WINDTECH

PEDESTRIAN WIND ENVIRONMENT STATEMENT

13-19 CANBERRA AVENUE, ST LEONARDS

WG232-01F02(REV3)- WS REPORT

OCTOBER 18, 2021

Prepared for:

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DOCUMENT CONTROL

Date	Revision History	Issued Revision	Prepared By (initials)	Instructed By (initials)	Reviewed & Authorised by (initials)
September 28, 2021	Initial.	0	KA	SWR	JG
October 11, 2021	Updated Level 2	1	KA	SWR	JG
October 13, 2021	Updated Cover Image	2	KA	SWR	JG
October 18, 2021	Updated Drawing Set	3	KA	SWR	JG

EXECUTIVE SUMMARY

This report presents an opinion on the likely impact of the proposed development at 13-19 Canberra Avenue, St Leonards, on the local wind environment at the critical outdoor areas within and around the subject site. The effect of wind activity has been examined for the three predominant wind directions for the region, namely the north-easterly, southerly, and westerly winds. The analysis of the wind effects relating to the proposed development have been carried out in the context of the local wind climate, building morphology and land topography.

The conclusions of this report are drawn from our extensive experience in this field and are based on an examination of the latest architectural drawings. No wind tunnel testing has been undertaken for the subject development, and hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection of the architectural drawings provided 15 October 2021 (Project No: 6429, Date: 13.10.2021). Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

The results of this assessment indicate that the development has incorporated several design features and wind mitigating strategies and is expected to be suitable for the intended use for the majority of the outdoor trafficable areas. However, there are some areas that are likely to be exposed to stronger winds. It is expected that the wind effects identified in the report can be ameliorated with the consideration of the following treatment strategies into the design of the development:

- Ground level areas:
    - Retention of the proposed landscaping plan along Canberra Avenue, East-West link and the outdoor childcare area. Landscaping should be of dense, evergreen variety with trees capable of growing to a height of 3-4m with canopies of 3-4m.
    - Retention of proposed awnings on East-West link and outdoor childcare area.
- Private Balconies and Communal Open Space
    - Retention of impermeable balustrade on north-western corner balconies on Levels 3-11.
    - Retention of proposed landscaping on Level 2 balconies. Planting should be able to grow to a minimum height of 0.5m above a 1.0m planter box in the following areas:
        - North-western and south-eastern corners.
        - Northern and southern recessed areas between apartments 204 and 205, and apartments 201 and 208.
        - Eastern corner between apartments 205 and 206.
    - Retention of proposed landscaping on Level 4. Planting should be able to grow to a height of 0.5m above a 1.0m planter box on the south-eastern corner and between apartments 406 and 407.

- Inclusion of either planting (capable of growing to a height of 0.5m above a 1.0m planter box) OR porous screen (maximum 30% porosity) of height 1.5m on the north-eastern corner of apartment 406.

- Inclusion of 1.5-2m high porous screen (maximum 30% porosity) on the northern aspect of apartment 1204 balcony.

- Retention of proposed landscaping on Level 12. Planting should be able to grow to a height of 0.5m above a 1.0m planter box on the western aspect of apartment 1201 balcony as well as the southern corner of the communal open space.

With the inclusion of the abovementioned recommendations in the final design, it is expected that wind conditions for the various trafficable outdoor areas within and around the development will be suitable for their intended uses, and that the wind speeds will satisfy the applicable criteria for pedestrian comfort and safety. Nonetheless, wind tunnel testing is recommended to be undertaken at a more detailed design to quantitatively assess the wind conditions and to optimise the size and extent of the treatments required.

CONTENTS

1 INTRODUCTION

An opinion on the likely impact of the proposed design on the local wind environment affecting pedestrians within the critical outdoor areas within and around the subject development is presented in this report. The analysis of wind effects relating to the proposed development has been carried out in the context of the predominant wind directions for the region, building morphology of the development and nearby buildings, and local land topography. The conclusions of this report are drawn from our extensive experience in the field of wind engineering and studies of wind environment effects.

No wind tunnel testing has been undertaken for this assessment. Hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection, and any recommendations in this report are made only in-principle.

