Hong Kong Housing Authority

Hung Shui Kiu Area 13 Phase 1, 2 and 3

Air Ventilation Assessment (AVA) - Expert Evaluation

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1 Introduction

1.1 Project Background

Ove Arup & Partners Hong Kong Ltd (Arup) was commissioned by the Hong Kong Housing Authority (HKHA) to carry out an Air Ventilation Assessment (AVA) – Expert Evaluation for the Development of Hung Shui Kiu Area 13 Phase 1, 2 and 3(The Development).

1.2 Objective

The objective of this study is to evaluate the wind performance of the Development using the methodology of Air Ventilation Assessment, based on the "Housing Planning and Lands Bureau – Technical Circular No. 1/06, Environment, Transport and Works Bureau – Technical Circular No. 1/06" issued on 19th July 2006 (the Technical Circular) and "Technical Guide for Air Ventilation Assessment for Development in Hong Kong – Annex A" (the Technical Guide). This file note presents the findings for the study of Stage 1 – Expert Evaluation.

1.3 Study Tasks

The major task of this study is to carry out an expert evaluation on the characteristics of the site wind availability data of the development area and assessment of the wind performance under existing development situation and the proposed building design option in a qualitative way. The expert evaluation will cover the following tasks:

- Identify the wind condition
- Identify good design features
- Define methodologies of the Initial Study

2 Wind Condition

To investigate the wind performance of the development site, the characteristic of the natural wind availability of the site is essential. As stipulated in the Technical Guide, the site wind availability (V∞) would be presented by using appropriate mathematical models (e.g. MM5 simulation).

Planning Department (PlanD) has set up a set of wind availability data of the Territory for AVA study, which could be downloaded at Planning Department Website (http://www.pland.gov.hk/misc/MM5/main.htm). The wind availability data obtained from the MM5 simulation is utilised for the Expert Evaluation, as shown in Figure 1 below.

