

SPLINE WALL

Grasshopper definition can be downloaded at: https://github.com/Elenabeth/Spline_Wall

Software:

Rhinoceros 3D (www.rhino3d.com)

Grasshopper (www.grasshopper3d.com)

Plugins:

Biomorpher (www.food4rhino.com/en/app/biomorpher)

Pufferfish (www.food4rhino.com/en/app/pufferfish)

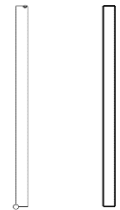
1. Create a new Rhino Document > Choose "Large Objects - Inches, Feet & Inches"
2. In the Front View, draw a rectangle that is 6 inches by 10 feet.

Type **RECTANGLE** - SPACEBAR/ENTER

Click on the screen on the location where you would like to draw the rectangle

Drag towards the direction of your desired shape and type **6"** - SPACEBAR/ENTER

Next type **10'** - SPACEBAR/ENTER



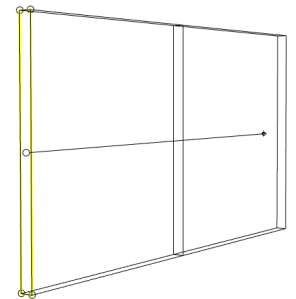
3. In the Perspective View, extrude the rectangle as a solid extrusion at a length of 20 feet.

Select the rectangle and type **EXTRUDECRV**

Toggle the option that says "Solid" to say "Yes"

Pull your cursor in the direction that you want to make the extrusion

Type **20'** - SPACEBAR/ENTER



4. In the Front View, use a polyline to define the section curves of the splines.

Turn Osnap (object snaps) on/ Turn Ortho off

(A) Type **POLYLINE** - SPACEBAR/ENTER

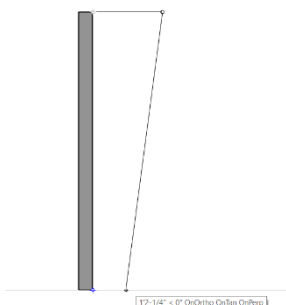
Snap-click to the top right-hand corner of the rectangle wall section and then define the section of the polyline curve as desired.

(B) Close the shape of the polyline by clicking until you return to the first point you created.

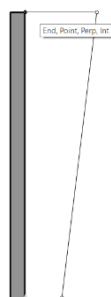
(C) Select the close polyline and insert a few edit points,

Type **INSERTEDITPOINT** - SPACEBAR/ENTER and click at desired locations

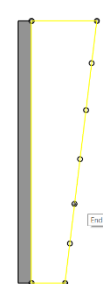
(A)



(B)



(C)



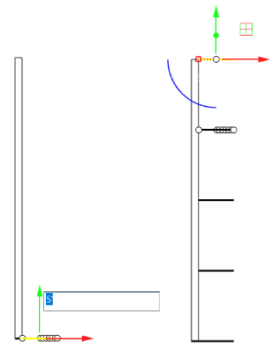
5. In the Top View, make four copies of the spline curve at 5 feet apart.

Start by selecting the spline curve you want to duplicate

Press **ALT** once and then click the gumball on the desired axis (the green Y axis)

Enter the units in the gumball's dialog box (5')

