Designing liveable urban open spaces in high density cities

IOP Conf. Series: Earth and Environmental Science **297** (2019) 012049 doi:10.1088/1755-1315/297/1/012049

Designing liveable urban open spaces in high density cities

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Abstract. Hong Kong is one of the densest cities compared to other metropolitan cities with population density in some districts exceeding 57,250 persons per sqkm. Hong Kong's liveability has been affected by factors such as escalating urban density, lack of open spaces, congested living environments, air pollution concentration and high proneness to pandemics.

Due to extremely high land premiums, some residents in Hong Kong live in nano flats small as 15sqm in high-rise towers. Given the congested nature of apartments, open spaces a play a vital role contributing to residents' psychological and physical well-being. Due to peculiar topography and extreme high density, Hong Kong open space per capita is far from the WHO recommended standards of 9 sqm per person. Most urban open spaces are pocket spaces located among developments or adjacent to traffic roads with a high ratio of hardscape compared to vegetation. Due to challenging Summer conditions in Hong Kong with high temperature, humidity and stagnant wind most urban open spaces are underutilized.

This research investigates the factors effecting enjoyment of open spaces and design factors that could contribute to improve their liveability as public amenities. Exploration is based on liveability parameters such as user comfort, user behaviour, and spatial attributes of urban open spaces. Field data was collected on seven urban open spaces within Tsuen Wan district during dry Summer days. Field data analysis was supplemented by simulation methods, photographic survey of users' movement within open spaces and user interviews.

All open spaces are located amidst of high-density urban environment facilitating easy access to residents in the neighbourhood proving sense of security. Findings indicate tendencies in using these open spaces in the afternoon after 4pm when these open spaces cool off from solar radiation. Majority of open spaces benefited from shading effect from surrounding buildings, however the seating arrangements have not benefited from the shading. Satisfactory wind speed could be observed in four open spaces out of the seven that benefited from South and SE wind directions providing desirable thermal comfort to users. The park that consisted of the highest ratio of greenery received the lowest wind speed due walled effect created by surrounding buildings. Ironically open spaces with high percentage of hardscape areas reported better wind performance indicating the possibility of high emissivity material creating low pressure pockets drawing winds in particularly in the afternoons.

1. Urban fabric of Hong Kong

Hong Kong is amongst the densest cities in the world due to its challenging topography where less than 25% of the total land area is developable out of total extent of 1064sqkm. Land population

density in some areas exceeds 57,250 persons per sqkm [1]; resulting on high-rise high density-built environment to accommodate 7.3million population within approximately 265sqkm of developable land. People live in high-rise towers tall as 60 storeys and in dwelling units small as 15sqm. Given congested living environments, easily accessible outdoor amenities play a vital role towards residents' well-being.

Urban open spaces not only play a vital role as public amenities contributing to emotional and physical well-being of residents, they are also important in maintaining ecological continuity, creating breathing spaces within the high-density fabric and creating desirable microclimates. Despite the size and nature of open spaces 'between' buildings still provides a frame-work for several activities, planned or spontaneous [2].

A study conducted covering all urban open spaces in Hong Kong reports that average open space per capita is 1.6sqm with a range of 0.89 and 2.82sqm [3] which is far below from open space per capita in many metropolitan cities. Approximately 93% of the population of Hong Kong have access to public open spaces within 400m [3].

1.1. Urban climatic challenges

Hong Kong inherits a sub-tropical climate with hot, humid and wet Summers. Thermal comfort conditions in urban centres are influenced by its peculiar hilly terrain and proximity to sea and high-rise high density built environment. Urban heat island effect, street canyon effect, shading from buildings, stagnant wind, air pollutant concentration and high humidity are unavoidable attributes of Hong Kong living. On average wind speed in most urban areas is approximately 1 m/s. Over the past five years humidity levels from June to September ranged between 75% - 84% with average Summer temperature reaching 34.5^{o}C [4].

High humidity, hot weather, stagnant wind and air pollution are some of the key challenges towards the enjoyment of outdoor life despite over 70 percent of woodlands and country parks and easily accessible urban open spaces. Urban open spaces are predominantly being used by elderly on a regular basis who are more vulnerable to heat stress and safety related issues.

