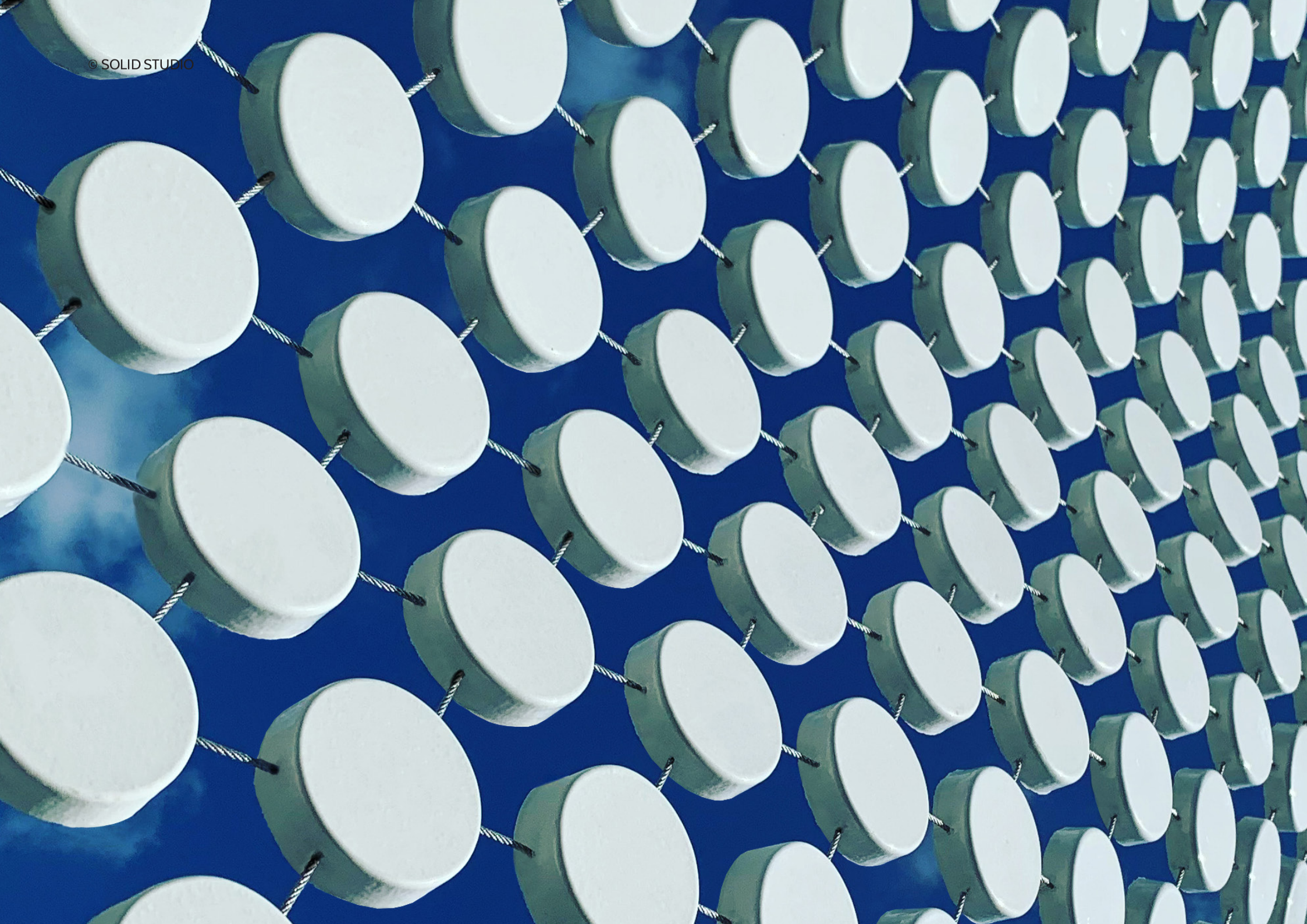
EN EDITION
2024

# ZEPHYR

ARCHITECTURAL SOFT MESH

By

SOLiD
STUDiO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# OUR STORY

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*Paul Haëntjens and Aurélien Faugères, partners.*

## Redefining the Use of Concrete:

**Solid Studio was founded when Aurélien Faugères (on the right) sought to merge his experience as a 3D designer for architects with his background as a high-performance boat builder.**

**He began crafting custom-designed furniture using UHPC (Ultra-High Performance Concrete) when he was joined by Paul Haentjens (on the left). Their collaboration pushed the boundaries of this unique material, opening new perspectives. Thus, redefining the use of concrete lies at the heart of Zephyr Mesh's identity.**

Naturally, Zephyr Mesh was developed as a façade material for architecture, showcasing its qualities as a flexible and customizable mesh. Its numerous functional, regulatory, and aesthetic benefits open up a wide range of applications.

Solid Studio has developed its own production line and robotic machinery to manufacture this distinctive façade product in France.



**With a team of engineers, mechatronics specialists, and 3D modelers, the startup Solid Studio addresses all technical aspects concerning the implementation of Zephyr Mesh (design, production, structural analysis, implementation study, assembly instructions, laying-out plans).**
The entire robotic industrial process, incorporating precision technology, is developed in-house by the team. Solid Studio has already filed several international patents to protect both the process and the material.

## Our Supporters:

**Promising and innovative, the company is currently receiving financial support from the Brittany Region and Bpifrance, both of which recognize its growth potential in France and internationally. Additionally, it is backed as a member of La French-FAB.** The startup recently raised private funds from an American investor who understands the development stakes, especially in warmer climates. Indeed, Zephyr Mesh addresses increasingly pressing environmental issues in certain regions across the globe.

# THE ZEPHYR MESH

## What is Zephyr Mesh?

**Similar to a fabric, our patented facade system was developed to wrap buildings, addressing contemporary architectural and environmental challenges. Zephyr Mesh is composed of an ultra-resistant stainless steel net onto which customizable elements made of UHPC (Ultra-High Performance Concrete) are inserted.**

In a context where climate change is at the forefront of concerns, Zephyr Mesh offers a transition to more sustainable and smart solutions, primarily due to its four functions :

- It allows ventilation of facades and covered areas.
- It can be used as an excellent sunshade.
- It is aesthetically attractive and adaptable to various geometries.
- It presents a low CO2 footprint for extreme durability.

From shading structures, partitions, stretched ceilings to safety implementation, visual and acoustic protection, our innovative system' s application field is extensive and adaptable to the most complex geometric forms.

# ENVIRONMENT

## Environmental Approach

***«Less is more»*** Ludwig Mies van der Rohe

**If the famous quote attributed to architect Mies van der Rohe applies particularly well to design and architecture, it fits perfectly to our environmental approach. Zephyr Mesh aims to offer a lightweight solution, economical in material usage, and subjected to a restrained and clean production process.**


**Low carbon footprint.**
The lightweight nature of Zephyr Mesh leads to a necessary carbon sobriety in current construction practices. Compared to existing solutions (perforated sheet metal, concrete mesh, etc.), Zephyr Mesh reaches a carbon footprint 5 to 10 times lower, ensuring increased durability.

