

CAVERSHAM ROAD

READING UK

PEDESTRIAN LEVEL WIND DESK BASED ASSESSMENT

RWDI #1900580

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SUBMITTED TO

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VERSION HISTORY

RWDI Project #1900850	Caversham Road, Desk Based Assessment Reading, UK	
Releases	Author	Dated
Version 1	Ender Ozkan	3 Dec 2018
Version 2	Ender Ozkan (updated GF plan and roof plan)	14 Dec 2018

EXECUTIVE SUMMARY

This is a qualitative assessment of the likely wind microclimate conditions around the proposed Caversham Road Development in Reading (hereafter referred to as the Proposed Development). This assessment is based on the massing scheme received from TP Bennett on the 4th of December.

RWDI – a world leading firm in the field of microclimate studies – has been working closely with TP Bennett and the design team to incorporate a number of highly beneficial design features that improve the wind microclimate around the site. Further quantitative assessment of wind conditions will be undertaken using wind tunnel tests to optimize the mitigation measures and ensure comfortable wind conditions in all areas.



Expected Wind Conditions

The meteorological data for the site indicates prevailing winds from the south-west throughout the year, with colder north-easterly winds during the spring months.

The arrangement and orientation of the buildings is very beneficial for the prevailing south-westerly winds, as the gradually increasing building height in this direction helps to 'lift' the oncoming wind flow, reducing the risk of downdrafting.

However, Block A to the northeast of the site will be very exposed to the colder north-easterly winds, and create significant downdrafting and acceleration of flow around the corners of this building. This part of the site will be more sheltered in the longer term when the Aviva Site is fully developed, but a number of highly beneficial design features have been incorporated around the tower in the shorter-term.

The recommendations for key areas are as follows;

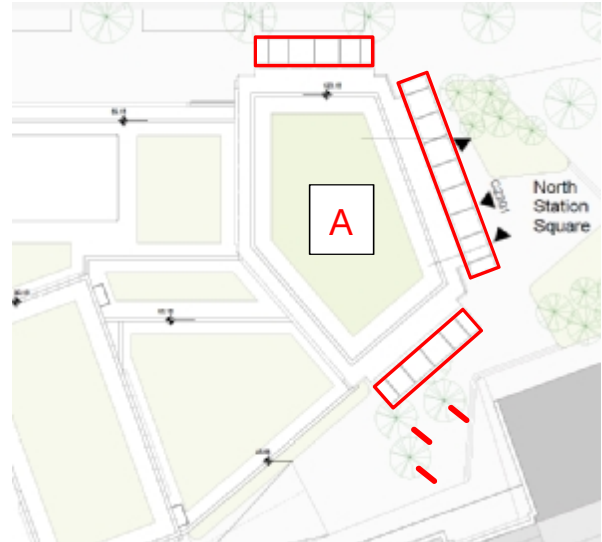
Entrances

- The office entrance on the southern side of Block J should be locally sheltered using porous elements (signage, artwork, etc.) that are 2m-by-2m and project out in a direction perpendicular to the façade,
- Similarly, the townhouses will benefit from localized screens or landscaping near their entrances, to create a comfortable transition zone for users entering and existing the buildings in these areas,



