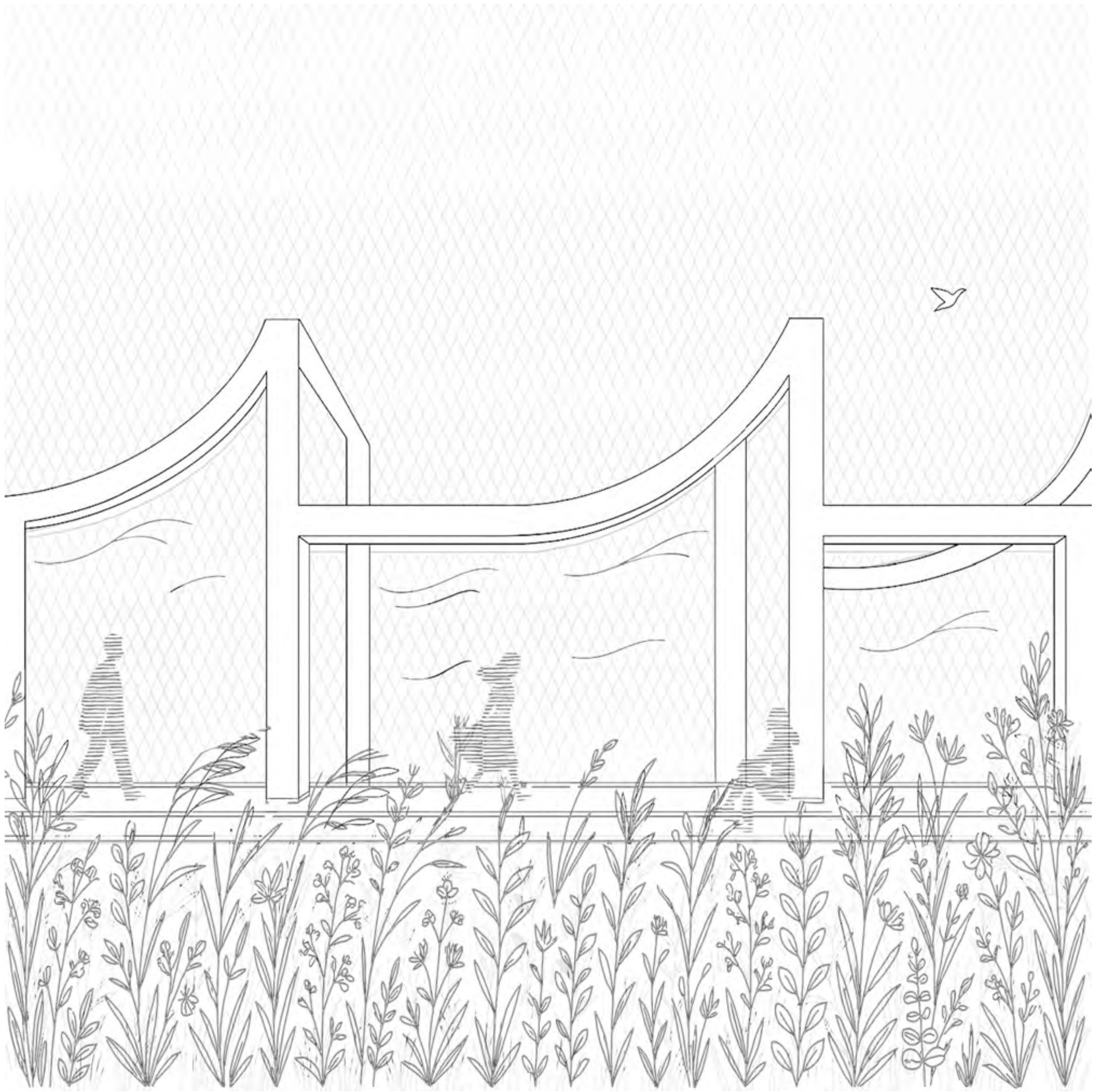
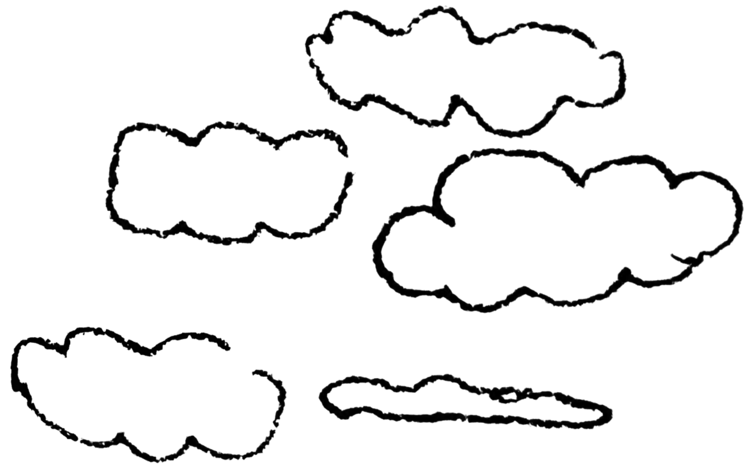


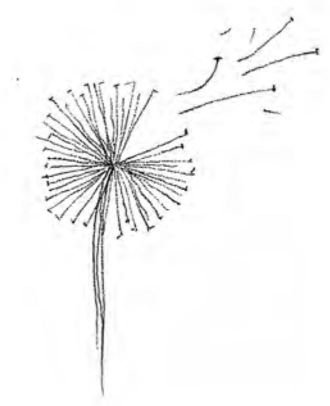
FRAME; A CLIMATE-RESPONSIVE ARCHITECTURAL MODEL

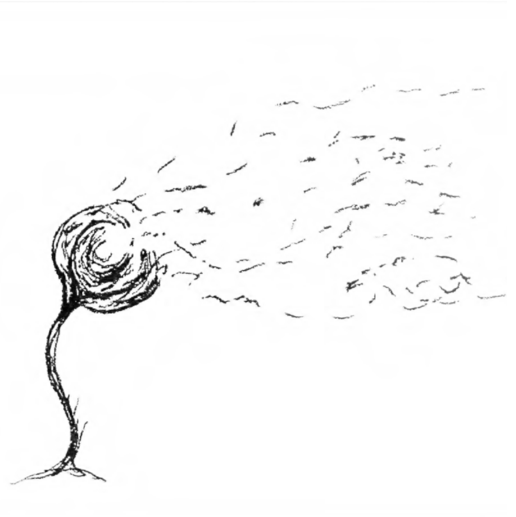
Contents



Project Overview

The focus of our exhibition centers on semi-open extension structures called "Frame: A Climate-Responsive Architectural Model" as a means to contribute to the passive conditioning of buildings and to maximize the benefits of air flows in response to — and in anticipation of — the known and unknown outcomes of an increasingly warming planet. The project aims to showcase the iterative design process for an architectural interior/exterior climate interface within one of our ongoing architectural projects: the new Izmir University of Economics Campus, situated on the western Aegean coastline of Turkey. The campus project is undertaken as a collaboration between two architectural practices, MAS and MIMLAB, while the research and exhibition produced for BAP is conducted solely by MAS.



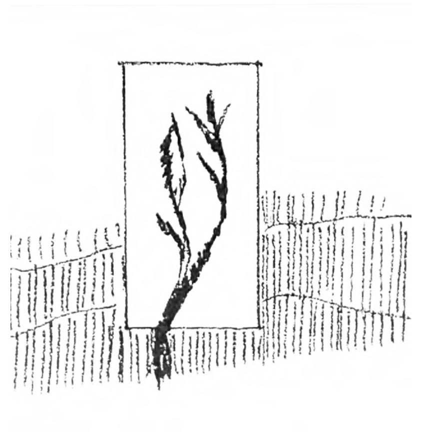


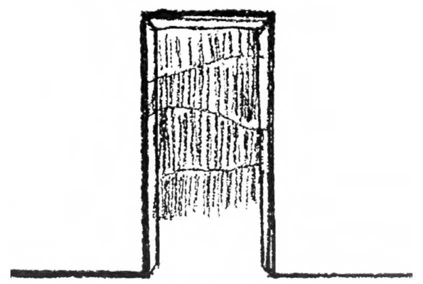
Air

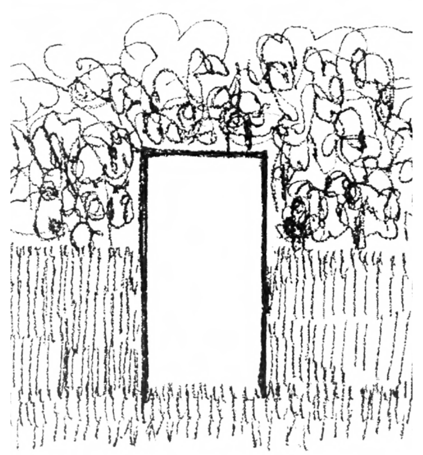
Rethinking Air : How We Shape and Perceive It

In response to climate change, our design approach emphasizes the importance of air in establishing a balanced relationship with the built environment. Often perceived as constant and ever-present, air is in fact dynamic — continuously shifting in movement and composition. To meet human comfort needs, it is typically controlled in specific, regulated ways. In reality, the rapid urbanization of many once-uninhabitable regions has largely been made possible by artificial air-conditioning systems.

However, we believe that treating air as something that must always be mechanically processed and purified is no longer sustainable. Instead, by understanding, anticipating, and guiding airflow as an essential element of design, we can reduce our reliance on artificial cooling and foster more environmentally responsible, climate-responsive buildings.







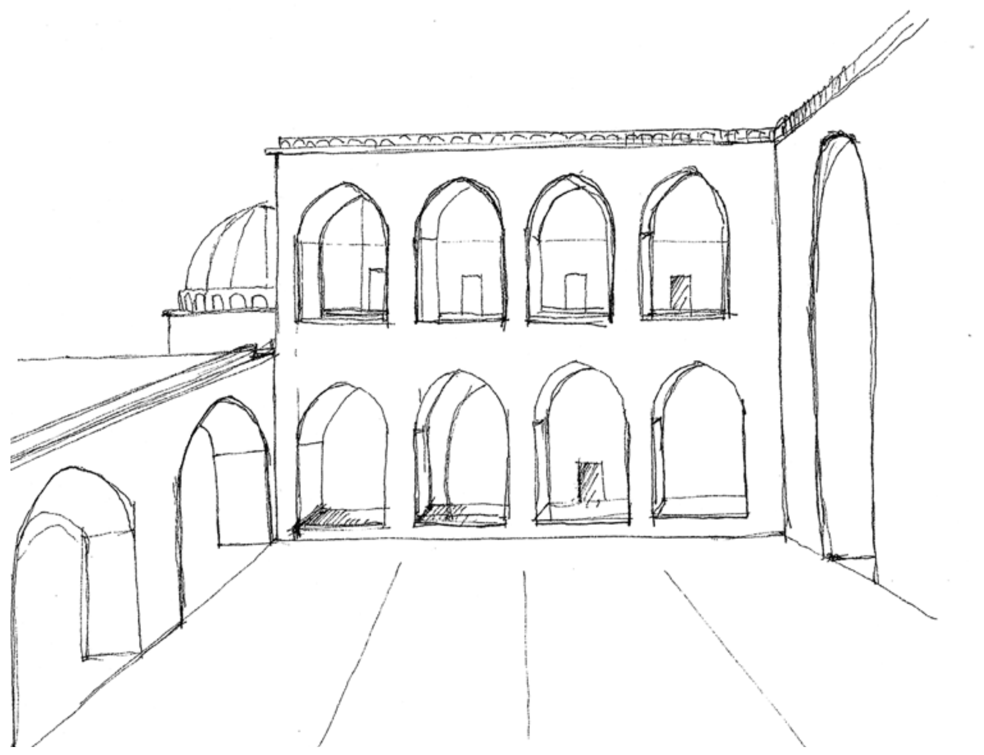
Project Overview

Frame

Defining Boundaries, Preserving Habitats

"Frame" elements are conceived as climate-responsive secondary structures that create intermediate habitats between interior and exterior spaces, fostering environments that support social life both indoors and outdoors in the context of global warming. These structures enhance the usability of adjacent buildings by introducing interstitial zones that adapt to and mediate exterior climatic conditions, thereby expanding the boundaries of human comfort within the built environment.

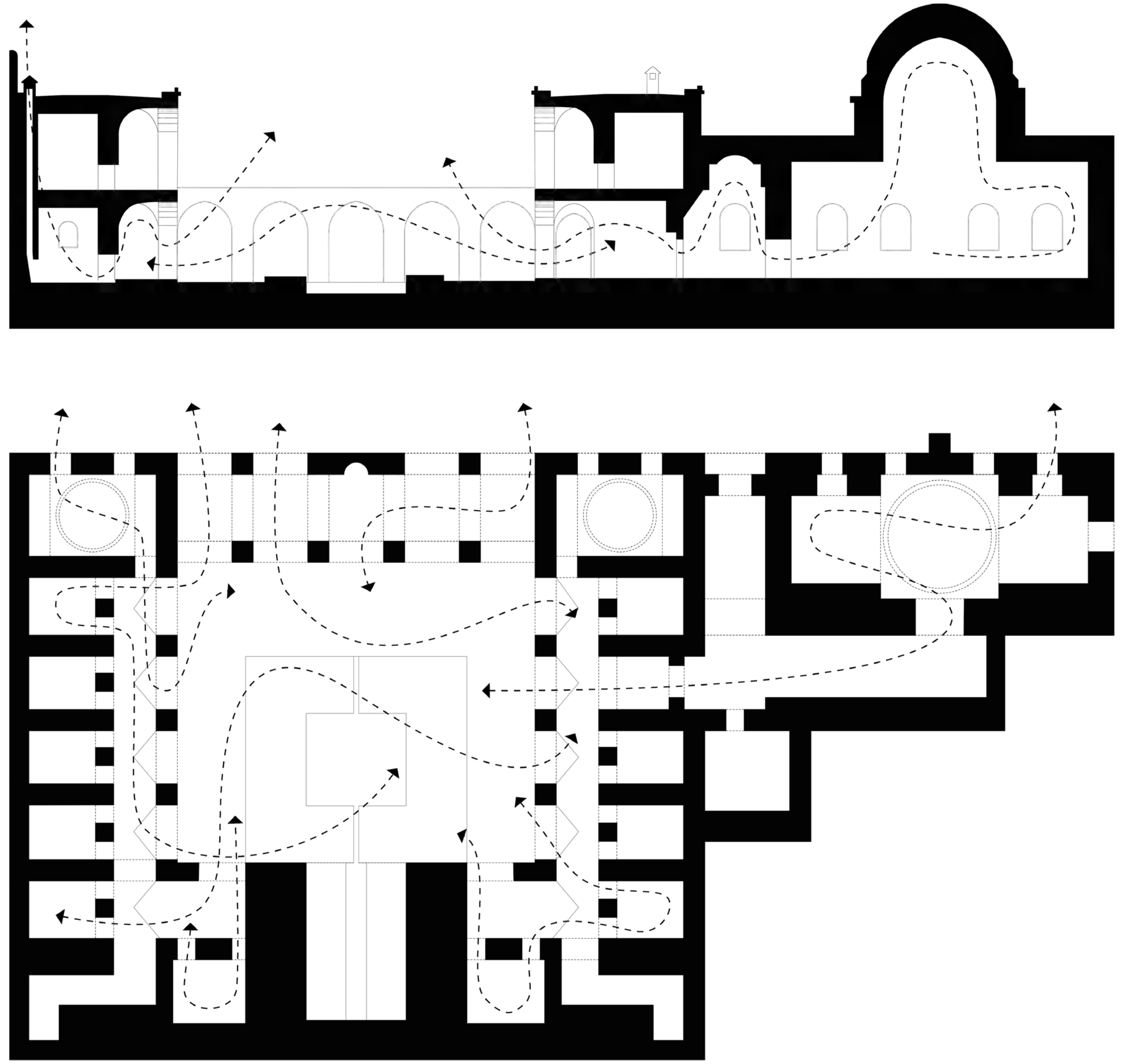
By broadening and redefining the threshold between indoor and outdoor, this design approach cultivates an experientially rich, layered, and harmonious co-habitation between the living and the inanimate.



Historical Reference; Revak (Portico)

The "Revak" is a prevalent architectural element found in traditional educational institutions throughout Seljuk and Ottoman architecture of the Middle Ages, known as madrasas. It functions as a covered, semi-open space that provides shade and promotes natural ventilation in climates ranging from desert to temperate.

Inspired by the madrasas of Mardin in the Southeastern Anatolia Region of Turkey, our "Frame" typology reinterprets the deepened façade as a means of addressing the needs of contemporary learning environments, offering both performative and experiential benefits.