**Positive impact on air conditioning.**
The principle of the ventilated facade generates natural cooling of buildings, significantly reducing the need for conventional air conditioning systems.

**Adaptation to climate change.**
Zephyr Mesh, enables architects to design shaded and cooling spaces, it contributes to proposing solutions for adapting our cities to a warmer climate.

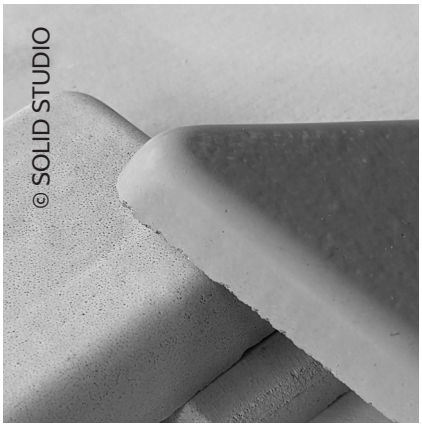
**Made in France manufacturing.**
Zephyr Mesh is produced in Brittany, France, within our workshops. Our production materials are sourced in France and European Union.

# A resistant product

### 316 stainless steel cables


We work with two of the most resistants materials of the construction industry :
Marine-grade stainless steel (grade 316).

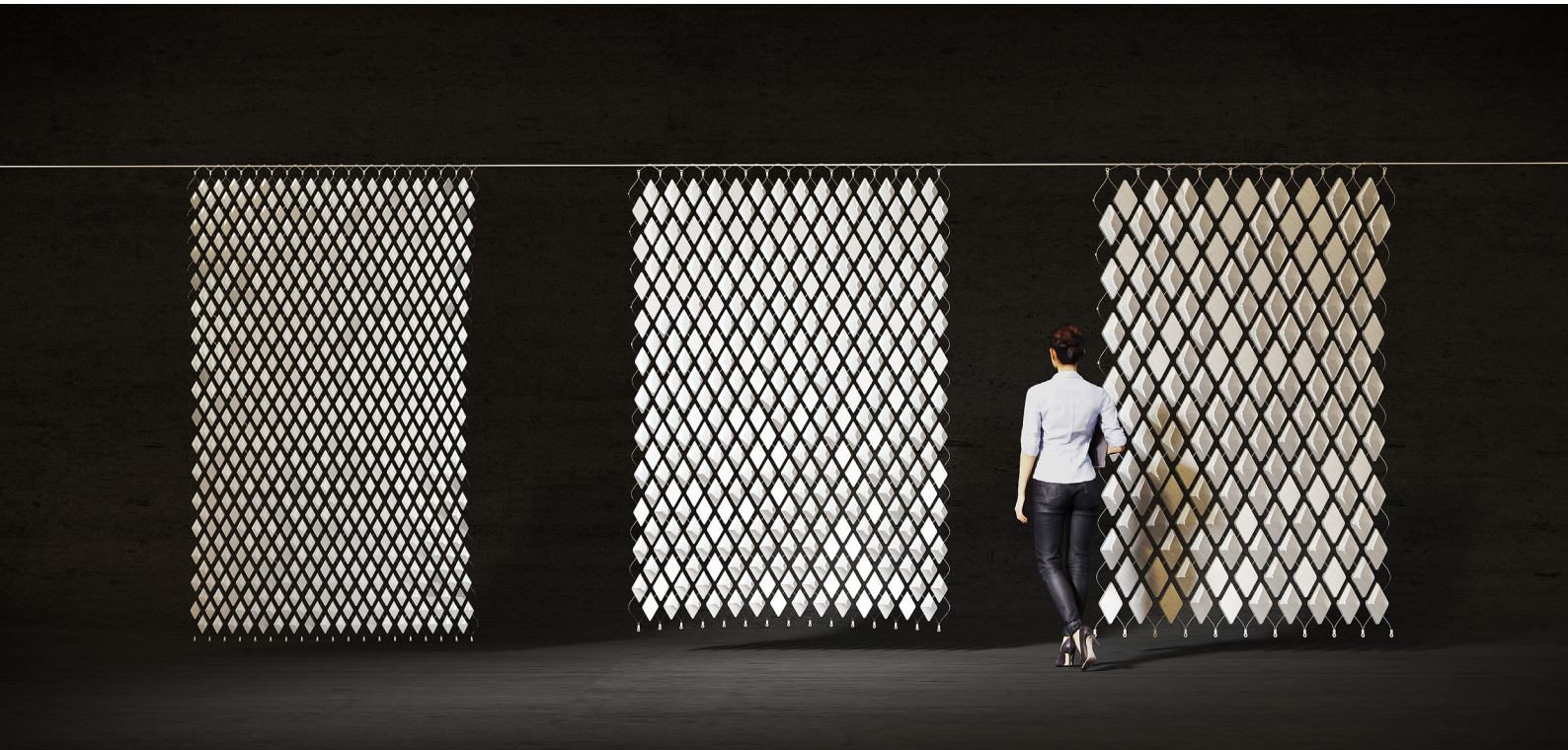
### UHPC studs



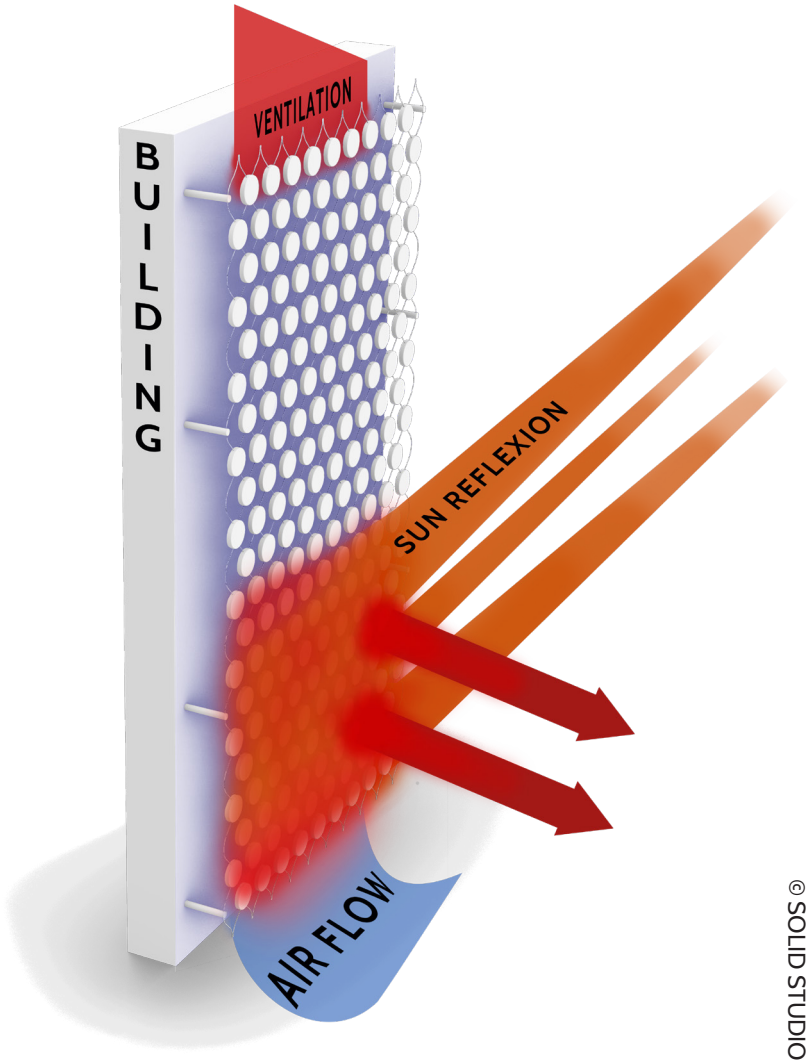

The UHPC (Ultra High Performance Concrete) is characterized by its very high mecanical specifications. We reinforce the formula by the integration of organic fibers.

# Shade creator

Zephyr Mesh is used to create shaded spaces both vertically and horizontally.



# And cooling.

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On facades, a **natural air conditioning phenomenon** (thermal convection) creates a flow of cool air along the buildings, significantly **contributing to their cooling.** This natural process leads to **substantial savings in air conditioning costs.**

**Through this natural process, Zephyr Mesh can generate up to 30% in air conditioning cost savings for buildings. For a 1,000 m² building, this represents a reduction in CO2 emissions of 16 tons per year.**

Calculation based on a reference country in hot and arid climates (Middle East).
*Sources: Complete Confindustria Ceramica SDG Report Building envelopes: energy upgrading, aesthetics, and savings.*


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# Ultra-resistant materials

