layouts)

Intended use : Floor plan automation



Input Types

Number



Boolean



Curve / Geometry



Subdivision



Subdivide a closed curve into parcels and streets



Subdivide a closed curve into parcels and streets and remove internal curves



Subdivide a closed curve from a given polyline

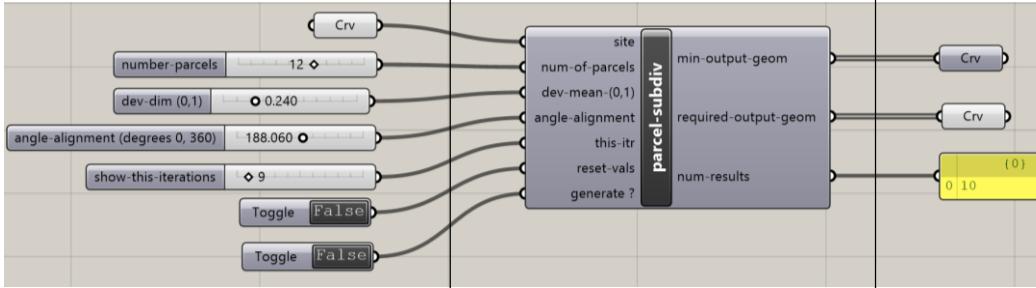
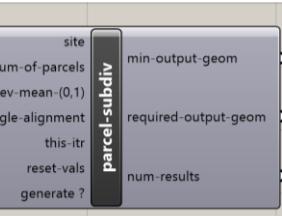
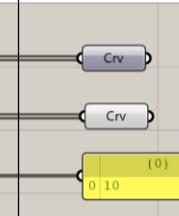
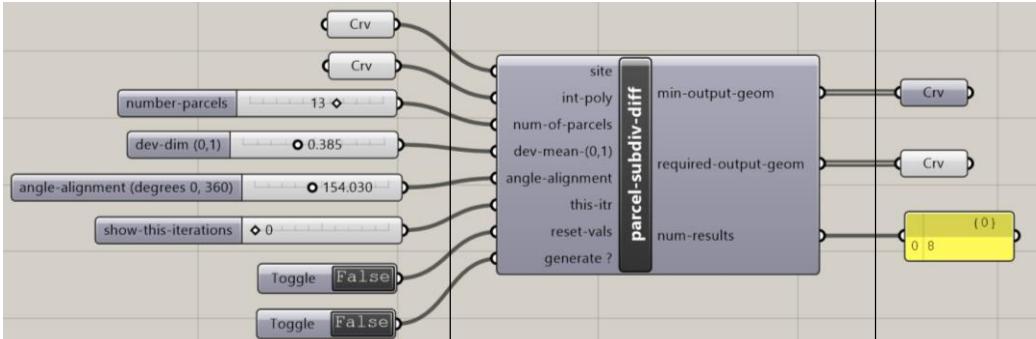
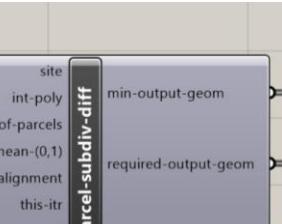
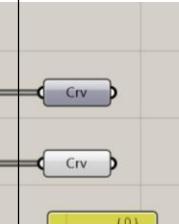
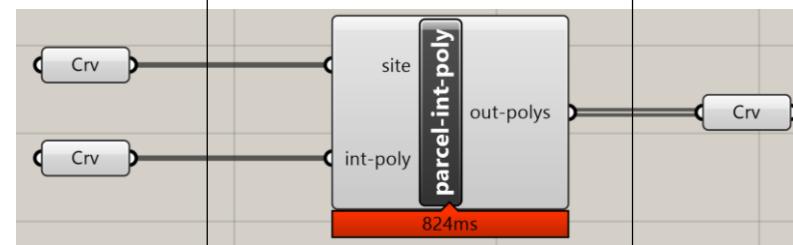


Generates parcels around the periphery



From given set of parcels, separate them for open-space requirements and build-able curves

Fundamental Components for *Partitions* of a region (urban layouts)

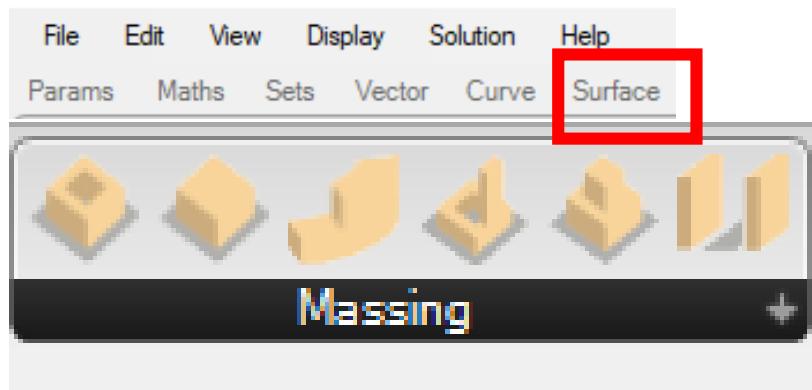
Name	Input	DOTS Component	Output	Illustration
 Parcels by Subdivision				
 Parcels by Subdivision & Subtraction				
 Parcels From Internal Polyline				

Fundamental Components for *Partitions* of a region (urban layouts)

Name	Input	DOTS Component	Output	Illustration
 Generate Parcels on Periphery		Parcel-subdiv site num-of-parcels dev-mean (0,1) angle-alignment this-itr reset-vals generate ? min-output-geom required-output-geom num-results		
 Select open-space requirements		select site parcels centralize? % open build open-space 25ms		random central

Fundamental Components for *Massing* or Typologies

Grasshopper - dotsTest



Massing

-  Subdivide a closed curve into parcels and streets
-  Subdivide a closed curve into parcels and streets and remove internal curves
-  Subdivide a closed curve from a given polyline
-  From given set of parcels, separate them for open-space requirements and buildable curves

Intended use : Generate building typologies from parcels

Input Type

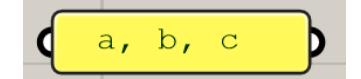
Number



Boolean



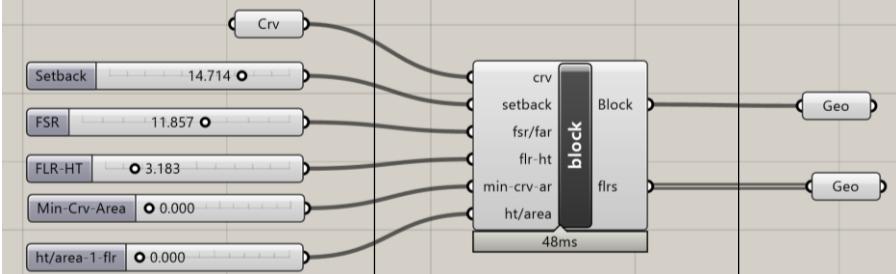
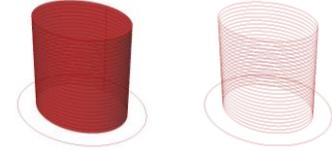
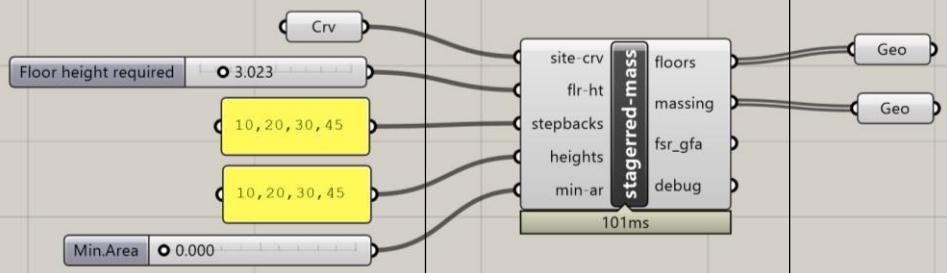
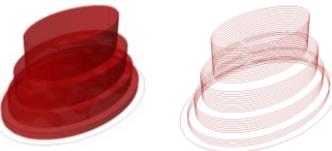
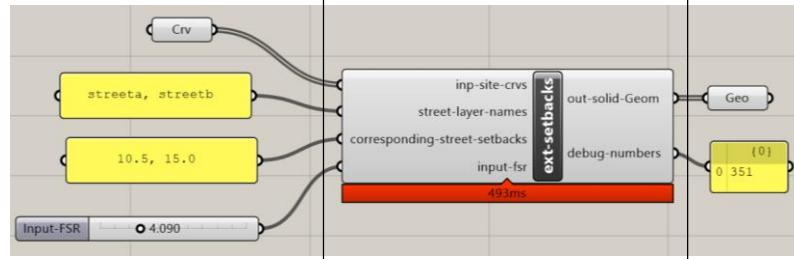
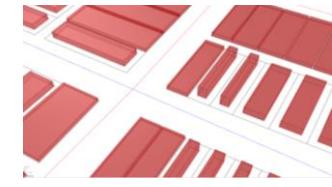
Text Panel



Curve / Geometry



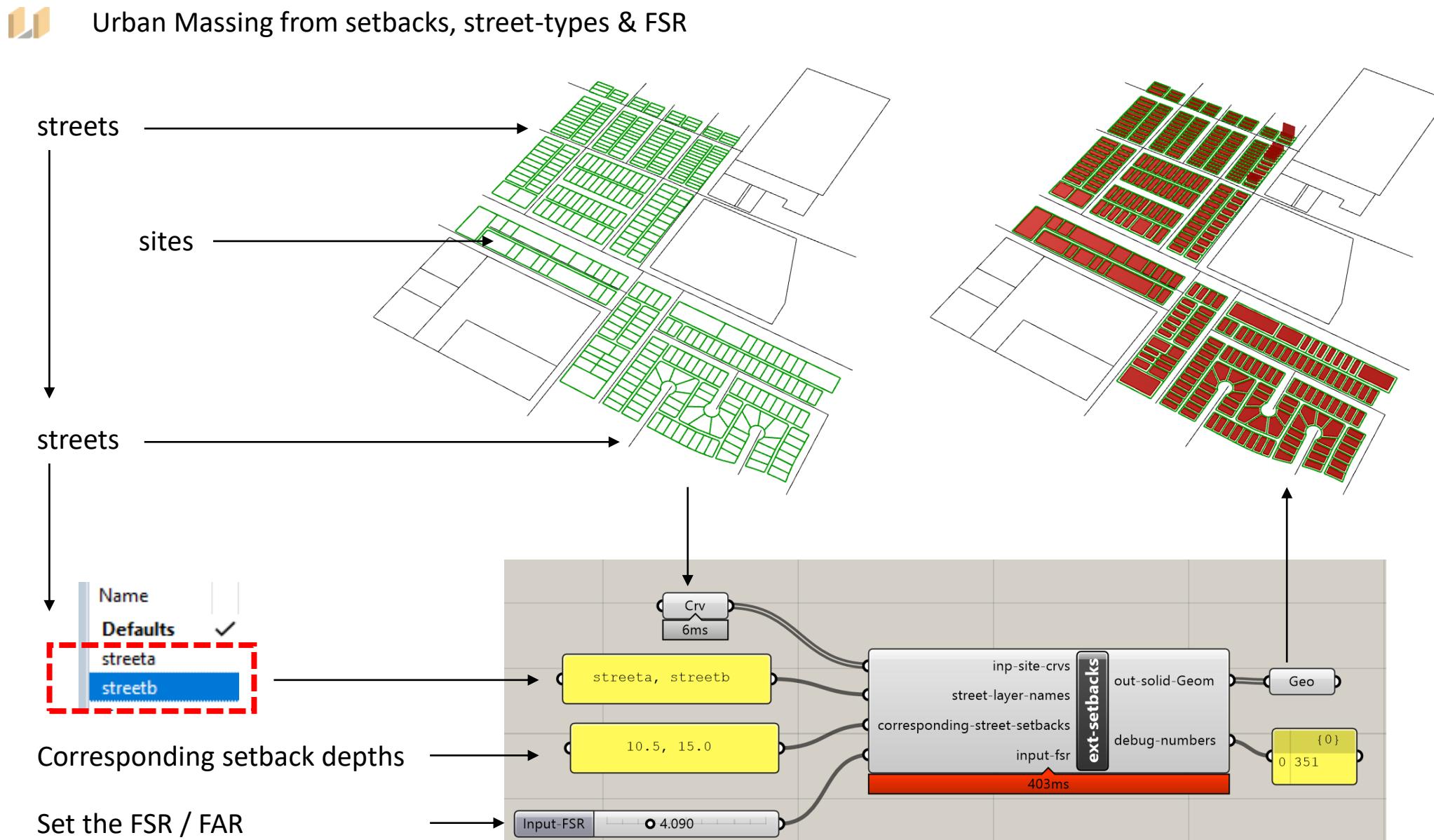
Fundamental Components for *Massing* or Typologies

Name	Input	DOTS Component	Output	Illustration
 Extrude Block				
 Staggered Massing				
 Urban Massing from setbacks, street-types & FSR				

Fundamental Components for *Massing* or Typologies

Name	Input	DOTS Component	Output	Illustration
Courtyard Massing				
Staggered Courtyard Massing - Interpolated				
Staggered Courtyard Massing - Normal				

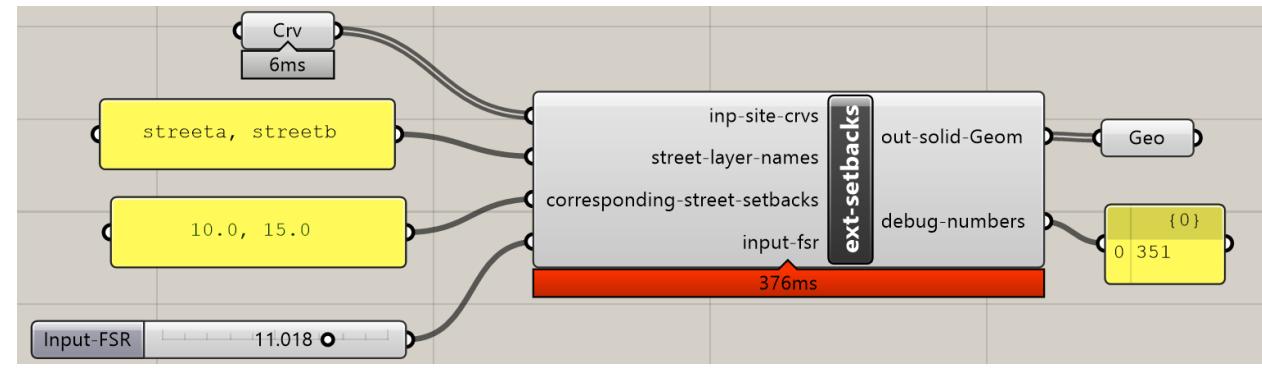
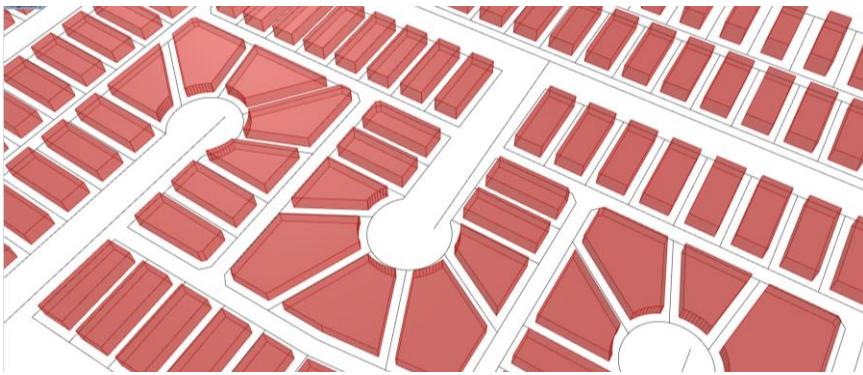
Sample Workflow



