Urban Living with Nature: Design for Human-nature Interactions in Communal Green Spaces at Residential High-rises

Tony Ip
Director, Tony Ip Green Architects Ltd., Hong Kong

Email: tony@tonyip.green

Abstract. The higher we live from ground level, the more disconnected we feel from the natural environment and community. Compared with people residing away from the metropolitan area, urban dwellers lack personal and open space and may seek room to escape from the hustle and bustle of the city. A new typology of sky gardens has been driving designs of residential high-rises to offer communal green spaces at high levels. Its potential benefits consist of improving human thermal comfort and urban microclimate; promoting social cohesion by serving as a community green space. It would provide a place for individuals escaping from the busy city life, improve the community integration for all age groups and improve the health and well-being of residents. In addition, it may enable and raise awareness of intimate contact with nature.

1. Introduction
The higher we live from the ground, the more disconnected we feel from the natural environment and community. Compared with people residing away from the metropolitan area, urban dwellers lack personal and open space and may seek room to escape from the hustle and bustle of the city. There is a lack of research evaluating the contribution of communal green spaces at high levels to the social integration and health developments of urban dwellers in high-density high-rise environments. Meanwhile, a new typology of sky gardens has been driving the design of residential high-rises to offer communal green spaces at high levels with the intention of enhancing social interaction and neighbourhood place-making while simultaneously improving environmental conditions.

This study is an attempt to evaluate the effectiveness of the sky gardens in contributing to the social integration and health developments of urban dwellers in high-density and high-rise contexts. Having reviewed the regulations and advisory guidelines in Hong Kong and Singapore, this study investigates the minimum and desirable provisions of communal green spaces and the success of its amenities in supporting a healthy living environment and co-relates their applicability in the context of high-rise residential development. Case studies of forty residential high-rises in Hong Kong and Singapore have mapped out diverse spatial, functional and landscaping designs of sky gardens.

2. Background
A high-density high-rise urban context has imposed challenges to enhancing inclusive and sustainable urbanization and offering universal access to safe, accessible, green and communal spaces, particularly
for women, children and older persons, in order to achieve the sustainable development goal for sustainable cities and communities.

The greatest rates of social isolation and the weakest neighbourhoods are found in the most densely populated high-rise buildings. High-rises have more feeble social networks and higher crime rates.[1] Forty years ago, a study conducted on residents’ behaviour in a high-rise apartment concluded that there was a high degree of anonymity and social isolation, including pervasive ignorance about neighbours and little inclination to establish friendly relations with them.[2] This phenomenon is not uncommon in residential high-rises even today.[3]

Research findings showed that residents of high-rises had strong requests for pleasant communal activity spaces and green areas. It suggests that these spaces could encourage social interaction among neighbours under certain circumstances. Findings of environmental behaviour analysis of high-rise buildings revealed that the first and second highest ratings of dissatisfaction in environmental quality were ‘lack of public space area’ and ‘lack of public facility/equipment’ respectively, and the exterior space was an important social aspect for residents.[4] A study of outdoor interaction spaces in high-rise housing concluded that both space types and design elements heavily impacted residents’ social behaviour. Higher rates of social interaction were prevalent with circulation, scenic and activity spaces. Additionally, design elements of visual focus, plants, play areas, and open space facilitate social interaction significantly.[5] Vertical landscaping and open spaces at the intermediate to high levels of skyscrapers not only benefit the microclimate but also create neighbourhoods that promote social cohesion.[6]

Sky gardens have been advocated as a sustainable building feature in Hong Kong and Singapore for two decades. Two governments’ emphases on the purposes of sky gardens are fundamentally different as observed from the guidelines. These differences have driven the sky gardens built based on them into distinct typologies.

Sky gardens have been advocated as a sustainable building feature in Hong Kong and Singapore for two decades. Two governments’ emphases on the purposes of sky gardens are fundamentally different as observed from the guidelines. These differences have driven the sky gardens built based on them into distinct typologies.