**Zephyr Mesh consists of two fundamental elements :**

**– The stainless steel net (316 – marine-grade, Carl Stahl) known for its exceptional elasticity and flexibility.** It easily withstands harsh weather conditions, is highly durable, and requires minimal maintenance. This stainless steel net is suitable for both indoor and outdoor applications.

**– The Ultra-High Performance Fiber-Reinforced Concrete (UHPFRC)** is affixed (through casting) onto the stainless steel net. Each concrete element is configurable (shape, color, density, etc.).

**The entire assembly represents a weight ranging from 5 to 20 kg/m² depending on the pattern... The concrete formulation comes from an innovative cement benefiting from TX Active® technology. Its composition accelerates the decomposition of pollutants and prevents their formation on surfaces.**

**Pollution-reducing system :**
**Concretes containing products formulated with TX Active® significantly reduce the presence of organic pollutants**, harmful gaseous substances (nitrogen oxide NOx), and volatile organic compounds (VOCs: benzene, toluene, etc.) produced by human activity (industry, automobiles, electric heating). This preserves the air quality and aesthetics of the buildings.

**Local cement :**
**The cements used are 100% sourced from local quarries near the manufacturing site of Zephyr Mesh located in Brittany, France.**

**Recyclable :**
**Stainless steel is fully recyclable, and concrete aggregates can be reused in the formulation of new concrete after crushing.**

# ZEPHYR SYSTEM

## Zephyr Mesh : Diverse Applications

**The industrial manufacturing process of Zephyr Mesh allows for the production of panels in various dimensions, tailored to the project's requirements.**

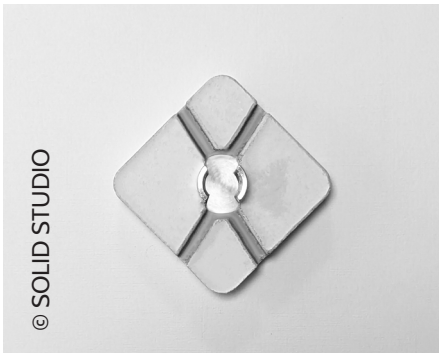
These panels are invisibly connected by a 316 stainless steel mechanical system. This system ensures the continuity of the pattern without revealing the layout.

Zephyr Mesh is deployed and tensioned over a custom-developed primary structure in collaboration with facade builders, carpenters, and other involved parties.

Solid Studio provides a static analysis of the forces exerted by the tensioning and the self-weight of Zephyr Mesh. This analysis supplies the necessary datas for the design of the supporting structure.

**We also supply a range of accessories and fastening equipment, enabling adjustment, tensioning, and fixation of Zephyr Mesh.**