2. Urban morphology in the case study area

The first 'New Town' 'Tsuen Wan district' developed in early 1960 as an industrial hub which has now been evolved into a mixed-use residential and commercial area was selected as the case study. This 6,000ha district accommodates 302,814 population with a density of 5,300 persons per sqkm and a stock of 103,219 households. About 70,000 people live in public and subsidized housing whilst the majority living in private housing [5]. Out of total population of 302,814 residents, 36.5% represent home makers, retirees, self-employed and others who are not employed who spend more hours of the day within the district. About 21.5% population are above 60 years of age [6].

Five to six storey Chinese tenement housing is the predominant typology with a commercial element at the road level. Public housing in the form of residential towers were developed in late 1970s to accommodate influx of population. Street grids are aligned to South East and North West directions without facilitating adequate wind flow along the roads in Summer where predominant Summer wind directions are from the East, South and South-East quarters [7].

Being an old district with many old housing estates, these open spaces are often being used by senior citizens, home makers, parents and domestic helpers who are waiting to pick up their children from schools. Tsuen Wan inherits a combination of parks, public open spaces and sports grounds of varying scales ranging from > 1ha to 5hs<, out of which 87 percent of residents are within 400m to public open spaces and 94 percent residents are within 800m to public open spaces [3]. In terms of accessibility public open spaces within 400m to residential areas, Tsuen wan ranks 16th position out of 18 districts in Hong Kong [3]. Six out of seven open spaces considered for this study are less than 1ha.

2.1. Open spaces planning standards and guidelines

Draft Outline Zoning Plan approved for Tsuen Wan district in 2017 includes land allocations for "Open Space and Green Belt" land uses [8]. 131.84ha out of 6,000ha is land is zoned as "Open Space" to provide active and passive recreational facilities for the community [9]. Parks in Tsuen Wan district have been planned prior to the release of the Draft Outline Zoning Plan which has provided several recommendations for creating sustainable and liveable open spaces. Therefore, findings from this study may be beneficial in redesigning and improving liveability and functionality of open spaces in Tsuen Wan and similar districts. Majority of these open spaces are pocket open spaces that are located among commercial and residential land uses. Local open spaces are primarily intended for passive uses, and hence the 3:2 active to passive ratio does not apply as for district level open spaces [10].

Planning Department [10] recommends that open spaces should be safe, functional, accessible and usable spaces for the community; not merely fulfilling regulations. Safety is a major consideration in open space design with regards to location, identifiable entrances, surface texture and facilities provided. Open spaces should cater to elderly, persons with disability, children and adults in an integrated manner with attention to surface finishes and layout providing adequate outdoor furniture under shading and away from the pedestrian paths with slip resistant hardscape finishes. Where possible parks are required to have a nature buffer to reduce pollutants infiltration. Longitudinal span of 90 percent of the open spaces considered for this study are aligned to North-East and South-West direction only allowing that are abutting streets to receive Summer wind from East, South and South-East quarters prevailing wind through their shorter span.

3. Methodology

The research engaged a multi-dimensional approach for data collection and analysis; field data on microclimatic conditions were collected during Summer months using Extech HT200 Heat Stress WGBT Meter and Kestrel 5000 Environmental Meter. Microclimatic data were supplemented by contextual analysis of these open space, photographic survey of user behaviour and interviews with open space users. Behavioral indicators contributing heat stress such metabolic rate, clothing insulation and moisture permeability were excluded as the WBGT index. Epstein and Moran cite Fanger to explain the scope of WBGT index as an empirical index that indicates heat stress under direct sunlight measuring temperature, humidity, wind speed, sun angle and solar radiation without counting users' physiological information [11] [12]. Field data were verified with the nearest Observatory weather station data. Shadow analysis was conducted using Grasshopper Ladybug plugin; results were correlated with field measurements and the photographic survey.

Field data were collected at 1130hrs and 1530hrs based on initial observations on peak usage trends by the non-working residents in the surrounding housing estates. Users were interviewed based on random sampling supplemented by a structured questionnaire to gather their perception on the factors that affect liveability during summer and their suggestions for improvements. Number of interviews and questionnaire surveys were limited when the responses followed similar trends. Photographic survey was conducted for recording user behavior, park layout, landscape and other features.

The study focused on seven urban pocket open spaces that are less than 1ha in extent that represent different geometries, contextual attributes and land use compositions to investigate their success in functioning as public amenities providing user comfort.

3.1. Developing liveability analysis matrix

The term liveability is mostly researched and discussed at cities' scale although there is no unified matrix for analysis. Even the most widely adopted indices such as Mercer Quality of Living ranking and The Global Liveability Index by The Economist Intelligence Unit vary in their parameters and hence the results.

