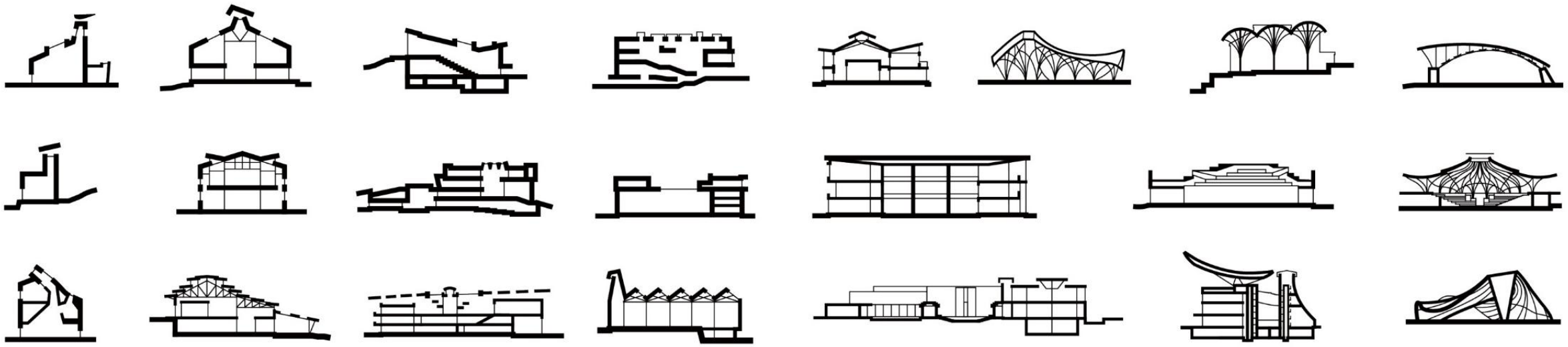


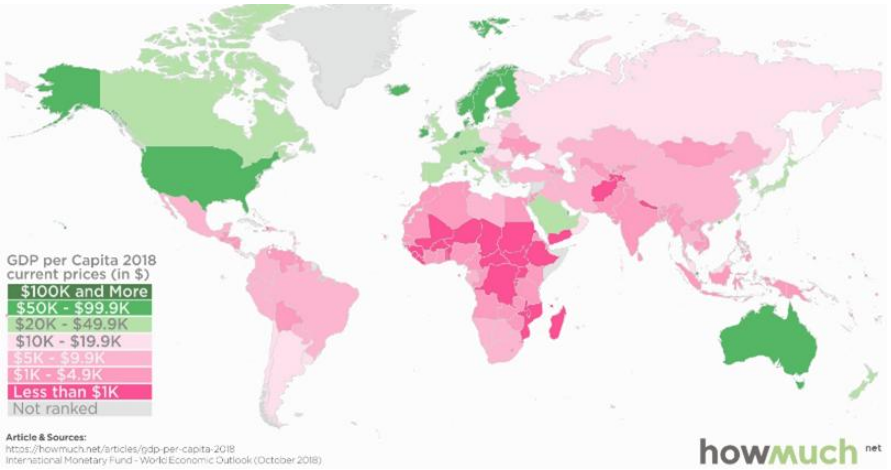
Form, Function, and Structure: Experimental Design with Bamboo and Timber

Yehao Song

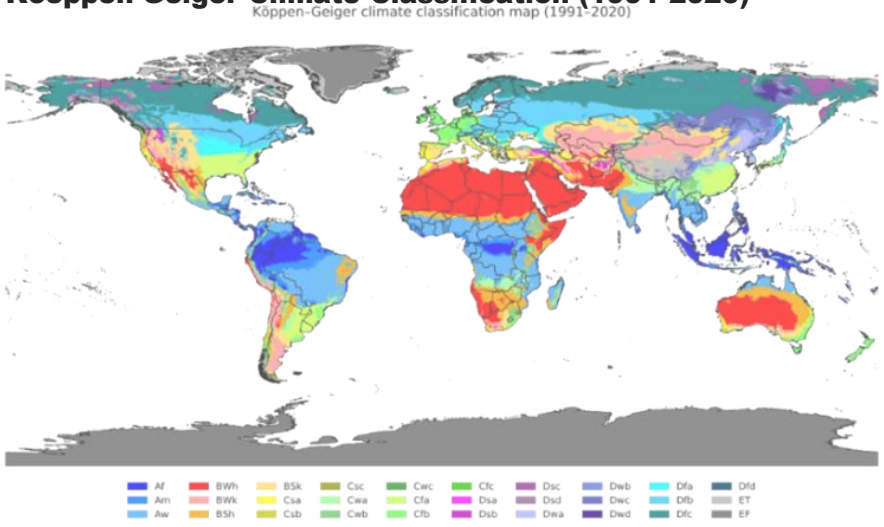
Head of the Department of Architecture, Tenure Professor, Tsinghua University
Director of SUP Atelier

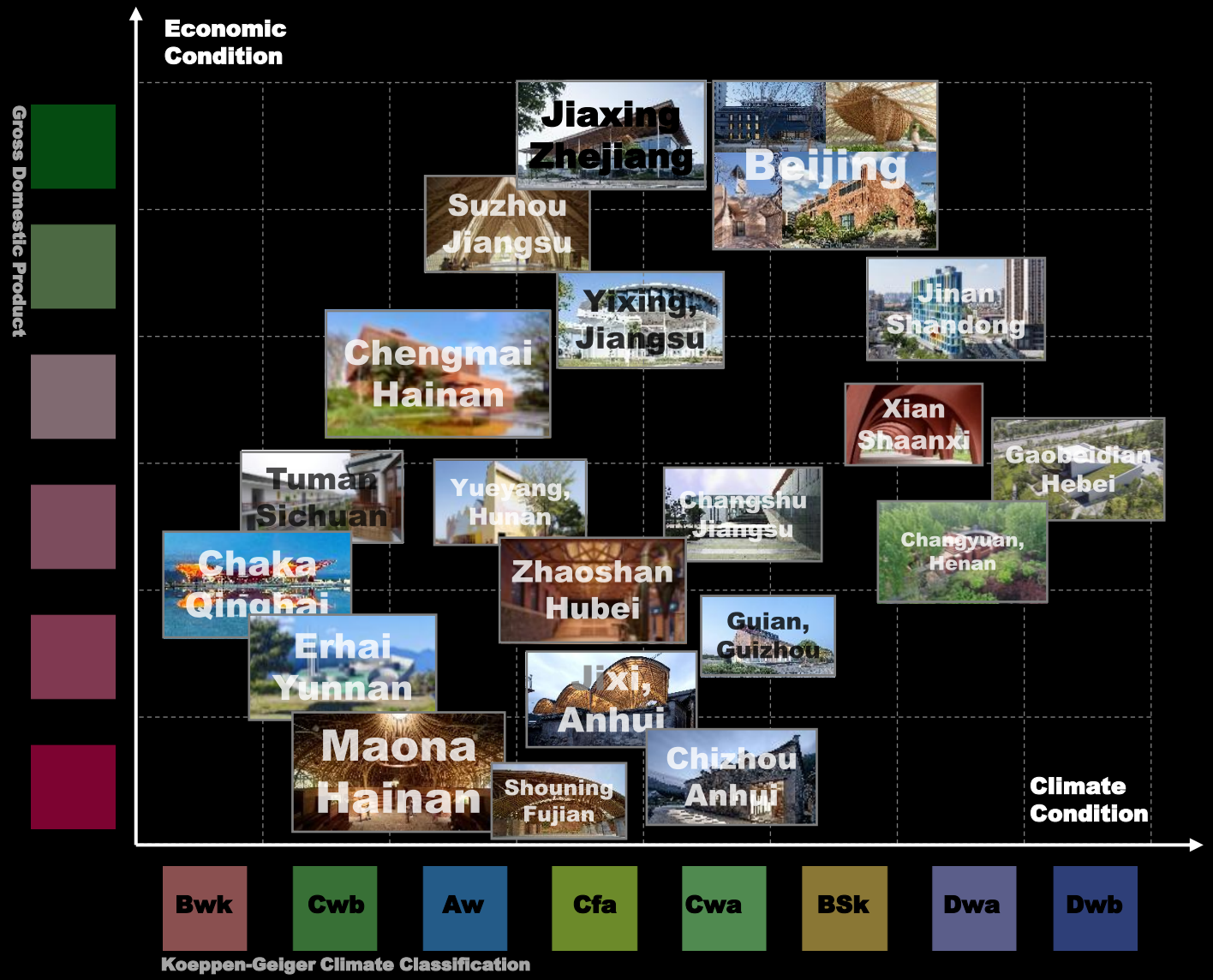
2026.10

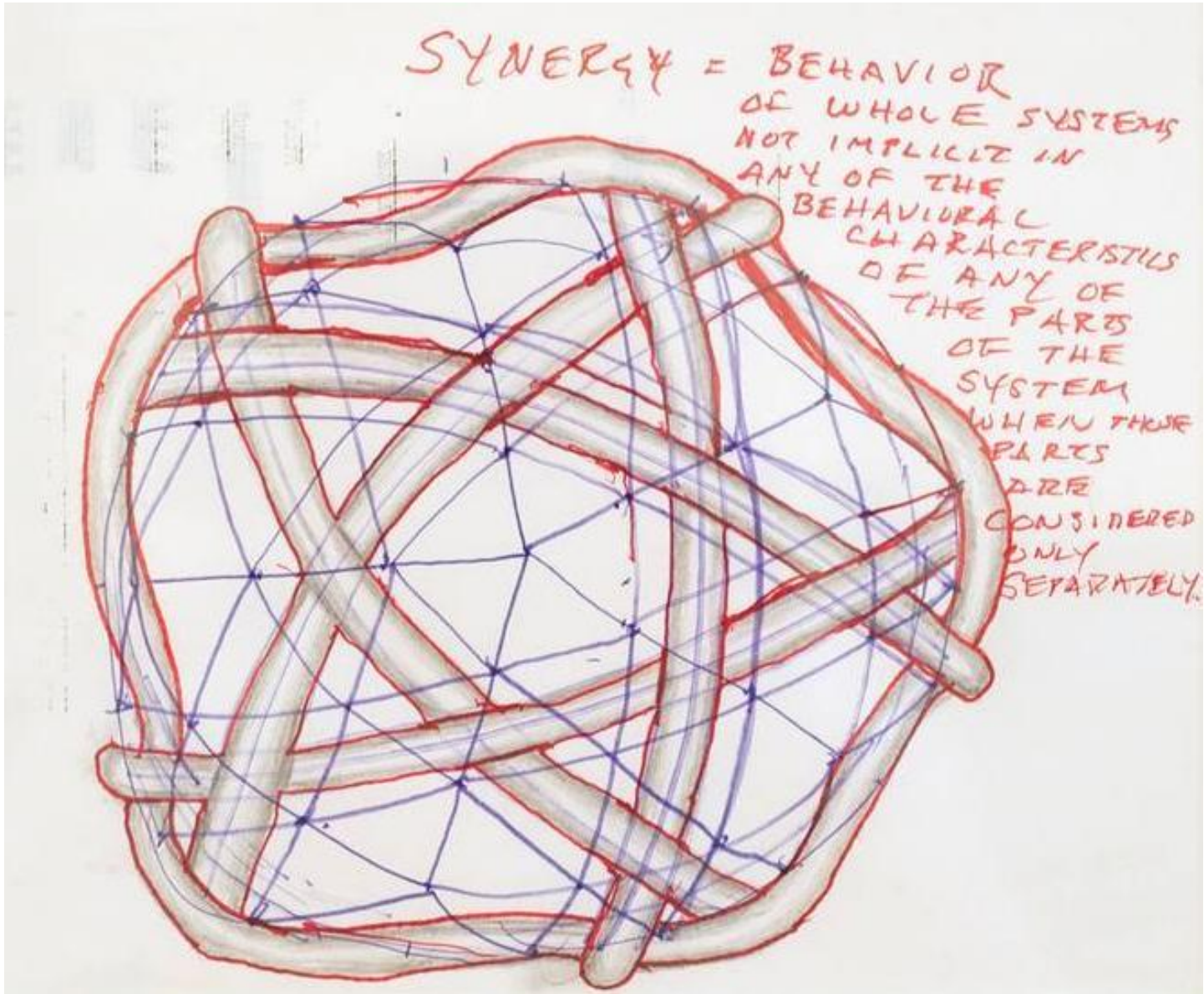
Gross Domestic Product (GDP) per Capita (2018)



Koeppen-Geiger Climate Classification (1991-2020)







Sketch by Buckminster Fuller illustrating synergy (https://shorturl.at/cEHQ4)

“Synergy means behavior of whole systems unpredicted by the behavior of their parts taken separately.”

Fuller, Buckminster. Synergetics: Explorations in the Geometry of Thinking (Macmillan Publishing Co. Inc. 1975, 1979). 100.00 Synergy, 900.00 Modelability.

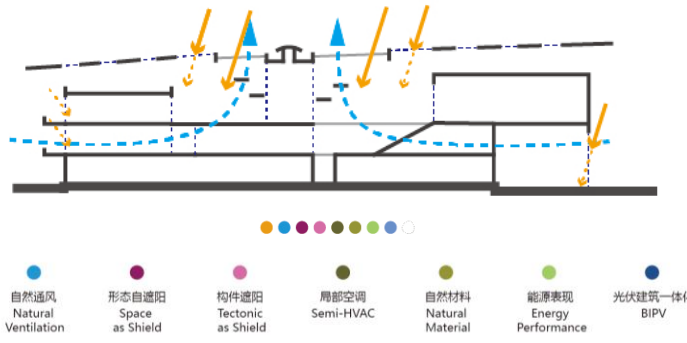


Model workshop at Thomas Herzog Architekten
(Herzog Archive)

Archetype : Scientific approach of sustainability in architectural design

Synergy : Holistic Design Strategies in reducing building carbon emissions

Material : Innovation design of low carbon and reused local materials



Space

Minimized Conditioned Space,
Maximized Semi-Outdoor Urban Life

Construction

Design–Fabrication–Installation

Environment feedback

User feedback



嘉兴高铁新城文化中心

Jiaxing HRNT Cultural Center

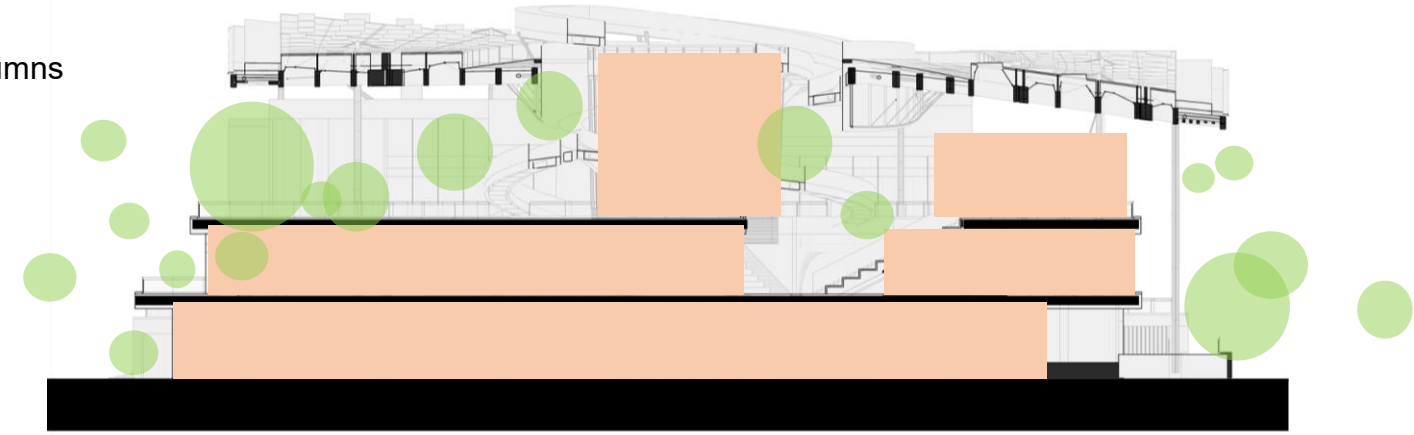
2025


風来四面卧當
中壽道士

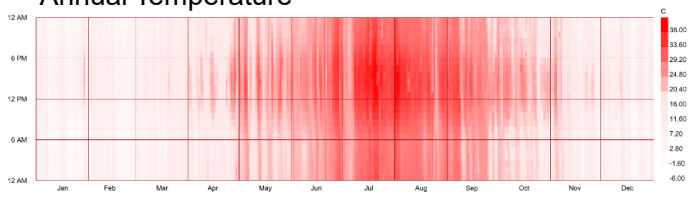


Site Climate Conditions and Overall Layout

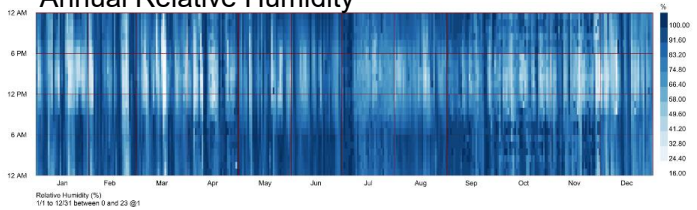
- Climate Zone: Hot Summer and Cold Winter (Zone II)(Köppen–Geiger: Cfa)
- Climate Type: Northern subtropical monsoon climate
- Seasonal Pattern: Long summers and winters; short springs and autumns
- Climate Features: Mild, humid, abundant sunshine and rainfall
- Annual Precipitation: 1,145.4 mm; ~60% from May to September



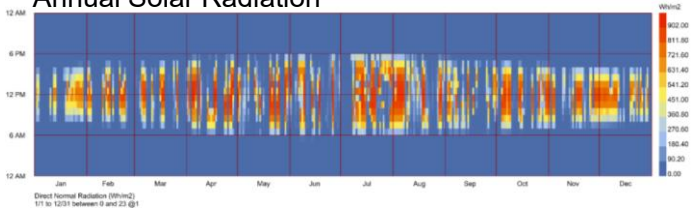
Annual Temperature



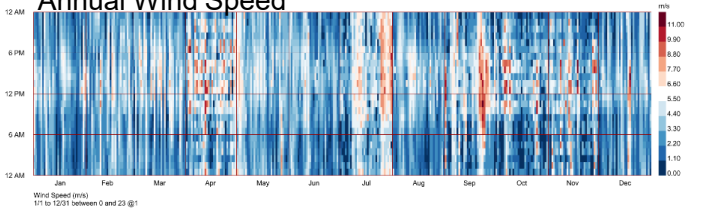
Annual Relative Humidity

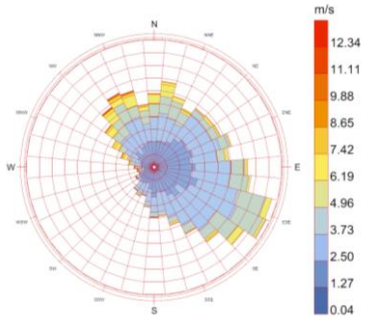


Annual Solar Radiation



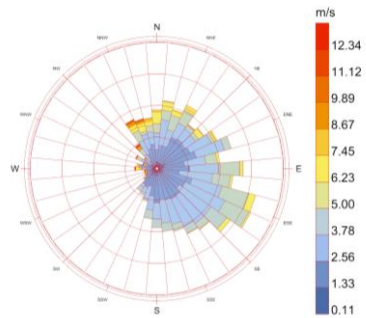
Annual Wind Speed





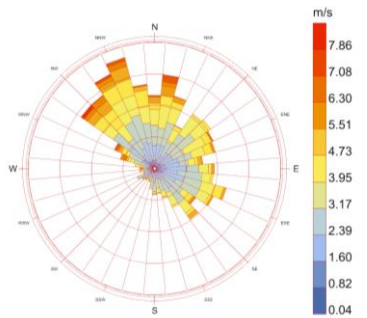
Wind Speed (m/s)
city: Jiaxing
country: China
source: ERA5 (ECMWF)
time-zone: 8.0
period: 1/1 to 12/31 between 0 and 23 @1
Calm for 0.0% of the time = 0 hours.
Each closed polyline shows frequency of 0.6% = 50 hours.

Annual Wind Rose



Wind Speed (m/s)
city: Jiaxing
country: China
source: ERA5 (ECMWF)
time-zone: 8.0
period: 6/1 to 9/30 between 0 and 23 @1
Calm for 0.0% of the time = 0 hours.
Each closed polyline shows frequency of 1.7% = 50 hours.

Summer Wind Rose (E/SE)

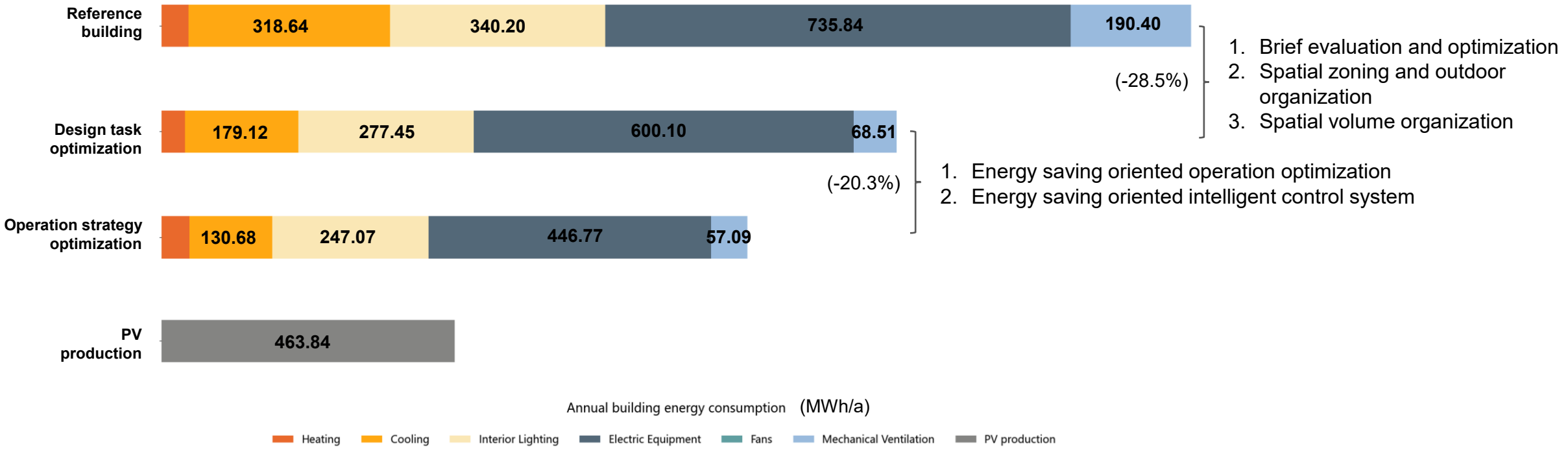


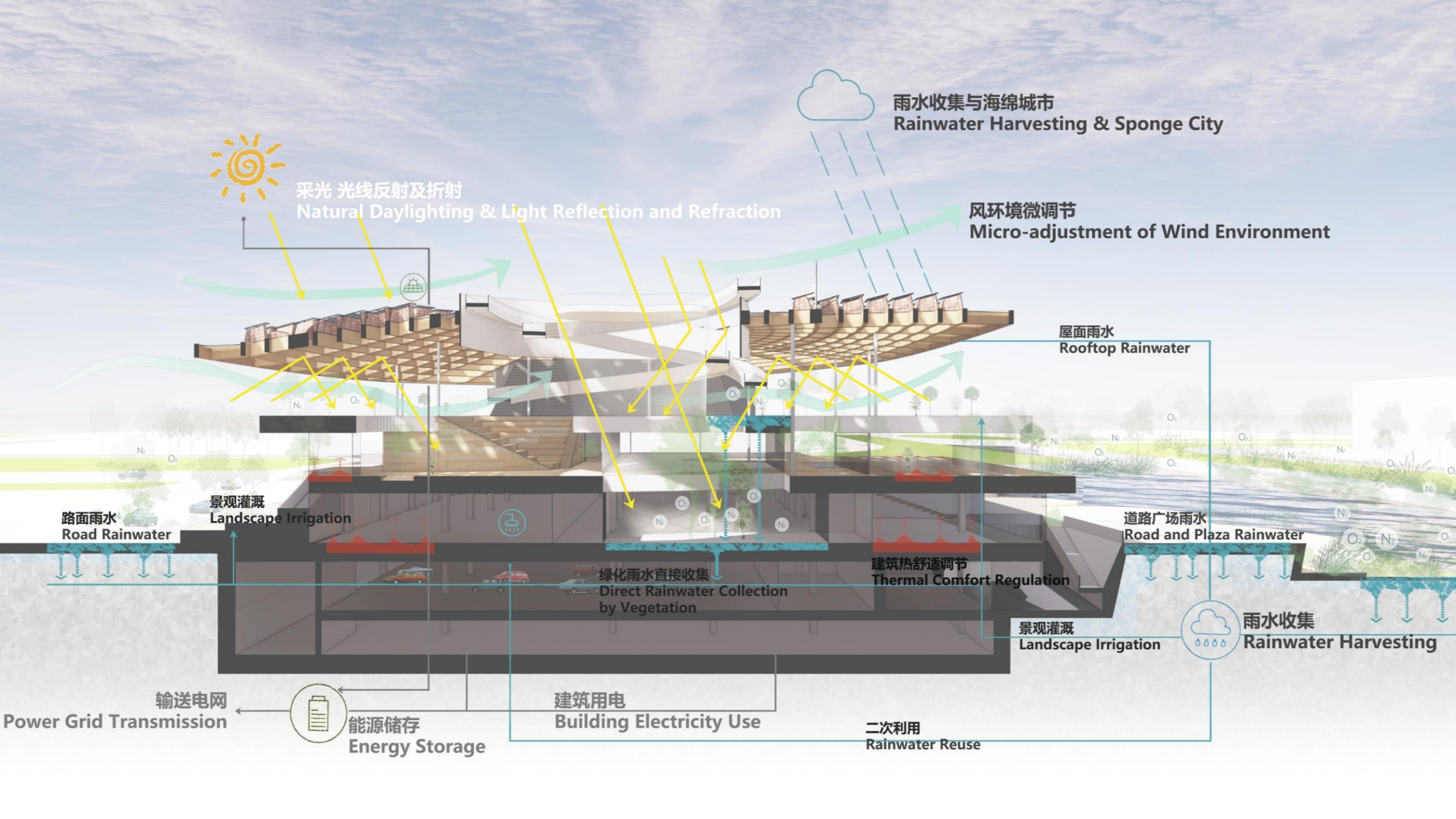
Wind Speed (m/s)
city: Jiaxing
country: China
source: ERA5 (ECMWF)
time-zone: 8.0
period: 11/1 to 2/28 between 0 and 23 @1
Calm for 0.0% of the time = 0 hours.
Each closed polyline shows frequency of 1.7% = 50 hours.

Winter Wind Rose (N/NW)

Design Strategy Decomposition		
Space Organization Design	**Integrated Design of Construction Systems**	**Comprehensive Design of Equipment System**
Space zoning and outdoor organization	High performance building envelope structure	PEDF system
Comfort optimization of semi-outdoor space combining natural ventilation and daylighting	BIPV roof system	Energy efficiency of equipment
Integrated design of site landscape	Low carbon structure and green material selection	Energy Saving Operation Strategy
	BIM Technology and Assembly Applications	Intelligent control system

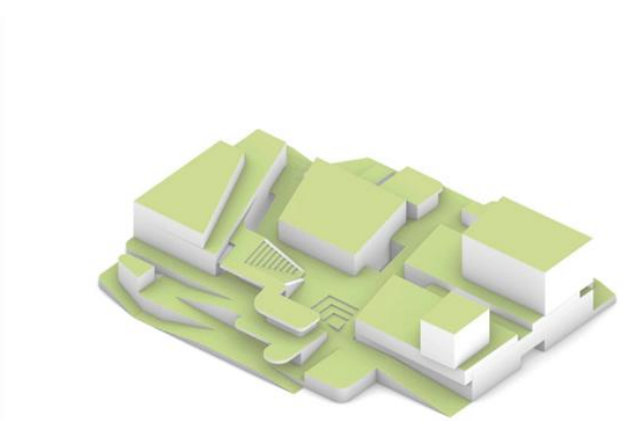
Overall strategy and strategy energy-saving contribution prediction

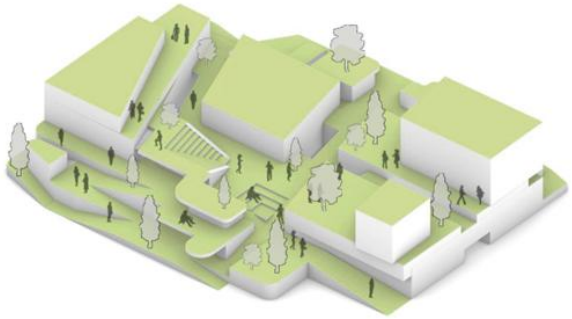


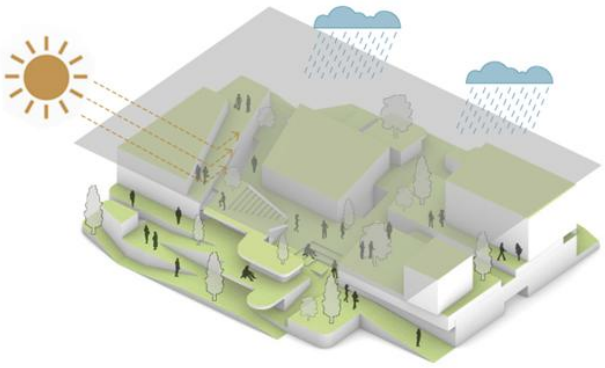

雨水收集与海绵城市
Rainwater Harvesting & Sponge City
采光 光线反射及折射
Natural Daylighting & Light Reflection and Refraction
风环境微调节
Micro-adjustment of Wind Environment
屋面雨水
Rooftop Rainwater
路面雨水
Road Rainwater
景观灌溉
Landscape Irrigation
绿化雨水直接收集
Direct Rainwater Collection
by Vegetation
建筑热舒适调节
Thermal Comfort Regulation
道路广场雨水
Road and Plaza Rainwater
景观灌溉
Landscape Irrigation
雨水收集
Rainwater Harvesting
输送电网
Power Grid Transmission
能源储存
Energy Storage
建筑用电
Building Electricity Use
二次利用
Rainwater Reuse

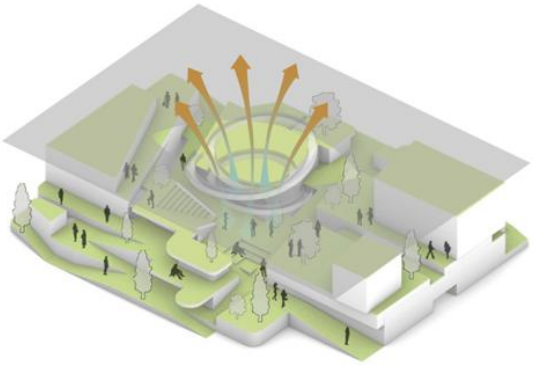
Space

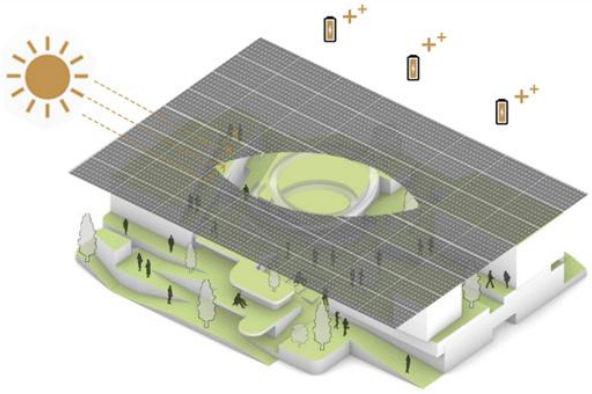
Minimized Conditioned Space,
Maximized Semi-Outdoor Urban Life









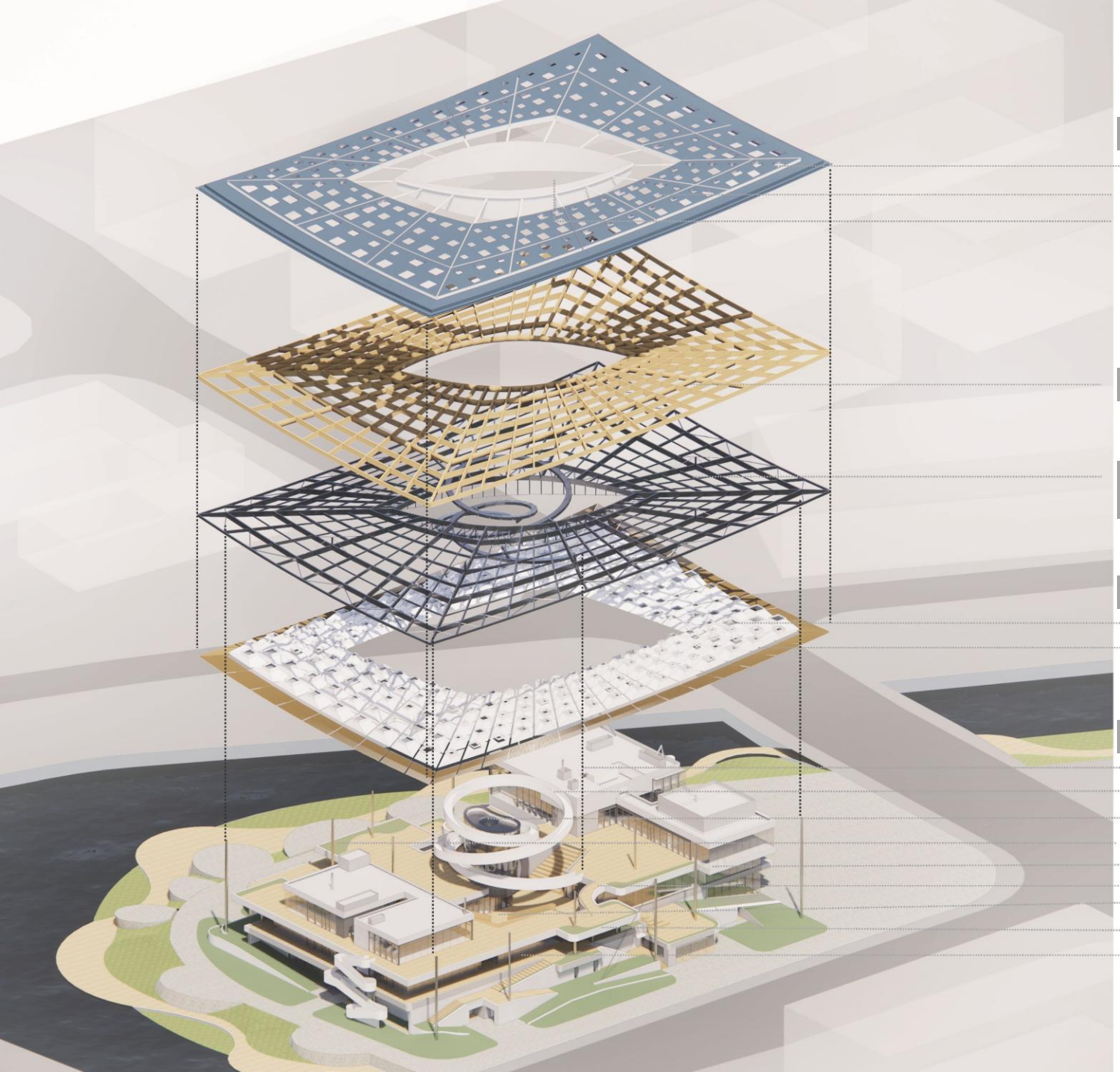












PV CANOPY

屋面单元

曲面多媒体投影幕

TIMBER TOOF TRUSS

STEEL STRUCTURE ROOF TRUSS

SUSPENDED CEILING

白色砂岩吸音板吊顶

木椽吊顶

MAIN BUILDING

剧场和放映厅

户外参观坡道

户外信息亭

沿河滨水自然湿地景观及活动平台

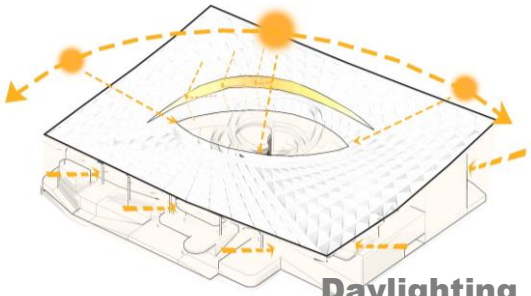
会议办公区

商业内街

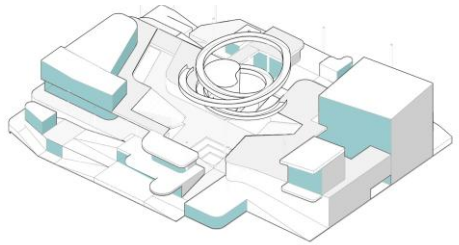
户外中庭

户外景观坡道及商店

立体绿化活动平台



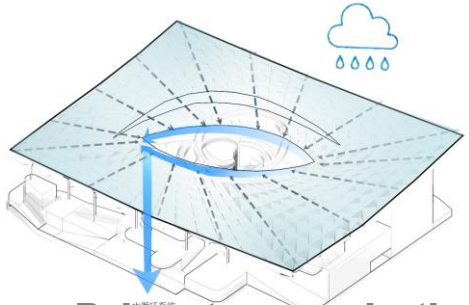
Daylighting



Ventilation Organization



Tridimensional Greening



Rainwater organization

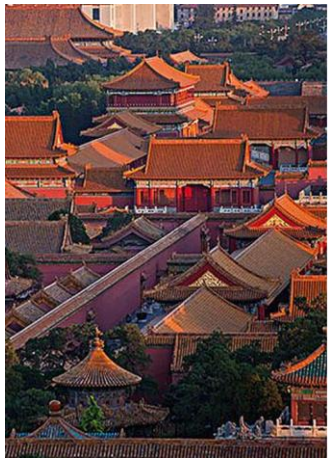
Integration of passive strategies

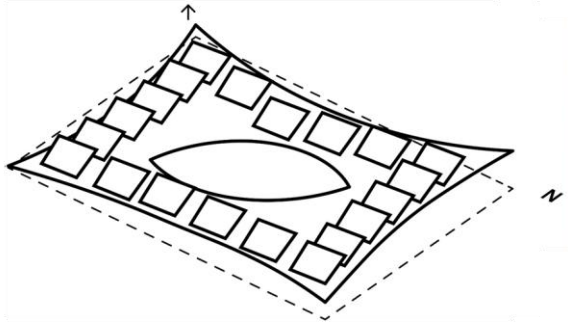
Semi-outdoor space

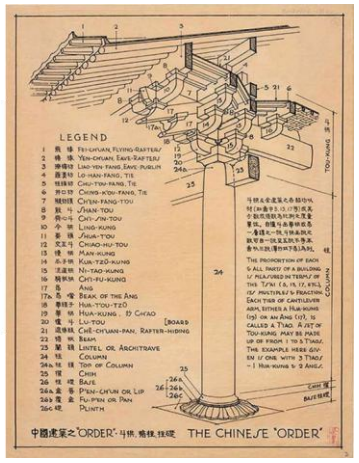
Interactive Form-Performance Optimization for Outdoor Thermal Comfort





