EVAPORA

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OpenFace is an Erasmus+ project

Introduction

The Facade Performance Gap - Aspects directly affected by Facade

Human Comfort

Envelopes have the potential to compromise indoor comfort, ventilation and daylighting quality.

Energy Performance

Rigid systems lead to inefficient reliance on mechanical HVAC.

Sustainability

High-performance often means complex, non-recyclable, and high-embodied-carbon materials.

Evaporative Cooling Facade

Why ?

- Global Warming & Urban Heat Island Effect
- Lower operational energy
- Lower CO2 emissions

What ?

Ancient cooling principle of evaporation to passively cool buildings. (Terracotta/Tezontle)

Where ?

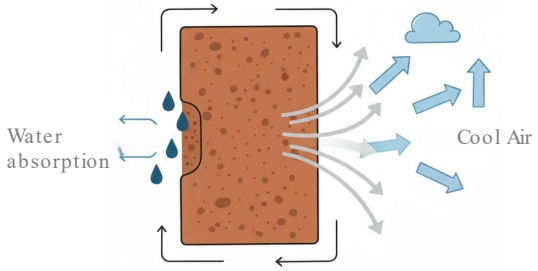
Hot & Arid Climates
Temperate Climates
Mediterranean, Middle East, parts of North Africa, American Southwest, Australian outback

How ?

Evaporative cooling uses the latent heat of vaporization of water, and cools the air. Use of a porous material that holds enough water to facilitate passive cooling

Why ?

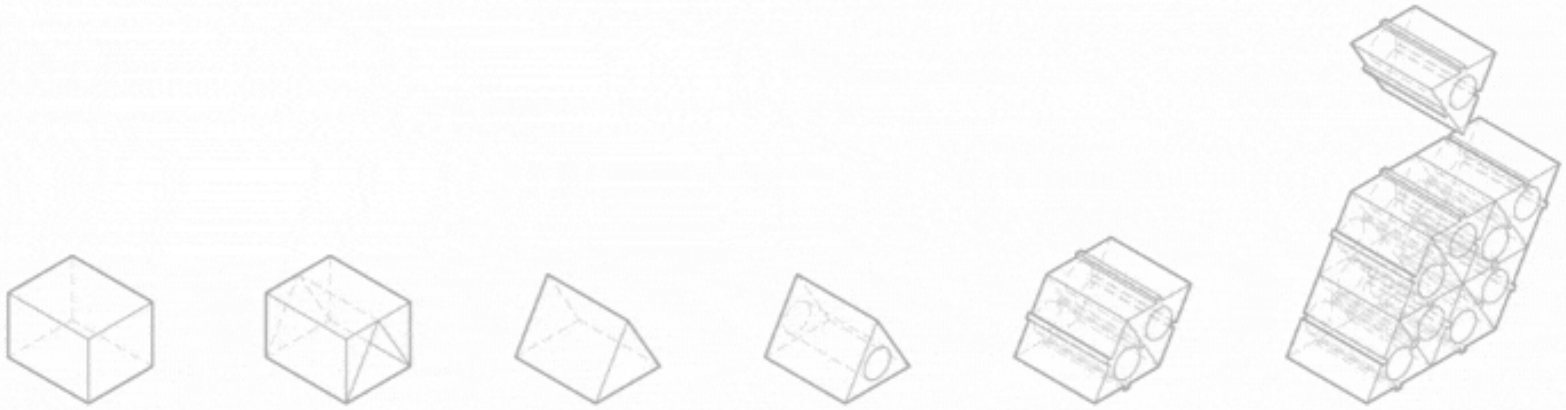
What ?



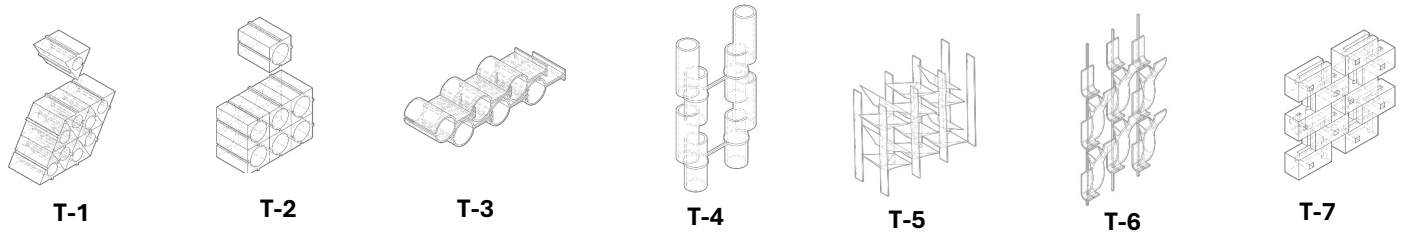
Where ?