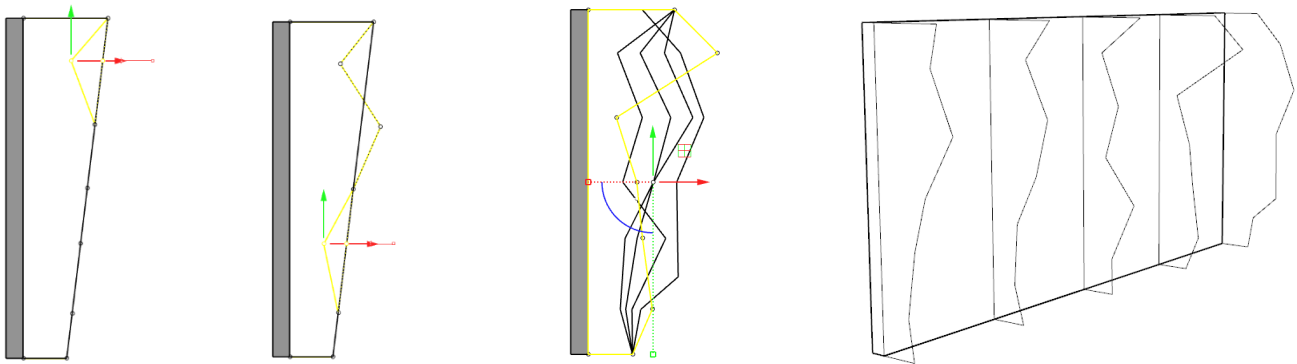
Repeat this process 3 more times for a total of 5 spline curves that span the 20' wall



6. Select one of the spline curves that you want to modify.

By clicking on the individual point, move the control points as desired to modify the spline

Repeat this process for each of the remaining spline curves until you have the desired variation



7. Now we are ready to start using Grasshopper to create the spline wall.

Launch grasshopper by typing **GRASSHOPPER - SPACEBAR/ENTER** in the Rhino command line

Open the grasshopper script "Spline_Wall_teaching-demo-EDI" (available on GitHub)

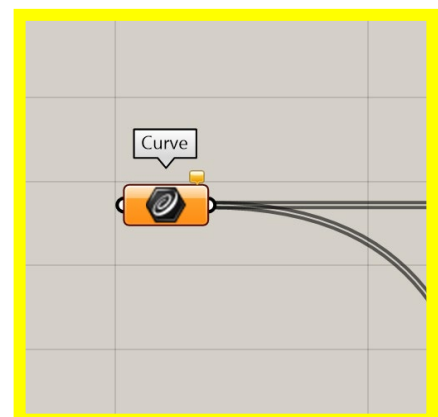
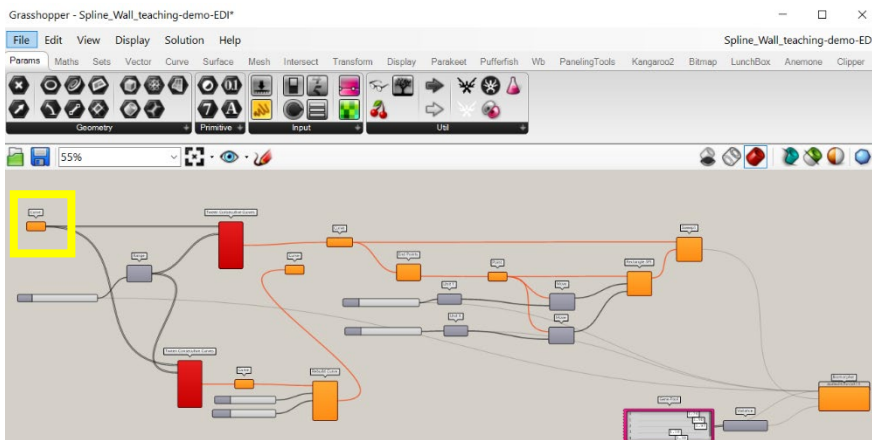
Navigate to the left-hand side of the grasshopper window and find the Curve Icon

Right-click on the curve icon and choose "Set Multiple Curves"