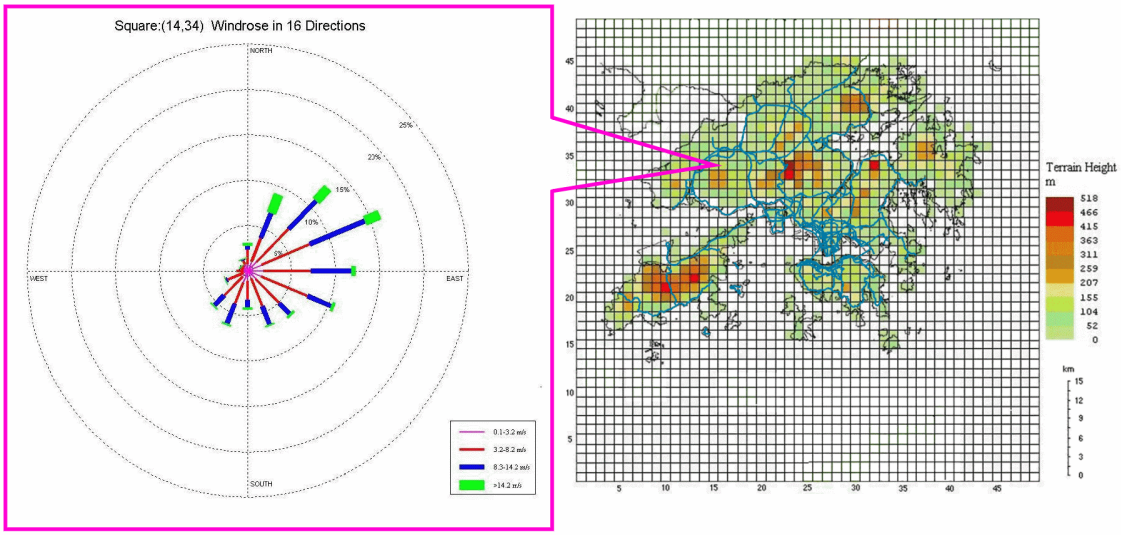


Figure 1 Wind Rose based on Mesoscale Model (MM5) Simulation

Table 1 Wind Frequency

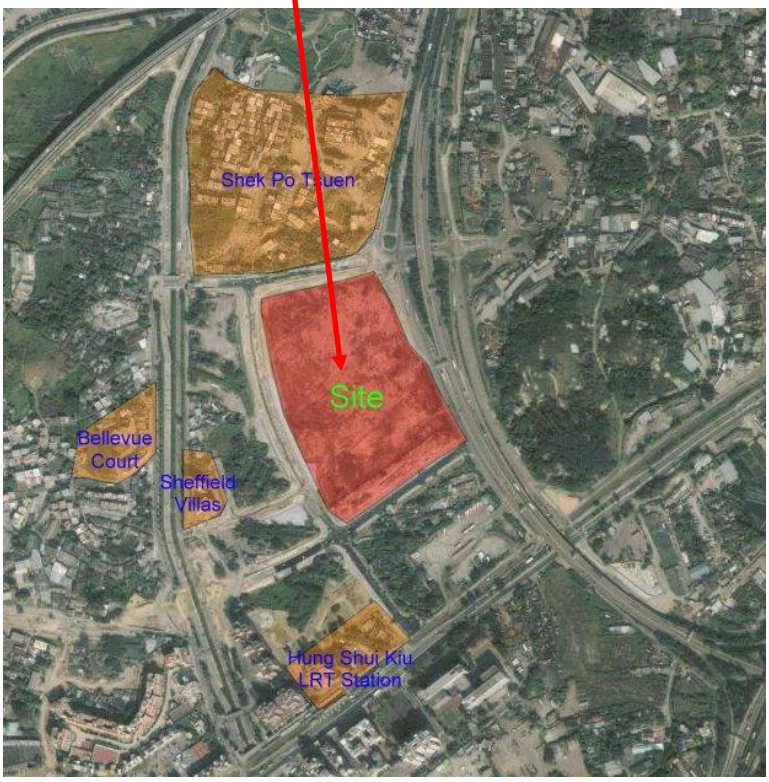
Wind Direction	Percentage of Occurrence (%)	Wind Direction	Percentage of Occurrence (%)	Wind Direction	Percentage of Occurrence (%)	Wind Direction	Percentage of Occurrence (%)
N	3	**E**	**12.1**	S	4.2	W	1.3
NNE	9	ESE	10.5	SSW	6.4	WNW	1
NE	**12.7**	SE	6.9	SW	5.5	NW	0.9
ENE	**16**	SSE	6.5	WSW	2.7	NNW	1.4

The wind from the NE/E contributes over 40% (Bold in the above table) of the annual wind frequency. As a result, the NE/E wind is chosen to be the annual prevailing wind. On the other hand, the monthly wind record from Waglan Island Weather station (which MM5 data made reference to) shows that the prevailing wind direction in summer is coming from southwest (SW/SSW). Hence, the prevailing winds taken for this study would be NE/E (annual) and SW/SSW (summer).

2.1 Site Characteristics

The Development is located in a semi-rural area with comparatively low rise developments to the north of Castle Peak Road, about 1½ miles west of Yuen Long. Hung Shui Kiu LRT Station is located to the South and Shek Po Tsuen to the North. Bellevue Court and Sheffield Villas are on its west side. These developments would be deliberately considered for the wind performance analysis. Figure 2 below shows the site location and major surrounding developments.

(Source: Centamap)



(Source: GoogleEarth)

Figure 2 The Site Location and Major Surrounding Developments

3 Study Scenarios

Two schemes are evaluated here to identify the impact on the wind performance due to different design options with different design features and mitigation measures.

3.1 Baseline Scheme

This is a reference scheme with Plot Ratio 3 of the former approved development of the Hong Kong Housing Society. It involves construction of 24 blocks with building roof levels ranging from 51-61mPD (Figure 3). **Table 2** shows the building roof levels in the Baseline Scheme.

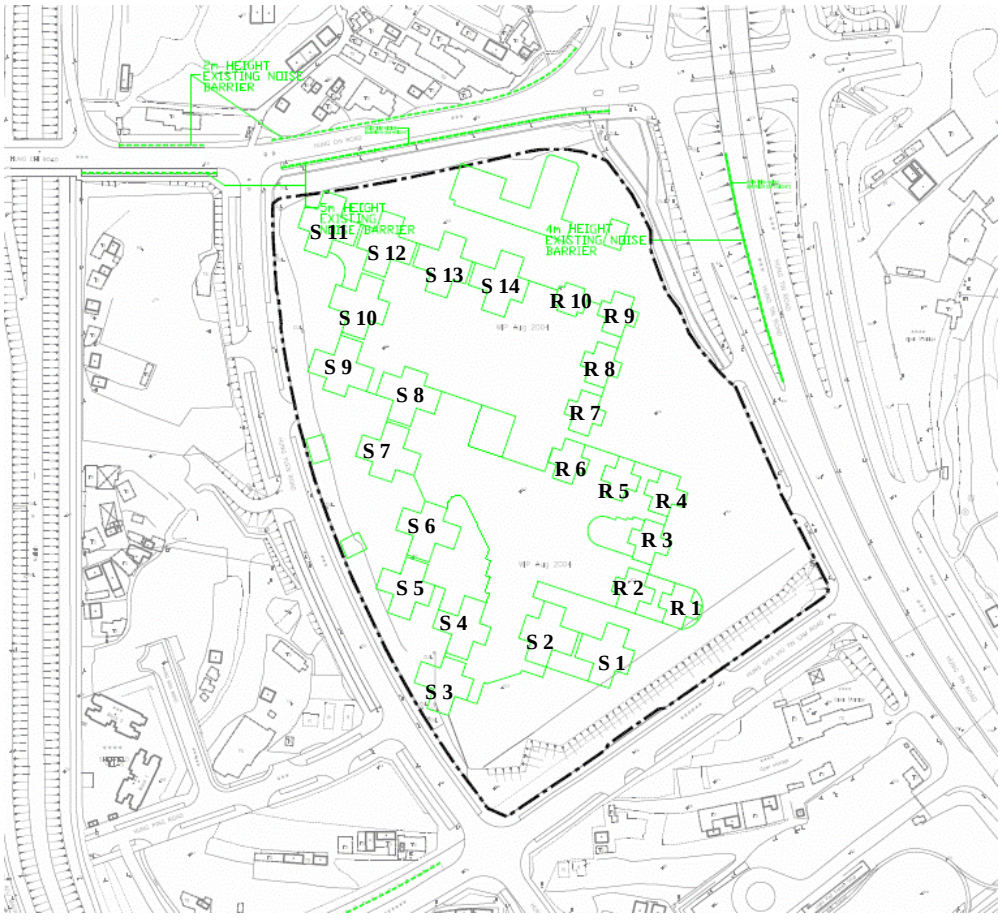


Figure 3 Master Layout Plan for the Baseline Scheme

Block	mPD	Block	mPD
S1	51	R1	51
S2	51	R2	51
S3	61	R3	51
S4	51	R4	51
S5	61	R5	51
S6	61	R6	51
S7	61	R7	51
S8	61	R8	51
S9	61	R9	51
S10	61	R10	51
S11	61		
S12	61		
S13	61		
S14	61		

