

Report on the AIA Dunbar Fellowship

NEXT GENERATION APARTMENT BUILDINGS

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This version posted online 3rd JUNE 2019 corrects two inadvertent errata:

Pa 18 Caption now reads Ms Hui Min CHAN, (not Chin).

Pa 49 Design Partnership was founded in 1967, not 1957. There were three founders, Koh Seow Chan, William Lim and Tay Kheng Soon.

Photography

All photographic images are by Rosemary Kennedy, except where noted.

Cover image: Sky Terraces@Dawson HDB Flats in Singapore designed by SCDA.



Rosemary Kennedy at the Singapore National Gallery, overlooking South Beach Towers .

THE NEXT GENERATION APARTMENT BUILDING

Preamble

Throughout my career as an architect, academic and teacher, the question that has consistently underpinned my interests and actions is “how can architecture and urban design contribute to environmental and social sustainability most effectively?”. Place-based design that responds to climate and landscape and local lifestyle preferences is the lens through which I view and attempt to respond to this question.

Prior to undertaking the Dunbar Fellowship, I conducted extensive research on the social and physical environments of multi-storey apartment buildings, particularly in the warm humid city of Brisbane. I was part of a transdisciplinary research team who won an Australian Research Council Linkage Grant¹ to explore residents’ first hand experiences of multi-residential living.

We found that while people generally like the conviviality and proximity to services found in higher density neighbourhoods, they prefer to dwell in buildings that modulate the climate well. Residents value designs that allow them to choose how they adjust and fine-tune the quality of their indoor environments for a comfortable balance of air movement, temperature, daylight, and aural and visual privacy. They also want to afford adequate indoor and outdoor space for everyday living.

Contemporary buildings with many small apartments on each floor tend to provide neither, and also erode residents’ sense of belonging and neighbourliness. People find the generic design of internalised corridors and lifts to be so alienating that they prefer to avoid encounters with neighbours and strangers in these settings, finding community outside the building instead.

My subsequent doctoral research found that these problems have come about in recent decades as the developer-driven quest for higher yields has been met with architectural responses that fail to deliver nuanced personal control to residents when it comes to how they choose to control thermal comfort, or how they would prefer to move between their apartment and the world outside. In terms of access or egress, the stairways are rarely an option. Instead, awkward encounters in the confines of lifts are something to be endured.

Since the late 1980s when air-conditioning started to become ubiquitous in Australian apartment towers, building configurations have focussed on highest yield rather than sensible human centred climatic design. Appropriate solar orientation has been ignored and single-sided apartments that cannot be cross-ventilated abound. In the second decade of the 21st Century, unshaded fully glazed building facades and total energy-dependence are winning out over climate-

¹ Australian Research Council Linkage Grant LP0668911 L Buys, P Grace, R Kennedy, C Wilson, M Hefferan with Port of Brisbane Northshore Development Group: *Managing the Social, Environmental and Economic Impacts of High-Density Living within Inner-urban Sub-tropical Environment*. 2006 - 2009.

responsive building configurations. Buildings' structural form and materials are predicated on an energy-intensive design methodology.

One of the main findings of my doctoral thesis was that poor design has become normalised. All stakeholder groups, including regulators, developers, architects and occupants, tolerate deficiencies in exchange for other gains.

For example, developers prefer to meet regulations with conservative 'acceptable' solutions for fast-tracked planning and building approvals, and tend to focus on development and construction costs rather than occupants' operational and maintenance costs. Architects' professional roles are often marginalised due to partial service (design to Development Approval stage), and they have little opportunity to learn from post-occupancy evaluation. Owners often seek familiar outcomes that reflect preconceptions of fashion trends and what is acceptable to the 'market' even if that means black glass exterior walls. Residents interested in views and location accept dwellings that lack comfort and energy performance, for a time.

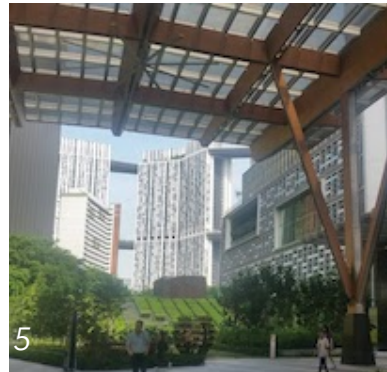
NSW has long had the *State Environmental Planning Policy No 65 - Design Quality of Residential Apartment Development* (SEPP65). The recently reviewed *Apartment Design Guide* requires 60% of dwellings in a development to be cross-ventilated. The Victorian Government introduced *Better Apartments Design Standards* (BADS) in 2017. In spite of these guidelines, Australian apartment buildings have steadily become larger, and more generic, while the apartments within them have become smaller, more energy-dependent and less connected to place-context than ever.

As cities all over Australia grapple with issues of urban expansion and lack of housing affordability, I am convinced that there is a better way to develop liveable, sustainable, affordable apartment dwellings and deliver a change for the better to Australian urban living. That is why I proposed a qualitative study to visit some major warm climate cities that have been dealing with urbanism and accommodating people on a massive scale for decades, and to learn from exceptional architects working in Asian cities to help answer the question - what can we do better here in Australia to ensure the next generation of our apartment buildings will make better homes, produce considerably fewer greenhouse gas emissions, consume less energy and be more affordable?

My main hope for this study is that it contributes in some positive way to the architectural, business and policy strategies that can influence the emergence of potent climate-based apartment building architecture in Australia for both private and public benefit (in counterpoint to the air-conditioned glass box typology that now dominates new Australian developments). In particular, I hope it will lead to positive steps towards the quest to achieve truly cross-ventilated dwellings for low-middle income residents.

The biggest assumption I am making in doing this study is that the conditions that nurture and support innovation are present in Australia.

Memorable moments



1. Meeting Mr Tan Cheng Siong (Image: Archurban 2016)
2. South Beach Road urban canopy Singapore
3. Guangzhou gold-wrapped trees grow through the sidewalk canopy
4. Seeing the Housing Development Board's vision for Tengah Green Forest City
5. Shelter and fans in urban open space at Tao Payoh, Singapore
6. The WindShell model at Pace Development's gallery in Bangkok
7. Dancing Lessons Peoples Park Guangzhou
8. Pinnacles@Duxton, built-to-order housing Singapore.

Acknowledgments

Thank you to the Australian Institute of Architects and members of the selection panel for the extraordinary opportunity provided by the Dunbar Fellowship, established in 2017 in memory of Professor Jennifer Taylor, architect, historian, teacher and mentor. In particular, I would like to thank Caroline Stalker and Phillip Follent for supporting my application by providing references for me.

Many people contributed to the success of my fellowship tour. I owe thanks to Leigh Shutter for introducing me to Professor Charlie Q. L. Xue from the City University of Hong Kong. He and his student Jessica Zhang welcomed me warmly and introduced me to Hong Kong's public housing and private condominiums. Prof Xue's vast local knowledge of the history of Hong Kong's architecture and urban development was invaluable. He is a top notch guide - not only did his meticulous attention to detail mean that we were able to locate each other with ease on a crowded subway platform at Kowloon Tong Station, he also knew how to pace a day's urban walk of discovery with perfect timing for rest stops and refreshments. His book *Hong Kong Architecture 1945 - 2015* is a fascinating resource that I recommend to anyone to read. I learned to my delight that Prof Jennifer Taylor provided much guidance during the writing of this book.

I am indebted to Edward Yihe Zhang, whose architectural practice Zenx International has studios in both Brisbane and Guangzhou, and who came to my rescue when I found myself behind the 'Great Fire Wall' without the usual means of either communicating or finding my way around (no Google maps!!!). He generously arranged for Zenx employees, office vehicle and a driver, to guide and accompany me to visit historic and contemporary local examples of high density residential development! He also kindly introduced me to the research team at the State Key Laboratory of Subtropical Building Science at the South China University of Technology, led by Professor Xiao Dawei. I thank them for helping me to understand housing development in Guangdong and could not have presented this information without their considerable input

Thank you to Chatpong Churendeemol, of Chat Architects Bangkok who told me about the extraordinary *Wind Shell* project under construction there and set in motion my visit to that fascinating city.

I could not have achieved so much in Singapore without Peter Hyland's help. As Regional Director of Singapore-based Cistri, Peter let me pick his brains as well as those of his experienced team. He introduced me to Mr Tan Cheng Siong, legendary founder of Archurban Architects and Planners, and to Ms Hui Min Chan, Director of DP Architects, the world's eighth largest architectural practice, and legacy of the Design Partnership formed by William Lim and Tay Kheng Soon in 1967. Peter also linked me to key people at the Government of Singapore Housing Development Board who shared insights and aspirations with me. Not only has the HDB achieved their original mission 'to house the nation' but they are now leading the world in upgrading the housing stock and impressive innovations in sustainable development. Thank you Peter.

Thank you to Wong Mun Summ for his generous and warm welcome to WOHA's eponymous Singapore office on Hong Kong Street. And to Henry Woon of Atelier Ten engineers for his insights into working with architects whose natural habitat is not the tropics.

Finally, thank you to all the architects who generously agreed to be interviewed for my study including Dennis Ho, Hassell Hong Kong, Tony Ip, Green Architects Ltd and formerly of Ronald Lu and Partners, Sean Affleck Make Architects, Roland Schnizer Foster & Partners, Hui Min Chan DP Architects, Tan Cheng Siong Archurban, Richard Hassell WOHA, Jaron Lubin and Charu Kokate, Safdie Architects, Ken Yeang, TR Hamzah and Yeang, and building designer Kevin Mark Low, Small Projects, passionate and committed individuals all.

EXECUTIVE SUMMARY

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I undertook the AIA Dunbar Fellowship in the context of four South East Asian mega-cities, Hong Kong, Guangzhou, Bangkok and Singapore. These are high-rise high-density cities and have a huge share of urban socio-economic and environmental problems, yet some of the most inventive tropical and subtropical apartment buildings are materialising there.

My aim was to gain insights into how visionary architects working in these locations have adapted classical tropical architecture principles to produce vibrant modern variants of residential and mixed-use apartment buildings. My study focussed on examining what motivates architects to realise non-standard apartment buildings rather than on the architectural designs themselves. This is an important and perhaps overlooked aspect of advancing architecture and the profession of architecture in Australia.

I investigated a significant number of exemplars and visited many apartment buildings in context. By visiting these tropical megacities and observing life and the urban environments there at close hand I was able to contextualise the projects and the experiences of the architects I met and situate them within the regulatory environment to some extent. My meetings with academics involved in urban research, and policy-makers in the various jurisdictions provided much needed explanations of the background conditions and aspirations going forward. These vast metropolises are instigating measures to try to meet the enormous challenge of housing expanding populations and meeting Paris Climate Agreement targets but progress is slow.

No matter the social, regulatory, geographic or environmental conditions of individual places, yield and profit are the driving objectives of private housing design, and the status quo prevails. Yet most of the architects I interviewed have successfully resolved the perennial tensions between economic drivers (developers' yield), social drivers (space, views, noise control and solar orientation) and environmental drivers of building form (natural light and cross-ventilated dwellings), and have derived public amenity as well.

I conducted in-depth interviews with ten architects, and these formed the main data for interrogation. Four main themes emerged from the narrative analysis to help explain the motivations of leading architects who are achieving different outcomes from the majority of apartment building projects of the same scope and complexity.

First, the architects I interviewed are motivated by making a difference at a far broader level than the individual building project. They are actively involved in theory-building through design research and are committed to the practical application of research outcomes to all spatial scales of urban structure. They also share and disseminate this knowledge widely and by various media.

Secondly, they are committed to climate-responsive place-based architecture and prioritise this in all their work. The applicability of the design principles they employ to more mainstream apartment projects was not questioned by the architects. Respondents also asserted that architects have a responsibility to do better, rather than settling for standard 'developer' solutions to justify lack of innovation. They believed that architects need to be more engaged and lead more critical discussion in the broader community regarding design quality, in counter-point to image-driven understanding and expectations.

Thirdly, they are committed to understanding clients' pragmatic objectives and matching sustainable design innovations to these business needs. In this way, they are able to experiment on 'live' projects. Of course this would not be possible without committed and courageous clients. Fourth, they have thorough knowledge of the regulatory environment and use this to innovate rather than fall back on limiting 'acceptable solutions'. They engage proactively with regulations and incentives, and support their alignment with desirable architectural strategies. These improvements become opportunities to move towards architectural innovations that benefit the city.

In terms of factors that are needed to lead to widespread change in the way sustainable living cities at higher densities are achieved, the respondents proposed three main concepts regarding strategies for robust future liveable apartment buildings. One - recognise that the issue is wider than the typology, with many social and ecological issues to be resolved. Two - the need to adopt mandatory green codes is urgent. Three - participation in visioning, and custodianship of the external environment is essential to make low-energy buildings and better public space. For example, urban noise and pollution stops us from opening the windows. Eliminating those negative impacts will reduce the need for energy in buildings and simultaneously improve surroundings, leading to better shared experiences in open space.

It is apparent that a strong sustainability agenda with formal regulatory processes is beneficial. Interviewees support clear regulations with clear compliance targets and verification. Respondents were also highly supportive of regulatory incentive schemes that match desirable architectural attributes.

Though the types of buildings and certain policies adopted in a city like Singapore cannot simply be overlaid onto the Australian political, economic, social and governance landscape, in order to bring about next generation apartment buildings, the types of actions and traits demonstrated by architects who refuse to accept the status quo of energy-dependent poorly designed buildings, can be encouraged and adopted.

Australian architects need to be proactive about climate-based architecture and be confident that we can be instrumental in influencing regulatory strategy. Public discourse is one of many ways to develop and strengthen each and every community state's understanding of objective design quality and its role in ensuring a resilient and robust built environment. My hope is that the findings of this study will lead to better design-led outcomes in Australia for resilient urban living for both private and public benefit.

Table of Contents

The next generation apartment building	3
Preamble	3
Memorable moments	5
Acknowledgments	6
Executive summary	7
Table of Contents	9
List of Abbreviations	II
1 Study context and theoretical framework	12
Foreword	12
Flipping the paradigm	13
Research questions	15
Structure of this Report	15
2 Research methods	16
The Study	16
The main steps	16
In-depth interviews	17
Data analysis techniques	18
Challenges and limitations	19
Itinerary and Programme	20
3 Four cities - first impressions, context and cases	23
The urban housing challenge	25
Urban vs open space	26
Urban form and microclimate	27
Sustainable Building Design Guidelines	28
Sample projects	29
Guangzhou - Trading Capital Old Canton	34
Planning and urban matters	35
Multi-residential building design	35
Super-Incredible Bangkok	39

Singapore - Spaciousness	43	
Chapter conclusion	52	
4 Outside the comfort zone	53	
Themes in conversations with architects in S.E.A.	53	
Theme 1 - Priority Design Principles	53	
Theme 2 - Design theory-building research and testing	55	
Theme 3 - Client leadership, value and values	57	
Theme 4 - The power of good policy: the regulatory environment	59	
Game-changers: strategies for future liveability	61	
5 Discussion and recommendations	63	
Learning from the South East Asian experience	63	
Where to next?	66	
Standard design is failing	66	
Rethinking principles and practices in planning and development culture in Australia	68	
Custodianship of the urban environment	68	
Actions	69	
6 Conclusion	70	
References	72	

List of Abbreviations

AIA	Australian Institute of Architects	LEED	Leadership in Energy and Environmental Design
ARC	Australian Research Council		
ASBEC	Australian Sustainable Built Environment Council	LOHAS	Lifestyle of Health and Sustainability
AVA	Air Ventilation Assessment AVA	MP GPR	Master Plan Gross Plot Ratio
BADS	<i>Better Apartments Design Standards. VICTORIA</i>	MTR	Mass transit railway
BCA	Building Construction Authority	NATHERS	National Housing Energy Rating Scheme
BEAM	Building Environmental Assessment Method	NCC	National Construction Code
CFD	Computational Fluid Dynamics	NV	Natural Ventilation
CPF	Central Provident Fund	PCM	Phase-change materials
GB	Green Building	PV	Photo voltaic
GFA	Gross Floor Area	RTTV	Residential Thermal Transfer Value
GM-GFA	Green Mark Gross Floor Area Incentive Scheme	SA/Vol	Surface Area To Volume ratio
GMIS-NB	Green Mark Incentive Scheme for New Buildings	SBDG	Sustainable Building Design Guidelines
GPR	Green Plot Ratio	SCUT	South China University of Technology
HDB	Housing and Development Board	SEA	South East Asia
HK URA	Hong Kong Urban Redevelopment Authority	SEPP65	State Environmental Planning Policy No 65 - Design Quality of Residential Apartment Development NSW
HKSAR	Hong Kong Special Administrative Region	SLEB	Super Low Energy Building
HVAC	Heating Ventilation and Air Conditioning	SRGI	Sky Rise Greening Initiative
JTC	Joint Town Council	UD	Universal Design
		URA	Urban Redevelopment Authority
		ZEB	Zero Energy Building

1 STUDY CONTEXT AND THEORETICAL FRAMEWORK

Foreword

Tall residential buildings are intrinsically dependent on the uninterrupted supply of electricity. In Australia, they are expensive to occupy, and despite being air-conditioned, they do not always provide comfortable interiors for residents. On the whole, the energy source is electricity from polluting coal-fired power-stations.

