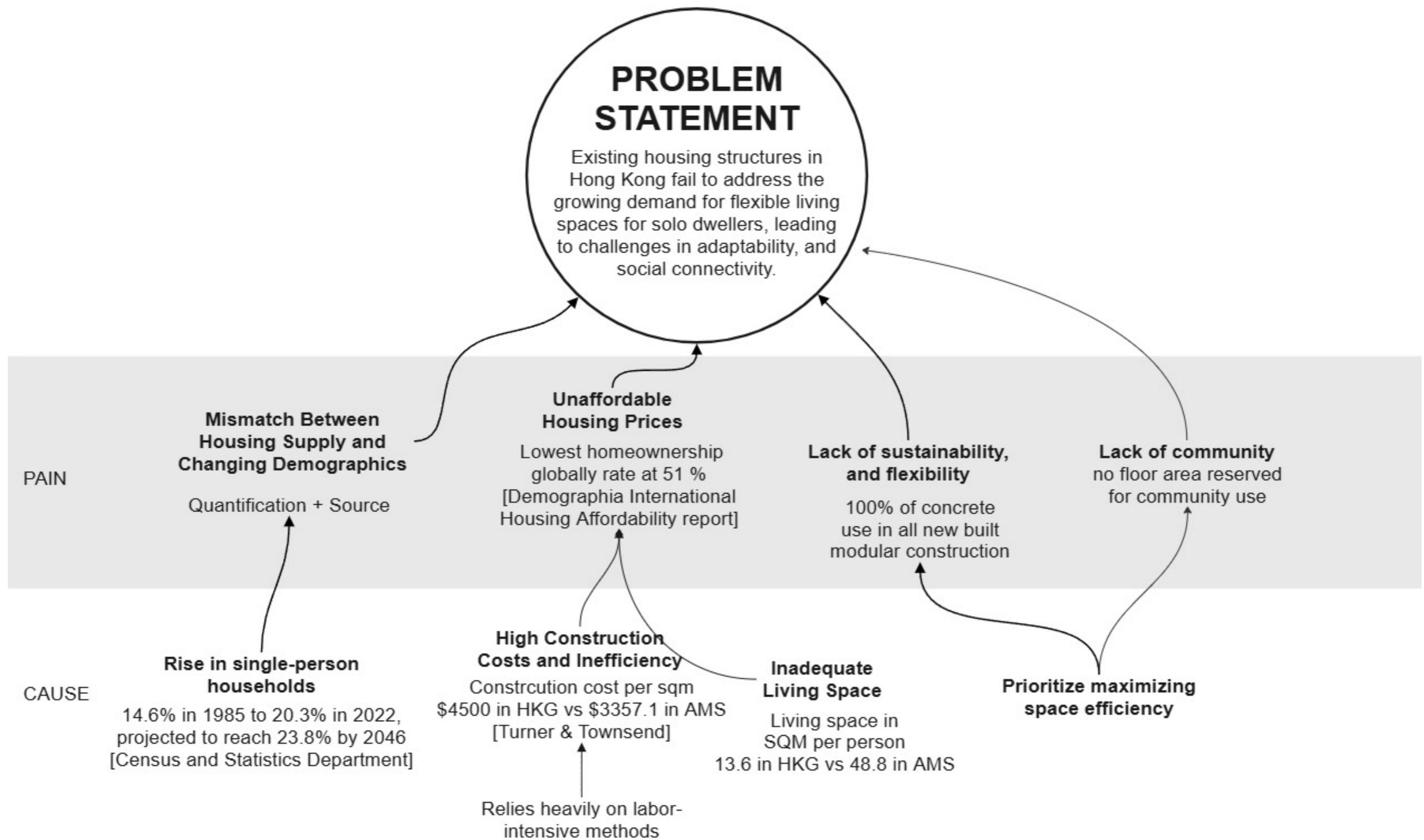


RESEARCH AND DESIGN PROPOSAL

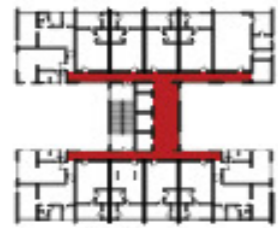
Modular Housing Design in Dense Urban Environment For Solo Dwellers

Autonomy, security, urban density, community, solitude,
Modularity, customization, sustainability, flexibility, small home

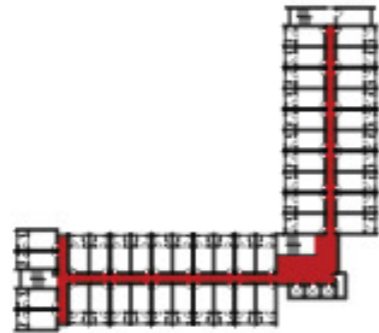




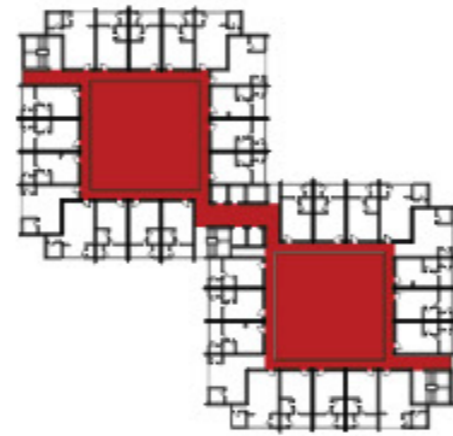
Massing and layout of Hong Kong Public Housing Estate



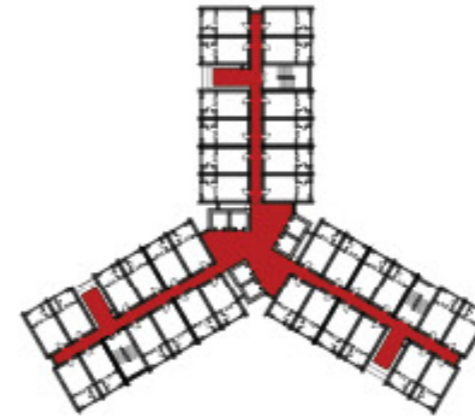
H Block
1950



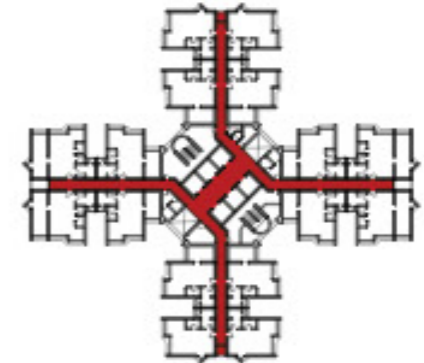
Slab Block
1960



Twin Tower
1970

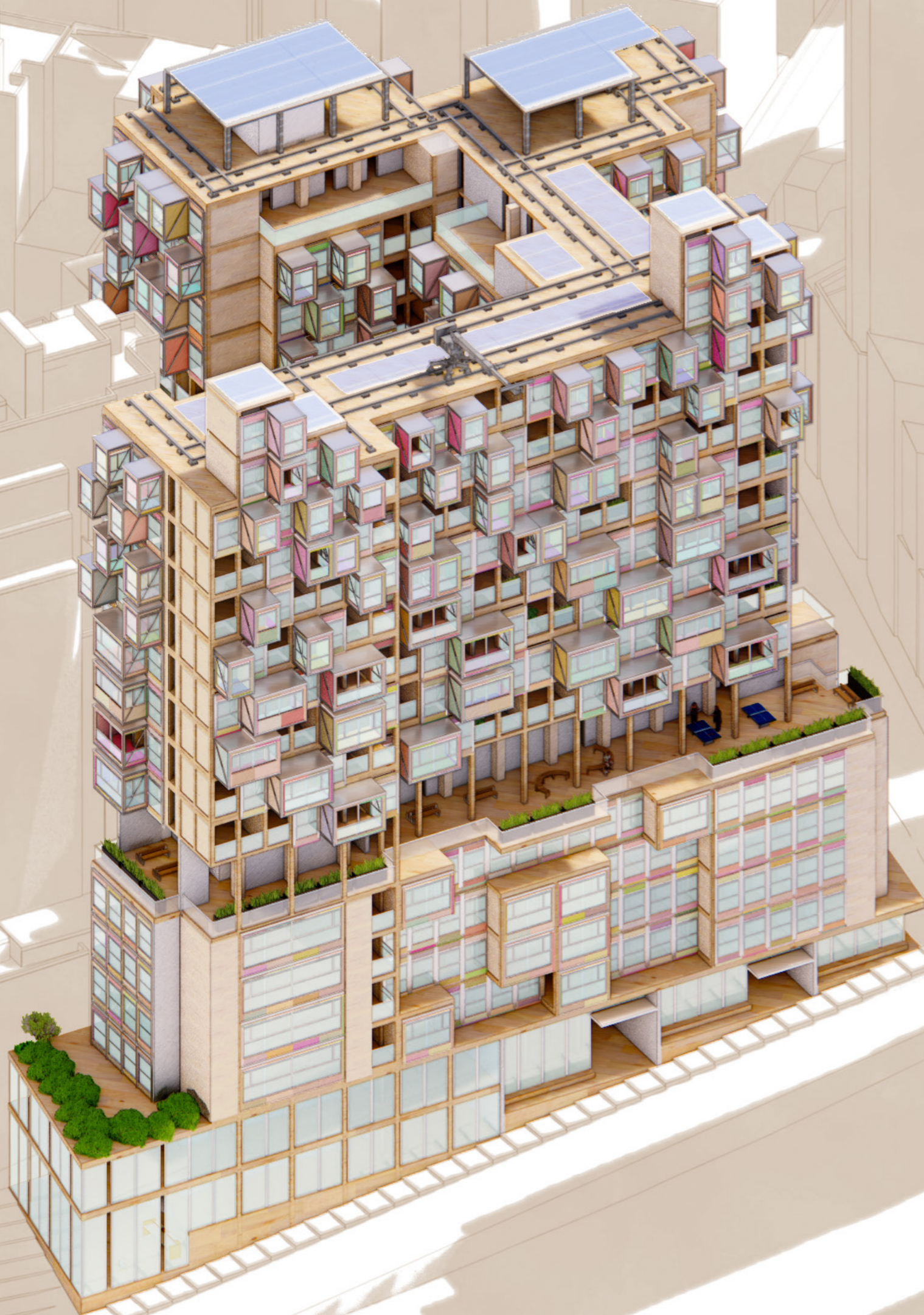


Trident
1980



Harmony
1990





BOLD VISION

A new structure form of housing for single person household that is self sustainable, helps to form community and is customisable for individual need, breaking away from monotonously stacked building

Hong Kong

High density, high rise

Increase average living space

Environmental sustainability

maximized use of Sustainable/ biobased material

Bio-based material
recyclable material

Residence mental need

Autonomy

Privacy
Security

Connectivity

Community

Circulation combines with program

Building system

Flexibility

Customization
Expandable

Modularity

Unit vs Component

Disassembly

Joint design

Single person households

Human proportion

ergonomic design
human matrix study

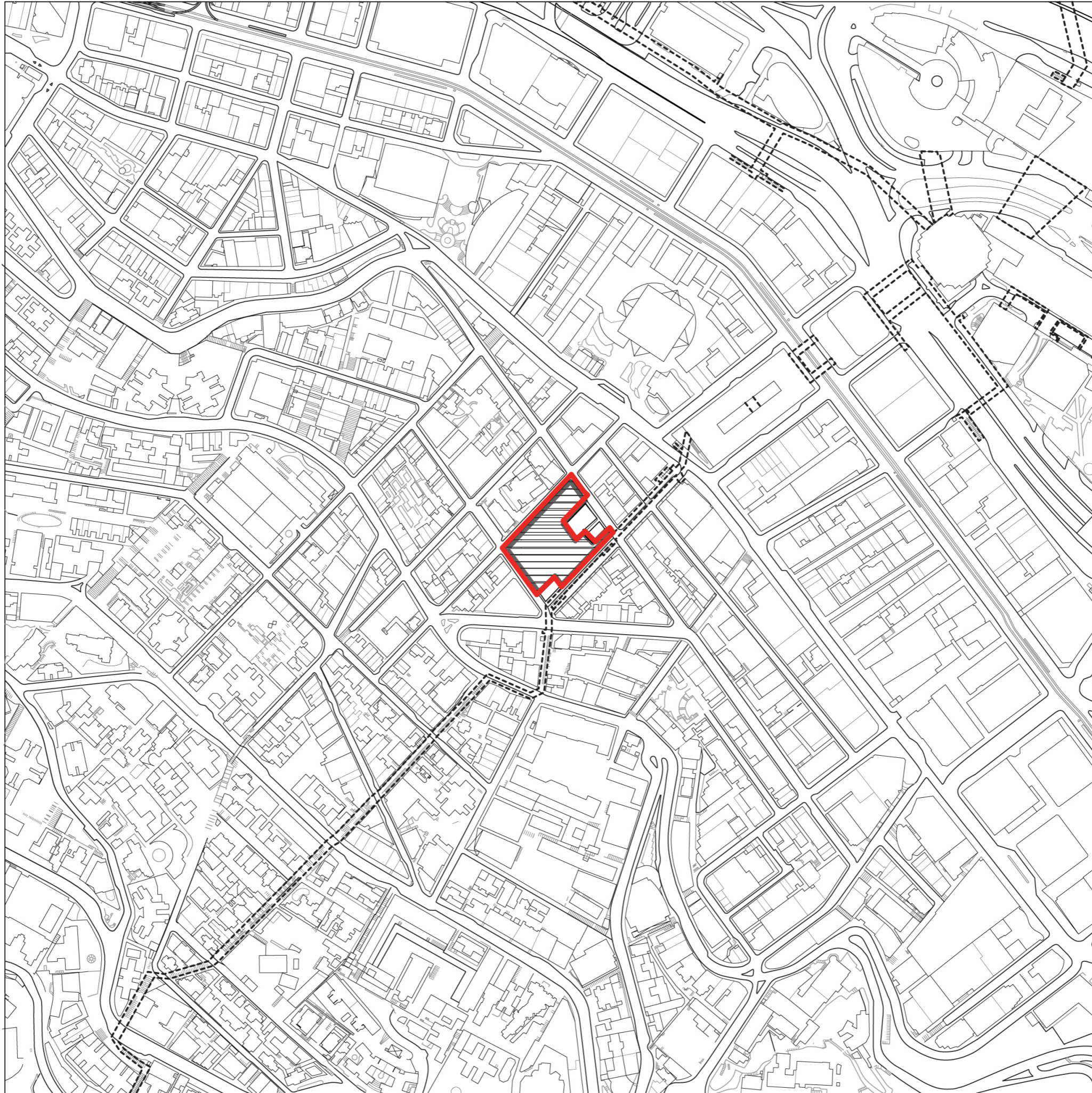
Compact design

shared kitchen or living space,
optimised private unit

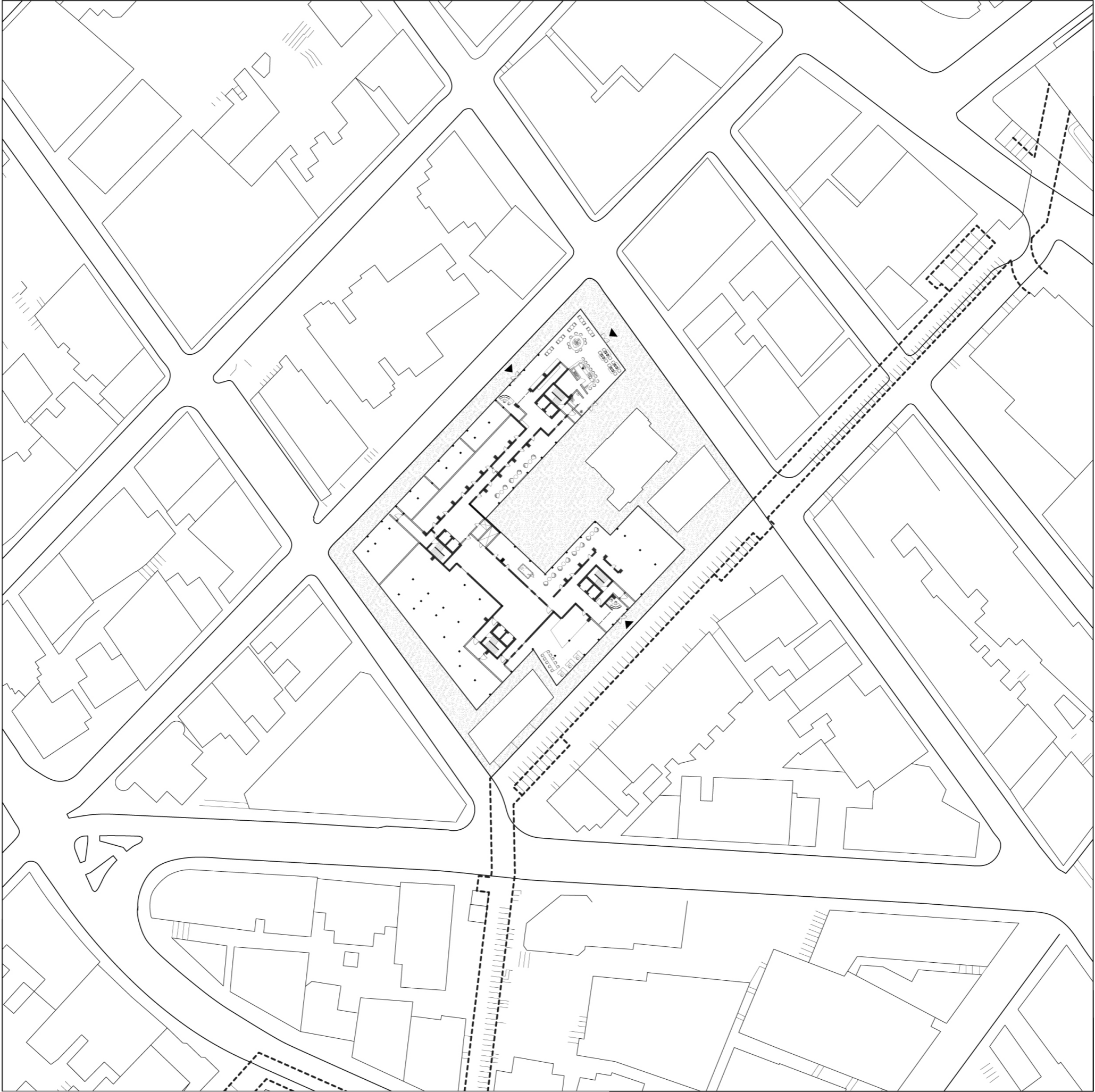
User preference

different types of unit
according to preference

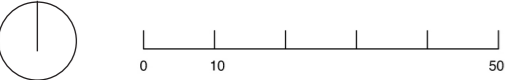




0 50 100 200

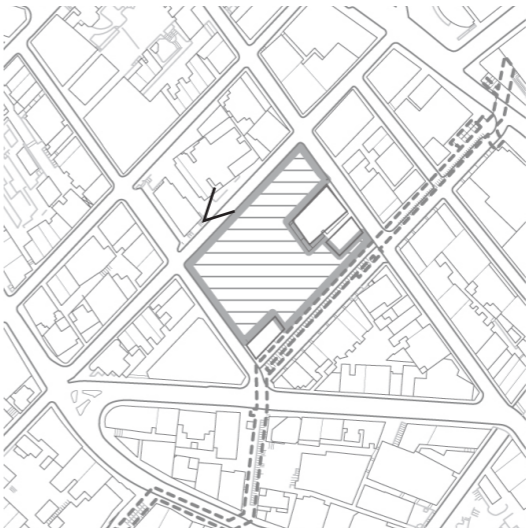
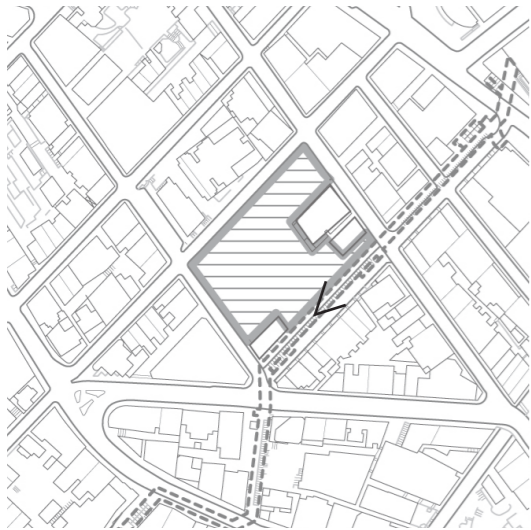


