From Houses to Hillsides:
Support for Adaptive Housing on Hong Kong's Slopes

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

ABSTRACT

Hong Kong's urban development is governed by the mountainous terrain of the city. The city is growing, and easily developable low-lying flat land is becoming increasingly scarce. As a result, Hong Kong's development is conflicted between the hillsides of the landscape and the urban built environment. On one hand, the avoidance of hillsides, characterized as liabilities, has created a hyper-dense environment where real estate economics and speculation separate public and private housing sectors with little opportunity for alternative affordable housing options. On the other hand, as urban expansion encroaches ever closer to the slopes of the city, new strategies for slope stabilization infrastructure are required for improved safety and resilience. With no resolution to this spatial struggle, informal settlements arise to create affordability through the absence of formal regulation, but these structures pose psycho-social and physical risks to their inhabitants. Rather than attempting to provide housing in an all-or-nothing manner, we can think of housing as an incremental process where citizens foster their social and economic capital. By acknowledging informality as a process that functions within the market, we break down the legal apartheid between formal and informal, and begin to design with, rather than against, bottom-up approaches to high-density urban living.

Through the redesign of slope infrastructure with architectural foundations, and the integration of services and amenities, we plant the seeds for building to occur on a site that would otherwise be avoided by conventional development. Expanding on existing geotechnical and slope landscaping methods, the man-made slope in the Mei Tung Estate in Kowloon is transformed into a support framework acting as both the stabilization for the slope and the foundation for transformative infill housing. It provides the basic services for occupation where homes can grow with participatory design and collective action. This foundation is not only a spot on which residents can build, but as a component of the three-dimensional public realm of the city, it also offers opportunities to foster social capital within the larger Hong Kong society to improve social cohesion and integration. The focus is on providing the architectural framework in which healthy, safe, and economical inhabitant-driven building can occur. Housing is not a product for the inhabitant, but a process in which families can make a place to call home.

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Lastly, to all the numerous people who supported me throughout this journey, no matter how small or fleeting, thank you.

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INTRODUCTION

Hong Kong has come a long way over the past 177 years since being called "a barren island with hardly a house upon it"[1] by the British. It has now become a thriving metropolis and home to over 7.4 million people.[2] While it is an economic marvel for Hong Kong to be where it is today, its rapid development, especially in the post-war period, does not come without shortcomings. It is challenged with dual political identities as a post-colonial state, and land development is complicated by restrictive topography and planning policies. Capitalist demands of the globalized market economy influence the capacity for the city to accommodate its population.

Even with an extensive public housing scheme, there remains a population of residents who are living in unsafe and unhealthy informal structures. Crafted from a historical culture of squatter settlements, sub-divided units, bedspace apartments, and rooftop apartments are the "new slums" in a highly dense urban environment. The residents are exploited by landlords and stigmatized by other members of society. These types of accommodations persist due to the lack of alternative low-income housing near the city centre. This thesis tackles the lack of housing options and addresses the social and economic barriers of the current forms of informal structures.

Firstly, it researches the history of Hong Kong's squatter settlements and the regulatory barriers to their legitimacy as structures. The government found squatter settlements undesirable and sought to eradicate these communities. The failure to do so has resulted in a policy which has frozen squatter structures in time. Learning from this outcome, and to prevent a similar reoccurrence, it is important to acknowledge and work with, rather than against, the informal building culture of Hong Kong. Through investigations into design methodologies of alternative housing typologies in the region as well as concepts of Open Building and incremental building, the thesis explores new possibilities in high-density housing with bottom-up approaches to design.

The shifting social landscape of Hong Kong also reflects the changing land uses of the city. There is a need for more affordable accommodations in the city centre, but the already highly built-up urban landscape leaves little room for this expansion. However, what remains is a network of more than 60,000 man-made slopes scattered across the city, some of which are potential sites for this investigation. This research into the problem

1 "A Place from which to Trade," , accessed July 19, 2019, https://www.yearbook.gov.hk/2006/en/21_03.htm.

2 "Population - Overview," last modified September 18, accessed September 24, 2017, https://www.censtatd.gov.hk/hkstat/sub/so20.jsp.

of slopes and landslides forms a set of strategies used to build on these unconventional sites. These strategies involve engineering structures, drainage techniques, and landscaping methods. These slope stabilization strategies are explored alongside historical hillside squatter settlements and current hillside developments to set a precedent for the unique conditions of slope occupation.

Lastly, the thesis focuses on a particular slope in the Mei Tung estate in Kowloon, Hong Kong, where the soon-to-be redeveloped estate presents a suitable scenario for the redesign of the slope infrastructure. The existing conditions and future of the site are outlined with a formulation of the possible strategies for this redesign. The slope will need to be upgraded along with the estate redevelopment. Since this work is already required, the goal is to use this opportunity to include affordable housing on the slope so that the upgrade is not only an improvement in slope stability but also contributes to the housing needs of the city. Embedding the capacity for housing will be using the work and capital that would already be provided to supplement housing construction, therefore eliminating the additional costs of building on a complicated site while adding value to an otherwise underutilized piece of infrastructure. The result is an economically practical solution that works within the same cost parameters as a new public housing estate in the New Territories. The new design hybridizes slope infrastructure with architectural qualities to create a framework in which inhabitant-driven infill housing can occur. The design provides the basic living spaces with open rooftop areas that can change and grow over time with the development. These elements are intertwined to function as components of the slope infrastructure and as pieces in the arrangement of architectural spaces. This framework is tied into a broader group of community services and amenities to facilitate the building of a larger social network.

This thesis continuously explores combining, integrating, and hybridizing to tackle unaffordability. Expenditures for engineering and housing come together to fund one project. Slope structures are designed so they become architectural structures as well. Informal construction methods are coupled with a formally built foundation. Bringing together these separate elements provides greater uses and improves resource efficiency. These disparate factors do not usually come together, and it is the realization of the outcomes of these combinations that forms this thesis.

CHAPTER 1: THE HONG KONG IDENTITY

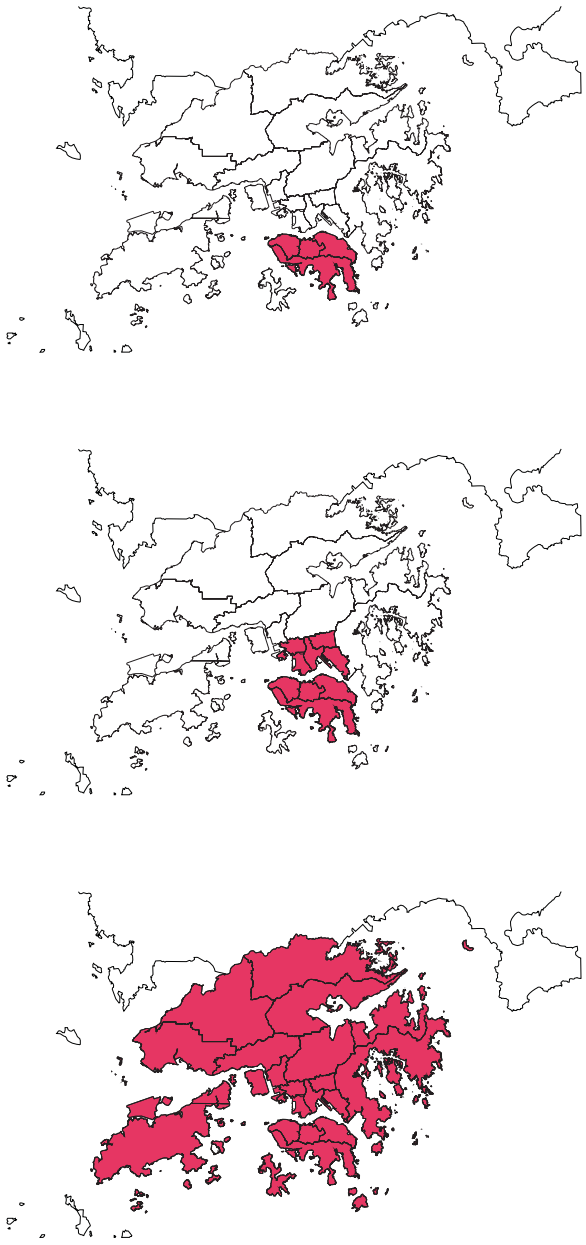


Figure 1.1 Hong Kong Territory

A BRIEF HISTORY OF HONG KONG

Hong Kong (Chinese: 香港) is located in the South of China and part of the Pearl River Delta along with Macau, and Guangdong. Its name translates into 'Fragrant Harbour' and reflects the territory's past as a cultivator and distributor of incense until the late 17th century. It remained a port for foreign traders entering China and was primarily composed of farming and fishing villages.[1] During the Opium War between the British and Chinese, the Treaty of Nanking signed in 1842 ceded modern day Hong Kong Island to the British. This became the birth of Hong Kong as a British Crown Colony. Subsequently in 1860, Kowloon was ceded to the British with the Convention of Peking, and along with the Convention between Great Britain and China regarding an Extension of Hong Kong Territory in 1898, or the Second Convention of Peking, the New Territories were leased to the British for a rent-free period of 99 years (Fig. 1.1).[2] The subsequent events throughout Hong Kong's history are tied to this colonial identity.

The establishment of Hong Kong as a British colony meant a different set of capitalist and legal systems, which set it apart from the Chinese mainland. The primarily Chinese inhabitants still had strong business ties to the mainland and other countries in the region. As such, Hong Kong became the bridge linking China with the rest of the world and an attractive location for merchants and workers (Fig. 1.2).[3] However, its colonial status made it a target during the Second World War. In 1941, Hong Kong fell under Japanese occupation and the population shrank from 1.6 million to 600,000. After the end of the war in 1945, floods of residents returned to the city. Its distinct political identity within the geography of China made it a target again during the Chinese Civil War, but this time as the place for refugees fleeing the war and the Communist government.[4]

However, Hong Kong remained a window to the outside world for China. Immigrants, money, and goods, both legal and smuggled, went through Hong Kong. Manufacturing industries grew which brought along job opportunities for the growing population. The city expanded in the 1950s to 1970s (Fig. 1.3) as more and more immigrants and refugees entered looking

1 Peh T'i Wei, "Why is Hong Kong Called 'Fragrant Harbour': A Synthesis," *Journal of the Royal Asiatic Society Hong Kong Branch* 54 (2014), 33-57. http://www.jstor.org/stable/jroyaaisasocihkb.54.33.

2 "Lease of the New Territories," , accessed July 19, 2019, https://www.yearbook.gov.hk/2006/en/21_04.htm.

3 John M. Carroll, "Chinese Collaboration in the Making of British Hong Kong," in *Hong Kong's History State and Society Under Colonial Rule*, ed. Tak-Wing Ngo (New York: Routledge, 1999), 13-29.

4 Sheila K. Johnson, "Hong Kong's Resettled Squatters: A Statistical Analysis," *Asian Survey* 6, no. 11 (November, 1966), 643. http://www.jstor.org/stable/2642287.

Figure 1.2 Aerial view of Central and harbour, 1927

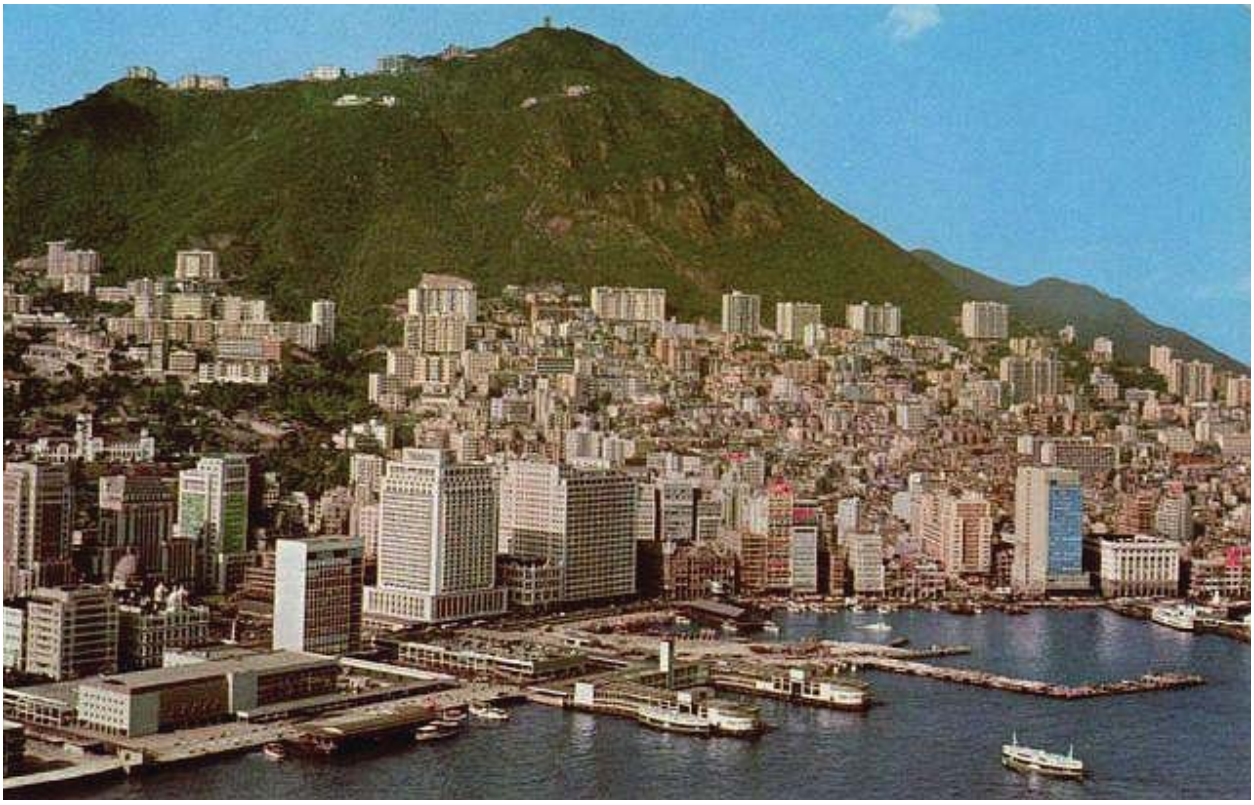
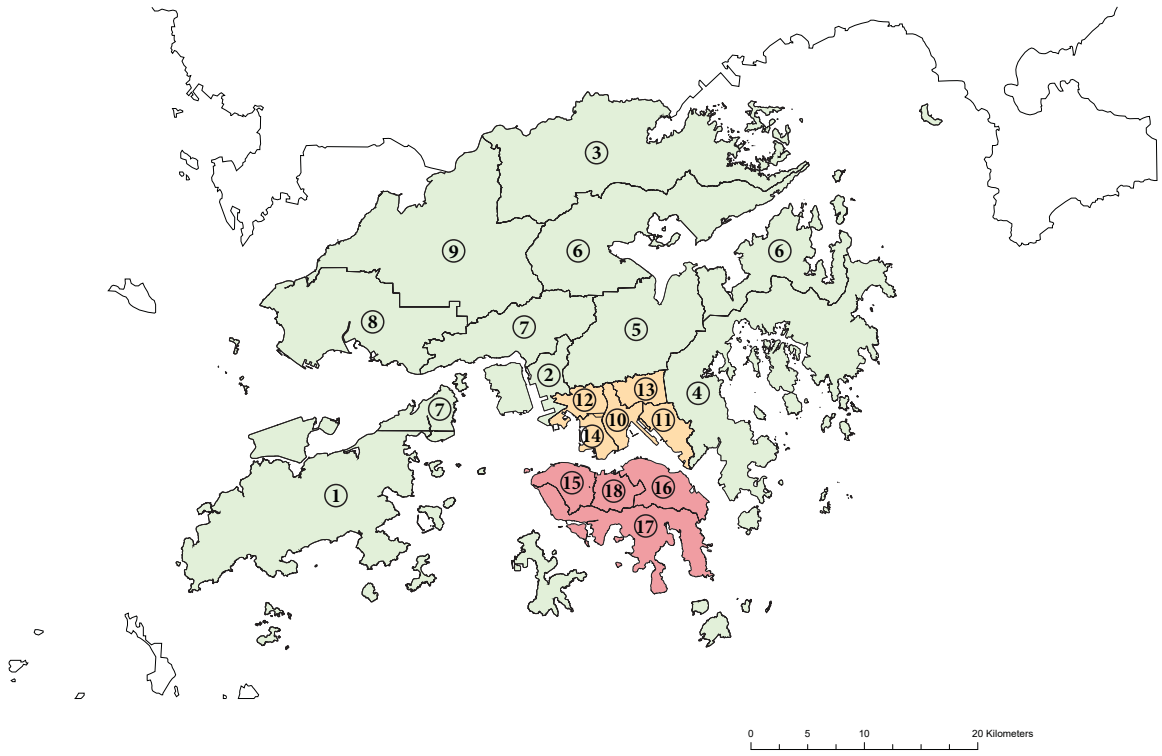


Figure 1.3 Hong Kong Skyline, 1960s



New Territories		Kowloon	HK Island
1. Islands	6. Tai Po	10. Kowloon City	15. Central & Western
2. Kwai Tsing	7. Tsuen Wan	11. Kwun Tong	16. Eastern
3. North	8. Tuen Mun	12. Sham Shui Po	17. Southern
4. Sai Kung	9. Yuen Long	13. Wong Tai Sin	18. Wan Chai
5. Sha Tin		14. Yau Tsim Mong	

Figure 1.4 The 18 Districts of Hong Kong

to make their living.[5] By 1965, the population was an estimated 3.8 million as compared to the 600,000 just 20 years prior.[6] By the 1980s we see yet again the influence of Hong Kong's colonial status when Mainland China decided to open up to foreign trade. The Open-door Policy led to the relocation of manufacturing industries into China where the production costs were lower, while the business activities and services remained in Hong Kong. From the 1980s until the present, the manufacturing sector slowly declined and was replaced with a service-oriented economy.[7] The British colony returned, commonly referred to as the handover, to the People's Republic of China as a Special Administrative Region in 1997 under a "one country, two systems" approach to acknowledge the differences of two societies separated for more than 150 years. Since the handover, Hong Kong continues to establish its post-colonial identity.

MOUNTAINOUS TOPOGRAPHY, URBAN MORPHOLOGY

Hong Kong is well known as a hyperdense city. It is composed of three major regions; Hong Kong Island, Kowloon, and the New Territories, which are further subdivided into eighteen districts. (Fig. 1.4) It has 7.4 million people housed on 7% of the 1,111 square kilometre land area.[8] 41.7% of this land area is designated as country parks not available for development. The reason for this compact urbanisation is the steep mountainous topography that limits the sprawl of urban development. Much of Hong Kong's flat land is not naturally occurring but a result of extensive land reclamation projects which continue to this day.

Due to this characteristic of the environment, the development of the city has grown up and in (Fig. 1.5). Where the city is urbanized it does so with extreme intensity where high-rise tower blocks hover over multi-layered streets, stairs, bridges, and underground passages.[9] Due to the dense environment and small nature of its homes, social spaces extend into public

5 Agnes S. Ku, "Immigration Policies, Discourses, and the Politics of Local Belonging in Hong Kong (1950-1980)," *Modern China* 30, no. 3 (Jul 1, 2004), 326-360. doi:10.1177/0097700404264506. https://www.jstor.org/stable/3181313.

6 Johnson, "Hong Kong's Resettled Squatters: A Statistical Analysis," , 643

7 Zhigang Tao and Richard Y. C. Wong, "Hong Kong: From an Industrialised City to a Centre of Manufacturing-Related Services," *Urban Studies* 39, no. 12 (2002), 2345-2358.

8 "Land Utilization in Hong Kong 2016," HKSAR Government, last modified August 30, accessed September 15, 2017, http://www.pland.gov.hk/pland_en/info_serv/statistic/landu.html.

9 Barrie Shelton, Justyna Karakiewicz and Thomas Kvan, *The Making of Hong Kong* (London: Routledge Ltd, 2011). doi:10.4324/9780203835609. https://www.taylorfrancis.com/books/9781136857621.

Figure 1.5 Skyline view of Hong Kong

Figure 1.6 Elevated pedestrian pathway, stairs, and sitting out area

Figure 1.7 Market stalls along the stairs of Hong Kong

Figure 1.8 Food stalls along pedestrian streets, elevated pedestrian pathway in the background

spaces (Fig. 1.6). Streets and stairs become places for markets, hawkers, and restaurants (Fig. 1.7 & 1.8). Covered pedestrian bridges become shaded areas where people gather to socialize, and underground passages lined with quick-stop stores link the streetscape with the underground public transit network. All these linkages and levels weave throughout Hong Kong's public and private spaces.[10]

FINDING NEW LAND

While the lack of available land is a common perception in Hong Kong due to its dense environment, it is just as easy to find land that is not built. Just outside these urban areas, often within walking distance, are stretches of undeveloped land either designated as country parkland or too difficult and costly to develop. This stark contrast between the built and unbuilt indicates there are barriers to Hong Kong's expansion. Physical limitations in land and constructability are present, but Hong Kong's urban development is also heavily predicated on planning practices.[11]

Hong Kong land is crown land, meaning it is owned by the Hong Kong government and leased to developers for 50 year periods. Land purchasers obtain leases through auction or tender, and the lease conditions are prepared by government surveyors. The purchaser must adhere to the conditions set out in the lease for the land development, or pay premiums to make amendments. The leasehold system is a form of planning control adopted through Hong Kong's colonial history. Regulatory control and prohibition are also barriers to the development of land in Hong Kong.

HISTORY OF PUBLIC HOUSING

Hong Kong's public housing program started in 1954, popularly credited to the fire of the Shek Kip Mei squatter village. In order to house the 50,000 people left homeless from the fire, eight six-storey H-shaped buildings were constructed on the burn site. Subsequently, multi-story estates began resettling squatter communities. An extensive public housing program (Fig. 1.9) helped free up land for development which would otherwise be locked by squatter areas. The development of public housing coincided with the development of Hong Kong as a manufacturing and trade economy. It sought to ease social discontent, especially with growing political tension between

10 Jonathan Soloman, Adam Frampton and Clara Wong, *Cities without Ground* (Woodbridge: Oro Ed, 2012).

11 Yue Chim Richard Wong, *Hong Kong Land for Hong Kong People : Fixing the Failures of our Housing Policy* (Hong Kong: Hong Kong University Press, HKU, 2015), 153.

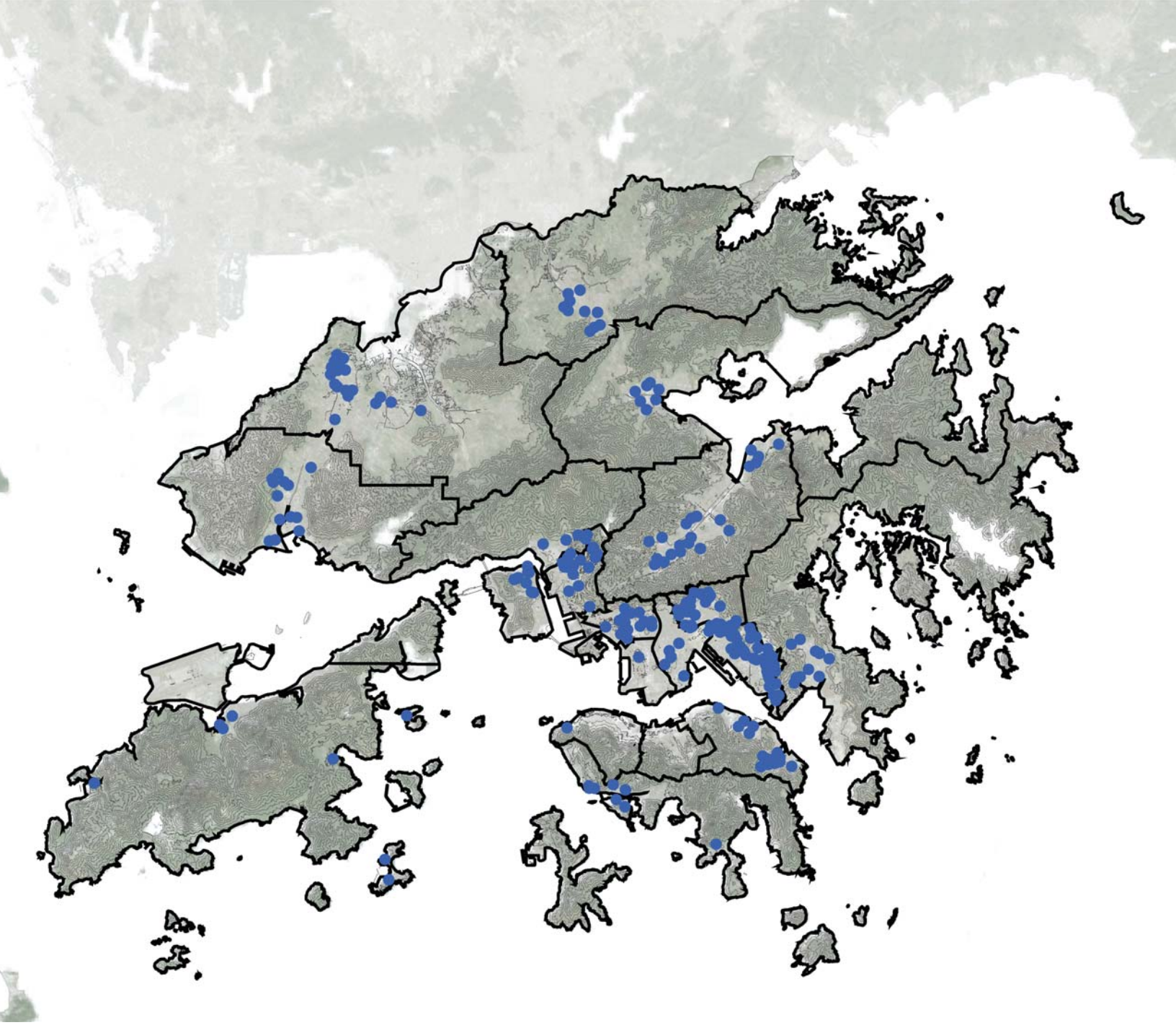


Figure 1.9 Public housing estates in Hong Kong

Source: Hong Kong Housing Authority

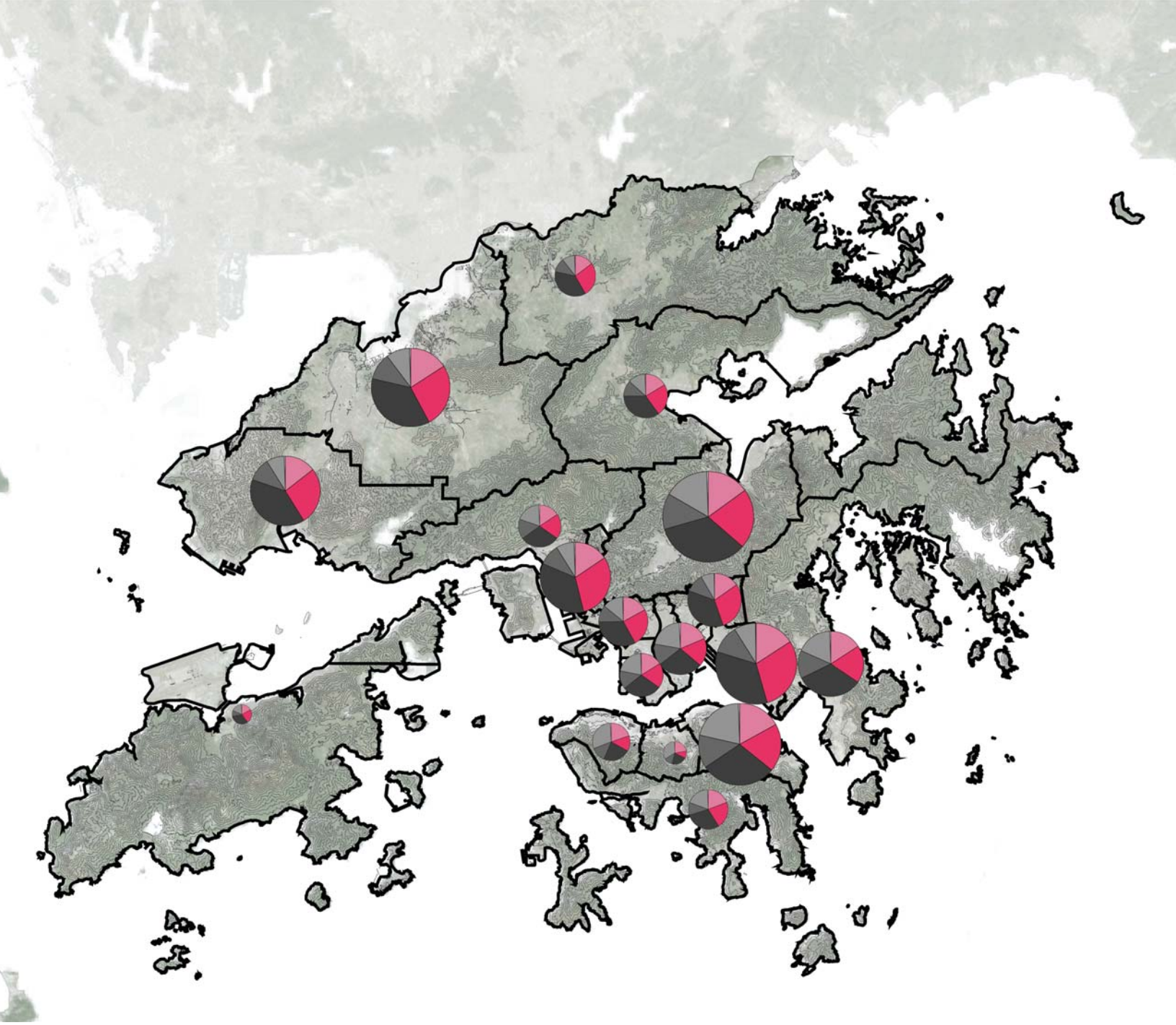


Figure 1.10 Working Population Monthly Income per District

0 5 10 20 Kilometers

Monthly Income (HKD):

- > $30,000
- $20,000 to $30,000
- $10,000 to $20,000
- $6,000 to $10,000
- < $6,000
- Unpaid family workers

Working Population Size per District:

- 100,000
- 200,000
- 300,000

*10,000 HKD ≈ 1700 CAD

Source: Census and Statistics Department

Figure 1.11 Public housing estates in Tin Shui Wai, Hong Kong

the British and Communist Chinese, and kept wages low by reducing housing costs, thus keeping the colony competitive in the global market. At the time, when most families were poverty stricken, public housing was seen as a stepping stone towards a more prosperous life outside the exploitation of private landlords.[12] Even nowadays, close to 40% of the working population still makes less than $10,000 HKD[13] per month (Fig. 1.10).

The New Town Development Programme started in 1973. The formation of New Towns boosted the public housing stock and intensified land use in the New Territories (Fig. 1.11), which was the first time large scale development occurred past the Kowloon foothills. Since 1973, nine New Towns have been created which currently house approximately 3.47 million people.[14] The expectation was these New Towns would contain living and working opportunities to create an independent community outside the urban centre. While they failed to meet this expectation as many New Town residents continue to commute to the urban area for work,[15] they still relieved the pressure in the urban centre.

Since the inception of Hong Kong's public housing scheme in the 1950s, there was significant transformation in the construction process, space allocation, and use patterns of the public housing flat. There were 4 significant generations of public housing design; the Mark series (Fig. 1.12) in the 1950s, the Twin Tower (Fig. 1.13) and H-block (Fig. 1.14) in the 1970s, the Trident (Fig. 1.15) in the 1980s, and the Harmony (Fig. 1.16) and Concord series (Fig. 1.17) in the 1990s until present. Through these design progressions, there were increases to the building construction efficiency and spatial standards in housing. The designs were largely symmetrical to allow for repetition of building elements. Many components, such as washrooms, stairs, and facade, of a public housing block are prefabricated

12 James Lee and Yip Ngai-ming, "Public Housing and Family Life in East Asia: Housing History and Social Change in Hong Kong, 1953-1990," *Journal of Family History* 31, no. 1 (Jan, 2006), 66-82. doi:10.1177/0363199005283008. http://journals.sagepub.com/doi/full/10.1177/0363199005283008.

13 Approximately $1,700 CAD

14 "Hong Kong: The Facts - New Towns, New Development Areas and Urban Developments," last modified May, https://www.gov.hk/en/about/abouthk/factsheets/docs/towns&urban_developments.pdf.

15 Eddie C. M. Hui and Manfred C. M. Lam, "A Study of Commuting Patterns of New Town Residents in Hong Kong," *Habitat International* 29, no. 3 (Sep, 2005), 421-437. doi:10.1016/j.habitatint.2004.01.001. https://www.sciencedirect.com/science/article/pii/S0197397504000025.

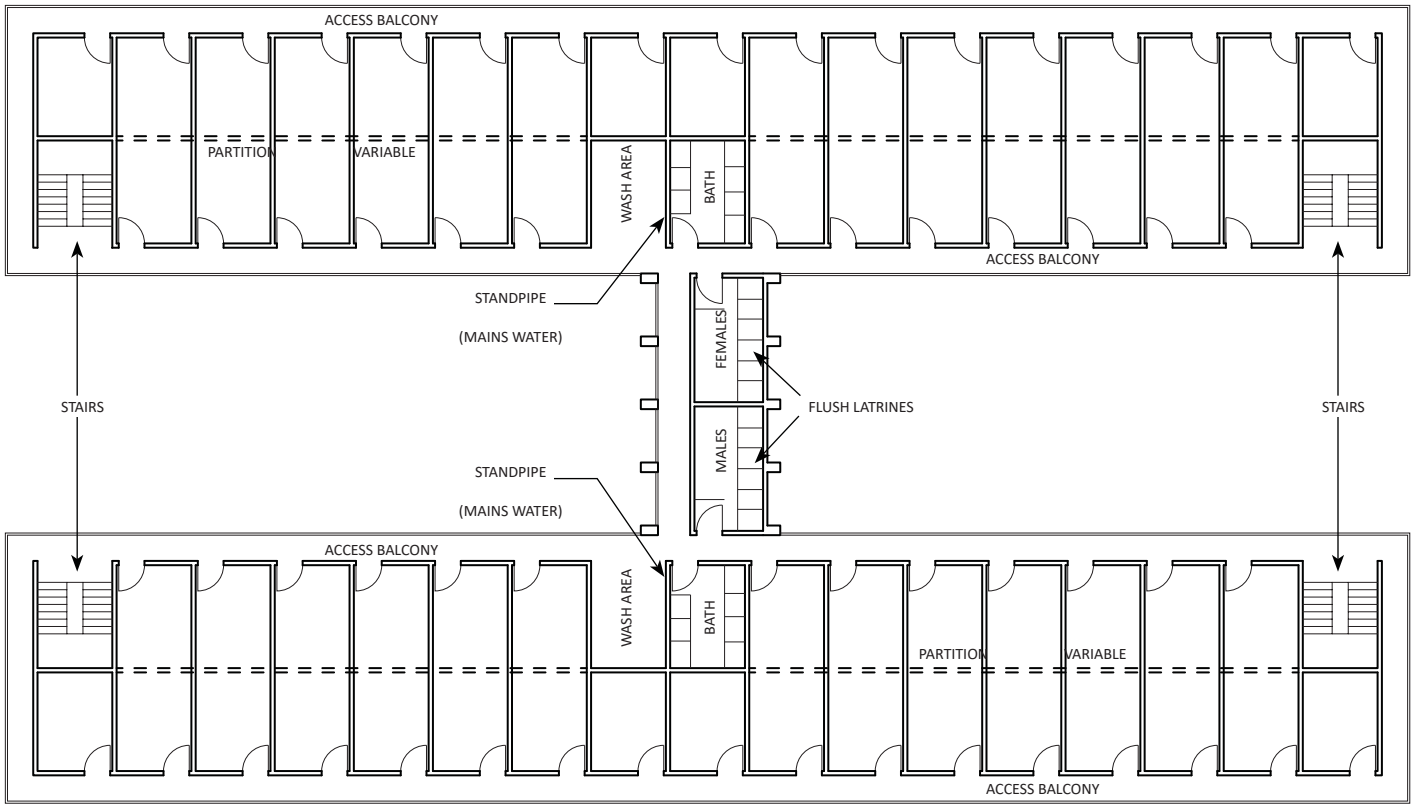


Figure 1.12 Standard H-Block Public Housing Floor Plan

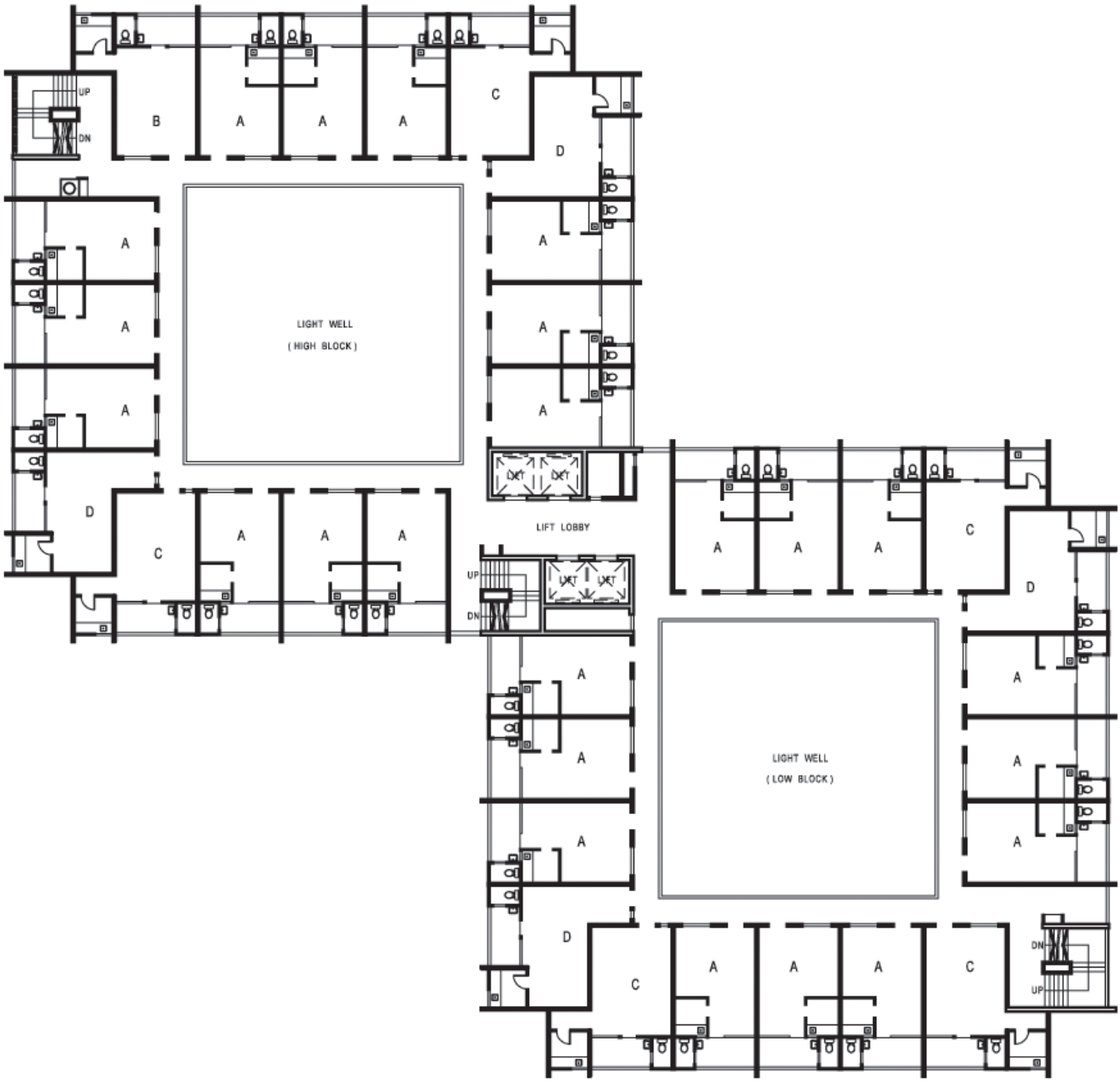
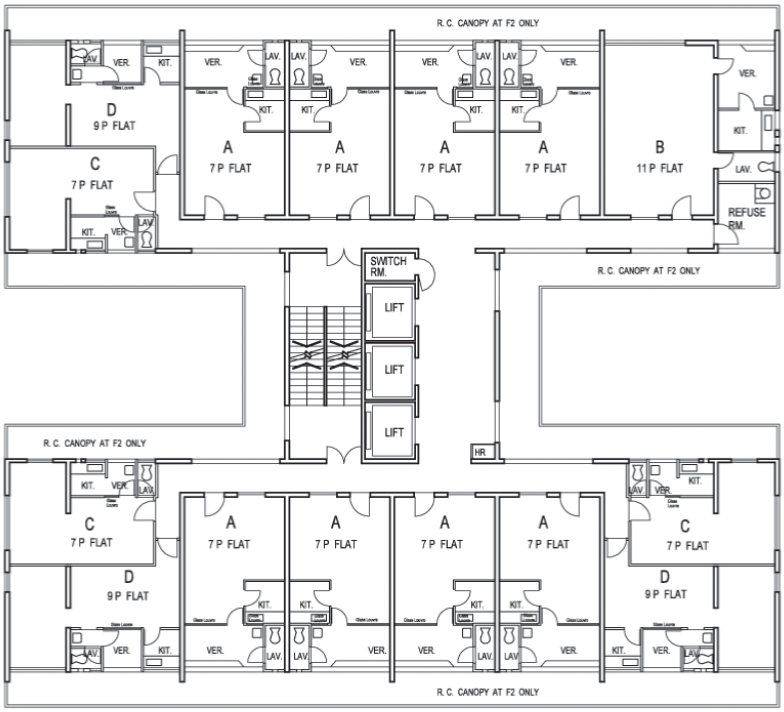


