Planning and Engineering Study for the Public Housing Site and Yuen Long Industrial Estate Extension at Wang Chau

Technical Report No. 3H (TR-3H) - Technical Assessment – Air Ventilation Assessment

[redacted]

Department of Civil and Architectural Engineering, City University of Hong Kong, Kowloon, Hong Kong

[redacted]

Contents

List of Figures

List of Tables

Abbreviations

AVA	Air Ventilation Assessment
SWAS	Site Wind Availability Study
PDA	Potential development area
EE	Expert evaluation
CityU	City University of Hong Kong
Arup	Ove Arup & Partners Hong Kong Limited
BLWT	Boundary layer wind tunnel
WGL	Waglan Island meteorological station
PlanD	Planning Department
OZPs	Outline zoning plans
YLIE	Yuen Long Industrial Estate
PHD	Public housing development
V_p	Wind speed at 2 m pedestrian height level
V_∞	Speed of gradient wind (at 600 m in this study)
F_i	Occurrence frequency of wind blowing from the ith direction
VR	Velocity ratio: $VR = V_p/V_\infty$
VR-with	VR with development
VR-without	VR without development
VR_w	Weighted average of directional VR values: $VR_w = \sum_{i=1}^{16} F_i \times VR_i.$
VR_w-with	VR_w with development
VR_w-without	VR_w without development
LVR	Local spatial average velocity ratio ($VR_{w,j}$ is the VR_w at the j^{th} test point (consider only perimeter and overall test points): $LVR = \frac{1}{N}\sum_{j=1}^{j=N} VR_{w,j}.$
SVR	Site spatial average velocity ratio ($VR_{w,i}$ is the VR_w at the ith perimeter point): $SVR = \frac{1}{M}\sum_{i=1}^{i=M} VR_{w,i}.$

1 Introduction

1.1 Background

1.1.1 As stated in the Chief Executive's 2011-12 Policy Address, the Administration is committed to expanding land resources and increasing the housing land supply. To meet this policy objective, the Planning Department (PlanD) carried out a comprehensive review of the areas zoned as the "Green Belt" (GB) on the outline zoning plans (OZPs), focusing on sites that are no longer green or spoiled. A number of GB and open storage (OS) sites in Wang Chau, Yuen Long were identified as having potential for public housing development (PHD), as shown in **Figure 1**.

1.1.2 The Innovation and Technology Commission (ITC) and the Hong Kong Science and Technology Parks Corporation (HKSTP) subsequently communicated the need to expand the Yuen Long Industrial Estate (YLIE), in addition to the three industrial estates (IEs) at Tai Po, Tseung Kwan O and Yuen Long. They requested use of a portion of the Wang Chau potential housing site for this purpose.

1.1.3 After due consideration, an agreement was reached between the Housing Department (HD) and ITC to tentatively share the site with the northerly portion to be allocated for the YLIE extension (YLIEE). The remaining south portion would be developed for public housing use. It was further agreed that no potential hazardous installations (PHIs) would be located at the YLIEE so as to minimise the potential adverse effect on the neighbouring PHD.

1.1.4 The public housing and YLIEE sites at Wang Chau are zoned as GB and OS in Ping Shan OZP No. S/YL-PS/14. Wang Chau is currently occupied by OS, vehicle parks, farmland, fallow land, grassland, rural residential dwellings and temporary structures.

1.1.5 Ove Arup & Partners Hong Kong Limited (Arup) was commissioned to conduct the Planning and Engineering Study for Public Housing Site and YLIEE at Wang Chau (the Study) to examine the feasibility of PHD and YLIEE development at Wang Chau. The Study will conduct planning, engineering and environmental assessments to formulate a proposal, implementation strategies and a programme for both developments. As part of the Study, an AVA study is required to assess the effect of the development proposal on the wind environment in the surrounding areas.

1.1.6 The Site Wind Availability Study (SWAS) was carried out in March 2013 at the wind tunnel lab by CityU to obtain precise wind availability and characteristics information in terms of the wind directions, magnitudes, frequencies, speed and turbulence intensity profiles at the subject site.

1.1.7 An expert evaluation (EE) was included in Final Technical Report No. 2 (TR-2) 'Option Generation, Evaluation and Preliminary

Assessments', submitted in September 2013 to assess the initial options related to wind characteristics at the site. A preferred option was then suggested based on the initial options with the following factors taken into account: environment, traffic and transport, infrastructure, geotechnical factors, slope works, natural terrain hazards, site formation works, foundation works, land requirements, air ventilation, urban design, visual factors, landscapes and sustainability among others.

1.1.8 Based on the SWAS and EE results, CityU conducted a detailed AVA study involving wind tunnel tests in relation to the revised preferred development option in December 2013.

1.2 Purpose of this report

1.2.1 The purpose of this report is to present the AVA wind tunnel test results and assess the effects of proposed developments on pedestrian-level wind speeds at the study site and assessment areas.

2 Site Wind Availability

2.1 Physical model and approach wind

2.1.1 A 1:4,000 scale topographical model 3 m in radius (equivalent to 12 km in radius in actual scale) was created. It covered the surrounding area up to a distance not less than 10 km from the PDA. A B5000 Digital Topographic Map was used for the model construction, and the modelling area is shown in **Figure 2**.

2.1.2 The approach wind field (mean wind profile, turbulence intensity profile and longitudinal turbulence spectrum) in the wind tunnel was adjusted according to the Japanese wind load code of AIJ-2004.

2.1.3 The mean wind speed profile was adjusted to follow the power law:

$$U(z) = U_{ref}(z / z_{ref})^{\alpha}. \quad (1)$$

where α is the power exponent and U_{ref} is the reference mean wind speed at the reference height of z_{ref}.

2.1.4 The turbulence profile was adjusted according to the AIJ-2004 wind code:

$$I(z) = 0.1(z / z_G)^{-\alpha-0.05}. \quad (2)$$

where z_G stands for the gradient height, and α is the same as the power exponent in **Equation 1**. For this project, α was set at 0.15.

2.1.5 The von Karman model was adopted for the wind turbulence spectrum. A reproduction of the adjusted approach wind field depicted by the preceding parameters in the Boundary Layer Wind Tunnel (BLWT) at CityU is shown in **Figure 3**.

2.2 Results

2.2.1 The wind tunnel measurements were taken at 22.5° intervals for the full 360° azimuth (i.e., 16 wind directions) at the geometric centre of the physical model. The wind directions were defined as positive travelling clockwise from the north.

2.2.2 For each wind direction, the mean wind speeds, turbulence intensities and yaw angles were determined at 10 different height levels, equivalent to 25, 50, 75, 100, 150, 200, 250, 300, 400 and 500m in actual scale.

2.2.3 **Figures 4-6** show the obtained vertical profiles of the mean wind speeds, turbulence intensities and yaw angles.

2.2.4 As shown in **Figure 4**, due to the shielding effect of Mountains 1-4 (marked in **Figure 2**), the mean wind speeds in the southern half-plane except for 225° are evidently lower than the reference speeds. The most severely affected azimuth section is 135-180°, which corresponds to an upwind terrain with continuous mountain bodies (Mountain 2). The 225° direction corresponds to an upwind valley (Valley 1), and the wind speeds up at the middle and upper atmospheric boundary layers. Although there are two mountains (Mountains 3-4) in the eastern direction, the wind flows are not severely obstructed, as these mountains are basically located in parallel to the 90° upwind wind. Instead, winds from these directions are accelerated due to the channelling effect of Valley 2 (Figure 2) formed by Mountains 2-4. This situation is similar to that at 225°. In the northern half-plane, due to the lesser influence of topographic effects, the mean wind profiles are similar to the reference profile (**Figure 4d**).

2.2.5 The turbulence intensity (TI) profiles are influenced by the topographic effects in a pattern similar to that of the wind speeds. As shown in **Figure 5**, the TI values in the southern half-plane are larger than those in the northern half-plane, due to the lesser influence of the surrounding topography.

2.2.6 The yaw angle results measure the topographical effects on horizontal wind direction. In general, the mountains/hills force the surface wind to move forward in parallel to their orientation. Negative values reflect that the upwind flows rotated clockwise, and positive values reflect that the winds rotated anticlockwise. As shown in **Figure 6**, the yaw angle results from the tests range from -10° to +10°. The abstract values above 200 m are very small and less influenced by the topographic features, and those below 200 m are somewhat sensitive to the upwind terrain conditions. At near-surface-height levels, relatively larger abstract values are found in the 0°, 225°, 270° and 292.5° sections. The first section corresponds to negative values, and the last three sections correspond to positive values, which may be attributed to the channelling effects of Valleys 1 and 2, respectively.

2.2.7 To determine the wind roses at the test point, field measurements from the Waglan Island Station (WGL) were adopted in the wind tunnel

tests. The methodology for calculating wind roses is shown in **Figure 7**.

2.2.8 The wind roses at WGL for both the annual and summer winds are shown in **Figure 8**, based on records during 2000-2013 (speed unit: m/s) and measured by the cup anemometer installed at a height of 82.7 above the mean sea level, or 28 m atop the Waglan Island zenith. There are three prevailing wind directions for the annual wind: east, with a wind occurrence frequency of 19%; east-northeast, with an occurrence frequency of 18%; and north, with an occurrence frequency of 12%. For the summer wind, there are two dominant wind directions: southwest, with an occurrence frequency of 20%, and east, with an occurrence frequency of 13%.

2.2.9 The estimated wind roses of the annual winds at the different height levels are shown in **Figure 9** and **Table 1**. The wind roses of the summer winds are shown in **Figure 10** and **Table 2**.

2.2.10 The resolution of the mean wind direction of the field measurements at WGL is 10°, and the sectional width is 22.5°. Thus, in calculating the wind rose information at the PDA using the method demonstrated in **Figure 7**, even if the yaw angles at the various levels evidently differ from one another, the angle differences may not be large enough to make the modified wind directions lie in other azimuthal sections. This is why the calculated marginal probabilities of each azimuthal section at the various height levels (**Tables 1 and 2**) may show little difference from one another.

2.2.11 According to the wind rose plots shown in **Figures 9,** there are three prevailing directions for the annual winds at the lower and middle atmospheric boundary layers: north-northeast, east-northeast and east. Northeast is another dominant direction at the upper height levels above 200 m. As shown in **Figure 10**, there are also three prevailing directions for the summer winds at the lower and middle atmospheric boundary layers: southwest, south-southwest and west-southwest. East-southeast is another prevailing azimuth at the upper height levels.

3 Methodology for Detailed AVA Study

3.1 Physical model of the project, assessment and surrounding area

3.1.1 The layout of the proposed buildings at the PDA is shown in **Figure 11**. There are 24 residential buildings, 16 industrial buildings in YLIEE, 4 GIC sites and school facilities, together with car parks, playgrounds and commercial activity infrastructure. The residential buildings range from 87.1 m (yellow) to 114.6 m (red) in height above ground, or 94.1-125.6 mPD. The four GIC/school facilities are 17.5 m (GIC) and 28 m (schools) in height above ground, or 32.5 (GIC), 39, 38, and 41 mPD, respectively. The 16 YLIEE buildings have a uniform height of 32 m above ground.

3.1.2 According to Technical Circular No. 1/06, the physical model for the AVA wind tunnel study had to cover both the project area and a surrounding area of up to a perpendicular distance of 2H from the project boundary, where H=114.6 m, the height of the tallest building on site. It was necessary to enlarge the surrounding area if there were prominent features (e.g., tall buildings or large and bulky obstructions) immediately outside the 2H zone.

3.1.3 The wind tunnel tests were conducted in accordance with the relevant technical guidelines stipulated in AWES QAM-1-2001 (the Australasian Wind Engineering Society Quality Assurance Manual) and the wind tunnel test guide for building structures in Japan.

3.1.4 The wind velocity ratio (VR) was used as an indicator to index the wind performance for the AVA. It is defined as V_p/V_∞, where V_∞ stands for the gradient wind speed (typically at a height of 400-600 m above the city centre) and V_p represents the wind velocity at the pedestrian level (2 m above local ground). This indicator reflects how much of the wind availability of a location can be experienced and enjoyed by pedestrians on the ground, taking into account the surrounding buildings and topography and the proposed development. It is a common practice in wind engineering studies to account for wind coming from the 16 main directions. The velocity ratio can then be calculated as follows:

$$VR_w = \sum_{i=1}^{16} F_i \times VR_i. \qquad (3)$$

where VR_i and F_i is the velocity ratio and probability of wind coming from direction i. Thus, VR_w is the weighted average of VR_i based on the wind occurrence frequency.

3.1.5 The preceding VR values are based on the results at each test point. There are also two kinds of VR values that are defined as the average of the VR_w values at a number of individual test points: SVR and LVR. The SVR is based on the VR_w values at the perimeter test points, which are located along the PDA boundary. It gives a hint of how the

proposed developments would affect the wind environment in the immediate vicinity. The LVR is based on both the perimeter points and the overall test points. It provides information related to how the proposed developments would affect the wind environment of the local area.

3.1.6 In consideration of the capacity of the BLWT at CityU and the regional proximity features around the study area, a 1:400 scale model was adopted. All of the topographic features and building structures within a 1,000-m radius from the centre of the PDA were fabricated. A photo of the physical model is shown in **Figure 12**.

3.2 Test points

3.2.1 The test points are the locations where the wind VRs are tested and reported. These test points are located within the assessment area, which consists of both the project area and a surrounding area of up to a perpendicular distance of H=114.6 m from the project boundary (H has the same meaning as above). A surrounding area larger than H was occasionally required to avoid omitting special surrounding features and open spaces. **Figure 13** shows the location of the test points for this project.

3.2.2 Two main types of test points should be specified for an AVA study: perimeter and overall test points. Perimeter test points are positioned along the project site boundary, especially at the junctions of any roads leading to the project site, the main entrances to the project site and the corners of the project site. They are used to provide data for the Site Air Ventilation Assessment, and to assess the 'immediate' effect of the project on the assessment area. Overall test points are evenly distributed and positioned in the open spaces, on the streets and places relevant to the project and in the assessment areas frequently accessed by pedestrians. This group of test points, together with the perimeter test points, are used for the Local Air Ventilation Assessment.

3.2.3 For this project, 43 perimeter test points and 71 overall test points were considered. The locations of these points are shown in **Figure 13**. The perimeter test points and overall test points are marked with point IDs starting with 'P' and 'O', respectively.

3.3 Approach wind fields

3.3.1 The approach wind field is set based on the SWAS wind tunnel test results. The 16 directional approach wind fields are categorised into 3 groups according to the vertical profiles of the mean wind speeds and turbulence intensities, and are respectively indicated as AF1 and af1, AF2 and af2, and AF3 and af3 ('AFi' and 'afi' stand for the target and adjusted approach wind fields, respectively). The wind directions in each group are listed as follows:

AF1 and af1: 90° and 135°

AF2 and af2: 225°, 292.5° and 315°

AF3 and af3: 0°, 22.5°, 45°, 67.5°, 112.5°, 157.5°, 180°, 202.5°, 245°, 267.5° and 337.5°

3.3.2 The details of these three kinds of approach wind fields are shown in **Figure 14** and **Tables 4 and 5**.

3.3.3 Wind speed scaling factors for each wind direction are required to match the mean wind speeds between the 1:4,000 scaled topographical model and the 1:400 scaled proximity model. The scaling factor is defined as a ratio of MBL1/MBL2, with MBL1 standing for the scalar average of speeds at each of the 10 height levels in a directional profile obtained from the SWAS tests and MBL2 standing for the average speed of the approach wind speed profile in the AVA study:

$$SF_i = MBL1_i / MBL2_i, i = 1,2,...16. \quad (4)$$

The mean wind speed based on the 10 height level records is adopted to decrease the uncertainty of the result at a single level. The directional values of the scaling factor are listed in **Table 6**.

3.3.4 The directional VR_w values can then be calculated based on the measurements at the gradient height level V_∞ and pedestrian level V_p. These directional values, determined by **Equation 3**, are further modified by multiplying the corresponding scaling factors (**Table 4**):

$$VR_w = \sum_{i=1}^{16} F_i \times VR_i \times SF_i. \quad (5)$$

3.3.5 In this project, the mean wind speeds measured at a height level of 1.5 m on the tunnel scale (600 m on the actual scale) were adopted as the V_∞ values, as the detected mean wind speeds at this height demonstrated little difference among the different directional sections, indicating that the mean wind flows were less influenced by the surrounding topographic effects.

4 Detailed AVA Study

4.1 Overall performance

4.1.1 The air ventilation performance based on the proximity AVA model with and without the installation of potential buildings within the PDA was assessed and reported using the VR indicator. The annual and summer wind conditions were also analysed.

4.1.2 The obtained directional VR values without and with the installation of potential buildings within the PDA are listed in **Table 7** and **Table 8**, respectively. These two sets of results are compared in **Figure 15** to examine the effect of the installation of potential buildings on air ventilation performance at the assessment area. The VR values range from **0.06 to 0.76** and from **0.04 to 0.85** in these two cases. According to **Figure 15**, although some test results deviate away from the 'y=x' line, most of the results are distributed around it. This indicates that the potential buildings may only affect the local air ventilation in some directions at a limited number of test points.

4.1.3 Based on these VR values and the obtained directional wind occurrence frequency, the VR_w ratios were calculated and are shown in **Tables 9 and 10** and **Figures 16 and 17**. These results indicate that potential buildings may increase the VR_w values at 40 test points and decrease the values at 74 test points. The relative difference percentage (RDT) of VR_w between the results with and without proposed building developments were also calculated and are shown in the tables (RDT=[VR_w(with)-VR_w(without)]/VR_w(without)). **Figures 18 and 19** compare the VR_w ratios with and without the developments under the annual and summer wind conditions, respectively.

4.1.4 Based on these results, the VR_w-with and VR_w-without values for the annual winds range from **0.11 to 0.56** and from **0.10 to 0.59.** Under the summer wind conditions, the VR_w-with and VR_w-without values range from **0.10 to 0.52** and from **0.11 to 0.51.** The comparison between VR_w-with and VR_w-without development for different VR range under annual and summer wind condition is shown below.

VR range	Number of test points			
	VR_w-without		VR_w-with	
	Annual	Summer	Annual	Summer
(0.1, 0.2)	19	21	25	28
(0.2, 0.3)	62	56	64	61
(0.3, 0.4)	25	34	19	49
(0.4, 0.5)	5	2	6	2
(0.5, 0.6)	3	1	0	1

4.1.5 The SVR and LVR values were calculated and are listed in **Table 11**. The SVR values with and without building developments are **0.27** and **0.28** for the annual winds and **0.26** and **0.27** for the summer winds. The LVR values are **0.26** and **0.27** for the annual winds and **0.25** and **0.27** for the summer winds. These results reveal that the building

developments only result in an insignificant decrease in SVR and LVR values by 3.6-7.4%.

4.1.6 The VR and VR_w values for the with- and without- development scenarios at most test points would differ from each other. At some testing points, the VR / VR_w values for the with development scenario are higher than those of the without the development scenario or vice versa. These suggest that the local air ventilation performances at these test points will be influenced by the development. Nevertheless, the SVR and LVR values for the with- and without- development scenarios would differ from each other slightly due to the averaging effect.

4.1.7 Basically, the developments will influence the local air ventilation performance adversely at a number of test points. But the overall performance will not be affected evidently in consideration of the small differences of the SVR and LVR values between the with- and without- scenarios. Meanwhile, VR_w values with development at all test points are found no less than 0.10 with most values larger than 0.2. Thus, the overall air ventilation performance is considered acceptable.

4.2 Performance at focus areas

4.2.1 Local air ventilation performance may be influenced by both the features of the nearby terrain and the layout of the surrounding buildings. The topographic effects caused by the surrounding mountains as discussed in **Section 2** also affect the VR and VR_w values. These effects are considered through the adjustment of approach wind fields and scaling factor (SF, **Equation 4**). The local terrain features here refer to the effect of the local terrain/topography.

4.2.2 Buildings can influence the structures of the wind flows around them. Flow stagnation, separation, vorticity and other complex phenomena may persist. The wind speed within the wake region sharply decreases in general. For buildings with small height-to-width ratios, downwash may contribute to air ventilation at the pedestrian level. However, for those with large height-to-width ratios, the downwash effects are very weak, and the horseshoe vortex serves as the main source of local air ventilation. The area influenced by these effects is relatively limited for a single building body. In cases of building arrays/blocks, such an area would be enlarged and the conditions would be much more complicated. When winds flow across two building blocks or in parallel to some roads/streets in which their two sides are bound by the building/podium structures, the urban canyon effect may influence the local winds significantly, and the wind speed would increase.

4.2.3 According to the features of the local terrain/topography and building layout, the PDA can be roughly divided into three focus areas (marked in **Figure 13**): the northern part in which the YLIEE buildings are located, the middle part and the southwestern part. Accordingly, the surrounding area can also be divided into three parts.

Southwestern part

4.2.4 The southwestern part of the PDA is distributed in a strip pattern. Almost all of the buildings are located beside the two boundary lines of the PDA. There are local hills to the northwest. Yuen Long town and its low density of high-rise buildings are located to the south and east. The perimeter test points located in this part comprise P1-P7 and P32-P43. The overall test points within this region comprise O46, O43, O52, O55, O57, O58 and O59.

4.2.5 According to **Tables 9-10**, the VR_w values for P1-P7 range from **0.18 to 0.29** with building developments and from **0.16 to 0.41** without building developments for the annual winds, and from **0.18 to 0.34** with building developments and from **0.18 to 0.33** without building developments for the summer winds. Directional wind velocity ratios measured at test points P1- P7 are were generally higher for 202.5° / 225° to 22.5° / 45° inclusive, reflecting the flow accelerations along the terrain and building layout.

4.2.6 For P32-P43, the VR_w values range from **0.18 to 0.45** with building developments and from **0.19 to 0.55** without building developments for the annual winds, and from **0.17 to 0.51** with building developments and from **0.21 to 0.52** without building developments

for the summer winds. Similar to P1 – P7, directional wind velocity ratios measured at test points P32- P43 are were generally higher under wind directions northern wind and south western wind direction, reflecting the flow is influenced by the terrain feature and the proposed road alignmnet.

4.2.7 **Figure 13** indicates that there is a valley located to the north of the P1 test point. As a result, local wind flowing from either the southern or northern direction would be guided and tend to converge, and wind flowing from other directions would be weakened to some extent due to the sheltering effects of the surrounding hills. There is also a groove sited to the northwest of P5. However, as the groove is neither large nor deep, the valley effect is not evident at this point. The P2-P4, P6 and P7 test points are located along hill edges. When winds blow from the hill bodies towards these points (HtP) or from these points towards the hill bodies (PtH), the sheltering effect (for HtP) and flow stagnation (for PtH) tend to dominate the local air motions, and air ventilation performance may degrade. In contrast, when winds flow along the edge, these effects become less evident. Instead, due to the guiding effect of the hill edges, the local wind speeds may increase. This is reflected in the 225° directional results at P6 (**0.41**) and P7 (**0.34**), as listed in **Table 7**.

4.2.8 The P43, P42, P41, P40, P39 and P37 test points are located near the edge of the local terrain terraces. The directional VR also indicate that the wind blowing from N or S direction will have higher VR value. This special location generally speeds up the local wind, especially when it blows along the local terrain. According to **Table 9**, all of the VR_w values at these points are much higher than the values at the other points.

4.2.9 The VR_w values for the overall test points in this part range from **0.14 to 0.49** with building developments and from **0.16 to 0.50** without building developments for the annual winds, and from **0.14 to 0.48** with building developments and **0.19 to 0.41** without building developments for the summer winds. The local airflow patterns at O52 and O58 are more evidently influenced by nearby buildings. O53 and O63 are surrounded by high density of buildings where the effects of air corridors are absent. Thus, the local VR_w values are relatively smaller.

