Contextualizing Urban Mobile Fabrics

by Michael Chia-Liang, Lin

Bachelor of Architecture (2004)
Fung-Chia University

Submitted to the Department of Architecture
in Partial Fulfillment of the Requirements for the Degree of
Master of Science in Architecture Studies
at the Massachusetts Institute of Technology
June 2007

Signature of Author ....
Department of Architecture
May 24, 2007

Certified by ....
William J. Mitchell
Professor of Architecture and Media
Arts and Sciences
Thesis Advisor

Accepted by ....
Julian Beinart
Professor of Architecture
Chair of the Department Committee on
Graduate Students

Thesis Reader
Michael Dennis
Professor of Architecture

Contexulizing Urban Mobile Fabrics

by

Michael Chia-Liang, Lin

Submitted to the Department of Architecture
on May 24th, 2007 in Partial Fulfillment of the
Requirements for the Degree of Master of Science
in Architectural Studies.

ABSTRACT

This thesis is focus on the urban fabric issues. To be more specific, I will focus on the "Mobile Fabrics" within the larger Asian urban context. Instead of working with a specific geographical site; I will focus on the "Duration" of these mobile fabrics. Certain duration during the day will be selected according to the specific phenomenon and the duration for incorporating elements which discovered in different places. The overall idea is to canvass a series of movements by its duration regarding some the current pertinent issues affecting urban and architectural design.

One of the most interesting Mobile Fabrics in the Asian context is the scooter and the Chinese traditional shop front. The scooter forms as a private space moving within the public space whereas the Chinese traditional shop front is a public space within a private property. The result of this design thesis is to aim at the different possibilities to intergrades these two mobile fabrics together; further more, creating different combinations for urban space orderings and shifting the identity of public and private spaces.

Thesis supervisor: William J. Mitchell
Title:Professor of Architecture and Media Arts and Sciences

Acknowledgements

I would like thank my wife Sophia Suen, with all her support and her love which make my MIT trip dreams come true.

I would like to thank my father-in-law, Harvey Edward Molé, for his constant encouragement and guidance.

I would like to thank Professor William J. Mitchell for his unlimited support and great insight.

I would like to thank Professor Michael Dennis who made my architectural lenses sharper.

I would like to thank Ryan Chin for his silent creativity and vision.

To all my fellow SMArchS students, thank you for the beautiful days.

To my Family is Taiwan, I love you.

CONTENTS

CHAPTER 1: INTRODUCING TAMSUI

Tamsui is located 17 km north of Taipei metropolitan city, the capital of Taiwan. Since 1997, the introduction of Tiapei Rapid Transit System connecting Taipei Railroad Station and Tamsui with 20 stations along Tamsui Line brings sharp increase in tourism to this city which is famous for its diversified historic heritage, traditional food, sunset viewing spot along the Tamsui river and the Fisherman's wharf.

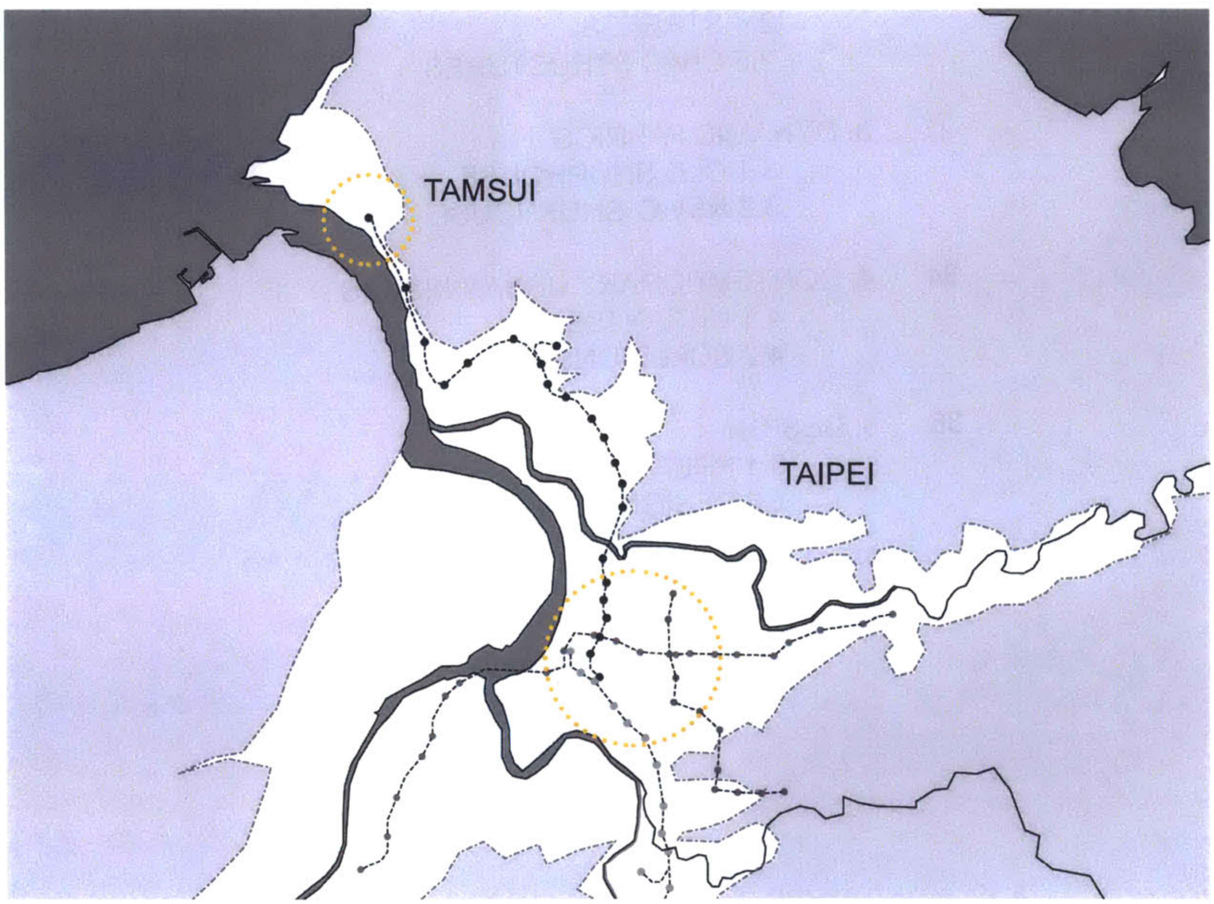


Figure 1.1.0

1.1 EUROPEAN OCCUPATION

1664

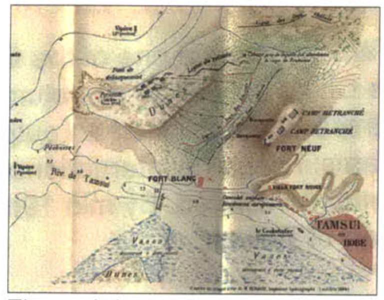


Figure 1.1.1

Tamsui under European Political Power

The first inhabitants in Taiwan were the several aboriginal tribes, it were the Dutch and the Spanish that first established formal political power in Taiwan in mid 17th century. Occupation by these European powers marked the beginning of Taiwan's transformation from an era of prehistoric obscurity into the modern new world that the Age of Exploration helped forge. The Dutch regulated policies while the Chinese implemented them, and thus built a new Taiwan.


Figure 1.1.2

With the Spanish political power mainly in the north of Taiwan and Dutch in the south, confrontation between these two European adversaries led to the expelling of Spanish. In 1642, the Spanish were forced to withdraw after only 16 years occupation. This left the Dutch as the sole ruling power on Taiwan until Zheng Cheng-gong's from conquest of the island in 1661.


Figure 1.1.3

The Spanish occupied northern Taiwan, mainly in today's Tamsui, where they found a fortress called Fort San Domingo. Spanish was interested in northern Taiwan for the purpose of securing Spanish interests in the Philippines against the Dutch, the British, and the Portuguese, as well as for facilitating trade with China and Japan.

When the Dutch took over Tamsui, the Spanish had already abandoned their settlement and the Dutch built a new fort in the old site which they named Fort Antonio. It is today known as Hong Mao Cheng at which is Fort San Domingo museum complex is located. Unlike Spanish who focused only on trade and missionary work, Dutch is the first foreign power that boost growth in Taiwan not only by introducing western policies, but more importantly, pacifying conflicts between different aboriginal tribes in the area, encouraging the immigration and settlement of the area by Han Chinese, as well as expanding the production and trade of sulfur, animal skins, and other indigenous resources.


Figure 1.1.4

1.2 QING DYNASTY

1684

Tamsui became one of the five major trading ports due to its proximity to facilitate trade to China as well as its natural advantage for being a good harbor. In 1808, the Qing Emperor established an outpost by the naval patrol. In 1858, under Treaty of Tianjing, Tamsui became international entrepot where trade of tea, sulfur, coal opium, and dyes once dominated. By mid 19th century, Tamsui has became the biggest port in northern part of Taiwan.

In 1861, with British consulate entering Tamsui opened a new chapter as western traders was protected whn they started business here. 1867 the British rented Fort San Domingo from Qing dynasty to be used as their consulate in Tamsui. In addition to taking care of the British people in Taiwan, the consulate was mainly in charge of customs taxation, information collecting, and other international affairs. It was not until 1880 that international traders got permission for land lease after long time negotiation. There created British Concession of where all the foreigners gathered for trade and live, for example, British Consulate's House, white house which comprised today's "Tamsui Historic Site". With the soaring export of tea and camphor products, the status of the Tamsui harbor was increasingly important. The British government thus built the consul's official residence on the east side of the fort in 1877.

In 1872, a Canadian medical doctor George Leslie Mackay arrived Tamsui as the most important missionary in the history of Taiwan. With the assistance of some local residence, he established the first hospital of western medicine in 1879. Later on in 1882, he also established an educational institute known as the Oxford Collage. Oxford Collage was the oldest western education institution in Taiwan which becomes the Aletheia University now. Not only did Mackay introduce western medical and educational

Figure 1.2.1 Old Map

system to Taiwan, the buildings also conveyed the beauty of colonial architecture and added attraction to Tamsui.

One of the most interesting building typology evolved from Chinese traditional architecture is Chinese shop houses. Chinese shop house is a unique building type in the history of Chinese architecture. These building types happened everywhere in both mainland China and Taiwan. Tamsui has also developed its own shop house typology. These shop houses are usually built along the topography of the city. Five meter wide in the elevation and 15 to 30 meters in depth. There is usually an opening between these houses. It looks like an insert crouching on the floor. for residential use. Later on Rice Street, a block away that parallel.

As most traditional cities in Taiwan, settlement of shop house development usually evolved from an origin at which temples or a square with a big tree situated. These elements sometimes occurred on the edge and formed a T-shape street system for the shack of protection. Tamsui city is developed or built around its oldest temple, FuDe Temple, with a square in front facing the river. Along time horizon, another street was gradually formed known as the Rebuilt Street. This is the first step of the development. A new settlement was set up along Rebuilt Street in which people moved from the other side of the river reside because of flood. This street where shop house without arcade became the dominant typology is mainly for residential use. Later on Rice Street, a block away that parallel to Rebuild Street was built for the retail use supporting daily necessity of the neighborhood. The building typology in Rice Street was originally the same as Rebuilt Street, but with an arcade for commercial purpose. These two streets were the most important streets during the early stage of development. Residential and commercial share the same building typology except the arcade. The Shop house arcades can be regarded as an indicator reflecting different uses occupying the space inside.


Figure 1.2.2


Figure 1.2.3 Arcades


Figure 1.2.4 Shophouse


Figure 1.2.5 Tamsui Port

1.3 JAPANESE COLONIAL PERIOD

1895

Being defected by Japan in Sino-Japanese War in 1984, Qing Empire was forced to sign the "Treaty of Shimonoseki" under which Taiwan was ceded to Japan. During Japanese Colonial Period, due to the accumulation of sediments in the Tamsui River, Tamsui port was abandoned gradually and lost its importance to port of Keelung in 1903. After a few years, the local economy of Tamsui switched primarily to agriculture.

Tamsui became a local administrative and cultural center when Japanese colonial government introduced several major infrastructure projects such as the construction of railroad connecting Tamsui to Taipei in 1891 and implementation of urban planning system in 1929. Japanese colonial government introduced the idea of urban planning to Taiwan during the early stage of its colonial. Small blocks with 45 degree cut through the corner due to the long history and development in this small city. The planning did not affect the pattern of the existing city. Most of the city was built along the edge of the topography. Instead of progressive urban renewal, widening of Chong-zheng Road from 4 meter to 9 meter to ease the traffic problem arised by the introduction of modern cars since 1990 made Tamsui into a modernized city. Shop houses along the road are tore down and rebuilt following the latest style with 2 stories and built in red brick.

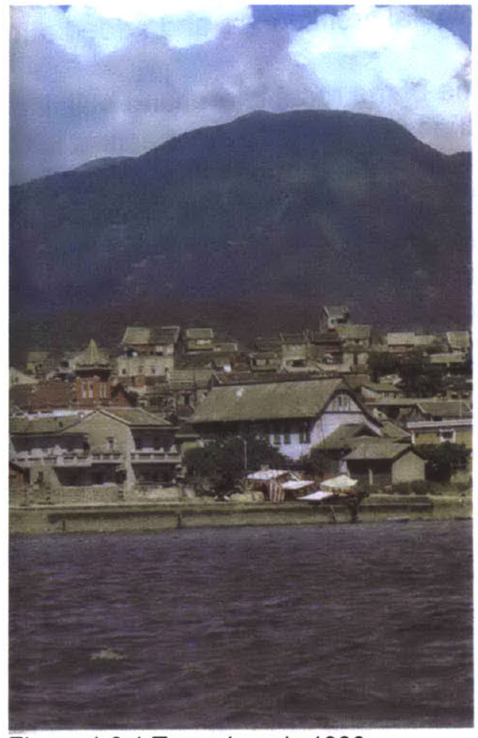


Figure 1.3.1 Tamsui early 1900

Figure 1.3.2 1920

Figure 1.3.3 1990

1.4 REPUBLIC OF CHINA

1945

After WWII, Republic of China took over Taiwan. Tamsui became a fish village despite its glory being an important trading port back in 19th century. Due to the introduction of the Taipei Rapid Transit System's Tamsui line, Tamsui, the last stop of the second mass transit line, has experienced a sharp increase in the tourism which is famous for its diversified historic heritage, traditional food, and sunset viewing spot along the Tamsui river.

Figure 1.4.1 Tamsui Wharef

Apart from tourism, it is the 3 universities in Tamsui, including Aletheia University founded by George Lesily Mackey that create an extra 150,000 population in this area during the academic seasons, which contributes to the prosperity and necessity more transportation for the rising demand.

Figure 1.4.2 Tamsui Bridge

For almost 50 years, the main transportation between Taipei and Tamsui relied on train, buses, cars, and motorcycles. The major road connecting Taipei and Tamsui is Da-du Road.
Most of the people above the age of 28 have the memories of illegal racing on this particular road. As the Rapid Transit System finished, Tamsui becomes one of the fastest growing city in northern part of Taiwan. Due to the necessity of tours, Blue Highway project was introduced and still under construction. This is actually a way connecting all the old cities along the Tamsui River.

