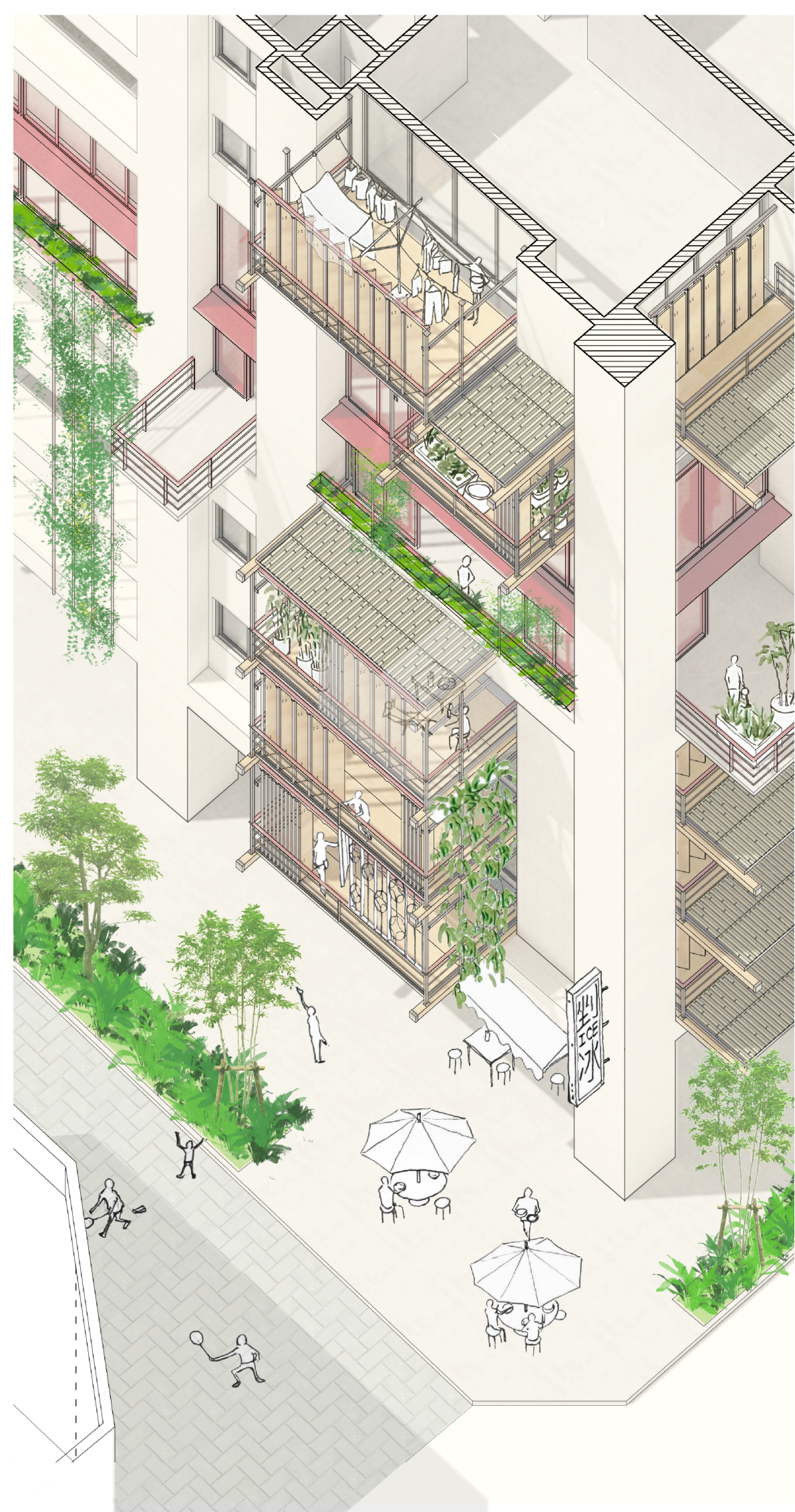


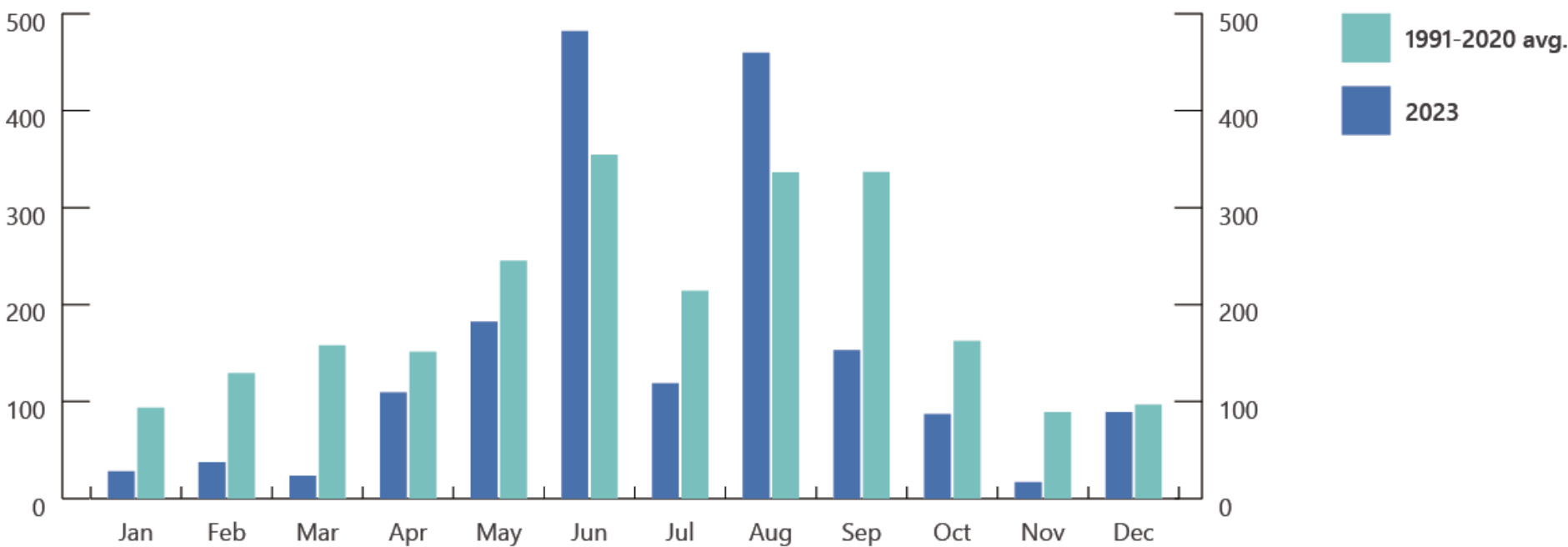
TAIWAN RENEWAL HANDBOOK

Tsung-Han Ou
2025 aE Studio | P5

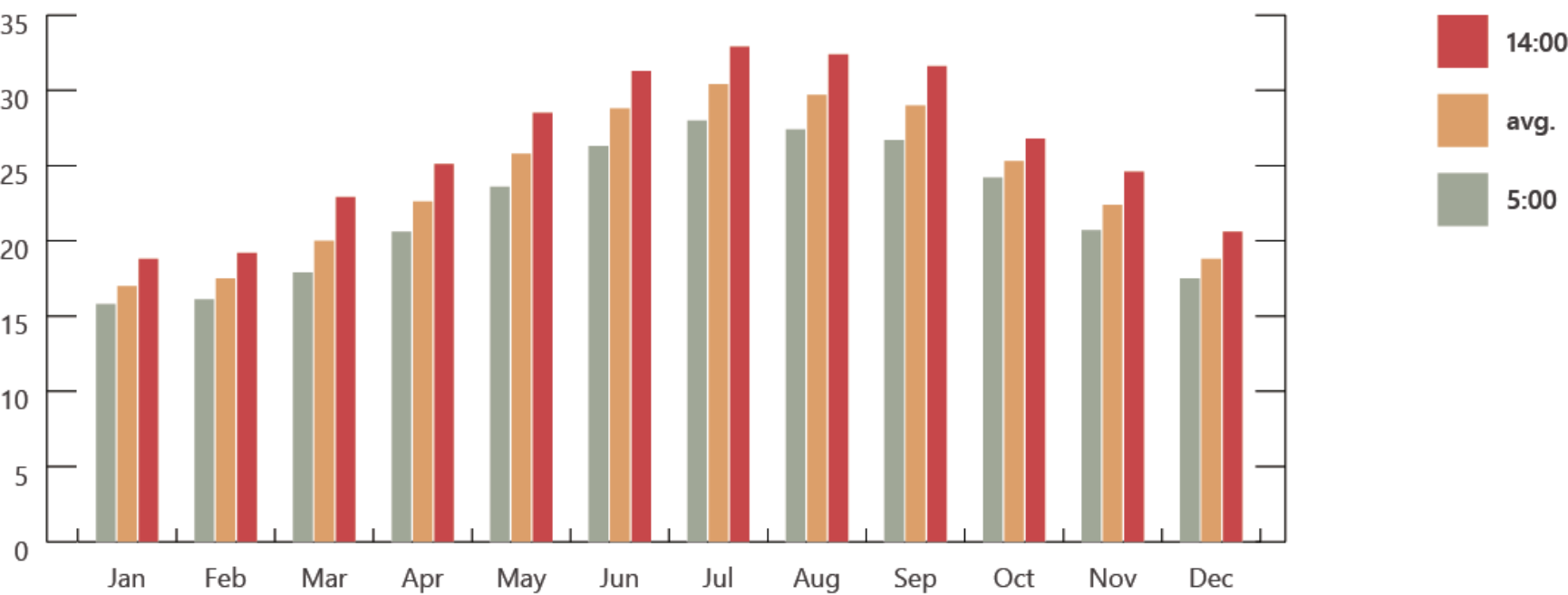


Research subject - Climatic design in Taiwan

Located on the Northern Tropics in east Asia, Taiwan experiences hot & humid weather most of the year



Monthly rainfall in Taipei, 2023 & 1991-2020 average

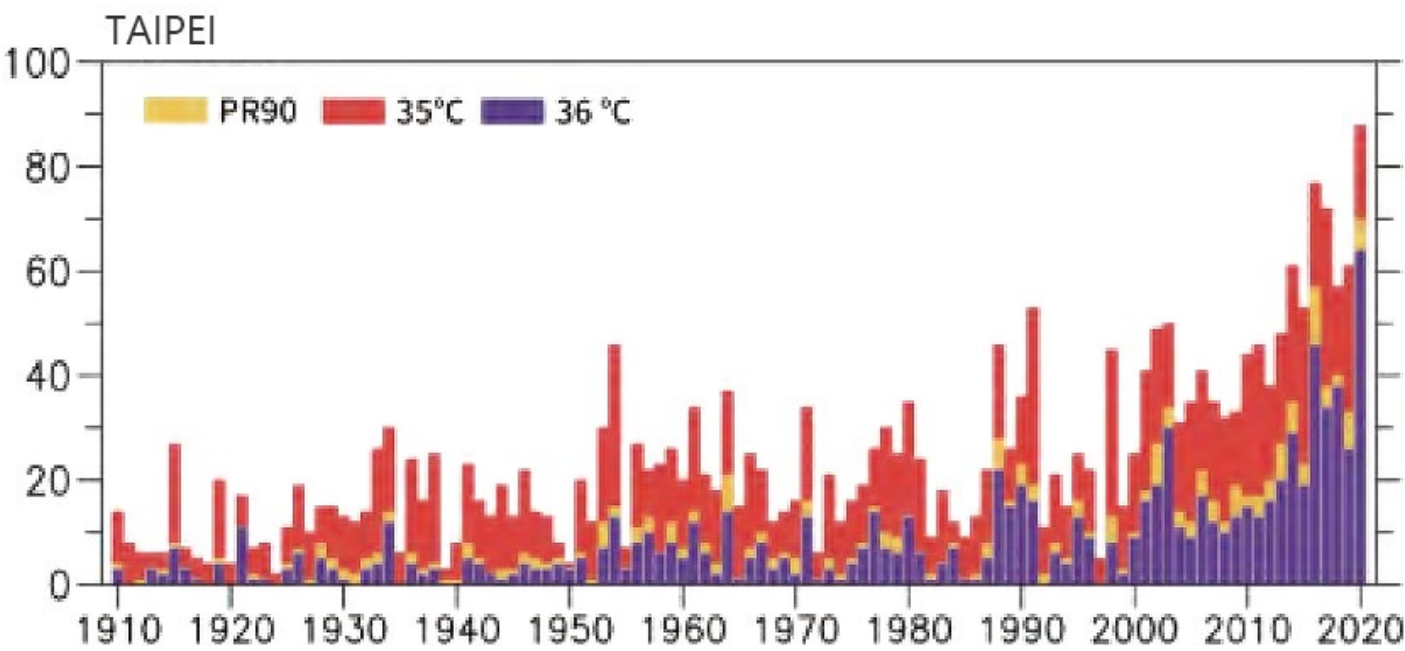


Hourly & average mean temperature in Taipei, 2023

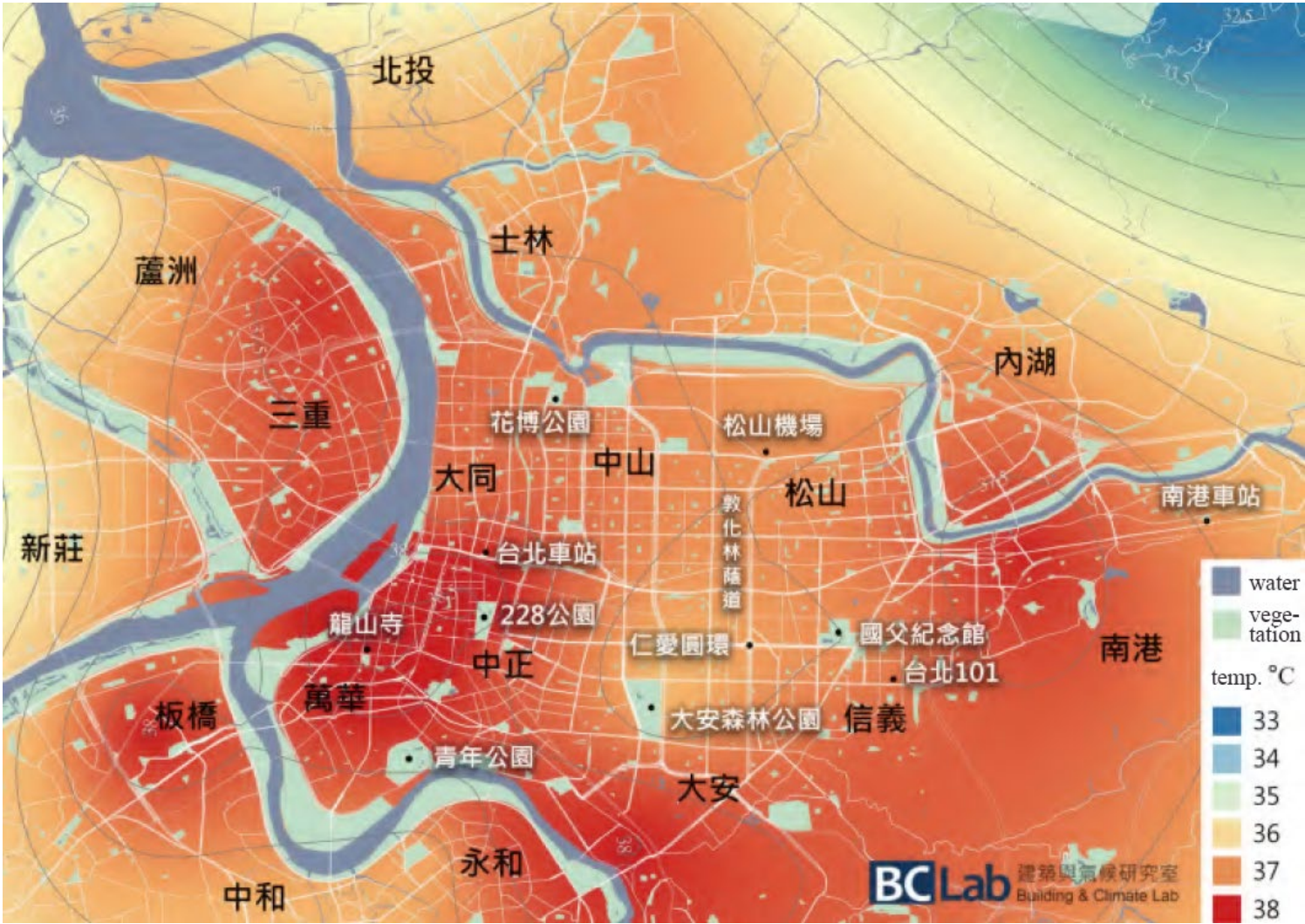


Problem statement - The necessity & response for sustainable architecture

Extreme heat in Taiwanese cities urges for cooler & more sustainable practices in the built environments



Number of days in extreme heat in Taipei last century



Recorded mean temperature in Taipei City in 13:00, 8/7/2023



Official response: aim for nearly-zero emission
for >85% of all buildings in Taiwan
through clean energy transition
& green building regulations

綠建築評估手冊-基本型
GREEN BUILDING EVALUATION MANUAL-BASIC VERSION



發行人：王榮進
編輯單位：內政部建築研究所
監修：羅時麒、徐虎嘯
總編輯：林憲德、林子平、蔡耀賢
執行編輯：李魁鵬、鄭政利、陳旭彥、
陳政榮、張矩塘、陳俊芳、
黃國倉、周瑞法、施繼昌、
黃克修、黃瑞隆、陳匯中、
林漢昌、王獻堂、黃威舜、
郭柏巖、洪國安
文字編輯：黃詠琦、羅子雯、王柳臻



綠建築評估手冊-舊建築改善類
GREEN BUILDING EVALUATION MANUAL-BUILDING RENOVATION



發行人：王榮進
編輯單位：內政部建築研究所
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林漢昌、王獻堂、黃威舜、吳彥輝
文字編輯：蔡宜芳、尤巧茵、黃詠琦、羅子雯



| | | |
|---|-------------------------------|--|
| 建築物名稱 | ○○○大樓 | 1⁺ 近零碳建築 |
| 坐落地址 | ○○市 | |
| 評估總樓地板面積A _{Fe} | ○○ m ² | |
| 建築能效標示字號 | ○○號 | |
| 耗電密度 kWh/(m ² .yr) | 得分 | 耗電密度指標 EUI* kWh/(m ² .yr) |
| ≤ 53.9 | 90 ~ 100 1⁺ | 22.24 11.32 kgCO ₂ /(m ² .yr) |
| ≤ 54.9 | 80 ~ < 90 1 | |
| ≤ 56.0 | 70 ~ < 80 2 | |
| ≤ 57.0 | 60 ~ < 70 3 | |
| ≤ 58.0 | 50 ~ < 60 4 | |
| ≤ 69.5 | 40 ~ < 50 5 | |
| ≤ 92.3 | 20 ~ < 40 6 | |
| > 92.3 | 0 ~ < 20 7 | |
| 耗電密度指標 EUI* [kWh/(m ² .yr)] | | 22.24 |
| 碳排密度指標 CEI* [kgCO ₂ /(m ² .yr)] | | 11.32 |

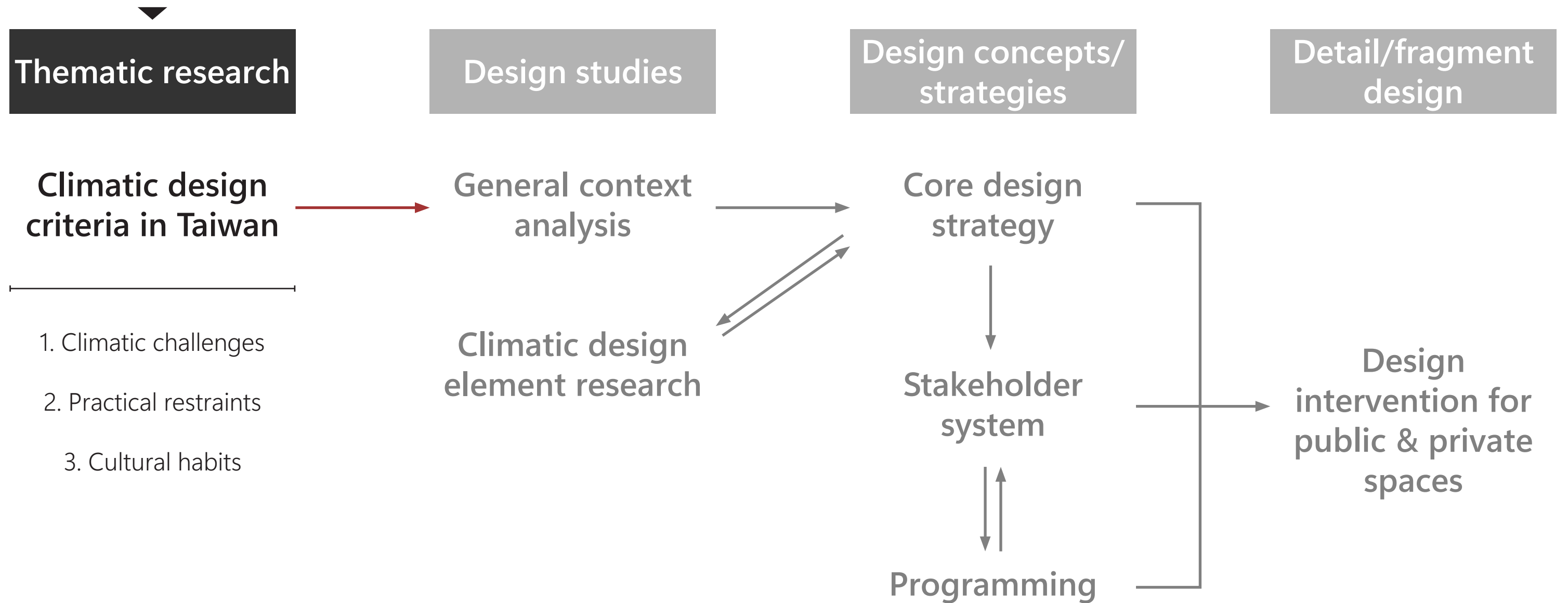
Left to right: Covers of basic & renovation version of EEWB Evaluation Manuals,
and The Building Energy Efficiency Label

Practical design challenges

stagnation of architectural practices,
and the need for existing building renovations



Project development method



Thematic research - Sustainable design criteria for Taiwan

1. Climatic challenges

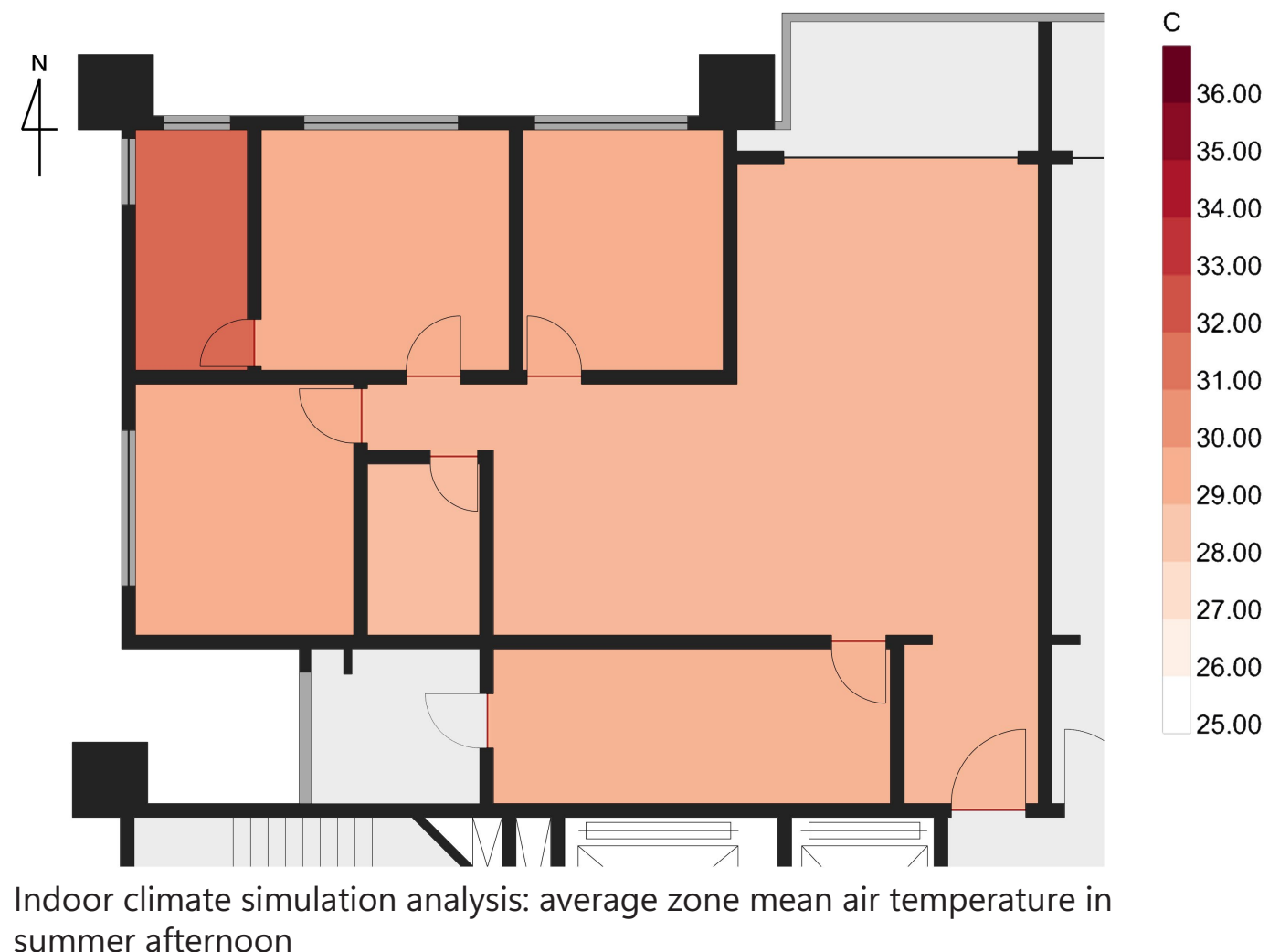
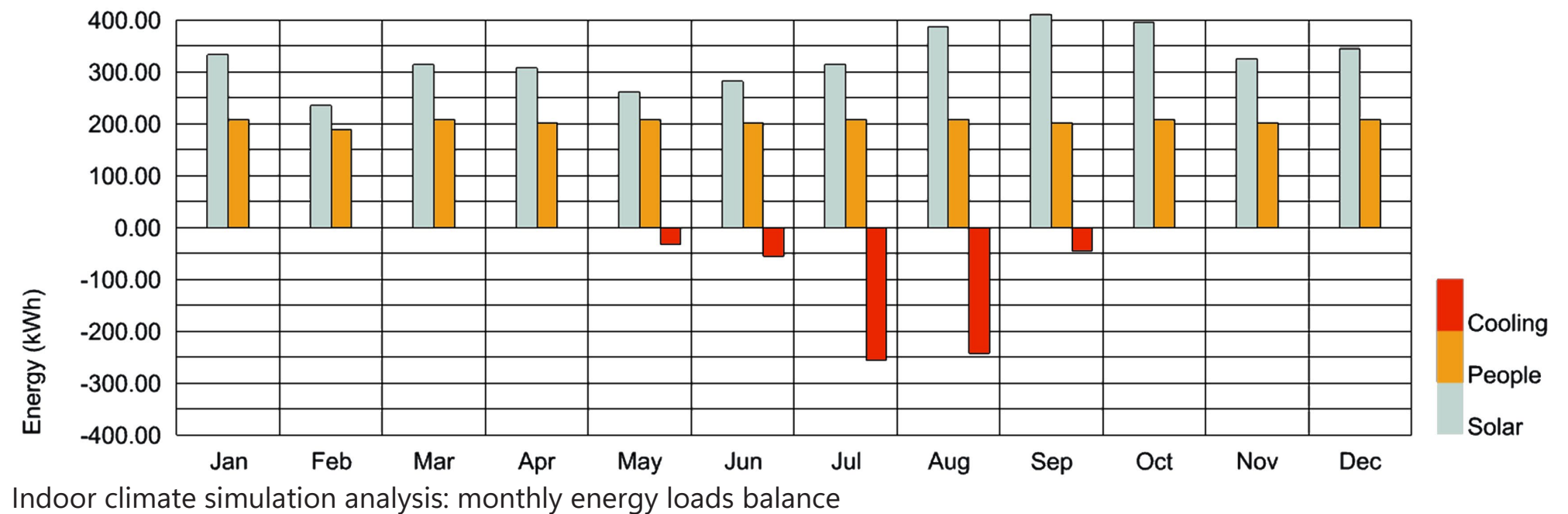
Attributes of tropical climate:

1. high ambient air temperature
2. very high solar heat gain
3. high humidity



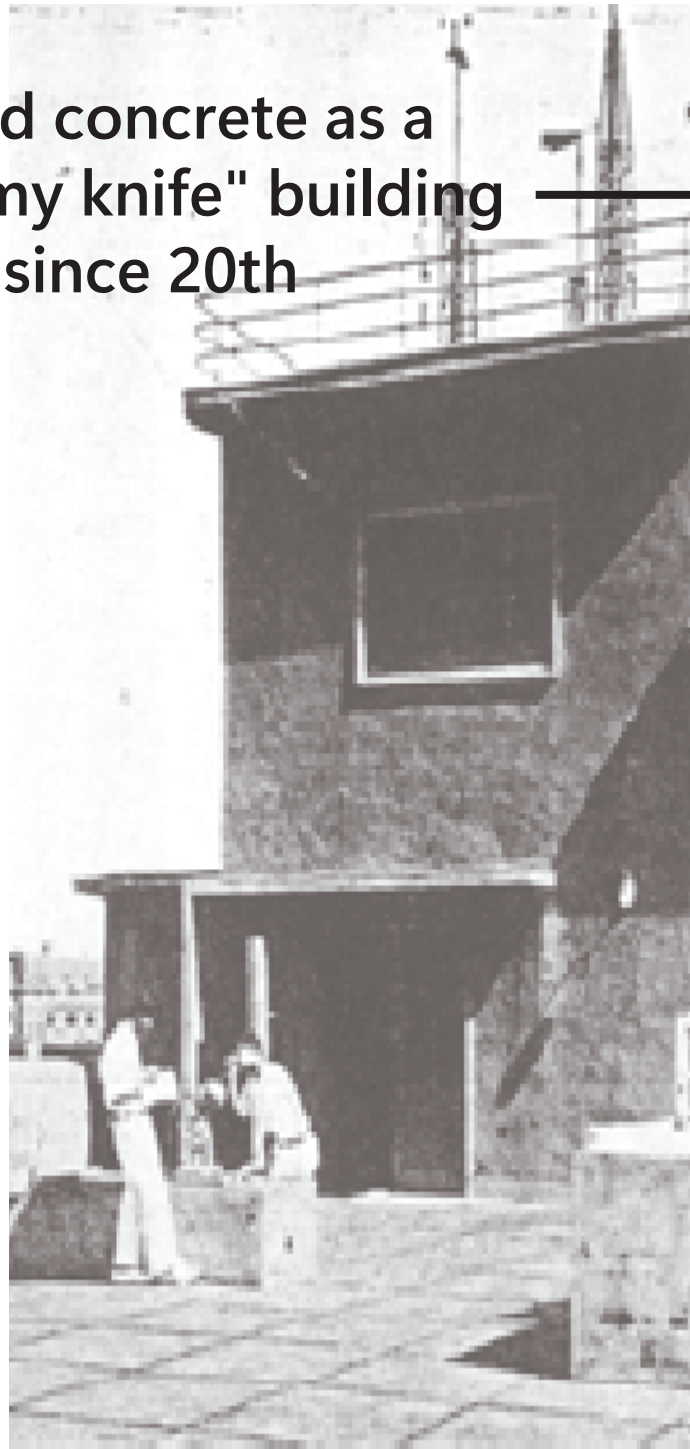
Passive solutions focusing on shading and natural ventilation

1. cross/stack ventilation
2. sunshading
3. effective insulation against solar heat
4. green/low albedo envelope
5. climatic program-zoning



2. Practical challenges:

Reinforced concrete as a "swiss army knife" building solutions since 20th century



Collective expectation for buildings to be simple, durable, and as cheap as possible

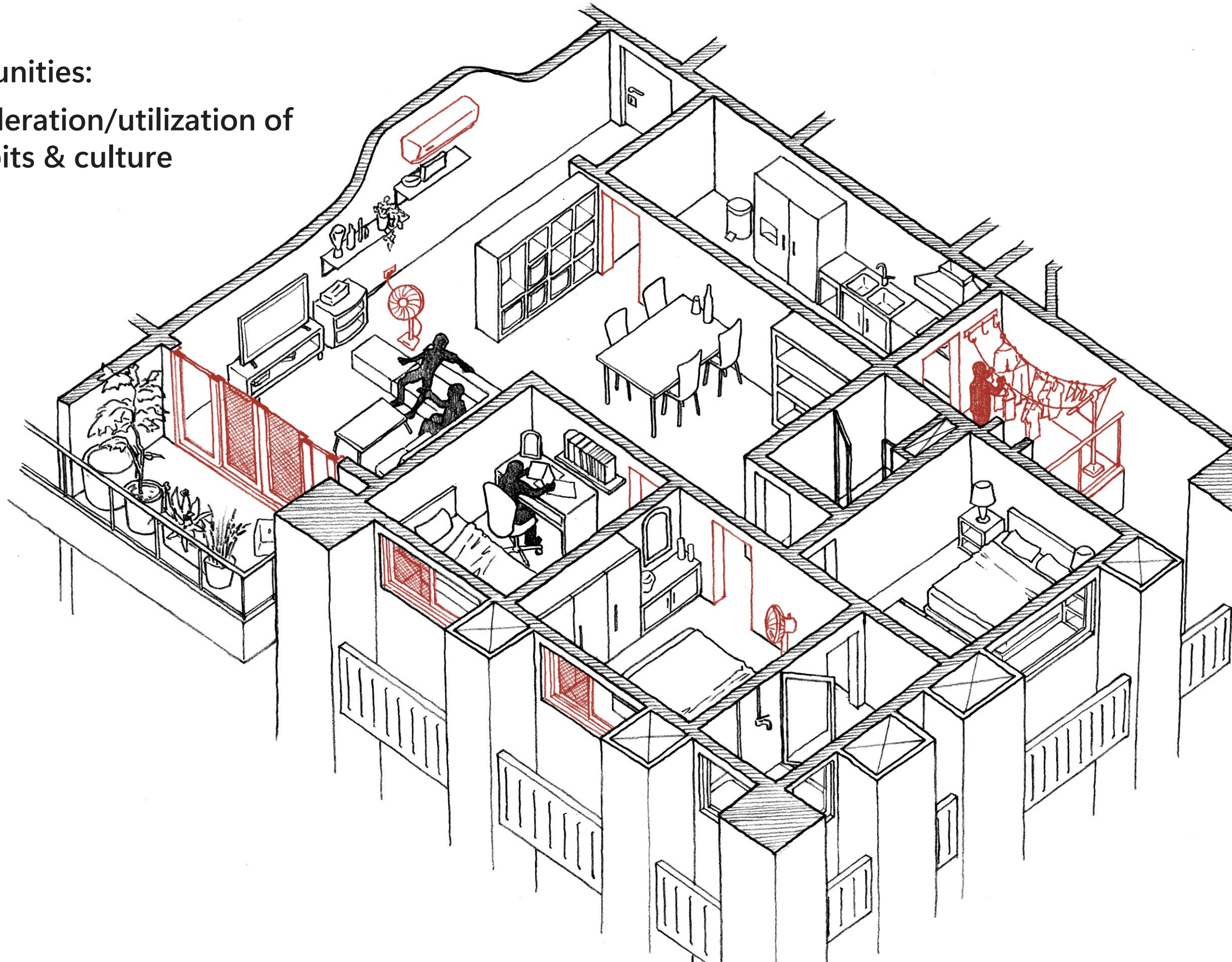


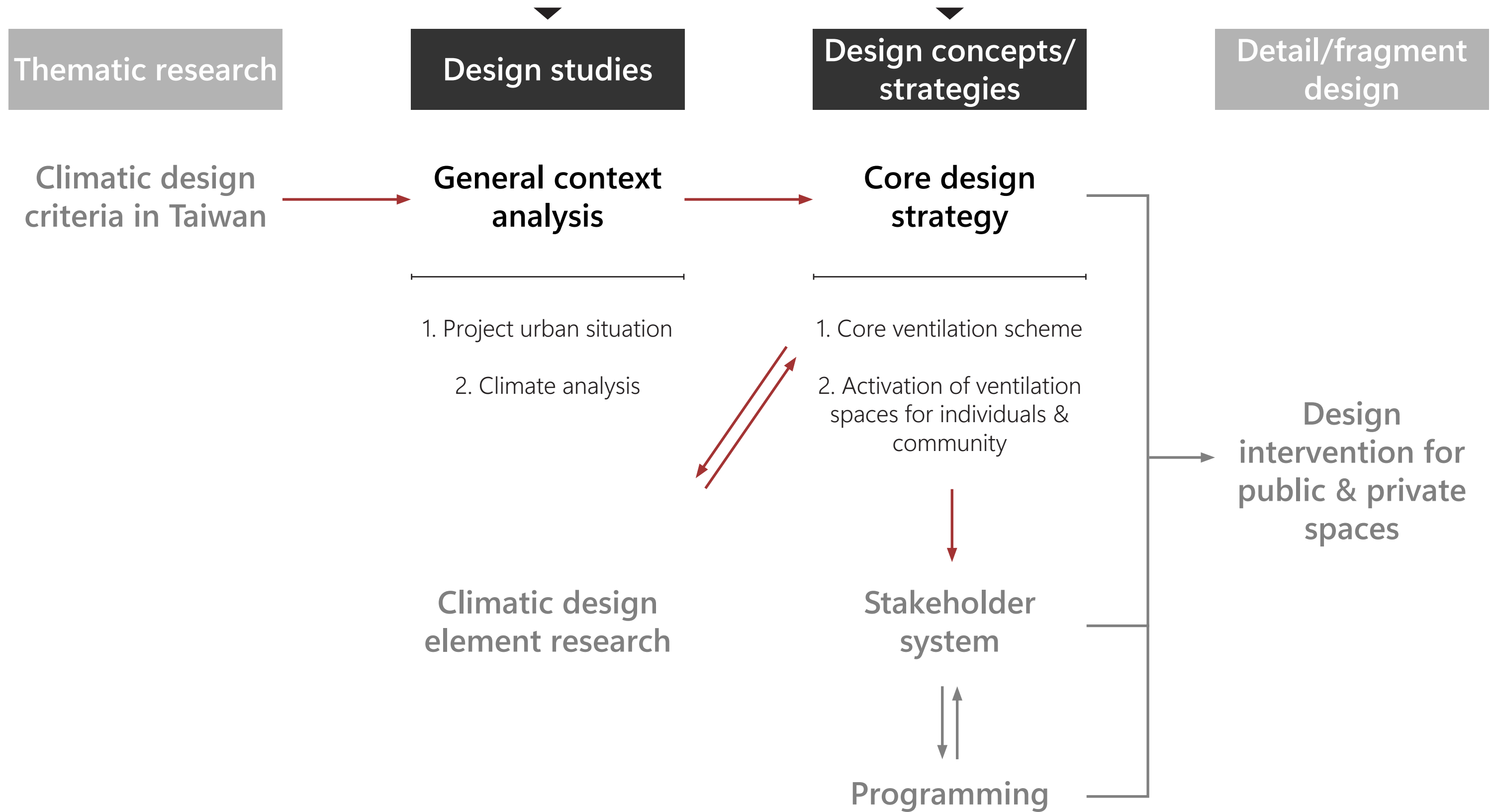
Architectural industry heavily favors low-tech & low-cost practices:

1. low material volume & cost
2. standardized materials
3. ease of manufacturing/installation
4. ease of maintenance
5. climate resistance/durability



3. Cultural opportunities:
design with consideration/utilization of
regional living habits & culture

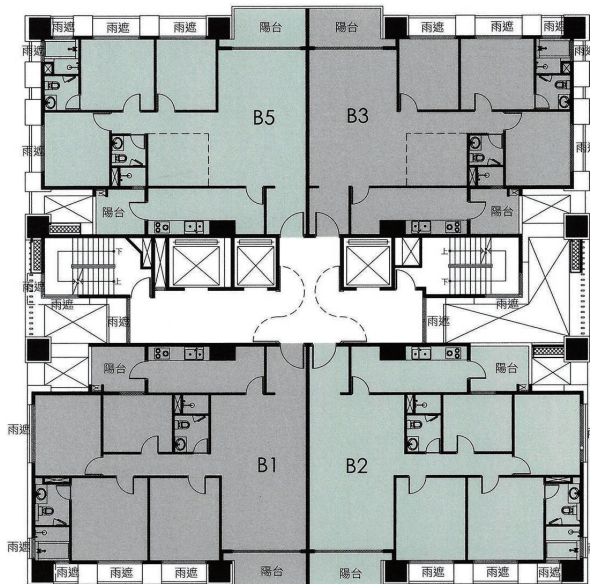
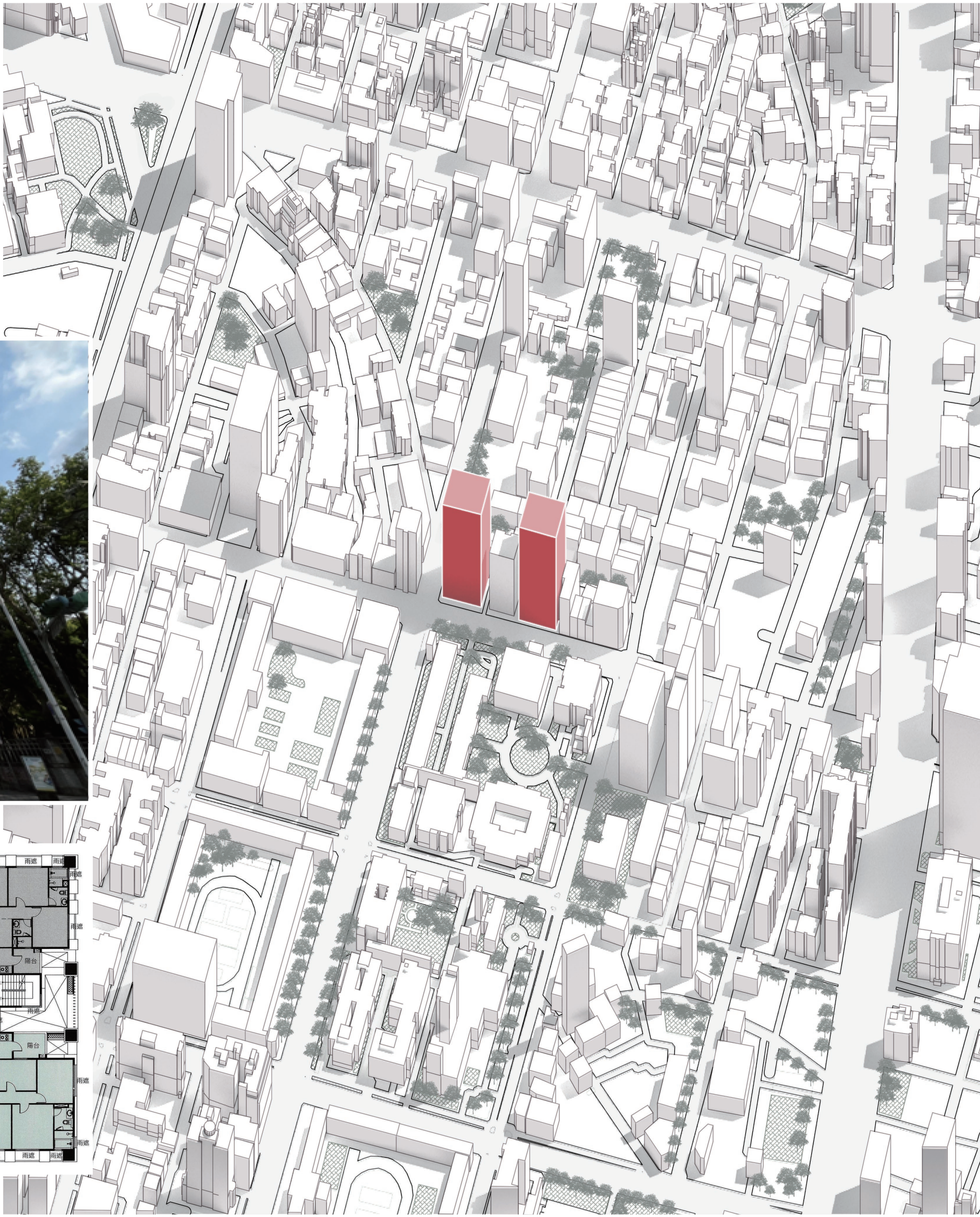




Renovation project selection

A generic highrise apartment building in Taipei City, Taiwan

Renovation and adaptive reuse for thermal comfort

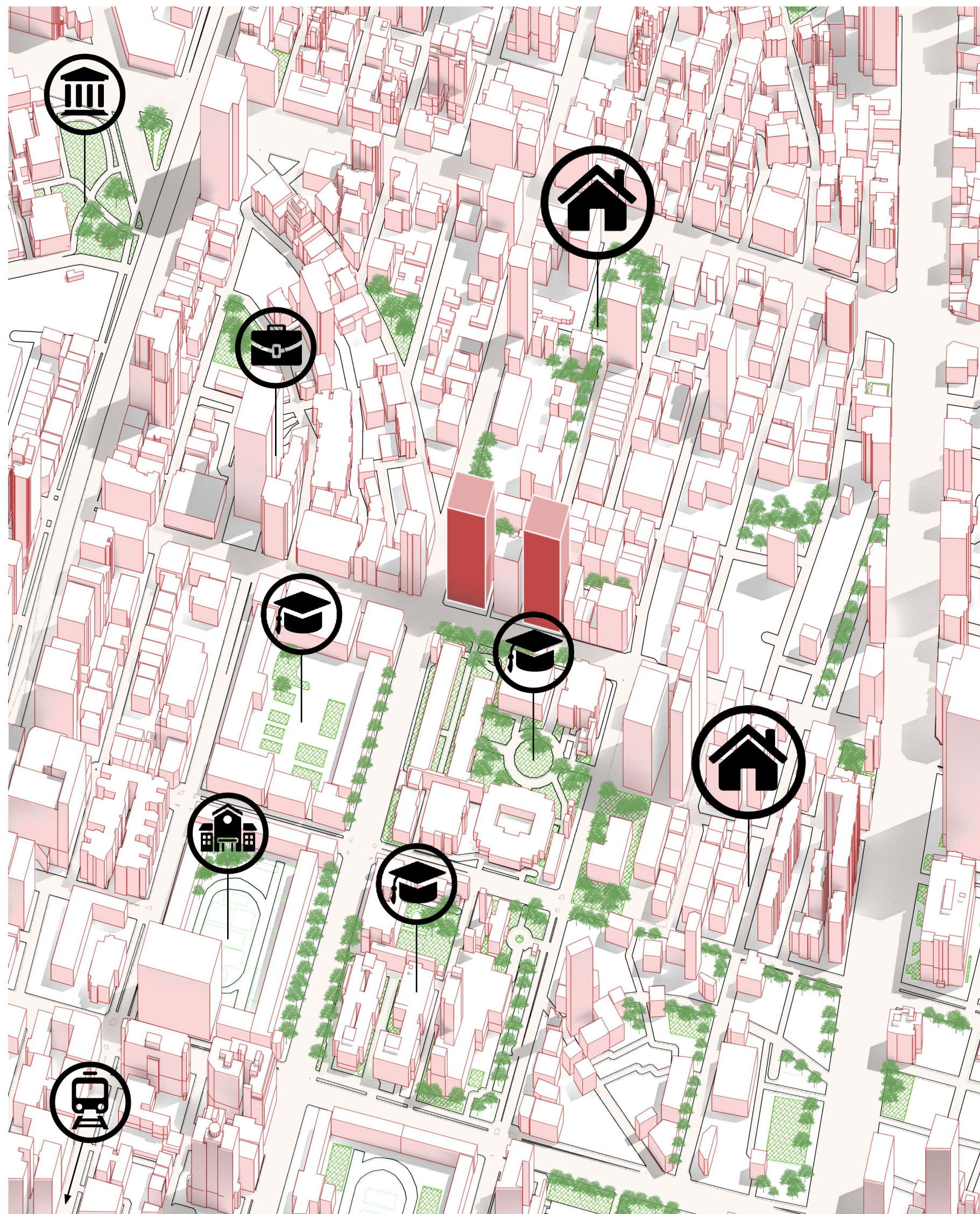


Situation

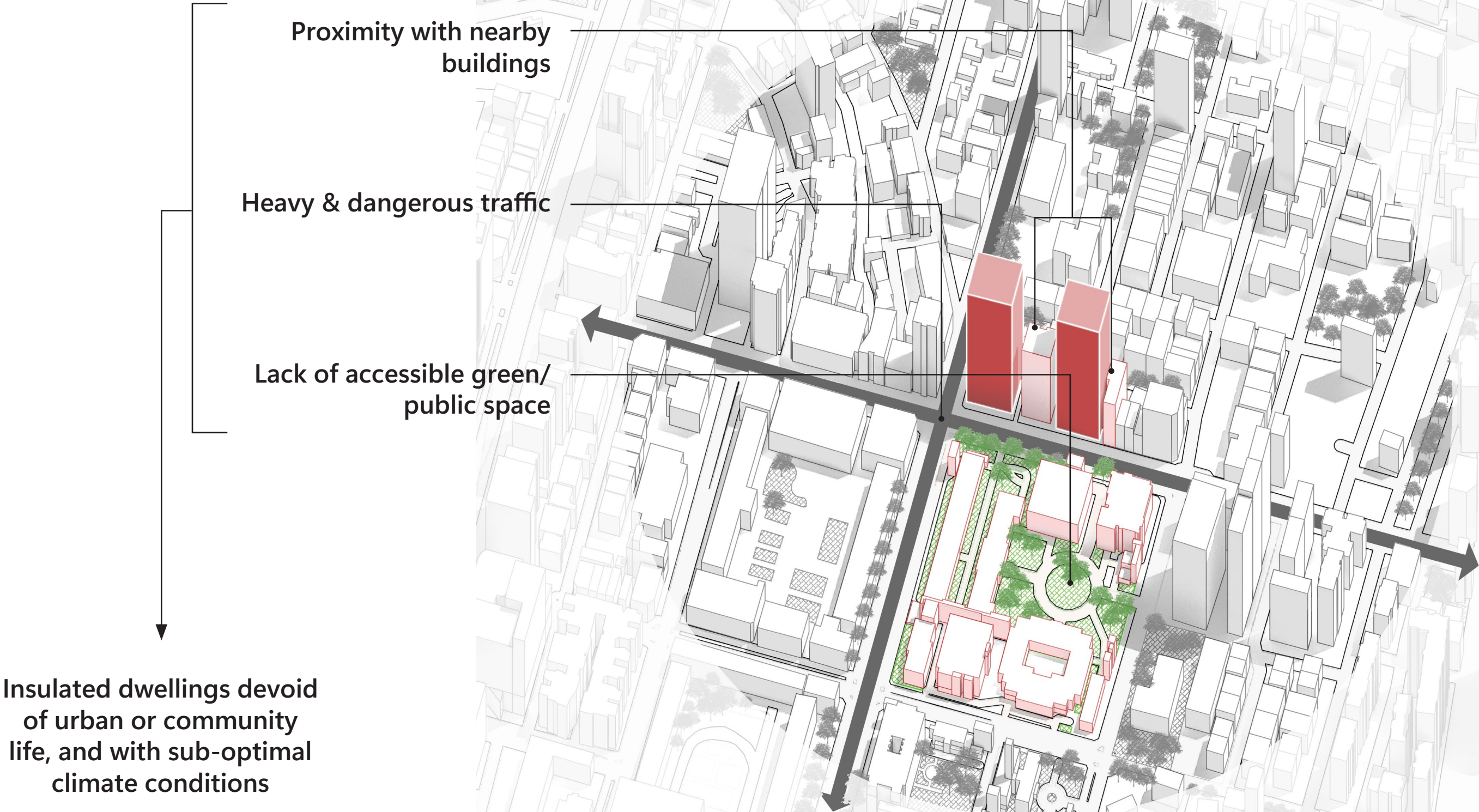
Majority-residential area, with close proximity to various urban facilities

Dwelling demographics:

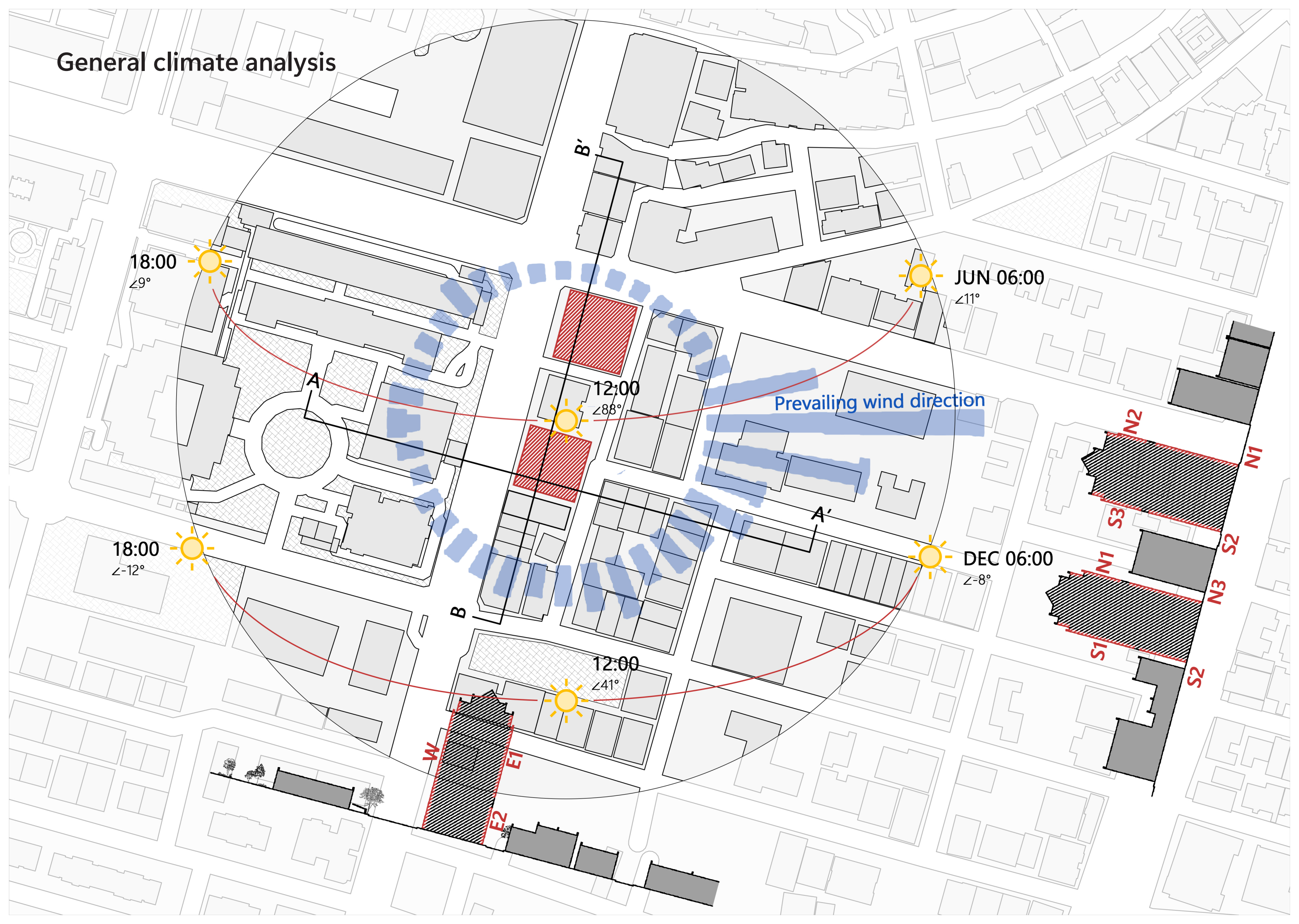
1. small families
2. multi-generation families
3. college student co-renting



