Pangolin

Plugin for resilient patterns

Author: M.Eng. Ghaith Tish

Pangolin plugin for resilient patterns

Table of Contents

Intro

Pangolin is a design plugin that turns mapping and projection into a creative process. Whether you're projecting data, unfolding 3D forms, or exploring patterns across surfaces, Pangolin lets you work fluidly with transformations between coordinate systems. Inspired by pioneers like M.C. Escher, who mapped infinite patterns into finite spaces using hyperbolic geometry, Pangolin brings those mathematical ideas into your hands—visually and intuitively. From conformal map projections to vector field decomposition, it offers tools once limited to scientists, now reimagined for designers.
With Pangolin, you can experiment with distortion, symmetry, and spatial logic—not as constraints, but as creative materials. Whether you're working in generative design, spatial layout, or data visualization, Pangolin helps you reshape space itself

Angels and Demons (1941) – M.C. Escher

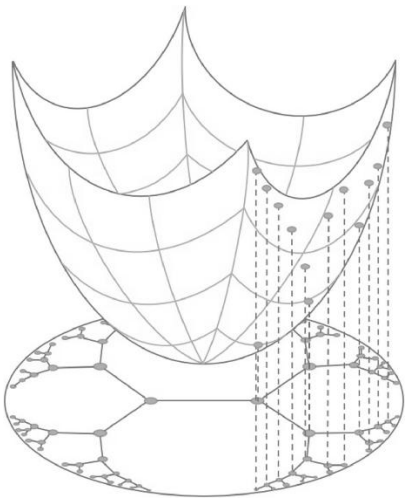
Mapping

In design, mapping is everywhere—on screens, in textiles, across surfaces, and through space. Whether it’s wrapping a pattern around a 3D object, projecting flat artwork onto a curved surface, or aligning visual systems with real-world geography, designers constantly face the mapping problem: how to translate form, pattern, or data from one space to another without losing meaning or control.

But mapping isn’t simple. Projection always comes with trade-offs—distortion of shape, scale, orientation, or alignment—and traditional design tools often hide or limit how those transformations behave. As a result, designers either avoid complex mappings or settle for rigid solutions that break under creative pressure.

Pangolin is a response to that frustration. It’s a nonconventional design tool built specifically to expose and play with mapping as a creative act. Instead of treating projections and coordinate systems as backend math, Pangolin makes them visible, manipulable, and expressive. Whether you’re experimenting with pattern flow, custom projections, or symmetry on curved surfaces, Pangolin gives you the tools to see distortion as a design language, not just a limitation.

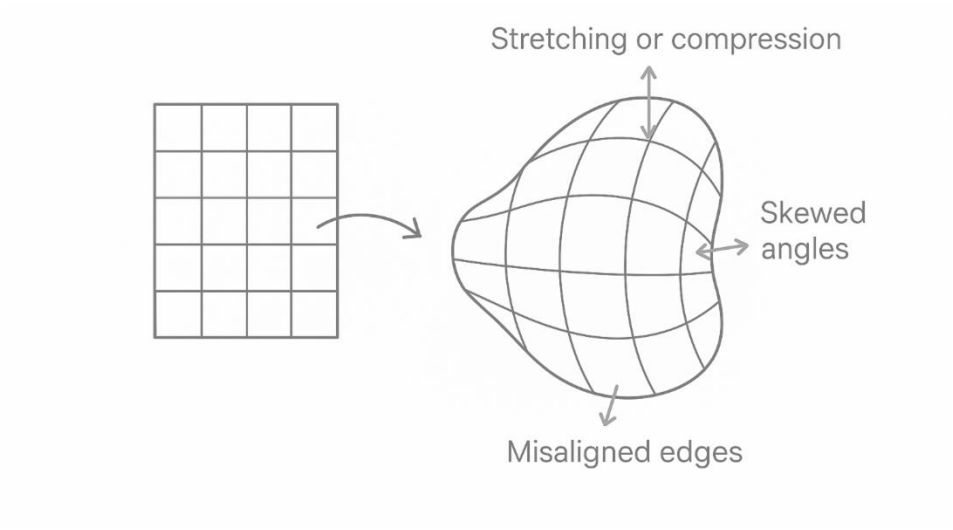
By bridging concepts from cartography, geometry, and generative design, Pangolin opens up new spatial workflows where you can sculpt how a pattern moves, bends, and fits. It's not just about getting a pattern onto a surface—it’s about designing the logic of that transformation itself.



(1) ***Mapping from hyperbolic space***

Mapping from hyperbolic space

Designing patterns on surfaces with curved boundaries presents more than an aesthetic challenge—it's a geometric one. When flat designs are projected onto curved forms, they often face incompatibilities like:
Stretching or compression
Skewed angles
Misaligned edges
Topological mismatches
These distortions aren't just technical glitches—they shape how patterns feel, flow, and fit. Traditional tools often treat them as errors to minimize. But what if they became part of the design language?
Pangolin is a design tool that rethinks how mapping works. Instead of hiding distortion, it exposes and lets you control it. Whether projecting a pattern onto a dome, fabric, or terrain, Pangolin helps you sculpt the transformation—letting your design respond to the surface, not just stick to it.



GPT- generated Mapping problems

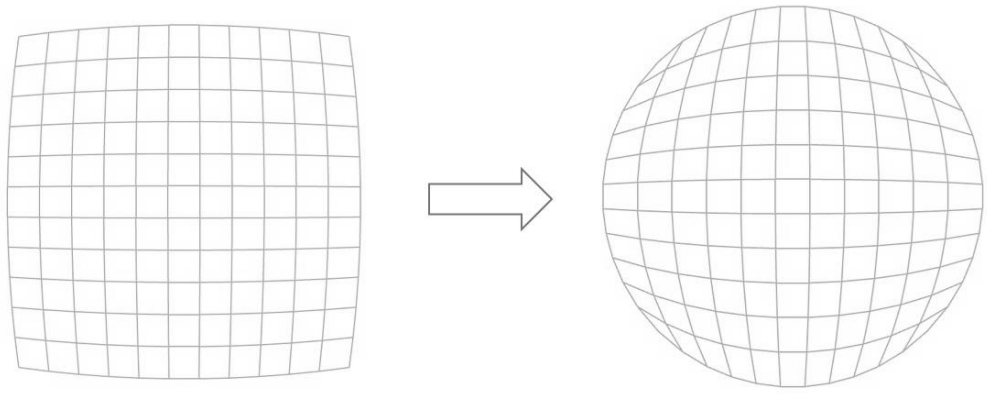
Disc Mapping

Mapping patterns to curved or circular surfaces often leads to stretching, angle skew, or misaligned edges. Disc mapping algorithms, especially those using radial (polar) coordinates, offer a geometric advantage: they align the pattern's flow with the surface's symmetry.
In radial projection, distortion is minimal at the centre and increases gradually toward the boundary. This allows designers to preserve shape integrity in focal areas while letting peripheral regions absorb deformation smoothly.