2 DESCRIPTION OF DEVELOPMENT AND SURROUNDINGS

The site is located at 13-19 Canberra Avenue, St Leonards, and is bounded by Canberra Avenue to the east and low rise residential buildings to the north, south and west. The buildings surrounding the subject development are predominately low-rise residential, with mid and high-rise apartment buildings located further to the north and east.

A survey of the land topography indicates slopes from south to north and east to west. These slopes are major topography changes within and around the site.

An aerial image of the subject site and the local surroundings is shown in Figure 1.

with the frequency and magnitude of the prevailing winds is superimposed for each wind direction.

The existing site consists of multiple1-2 storey residential buildings. The proposed development is 15 storeys high.

The critical outdoor trafficable areas associated with the proposed development, which are the focus of this assessment with regards to wind effects, are listed as follows:

- Ground Level areas and pedestrian footpath.
- Private Balconies and Communal Garden.

Figure 1: Aerial Image of the Site Location and Prevailing Wind Directions

3 REGIONAL WIND

The Sydney region is governed by three principal wind directions that can potentially affect the subject development. These winds prevail from the north-east, south, and west. These wind directions were determined from an analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained from the meteorological station located at Kingsford Smith Airport by the Bureau of Meteorology (recorded from 1995 to 2016). The data has been corrected to represent winds over standard open terrain at a height of 10m above ground level. The results of this analysis are presented in Figure 2 in the form of a directional plot of the annual and 5% exceedance mean winds for the region. The frequency of occurrence of these winds is also shown in Figure 2.

