

TAIPEI APARTMENT

by
Andy Chien-Che Hsu

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National Chao Tung University, 2008

Submitted to the Department of Architecture
in Partial Fulfillment of the Requirements for the Degree of

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Signature of Author:

Department of Architecture
January 17, 2013

Certified by:

Andrew Scott
Associate Professor of Architecture

Accepted by:

Takehiko Nagakura
Associate Professor of Design and Computation
Chair of Department Committee on Graduate Students

THESIS COMMITTEE

Thesis Advisor:

Andrew Scott

Associate Professor of Architecture
Director of the Master of Architecture Program

Thesis Readers:

Christoph Reinhart

Associate Professor in Building Technology

Tunney Lee

Professor Emeritus in Urban Studies + Planning

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ABSTRACT

To accommodate the rapid modernization and urbanization between 1960s and 1980s, a large number of mid-rise apartments has been built in Taipei. Today, these poorly designed apartments represent about 40 percent of the total residential buildings in the city, as much as 3,000,000 housing units. It has become a city-scale social issue, since these apartments no longer fit the needs of aging and wealthier inhabitants.

People have been finding ways to modify and improve their living space. However, generally, these building improvements are limited to a relatively small scale due to the influence of the floating real estate market and the high owner-occupied rate in the city. With limited legislation for apartment maintenance, it is difficult for the existing communities to reach a consensus that achieves the building improvements on a larger scale, such as creating more space for public amenities.

Today, the local government is promoting a series of city renewal policies to rebuild these aging apartments. In this situation, architects have a chance to create a new housing system with well-established regulations. The new system will help to well distribute the levels of control and provide greater adaptability to fit the living culture in Taipei City.

Thesis Supervisor: Andrew Scott
Title: Associate Professor of Architecture

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To my family and classmates, for your support through my architectural education

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INTRODUCTION

Today, city renewal has become one of the most controversial issues in the city of Taipei. Most of the people who live in the city expect to move into new residential units from the aging apartments built between the 1960s and 1980s. However, with more than 80 percent owner-occupied rate, the old apartment buildings could be replaced only if all the current residents reach an agreement to start the renewal project. Conflicts happen when residents have different opinions, and, even worse, have different real estate interest.

Unfortunately, to encourage the city renewal being successfully executed, the city government proposed a series of city renewal policies, which empower developers to dominate the overall renewal process. For example, one of the policies is rewarding additional Floor Area Ratio (FAR) if the new residential building reaches the new city planning safe code, provides a certain amount of public amenities space, or improves neighborhood externalities. To reach these goals, acquire more FAR and sell in housing market, developers generally come up with mass collective high-rise apartments with greater public amenities, better daylight and natural ventilation. Even so, these new apartment buildings do not fit with the current living culture, neglect the building adaptability for unit reconfiguration and sacrifice resident participation during the design process. These new high-rise apartment buildings remain a tool for real estate investments and, at the same time, a conservative living container.

In the past few years, after a series of struggles between the developers and groups of disadvantaged minorities, people started wondering if there is an alternative way to promote the city renewal in Taipei. A more sophisticated and democratic policy would create a win-win game between the government, developers, and existing residents.



THE EXISTING CITY RENEWAL GAME

From top to bottom :

STEP 1: Developer convinces occupants in the existing mid-rise apartments to participate in the city renewal.

STEP 2: Tear down the whole block and start the construction when more than 80% of the occupants agree on it.

STEP 3: Replace it with high-rise apartment and sell the extra units to balance the construction cost.

The challenge of the thesis was to design a new housing system to carry out the game of city renewal in Taipei. The new housing system, described in this paper, follows the city renewal policies by including a certain amount of public amenities, provides a greater adaptability for the future residents and can be easily applied on various building sites in the city. Furthermore, by redefining the levels of control in this new housing system, the new design of the apartment building will contain the appropriate regulations for the long-term apartment maintenance.

1 CITY RENEWAL IN TAIPEI



AN IDEAL HOUSING SAMPLE

Constructed by Continental Engineering Group and promoted by the national government in 1960s. Generally, each apartment include eight units. Symmetrical four units located at each side with a stair access located at the center. The apartments were built against each other with a 10 meters wide street at the front side and a 3 meters wide alley at the back side.

THE MID-RISE APARTMENTS AND RAPID DEVELOPMENT

To match up the rapid modernization and urbanization in the second half of twentieth century, huge amounts of mid-rise apartments have been built in the city of Taipei between 1960 and 1980. The building technique was supported and introduced by the Foreign Aid during the time of the Korean War and the Vietnam War.¹

This mid-rise flat slab housing typology was designed to reach the goals of rapid duplication and low construction cost. Therefore, its features include:

- Centralized modern housing utilities
- Minimized public access and amenities
- Fewer than five floors to avoid the cost of building basements and elevators
- Reinforced Concrete (RC) Constructed structures and finishing
- Repeated single floor plan; generally the 1,000 square feet 3 bedrooms suite
- High building coverage rate; generally reached 80-90%
- High floor area rate; generally above FAR 3.5

Today, these mid-rise apartment buildings represent around 40 percent of the total residential buildings in Taipei City. It includes a total amount of 327,304 buildings, as much as 3,000,000 housing units. Within such large numbers of residential units and the existing inhabitants, when these aging apartments no longer meet current living style and requirements, it has become an non-negligible city-scale social issue.

1 Ministry of Culture, Taiwan. Encyclopedia of Taiwan: U.S. Aid



THE RAPID URBANIZATION BETWEEN 1950 AND 1980

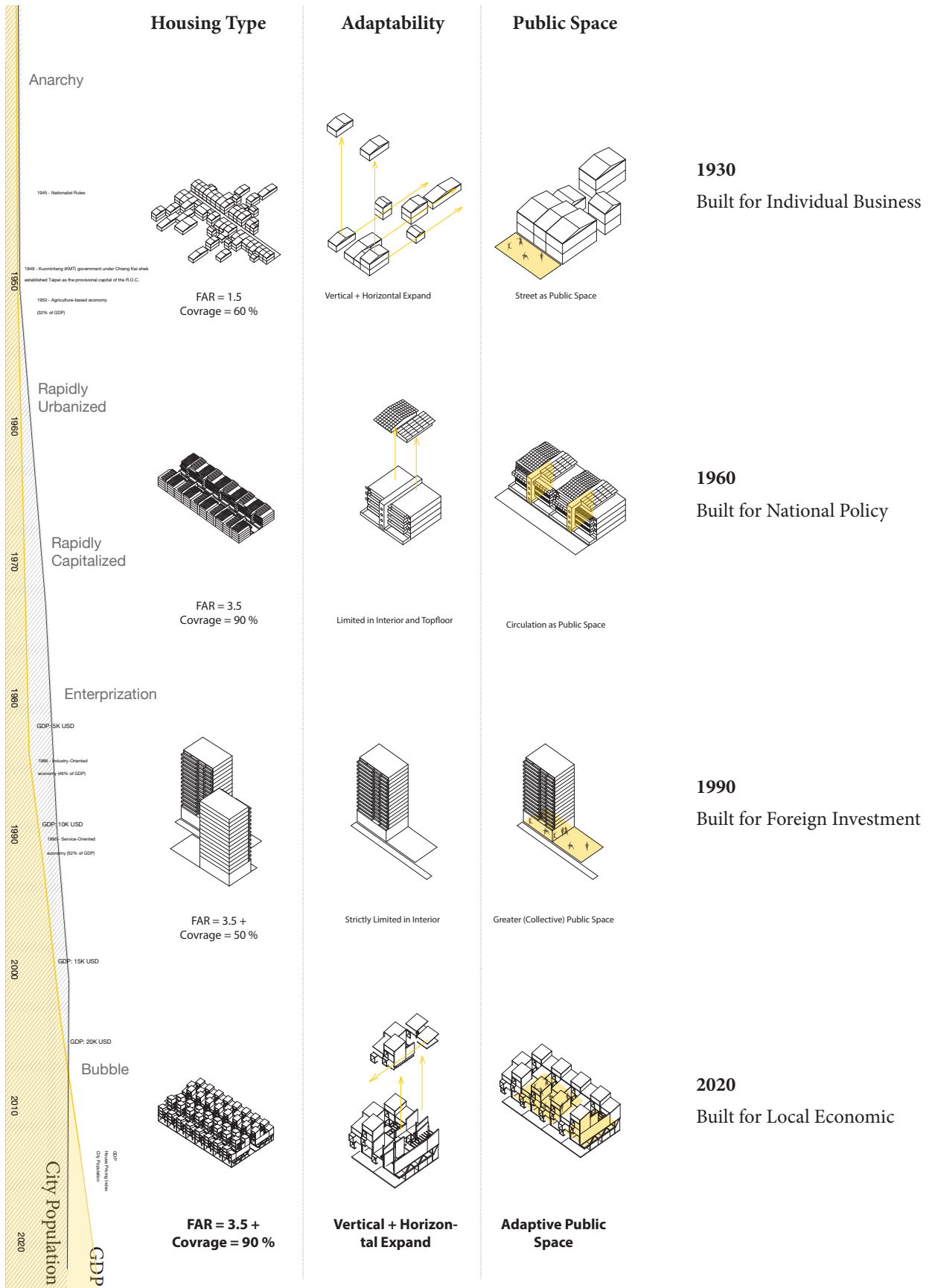
The city population increased 2 millions (248% of the original population) in 30 years, while its territory expanded more than 40 square kilometers.



Urban Fabric and Landscape before the Rapid Urbanization, 1950



Urban Fabric and Landscape after the Rapid Urbanization, 1980



Housing Type

Adaptability

Public Space

Anarchy

FAR = 1.5
Coverage = 60 %

Vertical + Horizontal Expand

Street as Public Space

1930
Built for Individual Business

Rapidly Urbanized

FAR = 3.5
Coverage = 90 %

Limited in Interior and Topfloor

Circulation as Public Space

1960
Built for National Policy

Rapidly Capitalized

Enterprization

FAR = 3.5 +
Coverage = 50 %

Strictly Limited in Interior

Greater (Collective) Public Space

1990
Built for Foreign Investment

Bubble

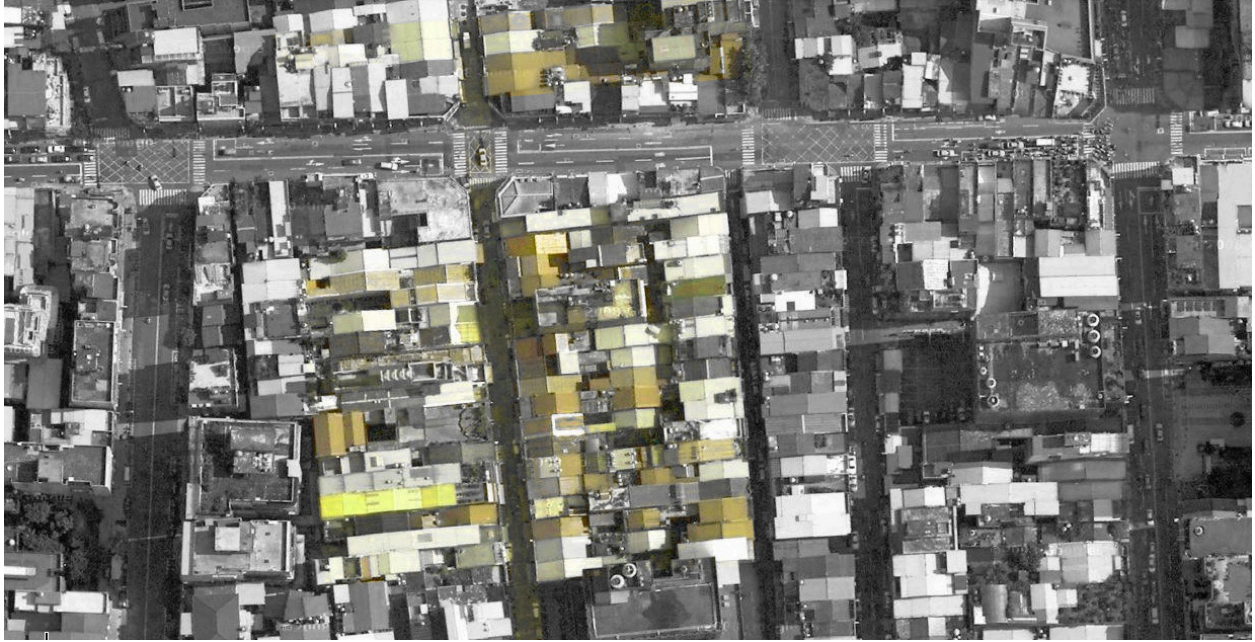
FAR = 3.5 +
Coverage = 90 %

Vertical + Horizontal Expand

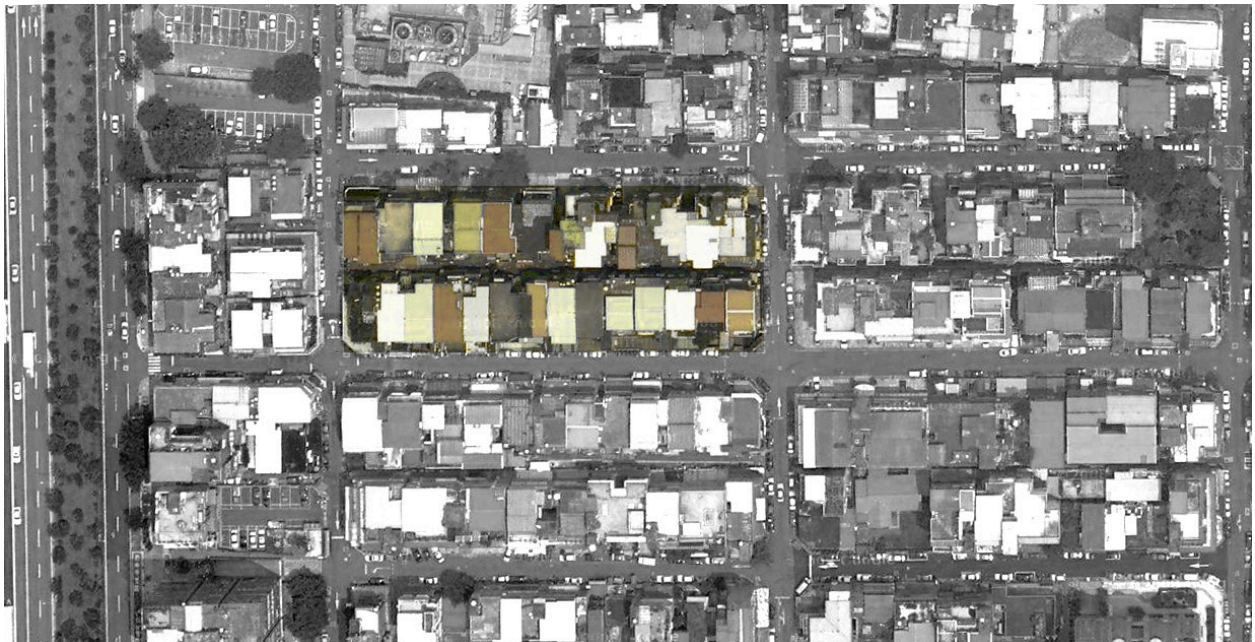
Adaptive Public Space

2020
Built for Local Economic

City Population
GDP



Built for Individual Business, 1930



Built for National Policy, 1960

THE CHANGE OF HOUSING TYPOLOGY BETWEEN 1930 AND 2010

The way local people build their housing have changed dramatically since the mid-twentieth century. The diagram on the left side shows how housing typology has been transformed within different purposes behind. There is no doubt that the economic and demographic changes in the city will keep leading it to a new foreseeable housing typology in the near future.



Illegal Construction



Poor Amenities



Limited Daylight

THE CURRENT HOUSING CONDITION

Nearly 40 years after the mid-rise apartment buildings were introduced into the city, these aging residential buildings have led to lots of social issues. For example, inhabitants have kept modifying their units illegally based on the original rigid design. Besides, apartments without elevators and sufficient public amenities are no longer welcomed by the aging and wealthier population. Moreover, the high building coverage rate and the high FAR limit the daylight and natural ventilation, which results high energy consumption and running cost for the building maintenance.

“When property market is on the up people treat homes as investments, making changes for imaginary next owners. When all houses are investments, no one will waste money on improvements, as the neighborhood determines value. No one is allowed to be less nice (by homeowners’ associations) so nothing changes.”¹

- Stewart Brand

Interestingly enough, in the owners-occupied scenario, property owners also see these aging apartment units in the downtown of Taipei City as real estate investments while live in it. They have the overall authority to improve their own property, but a floating property market always interrupts the consensus of apartment communities to make an agreement on it. It limits the building improvement on a relatively smaller scale, such as interior space plan reconfiguration, individual facade renovation, balcony modification, etc. Today, wealthier residents willing to spend considerable amounts of money for upgrading their living surrounding. However, all these building improvements are done in very inefficient ways unless a developer joins the project and dominates the overall renewal process.

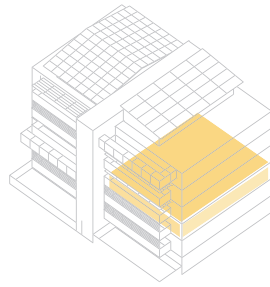
1 Steward Brand, *How Building Learn*, 1995



THE CURRENT SMALL-SCALE BUILDING IMPROVEMENTS

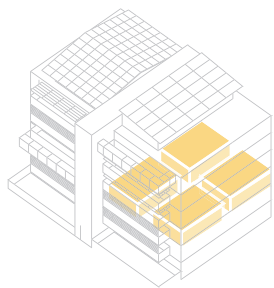
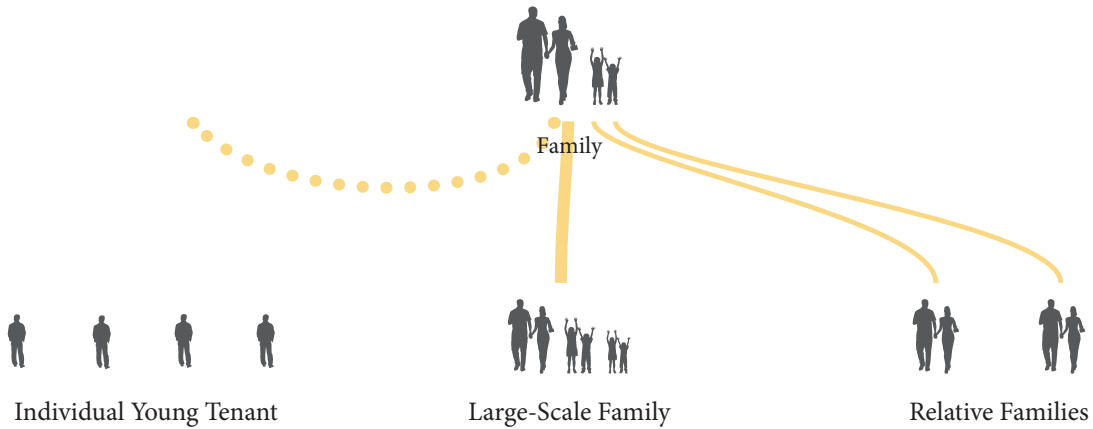
Above: The ground level has been modified for commercial activities, while the upper levels been modified for security and environmental reasons.

