



Building the Isocurve

Looking at a surface in Rhino gives you some obvious information what it is made of. Isocurves running in u and v direction not only represent but also generate the surface. Based on three degree curves in u direction the surface is represented by three degree curves in v direction as well, it is curved in both directions.

The first case study model will be based on extracted isocurves manifested into physical space. The following tutorial will explain you step by step how to build and align a curvilinear form into space.

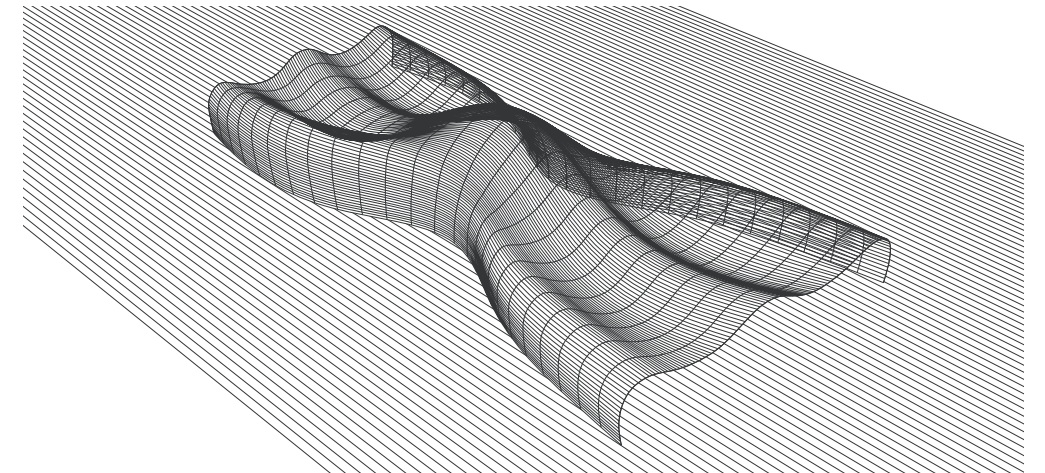
Extract Isocurve

We start extracting Isocurves in the u-direction in RHINO.

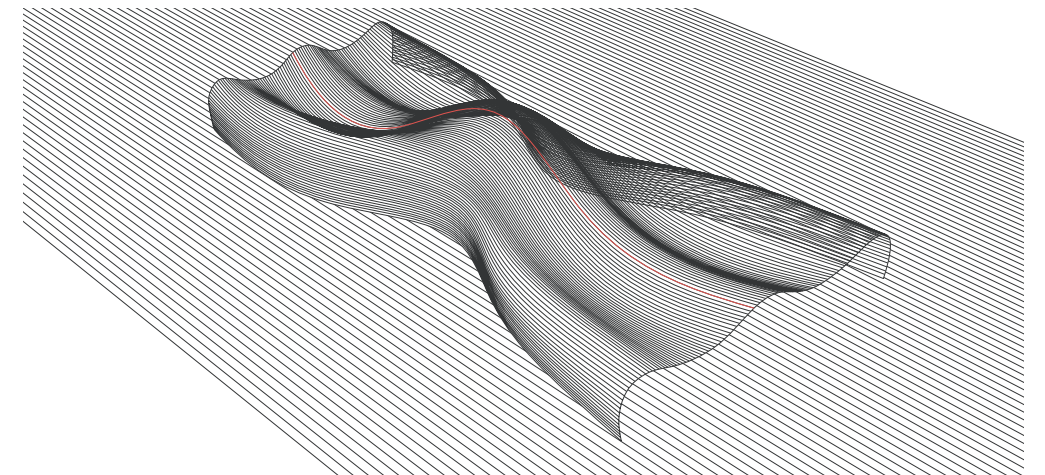
1.
Click on:
"Curve >> Curve from Objects >> Extract Isocurve"
2.
At the "Select surface for isocurve extraction:" prompt, choose your surface. At that point you can switch between u and v direction by clicking on the letters in the Command Line.
3.
When moving your mouse over the surface the Isocurves are highlighted in yellow. Click to choose the desired Isocurve for extraction and press "Enter" or right mouse button (RMB) to confirm your choice.
4.
The extracted Isocurve will be represented by a new curve independent from the surface.