How are people living here....?
GROUND PLAN 1:500



Design Concept

Site condition



MAIN CIRCULATION FACING A BRIDGE

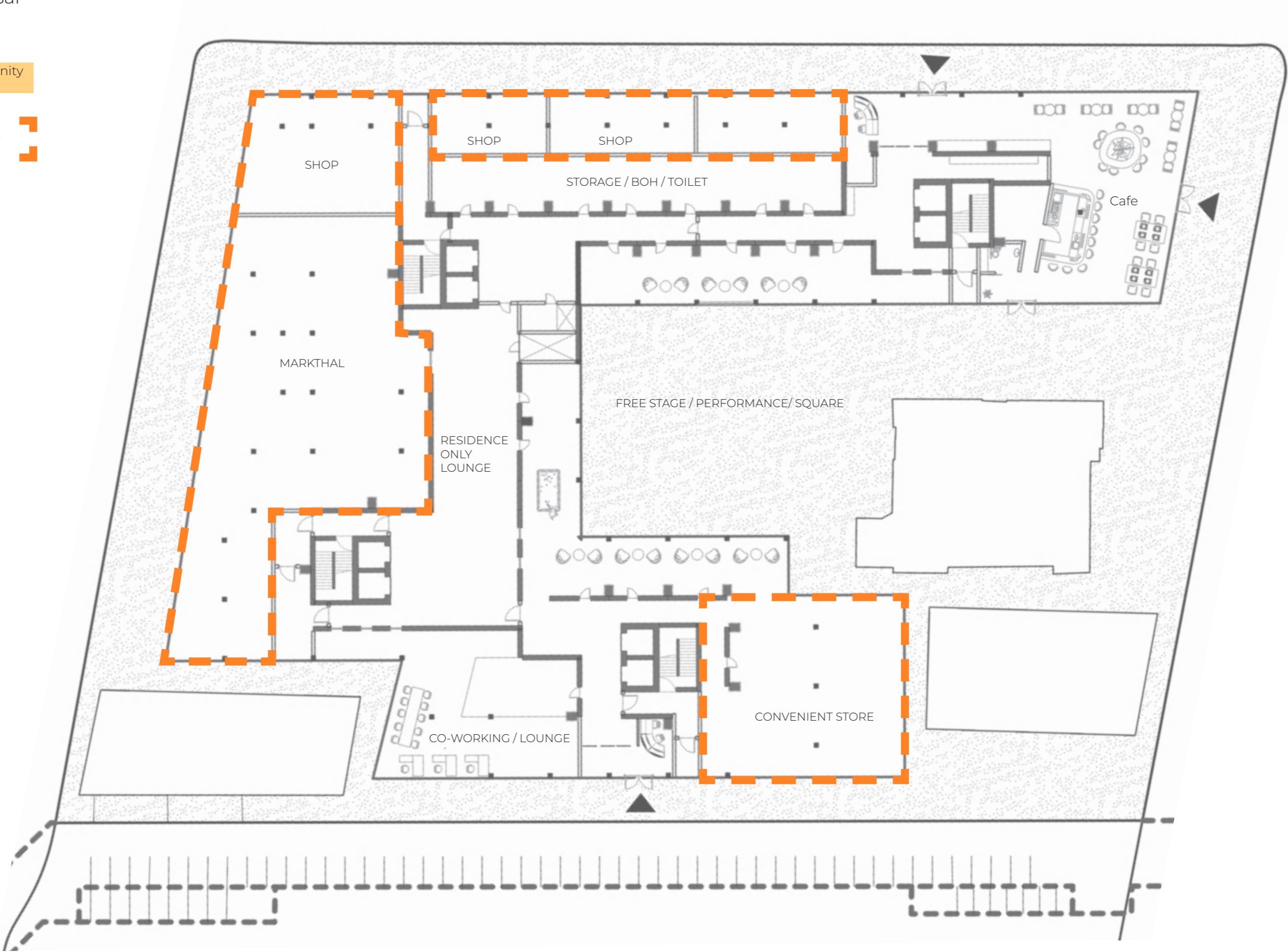


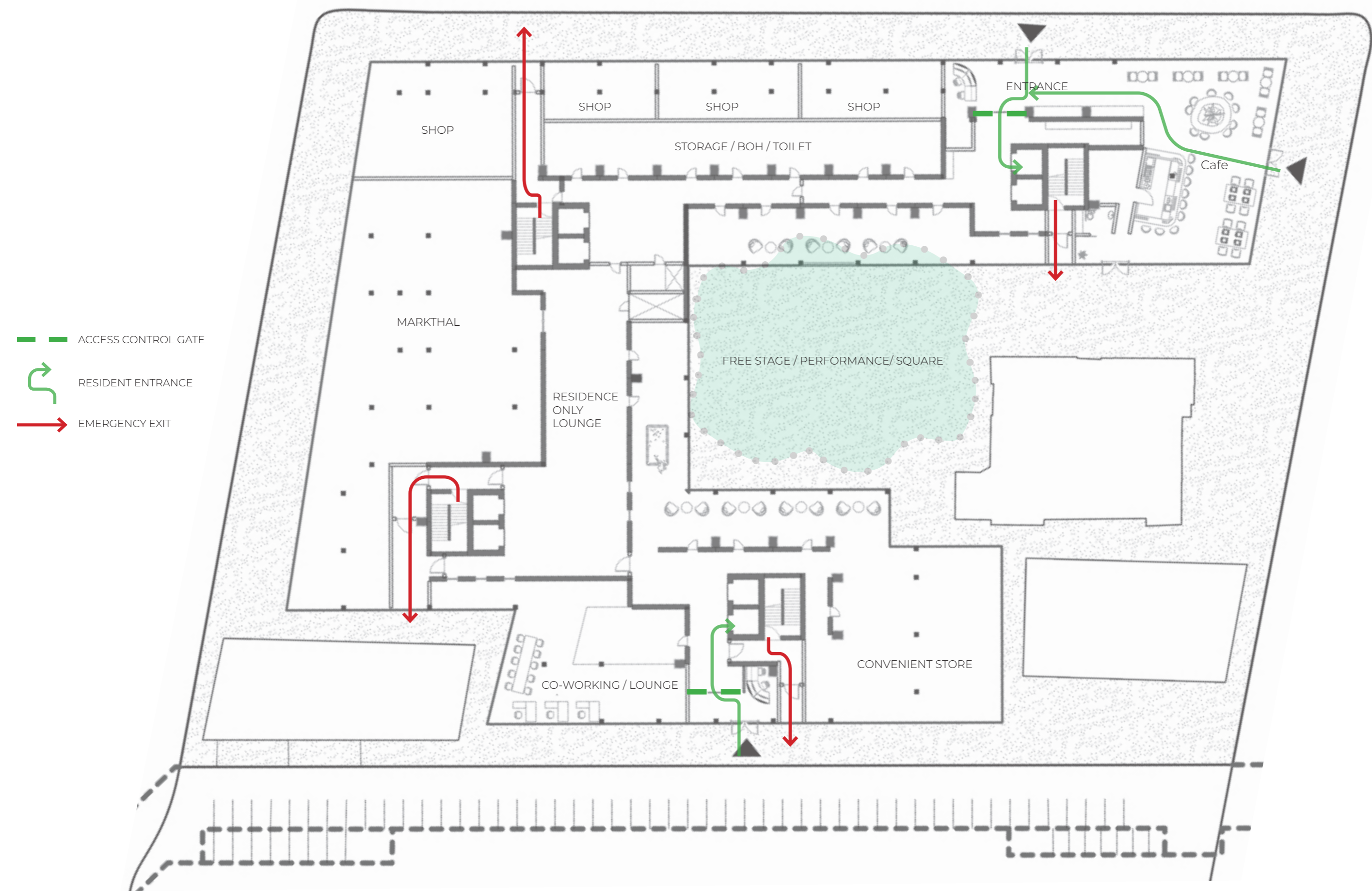
HAWKER STALL STREET

Design Proposal

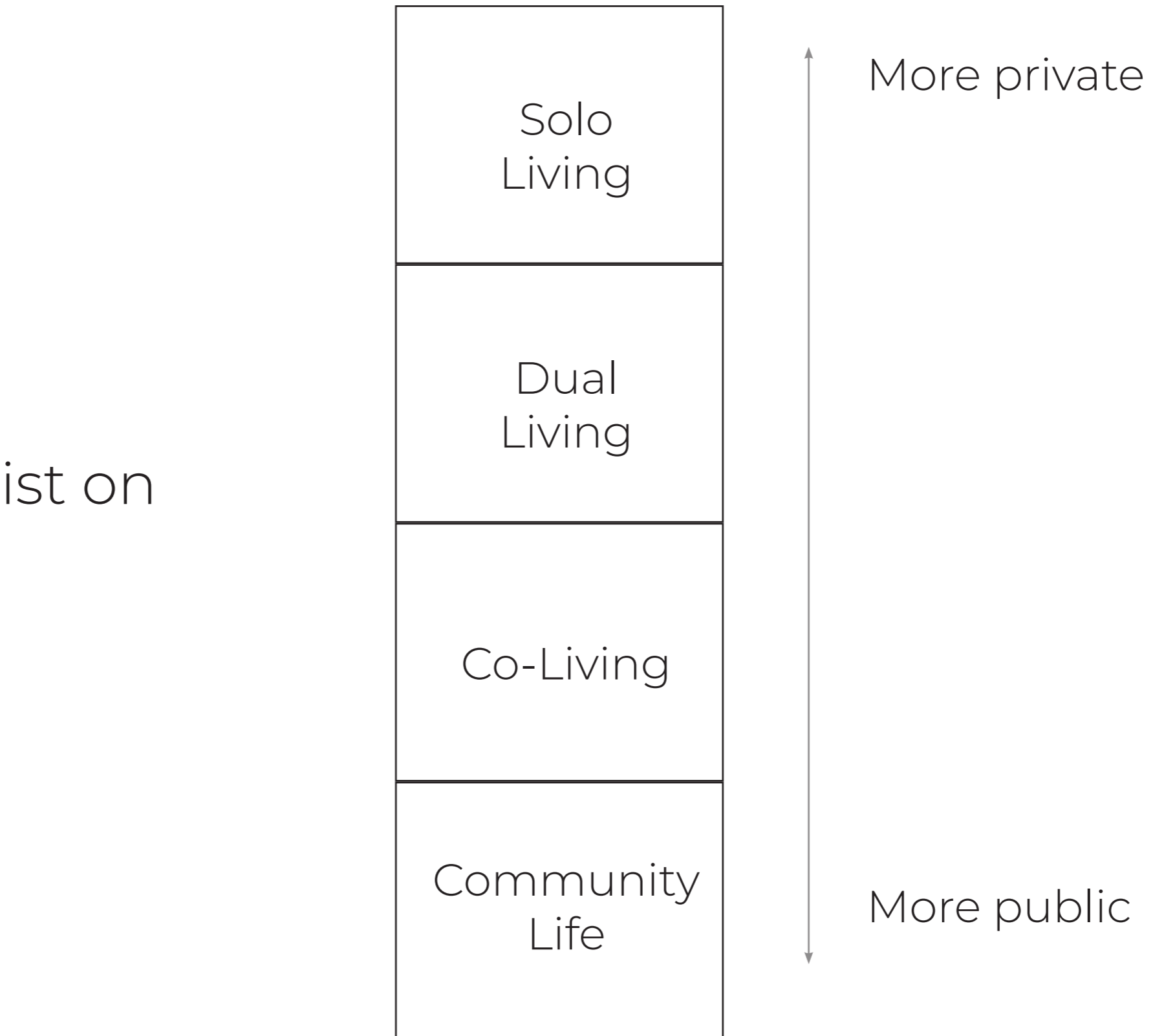
Community
Life

SHOP





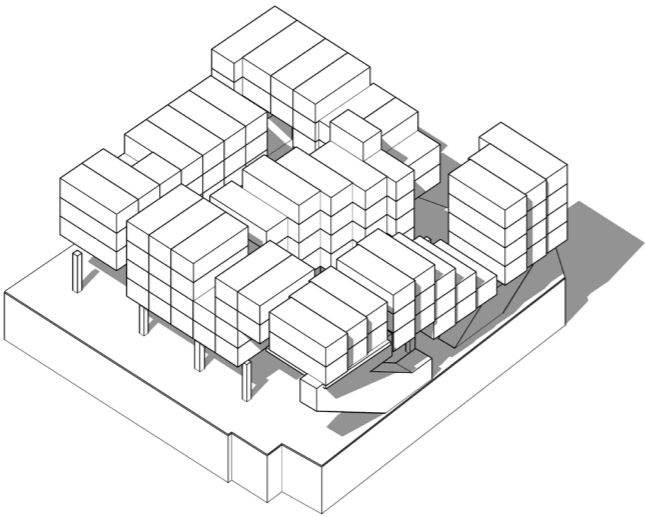
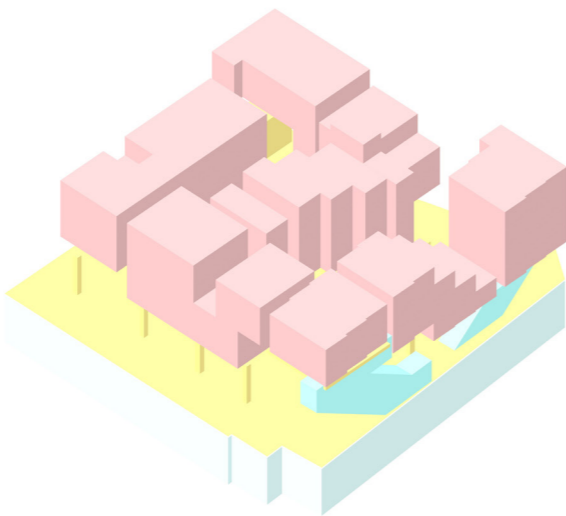
Social needs exist on
a spectrum...



Research findings: Spatial analysis in relation to Community Formation

Massing and layout

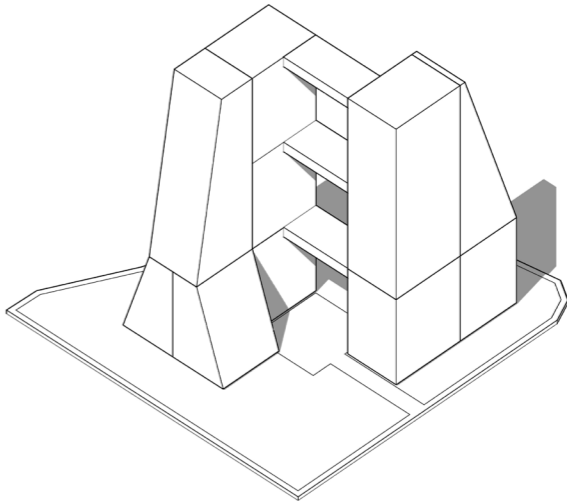
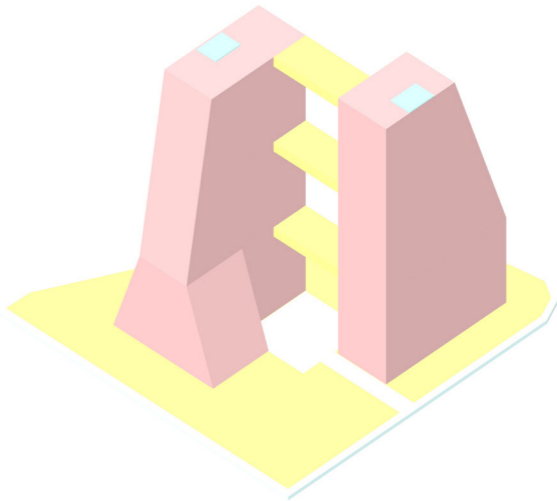
Star Apartment



From bottom to top
Medication Centre
Podium
Communal level
Residence unit

Vertical zoning

Sky Habitat

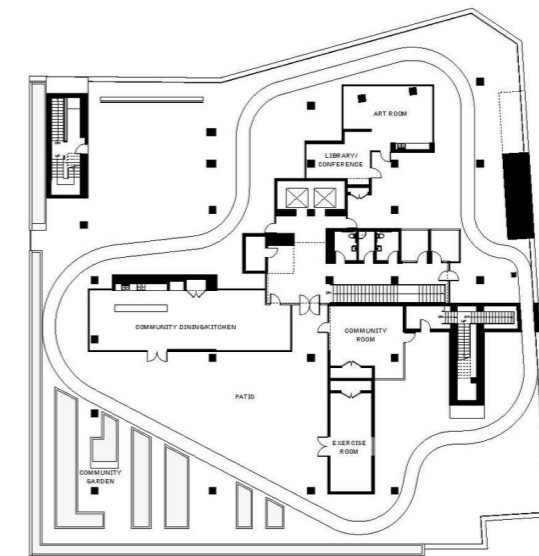


Ground floor with landscape
twin tower
3 bridges with amenities

Horizontal zoning

Part 2: Spatial analysis in relation to Community Formation

Degree of Co-living



SECOND FLOOR / COMMUNITY LEVEL

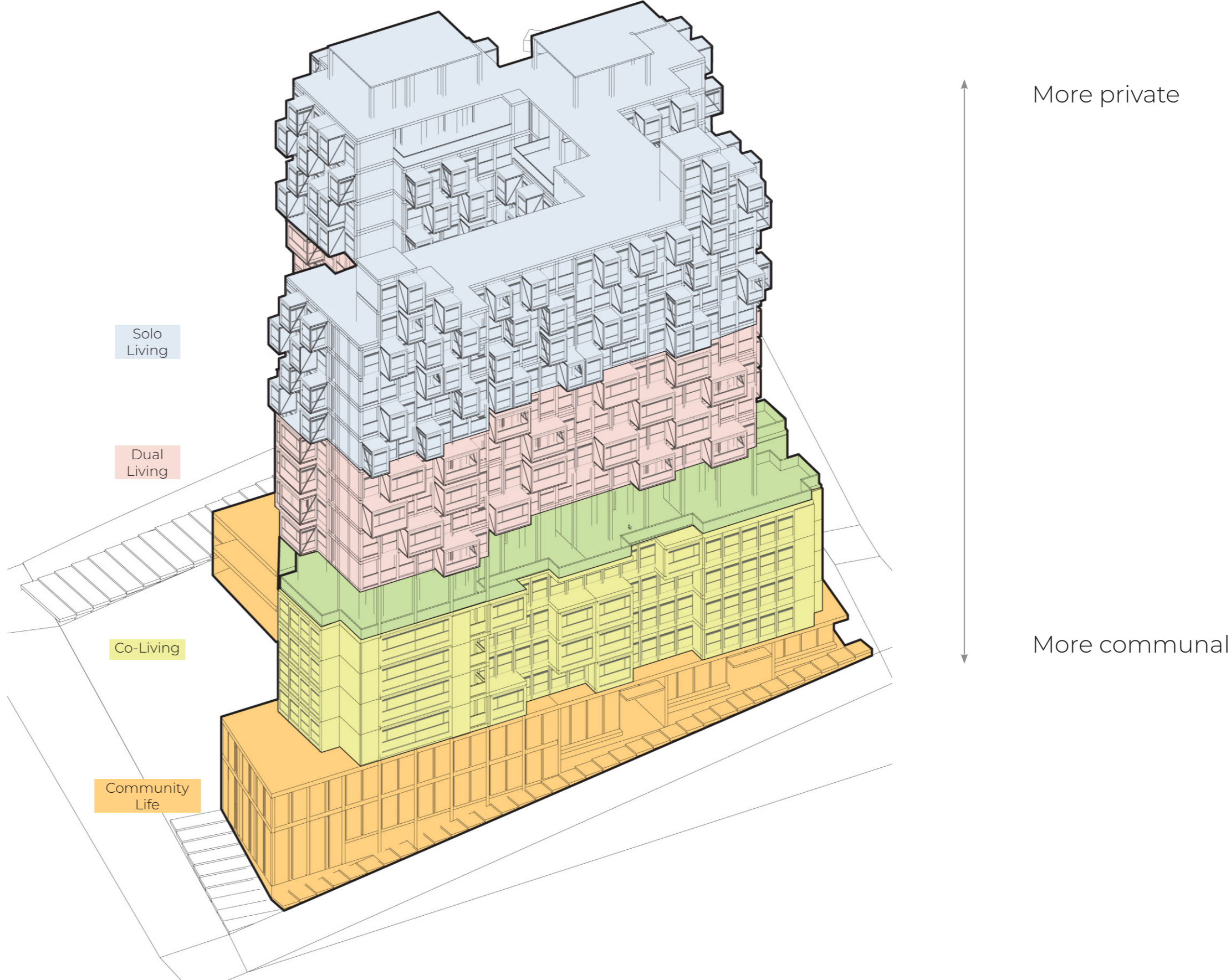


Concrete megastructure
Preserved existing medical centre



TYPICAL UPPER FLOOR / RESIDENTIAL UNITS

102 residents share 1,292.4 sqm
12.67 sqm per person.
Shared program space of 424.6 sqm
4.16 sqm per person.

