

Comfort Criteria

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- Desk studies
- Wind tunnel testing
- Failure investigation
- Software design
- Training / Seminars

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www.rwdi-anemos.com

"...wind environment affects comfort, safety and the commercial success of your development..."

Understanding Comfort Criteria for Pedestrian Level Wind Environment

Why does it matter?

The wind environment around a new development is a critical contributor to its success, certainly in the negative sense. Strong winds will deter users of the development, which affects footfall through a development and its attractiveness to a tenant or purchaser. Wind environment affects comfort, safety and the commercial success of your development. Consideration of the microclimate is also required by many planning authorities as part of the environmental impact assessment.

Assessment of comfort

Comfort criteria reflect our perception of the wind, which depends on what we are doing at the time. For example, when sitting and eating a meal at an outdoor café we look for calmer conditions than we would for a brisk walk to work. However, it is not only the wind speed that matters but also its frequency and persistence. Both must be included in the assessment, over a full range of wind directions.

Over and above any question of comfort is that of safety. Strong winds have the potential to make walking difficult and even blow people over. The criteria therefore include a threshold wind speed above which vulnerable pedestrians might be at risk.

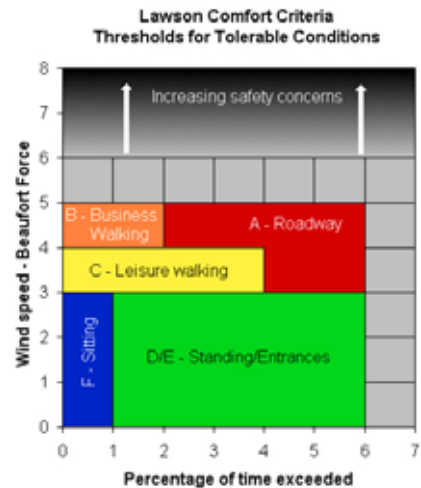


Figure 1 - Unacceptable thresholds

The Criteria

RWDI-Anemos use the Lawson criteria, developed over a period of some 30 years at the University of Bristol. These criteria are probably the most widely used in environmental impact assessments across the UK and have stood the test of time as a reliable indicator of user-acceptance.

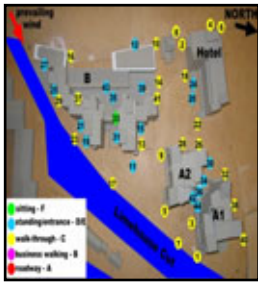
Six usage categories are defined in the table below. The "Unacceptable" thresholds are also shown in Figure 1, where coloured blocks indicate the most benign activity for which conditions are tolerable, or better. For example, if Beaufort Force 2 occurs for 3% of the time at a particular location then it would be assessed as tolerable for entrances or

PRESCRIBED USAGE		THRESHOLD VALUES OF WIND SPEED & EXCEEDENCE	
DESCRIPTION	LETTER	UNACCEPTABLE	TOLERABLE
Roads and Car Parks	A	6% > B5	2% > B5
Business Walking	B	2% > B5	2% > B4
Pedestrian Walk-through	C	4% > B4	6% > B3
Pedestrian Standing	D	6% > B3	6% > B2
Entrance Doors	E	6% > B3	4% > B2
Sitting	F	1% > B3	4% > B2

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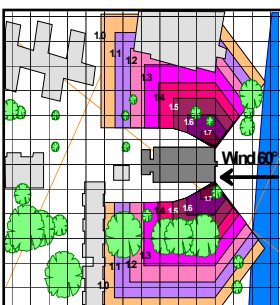
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Typical model with measurement locations

“...experienced wind engineers can identify where accelerated winds are most likely to occur...”



Typical desk study by Maruta method

standing. By implication it is also tolerable for walking, business walking and car park use but not sitting.

The ‘usages’ represent different levels and durations of activity. For example, sitting implies a longer duration than walking in a car park. Entrances are a special case. We may not spend long entering or leaving a building but we do need extra protection as we move from the calm interior to the ‘unknown’ conditions outside.

What does ‘tolerable’ mean?

We use the term ‘tolerable’ in a quite specific sense defined by the comfort criteria. It implies a level at which pedestrians will be conscious of the wind but will put up with it. Conditions that are tolerable for a particular pedestrian activity can be improved upon but don’t require remedial action if conflicting design constraints make this impossible or uneconomical to do. Testing is usually carried out without the local sheltering effects of trees, street furniture, etc so RWDI-Anemos favours the tolerable condition as the benchmark for assessing a development.

What about gustiness?

So far we have assumed that the criteria are based on mean wind speeds, usually the mean-hourly wind speed. However, wind is turbulent, or gusty, and short duration gusts also impact on safety and the perception of conditions. The Lawson criteria divide gust speeds by a factor of 1.85 to derive gust equivalent mean (GEM) speeds. These are assessed using the same comfort criteria as the mean winds.

How do we assess site conditions?

As experienced wind engineers, we can identify regions where accelerated winds are most likely occur; for example, near windward corners of a building or along narrowing streets. Usually, these high winds will only occur for a limited range of wind directions. So, a proper analysis of the pedestrian wind environment must consider all wind directions to keep matters in context and allow a meaningful consideration of remedial measures. This often leads to a 2-stage process in design

- Initial desk study of key problem areas - useful at pre-planning stage.
- Wind tunnel study over a full range of wind directions at numerous locations

In Figure 2 wind speeds at two locations from a real test are presented on a radial plot. The overall shape of the two plots is broadly similar but they are rotated approximately 90° relative to one another. In the UK prevailing winds are from the southwest, with a secondary prevailing wind from the northeast. These wind statistics for the site are incorporated into the analysis and the results added up for all wind directions. In this case, the red data set was tolerable for walking, whereas the black data set was tolerable for standing. This demonstrates the importance of considering all wind directions and the compound effect of building geometry and meteorological statistics.

What about computer analysis (CFD)?

RWDI-Anemos has the capability to do either a wind tunnel test or a CFD analysis. CFD has some advantages but presently we believe that the wind tunnel still represents the best approach in most situations.

CFD is still developing and its accuracy in the complex flows through urban streetscapes is unproven, especially for gust speeds. Only Large Eddy Simulation is likely to get close to the right behaviour, which is one of the more resource-intensive solutions. Modelling a full range of wind directions, there is unlikely to be any cost-saving, perhaps the reverse.

So, for now, we recommend the wind tunnel but we already use numerical techniques in other areas and keep these new methods under constant review.

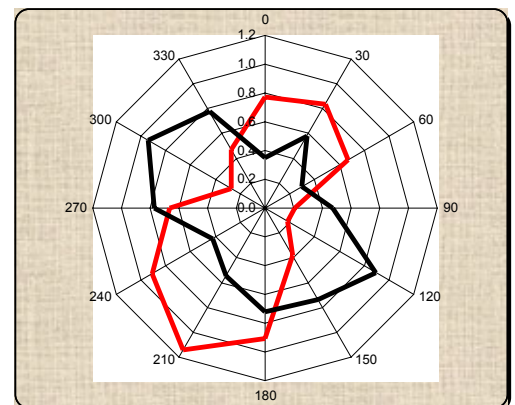


Figure 2 - Example measurement results