Figure 1.4.3 Tamsui River Back

Following the completion of the Taipei Rapid Transit System's Tamsui Line, Damsui has experienced a sharp increase in tourist traffic, reflected in the completion of several riverside parks, the growth of open-air markets specializing in traditional handicrafts, the construction of a fisherman's wharf, and the increase in passenger ferries traversing across and along the river.

All the picture and map in this chapter were provided by the Tamsui Local government. http://www.tshs.tpc.gov.tw

CHAPTER 2: STATIC FABRICS

In terms of urban design, it is without a doubt that the context of a city is the most important thing above all. According to Christopher Alexander, the definition of "Context" is "Anything in the world that makes demands of the form"—including different urban elements in a hierarchical way, different constituencies in different social levels, the overall environment and the economical forces behind it. However, only through understanding the history of the development of the city can we understand the relationship of what are the reasons behind a certain phenomenon and its result.

Most of the urban design methods seems to be a linear sequence of thinking and searching process, -- Thinking of how to create new possibilities and searching for the hints for the next movement within the context. One step is followed by the next step, like a tree that grows from its roots and spreads out as it grows. The word "spread" and "grow" contain two basic ideas. "Spread" is refers to topological issue and "grow" refers to the time factor.

Cities are a self-sufficiency organism which spread out by different forces. It often resulted in a systematically chaotic growth. Many urban design precedents were trying to analyze this chaos is by breaking the city into different hierarchical physical elements.-- building types, blocks, streets, neighborhood, and districts.— and study the developments through its history. However, nowadays cities especially Asian cities grow in a lightening speed with far more complex urban issues and urban systems.

I like to look at all these different element as part of urban fabrics. These fabrics are defferent urban elements. Building types. To be more specific, the fabrics are as following:

Building Types
Temples
Parks and Garden
Blocks
Streets
Civic Structures

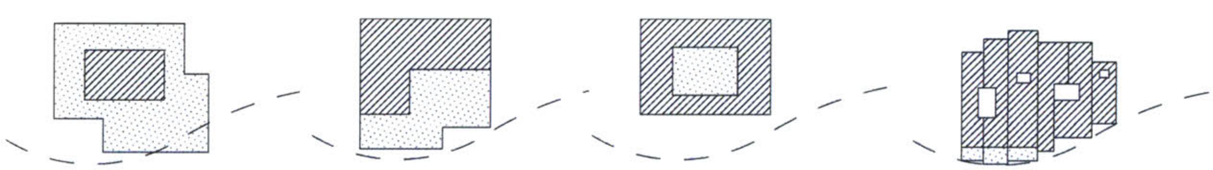
2.1 BUILDING TYPES

There are four different building types in Tamsui, fortress, churches, temple, and Chinese shop house. The diagram indicates the different relationships between public and private realm. The curvy dashed line represents the topography that strongly bonded the development of Tamsui. Different building types have a different relationship with the topography interacting with public and private realm.

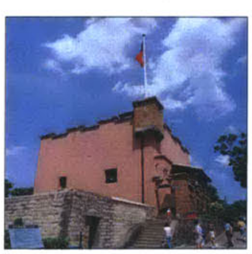
The Fortress has a private space in the middle site, and semi-public space around it. It cut through the topography and formed a castle.

There are a few churches in Tamsui which can dated back to frequent missionary by George Leslie Mackey in late 19th century. The most famous one, Tamsui Church, which was design by the son of Mackey in 1933, has a private space located on the edge surrounded by a public garden.

The Temples are the most important building type in every traditional Taiwanese city. They served as origins at which Tamsui city is developed from. The temple is rather a public space than private space. In terms of Feng-shui, site selection of Temples has its own rule of thumb as hills or mountains on the back and an open square in the front. In Tamsui, the oldest temple, Fu-An Temple is facing the opening water. The semi-public space on the edge of and opening in the center are sacred public space where people communicate with their God or Goddess.



FORTRESS   CHURCH   TEMPLE   SHOP HOUSES




CHINESE SHOP HOUSES

The history of the taiwanese shop house could trace all the way back to the beginning of 19th. As we can see in the diagram, the Tamsui is built around the temple with long shophouse. Depending on the function of these houses, the residential ones does not have arcade and the commercial ones has arcade. In the early stage of the development, there is a clear distingush betweeen residential and commercial. later on it becomes all mixed used. Most of the existing houses are used as commercial shops in the front and residential use in the back. Usually with one family live inside, but sometimes more than 2 families.

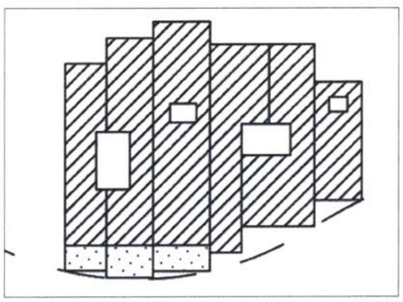


Figure 2.1.1

Figure 2.1.2

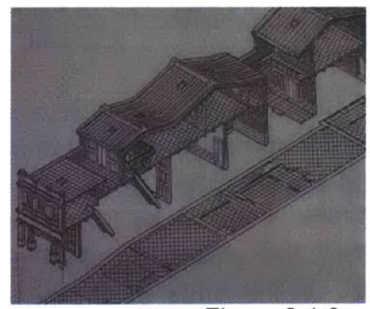


Figure 2.1.3

2.2 SQUARES, PARKS AND GARDENS

The hatched area in the map indicates the location of fabrics where squares are located in front of tradtioinal Chinese Temple. In traditional Chinese culture, square of temple not only served as a sacred place at which people communicate with God, but also function as public social space.

Figure 2.2.1 Temples

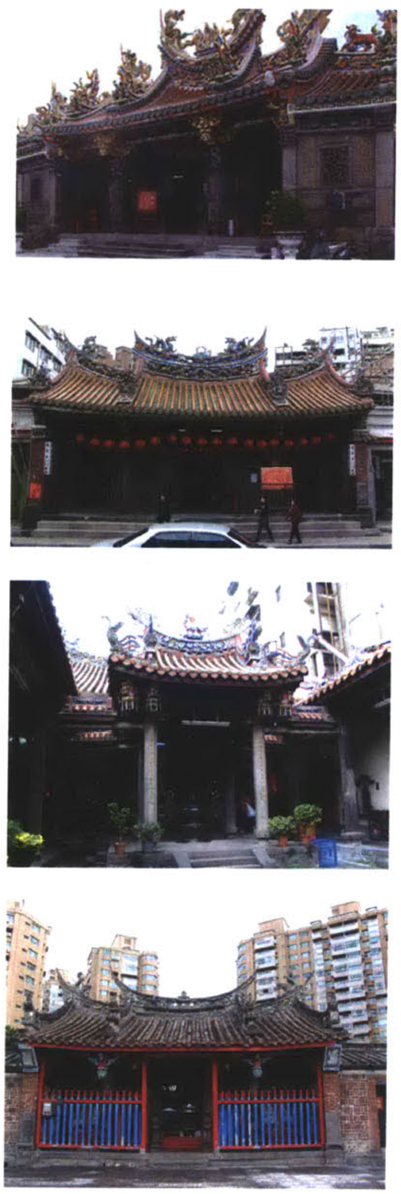


Figure 2.2.2 Parks

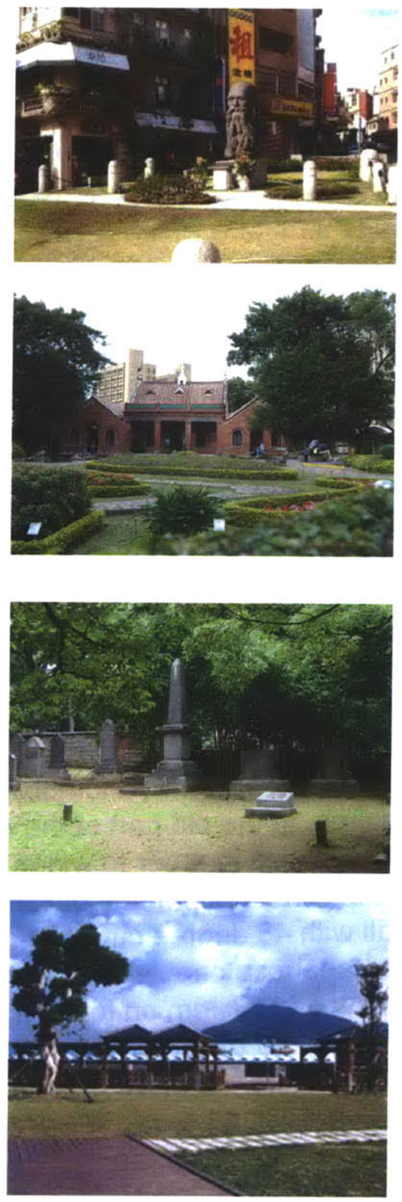
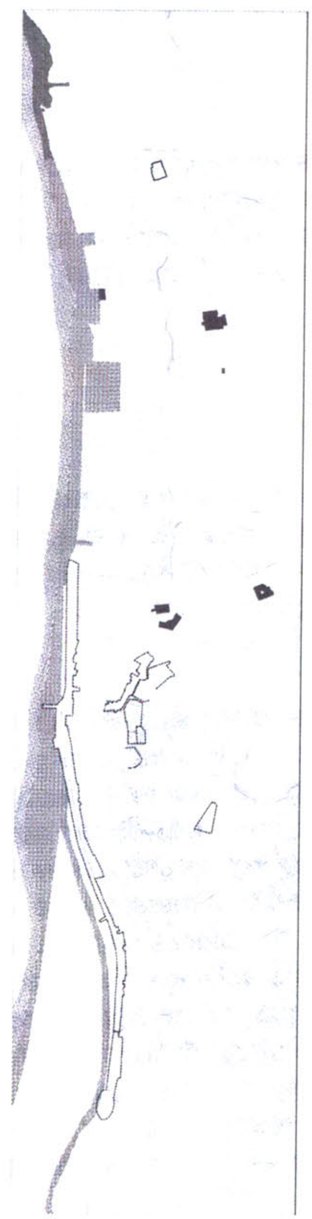


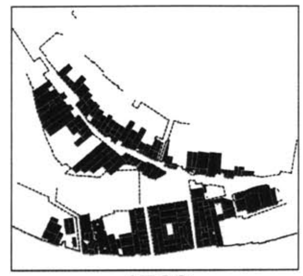
Figure 2.2.3



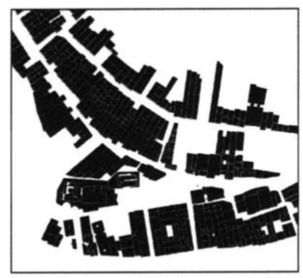
2.3 BLOCKS

In terms of the way of how the blocks are defined in this area, I would like to argue Tamsui blocks are defined by two different ways and can be roughly divided into two different stages.

The first phase is from 1769 to 1854.
As shown in diagram "1769," buildings are scattered on the site without clear edges. Taiwanese people at this time did not have a clear idea about the block, therefore they built streets intuitively; the pattern organization is more linear and focused on the street rather than blocks.


1769

As we can see in the second diagram below, the first block was formed around 1810. Shop houses were merged together from back to back, forming a huge structure which appears as an amorphous block.


1810

By1858, as the population increased and the growth of the city expanded, these huge structures scattered throughout the site and formed an organic shape in relative relation to the topography.


1858

The fourth diagram is the newer development done by the Japanese. Japanese people introduced the idea of urban planning and started to reorganize the street system. Automobiles were also introduced during this time. In the old part of the city, shop house arcades were reduced in size in order to widen the street to 9 meters wide. For the newer developments of Tamsui, the blocks were usually small with 45 degree cuts on the corners. Unlike Taipei city where Japanese people took off the old part of the city and rebuilt a new grid system on top of it. The street system in Tamsui was planned based on the topography and the existing buildings, therefore the block system still remained an organic shape. However, these blocks have a clear edges and moderate size with systematic orders.


1910

In the block diagram below, most of the grey blocks were built by local residents before 1894. And the hatched blocks belonged to the newer urban development attributed to the Japanese. The old blocks were the blocks formed by buildings whereas the new blocks are formed by streets.

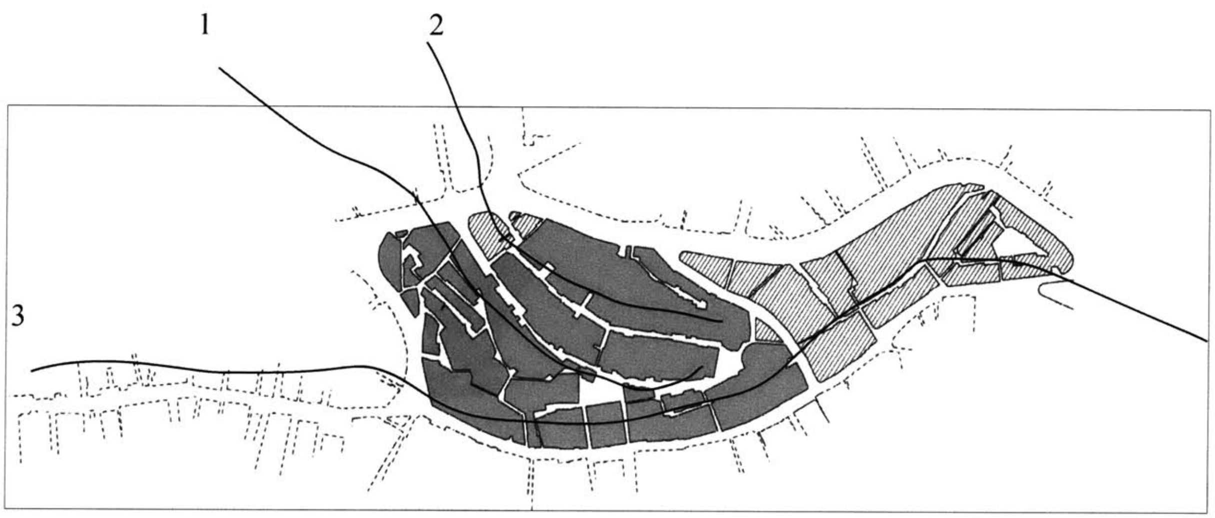


Figure 2.3.1

2.4 STREETS

I would like to refer the city of Tamsui as a city of streets. The development of this city follows the streets and the streets were built to accommodate to the site topography. There are four different phases of street development: See Figure 2.4.1

1769: Due to a flood that happened on the other side of the river, refugees move to Tamsui where the land is higher and affords natural protection against the floods. The street is called the rebuilt street. This street is mainly a residential street.

1810: As the population increased, a second street is built as a commercial street. In Chinese, the name of this street translates to "the rice street." The shop houses along this street have arcades which provide shelter from the sun and rain when people go for grocery shopping.

1858: The accumulation of the Tamsui River creates extra parcels along the riverbank. Local residents look at the accumulation of Tamsui River as an advantage, and start to build houses on these new parcels.

1910: The city becomes more linear along the riverbank towards the north where land was more flat.