Right: The diagram shows how the interior space has been modified because of the demographic changes.



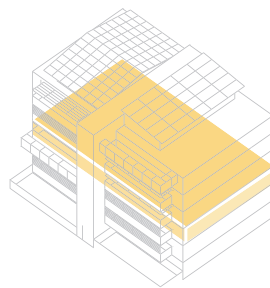
A FAMILY UNIT

A typical 2-beds apartment unit owned by a two generations family.



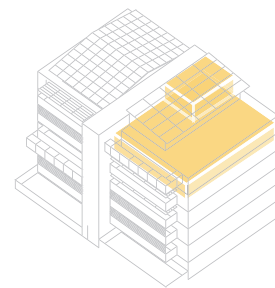
COMPARTMENT

While the family move out and young people move into the city. A typical 2-beds apartment unit may be divided into 4-studios units for individual rentals.



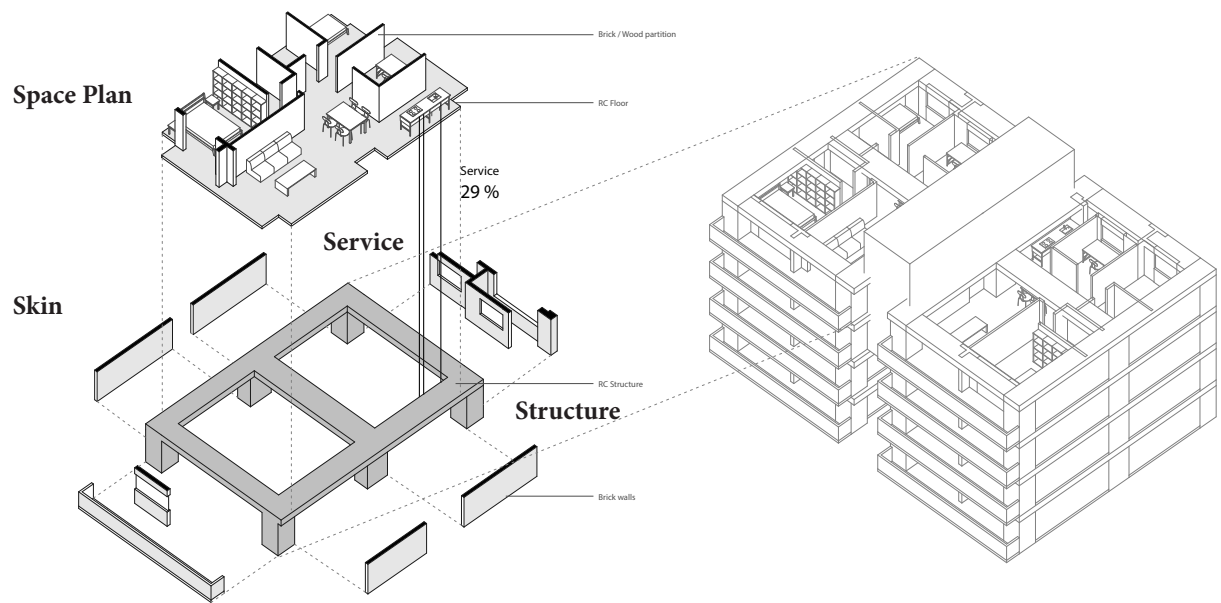
FAMILY EXPANSION

When the family members increase, the occupants may buy another unit next to it, and connect two typical 2-beds apartment unit to a 5-beds apartment unit.



INHERITANCE

When the parents intend to inherit their unit. Additional living space may be built on their property (rooftop) to equally share the inheritance.



SHEARING LAYERS IN CURRENT APARTMENT BUILDINGS

Today, most of the owners in aging apartment spend considerable amounts of money on building improvements. In average, every housing unit has been renovated in every 10 years. It usually costs from 5,000 USD to 100,000 USD, depends on the levels of renovations, which include space plan reconfigurations, service upgrades, skin/facade modifications, and partially structure changes.

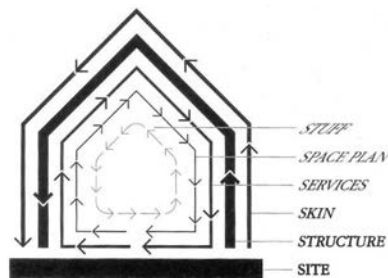
SHEARING LAYERS OF CHANGE

In the book of *How Buildings Learn: What Happens After They're Built*, the author, Stewart Brand proposes that each building can be separated to various shearing layers depends on their individual life cycle. The layers include:¹

- Site: Geographical setting, eternal.
- Structure: Foundation and load bearing elements, 30-300 years.
- Skin: 20ish years.
- Services: 7-15 years
- Space Plan: Interior layout, from three (commercial) to 30 (domestic) years.
- Stuff: Furniture and belongings.

Generally, in one apartment, different layers are controlled by different people. For instance, the tenant only owns the authority to replace his/her own stuff or modifies the space plan, while the landlord has right to change the building service, skin and even structure. It creates a clear regulation for building maintenance.

In contrast, most of the apartment units in Taipei are owners-occupied. The owners have the overall authority to modify a housing unit from the stuff layer to the structure layer. Therefore, it is lack of a ideal regulation for building maintenance and results in a disordered living surrounding. However, even under different building managing systems, the apartment buildings still follows the rule of the shearing layers proposed by Stewart Brand.

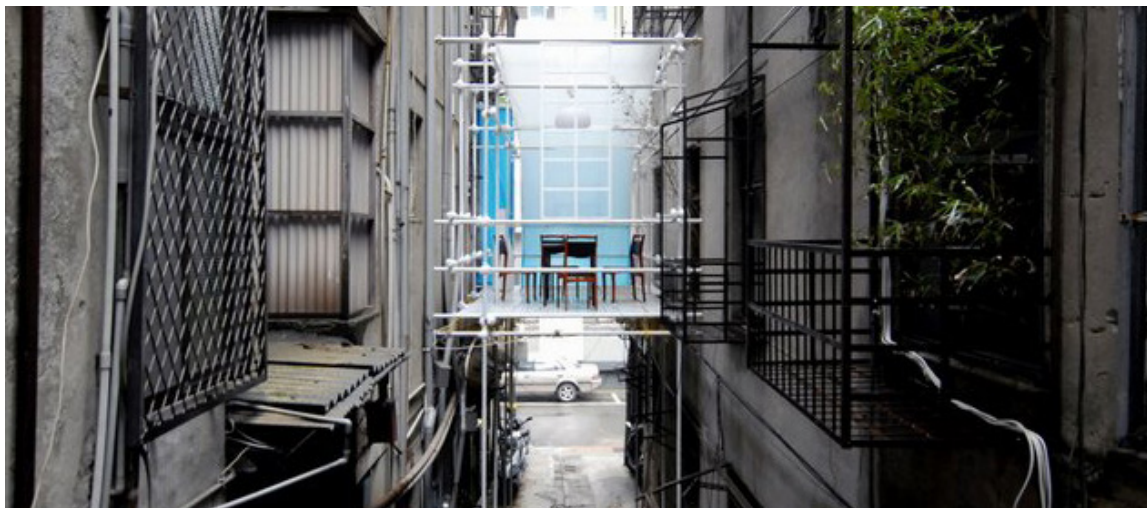


Various Shearing Layers of Change

1 Stewart Brand, *How Buildings Learn*, 1995



Both Square and Circle (Yi Fang Yi Yuan) by Wang, Shu in 2011



The Peach Blossom Spring in Backlanes (Hou Siang Tao Hua Yuan) by Hsieh, Ying Chun in 2011

THE CULTURE OF ILLEGAL ARCHITECTURE

More and more local architects and socialist have been studying the phenomenon of the illegal architecture in Taipei since the late-twentieth century. In 2011, an exhibition hold by local foundation, JUT Foundation for arts & architecture, invited the Chinese architect, Wang Shu, and the local architect, Hsieh Ying-Chun, to participate in the discussion about this regional living culture.

“The illegal architecture came from the conflict between the Western and Eastern cultures. Rather than between the legal and illegal, it is the dialog between two different civilizations.”¹

- Wang Shu

Both architects set up small scale experimental constructions to reflect the fact of illegal architectural culture. Their works encourage people in this city to explore new possibilities for future dwelling environment. Also, to resist and modify the current system of industrialized modern architecture by operating on an indie and small-scale way; Innovate within a bottom-up approach while respect the traditional skills and local cultures.

“The illegal architecture happens because the lacking of hegemonic authority in this city. The illegal architecture is a unprecedented building type of living architecture, full of new material usage and small innovations.”²

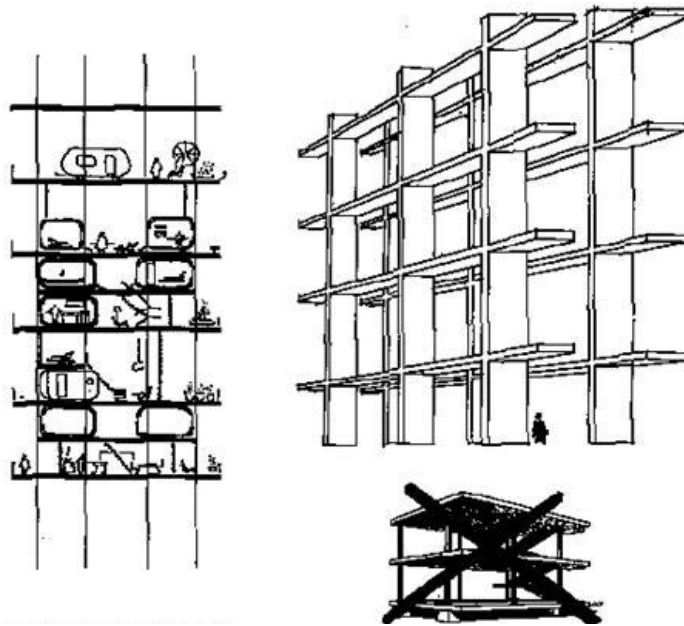
- Wang Shu

In other words, the aging apartment buildings in the city has unexpectedly become ideal platforms for the inhabitants inventing their own living space based on the local custom and living style.

1 Wang Shu, *eRENLAI Magazine*, 2011

2 Wang Shu, *eRENLAI Magazine*, 2011

2 TOWARD A NEW HOUSING SYSTEM



Concept of the Support/Infill Approaches applied on the mass housing design by N. John Habraken

STRATEGY: SUPPORT / INFILL

The concept of building support/infill appeared in the early-twentieth century when the modernist architects discriminated the building frame and infill with new construction materials. Since 1960s, the Dutch architect, N. John Habraken, has developed a series of study of how the support/infill approach have been applied on mass housing design.

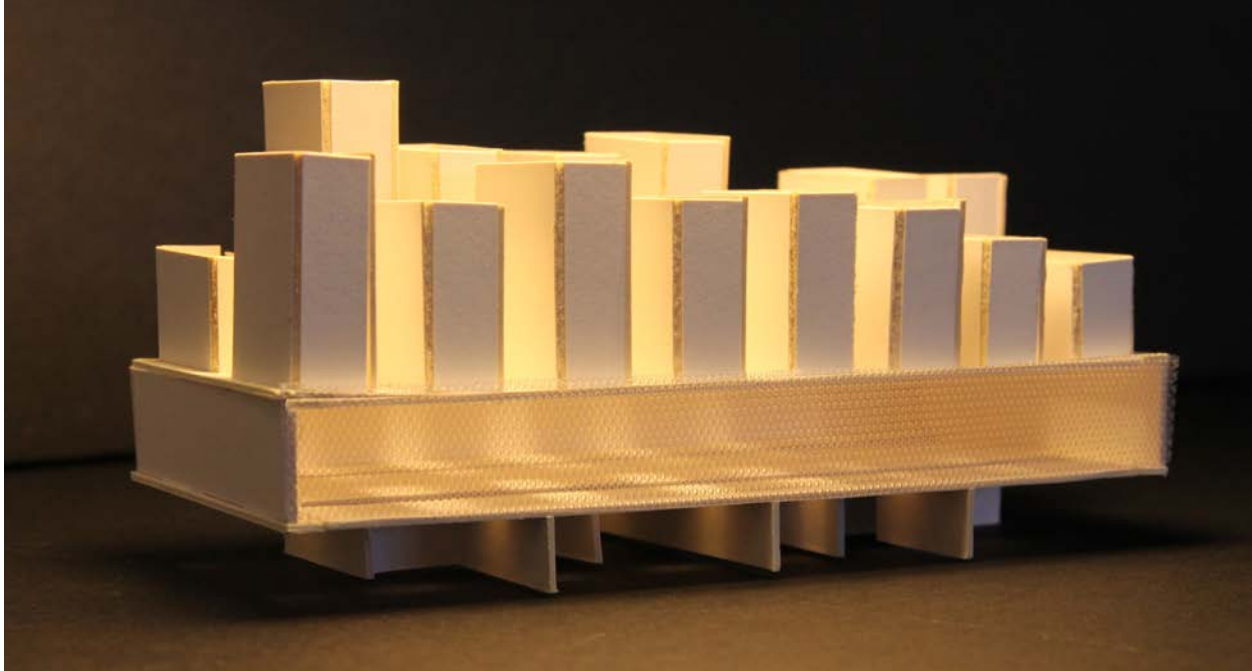
“It can be argued that what we call a ‘building’ includes the infill as much as the load bearing structure, facades and roof. Therefore a new term must be coined for what is left when the infill is taken out. This is called ‘support’. In this way we can say that a building is comprised of two levels: the support level and the infill level.”¹

- N. John Habraken

In his book, *Supports: An Alternative to Mass Housing*, N. John Habraken also argued that by using the support/infill approach, architects can be able to focus on the support level of an architectural project and remain the infill level to the users. In this way, architects can easily reproduce the products on the support level, especially when work on a mass housing project, under professional responsibility.

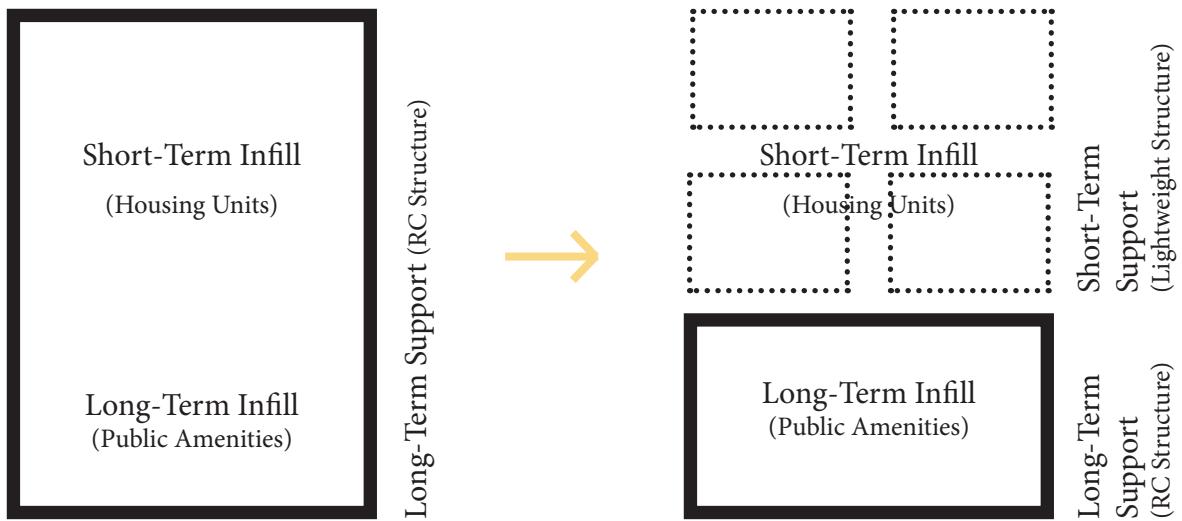
Toward a new housing system in Taipei, the game between residents, developers, and governments is pushing N. John Habraken’s support/infill approach to the next step. In the Taipei scenario, architects can not only consider the load bearing structure, facade and roof on the support level, but also the public amenities to its neighborhood, the property distributions between each unit and the potential connections with the next renewal project nearby.

1 N. John Habraken. *The Uses of Levels. Open House International Vol. 27, 2002*



THE CONCEPTUAL MODEL FOR NEW ADAPTABLE APARTMENT TYPE

A huge horizontal box at the lower part of the apartment building serves for public amenities, and, at the same time, as a foundation for the short-term infill (housing units) grow on top of it.



CONVENTIONAL APARTMENT

ADAPTABLE APARTMENT

THE CHANGE OF SUPPORT/INFILL SYSTEM

The conventional apartments usually built by an entire RC structure, which makes inhabitants difficultly to modify their living space and results in many maintenance problems. In contrast, the new support/infill system intends to apply different support types to different infill types.