Assembly of the binding



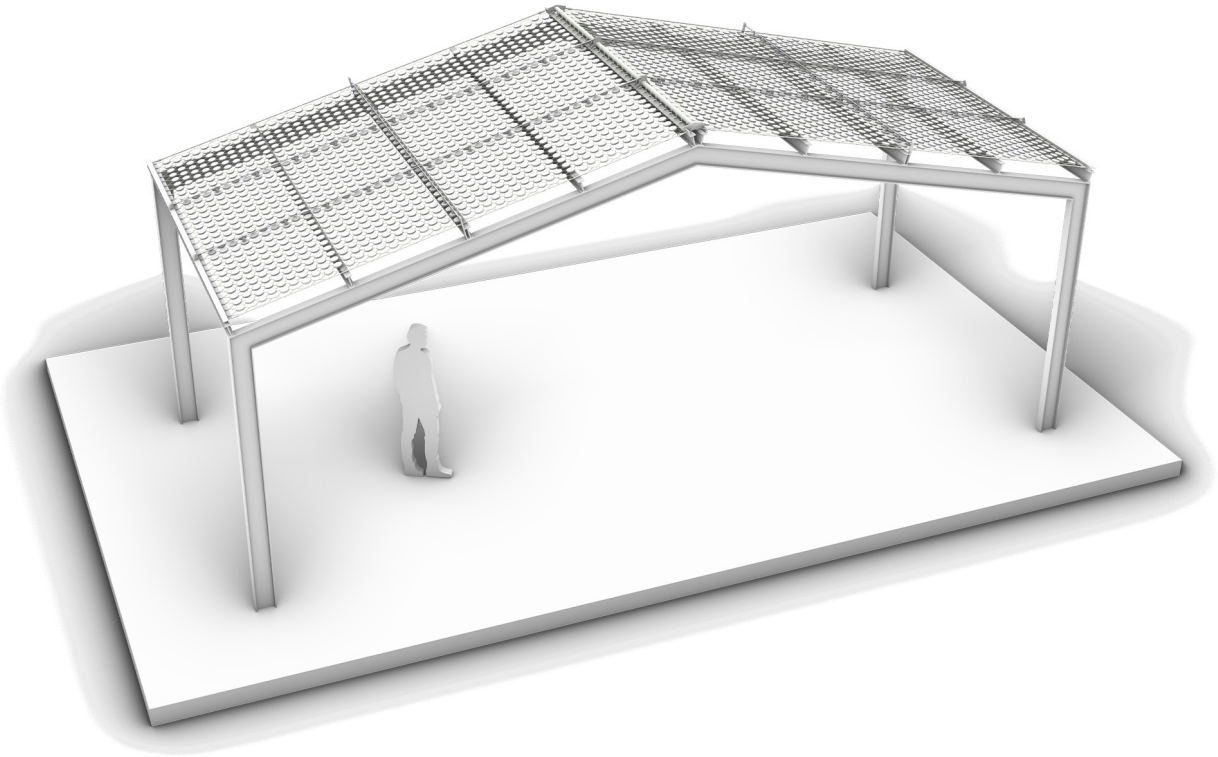

Connector Stud


Eyelet


Sleeve


Cable clamp


Tension cable



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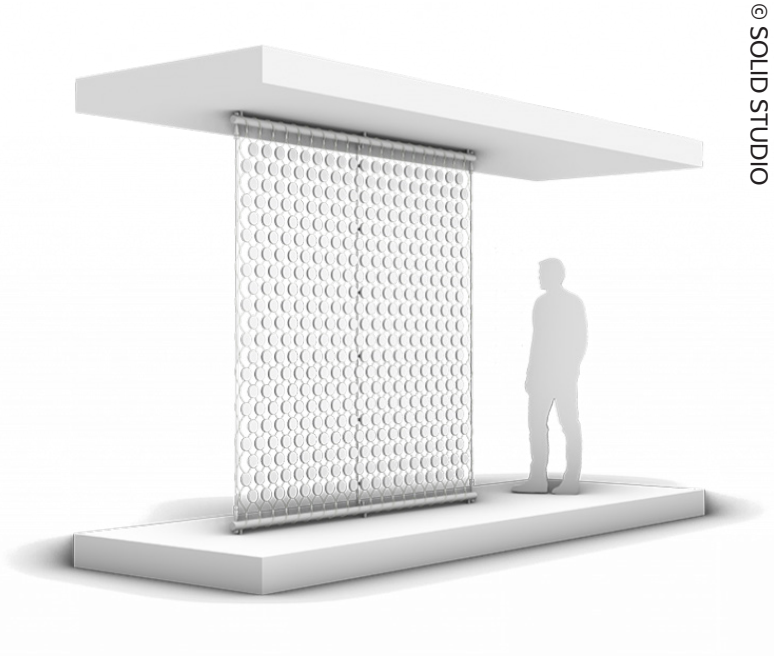
*Horizontal application, pergola, shading structure, sunbreaker*



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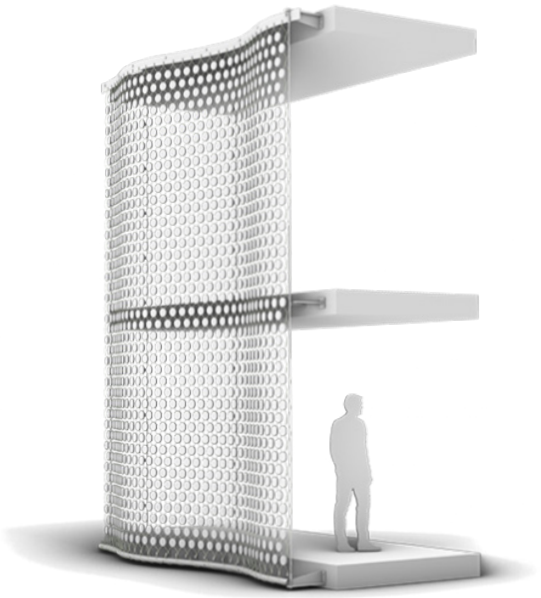
*Vertical indoor application, panel to panel*



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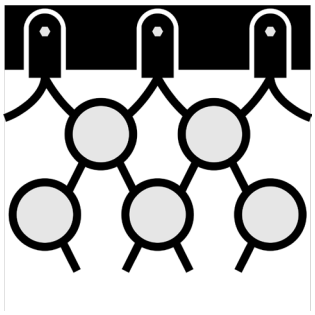
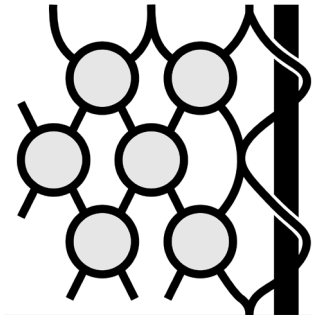
*Vertical application, projecting facade, volume generation*

# The implementation systems

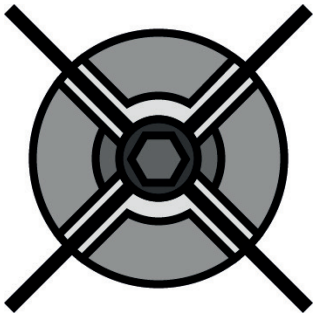
**Zephyr Mesh is implemented through a system developed by our engineering office. Depending on the projects and their specificities, it is possible to establish dedicated implementation systems.**



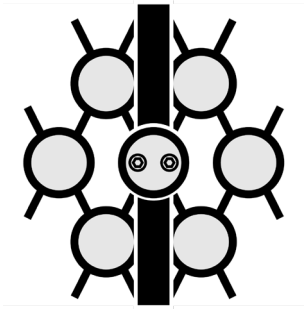
**Upper Fixation :**
In the case of vertical installation, Zephyr Mesh is installed on fixed points to ensure the geometry of the entire project.



**Lacing :**
To tension the Zephyr Mesh on its support, a lacing system is used to maintain the perimeter of the installed surface.

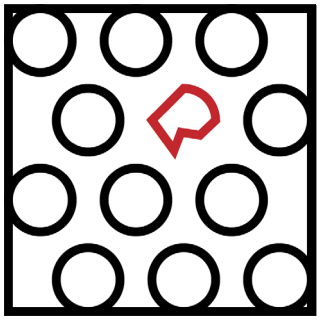


**The connector stud :**
To assemble the different panels, this stainless steel and concrete element allows for a strong junction that integrates the desired concrete pattern.

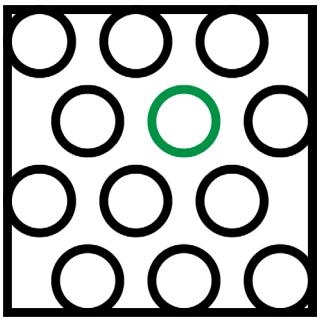


**Tension cables :**
The entire installed surface is supported by tension cables fixed to the Zephyr Mesh using cable clamps and stainless steel (316) spacers.

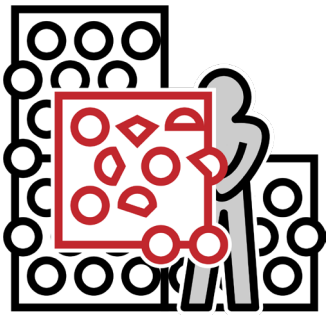
**If an element is damaged, a technician can easily replace either a single concrete stud, or an entire panel.**



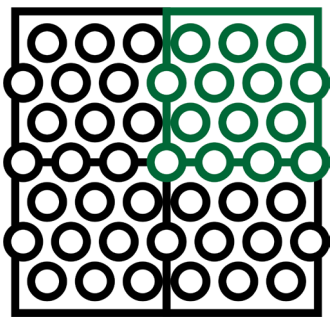
**Deteriorated stud :**
If a concrete element were to be damaged, a technician can proceed with the complete removal of the damaged stud.



