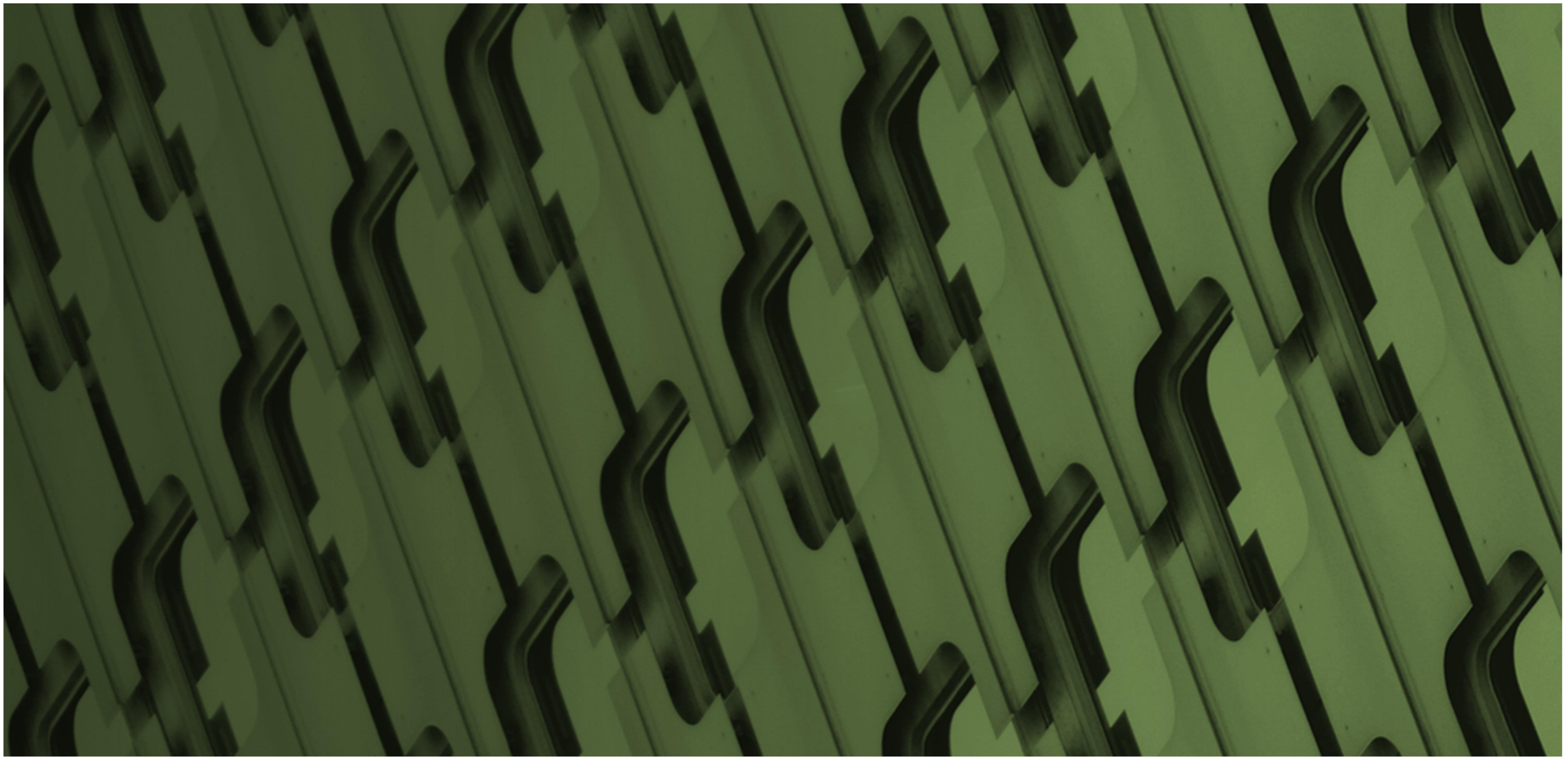
Wind Microclimate Assessment

Pedestrian comfort at 115B Victoria Parade



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Pedestrian comfort at 115B Victoria Parade

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Executive Summary

This report assesses the likelihood that wind-induced discomfort may be felt by patrons of various outdoor spaces around the proposed 115B Victoria Parade development for the Australian Catholic University. The assessment draws on a large local meteorological data set adjusted for location and height.