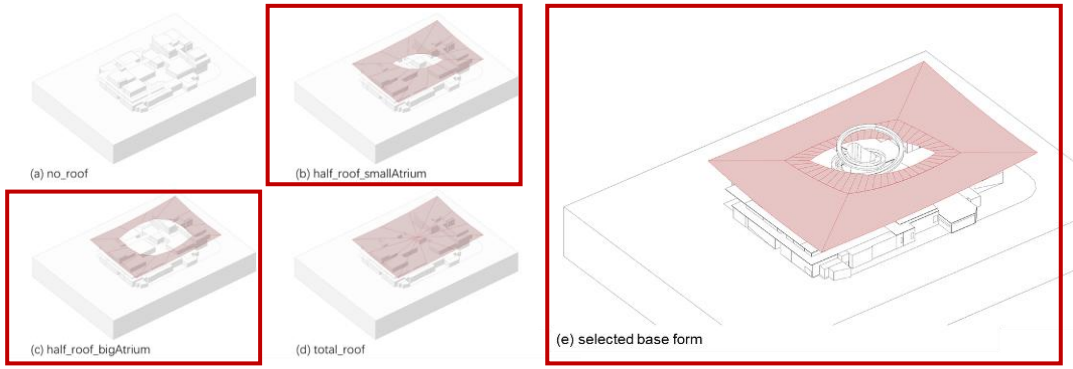


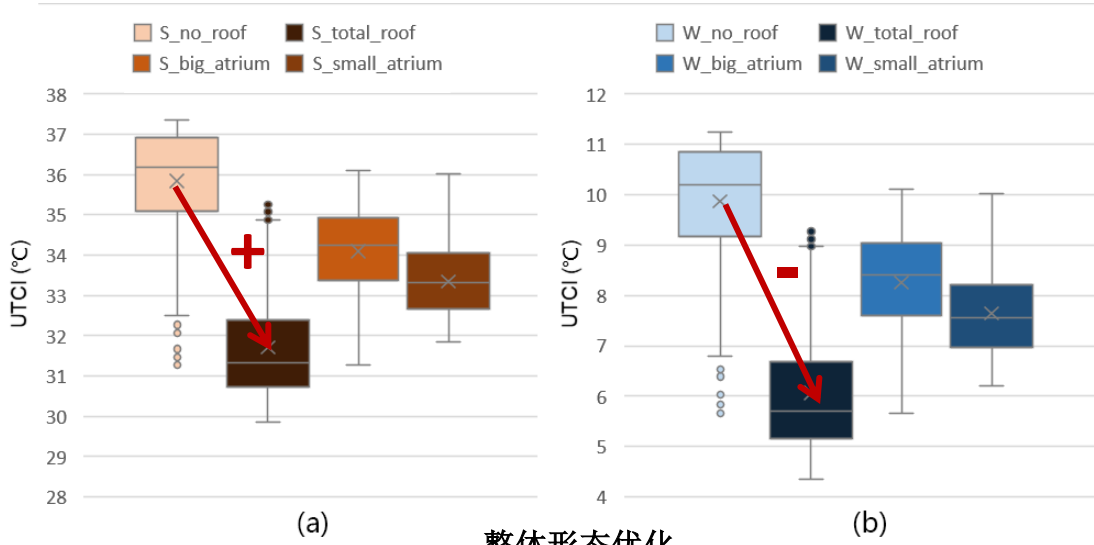




中国古代飞檐的启发和隐喻

Inspiration and Metaphor from Traditional Chinese Flying Eaves





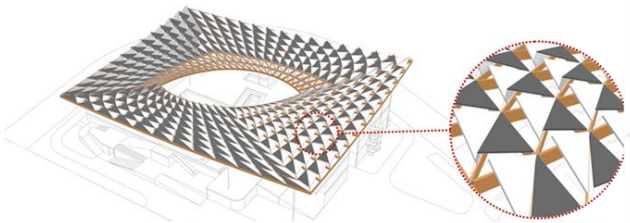
整体形态优化

Overall Morphological Optimization

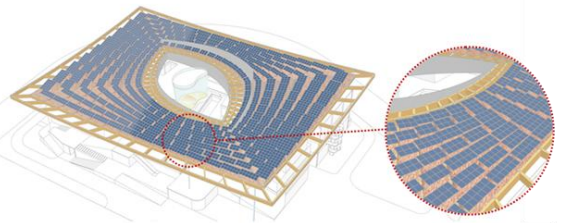
Optimization target: maximizing winter UTCI and minimizing summer UTCI

Semi-outdoor space

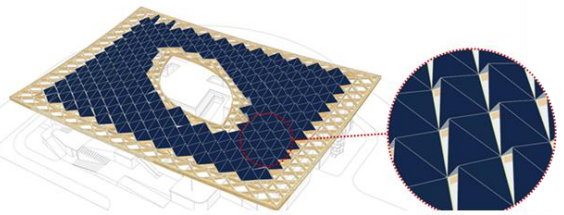
Interactive Form-Performance Optimization for Outdoor Thermal Comfort



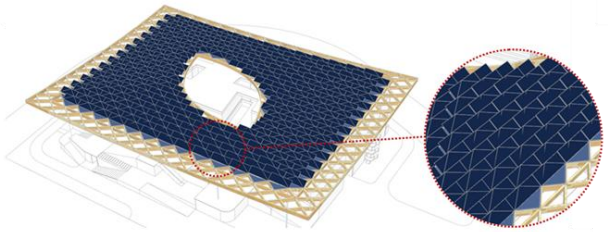
Triangular Scale Roof Unit Pattern



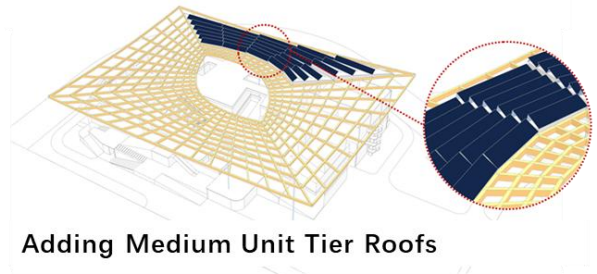
Square Platform Skylight Unit Mode



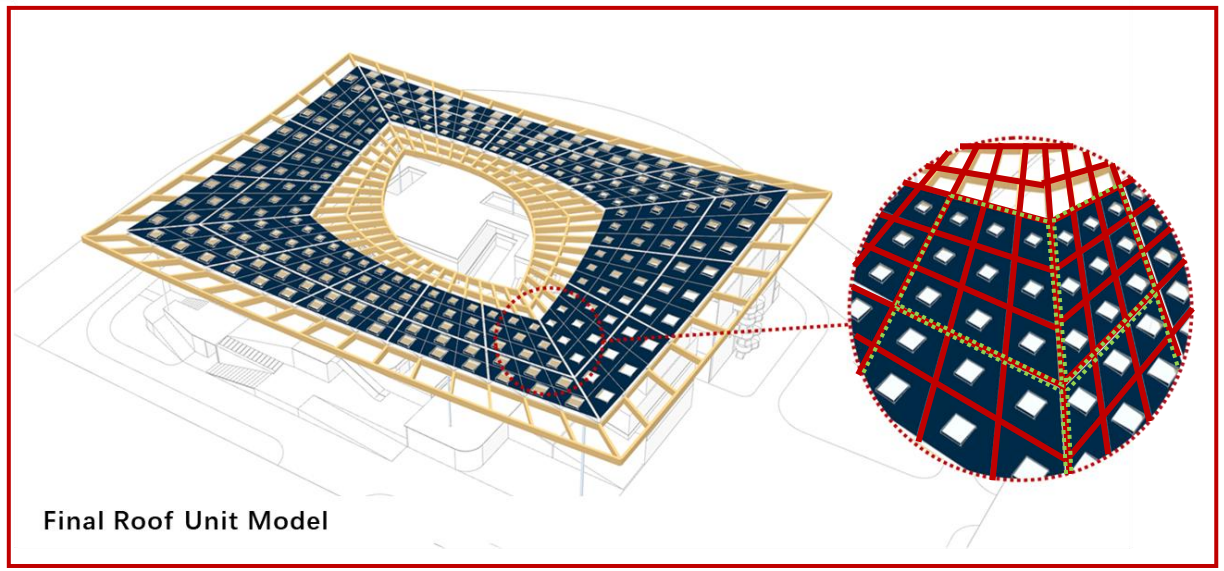
Parallel Divided Unit Roof Attempt 1



Parallel Divided Unit Roof Attempt 2



Adding Medium Unit Tier Roofs



Final Roof Unit Model

The overall roof canopy base form

Space grids
The coherence and geometric logic of construction.

Unitized structure
Technical integrations, including construction, photovoltaics, drainage, etc.

Two-levels grids overlay
Independent control of the space beneath and the fifth façade. Uniform control over the size and type of grid units.

屋顶单元模式对比
Roof Module Pattern Comparison

Semi-outdoor space

Interactive Form-Performance Optimization for Outdoor Thermal Comfort

Visual comfort

- Natural Daylighting Performance in Non-Visual Task Spaces
- Daylighting Design Integrated with the Urban Context
- Daylighting Design Considering Specific Usage Scenarios

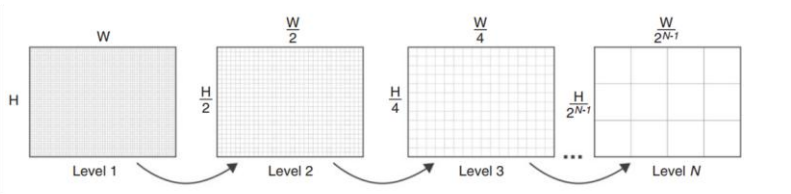
$$RAMMG = \frac{1}{N}\sum_{l=1}^{N}\bar{c}_l \quad (2)$$

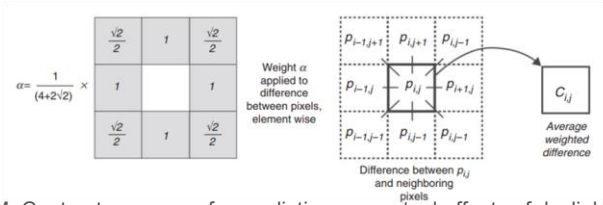
$$\bar{c}_l = \frac{1}{WH}\sum_{i=1}^{Wl}\sum_{j=1}^{Hl}\bar{c}_{i,j} \quad (3)$$

$$W_l = \frac{W_{l-1}}{2},\ H_l = \frac{H_{l-1}}{2} \quad (4)$$

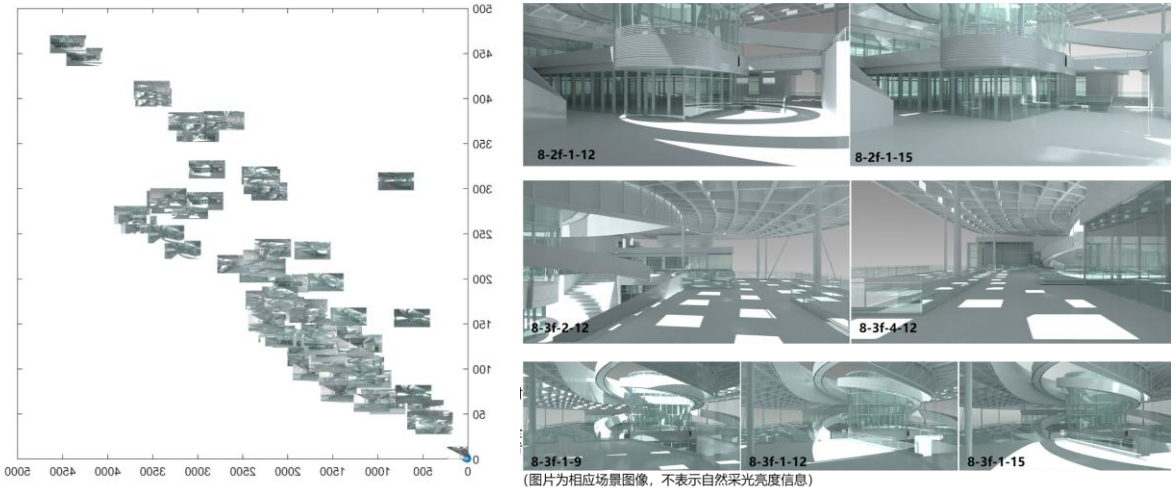
$$c_{i,j} = \sum_{k\in K_8}\alpha\left|p_{i,j} - p_k\right| \quad (5)$$

$$\alpha = \frac{1}{4+2\sqrt{2}}\begin{bmatrix}\frac{\sqrt{2}}{2} & 1 & \frac{\sqrt{2}}{2}\\ 1 & & 1\\ \frac{\sqrt{2}}{2} & 1 & \frac{\sqrt{2}}{2}\end{bmatrix} \quad (6)$$





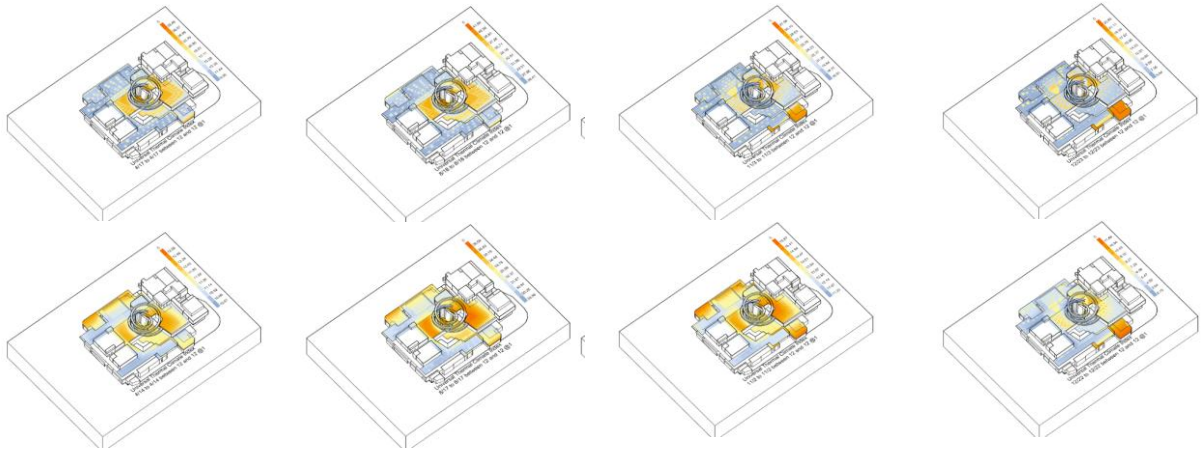
[1]Rockcastle S, Amundadottir M, Andersen M. Contrast measures for predicting perceptual effects of daylight in architectural renderings. Lighting Research & Technology. 2017;49(7):882-903.



(图片为相应场景图像，不表示自然采光亮度信息)

Thermal comfort

Thermal Assessment and Design Feedback: Performance of Morphological Strategies under Different Weather Conditions



typical sunny day (spring) 4.17 typical sunny day (summer) 8.18 typical sunny day (autumn) 11.3 typical sunny day (winter) 12.23
typical cloudy day (spring) 4.14 typical cloudy day (summer) 8.17 typical cloudy day (autumn) 11.4 typical cloudy day (winter) 12.22

form operations	Winter		Summer		Autumn		Winter	
	Sunny	Cloudy	Sunny	Cloudy	Sunny	Cloudy	Sunny	Cloudy
Overall Shading	-	-	+	+	-	-	-	-
Atrium Opening	+	+	-	-	+	+	+	+
Canopy Skylight	+	O	O	O	+	O	+	O
+ for positive contribution; - for negative effect; O for no significant effect								














FIND BOOK



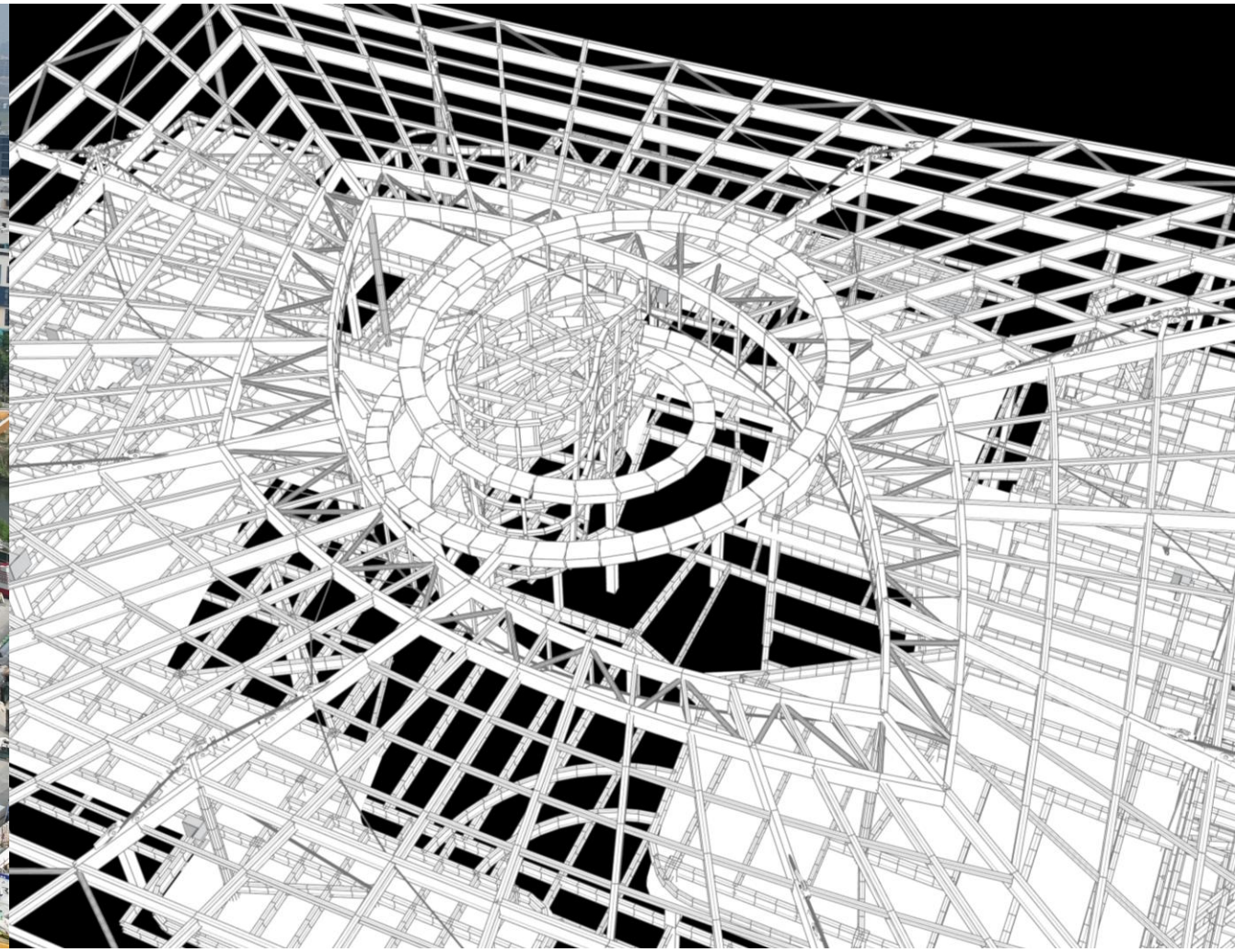


Construction

Design–Fabrication–Installation



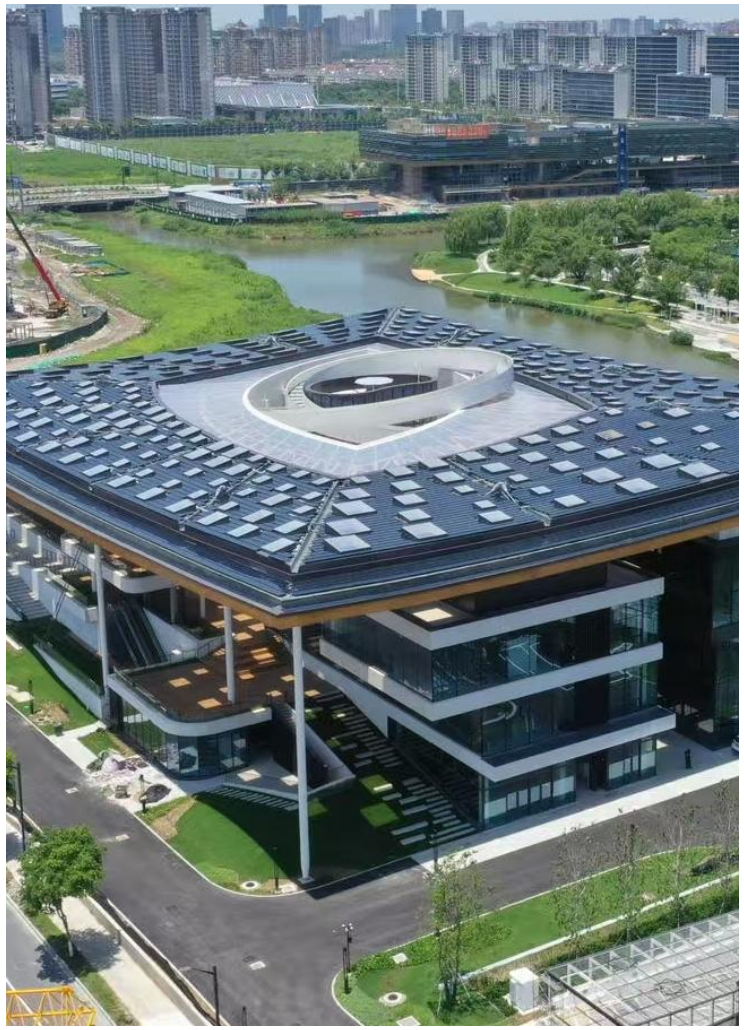
Roof-Truss Structure in Construction

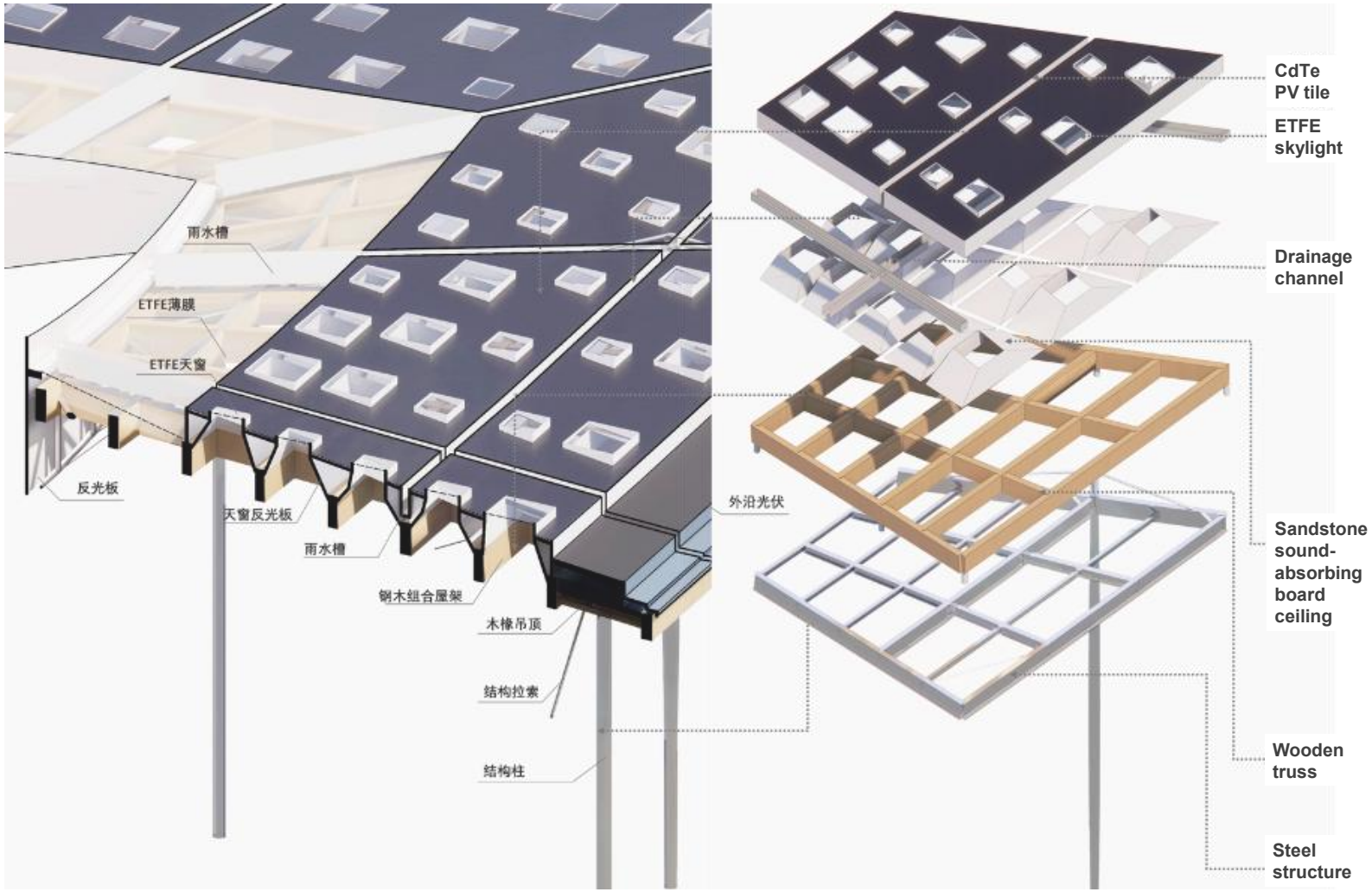


Structural Model

Parametric Design for Full-Process Coordination of Complex Surfaces

Integrated BIPV Roof: PV Installation, Structure, Rainwater, and Daylighting

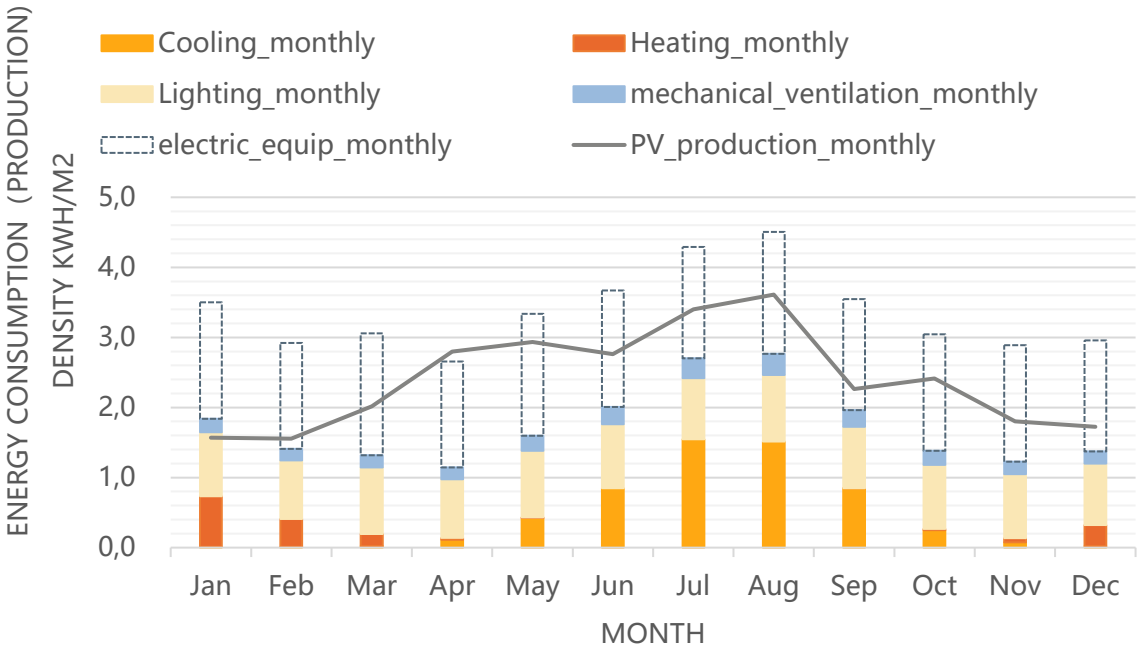




Conceptual Phase: Energy–Structure–Form Coordination for BIPV Design

Design

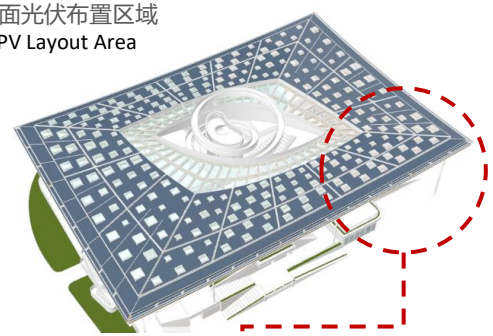
Concurrent Energy System Design



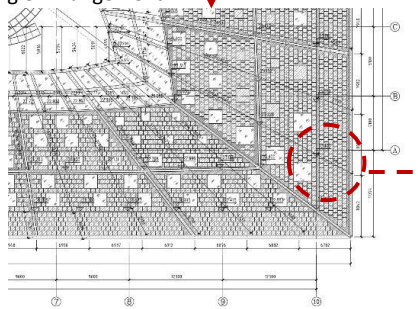
逐月建筑能量密度模拟
Building Energy Density Simulation by Month

3D Curved PV Form Integration

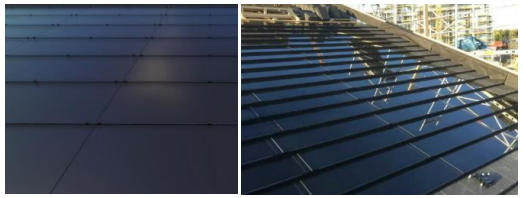
屋面光伏布置区域
PV Layout Area

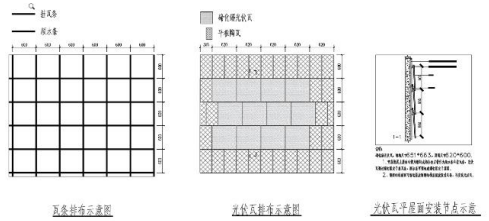


光伏瓦排布示意
PV Shingle Arrangement



碲化镉平板叠瓦
CdTe Flat Shingles





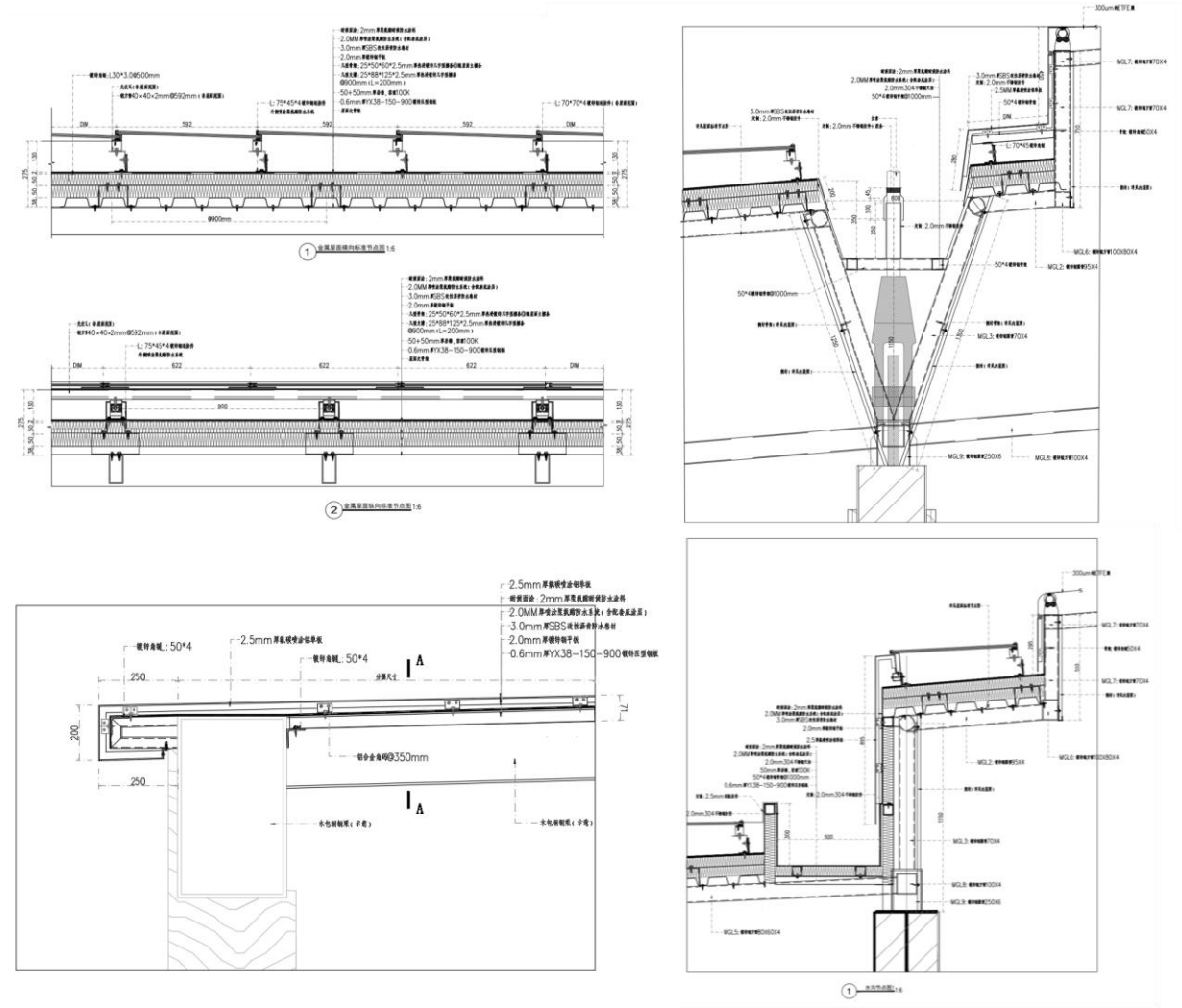
光伏瓦构造示意
PV Shingle Detail

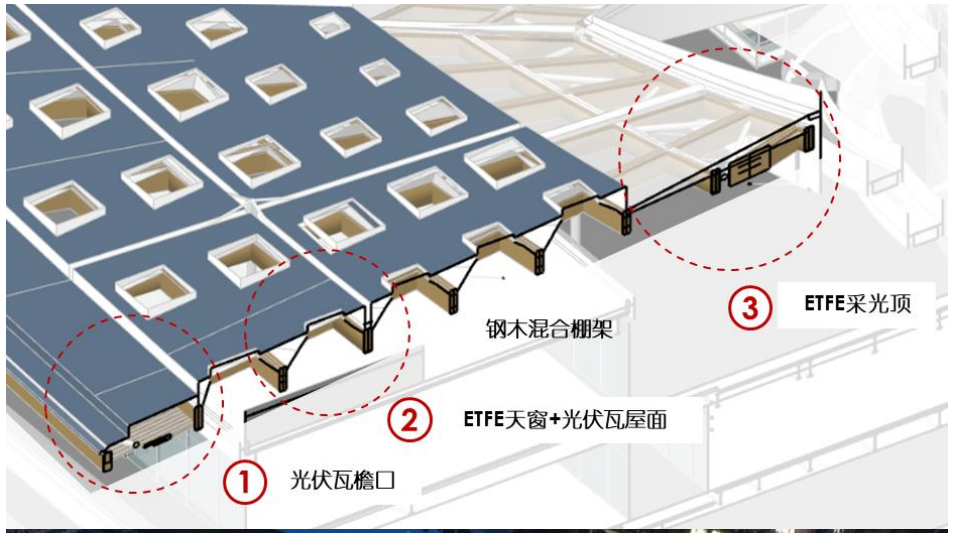
Integration of New Energy Components with Architecture

Design

BIPV Roof Skylights, Drainage, and Eaves Details

- **Roof Drainage**: Integrated circumferential and radial gutter system
- **Skylight Modules**: Square units in 1.2 m, 1.8 m, and 2.4 m sizes, with diffuse-reflecting light wells for uniform daylighting
- **ETFE Skylights**: Integrated high-transmittance ETFE membrane, eliminating conventional glass panel divisions





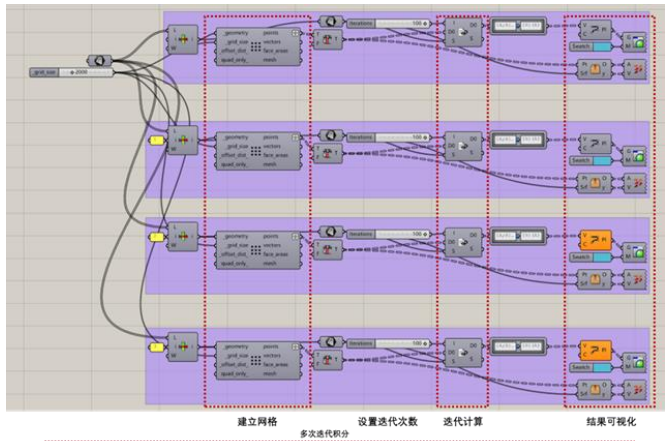


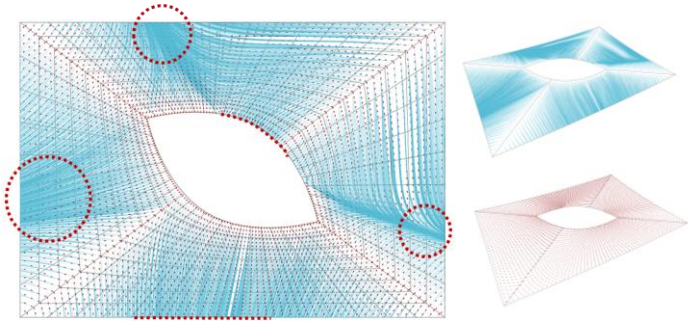
Roof Rainwater Drainage Optimization

Parametric optimization of roof slopes, flow paths, catchment areas, and drainage points.

