

Boundary Ecology

邊界生態學



Weaving the Socio-Ecological Fracture of Sai Sha

編織西沙社會生態裂縫

Urban Heat Island, Spatial Governance
Vernacular Resilience

GROUP 4 Fire

Carson Leung(Mentor), Yuan Liu(TSL)

Jason Cheung, Sean Leung

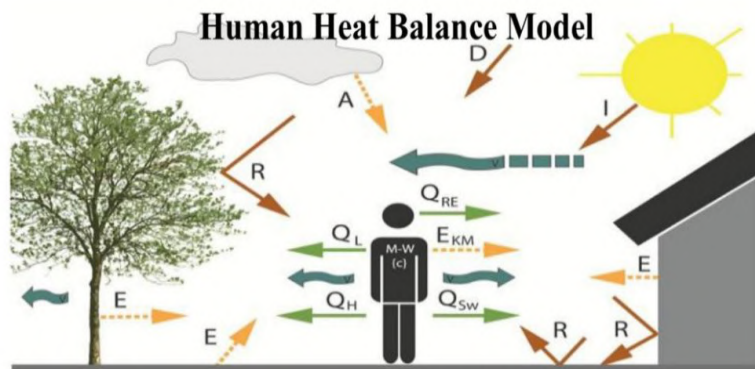
Alex Wong, Rocky Pak

特別鳴謝



這項活動由 Future Ecopreneur Programme 轄屬下的 Eco-pilot Project 資助，該計畫由香港科技园公司和富社會企業組織，並由恒生銀行提供支援。

Group Focus & Research Question / 研究焦點與問題



M metabolic rate
 Q_H turbulent sensible heat fluxes
 Q_{Sw} turbulent latent heat fluxes
 I direct solar radiation
 D diffuse solar radiation
 R reflecting solar radiation

UHI & Human Scale

熱動力學決定了微觀尺度的人類行為。當人體的熱平衡受阻，生理上的不適會侵蝕「社會共感」。

Thermal dynamics dictate behavior at a granular scale. When equilibrium is disrupted, discomfort erodes "social empathy."



Nature-Based Resilience

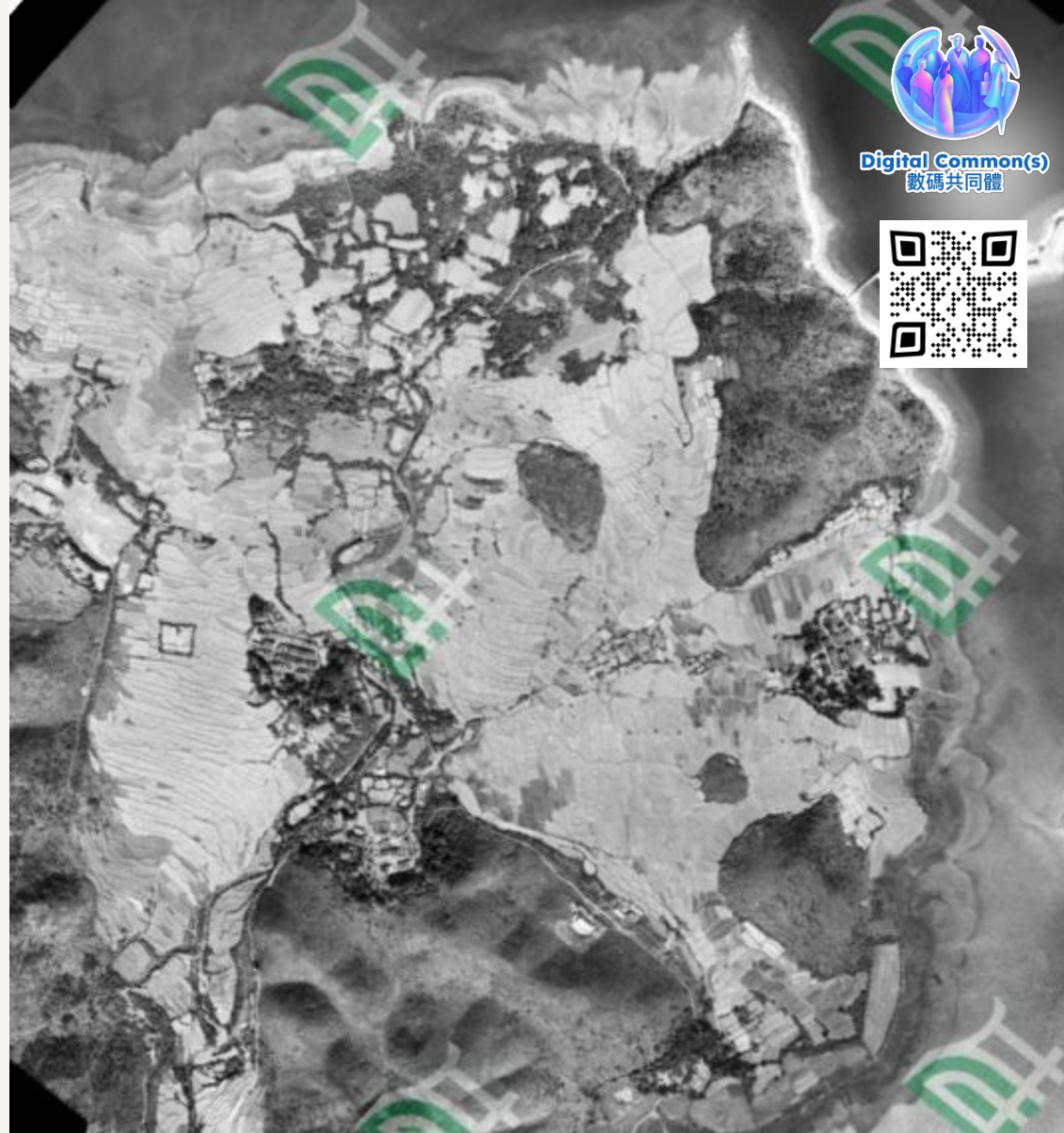
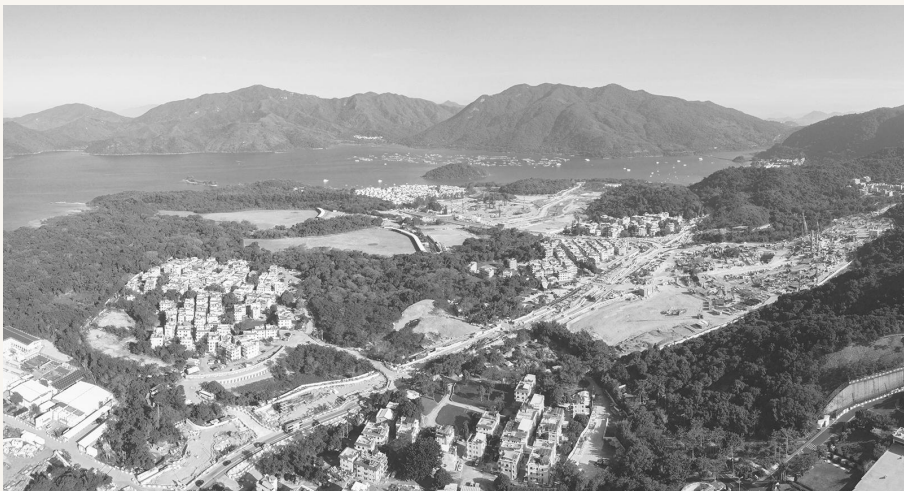
未來都市主義必須優先考慮氣候韌性。本計畫提議以自然為本的方案恢復熱舒適度。