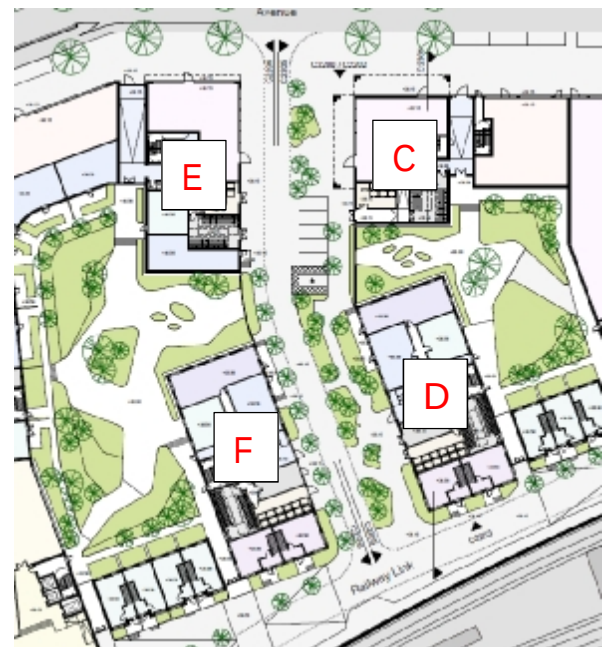
Areas Around Block A

- Without mitigation measures this will be the windiest part of the site, and will pose safety risks for pedestrians. This is primarily due to the north-east winds downdrafting and funnelling on the south side of the tower,
- However, the design of Block A incorporates two highly beneficial improvement features;
 - Large canopies on three sides of the tower, extending approximately 3m from the building,
 - Staggered porous landscaped screens to provide localized shelter to pedestrian accessing this area.
- The precise size and layout of these features will be optimized through wind tunnel tests carried by RWDI.



Amenity Areas

- Majority of the amenity spaces between the blocks will benefit from shelter provided by the proposed buildings, and are therefore expected to have acceptable wind conditions,
- The proposed design also includes a number of landscape features that are very beneficial in improving the amenity of the courtyard areas. These include hedges between blocks E and F and blocks C and D, line of trees along both sides of the central avenue, clusters of trees within the courtyards, and a line of trees along Vastern Road. These features should be retained in the design to maintain comfortable wind environment in all amenity areas.



Wind tunnel testing will be carried out in the coming months to confirm the levels of windiness and optimise the design and cost impact of wind mitigation measures.

1. INTRODUCTION

RWDI was retained by Chartplan to conduct a desk based assessment for the proposed mixed-use development at Caversham Road, in Reading, UK. This report presents the background, objectives, results and recommendations from RWDI's assessment. A summary of the overall recommendations from the study are presented in Section 6, "Conclusions & Recommendations".

2. SITE DESCRIPTION

2.1 Site and Surroundings

The site is located in Reading, immediately north of Reading Station. The site is bound by Caversham Road to the west, Reading Station to the south, Station Square to the east and the Station Shopping Park to the north. The Ordnance Survey Landranger reference for the site is SU713739.

The surrounding development to the Site is predominantly medium to low rise development. As such, the Site will be relatively unsheltered, resulting in higher mean wind speeds than in a dense urban area, but increased turbulence relative to an area surrounded by open countryside.

An aerial view of the Site is presented in Figure 1.



Figure 1: Aerial Photograph of the Existing site (Approximate extent of the Site highlighted)

2.2 The Proposed Development

The Proposed Development consists of nine blocks ranging in height from 66m to 122m. The massing of the Proposed Development is such that there is a gradual increase in building heights from west to east of the Site. This would be expected to provide some shelter to the tallest elements of the Proposed Development (Block A) from the prevailing south-westerly winds, reducing the likelihood of downdraught and channelling for these wind directions.

Amenity spaces are located centrally between the blocks, with a central vehicular road between blocks C, D, E and F. These amenity spaces will be sheltered by the surrounding buildings and the 2-3 storey townhouses on the southern side of the site.

