



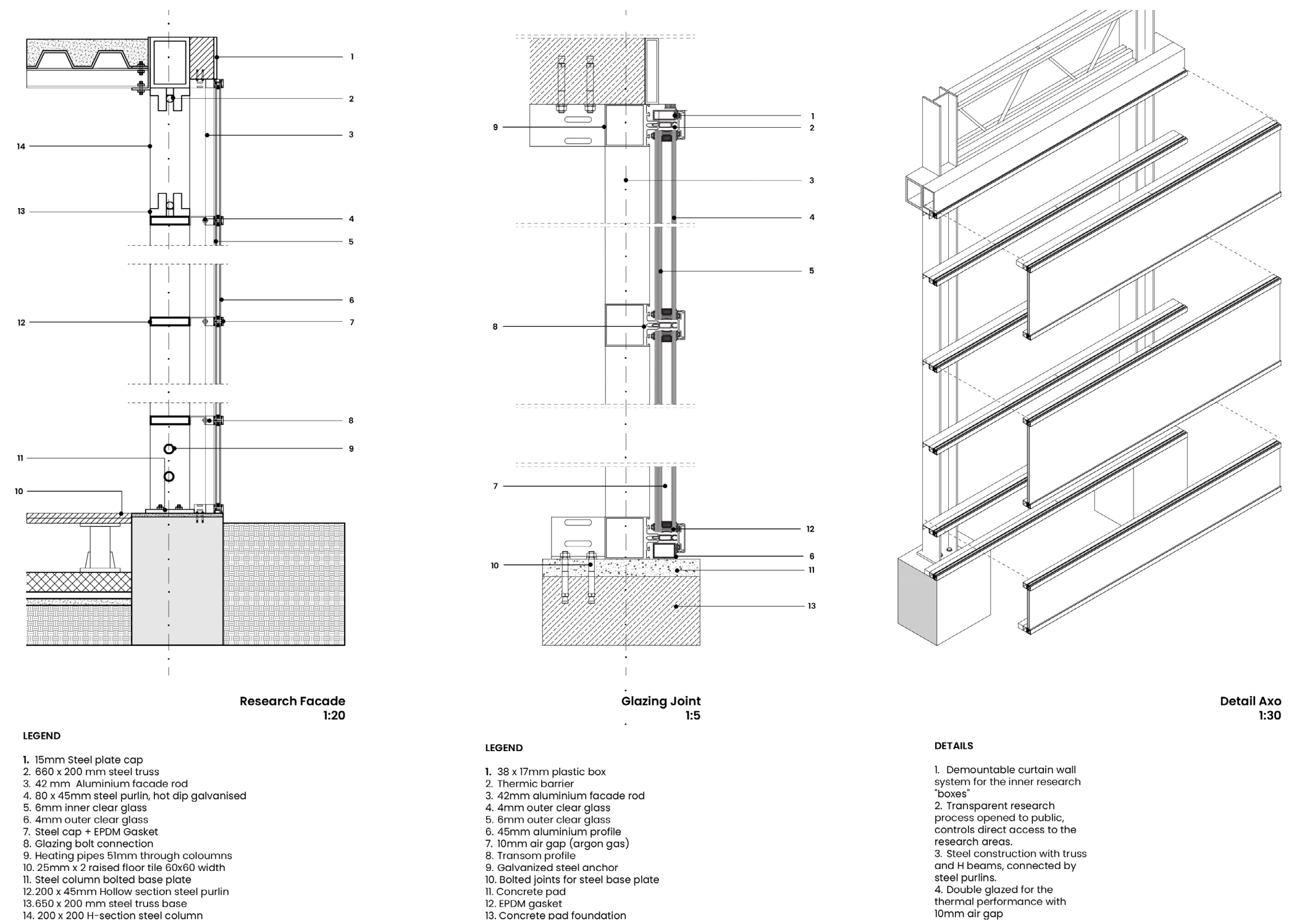
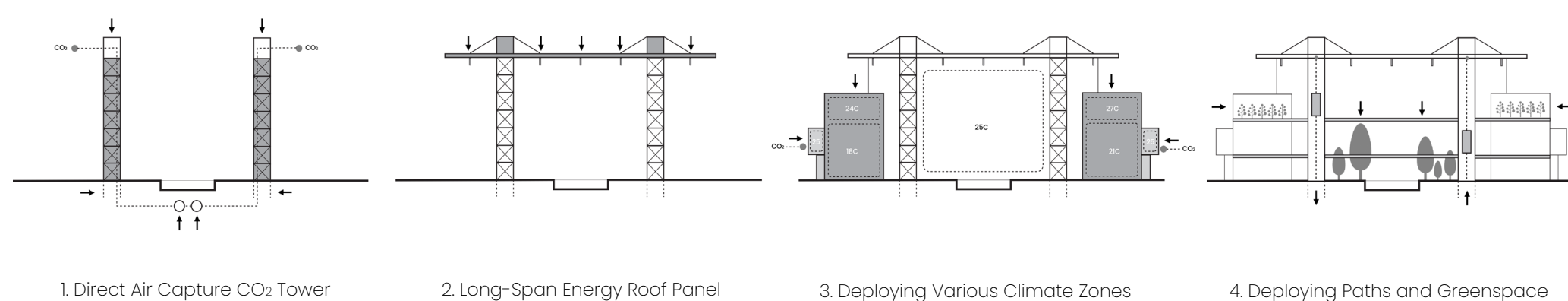
## Public Botanical Research Institute of Shanghai

### INTEGRATING CO<sub>2</sub> CAPTURE AND UTILISATION WITH THE REGENERATION OF ABANDONED POWERPLANT

In response to China's declaration to gradually close all coal-power plants, this design aims to pioneer an exemplary approach for regenerating these sites. While acknowledging that this research project alone may not revolutionize the fight against global warming or absorb all of Shanghai's carbon emissions, it seeks to develop a comprehensive methodology for revitalizing abandoned industrial sites, transforming them into carbon sinks. This initiative aims to set a precedent for urban carbon reduction and absorption through architectural methods, signaling a shift in architectural practices beyond traditional boundaries. The increasing population in mainland China has heightened interest in urban farming, agricultural sciences, and crop research. These fields require a CO<sub>2</sub> concentration level of 1000 ppm to accelerate crop growth, thereby speeding up the agricultural research process. Consequently, the design not only implements a carbon capture strategy and integrates a new facade system but also utilizes the captured carbon to enhance crop growth, promote faster food production, and facilitate natural CO<sub>2</sub> dissipation. The project's overarching objective emphasizes innovative methods to transform heavily contaminated industrial sites into sustainable environments, functioning as significant carbon sinks within urban settings. The research advances circularity and sustainable principles in architecture by adopting the circular carbon economy concept. This design aims to restore the site, addressing the environmental damage caused by past industrial activities and providing a new opportunity for the site to "apologize" by reversing its role to become a carbon eradiator.

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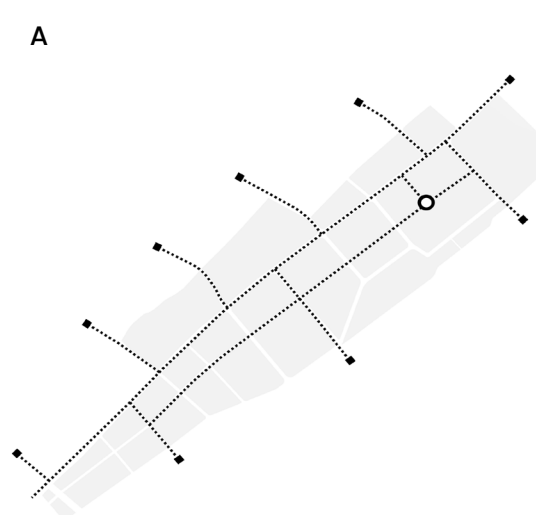
Utilizing the abandoned power plant holds special significance for the project. The same machinery that once emitted vast amounts of CO<sub>2</sub>, degrading the air quality in Shanghai's Yangpu district, will now emit CO<sub>2</sub>-free air. It will reverse its role to become a CO<sub>2</sub> cleaner and use CO<sub>2</sub> as a resource to power food production and agricultural research. The design vision crystallized throughout the process, ensuring that the entire growth, research, and production phases are transparent to the public, making the research journey an integral part of the visitor experience throughout the building.