Future urbanism must prioritize climate resilience. This project proposes nature-based solutions to restore thermal comfort.

Ecological Gradient / 生態梯度

西沙歷史上由紅樹林、濕地和稻田組成的過渡帶定義，透過蒸騰作用調節微氣候。

Sai Sha was historically defined by a soft transition of mangroves and wetlands, regulating climate through evapotranspiration.



Ecological Gradient / 生態梯度

巨大的細葉榕曾是「公民錨點」，為社區生活提供必要的遮蔭。

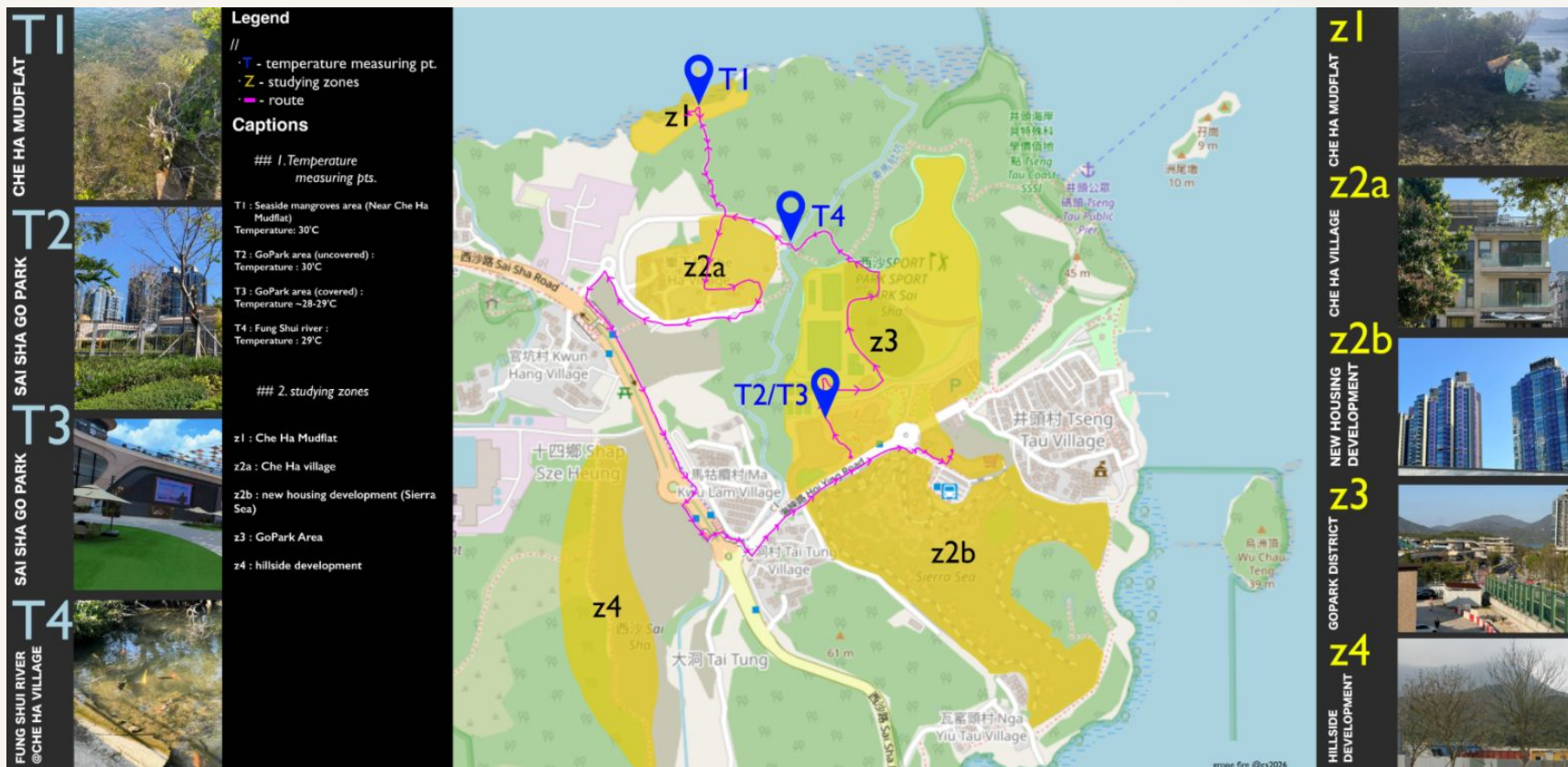
Ancient banyan trees served as "civic anchors," providing essential shaded canopies for communal life.