**Repair stud :**
Once the concrete stud is removed from the Zephyr Mesh, a repair stud with the correct pattern can be installed by the technician using a stainless steel mechanical fastening. The repair becomes completely invisible.



**Deteriorated panel :**
If a sub-assembly has too many defects due to mishandling or deterioration, the concerned panel can be easily removed by the technician.

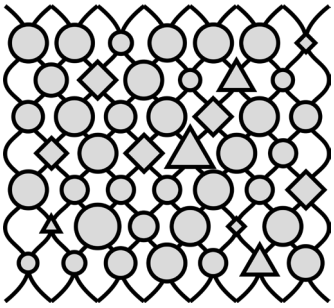


**Repair panel :**
A replacement panel with the correct pattern can then be installed by the technician. It simply needs to be reattached to the rest of the surface using the connector stud system.

# CUSTOMIZATION

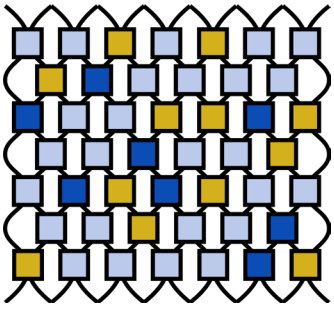
## A customizable pattern

**On a large scale, the grid of points generated by Zephyr Mesh creates a pixelation effect that can be worked on according to 3 parameters :**

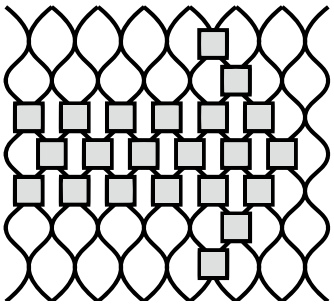


**The pattern and size :**
The technology developed by Solid Studio allows for the creation of all kinds of repetitive or non-repetitive geometric shapes. Hence, the designer or architect can design the shape and size of each of these concrete elements.

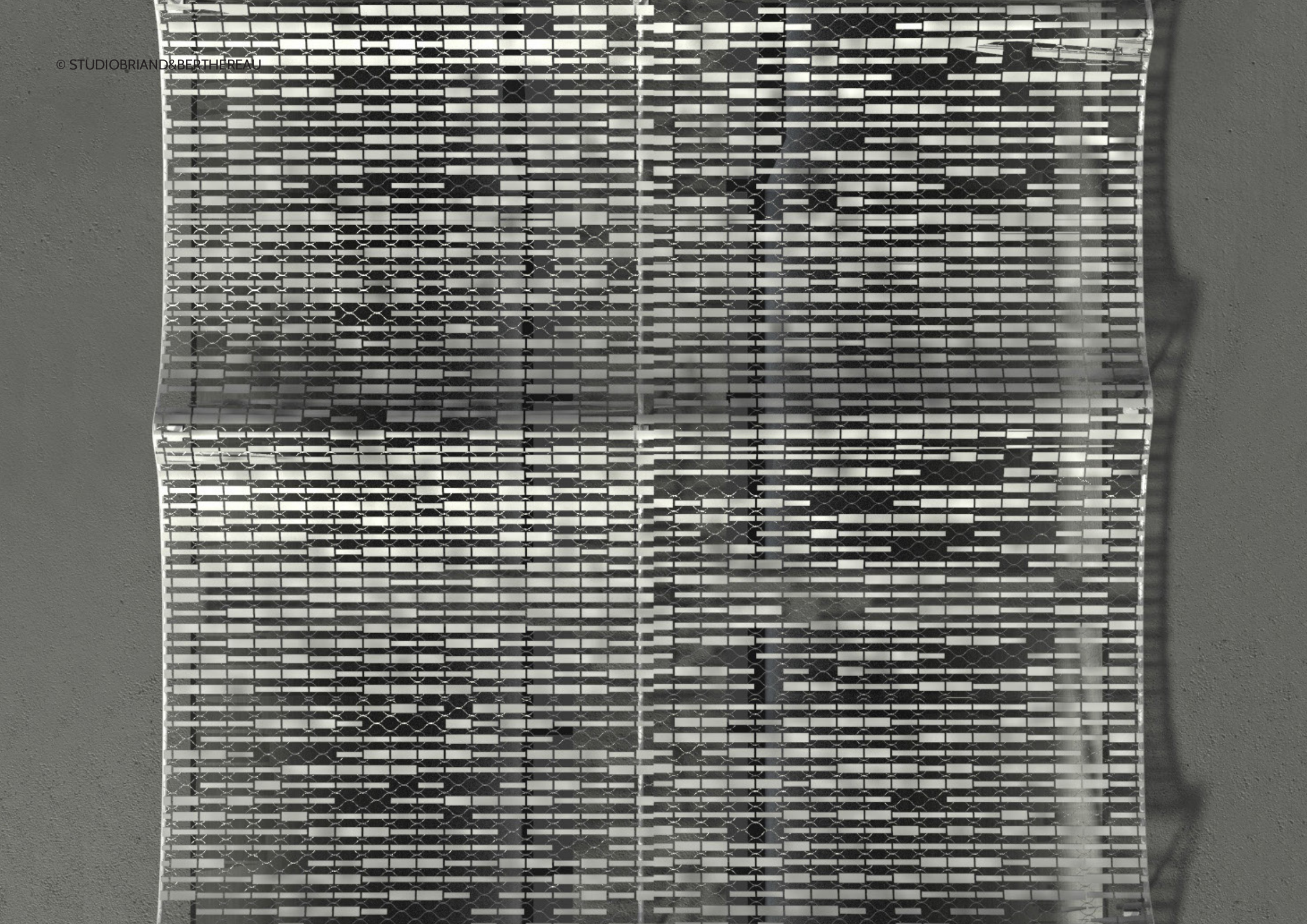
**Mesh size :**
Is available in different sizes from 100x175 to 300x525 mm.