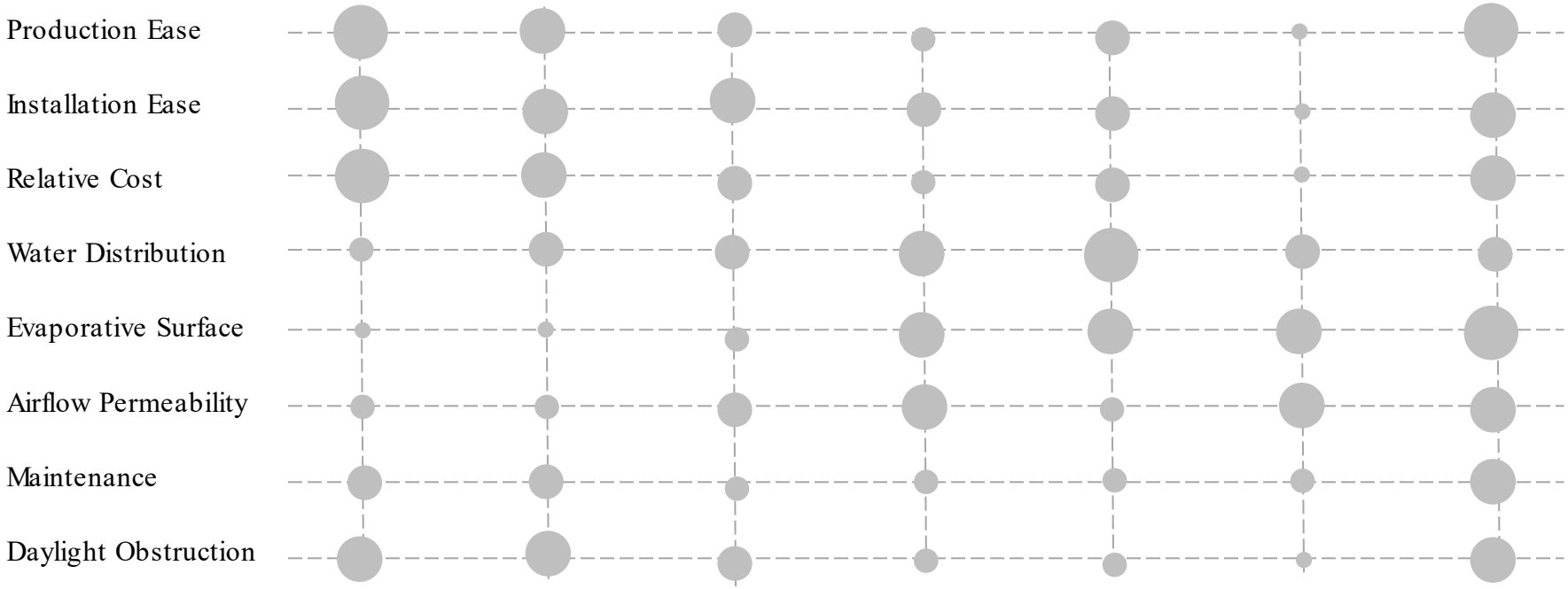
How ?