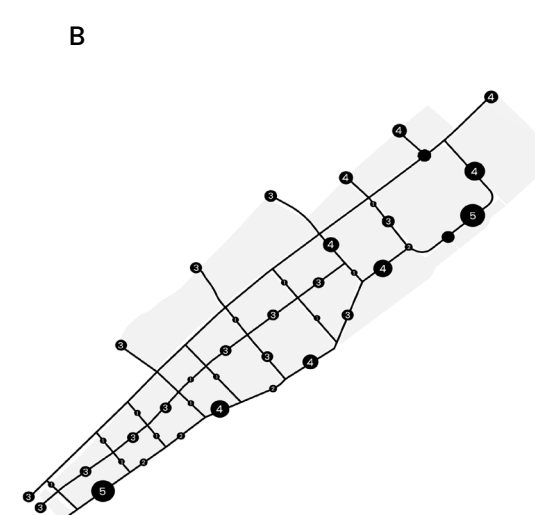


The Waterfront Regenerated Infrastructure



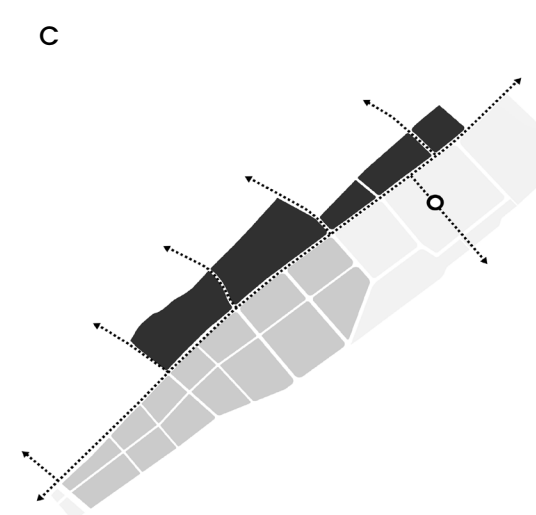
Connecting Education

The central research hub with close proximity to 8 technical universities of Shanghai



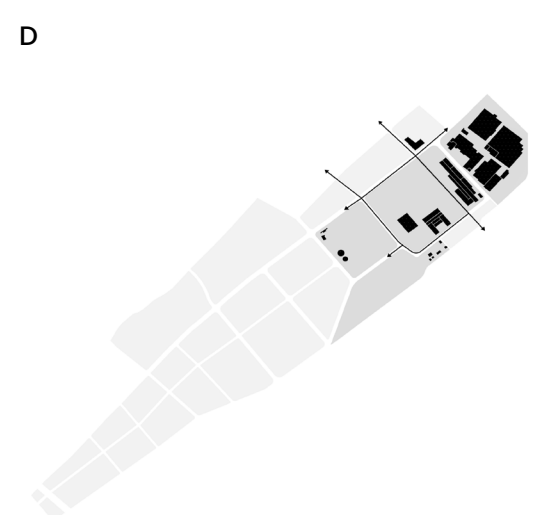
Revitalising the Streets

The contamination of streets and site from historical industrial activities



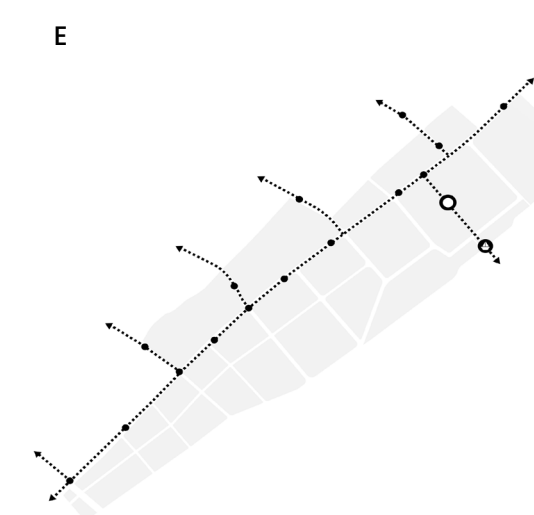
Reconnecting the Neighbours

The new planning for high-density residential scheme from the city's future vision



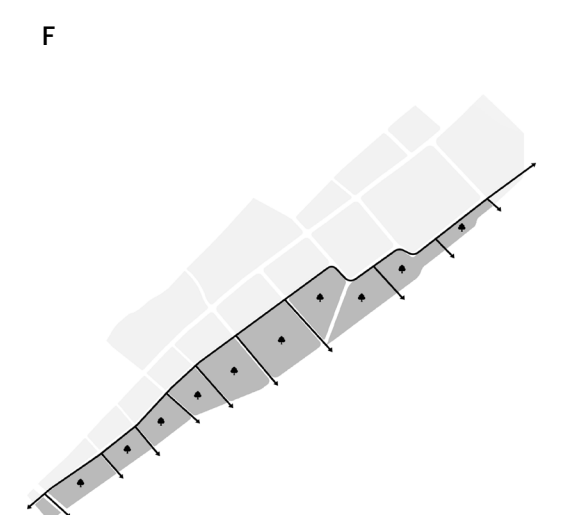
Preserving the Existing

The existing heritage buildings and powerplant reconnecting with the public



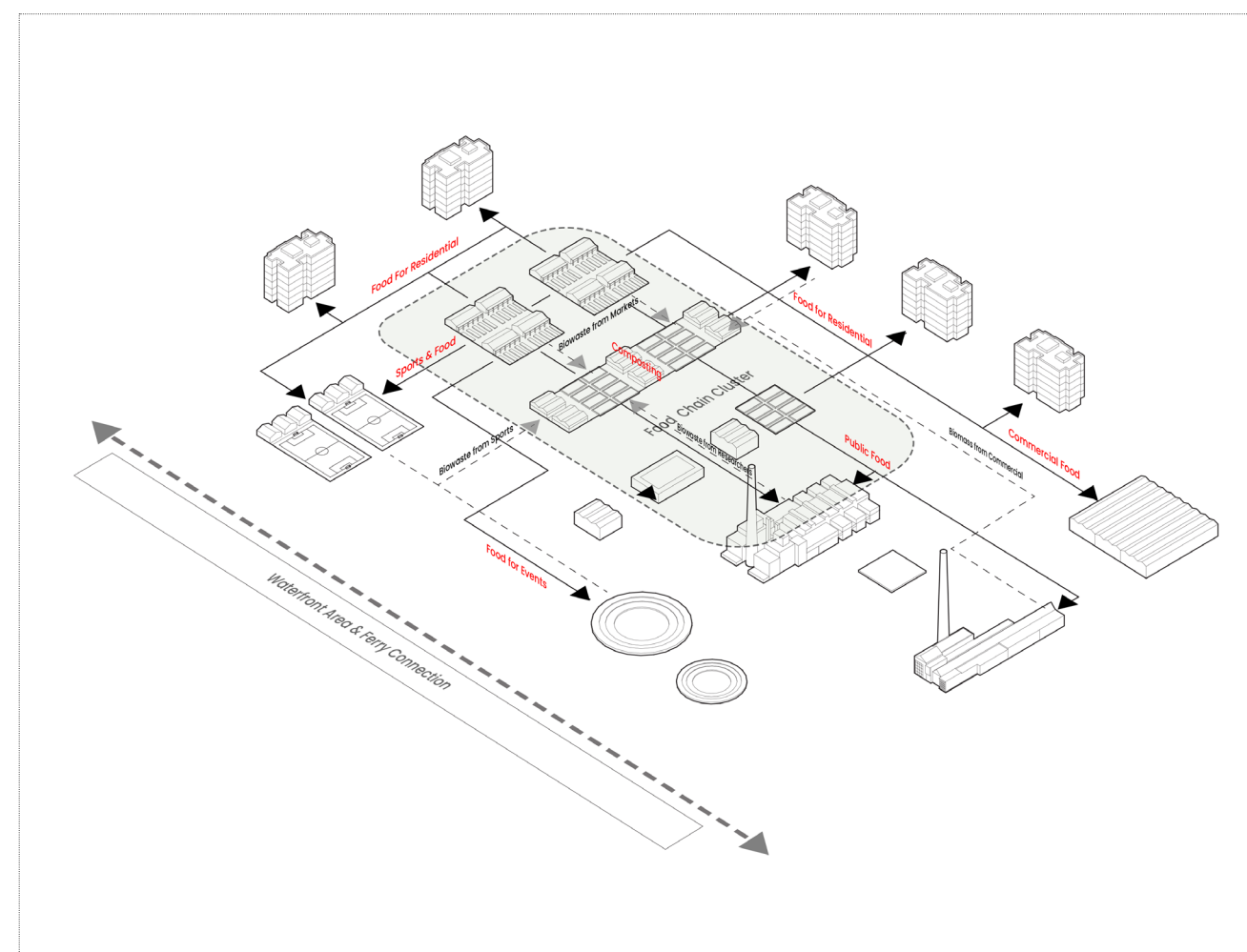
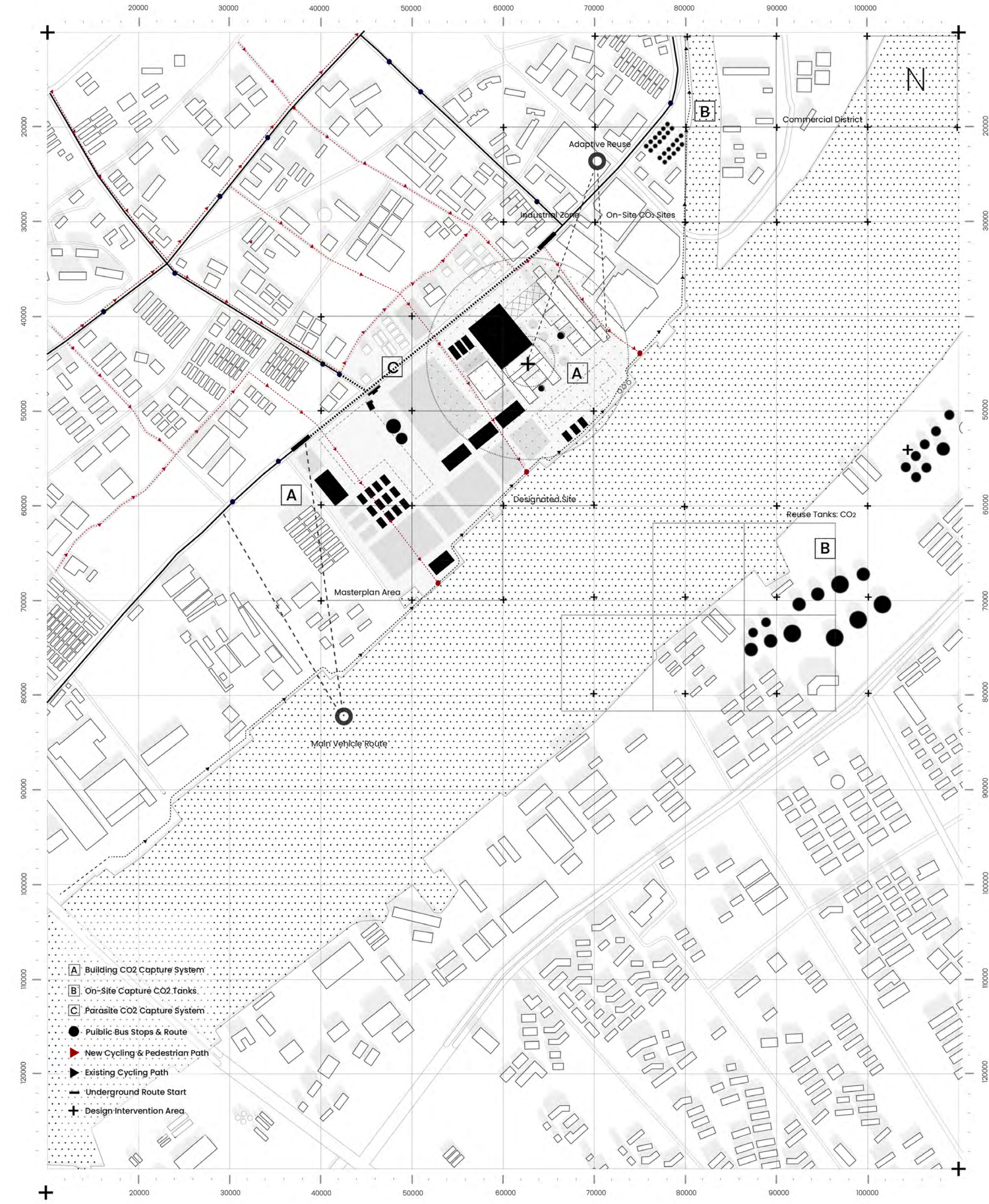
Connecting the Main Routes

