



WIND ENGINEERING
CONSULTANTS

QUALITATIVE PEDESTRIAN WIND ENVIRONMENT ASSESSMENT
CPP PROJECT 20329
1 OCTOBER 2024

792-794 Botany Road, & 33-37 Henry Kendall Crescent

Mascot, NSW

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Executive Summary

Cermak Peterka Petersen Pty. Ltd. have provided a qualitative wind environment assessment of the impact of the proposed development at 792-794 Botany Road, & 33-37 Henry Kendall Crescent on the local wind conditions for comfort and safety in and around the site. This report supports the development SSDA addressing the pedestrian-level wind environment assessment as detailed in Issue number 5 of the Secretary's Environmental Assessment Requirements (SEARs). This assessment was based on the local wind climate, the characteristics of the proposed development, and CPP's experience in the region and on comparable projects.

Being taller than the surrounding structures, the proposed development will have some effect 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 acceptable for pedestrian standing or walking from a Lawson comfort perspective and pass the safety criterion. No adverse conditions requiring specific mitigation are foreseen, however local amelioration may be advised for areas intended for long-term stationary or outdoor dining activities.

To quantify the qualitative advice provided in this report, physical or numerical modelling would be required, which is not considered necessary for this development.

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1. Introduction

GENERAL

This wind environment assessment has been prepared by Cermak Peterka Petersen on behalf of Homes NSW for a State Significant Development Application (SSD-72393459) for construction of a residential flat building ranging in height between three and eight storeys with a total of 126 social and affordable housing apartments at 792-794 Botany Road and 33-37 Henry Kendal Crescent, Mascot.

The purpose of this wind environment assessment is to address item 5. of the Secretary's Environmental Assessment Requirements (SEARs) for the project issued on 24 July 2024, which identified the following specific assessment requirements:

"Assess amenity impacts on the surrounding locality, including lighting impacts, reflectivity, solar access, visual privacy, visual amenity, view loss and view sharing, overshadowing and wind impacts. A high level of environmental amenity for any surrounding residential or other sensitive land uses must be demonstrated."

The Site

The site is located at 792-794 Botany Road and 33-37 Henry Kendal Crescent, Mascot and is located within Bayside Local Government Area (LGA).

The site has a total site area of 4,904 m² and has three street frontages: Henry Kendall Crescent to the west, Coward Street to the south, and Botany Road to the east.

The site comprises 25 social housing dwellings within five two storey brick buildings including three walk-up apartments buildings and two town house style buildings which were constructed in the 1960s. There are a number of mature street trees located along Botany Road, Coward Street and Henry Kendall Crescent, Figure 1.

The site is located opposite Mascot Memorial Park on Coward Street, a large public park which provides a range of passive and active recreation, including children's playground, formal gardens, and tennis courts.

The site is accessible by public transport (buses and trains) with frequent bus services that run along Botany Road. Mascot Train Station is also located within 850 m of the site.

Proposed development

The proposed development comprises demolition of existing buildings and construction of a residential flat building ranging in height between three and eight storeys to accommodate 126 social and affordable housing apartments, a communal room and on grade car parking including remediation, tree removal and associated landscaping and public domain works.