Winds are assessed against the Lawson comfort criteria, which sets upper wind speeds for comfort during a range of typical activities — long-term sedentary (e.g. sitting at café tables), short-term sedentary (e.g. queuing, talking), slow movement (e.g. window shopping, strolling), and rapid movement (e.g. fast walking).

Based on hourly wind speed and direction data collected from the Melbourne Regional Office (located approximately 1km to the west of the site), predominant winds are west south westerly and north easterly throughout the year and during business hours, as well as outside of business hours. These two key wind directions have therefore been the focus of the analysis provided for this submission.

Seven locations within and around the site have been identified as being sensitive to wind speed. These are summarised in the table below, along with the desired wind comfort and activity category. Potential issues have been highlighted.

Table 1: Wind assessment summary and impacts

Location		Desired wind comfort and activity category	Potential wind microclimate impacts
1	Ground level outdoor seating around within the site boundary	Comfortable for pedestrians sitting or standing for longer periods of time	Channelling of winds along Victoria Parade – some local mitigation may be required.
2	Along Napier Street	Comfortable for pedestrians leisure walking	Unlikely to be significant impacts caused by the proposed building.
3	Along Victoria Parade	Comfortable for pedestrians leisure walking	Unlikely to be significant impacts caused by the proposed building.
4	Level 4 Terrace	Comfortable for pedestrians sitting or standing for shorter periods of time	Exposed to predominant winds – balustrades likely to provide sufficient protection.
5	Level 6 Terrace	Comfortable for pedestrians sitting or standing for shorter periods of time	Exposed to predominant winds – balustrades likely to provide some protection. Additional local mitigation may be required.
6	Along Young Street	Comfortable for pedestrians leisure walking	Unlikely to be significant impacts caused by the proposed building.
7	Along Little Victoria Street	Comfortable for pedestrians leisure walking	Unlikely to be significant impacts caused by the proposed building.

Due to the relatively low wind speeds experienced in this area of Melbourne, there are unlikely to be any significant adverse impacts at Ground Level within or surrounding the site due to the construction of the proposed 115B Victoria Parade development. The staggered, non-uniform shape of the building envelope is likely to minimise wind acceleration, with horizontal shading further assisting in minimising potential issues.

A detailed computational analysis will be undertaken during the next design stage which will quantify expected wind speeds and compare these against the Lawson comfort criteria.

1.0 Introduction

It is somewhat inevitable that, with the construction of a new development, the wind microclimate in the vicinity will be changed. Where new buildings are significantly different in size and form, orientation or height from those in the immediate vicinity, winds can be introduced which may cause discomfort to pedestrians. The design of a development should therefore consider the provision of a quality outdoor environment, which is appropriate for its designated use for the majority of the year. Due to the height and layout of the proposed building at 115B Victoria Parade, a number of potentially adverse wind effects may be experienced.

This study is an experience based qualitative review of the pedestrian level wind environment around the proposed 115B Victoria Parade development. The assessment of wind conditions is based upon our experience with other similar schemes and our knowledge of the interaction of the wind with the built environment. The wind conditions around the proposed development in relation to planned pedestrian activities have been considered and an assessment of the potential impact that the proposed development may have on the surrounding area's wind microclimate is provided. Areas where wind is likely to be accelerated by geometrical features are highlighted and ways to mitigate these effects are recommended.

Local authority planning guidelines typically focus on user comfort and safety. Here, users are usually taken to be at ground level (or the main podium level etc.) of a particular space. They may be passing through on foot or bicycle; wandering slowly (e.g. talking); sitting or standing for a short period (e.g. at a bus stop) or for a long period (e.g. outdoor dining). Planning criteria focus on the frequency of high winds, which are known to be uncomfortable in various situations and for various durations of exposure.

Upper-level users of balconies etc. may also be affected by winds, but exposure is generally considered to be by choice and easily avoidable. In rare cases, outdoor dining or other regular outdoor activity may take place relatively high above ground level, in which case special assessments must be made.

As this is a desk based study, quantification of likely increases or decreases in wind speed cannot be given and only an indication of likely conditions that pedestrians will experience is presented here.

1.1 Purpose, basis and limitations of this report

The purpose of this report is to provide evidence as to the likelihood of wind-induced discomfort to ground-level users of the spaces around the building.

