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Thesis Title
More efficient usage of available land

Milestone 11
Final Thesis

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**BRIEF**

**Brief in short:**
The earth’s surface is limited, but human habitation isn’t limited. So we need to make the most of our limited land.

The **aims** of this thesis shall address:
- How to compose space and build a building on sloped ground.
- How to maximize the density-of-occupation of available land.
- How to do the two above points, while keeping urban-design considerations in mind. (Such as maintaining reasonable natural lighting, ventilation, visual linkage, physical linkage, active edge)

The **outcomes** are to demonstrate to other designers (who are doing similar projects or facing similar challenges), by providing examples of how to:
- How to compose space and build a building on a sloped site.
- How to build in a denser way, by squeezing the most functions into a long and narrow site; Hence, how to maximize useful floor space and the density-of-occupation of available land.
- Doing all this, while keeping urban-design considerations in mind. (Such as maintaining reasonable natural lighting, ventilation, visual linkage, physical linkage, active edge)

These demonstrations will be achieved via various aspect of my design; certain features in my design will show how these two issues are addressed.
By providing examples to other designers, which will demonstrate how these 3 issues can be addressed, will broaden the application of the outcomes of my thesis.
SITE
The site is the park beside Albert Park, between Bowen Avenue and Kitchener Street.

WHERE THE SITE IS:

The dark blue box encloses the Auckland CBD. The site is in Auckland CBD.

The red loop encircles the site.

The site is narrow and long. The shape of the site is shaped like an eye. The site’s length is about 250 meters, and the width of the site is about 35 meters. At its steepest part, the gradient is about 8/35.

Here is the site. It is the park beside Albert Park, between Bowen Ave and Kitchener St.
VEGETATION ON THE SITE:
Here is a 3D view of the site.

This area is densely vegetated.

SLOPE OF THE SITE:
Here is a section of the site.

The section line (black solid line in above map) is from Albert Park to the bottom of the site.
This is what the section of the site looks like.

The two red dotted circles mark where the two roads are. The upper circle marks Bowen Ave. The lower circle marks Kitchener St.
The green solid-line circle marks the area that is heavily vegetated.
The solid-line box marks the site.
MOTOR TRAFFIC AROUND THE SITE:

A lot of traffic comes up from or down to Victoria St. Traffic spread out from Victoria St into Kitchener St and Bowen Ave, or from Bowen Ave and Kitchener St into Victoria St. There are a lot of traffic on Princes St and Waterloo Quad too.

LIVELINESS AROUND THE SITE:

The grey ovals labeled A and B indicate empty areas on Kitchener St. These 2 places don’t have sufficient urban design qualities to attract people. Although it is very difficult to change the steepness of this part of Kitchener St and make these 2 areas have fewer shadows, more physical connections can be made to these areas, to make these spaces more pleasant. The oval labeled C indicates that the area at the edge of Albert Park, adjacent to the site. This area is open space with sunlight. However it can attract even more users. The design on my site needs to correspond more to this area and establish connections to this area.
SCALE AND GRAIN IMPOSED ON THE SITE BY ITS SURROUNDINGS:

The purple dotted lines mark out the **scale and grain**, which the project on this site should have.

FOOT TRAFFIC ON THE SITE:

It is important to maintain the existing **pedestrian circulation** across the site.
Traditionally, the high grounds between and around Symonds Street and High Street is the center of Auckland. 100 years ago this area's status is the equivalent to Queen Street's status today. Back then, the elevated position of this area makes this area a high quality area (in an interesting note: Queen Street 100 years ago was a low and dirty gully). It was only because of a fire, which damaged the area around High Street, which made the center-of-CBD shift to Queen Street.

HISTORY:
When Auckland was originally planned by Felton Matthews, the topography (and hence street pattern) of Auckland's CBD can be seen in 2 distinctive parts:
- To the area roughly to the west of High Street is the flat, lower-positioned plain, on top of which a grid street pattern is built upon it.
- While east of that is the higher-elevated, hilly part of Auckland, on top of which a more organic street pattern is built.

Today, this pattern still exists.
- To the West of the site is the flat plain with office buildings and grid street pattern. This can be seen as the CBD proper. To the North the topology and street pattern is a mixture of both; the functions are dominated by residence and hotels.
- To the South-East of the site are the inner city parks (Albert Park and Auckland Domain) and the Universities.

In a way, this site (between Bowen Avenue and Kitchener Street) can be seen as ‘left over’ space, because the grid pattern from the West can never fit perfectly into the organic street pattern from the East (just like how a circle can never fit into a square). The site between Kitchener Street and Bowen Avenue is the result of the imperfect fit between the two different street patterns.

THIS SITE IS SUITABLE FOR MY THESIS BECAUSE:
1. It is slopy, which suits the first point of my thesis.
2. Since the second point of my thesis is about building in higher density; a vacant and ‘leftover’ site in the CBD, that have the potential to be utilized and densified, would be an appropriate choice.
   When my thesis devises ways to densely utilize sloped sites, more sites in the CBD (such as this site and similar sites) will be possible to be utilized.
   In wider perspective — densification of every possible area in the CBD means that urban sprawl will be reduced.
USING PART OF THE SITE:
The site is 40 meters by 250 meters. This is a very large area to work with. It is more appropriate to use a section of the site. The building on this section can demonstrate how the rest of the site can be used.

The black line is the section line through the chosen section of the site. The blue circle encircles the existing adjacent apartment building. The red circle encircles the chosen section of site. The corners of the site obviously can't be built on, because they will create hazardous blind-corners for traffic.

Section of the chosen-section of the site:

This chosen section of site is about 20 by 20 meters, with a gradient of about 4/25. From top to bottom of this section of site, the overall drop in elevation is roughly 1 storey.

Beside the site there already exists an apartment block. It is narrow and tall (about 50 meters tall) (maybe the result of its dense urban surroundings). It is built on flat ground.

Using the section of the site (which faces this apartment building) will be interesting, because by doing this, the contrast between high-density buildings on flat and sloped grounds will be highlighted.

On the following page are the site, and the portion of the site, with proper contours and scaled section:
WHAT MY DESIGN SHALL DO:
To investigate:
- How to compose space and build a building on a sloped site.
- How to build in a denser way, by squeezing the most functions into a long and narrow site; Hence, how to maximize useful floor space.
- How to maintain good urban design qualities while doing the 2 above.

FUNCTIONS:
A mixed-use building will be designed.
Since the site is slopy, and that the two roads around it are too insufficient to support any loading zones, the site will not be able to hold any functions that require a ‘back-of-house’.
This rules-out functions such as hotel, retail and most entertainment.

IT WILL HAVE THE FOLLOWING FUNCTIONS:
- The functions that I’ve selected are: landscaped ground floor, kindergarten, lecture rooms for lease, offices, apartments, communal space.
- The landscape for the ground level is the replacement for the retail/active edges, since the site is too slopes for loading zones, and the roads around the site is too inadequate to support loading zones. Landscape is the next best option to provide a public friendly frontage.
- Kindergarten is useful in the CBD, because it is convenient for working adults. So far, there aren’t many kindergartens around the CBD.
- Lecture rooms can be leased out to the nearby universities and businesses. The shape of the lecture room is also suitable for the sloped site.
- Offices and residence are appropriate because they can be seen as an extension to the existing business area to the west and the existing residential areas to the north. Offices and apartments couple well with each others, because apartment can be on the sunny side of a deep-planned building, while offices can be on the darker side. More apartments next to the universities and businesses can also provide more residence for students and workers.

THE NATURE OF ITS SITE OCCUPATION:
- The 2 corners of the site are to be left empty, so that the traffic will not have blind corners.
- The bulk of the building mass will be broken by the surrounding scale and grain.

OTHER CHARACTERISTICS THAT THE DESIGN SHOULD HAVE:
- Have spaces that different functions can share.
- Encourage future developments to be of ad-hoc type development; in other words – not to over-plan the site, because if the plan is too strict, then the densest possible habitation will not be achieved. However, developments of ad-hoc nature can generate denser habitations.
- Be well connected at all levels, including roof levels. Because circulation is vital to support density.
- Not to have a design that is too massy, bulky, repetitive or mono-character, so that the inhabitants will not feel a sense of ‘melancholy’, which was characteristic of the mass socialist housing blocks of the previous decades.
- Be partially welcoming and partially revealing, so that it will draw more people in, which is good urban design quality.
- Respond, contribute and stimulate surrounding environment. Particularly, it will have to stimulate the dark, slopy parts of Kitchener St and the quiet part of Albert Park – because those 2 areas are currently deficient in urban-design qualities.
- In such a dense design, diverse functions will be mixed to the extent, that one function unit may no longer be one continuous physical bulk. Because the mixing the function to this extent can generate even more density. This way, diversity will be increased too.
- Be characterized by density, diversity and a lot of mixing, because density and diversity should coexist.
- Timeshare of functions in one space.
- Multiple functions can happen in one space.

- P664, 665:
  Services that run between the floors will increase the thickness of the floor plates. So building with too many storeys will have excessive height. To minimize the height yet build the maximum number of storeys, the floor thickness will have to be minimized.

![Diagram showing the relationship between floor thickness and building height.](image-url)
In the traditional building approach (left):
To increasing the span will either require floor to be thicker (which will waste vertical space), or require more columns (which will minimize useful floor space, especially the lower floors).
So, as shown on the right:
Instead of solid floor slabs, trusses will be used. One truss’s height will be the height of a storey. Effectively, one truss becomes one habitable storey, with people living in the spaces between the truss members.
It is also possible to have one truss per 2 floors – thus saving materials.
Koolhaas also mentioned here, that in buildings of sufficiently large scale or occupation, the way that services are run through the building can significantly affect the useful areas of the building. In sufficiently large buildings, services can no longer be run between the floor, because it will make the floor impractically thick and waste too much vertical space; services can no longer be fed up vertically through a centralized vertical service shaft, because the shaft would have to be so thick that it will waste too much floor space. Koolhaas says that in these scenarios, a better approach to servicing the building is to have smaller, decentralized and distributed service shafts and/or plant rooms spread out throughout the building, each serving their local areas.

- P764: Truss vs Vierendeel beams
Vierendeel beams and trusses are equally as strong, but Vierendeel beams gives less visual obstruction.
With the same site size, more floor space can be derived if the upper floors’ area is larger than the footprint.

Lower floors address the central & the public; upper floors address the private & the periphery.
• P927: a park in France

Here, Rem Koolhaas offered a generic, step-by-step process for designing:

1. Develop a strategy – i.e.: how to address problem. (Koolhaas calls this step the hypothesis)
2. Formulate the program; start zoning, with respect to program.
3. Putting in a regulating order. The order should be made of elements relevant to the program.
4. Put circulation in.

The strategy affects the program/zones, order and circulation.

From my point of view: steps 1 to 4 can be seen as the making of the ‘matrix’.

5. And in my interpretation, this step is where the ‘spectaculars’ (i.e.: the monumental) is put in, to break the order at certain points.

