



PEDESTRIAN WIND ENVIRONMENT STATEMENT
ENTERTAINMENT AND LEISURE PRECINCT,
WESTFIELD HURSTVILLE

WC257-03F02(REV0)- WS REPORT

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EXECUTIVE SUMMARY

This report presents an opinion on the likely impact of the proposed Entertainment and Leisure Precinct development located at Westville Hurstville, 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. Wind tunnel testing has been undertaken for the subject development for an earlier design, and hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects, taking into account the results of the previous wind tunnel testing undertaken where applicable..

The results of this assessment indicate that the development has incorporated several design features and wind mitigating strategies such as screens and awnings and is expected to be suitable for the intended use for the outdoor trafficable areas. Some recommendations to consider are the following:

- Retention of the densely foliating evergreen landscaping on either side of the south-western entry on Level Retail 04.
- Operator controlled screening or planter boxes adjacent to the seating areas adjacent to the north-western opening on Level Retail 04
- Retention of the proposed dense landscaping on Community Green Space on Level Retail 05.
- Retention of the proposed screening on the elevated terraces on Level Retail 05.

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.

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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 THE DEVELOPMENT AND SURROUNDINGS

The site is located at the existing Westfield Hurstville site, and is adjacent to Cross Street to the north-west, and Park Road underneath. Immediately surrounding the Westfield Hurstville building are medium to high rise commercial and residential buildings, which then become predominantly low to medium rise residential buildings further away from the site.

A survey of the land topography indicates a gradual slope towards the south-east and south west, however, these elevation changes are largely insignificant in terms of topographical wind effects.

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

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

- Pedestrian footpaths along Cross Street and Park Road.
- Shopfront walkway on Level Retail 03.
- Courtyard on Level Retail 04 (Parking P5)
- Community Green Space on Level Retail 05 (Parking P6)
- Footbridge and Elevated Terraces on Level Retail 05 (Parking P6)