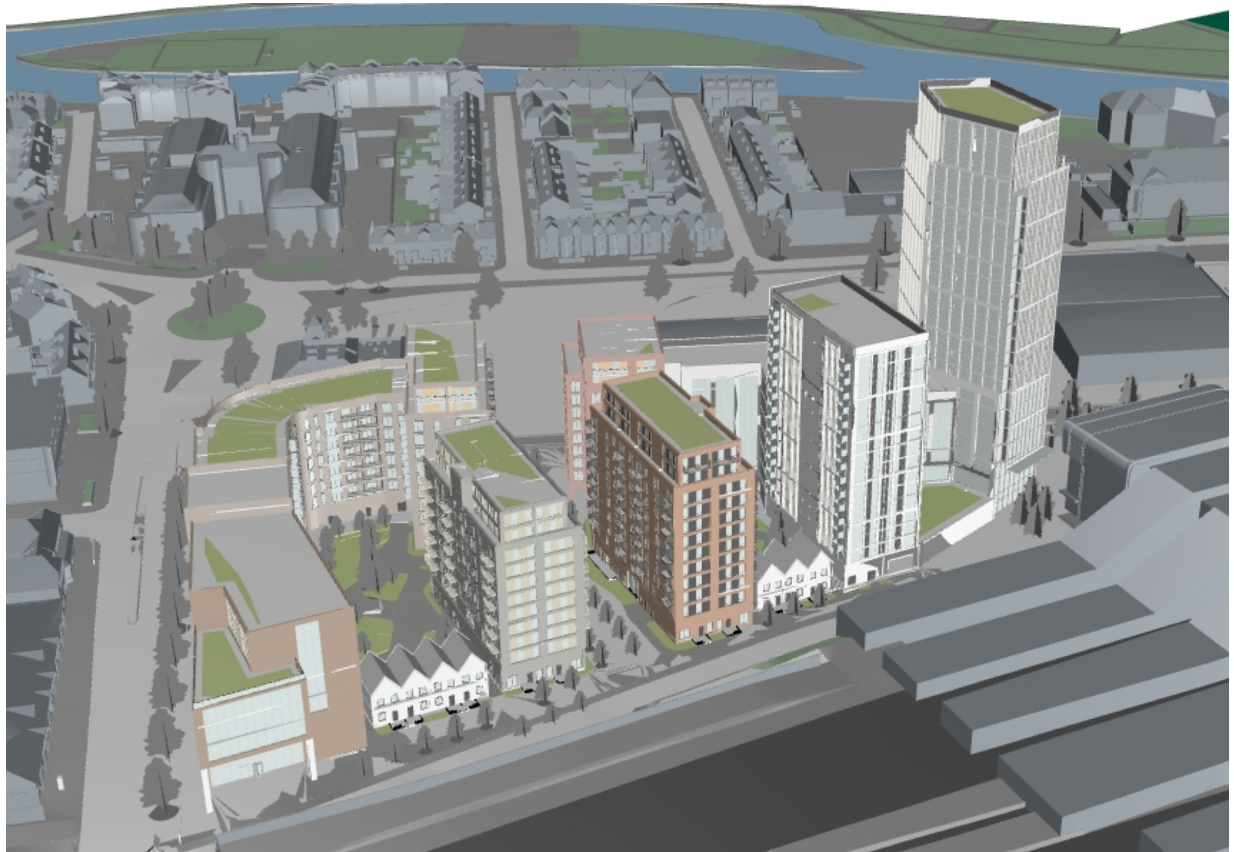


Figure 2: View of the Proposed Development with storey heights and block labels

3. METHODOLOGY AND ASSESSMENT CRITERIA

Knowledge of the prevailing wind direction focuses attention on the likely impact of these winds on the Site except where the proposed building massing / layout indicates that winds from other directions are likely to be important.

3.1 General Meteorological Data

Meteorological data derived from the meteorological station of London Heathrow airport have been corrected to standard conditions of 10m above open flat level country terrain. The meteorological station data is then adjusted to the Site conditions using the methodology implemented in the BREVe3.2 software package.

Approximately 30 years of meteorological data for London Heathrow was used in this report and is presented as wind roses by season in Figure 3. The assessment presented in this report focusses on winter, the windiest season, representing a 'worst-case' season for windy conditions between December and February and a summer season (representing a time of the year when amenity spaces are expected to be usable between June and August). Wind roses graphically depict the distribution of wind frequency and directionality for the four seasons.

The meteorological data indicate that the prevailing wind direction throughout the year is from the south-west. This is typical for many areas of southern England. There is a secondary peak from north-easterly winds, especially during the spring, and these tend to be cold winds.