6. This design process is very generic, and is helpful to refer to when I progress through my thesis.

• P884-855: describes how Koolhaas rejuvenated a ‘soviet-style’, socialist, mass-concrete apartment district in the Netherlands and brought it out of its ‘grey melancholy’.

This part of the book sums up to the fact that repetitions of forms and functions in large masses are devastating in terms of urban design. To avoid this, the designer need to:

- Have more quantity and diversity of activities & have more programmatic diversity, (Koolhaas demonstrated this by introducing a strip of market through the ever-repeating hexagonal-grid apartment blocks, therefore adding ‘flavor and activity to the bland order’)
- Have vegetation/greenery. (Koolhaas demonstrated this by introducing green strips)
- Have direct circulations and do not let hierarchy and order get in the way of direct circulation. (Koolhaas demonstrated this by remaking or introducing more direct paths)
- Have diverse building typologies, i.e.: give each block its own individual identity. (Koolhaas demonstrated this by giving each block an unique courtyard)
• The Berlin Wall, London examples and rest of chapter 1:
A strip of good neighborhood which runs through London City is surrounded by walls, to keep the bad neighborhood around it away, and keep the good neighborhood in. This has created negative social patterns since.

In the Berlin example: the wall itself is just a simple wall, but a simple wall can be anything under the appropriate circumstances. The wall can be seen as a form of absence, as it can be anything, however it is also a very powerful presence (e.g.: all of its connotations, impacts and repercussions). Berlin wall demonstrated that a simple ‘open-ended motif’ can be ‘anything’.

• The Dutch Prison renovations example:
New way of approaching a design: The design doesn’t always have to start from ground up, as conventionally done. The design can start at ground level and go downwards to underground, while an existing design or structure already exists on top. Koolhaas demonstrated this approach via the use of a ‘socle’, which is a ‘podium-like’ architectural form.
This can be seen as a way to tackle the slopy site.

• Chapter about Delirious New York:
The exterior appearance of the buildings is not relevant to the internal program of the buildings.
The external can look monumental and aesthetical, but the internal functions are completely controlled by programmatic needs. I realize that this is a very practical thing to do, and is a way to generate higher densities in buildings, because the internal activities is not limited by and not obliged to obey the external appearance, so any combination of activities can be inside the same building, as long as there are enough space, regardless of whether the function is related to the building’s symbolic exterior appearance. This is related to point 1b of my thesis.
This is one of the most notable densely used places in Lagos. Notice the doubling up of functions in a single space. A single urban space (a road) contains 2 functions: circulation and commerce, which takes place under the most basic of provisions (i.e.: the over bridge providing shelter and a strip of unpaved footpath providing a place to stand or sit). Also note that this isn’t bad density, as people would come here despite the crowd. It also make my aware that if we provide fancy amenities that the people cannot use, then it is no better than a simple provision of an over bridge and a strip of unpaved footpath.

In another part of the city (no pictures can be provided here): elevated overpasses create undefined spaces below. However this land has not gone into disuse, in fact, it has created employments; this space is used by the rubbish recycling workers as their work yard. This shows that elevating structures, like bridges can free up the land below for other opportunities.


- Rigidly planned developments are always less dense than the ad-hoc slums that they replaced.
- On the scale of a large city, to minimize travel distance, decentralization of a single central CBD into many smaller CBD’s can be helpful, so that different residential zones can be served by their own CBD, instead of all travelling to the same central CBD.
Those stereotypical European cities have positive urban density because they are dense AND MIXED USE – and these diverse functions are functionally compatible too (i.e. one needs the other, or one interact with each other.)

Having these integrative approaches (i.e. diverse functionally compatible functions in high density), as opposed to segregative approaches leads to long term positive coexistence. This also explains why Europe doesn’t have the American type ghettos.

Density without quality isn’t good enough. This point resounds the point made in Koolhaas’s book SMLXL – the part about the socialist, mass-concrete apartment district in the Netherlands – that mass repetition of single forms and single functions do not create good urban design qualities. So a design cannot be dense and mono, and it must have activities for people to do, and if I do come up with a design that is mono, I must add diversity and activity into it.
• The street has 2 functions doubled-up on it: circulation and commerce. A healthy commerce sector is taking place on the street, side by side with circulation. The physical provisions are simple: just a continuous concrete steps for people to sit on, and a footpath that is sufficiently wide for both commerce and circulation to take place in one space. This form of informal commerce is extremely efficient and effective (turning passerby into customers), and contribute to the economy significantly.

This resounds the example in Lagos: the doubling of functions in the same space – doubling up of commerce and circulation in a simple road or street, with the simplest physical provisions, like a simple shelter or a simple place to sit.

The Mexico City example also resounds the theme outlined in the “European City Model” example – that areas of good urban-design qualities must have density, diverse functions, and that functions are compatible (or interrelated). It is little wonder that this street in Mexico City is successful, because it is dense (i.e. different functions are in cheek-and-jaw with each other), diverse (i.e. 2 different functions doubled up in one place), and functionally compatible (i.e. roadside marketers turns passerby into customers).

• Always remember: ”Street is a public space”
• It is better to “celebrate extremes”
The idea of an ‘open city’ expands on the idea of density & diversity. Richard Senette refers to Jane Jacobs: Jane Jacobs argues against the ‘closed city’ is a city in a state of equilibrium, where everything that is predicted to happen has already been planned for and rigidly build out. She recommends that once a city (or a part of the city) have achieved density & diversity, and achieved public and private functions mingled with each other, the designer should then make that city an ‘open city’.

An open city is developed step by step, not all planned out at once. It has the ability to incorporate adaptations; it is in a way ‘un-neat’ and somewhat ‘unplanned’; it encourage public usage of space, it is not built from a completely defined starting point (i.e. an all-figured-out master plan).

An open city has 3 aspects:

1. Passage of territories: As a person walks through it, the person experiences a passage of territories (territories here means zones). This means that the city has diverse functions, organized appropriately in a way, such that it provides a person with a sequence of different encounters in the city as the person navigates through the city. This point is reminiscent of the idea from the “European city model” essay, that functions must be compatible. This point also continues the New York observation from Koolhaas: that a building, independent of its exterior, can accommodate any combination of functions inside according to need. From Jane Jacob, Joan Clos and Koolhaas’s ideas, it sums up to the fact that once a city or place have dense functional diversity, functional compatibility should then be achieved, so that these functions are in a network of interaction and/or dependency, and that the functions (i.e. zones or territories) are organized in a way which provides an experience to a city dweller.

2. Incomplete form: This means that building itself is in relation to its neighboring buildings; that the building can compliment, interact, correspond, acknowledge or even stimulate its surroundings, so that the individual building itself is ‘incomplete’. Incomplete also means that the building is not all planned for at once; that the building or city can change, adapt, alter, able to take extensions and internal revisions, able to accommodate all future possibilities. That the building or city should have no rigid form not fixed states/program. That it can accommodate diversity and all of its permutations. That it can harbor all types of interactions of an urban area’s elements (i.e. people, activities...). Building bridges and links between the city’s/building’s elements is a good way to achieve interaction between diverse elements.

This is similar to the lesson learnt from Lagos. Where here, the ad-hoc nature of planning and growth causes good urban qualities, in Lagos, it also shows that ad-hoc development can generate more denser areas of habitation. All this argues against the approach where everything is strictly planned for at once.
My site is surrounded by areas that do not possess the best urban design qualities. I should design some with incomplete form, which will stimulate, or at least help my site’s surroundings.

3. The city or building is like a developing narrative: this means that the building does not reveal itself completely at once. Instead, the building should show a part of itself to invite people in, but slowly unfold itself as the person walks through it, just like how a novel don’t tell you how the story ends at the beginning. This means that the building should be opened up and pushed up to the street-front, but veils parts of itself at the front, and slowly reveals itself.

Aspects 2 and 3 also imply that the design of entrances and street-fronts/active edges should be designed with care. Specifically, this means that the inside and outside should be blurred, a colonnade or similar structure should be before the entrance and the skin of the building, to provide a transitional area, in order to veil the building from complete revelation, and more importantly, to generate a healthy active edge, i.e. an active edge that can accommodate crowds, public and social orientated activities. Not like the London City Hall, where the building’s skin is just an impermeable sheet of glazing, where there is no blur between inside and out, nor transition zone that provides a ‘safe-harbor’ for crowds to gather at the boundary of the building.

- P302 about the secrets of a good city
  - Good cities have inclusive and unexpected spaces.
  - Public spaces need meaning, identity and specificality.
  - Public spaces need to give the strangers a sense of safety when being in a collective environment and give all members of public a sense of belonging.

These three things above reiterates some of Jane Jacobs’ idea of an open city: that it contains unexpected spaces (i.e.: a developed narrative, never completely reveals all at once); each space is unique (i.e.: diversity); and it contain spaces that harbors human and social gathering (spaces like the blurred entrance via colonnade that psychologically ‘protects’ crowds)


- P339 about skyscrapers:
  - Skyscrapers occur at places that:
    - Have sufficient transport infrastructure.
    - High FAR
    - Sufficient land to justify high floor areas
    - Sufficient distance to neighboring buildings, so that daylight doesn’t get blocked.


- P406-407
  When designing and ordering a tower: Consider:
    - Planning grid
    - Fenestration
    - Internal organization
  As façade quantity relative to room (i.e.: window/room ratio) affect planning grid & the rhythm of fenestration, which in turn affect the floor plates’ subdivisions (i.e.: the module of the planning grid), which affect the habitation density, occupation pattern and activity type.
“We see today that what makes the cities vital in the 21st Century are those very attributes of urbanism ... that were destroyed in the 20th Century. Density, complexity, diversity of people and cultures, the convergence of the physical environment at multiple scales, the messy intersection of activities, a variance of distinctive designs, the layering of the old and new. These are physical elements that advance competitive, sustainable and inclusive cities.”

So to design a chunk of urban area and have positive results, I need to consider connectivity, diversity, connectivity, interactivity, convergence, ad-hoc-ness, coexistence and individual identity.
P133 about intense agricultural usage of the Ciudad Valley Central, Chile, South America

The picture below shows how they dealt with sloped site:


“Double Decker: building the new highway as an elevated road would create space beneath it for parking and distribution centers. Raising it above ground level would moreover relieve the claustrophobic atmosphere of the area.”

This shows the benefits of elevating a structure or function, which is freeing the ground level for other opportunities and relieving ground floor from intense use.

Elevating existing structures (and functions) upwards to free up the ground space for other opportunities can lead to denser designs, and relieving ground level of intense use by lifting some functions up.

Since my site is on a slope, there may be no clear boundaries between ground floor and lower floors - there may even be many ground floors, so the idea of elevating some of the activity off the ‘ground level’ to provide more opportunity of other activities on ‘ground level’, and spread various functions upwards would be helpful and interesting to consider, especially on a sloped site.

The upwards migration of activity via lifting can also lead to diversity

Just as a note: recall the Lagos example: the recycling work yard under the overpasses is very similar to this example here, where lifting has created opportunity of other activities on the ground level.
• P224 about FlightForum, Urban plan business park, Eindhoven, Netherlands, MVRDV, 1997-2005. Here, some buildings are being built between the spaghetti junctions of a motorway.