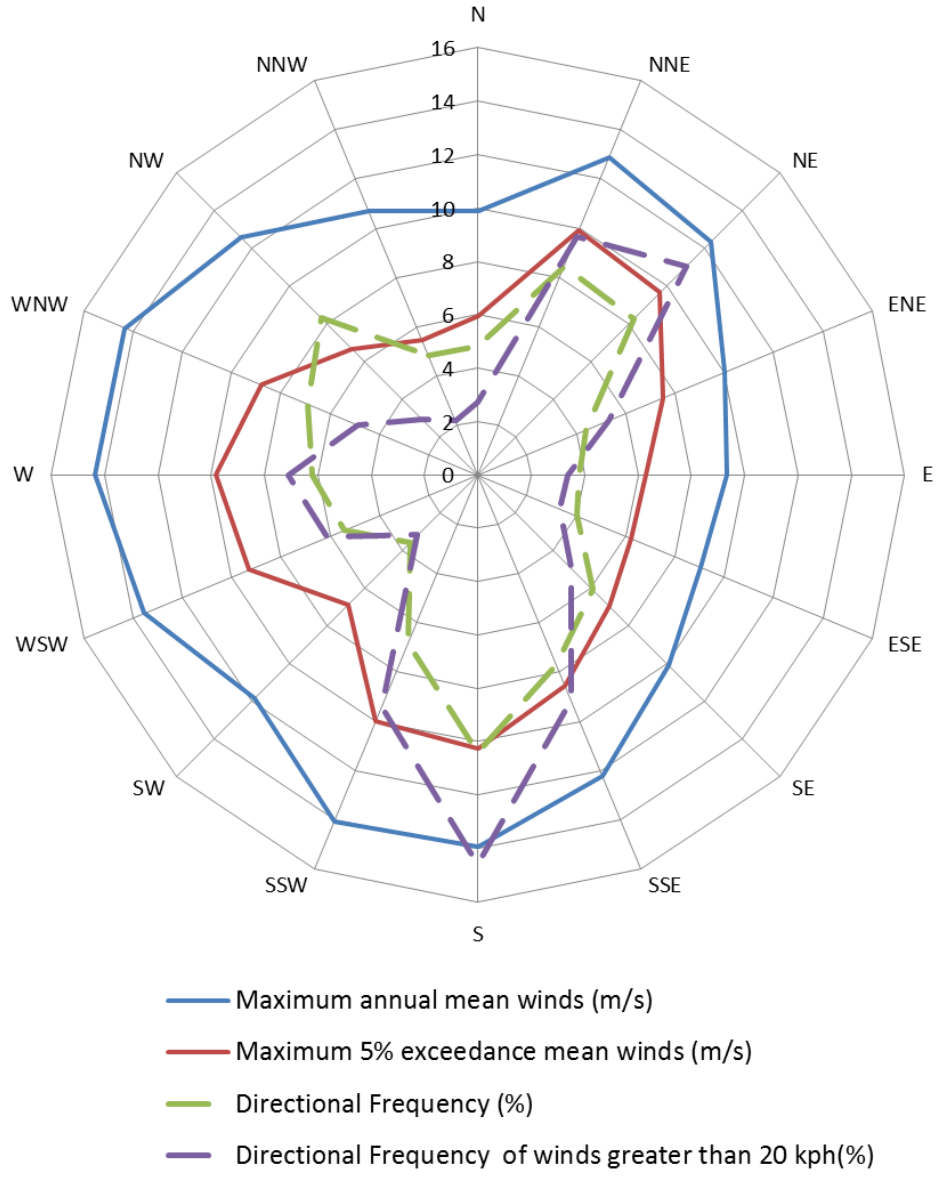

Figure 2: Directional Annual and 5% Exceedance Hourly Mean Wind Speeds (referenced to 10m height in standard open terrain), and Frequencies of Occurrence, for the Sydney Region

4 WIND EFFECTS ON PEOPLE

The acceptability of wind in any area is dependent upon its use. For example, people walking, or window-shopping will tolerate higher wind speeds than those seated at an outdoor restaurant. Various other researchers, such as A.G. Davenport, T.V. Lawson, W.H. Melbourne, and A.D. Penwarden, have published criteria for pedestrian comfort for pedestrians in outdoor spaces for various types of activities. Some Councils and Local Government Authorities have adopted elements of some of these into their planning control requirements.

For example, A.D. Penwarden (1973) developed a modified version of the Beaufort scale which describes the effects of various wind intensities on people. Table 1 presents the modified Beaufort scale. Note that the effects listed in this table refers to wind conditions occurring frequently over the averaging time (a probability of occurrence exceeding 5%). Higher ranges of wind speeds can be tolerated for rarer events.

Table 1: Summary of Wind Effects on People (A.D. Penwarden, 1973)

Type of Winds	Beaufort Number	Mean Wind Speed (m/s)	Effects
Calm	0	Less than 0.3	Negligible.
Calm, light air	1	0.3 – 1.6	No noticeable wind.
Light breeze	2	1.6 – 3.4	Wind felt on face.
Gentle breeze	3	3.4 – 5.5	Hair is disturbed, clothing flaps, newspapers difficult to read.
Moderate breeze	4	5.5 – 8.0	Raises dust, dry soil and loose paper, hair disarranged.
Fresh breeze	5	8.0 – 10.8	Force of wind felt on body, danger of stumbling
Strong breeze	6	10.8 – 13.9	Umbrellas used with difficulty, hair blown straight, difficult to walk steadily, wind noise on ears unpleasant.
Near gale	7	13.9 – 17.2	Inconvenience felt when walking.
Gale	8	17.2 – 20.8	Generally impedes progress, difficulty balancing in gusts.
Strong gale	9	Greater than 20.8	People blown over.

It should be noted that wind speeds affecting this particular development can only be accurately quantified with a wind tunnel study. This assessment addresses only the general wind effects and any localised effects that are identifiable by visual inspection and the acceptability of the conditions for outdoor areas are determined based on their intended use. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

5 RESULTS AND DISCUSSION

The expected wind conditions affecting the development are discussed in the following sub-sections of this report for the various outdoor areas within and around the subject development. The interaction between the wind and the building morphology in the area is considered and important features taken into account including the distances between the surrounding buildings and the proposed building form, as well as the surrounding landform. Note that only the potentially critical wind effects are discussed in this report. A glossary of the different wind effects described in this report included in Appendix A.

For this assessment, the wind speed criteria for pedestrian comfort that are considered are listed as follows:

- Comfortable Walking Criterion (7.5m/s with a 5% probability of exceedance)
  for general circulation and pedestrian thoroughfares, e.g. footpaths, private balconies/terraces, through-site links etc.

