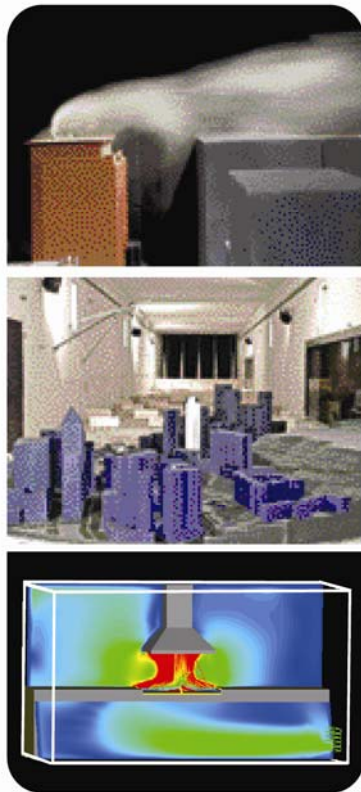




CERMAK
PETERKA
PETERSEN

WIND ENGINEERING AND AIR QUALITY CONSULTANTS

FINAL REPORT



Wind Assessment for:

7 Parkview Drive, Sydney Olympic Park
Homebush Bay, NSW, Australia

Bovis Lend Lease

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November 2009

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Introduction

Cermak Peterka Petersen Pty. Ltd. (CPP) has been engaged by Bovis Lend Lease to provide a qualitative pedestrian level wind assessment of the proposed Parkview Drive development. The following opinion based assessment draws upon previous work conducted on this and neighbouring sites.

The proposed development consists of several new buildings to the east of the existing Sydney Olympic Park, Figure 1. To the west of the site is a mix of grandstand and buildings associated with the facilities of Sydney Olympic Park. An historic brick pit site is located to the north, and Bicentennial Park and suburban zones are located to the east and south. The site generally slopes from north-west to south-east.



Figure 1: Location of the proposed development (Google Earth, 2007)

The development is made up of five main buildings; three commercial developments on the western half of the site and two residential towers with adjoining low-rise buildings on the eastern half of the site, Figure 2. The plant room of Building A rises 26.7 m above the lowest ground level and the proposed height of the other buildings is similar from a wind perspective. Various pedestrian thoroughfares and break-out areas are located throughout the development.

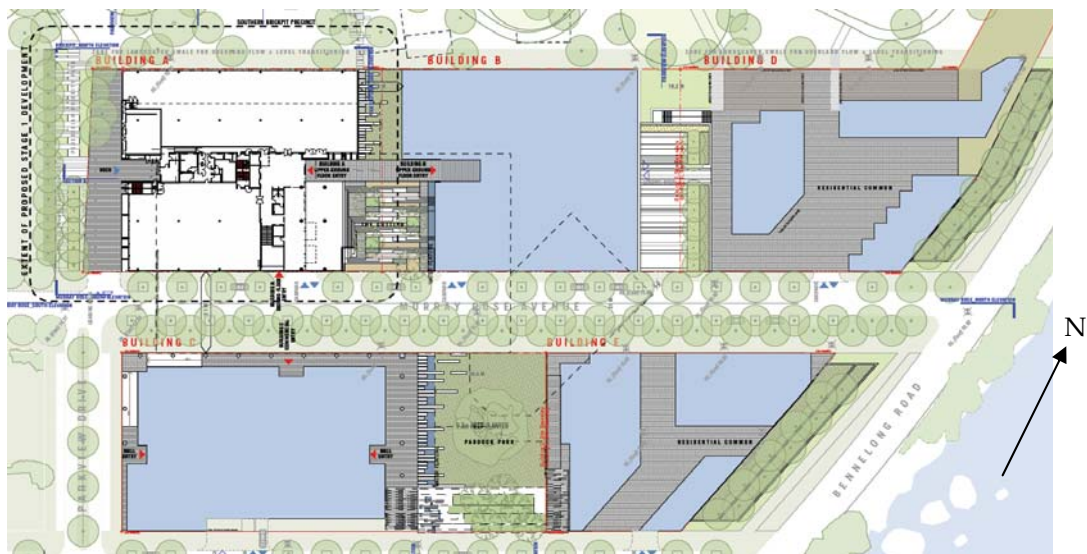


Figure 2: Ground floor plan

It is proposed that construction will be staged with commercial Building A to the west of the site being constructed first, followed by commercial Building B, with the remaining buildings at a later stage.