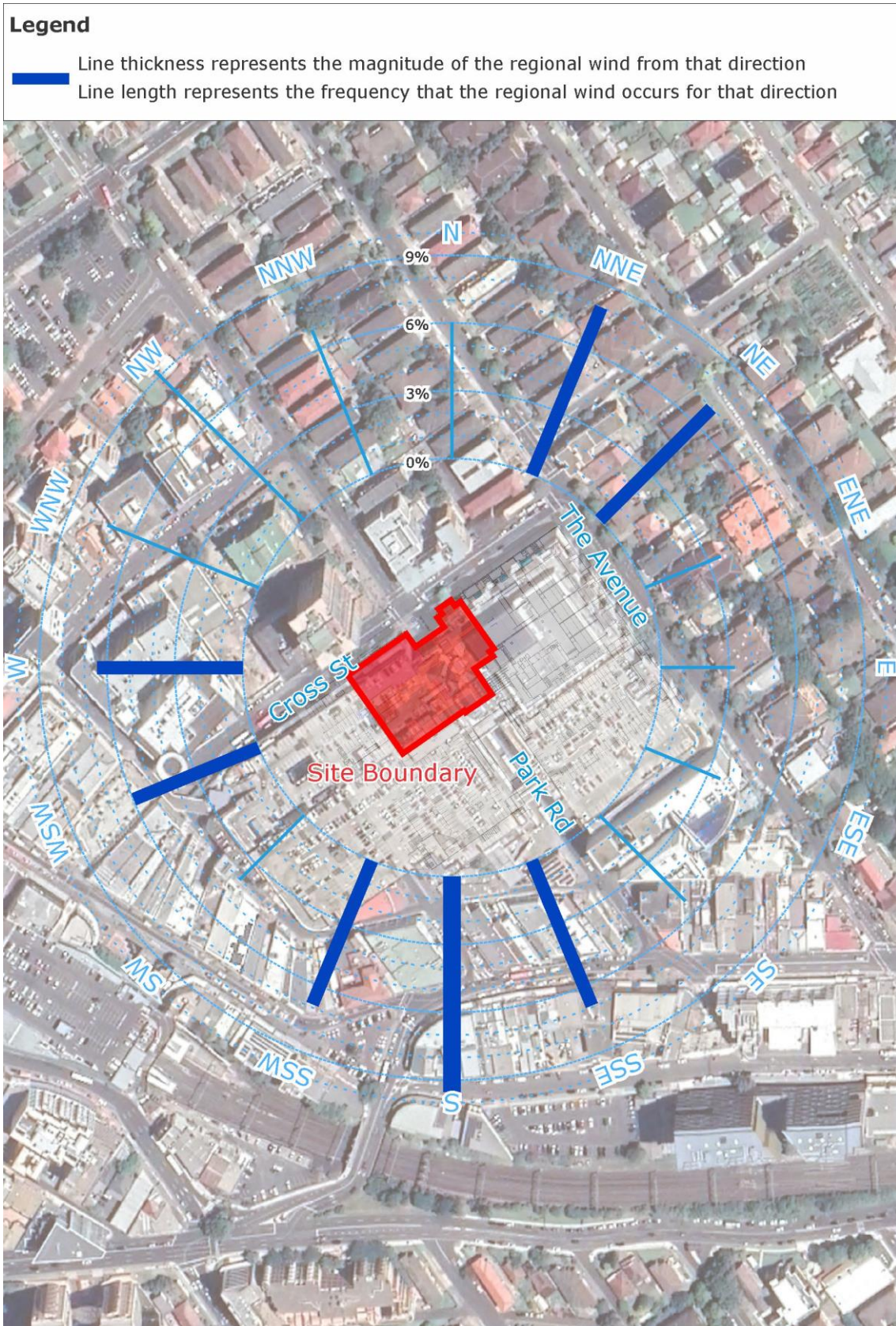


Figure 1: Aerial Image of the Site Location and Prevailing Wind Directions

3 REGIONAL WIND

The Sydney region is governed by three principal wind directions, and these can potentially affect the subject development. These winds prevail from the north-east, south, and west. A summary of the principal time of occurrence of these winds throughout the year is presented in Table 1 below. This summary is based on a detailed analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained at the meteorological station located at Kingsford Smith Airport by the Bureau of Meteorology (recorded from 1995 to 2016). From this analysis, directional probabilities of exceedance and directional wind speeds for the region are determined. The directional wind speeds and corresponding directional frequencies of occurrence are presented in Figure 2.

As shown in Figure 2, the southerly winds are by far the most frequent wind for the Sydney region, and are also the strongest. The westerly winds occur most frequently during the winter season for the Sydney region, and although they are typically not as strong as the southerly winds, they are usually a cold wind since they occur during the winter and hence can be a cause for discomfort for outdoor areas. North-easterly winds occur most frequently during the warmer months of the year for the Sydney region, and hence are usually welcomed within outdoor areas since they are typically not as strong as the southerly or westerly winds.

Table 1: Principal Time of Occurrence of Winds for the Sydney Region

Month	North-Easterly Winds	Southerly Winds	Westerly Winds
January	X	X	
February	X	X	
March	X	X	
April		X	X
May			X
June			X
July			X
August			X
September		X	X
October	X	X	
November	X	X	
December	X	X	