Figure 1.13 Standard Twin Tower Public Housing Floor Plan



0 8m

Figure 1.14 Standard H-Block Public Housing Floor Plan

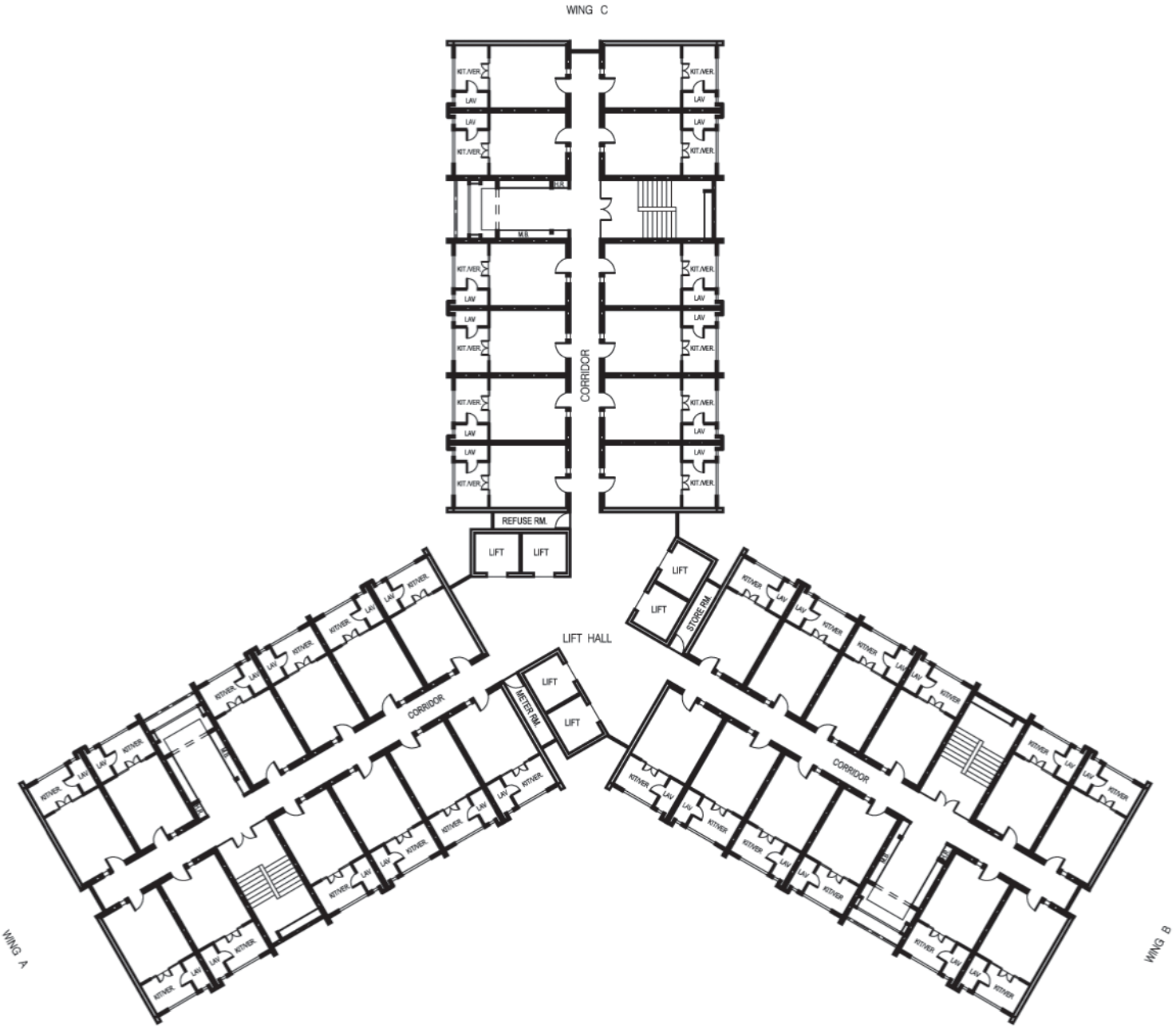


Figure 1.15 Standard Trident Public Housing Floor Plan

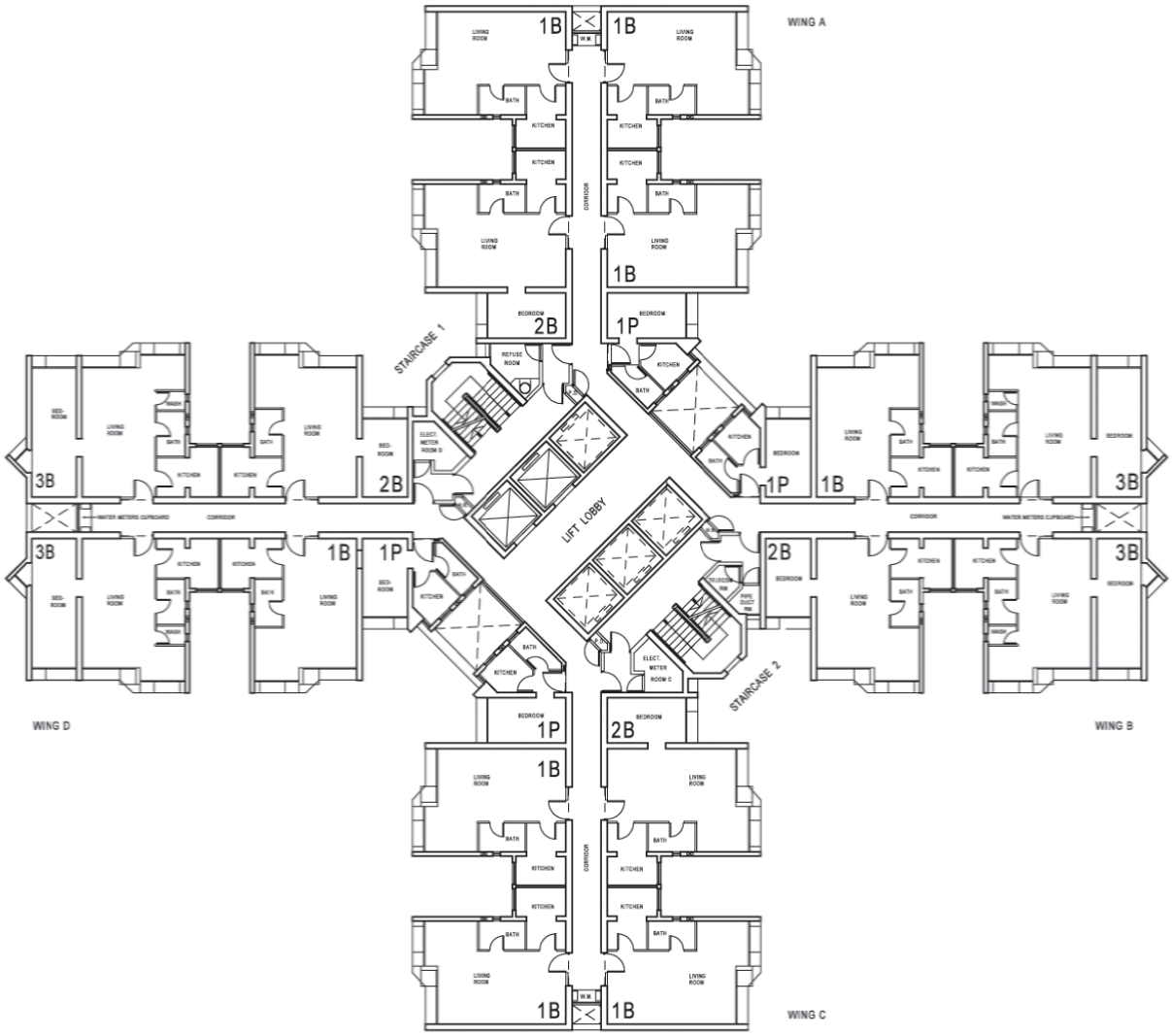


Figure 1.16 Standard Harmony Block Public Housing Floor Plan

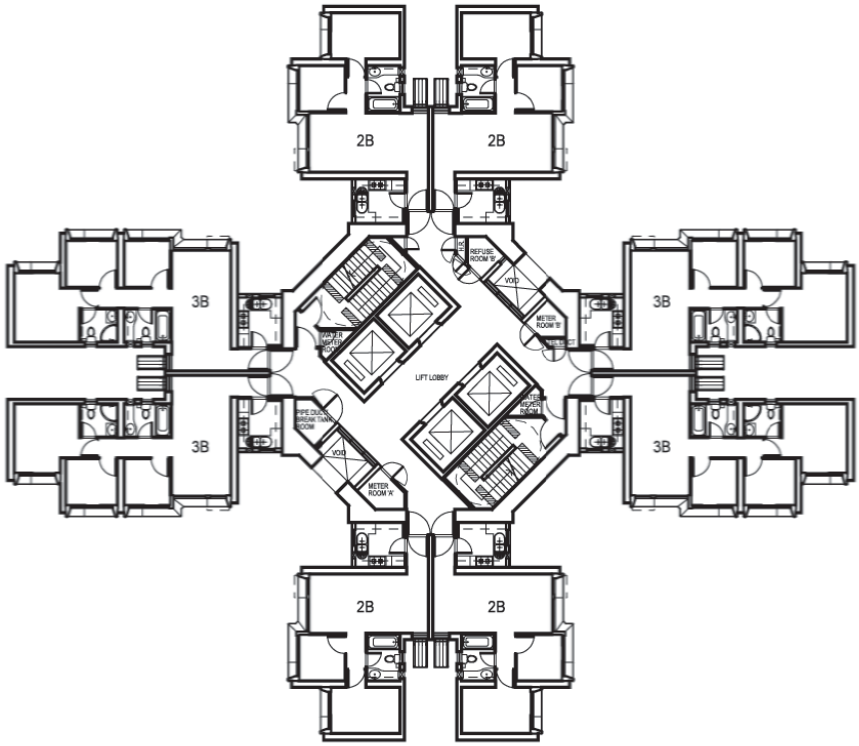


Figure 1.17 Standard Concord Block Public Housing Floor Plan

Precast Façades

Dimensions (mm):
Various dimensions
Type 1:
4625 (L); 150 (T); 2700 (H)
Maximum dimensions:
5500 (L); 150 (T); 3000 (H)
Weight (tonne): Type 1: ~5.25 t
Component/typical floor: 8 to 16
Manufacturing:
– Cast with window frame
– Steel formwork
– Ceramic tile finish applied after casting concrete
Application:
– Public housing projects

Semi-precast Slabs

Dimensions (mm):
Various dimensions, e.g.
4655x2125 (L); 75 (T)
Maximum dimensions:
5500x2400 (L)
Weight (tonne): 1.28 t
covers 100% of floor area in recent projects
Manufacturing:
– Cast with reinforcement
– Steel formwork
Application:
– Public housing projects

Precast Staircases

Dimensions (mm):
2651x1645 (L); 195 (T)
Weight (tonne): 2.8 t
Component/typical floor: 4
Manufacturing:
– Steel formwork
Application:
– Public housing projects and private sector

Precast Bathrooms

Manufacturing:
– Cast with window frame
– Steel formwork
– Unit completed with waterproofing, tiling, concealed conduits, and sleeves for pipe work before delivery.
– Installation of pipes and sanitary fittings inside the precast bathroom at the factory
Application:
– Public housing projects and private sector

Precast Beams

Dimensions (mm):
4200 (L); 500 (T); 800 (H)
Weight (tonne): 2.92 t
Component/typical floor: 2
Manufacturing:
– Steel formwork
Application:
– Public housing projects

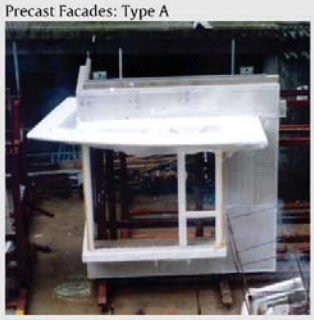
Precast mid-landings

Dimensions (mm):
3490 (L); 1730 (T)
Weight (tonne): 5 t
Component/typical floor: 2
Manufacturing:
– Steel formwork
Application:
– Public housing projects

Precast Facades: Type A&B

Dimensions (mm):
varies (L); 75 (T); 2534 (H)
Weight (tonne): less than 6 t
Component/typical floor: 12
Exempted area under the JPNs:
Precast facades: 9 m^2
Sunshades: 19 m^2
Manufacturing:
– Steel formwork
– Tile finish applied after casting concrete
Application:
– Private sector and public housing projects (in recent projects)

Precast Facades: Type A



Semi-precast Balconies

Dimensions (mm):
~1652x3040 (L); 100 (T)
Weight (tonne): ~2.5 t
Component/typical floor: 6
Exempted area under the JPNs:
13 m^2
Manufacturing:
– Steel formwork
Application:
– Private sector

Lost Form Panels

Dimensions (mm):
varies (L); 75 (T); 2534 (H)
Weight (tonne): ~2 to 4 t
Component/typical floor: 20
Exempted area under the JPNs:
5 m^2
Manufacturing:
– Steel formwork
– Tile finish applied after casting concrete
Application:
– Private sector and public housing projects (in recent projects)

Figure 1.18 Prefabricated Building Components in Hong Kong Public Housing

to improve quality and reduce construction time and cost (Fig. 1.18).[16] On average, public housing estates from planning to completion, take about five years.[17] Advancements in construction technology continue to improve the economic and environmental sustainability of public housing construction in Hong Kong.

The 2016-2017 public housing production was 14,433 units which is on par with the average annual public housing production in the last ten years. The ten-year supply target is an estimated 460,000 units.[18] Today, 45% of Hong Kong's population live in some form of public rental housing or government subsidized ownership flats,[19] but the supply is not meeting the demand. Public housing construction in Hong Kong is being limited to the areas outside the urban centre of the city. There has been barely any new public housing within the urban centre, and almost all the housing construction in this area is dominated by the highly unaffordable private sector.[20] Increasing housing costs and a growing population on limited land resources put pressure on the need for more affordable housing. Average waiting time for general applications to be granted public housing is 4.1 years.[21] The public housing selection process is based on a point system determined by factors such as applicant age, household size and makeup, income, assets, length of residency, as well as displacement due to other factors. This is only considering public housing as a form of affordable housing for Hong Kong citizens. Foreigners, particularly low-income immigrants from neighbouring Mainland China, cannot be granted public housing, and while they can apply to be on this waitlist, the path to a Hong Kong citizenship is 7 years ahead.

Whether it is the mass housing movement of the mid-20th century or property speculation in the present, housing has never ceased to be a hot topic in

16 Lara Jaillon and C. S. Poon, "The Evolution of Prefabricated Residential Building Systems in Hong Kong: A Review of the Public and the Private Sector," *Automation in Construction* 18, no. 3 (2009), 239-248. https://www.sciencedirect.com/science/article/pii/S0926580508001477.

17 Daniel W. M. Chan and Albert P. C. Chan, "Public Housing Construction in Hong Kong: A Review of its Design and Construction Innovations," *Architectural Science Review* 45, no. 4 (2002), 349-359.

18 Hong Kong Housing Authority, *Annual Report 2016-2017* (Hong Kong: HKSAR Government,[2017]), 16.

19 Census and Statistics Department, *2016 Population by-Census Key Statistics* (Hong Kong: HKSAR Government,[2016]).

20 Census and Statistics Department, *Hong Kong Monthly Digest of Statistics: August 2018* (Hong Kong: HKSAR Government,[2018]).

21 Hong Kong Housing Authority, *Annual Report 2015-2016* (Hong Kong: HKSAR Government,[2016]). http://www.housingauthority.gov.hk/mini-site/haar1516/index.html., 9.

Hong Kong. Housing issues occur in many parts of the world. In a society where people are increasingly moving towards cities as their homes, the challenges to high-density living become more apparent. The city continues to evolve and housing will evolve alongside it.

CHAPTER 2: OLD SLUM TO NEW SLUM

Figure 2.1 Exterior Facade of a Residential Building in Yau Ma Tei, Hong Kong

The areas on Hong Kong Island and Kowloon are already highly built up and the competition within the economy makes these areas all the less available for public housing sites. Nowadays the vast majority of new public housing is built in the New Territories, but no longer at the scale of the New Towns. Chosen applicants are most likely allocated to developments in the New Territories, and this is not always preferable for residents looking to stay close to job and education opportunities in the urban centre. Aside from public housing, there is no affordable housing alternative. Private housing can be 5 times more expensive than public housing and is sometimes out of reach for even middle class residents. In the demand for affordable housing close to the urban centre, and without formal affordable private housing to satiate this demand, emerges an informal sector of housing for low-income residents.

THE NEW SLUM - SDUS, BEDSPACES, ROOFTOPS

The lack of affordable housing for the low-income population of Hong Kong results in the creation of "slums" and informal settlements, such as sub-divided units, "cage-beds", and rooftop settlements, hidden behind the façade of existing housing typologies. (Fig. 2.1) Residents living in these conditions are often waiting for public housing and can be the same people you see walking down the streets, the local bus driver, or the diner delivery man. Each of these housing typologies offers different living conditions for this demographic.

Sub-divided units (SDUs) are single family dwellings divided into smaller units by physical partitions to house multiple families (Fig. 2.2). Existing non-structural walls may be removed to sub-divide the unit, and commonly fitted with independent electricity meters and toilets. Not all units may be fitted with operable windows to the outside or independent kitchens.[1] Improper division of unit spaces can lead to obstructed egress pathways (Fig. 2.3).

"Cage-beds", or bedspace apartments, are spaces divided in a single family dwelling by either a thin partition, some with openings at the top for ventilation, or a barrier, such as a metal mesh, around a bed for protection of private belongings. The area, approximately 12 square feet, is large enough to fit one adult. It is not uncommon for 12 residents to share one bathroom and shower, and there may not be kitchen facilities at all (Fig. 2.4, 2.5, &

1 Census and Statistics Department, *Thematic Household Survey Report no. 60 - Housing Conditions of Sub-Divided Units in Hong Kong* (Hong Kong: HKSAR Government,[2016]).

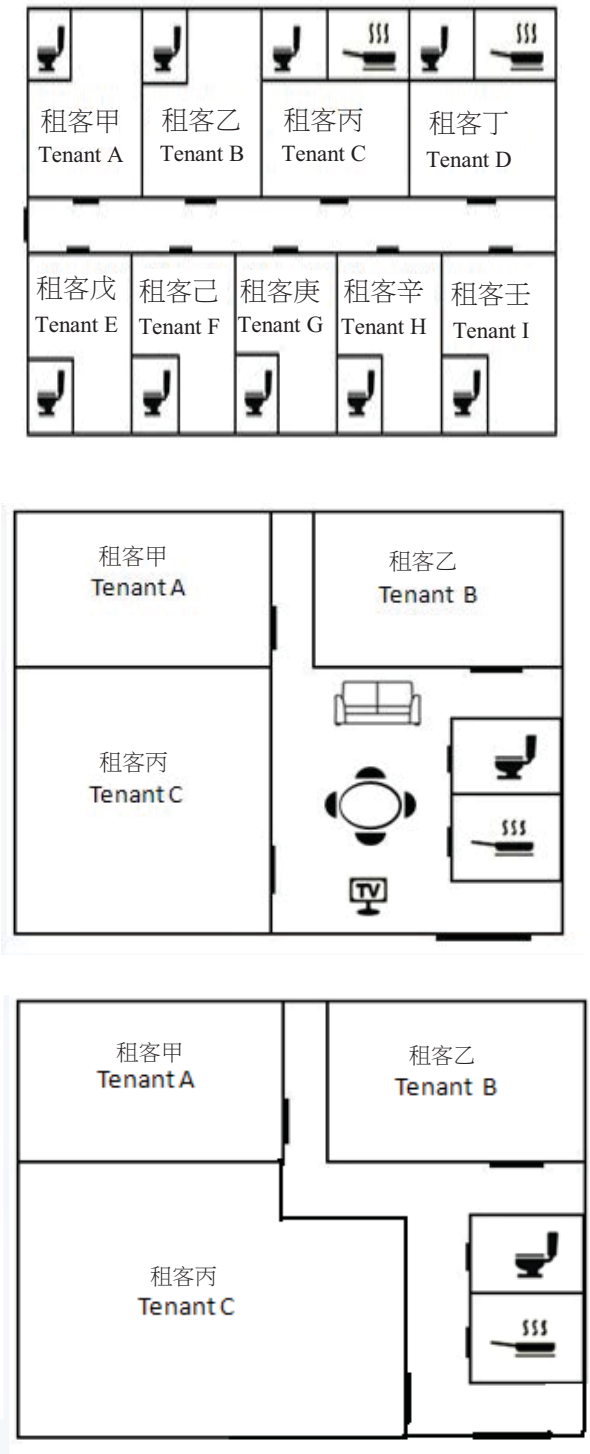


Figure 2.2 Examples of Sub-divided Unit layouts

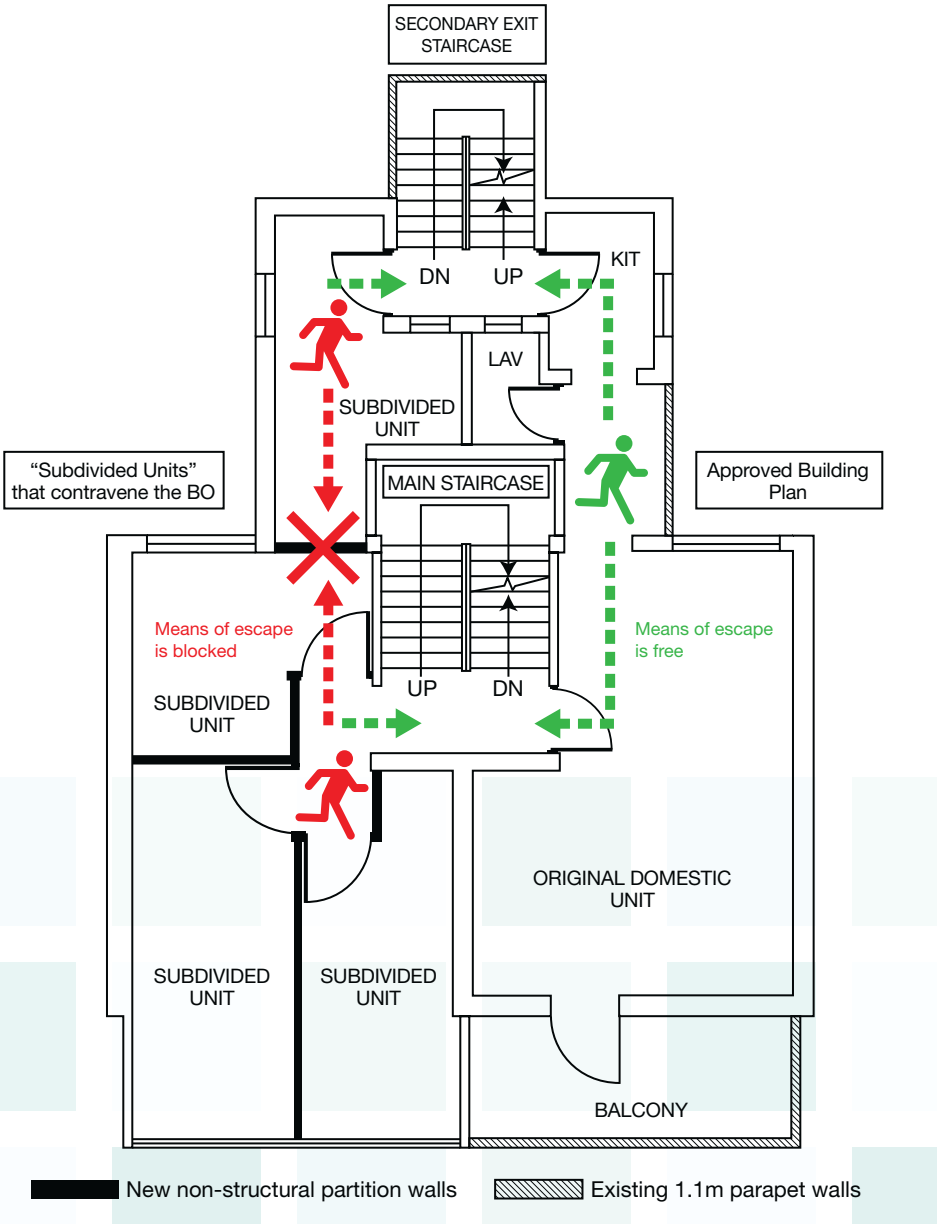


Figure 2.3 "Subdivided unit" obstructing the means of escape leading to the secondary exit staircase

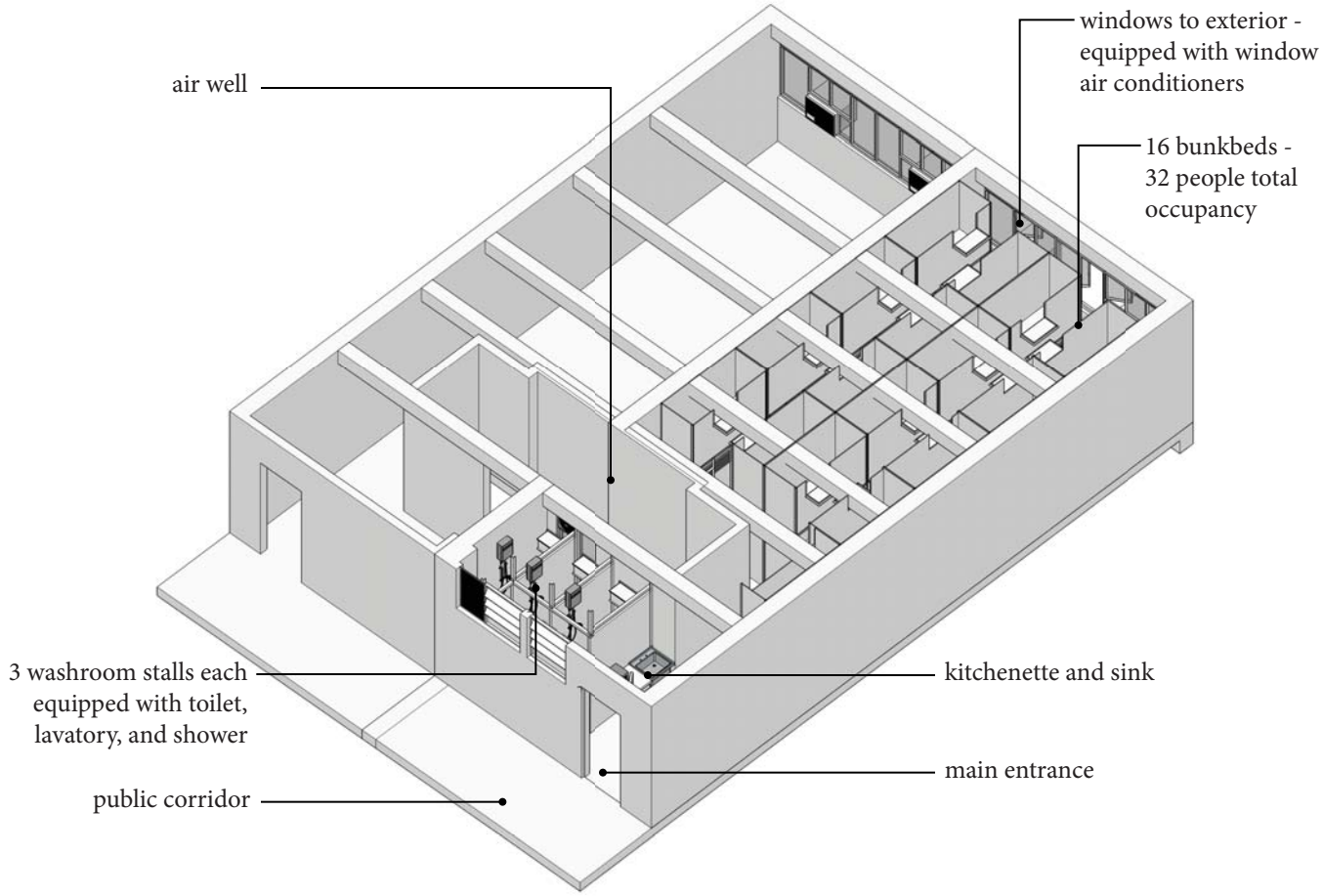


Figure 2.4 Lucky House Bedspace Apartment in Yau Ma Tei, Hong Kong

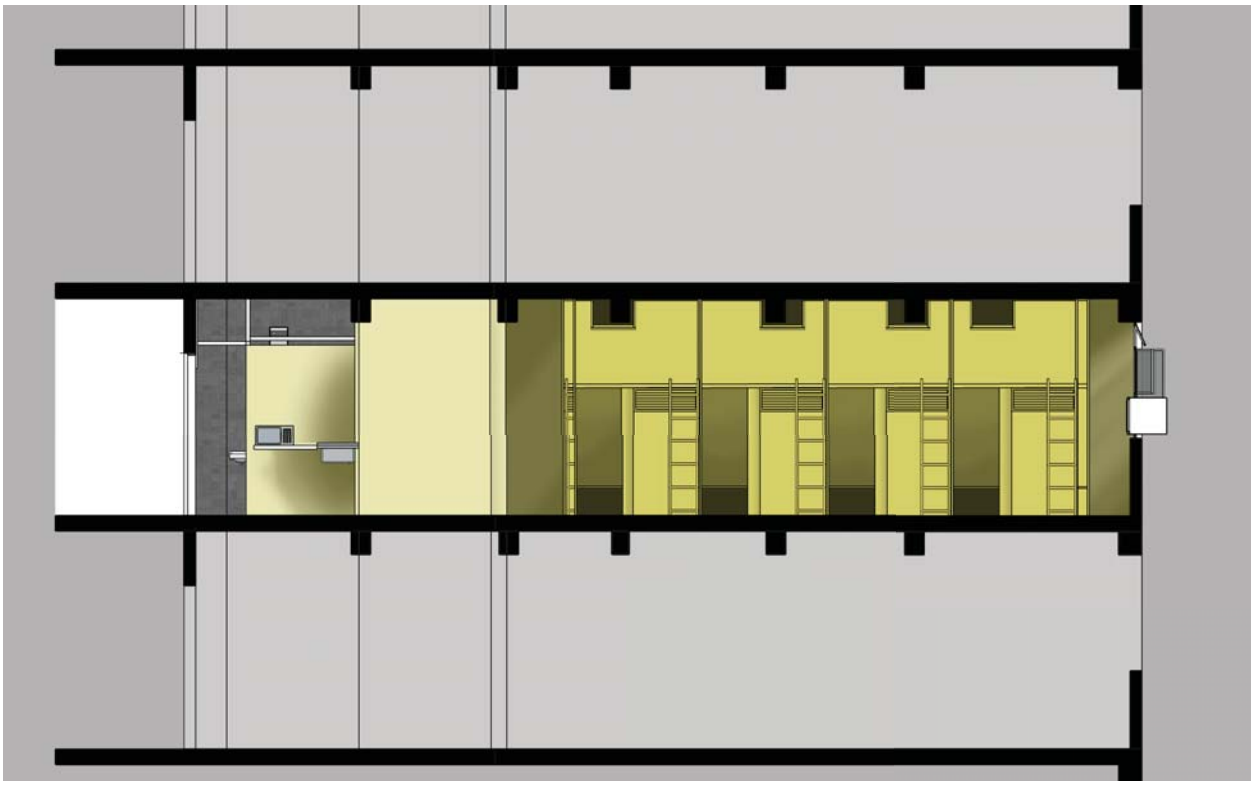


Figure 2.5 Section of Lucky House Bedspace Apartment

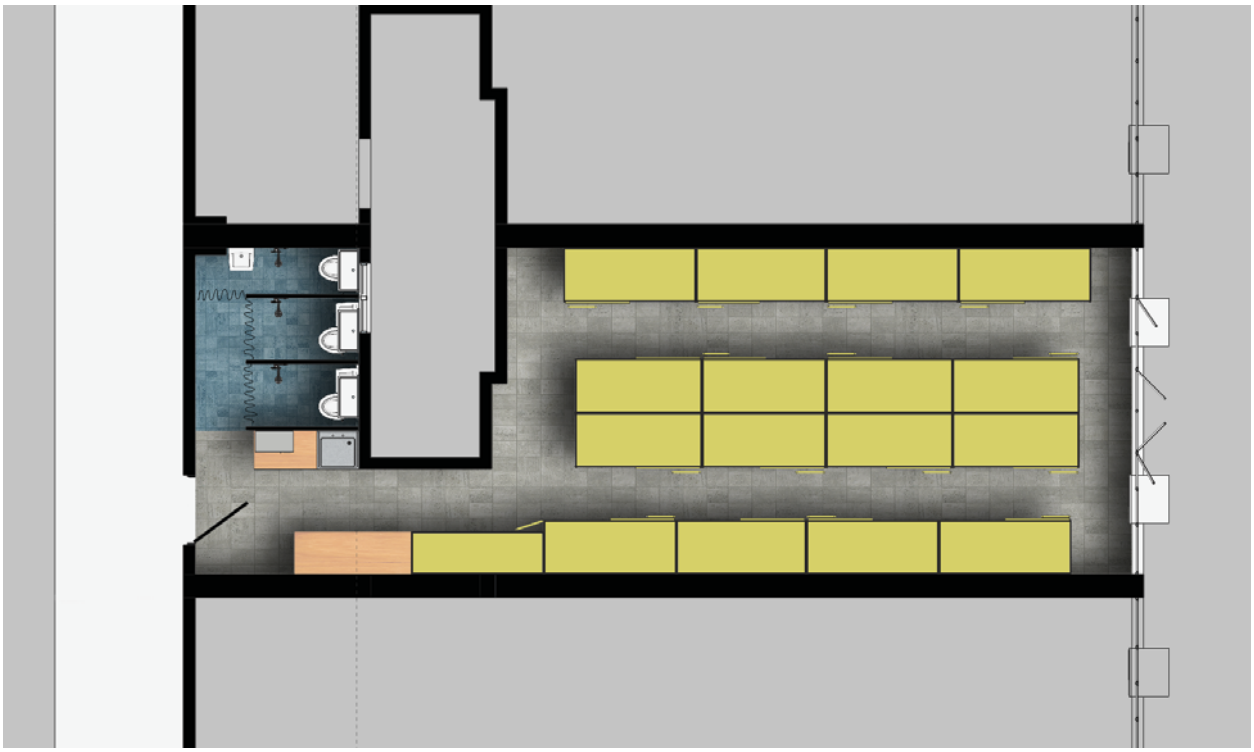


Figure 2.6 Floor plan of Lucky House Bedspace Apartment

Figure 2.7 Corridor in a sub-divided unit

Figure 2.8 Altar and incense in a cluttered location

Figure 2.9 Unorganized Electrical Panel for Subdivided Units

Figure 2.10 Communal kitchen facilities in a subdivided unit

Figure 2.11 Communal toilet facilities in a subdivided unit

Figure 2.12 Informal Rooftop Settlement

2.6).[2]

These spaces are often poorly constructed and maintained. Cramped quarters and overlapping electrical connections pose fire and safety risks (Fig. 2.7, 2.8, & 2.9). Unsanitary communal facilities and the proliferation of pests, such as bed bugs, pose hygiene and health issues (Fig. 2.10 & 2.11). An estimated 199,900 people live in these types of conditions.[3]

Informal rooftop settlements (Fig. 2.12) also arise as alternatives to the inhospitable conditions of these lightless and airless interior spaces.[4] These settlements are often built by the owners of the top floors of existing apartment blocks, and sold or rented for profit. They also pose fire and safety risks, and are subject to typhoons and the beating summer sun. They are not legally recognized as dwellings and the conditions in which this population find themselves do not evoke a sense of ownership or belonging. In a culture heavily based on "face",[5] residents are stigmatized for their living conditions resulting in a barrier against greater economic development and social wellbeing.[6]

The average rent per square foot for a sub-divided unit or "cage-bed" is greater than the rent per square foot of a typical private apartment (Fig. 2.13), but the lower class cannot afford the overall price of these apartments, and can only live within their means in these types of settlements. These settlements can be considered part of the declining private rental sector which has been affected by the government's actions toward public housing.[7] Aside from the provision of low-cost public rental housing[8] which diminishes the demand for private sector rental housing, the government's promotion

2 "The Other Faces of Hong Kong (SoCO)," last modified October 15, accessed November 10, 2017, https://www.youtube.com/watch?v=obThUqDlrvU.

3 Census and Statistics Department, *Thematic Household Survey Report no. 60 - Housing Conditions of Sub-Divided Units in Hong Kong*

4 Rufina Wu and Stefan Canham, *Portraits from Above - Hong Kong's Informal Rooftop Communities*, 1st ed. (Berlin: Peperoni Books, 2008).

5 Face (面子) is a sociological concept similar to ideas of reputation, prestige, or honour influenced by the perception of others in the social circle. In this context, to preserve one's 'face' is to not reveal to others that one lives in these types of conditions.

6 "Trapped - Photo Exhibition on Grassroots Housing in Hong Kong 2016," , accessed September 15, 2017, http://www.soco.org.hk/trapped/index.htm.

7 Adrienne La Grange and Frederik Pretorius, "Private Rental Housing in Hong Kong," *Housing Studies* 17, no. 5 (2002), 733.

8 Alan Smart theorizes in Making Room (1992) that the provision of low-cost public rental housing has kept the wage of the lower-class low since they did not require increased income to cover subsidized housing cost, therefore maintaining Hong Kong's competitiveness in the global market.