This reliance on technology and energy means that residents of contemporary apartment buildings are also vulnerable to disruptions from not-infrequent power outages caused by natural phenomena like heat waves, cyclones, floods and drought, or by man-made problems. Both accessibility and liveability are affected when the power goes out. If neither energy nor cross-ventilation is available, life in dense tall apartment buildings can be intolerable during these exceptional events.

On an everyday basis, these same energy-intensive apartment towers are having a negative affect on residents' behaviours regarding climate control choices, and how they interact with their neighbours. The way these buildings impact on the well-being of their occupants, and the role they play in the overall environment are vitally important in addition to the environmental performance of each building itself.

I undertook the AIA Dunbar Fellowship in the context of four South East Asian cities that are home to many multi-residential tower buildings: Hong Kong, Guangzhou, Bangkok and Singapore. These cities may have a huge share of urban socio-economic and environmental problems, yet some of the most inventive tropical and subtropical apartment buildings are materialising there.

My aim was to investigate phenomena encountered in the design and procurement process that can influence the emergence of potent climate-based architecture for apartment buildings in Australia in counterpoint to the 'glass box' typology that is dominating new Australian developments in every capital and most provincial cities, regardless of climate.

My study focusses on examination of what motivates architects to realise these non-standard apartment buildings rather than on the architectural designs themselves. This is an important and perhaps overlooked aspect of advancing architecture and the profession of architecture in Australia.

My hope is that the findings of this study will eventually lead to better design-led outcomes in Australian urban living for both private and public benefit.

A detailed itinerary, programme of meetings and field studies undertaken is contained in Chapter 2, Table 1.

Flipping the paradigm

Asian cities are quite literally the epi-centre of high-density living. Political and socio-economic events have shaped Asian urban expansion where country-to-city migration has exploded along with population growth in recent decades.

In the latter half of the 20th Century and this century, modernist ideals embodied in Corbusian city planning and international style buildings found their application in Asian cities that needed to build housing on a large scale to house their burgeoning populations².

Widespread adoption of Western technology including air-conditioning and the lift, has been one of the enabling factors that has allowed the rapid development of Asian urban settlements in the tropical climate zone into massive and dense metropolises with vast areas of climate-controlled indoor space.

Now, with the possible exception of Singapore, these cities suffer from chronic traffic congestion and air pollution. Loss of vegetation, and heat that is absorbed, re-radiated and trapped by buildings contribute to the urban heat island effect, leading to a vicious cycle of ever-increasing demand for cooling. The proportion of glass used in external walls of buildings has also gradually increased to the point where glazing is the predominant material in new buildings. The solar gain, potential for overheating and related energy consequences are significant.



Hong Kong, Kowloon, dense condominiums

² Xue, Charlie Q. L (2016) Hong Kong Architecture 1945 - 2015. From Colonial to Global. Springer. e-Book (p24)



Sky Habitat, Singapore, Safdie Architects

Yet some visionary architects working in South East Asia have adapted classical tropical design principles to produce vibrant modern variants of apartment towers that are attractive places to live and address important societal challenges associated with climate change, demographic shifts and technological advances and the transition to renewable energy.

A select few seem to break the mould of the apartment tower made up of repetitively stacked floor plates wrapped in glass, and these can point the way to emergence of a new paradigm.

These architects appear to have successfully resolved the perennial tensions between economic drivers (developers' yield), social drivers (space, views, noise control and solar orientation) and environmental drivers of building form (natural light and cross-ventilated dwellings).

The Dunbar Fellowship gave me the unique opportunity to ask whether Australia's next-generation apartment buildings can benefit from a reversal of recent historical trends, by embracing East—West knowledge transfer. My key objective was to explore factors and strategies that can influence the emergence of potent climate-based architecture in Australia for both private and public benefit.

Architects typically deal with a raft of competing interests in the myriad of issues and conundrums to be resolved in the design process. Rather than focussing specifically on the visual and technical aspects of multi-residential architecture, I was particularly interested in how architectural leaders promote design strategies that deliver liveability and affordability for occupants, value for developers, and public amenity. I wanted to know how they have innovated within the confines of regulatory environments; and what motivates them to do what they do.

The aim of this fellowship was to illuminate what goes into the making of game-changing apartment buildings in order to capture the attention of the Australian housing property development industry and regulators at different levels of government.

Research questions

What can we do better here in Australia to ensure the next generation of our apartment buildings will make better homes, produce considerably fewer greenhouse gas emissions, consume less energy and be more affordable?

The research questions at the heart of this study are:

1. How have these architects innovated within the confines of regulatory environments and property economics?
2. What motivates them to do what they do?
3. What strategies can influence the emergence of potent climate-based architecture in Australia for both private and public benefit?

Structure of this Report

In the next chapter I discuss the research methods of the study. In Chapter 3 I attempt to paint a picture of the physical and regulatory context and circumstances in which architects practice. I present the results and findings of interviews with architects in a thematic form in Chapter 4. Finally, in Chapter 5 I discuss the significance of the findings for Australia and the implications for the emergence of next generation apartment buildings.

2 RESEARCH METHODS

The Study

I used a qualitative methodology for this study. The main method of data collection was to interview leading architects who are designing and delivering apartment towers that do not conform to the repetitive stacked tower model, and where innovative architectural strategies for liveability and sustainability, based on responses to climate and place, are evident.

Though I also interviewed some academics and government policy-makers, the focus was on architects and their experiences. I acknowledge that numerous functional groups and stakeholders are involved in developing, designing, constructing and delivering apartment buildings, including planners and financiers, but purposely elected to keep the scope as narrow as possible by speaking to architects specifically.

The rich conversations generated by focussing on one group, architects, allowed me to build a picture of their interactions with the concerns of other groups. I sought to uncover their informed perspective on project drivers, design principles, the role of policies and compliance, and incentives that support non-standard apartment architecture. I asked how they measured the success of completed projects, and how the profession might promote liveability in the future that is coming toward us.

The main steps

In order to identify potential interviewees for this study, I initially identified several specific apartment buildings from online and print literature that demonstrated an architectural approach that combined climatic attributes and innovative design strategies aimed at liveability and sustainability.

I sought architectural design that overtly innovates or improves on standard solutions rather than 'business as usual' according to certain criteria. These included architectural form and materials to support key private residential experiences:

- Adequate space for everyday living
- Private outdoor space
- Resident control over indoor environment for daylight and thermal comfort, visual and aural privacy,
- Availability of personal choice and control over resource-use decisions
- Diversity of tenure, household types and life stages
- Sense of community and neighbourliness
- Useful communal open space; meaningful vegetation at ground level and above.

I was also looking for evidence of energy reduction 'designed 'in' rather than designed out, using passive design strategies including orientation, cross-ventilation and external shading. This may be achieved with qualitative architectural principles such as:

- High surface area to volume ratio (SA:Vol)
- Individual dwellings have openings in two or more external walls

- Cross-sectional depth supports cross-ventilation for individual dwellings
- Access (and egress) configuration supports natural light and ventilation in circulation areas
- Mix of solid and glazed external wall materials and shading.

The projects' locations were also important in the case selection process. My itinerary took me to South East Asia to visit the subtropical mega-cities of Hong Kong and Guangzhou, and tropical Bangkok and Singapore. I chose these destinations for a variety of reasons:

- Similar climate conditions to Australia's cities
- Rapid development - high density neighbourhoods and mass rapid transport
- Innovative policies and regulation
- High concentration of tall buildings and experimentation in multi-residential buildings.



Figure 1. Outline regional map of study cities

Next, I set about identifying the architectural practices and individual architects involved in conceptualising, designing and realising one or more of these exceptional apartment towers, and invited key individuals to participate in my research project, by emailing and phoning them. If they accepted, I made arrangements to meet them personally on site or at their office.

The resulting list of interviewees which resulted from this process was not exhaustive, but provided a purposive sample of architects who have designed apartment towers that break the formulaic configurations presented by repetitively stacked, single point access or double-loaded corridor typologies, wrapped in glass. As a result of this process I interviewed 10 architects in four cities in South East Asia.

The process was also useful in developing a data base of apartment building examples as secondary data. Further examples were collected during field study and opportunistically added to the inventory. My itinerary, program of interviews, and list of the buildings I visited are in Table 1 at the end of this chapter.

In-depth interviews

I prepared a set of interview questions focussed on understanding how architects managed the competing interests of key stakeholders while maintaining the central ideas of liveability and climate-

responsiveness. Pre-interview information for participants included a statement of consent regarding audio recording for my later reference, and agreement to be contacted for follow-up information later during the research process.

Each interview took approximately 40 - 60 minutes. A semi-structured approach was designed to flow as a natural conversation. Example questions included:

- What were the key objectives for this project and how were they arrived at? Were they design-led or client-led?
- What design principles and practices were adopted to negotiate the particular geographical, climatic, cultural, political/economic dynamic of the locale?
- What roles do statutory and compliance goals play in outcomes for apartment buildings?
- Were there incentives to meet or exceed compliance goals? If so, what were they?
- What approach was taken to resolve any 'expectation gaps' between key stakeholders?
- How do you know you have achieved design success?

Not every apartment development encountered during the interviews or site visits was an outstanding example of sustainable architecture, but every conversation and every case contributed to my understanding of the factors and conditions at play.



Hui Min Chan, Director DP Architects Singapore

Data analysis techniques

Interview transcripts and memos were the primary data sources. In order to induce a general theory of architects' experiences and motivations during project phases of planning, design and construction and post-occupancy, I used both categorising and contextualising data analysis techniques from which themes emerged.

A narrative analysis, identifying threads that run through individual interviews was important to maintain the context for quotes that are lifted out of the interviews, and provide a well-rounded account of the findings.

Secondary data comprised academic and professional literature and government reports (on line) and published case studies. This provided insights into project scale, site area and density, and various other descriptive and construction information such as building sections and plans of typical floors.

Challenges and limitations

Not all the architects I identified were willing or available to be interviewed. One reason for this was that some projects had been published already and busy architects deemed this to provide enough information. In other cases it was difficult to establish contact and some invitations to locally-based architects were not acknowledged.

Furthermore, I originally planned to visit each building and observe the place in everyday use. However, as most cases selected for study are residential buildings that are completed and fully occupied, it was not possible to arrange to gain access to visit the private dwellings or the communal areas of the projects, except for public housing projects in Hong Kong and Singapore, where the grounds are generally accessible. I visited the buildings in context and photographed them.

In each city on my itinerary, I selected accommodation that was either an exemplar or typical residential project, or had similar features and attributes to the subject matter. For example, in Hong Kong, my hotel room on the 22nd level of a Mon Kok tower was typically compact and had a cantilevered projection typical of the ubiquitous bay window employed in countless apartments. My hotel in Guangzhou was situated in the Yuexui District of the old city centre near Beijing Road. In that hotel, corridors were naturally lit and ventilated with openable windows at each end. In Bangkok, I stayed in the mixed-use Hansar Hotel and Residences in order to experience first-hand WOHA's architectural approach. During my stay in Singapore I lived in a typical contemporary two-bedroom private apartment: single-sided, fully glazed external wall, unshaded balcony. I also spent some time staying in a modest older hotel in the Modern style. The stairways were trafficable, ventilated, and daylit. Rooms and bathrooms had openable windows set in deeply shaded recesses.

Itinerary and Programme

TABLE 1 PROGRAMME OF STUDY

Date	Interviewee and Affiliation	Activity	Project
6-13 April	HONG KONG	Sub-tropical Humid	
7 April	Dr. Charlie Q.L. Xue and Jessica Tang . City University of Hong Kong Kowloon	Full day field study and discussion	Kai Ching, Kai Tak, and Ngau Tau Kok public housing estates. LOHAS Park private housing estate
8 April		Free Day	Flower market, Bird market Mon Kok
9 April	Tai Kok Tsui Kowloon Waterfront	Write up and field visit	Olympic Station Various private estates, street parks
10 April	Taikoo Place, Quarry Bay	Site Visit	One Island East Taikoo Ching
10 April	Tony Ip Principal, Green Architects Ltd. (formerly Deputy Director of Sustainable Design, Ronald Lu and Partners)	Interview at his office, Kowloon Bay.	3 Mok Chui St, Kai Tak Private housing
11 April	Dr Xue and Colleagues City University of Hong Kong Kowloon	Meetings and lunch Site Visit	Research interests, tropical and subtropical architecture and urbanism
12 April		Walking Tour - Mon Kok near Langham Place	Dunbar Place Mon Kok 88 Kai Yee Street Sky Park Kowloon
12 April	Dennis Ho HASSELL	Phone interview	Two towers at Zhuhai Waterfront near Macau
12 April	Sean Affleck MAKE	Interview on location	Luna 18 Lun Fat St, Wan Chai
13-19 April	GUANGZHOU, China	Sub-tropical Humid	19 - 33Deg C
14 April		Urban Walks	People's Park Archeological Site
15 April		Site Visits Urban Walks	Old Guangzhou Dade Lu to Enning Lu

Date	Interviewee and Affiliation	Activity	Project
16 April 2018	Prof Xiao Dawei and colleagues State Key Laboratory of Subtropical Building Science, South China University of Technology (SCUT)	Meeting and workshop	Housing types each decade since 1980s
17 April	Zenx International	Presentation (RK) and discussion on recent projects. Visits to exemplars	Guangzhou Plaza The Royal Quay The Canton Place 3 sites amalgamated - large inner public space
18 April 2018		Field Study Tianhe District	Guangzhou Opera National Museum
19-22 April	BANGKOK, Thailand	Tropical Savannah	22- 35 Deg C (276 days > 32 per annum)
20 April	Kevin Mark Low, Small Projects	Interview	Wind Shell (under construction)
21 April		Field Study Sathorn Road District	The Hansar The Met, MahaNakon
22 April - 3 May	SINGAPORE	Equatorial	
22 April		Planning Day	
23 April	Peter Hyland and Rahul Mittal Cistri	Information meeting	Sustainable urban design in the region
		Site Visit	Sky Habitat Bishan
24 April	Roland Schnizer Foster and Partners	Interview on location	South Beach Road
24 April	Jaron Lubin and Charu Kokate Moshe Sadie Architects	Interview	Sky Habitat
25 April	Tan Cheng Siong Archurban Architects and Planners	Interview	Pearl Bank
25 April		Site Visit	Marina Bay Sands
26 April	Hui Min Chan Director DP Architects	Interview	Peoples Park and Golden Mile Design Partnership (Chan, Lim and Tay) Tree Lodge at Punggoll (Surloana) Eco at Bedek

Date	Interviewee and Affiliation	Activity	Project
26 April		Site Visits	Pearl Bank Peoples Park Chinatown Park Royal on Pickering Oasia and Tanjong Pagar Singapore Botanic Gardens
27 April	Richard Hassell Principal WOHA	Interview	The Park and New Cuff Road, Mumbai Newton Suites I Moulemein Rise SkyVille@Dawson 443 Queen St Brisbane
	The URA Centre	Site Visit	URA City Model
28 April		Green Connectors	Henderson Wave and Little India
29 April		Public housing and Singapore cultural history Site visits	Pinnacle@Duxton National Museum Fort Canning
30 April		Field Study Site Visits	Interlace SkyVille@Dawson SkyTerraces@ Dawson
1 May		Punggol And Novena	Waterway Terraces Punggol Tree Lodge@Punggol (Surbana) 1 Moulemein Rise Newton Suites
2 May	Henry Woon Atelier 10	Interview	Various Singapore project
		Site Visits Private Apartment Developments	CBD One Shenton Marina One The Ardmore Le Nouvel Ardmore 14 Nouvel 18
3 May		Site Visits Buddha's Birthday	ECO (DP Architects) Bedok Court Condominium DUO
	Liow Tian Hong Principal Architect Development & Procurement Group Lee-Loy Kwee Wah Executive Associate (Design Development) Housing and Development Board	Discussion, and tour of HDB show flats at My Nice Home Gallery HDB Hub Toa Payoh Singapore Design Museum	Selected schemes and Tengah Forest City Exhibition Exhibition: Fifty Years of Design
4 May	In transit	Return to Brisbane	
7th May	Ken Yeang TR Hamzah and Yeang	Interview by Skype	EdiTT Tower Singapore (unbuilt)

3 FOUR CITIES - FIRST IMPRESSIONS, CONTEXT AND CASES

Invigorating, exhausting, a maelstrom. Hong Kong is high, high-density living and is the first of the 'mega-tropicalopolii' I encounter on this Fellowship journey. I sense that I am not the first visitor to have an extravagant reaction to Hong Kong and its extremes.

In Guangzhou, my sensory overload escalated on arrival, partly because it coincided with the massive twice-yearly Canton Trade Fair. The ancient trading capital of Old Canton is now a global city of wide tree-lined boulevards, congested freeways, a crowded subterranean train system and vast plazas.

On to Bangkok, where a broad multi-lane road lined by advertising billboards the size of football fields leads you in from the airport. Back alleys and eight lane roads alike are intersected by canals below and various lines of the privately owned mass transit system above. The threat of flood is ever-present. Everything is elevated.

After three weeks in these cities, the sense of spaciousness and greenness of Singapore boulevards and open spaces was like finding a pressure-release valve at the commencement of a ten day visit.