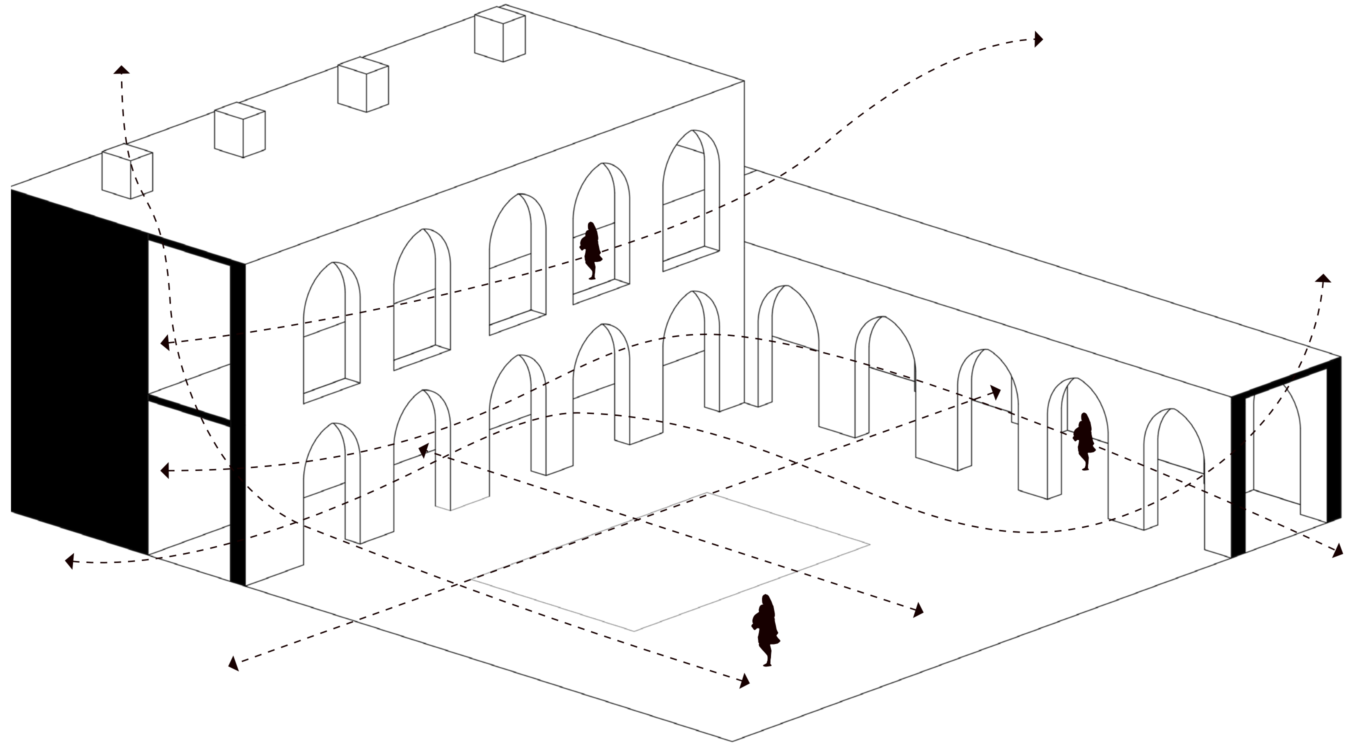
Kasımiye Madrasa, Mardin, Turkey

The Madrasa

Mardin, Turkey

The climate of Mardin is classified as semi-arid (BSh), characterized by hot, dry summers and cold, wet winters. In response to these conditions, Mardin's architecture incorporates various passive strategies, such as thick stone walls, vaulted ceilings, courtyards, revaks, and narrow streets, to maintain cool interiors during summer and preserve warmth in winter.

In traditional madrasa (medrese) buildings, revaks (porticos) are covered, open spaces supported by columns or piers that lean against the buildings they adjoin. These elements play a significant role in ventilating adjacent interior spaces. Their open sides allow for the controlled circulation of air around and through the structure, contributing to thermal comfort in a naturally responsive way.

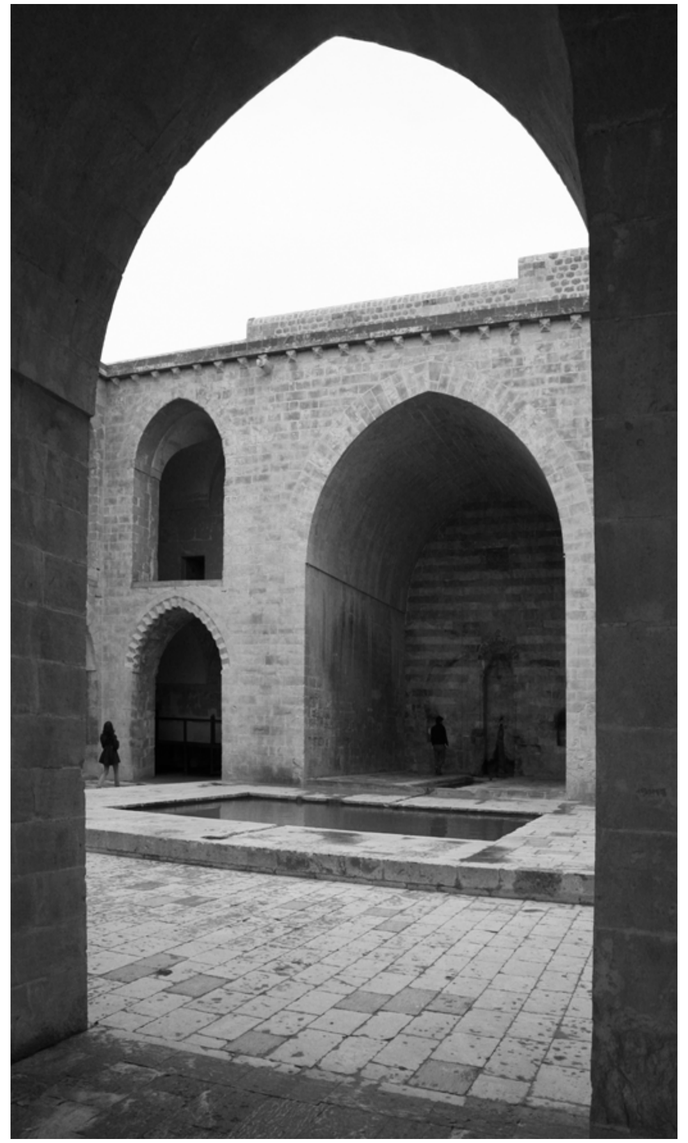


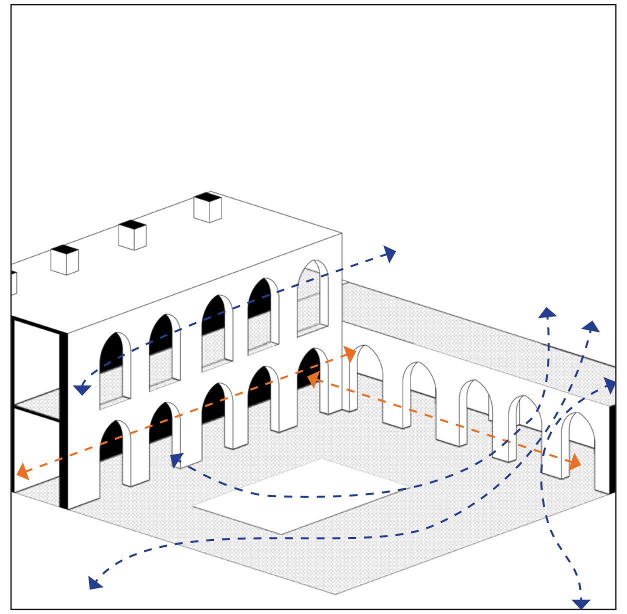
Historical Reference; Revak (Portico)

The Madrasa

Mardin, Turkey

These revaks, while creating a transitional area between indoor and outdoor spaces, also function as air channels, guiding fresh air into the central courtyard or adjoining rooms, and promoting constant ventilation throughout the building. In hot climates, they act as a shield against direct sunlight, reducing heat gain. The airflow facilitated by the revaks can also regulate humidity levels, ensuring that the interior air remains comfortable. Additionally, water features placed in the central courtyard work together with sunlight and air movement to passively humidify the interior spaces, enhancing thermal comfort through natural means.

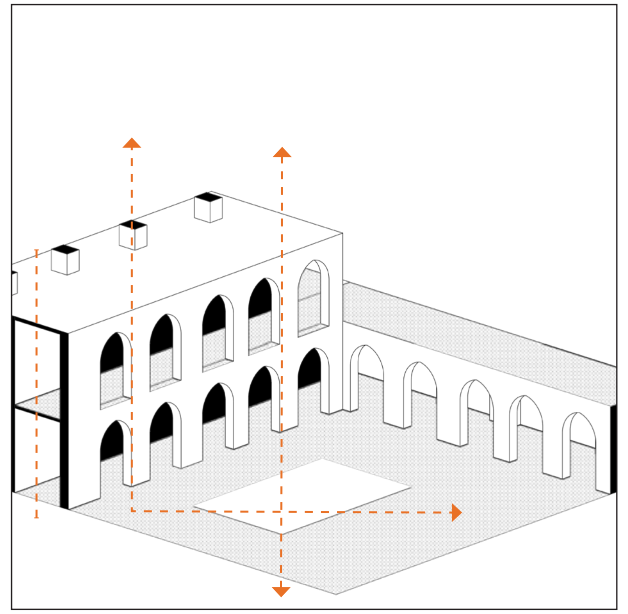




1. Providing Natural Airflow

Creating Open Air Spaces: Revaks, typically designed as long corridors opening onto courtyards, allow fresh air to flow freely into the interior. This natural ventilation helps maintain comfortable temperatures and improves air quality inside the building — particularly vital in hot climates where airflow is essential for controlling heat and humidity.

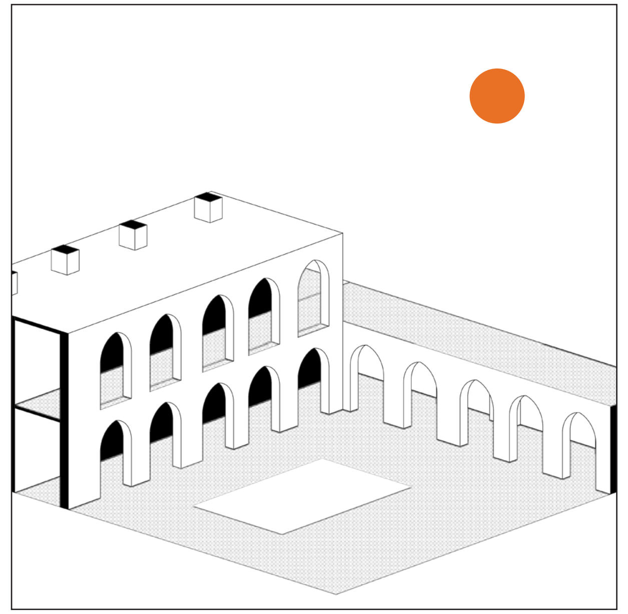
Air Channel Function: Revaks also often act as air channels, guiding fresh air into the central courtyard or adjacent rooms and promoting continuous ventilation throughout the building. This ensures that fresh air circulates inside, even during the hottest months.



2. Airflow from Different Directions

Cross Ventilation: Positioned on various sides of the building, revaks facilitate airflow from multiple directions, enabling effective cross ventilation. This ensures that every part of the interior receives fresh air, enhancing indoor air quality and thermal comfort.

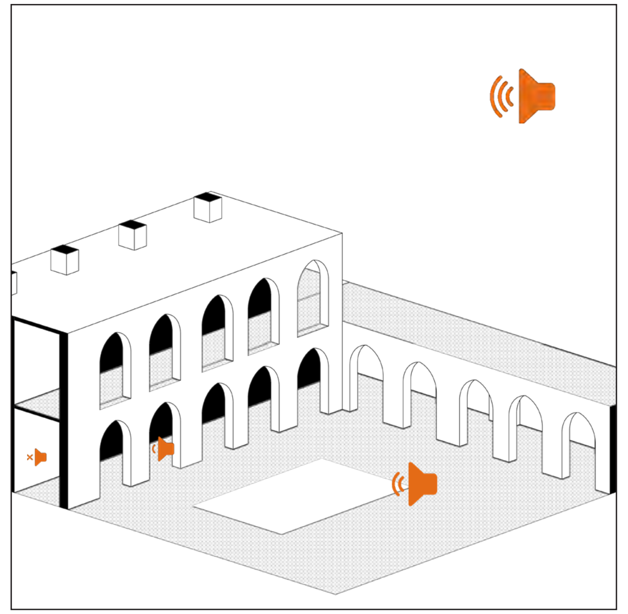
High Ceilings and Open Spaces: The open courtyards allow wind to enter from different directions, while the high ceilings of the revaks encourage warm air to rise and escape. This natural ventilation strategy helps maintain a balanced indoor temperature by allowing hot air to exit and cool air to enter, creating a continuous exchange of air.



3. Shading and Heat Control

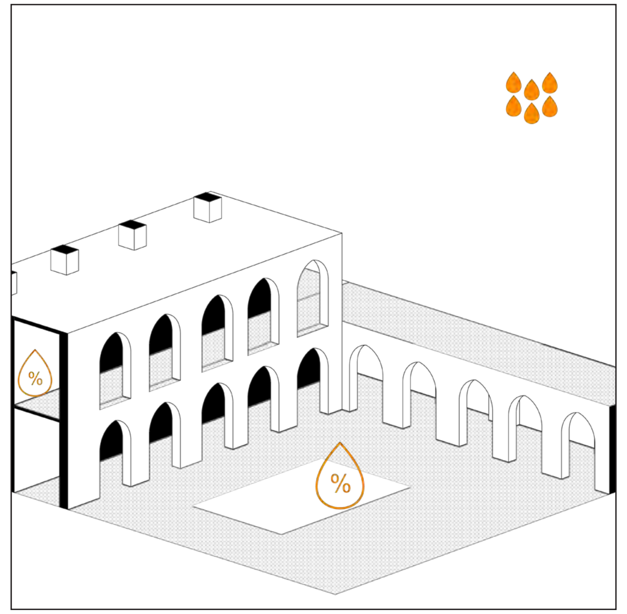
Shading Function: One of the primary roles of revaks is to provide protection from direct sunlight, preventing excessive heat from penetrating the building. This shading effect keeps interior spaces cooler, especially during the summer months. The temperature difference between shaded and sunlit areas also promotes airflow by encouraging movement from cooler to warmer zones.

Balancing Heat: By shielding interiors from daytime heat and facilitating the flow of cool air at night, revaks naturally regulate indoor temperatures. This passive cooling effect ensures a consistently comfortable environment for building occupants throughout the day and night.



4. Sound Insulation and Air Quality

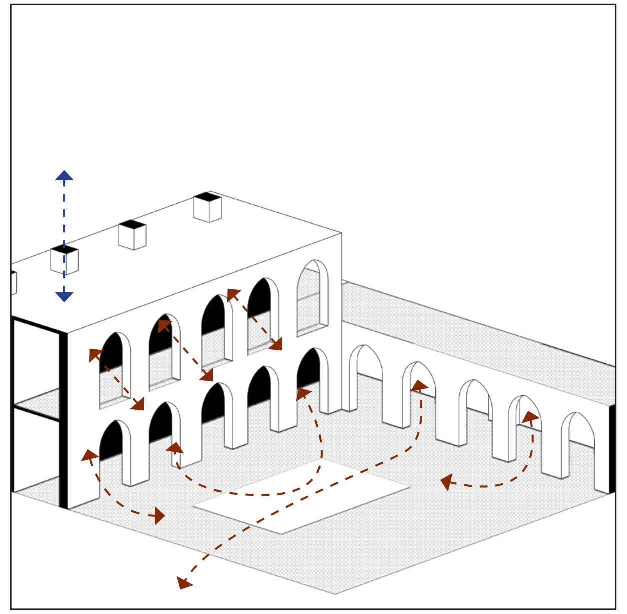
Slow Air Movement: Revaks also serve as a buffer against external noise, dust, and harsh environmental conditions. By promoting slow, regulated airflow, they help ensure that the air entering interior spaces is cleaner and gentler. This contributes to a peaceful, healthy indoor environment with reduced noise levels and improved air quality.