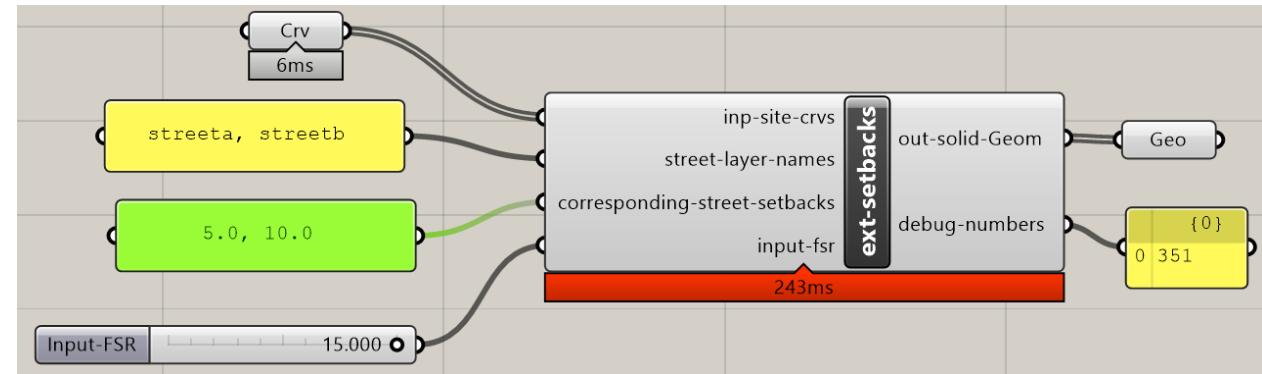
Alternatives



Urban Massing from setbacks, street-types & FSR

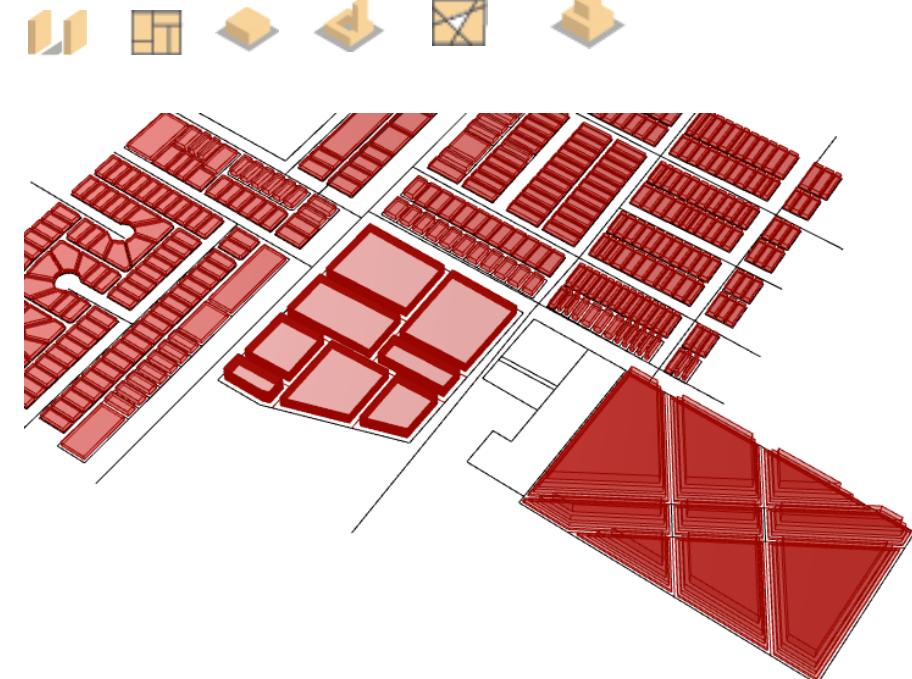
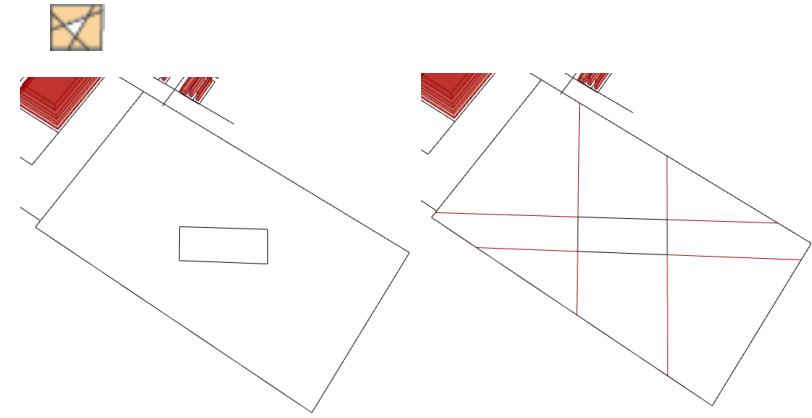
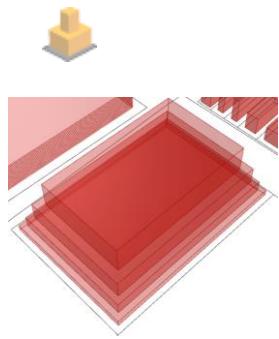
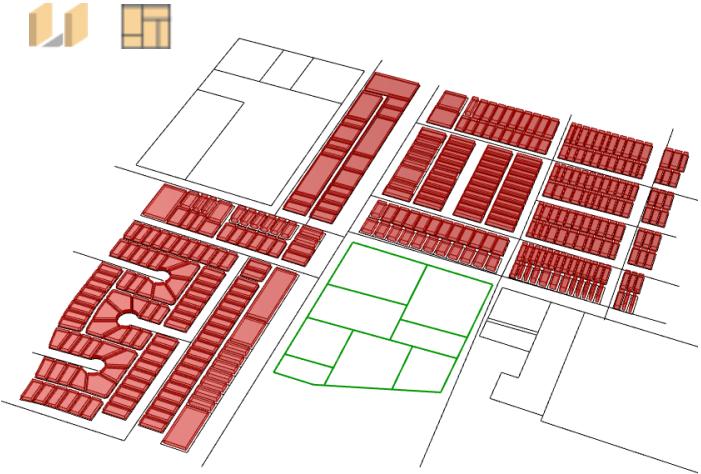


Setback depths = 10.5, 15.0; FSR = 11.018



Setback depths = 5.0, 10.0; FSR = 15.0

Setup ***workflows*** for urban layouts



Fundamental Components of Controlled Subdivision

Grasshopper - dotsTest



Intended use: Generate Floor Plans / Site Plan

- Controlled Subdivision**
 - Subdivide a closed curve
 - Place spaces along the periphery
 - Place orthogonal spaces in a plane
 - Find appropriate circulation

Intended use : Floor plan automation

Inputs

- Number



- Boolean



- Link to .csv file

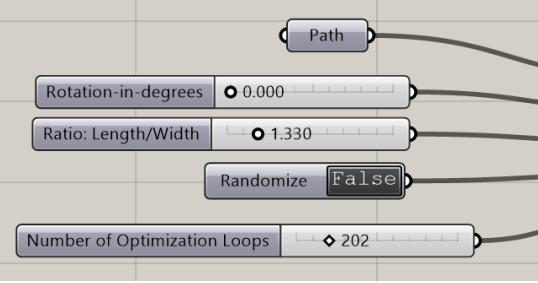
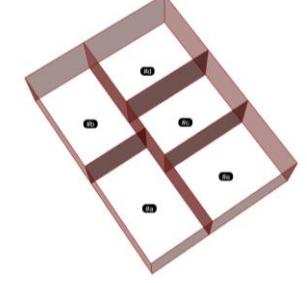
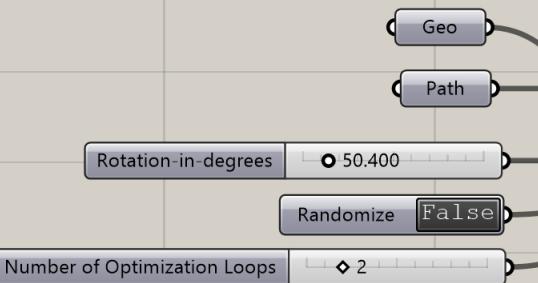
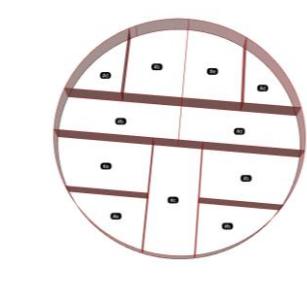
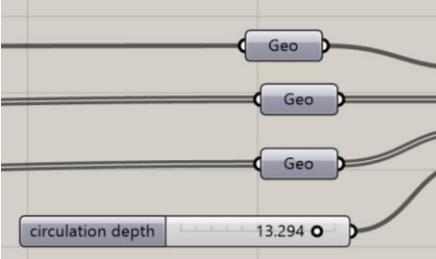
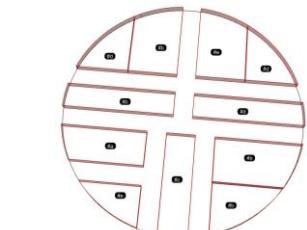


Name	Area	Number	Ratio	a	b	c	d	e
a	1000	1	0.25	0	0	20	0	0
b	1000	4	0.354	0	0	0	0	0
c	1000	1	1	20	0	0	0	0
d	1000	3	1.15	0	0	0	0	0
e	1000	2	1.3	0	0	0	0	-100

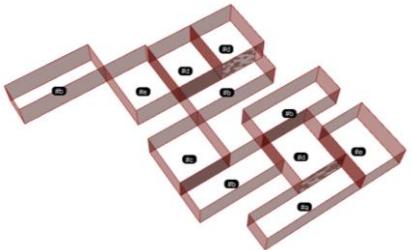
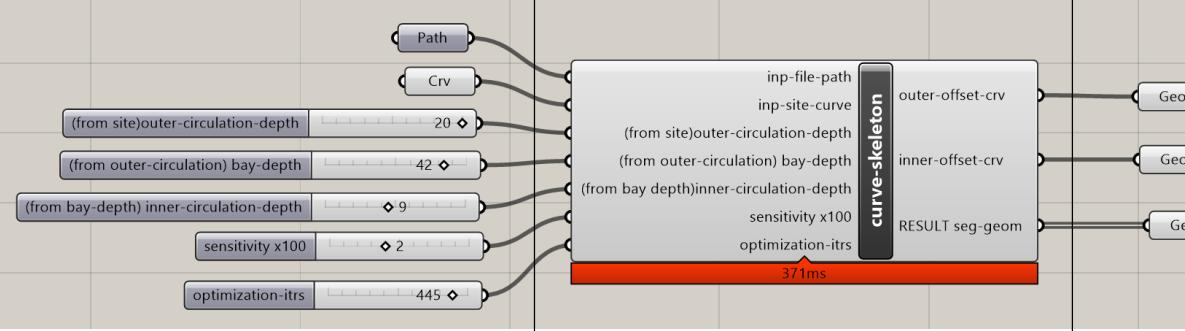
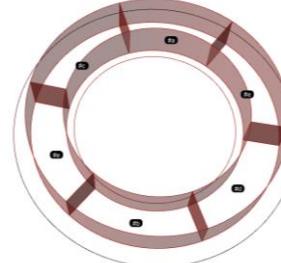
Geometric Requirements

Adjacency Matrix

Fundamental Components for controlled subdivision

Name	Input	DOTS Component	Output	Illustration
 Generate boundary and subdivide		CBSP input-files(csv) Rot-degrees ratio length/width randomize optimization-loops 447ms	debug-Adj-inp debug-BSP-config-inp outer boundary Crv	
 Input boundary and subdivide		cbsp-Site input-files(csv) input-site-crv Rot-degrees randomize optimization-loops 330ms	spatial-crv circulation-lines Geo	
 Generate circulation - corridors		circulation site-crv / outer-boundary cbsp-crvs partition-lines circulation-depth 722ms	0. partition-lines 1. circulation-poly 2. resultant-cbsp-crv Geo	

Fundamental Components for controlled subdivision

Name	Input	DOTS Component	Output	Illustration
 Generate spaces and occupy a plane		exploratory-McMC inp-file-path sensitivity-num-itrs rotation 3.9s	Crv	
 Place spaces along the periphery		curve-skeleton inp-file-path inp-site-curve (from site)outer-circulation-depth (from outer-circulation) bay-depth (from bay-depth)inner-circulation-depth sensitivity x100 optimization-itrs 371ms	outer-offset-crv inner-offset-crv RESULT seg-geom	

Scope & Constraints for optimization

Input Sample : Adjacency

Name	Area	Number	Ratio	a	b	c	d	e
a	1000	1	0.25	0	0	20	0	0
b	1000	4	0.354	0	0	0	0	0
c	1000	1	1	20	0	0	0	0
d	1000	3	1.15	0	0	0	0	0
e	1000	2	1.3	0	0	0	0	-100

Input Sample 2 : Area & Adjacency

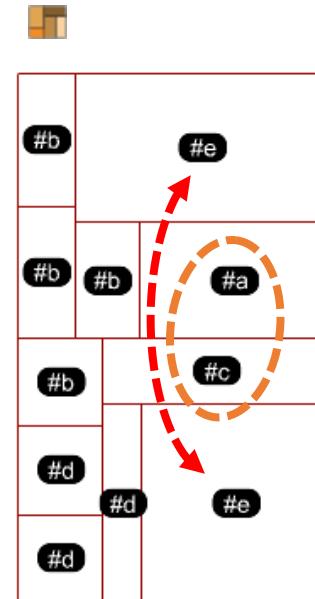
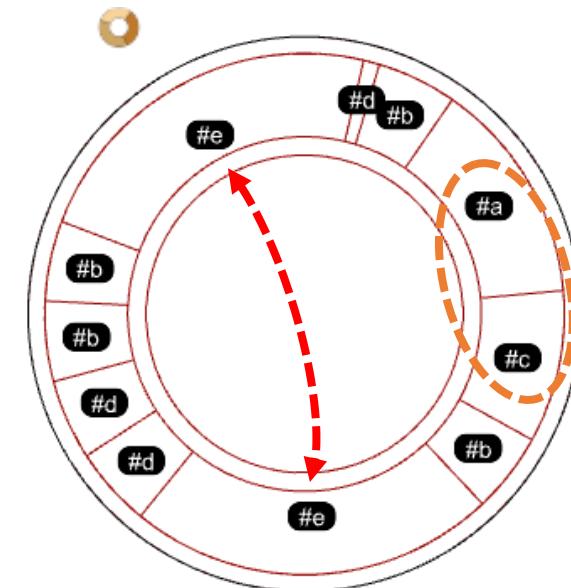
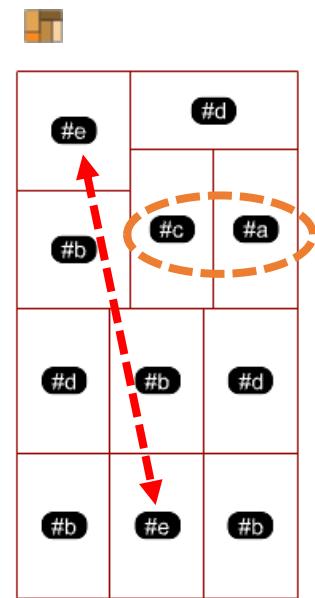
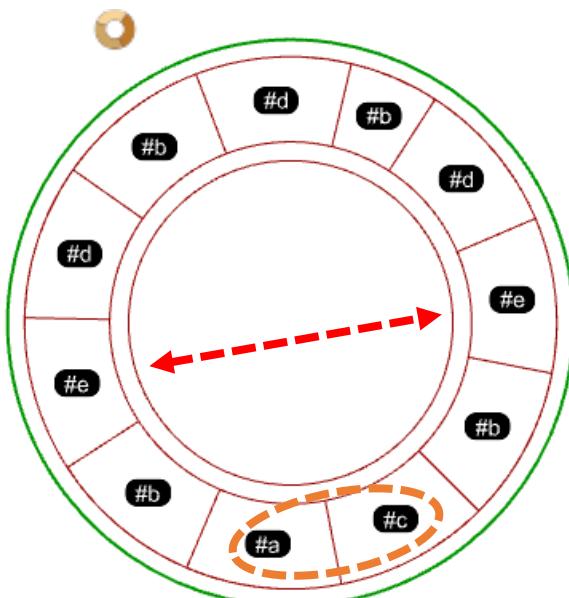
Name	Area	Number	Ratio	a	b	c	d	e
a	1500	1	0.25	0	0	20	0	0
b	500	4	0.354	0	0	0	0	0
c	1000	1	1	20	0	0	0	0
d	500	3	1.15	0	0	0	0	0
e	2500	2	1.3	0	0	0	0	-100

