

# LIVEABLE LANDSCAPE IN HIGH-RISE AND HIGH-DENSITY BUILT ENVIRONMENT FOR HEALTH PROMOTION IN SINGAPORE

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## ABSTRACT

In recent years, liveable landscape design for high-rise has been introduced as an antidote to elevate the significance and value of living environment in high-density urban developments. Liveable landscape could be designed together with buildings because architecture as an applied ecology (Yeang, 1999) challenges urban constructions to integrate with natural systems in a sustainable way.

New theories, such as green urbanism is proposed as an anchor which defines interdisciplinary design pedagogy to shape sustainable places, communities and lifestyles (Beatley, 2000). Furthermore, the feature of liveable landscape looks beyond the physiological parameters of health and comfort and includes the psychological well-being of people and communities as well.

In this paper, the author uses Singapore as an example to explore three main aspects of liveable landscape as a healing place for people who live in the “concrete jungle”, victims of green space scarcity; and discusses the potential of liveable landscape implement for other ultra-density urbanism such as Hong Kong’s.

## KEY WORDS

Liveable Landscape, high-rise, high-density, health promotion, Singapore

## INTRODUCTION AND BACKGROUND

Each day, the population on the planet is growing rapidly while natural resources and land supply in our world is declining. The concept of sustainable development as defined by *Our Common Future* is: ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs.’ (WCED, 1987) Based on the principle, maximizing land worth and minimizing resource waste become key issues in the process of human sustainable development.

After World War II, accompanied by booming economic development and infrastructural expansion, huge numbers of people flocked into cities, and sparked a fast urbanization all over the world, especially those developing countries. More than half a century past, there are already 21 cities with populations of more than 10 million in 2010<sup>1</sup>, and 10 of them located in Southeast Asia. Confronted by

severe land shortage and high population pressure, some cities adopted compact urban form with extremely high dense and high rise building morphology, i.e., Hong Kong and Singapore. The generalities of the cities in Southeast Asia show, as tropical and subtropical climates, ultra high-density urban form and rapid economic growth.

Recently, triggered by climate change and environmental degradation, liveable landscape system for high-rise morphology has been introduced as an antidote to elevate the significance and value of living environment in high-density urban context. The scope of “high-rise landscape” refers to the man-made ecological system of outdoor and indoor environment, including green roof, sky garden, podium parks and vertical greenery etc., which integrates natural ecosystem with buildings and urban infrastructure. From this point of view, the designed system must create a balanced ecosystem of biotic and abiotic components and a productive and even reparative (i.e., healing) relationship with natural environment (Yeang, 1999, p68).

## RESEARCH REVIEW

### Environmental Sustainable Philosophy

#### (1) Design with Nature

Although there is a wealth of literature exploring the philosophy between design and nature, the most authoritative originator comes from the forerunner of modern urban planning and design Ian L. McHarg’s immortal book, *Design with Nature* (1971). It reshaped the modern design theory towards a relationship of nature and man, and elaborated the methodology and vision to future ecological city. After city expansion in the early 20th century, the vast countryside was encroached by urban industrial production in the western world. McHarg argued that the loss of western urban civilization was caused by popular values: human power is the only master of the world and nature is just the weak background of human activity (McHarg, 1971). However, just as Hippocrates once said: ‘human life, whether sick or healthy, are closely related to the natural forces, and nature is irresistible and invincible, we must understand its laws, to respect its advice, and treat it as an ally’ (Mumford and Rui, 1995).

From historical culture to religion, the eastern vision considers that if man and nature could live in harmony, the world could be kept in balance. In ancient China, people understood how to deal with the deluge and make a self-sufficient life in a sustainable

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<sup>1</sup> Source: United Nations.  
<http://www.un.org/esa/population/unpop.htm>

way, which is the so-called “the art of survival” (Yu and Padua, 2006). Since natural sources will be used up and our future generation will lose their equity caused by the unsustainable lifestyle we once behaved, design with nature becomes the lifesaving approach to build a bio-diverse natural ecosystem and make a connection between city and nature. The philosophy in the large vision combined regional planning and landscape architecture together to deal with the problem in the process of urban expansion and nature conservation (Li, 2005).

