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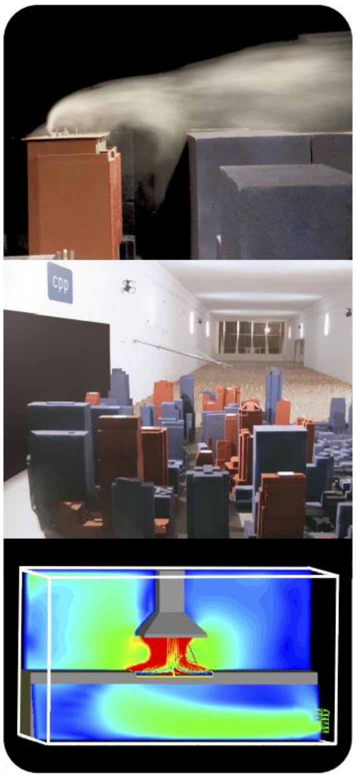
WIND ENGINEERING AND AIR QUALITY CONSULTANTS

FINAL REPORT



Wind Assessment for:

3 MURRAY ROSE AVENUE

Sydney Olympic Park, Australia

Lend Lease Project Management & Construction (Australia) Pty. Ltd.

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TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

Introduction

Cermak Peterka Petersen Pty. Ltd. has been engaged by Lend Lease Project Management & Construction (Australia) Pty. Ltd. to provide an opinion based assessment of the impact of the proposed development at 3 Murray Rose Avenue, Sydney Olympic Park on the pedestrian level local wind environment in and around the proposed development.

The proposed development consists of a new office building comprising ground floor plus four office levels above and four car parking levels below ground to the east of Sydney Olympic Park, Figure 1. To the west of the site is a mix of large 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 slopes from north-west to south-east.

Figure 1 Location of the proposed development (Near Map, 2012)

Bankstown Wind Climate

The proposed development lies approximately 11 km to the north-east of Bankstown Airport Bureau of Meteorology anemometer. The wind rose for Bankstown airport is shown in Figure 2. The Bureau of Meteorology anemometer at Homebush Bay is closer to the site, but is known to be directionally influenced by surrounding buildings, topography, and landscaping hence the readings are unreliable for pedestrian level wind comfort analysis. The prevailing strong winds at Bankstown come from the south-east and west quadrants.

Winds from the south-east, which tend to be cold, are often caused by frontal systems that can last several days and occur throughout the year. Winds from the west tend to be the strongest of the year and are associated with large weather patterns and thunderstorm activity. These winds occur throughout the year and can be cold or warm depending on the inland conditions. The prevailing wind directions associated with rain are from the south and west quadrants.

This wind assessment is focused on these prevailing wind directions.

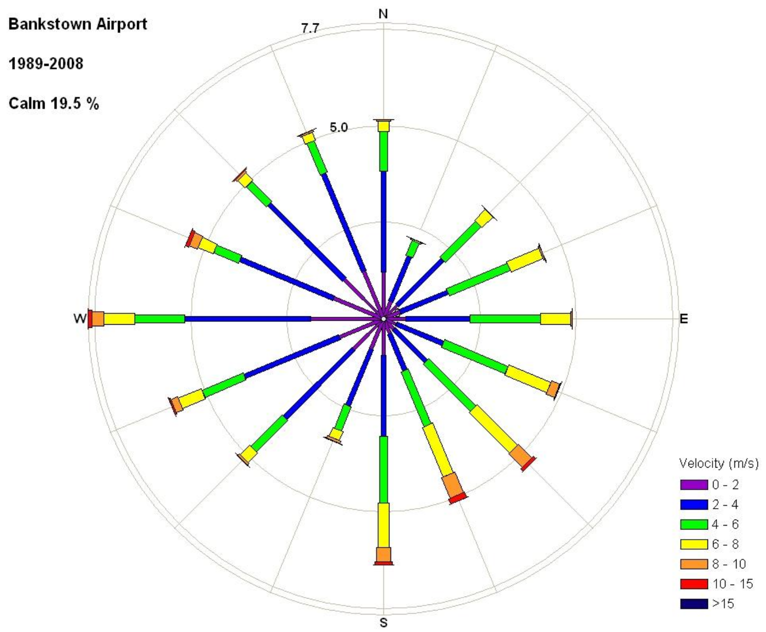

Figure 2: Wind rose for Bankstown Airport corrected to open country terrain

Environmental Wind Speed Criteria

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. Despite the apparent differences in numerical values and assumptions made in their development, it has been found that when these are compared on a probabilistic basis, there is remarkably good agreement.

Neither the Auburn Council development control plan (DCP) or the Sydney Olympic Park Master Plan 2030 have specific wind assessment criteria. The wind assessment criteria used in this study are based upon the research of Lawson (1990), which is described in Table 1 for both pedestrian comfort and distress. The benefits of these criteria over many in the field are that they use both a mean and gust equivalent mean (GEM) wind speed to assess the suitability of specific locations. The criteria based on the mean wind speeds define when the steady component of the wind causes discomfort, whereas the GEM wind speeds define when the wind gusts cause discomfort.