STRATEGY: HORIZONTAL PUBLIC AND VERTICAL INDIVIDUAL

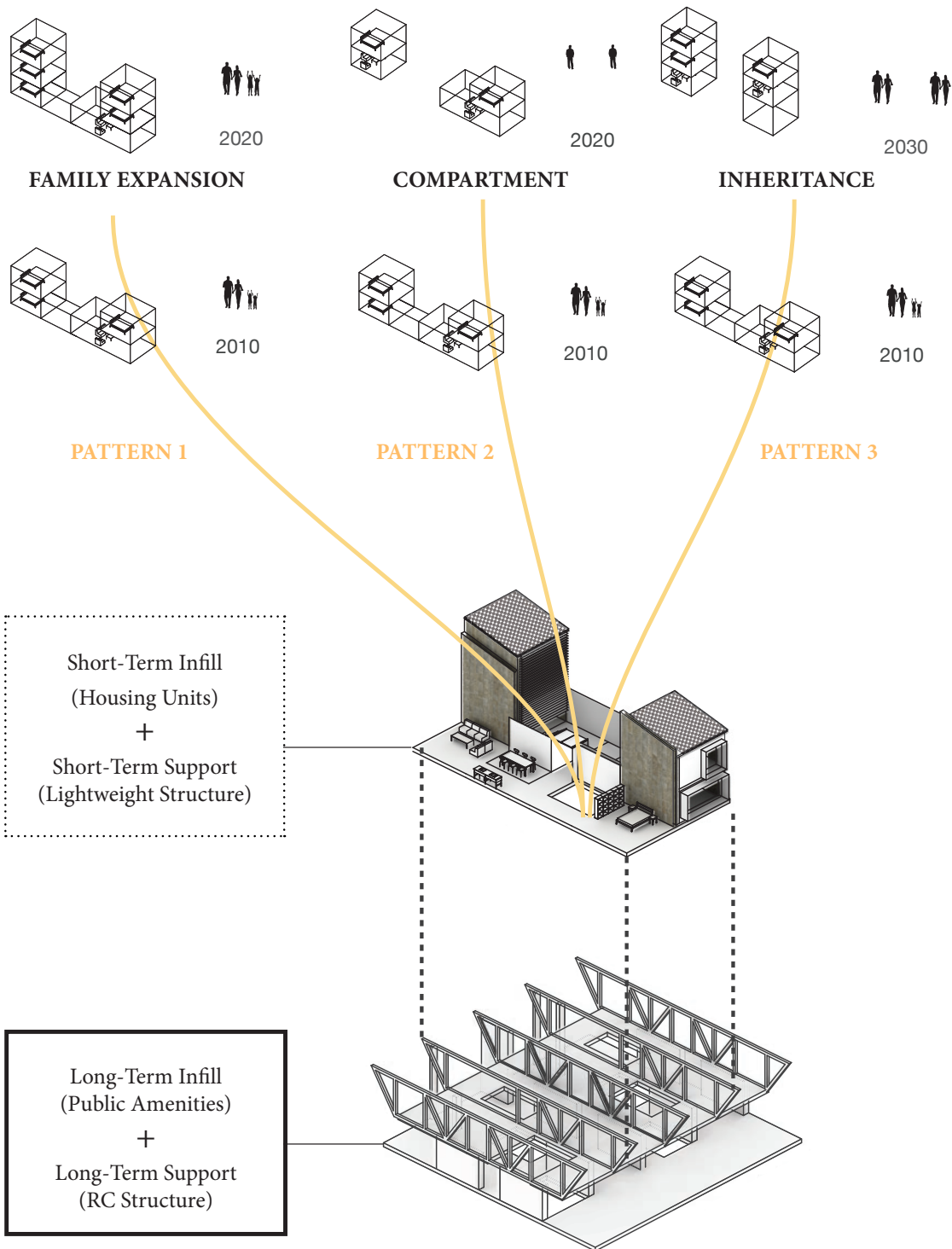
To applying the support/infill approach on the new housing system in Taipei, the support level should contents:

- 30% of public amenities space
- Commercial space at the ground level
- Public access
- Connection with adjacent renewal building
- Load bearing structure
- Building service
- Light well and micro climate controller
- Zoning for property distribution

While the infill includes:

- Unit space plan
- Potential enlargement space
- Personal stuff

To achieve it, the new support system is designed as a huge horizontal box, which represents the 30% of the overall FAR for public amenities. It also serves as a long-term foundation while the individual infill can grow on top of it. Beneath the box, the commercial space and public access occupied the ground level, as a connection with the community and its neighborhood. The horizontal box can be shared by individual residential units and expands when the adjacent apartment building join this new housing system in the future. Moreover, the expansive space can easily fit any sizable long-term public program like workout space, daycare center, performance center, etc.



THE TWO PARTS OF THE NEW HOUSING SYSTEM

STRATEGY: PATTERN LANGUAGE

The short-term infill above the long-term support intends to serve as a standardized platform for users to develop their own living space. Generally, the platform follows the traditional housing language of the shop-house, a housing types have been built in Southeastern Asian regions for more than 300 years.

“Group of people usually fail, because their assumption are different at every stage. But with a language, the assumptions are almost completely explicit from the start.”¹

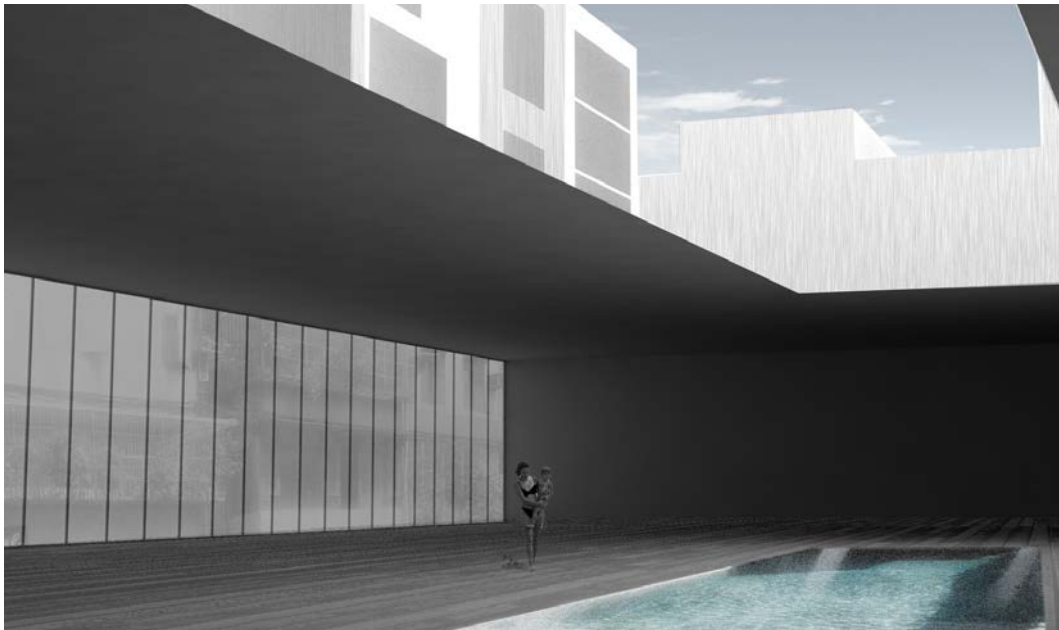
- Christopher Alexander

As a widely used pattern language, the urban facade of the aging apartments in Taipei is considered an ideal existing example that shows how current inhabitants have developed their own facade types based on the individual needs. The pattern of urban facade also helps to develop local business and local cultures like the customized window industry, the shading device industry, etc.

1 Christopher Alexander, A Pattern Language, 1977



The pattern language of urban facade, widely applied on the aging apartment buildings today.



Scale	Assembly	Program	Lifecycle	Population
City				3,000,000
District				300,000
Superblock (Neighborhood)		Urban Zoning		20,000
Block	Ground Floor Landscape	Shop / House / Park / Street		500
Building Amenity (Public)	Lightweight Structure	Shopfront / Entrance	20 years	50
Building Support (Semi-Private)	RC Structure	Circulation	40 years	50
Skin (Envelope)	Aluminum Frame / Glazing	Garden / Sun Space	15 years	2-6
Interior Layout / Service (Infill)	Partition	Room	10 years	2-6
Artifacts (Objects)		Activity	< 5 year	1-6

Top: The rendering shows how different programs own different architectural properties; Large rigid open space stands for the public amenities with small lightweight housing units above it.

Bottom: The chart shows the properties of each building component.

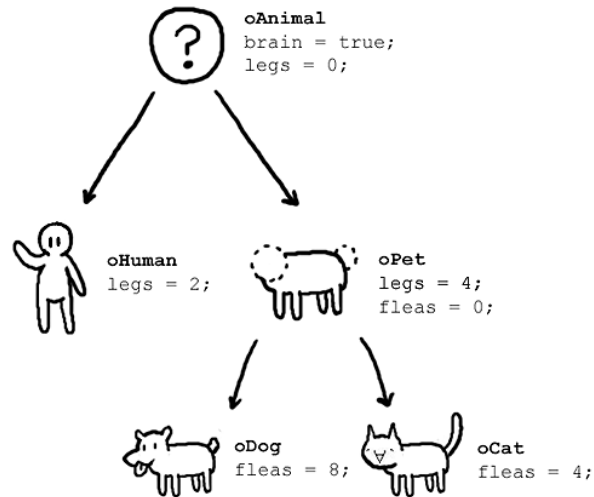
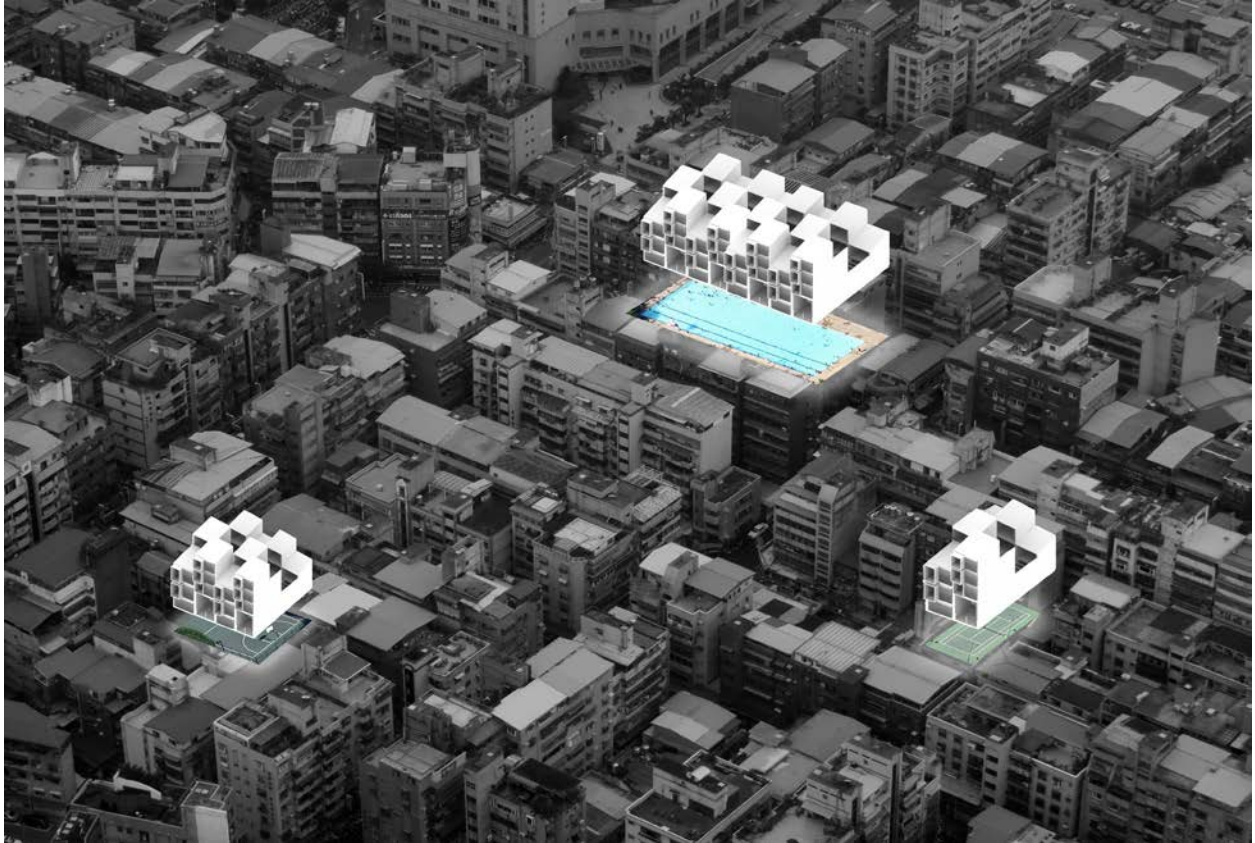


Diagram shows how Object-Oriented Design works in programming language.

STRATEGY: OBJECT-ORIENTED DESIGN

Following the idea of using the support/infill approach and the pattern language, the new housing system also attempts to define each assembly part with its own properties, such as different building scales, programs, life cycles, and user-populations. From the chart on the left page, it clearly shows the properties of each building component, and therefore, helps to set up the design pattern and language for the future development.



CREATING PUBLIC SPACE IN A HIGH COVERAGE AND HIGH FAR CITY

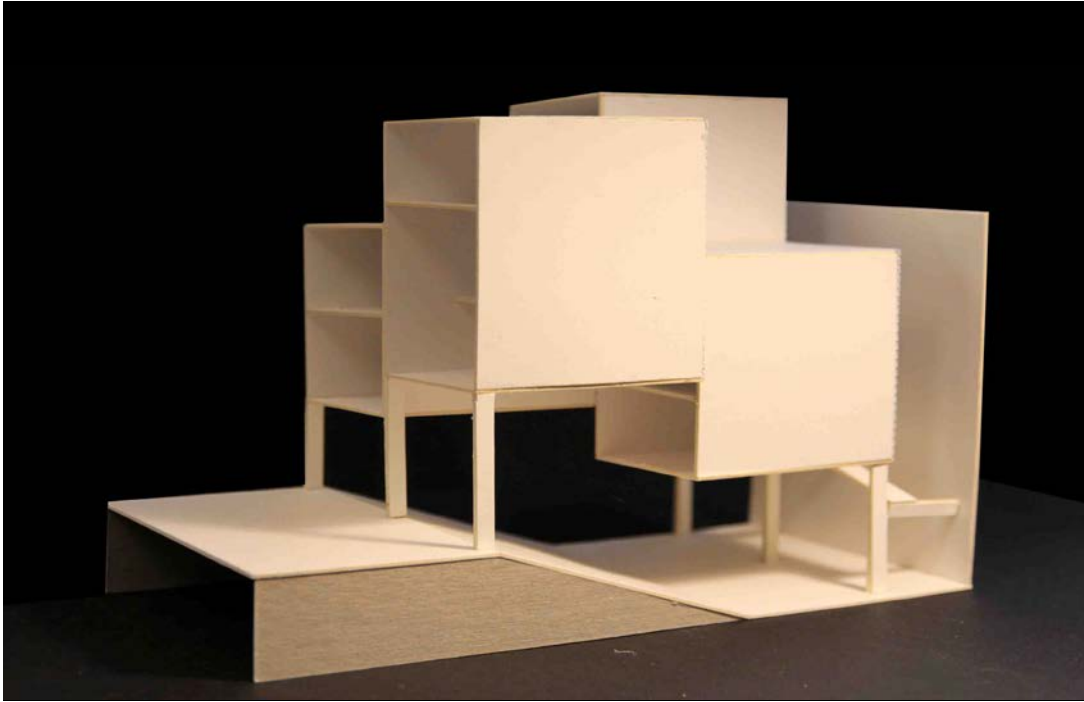
The crowded neighborhood with high coverage rate and high FAR needs various kinds and size of the public amenities. Therefore, the new housing system not only supports for the large-scale development with mass collective public amenities but also small-scale amenities in smaller developments.

STRATEGY: ADAPTABLE PUBLIC SPACE

Currently, Taipei is occupied by huge amounts of the high coverage rate and high FAR apartment buildings, which makes the city seriously lack of public and open space. To solve the problem, the local government has encouraged the new residential building to include up to 30% of the public amenities space and share with its neighborhood. However, this policy is hardly executed except for some mass collective housing renewal projects, when they have sufficient lands and budgets to support it.

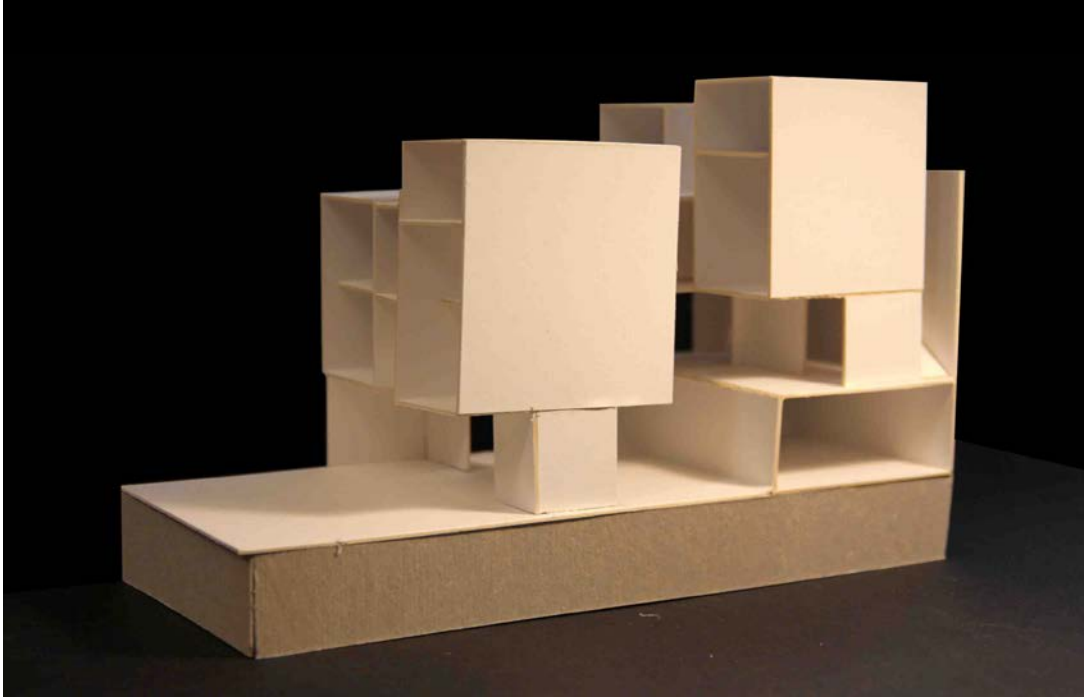
It has become one of the major reasons people choosing to move to a collective high-rise apartment that the new apartments always come with collective public amenities. For example, one new collective apartment in Taipei with more than 50 units normally includes a swimming pool, a workout room, community lounges and other small facilities. Therefore, today replacing the aging mid-rise apartment by mass collective apartment has become the only way to create public and open space in the city.

The new housing system intends to create an adaptable support for public amenities, which can fit to various building scales. In other words, if there is only a single apartment considers to be rebuilt, the adaptable support can still contain 30% of the overall FAR for a small-scale public amenity such as a community lounge. When the apartment expands or another housing renewal project be constructed beside it. The public space can be enlarged and serves for a larger-scale public program like a exercise room or a daycare center. It encourages the new housing buildings to include public amenities in various scale and increase the opportunities for small-scale individual city renewal project.



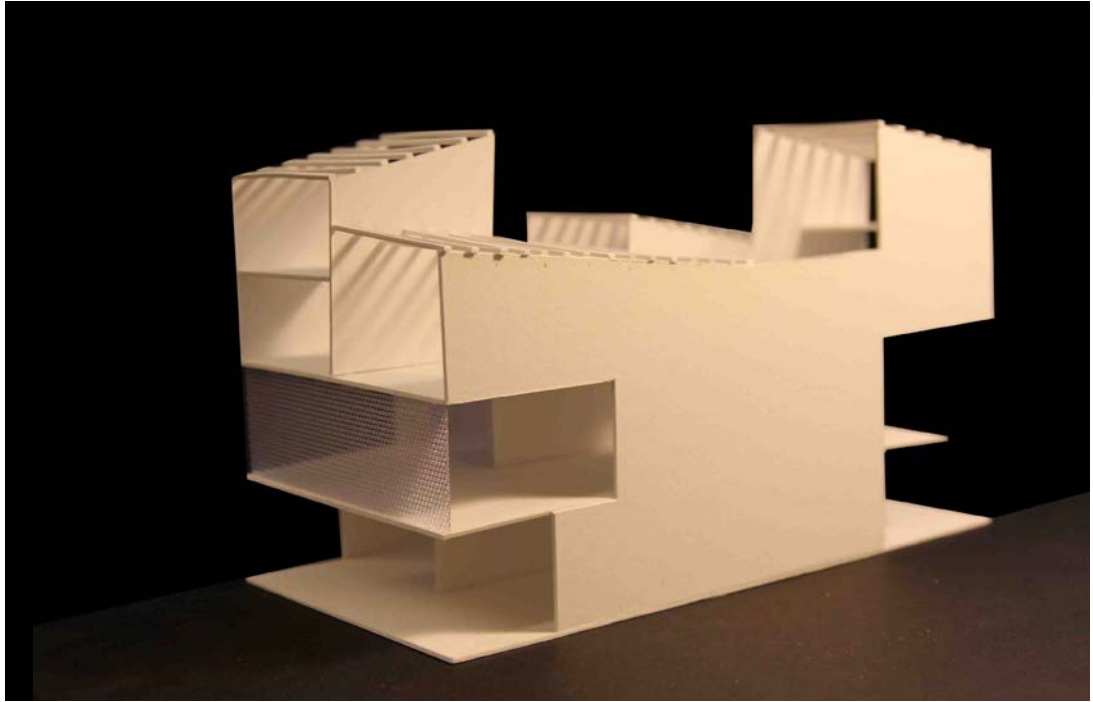
Experimental Section Model A:

To test the relationships between streets, public space, and individual housing units.