4.2.10 For the overall test points within the southern part of the surrounding area (shown in **Figures 16-17**), the VR_w values for both the annual and summer winds generally range from **0.2 to 0.3**. The local winds may be influenced by both the buildings and urban canyon effects. The test results reflect that potential building developments have a limited influence on the VR_w values within this area.

Middle part

4.2.11 For the middle part of the PDA, the perimeter points located along the western boundary line (P8-P14) are influenced by both the hilly terrain and local building layout. The VR_w values vary from a minimum value of **0.18** (at P12) to a maximum value of **0.34** (P8)

with building developments and **0.13** (P9) to **0.36** (P14) without building developments.

4.2.12 P8, P10, P11 and P14 are located along hill edges. Similar to the conditions around P2-P4, P6 and P7, under the HtP and PtH winds, the sheltering effect and stagnation may dominate the local air motions, and air ventilation performance may degrade. In contrast, when winds flow along the edge, these effects become less evident. Instead, due to the guiding effect of the hill edges, the local wind speed may increase. This is reflected in the 90° VR results at P8 (**0.39**), P10 (**0.41**) and P11 (**0.32**), as listed in **Table 7**.

4.2.13 P9 is located too close to the nearby cliff, which is surrounded by hills. Thus, the approaching winds were obstructed and/or stagnant around these areas, degrading the local air ventilation.

4.2.14 According to **Figure 13**, P12 is located within a long and deep valley. Winds may be sheltered when blowing from the direction that crosses the valley, and may converge when blowing parallel to it. According to **Table 7**, the VR value is **0.52** for the eastern wind at this point, which is much higher than the values under other directional winds.

4.2.15 The corresponding points within this part include O24, O27-O29, O30-O36, O39 and O40. The VR_w values at these points range from **0.20 to 0.28** with building developments and from **0.16 to 0.34** without building developments for the annual wind, and from **0.16 to 0.26** with building developments and from **0.18 to 0.31** without building developments for the summer wind. These points are surrounded by a high density of buildings where the effects of air corridors are absent. Thus, the local VR_w values and the directional VR values at around 180° are relatively small. According to **Figures 16-17**, the corresponding VR_w values are generally below **0.2**, which is lower than the average levels at the other parts. For annual winds, the differences between VR_w-with and VR_w-without values are limited at these points. But, in case of the summer winds, as the potential building arrays are located upwind to the test points, the local air ventilations may be slightly influenced. As a result, the differences between VR_w-with and VR_w-without values get relatively larger.

YLIEE part

4.2.16 For the YLIEE part, the VR_w values at most of the perimeter points (P15-P27) under the annual and summer winds range from **0.2 to 0.3**. However, the conditions at P16 and P17 are much more influenced by the local hilly features, and the VR_w values are smaller (**0.10** at P16, **0.15** at P17).

4.2.17 The directional VR values and VR_w value at P16 are lower than the values of most test points. According to **Figure 13**, this point is located too close to the nearby cliff, with its three sides surrounded by hills. Thus, the approaching winds are obstructed and/or stagnant around these areas, degrading the local air ventilation.

4.2.18 The VR_w values at the corresponding points (O1-O5, O7, O9, O12, O13 and O16) within the southern assessment part range from **0.23 to**

0.30 for the annual wind and from **0.28 to 0.35** for the summer wind. The directional VRs at O1-O5, O7 and O9 also indicate that the wind from 45° – 90° direction will have lower values, suggesting that the wind is affected by the local terrain and buildings.

4.3 Performance at main roads

4.3.1 There are three main proposed roads: Road -1, Road -2 and Road -3 within the PDA. These three roads are shown in **Figure 13**.

4.3.2 The existing main roads/streets in the vicinity of the development include Ping Yee Road, Long Ping Road, Wang Lok Street, Fuk Hi Street, Fuk Hang Street, Fuk Wang Street and Fuk Yan Street.

4.3.3 Each of these roads corresponds to a certain amount of test points, and the test results at these points may reflect the air ventilation performance on the roads. **Tables 12** and **13** list the VR_w results for the main roads within the PDA and surrounding area, respectively.

4.3.4 The mean VR_w for the proposed roads with and without development scenario is summarized as follows:

Road ID	VR_w-without		VR_w-with	
	Annual	Summer	Annual	Summer
Road -1	0.27	0.25	0.29	0.29
Road -2	0.25	0.23	0.25	0.22
Road -3	0.28	0.31	0.23	0.25

4.3.5 For Road-1, the conditions around O57 and O59 for southwestern winds are influenced by the urban canyon effect. The proposed buildings would promote local air ventilation. For Road-2, the proposed buildings may result in an ignorable change in average performance of the local air ventilation. For Road-3, the proposed buildings may slightly degrade the local air ventilation.

4.3.6 The mean VR_w for the existing roads with and without development scenario is summarized as follows:

Road ID	VR_w-without		VR_w-with	
	Annual	Summer	Annual	Summer
Ping Yee Road	0.26	0.27	0.27	0.28
Wang Lok Street	0.28	0.29	0.27	0.30
Long Ping Road	0.26	0.24	0.29	0.25
Fuk Hi Street	0.25	0.26	0.24	0.24
Fuk Wang Street	0.26	0.32	0.26	0.29
Fuk Hang Street	0.29	0.29	0.26	0.25

4.3.7 According to Table 13, all of the V_w with and without development are similar, which reflects the very limited influence of potential buildings on the average performance of local air ventilation.

4.4 Critical areas

4.4.1 As discussed previously, there are some test positions where the VR_w values are relatively low, and where air ventilation may be influenced by potential building developments. The following table summarises the findings.

Critical Area	Location	Testing Point	Remark
Relatively small VRw values	Phase 1 (inside development)	O46	The smaller VRw values may not be attributed to the installation of potential buildings, as the corresponding VRw values without potential buildings are in a similar order.
	Phases 2 and 3 (outside development)	O38	
	YLIEE (inside development)	P16	
Vw with development > Vw without development by more than 25% (see **Tables 9-10** for details)	Phase 1 (inside development)	P2 (S), P8 (B), P43 (S), O58 (B)	Local wind speed may be increased due to the terrain effect.
	Phases 2 and 3 (inside development)	P9 (B), O32 (A), O39 (A)	
	YLIEE (inside development)	P19 (S)	
Vw with development < Vw without development by more than 25%	Phase 1 (inside development)	P1 (A), P6 (S), O52 (B)	Local wind speed may be decreased due to the building layout. Meanwhile, the VRw values at these points are each larger than 0.15. It is possible that the air ventilation performance may be influenced but not degraded too much by the potential building developments, based on the wind tunnel test results.
	Phases 2 and 3 (inside development)	P12 (B), P29 (S), P30 (S), O24 (S), O33 (S), O27 (S), O28 (S), O40 (A)	
	YLIEE (inside development)	P18 (B), P27 (S), O10 (B), O14 (A), O22 (B), O23 (B)	

Note: A: annual; S: summer; B: both annual and summer.

5 Conclusion

5.1.1 The wind tunnel test procedures and main results for the AVA study of the captioned project are presented in this report.

5.1.2 Wind characteristics at the considered site were estimated based on wind tunnel tests conducted on a 1:4,000-scale topographic model. Vertical profiles of the mean wind speeds, turbulence intensities and yaw angles are provided. Wind rose information for both the annual and summer winds at nine different height levels above the PDA is also presented.

5.1.3 Detailed AVA wind tunnel tests were carried out based on a 1:400 proximity model. Forty-three perimeter test points and seventy-one test points within the assessment area were tested. Scenarios both with and without developments were investigated. VR values were obtained and analysed to assess air ventilation performance within the assessment area. The effects of the local terrain features and building layouts on air ventilation performance are discussed, and detailed analyses of the performance on a small local scale are presented.

Southwestern part

5.1.4 The VR_w values at the testing points within the southwestern part were greater than 0.14. The minimum VR_w value of 0.14 was identified at one testing point in the PDA (O46). The relatively smaller VR_w value at this point may not be attributed to the proposed development but rather features of the nearby terrain. Three critical points (P1, P6 and O52) were identified. Nevertheless, air ventilation performance should not be degraded too much by the proposed developments at these critical points, as the VR_w values are acceptably large.

Middle part

5.1.5 The VR_w values at the testing points within the middle part were greater than 0.13. The minimum value (VR_w-with: 0.14; VR_w-without: 0.13) was identified at one testing point outside the PDA (O38). The relatively smaller VR_w value at this point may not be attributed to the proposed development but rather features of the nearby terrain. A number of critical points (P12, P29, P30, O24, O33, O27, O28 and O40) were identified. Nevertheless, air ventilation performance should not be degraded too much by the proposed developments at these critical points, as the VR_w values were acceptably large.

YLIEE part

5.1.6 The minimum value (VR_w-with: 0.10; VR_w-without: 0.11) was identified at one testing point inside the PDA (P16). The VR_w values at all of the other test points were greater than 0.15. The relatively smaller VR_w value at P16 may not be attributed to the proposed buildings but rather features of the nearby terrain. A number of critical points (P18, P27, O10, O14, O22 and O23) were identified. Nevertheless, air ventilation performance should not be degraded too much by potential building developments at these critical points, as the VR_w-with values were acceptably large.

Figures

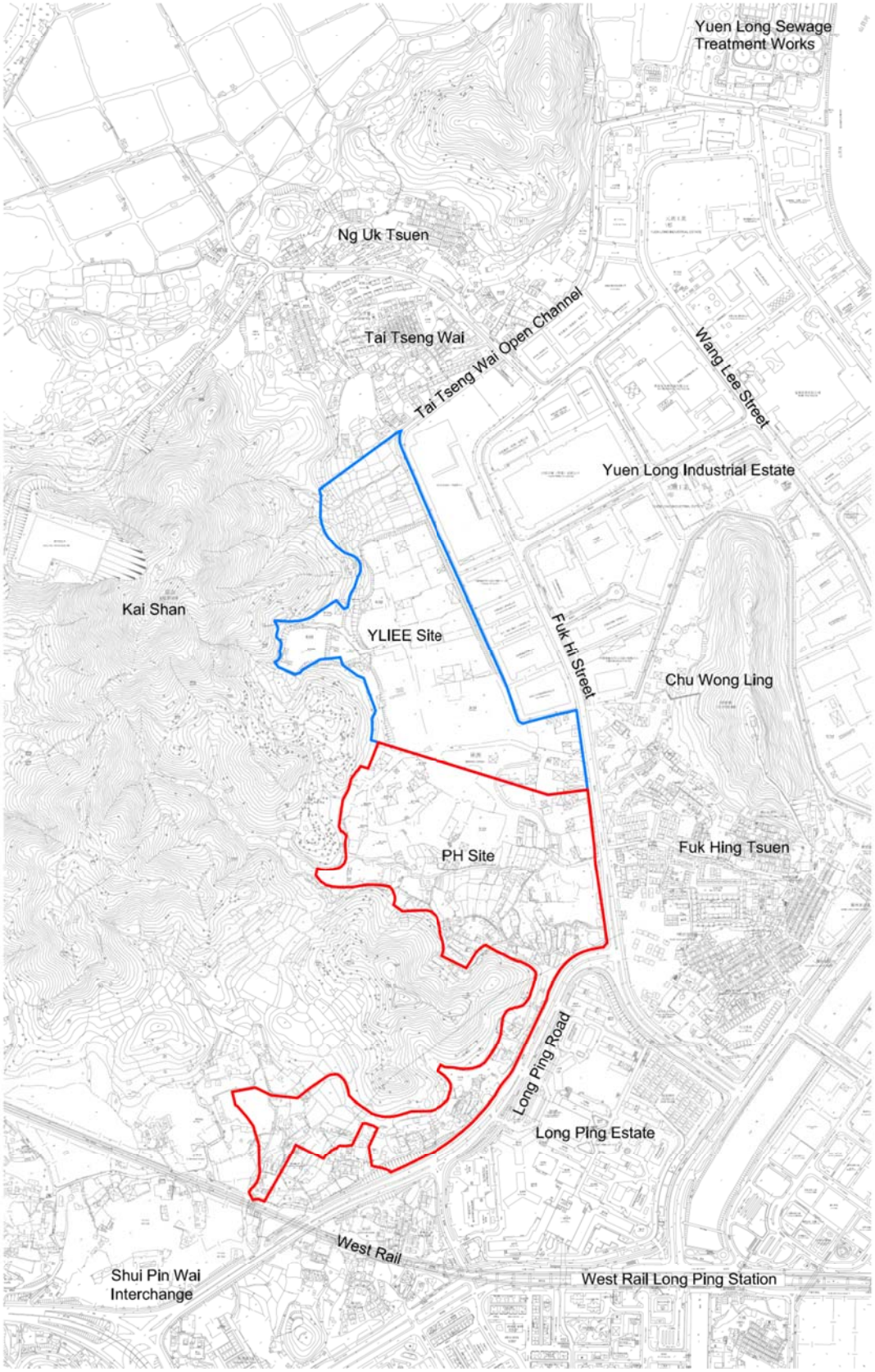
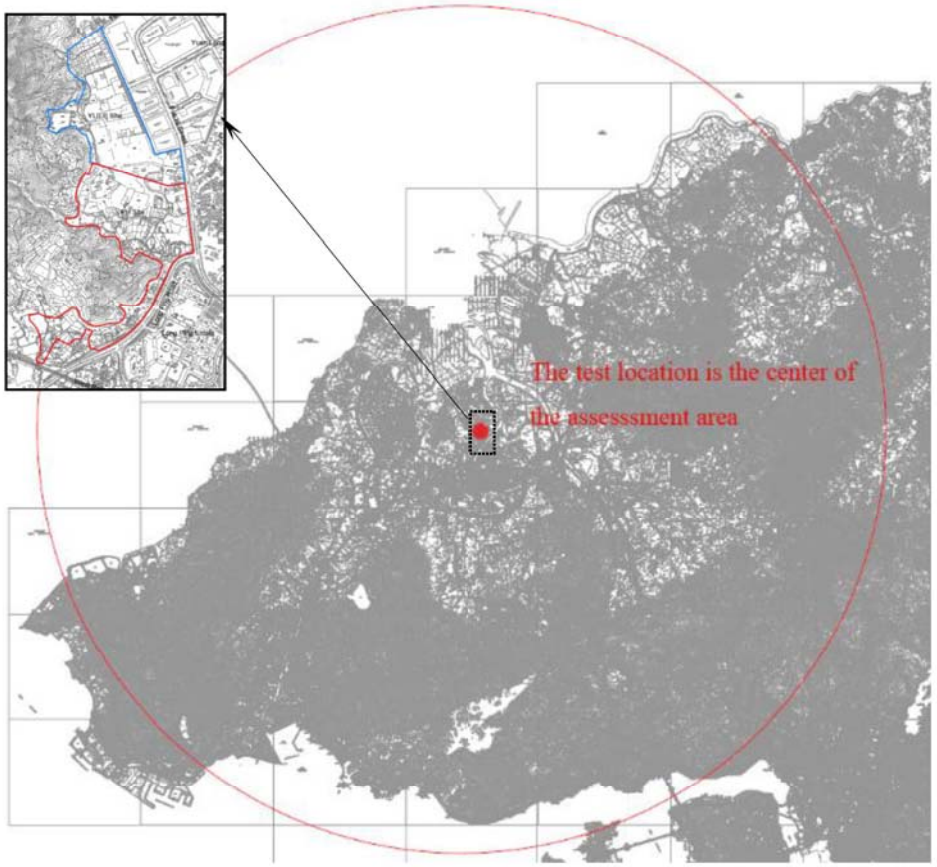
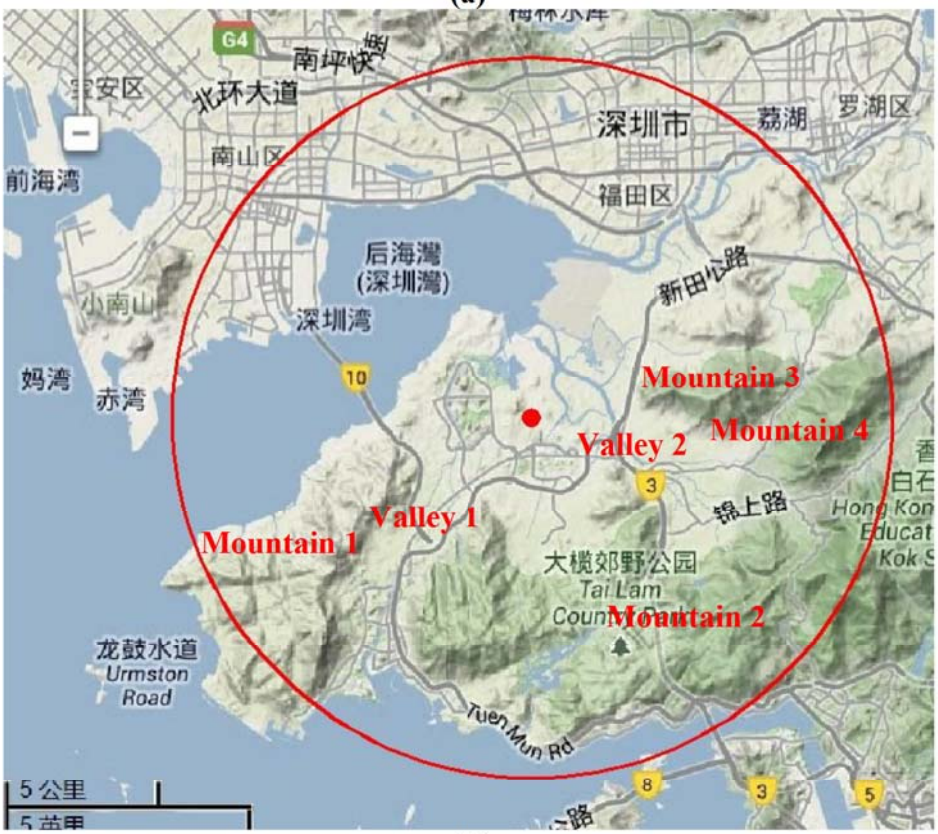


Figure 1. PDA (composed by the potential PRH Site and the Yuen Long Industrial Estate Extension) and study area of the captioned project.

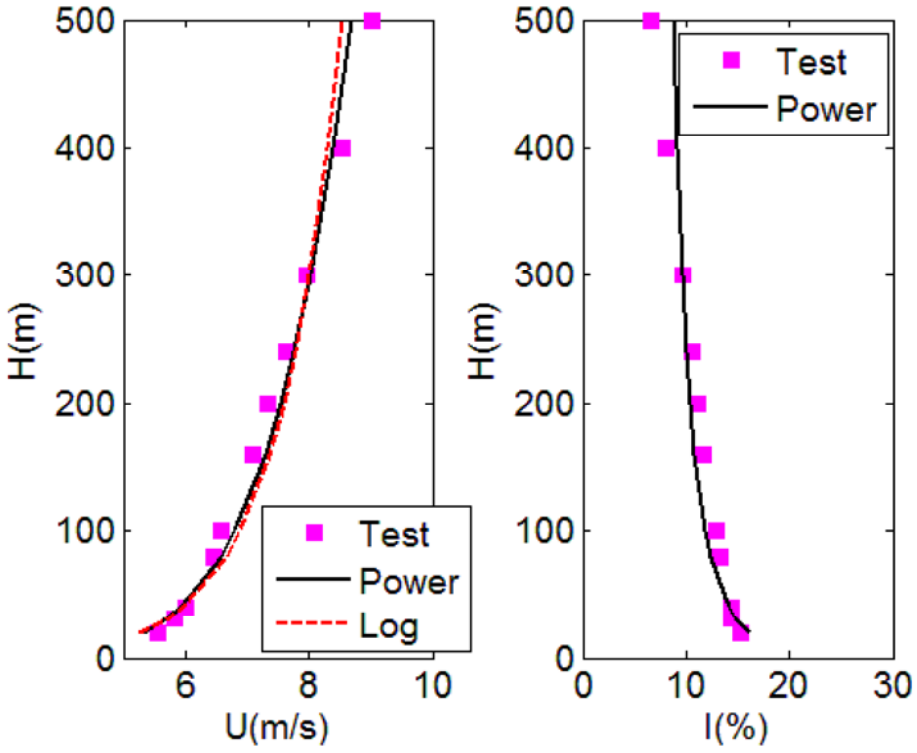


(a)

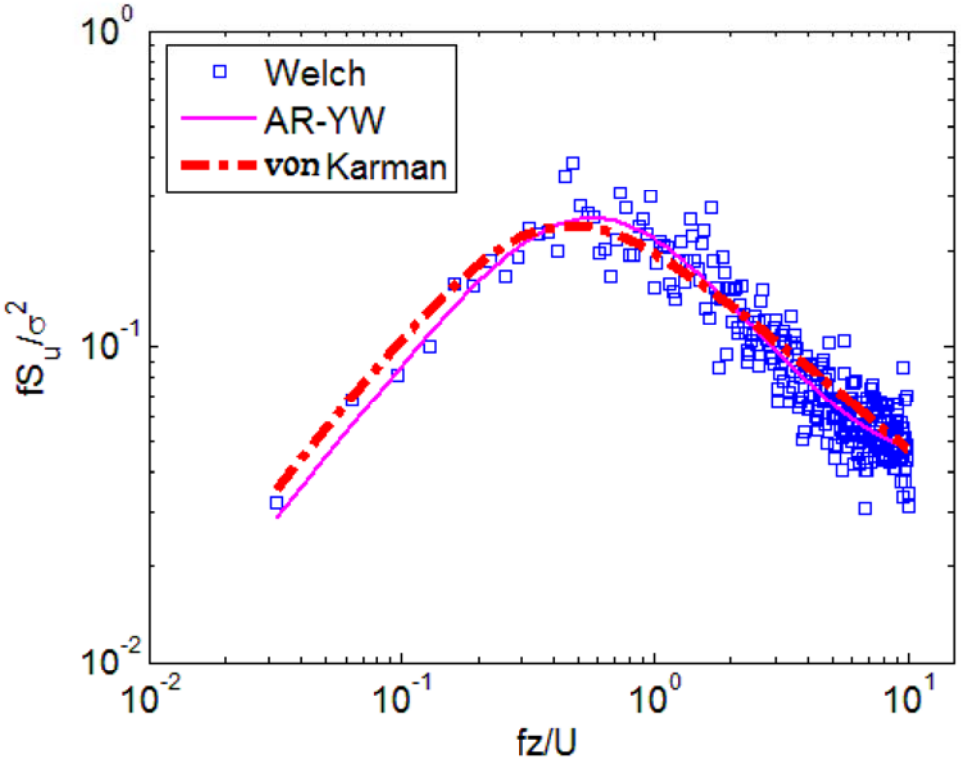


(b)

Figure 2. SWAS modelling area: (a) digital map; (b) topographic map.



(a)



(b)

Figure 3. Approach wind field for SWAS: (a) Profiles of mean wind speed and turbulence intensity; (b) Spectrum of turbulent component of longitudinal wind.