Design

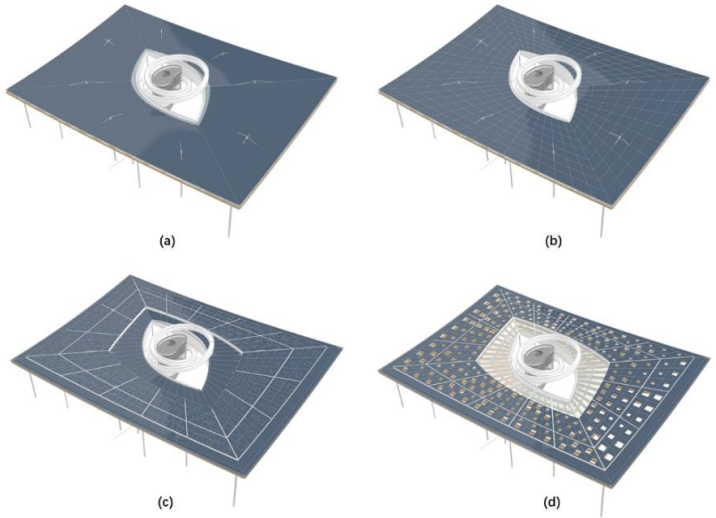
Roof Slope and Flow Direction Analysis

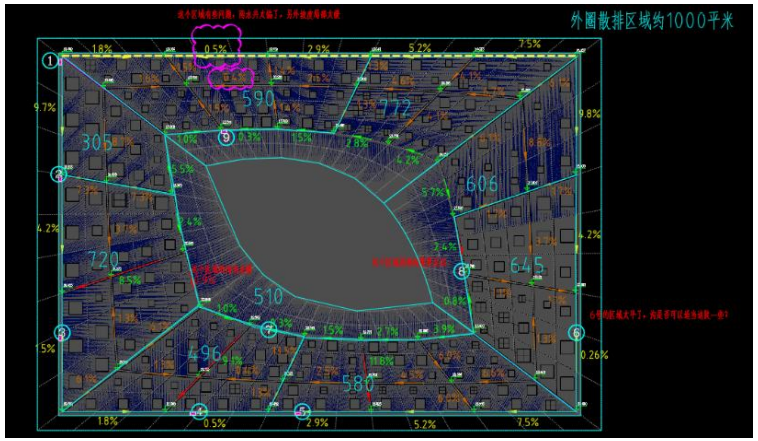




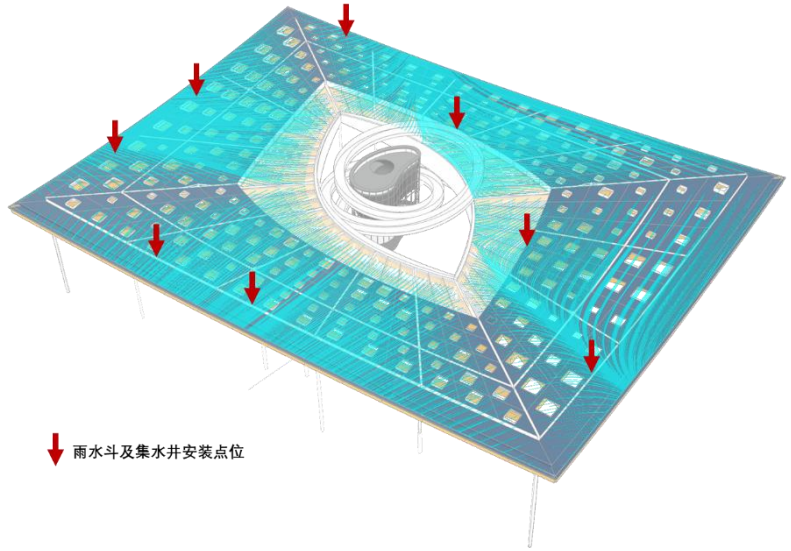
Rainwater Flow Simulation Logic and Algorithm

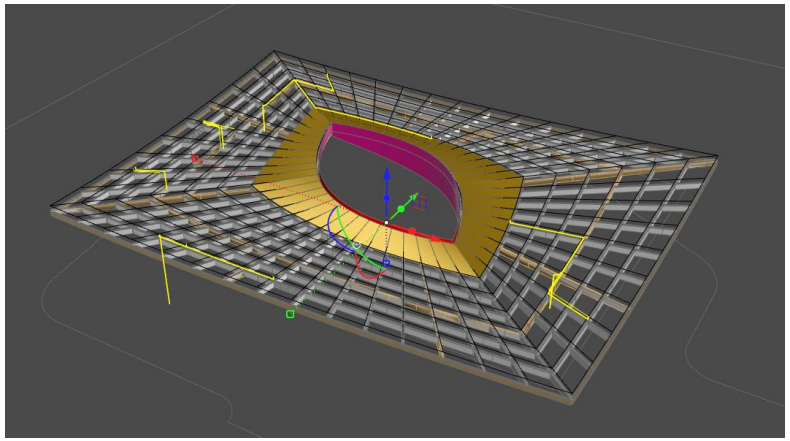
Catchment Area Delineation





Siphonic Drainage System Layout





Steel–Timber Components and Nodes:
Factory Fabrication with On-Site Connector Assembly

Fabrication

1. Components and Connection Testing
- Quality control of materials, fabrication, and bonding processes
- Structural analysis of steel–timber connections
- Prototype fabrication and strength testing to verify safety and durability

2. Factory Prefabrication
- Off-site prefabrication of composite steel–timber members
- Predefined connection points for efficient on-site assembly





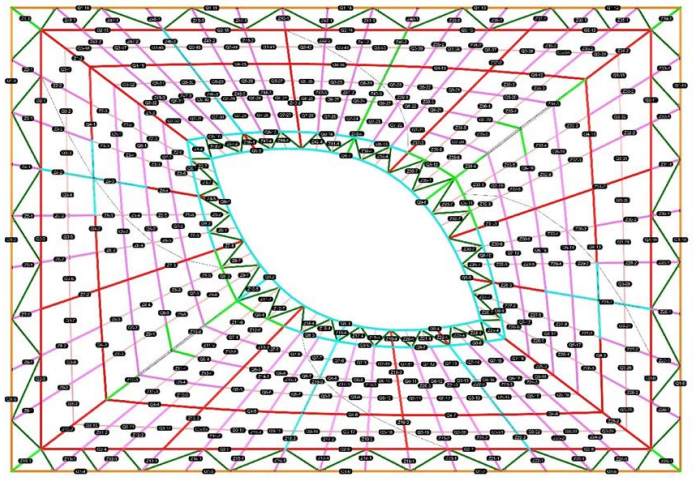
Steel–Timber Sample Test – Full-Scale (1:1)



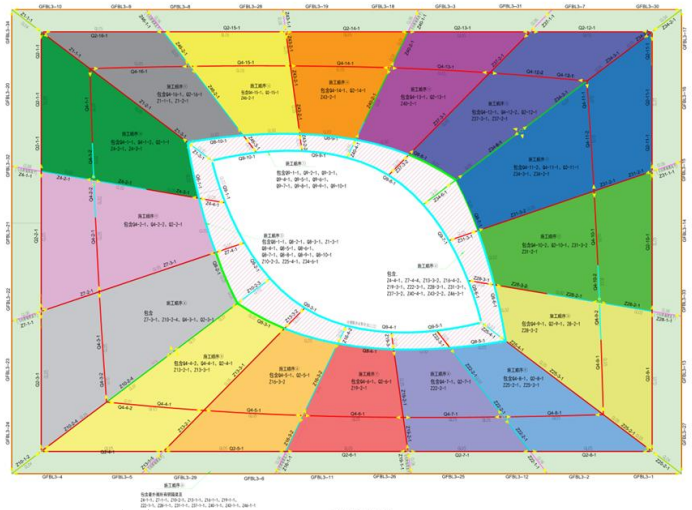
Connection Optimization – Half-Scale Node (1:2)

Efficient Installation

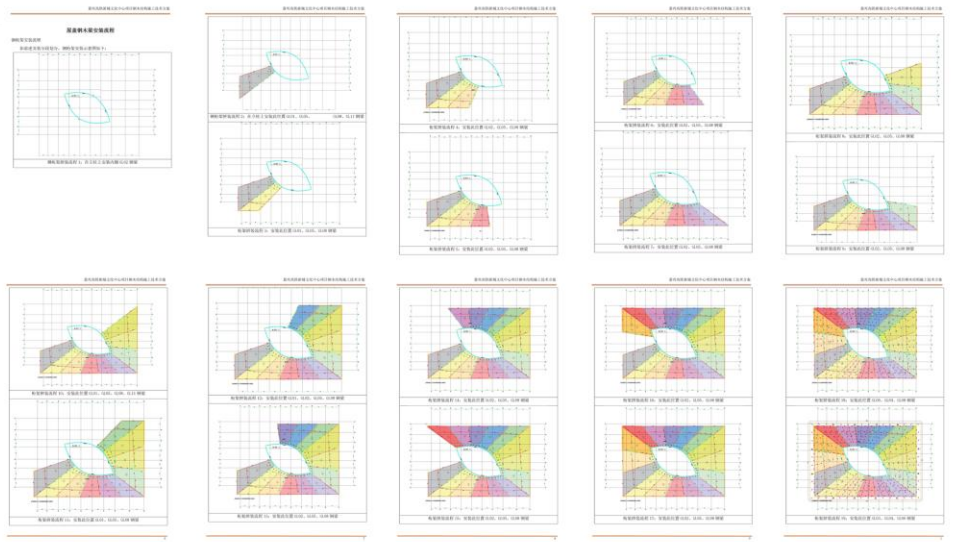
Installation



杆件标号 **Component Labels**



屋面安装工序 **Roof Assembly Steps**







2024-7-24





2024-8-28





2024-9-27





2024-11-03





2024-12-15



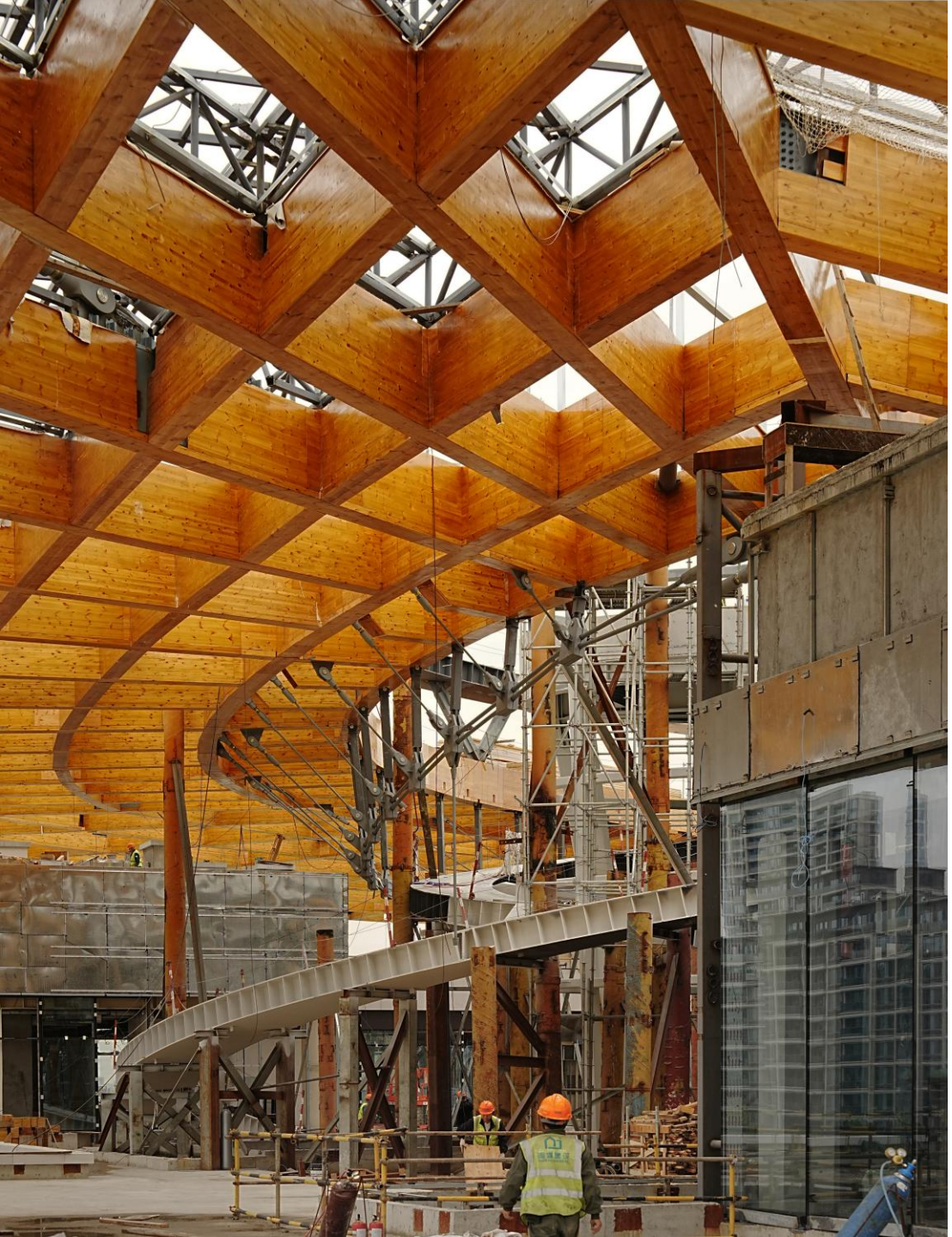


2025-01-08



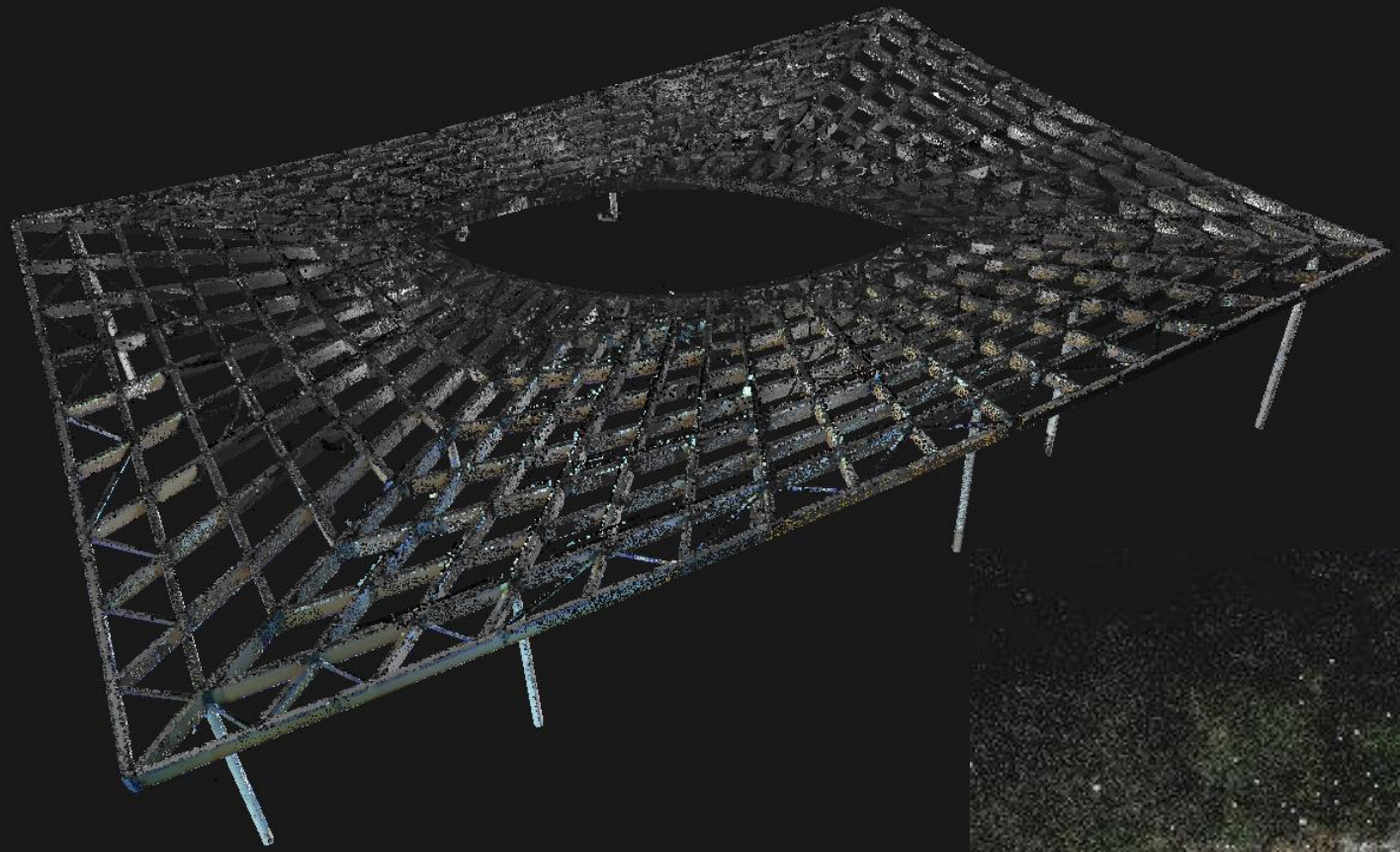


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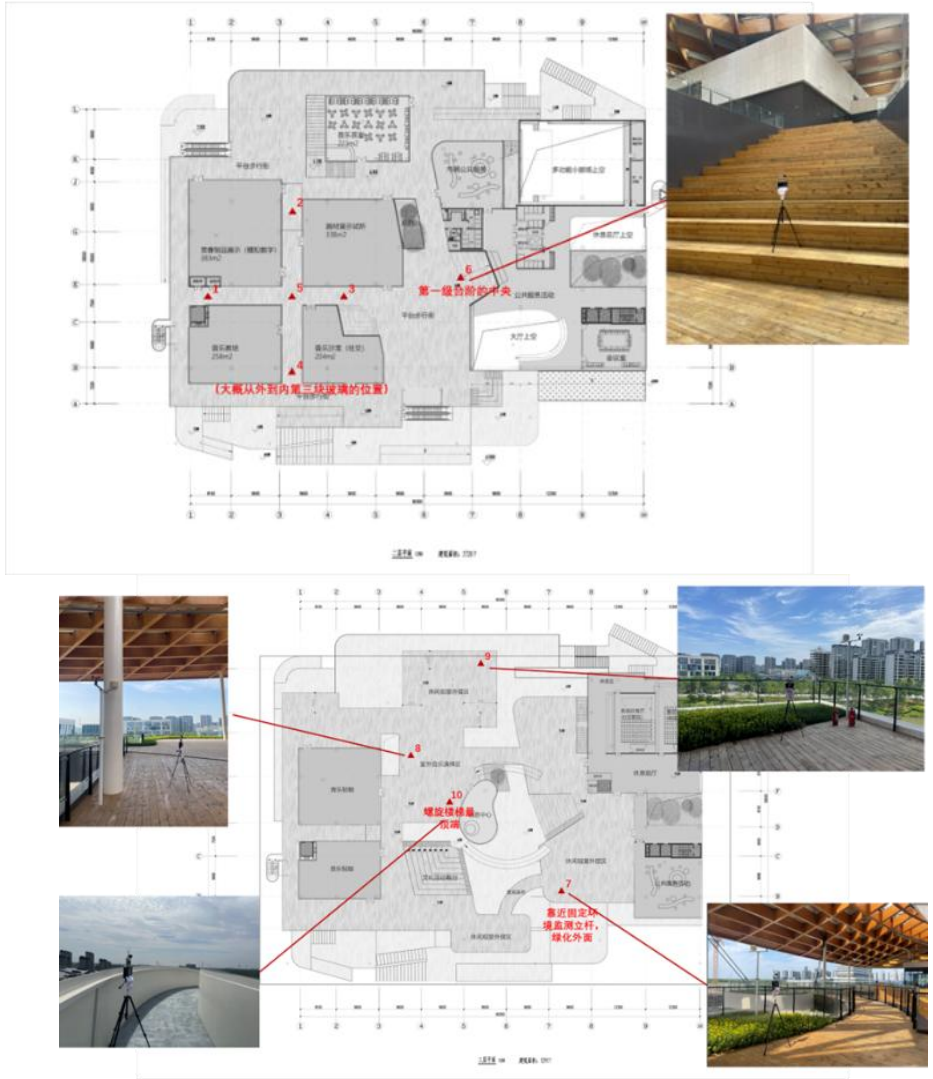




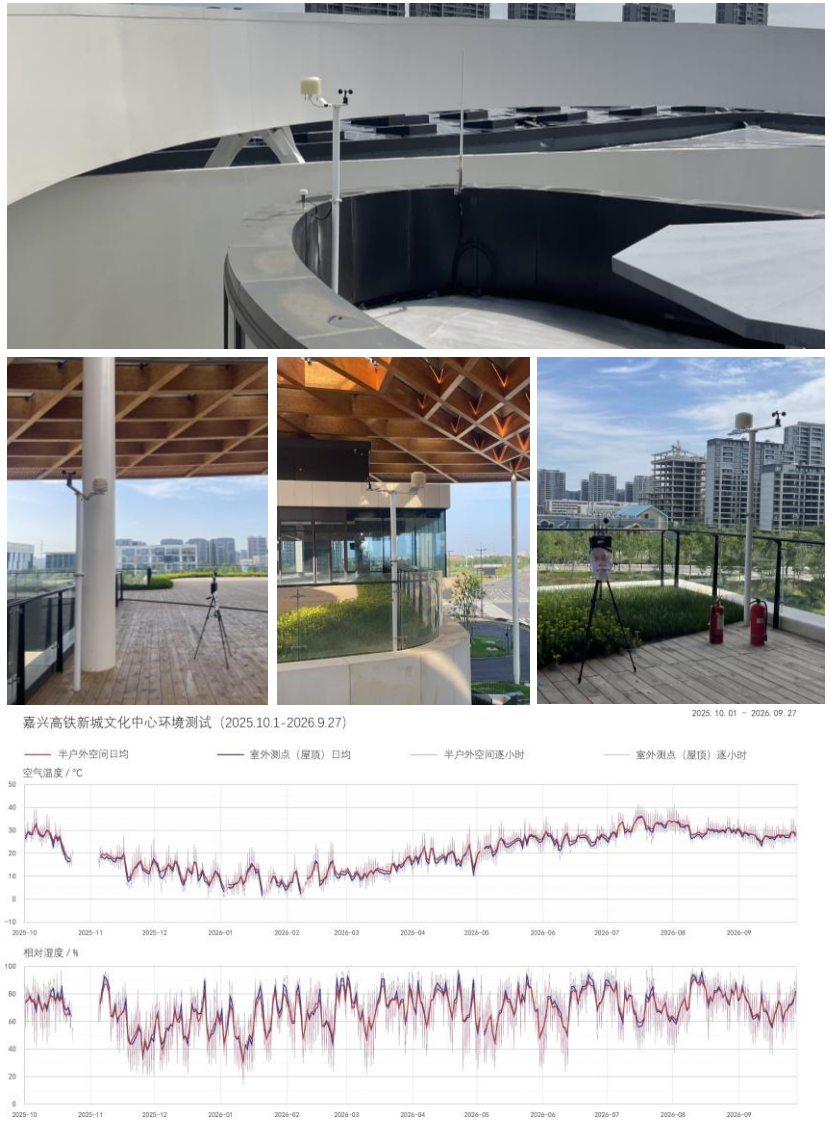

唐朝诡事录
西行
全感剧场
iQIYI
爱奇艺


以气味
NARRATOR

Environment feedback



Short-Term Environmental Testing

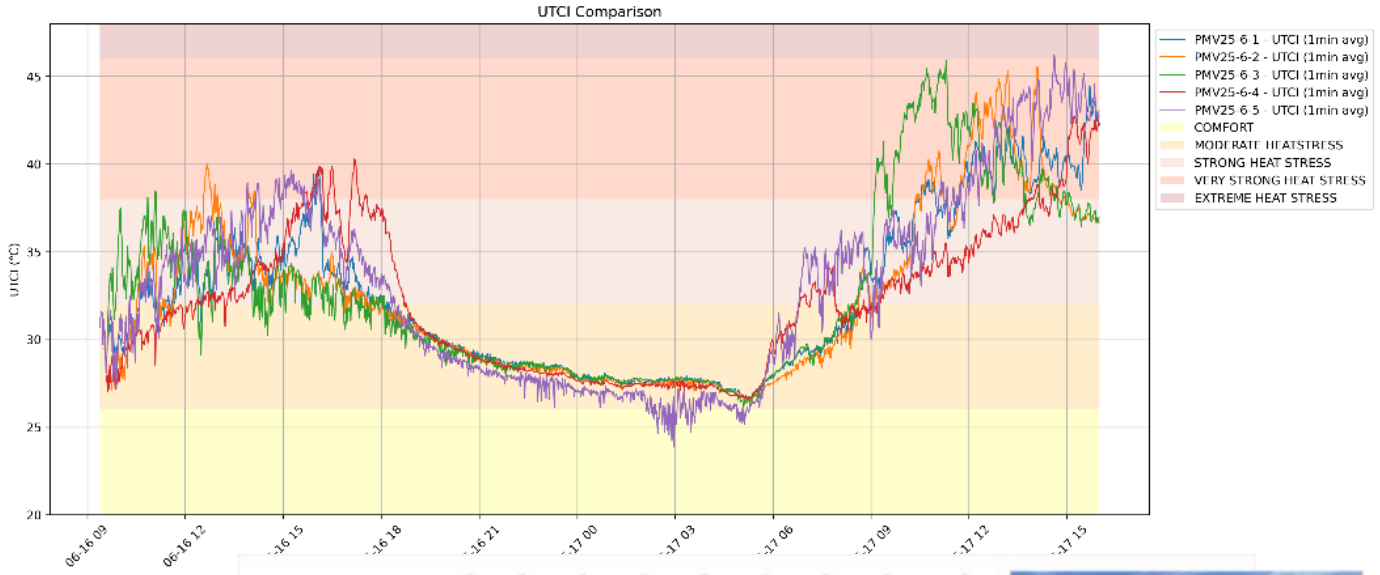


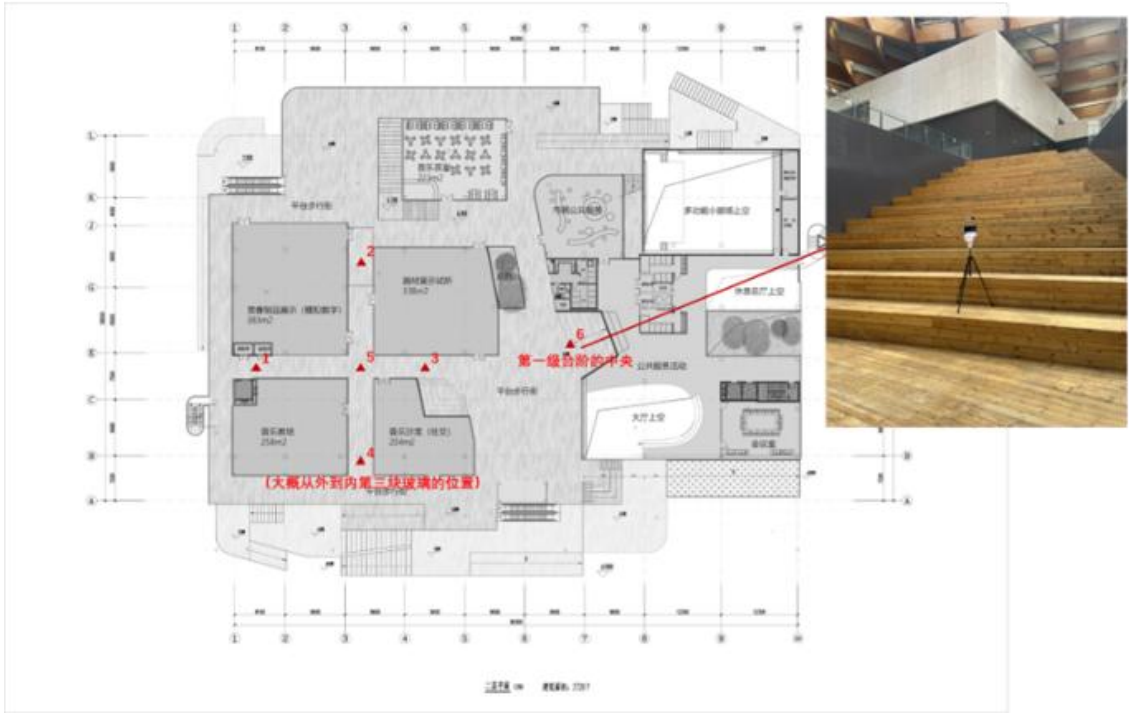
Long-Term Environmental Monitoring

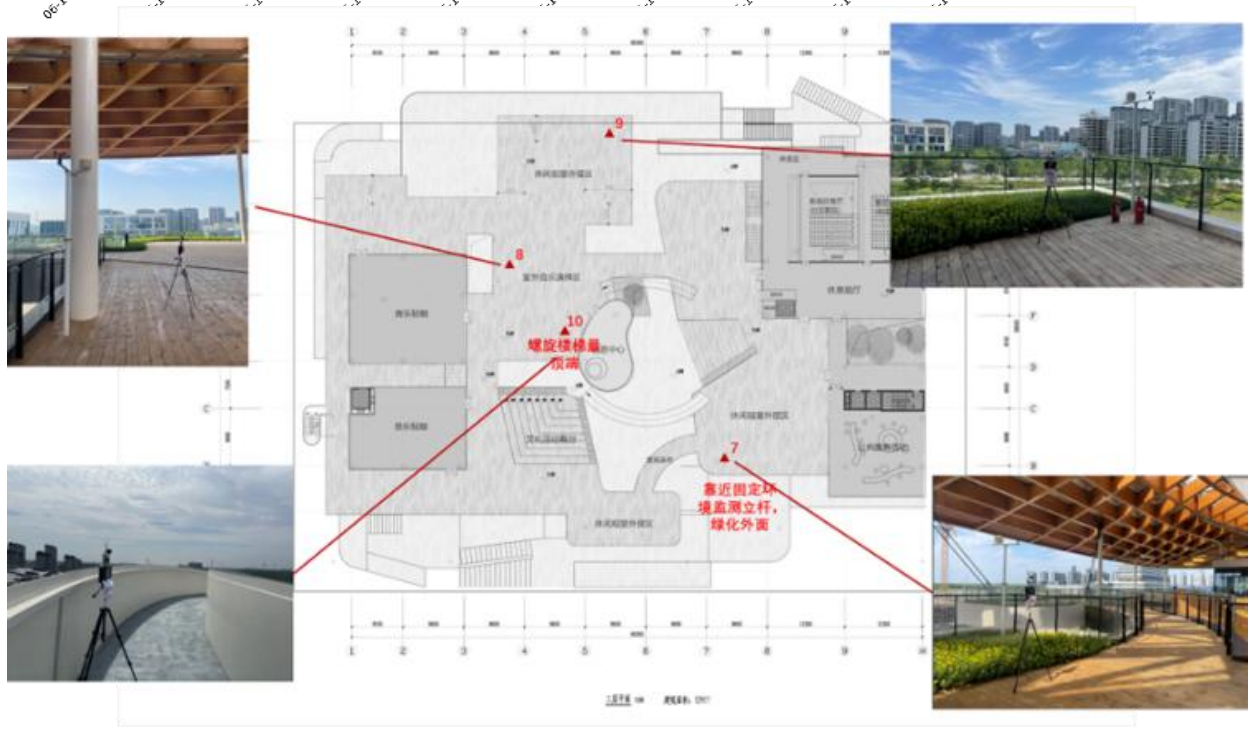
Post-construction On-site Environmental Testing

Short-Term Environmental Testing

- On-site measurements of air temperature, relative humidity, air velocity, and globe temperature
- UTCI-based assessment of spatial and temporal thermal comfort variations
- Preliminary validation of thermal comfort improvements through roof structure and spatial design