Gehl [2] & [13] has contributed to knowledge immensely by comprehensive research on quality of public spaces. Twelve quality criteria by Gehl [2] focuses on human senses; protection, comfort and

enjoyment, than on physical aspects of a public space. However, since Gehl's studies offers key insights for designing public places, this research extended Gehl's index to incorporate physical design parameters, microclimatic aspects, operational aspects and impacts from the surrounding and mapping them to sensory aspects of Gehl's matrix (Table 1).

Besides human sensation related factors, physical comfort conditions such as thermal comfort and design quality of open spaces play an important role when defining the liveability and functionality. ASHRAE 55 defines thermal comfort as a sensation that indicates the satisfaction with the thermal environment.

Table 1: mapping of Gehl's twelve quality criteria on to the extended matrix

Extended index		**Gehl's twelve quality criteria**
Planning aspects	Surrounding environment	Protection - against harm by others
	Location and accessibility	Protection - against traffic and accidents
	Clear separation of pedestrian traffic from vehicular traffic (automobiles)	
Spatial design and quality	Easy navigation within	Comfort - options for mobility
	Clear separation of relaxing areas from walkways	Comfort - options for mobility
	Amenities –active recreational facilities for all ages	Comfort - options for play, exercise, and activities
	Amenities – access to sanitary facilities, water fountains	
	Spatial arrangement – defined seating, shelters, choice of seating for few and a crowd, resting areas, pedestrian paths	Comfort - options to stand and linger Comfort - options for sitting Comfort - options for talking and listening/ hearing
	Sense of scale	Enjoyment – scale
	Aesthetics – landscapes, waterscapes	Enjoyment - Experience of aesthetic qualities and positive sensory experiences
	Inclusive design	Comfort - options for mobility
	Texture of surfaces	
	Views	Comfort - options for seeing
Operation and maintenance	Cleanliness / hygiene	Protection against unpleasant sensory experience
	Odor	
Microclimatic aspects	Noise	Protection against unpleasant sensory experience
	Temperature	Enjoyment - opportunities to enjoy the positive aspects of climate
	Humidity	
	Wind	

4. Findings

4.1. Planning aspects

As illustrated in Figure 1, the seven urban open spaces considered for this study are well integrated into the high density residential and commercial urban fabric of Tsuen Wan providing a sense of

protection, convenience and accessibility. All open spaces are located within 400m walking distance to residential estates and nearby schools and are connected through a network of routes. 400m is considered as a healthy walkable distance according to LEED green building rating tool. Other than three, others are located inland away from major traffic roads and majority are located within commercial or residential developments providing sense of safety for the users and sense of enjoyment due to lack of traffic noise and air pollution.

Figure 1. Park network in the case study area (Author, 2018)

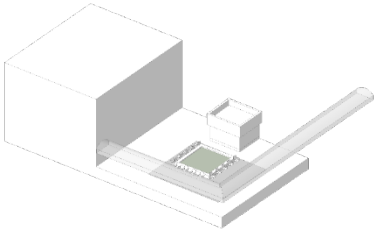
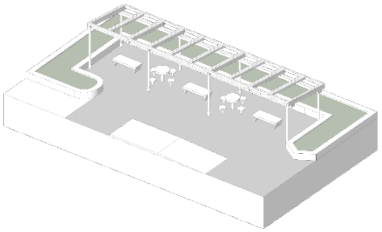
4.2. Spatial design and quality

Out of the seven cases, only Jockey Club Tak Wah park is designed according to classical Chinese garden theme whilst other open spaces can be classified as urban pockets. This park is approximately 1.6 ha in extent and about ten times larger compared to all other pocket spaces.

All open spaces facilitated easy navigation within because of their simple configurations. However, the separation of sitting out areas from pedestrian walkways are not adequate to provide sense of relaxation to users as seats are often positioned along the walkway. Out of the seven open spaces only one consists of recreational equipment for elderly and two consisted of simple play elements for children. Seating arrangements and shelters provided in majority of these open spaces and the usage patterns confirm that these open spaces are primarily for passive recreation. Out of the seven, only the Jockey Clun Tak Wah park had sanitary facilities. All these open spaces have followed inclusive design principles making them elderly and disable friendly. None of them however had any views as all of them are located within high density built environment.