Figure 2.4.1

Streets and Pedestrian Walks

Street #3 in Figure 2.3.1 is most interesting street in Tamsui . It is the second street parallel to the river. The first street is used as a river walkway. This street is built after the accumulation of Tamsui River during the late 19th-century. It is now the most famous street in the area and it has been redeveloped as a commercial district.

As shown in Figure 2.3.2 below, on each side of the street there is a pedestrian walk, 2 meters to 3.5 meter wide, unlike most of the Taiwanese commercial streets which have shop house arcades running through houses on the ground floor. The shop houses along this street do not have arcades because the Japanese removed the front part of the building in order to widen the streets.

The arcade provides a transaction space in between the public and private. It is also an important social space. Without these arcades, the pedestrian walks become a battle-field where pedestrians and vehicles are fighting over the spaces.

All kinds of elements were inserted on to the pedestrian walkways. Street vendors, scooters, bench, even information booths were scattered on the pedestrian walk. As a result, congestion was always an issue for pedestrians traveling to specific locations.

Figure 2.4.2

2.5 CIVIC STRUCTURES

Figure 2.4.1
This is the image of 1850's. Tamsui port was not abundant yet; different goods such as coal and tea were shipped from Tamsui to China and northern Asia such as Japan. During that time, Tamsui was the biggest port in northern part of Taiwan.

Figure 2.4.2
This picture was token around 1985 right in front of the Tamsui train station. The train was the major public transportation between Tamsui and Taipei. It is now replaced by the Taipei Rapid Transit System.

Figure 2.4.3
An interesting picture around 1990. This is the Tamsui Ferry waiting area. People sitting on the bank of the wharf and waiting for the ferry to come; the ferry runs to the other side of river Bali which connects to buses that goes into Taipei County.

Figure 2.4.4
The train system introduced by Japanese people is now no longer in use as the transportation shifted from train to Taipei Rapid Transit System. The old houses along the old railroad were replaced by new developments.

Figure 2.4.5
Tamsui port is used mainly for fishing activities. This port has moved further north due to the accumulation of Tamsui River.

Figure 2.4.6
Taipei Rapid Transit System Tamsui Station This station is built on the former location of the old train station. It is one of the most frequently used stations. Local residents use it for commuting to work in Taipei. It is also the last station of the Tamsui line.

Figure 2.4.7
The Tamsui Bridge. Completed in 2003, it becomes one of the most famous tourist sight-seeing spot in this area beside the old street.


Figure 2.4.1


Figure 2.4.2

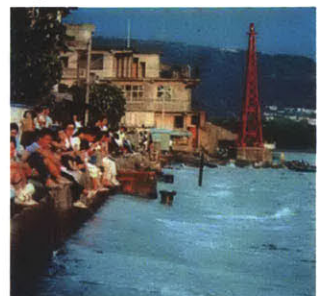


Figure 2.4.3


Figure 2.4.4


Figure 2.4.5


Figure 2.4.6


Figure 2.4.7

CHAPTER 3 DYNAMIC FABRICS

The fabrics which I mention above are more likely to be "Static Fabrics" .These fabrics could be defined as below.

1. They are stable urban elements.

2. They form permanent spaces.

3. They usually have single-use program.

I would like to propose a different kind of fabrics called the "Dynamic Fabrics". These new fabrics have the following characteristics:

1. They are unstable urban elements.

2. They forms or occupies temporary spaces.

3. They usually have mix-use program.

3.1 OLD SHOPHOUSES

OLD SHOP HOUSE I

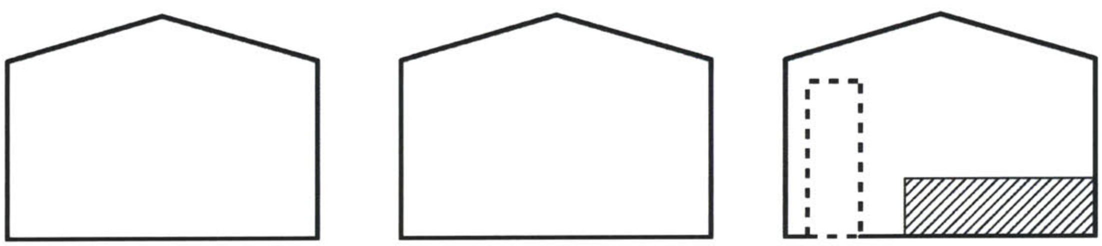
Most of the remaining traditional shop houses on the site are for residential-use. These houses have not changed much since the very beginning. These houses are usually single-family, where up to three families may reside, depending on the depth. With 5 to 8 meter wide in the front elevation, and 15 to 30 meters in-depth, they usually has an opening in the middle.

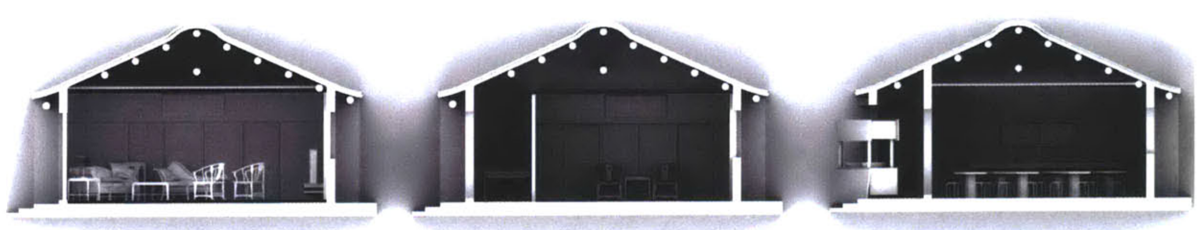
OLD SHOP HOUSE II

Some houses are divided into two different sections. The first part is more semi-public where local residents use it as a service area. The programs for the service area could be storage place or the ceremony place where Taiwanese people use this space to worship their ancestors.
This unit does not have any commercial activities, and are usually located in the center portion of the shop house.

OLD SHOP HOUSE III

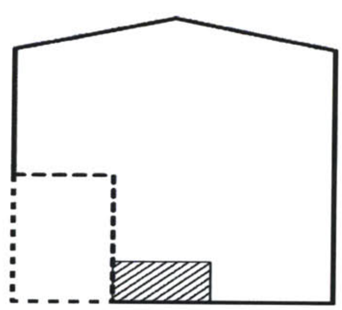
The shop house built in the second phrase of the city development has arcades in the front of the elevation. Local residents take the advantage of these arcade and use them as commercial shop fronts. They usually place a street vendor cart right at the arcade and used the inner spaces as commercial spaces. The commercial activities occupied the front, and all the way into the house, extending as far as possible.

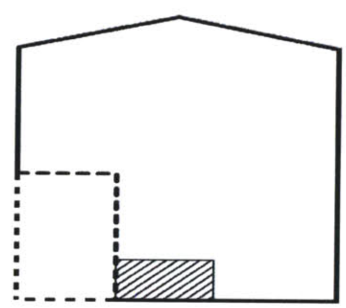


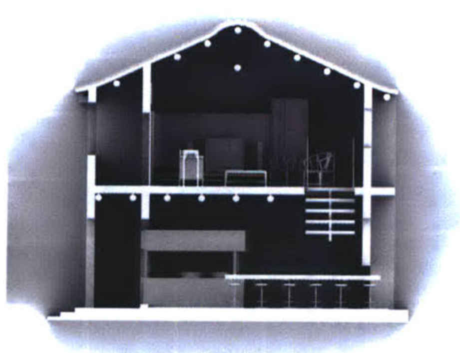


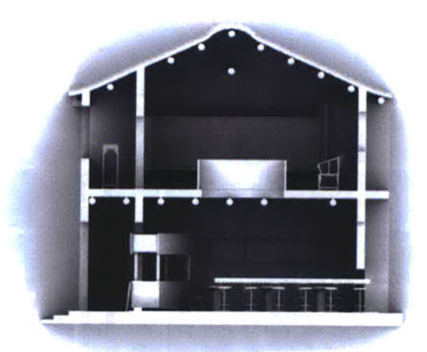
OLD SHOP HOUSE IV
Some of the shop houses on the site are two floors high. These units are usually divided into to two. The ground floor is often used as commercial spaces. Because the width of the front elevation is wider the former types, therefore, in many case, the local resident renovated into a commercial shop with the commercial space extend into the house.

OLD SHOP HOUSE V
These units have arcade in the front and an interesting openning in the middle of the house. This interesting openning is for the air circulation and sometimes even for the sunlight to drap off from the rooftop.









3.2 NEW SHOPHOUSES

NEW SHOP HOUSE I

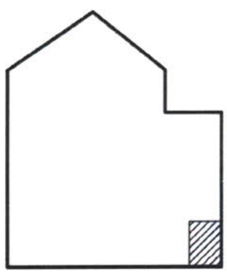
These were much more recent housing units, usually built by single families. These houses have mixed-use programs, usually with a commercial space on the ground floor, and an illegal add-on rooftop.

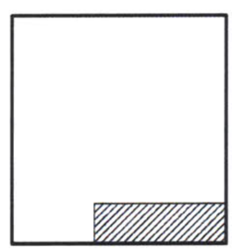
NEW SHOP HOUSE II

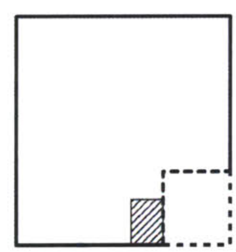
This type of house was build around the early 70's. Unlike the former one, this kind of shop house is usually built and shared by several families. Commercial use on the ground floor and sometime even second floor and residential use on the top.

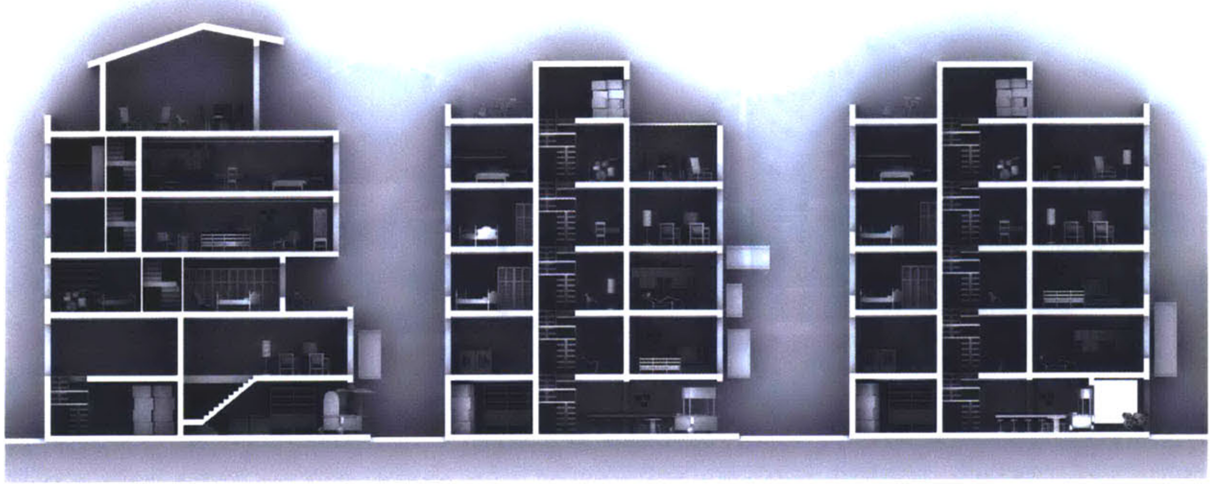
NEW SHOP HOUSE III

This is the typical and the most common kind of shop house in Taiwan. The only difference between this one and the former one is the arcade. These arcades are linked between buildings creating a walkway inside the building to provide a shelter from the rain.









NEW SHOP HOUSE IV

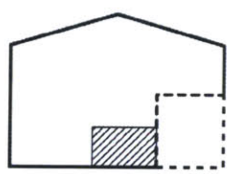
These houses used to be the two stories high, owned by single family. Usually commercial shop front and service area in the back. Most of the third floors are illegal add-ons in the late 80's.
Some of these houses have arcades where commercial activities are usually happened there.

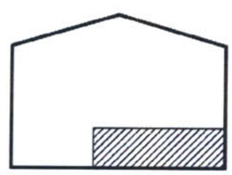
NEW SHOP HOUSE V

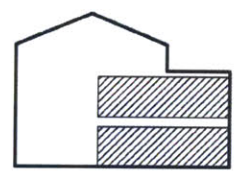
Pretty much the same as the former ones but without arcade. Convenient stores like this typology because there is no waste of space for the arcade. This can maximize the usage of the space they want to use.

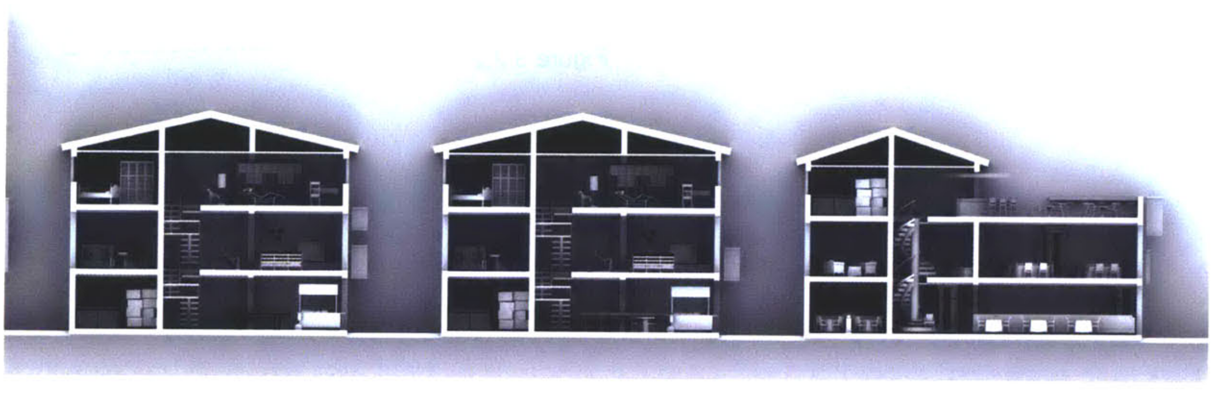
NEW SHOP HOUSE VI

If the house is located in commercial districts, it is usually renovated into commercial uses with service area in the back of the house. Depending on the size and the depth, the commercial activities could be varied from restaurant to supermarket or private learning institutions.