Existing Wind Environment

The Bureau of Meteorology (BoM) anemometer site at Homebush is known to produce directionally biased wind measurements, due to its proximity to surrounding developments. Therefore an analysis of meteorological data from Bankstown Airport (BoM Station 066137 66) has been conducted to assess the local wind climate and is considered to be representative of Homebush wind environment (Appendix A).

Analysis is based on data 24 hours per day from 10 January 1996 through to 16 October 2007. Wind speeds are mean speeds in km/h and temperatures are in degrees Celsius. Wind climate data have been grouped into bands of wind speed and direction with the probability of occurrence of each band calculated. The average temperature for each band of wind speed and direction was extracted.

The analysis has been performed on a seasonal basis; i.e. during summer (December, January, February), autumn (March, April, May), winter (June, July, August), and spring (September, October, November). In Appendix A, the cumulative bar graphs show the percent of time wind blows for a wind speed range and direction, and the radar plots show the average temperature for the given wind speed range and direction. Key characteristics of the Homebush wind climate are:

- Strong (>30 km/h) summer winds occur mainly from the south-east and west quadrants. Frequent lower intensity winds occur from the north-east. South winds generally provide the strongest gusts during summer.
- Autumn, late winter, and spring winds occur mainly from the south and west quadrants.
- West quadrant winds tend to produce the strongest winds affecting the site throughout the year.

Isolated structures in this area are known to have serviceability wind conditions and care needs to be taken in designing such unshielded structures.

Wind Flow Mechanisms

When the wind hits an isolated building, the wind is accelerated down and around the windward corners, Figure 3; this flow mechanism is called downwash and causes the windiest conditions at ground level on the windward side of the building. In Figure 3 smoke is being released into the wind flow to allow the wind speed, turbulence, and direction to be visualised. The image on the left shows smoke being released across the windward face, and the image on the right shows smoke being released into the flow at about third height in the centre of the face.

Techniques to mitigate the effects of downwash winds on pedestrians include the provision of horizontal elements, the most effective being a podium to divert the flow away from pavements and building entrances. Awnings along street frontages perform a similar function and the larger the horizontal element the more effective it will be in diverting the flow. It should be noted that colonnades at the base of a building with no podium create augmented windy conditions at the corners.

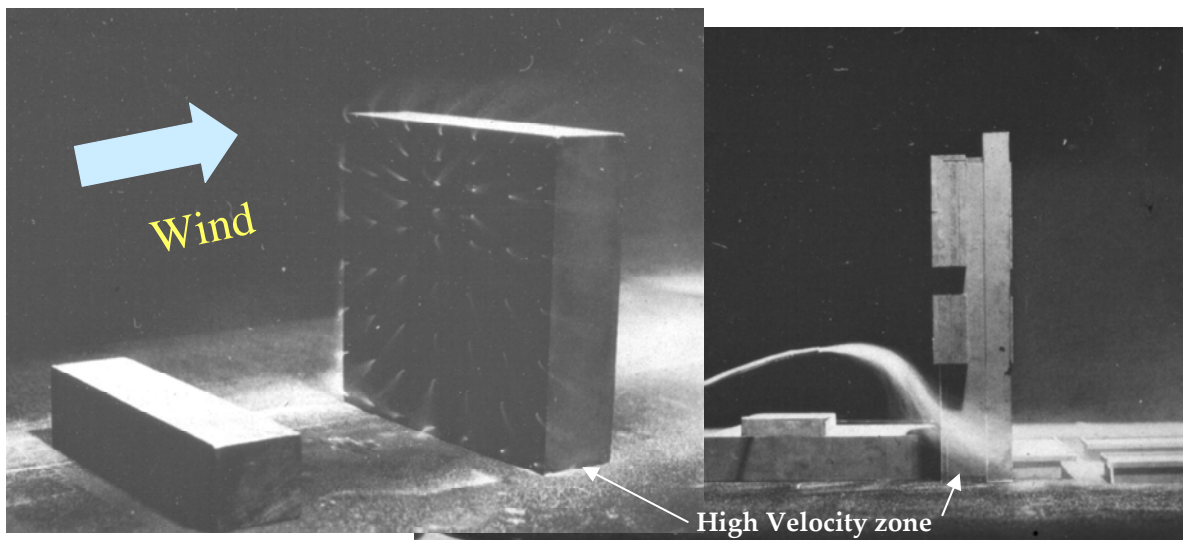


Figure 3: Flow visualisation around a building

Channelling occurs when the wind is accelerated between two buildings or along straight streets with buildings on either side, Figure 4. This will be the primary mechanism driving the wind conditions for this development.