- Short Exposure Criterion (5.5m/s with a 5% probability of exceedance)
  for stationary activities generally less than an hour, e.g. waiting areas, communal terraces, main entries, café seating etc.

Although this assessment is qualitative in nature, the abovementioned criteria for pedestrian comfort are considered when assessing the wind environment impacts. However, all areas are also assessed with consideration to a pedestrian safety criterion of 23m/s for the annual maximum gust.

5.1 Ground Level Areas

Wind conditions of the pedestrian footpath along Canberra Avenue have the potential to be impacted by the prevailing north-easterly and southerly winds. The prevailing north-easterly winds have the potential to sidestream along the Canberra Avenue pedestrian footpath resulting in adverse wind conditions. The prevailing southerly winds have the potential to accelerate around the south-eastern corner and sidestream along Canberra Avenue. It is recommended to retain the proposed tree planting on Canberra Avenue consisting of dense, evergreen trees capable of growing to heights of 3-4m and canopies of 3-4m.

Wind conditions along the east-west through site link have the potential to be impacted by the prevailing westerly and southerly winds. The westerly winds have the potential to funnel between the proposed site and neighbouring buildings resulting in adverse wind conditions. The southerly winds have the potential to downwash from the proposed building onto the east-west link. It is recommended to retain the proposed awning on the southern aspect of the building and the proposed tree planting. It is recommended that the proposed tree planting consists of dense, evergreen trees with heights of 3-4m and canopies of 3-4m.

Wind conditions within the childcare outdoor area have the potential to be impacted by the prevailing north-easterly, southerly and westerly winds. The north-easterly winds have the potential to accelerate around the north-western corner and into the outdoor childcare area. The southerly winds also have the potential to result in adverse wind conditions due to corner acceleration around the south-western corner. It is recommended that the proposed tree planting and landscaping on the East-West link and within the outdoor childcare area is retained. It is recommended that the proposed tree planting consists of dense, evergreen trees with heights of

3-4m and canopies of 3-4m. The prevailing westerly winds have the potential to downwash off the building façade onto the outdoor childcare area. It is recommended to retain the proposed awning over the outdoor childcare area to ameliorate any potential adverse wind conditions.

5.2 Private Balconies and Communal Garden

The majority of private balconies on the proposed development are expected to be suitable for their intended use due to the inclusion of various wind mitigation features such as their overall recessed design, single aspect opening, impermeable balustrades and impermeable intertenancy screens.

Wind conditions on the Level 2 balconies have the potential to be impacted by the prevailing north-easterly, westerly and southerly winds due to sidestreaming and corner acceleration. It is recommended that the proposed landscaping along the northern, southern and western perimeter of the proposed development is retained consisting of dense, evergreen varieties. It is recommended that the planting within the north-western, north-eastern and south-eastern corners as well as the northern and southern recessed areas are capable of growing to a minimum height of 0.5m above a 1.0m planter box to further ameliorate potential adverse wind conditions as shown in Figure 3.

The north-western corner balconies on Levels 3-11 have the potential to be impacted by the prevailing westerly and north-easterly winds due to corner acceleration. It is recommended that impermeable balustrades are utilised on both aspects of the balconies.

Wind conditions on the eastern balconies of Level 4 have the potential to be impacted by the prevailing north-easterly and southerly winds due to sidestreaming and corner acceleration. It is recommended to retain the proposed perimeter landscaping consisting of dense, evergreen varieties. It is recommended that the landscaping on the recessed areas on the southern corner and between apartments 406 and 407 are capable of growing to a height of 0.5m above a 1.0m planter box. It is recommended that additional landscaping or a porous screen (maximum 30% porosity) of 1.5-2m height be included on the north-eastern corner of apartment 406 to further ameliorate potential adverse wind conditions as shown in Figure 4.

The north-western corner balcony on Level 12 has the potential to be impacted by the prevailing westerly and north-easterly winds due to sidestreaming and corner acceleration. It is recommended that a porous screen (maximum 30% porosity) is included on the northern aspect of apartment 1204 balcony of 1.5-2m height to reduce the potential of adverse wind conditions as shown in Figure 5.