Physical model: The Wave, ABB Architekten/Bernhard Franken



Surface with isocurves in u and v-direction



Surface with isocurves in u-direction/Extracted isocurve



Project Isocurve

The Isocurve is a curvelinear object in space. To reduce complexity we can project it to a Construction Plane called CPlane in RHINO. After projection the curve is only curved in x and y direction but not in z direction any more

1.

In Top or Perspective View click on:

"Transform>> Project to CPlane"

The CPlane of the Top and Perspective View is a horizontal plane on $z = 0$.

2.

The projected curve is a 2dimensional derivative of the original curve without z coordinates.

The projected curves will later be used as a sort of "floorplan". In the next step we use them to create a new Surface.

Create a single-curved Surface

By creating a Loft-Surface between the original and the projected Curve we will get a single-curved Surface. The new Isocurves connecting both curves are a linear interpolation. Only one direction of the Surface is curved.

1.

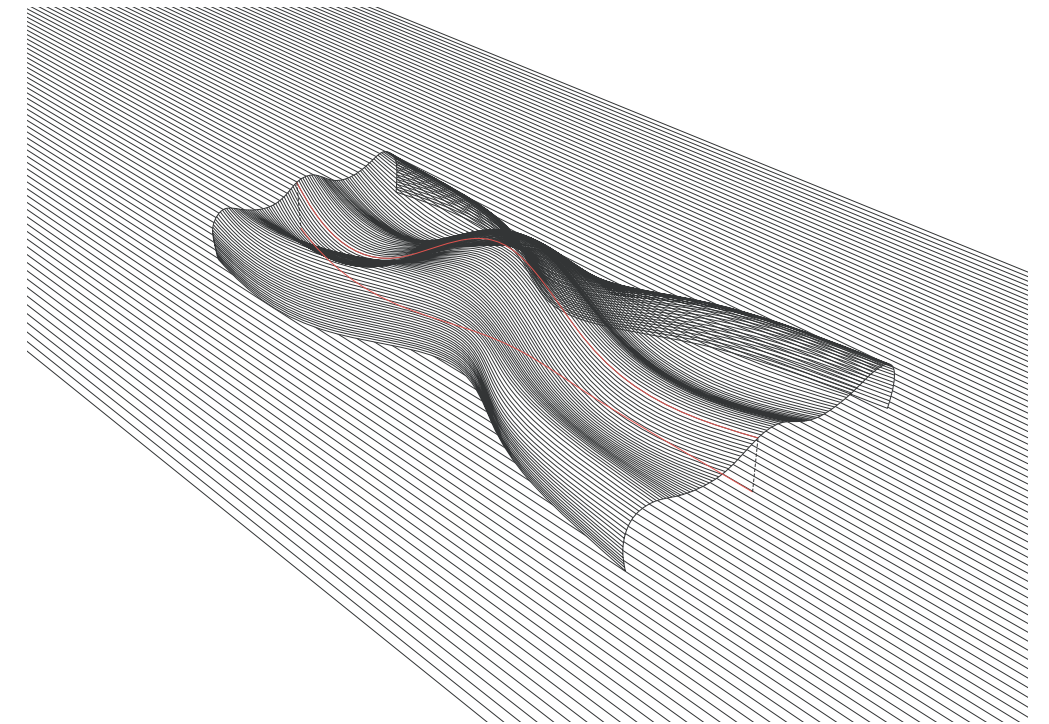
Choose original and projected Curve and click on:

"Surface>>Loft"