Dynamic fabrics inside buildings

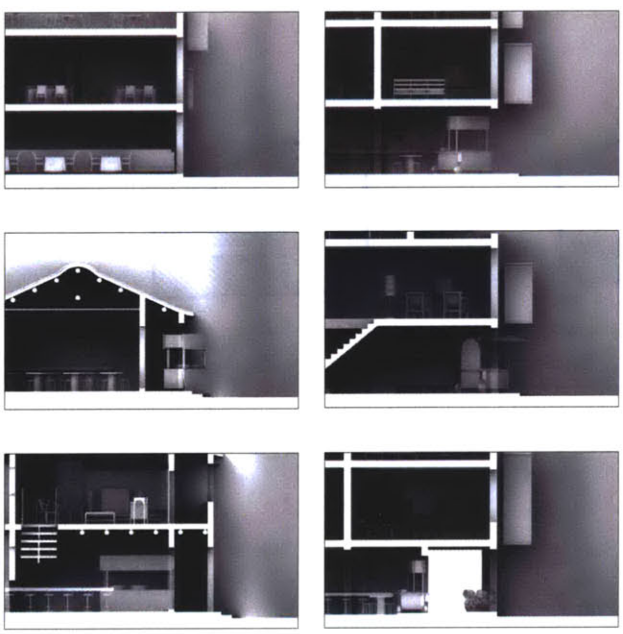


Figure 3.2.1

Dynamic Fabrics on the pedestrian walk

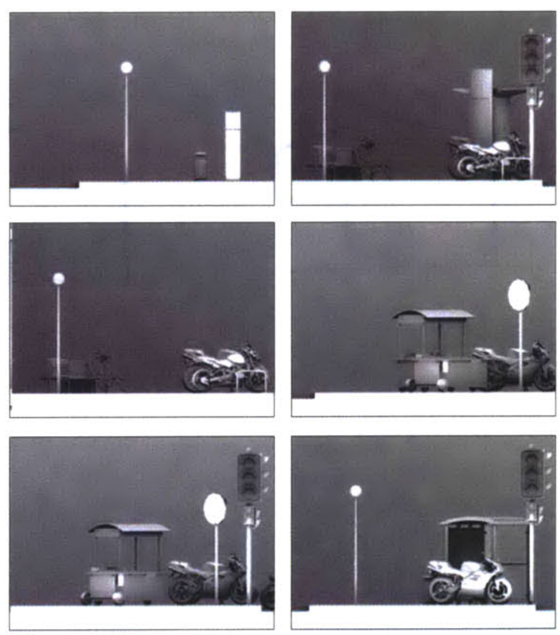


Figure 3.2.2

Dynamic fabrics inside buildings

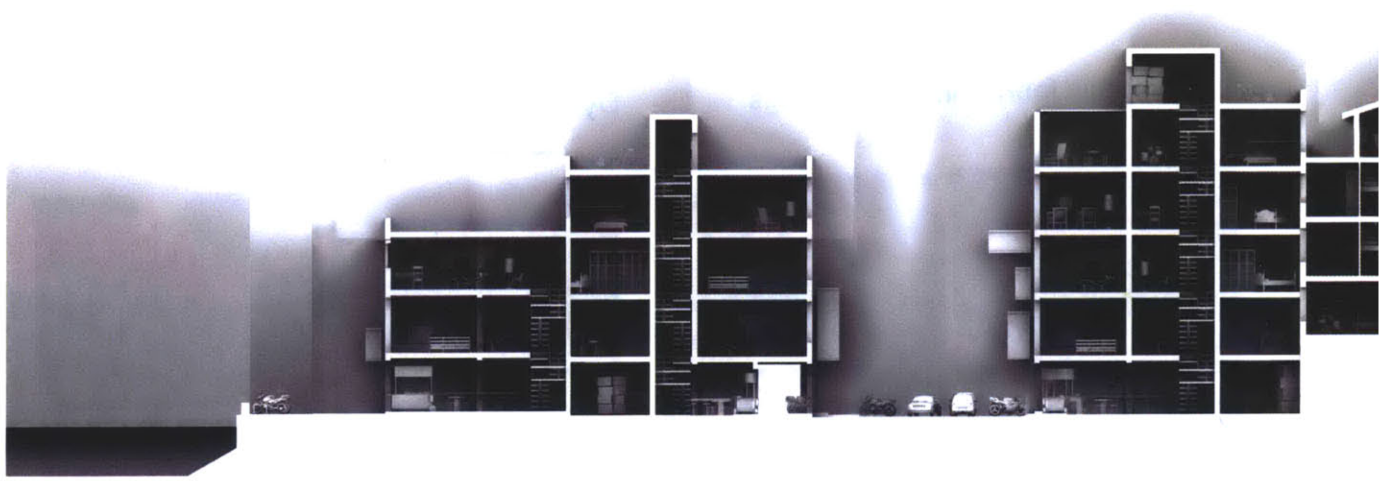
Figure 3.2.3

Dynamic Fabrics on the pedestrian walk

Figure 3.2.4

3.3 SECTION COLLAGE

POSSIBLE SECTION ON THE SITE BASE OF THE DYNAMICS FABRICS A



POSSIBLE SECTION ON THE SITE BASE OF THE DYNAMICS FABRICS B

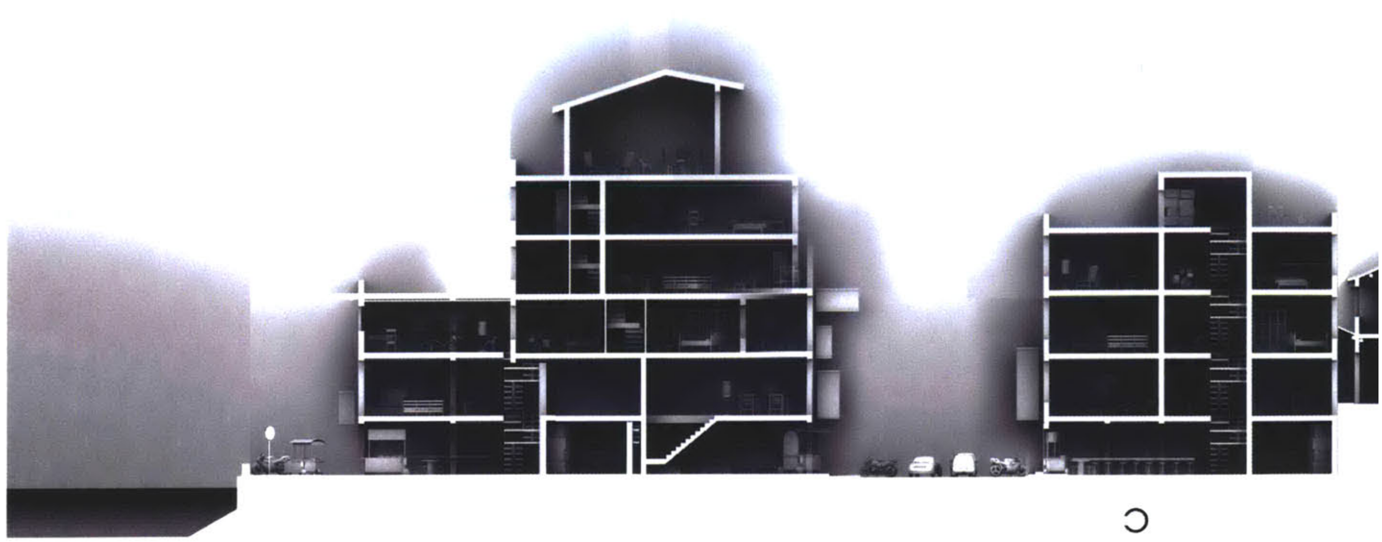


Figure 3.3.1

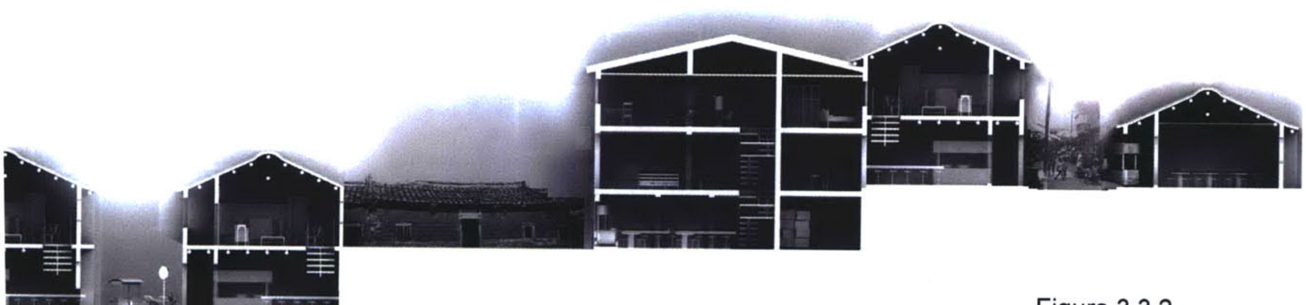
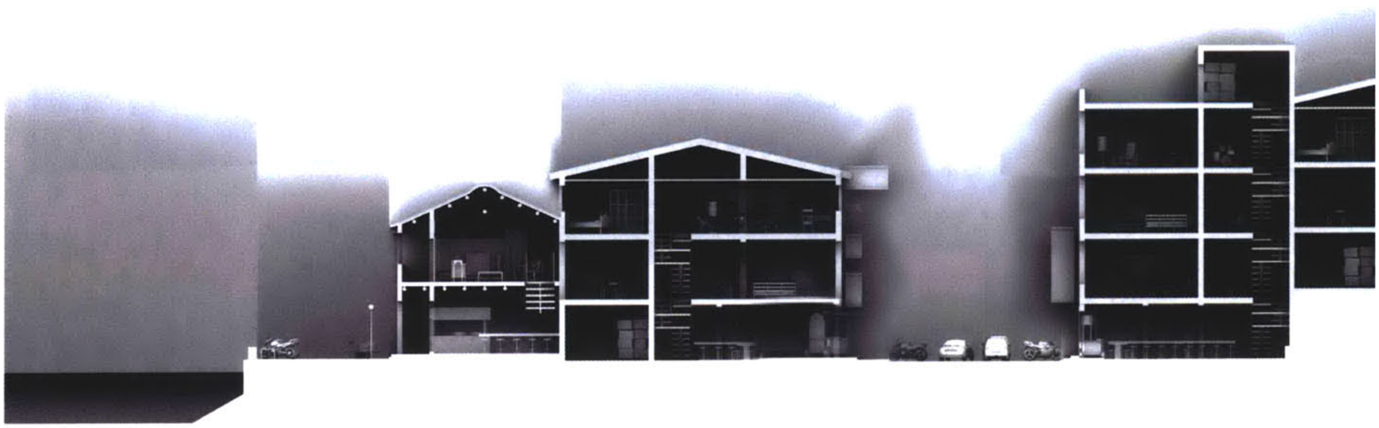
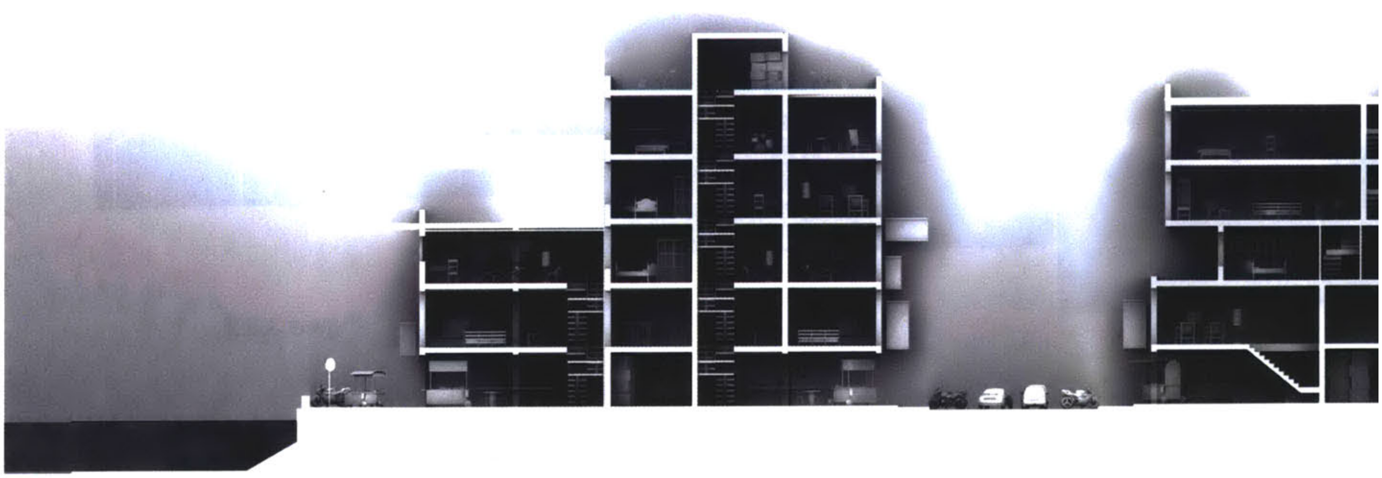


Figure 3.3.2

POSSIBLE SECTION ON THE SITE BASE OF THE DYNAMICS FABRICS C



POSSIBLE SECTION ON THE SITE BASE OF THE DYNAMICS FABRICS D



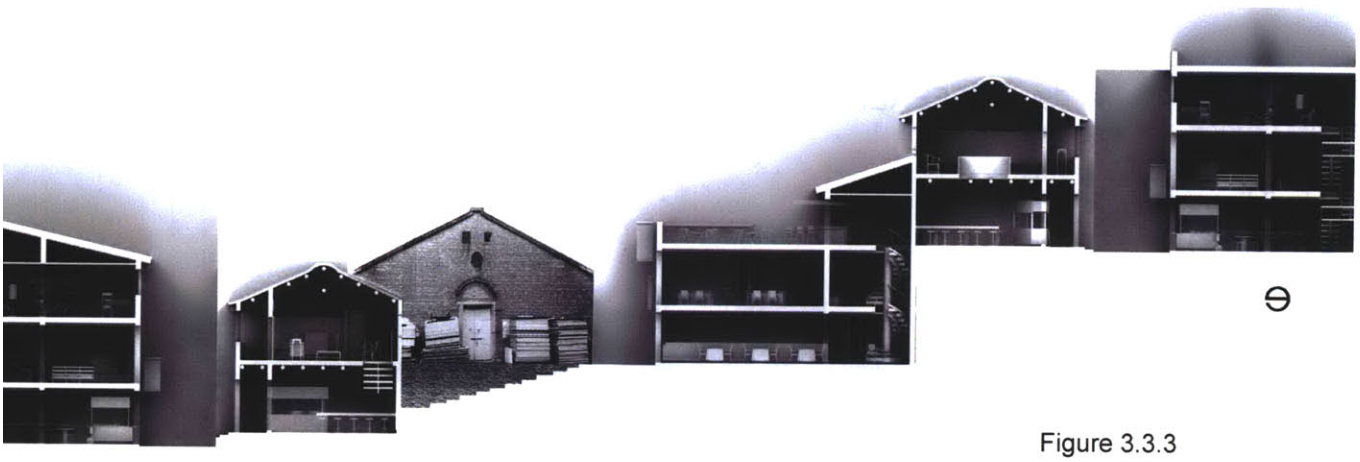


Figure 3.3.3

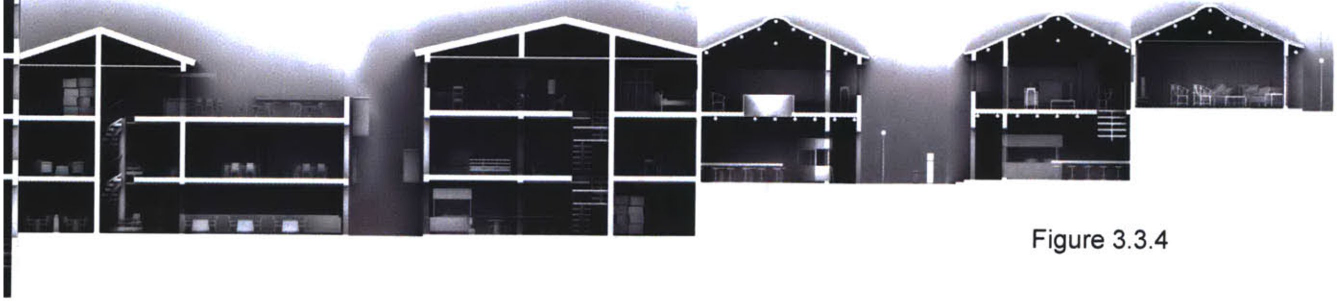
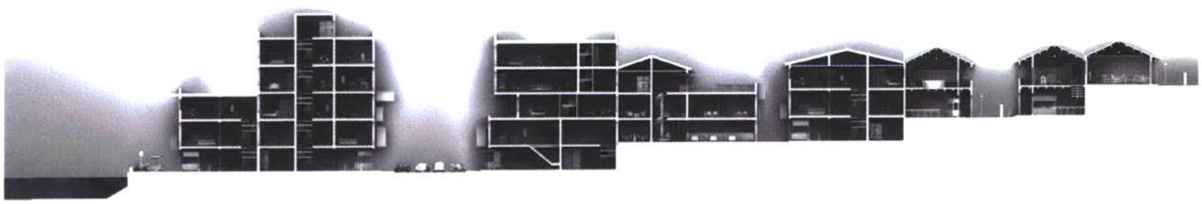