The land between the spaghetti junctions can be considered as awkward and marginal. My site is marginal. The motorway/spaghetti-ways can be considered as physical obstacles, just like the trees and the uneven slopes on my site.

Here, the architects avoided the obstacles (spaghetti-motorways) by constructing additional, looped and separate on-off ramps, in order to mediate the speed difference between motorway and driveway, so safety can be achieved. The new loops of on-off ramps are optimized for speed and driving comfort to minimize the chances of accident.

On my site, to avoid the obstacles may be as easy as creating near-direct linkages over or around the obstacles, which are streamlined (i.e. optimized) according to suitability and efficiency.


“All buildings are without backsides; they are ‘clad’ against each other. Fronts only appear where representation is combined with loading and docking. This creates a high level of social control in these otherwise remote areas”


Similar to Flight Forum. Built between motorway spaghetti junctions. Weaving zones are used to get access to the island plot between the spaghetti-motorways. Weaving zones are a system of separate on-off ramps with a required minimum length that would mediate the speed differences between the traffic speeds on the motorway and driveway, these separate off-ramps are curved (weaved) according to spatial constraints and optimized for driving comfort. They are one way, to save the need for traffic lights. It is proven here at Parkforum that weaving zones (the system of additional individual one-way ramps) saves a lot of space.

Here: another interesting note is that both industry and residence is built together between motorway traffic. Thanks to the green strip, which is 20 meters wide minimum, have separated residence from traffic and industry.
• P260-262 about 3DG – Urban strategy for intensification and programmatic mixture on 50 locations in the inner city of Groeningen, Netherlands, MVRDV, 2003-2004:

“...city of Groeningen conforms to an almost Paris-like model: a dense city surrounded by empty countryside. Intensification would make it unnecessary to expand. The surroundings of Groeningen thus remain empty and can be used for agriculture, nature and recreation, the city's facilities gain a greater raison d'être, and may even expand. The result is a lively, necessary mix in the city. What places are eligible for this development? Is it important in this respect that all short-term realizations come under consideration because the effect could be catalytic? There may be forgotten corners in the city. They are the first to be considered for further utilization. But pieces of land that are less intensely used are also eligible... by utilizing sites that are practically written off as economically viable, we can adapt them to the needs today. Old schools and sports halls that are in urgent need of renovation can be rebuilt in combination with housing because they will be partly financed by the new functions. The result may be an interesting mix with a certain double use, a certain surplus value. Not only can more floor space be built in the city, but it leads to a greater sense of community.”

The above quote states the advantages of what I am going to do in my thesis.

“... In situations of greater density... the potential of mixing with other programs also yields intriguing synergies. In the case of a new vertical mixing of homes and primary school, the elevated playground will enjoy safer situation... a new variant of open air school becomes achievable in the city. The mixing of housing with cinema can result in an intriguing combined use of the lobby; the cinema could be on top of the housing, giving the magnificent prospect of Groeningen will be unveiled on opening the back stage or rear wall. The combination of programmed functions with a sports field could be made available to those living in the vicinity...”

The above quote states some exciting ideas of cross-programming, and some moral implications to be aware of when cross programming.

• P271

“... density leads to much more programmatic diversity. More synergy, efficiency and mix will lead to more social encounters, urbanity, and possibilities for architecture... Can an urbanism be developed that enters the third dimension in a time when urbanism is still dominated by zoning – a very 2-dimensional approach? Can a city be made that literally creates more public levels, enlarging the capacity of the existing city floor plate?”

The above quote once again reinforces the idea that density will be inevitably accompanied by diversity and more social and functional mixing. Then the quote does implicitly but clearly suggest the idea to build upwards (i.e. the 3rd dimension be introduced to urban design). In my opinion, zoning is possible in 3-dimensions, as the lower floors are the more public ones by default, and upper ones are more private. Considering how this 3D zoning should be done & how far up would the public diminish would definitely be interesting aspects of my thesis, especially on a sloped site, where there may be many ground levels.
This is just a hypothetical proposal of a city of 1 million people living in one building, which is a self-sufficient cube with all 3 axis being 3.37km, which accommodate 1 million people and all aspect of their lives.

Despite its visionary nature, it does offer universal themes and must-have features for any building as big and self-sufficient as this.

- Functions are carved into the box proportionally, according to the program, which in turn is according to its need, in a similar way Koolhaas does his programming. And each part is designed specifically.
- Deep buildings can't be all solid, so to allow light and air.
- Valleys are inserted into the solid box to provide light to the deeper parts. Valleys are ideal shapes for light wells of this scale, because its shape is molded around the direct sun rays, which minimize reflections and maximized the solar energy and light received at the destination. The shape, size and orientation of these valleys have to be the result of extensive sun studies.

- Some waste can be turned into biomass and be burned as energy.
- Industries within the cube must be surrounded by buffer zones, in the form of cavities.
- Leisure space is evenly distributed
- Housing and offices should be surrounded, or next to some kind of well or duct to outside air and light, which restrict their density.
- Advantages: reduce need for car
- Disadvantages: claustrophobic, need sufficient air and light to avoid dangerous conditions.
- Do have social, cultural and psychological implications.
Denser residences have its architectural, social and moral implications:
- Home will be surrounded on all sides.
- Home may be next to industry.
- Challenges to the private domain.
- The feeling of captivity/lack of escape.
- Collective living?
- Ideals of individualism under threat?
- Altering the height of the boundary between private and public levels.
- A new system of addressing needed?
- More addresses.
- How can a dense complex be operated and used by people, and via what patterns of behavior?

This already exists in Bangkok, how do Bangkok people navigate a 3D city?
- When everything becomes so near to your house, the house and car loses its importance and personal possessions would gain more importance.
- The issue of privacy.
- The possible need to create fake windows and other illusions to escape the feeling of ‘captivity’.
- How to accommodate roads and circulation within residential clusters? – do circulations go under, over or between dwelling units?

How to incorporate roads within the house?
Can we live above and under them as well?
We still have to concentrate the sound in tunnels above the house. This project has un-flashy drawings that show interesting ideas.

House under a Road / Kyoda, Osaka, Japan

- Residence may be inter-dispersed with other functions. I.e. one functions may be wedged between another block of functions. Residence, or any function may not be in one cohesive continuous zone or block.
- Dense ‘tower-cities’ generates more densely crowded public areas and hence make public areas safer?
- More possibility for doubling up of functions.
- Create new programmatic relationships. E.g. walk out of house to enter supermarket.
- Functions becoming more porous towards each other due to close proximity.
- Will have different ways and meanings for moving houses.
- Different architectural typologies will be introduced.
• P472 SkyCarCity
  High buildings can be connected at all floors, even at the highest floors. The addressing system will change too.
  This is relevant to my thesis, because if I come up with any new typologies or unusual ideas, a corresponding addressing system may need to be devised, in order to make my design work.

• P476-481
  - Density may cause clashes between different cultures.
  - Dense areas may be more at risk to disasters, such as fires, explosions etc...
  - “can we insert parameters such as ecology, sustainability, density, diversity, phasing, individuality, proximity...?”

• P486 El Lissitsky with Mart Stam and Emil Roth – Wolkenbugel
  The building is thin at its lower storeys, but then cantilevers out horizontally at a higher level, in order to save ground space. It touches the ground via 3 poles, crouching over a street intersection.

• P486 Kiesler, the city in space
  A city is accommodated in a bridge structure, and suspended over the ground level, without much column support, but uses suspension as in a suspension bridge, freeing the ground level.

• P486 Walter Gropius’s Wohnberg and Henri Sauvage’s metropolis
  Mass apartment blocks. Residential units stacked up and terraced inward, creating a pyramidal form, the void inside is used for public space or circulation facilities.
• P487 Tullio Crali’s urban airport
An intersection of elevated roads has buildings under and surrounding it, turning the intersection into a city in its own right.

• Hugh Ferriss Metropolis of tomorrow
Skyscraper terraced inwards, these terraces hold elevated highways.

• P488 Yona Friedman La Ville Spatiale
Elevated space frame structure supported by concrete columns. Dwellings can be accommodates within the raised space frame. Partitions can move.
• P488 Walter Jonas, Intrapolis
  Doughnut planned apartment building. The elevation is centrifugally tapered outwards, creating terraces. Saves ground space. Because of its circular planar shape, the outwards tapering can be a lot. Due to terracing, natural lighting can be gained, with sun shading on the other side.

• P488 Paul Maymont Ville Flottante
  Space frame in the form of a conic-shaped cable frame suspended from columns, hanging down like spider webs. Don’t touch ground. Dwelling units attached to the conic web.

• P490 Kenzo Tange Boston Harbor
  Giant arch arching over earth’s surface. Dwellings attached to the arch.
• P490 Arata Isozaki, space city
  To preserve existing functions on ground and build new things on top of existing urbanscape, build vertical tube-structures as towers and space trusses as sky corridors.

• P490 Kisho Kurokawa Helicoids
  “Large helicoids structures float over the city, highways inside helicoids tubes structure the new city diagonally while confining the buildings containing urban programs”

• P490 Arata Isozaki Clusters in the air
  Tube structures with dwelling units cantilevering off it at altitude in clusters. Minimal footprint.
• P496 Stanly Tigerman Instant City
Hollow pyramidal shell forms arching over highway. Dwellings are accommodated within the thickness of pyramidal shells.

• P497 Parent & Virilio Bridge Cities
Dwellings sitting on folds (bridges), arching over anything below. Can accommodate a lot of dwellings, while arching over something else, without becoming a skyscraper.

• P497 Tsui, Ultima Tower
Circular concrete structures (i.e. 2 arches coupled into a vertical circle) can be used to achieve large span. Large spans give more room for higher density.

The above are precedents related to my thesis. They also offer structural and design ideas for my thesis.
• P500
Things to think about when you build vertically: density, public access, diversity in space, mixing of program.

<table>
<thead>
<tr>
<th>Floor Area Ratio are divided in:</th>
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<tbody>
<tr>
<td>1 = FAR 3-6</td>
</tr>
<tr>
<td>2 = FAR 6-9</td>
</tr>
<tr>
<td>3 = FAR 9-12</td>
</tr>
<tr>
<td>4 = FAR 12-15</td>
</tr>
<tr>
<td>5 = above FAR 15</td>
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</tbody>
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<tr>
<th>Public Levels scores are divided in:</th>
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<tbody>
<tr>
<td>1 = 10-20% of all levels are publicly accessible</td>
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<tr>
<td>2 = 20-40% of all levels are publicly accessible</td>
</tr>
<tr>
<td>3 = 40-60% of all levels are publicly accessible</td>
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<tr>
<td>4 = 60-80% of all levels are publicly accessible</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Programmatic Diversity scores are divided in:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = only two functions</td>
</tr>
<tr>
<td>2 = 3-4 functions</td>
</tr>
<tr>
<td>3 = 5-8 functions</td>
</tr>
<tr>
<td>*4 = 9-10 functions</td>
</tr>
<tr>
<td>5 = totally autarkic</td>
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</tbody>
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<table>
<thead>
<tr>
<th>The Programmatic Mix scores are divided in:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = no mix</td>
</tr>
<tr>
<td>2 = 25% mix</td>
</tr>
<tr>
<td>3 = 50% mix</td>
</tr>
<tr>
<td>4 = 70% mix</td>
</tr>
<tr>
<td>5 = mix max</td>
</tr>
</tbody>
</table>
Another layer of city can just be built directly over the existing city. The lower level can be used to accommodate dark functions, while upper levels can accommodate sunny functions.
To generate density, need to create a lot of connections and physical linkages.