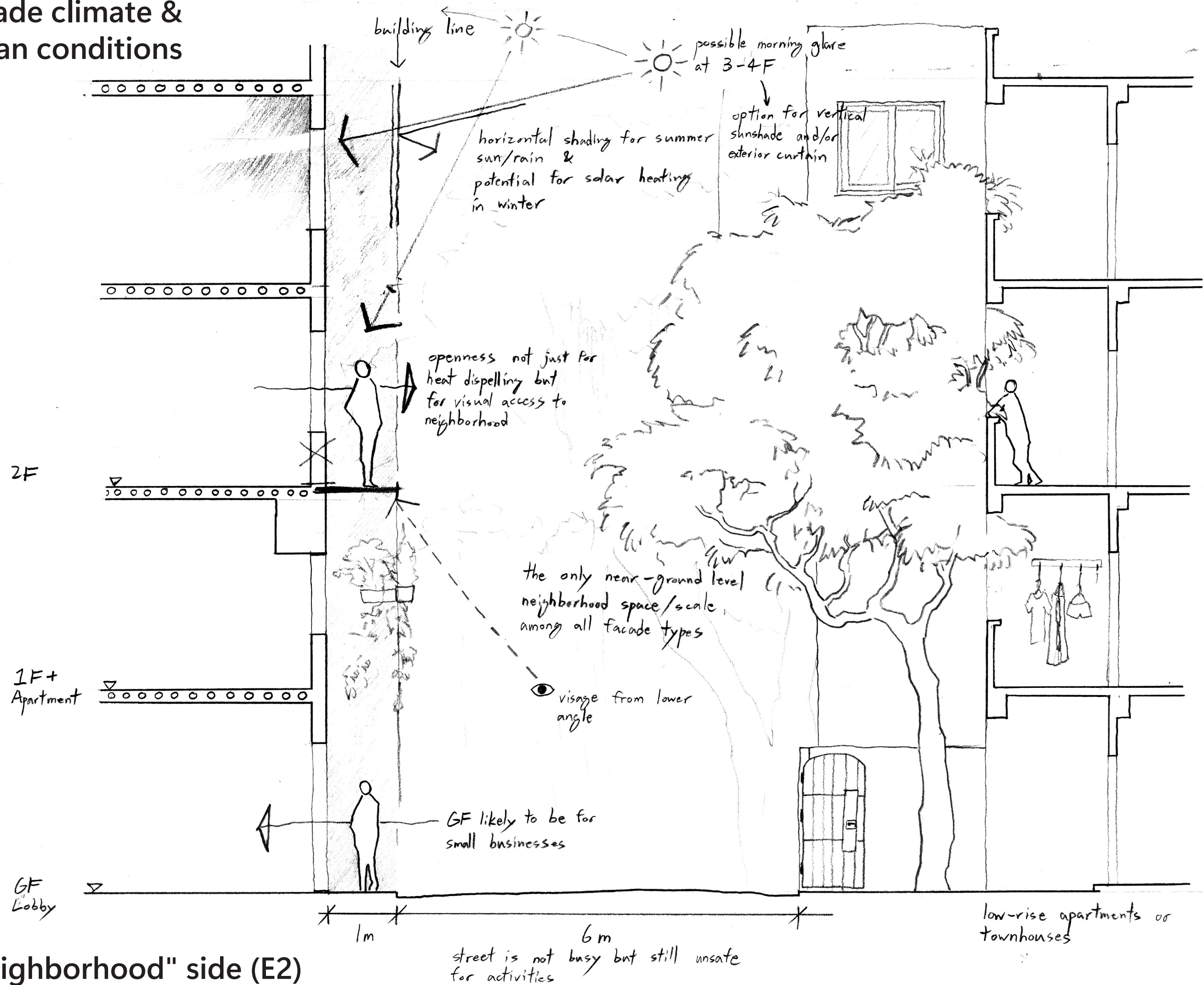
Site design challenges



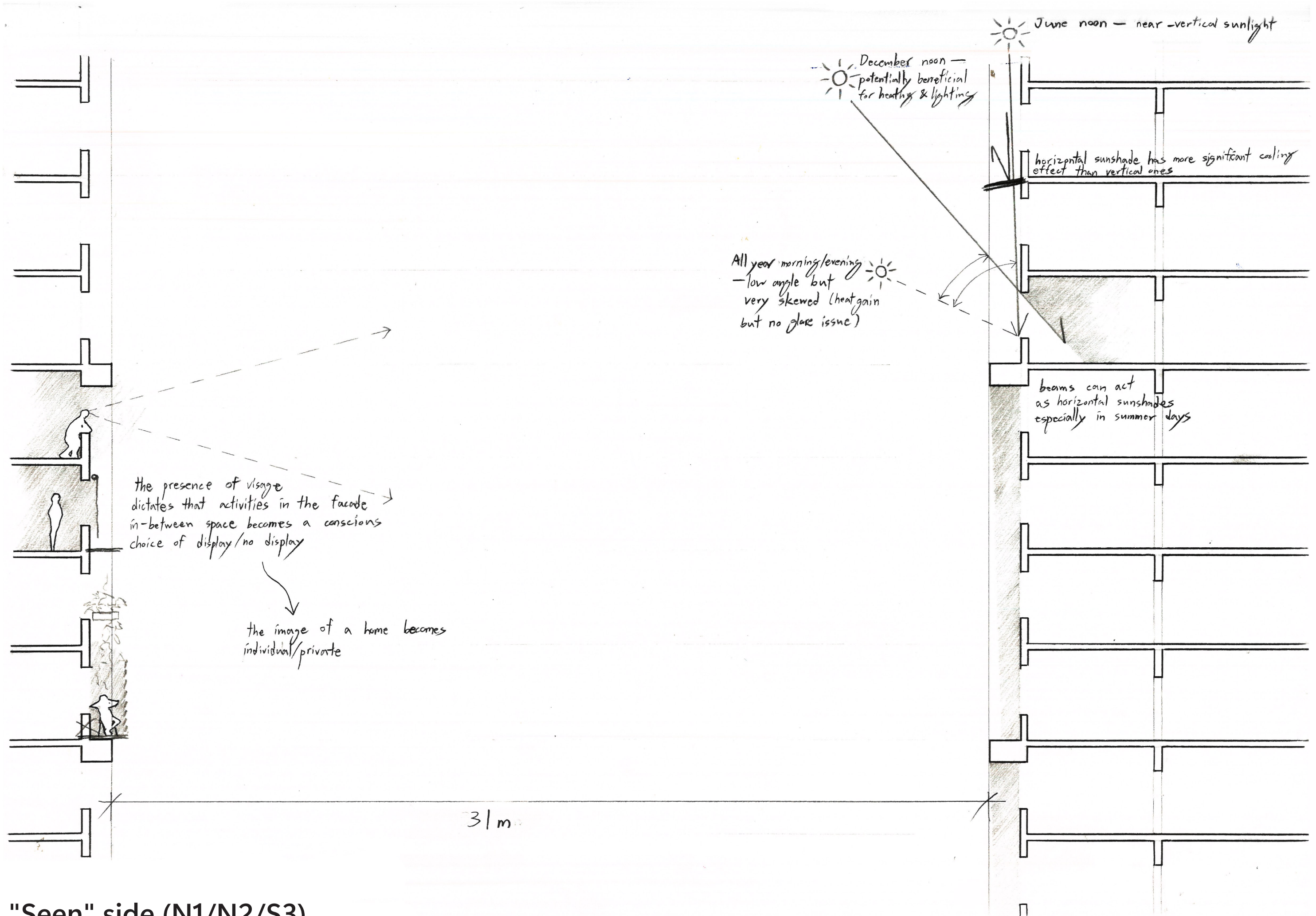
General climate analysis



Facade climate & urban conditions



"Neighborhood" side (E2)



↓
facade expression determined less by
visage/privacy but more by climatization



afternoon glare/
heating all year

college campus -
likely empty at night

"fake column" -
repose as solar
chimney
+
vertical support for
facade intervention?

orientation &
solar chimney
create underpressure

vertical shading
scheme necessary

block during day
fully open at night

additional SRC
beams every 4
floors

1. repurpose as
venturi roof to
facilitate solar
chimney?

wind direction

+ wind tower inlet?

ZIF
Elevator lobby
, OH, mechanical

20F

19F

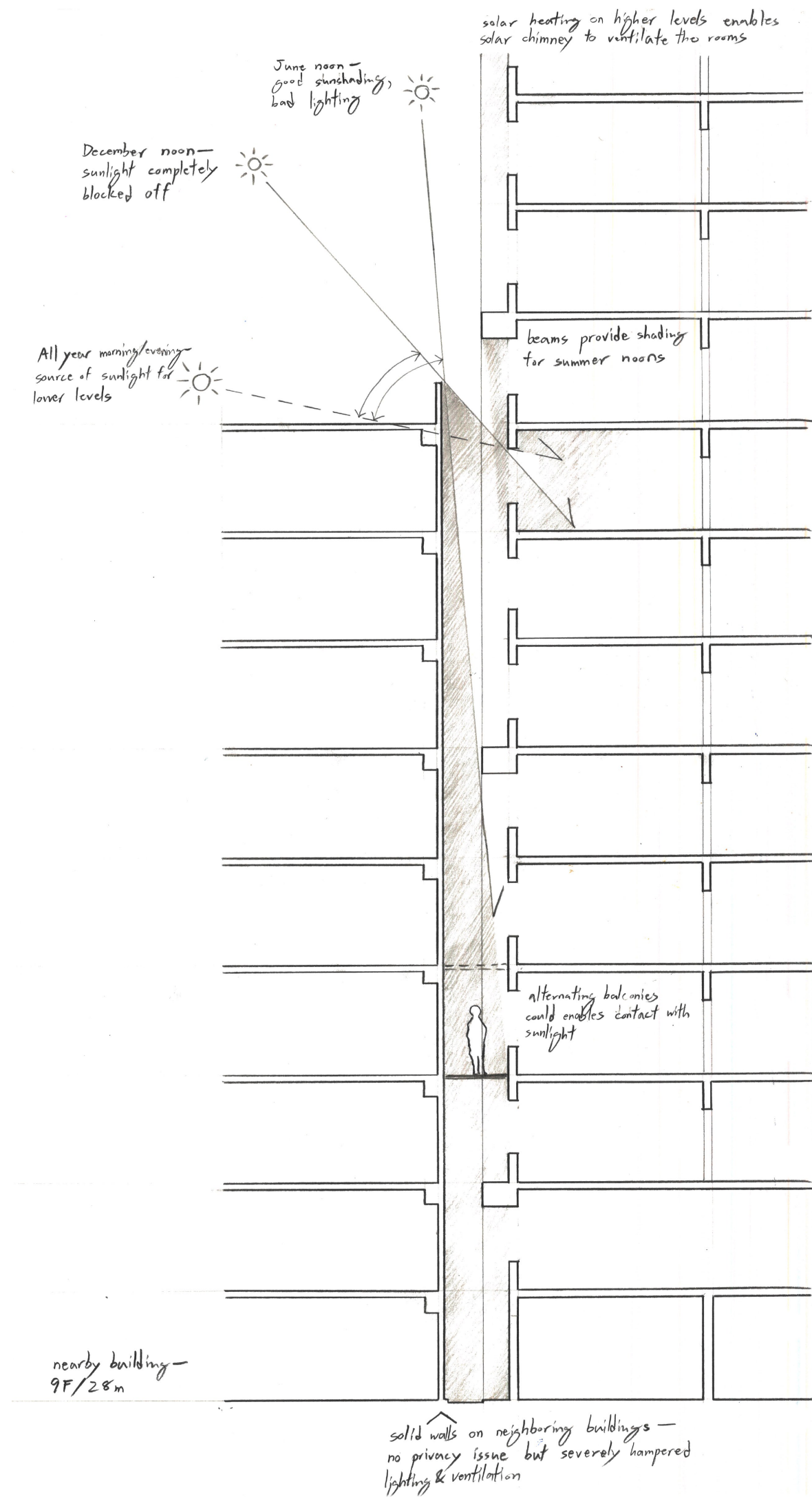
- effective cross ventilation scheme
- re-imagine a permeable house gateway?

ZF

1F
Apps.

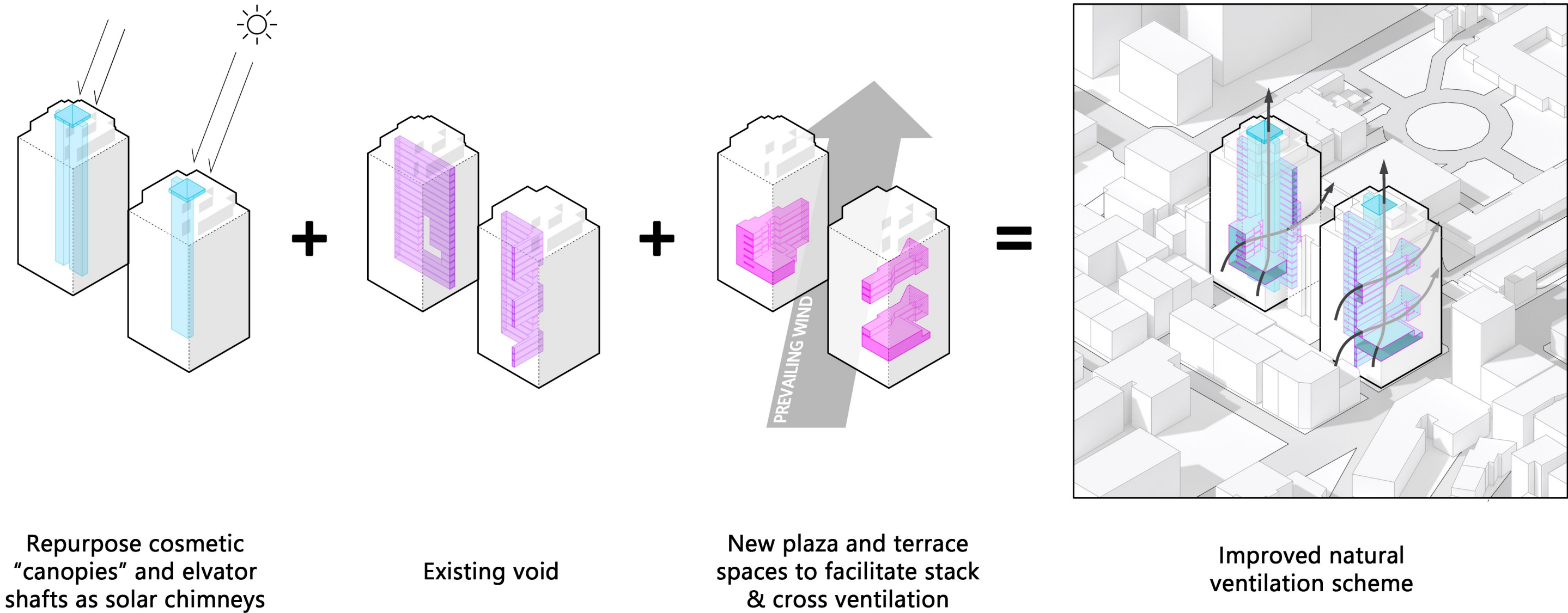
GF
Lobby

"Clear view" side (W/E1/N2/S1)



"Ravine" side (N3/S2)

Core climate design concept



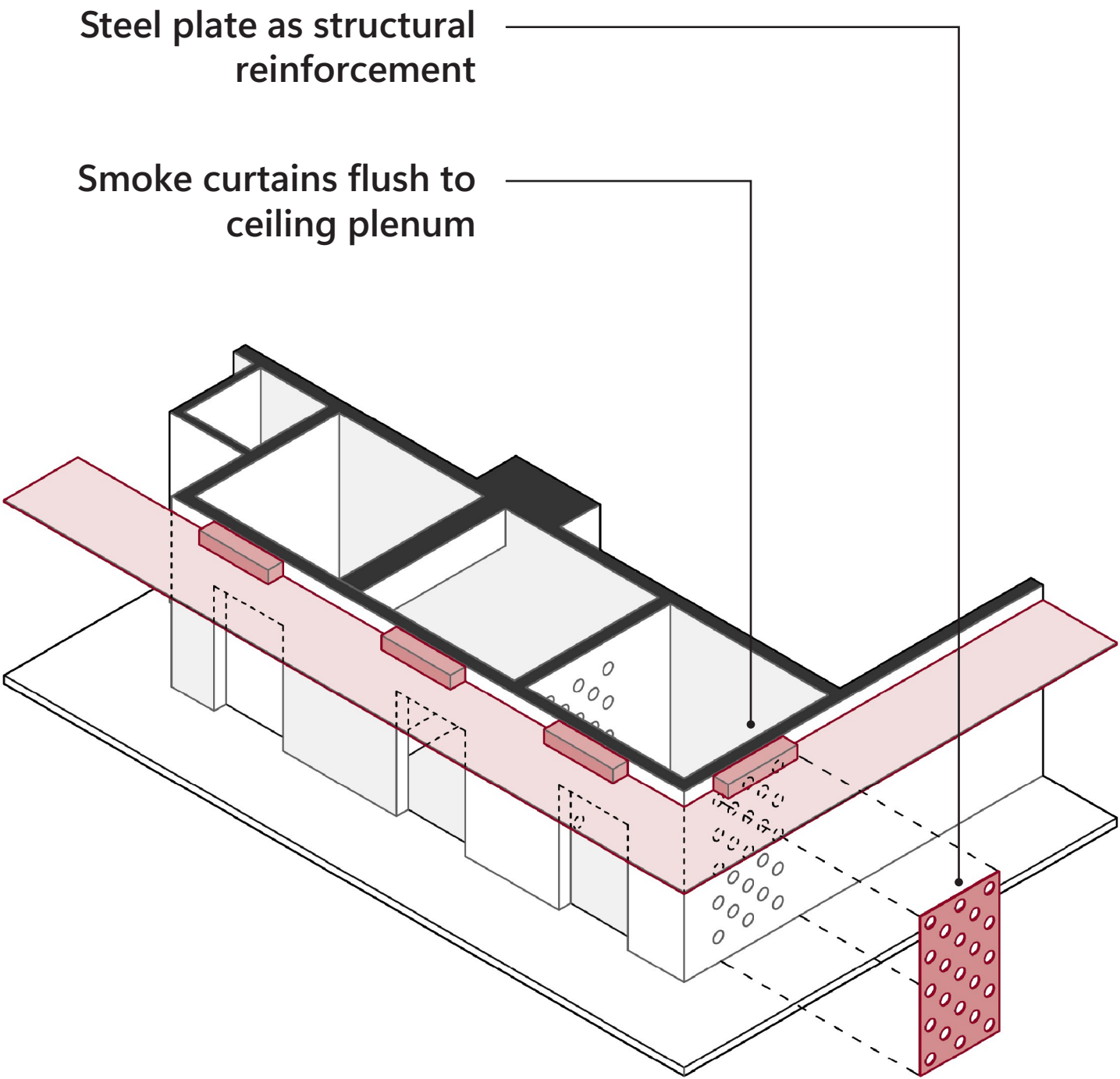
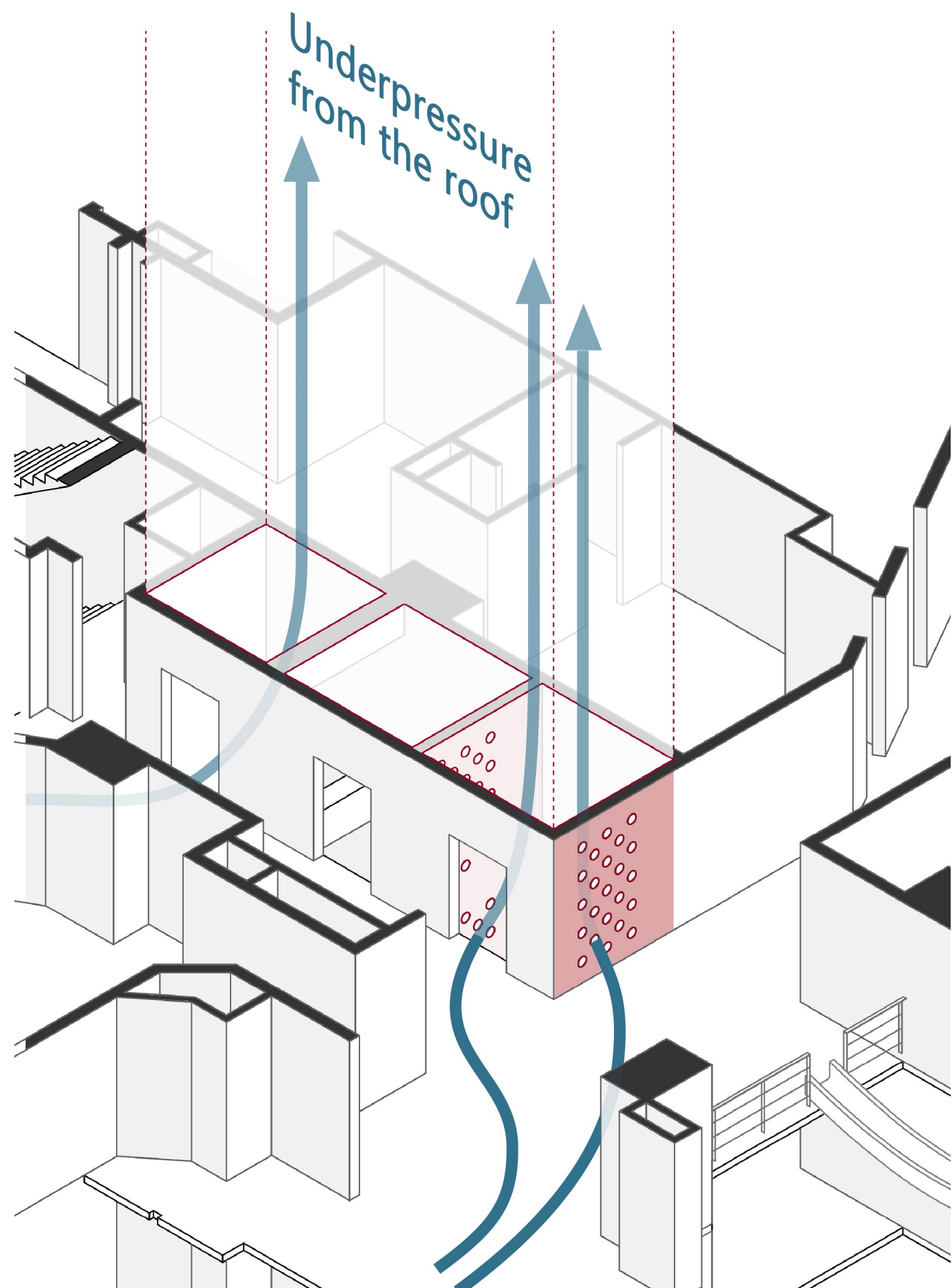
Repurpose cosmetic "canopies" and elevator shafts as solar chimneys

Existing void

New plaza and terrace spaces to facilitate stack & cross ventilation

Improved natural ventilation scheme

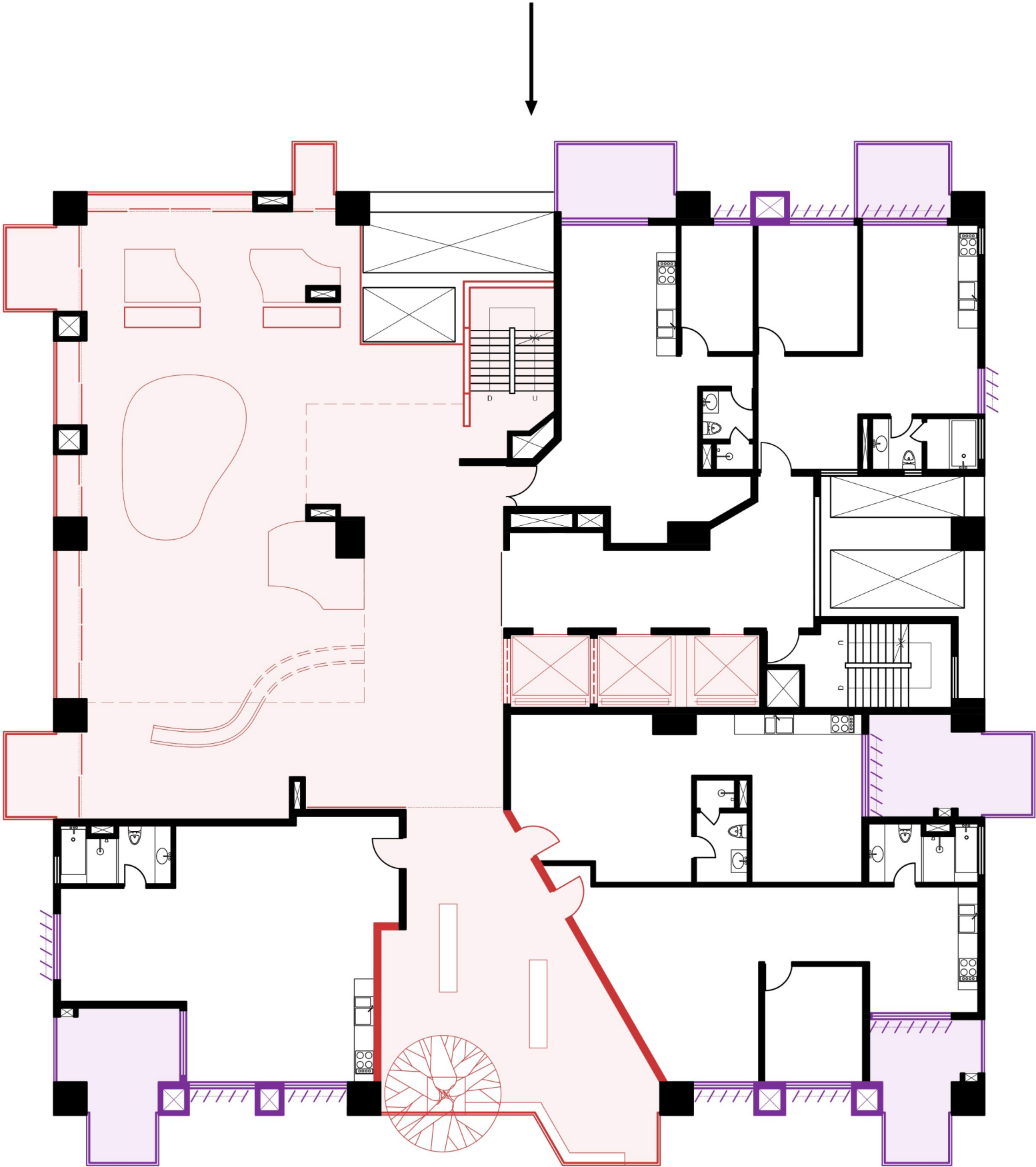
Elevator shaft to solar chimney conversion



Integrated design strategy: minimal interventions to improve passive cooling,
and activate community gathering & private in-between spaces

Basic intervention - Public

Stack ventilation intake
as community spaces



Basic intervention - Private

Revised cross ventilation scheme +
configurable balcony additions

↓

Activated community

Meaningful social programming to restore sense of community to highrise dwellings