The south-eastern corner balcony on Level 12 has the potential to be impacted by the prevailing westerly and southerly winds due to sidestreaming and corner acceleration. It is recommended to retain the proposed landscaping consisting of dense, evergreen varieties. It is recommended that the planting on the western aspect is capable of growing to a height of 0.5m above a 1.0m planter box to further ameliorate adverse wind conditions as shown in Figure 5.

The wind conditions on the proposed level 12 communal open space has the potential to be impacted by the prevailing north-easterly, westerly and southerly winds due to sidestreaming and corner acceleration. It is recommended to retain the proposed landscaping and tree planting consisting of dense, evergreen varieties. It is recommended that the planting on the southern corner is capable of growing to a height of 1.5m to further ameliorate adverse wind conditions as shown in Figure 5.

5.3 Effects of Masterplan

The St Leonards South masterplan consists of 25 mid-rise buildings ranging from 6 to 19 storeys in height. The increased height of surrounding buildings is expected to provide increased shielding to the direct winds from the north, south and west of the proposed site.

The north-south and east-west alignment of the building lots within the masterplan provides the potential for adverse wind conditions to develop due to sidestreaming, corner acceleration and funnelling effects. The prevailing westerly and southerly winds have the potential to accelerate due to funnelling between the buildings of the masterplan. Along with the north-easterly winds, these winds also have the potential to accelerate around corners of each site resulting in adverse wind conditions. The prevailing north-easterly wind is expected to sidestream along the building frontage along the Canberra Avenue footpath resulting in adverse wind conditions.

It is expected that the wind conditions within the proposed site will be maintained with the use of the proposed localised treatment strategies.