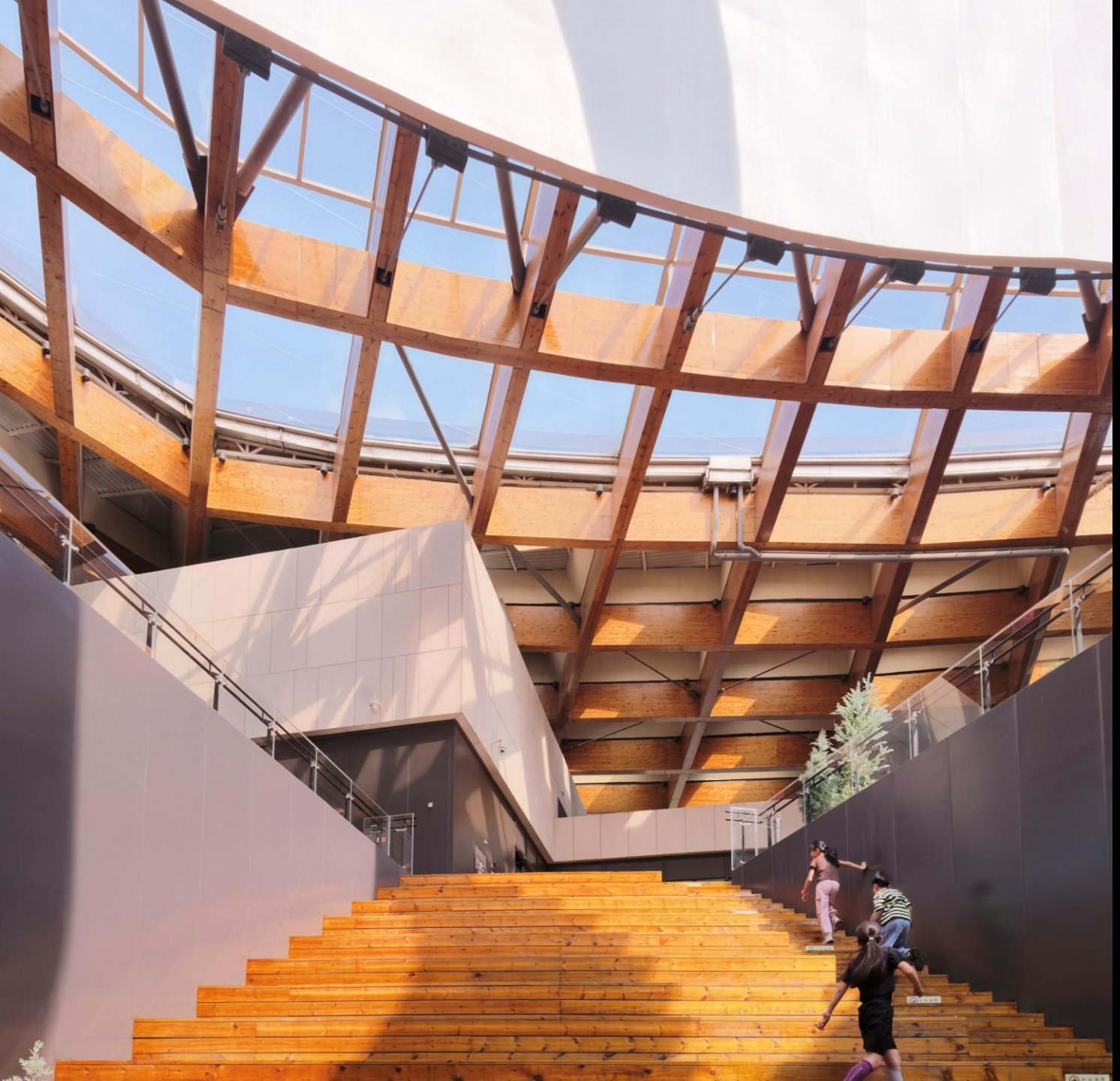
User feedback



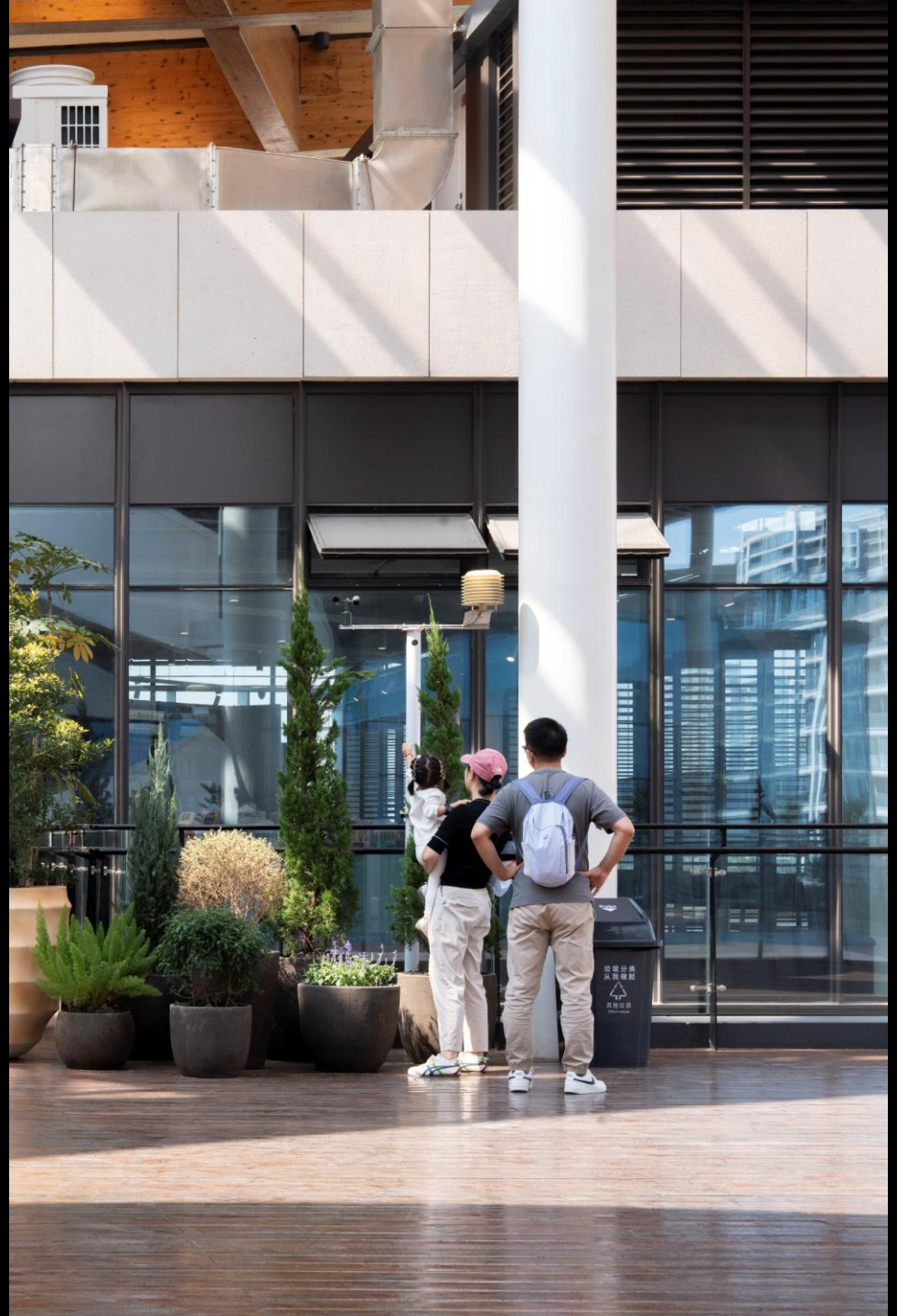


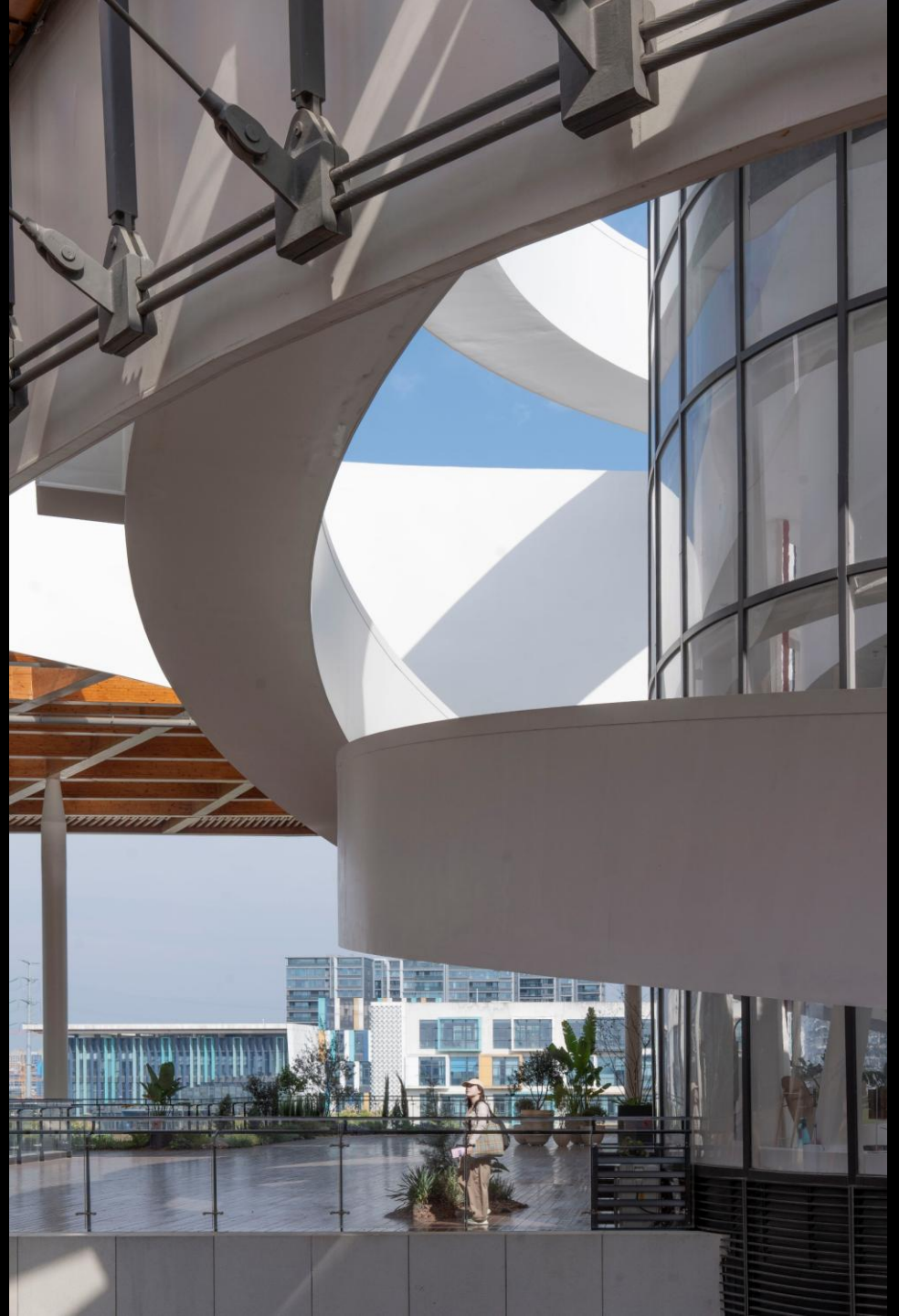

急诊 24h
Emergency


iQIYI
爱奇艺
敬请






垃圾分类
从我做起
其他垃圾




意向业态
Coffee
咖啡店「湖
边的灵感，比咖啡因更持
Office
创意办公
「在这里


鳥二焼






1701
COMING SOON
1701 · 双溪湖
FRONTIER
MUSICAL OASIS
FRONTIER
LIVE
往前走
ALL TOGETHER
&
GO STRAIGHT
秋秋岛 · Chill Chill Land
秋秋岛





















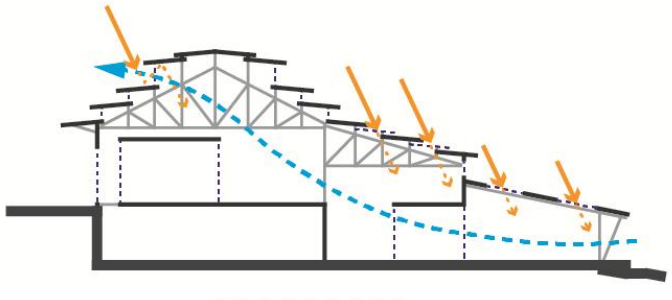









@新业态



自然采光 Natural Lighting
自然通风 Natural Ventilation
形态自遮阳 Space as Shield
构件遮阳 Tectonic as Shield
局部空调 Semi-HVAC
自然材料 Natural Material
能源表现 Energy Performance
光伏建筑一体化 BIPV
覆土 Earth-Sheltered

Space
Room-in-room climate buffer

Materials recycling
Local economy

Construction
Daylighting-Ventilation Integrated Structure
Rural Prefabrication

Environment feedback

User feedback



桃里 - 沼山村村民中心

Taoli - Zhaoshan Village Center

2024




Zhaoshan Village
Taoli Farm
Road on Dam
沼山水库
Abandoned farmland
→ Camping ground and farm
Existing factory
→ Community center
Hardened factory unloading area
→ Multifunctional activity plaza
Village Road

改造前 Conditions Before Renovation





改造后 Conditions After Renovation





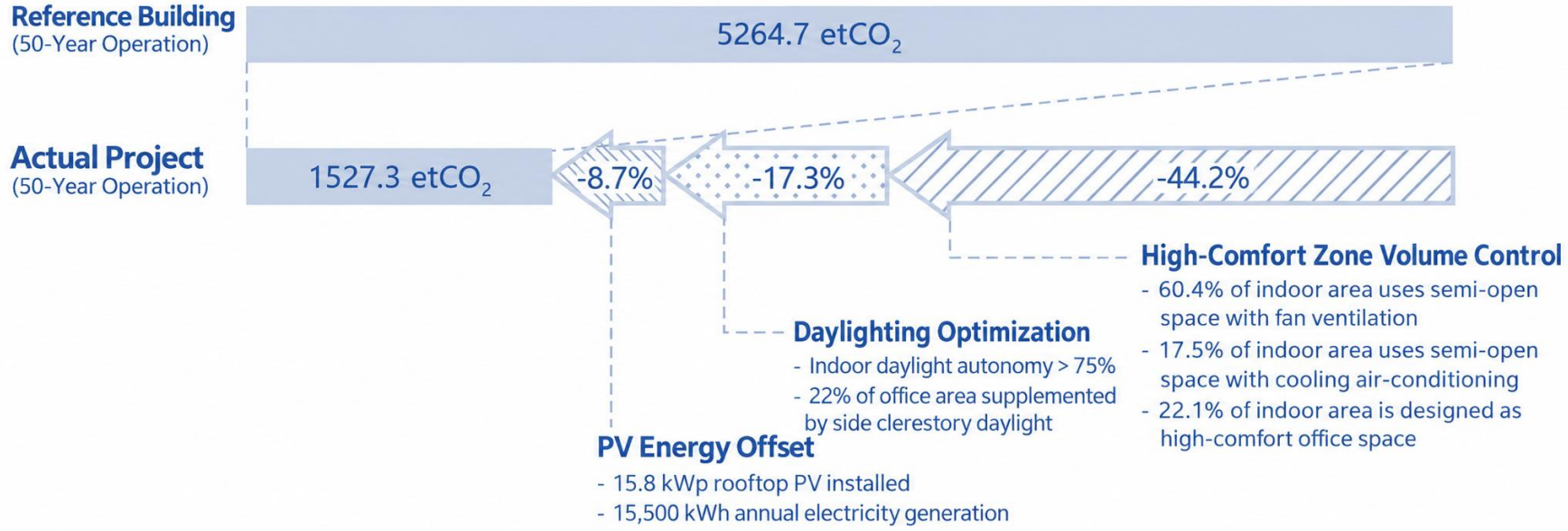




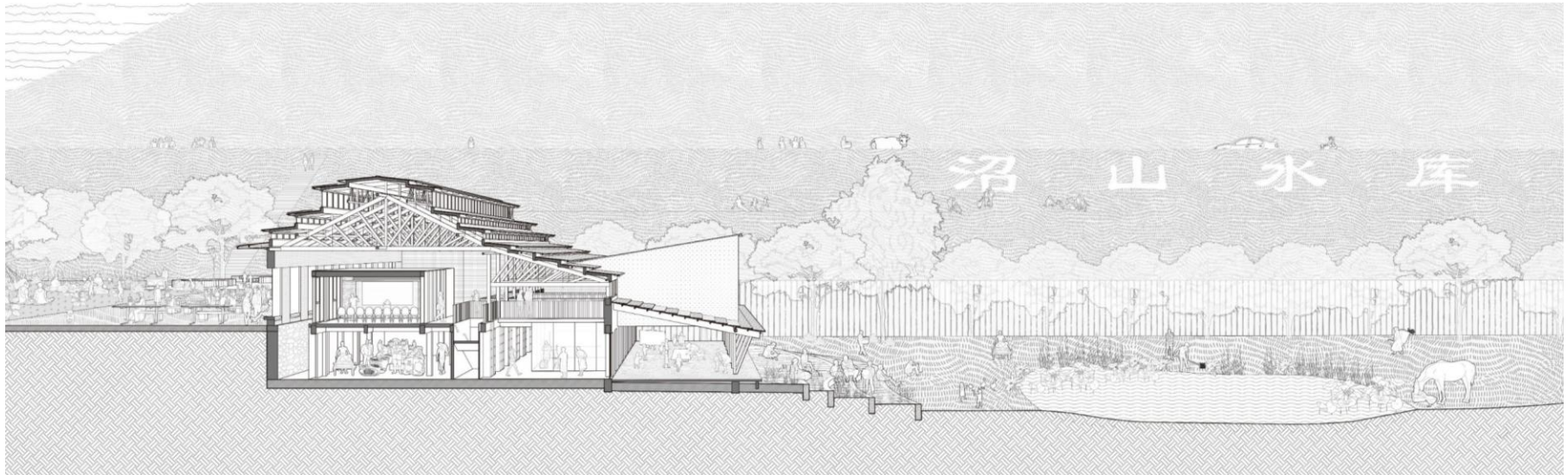




Prototype and Sustainable Design Strategies



Assessment of Carbon Reduction Benefits during the Building Operation Phase









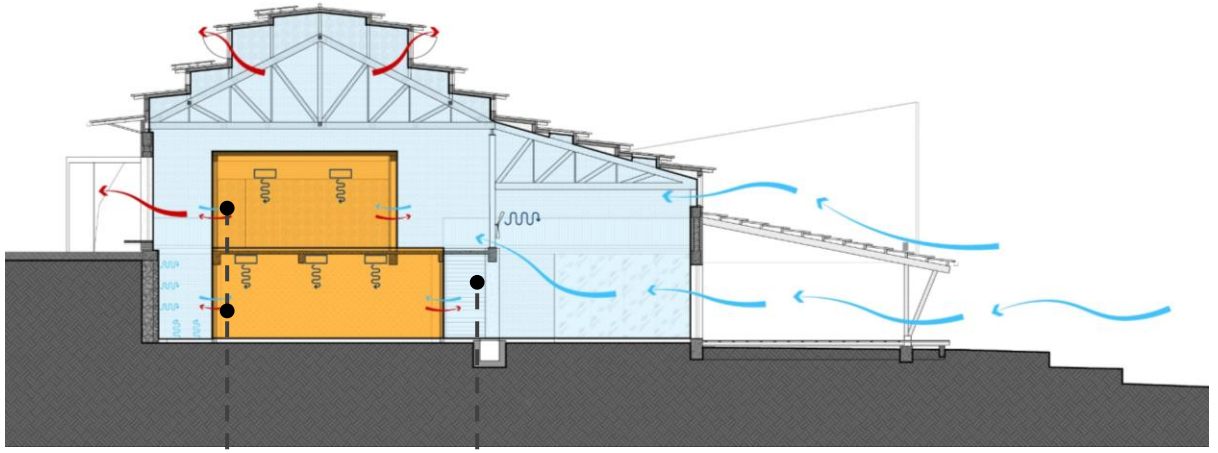
Room-in-room Buffer Zone

- Core Zones: Precise thermal comfort control through air-conditioning
- Buffer Zones: Acceptable thermal comfort with minimal conditioning
- Summer: Thermal storage for cooling in core zones; localized cooling in buffer zones
- Winter: Thermal storage for heating in core zones; localized heating in buffer zones

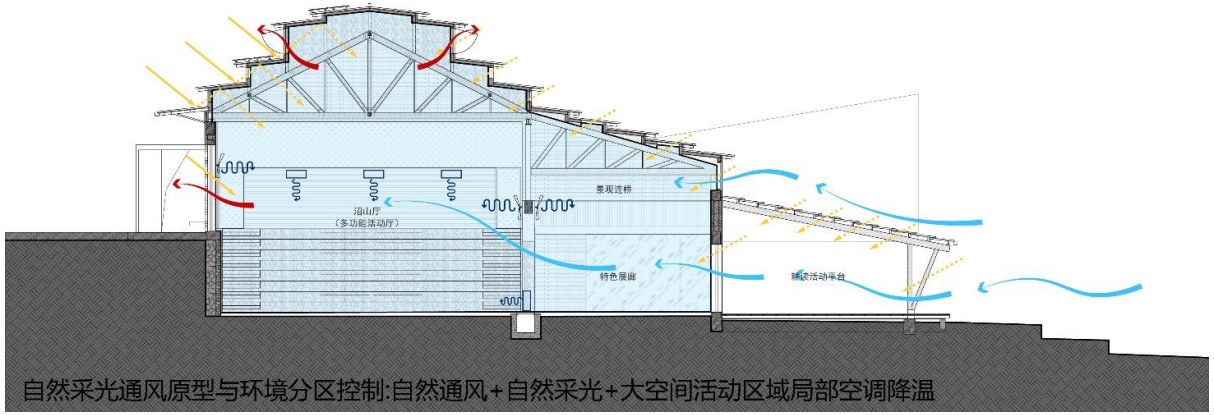




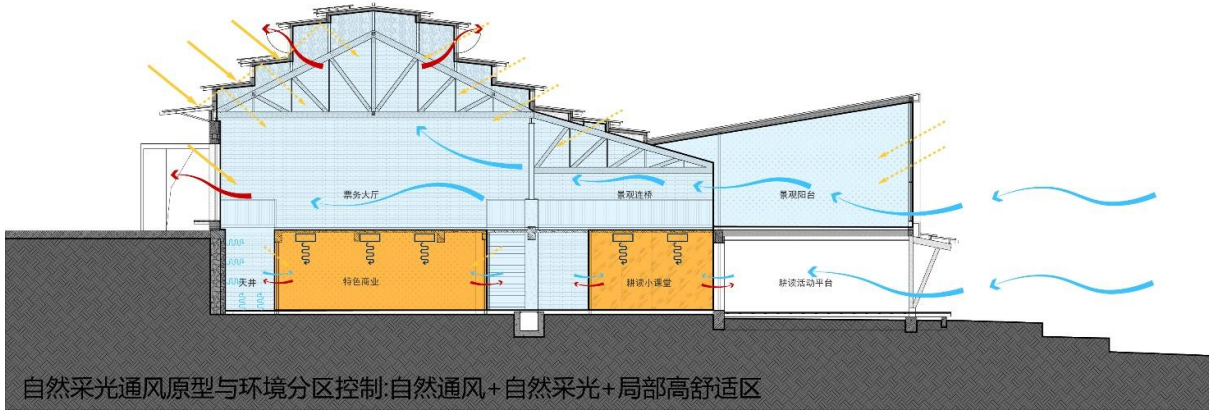
the buffer zones | the core zones | the core zones | the buffer zones



the core zones | the buffer zones



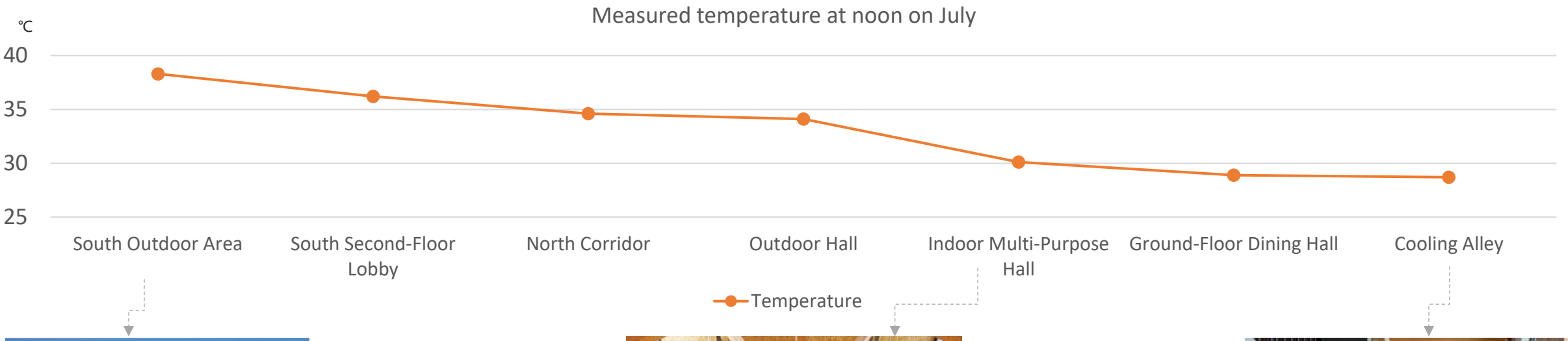
自然采光通风原型与环境分区控制:自然通风+自然采光+大空间活动区域局部空调降温



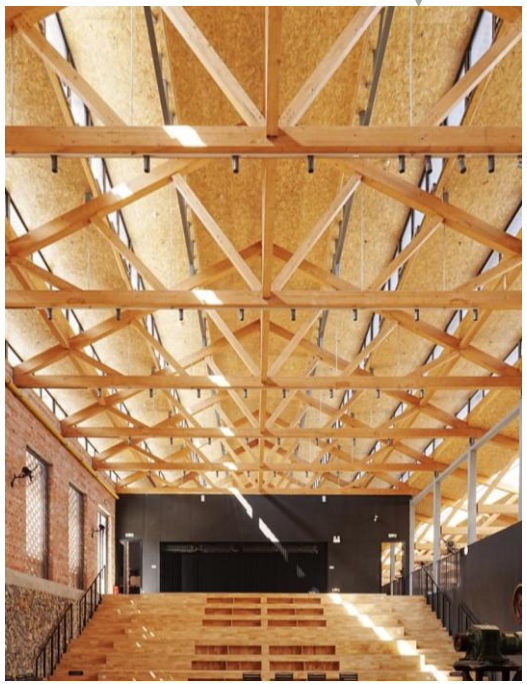
自然采光通风原型与环境分区控制:自然通风+自然采光+局部高舒适区

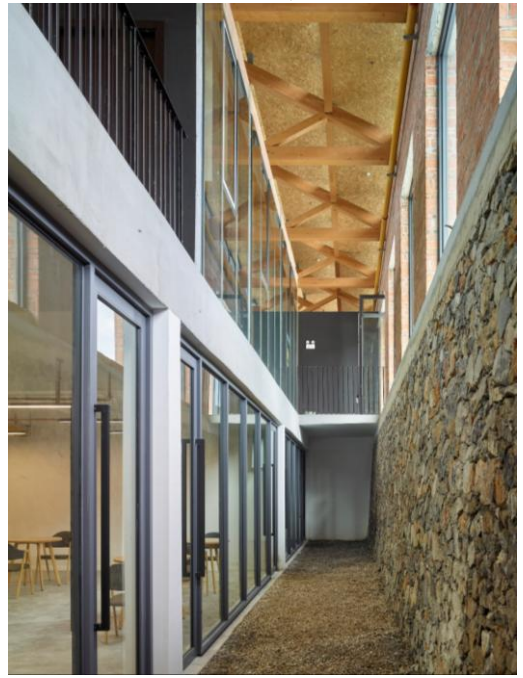
Post-construction On-site Environmental Testing

Long-Term On-Site Monitoring of Key Points Conducted After Project Completion



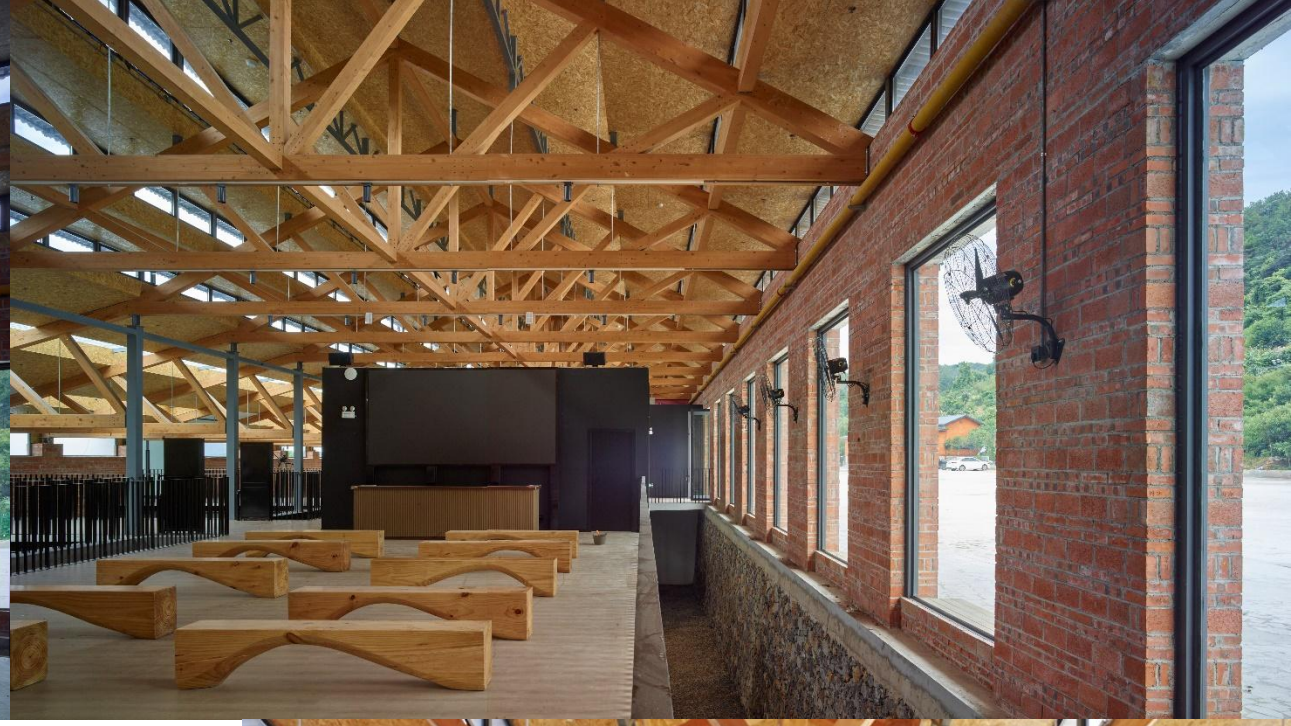


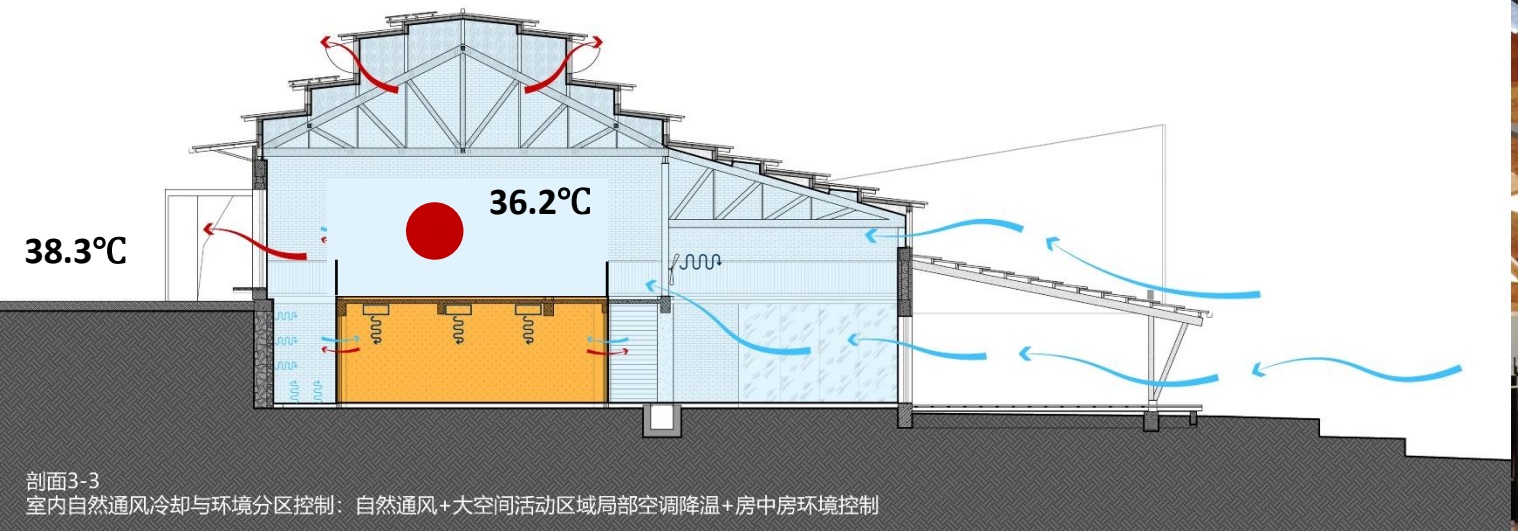












剖面3-3
室内自然通风冷却与环境分区控制：自然通风+大空间活动区域局部空调降温+房中房环境控制





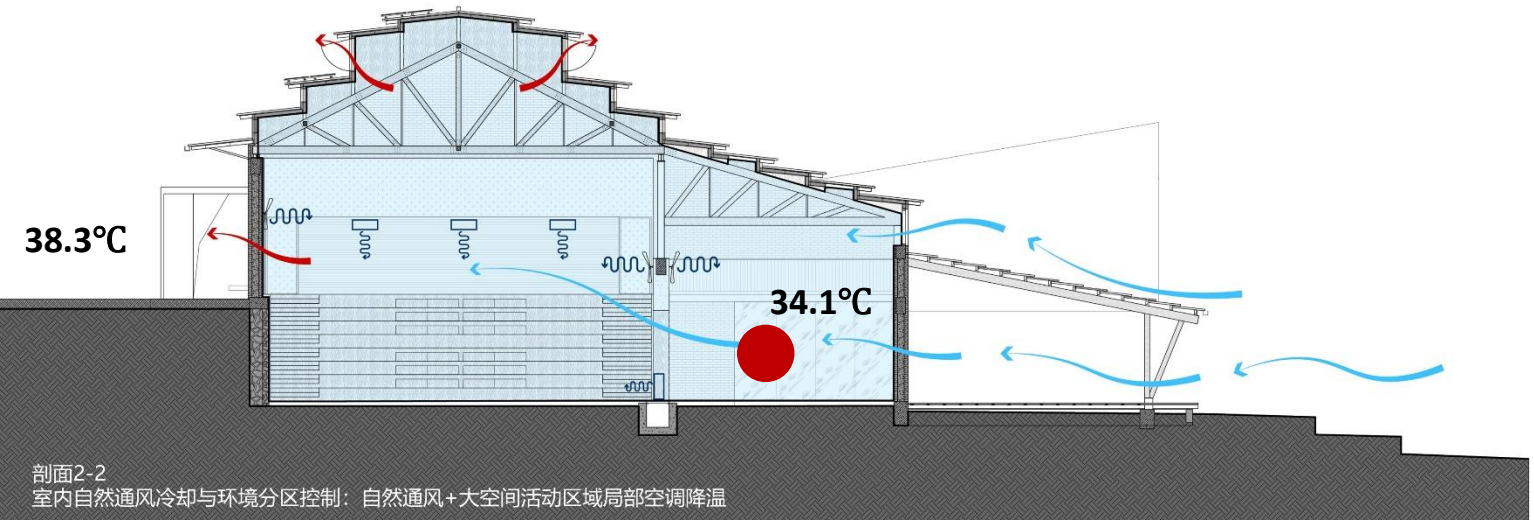

四、《主动式建筑评价标准》首页/AH AP、AH HSC 咨询培训
消火栓
灭火器











剖面2-2
室内自然通风冷却与环境分区控制：自然通风+大空间活动区域局部空调降温




第二届中国建筑学会主动式建筑专
第六次委员大会

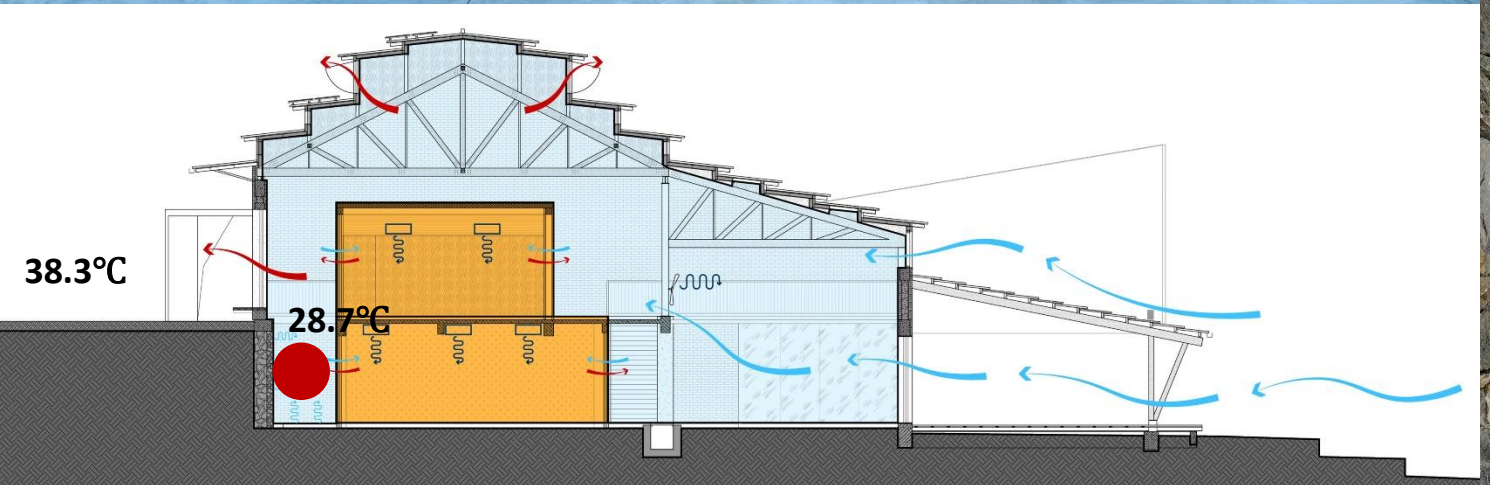












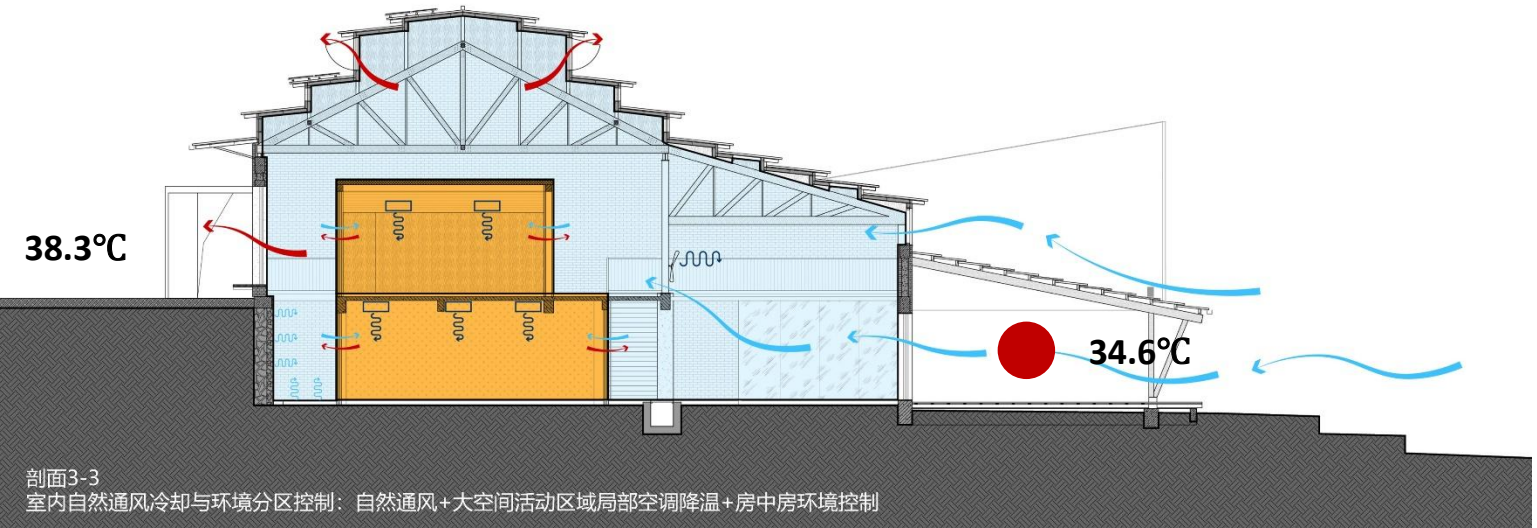
剖面3-3
室内自然通风冷却与环境分区控制：自然通风+大空间活动区域局部空调降温+房中房环境控制