![Figure 1 & 2. Hong Kong and Singapore Governments’ design guidelines on sky-rise greening for green incentives](image)
2.1 Hong Kong
The Hong Kong government issued ‘green incentives’ for sky gardens in domestic buildings in 2001, including Gross Floor Area (GFA) exemptions and relaxation of the allowable overall building height in regards to the provision of sky gardens. Such incentives, stipulated in the practice note jointly issued by the Buildings Department, Lands Department and Planning Department, are conceived to encourage developers to incorporate greening measures in new residential high-rise buildings. According to the practice note, sky gardens aim to provide natural ventilation, greenery and recreational garden space for communal use. The locations of the sky gardens are recommended to be determined by wind tunnel tests or by computation fluid dynamic modelling, but it is not compulsory. The maximum number of sky gardens provided is equal to or less than the number of residential storeys divided by fifteen. Such a garden can be split into multiple levels, but it should occupy no less than one-third of the area of the floor plate.

2.2 Singapore
GFA exemption for sky gardens in Singapore was first introduced in 1997, aiming to promote more quality communal spaces and contribute to the overall greenery and environmental quality of the surrounding areas. In principle, the area of the sky garden within a 45-degree line taken from the edge of the overhead projection is exempted from GFA calculation. Additional floor height allowance is granted if the sky garden exceeds 60% of the floor plate and is subject to the total number of storeys. In 2009, additional GFA exemption for areas covered with corridors serving for barrier-free access and fire escape routes was introduced to further encourage building larger sky gardens in terms of both total area and landscape area.

2.3 Different Design Implications
Hong Kong’s sky gardens are relatively environmentally-driven while Singapore’s are socially-oriented. The former requirements restrict the numbers and locations of sky gardens, with more prescriptive details. For instance, sky gardens should be located at least 10 stories apart from each other as well as from podium gardens unless under exceptional circumstances where strong environmental justifications are required. In Singapore, the design of doorstep green communal spaces scattered around various stories and seamlessly integrated into the common circulation space to facilitate neighbours’ interactions are observed.

Relaxation of floor height for sky gardens is the main factor in designing for flexibility and innovation. Building height and site coverage requirements stipulated under various departments most likely limit development bulks to maximize allowable development potential. Without relaxing the floor height limit, it may not be feasible to squeeze sky gardens into the compacted floor plates in many cases. Some may argue that the contexts of Hong Kong and Singapore are different. It is true, the former is much higher in density and compactness. However, the adverse impact on urban ventilation at street level and on surrounding environments caused by raising overall building height while enhancing building permeability shall be further studied.

3. Case Studies
Case studies were carried out to identify diverse forms and functions of existing sky gardens. Twenty residential buildings with sky gardens in Hong Kong and twenty in Singapore were selected. These buildings were designed or built in the last fifteen years since the governments of the two cities have implemented policies and incentives to encourage the provision of sky gardens. The functions, configurations, connectivity and amenities of the selected sky gardens are shown in Table 1.
Table 1. Case studies of sky gardens in Hong Kong and Singapore.