Table 2 Building Roof Levels in the Baseline Scheme

3.2 Proposed Development

The Proposed Development is developed by HKHA, which involves the construction of:

- 9 nos. of non-standard domestic blocks with building roof levels ranging from 59-82mPD;
- Commercial centre at street level along Tin Sum Road and Hung Tin Road;
- A three-storey carpark block integrated with the ground-level wet market;
- A public transport interchange (PTI) with cover.

The details are shown in Figure 4 and Table 3.

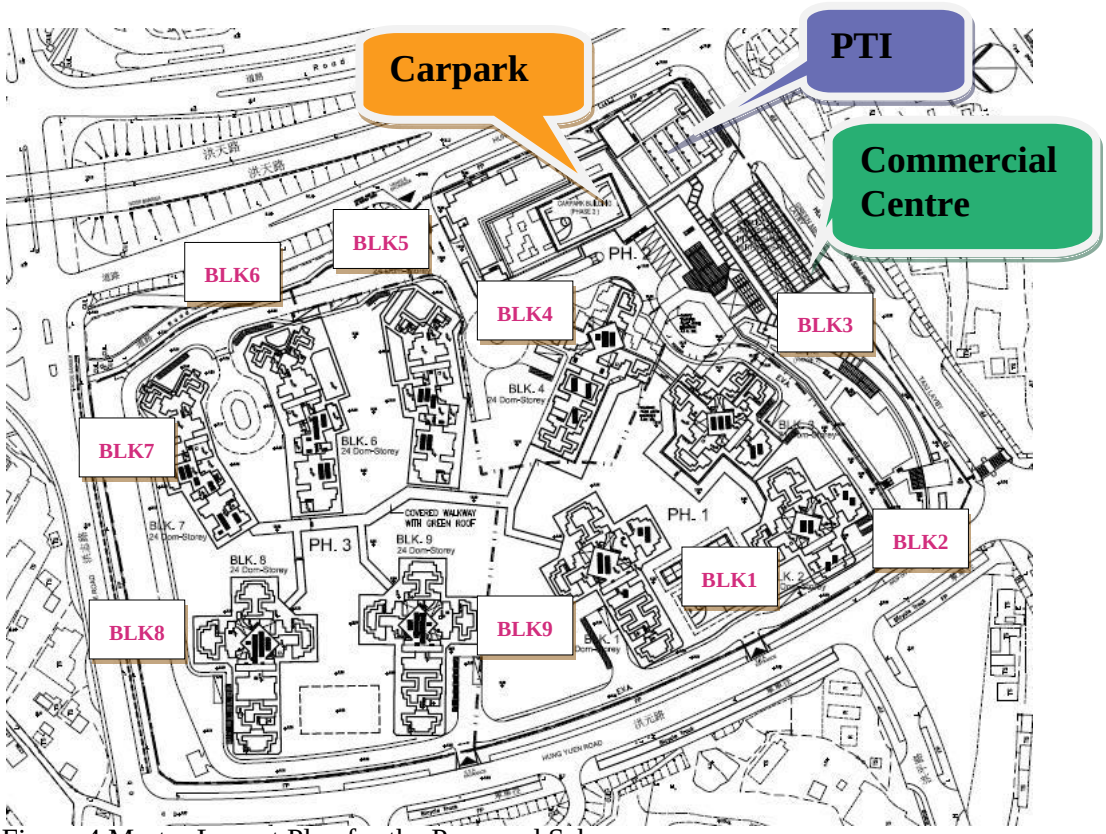


Figure 4 Master Layout Plan for the Proposed Scheme

Table 3 Building Roof Levels in the Proposed Scheme

Block	mPD	Block	mPD
BLK1	81	BLK5	81
BLK2	59	BLK6	81
BLK3	73	BLK7	81
BLK4	81	BLK8	82
		BLK9	82

4 Expert Evaluation

4.1 Approaching Wind Condition

As described in Section 2, the annual prevailing wind is from NE/E while the summer prevailing wind is from SW/SSW. The ventilation performance of the development site at pedestrian level is evaluated based on these prevailing wind directions. Figure 5 shows the annual and summer prevailing wind directions for the development. As it is surrounded by low rise and semi-rural developments, the impact from the surrounding to the development is minimal.

Figure 5 The Approaching Wind Directions under Annual and Summer time for the Development.

4.2 Focus Areas

To further assess the impact of the Development on the wind environment of its immediate vicinity, some focus areas are identified, as shown in the following figure and table.

