Urban compactness and its progress towards sustainability: the Hong Kong scenario

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Abstract

A significant development pattern emerging in Hong Kong and many Asian cities today is the compact urban form which is an alternative to urban sprawl. It implies intensification, high density and mixed uses as opposed to low density, mono use urban sprawl. Within such a definition the compact city has caught the attention of many professionals as having a potential for achieving sustainability. But as pointed out by many researchers, the compact city has its positive and negative implications on sustainability. Positive implications are conservation of the countryside, reduced needs to travel by car, reduction in the use of fuel and pollution, the support of public transport, walking and cycling, better access to services, efficient utility and infrastructure provisions and revitalization and regeneration of urban areas. The negative implications are poor environmental quality, crowding, social acceptability, the lack of urban greenery, open spaces, and privacy, effect of urban form on ecology, wildlife, natural resources, and economic well being. Although compactness is supported as a sustainable urban form, there is limited empirical evidence to support such a contention therefore the methods for measuring such developments and the success or failure of particular initiatives are crucial in order to justify its progress towards sustainability. In this paper compactness is discussed in terms of its quantitative and qualitative attributes. The quantitative attributes are density, intensity, mix use, scale, grain and permeability. The qualitative attributes are diversity, vitality and viability. These attributes will then be discussed taking a case study in Hong Kong. As sustainability is a vast and complex area of study, this paper is limited to selected implications on sustainability as highlighted in the theoretical framework.

Keywords: compact, urban, density, intensity, mix use, scale, diversity, open space, sustainability, Hong Kong.
1 Introduction

Increase in population and emerging trends in development to meet its requirements create rapid environmental deterioration and social problems which influence the social, environmental and economic sustainability of cities. Two significant development trends as a response to increase in population and scarcity of urban land are namely high-density urban compactness and low-density urban sprawl of which, urban compactness is an emerging trend in Asia today. Compactness can be evaluated using density, intensity, mix use, scale, grain and permeability as the predominant urban variables. Such urban variables are claimed to have both positive and negative implications on the city and its progress towards achieving sustainability. A theoretical framework outlining the implications of such emerging development trends and its influence on sustainability is of urgent need in order to study the behaviour of urban compactness. For urban planners, designers and policy makers such framework can be developed as a research tool to manipulate urban compactness and its implications on sustainability.

The objective of this paper is to establish a preliminary framework outlining the concept of compactness, its theoretical measures and its claimed implications on sustainability. The paper will review the quantitative and qualitative attributes of urban compactness; the means of measuring such attributes; the claimed positive and negative implications of such attributes and its implications on sustainability. An extensive review of literature and past research findings will form the theoretical basis for analyzing a compact development. As sustainability is a vast and complex area of study, the paper focuses on selected implications of compactness that is highlighted in the theoretical framework. A compact mixed-use development in Hong Kong is selected as the case study where qualitative analysis and a questionnaire interview survey of 100 respondents is conducted.

1.1 Research questions

The following research questions are addressed in this paper in order to formulate the theoretical framework for analyzing a compact development.
1. What are the quantitative and qualitative attributes of compactness and the means of measuring such attributes?
2. What are its positive and negative implications on sustainability?

1.1.1 Hypothesis

The compact city is defined as having high density; mix uses, efficient public transport and dimensions that encourage walking and cycling (Burton [1]). Jenks [2] discuss compactness as a theory that advocates mixing of uses within concentrated environments, to prevent urban sprawl and land fragmentation. According to [3–7] compactness can be discussed in terms of its quantitative attributes such as density, intensification, mix use, scale, grain and permeability which are the critical variables for evaluating any setting of multiple uses. The
quality of it according to [4, 8, 9] can be discussed in terms of its diversity, variety, vitality and viability. As established in theory and past research, such attributes have influence on city quality and thereby quality of life and sustainability.

2 Quantitative and qualitative attributes of a compact city as discussed in past research

2.1 Quantitative attributes

**Density:** high-density city is the most common interpretation of the compact city. Density is promoted in cities for achieving sustainability. It can be measured as density of population (gross density); density of built form (net density); Density of subcentres and density of housing (Burton [1]).