This report presents probabilistic estimates of the likelihood of events which may have comfort implications. These are based on historical wind data and measured against commonly available wind effects criteria using accepted estimated methods. Given these limitations, AECOM cannot guarantee with certainty that the development will not adversely impact upon safety and comfort in the public realm.

This report is based on drawings and other information supplied; a statistical analysis of data; published methodologies for wind assessment; and experience with assessing wind flows around buildings. The statistical analysis does not include an allowance for rare high-wind events such as severe storms. Also note that future wind patterns may not reflect past wind patterns. For example, changes in wind climate due to global warming are not accounted for. This report does not address structural aspects of wind phenomena.

All advice is provided with best intent and to the accuracy limits of the nature of the assessment undertaken.

2.0 Assessment criteria

2.1 Basis

Wind speed and gustiness are the primary measurable factors affecting people's comfort. Other factors such as air temperature and humidity, clothing, sun exposure, etc. are also significant, but these can often be addressed by a modification of effective wind speeds (Twidell, 2006).

Wind speed is understood to mean the average wind speed taken over a time of one hour or so. Gustiness refers to the rate of change of wind speed, usually identified with the turbulent intensity defined by ratio of the standard deviation of the mean wind speed to the mean itself. The important wind gusts are those lasting 2–3 seconds, being the time taken to perform a simple act such as a few walking steps, opening a door etc.

Gustiness is a difficult factor to assess on the urban micro-scale. Fortunately, the implied turbulent intensity may be related to the underlying means in order to recast gustiness criteria in terms of mean wind speed (Twidell, 2006), (Melbourne, 1978), (ASHRAE, 2001), (Blocken, 2004). Estimates of turbulent intensity in urban situations range from 15% to 30% (Twidell, 2006), implying that gust wind speeds are generally 1.5–2.0 times greater than mean wind speeds.

2.2 Comfort

In general, comfort criteria relate to both the thermal effects of wind on people, and the mechanical effects of wind on their activities.

The comfort criteria used in this study is the Lawson criteria (Lawson, 1978), based on the probability of exceeding certain mean wind speeds. The criteria are presented in Table 2. Wind conditions are unacceptable when the probability of the mean wind speed exceeding the given number is greater than 5%.

Table 2: The Lawson wind comfort criteria

Threshold wind speed (m/s)	Activity
4	Uncomfortable for pedestrians in the vicinity of entrance doors or sitting outside for long periods of time, such as outdoor cafes.
6	Uncomfortable for pedestrians standing or sitting for shorter periods of time, such as queuing or talking.
8	Uncomfortable for pedestrians 'leisure walking' e.g. strolling, window shopping and sightseeing.
10	Uncomfortable for pedestrians walking quickly e.g. walking to a destination, and cycling.

3.0 The local wind climate

3.1 Meteorological data

The wind data was taken from the Bureau of Meteorology automatic weather station at Melbourne Regional Office (RO)[1], which is located on the corner of La Trobe Street and Victoria Parade, approximately 1km to the west of 115B Victoria Parade.

The wind speed data was rescaled to account for the difference in land surface structure between the meteorological station and the development site, and the height difference between the anemometer and the level at which people are affected (assumed to be 1.5m above ground level). The rescaling was accomplished using a logarithmic-law approximation to a neutrally stable atmospheric boundary layer profile (Pasquill-Gifford Class D) (Oke, 2006) using the equation:

$$u_z = \frac{u_*}{\kappa} \ln \frac{z}{z_0}$$

In which u_z is the wind speed at height z (1.5m for pedestrian height), u_* is the friction velocity which is based on the reference wind speed from Melbourne RO, κ is von Karman's constant ($\cong$ 0.4) ans z_0 is the roughness height (taken as 2m for this site to account for physical obstructions such as cars).

Wind speeds below 0.5 m/s are registered by the anemometer as zero (calm).

3.2 Summary statistics

The wind data was analysed to assess the likelihood of uncomfortable winds, without allowing for the presence of the development. Local wind effects due to the development will be discussed in the next section.

