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WIND ENGINEERING AND AIR QUALITY CONSULTANTS

FINAL REPORT

Qualitative Wind Assessment for:

5-9 GORDON AVENUE, CHATSWOOD

Chatswood, NSW 2067, Australia

Prepared for:

DPG Project 32 Pty. Ltd.
c/- Develotek Property Group
97/97-99 Bathurst St, Sydney
NSW 2000, Australia

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CPP Project: 11937

Prepared by:
Kenneth Fung, Project Engineer
Matt Glanville, Ph.D., Director

CPP
Unit 2, 500 Princes Highway
St. Peters, NSW 2044, Australia
info-syd@cppwind.com
www.cppwind.com

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Cermak Peterka Petersen Pty. Ltd. has been engaged by DPG Project 32 Pty. Ltd. to provide a qualitative assessment of the impact of the proposed 5-9 Gordon Avenue, Chatswood development on the wind conditions in the surrounding areas.

The proposed development is located about 300 m south of the Chatswood CBD, in a region of low-rise suburban development, Figure 1. The proposed development will comprise of a single high-rise tower, rising to a height of about 90 m above ground level, Figure 2. As it is significantly larger than the surrounding structures, the addition of the proposed development is expected to have some impact on the local wind conditions, and the extents are broadly discussed in this report.

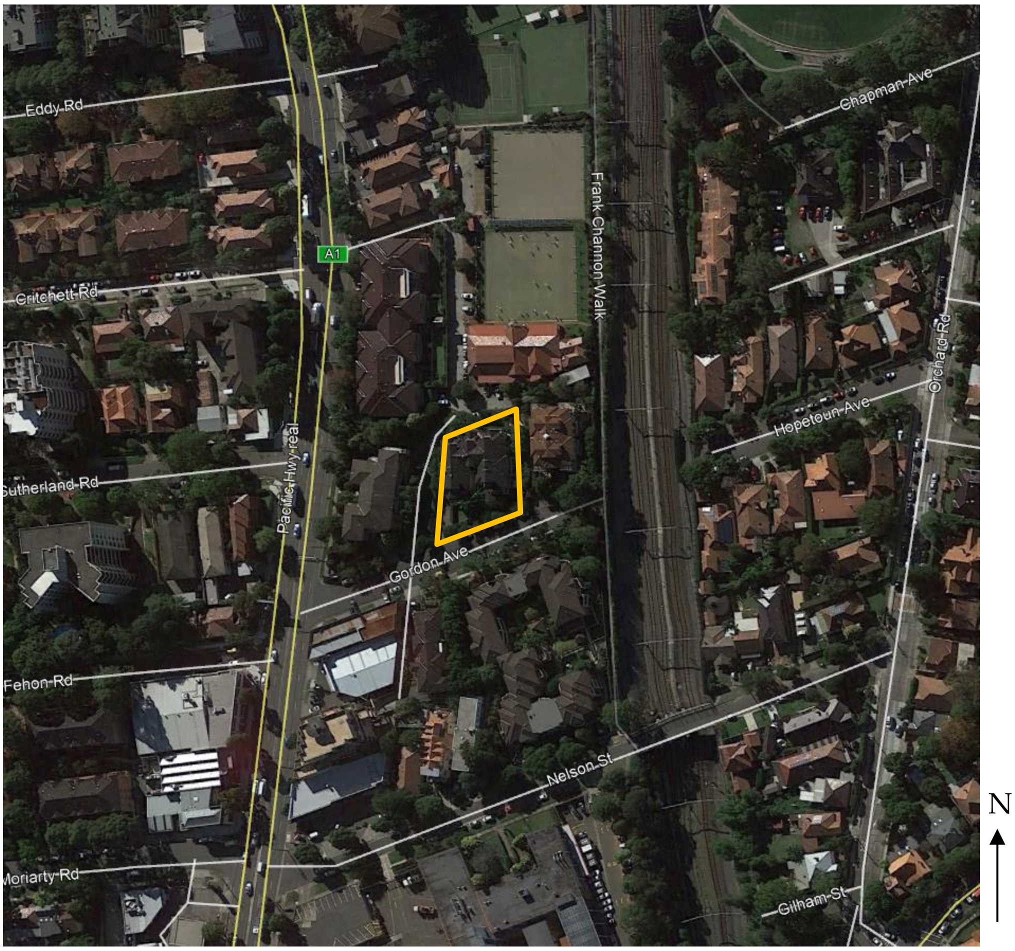

Figure 1: Aerial view of the proposed development site (Google Earth, 2016).