Figure 6 Locations of the Focus Areas

4.3 Ventilation Performance of the Baseline Scheme

4.3.1 Annual Wind Condition

The annual prevailing wind comes from the NE/E direction. Without any wind corridor provided, the building blocks (S11-S14, R1-R10) would obstruct the wind flowing to the downstream area. The Sheffield Villas, Open space at the western side of the development, part of the Hung Yuen Road and Bellevue Court would fall within the wind shadow area with relatively poor ventilation performance of these areas as shown in Figure 7.

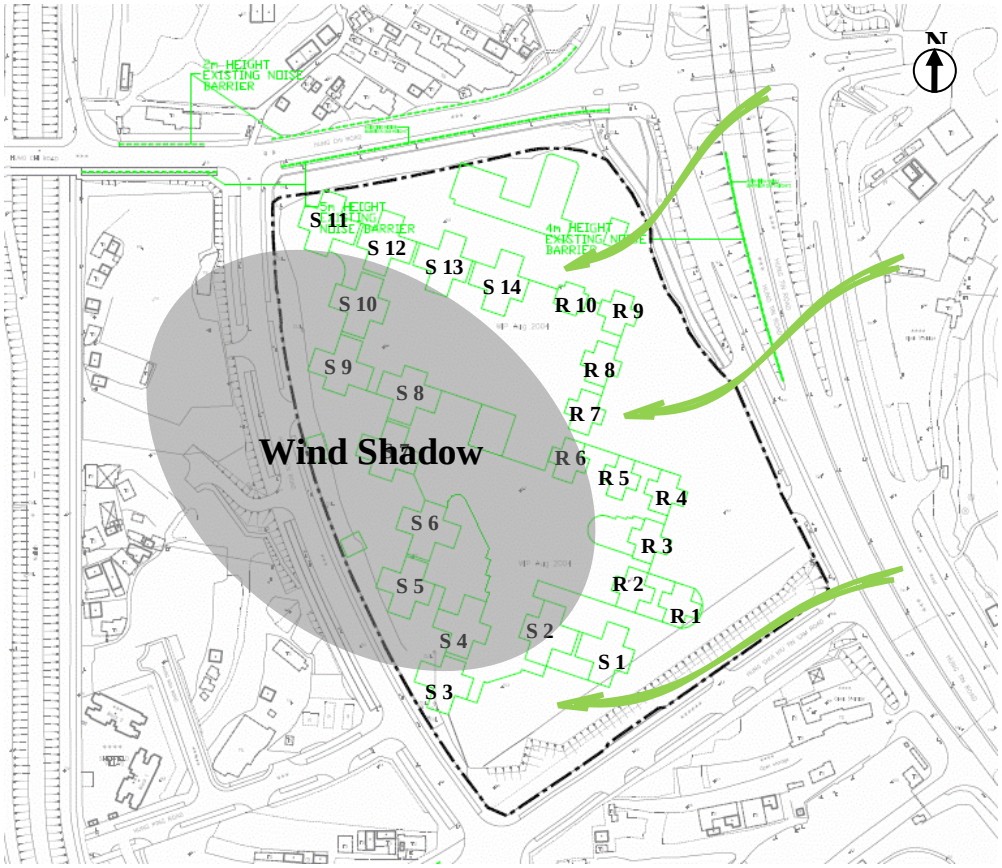


Figure 7 Annual Prevailing Wind Condition for the Baseline Scheme at Pedestrian Level

4.3.2 Summer Wind Condition

The summer prevailing wind comes from the SSW/SW direction. Same as the annual prevailing wind condition, the blocks S1-S11 would block the wind passing though the site. This would adversely affect the ventilation performance within the site, Hung Chi Road area and the southern part of Shek Po Tsuen as shown in Figure 8.