**Mixed land uses:** Mixing of uses takes place both horizontally and vertically and are categorized as commercial, residential, recreational, institutional and industrial uses (Coupland [7]). A refined description of mixed use is; primary and secondary uses, local and global transactions, scale and grain, public and private space relationship and spatial diffusion, linkages (Roberts et al. [4]). Primary uses are residential, employment and service functions which provide demands for secondary uses, such as commercial, restaurants etc. The activities generated by mix uses are classified as local and global transactions. Transaction means not only the exchange of commodities, but also includes the types of human exchange, in terms of conversations, and cultural and religious exchange through activities etc. (Jacobs [8]). Private space and public space in mix use is critical in influencing vitality and variety in public space (Hillier [10]).

**Scale and grain:** Compact developments occur within districts or neighbourhoods, streets or public spaces, building or street blocks and in individual buildings (Rowley [9] Williams et al. [6]). Scale is determined by plot ratio, and housing density. Urban Grain can be determined by size of block and the subdivisions of that block and the technique to expose urban grain is the “Figure Ground” theory. According to Jacobs [8] permeability is bound by the notion of urban scale and urban grain as fine grain and scale of buildings increase options of routes for pedestrians, and better use of functions.

**Permeability:** According to Jacobs [8] for a neighbourhood to support a number of small commercial outlets there is a need for multiplicity of routes – permitting pedestrians choices and variations in their journey, this idea was refined as “permeability”. According to Hillier [10] permeability is more significant than distance in determining pedestrian activity and is a critical issue in shaping the allocations of mix uses across urban space. Permeability is determined by building space index (BSI) or constitutedness (the number of buildings that are both adjacent and directly accessible from the space in concern); permeability per unit area (the intensity of buildings being accessed from that space per unit area of space); degree of adjacency/impermeability (number of buildings that are...
adjacent but not accessible to the space); relative depth / integration (the measure of depth of the whole settlement from the space in concern) and depth of space from carrier space (the value that describes the location of the space in relation to the space surrounding the settlement also referred to as carrier space which is measured by number of axial spaces one has to pass through before reaching the space in concern) (Moirongo [11])

2.2 Qualitative attributes

**Diversity, vitality and viability:** All above quantitative attributes of compactness facilitates the qualitative attributes. High densities are seen to be fundamental to urban vitality and creativity (Burton [1]) but increase in development pressure and demand for uses with high value addition to land can also destroy diversity (Jacobs [8]). It is suggested that a combination of high density and mix use is important to retain diversity and vitality. According to [4, 8, 9] Mix use is a key factor that brings variety, vitality and viability to a place. There are four conditions which are indispensable in generating diversity in a city’s street and district: 1. the district must serve more than one primary function. It must ensure that people go outdoors on different schedules and are in places for different purposes using many facilities in common. 2. Short blocks, streets and opportunities to turn corners must be frequent. 3. Mingle buildings that vary in age and condition and must be close grain. 4. Sufficient density or concentration of people. In combination all these four conditions must be present for effective economic pools of uses which will promote optimum diversity and variety. To maintain diversity, vitality and variety high density in combination with mix use, fine grain and permeability is essential (Jacobs [8]). Such measures can be used to evaluate the qualitative attributes of compactness.