Iterative Design Process



Comparative Matrix

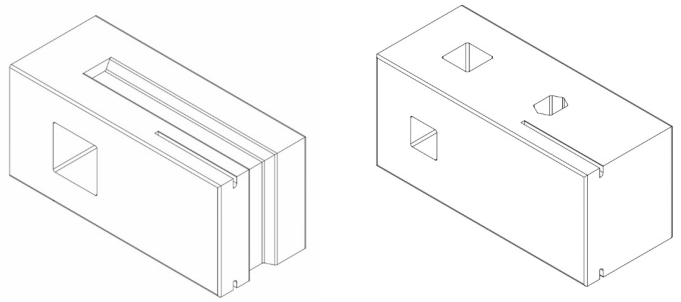


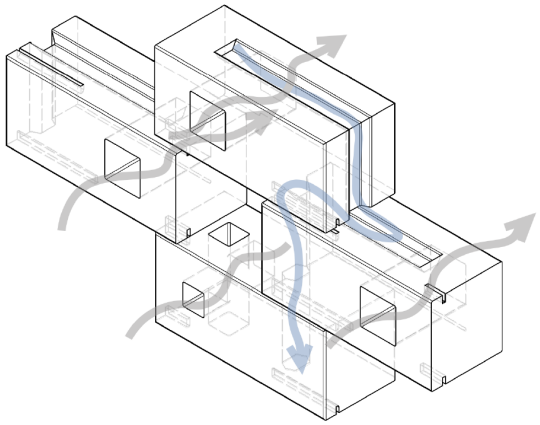


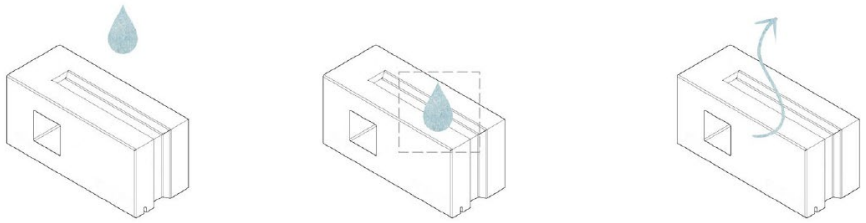
Concept

The final selected module is based on a simple and repeatable rectangular geometry, ensuring ease of production and assembly. A small longitudinal groove integrated on the surface functions as a water channel, guiding continuous water flow across adjacent modules and enabling uniform wetting for effective evaporative cooling. Internal voids reduce material usage and weight while increasing evaporative surface area and allowing airflow through the brick.

The resulting solid–void pattern creates a permeable façade layer that balances cooling performance, partial solar shading, and adequate daylight penetration when placed in front of glazing. The module's modularity and geometric clarity support scalable manufacturing, dry installation, and easy replacement, making it suitable for façade-scale application.