Figure 3.3.4

3.4 WHERE ARE THE DYNAMIC FABRICS



In order to locate the dynamic fabrics, we need to first differentiate the public and building areas. (Figure 3.4.1)

DIFFERENTIATE

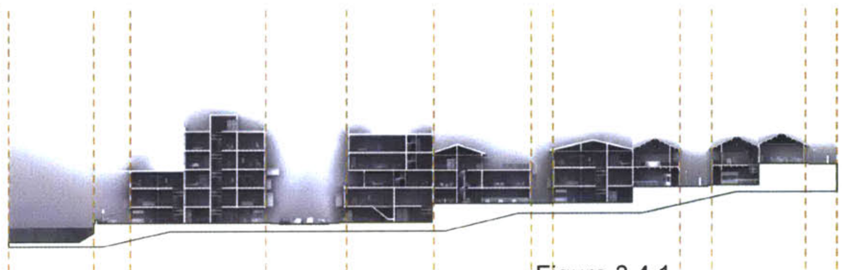


Figure 3.4.1

ABSTRACT

These fabrics does not locate in the sky, there for by abstract the outline of the buildings gives us a better sense of where would these fabrics be located. (Figure 3.4.2)

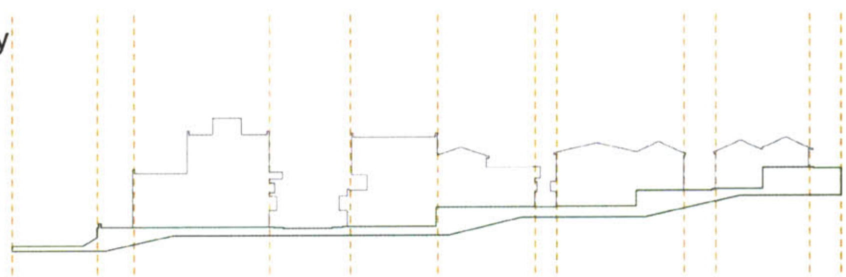


Figure 3.4.3

Residential fabrics are usually more stable and permanent fabrics. The yellow pattern represents the space used as residential service areas. The brown pattern represents the living room and the grey pattern represents the bedrooms. (Figure 3.4.3)

RESIDENTIAL FABRICS

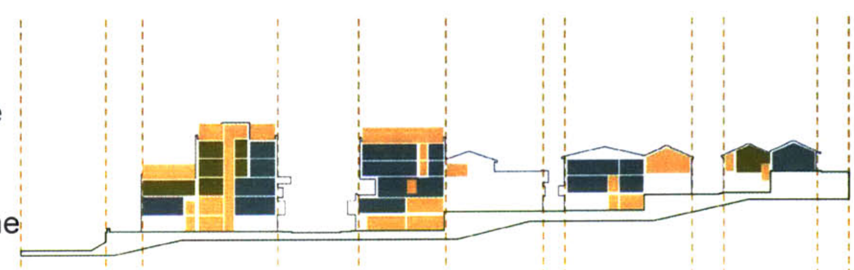


Figure 3.4.3

COMMERCIAL FABRICS

Figure 3.4.4

The green pattern indicates the commerical areas. These fabrics are important because a lot of temporary commercial events happend here. (Figure 3.4.4)

PUBLIC FABRICS

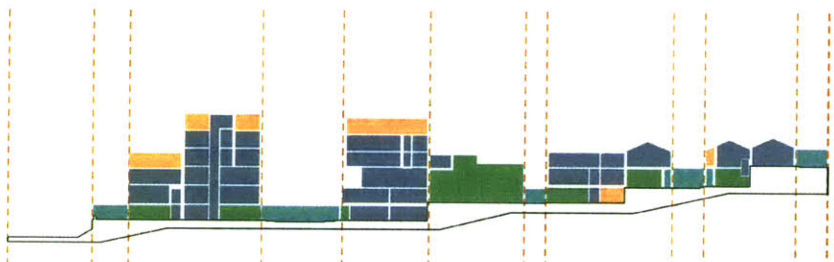


Figure 3.45

The blue pattern represents the public fabrics. These includes both the pedestrian walk and the streets. These areas are used as public areas. (Figure 3.4.5)

PROBLEMATIC FABRICS

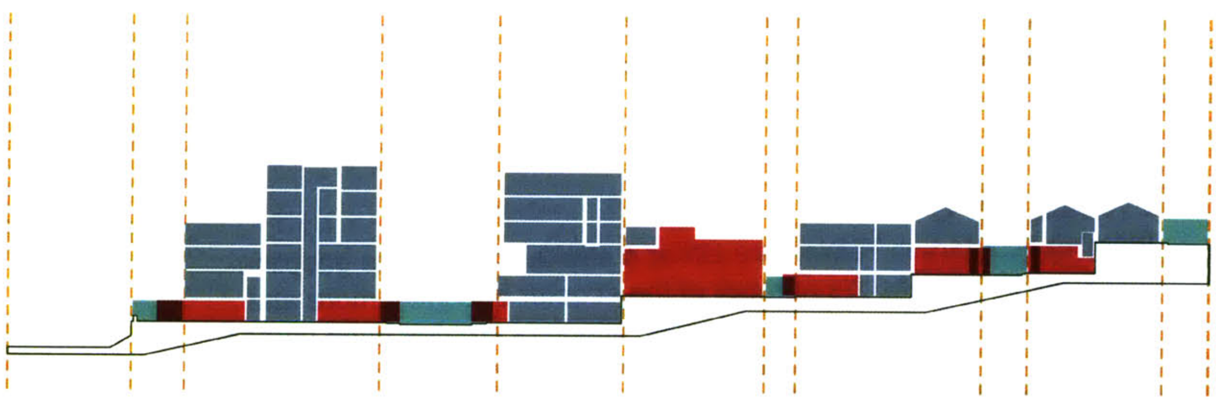


Figure 3.4.6

If we darken the residential fabric and leave the public and commercial fabrics, according to different period of time, we can see that these two fabrics change its boundary constantly. These two fabrics even interfered with each other form problematic dynamic fabrics. (Figure 3.4.6)

4.1 URBAN ISSUES

PROBLEM A

The shop houses at the old street of Tamsui do not have arcades because the Japanese removed the front part of the building in order to widen the streets. Therefore, the pedestrian walk becomes a linear battle field where pedestrians are fighting over spaces with scooters, street furniture, and street venders. Please see Figure 4.1.1.

PROBLEM B

There are 13.6 million of scooters running around inside the small island of Taiwan. Recently studies show that less than 30% of scooter commuters only travel less than 10 km per day. The city infrastructure does not meet with the demands; Not enough parking space for cars and scooters. 6.3 cars sharing one single parking space and 9.8 scooters share one parking space. In Tamsui there are 200 scooter parking spaces along this old street and the average of scooters parked here is 600. These 600 scooters are fighting over 200 scooter parking spaces everyday. Most of the scooter belongs to the local residents who ride their scooter from home, park on the street and switch to the Taipei Rapid Transit System. Please see Figure 4.1.1.

PROBLEM C

Existing scooters in Taiwan are either 4 strokes or 2 stroke gasoline powered scooter. As the number of the scooter becomes more and more every year, the tailpipes of these scooters creates huge carbon footprints. 11% of the air pollution in Taiwan is caused by the running around vehicles. Studies show that Scooter commuters without the mask is expose to nearly 400 second hand cigarettes every minute. Please see Figure 4.1.1.

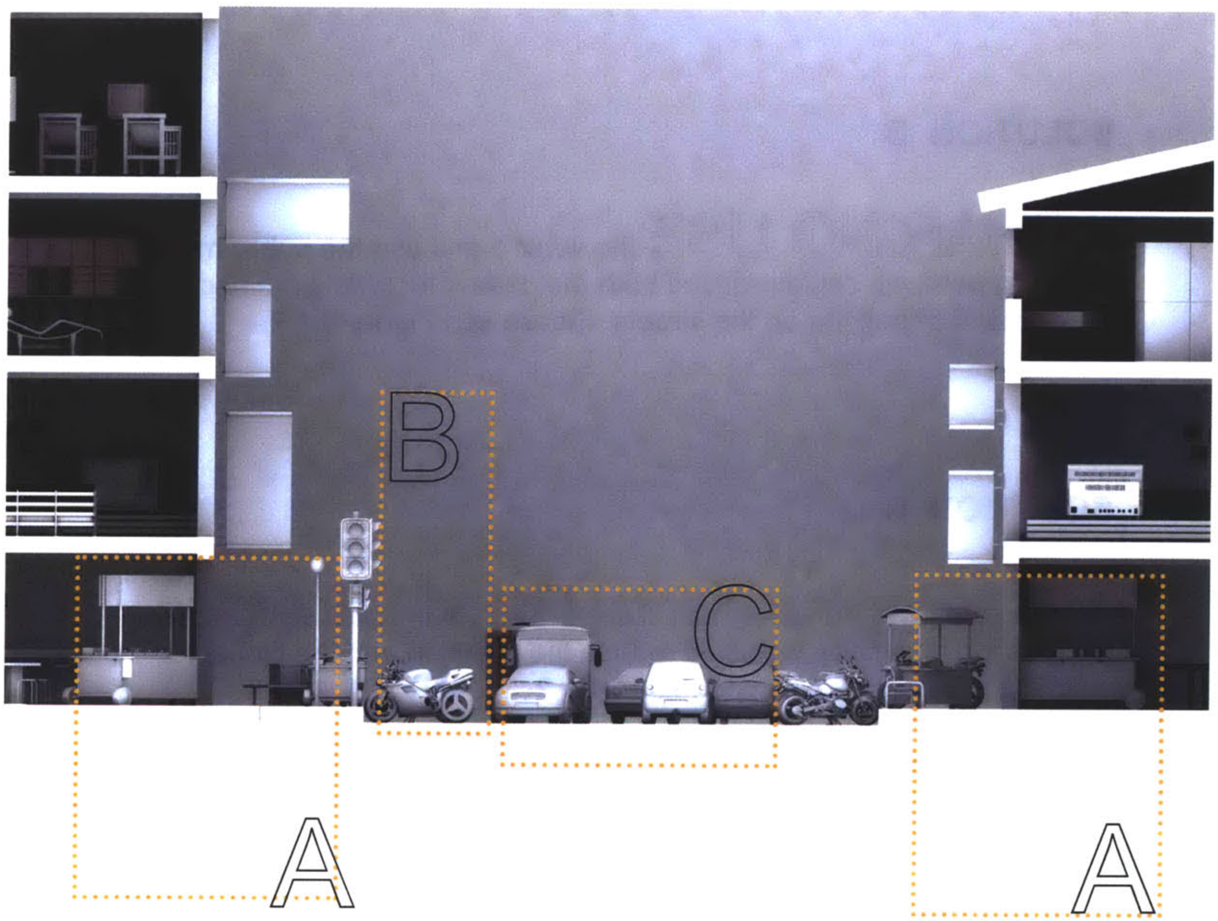


Figure 4.1.1

4.2 SOLUTIONS

SOLUTION A

By adding up the traditional 3 meter shop house arcades and regulate the scooter and street venders, we could make the space more organized. Please see Figure 4.1.2.

SOLUTION B

By SHARING USE the vehicle and use the public mass transit system, we could reduced both the carbon footprints created and the demand of parking on the streets. Please see Figure 4.1.2.

SOLUTION C

By using the Environmental Friendly Energies such as the electricity, we could reduce the pollution and the global warming problem. Please see Figure 4.1.2.

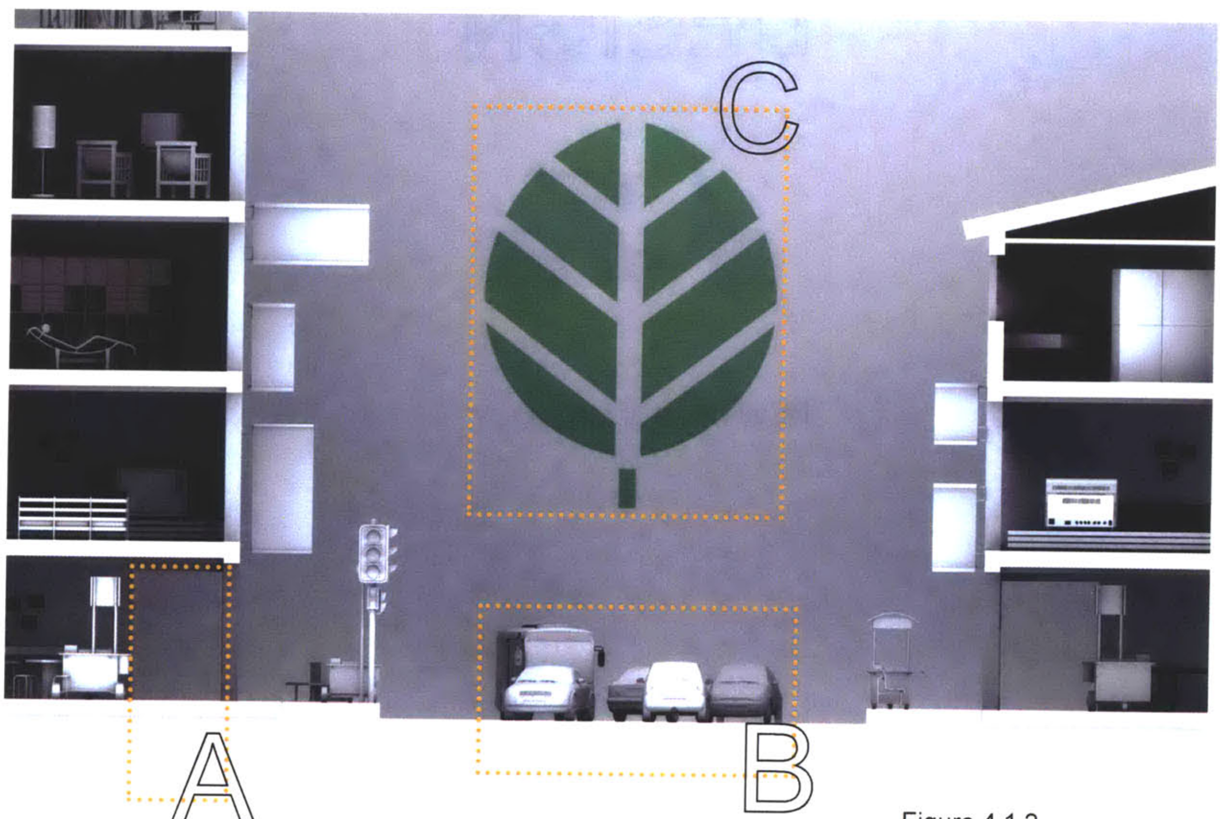


Figure 4.1.2

DESIGN

NEW URBAN MOBILITY

5.1 PREFACE

The proportion of one dollar bill is about the same as the parking space; 6 meters long and 2.5 meter wide. Imagine if we first fold the parking space once and then fold it again. We get something like 1 meter wide and 2.5 meter long shape. This is the size of standard scooter parking space. What if we fold it again and again and again? Can we introduce a new city vehicle with this footprint when parked without sacrifice the performance? Or in other word, how can we optimize the usage of the urban spaces. This question is somehow related to the urban congestion issues. Please see Figure 5.1.1 and Figure 5.1.2.