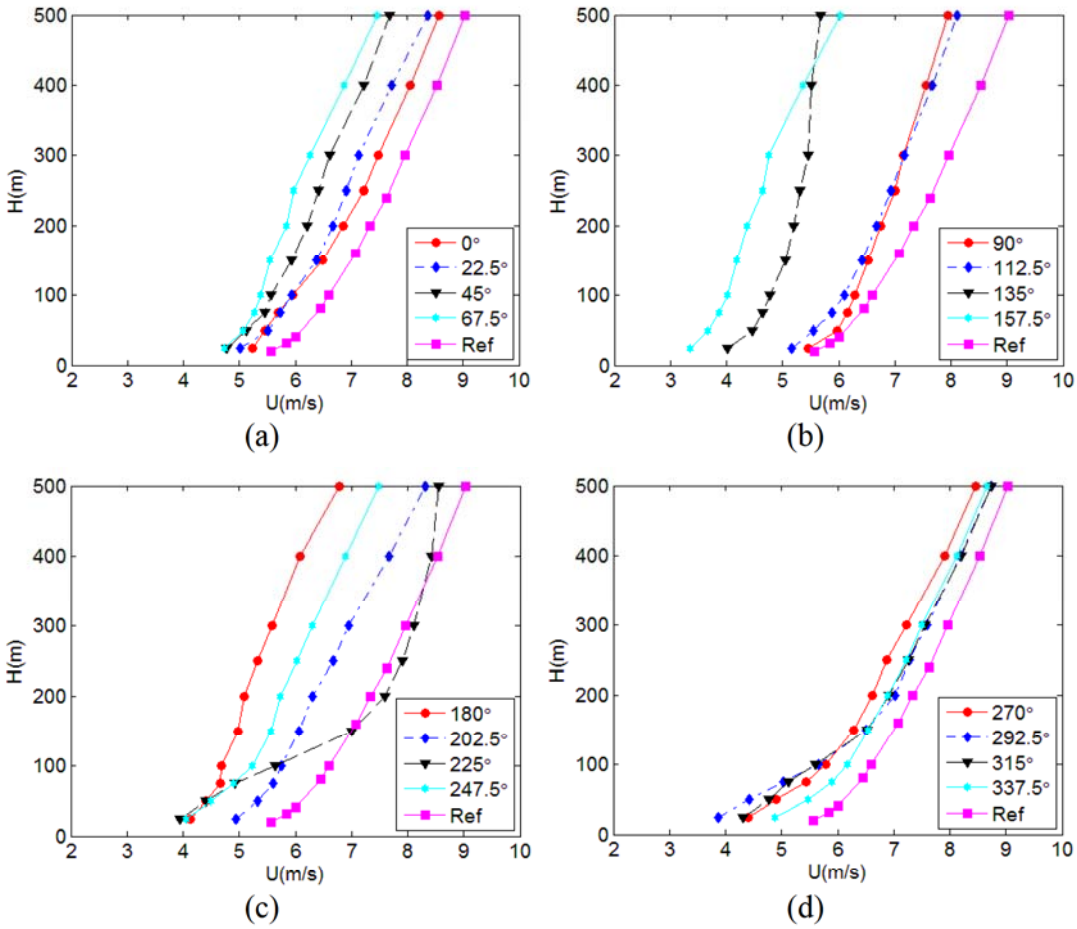


Figure 4. Directional vertical profiles of mean longitudinal wind speed for (a) 0°, 22.5°, 45°, 67.5°, (b) 90°, 112.5°, 135°, 157.5°, (c) 180°, 202.5°, 225°, 247.5° and (d) 270°, 292.5°, 315°, 337.5°.

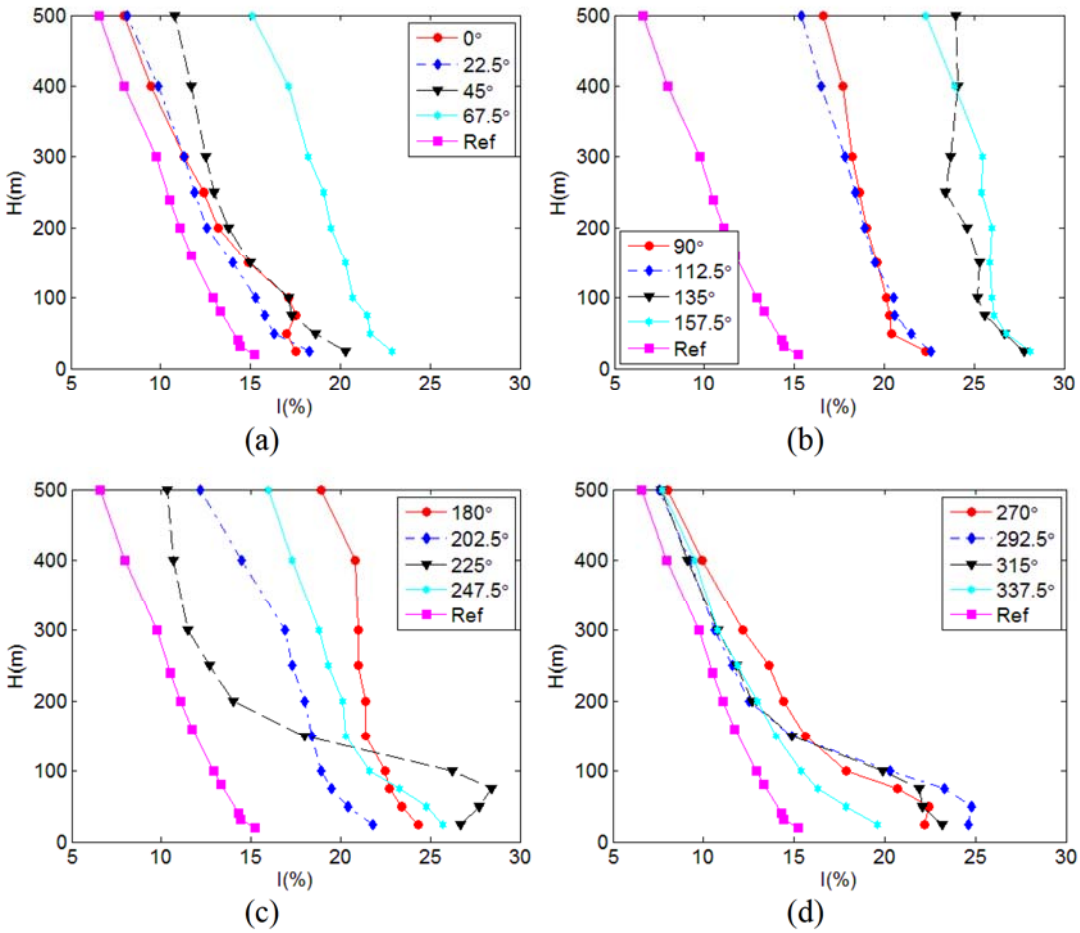


Figure 5. Directional vertical profiles of turbulence intensity for (a) 0°, 22.5°, 45°, 67.5°, (b) 90°, 112.5°, 135°, 157.5°, (c) 180°, 202.5°, 225°, 247.5° and (d) 270°, 292.5°, 315°, 337.5°.

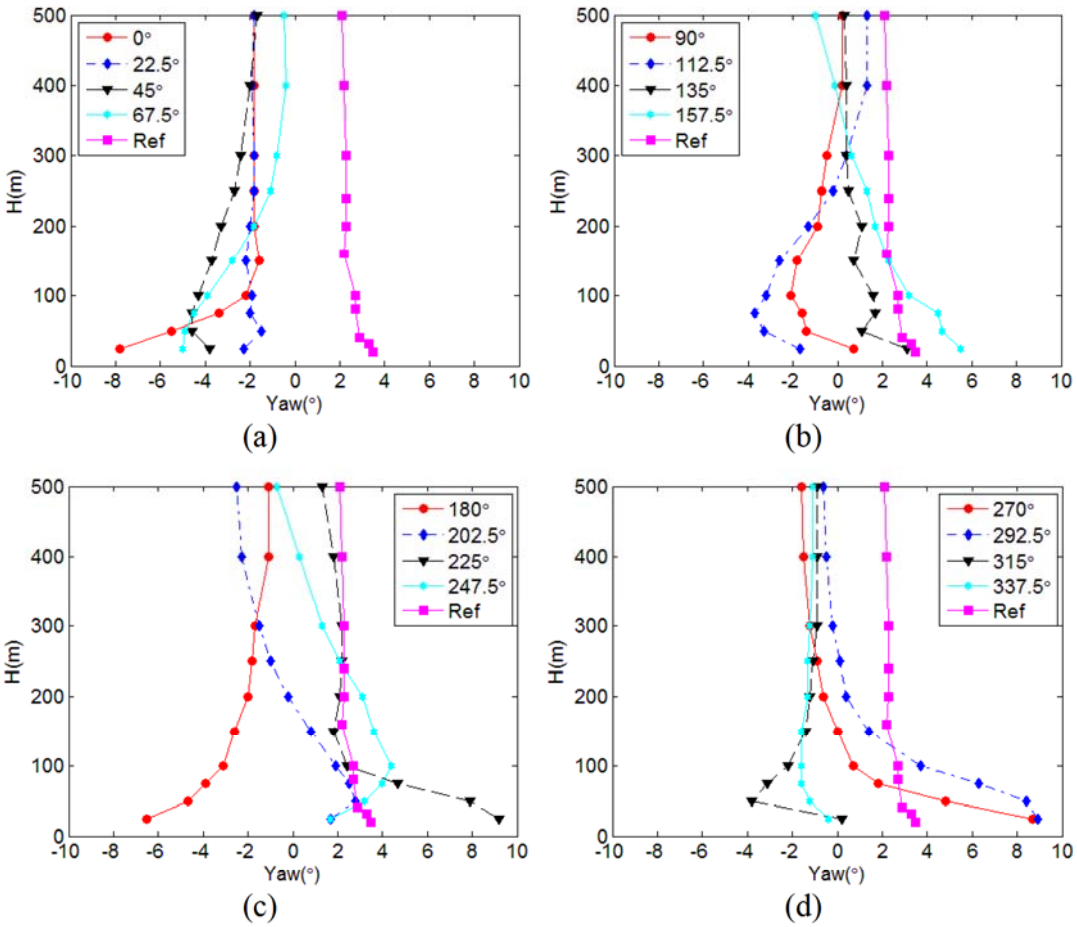


Figure 6. Directional vertical profiles of yaw angle for (a) 0°, 22.5°, 45°, 67.5°, (b) 90°, 112.5°, 135°, 157.5°, (c) 180°, 202.5°, 225°, 247.5° and (d) 270°, 292.5°, 315°, 337.5°.

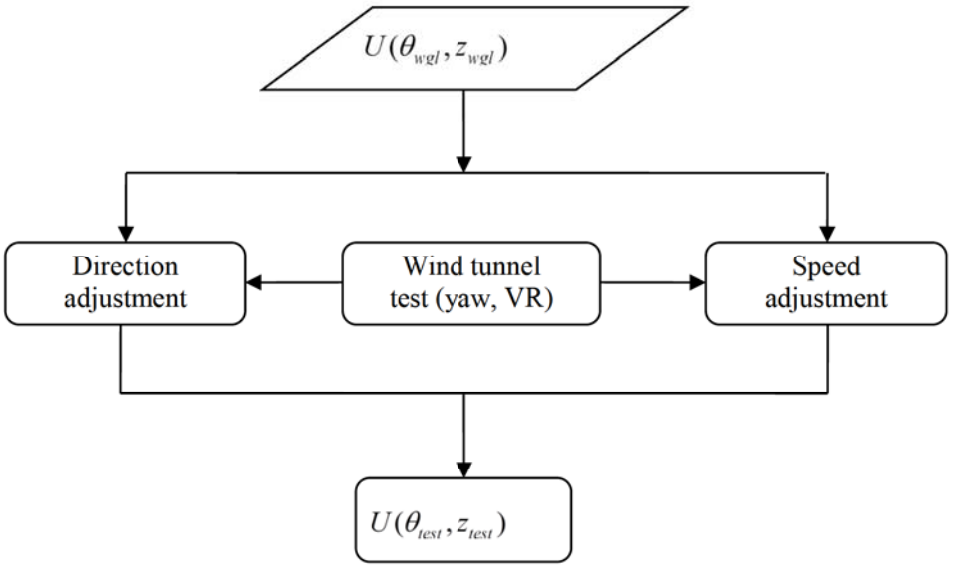


Figure 7. Flow chart for assessing wind rose at a test place based on WGL data

($\theta_{wgl}, \theta_{test}$ are the wind directions at the Waglan Island and the test point, z_{wgl}, z_{test} are the installation height of the anemometer at the Waglan Island and the height over the test position).

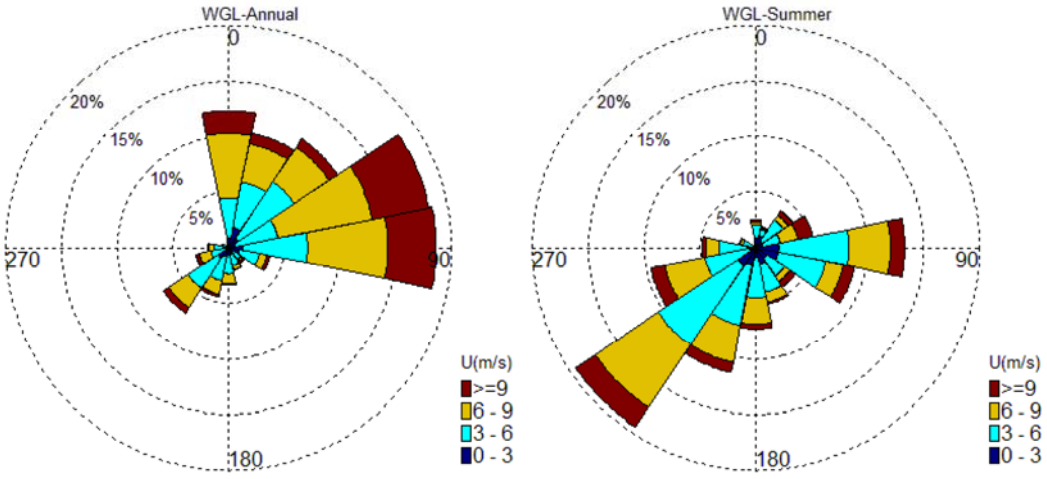


Figure 8. Wind roses of daily mean wind at the WGL station (13 years' data).

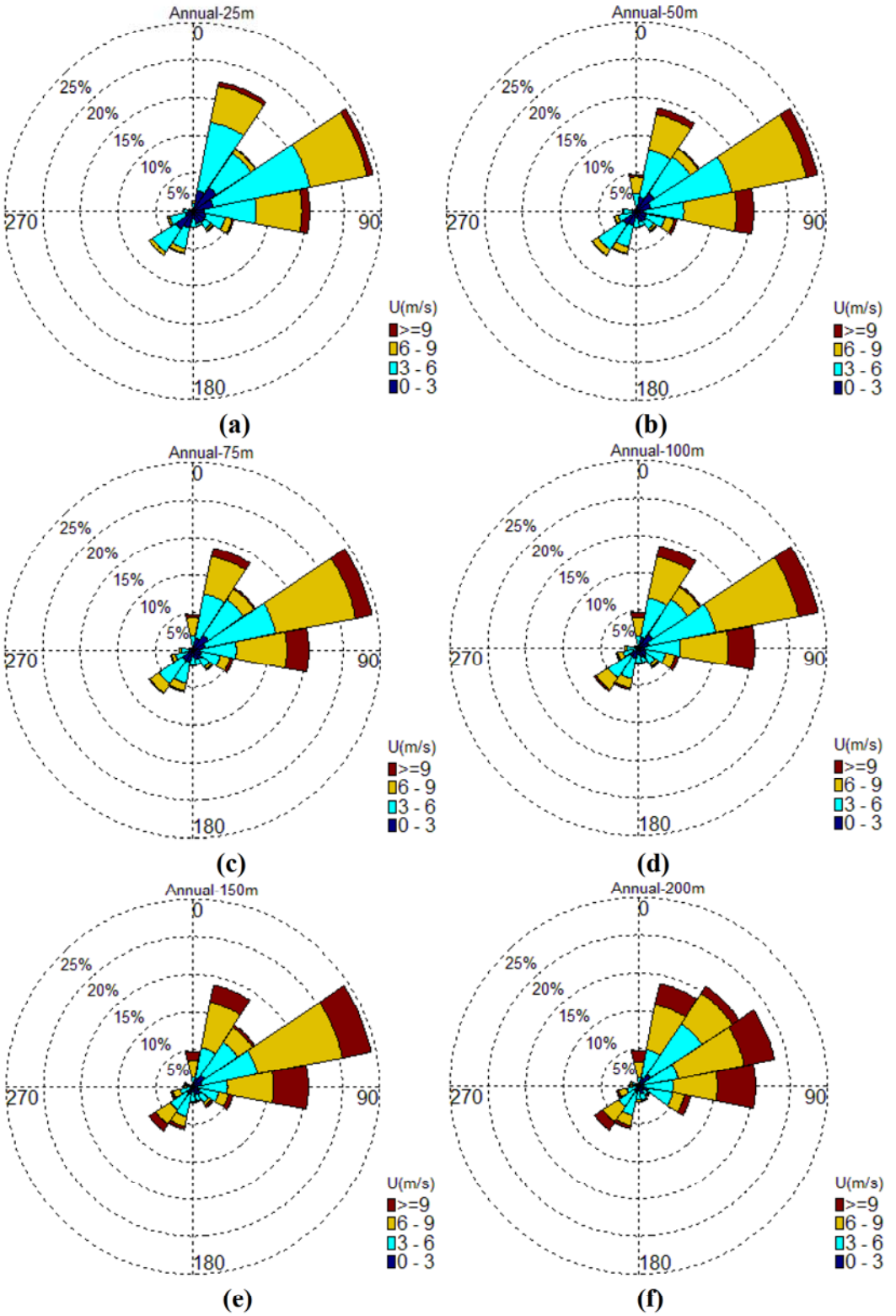


Figure 9. Wind roses at different height levels above the PDA under annual wind condition

(a) 25 m; (b) 50 m; (c) 75 m; (d) 100 m; (e) 150 m; (f) 200 m.

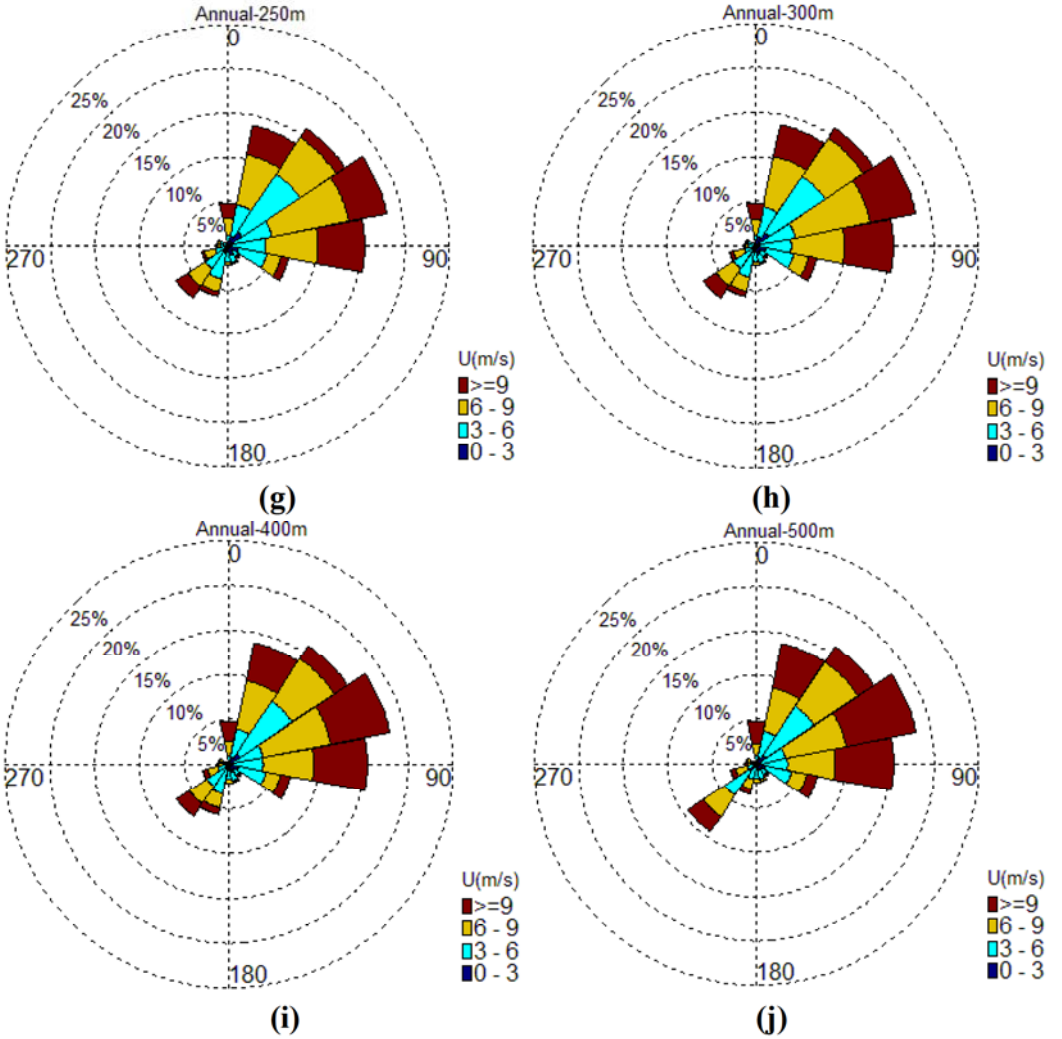


Figure 9. Wind roses at different height levels above the PDA under annual wind condition

(g) 250 m; (h) 300 m; (i) 400 m; (j) 500 m.

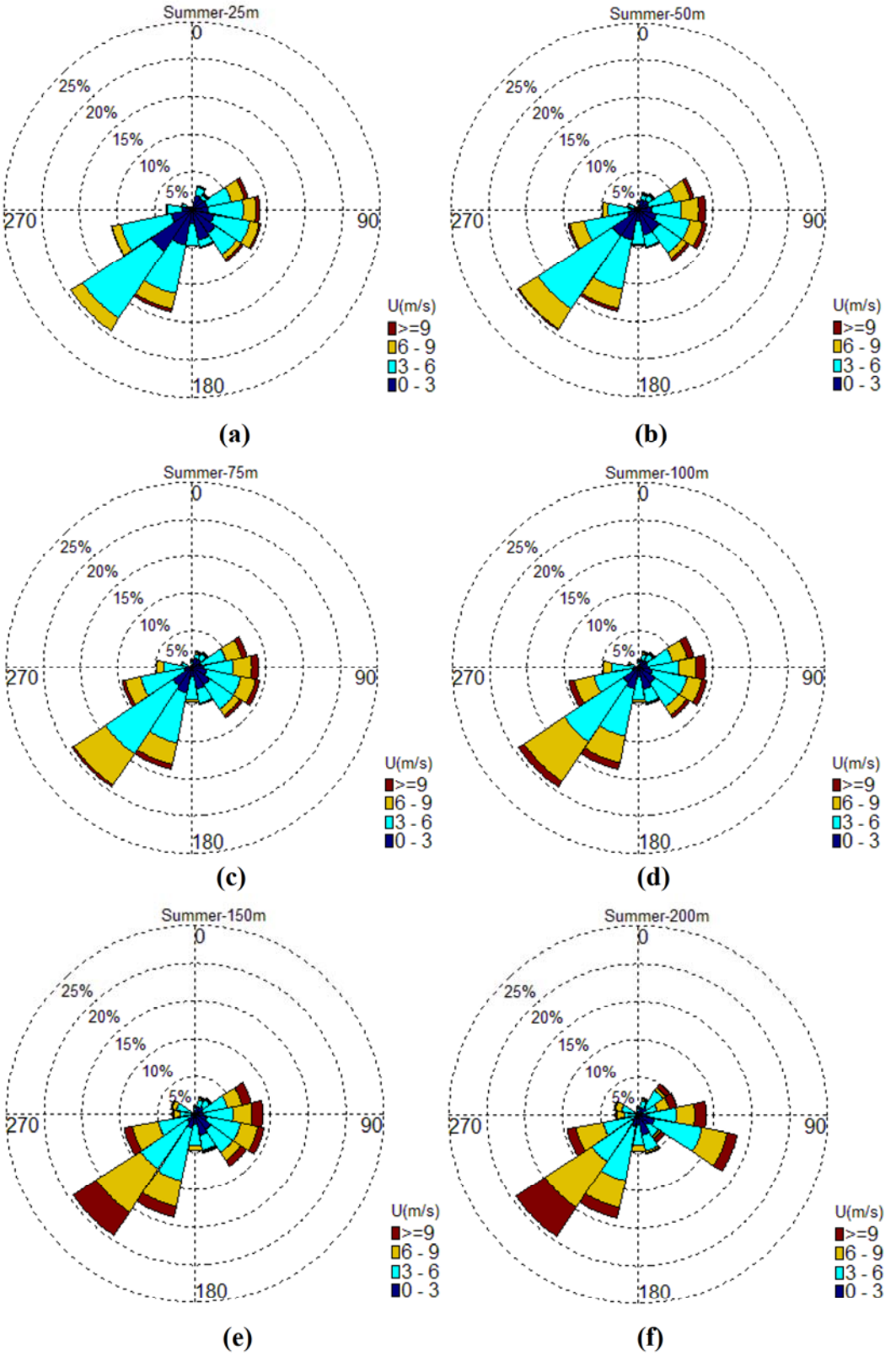


Figure 10. Wind roses at different height levels above the PDA under summer wind condition

(a) 25 m; (b) 50 m; (c) 75 m; (d) 100 m; (e) 150 m; (f) 200 m.