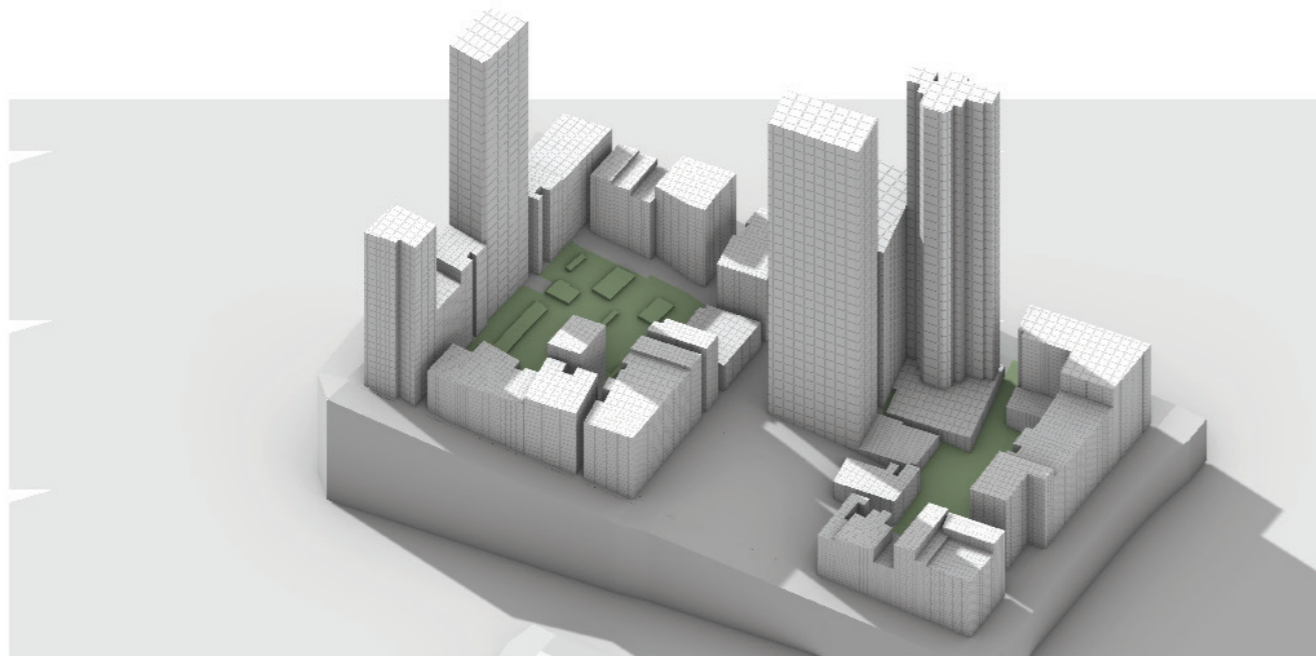
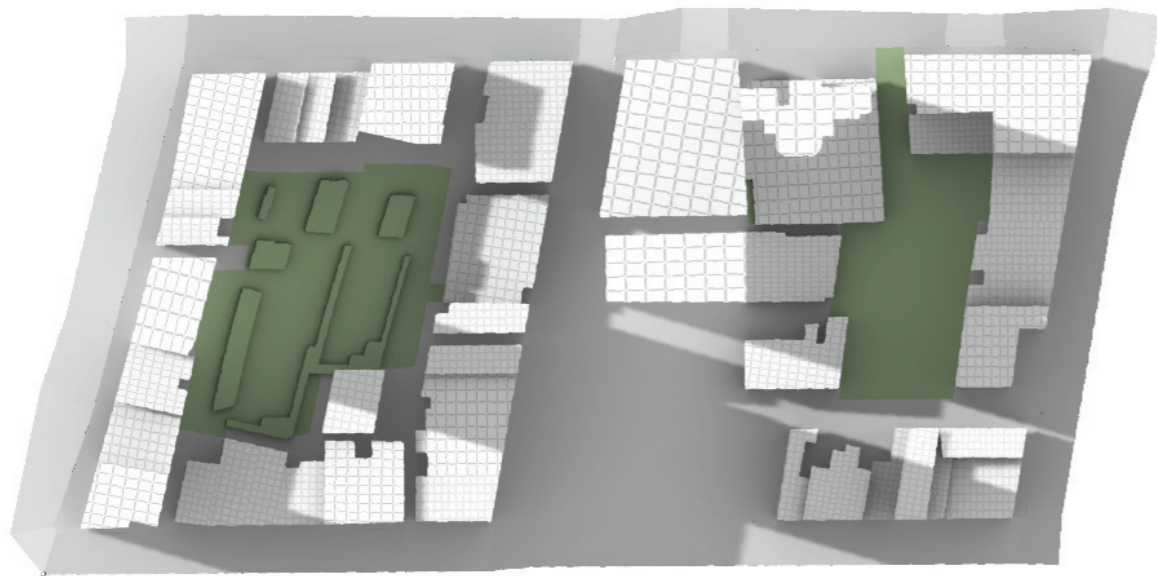


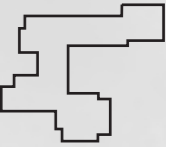


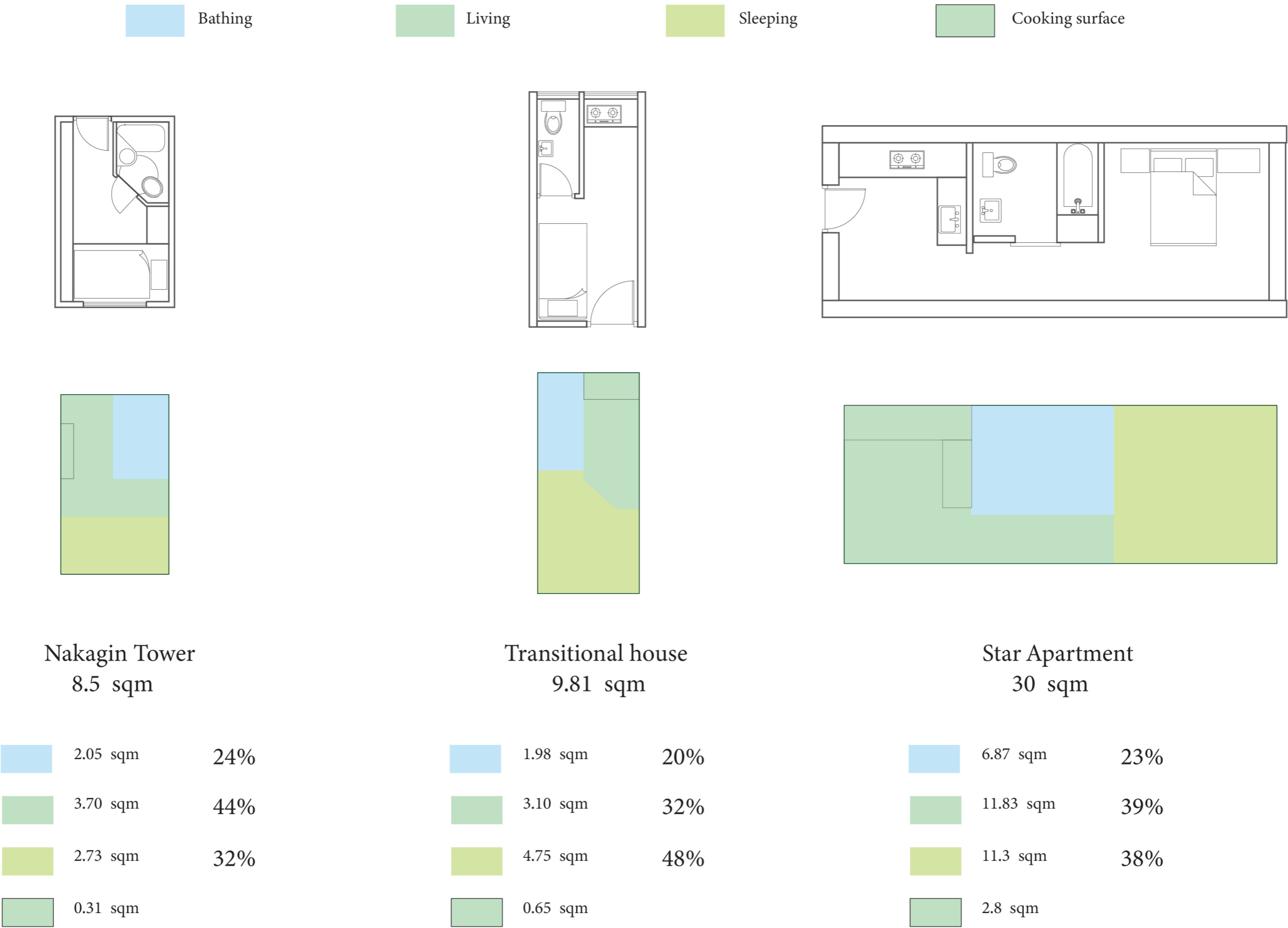


Design Concept

Site condition







"Hong Kong 2030+: Towards a Planning Vision and Strategy Transcending 2030"

initiative aiming to increase the average living space per person to 20-22 square meters

Bathing 22%

Living 38%

Sleeping 40%

1

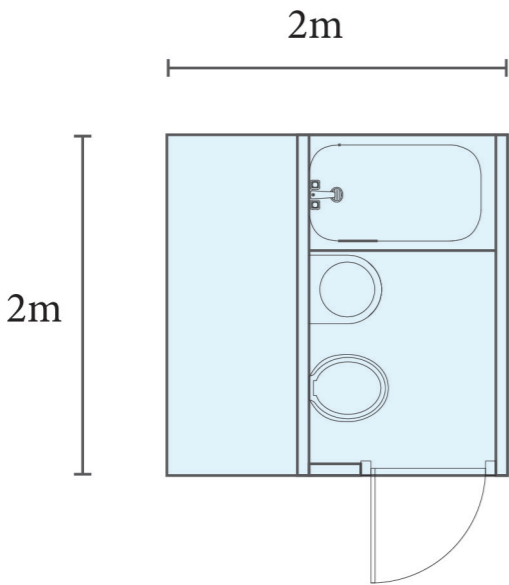
:

2

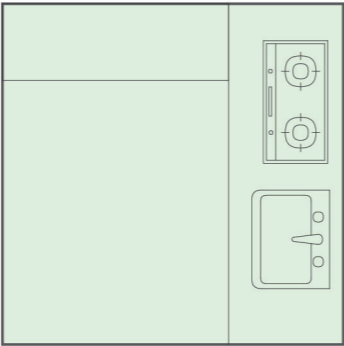
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2

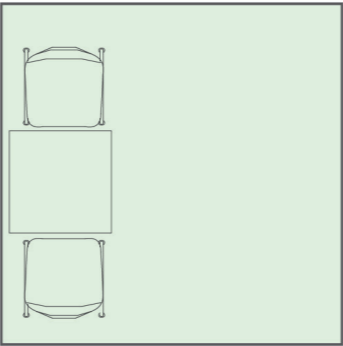
Functional modules 4 sqm



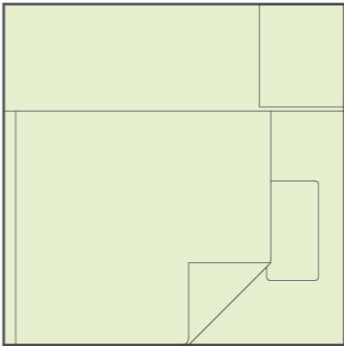
Bathing + Storage



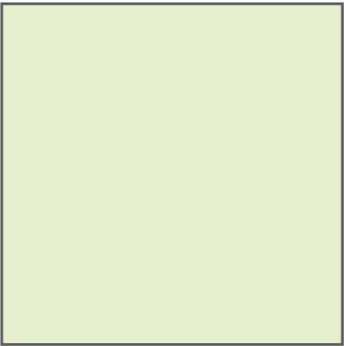
Cooking



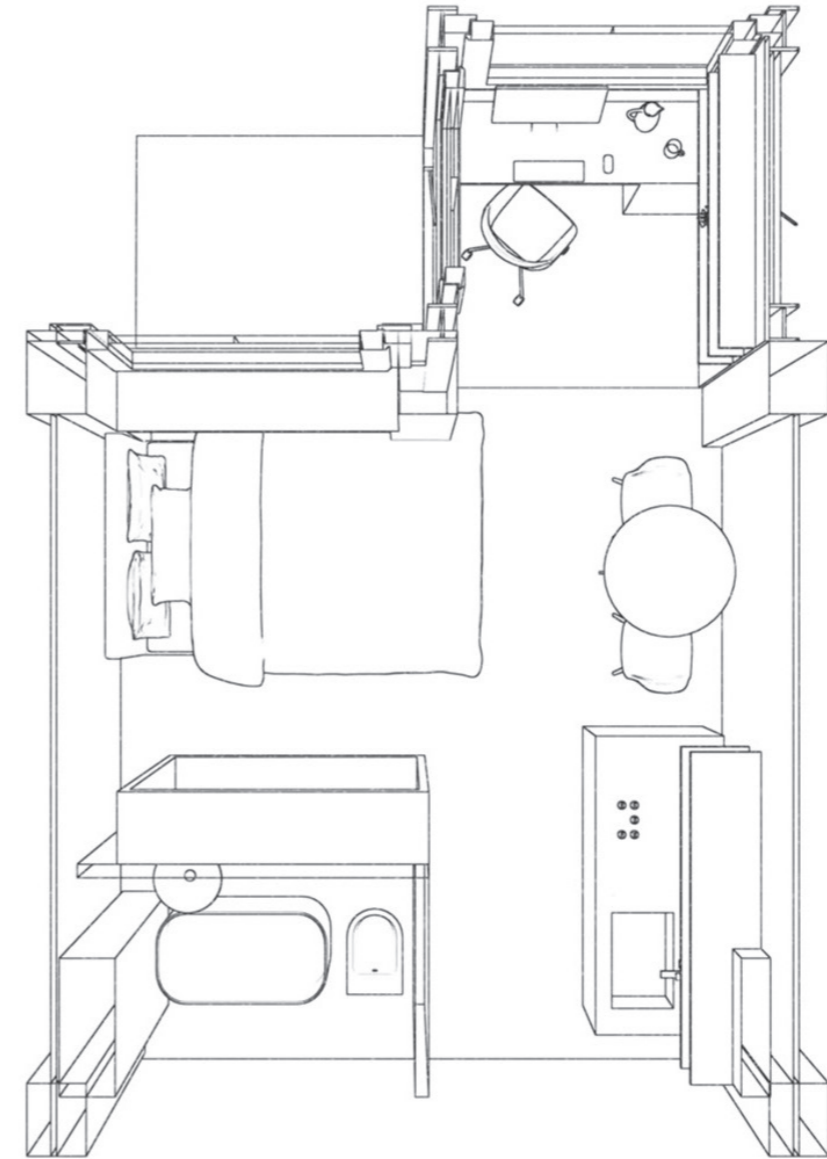
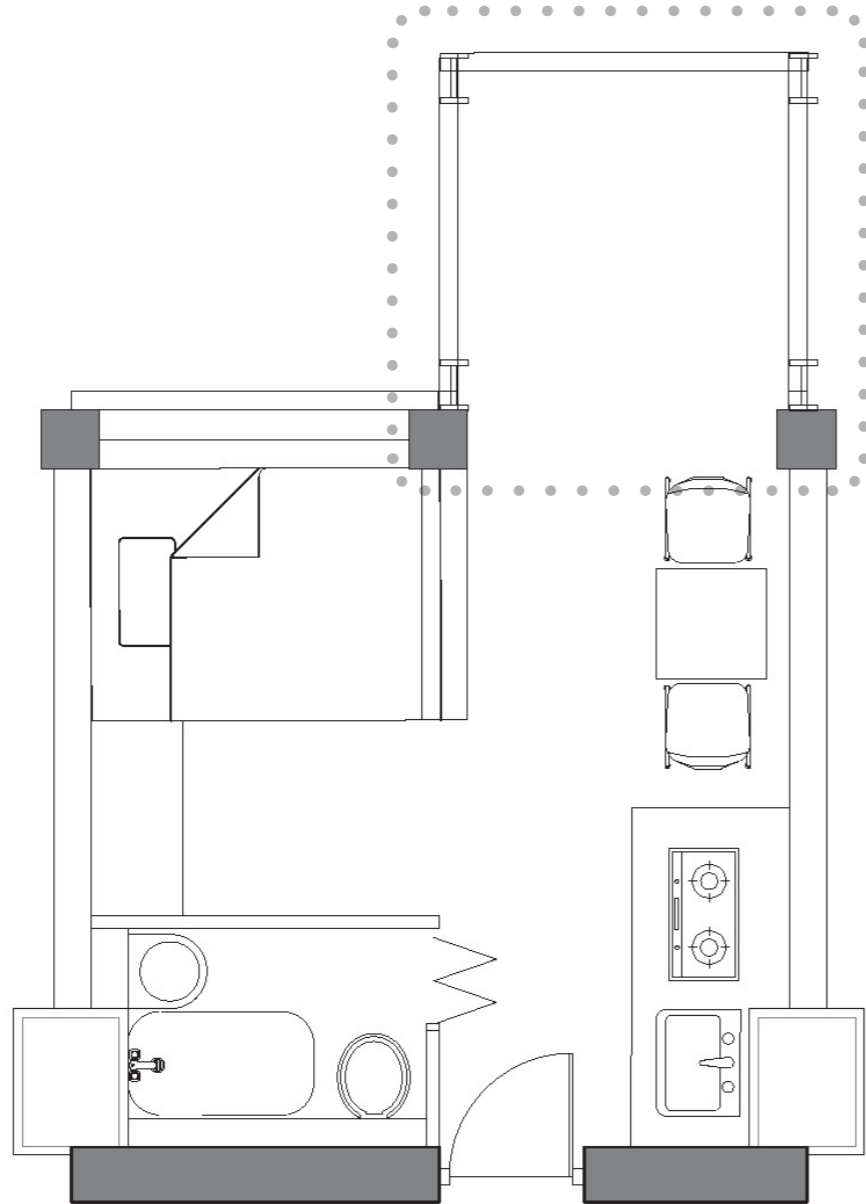
Dinning



Sleeping



Free space





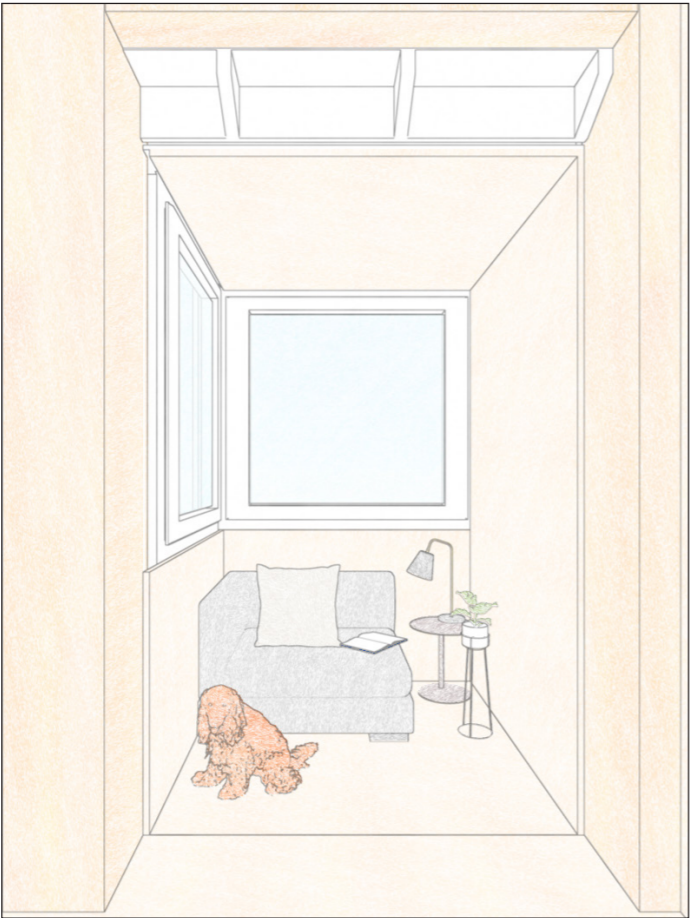
DIGITAL NOMAD



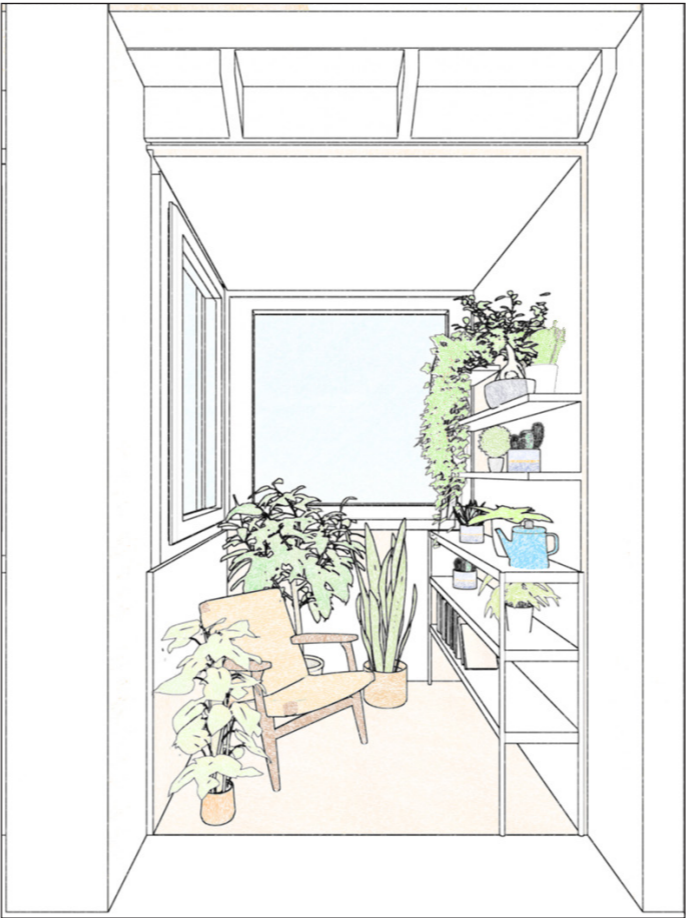
MESSY ARTIST



MINIMALIST YOGI



HOME READER

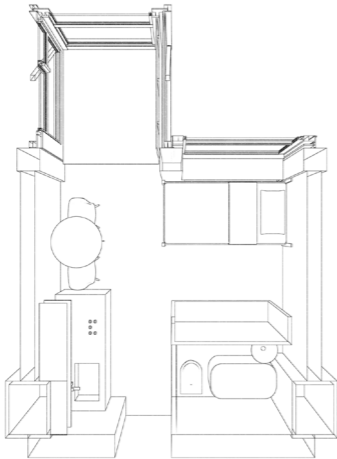


LITTLE GARDENER

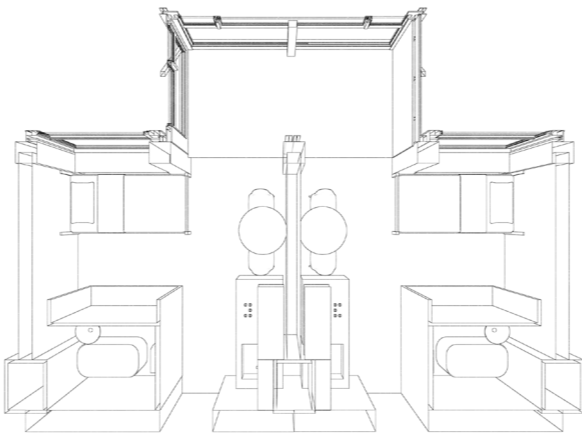


PET LOVER

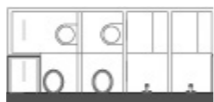
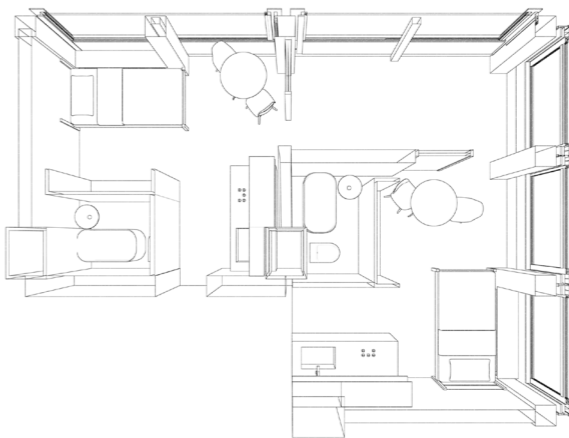
Design Concept