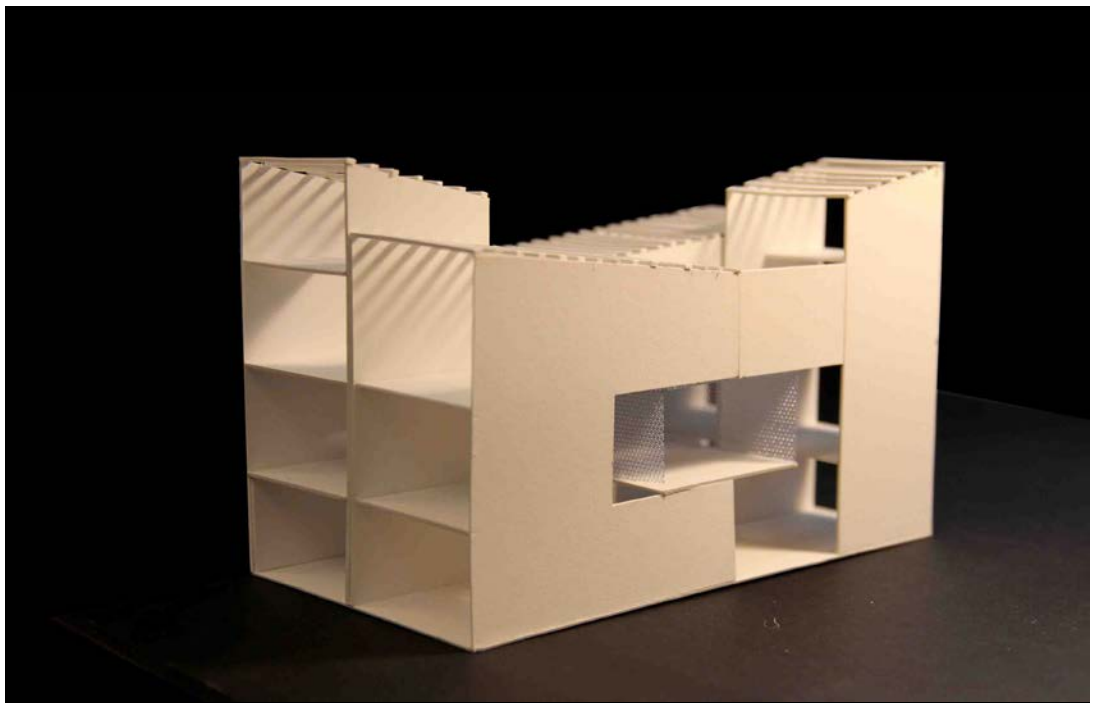
Experimental Section Model B:

To test the relationships between streets, public space, and individual housing units.



Experimental Section Model C:

To test the relationships between the shop fronts, public amenities and housing units.



Experimental Section Model D:

To test the relationships between the shop fronts, public amenities and housing units.



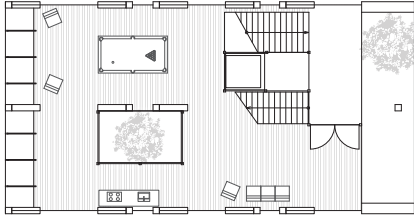
2014
Single-Row Apartment



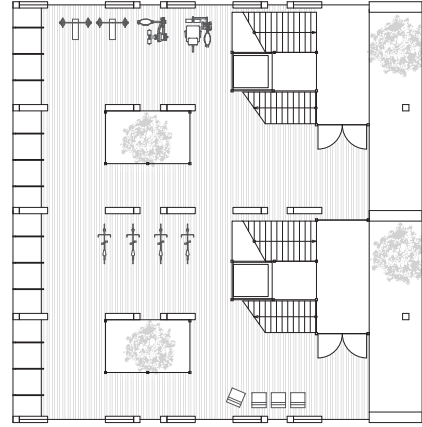
2016
Two-Rows Apartment



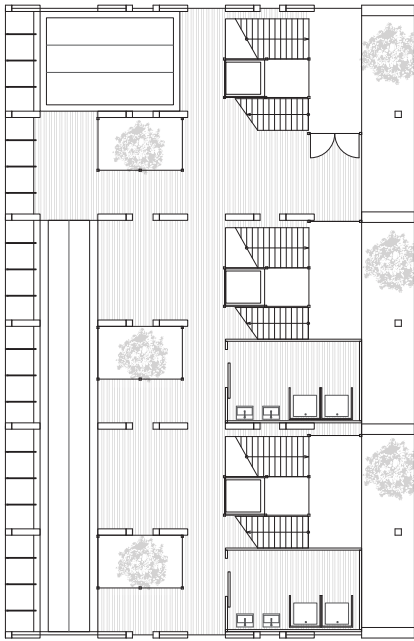
2020
Four-Rows Apartment



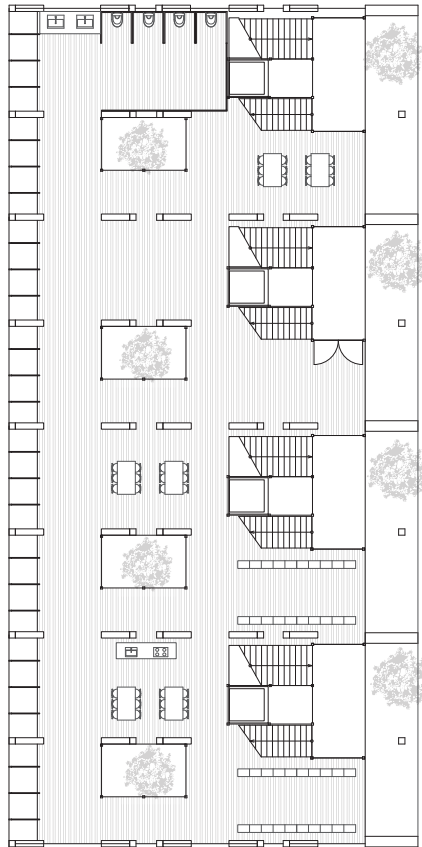
LOUNGE
2014
Single-Row Apartment



WORKOUT ROOM
2016
Two-Rows Apartment



SWIMMING POOL
2018
Three-Rows Apartment



DAYCARE CENTER
2020
Four-Rows Apartment

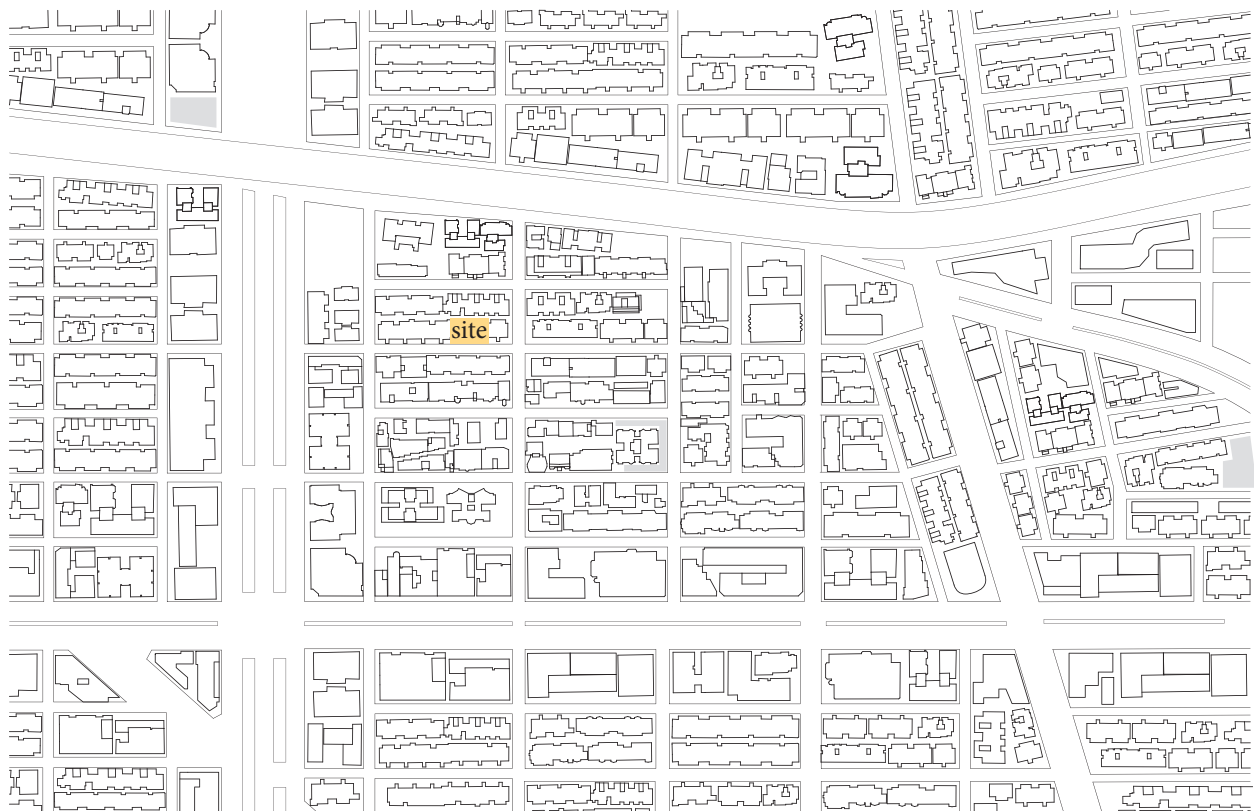
3 SITE PROPOSAL



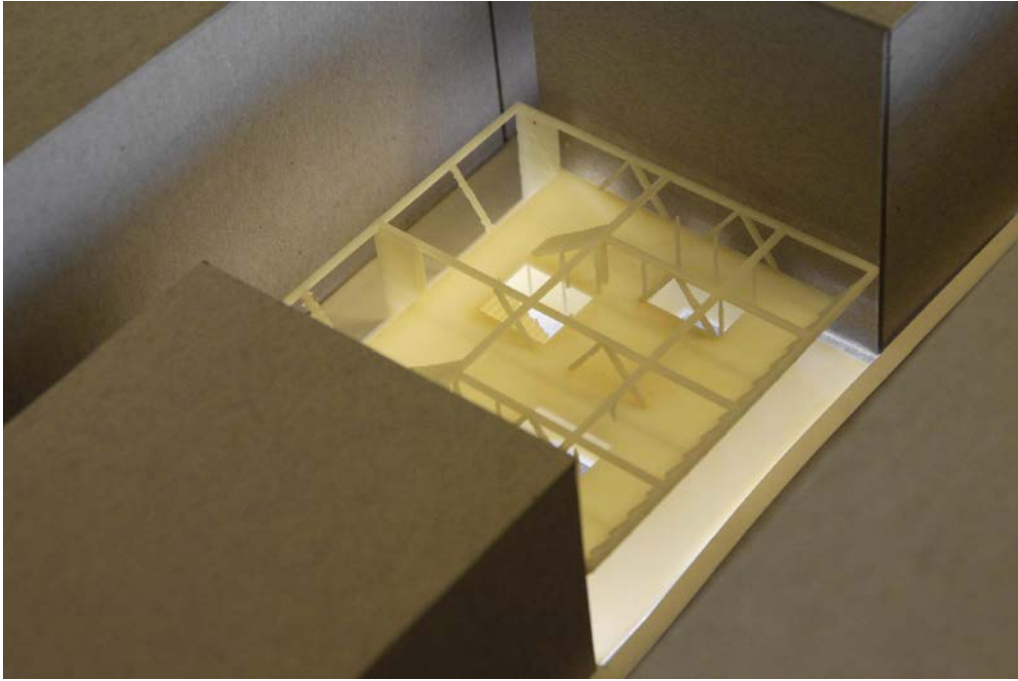
The aerial view of the selected site in Eastern District, Taipei City

THE SITE

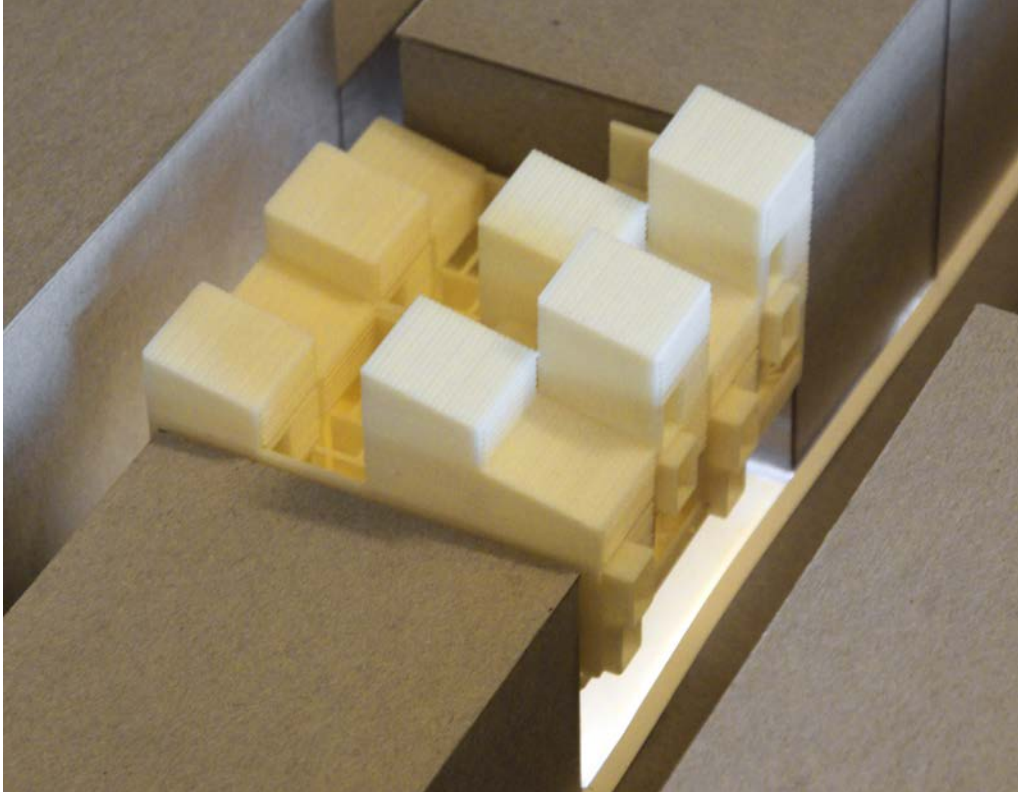
The selected site is located at the central area of Taipei City. The neighborhood was formed in 1960s and has become one of the most populous districts in the city. The aging mid-rise apartment buildings occupied most parts of the area and have been transformed into mixed-use buildings since the late-twentieth century. Today, the local commercial activities have formed unique street life and alley cultures around this neighborhood, which makes city renewal more challenging to be executed in this area. The site proposal attempts to show how the new housing system works in this city, especially in a well-developed area, and expects to be spread in different area of the city in the future.



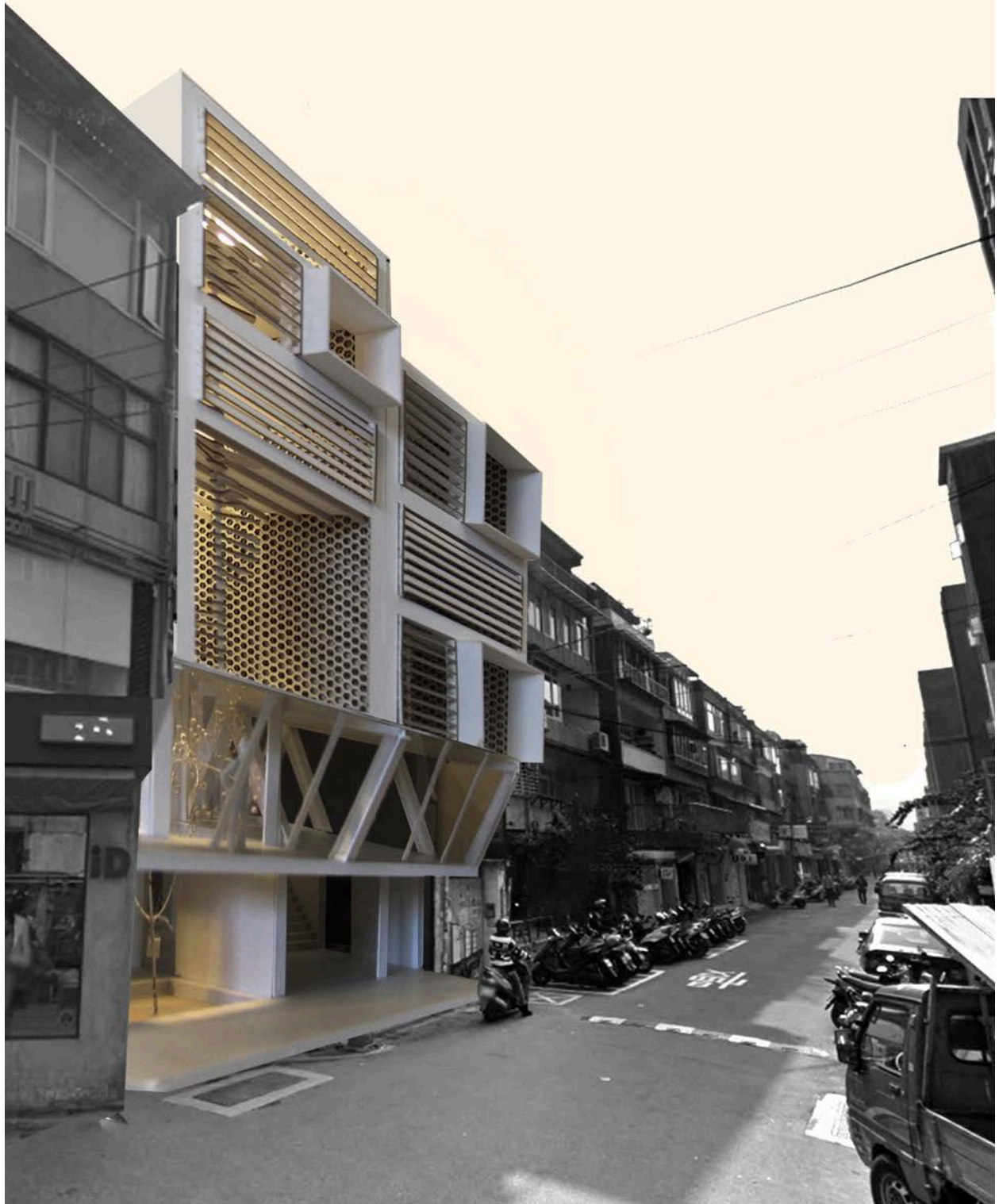
Site Plan, Eastern District, Taipei City