The analysis was carried out using:

- The entire data set, representing wind conditions 24 hours a day
- A subset restricted to the hours of 7am to 7pm (business hours) when outdoor areas would be most active

3.2.1 Wind speed

Calm conditions occur only rarely (5%) during business hours, slightly more frequently (8%) during winter. Wind speeds at pedestrian height are low compared to the comfort criteria (Figure 1 on the following page). Based on wind speeds experienced at the Melbourne RO, i.e. not taking in to account acceleration caused by the built environment local to 115B Victoria Parade, wind speeds are likely to be comfortable for long term sedentary activities for the majority of the time.

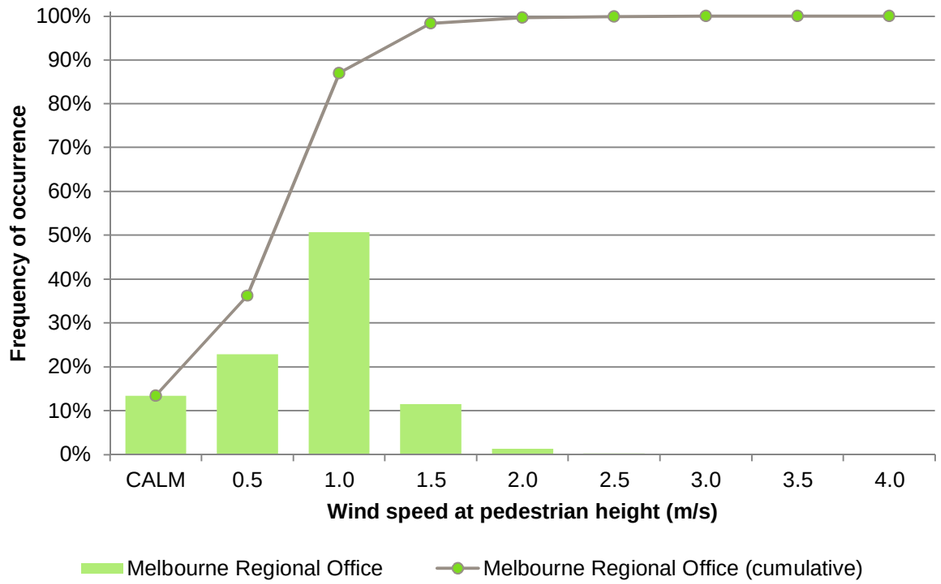


Figure 1: Distribution of wind speeds by band (bars) and cumulatively (line).

[1] Station number 086071. The data consisted of hourly wind speed and direction, maximum gust speed, temperature and other variables from 3/3/1997 to 31/8/2009. After quality checks, there were a total of 94,026 suitable records.

3.2.2 Wind direction

Figure 2 shows the frequency of winds from each direction (divided in to 10° increments) for all hours and seasons (top left), divided by season for all times of the day (top right) and divided by season during business hours (bottom). Within the CBD, there is very little variation in predominant winds between seasons, and during business hours and outside of business hours, with west south westerly winds occurring most frequently, closely followed by north easterly winds. Hence west south westerly and north easterly winds will be the focus of the assessment in section 4.0.