SOLO UNIT



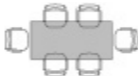
DUAL UNIT



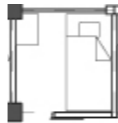
Bathing + Storage



Cooking



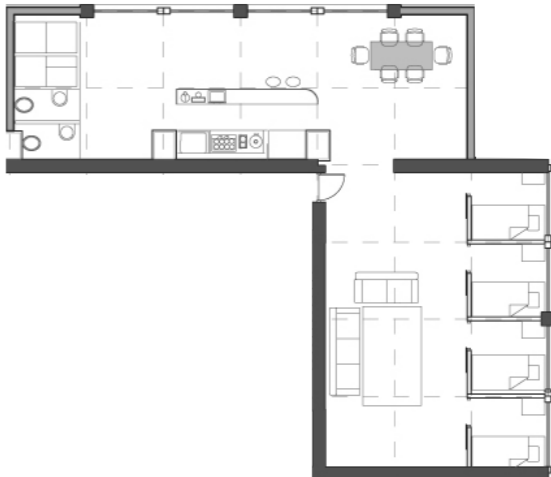
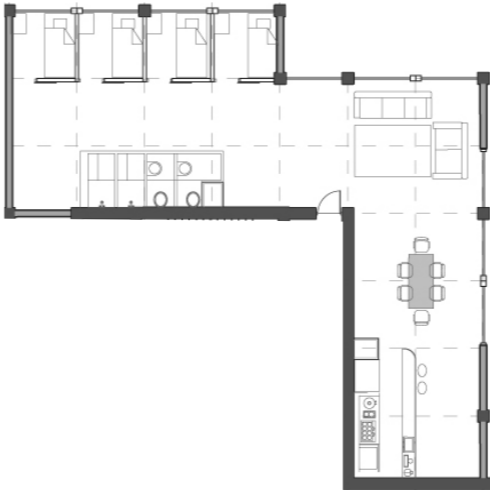
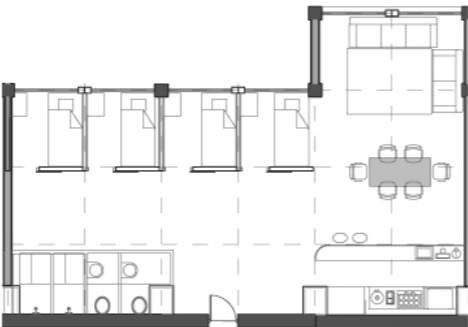
Dinning



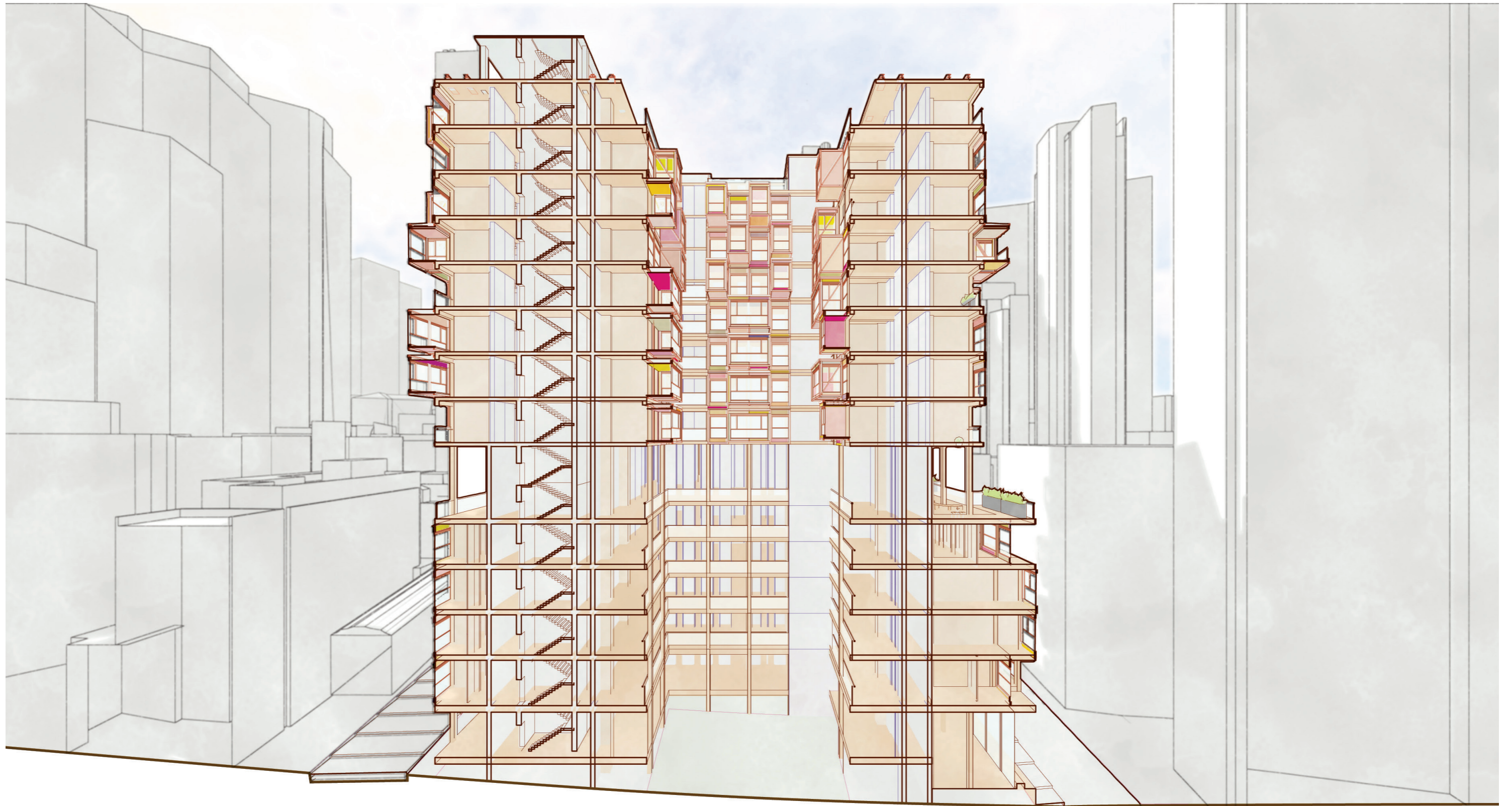
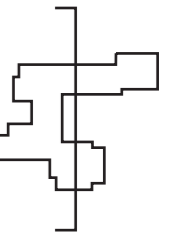
Sleeping



Free space



CO UNITS

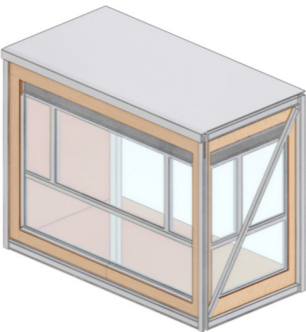


Design Proposal

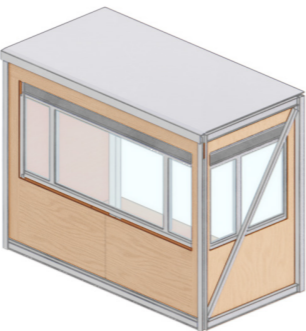
SOLO

DUAL

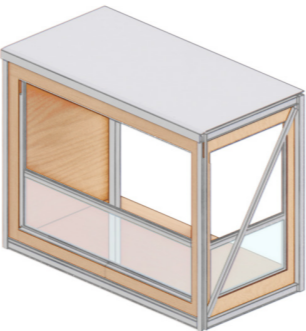
ENCLOSED WITH FULL-HEIGHT GLAZING



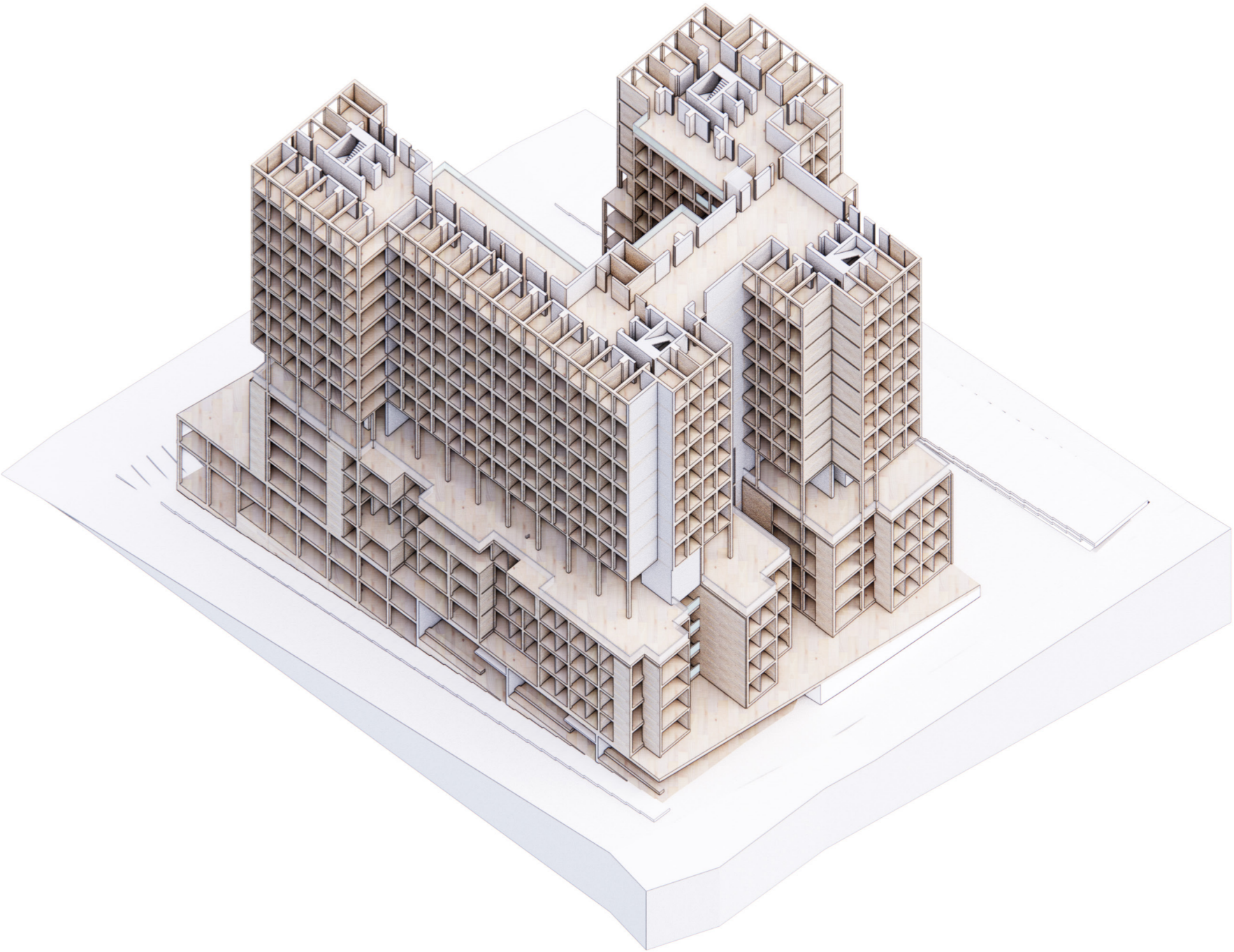
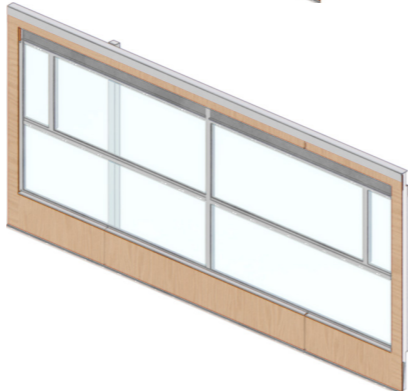
ENCLOSED WITH HALF-HEIGHT GLAZING



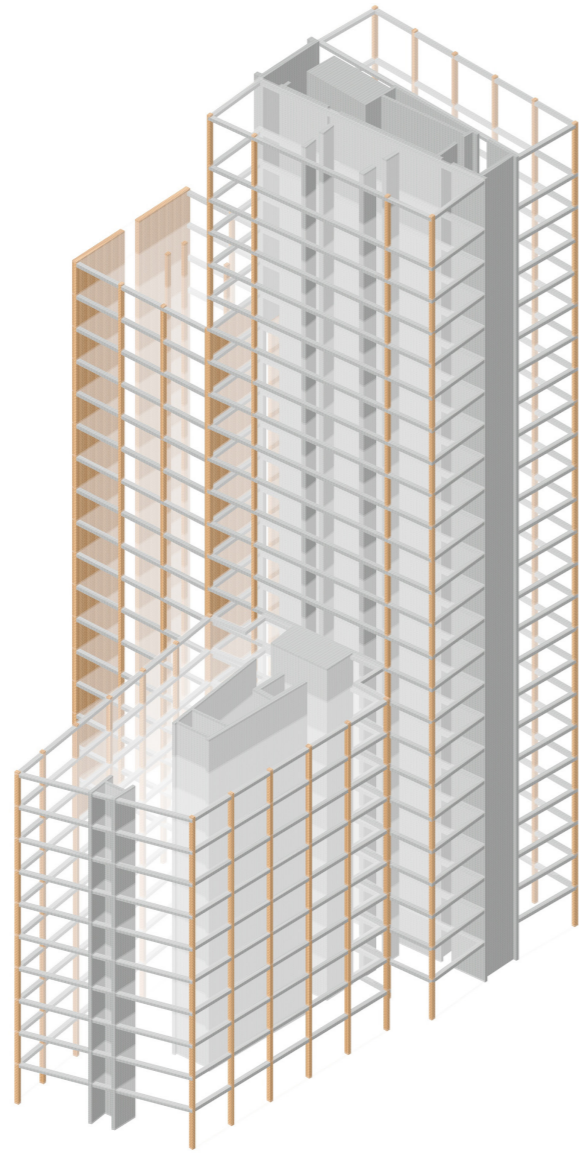
OPEN BALCONY WITH GLASS BALUSTRADE



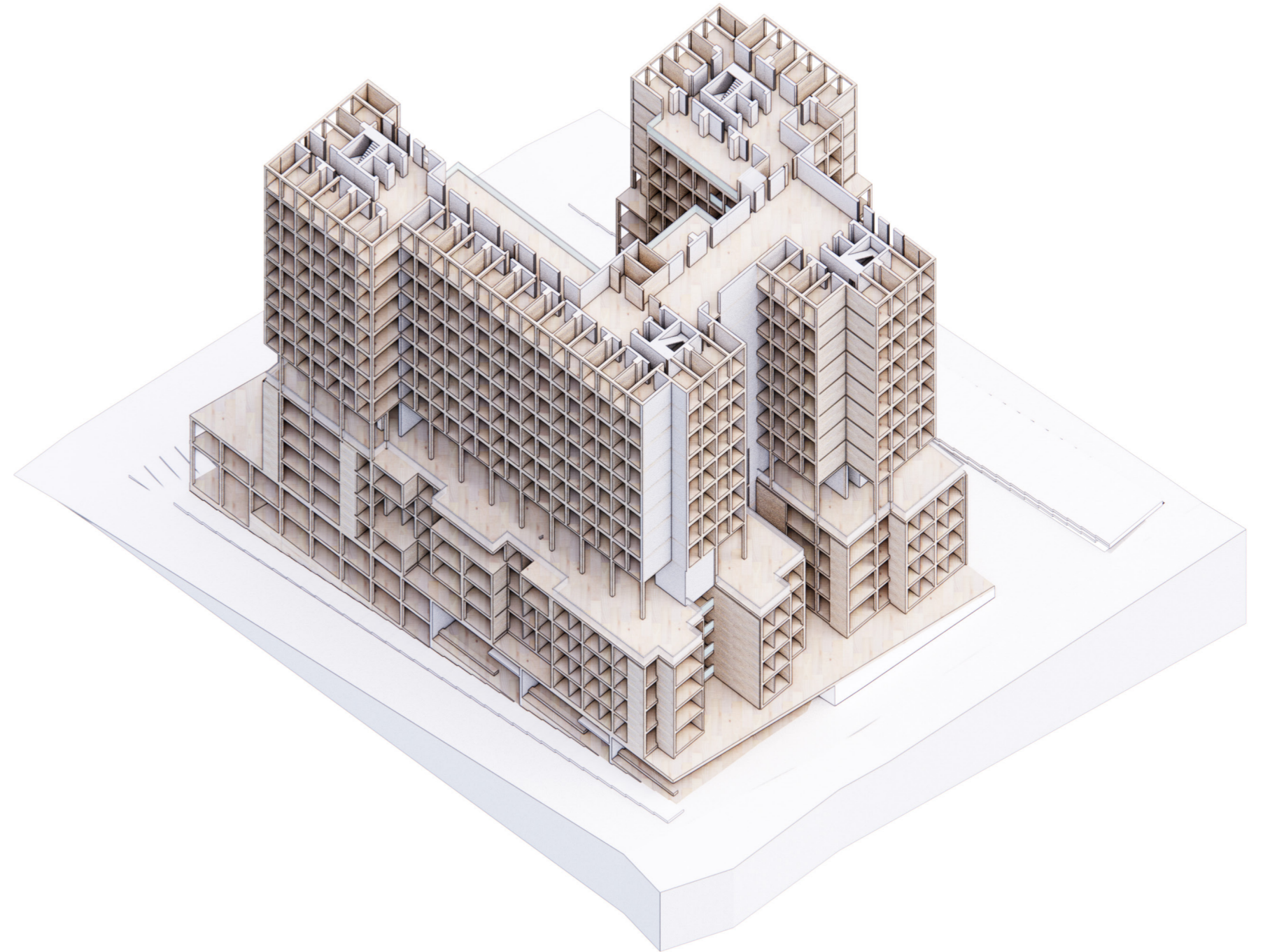
FACADE MODULE



STRUCTURE DIAGRAM



Hoho Vienna
Concrete core and beam
CLT slab
GLT columns



Part1: Structural Systems in Modular High-Rise Housing



Mjøstårnet



HoHo Vienna



Treet



Hotel Jakarta



Stadthaus

Metrics and Their Implications

1 Total Floor Area (TFA):

The total floor area of a floor plan.

