



Conference Proceedings – Long Paper

Designing walkable neighbourhoods in Singapore using Form-based Codes

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Abstract: While Singapore often tops the rankings as the most liveable city in Asia, especially due to its easy access to public amenities, active mobility, including walking and cycling, only accounts for a minority of all ridership in the city-state. This raises two key questions: 1) what factors hinder walkability in Singapore and 2) how can the built environment be improved to promote active mobility. This study argues that the lack of detailed urban design guidelines impedes the creation of pedestrian-friendly environments, especially for public housing neighbourhoods that form the main urban landscape of Singapore. It first diagnoses the main problems pertaining to poor walkability of public housing neighbourhoods at four different dimensions, namely connectivity, closeness and spatial distribution, comfort and safety. Then, it explores the possibility of using Form-based Codes (FBC) to improve walkability for these areas. On this basis, a series of guidelines and recommendations for improving walkability in public housing neighbourhoods are proposed. This study for the first time explores applying FBC to high-density tropical cities in Asia. The research findings indicate that the FBC principles and methods for improving neighbourhood walkability are also potentially useful for other similar urban environments of tropical Asian cities.

Keywords: walkability, Form-based code, public housing, neighbourhoods, Singapore

1. Introduction

Singapore is a tiny and young city-state of South-East Asia that is placed at the top of all rankings of liveability, economic performance, quality of life, and security (CLC 2016) especially thanks to its easy access to many public amenities such as good-quality schools and healthcare, and lower levels of pollution and crime (The Straits Times 2014, 2018). However, while active mobility is often regarded as a key liveability indicator for urban neighbourhoods (Robertson and Hachem-Vermette 2017), and despite Singapore government's continuous efforts to improve the quality standards of the city, walkability in Singapore remains relatively poor. For instance, a recent study conducted by the Centre for Liveable City, a leading Singapore-based think tank on urbanism, showed that while public transport usage makes up 66% of all peak-hour journeys, active mobility, including both walking and cycling, accounts for only 2% of ridership (CLC and ULI 2017).

While Singapore has a robust system of integrated land use and transport planning, accommodating a growing population on limited land will require a shift towards more space-efficient and pedestrian-friendly modes of transport and planning. Since 2016, property developers are required to submit a walking and cycling plan in development applications (CLC 2015), but it will take few years before concrete improvements become tangible. Also, despite all the initiatives carried out by the government, most efforts on improving active mobility mainly addressed land use and flows' capacity but failed in tackling the detailed and human scale environment. For instance, some smart planning tools have recently been developed and used to augment the design of urban neighbourhoods, such as CLC's CityScope and HDB's iPLAN¹. However, their focuses are mainly on the relatively large-scale urban layout and with the aim for improving efficiency of transport network and optimising land use locations, and, despite their considerable contributions, those attempts do not tackle the issue of walkability with respect to the physical form of the city/neighbourhood across different scales, and, specifically, they do not address the issue of walkability in residential neighbourhoods. This raises the questions of what factors hinder walkability in Singapore and how to improve the built environment to facilitate and promote active mobility.

Under these premises, this study argues that the lack of detailed urban design guidelines impedes the creation of a pedestrian-friendly environment, especially in public housing neighbourhoods that constitute the main urban landscape of the city-state. Following this, it explores whether and, if so, in which ways the Form-based Codes (hereafter as FBC), which has been repeatedly tested and proved in the Western cities as an effective design tool to regulate the built environment and create walkable neighbourhoods (Hansen 2014), can be applied to improving walkability of public housing neighbourhoods in Singapore.

2. Research approach

Methodologically, this research will first diagnose main problems pertaining to poor walkability of public housing neighbourhoods based on a comprehensive review of existing studies and site survey. The problems then will provide a lens to assess the literature and the best practices of FBC, identifying the strengths and limitations of applying it to Singapore's public housing neighbourhoods. On this basis, a series of design guidelines and recommendations will be proposed.