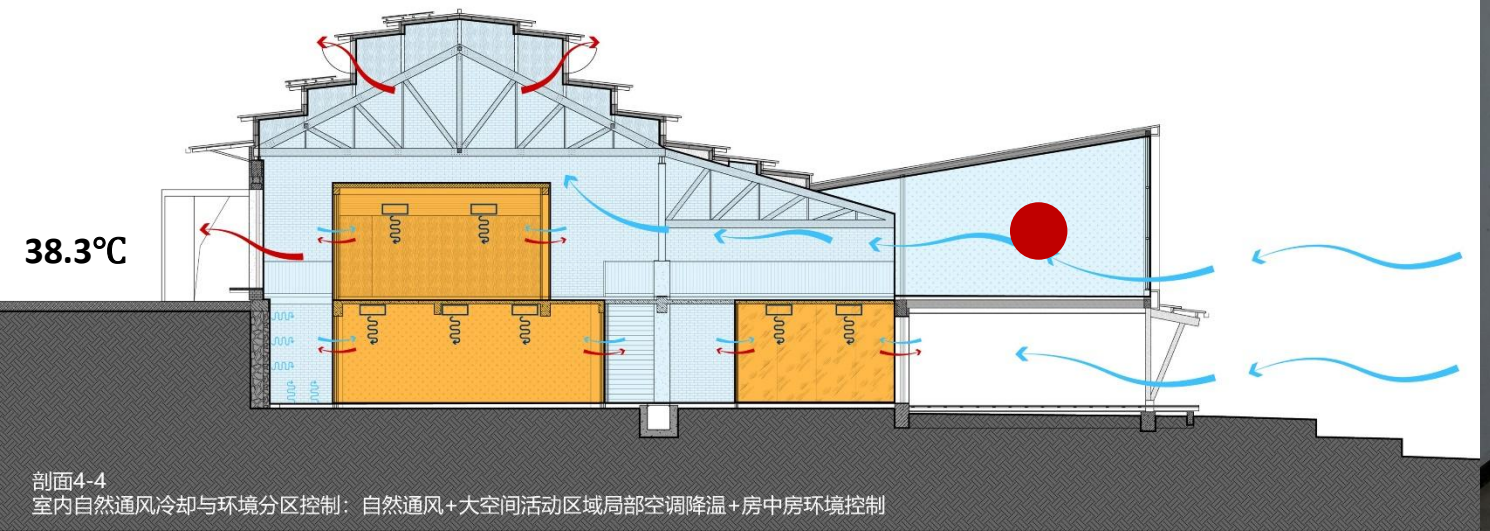


剖面3-3
室内自然通风冷却与环境分区控制：自然通风+大空间活动区域局部空调降温+房中房环境控制




【杉木桥酒坊·桃堂】
泰隆银行

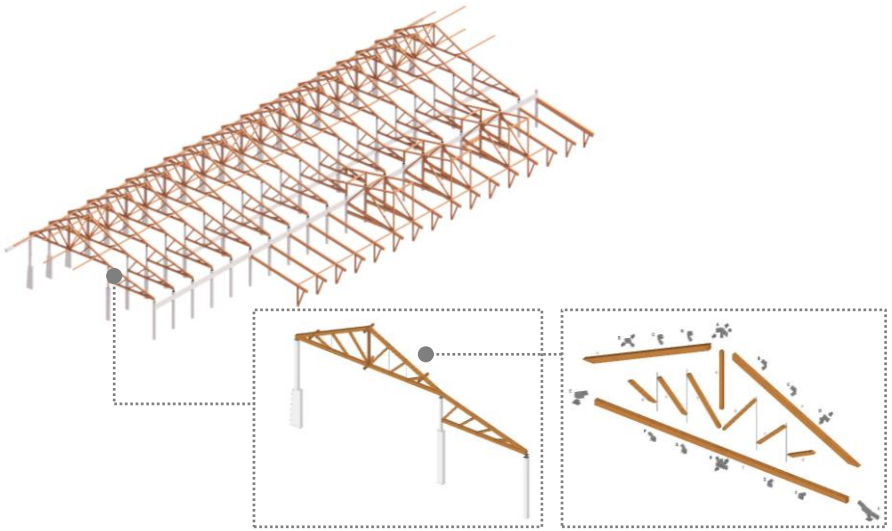


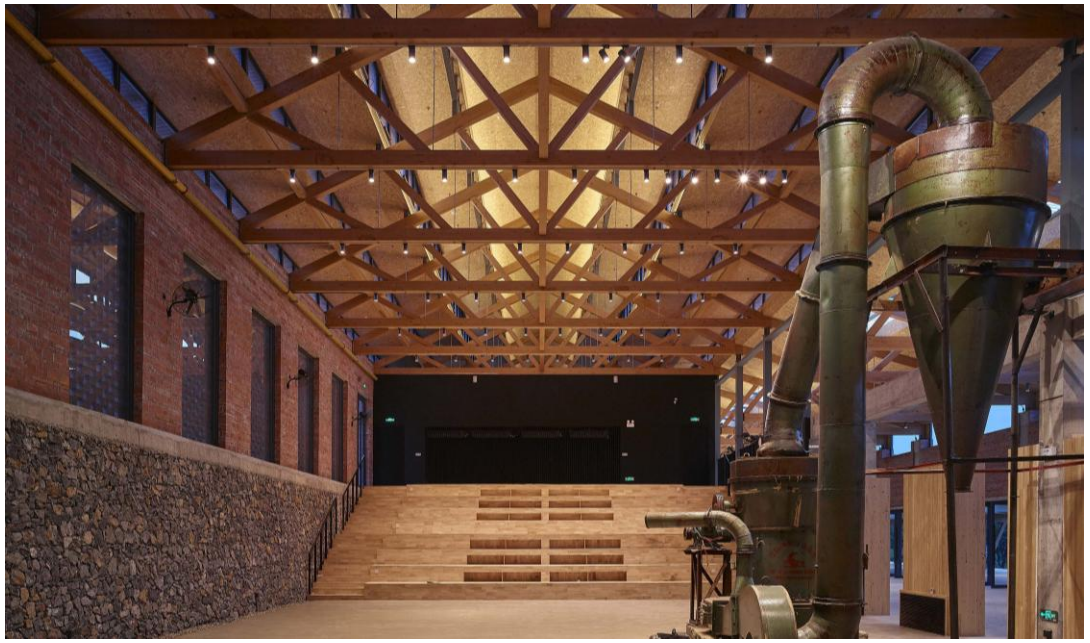


剖面4-4
室内自然通风冷却与环境分区控制：自然通风+大空间活动区域局部空调降温+房中房环境控制

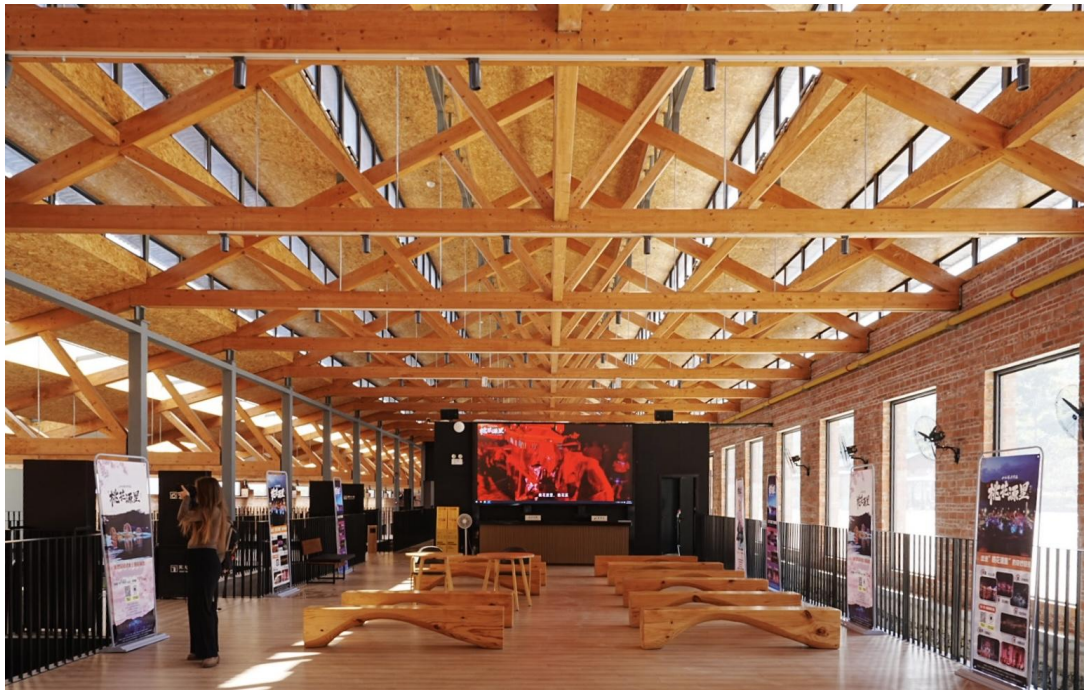


Structural Design Optimization





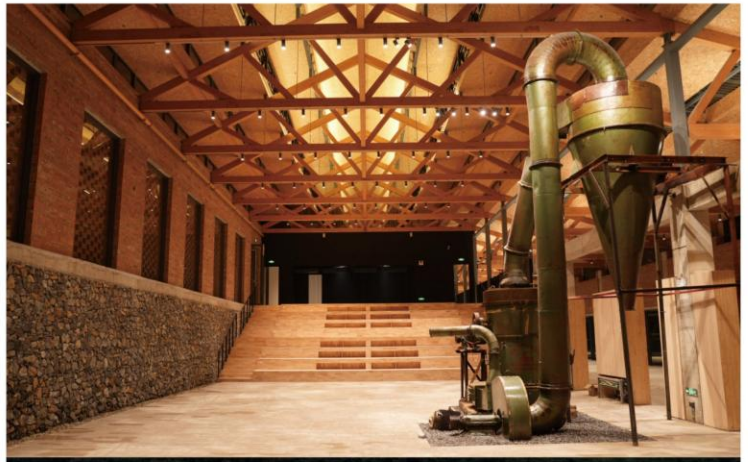








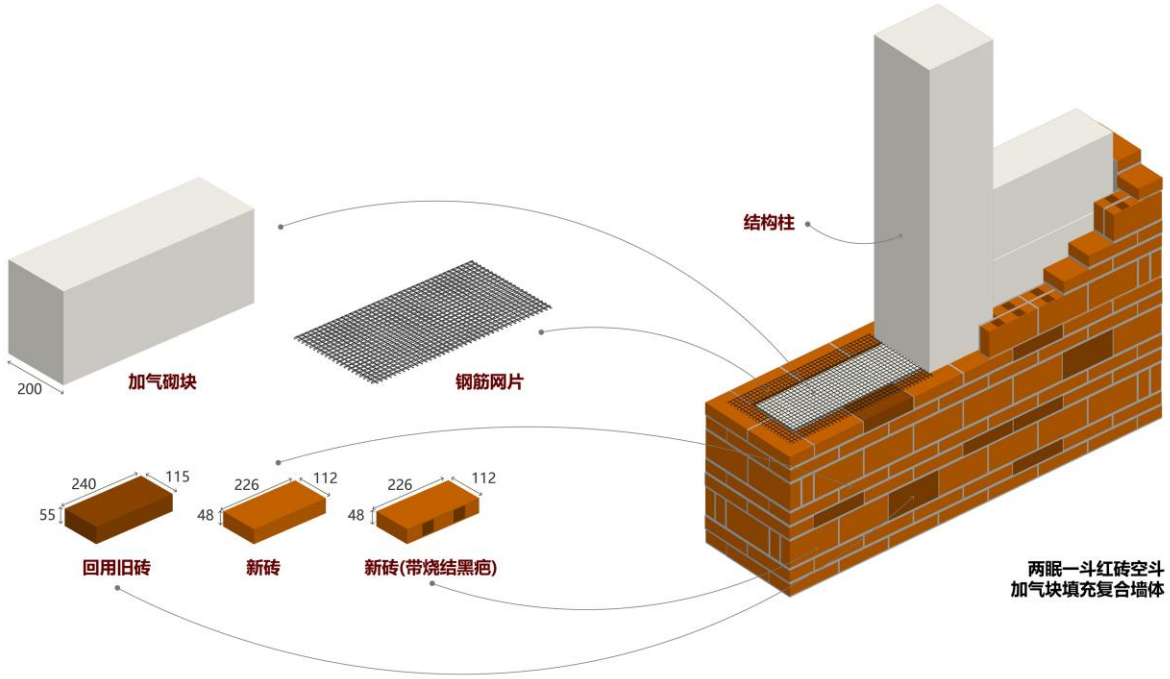
Material Reuse and Recycling

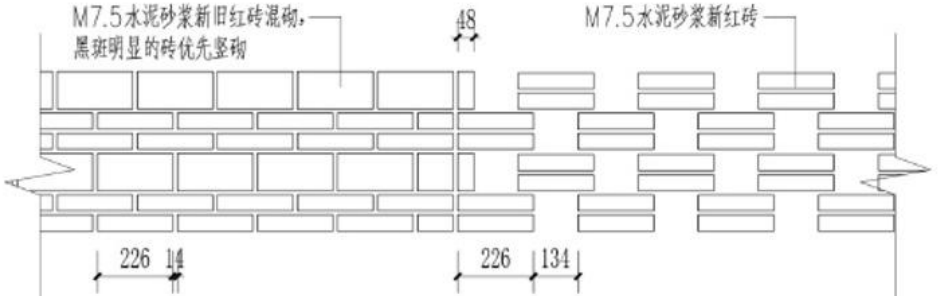
	Local materials 本 土 材 料	Treatment & Processing 材 料 处 理 加 工 及 再 利 用			Built photos 建 成 实 景
Brick 清水砖					
Rubble 毛石					
Slate waste 石刻废料					
Recycled wood 回收木料					
Equipment reuse 原设备利旧					

On-Site Reuse of Discarded Red Bricks

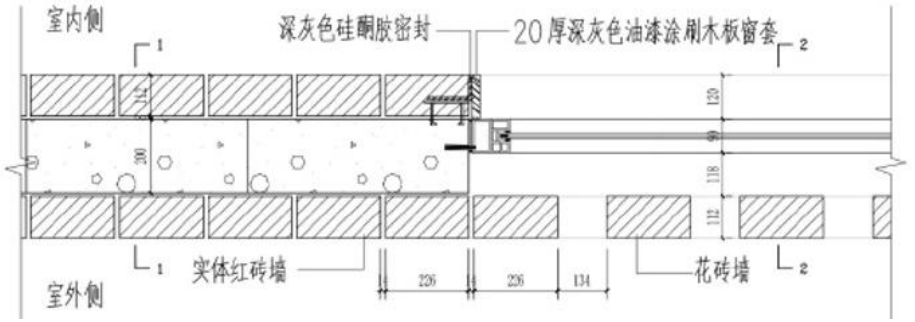




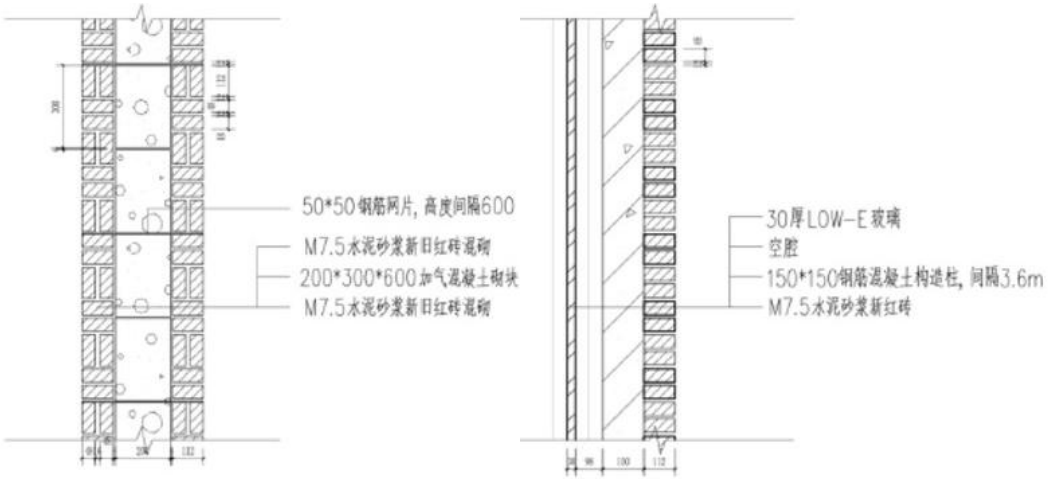




红砖墙立面详图 Elevation Detail of the Red Brick Wall



红砖墙平剖面详图 Horizontal Sectional Detail of the Red Brick Wall



红砖墙剖面详图 Sectional Detail of the Red Brick Wall








票务中心
50



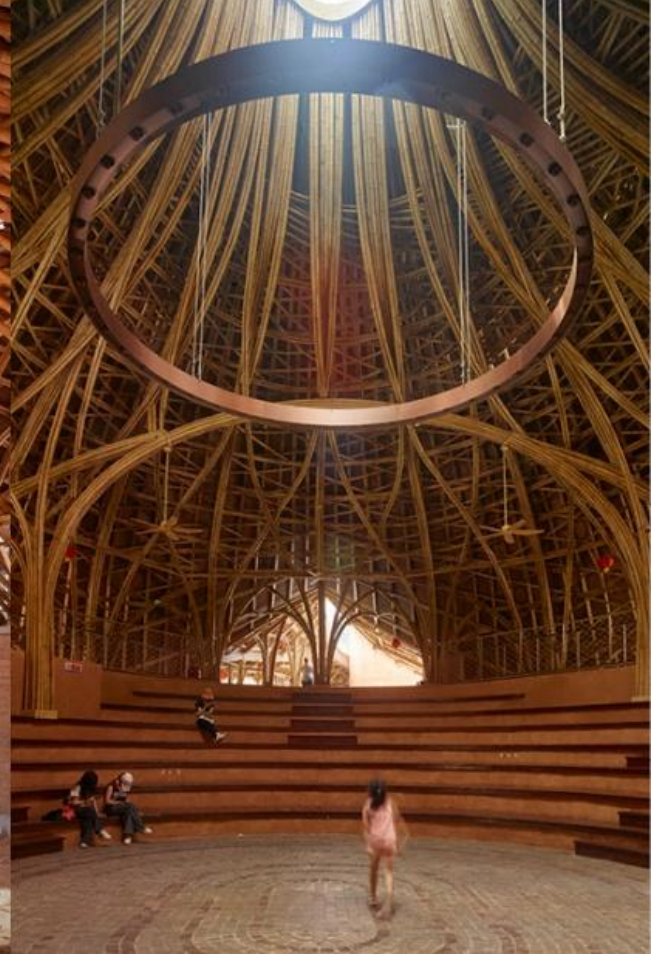


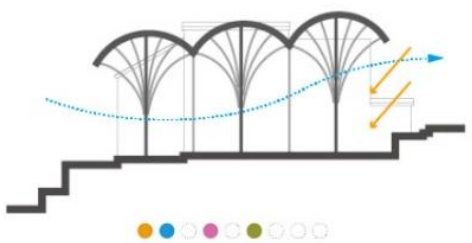


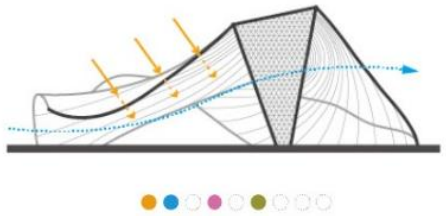


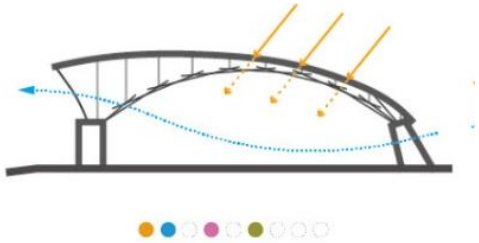


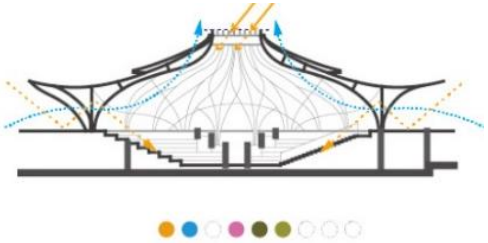














Bamboo lightweight structure

2017 Bamboo structure built with villagers
Shangcun Village Lounge , Anhui , China

2018 Deep exploration of bamboo structure
The Swirling Clouds Pavilion , Beijing , China

2020 Re-creation based on past experience and local characteristics
Zhuguanlong Tea Leaf Market , Fujian , China

2021 Integral woven grid structure of multifunctional space
the INBAR Pavilion , Yangzhou , China

2023 A multi-functional public service space formed by modular bamboo structures
Maona Village Community Centre – Hainan, China







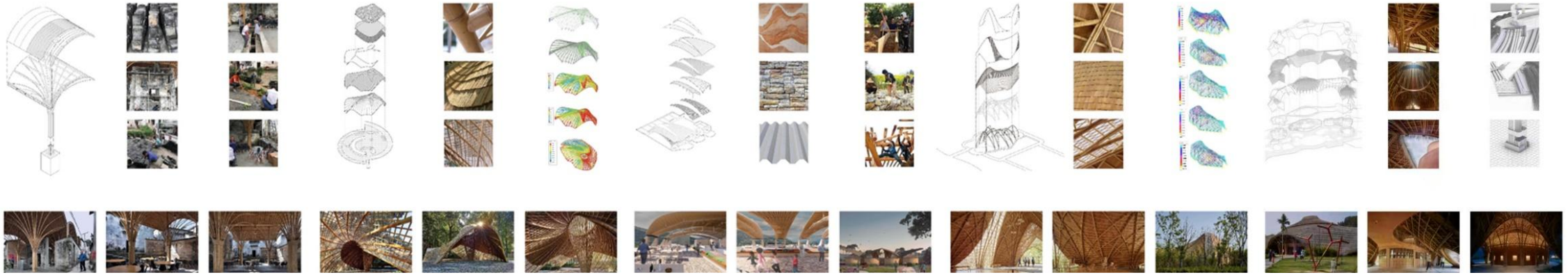
Modular construction | Local materials | Co-construction of villagers

Traditional craft with modern technology | Bamboo structure | Nonlinear structure

Modular construction | Traditional craft with modern technology | Bamboo structure | Local materials with modern materials | Nonlinear structure | Co-construction of villagers

lightweight structure | Bamboo structure | structure simulation

Modular construction | Traditional craft with modern technology | Bamboo structure | Local materials with modern materials | Nonlinear structure | Co-construction of villagers



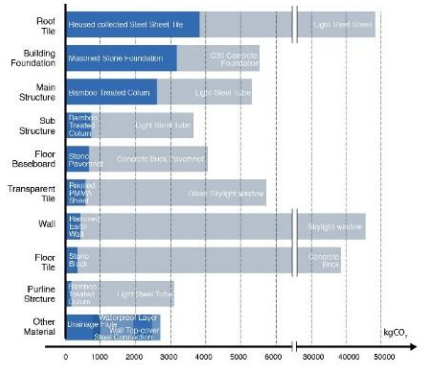
Lifecycle Carbon Emission Based Design Framework



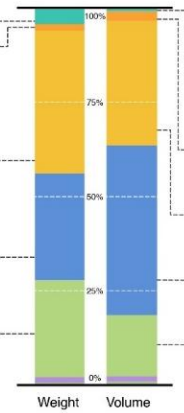
Material Import from Local District

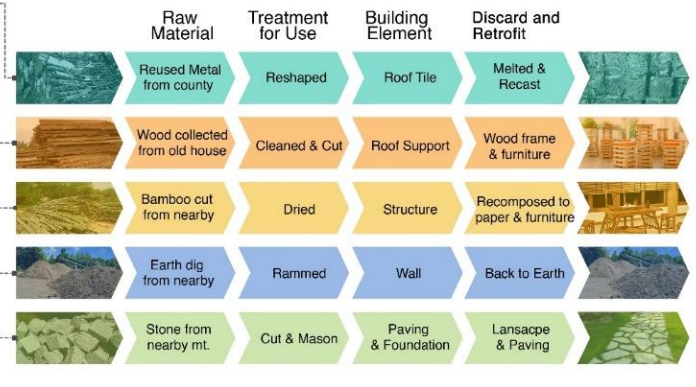


Material Lifecycle Evaluation











Case 1: Village lounge of Shangcun



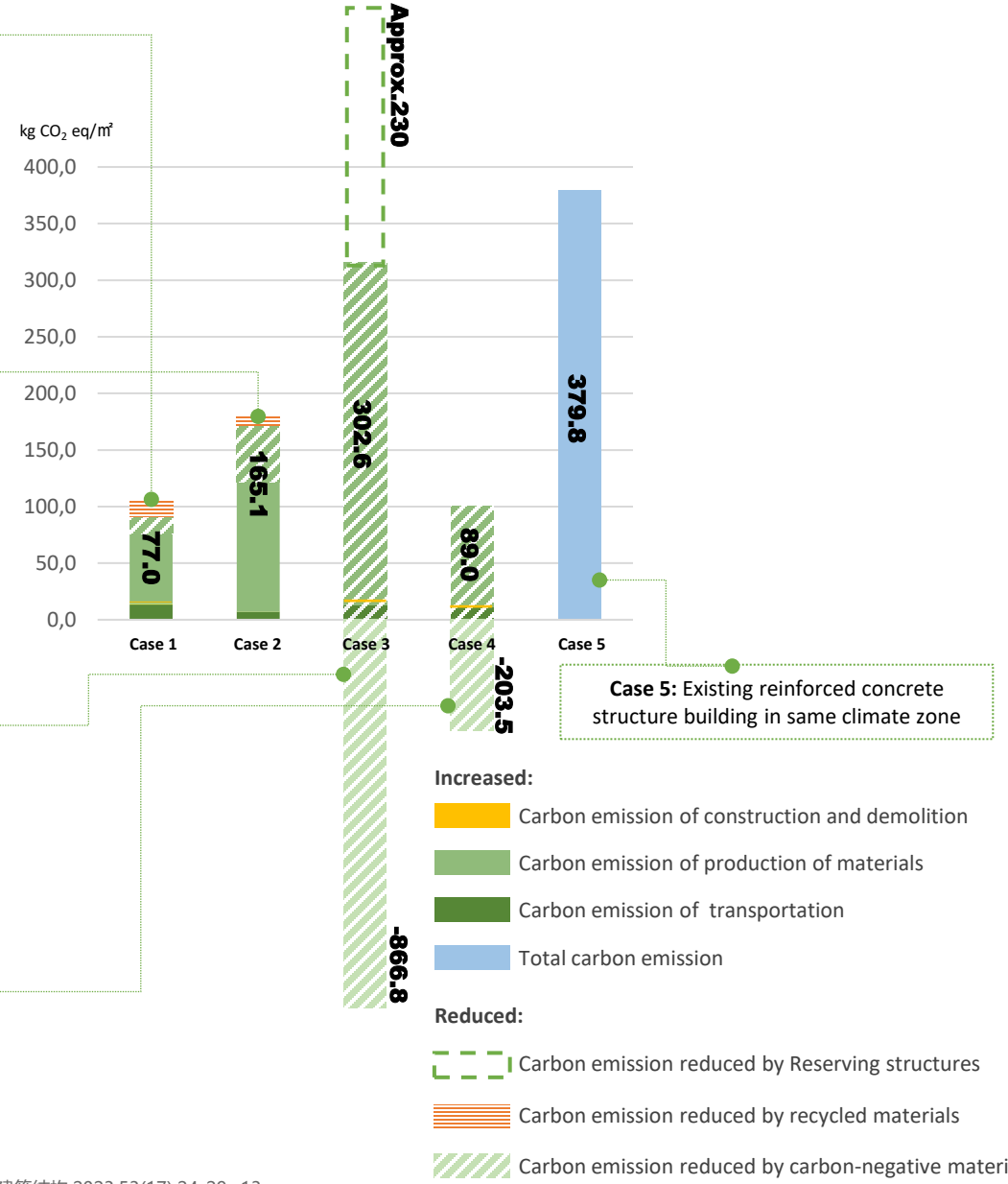
Case 2: Tea Leaf Market of Zhuguanlong



Case 3: History Museum of Qifeng Village



Case 4: Fish-Joy Bamboo Pavilion of INBAR



Carbon-negative materials

Using carbon sequestration materials (e.g bamboo and timber) as the main structure can significantly reduce carbon emissions, and the higher the proportion used, the better the carbon reduction effect.

Local materials

Using locally sourced materials can significantly reduce the carbon emissions generated during the transport of building materials. In Project Tea Leaf Market of Zhuguanlong, we used rammed earth to build the walls, and the materials were produced, transported and constructed without carbon emissions.

Recycled materials

In projects Village lounge of Shangcun, Tea Leaf Market of Zhuguanlong and History Museum of Qifeng Village, we recycled materials such as stone, wood and brick from houses demolished in the neighbourhood,which have an outstanding carbon reduction effect.

[1] 郑良基.皖南民居结构体系生命周期二氧化碳排放评价[D].安徽工业大学,2018.
[2] 张展诚;李瑜;孟鑫淼;刘可为;高颖;王军龙.圆竹结构景观建筑全生命周期碳排放分析[J].建筑结构,2023,53(17):24-29+13.
[3] 劳万里;李晓玲;段新芳.木竹产品碳足迹评价研究进展[J/OL].林业科学,1-9[2023-11-27]
[4] GB/T 51366-2019建筑碳排放计算标准[S].北京: 中国建筑工业出版社,2019.