Figure 3 shows wind at mid and upper levels on a building is accelerated substantially around the corners. When balconies are located on these corners they are likely to be breezy, and will be used less by the owner due to the regularity of stronger winds. Owners in medium-rise structures quickly become familiar with when and how to use their balconies. If the corner balconies are deep enough, articulated, or have regular partition privacy fins then local calmer conditions can exist.

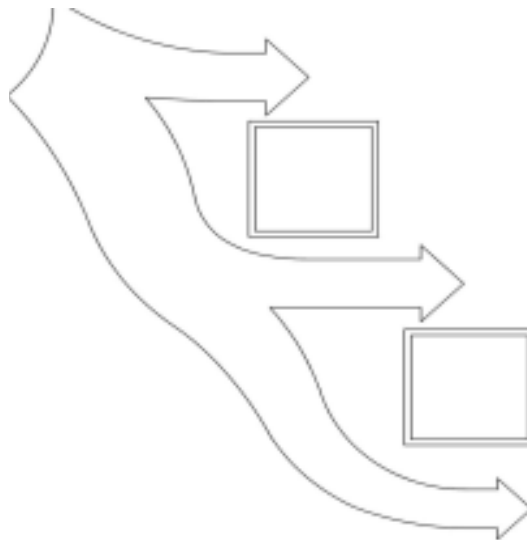


Figure 4: Wind channelling between buildings

Wind Acceptability Criterion

Prior to assessing the wind environment it is imperative to establish suitable targets in terms of the desired environmental wind conditions. Auburn Council development control plan (DCP) contains no specific wind speed criteria, however it is generally accepted that wind speed and the rate of change of wind velocity are the primary parameters that should be used in the assessment of how wind affects pedestrians.

Local wind effects can be assessed with respect to a number of environmental wind speed criteria established by various researchers, e.g. Melbourne (1978, referenced by Sydney City and other Australian Councils), and Lawson (1990), Table 1. Common to the cited criteria is a suggested list of suitable human activities associated at various levels of wind intensity and regularity. Despite the apparent differences in numerical values and assumptions made in their development, it has been found that when the criteria are compared on a probabilistic basis, there is remarkably good agreement.

Activity	Discomfort criterion
Long-term sitting	Wind speed of 4 m/s exceeded >5% of time
Standing or short term sitting	Wind speed of 6 m/s exceeded >5% of time
Strolling	Wind speed of 8 m/s exceeded >5% of time
Walking or cycling	Wind speed of 10 m/s exceeded >5% of time

Type of pedestrian	Distress criterion
General pedestrians	15 m/s wind speed exceeded once per annum (>0.022%)
Able bodied pedestrians	20 m/s wind speed exceeded once per annum (>0.022%)

The wind speed is either a mean wind speed or a gust equivalent mean (GEM) wind speed. The GEM wind speed is equal to the 3 s gust wind speed divided by 1.85.

Table 1: Lawson pedestrian comfort criteria for various activities

From Appendix A, the wind speed that occurs for 5% of the time is approximately 6.5 m/s. Table 1 would indicate that the site was suitable for strolling; any proposed outdoor café areas would therefore require significant shielding.

Wind tunnel testing is required to quantify wind conditions at the site against these established criteria. For structures of the proposed size and distribution, a qualitative estimate of wind conditions throughout the site based upon previous experience from wind tunnel tests is considered suitable. For consistency with the Melbourne and Lawson criteria, wind conditions in this qualitative report are described in terms of:

- Safety concerns - completely unacceptable for walking in main public accessways.
- Comfort of walking - generally acceptable for walking, wind conditions below safety concern.
- Short term stationary - generally acceptable for stationary short exposure activities (window shopping, or briefly sitting in plazas).
- Long term stationary - generally acceptable for stationary, long exposure activities (outdoor dining).

Environmental Wind Assessment

The main pedestrian access to the site is expected to be from the south-west along Murray Rose Avenue, which continues through the site.