The existing main road and water transportation access towards the site



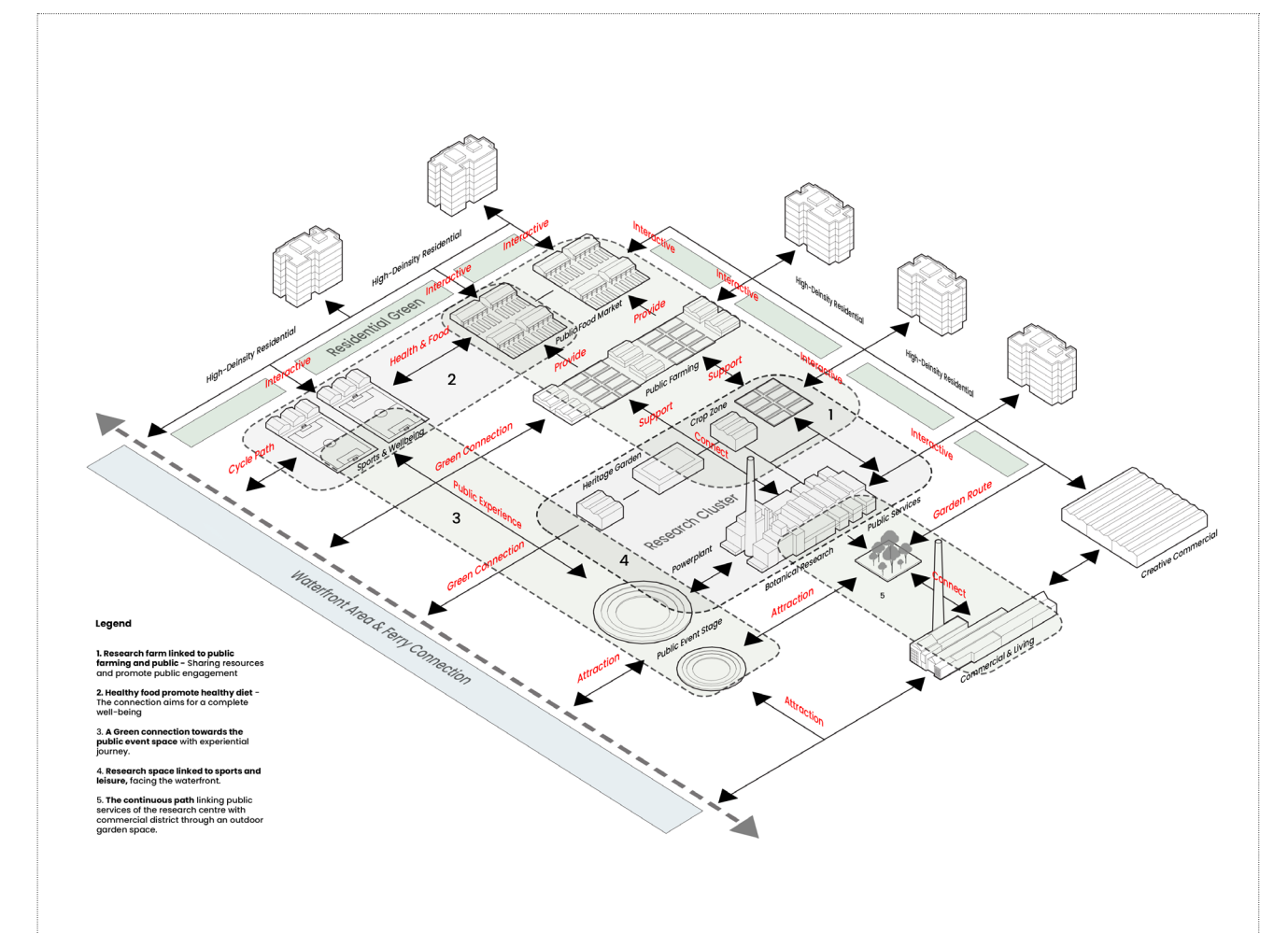
Waterfront Biodiversity

The contaminated industrial belt with an opportunity for extended biodiversity



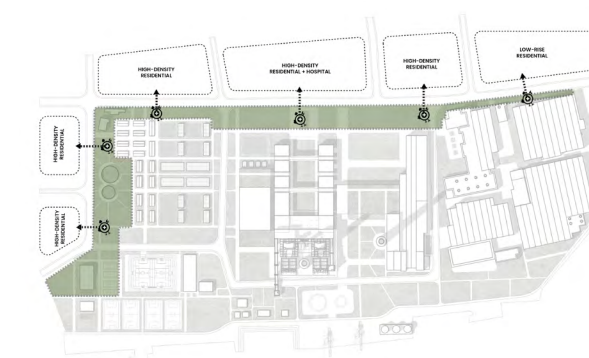
1. Establishing Organic Food and Production Circular Chain

The primary objective of the site masterplan extends beyond the revitalization of the contaminated area, it aims to establish a robust system of circularity and self-sufficiency in food production. Central to this vision is the integration of a research center with the surrounding environment. The Greenhouse, enhanced by carbon fertilization, accelerates food production, ensuring a steady supply to the market and the high-density residential district. Biowaste generated from the process is redirected to the composting area, thus supporting a continuous and sustainable food production cycle.

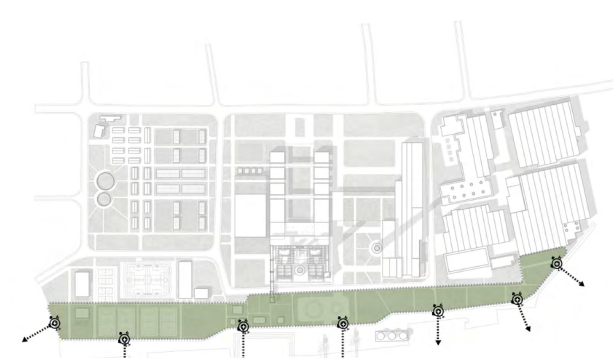


2. Establishing Carbon Absorption, Storage and Utilisation Through the Site

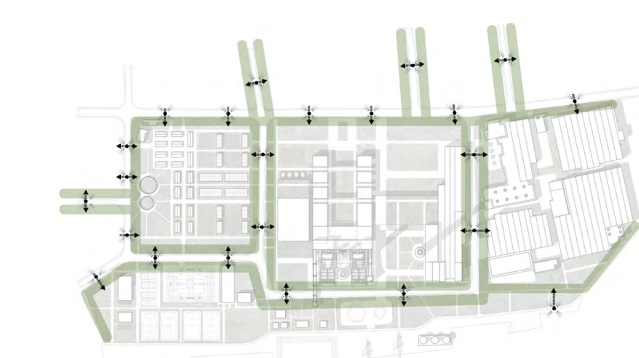
The research center, situated within the research cluster, serves as the central hub for public engagement. This cluster will integrate public farming, a commercial zone, sports facilities, and event spaces, fostering comprehensive and safe interactions that promote research, education, and both physical and mental well-being. The heritage powerplant and existing structures will be preserved and revitalized to coexist harmoniously with public activities. Once an area is avoided, the powerplant will be transformed into a vibrant center of interaction. Furthermore, none of the urban components within the masterplan are isolated.