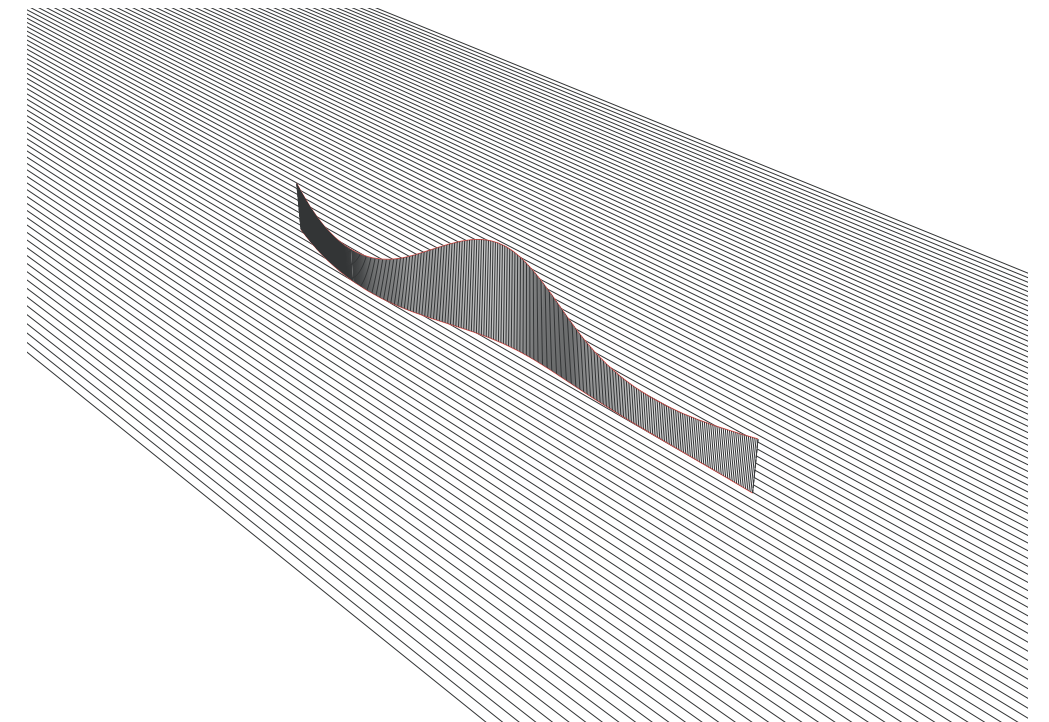
You will see a preview of the new surface and a small window popping up.

2.

If the previewed Surface looks ok, press the OK button in the small window.



Projected isocurve



Loft surface between original and projected isocurve



Unroll the Surface

Once more we are now able to reduce complexity: Since the new Surface is only curved in one direction it is developable. This means the surface can be unrolled into a planar surface without stretching or compressing. The original size stays the same. This allows us to use sheet material like cardboard to build this surface and bend it back into its original shape in the next step.

1.

Click on:

"Surface >> Unroll Developable Srf"

Choose the new surface and press "Enter" or the RMB.

A new planar surface will be generated and placed at the origin of your file.

2.

In the Top view window choose the unrolled Surface and click on:

"File >> Export".

Choose DWG or DXF and export the file to AutoCAD. Print the outline of the Surface on cardboard and cut it out.