This chapter is arranged excursively and describes my observations city by city.

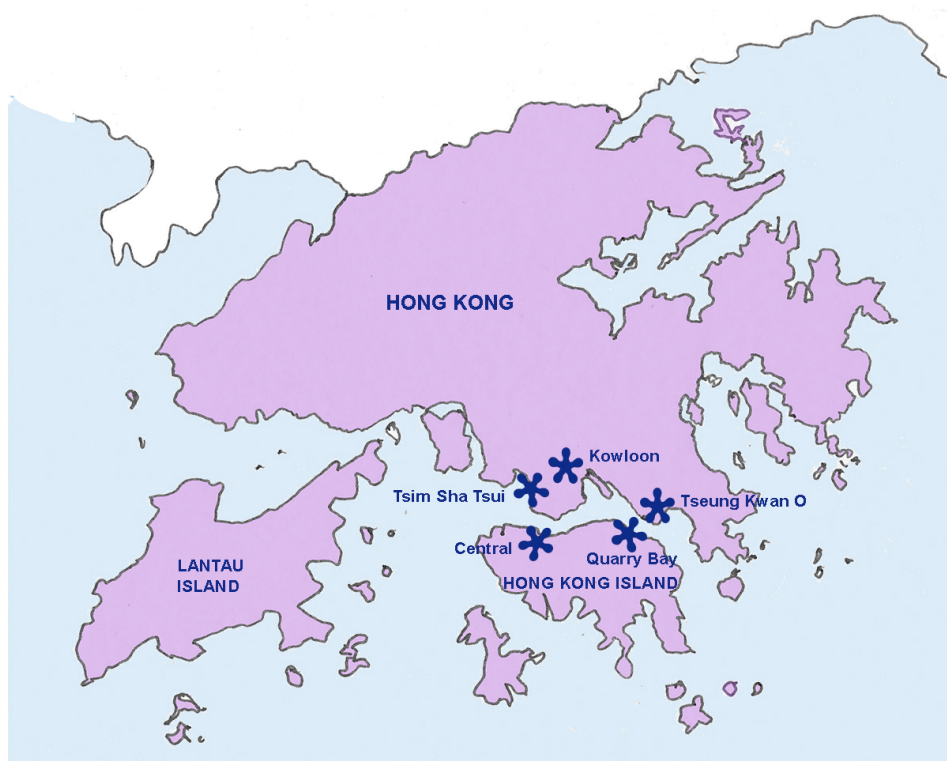


Figure 2. Hong Kong case study site locations

Hong Kong - High Density Living

The air was jagged with the noise of demolition and commerce. Jack hammering, the roar of vehicles speeding along the flyovers, and the blare of honking as trucks, cars, buses and taxis crawl along the crowded streets was a wall of noise. Every vista and street was over-packed with jostling signage, as well as signs, symbols and layers of human habitat. Come the lunch hour rush - the streets and cafes filled to bursting on the dot of noon!

The Mon Kok district of Kowloon where I based myself for a week is characterised by two representative urban forms. Narrow streets of densely packed 1960's mid-rise flats are ringed by towering clusters of 50+ storey private housing developments. In the nearby old quarter, streets and sidewalks are alive with private enterprise and public servicing. A contemplative park with mature shade trees, ponds and traditional Chinese structures occupies half a city block and provides a surprisingly green and tranquil refuge. Lines of washing flap on the tidy roof tops.

In contrast, eight multi-tower condominiums collectively combine with the Olympic Station and Shopping Mall to constitute a megastructure. One complex, the Metro Harbour View Plaza, is comprised of ten 50-story towers. Others are Harbour Green (six towers), Island Harbour View (nine towers), Imperial Cullinan, Silversea Tower (one building, eight lift cores), Hoi Rai Rd Garden, Long Beach Towers, and Hampton Towers. This is a transit-oriented development on a massive scale but one effect is that public open space at ground level is at a premium, and is clearly not envisaged as a place for pedestrians. The pedestrian environment is indoors in the maze of shopping-lined walkways and atria. While the waterfront edge of some of the condominium towers has a publicly accessible promenade, the street edges lined by long expanses of anonymous parking podia, and occasionally, walled gardens. Driveways are clearly demarcated as entries to gated private realms. For example, the Long Beach Towers podium is 150m long.

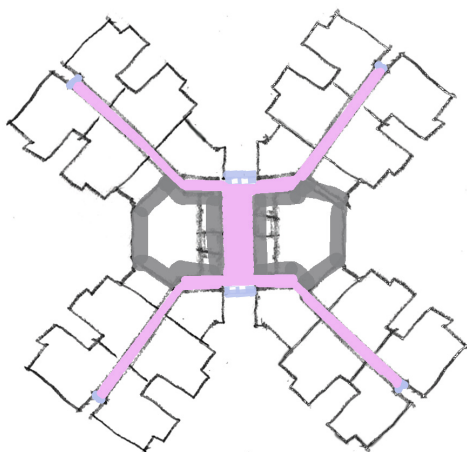


1. Mon Kok 1960s flats meet 2000s Condominiums
2. Mon Kok street life
3. Tranquil pocket park
4. Podium street edge

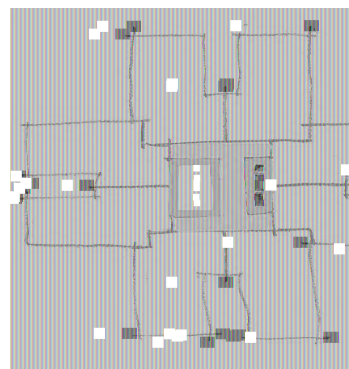
The urban housing challenge

Hong Kong's official population is 7.5 million people but some unofficial estimates put the actual population at 11 million. About 90% of people live in high-rise buildings. Nearly 45% of people live in public housing; almost 55% in private housing; and the rest in temporary housing. It is not known what percentage is made up of the hidden population who live in micro 'coffin' homes, 'cage' homes, and sub-divided units the size of half a parking space. One can only imagine the substandard living conditions and personal toll on dignity as domestic living space is drastically reduced. Nano or micro flats (slightly bigger than two taxis are selling for HK\$1million)³. In an effort to accommodate more people, much of Hong Kong's public housing of the 1950s–1970s has been demolished to make way for taller buildings, denser planning, better amenities and communal environments.

The constraints of managing the housing needs of a large and growing population seems to leave little room for architectural experimentation. Whether public or private housing developments, buildings are typically laid out in a cruciform with a large number of units clustered around a central core containing lifts, services and stairs. Cross-ventilation is not mandatory for thermal comfort, but externalised kitchen and bathroom windows are prescribed for hygiene reasons and are typically located in recessed or re-entrant areas of the cruciform to afford the best views to living rooms and bedrooms. Being a cruciform, solar orientation is not a consideration. Most Hong Kong residential towers do not have central air-conditioning (no central chiller plant). Every dwelling has an external ledge or utility platform for individual split systems or room air-conditioners.



Hong Kong Housing Authority - light and ventilation to core, circulation and public areas



Private Sector Apartments layout with compact core

Figure 3. Cruciform plans redrawn from Lai and Yik (2009) p 357.

Dwellings are vertically stacked in towers of 30 to 80 storeys, and these are often replicated in extensive clusters. Dwellings are notoriously small, and prices and rents outlandishly high. Apartments on high floors attract even higher prices because residents believe higher floors generally to be better living environments that have better ventilation, sunlight and views⁴.

³ Huang, C 'City of Shrinking Homes' in *The Straits Times*, Tuesday 24 April, 2018 pp A12, A13.

⁴ Chan EHW, So HM, Tang BS, Wong WS (2008) Private space, shared spaces and private housing prices in Hong Kong: An exploratory study, in *Habitat International* 32:336-348.

Urban vs open space

Despite being surrounded by sea and heavily forested mountains, only 24% Hong Kong's total land area is built up with the rest being open space and national park. This fact is often extolled as one of Hong Kong's green features, but low supply of urban land increases its rarity. As a result, space of all kinds is at a premium, and Hong Kong's image is that of a dense and overcrowded city. Space and the amount that buildings take up is incredibly tightly controlled. As will be seen later in the report, this is now playing out in terms of un-affordability and lack of opportunity for passive climatic architectural design.

The land price is the highest cost component in private housing development and is directly related to the maximum Gross Floor Area (GFA) allowed to be developed on that piece of land. As a result developers try to maximise their profits by increasing saleable area. Maximising the number of small dwelling units that can be accommodated in a tower and keeping lobbies and corridors to a minimum, is one way of doing this.

The Hong Kong Special Administrative Region (HKSAR) government exempts some shared external areas like gardens and car parks from the GFA calculation in order to encourage developers to build better communal facilities and more spacious design (up to 10% GFA bonus). The incentive for developers is that, compared to the land costs, the construction cost for these communal areas is minimal but they can add a disproportionate premium to the selling price for apartments without actually increasing the private space.⁵

A primary reason for tight control over GFA is to restrict illegal use of space which leads to density beyond the capacity of corresponding local infrastructure. An example of the extent and detail of constraints on space is that non-structural prefabricated external walls (such as glass curtain walls) may be no thicker than 150mm. This is to discourage manipulation of the wall thickness to design niches other than a bay window into the floor plan.

Up until 2011, bay windows were exempt from GFA and developers used them to eke more space, and more saleable area, out of the tight living area of a typical unit. A bay window could project 500mm from the outer face of the external wall, providing it was 500mm or more above the finished floor level, and 500mm or more from the underside of the finished ceiling. It could not occupy more than 50% of the facade area. Now, only a 100mm projection is permitted, with the same conditions. Obviously this can no longer double as a ledge to support air-conditioning condensers, and utility ledges are making an appearance for this purpose.

Formerly, architectural responses to climatic design of facades such as sunshades and reflectors, or non-load bearing wing walls, wind catchers and funnels to promote cross ventilation were encouraged. If projecting more than 1.5m, justification was required. Now, quantitative justifications on energy savings and enhancement of ventilation is required for all of these features; similarly for noise barriers and acoustic fins on facades.

⁵ Chan et al. *ibid.*



1. Quarry Bay. City carved out of the forested hills. Urban footprint meets open space.



2. Typical bay window walls with air conditioners on the ledges

Urban form and microclimate

Dense urbanisation in Hong Kong is reducing wind velocity (breezes) and having a marked effect on overnight minimum temperatures. Forty-one nights of 28°C or over were recorded in 2017 - up from 20 nights in 1987, and none in 1957.⁶

The urban microclimate is affected by urban morphology and the particular problem of air conditioners which directly contribute to the heat island effect in the dense vertical city. Many 'wall' buildings and podium buildings block wind at street level, while above, air-conditioners from every unit, stacked above each other pump out heated air. A Singaporean study of multi-storey housing estates found up to a 13°C increase in external temperatures surrounding the appliances as heated air rose, and a 32% drop in the efficiency of air conditioners on floors 10 and above.⁷

In Hong Kong's subtropical climate, residents prefer to use air-conditioning in the hot humid summers and natural ventilation in the cooler winter months. Unfortunately natural ventilation is associated with health risks caused by low urban ventilation rates, poor air quality and noise pollution. The combination of lack of air movement and traffic-related pollutants, as well as industrial pollution from nearby mainland Chinese cities of Shenzhen and Guangzhou in the Pearl River Delta, are not conducive to naturally-ventilated residential buildings.

The government is attempting to mitigate the urban heat island effect through better urban ventilation, enhanced environmental quality of pedestrian zones, and more urban greenery.

⁶ HK Observatory (2017, January) *The Year's Weather - 2017*. Retrieved from <https://www.hko.gov.hk/wxinfo/pastwx/2017/ywx2017.htm>.

⁷ Bruehlisauer et al. (2014) cited in Rohinton (2016) *Urban Climate Challenges in the Tropics*. Available from: https://www.researchgate.net/publication/303021244_Urban_Climate_Challenges_in_the_Tropics_-_Introduction [accessed Jan 30 2019].

At the city level of planning, the *HK Planning Standards and Guidelines* section on urban design contains illustrated principles of urban morphology for ventilation, including large scale urban breezeways like tree-lined boulevards or parks aligned within 30° of the prevailing summer wind direction.⁸ Since 2006, all major building projects, including public housing have been required to go through Air Ventilation Assessment (AVA) which is an objective method to evaluate how a project affects the urban air ventilation performance of its neighbourhood.

The guidelines discourage podiums that occupy the entire site by exempting underground parking from GFA. Developers seeking GFA exemptions for car parking must put it underground, a move which is also very controversial and not very sustainable. Apart from the excavation and pumping of water, vast underground car parks need to be artificially lit and ventilated.

The masterplan for the massive Kai Tak urban renewal area on the site of former HK international airport is influenced by the Air Ventilation Assessment (AVA) Technical Guidelines. Computation Fluid Dynamics (CFD) are used to verify air movement paths at ground level and above for new developments. Masterplan principles are:

- Major streets align with the prevailing winds
- Building densities related to the air path system
- Podium-free typologies
- Pedestrian walkways prioritised over roads.

Sustainable Building Design Guidelines

The HKSAR government has also promulgated the Sustainable Building Design Guidelines (SBDGs) introduced in 2011.

Newly built government buildings, including public housing, must achieve the second highest BEAM rating⁹. There is also a target to trim down carbon emissions for existing buildings by 2030.

The government also incentivises private sector developers to deliver better environmental outcomes. For example, there is a long and detailed list of mandatory and non-mandatory green and amenity features for which developers may obtain gross floor area (GFA) concessions, capped at 10%, in new buildings. These include complying with design parameters to achieve Residential Thermal Transfer Value (RTTV) and Natural Ventilation (NV). Currently a developer can choose to ignore the RTTV if they do not want to pursue a GFA exemption.

The Building Energy Ordinance (BEO) controls building services systems such as lifts, escalators, and essential air conditioning with very stringent requirements. Individual air conditioners are not essential plant.

Under the current arrangement, a private housing development is required to register and submit a BEAM^{Plus} provisional rating, regardless of grading, as one of the pre-requisites for the GFA bonus. To obtain the GFA concession, applicants must also meet SBDGs regarding building separation, setbacks and site coverage of greenery, and estimate energy performance/consumption for the common areas. Significantly, applicants must disclose all non-mandatory green and amenity features such as communal gardens and sky

⁸Ng E *Urban Air Ventilation in High Density Cities in the Tropics* cited in Rohinton E. Pp 79 - 108.

⁹BEAM (Building Environmental Assessment Method) is a voluntary private sector-owned rating tool for green buildings Hong Kong.

gardens in the sales brochure and on the Building Department's website.¹⁰ However very few private residential developers pursue a high BEAM rating because the 'transactional costs' of initiatives like naturally ventilated and daylit communal corridors are often perceived to outweigh the advantage of the bonus.¹¹

Sample projects

In this context I visited several projects, interviewed three practising architects and met with academics. The first two cases are representative examples of the most recent incarnation of public housing estates. Cases 3 and 4 are private housing estates which illustrate the differences between the early approach of private developers and more recent outcomes. Finally, cases 5 and 6 are a private housing project in the Kai Tak urban renewal area and a single residential tower in Central Hong Kong respectively.

TABLE 2 HONG KONG FIELD STUDIES

Case	Architect	Developer	Date	Typology	Notes
HONG KONG 6-13 April 2018 Sub-tropical Humid					
Ngau Tau Kok Estate		HK Housing Authority	Phase 1 1998-2000 original residents rehoused. Phase 2 completed 2009, 9x40 towers. Phase 3 completed 2016.	New Cruciform standard block design. Multiple public housing estates.	The original Ngau Tau Kok estate was built in 1969 to accommodate workers in the Kwun Tong industrial area. By the 1990s, the government was already initiating plans to increase dwelling numbers by rebuilding the estate. The concept of "rebuilding and resettling locally" was used to try to keep local communities and networks intact.
Kai Ching, Kai Tak		HK Housing Authority	2010	Multiple towers, landscaped open space and street edge shopping	First new housing estate built at Kai Tak
Taikoo Shing Quarry Bay		Swire Properties Limited	Commenced late 1970s completed 1986	69 cruciform residential towers 28 to 32-storeys, office buildings and a large shopping mall. No podiums.	Mass private housing. Gardens open. Secure buildings entries. Popular with high-income white-collar residents because of professional upkeep, Median income second only to Central mid-levels.

¹⁰ See Chan, W. (2016) Application of Sustainable Building Design Guidelines and Case Studies. Hong Kong Institute of Surveyors, Jan 2016. Retrieved from <https://www.hkis.org.hk/hkis/general/events/cpd-2016001.pdf> for an accessible overview of the HK building control system.