Figure 2: Proposed massing of the development, viewed from the south-west.

2. SYDNEY WIND CLIMATE

The proposed development lies approximately 16 km to the north of the Sydney Airport Bureau of Meteorology anemometer. To enable a qualitative assessment of the wind environment, the wind frequency and direction information measured by the Bureau of Meteorology at a standard height of 10 m at Sydney Airport from 1995 to 2016 have been used in this analysis. The wind rose for Sydney Airport is shown in Figure 3 and is considered to be representative of prevailing winds at the site. Strong prevailing winds are organised into three main groups which centre at about north-east, south, and west. This wind assessment is focused on these prevailing strong wind directions.

Winds from the north-east tend to be summer sea breezes and bring welcome relief on summer days, typically lasting from noon to dusk. These are small-scale temperature driven effects; the larger the temperature differential between land and sea, the stronger the breeze. Winds from the south are associated with large synoptic frontal systems and generally provide the strongest gusts during summer. Winds from the west are 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.

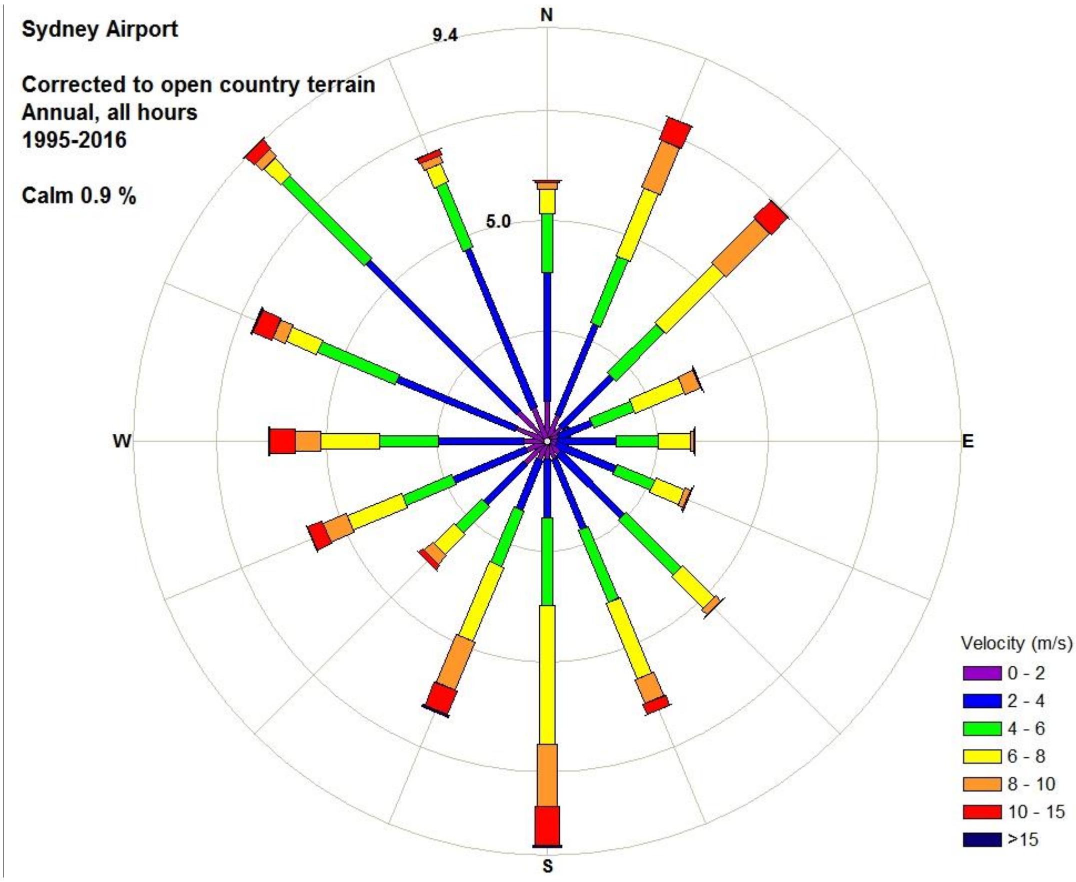

Figure 3: Wind rose for Sydney Airport corrected to open country terrain.