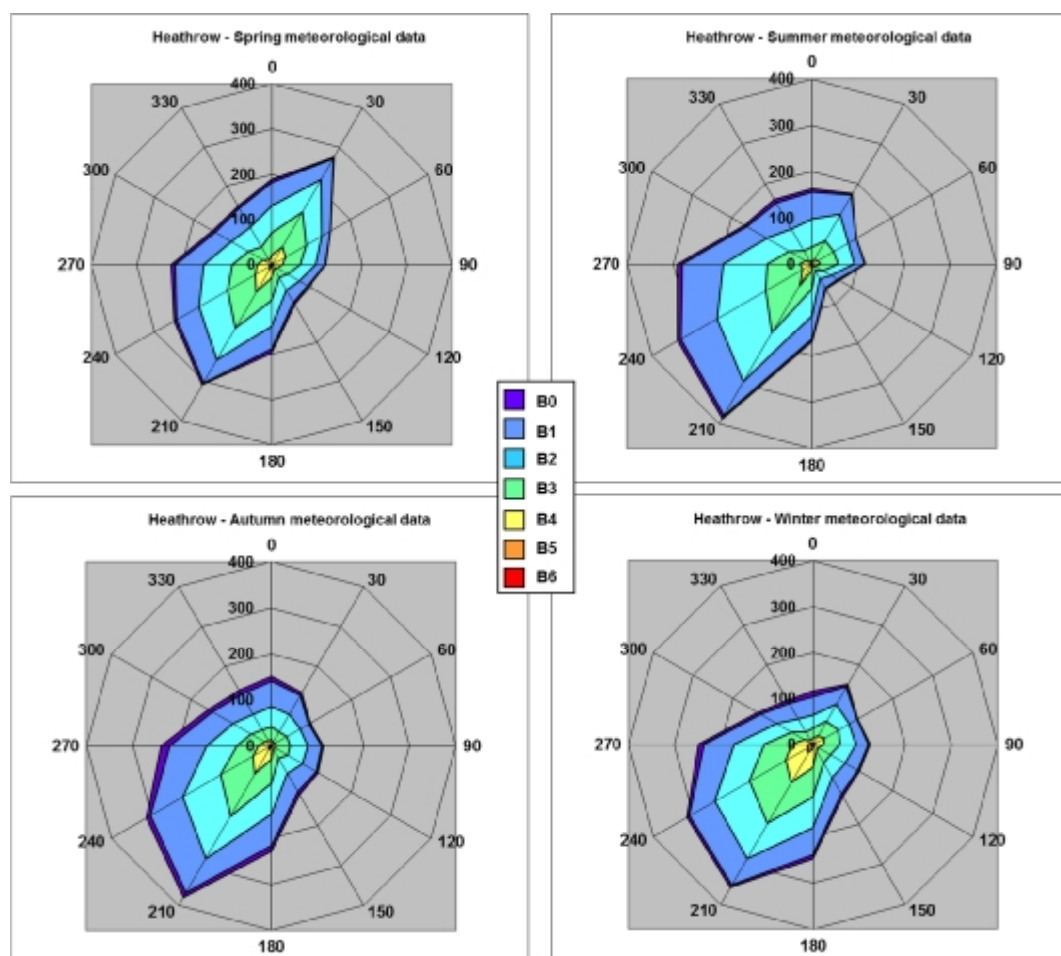


Figure 3: Seasonal wind roses for Heathrow (in Beaufort Force) - (Radial axis indicates the hours for which the stated Beaufort Range is exceeded)

3.2 Comfort Criteria

The assessment of the wind conditions requires a standard against which the measurements can be compared. This report uses the Lawson Comfort Criteria, which have been established for over thirty years. The Criteria, which seek to define the reaction of an average pedestrian to the wind, are described in Table 1. If the measured wind conditions exceed the threshold wind speed for more than 5% of the time, then they are unacceptable for the stated pedestrian activity and the expectation is that there may be complaints of nuisance or people will not use the area for its intended purpose.

The Criteria set out five pedestrian activities and reflect the fact that less active pursuits require more benign wind conditions. The five categories are sitting, standing, strolling, walking and uncomfortable, in ascending order of activity level. In other words, the wind conditions in an area for sitting need to be calmer than a location that people merely walk past. The distinction between strolling and walking is that in the strolling scenario pedestrians are more likely to take on a more leisurely pace, with the intention of taking time to move through the area, whereas in the walking scenario pedestrians are intending to move through the area quickly and are therefore expected to be more tolerant of windier conditions.

The Criteria are derived for open air conditions and assume that pedestrians will be suitably dressed for the season. Thermal comfort is discussed with reference to acceptable wind environments but not evaluated as part of the assessment.

The Lawson Criteria set out six pedestrian activities and reflect the fact that less active pursuits require calmer wind conditions, as shown in the coloured key in Table 1.

Table 1: Lawson Comfort Criteria

Key	Comfort Category	Threshold	Description
	Sitting	0-4 m/s	Light breezes desired for outdoor restaurants and seating areas where one can read a paper or comfortably sit for long periods
	Standing	4-6 m/s	Gentle breezes acceptable for main building entrances, pick-up/drop-off points and bus stops
	Strolling	6-8 m/s	Moderate breezes that would be appropriate for window shopping and strolling along a city/town centre street, plaza or park
	Walking	8-10 m/s	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
	Uncomfortable	>10 m/s	Winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended

Generally, the target conditions are:

- Strolling use during the windiest season on pedestrian thoroughfares (with walking conditions potentially being tolerated in areas where pedestrians would not linger);
- Standing / entrance use conditions at entrances, drop off areas or taxi ranks, and bus stops throughout the year; and

- Sitting use conditions at outdoor seating and amenity areas during the summer season when these areas are more likely to be frequently used by pedestrians. It is noted that in large mixed-use amenity spaces a mixture of sitting use and standing / entrance use can be considered acceptable as users can choose to sit in 'calmer' areas, with 'windier' areas acceptable for more active pursuits.