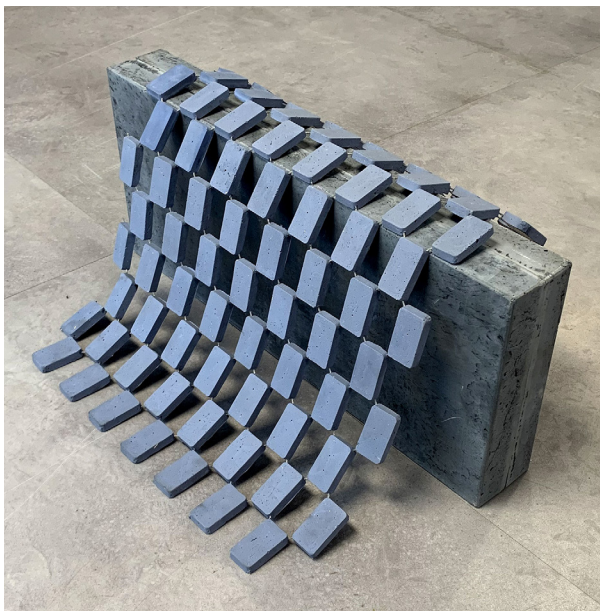


**Pigmentation :**
The concrete is colored throughout and can be produced in a multitude of colors, enabling the creation of contrasts and gradients. The pigments used in the formulation are natural mineral pigments, ensuring good color durability.

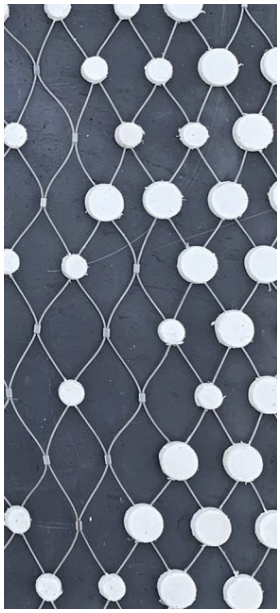


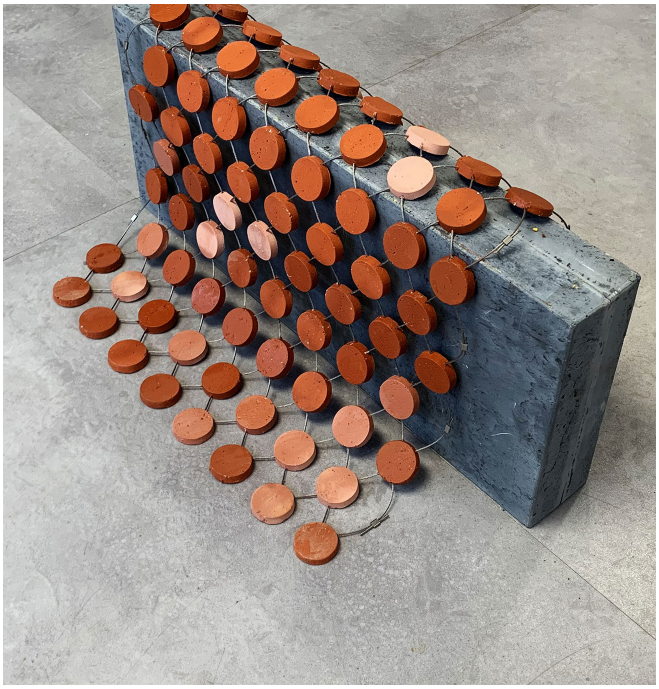
**The solid and the void :**
Zephyr Mesh can integrate areas without concrete, creating transparent zones. This parameter allows for managing the opacity of Zephyr Mesh. It also enables the generation of graphic concepts or signage.