Figure 5.1.2

Like most of the cities in the world, Tamsui has not exception. Even though it is located in the Taipei suburban, but due to the Taipei Rapid Transit System, this small town has become one of the fastest growing cities in Taiwan. More and more people come here to live, more and more people come here to visit. While the amount of traffic brought by this new public transportation system has way exceed the limit that local infrastructures can support, can we optimize the existing spaces without adding major public infrastructures to this beautiful small city? Or can we provide a new urban mobility for the city to solve the traffic and pollution problems?

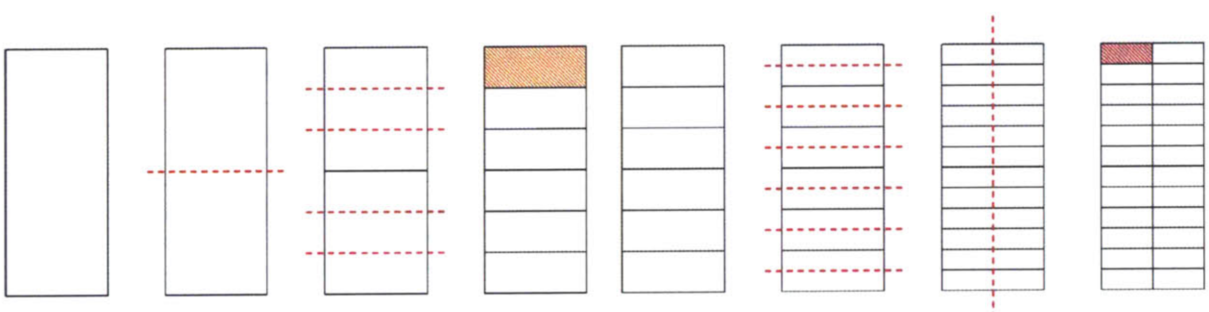


Figure 5.1.2

Folding is the most important concept in this design. By looking some of the folding logics, I summarized the folding logic into rotate shift and flip. We will have to insert at least one pivot into the scooter frame therefore some possible configuration of folding are discovered. Please See Figure 5.1.3.

Wheel Robot is a technology developed by the MIT Media Laboratory Smart City Group. It is an innovative design for future wheels. Unlike most of the existing vehicles which engine, suspension system and break system are independent, the wheel robot is integrate all these elements within a standard module. What will happen if we take the wheel robot and apply it on the scooter? Can we design a scooter without traditional engine, and how would this scooter would into the urban context and becomes part of it? This is just the beginning.

The overall idea of this project is to fold the scooter as small as possible without loosing the rigidity of the scooter structure. Scooters have been designed for more than 70 years. The very first scooter is design by an Italian company Piaggio call the Vespa.

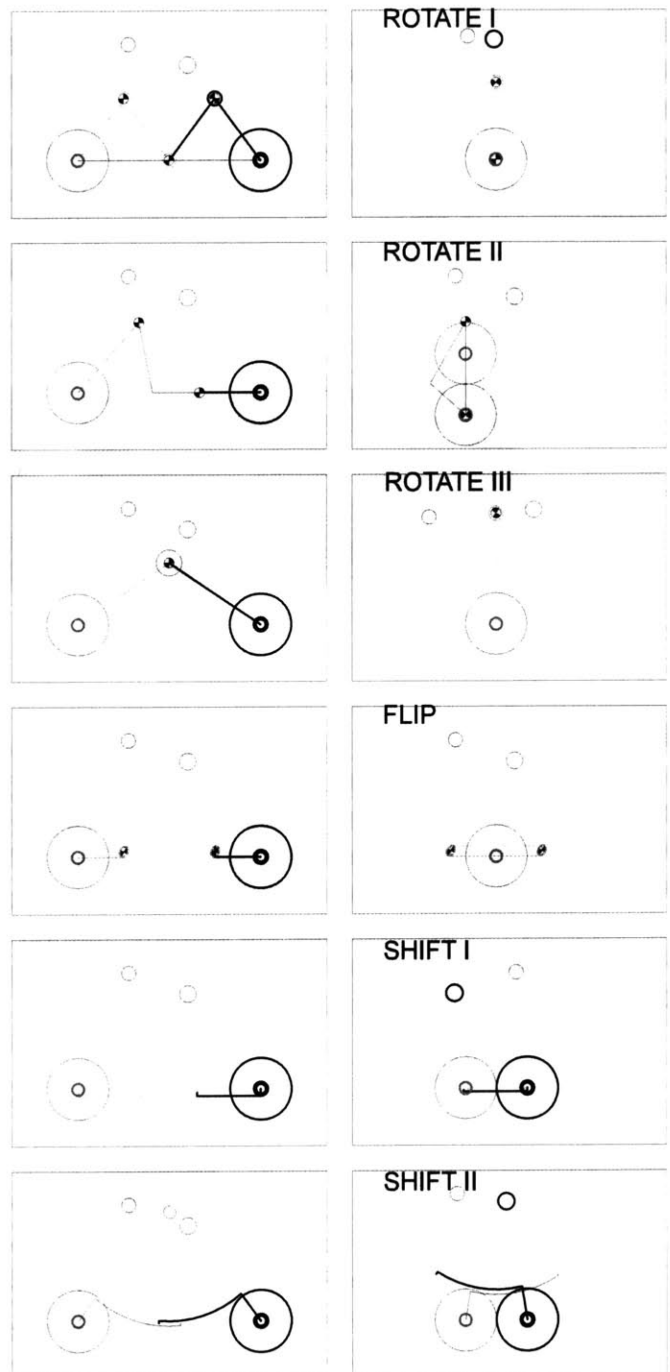


Figure 5.1.3

Piaggio Company used to make components for the air craft. The idea of using the existing components and apply them to create a new type of vehicle was very innovative The word VESPA means a small boat. This scooter provide a private space inside the scooter. It has a front penal which provides a protection form the road and weather issues.

PRECEDENTS

The design started with looking at some of the existing scooters. I use the side profile of these scooters to find out the relationship between the wheels, steering handle bar and the seat. These are the most important aspect of the scooter design. Please see Figure 5.1.4.

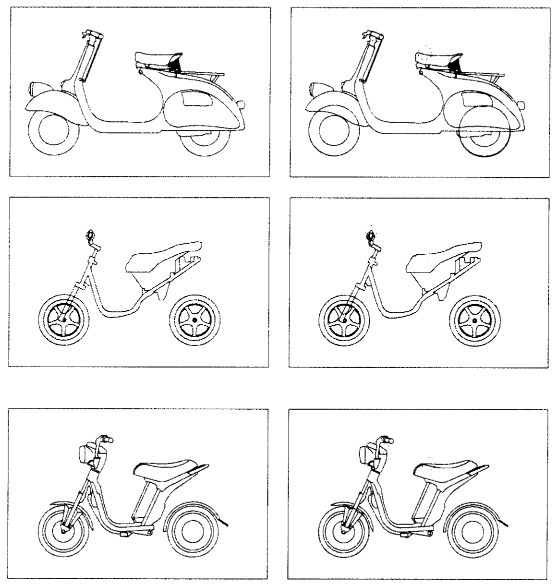


Figure 5.1.4

HUMAN ERGONOMICS

I did try to discover some more possibilities for driving ergonomics(Figure 5.1.5); however, because there is a chance that this scooter might be manufactured, therefore I decide to go for the most common riding position.

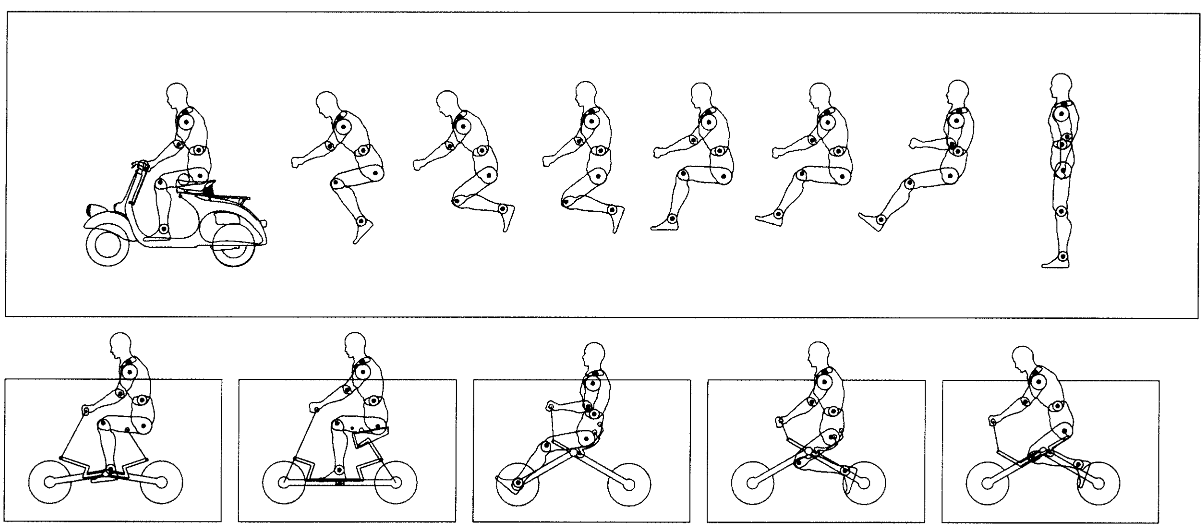


Figure 5.1.5

5.2 DESIGN DIARY

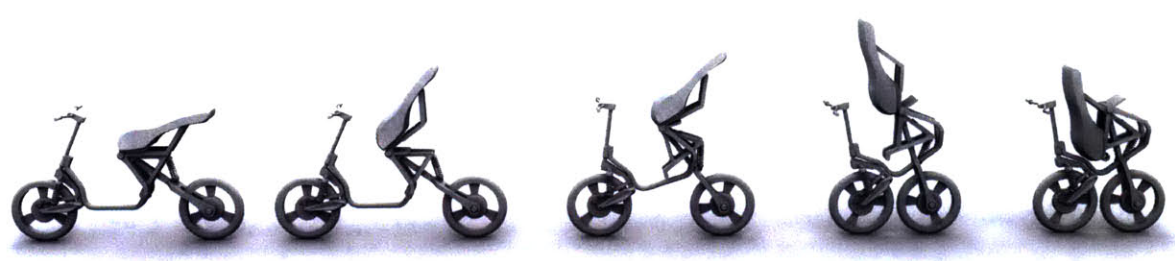
0207

During the very beginning of the design, I was trying to find a way to avoid the alignment of the wheels. I try to find a good geometry without dealing with this problem and come up with a method to juxtapose these two wheels without touch ing each other when folded.
The structure is divided into three different components. The first component is the seat. The seat is used as a locking mechanism and as a device to actuate the folding movement.
The second component is the front structure. When the seat is lifted and the folding mechanism is actuate, the front part of the scooter move back to touch the back wheel and minimize the size when it is folded.The third component is the back structure including the back swing arm.

The main problem which I am facing during this design stage is the overall geometric problems. How many folding points should I insert and where should I place them? This becomes a very tough question in the early stage of this design. The numbers of points will affect the overall rigidity of the structure and the location of these points will affect the shape when it is folded. Another challenge confronted me is where to put the seat when the scooter is folded. The space underneath the seat is used for storage in traditional scooter. It provides a secure place where you can put your personal belongings. Therefore how to use the seat as a lock mechanism and still provide a private locker becomes my first challenge.

All three layers of the structure rotate at one single pivot. This will make the folding easier and dimplier. The main body frame in the front has a wide opening in the part where the front intersects with the back swing arm. The swing arm is also rotate at the same pivot. The back swing arm is linked to a triangle shape structure which makes the whole structure more stable.

The overall structure and the folding mechanism is feasible except the size of this design is reduced to only 1/3 of the length, and because most of the spaces in between structure need to be empty where the back swing arm can access in complete. Therefore, there will be no space left for the battery and electrical components.



0302

The first attempt of the design works fine in terms of structure rigidity and the overall folding mechanism. However, the size is the biggest issue. I try to add a second pivot in the front of the main body frame, and make the front handle bar to rotate to the side of the main frame. This will reduce the size of the scooter another 1/4 which makes the total length into about 1/2 of the original length when folded. This will provide very small footprints when parking the scooter on the street.

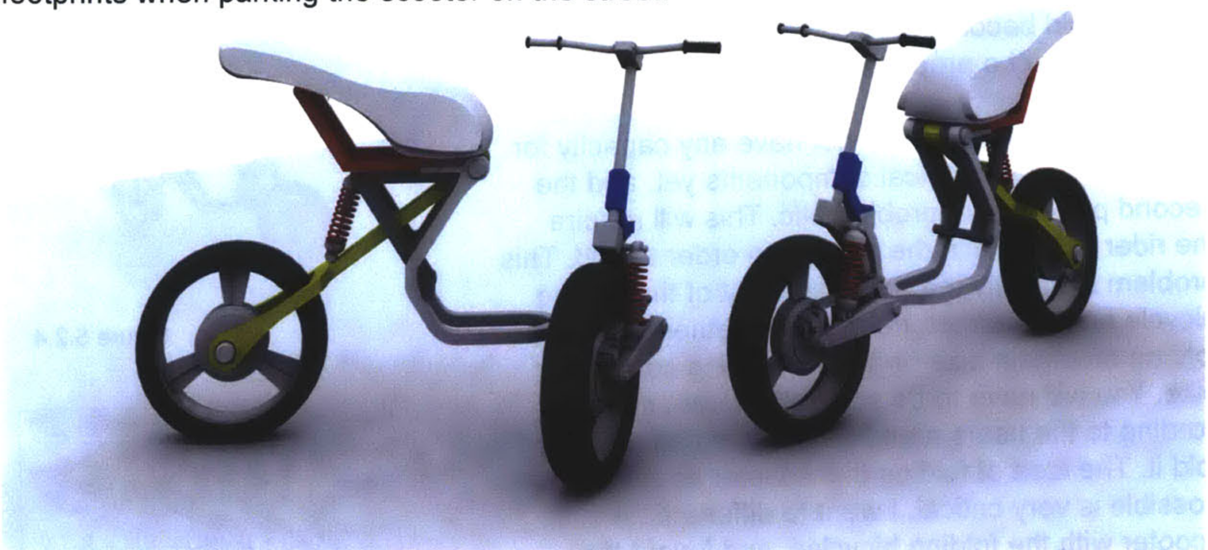


Figure 5.2.1

When we insert the pivot in to the frame, we divide the frame into two parts geometrically. The way to approach the smallest footprint is to imbed the relationship between the front main body frame, the back swing arm and the handle bar. The handle bar does not rotate with the frame body. The frame body is rotated around the z axis of the pivot I inserted while the front handle bar is rotate around the y axis. We need to either rotate the handle bar first or make a secondary rotation for the body frame or vice versa. In order to reach the smallest footprint when folded we need to consider these two parts together.