Urban Sprawl & Superior Ground / 城市擴張與硬性劃分

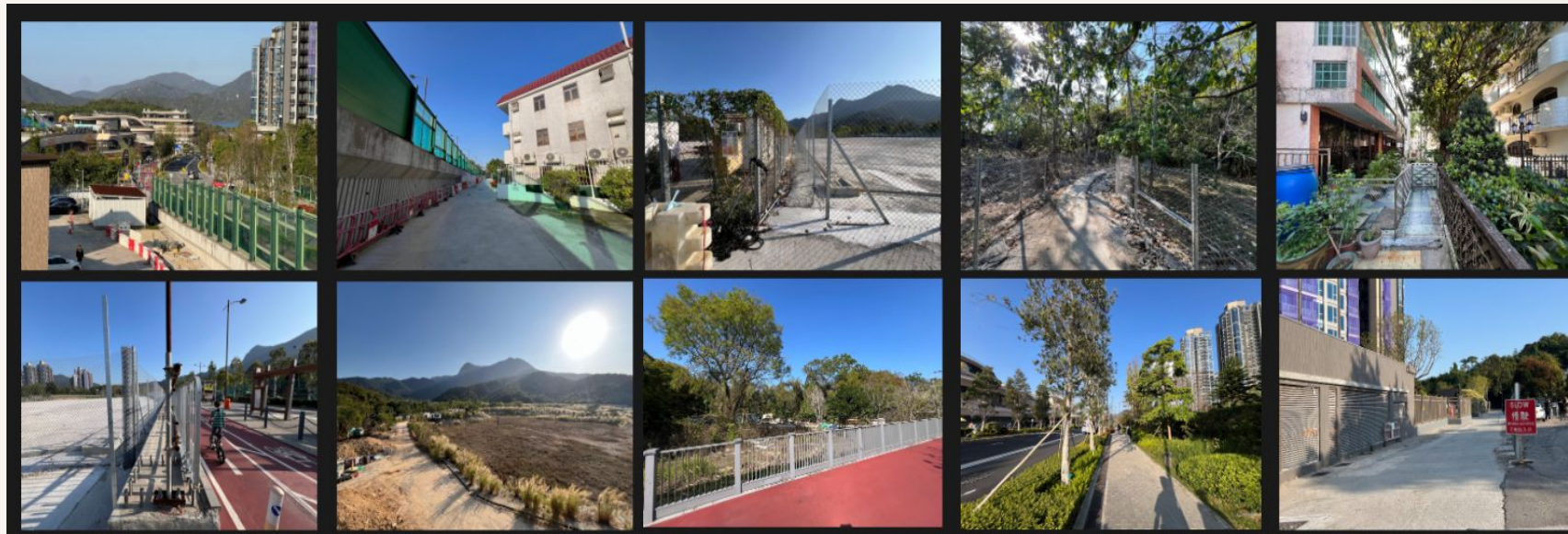
現代基礎設施(如 Go Park)在物理上俯視原村落織體, 產生心理摩擦與等級感。

Modern infrastructure like Go Park physically overlooks the original village fabric, inducing psychological friction.





Typologies of Exclusion / 排他性的空間類型



Solid Blockade / 固體封鎖
Opaque noise barriers enforcing sensory isolation.

封閉式隔音屏障強化了感官隔離。



Linear Flow / 線性流動
Inflexible paved paths dictating regulated movement.

僵硬的鋪裝路徑規範了移動軌跡。



Empty Plot Edge / 空地邊緣
Metal balustrades dissecting the wetlands.

