Attachment 3

171 – 189 PARRAMATTA ROAD, GRANVILLE

NATURAL VENTILATION REPORT

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Client

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INDEX

SECTION 1 EXECUTIVE SUMMARY

There are two predominant wind conditions that the building is subjected to. These are from the northwest and southeast. The northwesterlies occur just over 20% of the time (mainly in the mornings) and the southeasterlies around 15% of the time (mainly afternoons). The remaining occurrences are distributed fairly evenly from the remaining orientations.

Taking the "predominant" conditions, the northwesterlies are an excellent driver of natural ventilation. Striking the building at an oblique angle, they create alternating high and low pressures along the north elevation. This will drive air between rooms in an easterly direction. Although the wind is a single sided driving force, the air behaves as cross-ventilation (ie not in and out of the same opening).

Under northwesterly conditions, the corridor zone will be under negative pressure. This will allow the build up of stack-effect convection currents where cooler air is drawn on from the bottom of the corridor zone and exhausts from the south facing louvres at the top. This air movement through the corridor zone will induce air from the apartments, contributing to the cross-ventilation.

Under southeasterly breezes, the corridor zone behaves differently. This time it will be under positive pressure and as wind pressure increases with height, the top louvres will be under much greater pressure that the bottom. With a pressurised corridor zone and the north elevation under negative pressure, air will be drawn from the corridor zone to cross-ventilate the apartments in a north-south direction.

There are some key design limitations for this site which significantly impact on the design of natural ventilation systems. Noise from Parramatta Road to the south necessitates that the corridor zone is fully enclosed. Therefore, it is not possible for the apartments to open directly to outside on the south. By necessity, design of cross-ventilation is therefore compromised.

However, the design has been well considered and coordinated so as to optimise the extent of cross-ventilation. This report demonstrates that within the constraints, a good level of amenity meeting the requirements of SEPP 65 can be achieved.

SECTION 2 INTRODUCTION

EMF Griffiths building services and environmental engineers have been appointed by Beraci Pty Ltd to review the proposed architectural design for 171-189 Parramatta Road, Granville, with a view to optimising the amenity of the development through introduction of natural ventilation and to report on the initiatives.

It is intended that this report accompanies the Development Application submission to support compliance with the SEPP 65 requirement for natural ventilation.

171-189 Parramatta Road is proposed to be a nine-storey building with residential apartments on floors 1-9 and ground floor retail tenancies. The building sits on two stories of basement carparking. The residential apartments open up onto a glazed corridor which is open the full height of the building forming a naturally ventilated acoustic buffer zone. It is proposed that this corridor zone is open top and bottom to aid the ventilation.

A high-level mechanical exhaust system is to be provided for smoke control within the corridor zone. The final solution will be subject to a fire-engineering exercise as part of the detailed design.

The building's primary axis is orientated east-west with its major facades facing north and south.

The development also comprises a number of townhouses, but they are not the subject of this report.

The objective of SEPP 65 is as follows:

- i) To ensure that apartments are designed to provide all habitable rooms with direct access to fresh air and to assist in promoting thermal comfort for occupants;
- ii) To provide natural ventilation in non-habitable rooms where possible; and
- iii) To reduce energy consumption by minimising the use of mechanical ventilation and air conditioning.

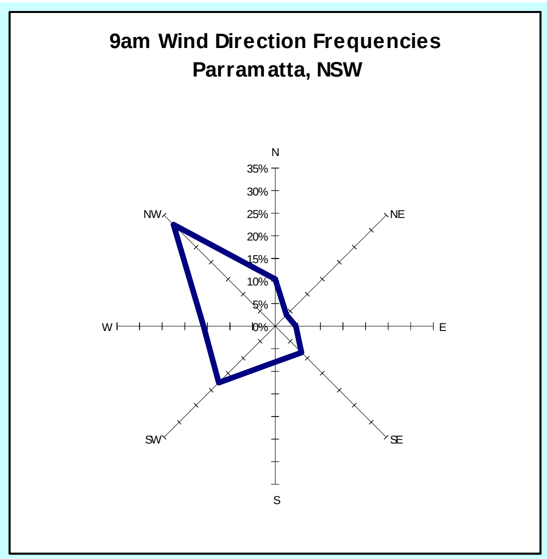
The findings of this report are based on a desktop study using limited climatic data available for Parramatta. To gain a more detailed understanding and greater certainty of the building's performance characteristics, techniques such as wind tunnel testing and/or computational fluid dynamic (CFD) analysis should be employed.