Parc-housing Parco Lambardo in Milan
Holes can be cut into big apartments, creating communal niches and mid-level gardens.
In my design, I will be designing over a park. So in a sense I am taking a sunbathing space away from the public. Whatever I take away from the public should be given back. This may provide me with a way to the park, and its sunbathing qualities back to the public.
Vertically undulating a single space can divide a room into many smaller rooms in an open-planned fashion. This is relevant to my thesis, as the site is already unevenly sloped, so a vertically undulating space can be readily placed on my site.

In the urban sofa example, the whole structure can be based on a distorted space frame, with dwellings resting within the space frame. This provides me with a possible structural solution if I decide to build an undulating form on my sloped site.
• **P652 extension European patent office, Rijswijk Netherlands.**
  To save floor space, services can be taken outside to the façade. Also: terracing & better facadal qualities (i.e. sun shading and windows lessen the need for services).
  To add life into the office building, open, connected green spaces are added to the roofs and bars are also added to diversify the program with functionally appropriate functions.

• **P700**
  Podium can be used to relieve ground level for opportunities to other functions and cause the upwards migrations of public functions.

• **P707 Shopping Tower Tirana**
  A building with spiraling floor plates is relevant to my sloped site, since my site is already sloped and already has a spiral-ish curve; a spiraled-floored building can be readily built on my site.
Stacking then tilting can create density and good outdoor environment.

Longtan Park, China
This is a master plan design for middle class residence on a slope. The dwellings hug the slope, just like how the faces are stuck to the mountain's side at MT Rushmore. The dwellings are terraced. The irregular orientation of each dwelling box gives individuality (a good urban design quality). The dwelling boxes are separated from the ground/slope by a gap, in order to have proper ventilation. Because of the irregular individualistic orientations of the dwelling boxes, gaps exist between the dwelling boxes, the streets meander through these gaps.
• P764-782 Hanging
Larger balconies can bring the garden to upper levels.

Also, this may offer the solution to return to the public that my design have taken away from them. Dwelling units can be can be hanged from the main body of the building.

Hanging some parts of the building saves the building’s footprint area.
This is related to my design, as this is a form of density, i.e.: increasing the Floor Area Ratio.
Also: On some slopy parts of my site, building directly on it may not be easy, so hanging a unit over it may become more suitable.
• P26 Old peoples’ apartment with 100 units

Having a 100 unit apartment building without much height would result in a very deep and dark building. So some of the 100 units were taken out of the main body of the building, they were cantilevered via trusses from the sides of the building (hanging is more expensive than cantilevering). Because these cantilevering units are very exposed, thicker walls and floors are used to clad them to protect them from e.g.: noise.

This is related to my thesis, as cantilevering increases the FAR and density of site occupation. It also shows the things that needs to be taken care of when hanging or cantilevering units – i.e.: protecting it from exposure.
Along with the building’s original program, nature and public space can be stacked up all into 1 building. The multileveled public space and nature are like extensions to public space and nature. Here it is a demonstration that nature and technology are not mutually exclusive. This creates higher density in used spaces and nature, and creates a dense and diverse compilation of functions.

A set of dense patio-houses have discarded the necessity for outwards looking windows altogether. Instead, the designers focused on internal light wells/courtyards/patios. This way, 46 units were grouped together into one continuous building with a very small area. The use of light wells is demonstrated here to enable collective residence buildings to be denser.
- The idea of Gotham: When a city is already crowded, instead of going up, downwards is another possible direction. By maintaining the tramways and footpaths or parts of the road and dig downwards to create valleys below the retained tramways will expose more underground levels to build on.

- Motorway A20 – the original concept of a road becomes a valley and many spaghetti-ways are accommodated in the valley.

- Friedman’s idea of stacking different sized forms in different phases on top of each other creates a diverse network of cantilevered connections. This, in my point of view, gives more public access to upper storeys.

These 3 ideas are related to density, connection, and the more public activity pushed up onto upper floors aspects of my thesis.
• P118 Flying Village
A ‘sandwich’ structure, buckled upwards, arching over the ground, with functions accommodated between the sandwich structure. This creates another level of functional use above the ground level. This is relevant to my thesis, as it offers an interesting solution to how to multiply the earth’s horizontal space.

Salazar, Jamie. *MVRDV at VPRO*. Barcelona: Actar, 1999

• P102
In an office building, difference in levels/heights and gaps in buildings can help to create more interest in a bland and repetitive office typology.
- P35 & 36
  "can we imagine a lighter mode of urbanism, one that is considered to be non-designed, non-designated, less regulated and more free? An urbanism that manifests itself more with the temporary and short-term behavior than with a ‘frozen’ eternal condition. An urbanism that cultivates the unexpected more connected with the word landscape..."
  This is relevant to urban design qualities; This once again re-iterates the advantages for a development to be more ad-hoc and less strictly planned, and overlaps with the ideas from Lagos and some of Jane Jacobs' ideas on the 'open city'.

- P50-55
  In solving the lighting problem in deep plan buildings, the traditional approach is do have 1 straight light well, but ‘precision bombardment of snake-like holes can also be applied to the building, making it possible to get light, air and views from the surroundings.

  ![Diagram](image-url)

  This is relevant to the density point of my thesis, because by using precision bombardment of snake-like holes to introduce light, air and view into the deeper parts of the building saves more space than the single light well approach, where there may be space wasted where the light well isn’t necessarily needed, hence precision bombardment of snake-like holes will allow me to design more denser buildings.

  The resulting form is a form cross penetrated by the outside space, blurring the difference between outside and inside.

  ![Model](image-url)

  Because my project takes a sunny, outdoors park away from the public, this may be a way to return the nature back to the public.
To preserve the value of heritage buildings, yet still be able build high-density areas around it, the new high-density developments can go for a low-rise option. The new high density building can be a low-level ‘carpet’ of developments that surrounds the heritage buildings. Hence the heritage buildings can stand out like a monument, and the low-level ‘carpet’ of high-density developments is like the matrix.

In this high-density, low-level solution, windows will no longer be opening in walls, but openings in roofs. As a result, buildings will no longer architecturally compete with neighbouring buildings, as the meaning of the façade is shifted to the roof, and a new form of contextual independence emerges.

Existing trees can be preserved. These trees can help to break the bland and repetitive patterns of the new development at irregular points, adding a sense of identity and peacefulness to certain points. Some units will be distorted in one way because of an obstructing tree, some units will be distorted in other ways, while some others are not. This gives the units more identity.

Giving each unit their own raised terrace provides a means to escape this high-density matrix.

Higher density can be generated by building a city on top of the existing city. The new city can have a flat and even roof, so that a third, fourth ... cities can be built on this flat plane in the future.

Because a city is built on top of an existing city, the lighting problem can be solved by letting the lower city accommodate dark functions, and the upper city accommodate light functions.
If a dwelling is to be hanged or cantilevered, then it cannot have too many internal partitions, to minimize its weight. The irregularity of their positioning and orientation generates spatial diversity and breaks the repetitive bulk. Hanging also provides sunshade and wind blocks to other units. The terraces and ‘balconies’ that result from hanging also create opportunities for socialization among neighbours. Hanging not only offers an alternative from a deep-planned building, but also frees up ground space.

Active edges don’t always have to remain on the ground level. In a multi-level building, parking and retail can be mixed at all levels. Parking and driveways incise through the bulk of retail, the walls between parking and retail is transparent and become active edges.
To make sure that every unit in an apartment gets sufficient amount of contact with the outside, each unit can be made to interlock into each other in the 3D space, to optimize the amount of exterior contact that each unit gets.
A building can be in the form of a bridge. This can increase density and preserve views.

A high density city should be diverse. In the extreme case, the city can be compared to a pile of sand, each speckle of sand represents a function, which differs from the other functions. To achieve some kind of coherence among this extreme pluralism, the satisfaction of common interests should be provided, so that a group of different people will be focused on one activity of common interest, and the next group of different people can be focused on another common activity.

To save space, use sliding doors.
Height to space ratio, spatial openness and complexity, number of people and fixtures, light level, naturalness of environment and rhythm of activity, overall building size, space between buildings, visual access to open and green space, street width, building height and ratio between built-up and vacant spaces can affect the perception of density. Short building length and more street intersections can make people think that the area is of higher density, but street width, shape, slope and building diversity do not significantly affect actual density.

High density doesn’t necessarily mean overcrowding. If more floor area is extracted from the same piece of land, then more floor area will be available to the same amount of people, so overcrowding is actually reduced.

The same density can be achieved in different forms:
Good urban design qualities require:
- Districts that provide many primary functions, to encourage different people to use the same facilities at different times.
- Smaller building blocks for easy access and movement
- A mixture of buildings in different conditions to encourage different uses.
- Dense concentration of people to support diversity.

Planning shouldn't be too deterministic and structured. Buildings shouldn't fit perfectly neatly together. Blocks should be small and through-fare should be encouraged. This is good in urban-design point-of-view because it encourages sociability and spontaneity. Urban areas should be built, managed and adapted incrementally, because in this way buildings can accommodate a wide range of programs and users, adapt to context and be distinguishable.

Over-determination reduces flexibility and causes a city to be 'brittle'. Instead, it is better to have a variety of functions that are 'undesigned' and 'unregulated' to create a loose-fitting environment.

Rich diversity should be able to be fostered by a flexible urban typology, which allows the coexistence of heterogeneous expressions, ease of adaptations and the change of use. Development of urban areas should be informal and autonomous. The opportunities for customization and individualization according to needs should be allowed.

Small-scale additions help to reorganize public space and reformat it into a more fine-grained hierarchy, which can suggest a clearer gradation from public, semi-public to semi-private space. In doing so, these additions transform the scale of the dispersed modernist residential blocks to an intimate and pleasant environment and reweave them back into an urban fabric of finer texture. Being an incremental process, these spontaneous developments constantly adjust themselves to the situation of the immediate physical and social context, thus making them more adaptable and resilient.

Urban transformation process should be:
- The incremental incorporation of parts into an existing core, which extends the likelihood of the preserving the existing.
- Retention of existing maintains continuity of the normal rhythm of the affect areas.
- A sedimentary process that ensure continuity, which contributes to the formation of the sense of place.

Buildings should, in time, become repositories of interventions.

The incremental process and its accumulation of elements results in true complexity and meaningful variety.

Dense places have its own set of environmental issues and considerations, such as:
- Local heat
- Ventilation
- Albedo

One may utilize ventilation paths, mountain winds and sea breezes to alleviate the effects of local heat islands.