The site will receive limited shielding to prevailing winds. As more of the buildings on the site are developed, localised wind conditions will typically become more pronounced due to channelling of the wind between buildings. Any further developments to the west and south of the site have the potential to improve overall wind conditions from increased shielding. The staggered nature of the buildings in plan, avoids wind corridors across site in the north-west/south-east direction. The number of trees in and around the site will assist in maintaining a suitable pedestrian level wind environment. In gaps between buildings and around corners the wind will accelerate and would likely approach distress levels in isolated areas. These general conditions would be similar for any building design of similar form and massing. The conditions can often be mitigated through the introduction of planting or porous screening at buildings corners. Images of the proposed development are reproduced in Figure 5.

The following discussion will concentrate on the completed development during prevailing wind conditions from the west and south quadrants.



a) west from Paddock Park to Building A

b) north to Buildings C, D (centre) and E

Figure 5: Photomontages of the proposed development

Westerly Winds

Winds from the west will be unimpeded on reaching the site and will accelerate around the north and south corners of Buildings A, B, and D; with Building A being the most exposed. The primary pedestrian access route is expected to be along Murray Rose Avenue passing close to the south corner of Buildings A and B, Figure 6. These south corners are marginally protected by the drop in terrain from the west and the slight set back in the adjacent building above the lowest level to account for the terrain change.

The south-western pedestrian paths are remote from Building A and B and shielded by trees, both of which will reduce the wind speed for pedestrians. The north corners of Building A and B are exposed to these winds with some protection being provided by the trees.

The winds will accelerate around the north corner of Building A and impact on the proposed outdoor dining area of Building B. Wind conditions at this outdoor dining area would be expected to be unacceptable for its intended use in accordance with the Lawson criterion and will require vertical screens to protect patrons during unsuitable wind conditions.

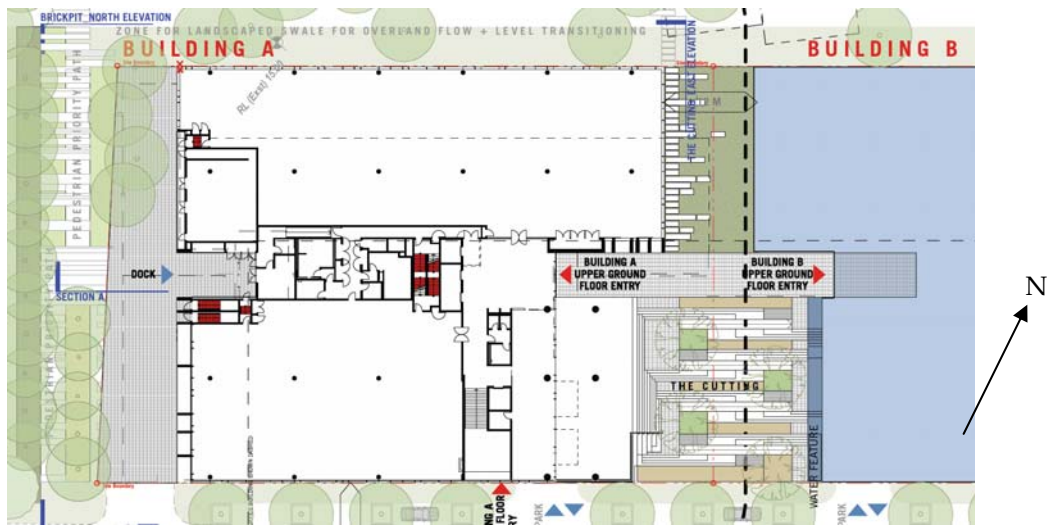


Figure 6: Ground floor plan of Building A

Building C, Figure 7, is also exposed to westerly winds, which will be accelerated along the north-west façade of Building C causing windy conditions under the colonnade. The height of the buildings will not cause significant downwash, but these winds will be drawn down under the colonnade near the northern corner, Figure 5a, and is expected to cause localised windy conditions. Outdoor dining is not considered acceptable near this northern corner during these wind events.

Wind conditions around the residential buildings are expected to be suitable for use as a main public accessway. If possible, corner balconies should be avoided, but if not should include side screening to discourage accelerating flows from passing through the open balcony spaces.