The wind conditions in an area for sitting need to be calmer than a location that people merely walk past and this is reflected in the Comfort Criteria. The Criteria are derived for open air conditions and assume that pedestrians will be suitably dressed for the season. The criteria address the force of the wind on a person, or activity, they do not take account of thermal factors.

3.3 Strong Winds

Lawson¹ also specified a lower limit strong wind threshold when winds exceed 15m/s for more than 2 hours of the year. Exceedance of this threshold may indicate a need for remedial measures or a careful assessment of the expected use of that location; e.g. is it reasonable to expect elderly or very young pedestrians to be present at the location on the windiest day of the year? Wind Speeds that exceed 20m/s for more than 2 hours of the year represent safety issue for all members of the population, which would require mitigation to provide an appropriate wind environment.

Strong winds are generally associated with areas which would be classified as acceptable for walking or as uncomfortable. In a mixed-use urban development scheme, walking and uncomfortable conditions would not usually form part of the 'target' wind environment and would usually require mitigation due to pedestrian comfort considerations. This mitigation would also reduce the frequency of, or even eliminate, any strong winds.

¹ Lawson T.V. (April 2001), Building Aerodynamics, Imperial College Press

4. BASELINE CONDITIONS

Often a new Development will alter the pedestrian activity (i.e. intended use) on site. Occasionally, although wind conditions may not change after the Proposed Development is completed (e.g. stay suitable for strolling use), mitigation would still be required if on the new Development the location of interest is intended for a critical activity (e.g. a main entrance) for which the wind condition would be unsuitable. Assessment in terms of the desired pedestrian activity on or around a site takes into consideration any change of use and this is where the comfort criteria are particularly helpful.

4.1 Pedestrian Comfort

Analysis of the meteorological data adjusted for the terrain roughness approaching the site provides an indication of the existing wind conditions within the Site. This analysis concluded that the existing conditions, at 2m above ground, in the vicinity of the Site are generally likely to be suitable for standing use during the windiest season. The implication of this result is that, after development, if the Site has a number of areas where the conditions are tolerable for an activity windier than standing use, say strolling use, then these would be perceived as 'windy' relative to general conditions in the area.

4.2 Strong Winds

Strong winds, in excess of 15 m/s for more than 2 hours a year are not expected to occur at the existing Site.

5. TYPICAL WIND MECHANISMS

Windy conditions around tall buildings (that is those prominent above their surroundings) are typically the functions of one, or a combination of, three generalised flow behaviours.

Channelling (Figure 4) of the wind occurs between buildings of similar height when in close proximity to each other. Windy conditions occur at pedestrian level since the flow accelerated as it is "squeezed" between the buildings.

Downdraughting (Figure 5) is common at buildings taller than the surrounding area. Due to their prominence above the surrounding development, undisturbed (higher speed) winds reaching the façade of a tall building are drawn down to ground level, creating a windy area at pedestrian level next to the building.

Corner acceleration (Figure 6) around building corners may occur due to the difference in pressure on the upwind and downwind façades (low pressure zones on the leeward side and zones of higher pressure on the windward side of the building). This effect is particularly pronounced around sharp corners which create localised windy areas in the vicinity of the corner where the flow is accelerated around the building.



Figure 4: Channelling



Figure 5: Downdraughting

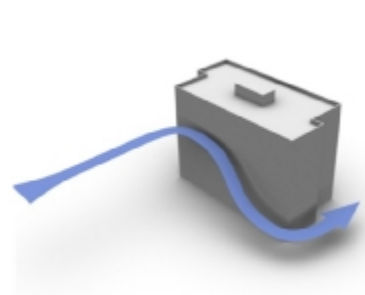


Figure 6: Corner acceleration

The design of the Proposed Development is stepped in height such that the lower western blocks are likely to provide some shelter to the taller eastern blocks. This arrangement likely to benefit pedestrians by increasing turbulence and preventing the wind from accelerating at ground level (Figure 7). The channelling between buildings on each block likely to result in windier conditions on the podium where the gap is closely aligned with south-westerly and north-easterly winds.