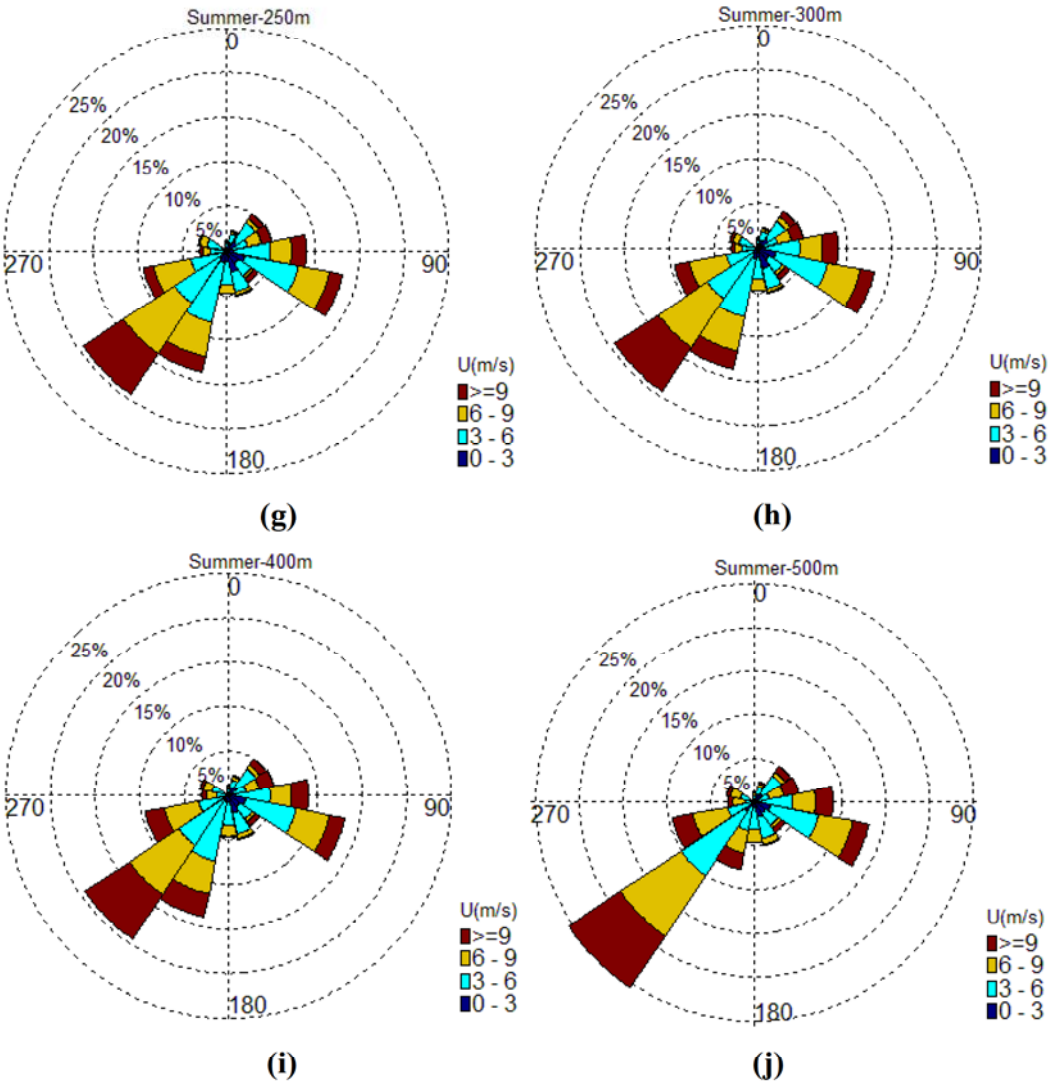


Figure 10. Wind roses at different height levels above the PDA under summer wind condition

(g) 250 m; (h) 300 m; (i) 400 m; (j) 500 m.

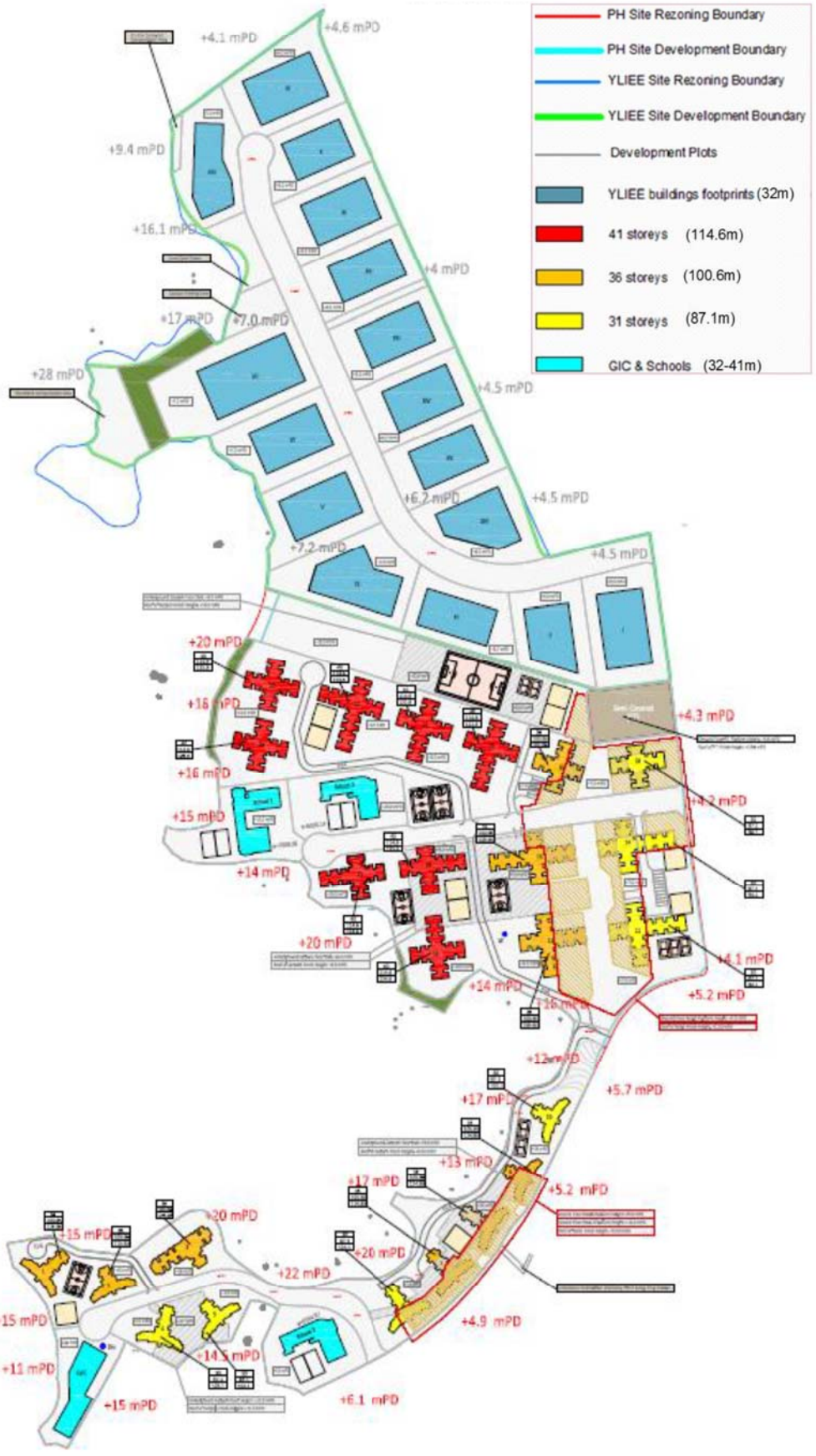
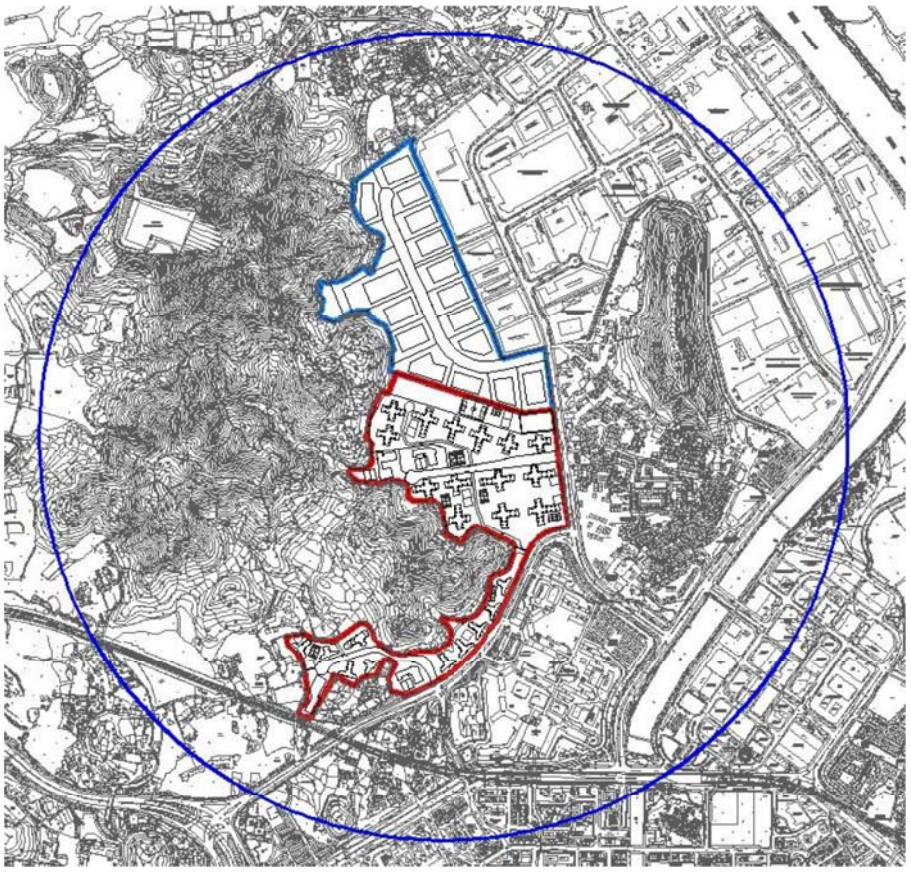


Figure 11. Layout of developments within PDA



(a)

(b)

Figure 12. 1:400 scale model for the AVA wind tunnel test

(a): modelling boundary (blue circle which is 1000m in radius); (b) overall view of the physical model.

(c)

Figure 12. 1:400 scale model for the AVA wind tunnel test.
(c) zoomed view of the potential buildings.

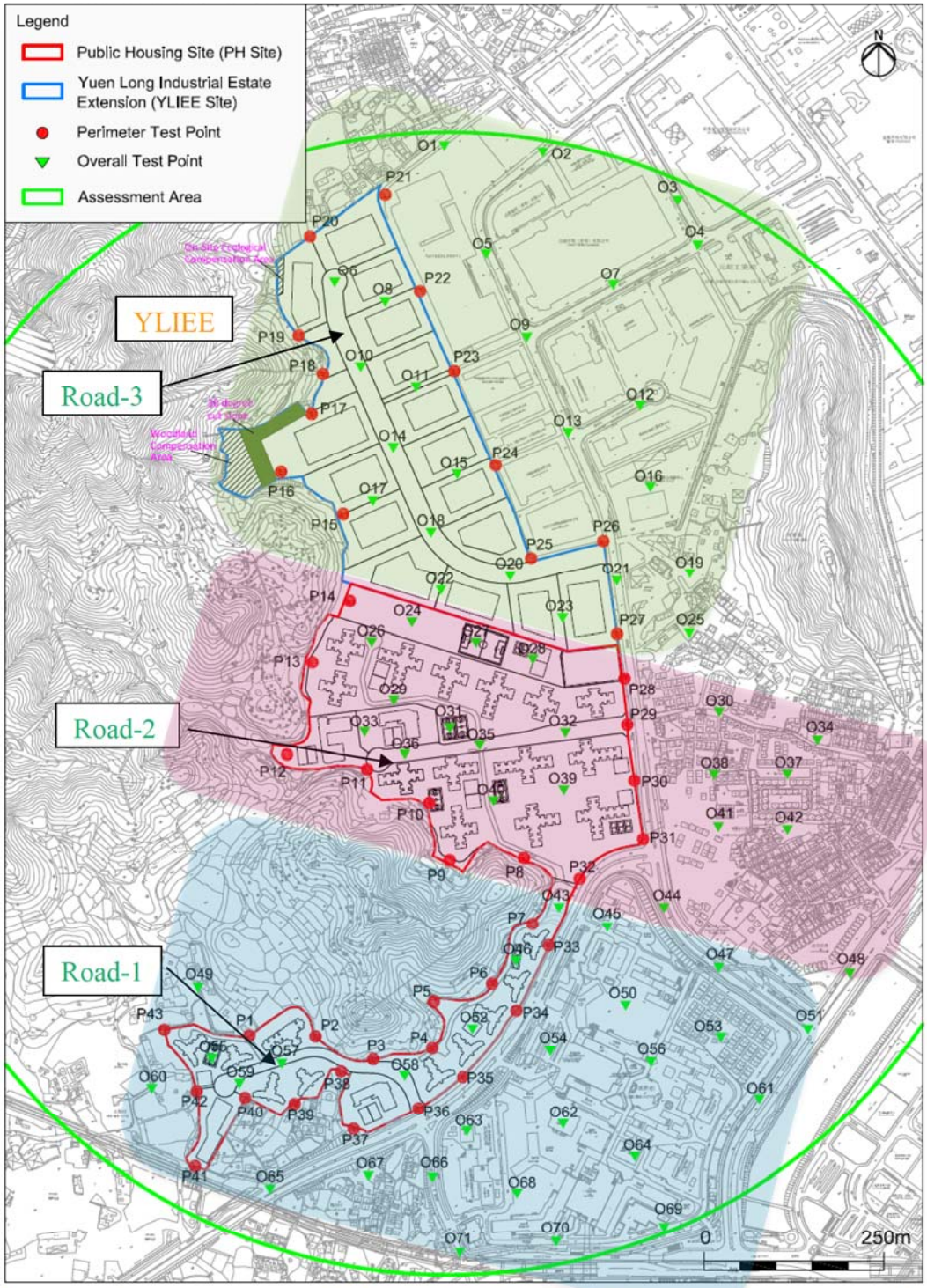


Figure 13. Location of AVA test points and assessment area (delineated by the green circle which is 850m in radius)

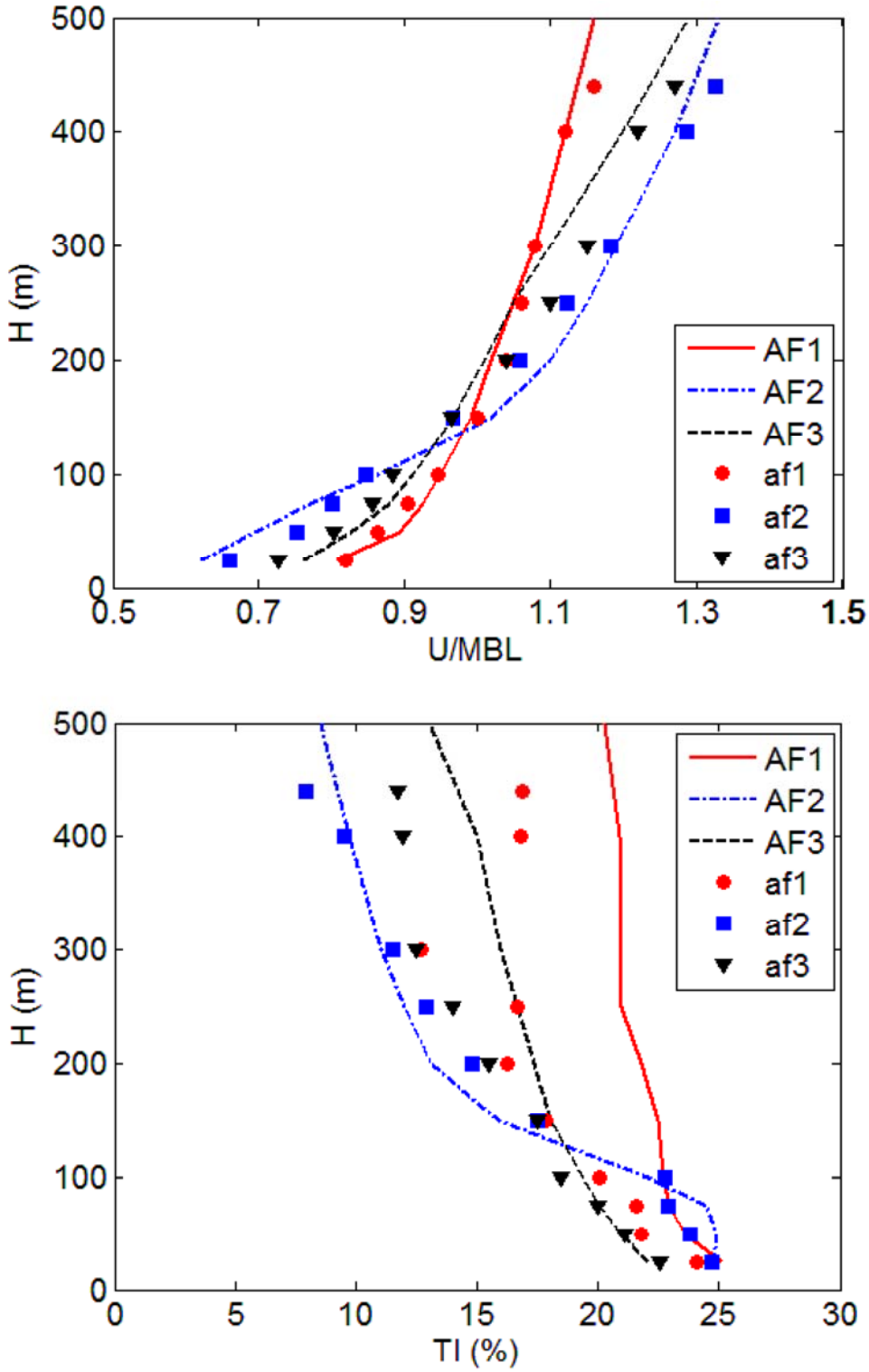


Figure 14. Profiles of normolized wind speed (U/MBL, MBL stands for the average speed of all the level speeds within the profile) and turbulence intentisy (TI) of the approach wind.

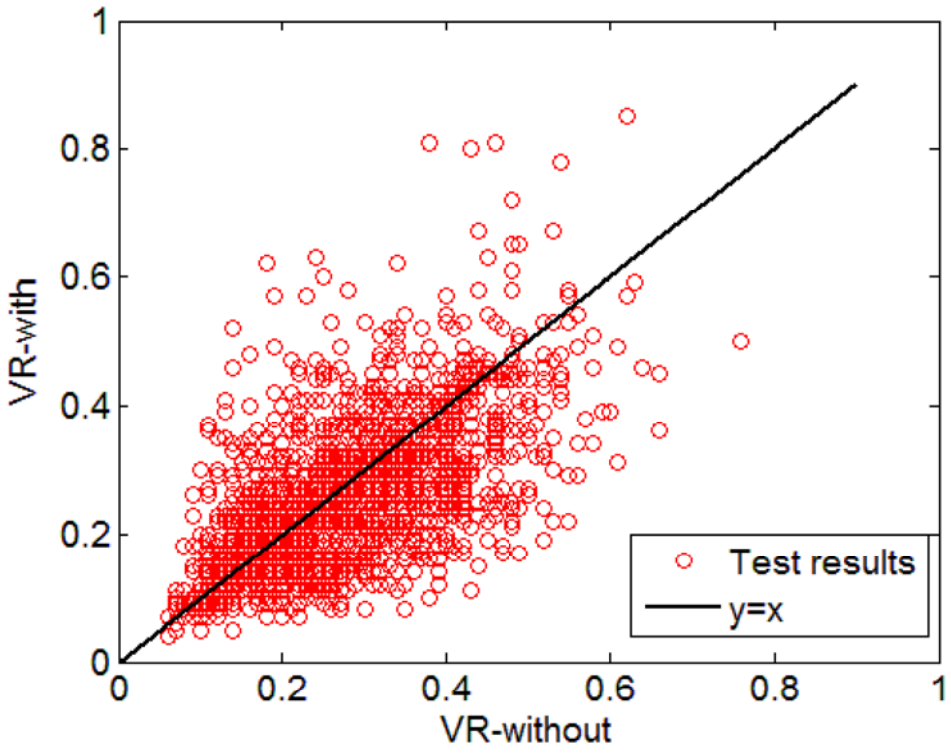


Figure 15. Comparison of directional VR values with and without installation of potential buildings within the PDA from the wind tunnel tests.