5. Temperature and Humidity Control

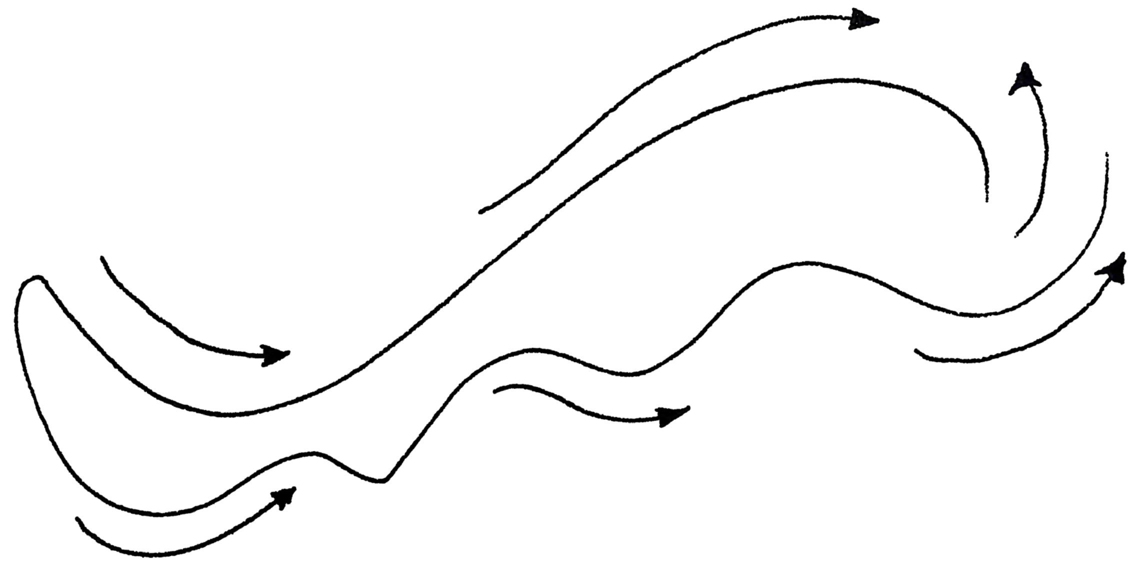
Maintaining Temperature Stability: In hot climates, revaks act as protective shields against direct sunlight, preventing interiors from overheating. Their continuous airflow also helps regulate humidity, keeping indoor air at a comfortable level. By blocking harsh sun exposure while encouraging ventilation, revaks contribute to cooler, more stable indoor environments.

Controlling Humidity: The carefully moderated airflow through revaks plays an important role in managing humidity inside the building. Depending on seasonal or daily climate shifts, this natural ventilation prevents excess moisture buildup, protecting both the structure and the comfort of its occupants.



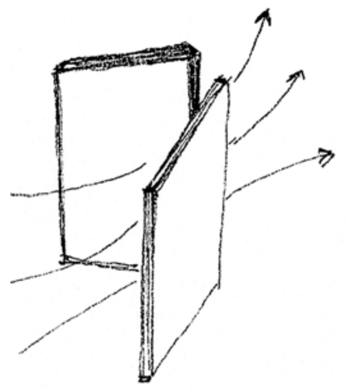
6. Energy Efficiency

Passive Cooling: Revaks play a crucial role in passive cooling. By allowing fresh air to circulate naturally through the building, they reduce reliance on artificial cooling systems, thereby conserving energy. This sustainable, climate-responsive design demonstrates how traditional architectural elements like the revak can inform and inspire the creation of modern, energy-efficient buildings.

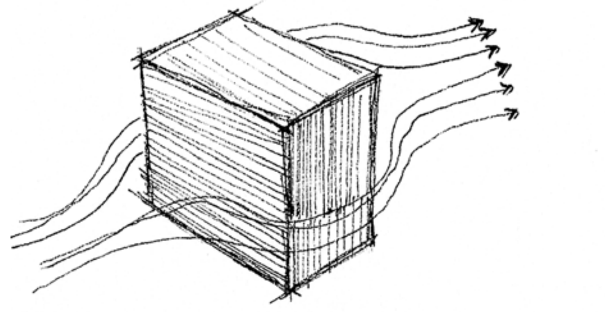


Wind Parameters and Form Studies

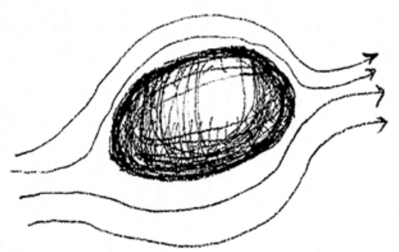
Wind plays a crucial role in architectural design, influencing both structural stability and environmental performance. Wind parameters—such as direction, speed, turbulence, and pressure differentials—directly impact the form and spatial organization of buildings. This study explores the interaction between wind and building envelopes to develop optimized forms that enhance natural ventilation, energy efficiency, and adaptation. Drawing inspiration from historical references, the design approach reinterprets traditional strategies, positioning wind not just as an environmental factor but as a key generator of architectural form.



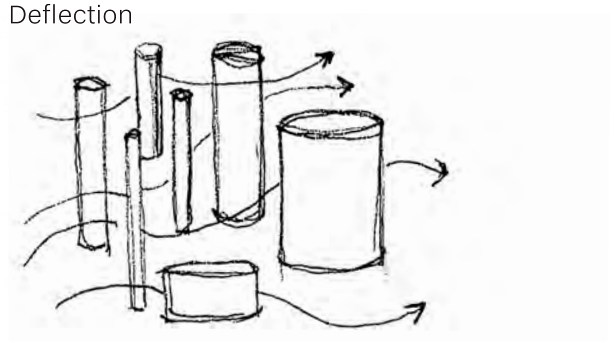
Concentration / Diffusion



Deflection



Minimum Resistance



Materialization

Wind Parameters and Form Studies

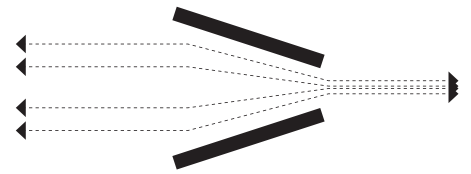
Airflow Dynamics

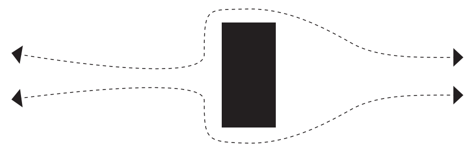
Performance-Oriented Architectural Forms

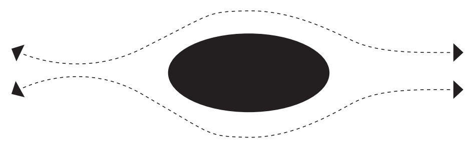
According to Kabošová et al.'s *Parametric Wind Design* study, parametric design processes can be integrated with *Computational Fluid Dynamics (CFD)* simulations to optimize form generation in response to wind interactions. Form design based on wind movement is an approach that enhances the performance of structures by optimizing environmental parameters.

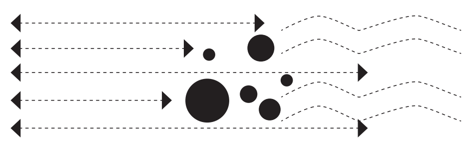
When evaluated under the headings of Concentration, Diffusion, Materialization, Deflection, and Minimum Resistance, the concentration of wind at specific points (concentration) and its subsequent dispersion (diffusion) play a crucial role in shaping the form. Materialization is related to selecting materials and structural elements that respond to these flow dynamics, ensuring a resilient and fluid structure against wind loads. Deflection refers to the strategic redirection of airflow to reduce turbulence and enhance structural stability. The minimum resistance principle aims to create an aerodynamic form by minimizing wind resistance.

Such iterative approaches transform wind movement into an active design input by providing performance-oriented architectural solutions based on microclimatic data.