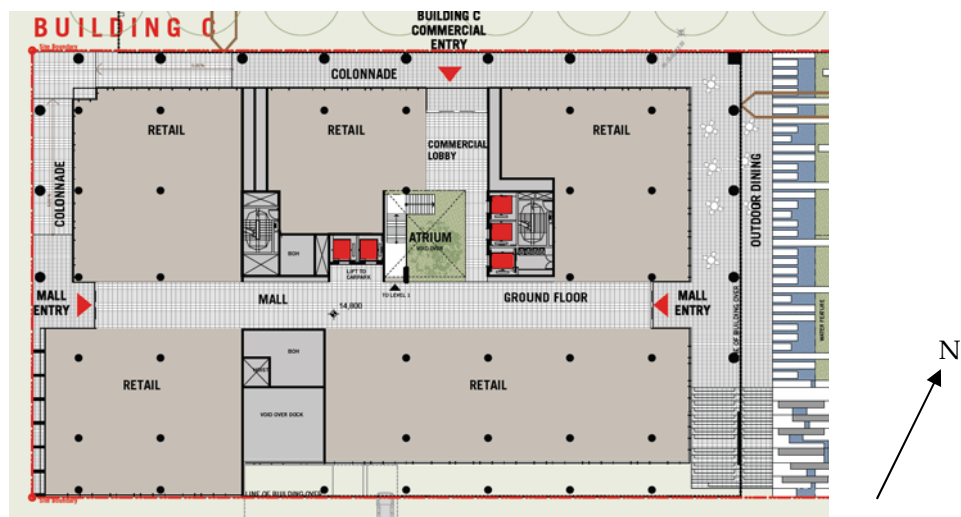


Figure 7: Ground floor plan of Building C

Southerly Winds

The site will receive limited shielding to winds from the south from upstream suburban developments. These winds will be accelerated around the east and west corners of the buildings, with Buildings A, C, and E being the most exposed. These winds will tend to accelerate across the site, from south to north, as the topography increases to the north-west, Figure 5.

The east and west corners of Building C are locally exposed to winds accelerating up the terrain and being drawn under the colonnades, especially in the east corner towards the top of the stairs, Figure 5b. This could be addressed by placing a mid-height horizontal awning extending beyond the building line then following the downward slope of the stairs, Figure 8, to encourage the flow to keep to the roof of the colonnade. Alternatively the façade of the building could be brought to ground level and external awnings placed surrounding the building.



Figure 8: Stair on east corner of Building C

The outdoor dining area in Building A may have unacceptable wind conditions for the intended use, during winds from the southern quadrants. These winds will accelerate around the eastern corner and create uncomfortable conditions at positions throughout, in particular overlooking Murray Rose Avenue. A high vertical screen, to meet the underside of the awning roof, along this section would offer protection to patrons. It should be noted that this awning will have to resist vertical wind loads during these events. The pedestrian priority path to south-west of Building A leading to Brickpit precinct is well placed to avoid any accelerated wind flow from the building massing.

General Discussion

The majority of the site is considered suitable for use as main public access, with the exception of a few potential localised conditions. These conditions would be expected to occur for any set of buildings of similar distribution and massing.

The main door entrances to the Buildings are considered to be well placed, in particular remote from building corners. Detailed operational issues associated with their placement will need to be considered once the detailed design is more fully developed.

The current proposed landscaping is considered appropriate for the site and the distribution is denser to that across the Olympic precinct. Generally street perimeter trees should include dense foliage canopies extending from 1-1.5 m above ground level attaining a minimum height of 4-5 m. Ideally, the trees should form a continuous arbour along the roadways to provide the necessary dispersion to channelling wind flows. Importantly, all trees should be evergreen to provide dispersion during winter months.

The type of screening for the outdoor dining areas depends on the desired quality of dining. It is recommended the screen be solid with a porous edge strip to break up accelerated shear flows. It

may be necessary to have temporary local screens to protect patrons from the elements (wind, rain, and temperature), this can be addressed during detailed design.

Summary

Cermak Peterka Petersen Pty. Ltd. has been engaged by Bovis Lend Lease to provide a qualitative assessment of the interaction of the proposed 7 Parkview Drive development with the local wind environment. Of most relevance to this study is the interaction of the completed site with prevailing local winds.

Areas most prone to higher wind velocities were identified; in particular building gaps associated with channelling flows, and in the form of shedding from sharp edge building corners. General comment has been made with respect to suitable mitigation strategies to deal with the interaction of prevailing winds with the overall building massing.

Detailed serviceability issues associated with outdoor cafes, door placement, internal pressure issues etc., can be considered after wind tunnel testing during detailed design.