Table 2 presents an analysis of spatial attributes indicating hardscape to greenery ratio and orientation in relation to wind direction. Open space sizes vary from 200 sqm to 10,600 sqm with only three open spaces with over 1000sqm extent. These open spaces predominantly comprise of hard surfaces and large canopy trees with limited green cover.

Table 2. Analysis of spatial attributes and response to prevailing wind directions (E, SE & S) (Author, 2018)

<table>
<tr><td colspan="2">Sha Tsui road playground – located adjoining a major traffic road
Orientation in relation to wind direction: A playground on NE, E and SE; a traffic road on S, SW; tall buildings on NW
Benefit from E, SE and S wind directions (average wind speed 1.79m/s)
Hardscape: Greenery = 774:1202 sqm = 1:1.55 (61% greenery in the park)</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Fuk Loi Estate urban pocket park – located adjoining a secondary road and surrounded by a residential estate
Orientation in relation to wind direction: N, NE, E, SE facing pedestrian roads; S, W facing school buildings; SW facing school ball court
Benefit from E and SE wind directions
(average wind speed 1.34m/s)
Hardscape: Greenery = 170:34 sqm = 1:02 (17% greenery in the park)</td><td>Fuk Loi Estate urban pocket park – located adjoining a secondary road and surrounded by a residential estate
Orientation in relation to wind direction: E, SE abutting a residential block; S, SW facing a road; NE facing housing estate courtyard surrounded by residential blocks
Benefit from S wind directions
Hardscape: Greenery = 169:61 sqm = 1:04 (27% greenery in the park)</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Tai Hoi road urban pocket park – located adjoining a major traffic road
Orientation in relation to wind direction: N, NW facing a major road; W, SE, S blocked by buildings; SSE facing a road
Benefit from SSE wind directions (average wind speed 1.34m/s)
Hardscape: Greenery = 174:172 sqm = 1:0.99</td><td>Tai Hoi road urban pocket park – located adjoining a major traffic road
Orientation in relation to wind direction: N, NW facing a major road; W, SW, SE, S blocked by buildings; SSE facing a road
Benefit from SSE wind directions
Hardscape: Greenery = 250:180 sqm = 1:0.72 (42% greenery in the park)</td></tr>
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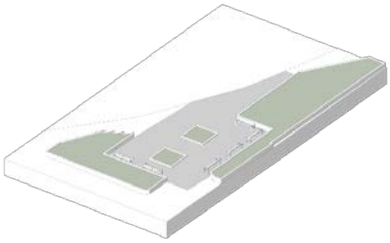
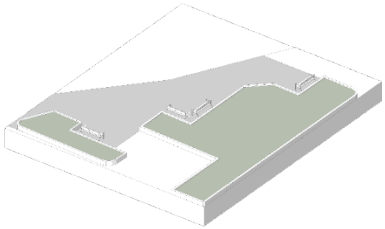
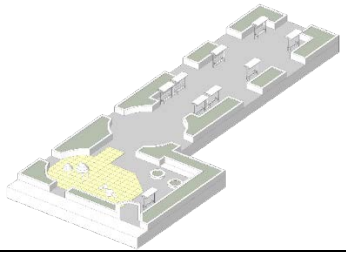
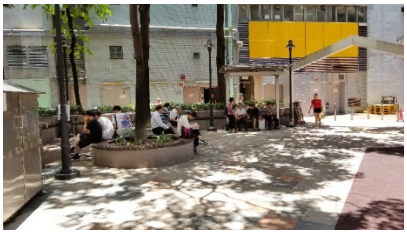
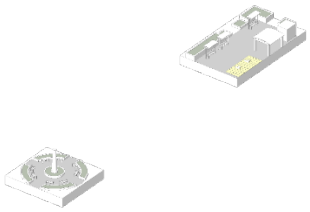
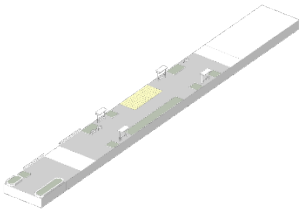
<tr><td>(50% greenery in the park)</td><td></td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Tai Pei square – located away from traffic routes
Orientation in relation to wind direction: surrounded by tall buildings with NE and SW connecting to pedestrian walkways and a small square on NE; S, SW facing a major road
Benefit from S wind direction ((average wind speed 1.79m/s)
Hardscape: Greenery = 784:279 sqm = 1:0.36 (26% greenery in the park)</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Jockey Club Tak Wah park – located in the middle of institutional and residential areas. Accessible through many pedestrian walkways
Orientation in relation to wind direction: Square park. E, SE facing a hospital; all other sides are facing pedestrian route and buildings
Not directly exposed to any wind direction (average wind speed 0.58m/s)
Hardscape: Greenery = 4903:4904 sqm = 1:1(42% greenery in the park)
Waterscape = 1745 (17%)</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Sam Pei Square – located away from traffic roads
Orientation in relation to wind direction: E, SE, facing a school block; S facing school ball court
Benefit from S wind directions (average wind speed 2.32m/s)
Hardscape: Greenery = 271:69 sqm = 1:0.26 (20% greenery in the park)</td></tr>
</table>