✓ Advantages:

- Less deformation at the centre
- Smooth, predictable distortion at edges
- Angle preservation with conformal mappings
- Better visual control over flow and focus

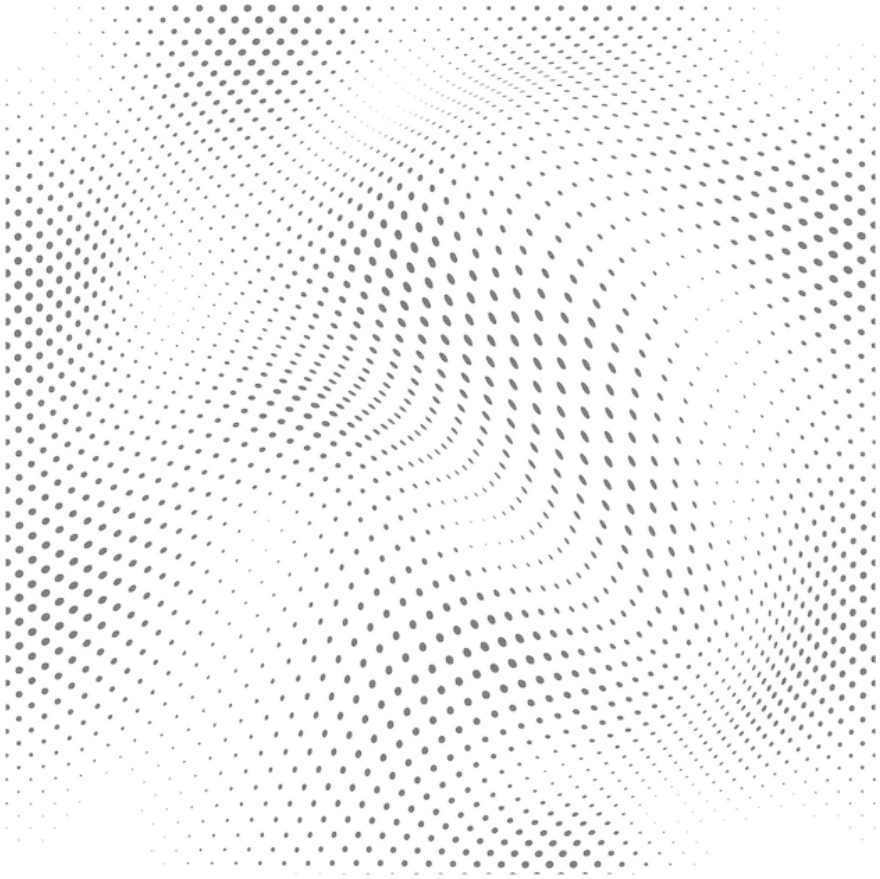
This technique is especially valuable in pattern design, data visualization, or surface texturing, where spatial coherence and visual clarity are key.



Disc Mapping using Pangolin

Gradient

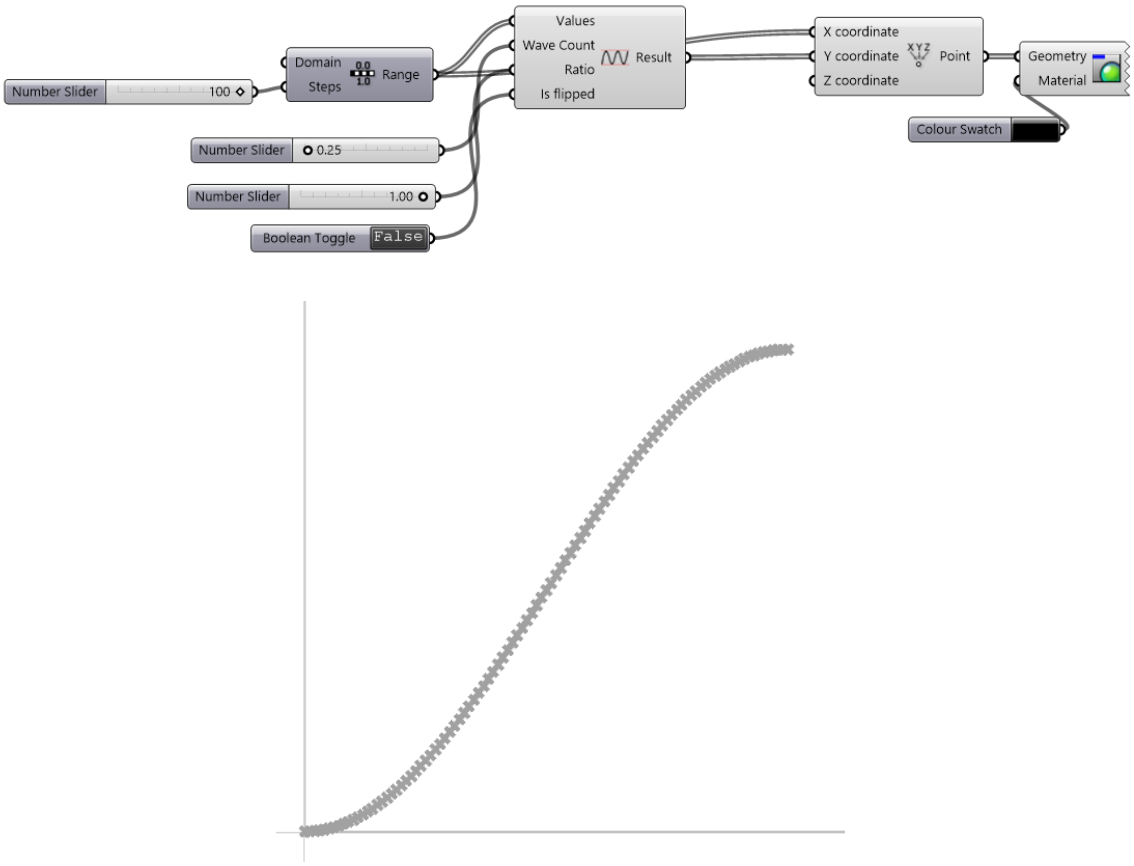
In geometric pattern design, gradients—whether scalar fields or directional flows—offer a powerful way to transform and adapt patterns across space. By guiding how elements scale, rotate, or flow in response to a gradient, designers can create patterns that respond fluidly to boundaries, surfaces, or structural shifts. This method supports design resiliency: patterns can stretch, compress, or realign smoothly without breaking visual rhythm. Gradients allow for controlled variation, helping patterns maintain coherence even across complex or irregular domains. Whether used to adapt motifs on curved surfaces or introduce smooth transitions in a layout, gradient-based transformation blends structure with flexibility—an essential quality in resilient, responsive design.



(2) Gradient transform

Sine Gradient

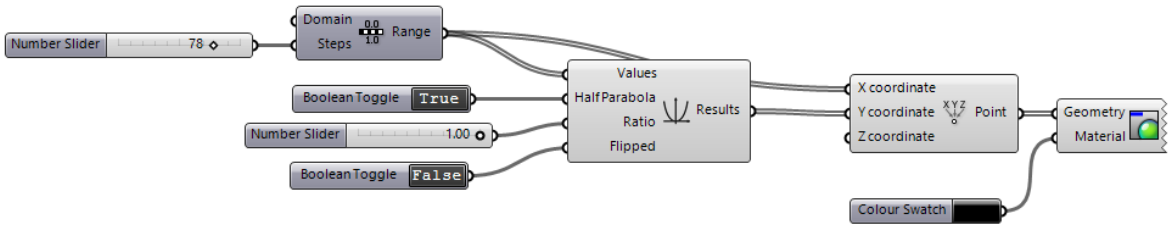
Sine gradient transformations introduce rhythmic, wave-like distortions into regular grids, allowing designers to create flowing, dynamic patterns without losing geometric coherence. The smooth periodic nature of the sine function makes it ideal for generating oscillating structures, surface ripples, or organic motion within static designs.
By adjusting amplitude, frequency, and phase, designers can control how the grid curves, bends, or repeats across space. When combined with boundary constraints, the sine wave can be tapered or modulated—keeping key features undistorted while allowing expressive variation elsewhere. This creates visually engaging, resilient patterns that adapt to surface or layout demands with a natural rhythm.