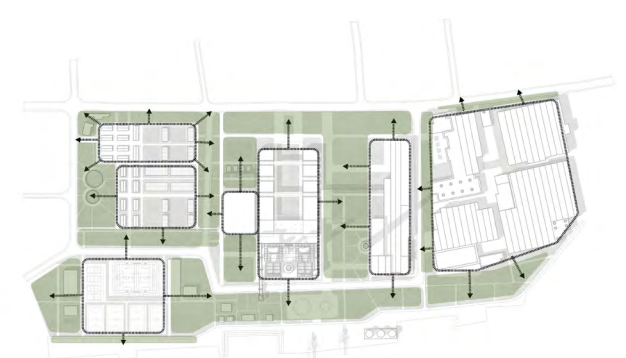
1. Green Extension for High-Density



2. Waterfront Park Extension



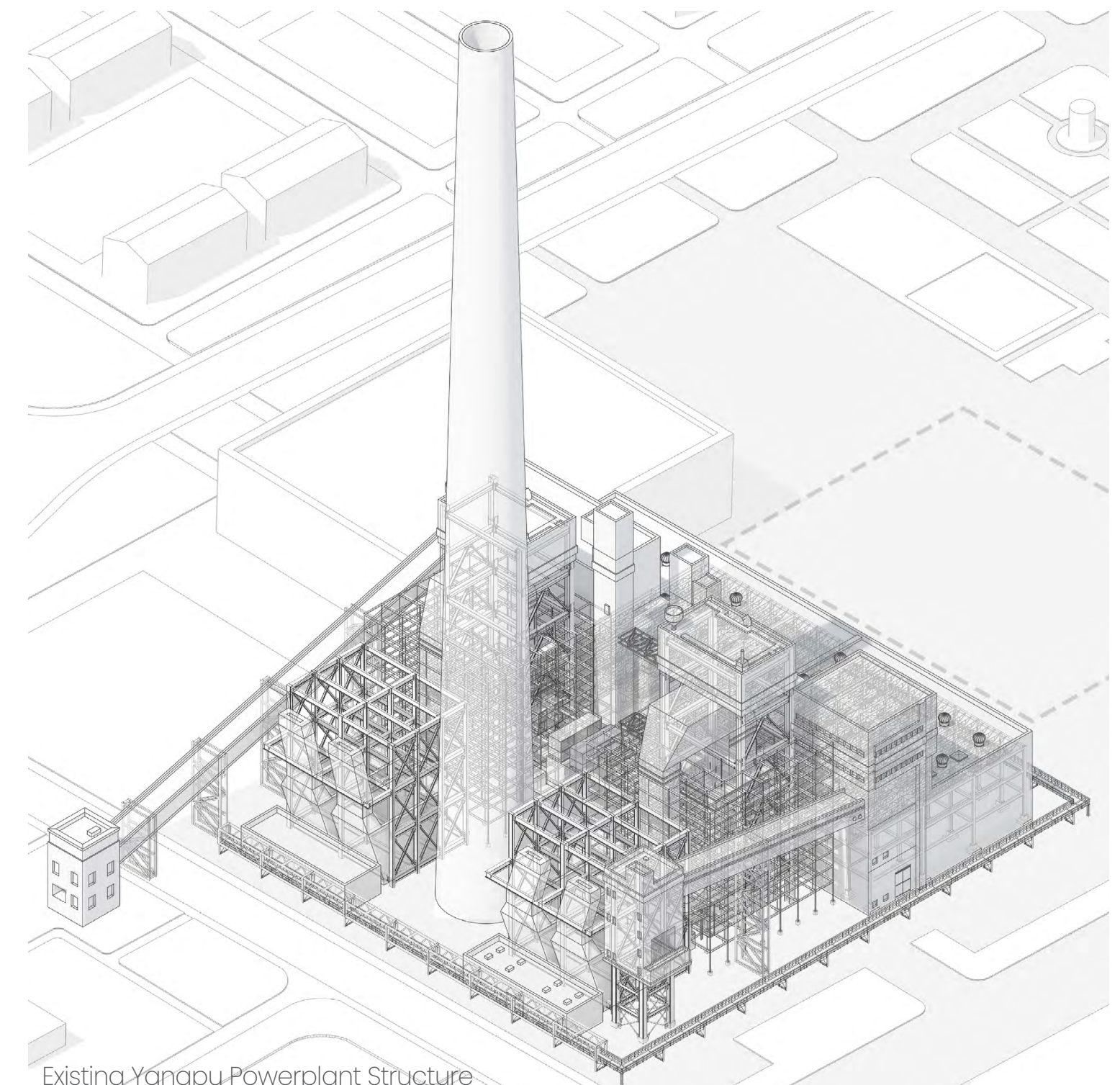
3. Green Corridor for Streets



4. Access to Greenspace



Preserved Heritage and New Intervention

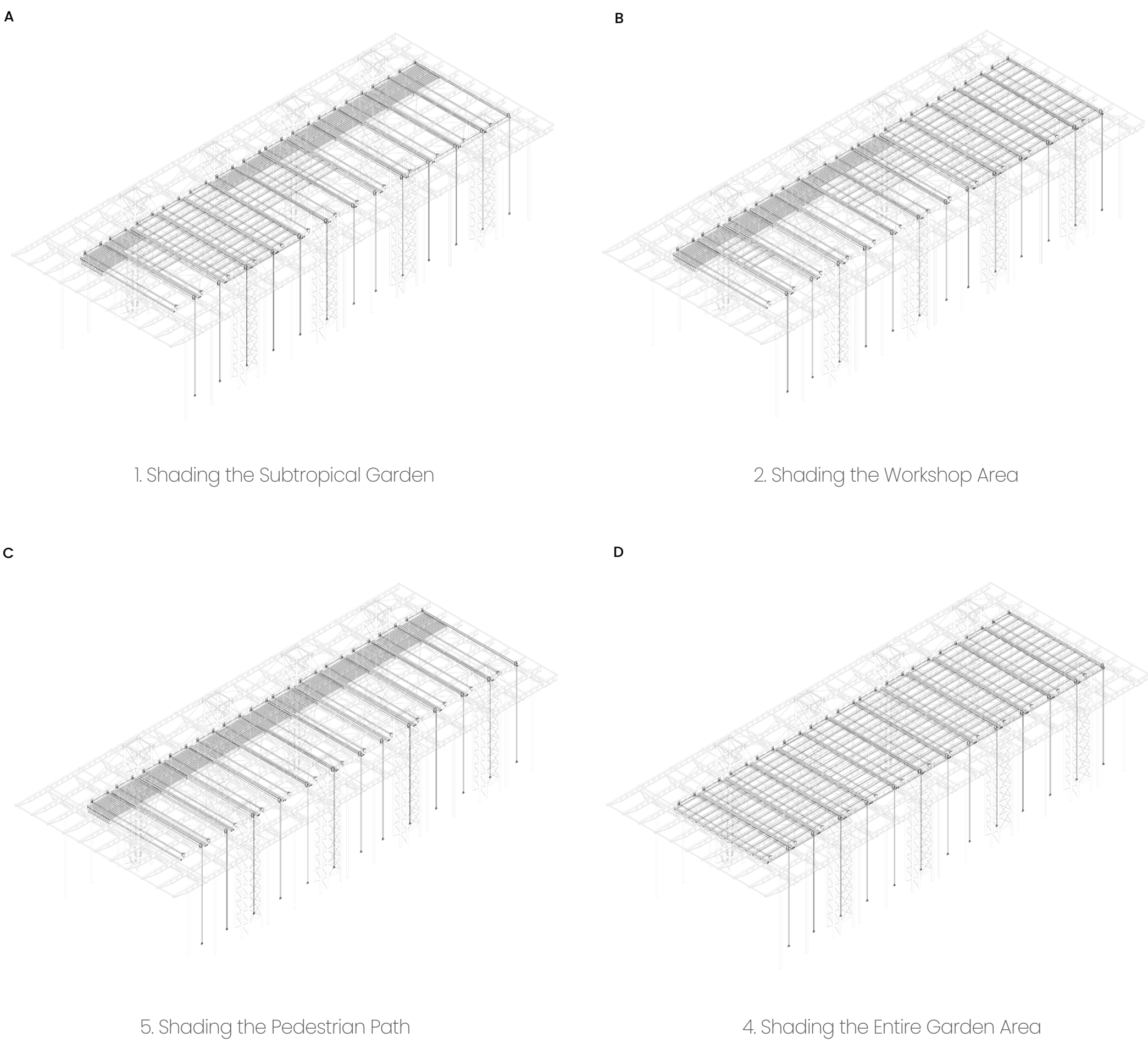


Existing Yangpu Powerplant Structure





Subtropical Garden View From the Entrance

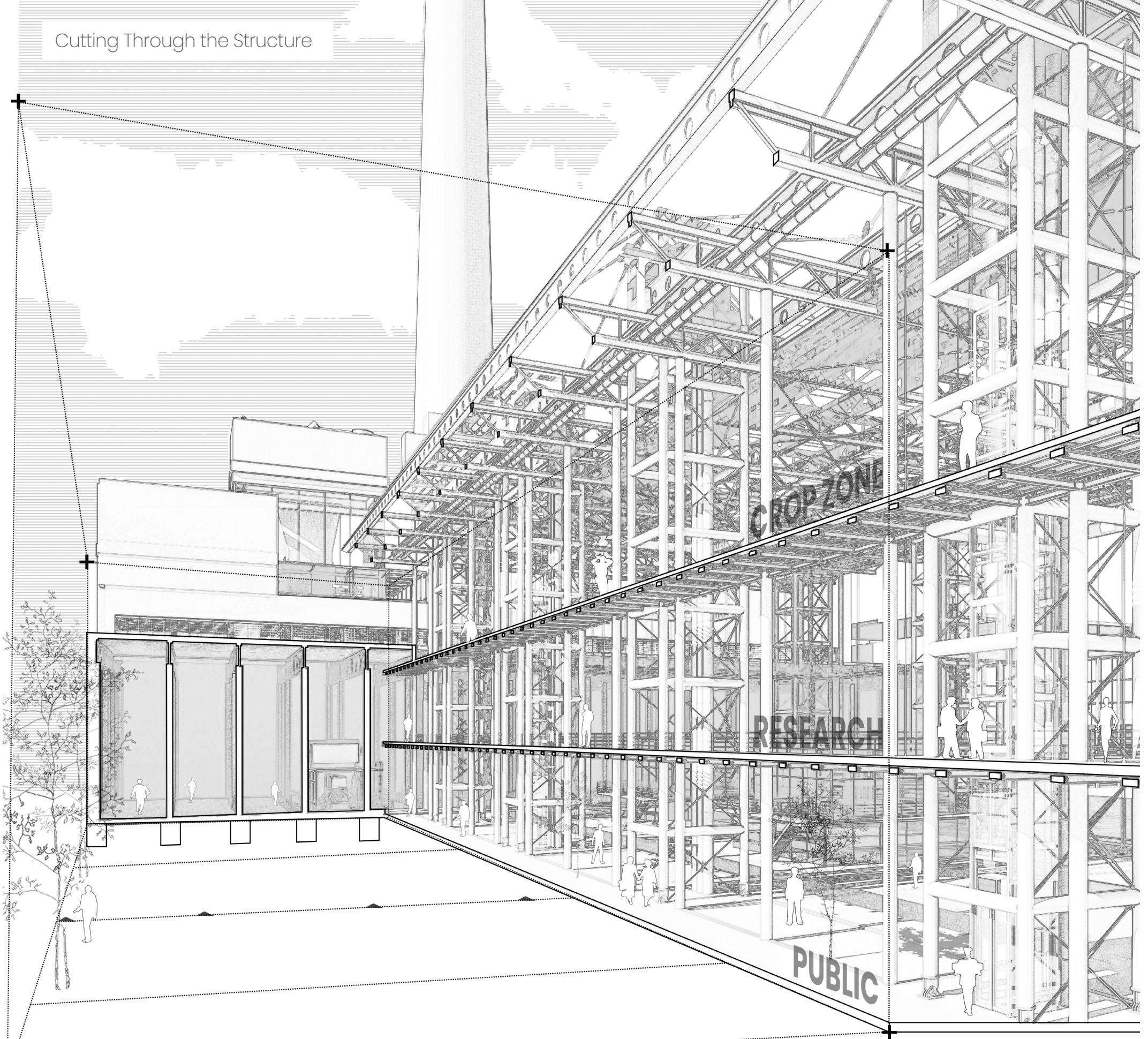


1. Shading the Subtropical Garden

2. Shading the Workshop Area

5. Shading the Pedestrian Path

4. Shading the Entire Garden Area



Cutting Through the Structure



View from the Crop Area Corridor



View from the Ground Workshop Space

### Walking Above the Subtropical Forest of Shanghai

Visitors to the research center have the opportunity to explore all green spaces, which include a subtropical garden area, crop zones, and public workshop areas. The building's design features complete transparency, enabling continuous visual connectivity to these verdant spaces from within the structure. To maintain a suitable temperature for both the public and the plants, the facility incorporates a retractable shading system. This system, crafted from aluminum fabric, is strategically positioned between the beams of the superstructure, effectively managing solar gain and providing necessary shade. Complementing this shading mechanism is an advanced climate control system that leverages natural ventilation. Openable windows located at the top of the building facilitate this process.

As the glazing heats up the internal air, the stack effect is initiated, promoting the upward movement of warm air and allowing cooler air to flow in, thus enhancing ventilation and maintaining a comfortable indoor environment. The architectural design also features an intricate network of hanging bridges and corridors. These pathways connect various crop areas with research zones, allowing for seamless circulation between researchers and visitors. This holistic approach ensures that the center remains a conducive environment for research and public engagement, while also maintaining the health and vitality of its extensive green spaces.