云　在　亭

Swirling Cloud

2018

Background



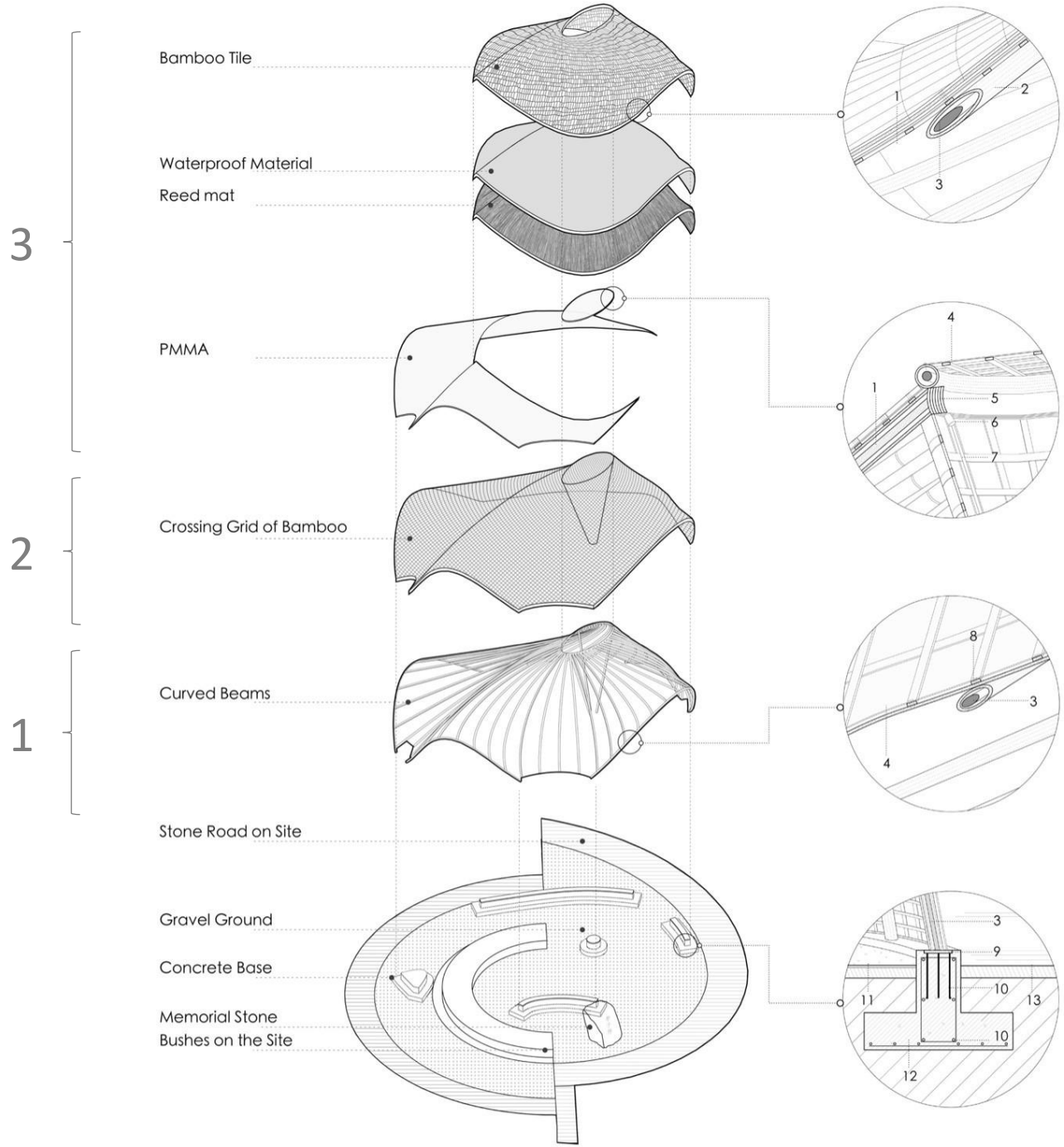
BJFU Garden Festival

Located in a grove in the campus of BJFU, the “pavilion of clouds” is a bamboo structure built for 2018 “Bamboo Garden Festival”, and will serve as a hub for information during the festival.

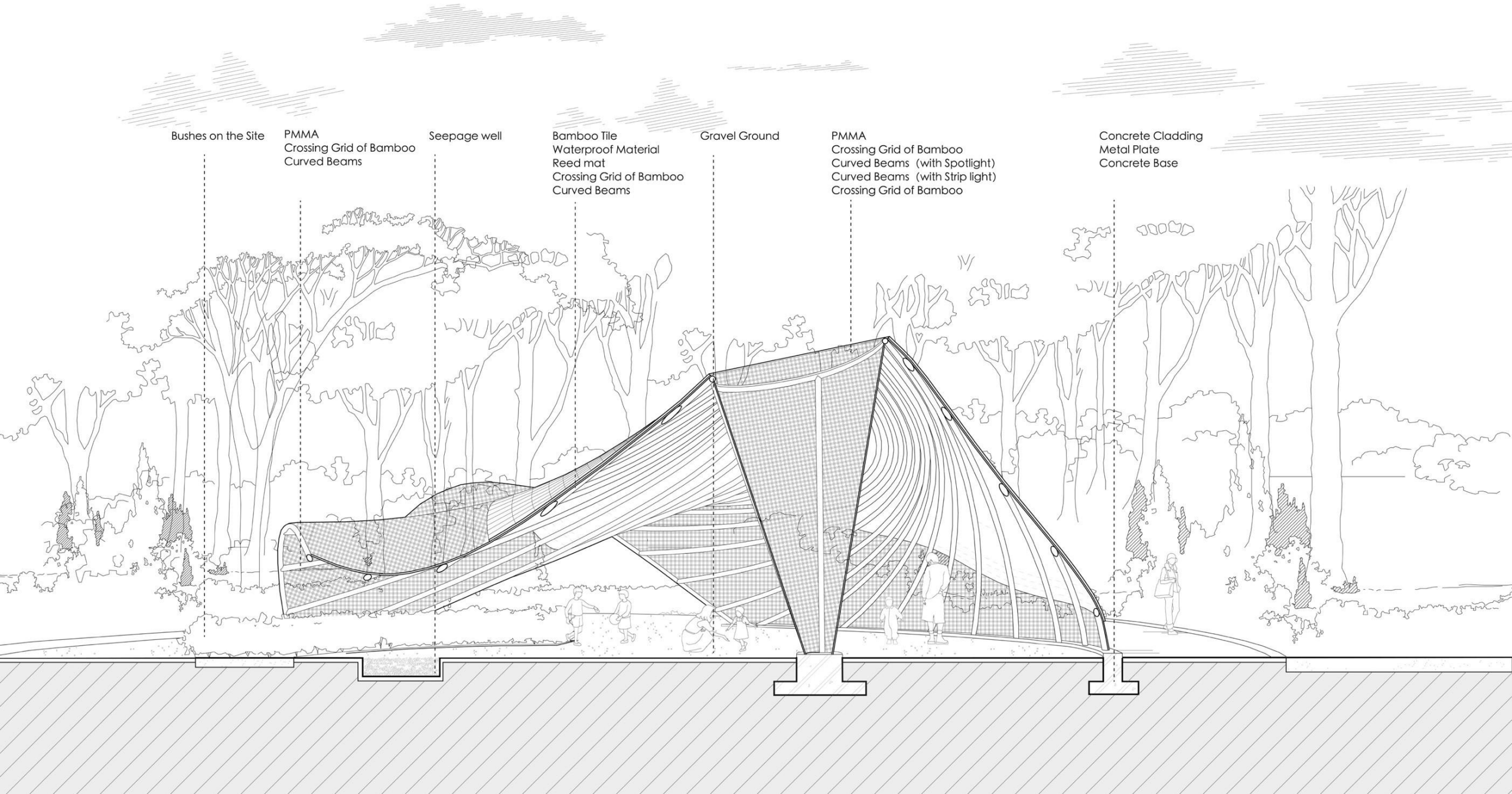



Campus gate
Bushes and memorial stone
T&R building

Inserting of Bamboo Structure



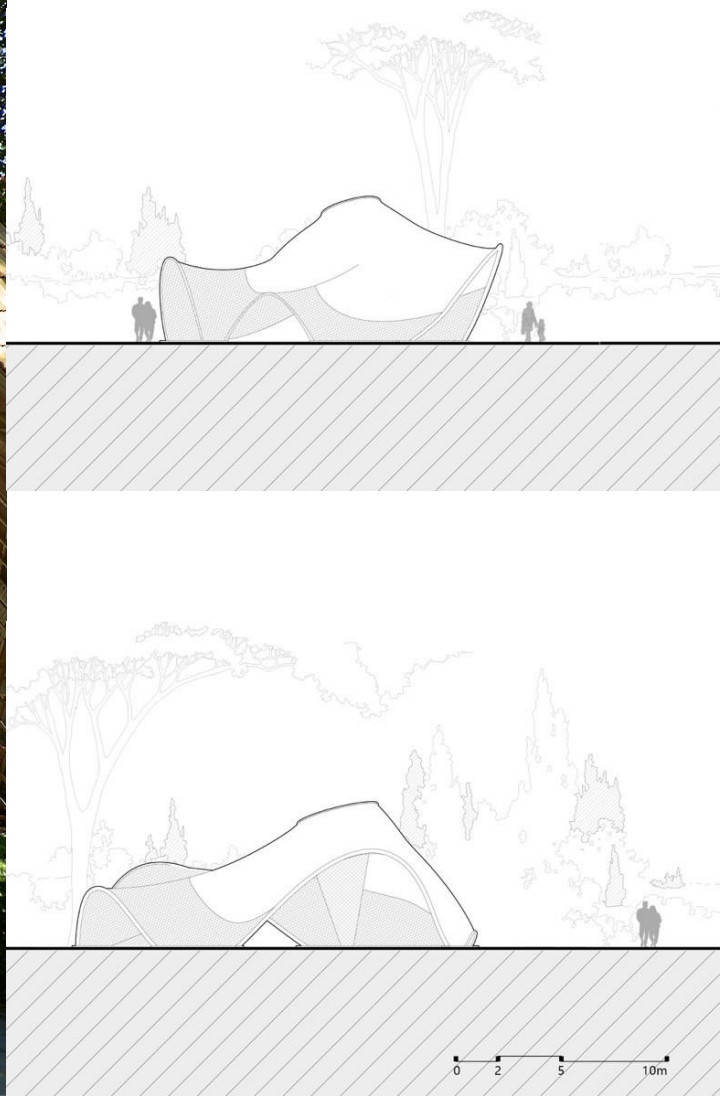
1. Bamboo Tile
   Waterfroff Material
   Reed Mat
   Crossing Grid of Bamboo
2. Moso Bamboo Beam, 90mm in diameter
3. Steel Tube, 35mm in diameter
4. PMMA
   Crossing Grid of Bamboo
5. 150mm Bamboo Roof Boarding
6. Spotlight
7. Striplight
8. Bolt
9. Connection Fittings for Fundation
   5mm Steel Plate
10. Reinforcement Bars in Fundation
    12mm in diameter
11. Gravel Ground
12. C30 Concrete Base
13. Stone Road on site


Bushes on the Site
PMMA
Crossing Grid of Bamboo
Curved Beams
Seepage well
Bamboo Tile
Waterproof Material
Reed mat
Crossing Grid of Bamboo
Curved Beams
Gravel Ground
PMMA
Crossing Grid of Bamboo
Curved Beams (with Spotlight)
Curved Beams (with Strip light)
Crossing Grid of Bamboo
Concrete Cladding
Metal Plate
Concrete Base






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0
2
5
10m



Constructing with Bamboo







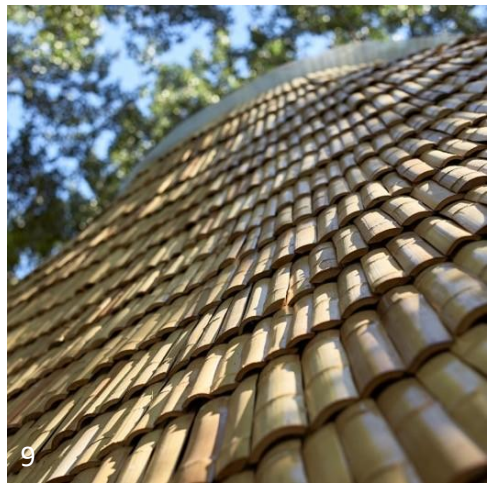






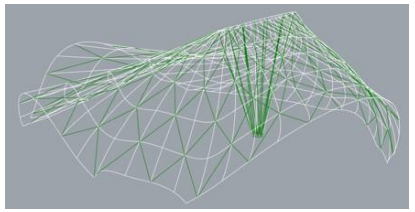




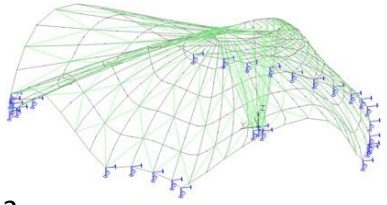


1. Raw bamboo as building materials.
2. Bamboo splits cut by workers.
3. Bamboo tiles with waterproof membrane and reed mats underneath.
4. Bamboo beams connected in traditional ways.
5. Waved bamboo splits above the bamboo beams.
6. Bamboo tile and PMMA as roof materials for light and rain-proofing
7. Central cone as a supporting structure and a channel for light.
8. Cast-in-place concrete as strip foundation for the bamboo beams.
9. Bamboo tiles used to create sense of rhythm.

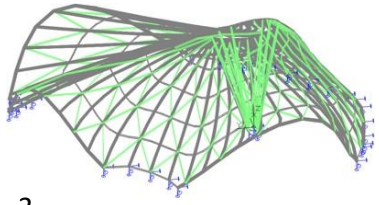
Structural calculation



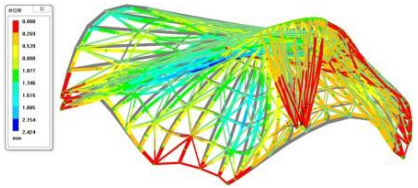
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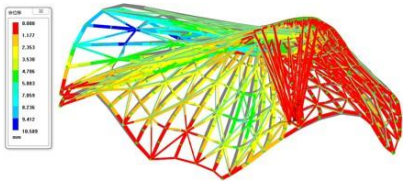
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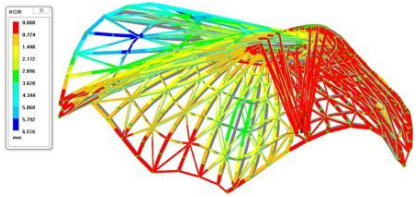
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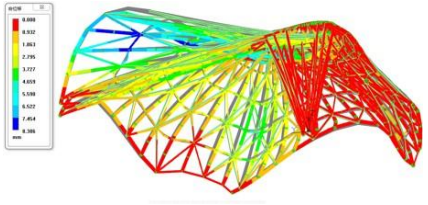
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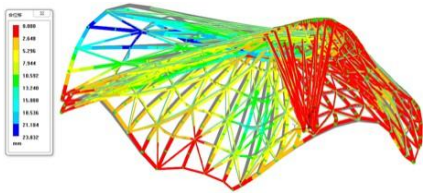
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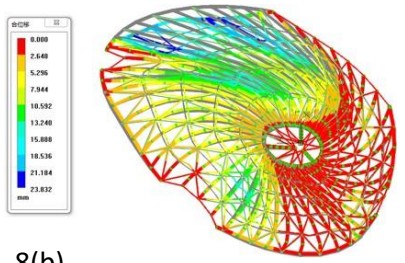
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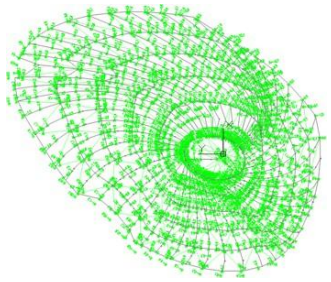
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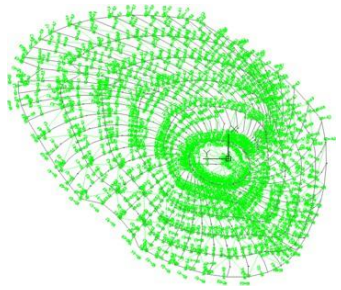
8(a)



8(b)



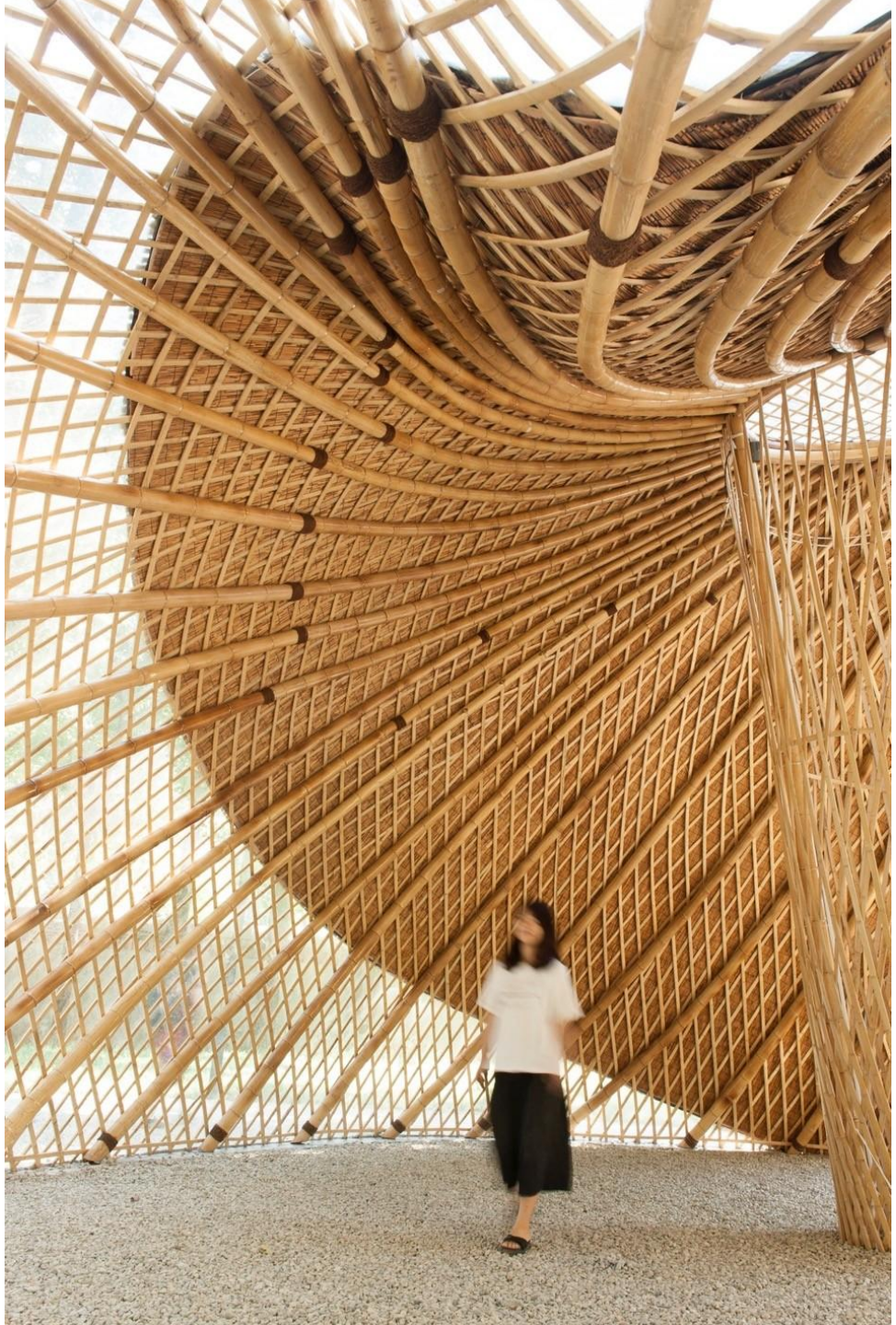
9



10

1. Line model in Rhino
2. Structural calculation model in 3D3S
3. Structural calculation model in 3D3S
4. Structural deformation under self-heavy load (maximum displacement 2.4mm)
5. Structural deformation under wind load (pressure) (maximum displacement 10.6mm)
6. Structural deformation under wind load (suction) (maximum displacement 6.5mm)
7. Structural deformation under snow load (maximum displacement 8.4mm)
8. Structural deformation under the most unfavorable load combination (maximum displacement 23.8mm)(a. perspective； b. top view)
9. Structural axial force distribution under the most unfavorable load combination
10. Distribution of bending moments of structures under the most unfavorable load combination









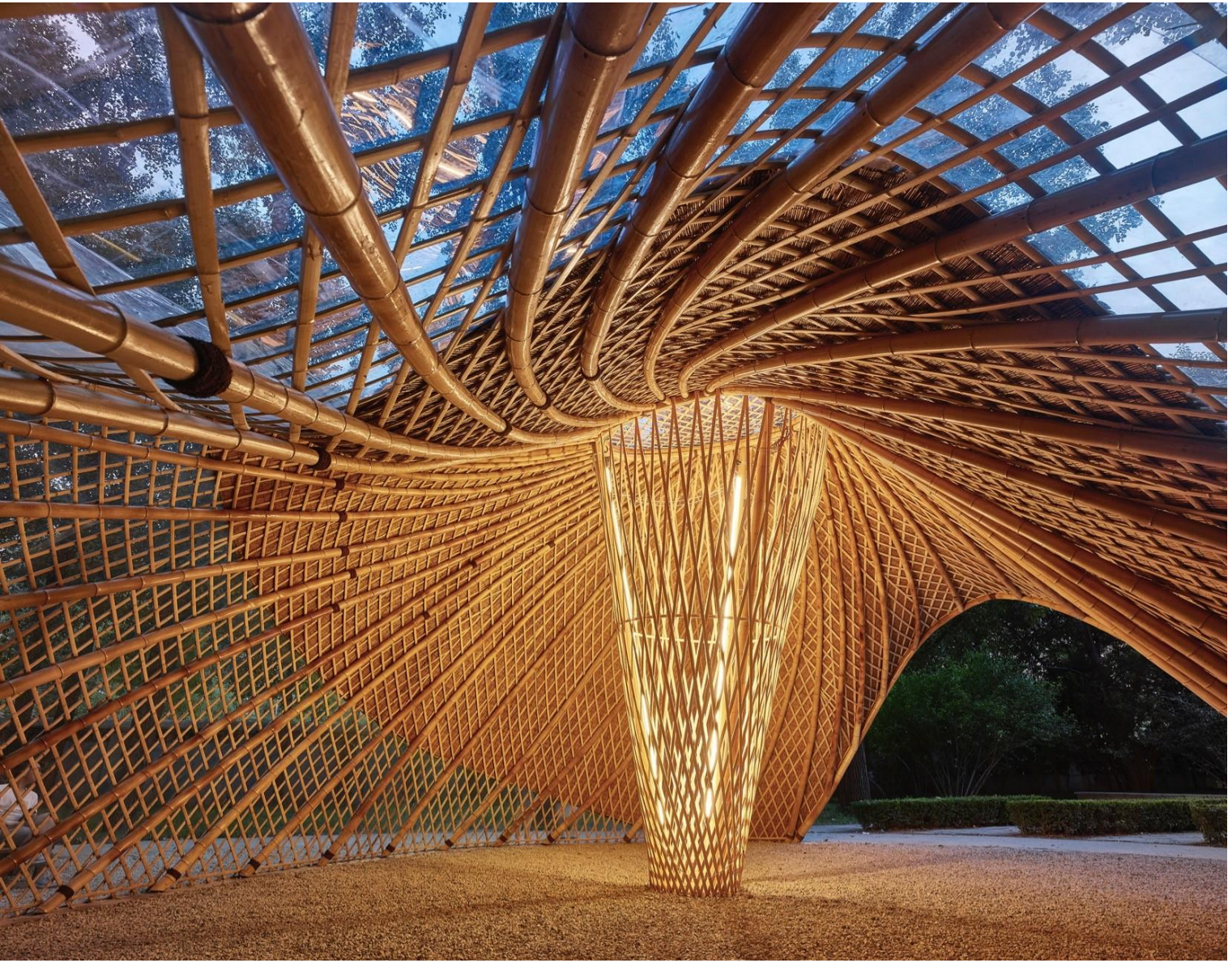










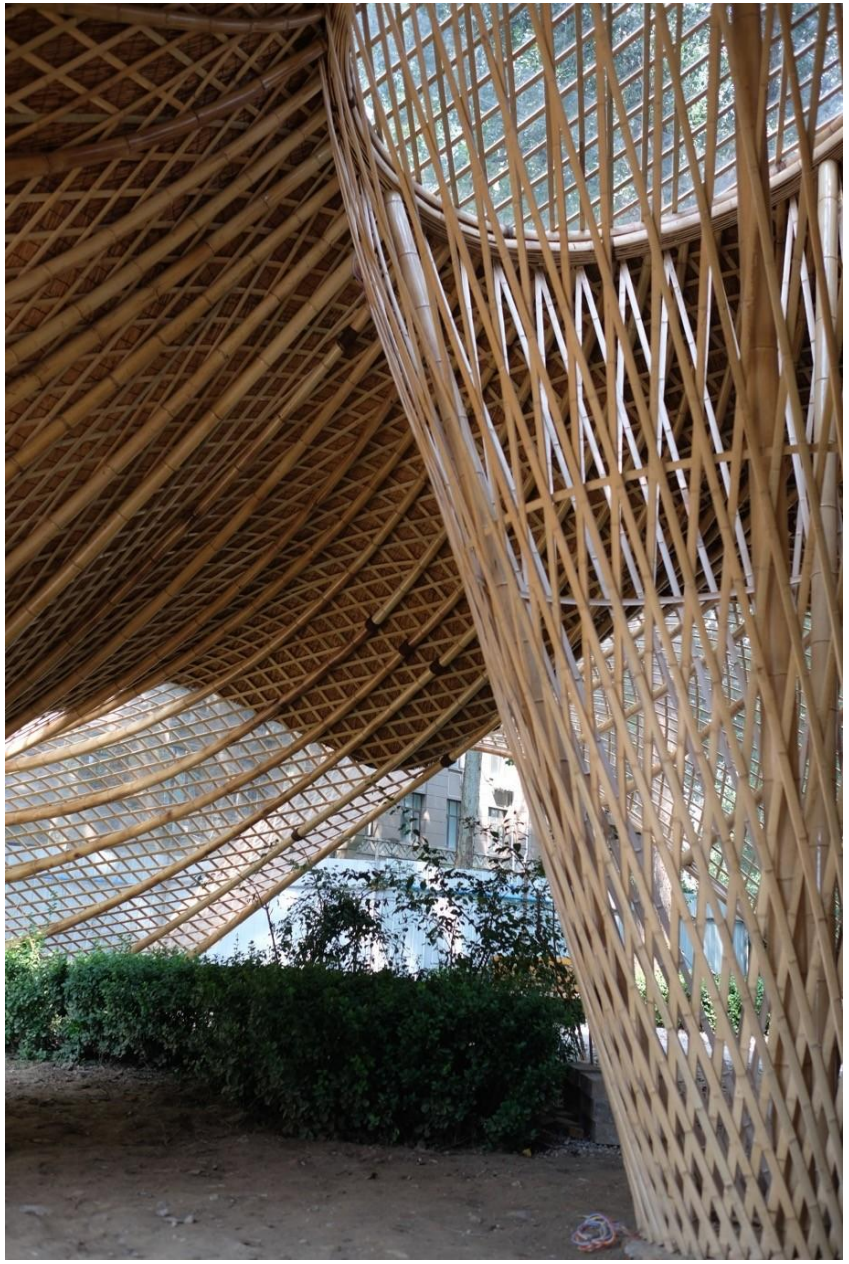








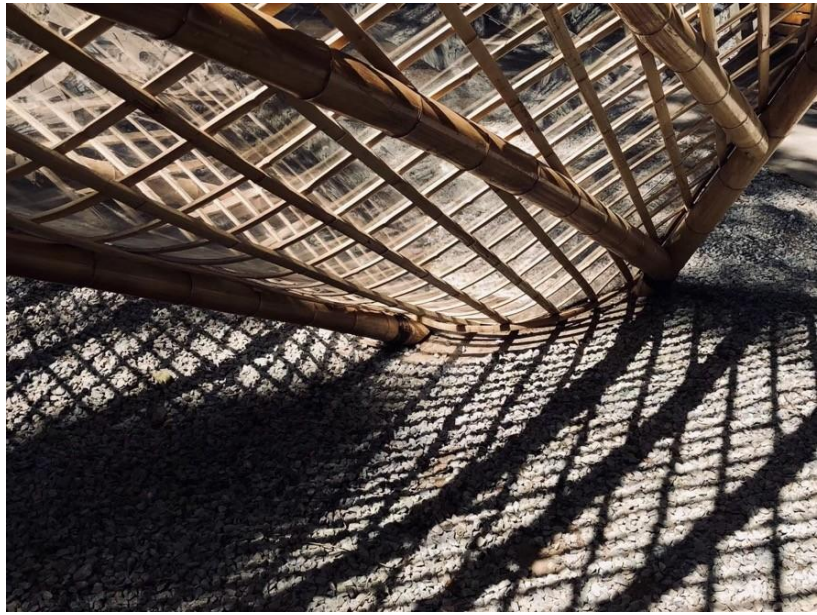












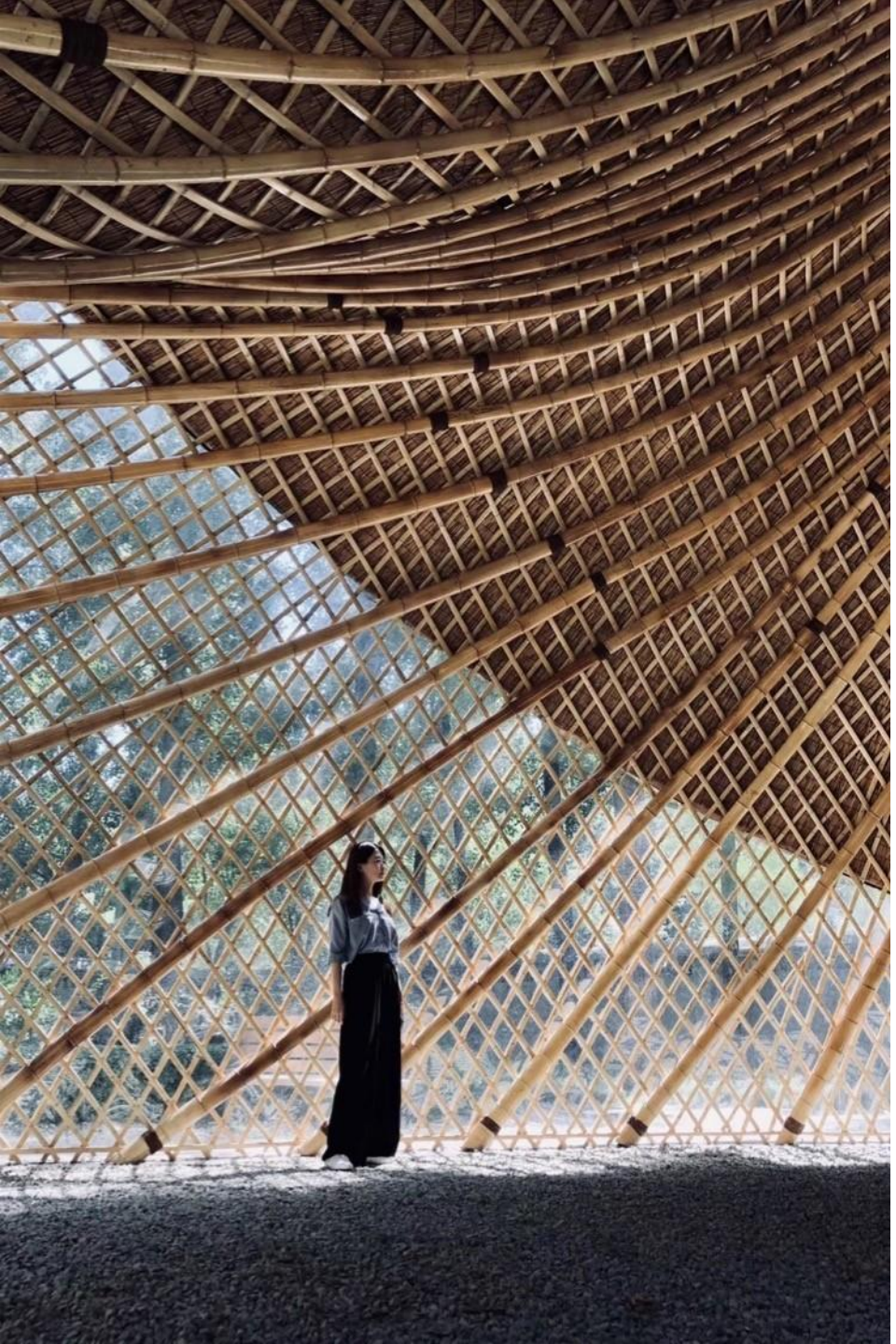






















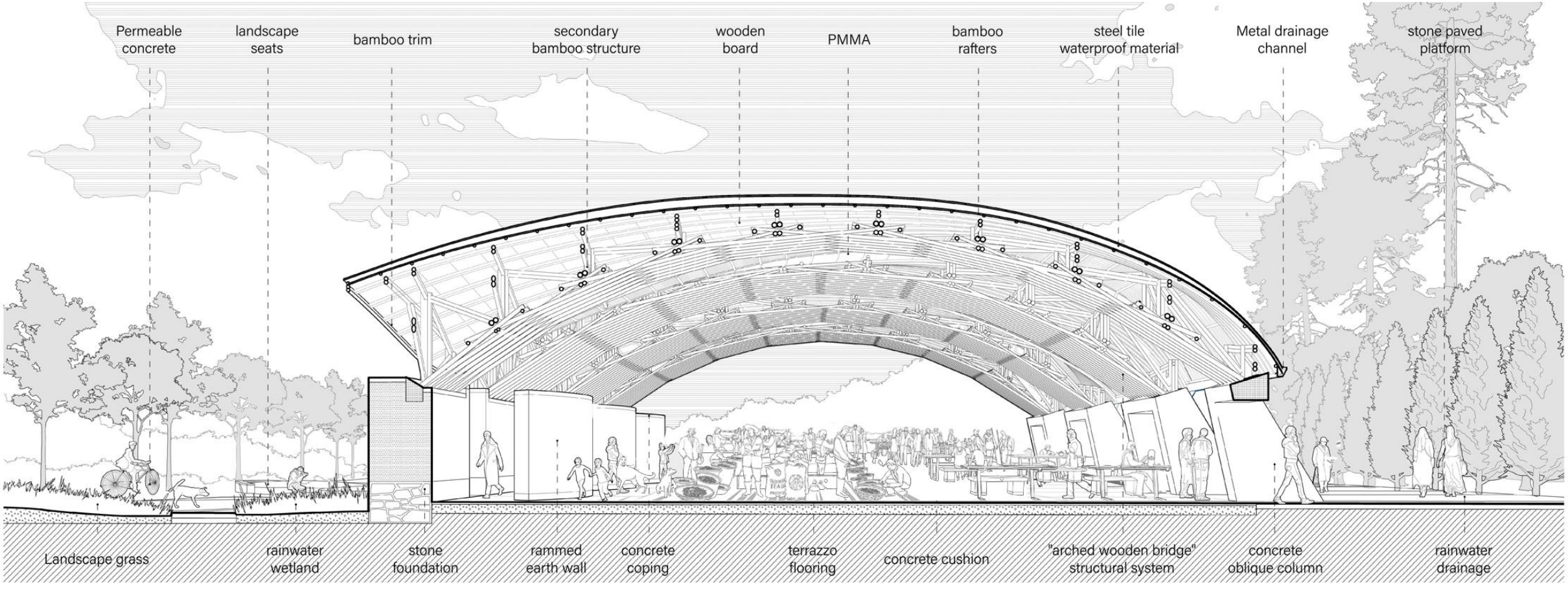


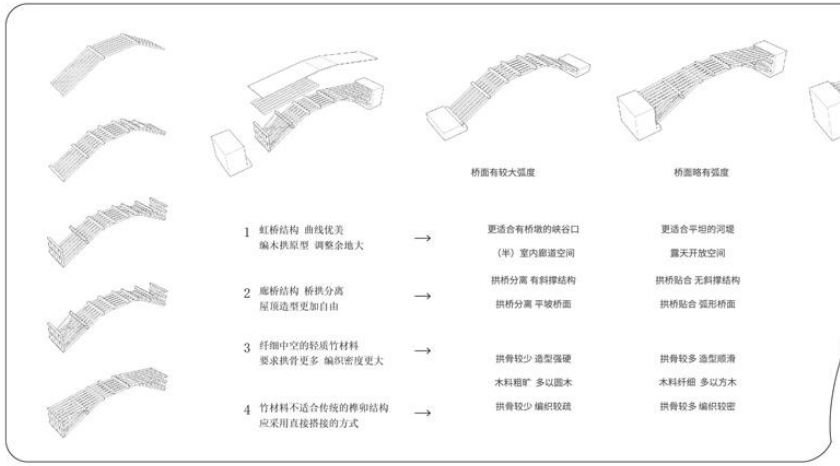


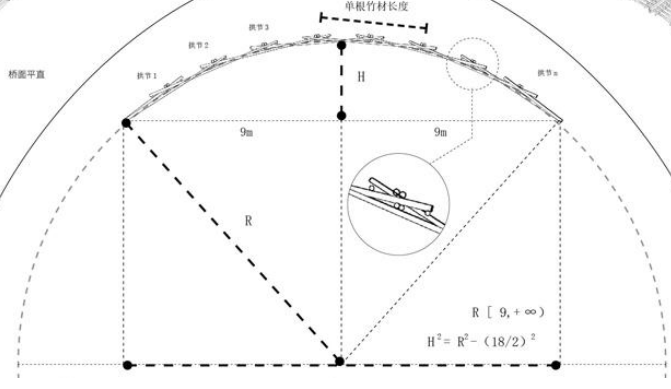
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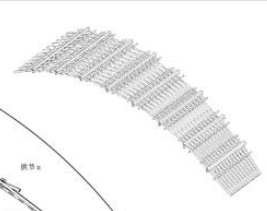
Tea-leaf Market of Zhuguanlng

2021







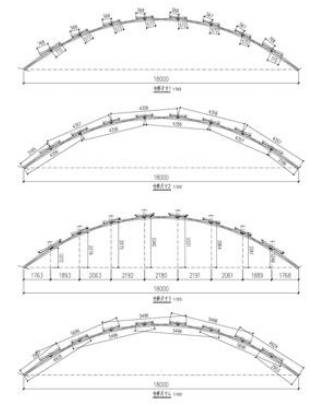


1 已经确定的条件：
a. 跨度为 18m
b. 单根竹材最长不要超过 4500mm 以确保不产生明显形变。
c. 拱节横插口径为 100mm

2 需要确定的量：
a. 拱架的拱节数
b. 拱弧半径大小（拱的最高点）
c. 拱节横插口径为 100mm

a. 拱架高度尽量低（尺度 / 抗风 / 限制造型）
b. 单根竹材尽量短（形变 / 大小头）
c. 拱节尽量少（节点少 / 施工难度）
d. 选择“双节拱”（单一系统对称施工）







拱节（节）	单根竹长（mm）	曲弧半径（mm）
3		
4		
5	>5500	
6	5360	18000
7	4820	14700
8	4440	12500
9	4170	11100
10	4000	10100
11	3890	9550
12	3800	9220
13		<9000

Abandoned Natural Stone

Vernacular elements



REUSE







Abandoned Timber









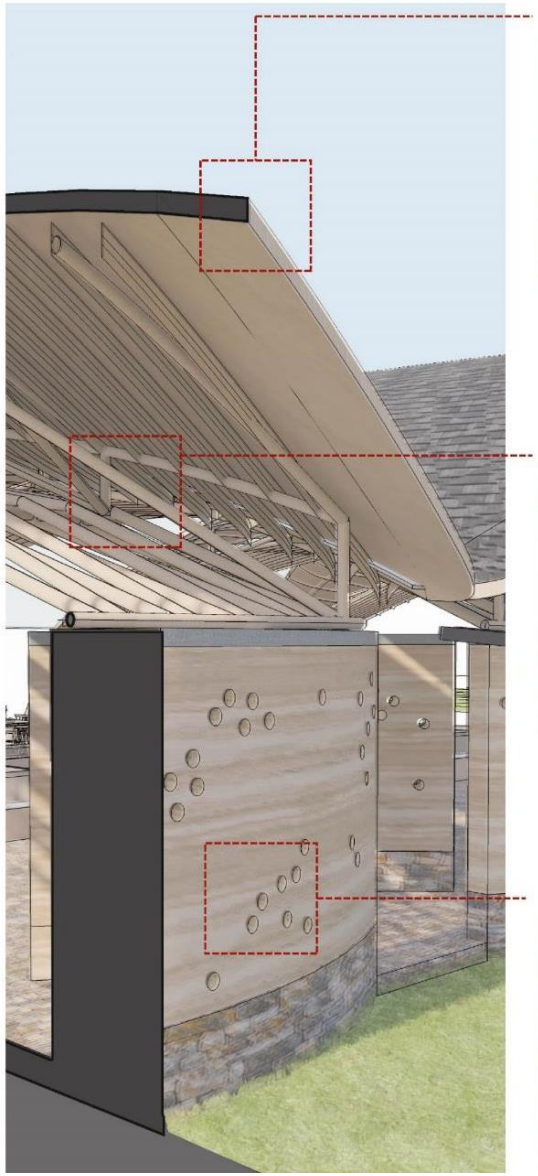
Broken Stone Plates







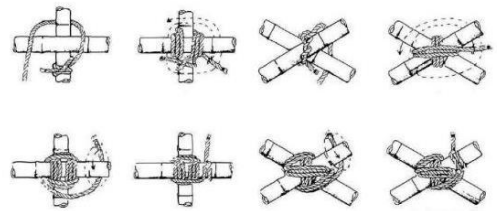




Bamboo for Roof





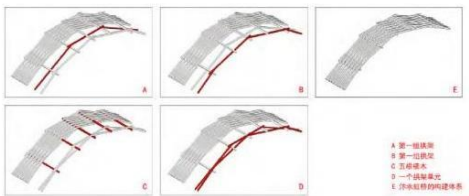


The roof secondary structure is made of bamboo, which is widely planted in Fujian and Zhejiang, China. As a building material, due to its light weight and good toughness, the earthquake resistance of bamboo is very outstanding, and it is a widely accepted regional building material. Durable bamboo can be used in pavilions, observation decks, corridors, pontoons, etc.