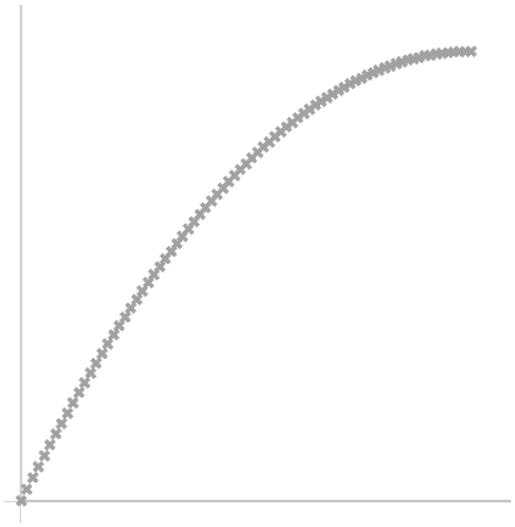


Sine output, Pangolin

Parabola Gradient

Parabolic gradient transformations allow designers to bend grids smoothly while preserving central structure and flow. By shaping the grid with a parabolic field, patterns can follow a natural curve—ideal for domes, arches, or focal layouts.
Setting boundary constraints is key: it controls where distortion accumulates and ensures that the pattern anchors correctly at edges. This balance between central focus and edge flexibility creates structured yet adaptive designs—resilient across both flat and curved spaces.





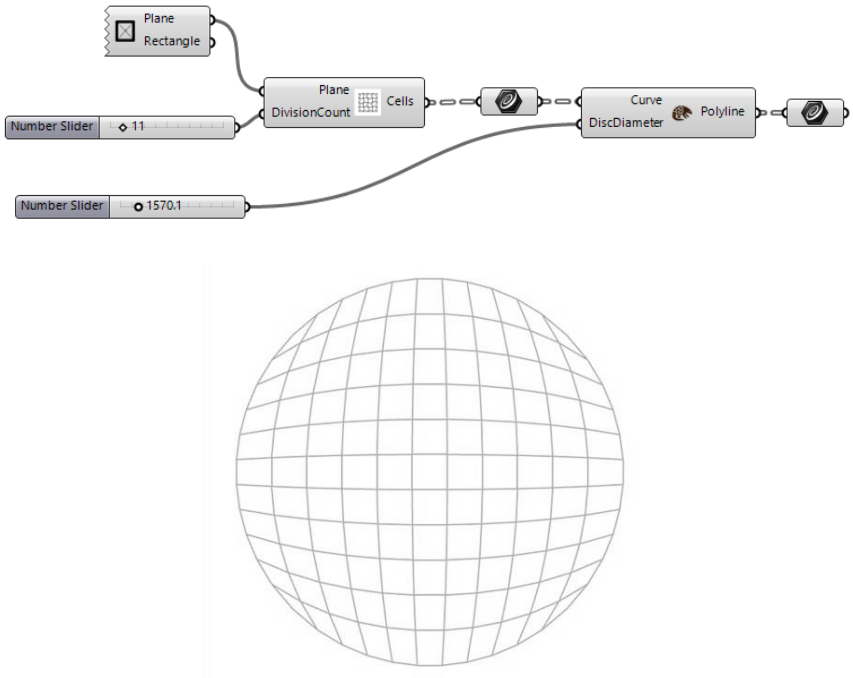
Parabola output, Pangolin

Samples

These examples showcase how Pangolin transforms pattern manipulation into a flexible, resilient design process. From structured grids to flowing gradients, each sample highlights the plugin's ability to adapt geometry to complex surfaces, boundaries, and spatial logic—unlocking new creative possibilities with precision and control.

4.1 Disc Mapping

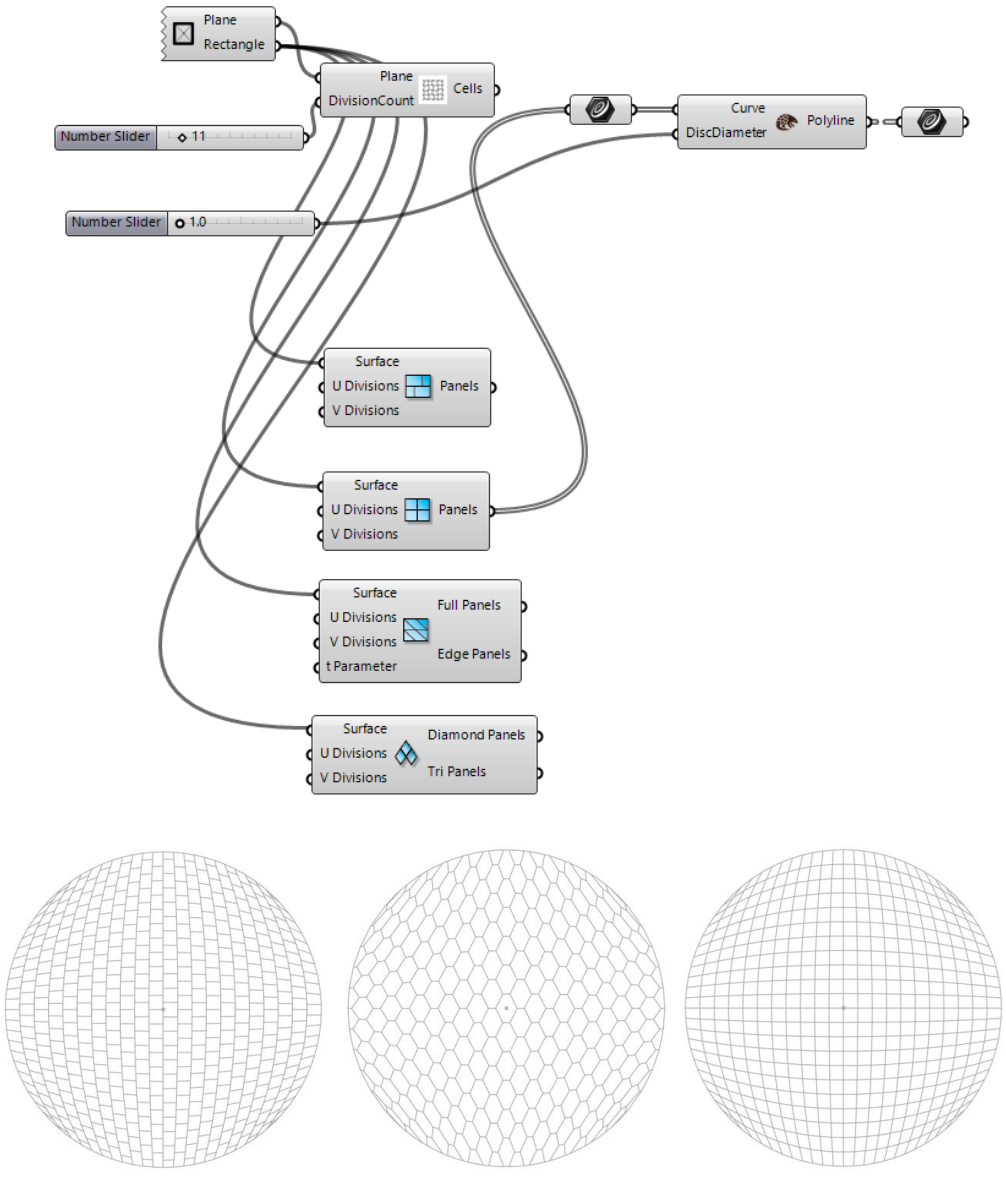
In many design tasks—especially when mapping patterns onto circular or curved regions—corners and edges often become problem zones, distorting the flow of geometry or breaking visual continuity. Disc mapping offers a powerful solution by remapping a square or rectangular domain into a circular one, eliminating hard corners and replacing them with a continuous, radial boundary. This transformation softens spatial tension: instead of abrupt directional shifts at corners, the pattern transitions smoothly outward in all directions. Inside the disc, the pattern is gently curved or warped, with the central region remaining the most stable—ideal for placing key visual elements. As the pattern approaches the boundary, distortion increases predictably, allowing designers to either embrace or attenuate it with intent. Disc mapping not only solves boundary constraints—it turns them into expressive features. It's a versatile method for generating radial symmetry, focus-driven layouts, or adaptive surface designs where spatial flow matters as much as form.



pangolin output-Disc mapping

4.2 Mapping Different patterns

For designers and planners, this is especially powerful: it means you can work comfortably in a rectangular grid—where alignment, symmetry, and spacing are easy to control—then use disc mapping to convert the result into a radial composition without manually redrawing or reflowing elements.
Whether you're designing mandalas, radial infographics, architectural domes, or surface patterns on circular objects, disc mapping bridges the gap between linear structure and circular form. It gives you the best of both worlds: the clarity of grid-based planning and the harmony of circular presentation.