### Surrounding the Public Workshop Area with Greenery

The workshop space within the research center is conveniently accessible from the ground floor, directly adjoining the main subtropical garden. This area functions as an interactive hub where visitors can engage with a small-scale research lab and gain a first-hand experience of the various crops and plants cultivated within the facility. This design not only showcases the research process through visual transparency but also engages all human senses, creating an immersive and interactive environment for visitors. The enclosed workshop area is meticulously designed to facilitate the injection of carbon into the vegetation space, ensuring a controlled environment where carbon is fully absorbed by the plants. The complete enclosure of this space prevents any carbon leakage into the atmosphere, thus maintaining the integrity of the research process.

Once the carbon absorption process is complete, the workshop area is opened to visitors during the day, allowing them to observe and interact with the research activities in a safe and controlled manner. This integrated approach underscores the center's commitment to both scientific research and public education. By providing a transparent and interactive experience, the research center not only highlights the intricacies of the research process but also fosters a deeper understanding and appreciation of sustainable practices among visitors. Overall, the workshop space and its associated features exemplify the center's innovative design and its dedication to promoting scientific knowledge and environmental awareness.





View from the Internal Bridge

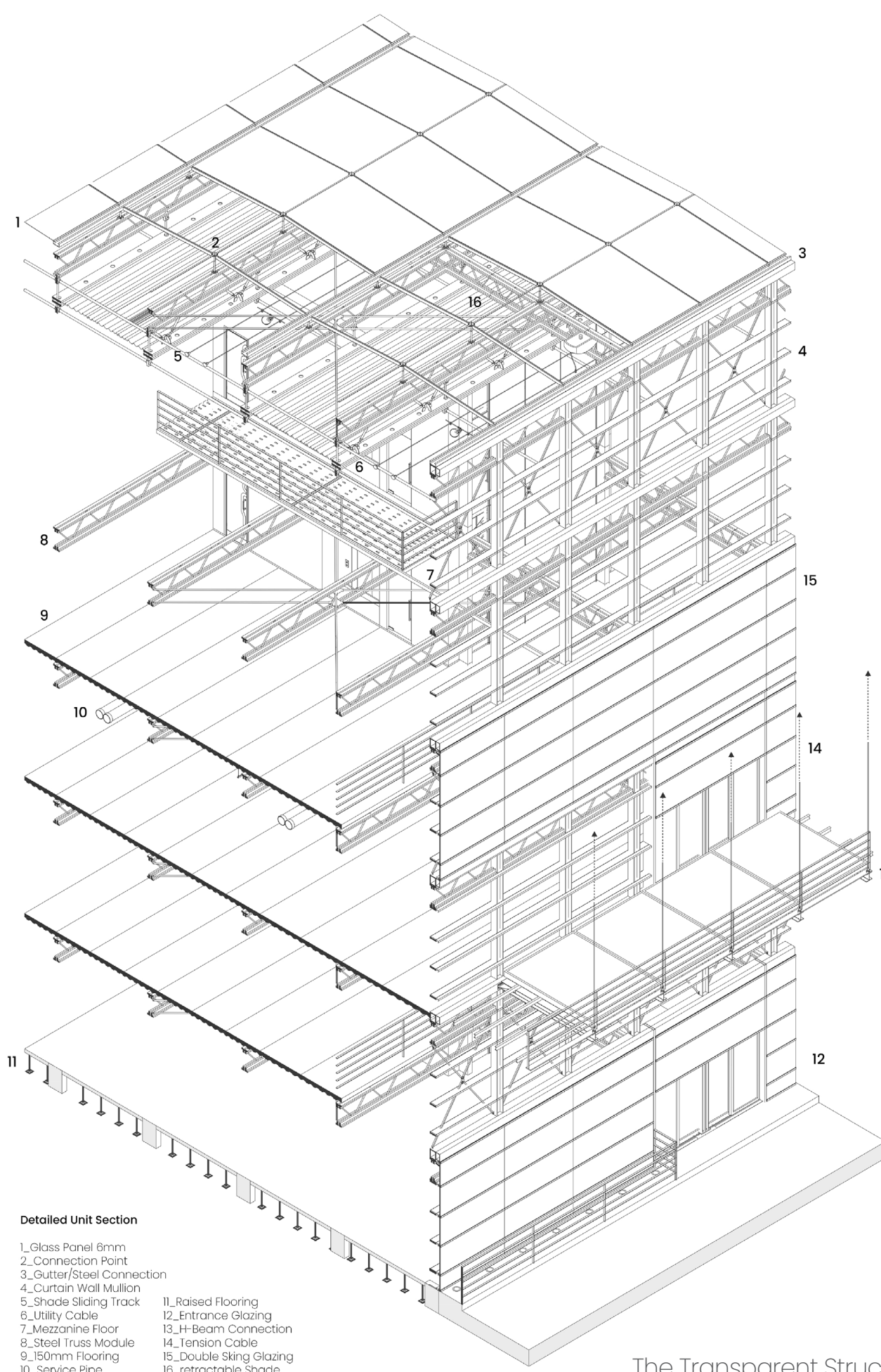
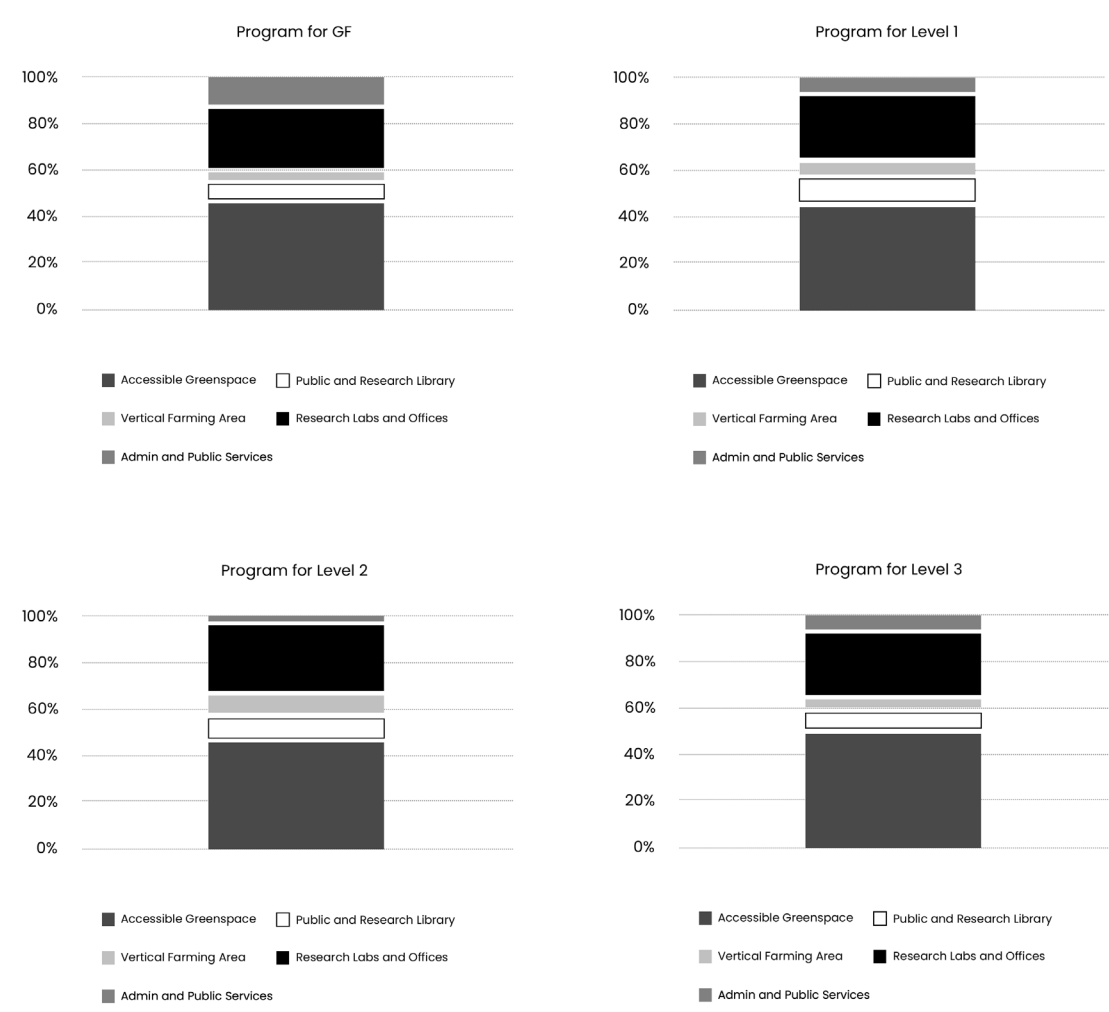
## The Transparency of the Research