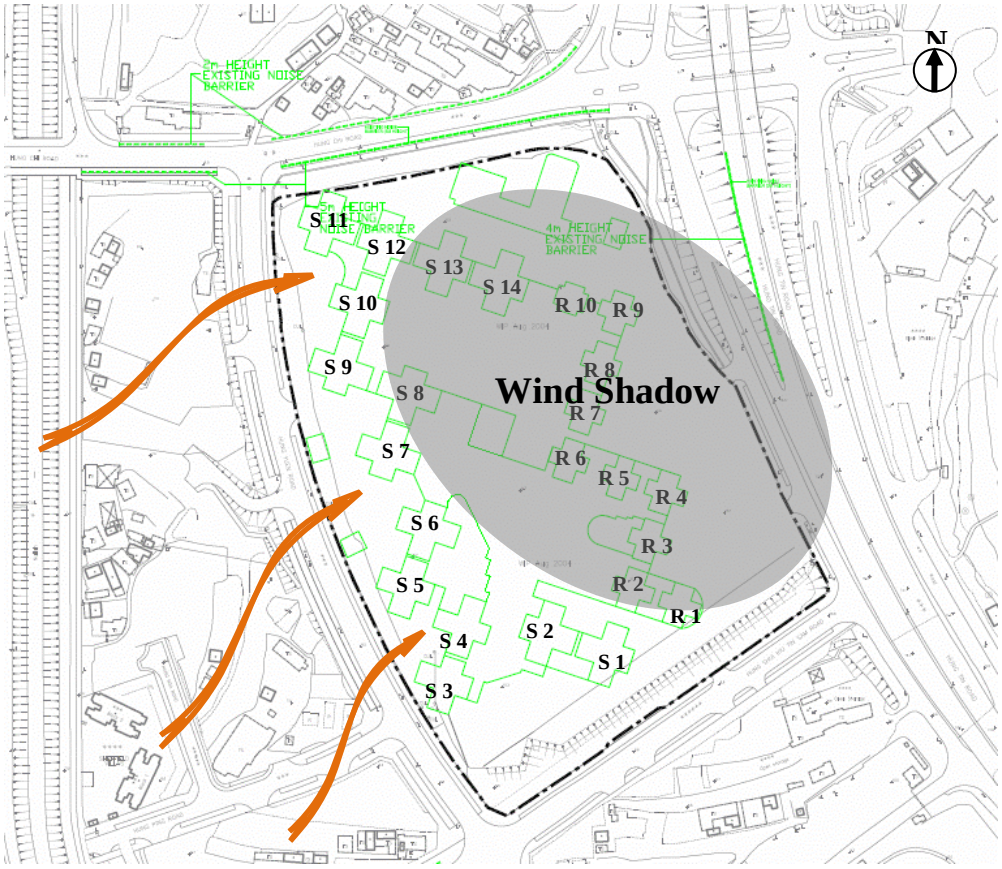


Figure 8 Summer Prevailing Wind Condition for the Baseline Scheme at Pedestrian Level

4.4 Ventilation Performance of the Proposed Development

4.4.1 Annual Wind Condition

The annual prevailing wind comes from the NE/E direction. To favour the prevailing wind condition, the Proposed Scheme aligned the blocks array parallel to the NE/E directions as recommended in the "Urban Design Guidelines", so as to maximize the wind penetration though the site. The wind corridors in between them help to enhance the ventilation performance within the site and its surrounding areas. The porous design of the carpark allows the annual prevailing wind to penetrate through it to ventilate the downstream area.

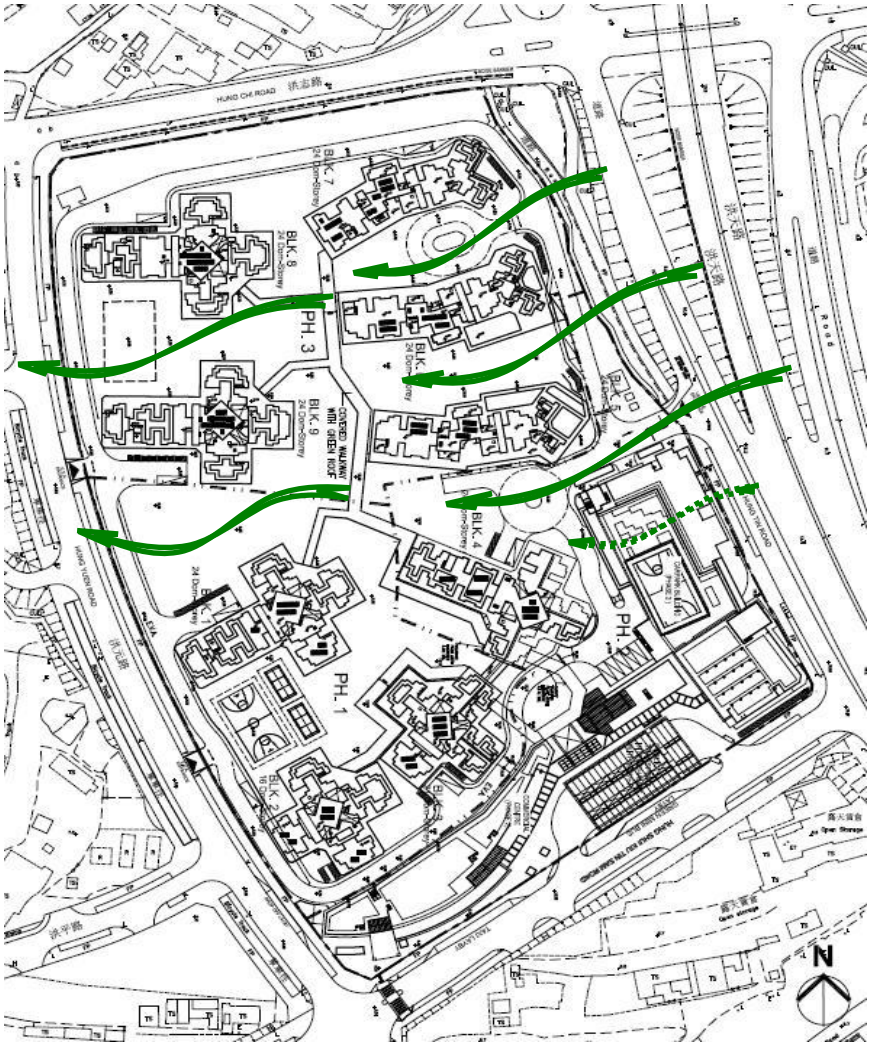


Figure 9 Annual Wind Condition for the Proposed Scheme at Pedestrian Level

4.4.2 Summer Wind Condition

The dedicated wind corridors located between Block 1 and 2, together with the southwest part of commercial centre, provide an easy path for the summer SSW/SW wind passing through the development effectively. The building blocks offer a general staggered building height profile from southwest to northeast, which allows downwash wind flow and avoids air stagnation. This also complies with the recommendation given in the "Urban Design Guidelines", in which a decreasing height of buildings towards the direction of the prevailing wind is suggested. (Figure 11)