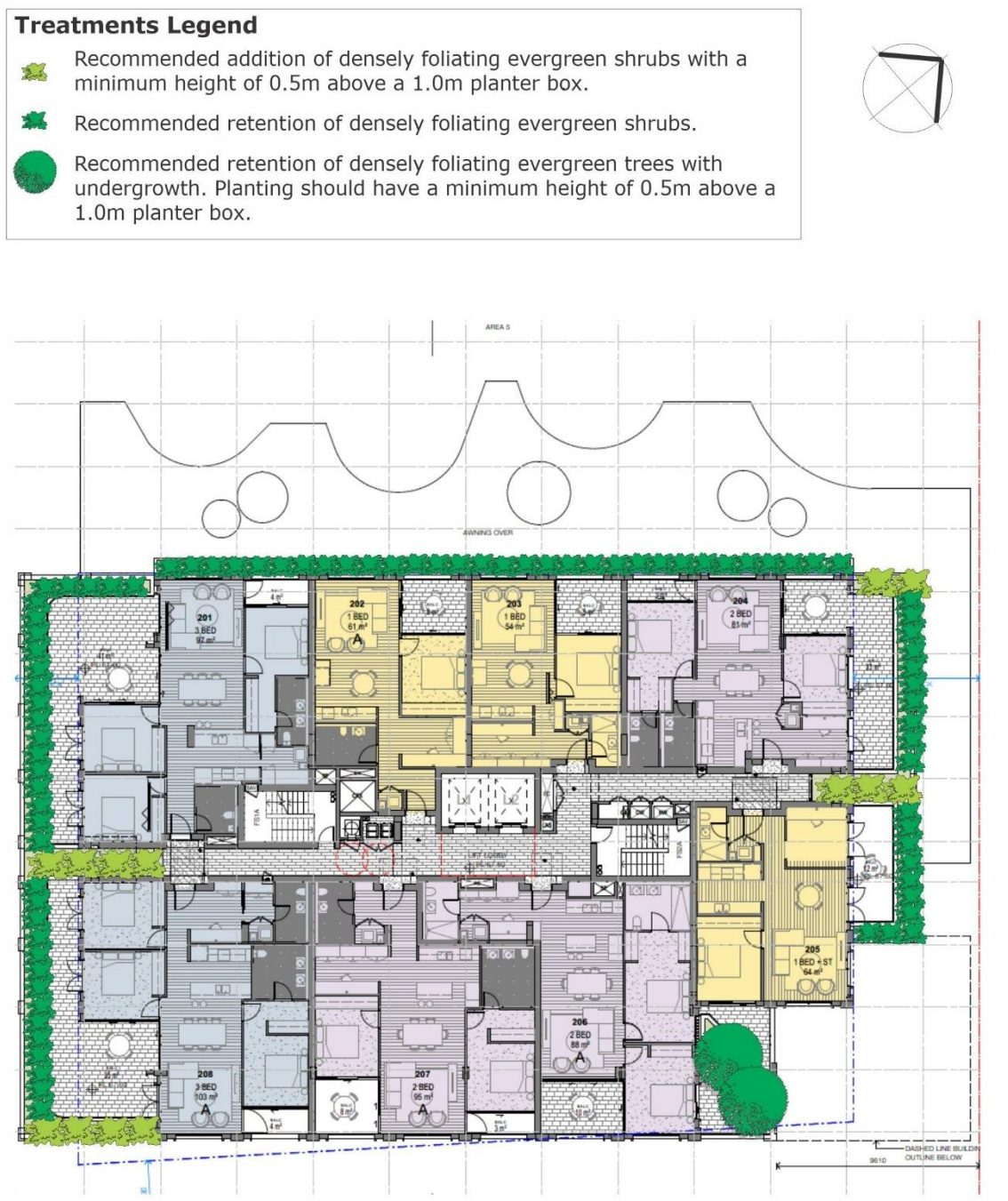

Figure 3: Recommended Treatments for Level 2.

Figure 4: Recommended Treatments for Level 4.

Figure 5: Recommended Treatments for Level 12.

6 REFERENCES

Davenport, A.G., 1972, "An approach to human comfort criteria for environmental conditions". Colloquium on Building Climatology, Stockholm.

Lawson, T.V., 1973, "The wind environment of buildings: a logical approach to the establishment of criteria". Bristol University, Department of Aeronautical Engineering.

Lawson, T.V., 1975, "The determination of the wind environment of a building complex before construction". Bristol University, Department of Aeronautical Engineering.

Lawson, T.V., 1980, "Wind Effects on Buildings - Volume 1, Design Applications". Applied Science Publishers Ltd, Ripple Road, Barking, Essex, England.

Melbourne, W.H., 1978, "Criteria for Environmental Wind Conditions". *Journal of Wind Engineering and Industrial Aerodynamics*, vol. 3, pp241-249.

Penwarden, A.D. (1973). "Acceptable Wind Speeds in Towns", Building Science, vol. 8: pp259–267.

Penwarden, A.D., Wise A.F.E., 1975, "Wind Environment Around Buildings". Building Research Establishment Report, London.

APPENDIX A WIND EFFECTS GLOSSARY

A.1 Downwash and Upwash Effects

The downwash wind effect occurs when wind is deflected down the windward face of a building, causing accelerated winds at pedestrian level. This can lead to other adverse effects as corner acceleration as the wind attempts to flow around the building, as seen in Figure A.1.

This can also lead to recirculating flow in the presence of a shorter upstream building, causing local ground level winds to move back into the prevailing wind.

The upwash effect occurs near upper level edge of a building form as the wind flows over the top of the building. This has the potential to cause acceleration of winds near the leading edge, as well as potentially reattaching onto the roof area. This effect causes wind issues particularly near the leading edges of tall building and on the rooftop areas if there is sufficient depth along the wind direction. Upwash is more apparent in taller towers and podia.

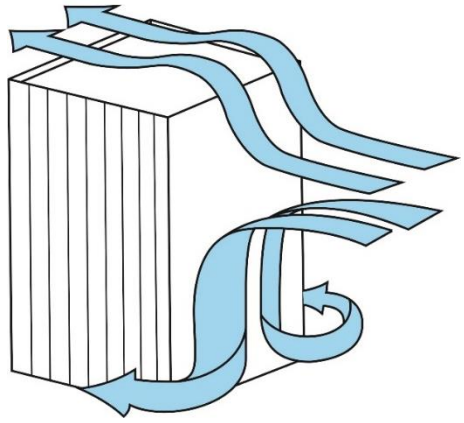

Figure A.1: Downwash Leading to Corner Wind Effect, and Upwash Effects

A.2 Funnelling/Venturi Effect

Funnelling occurs when the wind interacts with two or more buildings which are located adjacent to each other, which results in a bottleneck, as shown in Figure A.2. This causes the wind to be accelerated through the gap between the buildings, resulting in adverse wind conditions and pedestrian discomfort within the constricted space. Funnelling effects are common along pedestrian links and thoroughfares generally located between neighbouring buildings that have moderate gaps between them.

