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SOUTH OAKLEIGH VIC 3167
AUSTRALIA

(ACN 004 230 013)

Ref: 40-18-DE-VCAT-00
10 May 2018

Frank Walker and Sel Reklaw Pty Ltd
c/- Russell Kennedy Lawyers
Level 12, 469 La Trobe Street
Melbourne VIC 3000
Attn: Julie Colsell

Dear Madam,

**Fishermans Bend Planning Review Panel
Amendment GC81
Environmental Wind Criteria**

We noted in our evidence dated 29th March, 2018, that there is an error in the definition of the comfortable wind conditions criteria for the GC81 Amendment. The GC81 Amendment defined the criteria as follows:

Comfortable wind conditions means a mean wind speed from any wind direction with probability of exceedance less than 20% of the time, equal to or less than:

- 3 metres/second for sitting areas
- 4 metres/second for standing areas
- 5 metres/second for walking areas.

Mean wind speed means the maximum of:

- Hourly mean wind speed, or
- Gust equivalent mean speed (3 second gust wind speed divided by 1.85).

The error in the definition is the mean wind speed for the Melbourne wind climate does not occur from any wind direction for more than 20% of the time, therefore any location around a building development within the Fishermans Bend precinct would pass these criteria, i.e. all locations would achieve the sitting criterion, and the unsafe wind conditions criterion (discussed later) would be the limiting criterion.

We understand the criteria proposed have been copied from the Melbourne Planning Scheme for the central city and the intention of these criteria was to consider wind conditions associated with more frequent wind occurrences compared to the earlier criteria, prior to Amendment C270, that was based on winds with an annual occurrence.

Melbourne is located in the wind climate known colloquially as the roaring forties. The roaring forties take place when the atmospheric pressure systems move from west to east bringing with them a cycle of wind events. The prevailing winds are from the southwest through west to north, with the south a secondary strong wind sector. The north sector winds are strongly influenced by synoptic conditions with few stronger wind events such as thunderstorms. For the synoptic winds the west sector occurrences are considerably less frequent compared to the north sector, but the stronger wind events are strongly influenced by weather fronts and thunderstorm events. Therefore, the issue we have with defining the wind criteria based on more frequent wind events, i.e. weekly, monthly, in the mixed (synoptic and strong wind events [thunderstorms]) wind climate of Melbourne is that the less frequent but stronger wind events would be ignored. The ignoring of less frequent but stronger wind events that would still influence pedestrian comfort would infer that wind conditions in streetscapes would be better than they would be perceived by pedestrians. Additionally, a ridiculous situation of the walking comfort criterion approaching the safety criterion would occur due to the different probability definition of the comfortable wind conditions criteria (i.e. weekly, monthly) versus the unsafe wind conditions criterion (i.e. annually). The GC81 definition of the unsafe criterion is 20 ms^{-1} at a probability of 0.1% and this may result in the confusing scenario of passing the walking criterion but failing the unsafe criterion. As an example, the weather that occurred on the 4th May, 2018, a front and associated westerly winds would have been ignored by the more frequent occurrence wind criteria due to the wind speeds recorded being strong but less frequent for the west sector directions. These wind conditions on the 4th May clearly impacted the pedestrian wind conditions throughout the city.

We have considered the intention of these criteria, the mixed wind climate of Melbourne, and will suggest these following criteria for the Amendment GC81:

Comfortable wind conditions are defined as a mean wind speed from any wind direction (minimum 16 wind direction sectors) with probability of exceedance of 0.1%, equal to or less than:

- 5 metres per second for sitting areas
- 7 metres per second for standing areas
- 9 metres per second for walking areas.

Mean wind speed means the maximum of:

- Hourly mean wind speed, or
- Gust equivalent mean speed (3 second gust wind speed divided by 1.85).

The above wind speeds and probability of exceedance have been selected to be approximately an annual return period wind for Melbourne with consideration of the period of time when spaces will be activated/occupied by pedestrians and the mixed wind climate of the roaring forties in which Melbourne is located.