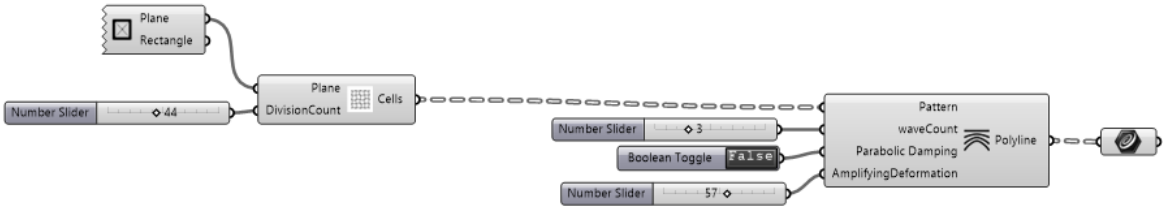
Pangolin output-Disc mapping

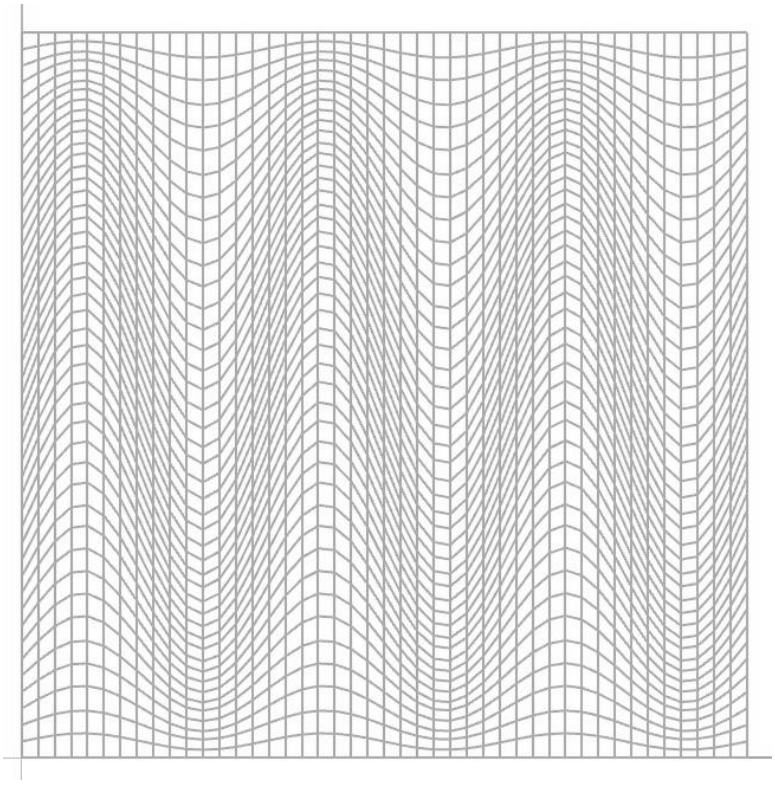
4.3 Pattern damping

Damping waves through **parabolic** or **sine deformation** is a useful modeling technique that simulates how a wave gradually loses intensity. In design tools like the damping approach in pangolin, this allows users to shape geometry with controlled wave-like forms that fade out smoothly.
These methods give designers several advantages:

- Smooth and organic control over form.
- Simulation of real behaviors like vibration or airflow.
- Easy adjustment of wave parameters (amplitude, frequency, decay).
- Visually expressive geometry with technical function.

This makes sine and parabolic damping valuable for both performance-based and aesthetic design workflows.

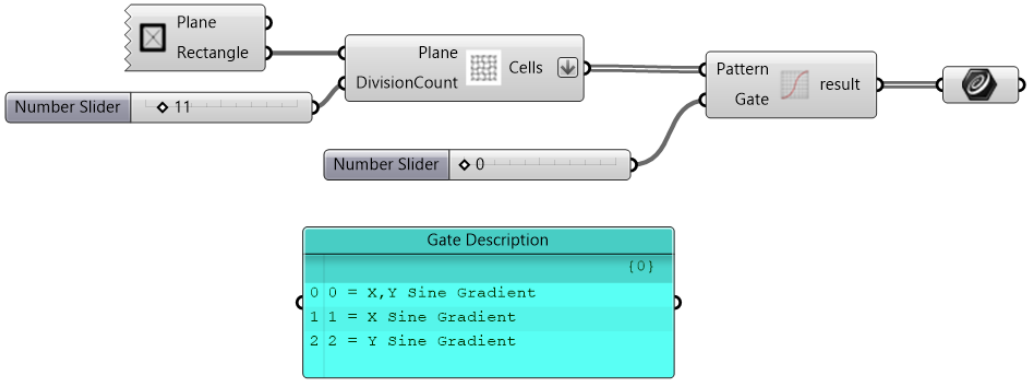


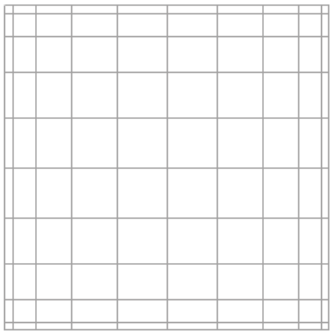


Geometry output from Pangolin

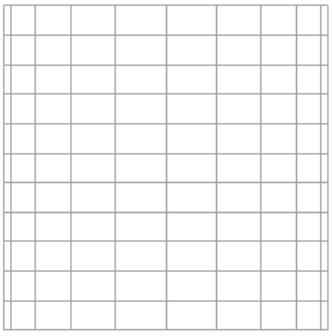
4.4 Directional Gradient Sine-Central

The central gradient aims to deform the patterns in a central manner using sine transformation. It is possible to create X as well as Y sine gradient. This helps the designers to create patterns that grows gradually from the sides.