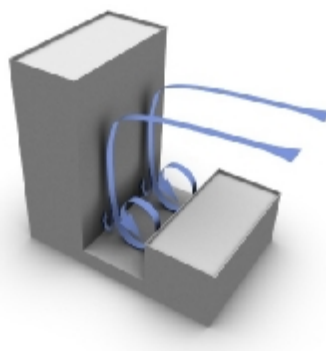


Figure 7: Channelling

The proximity of the elevated railway line to the south is likely to provide some shelter to the south of the Proposed Development. However, the narrow gap to the east of the Site between the Proposed Development and Reading Station would be expected to channel wind flow creating windy conditions.

Wind conditions suitable for strolling or calmer are desirable on main thoroughfares during the windiest season, for a mixed-use Development in an urban area. Standing conditions or calmer are generally required at entrances throughout the year. Wind conditions acceptable for sitting in the summer season are desirable for public amenity spaces.

Occurrences of strong winds in excess of 15m/s are not expected to exceed two hours per year when wind conditions meet the above criteria and are suitable for pedestrian comfort.

The assessment made below is based on a worst-case assessment of the expected wind conditions at the site. This worst-case assessment assumes no landscaping to be present. The presence of landscaping would generally result in calmer wind conditions.

6. CONDITIONS AROUND THE PROPOSED DEVELOPMENT

6.1 Pedestrian Comfort

6.1.1 General Overview

Figure 8 shows the expected comfort conditions around the site during worst season (typically winter). Summer season conditions will be approximately one category calmer.

