Glenveagh Living Ltd

East Road Development

Wind Microclimate Study

263693-00_East Road Wind Study Report_Issue02

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Contents

Executive Summary

The proposed mixed-use development (Figure E1), which is situated on East Road, will consist of 9 no. blocks, ranging in height from 3 to 15 storeys to accommodate 560 no. apartments, enterprise space, retail units, a food hub/café/exhibition space, residential amenity, creche and men's shed. Landscaping will include a new central space and residential podium courtyards.

Figure E1: Proposed Development Layout

The proposed development at the East Road site will influence on the local wind microclimate, affecting the existing and proposed pedestrian environment. It is necessary to ascertain if the proposed development enhances or reduces the quality of the public realm. The assessment of discomfort and distress of pedestrians has been carried out in accordance with the Lawson Comfort Criteria [1].

The objectives of the wind assessment are as follows:

- Examination of the level of pedestrian comfort within the proposed East Road development;
- Mitigation measure proposals to alleviate pedestrian discomfort and distress, where required;
- Assessment of the effectiveness of the mitigation measures, which are adopted in the design, at alleviating pedestrian discomfort and distress.

The local wind climate was determined from historical meteorological data recorded at Dublin Airport. The prevailing wind in Dublin is from the west and southwest. These are relatively warm and often bring rain. The winds from the east and southeast are not as common as the westerlies, however, they are relatively cold, which can make them as annoying as the stronger westerlies. The Wicklow Mountains to the south of Dublin influence the wind microclimate in the vicinity of Dublin. In order to account for differences in topography and terrain exposure, the local wind data from Dublin Airport was transposed to the development site using the ESDU (Engineering Sciences Data Unit) methodology, which is compatible with Irish practice for wind loading.

The conclusions of the East Road Residential Development wind microclimate study are as follows:

- The critical wind directions for this development in terms of pedestrian comfort are the East, Southeast, Southwest and West;
- In general, the proposed development is likely to provide a comfortable and an attractive environment for pedestrians and occupants;
- Without suitable mitigation, the winds can produce wind conditions that pedestrians may find distressing in certain areas of the site, which include:
    - The pedestrian walkway along the East Road near the main access to the development;
    - The main pedestrian and vehicular access into the development from East Road;
    - The public realm near Blocks B1 and B2 at eastern extent of the main thoroughfare through the development;
    - The elevated plazas on the southern side of the development, including the outdoor play area for the creche.
- Focused wind mitigation measures have been incorporated into the design to alleviate distress and these include:
    - Provision of planting and soft landscape features at ground level along the main thoroughfare;
    - Provision of planting and soft landscape features along the East Road;
    - Provision of planting and soft landscape features at podium level along the gap between Blocks D1 and D2;
    - Provision of 2.1m high wind screen at podium level between Blocks B1 and B2 to provide shelter to the public realm at ground level below;
    - Provision of 2.1m high wind screens on either side of the outdoor play area for the creche;
    - Provision of 2.1m high wind screens in conjunction with planting along the edge of the southern plazas;
    - Provision of canopy between Block DT2 and Block C2 to provide shelter against the downdraft occurring at the southwest plaza.
- It is anticipated that the proposed mitigation measures will help alleviate distress that could be encountered on occasion in certain areas of the site;

- Overall, it is anticipated that the wind conditions within the proposed development are considered within suitable limits with the adoption of appropriate mitigation measures and therefore, it is likely to provide a wind microclimate suitable for its intended use.

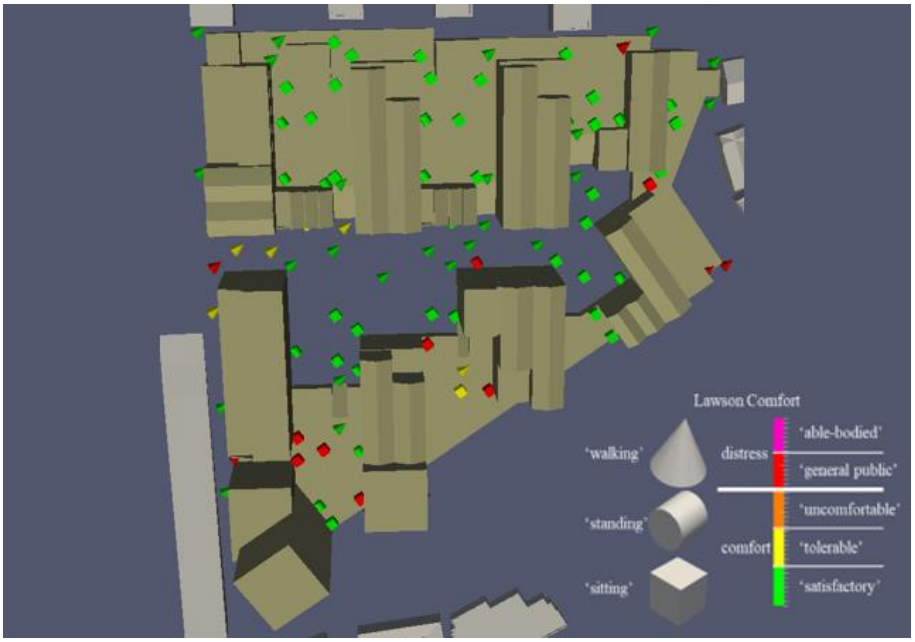


Figure E2: Lawson comfort criteria within the proposed development excluding any landscape features or other mitigation measures