| Development            | No. of storeys (residential floors) | No. of sky gardens | Sky garden location | Separate floor | Refugefloor | Doorstep from units | Near podium clubhouse | Near sky clubhouse | At roof level | Connect towers | Recreational amenities |
|------------------------|--------------------------------------|--------------------|---------------------|-----------------|-------------|--------------------|---------------------|-------------------|---------------|-----------------|-------------------------|
| The Orchard (2003)     | 38                                   | 2                  | 17, 32/F            | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| The Arch (2005)        | 50-51 (5-82/F)                       | 1                  | 62/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Centre Place (2006)    | 27                                   | 1                  | 25/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Grand Promenade (2006) | 55-58 (7-73/F)                       | 1                  | 47/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Indi Home (2006)       | 55                                   | 1                  | 45R/F               | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| 31 Robinson Road (2007)| 30 (8-42/F)                          | 1                  | 7/F                 | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Manhattan Hill (2007)  | 40-42                                | 1                  | 25-26/F             | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| The Apex (2007)        | 44 (2-50/F)                          | 1                  | R/F                 | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| SOHO38 (2008)          | 26 (5-38/F)                          | 1                  | 27/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| The Forest Hills (2008)| 48 (8/F-51/F)                        | 1                  | 29/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| The Sparkle (2008)     | 37 (7-49/F)                          | 1                  | 45/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| i-home (2009)          | 37                                   | 1                  | 20/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Shining Heights (2009) | 48 (5-60/F)                          | 2                  | 27, 50/F            | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| The Masterpiece (2009) | 38                                   | 2                  | 9, 47/F             | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Aria (2010)            | 30 (5-39/F)                          | 1                  | 37/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Island Crest (2010)    | 36 (2-50/F)                          | 1                  | 29/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Larvotto (2011)        | 25-28 (7-39/F)                       | 1                  | 20-24/F             | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Lime Stordom (2011)    | 36 (5-45/F)                          | 1                  | 18R/F               | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Harbour One (2012)     | 29 (9-42/F)                          | 2                  | 7, 32/F             | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| De Novo (2015)         | 23 (1-23/F)                          | 1                  | 23/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Newton Suites (2007)   | 36                                   | 7                  | every 4 floors      | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Central Horizon (2008) | 11/40                                | 1                  | 12/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Pinnacle at Duxton (2009) | 50                          | 2                  | 26, 50/F            | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| RiverGate (2009)       | 43                                   | 20+                | every 2-3 floors    | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Skypark at Somerset (2010) | 32                      | 15                 | every 2 floors      | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Reflections at Keppel Bay (2011) | 24/41 | 4                  | 8, 15, 22, R/F       | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Martin Place Residences (2011) | 33                  | 1                  | 14/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Soleil @ Sinaran (2011)| 33                                   | 1                  | 14/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Parc Seabreeze (2012)  | 20                                   | 1                  | 14/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Ascentia Sky (2014)    | 45                                   | 10                 | every 5 floors      | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Novel 18 (2014)        | 36                                   | 8                  | 11-26/F             | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Lincoln Suites (2014)  | 30                                   | 1                  | 24/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Spottiswoode Residence (2014) | 36                     | 3                  | 2, 10, 22/F         | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Spottiswoode 18 (2015) | 36                                   | 2                  | 14, 24/F            | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| SkyTerrace at Dawson (2015) | 40-43                     | 2                  | 19,33/F             | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Sky Habitat (2015)     | 38                                   | 3                  | 14,26.38/F          | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Robinson Suite (2016)  | 42                                   | 2                  | 7, 19/F             | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| Scotts Tower (2016)    | 31                                   | 1                  | 25/F                | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| The Tembusu Kovan (2017)| 18                            | 3                  | 6,12,18/F           | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |
| City Gate (2019)       | 30                                   | 2                  | 6,24/F              | ●               | ●           | ●                  | ●                   | ●                | ●             | ●              | ●                       |

4. Discussion

4.1 Design Intent

Sky gardens are commonly found to increase the overall building height, demarcate zones of residential units in different sizes and property values, add value to refuge floors, offer extended areas and/or circulation to clubhouse areas, increase greenery, and enhance building permeability. Meanwhile, some cases of sky gardens offer unique, pleasant, well-equipped communal green spaces that may stand out
from other garden spaces at podium or street level. Moreover, they are promoted as a key marketing selling point that adds to the property’s value.

Figure 3 & 4. Snapshots of sky gardens in Singapore and Hong Kong respectively.

4.2 Spatial Quality
Sky gardens at high levels provide better light and air quality compared with outdoor spaces at ground or podium level, especially in a high-density high-rise environment. Panoramic and open, distant views are offered to all occupants, even those who live in tiny units with a limited view of the outdoors.

Structures and fire service provisions restrain spatial configuration of sky gardens, particularly sky gardens as refuge floors. On average, the area distribution in a sky garden in Hong Kong is 20% greenery,
45% outdoor circulation and event spaces and 35% indoor circulation, services zones and plant rooms. The change in structure required for the creation of large event spaces is hardly found, thus restraining the configuration of spatial planning for activities and amenities in sky gardens. The largest dimensions of an outdoor space among the twenty sky gardens is about 6m x 6m which is equal to a combination of two large unit living rooms. Singapore’s sky gardens are more spacious, boasting higher ceilings. Some of the sky gardens extend their floor plate out over the edge of the residential tower to facilitate their functional or spatial requirements, for example, providing continuous jogging tracks projected away from the edge columns in Pinnacle at Duxton. Terraces or areas partially open to air are not uncommon.