Additionally, the safety criterion in GC81 has been defined as:

Unsafe wind conditions means the hourly maximum 3 second gust which exceeds 20 metres/second from any wind direction considering at least 16 wind directions with the corresponding probability of exceedance percentage.

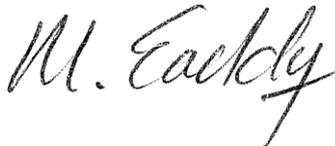
We would suggest improving the definition of unsafe wind conditions to be in line with the Australasian Wind Engineering Society (AWES) Guidelines for Pedestrian Wind Effects Criteria September 2014 (Attached for Reference). Therefore, the definition of the unsafe wind is suggested as follows:

Unsafe wind conditions are defined as the hourly maximum 3 second wind gust which exceeds 23 metres per second from any wind direction (minimum 16 wind direction sectors) with a probability of exceedance of 0.1%.

The probability of exceedance of 0.1% is approximately an annual occurrence and would include the strong wind events associated with thunderstorms and other less frequent strong wind events.

The Panel should also understand that the above definition of unsafe wind conditions is internationally recognised, but *'It is important to note that meeting this guideline in a given location does not imply that all individuals will be safe at all times from being knocked down by the wind. For example, frail individuals could be knocked down by winds lower than this limit. Further, wind conditions just meeting the recommended limit for safety will result in gust wind speeds higher than 23m/s occurring, however with a probability lower than 0.1%. It is therefore conceivable that, in a location just meeting the recommended criterion for safety, winds could occur, however infrequently, which could knock down even fairly robust individuals.'*(AWES Guidelines).

Yours sincerely,

A handwritten signature in black ink, appearing to read 'M. Eaddy', written in a cursive style.

M. Eaddy
MEL Consultants Pty Ltd

Guidelines for Pedestrian Wind Effects Criteria

Australasian Wind Engineering Society

September 2014





Introduction

This document provides some guidelines for the selection and application of criteria in pedestrian wind effects assessments. This guidance provided is primarily for pedestrian **safety**, but some comment is included on pedestrian comfort.

Background

In some cases property developers will request a pedestrian wind effects assessment if they are concerned to achieve a good wind climate around their development; but in most cases a wind effects assessment is conducted because a planning authority requires it.

When a development is proposed, the developer is obliged to demonstrate compliance with a wide range of requirements from shadowing and traffic to stormwater egress and acoustics. In Australia all of these requirements are set out in a document called the *Planning Scheme (or Control Plan in NSW)*. Each planning authority has its own Planning Scheme which it may update according to local issues and the will of the electorate at local and state level.

Many local planning authorities have not included specific requirements for wind in their Planning Schemes because most municipalities in Australia have little or no high-rise developments and wind has therefore not been an issue. Increasingly though, medium to high-rise developments are being proposed and built in predominantly low-rise municipalities and have caught the Planning Schemes in these areas napping.

In the case of larger developments, state government planning guidelines such as the Department of Planning and Community Development (Victoria 2013), will often trigger a request for a wind assessment by the local planning authority despite the authority having no defined criteria against which the assessment should be made. Testing and reporting without defined criteria against which to judge the results is clearly far from ideal.

This document aims to provide a guideline for a minimum safety criterion to be applied to all public areas in and adjacent to new developments. It is a criterion for public safety, not comfort. Discussion of the selection of comfort criteria is provided.

Wind flow through built-up areas and the human response to it is complex and there is limited research available. The guidance provided is based on the available published research and the experience of the Australasian wind engineering community.



Criteria Selection

There have been a number of criteria put forward by various researchers over the last 40 years. A concise summary of these is provided in Arens et al. (2003). There are similarities among many of them, however, disagreement between any two sets of criteria can be considerable.

Some researchers have shown that in certain flow scenarios there is good agreement between several of the criteria sets. For example Melbourne (1978) showed that at 15% turbulence intensity five well-known criteria were in close agreement. However, the majority of studies such as; Sparks and Elzebda (1983), Ratcliff and Peterka (1990) and Koss (2006), show that over a wider range of flow conditions there is no general agreement among the various criteria.