2 Structural Floor Area (SFA):

Portion of the building footprint occupied by structural components, such as columns, cores, or shear walls.

3 Structural Footprint Ratio (SFR):

Proportion of the footprint dedicated to structural elements.

A higher SFR : greater load-bearing capacity , overengineering or inefficiencies in space utilization.

A low SFR ratio likely have fewer structural components, reconfigurability and adaptability

Structural SFR= $\frac{SFA}{TFA}$

4 Height-to-Footprint Ratio:

Slenderness of a building

HFR= $\frac{Height\ of\ Building}{Footprint\ Area\ of\ Building}$

5 Structural Footprint Ratio -to-Height Relationship:

Short buildings with high SFR: high stability
Tall buildings with low SFR: Optimized

6 Actual Span

Average distance between structural supports

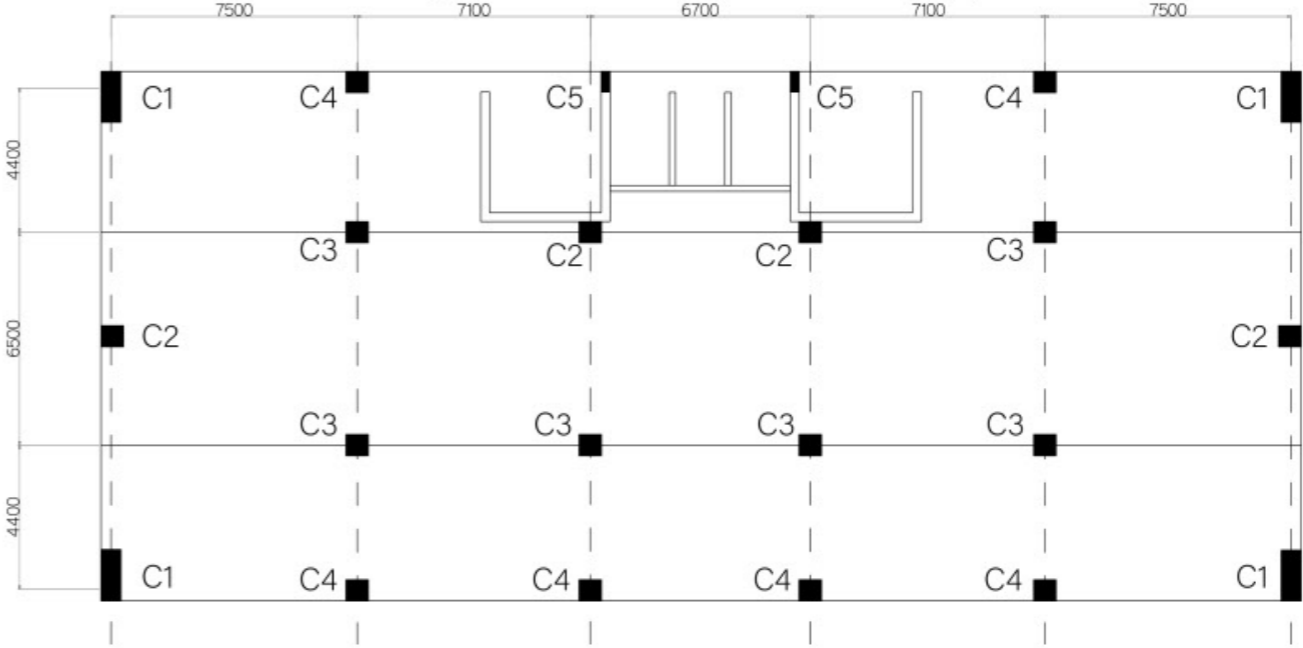
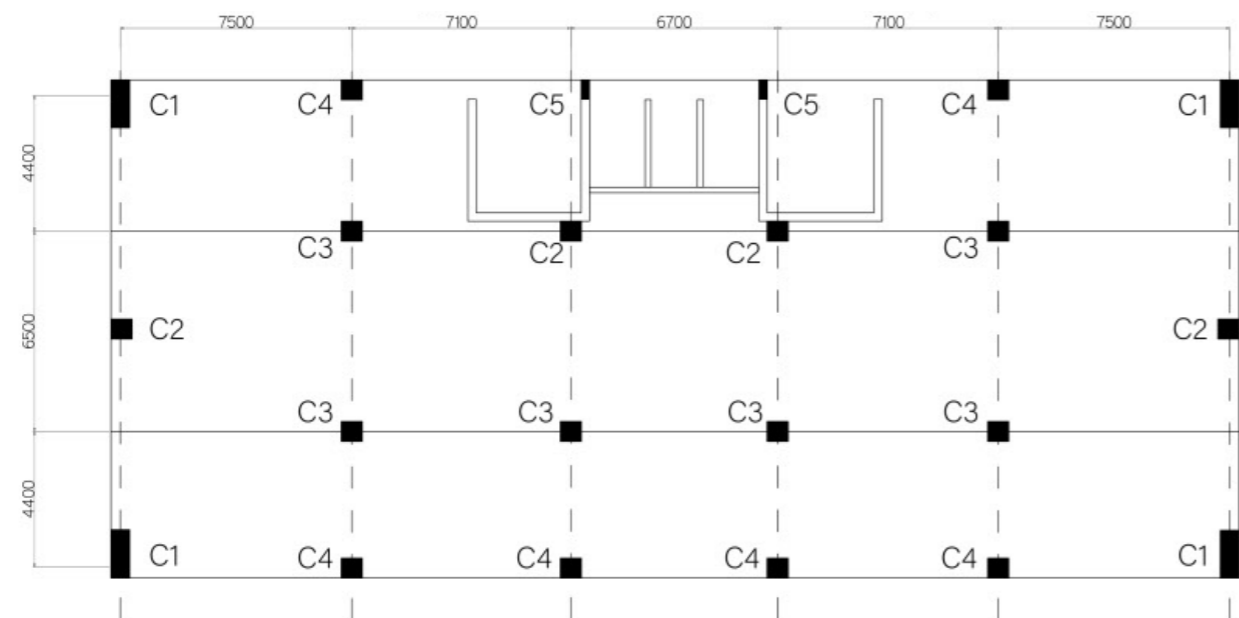


Figure 2. Structural plan of Mjøstårnet

Column dimension and number

Column	Width (mm)	Height (mm)	Number of columns
C1	625	1485	4
C2	625	630	4
C3	725	810	6
C4	625	625	6
C5	215	625	2

Part1: Structural Systems in Modular High-Rise Housing



a) Calculate Structural Footprint Area (SFA):

- Sum up the cross-sectional areas of all columns, load-bearing walls, and core zones.
- Example: In a 16.3m x 36.9m floor with 22 columns (each location and dimension stated in the table above), the SFA would be:
- $4 \times (0.652 \times 1.485) + 4 \times (0.652 \times 0.630) + 6 \times (0.725 \times 0.81) + 6 \times (0.625 \times 0.625) + 2 \times (0.215 \times 0.625) = 11.416m^2$

b) Calculate Total Floor Area (TFA):

- The **Total Floor Area** is the total footprint of the floor, calculated as: $TFA = Length \times Width$
- Example: For a 10m x 10m floor, the total floor area is: $TFA = 16.3 \times 36.9 = 601.47 m^2$

c) Determine the Structural Footprint Ratio (SFR):

- Example: Structural $SFR = \frac{SFA}{TFA} = 0.0189$
- This represents the proportion of the floor area consumed by structural elements.

d) Determine the Height-to-Footprint Ratio (HFR):

- $HFR = \frac{\text{Footprint Area of Building}}{\text{Height of Building}}$
- Example: For Mjöstårnet with a height of 85.4m and a footprint area of 601.47 m²:
- $HFR = \frac{85.4m}{601.47m^2} = 0.142 m^{-1}$
- This means that for every meter of footprint area, the building rises 0.142 meters.

Height-to-Floor Area Ratio

Building	Height (m)	Footprint (m²)	Height-to-Floor Area Ratio
Mjöstårnet	85.4	601.47	0.142
Treet	45	483	0.093
Stadthaus	29	289	0.103
HoHo Vienna	84	518.1 (Part)	0.162
Hotel Jakarta	34	784.2 (Part)	0.043

Structural Footprint Ratio

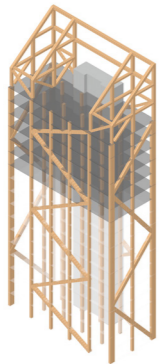
Building	Structural Area (m²)	Footprint (m²)	Structural Footprint Ratio
Mjöstårnet	11.4	601.47	0.0189
Treet	7.7	483	0.0159
Stadthaus	11.9	289	0.0412
HoHo Vienna	26.5	518.1 (Part)	0.0511
Hotel Jakarta	79.14	784.2 (Part)	0.101

Actual Span

Building	Actual Maximum Span (m)	Actual Minimum Span (m)	Footprint (m²)	System	Note
Mjöstårnet	7.5	4.4	601.47	Column-and-Beam	Best span with good flexibility.
Treet	8.7	1.6	483	Column-and-Beam	Large max span, but small min span limits layout.
Stadthaus	9.4	1.08	289	Panelized	Large max span, very small min span.
HoHo Vienna	7	4.8	518.1 (Part)	Column-and-Beam	Good max span with decent min span.
Hotel Jakarta	10.4	3.3	784.2 (Part)	Volumetric Modular	Large max span, but small min span.

Part1: Structural Systems in Modular High-Rise Housing

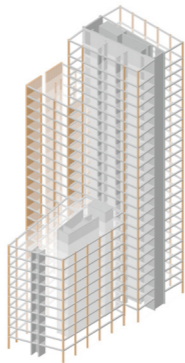
Mjøstårnet



Tallest
Most flexible
Most simple

Glulam column and beam
CLT core

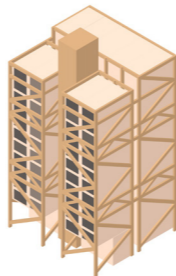
HoHo Vienna



Most Slender
Most flexible
Most simple

Concrete Core

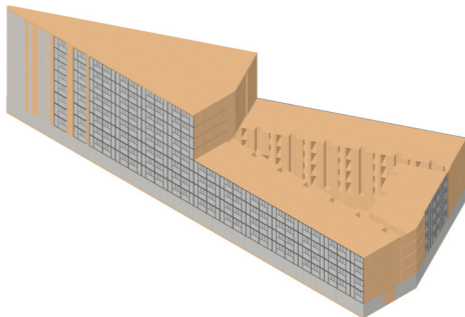
Treet



Least structural footprint
Flexible

Glulam column and beam
CLT core
CLT modules

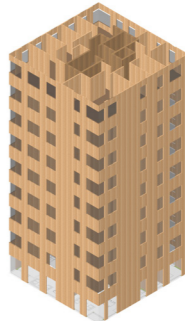
Hotel Jakarta



Most structural footprint
Least Flexible

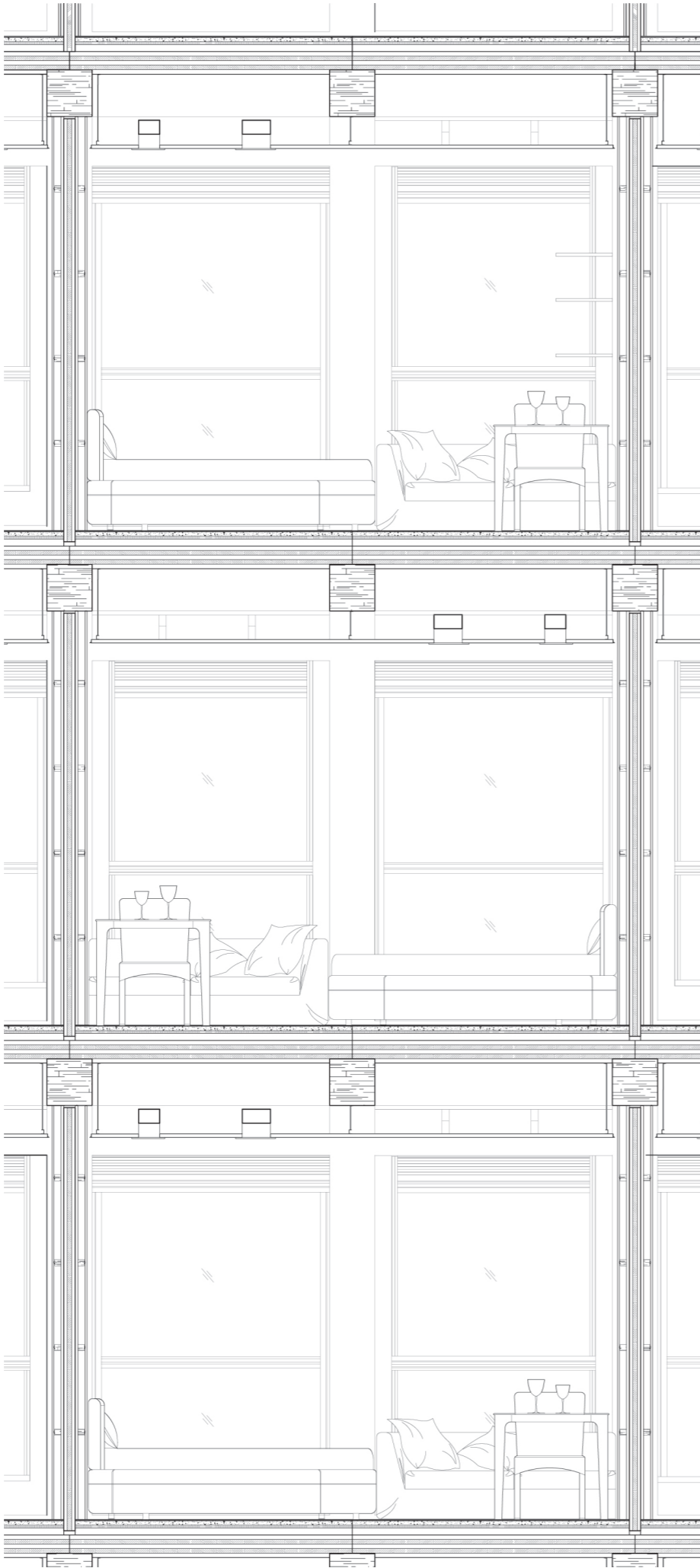
CLT modules

Stadthaus

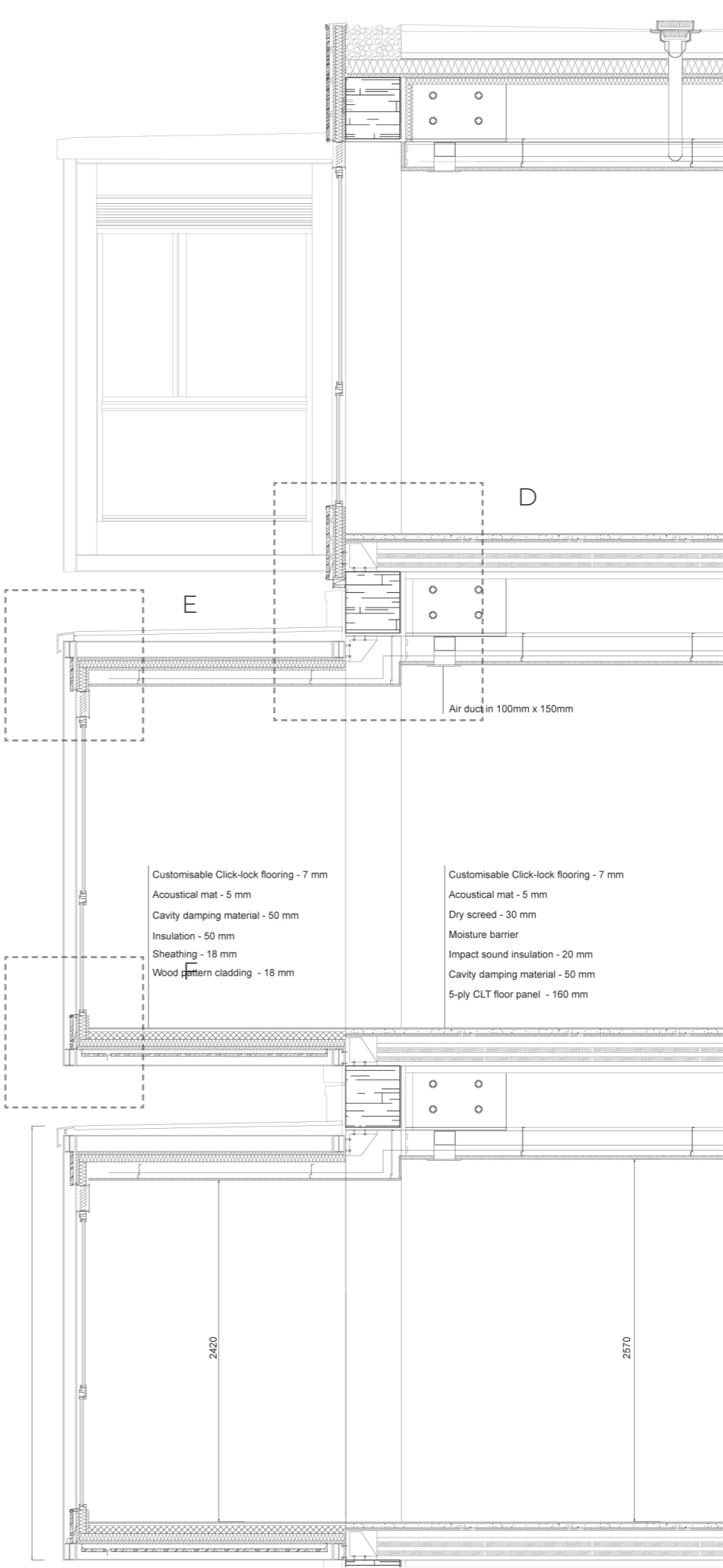


Most structural footprint
Least Flexible

CLT panel

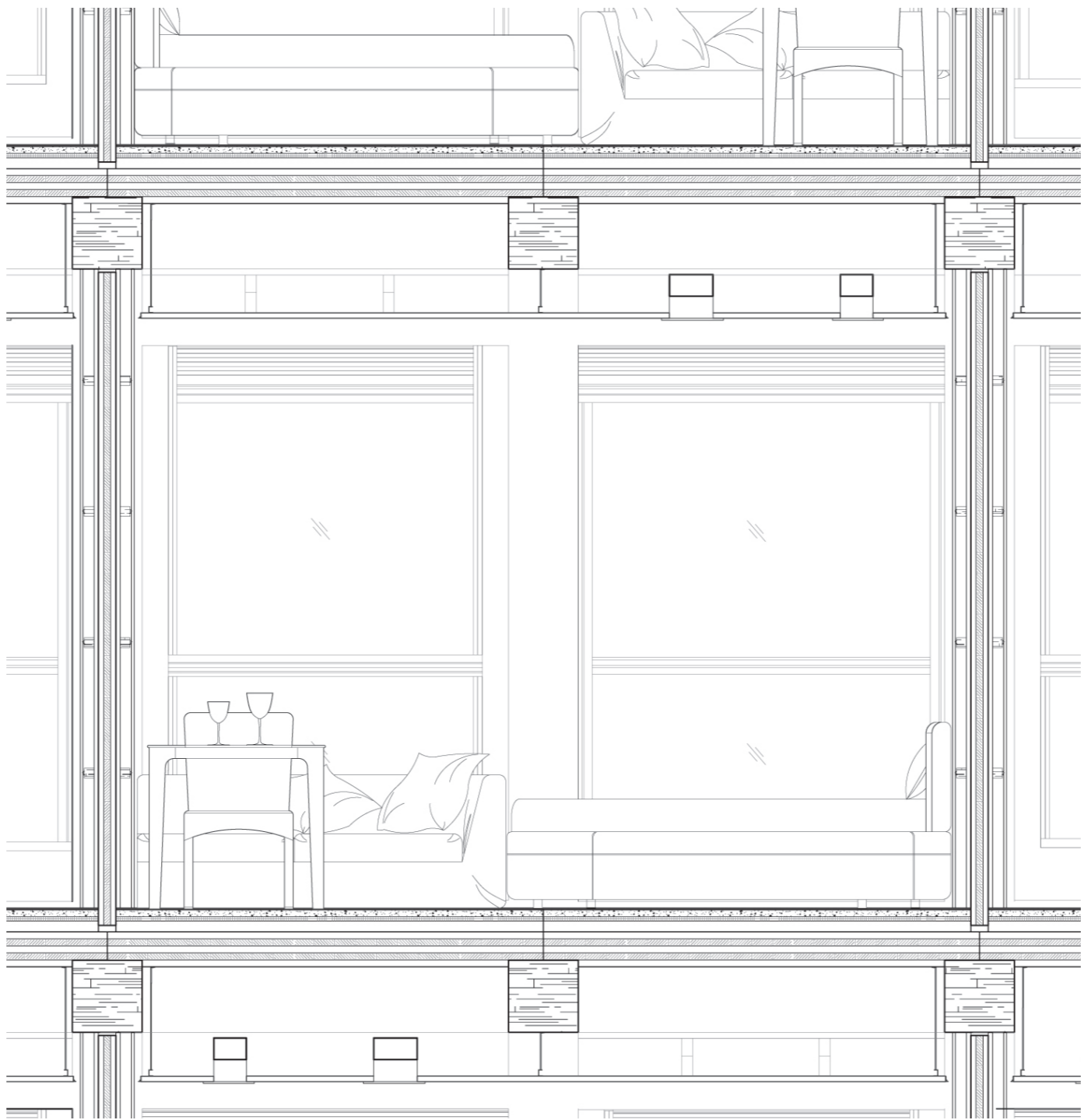
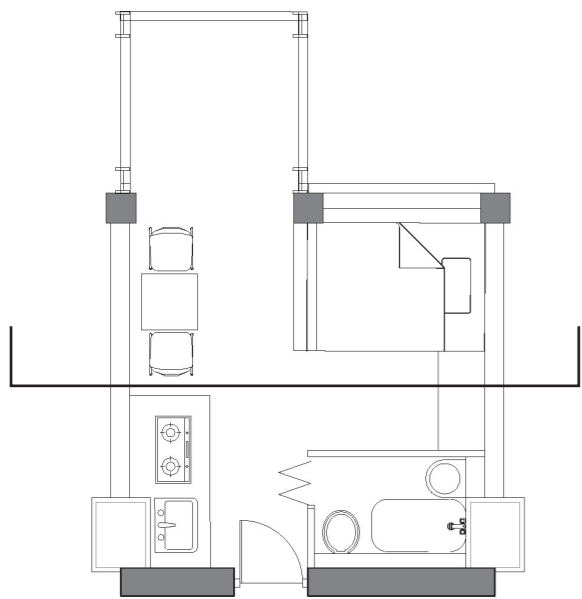


