

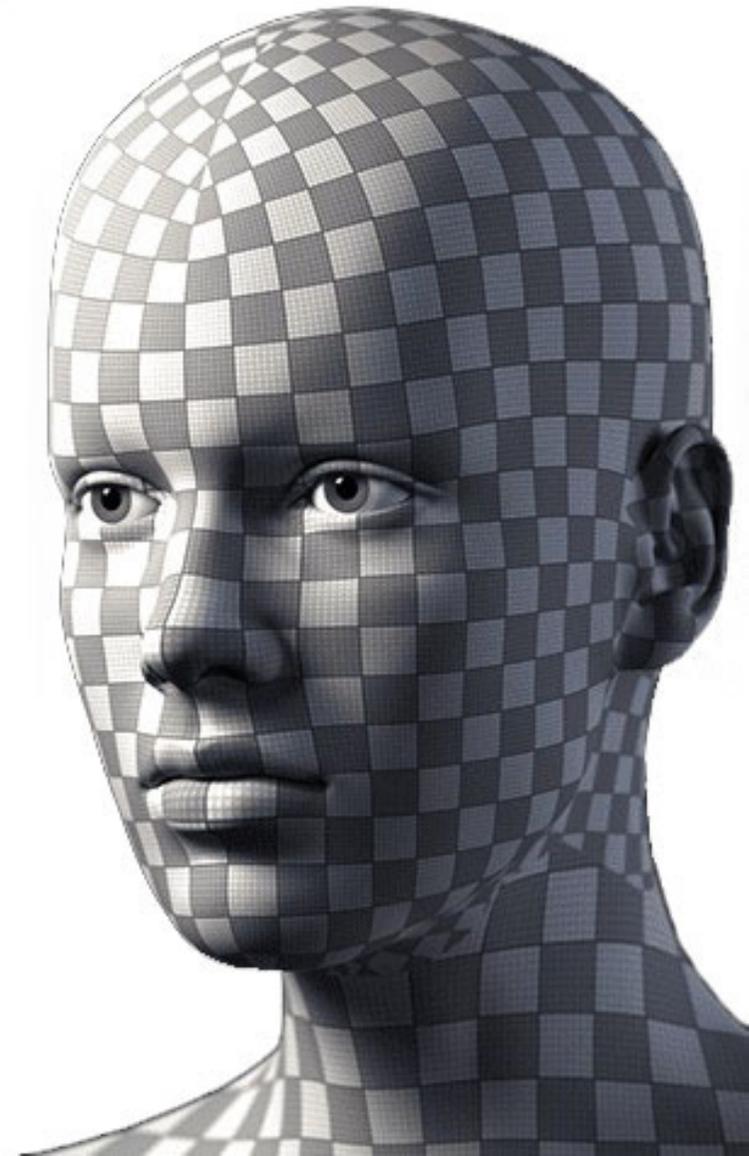
UV mapping

In Grasshopper

Dóra Varga

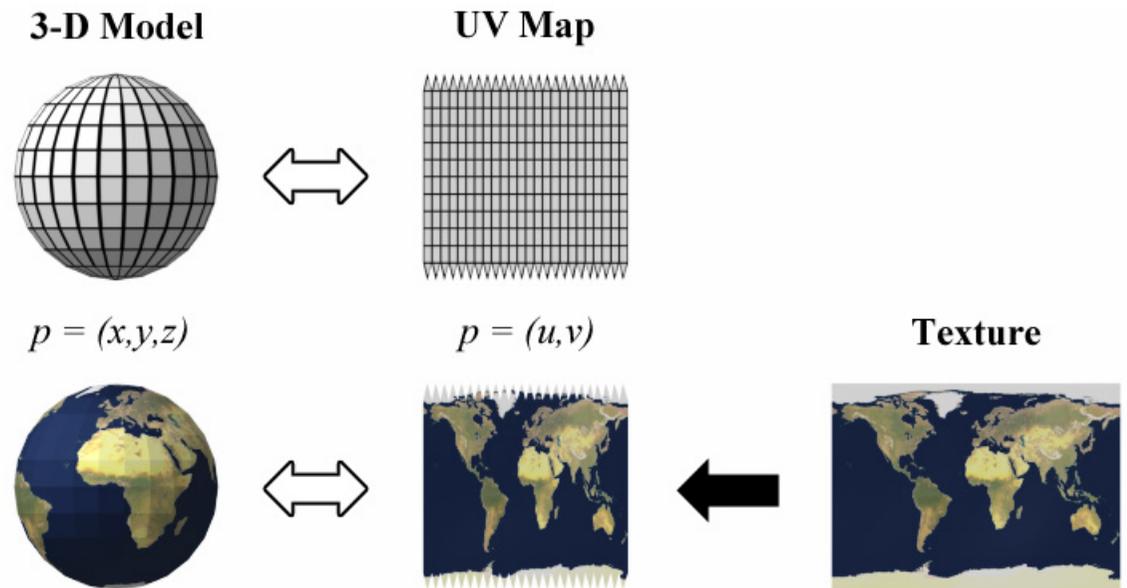
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zs 2020/21



UV mapping is the process of projecting a 2D image onto a 3D model's surface.

The process allows to correctly place a texture on a model without any deformations.

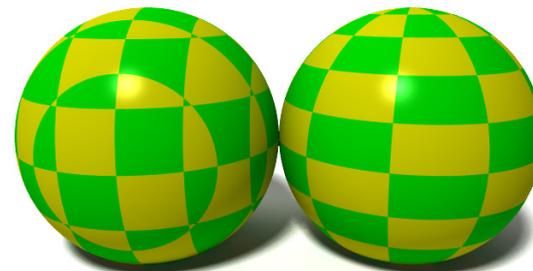


Examples:

Texture mapping on plain sphere:
-on the left: incorrect mapping
-on the right: correct mapping



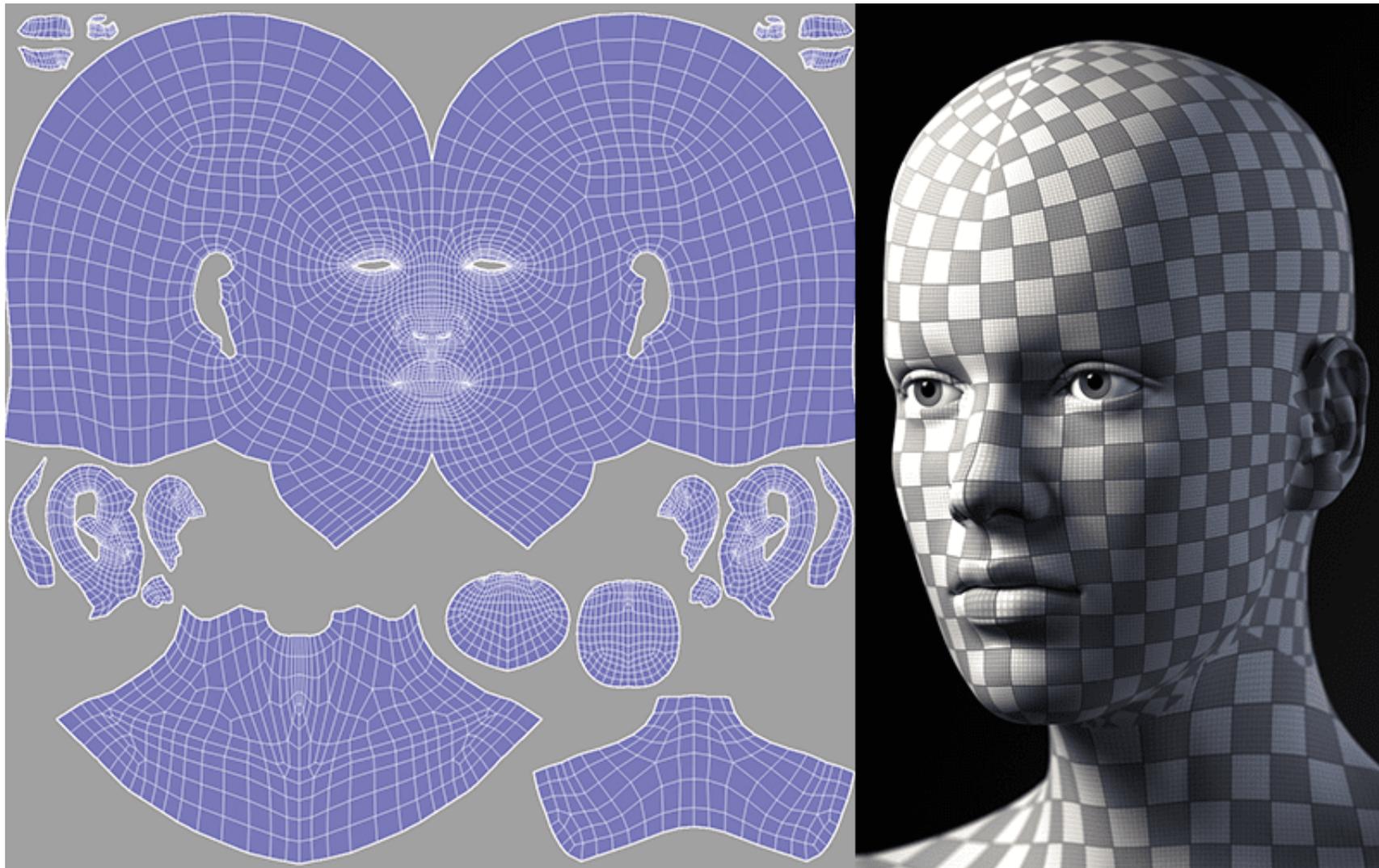
Checkered texture on sphere:
-on the left: without UV mapping
-on the right: with UV mapping