The transparency of the research center's building, as previously highlighted, serves both aesthetic and functional purposes. Aesthetically, the transparent design allows for the exposed steel structure to be prominently visible, continuing the architectural character of the adjacent abandoned power plant. This continuity of steel in the design was a crucial consideration to ensure the new extension seamlessly integrates with the existing industrial context. From a user perspective, the glass envelope significantly enhances the experience by providing clear views of the various stages of research occurring within the building. This transparency not only demystifies the research process but also creates a dynamic and engaging environment where visitors can witness scientific progress in real time.

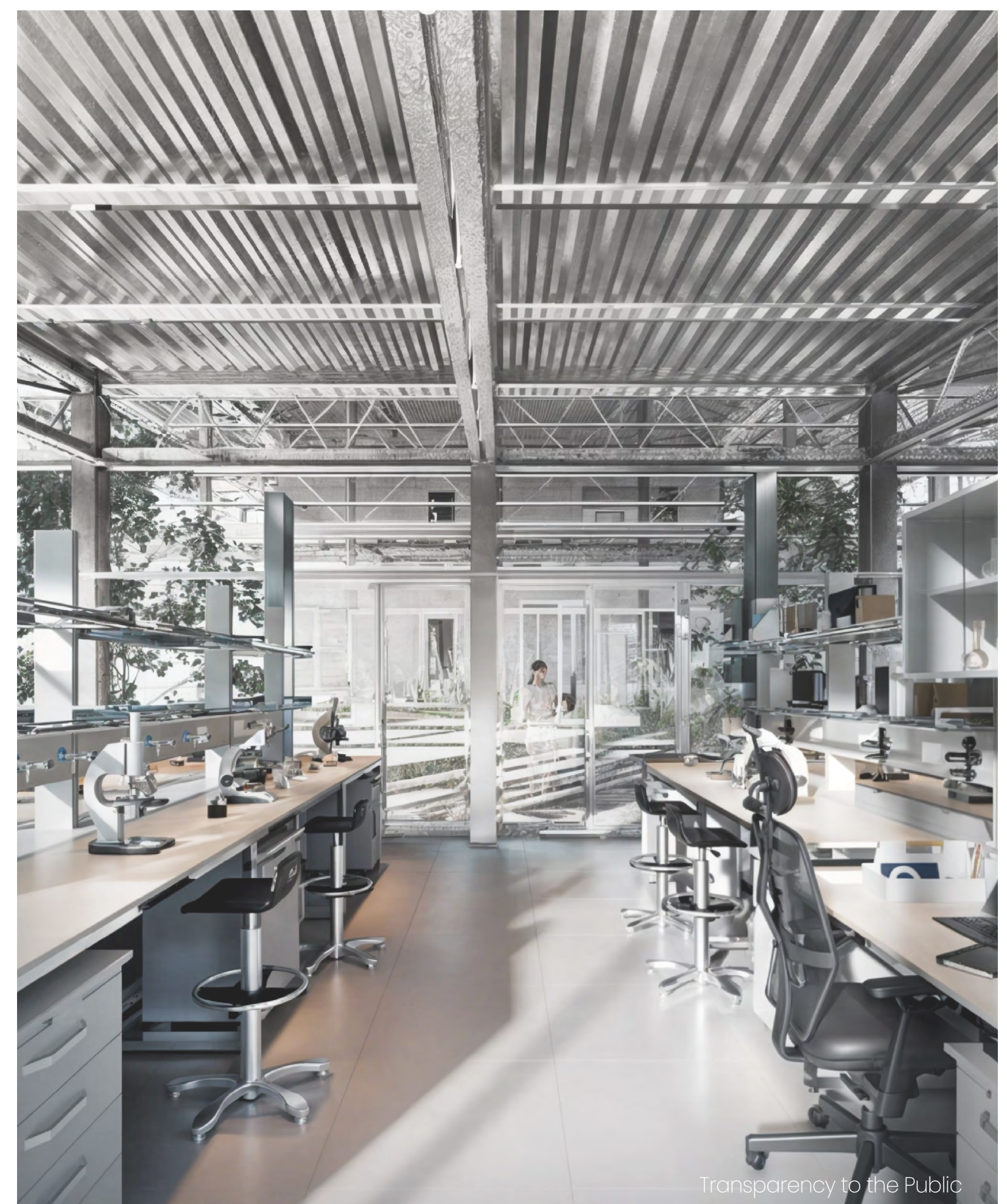
The central area of the facility, designed as a subtropical garden, is open to the public and serves multiple purposes. The research center aims to make the research process an integral part of the visitor experience, offering both aesthetic enjoyment and educational value. This garden area provides a unique learning environment for children and students, and also serves as a tranquil resting place for elderly visitors, fostering a sense of community and engagement.

In addition to the visual transparency, the research center's main programs are strategically organized across different levels of the building. Each floor accommodates a variety of programs, ensuring a cohesive and integrated experience throughout the facility. This thoughtful spatial arrangement prevents the isolation of activities and promotes fluid interaction between different areas, even in a large building.