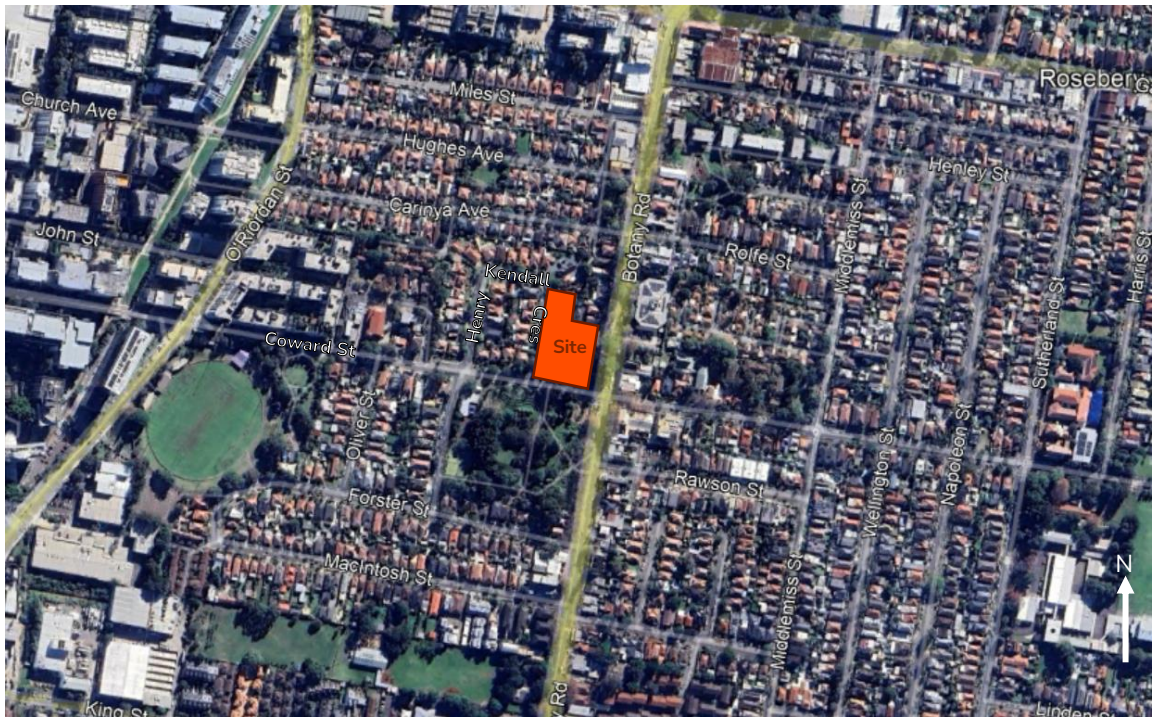


Figure 1: Aerial view of proposed development site (Google Earth, 2024)

The assessment of the wind environment around developments can ensure adverse impacts are minimized and inform designers about the suitability of outdoor areas for their intended uses. Where necessary, design modifications can be made, or intervention measures added to mitigate areas with the potential for excessive wind speeds.

The site is located in Mascot, approximately 6 km to the south of Sydney CBD. The area surrounding the site consists of low- to medium-rise developments, with some larger buildings to the west, Figure 1. Topography surrounding the site is essentially flat from a wind perspective. 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. Several wind flow mechanisms such as downwash and channelling flow are described in Appendix A and the effectiveness of some common wind mitigation measures are described in Appendix B.

2. Wind Climate

The proposed development lies approximately 4 km to the north-north-east of the Sydney Airport Bureau of Meteorology anemometer, which provides the best source of historical wind data for the project. 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 from 1995 –2022 have been used in this analysis.

The wind rose for Sydney Airport is shown in Figure 2. The arms of the wind rose point in the direction from where the wind is blowing from, the width and colour of the arm represent the wind speed, and the length of the arm indicates the percent of the time that the wind blows for that combination of speed and direction.

The distribution and frequency of winds on an annual basis were analysed to assess the project with regards to wind comfort and safety. As can be seen from the wind rose in Figure 2, strong prevailing winds come from the north-east, south, and west quadrants. These wind directions are considered in this assessment.