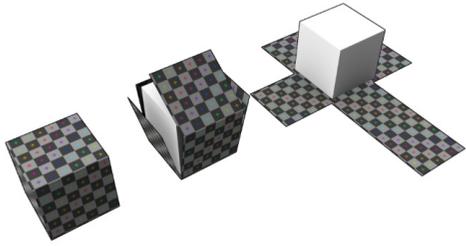


What are UVs?

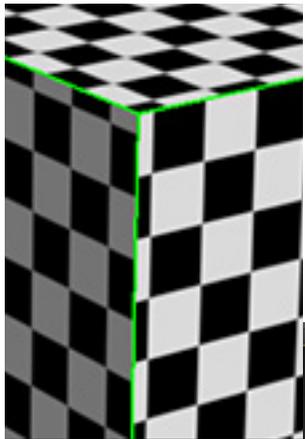
By unwrapping the models surface onto a 2D space, we produce UVs. UVs act like marker points that controll which points on the texture correspond to which points on the mesh.

A complex model with its unwrapped surface (UVs) on the left:





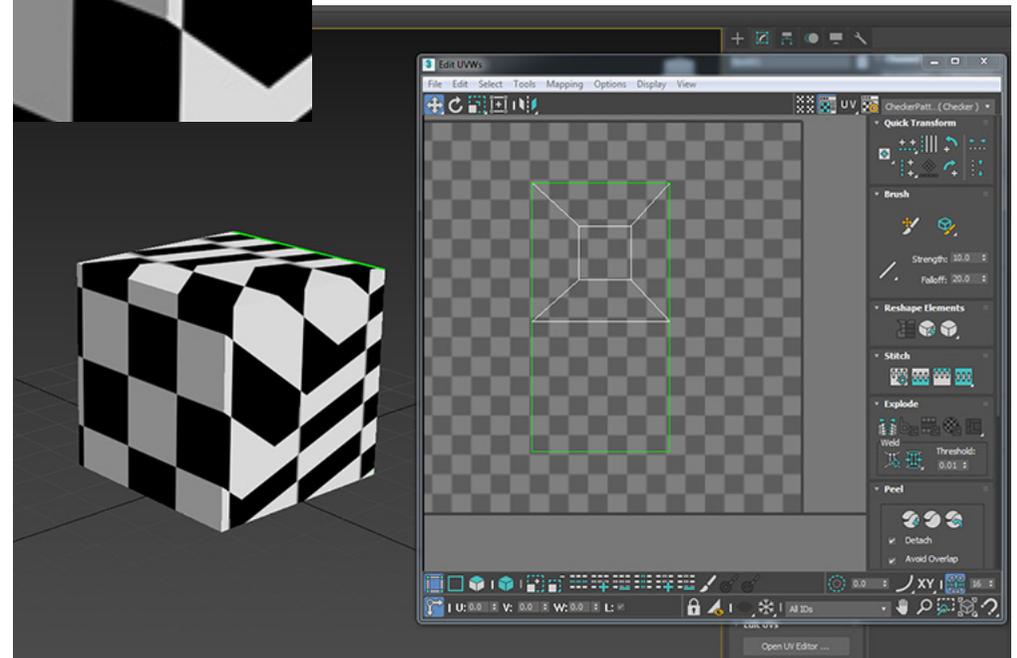
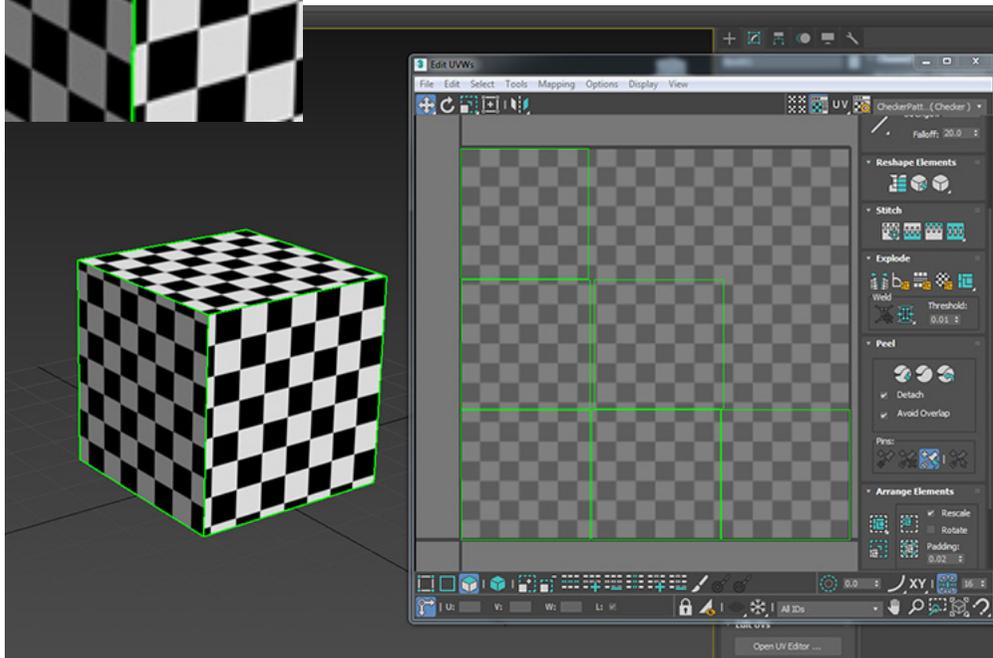
Examples of incorrect UV mapping a cube with chequered texture (3DS Max):



The way of unwrapping produced seams at the edges. Each side of the cube was textured separately from the neighbours. (green boundaries)

