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Climate-adaptive Urban Open Space Design Strategy in Workplace for Comfort and Health----Case in Hong Kong and Singapore

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Abstract

In recent years, accompanied by the massive increased urban population density and the compact built environment, the challenge lies in Asian metropolis has evoked the promotion of human health and well-being. This paper aims to deliver the authors' intention to evaluate the performance of diverse site configuration in the field of urban open space under the tropical and subtropical Asian climatic conditions. The empirical study was conducted in Hong Kong and Singapore in 2015 by the approach of objective environment assessment and perceived health survey. The research findings postulated two paradigms in climate-adaptive design strategy: 1) the precise composition of urban canopy directly impacts the thermal comfort of urban open space; and 2) the comprehensive site configuration significantly influences the personal evaluation of health perception. Based on the above findings, a framework is conceptualized as an attempt to strengthen the climate-adaptive open space design strategy.

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Keywords: Microclimate; site configuration; health perception; design strategy

1. Introduction

According to the 2014 United Nation report, 54% of the world population are currently residing in urban areas, and half of them lives in Asia [1]. Hong Kong and Singapore are two Asian world cities with comparable features in the urban index and social development. Hong Kong is one of the most densely populated places in the world that more than 7 million people crowded around 265 km^2 square kilometers built-up area [2]. Singapore is less congested, but

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the land area is limited for a large population as well [3]. The acute overcrowding urban morphology aggravated the heat island effect due to the intense land development and high concentration of human activity [4]. The reality of a high-density population and dense built environment has evoked the promotion of human health and well-being, which requests the provision of efficient urban open space to contribute to a better quality of life. This paper aims to deliver the authors' intention to evaluate the performance of diverse site configuration in the field of urban open spaces under the tropical and subtropical Asian climatic condition. The research contribution is to promote the quality of built environment, thus to enhance the perception of human health.

There is a well-established scientific relationship between health and green space [5] with plausible associations and causal pathways between greenery and workplace stress, learning performance, patient recovery, mental health, obesity, etc. It verified that even the modest unspectacular green space could contribute multiple benefits for human health and well-being as long as nature is available surrounded in daily life [6]. While an association between urban nature and these various health measures is well established, less is known about specific site configuration in urban open space relevant to the health measures; as well as the intermediating causal links, for example, between specific green space configuration and thermal comfort. It prospects that urban open space, if well configured and manipulated, could enhance better performance in objective thermal comfort and perceived health perception. The authors have identified domains, which could explore by investigating the associations between the objective components of environmental quality and the subjective evaluation of health perception. The overall research objective is to examine the correlations between health perception and the built environment in tropical and sub-tropical Asian context. The relevant nomenclatures are presented as follows.

Nomenclature

Aspect ratio (H/W): H/W reveals a negative linear correlation with the rate of decrease of air temperature in the particular period [7].
Green plot ratio (GPR): GPR is based on a standard biological parameter called leaf area index (LAI) to describe the average leaf density in a particular area [8].
Sky view factor (SVF): SVF is a dimensionless parameter used to express the extent to any point for a given location that the fraction of the overlying hemisphere occupied by the open sky [7].
Tree view factor (TVF): TVF is variable to indicate the shading factor by tree canopy. It referenced the concept of SVF, which defined as the fractions of the overlying hemisphere occupied by the vegetation canopy [9].
Total site factor (TSF): TSF performs as an integrated parameter in spatial geometry (i.e., buildings and trees), sun track, solar radiation intensity, and time, etc., which is the most robust and stable variable in determining the daytime UHI variation in the subtropical climate region [10].

2. Research Approach

2.1. Case selection

The research is constructed by an integrated approach which joins both objective fieldwork and subjective survey in the selected cases in Hong Kong and Singapore. The research indicators are extracted from the relevant domain of built environment and public health, urban meteorology, as well as demographic background in Southeast Asian context. The study employs a quantitative-based research method in site measurement and self-administered questionnaire which aims to test the divergence of health perceptions in the diverse built environment. The target typology is selected as the workplace where people occupy every day. According to the general evaluation of workload and intensity, the target research typology is selected into two categories: office setting and campus setting. The target cases are buildings adjacent to a green space or open area where occupants from the workplace can access and be restored by the green nature. Here, the potential green space includes street parks, courtyard, plaza, playground, cascading terraces, podium garden, green roof, green atrium, etc. In sum, fourteen cases are recruited in this research and the general green features are summarized in Table 1.