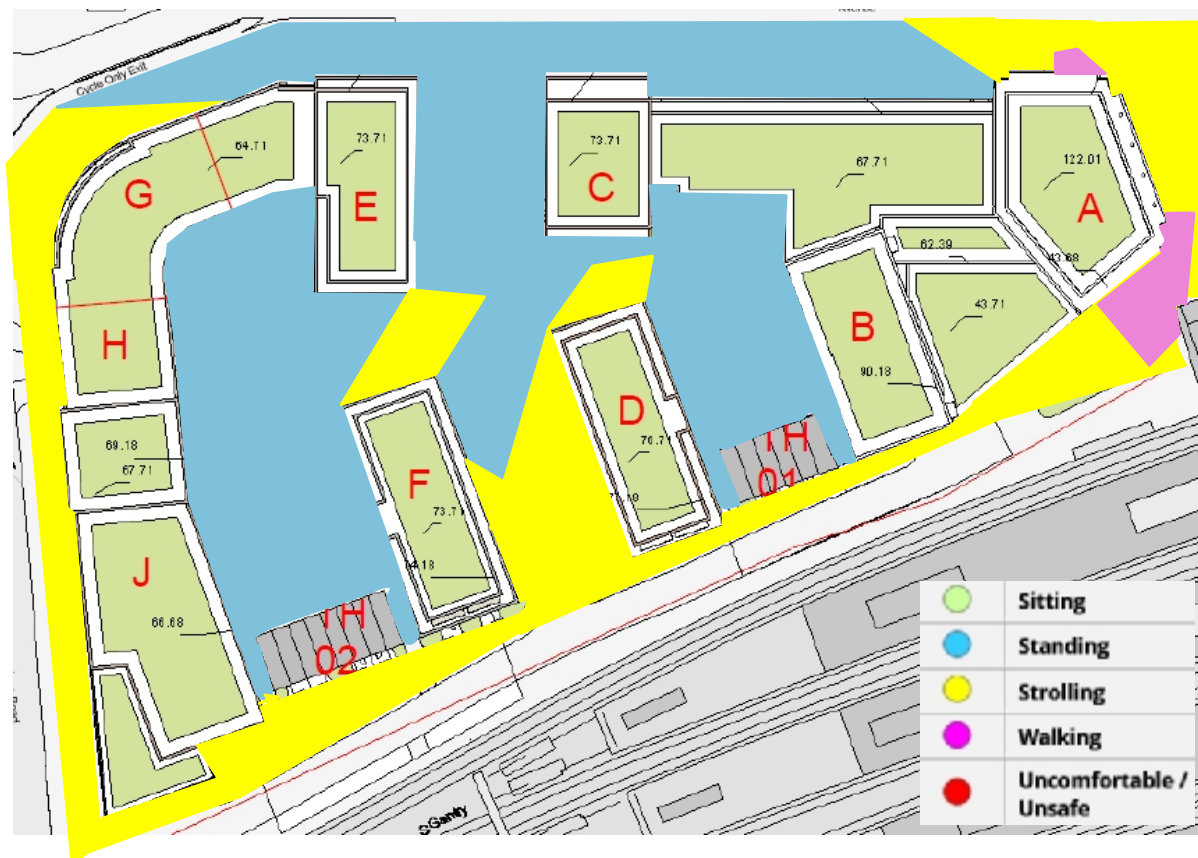


Figure 8: Lawson comfort conditions around the site, worst season.

6.1.2 Thoroughfares

Wind conditions along majority of thoroughfares across the Proposed Development would be expected to have acceptable 'Strolling' range conditions or better during the worst season (typically winter), which is acceptable for the intended walking use.

The only exception to this are the walking routes immediately to the south and north of Block A, where downdrafted winds from this building are expected to create 'Business Walking' conditions, which are acceptable for walking use in these areas. The wind mechanism which creates this accelerated flow is diagrammatically illustrated below. It is noted that the canopy and staggered landscaped screens proposed around the site play a very important beneficial role and must be retained in the design.

When the Aviva site is developed with similar height buildings it will shelter Block A and conditions are likely to be one category better than described above.

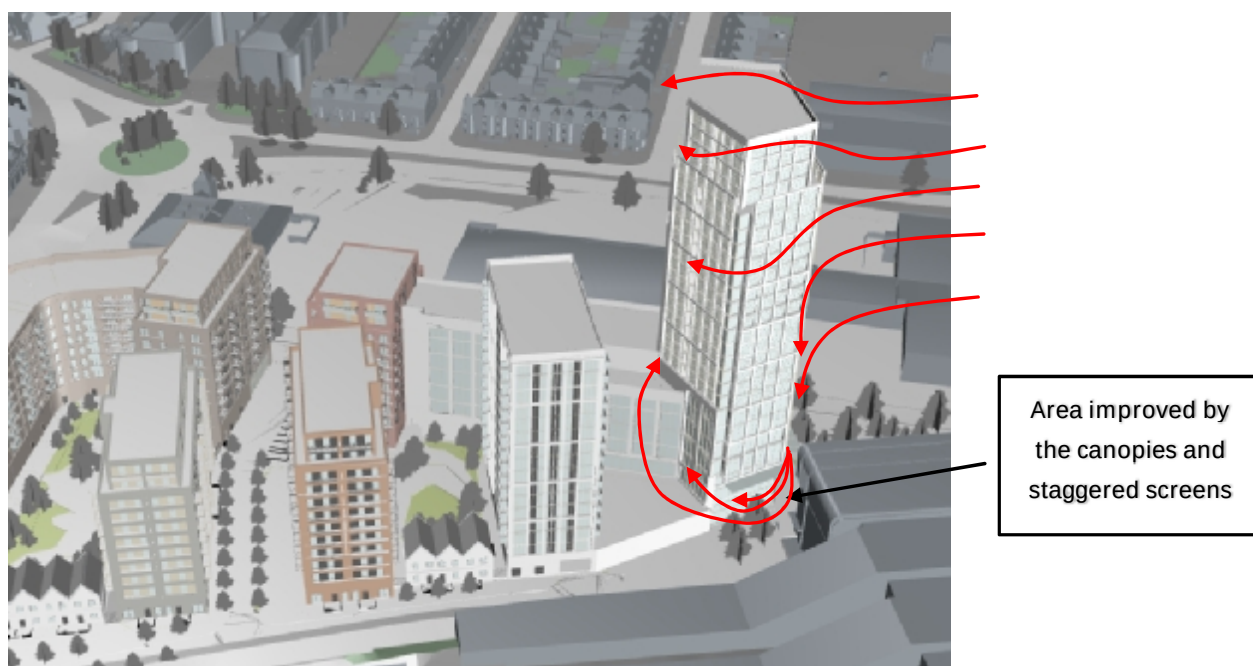


Figure 9: Downdraft and funnelling mechanism around Block A.

6.1.3 Entrances

Entrances to the Proposed Development should be located in areas suitable for standing use or calmer during the windiest season (Figure 8) in order to be suitable for the intended use.