金屬護欄割裂了濕地的有機織體。









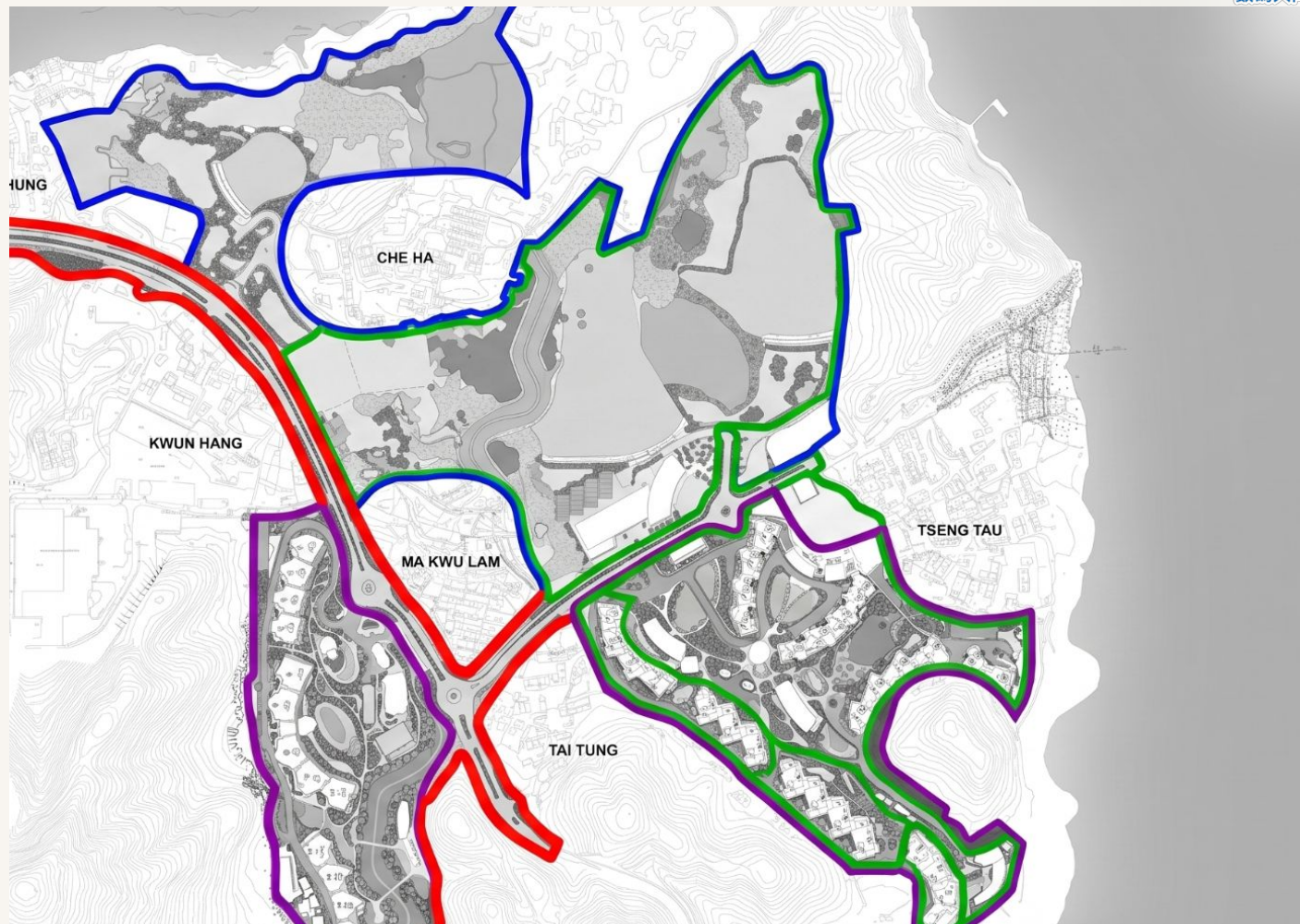
Urban Sprawl & Superior Ground / 城市擴張與硬性劃分

僵硬的空間治理取代了生態連貫性，導致不同群體間的隔閡。

Rigid spatial governance replaces ecological continuity, leading to segregation between communities.

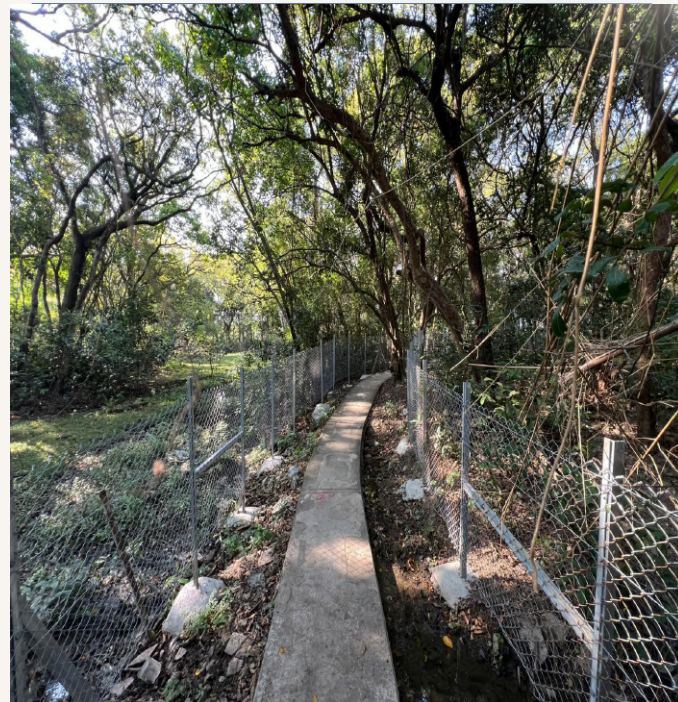
LEGEND:

-  SAI SHA ROAD BOUNDARY
-  SAI SHA SITE A PROPOSED DEVELOPMENT BOUNDARY
-  SAI SHA SITE B PROPOSED DEVELOPMENT BOUNDARY
-  SAI SHA SITE C PROPOSED DEVELOPMENT BOUNDARY





The 2025 Flood Crisis / 2025 水災與韌性失效



集中式排水系統在極端天氣下失效。開發商忽視了村民累積數十年的在地「挖渠」智慧。

Centralized drainage failed during extreme floods. Developers bypassed vernacular ditch-making knowledge.