3 Positive and negative implications of compactness

The compact city idea is identified as beneficial for quality of life by creating places that are busy, convenient, attractive, energy efficient and providing better health through less pollution (Masnavi [3]). Rowley [9] states the benefits of compactness as better social and environmental quality, vitality, urban experience and character and sustainability. Burton [5] identifies the advantages of compactness as conservation of country side, reduced needs to travel by car and thereby reduction in fuel and pollution, support public transport, walking and cycling, better access to services, more efficient utility and infrastructure provisions and revitalization and regeneration of urban areas. It is also claimed to have wider span of safe hours for walking which increases safety, security and social sustainability. Economic benefits in terms of concentrations of business and savings in infrastructure are also associated with compactness (Williams et al. [6]). In a broader sense compactness has social, environmental and economic implications. There are many debates on the validity of the above claims such as re use of urban land creates lack of urban green spaces and over crowding. According Masnavi [3] a compact city greatly favours walking with much better accessibility to facilities than a sprawling city but the quality of living
environments was found to be better in low density areas, where as compact city forms suffered from perceived lack of greenery, open spaces, parks and privacy which were seen to be better in low density environment Dispersed cities suffer from inefficient transport management and long commuting trips, which leads to a high dependency on automobile in contrast to cities that are dense and fine grained that are less car dependent and having efficient public transport which is considered more efficient. But yet it is argued that low-density urban dispersal leads to less congestion, pollution, and that quality of life in this type of development is much higher. Although compact city offers benefits such as transport and land savings its benefits were not as straight forward where there are considerable costs involved which were not foreseen by advocates of the model. The challenges are mainly associated with environmental quality and acceptability (Williams et al. [6]) and although much focus has been on travel behaviour and fuel consumption the challenges associated with ecology, wildlife, natural resources, social conditions and economic well being are equally important.

4 Theoretical framework

Following the literature review a hierarchical disaggregating procedure is used to identify the measures of compactness and its implications on sustainability.

Table 1: Quantitative and qualitative measures of compactness and its positive and negative implications on sustainability.

<table>
<thead>
<tr>
<th>Quantitative Measures</th>
<th>Qualitative Measures</th>
<th>Positive Implications</th>
<th>Negative Implications</th>
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</thead>
<tbody>
<tr>
<td>DENSITY/INTENSIFICATION</td>
<td>vitality</td>
<td>vitality/ viability/ diversity in urban space</td>
<td>Crowding perceived lack of open space lack of urban greenery/landscape</td>
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<tr>
<td>population and building density</td>
<td>viability</td>
<td>alternative recreational habits to open space use</td>
<td>Pollution/ poor environmental quality</td>
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<td>land use density and intensity</td>
<td>diversity</td>
<td>better social interaction</td>
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<td>pedestrian density / plot ratio</td>
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<td>better social equity</td>
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<td>MIX USE</td>
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<td>Safety</td>
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<td>mix of public &amp; private land uses</td>
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<td>Sustainability</td>
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</tr>
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<td>mix of primary &amp; secondary land uses</td>
<td></td>
<td>Efficiency</td>
<td></td>
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<tr>
<td>/ mix of local &amp; global transactions /</td>
<td></td>
<td>Efficient use of energy</td>
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<tr>
<td>ratio of land use mix</td>
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<td>reduce pollution in urban space</td>
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<td>mix of income/social groups / mix of</td>
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<td>better environmental quality</td>
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<td>household rents</td>
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<td>FORM - scale / grain</td>
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<td>plot ratio/ housing density / size of</td>
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<tr>
<td>block and vertical and horizontal</td>
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<td>subdivisions of blocks and uses</td>
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<td>average size of block</td>
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<td>FORM - permeability</td>
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<tr>
<td>(BSI) building space index/constitutedness</td>
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<td>permeability per unit area</td>
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<td>impermeability/degree of adjacency</td>
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<td>relative depth/integration</td>
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<td>depth of space from carrier space</td>
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<td>SUSTAINABILITY</td>
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5 Case study in Hong Kong

Hong Kong offers itself as a good specimen to study compact urban form. As discussed by [2, 12–14] its urban system with high density, high floor area ratio (plot ratio), mixed land uses, short distance between different uses and efficient public transport is a typical compact situation. HKSAR is a relatively small and high-density city, with a scarcity of buildable land. Total land area of Hong Kong is 1,103 square kilometers, with 21.8% of built up area which is concentrated in the triangular tip of kowloon and the coastal strip of northern Hong Kong Island. The built up area consists of 3.7% residential, 1.9% Government Institutional & Community (GIC), 0.3% of commercial, business and offices, and 1.8% of open space and the balance 78.2% consists of woodland, shrubs, grassland etc. (Hong Kong Planning Department, 2004). The total population is 6,882,600 with a population density of 6,380 persons/sq.km. The Hong Kong Island, Kowloon and the New Territories hold population densities of 15, 840, 43, 510 and 3,750 persons/sq.km respectively. A plot ratio of up to 15 for commercial uses and up to 10 for residential uses have led to high rise buildings of up to 80 floors. Designers in Hong Kong have taken advantage of high density to generate prolific mixed-use designs with efficient infrastructure and higher order connectivity to urban services. The intensification of mixed use is found in a majority of city centers which are built around mass transit nodes with an efficient public transport network.

