SPLINE WALL

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

Software: **Plugins:**

Rhinoceros 3D (www.rhino3d.com)   Biomorpher (www.food4rhino.com/en/app/biomorpher)
Grasshopper (www.grasshopper3d.com)   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] (to accept)
> Click on the screen at the location where you would like to draw the rectangle
> Drag towards the direction of your desired shape and type **6"** [SPACEBAR/ENTER]
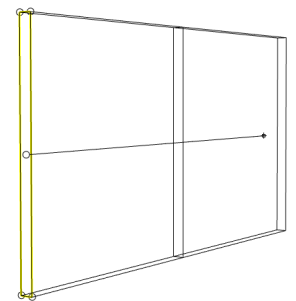> Next type **10'** [SPACEBAR/ENTER]
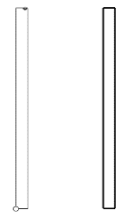
3. In the Perspective View, extrude the rectangle as a solid extrusion at a length of 20 feet.

> Select the rectangle and type **EXTRUDECRV**
> Toggle the option that says "Solid" to say "Yes"
> Drag 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 (*if you want)
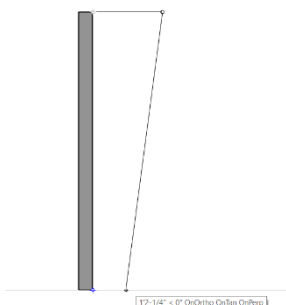> (A) Type **POLYLINE** [SPACEBAR/ENTER]
> Snap-click to the top right-hand corner of the rectangle wall section and then define the polyline as desired
> (B) Close the shape of the polyline by clicking until you return to the first point you created
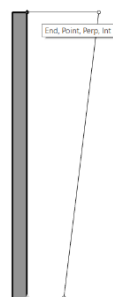> (C) Select the closed polyline and insert a few edit points
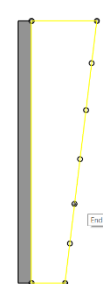> Type **INSERTEDITPOINT** [SPACEBAR/ENTER] and click at desired locations

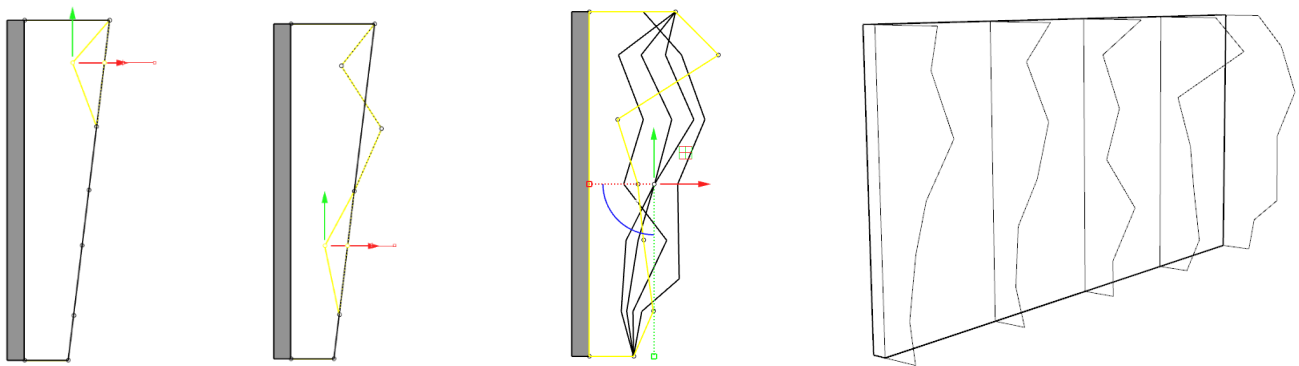(A)   (B)   (C)