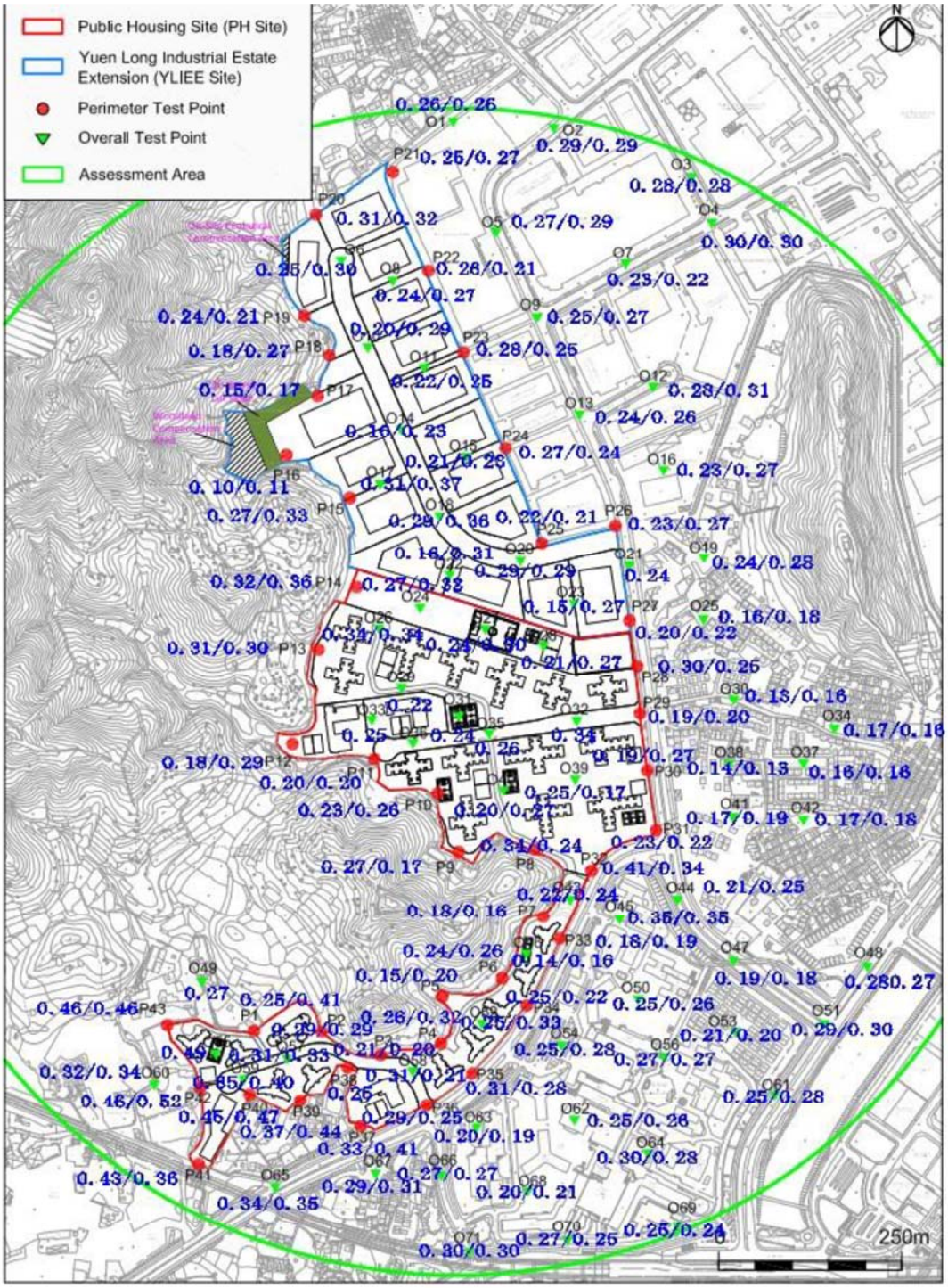


Figure 16. VR_w values with and without (VR_w-with/VR_w-without) installation of potential buildings within the PDA under annual wind condition at each test points.

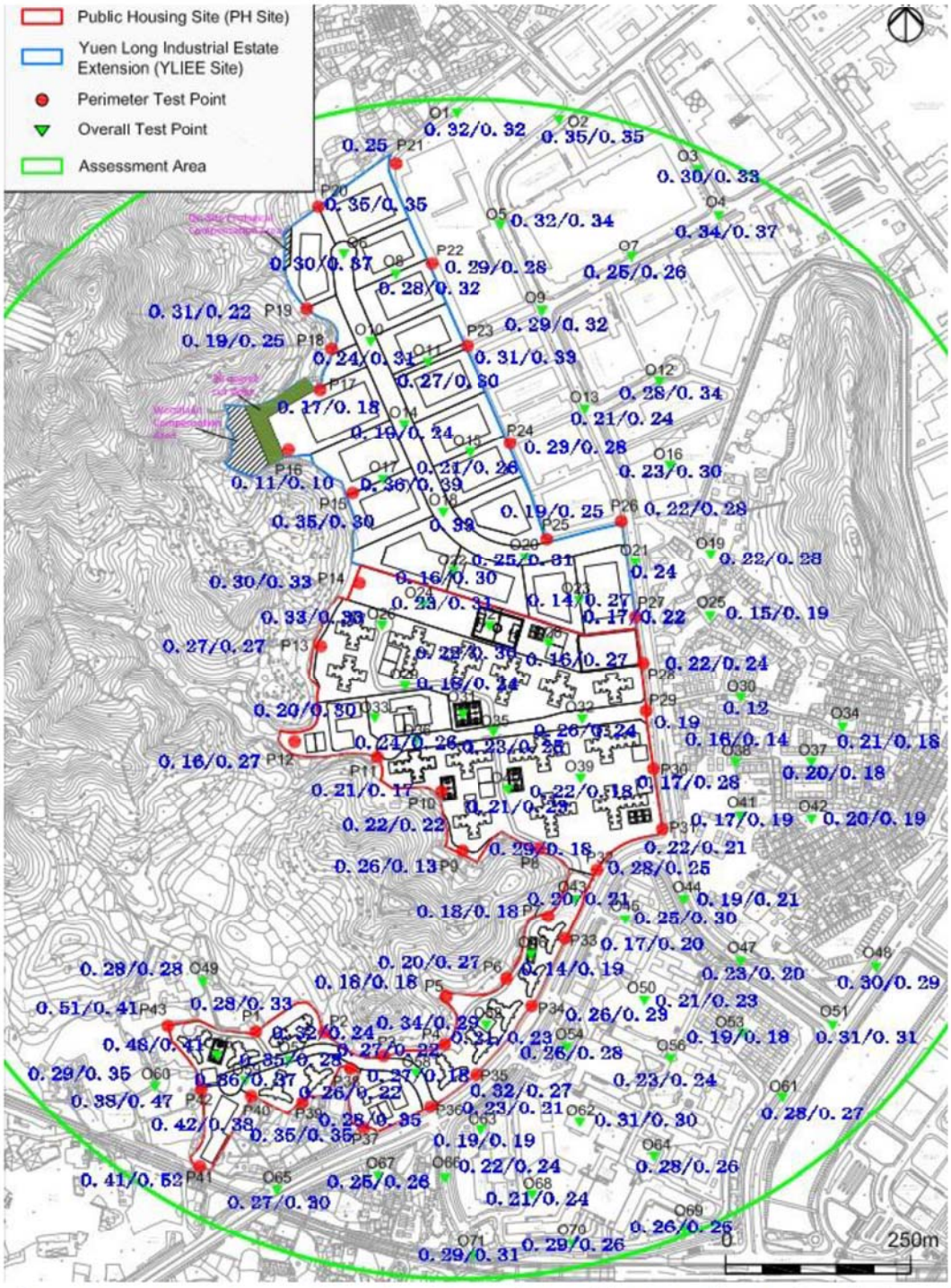


Figure 17. VR_w values with and without (VR_w-with/VR_w-without) installation of potential buildings within the PDA under summer wind condition at each test points.

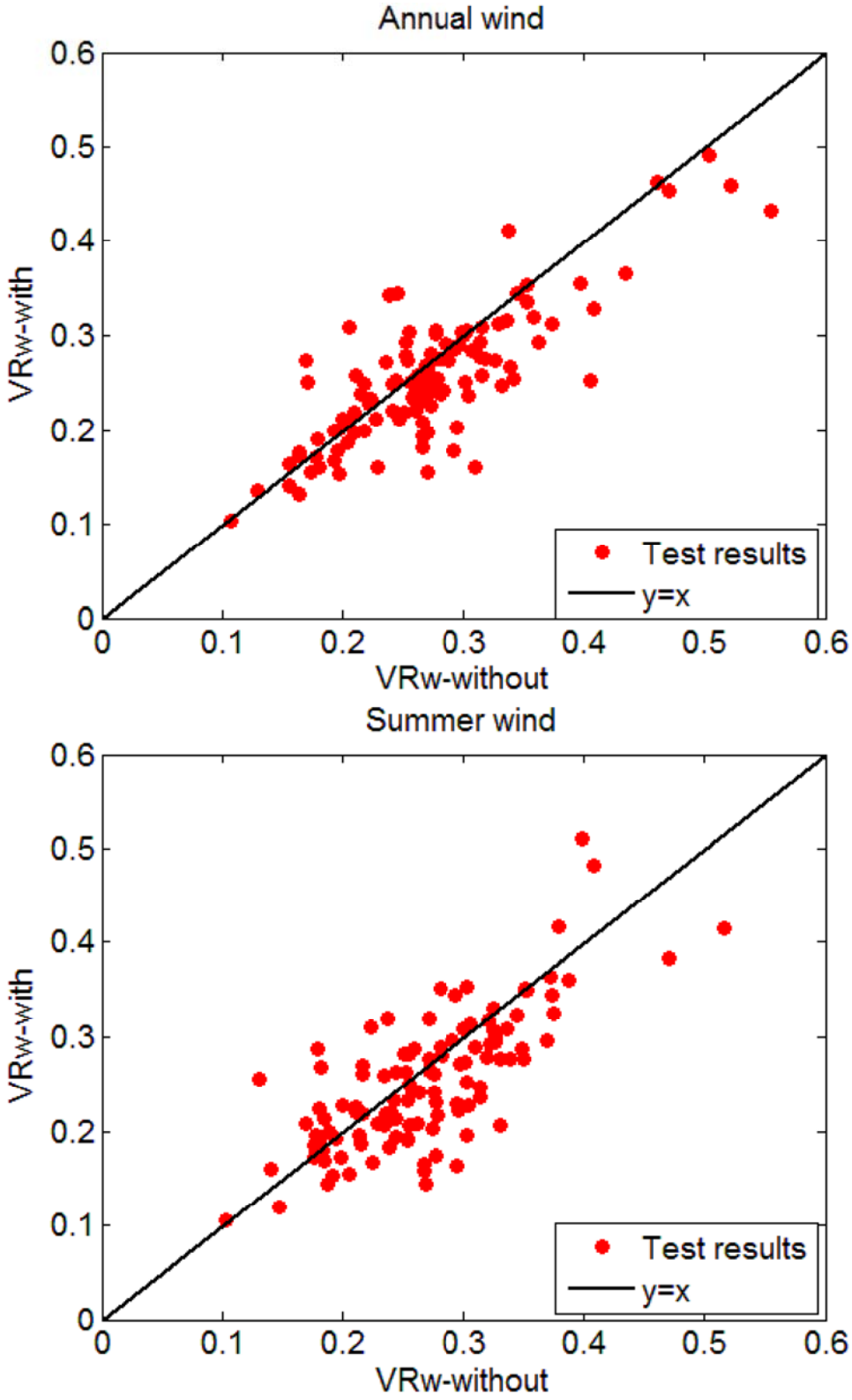


Figure 18. Comparison of VRw values with and without installation of potential buildings within the PDA from the wind tunnel tests.

Tables

Table 1. Directional occurrence frequency of annual wind (%)

Height	V-section	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
25m	0-1(m/s)	0	0	0.04	0.02	0	0.09	0	0.19	0.04	0.04	0.13	0	0.02	0.06	0.02	0.02
	1-2(m/s)	0.04	1.1	1.29	0.62	0.39	0.52	0.99	0.77	0.45	0.69	1.08	0.37	0.26	0.17	0.06	0.09
	2-3(m/s)	0.15	1.59	2.37	2.02	0.99	1.12	0.77	0.69	0.49	1.55	1.66	0.67	0.34	0.19	0.04	0.09
	3-4(m/s)	0.09	2.41	2.62	3.27	1.81	1.2	0.65	0.22	0.71	1.27	1.66	1.03	0.47	0.11	0.02	0.02
	4-5(m/s)	0.17	3.29	1.74	4.58	2.39	0.75	0.3	0.15	0.32	0.93	1.33	0.73	0.11	0.06	0	0.04
	5-6(m/s)	0.52	3.57	1.14	5.27	2.75	0.62	0.13	0	0.09	0.58	0.67	0.41	0.06	0	0	0.02
	6-8(m/s)	0.26	4.13	0.6	6.69	4.88	0.77	0.26	0.04	0	0.56	0.47	0.28	0.04	0.02	0	0
	8-11(m/s)	0.06	1.1	0.11	1.57	2.09	0.28	0.09	0	0	0.15	0.04	0.06	0	0	0.02	0.04
	11-14(m/s)	0	0.13	0.02	0.22	0.13	0.04	0.04	0	0	0.02	0	0	0	0	0	0
	>14(m/s)	0.02	0.02	0	0.02	0.02	0.04	0.02	0	0	0	0	0	0	0	0	0
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
50m	0-1(m/s)	0	0	0	0.02	0	0.06	0	0.06	0.04	0.04	0.06	0	0	0.04	0.02	0
	1-2(m/s)	0.15	0.73	0.77	0.47	0.24	0.37	0.56	0.69	0.39	0.49	0.77	0.19	0.22	0.13	0	0.09
	2-3(m/s)	0.28	1.12	2.04	1.42	0.73	0.93	0.95	0.65	0.43	1.31	1.18	0.41	0.28	0.17	0.11	0.02
	3-4(m/s)	0.43	1.66	2.24	2.6	1.18	1.08	0.6	0.37	0.69	1.16	1.74	0.62	0.67	0.15	0	0.11
	4-5(m/s)	0.62	1.98	2.19	3.66	1.94	1.01	0.43	0.17	0.32	0.97	1.31	0.82	0.3	0.09	0	0.02
	5-6(m/s)	0.77	2.71	1.29	4.65	2.17	0.41	0.24	0.09	0.19	0.82	1.01	0.41	0.17	0.02	0	0.06
	6-8(m/s)	1.81	3.87	1.2	8	4.63	1.08	0.26	0.02	0.04	0.73	0.82	0.43	0.19	0.02	0	0
	8-11(m/s)	0.65	1.53	0.15	3.08	3.98	0.41	0.13	0.02	0	0.22	0.13	0.11	0.02	0	0.02	0.02
	11-14(m/s)	0.06	0.22	0.02	0.3	0.52	0.06	0.06	0	0	0.04	0	0.02	0	0	0	0.02
	>14(m/s)	0.02	0.04	0.02	0.09	0.06	0.04	0.02	0	0	0	0	0	0	0	0	0
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
75m	0-1(m/s)	0	0	0	0.02	0	0.06	0	0.02	0.02	0.04	0.04	0	0	0.04	0.02	0
	1-2(m/s)	0.15	0.6	0.6	0.34	0.22	0.3	0.52	0.71	0.39	0.39	0.56	0.15	0.13	0.09	0	0.09
	2-3(m/s)	0.22	1.1	1.83	1.27	0.71	0.75	0.86	0.54	0.39	1.23	1.01	0.37	0.32	0.13	0.11	0.02
	3-4(m/s)	0.41	1.55	2.15	2.41	1.01	1.25	0.67	0.41	0.54	1.08	1.48	0.52	0.32	0.17	0	0.09

Height	V-section	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
75m	4-5(m/s)	0.49	1.72	2.11	3.08	1.83	0.86	0.41	0.19	0.39	1.01	1.38	0.77	0.58	0.09	0.02	0.02
	5-6(m/s)	0.67	2.62	1.4	4.17	2.02	0.47	0.26	0.15	0.3	0.82	0.99	0.56	0.19	0.09	0	0.04
	6-8(m/s)	1.89	4.11	1.48	8.43	4.54	1.05	0.22	0	0.09	0.9	1.31	0.41	0.22	0.02	0	0.02
	8-11(m/s)	0.82	1.85	0.3	4	4.35	0.52	0.22	0.04	0	0.28	0.26	0.19	0.09	0	0.02	0.02
	11-14(m/s)	0.11	0.26	0.04	0.37	0.71	0.11	0.06	0	0	0.04	0	0.04	0	0	0	0.02
	>14(m/s)	0.04	0.04	0.02	0.19	0.06	0.06	0.04	0	0	0	0	0	0	0	0	0
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
100m	0-1(m/s)	0	0	0	0.02	0	0.04	0	0	0.02	0.02	0	0	0	0	0.02	0
	1-2(m/s)	0.13	0.54	0.54	0.3	0.19	0.28	0.45	0.71	0.37	0.39	0.39	0.13	0.11	0.13	0	0.09
	2-3(m/s)	0.22	0.97	1.66	1.14	0.62	0.69	0.82	0.54	0.37	1.03	0.99	0.24	0.28	0.11	0.11	0.02
	3-4(m/s)	0.32	1.33	2.15	2.13	0.95	1.18	0.62	0.41	0.52	1.1	1.1	0.45	0.28	0.17	0	0.09
	4-5(m/s)	0.47	1.74	2.02	2.86	1.7	0.8	0.52	0.22	0.43	1.05	1.38	0.6	0.62	0.11	0.02	0.02
	5-6(m/s)	0.56	2.17	1.4	4.02	2.07	0.67	0.22	0.13	0.32	0.67	1.03	0.69	0.17	0.02	0	0.04
	6-8(m/s)	1.76	4.63	1.72	8.35	4.52	1.03	0.26	0.02	0.09	1.1	1.42	0.6	0.28	0.06	0	0.02
	8-11(m/s)	1.12	2.07	0.34	4.78	4.52	0.52	0.24	0.04	0	0.34	0.67	0.24	0.11	0.02	0	0.02
	11-14(m/s)	0.15	0.37	0.09	0.49	0.77	0.15	0.09	0	0	0.09	0.06	0.04	0	0	0.02	0.02
	>14(m/s)	0.06	0.04	0.02	0.19	0.11	0.09	0.04	0	0	0	0	0.02	0	0	0	0
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
150m	0-1(m/s)	0	0	0	0	0	0.04	0	0	0	0.02	0	0	0	0	0	0
	1-2(m/s)	0.11	0.3	0.43	0.26	0.13	0.24	0.34	0.54	0.28	0.24	0.19	0.06	0.02	0.15	0.02	0.09
	2-3(m/s)	0.15	0.93	1.4	0.93	0.54	0.62	0.82	0.58	0.41	0.8	0.65	0.24	0.09	0.22	0.04	0.02
	3-4(m/s)	0.24	1.08	1.61	1.83	0.84	0.82	0.54	0.54	0.32	1.16	0.71	0.32	0.15	0.17	0.06	0.06
	4-5(m/s)	0.43	1.51	2.04	2.5	1.4	1.08	0.58	0.15	0.65	0.97	1.05	0.52	0.34	0.24	0	0.02
	5-6(m/s)	0.43	1.61	1.74	3.29	1.72	0.71	0.24	0.15	0.26	0.86	1.08	0.6	0.3	0.22	0.02	0.02
	6-8(m/s)	1.42	4.41	1.89	8.48	4.45	0.93	0.32	0.06	0.19	1.05	1.61	0.75	0.22	0.13	0	0.06
	8-11(m/s)	1.72	3.25	0.69	6.05	4.84	0.75	0.26	0.04	0	0.56	1.48	0.41	0.13	0.09	0	0
	11-14(m/s)	0.22	0.6	0.11	0.73	1.38	0.17	0.09	0	0	0.11	0.22	0.09	0.02	0	0.02	0.02

Height	V-section	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
150m	>14(m/s)	0.09	0.17	0.02	0.24	0.15	0.09	0.06	0	0	0.02	0.04	0.02	0	0	0	0.02
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
200m	0-1(m/s)	0	0	0	0	0	0.04	0	0	0	0.02	0	0	0	0	0	0
	1-2(m/s)	0.06	0.24	0.43	0.17	0.13	0.3	0.22	0.52	0.28	0.24	0.17	0.06	0.02	0.13	0.02	0.09
	2-3(m/s)	0.17	0.9	1.51	0.47	0.47	0.93	0.49	0.56	0.39	0.71	0.47	0.24	0.09	0.17	0.02	0.02
	3-4(m/s)	0.26	1.01	2.35	1.08	0.9	1.18	0.26	0.54	0.34	1.18	0.75	0.28	0.15	0.17	0.09	0.02
	4-5(m/s)	0.34	1.38	2.84	1.31	1.12	1.2	0.28	0.19	0.62	0.86	0.82	0.47	0.24	0.24	0	0.06
	5-6(m/s)	0.37	1.46	2.93	2.24	1.87	0.9	0.15	0.11	0.24	0.97	1.03	0.6	0.34	0.22	0.02	0.02
	6-8(m/s)	1.23	4.15	3.94	5.96	4.02	1.08	0.11	0.11	0.24	1.01	1.81	0.8	0.28	0.19	0	0.06
	8-11(m/s)	1.94	3.64	1.7	5.94	5.12	1.03	0.11	0.04	0	0.67	1.48	0.45	0.13	0.09	0	0
	11-14(m/s)	0.28	0.84	0.15	0.88	1.64	0.17	0.06	0	0	0.11	0.43	0.06	0.02	0	0.02	0.02
	>14(m/s)	0.15	0.24	0.09	0.26	0.17	0.13	0.04	0	0	0.02	0.06	0.04	0	0	0	0.02
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
250m	0-1(m/s)	0	0	0	0	0	0.04	0	0	0	0.02	0	0	0	0	0	0
	1-2(m/s)	0.02	0.22	0.39	0.17	0.09	0.28	0.17	0.47	0.22	0.15	0.13	0.06	0.02	0.11	0.02	0.09
	2-3(m/s)	0.19	0.84	1.46	0.47	0.43	0.86	0.52	0.52	0.43	0.62	0.47	0.22	0.09	0.17	0	0.02
	3-4(m/s)	0.22	0.88	2.11	1.05	0.86	1.2	0.26	0.52	0.28	1.16	0.75	0.28	0.15	0.19	0.11	0
	4-5(m/s)	0.32	1.33	2.9	1.23	1.12	1.14	0.26	0.24	0.67	0.88	0.73	0.41	0.17	0.22	0	0.09
	5-6(m/s)	0.39	1.44	2.9	2.13	1.72	0.93	0.19	0.13	0.26	0.93	1.03	0.49	0.41	0.24	0.02	0.02
	6-8(m/s)	1.14	3.94	4	5.9	4	1.1	0.11	0.15	0.24	1.12	1.81	0.95	0.26	0.17	0	0.06
	8-11(m/s)	1.91	3.96	1.85	6.09	5.27	1.03	0.11	0.04	0.02	0.65	1.51	0.47	0.15	0.11	0	0
	11-14(m/s)	0.45	0.95	0.22	1.01	1.74	0.26	0.06	0	0	0.22	0.52	0.09	0.02	0	0.02	0.02
	>14(m/s)	0.15	0.3	0.09	0.26	0.22	0.13	0.04	0	0	0.04	0.09	0.04	0	0	0	0.02
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
300m	0-1(m/s)	0	0	0	0	0	0.02	0	0	0	0.02	0	0	0	0	0	0
	1-2(m/s)	0.02	0.22	0.37	0.13	0.09	0.24	0.15	0.47	0.19	0.15	0.13	0.02	0.02	0.11	0.02	0.09
	2-3(m/s)	0.17	0.77	1.38	0.45	0.39	0.86	0.47	0.49	0.41	0.58	0.45	0.26	0.09	0.13	0	0.02