	
Yi Pei Square – located away from traffic roads Orientation in relation to wind direction: All sides surrounded by buildings with access from SW, NW, NE, SE Benefit from SE wind direction (average wind speed 2.46m/s) Hardscape: Greenery = 621:115 sqm = 1:0.18 (16% greenery in the park)	
	

4.3. Impacts on microclimate

Planning Department stipulates greenery requirements for passive recreational areas; 70 percent soft landscape inclusive of 60 percent trees [10]. None of the open spaces in the study area achieved this greenery requirement; only two consisted of more than 50 percent landscape indicating the predominance of hardscape.

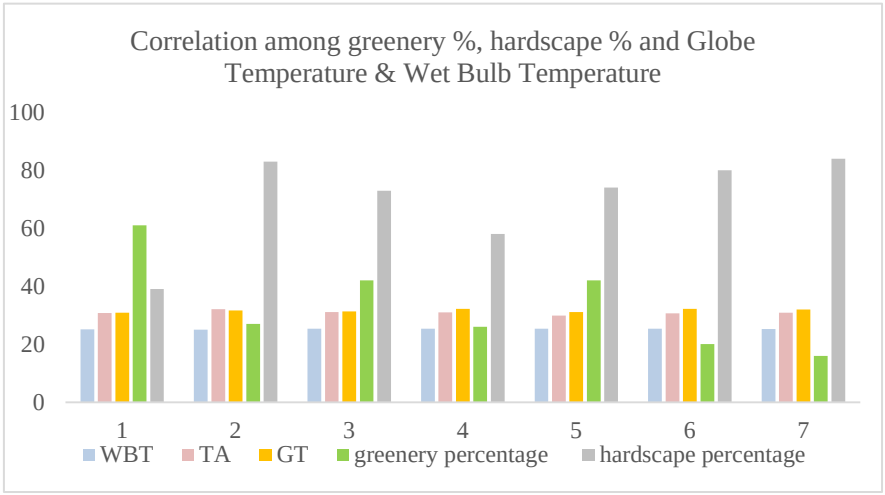


Figure 2. Greenery percentage, hardscape percentage and Globe Temperature in case study open spaces (Author, 2018)

Five out of seven open spaces consist of cement block paving and two consisted of orange color eco blocks; with two having dark color rubber mats in the activity areas. Although light color high albedo materials have been used on hardscape areas, compared to greenery hard surfaces contribute to high emissivity and therefore elevated mean radiant temperature increasing Urban Heat Island (UHI) Effect. Hong Kong is notorious for UHI effect with an average increase of about 2^{o}-3.5^{o}C in air temperature in urban areas [14]. A study on Taipei with a similar climate suggests how solar radiation

absorption within unshaded hardscape areas effected the thermal environment within a park during daytime elevating temperature in the surrounding areas [15]. The same study recommends reducing unshaded paved areas to less than 50 percent to alleviate negative effects. Supporting the above argument, Wong and Chen report positive contributions from greenery on microclimate within the parks and the surrounding [16]. Our analysis between hardscape percentage, greenery percentage and Globe Temperature (GT) presented in Figure 2 indicates the lowest GT in the park with the lowest percentage of hardscape and highest percentage of greenery. Parks with the lower percentage of greenery and relatively a high percentage of hardscape indicated a higher GT and elevated air temperature (TA) values. A study that compared thermal properties of material in a desert climate concluded that unlike concrete and asphalt, grass and poly material contribute to the least amount of thermal energy during a 24-hour average, thereby reducing UHI [17]. EPA US reports the importance of vegetation claiming that evapotranspiration from greenery could reduce peak summer temperatures by 1–5°C [18]. Shahmohamadi et al. opined that replacement of soil and vegetation by concrete and asphalt increases ambient temperature. These studies support the role of urban greening on thermal comfort [19]. Wet Bulb Temperature did not vary across the open spaces although the relative humidity ranged between 60.5 to 66.6 percent.