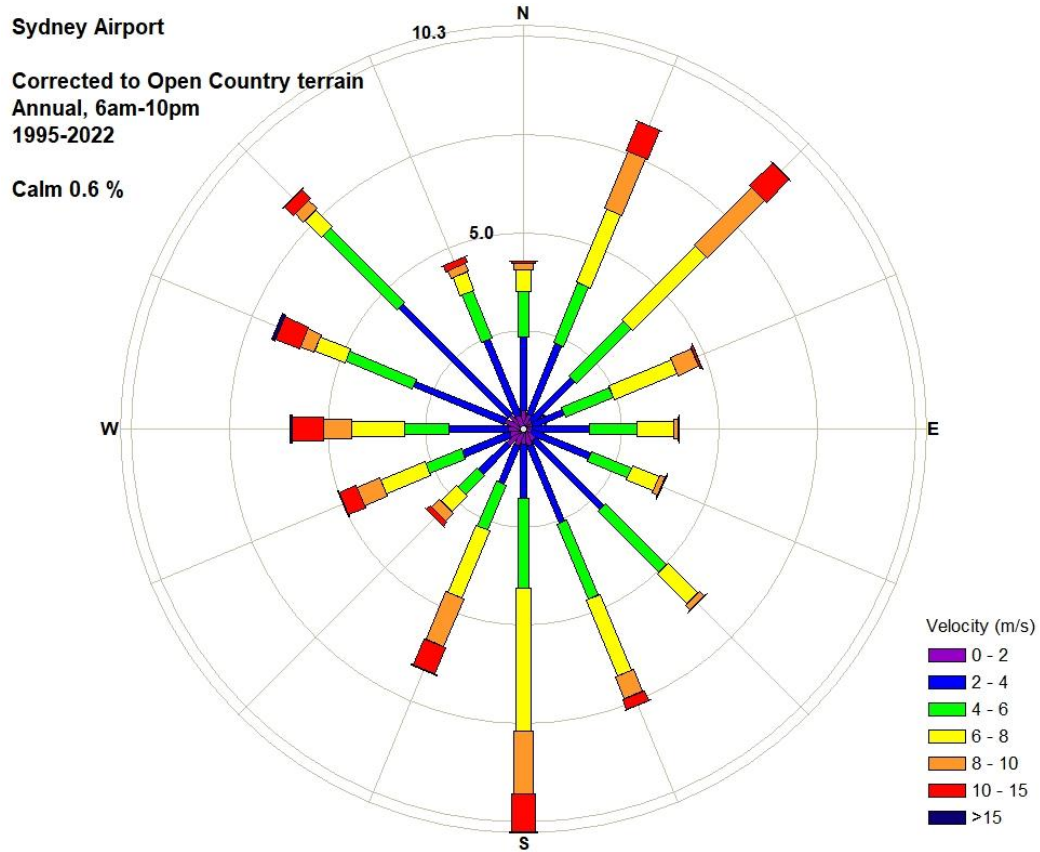


Figure 2: Probability of Wind Speeds by Direction Sydney Airport –(1995 –2022)

3. Wind Assessment Criteria

A number of researchers have suggested quantitative methods for assessing wind comfort and safety based on estimated wind speeds and local climate statistics. These criteria provide a means of evaluating the wind amenity of location based on the frequency of threshold wind speeds, noting that pedestrians will tolerate higher wind speeds for a shorter time period than lower speeds. The comfort criteria allow planners to assess the usability, with respect to the wind environment, of different locations for various purposes.

There are no specific wind criteria for this site. CPP uses a modified form of the widely-accepted pedestrian-level wind criteria developed by Lawson (1990). Lawson's criteria are divided into separate categories of comfort and distress (safety).







Lawson's criteria for comfort and safety are described in Table 1. The comfort criterion is based on a mean or gust equivalent mean wind speed being exceeded for 5% of the time, and are described as categories for comfort ranging from 'Pedestrian Sitting' to 'Business Walking', allowing planners to judge the usability of locations for various intended purposes. The safety criterion is based on an occasional (once or twice per year) wind speed exceedance, to identify locations where wind speeds may be hazardous to pedestrians.

In general, wind conditions comfortable for Sitting and Standing are considered appropriate for areas such as entrances where pedestrians are likely to gather for longer durations, while wind conditions comfortable for Casual Walking and Business Walking are more appropriate for sidewalks where pedestrians are actively in transit. Locations rated as Uncomfortable are generally less suitable for most pedestrian activities and wind control solutions are often sought. Whether mitigation is needed at a location depends upon the intended pedestrian use of the location.

Satisfaction of the safety rating is generally required for areas accessible to the general public. A rating of 'Able-Bodied' may be acceptable for areas with managed access or where pedestrians are unlikely to be present under adverse conditions.

Pedestrians' perception of wind can often be subjective and vary depending on regional differences in wind climate and thermal conditions, as well as by individual. Calibration to the local wind environment should be taken into account when evaluating predicted wind comfort conditions. Note that the ratings of 'Uncomfortable' and 'Safety' are the words of the published wind criteria and applicability may vary by project and location.




Table 1: Wind Comfort and Safety criteria (after Lawson, 1990)

COMFORT RATING	U _{EQUIV} *	DESCRIPTION
 Dining**	≤2 m/s	Calm / light breezes suitable for outdoor restaurant uses, seating areas, and other amenities based on CPP experience.
 Sitting	>2-4 m/s	Calm or light breezes suitable for long duration seating areas, and other amenities.
 Standing	>4-6 m/s	Gentle breezes suitable for sitting for shorter periods, main entrances and bus stops where pedestrians may linger.
 Pedestrian Walking	>6-8 m/s	Moderate winds appropriate for window shopping and strolling along a downtown street, or park.
 Business Walking	>8-10 m/s	Relatively high speeds that can be tolerated if one's objective is to walk, run, or cycle.
 Uncomfortable	>10 m/s	Strong winds unacceptable for all pedestrian activities; wind mitigation is typically required.

*U_{Equiv} = Max (U_{Mean}, U_{Gust} / 1.85).

*U_{Equiv} speeds are based on an annual exceedance of 5% (~8 hours / week) assessed over all hours.

** For regular outdoor dining, and in semi-enclosed spaces, it has been the experience of CPP that the comfort rating of Sitting may be windier than desired and a comfort criterion of 4 m/s or less may be more applicable.

SAFETY RATING	U _{EQUIV} *	DESCRIPTION
 Pass	≤15 m/s	Meets wind safety criterion.
 Able-Bodied	>15-20 m/s	Acceptable where only able-bodied people would be expected; not acceptable for frail persons or cyclists
 Fail	>20 m/s	Excessive wind speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is often required.