Height	V-section	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
300m	3-4(m/s)	0.19	0.86	2.02	0.99	0.8	1.12	0.3	0.47	0.26	1.1	0.75	0.22	0.15	0.19	0.11	0
	4-5(m/s)	0.32	1.29	2.84	1.23	1.14	1.2	0.22	0.28	0.58	0.86	0.69	0.37	0.15	0.22	0	0.09
	5-6(m/s)	0.39	1.29	2.78	1.7	1.57	0.9	0.24	0.15	0.28	0.82	0.99	0.43	0.43	0.26	0.02	0.02
	6-8(m/s)	1.03	3.87	4.09	5.44	3.83	1.08	0.13	0.15	0.37	1.2	1.74	1.05	0.24	0.15	0	0.06
	8-11(m/s)	1.96	4.13	2.07	6.71	5.46	1.14	0.11	0.04	0.02	0.8	1.61	0.45	0.17	0.13	0	0
	11-14(m/s)	0.54	1.1	0.3	1.4	1.83	0.28	0.06	0	0	0.19	0.56	0.17	0.02	0.02	0	0.02
	>14(m/s)	0.17	0.32	0.09	0.26	0.34	0.13	0.04	0	0	0.06	0.11	0.04	0	0	0.02	0.02
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
400m	0-1(m/s)	0	0	0	0	0	0.02	0	0	0	0.02	0	0	0	0	0	0
	1-2(m/s)	0.02	0.22	0.37	0.13	0.09	0.24	0.15	0.47	0.19	0.15	0.13	0.02	0.02	0.11	0.02	0.09
	2-3(m/s)	0.17	0.77	1.38	0.45	0.39	0.86	0.47	0.49	0.41	0.58	0.45	0.26	0.09	0.13	0	0.02
	3-4(m/s)	0.19	0.86	2.02	0.99	0.8	1.12	0.3	0.47	0.26	1.1	0.75	0.22	0.15	0.19	0.11	0
	4-5(m/s)	0.32	1.29	2.84	1.23	1.14	1.2	0.22	0.28	0.58	0.86	0.69	0.37	0.15	0.22	0	0.09
	5-6(m/s)	0.39	1.29	2.78	1.7	1.57	0.9	0.24	0.15	0.28	0.82	0.99	0.43	0.43	0.26	0.02	0.02
	6-8(m/s)	1.03	3.87	4.09	5.44	3.83	1.08	0.13	0.15	0.37	1.2	1.74	1.05	0.24	0.15	0	0.06
	8-11(m/s)	1.96	4.13	2.07	6.71	5.46	1.14	0.11	0.04	0.02	0.8	1.61	0.45	0.17	0.13	0	0
	11-14(m/s)	0.54	1.1	0.3	1.4	1.83	0.28	0.06	0	0	0.19	0.56	0.17	0.02	0.02	0	0.02
	>14(m/s)	0.17	0.32	0.09	0.26	0.34	0.13	0.04	0	0	0.06	0.11	0.04	0	0	0.02	0.02
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
500m	0-1(m/s)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1-2(m/s)	0.02	0.09	0.26	0.09	0.09	0.24	0.15	0.28	0.13	0.06	0.15	0	0.02	0.09	0.02	0.04
	2-3(m/s)	0.13	0.71	0.93	0.32	0.34	0.75	0.54	0.47	0.32	0.22	0.73	0.17	0.02	0.13	0	0.04
	3-4(m/s)	0.19	0.73	1.96	0.6	0.65	1.03	0.26	0.41	0.28	0.52	1.1	0.19	0.11	0.17	0.06	0.02
	4-5(m/s)	0.22	1.03	2.37	1.03	0.97	1.12	0.24	0.45	0.32	0.52	1.05	0.37	0.17	0.15	0.04	0.06
	5-6(m/s)	0.37	1.25	2.28	1.25	1.44	0.88	0.19	0.15	0.54	0.45	1.29	0.39	0.19	0.24	0	0.02
	6-8(m/s)	0.8	3.14	4.37	4.39	3.64	1.18	0.13	0.26	0.43	0.86	2.07	1.01	0.47	0.24	0.02	0.06
	8-11(m/s)	2.02	4.65	3.1	7.64	5.14	1.23	0.11	0	0.09	0.73	2.02	0.6	0.19	0.15	0	0.02

Height	V-section	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
500m	11-14(m/s)	0.8	1.7	0.49	2.37	2.62	0.37	0.06	0.04	0	0.06	0.77	0.22	0.06	0.04	0	0
	>14(m/s)	0.26	0.56	0.17	0.62	0.56	0.17	0.04	0	0	0.09	0.13	0.06	0.02	0	0.02	0.04

Table 2. Directional occurrence frequency of summer wind (%) (V: speed in m/s)

Height	V-section	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
25m	0-1(m/s)	0	0	0.08	0	0	0.17	0	0.25	0	0	0	0	0.08	0.08	0	0
	1-2(m/s)	0	1.02	0.85	0.59	0.85	0.93	2.12	2.03	0.76	1.1	2.2	0.76	0.34	0.25	0.25	0.25
	2-3(m/s)	0.08	0.93	0.85	1.36	1.19	1.86	1.61	1.78	1.1	3.64	4.41	2.03	0.93	0.51	0	0.08
	3-4(m/s)	0	0.51	0.34	1.44	2.2	1.78	2.03	0.59	1.53	3.39	4.32	2.97	1.44	0.34	0	0
	4-5(m/s)	0	0.25	0.17	1.27	1.1	1.86	1.02	0.34	1.02	2.03	4.32	2.37	0.25	0.25	0	0
	5-6(m/s)	0	0.34	0.08	0.59	1.44	1.19	0.34	0	0.34	1.27	2.29	1.53	0.25	0	0	0
	6-8(m/s)	0.08	0	0.08	1.78	1.27	0.93	0.68	0.17	0	1.95	1.69	1.02	0.17	0.08	0	0
	8-11(m/s)	0	0.17	0.17	0.34	0.68	0.42	0.25	0	0	0.51	0.17	0.25	0	0	0	0
	11-14(m/s)	0	0	0	0.08	0.25	0.08	0.08	0	0	0.08	0	0	0	0	0	0
	>14(m/s)	0.08	0	0	0.08	0	0.08	0.08	0	0	0	0	0	0	0	0	0
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
50m	0-1(m/s)	0	0	0	0	0	0.17	0	0.08	0	0	0	0	0	0.08	0	0
	1-2(m/s)	0.17	0.59	0.59	0.59	0.42	0.42	1.1	1.61	0.59	0.85	1.27	0.34	0.25	0.17	0	0.17
	2-3(m/s)	0.25	0.76	0.93	0.76	1.27	1.86	2.2	1.69	0.93	3.22	2.88	1.1	0.76	0.25	0.25	0.08
	3-4(m/s)	0.25	0.34	0.59	1.61	1.44	1.61	1.36	0.93	1.61	2.54	4.83	1.95	1.69	0.59	0	0.08
	4-5(m/s)	0.17	0.25	0.17	1.02	1.53	1.78	1.44	0.51	0.76	2.12	3.64	2.63	0.93	0.25	0	0
	5-6(m/s)	0.08	0.08	0	0.85	1.1	1.19	0.85	0.17	0.68	2.2	3.47	1.36	0.42	0.08	0	0
	6-8(m/s)	0	0.17	0.17	1.61	1.86	1.61	0.68	0.08	0.17	2.12	2.88	1.69	0.68	0.08	0	0
	8-11(m/s)	0.08	0.08	0.17	0.76	0.93	0.51	0.34	0.08	0	0.76	0.42	0.42	0.08	0	0	0
	11-14(m/s)	0	0.08	0	0.25	0.25	0.08	0.17	0	0	0.17	0	0.08	0	0	0	0
	>14(m/s)	0.08	0	0	0.08	0.17	0.08	0.08	0	0	0	0	0	0	0	0	0

Height	V-section	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
75m	0-1(m/s)	0	0	0	0	0	0.17	0	0	0	0	0	0	0	0.08	0	0
	1-2(m/s)	0.17	0.42	0.59	0.42	0.42	0.34	1.02	1.69	0.59	0.59	0.85	0.25	0.17	0.08	0	0.17
	2-3(m/s)	0.25	0.93	0.85	0.85	1.19	1.53	1.86	1.36	0.76	2.97	2.2	0.85	0.68	0.17	0.25	0.08
	3-4(m/s)	0.17	0.25	0.59	1.44	1.36	1.86	1.61	1.02	1.19	2.46	3.98	1.69	0.93	0.51	0	0.08
	4-5(m/s)	0.25	0.34	0.08	0.93	1.61	1.36	1.36	0.59	0.93	2.46	3.81	2.46	1.53	0.34	0	0
	5-6(m/s)	0	0	0.17	1.02	0.93	1.44	0.93	0.34	0.93	1.86	3.14	1.78	0.51	0.25	0	0
	6-8(m/s)	0.08	0.25	0.17	1.44	1.86	1.69	0.51	0	0.34	2.46	4.49	1.61	0.76	0.08	0	0
	8-11(m/s)	0.08	0.08	0.08	1.1	1.19	0.76	0.59	0.17	0	1.02	0.93	0.76	0.25	0	0	0
	11-14(m/s)	0	0.08	0.08	0.17	0.25	0	0.25	0	0	0.17	0	0.17	0	0	0	0
	>14(m/s)	0.08	0	0	0.17	0.17	0.17	0.08	0	0	0	0	0	0	0	0	0
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
100m	0-1(m/s)	0	0	0	0	0	0.17	0	0	0	0	0	0	0	0	0	0
	1-2(m/s)	0.17	0.34	0.51	0.42	0.34	0.34	0.93	1.69	0.59	0.51	0.59	0.17	0.17	0.17	0	0.17
	2-3(m/s)	0.17	0.85	0.85	0.76	1.1	1.36	1.69	1.36	0.76	2.46	1.95	0.68	0.59	0.17	0.25	0.08
	3-4(m/s)	0.25	0.42	0.59	1.44	1.27	1.78	1.44	1.02	1.02	2.37	2.88	1.36	0.68	0.42	0	0.08
	4-5(m/s)	0.25	0.34	0.17	0.85	1.69	1.27	1.69	0.59	1.02	2.8	3.81	1.78	1.61	0.42	0	0
	5-6(m/s)	0	0	0.17	1.1	0.93	1.69	0.68	0.25	1.02	1.27	2.8	2.12	0.59	0	0	0
	6-8(m/s)	0.08	0.25	0.08	1.36	1.86	1.69	0.68	0.08	0.34	3.05	4.75	2.29	0.85	0.25	0	0
	8-11(m/s)	0.08	0.08	0.08	1.19	1.27	0.68	0.76	0.17	0	1.19	2.46	0.93	0.34	0.08	0	0
	11-14(m/s)	0	0.08	0.17	0.25	0.25	0.17	0.25	0	0	0.34	0.17	0.17	0	0	0	0
	>14(m/s)	0.08	0	0	0.17	0.25	0.17	0.08	0	0	0	0	0.08	0	0	0	0
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
150m	0-1(m/s)	0	0	0	0	0	0.17	0	0	0	0	0	0	0	0	0	0

Height	V-section	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
150m	1-2(m/s)	0.17	0.17	0.34	0.34	0.25	0.25	0.68	1.19	0.42	0.17	0.17	0.08	0	0.34	0	0.17
	2-3(m/s)	0	0.85	0.93	0.68	0.85	1.19	1.78	1.61	0.85	1.69	1.1	0.51	0	0.25	0.17	0.08
	3-4(m/s)	0.25	0.59	0.51	1.19	1.1	1.36	1.1	1.27	0.68	2.8	1.69	0.93	0.51	0.34	0.08	0.08
	4-5(m/s)	0.25	0.17	0.34	1.02	1.86	1.61	1.69	0.34	1.27	2.2	2.88	1.53	0.76	0.76	0	0
	5-6(m/s)	0.17	0.17	0.17	1.1	0.93	1.53	0.76	0.42	0.85	2.12	2.88	1.95	0.76	0.85	0	0
	6-8(m/s)	0.08	0.25	0.08	1.1	1.95	1.86	1.1	0.17	0.68	2.63	4.58	2.54	0.51	0.42	0	0
	8-11(m/s)	0.08	0	0.08	1.61	1.36	0.93	0.68	0.17	0	1.86	5.17	1.61	0.42	0.34	0	0
	11-14(m/s)	0	0.17	0.17	0.34	0.42	0.25	0.25	0	0	0.42	0.76	0.34	0.08	0	0	0
	>14(m/s)	0.08	0	0	0.17	0.25	0.17	0.17	0	0	0.08	0.17	0.08	0	0	0	0
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
200m	0-1(m/s)	0	0	0	0	0	0.17	0	0	0	0	0	0	0	0	0	0
	1-2(m/s)	0.08	0.08	0.25	0.25	0.25	0.34	0.51	1.1	0.42	0.17	0.08	0.08	0	0.25	0	0.17
	2-3(m/s)	0.08	0.93	1.02	0.34	0.85	1.69	1.1	1.53	0.85	1.36	0.76	0.51	0	0.25	0.08	0.08
	3-4(m/s)	0.25	0.51	1.61	0.34	1.1	2.29	0.42	1.36	0.68	2.97	1.78	0.76	0.51	0.25	0.17	0.08
	4-5(m/s)	0.25	0.17	0.76	0.59	1.53	2.2	0.68	0.42	1.27	2.03	2.12	1.53	0.51	0.68	0	0
	5-6(m/s)	0.17	0.25	0.25	1.02	1.27	1.86	0.59	0.34	0.68	2.29	2.63	1.86	0.76	0.85	0	0
	6-8(m/s)	0.08	0.17	0.25	0.93	1.86	2.71	0.34	0.25	0.85	2.46	5.17	2.63	0.76	0.68	0	0
	8-11(m/s)	0	0.08	0.59	1.27	1.36	1.44	0.34	0.17	0	2.2	5.08	1.78	0.42	0.34	0	0
	11-14(m/s)	0.08	0.08	0.17	0.25	0.51	0.25	0.17	0	0	0.42	1.61	0.25	0.08	0	0	0
	>14(m/s)	0.08	0.08	0.08	0.17	0.25	0.34	0.08	0	0	0.08	0.17	0.17	0	0	0	0
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
250m	0-1(m/s)	0	0	0	0	0	0.17	0	0	0	0	0	0	0	0	0	0
	1-2(m/s)	0.08	0.08	0.25	0.25	0.08	0.25	0.42	1.02	0.42	0.08	0	0.08	0	0.25	0	0.17

Height	V-section	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
250m	2-3(m/s)	0.08	0.85	1.02	0.34	0.76	1.69	1.1	1.36	0.76	1.19	0.85	0.42	0	0.25	0	0.08
	3-4(m/s)	0.25	0.42	1.44	0.25	1.19	2.2	0.51	1.27	0.51	3.05	1.61	0.76	0.51	0.25	0.25	0
	4-5(m/s)	0.17	0.34	0.85	0.59	1.53	2.12	0.51	0.59	1.53	1.69	1.78	1.36	0.42	0.59	0	0.08
	5-6(m/s)	0.25	0.25	0.25	0.93	1.36	1.78	0.76	0.42	0.59	2.2	2.8	1.53	0.85	0.93	0	0
	6-8(m/s)	0.08	0.17	0.34	1.1	1.69	2.97	0.34	0.34	0.85	2.88	5.17	3.05	0.68	0.59	0	0
	8-11(m/s)	0	0.08	0.59	1.27	1.61	1.44	0.34	0.17	0.08	1.95	5	1.86	0.51	0.42	0	0
	11-14(m/s)	0.08	0.08	0.17	0.25	0.51	0.34	0.17	0	0	0.76	1.95	0.34	0.08	0	0	0
	>14(m/s)	0.08	0.08	0.08	0.17	0.25	0.34	0.08	0	0	0.17	0.25	0.17	0	0	0	0
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
300m	0-1(m/s)	0	0	0	0	0	0.08	0	0	0	0	0	0	0	0	0	0
	1-2(m/s)	0.08	0.08	0.25	0.17	0.08	0.17	0.42	1.02	0.34	0.08	0	0.08	0	0.25	0	0.17
	2-3(m/s)	0.08	0.76	1.02	0.42	0.76	1.78	1.02	1.27	0.68	1.1	0.76	0.42	0	0.08	0	0.08
	3-4(m/s)	0.25	0.51	1.19	0.25	1.02	2.2	0.59	1.27	0.51	2.88	1.69	0.59	0.51	0.42	0.25	0
	4-5(m/s)	0.17	0.25	1.1	0.59	1.61	2.12	0.34	0.59	1.27	1.78	1.69	1.19	0.34	0.51	0	0.08
	5-6(m/s)	0.25	0.25	0.08	0.76	1.19	1.61	0.85	0.51	0.68	2.03	2.71	1.36	0.93	0.93	0	0
	6-8(m/s)	0.08	0.17	0.51	1.1	1.69	2.97	0.42	0.34	1.19	2.71	4.75	3.31	0.68	0.51	0	0
	8-11(m/s)	0	0.17	0.34	1.44	1.69	1.61	0.34	0.17	0.08	2.46	5.42	1.78	0.51	0.51	0	0
	11-14(m/s)	0.08	0.08	0.42	0.25	0.59	0.42	0.17	0	0	0.68	2.03	0.68	0.08	0.08	0	0
	>14(m/s)	0.08	0.08	0.08	0.17	0.34	0.34	0.08	0	0	0.25	0.34	0.17	0	0	0	0
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
400m	0-1(m/s)	0	0	0	0	0	0.08	0	0	0	0	0	0	0	0	0	0
	1-2(m/s)	0.08	0.08	0.25	0.17	0.08	0.17	0.42	0.93	0.25	0.08	0	0.08	0	0.17	0	0.08
	2-3(m/s)	0.08	0.76	0.85	0.34	0.76	1.69	1.1	1.19	0.51	0.76	0.76	0.34	0	0.17	0	0.08

Height	V-section	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
400m	3-4(m/s)	0.17	0.51	1.02	0.34	0.93	2.2	0.51	1.1	0.76	2.54	1.53	0.51	0.34	0.42	0.25	0.08
	4-5(m/s)	0.25	0.25	1.27	0.59	1.61	1.86	0.42	0.85	0.85	1.78	1.69	1.1	0.25	0.34	0	0.08
	5-6(m/s)	0.08	0.17	0.25	0.51	1.27	1.69	0.76	0.42	1.02	2.37	2.8	1.44	0.76	0.85	0	0
	6-8(m/s)	0.17	0.17	0.42	1.27	1.44	2.97	0.42	0.51	1.1	2.88	4.58	3.22	0.93	0.59	0	0
	8-11(m/s)	0.08	0.25	0.42	1.36	1.95	1.86	0.34	0.08	0.25	2.46	5.59	2.03	0.51	0.59	0	0
	11-14(m/s)	0.08	0.08	0.34	0.34	0.51	0.42	0.17	0.08	0	0.76	2.12	0.68	0.25	0.17	0	0
	>14(m/s)	0.08	0.08	0.17	0.25	0.42	0.34	0.08	0	0	0.34	0.34	0.17	0	0	0	0
Height	**V-section**	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
500m	0-1(m/s)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1-2(m/s)	0.08	0	0.17	0	0.08	0.25	0.51	0.51	0.25	0	0	0	0	0.17	0	0.08
	2-3(m/s)	0.08	0.85	0.93	0.42	0.76	1.61	1.02	1.27	0.42	0.25	1.36	0.25	0	0.17	0	0.08
	3-4(m/s)	0.17	0.34	0.93	0.25	0.93	1.86	0.51	1.19	0.59	1.19	2.63	0.59	0.17	0.34	0.25	0.08
	4-5(m/s)	0.08	0.42	1.1	0.51	1.27	1.95	0.42	1.02	0.68	1.1	2.46	1.1	0.42	0.25	0	0.08
	5-6(m/s)	0.25	0.17	0.51	0.51	1.27	1.78	0.76	0.34	1.27	0.85	3.64	1.19	0.51	0.76	0	0
	6-8(m/s)	0.17	0.17	0.42	1.27	1.78	3.05	0.42	0.68	1.19	1.95	5.59	3.05	1.19	0.85	0	0
	8-11(m/s)	0.08	0.25	0.42	1.44	1.86	1.86	0.34	0	0.34	2.03	6.61	2.29	0.51	0.59	0	0
	11-14(m/s)	0.08	0.08	0.25	0.42	0.59	0.59	0.17	0.17	0	0.17	2.8	0.85	0.17	0.17	0	0
	>14(m/s)	0.08	0.08	0.25	0.34	0.42	0.34	0.08	0	0	0.34	0.42	0.25	0.08	0	0	0

Table 3. Directional occurrence frequency of both annual and summer winds at 25m height above the PDA (%).

Condition	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
Annual	1.31	17.3	9.93	24.3	15.5	5.43	3.25	2.06	2.10	5.79	7.04	3.55	1.30	0.61	0.16	0.32
Summer	0.24	3.22	2.62	7.53	8.98	9.30	8.21	5.16	4.75	14.0	19.4	10.9	3.46	1.51	0.25	0.33

Table 4. Target approach wind fields for AVA wind tunnel test from SWAS (MBL stands for the scalar average of all the height levels within the same profile).