The first step consists of an analysis of walkability in Singapore carried out through the review of all the available literature, official reports, online articles, etc., and then cemented by performing site visit

to key areas of the city. The aim of this step is twofold; firstly, we intend to assess the willingness of the government to improve walkability by analysing the current government agenda and efforts towards the improvement of active mobility; and secondly, we analyse and evaluate the present conditions of walkability in Singapore. The analysis focuses on HDBⁱⁱ neighbourhoods as they represent the predominant urban typology of the city. This step allows for assessing the performance of HDB neighbourhoods by listing the most recurrent built environment factors that prevent or impede walkability.

Subsequently, we investigate whether FBC could be applied in Singapore and, if yes, in which ways. Our research performs a review of the limited material available on Form-Based Codes, with aim of mapping strengths and limitations of FBC, and evaluates their applicability in the Asian continent, particularly in the Singapore's HDB neighbourhoods. The opportunities and uncertainties offered by FBC to foster walkable neighbourhoods and mixed-use developments are discussed.

Finally, the study attempts to propose a series of guidelines for designing walkable and human-scale HDB neighbourhoods. Specifically, these guidelines are developed to address the factors that prevent active mobility in HDB neighbourhoods identified in the first stage.

3. Assessing walkability of HDB neighbourhoods

3.1 Introduction of HDB

In the 1960s, the Ministry of National Development created the Housing & Development Board (HDB) to meet the issue of Singapore's fast-growing population and to clear slums and squatters that proliferated in the city after the end of the II World War (Yuen 1995, 2011). And because of the land scarcity in the city-state of only 720 square kilometres, residents were mainly settled into dense, low-cost and state-built housing properties, which largely characterised the urban landscape of the city (Figure 1 and 2). In general, HDB towers are aggregated into precincts, areas of about 2.5 – 3.5 hectares of land that are planned to accommodate up to 700-1000 units (Heng 2016). Groups of about three precincts are then aggregated into neighbourhoods while groups of three-four neighbourhoods into new towns, which are wider areas of approximately 12 square kilometres and housing around 200,000 people (Ker and Tuminez 2015). Usually, HDB neighbourhoods include a community centre, parks and sport complexes, a hospital or polyclinic, and schools in order to meet recreational, educational and social needs of local residents. These facilities are planned to be accessible at walkable distance to facilitate residents' everyday life and avoid commuting to and from the city centre. However, as mentioned before, although walkability is one of the key considerations of HDB neighbourhood developments, there are still relevant issues about the ability of pedestrians to move around these areas, as the next section will show.

Figure 1. Example of Singapore's public housing (HDB) -1.



(Source: Housing in Singapore: A Guide to Public Housing by Singapore Expats (2016))

Figure 2. Example of Singapore's public housing (HDB) -2.



(Source: THEME: Public Housing - A Home for Every Singaporean by Tan Lam Siong – Singapore Politician. Lifestyle Personality (2015).)

3.2 Dimension 1: Connectivity

At the HDB neighbourhoods, urban blocks have been mainly developed for the use of car (Leow 2008, Lam and Toan 2006, Mohareb, Derrible and Peiravian 2016, Meng, Zhang and Wong 2016, URA 2017, Yuen 2011) with precincts that are often surrounded and divided by wide, car-based corridors (Chan 2015, Erath *et al.* 2017, Lam and Toan 2006, Meng, Zhang and Wong 2016, Yuen 2011) that affect active mobility. And although pedestrians are usually able to go from a departure to destination point, walking is made difficult by frequent traffic lights along the route or by the necessity to use ramps and over bridges to cross a street. Additionally, permeability is low as few or no alternative routes are made available. For example, to cross a road, it is often necessary to take a long detour and use over bridges or a ramp instead of covering the shortest route possible. Erath *et al.* (2017) found that crossing a road in Singapore is perceived as adding an additional distance of about 55 m to the original route, while climbing an overhead bridge, so common in Singapore, is perceived as an additional 90 m distance. According to their research, replacing a pedestrian overhead bridge with at-grade crossing would reduce the perceived crossing time of as much as 3 minutes, while a 40% larger area would be accessed.