¹¹ Qian, Q.K, Fan, K & Chan, E.H.W. (2016) Regulatory incentives for green buildings: gross floor area concessions, *Building Research & Information*, **44**:5-6, 675-693, DOI: 10.1080/09613218.2016.1181874

Case	Architect	Developer	Date	Typology	Notes
LOHAS Park (Lifestyle of Health and Sustainability) Tseung Kwan O New Town in the east of Hong Kong.		MTR Corporation	Phase1 Completed 2009. Phase 2B, 2011, Ongoing	50 residential towers (57 to 63 storeys) over 10 storey parking podia. Each tower has 3 or more cruciform interconnected buildings with identical left and right sides with different entries. eg Tower 8 has <i>Sunshine</i> and <i>Flora</i> .	Private housing estate. 25,500 units; 68,000 people. Will be the largest single residential estate in the territory when complete.
3 Mok Chui St, Kai Tak Public housing at Kai Tak.	Ronald Lu and Partners (Tony Ip)	HK Urban Redevelopment Authority	2010	Fragmented tower (30 storeys) in three wings laid out in fan configuration, joined by open walkways, from centralised edge core; towers connected by roof top sky gardens. Highly articulated plan form provides high SA/Vol ratio.	462 dwelling units. Site Cover 31%. No parking. Close proximity to new MTR station under construction. Achieved GFA exemptions. Design parameters to achieved Residential Thermal Transfer Value (RTTV) and Natural Ventilation (NV). HK Green Building Award 2014
Luna 18 Lun Fat St, Wan Chai Hong Kong Island	MAKE Sean Affleck	Vanke, China	2018	Single tower, 20 storeys, central core.	5 apartments/floor. 3 x 1 Bed 'corner' apartments with openable windows on two sides offer daylight, ventilation and views. 2 x Studio apartments (25m2)



Kai Ching, Kai Tak Public housing estate entry.

1 Ngau Tau Kok: The estate layout and form responds to both macro and microclimate as per the AVA requirement. Well-designed gardens, integrated public art and high quality communal recreation and amenity spaces link the towers and surrounding urban village at lower levels. A 1km long covered pedestrian path between the estate and the mass transit railway (MTR) station in Kowloon Bay crosses over several streets and through central and peripheral gardens.



2 How to tell the difference between public housing and private housing. The one on the right painted with the pastel colours, beautiful landscaped gardens and open covered walkways is public housing. Private housing is the one on the left - its tile-clad external walls reading as homogeneous colour. There is little space between buildings and literally no private outdoor space or shared gardens in private housing developments.



3, 4, 5, Taikoo Shing 1980's private housing estate. Compared to more contemporary private housing estates, earlier developments such as Taikoo Shing actively contribute to the city life. It is pedestrian-friendly and the buildings do not have podia. Most ground floors are retail shops and malls open to the general public, with covered arcades providing shade and shelter at street level. Roof gardens are for private use of top floor residents.





LOHAS Park (Lifestyle of Health and Sustainability) condominiums Tseung Kwan O New Town.

1. *Landscaped podium overlooked by towers rising above the 4m thick solid concrete transfer 'slab'*
2. *The stark reality of the 'luxury' apartments: the occupants' goods and chattels, personal belongings stacked and jammed up against the toughened thick green glazing panels of the bay window.*
3. *Identical resort-style foyers to each tower - each entry only differentiated by name. Columns bearing the weight of the massive transfer floor on which the load of the towers is spread out.*
4. *Podium, towers and driveways form a new topography of canyons and plateaus.*



"We created place-making at the roof level, not just at the ground level, in memory of the old buildings that had some roof activities."

Tony Ip

- 1 Mok Chui St, Kai Tak. First privately developed URA project at Kai Tak. High level of shared communal facilities and open space. Recreation deck on podium raised above ground on piloti; Residents' communal farm at ground level; Arrival gardens on some levels; Roof top view accessible to all rather than to one owner and typical 'Club House' (reading, fitness and other



- 2 Luna Apartment Tower, Wan Chi, Central HK. MAKE's interventions on a tight site with an existing approval and no GFA concessions in HK Central led to improvements that allowed three 'corner' apartments with openable windows on two sides offer daylight, ventilation and views. They added some (minute) outdoor space by considered design of the utility ledge, and shaded the facade as well, using perforated metal balustrades instead of glass and staggering the locations of these ledges floor to floor.

The project achieves generosity in public space by opening up a public space on an otherwise tight CBD site where adjacent buildings required access to emergency services and utilities

Guangzhou - Trading Capital Old Canton

On arrival in Guangzhou in South China, the assault on my senses was magnified. Hong Kong seemed positively tame in comparison. On the other hand, a delightful characteristic that struck me was the extent of large flowering street trees, especially thousands of bauhinia and fig trees. *Ficus Benjamina* everywhere.

Guangzhou is an ancient city transformed from Old Canton into a global city of wide tree-lined boulevards in just under 40 years. The vast roads and plazas of the Tianhe District - the new city centre east of the old Beijing Road city centre - are filled with global space. Glass skyscrapers including the Pearl River Tower at the junction of Jinsui Road/Zhujiang Avenue West designed by Skidmore, Owings & Merrill with Adrian D. Smith and Gordon Gill. Major public buildings - the Guangzhou Library, New Guangdong Museum, and the Guangzhou Opera by Zaha Hadid Architects. Glass walled apartment building complexes abound. The not-so-distant skyline of communications towers, and stadium engineering hijinks is barely discernible through the haze.



1 Vast shadeless plaza setting for public



2 Sunken pedestrian mall at Tianhe

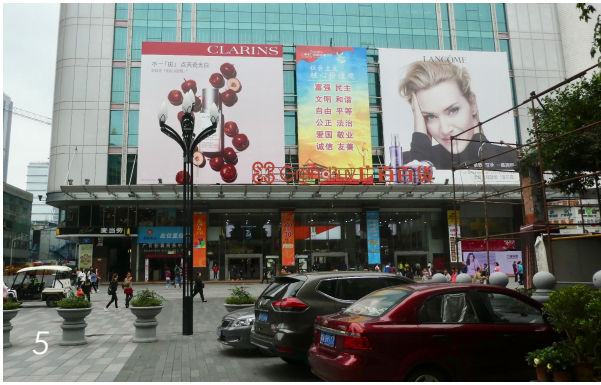
In the older centre, streets are a labyrinth of alleys and lanes so narrow and winding, that they can only be accessed by hand-drawn cart. Dade Lu leads to a vast network of pedestrian malls around Shang Jui Lu where hundreds of thousands of people throng on the weekends. The area around Enning Lu, known as Xiguan, contains some examples of Lingnan-style arcades and shop houses. The Lingnan school of architecture founded in the 1950s combined mid-Century Contemporary style with features of the distinctive local style to produce 'open' and clearly planned buildings which incorporated indoor gardens. In the semi-pedestrianised zone around the 'time-honoured shops of Beijing Road', walled ancient archaeological sites and crumbling tenements on narrow lanes lie side-by-side with new apartment buildings and huge shopping malls in the generic Western style rival bustling Buddhist temples.



3 Trees intensified in the older public domain



4 Pedestrian mall on Sunday around Enning Lu



5, 6 Western style billboards facing a monastery and temple across the street

Planning and urban matters

It was difficult to gather precise information about planning or building policy but I gained much from a detailed conversation with Prof Xiao Dawei and members of the SCUT Key Laboratory of Subtropical Building Science. Prof Xiao's team made a presentation on the evolution of Guangzhou urban housing development styles over the past four decades.

Mass housing layouts in the 1980s were typically designed as densely ranked rows of nine-storey apartment blocks, leaving narrow streets between them. For example Liuyun Housing Estate in which the whole block of a large urban grid of tree-lined multi-laned boulevards were developed.

By the 1990s, towers were more likely to be arranged on the perimeter of large urban blocks with substantial green courtyards in the enclosure (Donghu New Village, Wyang New Town and Lijiang Garden). This arrangement facilitated phased construction and building management and upkeep.

In early 1990s, a movement called City Construction had an alarming effect on city planning. Typically, large suburban residential areas with residential blocks in regimented rows were built by one developer. No public city roads cross these very large gated communities such as Phoenix City. For example, Qifu New Village has about 7000 dwellings and is totally car-dependent. This trend increased the demand for private vehicles, disrupted the urban road system and increased traffic emissions. At the same time the sharing efficiency of social resources and infrastructure, including schools and shops was reduced, causing dissatisfaction.

Also in the 1990's, developers' appreciation of the value of environmental landscape design grew as people demanded more communal open landscape space. By the 2000s, site layouts were more likely to respond to the topography of sites and the landscape became more naturalised and decentralised in suburban housing estates, such as Yajule Garden and Jinhaian Garden.

Multi-residential building design

During the 1980s to early 1990s, buildings changed from slab type apartment buildings to walk-up tower dwellings about nine storeys high with three to four dwellings per floor. These early tower buildings provided variety in dwelling layouts to adapt to the diverse needs of the housing market.

Larger multi-tower developments with communal facilities such as tennis courts, swimming pools and club houses on massive podia also began to make their appearance. Some facilities like kindergartens were provided for priority access or exclusive use of residents. These podia occupied large scale city blocks, with banks and commerce and public facilities like bus stations integrated into them. Liwan Plaza was given as an example. Most of these featured concrete external walls. The 30 storey Dongfeng Plaza displayed fully-glazed facades replete with internal blinds. This style appeared in Vancouver around the same time, where so-called ‘winter gardens’ were prone to overheating.

1 Four eras of housing



2 SCUT Team. Key Laboratory of Subtropical Building Science



Architectural stylisation was pursued mid-1990s to mid-2000s. Apartment buildings denoted as European, Spanish, Mediterranean, Hawaiian and so on, differentiated mainly by roof profiles, appealed to the perception and market psychology that exotic styles were highly desirable and superior to local design.

However, the Lingnan style of South China regional architecture based on natural ventilation and openness to gardens is well-respected, and others explored this approach in suburban developments such as Lingnan Garden and Lingnan Yueyuan.

New buildings in the urban renewal area the old city centre were more connected to the old buildings in terms of height, scale and proportion. A contemporary low-rise housing in Jiefangzhong Road was designed by the architecture faculty in the SCUT.

Several high rise residential buildings in the Tianhe district based on the modernist style were popular at this time because features like *brise soleil*, double height balconies and cross ventilation improved the living environment to an extent. These designs also provided a better balance between private living space and communal areas.

The earliest super high rise buildings (40 storeys) appeared around the same time in the Haizhu Bandao Garden development. The towers had eight or more apartments per floor in a cruciform shape arranged around a central corridor. Regardless of solar orientation, the apartments also emulated Hong Kong's unshaded fully-glazed bay windows.

Apart from this overview, it was difficult to gather information about building regulations or particular goals that the provincial government is seeking in terms of reducing energy. There is a national standard regarding daylighting and orientation in residential design. In all apartments there must be at least one room which is south-facing, that achieves prescribed minimum hours of sunlight during the winter solstice. It seems that external shading is not required by the government.

In terms of natural ventilation, the openable area and the percentage of openable windows needed in each room and each unit must be taken into account. Each bedroom needs to have at least one openable window. These statutory requirements are about health and safety rather than building energy per se.

From the late 2000s onward 'hanging gardens' have become popular. Another interesting feature of the residential characteristics of South China are split level balconies. (This building has a split-level balcony) The greater height between every two floors is good for more sunlight and ventilation, but it is unclear how well the balconies, which overlook and are overlooked by other apartments, work socially.

In other examples, two or more buildings are connected by bridges which are actually shared communal spaces on every second level. With limited open space on the ground level, the bridges give residents access to more of the building's communal spaces. SCUT researchers found mixed feelings toward these spaces on the part of residents. On the one hand, people like the open bridge communal space from a prestige point of view, because apartments on the floors with the corridors are much more expensive than those on other floors, but on the other, they consider them a waste of space. People are reluctant to use these shared spaces if it means sharing with other residents. "In China, the people don't like to talk to other people who they don't know....maybe the people communicate in the garden, not in the building." SCUT Researcher. A review of housing literature shows that this attitude is a universal trait that is not so different to the findings of social scientists from New York to Brisbane.

The practice of building-in balconies post-construction is forbidden. However enclosed balconies are allowed in the original construction if approved. If the balcony is to be enclosed, then the whole area is included in GFA calculations. If it is open, then half is included in GFA.



1. Split level balconies
2. Double height balconies
3. Canton Place. Image sourced from Zenx boardroom presentation
4. Canton Place
5. Large scale towers above podium



Super-Incredible Bangkok

Bangkok - gigantic, vibrant, relentless, garlanded, festooned, joyous and chaotic. Capital of Thailand, majority Buddhist nation, unique amongst Asian countries in that it has not been colonised by a foreign power.

Bangkok has a history of entrepreneurship and residents are often early adopters of new technologies and innovations.

The city is architecturally and culturally diverse. My study area was confined mainly to the Ratchadamri Road area, from the Elephant Head Bridge, in the prime shopping district, to Sathorn Road in Bangrak. Neighbourhoods are punctuated by the elevated mass rapid transport system and the grid of roads beneath.

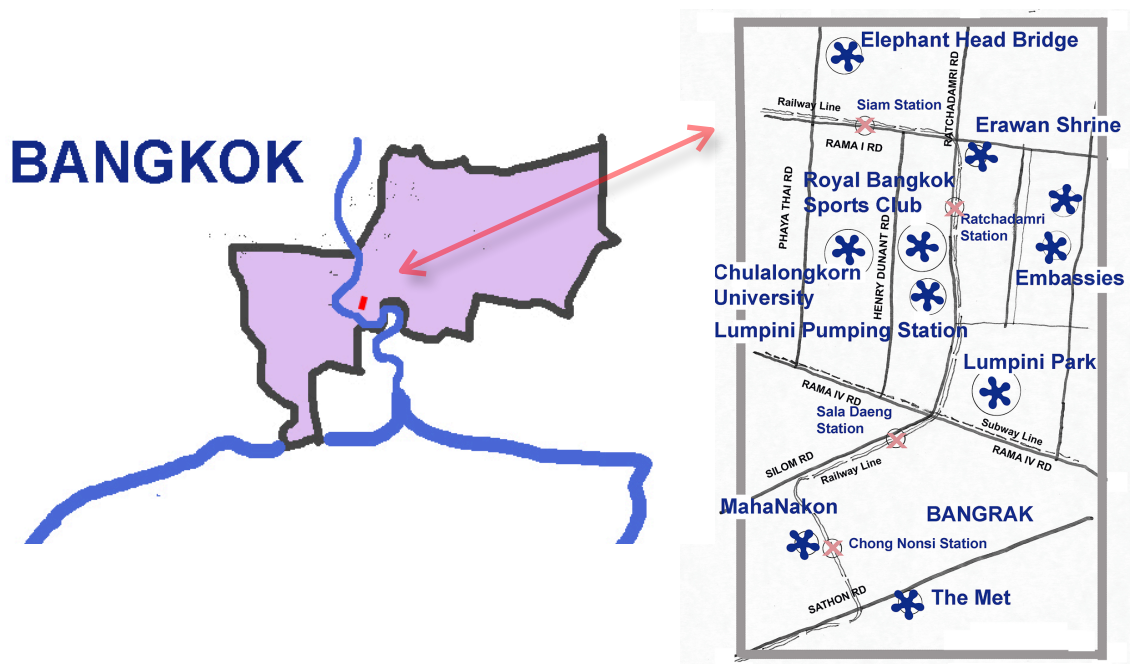
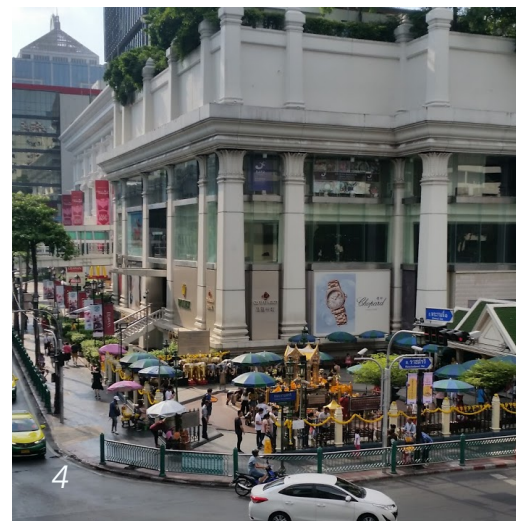


Figure 4. Bangkok locality map with main landmarks and indicative projects visited.

The Skytrain system running overhead rather than underground avoids the high water table and frequent flooding. It passes close by buildings at the first and second level and overlooking the streets giving a special type of vantage, passing by small shrines, international resort hotels in lush gardens, glossy and glazed walls of shopping malls walled palaces, the vast open spaces of the Royal Bangkok Sports Club and Lumpini Park, enormous fig trees, temples, and government compounds.

There exists a very large array of buildings with elevated gardens, far more than in Brisbane.

The juxtaposition of the glass MahaNakon Tower that houses the Ritz-Carlton Residences with tattered urban fabric was quite revealing. Here I also encountered the model for WindShell Naradhiwas at the Cube, the MahaNakon's display gallery.