Adjacency Constraints

a & c should be together



e should be separated



Sample Workflow

Input

geometry				adjacency				
Name	Area	Number	Ratio	a	b	c	d	e
a	1500	1	0.25	0	0	20	0	0
b	500	4	0.354	0	0	0	0	0
c	1000	1	1	20	0	0	0	0
d	500	3	1.15	0	0	0	0	0
e	2500	2	1.3	0	0	0	0	-100

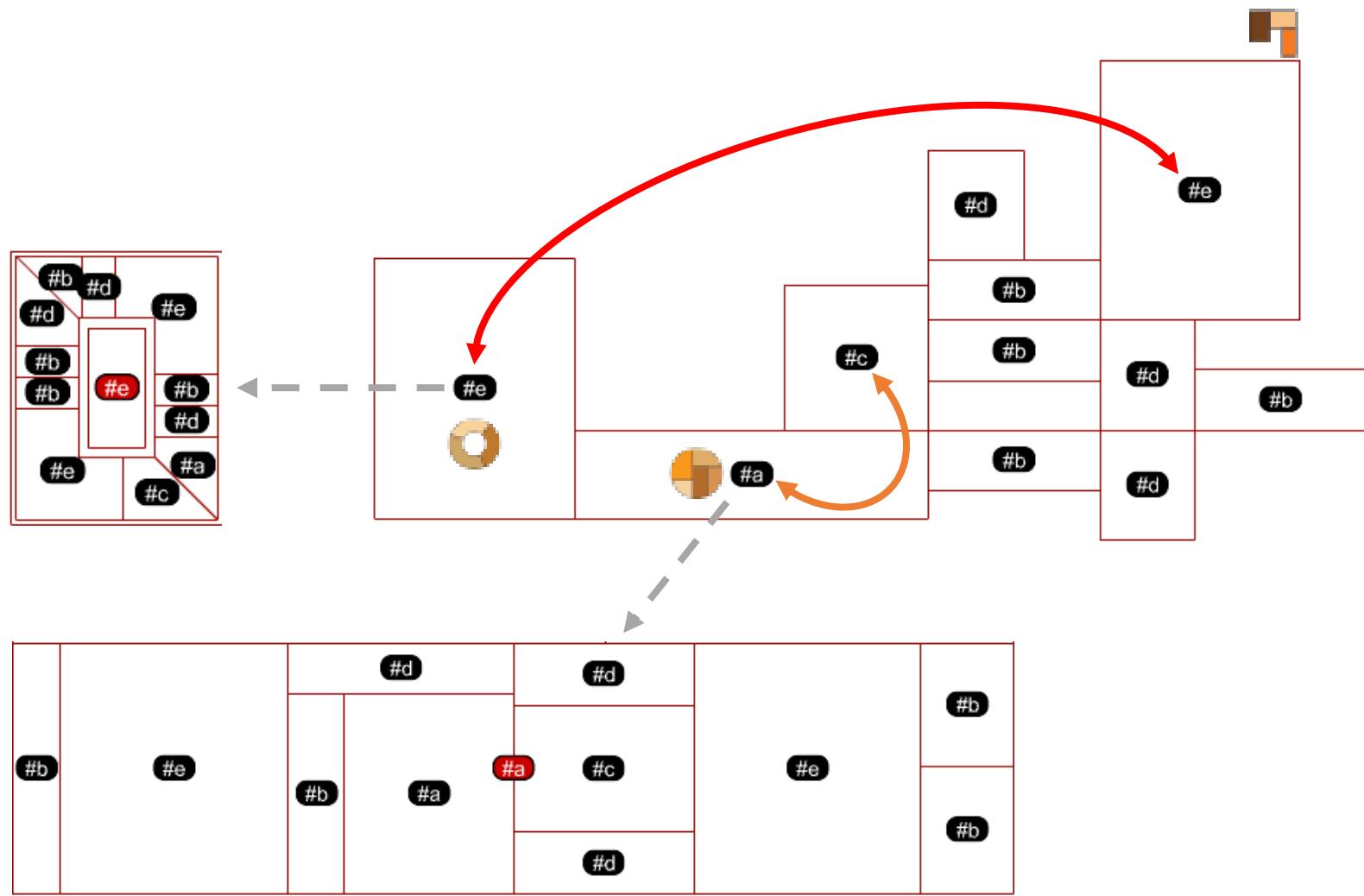
Join the DOTS components

Meet area requirements
a & c should be together
e should be separated

Step 1. use the curve skeleton component

Step 2. Use the cBSP 2 component

Sample Workflow



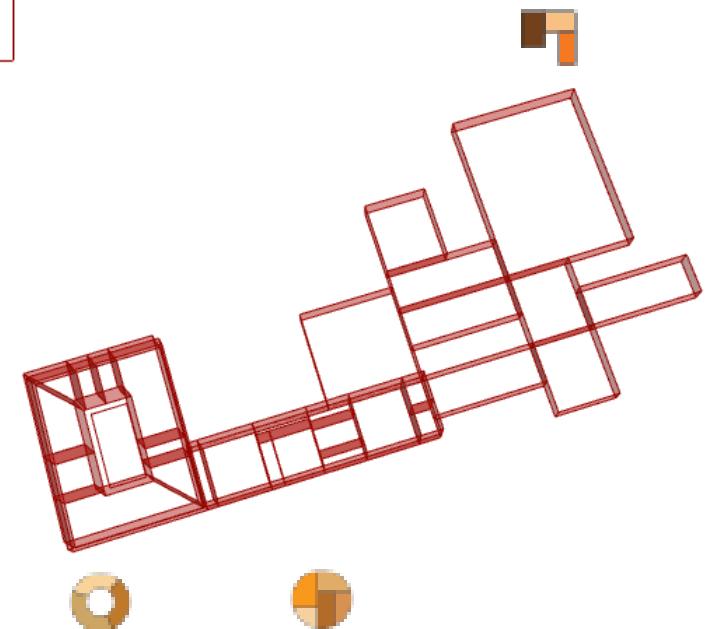
Join the DOTS components



Sample 2 : Area & Adjacency

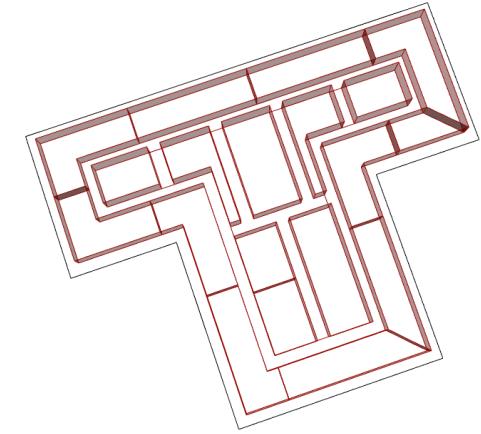
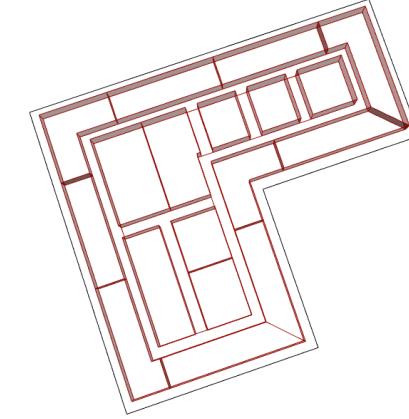
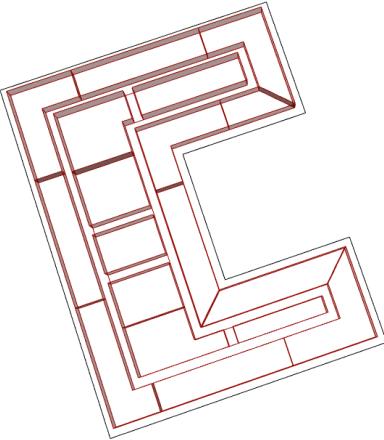
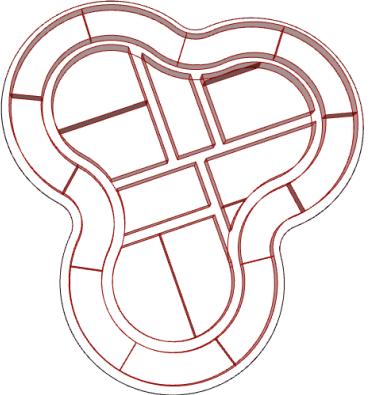
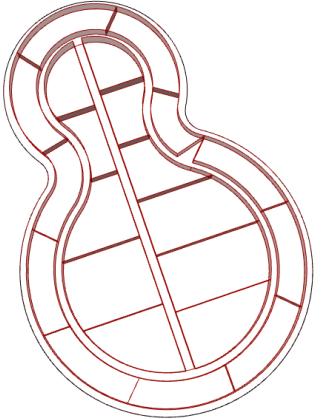
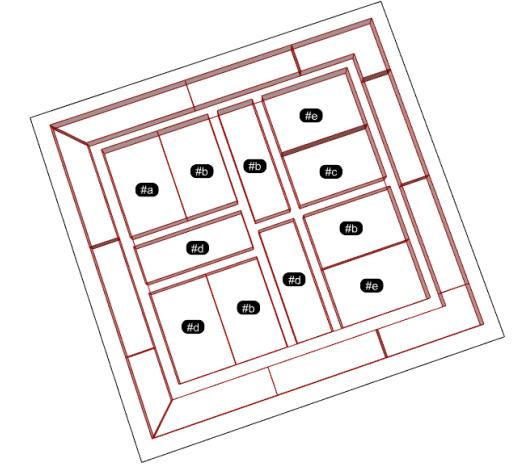
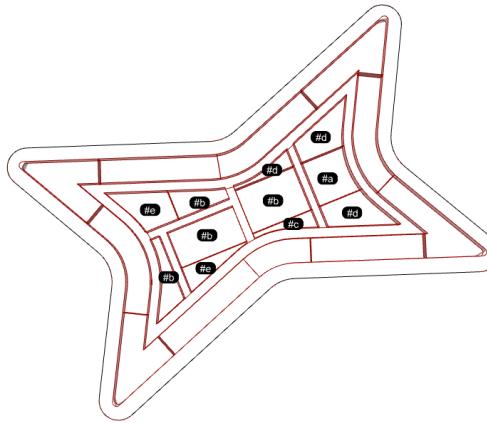
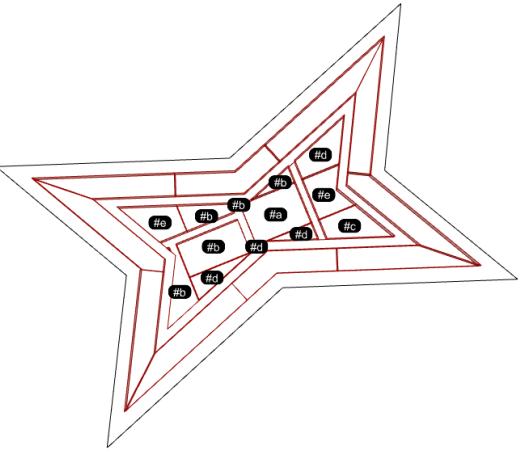
— orange — a & c should be together

— red — e should be separated



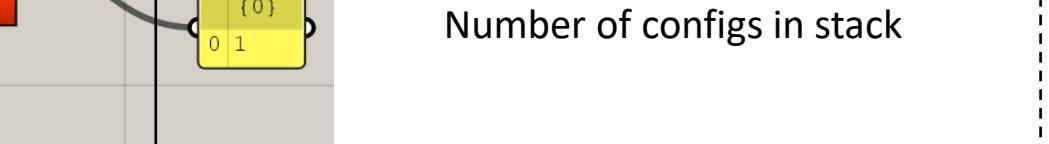
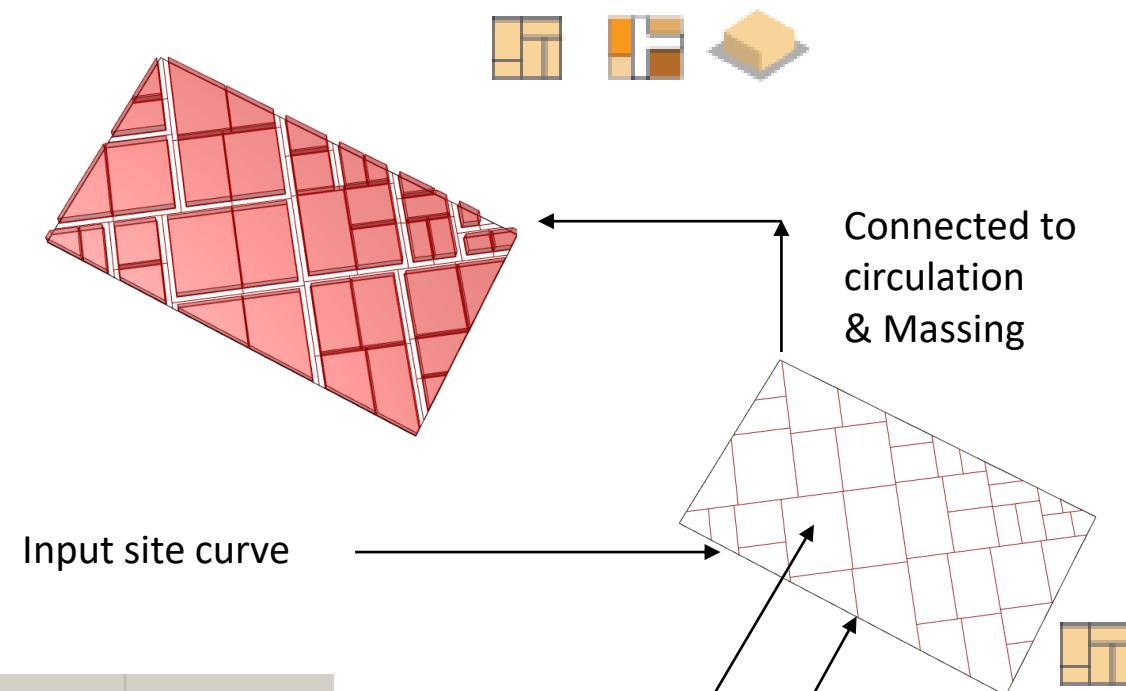
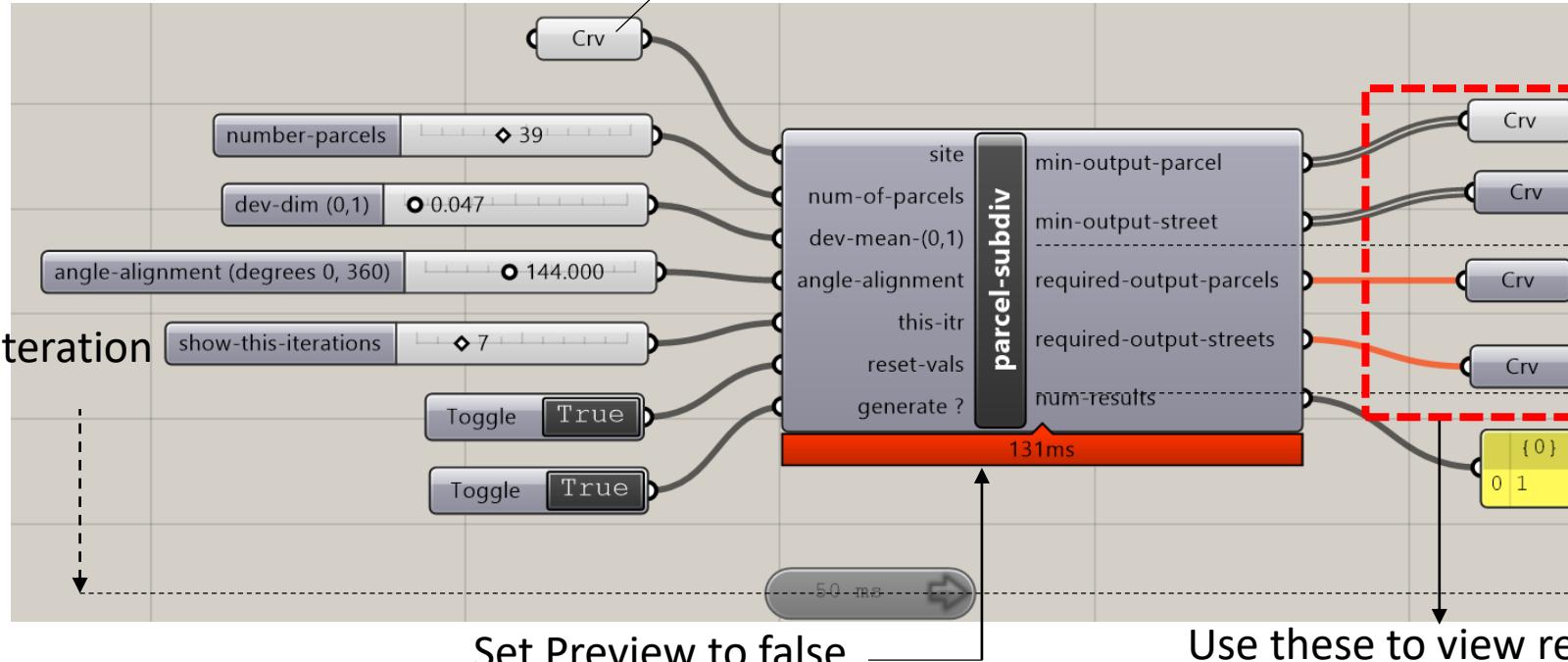
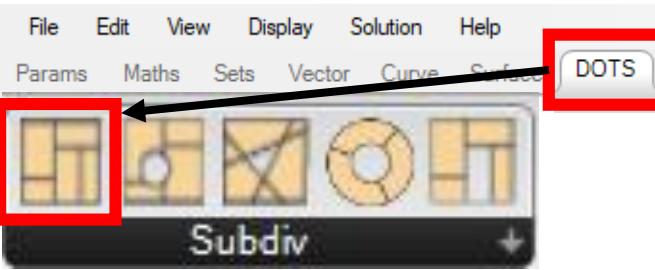
Applicable to a wide variety of geometric forms