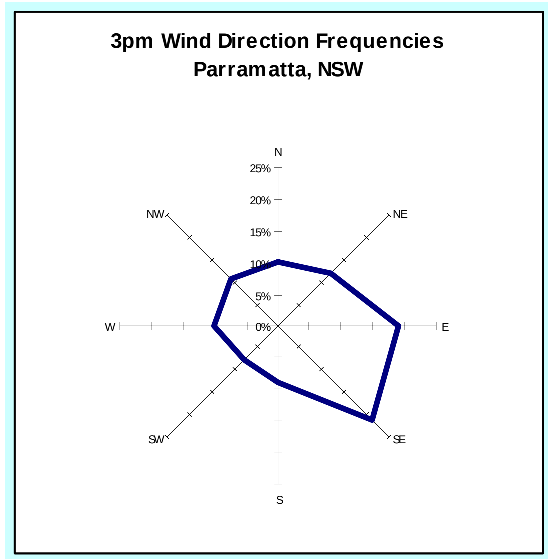
SECTION 3 LOCAL CLIMATIC CONDITIONS

3.1 WIND DATA

For conducting this type of investigation, the Bureau of Meteorology (www.bom.gov.au) is the prime resource for historic weather data. Wind roses are a convenient way of illustrating the local wind characteristics. These typically represent at least 15 years of data for conditions at 9am and 3pm. The closest published wind rose is for Sydney. Although this is not geographically far from Granville, without the local affects of Port Jackson the conditions at Granville are significantly different.

In preparation of this report, we have obtained wind data for the past 12 months at Parramatta, NSW. This sample period is relatively short, but the data is considered adequate for this exercise. Data was obtained in the form of wind velocity and direction at 9am and 3pm every day for a year. These data are presented as follows:





In these simplified wind roses, we have charted the annual percentage frequency that wind blows from any given direction in mornings and afternoons. These diagrams illustrate a general trend that morning breezes predominantly emanate from the northwest, and afternoon breezes emanate from the southeast.

For the purposes of this report, the effects of these prevailing conditions are investigated.

The average morning wind speed was found to be 6.2 m/s (22kph), and the afternoon wind speed is greater at an average of 9.8 m/s (35kph).

3.2 EXPOSURE

In terms of exposure, Granville would be considered an "urban" location. This relates to the density of the surrounding built-up area, which effects the level of turbulence and how predictable the local wind behaviour will be.

However, as the building rises considerably above the surrounding buildings, the upper floors will be subjected to a relatively unimpeded airflow. Therefore, for the purposes of this report the exposure is considered as being "open".

SECTION 4 NATURAL VENTILATION

Natural ventilation relies on moving air through a building under the natural forces of gravity and wind. Generally, air is brought through the building façade by way of openable windows or natural ventilation openings such as fixed louvres.

As the driving forces are typically fairly weak, there are limitations on the maximum distance a naturally ventilated space can be from a ventilation opening. The maximum plan width for effective natural ventilation is recognised as being in the order of 5 times the floor to ceiling height[1]. In the case of 171-189 Parramatta Road, this would limit the plan width to approximately 13m. The proposed apartments are all within these limits.