4.3 Connectivity and Accessibility
Neighbourhoods cannot be fostered without social interaction. Moreover, architectural articulations cannot make spaces more vibrant. Only functions, accessibility and connectivity can. Connectivity not just enhances the chances of neighbours’ interactions but also accommodates various recreational activities. Sky gardens bridge different towers in the form of a footbridge, an observation deck, even as a gym, a swimming pool, a garden space or a park.

Most of the sky gardens in Hong Kong are sandwiched in between intermediate levels of buildings, which are mainly accessed by passenger lifts. Staircases reaching these floors are mainly used for escape routes in the event of a fire but not for daily use. In the interest of rendering efficient lift service arrangements, passenger lifts are usually split into high and low zones or odd and even numbers of floors for operation. Therefore, not all lifts can access sky gardens and, in most cases, only one lift, which is also the firemen’s lift, is made available on the floor of the sky garden. In the case of ‘Indi Home’, residents living in the high zone have to take another lift to the sky garden by going down to the ground floor as sky garden is allocated to the low zone lift operation. Inconveniences may be induced under such lift arrangements.

On the contrary, scattered communal gardens in proximity to doorsteps of residential units are found in Singapore, which makes garden spaces more accessible. Doorstep gardens or sky gardens as part of the main circulations can facilitate daily activities and intentional or causal interactions.

4.4 Greenery
Both the quality and quantity of greenery are essential. Extensive greenery in a deliberately designed volume of vegetation creates a thermally comfortable outdoor environment and may even act as visual buffers for the densely populated surroundings.

In both cities, recreational space is the prioritized element of sky gardens, while the provision of greenery comes second. Narrow planter strips are located at the perimeters of sky gardens. The planters usually create an irregular profile of the floor plate to shape larger usable floor spaces. Hence, planters can still be found in the centre of the floor plate, out of reach of daylight.

Both the quality and quantity of greenery are essential. Extensive greenery in a deliberately designed volume of vegetation creates a thermally comfortable environment and visual buffers from the densely populated surroundings. Soft fascination through appreciating greenery and nature is promoted. Furthermore, edible plants relate to community gardening and promote appreciation of natural foods. Additionally, different configurations of greenery are observed, such as greenery lining the edges or screening the structure core. Vegetation at the edges can improve windy conditions and foster a sense of safety. Vegetation structures with deliberated height and species variation intend to ameliorate wind at high levels but shall not block daylight penetration. Planting strips at the edges set around the edge creates a physical barrier and also acts as a visual barrier, enhancing the residents’ sense of safety.
The selection of plants is generally up to either the designer or the developer depending on the atmosphere they intend to create. Technically, some plants and trees are not wind tolerant. Some trees with big canopies may be uprooted when placed at a high level with windy conditions. Utilizing trees with more open canopies can prevent uprooting during typhoons and avoid blocking sunlight penetration at daytime. Greening, Landscape and Tree Management Section of Development Bureau of HKSAR issued “Pictorial Guide to Plant Resources for Skyrise Greenery in Hong Kong”;[9] which serves as a database for plant information, including biological and physical properties, wind tolerance, recommended soil depth, seasonal effects, modes of support for vertical greenery, maintenance demand and points of interest for plant appraisal and selection.

4.5 Amenities
Amenities for a garden landscape with a scenic view include self-retreat and reading in a peaceful environment but leisurely walks with family and friends are the most popular. Indeed, outdoor fitness-friendly spaces encourage residents to consistently engage in fitness-related activities, such as playgrounds, workout stations, trails or an accessible body of water; and free access to gyms, playing fields or swimming pools. On the other hand, a covered landscape is good for provisioning semi-outdoor spaces on rainy or hot summer days.

The most popular amenities in sky gardens are the sitting area, viewing platform, Tai-chi square, foot massage trail and strolling path. Their spatial requirements are quite flexible without any complicated or high-maintenance facilities required. Except for the viewing platform, these amenities are not necessarily to be situated at sky garden height. However, abundant greenery with good natural ventilation and appealing distant view are significantly advantageous to outdoor activities, including doing exercises, chatting with family members and self-retreat. In some cases, the sky gardens will be the naturally ventilated residents’ clubhouses instead of the air-conditioned ones. For instance, water facilities comprising of swimming pools, Jacuzzi pools and spa at sky-high levels.