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Design Intervention 設計干預

The Porous Ecotone / 多孔生態交錯帶



Idea -Proposal

城市發展當然會影響大自然，唔只衝擊生態同生物，仲會連帶影響我 哋嘅生活同環境體驗。咁問題唔係淨係「點改善」，而係：點樣 喺設計上做到共存——喺城市入面營造一個接近自然生態嘅生長環境，去減低城市發展對景觀、氣候同生態造成嘅衝突，同時又能 夠平衡城鄉共融嘅需要。

Urban development certainly impacts nature, not only affecting ecosystems and living organisms, but also consequently influencing our lives and environmental experience. Therefore, the issue is not just "how to improve," but rather: how to achieve coexistence through design—creating a growing environment within the city that is close to natural ecology, to reduce the conflicts caused by urban development on landscape, climate, and ecology, while also balancing the need for urban-rural integration.



Site of Intervention – boundaries



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仿生規劃 將這些硬邊緣重新想像為「生態交錯帶」(Ecotones)——以活生生的滲透性景觀取代靜止的邊界。

biomimetic planning, the project transforms these hard edges into ecotones—dynamic, living transitional zones.





The living fence Methodology

透過「連生」(Inosculation) 技術, 植物融合成一個持續固碳的結構生態系統。

Through inosculation, flora transforms into a singular structural ecosystem that sequesters carbon.

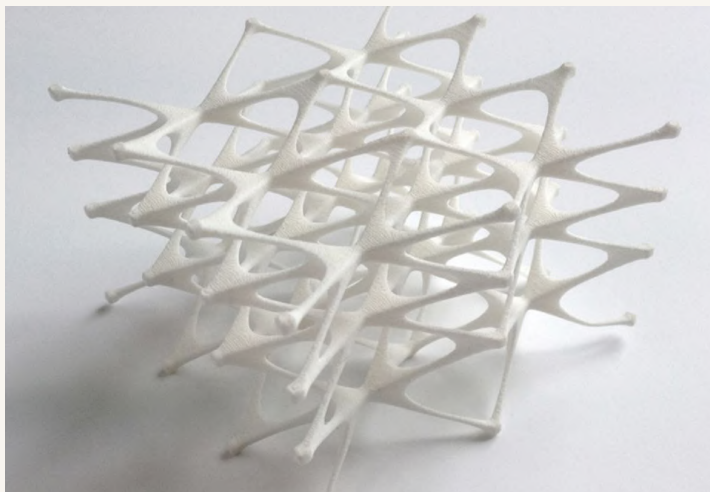


The living fence 3D print framework base

Architecture as Guided Growth

利用 3D 打印的可生物降解模板，引導原生濕地植物生長，將硬性邊界轉化為活生生的交錯帶。

Using 3D-printed biodegradable formwork to direct the energy of native flora, transforming hard edges into living ecotones.



3d print frame



growing



decompose frame
vegetation take form



4 Core Growing Techniques / 四項核心生長技術



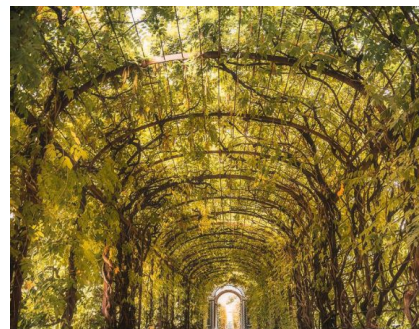
Lattice Weaving

Breathable skins / 透氣表皮



Vertical Training

Bearing uprights / 承重立柱



Overhead Grafting

Shaded canopies / 遮蔭頂蓬



Root-Guided Casting

Integrated foundation / 根系地基



Precedent Study / 先例研究

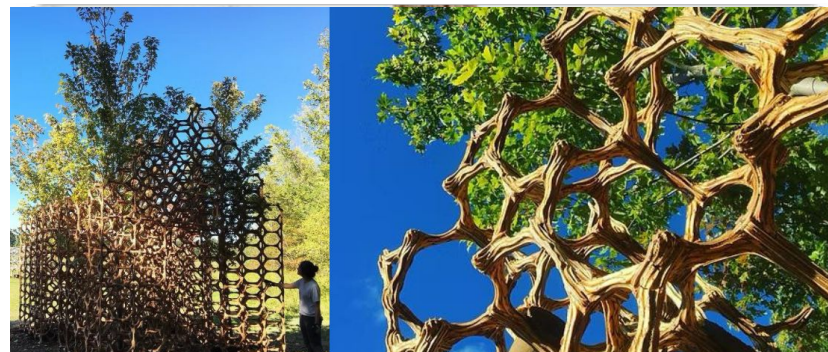
Baubotanik Method



懸鈴木魔方 (Plane Tree Cube, 2012) 證明了活體建築能為高密度城市提供冷卻功能。

The Plane Tree Cube demonstrates that living plants can serve as primary load-bearing systems and natural cooling.