From a wind perspective, Bankstown Airport is relatively mild, with an average wind speed at 10 m reference height of approximately 3 m/s (6 kt, 11 kph), and five percent of the time the mean wind speed is approximately 8.5 m/s (17 kt, 31 kph). Converting the five percent of the time mean wind speed to typical pedestrian level at the site using Standards Australia (2011) would result in about 5.4 m/s (11 kt, 20 kph). Comparing this with the comfort criteria of Table 1 indicates that pre-existing winds at any Bankstown location with a similar built environment surrounding the proposed development site would be classified as acceptable for pedestrian standing. Specific building massing of the proposed development and their interaction with approaching wind flows will dictate the actual wind environment at the site and the resulting wind acceptability levels; these are explored in detail below.

Table 1: Pedestrian comfort criteria for various activities

Comfort (maximum wind speed exceeded 5% of the time)	
<2 m/s	Outdoor dining
2 - 4 m/s	Pedestrian sitting (considered to be of long duration)
4 - 6 m/s	Pedestrian standing (or sitting for a short time or exposure)
6 - 8 m/s	Pedestrian walking
8 - 10 m/s	Business walking (objective walking from A to B or for cycling)
> 10 m/s	Uncomfortable
Distress (max. wind speed exceeded 0.022% of the time, twice per annum)	
<15 m/s	General access area
15 - 20 m/s	Acceptable only where able bodied people would be expected; no frail people or cyclists expected
>20 m/s	Unacceptable

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.

Wind Flow Mechanisms

When the wind hits a large 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 corners and sides 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.

Channelling occurs when the wind is accelerated between two buildings or along straight streets with buildings on either side.

Figure 3 shows wind at mid and upper levels on a building is accelerated substantially around the corners of the building. 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 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.

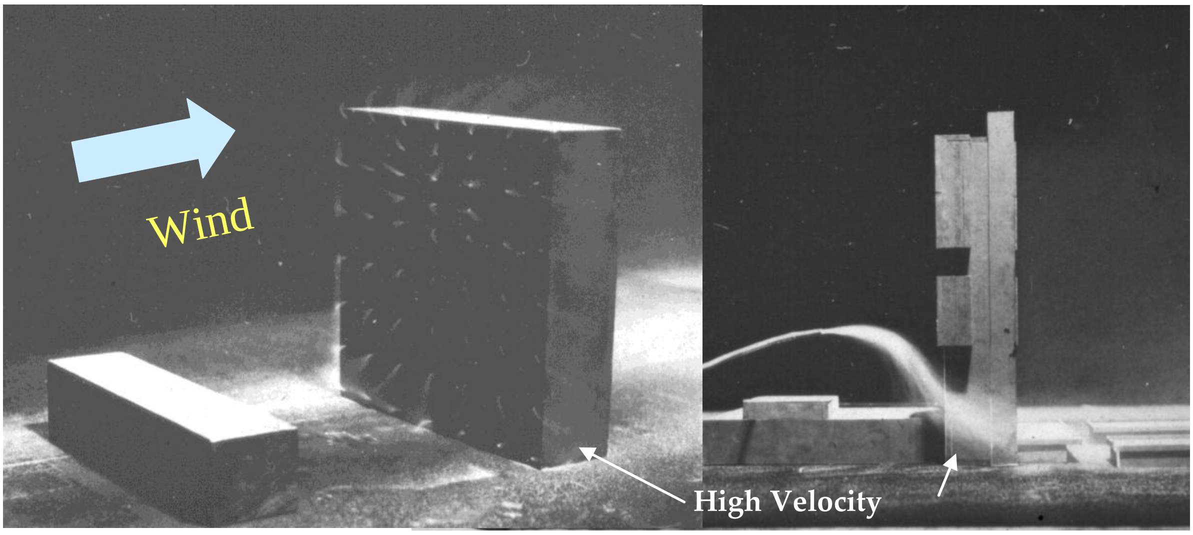

Figure 3: Flow visualisation around a tall building

Environmental Wind Assessment

The proposed commercial development is located to the east of Sydney Olympic Park, Figure 1. The proposed development consists of a 9-level building including three basements, rising approximately 30 m above the lowest ground level to the top of plant, Figure 4. Ground floor plans are shown in Figure 5 indicating the main entrances and outdoor area on Level 5. Topography surrounding the site generally slopes from north-west to south-east.