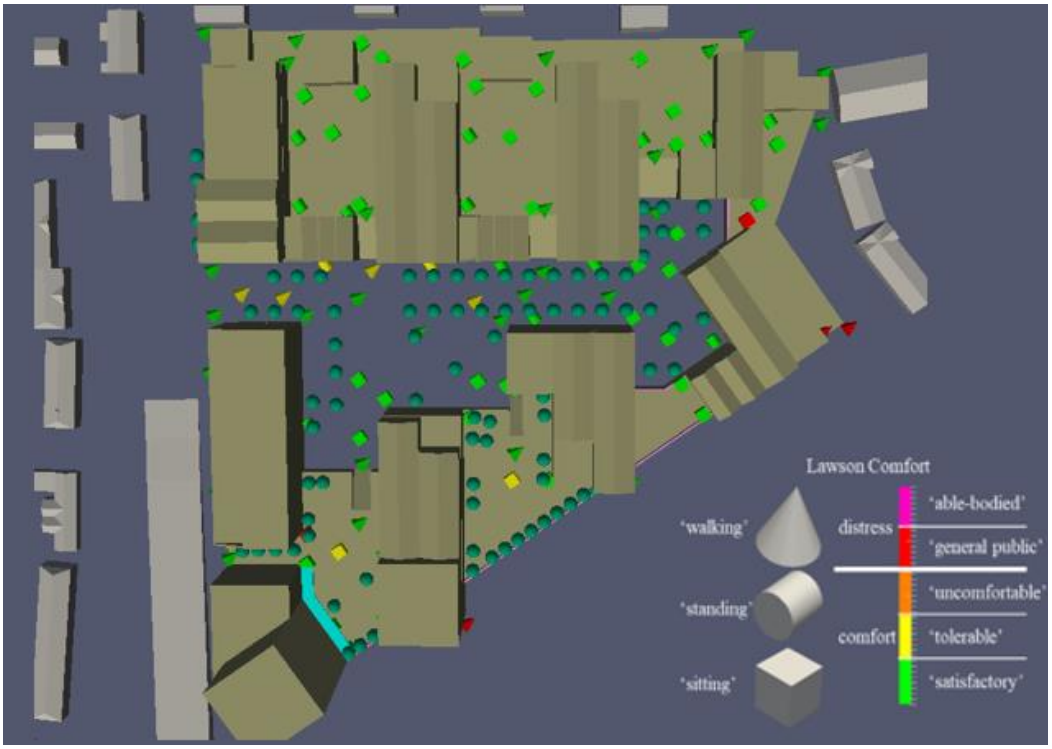


Figure E3: Lawson comfort criteria at main walkway following mitigation.

1 Introduction

1.1 Overview

The proposed development is situated in East Road, Dublin, immediately north of the railway yard, as shown in Figure 1.1. The proposed development comprises the demolition of all existing structures on site and the construction of a mixed-use development including 9 no. blocks, ranging in height from 3 to 15 storeys to accommodate 560 no. apartments, commercial/enterprise space, residential amenity services, retail units, food hub/café/exhibition space, residential amenity services, a creche and a men's shed. Landscaping will include a new central public space and residential podium courtyards.

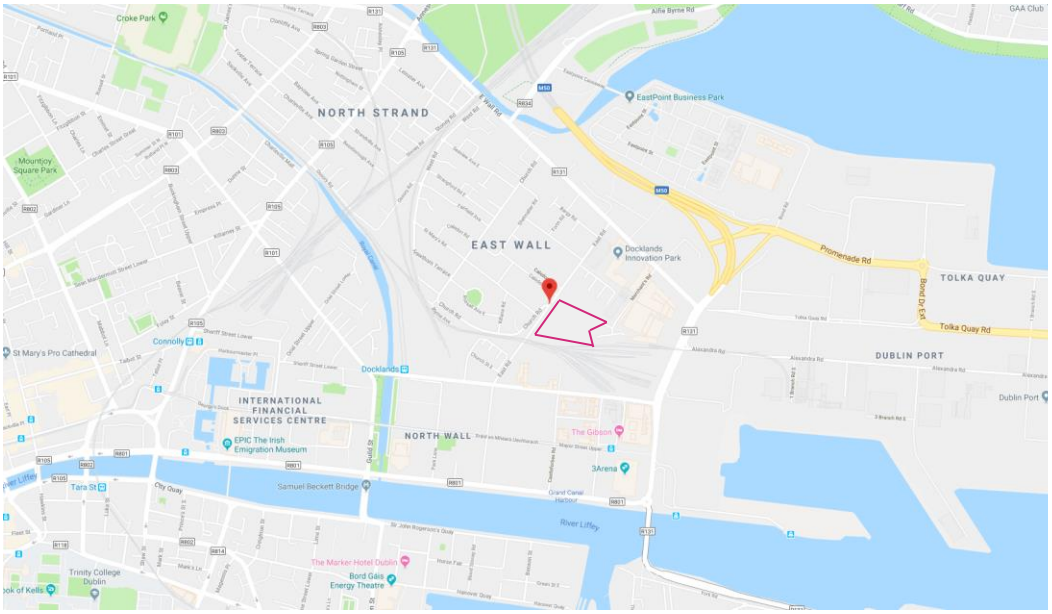


Figure 1.1: Proposed development location

During the design process, the influence of the development on the local wind microclimate and its impact on the quality of the pedestrian environment was examined. This report describes the methods used to assess these impacts in terms of pedestrian comfort and safety and outlines how the findings informed the design process.

This report assesses the impact of the proposed East Road development on the wind conditions affecting pedestrian activities in areas within and surrounding the development. The erection of new taller buildings may alter the flow of the wind in the surrounding area. The windiness depends on both the massing of the buildings within their surroundings, their orientation with respect to the wind, and the local climate.

The proposed development at the East Road site will influence on the wind environment at ground level. It is necessary to ascertain if the proposed development enhances or reduces the quality of the public realm. The assessment

of discomfort and distress of pedestrians has been carried out in accordance with the Lawson Comfort Criteria [1].

1.2 Objectives

The objectives of the wind assessment are as follows:

- Evaluate local microclimate that is experienced on site and examine the level of pedestrian comfort within the proposed development;
- Propose mitigation measure to alleviate the corresponding issues relating to pedestrian comfort and distress;
- Assessment of the effectiveness of the mitigation measures, which are adopted in the design, at alleviating pedestrian discomfort and distress.

2 Study Methodology

It is important to understand the wind microclimate around a proposed development in order to understand the level of pedestrian comfort. The assessment has been undertaken in the following key locations:

- Recreational areas;
- Entrances;
- Pedestrian access routes;
- Pedestrian walkways and cycle thoroughfares;

In addition, the study has examined if any additional mitigation measures, such as canopies, screens and landscaping.

2.1 Lawson Comfort Criteria

The criteria used to describe windiness in this study are those of TV Lawson of Bristol University, extracted from “The evaluation of the windiness of a building complex before construction”, TV Lawson, London Docklands Development Corporation. These are used widely in Ireland, UK and around the world.