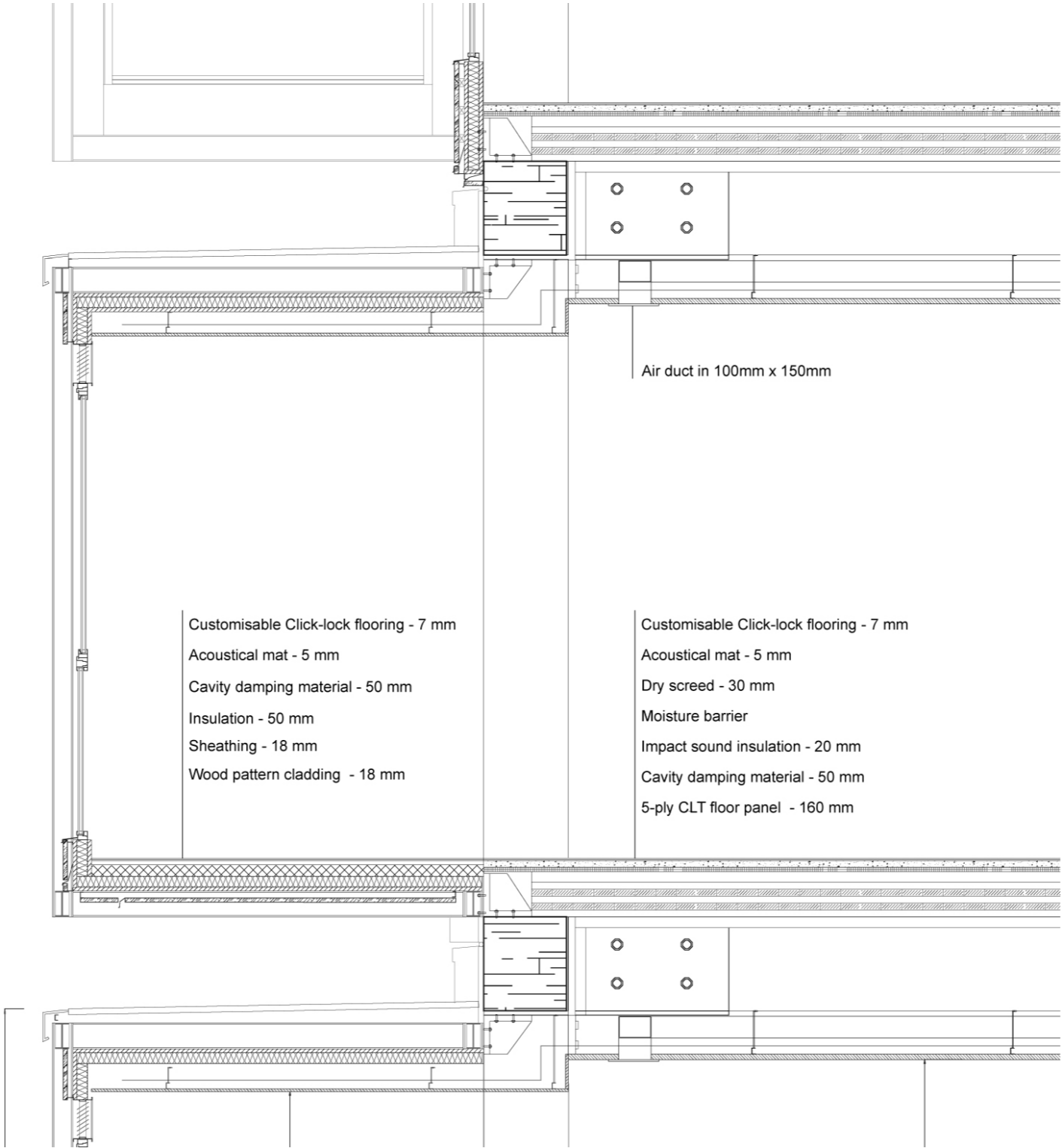
FACADE VIEW FROM INTERIOR & STRUCTURE FRAGMENT 1:20



FACADE FRAGMENT 1:20

Design Proposal



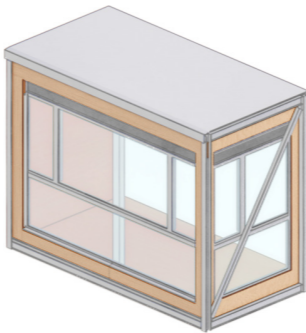


Design Proposal

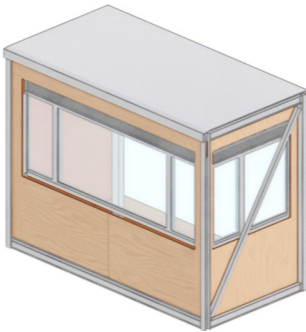
SOLO

DUAL

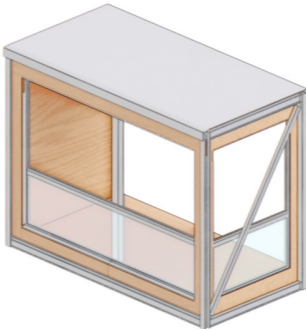
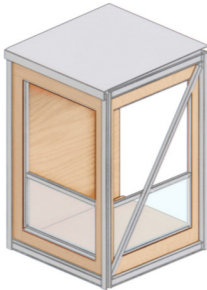
ENCLOSED WITH
FULL-HEIGHT GLAZING



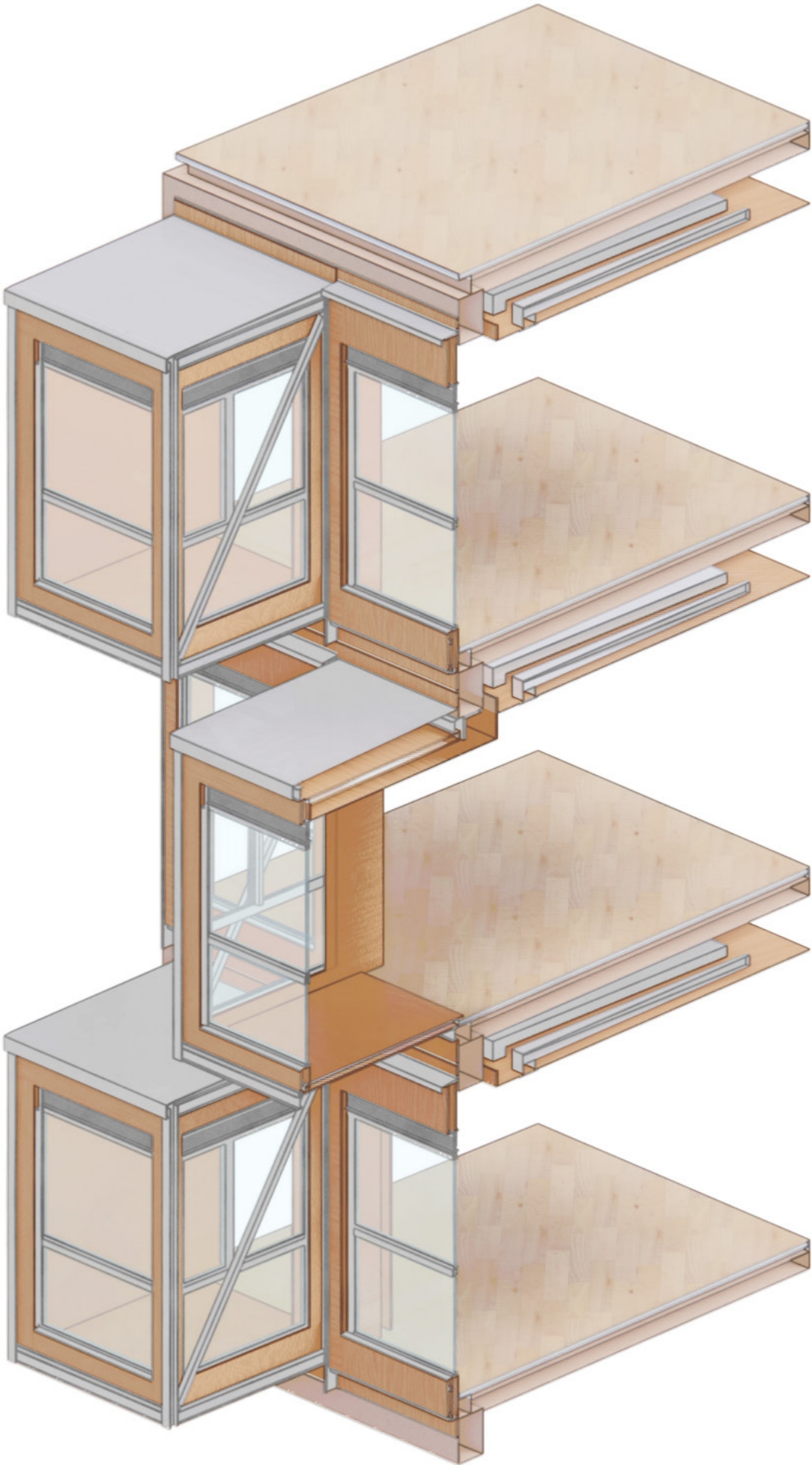
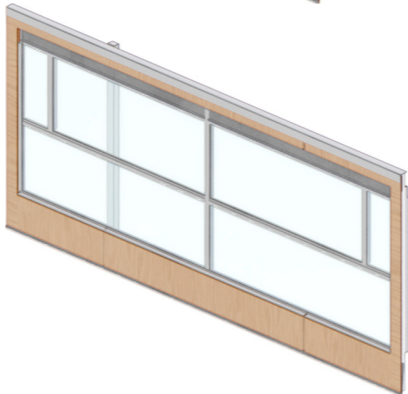
ENCLOSED WITH
HALF-HEIGHT GLAZING



OPEN BALCONY WITH
GLASS BALUSTRADE

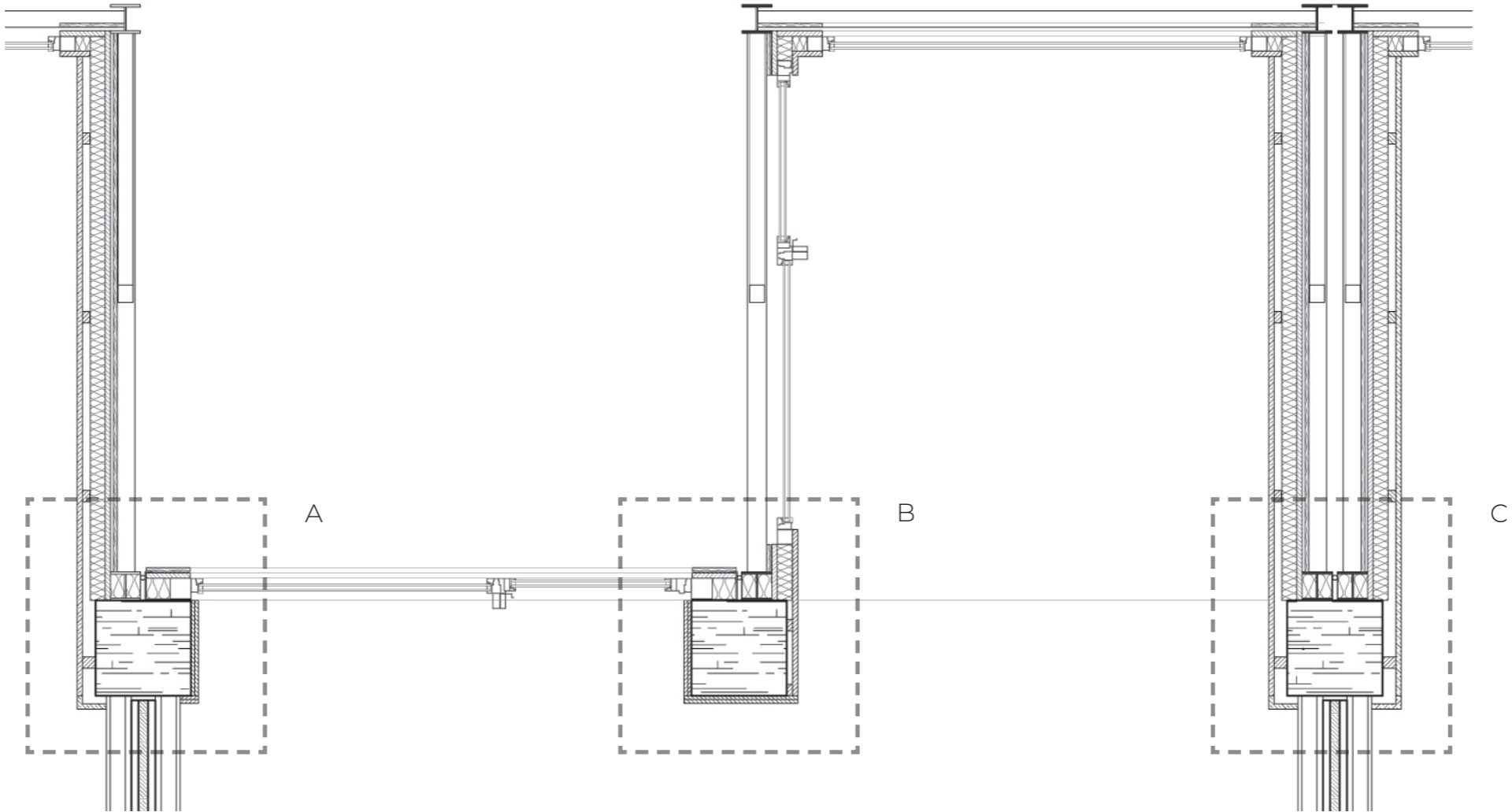


FACADE MODULE

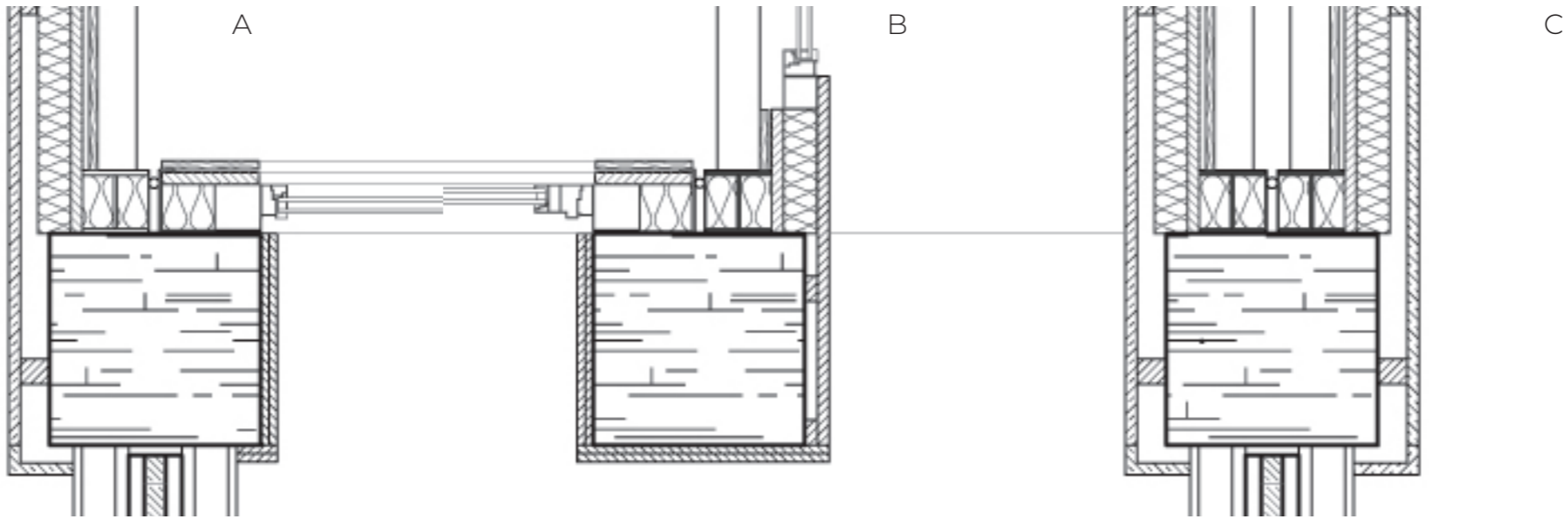


Design Proposal





FACADE VIEW FROM INTERIOR & STRUCTURE FRAGMENT 1:20



STRUCTURE FRAGMENT DETAIL 1:10

Design Proposal

1. Room Setup and Load Assumption

Room size: 2m x 2m

Use: Small domestic room (garden corner, reading/work station)

Type of loading: Light domestic use (Eurocode category A)

Live load: 2 kN/m²

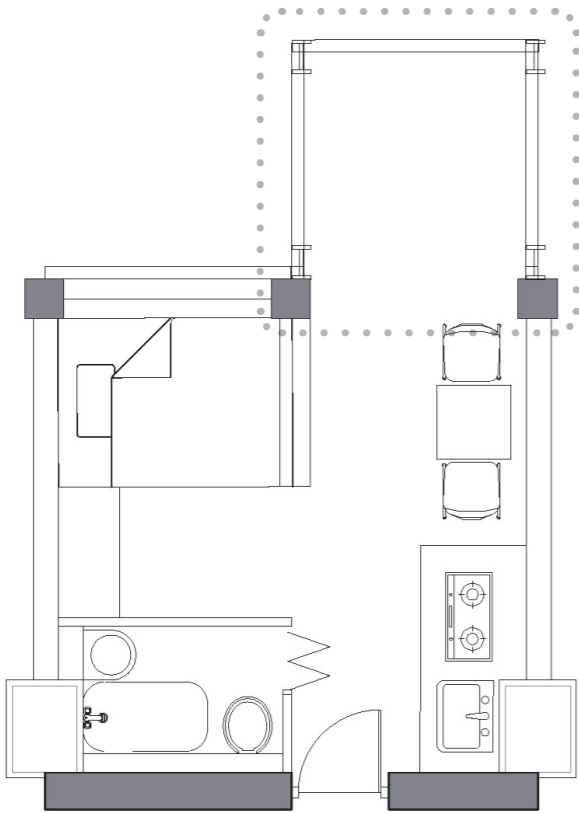
Dead load (structure + finishes): 1.5 kN/m²

Total load (conservative):

$$q = 2 + 1.5 = 3.5 \text{ kN/m}^2$$

Effective load on 2m x 2m floor (assuming beam supports 2m span):

$$w = 3.5 \text{ kN/m}^2 \times 2 \text{ m} = 7 \text{ kN/m}$$



2. Beam Selection – IPE 100

Beam type: Steel I-beam (IPE 100)

Span: 2m cantilever

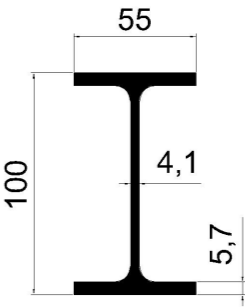
Max moment (cantilever):