Navigate back to the Rhino workspace and select the 5 spline curves

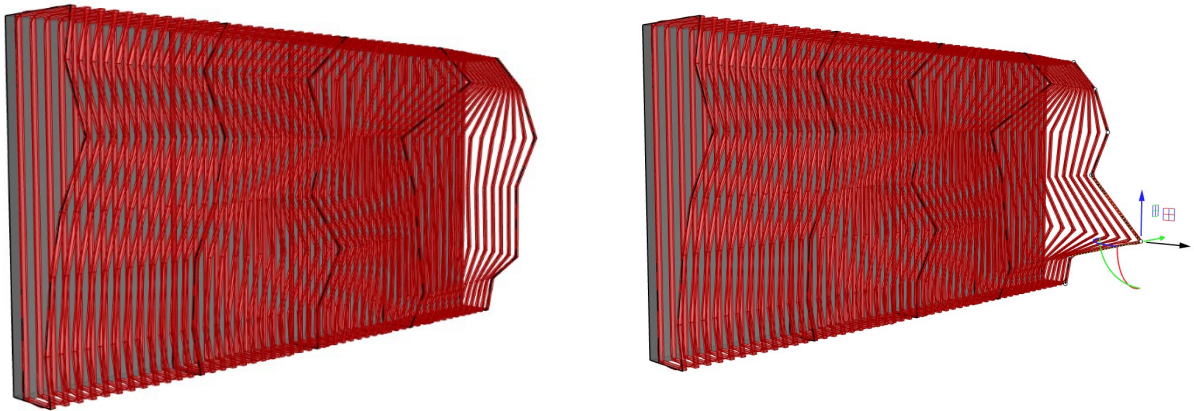
When you are done selecting the spline curves press **SPACEBAR/ENTER**

The icons should turn from orange to grey indicating they now have the required inputs



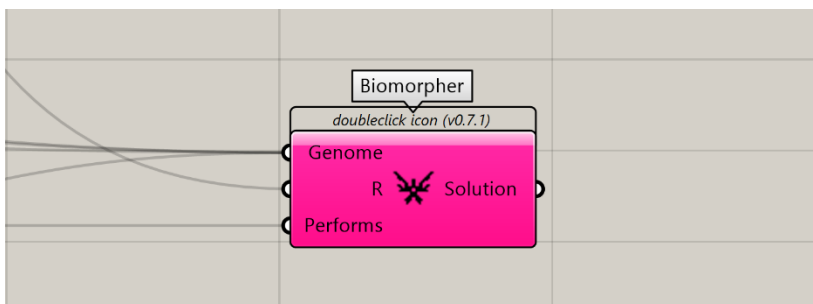
8. Adjust the spline curves for your desired design outcomes.

You should now see a preview of the geometry produced by the Grasshopper in the Rhino workspace
If you want to modify any of the spline curves, manually adjust the control points in Rhino as desired
As you adjust the control points, you will see the Grasshopper preview automatically update the preview



9. Use the Biomorpher component to create a set of distinct design iterations.

Double-click on Biomorpher component to initiate interactive genetic algorithm
Adjust the settings as desired (see sample settings on the right)
A larger the population will generate a more diverse sample pool of designs
Play around with the mutation rate, crossover rate, and population size
These settings can have a large impact on the time it takes to compute
ALWAYS SAVE BEFORE USING THE BIOMORPHER PLUGIN!!!!
Depending on complexity and computing power this may take several minutes



Initial Settings

Choose the initial population size and mutation rate. During evolution, mutation rate can be altered whereas population size cannot.

Population size 24

Crossover rate 0.30

Mutation rate 0.10

GO GO

Random Current

K-means Clusters

Designs are clustered into 12 groups based on parameter similarity. Click on the 'design' tab to see representative closest to each group centroid.