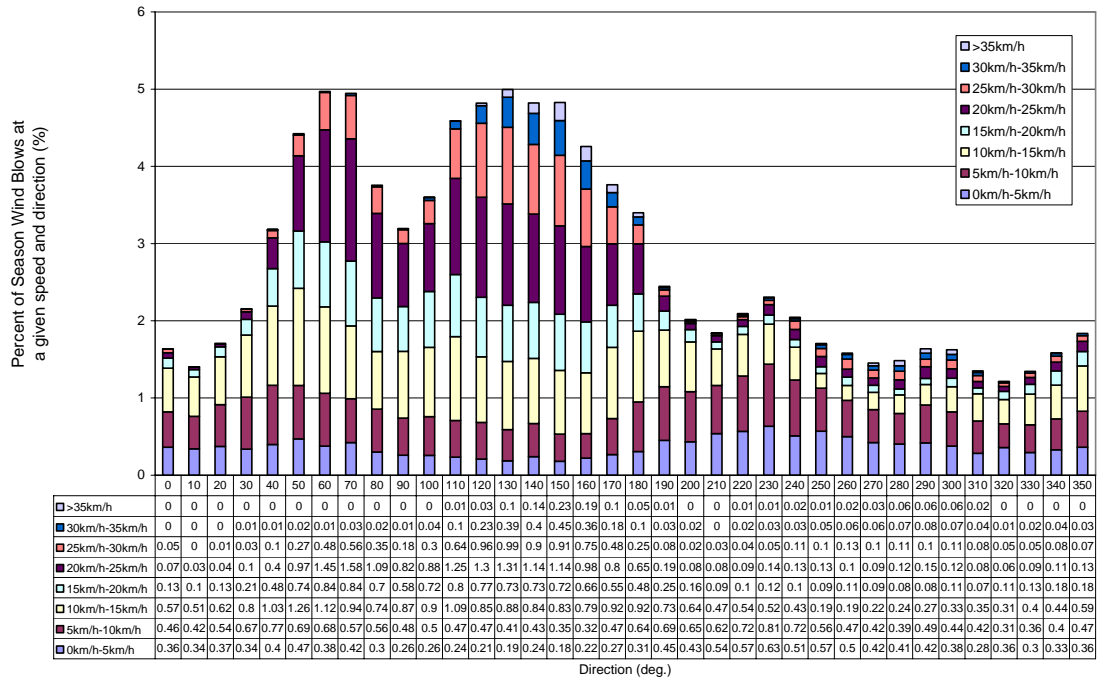
References

- Lawson, T.V., The Determination of the wind environment of a building complex before construction, Bristol University, England, 1990.
- Melbourne, W.H. (1978), Criteria for environmental wind conditions, *Journal of Industrial Aerodynamics*, 3, pp. 241-249.