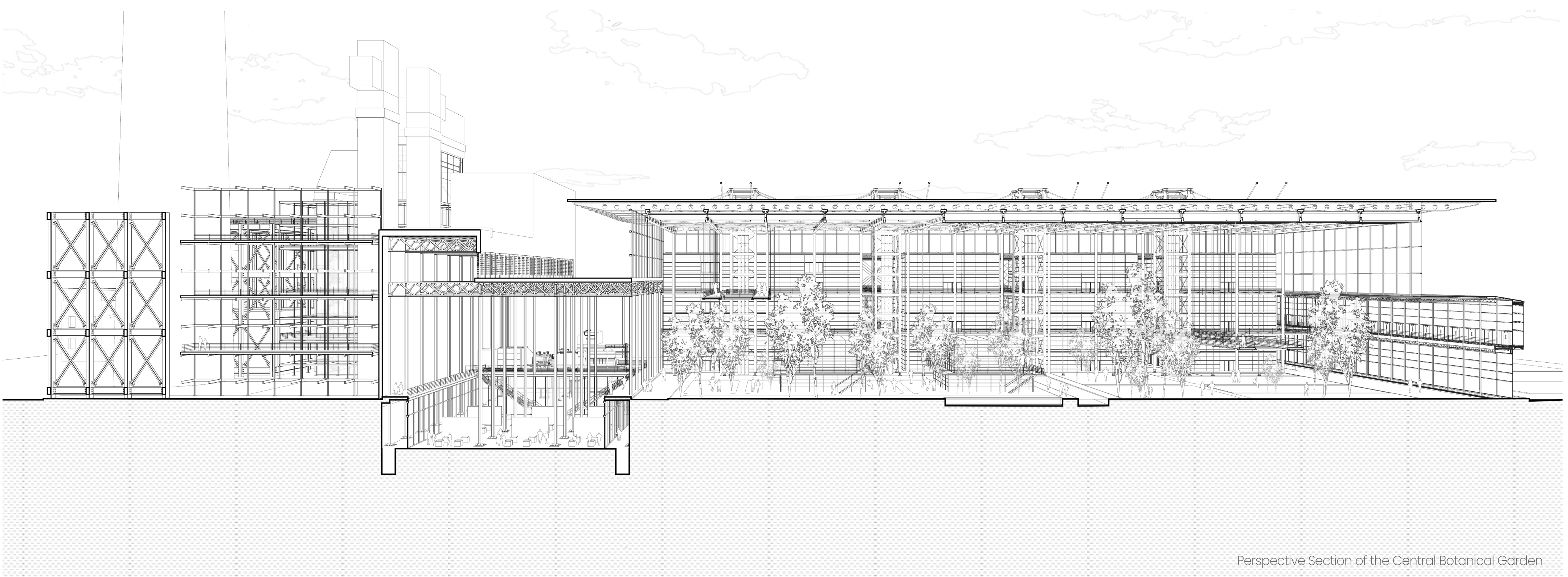
Overall, the research center exemplifies a harmonious blend of aesthetic appeal and functional design. By maintaining the continuity of the steel structure, embracing transparency, and thoughtfully organizing its programs, the center not only enhances the user experience but also fosters an environment of learning and interaction.



The Transparent Structure

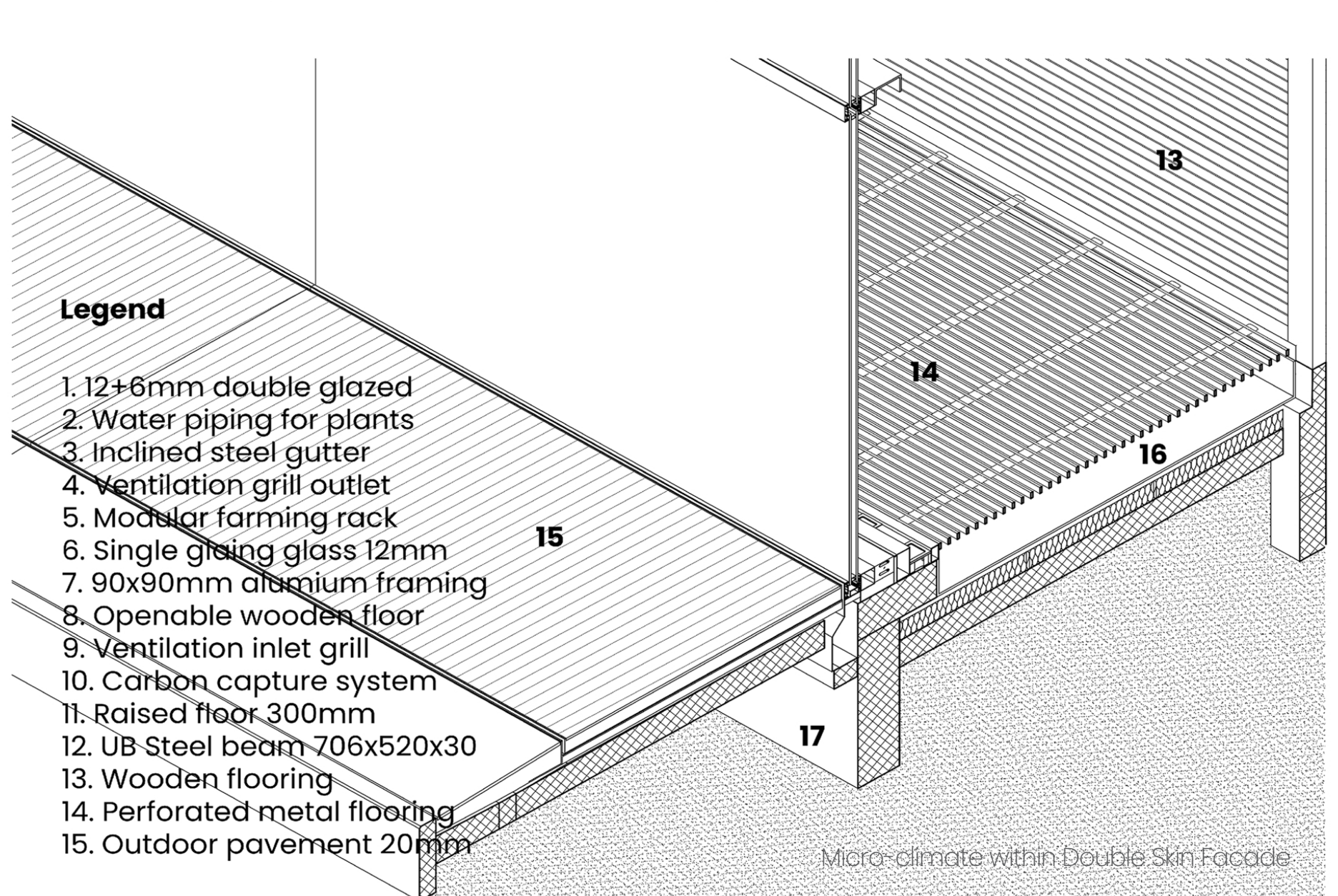
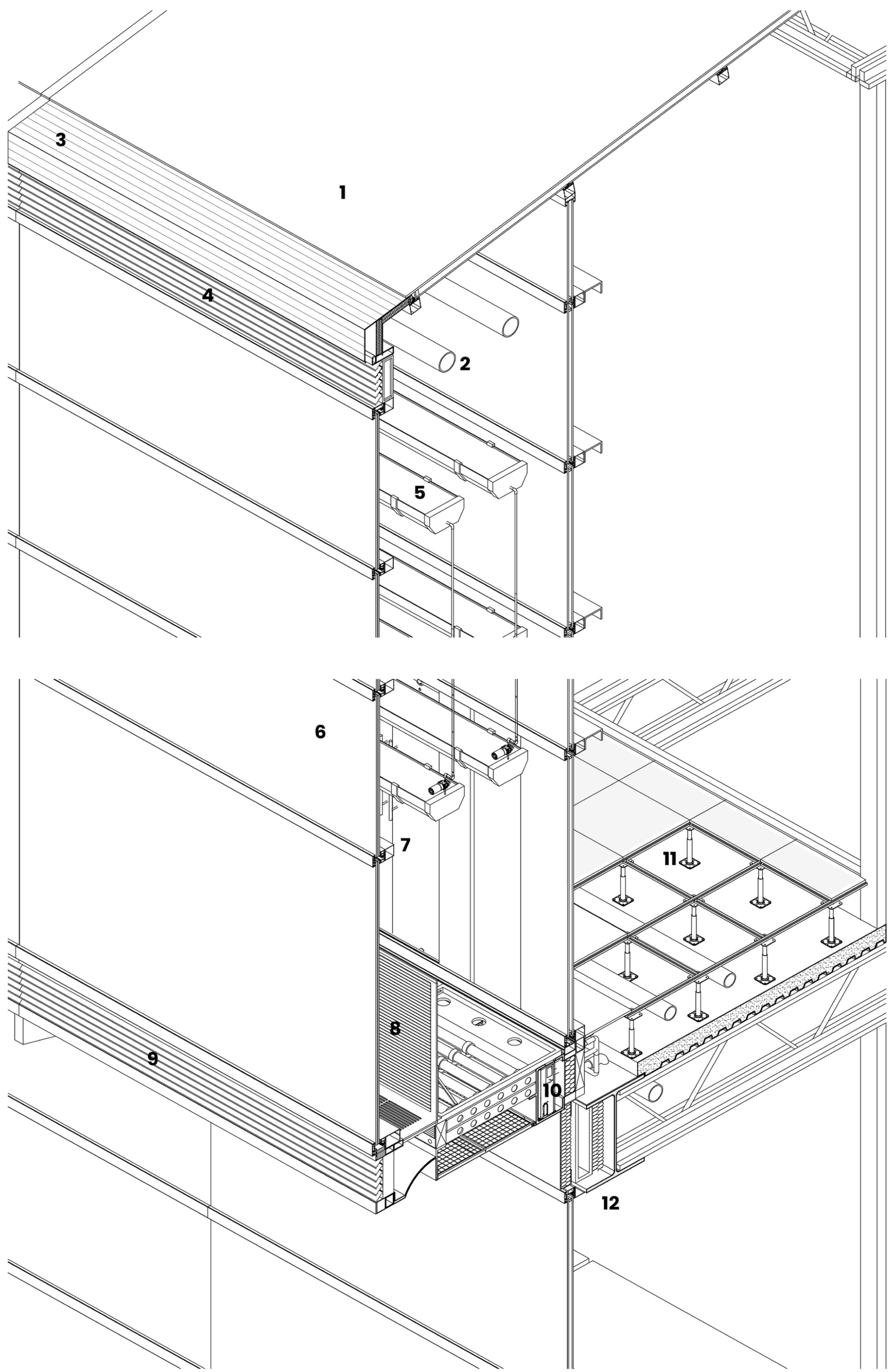