Primitive Hut (Art Omi)



利用可分解晶格滋養幼樹，最終生物形態完全取代人造結構。

Utilizes a decomposing lattice to nourish saplings, allowing biological forms to eventually replace architectural ones.

The Porous Ecotone



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before

after

Construction Sequencing



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Vegetation Species



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抗風桐 Pisonia tree

The wind-resistant Pisonia tree reaches its desired shape within just one year, thanks to its fast growth rate and solid structural integrity.

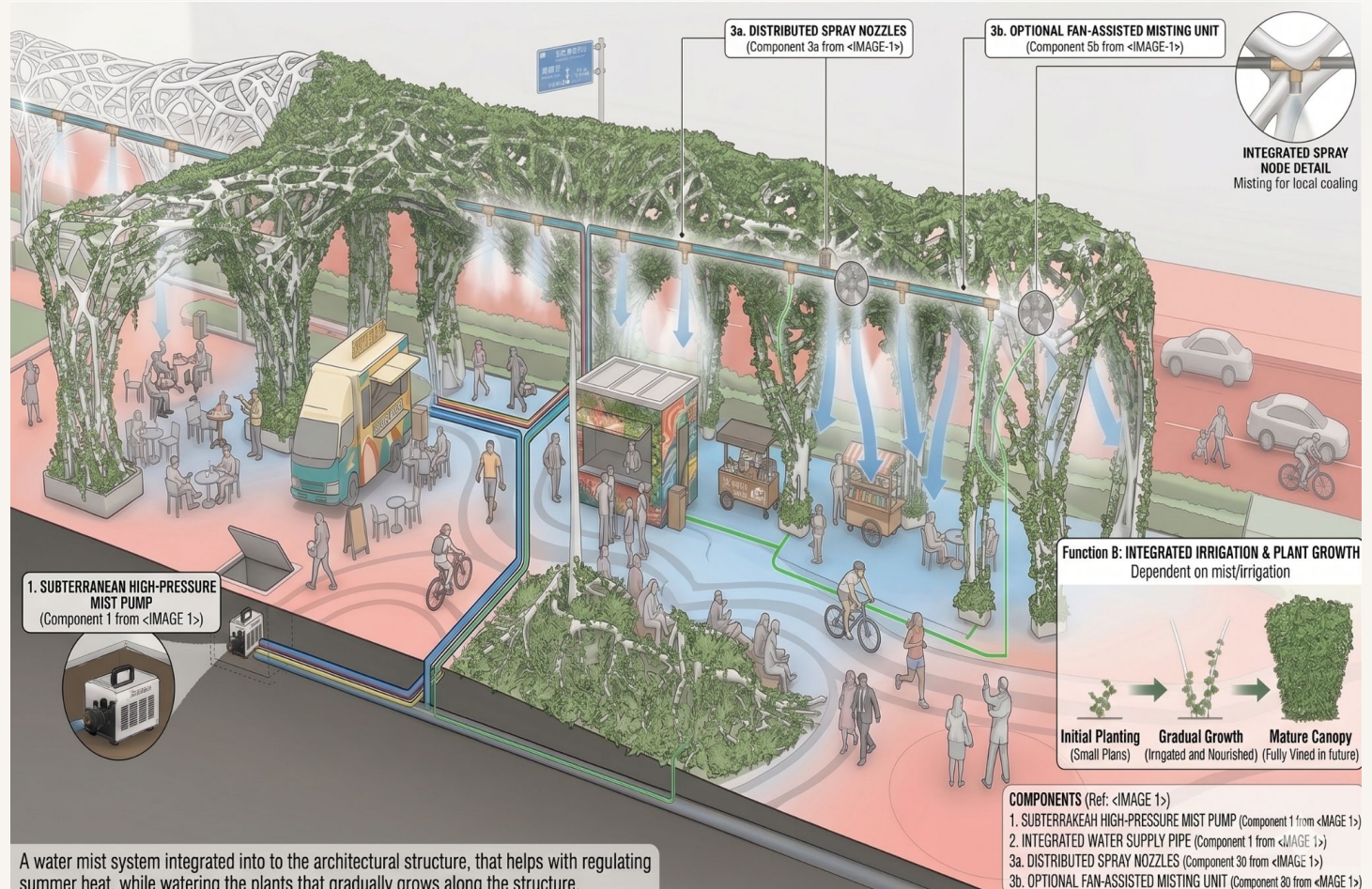
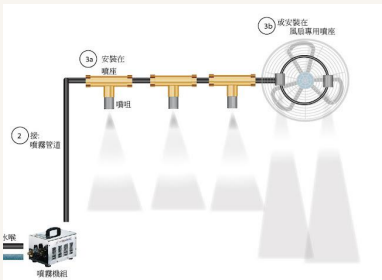