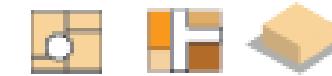
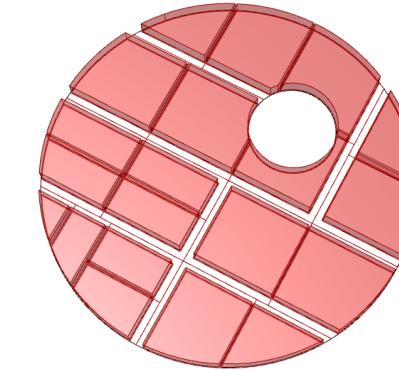
Illustrations



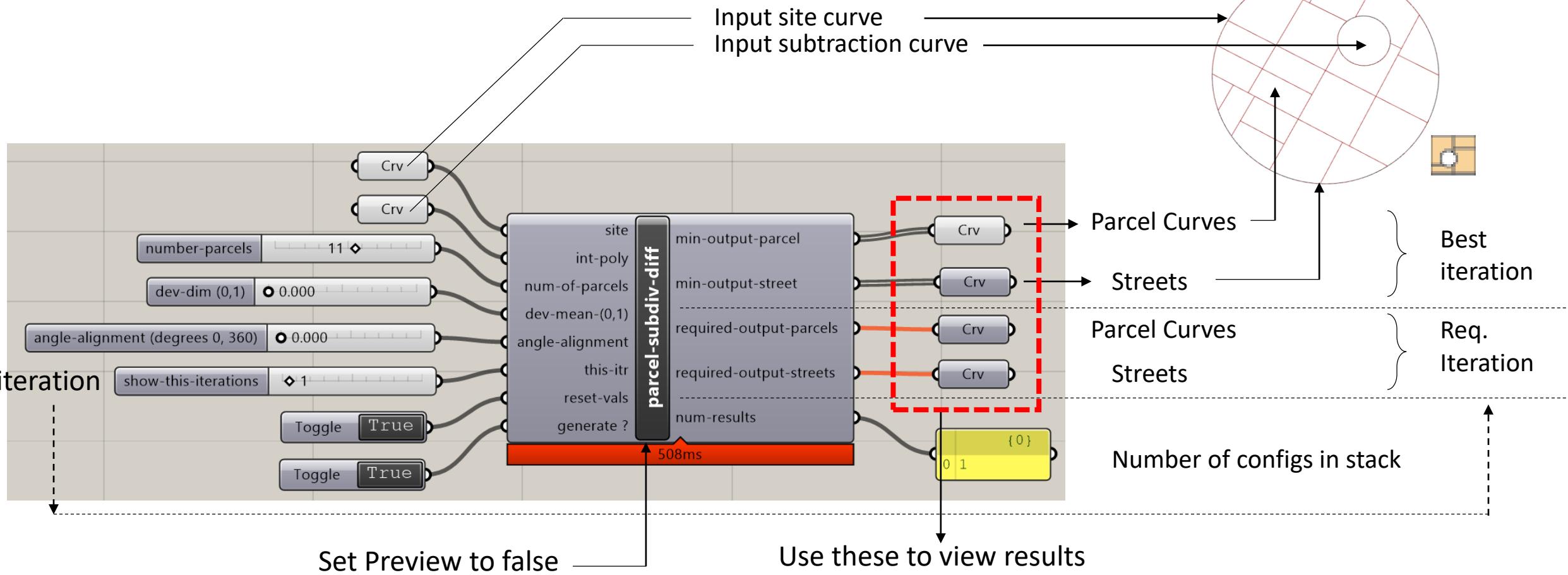


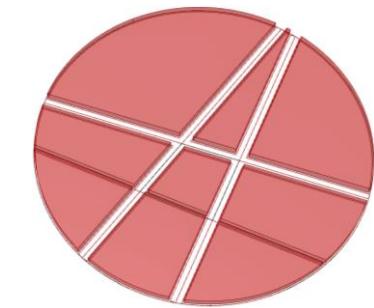
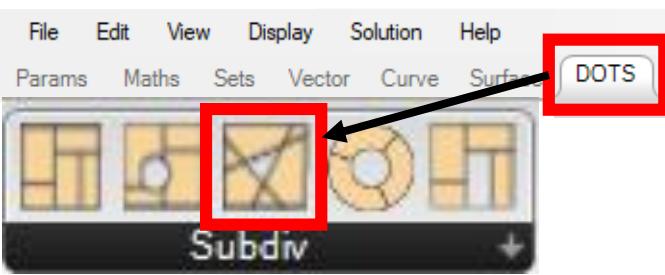
Thank you



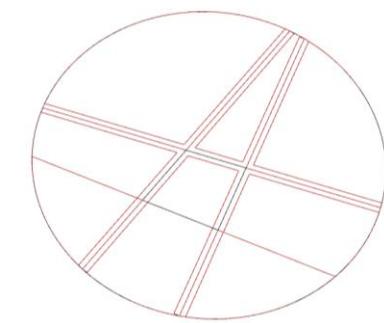


Connected to circulation & Massing

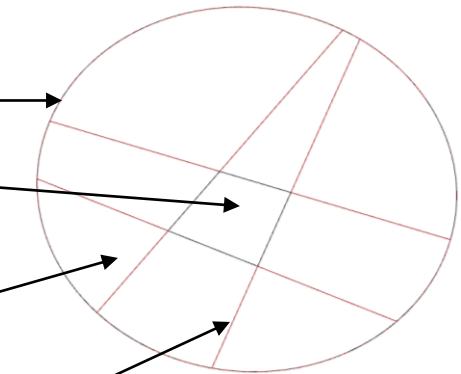
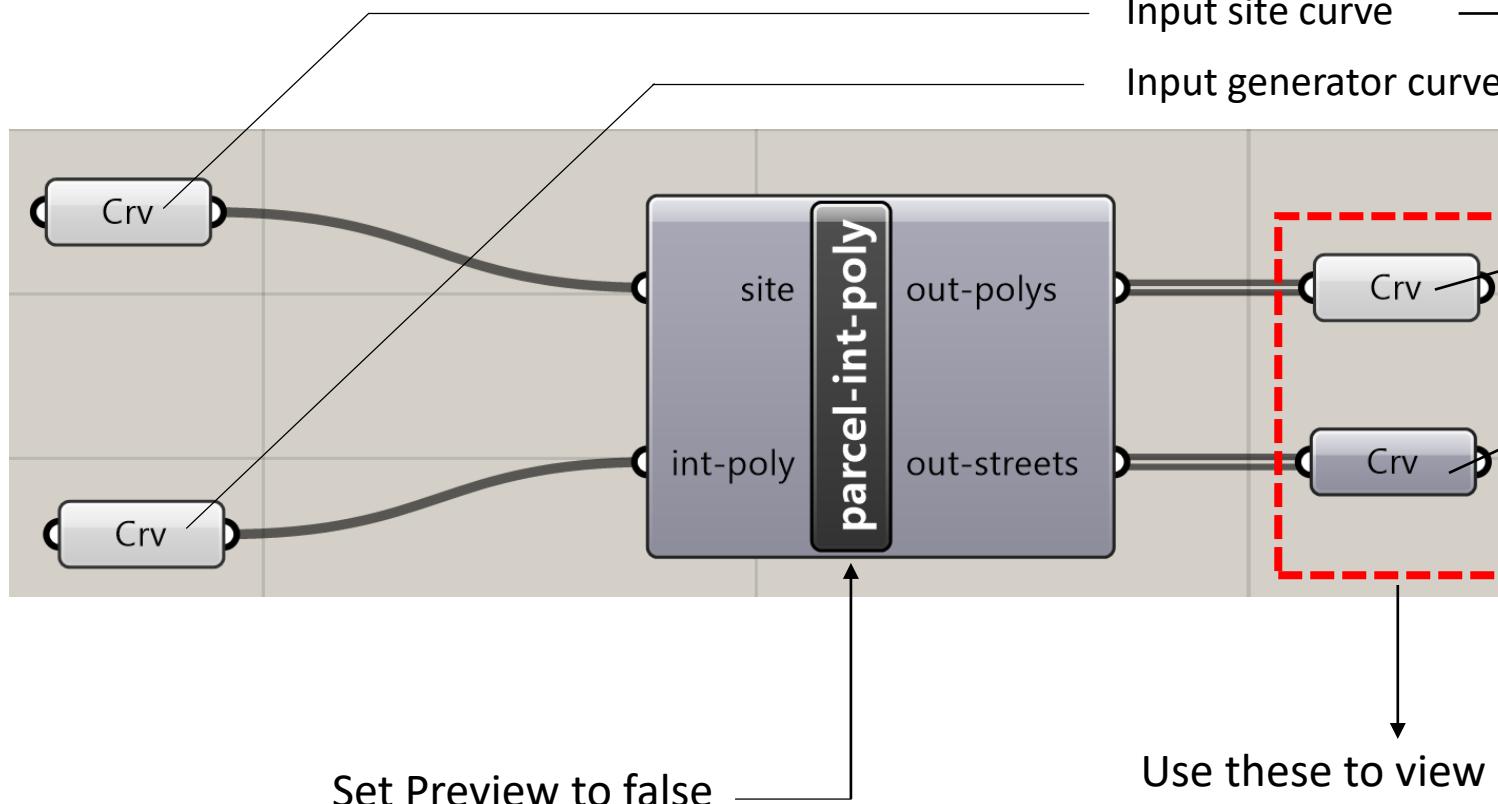


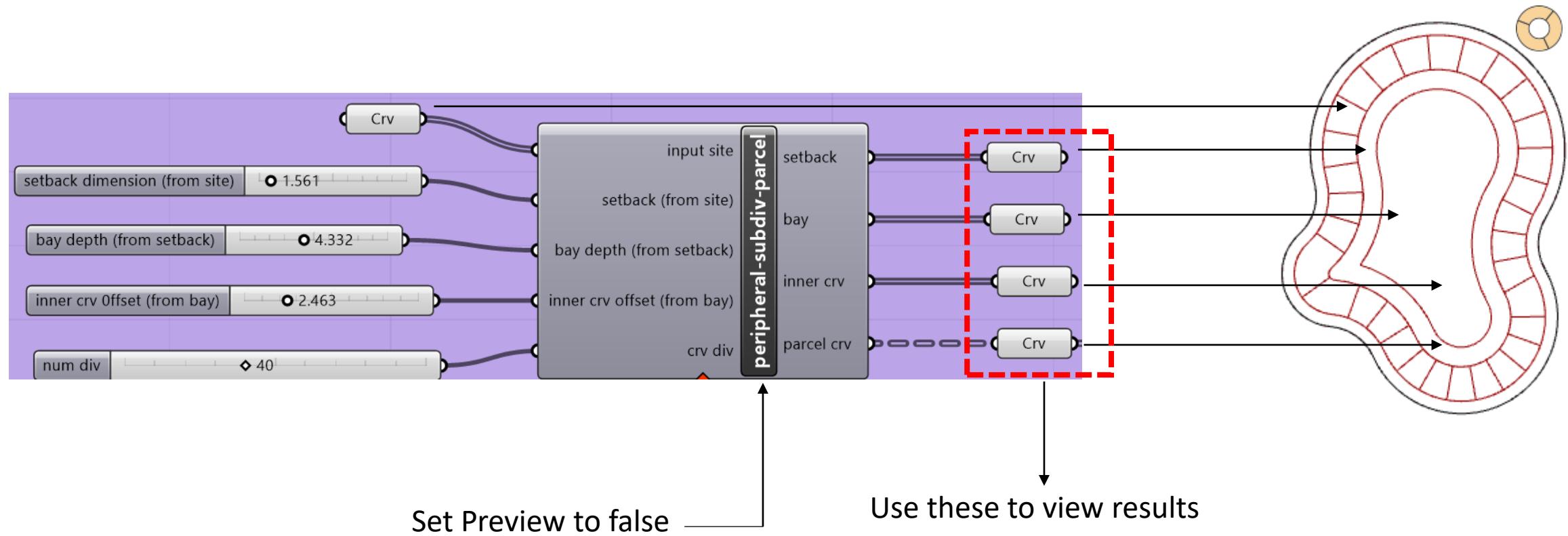
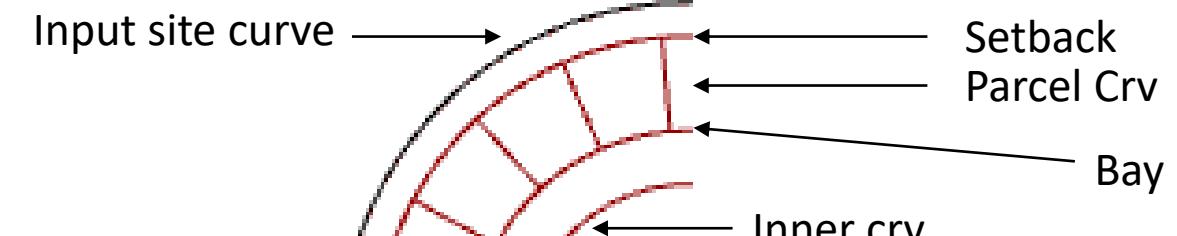
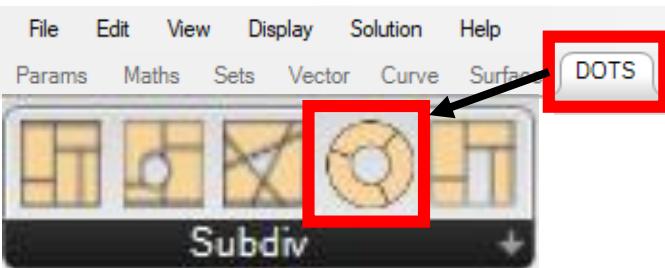