HDB neighbourhoods and new towns have a car-based planning (car-centric design) with wide car-oriented corridors that cut their urban fabric. Space and time for crossing are not equally distributed between cars and pedestrians and traffic priority is always given to vehicles. Also, block units are surrounded by parking areas and leftover spaces. The result is that active mobility neither optimised nor efficient due to disruptions and lack of continuity of walking, and this often leads to jaywalking.

3.3 Dimension 2: Closeness and Spatial distribution

In Singapore, the amount of land for housing, working, and transport infrastructure is very similar, between 12% and 14%. This should be in favour of mixed use, but the percentage of land dedicated to residential increases to up 45% in new towns (Heng 2016), reducing mixed use. It is well known that with a greater variety of activities and services next to each other, an urban neighbourhood can create a more engaging journey for walking and cycling. This also opens up more opportunities for social interactions and increases traffic for local businesses, helping to reinforce the positive attributes of walking and cycling within a community. However, this is a missed opportunity for the HDB neighbourhoods in Singapore. With the planning that privileges use over form and numbers to people-oriented design, Singapore's urban fabric is dense environment of 7,500 persons/km² (CLC 2015) but it lacks compactness and mixed-use.

Another issue is the lack of a consistent, sound, and well-defined urban block planning, because HDB blocks are usually neither homogeneous nor consistent and they differ sizes, design, and patterns, diminishing the overall way finding and sense of place. Also, each tower is surrounded by parking areas and internal car-based streets that reduce compactness. The predominant feelings when walking through an HDB neighbourhood is the unnecessary long trips to reach a destination caused by lack of continuity of walking and fragmentation of the urban fabric. Longer distances between towers and between blocks, lack of compactness due to the spread of stand-alone towers could discourage people from walking.

3.4 Dimension 3: Comfort

With its tropical weather and hilly topography, Singapore's natural environment can be challenging for pedestrians, and therefore addressing climatic conditions is a key step towards creating a more comfortable and appealing environment for active mobility. In Singapore, a street-planting programme in several parts of the city has contributed to enhancing the comfort and appeal of walking and cycling. Indeed, trees provide visual relief as well as shade from the sun and some shelters from the rain (Cho *et al.* 2016). Also, to mitigate climate challenges, covered link ways are placed between some bus interchanges and MRT stops, or at the entrances of HDB towers, but they usually extend for only 200-400 m. Additionally, these paths are 'imposed', not flexible and usually do not follow the shortest route between point of origin and destination. The result is that pedestrians often tend to find their own (dangerous) shortcuts by jaywalking.

While separation from traffic, width of the sidewalk, presence of other people and availability of trees and greenery make a street more attractive for pedestrians, the unnecessarily wide streets of Singapore fragment the urban fabric and the continuity of walking. Sidewalks are usually 1.50 m wide only and too narrow to host both pedestrians and bikes, creating conflict of modes, and, also, they generally do not provide enough shelter from rain or sun. The lack of quality of walking environment due to an austere street and urban environment, wide corridors to cross, time wasted at traffic lights and at overhead bridges, lack of lifts, lack of at grade crossings, car-priority, lack of street furniture, and conflict of modes (narrow sidewalks for accommodating both bikes and people) create a lack of comfort and pleasantness and an altered perception of time needed to walk from one point to destination.




3.5 Dimension 4: Safety

Personal safety is very high in Singapore evidenced by an impressive low crime rate. However, Singapore is not equally safe in terms of cars and traffic security. In the small city-state, in the first four months of 2018, a total of 38 people died in 36 accidents with an increase of 12 per cent for traffic fatalities and 9 per cent for fatal accidents over the same period of previous year. Among the top three causes of fatal accidents is pedestrians jaywalking or crossing roads without paying attention to traffic (Channel NewsAsia 2018a). While giving pedestrians equal space and time over cars by replacing ramps and over bridges with at-grade crossings would help in preventing jaywalking, a key issue relevant to safety is conflict in transport modes. For example, e-scooters and personal mobility devices (PMDs) are very popular in Singapore but their use often causes accidents and injures pedestrians. These accidents usually occur on public paths, or at road junctions when PMD riders are crossing the road, or on roads when PMD riders are riding parallel to vehicle traffic illegally.