The main factors in urban areas that affect thermal comfort is temperature and wind speed.
In dense places, regional winds should be utilised, it should be allowed to penetrate into the deepest part of the built-up areas. So street layout and orientation should be considered. Open spaces between buildings should also be considered.

In hot humid climates, landscaping should be used to provide shade, to lower the surface temperatures and to block wind without blocking ventilation. In hot dry areas, landscaping should be used to minimize dust levels. So trees should be placed in front of buildings, but not directly in front of windows. Short trees and small plants will not provide the needed shade, they only increase the humidity level. Therefore proper trees should be used for shade. Small trees and plants should not be placed in front of buildings, especially on the windward side, unless that wall has no windows.

In winter, the priority is protection from wind and access to sun. During cold winters, inside areas should be insulated, but more importantly, the outside temperature should not be too cold, so that street dwellers and park users won’t be too cold. In climates with hot humid summer and cold winters, the difference between summer and winter wind directions should be utilized to block the wind in winter and provide ventilation in summer. A typical typology to provide this year-round comfort is the U-shaped block, with the butt end facing the winter winds, the open end will receive summer wind, and the courtyard in the middle should be able to receive low angle winter sun. For parks to be protected from winter wind and receive winter sun, so that the parks can be used all year round, a U-shaped formation of big trees should be used around the park. When lower buildings are next to higher buildings, wind can be directed downwards towards the lower building and cause uncomfortable downdrafts.

Urban ventilation is for the purpose of:
- Indoor ventilation
- Pollution dispersion
- Urban thermal comfort

For hot summer climates, buildings should be in smaller bulks to increase the wind permeability, so that sufficient ventilation can happen in summer.
When designing high density areas, consider:

- **Air paths**
  Streets should be wide enough for wind to reach ground level from higher levels, otherwise wind will just skim over the top of the buildings. If all the streets cannot be wide enough, then wind paths should be introduced, to let wind in. So as a result, some street will be narrow, while other streets are wide. The wide streets are there to get winds (which come from high levels) into the narrower streets.

- **Deep street canyons**
  In very deep streets, wind vortexes that provide ventilation may not able to reach the ground level of the streets.

- **Street orientation**
  For ventilation in summer, streets should be roughly, although not directly aligned towards the summer winds. Sun and shadow is another important factor. In terms of sun and shadow, north-south oriented streets are more thermally comfortable than east-west orientated streets.

- **Ground coverage ratio**
  Spatial porosity and permeability is effective when it comes to ventilation.

- **Building height differentials**
  Buildings of different heights are preferred, as they can catch and ‘scoop’ the high level wind that passes over them, and direct these winds down to ground level in the form of vortexes. If the buildings are bulky and of similar heights, then the wind that passes over their tops will just skim right over them, leaving the streets at ground level with no ventilation.

Building in higher density requires the introduction of more light-insensitive functions. Hence the mixing of functions and densification goes hand-in-hand.

In terms of ventilation, a good urban area is one that can receive wind from many directions, the more the better. However, building should be able to block gust.

Large podiums can block ventilation at pedestrian level. Therefore it is important to ensure that podiums are permeable. A terraced podium can help to direct airflow to pedestrian level.
Street parallel to the prevailing wind direction. This ensures penetration of wind suction pressure on the facade of the building.

Streets which are perpendicular to the wind direction. The principal air current could hardly penetrate and would flow above the buildings' roofs or away from the cluster.

Street oblique to wind direction at small angle promotes ventilation across streets.

Figure 10.11 Aligning street orientations properly is better for city air ventilation.
In areas that needs ventilation and where signages are numerous, vertical signages are preferred to horizontal ones, because horizontal ones blocks more airflow.

Figure 10.13 Reducing ground cover and breaking up building podiums is better for city air ventilation

Figure 10.14 Buildings with gaps along the waterfront are better for city air ventilation

Figure 10.15 Improving air volume near the ground with stepping podiums is better for city air ventilation

Figure 10.16 Varying building heights is better for city air ventilation
• P154 - P163: About the highly dense Kwonloon Walled City, Hong Kong.

  • Density is so high that the ordinary scales, orders, patterns and typologies are replaced by a more fluid form of mass. This means that various functions are interlocked over, under, around and even into each other; wherever there is a gap of empty space between the existing mass, a new blob of mass is built right into it, in a cheek-in-jaw fashion. Mass has become 'liquid', flowing into and occupying whatever in-between space that is left.

  • Block, street, light-well, circulation, staircase and other building components are no longer in its conventional form, but all collapsed into each other to form a monolithic, deep-planned mass (like a Tetris game, or weeds growing between the cracks in the rocks, or water occupying the gaps between solids). Forms are built over, or even hanged/attached over other forms in mid-air, blocking the existing function from the outside. Functions that specifically operate in darkness are introduced to utilise the dark parts of this new building topology.

  • From this new fluid-mass typology, a new order (or pattern of occupation) seems to have emerged: one that is divided into and ordered by light and dark. The functions at the very core of the deep-planned forms seem to have found a new form of contextual-independence, as they are deprived of any contact with the outside environment.

  • In such dense and mixed places, a very dense and complex circulation system exists, in order to keep this place operating. Characteristics of these circulation systems are: high number of forks and branches that form a highly connective, dense and efficient circulation system; Circulation infrastructures exist at all levels from ground to roof; The roof is a continuous, all-connected and all-accessible plane.

  • Circulation is typically in the form of narrow winding alleyways. These alleyways offer resistance to fast moving circulation and encourage social mixing. The exterior and interior are blurred, as activities and retail spill out from the dwellings into the alleyways, which raises the density of activity. These grey-areas (or transitional areas) between the inside and outside form areas that harbours crowds and lively activities.

  • Another characteristic of the Kwonloon Walled City is the timesharing of facilities and services between people and programs.
Residence and non-residence are completely mixed at all levels.
A service space, or a double façade can be a part of the cross ventilation set-up, shown in the diagram above.

A wind tower can be used to bring ventilation down into an interior room.

Vegetation is not useful in dense urban areas to reduce noise, unless it is of significant depth or if it is in a street canyon. Strategically positioned rib structures (parallel grooves) on surfaces can help to reduce most noises.
• P176-P177: About Hong Kong's residential high-rises

To avoid deep dark plans in residential towers, a ‘flower’ shaped plan is used. This plan maximizes the perimeter, so that contact with the outside is maximized; every room will at least have a window.

The bulk of mass in the middle is the circulation/services shaft, the four bulks around this shaft are where the residential units are.

• P182-P183

To make sure that building dimension (especially height) doesn't go too excessive, the balance between the height of building, spacing between buildings (for sunlight) and the slenderness of building must be optimized.

• P177,P178 (cont.)

Podiums and balconies can block direct noises from below, and shelter the level(s) above.

• P190

Building taller, slender buildings is better than shorter, fatter buildings, in terms of sun and wind.

• P235

Nature too can be stacked alongside other functions into a high density building. If the greenery is continuous and concentrated enough, then the greenery can thermally cool down the building. However, if plants are small, then the effects are local. Only big vegetations in or near buildings can provide sufficient building cooling.
• P256
Large scale greenery can be used to protect a façade of unfavorable orientations. Metal roofs can also be helpful in providing thermal comfort.

• P210-P211
To have high rise building close to each other, yet maintain good natural lighting, the bounding box of the building can be more pyramidal and less rectangular, because when the upper parts of the building become more slender, it’ll block less light.

• P210
Fire is another hazard to consider when designing a high density area. To reduce the impact of smoke, external windows on the leeward side of the prevailing winds should be provided, as they provide negative pressure to suck out the smoke.

• P210-P222
Things to consider in regards to high density and fire:
• Horizontal spreading
• Crowd movement and control
• Effectiveness of sprinklers and its positioning with regards to the shape of internal spaces
• Fire enclosures should be provided to trap fire
• Many escape points should be evenly distributed through the building, especially along the vertical axis.
• Material choice is important. Certain materials are combustible. Normal mass glazing is weak in the event of a fire.
3 CHAPTERS

HERE ARE THE 3 MAIN POINTS (AND THEIR SUB-POINTS) THAT WILL BE DISCUSSED IN THE FOLLOWING 3 CHAPTERS:

- **Building on slope site**
  - Using non-flat floor slabs
  - Open planned approach

- **Densification**
  - Ad hoc development for future expansion
  - Building top-heavy
  - Using trusses for floor system
  - Minimizing service space
  - Minimizing corridor space
  - Cross-programming in a dense way
    - Light/dark functions
    - Flat/sloped functions
    - Visually obscured / visually un obscured functions
  - Density need circulation
  - Have multiple functions in one space

- **Urban design issues**
  - Street frontage
  - Wind
  - Scale and grain
  - Connections
1. **BUILDING ON SLOPY SITE:**
I've decided to use an open plan strategy to deal with this complex slope.

**NON-FLAT FLOOR SLABS**

**Challenging the idea of flat floor slabs:**
The traditional approach for building in sloped sites is to make up for the height differences, so that the flat floor slabs can then be put onto the site. The four diagrams below show the conventional ways of building on sloped sites:

- **Excavating**
- **Elevating**
- **Having partial floors**
- **Partial excavation**

In diagram (a): effort will be spent excavating the site, before any building can be built.
In (b) and (c): the parts circled in dark blue are unusable, because the ceiling height would be too low. These types of spaces are usually used as storage spaces or plant rooms. There must be a better way to use every bit of space in better ways.
In (d): both excavation efforts will be needed and wasted/underused spaces will be present.

The following diagram shows another conventional solution to build on sloped ground.

The biggest problem with this approach is one to do with urban design: the addressing system needed for this design will be complex. To locate a room, one has to say, for example: “part A, floor 2, room 5”. And if one says “to meet at level one”, there would be confusion, because there isn’t a clear and obvious level one, as level 2 of part C will be on the same level as level 3 of part A.

So a less conventional way need to be developed, in order to address the issue of building on sloped sites and to overcome the lackings of the 5 conventional approaches above.
Instead of using flat floor slabs all the way through, stepped slabs (slabs that mould to the topology of the site) will be used:

This is a diagrammatic illustration of the slope-floor-slab idea.

This is the section of my design, showing what the building looks like, as it utilizes the sloped-floor-slab idea.

This way, first level will always be first level, and second level will always be second level. There are also no wasted spaces, like the ones in the above diagrams b, c and d.
OPEN-PLAN APPROACH:

By using floor slabs that are not completely flat, the spatial design within the building is opened-up to a new opportunity: open-planned spaces and the dividing-up of spaces in an open-planned way.

Traditionally, open-plan techniques often manipulate spaces on the horizontal plane. In diagram (e-i) of the left picture (below): The division of space is done by manipulating space on the horizontal plane. In diagram (e-ii) of the left picture (below): The division of space is done by the changes in levels on the vertical plane. In the right picture (below): The One Room House is an example of how spaces can be divided-up in an open-planned manner, by changing the floor levels.