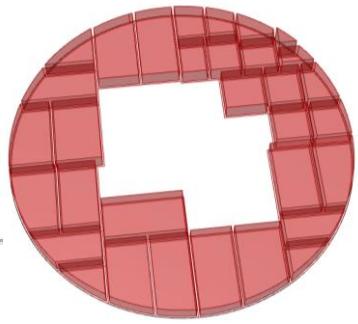
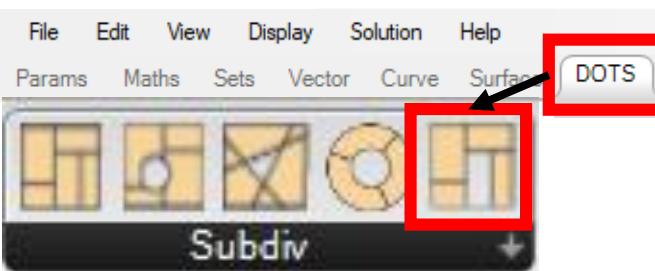
Generate Mass



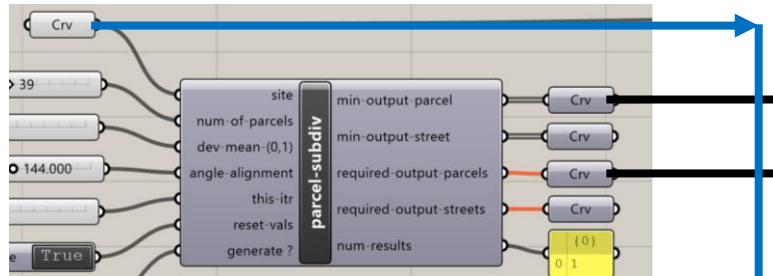
Compute
Circulation



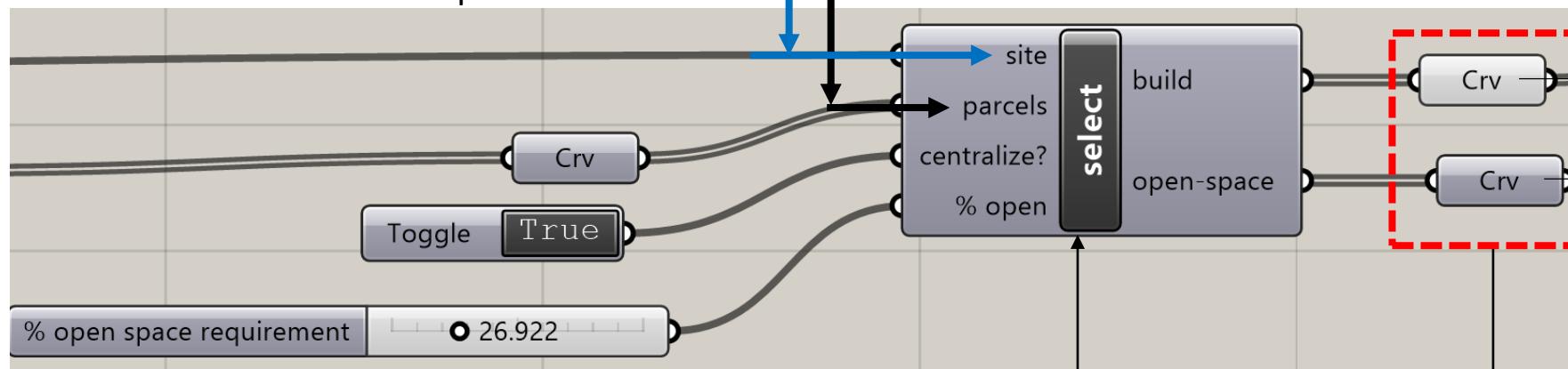




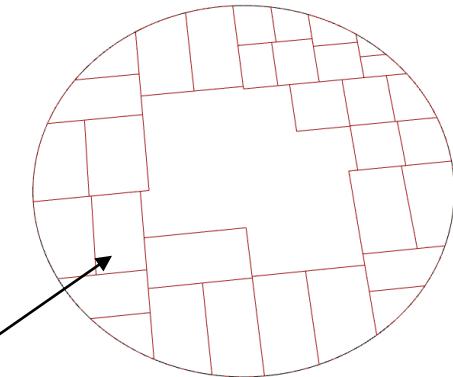
Sample of Previous Subdivision Component



From Subdivision component

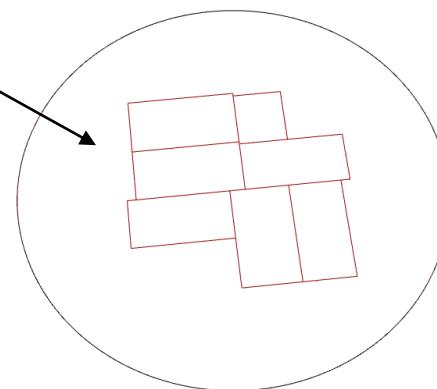


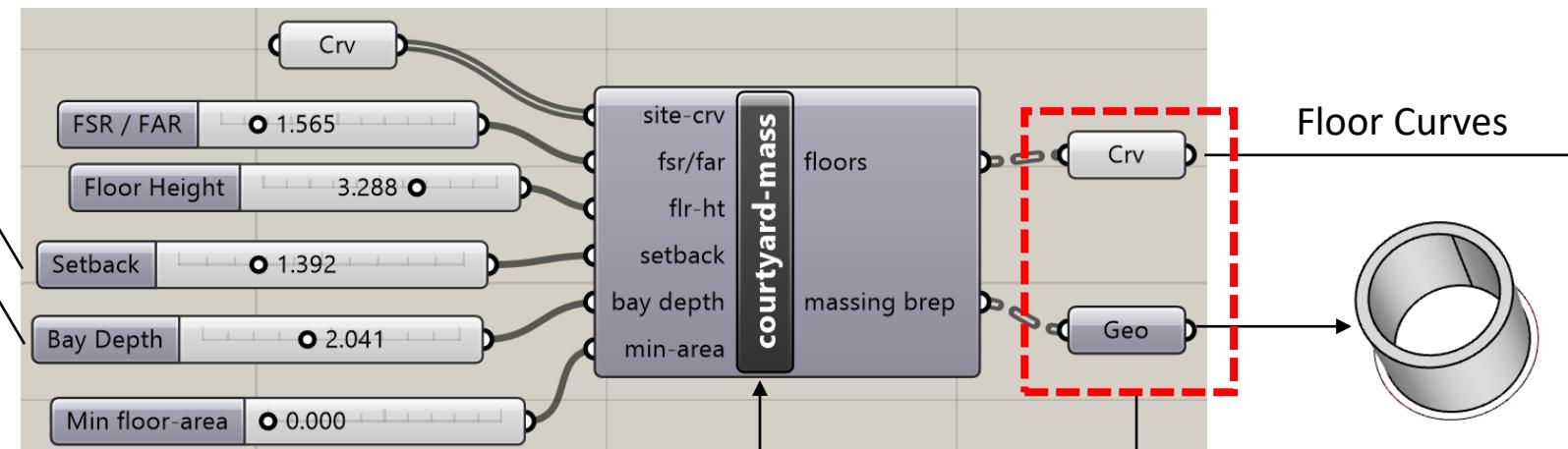
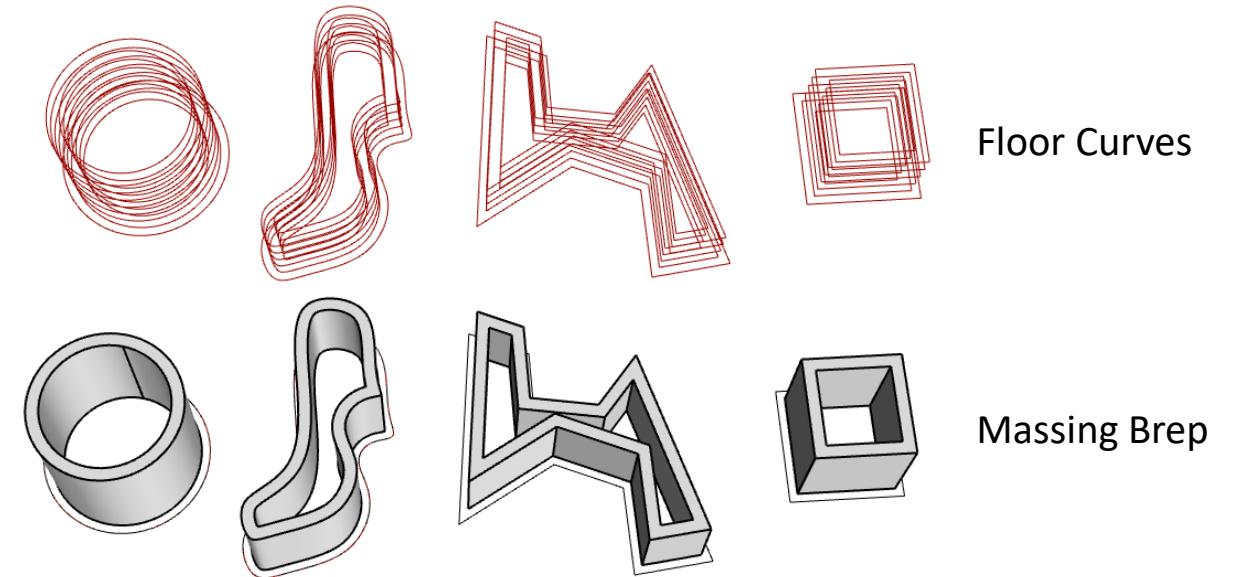
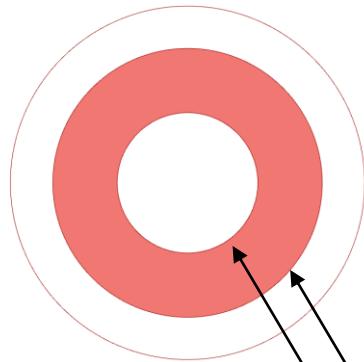
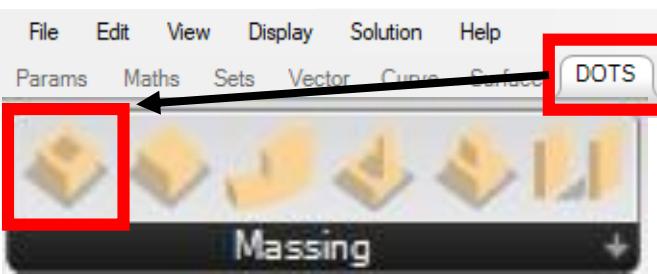
Add massing



Set Preview to false

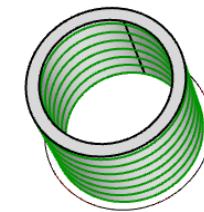
Use these to view results



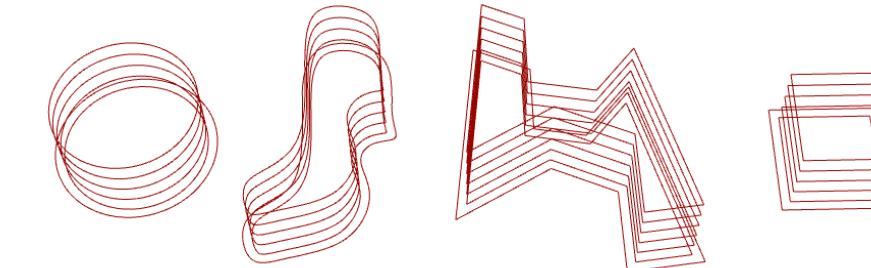
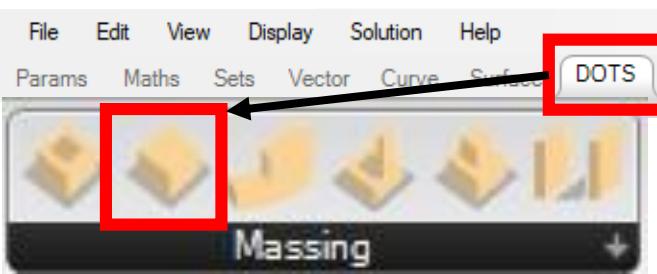


Set Preview to false

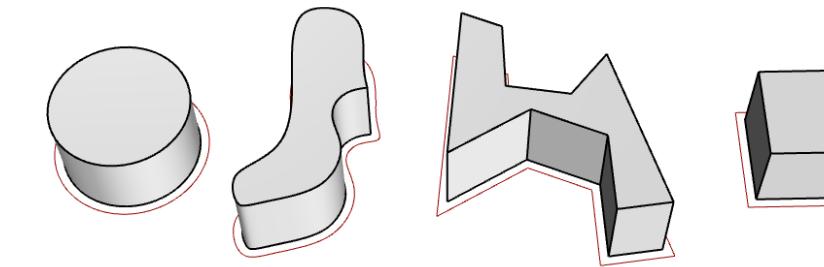
Use these to view results



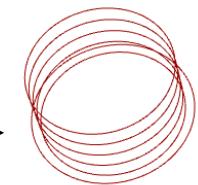
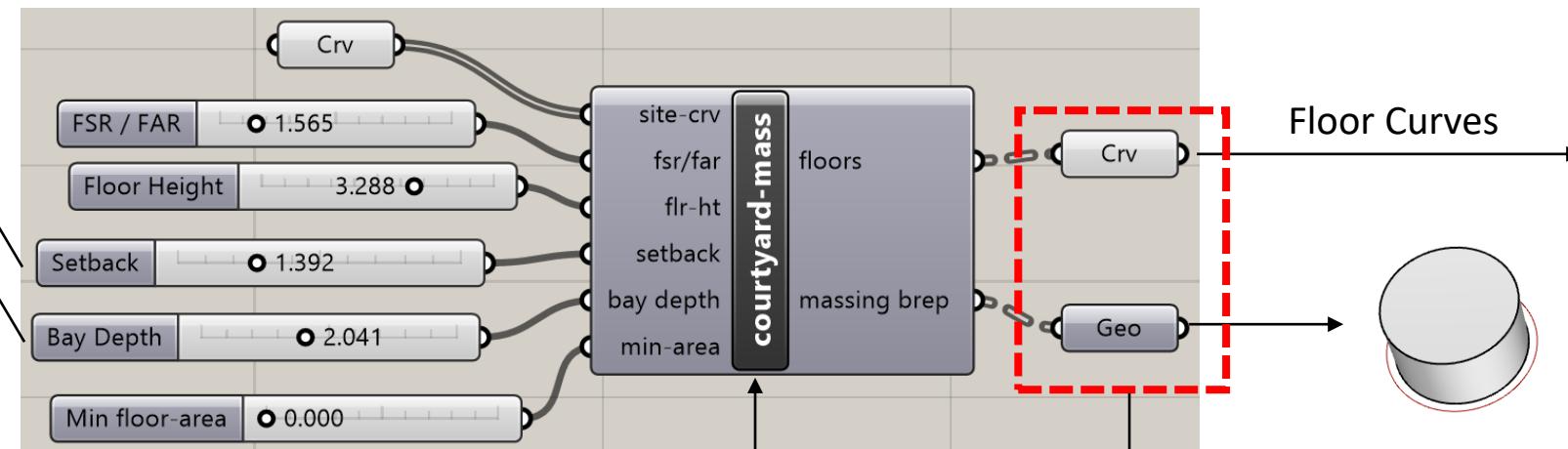
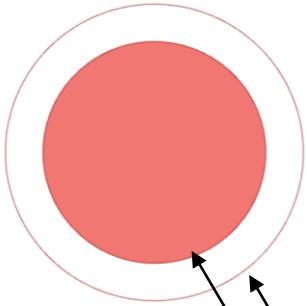
Massing Brep