Misting System Integration

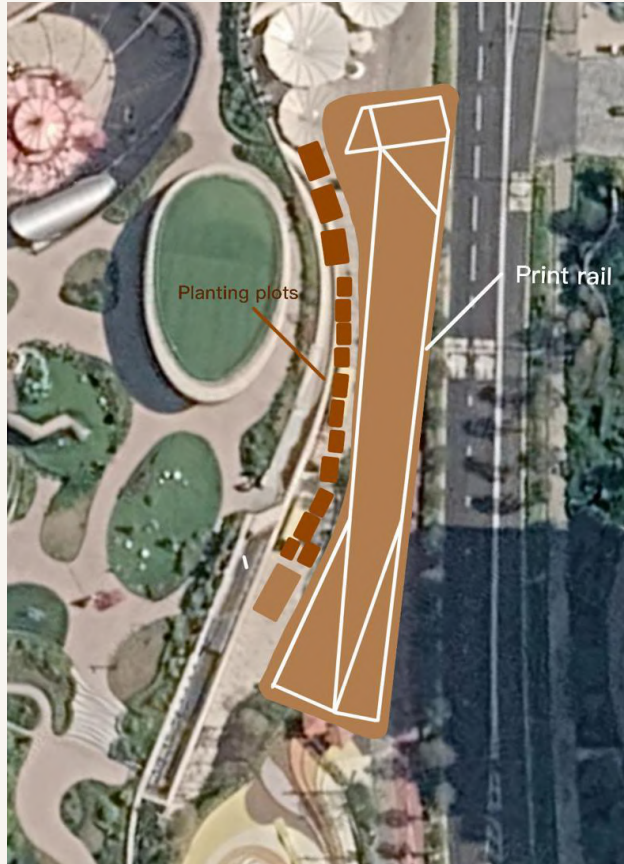


Transition Period Cooling System

During this one-year transition period, we will adopt a misting cooling system. The specific approach is to install nozzles at various high positions to intermittently spray fine water mist. This utilizes the evaporation of water to draw away heat, achieving a cooling effect.



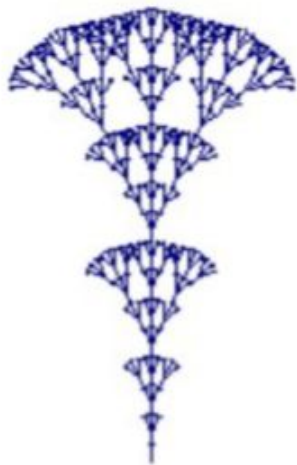
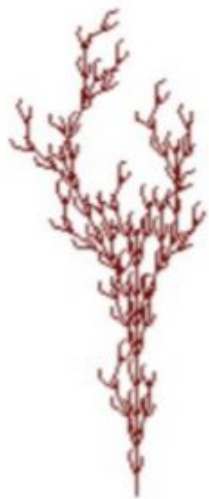
Printing



A horizontal row of seven fractal tree structures. From left to right, they are colored red, blue, green, blue, purple, grey, and black. Each tree exhibits a complex, branching, self-similar pattern characteristic of fractal growth.

FRACTAL GROWTH || L-SYSTEMS

L-systems, devised by **biologist Aristid Lindenmayer in 1968**, provide a mathematical foundation for studying biological development. They find crucial applications in generating fractals and accurately modeling plant structures. L-systems offer a versatile framework for **simulating the growth processes of plants**, enabling researchers to understand and replicate their complex forms. The **system begins with a string of symbols called the axiom, and applies to the axiom a set of production rules which are used to rewrite the axiom.**

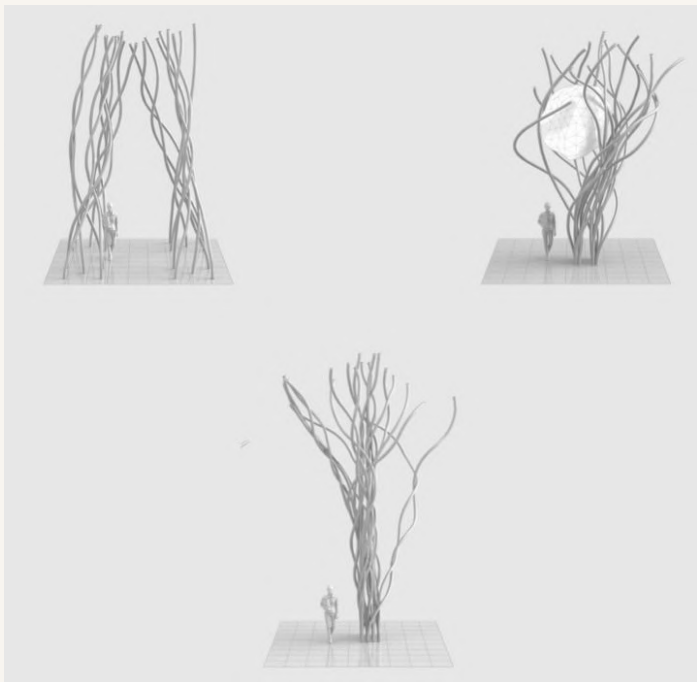


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frame forming



Bearing uprights / 承重立柱



Shaded canopies / 遮蔭頂蓬

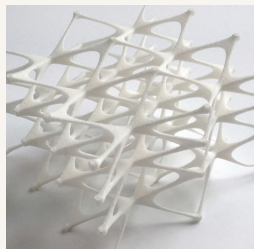


Integrated foundation / 根系地基

Design Iteration



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Maintenance-as-Construction

以維護代建造

Community members become "architectural arborists," practicing seasonal pruning and grafting. The structure's porosity is adjusted mid-growth, fostering a resilient civic life through collective stewardship.