	AF1		AF2		AF3	
Height(m)	**U/MBL**	**I(%)**	**U/MBL**	**I(%)**	**U/MBL**	**I(%)**
25	0.808	25.1	0.620	24.8	0.762	22.1
50	0.893	23.6	0.695	24.9	0.827	21.0
75	0.925	23.0	0.770	24.5	0.879	20.1
100	0.948	22.7	0.864	22.1	0.911	19.4
150	0.993	22.5	1.02	15.9	0.967	18.1
200	1.02	21.8	1.10	13.1	1.01	17.4
250	1.05	21.0	1.15	12.0	1.05	16.7
300	1.08	21.0	1.19	11.0	1.10	16.0
400	1.12	20.9	1.27	9.68	1.20	15.0
500	1.16	20.3	1.33	8.53	1.29	13.0

Note: MBL stands for the scalar average of all the height levels within the same profile

Table 5. Approach wind fields for AVA wind tunnel test

	af1		af2		af3	
Height(m)	**U/MBL**	**I(%)**	**U/MBL**	**I(%)**	**U/MBL**	**I(%)**
25	0.818	24.1	0.659	24.7	0.726	22.6
50	0.863	21.8	0.752	23.8	0.803	21.1
75	0.905	21.6	0.801	22.9	0.856	20.0
100	0.946	20.1	0.846	22.8	0.883	18.5
150	1.00	17.9	0.967	17.5	0.964	17.5
200	1.04	16.3	1.06	14.8	1.04	15.5
250	1.06	16.7	1.12	12.9	1.10	14.0
300	1.08	12.7	1.18	11.5	1.15	12.5
400	1.12	16.8	1.29	9.5	1.22	11.9
440	1.16	16.9	1.33	7.9	1.27	11.7

Table 6. The scaling factors (SF) involved in calculating VR_w values

Section	**0°**	**22.5°**	**45°**	**67.5°**	**90°**	**112.5°**	**135°**	**157.5°**	**180°**	**202.5°**	**225°**	**247.5°**	**270°**	**292.5°**	**315°**	**337.5°**
SF	1.27	1.24	1.16	1.11	1.23	1.25	0.92	0.84	0.98	1.21	1.19	1.08	1.22	1.15	1.16	1.28

Table 7. Directional VR values without the installation of potential buildings within the PDA from the AVA wind tunnel test

Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
P1	0.46	0.48	0.4	0.45	0.46	0.41	0.19	0.16	0.25	0.35	0.33	0.25	0.26	0.23	0.26	0.42
P2	0.47	0.33	0.12	0.36	0.36	0.22	0.14	0.15	0.22	0.22	0.25	0.19	0.22	0.2	0.25	0.37
P3	0.15	0.12	0.23	0.21	0.22	0.2	0.19	0.16	0.13	0.23	0.34	0.14	0.16	0.16	0.22	0.15
P4	0.29	0.53	0.33	0.22	0.28	0.23	0.18	0.2	0.15	0.33	0.46	0.22	0.21	0.27	0.21	0.17
P5	0.35	0.23	0.26	0.2	0.16	0.13	0.16	0.13	0.11	0.2	0.22	0.12	0.15	0.21	0.27	0.36
P6	0.44	0.44	0.25	0.11	0.23	0.19	0.16	0.11	0.16	0.42	0.41	0.23	0.26	0.36	0.3	0.23
P7	0.22	0.24	0.17	0.11	0.1	0.09	0.09	0.06	0.07	0.25	0.34	0.18	0.19	0.23	0.14	0.19
P8	0.16	0.16	0.21	0.34	0.39	0.15	0.11	0.09	0.07	0.17	0.15	0.11	0.19	0.25	0.28	0.31
P9	0.22	0.2	0.19	0.19	0.2	0.09	0.09	0.07	0.08	0.12	0.14	0.11	0.12	0.14	0.16	0.27
P10	0.31	0.26	0.24	0.27	0.41	0.19	0.16	0.11	0.13	0.19	0.19	0.21	0.26	0.29	0.28	0.41
P11	0.29	0.2	0.17	0.18	0.32	0.17	0.13	0.11	0.1	0.15	0.17	0.12	0.18	0.24	0.22	0.35
P12	0.18	0.19	0.25	0.32	0.52	0.23	0.15	0.16	0.19	0.25	0.33	0.2	0.2	0.22	0.31	0.17
P13	0.22	0.27	0.31	0.34	0.4	0.23	0.2	0.19	0.25	0.3	0.31	0.18	0.21	0.23	0.2	0.21
P14	0.37	0.4	0.38	0.37	0.38	0.22	0.26	0.24	0.35	0.42	0.37	0.23	0.27	0.27	0.24	0.33
P15	0.43	0.4	0.29	0.27	0.4	0.4	0.4	0.26	0.3	0.23	0.28	0.23	0.26	0.33	0.32	0.49
P16	0.12	0.12	0.08	0.09	0.14	0.15	0.11	0.07	0.08	0.09	0.1	0.07	0.12	0.15	0.16	0.14
P17	0.18	0.22	0.13	0.14	0.18	0.24	0.14	0.14	0.27	0.24	0.16	0.09	0.17	0.24	0.16	0.12
P18	0.39	0.39	0.22	0.2	0.27	0.25	0.33	0.3	0.41	0.26	0.2	0.16	0.26	0.35	0.36	0.42
P19	0.29	0.21	0.15	0.21	0.23	0.26	0.35	0.26	0.23	0.16	0.25	0.14	0.17	0.27	0.25	0.31
P20	0.32	0.23	0.19	0.31	0.38	0.49	0.4	0.35	0.38	0.41	0.32	0.27	0.28	0.39	0.38	0.43
P21	0.42	0.35	0.14	0.12	0.22	0.48	0.29	0.35	0.45	0.5	0.35	0.24	0.4	0.24	0.25	0.37
P22	0.35	0.16	0.2	0.13	0.2	0.16	0.41	0.35	0.31	0.21	0.46	0.26	0.22	0.27	0.43	0.34

Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
P23	0.2	0.22	0.21	0.16	0.25	0.31	0.32	0.28	0.32	0.43	0.45	0.24	0.35	0.34	0.51	0.31
P24	0.19	0.19	0.25	0.21	0.21	0.23	0.21	0.2	0.23	0.34	0.41	0.26	0.23	0.29	0.47	0.22
P25	0.16	0.13	0.14	0.16	0.3	0.33	0.23	0.21	0.17	0.23	0.33	0.26	0.24	0.23	0.38	0.23
P26	0.22	0.23	0.25	0.28	0.28	0.3	0.2	0.18	0.2	0.27	0.39	0.27	0.21	0.25	0.27	0.21
P27	0.21	0.19	0.23	0.13	0.38	0.24	0.2	0.2	0.18	0.16	0.22	0.27	0.27	0.3	0.36	0.2
P28	0.39	0.37	0.32	0.14	0.31	0.16	0.17	0.15	0.13	0.2	0.35	0.27	0.24	0.2	0.21	0.29
P29	0.2	0.17	0.15	0.18	0.32	0.24	0.21	0.17	0.17	0.16	0.19	0.2	0.27	0.33	0.32	0.2
P30	0.28	0.27	0.21	0.22	0.35	0.27	0.26	0.18	0.19	0.2	0.37	0.28	0.35	0.38	0.39	0.27
P31	0.28	0.21	0.18	0.22	0.31	0.25	0.26	0.13	0.13	0.14	0.22	0.21	0.24	0.16	0.23	0.28
P32	0.35	0.44	0.36	0.39	0.4	0.16	0.14	0.11	0.11	0.16	0.32	0.22	0.28	0.33	0.21	0.23
P33	0.36	0.34	0.2	0.1	0.15	0.13	0.14	0.1	0.11	0.26	0.27	0.2	0.28	0.33	0.26	0.26
P34	0.27	0.36	0.19	0.11	0.19	0.17	0.14	0.09	0.11	0.37	0.37	0.18	0.18	0.24	0.18	0.19
P35	0.34	0.36	0.2	0.27	0.27	0.17	0.09	0.1	0.12	0.39	0.45	0.2	0.16	0.31	0.14	0.13
P36	0.46	0.23	0.16	0.35	0.29	0.18	0.18	0.14	0.12	0.26	0.21	0.13	0.14	0.25	0.25	0.34
P37	0.56	0.52	0.32	0.46	0.41	0.35	0.24	0.21	0.26	0.32	0.46	0.23	0.27	0.37	0.45	0.46
P38	0.43	0.19	0.28	0.35	0.19	0.17	0.16	0.11	0.13	0.14	0.29	0.24	0.3	0.18	0.32	0.42
P39	0.48	0.52	0.38	0.53	0.47	0.35	0.17	0.19	0.31	0.33	0.42	0.26	0.25	0.24	0.37	0.42
P40	0.56	0.63	0.41	0.54	0.47	0.4	0.17	0.17	0.3	0.39	0.45	0.3	0.26	0.25	0.4	0.49
P41	0.54	0.66	0.55	0.61	0.49	0.31	0.19	0.25	0.48	0.66	0.76	0.5	0.19	0.34	0.41	0.48
P42	0.53	0.62	0.55	0.56	0.5	0.4	0.23	0.18	0.32	0.49	0.64	0.49	0.43	0.26	0.31	0.49
P43	0.49	0.53	0.53	0.49	0.48	0.43	0.25	0.16	0.24	0.38	0.48	0.4	0.31	0.23	0.22	0.46
O1	0.19	0.34	0.16	0.15	0.23	0.34	0.48	0.44	0.35	0.38	0.35	0.23	0.3	0.34	0.35	0.29
O2	0.42	0.41	0.29	0.11	0.23	0.28	0.41	0.39	0.4	0.58	0.37	0.33	0.28	0.19	0.29	0.33

Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
O3	0.35	0.42	0.27	0.17	0.17	0.24	0.27	0.27	0.44	0.37	0.41	0.47	0.3	0.23	0.24	0.23
O4	0.42	0.22	0.37	0.28	0.18	0.21	0.26	0.45	0.4	0.33	0.54	0.57	0.39	0.5	0.28	0.2
O5	0.38	0.4	0.25	0.14	0.23	0.35	0.28	0.27	0.38	0.47	0.38	0.42	0.4	0.26	0.36	0.43
O6	0.32	0.26	0.19	0.24	0.32	0.41	0.41	0.34	0.39	0.37	0.51	0.29	0.34	0.31	0.45	0.41
O7	0.24	0.28	0.25	0.15	0.15	0.13	0.23	0.22	0.18	0.33	0.41	0.22	0.29	0.29	0.19	0.21
O8	0.36	0.36	0.2	0.16	0.24	0.28	0.35	0.32	0.37	0.35	0.43	0.27	0.25	0.44	0.49	0.33
O9	0.27	0.3	0.29	0.18	0.22	0.22	0.23	0.25	0.32	0.39	0.52	0.29	0.32	0.28	0.28	0.27
O10	0.4	0.38	0.23	0.22	0.27	0.31	0.38	0.31	0.4	0.4	0.32	0.21	0.3	0.37	0.52	0.47
O11	0.4	0.23	0.22	0.18	0.23	0.3	0.31	0.31	0.34	0.4	0.36	0.22	0.28	0.41	0.52	0.36
O12	0.25	0.24	0.27	0.35	0.33	0.22	0.19	0.23	0.25	0.41	0.52	0.31	0.33	0.26	0.22	0.2
O13	0.24	0.29	0.3	0.26	0.24	0.2	0.17	0.2	0.27	0.33	0.23	0.22	0.24	0.33	0.33	0.28
O14	0.32	0.24	0.2	0.2	0.21	0.29	0.26	0.2	0.26	0.29	0.27	0.17	0.22	0.27	0.31	0.29
O15	0.23	0.21	0.2	0.2	0.22	0.25	0.24	0.2	0.21	0.32	0.33	0.22	0.19	0.26	0.4	0.25
O16	0.25	0.18	0.27	0.34	0.23	0.27	0.24	0.22	0.29	0.22	0.43	0.35	0.22	0.28	0.28	0.21
O17	0.43	0.36	0.33	0.33	0.43	0.45	0.4	0.26	0.39	0.46	0.42	0.29	0.31	0.39	0.38	0.46
O18	0.39	0.33	0.36	0.33	0.42	0.39	0.35	0.25	0.28	0.42	0.46	0.31	0.32	0.33	0.41	0.41
O19	0.4	0.33	0.32	0.26	0.26	0.26	0.17	0.15	0.16	0.23	0.43	0.28	0.27	0.36	0.35	0.33
O20	0.22	0.23	0.22	0.28	0.4	0.35	0.28	0.23	0.16	0.3	0.39	0.32	0.28	0.32	0.45	0.3
O21	0.24	0.24	0.3	0.25	0.33	0.3	0.22	0.19	0.21	0.26	0.34	0.26	0.25	0.32	0.36	0.24
O22	0.31	0.27	0.3	0.33	0.4	0.28	0.26	0.14	0.18	0.27	0.37	0.27	0.26	0.26	0.32	0.34
O23	0.22	0.25	0.3	0.22	0.38	0.26	0.2	0.19	0.14	0.22	0.35	0.28	0.29	0.28	0.35	0.24
O24	0.34	0.3	0.32	0.32	0.39	0.25	0.26	0.12	0.22	0.31	0.41	0.25	0.3	0.26	0.24	0.33
O25	0.19	0.17	0.15	0.13	0.27	0.22	0.13	0.14	0.16	0.16	0.23	0.19	0.24	0.32	0.31	0.19

Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
O26	0.38	0.33	0.32	0.35	0.44	0.28	0.26	0.19	0.26	0.36	0.4	0.24	0.3	0.28	0.25	0.41
O27	0.28	0.3	0.31	0.27	0.41	0.24	0.26	0.13	0.16	0.29	0.39	0.27	0.31	0.3	0.32	0.33
O28	0.28	0.32	0.29	0.19	0.32	0.19	0.23	0.14	0.12	0.3	0.36	0.25	0.31	0.3	0.38	0.33
O29	0.3	0.25	0.27	0.25	0.37	0.2	0.18	0.11	0.14	0.19	0.32	0.2	0.24	0.27	0.17	0.32
O30	0.15	0.14	0.1	0.19	0.26	0.11	0.11	0.11	0.13	0.12	0.15	0.14	0.17	0.2	0.17	0.12
O31	0.31	0.3	0.3	0.22	0.42	0.27	0.24	0.1	0.15	0.23	0.29	0.26	0.28	0.31	0.23	0.36
O32	0.25	0.25	0.27	0.17	0.38	0.2	0.17	0.14	0.09	0.19	0.34	0.27	0.29	0.29	0.27	0.22
O33	0.36	0.35	0.34	0.33	0.49	0.25	0.2	0.18	0.19	0.27	0.4	0.22	0.27	0.33	0.23	0.38
O34	0.14	0.12	0.15	0.13	0.23	0.15	0.12	0.08	0.12	0.21	0.28	0.15	0.2	0.25	0.22	0.2
O35	0.28	0.29	0.3	0.2	0.41	0.27	0.23	0.1	0.13	0.24	0.25	0.27	0.3	0.31	0.25	0.32
O36	0.37	0.32	0.33	0.27	0.49	0.25	0.2	0.13	0.16	0.18	0.29	0.25	0.3	0.31	0.27	0.39
O37	0.15	0.14	0.16	0.13	0.16	0.14	0.18	0.13	0.18	0.16	0.22	0.22	0.18	0.29	0.34	0.19
O38	0.14	0.13	0.1	0.1	0.16	0.13	0.12	0.13	0.13	0.14	0.13	0.19	0.22	0.2	0.19	0.15
O39	0.21	0.18	0.13	0.14	0.21	0.18	0.18	0.08	0.08	0.18	0.25	0.17	0.16	0.18	0.24	0.24
O40	0.27	0.29	0.27	0.26	0.38	0.21	0.17	0.11	0.12	0.23	0.25	0.2	0.3	0.3	0.27	0.35
O41	0.18	0.17	0.16	0.19	0.27	0.22	0.17	0.18	0.18	0.18	0.14	0.13	0.3	0.38	0.36	0.22
O42	0.17	0.15	0.15	0.16	0.24	0.17	0.14	0.13	0.16	0.16	0.25	0.16	0.23	0.38	0.46	0.21
O43	0.4	0.44	0.25	0.17	0.19	0.14	0.12	0.1	0.11	0.23	0.3	0.21	0.26	0.3	0.19	0.32
O44	0.27	0.22	0.22	0.26	0.36	0.29	0.27	0.12	0.15	0.17	0.14	0.18	0.24	0.38	0.5	0.38
O45	0.24	0.34	0.34	0.4	0.49	0.29	0.17	0.06	0.1	0.14	0.48	0.28	0.28	0.35	0.34	0.36
O46	0.22	0.23	0.14	0.08	0.11	0.1	0.1	0.07	0.09	0.26	0.34	0.19	0.21	0.24	0.19	0.14
O47	0.27	0.18	0.15	0.14	0.19	0.2	0.18	0.14	0.18	0.19	0.29	0.16	0.14	0.32	0.46	0.37
O48	0.24	0.23	0.15	0.24	0.44	0.24	0.2	0.16	0.2	0.23	0.38	0.39	0.29	0.32	0.35	0.33

Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
O49	0.34	0.47	0.3	0.27	0.48	0.38	0.16	0.17	0.28	0.37	0.24	0.15	0.17	0.21	0.22	0.22
O50	0.35	0.27	0.23	0.26	0.35	0.33	0.4	0.09	0.17	0.16	0.14	0.16	0.26	0.46	0.52	0.44
O51	0.55	0.36	0.18	0.23	0.38	0.26	0.25	0.26	0.2	0.19	0.41	0.38	0.42	0.36	0.52	0.39
O52	0.5	0.48	0.32	0.23	0.34	0.21	0.21	0.17	0.19	0.45	0.49	0.26	0.26	0.37	0.36	0.42
O53	0.14	0.14	0.16	0.23	0.34	0.27	0.23	0.13	0.1	0.11	0.15	0.14	0.16	0.14	0.27	0.22
O54	0.42	0.28	0.37	0.26	0.23	0.3	0.23	0.13	0.11	0.29	0.35	0.28	0.25	0.39	0.54	0.53
O55	0.58	0.62	0.54	0.55	0.54	0.43	0.22	0.19	0.34	0.44	0.43	0.34	0.32	0.25	0.32	0.58
O56	0.46	0.41	0.19	0.22	0.3	0.22	0.28	0.17	0.13	0.17	0.25	0.27	0.36	0.37	0.23	0.41
O57	0.42	0.42	0.35	0.34	0.33	0.31	0.17	0.12	0.17	0.22	0.35	0.28	0.32	0.21	0.26	0.4
O58	0.29	0.21	0.14	0.29	0.17	0.16	0.17	0.13	0.11	0.18	0.23	0.13	0.15	0.19	0.22	0.26
O59	0.28	0.3	0.44	0.47	0.47	0.37	0.18	0.17	0.31	0.42	0.47	0.3	0.32	0.25	0.27	0.48
O60	0.33	0.4	0.35	0.29	0.28	0.36	0.22	0.18	0.26	0.5	0.4	0.39	0.3	0.25	0.28	0.47
O61	0.56	0.43	0.23	0.19	0.28	0.19	0.3	0.24	0.18	0.22	0.33	0.3	0.41	0.25	0.22	0.46
O62	0.34	0.35	0.21	0.17	0.17	0.3	0.32	0.22	0.27	0.27	0.42	0.35	0.33	0.33	0.43	0.35
O63	0.36	0.21	0.11	0.2	0.2	0.16	0.14	0.08	0.1	0.22	0.28	0.18	0.15	0.24	0.28	0.34
O64	0.36	0.34	0.24	0.23	0.37	0.22	0.28	0.27	0.19	0.25	0.31	0.1	0.15	0.43	0.4	0.5
O65	0.37	0.44	0.41	0.42	0.26	0.22	0.1	0.13	0.31	0.44	0.41	0.14	0.12	0.31	0.43	0.42
O66	0.59	0.26	0.22	0.34	0.31	0.23	0.15	0.2	0.24	0.24	0.24	0.14	0.19	0.44	0.33	0.48
O67	0.52	0.5	0.32	0.29	0.28	0.25	0.18	0.13	0.15	0.18	0.38	0.16	0.17	0.33	0.52	0.6
O68	0.32	0.2	0.22	0.18	0.15	0.13	0.18	0.35	0.4	0.34	0.31	0.15	0.16	0.27	0.46	0.61
O69	0.55	0.31	0.26	0.15	0.2	0.43	0.25	0.22	0.25	0.3	0.24	0.16	0.26	0.32	0.3	0.24
O70	0.31	0.4	0.41	0.14	0.12	0.2	0.26	0.19	0.34	0.39	0.35	0.13	0.17	0.24	0.32	0.26
O71	0.42	0.24	0.45	0.31	0.21	0.14	0.29	0.27	0.35	0.48	0.43	0.15	0.24	0.21	0.36	0.34

Table 8. Directional VR values with the installation of potential buildings within the PDA from the AVA wind tunnel test

Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
P1	0.34	0.25	0.23	0.22	0.26	0.18	0.11	0.11	0.23	0.43	0.35	0.33	0.28	0.26	0.28	0.26
P2	0.27	0.21	0.29	0.31	0.28	0.24	0.12	0.23	0.36	0.45	0.45	0.2	0.41	0.4	0.46	0.52
P3	0.24	0.13	0.15	0.19	0.21	0.21	0.09	0.25	0.35	0.35	0.49	0.14	0.2	0.25	0.21	0.34
P4	0.22	0.3	0.15	0.17	0.18	0.18	0.1	0.2	0.26	0.47	0.81	0.18	0.18	0.22	0.23	0.29
P5	0.27	0.17	0.13	0.11	0.11	0.13	0.11	0.11	0.15	0.24	0.35	0.09	0.19	0.24	0.23	0.19
P6	0.15	0.25	0.32	0.27	0.2	0.22	0.27	0.07	0.12	0.18	0.24	0.11	0.2	0.29	0.26	0.23
P7	0.11	0.15	0.2	0.17	0.2	0.15	0.14	0.04	0.05	0.09	0.28	0.16	0.38	0.57	0.52	0.42
P8	0.26	0.4	0.36	0.36	0.42	0.31	0.27	0.09	0.11	0.18	0.3	0.37	0.32	0.27	0.21	0.12
P9	0.11	0.26	0.29	0.29	0.34	0.23	0.18	0.1	0.18	0.22	0.26	0.36	0.35	0.29	0.25	0.16
P10	0.19	0.24	0.26	0.21	0.28	0.15	0.15	0.14	0.22	0.19	0.27	0.21	0.33	0.3	0.26	0.17
P11	0.27	0.27	0.24	0.16	0.14	0.11	0.13	0.2	0.3	0.17	0.26	0.3	0.29	0.29	0.25	0.33
P12	0.25	0.27	0.18	0.12	0.19	0.2	0.16	0.13	0.13	0.15	0.18	0.13	0.16	0.2	0.24	0.25
P13	0.46	0.49	0.41	0.28	0.18	0.11	0.14	0.18	0.15	0.22	0.43	0.28	0.29	0.35	0.2	0.47
P14	0.32	0.38	0.39	0.31	0.32	0.19	0.13	0.12	0.17	0.24	0.45	0.31	0.39	0.46	0.28	0.39
P15	0.3	0.19	0.2	0.2	0.32	0.3	0.25	0.13	0.29	0.41	0.58	0.35	0.34	0.41	0.31	0.24
P16	0.11	0.1	0.09	0.1	0.11	0.11	0.09	0.09	0.11	0.1	0.12	0.08	0.13	0.24	0.12	0.15
P17	0.2	0.2	0.1	0.11	0.14	0.18	0.11	0.1	0.21	0.27	0.22	0.1	0.14	0.21	0.23	0.23
P18	0.16	0.14	0.18	0.17	0.22	0.22	0.2	0.14	0.17	0.18	0.22	0.13	0.21	0.3	0.27	0.17
P19	0.15	0.13	0.16	0.22	0.22	0.32	0.39	0.27	0.25	0.48	0.41	0.13	0.26	0.37	0.44	0.43
P20	0.47	0.38	0.16	0.21	0.34	0.44	0.32	0.22	0.27	0.43	0.43	0.29	0.31	0.4	0.39	0.31
P21	0.25	0.28	0.13	0.17	0.18	0.45	0.34	0.37	0.26	0.36	0.37	0.23	0.33	0.28	0.6	0.32
P22	0.34	0.32	0.22	0.18	0.22	0.35	0.41	0.34	0.17	0.3	0.32	0.28	0.21	0.31	0.35	0.14

Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
P23	0.32	0.26	0.25	0.24	0.3	0.3	0.28	0.27	0.2	0.31	0.47	0.22	0.22	0.29	0.32	0.14
P24	0.19	0.24	0.29	0.32	0.36	0.27	0.23	0.21	0.12	0.11	0.23	0.27	0.18	0.17	0.17	0.12
P25	0.14	0.17	0.23	0.25	0.31	0.29	0.19	0.16	0.14	0.1	0.12	0.25	0.21	0.27	0.16	0.14
P26	0.15	0.16	0.19	0.22	0.41	0.32	0.24	0.22	0.22	0.14	0.16	0.17	0.23	0.26	0.22	0.16
P27	0.14	0.18	0.25	0.16	0.36	0.22	0.18	0.15	0.13	0.13	0.13	0.08	0.13	0.19	0.17	0.14
P28	0.41	0.47	0.4	0.23	0.39	0.33	0.27	0.19	0.15	0.15	0.16	0.08	0.11	0.31	0.32	0.33
P29	0.29	0.23	0.17	0.17	0.25	0.21	0.21	0.12	0.13	0.12	0.11	0.09	0.16	0.22	0.2	0.23
P30	0.28	0.23	0.2	0.17	0.23	0.21	0.27	0.13	0.13	0.15	0.17	0.11	0.12	0.1	0.12	0.17
P31	0.32	0.32	0.27	0.17	0.24	0.22	0.27	0.11	0.09	0.15	0.28	0.26	0.22	0.17	0.15	0.16
P32	0.54	0.58	0.42	0.44	0.54	0.35	0.28	0.14	0.1	0.14	0.23	0.19	0.28	0.38	0.32	0.21
P33	0.14	0.18	0.18	0.18	0.2	0.17	0.2	0.05	0.12	0.15	0.2	0.16	0.24	0.25	0.21	0.11
P34	0.28	0.33	0.25	0.19	0.2	0.24	0.25	0.09	0.2	0.32	0.33	0.16	0.35	0.63	0.62	0.57
P35	0.51	0.43	0.31	0.22	0.24	0.24	0.26	0.15	0.19	0.39	0.54	0.21	0.19	0.37	0.46	0.41
P36	0.45	0.41	0.22	0.35	0.3	0.18	0.12	0.15	0.17	0.23	0.26	0.13	0.21	0.2	0.36	0.62
P37	0.29	0.46	0.26	0.35	0.35	0.24	0.16	0.17	0.21	0.21	0.38	0.23	0.25	0.26	0.38	0.24
P38	0.35	0.22	0.22	0.24	0.29	0.23	0.14	0.26	0.39	0.34	0.33	0.17	0.16	0.15	0.19	0.23
P39	0.61	0.43	0.27	0.35	0.42	0.21	0.12	0.24	0.42	0.52	0.47	0.24	0.19	0.3	0.33	0.42
P40	0.54	0.59	0.35	0.44	0.52	0.28	0.13	0.26	0.53	0.42	0.54	0.42	0.45	0.27	0.29	0.51
P41	0.78	0.36	0.22	0.49	0.65	0.21	0.15	0.22	0.48	0.45	0.5	0.46	0.49	0.28	0.31	0.65
P42	0.47	0.57	0.58	0.49	0.44	0.35	0.24	0.15	0.27	0.27	0.46	0.46	0.43	0.32	0.25	0.44
P43	0.39	0.67	0.53	0.33	0.24	0.47	0.3	0.21	0.44	0.81	0.72	0.54	0.28	0.26	0.39	0.29
O1	0.2	0.31	0.18	0.16	0.21	0.36	0.58	0.44	0.28	0.36	0.34	0.22	0.27	0.19	0.32	0.31
O2	0.4	0.4	0.27	0.12	0.23	0.3	0.44	0.39	0.4	0.46	0.41	0.35	0.27	0.19	0.24	0.32

Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
O3	0.3	0.45	0.24	0.18	0.17	0.22	0.26	0.27	0.46	0.3	0.39	0.36	0.31	0.2	0.15	0.25
O4	0.4	0.23	0.36	0.31	0.19	0.23	0.28	0.46	0.4	0.39	0.42	0.38	0.39	0.41	0.28	0.2
O5	0.39	0.37	0.24	0.14	0.22	0.35	0.28	0.29	0.37	0.39	0.32	0.46	0.38	0.25	0.29	0.45
O6	0.31	0.24	0.18	0.18	0.27	0.32	0.25	0.21	0.33	0.42	0.37	0.2	0.21	0.35	0.63	0.52
O7	0.23	0.29	0.25	0.18	0.16	0.15	0.26	0.22	0.17	0.24	0.39	0.23	0.29	0.2	0.17	0.22
O8	0.26	0.38	0.16	0.12	0.17	0.39	0.22	0.2	0.2	0.41	0.39	0.14	0.25	0.35	0.41	0.21
O9	0.22	0.28	0.26	0.19	0.22	0.22	0.23	0.25	0.32	0.28	0.44	0.32	0.3	0.28	0.27	0.28
O10	0.18	0.16	0.15	0.18	0.22	0.26	0.28	0.16	0.24	0.27	0.29	0.15	0.25	0.34	0.48	0.18
O11	0.25	0.2	0.2	0.14	0.2	0.3	0.22	0.17	0.19	0.35	0.47	0.16	0.18	0.25	0.39	0.19
O12	0.22	0.22	0.25	0.34	0.28	0.21	0.21	0.24	0.31	0.27	0.33	0.28	0.3	0.25	0.22	0.18
O13	0.2	0.26	0.23	0.28	0.23	0.19	0.18	0.2	0.25	0.15	0.19	0.27	0.25	0.27	0.31	0.26
O14	0.14	0.15	0.14	0.12	0.16	0.18	0.16	0.11	0.11	0.21	0.33	0.15	0.19	0.25	0.35	0.15
O15	0.12	0.15	0.2	0.24	0.27	0.3	0.2	0.17	0.08	0.16	0.26	0.15	0.13	0.13	0.18	0.11
O16	0.2	0.17	0.24	0.26	0.2	0.34	0.25	0.26	0.38	0.17	0.11	0.34	0.24	0.24	0.28	0.22
O17	0.29	0.19	0.28	0.28	0.41	0.38	0.28	0.15	0.29	0.39	0.53	0.31	0.28	0.36	0.28	0.26
O18	0.24	0.27	0.28	0.24	0.35	0.28	0.26	0.2	0.19	0.29	0.53	0.3	0.29	0.31	0.36	0.23
O19	0.34	0.28	0.31	0.2	0.29	0.22	0.15	0.15	0.19	0.18	0.21	0.23	0.28	0.33	0.37	0.32
O20	0.24	0.29	0.32	0.3	0.36	0.32	0.23	0.18	0.11	0.13	0.22	0.32	0.25	0.29	0.25	0.23
O21	0.24	0.22	0.17	0.18	0.42	0.29	0.25	0.22	0.22	0.17	0.18	0.27	0.37	0.43	0.47	0.31
O22	0.18	0.13	0.15	0.15	0.23	0.14	0.08	0.05	0.07	0.09	0.25	0.22	0.21	0.28	0.29	0.21
O23	0.12	0.15	0.13	0.14	0.24	0.18	0.14	0.11	0.08	0.07	0.08	0.22	0.28	0.38	0.28	0.18
O24	0.4	0.34	0.32	0.24	0.36	0.26	0.1	0.08	0.09	0.14	0.3	0.2	0.27	0.37	0.26	0.45
O25	0.19	0.15	0.15	0.15	0.21	0.16	0.13	0.15	0.2	0.15	0.12	0.11	0.24	0.33	0.33	0.2

Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
O26	0.36	0.34	0.36	0.31	0.48	0.15	0.12	0.19	0.22	0.29	0.53	0.34	0.31	0.37	0.29	0.42
O27	0.29	0.29	0.28	0.18	0.31	0.15	0.11	0.09	0.08	0.12	0.31	0.34	0.32	0.28	0.26	0.34
O28	0.27	0.26	0.26	0.16	0.34	0.19	0.11	0.09	0.07	0.08	0.14	0.13	0.2	0.3	0.24	0.29
O29	0.28	0.3	0.33	0.23	0.16	0.07	0.09	0.13	0.15	0.18	0.27	0.15	0.14	0.3	0.17	0.3
O30	0.16	0.15	0.11	0.15	0.13	0.09	0.1	0.12	0.14	0.14	0.11	0.1	0.09	0.2	0.16	0.15
O31	0.31	0.34	0.31	0.21	0.22	0.11	0.1	0.09	0.14	0.18	0.3	0.22	0.25	0.37	0.18	0.25
O32	0.36	0.45	0.41	0.31	0.49	0.28	0.18	0.13	0.08	0.15	0.31	0.22	0.22	0.28	0.18	0.19
O33	0.41	0.41	0.37	0.24	0.17	0.12	0.15	0.13	0.19	0.15	0.2	0.21	0.29	0.34	0.19	0.33
O34	0.14	0.13	0.16	0.13	0.19	0.13	0.13	0.08	0.15	0.28	0.43	0.11	0.14	0.22	0.23	0.21
O35	0.23	0.32	0.35	0.23	0.27	0.22	0.19	0.07	0.11	0.18	0.29	0.26	0.28	0.37	0.19	0.24
O36	0.18	0.29	0.37	0.3	0.36	0.12	0.1	0.17	0.19	0.17	0.3	0.27	0.34	0.43	0.21	0.2
O37	0.2	0.15	0.17	0.12	0.15	0.13	0.16	0.14	0.17	0.2	0.32	0.2	0.15	0.33	0.31	0.21
O38	0.19	0.15	0.08	0.1	0.14	0.14	0.15	0.12	0.12	0.16	0.23	0.19	0.14	0.16	0.2	0.18
O39	0.25	0.31	0.24	0.2	0.36	0.24	0.22	0.08	0.07	0.1	0.3	0.26	0.22	0.19	0.18	0.26
O40	0.16	0.17	0.21	0.18	0.24	0.17	0.18	0.11	0.14	0.2	0.22	0.23	0.39	0.37	0.28	0.28
O41	0.23	0.19	0.13	0.15	0.18	0.16	0.13	0.17	0.17	0.23	0.17	0.13	0.19	0.16	0.2	0.19
O42	0.22	0.15	0.15	0.14	0.18	0.14	0.14	0.13	0.17	0.2	0.34	0.17	0.18	0.22	0.37	0.21
O43	0.26	0.23	0.23	0.2	0.32	0.19	0.18	0.11	0.08	0.13	0.21	0.16	0.31	0.42	0.42	0.29
O44	0.18	0.2	0.18	0.24	0.28	0.24	0.22	0.09	0.11	0.15	0.16	0.16	0.18	0.29	0.26	0.2
O45	0.28	0.41	0.4	0.4	0.5	0.3	0.16	0.07	0.12	0.2	0.21	0.15	0.27	0.38	0.35	0.24
O46	0.16	0.19	0.16	0.11	0.11	0.08	0.09	0.06	0.07	0.14	0.22	0.13	0.28	0.41	0.36	0.33
O47	0.28	0.18	0.14	0.15	0.2	0.18	0.17	0.11	0.14	0.24	0.38	0.25	0.14	0.21	0.33	0.31
O48	0.25	0.26	0.15	0.25	0.44	0.23	0.2	0.18	0.21	0.19	0.41	0.42	0.31	0.27	0.2	0.34

Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
O49	0.26	0.32	0.21	0.25	0.22	0.26	0.19	0.12	0.24	0.32	0.47	0.21	0.16	0.19	0.2	0.19
O50	0.28	0.29	0.27	0.25	0.33	0.33	0.38	0.08	0.14	0.13	0.15	0.11	0.15	0.23	0.32	0.31
O51	0.57	0.35	0.16	0.2	0.38	0.26	0.26	0.25	0.2	0.21	0.44	0.41	0.43	0.26	0.43	0.42
O52	0.27	0.36	0.25	0.26	0.19	0.28	0.16	0.1	0.18	0.19	0.24	0.12	0.17	0.26	0.3	0.27
O53	0.14	0.17	0.16	0.22	0.34	0.26	0.23	0.13	0.1	0.13	0.18	0.18	0.18	0.17	0.2	0.14
O54	0.28	0.21	0.37	0.23	0.2	0.29	0.26	0.09	0.16	0.27	0.35	0.24	0.22	0.44	0.45	0.22
O55	0.51	0.85	0.48	0.29	0.41	0.42	0.17	0.23	0.48	0.67	0.8	0.3	0.2	0.29	0.41	0.34
O56	0.53	0.42	0.21	0.22	0.29	0.23	0.3	0.16	0.11	0.17	0.26	0.18	0.29	0.32	0.21	0.28
O57	0.49	0.26	0.43	0.25	0.3	0.19	0.16	0.18	0.29	0.37	0.54	0.44	0.48	0.42	0.53	0.57
O58	0.42	0.38	0.17	0.36	0.36	0.2	0.12	0.18	0.27	0.33	0.35	0.12	0.23	0.21	0.24	0.36
O59	0.26	0.38	0.46	0.25	0.44	0.22	0.18	0.22	0.45	0.31	0.45	0.53	0.51	0.26	0.29	0.44
O60	0.37	0.41	0.31	0.27	0.35	0.32	0.23	0.17	0.36	0.35	0.29	0.18	0.21	0.33	0.23	0.38
O61	0.34	0.31	0.19	0.18	0.3	0.18	0.29	0.23	0.21	0.2	0.38	0.34	0.38	0.25	0.21	0.44
O62	0.52	0.34	0.21	0.14	0.15	0.31	0.32	0.2	0.25	0.32	0.46	0.34	0.3	0.39	0.44	0.3
O63	0.21	0.29	0.19	0.17	0.16	0.16	0.22	0.11	0.12	0.16	0.27	0.17	0.19	0.22	0.3	0.37
O64	0.33	0.4	0.25	0.24	0.38	0.2	0.31	0.25	0.2	0.29	0.39	0.12	0.19	0.42	0.27	0.35
O65	0.24	0.43	0.37	0.42	0.27	0.18	0.11	0.1	0.22	0.33	0.38	0.18	0.15	0.2	0.44	0.32
O66	0.39	0.3	0.21	0.37	0.3	0.16	0.2	0.19	0.15	0.16	0.24	0.15	0.16	0.41	0.35	0.32
O67	0.24	0.4	0.32	0.3	0.28	0.2	0.15	0.13	0.15	0.2	0.39	0.16	0.26	0.26	0.53	0.39
O68	0.24	0.22	0.24	0.16	0.15	0.11	0.14	0.31	0.31	0.3	0.28	0.14	0.14	0.25	0.36	0.31
O69	0.53	0.32	0.28	0.14	0.22	0.41	0.26	0.24	0.24	0.3	0.29	0.16	0.24	0.31	0.26	0.2
O70	0.29	0.44	0.46	0.14	0.11	0.19	0.26	0.2	0.33	0.47	0.41	0.17	0.17	0.25	0.33	0.24
O71	0.3	0.28	0.45	0.36	0.19	0.13	0.23	0.29	0.29	0.47	0.37	0.14	0.14	0.3	0.38	0.32

Table 9. VR_w values with and without the installation of potential buildings within the PDA under annual wind condition.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15
with	0.25	0.29	0.21	0.26	0.15	0.24	0.18	0.34	0.27	0.23	0.20	0.18	0.31	0.32	0.27
without	0.41	0.29	0.20	0.32	0.20	0.26	0.16	0.24	0.17	0.26	0.20	0.29	0.30	0.36	0.33
	P16	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**	**P25**	**P26**	**P27**	**P28**	**P29**	**P30**
with	0.10	0.15	0.18	0.24	0.31	0.25	0.26	0.28	0.27	0.22	0.23	0.20	0.30	0.19	0.19
without	0.11	0.17	0.27	0.21	0.32	0.27	0.21	0.25	0.24	0.21	0.27	0.22	0.25	0.20	0.27
	P31	**P32**	**P33**	**P34**	**P35**	**P36**	**P37**	**P38**	**P39**	**P40**	**P41**	**P42**	**P43**	**O1**	**O2**
with	0.23	0.41	0.18	0.25	0.31	0.29	0.33	0.25	0.37	0.45	0.43	0.46	0.46	0.26	0.29
without	0.22	0.34	0.19	0.22	0.28	0.25	0.41	0.24	0.44	0.47	0.55	0.52	0.46	0.26	0.29
	O3	**O4**	**O5**	**O6**	**O7**	**O8**	**O9**	**O10**	**O11**	**O12**	**O13**	**O14**	**O15**	**O16**	**O17**
with	0.28	0.30	0.27	0.25	0.23	0.24	0.25	0.20	0.22	0.28	0.24	0.16	0.21	0.23	0.31
without	0.28	0.30	0.29	0.30	0.22	0.27	0.27	0.29	0.25	0.31	0.26	0.23	0.23	0.27	0.37
	O18	**O19**	**O20**	**O21**	**O22**	**O23**	**O24**	**O25**	**O26**	**O27**	**O28**	**O29**	**O30**	**O31**	**O32**
with	0.29	0.24	0.29	0.24	0.16	0.15	0.27	0.16	0.34	0.24	0.21	0.22	0.13	0.24	0.34
without	0.36	0.28	0.29	0.27	0.31	0.27	0.32	0.18	0.34	0.30	0.27	0.26	0.16	0.28	0.25
	O33	**O34**	**O35**	**O36**	**O37**	**O38**	**O39**	**O40**	**O41**	**O42**	**O43**	**O44**	**O45**	**O46**	**O47**
with	0.25	0.17	0.26	0.28	0.16	0.14	0.25	0.20	0.17	0.17	0.22	0.21	0.35	0.14	0.19
without	0.34	0.16	0.27	0.31	0.16	0.13	0.17	0.27	0.19	0.18	0.24	0.25	0.35	0.16	0.18
	O48	**O49**	**O50**	**O51**	**O52**	**O53**	**O54**	**O55**	**O56**	**O57**	**O58**	**O59**	**O60**	**O61**	**O62**
with	0.28	0.27	0.25	0.29	0.25	0.21	0.25	0.49	0.27	0.31	0.31	0.35	0.32	0.25	0.25
without	0.27	0.34	0.26	0.30	0.33	0.20	0.28	0.50	0.27	0.33	0.21	0.40	0.34	0.28	0.26
	O63	**O64**	**O65**	**O66**	**O67**	**O68**	**O69**	**O70**	**O71**						
with	0.20	0.30	0.34	0.27	0.29	0.20	0.25	0.27	0.30						
without	0.19	0.28	0.35	0.27	0.31	0.21	0.24	0.25	0.30						

Table 10. VR_w values with and without the installation of potential buildings within the PDA under summer wind condition

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15
with	0.28	0.32	0.27	0.34	0.18	0.20	0.18	0.29	0.26	0.22	0.21	0.16	0.27	0.30	0.35
without	0.33	0.24	0.22	0.29	0.18	0.27	0.18	0.18	0.13	0.22	0.17	0.27	0.27	0.33	0.30
	P16	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**	**P25**	**P26**	**P27**	**P28**	**P29**	**P30**
with	0.11	0.17	0.19	0.31	0.35	0.31	0.29	0.31	0.23	0.19	0.22	0.17	0.22	0.16	0.17
without	0.10	0.18	0.25	0.22	0.35	0.34	0.28	0.33	0.28	0.25	0.28	0.22	0.24	0.21	0.28
	P31	**P32**	**P33**	**P34**	**P35**	**P36**	**P37**	**P38**	**P39**	**P40**	**P41**	**P42**	**P43**	**O1**	**O2**
with	0.22	0.28	0.17	0.26	0.32	0.23	0.28	0.26	0.35	0.42	0.41	0.38	0.51	0.32	0.35
without	0.21	0.25	0.20	0.23	0.27	0.21	0.35	0.22	0.35	0.38	0.52	0.47	0.40	0.32	0.35
	O3	**O4**	**O5**	**O6**	**O7**	**O8**	**O9**	**O10**	**O11**	**O12**	**O13**	**O14**	**O15**	**O16**	**O17**
with	0.30	0.34	0.32	0.30	0.25	0.28	0.29	0.24	0.27	0.28	0.21	0.19	0.21	0.23	0.36
without	0.33	0.37	0.34	0.37	0.26	0.32	0.32	0.31	0.30	0.34	0.24	0.24	0.26	0.30	0.39
	O18	**O19**	**O20**	**O21**	**O22**	**O23**	**O24**	**O25**	**O26**	**O27**	**O28**	**O29**	**O30**	**O31**	**O32**
with	0.33	0.22	0.25	0.24	0.16	0.14	0.23	0.15	0.33	0.22	0.16	0.18	0.12	0.21	0.26
without	0.38	0.28	0.31	0.28	0.30	0.27	0.31	0.19	0.33	0.30	0.27	0.24	0.15	0.26	0.24
	O33	**O34**	**O35**	**O36**	**O37**	**O38**	**O39**	**O40**	**O41**	**O42**	**O43**	**O44**	**O45**	**O46**	**O47**
with	0.20	0.21	0.23	0.24	0.20	0.16	0.22	0.21	0.17	0.20	0.20	0.19	0.25	0.14	0.23
without	0.30	0.18	0.25	0.26	0.18	0.14	0.18	0.23	0.19	0.19	0.21	0.21	0.30	0.19	0.20
	O48	**O49**	**O50**	**O51**	**O52**	**O53**	**O54**	**O55**	**O56**	**O57**	**O58**	**O59**	**O60**	**O61**	**O62**
with	0.30	0.28	0.21	0.31	0.21	0.19	0.26	0.48	0.23	0.35	0.27	0.36	0.29	0.28	0.31
without	0.29	0.28	0.23	0.31	0.33	0.18	0.28	0.41	0.24	0.28	0.18	0.37	0.35	0.27	0.30
	O63	**O64**	**O65**	**O66**	**O67**	**O68**	**O69**	**O70**	**O71**						
with	0.19	0.28	0.27	0.22	0.25	0.21	0.26	0.29	0.29						
without	0.19	0.26	0.30	0.24	0.26	0.24	0.25	0.26	0.31						

Table 11. SVR and LVR values with and without the installation of potential development under both annual and summer wind conditions

	Annual		Summer	
	with	**without**	**with**	**without**
SVR	0.27	0.28	0.26	0.27
LVR	0.26	0.27	0.25	0.27

Table 12. Test results for the main roads within the PDA.

		VR_w results for annual wind			VR_w results for annual wind		
Road	**Test Point**	**with**	**without**		**with**	**without**	
Road-1	P36	0.29	0.25		0.23	0.21	
	O58	0.31	0.21		0.27	0.18	
	P3	0.21	0.20		0.27	0.22	
	P38	0.25	0.24		0.26	0.22	
	O57	0.31	0.33		0.35	0.28	
	O59	0.35	0.40		0.36	0.37	
	Mean	***0.29***	***0.27***		***0.29***	***0.25***	
Road-2	P29	0.19	0.20		0.16	0.21	
	O32	0.34	0.25		0.26	0.24	
	O35	0.26	0.27		0.23	0.25	
	O36	0.28	0.31		0.24	0.26	
	P11	0.20	0.20		0.21	0.17	
	Mean	***0.25***	***0.25***		***0.22***	***0.23***	
Road-3	P26	0.23	0.27		0.22	0.28	
	P25	0.22	0.21		0.19	0.25	
	O20	0.29	0.29		0.25	0.31	
	O18	0.29	0.36		0.33	0.38	
	O14	0.16	0.23		0.19	0.24	
	O10	0.20	0.29		0.24	0.31	
	O6	0.25	0.30		0.30	0.37	
	Mean	***0.23***	***0.28***		***0.25***	***0.31***	

Table 13. Test results Test results for the main roads in the surrounding area.

		VR_w results for annual wind			VR_w results for annual wind	
Road	**Test Point**	**with**	**without**		**with**	**without**
Ping Yee Rd.	O69	0.25	0.24		0.26	0.25
	O70	0.27	0.25		0.29	0.26
	O71	0.30	0.30		0.29	0.31
	Mean	***0.27***	***0.26***		***0.28***	***0.27***
Wang Lok St.	O48	0.28	0.27		0.30	0.29
	O51	0.29	0.30		0.31	0.31
	O61	0.25	0.28		0.28	0.27
	Mean	***0.27***	***0.28***		***0.30***	***0.29***
Long Ping Rd.	P31	0.23	0.22		0.22	0.21
	P32	0.41	0.34		0.28	0.25
	P33	0.18	0.19		0.17	0.20
	P34	0.25	0.22		0.26	0.23
	P35	0.31	0.28		0.32	0.27
	P36	0.29	0.25		0.23	0.21
	O65	0.34	0.35		0.27	0.30
	Mean	***0.29***	***0.26***		***0.25***	***0.24***
Fuk Hi St.	O2	0.29	0.29		0.35	0.35
	O5	0.27	0.29		0.32	0.34
	O9	0.25	0.27		0.29	0.32
	O13	0.24	0.26		0.21	0.24
	P26	0.23	0.27		0.22	0.28
	O21	0.24	0.27		0.24	0.28
	P27	0.20	0.22		0.17	0.22
	P28	0.30	0.25		0.22	0.24
	P29	0.19	0.20		0.16	0.21
	P30	0.19	0.27		0.17	0.28
	P31	0.23	0.22		0.22	0.21
	O44	0.21	0.25		0.19	0.21
	O47	0.19	0.18		0.23	0.20
	O51	0.29	0.30		0.31	0.31
	Mean	***0.24***	***0.25***		***0.24***	***0.26***
Fuk Wang St.	O4	0.30	0.30		0.34	0.37
	O7	0.23	0.22		0.25	0.26
	O9	0.25	0.27		0.29	0.32
	Mean	***0.26***	***0.26***		***0.29***	***0.32***
Fuk Hang St.	O12	0.28	0.31		0.28	0.34
	O13	0.24	0.26		0.21	0.23
	Mean	***0.26***	***0.29***		***0.25***	***0.29***