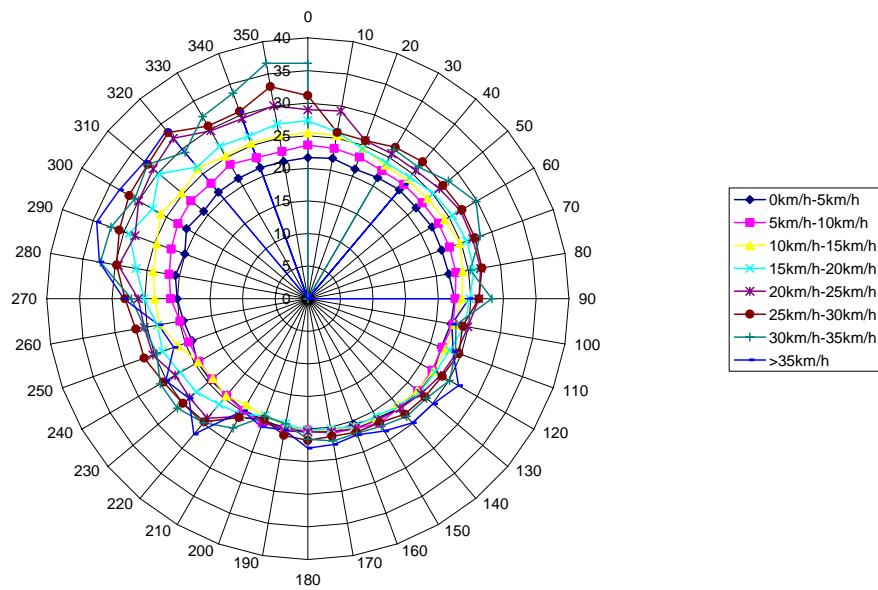
Appendix A – Wind Climate Analysis

Summer

Seasonal Average Wind Speed Distribution - Summer



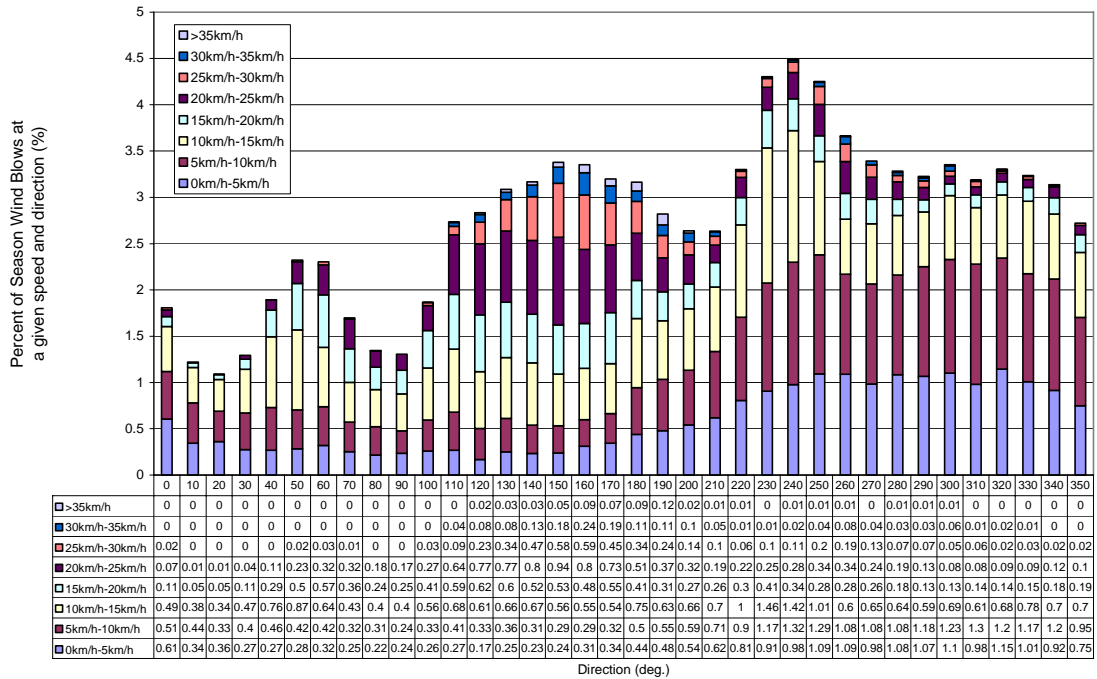
Average Wind Temperature vs Average Speed and Direction - Summer



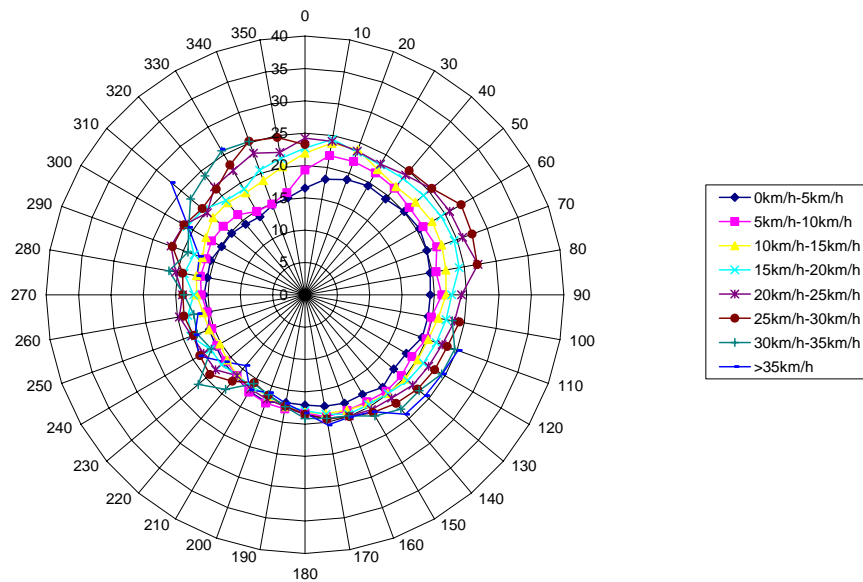
Radial scale in degrees centigrade.