The infill of the public amenities and commercial space at the lower levels



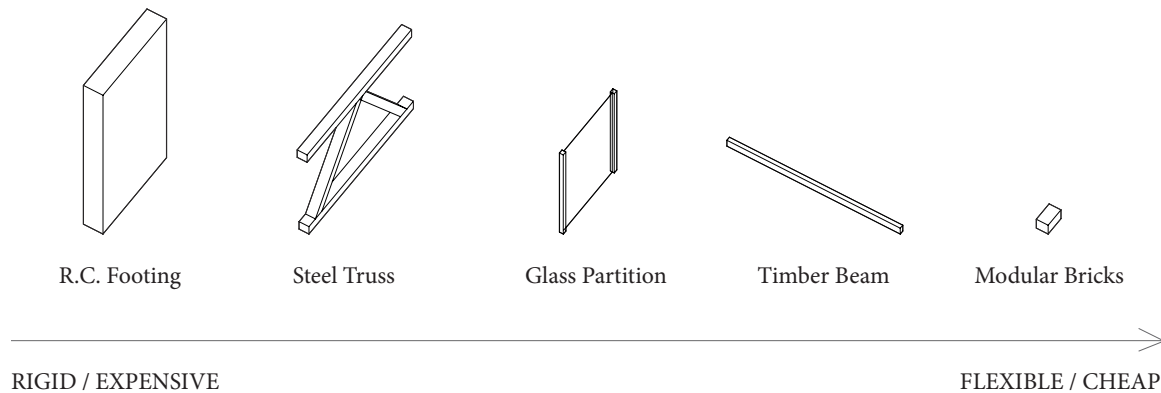
The infill of the adaptable residential units at the higher levels



The street view of one single-row apartment building located in Eastern District, Taipei City



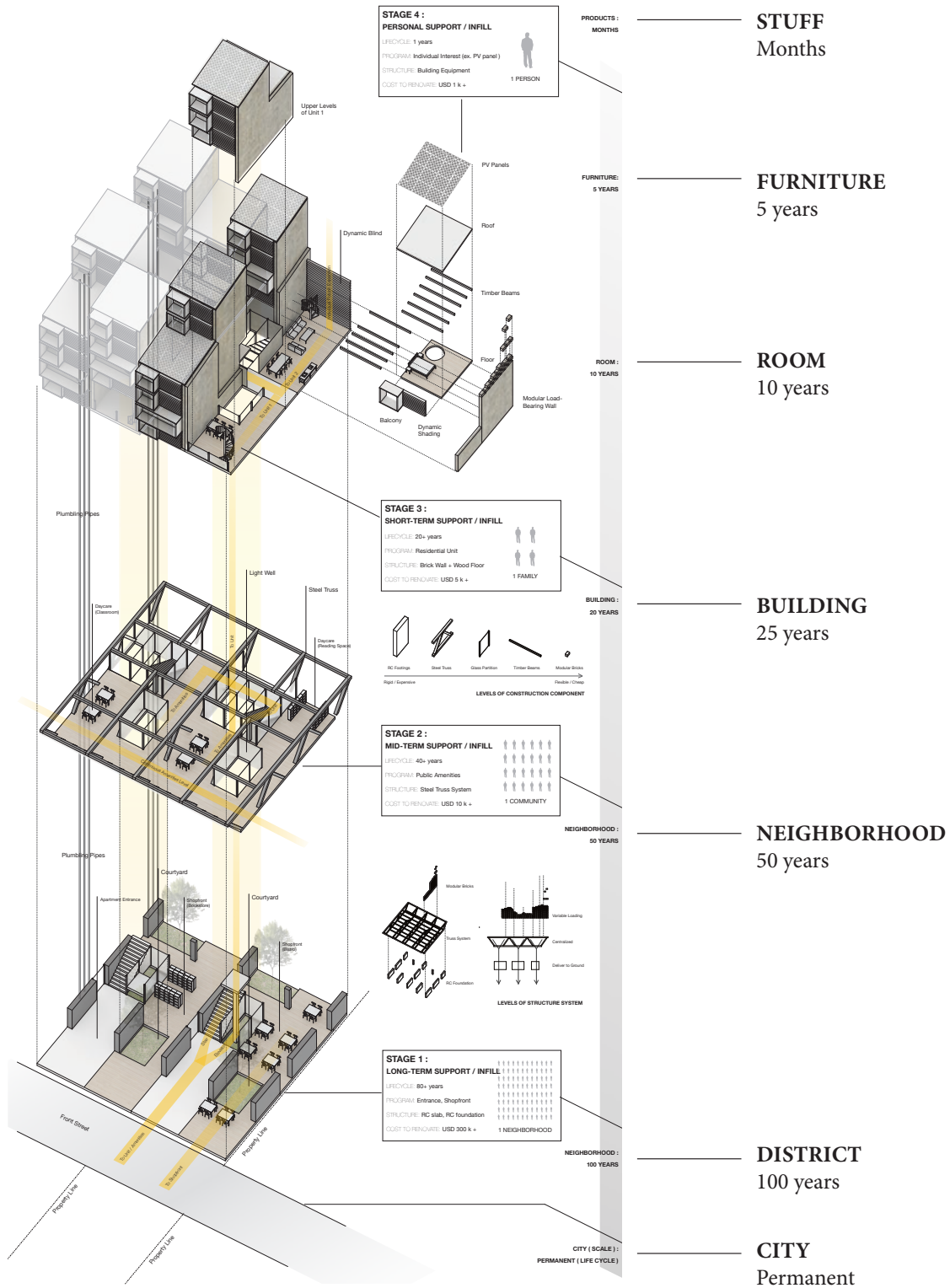
The section model to show the overall apartment design with various construction components



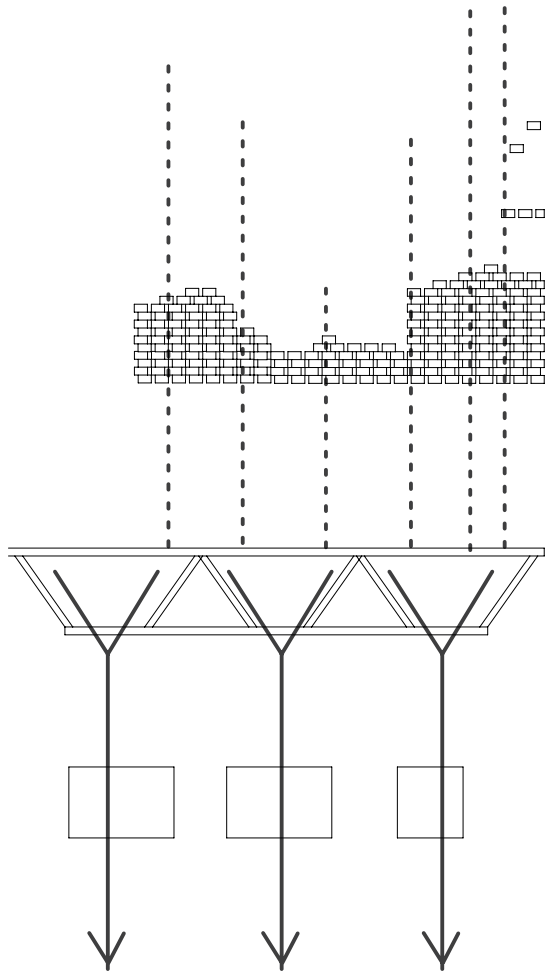
THE LEVELS OF CONSTRUCTION COMPONENTS

LEVELS OF CONSTRUCTION COMPONENTS

The new apartment design includes different levels of construction components. From rigid/expensive to flexible/cheap, it includes RC footings, steel trusses, glass partitions, timber beams and modular bricks. These various construction components are designed not only to respond to their different maintaining life cycle and running cost but also for their various structural performance. For example, the modular brick wall system provides a more adaptable way for users to easily modify their living space, while the steel truss system and the RC footings beneath it holds the permanent public space and simply transfer the vertical load to the ground.



THE EXPLODED AXONOMETRIC SHOWS DIFFERENT CONSTRUCTION STAGES



VARIABLE LOADING

The modular brick wall system, serves as an adaptable structural system, which helps the users easily modifying their own living space.

CONCENTRATION

The steel truss system collects the floating load from above. At the same time, it concentrates and transfers it to the RC footings under it.

DELIVER TO GROUND

The RC footings deliver the overall vertical load to the ground

THE FUNCTIONS OF VARIOUS CONSTRUCTION COMPONENTS

STAGE 2 :

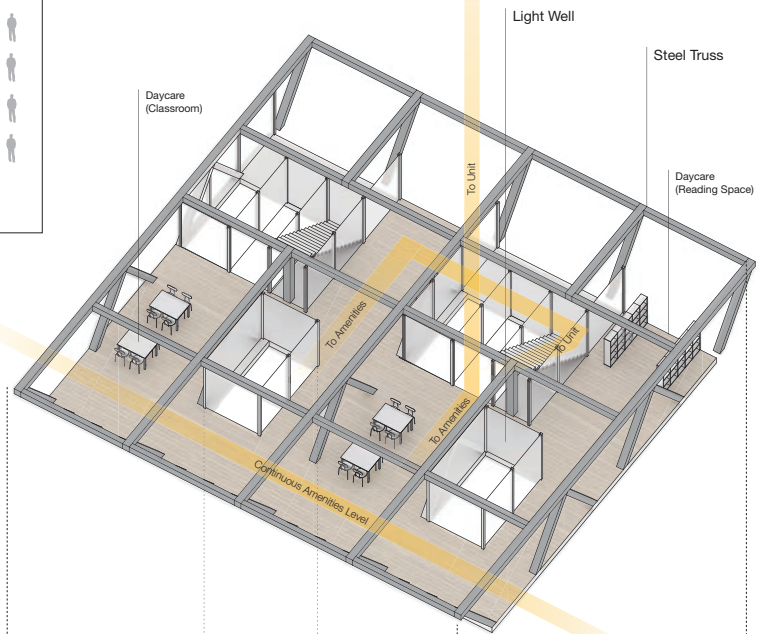
MID-TERM SUPPORT / INFILL

Lifecycle: 40+ years

PROGRAM: Public Amenities

STRUCTURE: Steel Truss System

COST TO RENOVATE: USD 10 k +



STAGE 1 :

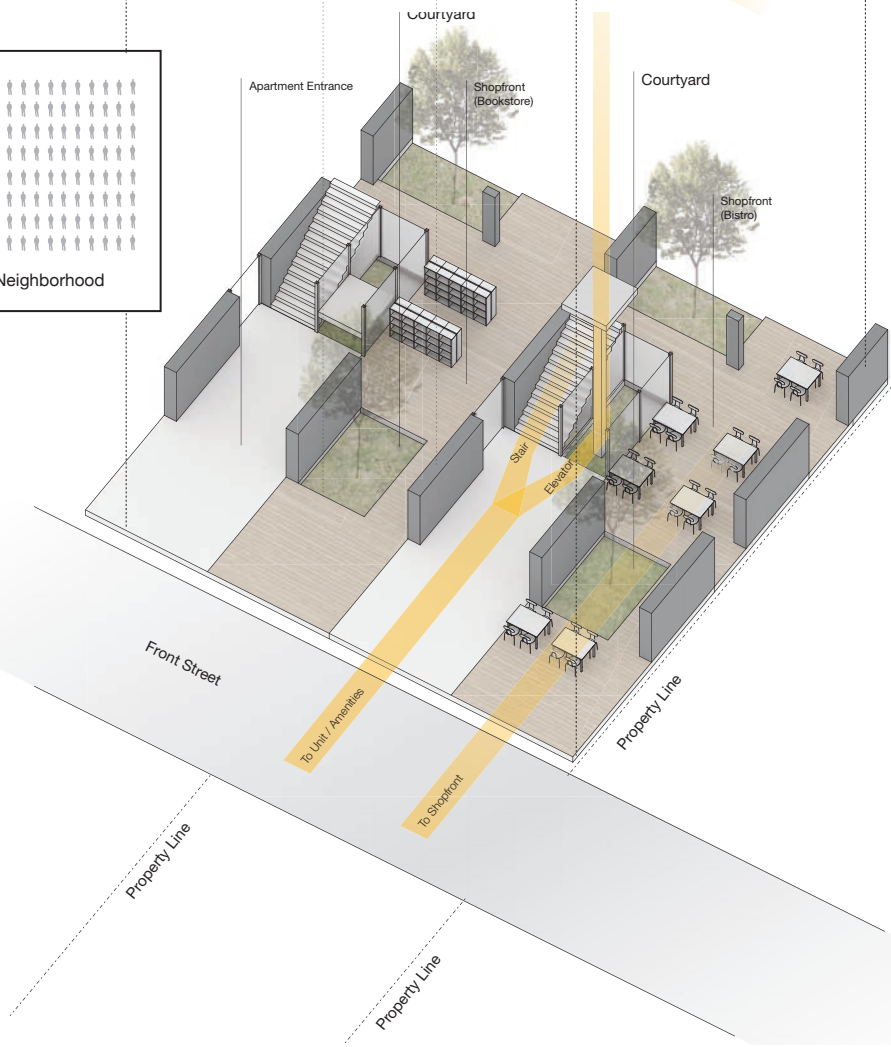
LONG-TERM SUPPORT / INFILL

Lifecycle: 80+ years

PROGRAM: Entrance, Shopfront

STRUCTURE: RC slab, RC foundation

COST TO RENOVATE: USD 300 k +

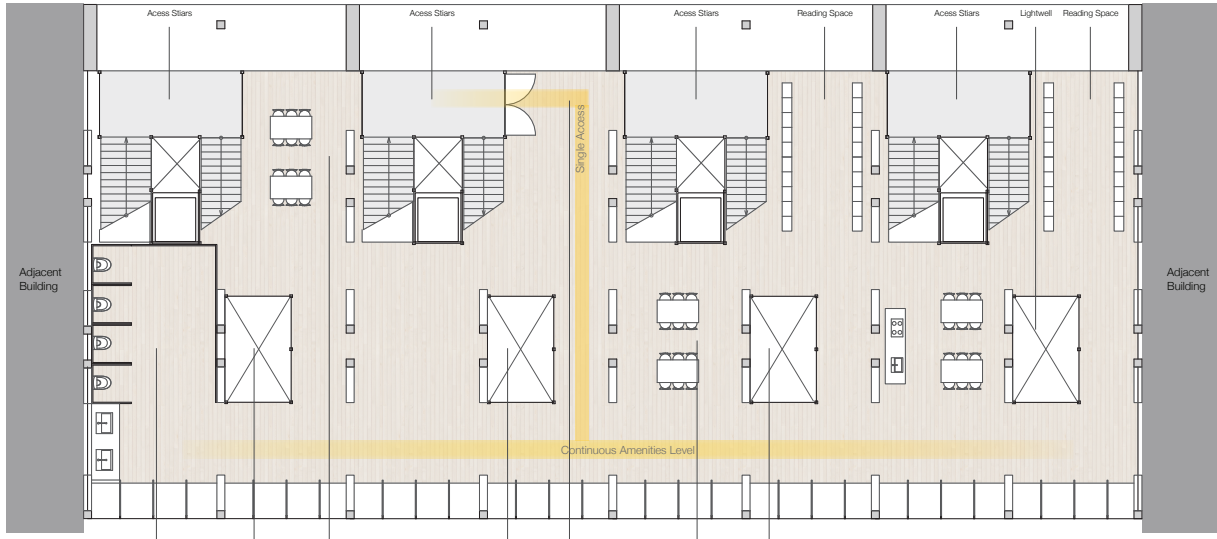


STAGE 1 & 2 - THE PUBLIC AMENITIES

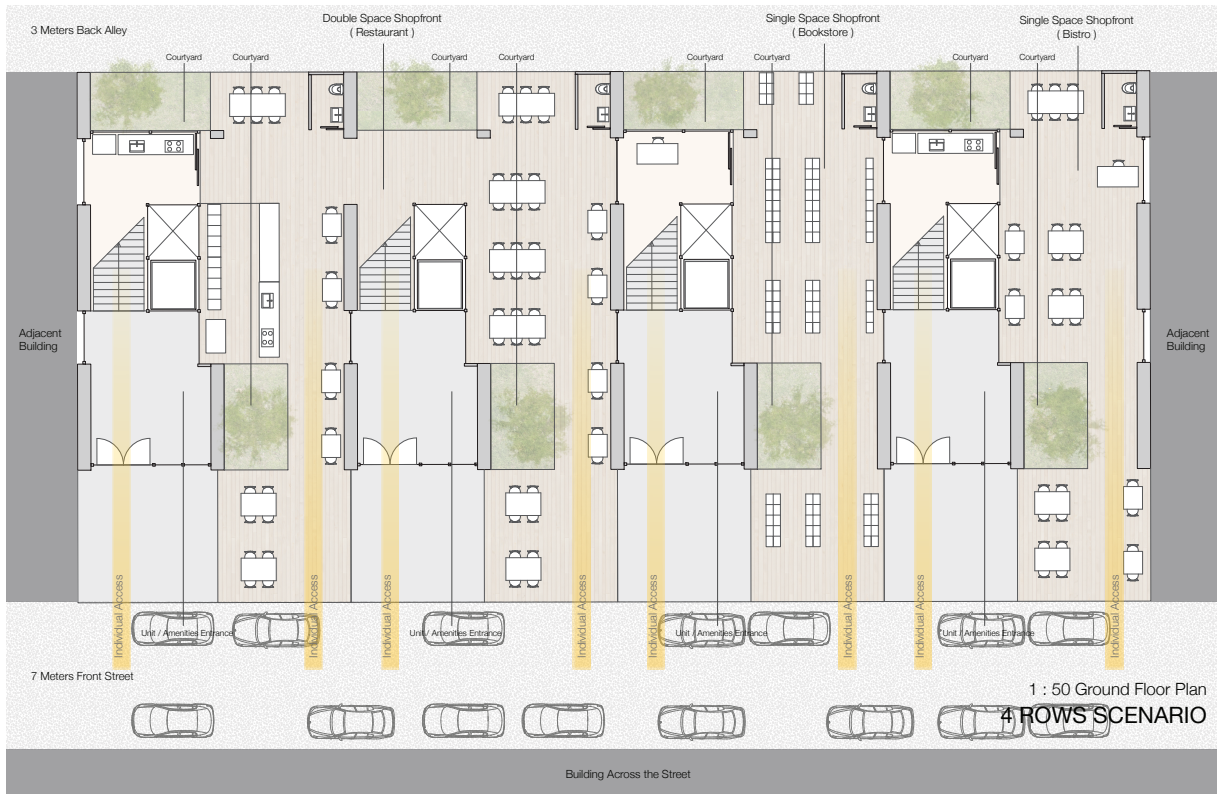
The mission of stage 1 & 2 is to serve as a connection between the street and the housing units on both neighborhood-scale and community-scale. The space layout at the ground level is made for individual access to the apartment entrance and strip-type commercial space. At the second level, the truss system provides an open floor plan to connect between each row of the apartment buildings and form a space for public amenities, shared by the community above. It is worth mentioning, two light wells in each apartment row not only bring the daylight to lower levels of the building, but also provide indoor/outdoor landscape in the commercial space and, at the same time, become transparent partitions for the open public amenities space.