1. Bodhi tree shrine
2. Slab and podium apartments
3. Apartments and hotels sit over high parking podiums
4. The Hindu Erawan Shrine carved out of the grounds of an international hotel.
5. Layers of infrastructure
6. Significant elevated infrastructure systems





1. *The Met*
2. *MahaNakon Tower*
3. *MahaNakon West face*
4. *Hansar*
5. *Windshell scale model*

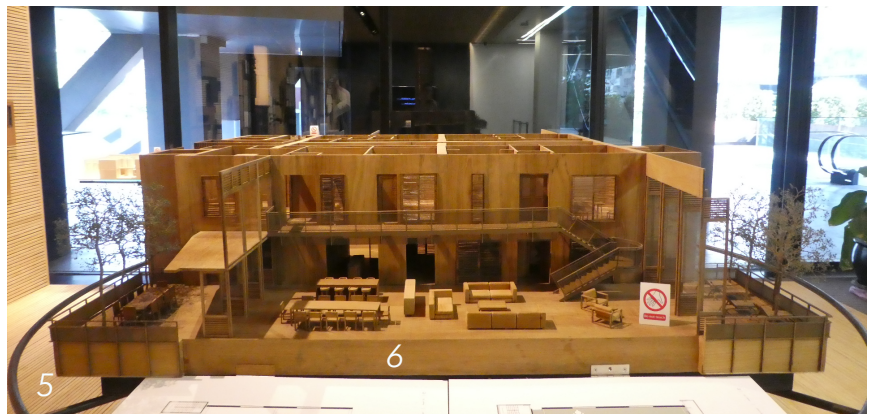


TABLE 3 BANGKOK APARTMENT BUILDINGS

BANGKOK, Thailand 19-22 April Tropical Savannah	Architect	Developer	Date	Typology	Notes
Windshell Naradhiwas 2108/1 Naradhiwat Rajanagarindra Rd, Chong Nonsi, Yan Nawa, Krung Thep Maha Nakhon 10120, Thailand	Building Designer Kevin Mark Low, Small Projects, Malaysia	PACE	Estimated Completion: 2019	28 Storey tower over 10 storey parking podium	Said to be entirely cross ventilate able
MahaNakhon Tower Soi Sueksa Witthaya, Khwaeng Silom, Khet Bang Rak	Buro Ole Scheeren	PACE	2018		209 luxury residences managed by Ritz Carlton (about 50 floors) + 155 room Marriot Hotel.
The Hansar Hotel , Soi Mahatlek Luang 2, Khwaeng Lumphine, Ket Pathum Wan, Krun Thep Maha Nakhon. Off Ratchadamri Road	WOHA			Mixed Use - hotel and apartments	
The Met 123 South Sathorn Road	WOHA	Pebble Bay Thailand	2003- 2009	Breezeway towers. Six towers separated by vertical breezeways and horizontal perforations bridged by layers of communal terraces and sky gardens.	One-unit thick apartments. Double height balconies receive good daylight. Frangipani trees give human scale to the facades. Air rises through the buildings vertical voids at velocities to ventilate apartments and sky gardens. (WOHA and P Bingham- Hall 178-179, 193.)

Singapore - Spaciousness

Singapore is contained and easier to understand physically than the other cities I visited. It can be held in the mind's eye. In fact you can see most of it from the public roof top and park at Pinnacle@Duxton, the 50-storey Housing and Development Board apartments on the edge of Chinatown. Except the parts that are underground.

The multi-layered city is a reality here. Entire urban areas and buildings are connected by pedestrian subways, vehicular tunnels and transit tunnels. Compared to other South East Asian cities, crowds are not as dense and life on the street seems much less hectic. People have become very used to the conditioned indoor climate. In Singapore no one wants to be in the sun. Privately-owned indoor malls are the real public spaces. Here the incongruous sight of office workers wearing winter jackets in the equatorial city is most pronounced. It's freezing in the tropics.

When Singapore became a nation in 1965 it had few resources and very poor housing. It built a city on low cost high density housing and has become a First World city state. But now, new problems of land scarcity, ageing population, low fertility and low growth, and decreasing housing affordability are surfacing. Singapore is on an island of 715km². It has grown physically by 23% over the past 50 years by land reclamation projects. However, unlike Hong Kong, Singapore cannot rely on the mainland for essential water, energy and food resources.



1. *Pinnacle@Duxton balconies and sunhoods*
2. *Pinnacle's roof top and Singapore skyline*
3. *Oasia Hotel, the Pinnacle@Duxton in the background*
4. *200kms of sheltered walks.*

The impression is one of spaciousness, but there are calls for careful planning to ensure neighbourhoods have good amenity and social spaces, not just tall towers, as the population grows by at least another 2 million people by 2030. The 2013 Masterplan brought in big gestures to 'green' neighbourhoods and support 'car light' connectivity and to piece all the green spaces together. It is now possible to cycle the whole of Singapore using park connectors.

Government Agencies

The Urban Redevelopment Authority (URA) is Singapore's national planning authority. Its task is to plan and facilitate the physical development of Singapore and ensure that Singapore's limited land resource is put to optimal use. Most of the land is owned by the state perpetually. Parcels are leased out to the private sector for 99 years. The government is committed to growth within that constraint. The Joint Town Council (JTC) controls industrial land and is tasked with creating new employment centres which are sub-regional centres.

The Building Construction Authority (BCA) is responsible for building regulations. It launched the first Green Building Masterplan in 2005 and is the lead agency for Green Mark certification for residential and non-residential buildings developed in Singapore, specifically for tropical conditions.

The Housing & Development Board (HDB) is responsible for public housing. It was established in 1960 to improve living conditions and provide affordable housing. The mission was "to house the nation", and it has achieved outstanding success. From 1968, Singaporeans could use their Central Provident Fund (CPF) to purchase their HDB flats. Now, the rate of home ownership is one of the highest in the world. 83% of Singaporean people live in apartments developed by the HDB with nine out of ten owning their properties. The HDB values progressive architecture and it builds genuine communities in precincts with a diverse mix of home types and building typologies.

The HDB has a very robust research facility and continues to build and develop knowledge of what people want, and is buildable. They are currently trying to develop how to kit out individual units to prepare them for tele-health and to allow people to stay in their own homes as they age. The Universal Design code has been around ever since housing improvement plans commenced around 20 years ago and lifts were retrofitted to every floor of HDB flats. All new dwellings are accessible and older ones are being brought up to code.

The HDB is also making a difference in things like city-wide services that have an impact on the city image and space, for example, they install pneumatic waste collection systems and reduce the need for large collection bins and trucks. They are also using district-wide solar power to harness renewables at neighbourhood scale and overcome the problem of small roof area of tall buildings compared to occupiable space. Singapore's public housing is accessible, adaptable, and flexible. Sub-dividable space means that apartments are configurable to purpose when it comes to multigenerational living. Apartment design is focussed on privacy and a sense of spaciousness, as well as connections to community. However, the HDB model does not include land cost in its development costs. Some worry that Singapore may not be able to afford this in the long run.

Condominium flats (private sector housing) form the bulk of medium to high density housing in Singapore.¹² Condominium housing requires a larger land area than HDB flat developments. Spaciousness is

¹² URA 2015 *Handbook on Parameters for Residential Development*, Singapore

the big difference between public and private housing, public flats usually being much larger internally than private housing in Singapore. However, there is usually more generous provision of communal and recreational facilities in condominium flats and many people aspire to owning privately-developed flats, seeing them as a symbol of being successfully middle class, despite their lack of private space compared to public housing.



Planning Guidelines¹³

Government agencies are very prescriptive about how they frame their planning guidelines. Residential development in Singapore is controlled by plot ratio and building height at the macro level. At the micro level, there are guidelines on the housing type and form. Plot ratio and building height are subject to planning evaluation depending on the locality. There is an incremental scale of setbacks according to building height.

¹³ ibid

The taller the building, the greater the requisite setback (up to 36 storeys). The setback requirement is the same for buildings above that height.

The URA grants bonus Gross Floor Area (GFA) incentives to encourage the provision of specific building features or uses. Essentially, the GFA of the incentivised features are allowed above the Master Plan Gross Plot Ratio (MPGPR) control. These bonus GFA incentives are given to help realise various planning objectives for the city. For example, the 'balcony' scheme encouraged tropical architecture while the lighting incentive scheme aimed to enhance the city's image and highlight the distinctive Singapore skyline. The GFA bonus is higher in some suburban areas and is restricted in high-density, high land-value areas in order to reduce negative impacts of increased density on the surroundings.

For a site that qualifies for multiple bonus GFA incentive schemes, developers are free to determine which scheme(s) to adopt and the quantum of bonus GFA to use under each scheme. This is subject to compliance with the guidelines of the individual schemes, and as long as the cumulative bonus is within the overall budget of 10% above the MP GPR. Incentives are based on published, transparent formulae and development proposals are assessed electronically.

Guidelines on controlling the minimum size of dwelling units.

At one time, Singapore developers were building very small units (35m²).

To counter this, the government controls dwelling size through a formula which determines the maximum number of units allowable based on the average size of units, rather than prescribing guidelines on minimum dwelling size.

Maximum number of dwelling units per development \leq MP Allowable GPR* x Site Area divided by 70m² (the required average size of apartments). * Excludes bonus GFA.

In this way, a variety of large and small units are permitted.

Green building

Singapore is committed to transforming the development industry and mandating higher performance in terms of energy and emissions in the building sector. Green Building (GB) policy is purposively linked to land-use planning. It is a prerequisite for urban development, with concessions encouraging development in strategic growth areas. It also drives economic development. As green technology replaces existing technology, new business development opportunities emerge.

The Building Construction Authority introduced Green Mark in 2005 as part of the first Green Building Masterplan (the third Masterplan was released in 2014, with updates in 2017). Green Mark is endorsed by whole of government including Urban Redevelopment Authority (URA) and Housing Development Board (HDB), Ministry of Environment and Water Resources, and Ministry of National Development.

Green Mark has been described as the tropics' answer to the US Green Building Council's Leadership in Energy and Environmental Design (LEED). It differs from LEED in four important ways:¹⁴

- It places greater emphasis on energy efficiency.
- Cooling of interior spaces using air-conditioning is a key consideration; and
- It has higher standards of measurement and verification.
- It is mandatory (to an extent).

¹⁴ Ibid.

Green Mark has a strong emphasis on substantial energy efficiency enhancements and uses precise instruments to monitor performance. Assessment tools include a carbon calculator and energy performance calculator. Design Stage and Verification requirements are highly technical and require sophisticated skills and tools.¹⁵

Four rating 'grades' are available: Platinum, GoldPlus, Gold and Certified. Since 2012, all newly constructed buildings and retrofits must achieve at least the 'Certified' grade, and all certified buildings must be reassessed every three years on the basis of actual performance. Two new categories of Platinum certification were introduced in 2018¹⁶:

Super Low Energy Building (SLEB) "The best-in-class energy performing Green Mark Building that achieves at least 40% energy saving based on prevailing code". This refers to 60% energy saving above 2005 building codes.

Zero Energy Building (ZEB): "The best-in-class energy performing Green Mark Building with all of its energy consumption, including plug load, supplied from renewable source both on-site and off-site." Building development should maximise the on-site renewable source first before exploring off-site renewable sources.

The government strategically links incentives for Green Mark:

- Green Mark Incentive Scheme for New Buildings (GMIS-NB) - cash incentives for Green Mark Gold rating or higher.
- Green Mark Gross Floor Area Incentive Scheme (GM-GFA) - additional GFA for achieving Green Mark Gold^{Plus} and Platinum standards - tied to land sales in strategic growth areas.¹⁷
- Because the GM-GFA incentive scheme has a strong emphasis on substantial energy efficiency enhancements, requiring intensive professional input at the design stage, special financial incentives are provided to pay architects and engineers for their additional efforts and time spent on green building.¹⁸

Schemes are monitored, evaluated and updated regularly to ensure standards are being met, and to avoid unintended consequences (for example exploitation of a GFA concession for uncovered balconies led to tiny apartments with over-scaled balconies and was withdrawn as the trend emerged).¹⁹ Other GFA incentives have been provided to encourage environmental decks - basically car-free outdoor recreation area with greenery.

The Sky Rise Greening Initiative (SRGI) provided a subsidy up to half the cost for installing green roofs and green walls and was phenomenally successful. Initially there was resistance to green roofs in Singapore. 'Skyrise Greenery' was a government initiative to encourage building owners to upgrade their roof tops to green roofs. The government subsidised upgrades for a fixed period of time. The seed funding had the desired effect of typological transformation to greening and supported targeted technical transformation to a 'green roof' industry. WOHA's tropical high-rise residential tower, Newton Suites was the recipient of a Sky Rise Greenery Initiative subsidy.

¹⁵https://www.bca.gov.sg/greenmark/green_mark_buildings.html Singapore Building Construction Authority

¹⁶ Building Construction Authority (2018) Green Mark for Super Low Energy Buildings. Singapore.

¹⁷ Queena K. Qian, Ke Fan & Edwin H. W. Chan (2016) Regulatory incentives for green buildings: gross floor area concessions, *Building Research & Information*, 44:5-6, 675-693, DOI: 10.1080/09613218.2016.1181874

¹⁸ Author's note: I have no further detail on this but I assume this was built into the procurement pathway and linked to contract value and building's performance after at least a year of occupancy, to encourage both developers and design-build teams to engage beyond 'business-as-usual' to achieve high levels of performance.

¹⁹ Safdie Architects, personal communication with R Kennedy, April 2018.

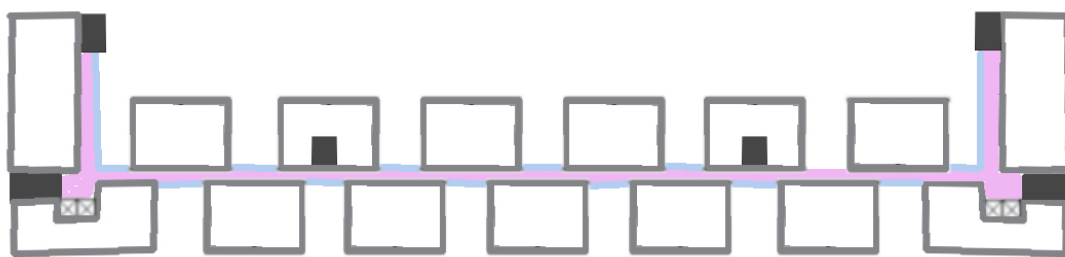
The key to these types of initiatives is to provide enough funding to give business and industry enough time to develop skills and products that the market can use to meet new regulations. While sky rise greening is a visible move, Singapore has used the same strategy to upgrade less visible elements of green building like changing cooling towers to chilled water systems and in the process have developed new markets in components and contracting.

Towers on pillars are the main apartment building forms in Singapore. In terms of urban ventilation the Singapore model is far better in terms of improving urban air ventilation than Hong Kong's high-rise towers on podiums. The shaded undercroft on ground level also provides a welcome sheltered cool place.

The apartments and sky gardens in projects like Pinnacle@Duxton, SkyVille@Dawson and others in Singapore which are comprised of interconnected clusters of towers are directly ventilated by air that rises through the vertical breezeways and is directed through horizontal breezeways.

“They can ‘breathe’ without the need for artificial cooling.”²⁰

WOHA describes these clusters as a large scale permeable three-dimensional lattice that could be extended as an urban megastructure in the city of the future. It is possible to discern the heritage of these interlinked cross-ventilated towers in the heritage of apartment buildings in Asia. Two Hong Kong examples identified by Xue are the North Point Estate²¹ and Clague Garden Estate. North Point was the first Housing Authority project, 1957, now demolished. Designed by Eric Cumine, staggered planning of groups of dwellings around open corridors produced light and cross-ventilation in dwellings. The 1988 Clague Garden Estate HK, was a multi-tower development designed by Palmer and Turner.²² Each of three blocks consists of four towers laid out in a square and separated by vertical breezeways and linked by walkways every third floor, and by ‘sky gardens’ on levels, 3, 12, 21, 30 and 39.



Early work in apartment design and planning for air and light. North Point Estate. HK Housing Authority 1957 had staggered building zones allowing light and cross ventilation to circulation spaces. (Source: Diagram redrawn from Xue p26 Fig.2.1)

²⁰ WOHA and Bingham-Hall P (2016) *Garden City Mega City* Pesaro Publishing. p176.

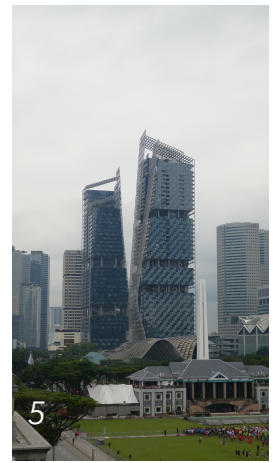
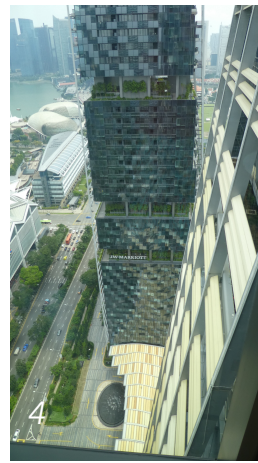
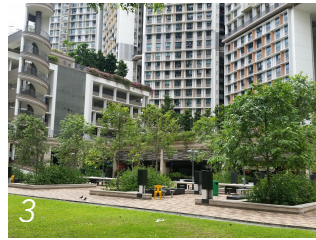
²¹ Xue p.26

²² Xue pp 33 - 34.