4.4. Outdoor thermal comfort

With 15.9 percent elderly in Hong Kong with an increasing trend and 91.9 percent of them living in compact domestic households, provision of active and passive public recreational facilities has become an agenda towards facilitating healthy communities. Given the hot humid climate in Hong Kong and challenging weather conditions in Summer it is important that these outdoor spaces don't create heat stress in vulnerable population.

WBGT Index was used to assess outdoor thermal comfort as it combines different temperature readings, relative humidity, solar radiation and wind. Although the WBGT Index has its limitations excluding physiological changes. However, given that the majority of users are elderly with similar physiological state WBGT Index was considered adequate for this analysis. Thermal comfort is a state of mind than what reads on the measuring devices; park users was interviewed to accommodate these responses.

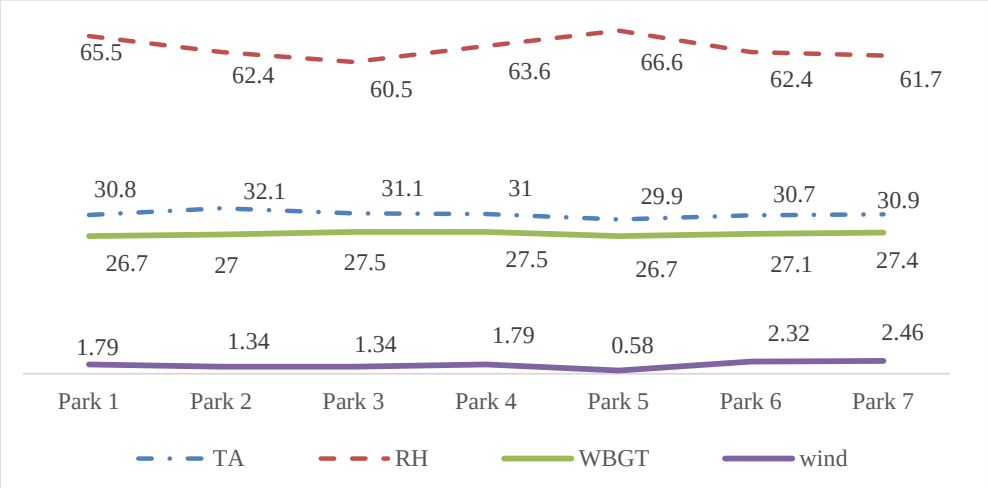


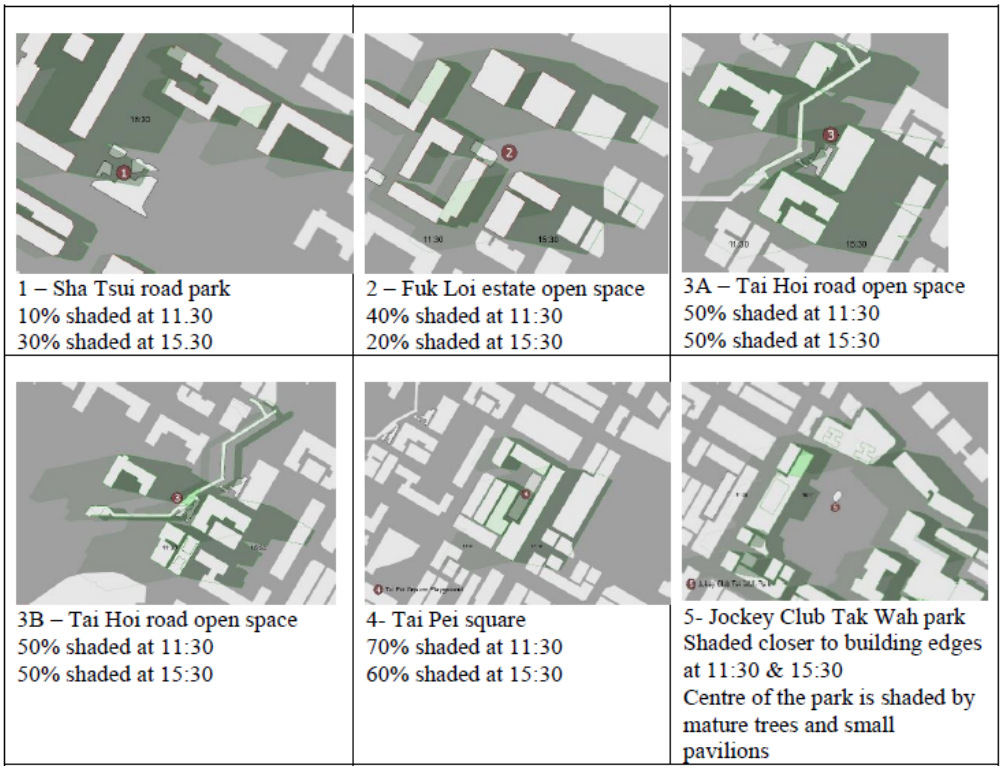
Figure 3. Microclimatic conditions in the seven open spaces collected in Summer (Author, 2018)