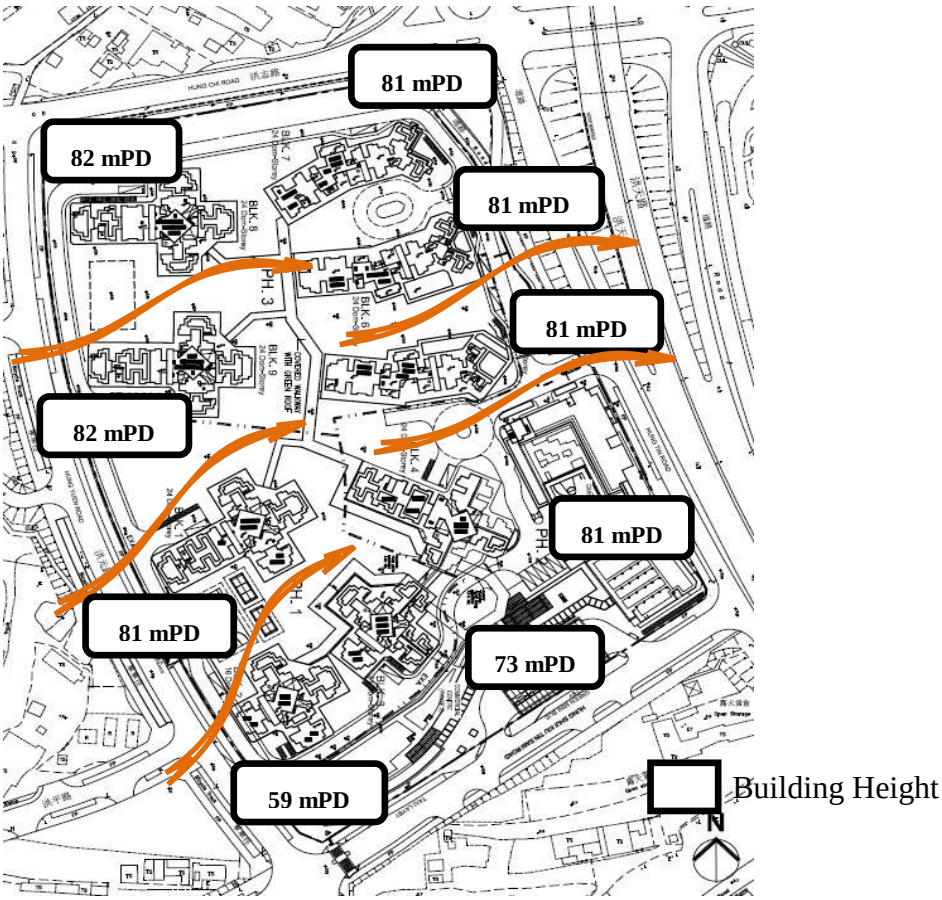


Figure 10 Summer Wind Condition for the Proposed Scheme at Pedestrian Level

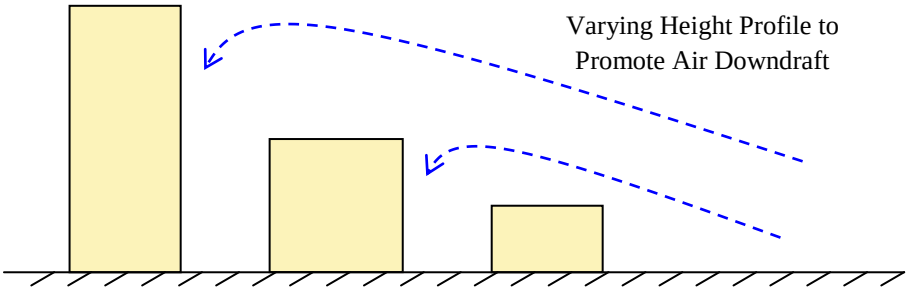


Figure 11 Staggered Building Height to Promote Air Movements

5 Wind Enhancement Features of the Proposed Scheme

The following wind enhancement features are incorporated in the Proposed Scheme to enhance the ventilation performance of the Development.

5.1 Low-level Openings

Low-level openings (e.g. empty bay and void deck) would reduce wind blockage at low level and enhance the wind penetration at pedestrian level throughout the site. Therefore, the ventilation of the open space within the site as well as the pedestrian area immediately surrounding the site could be improved. The locations of the ground floor empty bays are illustrated in Figure 12.