Area and Cost of Housing Types and Informal Settlements					
Housing Type	Private Flat	Public Flat	Informal Housing Types		
			Rooftop Apartment	Sub-divided Unit	Bedspace Apartment
# person/ household	2	2	2	2	1
Area (sq. ft.)	592[1]	370[2]	183[3]	124.8	18[4,5]
Area/Capita (sq. ft.)	**296**	**185**	**92**	**62.4**[6]	**18**
Rent/Month (HKD)	17,760[7]	2220[8]	1100[9]	4200[10]	2200[11,12]
Rent/sq. ft. (HKD)	**30**	**6**	**6**	**34**	**122**

Sources:
[1] Rating and Valuation Department, *Hong Kong Property Review 2017* (Hong Kong: HKSAR Government,[2017]).
[2] Hong Kong Housing Authority, *Annual Report 2015-2016* (Hong Kong: HKSAR Government,[2016]). http://www.housingauthority.gov.hk/mini-site/haar1516/index.html.
[3] Estimate based on various sources from:
Wu and Canham, *Portraits from Above - Hong Kong's Informal Rooftop Communities*
[4] Estimate based on:
"Life Inside Hong Kong's 'Coffin Cubicles'," last modified July 26, accessed September 15, 2017, http://www.nationalgeographic.com/photography/proof/2017/07/hong-kong-living-trapped-lam-photos/.
[5] Estimate based on:
"The 'Coffin Homes' of Hong Kong," last modified May 16, accessed September 15, 2017, https://www.theatlantic.com/photo/2017/05/the-coffin-homes-of-hong-kong/526881/.
[6] Census and Statistics Department, *Thematic Household Survey Report no. 60 - Housing Conditions of Sub-Divided Units in Hong Kong*
[7] Rating and Valuation Department, *Hong Kong Property Review 2017*
[8] Hong Kong Housing Authority, *Annual Report 2015-2016*
[9] Estimate based on various sources from:
Wu and Canham, *Portraits from Above - Hong Kong's Informal Rooftop Communities*
[10] Census and Statistics Department, *Thematic Household Survey Report no. 60 - Housing Conditions of Sub-Divided Units in Hong Kong*
[11] Estimate based on:
"Life Inside Hong Kong's 'Coffin Cubicles',"
[12] Estimate based on:
"The 'Coffin Homes' of Hong Kong,"

Figure 2.13 Comparison between the Floor Area and Cost of Hong Kong's Housing Types and Informal Settlements

of homeownership, combined with the city's laissez-faire[9] economy, has reinforced housing speculation. This results in the shift from a labour-wage dynamic to a culture of speculation, where the speculation of properties and rent is more profitable than the labour-wage market.[10]

With the landlord pushing the limits of legality in housing situations (Fig. 2.14), they demand high rental costs to cover the initial capital before the looming possibility of required clearance. As such, the landlords of these properties are playing in the speculation game through the exploitation of the labour-wage population. This leaves the low-income population out of the game altogether, neglects the integrity of the building in which these spaces reside, and risks the safety of the people who inhabit them. The people living in subdivided units, bedspace apartments, and rooftop apartments live there primarily because of the affordability, and convenience to work or school.[11]

These informal forms of housing are responses to an increasingly unaffordable real estate landscape in a high density environment, in contrast to the sprawling settlements in areas such as Latin America and South-East Asia. They are extensions of a once highly visible landscape of informal settlements in Hong Kong occupied by squatters. Squatter settlements used to dominate the landscape of the city, and they persist in small pockets in modern day Hong Kong[12] because there continues to be a need for an affordable housing alternative outside of the limited public housing supply and the private housing sector. However, the existence in their current form is also because of a policy in 1982, the Squatter Control Policy, which has frozen squatter settlements in time for the past 36 years. Due to the chaos of informality in the past,[13] the perception of informal settlements is mostly a negative one, which translates onto the people who live in them.[14]

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9 Based on the French for "let-do".

10 Chan Kam Wah, "Prosperity Or Inequality: Deconstructing the Myth of Home Ownership in Hong Kong," *Housing Studies* 15, no. 1 (2000), 37-38.

11 Census and Statistics Department, *Thematic Household Survey Report no. 60 - Housing Conditions of Sub-Divided Units in Hong Kong*

12 Oluwole Soyinka and Kin Wai Michael Siu, "Investigating Informal Settlement and Infrastructure Adequacy for Future Resilient Urban Center in Hong Kong, SAR," *Procedia Engineering* 198 (2017), 91. doi:10.1016/j.proeng.2017.07.075. https://www.sciencedirect.com/science/article/pii/S1877705817329181.

13 The Kowloon Walled City is another example of unregulated informal settlements that has produced a negative image in self-building, although there are also positive accounts of the community it created. It was demolished in 1994, and the site is now home to the Kowloon Walled City Park.

14 Alan Smart, "Unruly Places: Urban Governance and the Persistence of Illegality in Hong Kong's Urban Squatter Areas," *American Anthropologist* 103, no. 1 (Mar 1, 2001), 37. doi:10.1525/aa.2001.103.1.30. http://www.jstor.org/stable/683920.

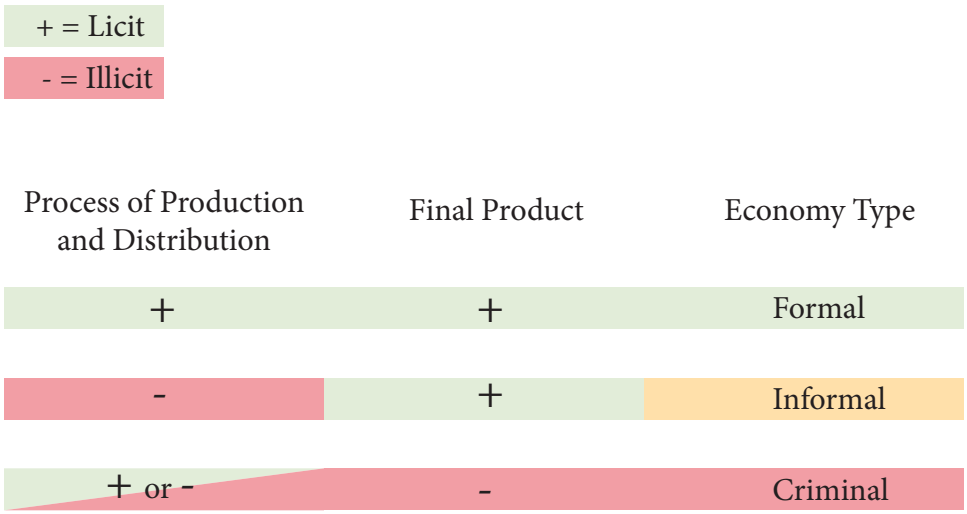


Figure 2.14 Types of economic activity: definition

THE SQUATTER CONTROL POLICY

Squatter settlements came about when the colony had insufficient legal housing for all its inhabitants (Fig. 2.15). Some of the people were returning residents who fled during the Japanese occupation, and some were refugees fleeing the Chinese Civil War.[15] At the time, existing tenement buildings were severely overcrowded with one hundred square metre flats housing more than twenty people.[16] Rather than live in overcrowded conditions, people would rather illegally occupy government land. There were government efforts to resettle these squatters into designated areas[17] since these informal settlements were considered unruly places rife with fire and disease hazards, and are threats to public safety that needed to be eradicated,[18] but there was hesitation to rehouse these squatters. Efforts to remove squatters simply meant they rebuilt their homes elsewhere, moving towards the periphery of the inner city. With a housing shortage, there was nowhere to house the displaced. The squatter population grew as people realized they could squat and likely get away with it without government intervention.

It was not until 1953 that the fire of the Shek Kip Mei squatter settlement catalyzed the public housing scheme, paving the way for the clearance of squatter settlements to build public housing and consequently freeing up land for private development.[19] Some squatter sites, though, were not of particular interest to clear because they were not easily developable such as steep hillside settlements and those outside the urban periphery. Instead, these were subject to the improvement of health and safety infrastructure.[20]

However, what started off as squatter clearance quickly snowballed into

15 Sheila K. Johnson, "Hong Kong's Resettled Squatters: A Statistical Analysis," *Asian Survey* 6, no. 11 (November, 1966), 643-656. http://www.jstor.org/stable/2642287.

16 James Lee and Yip Ngai-ming, "Public Housing and Family Life in East Asia: Housing History and Social Change in Hong Kong, 1953-1990," *Journal of Family History* 31, no. 1 (Jan, 2006), 66-82. doi:10.1177/0363199005283008. http://journals.sagepub.com/doi/full/10.1177/0363199005283008.

17 Johnson, "Hong Kong's Resettled Squatters: A Statistical Analysis," , 644

18 Chi-Kwan Mark, "The 'Problem of People': British Colonials, Cold War Powers, and the Chinese Refugees in Hong Kong, 1949-62," *Modern Asian Studies* 41, no. 6 (November 1, 2007), 1150. doi:10.1017/S0026749X06002666. http://www.jstor.org/stable/4499816?seq=1&cid=pdf-reference#references_tab_contents.

19 Alan Smart, "Making Room" The University of Hong Kong, Centre of Asian Studies, 1992), 33.

20 Housing Department, *Report on Squatter Area Improvements 1982* (Hong Kong: Housing Department,[1982]).
The squatter improvement sites in this report have since been redeveloped, and no longer exist as squatter sites.

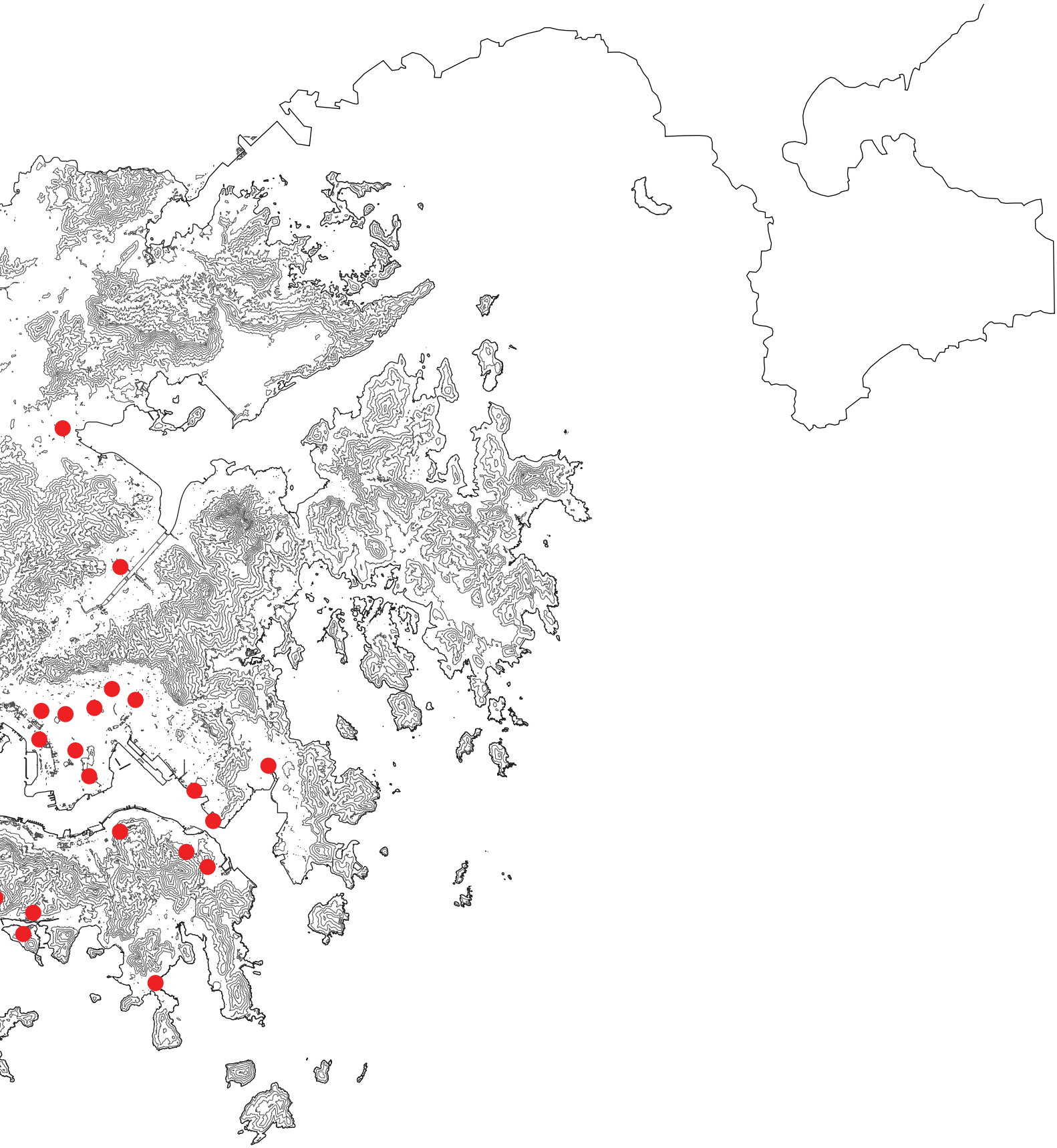


Figure 2.15 Previous locations of major squatter settlements

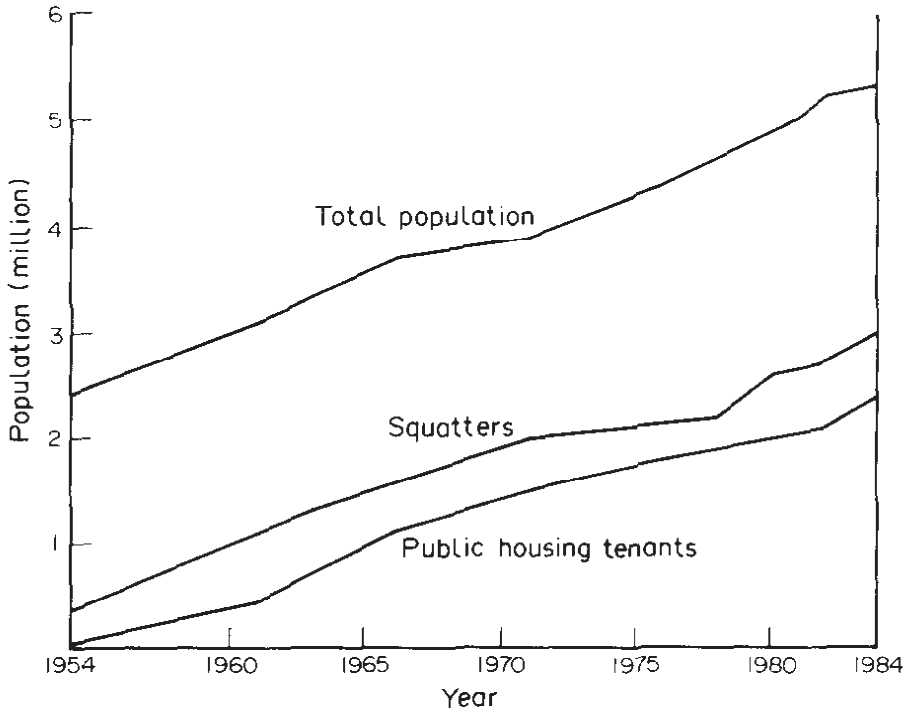


Figure 2.16 The distribution of squatters and public housing tenants in Hong Kong, 1954-1984.

squatter resettlement.[21] Even though squatters were being rehoused, the squatter population continued to grow (Fig. 2.16). As people realized there was compensation for evicted tenants, there was more opportunistic squatting. In order to curb opportunistic squatting and to only rehouse those truly eligible, the government undertook an extensive survey in June 1982 called the Squatter Control Survey (SCS).[22] This 36-year-old policy registered the squatter structures, but not their occupants, and effectively froze the structures in time to this day. Existing structures are "tolerated" only until they disappear naturally, or by clearance or development. Any new structures built after 1982 are in breach of the SCS and would not be allowed to remain, nor are the occupants eligible for any sort of compensation.[23] This was the way the government could stop any new squatter structures from emerging to take advantage of the opportunity towards public housing.

"Under the current squatter control policy, squatter structures which were covered in the SCS in 1982 are unauthorised and temporary in nature and are "tolerated" and "allowed to exist" until they are phased out through natural wastage or are required to be cleared for development, environmental improvement or safety reasons."
Lands Department, HKSAR, 2016[24]

Squatter structures' length, width, and height dimensions were recorded and are not allowed to expand beyond their surveyed dimensions. This includes alterations and additions to the structures. The Squatter Control Office (SCO) routinely checks on squatter settlements. If additions or alterations are found, the SCO will give residents the opportunity to rectify the structure to its original condition within a specified timeframe.[25] If no action was taken to rectify the structure, the SCO will demolish the addition, or in some cases the entire structure along with it.[26] To have your entire home

21 Alan Smart, "Agents of Eviction: The Squatter Control and Clearance Division of Hong Kong's Housing Department," *Singapore Journal of Tropical Geography* 23, no. 3 (Nov, 2002), 333-347. doi:10.1111/1467-9493.00134.

22 The Government of the Hong Kong Special Administrative Region, *Squatter Control Policy on Surveyed Squatter Structures* (Hong Kong: Lands Department, 2016b).

23 Ibid.

24 "Lands Department Announces the Findings of its Investigation and Follow- Up Actions in Tung Ah Pui Village," last modified June 22, accessed Aug. 02, 2018, http://www.info.gov.hk/gia/general/201606/22/P201606221063.htm.

25 The Government of the Hong Kong Special Administrative Region, *Squatter Control Policy on Surveyed Squatter Structures*

26 Alan Smart, "Impeded Self-Help: Toleration and the Proscription of Housing Consolidation in Hong Kong's Squatter Areas," *Habitat International* 27, no. 2 (2003), 205-225. doi:10.1016/S0197-3975(02)00046-2. https://www.sciencedirect.com/science/article/pii/S0197397502000462.

Figure 2.17 Exteriors views of squatter huts, Tai Po, Hong Kong

possibly destroyed without any compensation was a huge risk for attempting to expand it. This restricts any expansion that would increase the living area of the home, especially when families grow bigger.

"No extension or alteration can be made to those surveyed structures of which the uses and building materials must comply with the SCS records."
Lands Department, HKSAR, 2016[27]

The physical restriction also limited the choice of materials. Structures are not allowed to deviate from the materials recorded in the SCS. At the time of the survey, many structures were composed of simple stone construction, wood, or galvanized sheet iron (Fig. 2.17).[28] With the exception of asbestos, changing materials, such as upgrading from galvanized sheet iron to concrete block, is not allowed. While the physical restriction on dimension is to prevent any further unauthorized occupation of government land, the restriction to physical materials is to prevent any sense of permanence. If squatters were permitted to improve their homes by using more permanent materials, it would evoke a sense of permission to permanently occupy the land.

While most modern-day squatter structures do not superficially look any more advanced or permanent than their historical counter parts, the interiors of homes have become increasingly modernized. Since Squatter Control Officers, who patrol the settlements, are not investigating into the homes of the squatters but rather just their exterior, squatters are free to upgrade the interior of their homes outside the prying eyes of the government.

"Such tolerance does not create any legal rights or interests or obligations and does not confer on any person the right of occupation of land."
Lands Department, HKSAR, 2016[29]

The reason the government allows them to remain is because they know there is no alternative for the squatters if they were to evict them from their current homes. The government would need to rehouse these evicted residents, and public housing is already insufficiently supplied with an increasingly longer line up. That is not to say that living in informal settlements is always

27 "Lands Department Announces the Findings of its Investigation and Follow- Up Actions in Tung Ah Pui Village,"

28 E. G. Pryor, "Squatting, Land Clearance and Urban Development in Hong Kong," *Land use Policy* 1, no. 3 (1984), 225-242. doi:10.1016/0264-8377(84)90066-8. https://www.sciencedirect.com/science/article/pii/0264837784900668.

29 The Government of the Hong Kong Special Administrative Region, *Squatter Control Policy on Surveyed Squatter Structures*

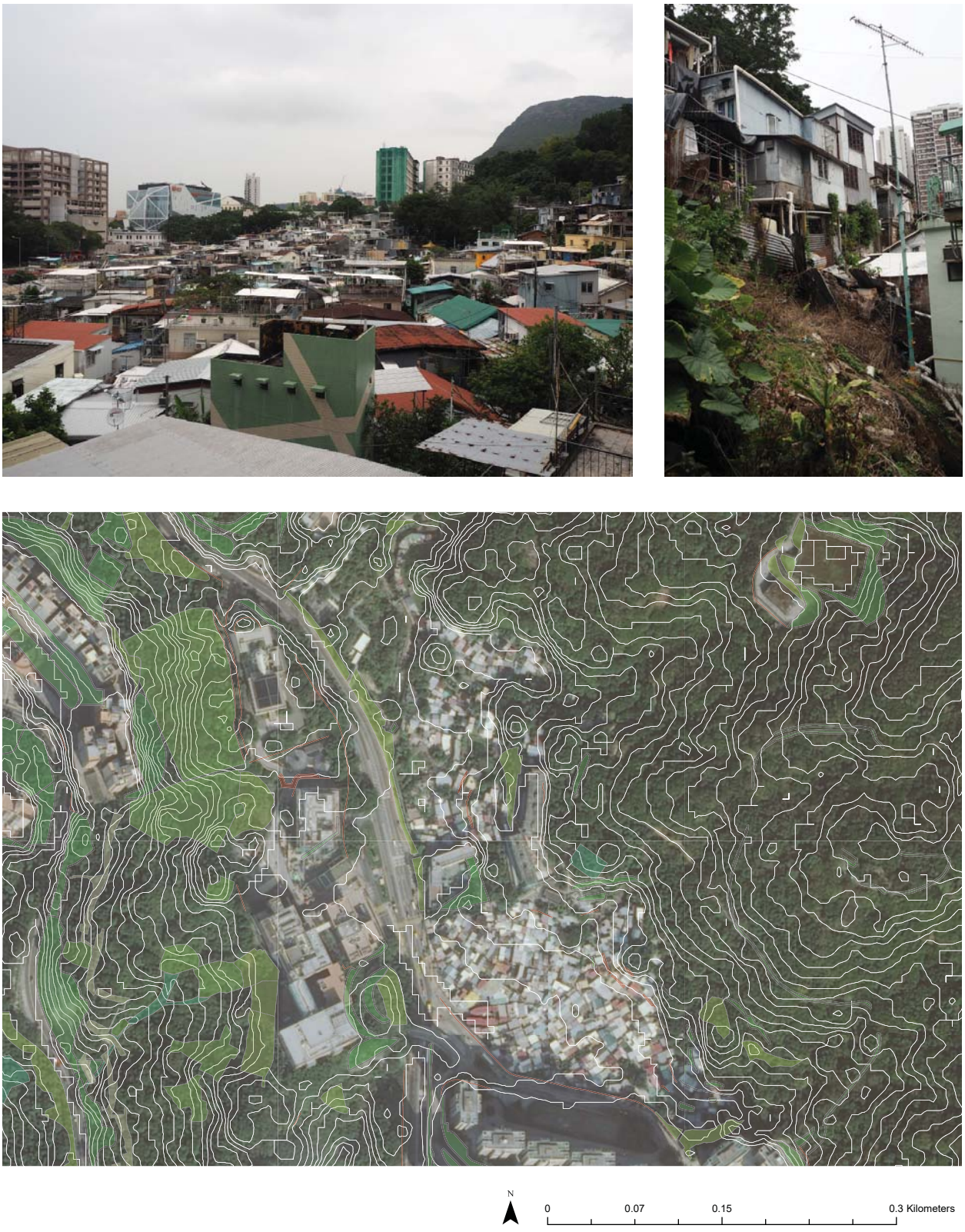


Figure 2.18 Pok Fu Lam Village, Pok Fu Lam, Hong Kong

living in squalid environments. While they do not hold any legal status and do not need to conform to formal planning and building regulations, as mentioned previously, the homes are upgraded as much as possible on the interior to improve the living environment.[30] While the structures keep to the restrictions placed by the Squatter Control Policy, it also puts them in a bind as they cannot upgrade the architecture to meet modern planning and building regulations. By conforming to one policy, it doesn't conform to another. It is a lose-lose situation.

There is a pseudo-legality to these structures though. Gaining access to common necessities such as a bank account, mobile phone, or access to other government resources requires a permanent address, [31] and electricity and water bills sent to these squatter structure addresses are used for these purposes, even if these structures have no legal rights. Points of contention arise when clearances are announced and squatters, who have remained for several decades due to the government's toleration, are suddenly asked to relocate. Pok Fu Lam Village was one of these settlements that were under threat of redevelopment (Fig. 2.18 & 2.19).[32] In legal terms, the squatters do not belong there, but they have created for themselves a home and sense of belonging in a place beyond what the policies say. This, however, was and still is not a winning argument towards legality.

THE INFORMAL ECONOMY

Hong Kong's squatter settlements, although not formally recognized as having any legal rights, still function within a market tangential to the legal private housing sector. Everything in Hong Kong is commodified, and squatter structures are no exception. They fall into three forms:[33]

1. Auto-Construction
2. Commercial Construction for Sale
   and
3. Rental

30 Wu and Canham, *Portraits from Above - Hong Kong's Informal Rooftop Communities*

31 "Requirement of Proof of Address," last modified July 6, accessed Aug. 10, 2018, https://www.td.gov.hk/en/public_services/licences_and_permits/proof_of_address/index.html.

32 Ada Lee, "Preserving Pok Fu Lam Village is a Chance to Save some of City's History," *South China Morning Post*Nov. 17, 2013. https://www.scmp.com/news/hong-kong/article/1358094/preserving-pok-fu-lam-village-chance-save-some-citys-history.

33 Smart, "Unruly Places: Urban Governance and the Persistence of Illegality in Hong Kong's Urban Squatter Areas," , 30-44

Figure 2.19 Details of Pok Fu Lam Village, Pok Fu Lam, Hong Kong

When squatter settlements were appearing in the post World War II period they lacked tenure security, which meant structures were constructed at the minimum since they could be destroyed at any time. They were not all self-built structures though. The appearance of a commercial construction and rental market within the squatter community meant that revenue from the squatter structure investments outweighed the risks of demolition.[34]

The squatter real estate market faced some drastic changes throughout the years. When opportunistic squatting was occurring just after 1954, it stifled the rental sector of squatter settlements because only occupants were compensated and not the "owner" of the structures.[35] When the SCS took place, it removed the possibility for new auto-construction since only existing structures were tolerated. Because there is no formal regulation of the squatter market, they operate informally in a community scale. Neighbourhood groups, sometimes called *Kaifong*[36] Associations, would manage and regulate the titles offered in these settlements. Titles, sometimes called *ok kai*, need not be any official document. It could be a receipt of sale, or a record by the *Kaifong* Association.[37] There was no regulated body, such as the government, overlooking the transactions and ownership of these structures. In cases where disputes over ownership would force someone out of their homes, people relied on community members and neighbours to become juries to any unjust evictions. Collective action and social capital were huge in these settings. No one would want to lose the support or rouse the anger of their entire community in case they require someone to vouch for them in the future.

The government advises the public to not purchase or rent squatter structures since they are illegal and do not provide any rights. Potential buyers or renters would need to check that the structure is surveyed and tolerated rather than a completely unauthorized structure.[38] However, within this self-regulating informal market, it functions quite similarly to transactions within a private

34 Ibid.

35 Smart, "Impeded Self-Help: Toleration and the Proscription of Housing Consolidation in Hong Kong's Squatter Areas," , 205-225

36 Kaifong (街坊) roughly translates to neighbourhood, sometimes referring to neighbours as a collective. It often evokes a sense of collective action and reciprocal support among neighbours.

37 Alan Smart, "Invisible Real Estate: Investigations into the Squatter Property Market," *International Journal of Urban and Regional Research* 10, no. 1 (Mar, 1986), 29-45. doi:10.1111/j.1468-2427.1986.tb00003.x. https://search.proquest.com/docview/1302644879.

38 The Government of the Hong Kong Special Administrative Region, *Squatter Control Policy on Surveyed Squatter Structures*

Figure 2.20 Visible UBWs in Kowloon, Hong Kong

market.

INEQUALITY IN INFORMALITY

Informality is often associated with the poor because it creates affordability through the absence of formal regulation.[39] There is no absolute definition for what is formal and what is informal because it is the existence of a formal economy that defines the informal one.[40] There are attempts to control these conditions. The government has published guidelines for what constitutes appropriate designs for subdivided units according to the Building Ordinance, as well as the Bedspace Apartments Ordinance and bedspace apartment licensure to regulate these markets. Currently there are 10 licensed bedspace apartments,[41] which shows that regulation has not really taken off. These conditions are particularly difficult to regulate because of their hidden nature. Rooftop apartments and squatter structures are quite visible and there have been continued efforts to remove these structures, but internally constructed units are much less visible and prone to dangerous overcrowding conditions.

More broadly regarded as Unauthorized Building Works (UBWs) by the Building Department of Hong Kong, these works encompass anything without Building Department approval and the contravention of building codes. Most often these are the most visible types of UBWs such as rooftop apartments, balcony extensions, and overhanging signage (Fig. 2.20). The contrast between the old and new, Western and Eastern influences, and formal and informal contribute to the messy urban jungle. At the same time, however, the messy urbanism is an outcome of the government's attempt to control the development of the city, and the failure to deal with what occurs beyond their control.[42] The situations surrounding the emergence and persistence of these UBWs reflect the much larger cultural history in illegal construction. It is not only the poverty stricken who go for these modes of building, but comparatively well-off individuals also take advantage of

39 Ananya Roy, "Urban Informality: Toward an Epistemology of Planning," *Journal of the American Planning Association* 71, no. 2 (Jun 30, 2005), 147-158. http://www.tandfonline.com/doi/abs/10.1080/01944360508976689.

40 *The Informal Economy : Studies in Advanced and Less Developed Countries*, eds. Alejandro Portes, Manuel Castells and Lauren A. Benton (Baltimore: The John Hopkins University Press, 1989).

41 "Licensed Bedspace Apartments," last modified June 30, accessed July 19, 2019, https://www.hadla.gov.hk/cgi-bin/hadlanew/bsearch.pl?searchtype=1&licenceNo=&name=&address=&district=0&displaytype=2.

42 Smart, "Unruly Places: Urban Governance and the Persistence of Illegality in Hong Kong's Urban Squatter Areas," , 30-44

the system to avoid the hassle and fees of the Building Department. Yet there remains a kind of tolerance, or even acceptability, to these informally or illegally constructed flats. The government is careful not to prioritize the resettlement of these "new slums" lest people become encouraged to move into these dwellings for exploitative gain; a lesson learned from the opportunistic squatting of public housing resettlement.[43]

The problems with today's informal settlements are very much spatial, with the architecture lacking the light, air, sanitation, and safety for comfortable living. They also feed into the social inequality of the society, where exploitation and stigma negatively affect the lower class' mobility in the social landscape. Tackling the problem through architecture is possible by introducing more flexibility into the space and giving the residents the ability to participate in housing management as a community. Housing will inevitably require maintenance, repair, and adaptation, and sharing the responsibility for upkeep of common areas gives residents a stake in their own homes. This coordination and cooperation will not come naturally or easily, so the architecture must also enable the formation of neighbour relations and the desire for collective action.[44]

It is important to take a step back and not cast these residents as helpless individuals awaiting professional social support. People are adaptable and resilient. Regardless of whether they live in squatter huts, subdivided units, rooftop units, or "cages", they continue to lead normal daily lives. Within these informal communities they form social ties to support each other. Not every person is going to always co-operate, but each person continues to go about facing their daily challenges.[45] As much power as the government has to change the housing conditions of the city, not everything needs to be taken from the top down. Grassroots movements are strengthening the lower stratum of the economic ladder, and as the social landscape changes, it is just as important to acknowledge the power of those living at the bottom.

43 "Press Release: LC Urgent Q3: Sub-Divided Units," last modified Dec 7, accessed June 17, 2019, https://www.devb.gov.hk/en/publications_and_press_releases/press/index_id_6916.html.

44 Yung Yau, "Sense of Community and Homeowner Participation in Housing Management: A Study of Hong Kong," *Urbani Izziv* 21 (2010), 129. http://www.jstor.org/stable/24920518.

45 Siu-keung Cheung, "Speaking Out: Days in the Lives of Three Hong Kong Cage Dwellers," *Positions: East Asia Cultures Critique* 8, no. 1 (2000), 235-262. doi:10.1215/10679847-8-1-235. https://muse.jhu.edu/article/27938.

CHAPTER 3: SHIFTS IN HOUSING

A NEW SOCIAL LANDSCAPE

The social landscape in Hong Kong is changing. Increased mobility offered by better transportation and technology changes the way people move across the border, especially between Mainland China and Hong Kong. More job opportunities or better quality of life are just some of the reasons people move from one side to the other. Since 1995, the Hong Kong government established a 150 daily quota for Mainland Chinese on one-way permits, primarily to reunite families separated by differential birth rights or cross-border marriages. Mainland Chinese wives commonly move in with their Hong Kong husbands,[1] as well as end up having children in Hong Kong. These people are a significant portion of the inflow movement into Hong Kong.[2]

Population projections predict Hong Kong's population will peak in the mid-2040s at 8.2 million with a third of the population aged 65 and over.[3] Improved access to healthcare and better overall standard of living extends the lifespan of the elderly and increased elderly dependency makes long term filial piety more strenuous and less desirable for the younger generation. Greater independence amongst the younger generation and the prevalence of nuclear families separate the population into smaller yet numerous groups each demanding individual living spaces. Housing is seen as the most important issue to be dealt with in the current society.[4]

The political realm is also undergoing changes. Hong Kong struggles with forming a post-colonial identity. More Hong Kong people view themselves as broadly "Hong Kongers" than "Chinese",[5] indicating a detachment from relations to China. The Hong Kong view of Mainland Chinese is generally negative. Remarks about poor social etiquette and Communist ideals contribute to the social stigma against the Mainland Chinese. While the city was established on a British system, the notion of "one country, two systems" seems to be diminishing as the Beijing government continues to make changes to Hong Kong.

In the 1950s, Hong Kong was a hotbed for Nationalist and Communist confrontations. By the 1960s protests focused on critiques on the colonial

1 Nicole DeJong Newendorp, *Uneasy Reunions : Immigration, Citizenship, and Family Life in Post-1997 Hong Kong* (Stanford: Stanford University Press, 2008). http://catalog.hathitrust.org/Record/005690061.

2 Census and Statistics Department, *Hong Kong Population Projections 2017-2066* (Hong Kong: HKSAR Government,[2017]).

3 Ibid.

4 "HKU POP Releases Survey on Hong Kong People's Ethnic Identity and the 2018 Review and 2019 Forecast Survey," last modified December 27, accessed Aug. 06, 2019, https://www.hkupop.hku.hk/english/release/release1563.html.

5 Ibid.

government, its elite authoritarianism, and the closed political system. However, by the 1970s the colonial government quelled these oppositions by responding to some of the challenges and dissatisfaction of the society. It began creating anti-crime and cleanliness campaigns, establishing the anti-corruption commission, and providing social services such as public housing, welfare, education and medical services. These initiatives helped ease the social discontent in the city and crafted an image of the colonial government as an effective administrator. It made questions no longer focus on the colonial government but rather the allocation of resources in a rapidly growing society. It was not until the 1980s with the looming return to China that questions about decolonization, identity, and the political system began to resurface. The lead up to 1997 offered a platform for realizing a political reform and many pressure groups and social movements emerged to voice their opinions.[6] In the current post-colonial stage, there is rising social discontent again. Protests and riots focus on a pro-democracy movement led by a portion of the largely dissatisfied younger generation. The government either accepts a political reform or finds a way to ease the unrest. Like the previous colonial government, it may be beneficial to focus on the pressing housing issues that fuel this dissatisfaction.

RETHINKING THE HOME

Addressing current housing crises around the world takes many forms, and evidently, these address the amount and cost of housing. Suburban sprawl trades urban proximity towards less costly land for housing production. Prefabricated homes and shipping container homes (Fig. 3.1) take the approach of increasing production and reducing labour by using standardized or readily available materials. Laneway housing activates land use by squeezing into existing underutilized spaces. Brownfield developments repurpose existing industrial sites and architecture to reduce costs for new housing construction. High-rise buildings increase density and maximize floor area on a compact footprint. These numbers are definitely important to development and setting goals to tackle the housing crisis today, but these forms of housing also need to address the changes that would occur throughout their lifespan.

Although Hong Kong public housing has evolved over the years to reflect the changing housing standards in a developed city, it has yet to expand beyond the typical high-rise tower form. Hong Kong's public housing scheme is not

6 Tai-Lok Lui and Stephen W. K. Chiu, "Social Movements and Public Discourse on Politics," in *Hong Kong's History: State and Society Under Colonial Rule*, ed. Tak-Wing Ngo (London: Routledge, 1999), 101-118.

Figure 3.1 Shipping Container Homes

to be understated, but the focus on quantity during the population boom of the post-war period, and the added pressure to maximize limited land resources open up questions as to whether this housing stock is sustainable.[7] Other cities in the region are experimenting with new developments in high-density housing to tackle rapid urban growth and housing shortages while also addressing the need for well planned and designed living environments in increasingly dense conditions.[8] Singapore is a common case study for public housing since over 78% of the housing is by the Housing and Development Board (HDB), the local public housing authority.[9] Singapore and Hong Kong are often compared to one another. They were both British colonies extracted from their mainland counterparts, Malaysia for Singapore and China for Hong Kong. They were both trading and military ports and faced turmoil during Japanese occupation in World War II. Their climates both boast hot humid summers with typhoon seasons. Their cultures are primarily Chinese, and much of the two cities was established in the economic boom of the post-war period from manufacturing to major financial centers of their respective regions in Asia. They share many similarities and public housing is no exception.

The two public housing systems were established during the period of colonization when British standards for planning and housing came into play, and large scale residential towns were created in the surrounding sub-urban areas. A big difference between the two is the topography, where Hong Kong is hilly while Singapore has an extremely flat landscape. Although both cities have their fair share of identical housing block towers (Fig. 3.2), Singapore brings about some innovative housing typologies for public housing. The Skyville @ Dawson (Fig. 3.3) and Pinnacle @ Duxton (Fig. 3.4) are two public housing estates completed in 2005 and 2009 respectively. Both these developments integrate public amenities through elevated walkways connecting individual towers. Similarly, the Dangdai Moma in Beijing (Fig. 3.5), and the Shinonome Codan Court in Tokyo (Fig. 3.6) offer multiple levels of pedestrian networks and public spaces. This dispersal of space contrasts the single connected podium where most high-rise tower developments concentrate their common areas. The spatial variety created

7 Ying Deng, Edwin H. W. Chan and S. W. Poon, "Challenge-Driven Design for Public Housing: The Case of Hong Kong," *Frontiers of Architectural Research* 5, no. 2 (June, 2016), 213-224. https://doi.org/10.1016/j.foar.2016.05.001.

8 Im Sik Cho, Zdravko Trivic and Ivan Nasution, "New High-Density Intensified Housing Developments in Asia: Qualities, Potential and Challenges," *Journal of Urban Design* 22, no. 5 (2017), 613-636. https://doi.org/10.1080/13574809.2017.1311770.

9 "Households - Latest Data," last modified February 13, accessed February 26, 2019, https://www.singstat.gov.sg/find-data/search-by-theme/households/households/latest-data.