Arched Wooden bridge as pototype for large span structure





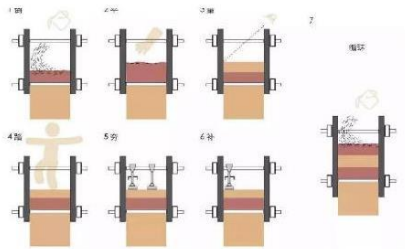


The main structure of the building's large-span structure is inspired by the arched wooden bridge. The wooden arch bridge is a traditional bridge structure form in Fujian, China, which utilizes the principle of overlap between bamboo and wood to convert deflection into side thrust and solve the need for long spans. At present, the technique of wooden arch bridge has become China's intangible cultural heritage.

Rammed earth for Wall











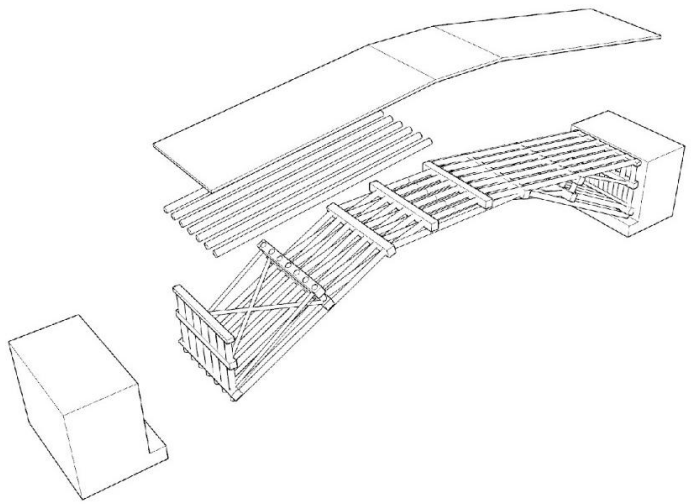
Nearby Vaulted Timber Bridge



竹构编木拱设计策略 Bamboo–Woven Timber Arch Design Strategy

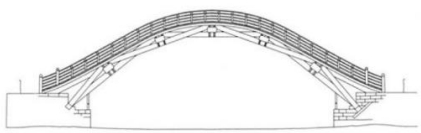
虹桥与廊桥的对比研究 – 异

	木拱廊桥	汴水虹桥
1 虹桥结构 曲线优美 编木拱原型 调整余地大 →	更适合有桥墩的峡谷口	更适合平坦的河堤
	（半）室内廊道空间	露天开放空间







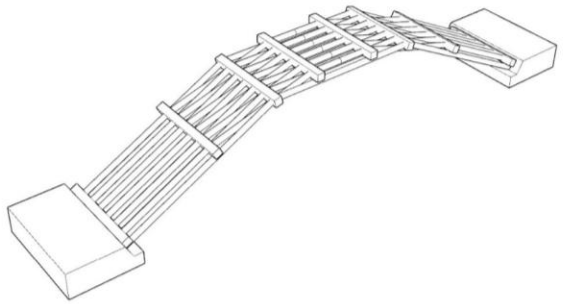




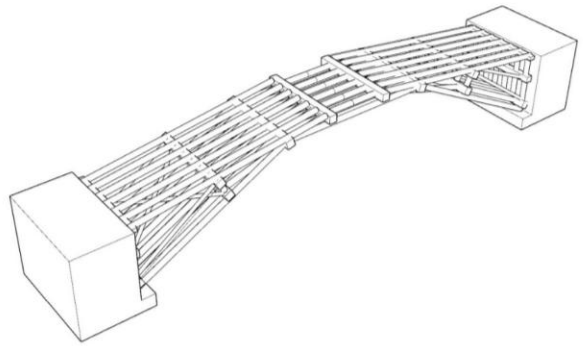
竹构编木拱设计策略 Bamboo–Woven Timber Arch Design Strategy

虹桥与廊桥的对比研究 – 异

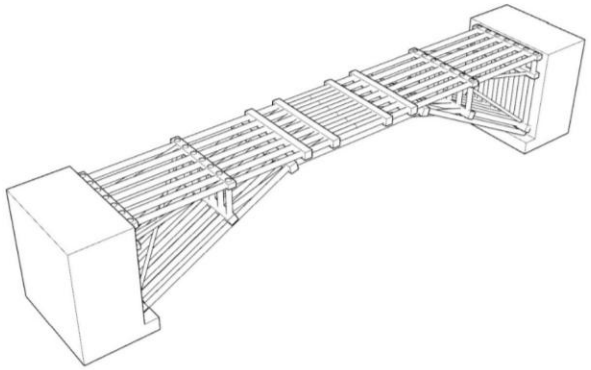
	木拱廊桥	汴水虹桥
2 廊桥结构 桥拱分离 屋顶造型更加自由 →	拱桥分离 有斜撑结构	拱桥贴合 无斜撑结构
	拱桥分离 平坡桥面	拱桥贴合 弧形桥面



桥面有较大弧度



桥面略有弧度

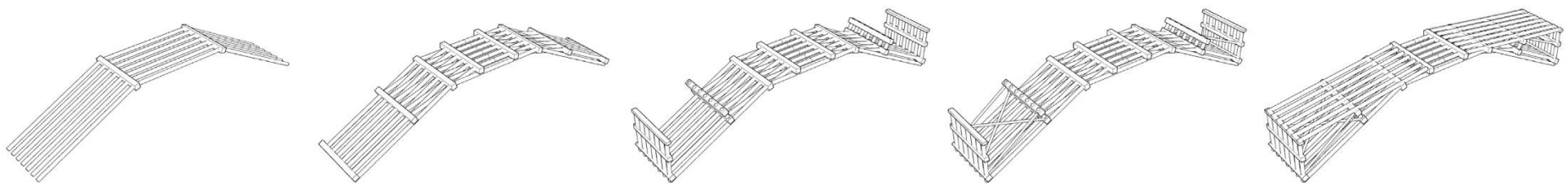


桥面平直

竹构编木拱设计策略 Bamboo–Woven Timber Arch Design Strategy

虹桥与廊桥的对比研究 – 同

	木拱廊桥	汴水虹桥
1 纤细中空的轻质竹材料 要求拱骨更多 编织密度更大 →	拱骨较少 造型强硬	拱骨较多 造型顺滑
	木料粗旷 多以圆木	木料纤细 多以方木
2 竹材料不适合传统的榫卯结构 应采用直接搭接的方式 →	拱骨较少 编织较疏	拱骨较多 编织较密



竹构编木拱设计策略 Bamboo–Woven Timber Arch Design Strategy

单元编木拱设计

1 已经确定的条件：

a. 跨度为 18m

b. 单根竹材最长不要超过 4500mm 以确保不产生明显形变。

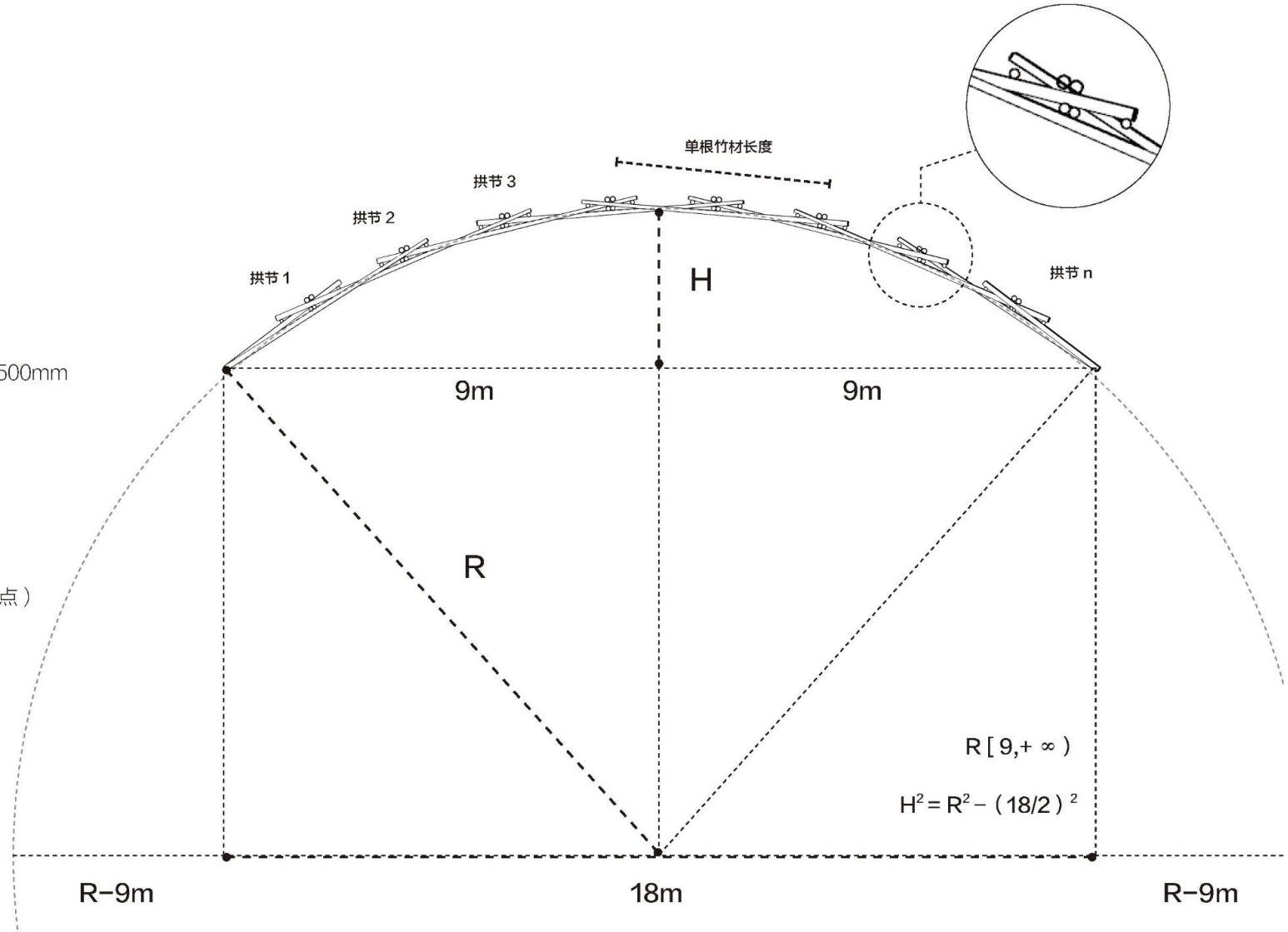
c. 拱节横插口径为 100mm

2 需要确定的量：

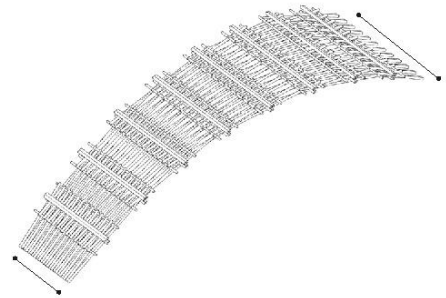
a. 拱架的拱节数

b. 拱弧半径大小（拱的最高点）

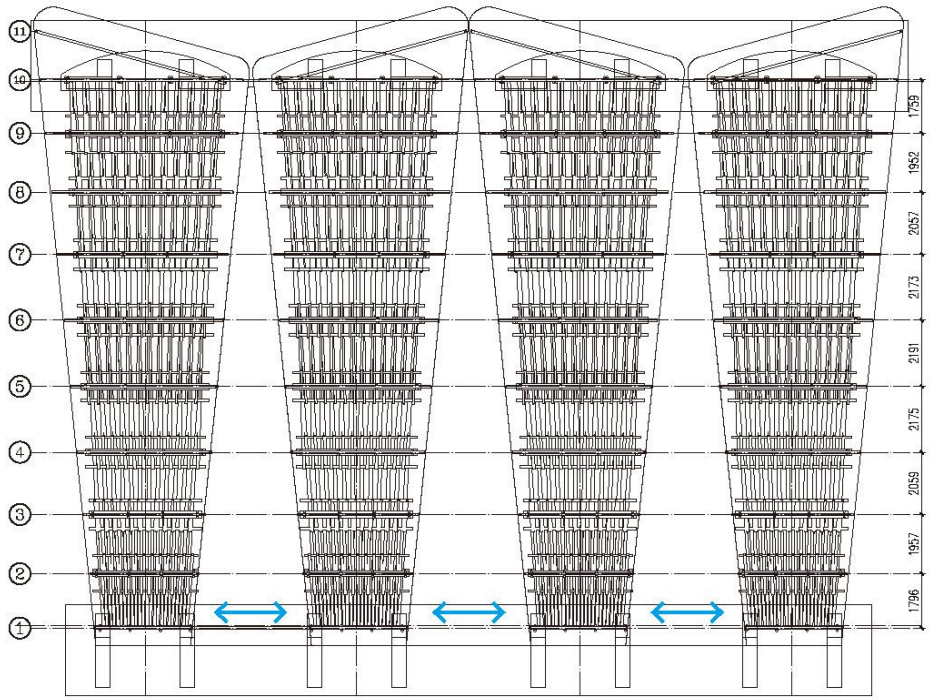
c. 拱节横插口径为 100mm

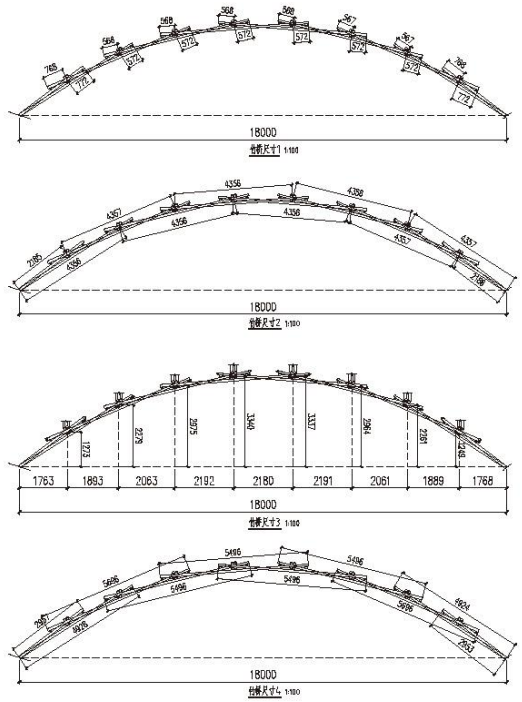


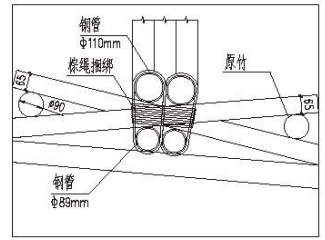
竹构编木拱设计策略 Bamboo–Woven Timber Arch Design Strategy

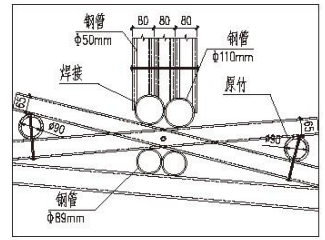


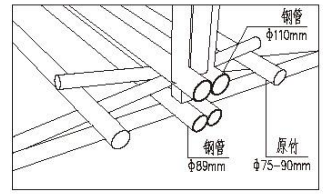
单元编木拱设计



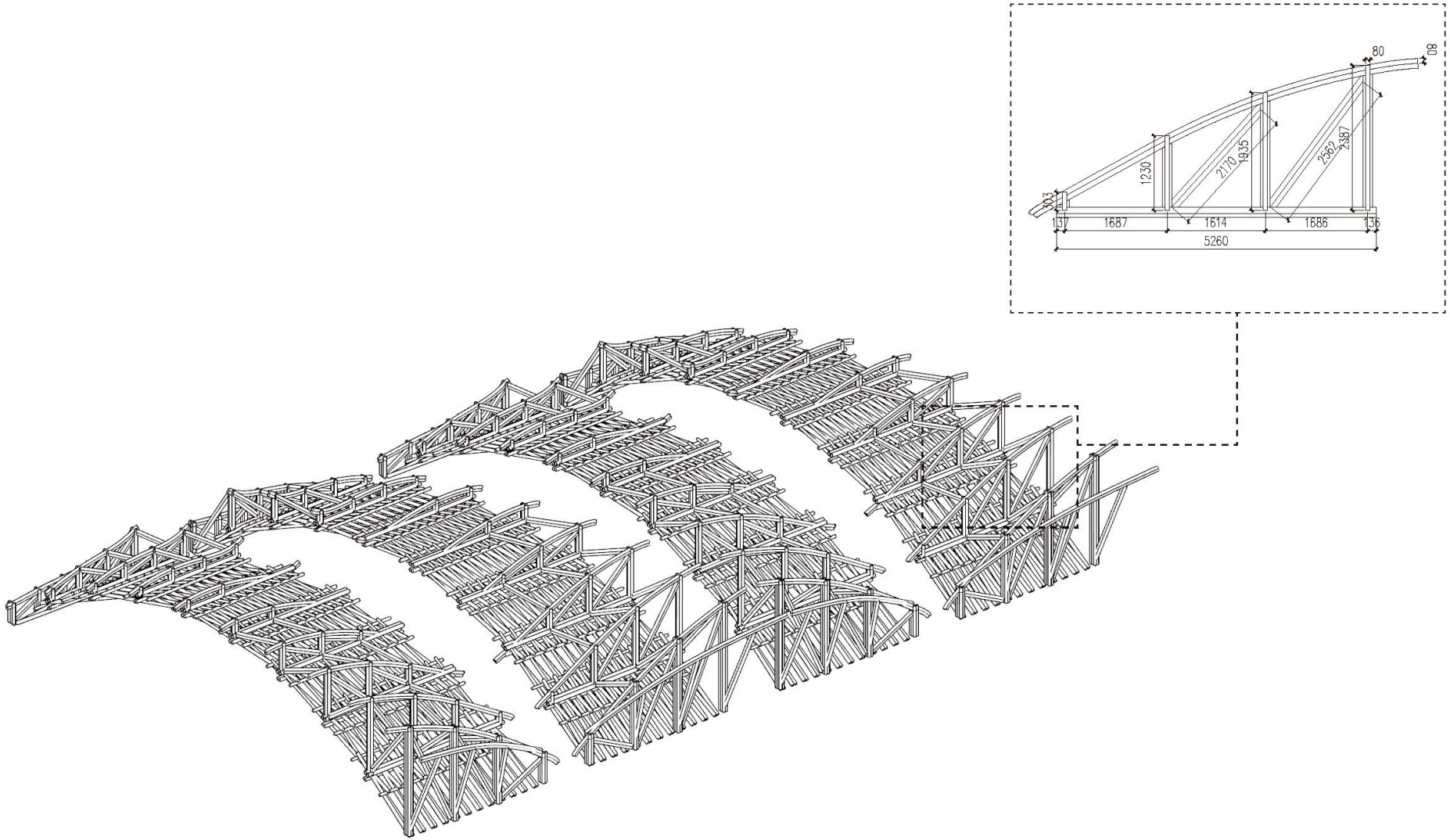




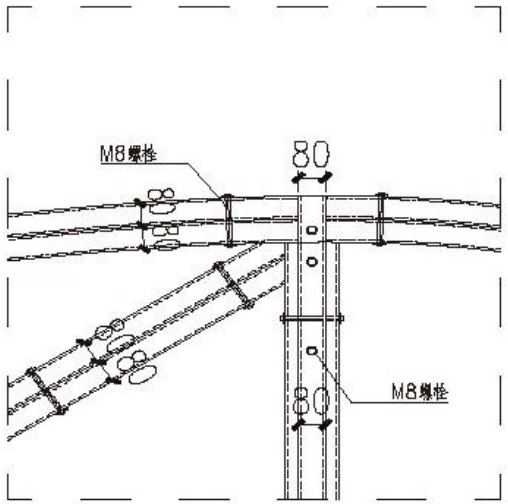


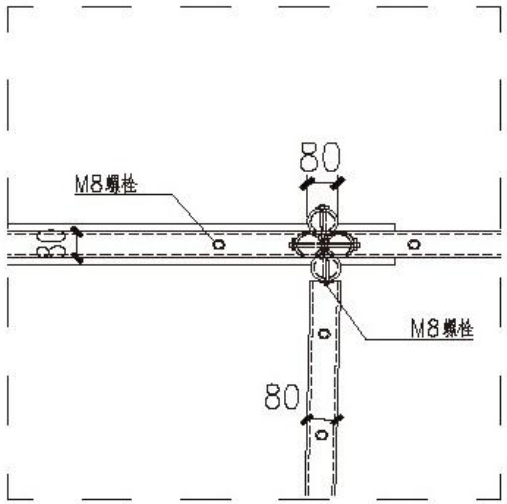


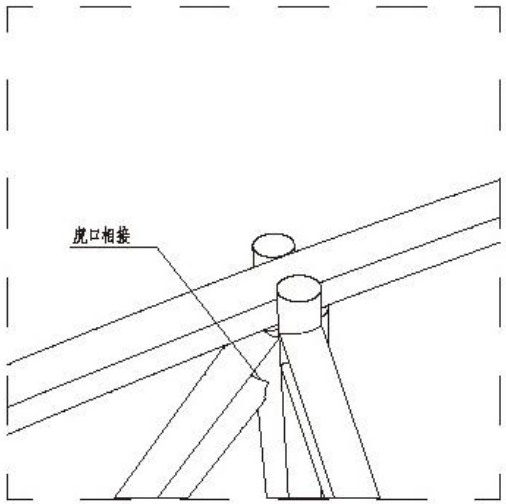
竹构编木拱设计策略 Bamboo–Woven Timber Arch Design Strategy