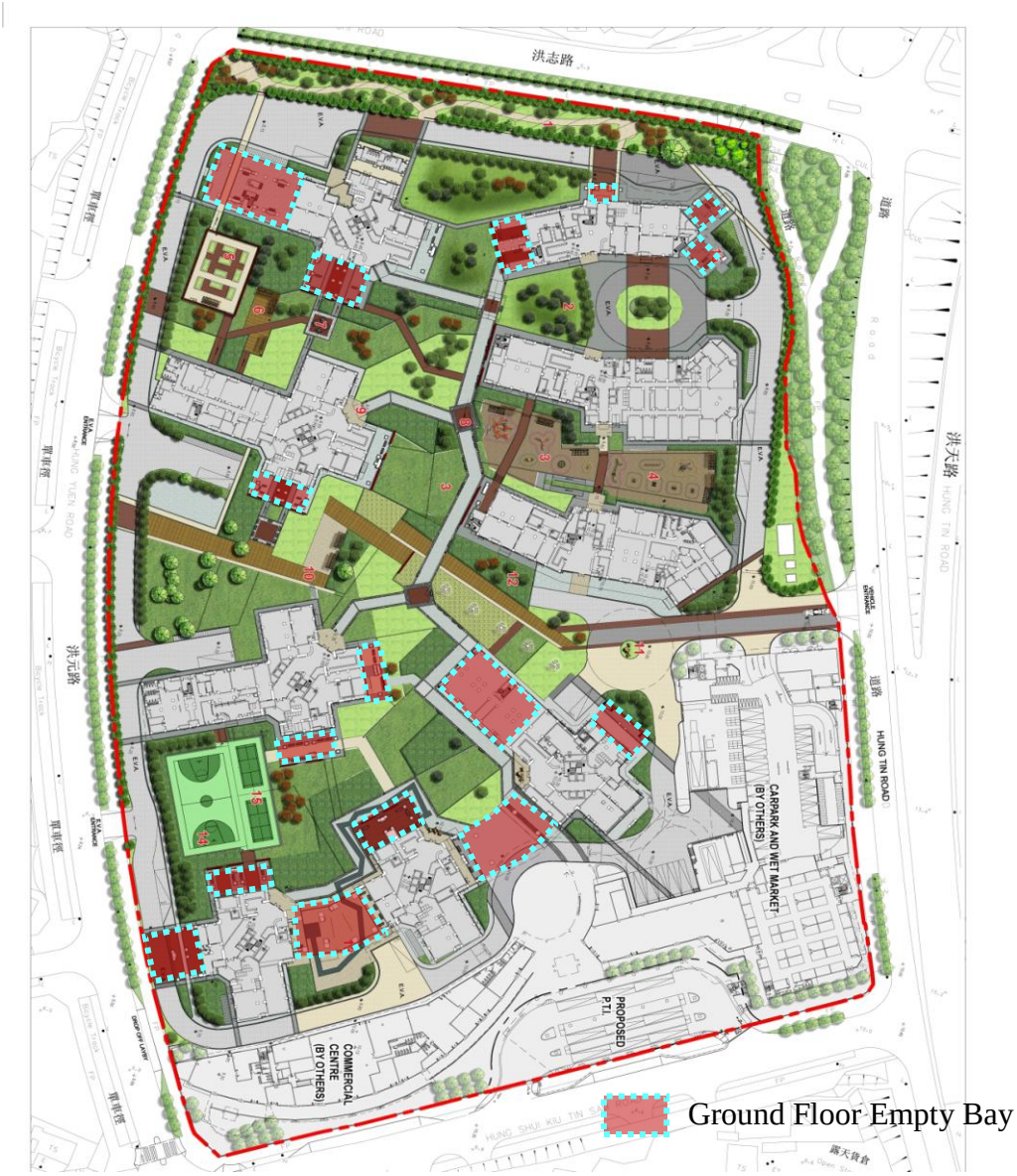


Figure 12 Empty Bay Location of the Proposed Development

5.2 Large Building Separation

The following figure shows the building separation of the Proposed Development. It shows that the minimum separation among the buildings is 12m while the largest is 34m. The optimal building separations minimize wind blockage within the site and help the ventilation performance of the surrounding area.

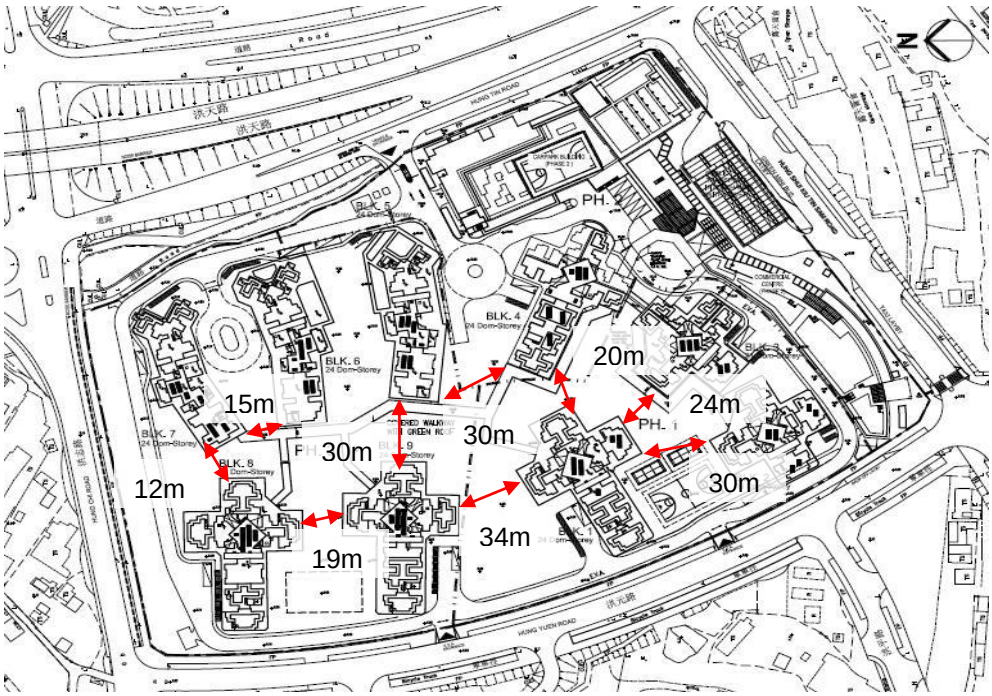


Figure 13 Building Separation of the Proposed Development

5.3 Porous Carpark Design

The porous design of the carpark block increases the permeability of the development toward the annual prevailing wind directions. It reduces the blockage to prevailing winds which ventilate the downstream area.