Table 1 below summarises and exemplifies the main findings discussed above from assessing the walkability of HDB at four different dimensions.

Table 1. Summary of main problems of walkability in HDB neighbourhoods

Issues	Space typology	Photo illustrations	Assessment
Lack of continuity of walking	Overhead bridge		Overhead bridges and underpasses, especially at non-arterial roads, can create ‘mini-highways’ that inconvenience pedestrians and cyclists.
(Source: Singapore Overhead Pedestrian Bridges by SG Pedestrian Bridges (2011))			
Lack of continuity of walking; Long waiting time for crossing	Traffic light that prioritises cars and wide car-based corridors		With regular gaps in traffic (especially at night or during the weekend), cars always have priority. Waiting time for the green man is always long.
(Source: Change traffic light rules to prevent further casualties (Singapore) by Change.org)			
Lack of continuity; Safety	Un-signalised intersection		Priority always goes to cars instead of pedestrians (lack of zebra crossings at un-signalised junctions)
(Source: Toa Payoh Town Park (Car Park Entrance) by Street Directory (2009))			
Safety; (dis)Comfort	Shared footpath both pedestrians and bicycles		Sidewalks are generally too narrow to accommodate both pedestrians and bicycles creating conflicts and safety issues
(Source: Lets Go Bike Singapore)			

<p>Lack of compactness</p>	<p>Leftover spaces around HDB towers and hawker centres</p>	 <p>(Source: The Urbanism Of Singapore's Public Housing by Courtney Banker (2018))</p>	<p>Parking areas and access roads around HDB towers reduce compactness and safety of pedestrians, affecting walkability</p>
<p>Lack of mixed-use</p>	<p>Residential-only tower</p>	 <p>(Source: Website URL - https://www.straitstimes.com/singapore/housing/bto-flat-prices-far-lower-than-what-people-estimate-mnd-survey)</p>	<p>Segregated functions increase the need for commuting from home to work, and the use of cars</p>
<p>Lack of amenities and compactness</p>	<p>Typical road within an HDB precinct</p>	 <p>(Source: Website URL - http://holeegroup.com.sg/hdb-punggol-west-c8-punggol-sails/)</p>	<p>The result is a large proportion of 'wasted' space. Instead, this space could be designed and used to create a more compact neighbourhood</p>

4. Form-Based Code: Can it be effective for HDB neighbourhoods?

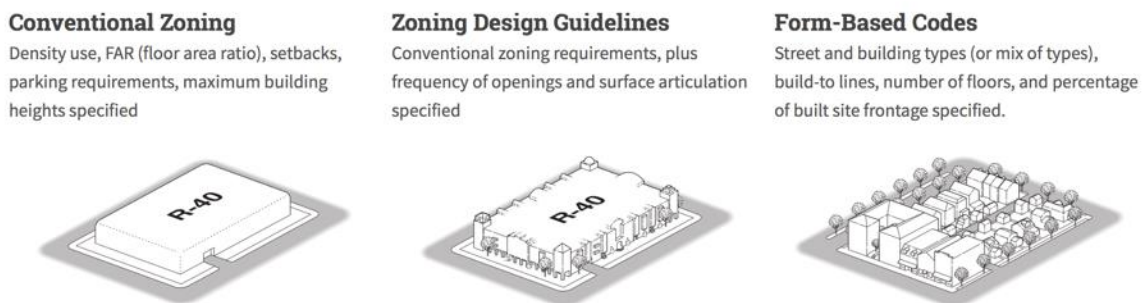
This section briefly presents FBC and investigates whether the use of urban design guidelines is an appropriate approach to address the built environment issues that affect walkability of HDB neighbourhoods in Singapore.