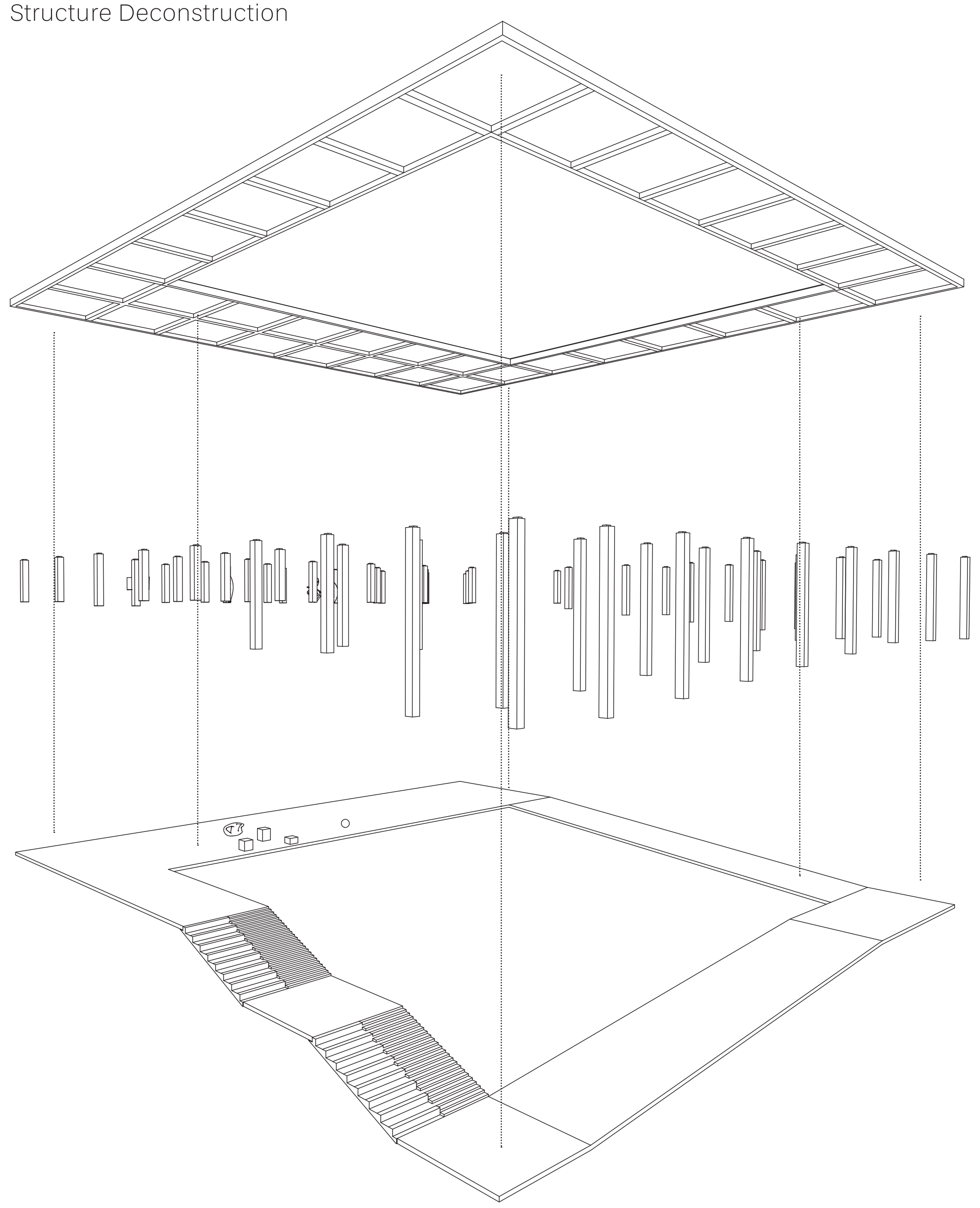








Structure Deconstruction



TOP

roof / beams / shading elements

SIDE

walls / columns / parapets

BOTTOM

floors / stairs / plinth beam

Wind Parameters and Form Studies

TOP

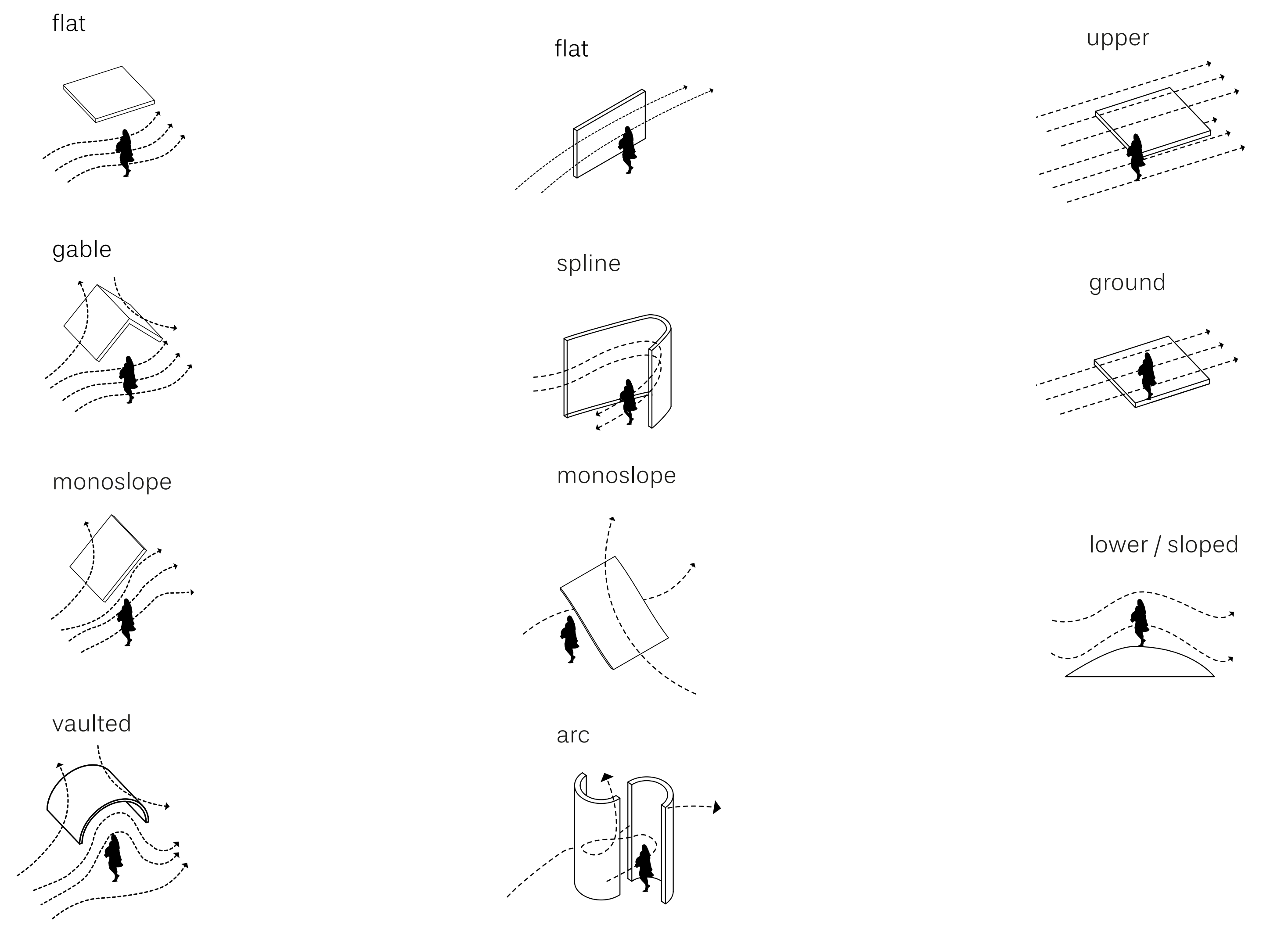
roof / beams / shading elements

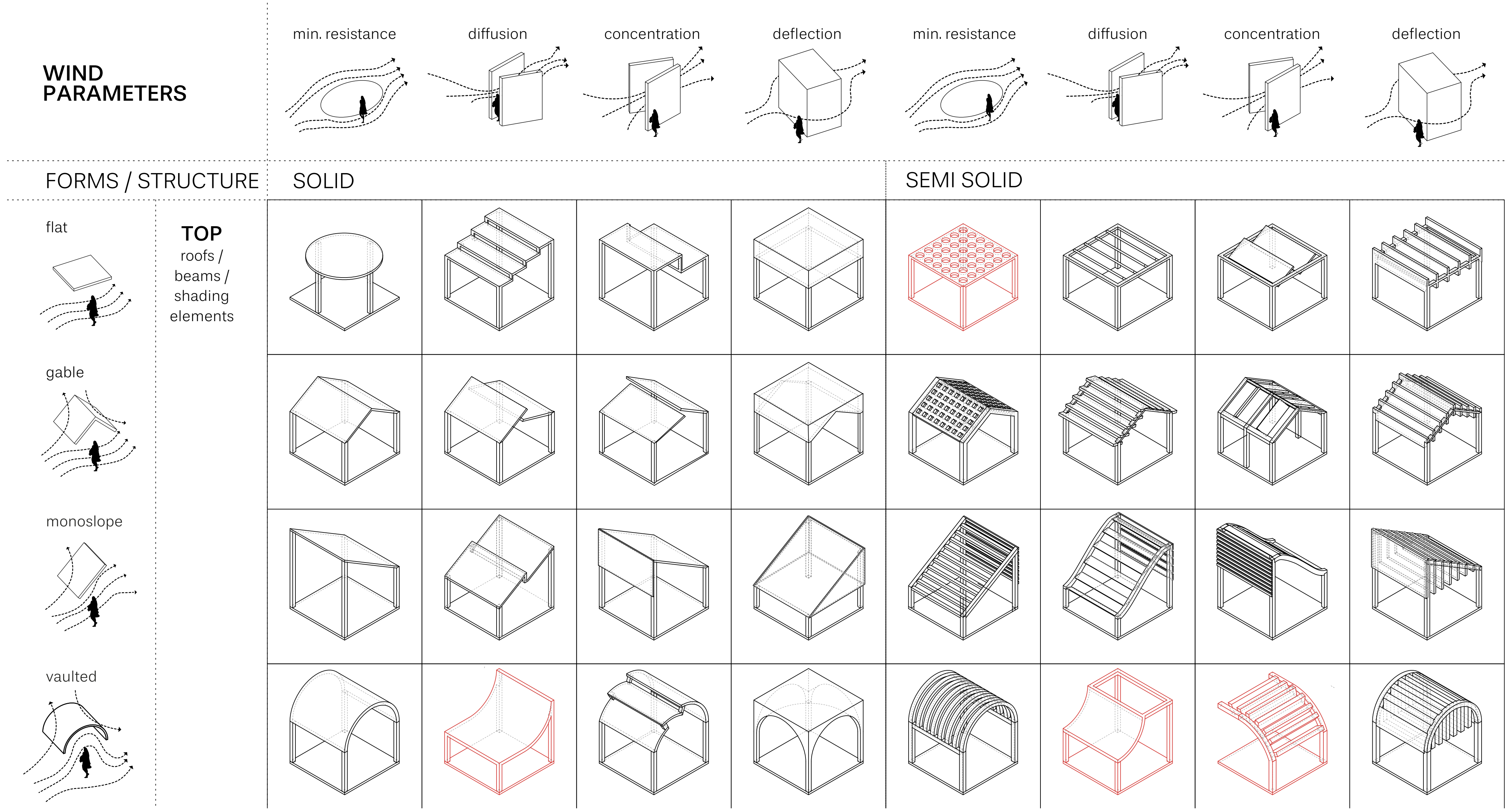
SIDE

walls / columns / parapets

BOTTOM

floors / stairs / plinth beam





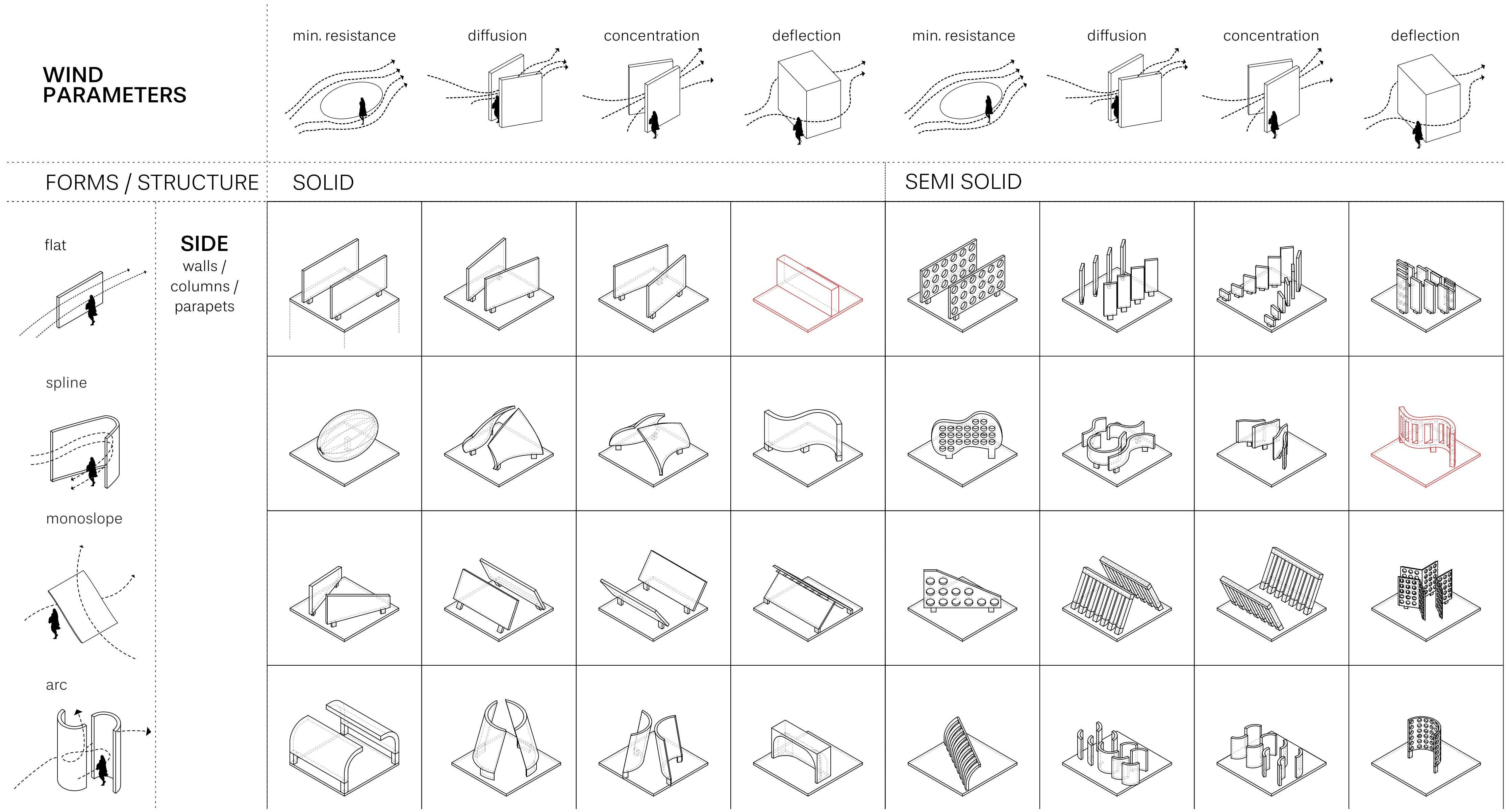
Wind Parameters and Form Studies

Top

Roofs / Beams / Shading / Elements

The upper section of the structure interacts with high-velocity wind currents, requiring forms that effectively manage wind pressure and turbulence. To address these challenges, various roof typologies—including Flat, Gable, Monoslope, and Vaulted Roofs—were explored. Each typology was assessed based on its ability to deflect wind forces and reduce uplift effects.

Furthermore, these roof forms were categorized into Solid and Semi-Solid configurations to analyze their impact on airflow permeability and structural efficiency. Solid roofs provide complete wind shielding, while semi-solid variations introduce controlled permeability, enabling a balanced interaction with wind dynamics.



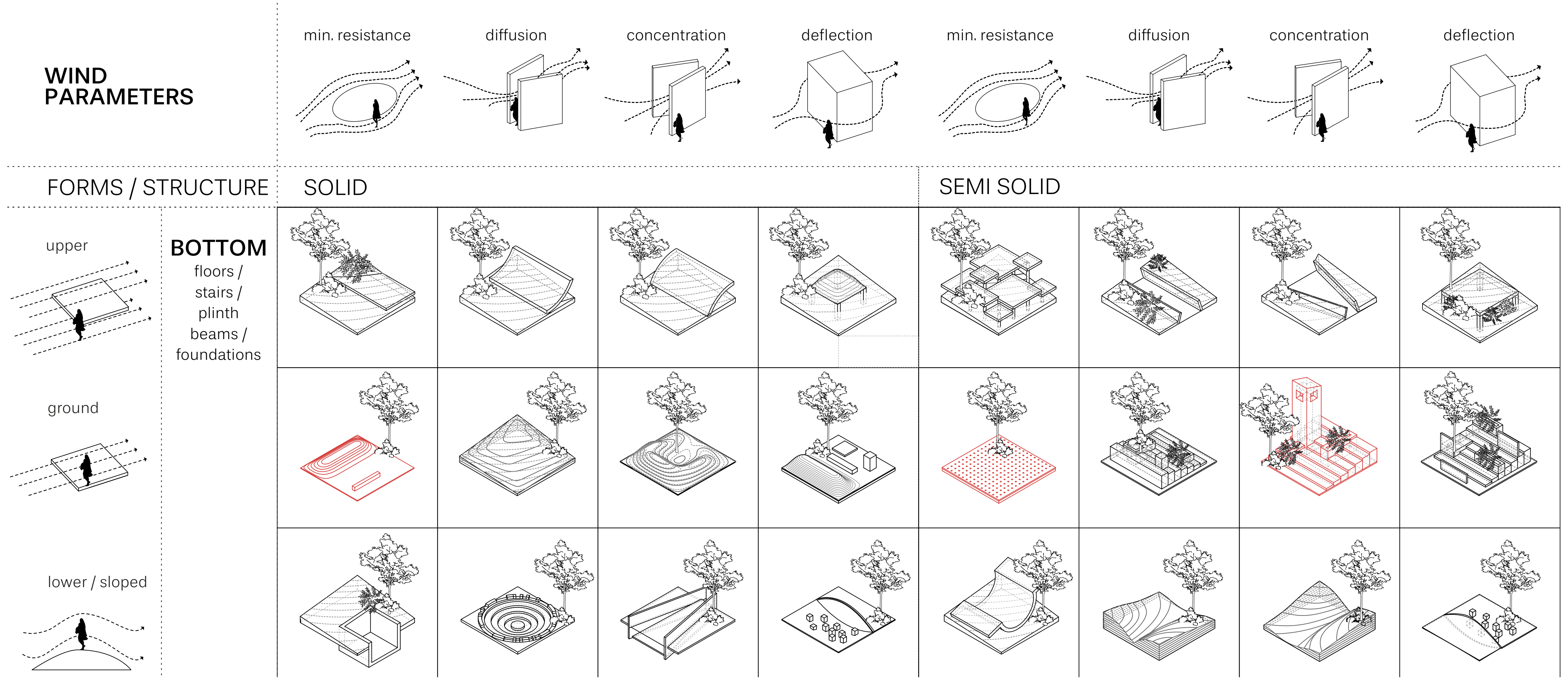
Wind Parameters and Form Studies

Side

Walls / Columns / Parapets

The lateral surfaces are primarily influenced by wind concentration and diffusion, requiring forms that regulate airflow while minimizing drag forces. To achieve this, different geometric configurations—Flat, Monoslope, Arc, and Spline—were examined. Flat surfaces provide a straightforward approach but may generate wind pressure buildup.

Monoslope forms help redirect wind forces efficiently, reducing turbulence along the facade. Arc geometries encourage smooth wind flow by gradually deflecting air currents, while Spline surfaces introduce dynamic curvature to optimize aerodynamic performance. These variations were evaluated to balance wind resistance, natural ventilation, and structural stability.



Wind Parameters and Form Studies

Bottom

Floors / Stairs / Plinth Beam

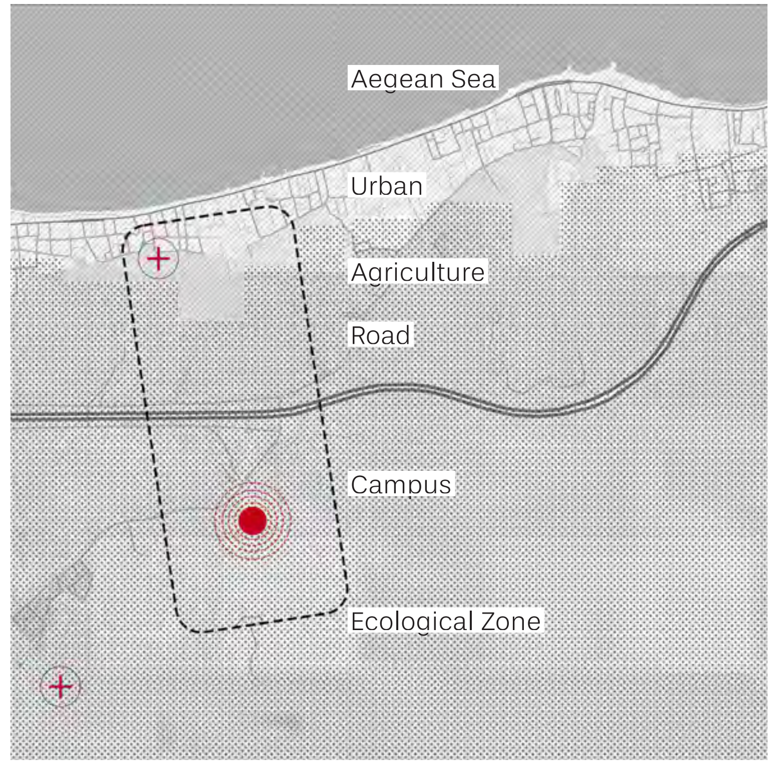
The lower part of the structure interacts with ground-level wind dynamics, where turbulence and eddies are more pronounced. Various sub-ground, ground-level, and stepped above-ground configurations were explored to optimize aerodynamic efficiency and structural integration. Sub-ground structures utilize underground air channels to capture and redirect airflow, reducing turbulence while supporting passive cooling strategies. Ground-level forms interact directly with prevailing winds, requiring aerodynamic shaping to control wind dispersion. Stepped above-ground designs break wind intensity gradually, mitigating harsh airflow impact on the surrounding environment.

Additionally, a tower form was introduced to channel air collected from sub-ground intakes, enhancing airflow through controlled vertical movement. This strategy leverages wind pressure differentials to improve natural ventilation and support passive cooling, demonstrating an integrated approach to performance-driven design.

Case Study; Izmir University of Economics Guzelbahce Campus

The 'Guzelbahçe Campus Architectural Project Design Competition' was organized by the Izmir Chamber of Commerce (IZTO) Education and Health Foundation with the goal of delivering a world-class, environmentally conscious, and state-of-the-art campus to the city. The competition was held at a national scale, attracting 52 project proposals from across Turkey. Following a thorough and rigorous evaluation by a 19-member expert jury, our proposal was selected as the winning entry.

The project covers a total program area of 160,000 m², including facilities for academics, administration, sports and recreation, social amenities, and dormitories. The campus is located in the Guzelbahçe district, a rural area in the Aegean region of Turkey, situated 45 kilometers west of Izmir, the country's third most populous city.



Izmir, Turkey

Site Information

The design approach focuses on the physical and social relationship of the campus with its location. At the outskirts of Izmir metropolis, the area exhibits an interfacial character between ecological protection zones neither urban nor rural. These zones typically combine the production-oriented and compact lifestyle of the countryside with the polycentric, mixed-user profile of the city, and the rural-urban character emerges. Contrary to the introverted education model of the past, the design strategy is based on interaction at the city, campus and building scales. With the infrastructure investments envisaged within the scope of the University and Izmir 2030 Transportation Master Plan, a growth pressure on Guzelbahce is inevitable.

It is also important that the campus land has a natural landscape between agricultural production and ecological protection areas. The area exhibits a transitional character between ecological protection zones neither urban nor rural. These zones typically combine the agricultural production-oriented and compact lifestyle of the countryside with the polycentric, mixed-user profile of the city, resulting in an ephemeral hybrid urban quality. Contrary to the monastic, introverted education model of the past, the design strategy seeks to foster interaction at the ecological, urban, campus and building scales.

Izmir, Turkey

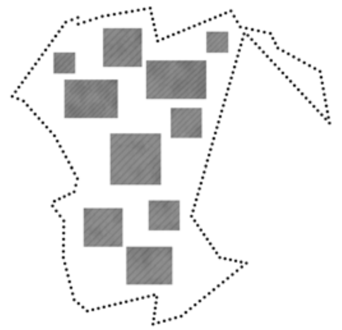
Site Information

As a spatial device, Frame figures are deployed on site to establish multiple microcosms by identifying and responding to various pre-existing topographic qualities such as valleys, hillsides, plateaus, groves & streambanks, considering the form and size that will meet the necessary program and access needs for the campus. Following the identification of these negative spaces that form the heart of each microcosm, programs are deployed around the Frame figures to balance spatial needs with the constraints within each specific part of the topography.