* U_{Equiv} = Max (U_{Mean}, U_{Gust} / 1.85).

*U_{Equiv} speeds are based on an annual exceedance of 0.022% (~2 / year or 1 / season) assessed over all hours.

4. Assessment

PROPOSED DEVELOPMENT DESCRIPTION

The subject site is described in the Introduction Section. The proposed development is of varying height between 3 to 8 storeys, rising to a maximum height of about 29 m above local ground level, Figure 3. As it is taller than the surrounding structures, the addition of the proposed development is expected to have some impact on the local wind conditions.



Figure 3: East elevation (T), ground floor plan (BL), Level 1 plan (BC), and Level 3 plan (BR)

WINDS FROM THE NORTH-EAST

The site is exposed to winds from the north-east. The existing neighbouring buildings and irregular street pattern will offer some shielding at ground level from direct winds. Higher winds would impinge on the north-east corner of the building, which tends to encourage horizontal flow rather than inducing downwash. The flow will be channelled along the length of the east façade producing windy conditions around the south-east corner, Figure 4.

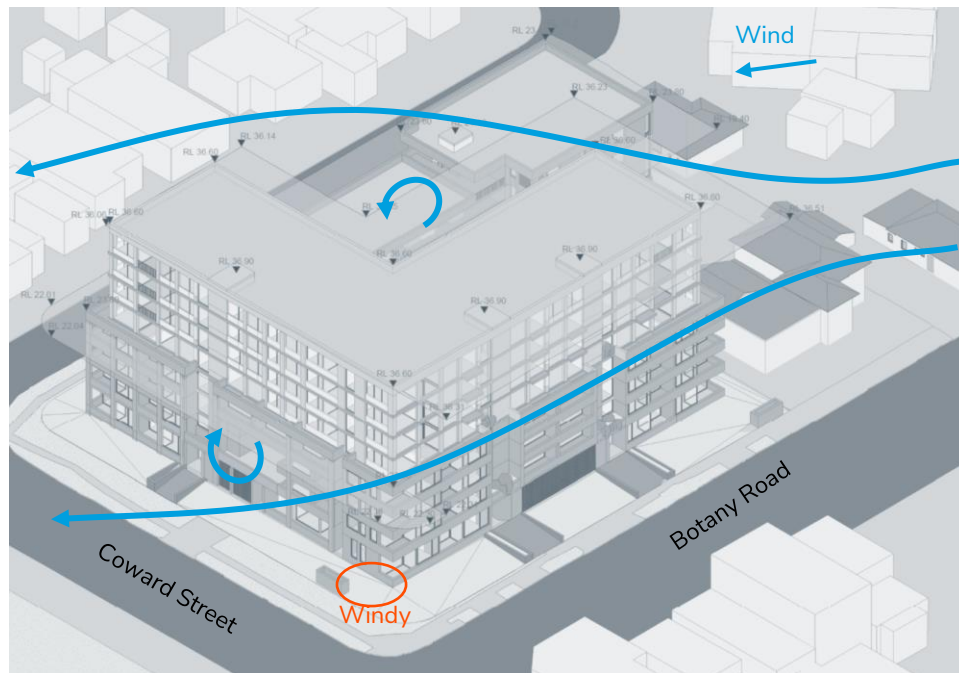


Figure 4: Flow visualization for winds from the north-east, viewed from the south-east

The wind conditions in the central courtyard will be relatively calm for winds from this direction with recirculating flow.

WINDS FROM THE SOUTH

The site is exposed to winds from the south passing over low-rise buildings, which will tend to lift the flow above building height with some channelling along Botany Road. These winds would impinge on the exposed wide southern façade, inducing downwash and causing localised windy conditions around the southern corners, Figure 5. Calm conditions would be experienced near the centre of the building and in the Level 1 courtyard in the lee of the taller section of the building.