Floor Curves



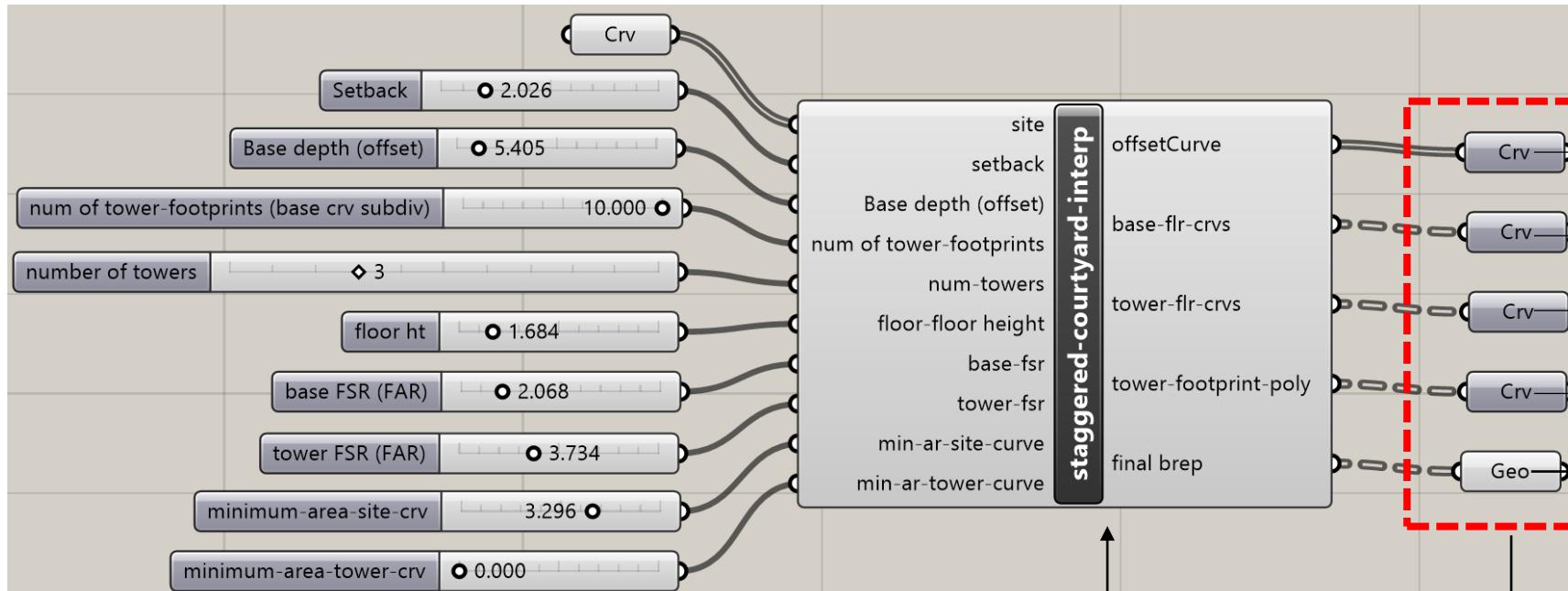
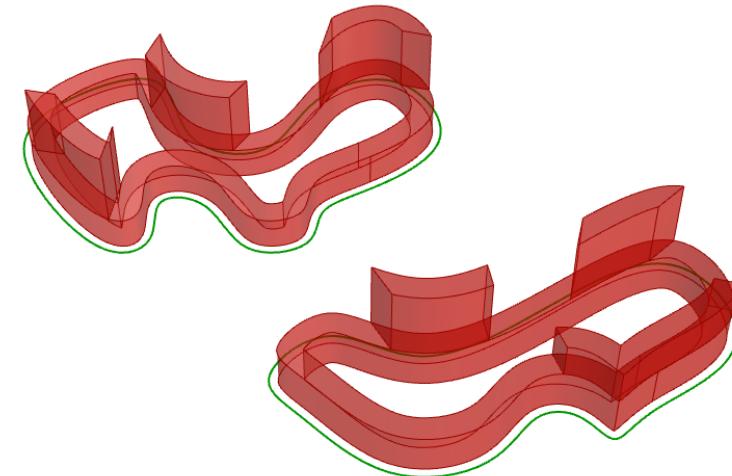
Massing Brep



Massing Brep

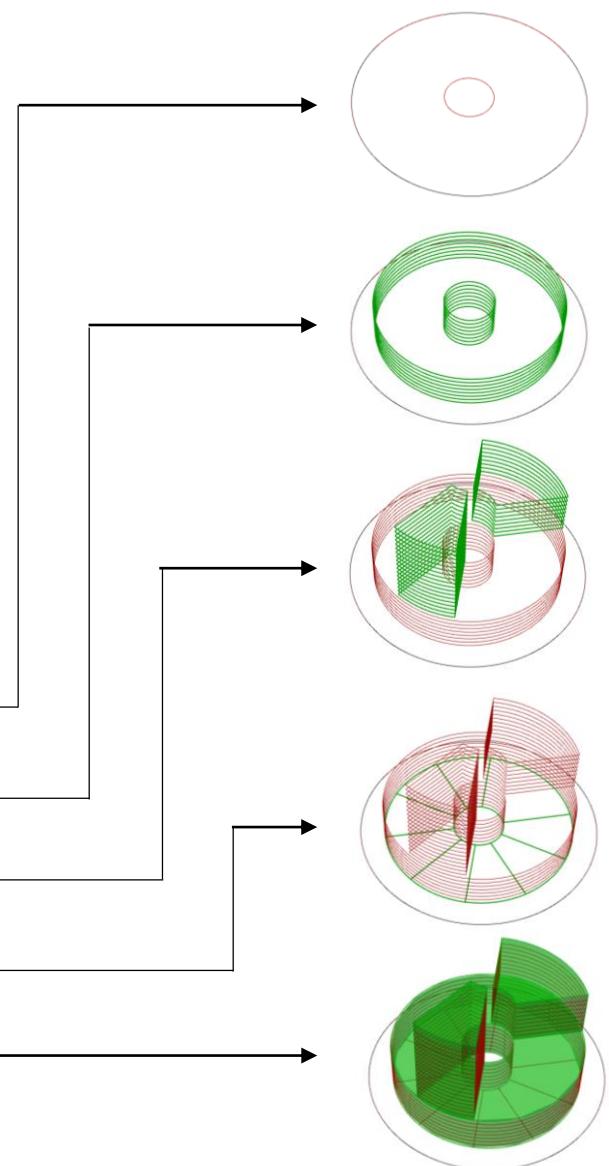
Set Preview to false

Use these to view results

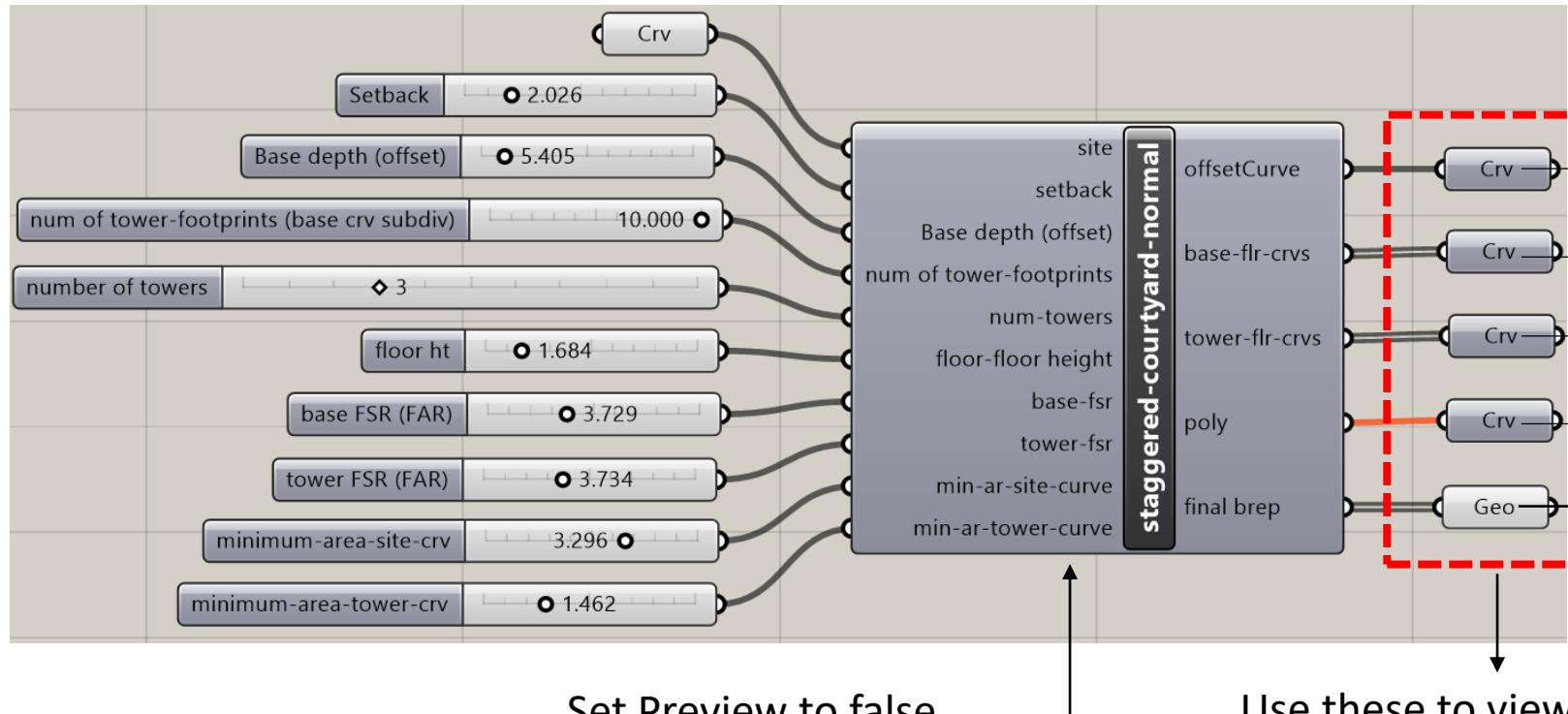
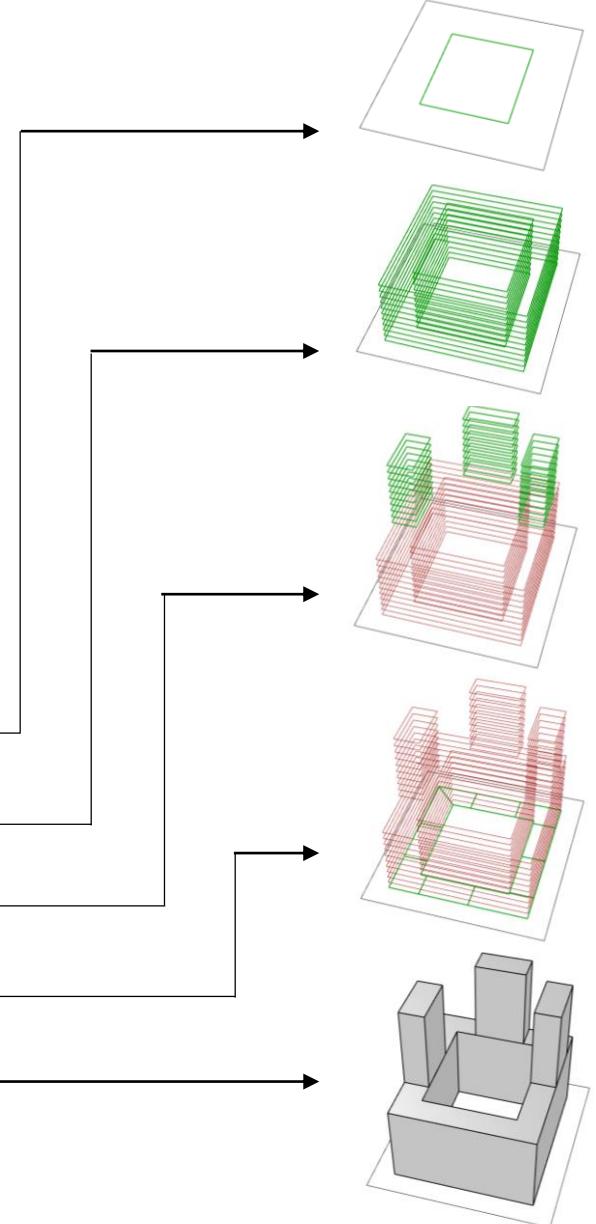
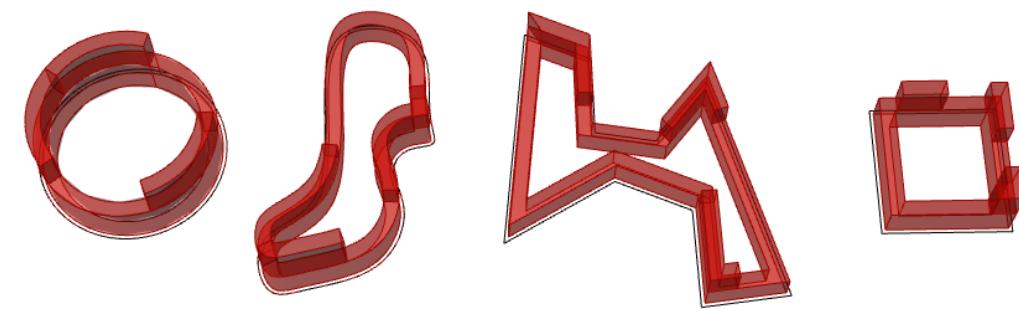
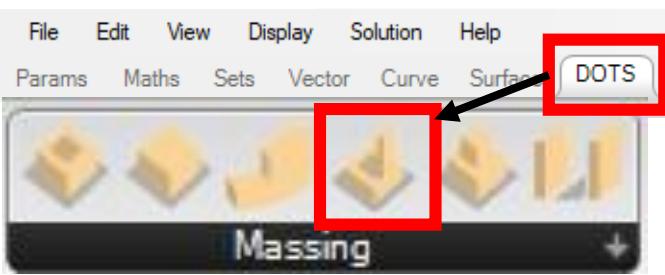