The acceptability of windy conditions is subjective and depends on several other factors, including but not limited to, normal clothing for the time of the year, expectations of the wind environment, air temperature, humidity and sunshine and most notably the activities to be performed in the area being assessed. The Lawson Criteria describe acceptability for particular activities in terms of 'comfort' and 'distress' (or safety). Acceptable conditions for various activities in order of increasing windiness are described in Table 2.1.

Gusts cause the majority of cases of annoyance and distress and are assessed in addition to average wind speeds. Gust speeds should be divided by 1.85 and these "gust equivalent mean" (GEM) speeds are compared to the same criteria as for the mean hourly wind speeds. This avoids the need for different criteria for mean and gust wind speeds.

Table 2.1: Comfort Criteria as Defined by TV Lawson

Activity	Description
'sitting'	Regular use for reading a newspaper and eating and drinking
'standing'	Appropriate for bus stops, window shopping, building entrances, and public amenity spaces such as parks
'strolling'	General areas of walking and sightseeing
'business walking'	Local areas around tall buildings where people are not expected to linger

Note: *A classification of 'business walking' does not mean that a location will never be suitable for 'sitting', however, it is likely to occur relatively infrequently.*

2.1.1 Comfort Levels

The onset of discomfort depends on the activity in which the individual is engaged and is defined in terms of a mean hourly wind speed (or GEM, see above) which is exceeded for 5% of the time. The conditions, as described in Table 2.1 above, are the limiting criteria for comfort. For ideal conditions, the windiness will be a category better than outlined above. For more sensitive activities, such as regular use for external eating, conditions should be well within the 'sitting' category. Ireland is a windier climate than the UK, where these criteria were developed. It is generally accepted that residents in windier climates are more resilient to stronger winds. Therefore, a slight exceedance of the limiting criteria for comfort is not considered significant.

2.1.2 Distress Levels

There is a criterion to define the onset of distress. For the 'General Public', this is equivalent to an hourly mean speed of 15 m/s and a gust speed of 28 m/s to be exceeded **less often than once a year**. This is intended to identify wind conditions which less able individuals or cyclists may find physically difficult. Conditions in excess of this limit, may be acceptable for optional routes and routes which less physically able individuals are unlikely to use.

Table 2.2: Distress Criteria as defined by TV Lawson

Activity	Description
General Public Access	Above which the less able and cyclists may at times find conditions physically difficult
Able-bodied Access	Above which it may become impossible at times for an able bodied person to remain standing

There is a further limiting distress criterion beyond which even 'Able-Bodied' individuals may find themselves in difficulties at times. This corresponds to a mean speed of 20 m/s and a gust speed of 37 m/s to be exceeded less often than once a year. Aerodynamic forces may exceed body weight in stormy conditions, which makes it difficult for anyone to remain standing. Where wind speeds exceed these values, pedestrian access should be limited.

Table 2.3: Lawson Comfort Criteria

Beaufort Scale	Wind Effects on the Environment	Wind Speed (m/s)		Activity			
		At 10m	threshold	'sitting'	'standing'	'strolling'	'business walking'
0 - 1	Calm – no significant wind	<1.5					
2	Wind felt on the face, leaves rustle	1.5 – 3.3					
3	Leaves and twigs move, wind carries small flags	3.4 – 5.4	**4.0**				
4	Dust and papers raised from the ground, small branches are agitated	5.5 – 7.9	**6.0**				
5	Wind is felt on the body, small trees move	8.0 – 10.7	**8.0**				
6	Difficult to walk straight, umbrellas are difficult to use, large branches begin to move	10.8 – 13.8	**10.0**				
7	Difficult to walk into the wind, trees are completely moving	13.9 – 17.1					
8	Storm – walking is hampered, branches break	17.2 – 20.7	**15.0**				
9	Storm – risk of losing balance, dangerous to walk	> 20.8	**20.0**				

Recreational Area | Entrances | Access Route

Legend

- Acceptable
- Tolerable
- Unacceptable

} Comfort Criteria

- Dangerous – General Public including Cyclists
- Dangerous – Able-bodied Pedestrians

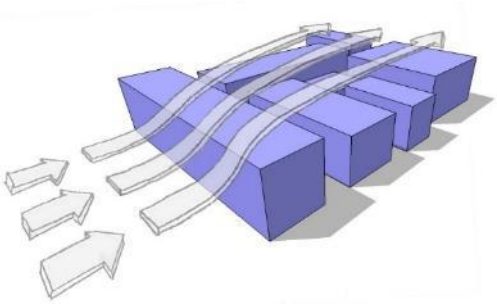
} Distress Criteria

2.2 Key Flow Mechanisms

There are certain flow patterns that can result in increased flow velocities. The main flow mechanisms of concern are described below:

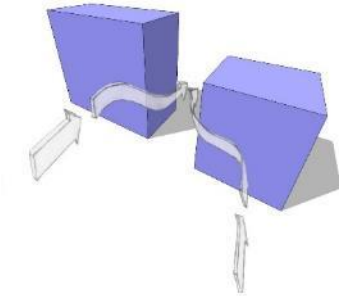
1. Exposure and Shelter:

When buildings of similar height are in close proximity to each other, the first line of buildings can shelter the buildings behind from the wind. However, if the gap is relatively large, the building upstream may not provide adequate shelter. In this case, the higher velocity high level wind from above may descend to ground and therefore, this may create an inclement environment for pedestrians.



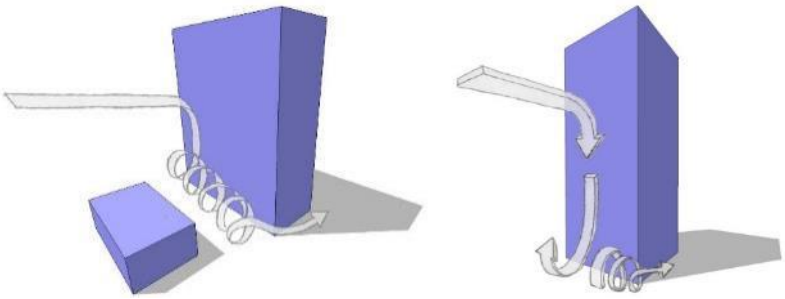
2. Funnelling:

When the gap between buildings is relatively narrow in comparison to their overall width, a large volume of wind is forced through the narrow opening. It is necessary for the wind speed to increase through the opening, which can result in discomfort for pedestrians.