The model demonstrates the space of stage 1 & 2, which includes shopfronts, apartment entrances, light wells, and indoor/outdoor landscape.



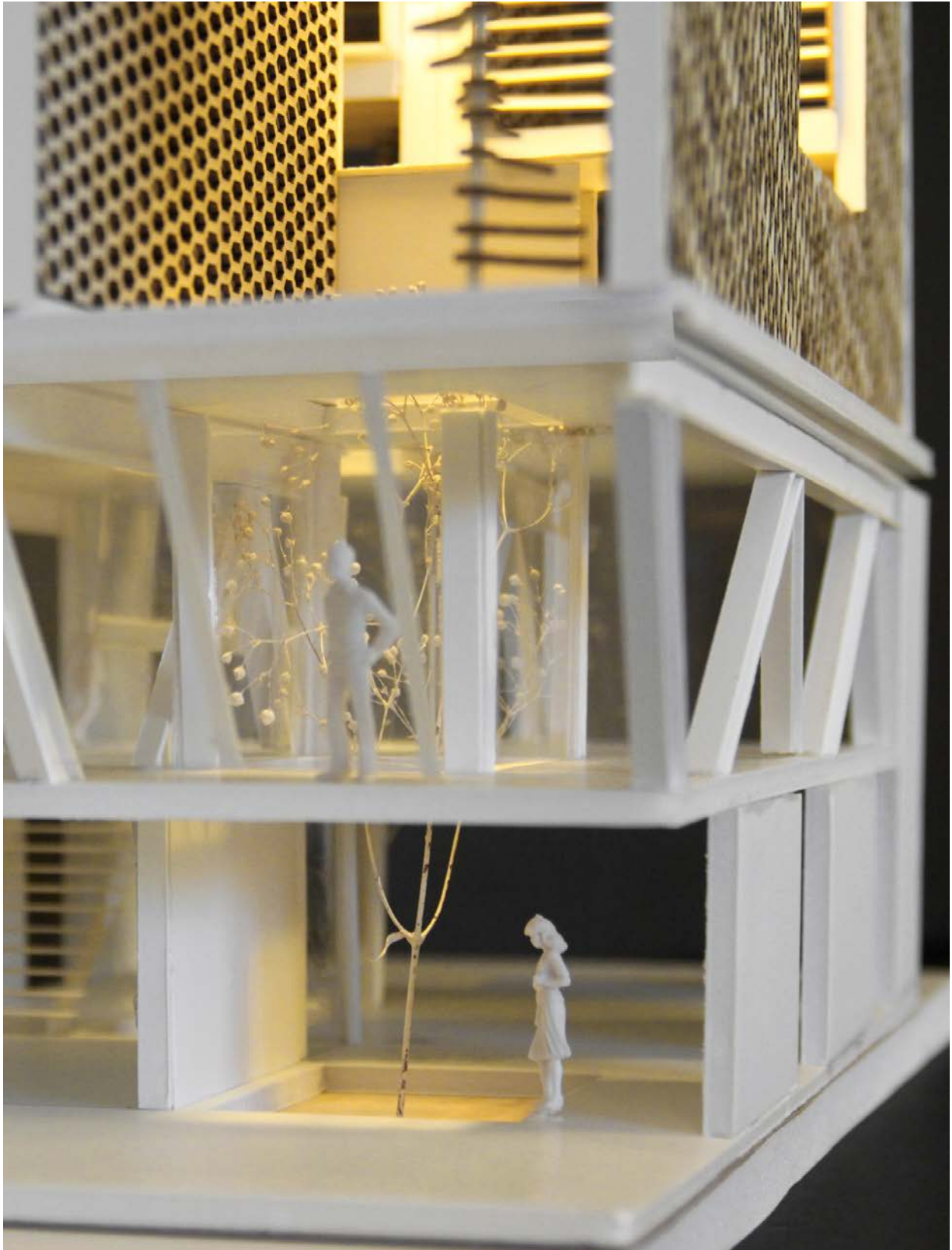
1 : 50 Second (Amenities) Floor Plan
 4 ROWS SCENARIO (DAYCARE)



1 : 50 Ground Floor Plan
 4 ROWS SCENARIO

Top: The second level floor plan contents a daycare center.

Bottom: The ground level floor plan contents commercial space and individual apartment entrances.



The model demonstrates the light wells at central of the building bring daylight to the lower public space.

STAGE 4 :
PERSONAL SUPPORT / INFILL

Lifecycle: 1 years

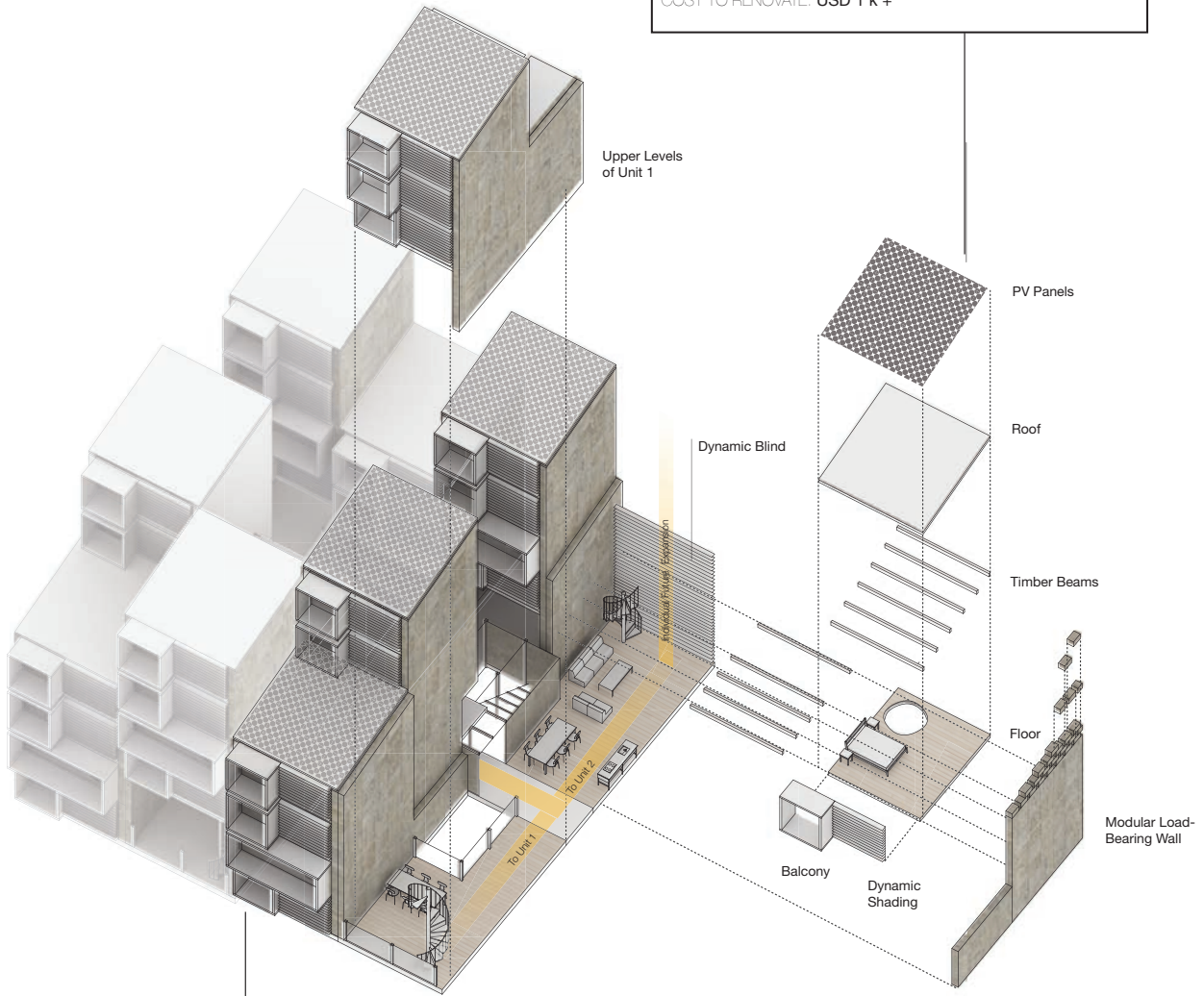
PROGRAM: Individual Interest (ex. PV panel)

STRUCTURE: Building Equipment

COST TO RENOVATE: USD 1 k +



1 person



STAGE 3 :
SHORT-TERM SUPPORT / INFILL

Lifecycle: 20+ years

PROGRAM: Residential Unit

STRUCTURE: Brick Wall + Wood Floor

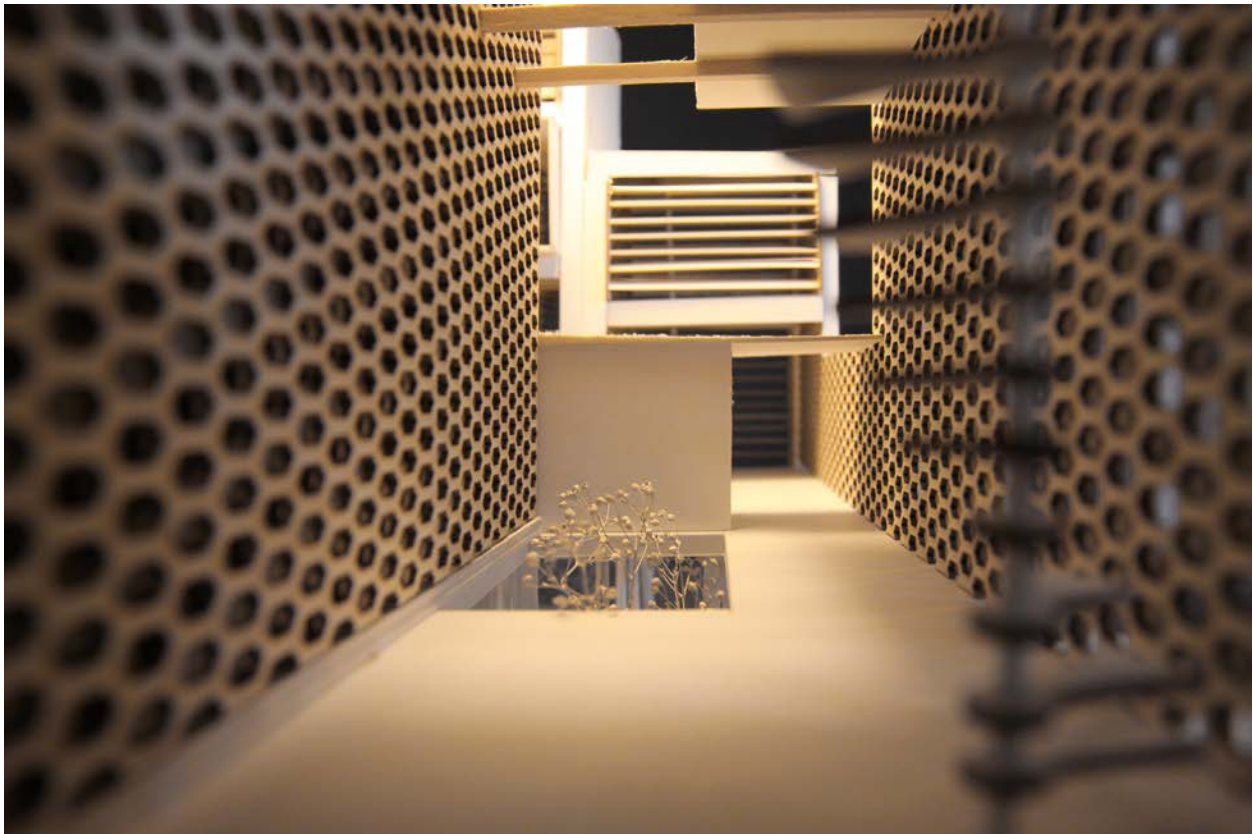
COST TO RENOVATE: USD 5 k +



1 Family

STAGE 3 & 4 - THE RESIDENTIAL UNITS

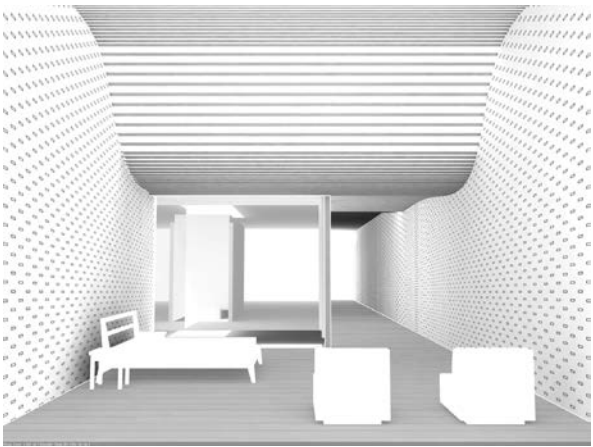
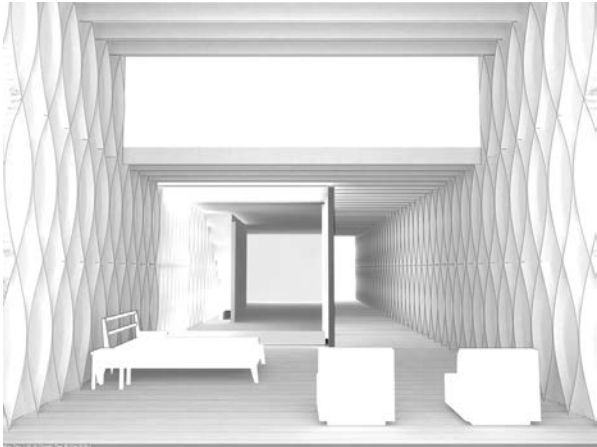
The mission of stage 3 & 4 is to serve as an adaptable living space that can be easily modified by inhabitants on both family-scale and person-scale. The floor plan at the third level of the apartment building can be divided from the minimum of two housing units to the maximum of five housing units. Like the building language of the traditional shophouse building, each housing unit can grow either vertically or horizontally since the building structure and service of each property are clearly separated.



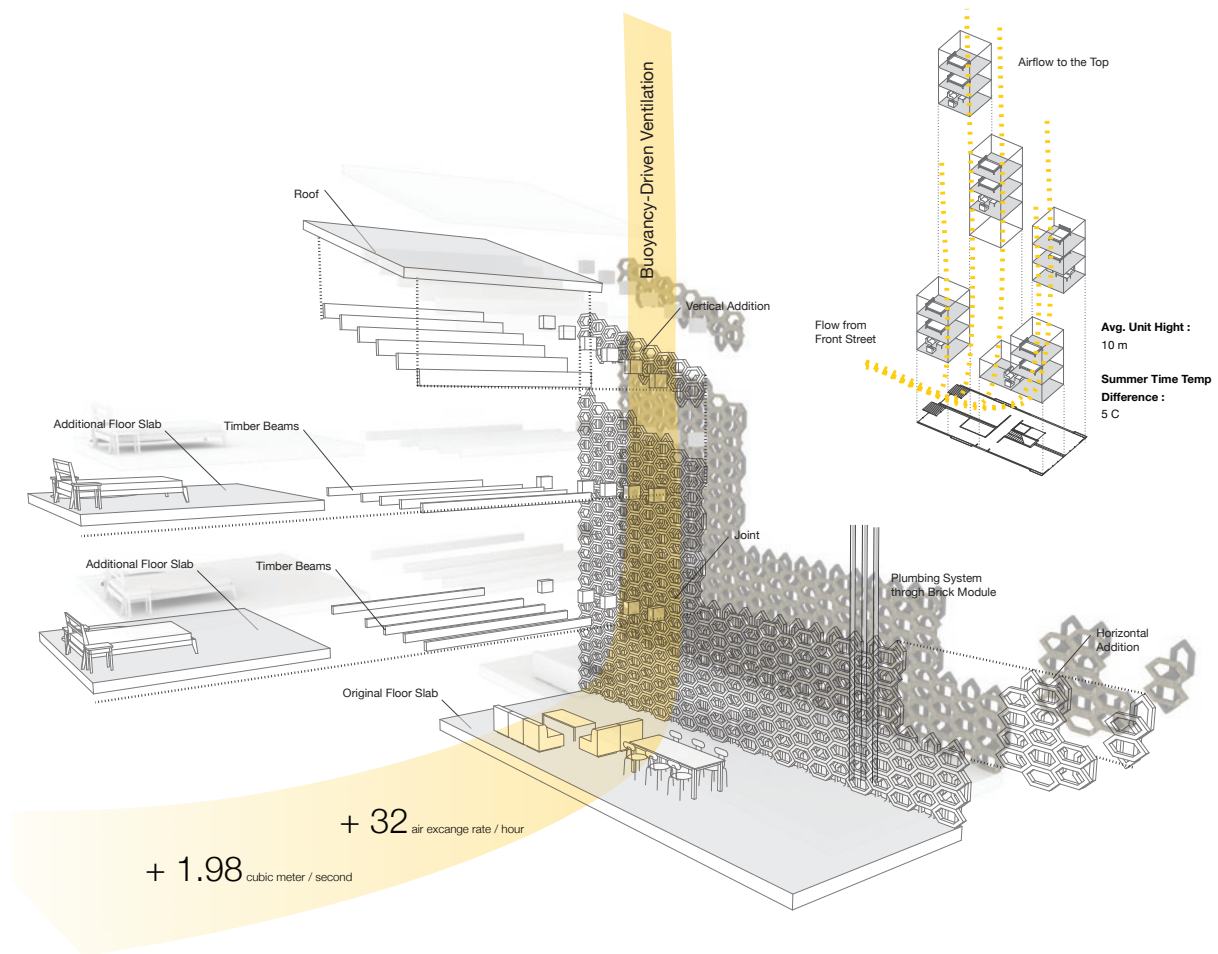
The model demonstrates how beams and floor slabs are built with the modular brick wall system in a apartment unit.