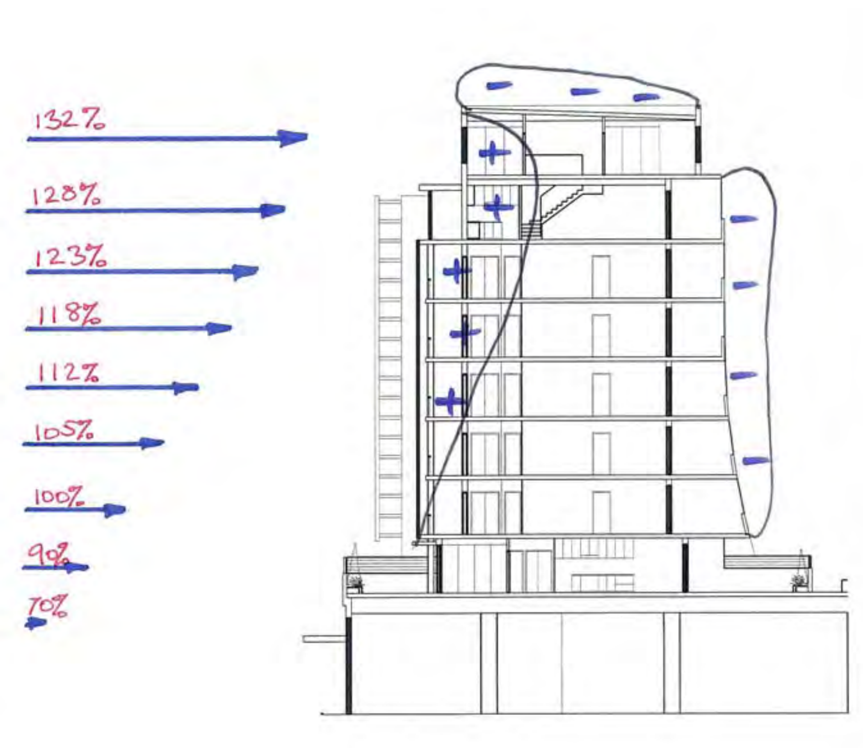
The requirements for large openings in the building envelope introduce acoustic and air quality considerations. For this project, the acoustic implications are being investigated by others.

4.1 DRIVING FORCES

4.1.1 Wind

Wind driven ventilation is caused by differences in pressures acting across the external surface of a building.

Air will flow through a building from areas of high pressure to areas of low pressure. Wind speed increases with height, and wind pressure increases as the square of its speed. Therefore imposed pressures at the top of a building are much greater than those at lower levels. The effects of this at 171-189 Parramatta Road are illustrated as follows:



Pressure variation throughout building with wind speed increasing as height increases

[1] – CIBSE Applications Manual AM10 - Natural Ventilation in Buildings

4.1.2 Buoyancy

As warm air is less dense than cooler air, warm air will rise within a building drawing in cooler air from a low level to replenish it. The greater the temperature differences, the greater this driving force. The effect of this form of ventilation is known as the "stack effect". As this is a relatively weak force, it can be counteracted by oncoming wind which develops a high pressure region at the top of the building.

4.2 STRATEGIES

4.2.1 Single Sided Ventilation

Single sided ventilation occurs when air flows in and out of an enclosure on the same side of the building. The effectiveness of this form of ventilation is limited to areas within 6m of the ventilation openings. The performance of single sided ventilation can be enhanced by distributing the openings at high and low levels.

4.2.2 Cross-Ventilation

Cross-ventilation occurs where there are ventilation openings on both sides of the space. Air flows from one side of the building to the other driven by pressure differences.