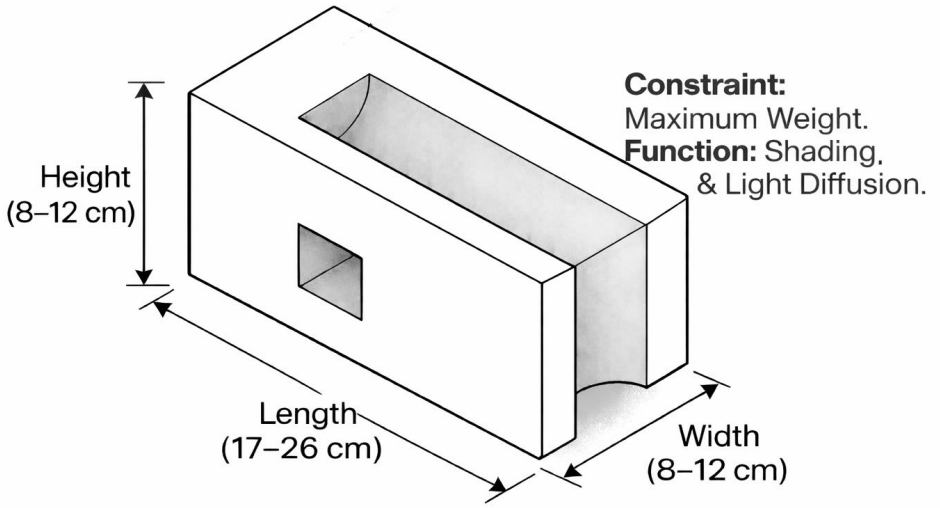
Absorb Hold Release

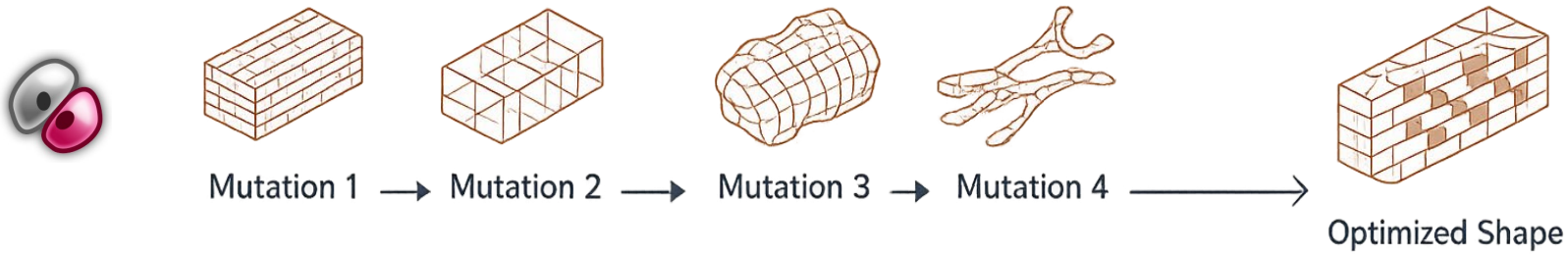
Genetic Optimisation

The optimization was performed using the Galapagos genetic algorithm within Grasshopper.

The system iteratively tested different brick geometries to identify the fittest configuration for the climate conditions of a typical hot and dry climate, maximizing daylight performance.

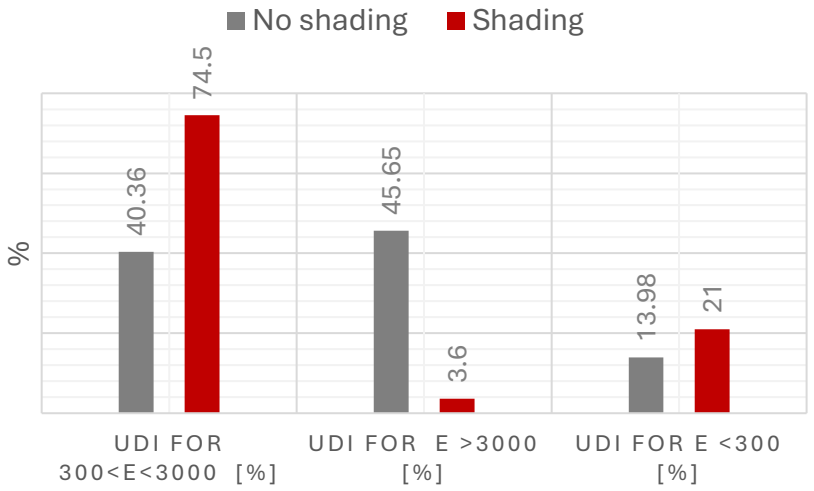
Fitness goal: maximize UDI300,3000 on 21st of December