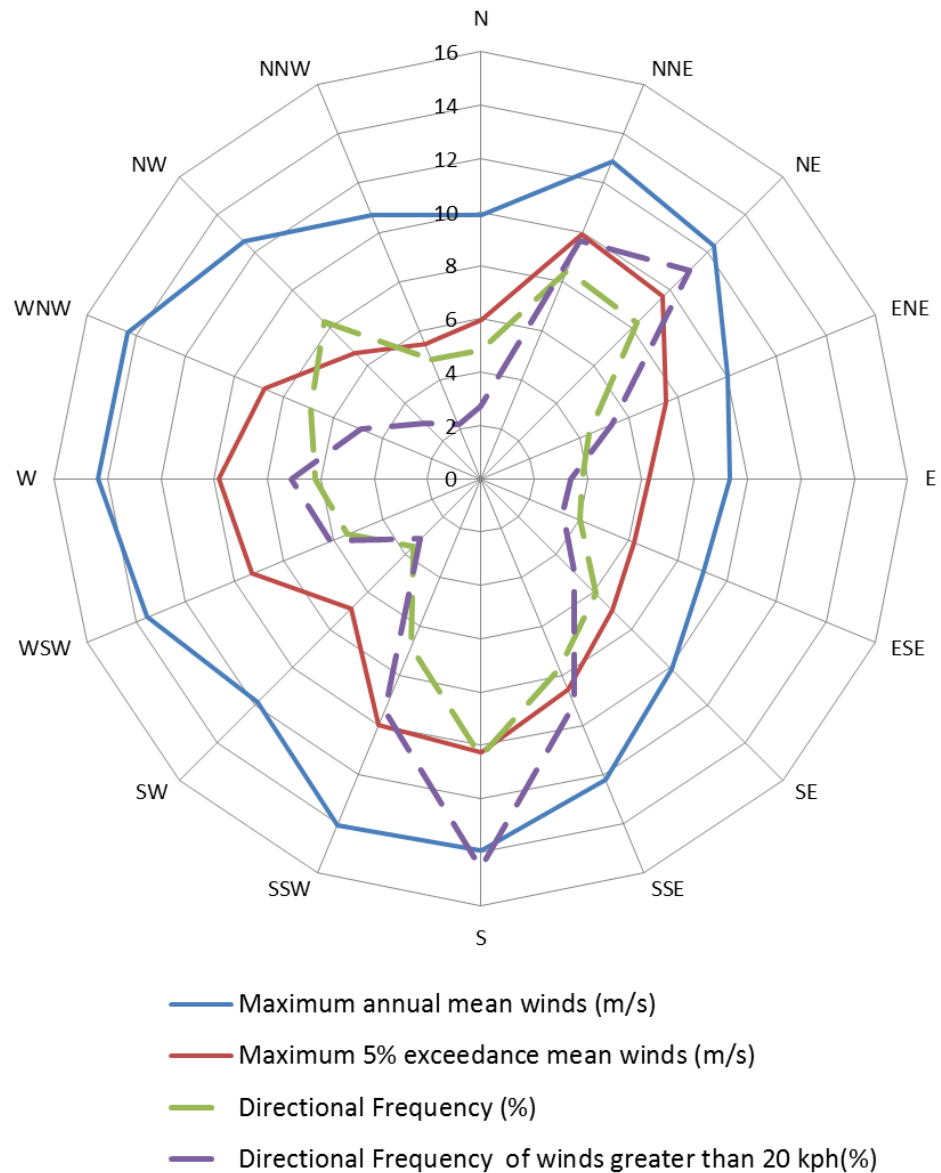


Figure 2: Annual and 5% Exceedance Hourly Mean Wind Speeds, and Frequencies of Occurrence, for the Sydney Region (referenced to 10m above ground in standard open terrain)

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 2 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 2: 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 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 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 the Appendix section.

For this assessment, the wind comfort criterion that were considered as part of this assessment were the following:

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

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

5.1 Pedestrian Footpaths

The pedestrian footpaths around the site along Park Street and Cross Road will be largely unaffected by the changes to the design. The wind conditions along these pedestrian footpaths are expected to be similar to the existing site wind conditions.

5.2 Shopfront Walkway on Level Retail 03

The shopfront walkway along the western aspect is expected to be similar to the existing conditions along Cross Street. The proposed development is not expected to have any significant impact on the amenity of this area.

5.3 Courtyard on Level Retail 04

The courtyard on Level Retail 04 is potentially exposed to the southerly and westerly prevailing winds that can funnel through the openings. However, the prevailing north-easterly winds are shielded by the surrounding buildings and the development itself. The landscaping flanking the southern-western entry is recommended to be retained in the final design to buffer the winds

entering the seating areas further within the courtyard. It is recommended that a densely foliating evergreen species be selected to ensure that the landscaping remains effective throughout the year. The awnings also prevent the wind from reattaching onto the more wind sensitive areas below. Furthermore, the north-westerly aspect opening may cause some westerly winds to directly impact the seating area immediately adjacent to the opening. This can be mitigated through the use of operator controlled localised screening or planter boxes (approximately 1.2-1.5m high for example) next to the seating area to further improve comfort when desired.

With consideration of the recommendations above, it is expected safe and comfortable wind conditions will be achieved throughout this area and be suitable for its intended uses.

5.4 Community Green Space on Level Retail 05

The Community Green Space is primarily exposed to the southerly and westerly prevailing winds, while the north-easterly winds remains largely shielded by the development itself. The proposed planting around the perimeter of this space is expected to mitigate the adverse winds and be suitable for its intended use. It is recommended that a densely foliating evergreen species be selected to ensure that the landscaping remains an effective wind mitigation measure throughout the year.

5.5 Footbridge and Elevated Terraces on Level Retail 05

The footbridge and Elevated Terraces on Level Retail 05 are primarily exposed to the prevailing westerly winds. These areas are generally shielded by the development itself from the north-easterly and southerly prevailing wind directions. It is expected that the footbridge will be suitable for its intended use of pedestrian circulation, while the elevated terraces are expected to be suitable for its intended use for short to long duration stationary activities due to the full height porous screening along the western aspect.

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7.1 Downwash and Upwash Effects

The downwash wind effect occurs when wind is deflected down the building's windward facade causing accelerated wind speeds 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 A1. This can also lead to recirculating flow in the presence of a shorter upstream building, causing the local ground level wind flow to move towards 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.