Recall: the One Room House from the literature review. The One Room House is one example of how open planning can be done by elevational shifts.
The section and 3D image of my design (below) shows how my design implements the ideas of sloped-floor-slabs and open-planning via vertical space manipulation.
The 2 bedrooms are private areas, so they obviously need walls around them.
Living room and kitchen don’t need wall between them, so these 2 spaces can be divided by a change in level on the vertical plane.
Bedrooms need sunlight, so they take up all the front window space.
The living room (in the context of people flatting in apartments) doesn’t really need sunlight. Flatters can do activities that require sunlight in their own room. Sometimes flat mates may watch TV in together in the living room, which does not require sunlight anyways.
The kitchen is located at the back, at the highest elevation, because steam and smoke from cooking rises upwards, and it isn’t desirable for cooking fumes to enter the living and bedrooms. A small window at the back of the kitchen, which opens to the circulation shaft, will let the cooking fumes out.

The bathroom is next to the kitchen, because it is convenient to group together all the water-related rooms. It is private space, so it needs to be surrounded by walls; open-planning will obviously not apply to bathroom. Because it will not get natural ventilation, because the spaces are so squeezed, mechanical ventilation will be used; many larger apartments in central Auckland already use mechanical ventilation for bathroom anyways, so it is fine to use mechanical ventilation for bathroom in my design.

The results of open-planning:
- Will positively utilize non-flat qualities of the floor slabs.
- Will offer an alternative to corridors. This is good because this thesis is trying not to use corridors.
- Can divide space without the need for walls. Less walls means:
  - Less floor spaces will be taken up by walls
  - The building will be lighter, which means:
    - Thinner columns, which will take up less ground space, and
    - It will be beneficial to buildings which are top-heavy
- Can affect the patterns of cross programming, because functions like theaters need sloped floors, while functions like a bedroom need flat floors. This will be discussed more in the Density section of this thesis.
2. BUILDING IN HIGHER DENSITY:

AD HOC DEVELOPMENT FOR FUTURE EXPANSION:

Recall:

“Rigidly planned developments are always less dense than the ad-hoc slums that they replaced. This is worthy to be aware of when I am designing my thesis project, as I would not plan my design too strictly, and let my design be able to accommodate more ad-hoc growth, expansion or alteration.”


Recall:

“The idea of an ‘open city’ expands on the idea of density & diversity. Richard Senette refers to Jane Jacobs: Jane Jacobs argues against the ‘closed city’ is a city in a state of equilibrium, where everything that is predicted to happen has already been planned for and rigidly build out. She recommends that once a city (or a part of the city) have achieved density & diversity, and achieved public and private functions mingled with each other, the designer should then make that city an ‘open city’. An open city is developed step by step, not all planned out at once. It has the ability to incorporate adaptations; it is in a way ‘un-neat’ and somewhat ‘unplanned’; it encourage public usage of space, it is not built from a completely defined starting point (i.e. an all-figured-out master plan).”


The following diagrams illustrate how my design allows for ad-hoc nature developments:

The 3D space between the kindergarten and the lecture theater above is irregular on the vertical axis, due to the sharper slope of the lecture theater’s floor relative to the kindergarten’s floor. On one side the space is almost 6m high, and on the other side the space is almost 9m high. This high ceiling space shouldn’t be wasted. The kindergarten’s mezzanines (which you can see in the 2 diagrams above, marked by red; and in the final plan drawings in the appendix) are placed anywhere where there’s a headroom of around 2.5m to 3m. This is just one way, of how this high ceiling space can be filled up, in an ad-hoc way; and demonstrates how spare spaces around the building can be utilized in an ad-hoc manner.
The 3 diagrams on the previous page also shows how spare spaces around the building can be filled up in an ad-hoc manner. In the case of what the 3 diagrams above shows: The lecture theaters at level 2 have a ceiling height of 6 meters throughout. This 6m ceiling height in the front of the lecture theater cannot be used, otherwise visibility to the lecture screen may be blocked. However the 6m ceiling height at the rear of the lecture theater can be filled by other functions; in this case, this spare space with a ceiling height of 6m, is filled up by a quarter-ring-shaped floor slabs. The functions on these quarter-ring-shaped floor slabs are offices (extensions to the adjacent offices)

**BUILDING TOP-HEAVY:**

Although the site is narrow and long, a lot of usable floor space can be extracted. Using a top-heavy elevation for my design is one way of maximizing the usable floor area and the FAR (Floor Area Ratio)
USING TRUSSES FOR FLOOR SYSTEM:

One way to support the maximum amount of activities within the smallest building is to maximize the amount of usable floor area.
The floor area which is occupied by columns does not count as usable area.
One way to reduce the floor area which is taken up by columns is to reduce the number of columns.
To reduce the number of columns, the span of the floor slabs have to increase.

![Diagram 1](image1.png) ![Diagram 2](image2.png)

However, as the 2 diagram above shows, as floor span increases, the floor slab’s thickness increases also.
This increase in floor-slab thickness is a waste of space in the vertical dimension.
This wastage of space in the vertical dimension isn't acceptable when we are trying to build in a very dense way.

Therefore the structural system for the flooring will have to change: Instead of having solid concrete floor slabs as flooring, trusses can be used.

![Diagram 3](image3.png) ![Diagram 4](image4.png)

The diagram on the left shows the traditional structural system of the floors, which are solid concrete slabs.
As the floor span increases, so will the slab’s thickness. This is a waste of space on the vertical dimension.
Eventually, the floor span will be so large, that the slab’s thickness will be the height of a whole storey.
Since the floor slabs are made of solid concrete, habitation can't take place inside of them, regardless of how thick they are.
So the better solution is demonstrated by the diagram on the right: trusses will be used for flooring. The trusses' thickness will be as thick as an entire storey (i.e.: between 2 to 3 meters). Trusses' aren’t solid like concrete slabs, so habitation can take place inside the trusses.
This way, the maximum amount of habitation will be possible, with both the horizontal and vertical spaces used in the most efficient way.
One problem with trusses is their diagonal members, which gives visual obstruction. Vierendeel Beams are a variation of trusses, which have no diagonal members. So in this thesis, Vierendeel beams will be used as the structure for the floors.

The section below shows how my design implements a top-heavy elevation and truss-based flooring system:

The 2 diagram below shows the apartment part of the in more detail. It shows how the truss-based floor-system is implemented in detail in this apartment unit.
The space between lecture theater floors will accommodate air conditioning and lighting for the lecture theaters. This is because:

- There will inevitably be gap spaces between the lecture theater’s flooring and the structural slab underneath.
- Air conditioning and lighting for lecture theaters are best to be placed between these floor gaps, due to proximity, so that extra ducts and wires won’t be needed.

Electric boards and high tech electronics require negligible space, and will not be explored in this thesis in deep.
The elevators are outside. Their servicing equipments are on top of, beside and below the elevator shaft.
MINIMIZING CORRIDOR SPACE:

Corridors are a big waste of space. The usage of corridors should be minimized, if not completely eliminated. The diagram (left below) shows the conventional topology of a floor plan: there are stair shafts on either sides of a building, there is a corridor running between the 2 shafts, and the rooms are distributed along the corridor. The problem with this conventional topology is the presence of the corridor. The corridor wastes too much usable floor space.

It is possible that only shafts can be used to deliver all the circulation. This is shown in the diagram (right below). Doing this will eliminate the corridor and its wasted floor space.

The 2 images below show how my design implements the corridor-free floor-plan typology.
In the diagram (topmost) shows the topmost floor’s apartments. Since the top floor can have a lot of sunlight via roof windows, the entire top floor can be used for apartments (instead of half office half apartments, like the floors below).

Also: observing my plans in Milestone-9 to Milestone-11 in the Appendix, the plans has progressively transformed towards more and more of a circular (or radial) pattern.
"To preserve the value of heritage buildings, yet still be able build high-density areas around it, the new high-density developments can go for a low-rise option. The new high density building can be a low-level ‘carpet’ of developments that surrounds the heritage buildings. Hence the heritage buildings can stand out like a monument, and the low-level ‘carpet’ of high-density developments are like the matrix. In this high-density, low-level solution, windows will no longer be opening in walls, but openings in roofs. As a result, buildings will no longer architecturally compete with neighbouring buildings, as the meaning of the façade is shifted to the roof, and a new form of contextual independence emerges.”


“A set of dense patio-houses have discarded the necessity for outwards looking windows altogether. Instead, the designers focused on internal light wells/courtyards/patios. This way, 46 units were grouped together into one continuous building with a very small area.”

Major advantages of using roof lighting had led me to the decision of using roof lighting. These advantages are:

- Inner parts of the upper floors can have roof windows, therefore can receive adequate lighting.
- In such dense environments where e.g.: an office window have to be face-to-face with someone’s bedroom window, the utilization of roof windows on these residence units are good solutions to privacy, because roof windows are more contextually independent than façade windows, and can therefore solve privacy problem, where an office might be looking into someone’s bedroom.
CROSS-PROGRAMMING IN A DENSE WAY:

The nature of the spaces in various parts of the building determines what function those spaces will hold. This approach shall result in the most dense and efficient use of all usable floor space.

Recall:

“The idea of an ‘open city’ expands on the idea of density & diversity. Richard Senette refers to Jane Jacobs: Jane Jacobs argues against the ‘closed city’ is a city in a state of equilibrium, where everything that is predicted to happen has already been planned for and rigidly build out. She recommends that once a city (or a part of the city) have achieved density & diversity, and achieved public and private functions mingled with each other, the designer should then make that city an ‘open city’.”


Recall:

Things to think about when you build vertically: density, public access, diversity in space, mixing of program.

Recall:

About the highly dense Kwonloon Walled City, Hong Kong.

Density is so high that the ordinary scales, orders, patterns and typologies are replaced by a more fluid form of mass. This means that various functions are interlocked over, under, around and even into each other; wherever there is a gap of empty space between the existing mass, a new blob of mass is built right into it, in a cheek-in-jaw fashion. Mass has become ‘liquid’, flowing into and occupying whatever in-between space that is left.

Block, street, light-well, circulation, staircase and other building components are no longer in its conventional form, but all collapsed into each other to form a monolithic, deep-planned mass (like a Tetris game, or weeds growing between the cracks in the rocks, or water occupying the gaps between solids). Forms are built over, or even hanged/attached over other forms in mid-air, blocking the existing function from the outside. Functions that specifically operate in darkness are introduced to utilise the dark parts of this new building topology.

From this new fluid-mass typology, a new order (or pattern of occupation) seems to have emerged: one that is divided into and ordered by light and dark.

The functions at the very core of the deep-planned forms seem to have found a new form of contextual-independence, as they are deprived of any contact with the outside environment.

The exterior and interior are blurred, as activities and retail spill out from the dwellings into the alleyways, which raises the density of activity. These grey-areas (or transitional areas) between the inside and outside form areas that harbours crowds and lively activities.

... 

Another characteristic of the Kwonloon Walled City is the timesharing of facilities and services between people and programs.

Residence and non-residence are completely mixed at all levels.