Office entrances at ground-level of Blocks H, G and J will require mitigation as the 'Strolling' conditions expected here will be one category above the required levels. Similarly, residential entrances along the south side of the development will required localized mitigation.

Possible mitigation measures for these areas have been discussed within Section 7: Mitigation Measures.

6.1.4 Ground Level Amenity Spaces

With the proposed landscape features, ground level amenity spaces are located centrally between the proposed buildings. Therefore, majority of the amenity areas have calm 'Standing' range conditions during winter, and largely 'Sitting' range conditions in summer.

7. RECOMMENDED MITIGATION

This section provides general examples and guidelines for wind improvement measures at this stage of design. These mitigation measures will be developed with the aid of wind tunnel testing to ensure the effectiveness and architectural conformity of the proposed measures.

Block A

Block A will feature three solid canopies on three sides of the building, which provides a very beneficial effect against downdrafting. The width and design of these canopies can be optimized through wind tunnel testing, but it is expected that the canopies may be 3-5m in depth and made of a solid impermeable material such as glass.

Furthermore, the landscape design around Block A will feature several staggered porous screens near the southern corner of this block, in the gap between Block A and the station. These screens will provide low-level localised shelter and may need to be approximately 2m-by-2m, with the precise dimensions optimised through wind tunnel testing. Examples of such staggered screens are shown below.



Figure 10: Mitigation measures proposed around Block A, and several examples of staggered porous screens.

Residential, Office and Townhouse Entrances

The office entrance on the southern corner of Block J should be locally sheltered using porous elements (signage, artwork, etc.), that projects in a direction perpendicular to the façade for 2m and is 2m high,

Similarly, the residential and townhall entrances to the west and south of the site would benefit from localised screening or landscaping, to create a transition zone for occupants entering or existing the buildings in these areas.



Figure 11: Mitigation measures proposed around entrances of Block J, residential buildings and townhouses.

Amenity Areas

Majority of the amenity spaces between the blocks will benefit from shelter provided by the proposed buildings, and are therefore expected to have acceptable wind conditions.

It is recommended that the landscape layout in the central amenity areas feature semi-mature trees and robust plants that can provide shelter to pedestrians immediately after the completion of the project.

Wind tunnel testing will be carried out in the coming months to confirm the levels of windiness and optimise the design and cost impact of wind mitigation measures.

8. CONCLUSIONS

In conclusion:

1. This assessment provides a qualitative review of wind microclimate conditions within and around the proposed Reading Metropolitan development. This study was conducted by RWDI – a world leading firm specialising in microclimate studies – and is based on a careful review of the site wind climate, massing and orientation of proposed buildings, a review of pedestrian activities, and RWDI's significant experience of wind tunnel testing similar developments across the world. More detailed wind tunnel tests are planned in the later design stages to confirm the effectiveness of wind improvement measures.
2. The meteorological data for the site indicates prevailing winds from the south-west throughout the year, with colder north-easterly winds during the spring months.
3. For the existing site the wind microclimate at ground level is expected to be acceptable for the required use during the windiest season, as the existing buildings are not tall or exposed.
4. The massing of the proposed buildings is highly beneficial for the prevailing south-westerly winds, as the buildings gradually increase in height from west to east. This will create a degree of mutual shelter between buildings.
5. The site is exposed in the north-easterly wind direction, prior to the construction of the Aviva Site development. Block A, which will be the tallest building on the site, is expected to be very exposed and without any intervention could create unsafe wind conditions around the southeast and northeast corners of the site. However, the design of Block A incorporates large solid canopies on three sides Block A and an arrangement of staggered porous screens near the southern corner which will effectively mitigate the wind conditions. The precise size and location of these measures will be confirmed through wind tunnel testing carried out in the next design stages.
6. The amenity spaces are largely protected from the prevailing winds by the proposed buildings, and therefore conditions are expected to be acceptable in most ground-level amenity spaces. The landscape features will also play a beneficial role, and it is suggested that these be planted in semi-mature form to provide shelter immediately after the completion of the development.
7. While a large majority of entrances will have acceptable wind conditions, the office entrances beneath block J will be exposed to prevailing southwest winds and will require localized shelter in the form of porous screens. Other residential entrances on the west and south sides of the site would also benefit from localized screening or landscaping.
8. The detailed design and the mitigation for the Proposed Development will be developed using wind tunnel testing, in order to ensure safe and comfortable wind conditions at the Site.