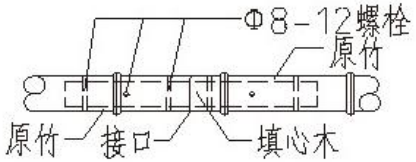


竹构编木拱设计策略 Bamboo–Woven Timber Arch Design Strategy

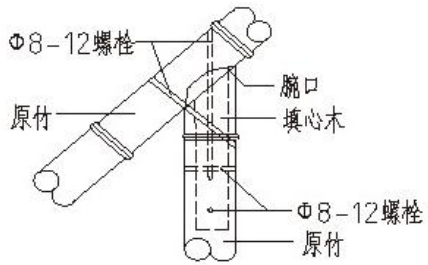




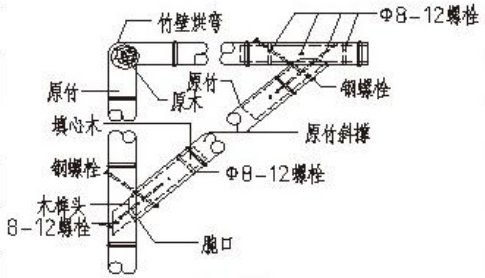




直行接头



斜行接头



牛腿接头

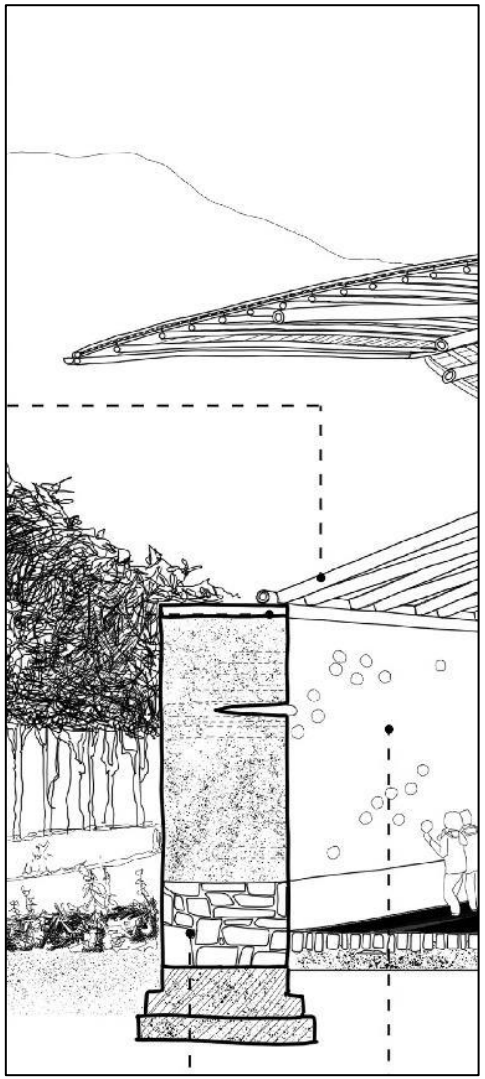




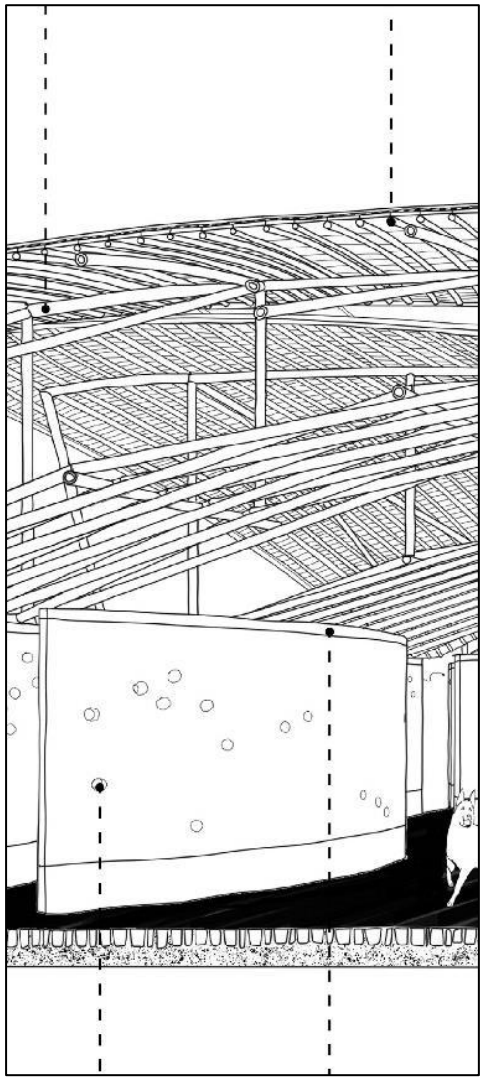


竹构编木拱设计策略 Bamboo–Woven Timber Arch Design Strategy

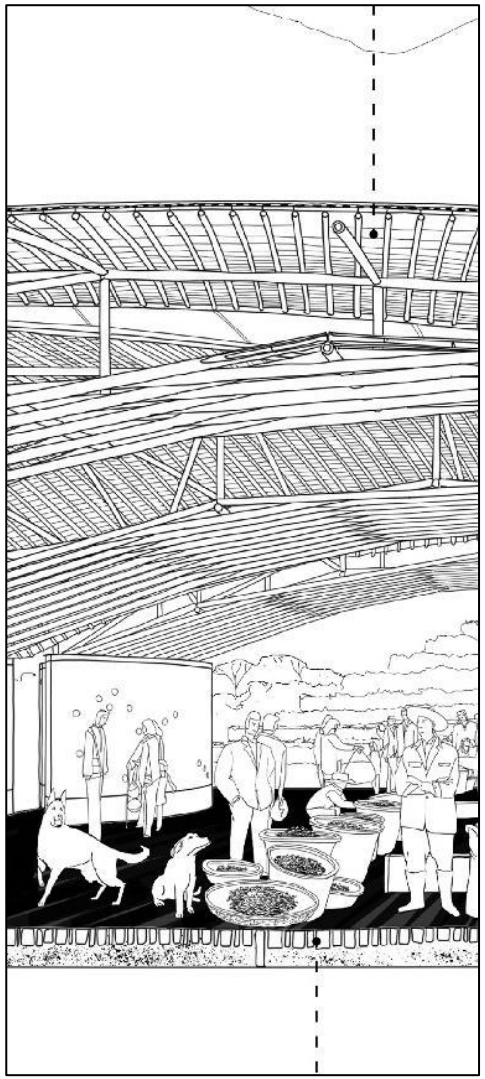
Rammed Earth|Stone



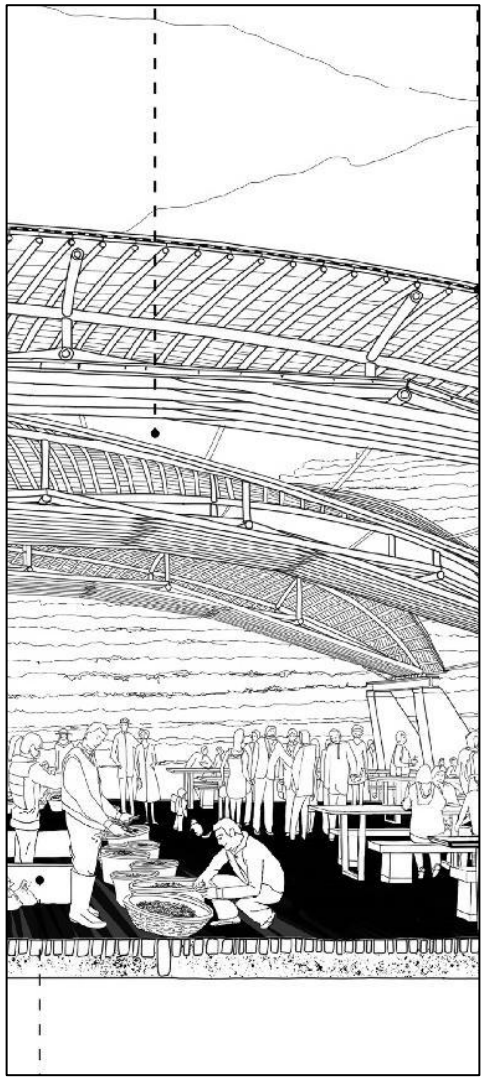
Rammed Earth



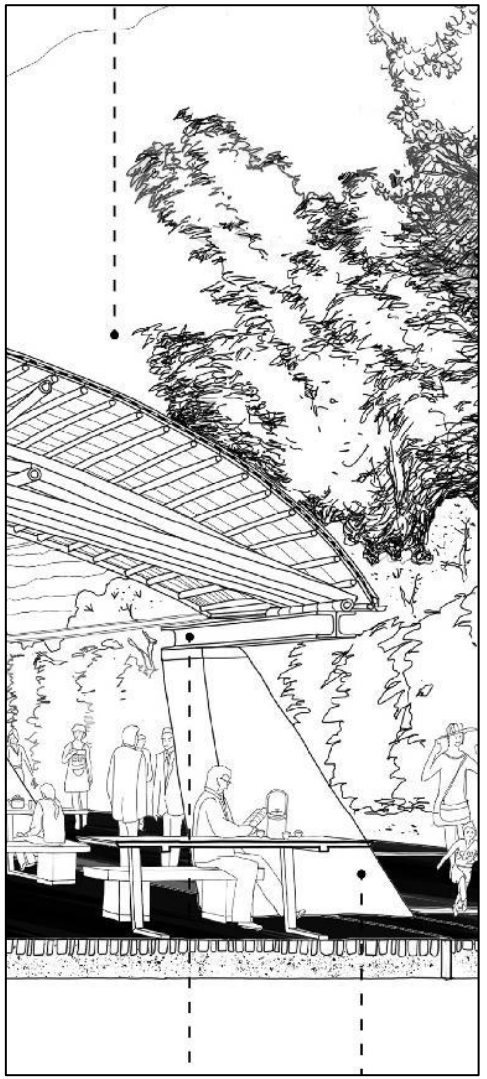
Vaulted Bamboo



PMMA

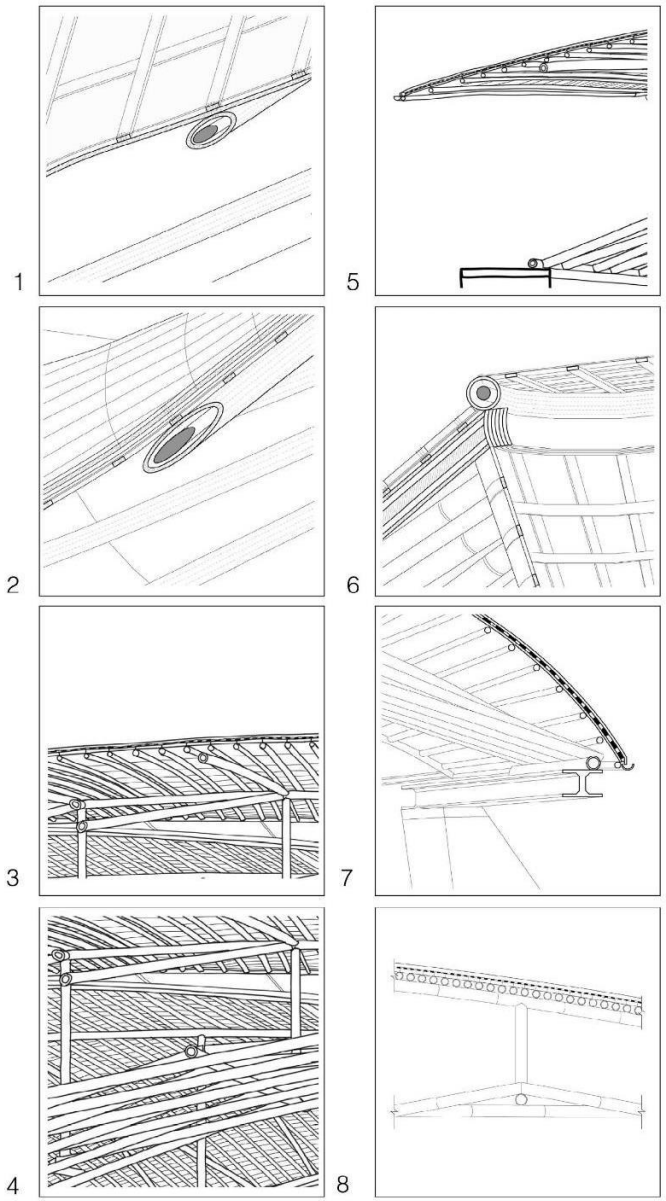


Bamboo Roof

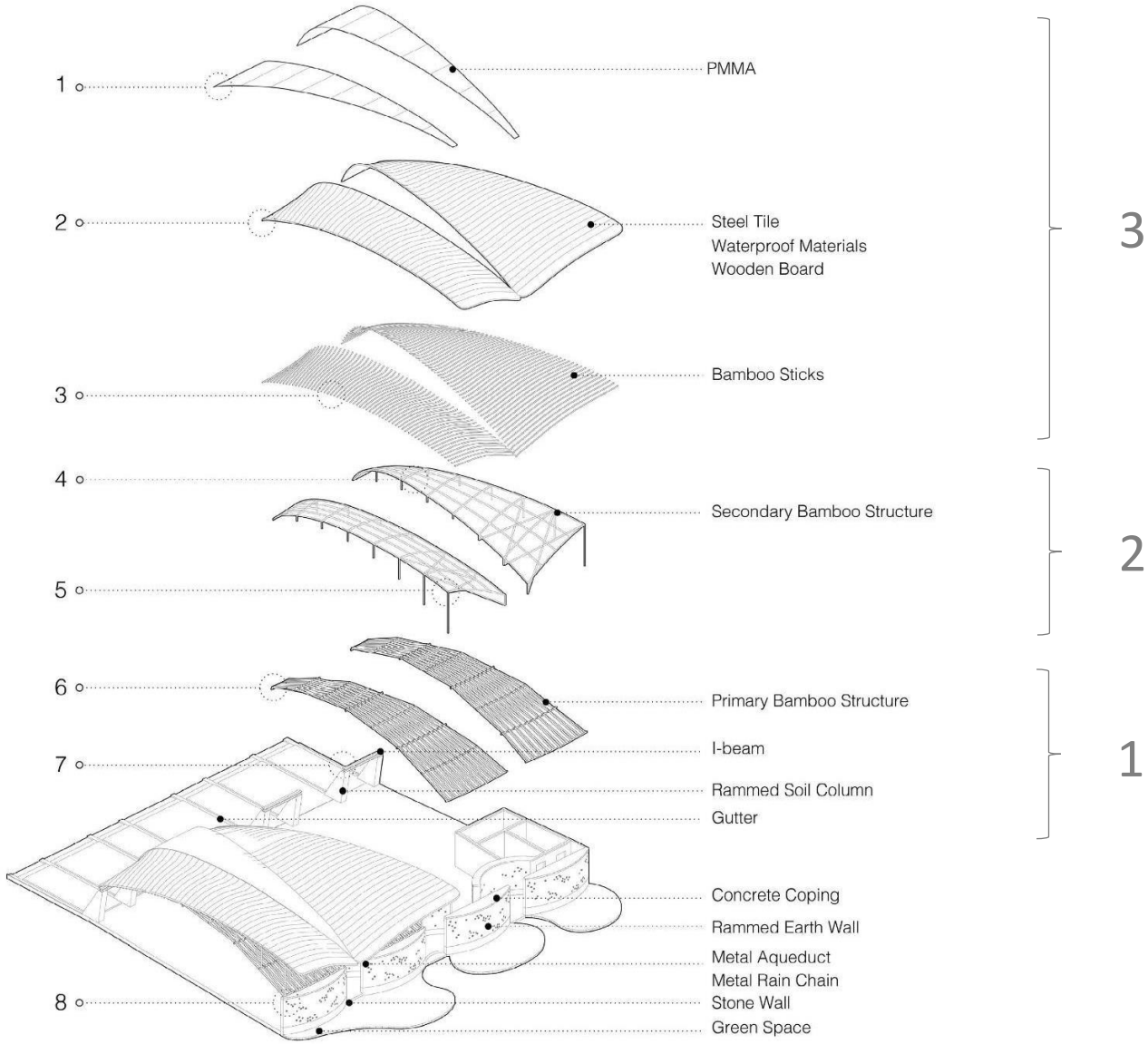


竹构编木拱设计策略 Bamboo–Woven Timber Arch Design Strategy

Details of Construction



Assembly Diagram

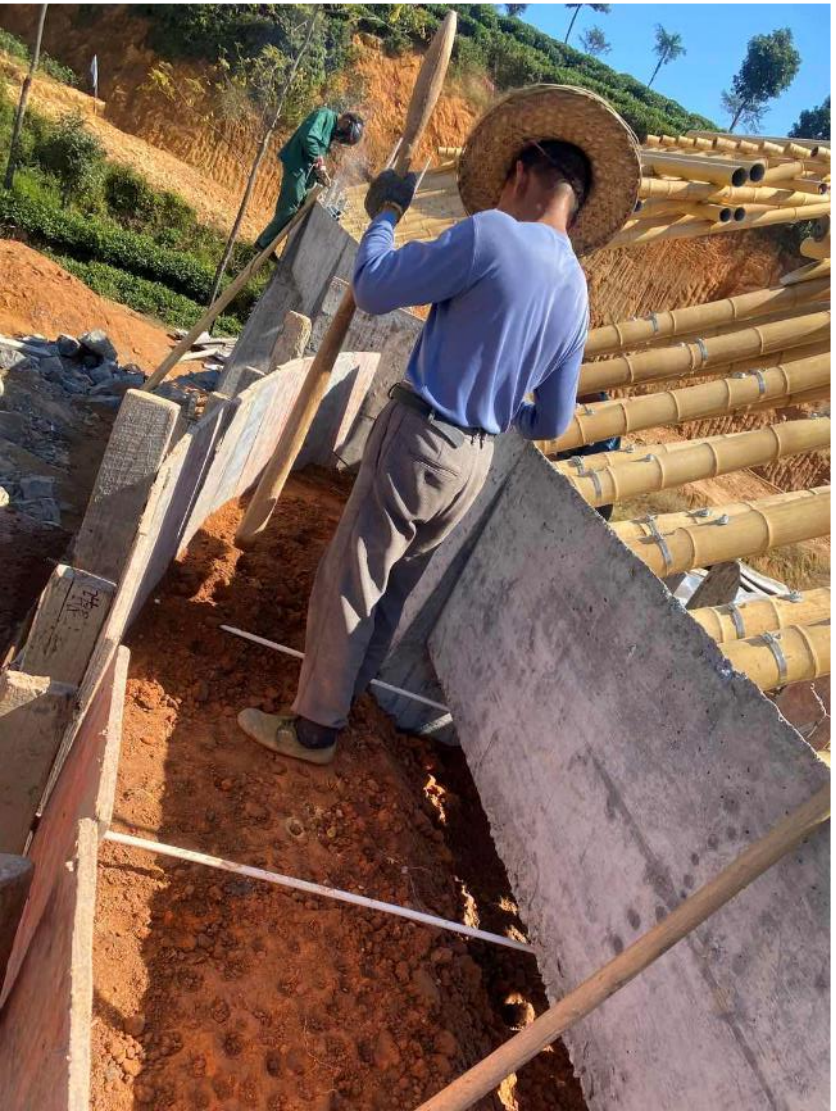


Traditional Stone Base

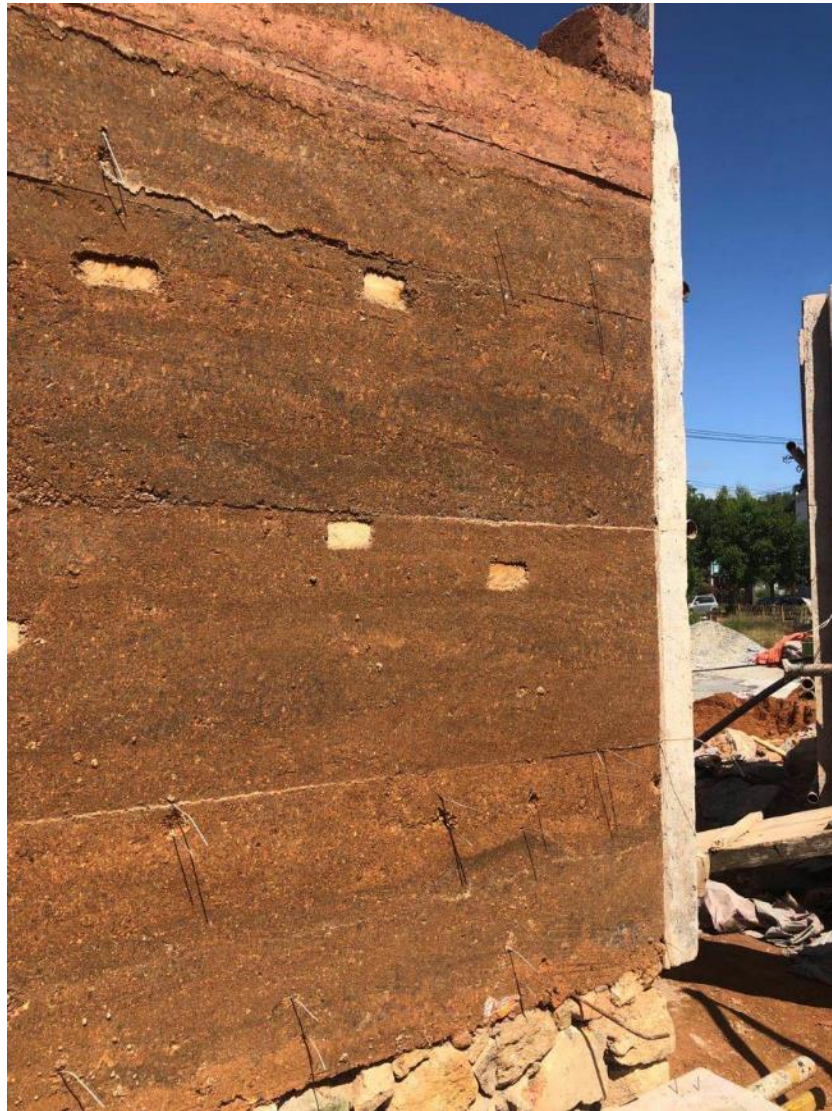




Rammed Earth





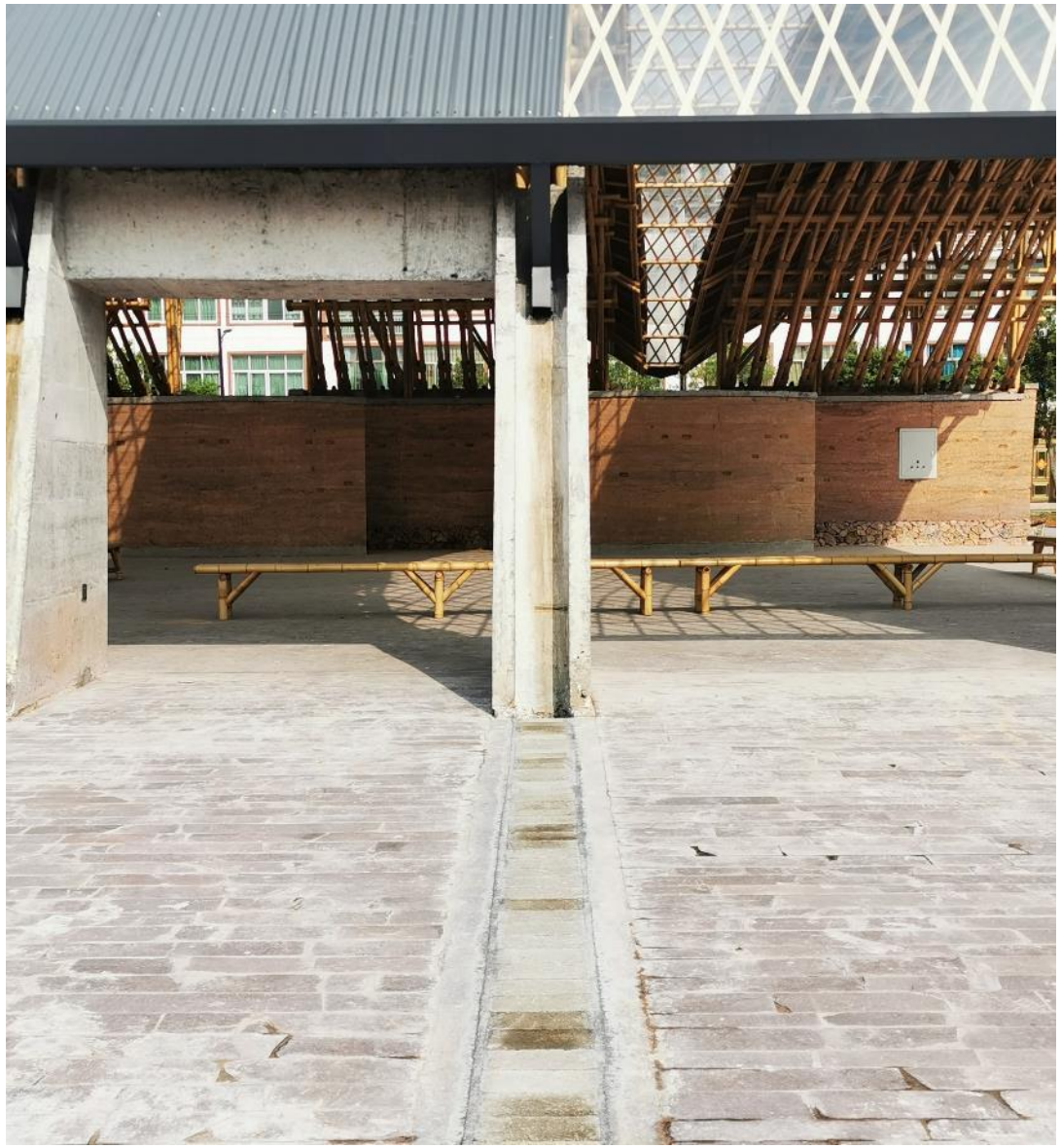

















毛 纳 村 村 民 中 心
Maona Village Center
2023



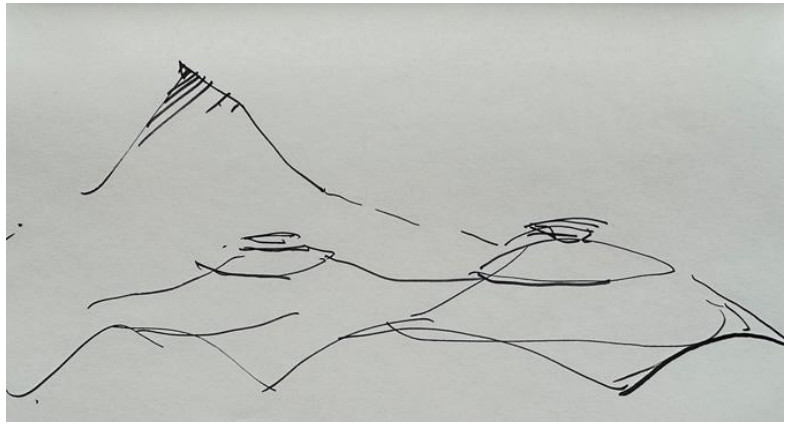
traditional dwellings - boat shaped houses

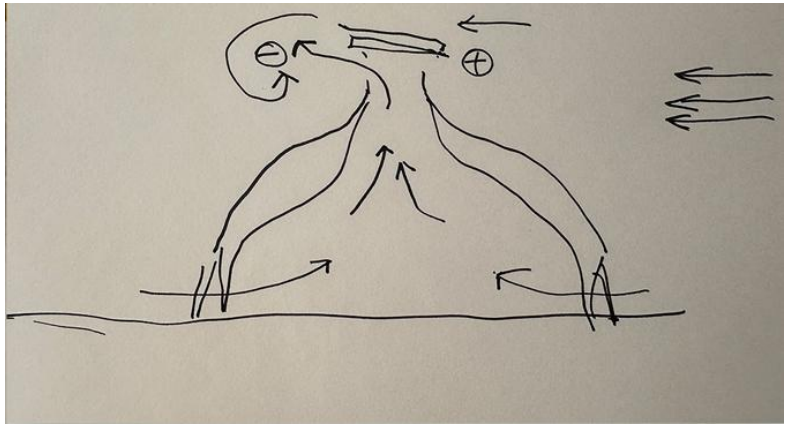


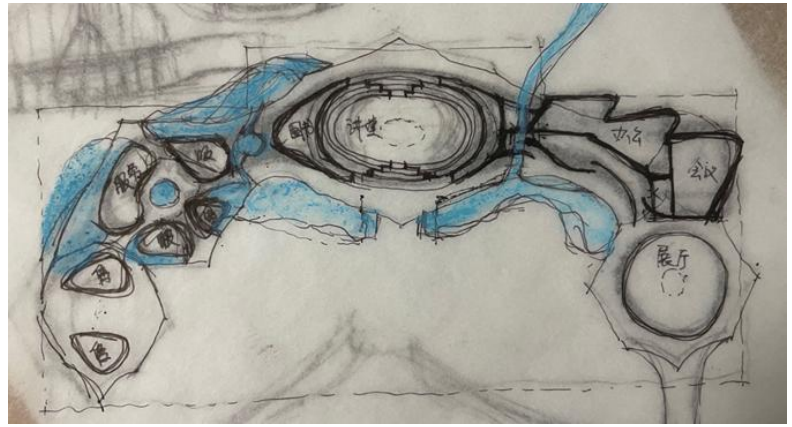




concept generation

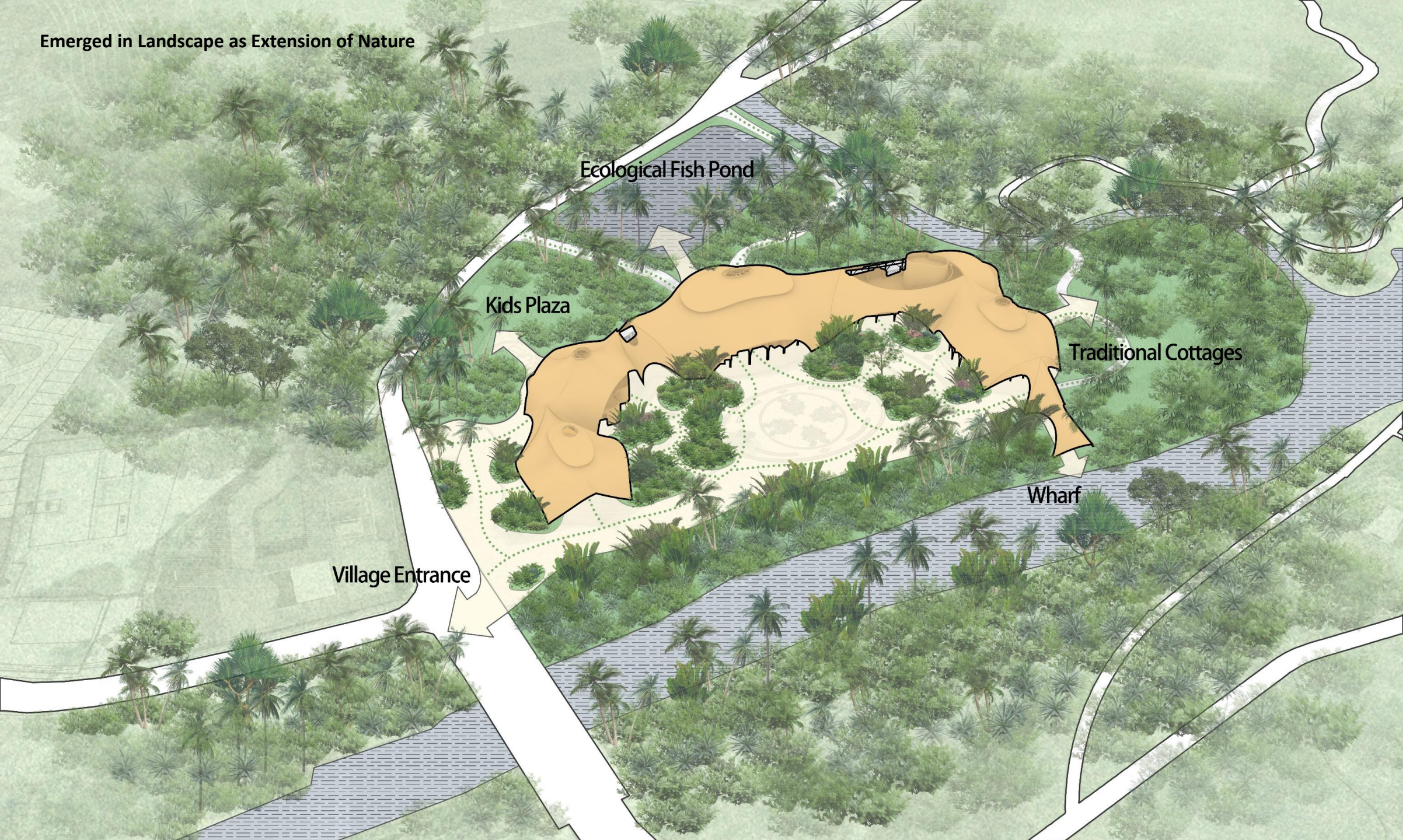






Master Plan of Maona Village – Village Center




Emerged in Landscape as Extension of Nature
Ecological Fish Pond
Kids Plaza
Traditional Cottages
Wharf
Village Entrance

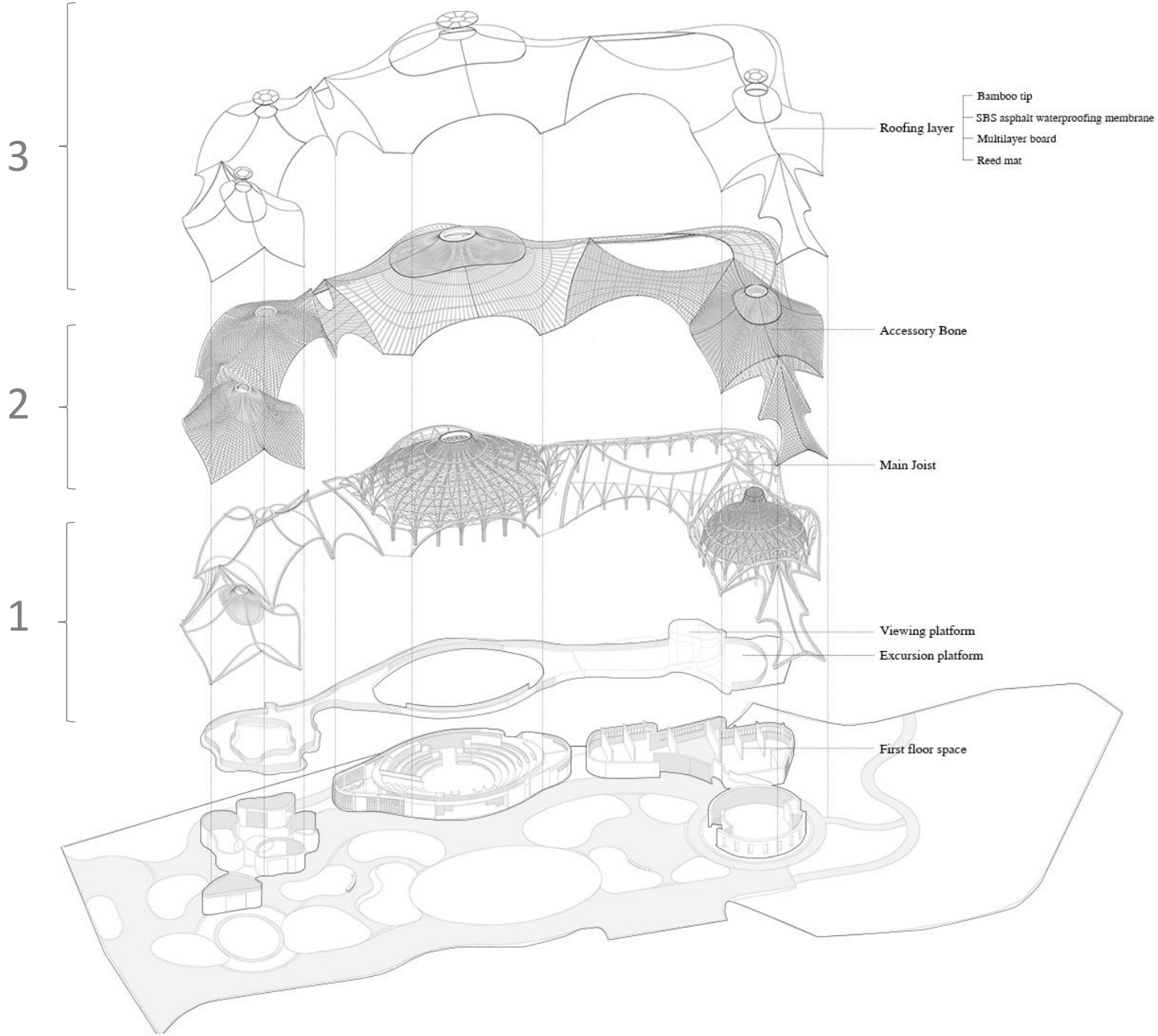




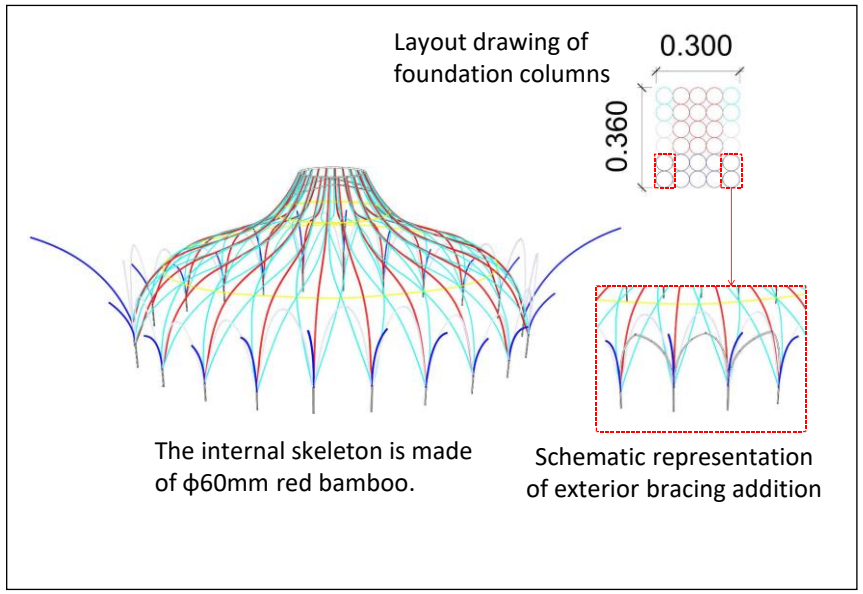


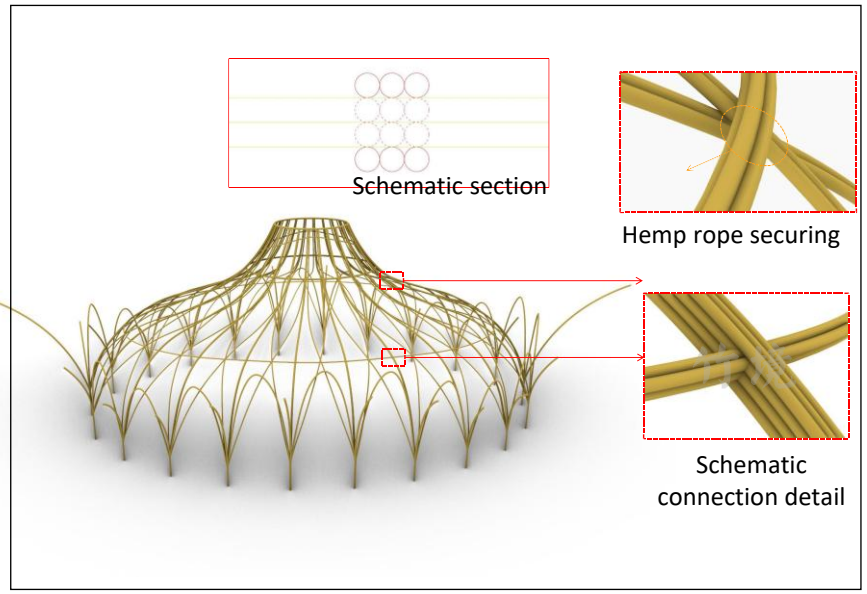


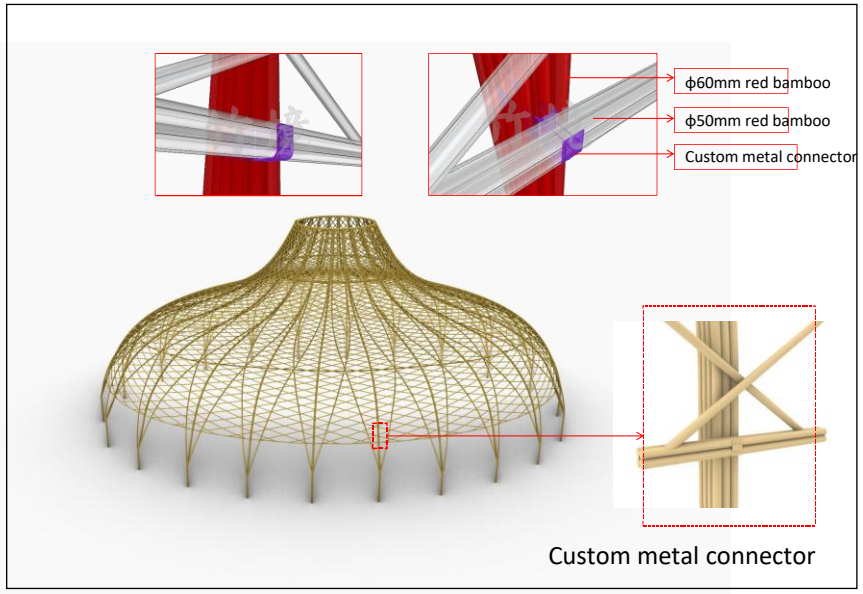
Holistic System Approach of the Project

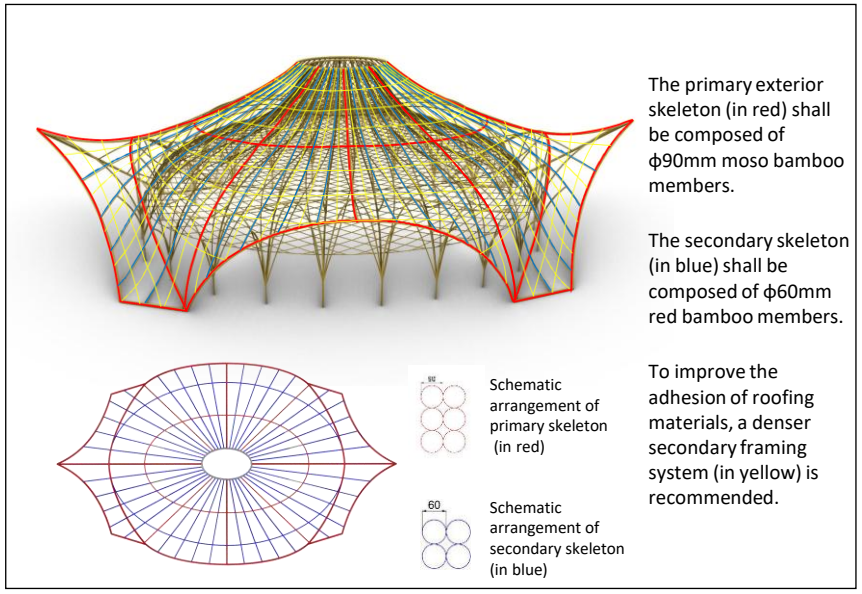


Hierarchy of the Bamboo Structure System





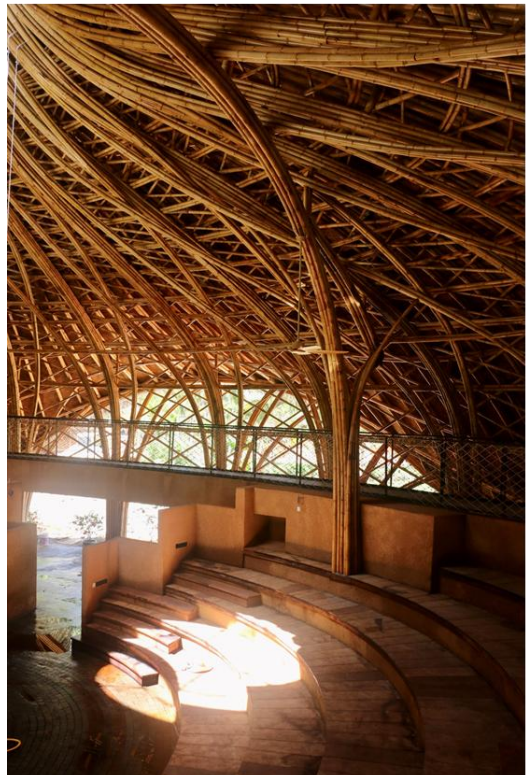





Integrating Multi-activities with Light, Wind, Earth and Bamboo

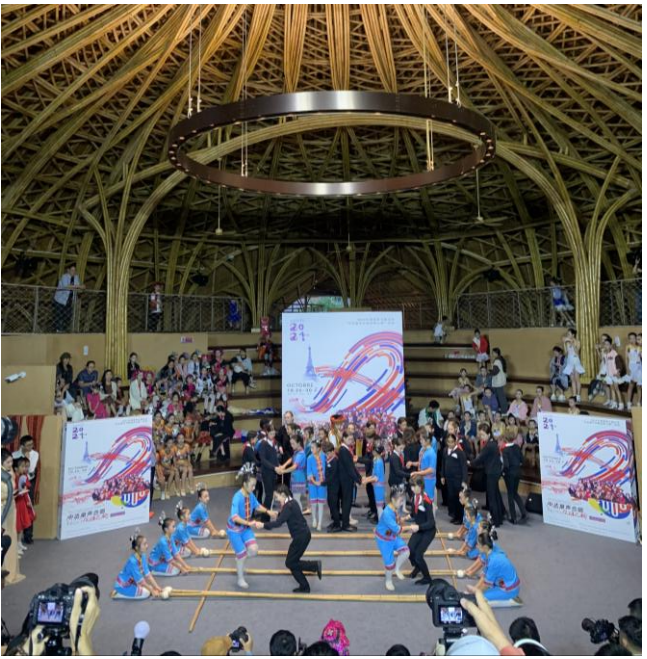








Multipole activities hold on, organized by local villagers




























T h a n k s !