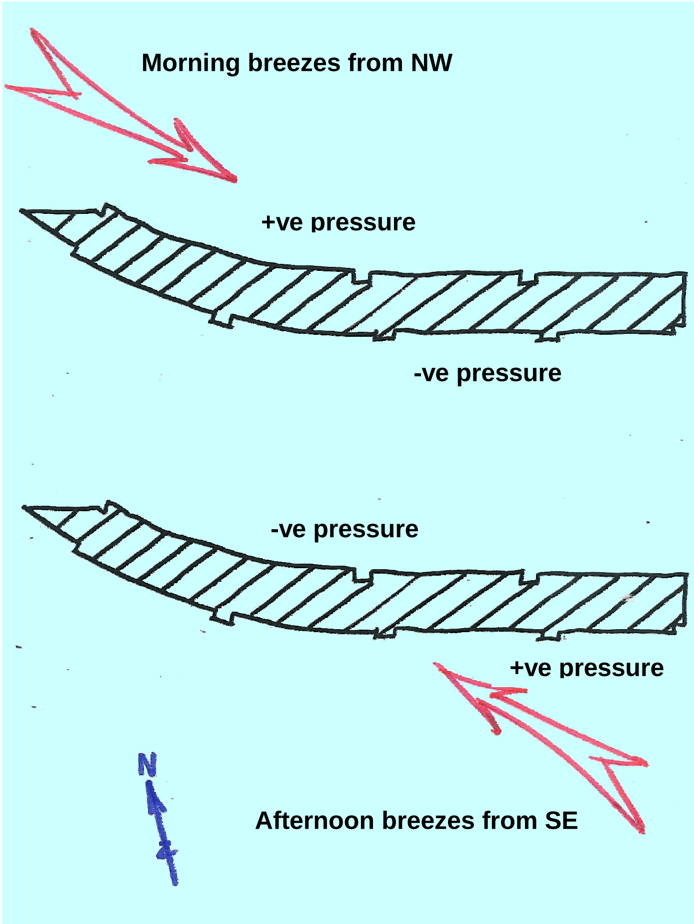
4.2.3 Stack Ventilation

Stack ventilation describes an outflow of air from a building at high level, which draws fresh air in via low-level ventilation openings. This effect is driven by the buoyancy of warmer air.

SECTION 5 BUILDING CHARACTERISTICS

5.1 GENERAL

There are a number of clear sets of conditions under which the building will be exposed to. Each of these in turn affects how air will flow through the building and the level of amenity achievable through natural ventilation. Theses are illustrated as follows:



The building elevation facing the oncoming airflow is subjected to a positive pressure. Consequently, the roof and opposing elevation is under negative pressure. As air tends to move from areas of high pressure to low pressure, air will make its way through openings in the building.

5.2 VENTILATION OPENINGS

5.2.1 <u>Windows</u>

The northern elevation is predominantly glazed. These openable windows are excellent for facilitating natural ventilation.

Full height sliding glazed sections should be openable from either end to take advantage of the differing pressure characteristics when air hits the elevation obliquely. This can greatly increase the ventilation effectiveness.

The southern elevation has windows opening onto a glazed corridor zone. The dimensions of the currently proposed windows are 1800mm x 800mm. It is expected that the bathroom windows will be inoperable.

To maximise their ventilation effectiveness, openable windows should be horizontal centre pivot type. Assuming this configuration, based on the proposed window sizes, the ventilation free area is approximately 0.5m² which is roughly half of the ideal requirement for cross-ventilating these apartments. However, architectural and planning constraints dictate that this is the maximum achievable area.

As a consequence, cross ventilation with this configuration will be some 50% as effective as an ideal scenario.

5.2.2 Corridor Ventilation Slot

Air can pass freely through the corridor zone by way of openings between the corridors and curtain glazing. This opening is currently proposed as being 600mm wide. As the ventilation slot is only open at the bottom and the top, it is beneficial in assisting stack effect ventilation.

The proposed apartment window area limits the amount of air required to pass through the corridor zone. The 600mm slot appears to be sufficient for these conditions, but should the window area be increased to the ideal, the slot width would need to be increased to 800mm.

5.2.3 Corridor Ventilation Louvres

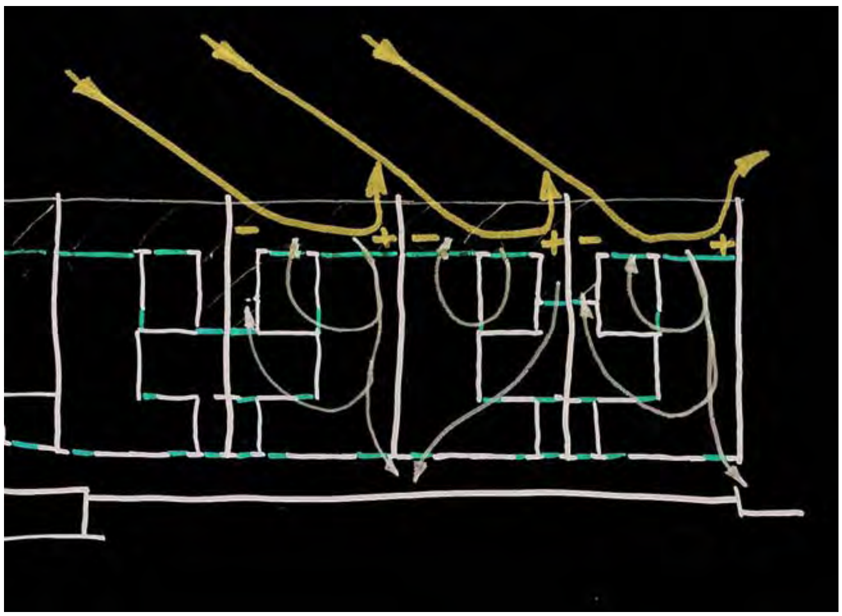
The corridor zone is open to atmosphere at high level by way of 1350mm high horizontal louvres. Based on a 50% free area, this configuration is acceptable. However, acoustic constraints may dictate a smaller free area. In this case, the louvre size would need to be increased accordingly. Similarly, if the apartment window area is increased the louvre area needs to be increased.