In the quest to build cities that are both beautiful and functional, urban planners have sought to implement a variety of land use and design related tools that emanate from historic zoning codes. Form-based code is the newest tool in the evolution of this pursuit for better city planning (Garvin and Jourdan 2008). "A form-based code is a land development regulation that fosters predictable built results and a high-quality public realm by using physical form (rather than separation of uses) as the organizing

principle for the code” (Parolek, Parolek and Crawford 2008, Form-Based Codes Institute 2017). While ‘traditional zoning’ focuses mainly on land use and density, FBCs aims at regulating the scale and types of blocks and streets, and the form and mass of buildings in relation to one another. Figure 4 shows the differences between conventional zoning and FBC. FBC is implemented through words but also other visual elements as diagrams, images and frameworks.

FBC is place-based and based on spatial organization principles and it includes a set of required and optional components. Usually, minimum components include public space standards, building form standards, a glossary and an organizing principle. The choice of the organizing principle is the fundamental step for the successful implementation of these urban design guidelines. Usually, FBC is applied using a transect-based organising principle. The transect defines a series of zones that transition from sparse rural farmhouses to the dense urban core. Each zone contains a similar transition from the edge to the centre of the neighbourhood. In the case of Singapore, as the city does not present a smooth transition from rural to dense urban core and green areas as parks are often just besides high-density areas, a different organizing principle may be applied. Focusing on the improvement of walkability, street-based codes may be a more appropriate.

Figure 3. Conventional zoning vs. FBC.



(Source: source: Form-Based Codes Institute, 2017)

One of the most cited strength of FBC is that it is based on spatial organization principles and focuses primarily on the urban form of an environment by designing the layout of streets, public spaces and blocks, and by defining their placements, height, width, and interaction (Talen 2002). FBC creates technical, extremely detailed, and clear guidelines for the form that new development, or re-development, should take in each zone (Duany and Talen 2002, Woodward 2013, Walter and Read 2014). Singapore government recently introduced some embryonic urban design guidelines, although not specifically designed to improve walkability and strictly applied to selected central areas (i.e. Orchard road, the main shopping area of Singapore – see URA, 2018). In this sense, the introduction of more elaborated FBC applied on wider areas of the city, specifically to the HDB neighbourhoods, could complement Singapore’s urban planning and management system with a new tool to improve walkability and active mobility.

Although little research has been discussed about why FBC is suitable for the improvement of walkability in high-density tropical cities up to now, there are some factors that suggest the potential use of FBC in Singapore. A first consideration is that FBC works very well at the human scale level (Borys, Talen and Lambert 2017), which fits perfectly the characteristics and dimension of an HDB

neighbourhood. Indeed, the majority of the case studies that utilised FBC up to now fall into the district/neighbourhood dimension. And the kind of human-scale, convivial urban environment that FBC aims to create and produce is not unfamiliar to Singapore in terms of the old neighbourhoods and historical quarters. An example is Toa Payoh, a mature residential town located in the northern part of the Central Region of Singapore. It was created after the independence of Singapore, and is densely packed with shops, malls, eateries, sports and recreation options. Particularly, its main street, which is fully pedestrianised and has low rise and mix-use units, represents that kind of urbanity that FBC aims to create.

Another strength of FBC is that it is inherently customisable to individual places because it is created based upon a community's shared ideal for their built environment (Katz 2004; Brower 2002; Woodward 2013) and this is important as each HDB neighbourhood has its own identity and uniqueness. Also, the relevant role of public participation and participatory planning of FBC fits latest policy of Singapore government and particularly its “Smart Nation”, a people-centred vision that aims at improving Singaporeans’ overall living conditions through their direct involvement in planning decisions (Smart Nation Singapore 2017).

On the basis of these statements, we argue that, at least in theory, FBC can enhance Singapore’s urban design guidelines – they work well across different scales, and can be customised to individual HDB neighbourhoods.