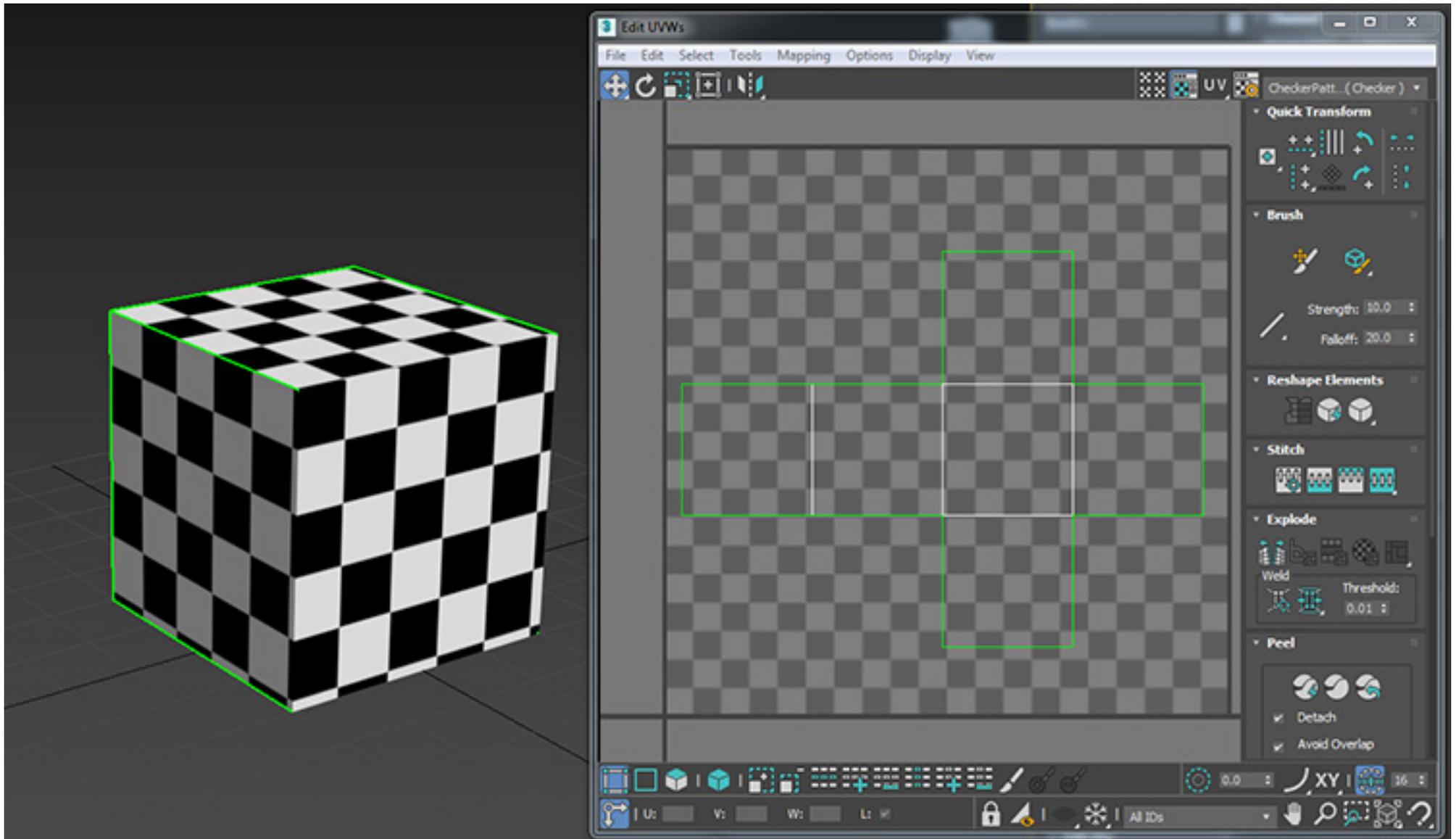


This way there are no seams, the edges are continuous, but the texture becomes deformed.



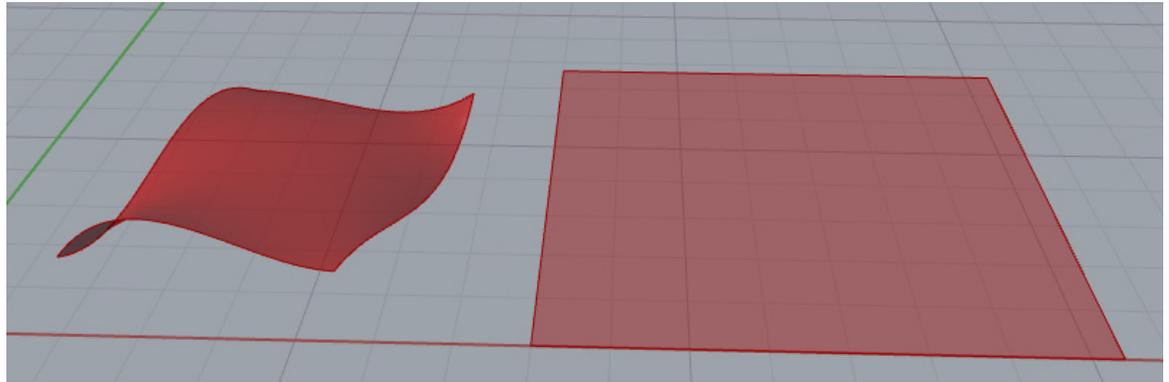
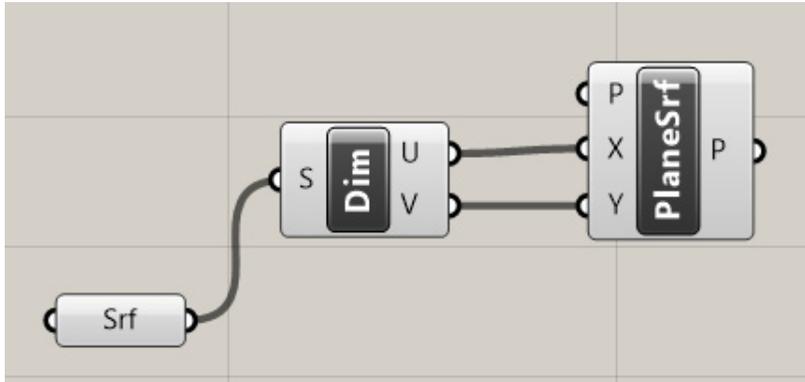
The unwrapping is done right here, the pattern around the edges is continuous and there is no distortion.

(The only visual problem here is that the pattern is not scaled correctly to the proportions of the unwrapped surface.)

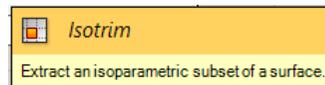
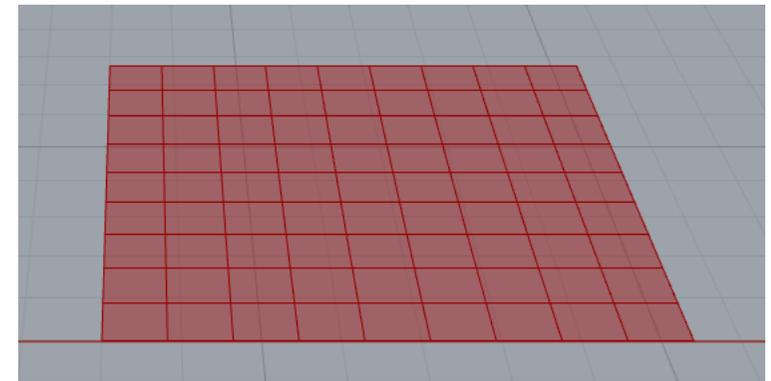
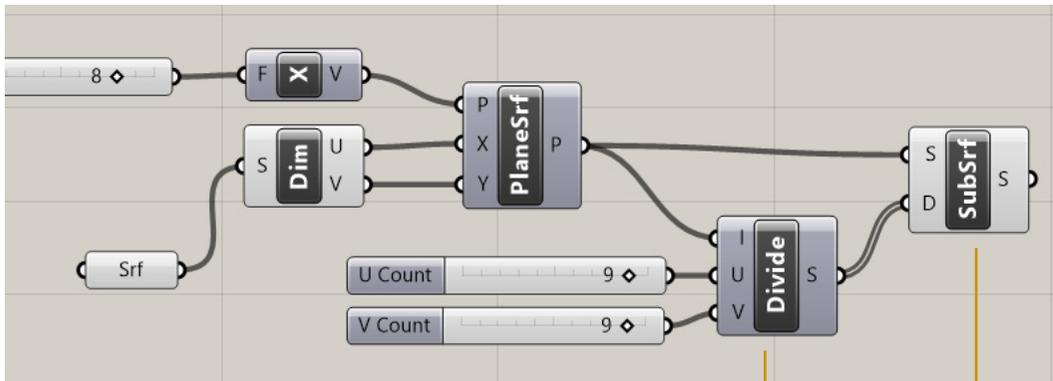


In grasshopper we can't use an image to wrap the surface, but we can use different shapes.