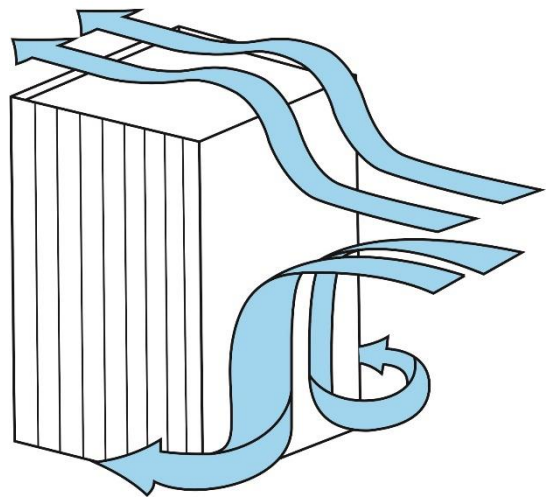


Figure A1: Downwash Leading to Corner Wind Effect, and Upwash Effects

7.2 Funnelling/Venturi Effect

Funnelling effects occur when the wind interacts with two or more buildings which are located adjacent to each other and the building form design results in a bottleneck, as shown in Figure A2. This can cause the wind to be forced 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.

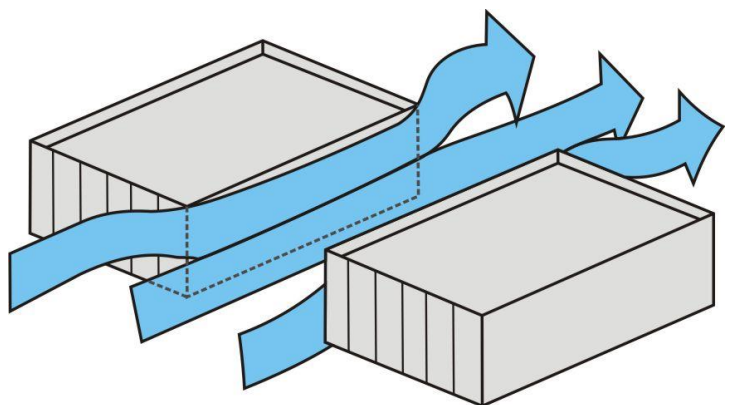


Figure A2: Funnelling/Venturi Wind Effect

7.3 Gap Effect

The gap effect occurs in small openings in the façade that are open to wind on opposite faces, as seen in Figure A3. 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.

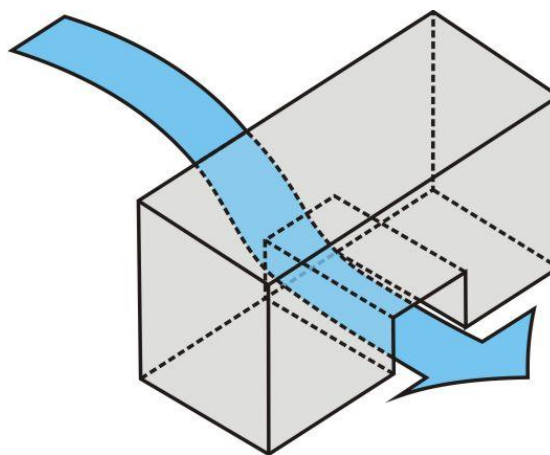


Figure A3: Gap Wind Effect

7.4 Sidestream and Corner Effects

The sidestream effect is due to a gradual accumulation of winds 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 A4

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.

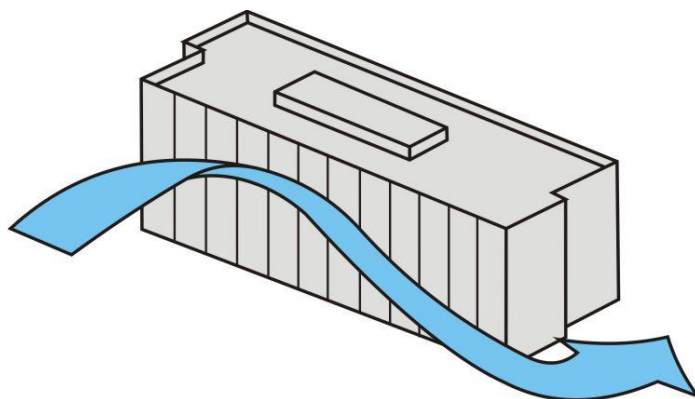


Figure A4: Sidestream and Corner Wind Effect

7.5 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.