### (2) Green Urbanism

After the energy crisis erupted in the 1970s, the western world was shocked by the huge amounts of oil consumption and the natural resources scarcity simultaneously. New theories, such as green urbanism is being proposed as an anchor of the future vision of sustainable construction. It is an interdisciplinary design pedagogy that combines the collaboration of landscape architects, urban planners, engineers, ecologists, transport planners, sociologists, economists, physicists and psychologists in addition to that of architects and urban designers, to shape sustainable places, communities and lifestyles (Beatley, 2000). Green urbanism encompasses the ecological functions of urban greenery which has a positive impact on the performance of building through its whole life-circle.

The theory of green urbanism truly supports that cities are fundamentally embedded in a natural environment, and they will behave like an ecosystem network with the function of metabolism (Beatley, 2012). When William McDonough argued that “buildings like trees, cities like forests” (Beatley, 2009), it could be deduced that buildings and cities will be not linear systems which just consumes energy and products and produces waste and pollution. Actually, a healthy urban system will have ecological cycle, with green network between cities and buildings. New approaches, such as green roofs, green walls, green streets and neighbourhood, city farms and urban gardens will remodel the built environment with organic, living buildings and urban landscapes.

### (3) Green Skyscraper

In the early 1960s, early study of “Metabolism” architecture argued that the way to develop a city is the continuous renewal and organic growth, and architecture with limited land will be regeneration in a biological approach. At the end of the 20th century, well known avant-garde green eco-architect, Ken Yeang proposed that green and ecological skyscrapers could be the main force for the future urban construction (Yeang, 1999). Since architecture as an applied ecology challenges urban constructions to integrate with natural systems in a sustainable way, eco-architecture such as “Vertical Urban Design”, starts a new high-rise typology: City in the Sky. In Yeang’s research, urban greenery could be shifted from the ground to the podium and rooftop in a high-rise buildings and skyscrapers, which largely

improved the efficiency of land use and promoted the multiple diversity of community life. Just like Yeang’s vision, where there is symbiotic relationship between manmade system (building) and the ecosystem (landscape), in order to create ‘building-as-landscape’ and ‘landscape-as-building’ (Yeang, 1999, P89).

Ken Yeang adopts natural greenery as an organic air conditioning system, which aims to produce additional oxygen, sun-shade and performs as a microclimate producer (Ruby, 1999). Meanwhile, studies on vertical greenery systems in Singapore by scholars from NUS have made credible up-to-date information and findings of the benefits and concerns of vertical greenery system in the built up urban environment (Wong et al., 2010).

### Compact City and Intensive Land Use

Over the last decades, the majority of urbanists, architects and territorial planners regard the compact city as the most sustainable settlement typology of urban development theory to deal with the continuous broadening of modern urbanization. However, according to previous case studies, it depends on the environmental, social and economic context, and defers from the developed world and the developing countries. In our topic, the main problem of the compact city theory is the lesser green and open spaces than could be obtained in a dispersed city (Holden and Norland, 2005). Actually, compact city can be very large and function well under elaborate planning and organization, which requires compatible management at the governmental level, i.e., Singapore (Gugger and Kerschbaumer, 2013), who favors promoting community greening amid a high density built environment.

Since land and resources are limited, only an intensive land use in urban context could address the needs of huge populations, especially in Asian countries (Lau et al., 2003). The 20th century was a century of skyscrapers (Ali, 2006). Based on the social, political, cultural and economic reasons, mega-structures become the normal habitus in the megalopolis all over the world. Yet, previous studies have prejudiced towards the skyscraper and other large buildings for the negative effects to our ecological environment, since they are energy-hungry parasites (Yeang, 1999) because of their huge size. Actually, high-rise or skyscraper is not an architect’s personal favourite, but a coping strategy to deal with the serious problem of swift and accelerated urbanization. Yeang’s attempt is to interrupt the omnipresence of architecture with botanical oases (Ruby, 1999) and these oases located at the sky scrapers morphologically appeared as sky gardens, the podium parks, the green walls, etc., which constitute a great compensation for the scarce of open space and greenery in the context of high density built environment.