These areas, called microcosms, get their characteristics from the ground; their plant textures, altitude differences, strategic locations or vista points. In fact, they protect, amplify and mediate a characteristic topography by framing it. The first step of the design setup is taken at this point.

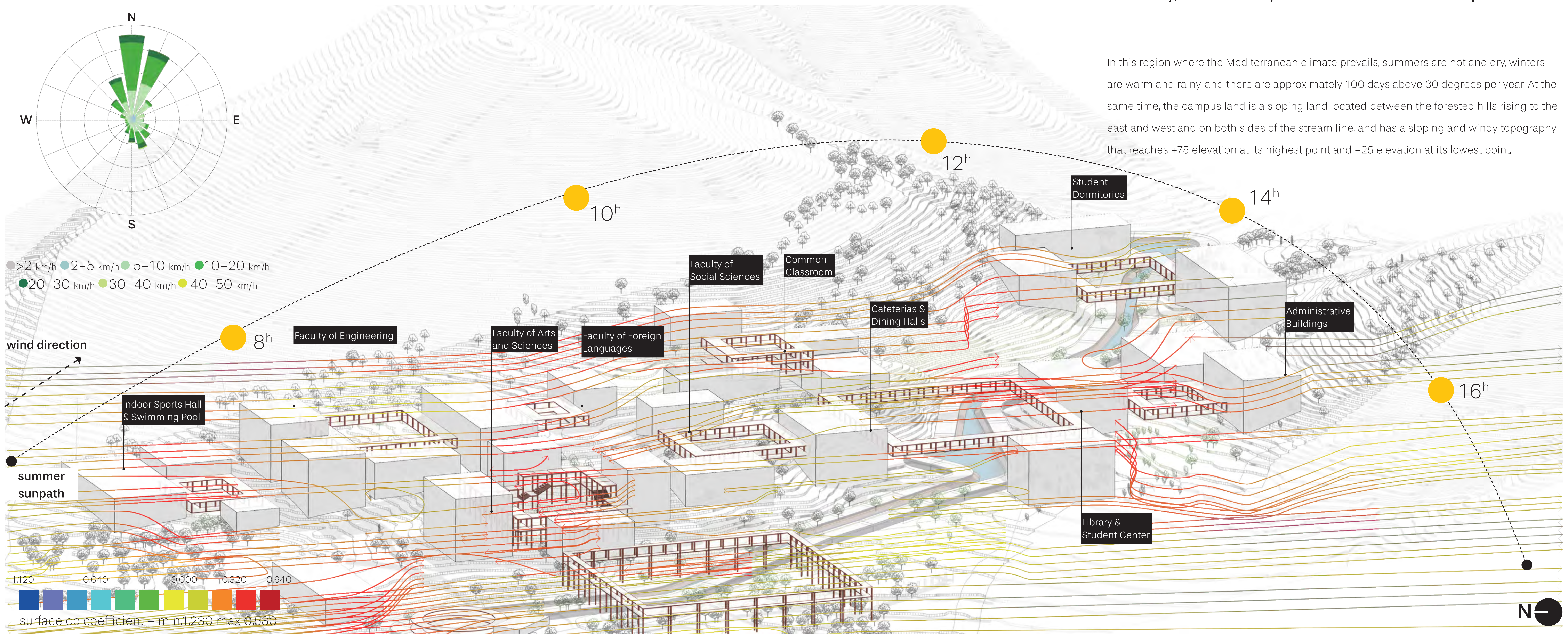
Frames, which are transitional – connecting – shading circulation spaces between buildings and microcosmoses, are designed to be connected to each other. In this way, a person who starts walking from one end of the campus in hot weather or on rainy days will be able to reach the last point. This allows walking from one end of the campus to the other, staying sheltered from the sun or rain along the way.

Place-finding

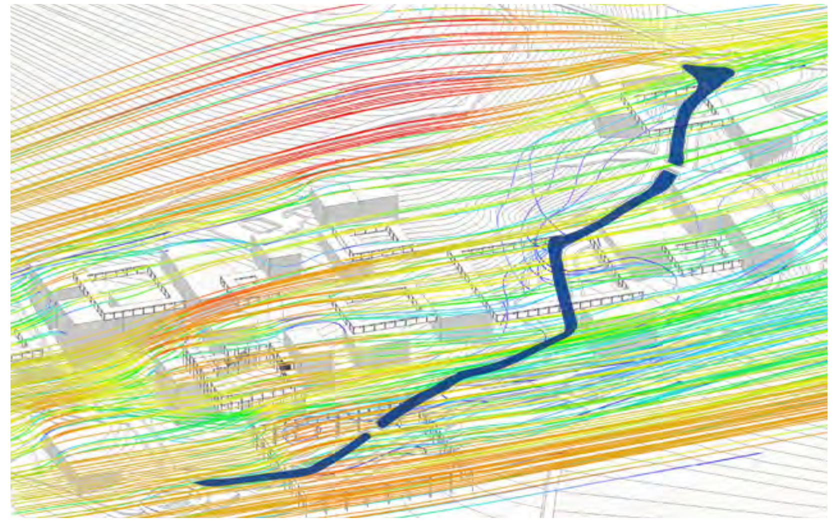


Microcosms

Frames & Program Clusters



In this region where the Mediterranean climate prevails, summers are hot and dry, winters are warm and rainy, and there are approximately 100 days above 30 degrees per year. At the same time, the campus land is a sloping land located between the forested hills rising to the east and west and on both sides of the stream line, and has a sloping and windy topography that reaches +75 elevation at its highest point and +25 elevation at its lowest point.



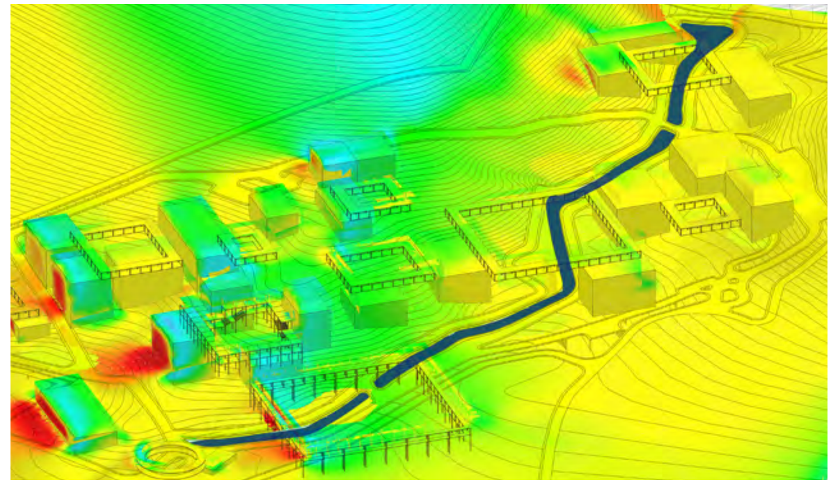
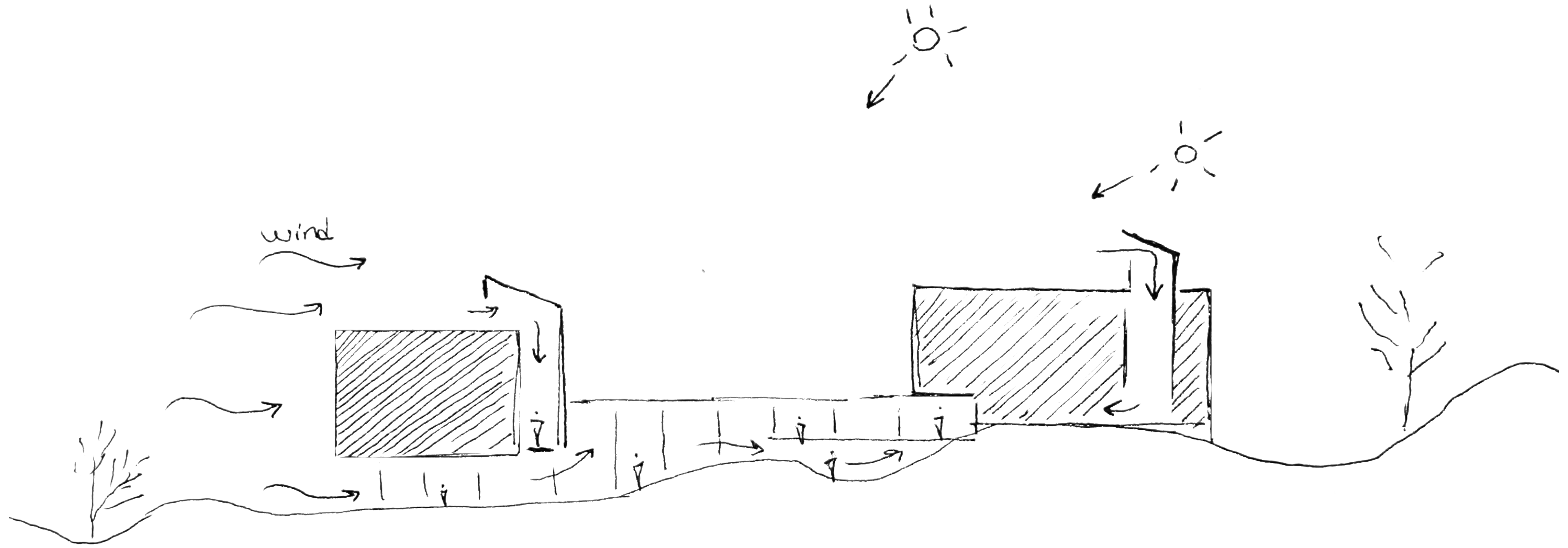
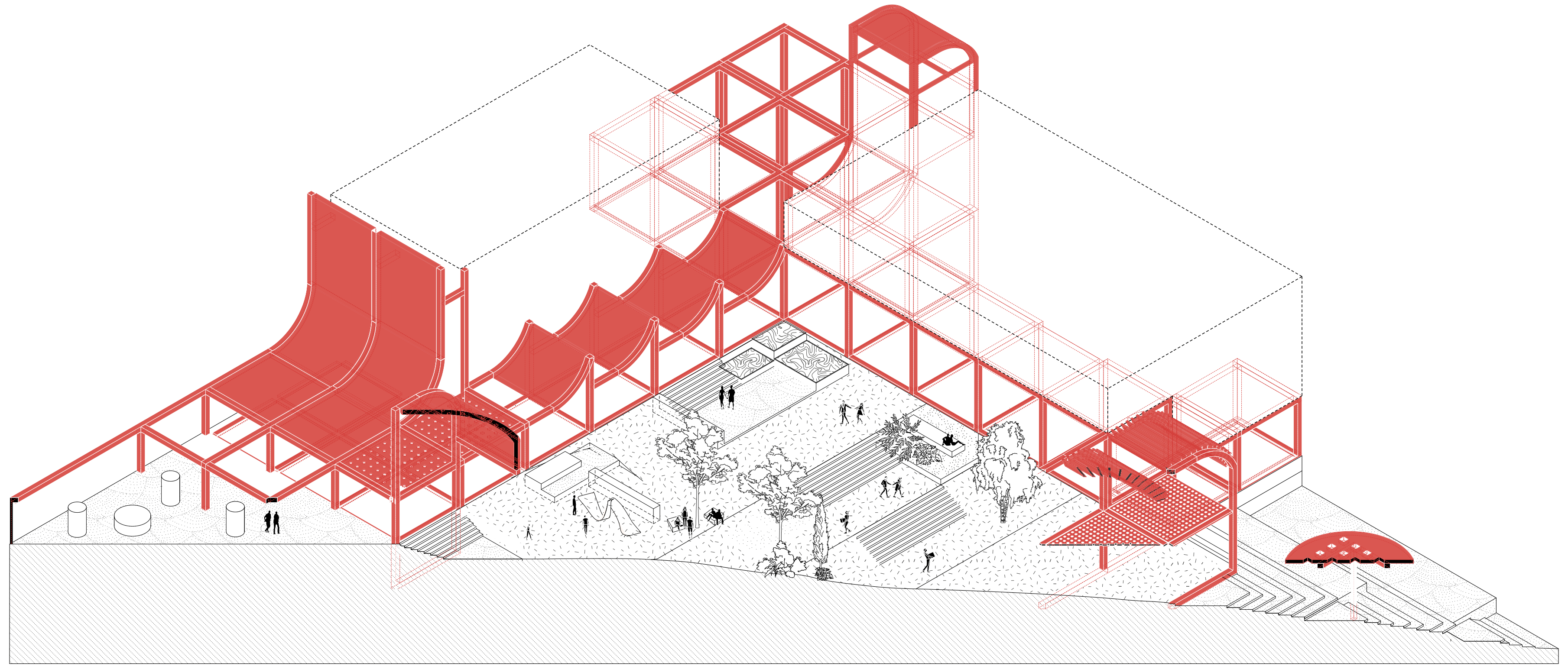


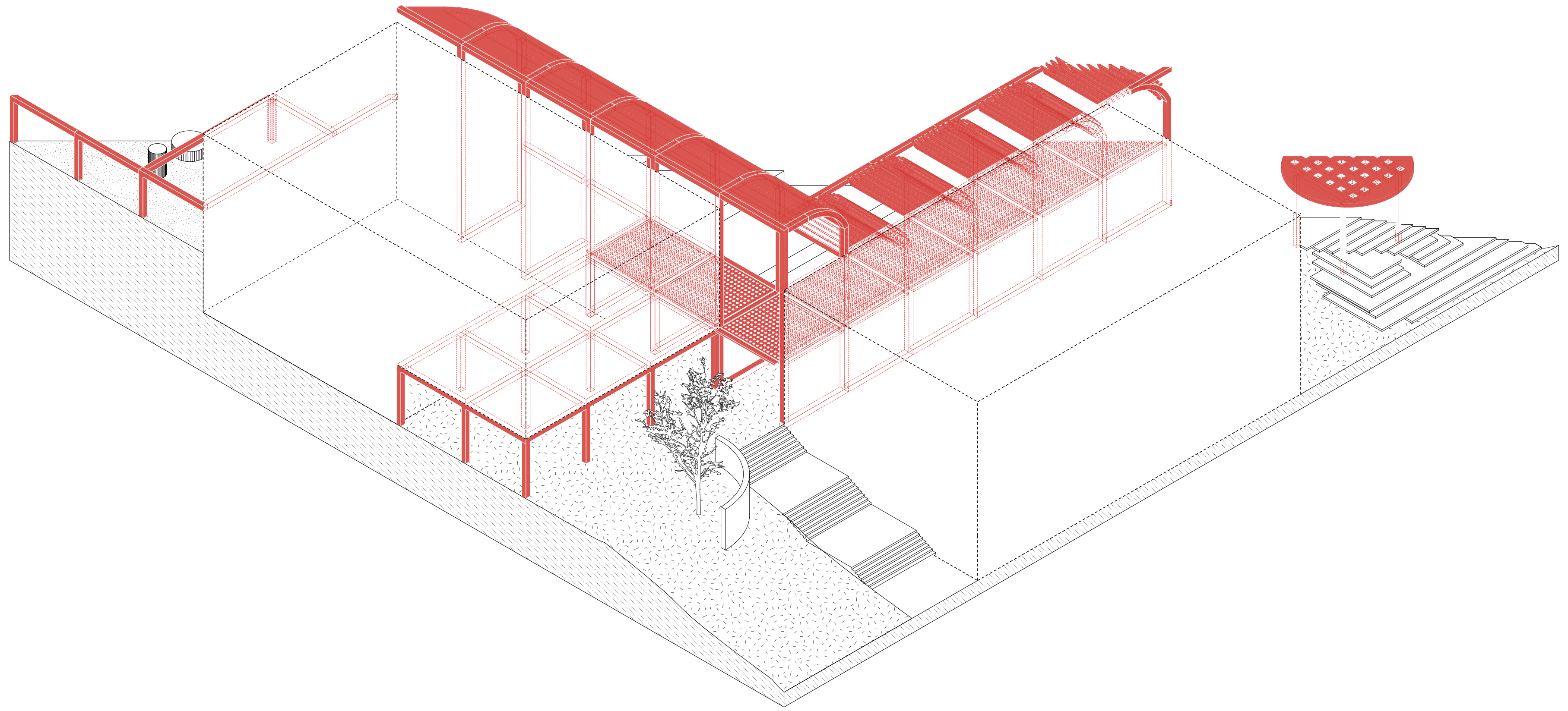
Figure: Wind pressure simulation obtained using the free version of RWIND Simulation software
Source: Dlubal Software – RWIND Simulation (free version)



Frame

The entire campus program is organized around "frame" structures, inspired by traditional revak designs and reinterpreted for contemporary use. A wind model research study conducted on the Güzelbahçe Campus focuses on the frame structure of the Faculty of Fine Arts. Designed to channel cool winds, this structure improves air circulation within the courtyards, reducing the need for artificial ventilation in the surrounding buildings. Beyond their environmental function, these frames also act as transitional elements, adding spatial depth to the buildings they come into contact with and the courtyards they connect.