In general, the wind climate around Sydney Olympic Park is relatively mild and all the areas around the development are expected to be suitable for use as a main public accessway. This was confirmed by previous wind tunnel testing conducted around 5 Murray Rose Avenue, which included models for the neighbouring developments including 3 Murray Rose Avenue. The results of this previous testing showed that all locations around 5 Murray Rose Avenue were relatively calm and suitable for use as a main public accessway. The strongest winds are from the south-east and west quadrants. Due to the lack of shielding from upstream buildings, wind from the south-east will stagnate on the exposed south façade and accelerate down and around the windward corners creating local windier conditions. The change in topography to the north and the articulation of the west façade will assist in reducing these acceleration effects particularly at the main entrance on the west facade, Figure 5. The terrace area to the north-west of the site is located in an undercroft area. Wind will be accelerated through this area during winds from the south-east. It is considered that the terrace area would be classified as suitable for pedestrian standing similar to the previous wind-tunnel testing conducted on 5 Murray Rose Avenue. The pedestrian and bike entrance near the south-west corner from Murray Rose Avenue may experience serviceability issues during strong winds, as there will be a rapid change in wind speed over a short distance when exiting the façade line. Wind conditions, although slightly stronger at the southern corners are expected to remain acceptable for use as a main public accessway.

For winds from the west, the building will be shielded by the similar sized existing building at 5 Murray Rose Avenue.

Figure 4: South and east elevations of the proposed building

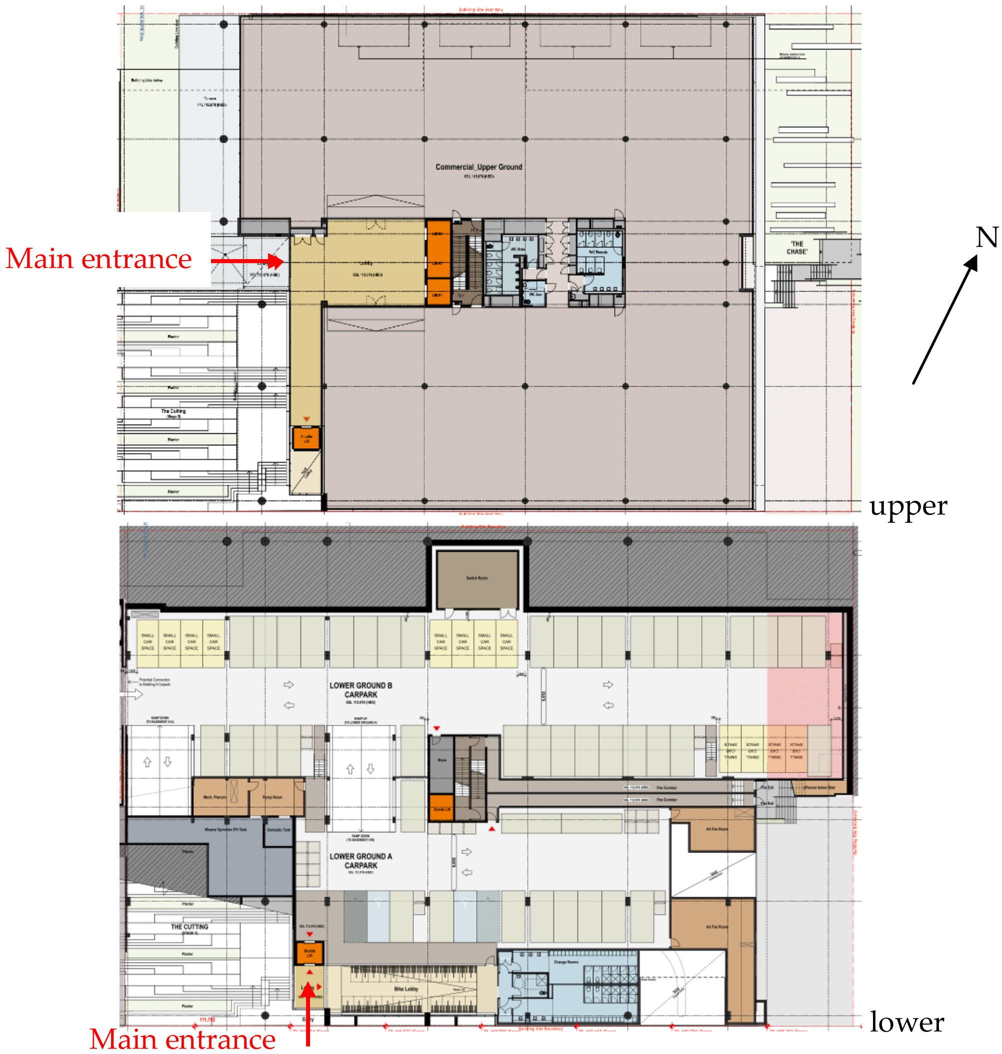

Figure 5: Upper and lower ground floor plans

Conclusions

Cermak Peterka Petersen Pty. Ltd. has provided an opinion based assessment of the impact on the local wind environment of the proposed development at 3 Murray Rose Avenue. Wind conditions around the site are expected to be suitable for use as a public accessway without any additional wind mitigation measures.

References

Lawson, T.V., (1990), The Determination of the wind environment of a building complex before construction, *Department of Aerospace Engineering, University of Bristol*, Report Number TVL 9025.

Standards Australia (2011), *Australian/New Zealand Standard, Structural Design Actions, Part 2: Wind Actions* (AS/NZS1170 Pt.2).