### Environmental Therapy

#### (1) Environmental Psychology in Urban Context

According to the Master Robert Gifford's definition, Environmental psychology (EP) is the study of transactions between individuals and their physical setting (Gifford, 1997). Simply, EP is a study of man as part of his milieu. It sees man not as a passive product of his environment, but as a goal-directed being who acts upon his environment and who in turn is influenced by it (Ittelson, 1974). For instance, good lighting promotes better learning in schools, green open space reduces pressure from work, etc.

In addition, EP serves as a key link between individuals and policymakers (Gifford, 2007). According to the policy making, individual's behaviour, well-being, stress and quality of life could be changed. Our question is how to make a city liveable? To be focused on the environmental study, a liveable city should have the characteristic of aesthetic and stimulus qualities which encourages people to live in the city (Ittelson, 1974). Cities as the built environment change the style of urban life through changing the urban form. From the traditional courtyard house and street market to the skyscraper and high-rise apartment, the living habits of millions of people has changed by the fast urbanization, and in turn, new demands has raised along with the changes in the environment. The lack of natural space becomes a huge shortage in modern city, since a positive distraction of natural environment could improve emotional state and block or reduce worries from the chaos around (Marcus and Barnes, 1999).

#### (2) Design and Health

The World Health Organization (WHO) defines 'Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity' (WHO, 1946). The emphasizing of mental health and social well-being raises a new concept, Salutogenesis, proposed in 1979 by medical sociology Aaron Antonovsky as the study of the relationship between health, stress, and coping. Different from the traditional vision of Pathogenesis, Salutogenesis works prospectively by considering how to create, enhance, and improve physical, mental, and social well-being (Becker et al., 2010), and guides the framework of health care system in the new era.

Previous research about Salutogenesis indicates that the environment (indoor and outdoor) plays an important role in affecting people's physical and mental health. The garden labeled as "healing" should have therapeutic or beneficial effects on the great majority of its users (Ulrich, 1999). The core capacity of healing landscapes would have fostered emotional well-being and health, and enhanced chances by promoting faster and more complete recovery from the negative stress and threats from surroundings (Ulrich, 1999). In this paper, the concept of healing is not focused on the health care place and patient regimen. Instead of that, the author would like to

explore the healing places served to the residents, the office employees and others who live in the "concrete jungle" and suffer from the scarcity of the green space.

### Summary of Research Review

The philosophy of sustainable development has a deep foundation in theory and practice of urban and architectural design since late 1960s. With the rapid increase of urbanism, compact city and intensive land use became the main stream in the process of urban development, especially in high-density Southeast Asian cities. Meanwhile, the ultra-compact and lack of greenery and open space in urban built environment has made a great impact on people's physical and mental health. According to previous research of environmental psychology and therapy, qualified natural resources which performed as urban oases in the forms of sky garden, green roof, vertical greenery and green terrace etc have increased living quality and human well-being. Since the perceived benefits of the integration of ecosystem and manmade system have been well studied in ecological, social and economic levels of high-rise and high density urban context, the author's interests will be focused on the non-material efficacy which liveable landscape brings to the individual and the community.

## RESEARCH DESIGN: CASE STUDIES IN SINGAPORE

### Framework

#### (1) Research scope and factors

From the analysis of figure 1, the 3 levels of ecosystems link together as a holistic recycled system. Since the urban built-up area has interaction effect with the suburban ecological environment, so does the buildings and infrastructures with the semi-ecological open space within the urban area. In the author's research, the liveable landscape integrated with the buildings especially high-rise and skyscrapers, behaves like a live ecological system to metabolize and communicate with the outside open space.



Figure 1 Research Scope

Since 2005, as defined in the publication of the Millennium Ecosystem Assessment (MEA), the main categories of ecosystem services is "provisioning, such as food and water; regulating, such as regulation of floods, drought, land degradation, and disease;

supporting, such as soil formation and nutrient recycling; and cultural, such as recreational spiritual, religious and other non-material benefits". Based on the principle of ecosystem services, the research factors of liveable landscape system will be focused on the context of high-rise and high-density urban context and the supported to the buildings and the communities.

