PEDESTRIAN WIND ENVIRONMENT STATEMENT

12-20 BERRY ROAD & 11-19 HOLDSWORTH AVENUE, ST LEONARDS NSW, 2065

WG715-01F06(REV2)- WS REPORT

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30 YEARS OF EXCELLENCE IN WIND ENGINEERING

DOCUMENT CONTROL

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EXECUTIVE SUMMARY

This report presents an opinion regarding the likely impact of 12-20 Berry Road & 11-19 Holdsworth Avenue, located in St Leonards, on the local wind environment at 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; hence this report only addresses general wind effects and any localised effects that are identifiable through visual inspection of the architectural drawings and landscape masterplan received on May 11, 2022. It is worth noting again that any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

Our assessment indicates that the development has incorporated several design features and wind mitigating strategies. As such, it is expected to be suitable for the intended use of the majority of outdoor trafficable areas. However, some areas are likely to be exposed to stronger winds. It is expected that wind effects identified in this report can be ameliorated with the consideration of the treatment strategies listed below into the design of the development.

- Ground level trafficable areas:
  - Retention of all proposed dense tree landscaping.
- Private and communal terraces on Levels 4-6:
  - Retention of all planter box landscaping for the large private/communal terraces for both buildings between Levels 4 to 6.
  - Inclusion of horizontal shielding at least 2m wide on Holdsworth Building, Level 4 southern private terrace and Berry Building, Level 5 southern private terrace.
  - Inclusion of landscaping or impermeable screen, both at least 1.8m high on eastern aspect of Berry Building, Level 5 southern private terrace.
  - Inclusion of horizontal shielding at least 2m wide along the northern aspect of the Berry Building, Level 6 northern private terrace.
- Rooftop communal terraces:
  - Retention of all landscaping.
  - Inclusion of localised canopies to shield poolside lounge area.
- * Note that any landscaping present on the western aspects of the site should be of an evergreen variety.

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 12-20 Berry Road & 11-19 Holdsworth Avenue, St Leonards, situated between Berry Road to the west and Holdsworth Avenue to the east. The site is immediately surrounded by low-rise residential buildings. Mid to high-rise buildings are located further to the north and north-east. With respect to the masterplan, the site sits at the centre of the St Leonards South redevelopment scheme. The St Leonards South masterplan describes a cluster of 25 structures bounded by Marshall Avenue, Canberra Avenue, River Road, and Park Road.

The existing site consists of 10, 1-2 storey residential buildings. The proposed development consists of two buildings with 10 full-height and two partially excavated storeys, facing Berry Road (Berry Building) and Holdsworth Avenue (Holdsworth Building) respectively. The two buildings are separated by ground level communal areas.

A survey of the land topography in the area indicates a gradual slope towards the north along Berry Road and Holdsworth Avenue and a moderate incline across the site from east to west. 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 superimposed for each wind direction.

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 trafficable areas and pedestrian footpaths.
- Private balconies and terraces.
- Communal rooftop terrace areas.
- Influence of Masterplan.

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.