4.6 Design of Effective Sky Gardens
Three types of sky gardens are proposed in view of specific environmental and social functions.
1. Sky gardens at low levels;
2. Sky gardens at high levels; and
3. Sky gardens integrated with circulation spaces and scattered at multi-levels.

First, the design of sky gardens located at or below 60m emphasizes improvement of building permeability and environmental quality. Since most of the existing buildings aged over 20-30 years are less than 20 storeys, 60m above the street level becomes the datum of the roofline of the existing urban fabric. The sky gardens offer high ceilings, approximately 3-4 storeys in height, which maximizes the beneficial effect on the micro-climate and air ventilation of the urban environment.

Second, sky gardens above 60m facilitate more outdoor recreational spaces for residents, acting as a natural-ventilated sky clubhouse. Large-span column-free gardens and event spaces are provided with attractive amenities. Elderly friendly facilities and children’s play amenities are also recommended for daytime garden users.

Third, sky gardens in pocket sizes with extensive planting are integrated with communal circulation spaces, such as lift lobbies and corridors at residential floors, and are scattered in the building at multiple levels. The spatial requirement is not critical, only needing to allow sufficient daylight and natural ventilation to the garden and the adjoining circulation spaces. The garden areas are in close proximity to living units and offer more chances of social interactions among neighbours and physical contact with greenery. Also, a pocket sky garden facilitates impromptu extension of residents’ living spaces for occasional family gatherings.
5. Conclusion

Urban dwellers are characterised by a more affluent living style and exhibit patterns of routine related to fewer opportunities for unplanned human-nature interactions with gain in affluence but are critical for developing a sense of neighbourhoods and community, or appreciation for the natural environment.

Subject to a better understanding of the typology of sky gardens, potential benefits comprise of improving human thermal comfort and urban microclimate, promotion of social cohesion through the provision of a community green space, provision of a place for individuals to escape from their busy city life, improving community integration for all age groups and improving the health and well-being of the residents, and raising awareness of intimate contact with nature.

Recommendations are that the design of sky gardens need to include consideration of specific environmental and social functions. Sky gardens located at relatively low levels emphasize building permeability with sufficient headroom. Sky gardens at high levels serve the purposes of recreation, social gathering and ambient cooling. Sky gardens with wider spaces and attractive amenities act like natural-ventilated sky clubhouses, and those with extensive planting integrate well with circulation spaces at multi-levels of the building.

Quality urban living environment not only furnishes residents with convenient accessibility and adaptable conditions but also embodies welcoming communal amenities and enjoyable greenery. The ratio of green spaces in new, high-density, high-rise developments is suggested to be in relation to the population of residents. Provision of appealing, covered landscaping areas including sky gardens with a deliberate design should be advocated for in order to gain access to benefits for both the residents and the community.

References

[1] Zito J M 1974 Anonymity and neighbouring in an urban, high-rise complex Journal of Contemporary Ethnography 3 243-263
[2] Fowler E P 2008 Faulty towers: contrary to popular belief, high-rises are not the answer for higher density living Alternative Journal 1 24-26
[3] Robert, G 2007 The consequences of living in high-rise buildings Architectural Science Review 50 2-17.
[4] Chien H T and Wang M S 1999 Environmental behaviour analysis of high-rise building areas in taiwan Building and Environment 34 85-93
[5] Huang S C L 2006 A study of outdoor interaction spaces in high-rise housing Landscape and Urban Planning 76 193-204
[6] Yeang K 1995 The bioclimatic skyscraper Collected papers of Habitat and the High-rise – Tradition and Innovation: Fifth World Congress, Amsterdam, The Netherlands pp 273-290
[7] HKSAR Government 2001 Buildings Department, Lands Department and Planning Department: Joint Practice Note No.1 – Green and Innovative Buildings
[8] Singapore Government 1997 Urban Redevelopment Authority: Circular to Professional Institutes (Circular No. URA/PB/ 2009 12 DCG)
[9] HKSAR Government 2013 Greening, Landscape and Tree Management Section, Development Bureau: Pictorial Guide to Plant Resources for Skyrise Greenery in Hong Kong