The perspective view shows the modular brick wall system creates indoor/outdoor living space in a housing unit.

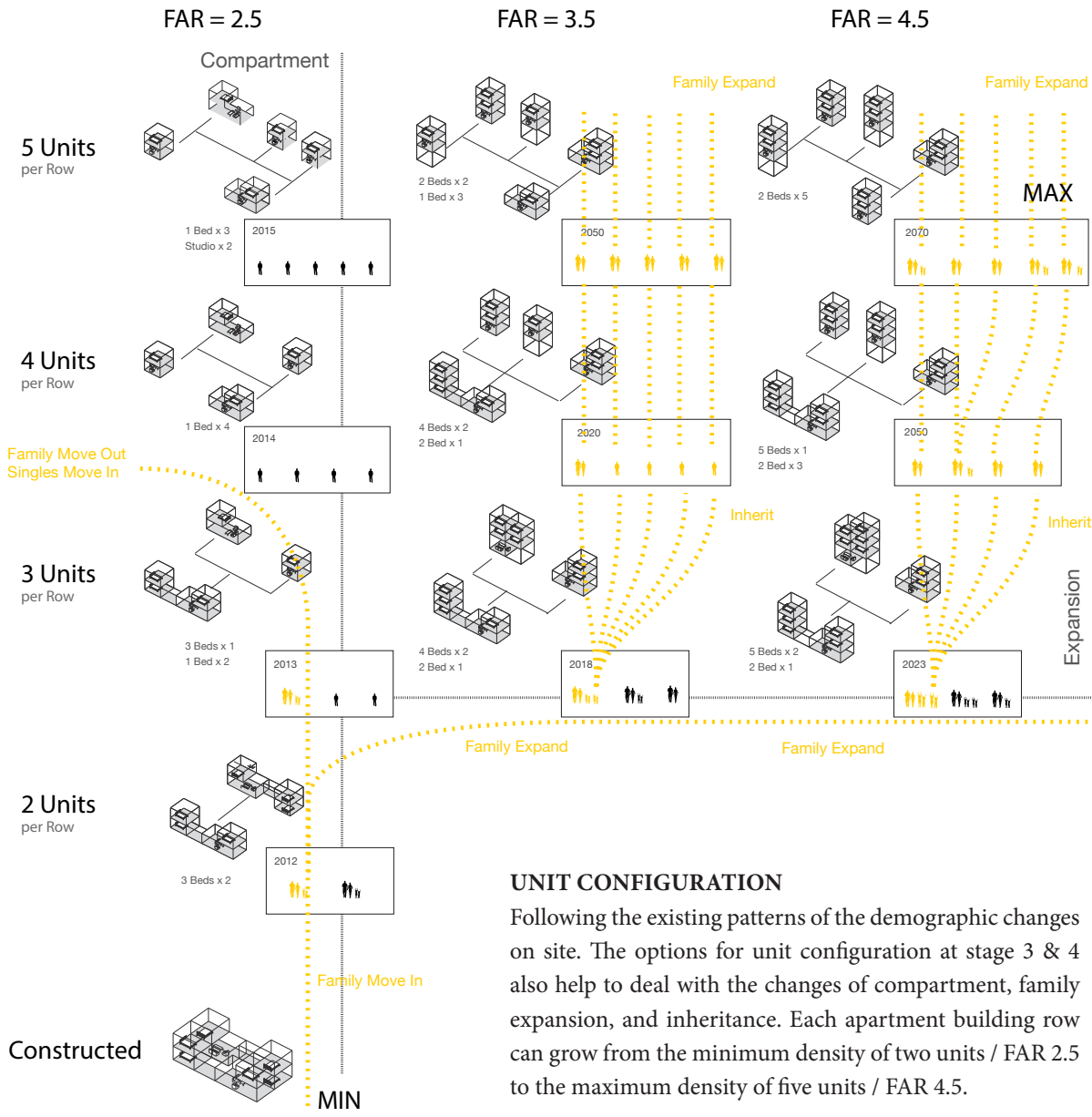


Bottom Left and Right: The idea of creating skylight in residential units by using the modular wall system.



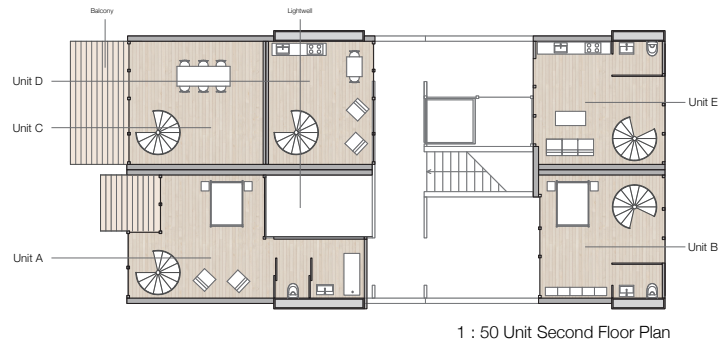
THE FUNCTIONS OF THE MODULAR BRICK WALL SYSTEM

The modular brick wall system, as a load bearing wall system, stands on the two sides of one residential unit. This adaptable structure allows users to determine where to add an additional floor when they intend to expand their living space. The brick wall also helps the buoyancy-driven ventilation, which increase the air exchange rate up to 32 per hour.

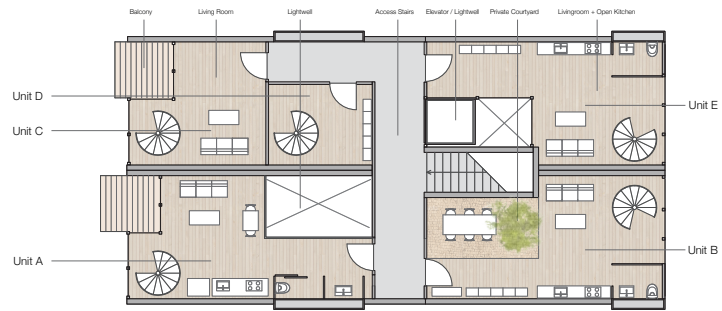


UNIT CONFIGURATION

Following the existing patterns of the demographic changes on site. The options for unit configuration at stage 3 & 4 also help to deal with the changes of compartment, family expansion, and inheritance. Each apartment building row can grow from the minimum density of two units / FAR 2.5 to the maximum density of five units / FAR 4.5.

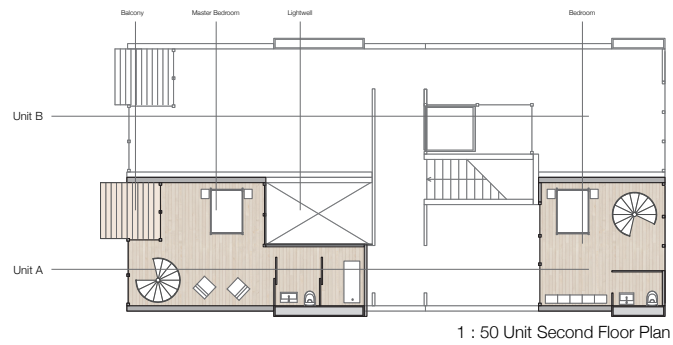


1 : 50 Unit Second Floor Plan

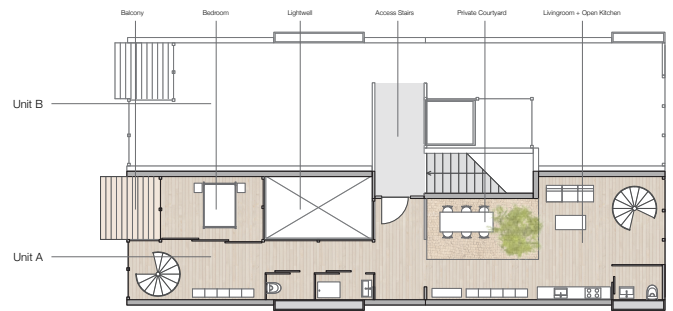


1 : 50 Unit First Floor Plan

The scenario floor plans of five units in one apartment row.



1 : 50 Unit Second Floor Plan



1 : 50 Unit First Floor Plan

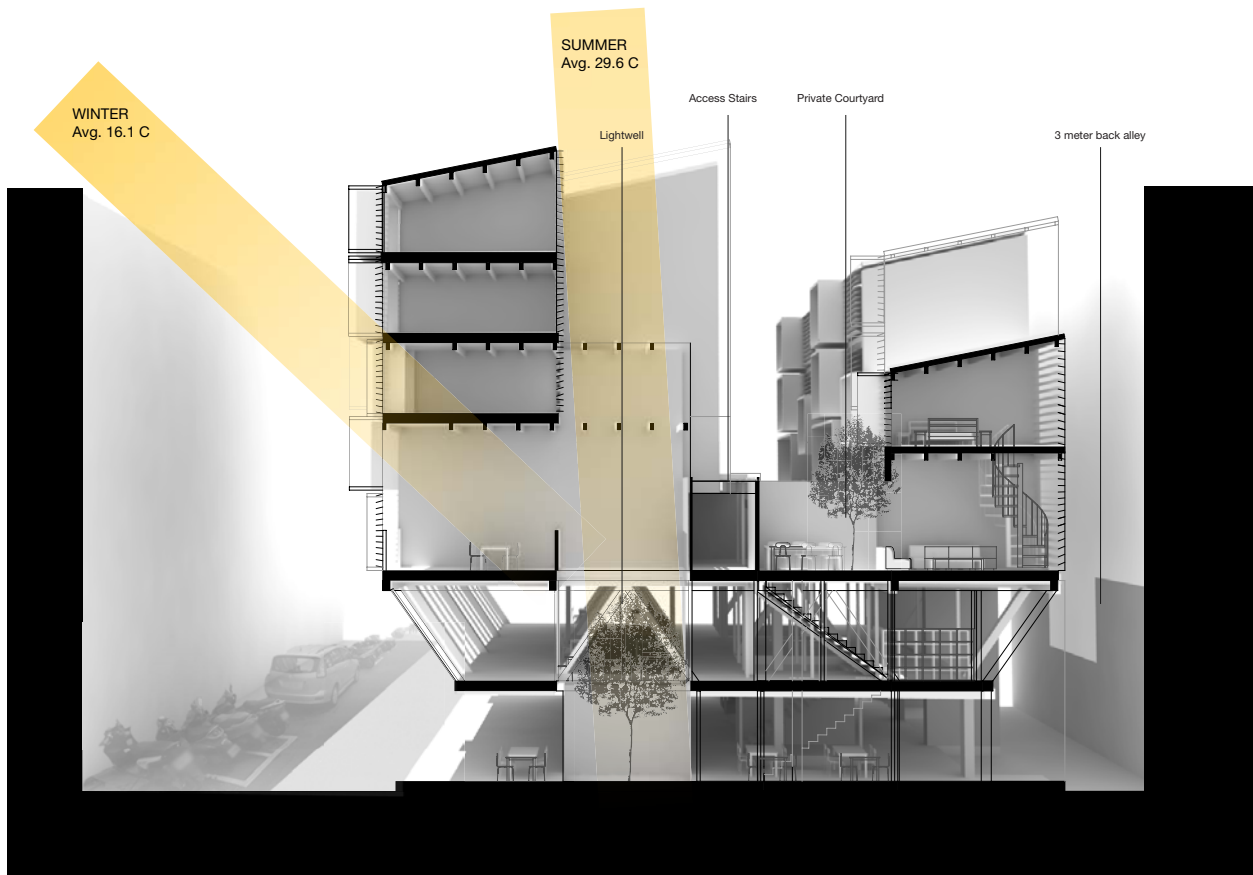
The scenario two plans of five units in one apartment row.



The maximum build-up of the new housing system. Includes two floors for the public and five floors for the residential.

DENSITY VERSUS DAYLIGHT

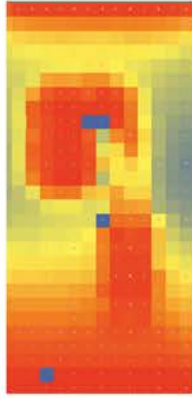
One of the major challenges for this new housing system is to reach the needs of high density, with more than FAR 3.5 (Housing) plus 1.0 (Public). The building height is limited by the daylight accessibility and the floor numbers for each residential unit. Therefore, a series of daylight simulation helps to find the relationship between the daylight autonomy in the lower levels and the building height. From the result, the new housing system, with courtyards and light wells at the center, can evenly distribute the daylight and solar resource to the entire building with the density up to FAR 4.5 (Housing) plus 1.0 (Public.)



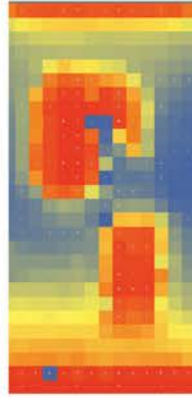
The section shows the sun angles during the summer time and winter time.



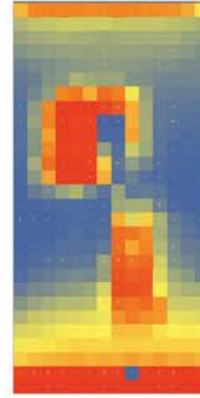
**GL (Ground Level)
Floor Plan**



GL Floor Plan
FAR = 2.5 + 1
DA = 70.4 %



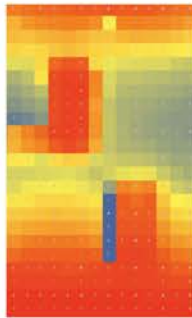
GL Floor Plan
FAR = 4.5 + 1
DA = 56.5 %



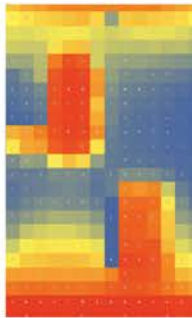
GL Floor Plan
FAR = 5.5 + 1
DA = 48.1 %



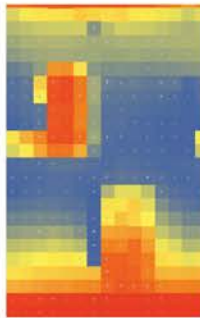
**SL (Second Level)
Floor Plan**




SL Floor Plan
FAR = 2.5 + 1
DA = 67.6 %

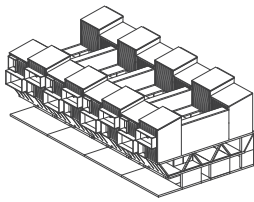


SL Floor Plan
FAR = 4.5 + 1
DA = 50.8 %

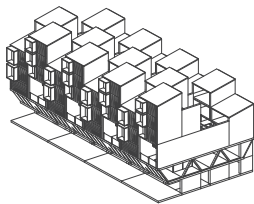
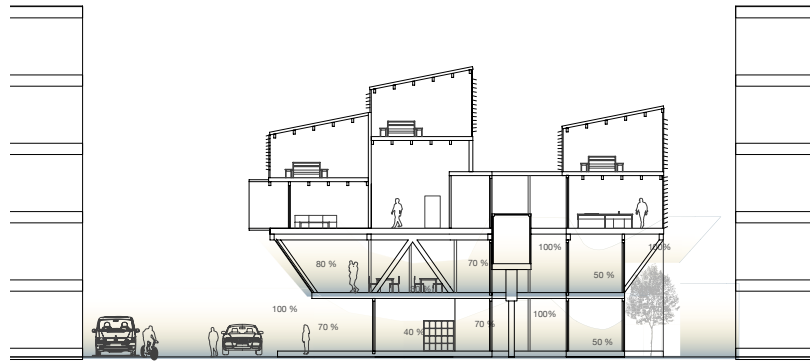


SL Floor Plan
FAR = 5.5 + 1
DA = 38.6 %

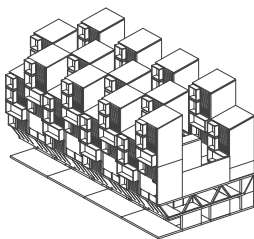
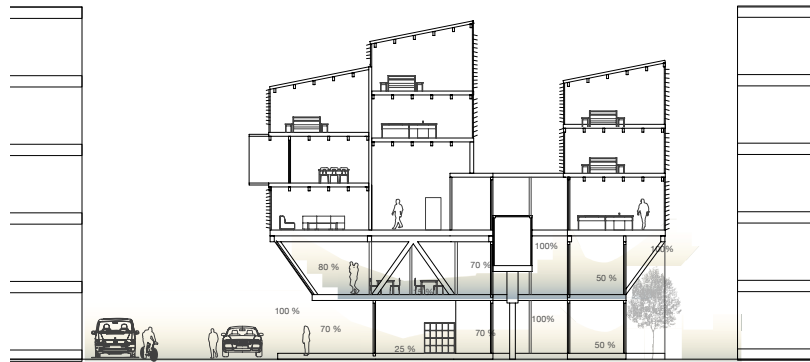
100%  **DAYLIGHT AUTONOMY SIMULATION**
 Measure from 0% to 100%; with occupied hours from 7am to 10pm., Monday to Saturday.
 0%
 The goal is to find the ideal FAR with overall daylight autonomy above