Transparency to the Public



Perspective Section of the Central Botanical Garden





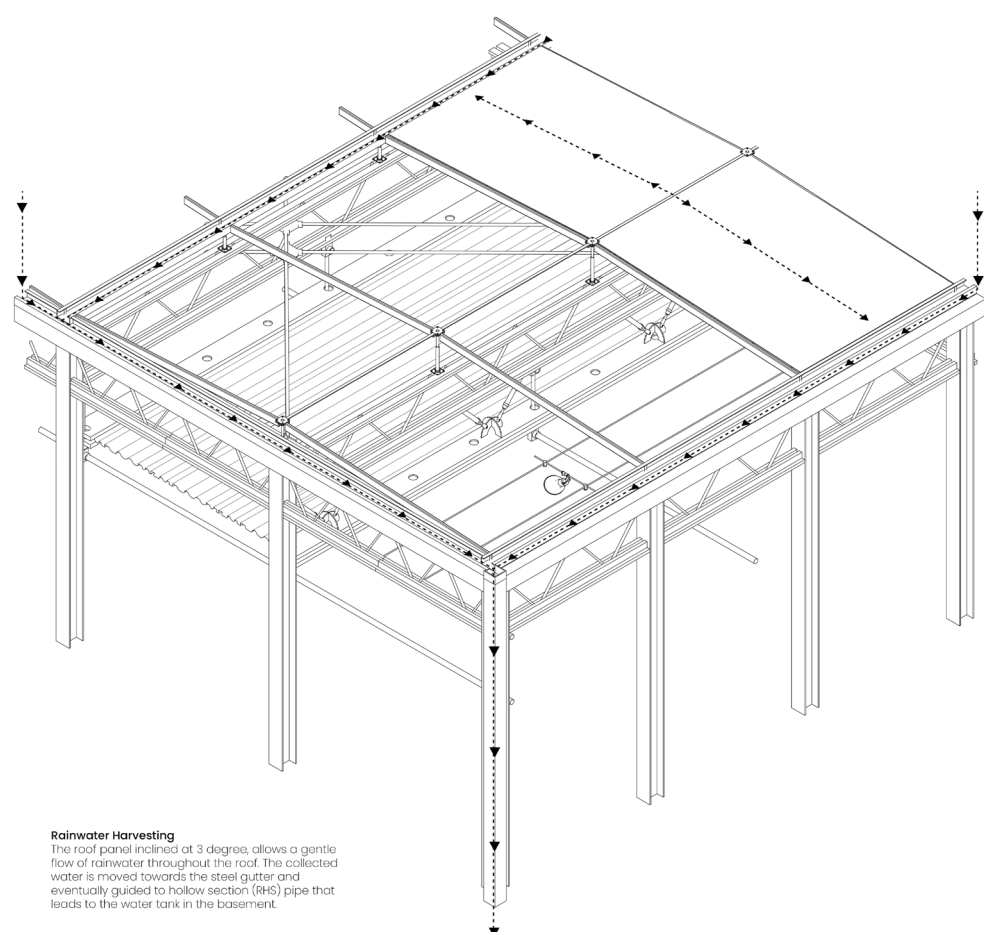
**Legend**

- 1. 12+6mm double glazed
- 2. Water piping for plants
- 3. Inclined steel gutter
- 4. Ventilation grill outlet
- 5. Modular farming rack
- 6. Single glazing glass 12mm
- 7. 90x90mm aluminium framing
- 8. Openable wooden floor
- 9. Ventilation inlet grill
- 10. Carbon capture system
- 11. Raised floor 300mm
- 12. UB Steel beam 706x520x30
- 13. Wooden flooring
- 14. Perforated metal flooring
- 15. Outdoor pavement 20mm

Micro-climate within Double Skin Facade



Transparency to the Public

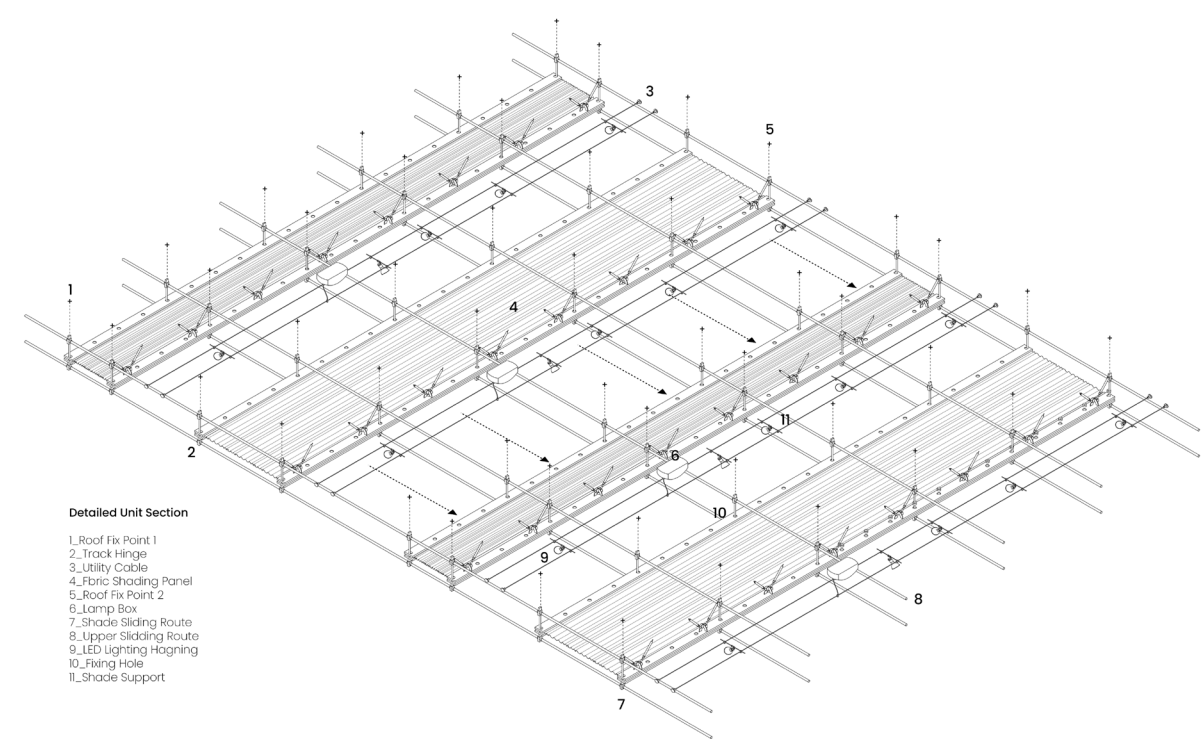


**Capillary Harvesting**  
The roof panel is inclined at 3 degrees, allowing a gentle slope of rainwater through the roof. The capillary water is channelled through the steel gutter and down to a network of pipes in the steel gully. The water is then guided to a water tank in the basement that feeds to the water tanks in the basement.

**1. Harvesting Water Through the Roof**

The roof glazing of the research space is meticulously designed with a slight incline of approximately three degrees. This subtle inclination facilitates the efficient movement of water towards the edges of the roof.

At these edges, U-shaped metal plates are installed to guide the water into a hollow-section pipe system. This system effectively channels the water down to a sophisticated water tank and filtration system located in the basement of the facility. The harvested water plays a crucial role in supporting the research center's operations. Not only is it integral to various research processes and services, but it also provides essential hydration for the plants in the subtropical garden area. Additionally, this water is used for the irrigation system that sustains the crop areas, ensuring optimal humidity levels and cooling for the diverse plant species cultivated within the facility. This self-sufficient water management system exemplifies the center's commitment to sustainability and efficient resource utilization.



**Detailed Unit Section**  
1. Roof to Panel 1  
2. Roof to Panel 2  
3. Glass Glazing Panel  
4. Glass Glazing Panel  
5. Roof to Panel 2  
6. Glass Glazing Panel  
7. Glass Glazing Panel  
8. Glass Glazing Panel  
9. Glass Glazing Panel  
10. Glass Glazing Panel  
11. Glass Glazing Panel  
12. Glass Glazing Panel

**2. Climate Control Shading System**

The research center employs a sophisticated climate control system. This system integrates a retractable shading feature specifically designed to prevent overheating within the crop areas, which are particularly vulnerable due to the extensive glazing. The retractable shading system is an essential component for maintaining an optimal growing environment, especially for sensitive crops such as leafy vegetables. These plants require precise control over exposure to direct sunlight and temperature to thrive. The shading system helps mitigate the risk of overheating, ensuring that the plants receive the right amount of light and warmth without being subjected to harmful excesses.

The shading system comprises four automated units, each individually controlled to adapt to varying external conditions. This flexibility allows the system to respond dynamically to changes in weather, sunlight intensity, and temperature throughout the day. By adjusting the shades in real-time, the system ensures that the indoor climate remains stable and conducive to plant growth for the success of the research.



View from the Central Entrance Garden



View from the Central Entrance Garden