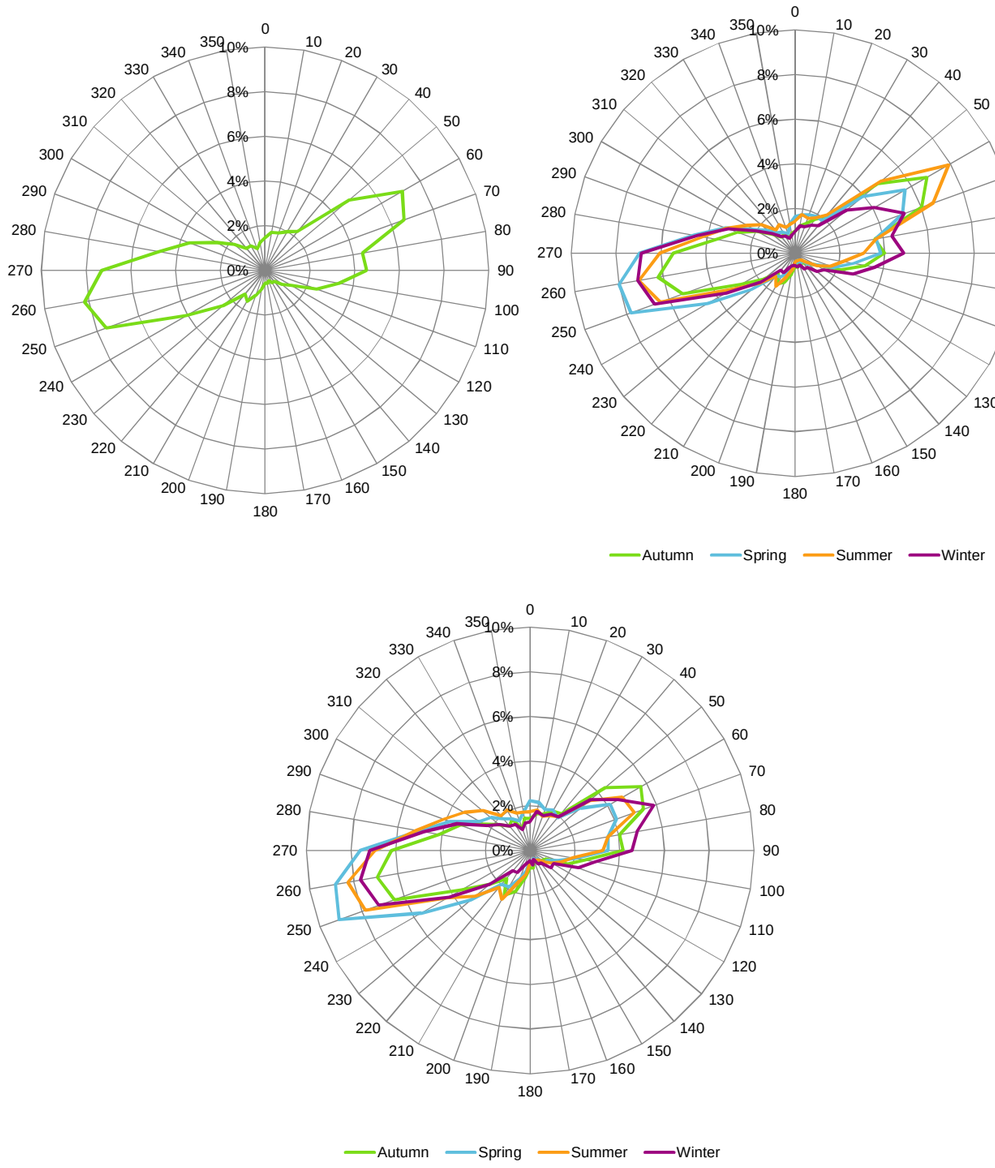
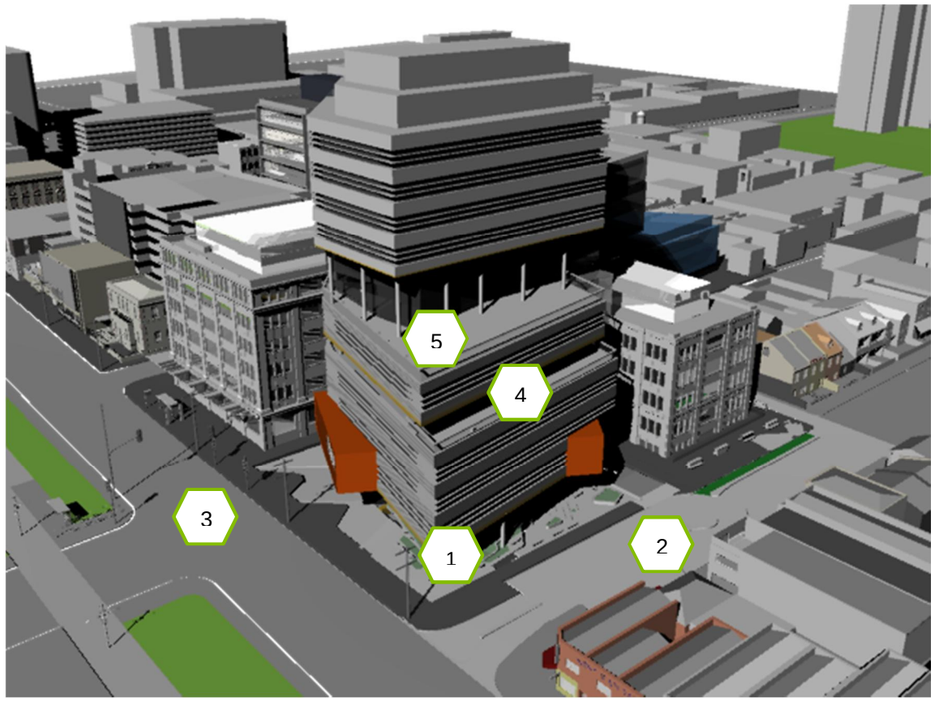


Figure 2: Distribution of wind heading for all times and seasons (top left), all times divided by season (top right), and by season during business hours (bottom).