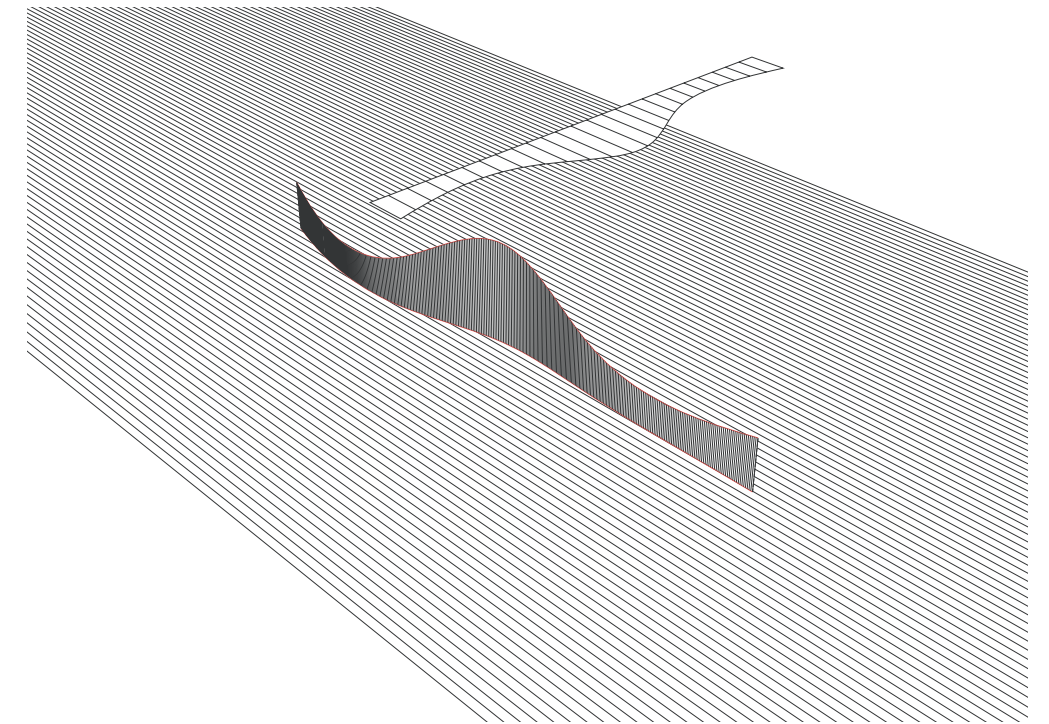
Built the Isocurve Lattice

The planar cardboard stripes can now be bend in the shape of our projected Isocurves from the beginning. They act now as a floorplan defining the bending in x/y direction. Since the upper edge of the cardboard stripe is curved in z direction we now the the curvelinear direction of the original Isocurve in physical space. This lattice can be used to align a linear material like polystyrol on top. Before repeating these steps for the v direction offset your original surface corresponding to your material thickness this will avoid intersections of both directions (Intersections are easy in the digital model but they are a mess in the physical one leading to imprecise objects.

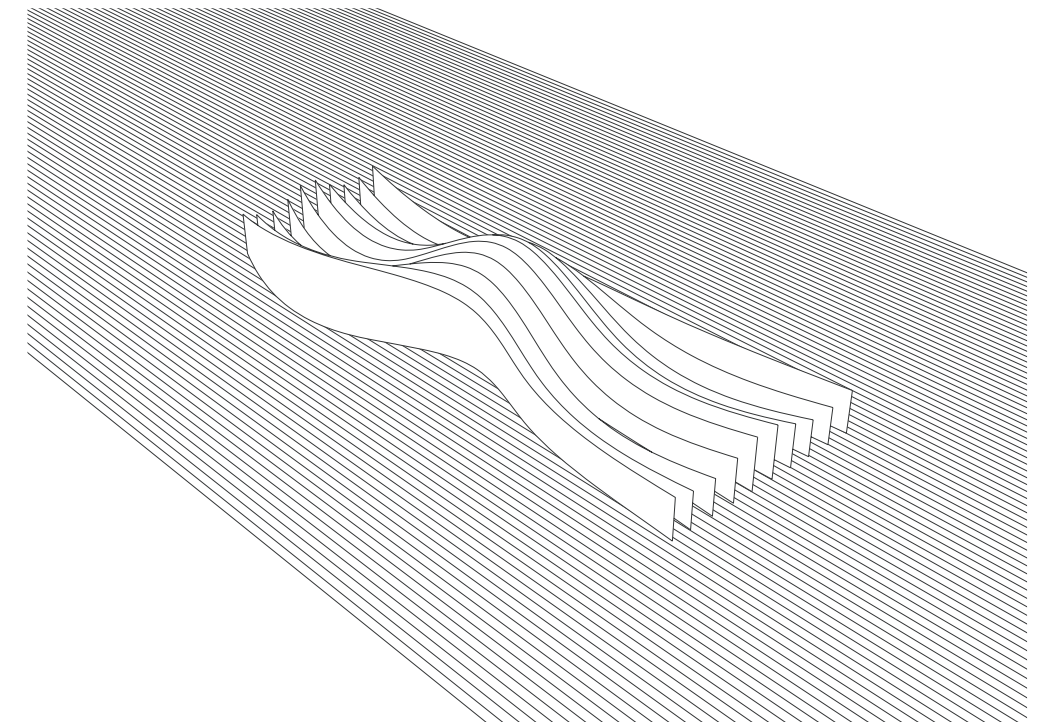
1. To Offset a surface click on:

"Surface >> Offset Surface"

At the "Offset distance" prompt, enter the thickness of the material you are going to use to build your model.



Original and unrolled surfaces



Reverse engineering double curved lines in space