Autumn

Seasonal Average Wind Speed Distribution - Autumn



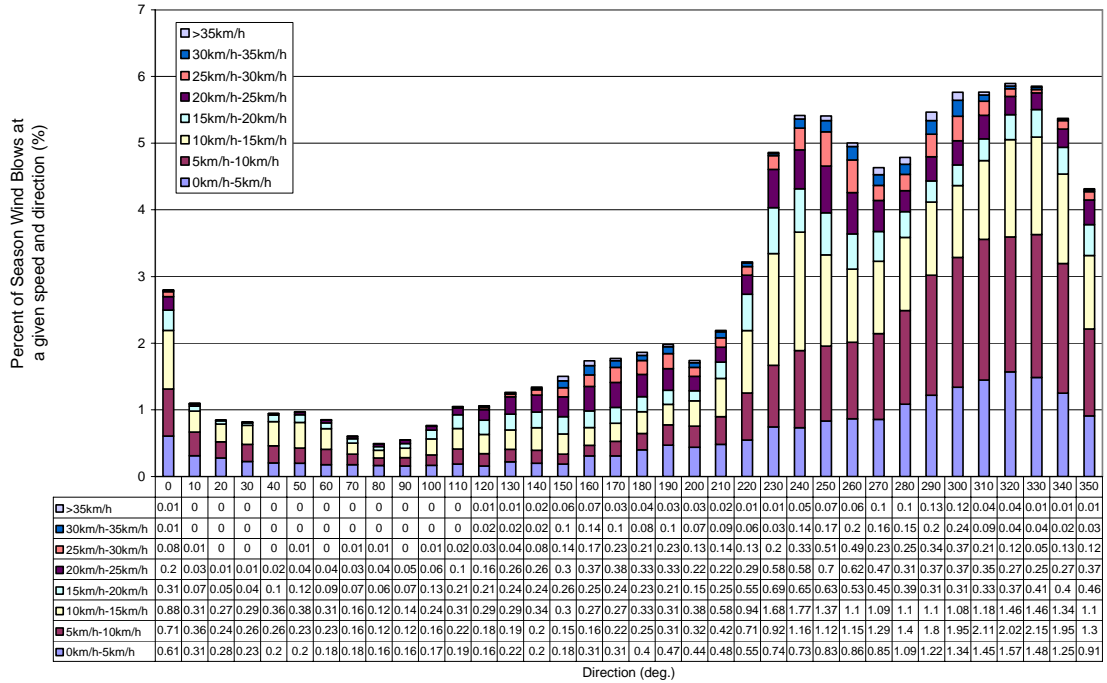
Average Wind Temperature vs Average Speed and Direction - Autumn



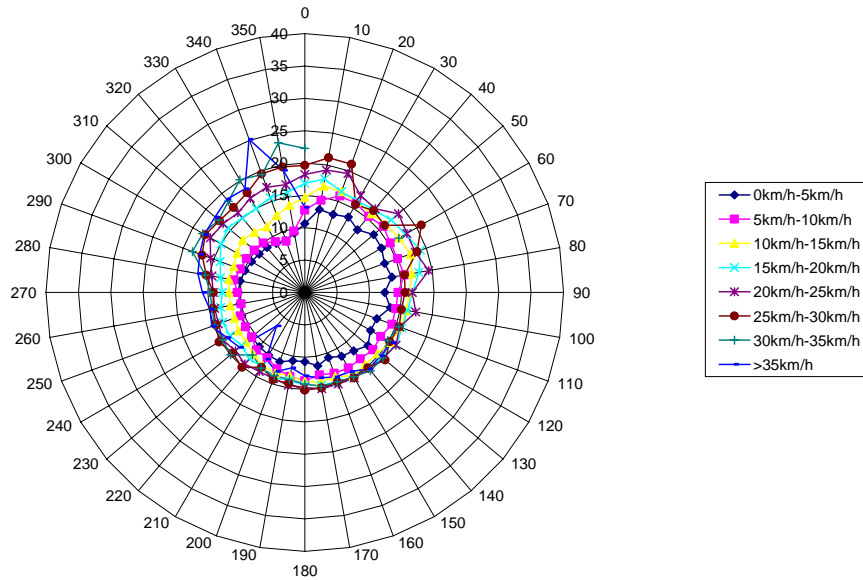
Radial scale in degrees centigrade.

Winter

Seasonal Average Wind Speed Distribution - Winter



Average Wind Temperature vs Average Speed and Direction - Winter



Radial scale in degrees centigrade.