Set Preview to false

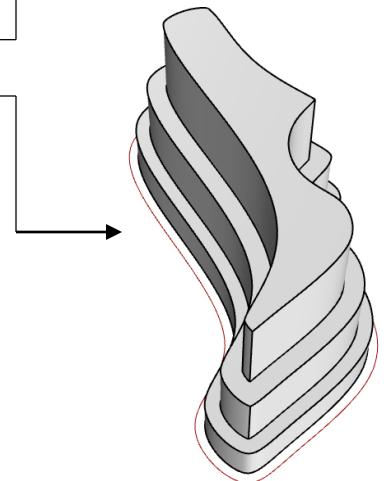
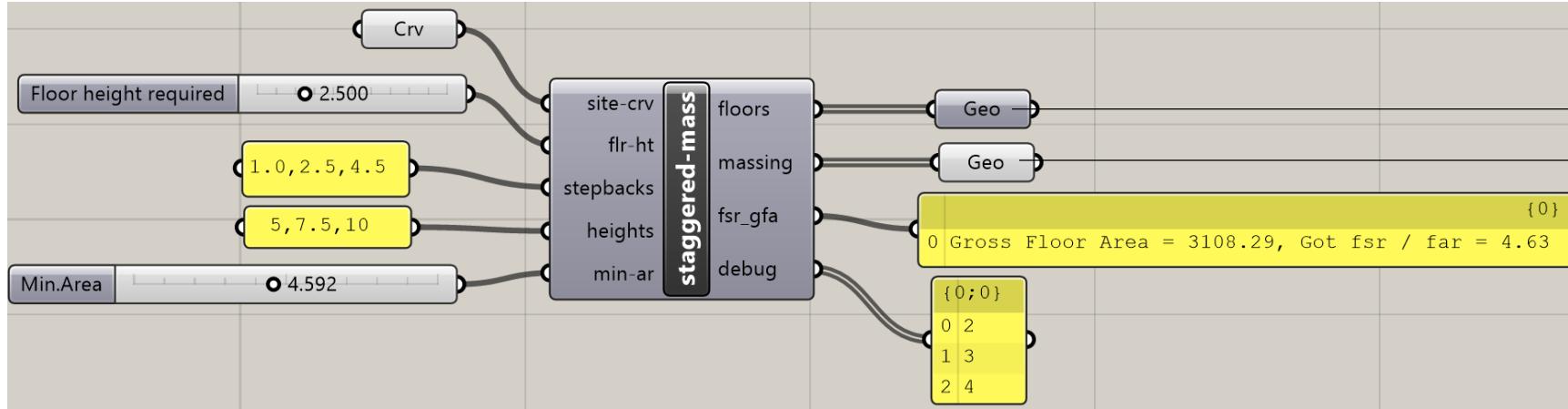
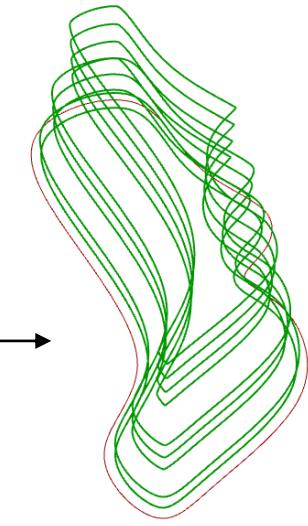
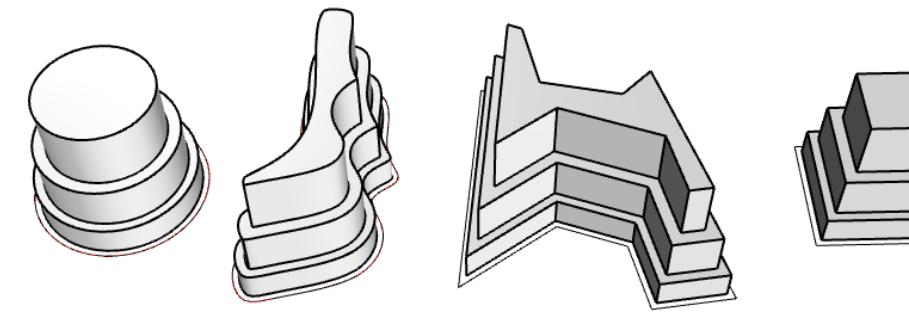
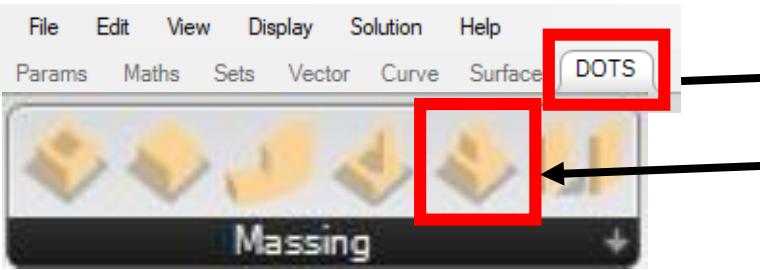
Use these to view results

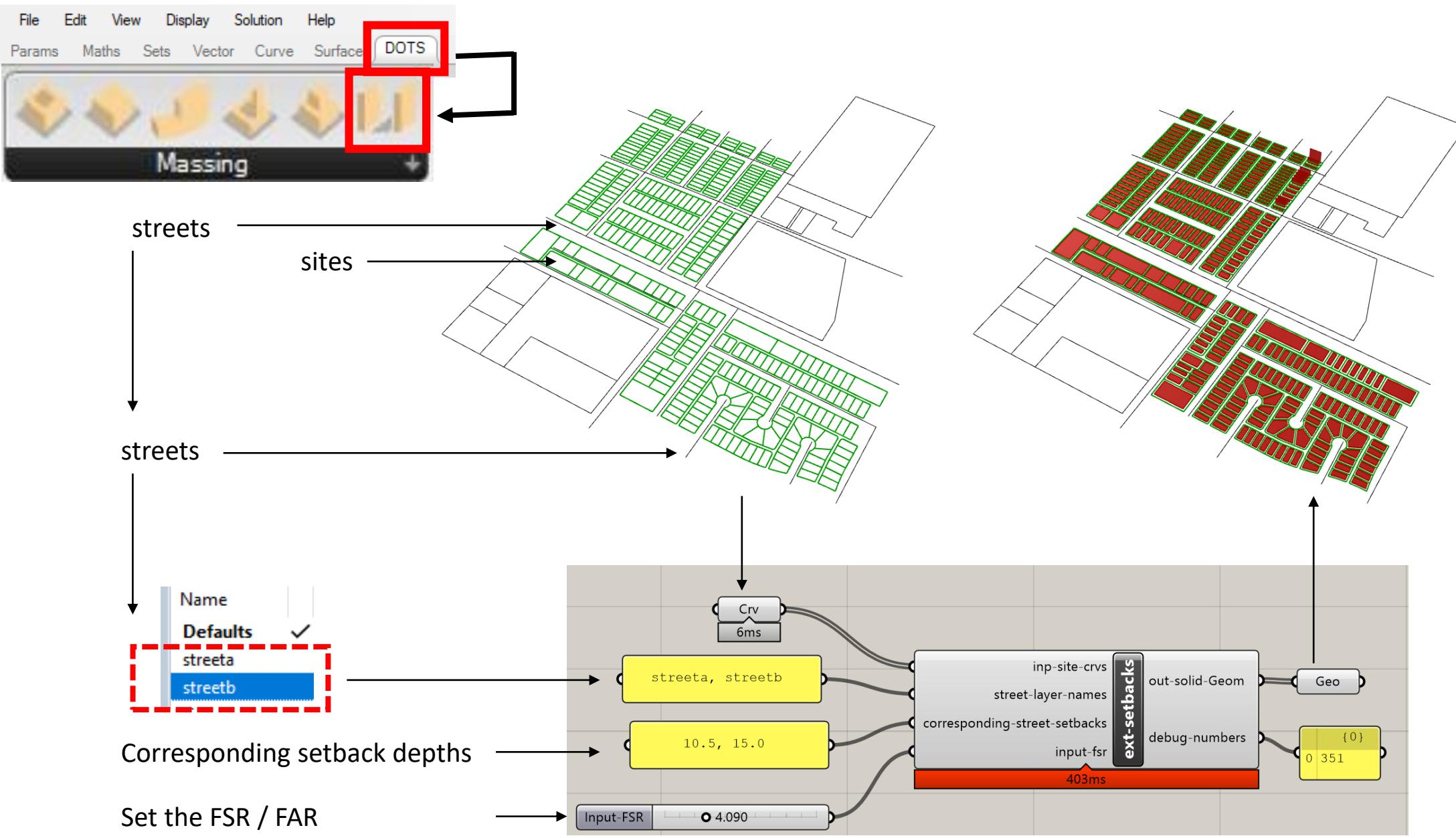


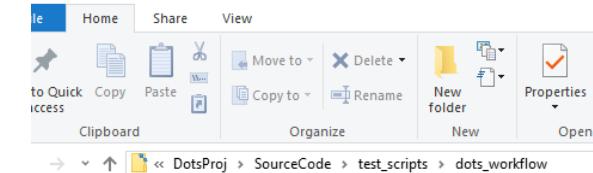
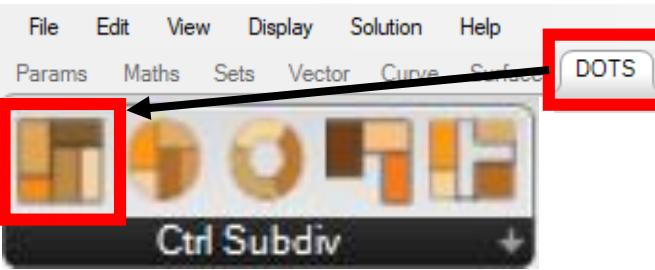
Grasshopper - dotsTest



Grasshopper - dotsTest





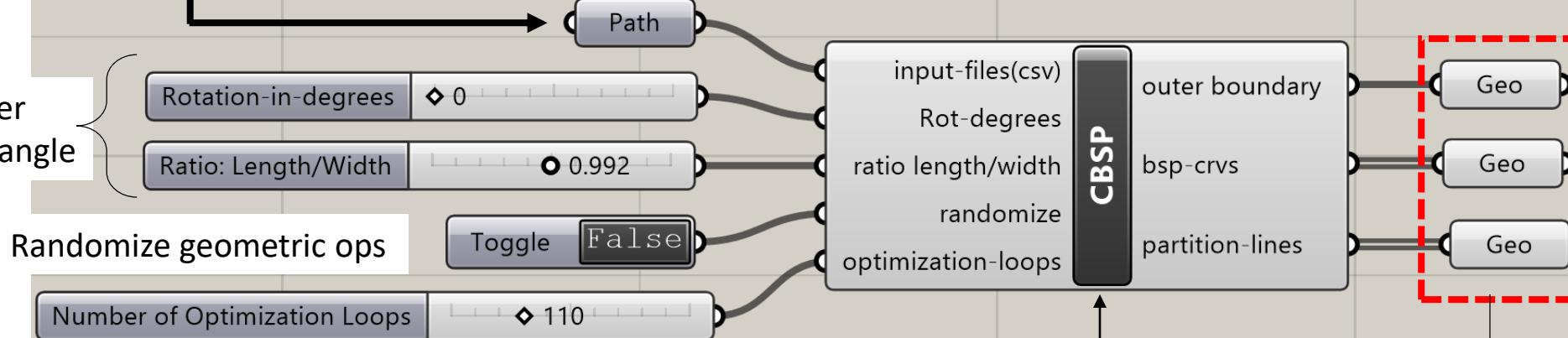


sample1.csv

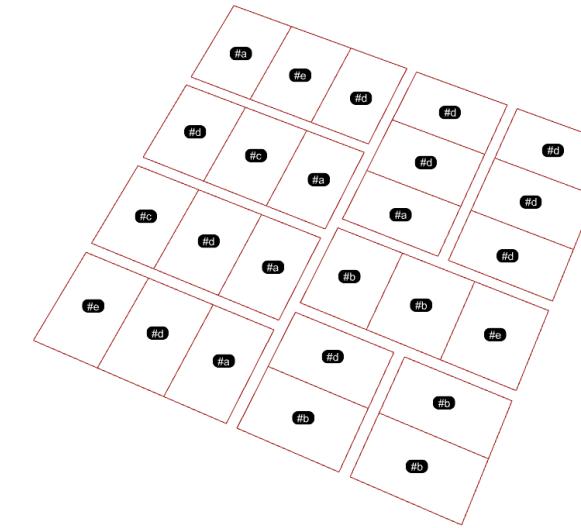
Right-Click:
“Set File Path”:
navigate to file

Name	Area	Number	Ratio	a	b
a	1000	5	0.25	0	0
b	1000	5	0.354	0	0

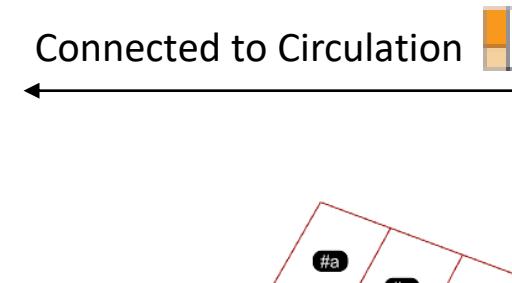
Outer rectangle



Set Preview to false



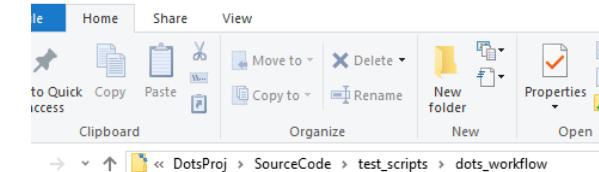
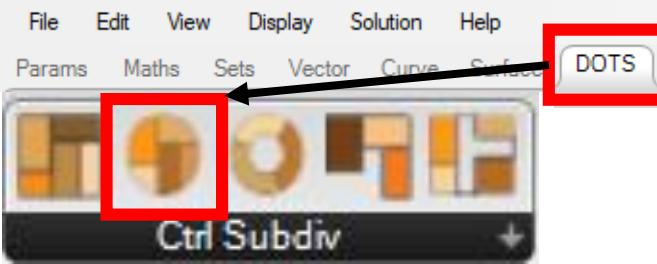
Connected to Circulation



Optimization iterations = max 500

Use these to view results

Grasshopper - dotsTest



Right-Click:
“Set File Path”:
navigate to file

Name	Area	Number	Ratio	a	b
a	1000	5	0.25	0	0
b	1000	5	0.354	0	0

Path: (red box)

Geo: (red box)

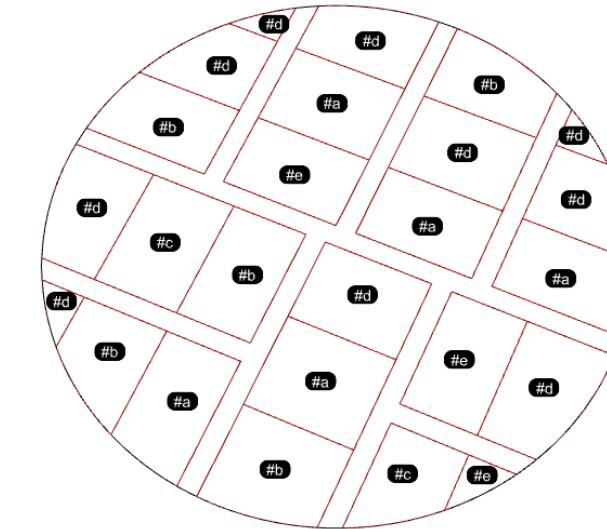
Rotation-in-degrees: 0.000

Randomize geometric ops: Randomize False

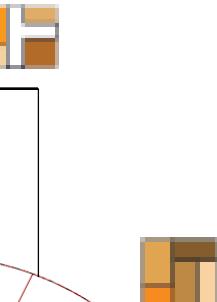
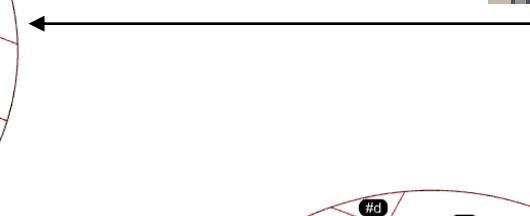
Number of Optimization Loops: 1