5. Proposed guidelines for increasing walkability of HDB neighbourhoods

The final section of the article aims to address walkability issues of HDB neighbourhoods by proposing a set of guidelines and recommendations. The guidelines and recommendations will be discussed according to the aforementioned 4 dimensions for assessing walkability.

5.1 Dimension 1: Connectivity

First of all, the establishment of a comprehensive and well-connected network of footpaths and bicycle lanes for pedestrians and cyclists would make door-to-door travel on foot or by bicycle more convenient and efficient. Fenced developments should be discouraged to minimise the length of journeys by pedestrians and cyclists. In Singapore, through-block links are stipulated in certain land sales conditions for development, while HDB towers are generally not fenced. This ensures 24-hour pedestrian corridors through these developments and promotes connectivity within the city.

Additionally, the main recommendation is to shift from a car-based model to a people-centric design by reclaiming space from vehicles. This can be done by providing equal space and time for cars and pedestrians, and, particularly, through the following initiatives:

- Remove bridges, ramps, and underpasses and replace them with grade crossings;
- At signalised intersections, pedestrians need to have equal rights and time as vehicles to cross (green man and red man at traffic lights to last the same amount of time and, during off peak hours, green man to be extended).
- Add pedestrian crossings at un-signalised junctions to prioritise pedestrians and add scramble intersections in strategic areas.

- Provide dedicated space for all mode shares (pedestrians, bikes, cars, PMDs). This can be implemented by reducing the number of lanes dedicated to vehicles of existing roads and convert them into bike lanes; for new roads, plan carefully lane width and the number of lanes dedicated to cars and provide dedicated lanes for bicycles.

5.2 Dimension 2: Closeness and spatial distribution

With regards to closeness and spatial distribution, the new guidelines should aim to enhance mixed-use and reduce distance. At the block level, compactness should be increased and variety of uses added by defining a consistent block size and set of consistent block standards in order to increase continuity and decrease distance to perform daily activities. Specific recommendations include:

- Define a new prototype of urban block (specify min/max size; shape/typology; and location/perimeter of a block) to have homogeneous/ consistent patterns
- Reduce the size of new blocks to and use orthogonal grids to increase way finding;
- All buildings must face a street;
- Increase compactness by adding a podium that link adjacent towers, and mix-use;
- Increase mixed use and diversity of activities also by increasing vertical integration of modes (i.e. similarly to the integration of land use and transport planning of MRT stations and malls);
- Reduce road width to increase sense of place; new streets need to be interconnected;
- Consistent signage and standard infrastructure design should be granted for the whole network to enhance user friendliness and wayfinding;

Recommendations at the building level include:

- Void deck (HDB tower): Consider adding new uses to attract people and increase walkability and liveability; consider make those spaces more attractive by using colours (floor and walls) and furniture to revitalize the space.
 - Bike parking: Introduce bike racks where not available.
 - Parking drive width and length to be reduced, to minimise space dedicated to car;
 - The use of back or underground parking areas should be encourage to increase pedestrian safety and reduce fragmentation.

5.3 Dimension 3: Comfort

Public transit systems should make it as convenient as possible for people to complete their journeys on foot or bicycle. Effective connections provide viable approach to ‘last mile’ challenges and can help alleviate the need for bus feeders at rail transit stations. This is especially important in promoting active mobility for tropical cities like Singapore, as transit integration allows people to cycle for the first or last legs of longer commutes, which may otherwise be unfeasible for most people to complete on bike due to the hot and wet weather. In order to make a journey not only convenient but pleasant and to shift to a people-oriented design, street environment should be design as appealing and comfortable:

- Give more attention to street furniture, for example, by extended the amount and length of covered pathways, tree planting, greenery and landscape. That is, increase length of covered paths from 200 to 600 m and add covered paths to link existing adjacent buildings and extend sheltered links;
- If a bridge or ramp cannot be removed, add escalators (both going up and down) and lifts and improve the design of ramps to facilitate mobility;
- (Re)-define main entrance locations to avoid steps/stairs and any other facility that reduce accessibility;
- Sidewalk width should be increased to allow space for several modes of transport (i.e. two bikes or one bike and one pedestrian or two pedestrians);
- Provide continuous sidewalks that require cars to stop and allow pedestrians and cyclists to continue through intersection without stopping;
- Define Planter and Landscape type and define Walkway type to adapt to the tropical climate of Singapore.