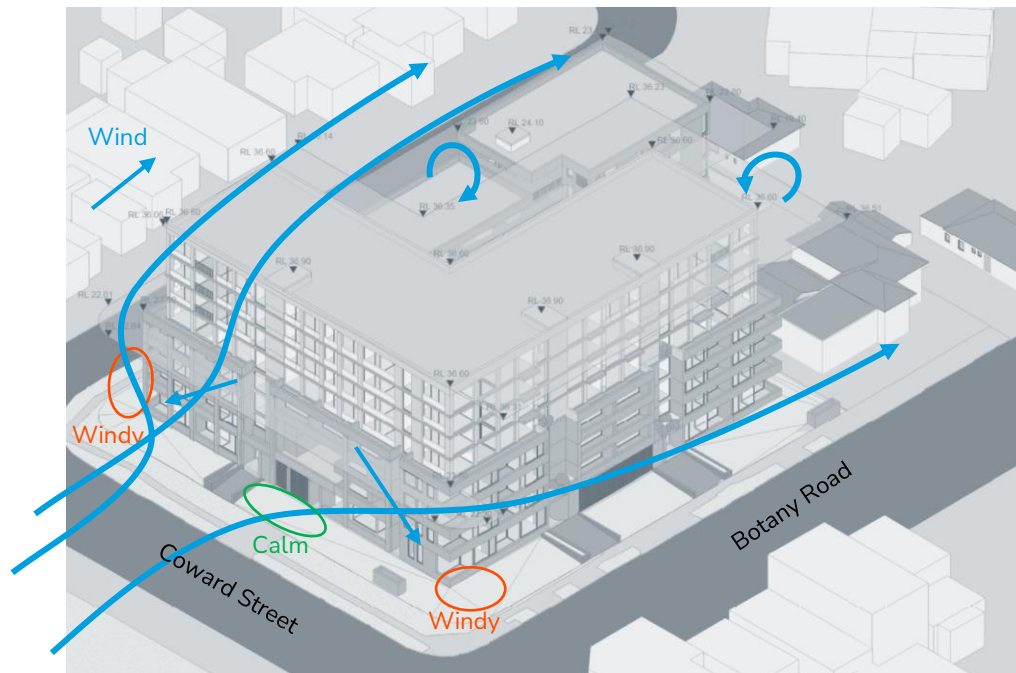


Figure 5: Flow visualization for winds from the south, viewed from the south-east

WINDS FROM THE WEST

Winds from the west and north-west are ameliorated by the high-density taller buildings in Mascot, Figure 1. These winds would impinge on the exposed narrow western façade of the L-shaped building redirecting the flow predominantly to the north across the Level 1 open terrace thereby reducing the amount of flow into Coward Street, Figure 6. Calm conditions would be experienced in the inner elbow of the Level 1 terrace and along Botany Road. Windy conditions would be experienced in the inner elbow of the Level 1 terrace and along Botany Road.

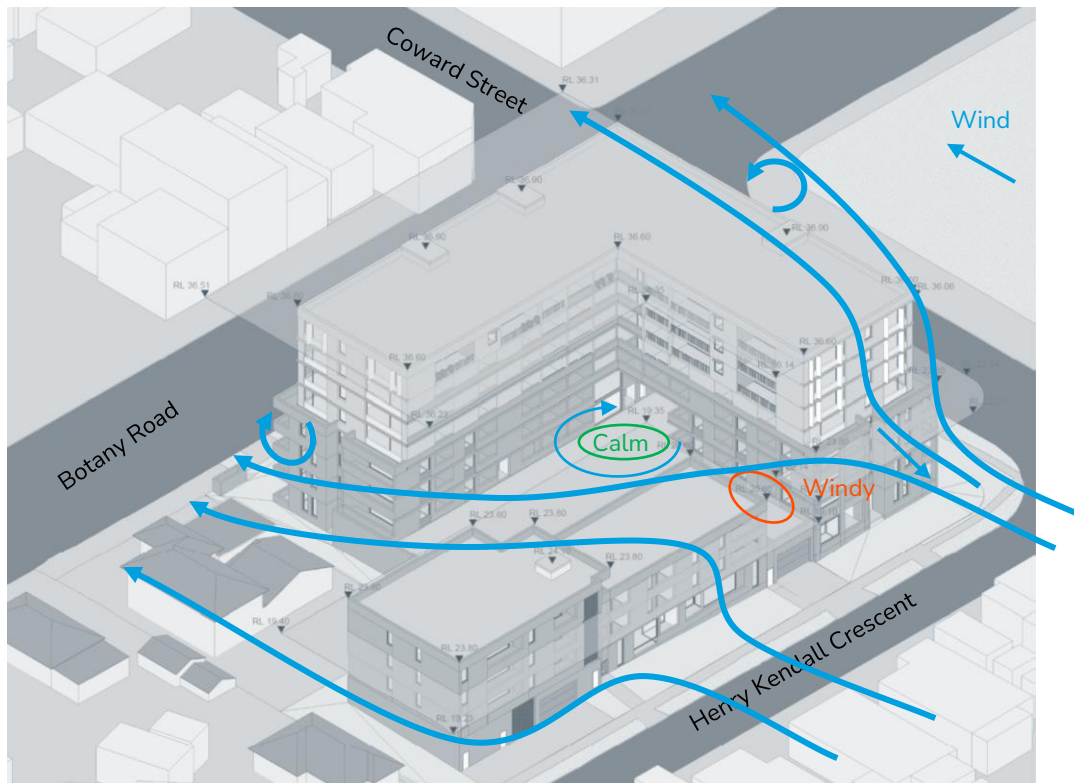


Figure 6: Flow visualization for winds from the west, viewed from the north-west

SUMMARY – PUBLIC DOMAIN

The height and massing of the proposed 8-storey development is currently taller than the surrounding buildings, so is expected to change the wind conditions making some areas windier and some calmer depending on the incident wind direction.