Figure 3.2 Singapore Skyline with public housing

Figure 3.3 Skyville @ Dawson

Figure 3.4 Pinnacle @ Duxton, Singapore - elevated bridges are public pathways and common space

Figure 3.5 Dangdai Moma, Beijing

Figure 3.6 Shinonome Codan, Tokyo

through larger open areas for the public and residents, intimate spaces for neighbourly interactions, and semi-public areas for community social activities breaks the monotony and rigidity of a singular public amenity, particularly in dense areas where the ground level is already limited. Different levels of public access, whether through spatial or visual isolation or regulatory control, suggest a shift in the design of high density living.[10] This contrasts with the persisting cruciform block tower in Hong Kong. The market in Hong Kong focuses on the saleable floor area of a unit to advertise to consumers the most bang for their buck, whereas common areas such as corridors, lift lobbies, staircases, and utility rooms would be unsaleable and considered a waste of valuable area. The cruciform tower maximizes saleable floor area leaving common areas to serve the units rather than play a role as an active space in itself. This outdated model for density control no longer meets the changing landscape of Hong Kong.[11]

Since the 1970s, architects such as John Habraken[12] and John Turner[13] have been looking at responses to mass housing of the post World War II period. Similar to how Hong Kong developed during this period, standardization was the way to rid cities of slums and informal settlements by providing cheaper and quicker ways of building. Anyone who has worked with a client can understand that creating a customized product is a complex process that takes additional time, money, and care. While the process is simplified when the opinionated user is removed altogether, the result is the removal of the individual and the home as a reflection of this individuality. The inhabitant is no longer an active participant in the process but rather an end-user of a product.[14]

Turner and Habraken break down the system of housing into various levels. Turner breaks the process into planning, construction and management, with the actors as users, suppliers, and regulators. When users have authority over the planning, construction, and management it is a self-governing or autonomous system. When regulators control the planning, construction, and management, it is a centrally administered or heteronomous system

10 Cho, Trivic and Nasution, "New High-Density Intensified Housing Developments in Asia: Qualities, Potential and Challenges," , 613-636

11 Edwin H. W. Chan, Bo-sin Tang and Wah-Sang Wong, "Density Control and the Quality of Living Space: A Case Study of Private Housing Development in Hong Kong," *Habitat International* 26, no. 2 (2002), 159-175. doi:10.1016/S0197-3975(01)00041-8. https://www.sciencedirect.com/science/article/pii/S0197397501000418.

12 N. J. Habraken, *Variations : The Systematic Design of Supports* (Cambridge, MA: Laboratory of Architecture and Planning at MIT, 1976).

13 John F. C. Turner, *Housing by People : Towards Autonomy in Building Environments* (London: Marion Boyars, 1976).

14 Ibid., 106-107.

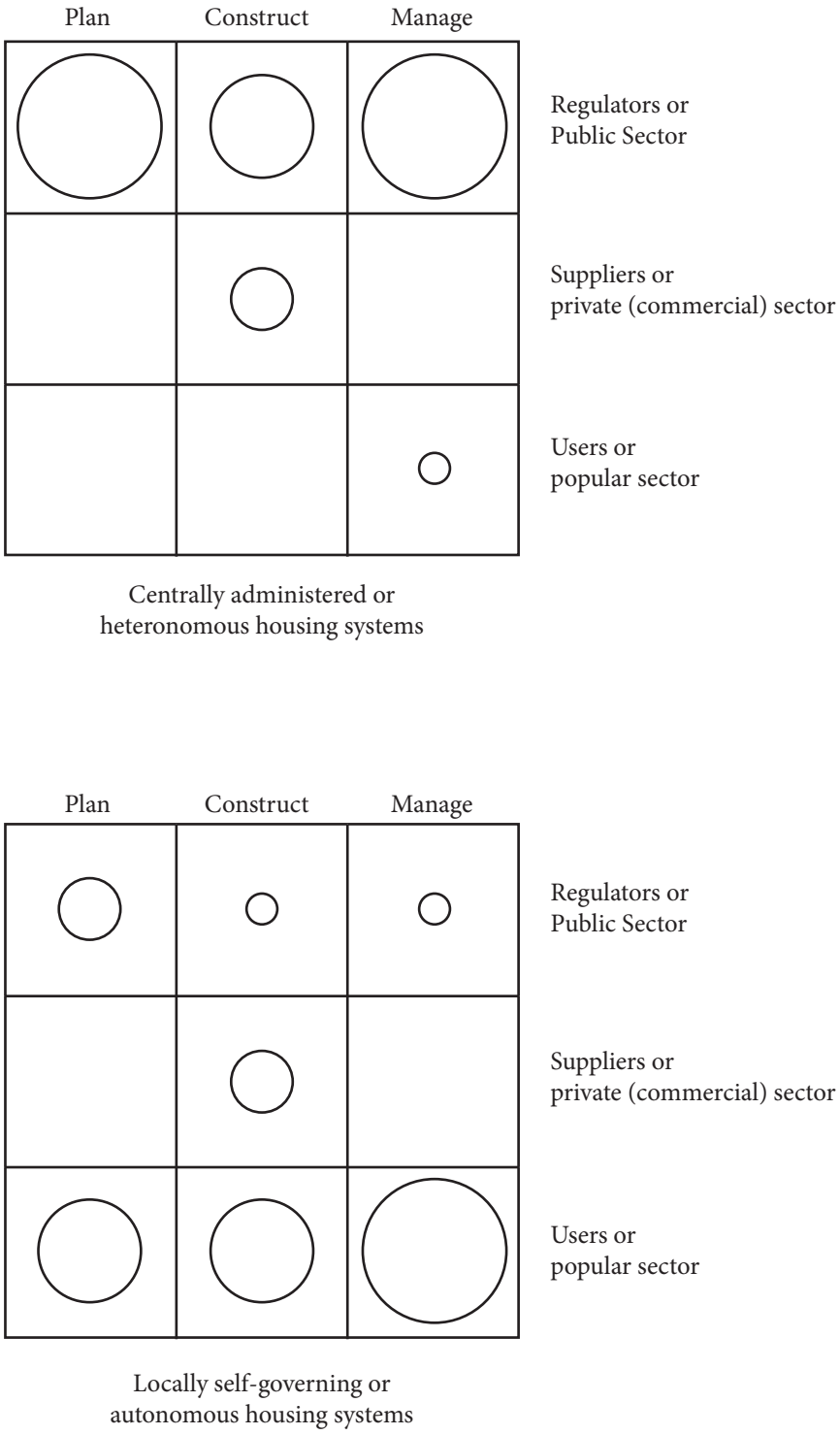


Figure 3.7 John Turner's heteronomous vs autonomous housing system

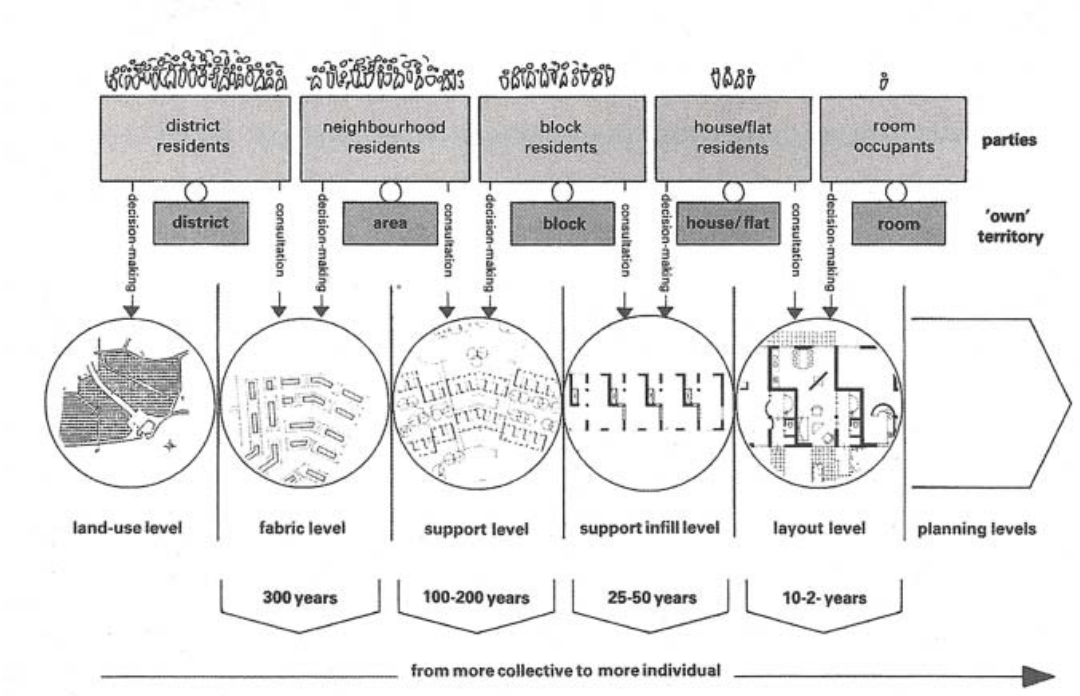


Figure 3.8 Open Building Levels

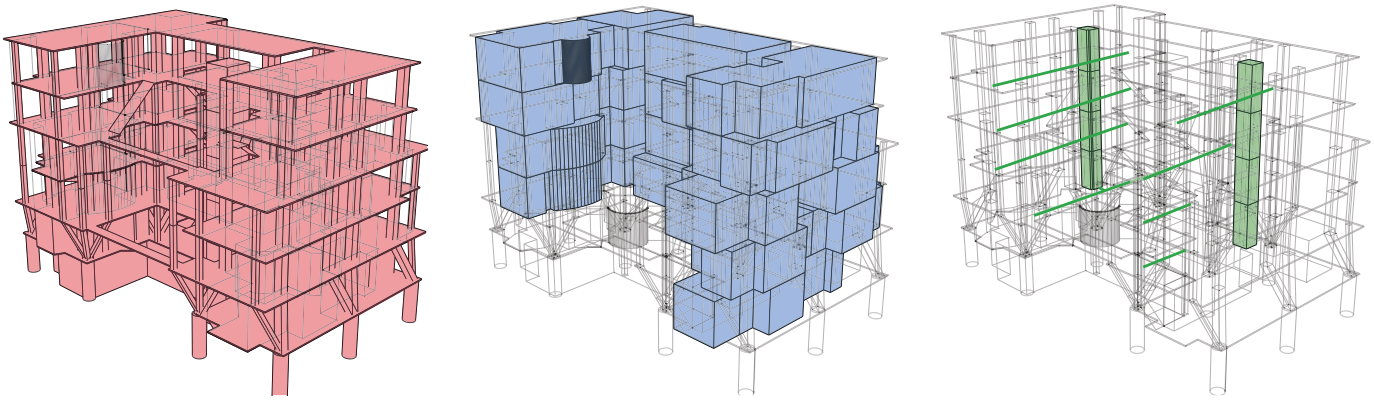
(Fig. 3.7).[15] This dichotomy is shown in the situations in Hong Kong, where squatter and informal settlements are an autonomous system and public housing is a heteronomous system. While Turner's assertions focus on processes,[16] Habraken breaks down housing into more architectural features such as "supports" and "infill", or a base building and a fit-out.[17] In Open Building, the "support" is an organization of superstructures, services, and amenities for the formation of "infill" structures.[18] Infill is an inhabitant driven space with the flexibility for changes and adaptations. The idea of a base building and fit-out is seen in large commercial buildings such as offices or shopping centres since it offers greater freedom for tenants to customize their workplace or store to suite their company image, but this idea is uncommon in contemporary residential buildings. The degree of freedom for housing residents to change or adapt their homes is not there. Open Building is an understanding of the relationship between static and dynamic architectural systems, and the different degrees of permanence of building elements.[19] These elements are organized into separate planning levels such that changes at the infill level does not significantly impact the support level (Fig. 3.8).[20] This organization needs to be considered in the design of new forms of housing.

Metabolism and structuralism are common architectural movements using the ideas of a static backbone with dynamic additions. The Nakagin Capsule Tower, completed in 1972, was designed so that individual capsule owners could attach and detach from the tower core, allowing the tower the ability to adapt and change (Fig. 3.9).[21] However, the tower failed to realize the interchangeability of the capsules and it has become a static architectural experiment.[22] Next21 is also an experimental residence in Japan (Fig. 3.10 & 3.11). Built in 1993, it consists of a concrete superstructure that allowed for the 18 units to be designed by 13 different architects.[23] Sunken floor

15 Ibid., 29.
16 Ibid., 62.
17 Habraken, *Variations : The Systematic Design of Supports*
18 Stephen Kendall and Jonathan Teicher, *Residential Open Building* (London: Spon, 2000).
19 Ibid., 49-51.
20 Ibid., 51-53.
21 Kishō Kurokawa and Charles Jencks, *Metabolism in Architecture* (London u.a: Studio Vista, 1977).
22 Zhongjie Lin, "Nakagin Capsule Tower: Revisiting the Future of the Recent Past," *Journal of Architectural Education* 65, no. 1 (Oct 1, 2011), 13-32. doi:10.1111/j.1531-314X.2011.01158.x. http://www.tandfonline.com/doi/abs/10.1111/j.1531-314X.2011.01158.x.
23 Committee for the Osaka Gas NEXT21 Project, "Osaka Gas Experimental Housing NEXT21," *Japan Architect*, no. 17 (April 1, 1995), 160.

Figure 3.9 Nakagin Capsule Tower, Tokyo, Japan

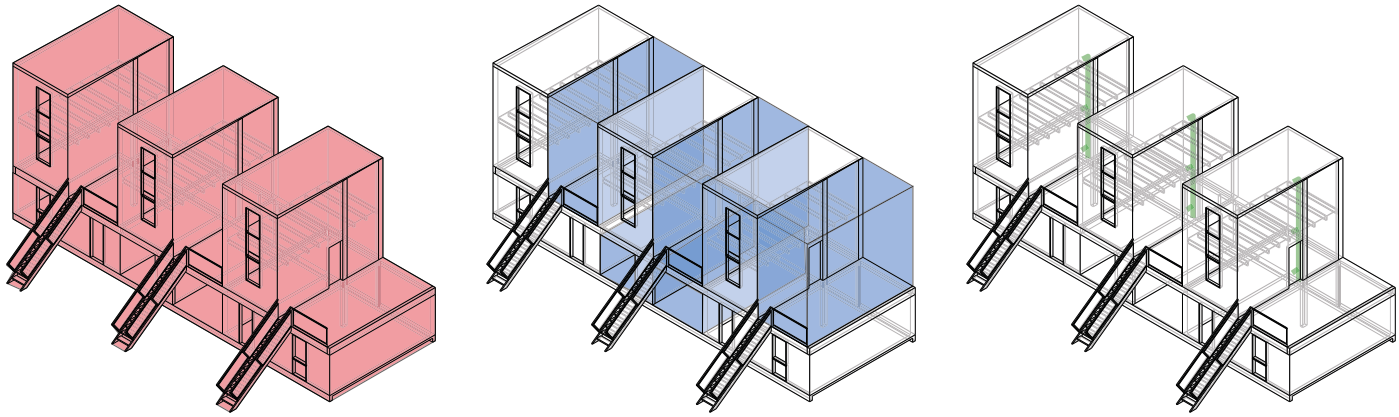
Figure 3.10 Next21 Exterior View



Support Infill Service

Figure 3.11 Separation of Building Elements in Next21

Figure 3.12 Quinta Monroy before and after occupation



Support Infill Service

Figure 3.13 Separation of Building Elements in Quinta Monroy

areas, termed "canal" zones, in the skeleton offered space for ductwork and planting, primarily in the hallways and balconies. Raised areas, termed "table" zones, offered living area with space for ceiling services. The project offered the capacity for the units to renovate and upgrade to keep up with the latest generation of building products and adapt to meet the needs of changing families.[24] The architectural strategies in Open Building utilize the separation, organization, interchangeability, and balance of individual building elements. The vision is not set in stone as a complete and wholistic entity, but a collection of parts within a framework in which they function.

ELEMENTAL's projects in incremental housing also work with metabolic concepts. Working with the idea of providing only half the house, the Quinta Monroy development consists of 3m by 6m units with a mix of cast-in-place concrete structure, concrete block walls, and wood construction walls (Fig. 3.12 & 3.13). Each unit offered the basic amenities; a bathroom, a kitchen, and an open area for the residents to partition into living and sleeping spaces. Between every unit was a 3m by 6m gap. This gap started off as outdoor living space for the residents, but over time with the accumulation of additional wealth and through sweat equity, the residents expanded their interior living space into these gaps. This was the intent of the architecture. The concrete block and wood walls allowed for easy renovation without disruption to the structure of the units. The wood walls were also reused for the exterior walls of the extensions, and each unit has its distinct characteristic despite the standardized and repetitive nature of the initial concrete units (Fig. 3.12).[25] The ability to grow the home alongside the residents is supported through the architecture.

Incremental building is a common form of residential building among developing countries[26] because it works alongside the development of the families. Resources put toward the home come only after other basic living expenses are met, and this usually results in families living within their means until they can save up enough to improve the home for a better quality of life. While Hong Kong is not considered a developing country, the development of the home can work the same way for low-income families in Hong Kong. Layouts and sizes of existing housing typologies in Hong Kong push a fixed way of living. The reliance on structural walls as room

24 Utiba Yositika, "Next21," *Japan Architect*, no. 73 (April 1, 2009), 29.

25 Elemental, *Elemental: Incremental Housing and Participatory Design*, eds. Alejandro Aravena Mori and Andres Iacobelli (Ostfildern: Hatje Cantz, 2012).

26 Bruce Ferguson and Peer Smets, "Finance for Incremental Housing; Current Status and Prospects for Expansion," *Habitat International* 34, no. 3 (2010), 288-298. doi:10.1016/j.habitatint.2009.11.008. https://www.sciencedirect.com/science/article/pii/S0197397509000964.

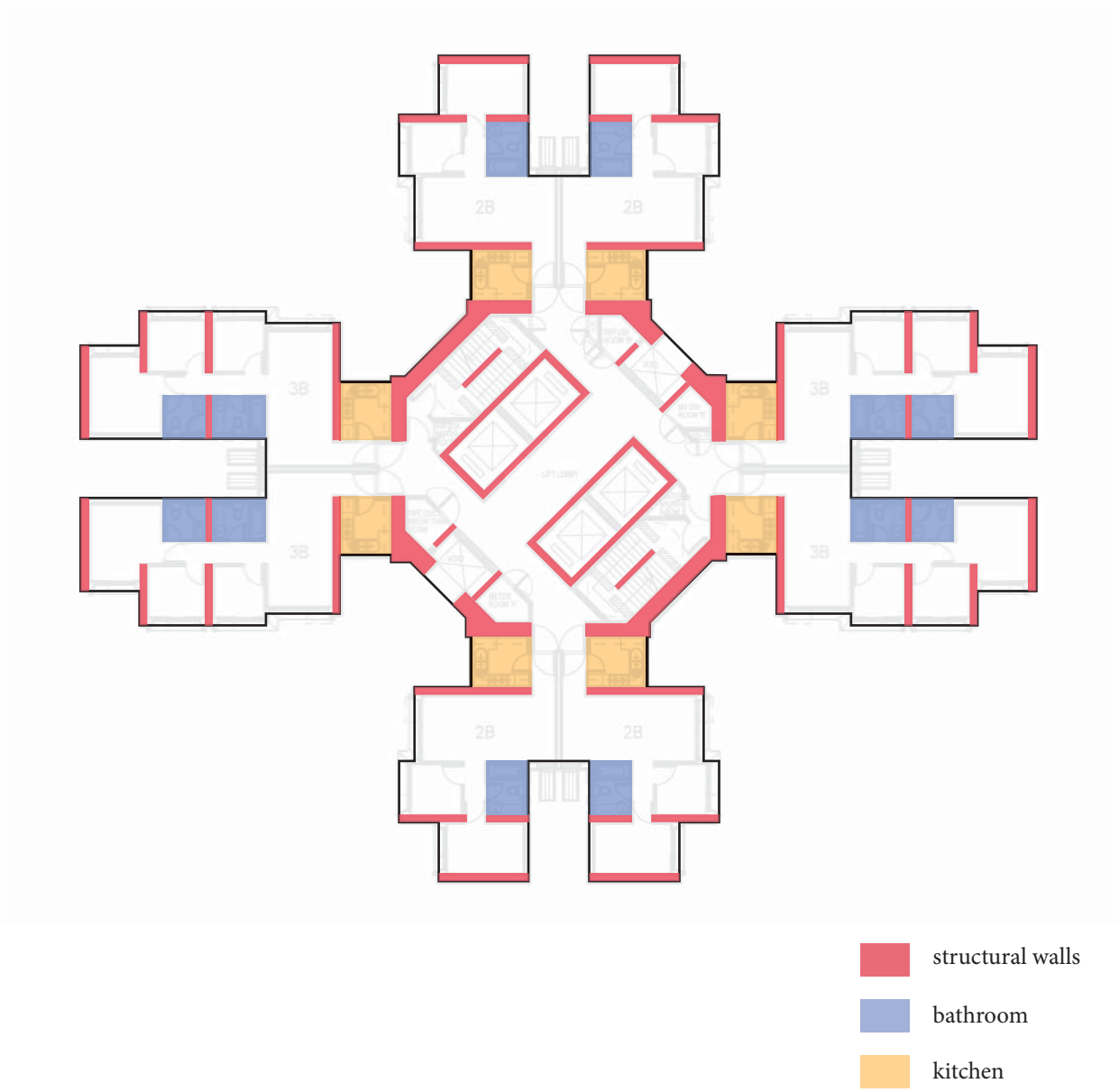


Figure 3.14 Hong Kong Restrictive Floor Plan

partitions, while improving building cost efficiency, divides spaces into individual compartments and restricts the flexibility of spaces to cater to various uses (Fig. 3.14). It greatly affects the architecture's ability for changes to unit layouts.[27] Rather than attempting to provide housing in an all-or-nothing manner, we can think of housing as an incremental process that acknowledges bottom-up approaches to high-density urban living. A more resilient and sustainable form of mass housing involves a movement away from the empirical understanding of housing provision to an approach shaped by community building and social capital in order to leverage the aspirations of residents and empower them in their neighbourhood and society.

ALTERNATIVE HOUSING IN HONG KONG

There are pushes toward alternatives in living amidst housing shortages in Hong Kong. A typical approach is to shrink apartments where recent years have seen the appearance of private nano-flats[28] which reinforce the trend for the scalar reduction of living space while not necessarily improving affordability since the rent per square foot remains high. A market for co-housing apartments is popping up and is particularly popular among students and young adults.[29] Radical visions of Hong Kong's future include vertical units, stackable concrete pipe micro-homes, or bamboo shelters inside industrial buildings. Taking inspiration from projects in Europe, Hong Kong has begun to entertain the idea of shipping container homes as shelters for the poor.[30] While these proposals attempt to use low cost materials and methods to address affordability, criticism behind these proposals include the feeling of impermanence in the units themselves as well as the temporary nature of the sites they are located on.[31] A big question

27 Brian Sullivan and Ke Chen, "Design for Tenant Fitout: A Critical Review of Public Housing Flat Design in Hong Kong," *Habitat International* 21, no. 3 (1997), 291-303. doi:10.1016/S0197-3975(97)00061-1. http://www.sciencedirect.com/science/article/pii/S0197397597000611..

28 Sandy Li, "Tuen Mun's 'Nano-Flats', Smaller than Standard Car Parking Lots, Command Outsize Rents," *South China Morning Post*July 14, 2017. http://www.scmp.com/property/hong-kong-china/article/2102556/nano-flats-tuen-mun-command-outsize-rental-rates-agents-say.

29 Pearl Liu, "Co-Living Becomes quite the Rage among Hong Kong's Young Professionals," *South China Morning Post*September 29, 2018. https://www.scmp.com/business/article/2159662/co-living-becomes-quite-rage-among-hong-kongs-young-professionals.

30 Kang-chung Ng, "Homes made from Old Shipping Containers Set to be Built for 100 Need Families in Sham Shui Po," *South China Morning Post*July 20, 2018. https://www.scmp.com/business/article/2186821/mainland-developers-face-hard-choices-fizz-goes-out-hong-kong-property-boom.

31 Louise Moon, "Why is Hong Kong Getting Container Homes? and Will they

Figure 3.15 Typical Industrial Building Facade

Figure 3.16 Jockey Club Creative Arts Centre, Shek Kip Mei, Hong Kong

in Hong Kong still remains as to where to build.

More recently, since the decline of the manufacturing sector in Hong Kong, industrial buildings have become popular sites for revitalization and land use. The "Industrial to Office Building Scheme" was introduced in 1989 with revised zoning laws and land premiums to encourage reuse of industrial buildings. Many industrial complexes are made up of individual businesses that own a part of the building. This ownership stratification makes wholesale conversion of industrial buildings difficult if not all owners agree. A typical industrial building in Hong Kong is multi-storeyed with minimal façade treatment (Fig. 3.15). Their floors and structural elements are robust to support equipment and goods which complicate revitalization, especially if portions of the building need to be renovated to meet residential living standards and safety requirements not inherent in the architecture of an industrial building. Revitalization potential dwindles when coupled with the dislocated nature of many industrial sites from effective transit and amenities without large scale planning redevelopment. A successful conversion of an industrial building is the Jockey Club Creative Art Centre (JCCAC) (Fig. 3.16), an artist village and arts centre in Shek Kip Mei.[32] Changes to the scheme in 2000 and 2009 expanded the array of permitted uses, including the possibility for hotel conversions. However, the number of conversions remains small, with many proposals unable to proceed due to bureaucratic barriers and pragmatic issues related to cost, feasibility of conversion, and return on investments.[33]

In the areas that are already built up, redevelopment of old buildings becomes the norm in the intensification of land use. This usually involves the acquisition of multiple buildings and the displacement of residents and commercial tenants. Not only is this approach resource intensive since it requires the demolition of the old buildings in order to build new, it also disrupts the neighbourhood built up over time. Rehabilitation of old buildings is insufficient in meeting the demand, and with an ever-increasing demand, constant redevelopment of buildings in the urban centre will continue.

Work?" *South China Morning Post*July 20, 2018. https://www.scmp.com/news/hong-kong/community/article/2113349/why-hong-kong-getting-container-homes-and-will-they-work.

32 "About JCCAC," , accessed September 15, 2019, https://www.jccac.org.hk/?a=group&id=b_1.

33 Lianping Ren, Louis Shih and Bob McKercher, "Revitalization of Industrial Buildings into Hotels: Anatomy of a Policy Failure," *International Journal of Hospitality Management* 42 (Sep, 2014), 32-38. doi:10.1016/j.ijhm.2014.06.007. https://www.sciencedirect.com/science/article/pii/S0278431914001030.

UNDERUTILIZED SPACES

Outside of intensifying existing land, part of the redevelopment endeavour is to make new land or find a way to release land for other uses. Two methods used in Hong Kong are land reclamation and rock cavern development. Land reclamation has been a popular approach to the land supply issues in Hong Kong, and it makes up the bulk of the flat land in the city. The current Hong Kong International Airport, as well as the old Kai Tak Airport, are both prominent examples of the need for flat land met through land reclamation (Fig. 3.17). Projects today continue to balance environmentally sensitive coastlines, existing marine channels, and effects on local neighbourhoods along the shoreline. While Hong Kong's topography poses challenges for flat land development, it opens up opportunities for underground space, particularly rock caverns. Development of underground space began in the 1980s for underground oil storage. The Study of the Potential Use of Underground Space (SPUN) began in 1988 to take advantage of Hong Kong's topography, determine suitable sites, evaluate the potential uses, and address environmental problems and opportunities. [34] It laid the foundation for the viability of underground development as an alternative to conventional above-ground development. Subsequent investigations continued to determine the suitability and economic feasibility of cavern developments across Hong Kong. The preference was to move government facilities, such as water treatment plants, reservoirs, refuse transfer facilities, and warehouses into the caverns to free up the land they currently occupy (Fig. 3.18). The 2011 Enhanced Use of Underground Space in Hong Kong Feasibility Study found 64% of the land area is suitable for large-scale cavern development. It also established some reasons rock cavern schemes may not be implemented. Lack of established policies and strategies for cavern developments, and greater operation and maintenance costs, deter governments and developers from planning or implementing these types of projects. There is also no perceived need for cavern options when other suitable and more established above ground options, such as land reclamation, exist. Cavern construction would appear to be more costly due to excavation and temporary supports as opposed to above-ground development, but the economic feasibility of cavern developments takes into consideration the savings in land cost and the potential use of the above-ground land freed up by the relocation of the facilities.[35] These types of projects then must be related back to an above-ground location and its land cost. However, these

34 Civil Engineering and Development Department, *Enhanced use of Underground Space in Hong Kong Feasibility Study* (Hong Kong: HKSAR Government,[2009]).
35 Ibid.

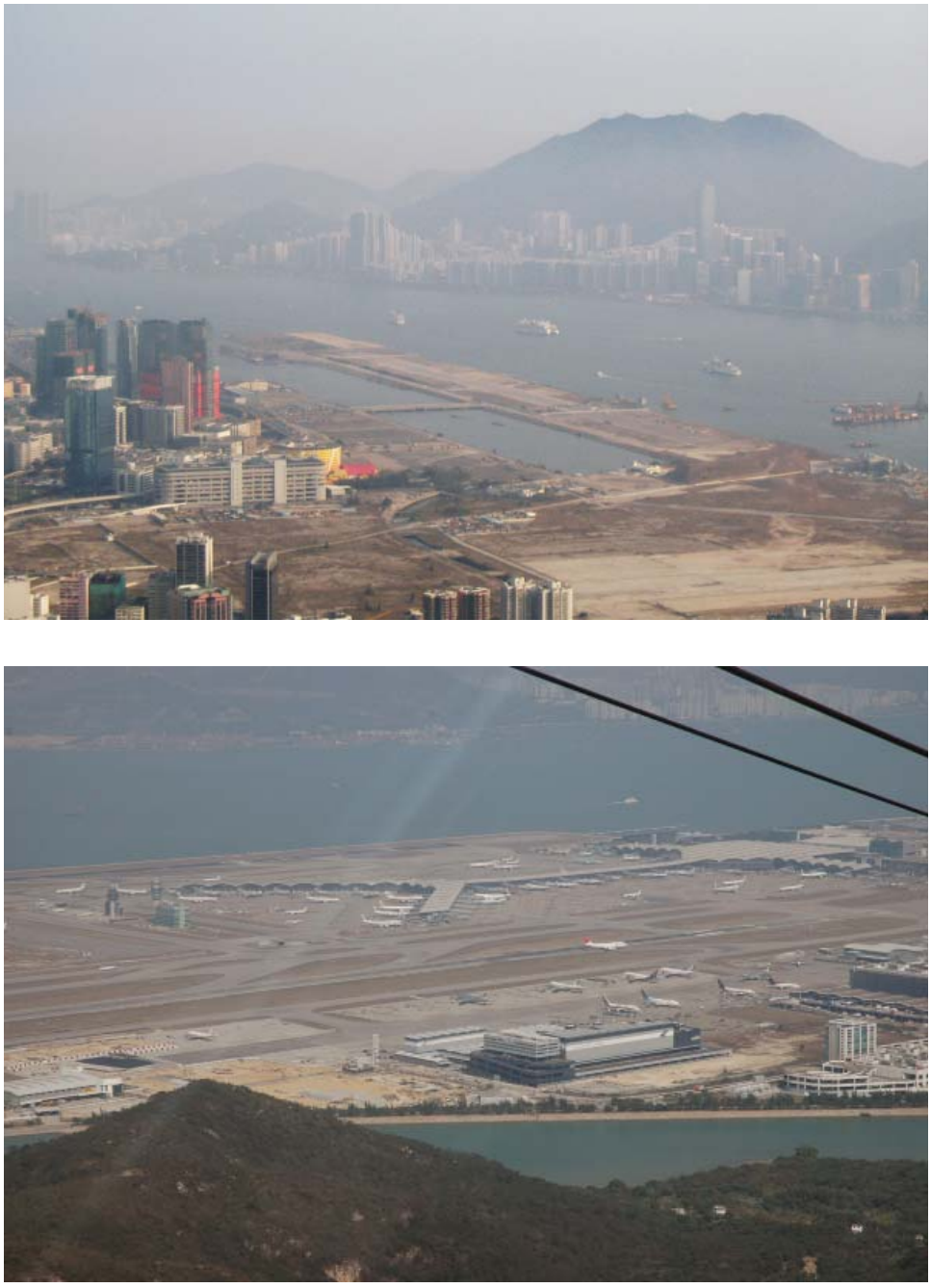


Figure 3.17 Kai Tak Airport (Top) and Hong Kong International Airport (Bottom)

Potential Land Uses for Rock Cavern Development		
Land Use Category	**Potential Land Uses in the Current HKPSG**	**Potential Land Uses Proposed to be Added to HKPSG**
Commercial	Retail	Food / Wine storage Warehousing
Industrial	Industry LPG bulk storage Oil bulk storage Storage / Warehousing	Dangerous goods Data centre Research laboratories Science park
Government, Institution & Community (GIC)	Civic centre Columbarium / Mausoleum / Mortuary Incinerator Indoor games / Sports hall Refuse transfer facility Sewage / Water treatment plant Service reservoir Slaughterhouse Transport connections & networks Wholesale market	Archives Bicycle park-and-ride Car / Vehicle parking Crematorium Refuse collection point Maintenance depot for rail and others Underground quarrying
Public Utilities	Power station	Substation

Figure 3.18 Potential Land Uses for Rock Cavern Development

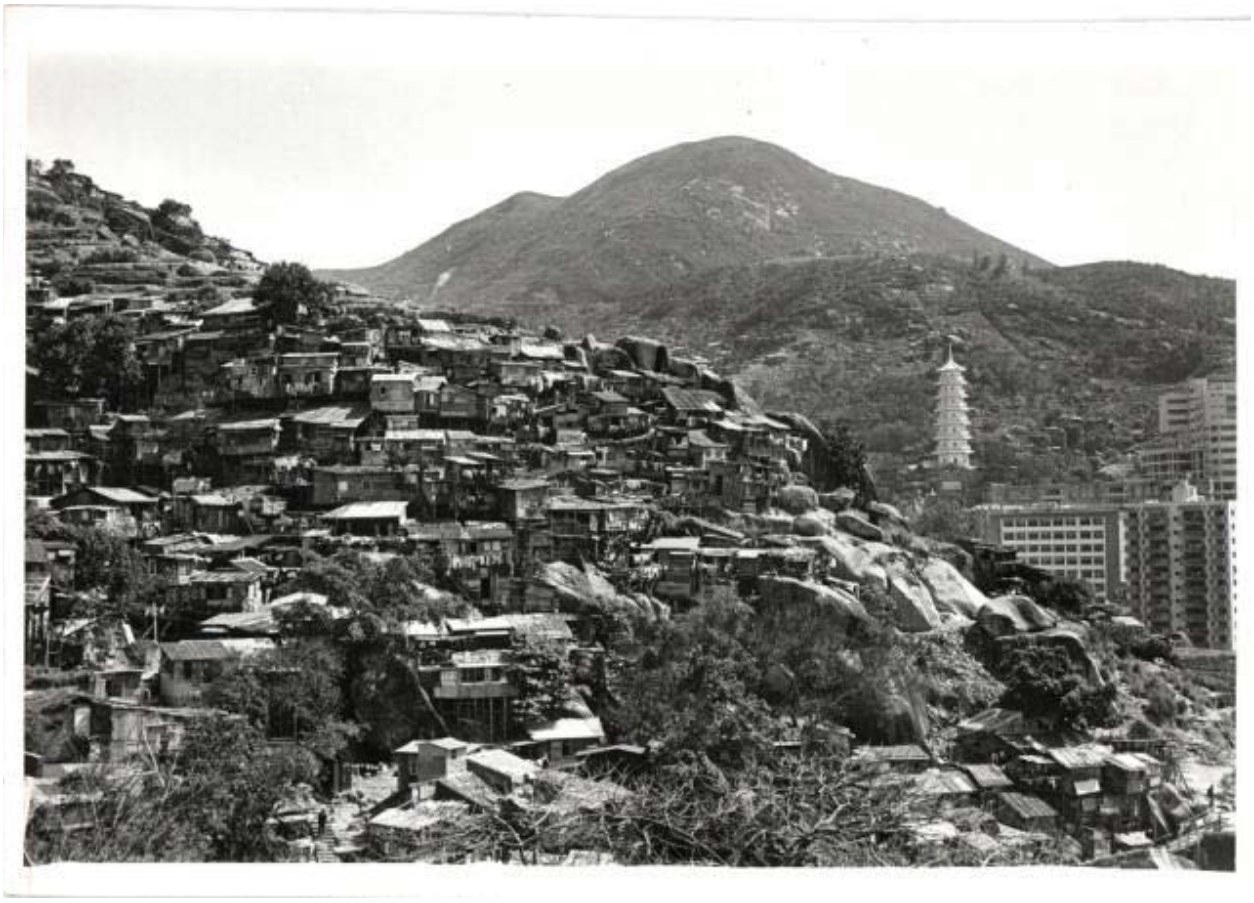


Figure 3.19 Hong Kong hillside huts in Causeway Bay, c. 1969

investigations into unconventional spaces point to possible alternatives in residential development.

Underground caverns would not make the most desirable places to live, but one of the other areas Hong Kong commonly manages is the surface of its hilly terrain. Hillside housing is not out of the ordinary, as there are plenty of fascinating architectural examples using the hillside as a key part of the design. Brazil's favelas are examples of large hillside communities that have grown to engulf the hillside.[36] Similarly, Hong Kong also experienced this type of unregulated sprawl along its hillsides during the mid-20th century (Fig. 3.19), most of which have been cleared since the introduction of public housing.[37] Yet the slopes remain as liabilities that are heavily regulated and controlled to deter development. Safety of life and property is of utmost importance, but with the right strategies these slopes can be unlocked for their potential as unconventional sites for architectural design.

The housing shortage is not only focused on the need for more housing, because this further emphasizes the house as simply a commodity in the market. The realities at play take the house much further than just a shelter, but as a home. It is important to look at alternatives not just in the type of sites or land, but also in the way these sites are developed. The way housing is constructed and the ever changing ways people use the space are as important as creating enough space for those people to inhabit. Other cities in the region are experimenting with different ways to address housing in an increasingly dense environment, yet Hong Kong remains fixated on its current public housing methods. The uncertainty of experimental development, conflicting opinions from stakeholders and public groups, and bureaucratic barriers make it difficult for Hong Kong to take a leap forward.

36 Solange Carvalho, "Managing Growth in Rio's Favelas," in *Metropolis Nonformal*, eds. Christian Werthmann and Jessica Bridger (Novato, USA: Applied Research and Design Publishing, 2015), 134-137.

37 Wai Chung Lai, "The Formation of Squatters and Slums in Hong Kong," *Habitat International* 9, no. 3/4 (1985), 251-260.

CHAPTER 4: BUILDING THE HILLS

THE PROBLEM OF SLOPES

Sloped sites pose challenges due to access, foundation and soil stability, usability of space, and management and maintenance of site conditions for safety. These conditions are weighed against the desirability and economic feasibility of building on the slope based on their geotechnical limitations, suitability, potential cost, and site investigation required.[1] Hong Kong, being located in a subtropical climate, experiences typhoon seasons with periods of torrential rain, making landslides the primary concern when dealing with the slope. Hong Kong has an extensive history with landslides with the earliest records dating back to 1889,[2] but managing these natural hazards became more important as the city grew denser and the loss of life and property became a great concern.

LANDSLIDES IN HONG KONG

On June 18, 1972, after three days of heavy rain, a slope in Kwun Tong collapsed and destroyed the Sau Mau Ping resettlement area as well as 78 squatter huts, killing 71 people with tens of people buried under the debris (Fig. 4.1).[3] Later that night, a slope at the Mid-Levels collapsed and destroyed a 12-storey and 6-storey building, with damage to adjacent buildings (Fig. 4.2). 67 people were killed in this landslide, making these two incidents the highest death toll caused by a rain-induced disaster in Hong Kong on one day.[4] On August 25, 1976, disaster struck Sau Mau Ping again just 200 metres from the landslide in 1972. After two days of heavy rain, a fill slope behind Sau Mau Ping estate collapsed, killing 18 and injuring 24 people, with mud filling the lower floors of the estate block. After these two disastrous landslides at Sau Mau Ping, the government needed to take immediate action. A turning point in Hong Kong's history came about in 1977 with the establishment of the Geotechnical Control office, now renamed as the Geotechnical Engineering Office. The office continues to use geotechnical and geological knowledge to ensure safety of slopes and prevent landslides. Although slope failures still occur, they are much less severe than before the establishment of the office. To further reduce the risk, planning and architectural practices have been established that indicate a reasonable distance from the slope face as well as increased public awareness of indicators and hazards.