**Light/dark functions:**
Having multiple functions is helpful for denser designs, because in a dense building, not every part of the building will have good light. Some functions need good light, while some other functions don’t need good light. Therefore putting functions that need light on the sunny parts, and putting functions that don’t need much light on the darker parts results in more efficient space usage.

Apartments need the most natural lighting. Kindergarten needs some natural lighting. Offices need very little natural lighting. Lecture theaters need no natural lighting.

Inside an apartment unit: bedroom needs most natural lighting, living room needs almost none (in a flatting context), kitchen needs ventilation and some natural lighting, and bathroom (in a very dense context) needs no natural lighting.

So the apartments are placed on the north side and on the top floor. Kindergarten is placed on the north side of the 1st level. Offices and lecture theaters are placed on the south side.

Inside an apartment unit: bedrooms are placed on the north side, living room is placed in the middle, and kitchen placed towards the south end, with a little opening to the outside environment via a small opening to the vertical circulation shaft. Bathroom is placed close to kitchen, so the water-related rooms are grouped together.

**Flat/sloped functions:**
Lecture theaters needs sloped floors. All other functions needs flat floors.

The south ends of the middle floors have sloped floors, lecture theaters are put here.

Everywhere else in the building has flat terraced floors, so the other functions are located everywhere else.

**Visually obstructed/ Visually un-obstructed functions:**
Due to the usage of Vierendeel Beams as a part of the structural system, every alternating floor will have visual obstruction due to these Vierendeel Beams.

Although Vierendeel Beams give less visual obstruction than normal trusses, floors with no Vierendeel Beams will still have a clearer view of the outside than the floors with Vierendeel Beams.

Offices can have visual obstruction. Kindergarten can handle visual obstruction too. It is not desirable for apartments to have their views obstructed. Lecture rooms needs no view to the outside, so it does not matter if it have visual obstruction.

The north side of the building has the Vierendeel Beams attached to the internal walls, and no Vierendeel Beams around the outside. So the north side of the building has no obstruction, so apartments can be here.

The top floor have Vierendeel Beams around the outside, giving some visual obstruction. Despite this, apartments should still be put here, because the little visual obstructions caused by Vierendeel Beams are counter-balanced by the benefit of natural lighting via roof windows.

The 1st floor has Vierendeel Beams around the outside, so offices are places on its southern half, and kindergarten is placed on its northern half.

On the 6th floor, there are not Vierendeel Beams around the outside. However, offices are placed at the southern half of this floor, due to its southern orientation and poorer natural lighting.
The southern ends of the middle floors have their views partially obstructed by Vierendeel Beams. Lecture theaters are placed here, as it doesn’t matter whether lecture theaters get visual obstruction or not. The diagrams below show how the 3 factors (levels of light, gradient of floor and level of visual obstruction) affect how the cross-programming is done:
DENSITY NEEDS CIRCULATION

Recall:

About the highly dense Kwonloon Walled City, Hong Kong.

In such dense and mixed places, a very dense and complex circulation system exists, in order to keep this place operating. Characteristics of these circulation systems are: high number of forks and branches that form a highly connective, dense and efficient circulation system; Circulation infrastructures exist at all levels from ground to roof; The roof is a continuous, all-connected and all-accessible plane.

Circulation is typically in the form of narrow winding alleyways. These alleyways offer resistance to fast moving circulation and encourage social mixing.


The red arrows mark the alternative circulation routes. The circulation shafts and these alternative routes are the circulation network of this high density building.
HAVING MULTIPLE FUNCTIONS IN ONE SPACE

Recall:

“The street has 2 functions doubled-up on it: circulation and commerce. A healthy commerce sector is taking place on the street, side by side with circulation. The physical provisions are simple: just a continuous concrete steps for people to sit on, and a footpath that is sufficiently wide for both commerce and circulation to take place in one space. This form of informal commerce is extremely efficient and effective (turning passerby into customers), and contribute to the economy significantly.”

This resounds the example in Lagos: the doubling of functions in the same space – doubling up of commerce and circulation in a simple road or street, with the simplest physical provisions, like a simple shelter or a simple place to sit.

The Mexico City example also resounds the theme outlined in the “European City Model” example – that areas of good urban-design qualities must have density, diverse functions, and that functions are compatible (or interrelated). It is little wonder that this street in Mexico City is successful, because it is dense (i.e. different functions are in cheek-and-jaw with each other), diverse (i.e. 2 different functions doubled up in one place), and functionally compatible (i.e. roadside marketers turns passerby into customers).

Recall:

“This is one of the most notable densely used places in Lagos. Notice the doubling up of functions in a single space.
A single urban space (a road) contains 2 functions: circulation and commerce, which takes place under the most basic of provisions (i.e.: the over bridge providing shelter and a strip of unpaved footpath providing a place to stand or sit)
Also note that this isn’t bad density, as people would come here despite the crowd.
It also make my aware that if we provide fancy amenities that the people cannot use, then it is no better than a simple provision of an over bridge and a strip of unpaved footpath.”


The areas marked in yellow are the areas where multiple functions occur. They are the front end of the office section of the building, so they can be reception areas or waiting foyers. They are also thoroughfare areas where people can go from lecture theaters to offices.
URBAN DESIGN ISSUES

STREET FRONTAGE:

Recall:

“... the inside and outside should be blurred, a colonnade or similar structure should be before the entrance and the skin of the building, to provide a transitional area, in order to veil the building from complete revelation, and more importantly, to generate a healthy active edge, i.e. an active edge that can accommodate crowds, public and social orientated activities. Not like the London City Hall, where the building’s skin is just an impermeable sheet of glazing, where there is no blur between inside and out, nor transition zone that provides a ‘safe-harbor’ for crowds to gather at the boundary of the building.”

The apartment building opposite the Kitchener St already has active edge on its ground floor; this apartment building is building on flat ground, so it can handle a front-of-house and back-of-house functions, such as shops.

However my design is on sloped ground. Because of the sloped ground, and that the roads around site are narrow, steep and busy with traffic, a loading zone is impossible to have on my site, hence my site cannot support front-of-house and back-of-house functions, such as shops.

My design does, however, have a landscaped ground floor. This is like a covered street. It allows thoroughfare between Bowen Ave and Kitchener St. It can also be a place where people can sit and have lunch, or a place where people can take shelter from a temporary burst of Auckland rain. The landscaped ground floor is my design’s equivalent of a transitional space, in which lively crowds will be harbored. Although my design can’t host shops, my design can ‘borrow’ from the opposite building’s active edge.
WIND:

If a building are close together and their heights are similar, then the alleyways between them will not get sufficient ventilation. This is because high level winds will just skim over the tops of the buildings, and no wind will be able to go down the gaps between the buildings, so no wind will be able to reach down to the alleyway.

The diagrams above show how my design can be multiplied across the rest of the site, in case of future expansion. It also shows how winds can be captured by the different building heights, ‘scooped-down’ into the alleyways, in order to provide ventilation to the alleyways and all the rooms with windows that faces the alleyways. This would be my suggestion for future expansion regarding winds and natural ventilation.

Note: The duplicated buildings are shown in dark grey. They are not shown in any detail, but just in their bounding-box form.
SCALE AND GRAIN:

The diagram below shows the scale and grain imposed on my site, by the surrounding streets and buildings. This was defined in my brief.

The diagram below shows how my design follows the scale and grain that was previously defined. The bulk is separated by alleyways, which corresponds to surrounding streets and buildings. The interior alleyways also correspond to these scales and grains. Breaking up bulk and repetity is an important element of urban design considerations, as repetitions and bulk at a mass scale causes unpleasant feelings. The diagram below shows my suggestion for future expansion, regarding scale and grain.
The bulk of the façade is broken up by the pattern of massing (shown above). This pattern of massing results from the top heavy elevation, which was the strategy to increase the FAR. The breaking up of bulk is vital to urban design qualities, especially in regards to scale and grain. Because a piece of mass at an ‘inhumanly’ large scale is unattractive to lively crowds of people. Large bulks are also ‘melancholic’ to people’s senses, and are reminiscent of the Soviet-era-styled concrete mass-housing apartments.
CONNECTIONS:

In the brief, popular pedestrian paths across the site are defined. These are to be preserved.

The diagrams below show how these popular pedestrian paths across the site (between Bowen Ave and Kitchener St) are preserved by the exterior and interior alleyways. The diagram below shows my suggestion for future expansion, regarding cross-site physical connections.
Recall:

“... The city or building is like a developing narrative: this means that the building does not reveal itself completely at once. Instead, the building should show a part of itself to invite people in, but slowly unfold itself as the person walks through it, just like how a novel don’t tell you how the story ends at the beginning. This means that the building should be opened up and pushed up to the street-front, but veils parts of itself at the front, and slowly reveals itself.”


Squiggly alleyways:
- breaks lateral wind;
- provide both flow and resistance to people flow, hence encourage spontaneous meet-ups;
- reveals and conceals itself – attract people to enter.
The landscaped first floor:

The landscaped first floor has the risk of becoming dark and damp if ventilation and sunlight isn’t enough.

So the alleyways should be done in a way, to allow sun and wind to reach landscaped ground level. **This would be my suggestion for future expansion.**

**Visual connections**

The apartments at the Northern end of my building have clear and sunny view out into the north.
REJUVINATING UNLIVELY AREAS

In the brief: 3 un lively areas are defined around the site. My design should make these 3 areas better, mainly by connecting to them physically and visually. However this point is under-developed at this stage, as the chosen portion of the site (which my design affects) is out of range of the 3 un lively areas. So my suggestions for future expansion, regarding rejuvenating these areas will be to make a lot of visual and physical connections to these areas; and make a lot of active edges, open spaces or transitional areas face these 3 un lively areas.
OUTCOMES

Regarding building on sloped ground:
- The aim of building on sloped ground has been achieved reasonably well.
  - My section of the site dips by 4 meters from top to bottom, but no vertical space is wasted due to ‘half-height’ places.
  - Although my section of site dips for more than 1 storey from top to bottom, my design still have only one ground floor, instead of two ground floors, which is helpful if someone tells another person to ‘meet at the ground floor of my building’.
- These are done by using non-flat floor slabs.
- Utilizing the undulating nature of my non-flat floor slabs has also achieved open-plan design. The open-plan design makes the interior spaces more interesting. It also reduce the need to use walls, which is helpful for designing dense buildings, as walls and the structure that is needed to carry the walls takes up space.
- However, more can be done to undulate the floor slabs, to make the open planning much more interesting and make the need for walls even less.
- The 0.5m level changes in the non-flat floor-slabs take up space. The research should go further to seek a way to minimize the area of those drops, hence maximizing the area of useful floor space. Such 0.5m level changes in the non-flat floor-slabs are marked in red in the diagram below.