Qualitatively, integrating the expected directional wind conditions around the site with the directional wind climate, it is considered that wind conditions under the Lawson criterion would be classified as suitable for pedestrian standing increasing to pedestrian walking around the southern corners. The pavements are remote from the building line where the wind conditions would improve. These conditions are considered appropriate for the intended transient use of the space.

All locations would be expected to pass the Lawson safety criterion.

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.

Melbourne, W.H., 1978, Criteria for Environmental Wind Conditions, Journal of Wind Engineering and Industrial Aerodynamics, Vol.3, No.2-3, pp.241-249.

Penwarden, A.D. (1973), "Acceptable wind speeds in towns", Building Science, Vol.8, pp. 259-267.

Standards Australia (2021), *Australian/New Zealand Standard, Structural Design Actions, Part 2: Wind Actions* (AS/NZS1170.2:2021).

Appendix A – Wind Flow Mechanisms

When the wind hits a large isolated building, the wind is accelerated down and around the windward corners, Figure A1 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 A1 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 A2 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.

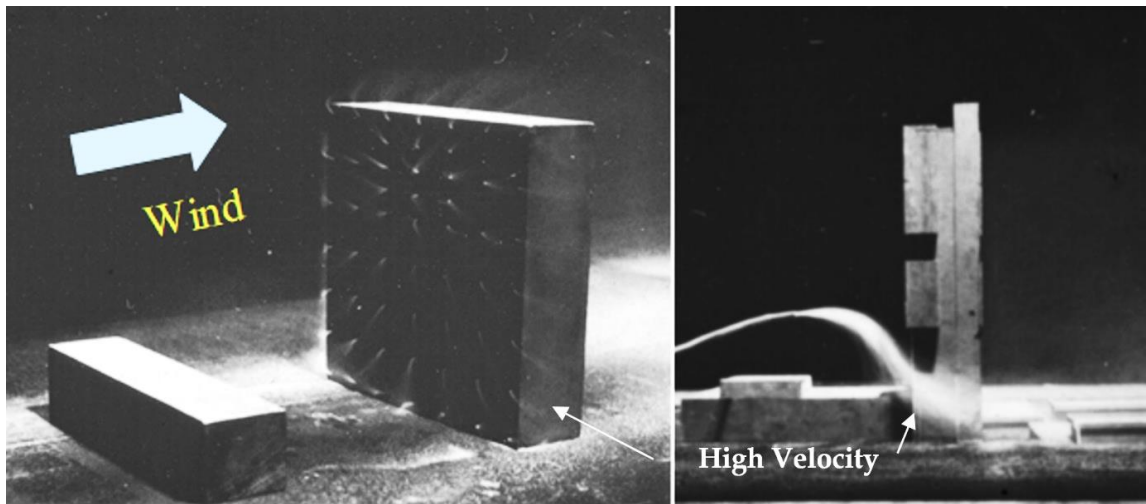


Figure A1: Flow visualisation around a tall building (Penwarden and Wise, 1975)