Figure 5.2.2

First take the front handle bar and rotate 180 degree to the side of the body frame. We will insert the pivot point right in the middle of the distance for the center of the front wheel to the center of the back wheel. The location of the y-axis pivot will effect the location of the z-axis pivot depending on which pivot we like to decide first we can find the second point. However, we have to reinforce the structure because these pivots would become the problem later on if we successfully select a proper location.

Figure 5.2.3

These series of design do not have any capacity for the battery and electrical components yet, and the second pivot is very problematic. This will require the rider to fight with the scooter in order to fold. This problem is exactly the same as most of the folding bicycle on the market, no matter whether it is a big folding mountain bike or a small folding commute bike. You will have to do several different steps according to the users menu before you can actually fold it. The idea of folding this scooter as simple as possible is very critical. I want to differentiate this scooter with the folding bicycles, and I want the folding process becomes an art that you can enjoy without struggling.

Figure 5.2.4

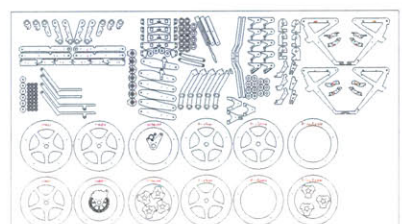


Figure 5.2.5

5.3 STRUCTURE STUDY

0309

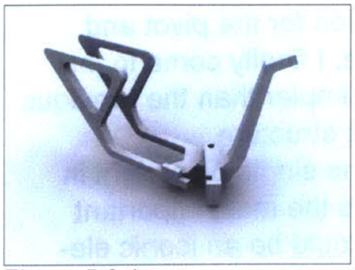


Figure 5.3.1

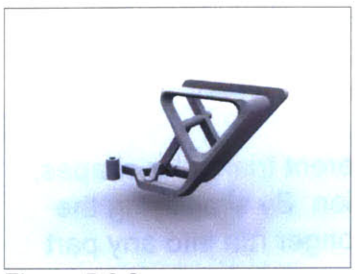


Figure 5.3.2

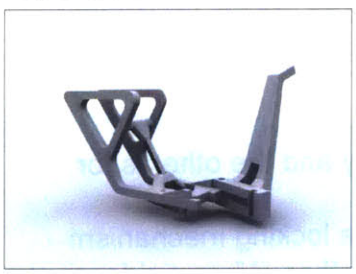


Figure 5.3.3

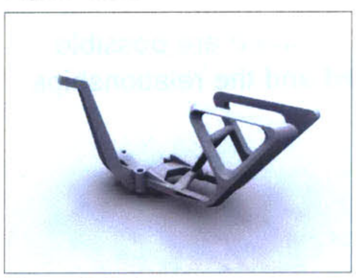


Figure 5.3.4

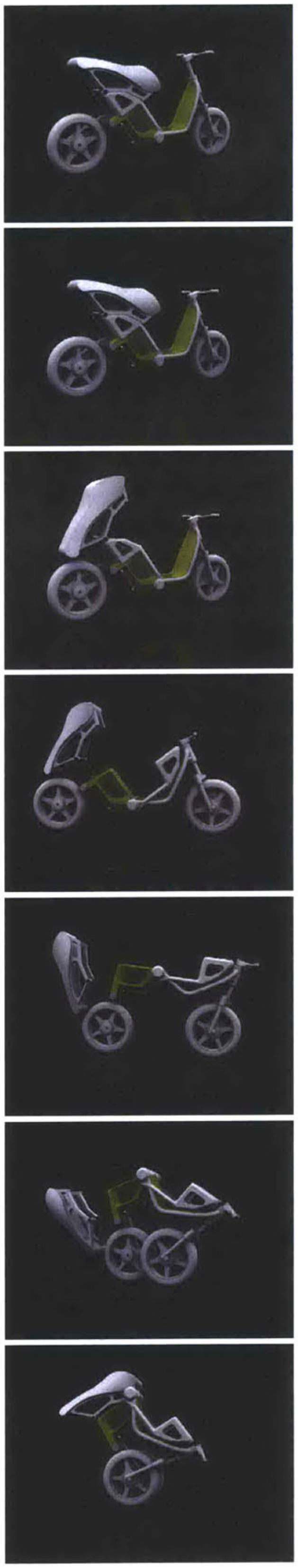
Figure 5.3.5

Staring from this point, I realized that in order to reach the optimal size of the material section about 40 mm by 40 mm, the frames would become way out of the original proportion. Therefore how can we make the structure as strong as possible, reach a good section size for each components and still maintain the relative proportion of the frame body has become one of my biggest challenge during this stage.

As an architecture student, I tend to solve this problem by looking into architecture structural design. It seems to me that the triangular structure is the most stable shape. I did a rough study on these structure and then jump back to the scooter design and try to apply some of these ideas into the scooter architecture.

Another challenge which I am facing is the big opening on the main body frame. This reason for this big opening is to allow the back swing arm to be able to rotate into the main body frame for reaching the smallest footprint when folded. I try to add a secondary reinforce structure bars on the main frame in order to maximize the frame rigidity.

The third challenge I confronted is the rotating pivot. I tried to transform the point like a pivot to a surface to reach the maximum rigidity.
Adding up all these considerations, we have something looks like the last image in this page. It is more like fixing up the old problem piece by piece. The design language is very different. Therefore I decide to give up this structure and start a new approach.



0314

After all these lessons in find the location for the pivot and the technical of improving the structure, I finally come to this design. This version of the scooter is simpler than the previous ones both in the way of folding and the structure.
Instead of two folding pivots, I place one single pivot right in the middle of the structure. This pivot is the most important piece in the folding scooter design. It could be an iconic element on the scooter.
The center rotate pivot has two degree freedom. It rotates on the z-axis and shift along the same axis to the extent where back wheel is placed juxtaposed to the front wheel.

The structure is the combination of different triangular shapes, both in the appearance and in the section. By simplifying the folding action, the back swing arm no longer run into any part of the structure. Therefore I can take the advantage of the space inside the back swing arm structure. There were many different possibilities when considering how to use these spaces.

One of the possibilities is for the battery and the other is for the electric components.
The structure for the scooter works as a locking mechanism that each part interlocks with each the other. When a rider seat on the top of the structure, the seat, his body weight help stabilize the whole structure when riding. And there are possible combinations of how it looks when folded and the relationships between these components.

0412

After discussing the final configuration and comparing with the previous folded position, I realized that the actual footprint of this scooter is determined by point A and point B, I might need to fold the front handle bar once more just to reach the smallest footprint. During this stage of design, I think I should finalize the folding movement and try to simplify it as much as possible by breaking the whole structure into three complete pieces instead of different components. Here are the three complete pieces:

A. The Front Piece: The front piece includes the main body frame, and the steering handle bar.

B. The Back Piece: The back piece includes the back swing arm, and the structure layers holding the battery and electrical accessories inside.

C. The Top Piece: The top seat with storage underneath. This piece is also the piece which actuates s the folding movement. Therefore, the whole folding process is simplified into three movements.

1. Lift up the top seat part.
2. Grab the front break
3. The back will move towards the front wheel.

The Pivot has two degree movements including rotating 180 degree and shifting 25 cm. This is a complicated mechanism that I will discuss another pivot later. It is a simplified version base on the original rotating pivot.

ELECTRICAL ACCESSORIES

Figure 5.3.6

Figure 5.3.7

Scooter design consists of several different parts. The first part is the main body frame holding the engine, the front steering handle bar and the seat. The second part is the wheel and most importantly, the electrical system. In this design I mainly focus on the basic architecture design rather than the electrical components. However, how to locate the front light, the back light and the singal lights would be also critical.

The design strategy for this scooter is to find a place in between traditional scooter and new motorcycle. This motorcycle has its structure exposed as the design itself and the scooter is usually covered with plastic panels protecting all the components. I try to design the Folding Scooter following the basic architecture rules: "form follows function". Therefore, I try to avoid any unnecessary components.

The Folding Scooter will have as little plastic cover as possible. The protection shell is considered the extension of the body frame. The structure part will be made of cast aluminum covered by reinforced high quality plastic. The back light is hidden under the seat. However, the front light is under developed due to lack of time.

Structure Layers

One of the major differences between the Folding Scooter and traditional scooter is the architecture of Folding Scooter. Traditional scooter architecture has a main body frame running as the base structure of the scooter. The handle steering bar, the engine, and the electrical components are located around it. In order to fold the scooter, I introduce a new scooter architecture which is called the structure layers.
The structure layers are separate structures one of which layer interlocks with each other. Depending on the different positions, these layers stock differently. It is more like a soft structure when folded and a rigid structure when unfolded. These different layers of structure also provide an idea flow path to distribute the carrying weight equally. As shown in the fist diagram, the white part is the main body frame which has a complete shape as the traditional scooter. The second layer of the structure is the grey and yellow part. The grey part holds the suspension system inside to make the suspension system shifts and rotates. The yellow part indicates the back swing arm which holds the back wheel. The third layer of structure is the red part. This part grabs all the layers together into one complete piece and provides a protection to reinforce the whole structure. The blue part indicates the possible location to hold the battery which will be flowing inside the structure without moving around.

Figure 5.3.8

structure layers

Figure 5.3.9

back swing arm

Center Pivot

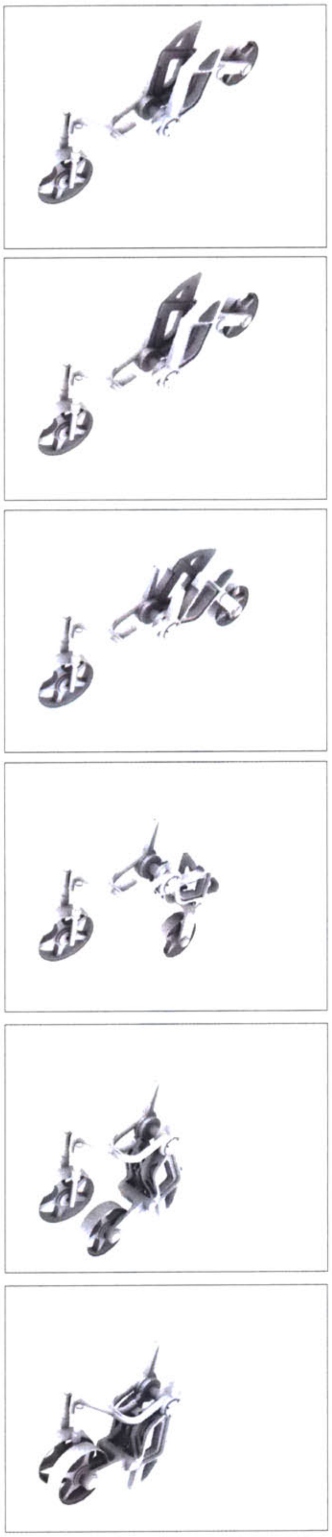


Figure 5.3.10 Tilt Six Degree

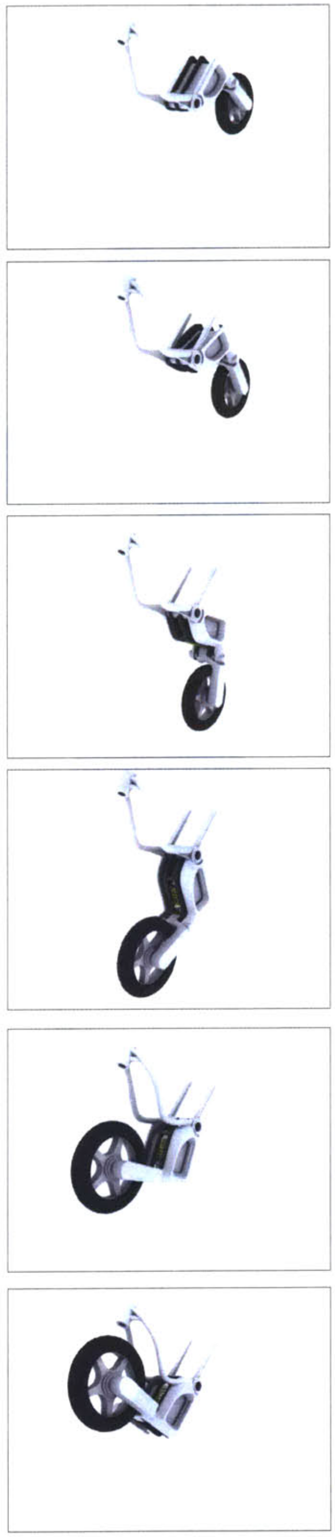
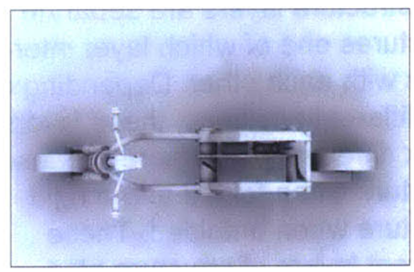


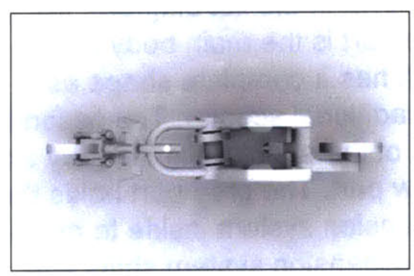
Figure 5.3.11 Rotate + Shift

The alignment of the wheel has been always a big problem during the folding scooter frame. The front and back wheel has to be align on the same axis in riding position. We have to figure out a way to move one of the wheel right next to the other one when folded. There are two solution which makes this possible.

SOLUTION A: Rotate+Shift



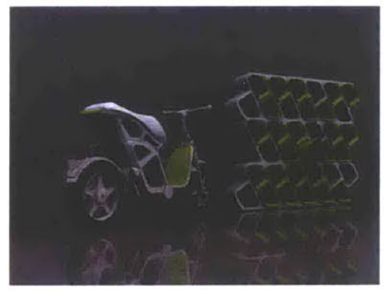
SOLUTION B: Tilt Six Degree



5.4 FINAL DESIGN

0502

The idea of removable battery module is first introduced in this design phase. Current battery technology requires recharging after about 50 miles' ride in average. It usually takes up to 8 hours of recharging depending on which kind of battery system we use. Therefore, what if we run out of the electricity while we are trying to travel form one point to another?