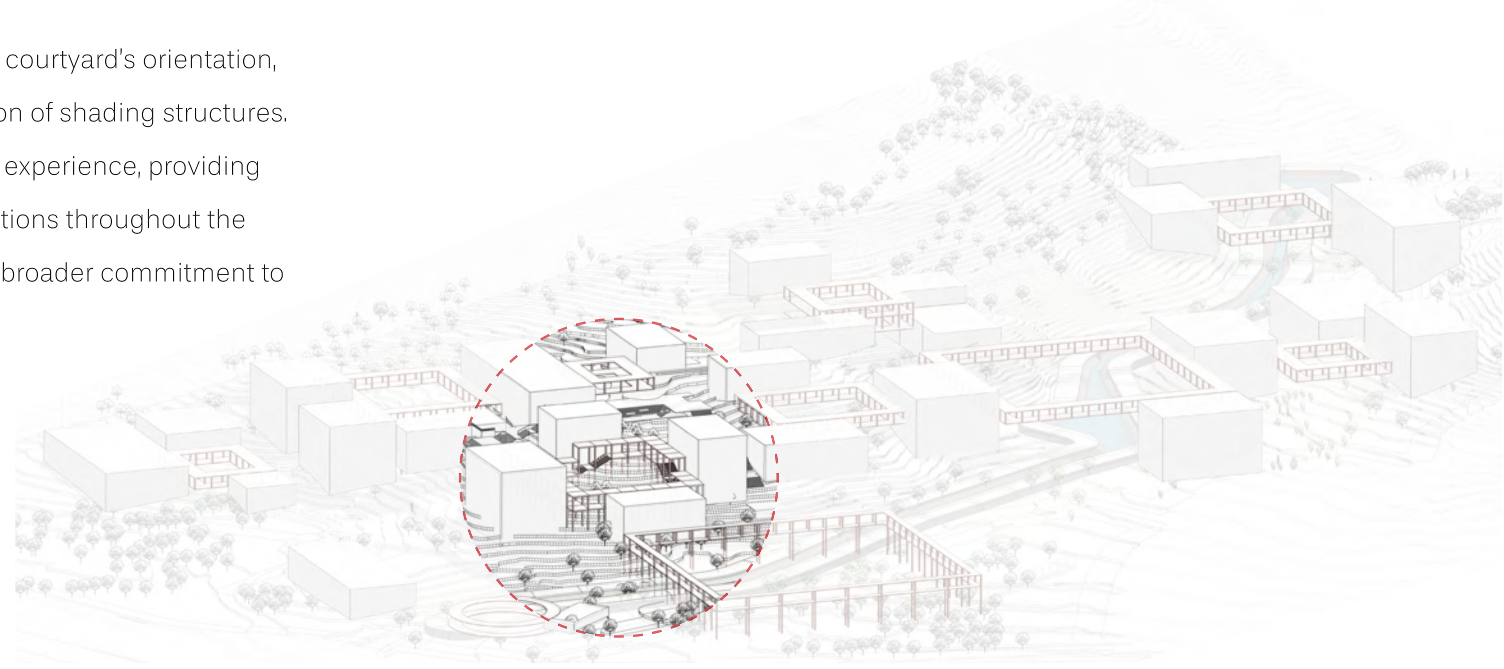
Frame

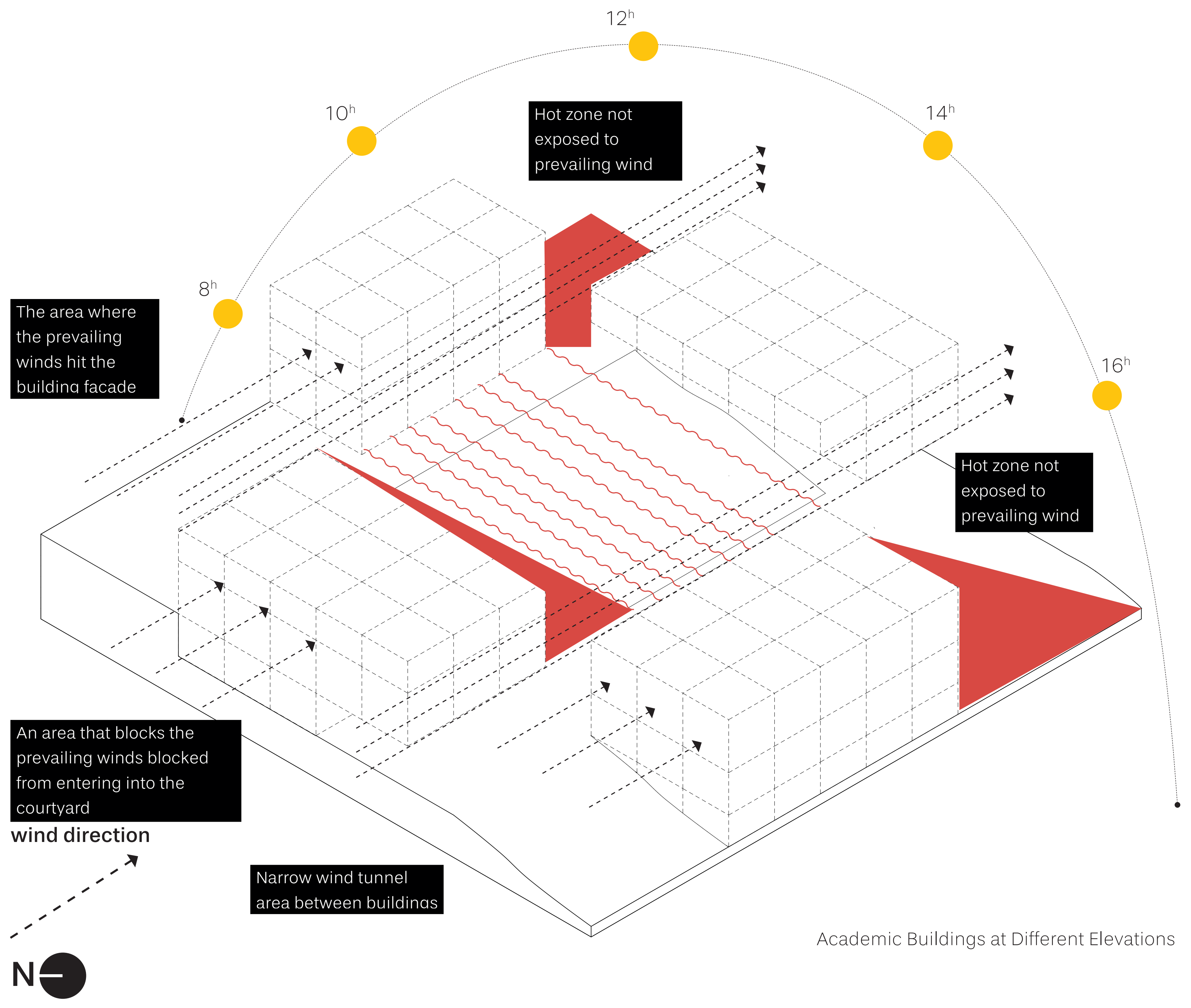
Redesigned Revak (Portico)

Faculty of Fine Arts Courtyard

There are a total of ten courtyards within the university campus, each designed to encourage outdoor use and facilitate transitions between buildings, serving as integral parts of campus life. Among these, the Faculty of Fine Arts courtyard stands out with a unique design approach shaped by environmental data. During the design process, dominant wind directions, wind speeds, and the annual movement of the sun were carefully analyzed.

These natural factors played a crucial role in determining the courtyard's orientation, the positioning of its boundary elements, and the configuration of shading structures. As a result, the courtyard offers users a comfortable open-air experience, providing natural ventilation and creating optimal sun and shade conditions throughout the day. This climate-responsive design highlights the campus's broader commitment to environmentally conscious and sustainable architecture.