Figure 3 presents a comparison of TA, WBGT, RH and wind speed for discussing their effect on thermal comfort. Based on CBE Thermal Comfort Tool analysis none of the open spaces meets the thermal comfort standards required in ASHRAE 55 standards (CBE). To meet ASHRAE 55 standards, at 60% RH, the TA should be between 24-29^{o}C. Ambient Temperature varied from 29.9 to 32.1^{o}C in

park 2 and park 5 respectively with a median of 30.9°C. Whereas WBGT results varied from 26.7 to 27.5°C within a median of 27.1°C maintaining a narrow range. Humidity varied between 60.5% to 65.5% with a median of 62.4%. A study on neutral physiological equivalent temperature (PET) reports that in summer in Hong Kong under shaded conditions when the temperature is 28°C, a wind speed of 0.9-1.3m/s is required to provide neutral thermal comfort for a person in light clothing [20]. All open spaces reported air temperature above 29.9°C; however, WBGT levels were between 26.7-27.5°C with lower humidity levels and wind speed in majority of open spaces ranged between 1.34-2.46m/s providing users with comfortable thermal environments. Open spaces (3B, 4, 5, 6 & 7) that are abutting to major traffic roads or surrounded by streets or located amidst of buildings reported elevated Ambient Temperature around noon. Open spaces 5, 6 and 7 cooled off around 4pm perhaps because of high wind speed reported in open space 6 and 7 and high ratio of greenery in open space 5. Hong Kong Observatory station located on a higher plane surrounded by vegetation and about 1.5km direct distance away from the study area reported, 26.8 to 32.2oC range of Ambient Temperature alluding to the effect of greenery on outdoor temperature.

Due to high rise high density built environment, most urban areas in Hong Kong experience stagnant wind. Average Summer prevailing wind speed at 200m elevation for Tsuen Wan is approximately 3.3 m/s [21]. Attributed by microclimatic conditions such as orientation to wind direction, vegetation ratio and surrounding density etc., these open spaces demonstrated varying wind speeds. As reported in Table 2 & Figure 3 satisfactory wind speed could be observed in open spaces 1, 4, 6 and 7 that benefit from South and SE wind directions. Although having a high greenery ratio amongst all, open space 5 reported the lowest wind speed because of the surrounding buildings and perhaps because of the friction created by the tree crowns. Ironically open spaces with high percentage of hardscape areas reported better wind performance indicating the possibility of high emissivity material creating low pressure pockets drawing winds in particularly in the afternoons.

4.5. Impacts from surrounding built environment on the open spaces



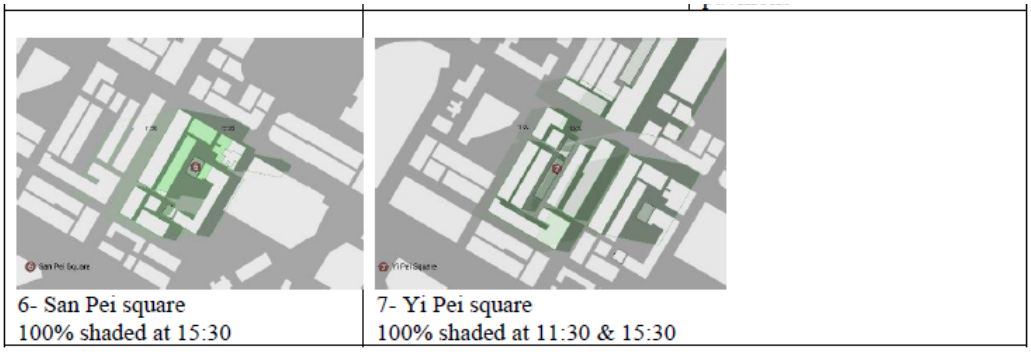


Figure 4. Shadow analysis that compare 11:30 & 15:30 hrs. on a sunny day (Author, 2018)