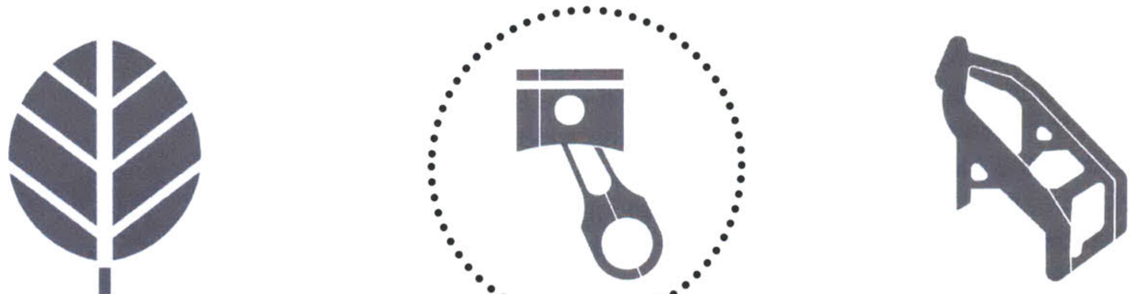


The core idea about the batter dispenser is that you can take out the exhausted battery from your scooter without any effort and replace it with a fully charged one taken out from the dispenser. This will provides the extension of travel distance and reduce the waiting time for recharging into almost zero.The battery has an outlet located right in the front panel of the battery. There are three different options for recharging the battery. The first one is by plugging in an electricity power to the body of scooter and charge the battery with the scooter. The second option would be taking your battery to your home with you. With a converter provided by SYM, you can plug the power core to any of the electricity outlet on the wall. The third option, which is the most interesting possibility, is the idea of "share use battery". By sharing use the battery, the battery becomes a new service rather than a product.

This battery service could be even further developed into a new business model for the scooter. Customers who are interested in buying this scooter will only have to pay for the scooter itself . The battery is a separate service plan which works pretty much like the Apple care for Mac. Customers are only required pay a certain amount of money, and then they will have the chance to exchange the empty battery with a fully charged one.In some of country, electricity vehicle is not allowed due to the lack of recycling battery plans. It would cause a great hazard to the environment if we do have a plan for recycling these exhausted batteries. If we consider this battery share system as part of the service, we will be able to provide a smart way of recycling the battery. No body wants to carry an exhausted battery back home, now, the this newly introduced business model, we can recycle the battery by leaving the exhausted ones in the dispenser.

Basic Principles

Reduce the carbon footprints by clean and environmental friendly energy
Simplify the complexity of the machine by introducing the wheel robot
Maximize the use of existing parking space by the foldable structure vehicles



Small Parking Footprints

The traditional idea of vehicle parking is defined by the physical space. As vehicle usage increases by 3.5% year, the speed of building new parking structures can never reach needs for parking spaces. As the result, illegal parking or double parking both for scooter and cars become a huge urban problem in Asia.

Tamsui has a very unique phenomenon, Taipei Rapid Transit system does ease needs for commuting between Tamsui and Taipei. However, local Tamsui residents tend to ride their personal transportation tools to the station; they parked as close as possible and then switch to the public transportation system. There are at least 600 scooters fighting over 200 scooter parking spaces. Scooters are parked on the street for more than 8 hours a day. This is a very serious problem.

The benefit of the folding scooter is that it folds up to half the size of its original footprint. This is about 82cm in depth. This footprint is about the same size as an ordinary street bench.

A parking rack will be provided for the folding scooter. The overall dimension for the scooter and the parking rack together is about 83cm long and 30 cm wide. This one-fourth the size of an ordinary scooter parking space. There are 3 different functions for the parking rack. The first function is to provide a charging station for the folding scooter when folded. The second function is to make sure that the scooter is parked properly. This is important because the scooter rack works as a positioning device to help optimize the usage of expensive urban land parcels. The third function of the scooter rack will be different to fit into different urban scenarios. It would complement and integrate with the existing urban furniture and landscape.

STEP COMPO L x W x H
Open 1440mm x940mm x 570mm
Folded 755mm x940mm x 590mm

FOLDING SCOOTER L x W x H
Open 1560mm x950mm x 30mm
Folded 655mm x1160mm x 30mm

Figure 5.4.1 Unfolded Position

Figure 5.4.2 Folded Position

Scooter as a service

There are many convenience stores in most Asian cities. In Taipei for example, you can easily find at least one or even more convenience stores within 10 minutes walking distance. That is to say, one convenience store every 2 to 3 blocks. These convenience stores such as 7-11 providing not only daily groceries, but also many different services. You can pay your telephone bills, make a photocopies, or print out your files. Some neighborhood services are provided, such as mailing and receiving packages, or asking friends to mail a package to your nearest 7-11 when you are away from home. These convenience stores become a fusion of post office and supermarket.

Convenience stores around your corner will be providing a new service for city mobility: the one-way share use scooters. This service is an extension of the existing neighborhood services.

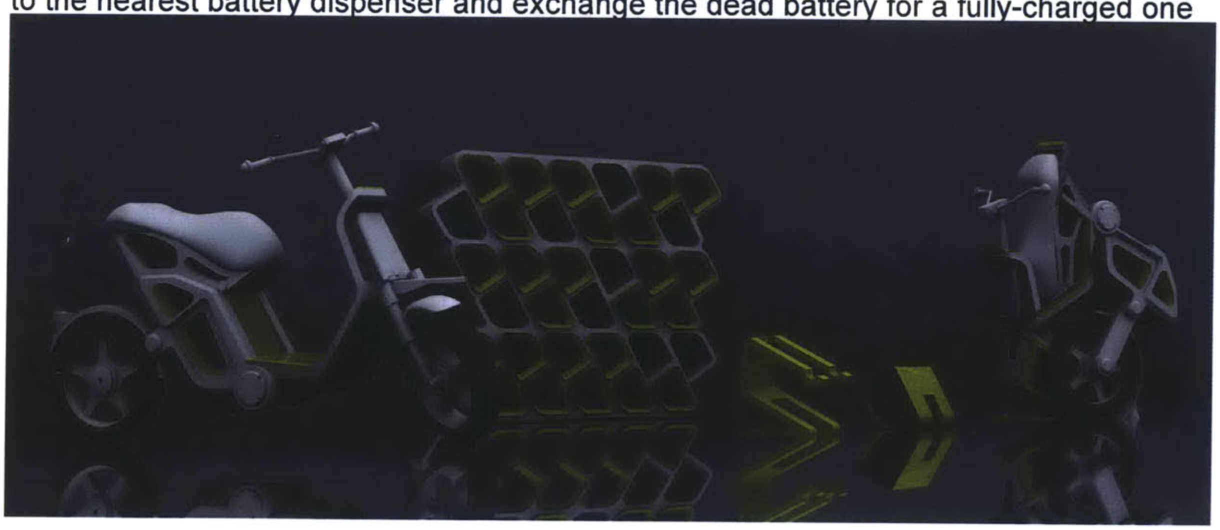
Figure 5.4.3 Scooter and scooter rack out side the 7-11

Figure 5.4.4

The package of this new mobility service includes two different elements:

The Scooter Rack:
By placing the scooter rack units outside of these convenience stores, we can reach the maximum accessibility for the residents.

The Battery Dispenser:
Battery dispenser will be located out side of the convenience stores. One of the most difficult problems with the current battery technology is that it is limited to the travel range of 50km. The battery runs out every 50 km or even less depending on the driving behaviors. You will have to wait for a while before it is fully-charged. By sharing scooters, battery usage is no longer a concern. Furthermore, Folding Scooter users will not have to worry about their travel distrances. If the battery is running out, riders can go to the nearest battery dispenser and exchange the dead battery for a fully-charged one

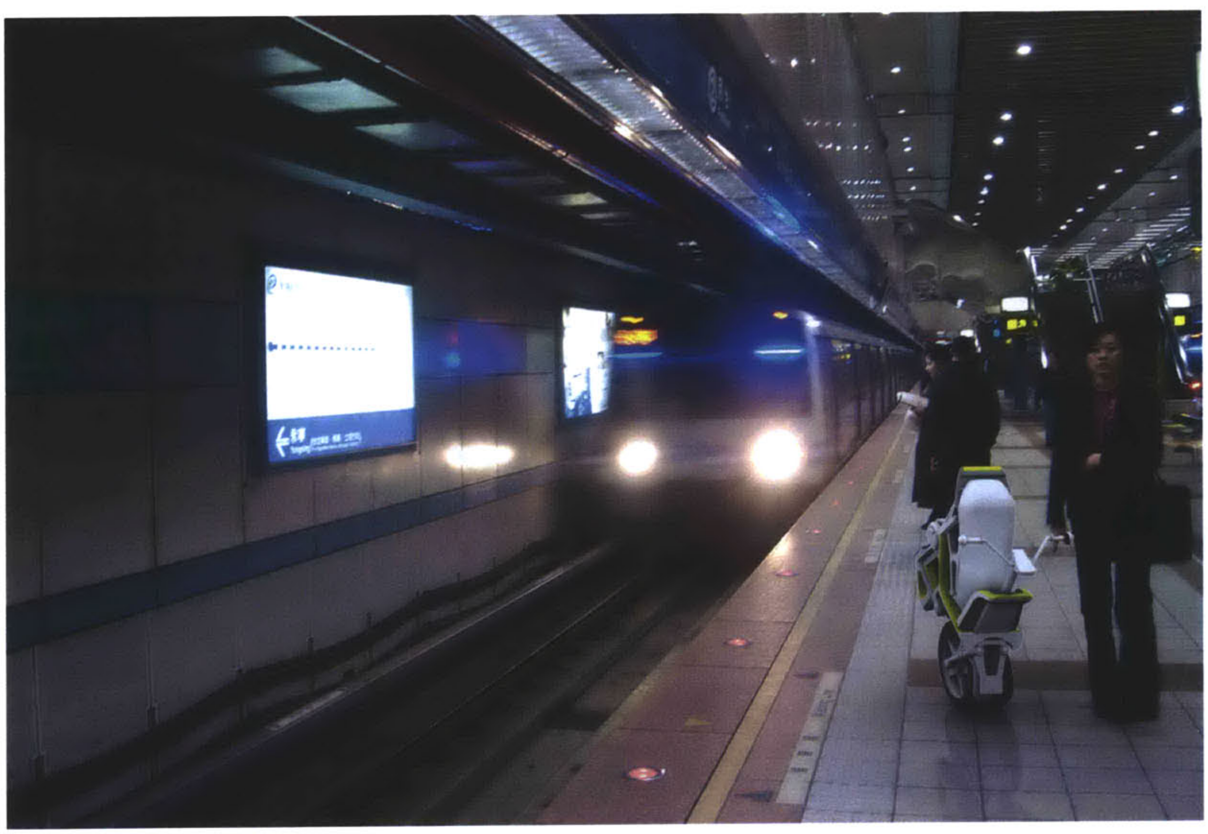


Clean + Green + Lightweight

Traditional two or four stroke gasoline scooters creates a serious air pollution problem, 11% of the air pollution problem is caused by the running around scooter in Taiwan. These scooters created a very dangerous environment. Recent studies show that scooter commuters without the mask are exposed to nearly 400 second-hand cigarettes every minute.

The Folding Scooter will be using a clean energy source and creating a better, greener atmosphere. The Folding Scooter uses the electricity as its power source. The benefit of the electricity is that it does not generate any air pollution problem at all. As a result you will be able to take it with you as you walk into the Taipei Rapid Transit System.
Another benefit of using the electricity as the power source is that where ever there is an electricity outlet, there could be a charging station. It could be at your home, or even integrate with the street light. The future goal will be to integrate with the urban electricity grid.
The Folding Scooter will use cast aluminum as the main structure; unlike the traditional scooter which is covered with plastic panels, the Folding Scooter will have its structure exposed giving it a sense of structure beauty. Because of the lightness of aluminum, the overall weight can be reduced down to 50 kg. It will be very easy to drag along as you walk.

Figure 5.4.5



Scooter as an Extension of Mass Transit System

The coverage of current Taipei Rapid Transit System will require 10 to 20 minutes walking depending on the different areas. Rather than a network, it is more like several linear lines integrate with each other. The closer to the downtown area, the more stations there are. Most people have to switch between buses and taxis to get to the nearest station. Although there are some other public transportation systems inside the cities; you will still waste a lot of time on switching between different public transportation tools.

The Folding Scooter will be integrated with the existing mass transit network. The Folding Scooter stack will be place at each of the Taipei Rapid Transit System stations. You can walk to the nearest 7-11 in, pick up a Folding Scooter, unfold it, and ride it to the nearest station. This will make the commute experience much more efficient.

Figure 5.4.5

Bibliography

English
- Alexander, Christopher. 1964. Notes on the Synthesis of Form. Cambridge, Harvard University Press.

- Alexander, Christopher. 1966. From A Set of Forces to a Form. In Kepes, Gyorgy.. The man-made object. London, Studio Vista.

- Alexander, Christopher. Autumn 1967. The Question of Computers in Design. Landscape

- Arnheim, Rudolf. 1977. The Dynamics of Architectural Form: Based on the 1975 Mary Duke Biddle Lectures at the Cooper Union. Berkeley: University of California Press.

-Baccini, Peter and Oswald, Franz. 1999. Netzstadt: Designing the Urban. Birkhauser, Publisher for Architecture.

-Cook, Peter. 2003.The City, Seen as a Garden of Ideas. New York, Monacelli Press.

-Kipnis, Jeffery. 2001. Perfect Arts of Architecture. New York, Museum of Modern Art Press.

-Schaik, Martin and Macel, Otaka. 2005. Exit Utopia. Munich, Berlin, London, New York, Prestel Verlag.

Chinese
-Fu, Chao-ching. 1999. Tawanese Architecture during Japanese Occupation Period(1895-1945). Taipei, Earth Press.

-Lee, Chien-Lang. 2005. Taiwanese Architecture in 19th Century. Taipei, Yu-Shan Press.

-Lee, Chien-Lang. 2001. Taiwanese Architecture in 20th Century. Taipei, Yu-Shan Press.

-Lee, Chien-Lang. 1996. Traditional Architecture in Taiwan. Taipei, Tung-hwa Press.

-Lee, Chien-Lang and Yu, Yi-Ping. 1999. Introduction to Historic Buildings. Taipei, Yuang-Liu Press.

-Lee, Chien-Lang and Yu, Yi-Ping. 1986. History of Taiwanese Architecture. Taipei, Shung-Shi Press.

-Liu, Cho-Hung. 1995. A Research of Taipei's Townhouse Arcade During Japanese Occupation (1895-1945). Taichung, Thesis of School of Architecture, Tunghai University

-Mi, Fu-Guo. 1998. 1860-1890 A Research of Colonial and Post-Colonial Arhcitecture in Tamsui, Dadaocheng and Munggia. Taipei, National Science Council.

Special Note: Unless specified all images are the property of the author.