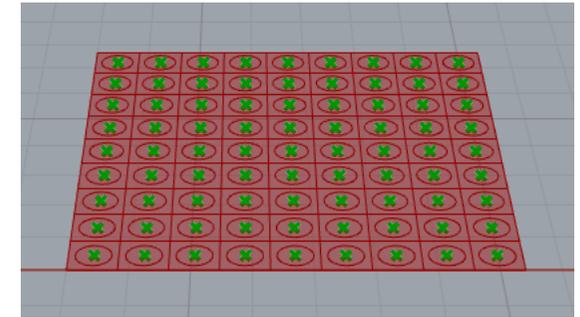
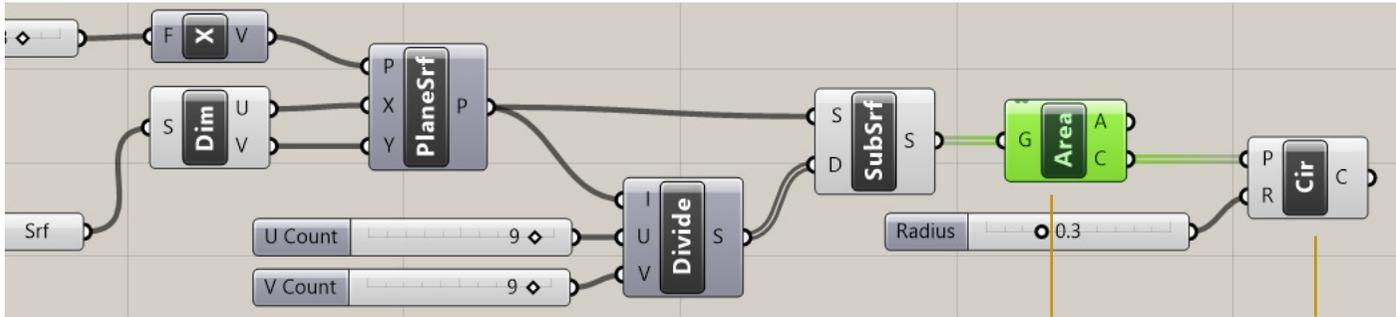
Here is an example of the process of wrapping a created pattern to a surface:



Unwrapping the 3D surface into a plane surface. (giving it's dimensions to the plane surface)



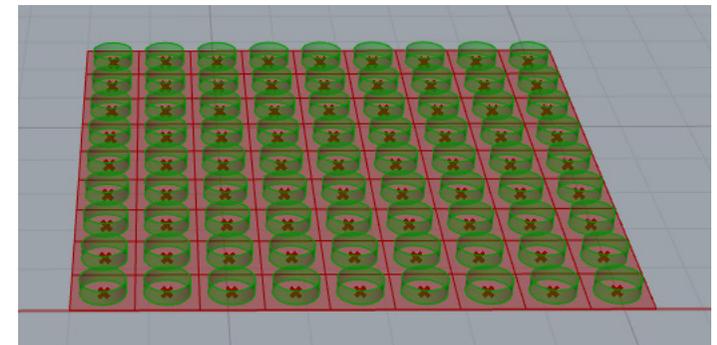
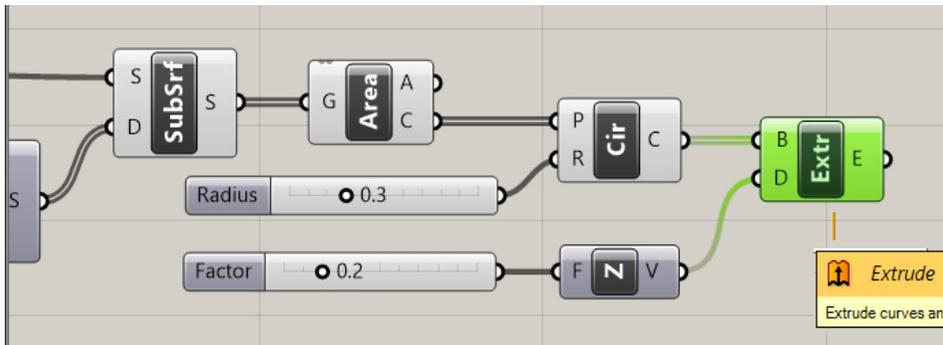
Dividing the new plane surface in the directions X (U) and Y (V).



m² Area
Solve area properties for breps, meshes and planar closed curves.

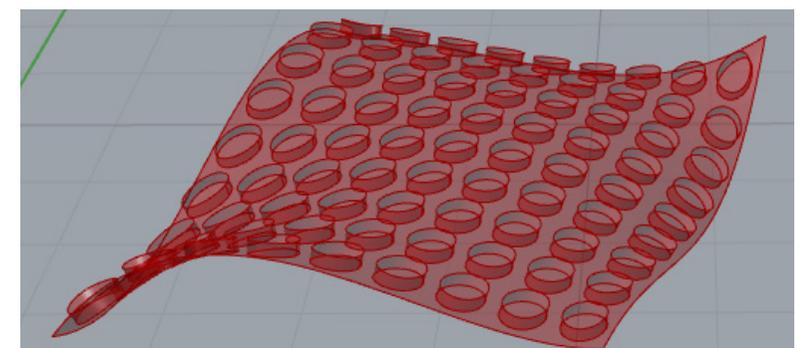
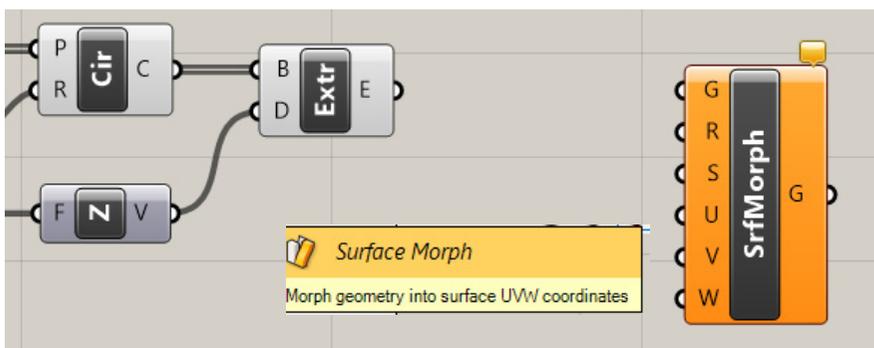
Circle
Create a circle defined by base plane and radius.

Creating circle pattern around the middle points of the squares.



Extrude
Extrude curves and surfaces along a vector.

Extrude the circles into the Z direction. The pattern is ready.

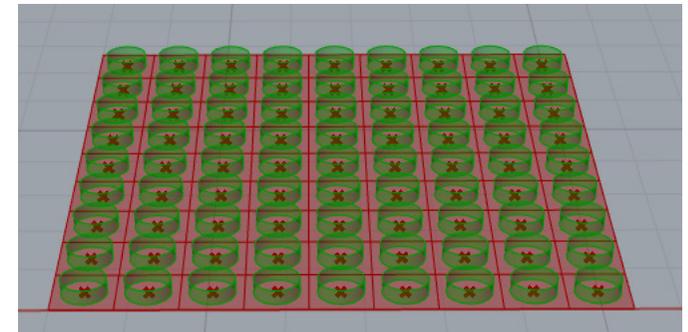


Surface Morph
Morph geometry into surface UVW coordinates

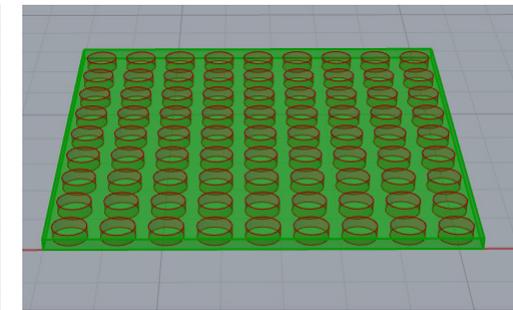
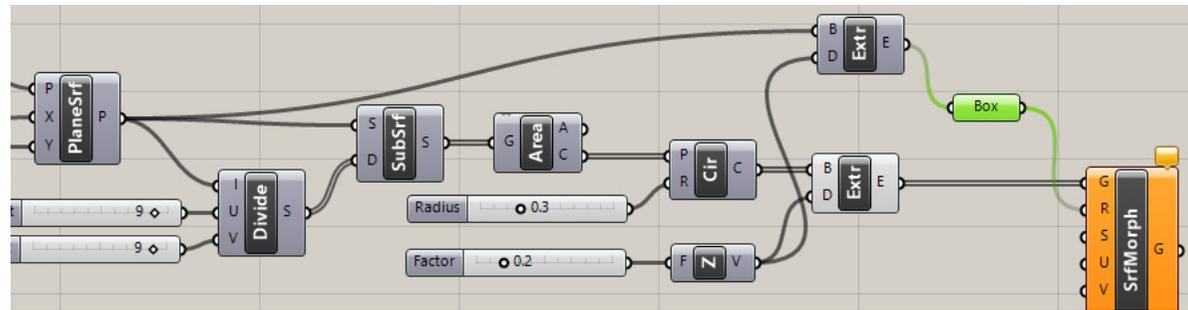
To achieve the result on the right, I used the SurfaceMorph component.