TABLE 4 SINGAPORE APARTMENT BUILDINGS

Case	Architect	Developer	Date	Typology	Notes
SINGAPORE 22 April - 3 May Equatorial					
South Beach Towers 38 Beach Road	Foster and Partners and Aedas Roland Schnitzer		2015	2 towers on whole city block; South Tower hotel and apartments (35); North Tower offices (45)	All apartments are naturally ventilated. Air well provides cross-vent opportunity. Green Mark Platinum Rating mandatory part of brief.
Sky Habitat Bishan	Moshe Sadie Architects Jaron Lubin and Charu Kokate	CapitaLand Mitsubishi Shimizu	2015	Two 38 Storey towers are composed twin 7m wide sections with a 7m space between. The north tower splays at the based forming a 15 storey open-sided atrium. connected at ground, mid-level and rooftop by bridges with communal space.	Circulation is organised as a system of outdoor streets on each level. Open stairs connect all levels and double as required egress. Primary emergency egress via enclosed stairs.
Pearl Bank	Archurban Architects and Planners Tan Cheng Tsiong	HDB	1976 - 2018	Tallest residential tower in South East Asia when built. 288 apartments	Single tower, multi-core Cylindrical C shaped. Four types of split section apartments. Sold <i>en bloc</i> and demolished 2018.
Golden Mile	Design Partnership Founded 1967 by Koh Seow Chan, William Lim and Tay Keng Soon Now, DP Architects		1974	One 'Golden Mile' building 16 storey terraced slab.	Originally programmed as a vertical city containing amenities and outdoor social spaces. A mile-long pedestrian promenade linked each Golden Mile building. Concept was new strategy autonomous from vehicular streets below.
Peoples Park	Design Partnership Established 1967 Now, DP Architects	HDB	1970s	Housing 'slab' multiple access points - offset stair towers and gallery access.	Urban Renewal era exemplars
ECO Bedok Court	DP Architects Formerly Design Partnership			More than 1000 units. On a single plot - Over 100 different activities for residents in this private park.	

Case	Architect	Developer	Date	Typology	Notes
Bedok Court Condominium 297 Bedok South Ave 3 Singapore	Cheng Jian Finn			Multiple buildings Stepping form	Successful bio-climatic and socio-climatic design. Each apartment has an external verandah and an internal forecourt. See Udaykumar.
Newton Suites 60 Newton Road	WOHA Wong Munn Sum and Richard Hassell		2007	36 storey single tower	Received Skyrise Greenery subsidy. First tower to realise over 100% Green Plot Ratio (vegetal replacement on site) The URA established GPR 1 as minimum requirement.
I Moulemein Rise	WOHA		2001	Single tower.	The bay windows designed as 'monsoon windows' - an opening in the horizontal surface, allows fresh air to the apartment even during the heavy monsoon rains. Also features full sunshades and rain overhangs.
SkyVille @Dawson	WOHA	HDB	2007-2015	Residential megastructure. 12 x 47 storey towers, in a triple diamond-shaped plan linked to three central lift cores forming vertical breezeways.	Every apartment is one unit thick, is cross ventilated, receives daylight and has views. Human scale is maintained by location of tropical community spaces as artificial ground levels, every 11 floors. WOHA and P Bingham-Hall Page 182-183, 192
Pinnacle @Duxton 1 Cantonment Road Singapore.	ARC Studio Architecture and Urbanism and RSP Architects Engineers and Planners	Housing and Development Board	2010	First 50 Storey HDB estate and first to be procured by international design competition. 1848 units 8 towers interconnected by two 'sky bridge' parks	Publicly accessible roof top
SkyTerraces@ Dawson	SCDA			see info on Singapore Design Centre photos - google	Winner of 2016 RIBA Award for International Excellence
EDITT Tower Singapore (unbuilt)	Ken Yeang TR Hamzah and Yeang		Unbuilt		Unbuilt competition winning scheme



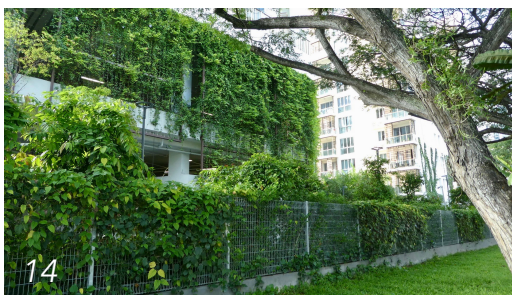
1. Newton Suites
2. Nouvel 18
3. SkyVille@Dawson
4. Sth Beach Tower
5. Sth Beach Road
6. Sky Habitat Towers
7. Sky Habitat ext stairs
8. Pearl Bank
9. Pearl Bank



10. Peoples Park access elevation
11. Peoples Park stair well

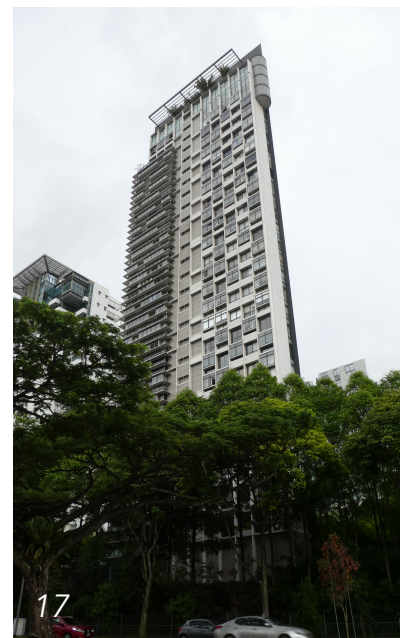


12. Golden Mile
13. Golden Mile street view



14. ECO and Parking Pavilion
15. Bedok Court ECO behind

16. 1 Moulemein Rise
17. SkyVille@Dawson



Chapter conclusion

The complexity and contrasts of these huge hot and humid cities is remarkable. They are planned and haphazard; spacious and messy; dazzling and dazing; vast and unwalkable, yet walked and trolleyed. Vast wealth and extreme poverty co-exist.

The scale of population and infrastructure challenge is vastly different from Australian cities. Hong Kong and Singapore are high-rise high-density cities. In sprawling Guangzhou and Bangkok, very tall buildings are juxtaposed against very low rise tracts. They have all invested in state-of-the-art mass public transport to varying degrees while Australian cities are still largely low-density and highly car-oriented.

In these crowded cities that are experiencing ever-increasing urbanisation, it seems that residents are locked into a vicious cycle of diminishing liveability and increasing un-affordability. Apartments in Hong Kong get smaller and smaller, and policy makers attempt to compensate for lack of private space with communal facilities. Not everyone has access to air conditioning for cooling in their homes and in the overheated tropical urban environment. This poses as many health problems for them as having no access to light and natural ventilation, and having to rely on air conditioning continuously. Heat and humidity caused by the Urban Heat Island effect may even get worse in the next ten years or so as the effects of global warming intensify.

The architects I interviewed for this study are achieving exceptional outcomes against the backdrop of the many challenges presented in these cities.

1. SkyPark by URA
2. SkyPark by URA
3. SkyPark detail
4. 88 Kai Yee St



Glass towers near Langham Place, Kowloon

4 OUTSIDE THE COMFORT ZONE

Themes in conversations with architects in S.E.A.

The previous chapter contextualised the physical and regulatory environments within which architects are working and achieving exceptions to the status quo.

This chapter presents the results and findings of interviewees' responses to a range of questions aimed at throwing light on the motivators and drivers that brought non-standard designs for apartment buildings to fruition. Four main themes emerged which can help explain how leading architects achieve different outcomes from the majority of apartment building projects of the same scope and complexity.

Firstly, they are committed to climate-responsive place-based architecture. Second, they are motivated by making a difference at a far broader level than the individual building project. They are actively involved in research and are interested in the practical application of research outcomes to all spatial scales of urban structure. Thirdly, they are committed to understanding clients' pragmatic objectives and matching ideas about the future and sustainable design innovations to these business needs. Fourth, they have thorough knowledge of the regulatory environment and use this to innovate rather than fall back on limiting 'acceptable solutions'.

In summary they use their research findings to promote integrated architectural strategies that deliver value for developers, liveability and affordability for occupants, and amenity for the city. In terms of their views on future directions for next generation apartment building, three concepts stand out. (1) High density housing is integral to the sustainable city of the near future, but the issues are much broader than the typology alone. (2) Effective planning policies and building regulations with mandatory requirements and incentives to eliminate carbon emissions rapidly are needed urgently. (3) Custodianship of external environments and rethinking planning policy is essential.

Theme 1 - Priority Design Principles

'When you build in the tropics you have to have the architecture of the tropics'.

Charu Kokate, Safdie Architects

"Climate-responsiveness is the first step in ecological design. Even in nature all the plants and organisms of a particular location respond to climate. The climate determines the organisms and so in a similar way our buildings have to respond to climate to become passive low energy building before we start looking at any technology." Ken Yeang.

The first and foremost architectural principle pursued by the architects I interviewed was cross-ventilation. Deliberate design to induce air flow through dwellings - whether required by planning codes or building regulations or not - was the starting point to utilising passive design principles to control solar radiation (thermal mass, orientation and appropriate shading) and daylighting, and make usable indoor-outdoor private space. In some jurisdictions, cross-ventilation is required by law: *"L-shaped configurations,*

or corner units are not enough ... cross ventilation and the fire protection requirements for smoke dispersal also mean that you have to articulate your units." Hui Min Chan, Director DP Architects,

Segmentation of form vertically and horizontally was a key strategy for physical configurations that support cross-ventilation, in concert with the organisation of horizontal and vertical circulation and access. For example, Pearl Bank was organised around multiple cores and single-loaded access.

In more recent designs, stairways located on the outer edge of buildings instead of buried in an internalised central core, are more user-friendly and can be day lit and ventilated. The Met in Bangkok and SkyVille@Dawson in Singapore are two examples of WOHA's breezeway tower developments where all the circulation is naturally ventilated and not climatically controlled. These embody the principle of the 'One Unit Thick' towers²³ clustered around vertical breezeways, specifically to achieve low cost, low-maintenance, passive ventilation and lighting.

Interviewees were not inclined to use glass as the default material for the external envelopes of residential buildings they design. Where used, glass was deliberately applied for daylighting and views, and is shaded.

"We are never going to do a project on the Equator where we don't take the glass and recess it within the frame. Even where certain projects require bay windows, we put screen systems on top of them to entirely shade them." Jaron Lubin, Safdie Architects.

Meanwhile, external shading in Hong Kong and some Chinese cities was very difficult to achieve. It is not required by regulation and if proposed, must be an integrated part of the external cladding, the depth of which is seriously restricted. MAKE used the HK regulations and lateral thinking to achieve their design objectives within the GFA rules. A multi-functional design approach provided wall shading, balconies and more amenity for residents. *"We wanted to avoid glass balustrades on the small balconies so designated balconies as utility platforms, which are required to be open and cannot have a glass balustrade. The staggered layout of balconies shades window-walls below."* Sean Affleck.

Multiple green levels and variety of outdoor communal spaces throughout buildings are becoming common in cities and developments I visited. The viability of vegetation on buildings seems to have varying levels of success depending on local by-laws. The architects interviewed actively incorporate meaningful vegetation at ground level, mid levels including vertical greenery and roof tops for the purposes of lowering ambient temperatures, cooling buildings and reducing cooling loads, as well as presenting a 'green' view for residents and adding discernible human scale to tall buildings.

Yeang's approach is to design buildings as authentic living systems. *"We are not just putting plants in the buildings - we design habitats within the buildings. And some buildings have several types of habitats, on the roof, within the atria, within the ground, green walls, in containers within the buildings. But we have to design habitats - because having habitats mean we start to look into the native fauna we want to bring into the site and we correlate the fauna with the flora of different habitats."*

Applicability of design principles to mainstream developments

²³ See WOHA and P Bingham-Hall (2016) *Garden City Mega City: Rethinking Cities for the Age of Global Warming*. Oxford: Pesaro Publishing pp.184-185.

The projects designed by the architects I interviewed ranged from 'luxurious' condominiums, with apartments upwards of 250m² with views over the ocean, large balconies and planters, and private lifts taking residents directly into their units, to public housing projects in high rise towers.

The applicability of the design principles to more mainstream apartment projects was not questioned by the architects.

"Yes this is a luxury development, but all the ideas are free. All the principles are free. The compact streets and the self-shading character. The funnelling of the winds; the natural ventilation in the buildings. These ideas are all the standard vocabulary the architect can use." Roland Schnizer, Foster and Partners.

"The core principles of the project are generic: to provide air and light, to provide windows that do not overlook neighbours, and to provide spaces for both indoor and outdoor living." Jaron Lubin, Safdie Architects

"Sustainability and enjoyment are not mutually exclusive. Yes we want it to look beautiful, yes it must be elegantly detailed but that is not the whole story. These other things are where our innovations lie and (architectural critics) are not even noticing them!" Richard Hassell, WOHA.

Respondents asserted that architects have a responsibility to do better, rather than settling for standard 'acceptable' solutions to justify lack of innovation.

"Everyone is obliged to follow the same local codes and regulations. It's how you make the most of the rules to the architectural advantage rather than produce run of the mill extrusion buildings. Architects can do this without sacrificing the fundamentals of human liveability." Charu Kokate.

Respondents believed that more critical discussion regarding design quality is needed in the broader community in counter-point to image-driven understanding and expectations. The general public and professionals need assistance in developing objective judgement and clear focus on the rationale of fundamental design principles, how they are embodied in buildings and how they benefit the occupant. Photographic imagery is often the only information the general public has to go on. It is generally presented with the express aim of supporting the marketing concept that having a good view is the most desirable feature of an apartment dwelling. The reality of life for occupants of the built object is often different to the dream.

Theme 2 - Design theory-building research and testing

Research and exploration of ideas beyond the individual building, addressing bigger picture concerns, are key components of leading architects' practice. Experimentation and testing of theories are present in how they develop innovative and practical solutions as well as how they define and measure their design success.

Several architects I interviewed are public intellectuals who actively engage and educate the community, the development industry and regulatory authorities through their scholarship, authorship, publication and dissemination of ideas through publications, exhibitions and lectures. Sharing the ways in which the buildings can be made more sustainable and enhance liveability, and asking for commentary and input, is a major part of their business and marketing plans, but is values-led.

“The more people who listen, the more it gets traction.” Richard Hassell

For example, architects like Richard Hassell, Ken Yeang, and Tan Cheng Siong, acknowledge that ‘green’ buildings can only have piecemeal and minimal benefits, and they are constantly searching for climate-resilient urban scale concepts that encompass four infrastructure domains - natural ecosystems, hydrological systems, the human social and economic system, and engineering and technological infrastructure.

“No matter how green it is, if the building is connected to an energy grid in which the energy comes from fossil-fuels, then it makes total nonsense of designing a green building.” Ken Yeang

Dr Yeang asserted that the wide discrepancy between nature and what the existing built environment is, how it performs, what it uses as energy and materials, is the cause of environmental devastation and impairment. Yeang’s guiding principle is that the built environment must imitate nature and acquire the properties and attributes of ecosystems. He uses a biodiversity matrix in his approach to architectural design. In this way the whole building becomes a total living system and not just a building with vegetation in it.

According to Richard Hassell, WOHA invests extensive enquiry and design research in futurist studies and have developed a deep body of work on rethinking cities for the age of global warming. They conceptualise new urban prototypes for making cities of the future in which individual buildings are merely components within a self-sufficient city system. Innovations WOHA have achieved in discrete projects are the precursors and demonstrate how incremental change can occur on a wider level at all spatial scales.

As well as re-imagining city shape and structure, WOHA has developed five measurable indices and uses them to evaluate the social and ecological performance of their own high-density residential buildings and precincts.²⁴

- Green Plot Ratio - landscaped surface area compared to site area.
- Community Plot Ratio - area of community space allocated within the site area.
- Civic Generosity Index - the extent to which a development facilitates the public life of a city.
- Ecosystem Contribution Index - the degree to which a development supplements a city’s ecosystem.
- Self-Sufficiency Index - a development’s capacity to provide its own energy, food and water.

They conduct these measurements on behalf of a city’s residents, rather than its property developers, and demonstrate how to factor a social and ecological rating system for all city developments into property investment formulae.

Safdie Architects revisited *Habitat ’67*, Moshe Safdie’s competition-winning housing project for Montreal Expo 67, to examine the concept for contemporary dense Asian cities. They developed a high-rise model that achieved cross-ventilated dwellings with generous outdoor spaces. The stacking and stepping attributes of the original Habitat were a major aspect of the architectural design intent of the *Habitat of the Future* concept. *“When Moshe Safdie began to lecture about this concept ... CapitaLand of Singapore invited us to do a project with them.”* Jaron Lubin. (Sky Habitat, Bishan)

²⁴ WOHA and Bingham-Hall, P. *Garden City Mega City* pp.206-209

In Hong Kong, where the developer-led and market desires for views and large windows dominate development culture, curtain wall residential buildings have proliferated in the last decade. Tony Ip with Ronald Lu and Partners conducted research with the HK Buildings Department on how to save building energy. Their analysis showed that under existing planning constraints which tightly controlled GFA, the chief parameters available to effect energy savings were control of heat transfer through the building envelope and encouraging ventilation. This research led to the development of the HK Residential Thermal Transfer Value (RTTV) for wall glazing and roof materials, and the Natural Ventilation Value (NV) which are key measures in Hong Kong's BEAM rating system.

Tan Cheng Siong, one of Singapore's so-called Pioneers, continues to lead Archurban Architects Planners in exploring future urbanism and the future urban challenges including addressing under-utilisation of land. He is investigating the second and third wave of high density urban living. His research is driven by concern for the future of a healthy society. He notes that conflict and contested space are the new social and cultural norms in high rise cities where land scarcity and affordability is aggravated by present development and planning models. These are the social-economic aspects of cities which architects are trying to change through the hardware.