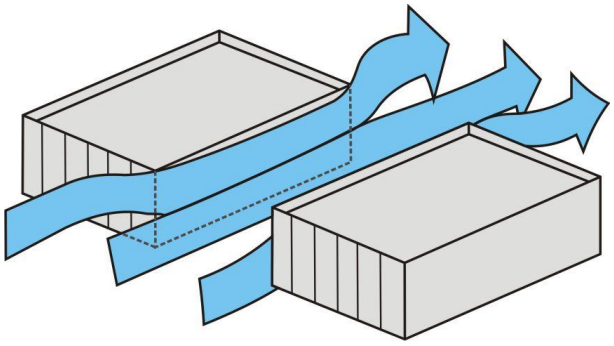

Figure A.2: Funnelling/Venturi Wind Effect

A.3 Gap Effect

The gap effect occurs in small openings in the façade that are open to wind on opposite faces, as seen in Figure A.3. This can involve a combination of funnelling and downwash effects. Presenting a small gap in the façade on the windward aspect as the easiest means through which the wind can flow through can result in wind acceleration through this gap. The pressure difference between the windward façade and the leeward façade also tends to exacerbate the wind flow through this gap.

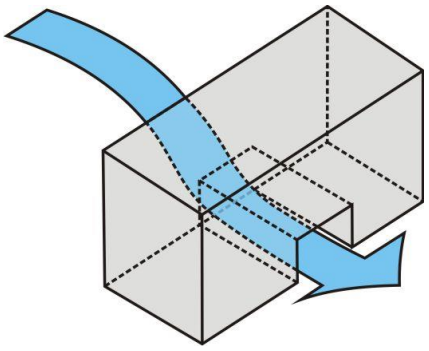

Figure A.3: Gap Wind Effect

A.4 Sidestream and Corner Effects

The sidestream effect is due to a gradual accumulation of wind shearing along the building façade that eventuates in an acceleration corner effect. The flow is parallel to the façade and can be exacerbated by downwash effects as well, or due to corner effect winds reattaching on the façade.

This is shown in Figure A.4. The corner refers to the acceleration of wind at the exterior vertical edge of a building, caused by the interaction of a large building massing with the incident wind, with the flow at the corner being accelerated due to high pressure differentials sets up between the windward façade and the orthogonal aspects. It can be further exacerbated by downwash effects that build up as the flow shears down the façade.

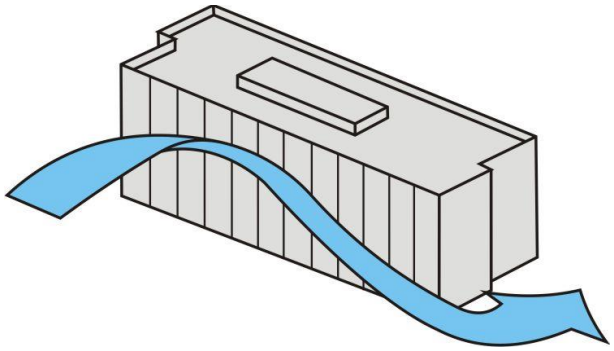

Figure A.4: Sidestream and Corner Wind Effect

A.5 Stagnation

Stagnation in a region refers to an area where the wind velocity is significantly reduced due to the effect of the flow being impeded by the bluff body. For a particular prevailing wind direction, this is typically located near the middle of the windward face of the building form or over a short distance in front of the windward face of a screen or fence. Concave building shapes tend to create an area of stagnation within the cavity, and wind speeds are generally low in these areas.