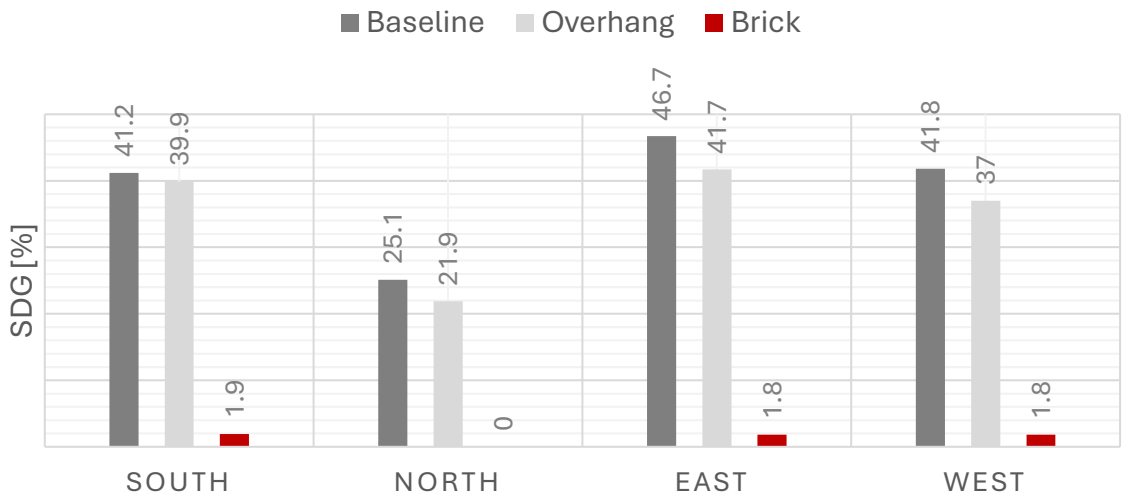


Optimisation Results

UDI

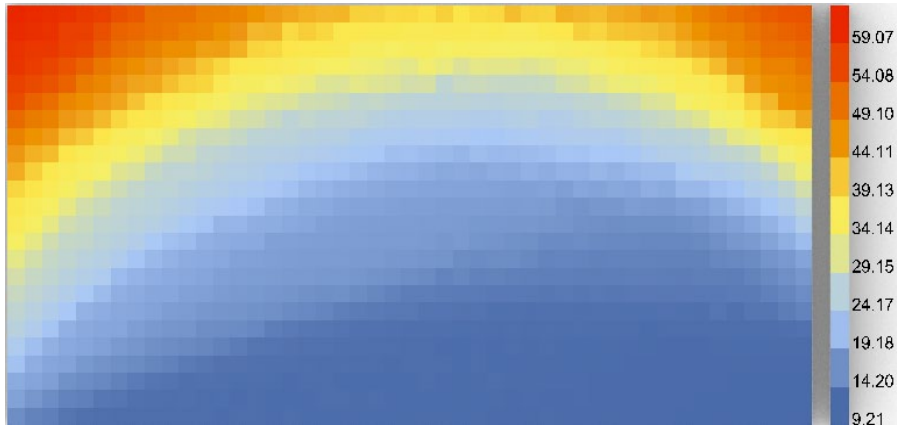


Glare

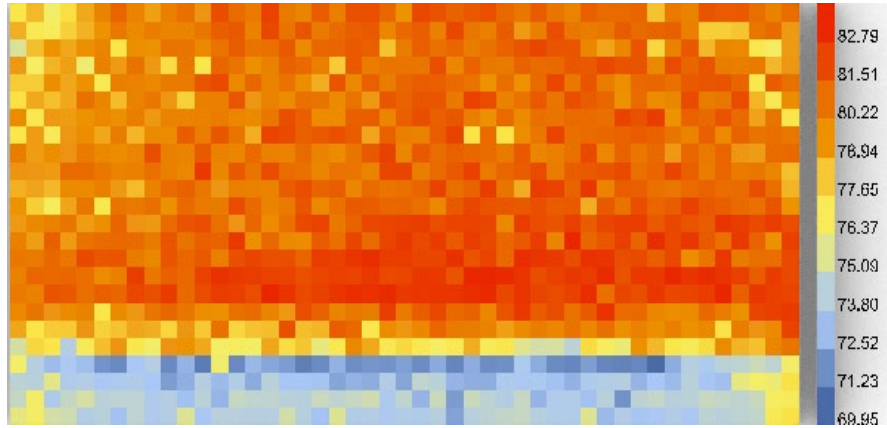


South Orientation Impact - UDI

No Shading



Shading

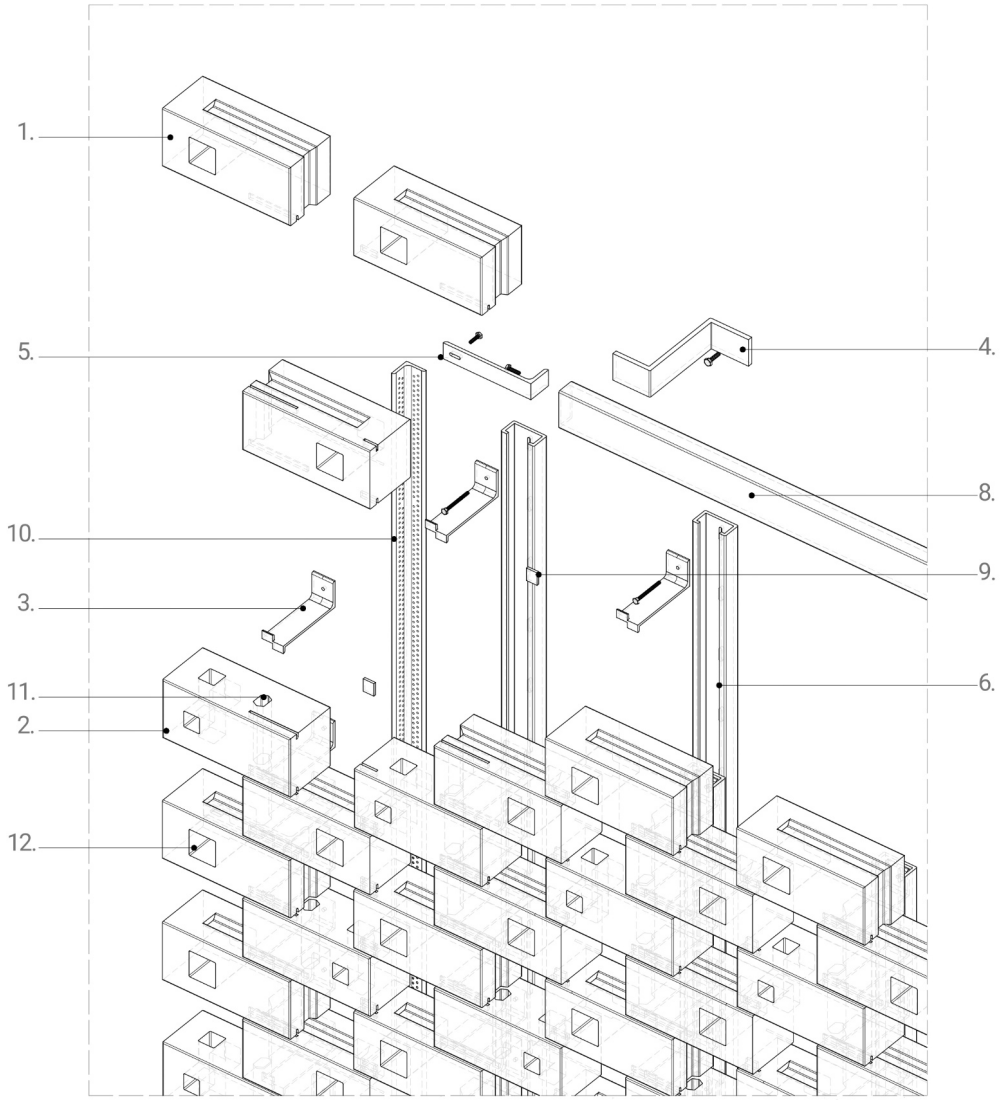


(UDI 300–3000 lux)

Axonometric

Legend

1 - Brick (Typology 1): Custom porous brick unit
2 - Brick (Typology 2): Custom porous brick unit
3 - Retention Clip: 5mm Stainless Steel (Grade A4/316) L-clip for brick support and stability.
4 - Primary Bracket: 8mm S355 Steel plate for facade-to-Structure load transfer.
5 - Edge Support: 6mm S355 Steel L-angle for perimeter frame lateral stability.
6 - Vertical Mullion: Cold-formed Steel C-channel secondary structural member.
7 - Retention Clip (Type 2) 5mm Stainless Steel (Grade A4/316) L-clip for brick support and stability.
8 - Horizontal Transom: Steel RHS (Rectangular Hollow Section) primary spanning member.
9 - Anchoring Clip: Mechanical SS316 clip ensuring brick-to-brick connection.
10 - Framing Angle: 6mm S235 Steel Perforated L-section for perimeter frame.
11 - Vertical Conduit: Internal brick aperture for gravity-fed water circulation.
12 - Air Plenum: Horizontal brick void for intake and evaporative cooling exchange.
13 - Drain Cover Plate, finished in terracotta/ceramic tile
14 -Drainage Channel Stainless Steel laid to slope



