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**Designing Walkable Urban Spaces in High-Density Cities: Urban Morphology, Thermal Comfort, Air Quality, and Perceived Walkability**

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**Abstract Text:**

Walking activities improve physical and mental well-being. Urban spaces with good walkability promote social engagement and enhance sense of community. The densely built and highly diverse environments in Hong Kong offer good pedestrian connectivity and accessibility, while at the same time create environmental stressors such as compact urban settings and unfavorable thermal conditions in summer.

Walkability is a measure of how effective the urban design is in promoting walking (Rattan *et al*., 2012). International standards and instruments were developed to measure perceived walkability. The Neighborhood Environment Walkability Scale (NEWS) is one of the most commonly used validated questionnaires to measure residents' perceptions of environmental attributes that are related to the frequency of walking trips. In the COST 358 report (European Cooperation in Science and Technology, 2010), physical environmental factors such as urban morphology, pollution and disturbance, and microclimate were identified as important indicators for walkability. It implies that perceived walkability is associated with the physical environment and can be improved through urban design. The measures used to characterize built environment in previous studies, however, were relatively gross and little empirical evidence is available to offer scientific justification for designers (Ewing *et al*., 2006). To fill the gap and increase policy relevance, this study proposes an integrated measure to incorporate the effects of urban morphology, thermal comfort, air quality in the assessment of walkability in highly developed urban areas.

Based on Travel Characteristics Survey (TCS) 2011 (Transport Department, 2014), bivariate correlation analysis was conducted to study the relationship between numbers of walking trips and urban morphology in different districts in Hong Kong. Average building height ($R^2$ 0.35), sky view factor ($R^2$ 0.48), and building volume ($R^2$ 0.57) were found to be closely linked to short-distance walking activities in urban areas (fig.1). At the same time, based on the proportion of walking trips made, three types of districts, i.e. high walkable, medium walkable, and low walkable, were selected as the study areas (fig.2). Mobile measurements were conducted in typical summer and winter days in 2017, to obtain quantitative data for the assessment of thermal comfort and air quality in selected districts (fig.3). Data of air temperature, relative humidity, wind speed, globe temperature and pollution concentration were collected at a 5-sec interval along the designated paths with a mobile meteorological station containing TESTO 480 digital temperature, humidity and air flow meter, and DUSTTRAK™ DRX Aerosol Monitor. Based on the data, thermal conditions were evaluated with the calculated mean radiant temperatures and physiological equivalent temperatures. Air quality in the pedestrian spaces was assessed with the measured fractions of

particulate matter ($PM_{10}$, $PM_{2.5}$) obtained by the aerosol monitor, and will be cross-validated with the subjective opinion of pedestrian.

A comprehensive questionnaire survey targeting 2,000 subjects is ongoing to collect information about pedestrians' walking behavior and perceived walkability in selected districts. The first part of the questionnaire contains questions based on the International Walking Data Standard (Measuring Walking, 2016). For each district, key performance indicators for walking—average number of daily trips, average daily time and distance walked, etc.—are obtained. The second part contains questions from NEWS, a survey instrument evaluates characteristics of built environments relevant to walking activity. Due to the unique high-density high-rise urban morphology in Hong Kong, questions on building geometry were adapted to the characteristics of urban morphology in the city (Cerin *et al*., 2013). Questions on thermal comfort were also added to examine the effect of microclimate. Participants are recruited on site, and sample size of a particular district is determined based on observed pedestrian volume and effect size statistics (Bakeman, 2005). The questionnaire survey is conducted during peak hours and non-peak hours (based on results of TCS 2011) to include walking for both recreation and travel purpose.

With the final results from questionnaire survey, a conceptual statistical model on environment attributes – neighborhood walkability relationship will be established for each of the studied districts. Contribution of building morphology, thermal comfort, air quality, and urban design characteristics to the levels of walkability will be quantified with a multiple regression model. The model will help tease out essential environmental quality and design features that contribute to a highly walkable neighborhood. To explore the influence of environmental attributes, association, effect modification and mediation analysis will be carried out. Factor analysis, including principal component analysis and cluster analysis, will also be conducted to identify the most important aspects related to perceived walkability (fig.4).