5.4 Dimension 4: Safety

To increase pedestrian safety, the following recommendations should be implemented:

- Safe junction designs that allow drivers to look out for pedestrians and cyclists when turning;
- Improvement of signage/advertisement and use colours (floor) and signage to channel pedestrians and bikes (i.e. Painted cycling lanes at junctions to maximize and hold onto drivers' attention. Painted cycling lanes can help to direct a driver's attention to the presence of cyclists. Still, painted cycling lanes to enhance cycling infrastructure are best limited to danger areas like junctions in order to maintain its intended efficacy);
- Reduce speed (of cars): Stringent speed limit and slow speed zones at high pedestrian traffic area;
- Define pedestrian accesses;

6. Conclusions

This article presents our initial attempt in searching for alternatives to improving walkability of HDB neighbourhoods. While Singapore often tops the rankings as the most liveable city in Asia, especially due to its easy access to public amenities, active mobility, including walking and cycling, only accounts for a minority of all ridership in the city. And despite Singapore government's continuous efforts to improve the quality standards of the city, walkability in Singapore, especially Singapore public housing neighbourhoods remains relatively poor. Based on this observation, we conducted a detailed assessment of the walking conditions of HDB neighbourhoods through both existing literature and site survey. Problems pertaining to walkability of HDB neighbourhoods were summarised and discussed in four dimensions, namely connectivity, closeness and spatial distribution, comfort and safety. Following this, we argued that Form-based Codes, a well-developed urban design and management tool primarily applied in the Western context, can potentially be effective in guiding the future planning and design of HDB neighbourhoods, in particular improving their walkability. Our main arguments focused on the strengths of FBC and how they are aligned with the physical environment characteristics of HDB neighbourhoods as well as governments' policy and vision of HDB neighbourhoods' future. This then

provided us with a basis to propose a series of guidelines and recommendations to address the above-mentioned walkability problems of HDB neighbourhoods at different dimensions.

This study for the first time explored applying FBC to high-density tropical cities in Asia. Although the research findings seem to indicate that the FBC principles and methods for improving neighbourhood walkability are potentially useful for enhancing walkability of HDB neighbourhoods and presumably other similar urban environment, our endeavour is still at a preliminary stage. While the observation and assessment of HDB neighbourhoods' walking conditions are largely based on our familiarity with the context, our arguments for relating FBC to HDB neighbourhoods' environment certainly needs to be substantiated with future research. Our aim here is only to raise the issue and relevant discussions and use our preliminary proposal of the guidelines to provoke more thinking and debates. It is hoped that more attentions can be paid to this often-ignored aspect of a well-known model of urban development, i.e. poor walkability of HDB neighbourhoods in Singapore.

Acknowledgments

We would like to thank the NUS-Cambridge-Berkeley Global Alliance Fund to support this study.

Conflict of Interest

The authors declare no conflict of interest

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ⁱ CLC (Centre for Liveable City) recently unveiled the real-time interactive tool, CityScope that allows city planners to quickly and intuitively understand the constraints and challenges of building within the parameters of an existing community'. And HDB's iPLAN (Integrated Planning & Analysis) is a GIS-based decision-making platform that integrates spatial and textual data analytics to better assess impacts of different planning initiatives. It earned global recognition and was awarded a prestigious Special Achievement in GIS from the global mapping giant ESRI in 2017.

ⁱⁱ The Housing & Development Board (abbreviation: HDB) is the statutory board of the Ministry of National Development responsible for public housing in Singapore.