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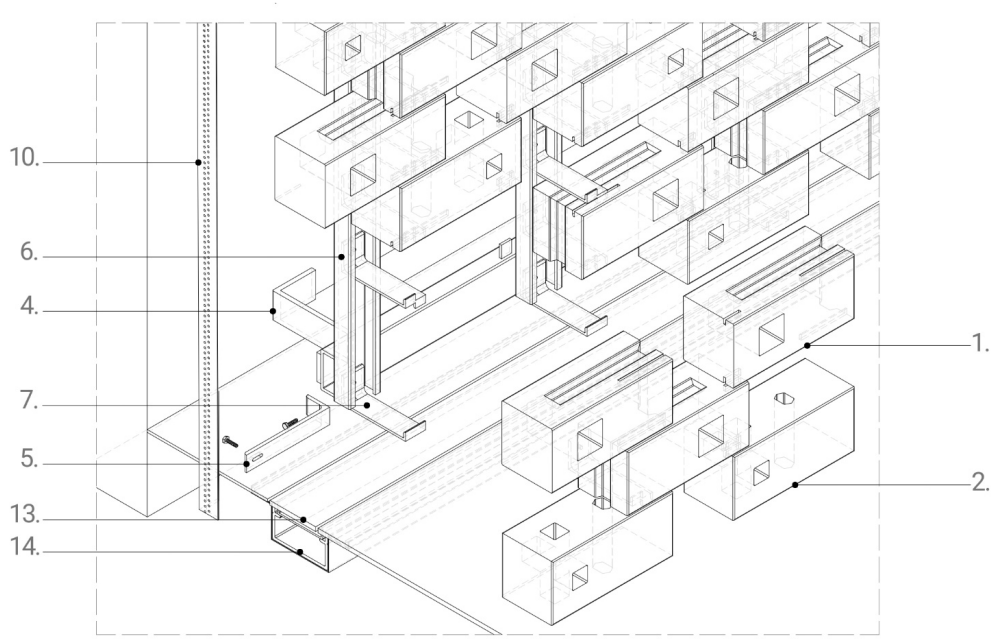


Water Management System

A closed-loop, gravity assisted network designed to support evaporative cooling within the façade. Water is supplied from an overhead storage tank and distributed uniformly across the façade through a controlled distribution system. A control unit and pump regulate flow rates and timing based on operational requirements and environmental conditions. Excess water is collected at the base through a dedicated drainage channel and directed into a collection tank, from where it can be filtered and recirculated or connected to the main plumbing system.

Legend

1 – Overhead water tank

2 – Water Distribution System

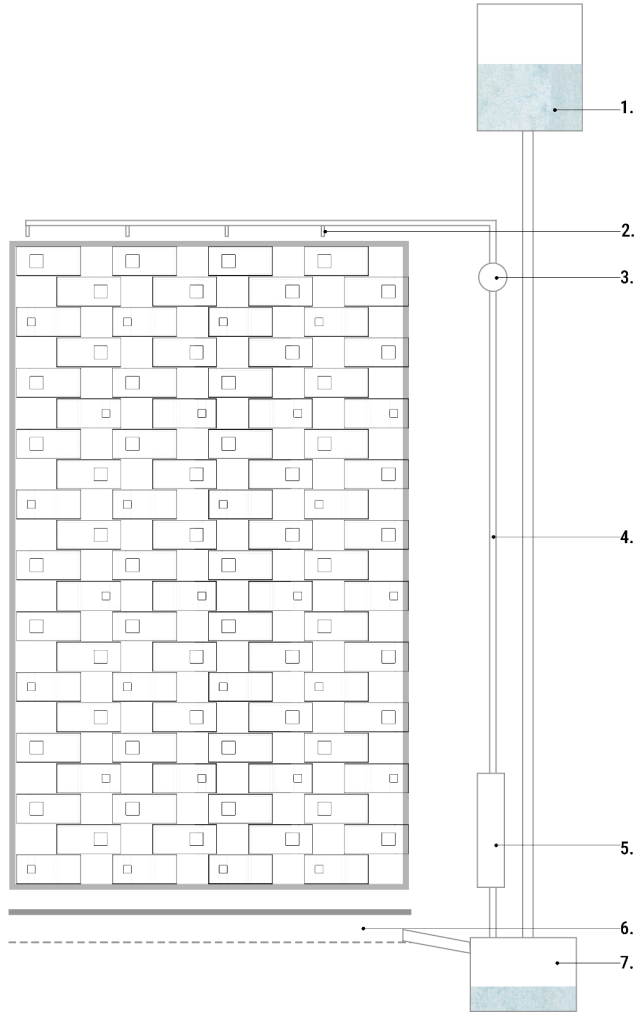
3 – Control unit

4 – Connection to main plumbing

5 – Pump

6 – Water Collection Drain

7 – Water Collection Tank



Thank you for your attention!