We need 6 data sources for the process:

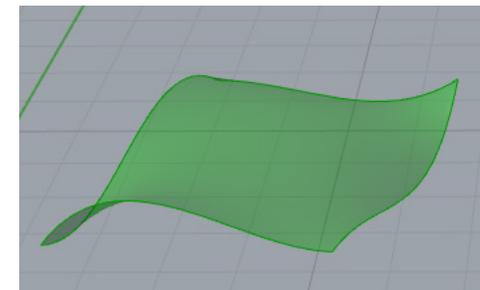
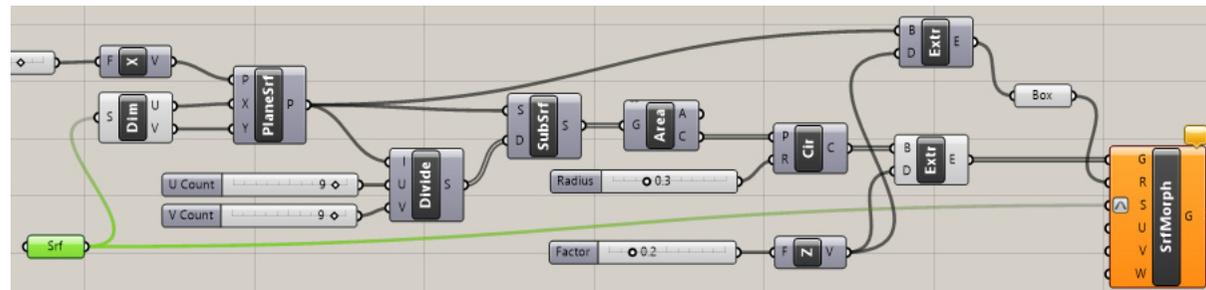
Geomerty
(the extruded circles)



Reference
(reference box around the pattern)

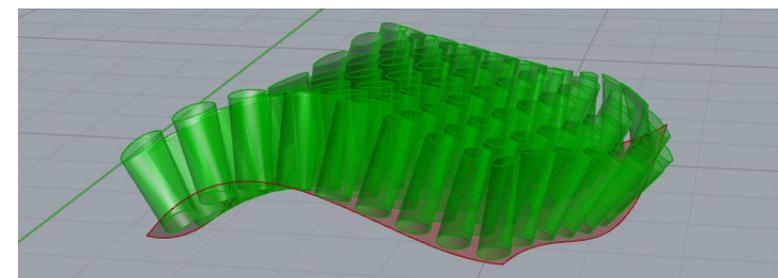


Surface
(the 3D surface, reparameterize* it)



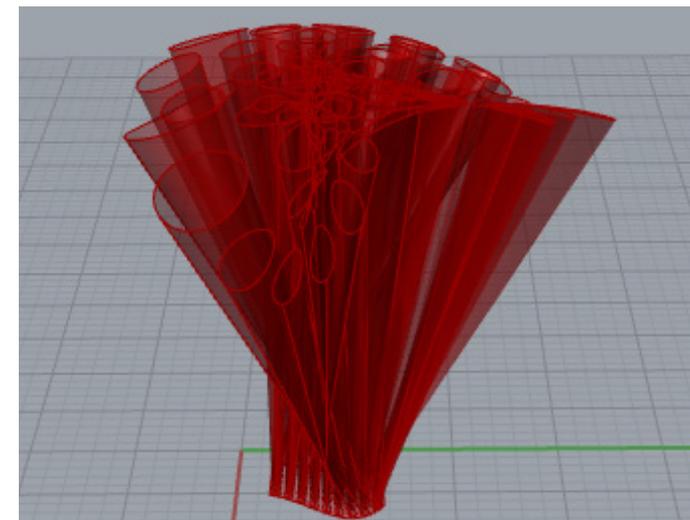
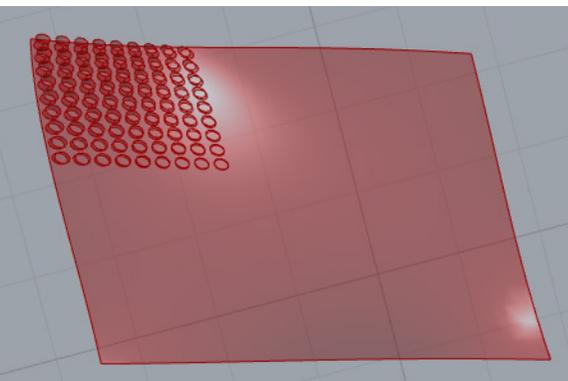
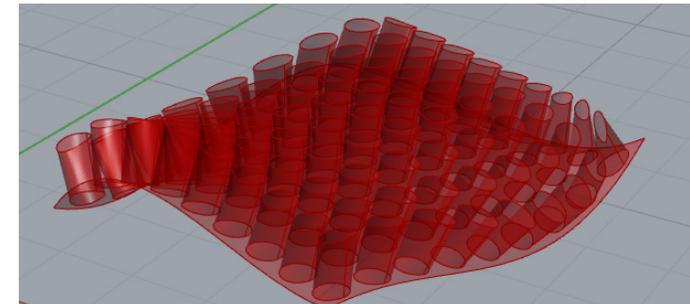
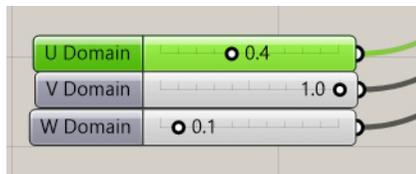
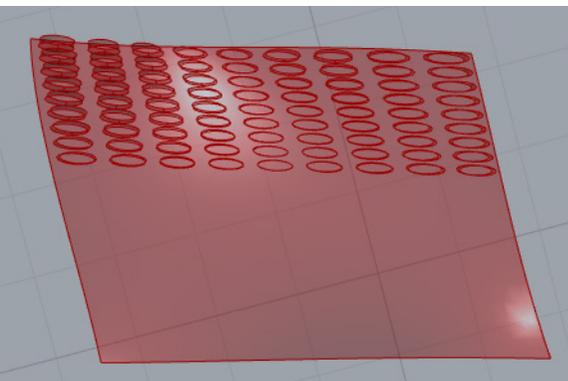
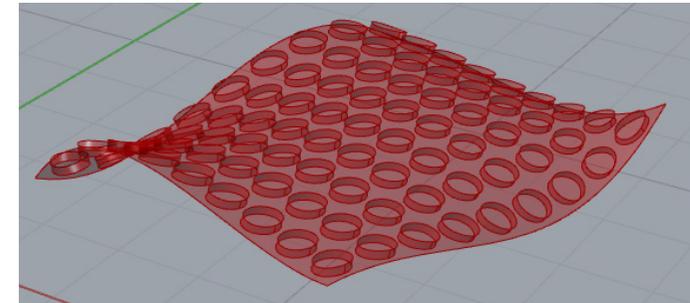
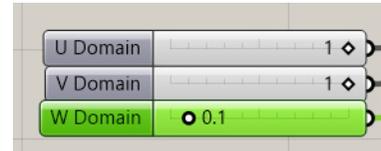
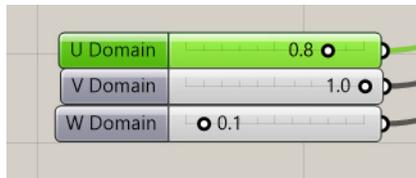
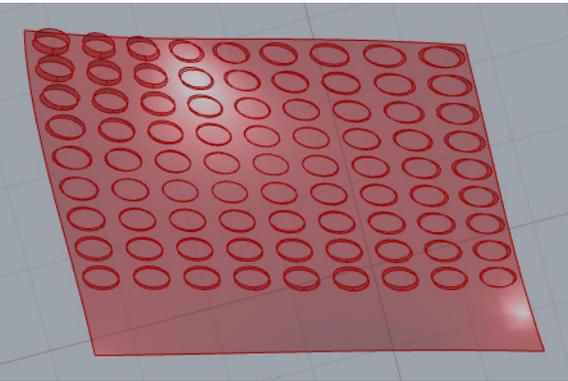
(*Reparameterize means to set U and V of a surface from 0 to 1 instead of the real sizes)