Minimum Requirements for Public Safety

In the event that the relevant Planning Authority has no specific requirements for wind, a minimum acceptable criterion for public areas adjacent to a proposed development is one that ensures public safety.

The Arens et al (2003) recommendation for safe wind conditions in public areas was based on a review of various safety criteria and noted the majority of safety criteria were "...gust speeds...in the range of 20m/s and 30m/s...". The review took an average value and surmised that "If wind conditions with this gust speed [25m/s] are exceeded more than two to three times per year then the chance of someone being injured becomes unacceptably high. Two or three times per year corresponds to events that occur for about 0.1% of the time. Thus, to satisfy the requirement for safety it is suggested that wind conditions with peak 3-second gusts exceeding 25m/s should not occur for more than 0.1% of the time."

A review of the published papers on pedestrian wind effects criteria suggests only Melbourne (1971) made field observations of unwitting members of the public being knocked over by the wind and measured the corresponding wind speeds (peak gusts of 23m/s). Of the many published criteria, the Melbourne (1978) criterion is among the most stringent, however, given public safety is at stake, it seems reasonable to err on the side of caution when selecting a safety criterion.

These guidelines recommend the use of the Melbourne (1978) criterion as the limit for safety in public areas, i.e. maximum 0.1% probability 3 second moving average gust wind speed of 23m/s at pedestrian height.

It is important to note that meeting this guideline in a given location does not imply that all individuals will be safe at all times from being knocked down by the wind. For example, frail individuals could be knocked down by winds lower than this limit. Further, wind conditions just meeting the recommended limit for safety will result in gust wind speeds higher than 23m/s occurring, however with a probability lower than 0.1%. It is therefore conceivable that, in a location



just meeting the recommended criterion for safety, winds could occur, however infrequently, which could knock down even fairly robust individuals.

Exceptions

In some cases, the relevant planning authority will have requirements for pedestrian wind criteria (eg. Wellington City Council). Where the relevant planning authority has criteria, those criteria take precedence over the recommendations stated in this document.

It is possible that in some exceedingly windy locations the site wind speeds may be in excess of the criterion for public safety recommended in this document. In these cases it may not be possible for the form of a new development to ensure wind conditions meet the criterion for safety. In a scenario such as this it is recommended that the proposed development not result in higher gust wind speeds in adjacent public areas than previously existed at the site. This could be demonstrated by, for example, before-and-after wind tunnel tests of the proposed development.

Application of Recommended Minimum Criterion

The minimum criterion for public safety should be applied to public pedestrian areas within and immediately adjacent to the proposed development being tested with reference to the exceptions noted.

In applying the safety criterion to a public space it is important to note that wind speeds close to this limit are usually not an ideal outcome for that public space.

The recommended minimum criterion should not be the sole measure of an area's suitability where there is a clear requirement for a certain level of comfort, for example an existing adjacent outdoor dining area. Further, in fairness to existing neighbouring individuals and businesses, where those neighbours may use the outdoor areas of their property, including adjacent public areas that may be used for trade or recreation, the minimum criterion should not solely be applied to:

- i) public areas immediately adjacent to existing nearby developments
- ii) adjacent private property

Instead, assessments of proposed developments should also apply comfort criteria to these areas consistent with current use.

Assessments of proposed developments should consider adjacent public and private property areas within a distance 'R' from the building envelope, where R is defined as the minimum of $h/2$ and $b/2$ where h is building height and b is the largest plan dimension of the building (Figure 1).