"We were called the Pioneers - we wanted to have a new city, a new life, a new country. Those were the days when we were poor - we didn't have the energy, the economy - they were just very basic - we were trying to move from slums to proper organised homes. Singapore became different when we did high-rise high-density housing. Our public housing now is world famous and people want to come and learn from us. Some Asian countries are starting what we started 50 years ago. But we are in a different mode now. We are in a different stratum. We are now considering community that has little to do, we are now considering virtual reality homes; we are talking about a different kind of society."

Not only is Tan proposing new typologies and paradigms for the city of the future with his *Skyland* concept, but he is also exploring the impacts of virtual reality and societal and demographic change in high rise cities like Singapore. *"It is very complex situation which is really beyond infrastructure, beyond the built frame. What are all these boxes for? What is all this fantastic architecture for? Architecture is going to be totally different."*

Theme 3 - Client leadership, value and values

Client leadership is key to developing exceptional projects. Alignment between clients' vision and the way architects' proposals met their objectives was the key to achieving projects that exceed the 'business-as-usual' paradigm. For developers, yield, a focus on the views available from proposed apartments (panoramic or otherwise) and raising the property value were almost always the key drivers, yet their own rules were allowed to be changed for the right reasons. They were willing to experiment with new ideas on 'live' projects if it had clear benefits.

Opportunities to implement projects that break the mould are limited without client leadership. However, regarding whether the desire to produce climate-responsive sustainable liveable apartments was a particular client's project driver in particular projects, interviews revealed a spectrum of responses that ranged from 'they saw value in it' to 'they had a vision and were very passionate...' to 'people come to us because we do super-green buildings - they just want to have a super-green building like the ones we do.'

Some developers valued architectural design as a strategy to differentiate their product from the market and were searching for an 'alternative to the glass towers and extrusions you see all over Asia'. For example, the distinctive stepping form of Sky Habitat at Bishan provided an overt visual statement of liveable outdoor space that people could recognise. "*We were matching the aspirations of what we wanted to do ourselves as designers, to an extremely focussed brief from the client, and also a very interesting list of incentives and policies from the government.*" Jaron Lubin (Safdie Architects). Such clients were more likely to use an integrated decision-making methodology involving key participants from the point of project inception.

For some developers, low energy design was not important at all unless compelled by local regulations. They were more interested in the image or the 'look' of the building than wholistic environmental performance. In some cases, the image the client was seeking was coincidentally linked with better apartments with better environmental performance. For example a respondent noted that 'the initial cost to the developer was greater, but the more integrated image was a feature that they were very keen to demonstrate to a potential buyer, and they could put money against it'. Thus market expectations also play an important role in promoting innovative proposals. Moreover, image-conscious developers' emphasis in decision-making and how they worked with consultants in the design process was linear rather than iterative. They were less inclined to bring in sub-consultants until much later in the design process.

Various respondents noted that the quest for city living spaces to feel 'more like a house' was a recurring theme. This was seen as a reaction by developers to large scale buildings, where building form, layout and materials contribute directly to anonymity and lack of community interaction. They wanted to redress residents' sense of lost control over indoor climate comfort, and provide space for home-like activities like having guests and hobbies. They were seeking to break down the hermeticised experience of tower dwelling, and were looking for ways to achieve the attributes of home. Phraseology during the early briefing stages included the 'family house in the sky', 'bungalow in the sky', 'villas in the sky' and so on. Though these developers' previous records may have focused on typical standard apartment buildings similar to projects found the world over and marketed as 'high end', they saw significant benefits in departing from the generic approach.

The client's charter or mission was another strong factor that presented opportunities for architects to propose innovative solutions. For example, the Hong Kong Urban Redevelopment Authority (HK URA) has a long history in Hong Kong property development in partnership with other developers but the Mok Chui Street condominium project was the first development where the URA took sole control and drove the vision. As a quasi-government department, led by 'passionate sustainable design advocates' social and environmental sustainability rated highly in their key concerns because it was one of the first buildings in the Kai Tak Urban Renewal area.

The Singapore Government set major measurable environmental and social parameters in its brief to consortia bidding for the right to develop the South Beach Road project. For example, a Green Mark Platinum rating was a requirement and stipulated natural ventilation for 100% of the residential component. Computational fluid dynamics (CFD) verified that every apartment could achieve cross-ventilation at the benchmark wind-speeds set by GreenMark.

From the architects' accounts, the most engaged clients and developers have typical characteristics of 'place-entrepreneurs'²⁵: strong personal associations and ties to the locality; are personally embedded in the

community; have local knowledge and expertise; value diversity over homogeneity and gain significant psychological benefits from developing a place-based project.

The dialogue between 'concept' and 'delivery' and end-to-end design throughout the procurement process was also important for project success. Nevertheless, few private developers truly formally assessed the social and environmental success of their vision, post occupancy. The sale of units was their first priority and first measure of success. Any formal evaluation regarding social or environmental performance was considered to carry the risk of negative feedback and better avoided rather than create any perception of disadvantage in the market.

Post-construction evaluation was part of the methodology of some of the architects I interviewed but it was generally undertaken from the point of view of their own research and development strategy rather than directly on behalf of clients. For example, Foster and Partners' studios around the world contribute to an independent engineering and sustainability team that travels globally specifically to assess the reliability of the firm's own building design performance predictions.

To TR Hamzah and Yeang, evaluating project performance is intrinsic in the entire ecological design process. *"It's not a case of topping up our fee to do post-occupancy evaluation - it's a case of the minimum fee that we need to do our work."* Ken Yeang.

Like developers, the architects' motivations were also essentially commercial in that they need to operate profitably. They also benefited from visibility of high-profile completed projects. Typically they derived satisfaction from their involvement in designing better apartment buildings for people to live in.

"The value for the developer is about the view, but you're working on liveability and the view is accounted for naturally. Maybe people don't quite appreciate what (good design) gives them but it gives them light from both sides, connection with nature, all those sorts of things... people like that". Sean Affleck MAKE

For some, the motivation is purely internal and is the driver of their entire ethos. *"Sustainable design is an ethical issue. That's what we do and have been doing for nearly forty years."* Ken Yeang

Finally, the respondents frequently referred to the environment, society, place-making, and how memories enrich a city, noting that economic uses are not the only things that matter in city making. Site issues and ethical choices regarding public amenity were also important. Careful attention to the specificity of place was high priority with several interviewees discussing how they take up urban implications in the design of the singular piece to deliver a physical outcome that is beneficial to everyone.

Theme 4 - The power of good policy: the regulatory environment

Several strong themes pertaining to the regulatory environment emerged. First, thorough knowledge of regulations is necessary in order to innovate. Second, a strong sustainability agenda with formal regulatory processes is beneficial. Interviewees support clear regulations with clear compliance targets and verification. Third, respondents were also highly supportive of regulatory incentive schemes that match desirable architectural attributes. They see certain incentives as opportunities to move a developer toward an architectural innovation that will benefit the city. They engage proactively with regulations and incentives to improve them.

Respondents valued a regulatory strategy which was integrated and consistent across planning, building and economic development policies and actions. The 'right kind' of regulations could deliver positive change to the typology of high-density apartment buildings, and could even achieve transformative change for cities.

"Regulation can tell people exactly what they need to do ... and what they need to do if it's not green."
Roland Schnizer.

Talking about the power of good policy, Jaron Lubin cited Singapore's Skyrise Greenery Initiative as an example: *"You can see the effects of it everywhere. In fact if you're asking young children growing up in Singapore now, the notion of living in a community that has sky gardens and mid-levels with planting - it's just kind of common.... And if you don't have that, commercially you're a failure.... People go: Oh, where's my? I'm not going to buy there because it doesn't have that amenity"*.

Respondents also cautioned against the pitfalls of some well-intentioned regulatory controls. All of the Singaporean interviewees mentioned the debacle of the balcony incentives which eventually led to imbalance between indoor and outdoor private space, and was discontinued. Developers were offered bonus GFA to provide unroofed balconies but certain configurations led to small units with outsized balconies.

Some pointed out a growing imbalance between increasing statutory spaces and decreasing affordable apartment size that could have the unwanted effect of decreasing functionality and liveability of apartments in Singapore. For example, there was general support regarding Singapore's Universal Design (UD) regulations which are aimed at ensuring residential buildings can continue to accommodate people as their mobility changes, either through health or ageing. There is a very clear BCA guideline and it is updated every few years. However, some were concerned that the regulatory spatial requirements for 'ageing in place' placed unrealistic expectations on private developments. *"The bathrooms and corridors are getting enormous, but people can't afford larger apartments - so you end up with an apartment that is all bathroom and corridor."* Despite land costs being the major component, there is a limit to how much a developer can afford to build and expect to be able to sell at an acceptable market price point.

GFA Incentives

In Hong Kong and Singapore it is evident that the governments use development incentives deliberately to stimulate certain outcomes that exceed compliance goals. Singapore seems to be leading the way in terms of alignment between incentive policy and design aspirations.

Compared with HK's BEAM rating system, architects rated Singapore's Green Mark system to be more effective because it is tied to regulations and clear development incentives that architects can promote to improve building liveability and sustainability. Whereas in Hong Kong, few private residential buildings get the higher rank in the green building scheme. The potential returns for BEAM+ Certification are not enough to incentivise private developers to pursue them. Even though BEAM registration is required, approval processes are not supportive of designs that exceed compliance benchmarks. Paradoxically, schemes that fit within the defined envelope rather than claiming GFA bonuses by using sustainability incentives, are approved faster, which of course appeals to developers to whom time means money.

Respondents valued transparency in formulae for calculating GFA bonuses. The Singaporean system publishes exact formulae on how a bonus is calculated, and consistently applies these formulae with the

help of robotic assessment. Singapore experiments with incentive schemes, but they are monitored closely and are changed in a timely manner if they are abused or are anti-productive.

Game-changers: strategies for future liveability

Three main themes emerged regarding strategies for future apartment buildings.

Firstly, the issue is wider than the typology.

“Whether there are tropical versions of apartment buildings that are relevant - I’m sure there are, but other forces are coming in to negate this..... If you don’t have great built environment, you are that much poorer - environmentally, economically and socially.” Tan Cheng Siong.

Next, mandatory green codes are needed urgently. Interviewees were strongly aware of the Paris Climate Agreement and some made a strong argument to adopt mandatory green codes, rather than voluntary rating systems, on a wide-spread basis in order to impact change to the built environment rapidly and extensively. The sentiment was that voluntary rating systems like Green Star, LEED or GreenMark Platinum have not made much of difference to carbon emissions compared with the task ahead to meet benchmarks on carbon emissions targets set in the Paris Agreement.

“We need to go to carbon zero energy emissions. That’s where we need to be - that’s where we want to go. We need to go to Carbon zero buildings.” Roland Schnizer

Green Mark has already introduced the Super Low Energy Building and Zero Energy Building ratings but these are still voluntary. Moreover, Ken Yeang asserted: *“We must regenerate natural systems. It is very dangerous to look at ecological design only on carbon emissions and carbon neutral design. We have to look at design holistically, with ecology and the factors of the locality.”*

The interviewees acknowledged that achieving zero carbon is a major challenge, height and small roof surface area being the inevitable dimension in the current high-density contexts but horizontality being the critical dimension for greening and solar energy collection. High-density buildings that generate all the energy they need on site are not likely to be tall individual towers.

Several ideas were canvassed. Alternative density models should be sought in order to find ways to create wide flat roofs for more effective catchment areas for solar energy. Currently roofs tops are a wasted city resource. Making big connected roof-scapes that could be leased back to the government or private enterprise for solar farming could be easily legislated in a district using tools like requiring new buildings to conform to a certain datum level and making provision for easy connections between roofs.

This type of thinking was also linked to possibilities such as space for urban farming, concepts of urban ecology and creating habitat through connected sky gardens, self-sufficient districts, and shrinking a city’s ecological footprint to the size of that city.

Moreover, three-dimensional planning that utilises the ‘natural capital’ of solar energy by placing value on sunlight in the city was seen as being a key way forward to low carbon liveable cities. Currently, access to daylight is not only desirable but is vital to human health and well-being. But it is not well-protected in the

dense canyons of high-rise high-density cities. Sunlight can reduce the need for artificial lighting, but most importantly it can be converted to energy for electricity.

Thirdly, citizen participation and custodianship of the external environment will be important.

“We need to be custodians of the external environment to make low-energy buildings and get rid of the things that stop us from opening the windows.” Richard Hassell

Respondents noted that poor air quality and urban noise are major threats to effective energy demand reduction. If the external sources of pollution that work against natural ventilation, were eliminated or reduced, apartment building design and regulation would not have to work so hard to achieve liveable and less energy-dependent dwellings. The interviews revealed scope for potential synergies between different areas of regulation, such as ways of controlling external noise, rather than acoustic controls and sealed buildings.

“...You get rid of traffic, you get rid of noise. Get rid of cars and you can plant half the road with trees. That would make such a difference to improving air quality and noise pollution in traffic corridors” Sean Affleck.

The interviewees also had some strong messages for the profession.

Architects must use their skills and knowledge to:

- Promote ways of rethinking development culture and measuring and valuing public benefit over private profit must be elevated.
- Lead and engage in critical discussion about better quality living environments.
- The profession needs to step up to demonstrate how change will look.
- Be informed, know your numbers
- Do more with the roof.

“If you want to design a sustainable future...if you want a sustainable built environment...you have to start at the scale of sustainable infrastructure.”

Dr Ken Yeang (May 2018)

5 DISCUSSION AND RECOMMENDATIONS

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In this chapter I attempt to answer the main research question - what can we do better here in Australia to ensure the next generation of our apartment buildings will make better homes, produce considerably fewer greenhouse gas emissions, consume less energy and be more affordable? First I discuss what the findings mean for Australia and where to next.

Learning from the South East Asian experience

Though the cities I visited may have different customs, languages, and political environments to Australian cities, on a human level the dynamics of everyday life are universal. People are going about their roles in society, trying to make a living and to live decently. Citizens have similar desires and want city leaders and governance to deliver, with themes that are familiar: "Give us green space....we accept high density but we want green and liveable cities".

Obviously there are huge differences between the scale, effect and conditions experienced in the mega-cities of Asia and Australia's growing cities. Yet the concerns of architects and academics working in them are reflected in Australian practice. My purpose was to learn about both the good things achieved in high density housing in South East Asian cities and the mistakes we should look to avoid as Australian cities grow.

The housing densities experienced there are just not needed in Australia where the entire population of the nation is fewer than some cities. The Guangzhou - Hong Kong - Shenzhen conurbation of South China alone has 55 million people and illustrates the huge challenges of managing populations and infrastructure sustainably.

Acute pressures to maximise land use are placing acute pressures on people. Asian cities are suffering tremendously because of the competition for space. The cost of land represents approximately 70% of development costs. Because it is so expensive, people can barely afford to occupy any space. Intense development is producing economically and socially uneven societies, and ecologically unhealthy environments.

Tan Cheng Siong, one of the Singaporean 'Pioneers' whose professional career has spanned through the transformation of Singapore from post-WW2 housing shortages and substandard housing to a First World nation, stresses that urban living is not yet understood. He warns that major unforeseen social upheavals are yet to come in urbanising societies globally, and he is extremely concerned about the majority of urban populations who will have very little to do in future cities. "*Asia is experiencing something that the West has never had to understand. We suddenly became so dense, so rich, so wasteful.*"

At the same time as societies world-wide are grappling with climate change mitigation and adaption, many cities are expanding and densifying to accommodate both country-to-city migration and increasing global population. Despite complacency about climate change, dramatic changes are actually occurring at a faster rate than expected. The most recent report from the Intergovernmental Panel on Climate Change

(Special Report on September, 2018) revealed that global temperatures are on track to increase by 1.5°C above pre-industrial levels by 2030 - 2052 unless dramatic reductions to carbon emissions occur from now on. This increase will negatively impact ecosystems, weather systems, and the general liveability of much of the world.

Worryingly, Rohinton²⁶ gloomily reports that our ability to provide indoor environments at temperatures tropical dwellers expect, without the use of energy is steadily diminishing due to changing climatic regimes in tropics. He points out that the crux of the technical problem is that the tropics (especially the urban tropics) have warmed to an extent that passive, building-level strategies to tackle it have been more or less exhausted. Yet, future-focussed visionaries like the architects I interviewed are steadfastly pursuing passive strategies in innovative ways.

Buildings account for 90% of Hong Kong's energy use and most of its carbon emissions (60%).²⁷ The residential sector accounts for 20-25% of total energy use. Meanwhile the total housing supply target for the next decade, the ten year period from 2017/18 to 2026/27 is 460,000 new dwellings. This programme will bear a large carbon footprint in embodied energy alone, and will be a challenging task to accomplish sustainably. The Hong Kong government has responded to the Paris Climate Agreement which came into force in November 2016, with the Climate Change Action Plan 2030+. The HKSAR's target is to reduce carbon intensity by 65%-70% by 2030 compared with Hong Kong's 2005 level. Progress and targets will be reviewed every five years, commencing 2019. Meanwhile, Hong Kong relies on mainland China for its energy.