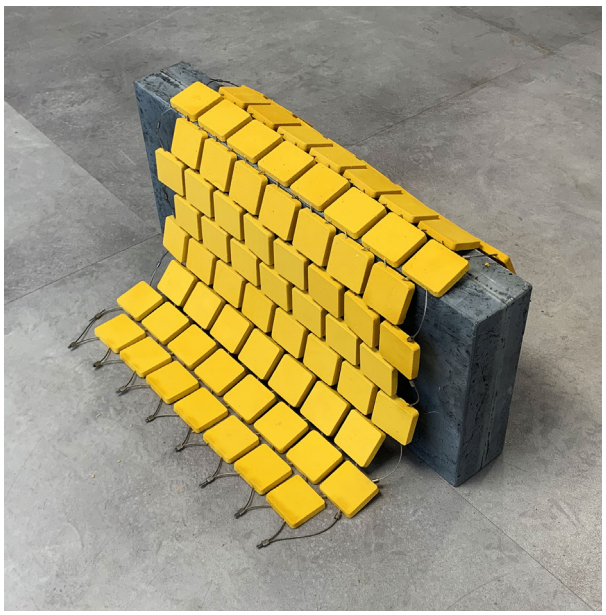


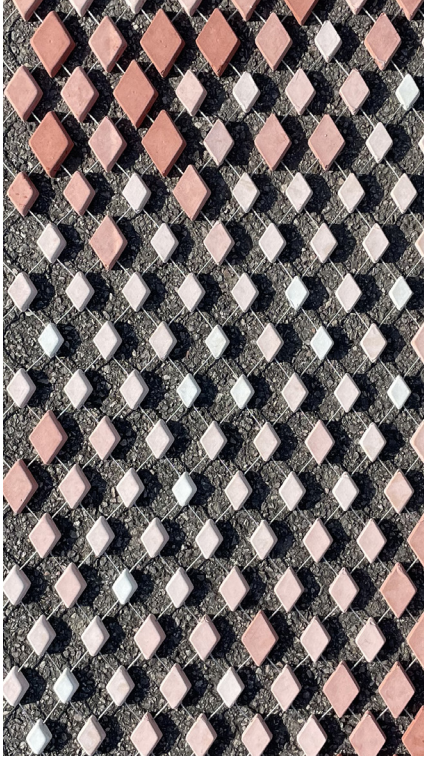


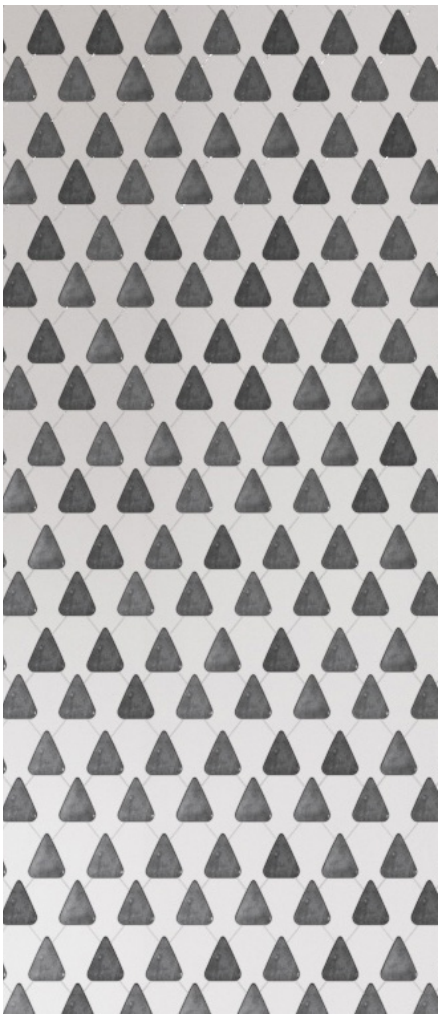
## Multiple possibilities

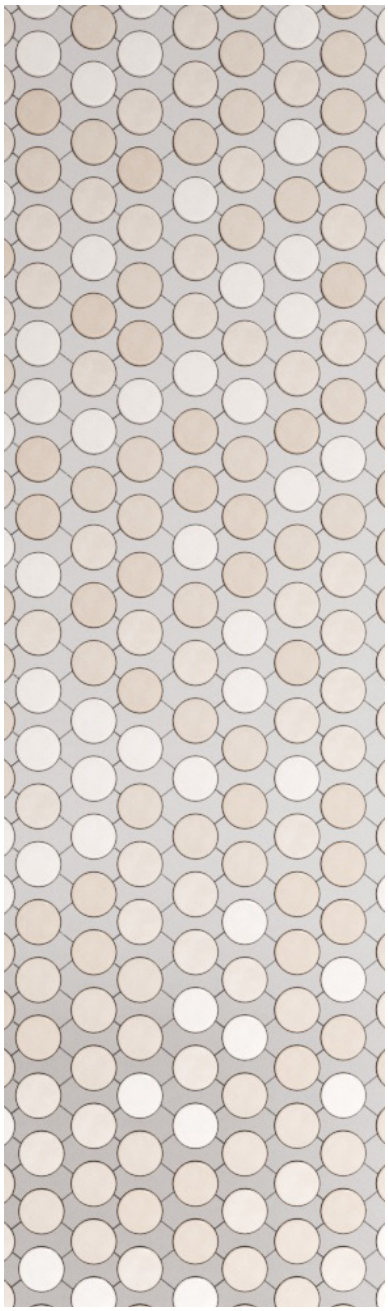












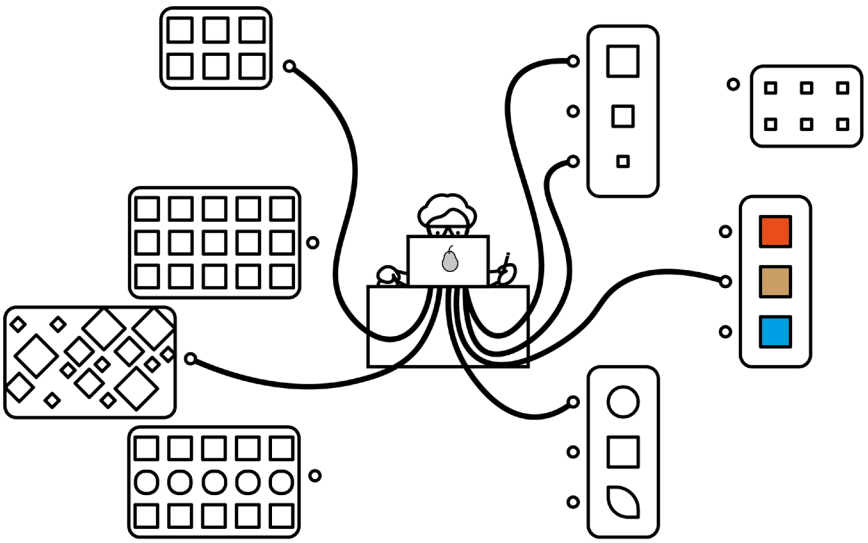
# ZEPHYR COMPOSER

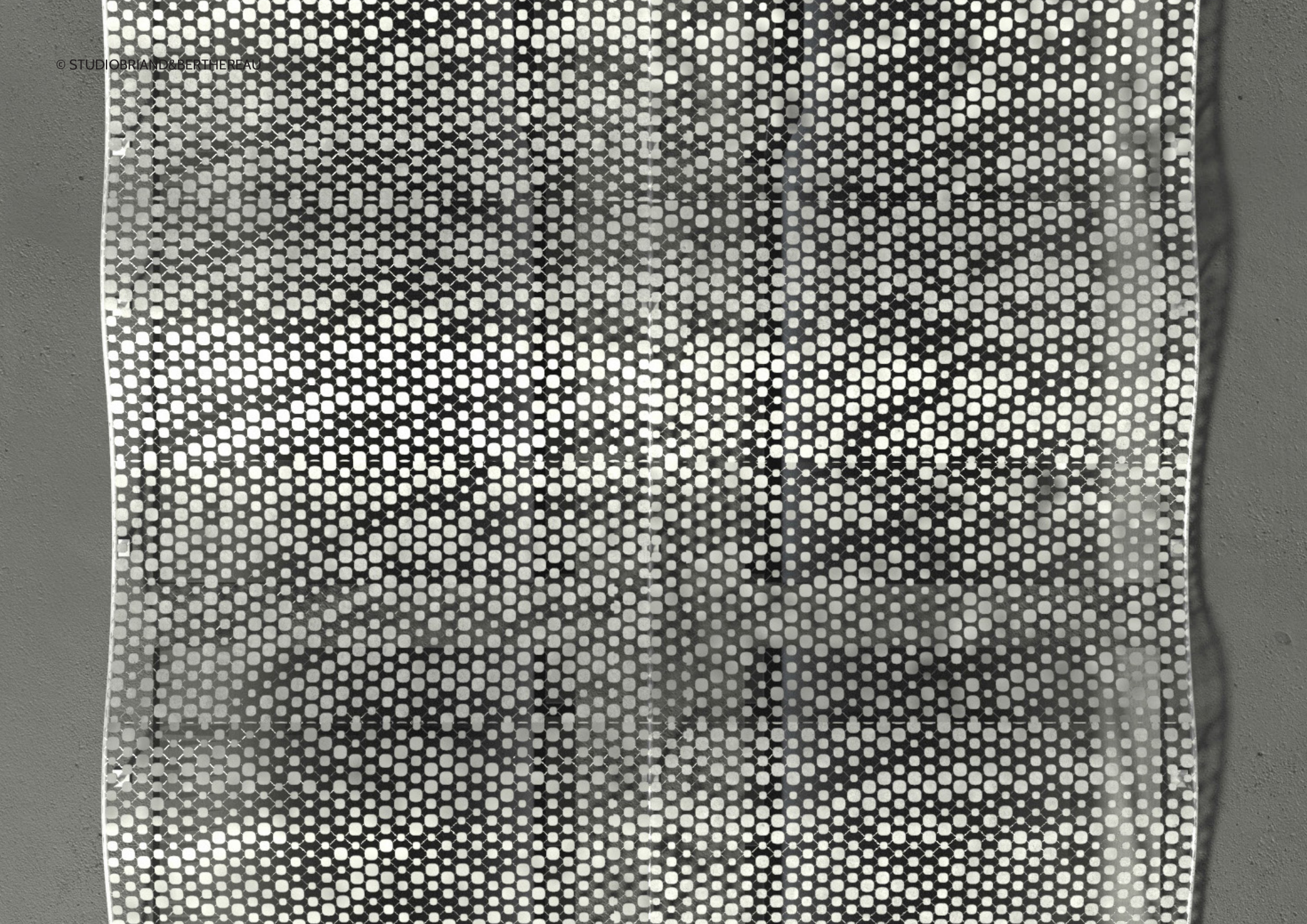
## Powerful Parametric Design

**Zephyr Composer is a tool developed by Solid Studio. It enables the creation of facade concepts using parametric design.** This software is particularly useful for managing complex geometries with an algorithm-based approach.
Our tool allows designers to explore new creative possibilities, from the simplest to the most complex.