社區成員成為「建築林務員」，實踐季節性修剪與接枝。結構孔隙率隨生長動態調整，透過集體守護培育韌性的公民生活。

Community Storyboard



SHIFTING TO SOCIO-ECONOMIC ARCHITECTURE

Moving from 'keeping things out' to 'immunity Inclusion (on a 40 cm boundary)'

OLD: DEFENSIVE ARCHITECTURE (Standard)

Spikes Metal bars resulting in as 'dead zone' CCTV

NO TRESPASSING =

NEW: SOCIO-ECONOMIC ARCHITECTURE (The Shift)

Integrated Integrated garden architecture creates 'living zone' 'Eyes on the Street'

1 PRODUCTIVE EDIBLE LANDSCAPES
(The 'Vertical Forage-Fence')

40 cm WIDTH TRELLIS

- Porous Visual Screen
- Community Buffer
- Free Food Source
- Replaces railing with 'Commons'

2 MULTI-FUNCTIONAL SEATING
(Social 'Plinths')

40 cm PERCH

- Comfortable Linger Zone
- Natural Social Presence
- Eyes on the Street
- Creates self-policing boundary

ANTI-HOMELESS SPIKES

3 THE 'PLAY-PATH' BOUNDARY
(Micro-Habit)

40 cm TACTILE PATH

Dangerous drop or sensitive zone

- Intergenerational Play
- Balance Log/Boulder
- Slows Traffic
- Defines edge through texture, not height

4 BIO-SWALES & RAIN GARDENS
(The 'Ribbon' Swale)

40 cm RAIN GARDEN/SWALE

- Ecological 'Work'
- Visual Amenity
- Water Cycle Education
- Manages stormwater locally

Comparison of 40 cm Boundaries		
Primary Goal	Exclusion & Control	Inclusion & Utility
Visual Language	Spikes, bars, "No Trespassing"	Benches, fruit trees, open paths
Safety Mechanism	Physical obstruction	"Eyes on the Street" & Community Ownership
Economic Value	Sunk cost	Value-add (food/social health)

By designing for social density and ecological productivity, the need for 'security hardware' evaporates because the community sees the space as their own.



POLICY REFLECTION: TRANSFORMING SAI SHA'S BOUNDARIES THROUGH NATURE-BASED SOLUTIONS

THE PROBLEM: SAI SHA'S UNRESOLVED PLANNING JUXTAPOSITION

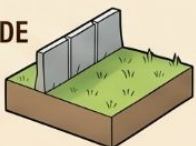


- Traditional landscape persists in form
 - Ecological/ social, Feng Shui woods
 - Ecological and social substance proded by urban land amalgamation
 - Go Park has irroccocilable adjacencies
- Yu & Hoi (2016), Ng (2016), Tang et al. (2017)

THREE EXCLUSIONARY BOUNDARIES

1. SOLID BLOCKADE

- opaque noise barriers
- sensory isolation

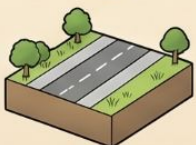


GOVERNANCE GAP

- IMPACTS:**
- Severed Ecology
 - Habitat Fragmentation
 - Socio-spatial Segregation

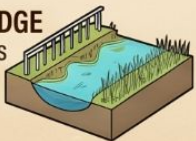
2. LINEAR FLOW

- paved paths
- regulated movement



3. EMPTY PLOT EDGE

- metal balustrades in marshland
- discontinued continuity

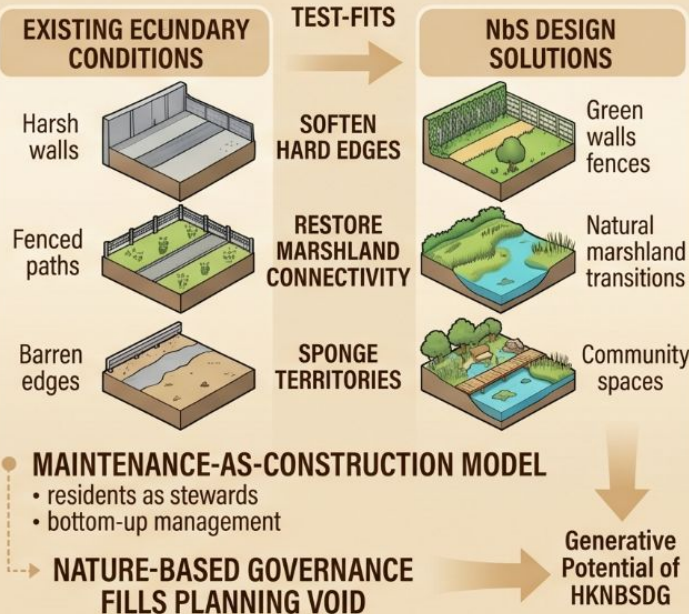


Yu & Hui (2018), Kg (2024), Jim (Tang), Tang et al. (2017), etc.

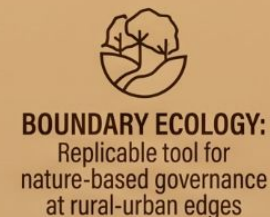
THE RESEARCH APPROACH: DESIGN AS DIAGNOSTIC INSTRUMENT



THE FINDINGS & INTERVENTIONS: FROM EXCLUSION TO CO-DESIGN



THE WAY FORWARD: BOUNDARY ECOLOGY MODEL



NEGOTIATING POLICY INTEGRATION AT CONTENTED EDGES FOR SUSTAINABLE FUTURES



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BIO-GROVE PARK





第三屆 青年建築師計劃



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Design Scientist 2026 Incubation Program | The 3rd Annual
Program of The Citizen Architect Initiative

AI 仿生設計營 | 設計成果展

AI+ Biomimicry Design Final Showcase cum Exhibition



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