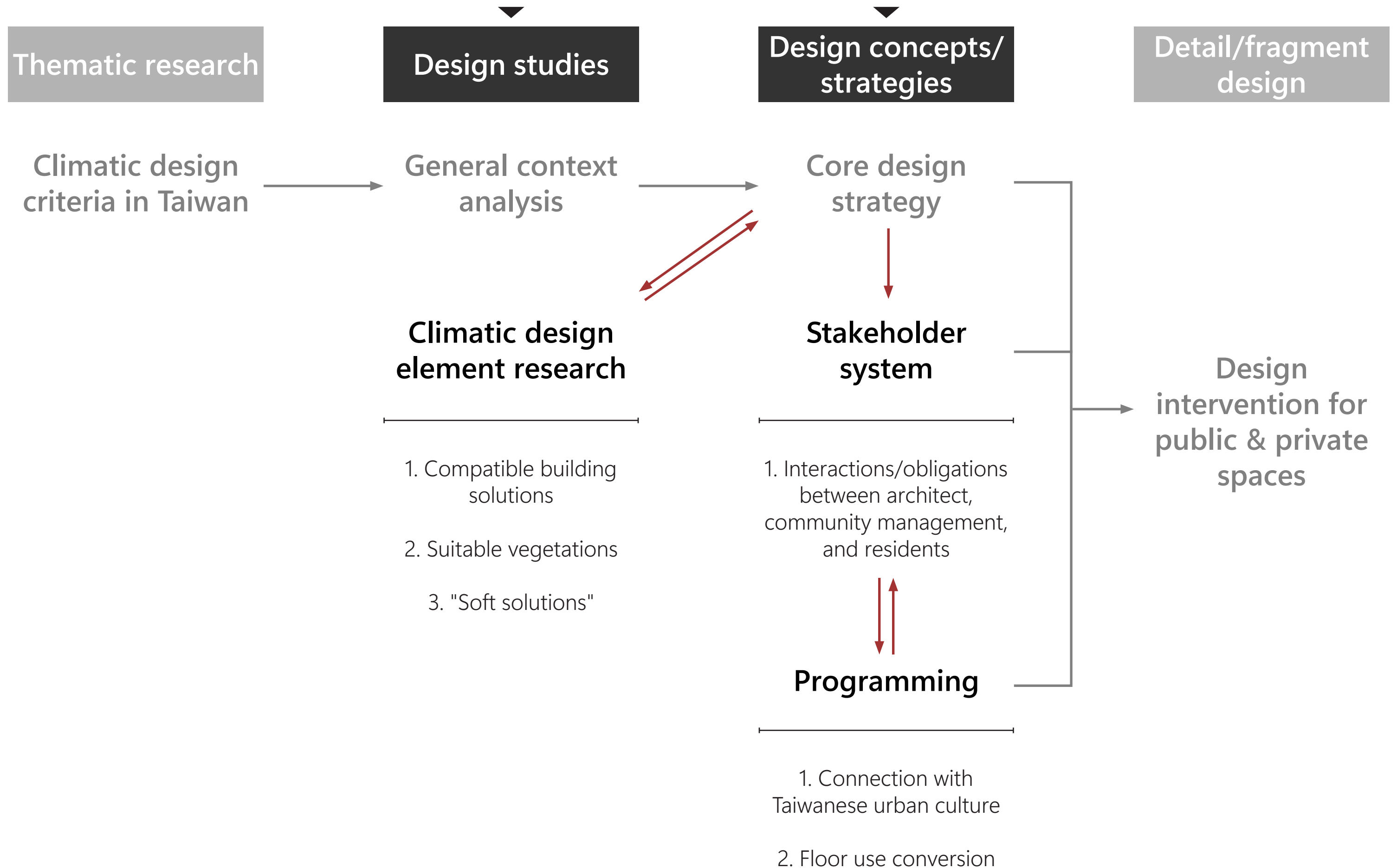
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Personalized outdoor space

Structural additions/alterations from the residents to suit the programmatic demands and spatial quality

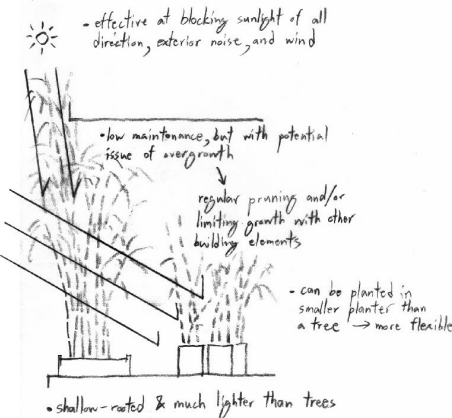
↓

Community + private experienced facilitated by cooler spaces & combine to form a new activity-driven expression for the building

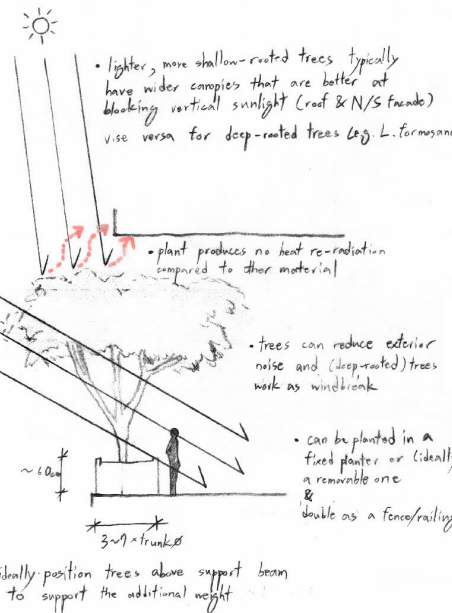


Design element selection

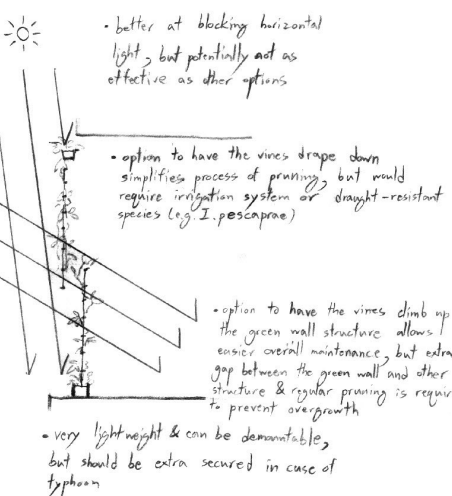
Green sunshade - bamboo



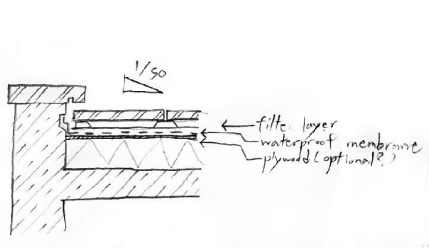
Tree



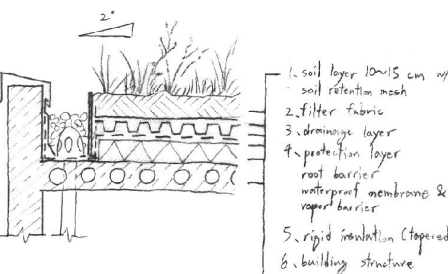
Green wall



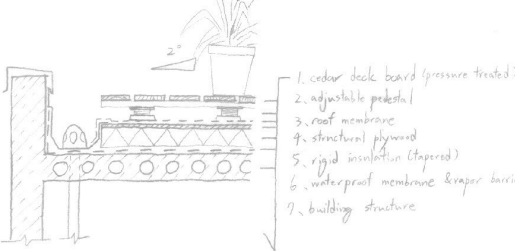
Pedestal pavement system



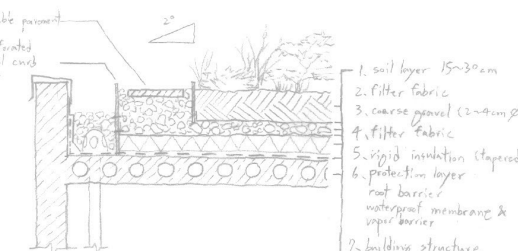
Regular green roof



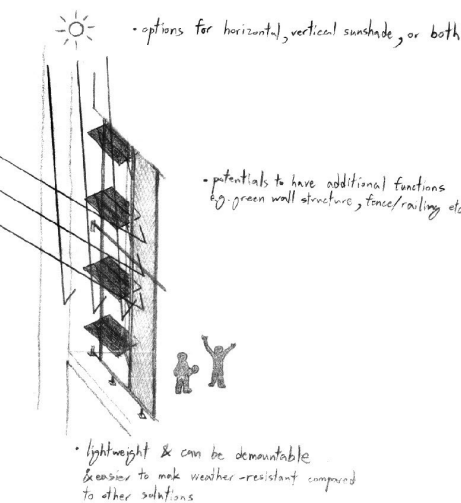
Roof deck + freestanding planters



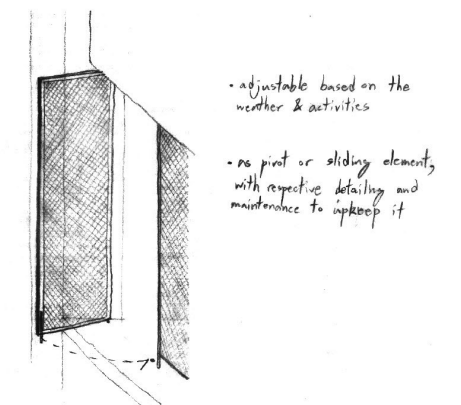
Gravel-based roof garden



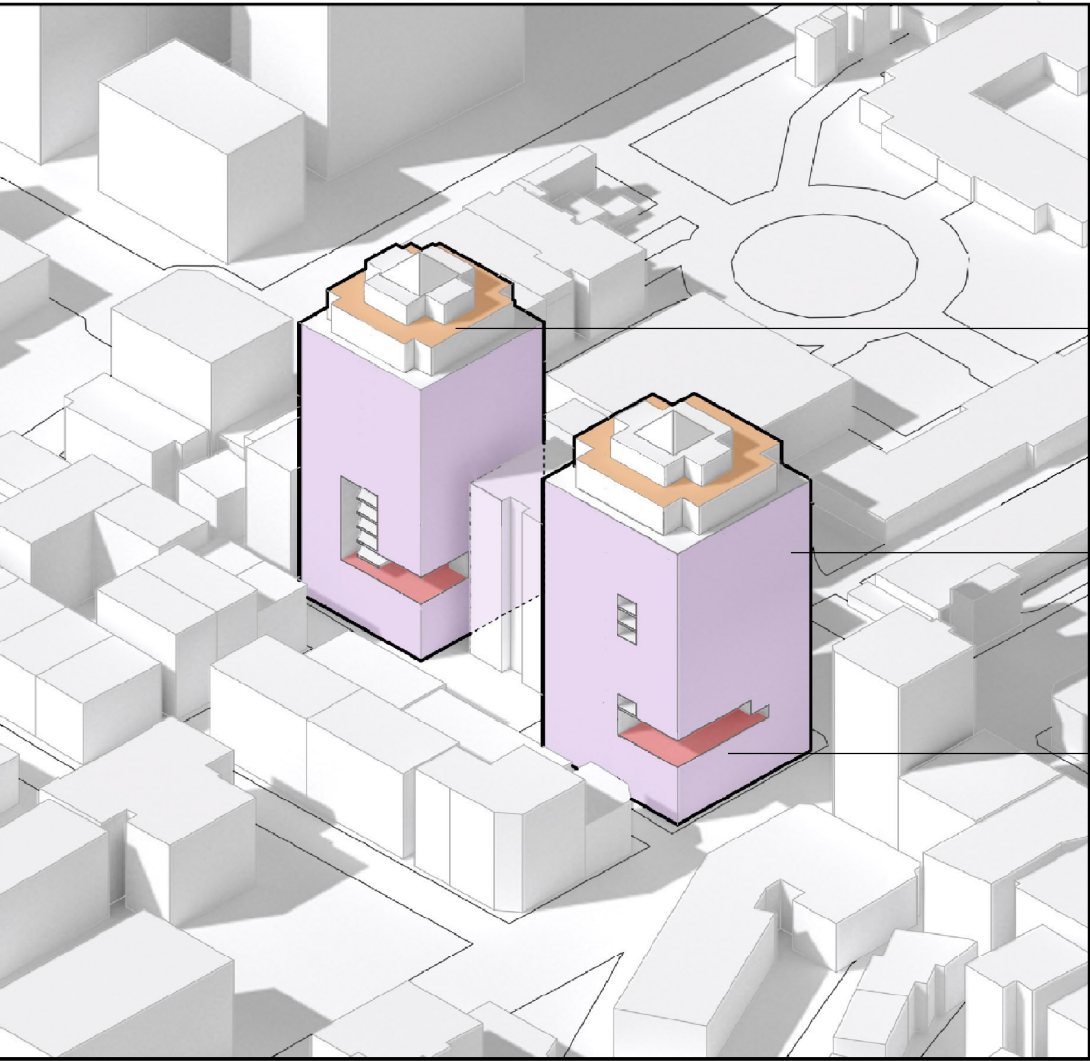
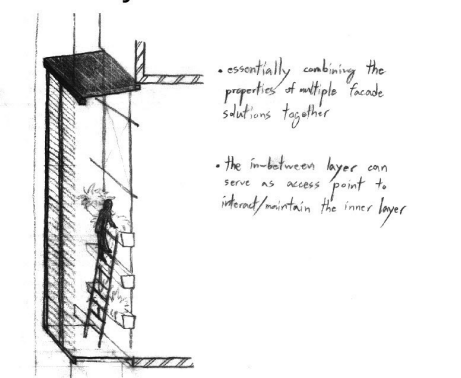
Fixed sunshade



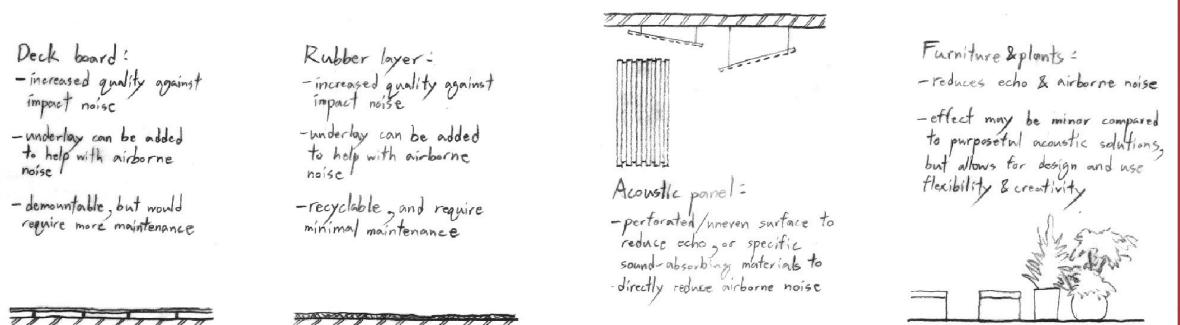
Operable sunshade



Multi-layer facade



Acoustic solutions




Suitable vegetation types




Z. matrella

- ✓ Endemic species
- ✓ Very low maintenance; no mowing required
- ✓ Very drought-tolerant




D. chrysantha (Zoll. & Moritzi.) Miq.

- ✓ Endemic species variant
- ✓ Drought-tolerant
- Spreads slowly



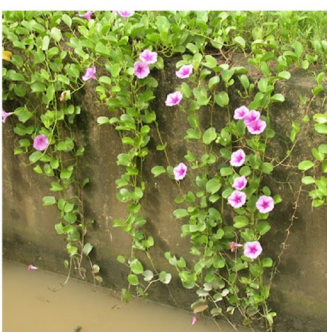
W. chinensis

- ✓ Endemic species
- ✓ Very hardy
- ✓ Suitable for consumption (herbal tea)
- Prefers full-light environment
- Rapid growth




S. taccada

- ✓ Endemic species
- ✓ Tolerant to wind, salt, harsh exposure




I. pescaprae

- ✓ Endemic species
- ✓ Hardy, draught-tolerant
- ✓ Doesn't attach to & erode building surfaces
- Prefers full-light environment



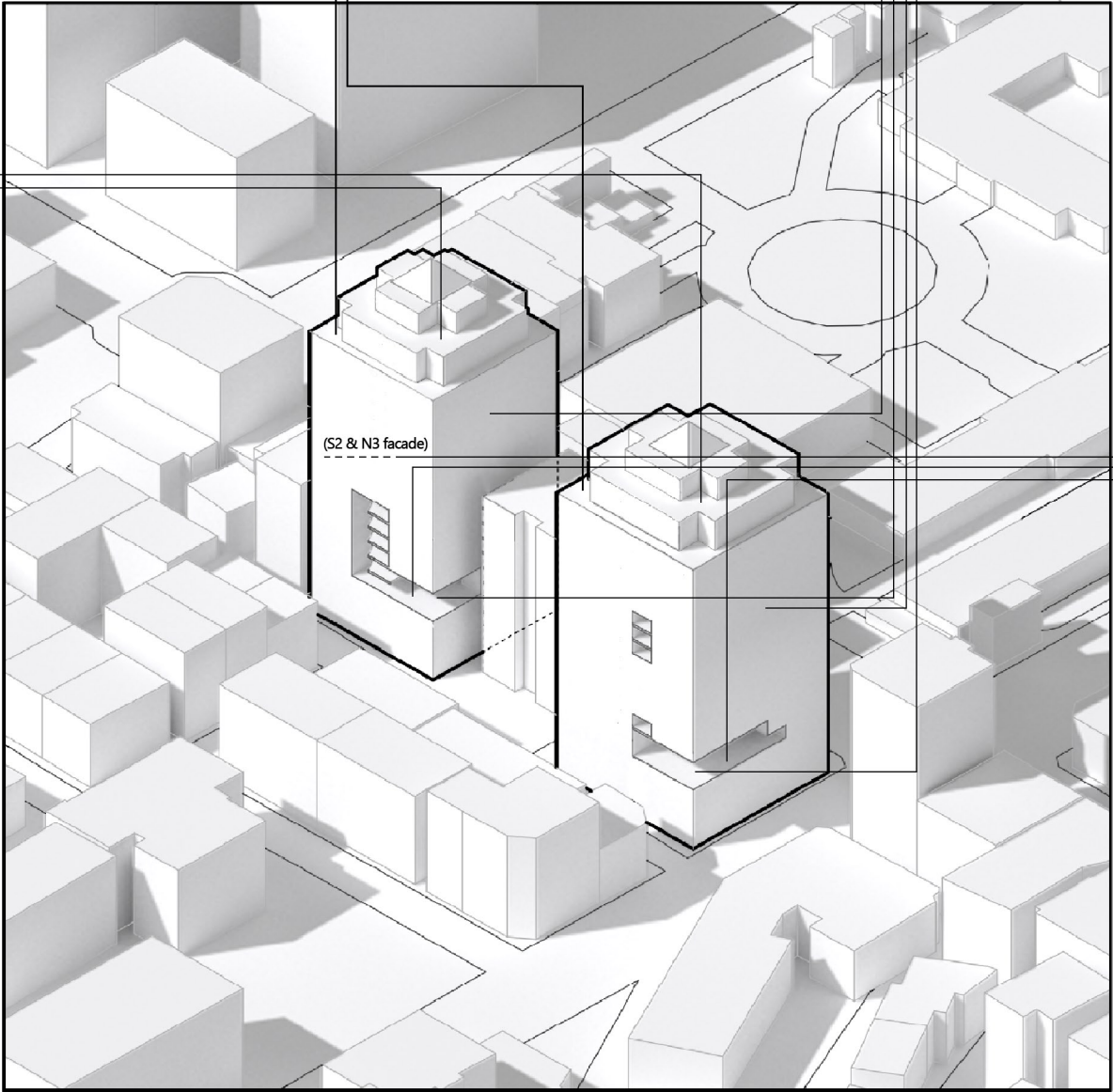
L. formosana


- ✓ Endemic species
- ✓ Low maintenance
- ✗ Deep roots (5-7x trunk ø)
- Prefers full-light environment



P. pinnata


- ✓ Low maintenance
- ✓ Wide & dense crown
- ✓ Nitro-fixing property for the soil
- ✓ Draught-tolerant
- ✓ Shallow roots (3-5x trunk ø)
- Prefers full-light environment






L. indica

- ✓ Low maintenance
- ✓ Wide & dense crown on mature trees
- ✓ Beautiful pink/purple flowers in the summer
- ✓ Shallow roots (3-5x trunk ø)




C. indicum

- ✓ Endemic species
- ✓ Produces fragrant flowers all year round
- Fast-growing climber



D. volubilis


- ✓ Endemic species
- Fast-growing climber
- Adapts to full & half-light environments



N. cordifolia (& other common fern species)

- ✓ Hardy, low maintenance
- Prefer low-light environment

Compatible & can be utilized in most spaces



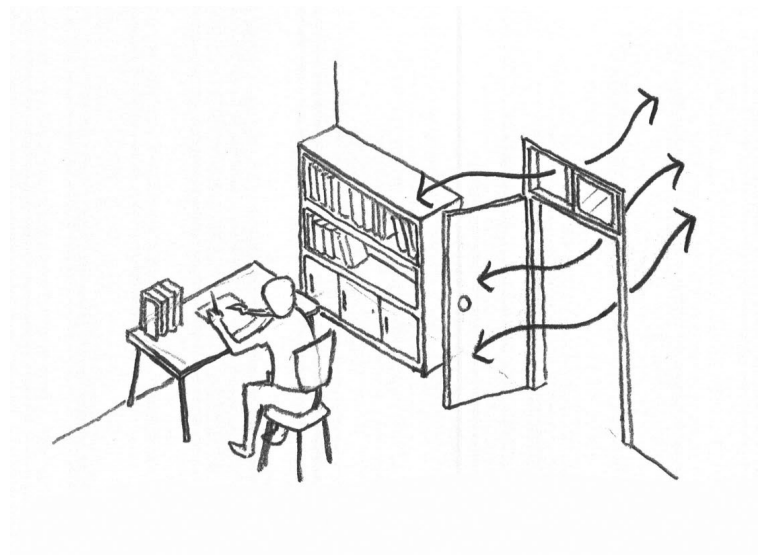
B. multiplex

- ✓ Very low maintenance
- ✓ Dense foliage
- ✓ Wind-resistant & can be used as wind-breaker
- ✓ Draught-tolerant
- ✓ Shallow, clumping roots ideal for planters

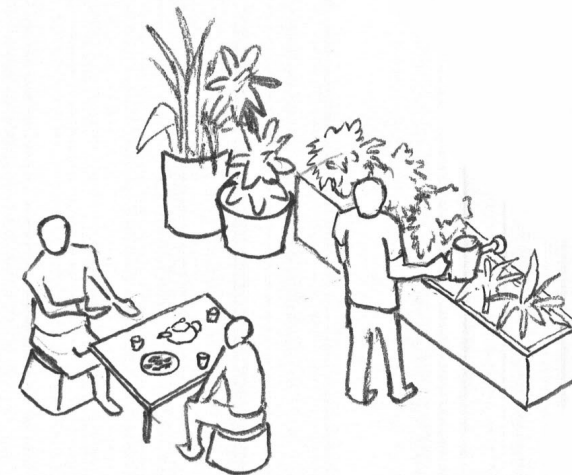


Soft solutions:

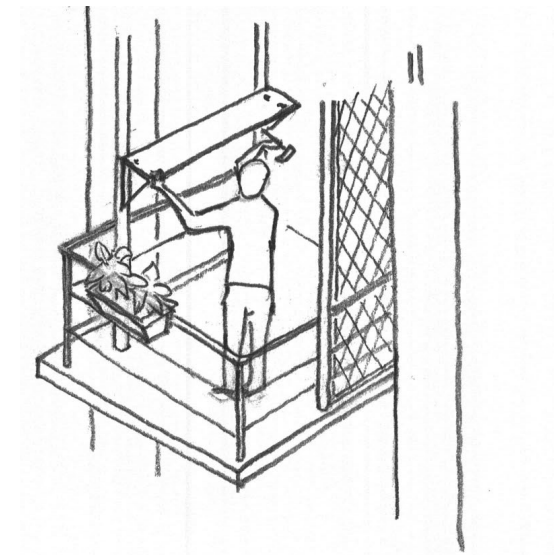
User habits and/or activities that creates specific (positive) spatial or climatic conditions



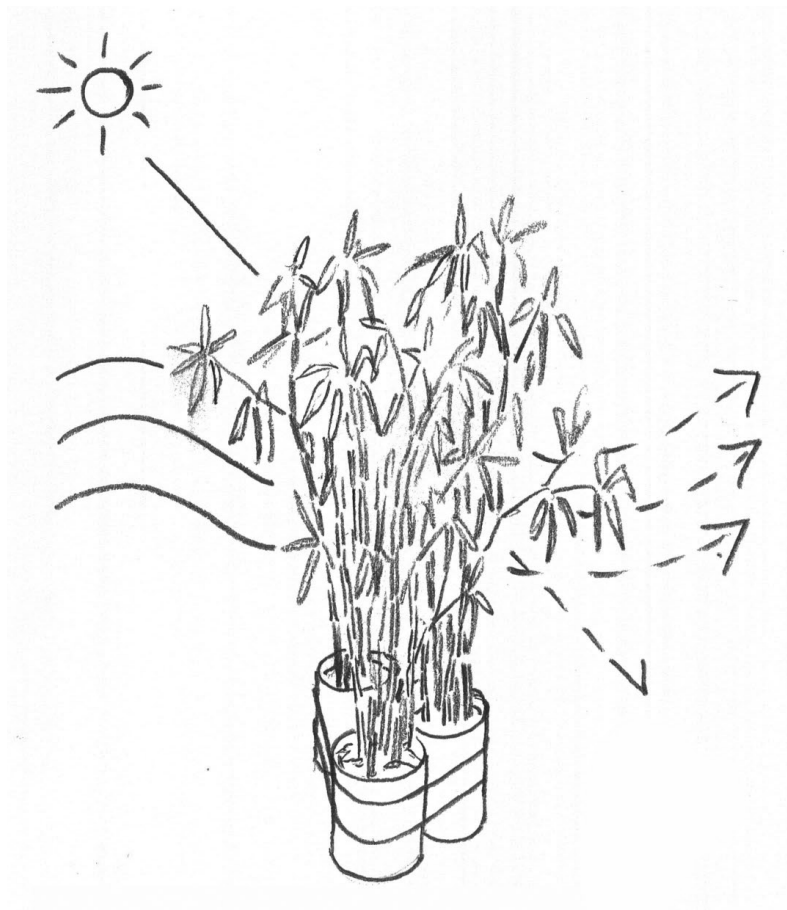
Windows/doors constantly kept open for airflow



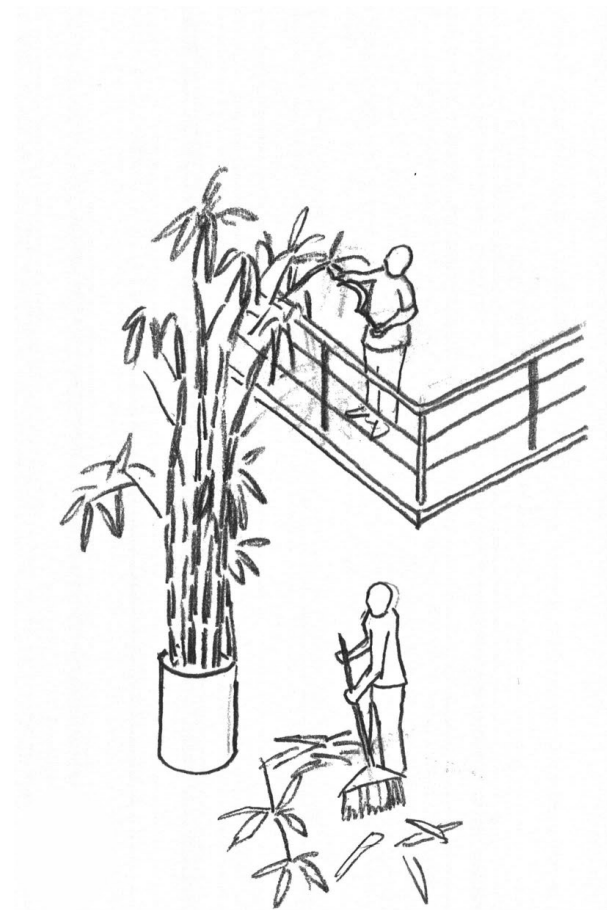
Neighborhood socializing helps contextualizing and maintain public spaces