3. Downdraft:

When buildings are considerably taller than the other buildings in their surroundings, they can re-direct the high-speed winds that they interact with at a high level down to ground in the form of a downdraft. The downdraft effect can be further exacerbated by lower level buildings in close proximity upstream.



2.3 Computational Fluid Dynamics (CFD)

Computational Fluid Dynamics (CFD) is a numerical technique to simulate fluid flow, heat and mass transfer, chemical reaction and combustion, multiphase flow, and other phenomena related to fluid flows. Modelling in CFD includes three main stages: pre-processing, simulation and post-processing. Computational Wind Engineering (CWE) is a branch of CFD concerned with behaviour of wind. It can be used to understand the wind flow through an urban environment and the effect of a proposed development on the local wind microclimate.

3 Existing Receiving Environment

3.1 Site Location and Surrounding Area

The proposed development is situated to the east of East Road immediately north of the railway yard in the North Docks area of the city. The lands are accessed from East Road on the western boundary of the site. The eastern boundary of the site abuts Merchant's Square Residential Development. The southern boundary is bounded by CIE lands. Industrial, commercial, leisure and retail land uses are all present in close proximity. There are existing apartment buildings in the lands adjacent to the north while there is lower level terraced housing (i.e. 2-3 storeys) situated on the opposite side of the East Road to the west.

Figure 3.1: Proposed Development Layout

3.2 Proposed Development

The proposed development comprises the demolition of all existing structures on site and the construction of a mixed-use development including 9 no. blocks, ranging in height from 3 to 15 storeys to accommodate 560 no. apartments, commercial/enterprise space, residential amenity services, retail units, food hub/café/exhibition space, residential amenity services, a creche and a men's shed. Landscaping will include a new central public space and residential podium courtyards.

The development also serves a leisurely function through the provision of open public spaces. This space will include landscaping and planters designed for sitting purposes.

To accommodate for the resident's accessibility the proposed development includes 250 carpark spaces under the podium with some visitor spaces at surface. This is accessible from the existing East Road – Church Road Junction. Furthermore, the development also includes for approximately 1000 bicycle spaces, with long term cycle spaces being covered and secure. Short term cycle parking will be located in easily accessible areas in close proximity to entrances and desire lines. Additional cycle spaces will be provided for the commercial element of the development in accordance with Dublin City's Development Plan.

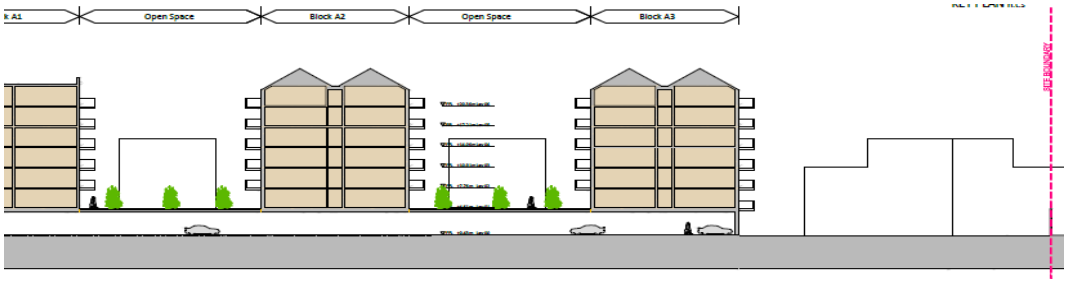


Figure 3.2: Elevation facing the Northeast

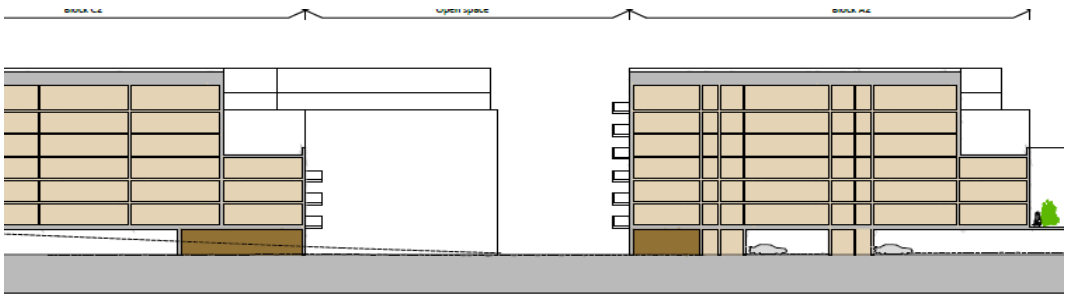


Figure 3.3: Elevation facing the Northwest

Figure 3.4: Ground Level Plan

3.3 Wind Microclimate

Met Eireann's meteorological station at Dublin Airport is the closest meteorological station to Dublin and to the site. The expected statistics for wind strength and direction are based on historic wind data recorded at this weather station. The meteorological data, which was associated with the hourly wind speeds recorded over a 30-year period between 1988 and 2018, was analysed. The data is recorded at a weather station at the airport, which is located 10m above ground or 71mOD.

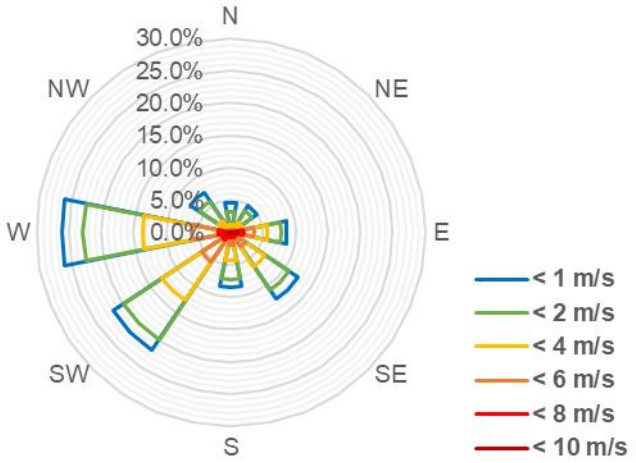


Figure 3.5: Dublin Airport Wind Rose

In this study, winds were considered to approach from eight distinct sectors. A Weibull distribution was fitted to the wind data for each sector through the adoption of an appropriate dispersion parameter, c, and shape parameter, k, given in the table below. The 95th percentile and 'once-a-year' wind speeds were derived from the subsequent cumulative Weibull distributions.