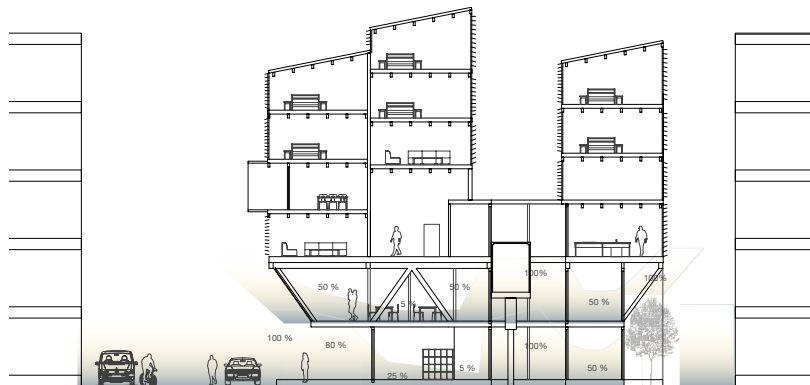
FAR = 2.5 + 1



FAR = 3.5 + 1



FAR = 4.5 + 1

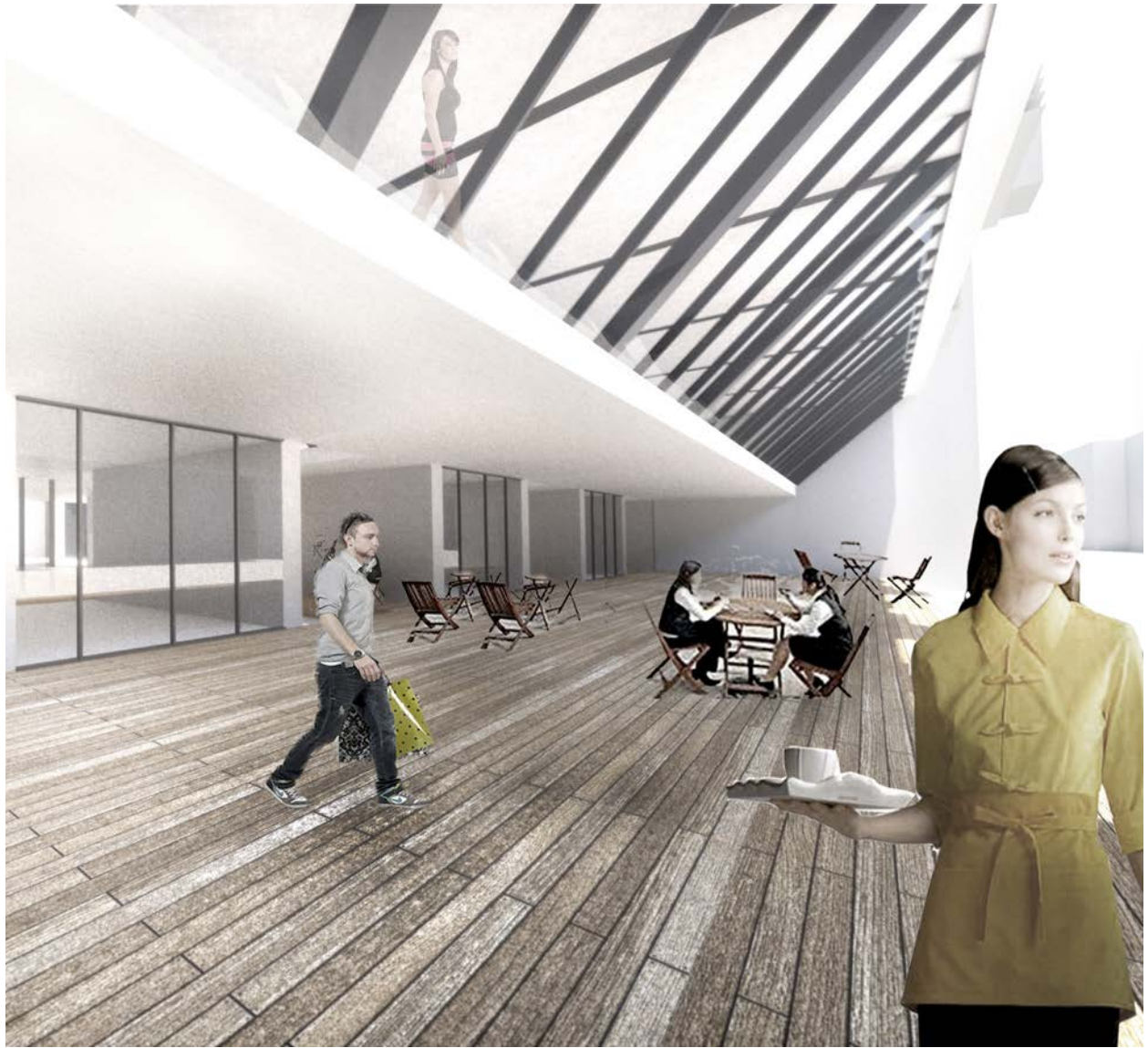


DAYLIGHT AUTONOMY SIMULATION

The series of simulation intends to exam the relationship between the daylight autonomy and the building height.



The perspective view of the apartment entrances and shopfronts at the ground level





The perspective view of the public amenity (a daycare center) at the second level





View from the Front Street



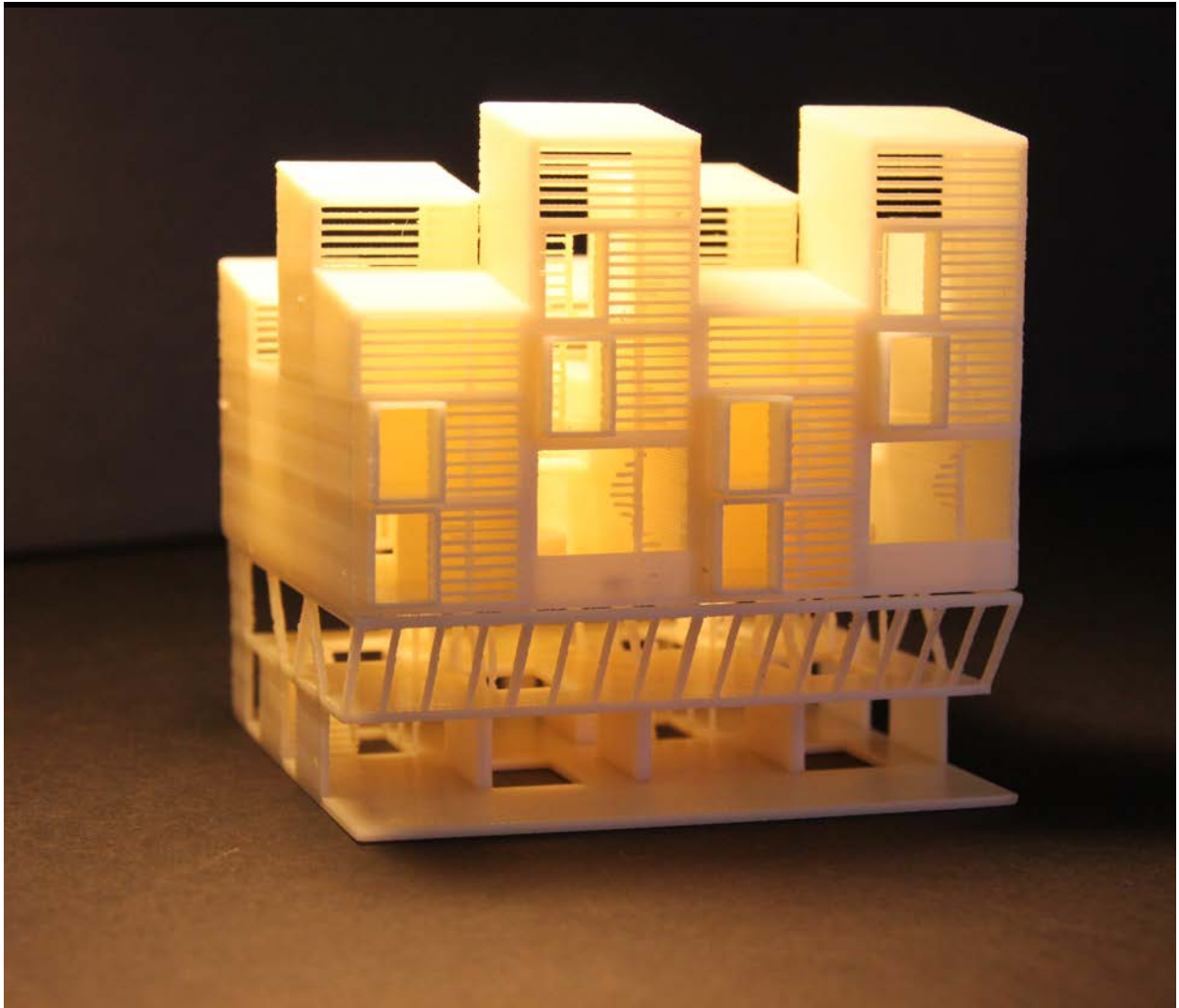
View from the Front Street: Close Up



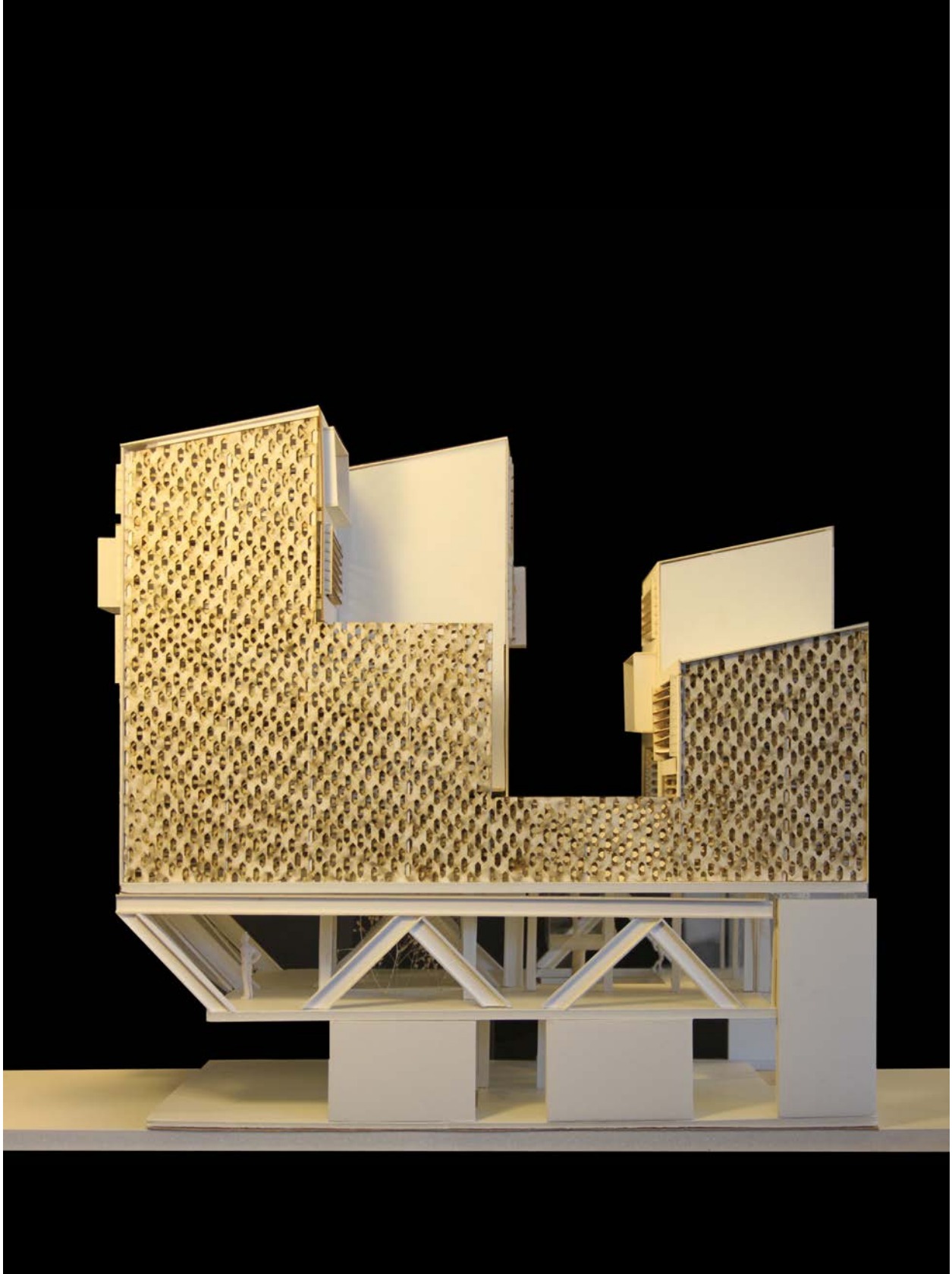
View from the Back Alley



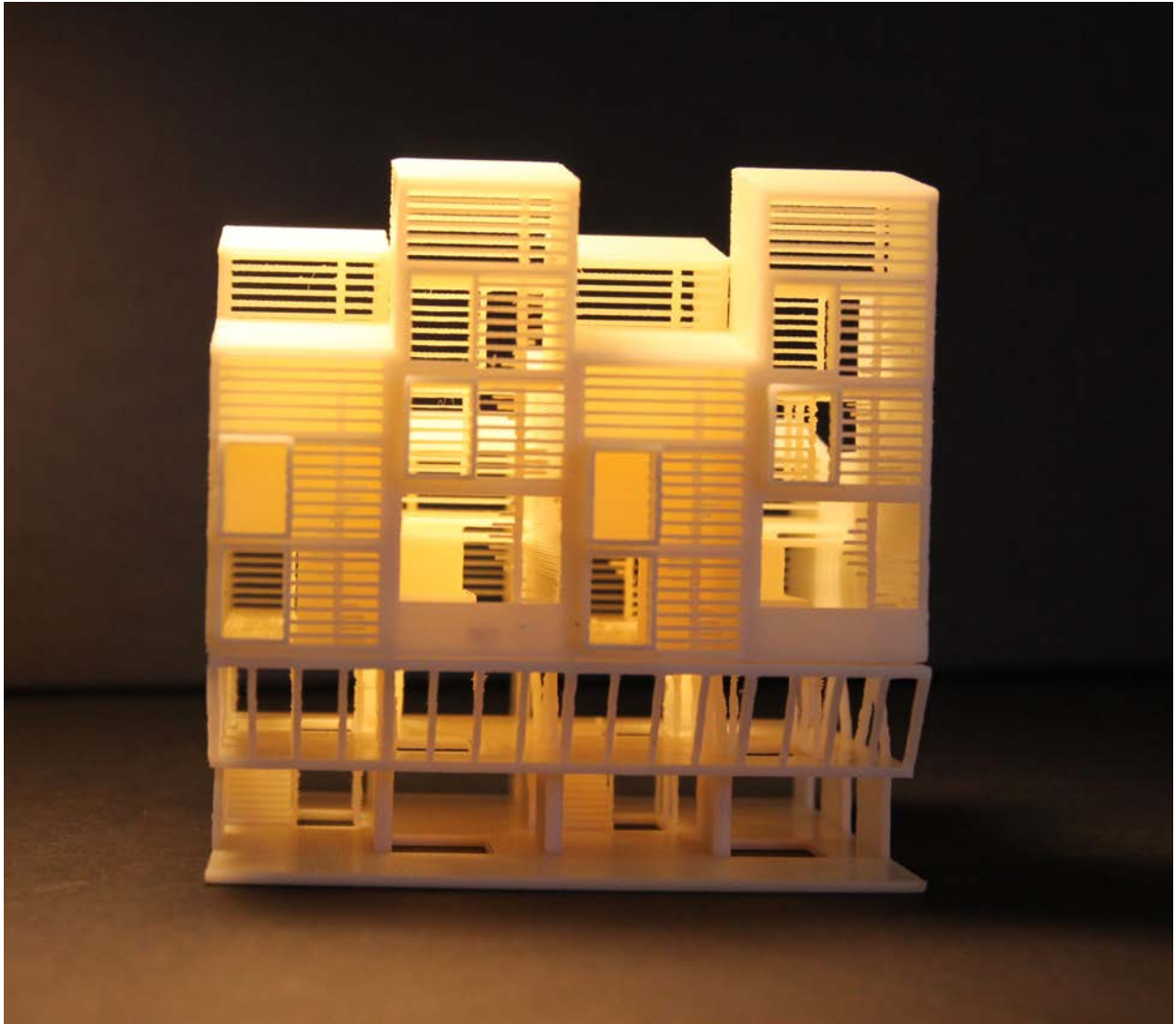
View from the Back Alley: Close Up



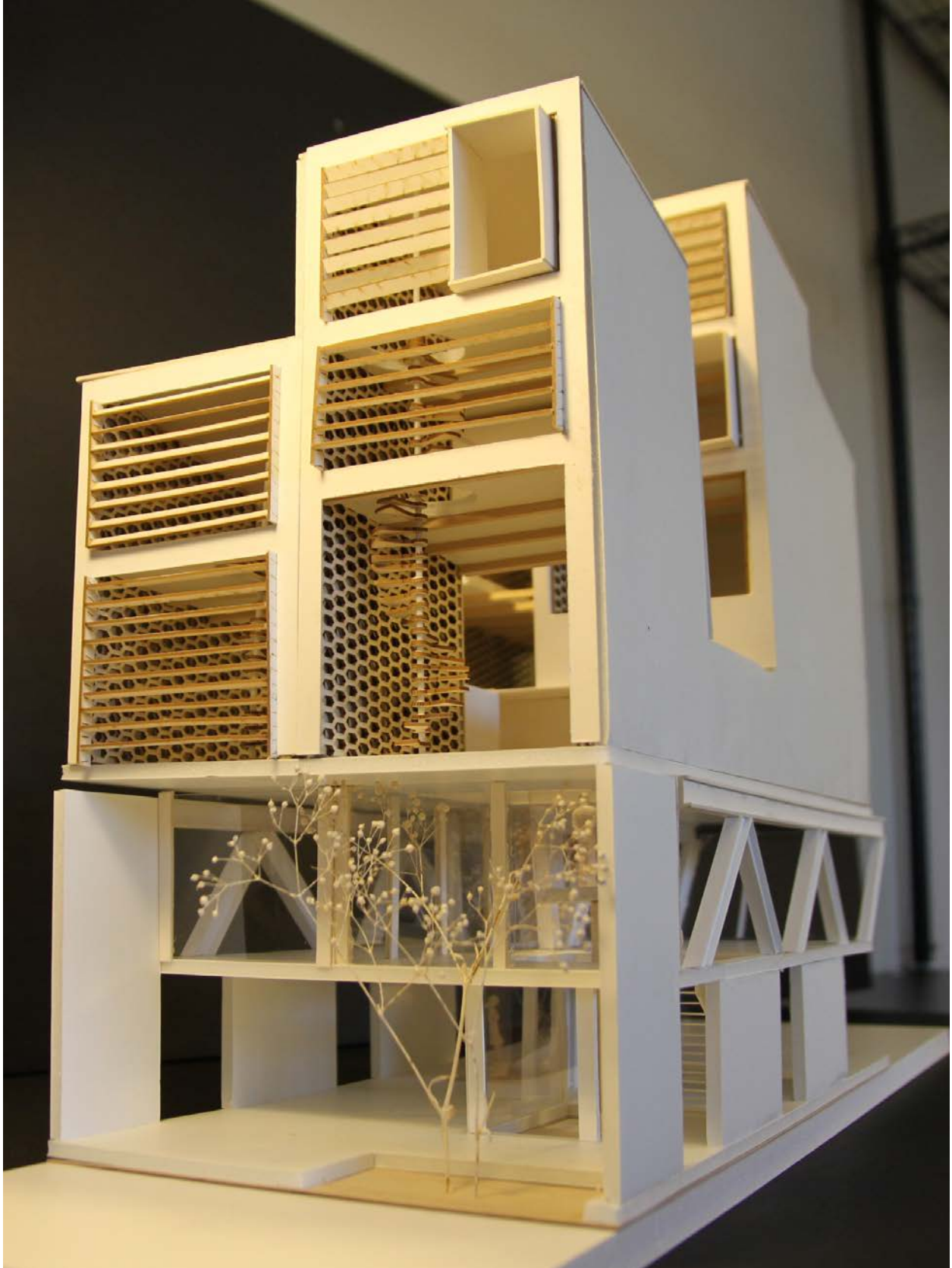
Four-Rows Apartment Buildings



View from the side



Four-Rows Apartment Buildings



View from the Back Alley



The public final thesis presentation on December 20, 2012



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TAIPEI APARTMENT

by
Andy Chien-Che Hsu

B.S. Civil Engineering
National Chao Tung University, 2008

Submitted to the Department of Architecture in Partial
Fulfillment of the Requirements for the Degree of

MASTER OF ARCHITECTURE at the
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
February 2013

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