Singapore's building sector consumes nearly 50% of the nation's energy. Singapore has quite successfully 'greened' its environment and to some extent has addressed 'green buildings' innovations but its transition away from fossil fuels is slow. The Singapore government is targeting 80% of all buildings to achieve Green Mark certification by 2030²⁸. However, more than 10 years after the introduction of the Green Mark scheme, it is uncertain whether it will be able to meet this target.²⁹ Despite the government's strategy of comprehensive integrated carrot and stick incentives and regulations, support programs, test beds, engagement and education for all economic sectors to primary school children, only a few specialist and committed professionals like architects and consultants are actively leading adoption. According to a Delft TU study³⁰ sustainability is not top of mind for the majority of stakeholders from top tier management within development and construction companies to building users.

The reasons for this lack of take-up could provide useful reflections for Australian policy makers and professional bodies. The Singaporean experience is a top down approach, and though policy makers seek input, there is little involvement by non-government organisations, including the Singapore Institute of Architects, and community groups. Professional groups are reactive rather than proactive regarding policy and regulation. There is no lack of knowledge but sustainability expertise is not influencing corporate management of major enterprise sectors. Another problem is that smaller innovative developers are ineligible for incentives and have less access to land than large development companies who can assemble larger sites.

²⁶ Rohinton E (2016) P 11

²⁷ HK Green Building Council and Construction Industry Council *Hong Kong Report on the State of Sustainable Built Environment 2017*

²⁸ 2030 Targets set out in Government of Singapore *Sustainable Singapore Blueprint 2015*

²⁹ Siva, V, Hoppe, T & Jain, M (2017) Green Buildings in Singapore; Analysing a Frontrunner's Sectoral Innovation System. *Sustainability* 9(919):23.

³⁰ *ibid.*

On the positive side of the ledger, Singapore's mandatory regulations on energy efficient equipment have led to a surge in demand for efficient technology, and development of new markets and methods to replace old non-compliant technology. For example, some solar photo voltaic companies are adopting a 'solar leasing' model to support consumers to offset the high start-up cost of renewable energy. Consumers contract to make their roof space available to solar companies to install PVs and generate electricity, in return for a discounted rate for the energy they consume for a fixed period, say 20 years.

We may think that the problems of housing the swelling populations of South East Asia's mega cities is remote from Australia's reality, yet the Population Forecasting Unit (Census) projections for the nation's population is that it will reach 40,000,000 people by 2050 - with our largest cities becoming comparable to current Hong Kong and Bangkok. What kind of transformed cities will we inhabit by then?

We may think that the future city concepts proposed by WOHA, TR Hamzah and Yeang, and Archurban are just too outlandish and never likely to materialise. But the multi-layered city visualised by Richard Hassell and others is already a reality in many Asian cities, including Hong Kong and Singapore. At ground level, streets, backstreets, alleys and lanes are for family-owned businesses, taxis, merchants, and cyclists. Everything takes place there on the street, from general repairs to pre-fabrication; stocking and re-stocking everything from motorcycles to lumber and steel. Traffic runs on main roads on elevated freeways several layers above ground. A vast network of publicly-accessible privately-owned pedestrian outdoor spaces are above street level. Walking, shopping, eating, working are interconnected above ground with parks and corporatised businesses and franchises, aquatic centres, entertainment and education facilities. Multiple city layers spread below ground as well: road and rail tunnels, labyrinthine subterranean plazas, shopping centres, fast food, fast repairs.

Megastructures which can be plugged into and extended of the scale envisioned by WOHA and Mr Tan have precedents already - such as the West Kowloon Station which has replaced the grid of city streets³¹ and the Olympic Station on reclaimed land in West Kowloon.³² The US National Intelligence Agency³³ predicts that some of the world's future megacities will essentially be built from scratch, enabling a blank-slate approach to infrastructure design and implementation that could allow for the most effective possible deployment of new urban technologies - 'or create urban nightmares, if such new technologies are not deployed effectively'. Do Australian cities need or want mega structures and tall apartment towers?

Our shared atmosphere is the common denominator. Australia has also signed the Paris Climate Agreement but there is little movement in the regulatory environment toward effective change on carbon emissions from the building sector. In Australian cities, much of the debate about tall apartment buildings has been about their height and perceived detrimental affect on public amenity, such as overshadowing, loss of privacy and added traffic congestion. These are valid concerns but we should also be concerned about their social impacts and high environmental footprints.

My research is about next generation apartment buildings and the need to rethink and reduce carbon emissions in which buildings contribute a high share. In Australia we may still have the luxury of pursuing a place-based climate sensitive approach to urban density, if we heed the messages from Asian mega cities and take action now.

³¹ Xue p.152

³² *ibid.* p.162

³³ National Intelligence Council (2012) *Global Trends 2030: Alternative Worlds*. Office of the Director of the National Intelligence Council, USA. www.dni.gov/nic/globaltrends

Tall buildings are energy-hungry and lack ability to adapt to a de-carbonised economy. In Australia, contemporary residential towers have little potential to generate their own power and store enough for the use of all households and to power electric vehicles. Their decline in value and obsolescence is guaranteed as the community demands better quality building. People will be hit hard and start walking away from buildings that have very high energy bills, and lack access to renewable energy. Those who can least afford it will be forced to occupy existing sub-standard buildings and face energy poverty.

Why build apartment buildings that rely on last century technology in Australia? Taller and larger may not be the answer. There are numerous challenges involved in achieving change. My conversations with architects working in South East Asian jurisdictions suggested potential ways to address them.

In the next part, I use the findings of interviews with visionary architects to identify strategies that could influence the emergence of potent climate-based architecture in Australia for both private and public benefit.

Where to next?

Formulaic apartment towers with glazed facades and no cross ventilation mainly respond to the developer's key interests of attaining maximum yield rather than to long term liveability and sustainability. Buildings like these require very high energy inputs to contend with the rigours of heat and humidity even in Australia's milder climates and as a result HVAC makes up a significant proportion of total power consumption. Air conditioning and natural ventilation is always a hot topic in Australian conversations about apartment buildings and the dwellings within them. Consumers want both optimum comfort levels and to save on utilities bills. They also to be able to choose natural ventilation when it is desirable.

On its own, climate-sensitive design does not seem to be gaining traction with architects or developers. The interviews suggest that clear consistent effective regulation is the most important factor to achieve better apartment buildings. Rethinking the principles and practices in planning and development will also be significant. In order to achieve these in ways that meet architectural objectives, architects must be more proactive in leading their own and others' behaviour change, and in raising discourse beyond the visual imagery. The AIA already has national policies regarding multi-residential standards, and affordable housing. Yet even with objective judgement of design quality and liveability, it is notoriously difficult to cut through yield and profit.

Standard design is failing

In the not so distant past time-wise, but long ago society-wise, the structural approach to multi-storey apartment building design prioritised passive climatic design by necessity. Up until the late 1980s in Australia, air conditioning was not widely available and apartment buildings required the means to naturally ventilate. They were not always perfectly designed or delivered, commonly lacking shading to windows, and insulation to roofs and walls, but the structural shell supported the potential to cross ventilate dwellings. Currently, highest yield dominates and the least external surface area enclosing the most internal volume the better.

In practice, significant design decisions are often made by pre-set standard real estate product formulae ('form follows financing'³⁴). Design for thermal comfort and daylighting is resolved with energy intensive technology rather than with architectural ingenuity and inventiveness. Architectural effort is focussed on

³⁴ Ellin, N (1997) *The Architecture of Fear*. Princeton Architectural Press, London, cited in Carmona et al (2010) p.282.

finessing the image of the outer wrapping. Cities are full of more and more weirdly shaped objects wrapped in dark glass with some clever pattern-making on facades.

Xue³⁵ wrote of Professor W.G. Gregory, head of the Department of Architecture at the University of Hong Kong in the 1960s, who criticised that many Hong Kong architects took building regulation as a design guideline. “They only know how to utilise the plot ratio and forget the arts of design and comfortable functions. These can only be called ‘by-law buildings’ instead of architecture.” The same may be said of Australian architects now whether practising in Australia or abroad. One of the interviewees noted “*When we collaborate with Australian architects in Asia, they always come back with the square plan - the square units are just really maximising the yield for the developer and not doing anything else...*”.

Technical considerations of cross-ventilation, fire protection and smoke dispersal are the reasons for the high percentage of external facade and articulation in Singaporean apartment buildings. Cross-ventilated apartments require building layouts that can give them access to more than one external walls with openings in them. Adapting the open corridors of tropical models to Australian subtropical conditions would need to deal with wind and more severe conditions like possible cyclone hit and hail storms, but this is a question of architectural design and problem solving.

Australia’s *National Construction Code*’s (NCC) performance standards do not preclude the use of fundamental principles of passive climatic design for energy efficient Class 2 buildings. Only the Code’s performance standards are mandatory, yet many developers, architects and building designers take the non-mandatory lowest common denominator ‘acceptable’ solutions as their starting and end point.

Performance-based codes require concerted effort on the part of design teams and assessment teams. Despite their more demanding approach, performance standards are more progressive and more responsive to changing societal expectations than prescriptive regulations. However, researchers in Victoria found that regulatory prescriptive approaches can be more effective for implementing ecologically sustainable development.³⁶ This suggests that stronger policies and improvements in minimum standards mandatory standards are needed.

The AIA is a founding member of the Australian Sustainable Built Environment Council (ASBEC). One way forward is to support and promote ASBEC’s call for a mandatory zero-carbon-ready building code, using the ready-made NCC as the vehicle.³⁷ The NCC already regulates the building envelope (structure and ‘skin’) and fixed equipment, lighting and water heating, but stronger energy standards and targets are needed. Currently Class 2 buildings require a 6 Star rating under the compulsory National Housing Energy Rating Scheme (NATHERS); in Queensland, only a 5 Star rating is required on a scale of 1-10.

As the experience in the hot humid crowded cities Asia has shown, it is more important than ever to know the numbers and use modelling to design and verify environmental performance. Simulated wind flow studies using Computational Fluid Dynamics (CFD) helped locate individual buildings to facilitate air flow in projects in Singapore and Hong Kong.

³⁵ Xue, p.91

³⁶ Collia C and March A (2012) Urban Planning Regulations for Ecologically Sustainable Development (ESD) in Victoria: Beyond Building Controls, *Urban Policy and Research*. **30**:2 pp105-126.

³⁷ ASBEC *Built to Perform: An Industry-led Pathway to a Zero Carbon Ready Building Code* (www.asbec.asn.au)

We need to embrace technology to power new and existing homes with renewables. Alternative fuels, particularly solar energy, and battery storage are now considered far less risky than even eight to ten years ago. We can investigate alternative technologies like phase-change materials (PCM) that ‘store’ solar power during the day. Solar power actively chills the property, solidifying the PCMs in the daytime). At night as the power is discharged, materials change phase ready to collect and store energy the following day.

Rethinking principles and practices in planning and development culture in Australia

Yield and profit has led to Australia’s fixation with ‘compact’ floor plans that fail to provide long term liveability. There is an entrenched belief in the urban development and planning system that developer-led ratios like net-to-gross are intrinsically good, rather than being a measure of how mean or unsustainable the building actually is.

In Singapore, incentives linked to GFA bonuses are very effective ways of encouraging innovation because of the high cost of land, and because their effectiveness is closely monitored. In Australia we are currently missing the benefits to be gained by the carrot and stick of density bonuses combined with defined GFA. Currently factors influencing planning decisions are opaque to the general public and more often than not are perceived to benefit only the developer.

Are we measuring the things that matter? To date, climate-responsive design has lacked clout in the regulatory system. Efforts at the local government level are stymied by state government planning regulations which separate ‘building matters’ from ‘planning matters’. Local governments are prohibited from requiring ‘cross-ventilation’. It needs to be purposely linked it to other desirable social, environmental and economic outcomes, including the affordability/energy security nexus, and greenhouse gas emissions reductions.

What is to say that the indices developed by Richard Hassell and Wong Man Summ at WOHA are not as, or more, valid as the measures used by the development industry to assess capital cost efficiency? The data used to calculate each of the five metrics developed by WOHA are as readily available as formulae already used in property investment formulae, and respond to the needs of wider community as well as the individual building occupants. The process is simple and repeatable by any city, developer, or consultant team to score their own projects, and could herald a transformation of the planning system by shifting values towards environmental integrity rather than exacerbating societal and environmental problems. These indices provide clear and transparent measures of public benefit and could underpin an incentive system, and deliver accountability.

As with other ways to implement action on reducing energy demand and emissions, meaningful targets for these indices should be set.

Custodianship of the urban environment

Another way of rethinking regulations is to shift the emphasis from the need for the building to ‘do everything’. For example, high levels of urban noise prompt regulations about acoustic glazing and compel residents to keep the windows shut to avoid unwanted noise and dust.

The architects I interviewed take an optimistic design-centred approach with the view that there is much scope for potential synergies between urban level strategies, climate-responsive building-level strategies and new technology.

Greater custodianship of the urban environment could lead to game-changing mandatory regulations on reducing urban noise. Fewer cars on the road, could lead to less noise and dust, more natural ventilation, less energy demand and more space for renewable energy systems, and more capacity for dense cities to be able to regenerate natural systems and create far more natural urban systems.

Architects are three-dimensional thinkers with visualisation skills that we can bring to transform current land-use spatial planning to three-dimensional city and urban planning that makes the most of the natural capital available to a city to achieve the twin goals of reducing energy demand and producing renewable energy. City planning based on passive solar design strategies that deliver walkable sociable communities and low-energy place-based buildings require the type of systems thinking that architects routinely use but rarely elevate to the scale of the city.

Actions

What can we do better here in Australia to ensure the next generation of our apartment buildings will make better homes, produce considerably fewer greenhouse gas emissions, consume less energy, be more affordable, and more acceptable to wider community concerns?

Contemporary high density residential architecture is mostly free of critical examination, and the developer model is accepted. What really is missing in the middle of Australian urban development? We do not need to accept that our future is either low-rise sprawl or taller and taller towers.

In order to advocate change, we need to be clear on what is needed. In order to create the future we want we have to imagine it. Whether we play a central role in procurement or not, architects are the three-dimensional thinkers with the skills to question the status quo and help the community visualise positive change rather than continually being dismayed at the type of urban environment which results from speculative development.

Architects are professional integrators and we can and must play a more strategic role in urban reform by collaborating with our counterparts in the development industry to innovate on win-win ways to transform high density living and cities. In the first instance design quality standards that go beyond current mandatory performance requirements for apartment buildings are needed.

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6 CONCLUSION

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The Dunbar Fellowship gave me the unique opportunity to ask whether Australia's next-generation apartment buildings can benefit from a reversal of recent historical trends, by embracing East—West knowledge transfer. My key objective was to explore factors and strategies that can influence the emergence of potent climate-based architecture in Australia for both private and public benefit.

Asian cities are quite literally the epi-centre of high-density living, dealing with rapid urbanisation and accommodating people on a massive scale. In the endless hectares of residential towers in the subtropical cities of Hong Kong and Guangzhou, and tropical Bangkok and Singapore, a select few apartment buildings break the mould of the energy-intensive glass-wrapped private tower and the repetitive mass-housing models.

Many studies on architecture of south east Asia focus on visual aspects and some technical aspects of building design. However, I was more interested in understanding the reasons that some architects were able to resolved the same complex competing issues and interests that others architects are dealing with, in a more contextual and future-focused way.

As well as visiting many apartment buildings in context, I conducted in-depth interviews with eminent and emerging architects, and meetings with academics, and government organisations involved in domestic research and policy-making. The interviews covered topics of influences on design for liveability, affordability, energy and emissions profiles and architectural expression, project relationships, and how they innovated within the confines of regulatory environments. And what motivates them to do what they do?

My physical visits to the cities, also enabled a brief outsider's look at the physical, political and regulatory contexts within which the architects work. This was important in contextualising the findings. I gained some understanding of the complexities at play in these complex and crowded cities from over-crowded Alpha city Hong Kong, to Singapore whose innovations in high-quality high-density and affordable housing and town planning are recognised internationally.

The outcome of the research is that benefits for Australian high-density apartment design will not result from a simple flipping of the paradigm by transferring knowledge from East to West. There is much to be learned but designs and policies cannot simply be overlaid onto the Australian political, economic social and governance context.

The architects I interviewed refuse to accept the status quo of energy-dependent poorly designed apartment buildings and they demonstrated leadership behaviour. The main themes that emerged from the interviews were that these architects are committed to climate-responsive place-based architecture and prioritise this in all their work. They match their clients' vision and objectives to their architectural objectives. They use thorough knowledge of the regulatory environment to innovate rather than settle for 'compliance' and they are actively involved in theory-building through design research all spatial scales of urban structure, not just the building. They also share and disseminate this knowledge widely and by various media.

They advocate the need for architects to be more engaged and lead more critical discussion in the broader community regarding design quality in counter-point to image-driven understanding and

expectations. They advocate a strong sustainability agenda, and are supportive of effective regulation based on sound policy. Architects need to be critically engaged in shaping this agenda by doing the design research and thinking 'outside the building' as custodians of the external environment.

The last word comes from Dr Ken Yeang.

"It's an audacious aspiration but we have to do it. We as architects and designers are not very powerful people; we are not influential; but we can do it by example."

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