Table 3.1: Weibull distribution parameters (based on wind speed in m/s)

Wind Direction	N	NE	E	SE	S	SW	W	NW
Directional probability, p	5.57%	5.25%	9.10%	13.14%	9.04%	22.45%	27.35%	8.09%
Dispersion parameter, c	4.02	4.95	4.75	5.3	6	7	6.4	4.7
Shape parameter, k	1.45	1.9	1.67	1.9	1.8	2.25	1.93	1.95

In order to account for differences in topography and terrain exposure, the local wind data from Dublin Airport was transposed to the development site using the ESDU (Engineering Sciences Data Unit) methodology, which is compatible with Irish practice for wind loading. The transformation considers the exposure of the site, which is a measure of the terrain roughness (i.e. size and number of obstacles) upstream of the site. The exposure is dependent on the direction of the oncoming wind. The local transformation factors used in this study are outlined in Table 3.2.

Table 3.2: Local wind transformation factors

Wind Direction	N	NE	E	SE	S	SW	W	NW
'Open' terrain at 10m to Dublin Airport at 10m								
Mean wind speed	1.00	0.95	0.95	0.95	0.92	0.90	1.00	1.00
Gust Speed	1.61	1.57	1.58	1.57	1.54	1.52	1.61	1.61
'Open' terrain at 10m to East Road Residential Development at 10m								
Mean wind speed	0.76	0.88	0.84	0.85	0.87	0.88	0.74	0.73
Gust speed	1.43	1.50	1.46	1.46	1.46	1.46	1.40	1.40

4 Preliminary Desktop Analysis

A desktop study was undertaken in advance to identify key areas of concern where potential wind effects may adversely affect pedestrian comfort levels. The desktop study is a qualitative assessment of the proposed development with respect to wind. The study considered the west, southwest, east and southeast winds as the most critical given their frequency and orientation with respect to the proposed development as well as their strength.

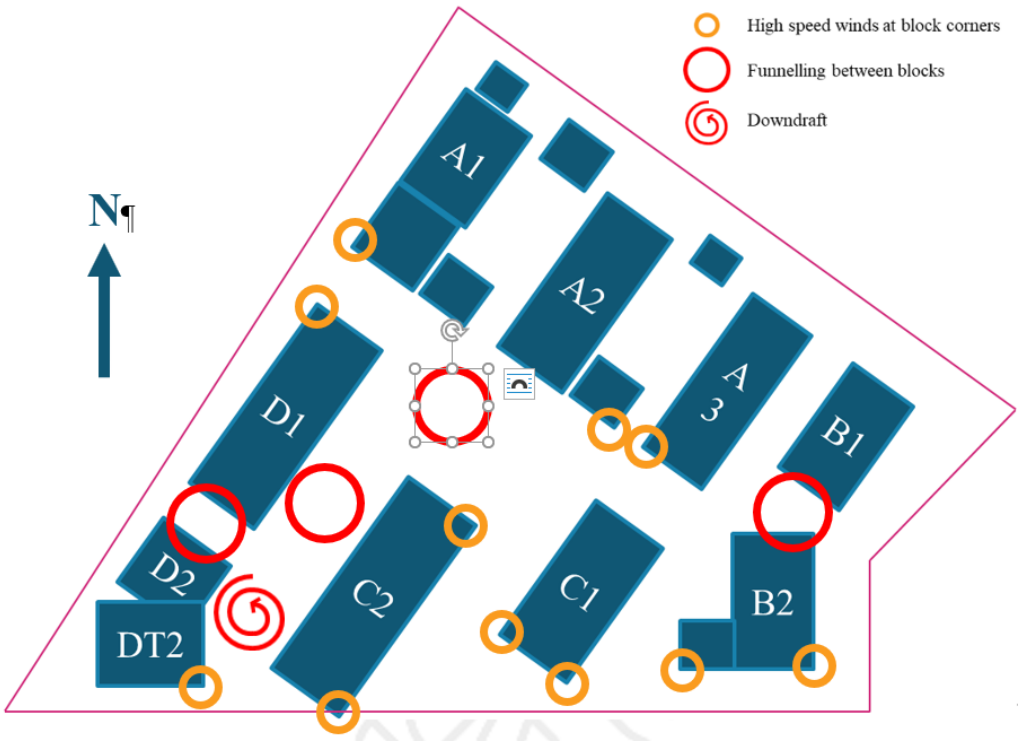


Figure 4.1. Summary of the Desktop Study

The key items raised during the desktop study are summarised in Figure 4.1 and are as follows:

- It is anticipated that higher speed winds will form near corners of blocks depending on the wind direction;
- There is potential for downdrafts to occur around the Block DT2 at the Southeast side of the development;
- There is potential for funnelling between blocks, as shown by the red circles in Figure 4.1, depending on wind direction;
- General windiness and funnelling along the main walkway of the development due to various wind directions;
- There is potential of high speed southwesterly winds along the footpath on East Road;

5 Detailed Quantitative Analysis

Following the desktop study, a more comprehensive analysis was undertaken to quantify the pedestrian comfort level at key locations in the domain using computational fluid dynamics (CFD). In general, the proposed development is likely to provide a comfortable and an attractive environment for pedestrians and occupants. It is exposed to the easterly, southeasterly, westerly and southwesterly winds which have the potential, on occasions, to cause conditions that pedestrians may find distressing without the appropriate mitigation measures in place.

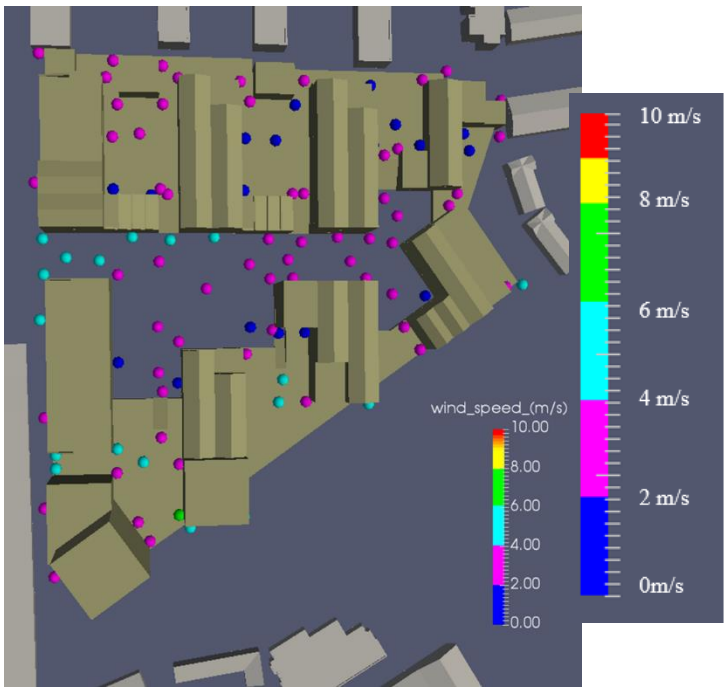


Figure 5.1: Lawson comfort wind speeds within the proposed development excluding any landscape features or other mitigation measures