According to the ecosystem services, the main factors of liveable landscape values in this research reveals the following: A. Environmental conservation: covers biodiversity promoting, rain water recycling, nutrient/waste recycling, food self-supporting, energy saving and micro-climate regulation; B. Healing therapy: covers spiritual enrichment, pressure reduction, cognitive development and aesthetic experiences; C. Community placemaking: covers recreation, education, neighbourhood identity and social interaction, volunteer action.

The author will focus on analyzing the above three key issues, and discuss the important value and the future trend based on the comparative case studies.



Figure 2 Research Factors

## (2) Strategy analysis

The research strategy will mainly follow the logical deduction process. Firstly, is to identify the research object as liveable landscape in high-rise and high-density built up environment; Secondly, through previous research literature review, to find the theoretical basis of sustainable development in urban construction, compact city mixed intensive land use and environmental therapy in health promotion to support the research hypothesis; Thirdly, to choose three representative cases in Singapore as data sources, analyse the information, summarize the findings and discuss the advantages and shortcomings of the current status.



Figure 3 Research Framework

## Case Studies

Three types of high-rise buildings with liveable landscape systems were chosen as case studies, including residential, office, and health care, and each case has unique characteristics and innovations. The information of case studies came from site studies, experts/architects interviews and internet resources. These cases are newly developed famous projects in recent years which establish an unprecedented height of green building design and management as well as the models for the future development.

Pinnacle@Duxton is an outstanding iconic housing project in the public housing history of Singapore. It has 115,415.58 m2 GFA with 7 high-rise towers and 1,848 apartments makes up of the community. 158 Cecil Street is a pioneer existing building addition and alteration ("A&A") project located at the traditional CBD of Singapore. An obsolete building was transformed into avant-garde building through façade renovation, and it became the highlight of the city centre. Khoo Teck Puat Hospital (KTPH) is an eye-catching program aimed to integrate various ecological resources to build a "hospital in a garden, and a garden in a hospital". (San, 2013) All of the three projects have a commonly spectacular character by integrating large-scaled liveable landscape systems into buildings and communities which provide green courtyard, podium garden, sky (roof) garden, and vertical greenery to everyday life. The three projects stand for living, working and health care, three key components of human society which covers the most part of everyday life.

Table 1 Basic information of three projects

Category	Pinnacle @ Duxton	158 Cecil Street	Khoo Teck Puat Hospital
Completed	2009	1984 (origin) / 2011 (retrofit)	2010
Project type	7-Tower residential community	Single office tower, existing building retrofitting	Three blocks healthcare center
Services type	Public house	Rent office	Public hospital
Key study factors and Unique feature	2 Layer of connected sky gardens  Iconic housing project in Singapore's public housing history	Existing Building ("A&A") project  Office retrofitting with a Hanging Garden in the Atrium	patient-friendly, environmentally friendly and hassle-free hospital Healing Environment: hospital within a garden,
GFA	115,415.58 m <sup>2</sup>	11,977.28 m <sup>2</sup>	105,000 m <sup>2</sup>
Stories	50	14	6, 8, 10
Cost	SGD 279 million	checking	SGD 490 million
Height	156 m	45 m	48/58 m
Greenery Area	1 hectare	37,000 sq feet (The latest A&A Part)	checking

### (1) Environmental Conservation

After reviewing the three projects, Pinnacle@Duxton has a large green courtyard at the community centre, which conserves the original big trees out of ruining during construction; and 2 layers of continuous sky gardens weave through the seven tower blocks, which added almost 1 hectare of green land in the sky and is kept as a habitat for biodiversity. 158 Cecil Street has a fascinating turn by creating a “Hanging-Garden” in the concrete jungle of CBD. Benefit from the designer’s innovative experiment, a vertical greening took place of the existing “mesh façade”, and the end wall and columns turned into a hanging living garden (Kan, 2011). After the lush green atrium set up, birds and butterfly go there to nest and people and nature live in harmony. Khoo Teck Puat Hospital (KTPH) is a paragon of “design with nature”. KTPH is actually a living habitat with more than 500 plants species and over 100 butterfly species (San, 2013). With the technique of rain water harvest and nutrient/waste recycling, KTPH has built an urban farm on the roof top to provide food self-support within the community ecosystem. All three project performed well in energy saving and micro-climate regulation by the artificial liveable landscape system which also supports the shading, fresh air provision and ecological balance for human beings.