Show all 12 cluster centroids in history ☒

Disable Grasshopper preview (faster) ☒

Mutate elite (fittest) designs ☒

Brightness 1.00

10. Once the Biomorpher Interactive Genetic Algorithm has finished computing explore your design outcomes.

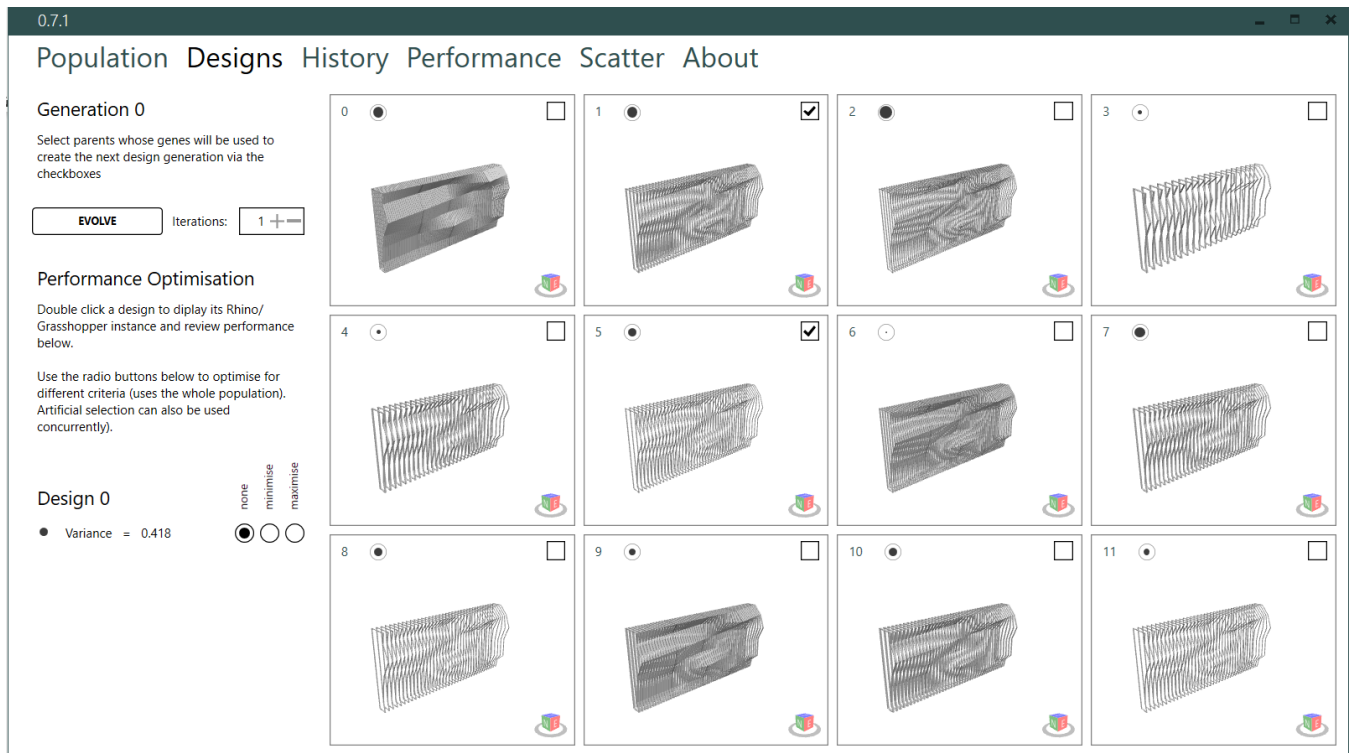
Select the "Design" tab from the top of the Biomorpher dialog window
To see one of the design outcomes in more detail click on the design of interest
This will create a preview of your selected design in the Rhino workspace and allow you to examine the Grasshopper settings that were used in the Grasshopper workspace

11. Select the “parent” designs you want to use for “artificial selection” process

After examining the design outcomes, select the most promising designs

These genes will be used to produce the next generation of design outcomes

Press EVOLVE to initiate a new iteration of design outcomes.



12. Create your final design outcome.

Once you have settled on a design you are happy with, we will need to “Bake” the geometry

“Baking” brings the geometry from the Grasshopper preview into the Rhino workspace

Select the “Sweep1” component, right-click and choose **BAKE**

During this process you can assign the output to a specific layer and group the geometry

You can now modify and/or render the geometry in the Rhino workspace