Academic Buildings at Different Elevations

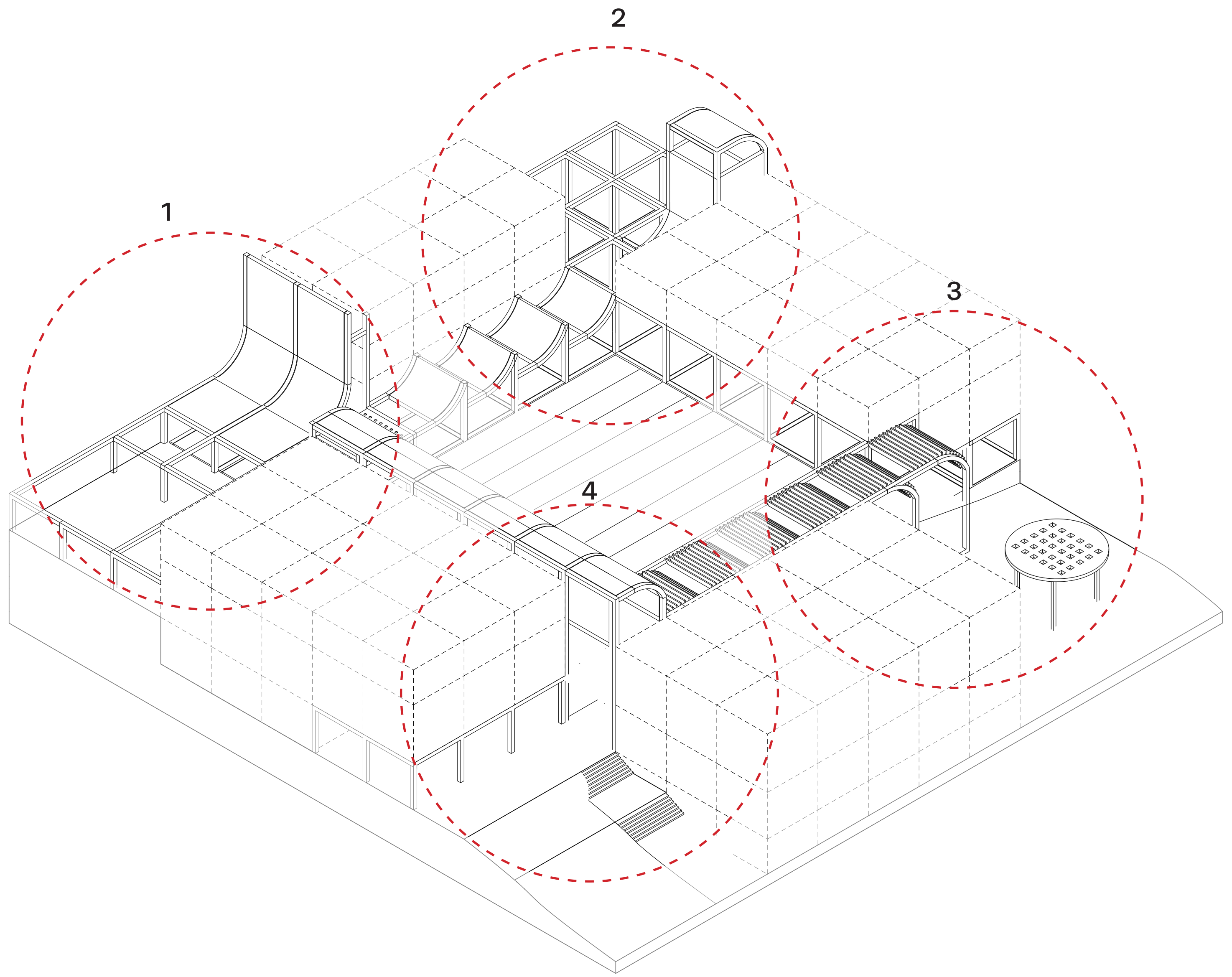
Frame

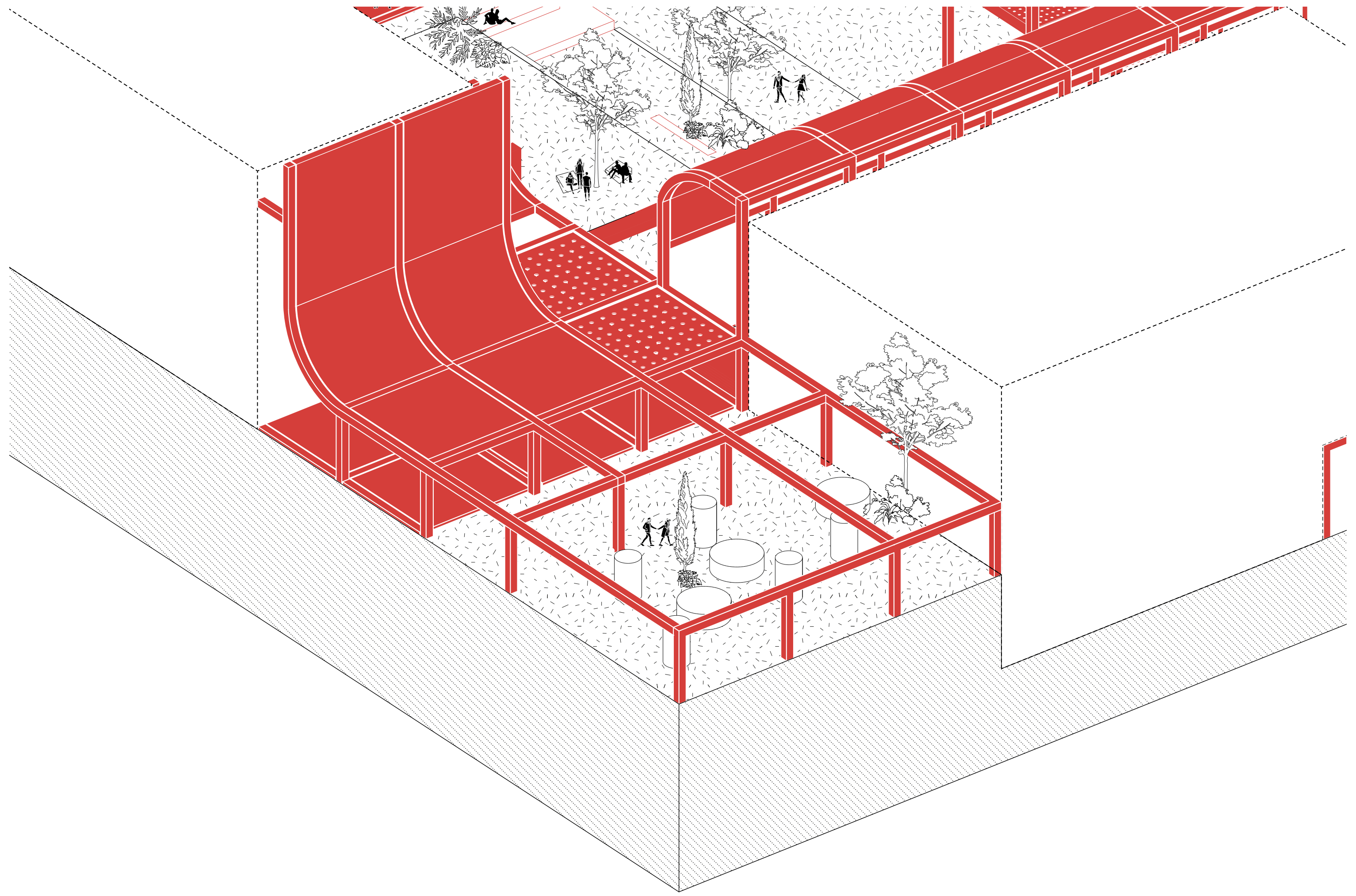
The Zones

Detection of problematic areas in terms of temperature

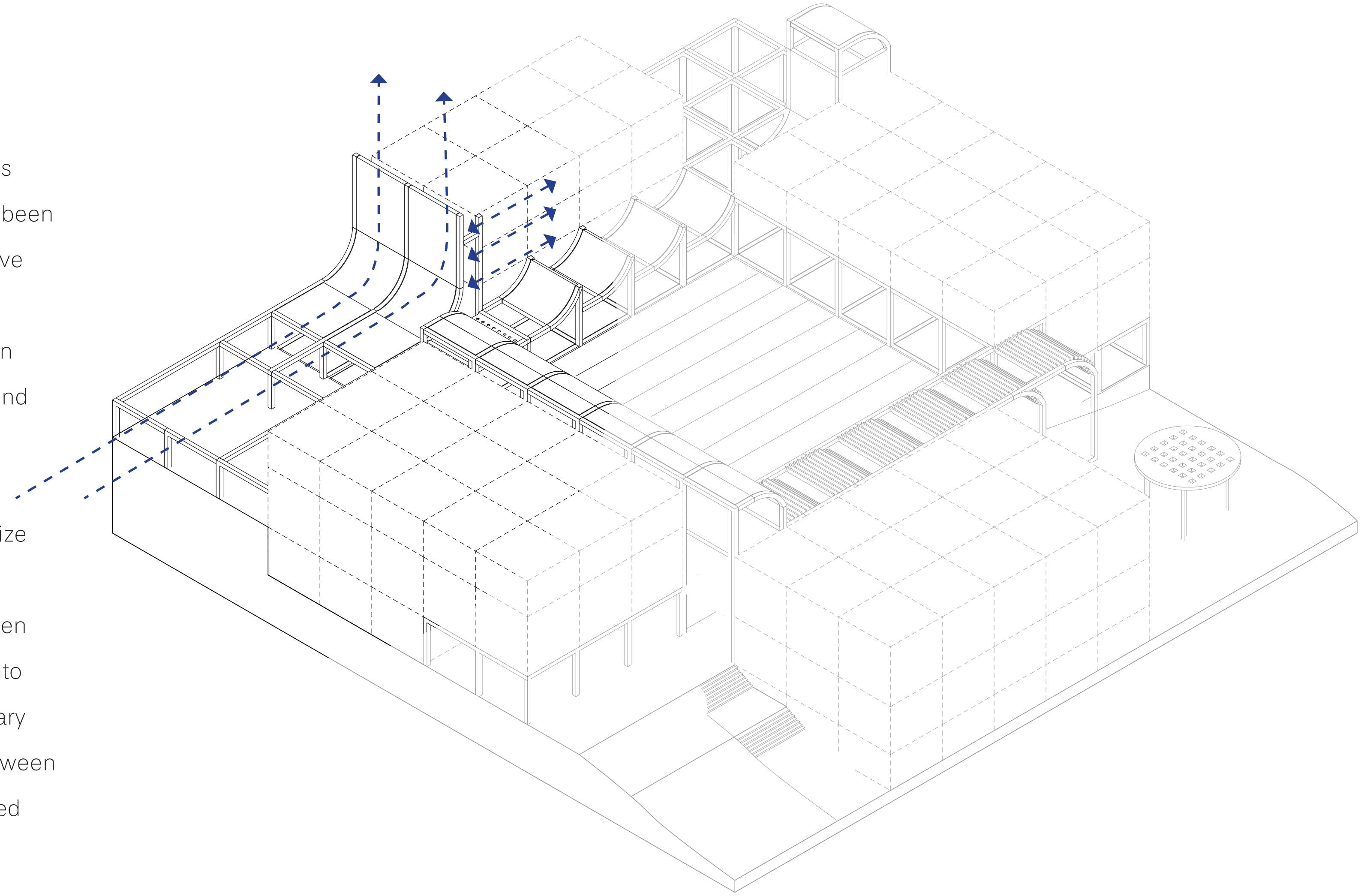
Initially, problematic areas in terms of temperature control and airflow within the building block were identified. Analyzing the building's position and the prevailing wind direction revealed that certain zones experience imbalanced airflow, leading to heat loss or accumulation issues.

Based on these findings, a specific design approach was developed for each of the four identified critical points.





Frame

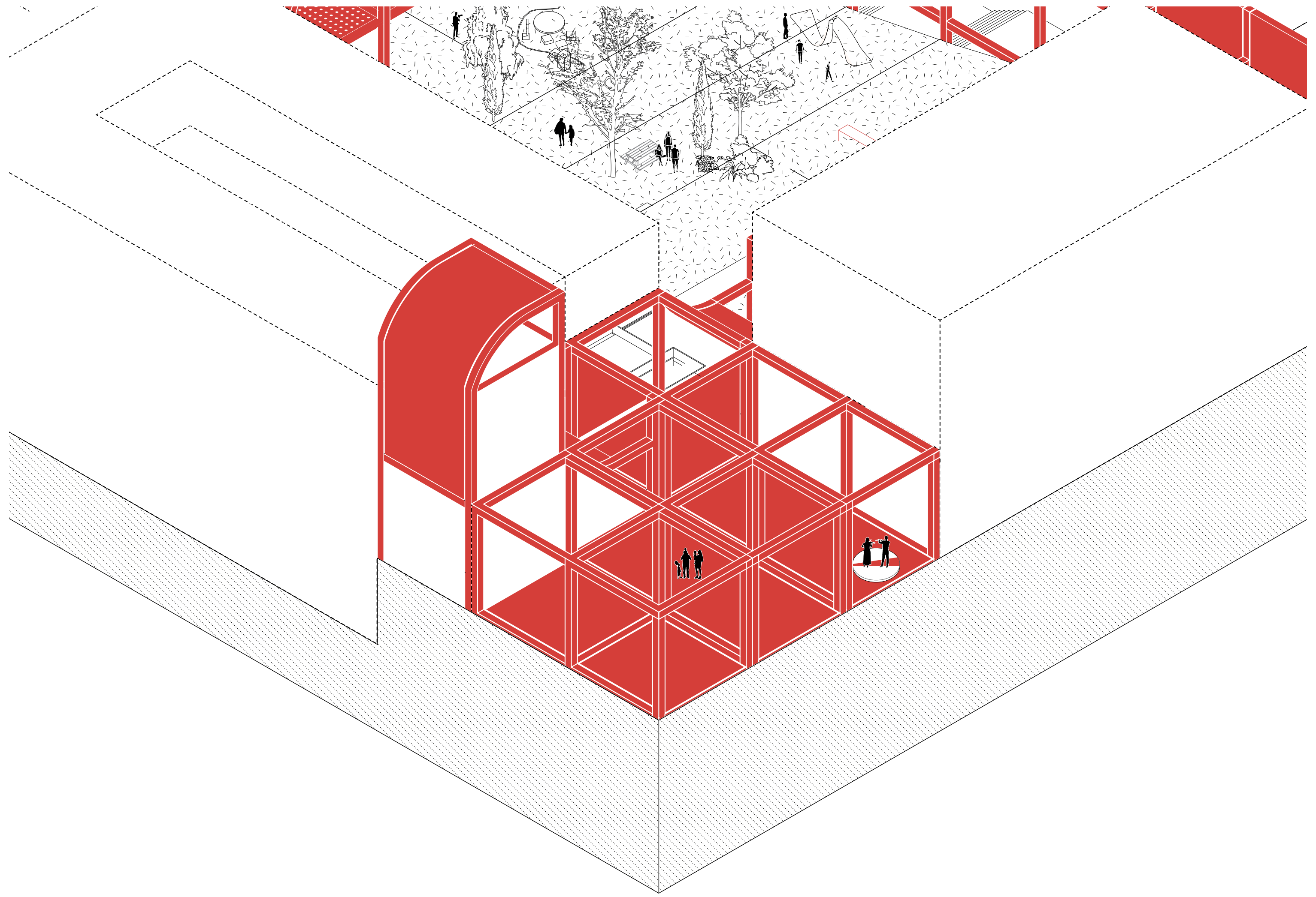


Zone 1

In a structure where the prevailing wind comes from the north, the Frame design strategy has been implemented to regulate wind flow and improve building performance. In this context, the roof form was designed as a convex arc, creating an aerodynamic surface that efficiently guides wind currents.

The arc-shaped roof helps to break and stabilize wind forces, while a secondary surface on the façade directs the concentrated airflow between the two layers, allowing controlled air intake into the building's ventilation system. The secondary surface forms a concentrated airflow zone between the outer and main façades, enabling controlled entry of cold northern air into the interior.

This system creates a buffer zone for cold air, optimizing indoor air circulation while minimizing heat loss during winter. In summer, the negative pressure generated by the wind facilitates the upward movement of warm air, contributing to passive cooling strategies. Additionally, the convex roof form and the secondary façade surface aim to actively utilize strong winds hitting the building. By redirecting wind forces at impact points, the system integrates natural airflow into the interior environment, maintaining thermal balance and enhancing overall comfort. This approach transforms wind movement into a functional design element, aligning with passive ventilation strategies to improve energy efficiency and optimize climatic responsiveness in architectural design.

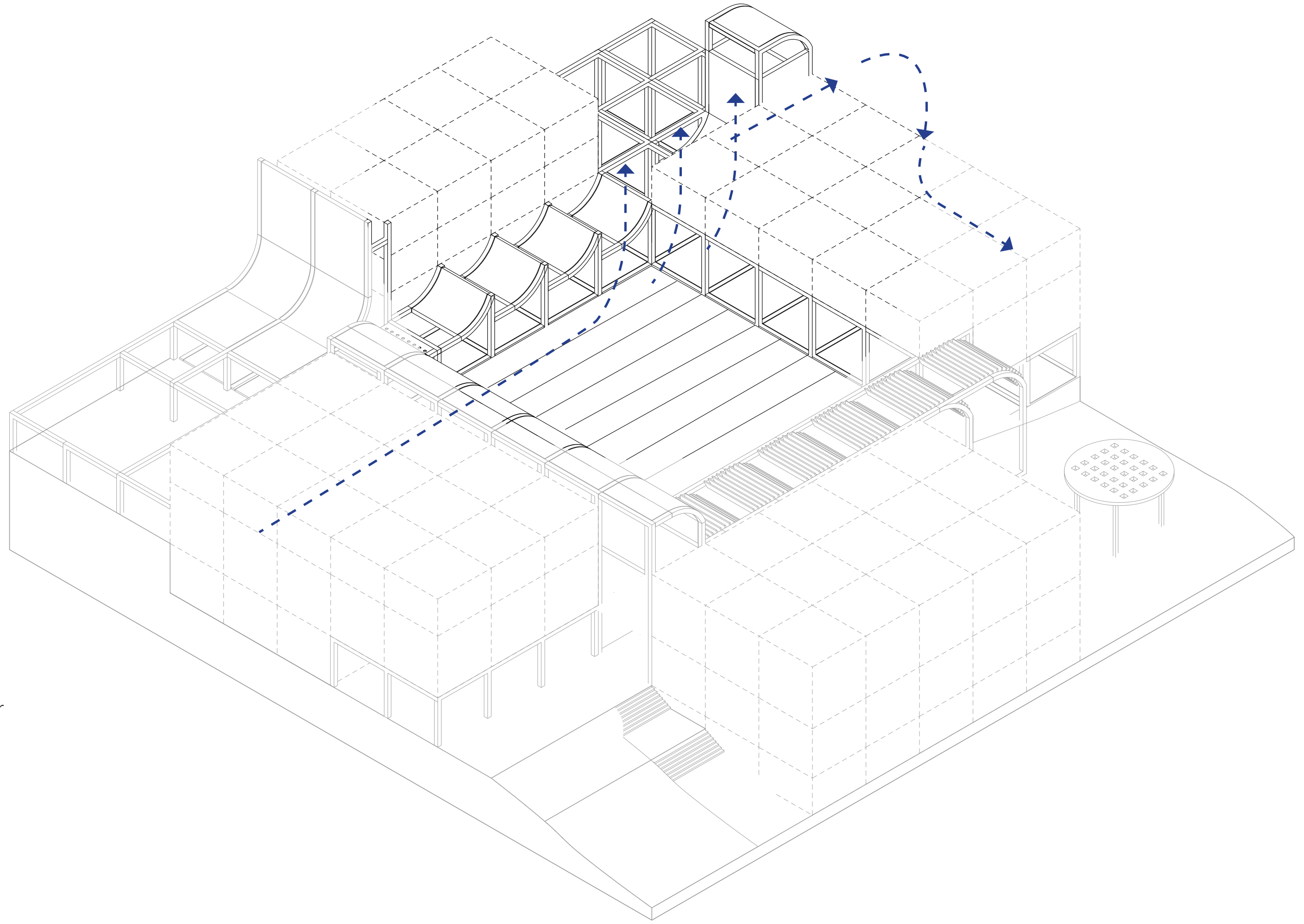


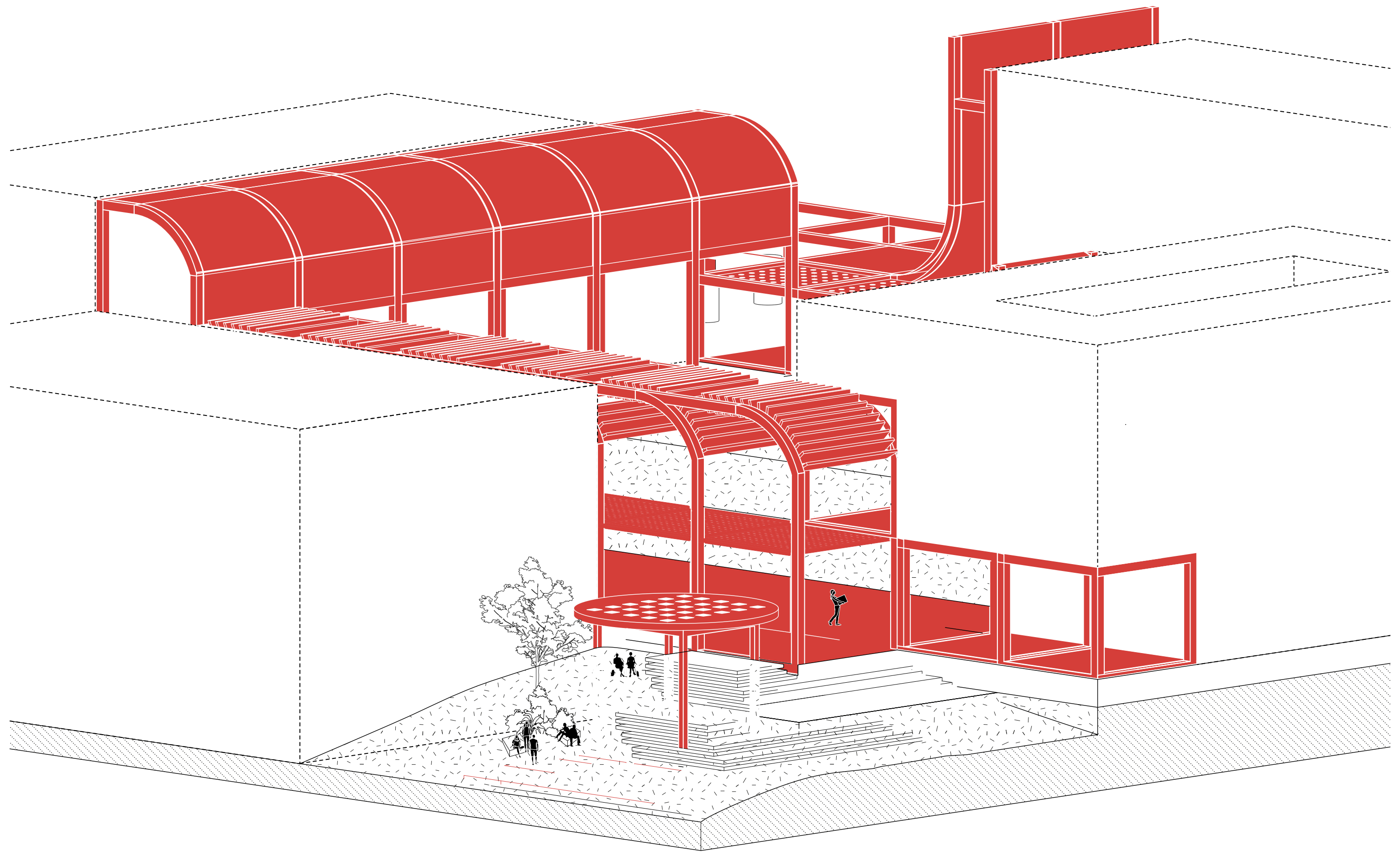
Frame

Zone 2

In the second zone, the prevailing wind enters the Frame through the gap between two buildings, creating a wind tunnel effect. To regulate and distribute airflow more efficiently, the wind path has been designed with curved redirections that help diffuse its intensity.

Additionally, for the partially embedded structure, a wind tower has been integrated to capture the prevailing wind at higher levels and redirect it to the lower zones, enhancing natural ventilation. Positioned at the southeastern corner of the building cluster, this area receives direct sunlight. Therefore, the design leverages the cooling effect of the wind, optimizing thermal comfort in sun-exposed spaces.