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1 Geotechnical Control Office Civil Engineering Services Department, *Geotechnical Area Studies Programme - Hong Kong and Kowloon* (Hong Kong: Government of Hong Kong,[1987]).

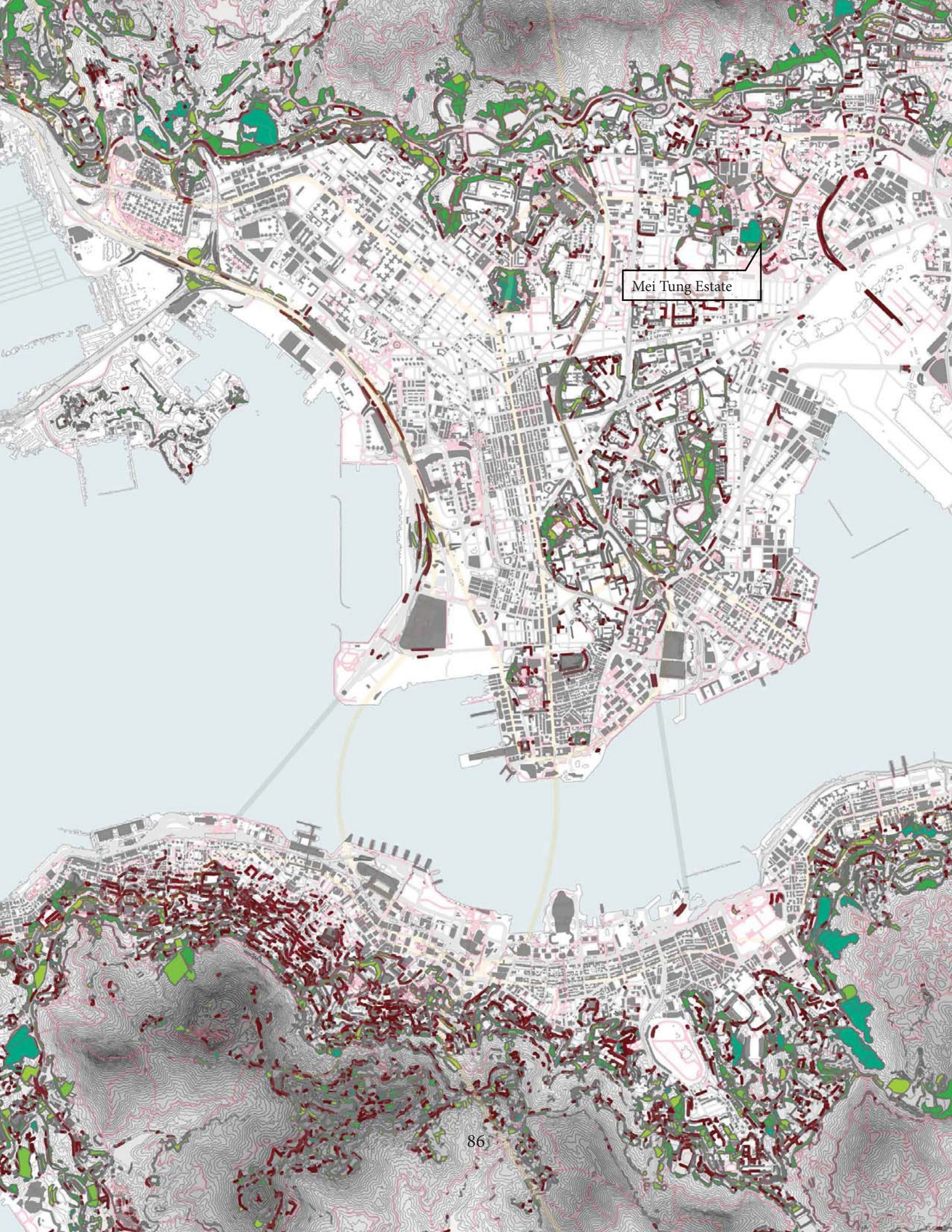
2 Civil Engineering and Development Department, *When Hillsides Collapse: A Century of Landslides in Hong Kong*, 2nd ed. (Hong Kong: HKSAR Government, 2014), 10.

3 Ibid., 79-83.

4 Ibid., 77.

Figure 4.1 Aerial Photograph of the 1972 landslide at Sau Mau Ping, Kwun Tong, Hong Kong

Figure 4.2 Aerial Photograph of the 1972 landslide at Kotewell Court, Mid-Levels, Hong Kong


Mei Tung Estate

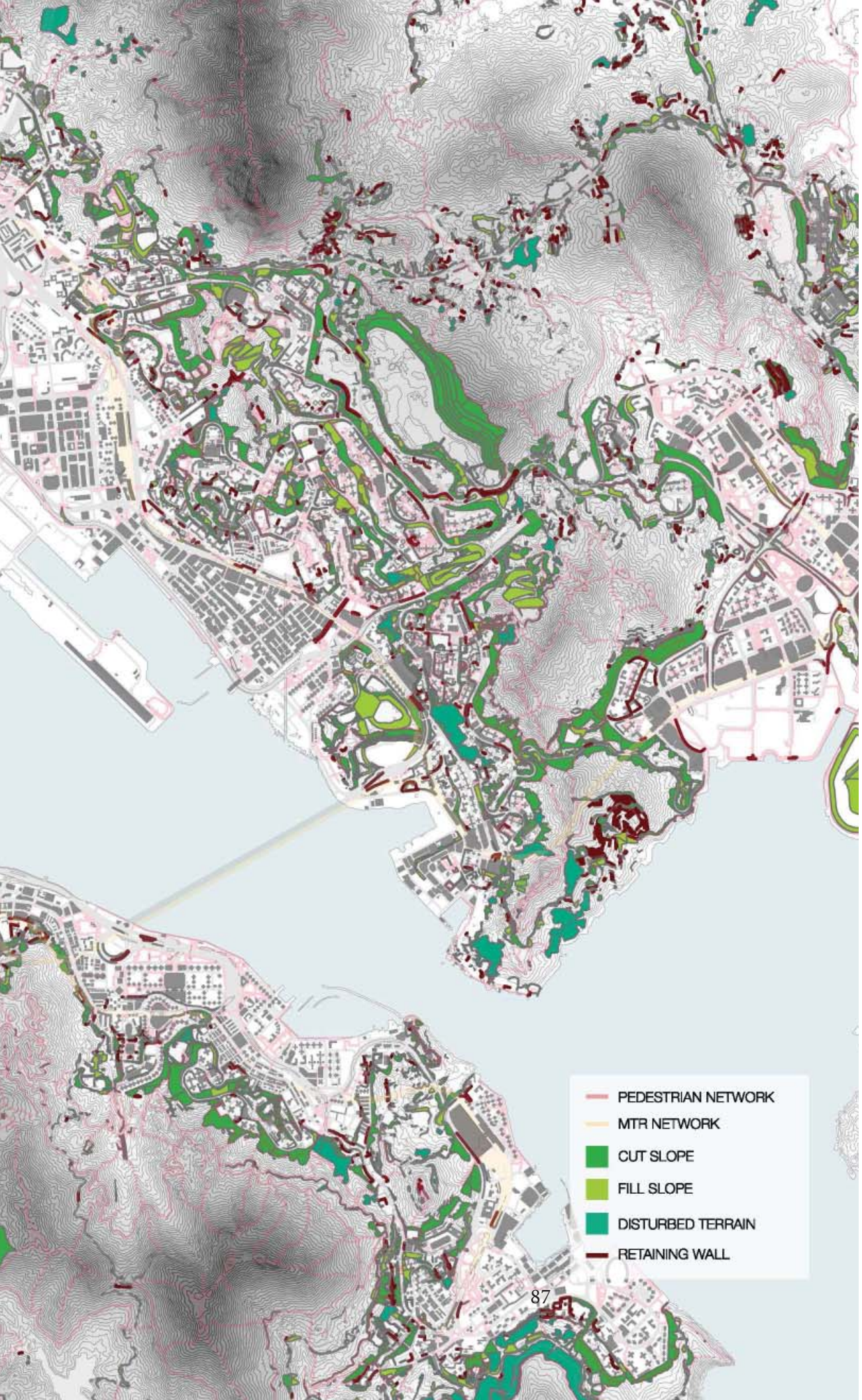


Figure 4.3 Network of Man-made slopes and walls on Hong Kong Island and Kowloon

Figure 4.4 Gate and sign prohibiting the use of slopes

AN ENGINEERED LANDSCAPE

The slopes are not natural terrain. There are close to 60,000 registered man-made slopes in Hong Kong, both privately and city owned,[5] and they are highly engineered pieces of infrastructure with a great deal of investment in geotechnical engineering (Fig. 4.3). With the mountainous topography in Hong Kong, there exists a friction between the urban built forms on low-lying flat land and the slopes of the landscape. With further development of the city, urban built-up spaces either reclaim land from the sea, or encroach on the slopes of the city. While the slopes are prominent features in the city, they have been relegated to the background of urban development (Fig. 4.4). Thought of as a liability, they become indeterminate spaces, neither being part of the urban public realm, nor are they a constituent of the park landscape. Under existing planning guidelines, slopes greater than 1:3 are not suitable for open space,[6] so these fringe spaces become underutilized and exist merely to allow for other parts of the city to flourish. How can we look at these slopes, details, and strategies, not only as ways to keep the hillside from collapsing, but as opportunities to realize their architectural potential and relationship in the city?

Man-made slopes in Hong Kong include fill slopes, cut slopes, retaining walls, and disturbed terrain slopes. Slopes in Hong Kong are classified as "man-made" when their geometry or soil conditions have been significantly modified to suit urban development needs or address stability issues, and require a level of routine maintenance carried out by their respective slope owners (Fig. 4.5). In contrast, natural terrain has not been modified with the exception of rigid or flexible barriers installed to protect surrounding areas from hillside debris. Natural terrain is usually unmaintained, and does not have stabilization measures since they are costly to implement and are not imperative when there is no high threat to life and property (Fig. 4.6).

Soil nailing, retaining walls, and reinforced fill are common geotechnical engineering structures for slope stabilization of man-made slopes, each with their own visual impact and suitability for various slope conditions.[7] Soil nails are closely space, slender high yield steel bars installed into the slope to increase the shear resistance of the soil (Fig. 4.7). They can be drilled or driven into the slope and grouted for corrosion protection and to transfer stress between the soil and reinforcement. The nails are capped with soil

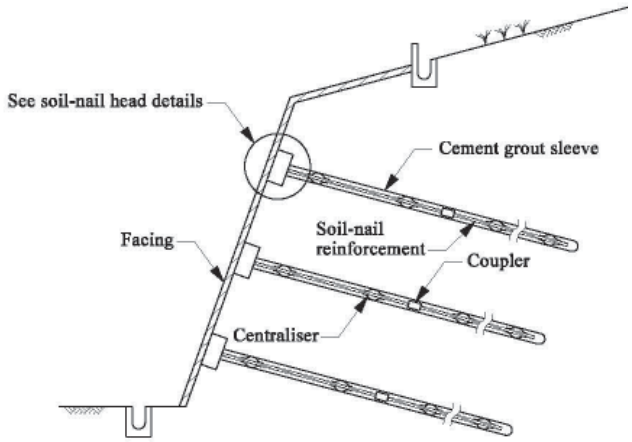
5 "HKSS - Slope Information System," last modified December 29, accessed April 6, 2018, http://hkss.cedd.gov.hk/hkss/eng/sis.aspx.

6 Planning Department, "Chapter 4: Recreation, Open Space and Greening," in *Hong Kong Planning Standards and Guidelines* (Hong Kong: HKSAR Government, 2015), 11-12.

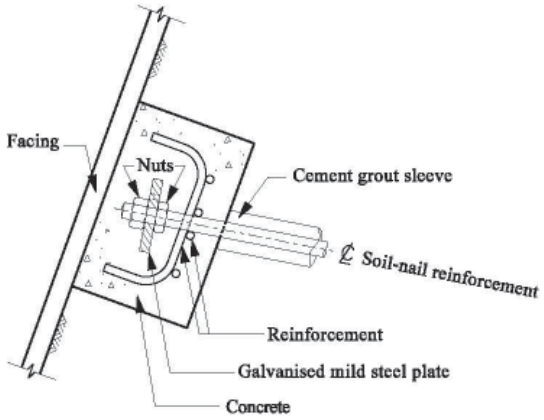
7 Civil Engineering and Development Department, *Geotechnical Manual for Slopes*, 5th ed. (Hong Kong: HKSAR Government, 2011a).

Figure 4.5 Man-made Slope

Figure 4.6 Natural Terrain



Typical Cross-section



Typical Details of a Soil-nail Head

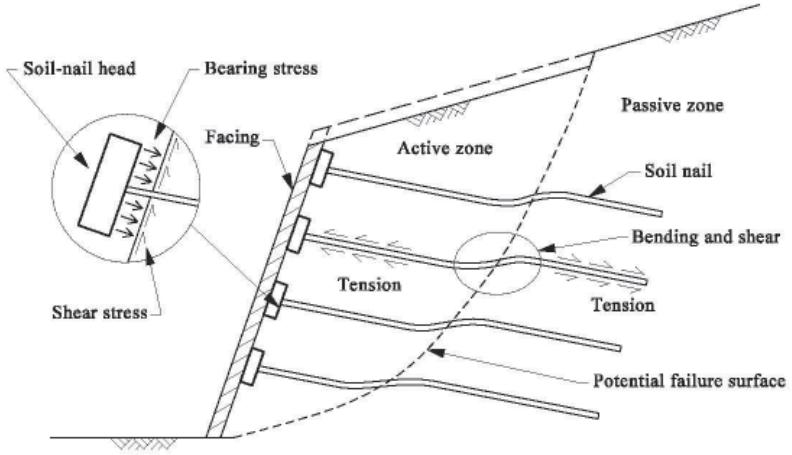


Figure 4.7 Typical Soil Nail Details

Figure 4.8 Soil nail in a retaining wall

nail heads consisting of reinforced concrete pads, steel bearing plates, and nuts (Fig. 4.8). Soil nails are effective for cramped sites and require less earth movement and tree felling. They can also be installed into existing or new man-made cut or fill slopes. This system has greater redundancy and shows early warning signs from ductile failure. They are less effective for slopes with deep seated failure sites since long nails become more costly and difficult to install, nor are they effective for particularly steep or overhanging areas. High ground water levels, soil creeping, and high erosion also affect the suitability of soil nail systems.[8]

Retaining walls (Fig. 4.9) require more earth movement than soil nail systems but are often constructed alongside levelled areas for walkways and streets. The type of retaining wall used can be influenced by the surrounding soil conditions and forces, availability of wall and backfill materials, and height and aesthetic of the wall. Retaining walls require effective drainage for hydrostatic pressure. These include drainage channels to direct excess water away from the wall, a filter and drainage material or free-draining backfill to allow water movement to a suitable outlet, and weep holes through the wall for water to escape without pressure build up (Fig. 4.10). Multi-tiered walls are also common for larger slopes. Walls are also designed for their aesthetic on the slope. Patterns, colours, and planting add to the interest of the wall and break up the monolithic visual impact (Fig. 4.11).[9]

Reinforced fill is a construction technique involving horizontally layered high-strength membranes placed within fill to increase the tensile and shear capacity of the soil (Fig.4.12).[10] The concept is not new and is demonstrated in nature through tree roots in soil. Reinforced fill can offer greater economic savings compared to situations where retaining wall structures would require additional foundation support. It is popular in highway and railway infrastructure for its application in bridge abutments and wing walls, retaining walls, embankments, and sloping ground construction.[11] It is also applicable in repairing failed slopes by reusing the landslide debris for reconstruction. With advancements in synthetic fabrics and geotextiles, modern construction commonly uses synthetic materials as reinforcing membranes. However, the reinforcement may conflict with the routing of underground services and should be kept away from such services in case

8 Civil Engineering and Development Department, *Guide to Soil Nail Design and Construction (Geoguide 7)* (Hong Kong: HKSAR Government, 2017b).

9 Civil Engineering and Development Department, *Guide to Retaining Wall Design (Geoguide 1)* (Hong Kong: HKSAR Government, 2000).

10 Civil Engineering and Development Department, *Guide to Reinforced Fill Structure and Slope Design (Geoguide 6)* (Hong Kong: HKSAR Government, 2017a), 11.

11 Ibid., 14.

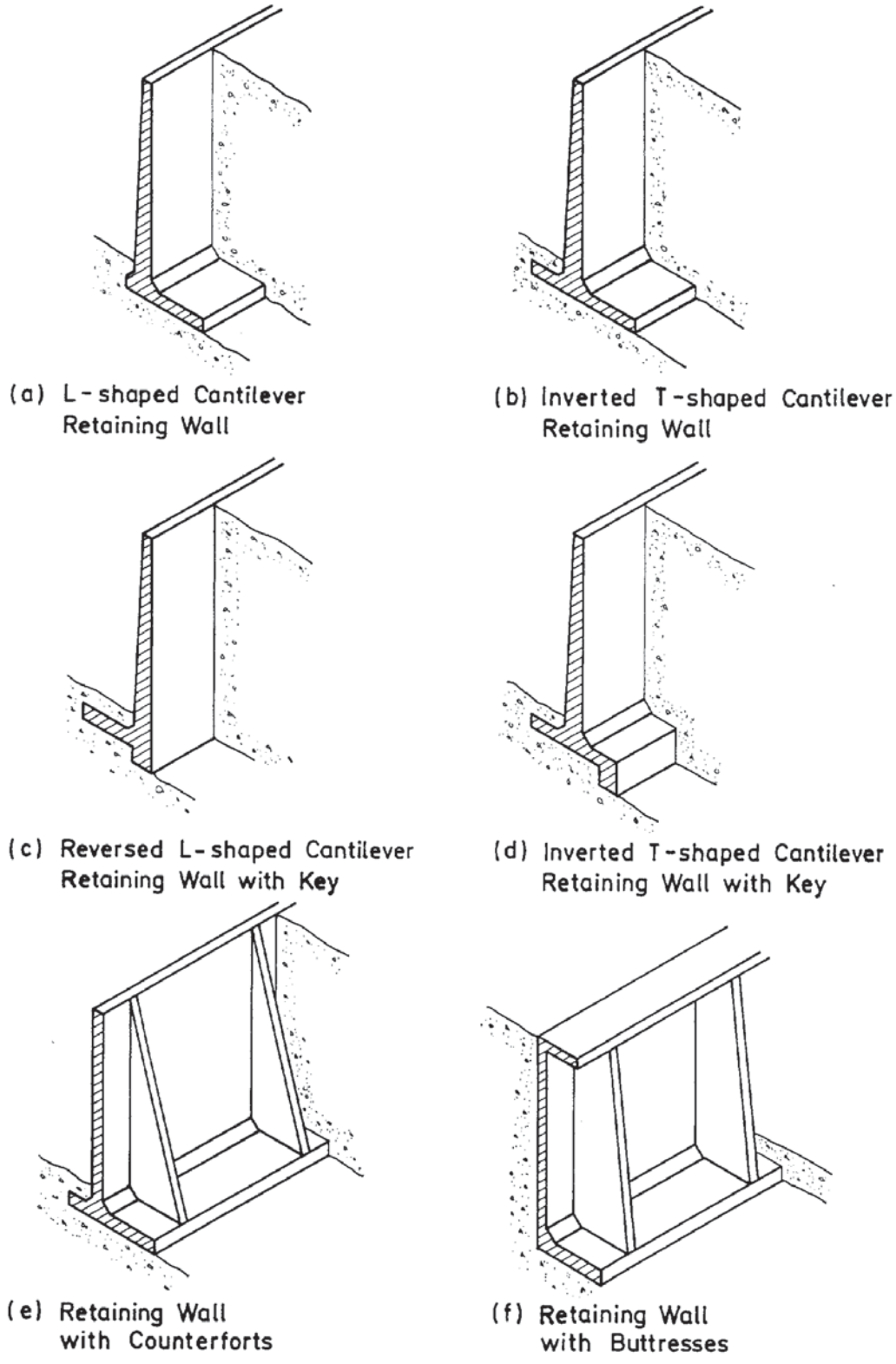


Figure 4.9 Types of Reinforced Concrete Retaining Walls

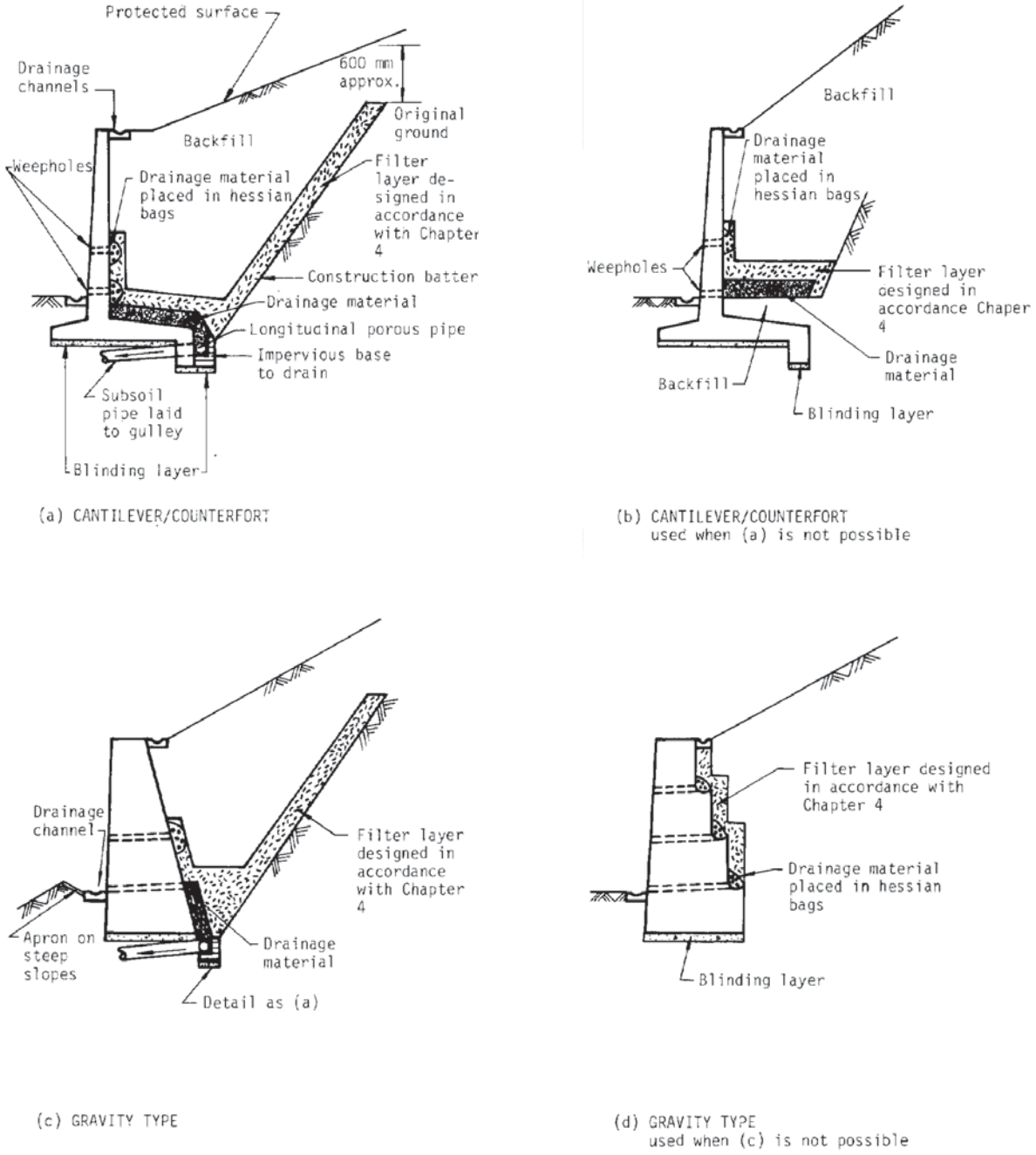


Figure 4.10 Drainage Details for Retaining Walls

Figure 4.11 Retaining Wall Designs

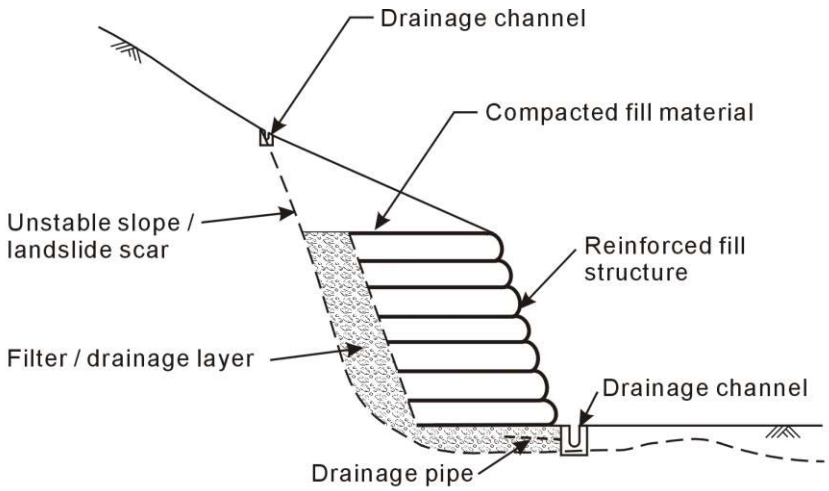


Figure 4.12 Slope stabilization using reinforced fill

future maintenance works disrupt the soil. Reinforced fill construction must also consider the availability of fill material as imported material becomes more expensive.[12] This technique is only applicable to new fill slopes or slope reconstruction and does not stabilize existing or cut slopes.

In conjunction with the primary stabilization structures are the water management strategies applied to control surface drainage. Water affects the stability of slopes by altering the stress conditions in the soil, changing the material makeup and density, and eroding the slope.[13] Controlling the water runoff and infiltration will maintain the integrity of the slope and mitigate the risk of landslides. Strategies include surface treatment to control surface erosion and water infiltration and drainage channels to collect and direct runoff. Concrete U-channels installed along the slope gather water runoff and direct it towards the toe of the slope where it is discharged to larger storm water management infrastructure.[14] For large slopes, channels can divide the slope into smaller horizontal sections that limit water from running down the entirety of the slope as well as allow the water to collect in multiple smaller channels rather than one large channel (Fig. 4.13). The slope surface is treated with either a rigid or vegetative cover. Chunam, a type of cement, lime, and soil plaster,[15] is a common rigid surface treatment material on many older man-made slopes in Hong Kong. Their surfaces degrade over time with cracks that can prompt localized water infiltration and cause slope instability (Fig. 4.14). Chunam has fallen out of favour for more vegetative slope covers that use a variety of plant species as erosion protection (Fig. 4.15). Other common rigid covers include sprayed concrete and masonry, which are used on slopes less suitable for vegetative covers due to steepness, slope composition, or infiltration limits. PVC coated wire mesh is also a common material for extremely steep slopes where vegetation cannot grow or falling debris is an issue (Fig. 4.16).[16]

Vegetative surface protection is preferred to aesthetically match the surrounding hillside and provide a surface more resilient to degradation. The slope face is first protected with an erosion control mat. These can be

12 Ibid., 18.

13 Civil Engineering and Development Department, *Geotechnical Manual for Slopes*, 53-56.

14 "CEDD - CEDD Standard Drawings," last modified January 8, accessed April 7, 2018, http://www.cedd.gov.hk/eng/publications/standards_handbooks_cost/stan_drawing.html.

15 *Building (Construction) Regulations,* Public Law Cap. 123 § 14, (1990): .

16 Civil Engineering and Development Department, *Technical Guidelines on Landscape Treatment for Slopes (GEO Publication no. 1/2011)* (Hong Kong: HKSAR Government, 2011b), 41.

Figure 4.13 Concrete U-channels and catchment pit

Figure 4.14 Cracking chunam

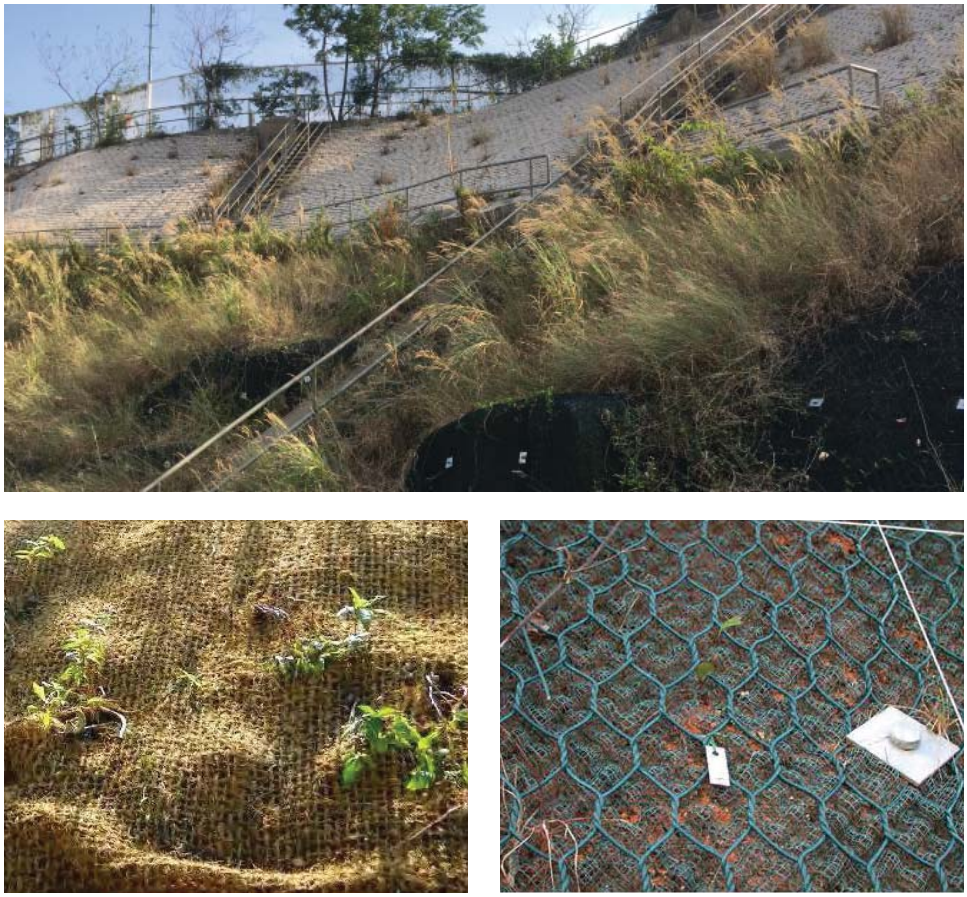


Figure 4.15 Vegetative cover (top) and biodegradeable (bottom-left) and non-biodegradeable (bottom-right) erosion control mat

Figure 4.16 Wire mesh cover

biodegradable erosion control mats of woven natural fibres that temporarily protect the slope surface until vegetation is established as permanent erosion control (Fig. 4.17). Erosion control mats can also be made from non-biodegradable synthetic materials for slopes where natural vegetation would not provide enough erosion protection. The steepness of the slope, its proximity to roads and other programs, and its orientation influence the plant types and species applied onto the slope.[17] Gentle slopes, or flattened areas, can support small trees and large bushes, while steeper areas begin to support smaller plant types such as small bushes and grasses. In conjunction with stabilization infrastructure, landscaping strategies provide the appropriate vegetation that can thrive on the slope and provide ecological habitats, while details of drainage and access allow for continued inspection, maintenance, and function of the slope (Fig. 4.18).

Slope maintenance is especially important for keeping the slope in good working order. Small, local landslides are the most common, and these can be mitigated through proper maintenance of slope infrastructure. Clearing accumulated debris in drainage channels and catchpits, checking for cracked or damaged walls and slope surfaces, unblocking weepholes and outlets, maintaining the vegetation, and repairing railings and service stairs are part of ensuring the safety and longevity of the slope (Fig. 4.19). Routine inspections by an engineer will also catch problems that laypeople may not recognize.[18]

Several methods employed for building on the terrain include elevating the structures, terracing the landscape, or excavating a platform (Fig. 4.20).[19] Depending on the surrounding space available, the geotechnical conditions of the slope, and the degree of ecological impact, one or a mixture of these methods may be employed. Elevating the structures on platforms or podiums avoid the terrain altogether and create an artificial ground zero on which to build. It reduces the excavation and impact on the slope but detaches the building from its surrounding environment. Terracing the hillside sets up smaller areas for development and relies on man-made slopes and retaining walls to form the landscape. Large scale excavation can cut back a slope to create a platform for development. This requires the most excavation and has the greatest environmental impact. Regardless of the chosen method, the slope is also not a standalone object. Its relationship to the rest of the

17 Ibid., 33.

18 Civil Engineering and Development Department, *Guide to Slope Maintenance (Geoguide 5)* (Hong Kong: HKSAR Government, 2018b), 28.

19 Civil Engineering and Development Department, *Natural Terrain Landslide Hazards in Hong Kong* (Hong Kong: HKSAR Government, 2016), 30-31.

Figure 4.17 Establishing vegetation over time on a man-made slope

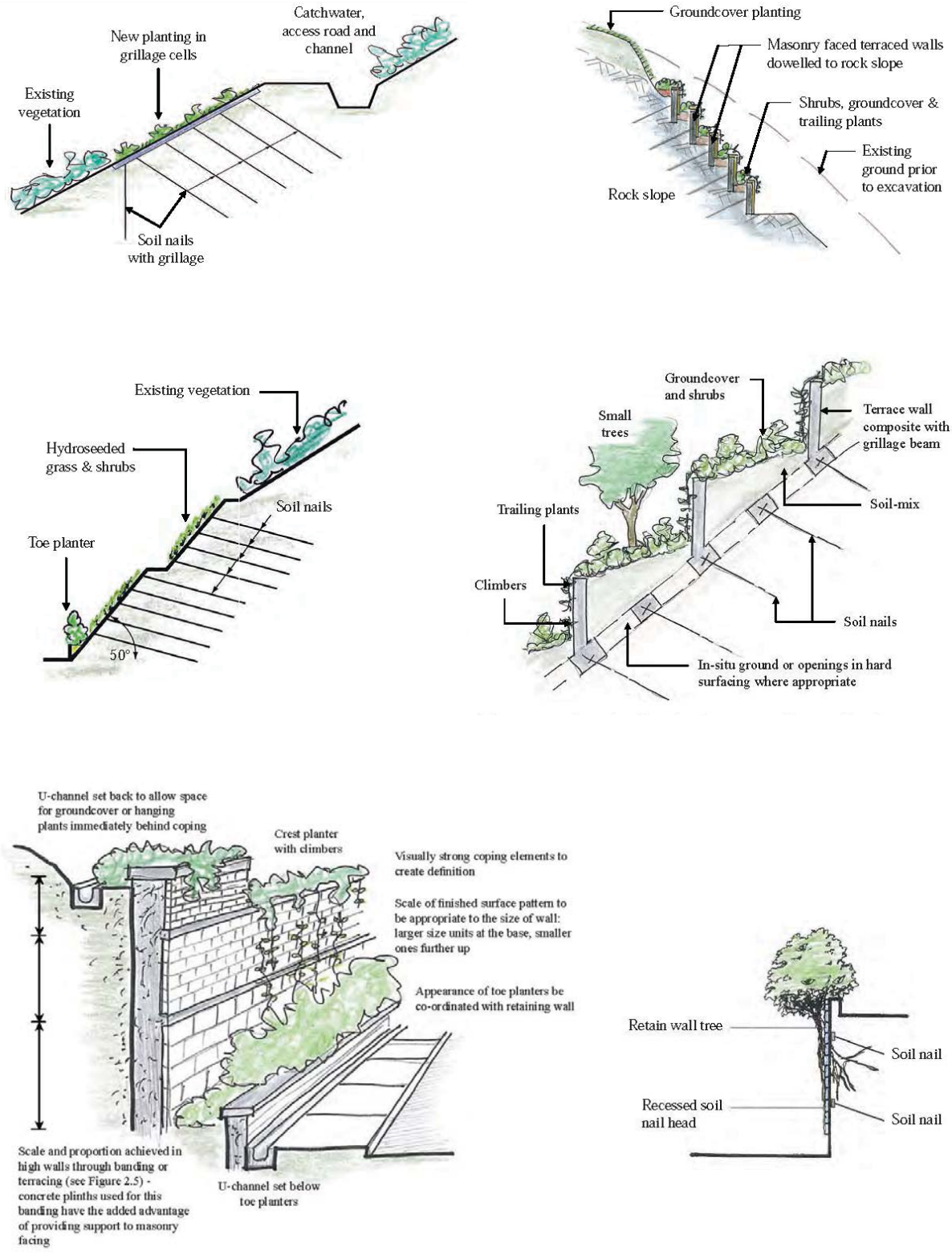


Figure 4.18 Examples of landscaping strategies integrated with slope engineering

Figure 4.19 Slope maintenance stairs

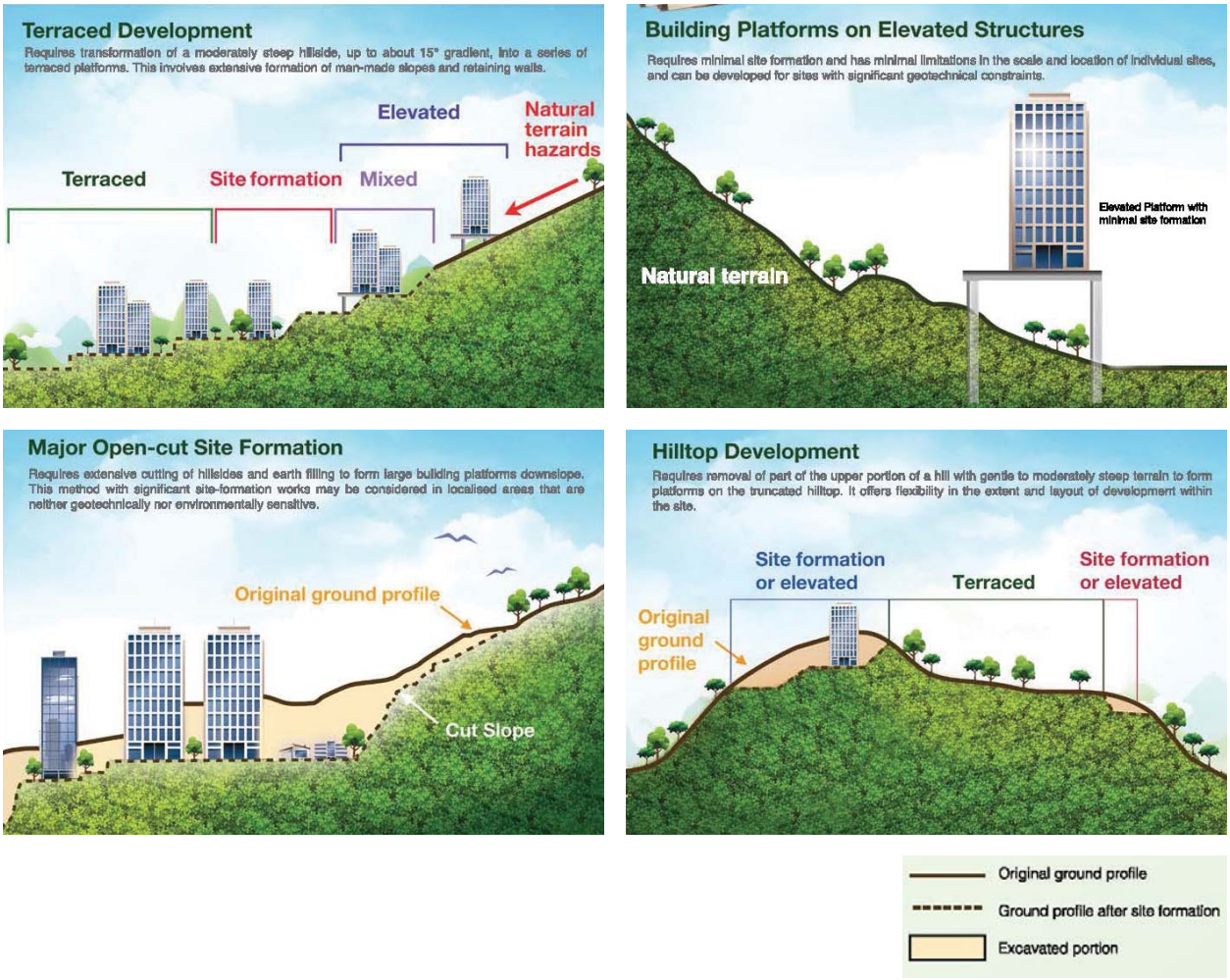


Figure 4.20 Slope Development Strategies

urban fabric is integral to its success as a component in the city.