Table 2 Environmental Conservation Analysis

Category	Pinnacle@Duxton	158 Cecil Street	Khoo Teck Puat Hospital
<b>Original plants protection</b>	Yes. Protect the historical trees	N/A	N/A
<b>Biodiversity promoting</b>	Good. Birds / Insects	Good. Birds / Insects	Excellent. Birds / Fish / Insects
<b>Pest Control and Prevention</b>	N/A	Yes. Inorganic medium	Yes. Organic pesticides instead of chemicals
<b>Rain water recycling</b>	Checking	Yes. Rain water for plants irrigation	Yes. Yishun pond collect rain water and irrigate plants
<b>Nutrient /waste recycling</b>	N/A	N/A	Yes. Leave and fruit harvest for the farming fertilizer
<b>Food self-support</b>	N/A	N/A	Yes. Urban farming on the roof garden
<b>Energy saving</b>	Moderate. AC reduction	Good. AC reduction	Good. AC reduction
<b>Micro-climate regulation</b>	Yes. Heat island effect reduction	Yes. Heat island effect reduction and indoor air quality promoting	Yes. Heat island effect reduction and indoor air quality promoting
<b>Sum</b>	Good	Good	Excellent

### (2) Healing Therapy

In the author’s view, creating a healing environment dominates the design concept of the three projects. Pinnacle@Duxton is a showcase to improve the living condition of public house. Government made great efforts to build a modern green community in the neighbourhood not only to promote a material environment, but also to create a qualified spiritual home for people to enjoy healing therapy from the garden and nature. 158 Cecil Street is a miracle to turn the concrete jungle into a natural garden. The retrofitting of façade and atrium brings a new approach to integrate natural elements to the “cold place” to make the building alive. After that, the office building fosters a place identity and place dependence which has promoted the intimacy with people and nature and guides people to become biophilia. KTPH has made a cold and fearful hospital into a “hassle-free” garden. Healing and therapeutic green space by the powerful design of natural gardens has gained great success which becomes a premier hospital of the future, and a new approach for future lifestyle.

Table 3 Healing Therapy Analysis

Category	Pinnacle@Duxton	158 Cecil Street	Khoo Teck Puat Hospital
<b>Spiritual enrichment</b>	Yes. Lead residents to join outdoor activities	Yes. Promote employees to enjoy the natural communication space	Yes. Provide patients ,staff and visitors beautiful and vivifying natural environment
<b>Pressure reduction</b>	Yes. Sky gardens reduce the pressure by high density living condition	Yes. Green wall and atrium reduce the pressure by intensive working load	Yes. Natural courtyard, roof garden and vertical greenery relieve the stress from both mind and body
<b>Cognitive development</b>	Yes. Encourage residents to foster biophilic habit	Yes. Encourage employees to feel and love for nature	Yes. People understand the nature well by the biodiversity of KTPH
<b>Aesthetic experiences</b>	Yes. Beautiful view in the theme park on the roof top promote a pleasant mind	Yes. Hanging garden creates natural beauty	Yes. The wonderful courtyard and vertical greenery promote a nice mood for patients and staff
<b>Sum</b>	Good	Good	Excellent

### (3) Community Placemaking

The most significant placemaking in the neighbourhood is to promote a healthy lifestyle to individuals and families. Including the residential, the office and the healthcare centre, three cases have made wonderful achievement by demonstrating how to lead a healthy life both physically and mentally. The placemaking in Pinnacle@Duxton opens a gallery

for visitors to experience the fantastic sky gardens with the city's skyline. The residents could enjoy the lush open space within their blocks and spend the family time with community activities. The huge success of the "hanging garden" in 158 Cecil Street made this humble building become a CBD icon. Without ornate decoration and high-tech stack, this office building has skilfully built an eco-bridge between the man-made world and the natural environment. The approach of placemaking changed the cold, boring and rigid work place into a vivifying, cheerful and creative human oriented space, which proves that liveable landscape system could transform the negative to positive successfully. Not to mention the KTPH, which is an integrated modern community centre including the function of healing, work, entertainment, popular science education and park for the nature lovers. The placemaking of the KTPH has changed the hospital from a fearful disease treatment place into a health-promoting park, which is called "hospital within a garden, garden within a hospital" (San, 2013).