3. 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.

The Willoughby City Council DCP (2016) has no specific wind assessment criteria. This study is based upon the criteria of Lawson (1990), which are described in Table 1 for both pedestrian comfort and distress/safety. The benefits of these from a comfort perspective is that the 5% of the time wind event is appropriate for a precinct to develop a reputation from the general public. The limiting criteria are defined for both a mean and gust equivalent mean (GEM) wind speed. 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.

Table 1: Pedestrian comfort criteria for various activities

Comfort (max. 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/Safety (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 an hourly 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.

4. WIND FLOW MECHANISMS

When the wind hits a large isolated building, the wind is accelerated down and around the windward corners, Figure 4; 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 4, 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 4 shows the wind at mid and upper levels on a building being 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.

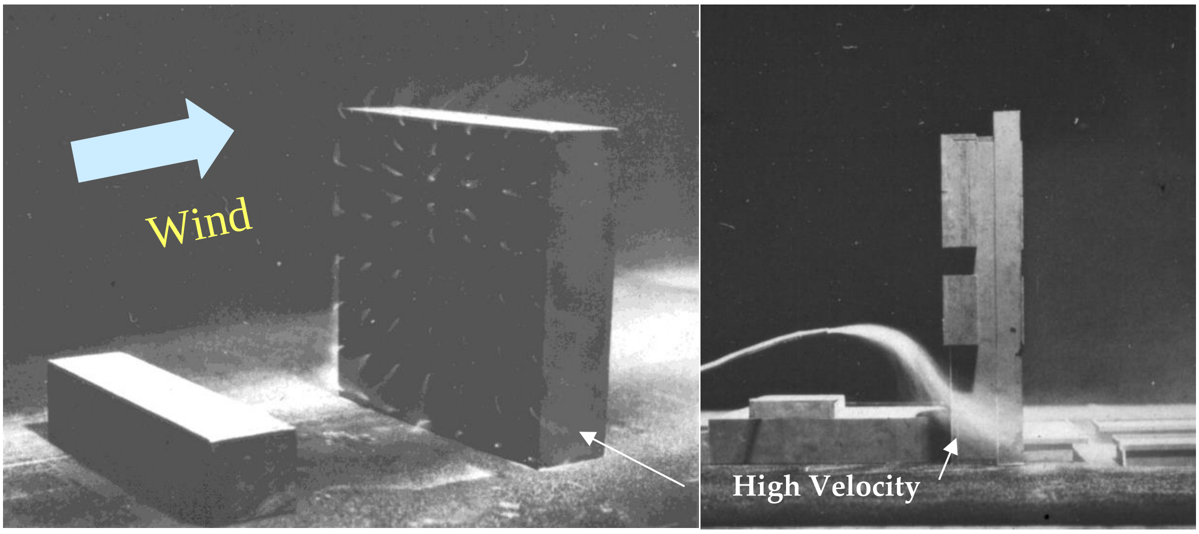

Figure 4: Flow visualisation around a tall building

Figure 5: Visualisation through corner balconies (left) and channelling between buildings (right)

5. ENVIRONMENTAL WIND ASSESSMENT

The development site is surrounded by low-rise buildings, with the North Shore Railway line situated to the east, and Chatswood CBD to the north. Topography surrounding the site is relatively flat from a wind perspective and unlikely to significantly affect the wind climate at the site. Winds in such surrounds tend to experience less channelling than areas with many tall structures, with local effects instead being dictated by exposed buildings and their relation to prevailing strong wind directions.

The subject site is located on the north-east corner of Gordon Avenue and Hammond Lane. The proposed development consists of a single high-rise tower sitting on top of a podium. A ground floor plan is shown in Figure 6.