SECTION 6 NATURAL VENTILATION PERFORMANCE

The following sections describe how the whole building is likely to perform under the predominant wind conditions.

6.1 MORNINGS

In mornings, the predominant wind direction is northwesterly which is an excellent driver of natural ventilation. Striking the building at an oblique angle, the wind sets up areas of alternating high and low pressures either side of the protruding blade walls. This will drive air between rooms in an easterly direction. Although the wind is a single sided driving force, the air behaves as cross-ventilation (ie not in and out of the same opening). This is illustrated as follows:



Following the path of least resistance, it can be expected that this will be the dominant airflow pattern. However, a degree of air will pass through the apartments in a conventional "cross-ventilation" manner.

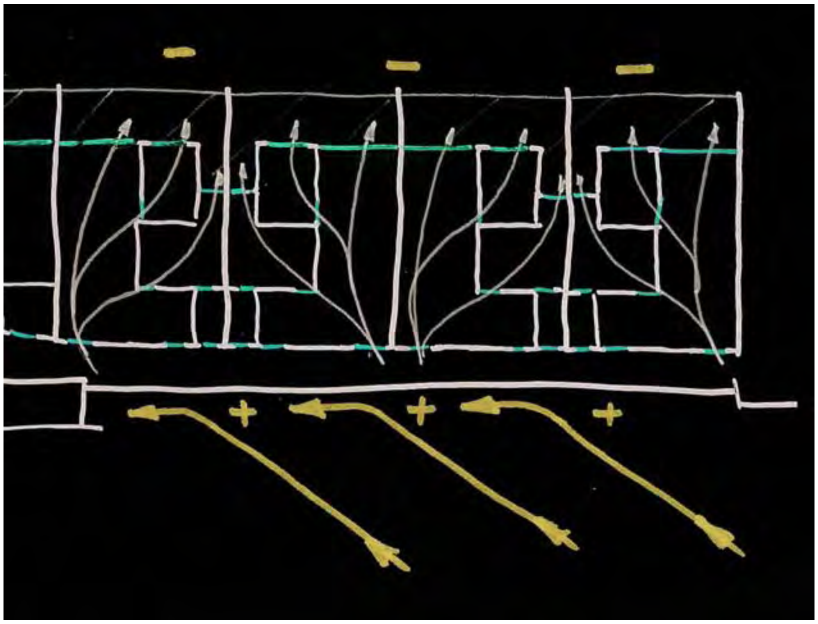
Under these northwesterly conditions, the corridor zone will be under negative pressure. This will allow the build up of stack-effect convection currents where cool air is drawn in from the bottom of the corridor zone and exhausts from louvres at the top. Because the louvres face away from the oncoming wind, negative pressure at the top will help induce air up through the corridor zone. This air movement will assist cross-ventilation through the apartments.

These effects contribute to an effective natural ventilation strategy under these conditions.

6.2 AFTERNOONS

Analysis of wind data suggests that the predominant afternoon condition is a southeasterly breeze. Under these conditions, the corridor zone behaves differently. This time it will be under positive pressure and as wind pressure increases with height, the top louvres will be under much greater pressure than the bottom. These forces will overpower any stack effect so the tendency will be for air to flow from top to bottom.

With a southeasterly breeze, the north side of the building is under negative pressure so air will be drawn into the apartments from the corridor zone. This behaviour is illustrated as follows:



With air filling the corridor zone, an internal positive pressure will be set up. This will then drive air through the south facing windows and out of the opposing north facing apartment windows providing an efficient degree of cross-ventilation.

As previously discussed, there are limits to the possible opening areas for the south facing windows. Although the proposed sizes are approximately 50% of what would ideally be required, under these conditions there will be an appreciable degree of cross ventilation.

Due to the very nature of the south facing glazed curtain façade and the requirement for maintaining acoustic integrity, designing for cross ventilation though the apartments is by necessity compromised. However, the design has been well considered and coordinated so as to optimise the extent of cross-ventilation.