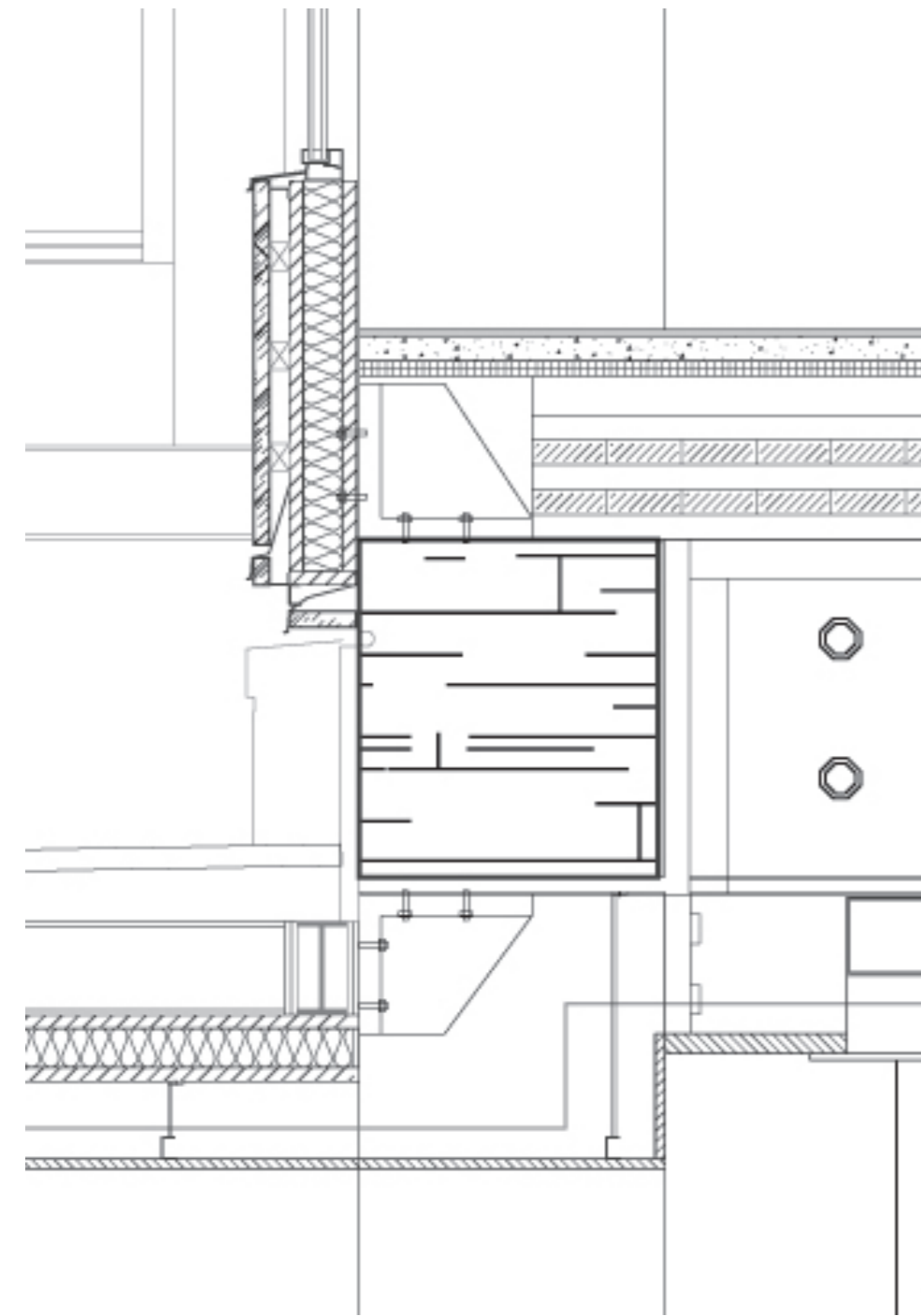
$$M = \frac{w \cdot L^2}{8} \qquad M = \frac{7 \cdot (2)^2}{8} = \frac{28}{8} = 3.5 \text{ kNm}$$

Required section modulus (Z):

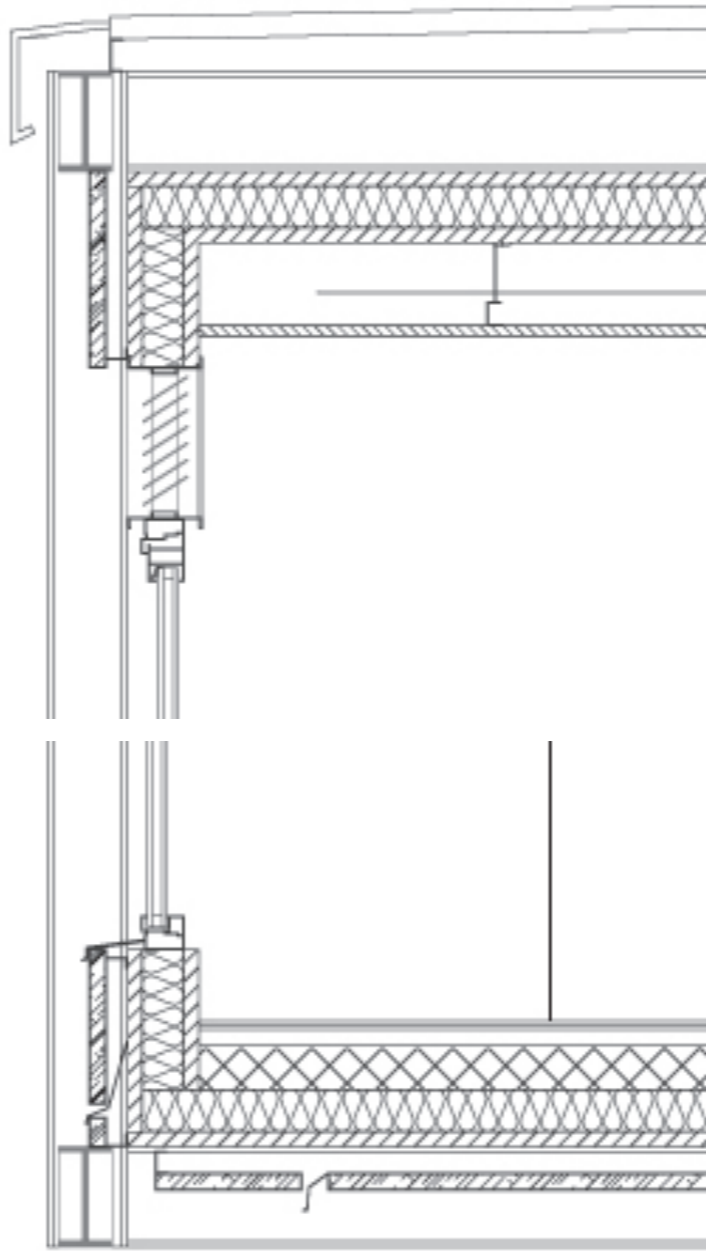
$$Z = \frac{M}{f_y} \qquad M = 3.5 \times 10^6 \text{ N}\cdot\text{mm}$$
$$f_y = \text{yield strength of steel} = 235 \text{ MPa} = 235 \text{ N/mm}^2$$
$$Z = \frac{3.5 \times 10^6}{235} \approx 14,894 \text{ mm}^3$$

IPE 100 has $\approx 19,000$
 $Z \approx 19,000 \text{ mm}^3$

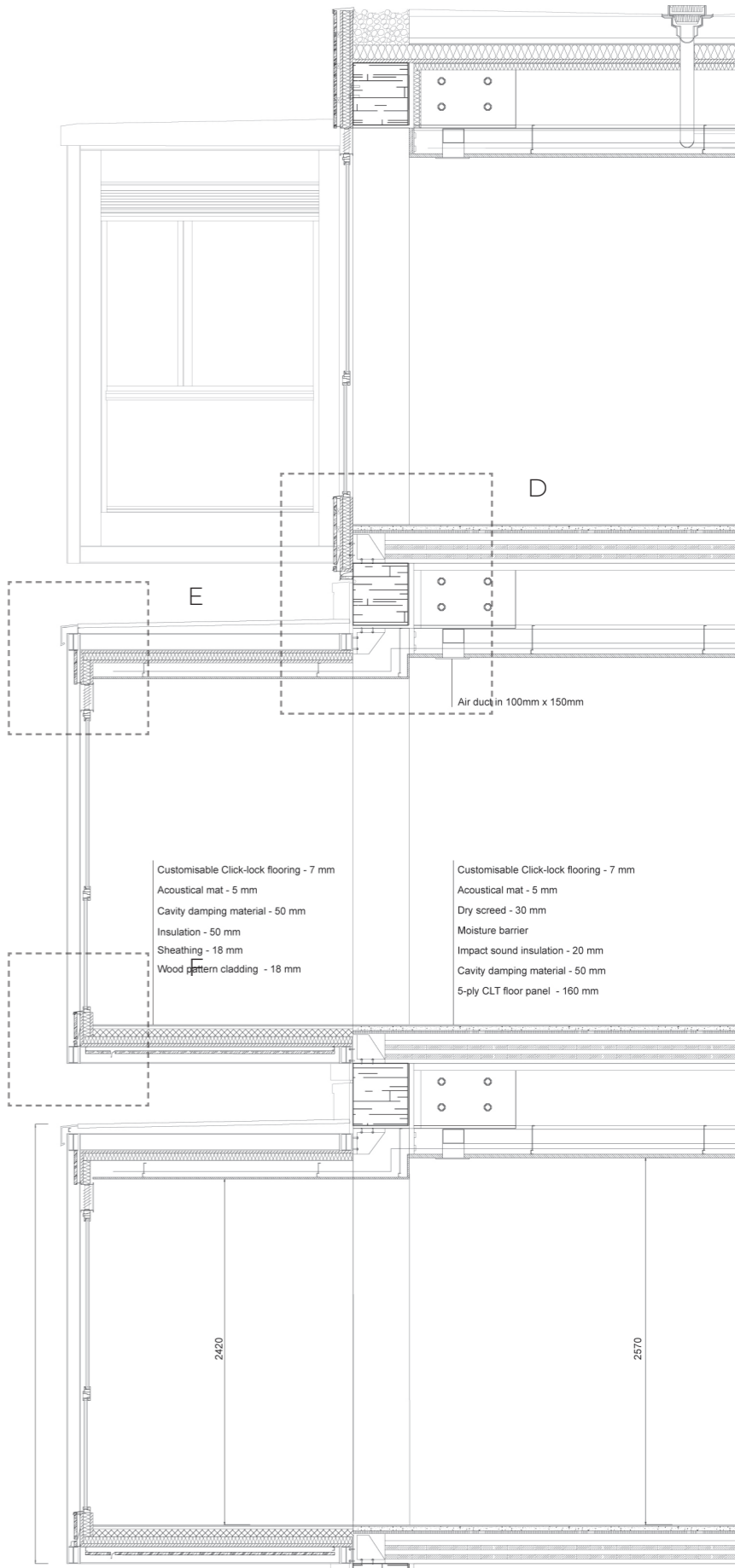




D



E



D

E

F

FACADE FRAGMENT DETAIL 1:10

FACADE FRAGMENT 1:20

Part 2: Spatial analysis in relation to Community Formation

Create social and consultative spaces

Definition of the informal, or personal spaces that surround individuals (Edward T. Hall):

Intimate space

the closest "bubble" of space surrounding a person. Entry into this space is acceptable only for the closest friends and intimates.

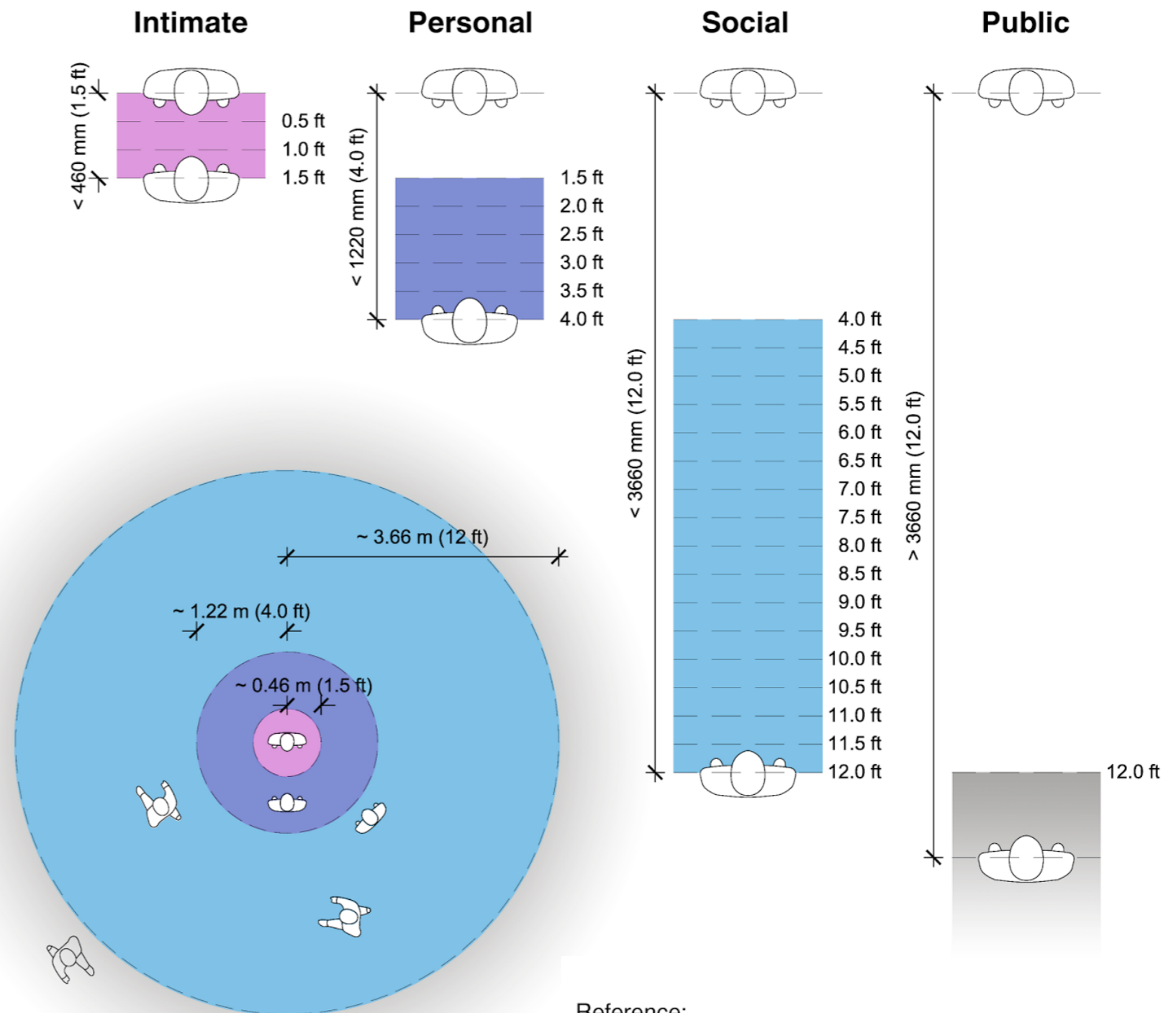
Social and consultative spaces

The spaces in which people feel comfortable conducting routine social interactions with acquaintances as well as strangers.

Public space

The area of space beyond which people will perceive interactions as impersonal and relatively anonymous.

The Death and Life of Great American Cities emphasizes the importance of smaller, close-knit environments in fostering casual interactions and trust.



Reference:

De Chiara, Joseph, Panero, Julius, and Zelnik, Martin, *Time-saver Standards for Interior Design and Space Planning*, 2nd edn., New York, McGraw-Hill, c2001.

Research findings : Spatial analysis in relation to Community Formation

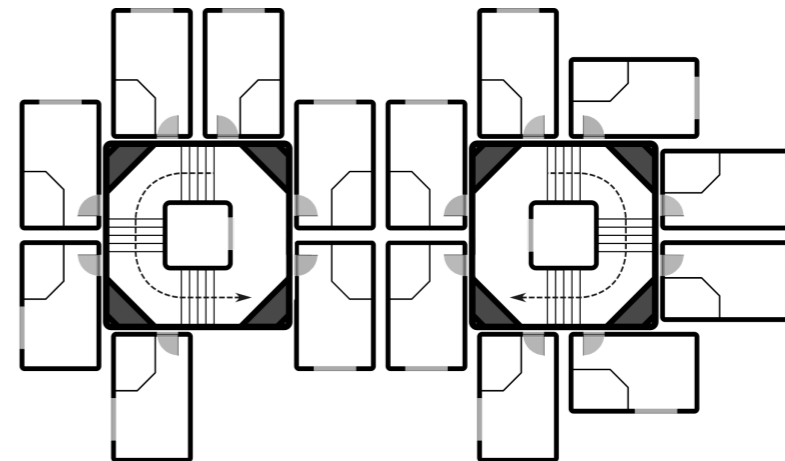
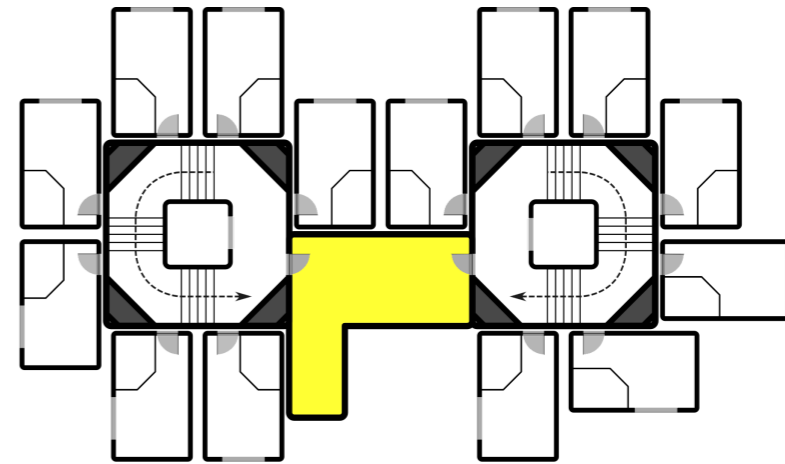
Takeaways from case study

Habitat 67



Transitional space as communal space

Nakagin Tower



Platform of one unit size on only 3 levels



International Student
Looking for Connection



Young Professional Expat
New to city for Work



Heartbroken Individual
Seeking a New Start



Highly Focused Remote Worker
Looking for uninterrupted flow



Introvert
Seeking solitude



Older Local Resident
Adjusting to Solo Living and peace



Creative Freelancer
Needing Space and Inspiration



Social Butterfly
Looking for spontaneous moment of togetherness

Design Concept

Target group and their specific needs

Target Group	Privacy Needs	Socialization Needs	Responsibility for Shared Spaces	Ideal Living Type	Ideal Zone
Independent Professional (Expats, young professionals)	●●●●●	Casual encounters only	●●●●●	SOLO	● Linear
Casual Socializer (Freelancers, PhD students)	●●●●●	One-on-one or small group interaction	●●●●●	DUAL	● Linear
Flexible Extrovert (Creative professionals, entrepreneurs)	●●●●●	Wants social flexibility	●●●●●	DUAL	● Communal
Co-Living Residence (Social but elective individuals)	●●●●●	Strong bond with flatmates only	●●●●●	Co-Living	● Linear
Social Butterfly (Students, first-time expats)	●●●●●	Wants to engage with both flatmates & neighbors	●●●●●	Co-Living	● Communal

Design Concept

Zoning and unit type

(● = More private, ● = More social)

● SOLO — DUAL — CO-LIVING ●

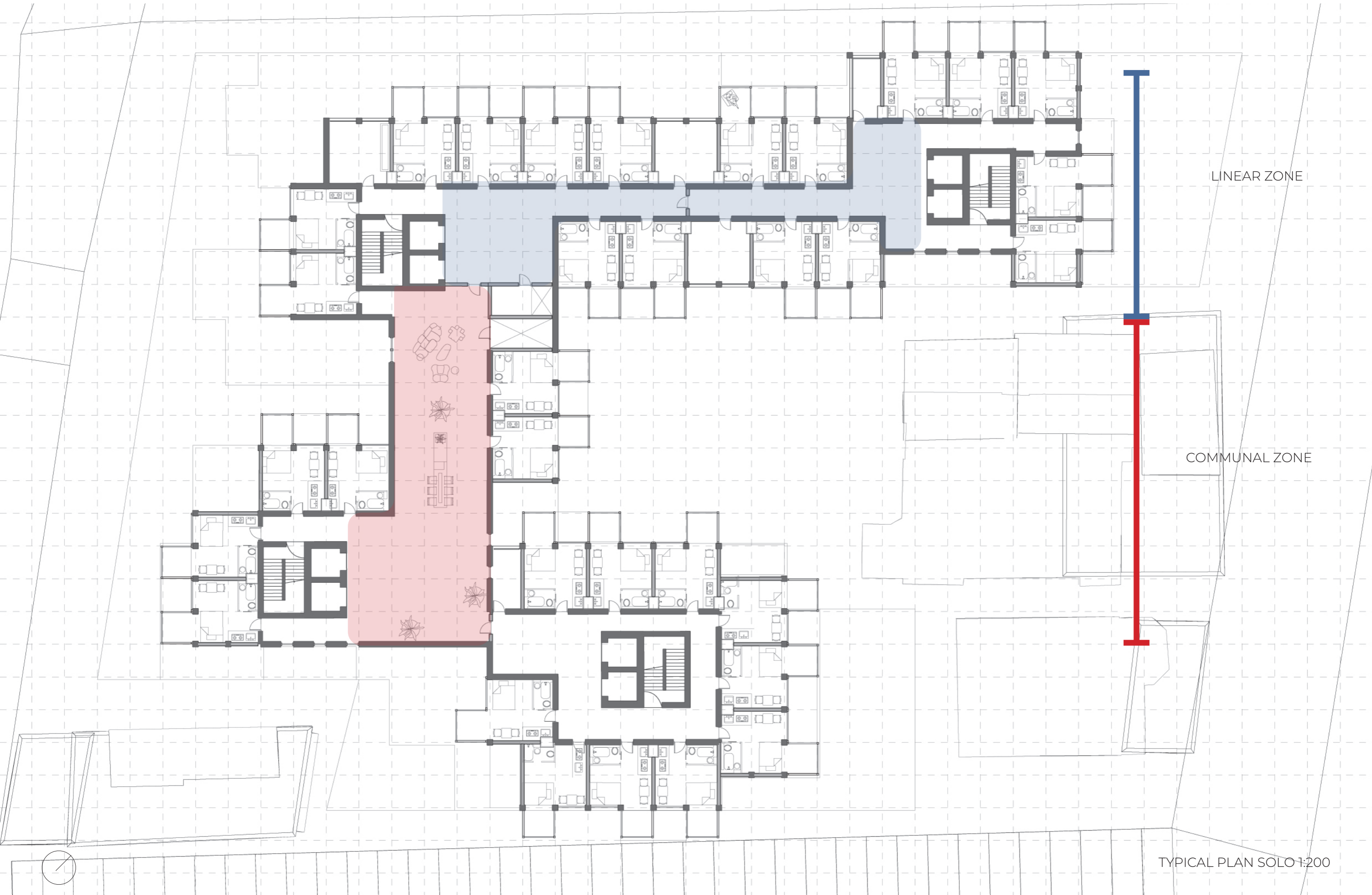
- SOLO → **Maximum privacy**, only casual encounters in hallways.
- DUAL → Private unit with **Optional interaction via the shared balcony.**
- CO-LIVING → Shared common spaces inside the flat, fostering strong **Flatmate bonds**.