5.1 Analysis of Telford Gardens mixed use development

Telford Garden is a well facilitated and the largest private mix use development estate in Kowloon Bay district in Kowloon, with a total site area of 161,047 sq.m./16 ha, built around a mass transit node with easy access to public transport.

**Mix use and density:** Telford consists of a 4 storey mix use development with 100% site coverage and residential and office towers situated on the podium. The 4 levels consist of the Kowloon Bay mass transit railway station (MTR), terminal for local commuter buses, taxis, commercial and Government Institutional and Community (GIC) uses. The 41 residential blocks range from 11 to 26 floors and consists of 4992 flats with square areas ranging from 473-667 sq.ft. The total resident population is 20,000 with a Net population density of 1,250 persons/ha and a Net residential density of 310.12 dwelling units/ha. The mix land uses consist of resident gross floor area (GFA) of 278,702 sq.m, commercial GFA of 83,201 sq.m, office GFA of 52,482 sq.m and GIC, GFA of 909 sq.m which include housing, offices, shopping mall, retail and departmental stores, restaurants, super market, cinema, sports and recreations, kindergarten, primary and secondary school, part of the City University, banks, post office etc.

**Primary and secondary land uses:** The development portrays a good mix of primary and secondary land uses with GFA of 331, 184 sq.m. and 84, 110 sq.m. respectively. Primary land uses consists of residential and office uses while the supporting secondary land uses consists of commercial, recreation and GIC uses.
Mixing has taken place both vertically and horizontally. Vertical mixing of transport, commercial, residential, and office uses is observed from below ground to podium and above podium. Horizontal mixing is observed in each of the commercial layers and podium levels, where shops, restaurants, recreation facilities, banks and schools are connected through walkways, and public spaces.

**Global and local transactions:** Shopping mall, retail outlets, restaurants, cinema and recreation facilities generate activity where human exchange, in terms of conversations, values, cultural and religious exchanges takes place but the office spaces generate activity and exchange at a global level and do not directly add to the vitality, variety and diversity of activity within the development.

**Public and private space:** mixing of public and private space has taken place vertically, where private uses are located in towers above podium while public uses are located on podium and below and the private and public is linked via open spaces and walkways. In this manner the privacy of the residents and office is secured while ensuring accessibility and integration with public functions and services. Linking of public and private space is critical in influencing the vitality of the public space in mixed-use developments (Hillier [10]).

**Scale:** An interdependency of primary and secondary land uses takes place not only within the development but also within two or three surrounding developments. Interdependency takes place between primary and secondary land uses of Telford and surrounding land uses such as Kowloon Bay sports ground, indoor games hall, Kowloon Bay Park and shopping and grocery markets, industry, offices and residents which are in close proximity connected by an efficient transport network. According to Lau et al. [15] scale of compactness takes place at primary, secondary and tertiary zones. When one primary node is dependent on adjoining ones for missing land uses such interdependency leads to secondary zones comprising several primary nodes and a combination of secondary zones forms a tertiary zone.

### 5.2 Survey on perceptions of public outdoor spaces within Telford gardens

Since focusing on all implications of compactness and its influence on sustainability is beyond the scope and limitations of this paper the questionnaire interview survey is focused on the following issues relating to public outdoor spaces within the development, such as; distribution of user groups; travel time to public space; satisfaction with the provisions of open space and use of alternatives to open space, perceptions on environmental quality, social interaction and crowding. Such issues are implications of compactness as studied in literature and important in any compact development as implying on quality of life and sustainability. A total of 100 questionnaire interviews were conducted randomly in two public open spaces within the development from 11 a.m. to 7 p.m. on two consecutive working days. Questionnaire survey focused on public open space as it is common to all user groups, and gives respondents the ease of
relating to a defined spatial component within the development rather than having to relate to an entire development which would be difficult to grasp.