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 an 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.gh" (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
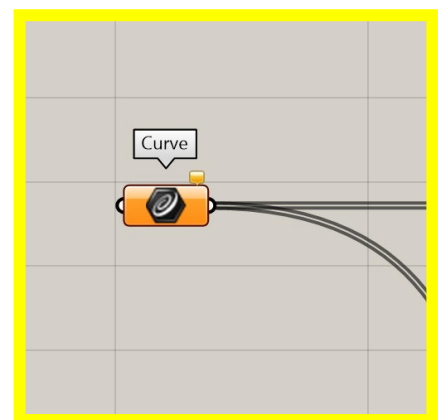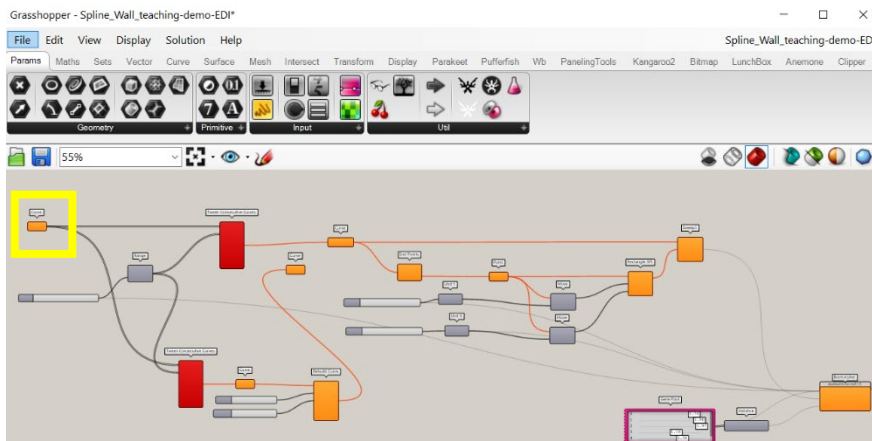
8. Adjust the spline curves for your desired design outcomes.

> You should now see a preview of the geometry produced by 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
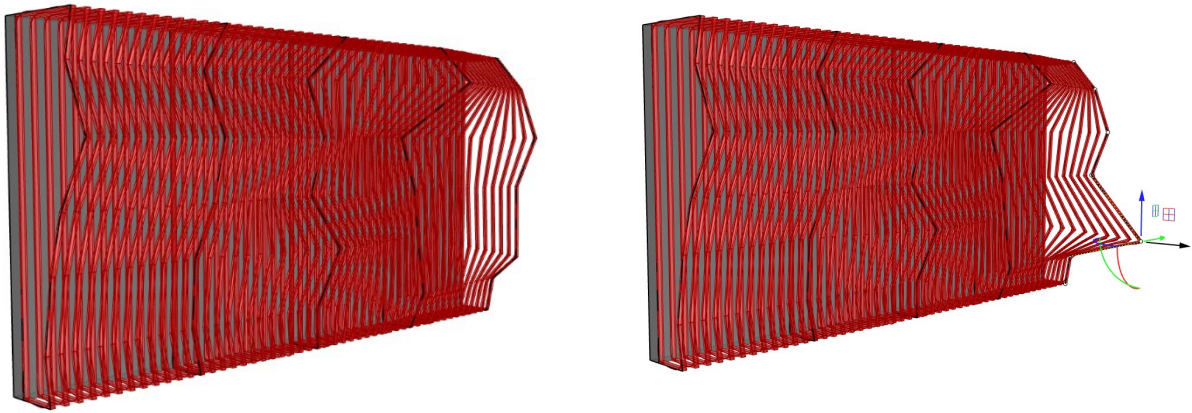
9. Use the Biomorpher component to create a set of distinct design iterations.