Zone Type	Key Features	Best For
Linear Zone	Narrow corridor only for circulation	Selective interactions (Completely private /just with flatmates)
Communal Zone	Wide corridors as social lounges	Spontaneous socializing with neighbors / flatmates

Responsibility vs. Socialization Grid

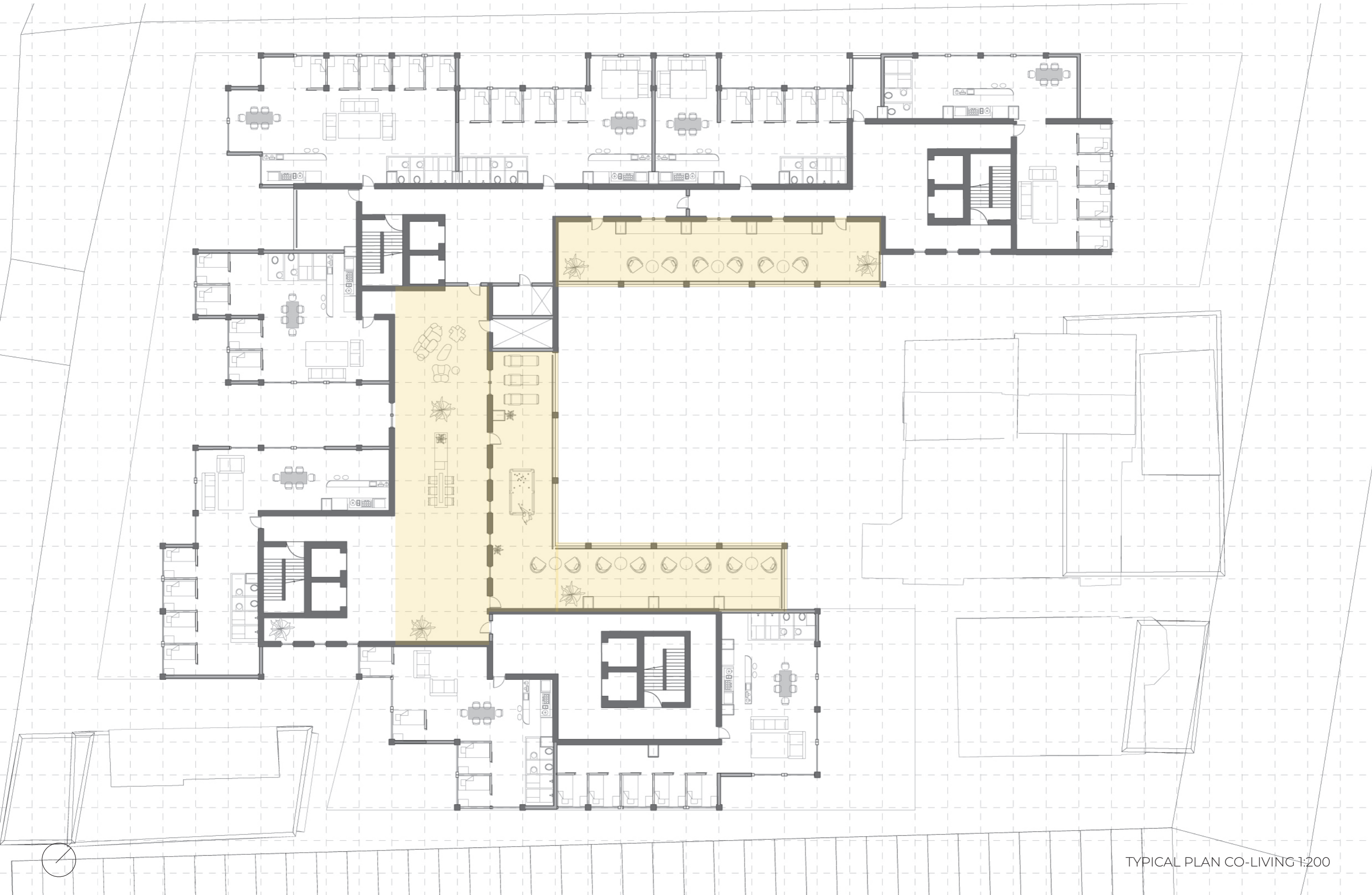
- No shared responsibilities → **SOLO** or **DUAL**
- People who only want to bond with their flatmates → prefer **CO-LIVING (Linear Zone)**.
- Open community → prefer **CO-LIVING (Communal Zone)** with wide, shared corridors.

	Low Socialization	Medium Socialization	High Socialization
No Shared Responsibility	● SOLO (Linear Zone)	● DUAL (Linear Zone) ● SOLO (Communal Zone)	● DUAL (Communal Zone)
Shared Responsibility (Flatmates Only)	—	● Co-Living (Linear Zone)	—
Shared Responsibility (Flat + Neighbors)	—	—	● Co-Living (Communal Zone, Fully Open Corridor)







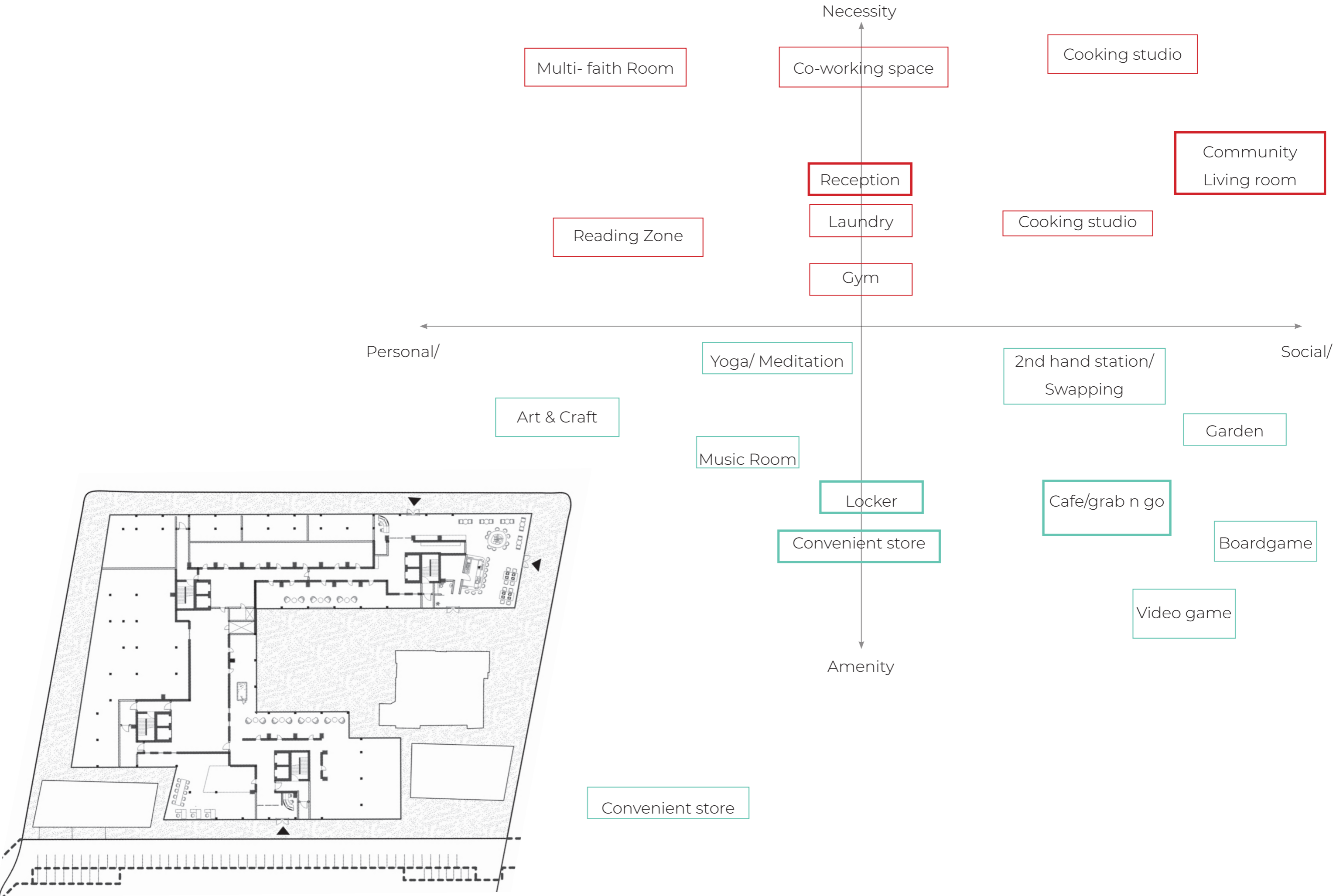


Design Concept

Street-like concept and shared economy programs

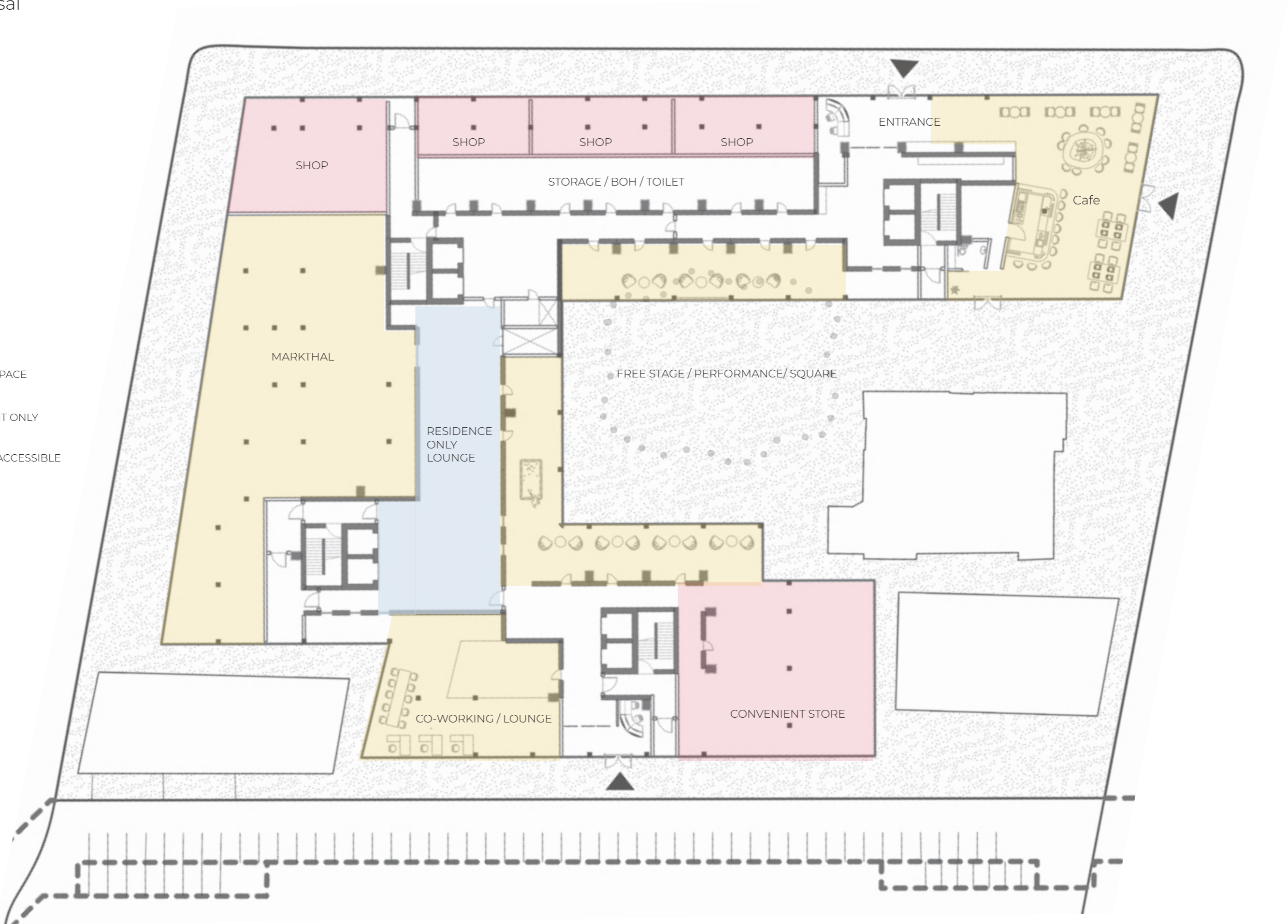
Program	Significance	Benefited user
Second-hand Market / Swapping Station	<ul style="list-style-type: none"> - Lack of storage. - Promote sustainability. 	<ul style="list-style-type: none"> ♦ Budget-conscious residents ♦ Eco-conscious individuals
Shared Baking & Cooking Space	<ul style="list-style-type: none"> - Lack of kitchen appliances. - Promote social cooking. 	<ul style="list-style-type: none"> ♦ Hobby bakers ♦ Those with limited kitchen space
Library & Book Exchange	<ul style="list-style-type: none"> - Lack of storage for books. - Promote reading culture. 	<ul style="list-style-type: none"> ♦ Readers ♦ Students
Repair Workshop & Tool Lending	<ul style="list-style-type: none"> - Lack of repair tools. - Promote DIY culture. 	<ul style="list-style-type: none"> ♦ DIY enthusiasts ♦ Cost-savvy residents
Giveaway & Upcycling Station	<ul style="list-style-type: none"> - Reduce waste. - Promote sustainability. 	<ul style="list-style-type: none"> ♦ Minimalists ♦ Eco-conscious individuals
Co-working & Study Area	<ul style="list-style-type: none"> - Lack of workspace. - Promote productivity. 	<ul style="list-style-type: none"> ♦ Freelancers ♦ Students ♦ Remote workers
Social Lounge & Community Café	<ul style="list-style-type: none"> - Lack of common areas. - Promote social interaction. 	<ul style="list-style-type: none"> ♦ Social residents ♦ Work-from-home individuals
Hobby & Art Studio	<ul style="list-style-type: none"> - Lack of personal workspace. - Promote creativity. 	<ul style="list-style-type: none"> ♦ Artists ♦ Craft lovers
Fitness Corner / Yoga Space	<ul style="list-style-type: none"> - Lack of gym space. - Promote well-being. 	<ul style="list-style-type: none"> ♦ Fitness enthusiasts ♦ Wellness-focused residents
Urban Farming / Hydroponics Garden	<ul style="list-style-type: none"> - Lack of greenery. - Promote sustainability. 	<ul style="list-style-type: none"> ♦ Plant lovers ♦ Sustainability advocates

Many essential amenities (e.g., baking tools, workshops, libraries) are impractical for solo residents to own or maintain individually....



Design Proposal

- RETAIL SPACE
- RESIDENT ONLY
- PUBLIC ACCESSIBLE



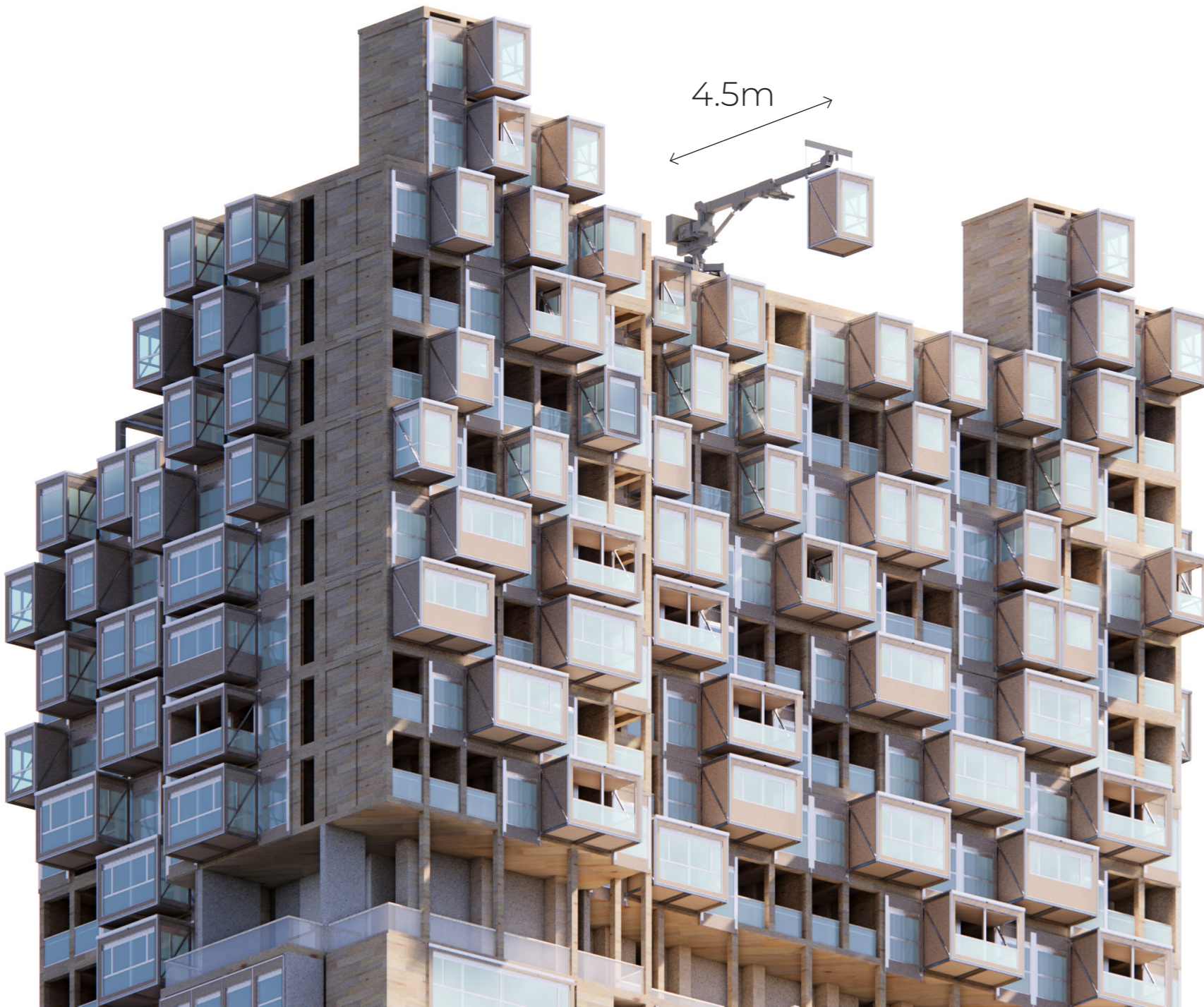
Design Proposal

BMU System

- Compact BMU body (~2.5m x 2.5m) stored on flat roof zones between rooftop modules
- Roof-mounted rail system

Storage shed for
spare modules

4.5m



Percentage of one-person households, 1960 to 2018

Number of one-person households as a share of the total number of households. Estimates combine multiple sources, including cross-country surveys and census data.