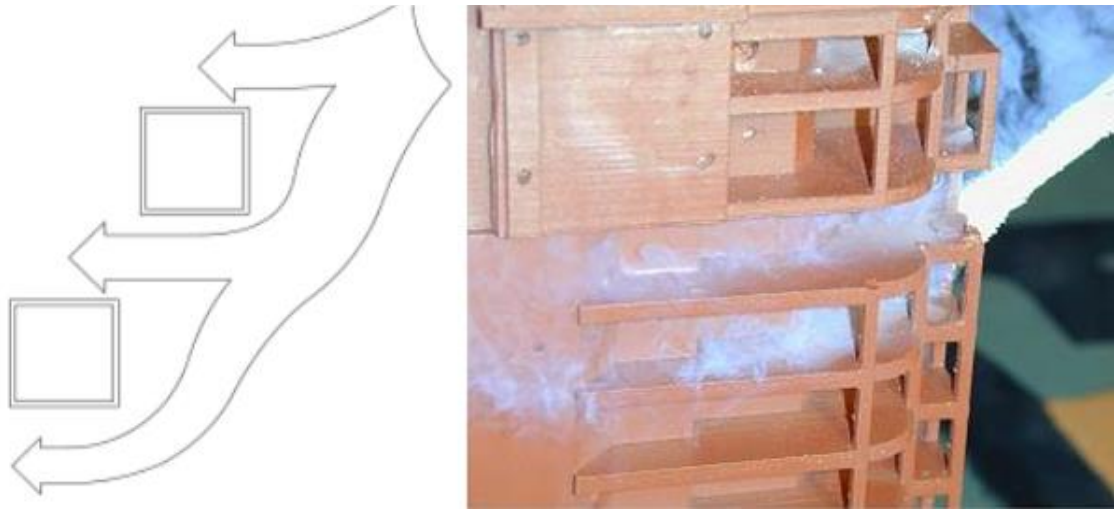


Figure A2: Channelling between buildings (L) and visualisation through corner balconies (R).

Appendix B - Wind Impact Planning Guidelines

It is well known that the design of a building will influence the quality of the ambient wind environment at its base. Below are some suggested wind mitigation strategies that should be adopted into precinct planning guidelines and controls (see also Cochran, 2004).

Building form – Canopies

A large canopy may interrupt the flow as it moves down the windward face of the building. This will protect the entrances and sidewalk area by deflecting the downwash at the second storey level, Figure B1. However, this approach may have the effect of transferring the breezy conditions to the other side of the street. Large canopies are a common feature near the main entrances of large office buildings.

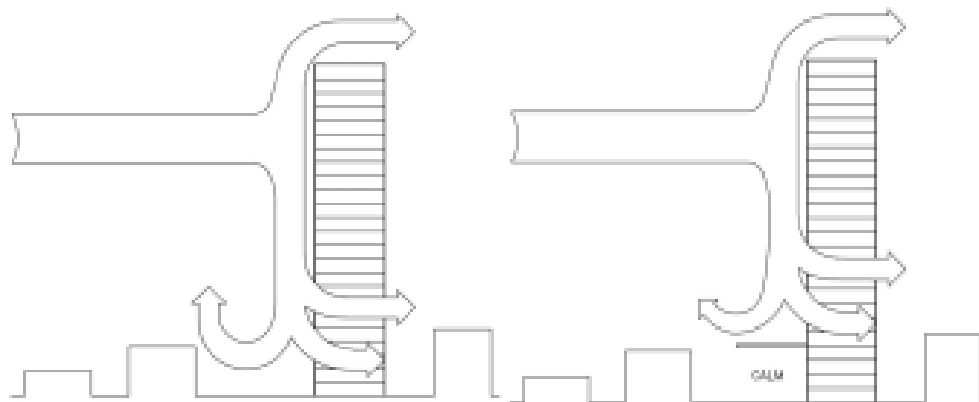


Figure B1: Canopy Windbreak Treatment. (L) Downwash to street level may generate windy conditions for pedestrians. (R) A large canopy is a common solution to this pedestrian-wind problem at street level.

Building form – Podiums

The architect may elect to use an extensive podium for the same purpose, Figure B2, if it complies with the design mandate. This is a common architectural feature for many major projects, but it may be counterproductive if the architect wishes to use the podium roof for long-term pedestrian activities, such as a pool or tennis court.

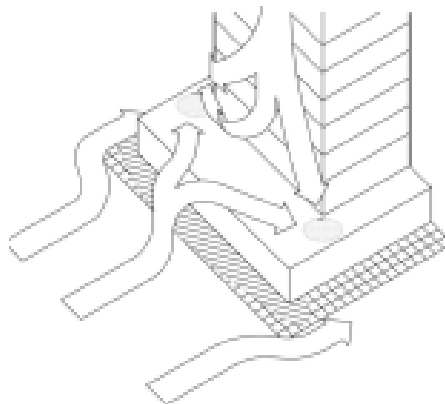


Figure B2: The tower-on-podium massing often results in reasonable conditions at ground level, but the podium may not be useable.

Building form – Arcades

Another massing issue, which may be a cause of strong ground-level winds, is an arcade or thoroughfare opening from one side of the building to the other. This effectively connects a positive pressure region on the windward side with a negative pressure region on the lee side; a strong flow through the opening often results, Figure B3. The uninvitingly windy nature of these open areas is a contributing reason behind the use of arcade airlock entrances (revolving or double sliding doors).