THE SLOPE AS ARCHITECTURE

Early examples of slope occupation in Hong Kong came from the large squatter settlements dominating the hillsides, since they were peripheral to the main core of the city and deterred urban redevelopment. They did not come without risks though as the added load, disturbance of the soil, and water runoff increased the potential for landslides. This made them especially prone to clearances compared to other squatter settlements at the time. Squatter clearances are categorized into:

1. Emergency clearance (EC) due to landslides,
2. Non-development clearance (NDC) for slope safety excluding emergency clearance, and
3. Development clearance (DC).[20]

Many of these slope settlements were cleared in emergency and non-development clearances. However, some squatter settlements remained due to the shortage of land and the lack of available permanent facilities to accept the dislocation of a community. A 1982 report on squatter area improvements explored some solutions for these communities (Fig. 4.21). The proposed solutions were more complex for squatter settlements on the slopes. One approach would have been to re-construct the squatter settlements into temporary housing areas, but this became expensive and inefficient on hilly sites which required extensive site formation. Allowing the squatters to use more permanent materials to rebuild would increase the load on the slope without the proper treatments to support this additional load. The alternative was providing the basic services available in permanent facilities to the squatter settlements. The improvements were carried out based on the areas with the greatest need and the most beneficiaries, so smaller settlements with less than 500 people or ones with a lifespan of less than 3 years were excluded. Improvements included metered electricity and water services, slope surfacing and better drainage, public toilet and shower houses, refuse collection, street lighting, firebreaks, and better access (Fig. 4.22 & 4.23). The local police and government administrators also established better communication with the squatter communities to provide improved security and management. However, they remained as improvements designed for temporary relief until other resources and housing could be made available. The belief was these settlements would eventually be cleared for development. [21] As anticipated, squatter settlements on slopes have

20 W. M. Cheung and Y. K. Shiu, *Evaluation of the Effectiveness of Squatter Clearance Actions in Reducing Landslide Risk* (Hong Kong: HKSAR Government,[2003]).

21 Housing Department, *Report on Squatter Area Improvements 1982* (Hong Kong:

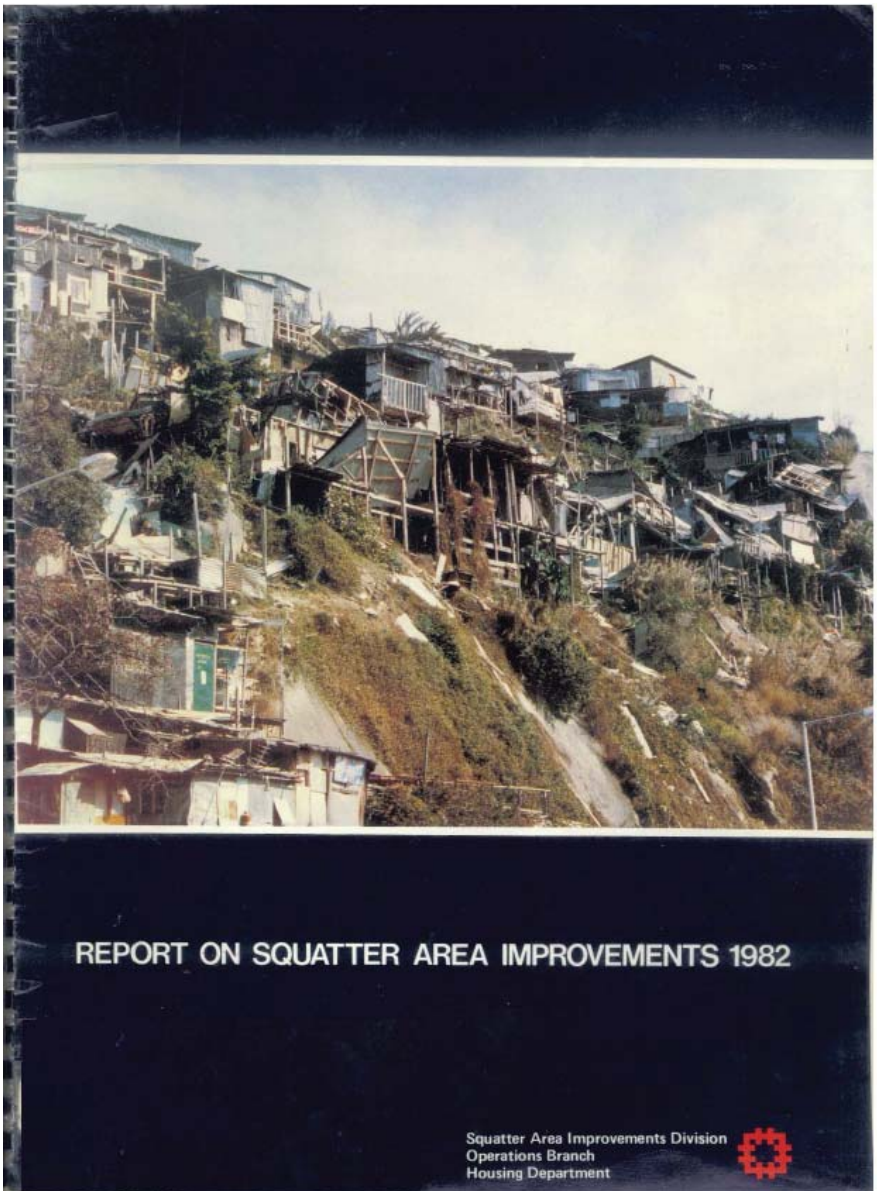


Figure 4.21 Cover of the "Report on Squatter Area Improvements 1982"

Figure 4.22 Fire break in a squatter community

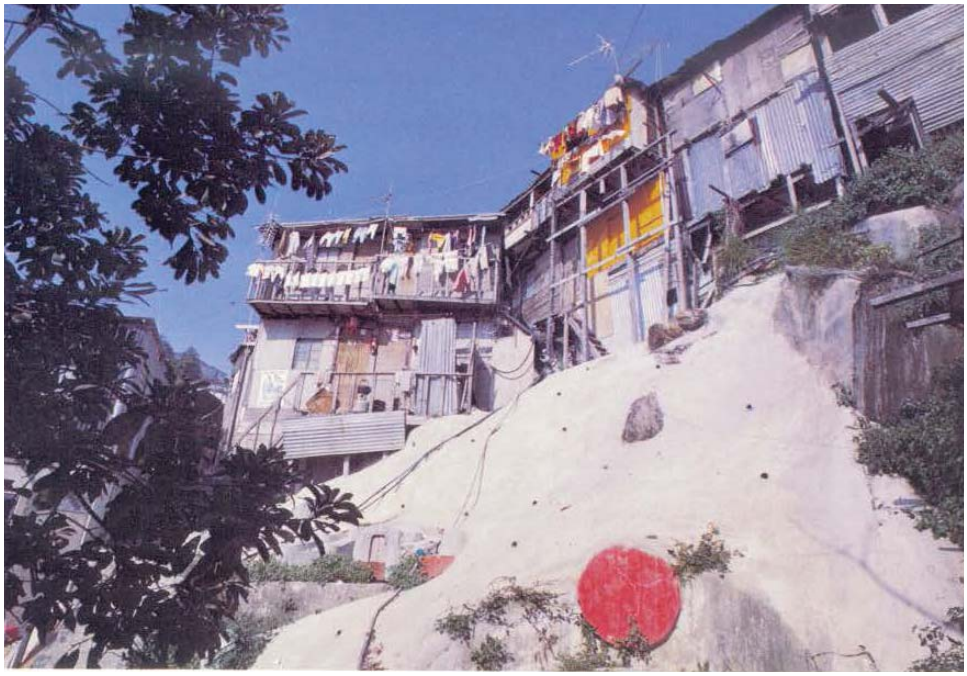


Figure 4.23 Slope surface improvements in a squatter community

largely disappeared; even those that were improved have been redeveloped into large housing estates. These are rare examples of the improvement of existing communities without complete redevelopment, but they were pilot programmes which were short-lived. If the improvements were intended to be permanent, then the outcome of these squatter settlements might have been different.

More permanent examples of hillside development exist in Hong Kong's central core. The sloping topography shaped the city's morphology and approach to urban development, creating the underlying condition for the city's three-dimensional layered public realm of streets, stairs, and bridges.[22] This is best represented in the Mid-Levels and Central areas backed onto the foothills of Tai Ping Shan. Central is home to the primary central business district and highly developed to cater to swift movement of everyday workers, tourists, and vehicles. Mid-Levels (半山區) in Chinese is literally named "mid-mountain area" as a reflection of the neighbourhood's location on the hillside. This neighbourhood was one of the sites of early colonization and developed alongside the growth of Hong Kong (Fig. 4.24). It is also home to the Mid-Levels Escalator which links street to street as it climbs along the hillside. It invigorates the surrounding area by providing pedestrians with an effortless vertical transportation network to local shops, bars, and restaurants. Stairs and pedestrian bridges become streets for commercial and pedestrian activity, linking podium levels of high-rise blocks, and offering outdoor living spaces outside the confines of miniscule living interiors (Fig. 4.25). People use stairs and landings as areas to sit or as an outdoor extension to shops (Fig. 4.26). The buildings and streets become the landscape of the hillside. Street vendors alter their stalls to fit into the sloping environment (Fig. 4.27). Retaining walls and drainage elements are architectural elements (Fig. 4.28). These adaptations form a culture of sloped living and show the possibilities of hillside occupation. However, the Mid-Levels enveloped the hillside over time and with great investment from developers willing to tackle the terrain for prime real estate.

The slopes of Hong Kong are prominent features in the city and have tremendous impact on the urban fabric. The city adapted by engineering the landscape to control the slopes and maintain a greater level of safety. New landscaping strategies indicate the importance of environmental sensitivity on these man-made slopes. The structure, surface treatments, and serviceability elements have potential to act as architecture. The

Housing Department,[1982]).

22 Jonathan Soloman, Adam Frampton and Clara Wong, *Cities without Ground* (Woodbridge: Oro Ed, 2012).

Figure 4.24 Pottinger Street (1930s to 2018), Mid-Levels-Central, Hong Kong

Figure 4.25 Outdoor living spaces

Figure 4.26 Stairs as an extension of public space

Figure 4.27 Altered stalls to fit the landscape

Figure 4.28 Mid-Levels retaining walls and environments

challenge is unlocking this potential within geotechnical limitations and cost requirements. By expanding from these existing geotechnical and slope landscaping methods, how can we use this slope infrastructure to support occupation and enhance the slope? Using retaining walls as a framework for slope stabilization, incorporating pedestrian access, using drainage channels and planters as ways to control run-off water, and providing the amenities for inhabitation, these components then work together not only to manage the forces that influence the stability of the slope, but also to invigorate it as a space for inhabitation. The relationships of water management, circulation, vegetation and material coverings inform the processes of construction on the slope, how the spaces are used, and how they can be inspected and maintained to ensure safety and functionality. We already need to upgrade our slopes, so why not invigorate them with architectural potential while we are at it?

CHAPTER 5: THE MEI TUNG ESTATE

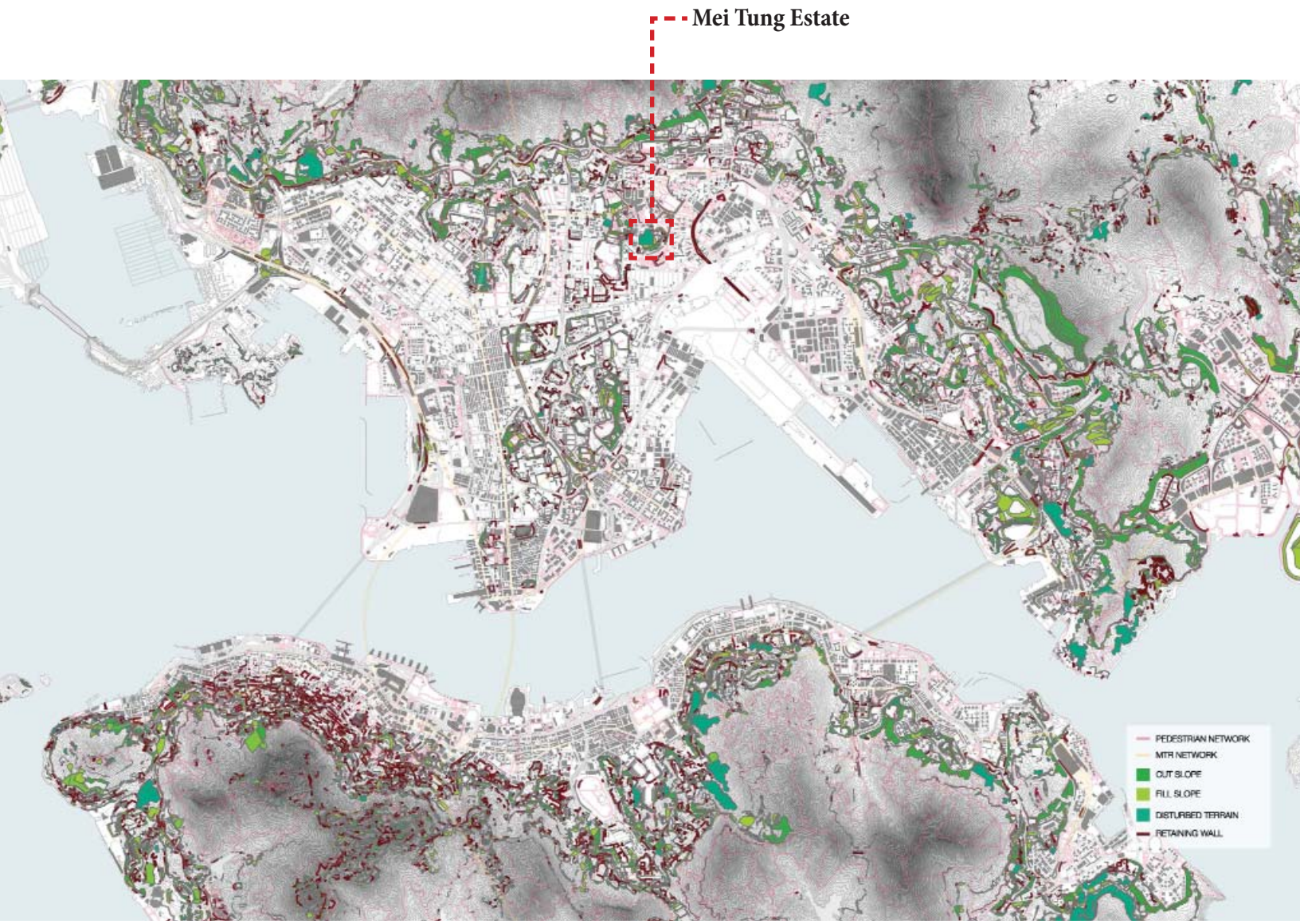


Figure 5.1 Victoria Harbour with Kowloon to the North and Hong Kong Island to the South

Public housing construction in Hong Kong is limited to the areas outside the urban centre of the city. There has been barely any new public housing within the urban centre, and almost all the housing construction in this area is dominated by the highly unaffordable private sector.[1] We know there is a need for more affordable housing within the city centre since the people living in subdivided units, bedspace apartments, and rooftop apartments live there primarily because of the affordability and convenience to work or school.[2] The man-made slopes are the few spaces in the city centre that are not already built up. Using these sites for affordable housing can inject the city centre with the housing it currently lacks. Their land costs are lower since they are not highly sought after due to the difficult terrain, and some of these slopes already require an upgrade to improve their stability in their increasingly denser surroundings. These two factors improve the housing affordability and combat the greater construction costs that would come with these difficult sites, and are integral to determining a suitable site for development. Including being located near the city centre for more job and school opportunities, the site must also be serviced by public transit and community amenities. One of the sites in Hong Kong that offers all these possibilities is the Mei Tung Estate in Kowloon, Hong Kong.

SITE HISTORY AND DESCRIPTION

The Mei Tung Estate is a public housing estate. It is in the Kowloon City-Wong Tai Sin districts, placing it within some of the densest areas of the city (Fig. 5.1).[3] The estate is built at the foot of an existing granite hill (Fig. 5.2). The two oldest blocks, Mei Tung House and Mei Po House, were completed in 1974 and 1983 respectively (Fig. 5.3-5.5). Two newer blocks, Mei Yan House and Mei Tak House, were completed in 2010 and 2014 respectively (Fig. 5.6). The entire estate consists of approximately 2,500 rental flats with an authorized population of 6,100.[4]

South of the site is the Kowloon Walled City park which was the site of the Kowloon Walled City prior to its demolition in 1994. The neighbourhood

1 Census and Statistics Department, "Section 9: Housing and Property," in *Hong Kong Annual Digest of Statistics* (Hong Kong: HKSAR Government, 2018), 228.

2 Census and Statistics Department, *Thematic Household Survey Report no. 60 - Housing Conditions of Sub-Divided Units in Hong Kong* (Hong Kong: HKSAR Government,[2016b]).

3 Census and Statistics Department, *2016 Population by-Census Key Statistics* (Hong Kong: HKSAR Government,[2016a]).

4 "Housing Authority Property Locator and Profile," last modified August 1, accessed August 19, 2019, https://www.housingauthority.gov.hk/en/global-elements/estate-locator/detail.html?propertyType=1&id=2719.

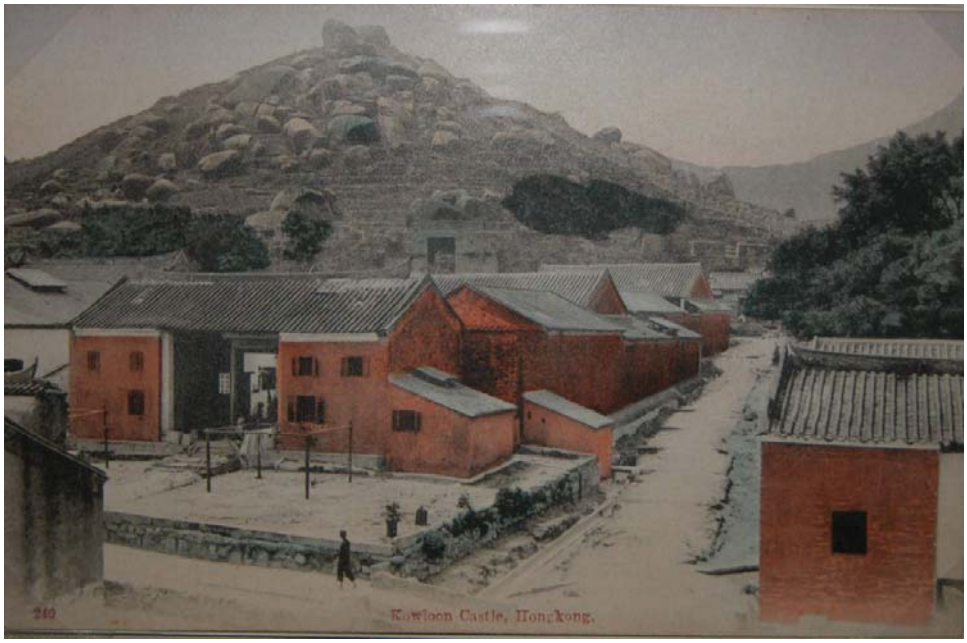


Figure 5.2 View of Kowloon Walled City with the future Mei Tung Estate site in the distance, c. late 1800s

Figure 5.3 Aerial view of Kowloon Walled City (centre), Tung Tau Estate (top), and Mei Tung Estate site (left), c. 1970s

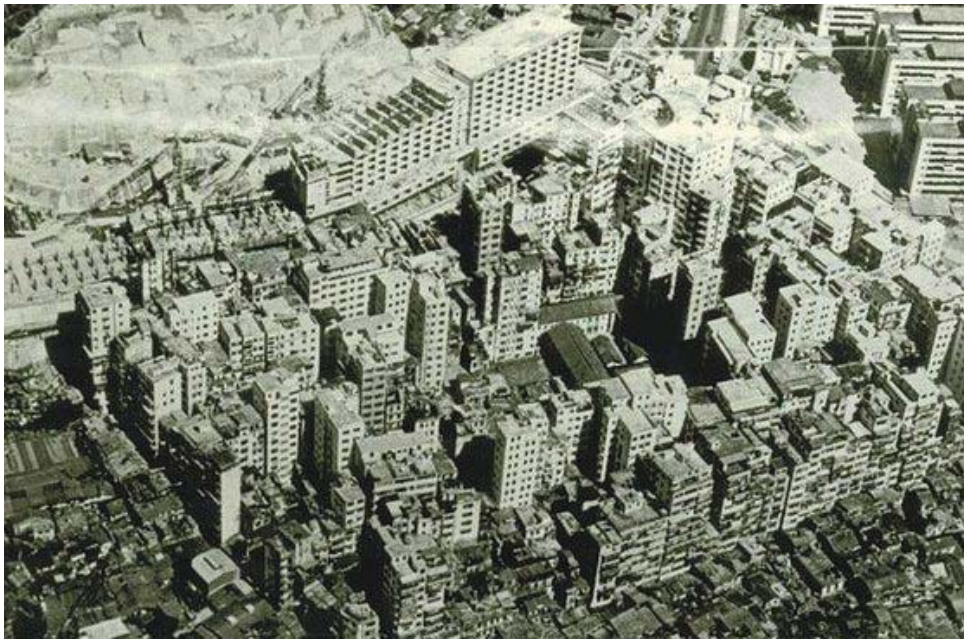


Figure 5.4 Aerial view of Kowloon Walled City (centre) and Mei Tung Estate under construction (top-left), 1973

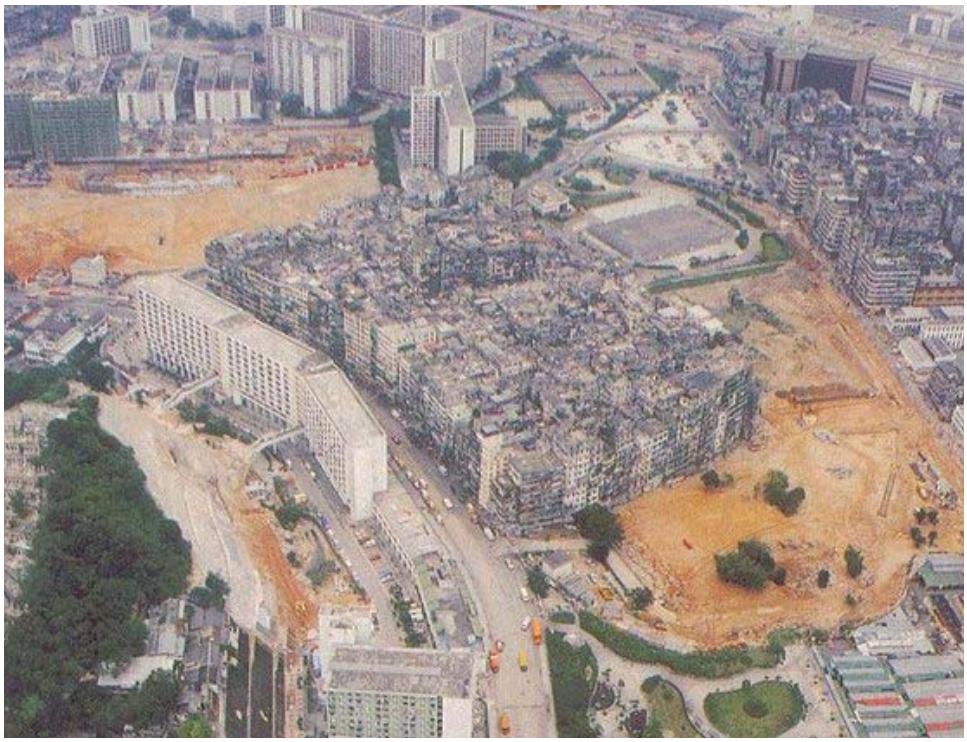
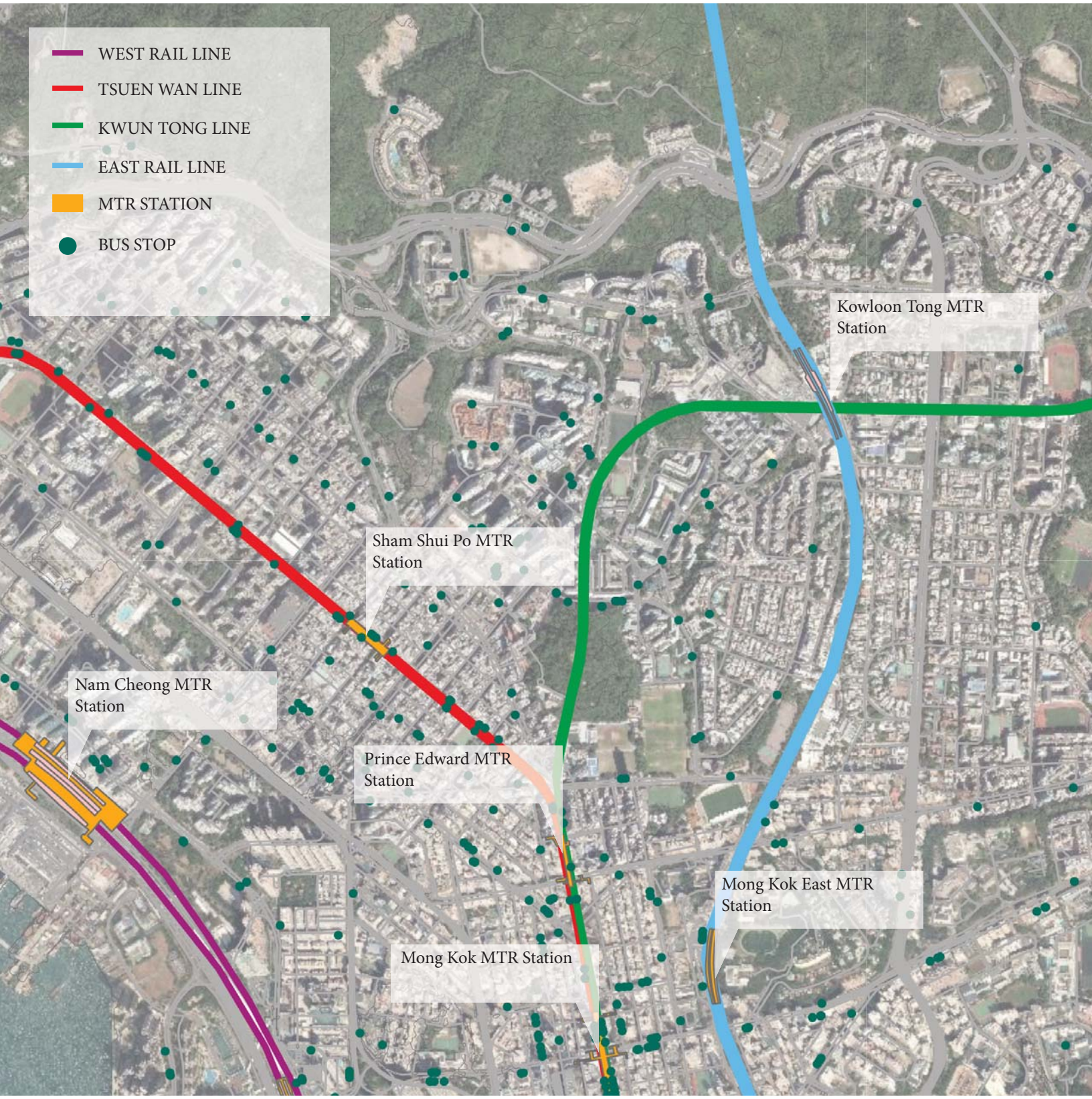


Figure 5.5 Aerial view of Kowloon Walled City (centre), Tung Tau Estate under redevelopment (top-left), and Mei Tung Estate completed (left), c. 1980s


Mei Yan House
Mei Po House

Figure 5.6 Mei Tung Estate Aerial View, 2018


WEST RAIL LINE
TSUEN WAN LINE
KWUN TONG LINE
EAST RAIL LINE
MTR STATION
BUS STOP
Kowloon Tong MTR Station
Sham Shui Po MTR Station
Nam Cheong MTR Station
Prince Edward MTR Station
Mong Kok East MTR Station
Mong Kok MTR Station
N
0
1km
2km

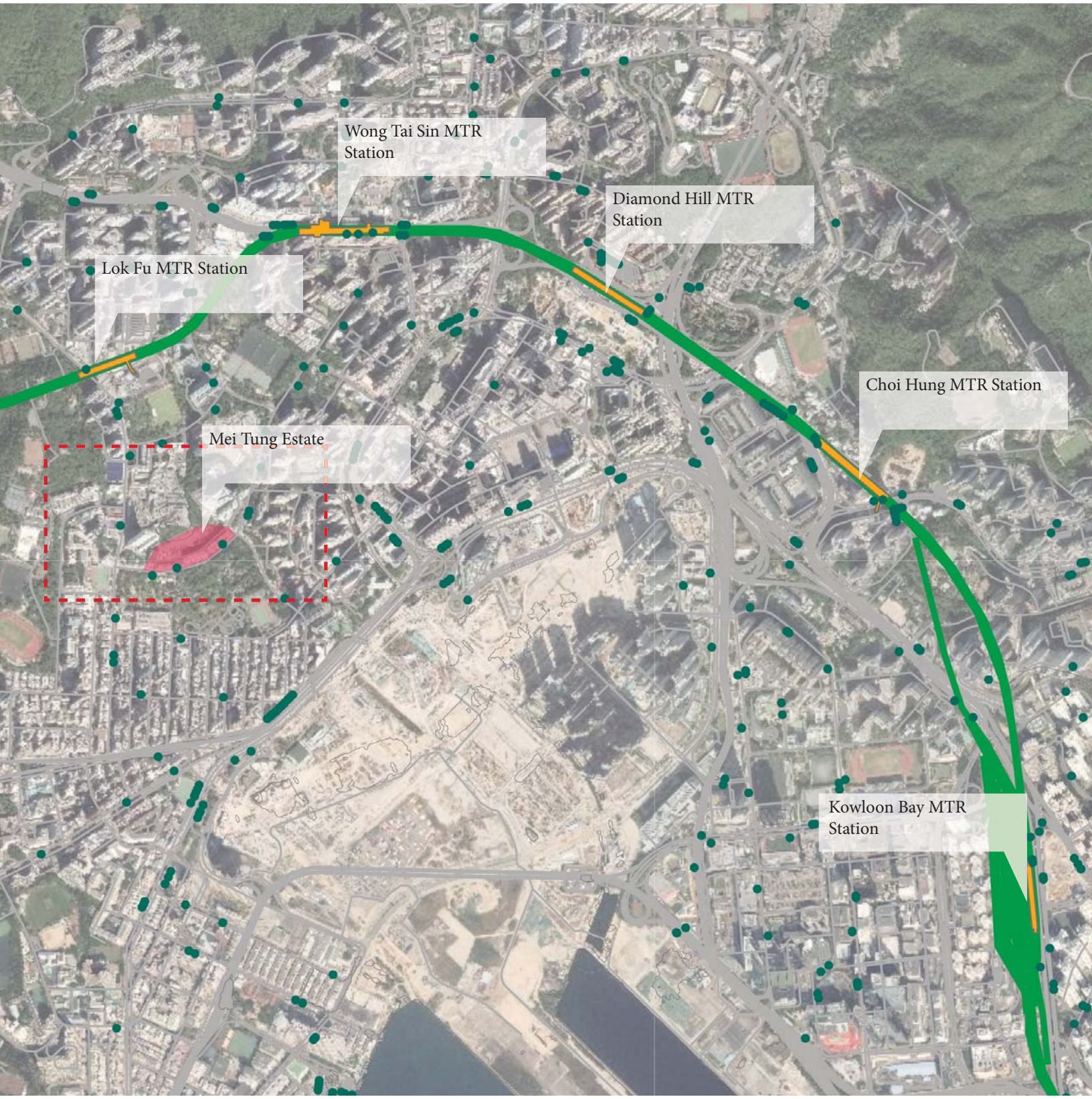
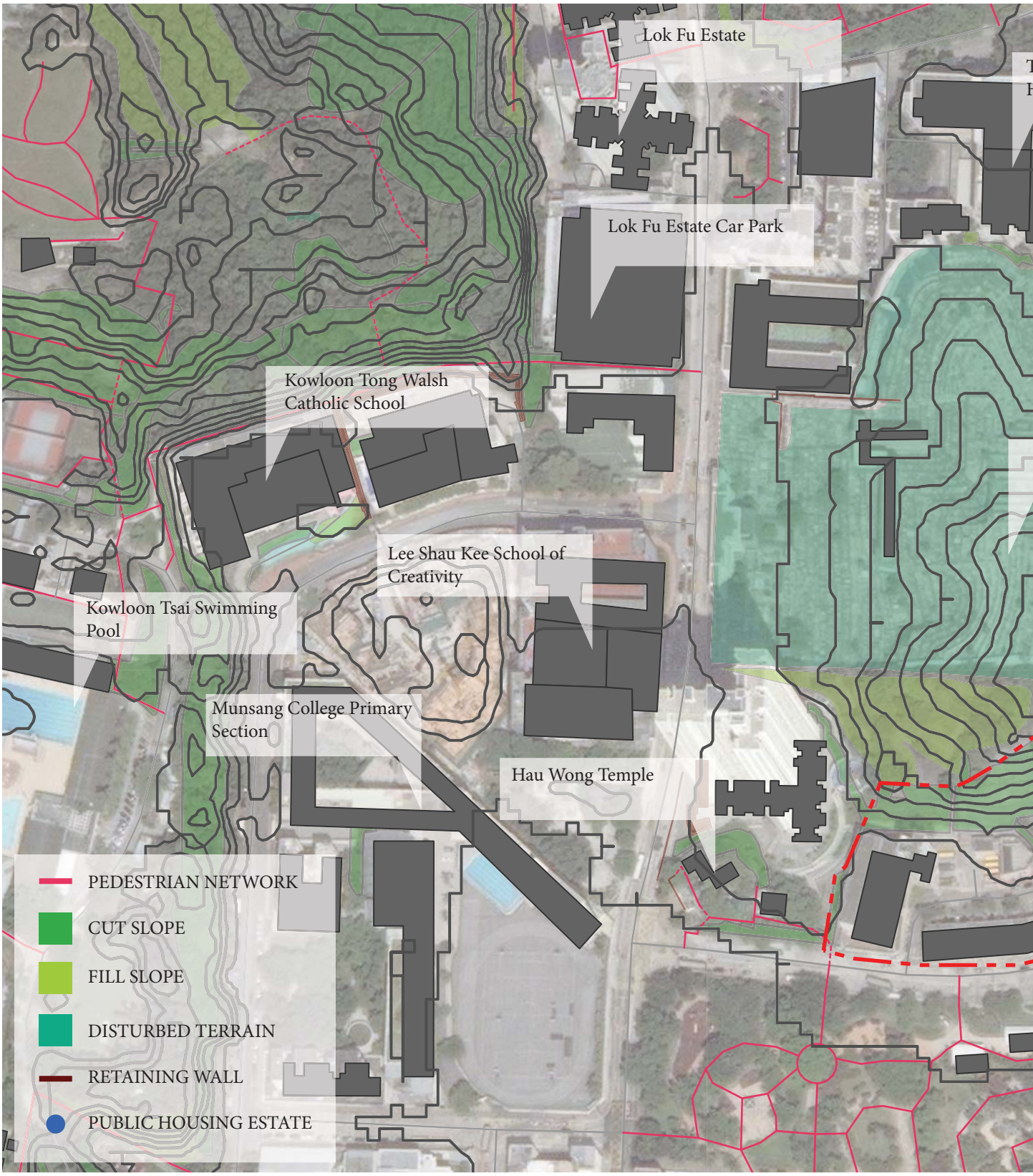


Figure 5.7 Mei Tung Estate Site Plan


Lok Fu Estate
Lok Fu Estate Car Park
Kowloon Tong Walsh Catholic School
Lee Shau Kee School of Creativity
Kowloon Tsai Swimming Pool
Munsang College Primary Section
Hau Wong Temple
PEDESTRIAN NETWORK
CUT SLOPE
FILL SLOPE
DISTURBED TERRAIN
RETAINING WALL
PUBLIC HOUSING ESTATE
N
0
150m
300m

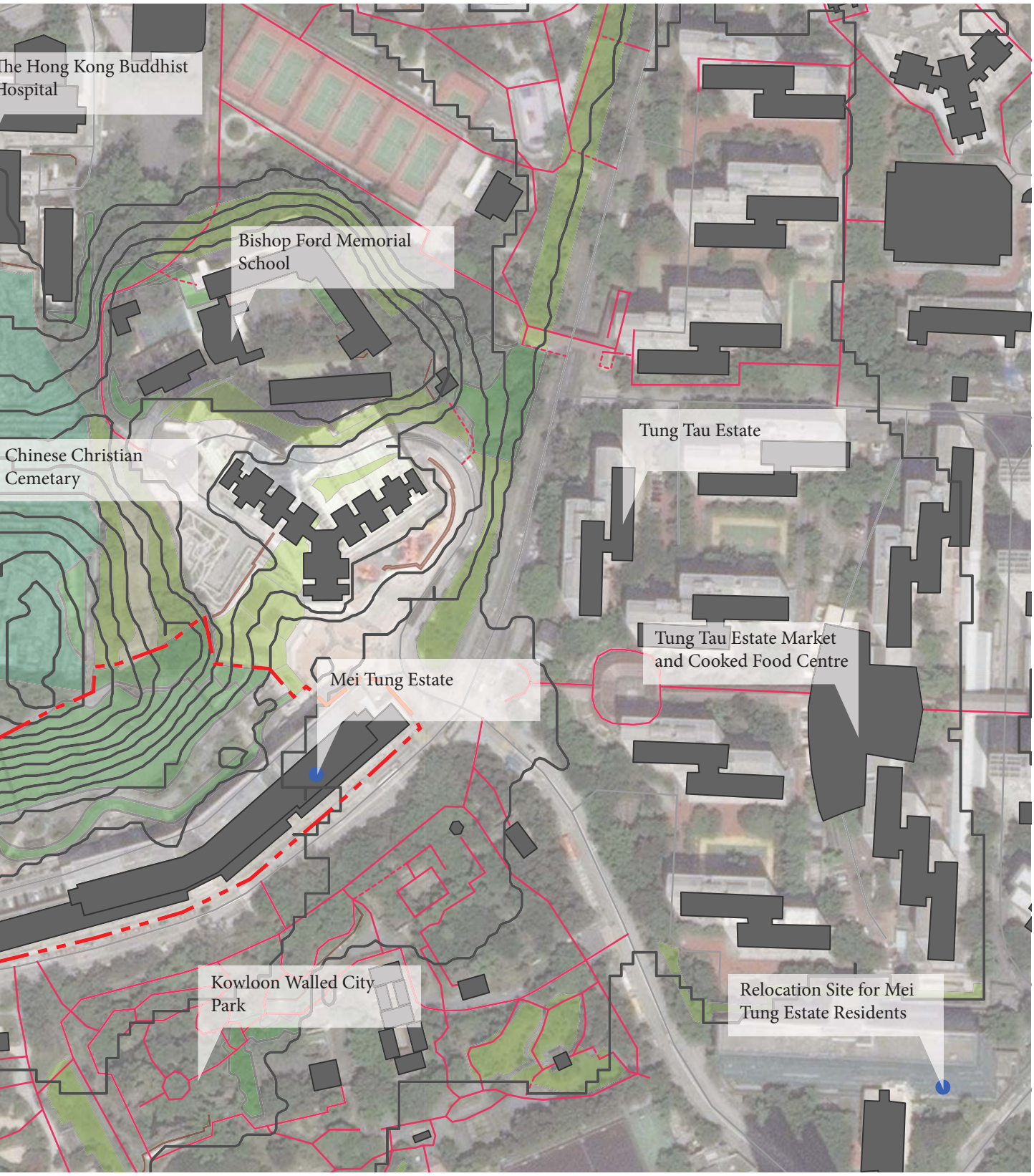


Figure 5.8 Mei Tung Estate Site Plan

is surrounded by several other parks that serve the greater community. Further to the South is Kai Tak, a major redevelopment area since the Hong Kong International Airport replaced the outdated Kai Tak Airport in 1998. Directly adjacent the site is a small historic temple, and further to the West are a collection of schools along the major Junction Road. To the East is another public housing development, Tung Tau Estate, comprised of 20 housing blocks. Prior to this, Tung Tau Estate was comprised of 23 Mark Series resettlement blocks which were redeveloped during the 1980s and 1990s into their current state. The site is served by several bus routes as well as an MTR station approximately 1km to the North (Fig. 5.7). Directly North of the site is the Chinese Christian Cemetery (Fig. 5.8).