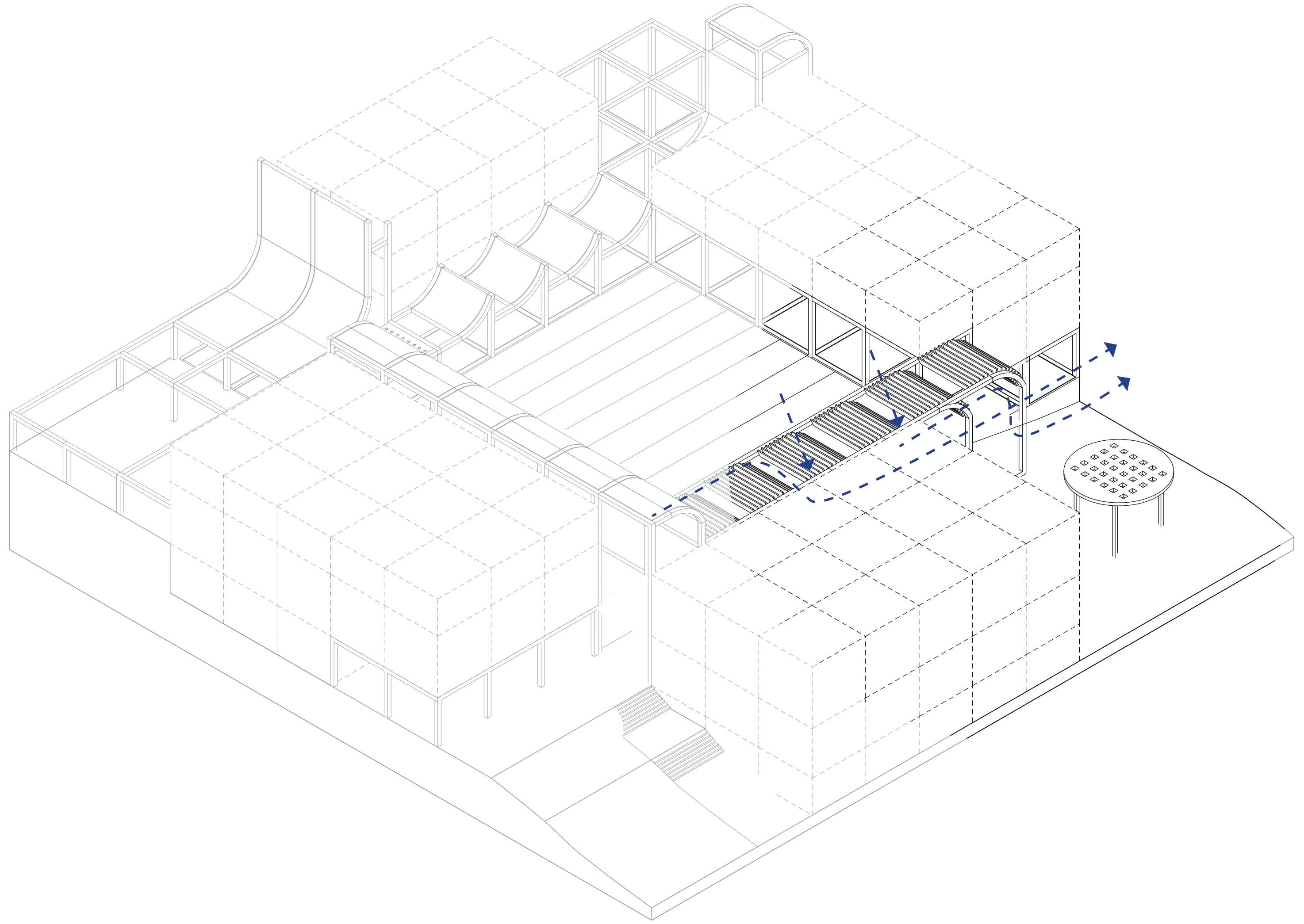


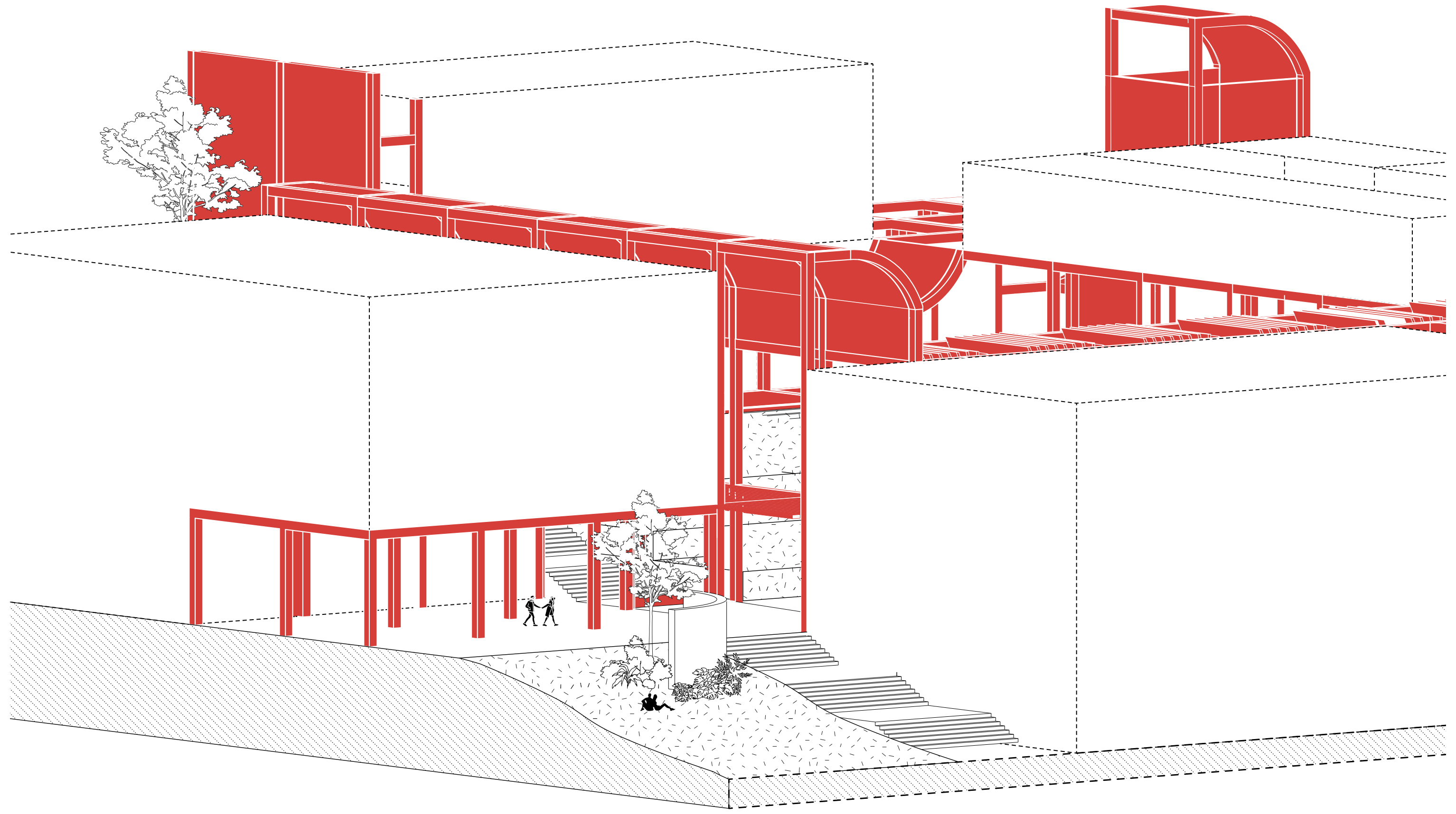
Frame

Zone 3

In the third zone, located at the southwestern corner, the combination of building blockage and the site's lower elevation creates a warmer microclimate. To mitigate heat accumulation, a wind tunnel has been designed to channel cool air beneath the overhangs.

This airflow is then directed through a canopied structure, ensuring continuous ventilation and enhancing thermal comfort in the area.

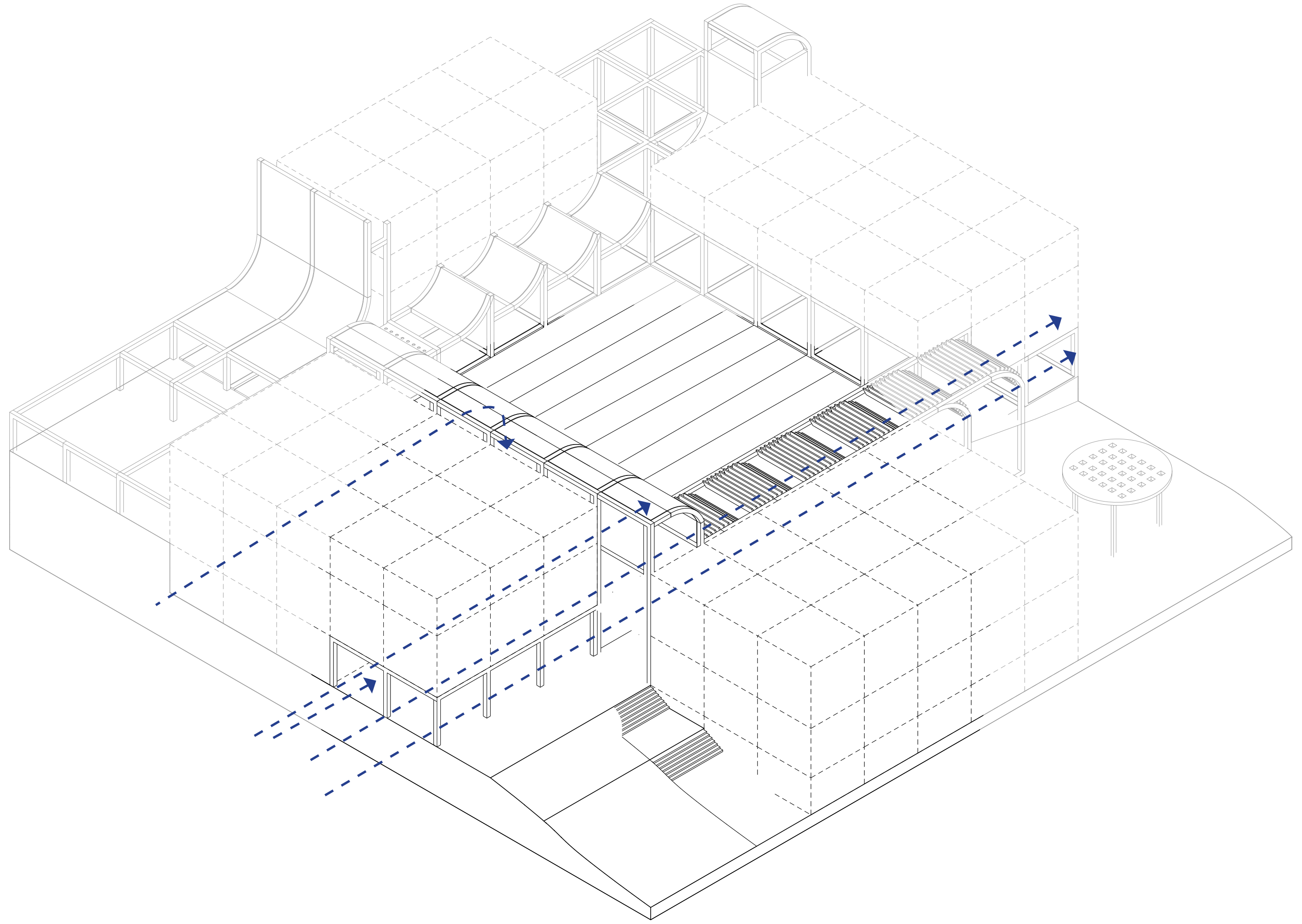


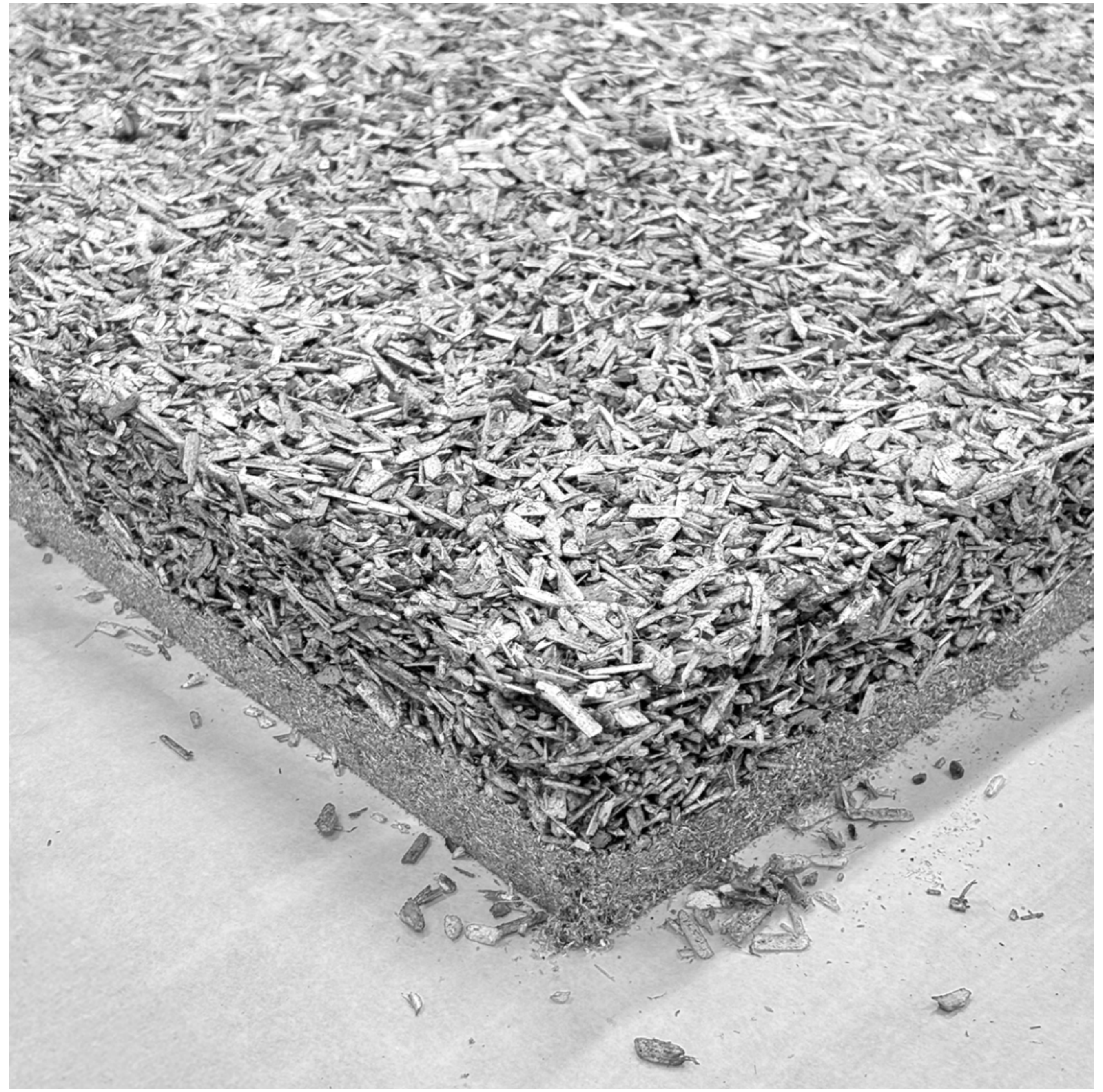


Frame

Zone 4

At the northwestern corner, a wind tunnel has been integrated beneath the building to draw cool air into the lower courtyard level. To enhance airflow, the overhanging frame structure is designed to capture and direct the wind into the interior. Additionally, a curved rooftop extension redirects the wind flowing over the main roof toward the sunniest area of the courtyard, optimizing passive cooling and natural ventilation.





Material; HempBoard

In line with the biennale's theme, hempboard was selected as the main material of the installation due to its carbon-smart characteristics. This board, produced from compressed hemp hurds, incorporates a bio-based resin, making it a fully sustainable and non-toxic alternative to conventional panel materials. Derived from the fast-growing and renewable hemp plant, it offers significant environmental advantages.

"Hempcrete, made from the woody core of the hemp plant and a lime-based binder, provides excellent thermal insulation while sequestering carbon throughout its lifecycle." Similarly, hemp wool is "non-toxic, biodegradable, and offers high insulation performance," serving as a sustainable alternative to petroleum-based insulation. Together, these hemp-based materials help reduce environmental impact while improving indoor air quality and energy efficiency in architectural applications.

MAS

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