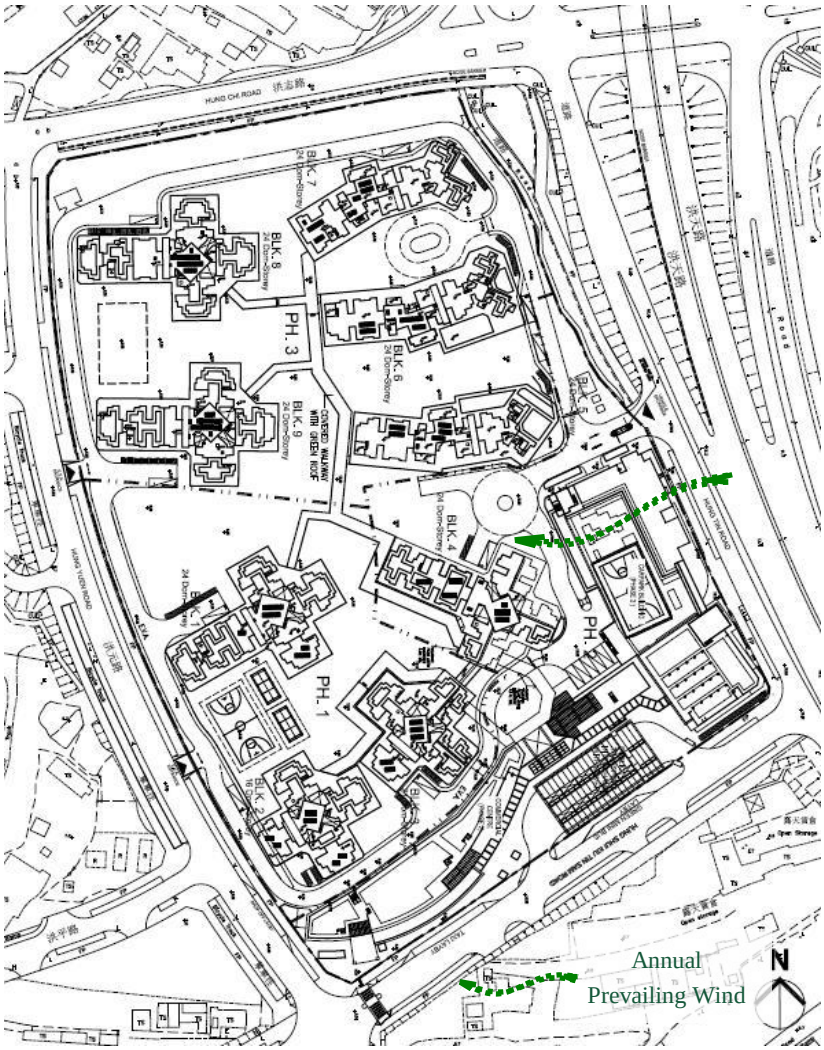


Figure 14 Porous Design of Carpark to Increase the Permeability of the Proposed Development

6 AVA Initial Study at the Scheme Design Stage

The Expert Evaluation aims at providing qualitative identification of wind performance of the site based on different schemes. To quantitatively estimate the wind performance at the pedestrian level and determine the airflow pattern, AVA Initial Study is suggested at the later scheme design stage (i.e. BC Submission) to provide better illustration of the air ventilation performance of the Development.

According to the Technical Circular, Computational Fluid Dynamics (CFD) coupled with meteorological data collected from the MM5 is considered as the appropriate tool for AVA Initial Study to determine the Velocity Ratios (VR) at different concerned locations. The model should contain information of the surrounding buildings and site topography from Geographical Information System (GIS) platform. The airflow distribution within the flow domain, being affected by the site-specific design and the nearby topography, should be visualized under the prevailing year-round wind conditions.

7 Conclusion

Qualitative assessment of the wind environment of the Development of Hung Shui Kiu Area 13 Phase 1, 2 and 3 was conducted. The air ventilation impacts of the different design schemes were studied.

According to the analysis, the annual prevailing wind comes from NE/E and the summer prevailing wind is SSW/SW. The Proposed Development has incorporated some effective measures to enhance the ventilation performance of the surrounding area, such as building orientation, wind corridor and staggered building height. More wind responsive enhancement measures were suggested in this report which includes ground floor empty bay and podium void so as to further enhance the wind performance of its surrounding areas.

To quantitatively assess the air ventilation performance of the Development as well as concerned areas surrounding the site, AVA Initial Study using Computational Fluid Dynamics (CFD) technique is suggested in the later scheme design stage.