Optimization iterations = max 500

Set Preview to false



Connected to Circulation



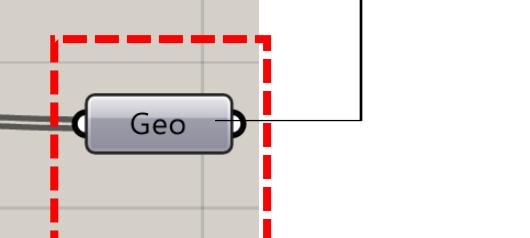
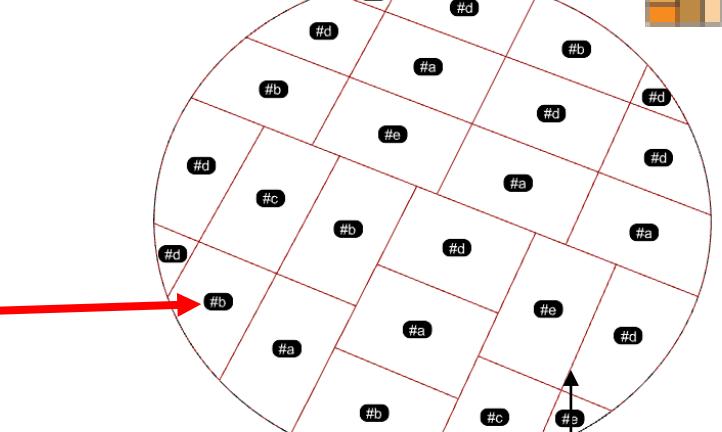
Name of space

input-files(csv)
input-site-crv
Rot-degrees
randomize
optimization-loops

cbsp-Site

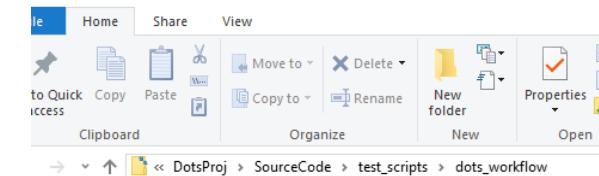
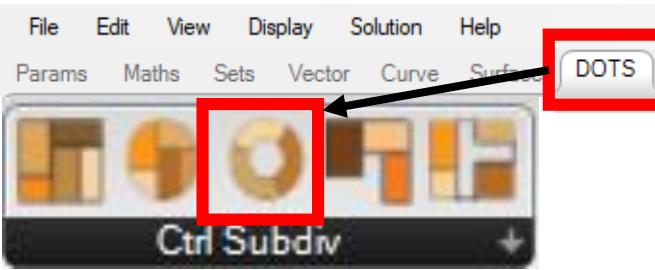
spatial-crv

circulation-lines



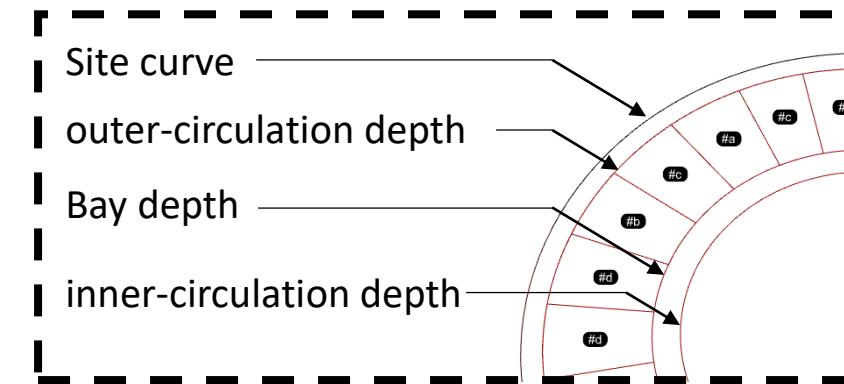
Use these to view results

Grasshopper - dotsTest

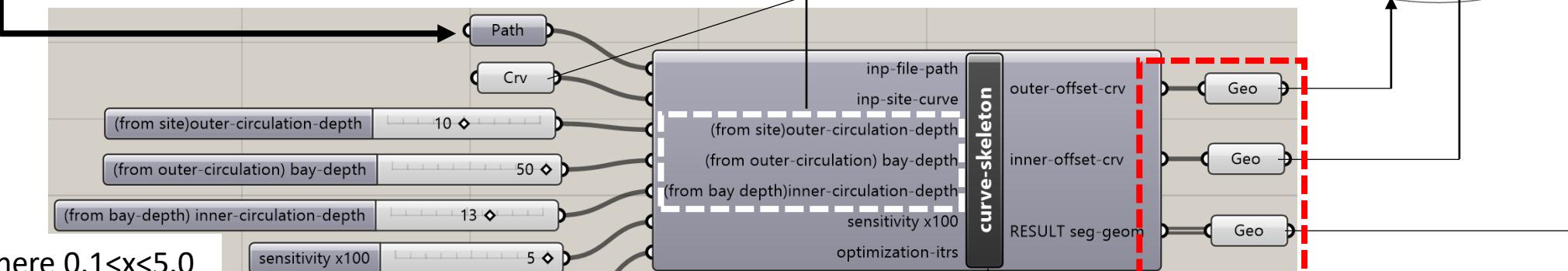
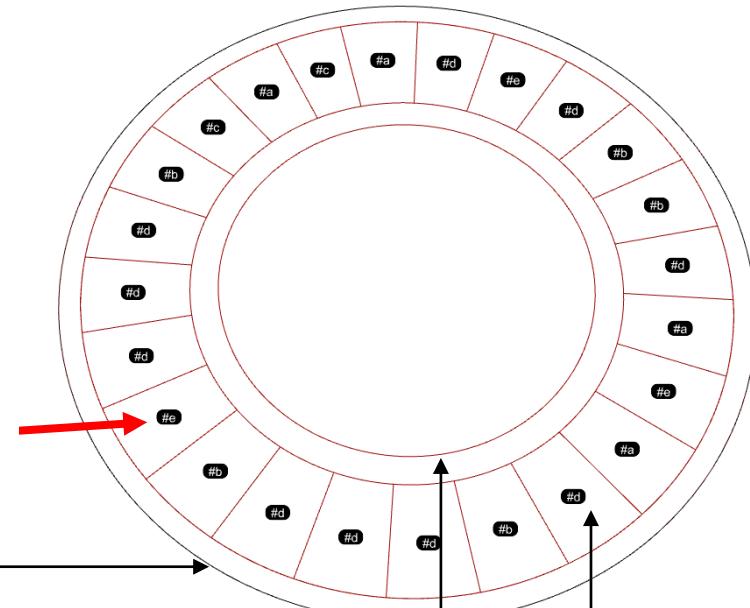


Right-Click:
"Set File Path":
navigate to file

Name	Area	Number	Ratio	a	b
a	1000	5	0.25	0	
b	1000	5	0.354	0	



Name of space

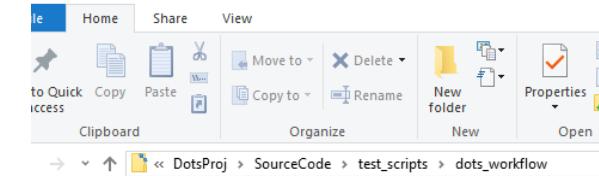
Sensitivity = x, where $0.1 < x < 5.0$

Optimization iterations = max 500

Set Preview to false

Use these to view results

Grasshopper - dotsTest



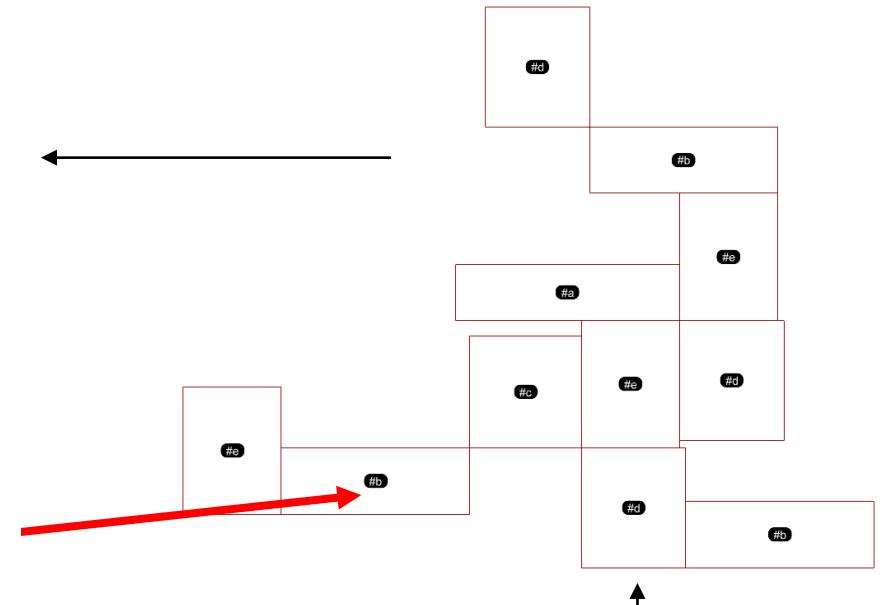
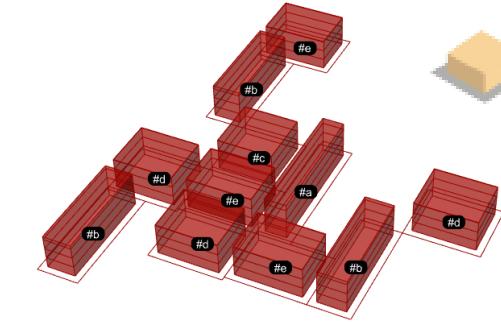
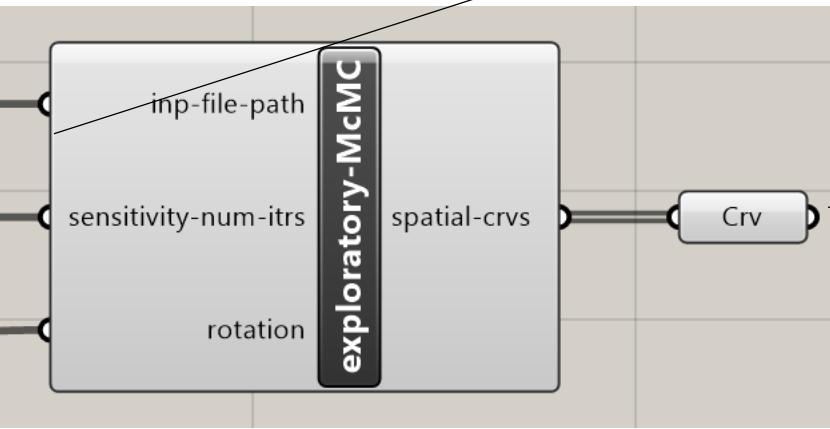
Right-Click:
"Set File Path":
navigate to file

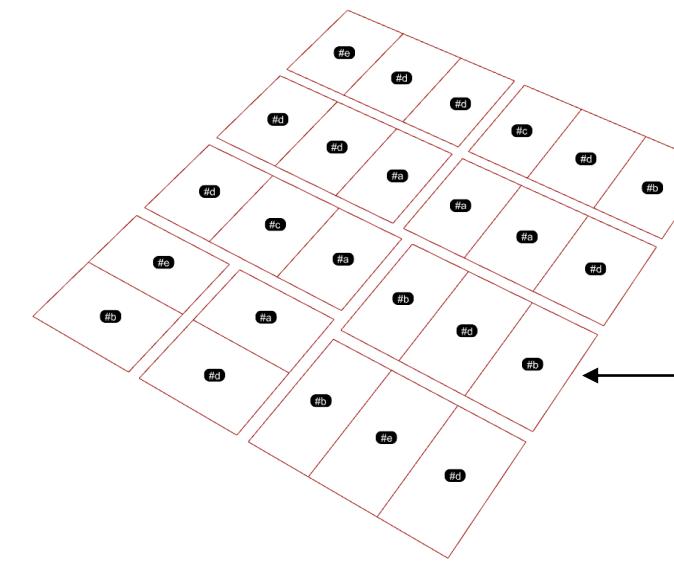
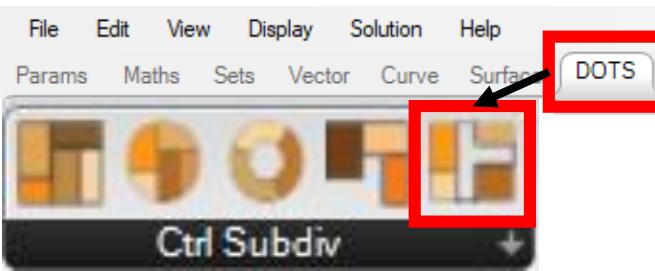
Name	A	B	C	D	E	
	Name	Area	Number	Ratio	a	b
a		1000	5	0.25	0	
b		1000	5	0.354	0	

Sensitivity = x, where $1 < x < 10$

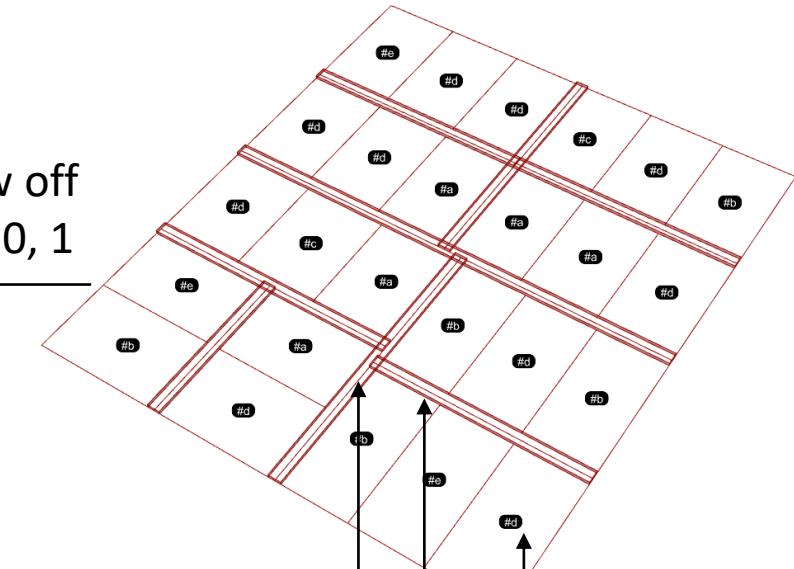
sensitivity-num-iterations

Rotation

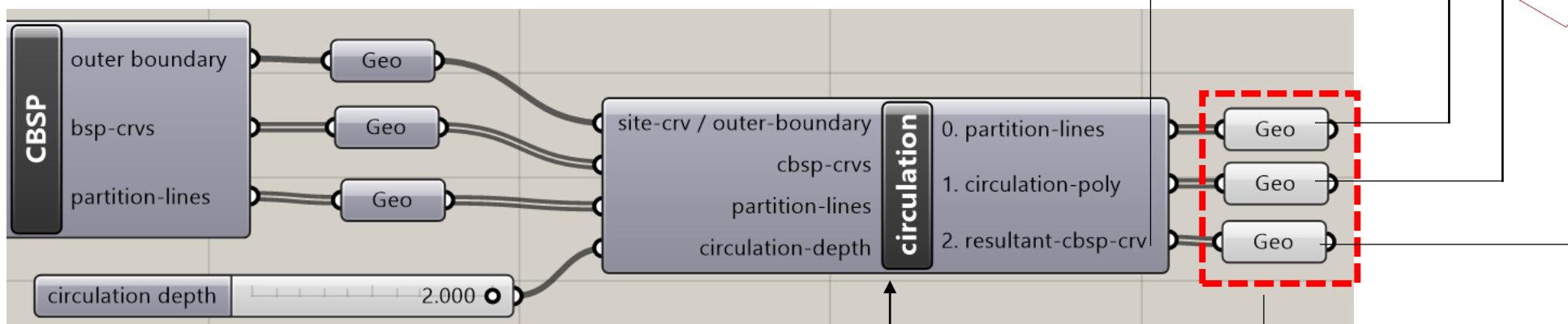




Preview off
output 0, 1



Ex. Previous Generative Component



Set Preview to false

Use these to view results