With the factors influencing perceived walkability identified, planning and design strategies will be formulated to incorporate people’s preferred environmental attributes in the context of walkability. Findings of the study are expected to strengthen the current version of BEAM Plus Neighborhood assessment tool, which aims to “create a sustainable neighborhood with a vibrant public realm”. At the same time, district-specific planning strategies provided by the study may benefit the implementation of the planning vision of Hong Kong 2030+, especially in designing for pleasant transient experience and providing a diverse and enjoyable pedestrian network. The study will also contribute to a healthier practice of designing sustainable society in high-density Asian cities.

Reference:

Bakeman, R. (2005). Recommended effect size statistics for repeated measures designs. *Behavior Research Methods, 37*(3), 379-384.

Cerin, E., Macfarlane, . . . Ho, K. (2013a). Effects of built environment on walking among Hong Kong older adults. *Hong Kong Medical Journal, 19(3)*, S39-S41.

European Cooperation in Science and Technology. (2010). *Pedestrians' quality needs final report part B1–functional needs*. *Cost 358,*

Ewing, R., Handy, S., …Winston, E. (2006). Identifying and measuring urban design qualities related to walkability. *Journal of Physical Activity and Health, 3*(s1), S223-S240.

Transport Department. (2014). *Comprehensive transport study model enhancement - feasibility study.* ( No. CE 67/2009 (TT)).

Rattan, A., Campese, A., & Eden, C. (2012). Modeling walkability. *Arc.User.Winter, 2012*, 30-33.

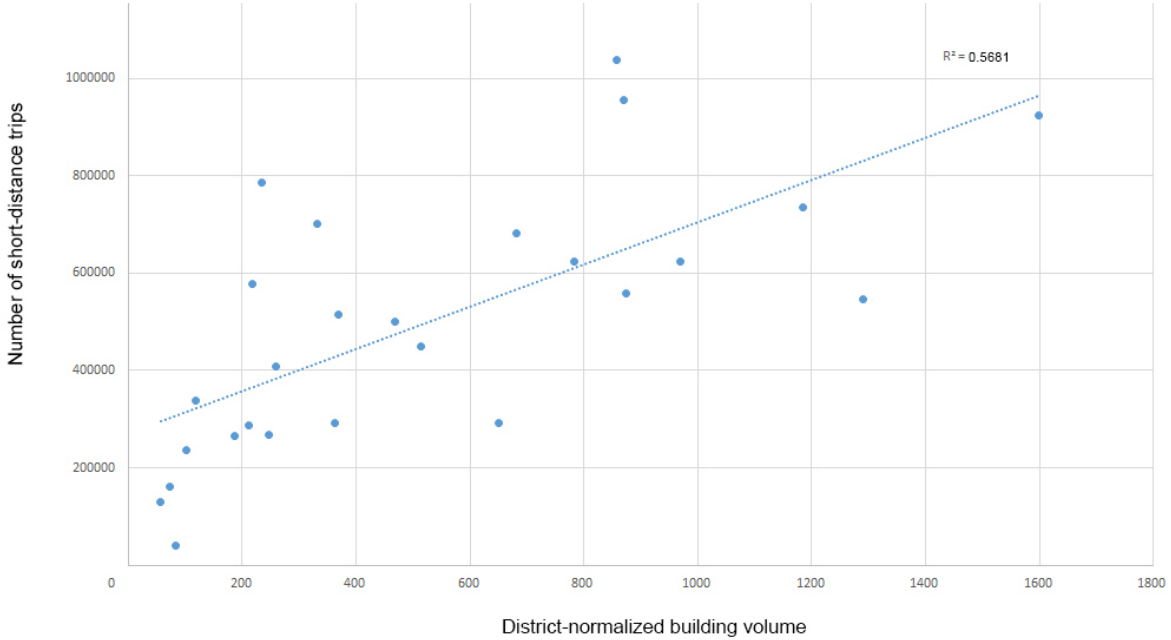


Figure-1 Correlation between numbers of short-distance (3-5 mins) walking trips in different districts and district-normalized building volume.


High-walkability (a) Tai Po (b) Tuen Mun (c) street view (Google Maps, 2017)


Medium-walkability (a) Tsuen Wan (b) Tin Shui Wai (c) street view (Google Maps, 2017)


Low-walkability (a) Tsing Yi (b) Tseung Kwan O (c) street view (Google Maps, 2017)

Figure-2 Selected districts for study.