A distinctive feature of the site is the large concrete faced slope on the Northern end (Fig. 5.9). This slope is part of a naturally occurring granite hill. The Chinese Christian Cemetery also shares this hill to create its terraces for its gravestones (Fig. 5.10). The granite hill was cut back to create a platform for the establishment of the Mei Tung Estate in the early 1970s. The resulting slope is a man-made, cut slope under the identification number "11NE-A/C 95". The base of this slope hosts a small seating area raised above the vehicular way below and connects with the Mei Tung House through two small pedestrian bridges (Fig. 5.11).

The Mei Tung House is an 11-storey mixed use block based on the old slab typology. The first three storeys form a podium. The ground floor contains various shops and a kindergarten while the two storeys above are residential units. An 8-storey linear block comprised of residential units rises from the podium (Fig. 5.12).The podium rooftop acts as a seating area and is accessible from the third floor. The Mei Po House is a smaller 8 storey residential building separate from the Mei Tung House. The area around the buildings is used as a parking lot for residents and other small buses and trucks (Fig. 5.13). The much larger Mei Yan House, 41 storeys, and Mei Tak House, 33 storeys with a podium, were added into the Mei Tung Estate as modern additions to the old housing estate.

FUTURE OF THE ESTATE

Following the development of the newer houses, the city announced in 2017 that it will redevelop Mei Tung House and Mei Po House. The pressure for more public housing and a site which by today's standards is quite low in density means the Mei Tung House and Mei Po House will be demolished to increase the density. These two buildings currently accommodate 665 Public Rental Housing (PRH) units which will be increased to approximately 1,900 PRH units. Even though there are not any problems with the estate to

Figure 5.9 The Mei Tung Estate Slope

Figure 5.10 Gravestone terraces in the Chinese Christian Cemetary

Figure 5.11 Features of the Mei Tung Estate

Figure 5.12 Mei Tung House Front (South Facade)

Figure 5.13 Mei Tung Estate Parking

warrant redevelopment, it is simply a suitable site to increase the density.[5]

Residents are free to move to available refurbished flats in other neighbourhoods, move into the new On Tai Estate approximately 3km away, or be rehoused into the nearby Tung Tau Estate Phase 8 which is anticipated for intake in mid-2020. Residents will be compensated with a small moving allowance. One or two person households can opt out of rehousing, but instead receive a calculated allowance towards a year's rent in a comparable private flat. A community service team is also stationed on site to support the affected tenants, especially elderly households, through the clearance. Commercial tenants are offered an ex-gratia allowance or the opportunity to participate in a restricted tender for other public housing commercial premises with a three-month rent-free period on successful bids.[6]

The site is anticipated to be cleared by November 2020, and redevelopment would occur. The plans for this development are currently unknown, but we can use the 1,900 PRH units as an estimate to the size of these new buildings. The two newer towers in the Mei Tung Estate range from 33 to 41 storeys and a typical public housing floor plan could house around 16 units. Using these figures as a benchmark for our estimate, we can anticipate three towers approximately 40 storeys tall. The average domestic household size in Hong Kong is 2.8 people,[7] giving us an approximate population in the new development as 5,320 people. The standard provision for open space in Hong Kong is 2 square metres per person[8] which equates to approximately 10,640 square metres of open space. Since the current Mei Tung Estate offers commercial space and amenities on its ground floor, we can also assume a mixed-use podium will be created to keep the street condition.

With this new development, the large man-made slope which occupies close to half of this site (Fig. 5.14) would need to be addressed. The slope was created in the 1970s along with the Mei Tung Estate. It underwent an upgrade in the 1980s with the removal of several boulders and a marginal flattening from 60˚ to 50˚. The slope is a granite slope 46m high with a length of 190m along its base (Fig. 5.15). Three berms divide the slope and set the strata for the drainage channels. The berms act as walkways for slope maintenance as well as fragmenting the potential slip planes of the slope. Maintenance stairs

5 Hong Kong Housing Authority, *Proposed Rehousing and Associated Arrangements for the Clearance of Mei Tung House and Mei Po House at Mei Tung Estate Paper no. CPC 20/2017 - SHC 42/2017* (Hong Kong: HKSAR Government,[2017b]).

6 Ibid.

7 Census and Statistics Department, *2016 Population by-Census Key Statistics*

8 Planning Department, "Chapter 4: Recreation, Open Space and Greening," in *Hong Kong Planning Standards and Guidelines* (Hong Kong: HKSAR Government, 2015), 9.

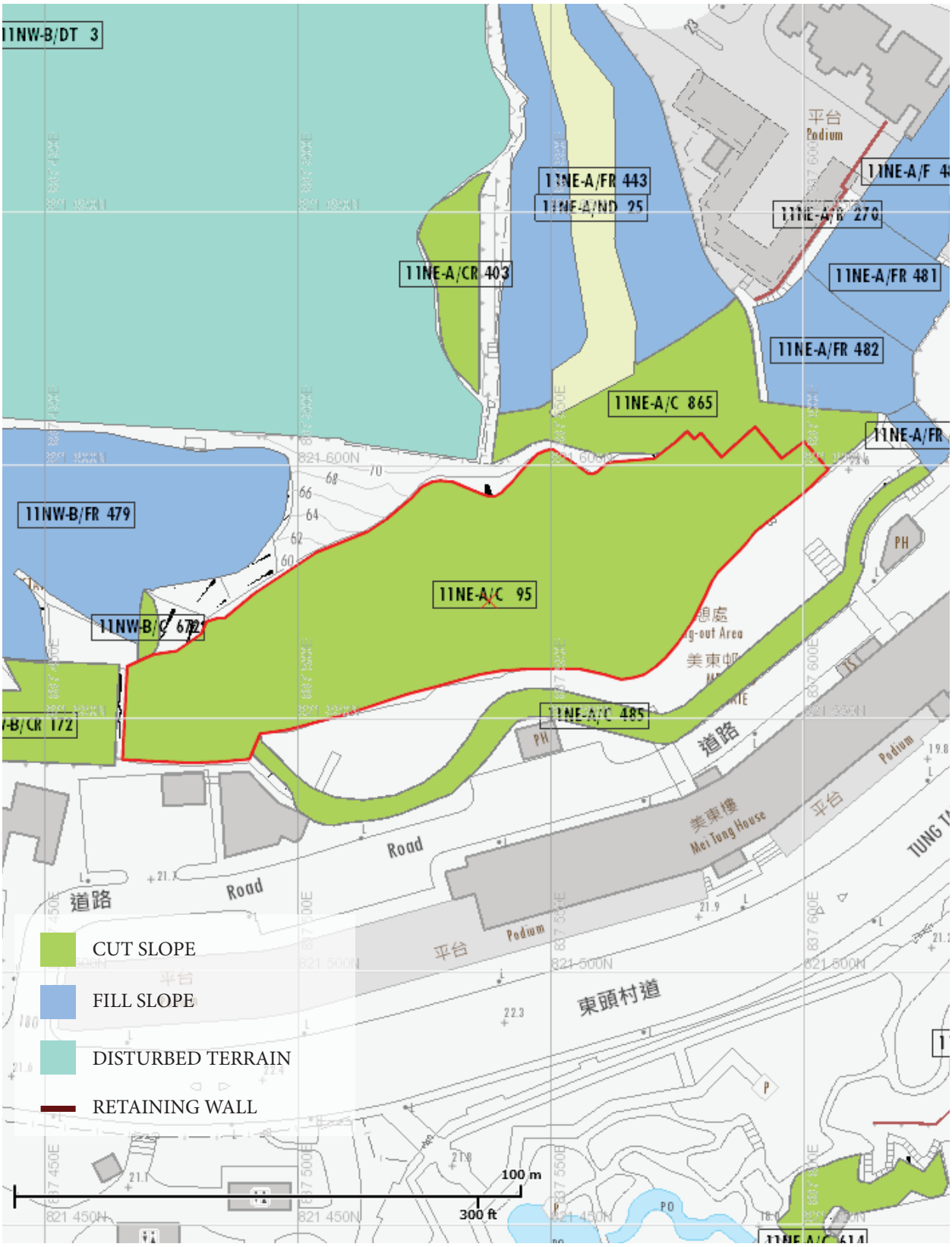


Figure 5.14 Site Plan of 11NE-A/C 95

BASIC INFORMATION

Location: MEI TUNG ESTATE, KOWLOON CITY

SIFT Ref.: 11NE-11A/S 2
First Registration Date:
SIFT Class: C1
Data Source: Project Office
Approximate Coordinates: Easting: 837537 Northing: 821579

CONSEQUENCE-TO-LIFE CATEGORY

Facility at Crest: Cemetery

Distance of Facility from Crest (m): 5
Facility at Toe: Residential

Distance of Facility from Toe (m): 25
Consequence-to-life Category: 1
Remarks: N/A

SLOPE PART

(1) Max. Height (m): 46 Length (m): 190 Average Angle (deg): 50

WALL PART

N/A

MAINTENANCE RESPONSIBILITY

(1) Government Feature Maintenance Party: HD MR Endorsement Date: 04-Apr-2005

DETAILS OF SLOPE / RETAINING WALL

Date of Inspection: 08-Jan-2014
Data Source: Project Office
Slope Part Drainage:
(1) Position: Crest Size(mm): 300
(2) Position: Berm Size(mm): 300
(3) Position: Toe Size(mm): 375
(4) Position: On slope Size(mm): 300

Wall Part Drainage: N/A

SLOPE PART

Slope Part (1)
Surface Protection (%): Bare: 0 Vegetated: 0 Chunam: 0 Shotcrete: 100 Other Cover: 0
Material Description: Material type: Soil Geology: N/A
Berm: No. of Berms: 3 Min. Berm Width (m): 1
Weepholes: Size (mm): 40 Spacing (m): 1.70

Figure 5.15 Slope data for 11NE-A/C 95

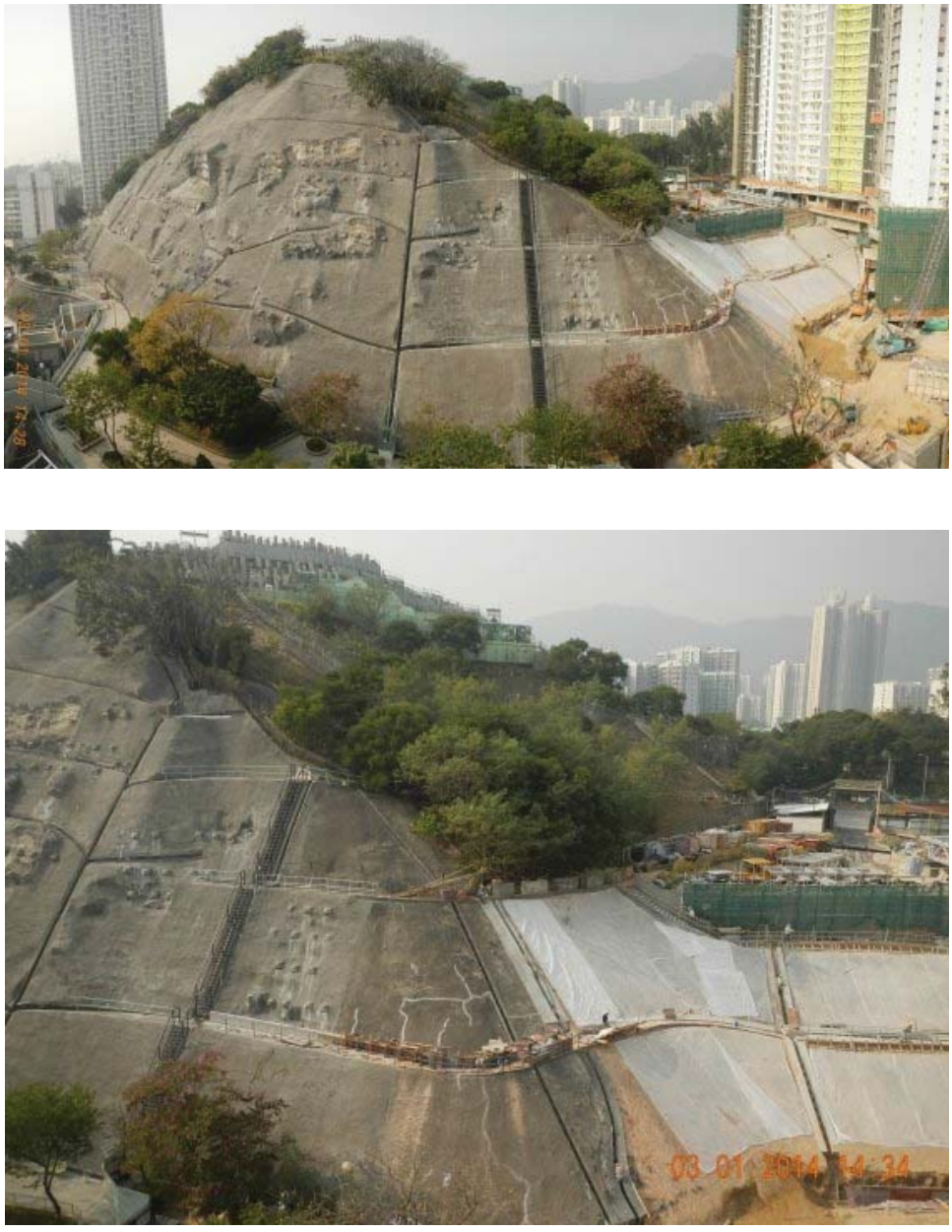


Figure 5.16 Aerial images of slope 11NE-A/C with slope upgrades due to Mei Tak House (right), 2014

and railings improve access and safety during maintenance. Several large boulders still remain in the slope which are stabilized with rock anchors (Fig. 5.16). The rest of the slope is made up of decomposed white and reddish granite. The surface is covered with a layer of shotcrete to prevent rainwater infiltration. With the intensification of the Mei Tung Estate, new strategies for slope stabilization infrastructure are required for improved safety and resilience.

THE ECONOMICS TO BUILD

Like the investigations into cavern development, we know the slopes pose greater limitations and are often unsuitable for conventional development without intense capital investment.[9] With land in Hong Kong at a premium, rather than investing this capital to upgrade the slope infrastructure to simply hold the hillside back, we can make it do more than it currently does by embedding the capacity for housing. These sites can become extremely expensive housing locations, or we can devise a housing strategy that can use these urban pockets of land without requiring much more capital investment beyond that put towards slope engineering, and as such use this infrastructure as a base to support low-income housing.

Hong Kong spends over $1 billion HKD[10] annually on landslip prevention and mitigation. This includes upgrading government man-made slopes, conducting safety studies on privately owned slopes, and implementing mitigation works on natural hillsides.[11] Landslip mitigation works cost on average $2 million HKD for each slope,[12] along with maintenance costs of upwards of $100,000 every 1-5 years.[13]

Compared to the annual expenditure of $17.5 billion HKD[14] on public housing,[15] the $2 million HKD cost for each slope improvement is minimal.

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9 Geotechnical Control Office Civil Engineering Services Department, *Geotechnical Area Studies Programme - Hong Kong and Kowloon* (Hong Kong: Government of Hong Kong,[1987]).

10 $1 HKD = $0.17 CAD, $1 Billion HKD = $170 Million CAD

11 "Report no. 1/2018 on Landslip Prevention and Mitigation Studies and Works Carried Out by the Geotechnical Engineering Office," last modified April, accessed August 30, 2018, https://www.cedd.gov.hk/eng/projects/landslip/land_quar.html.

12 Audit Commission, *Chapter 10 the Government of the Hong Kong Special Administrative Region Capital Works Reserve Fund Government Secretariat - Slope Safety and Landslip Preventive Measures* (Hong Kong: HKSAR Government,[2002]).

13 Lai-Ling Iu, "Slope Maintenance and Repair Works in Hong Kong" The University of Hong Kong, 2005), 119-120.

14 Approximately $2.975 Billion CAD

15 Hong Kong Housing Authority, *Annual Report 2016-2017* (Hong Kong: HKSAR

We would not want to be making this slope infrastructure more capital intensive than existing public housing. Based on an average of approximately $1 million HKD[16] to construct one Public Rental Housing unit in Hong Kong,[17] we can consider an upper threshold equivalent to $100 million HKD[18] to upgrade the Mei Tung slope to support 100 'units' of affordable housing. With the intent that these 'units' are not fully developed PRH units, but simple structures with basic amenities where inhabitants can begin to fit-out and eventually expand, we can ensure our infrastructure can provide the same amount of accommodations within our $100 million limit. By making this a productive piece of infrastructure that can also generate income through rent, it will also be able to cover the ongoing inspection and maintenance costs of the slope to ensure it remains safe.

Figure 5.17 breaks down the work required for the Mei Tung slope. This includes the work required for the upgrade and stabilization of the slope, such as excavation and landforming, new soil nails and anchors, and new surface treatments (in orange). Elements such as drainage channels, catchpits, weep holes, and landscaping are also part of the proper function and maintenance of the man-made slope (in green). The cost breakdown takes into consideration that there will be a premium attached to making these elements appropriate for supporting a housing component. Embedding the capacity for housing will be using the work and capital that would already be provided for stabilizing the slope to supplement the housing construction. As such, there would be little foundation work involved as this is already hybridized into the slope infrastructure. Floors and walls, formwork, mechanical and electrical services, windows, doors, and guardrails are architectural elements that would need to be added for the housing construction cost (in blue). The greatest cost, aside from the housing component, is the general construction set-up, scaffolding, and miscellaneous fees, which would be required regardless of the housing (in white). By doing this, a large portion of the additional costs of building on a complicated site is already taken care of and housing construction only accounts for 41% of the total construction cost.

The estimate of $88 million HKD[19] for 100 'units' of housing is well within the construction cost range of $1 million HKD per unit of public housing,

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Government,[2017a]).

16 Approximately $170,000 CAD

17 "LCQ2: Construction Costs of Subsidised Housing Flats," last modified April 12, accessed August 30, 2018, http://www.info.gov.hk/gia/general/201704/12/P2017041200464.htm.

18 Approximately $17 Million CAD

19 Approximately $15 Million CAD

Description	Quantity	Unit	Rate	Amount $HK	
Excavation & Fill	5000	m^3	200	$ 1,000,000.00	12.91% Work required for the upgrade and stabilization of the Mei Tung Slope
Extra for excavation in rock	50	m^3	2000	$ 100,000.00	
Stripping sprayed concrete surfacing	5000	m^2	50	$ 250,000.00	
Slope stabilization including soil nailing and anchors	2000	no.	5000	$ 10,000,000.00	
Subtotal				**$ 11,350,000.00**	
Drainage channels including excavation, materials, formwork, finishes, and joints	1200	m	1000	$ 1,200,000.00	1.82% Work required for the proper function and maintenance of the slope
Catchpits including excavation, materials, formwork, mesh reinforcement, finishes, and connections to channels	12	no.	14500	$ 174,000.00	
Weepholes through walls	1600	no.	50	$ 80,000.00	
Landscaping and Hydroseeding	1200	m^2	120	$ 144,000.00	
Subtotal				**$ 1,598,000.00**	
Concrete structure including floors, walls, & high tensile reinforcement	2600	m^3	3625	$ 9,425,000.00	40.83% Work required to embed the capacity for housing
Sawn formwork for concrete structure	10000	m^2	410	$ 4,100,000.00	
Services, including mechanical, electrical, fire, lift/escalators, and hydraulics	5600	m^2	3250	$ 18,200,000.00	
Windows and Doors	740	m^2	3800	$ 2,812,000.00	
Handrails and Guardrails	1140	m	1200	$ 1,368,000.00	
Subtotal				**$ 35,905,000.00**	
Add 60% for general, preliminary, dayworks and scaffolding				$ 29,311,800.00	33.33%
Add 20% allowance for contingencies				$ 9,770,600.00	11.11%
Total				**$ 87,935,400.00**	

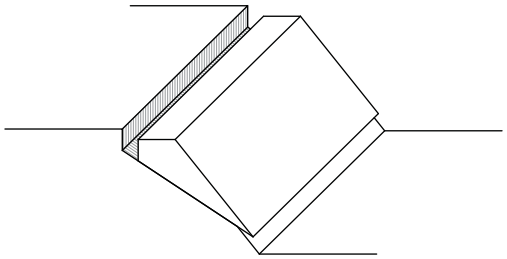
Figure 5.17 Cost breakdown of works on the Mei Tung Slope

particularly if it is possible to provide these accommodations within the city centre. The construction is suitable because it coincides with the work required in the upgrade of an outdated slope. The city is continuously upgrading its slopes to address environmental concerns and maintain modern safety standards. To maximize resource efficiency, it would make practical sense to take advantage of these upgrades and use them as opportunities to add value to these large pieces of infrastructure in the city. We do not need to be pre-occupied with the conventional high-rise development, otherwise we cannot realize the potential of these pieces of highly engineered urban infrastructure.

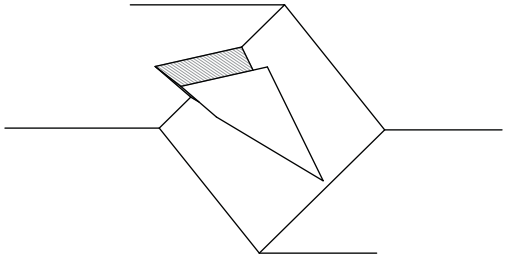
SETTING THE FRAMEWORK

The process of upgrading and integrating engineering, architectural, and landscaping practices onto slopes requires a careful balance of various measures. This includes understanding the existing characteristics of the slope, the possible types of failures, and what strategies can be implemented (Fig. 5.18). These strategies will also influence which elements can be hybridized to perform more than one function. The Mei Tung slope is a steep slope with the Chinese Christian Cemetery at the crest and the Mei Tung Housing Estate at the toe. These sites prevent the possibility of further reducing the steepness of the slope, which means the upgrading must work with the existing angle and geometry of the slope. Large existing boulders and their rock bolts will be kept in place to prevent any major excavation which would require extensive temporary support of the slope. Stabilization methods would involve benching, setting up retaining walls, implementing anchors, or any combination of these elements (Fig. 5.19). Constructability is also a factor in slope works. The housing estate will be demolished, leaving plenty of space for movement of materials to the slope. Working on the slope requires scaffolding that has limited space for workers and machinery. Large vehicles and machinery would not be able to work on the slope due to limited access.

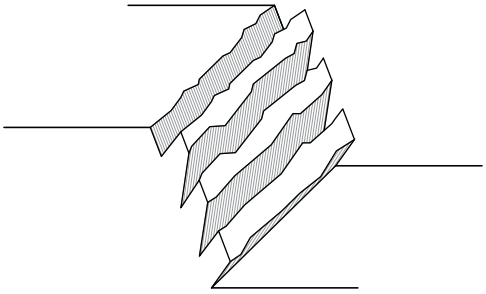
The surface covering will be replaced with a vegetative cover which provides a more resilient surface to damage and deterioration. The slope is south facing and exposed to plenty of sunlight for plant growth. It is also not shrouded by other overhanging trees or vegetation which would affect the landscaping. However, the new Mei Tung Estate buildings will potentially cast shadows over the slope. The Mei Tung slope is adjacent to a new vegetated slope that can be connected with the new landscaping. The steepness of the slope also constrains the types of plants that can be grown. At an average of 50˚, grasses, ferns, and climbers can be grown through a non-biodegradable erosion control mat. Small shrubs can be planted in areas where the slope is



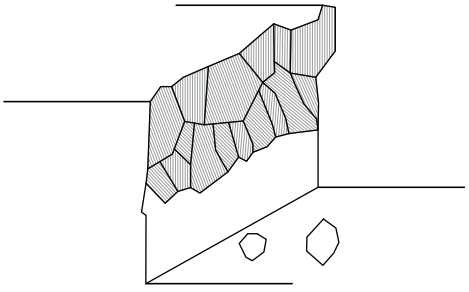
Plane Failure



Wedge Failure



Toppling Failure



Rock or Debris Fall

Figure 5.18 Types of Slope Failure

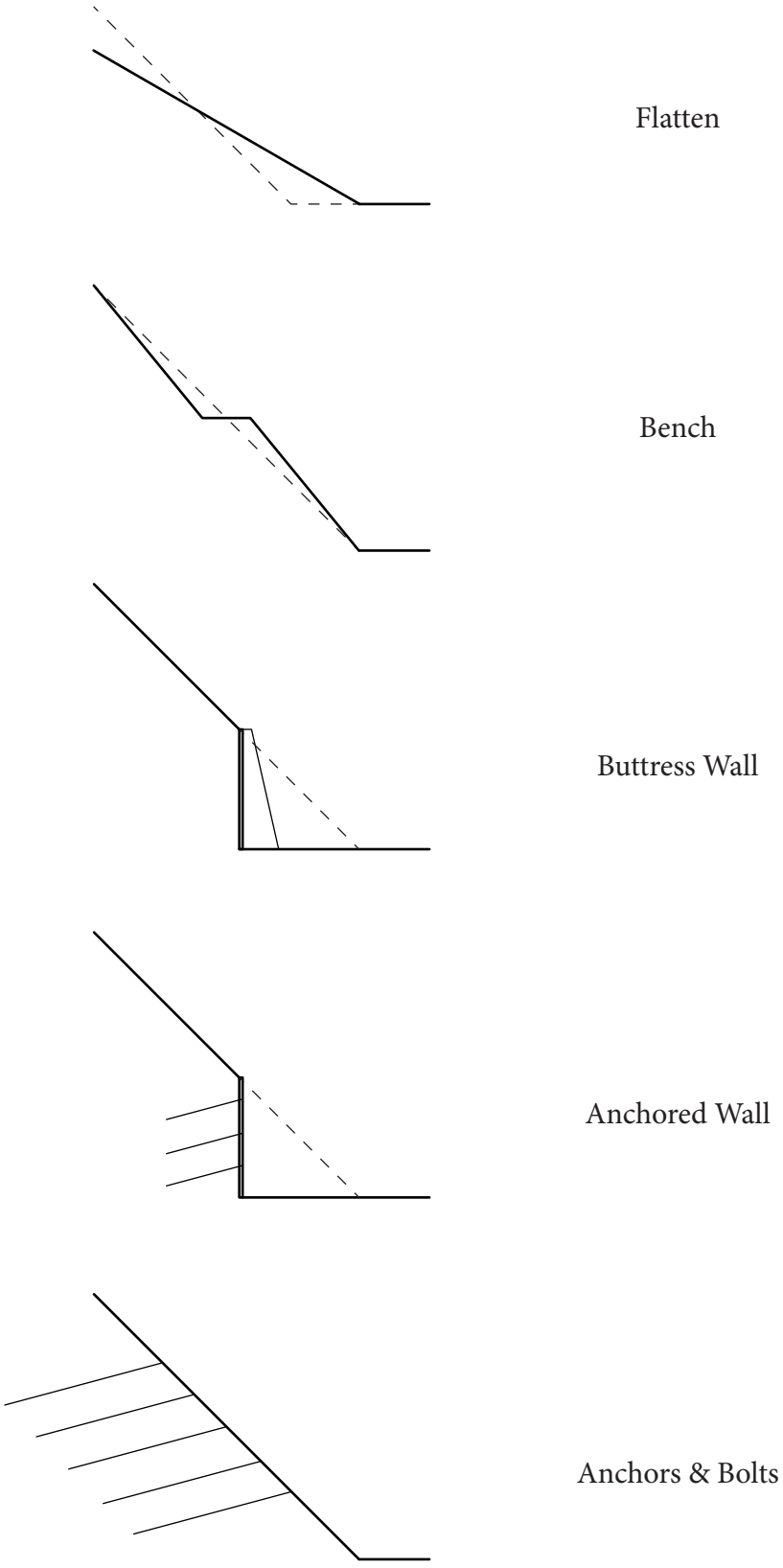


Figure 5.19 Slope stabilization strategies

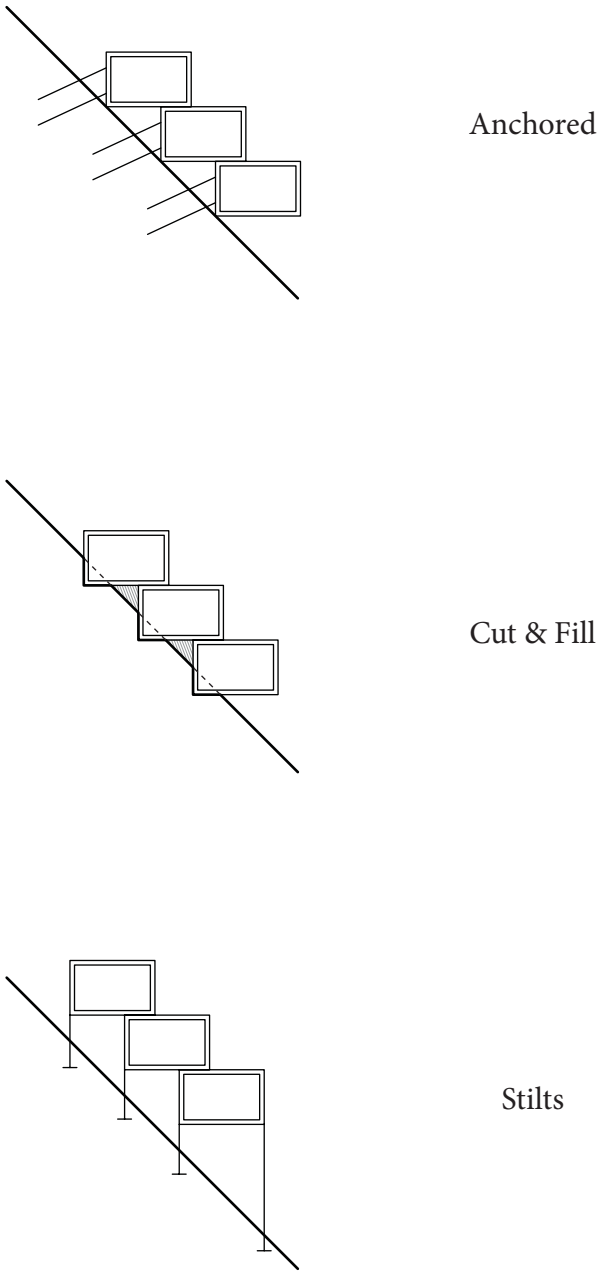


Figure 5.20 Foundational relationship to slope

gentler.

Residential occupation on a slope will require access in the form of stairs and walkways. Escalators or elevators can improve access for elders and small children, and provide a mode of transportation for heavier goods or construction material. There will need to be levelled areas where living can occur, which can be offered through anchoring platforms to the slope, terracing through excavation and fill, or stilted platforms (Fig. 5.20). Access to natural light and ventilation is limited to the sections of the structure that are not backed onto the slope. Living spaces will also require connections to water and electrical services. These services cannot be buried underground since this would affect the integrity of the slope if they were to fail, such as a burst pipe, or disturb the soil for maintenance or repair.

By setting up the limitations of the site, we can determine which elements can be used to perform both stabilization and architectural functions. Retaining and buttress walls that act as slope stabilization elements can also act as architectural walls for living spaces. Berms created through benching the slope work as both maintenance walkways and resident circulation pathways, and stairs can do the same. Excavation and fill prevent large scale removal of material offsite, and better utilize the existing slope material as a foundational element for residential living spaces. Drainage channels can redirect potential water runoff from residential occupation while also channeling rainwater during typhoons. Vegetative slope covers also provide an amenity to living spaces. Through this process of hybridization, we can add value to elements that would already be required in a slope stabilization project.

LAYING THE INFRASTRUCTURE

The design of the Mei Tung slope infrastructure follows the existing face of the slope to minimize the costs associated with landforming. The intent is to use slope stabilization as the primary foundation. The design is a balance between enough density while not overproviding to the point where the slope infrastructure cannot act as a foundational element. It is based on the fact that a housing development can be embedded into this slope work rather than designing a purposely built structural foundation for housing. The design takes shape with this in mind.

A series of anchored retaining walls provide the backdrop to this infrastructure. The terraced formation creates the levelled areas we need for occupation, and by articulating the depth of these spaces into smaller and larger areas creates our circulation and living spaces respectively.

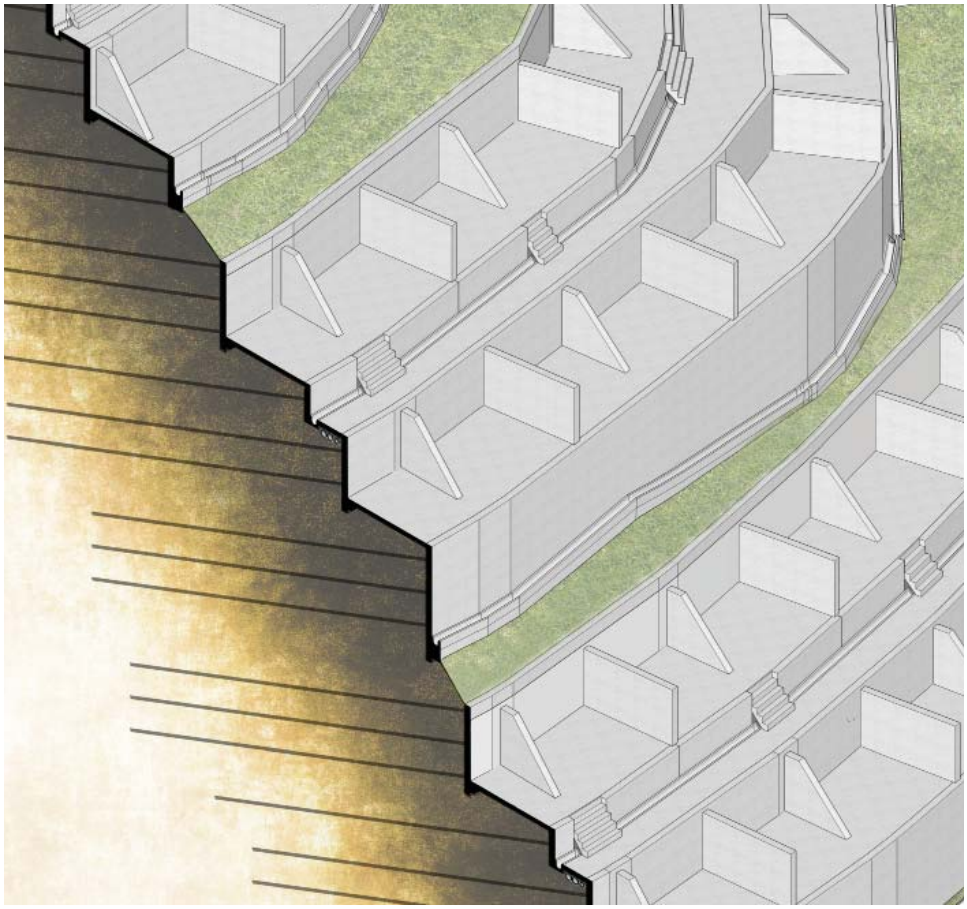


Figure 5.21 Slope works and infrastructure

The Mei Tung slope is upgraded as part of the Mei Tung Estate redevelopment. The slope stabilization infrastructure is designed to include the capacity for inhabitation.

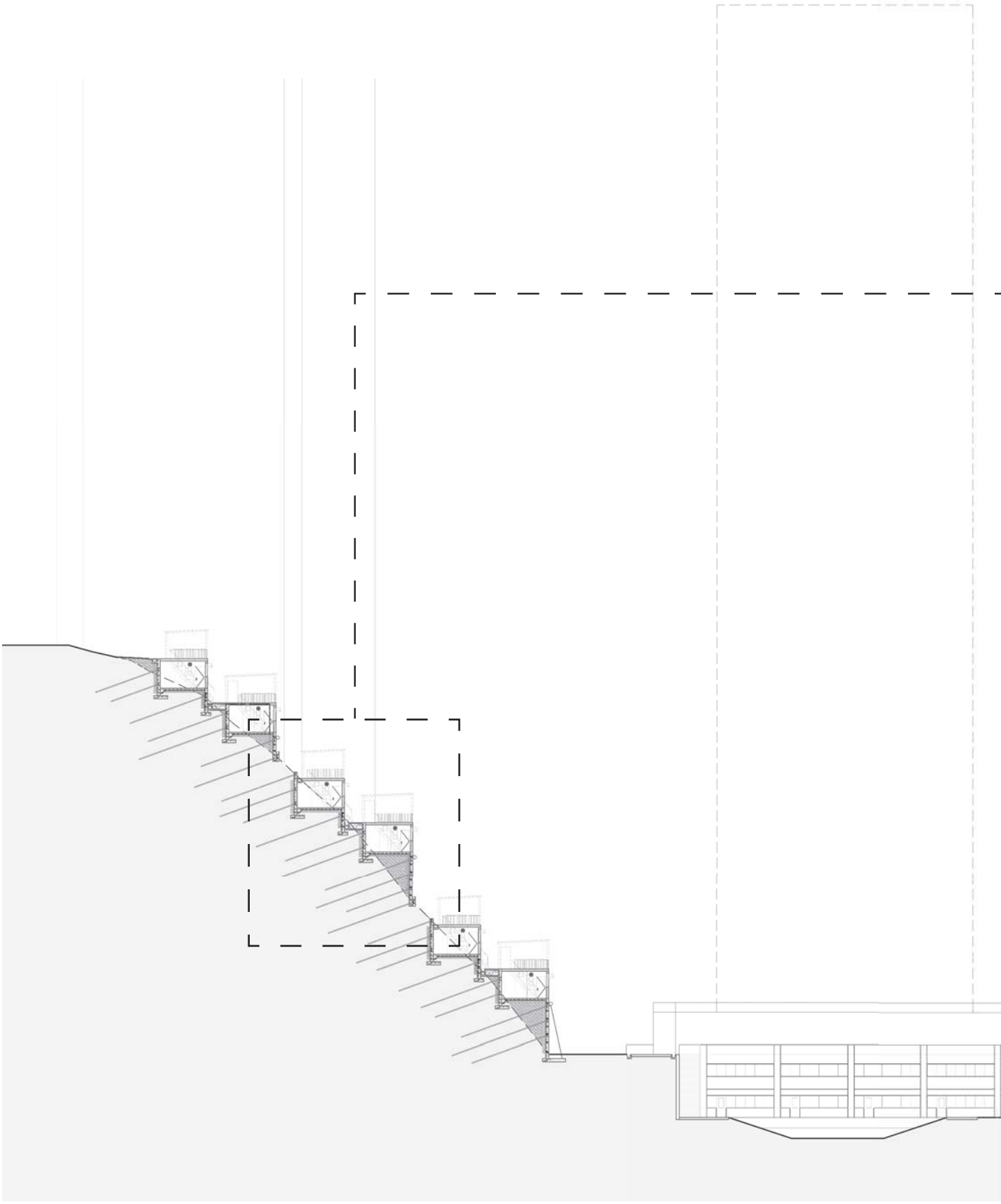


Figure 5.22 Site Section
The components of the slope stabilization infrastructure and housing structure work together to not only manage the forces which influence the stability of the slope, but also invigorate it as a space for occupation.