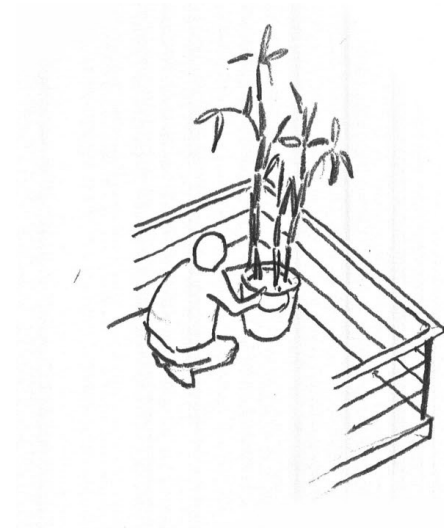
Resident's ability to modify living spaces with item, furniture, or structural addition



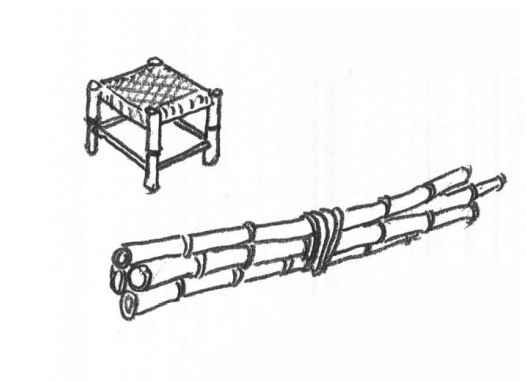
Potted bamboo - superior sunshading and windbreaking properties + easy to handle



Community provides regular pruning & positioning of the bamboo plants



Bamboo (& other selected plants) can be shared for personal gardening



Bamboo logs can be used in the construction of items or light structures

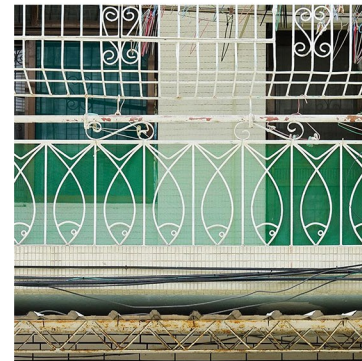
Ordinary
leisure



Community
gatherings

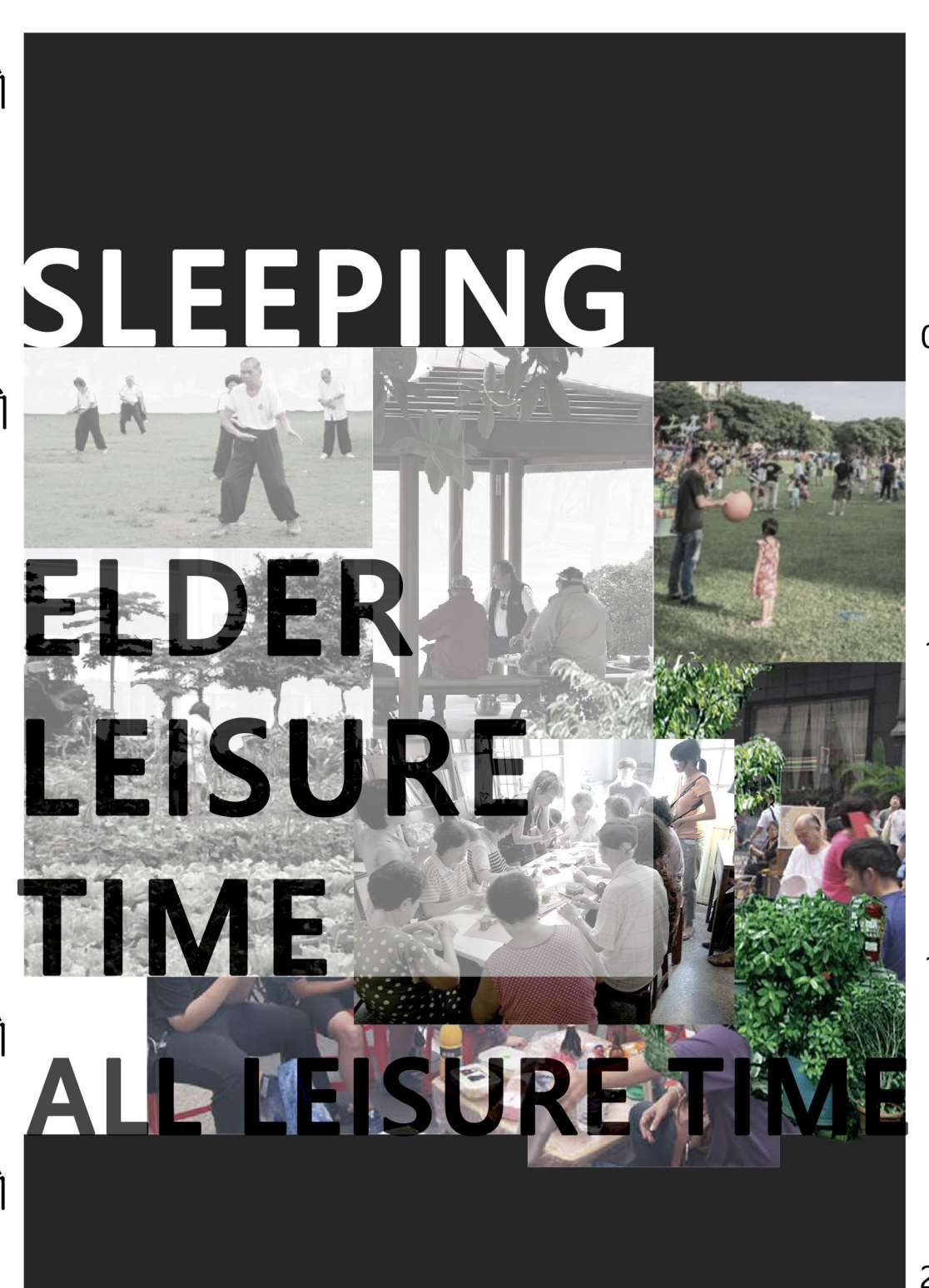


Urban
motifs



Activity schedule of the
apartment residents

M T W T F S S



0:00

06:00

12:00

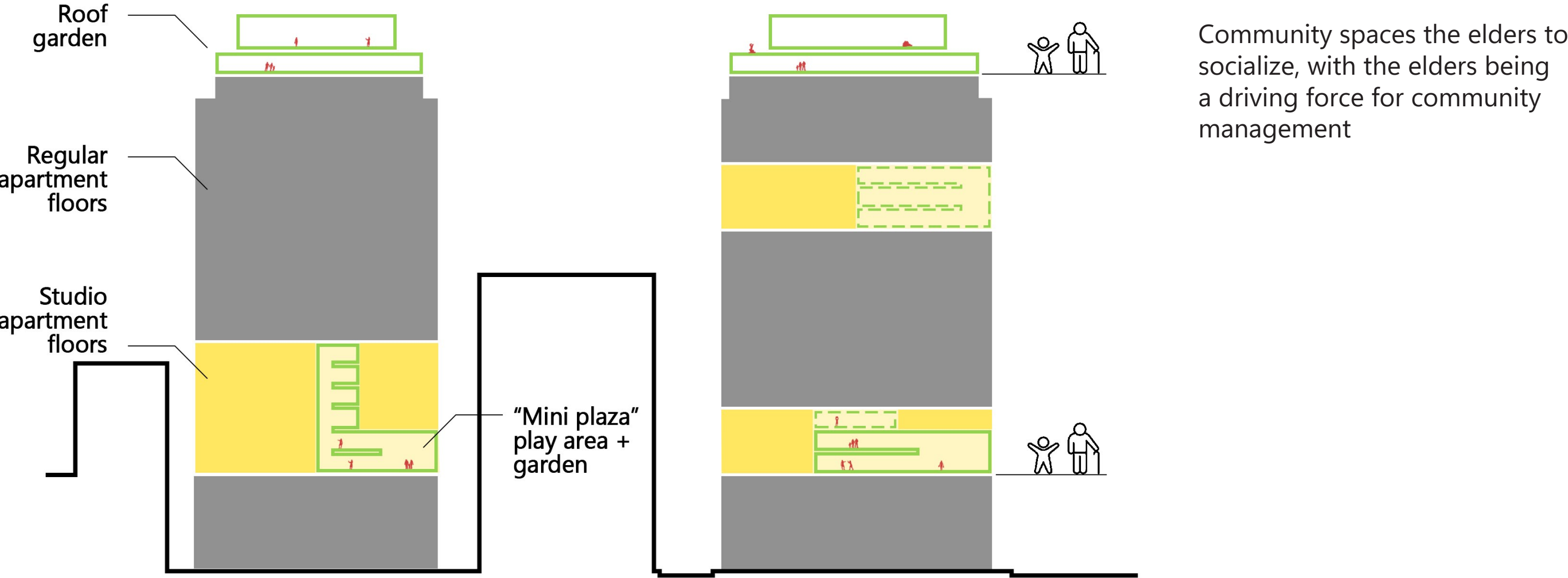
18:00

24:00

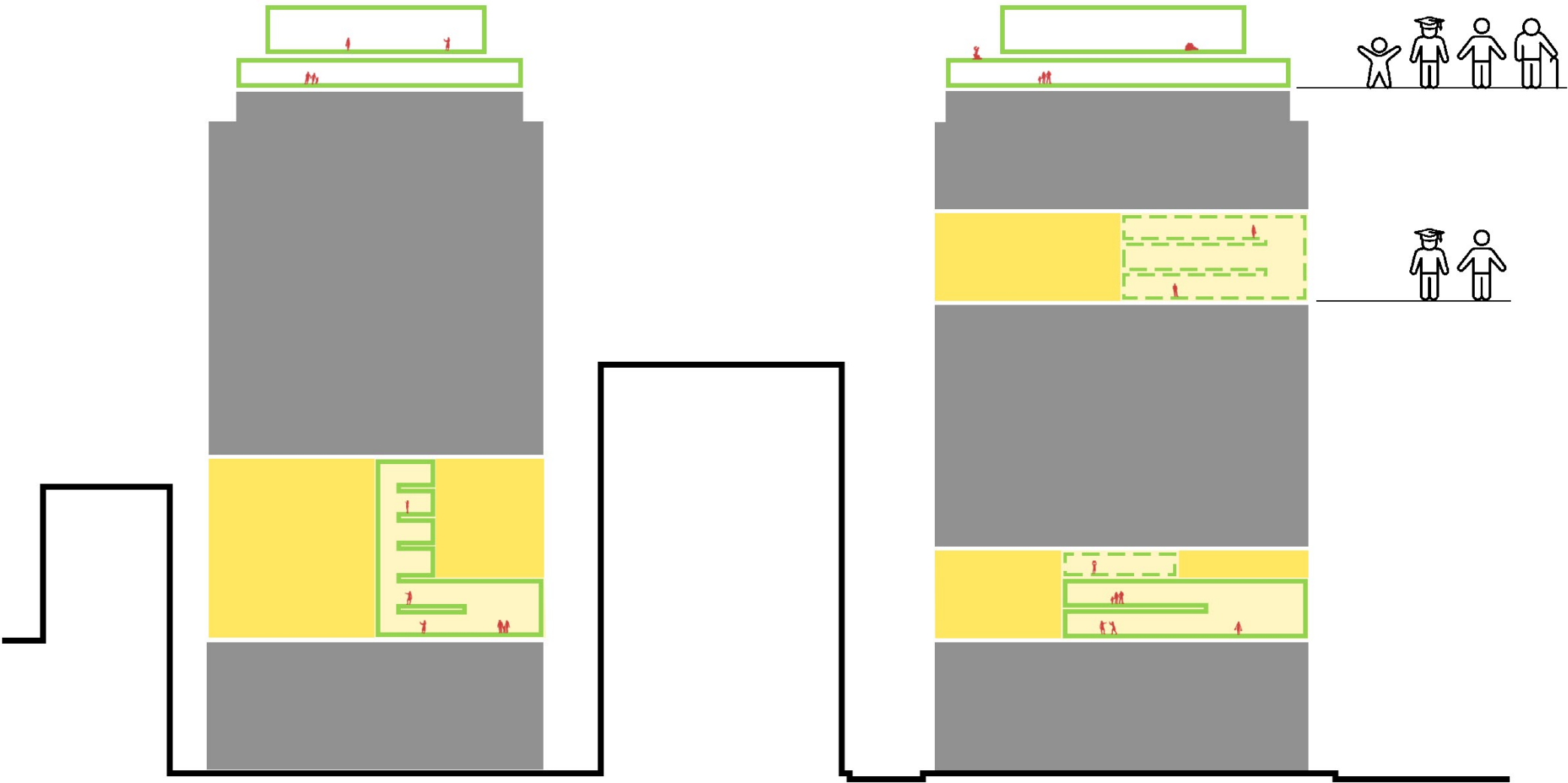
Grassroot urban culture to contextualize the
collective living experience

Program zoning

Space/demographics relation during work hours

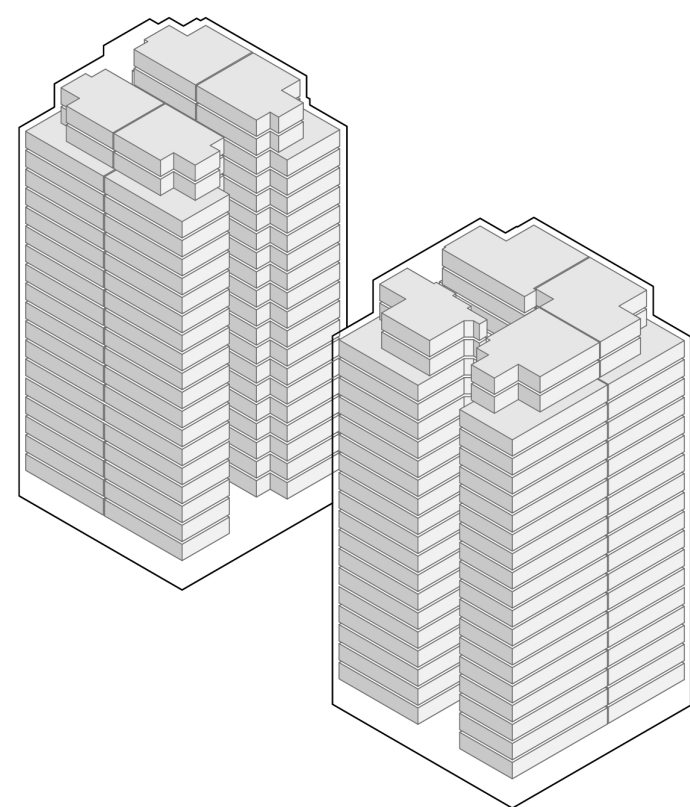


Space/demographics relation during evening/weekend



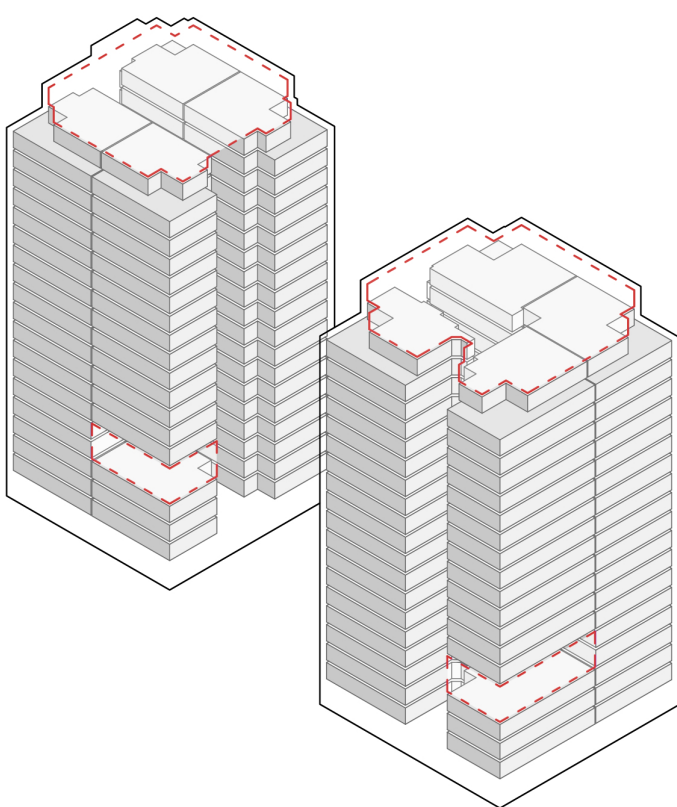
Community spaces can be enjoyed by everyone during evening or weekend

Apartment conversion volume



168

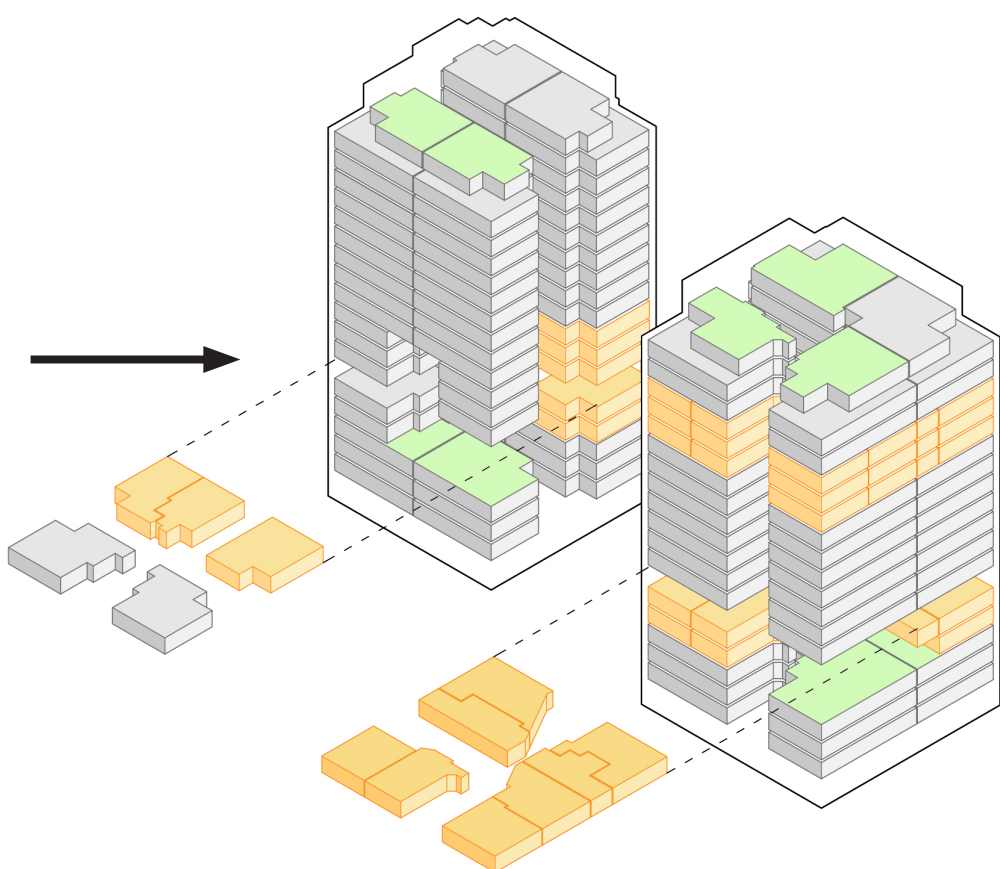
Existing apartment units



-12

156

Partial conversion for
community & ventilation
purposes

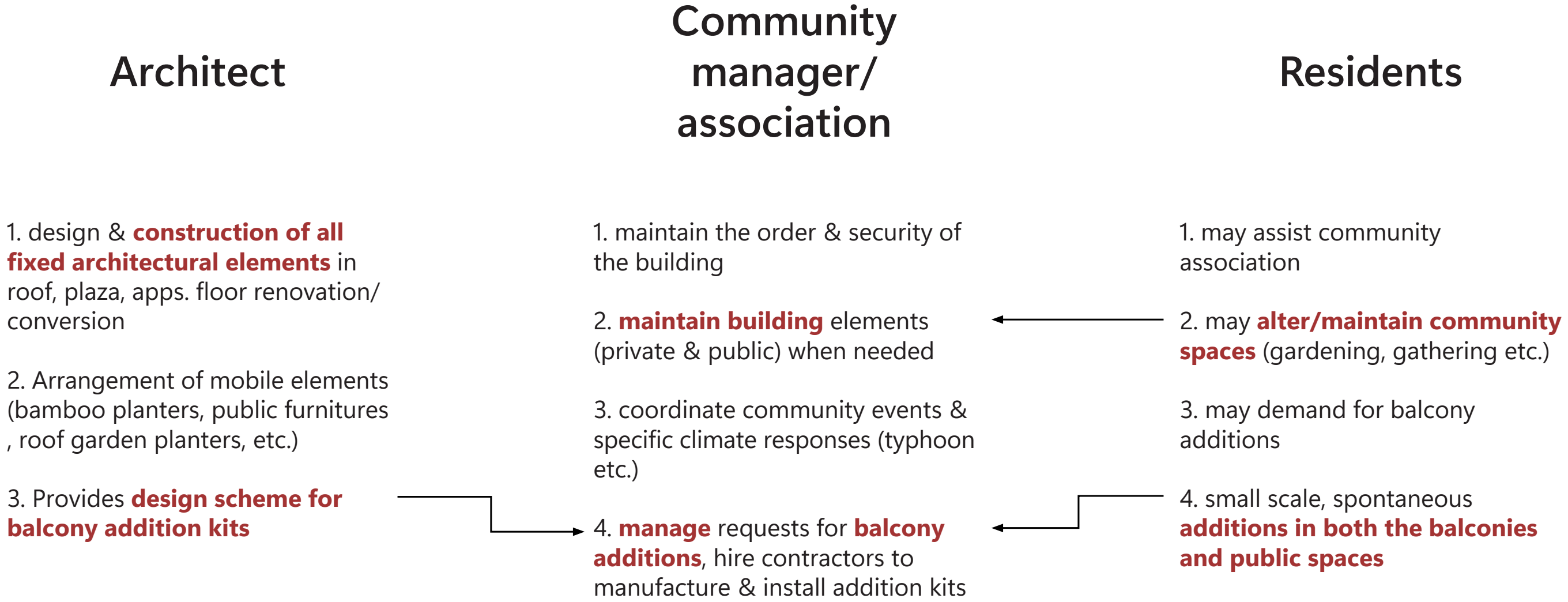


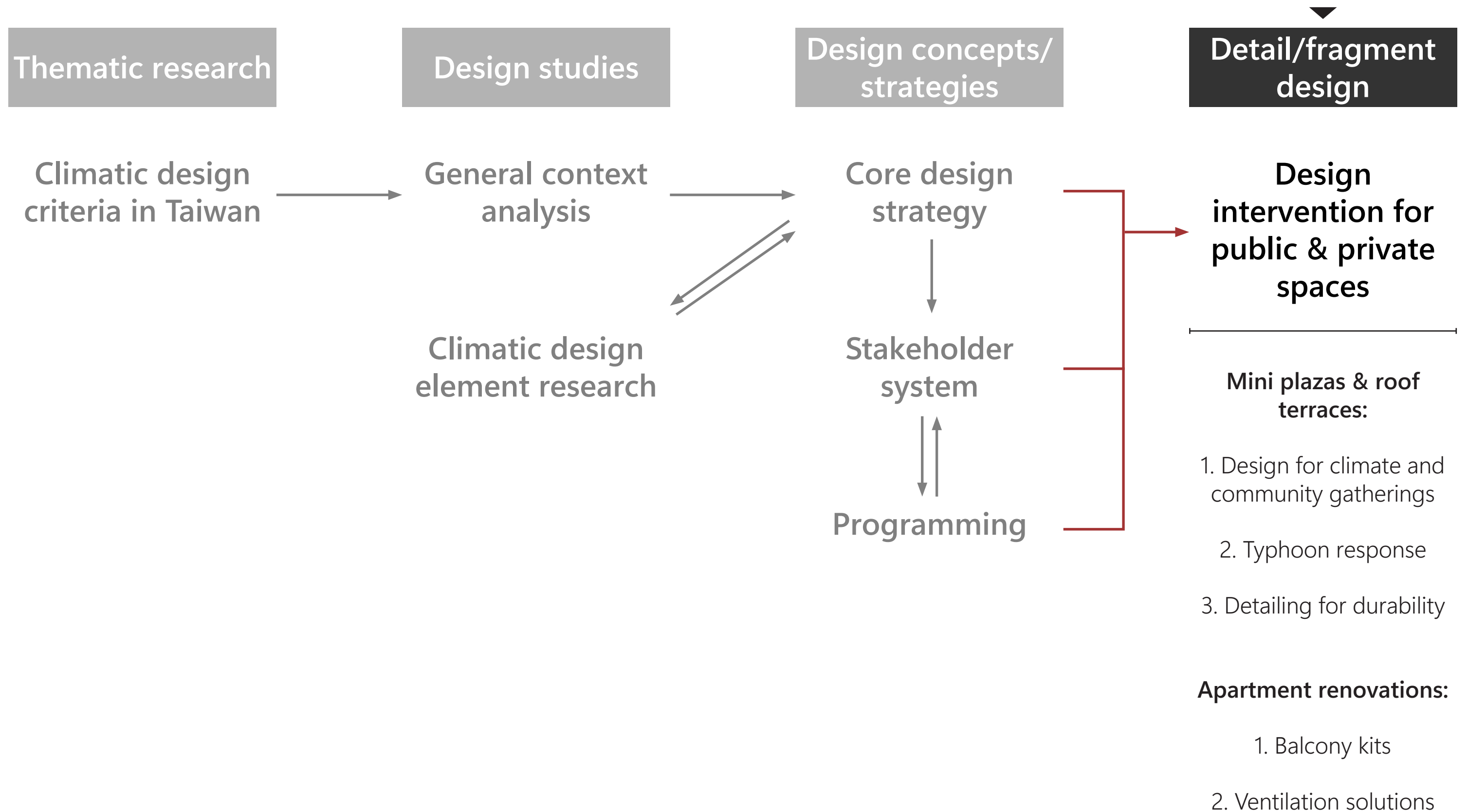
+22

190

Partial conversion into studio
apartments
(140 regular / 50 studio apps.)
+community spaces
+improved cooling for whole
building