> Double-click on Biomorpher component to initiate interactive genetic algorithm
>
> Adjust the settings as desired (see sample settings on the right)
>
> A larger 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
>
> <u>ALWAYS SAVE BEFORE USING THE BIOMORPHER PLUGIN!!!!</u>
>
> Depending on complexity and computing power this may take several minutes
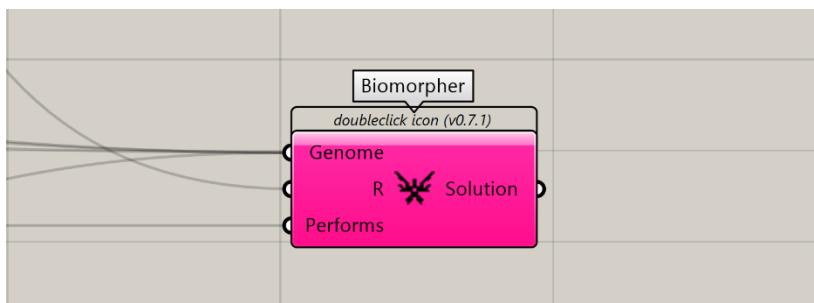
Initial Settings

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 the "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
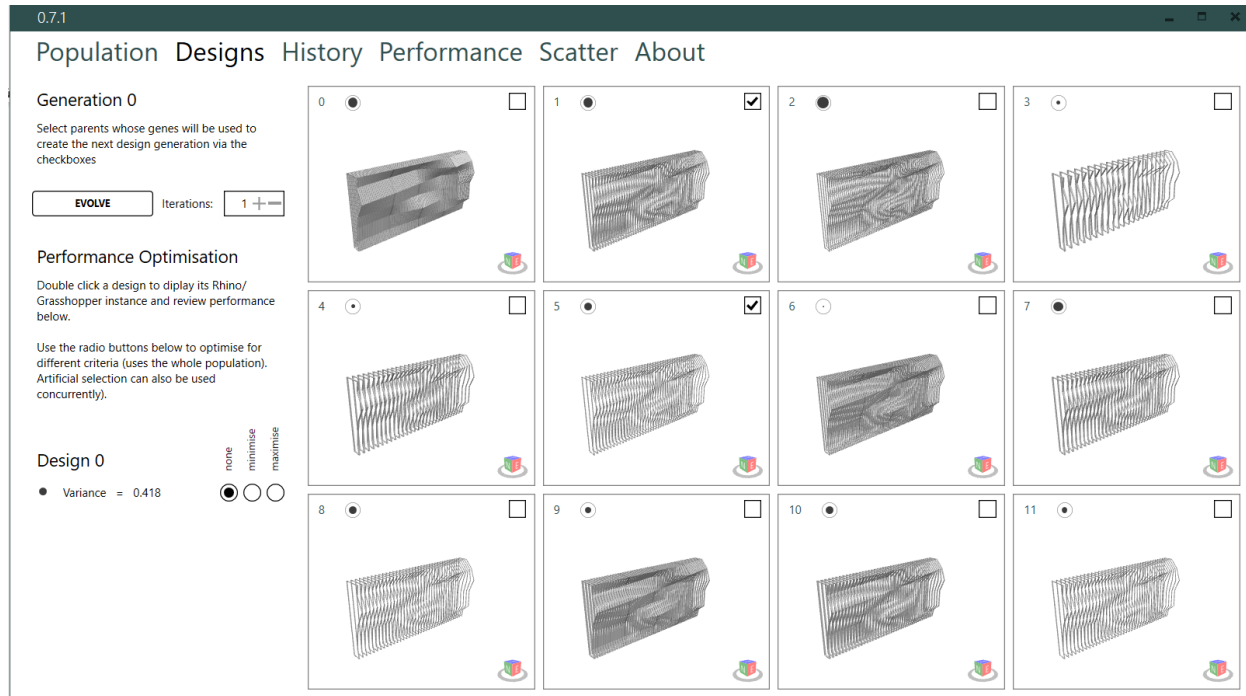
12. Create your final design outcome.

Once you have settled on a design you are happy with, you 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