**Distribution of user categories:** A balanced mix of user categories was observed among the random sample population (fig 2). Mixing of land uses congregates a good mix of user categories for different purposes, which is essential for vitality and variety and enriches the diversity of public spaces within the development. Survey shows a relatively high ratio of visiting population which means there is a high interdependency among land uses and inhabitants in the surrounding developments. Such interdependency creates efficient use of infrastructure and services which is essential for sustainability.

**Travel time to the public space:** 82% of respondents spend less than 15 minutes to travel to public space for relaxing, meeting friends etc, while only 18% spend more than 20 minutes (fig 3). Accessibility to public open space is seen as an essential criterion for quality of life which is well fulfilled within the development. Reduced travel time from home to shops, to work places, recreational spaces and open space can be encouraged by space proximity, well connected walkways linking primary-secondary land uses and public-private land uses, and an efficient transport network. Reduced travel time creates neighbourhoods that people can live, work and play encouraging better social ties and sustainable communities.

![Figure 1: Distribution of user groups.](image1.png)

![Figure 2: Distribution of travel time.](image2.png)

**Provisions for open space:** Although open space is claimed to be lacking in compact zones survey shows that 65% are satisfied with the provisions for open space and 52% respondents go shopping and use indoor recreation as an alternative to using open space for recreation (fig. 4). Mix uses and reduced travel time to other recreational functions have generated substitute options that are alternatives to using open space for recreation. Therefore perceptions on lack of open space in compact cities is bound by the real need for open space and changes in leisure habits where the shopping mall has become a relatively popular recreational space as a substitute to open space.

**Environmental quality:** 62% respondents are satisfied with environmental quality of public open spaces although situated in a district with heavy traffic and
pollution. Elevated walkways and open spaces on podium buffer from noise and pollution enabling more habitable public open spaces within the development. But only 10% are highly satisfied while 52% are of average satisfaction.

**Social interaction:** 65% respondents are satisfied with social interaction in open space. It is mostly used to meet friends, and relax or for short breaks on the way to shopping mall, restaurants, cinema, or office. But 45% respondents are of average satisfaction while only 19% are highly satisfied. Dissatisfaction with facilities and aesthetics such as seating, tables, greenery and landscaping were also mentioned as not inducing social activity. Mix uses generate necessary and optional activity and according to Gehl [16] such activity induces social activity when a good quality public space exists. Although mix use generates active, vibrant urban spaces with more necessary and optional activity, the lack of facilities and poor aesthetic conditions discourage social activity.

**Crowding:** Although crowding is a negative implication on quality of life and sustainability a majority of 83% respondents perceive low to average crowding levels. Living in constrained environments could be attributed to Chinese history and culture Zang [17] and perceptions on high density are clearly culturally bounded Rapoport [18]. In this case the perceptions on crowding may be biased by the Chinese peoples’ tolerance and acceptability of such a spatial attribute.

![Figure 3: Perceptions on provisions for open space the use of alternatives and the quality of open space within the development.](image)

### 6 Conclusion

The case study reveals a successful intensifications and integration of mix uses that enhances activity and diversity in urban spaces. Respondents’ satisfaction with open space provisions, environmental conditions, social interaction and reduced travel time are essential criteria for better quality of life. Also the interdependency of land uses within the development and neighbouring developments enables efficient use of resources, infrastructure and services. Respondents’ tolerance, acceptability and adaptability to high density and
crowding are bounded by culture and such behavioural attitudes are as important as urban form and land uses in the progress towards sustainability. It can be concluded that a well integrated mix use urban form has high potentials for achieving sustainability but sustainability does not depend on form alone but also on huge shifts in behaviour and attitudes which is critical when examining a development’s progress towards sustainability.

References