Roles for stakeholders &
System for project maintenance





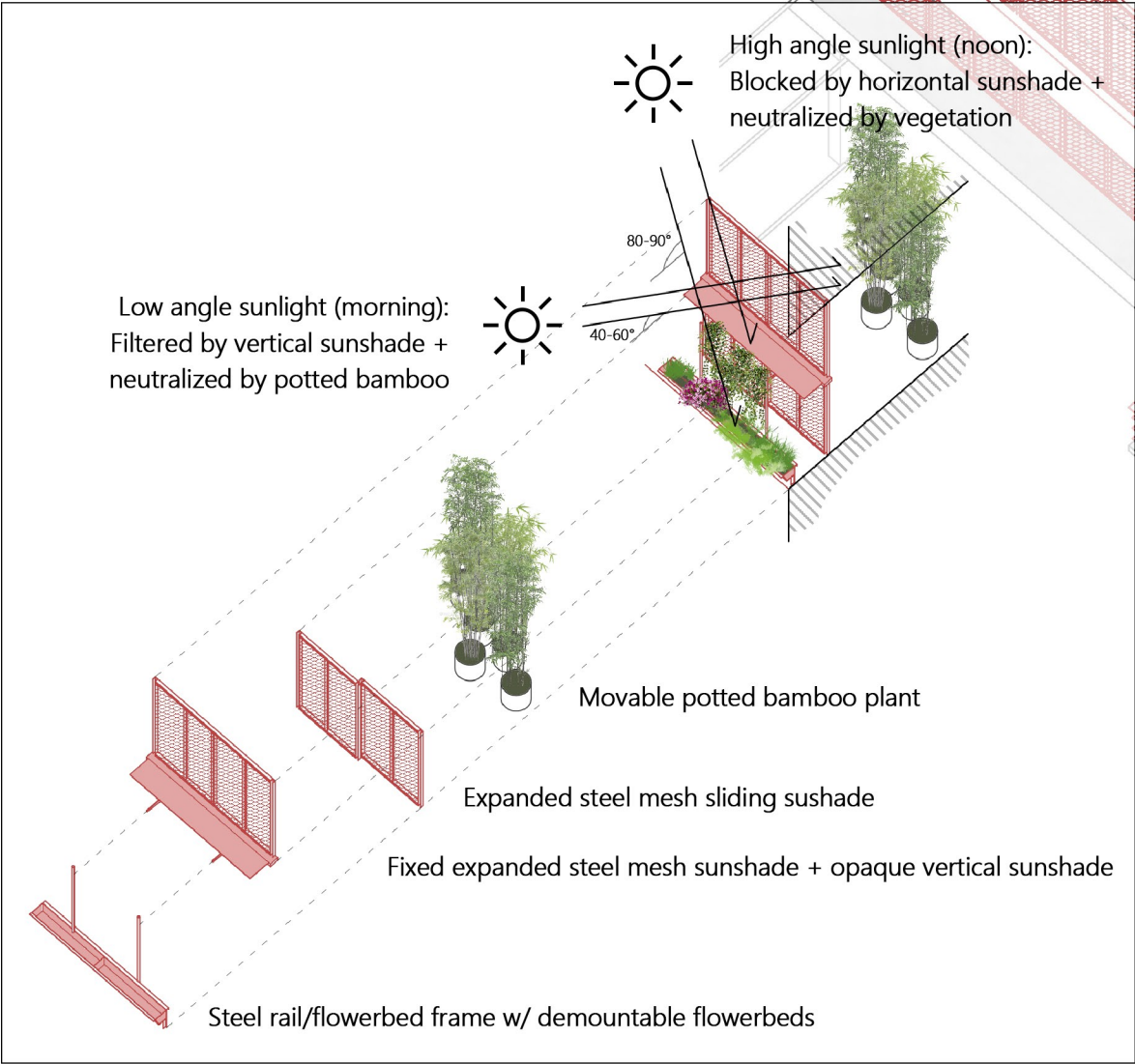
Mini plaza - Warm/hot days

Upper floor platform to spatially connect with the main plaza, while serving as an easy access spot to prune the bamboo (or other tall plants)

Gardening as the main activity to connect the community while serving as a key element to cool the space via sunshading and transpiration cooling

Perforated timber acoustic panels, recyclable rubber pavement, and potted bamboo to reduce both impact and airborne noise

Envelope composition



Facade structure offers control over the sunlight, and safety for the people and items in the plaza space



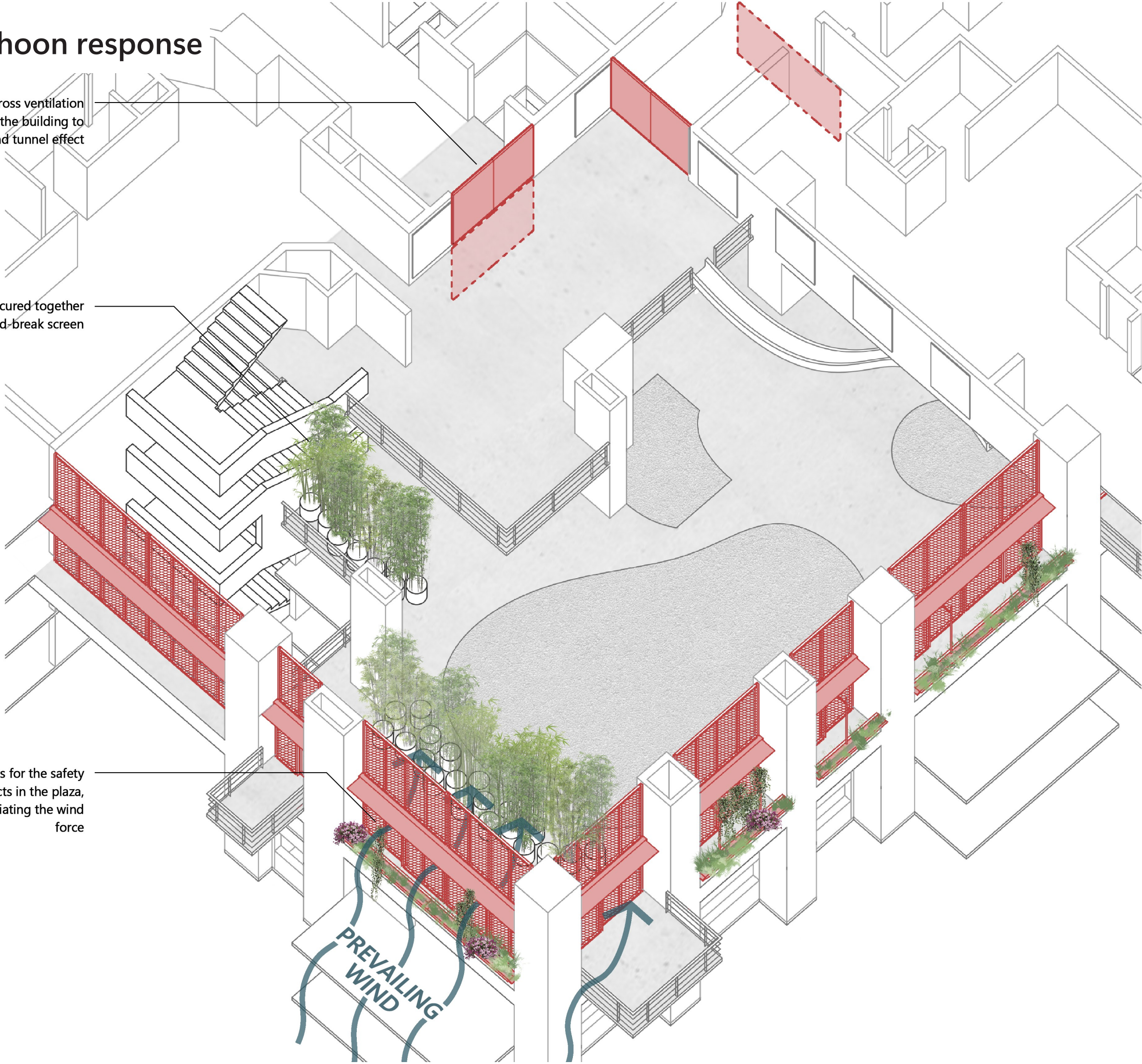


Mini plaza - Typhoon response

Gates to block off cross ventilation channels through the building to eliminate potential wind tunnel effect

Potted bamboo can be secured together to create an effective wind-break screen

Closed operable sunshades for the safety of the people and the objects in the plaza, while also help with alleviating the wind force



Mini plaza elevation fragment



Screw sleeve 70mm embedded
in existing RC floor structure

Steel sunshade:
70/70/5mm steel C-section
expanded steel mesh
galvanized & powder-coated

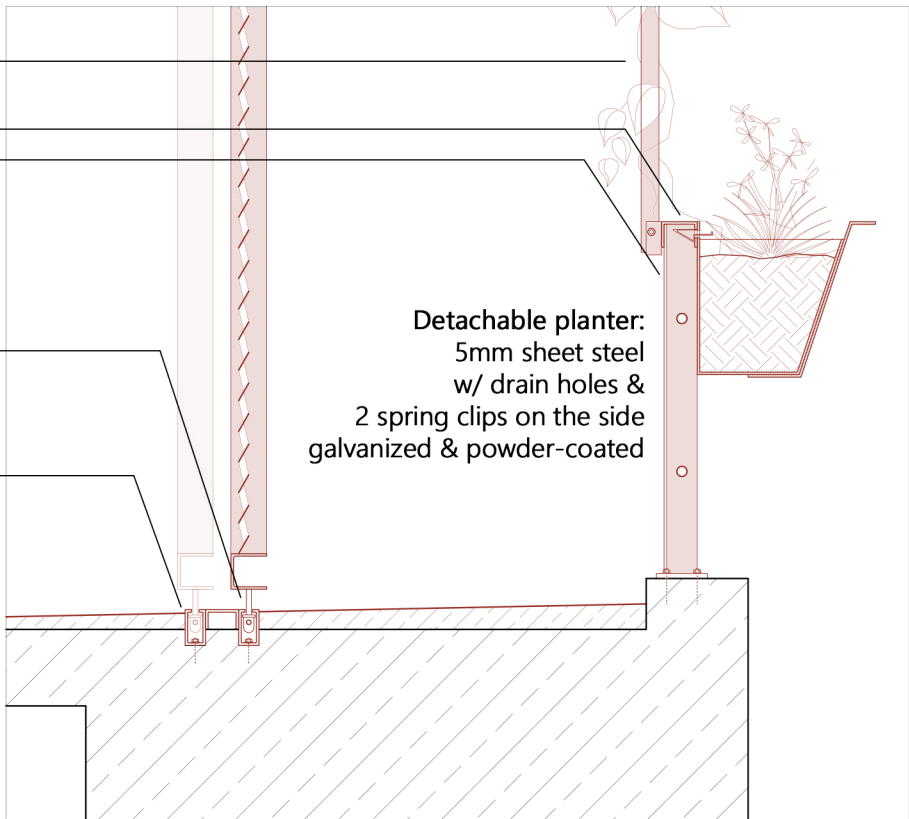
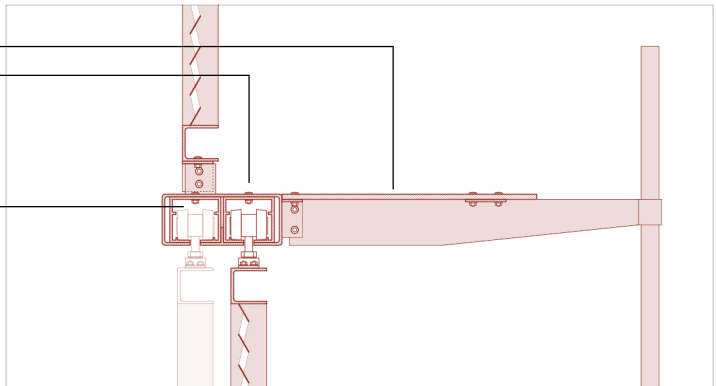
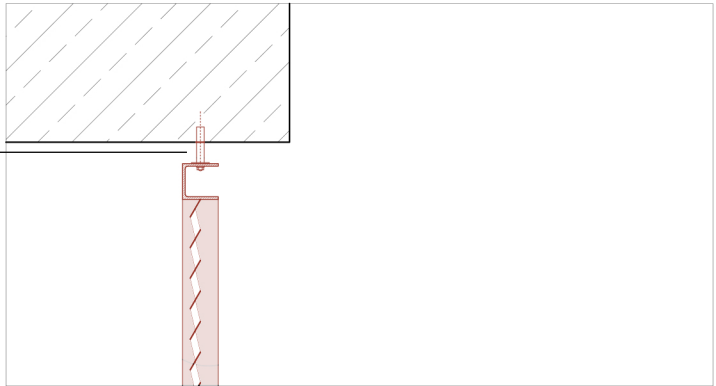
Main steel beam:
1. 500/10mm steel plate
2. 235/100/5mm steel RHS
w/ two slit cutouts
galvanized & powder-coated,
housing two extruded aluminum
top-hung sliding sunshade rails

Steel railing:
1. Ø 35mm steel tube,
fixed at the bottom w/ bolt
2. 70/50/5mm steel C-section
3. 65/50/5mm steel T-section
4. 5mm steel sheet profiles as
support structure
for planters
galvanized & powder-coated

steel pin w/ silicone
sheath as roller connection for
the bottom of sliding sunshade

70/40/5mm steel RHS

Floor finish:
PU clearcoat
poured clear concrete screed
w/ 1:50 slope to central drainage
existing RC slab & beam



Detachable planter:
5mm sheet steel
w/ drain holes &
2 spring clips on the side
galvanized & powder-coated

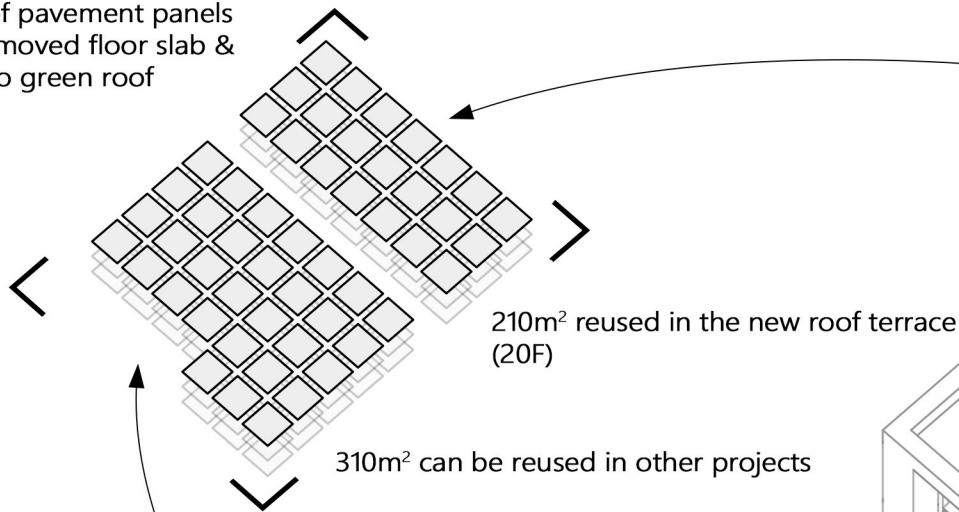


Roof terrace - New, old, reused elements

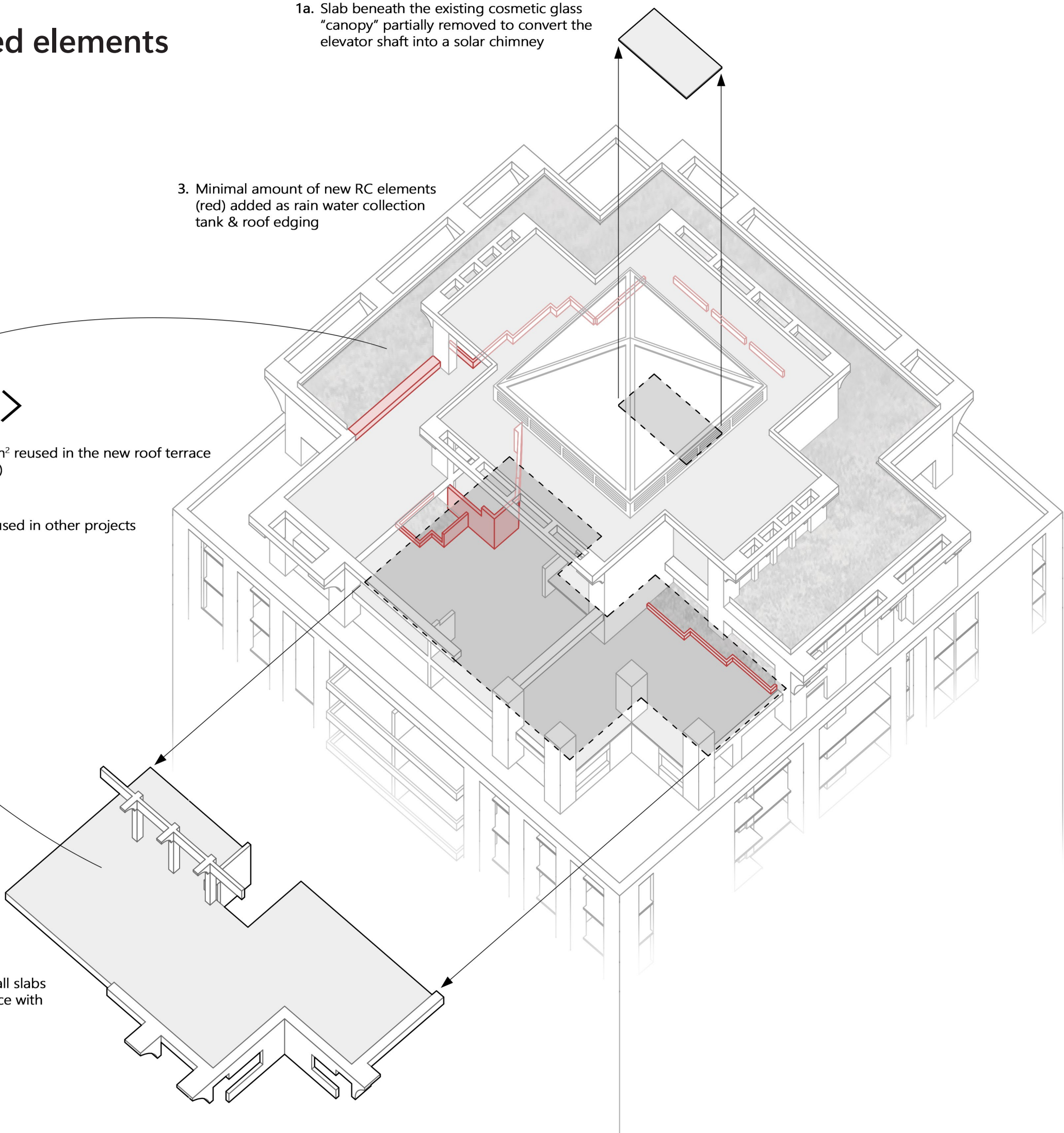
1a. Slab beneath the existing cosmetic glass "canopy" partially removed to convert the elevator shaft into a solar chimney

3. Minimal amount of new RC elements (red) added as rain water collection tank & roof edging

2. 520m² existing roof pavement panels recovered from removed floor slab & area converted into green roof



1b. West side of 20F ceiling & partition wall slabs partially removed for roof garden space with better sunshading scheme

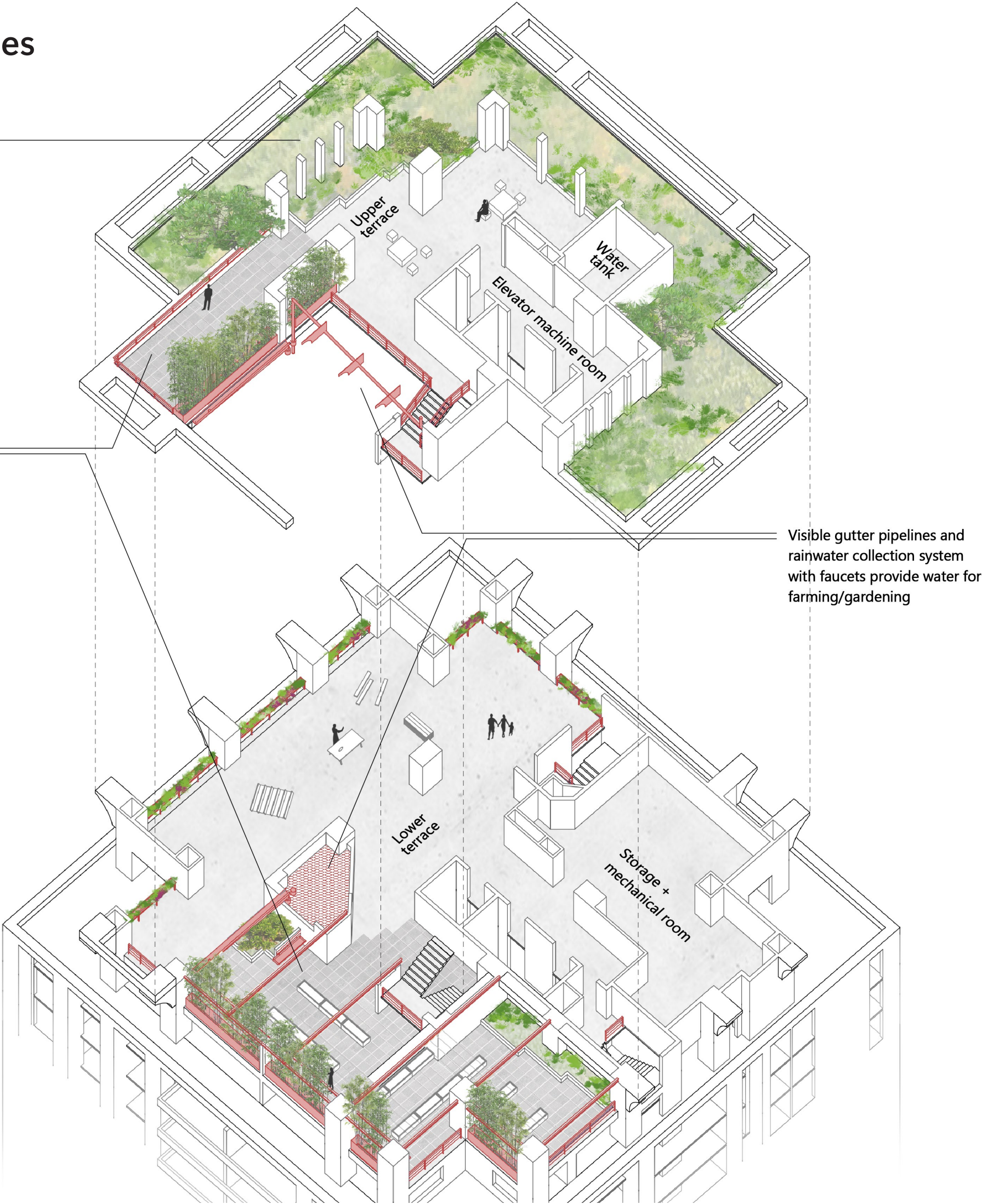
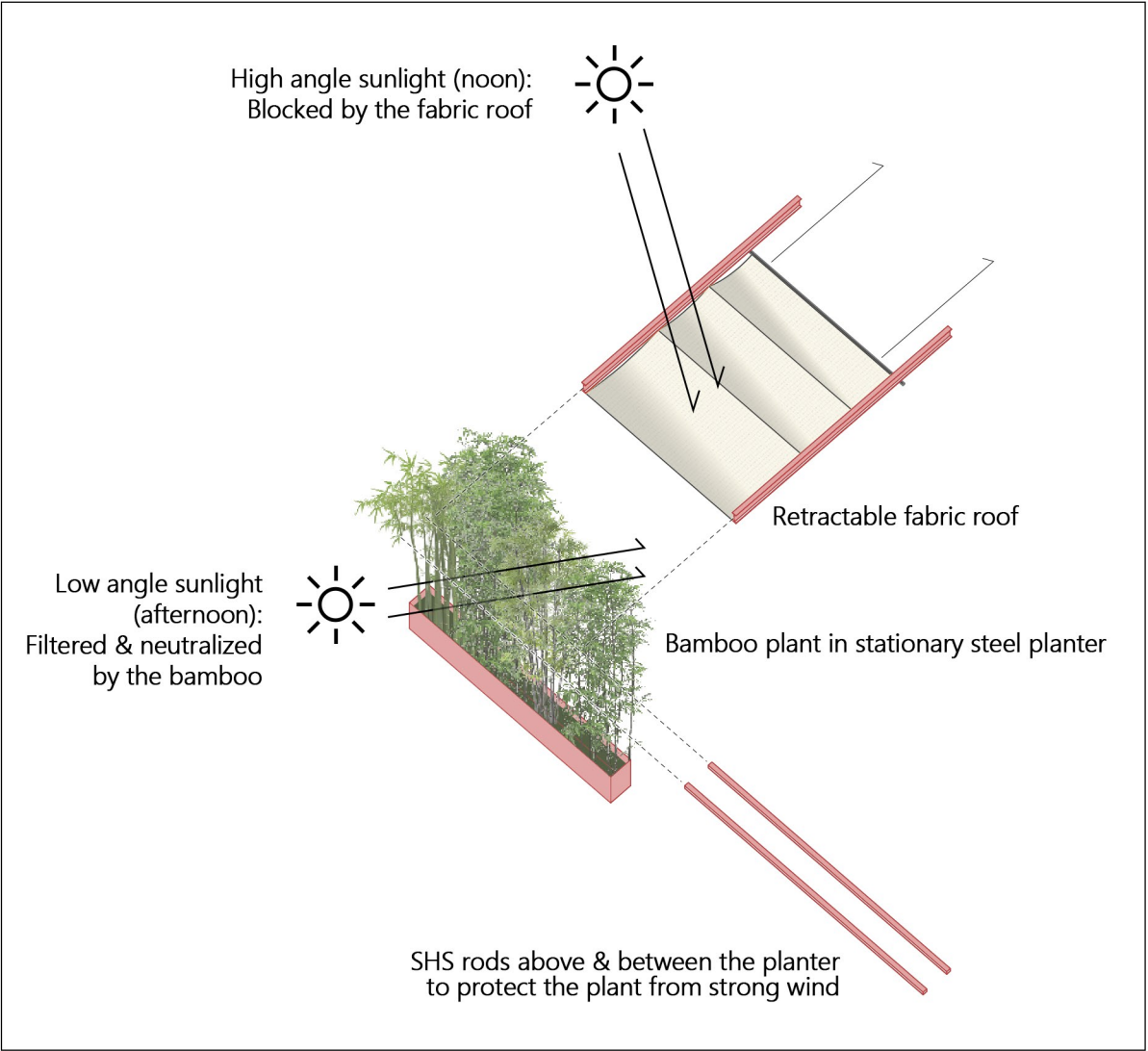


Roof terrace - Climate strategies & activities

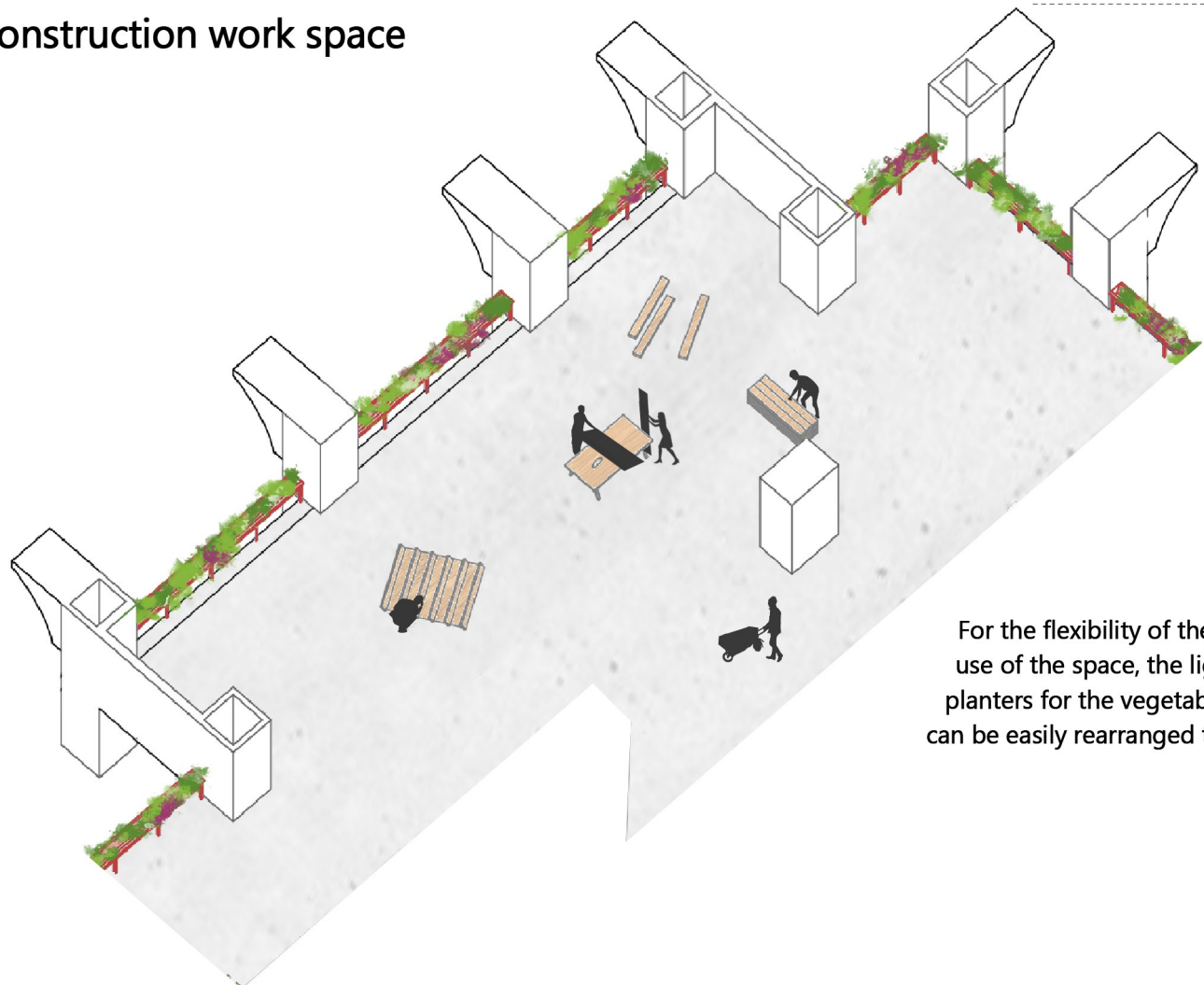
Green roof with grass & sprawling bushes (*S. taccada* etc.) to minimize solar heat absorbtion