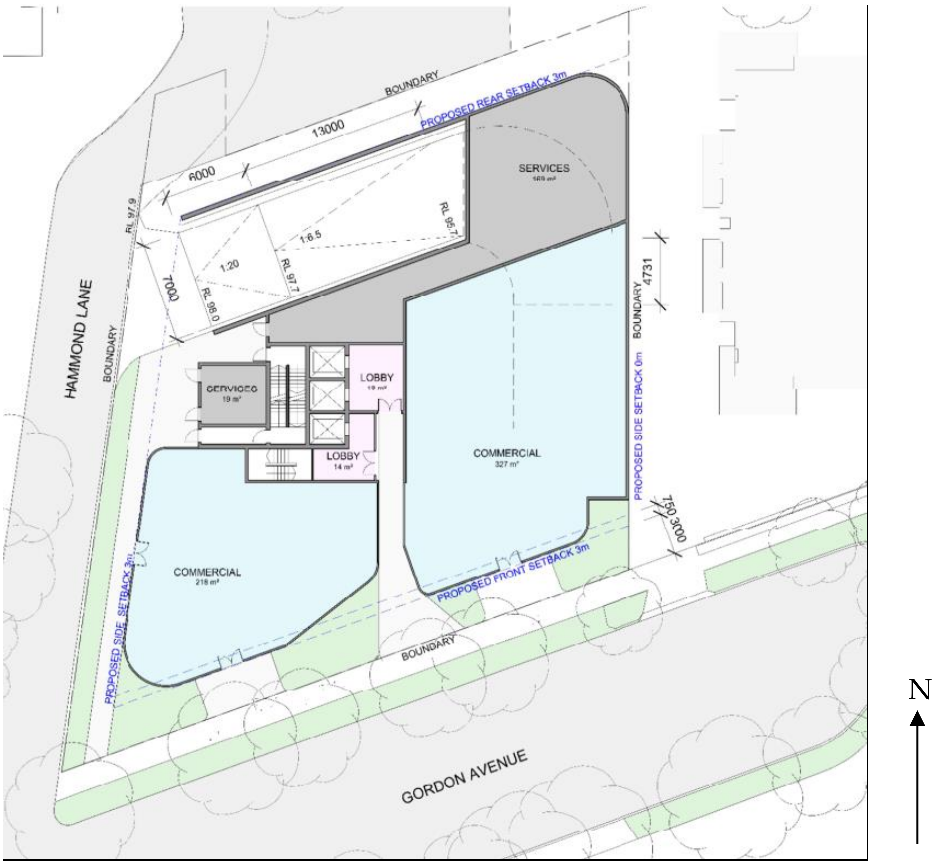

Figure 6: Ground floor of the proposed development

Winds from the north-east

Winds from the north-east quadrant will primarily approach over the low and medium-rise buildings of Chatswood. The proposed development would be expected to experience some shielding from winds from the north by the massing of the Chatswood CBD, but is relatively exposed to prevailing winds from the north-east. The orientation of the proposed development is considered beneficial from a wind perspective as it will encourage winds from the north-east to flow around the tower envelope, thereby reducing the amount of downwash generated from the building façades. The setback of the tower from the podium is also beneficial, as it will assist in deflecting downwash flow away from ground level. Residual downwash from the east façade would be expected to accelerate around the south-east corner of the podium before discharging along Gordon Avenue. It is noted that the undercut between the tower and podium will encourage flow to accelerate through this space, creating windy conditions on the podium.

Winds from the south

Winds from the south quadrant will pass over the low-rise buildings of Artarmon, reaching the proposed development relatively unimpeded. Incoming flow will impinge on the southern façade generating downwash, this flow will accelerate around the south-east and south-west corners of the tower before discharging over the neighbouring low-rise structures. The placement of ground-level awnings, Figure 2, and podium setback are expected to deflect the majority of this downwash away from ground level, with the awnings also providing rain protection for residents and visitors. The lobby entrance is well recessed within the building line, creating calm conditions for residents as they enter/exit the lobby. Calm wind conditions are also expected around retail entrances as they are within the awning line, and away from the building corners. If this space is to be activated for café-style seating, the use of portable vertical screens is recommended to assist in creating local areas of calm on windier days.