U,V,W Domain
(we can set each to 1 to get a result)

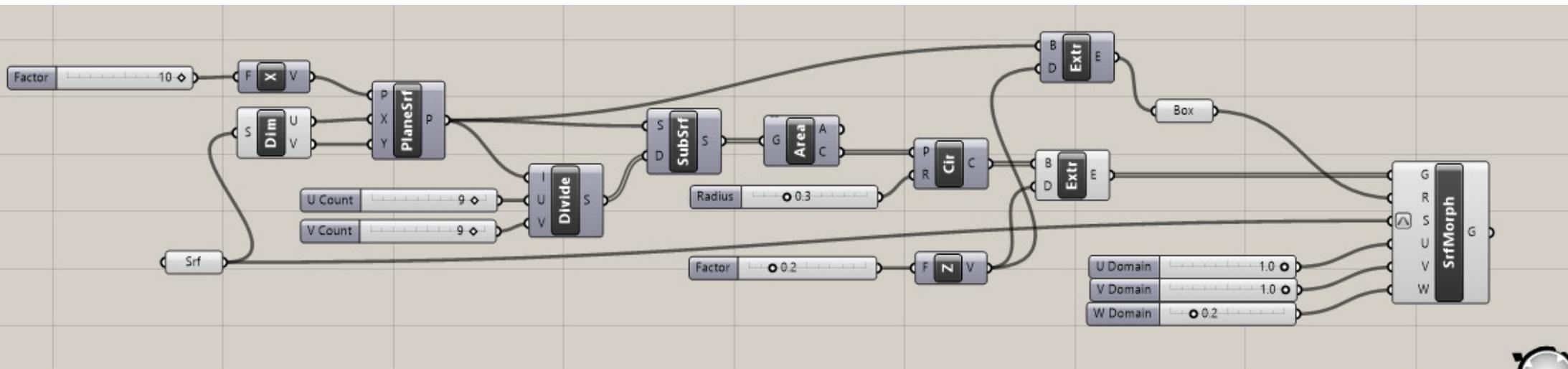


With “U” and “V” we can change the area of the pattern on the 3D surface.

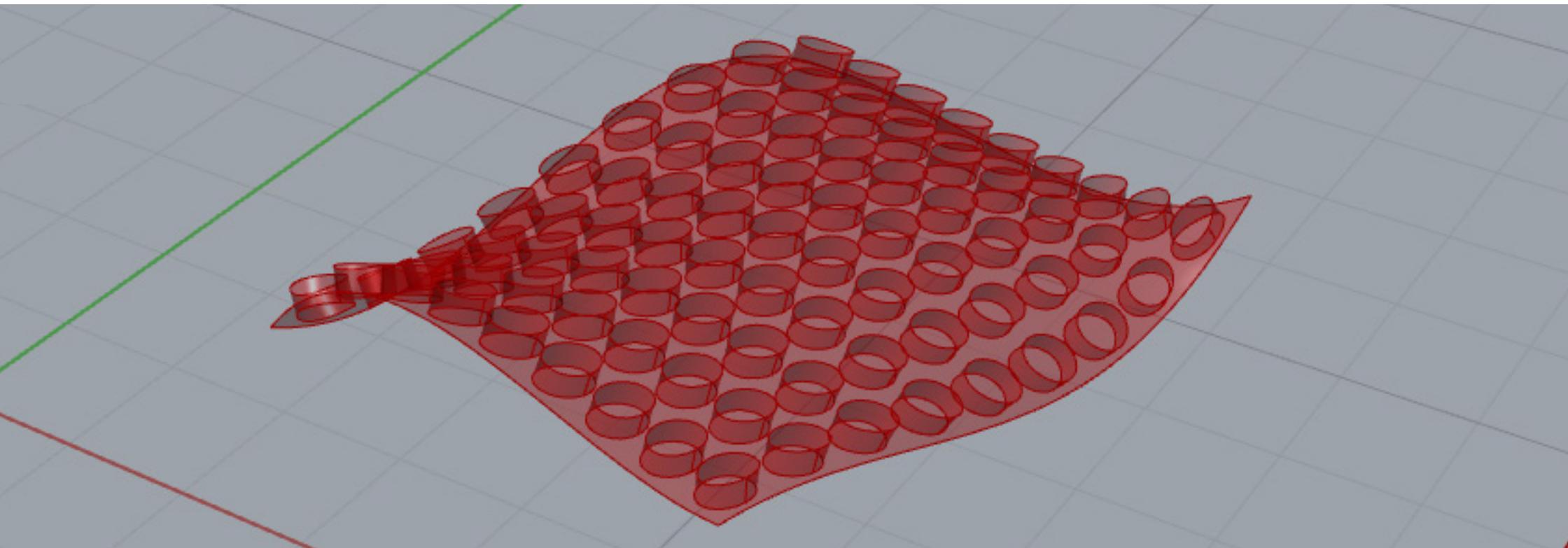
“U” and “V” Domain has maximum in 1 because of the reparameterization. But “W” has just a lower limit, which is approaching 0.
“W” stands for the length of the pattern.



The whole proces:

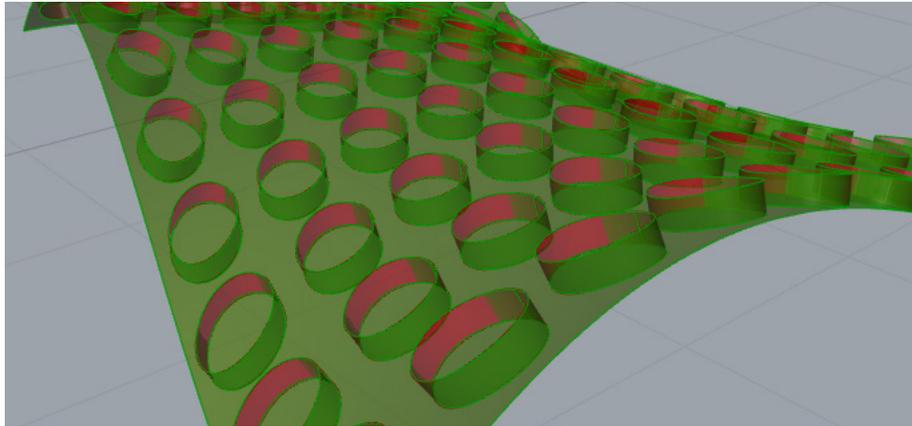


The result:

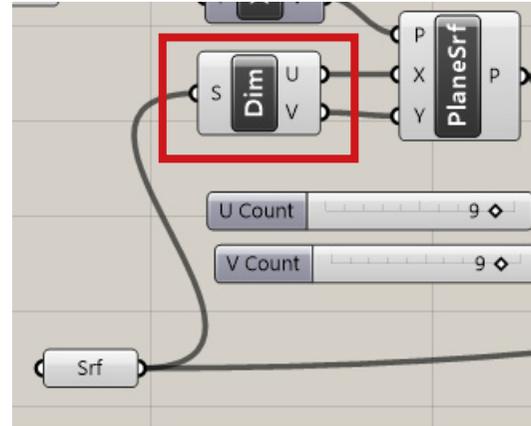


The effects of unwrapping the surface are not always visible.