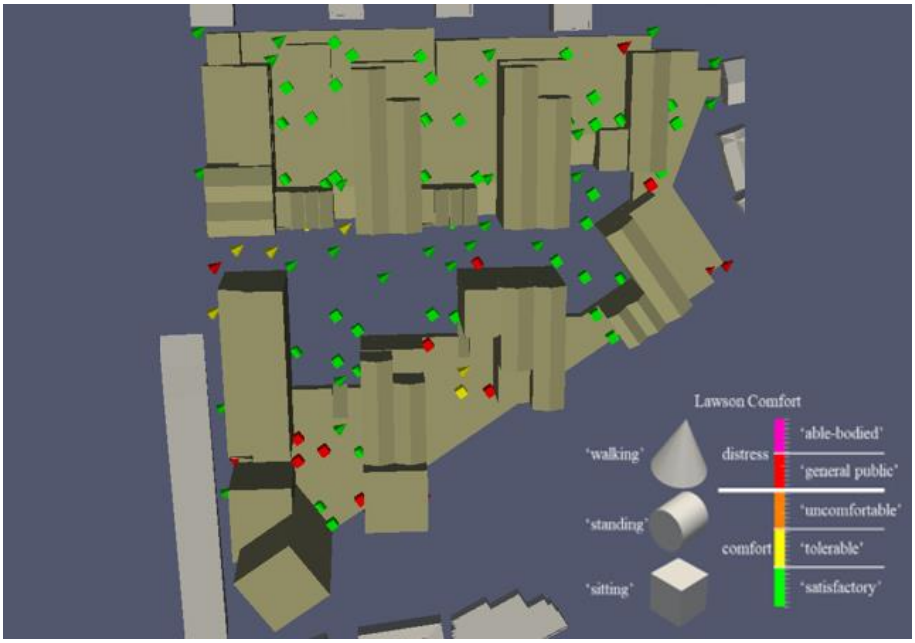


Figure 5.2: Lawson comfort criteria within the proposed development excluding any landscape features or other mitigation measures

5.1 East Road

Figure 5.3: Extent of East Road

East Road provides connectivity between the proposed development and its surroundings. Pedestrians and cyclists will use East Road to access other places in the city. The main vehicular and pedestrian access into the development will be

via East Road, however, there are no entrances directly accessing the development from East Road. The road consists of a single carriageway with pedestrian footpaths on either side and therefore, it will be used as a thoroughfare by pedestrians and cyclists.

5.1.1 Thoroughfare

The study reveals strong wind conditions due to southwest winds along East Road due to the orientation of the development and its relationship to the East Road, as shown in Figures 5.4 below. The wind speeds are envisaged to be in the 'walking' range with the potential to exceed the threshold for distress for more vulnerable pedestrians (i.e. young children, the elderly or cyclists) on occasion with any further mitigation. This is found to be the case near the main access to the development.

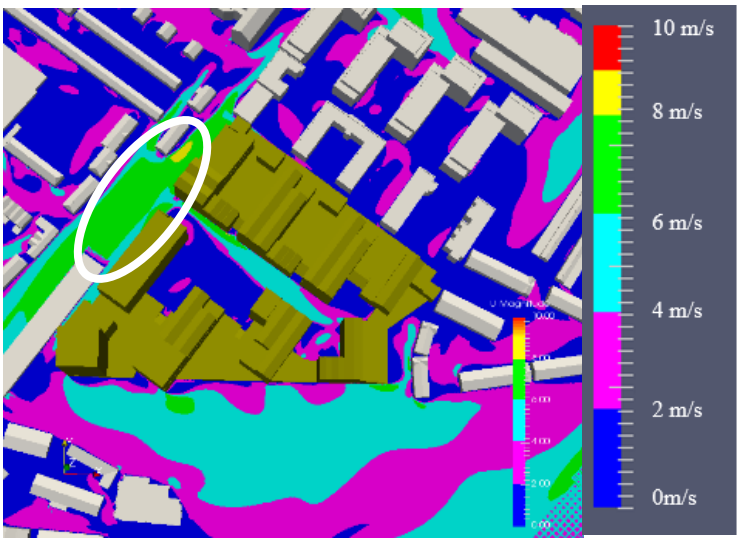


Figure 5.4: Wind speed (m/s) at East Road due to Southwest winds at ground level

The provision of clustering planting along the pathway would be beneficial for the occupants of the development, eliminating to some extent the distress might be caused to pedestrians and cyclists.

5.2 Central Thoroughfare

The main thoroughfare from the main vehicular and pedestrian access into the development across the development to Blocks B1 and B2. It is a multi-functional space, which includes:

- access into the development for vehicles and pedestrians;
- access to raised plazas at podium level for pedestrians and cyclists via ramps and stairs;
- access to residential blocks via entrances;
- amenity and leisure spaces for pedestrians;

- parking areas for vehicles.

The raised podium at the end of the central thoroughfare between Blocks B1 and B2 is a green roof. It will not be accessible to the general public or occupants of the proposed development. It will only be accessible for the purposes of operations and maintenance.

Figure 5.5. Extent of Central Thoroughfare

5.2.1 Public Realm

The model indicates that the eastern extent of the main thoroughfare may suffer from windiness. It is most is exposed to east winds at the ground and podium levels. It is anticipated the following that wind will funnel through the gap between corner Block B2 and Block B1. However, it is only a concern when the high speed winds are encountered at ground level given that the green roofs at podium level are not readily accessible.

The provision of a 2.1m high balustrade in the gap between Blocks B1 and B2 will force the wind to funnel between the blocks at a higher level and therefore, it should help limit the windiness that occurs at ground level. Typically, the wind speeds are likely to be within the ‘walking’ range, which will be acceptable to most pedestrians, and pedestrians may encounter winds that are distressing on occasion.