## Time-saving

**Solid Studio offers designers training in our parametric design tool to maximize the potential of Zephyr Mesh. Based on a project, our experts can :**
– Generate the desired pattern or graphical concept on the Zephyr Mesh surface for you.
– Train you to use Zephyr Composer yourself (Rhino + Grasshopper prerequisites required).
Create mathematical, abstract, or organic patterns at lightning speed !





# A simplified design process

**Zephyr Composer generates an overall pattern projected onto the 3D model.** A multitude of parameters can be adjusted (point dispersion, volume, geometry, color gradients, pixelation, absence of points, etc.).
The design process of Zephyr Mesh involves 5 steps :

**1)** Definition of a plot alphabet.

**2)** Determination of a developable surface.

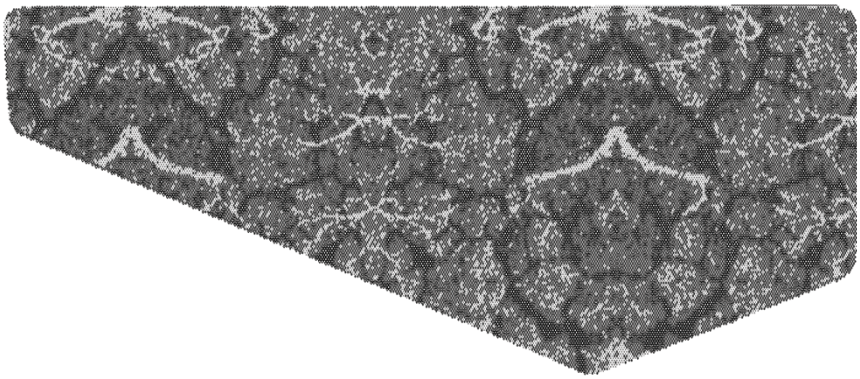
**3)** Establishment of rules for the distribution of different plots.

**4)** Projection onto a 3D model for three-dimensional visualization.

**5)** Adjustment of volume, dispersion, colors, etc.

Image selection...

...processed in black and white, simplified...



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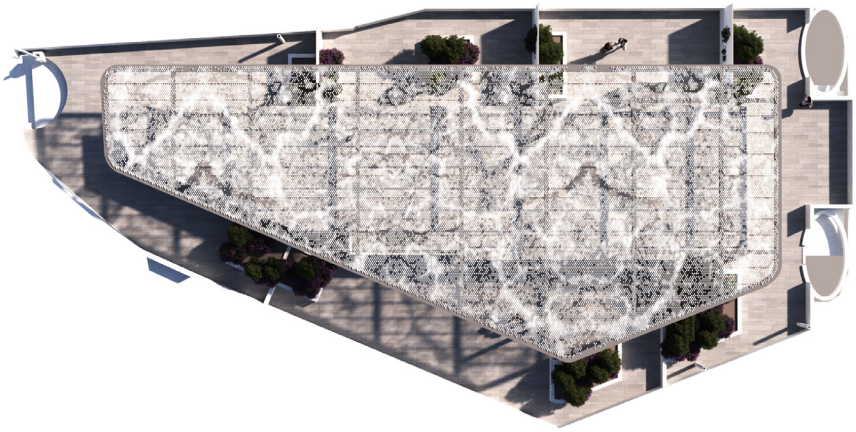
...applied to a developable surface (here, a pergola)...



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...3D projection of the studs according to pre-established rules...

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3D rendering, layout plan, and production in our workshop.

# TECHNICAL DATA

| **Ultra High Performance Fiber Reinforced Concrete** | |
|---|---|
| Properties tested | Guaranteed minimum values |
| Compressive strength (MPa) | ≥100 |
| Tensile strength (MPa) | ≥5 |
| Density | 2,2~2,4g/cm$^3$ |
| Modulus of elasticity (GPa) | ≥40 |
| Yield strength in bending (MPa) | ≥7 |
| Flexural strength (MPa) | ≥12 |
| Flexural strength limit after 100 freeze-thaw cycles (MPa) | 10~25 |
| Impact resistance | No through cracks on the slab |
| Air permeability | <7,14*10-17m$^2$ |
| Chloride diffusion coefficient | <1,2*10-12m$^2$/s |
| Carbon dioxide penetration | Depth of carbonation <0,5mm |
| Water absorption | <3% |
| Poisson's ratio | 0,24 |
| Shrinkage upon drying | <1000 μm/m |
| Creep coefficient Cu | 0,8~1,2 |
| Linear expansion coefficient (1/°C) | (1,0~1,5)*10$^{-5}$ |
| Shrinkage during drying (x10$^{-6}$) | ≤300 |
| Self-treatment (x10$^{-6}$) | ≤800 |
| Rupture modulus (first crack) (MPa) | 10-25 |
| Mohs hardness | 4 |
| impact resistance K/m$^2$ | ≥8,0 |
| Freeze resistance | After 50 freeze-thaw cycles, there are no signs of damage such as lifting, peeling, etc. |

| **Zephyr Mesh - by Solid Studio** | |
|---|---|
| Minimum-maximum thickness of the pattern | 10-20 mm |
| Minimum spacing | 5 mm |

| | |
|---|---|
| Trame height and width (center to center) | **Customizable** |
| Maximum weight (solid pattern) | 5-30 kg/m² |
| Stainless steel mesh reference | SCX015040S400M |
| Maximum width and height per panel | **Customizable** |
| The assembly of panels | Invisible junction - stainless steel 316 mechanical attachment |
| Hard shock & soft shock | NFP08-301 & NFP08-302 standards |
| Gel/thaw | NF P18-424 |
| Sinusoidal vibrations | IEC 60068-2-6 standard |
| Fire resistance | A1 |
| Salt spray | ISO 92227 standards |
| Anti-graffiti cleaning | Intern protocol |
| Repair protocol | Intern protocol |

| **Mesh X-TEND CXE super micro - Carl Stahl** | |
|---|---|
| Material | INOX AISI 316 |
| Construction cable | Variable depending on the mesh |
| Manufacturing | Setting |
| Mesh shape | **Customizable** |
| Mesh dimension | **Customizable** |
| Finish | Passivated raw |

| **Cable - Carl Stahl** | |
|---|---|
| X-TEND CXE super micro - Carl Stahl* **(Variable product/Project)** | Protocols |
| Reference | SCX015040S400M |
| Material | INOX AISI 316 |
| Cable diameter | 3 mm |
| Nominal resistance | 1570 N/mm² |
| Breaking load | 5,12 kN |
| Weight for 100/173 mm | 0.90 Kg/m² |

** Reference data for the X-TEND CXE super micro 3 mm. Depending on the project, the mesh pattern can be customized..*

## CONTACT :

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