Open spaces are surrounded by the residential, commercial and institutional buildings around providing convenience to park users. Majority of these buildings are above six stories high casting shadows on the open spaces. Figure 4 shadow analysis indicates a positive effect by creating partial shading on the exposed areas at different times of the day contributing to lower solar radiation caused by the hardscapes. Most open spaces seem to benefit from shadows in the afternoon mitigating radiant heat. Shadow analysis correlated with people's preferred locations within the open spaces which, could be used as a basis for positioning shelters and seating for better integration of amenities.

4.6. Users' perceptions

Protection, comfort and enjoyment criteria from Gehl's study was adopted in the user survey [2]. Since these urban spaces are primarily intended for passive recreation, around 80 percent of the users are elderly from the vicinity who enjoy these open spaces 2-7 days per week between 3-5pm for socializing with friends and for relaxation. Not all seating places are provided under shades by trees or shelters, photographic survey confirmed users' preference for these spots. Elderly expressed the need for shade and young responded expressed the need for more seating. There was a consensus about the proximity of these open spaces to their residences and the emotional comfort they receive from being outdoors. Majority of respondent reported the benefit of large mature trees and nature on these parks providing them breeze and comfort. Although ambient temperature is above the comfortable range as per Ng & Cheng study [19], respondent didn't express any discomfort perhaps because of relatively lower humidity in these open spaces compared to average humidity level in Hong Kong.

For future development of parks, users suggested the need for more amenities such as more seating and toilets and proper drainage systems to reduce storm water stagnation. Compared to small open spaces they expressed the preference for large parks with big squares, more trees, seats and more natural elements such as water and rocks.

5. Conclusions & recommendations

Open spaces are vital in Hong Kong given the nature of high-density high-rise living and compact apartments. Although the parks are rather small in extent with limited amenities, facilities, and greenery, their location in close proximity to residential and commercial areas, provided convenience and sense of security and protection for elderly and children. Other than two open spaces, all others are located away from traffic roads providing protection against vehicular traffic and screening from noise and air pollution. Other than Jockey Club Tak Wah park, other parks layouts provide user-friendly navigation within. Due to compact nature of majority of open spaces, they have not been able to provide adequate separation between relaxing areas and walkways enhancing users' comfort and enjoyment. Majority of open spaces benefit from shadow casting in some areas from surrounding buildings most of the day; however, seating arrangements have not followed these natural patterns. These parks are often been used in the late afternoon when the parks cool off. Due to non-alignment with prevailing wind directions, only two parks received above 2m/s wind speed; planning and design

measures such as proper positing of vegetation and wind deflectors may be considered for improving wind penetration through these open spaces.

Although these open spaces are connected forming a network, they don't appear to be successful in forming ecological continuity due to limited amount of greenery compared to predominant hardscapes. Regardless of high Urban Heat Island effect in Hong Kong urban areas, these parks consist of over 66 percent of hardscape on average. Users expressed concerns with storm water drainage on these open spaces that could be attributed to lack of ground cover vegetation to absorb water. Considering the increasing amount of rainfall and global warming in the recent years, it would be sensible to replace impervious paving with vegetation cover. Instead of adopting engineering approaches, these parks should consider adopting 'nature based solutions' to promote ecological continuity and to mitigate adverse impacts from Urban Heat Island effects and storm water stagnation. Native plants and local material could be sensible options to consider when implementing 'nature-based solutions' to reduce maintenance and water efficient. However, feasibility studies and proper planning is required in order to reap best benefits out of 'nature-based solutions'. Considering the rising ageing population in Hong Kong, public amenities should adopt an integrated approach focusing on user comfort and safety, careful choice of material, natural shading patterns, providing adequate amenities and improving ecological value, and microclimatic conditions of the open spaces and the surrounding.

6. Acknowledgements

The author is grateful to Chu Hai College of Higher Education for research funding. Author would like to thank research assistants, Mr. Lam Ho and Mr. Yiksun Lai for their contribution in data collection and simulation studies and Prof. Paul Chu and Mr. Roger Tan for advice and thought-provoking ideas.

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