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Policies and technical guidelines for urban planning of high-density cities – air ventilation assessment (AVA) of Hong Kong

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ABSTRACT

In 2003, Hong Kong was hit by severe acute respiratory syndrome (SARS) from which many people died. The Hong Kong Government subsequently set up a Governmental Team Clean Committee to investigate possible urban design policies. Team Clean charged the task to the Planning Department, HKSAR. In 2003, it initiated a study titled: "Feasibility Study for Establishment of Air Ventilation Assessment (AVA) System." A number of focused studies were conducted. It eventually led to the technical methodology and guidelines of the air ventilation assessment (AVA) system. Unlike many countries with guidelines for dealing with gust wind problems, AVA is a guideline for weak wind conditions specifically designed to deal with congested urban conditions. The AVA system basically establishes a method for project developers to objectively assess their designs. In 2006, the government of Hong Kong officially adopted the system and required all major publicly funded development projects to undertake the assessment. The scientific and implementation processes leading to the AVA system are reported in this paper.

1. Introduction

Hong Kong is one of the most densely populated cities in the world. (Fig. 1) High-density living has the advantages of efficient land use, public transport and infrastructure, as well as the benefits of closer proximity to daily amenities. The "sunk cost" of high-density living is that it is more difficult to optimize urban design for the benefits of the natural environment – daylight and natural air/wind ventilation. Good planning and building designs are critically important.

In Hong Kong, it is opined that air ventilation in the densely populated city is generally not optimized; stagnant or slow air movements in streets and urban spaces are often experienced. It is important to initiate steps to improve the situation. Design and assessment tools are beneficial to assist the government, planners, engineers, architects, designers and industry stakeholders to better optimize air ventilation for the city. In 2003, after Hong Kong was hit by the severe acute respiratory syndrome (SARS) from which many people died, there were calls from the community for measures to improve the quality of our urban living environment. Among the recommendations in the Team Clean Final Report [1], it was proposed to examine the practicality of stipulating air ventilation assessment (AVA) as one of the considerations for all major development or redevelopment proposals and in future planning. The Planning Department of the Hong Kong Government was requested by Team Clean to discuss among government departments and consult relevant professional institutes and stakeholders on the standards, scope and mechanism for application of an air ventilation assessment (AVA) system. The Planning Department initiated a study titled: "Feasibility study for establishment of air ventilation assessment (AVA) system". In 2003, the research contract was entrusted to a team of researchers at the Department of Architecture, Chinese University of Hong Kong.

An underlying spirit of the study is to develop more science-based urban interventions – conceptually described as a form of "urban acupuncture" – for enhanced, long-term quality of life in the high-density urban context of Hong Kong. The study focuses on the fundamental mission: how to design and plan the city fabric for better natural air ventilation?

2. Study objectives

The primary objective of this study was to explore the feasibility of establishing some protocols to assess the effects of major planning and development proposals on external air movement for achieving an acceptable macro wind environment.

3. Health, comfort and SARS

Although the study was initiated by the Team Clean report, the study concentrated on what town planning could influence by taking SARS as a wake up call to establish the feasibility of an air

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Fig. 1. An urban skyline of Hong Kong with densely packed high rise buildings (30 to over 80 storeys) very closely built next to each others. The hills at the back further block the summer prevailing wind to the city.

ventilation assessment (AVA) system for planning with a view to improving the general living environment, quality and sustainability of the city.

Health and comfort are inter-related. Psychological and physiological thermal comfort is conducive to health. The World Health Organization (WHO) has since 1948 defined it as: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." Whereas health (the immediate effects of the environment on a human's well being) is a consideration, the study should not neglect the long-term well being of the inhabitants of the city which has a lot more to do with comfort, both physiologically and psychologically.

4. Study methodology and main tasks

"Find the problem, else we risk solving the wrong one". This was the opening sentence of Professor Mat Santamouris when he was invited to be an expert reviewer during early stages of the study. The methodology and main tasks are summarized as follows:

(A) A desk top study of related works and study examples around the world – not just scientific investigations, but also policy measures.
(B) A review to understand the current urban conditions of Hong Kong, and to identify issues and problems.
(C) Explore the possibility of establishing performance criteria needed for considering the impact of development on the wind environment.
(D) Define the critical issues and explore the feasibility of developing a practical and cost-effective assessment methodology.
(E) Examine the practicality of an effective implementation mechanism, and develop a methodology.
(F) Establish principles and good practice for the use of professionals and practitioners in the shaping of the built environment for a better wind environment.

The key policy outcomes of this study include (1) to advise on the framework for analyzing the urban fabric in relation to the planning context of Hong Kong; (2) to identify the key factors in planning terms that would have a bearing on air ventilation; (3) to identify the key factors for consideration in determining the circumstances under which air ventilation assessment should be required having regard to the prevailing planning context; and (4) to advise on implementation approaches and the corresponding implementation mechanisms.

5. Review

A quick literature survey was conducted. There are a lot of scientific studies dealing with the wind environment and modelling [2–4]. It was very quickly established that although many countries have codes and design guidelines for gust and strong wind problems [5,6], few seem to have touched on the issue of urban air stagnation and city air ventilation problems. Notable exceptions are studies dealing with air pollution and dispersion [7,8], for example Professor Chris Baker's group at Birmingham University [9,10]. In Japan, The Tokyo Metropolitan Government has an environmental map so that designated areas for the implementation of measures can be identified and used as a guide for redevelopment projects [11] (Fig. 2). In Germany, there is a legal requirement that developments should not worsen the climatic conditions of the site. Urban climatic maps have been produced (Fig. 3). They have been used to guide planning and development decisions. In the city of Kassel, the climatic map has been translated into a planning evaluation map. This map further identifies possible action for planners to reference [12,13]. Using this guiding map, which has factored the dynamic characteristics of the wind movement in the city to alleviate the adverse effects of urban heat islands, planners can decide if a development might block the wind to the city, and if a project proponent should be given permission, or is required to do further tests to provide justification. The review also identified ad-hoc studies in Hong Kong dealing with the wind environment for extreme high-density conditions. But in Hong Kong, weak wind studies are still rare.

6. Review of Hong Kong's urban issues

To shorten the study period, the existing conditions in Hong Kong were evaluated based on expert qualitative evaluation. Professor Baruch Givoni, Professor Lutz Katzschner, Professor Shuzo Murakami, Professor Mat Santamouris, and Dr Wong Nyuk Hien were the five experts. With minor differences in opinion, the following key comments were received.

6.1. Breezeway/air path

The more air ventilation to the streets, the better it will be for these dense urban areas. The overall permeability of the district has to be increased at the ground level. This is to ensure that the prevailing wind travelling along breezeways and major roads can penetrate deep into the district. This can be achieved by proper linking of open spaces, creation of open plazas at road junctions, maintaining low-rise structures along prevailing wind direction