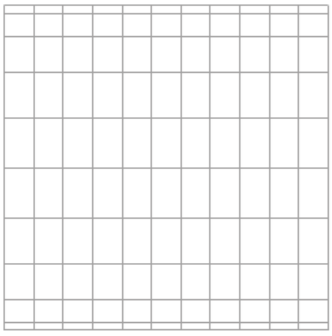




output Gate 0



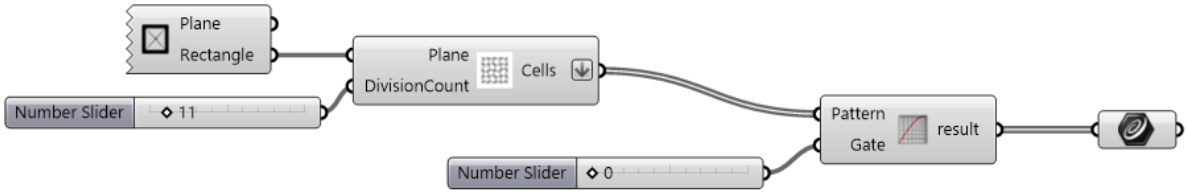
output Gate 1

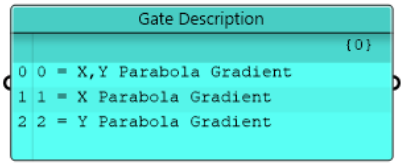


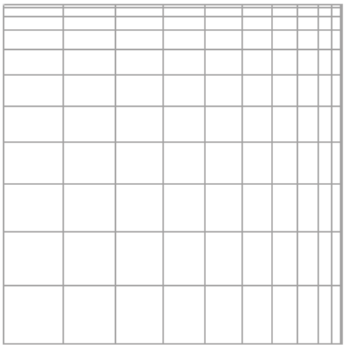
output Gate 2

4.5 Directional Gradient Parabola-Directional

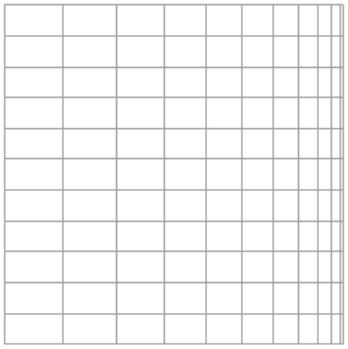
The directional gradient aims to deform the patterns in a directional manner using parabola transformation. It is possible to create X as well as Y parabola gradient. This helps to make pattern gradients that follow specific direction more accessible for designers.



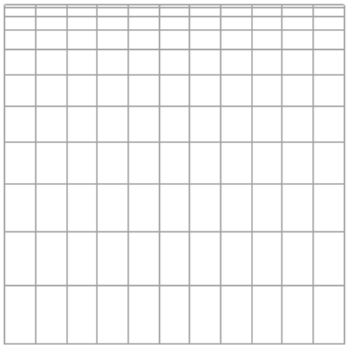




output Gate 0



output Gate 1



output Gate 2

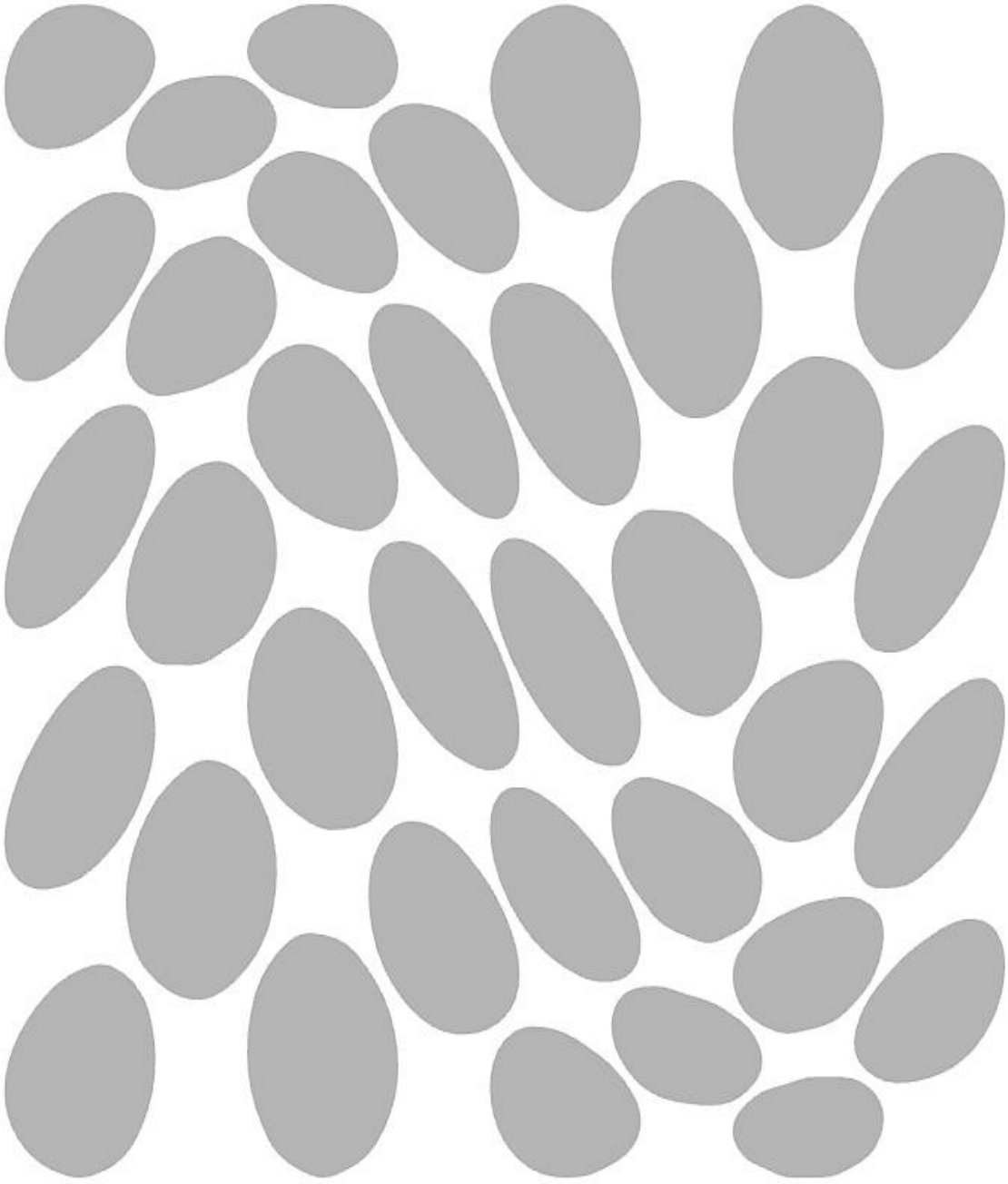
Potential Projects

These projects aims to introduce designers of the process of using pangolin. Pangolin design process starts from using its core components to design the deformation and then apply it to coordinates of patterns that are drawn on a 1, 1 square frame.

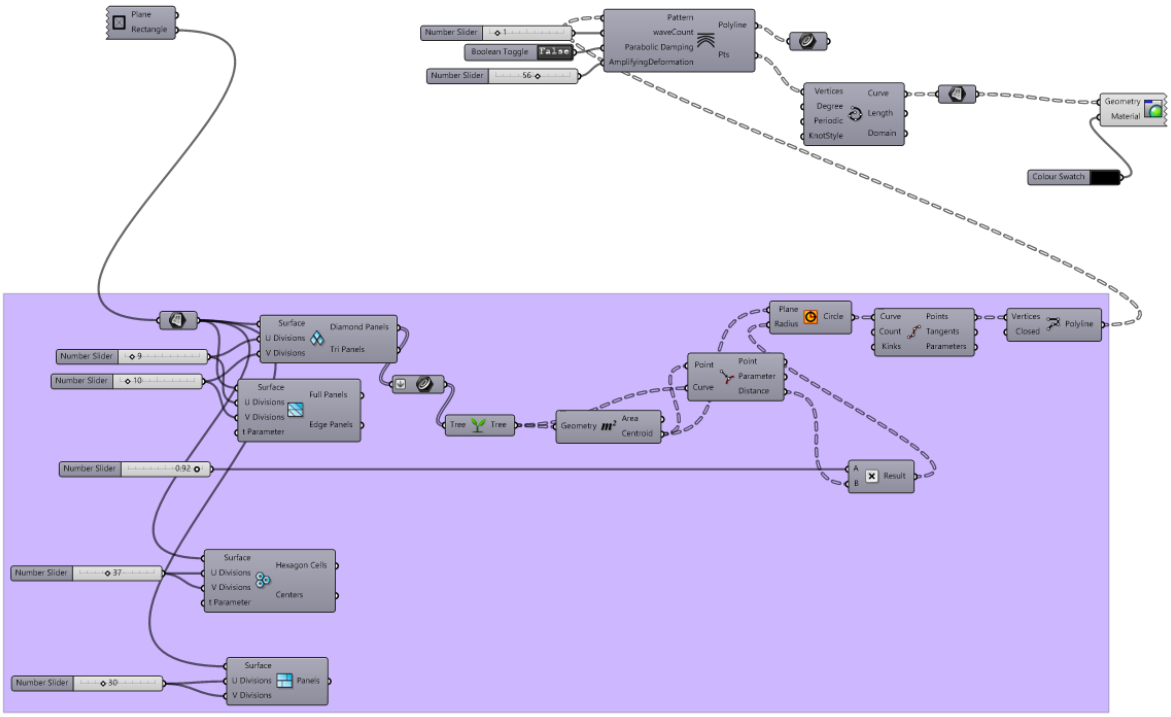
The projects are:

1. Circular pattern sine damping deformation
2. Diamond Parabola Direction
3. Checker Shear Central Sine
4. Sine Shell

5.1 Circular pattern sine damping deformation



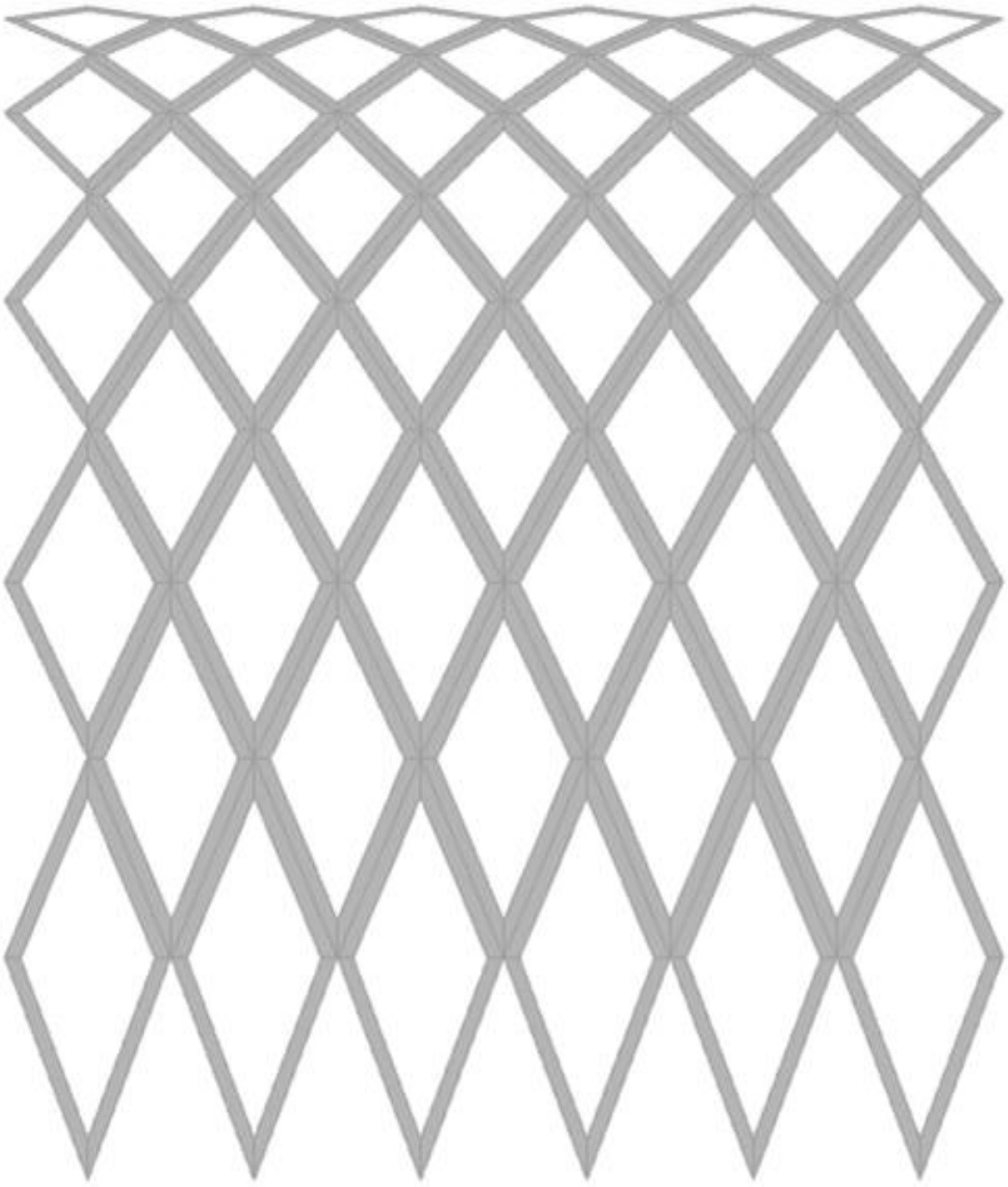
Circular pattern, wave damping output



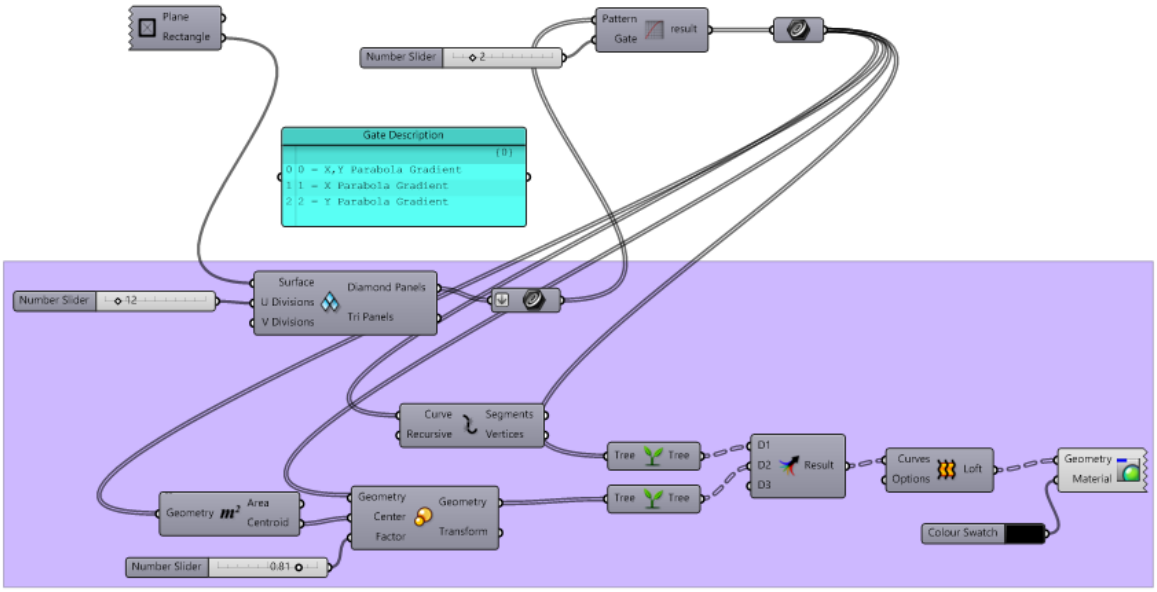
Steps:

1. Create lunchbox pattern
2. Use the pattern to draw circles inside the cells
3. Divide the circles
4. Create polylines on the division points
5. Add the division points as inputs to the wave damping
6. Colour the results

5.2 Diamond Parabola Direction



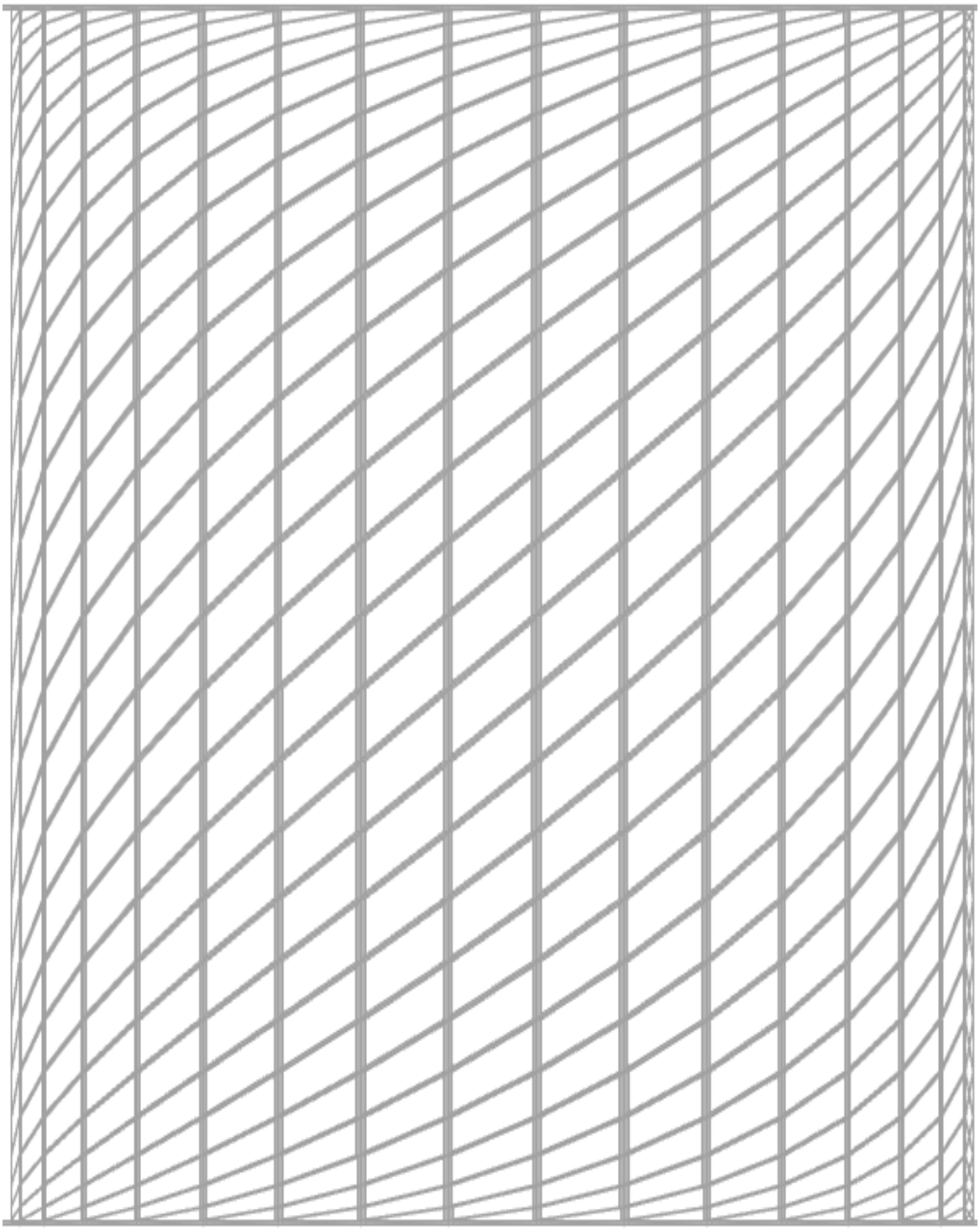
Diamond pattern, Parabola Direction Output



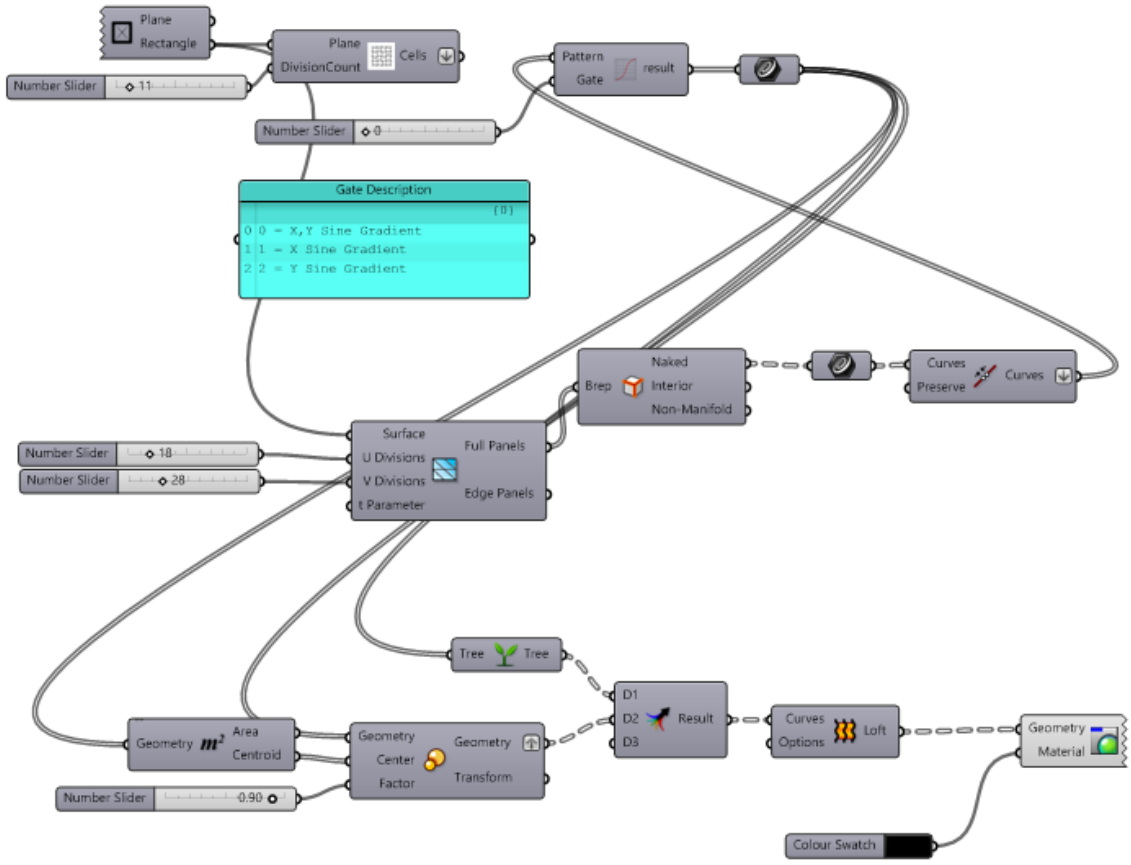
Steps:

1. Create lunchbox pattern
2. Input the pattern in directional parabola
3. Create a loft frame and colour the result

5.3 Checker Shear Central Sine



Sheer pattern with central gradient, central sine output

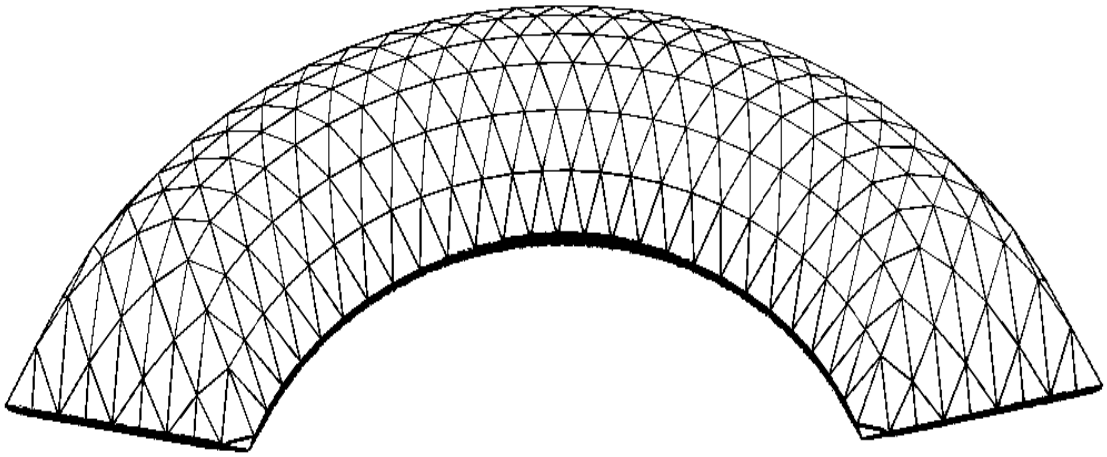


Steps:

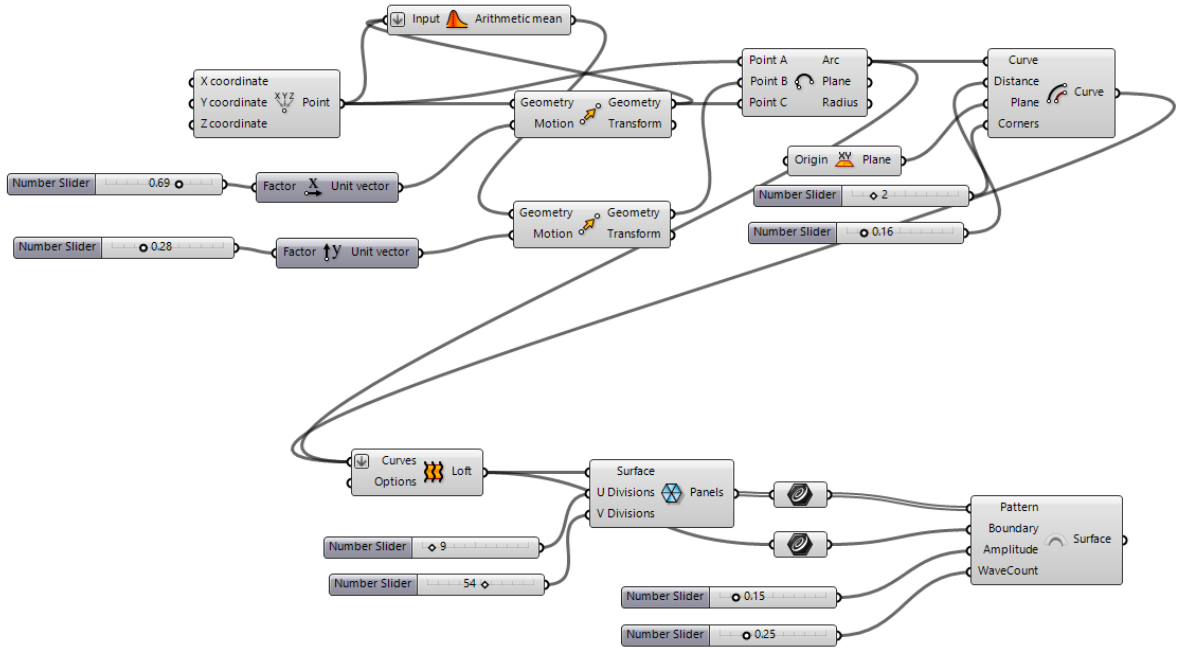
1. Create lunchbox pattern
2. Input the pattern in sine central
3. Create a loft frame and colour the result

5.4 Sine to Thickness

The sine transform introduces gentle, wave-like distortions into patterns, allowing designers to create forms that feel organic, rhythmic, and adaptable. Unlike rigid grids, sine-based patterns can stretch, bend, or ripple across surfaces—making them more resilient to curvature, boundaries, or spatial constraints. This transformation helps maintain visual continuity where uniform patterns might break. And when combined with other methods—like radial projections, gradients, or disc mappings—the sine transform adds motion and softness, helping patterns flow with purpose while adapting to complex shapes.



Dome based on sine wave, mean curvature analysis



Steps:

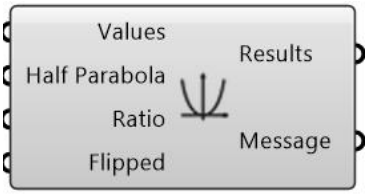
1. Create disc grid using pangolin disc mapping
2. Create the bounding circle of the disc
3. Measure the distance to the bounding circle
4. Apply sine deformation over the distances
5. Use the results of the sine deformation for the Z values of the grid panels points
6. Unflatten the points
7. Draw the panels polylines

Component Description

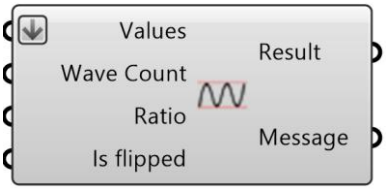
This component create reference geometry for pattern

This plugin aims to create grid using reference geometry from the rectangle component

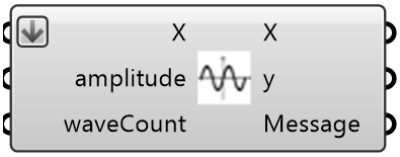
This component reset coordinates of the pattern to 0,0



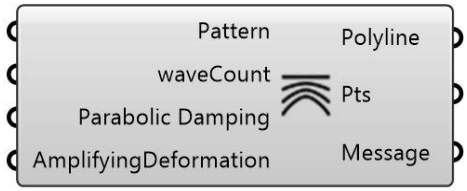
This component applies parabolic deformation to coordinates. It includes the parameters of the parabola formula.



This component applies sine deformation to coordinates. It includes the parameters of the sine formula.

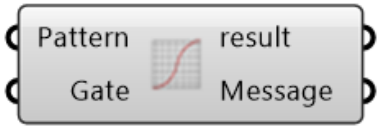


This component applies central sine deformation to coordinates. It includes the parameters of the sine formula.



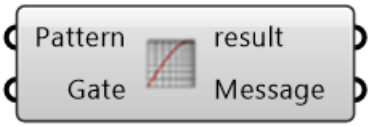
This component is responsible of damming waves on the Y axis using parabolic or sine deformations

This component applies disc deformation to any pattern.

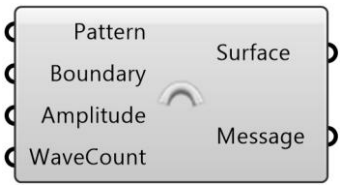


This component applies sine central gradient to patterns

Pangolin plugin for resilient patterns



This component applies parabola gradient to pattern



This component applies Half sine wave to add thickness to any closed boundary pattern

References

(1) Xuchao Liu, Jiayang Li etal, Research Gate

(2) https://www.freepik.com/free-photos-vectors/pattern-png