Winds from the west

Winds from the west quadrant will pass over the low-rise buildings of Chatswood West, and are relatively unimpeded upon reaching the proposed development site. These winds will strike the broad western façade, generating downwash flow. The tower setback from the western podium edge is considered sufficient to deflect the majority of downwash flow coming off the west façade away from ground level. As the downwash flow reaches podium level, the undercut beneath the tower will encourage flow to accelerate through this space and around the south-west and north-west corners of the tower, creating windy conditions on the podium.

Summary

Wind conditions around the proposed development site are expected to pass the Lawson distress criterion. Most locations around the proposed development site would be expected to be classified as acceptable for pedestrian standing or walking activities from a Lawson comfort perspective. These pedestrian comfort levels would be suitable for public accessways, and for stationary short-term exposure activities.

Winds within the proposed development

Several locations throughout the development are relatively exposed from a wind perspective, and amelioration measures may be required to achieve wind amenity suitable for the intended use of space.

The podium is relatively exposed from a wind perspective, and downwash coming off the tower façade will likely impact the podium as well as accelerate into the undercut area beneath the tower. The use of awnings around the perimeter of the tower above podium height, Figure 7, will likely reduce the amount of flow accelerating into the undercut area beneath the tower. The improvement in wind conditions in the undercut area will depend on the outward extent of the awning, with awnings that extend further out from the façade leading to a reduced amount of accelerated flow into the undercut area. If the podium level is to be activated for café-style dining, then further mitigation measures, in the form of local vertical screens, would also be recommended to create local areas of calm. Quantifying the effectiveness of the above mitigation measures would require wind tunnel testing.