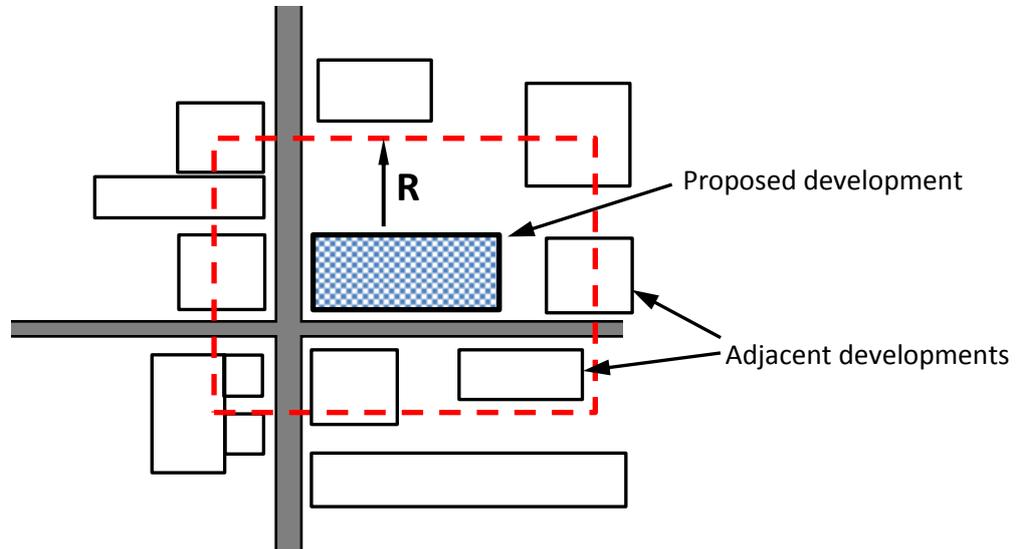


Figure 1 – Schematic plan view of a proposed development and existing developments showing the extent of the minimum recommended area to be considered in the pedestrian wind assessment.

The Use of Vegetation to Ameliorate Excessive Wind Speeds

The use of trees, shrubs and the like to reduce exceedences of the minimum criterion for public safety is strongly discouraged. Experience in many locations has shown the short-comings of this approach. Trees planted in locations where the 0.1% probability 3 second gust wind speed *at pedestrian height* is in excess of 23m/s will tend to experience wind speeds at the height of the tree canopy once every 5 years or so sufficient to destroy or severely damage many trees. Trees planted in windy locations rarely mature to their normal full height as modelled in the wind tunnel for a range of reasons including loss of limbs, the drying effect of the wind and the natural tendency of trees to remain stunted in such locations to provide the best chance of survival.

In many cases trees placed in high wind areas to protect pedestrians tend to shed limbs during the highest winds causing a public danger and a public nuisance by damaging power lines, vehicles etc.

Furthermore, trees planted to reduce adverse wind conditions are frequently located on public footpaths. As such they become the responsibility of the local municipality. The frequent pruning of damaged limbs, removal and replacement of damaged or destroyed trees is unfairly onerous on the municipality and cannot be guaranteed.



These Guidelines therefore recommend that the built form be designed in such a way that wind conditions meet the recommendation for public safety without recourse to planting of vegetation.

Guidelines on the Selection of Comfort Criteria

If possible, determine which comfort criteria have been successfully applied to other developments in the same region. For example the Melbourne (1978) comfort criteria have been successfully applied to cool-temperate climates such as those found in southern Australia. They are arguably unsuitable for tropical and equatorial regions where areas of relatively low wind speeds are perceived less favourably as they result in uncomfortably hot conditions for human habitation.

In hot, humid climates it may be appropriate to consider the application not only of a maximum wind speed criterion for comfort but also a minimum wind speed.

In all cases consider sun access when recommending comfort criteria. For example, patrons in a north facing café terrace in a cool temperate climate will be more tolerant of wind than a similar location facing south.

In areas with high levels of local wind turbulence the mechanical effects of gusts can dominate perception of comfort or suitability of a location for a given activity. For example, a low mean wind speed may seem suitable for outdoor dining, however, if it coincides with high turbulence, the resulting gusts may be sufficient to remove table settings, upset umbrellas etc and generally result in negative perceptions in regards to the comfort of the location.

A summary of published criteria is available in Arens et al (2003).



References

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- 9 Wellington City (2000) District Plan Design Guide for Wind (online: <http://wellington.govt.nz/~media/your-council/plans-policies-and-bylaws/district-plan/volume02/files/v2wind.pdf>)