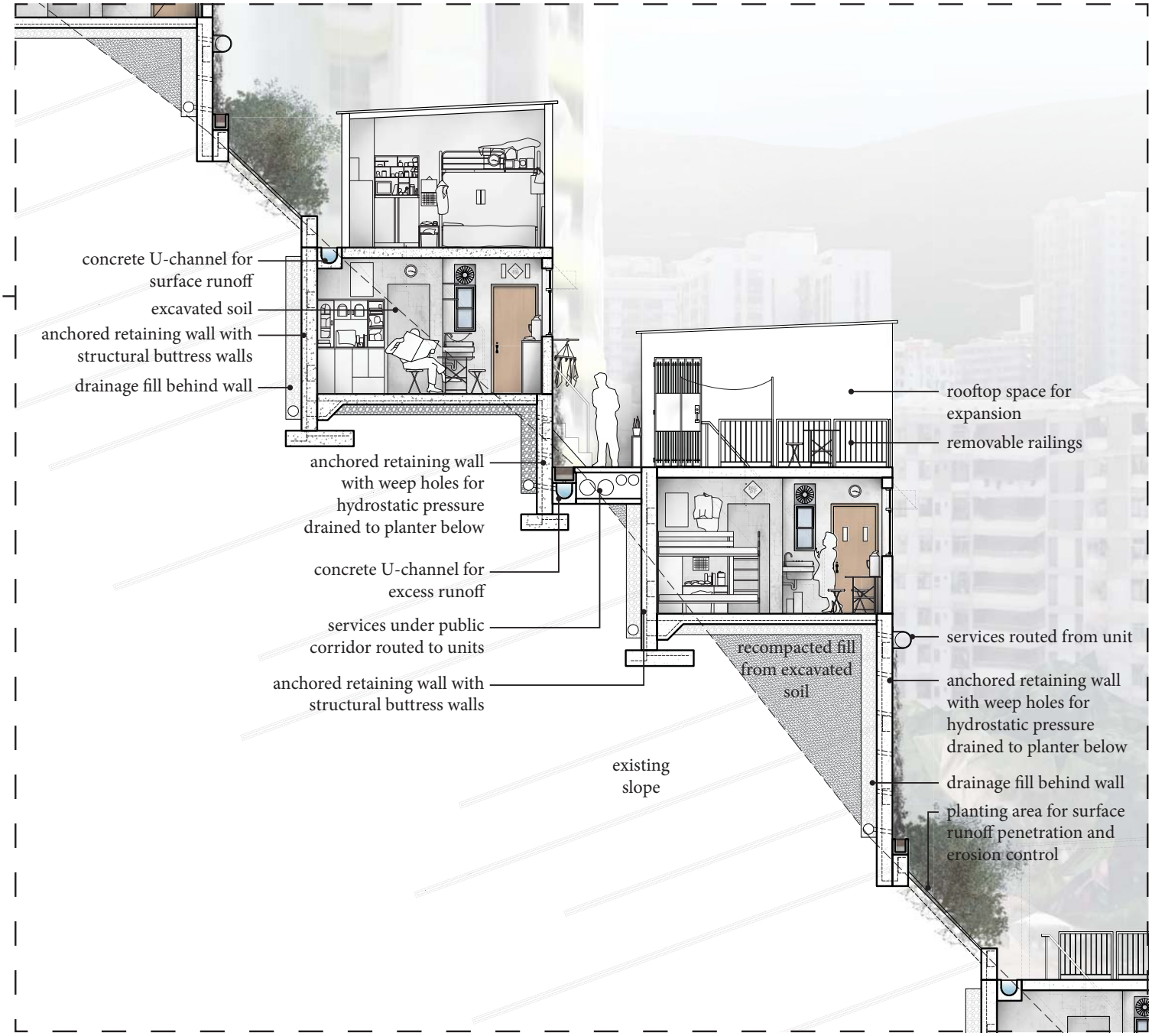
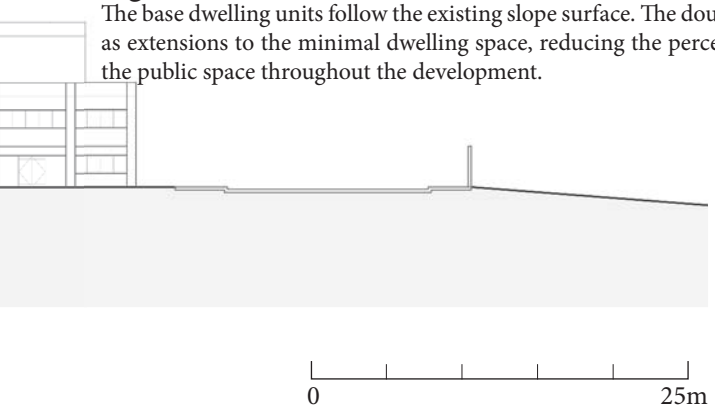


Figure 5.23 Unit Section

The base dwelling units follow the existing slope surface. The double loaded corridor and exterior stairs act as extensions to the minimal dwelling space, reducing the perception of overcrowding and interweaving the public space throughout the development.



The elevation differences between circulation space and unit space, while dictated by the geometry of the slope, is designed to clearly delineate the common and private areas. Buttress walls improve the stability of the wall structure while providing a set of demising walls between residential units (Fig. 5.21). The buttress walls are spaced 5m apart for a typical unit width, but the location of these walls can be influenced by the site conditions and geometry of the slope. The entire slope development is separated into three sections. This sectioning is part of the construction process. Beginning at the toe, the first section will be erected to strengthen and stabilize the slope and provide a base for the scaffolding for the next section above (Fig. 5.22). With the introduction of many impenetrable concrete surfaces there will be surface runoff. Between each section is a band of vegetative cover that will also absorb runoff. However, these vegetative areas cannot act as the only runoff measures as that would introduce too much infiltration into the slope. Three drainage channels in each section, one each at the top, middle, and bottom, catch excess runoff (Fig. 5.23).

With the primary slope stabilization structure in place, architectural elements further define the spaces for inhabitation. Since the development is backed onto a slope, there is a greater need for access to light and ventilation. The shared stair between every other unit is a semi-public space and acts as a transition between the main corridor and the entrances to each unit. The walls facing into this stair space are also outfitted with windows to provide light deeper into the units and to promote cross ventilation from the south facing windows. To maximize the potential of each element, roofs not only shelter the unit below, but create an open space adjacent the public corridor. Underneath the public corridor is a crawl space for the main service trunks. This way the services are accessible for maintenance and repair without disturbing the soil of the slope. Each unit is outfitted with a service core for a toilet, shower, lavatory, and kitchenette. The rest of the interior is $15m^2$ which serves as a multifunctional space for living, dining, and sleeping (Fig. 5.24).

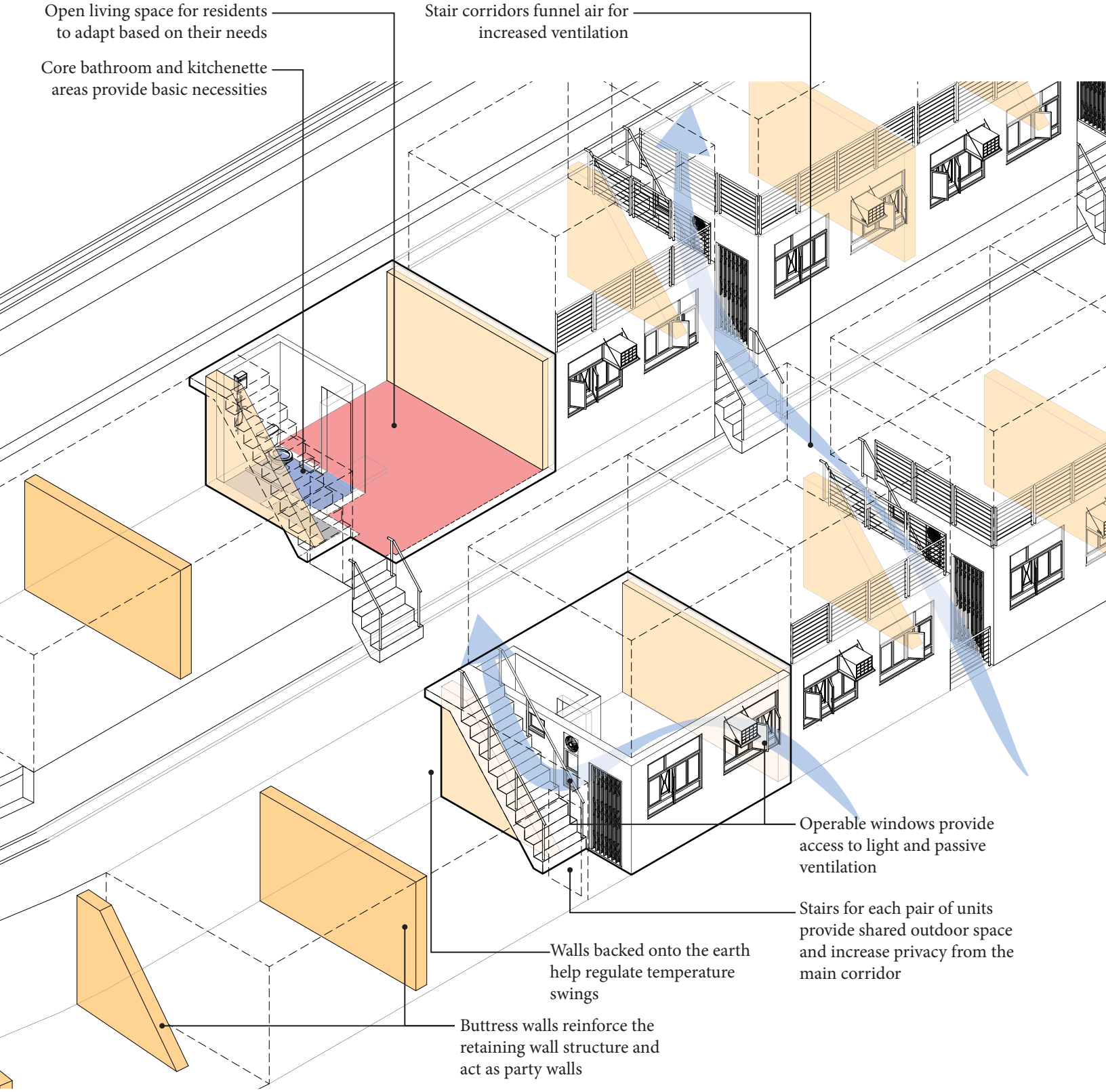


Figure 5.24 Core spaces within the slope structure

Buttress walls of the slope structure act as party walls between units. Each unit is outfitted with a core bathroom and kitchennette space, while the rest of the space is open for resident customization.

Comparatively, these units are not much larger than the subdivided units we investigated in Chapter 2. However, there is much more common area used to relieve the feelings of overcrowdedness. The stairs, exterior corridor, and rooftop space all add to the additional space residents would have access to and use on a regular basis. The rooftops are integral to the design of these spaces. The culture and industry of informally built structures are a part of the growth of this project (Fig. 5.25). Rather than eliminate these forces, the design works with and acknowledges the fact that these structures will occur. While the concrete structure sets an initial space, the rooftop area acts as a space for expansion or contraction. In the sense of an Open Building project, the initial structure is a support on which the infill of inhabitant

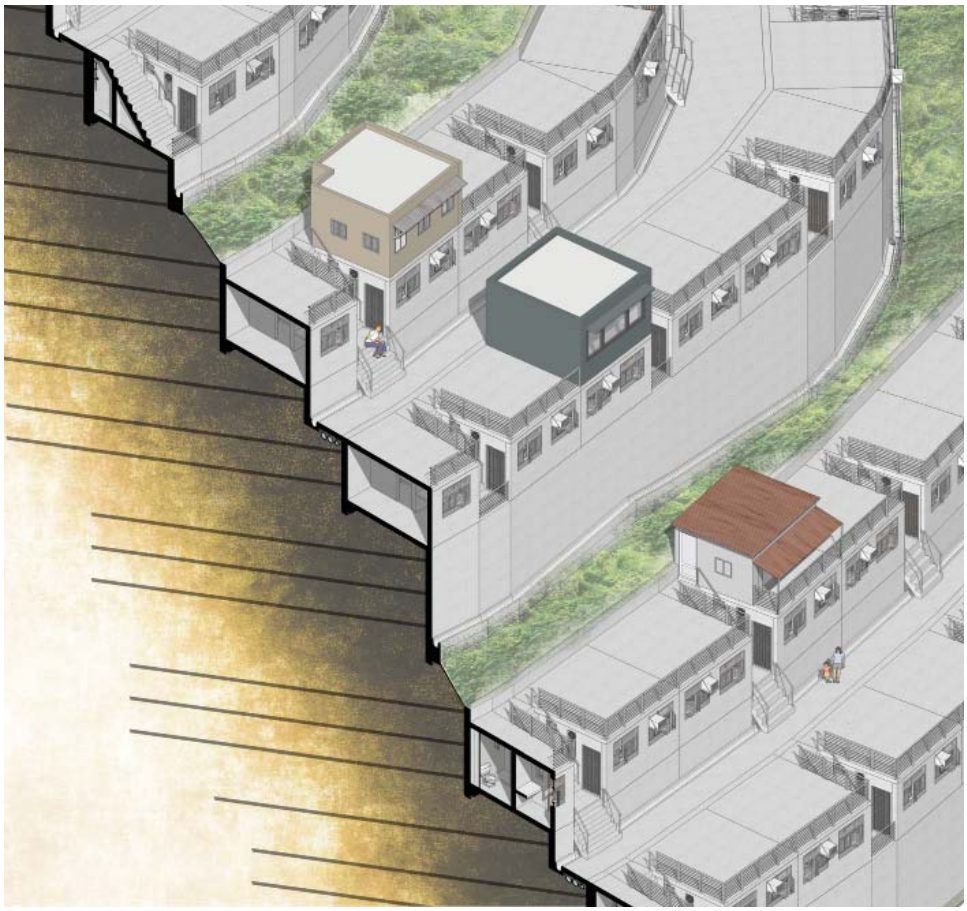


Figure 5.25 Architectural framework before occupation
The slope structure provides a basic foundation for initial inhabitation, and acts as a support framework for transformative infill housing.

driven building occurs.[20] These spaces can be fully built for additional bedrooms or more living space, they can be left as open space for laundry or vegetable growing, or a combination of the two based on the needs of the family (Fig. 5.26) The public corridor and shared stairs act as boundaries to the formation of these rooftop units. Since residents have a stake in their living space, especially in the common areas, there is a greater chance for collective housing management and maintenance to ensure the safety of this housing project.

20 Stephen Kendall and Jonathan Teicher, *Residential Open Building* (London: Spon, 2000).

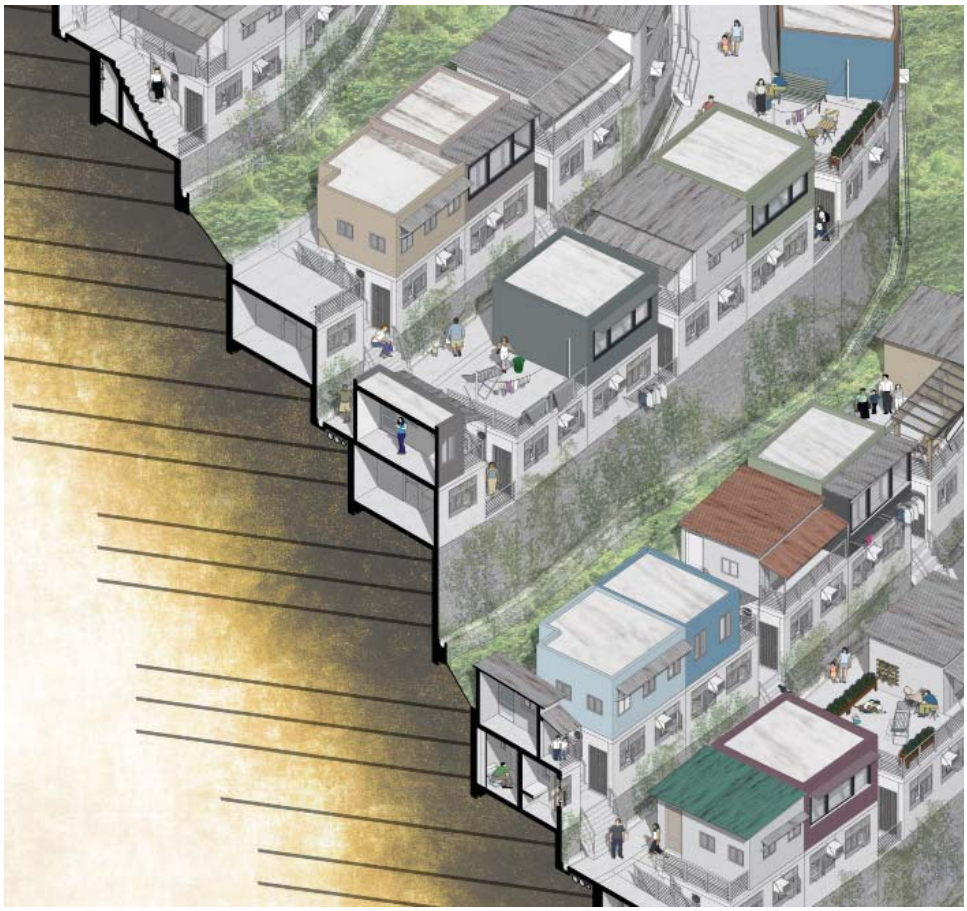


Figure 5.26 Incremental building during occupation

The slope infrastructure takes advantage of the existing informal building sector in Hong Kong, acknowledging the tendency for residents to expand and adapt their dwellings to suit their needs in a hyper dense environment.

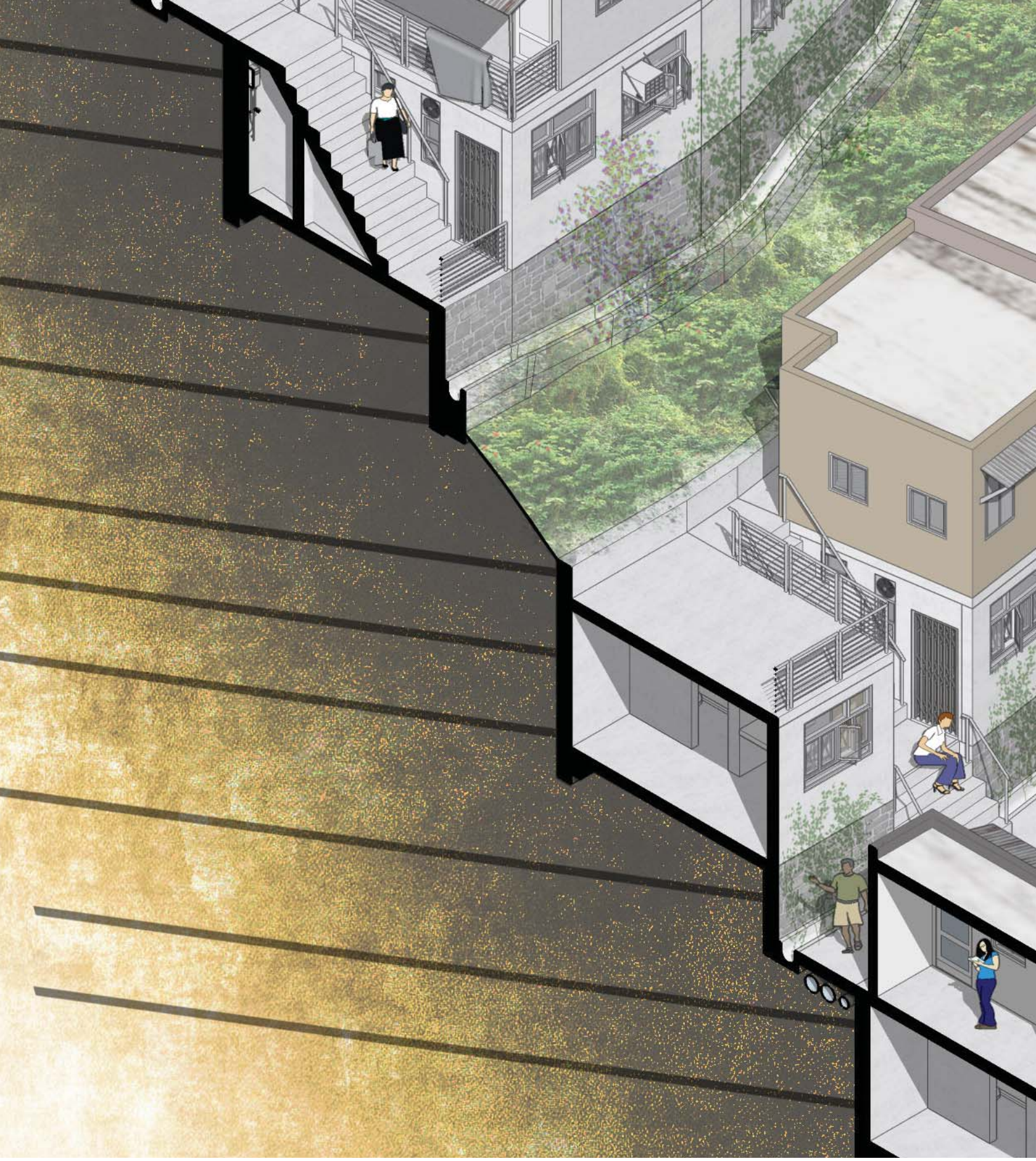


Fig. 5.26 Incremental building during occupation (enlarged view)

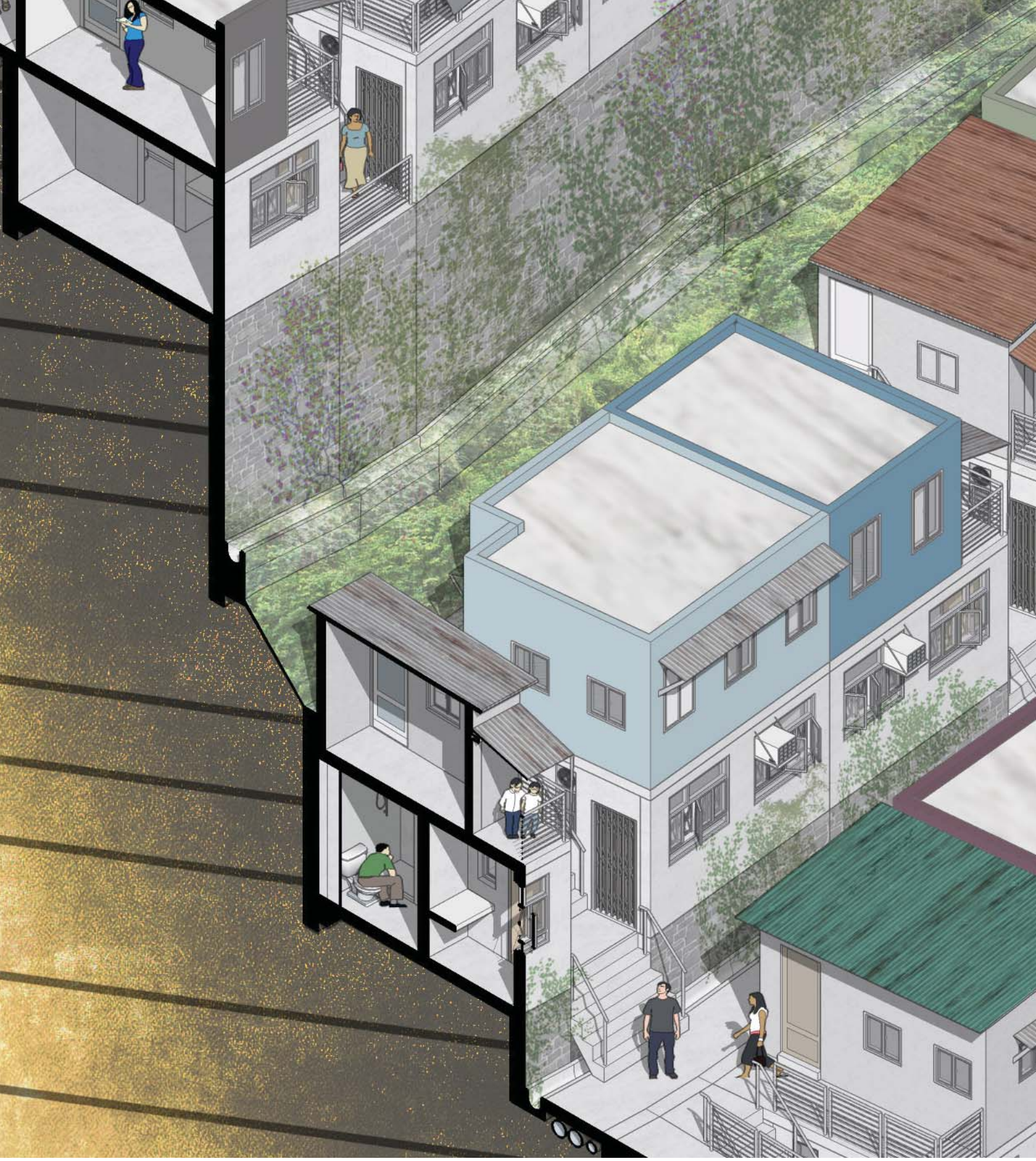


Fig. 5.26 Incremental building during occupation (enlarged view)

EXTENDING THE NETWORK

This slope development is not meant as a standalone object. Feeding from the existing pedestrian network, the slope no longer becomes the backyard of the site, but is a prominent feature that absorbs and concentrates pedestrian movement and activity. Its success is also based on its connection with the development of the Mei Tung Estate. Some programs and functions are simply not possible on the slope, so they need to be supplemented during the redevelopment of the estate. The commercial podium and streetscape created by the housing estate will provide local services and job opportunities to the residents of the Mei Tung slope. The people brought into the estate by these opportunities will foster connections with the broader Hong Kong community to improve the social integration of residents with the rest of society. A community centre and school help form the neighbourly interactions that are needed for the successful management of this housing project. A water pond retains excess runoff before being released into the city's stormwater network to relieve the load on the system, as well as creating a central park space for all members of the community to congregate (Fig. 5.27).

As easily developable land becomes increasingly scarce, every piece of land becomes ever more precious in Hong Kong. When urban development encroaches onto the steep slopes of the city, rather than view them as left-overs of the urban fabric, we can use slope stabilization infrastructure as the backbone for architectural opportunities to realize a new expanded role for the slopes to play in shaping the city and its functions. The Mei Tung Estate will be redeveloped, and this gives us the opportunity to re-envision the possibilities of the estate and its slope. The large man-made slope is a prominent feature of this site but is not treated as an integral part of the development. The redevelopment of the estate means an upgrading of this slope infrastructure. Through the redesign of the Mei Tung slope, we have created a foundation for our architectural elements. This infrastructure is no longer only a stabilization element, but a support for living and transformative infill housing. It invigorates a space that would otherwise be avoided by conventional development. The architectural framework provides a place in which healthy, safe, and economical inhabitant-driven building can occur. It is an experiment of affordable housing in a high-density environment within an increasingly unaffordable landscape.

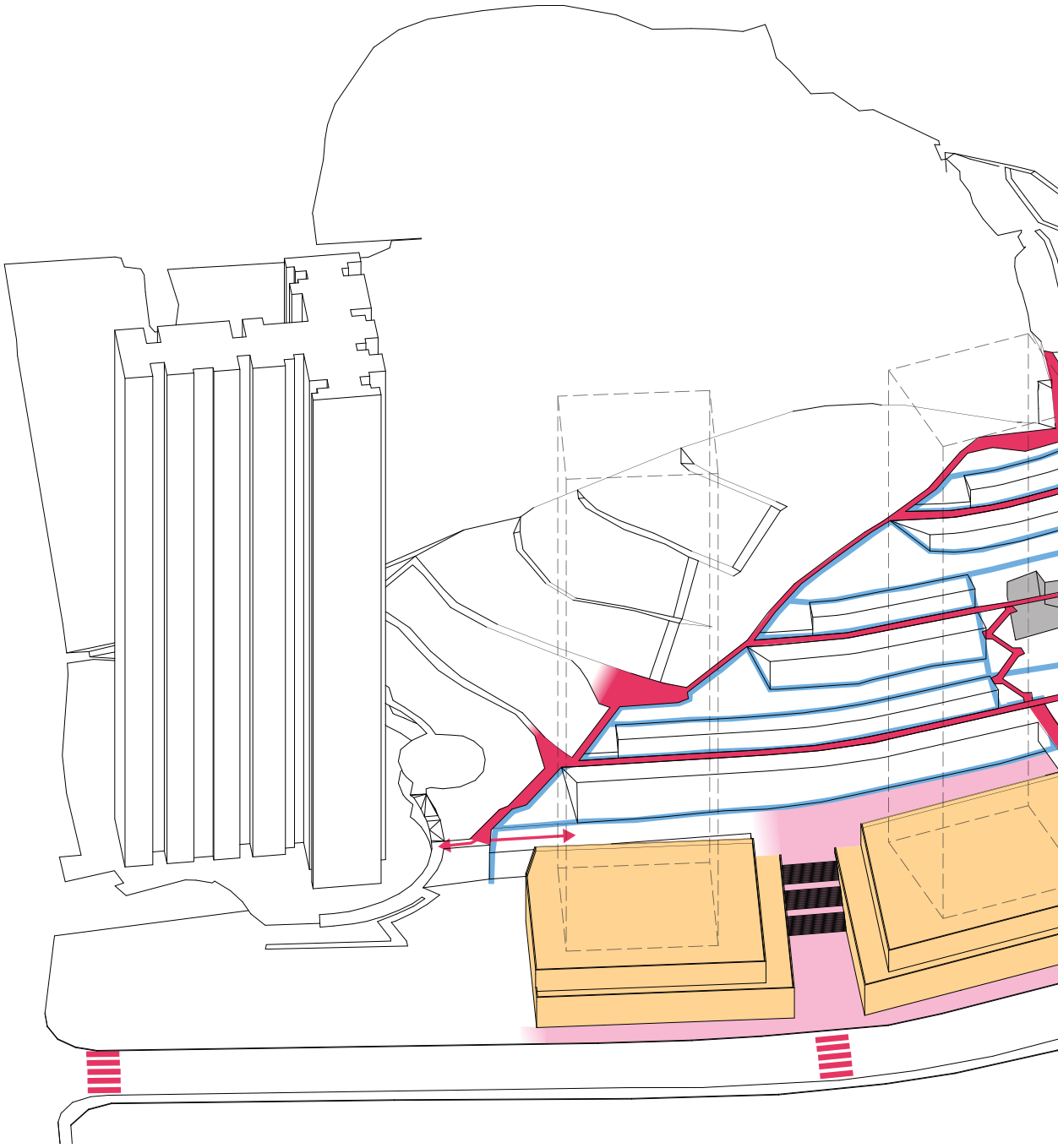
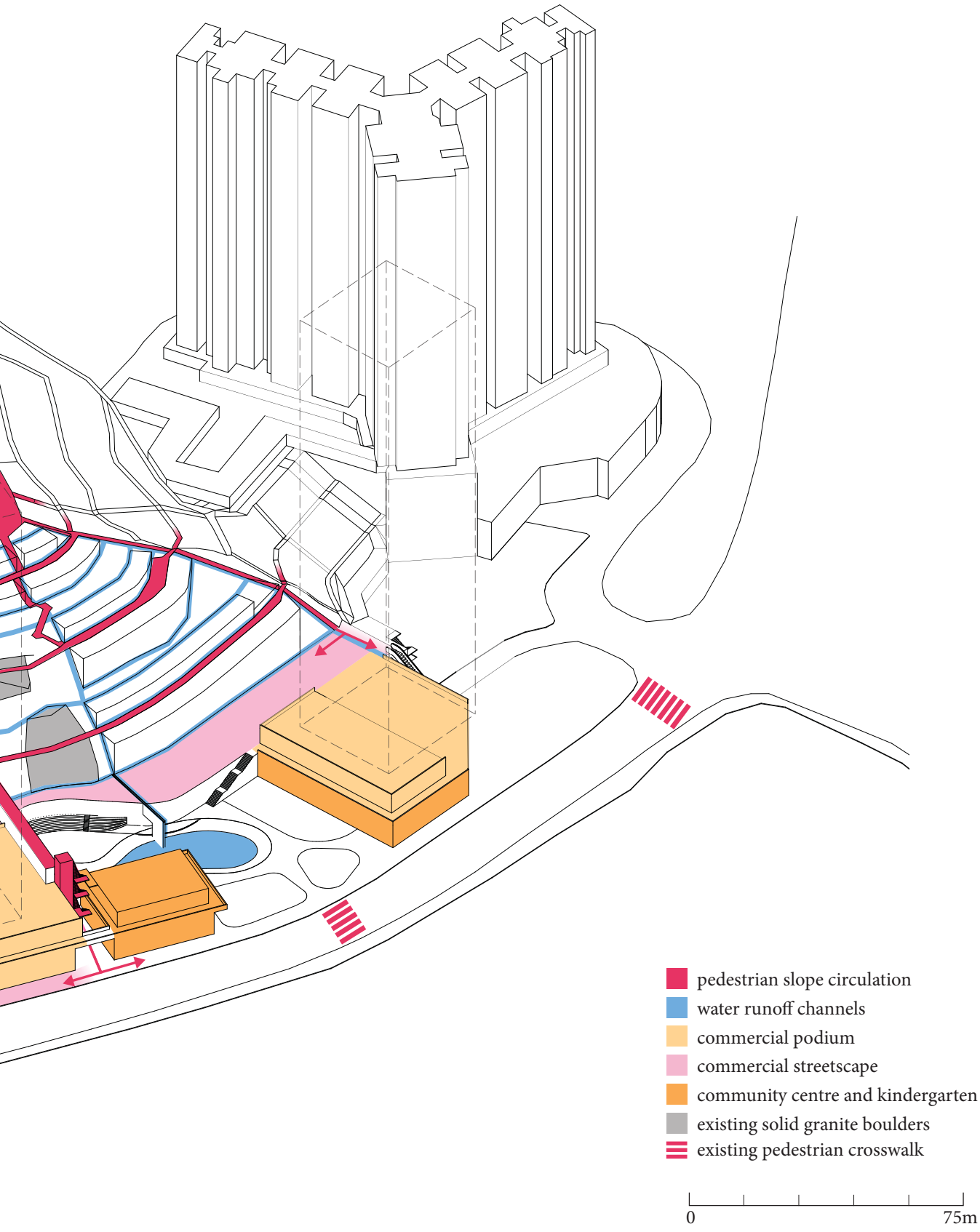


Figure 5.27 Site program and strategies

The slope is not a stand-alone object. Its relationship to the rest of the urban fabric is integral to its success as a component of the city. The slope becomes an extension of the public housing estate and park spaces around it, absorbing and concentrating pedestrian movement and activity.


pedestrian slope circulation
water runoff channels
commercial podium
commercial streetscape
community centre and kindergarten
existing solid granite boulders
existing pedestrian crosswalk
0
75m

CONCLUSION

Hong Kong is one of the world's densest and most expensive places to live. Its topography impacts urban development and creates challenges in securing easily developable flat land. Planning and land development face many bureaucratic barriers making it difficult for new forms of housing to emerge. Those that do emerge circumvent the system and end up as informal housing. Sub-divided units, bedspace apartments, and rooftop apartments are some of these types of housing, but their illegitimacy reinforces the lack of proper attention to health and safety in these living environments. Regulations do little to control these informal structures, nor can they be feasibly eradicated. New forms can offer alternatives to the limited selection of housing in Hong Kong. Acknowledging these modes of living and building upon them become ways to tackling this problem.

Our societies are becoming more urbanized and globalized, and it is important to realize that the way we live is also ever-changing. Hong Kong is also searching for a new identity after decolonization, and government housing programmes will be part of this transition. The solutions we propose need to be adaptable to the changes ahead. It is impossible to predict what will happen in the future, and this uncertainty continues to be a deterrent to envisioning new possibilities. Providing half a house hosts a lot of uncertainty that governments and architectural designers strive to avoid. Housing development is driven by economics, land planning and ownership, and influences from various interest groups. The vision laid out in this thesis is one possibility for how this development would play out. It is also very possible that a development of this scale and in this location can be gentrified into high-end residential homes. Yet, if this type of proposal moves forward, it would be with the intent to provide and retain a design that gives power to those at the bottom of the social ladder.

The strategies and methods examined throughout this thesis can be applied to many more sites in Hong Kong, and the design at Mei Tung Estate is only one of the possibilities in exploring a greater multidisciplinary approach to slope infrastructure design. The slopes impact Hong Kong's urban morphology and approach to development. More than 60,000 man-made slopes are scatter throughout the city, and their structures, surface coverings, landscaping, and water management are integral elements in the function of the city. There is headway in the form of geotechnical engineering and landscape design, but the architectural potentials of slope infrastructure are much less defined. Yet in a city continuously grappling with land, there is hesitation to utilize these sites. Unlocking these potential uses helps establish better strategies and policies to using slopes as a space for occupation.

Capital is already going into the upgrading of Hong Kong's slopes, and

an even greater expenditure goes into public housing. By supplementing housing construction with the work and capital already going into slope upgrading, it will maximize resource efficiency and provide an economically practical solution to the otherwise greater costs of slope development. Embedding the capacity for housing onto the slopes of Hong Kong brings a much-needed resource into the limited space of the city center, and at a cost equivalent to the provision of housing out in the New Territories. If only 200 of the 60,000 slopes can be developed in a similar way as the Mei Tung Estate, there would still be 20,000 more affordable homes for Hong Kong's low-income population.

It was not long ago that many of the people in Hong Kong were immigrants or refugees just trying to find a place to call home. Everyone seemed to be on the same boat. It was hardly called poverty if everyone seemed to be equally poor. Nowadays this has largely changed and the gap between social classes continues to grow. As this gap grows, housing as well as other basic life necessities become increasingly unaffordable. These issues of inequality are deeply rooted in economics and politics, but architecture also has an impact. We begin to address these issues through the housing development on the Mei Tung Estate slope by creating a space where low-income families have control of their lives and surroundings. It is this architectural intervention that strengthens the lower rungs of this tall economic ladder.

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