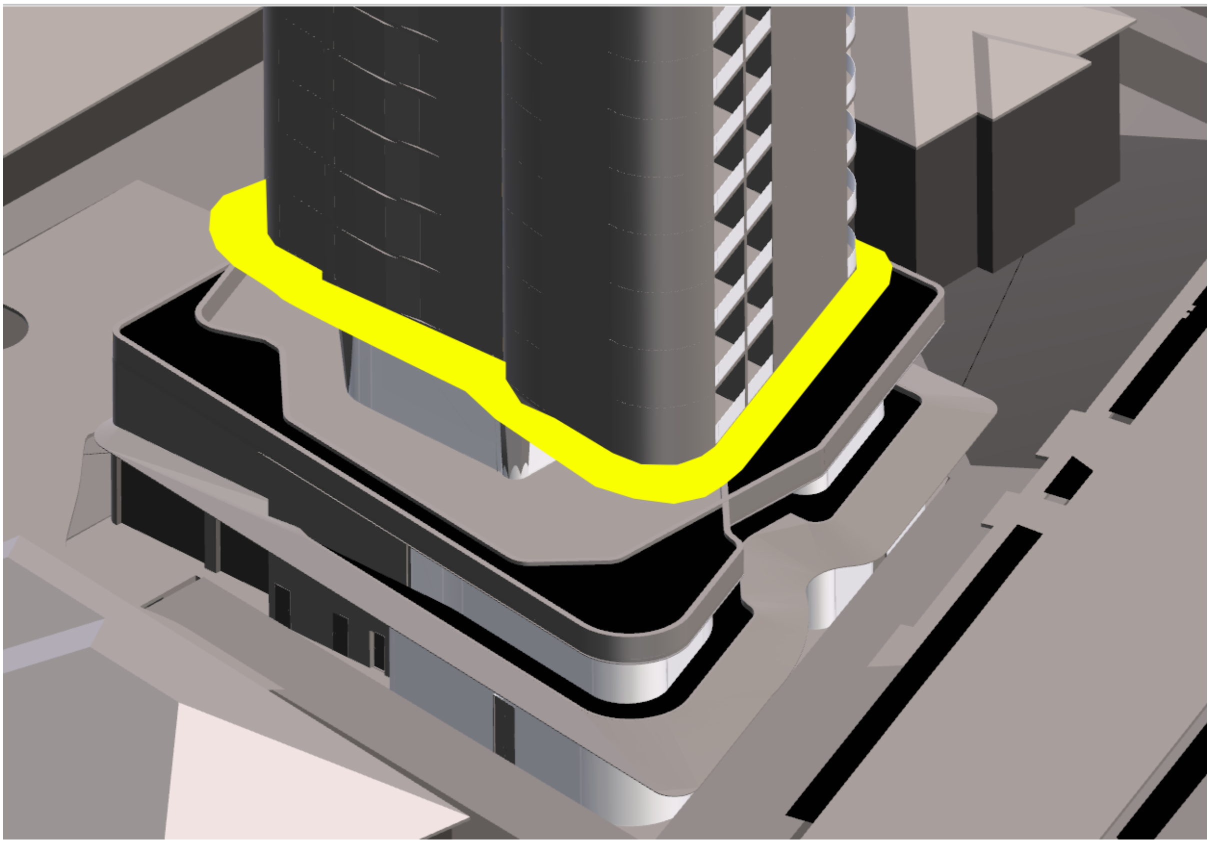

Figure 7: Placement of awnings around the perimeter of the tower above podium height, viewed from the north-east.

There are several balconies located throughout the development. Wind conditions on balconies recessed into the façade are expected to be calm, while those located on building corners or protruding from the façade are more exposed and may experience strong cross flows. The use of vertical, slightly porous screens installed along one (for corner balconies) or both (for protruding balconies) of the exposed faces, Figure 8, is expected to improve wind conditions within these spaces by reducing the amount of cross flow through these balconies. The balconies above level 19 and situated along the south façade are particularly exposed to the prevailing winds from the south and west quadrants and are likely to experience stronger wind conditions than the lower level balconies as these elevated balconies extend around the corners of the tower. The use of vertical, slightly porous screens to partition the balconies, Figure 9, is expected to improve wind conditions in these areas by preventing cross flow through the elevated balcony spaces. It should be noted that it is relatively common for such elevated and exposed balconies to experience stronger wind conditions. As such, residents tend to learn to determine the usability of their balconies over time based on the seasonal weather conditions.

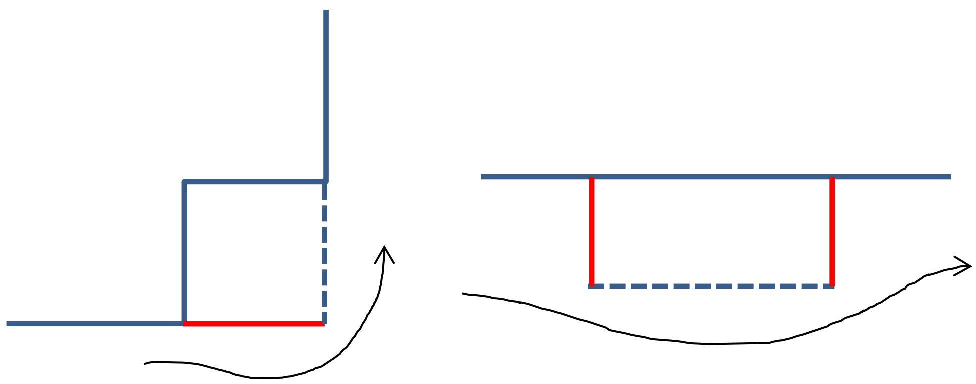

Figure 8: Installation of fixed porous screens (red) along the exposed faces of corner balconies (L) and balconies protruding from the façade (R), viewed from above, with the exposed balcony edges shown as dashed lines.

Figure 9: Installation of fixed porous screens (red) to partition the elevated balconies that curve around the corners of the tower.

The inclusion of sliding, or revolving, doors at entrances to the development would also be beneficial in reducing the potential for downwash to generate pressure-driven flow into indoor areas. Furthermore, sealing the lift lobby is recommended to assist in mitigating any potential stack effect flows through tower lift cores associated with thermal and wind stratification effects.

6. CONCLUSIONS

Cermak Peterka Petersen Pty. Ltd. has provided a qualitative assessment of the impact of the proposed 5-9 Gordon Avenue, Chatswood project on the local wind environment in and around the development site. Being larger than the surrounding structures, the proposed development will have some impact on the local wind environment, though any changes are not expected to be significant from the perspective of pedestrian comfort or safety. Wind conditions around the development are expected to be classified as suitable for pedestrian standing or walking activities from a Lawson comfort perspective and pass the distress criterion.

For such a large, isolated development, wind-tunnel testing during the detailed design stage is needed to confirm the qualitative assessment provided herein, and quantify the wind conditions in and around the proposed development.

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