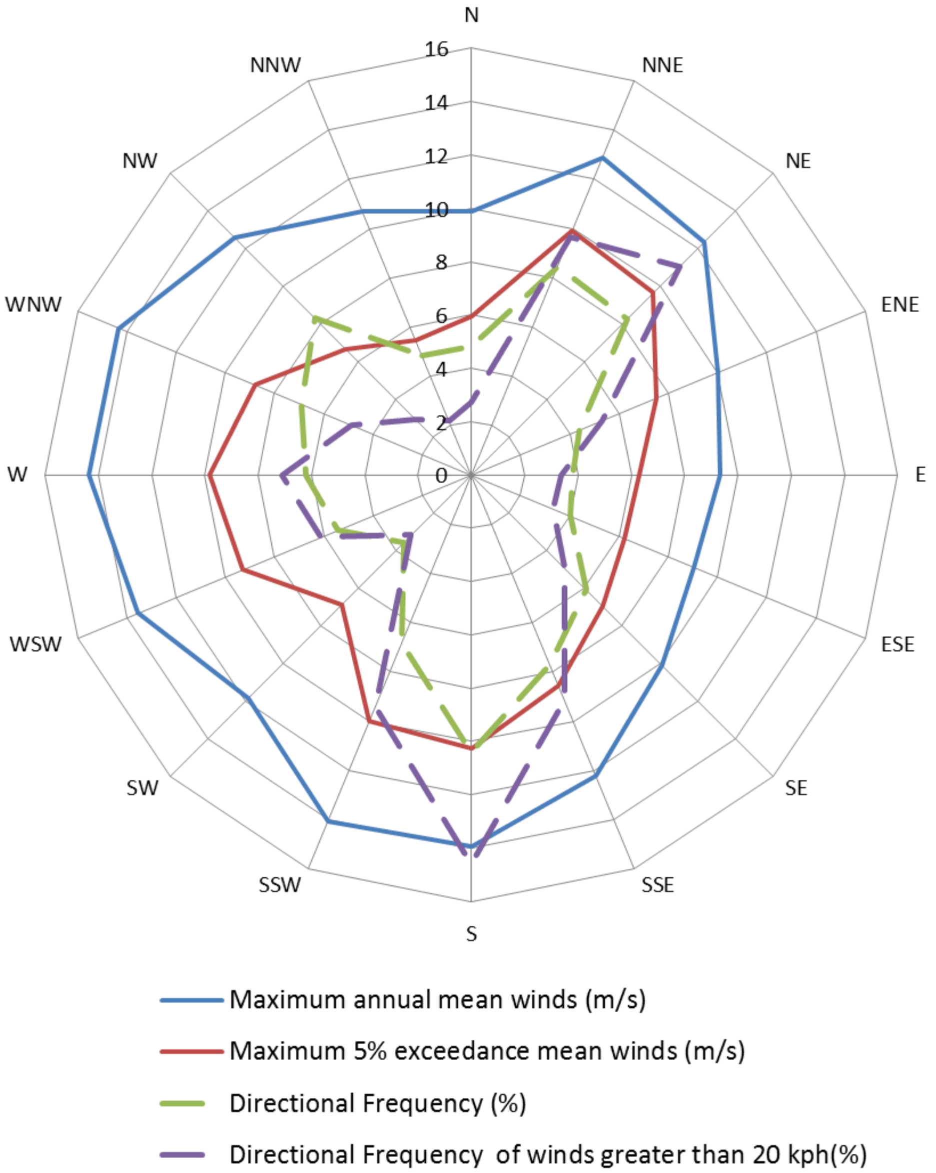

Figure 2: Directional Annual and 5% Exceedance Hourly Mean Wind Speeds (referenced to 10m height in standard open terrain), and Frequencies of Occurrence, for the Sydney Region

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. It is worth noting that the proposed development is located within the centre of the St Leonards South redevelopment. The impact of the masterplan development will be briefly discussed in Section 5.4.

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 to 8m/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 to 6m/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.

- Long Exposure Criterion (3.5m/s to 4m/s with a 5% probability of exceedance)
  for stationary activities longer than an hour, e.g. outdoor cinemas, outdoor fine dining etc.

Note that the lower end of the above ranges reflect the Davenport (1972) criteria and the upper end of these ranges reflect a modified Lawson (1975) criteria. 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 Trafficable Areas and Pedestrian Footpaths

5.1.1 Public Areas

Landscaping within and around the site boundary is expected to provide shielding to the adjacent Berry Road/Holdsworth Avenue pedestrian footpath areas, against each of the three prevailing wind directions. It should be noted that, as prevailing westerly winds are specific to winter months, any landscaping around the western aspects of the site should be of an evergreen variety.