Table 4 Community Placemaking Analysis

Category	Pinnacle@Duxton	158 Cecil Street	Khoo Teck Puat Hospital
Open to public	Partly. The 50 <sup>th</sup> storey sky gardens are open to the public while the 26 <sup>th</sup> storey ones are not.	Case by case. Only an appointment with the property management before.	Yes. Besides the patients and stuff, visitors and residents in the neighborhood are welcome.
Recreation supporting	Yes. There are 12 theme sky parks function as recreation facilities for residents	Yes. There are benches and sky bridges for employees to chat and communicate under the green environment.	Yes. The gardens provide large theme park and lush green land for visitors and children to play with.
Education and cultivation	Yes. Visitors come to learn the wonderful approach of a large sky gardens above apartment.	Yes. Employees of the building learn to symbiosis with the ecosystem; visitors learn the approach to build a green office	Yes. Visitors learn to cognize biodiversity; designers learn how to build a healthcare center in a garden.
Neighborhood identity and social interaction	Yes. Residents communicate with each other through the garden placemaking	Yes. People near neighborhood come to visit the hanging garden and cherish the community environment	Yes. KTPH is more than a healthcare center, but a community park to attract people come and enjoy life here
Volunteer action	N/A	N/A	Yes. People from neighborhood voluntarily take care of the

			roof farm to experience the sustainable lifestyle
Sum	Good	Good	Excellent

#### Discussion

Singapore's successful experience in liveable landscape system has a significant influence on other compact Asian cities, i.e. Hong Kong. With the similar level of economic development, Hong Kong suffers from low urban eco environment in residential, work, healthcare and other urban public space. In recent years, government has recognized the importance of a healthy environment towards the future development and made relevant legal provisions to ameliorate the "concrete jungle" urban environment. With the binding of "liveable landscape" and "concrete jungle", the life quality will be largely promoted and the negative life style will be changed by the healing therapy of natural environment.

However, the concerns of roof load, subtropical plant chosen, system maintenance, financial subsidies, cost issues and professional support needs to be settled in the process of new policy promotion. With the government's policy guidance and civil society's advocates, the liveable landscape system will be located in every neighbourhood, the healing power will be transferred to the citizens and the love of nature will be fostered in this and future generations.

#### CONCLUSION

The multiple benefits of liveable landscape system has been adequately represented by three representative case studies in the ways of environmental conservation, healing therapy and community placemaking. The liveable landscape integrated with high-rise and high density urban built environment could connect the city with the natural habitats, and largely cultivate the biophilic love of nature and wild life as below:

(1) Under the high-density and high-rise urban context, urban ecosystem could mitigate the negative effects of ecological and social crisis from compact city morphology through establishing liveable landscapes integration with buildings and infrastructures.

(2) Liveable landscape not only has a huge advantage in ecological benefits, but also plays a lead role in spiritual healing and social value promotion.

(3) Liveable landscape in high-rise residential communities where lack of urban open space in the compact city could be available to proximity to nature by building sky gardens, podium gardens and vertical greenery etc., which greatly improves the quality of life as well as happiness index.

(4) Liveable landscape in high-rise office buildings where people suffer from bad air quality and high pressure working load could largely improve the

work efficiency, reduce work pressure, and promote harmonious communication among colleagues.

(5) Liveable landscape in healthcare centre has a special contribution to relieve patients' physical and mental pain, reduces staff psychological stress, and provides amiable public open space for community members. The healing park could draw a big picture in promoting social well-being.

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*Figure 4 Pinnacle@Duxton*



*Figure 5 158 Cecil Street*



*Figure 6 Khoo Teck Puat Hospital*