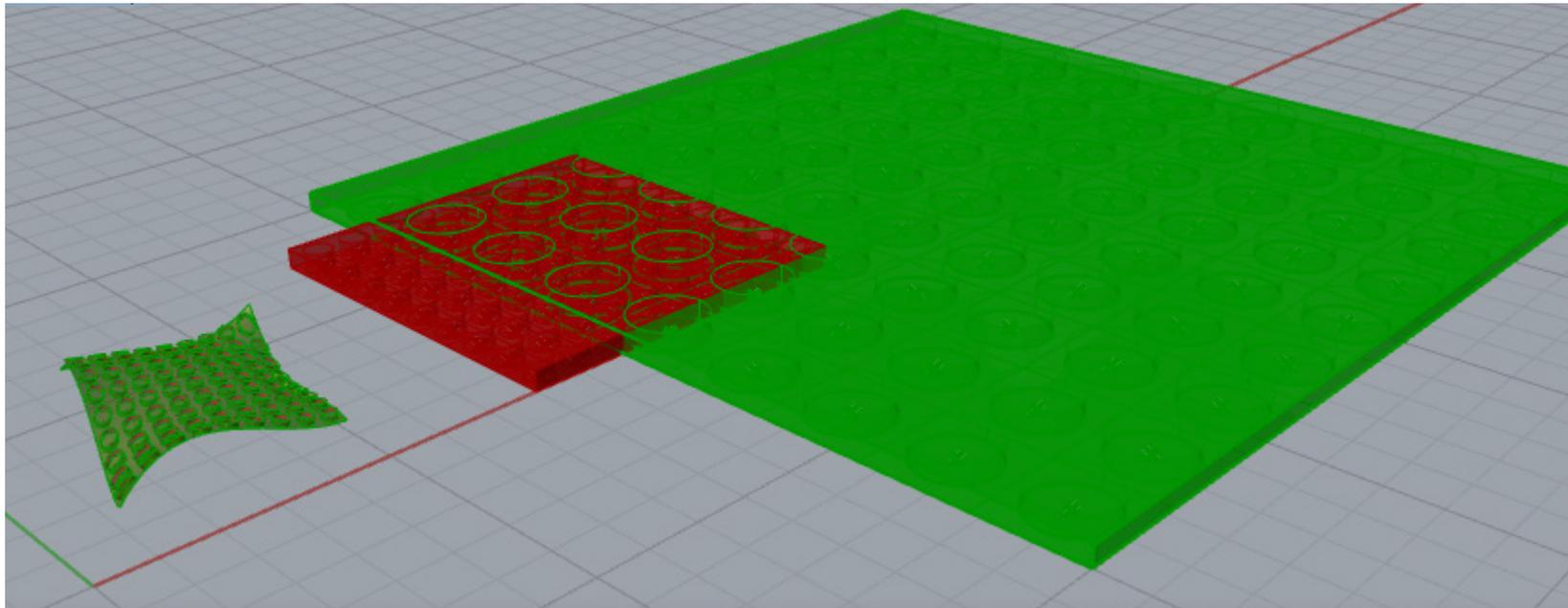
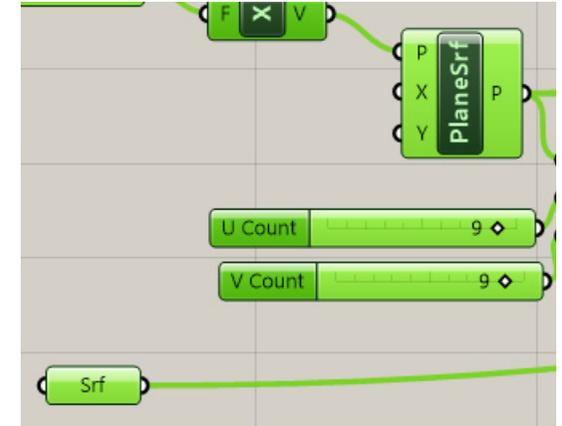
In this case it's just in bigger scale, but the result is the same with a few corrections (in this case the radius of the circles).