4.0 Comfort assessment

4.1 Wind-sensitive locations

Figure 3 and Figure 4 identify the locations that are potentially sensitive to wind flows, both within the site boundary, and the impact that the proposed building may have on adjacent streets. Each location is discussed in the followings sections.



1. Ground level outdoor seating area
2. Along Napier Street
3. Along Victoria Parade
4. Level 4 Terrace
5. Level 6 Terrace

Figure 3: View from south east

6. Along Young Street
7. Along Little Victoria Street

Figure 4: View from north west

4.1.1 Ground level outdoor seating area

This area is required to be comfortable for pedestrians sitting or standing for longer periods of time.

West south westerly winds are likely to channel along Victoria Parade from the city. Buildings on the opposite side of Victoria Parade are likely to provide little shelter, however winds are unlikely to be excessive in speed. Local mitigation features may be required, and this will be confirmed during the detailed analysis that will be carried out during the next design stage.

The adjacent buildings across Napier Street are likely to provide some shelter from north easterly winds, with down was on the eastern façade unlikely due to the staggered floor plate of the buildings and horizontal fins used for provide shade.

4.1.2 Along Napier Street

Conditions along Napier Street should be suitable for leisure walking as a minimum. The proposed building is unlikely to accelerate wind speeds above this threshold, and more detailed analysis will be undertaken during the next stage of design in order to confirm this.

4.1.3 Along Victoria Parade

Conditions along Victoria Parade should be suitable for leisure walking as a minimum. The proposed building is unlikely to accelerate wind speeds above this threshold, and more detailed analysis will be undertaken during the next stage of design in order to confirm this.

4.1.4 Level 4 Terrace

The Level 4 Terrace should be suitable for shorter periods of sitting or standing, however exposure is generally considered to be by choice and easily avoidable.

The terrace area is exposed to north easterly winds with no shelter provided by surrounding buildings are they are all considerably lower than this level. The balustrades (currently shown at around 1.6m high) will provide protection to users of this space, and an estimate of likely wind speeds will be provided in the detailed analysis in the next stage of design.

4.1.5 Level 6 Terrace

As with Level 4, the Level 6 Terrace should be suitable for shorter periods of sitting or standing, however exposure is generally considered to be by choice and easily avoidable.

This terrace is exposed to both west south westerly winds and north easterly winds, and so has the potential to experience elevated winds compared to the Level 4 Terrace, due to the depth of the terrace. Again, the balustrades (currently shown at 1.6m high) will provide protection to users, and further analysis will be provided in the next design stage.

4.1.6 Along Young Street

Conditions along Young Street should be suitable for leisure walking as a minimum. The proposed building is unlikely to accelerate wind speeds above this threshold, and more detailed analysis will be undertaken during the next stage of design in order to confirm this.

4.1.7 Along Little Victoria Street

Conditions along Little Victoria Street should be suitable for leisure walking as a minimum. The proposed building is unlikely to accelerate wind speeds above this threshold, and more detailed analysis will be undertaken during the next stage of design in order to confirm this.

5.0 Summary

5.1 Likelihood of discomfort

A high level desktop study of likely wind conditions around the proposed 115B Victoria Parade building and surrounding streets has been undertaken. Due to the relatively low wind speeds experienced in this area of Melbourne, there are unlikely to be any significant adverse impacts at ground level within or surrounding the site due to the construction of this building. The staggered, non-uniform shape of the building envelope is likely to minimise wind acceleration, with horizontal shading further assisting in minimising potential issues.

The terraces on Levels 4 and 6 are relatively exposed to prevailing winds. Although the current balustrades will provide some protection, additional local mitigation measures may be required

A detailed computational analysis will be undertaken during the next design stage which will quantify expected wind speeds and compared these against the Lawson comfort criteria.

5.2 Mitigation

No additional mitigation requirements are proposed at this stage, however smaller local features may need to be incorporated following the detailed analysis.

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