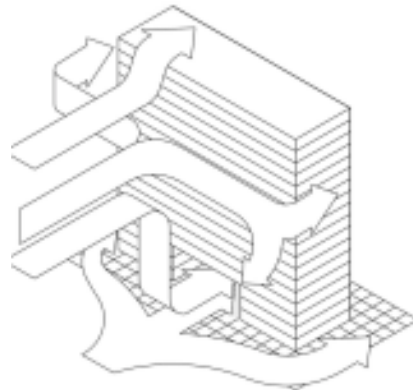


Figure B3: An arcade or open column plaza under a building frequently generates strong pedestrian wind condition.

Building form – Alcove

An entrance alcove behind the building line will generally produce a calmer entrance area at a mid-building location, Figure B4(L). In some cases, a canopy may not be necessary with this scenario, depending on the local geometry and directional wind characteristics. The same undercut design at a building corner is usually quite unsuccessful, Figure B4 (R), due to the accelerated flow mechanism described in Figure B1 and the ambient directional wind statistics. If there is a strong directional wind preference, and the corner door is shielded from those common stronger winds, then the corner entrance may work. However, it is more common for a corner entrance to be adversely impacted by this local building geometry. The result can range from simply unpleasant conditions to a frequent inability to open the doors.

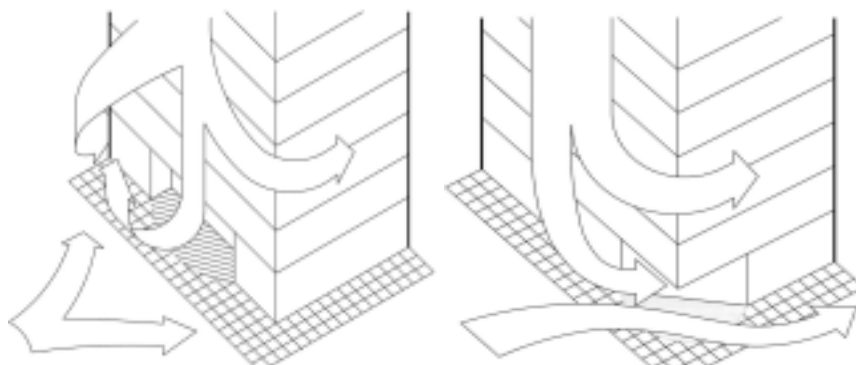


Figure B4: Alcove Windbreak Treatment. (L) A mid-building alcove entrance usually results in an inviting and calm location. (R) Accelerated corner flow from downwash often yields an unpleasant entrance area.

Building form – Façade profile and balconies

The way in which a building's vertical line is broken up may also have an impact. For example, if the floor plans have a decreasing area with increased height the flow down the stepped windward face may be greatly diminished. To a lesser extent the presence of many balconies can have a similar impact on ground level winds, although this is far less certain and more geometry dependent. Apartment designs with many elevated balconies and terrace areas near building ends or corners often attract a windy environment to those locations. Mid-building balconies, on the broad face, are usually a lot calmer, especially if they are recessed. Corner balconies are generally a lot windier and so the owner is likely to be selective about when the balcony is used or endeavours to find a protected portion of the balcony that allows more frequent use, even when the wind is blowing.

Use of canopies, trellises, and high canopy foliage

Downwash Mitigation – As noted earlier, downwash off a tower may be deflected away from ground-level pedestrian areas by large canopies or podium blocks. The downwash then effectively impacts the canopy or podium roof rather than the public areas at the base of the tower, Figure B2. Provided that the podium roof area is not intended for long-term recreational use (e.g. swimming pool or tennis court), this massing method is typically quite successful. However, some large recreational areas may need the wind to be deflected away without blocking the sun (e.g. a pool deck), and so a large canopy is not an option. Downwash deflected over expansive decks like these may often be improved by installing elevated trellis structures or a dense network of trees to create a high, bushy canopy over the long-term recreational areas. Various architecturally acceptable ideas may be explored in the wind tunnel prior to any major financial commitment on the project site.

Horizontally accelerated flows between two tall towers may cause an unpleasant, windy, ground-level pedestrian environment, which could also be locally aggravated by ground topography. Horizontally accelerated flows that create a windy environment are best dealt with by using vertical porous screens or substantial landscaping. Large hedges, bushes or other porous media serve to retard the flow and absorb the energy produced by the wind. A solidity ratio (i.e. proportion of solid area to total area) of about 60-70% has been shown to be most effective in reducing the flow's momentum. These physical changes to the pedestrian areas are most easily evaluated by a model study in a boundary-layer wind tunnel.

References

Cochran L., (2004) Design Features to Change and/or Ameliorate Pedestrian Wind Conditions, Proceedings of the ASCE Structures Congress, Nashville, Tennessee, May 2004.

Penwarden, A.D., and Wise A.F.E., (1975), Wind environment around buildings, Department of the Environment Building Research Establishment, London.