In addition, it is recommended that the provision of further landscape features along the main thoroughfare will help provide some localised shelter to pedestrians from the wind.

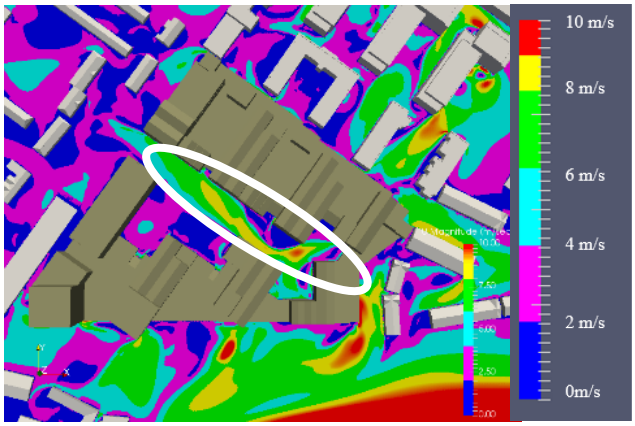


Figure 5.6: Wind speed (m/s) due to East winds at ground level

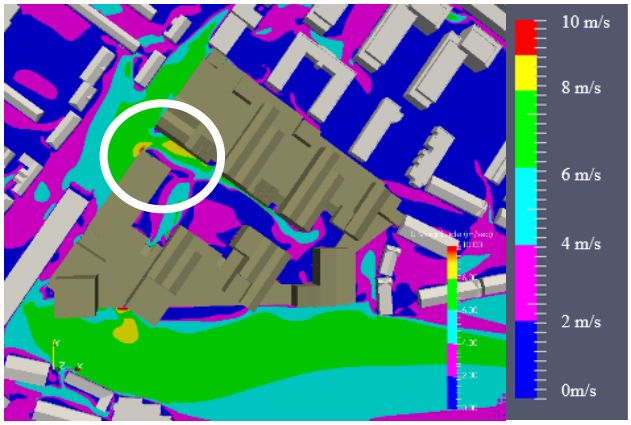


Figure 5.7: Wind speed (m/s) due to West winds at ground level

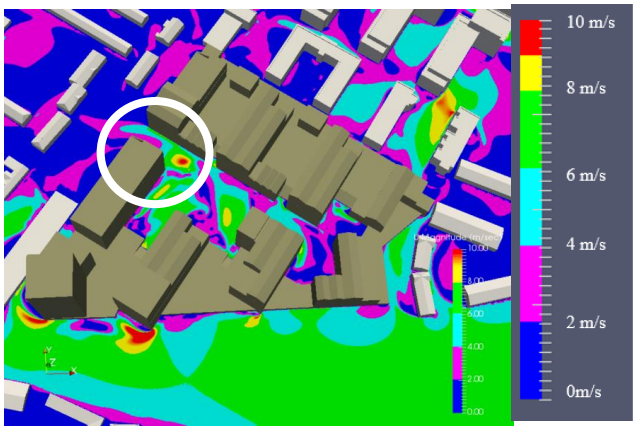


Figure 5.8: Wind speed (m/s) due to Southeast winds at ground level

5.2.2 Entrances

It is beneficial that the entrances are located near the centre of the building and away from the corners of the block, where the higher speed winds occur. The

outcome is that the wind conditions are tolerable for ‘standing’ and therefore, they are considered acceptable for their proposed use.

5.2.3 Thoroughfare

The results reveal that there would be general windiness along the main entrance caused by westerly, southeasterly and easterly winds which might cause distress to pedestrians and cyclists, as shown in Figures 5.6, 5.7 and 5.8.

Where high wind speeds are unavoidable, the provision of substantial planting along the entire main walkway is recommended to reduce the influence of wind. In addition, consideration should be given to redirecting pedestrians away from corners, where appropriate.

5.3 Southern Plazas and Creche Outdoor Play Area (Blocks B2, C1, C2, D1 and D2)

Figure 5.9: Extent of southern plazas

There are three plazas on the raised podium on the southern side of the proposed development. The plazas between Blocks C1 and C2 and between Blocks D1, D2 and C2, respectively, are multi-functional plazas. The plazas can be accessed from the main thoroughfare via ramps and stairs. They facilitate access into the surrounding blocks through designated entrances as well as acting as amenity and leisure spaces for occupants and public alike. The plaza between Blocks B2 and C1 is designated as the play area for the creche. It is accessed from Block B2.

5.3.1 Public Realm

The study revealed that the plaza between Block C2, D1 and D2 around the Block DT2 of the development suffers from windiness due to east and southeast winds.

Block DT2 is considerably higher than its surrounding buildings. Winds from the east are downdraft into the elevated plaza below, as shown in Figure 5.10. It is anticipated that the typical wind speeds will be tolerable for pedestrians within the public realm, however, it is likely that wind speeds could be distressing on occasion. The provision of a canopy will help maintain wind at high levels and prevent it from descending to ground level.

In addition, wind will funnel between Blocks D1 and D2 due to east winds. It is predicted that the wind speeds could be distressing from time to time. Funnelling in the narrow gap between Blocks D1 and D2 at East Road will be mitigated through landscape treatment that will shelter pedestrians on the pathway between the blocks.

Funnelling between Blocks C2 and DT2 due to southeast winds cause the formation of high speed winds in the public plaza, as shown in Figure 5.10. It is anticipated that pedestrians will find these winds distressing. The provision of a 2.1m high windscreen along the south edge of the development on podium level will provide shelter to the users from southeast winds. In addition, the provision of tall vegetation in the gap between Blocks C2 and DT2 will also assist in mitigating the wind.