It is expected that the dense tree planting along the northern aspect of the Holdsworth Building, in addition to the Ground Level set-back will provide shielding to the northern thoroughfare from potential prevailing north-easterly wind downwashing. This tree planting should be retained.

The dense tree planting along the Berry Road/Holdsworth Avenue frontages is expected to reduce the impact of wind funnelling/gap effect flow at the through-site link area from prevailing north-easterly and westerly winds.

Landscaping on the northern and southern aspects of the courtyard is expected to provide shielding from wind funnelling of the prevailing southerly and north-easterly winds and should be retained. Dense landscaping within the courtyard itself should provide further shielding from funnelling effects as well as potential downwashing of prevailing north-easterly winds off the Berry Building and should be retained. The Berry Building is expected to provide direct shielding from prevailing westerly winds and any subsequent downwashing off the shorter Holdsworth Building (refer to Figure 3a).

5.1.2 Private Areas

Existing landscaping along the communal courtyard area is likely to provide adequate shielding to the Edible Garden/Secret Garden area from wind downwashing/side streaming from the north-east. At the times when the horizontal, operable glass panel along the western aspect of the Berry Building is open, it is expected that the tree planting along the Berry Road frontage will provide substantial shielding against potential wind downwashing and subsequent pressure driven flow effects from the west.

5.2 Private Balconies and Terraces

5.2.1 Balconies

It is expected that the small corner balconies will benefit from their recessed design, as such, the existing design may be retained. Furthermore, all protruding balconies on the eastern and western aspects of the Holdsworth and Berry Buildings respectively throughout Levels 5-9 have the potential to be directly exposed to at least one prevailing wind direction. Any requirement for treatments is to be further assessed during the detailed design stage.

5.2.2 Open Terraces

The planter box and intertenancy landscaping on the Level 4 Holdsworth Building and Level 5 Berry Building southern terraces should be retained as it is expected to reduce the impact of wind side-streaming and direct wind impact from the south. It is likely that the terrace will be impacted by adverse wind conditions in the form of wind downwashing, and corner accelerated flow. These wind conditions are expected to occur from the north-east/south for the Holdsworth Building and the west/south for the Berry Building. Hence, it is recommended that some form of horizontal shielding be included along the southern edge for each of the two terraces. The shielding should extend at least 2m from the façade line and may be in the form of tree planting, canopies or awnings (refer to Figures 3b and 3c).

We suspect that a similar wind effect will occur along the northern terraces at Level 5 of the Holdsworth Building and Level 6 of the Berry Building - a wind downwash and corner accelerated flow from the north-east/west. Hence, it is recommended that the proposed planter box design be retained for both the Berry and Holdsworth buildings along the abovementioned terrace areas. Furthermore, it is recommended that some form of horizontal shielding be included along the northern edge of the Level 6 northern terrace of the Berry Building. The shielding should extend at least 2m from the façade line and may be in the form of tree planting, canopies or awnings (refer to Figure 3d).

5.3 Communal Rooftop Terrace Areas

5.3.1 Holdsworth Building Rooftop Terrace

The proposed planter box landscaping on the Holdsworth Building rooftop terrace area is expected to provide shielding from prevailing westerly and north-easterly winds and should be retained (refer to Figure 3e). It is also recommended that the planter box structure and the planting be at least 1m and 0.8m in height respectively (an effective height of 1.8m above the floor slab). The Berry Building is also expected to provide additional shielding from prevailing westerly winds.

5.3.2 Berry Building Rooftop Terrace

The planter box landscaping on the Berry Building rooftop terrace is expected to provide shielding from prevailing westerly winds and should be retained (refer to Figure 3f). The raised pool design is expected to provide some shielding to the seated areas from the south prevailing winds. However, it is expected that the seated areas will be affected by adverse wind effects in the form of wind upwashing from the south. As a result, it is recommended that some form of horizontal shielding be included to enhance pedestrian comfort. This shielding may be in the form of tree planting or localised impermeable canopies (refer to Figure 3f).