Existing roof pedestal paver system reused to minimize the need for new materials, with additional facade layers to moderate solar heat gain

Envelope composition

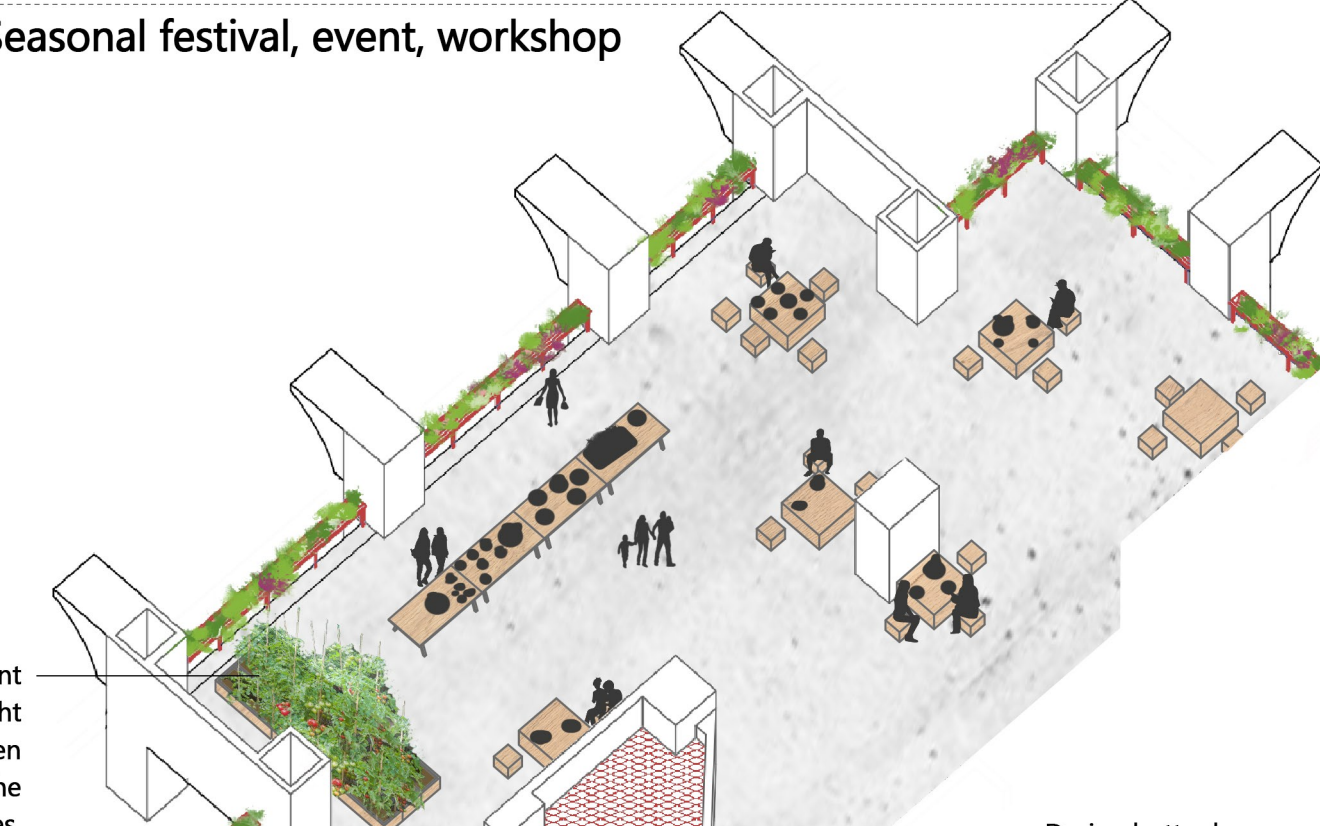


Temporary construction work space



The terrace offers a shaded, well-ventilated space for residents and/or construction workers to assemble or craft components for the residents' balcony additions. The rooftop location effectively minimizes the impact of the noise on both the building and the surrounding urban space during day time.

Seasonal festival, event, workshop



For the flexibility of the different use of the space, the lightweight planters for the vegetable garden can be easily rearranged to suit the activities.

During hotter hours, or when the space is not used for gardening, the fabric roof can be extended to provide shading.

Vegetable garden

Rainwater collection system provides water for irrigation



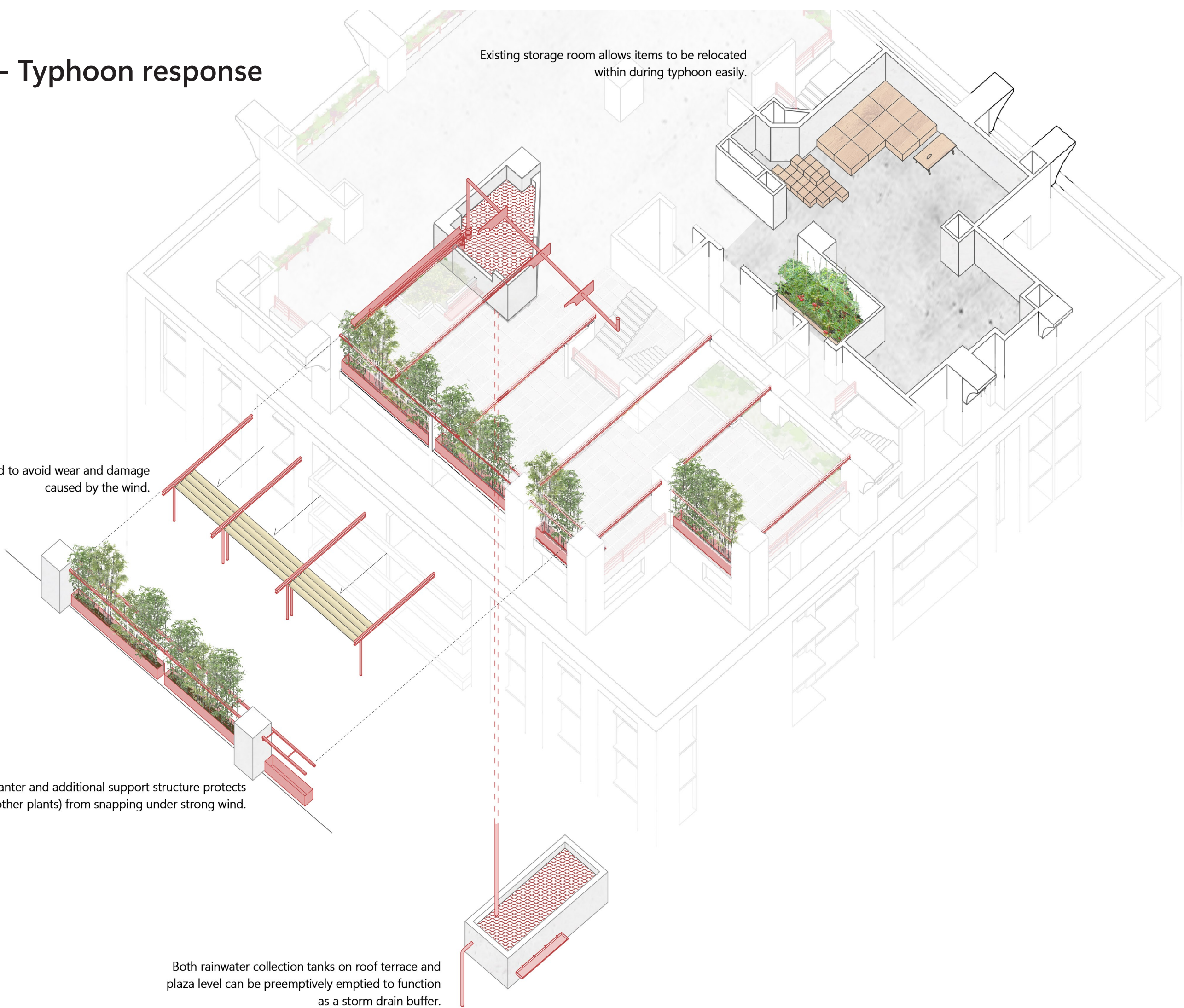
Roof terrace - Typhoon response

Existing storage room allows items to be relocated within during typhoon easily.

Fabric roof fully retracted to avoid wear and damage caused by the wind.

Fixed planter and additional support structure protects bamboo (or other plants) from snapping under strong wind.

Both rainwater collection tanks on roof terrace and plaza level can be preemptively emptied to function as a storm drain buffer.



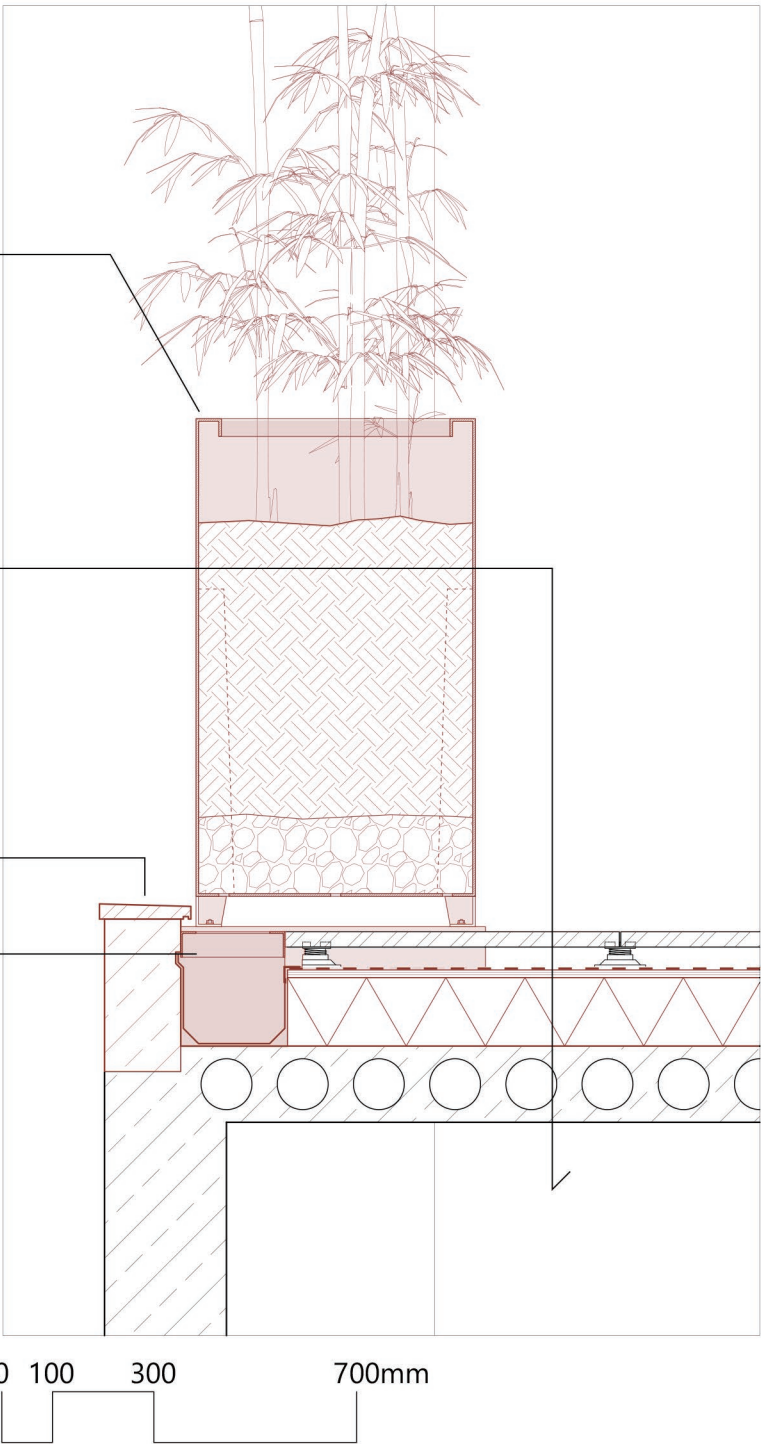
Roof terrace elevation fragment



Steel planter:
5mm folded & welded sheet steel,
w/ corner supports
galvanized & powder-coated,
fixed via corner support to concrete
edging on the sides

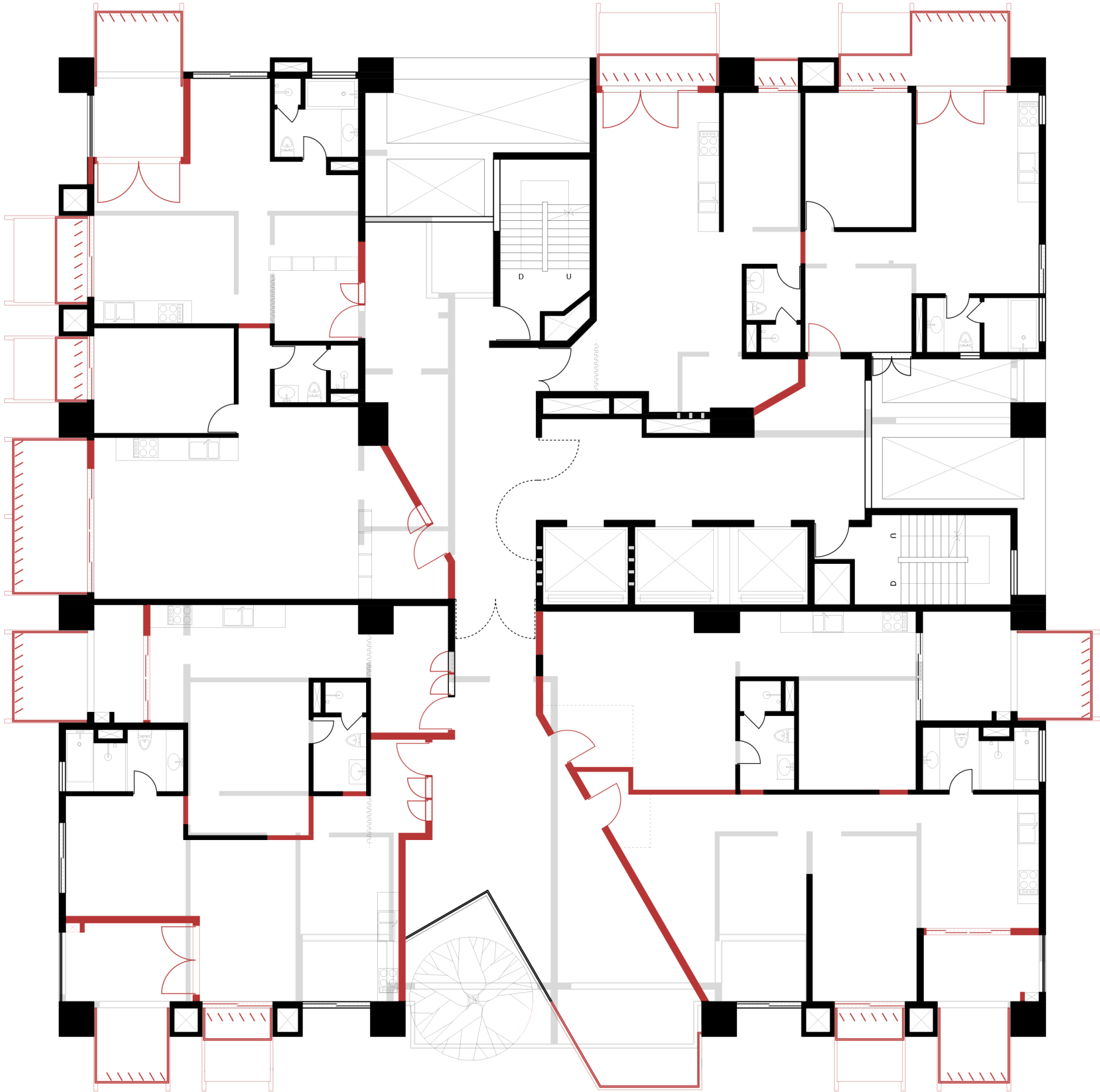
- Roof pavement:
- 1. reused concrete pavement slab
 - 2. reused pavement pedestal
 - 3. roof membrane
 - 4. 15mm structural plywood
 - 5. 135mm rigid insulation
 - 6. existing RC slab

pre-fab RC parapet
w/ coping stone slab
galvanized steel gutter w/ grating

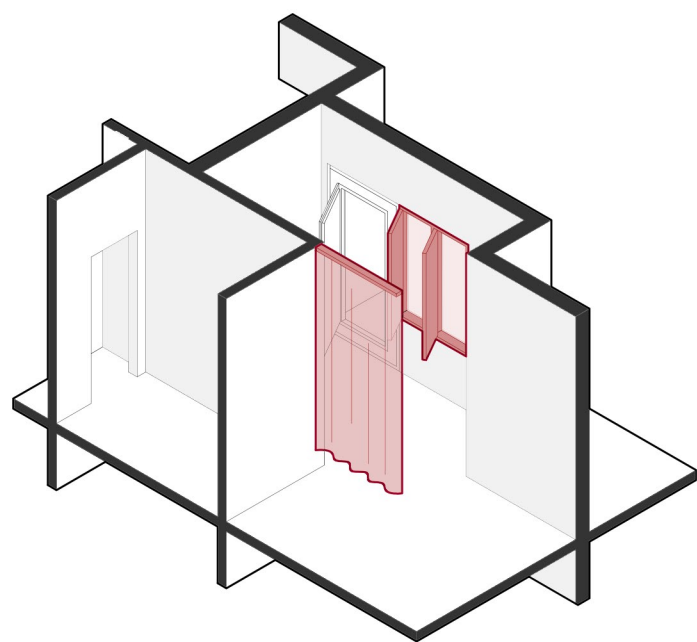


Normal → studio apartment conversion

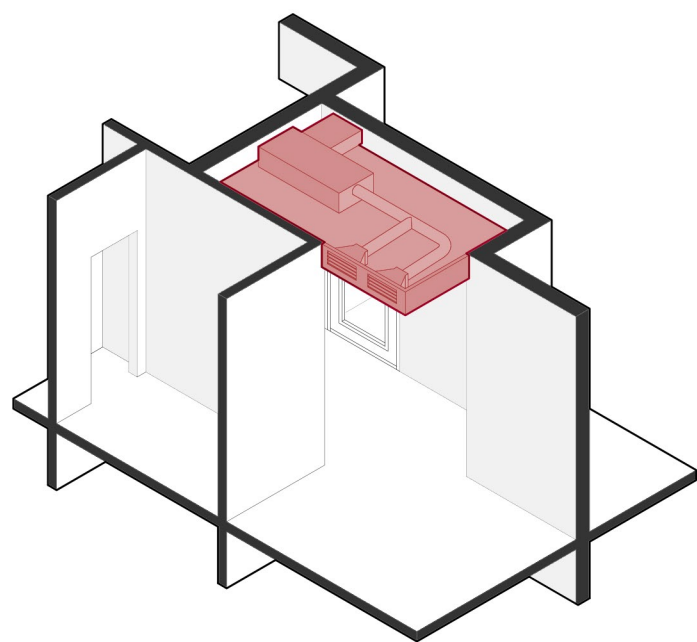
- New structure
- Preserved structure
- Removed structure



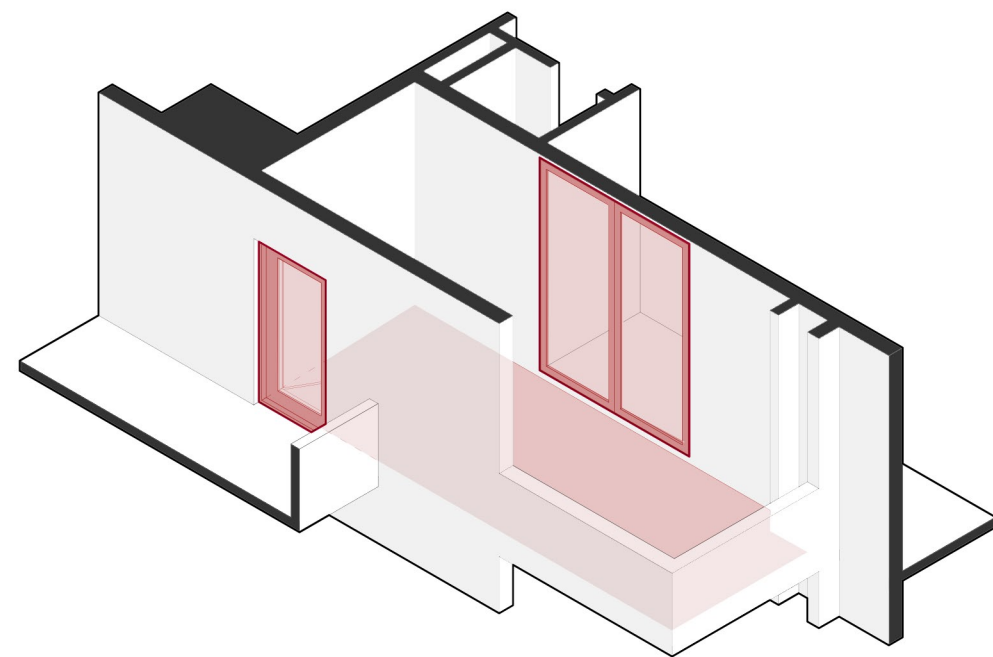
Ventilation elements for apartment units



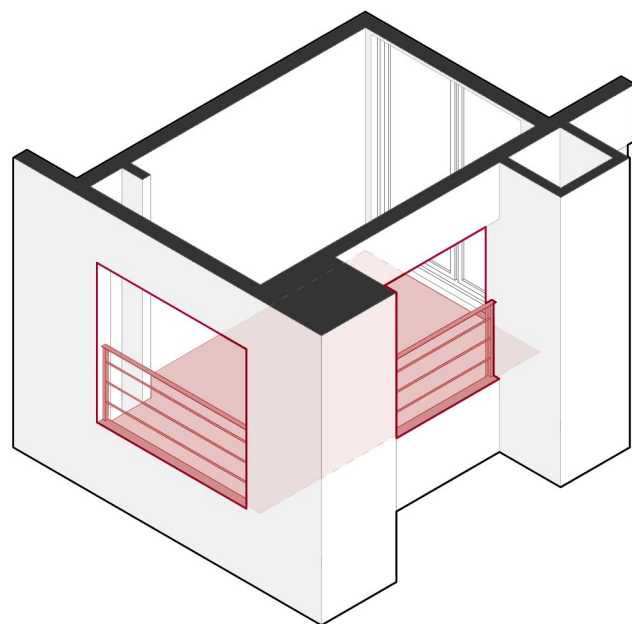
A. Entryway screen window
(+visual partition)