Figure-3 Questionnaire survey and environmental assessment in typical summer days in high-density urban areas

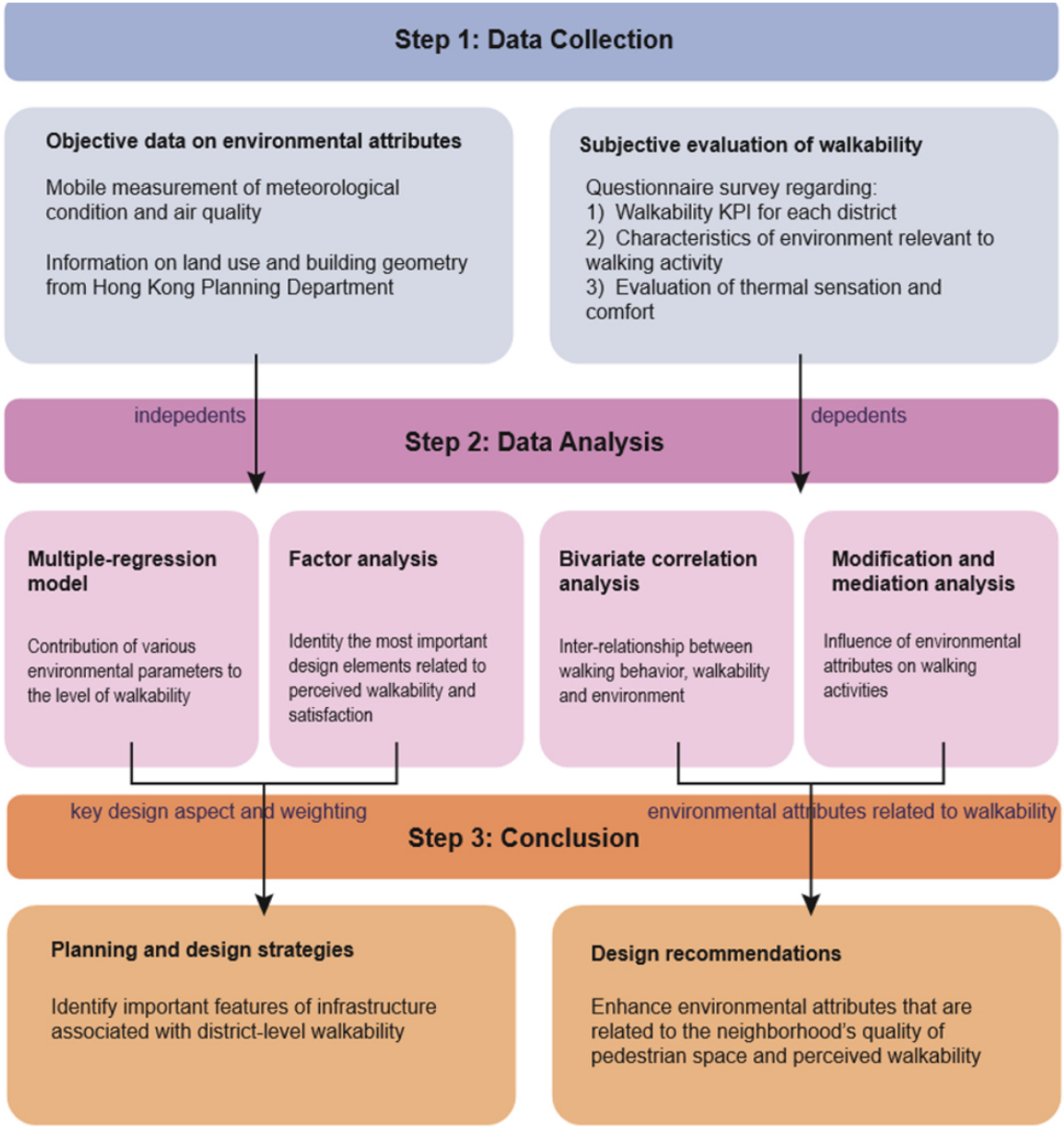


Figure-4 Research diagramme

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