5.4 Influence of Masterplan

As mentioned in Section 2, the site sits at the centre of the St Leonards South masterplan. As such, the site is surrounded on all sides by buildings 6-19 storeys in height providing increased shielding of prevailing north-easterly, southerly, and westerly winds. However, the masterplan may also increase potential for the development of adverse wind effects. Specifically, all prevailing wind directions have the potential to accelerate due to funnelling between buildings of the masterplan and result in adverse wind conditions. It is expected that wind conditions within the proposed site will be maintained with the use of the proposed localised treatment strategies, including the dense vegetation/tree planted proposed along the Ground Level plane.

Treatments Legend

Recommended retention of landscaping and artificial canopies. West-facing landscaping should be of an evergreen variety

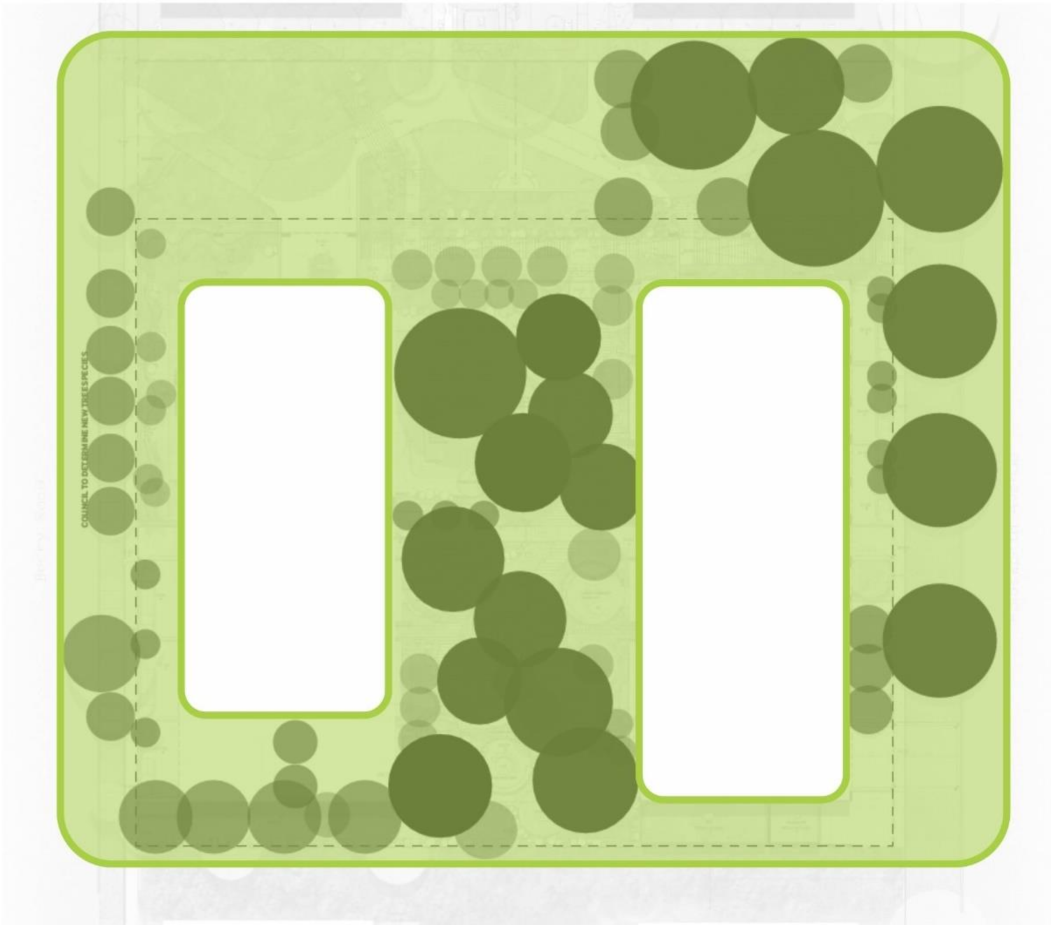

Figure 3a: Recommended Treatments - Level 4 Terraces

Figure 3b: Recommended Treatments - Level 4 Terraces

Treatments Legend

- Recommended retention of planter box and landscaping. West-facing landscaping should be of an evergreen variety