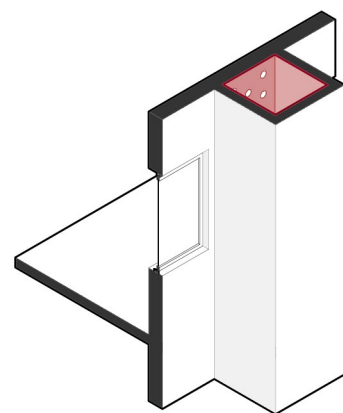
B. Plenum forced ventilation
system



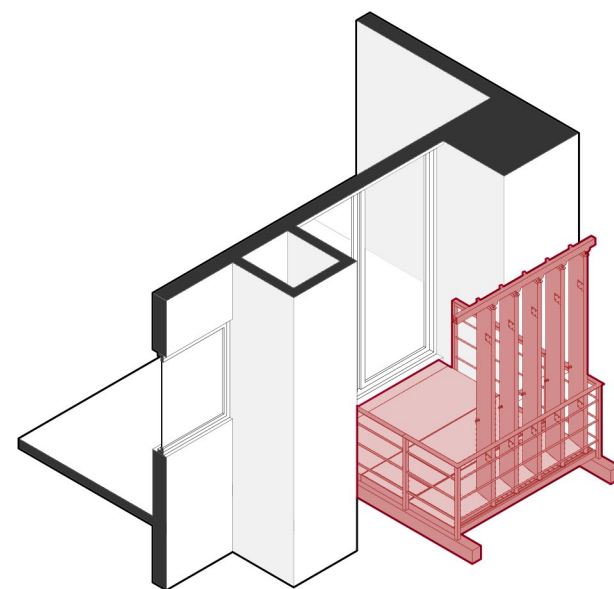
C. Balcony entryway



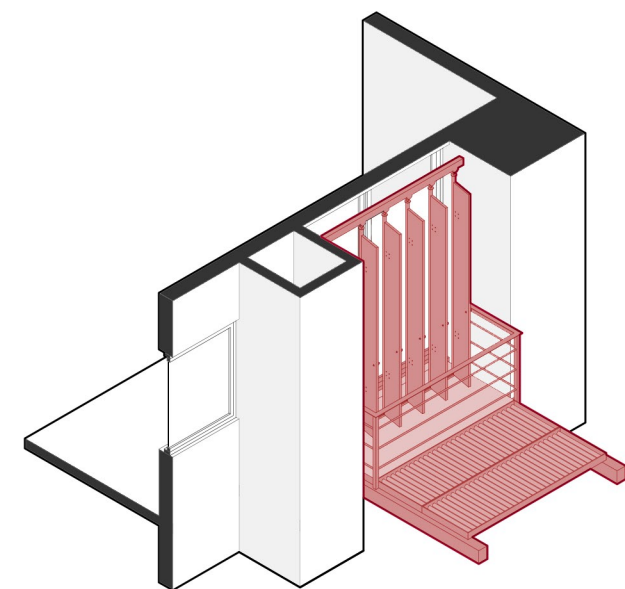
D. Reconfigured corner balcony



E. Repurposed fake
column & vertical shaft
as solar chimney

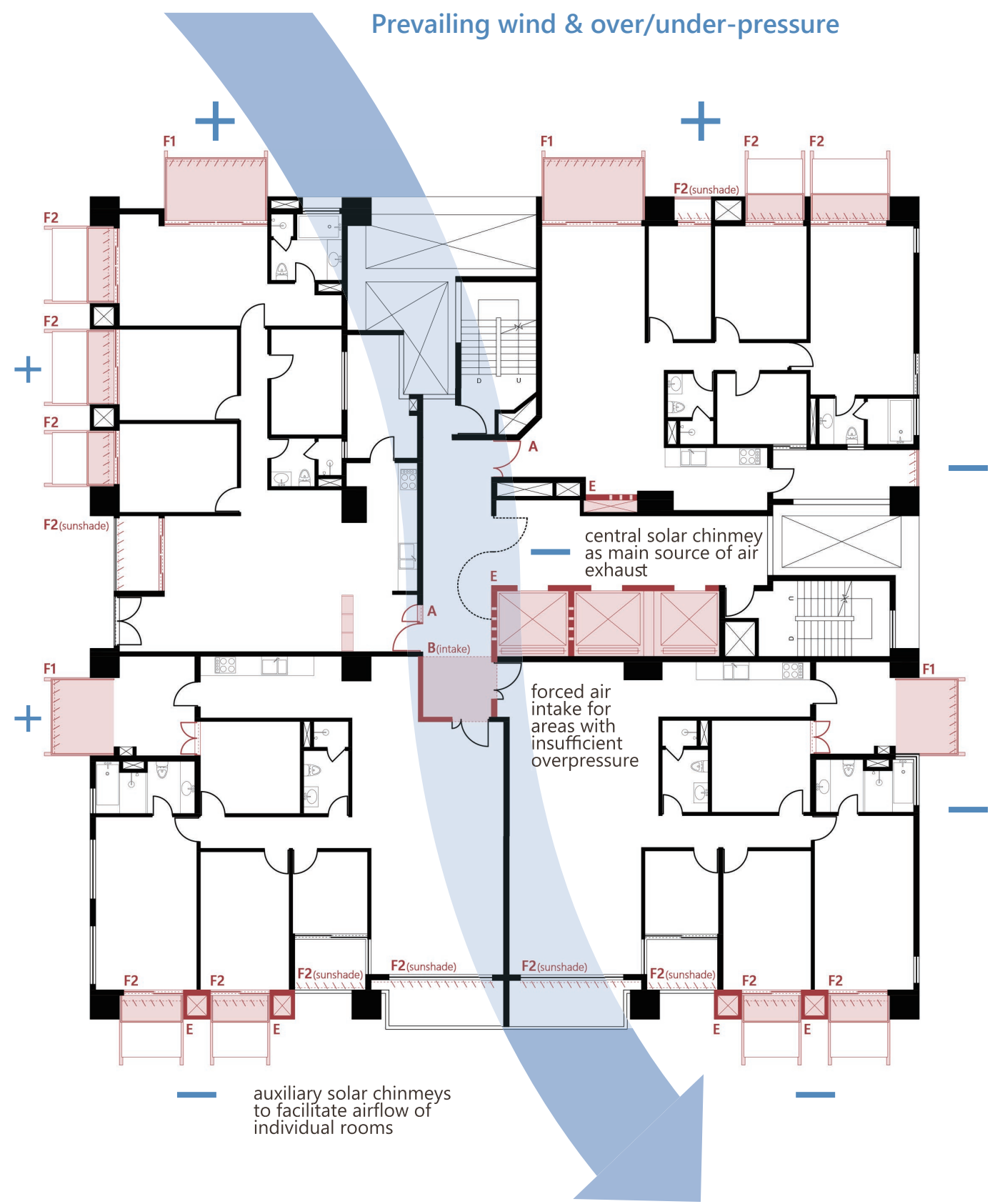


F1. Fully-extended
balcony kit



F2. Basic balcony kit

Implementation of ventilation elements



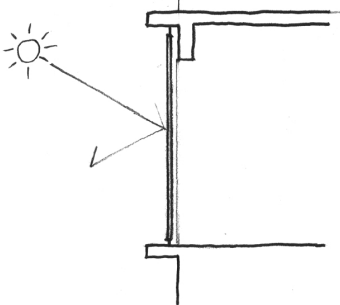
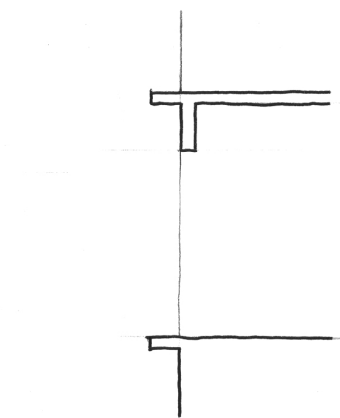
Standard apartment plan (north tower)



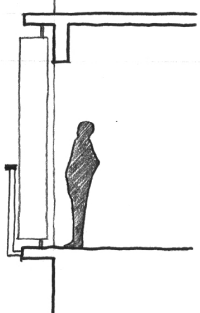
Studio apartment plan (north tower)

Balcony kit design criteria

Generic openness

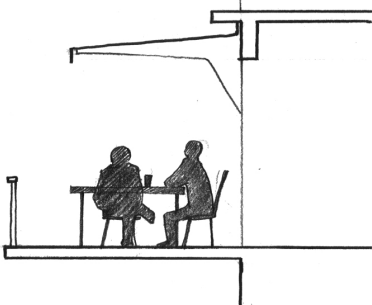
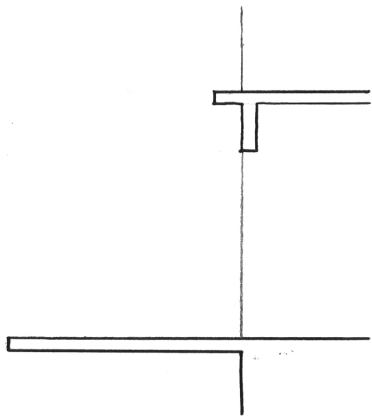


glare & heat-blocking

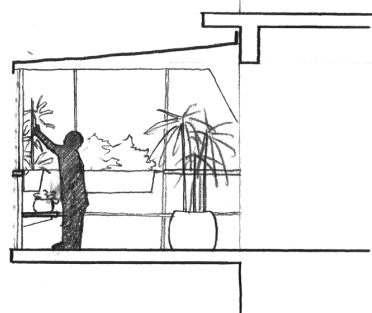


open view + ventilation + safety

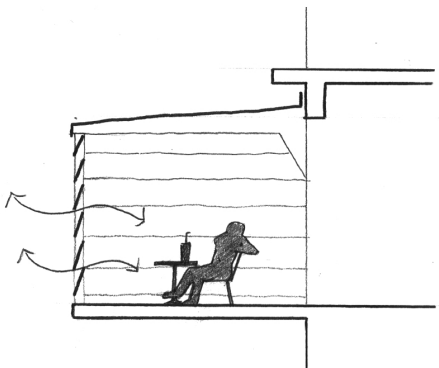
Extroverted openness



activities requiring shelter & more floor area

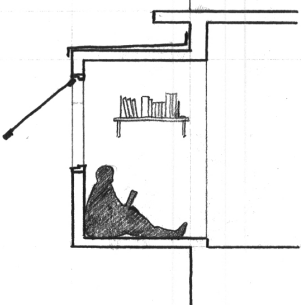
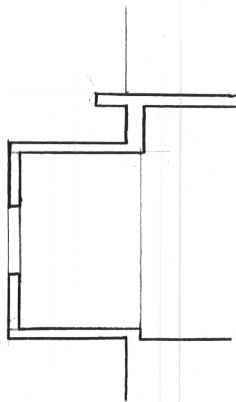


structures for planters

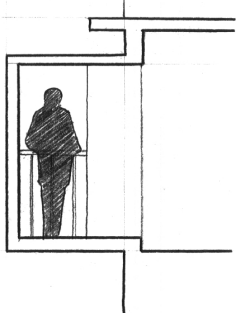


well-ventilated privacy

Enclosed aperture



extension of room program

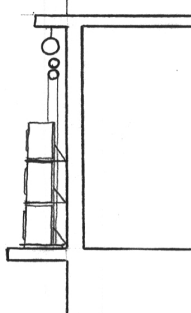


redirected opening(s)

Utility modification

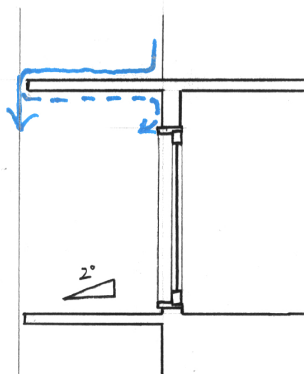


+ ledge/shelf



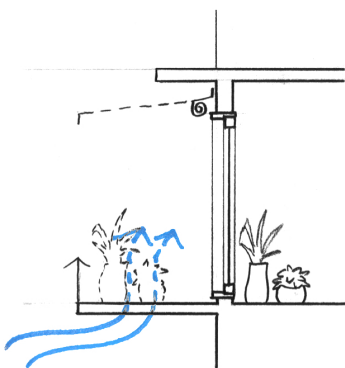
mechanical side

Weather response



watershedding

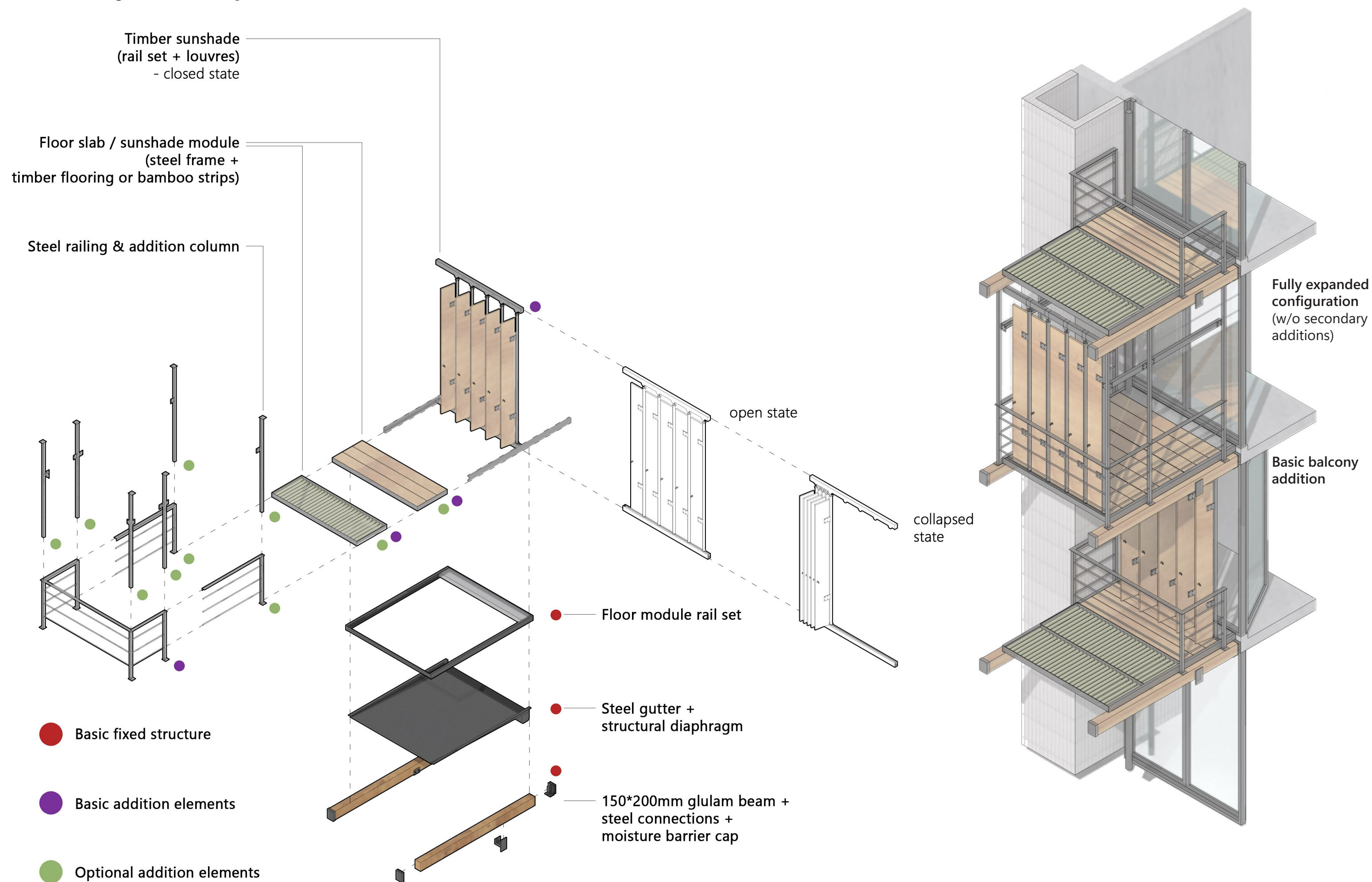
Water can move in any direction during typhoon; extra waterproofing/ventilation measures should be taken



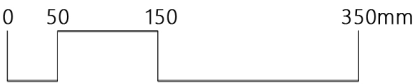
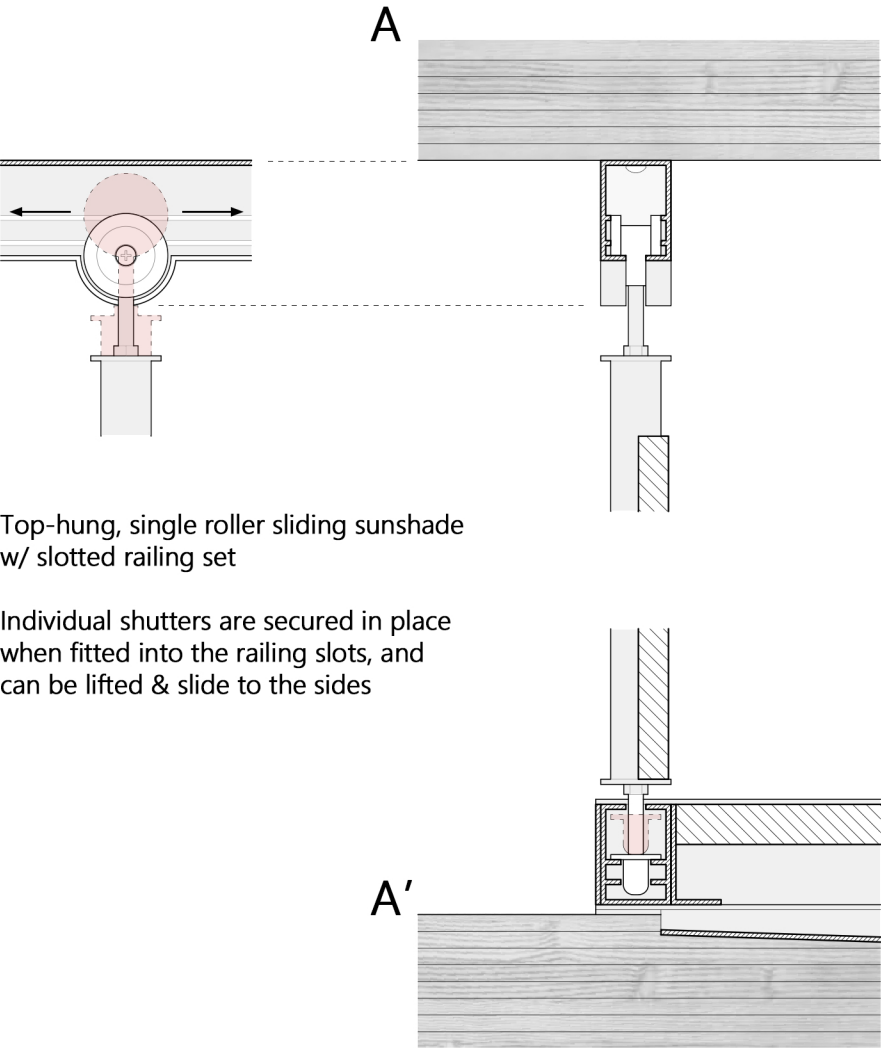
typhoon

1. Operable/portable elements should be made adjustable to minimize damage
2. With strong wind lift, rigid structure is preferable over tensile structure

Balcony kit composition



Balcony kit fragment section

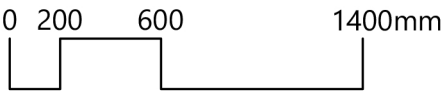


Modular steel casket housing
timber deck board
or bamboo strip sunshade

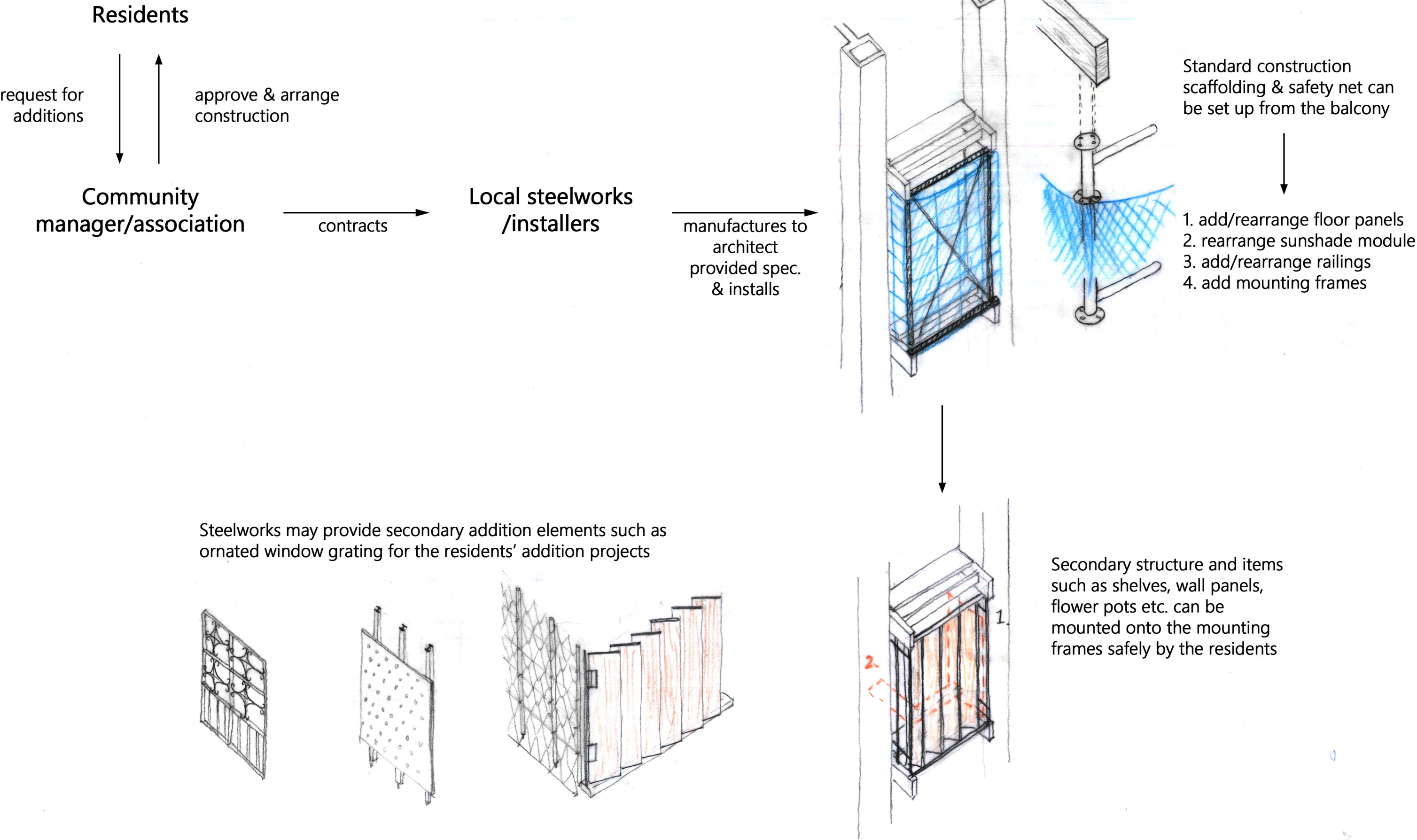
Steel railing & frame
w/ slotted screw holes as
connections for secondary
addition items/structures

Glulam beam
w/ steel cap & vapor barrier tip
fixed via bolt connections
onto existing RC structure

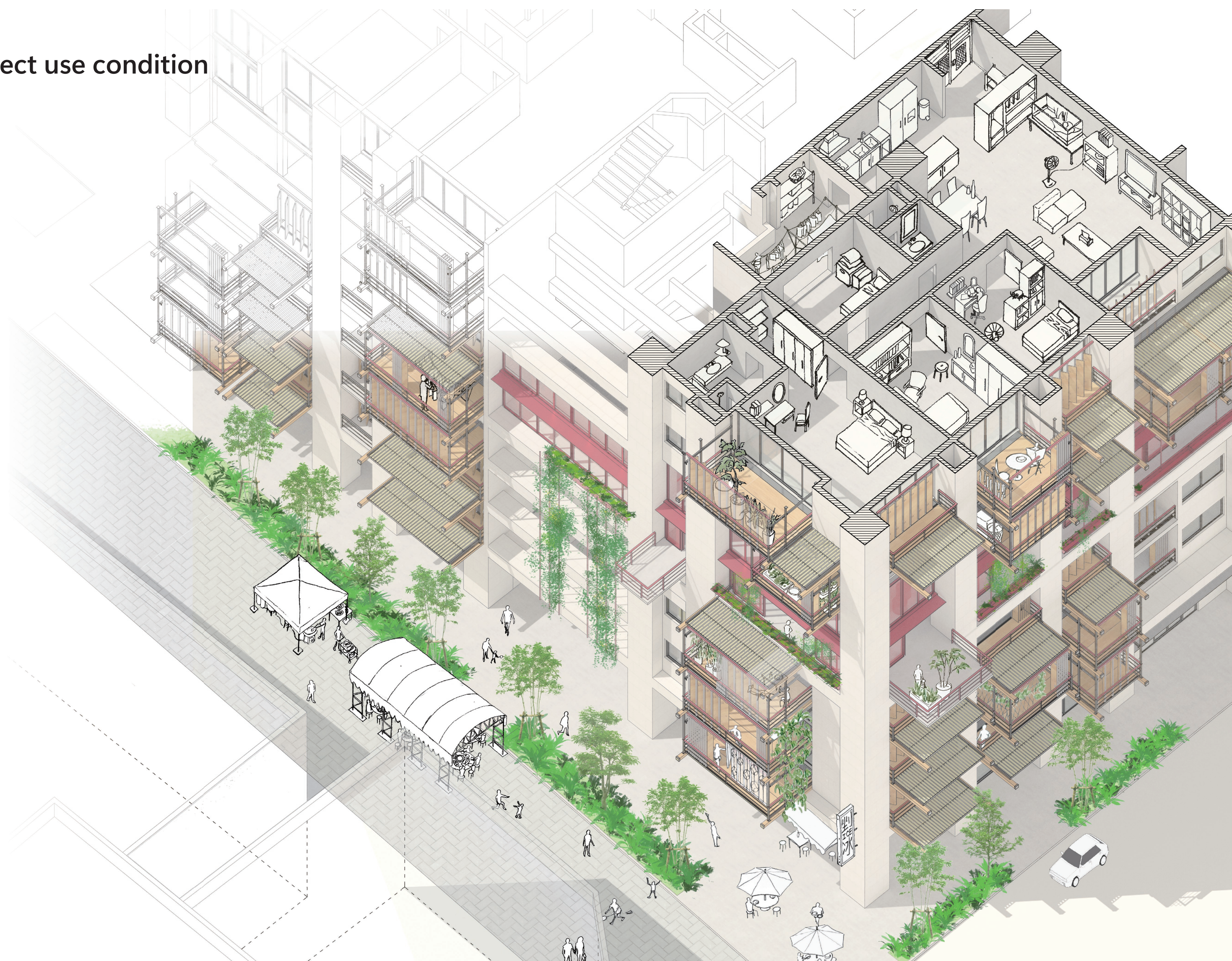
Integrated steel gutter +
structural diaphragm +
floor module rail set
w/ removable top cover for
gutter cleaning



Basic kit & addition construction process



Project use condition



Facade inviting to be opened
and used, see and be seen
(or not)

Mini plaza as a
safe & accessible
community space



Pedestrian street as an
extension of the community
& a connection to the city



Urban influence

Project as evaluation + intervention strategies to renovate/reuse old structures/typologies:

Remove & convert existing elements



Reduced energy consumption in renovation process



Negative spaces for passive cooling



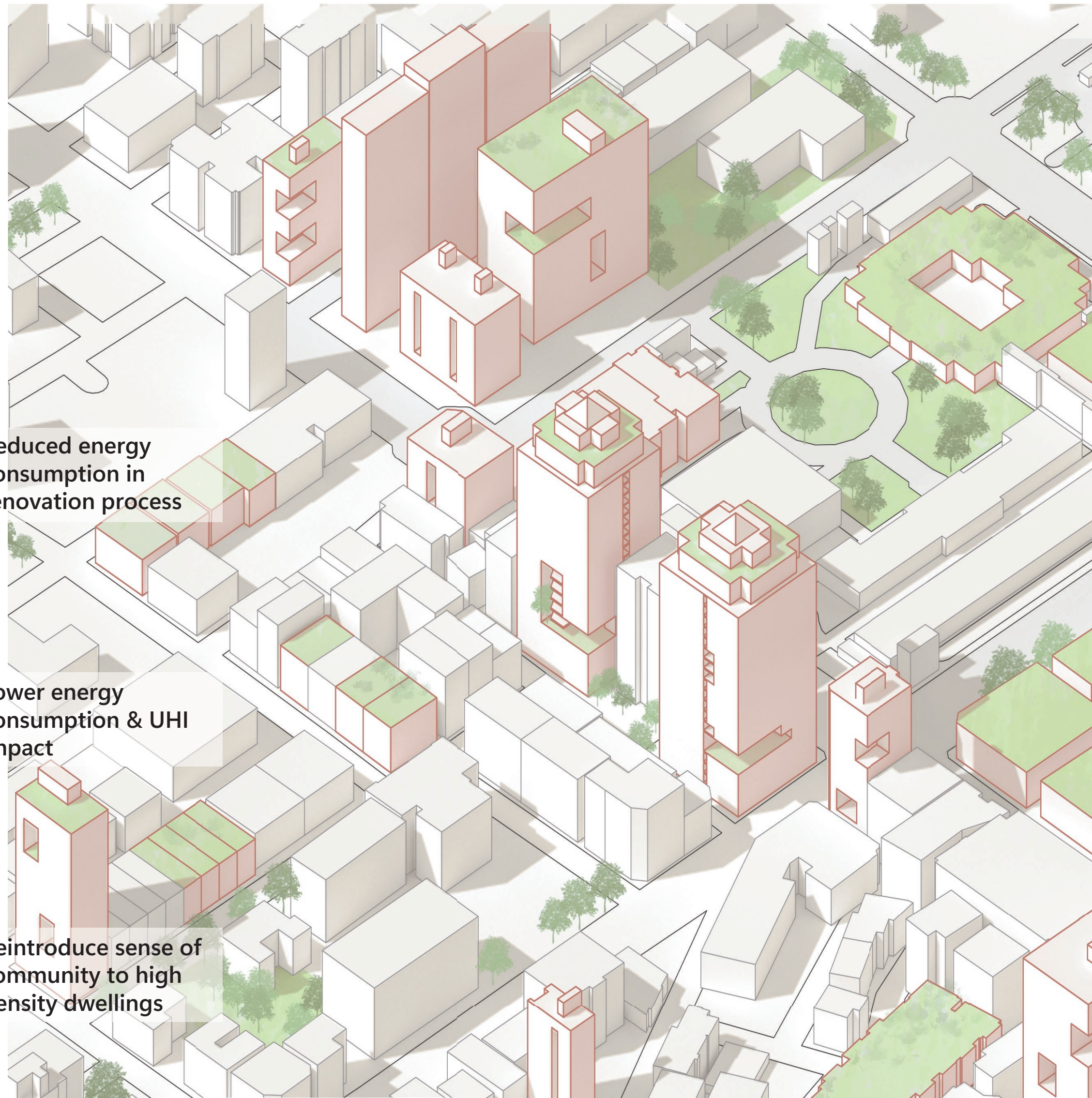
Lower energy consumption & UHI impact



Converted spaces for community/personal leisure



Reintroduce sense of community to high density dwellings



Thanks for listening!
& questions