Regarding Maximize the density-of-occupation of available land:
- The aim of maximizing the density-of-occupation of available land has been achieved, although not completely and thoroughly yet.
  - The apartments towards the Northern end of the building have a ‘fan-shaped’ plan, in which circulation is supplied by a vertical circulation shaft, and the apartment units ‘fans out’ around the shaft. This is the idea I had in at the initial idea stage, to eliminate corridors and therefore maximize the useful occupation of floor space. The apartment part of my building, at the Northern end of my building clearly demonstrates this idea, and has no corridor. However this planal arrangement is not done to the apartments at the Southern end of the top floor. The Southern end of the top floor can be improved a lot from its current state.
  - The use of ‘storey-thick’ trusses has saved a lot of vertical space and horizontal space. However the diagonal members of the trusses are occasionally blocking passageways, and these needs to be fixed.
  - The top-heavy elevation has increased the FAR (floor area to site area ratio). However the extreme cantilevers in my design may need more structural technology to make my design structurally viable.
The cross-programming system, based on 'functions allocated into the most suitable spaces' (or more accurately speaking: light/dark functions; visually obstructed/unobstructed functions; sloped/flat floored functions) have helped with designing a densely inhabited building.

Service spaces has been distributed to local areas of the building, to minimize service space.

About the radial circular plan: Geometrically circles cannot fit exactly into another circle. This have both good and bad consequences:

- **Bad consequences are:** External alleyway waste space, as the circular building perimeters cannot fit perfectly. Attempt to solve this problem by using square radial plans also have mixed consequences:
  - **Bad consequence is:** with square radial plans some corners would have very acute angles, many of which are uninhabitable.
  - **But the good outcome is that** if the angle isn't too acute, it can add more variations to apartment units and make them more interesting.

- **But good consequence is:** this imperfect between the circular building perimeters create good urban-design quality, because the squiggly alleyways
  - Breaks lateral wind;
  - Provide both flow and resistance to people flow and encourage spontaneous meet-ups;
  - Reveals and conceals itself – attract people to enter).

Regarding the distribution of service spaces: The main disadvantage concerning efficient space usage, with regards to distributed boilers and fans, is that more ducts may be required and even waste space as the service spaces has to increase in size to accommodate these ducts.

Pipes coming down from the apartments' bathrooms have to ultimately find its way down to ground level. Due to the scope of this thesis, how these pipes should reach the ground, or through where those pipes should go through, is not clarified. The most likely way for these pipes to reach the ground is to go parallel to the circulation shaft. A major problem with this is that the circulation shaft, which is doubled up with the service shaft, may be overloaded with circulation and services and may also become bottlenecks. Overcoming these potential bottlenecks require alternative routes for circulation and services, which means that the building need a more intensive circulation system, which is undeveloped in my design due to the scope of this thesis.

The apartments' bathrooms concerned in this point are marked in red in the diagram below:
Regarding top-heavy elevation, more could be done to use the top-heavy elevation to further increase the FAR:

- Structurally, the building could have used the surrounding buildings for structural support, i.e.: latching onto the neighboring buildings.
- Form-wise: the design could have bridged completely over the surrounding streets and transforming the streets into tunnels, instead of just bridging half over the surrounding streets, like the way the design is right now. Such bridgings are illustrated in the diagram below.

Urban-design qualities:

- The aim of maintaining urban-design qualities has been somewhat achieved at this stage. The ground level of my building is a public orientated indoor-outdoor transitional space, offering spaces to do sports, play, sit, gather, eat lunch or relax. This transitional space mediates the inside and outside, and this is where lively crowds will gather. A ground level like the one in my design would be the typical active edge for buildings on very sloped sites with insufficient nearby roads, because very sloped sites surrounded by narrow and curvy roads cannot support loading zones, hence cannot support front-of-house and back-of-house, and hence cannot use retail and shops as active edge. A landscaped, public leisure area on the ground floor would be the next best option for active edge, for this sloped site. However, this landscaped first level have the risk of becoming dark and damp if ventilation and sunlight isn't enough. So future expansion should be done in a way, which allows sun and wind to reach landscaped ground level.
- Scale and grain, cross site circulation, natural ventilation by 'catching' summer winds and blocking winter winds, and making the neighboring unlively areas lively - cannot be implemented at this stage, and will not be implemented unless future designers follow my suggestions about how to build future expansions on this site.
- Indoor ventilation have been more or less achieved. Most of the apartments (including all the ones in the North end of the building) have kitchens located on the highest terrace, with entry-door and ventilation window on the kitchen's back wall. However some of the apartment units at the South end of the top floor still have no means of ventilating kitchen smoke.
- Physical connections to some extent, is still unable to be implemented at this stage, until future designers follow my suggestion for future expansion.
- My building currently has minimal visual connections, other than the apartment units at the North end of the building, which have clear and sunny view into the North.

- Still, quality is hindered by density, because:
  - The apartment units lack that family feel, despite the variations that the apartment units currently have.
  - The elimination of internal corridors means that there are no chance spontaneous meet-ups; hence the community or social environment is hindered.

**The 3 major price of density:**
  - Hindering of the urban design qualities and living qualities. Ultimately this proves the point that the solution between density and quality is always a struggle, which leads to a compromise.
  - More energy will be consumed, by distributing the centralized boiler into smaller distributed boilers, there will be more heat loss, hence requiring more heating energy.
  - More resources will be consumed, because with single boiler, air conditioning and electrical units are distributed into smaller units and are spread over the building, more pipes, ducts and wires will be needed to link them to their served areas and to each other, causing more materials to be used to make those pipes, ducts and wires.

**Other lackings:**
  - Alleyways’ stair-and-ramp based circulation system can be better developed to:
    - Increase architectural quality by arranging the ramps and stairs in a more aesthetical pattern
    - Save more space streamlining all possible paths between 2 points.
    - Maintain some level of visual connection by identifying wanted view-paths, then streamlining the ramps and staircases in a way that avoids these view-paths.
    - Allow ventilation by streamlining the ramps and stairs, to that the alleyway won’t be cluttered by unnecessary or over-abundant ramps and stairs.

  Recall:

  In areas that needs ventilation and where signages are numerous, vertical signages are preferred to horizontal ones, because horizontal ones block more airflow.

Ng, Edward. *Designing high-density cities for social and environmental sustainability.* London ; Sterling, VA : Earthscan, 2010, P133

Signages cause disturbances to ventilation, and different types of signages cause varying degree of ventilational disturbances. Likewise, ramps and stairs located in mid-air also have disturbances to ventilation, which should be mitigated.

- The initial of timeshared spaces remain unexplored.
- The initial goal of having multiple functions in one space could have been more extensively implemented.
APPENDIX

- First set of drawings: Milestone 9 plans and section

- Second set of drawings: Milestone 11 plans and section
Albert Park

- Bowen Ave
- Kids play area
- Sitting steps
- Sports
- Skate
- BBQ area
- Fountain
- Circulation Shaft

Kitchener St

SECTION A-A
2ND FLOOR

- Master Office
- Main Office
- Aux. Office
- Entry Foyer
- Kindergarten

A SECTION - A'
4TH FLOOR

(Empty)
(Double floor space-Below)

Shared Entry

SECTION A-A1
Opposite Apartment Building is about twice the height.
Reading List

- Salazar, Jamie. MVRDV at VPRO. Barcelona: Actar, 1999.
Other resources that is yet to be read

- Predecessors – Slopy ones
  - Mont Saint Michel, Brittany, France
  - Mardin, SE Anatolia, Turkey
  - Masouleh, Gilan, Iran
  - Lisbon, Portugal
  - San Francisco, California, USA
  - Athens, Greece
  - Boccadasse, Italy
  - Polignanoamare, Italy
  - Ostuni, Italy
  - Dalian, Manchuria, China
  - Pusan, South Korea
  - Favela bairro, Rio de Janeiro, Brazil
  - Seattle, Washington, USA
  - Honolulu, Hawaii, USA
  - Portland, USA
  - Los Angeles, California, USA
  - Long Beach, USA
  - Tulsa, USA
  - Tucson, USA
  - Phoenix, Arizona, USA
  - Pittsburgh, USA
  - Kansas City, USA
  - Little Rock, USA
  - Memphis, Nashville (& Every other Tennessee City), USA
  - Albuquerque N.M, USA
  - El Paso
  - La Paz, Bolivia
  - Rome, Italy
  - Idrija (Slovene small town)
  - Sarajevo, Bosnia & Herzegovina
  - Bangor, UK
  - Bradford, UK
  - Bristol, UK
  - Durham, UK
  - Edinburgh, UK
  - Glasgow, UK
  - Lancaster, UK
  - Leeds, UK
  - Lincoln, UK
  - Liverpool, UK
  - Norwich, UK
  - Sheffield, UK
  - St Albans, UK
• Predecessors – Dense ones
  • Tokyo
  • Surat
  • Mumbai
  • Netherlands
  • Lagos
  • Shanghai
  • Manila
  • Bogor
  • Titagarh
  • Baranagar
  • Serampore
  • Pateros
  • Delhi
  • South Dum dum
  • Kamarhati
  • Kolkata
  • Mandaluyong
  • Levallois-Perret
  • Neapoli
  • Caloocan
  • Chennai
  • Vincennes
  • Sukabumi
  • Saint-Mandé
  • Le Pré-Saint-Gervais
  • Saint-Josse-ten-Noode
  • Levallois-Perret
  • Vincennes
  • Kallithea
  • Ampelokipoi
  • Mislata
  • Nea Smyrni
  • Paris
  • Athens
  • L’Hospitalet de Llobregat
Other resources that is yet to be read

Books

- The Favela-Barrio project: Jorge Mario Juregui Architects - 72.036.6(81) J826 - Available
- Contemporary urbanism in Brazil: beyond - 711.4(81) R585 - copy1 On loan
- Reading MVRDV / [essays by Winy Maas...[et al.]; edited by Véronique - 72.036.6(492) M994r - copy1 On loan - Due on 16/05/11
- Five minutes city: architecture and (im)mobility: forum & workshop - 72.012 M999f - copy1 On loan - Due on 16/05/11
- Marginal lands assistance / by John Cornwell - Cornwell, John, editor - GENERAL LIBRARY SPECIAL COLLECTIONS NZ Pamphlets - Ask at the Special Collections Desk - PAMPHLETS 07-004 - Available
- Diller + Scofidio (+ Renfro), the ciliary function: works and projects - Incerti, Guido - DVD held at library lending desk - 72.036.6(73) D578c - Text copy1 On loan - Due on 16/05/11 - DVD copy1 On loan - Due on 13/05/11
- The landscape of contemporary infrastructure / Kelly Shannon, Marcel Smets - Shannon, Kelly - On Order: 1 Copy Received as of 06/08/10
- The urban housing handbook / Eric Firley and Caroline Stahl.
- The sustainable city IV: urban regeneration and sustainability / editors, Ü. Mander, C.A. Brebbia, E. Tiezzi.
- Space unjust: socio-spatial discrimination in urban public space: cases from Helsinki and Athens / Michail Galanakis; [translations ... Michail Galanakis ... Mika Snellman]; [photographs by the author ...].
- The sustainable city V: urban regeneration and sustainability / editors, A. Gospodini, C.A. Brebbia, E. Tiezzi.
- Total housing: alternatives to urban sprawl / [edited by Albert Ferre, Tihamer Salij].
- Verb crisis / [edited by Mario Ballesteros ... et al.].