- Recommended inclusion of horizontal shielding at least 2m wide. Shielding may be in the form of tree planting, awnings, or localised canopies
- Recommended addition of landscaping or impermeable screen, both at least 1.8m high

Figure 3c: Recommended Treatments - Level 5 Terraces

Figure 3d: Recommended Treatment - Level 6 Terrace

Figure 3e: Recommended Treatments - Level 9 Terrace

Figure 3f: Recommended Treatments - Level 10 Terrace

6 REFERENCES

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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 buildings and podia.

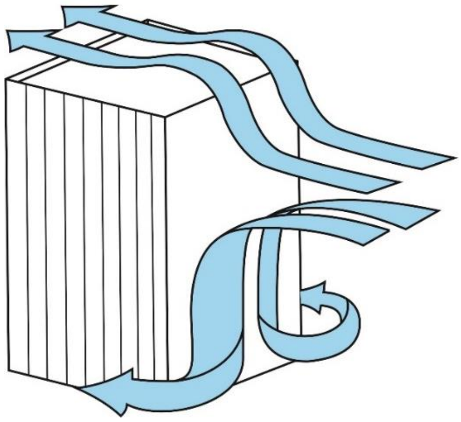

Figure A.1: Downwash Leading to Corner Wind Effect, and Upwash Effects

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.

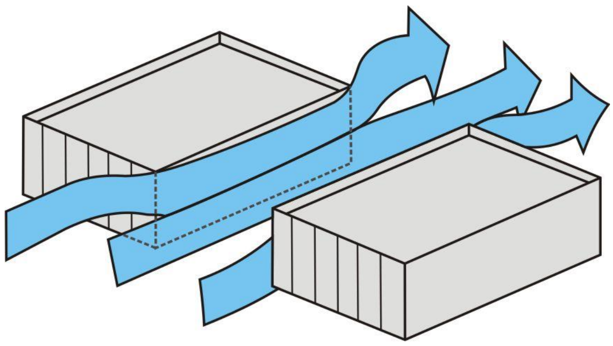

Figure A.2: Funnelling/Venturi Wind Effect

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.

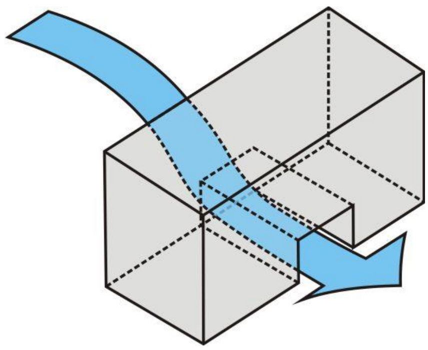

Figure A.3: Gap Wind Effect

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.

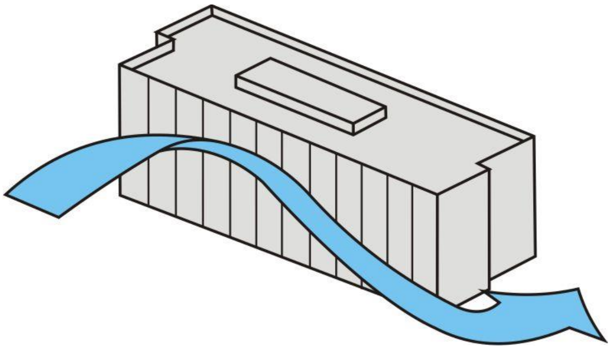

Figure A.4: Sidestream and Corner Wind Effect

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.