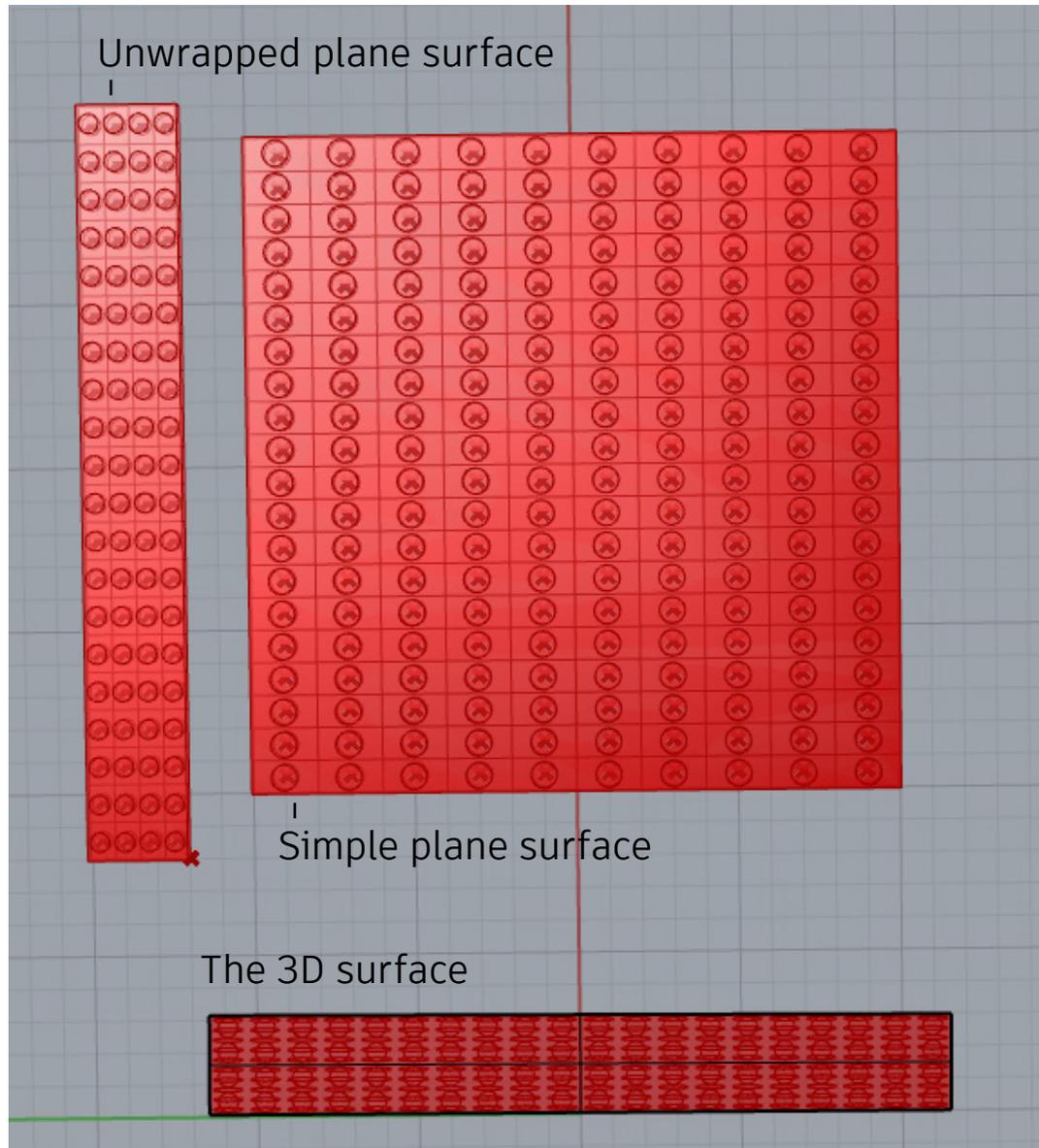
Unwrapped



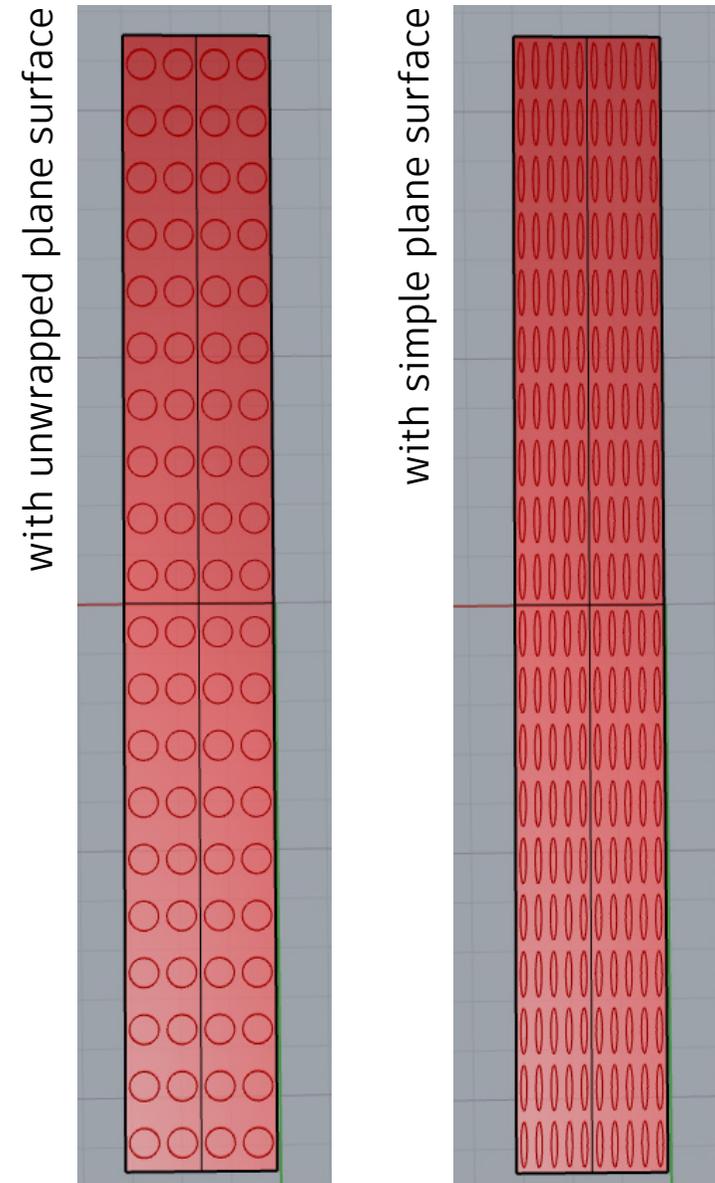
Simple plane surface



However on a prolonged surface:



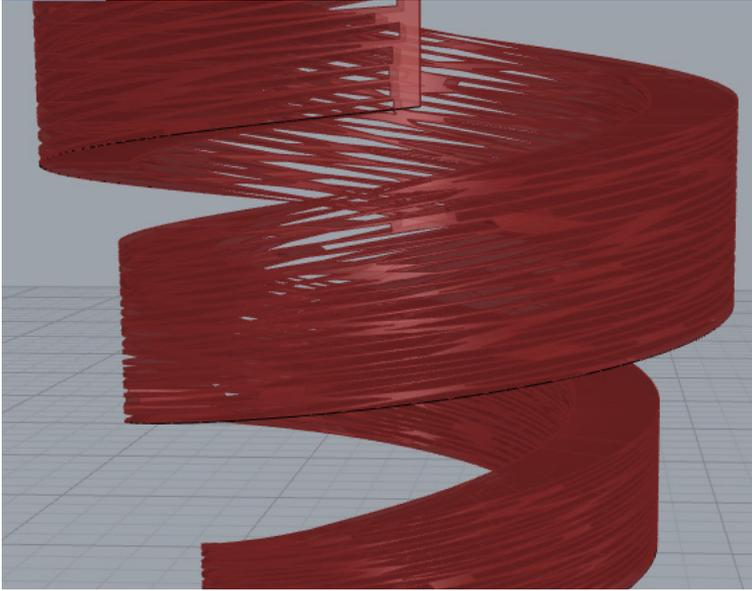
Closer on the result:



When unwrapping the surface, the pattern will be the same as we created, with the same proportions. When using a simple plane surface the result becomes different (deformed) from the created pattern.

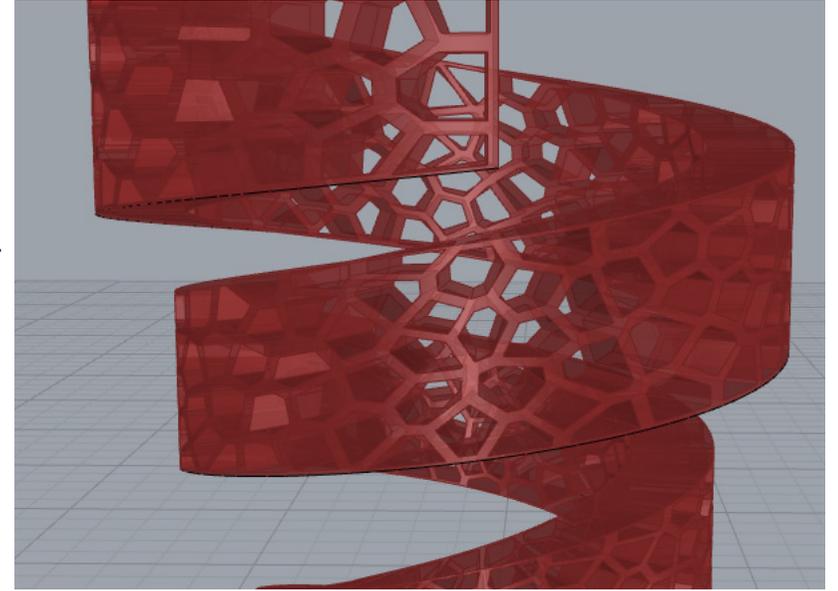
Better example with a more difficult pattern on a more difficult surface:

Simple plane surface

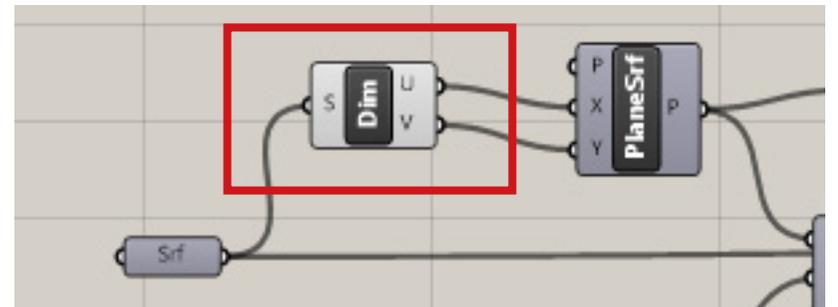
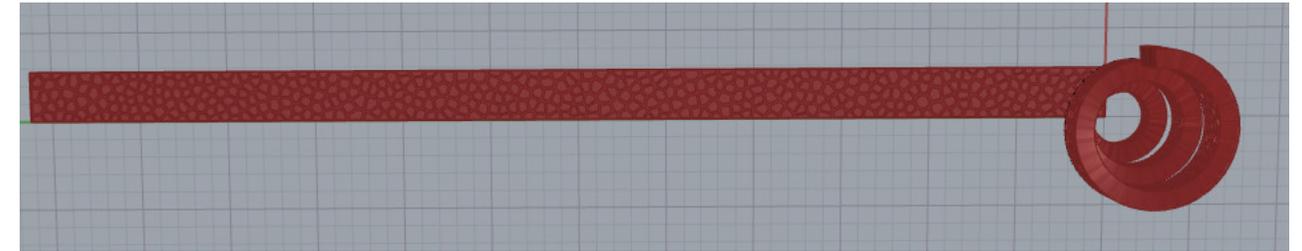
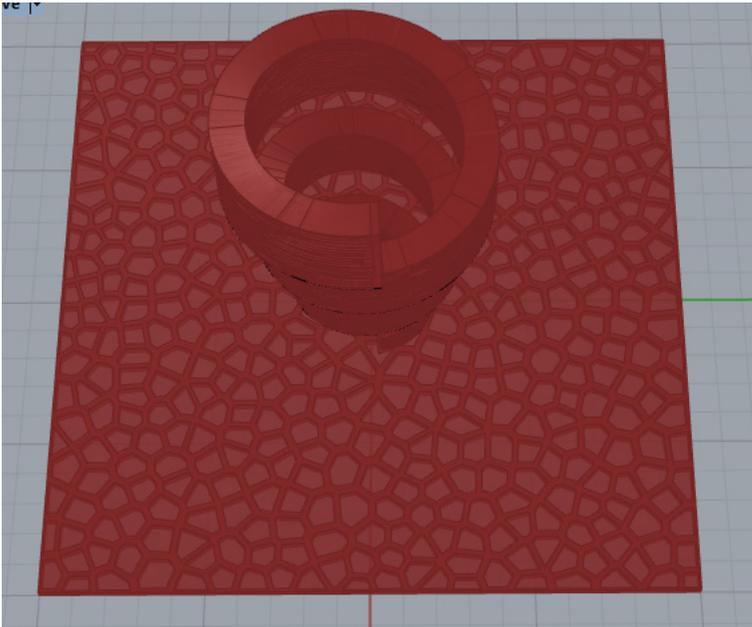


— The result on the 3D surface —

Unwrapped plane surface



— The plane surface —





Thank you for your
attention!

