

Window Opening Behavior in High-Density Housing Development in Subtropical Climate

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Abstract : This research discusses the results of a study of window opening behavior of large housing developments in the high-density megacity of Hong Kong. The methods used for the study involved field observations using photo documentation of the four cardinal elevations (north, south-east, and west) of two large housing developments in a very dense urban area of approx. 46,000 persons per square meter within the city of Hong Kong. The targeted housing developments (A and B) are large public housing with a population of about 13,000 in each development of lower income. However, the mean income level in development A is about 40% higher than development B and home ownership is 60% in development A and 0% in development B. Mapping of the surrounding amenities and layout of the developments were also studied to understand the available activities to the residents. The photo documentation of the elevations was taken from November 2016 to February 2018 to gather a full spectrum of different seasons and both in the morning and afternoon (am/pm) times. From the photograph, the window opening behavior was measured by counting the amount of windows opened as a percentage of all the windows on that façade. For each date of survey data collected, weather data was recorded from weather stations located in the same region to collect temperature, humidity and wind speed. To further understand the behavior, simulation studies of microclimate conditions of the housing development was conducted using the software ENVI-met, a widely used simulation tool by researchers studying urban climate. Four major conclusions can be drawn from the data analysis and simulation results. Firstly, there is little change in the amount of window opening during the different seasons within a temperature range of 10 to 35 degrees Celsius. This means that people who tend to open their windows have consistent window opening behavior throughout the year and high tolerance of indoor thermal conditions. Secondly, for all four elevations the lower-income development B opened more windows (almost two times more units) than higher-income development A meaning window opening behavior had strong correlations with income level. Thirdly, there is a lack of correlation between outdoor horizontal wind speed and window opening behavior, as the changes of wind speed do not seem to affect the action of opening windows in most conditions. Similar to the low correlation between horizontal wind speed and window opening percentage, it is found that vertical wind speed also cannot explain the window opening behavior of occupants. Fourthly, there is a slightly higher average of window opening on the south elevation than the north elevation, which may be due to the south elevation being well shaded from high angle sun during the summer and allowing heat into units from lower angle sun during the winter season. These findings are important to providing insight into how to better design urban environments and indoor thermal environments for a liveable high density city.

Keywords : high-density housing, subtropical climate, urban behavior, window opening

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