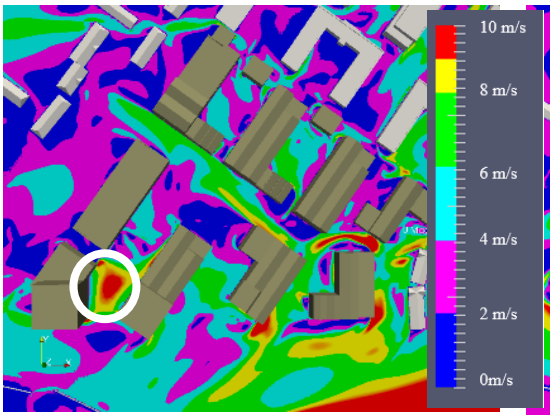


Figure 5.10: Wind speed (m/s) due to East winds at podium level

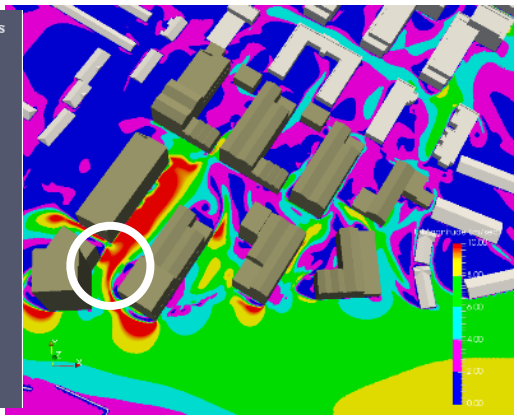


Figure 5.11: Wind speed (m/s) due to Southeast winds at podium level

Funnelling between Blocks C1 and C2 due to southeast winds cause the formation of high speed winds in the public plaza, as shown in Figure 5.11, that pedestrians will find uncomfortable and may even be distressing on occasion. The provision of a 2.1m high windscreen along the south edge of the development at podium level will provide shelter to the users from southeast winds. In addition, the provision of tall vegetation in the gap between Blocks C1 and C2 will also assist in mitigating the wind.

It is anticipated that the creche will suffer from windiness due to easterly and south-easterly winds without mitigation. It is predicted that the wind speeds

within the creche may exceed the ‘sitting’ threshold without mitigation, which could render the space unsuited to its intended use. The provision of a 2.1m high windscreen on either side of the podium level will provide shelter the occupants of the creche from the wind.

5.3.2 Entrances

It is beneficial that the entrances are located near the centre of the buildings and away from the corners of the block, where the higher speed winds occur. The outcome is that the wind conditions are suitable for ‘standing’ and therefore, they are considered acceptable for their proposed use.

5.3.3 Thoroughfare

In general, the wind conditions along the thoroughfares around these blocks will be suitable for pedestrian ‘walking’.

The windiness that occurs in the vicinity of Block DT2, which are discussed in Section 5.3.1, will impact on pedestrians walking through the elevated plaza. The provision of a canopy will help maintain wind at high level and protect pedestrians from the worst effects of the wind. Moreover, the provision of a 2.1m high windscreen along the south edge of the development on podium level will provide shelter to the users from southeast winds. In addition, the provision of tall vegetation in the gap between Blocks C2 and DT2 will also assist in mitigating the wind. Landscape treatment between Blocks D1 and D2 will shelter pedestrians on the pathway between the blocks.

5.4 Northern Plazas (Blocks A1, A2, A3 and B1)

Figure 5.12: Extent of northern plazas

Northern plazas are sheltered from the most critical winds, i.e. east, southeast, west and southwest, anticipated in the development.

5.4.1 Public Realm

In general, the northern plazas are sheltered from the wind. The plazas suffer from slight windiness due to easterly winds. The conditions within the plazas will be suitable for pedestrian ‘sitting’. Landscape treatments within the plazas will be beneficial in providing more localised shelter.

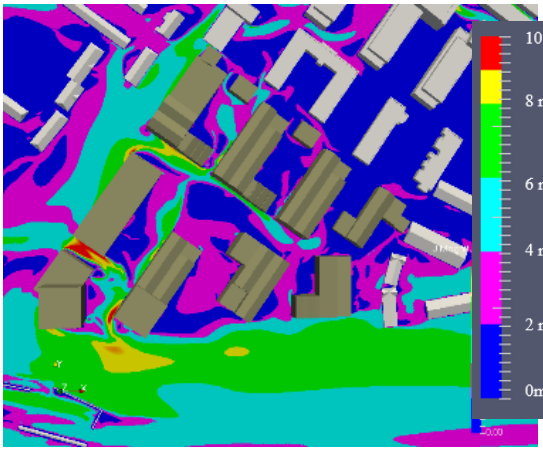


Figure 5.13: Wind speed (m/s) due to West winds at podium level

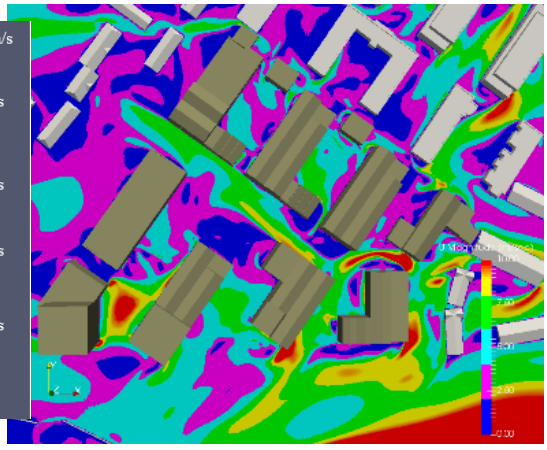


Figure 5.14: Wind speed (m/s) due to East winds at podium level

5.4.2 Entrances

It is beneficial that the entrances are located near the centre of the buildings and away from the corners of the block, where the higher speed winds occur. The outcome is that the wind conditions are suitable for ‘standing’ and therefore, they are considered acceptable for their proposed use.

5.4.3 Thoroughfare

In general, the wind conditions along the thoroughfares around these blocks will be suitable for pedestrian ‘walking’. Trees and planting between the along the pedestrian linkage will be beneficial in roughening the terrain and providing more localised shelter.

6 Mitigation

The following mitigation measures are implemented in the design:

- Provision of planting and soft landscape features at ground level along the main thoroughfare;
- Provision of planting and soft landscape features along the East Road;
- Provision of planting and soft landscape features at podium level along the gap between Blocks D1 and D2;
- Provision of 2.1m high wind screen at podium level between Blocks B1 and B2 to provide shelter to the public realm at ground level below;
- Provision of 2.1m high wind screens on either side of the outdoor play area for the creche;
- Provision of 2.1m high wind screens in conjunction with planting along the edge of the southern plazas;
- Provision of canopy along western edge of Block D2/DT2 in conjunction with a covered walkway between Blocks C2 and D2 to provide shelter against the downdraft occurring at the southwest plaza.

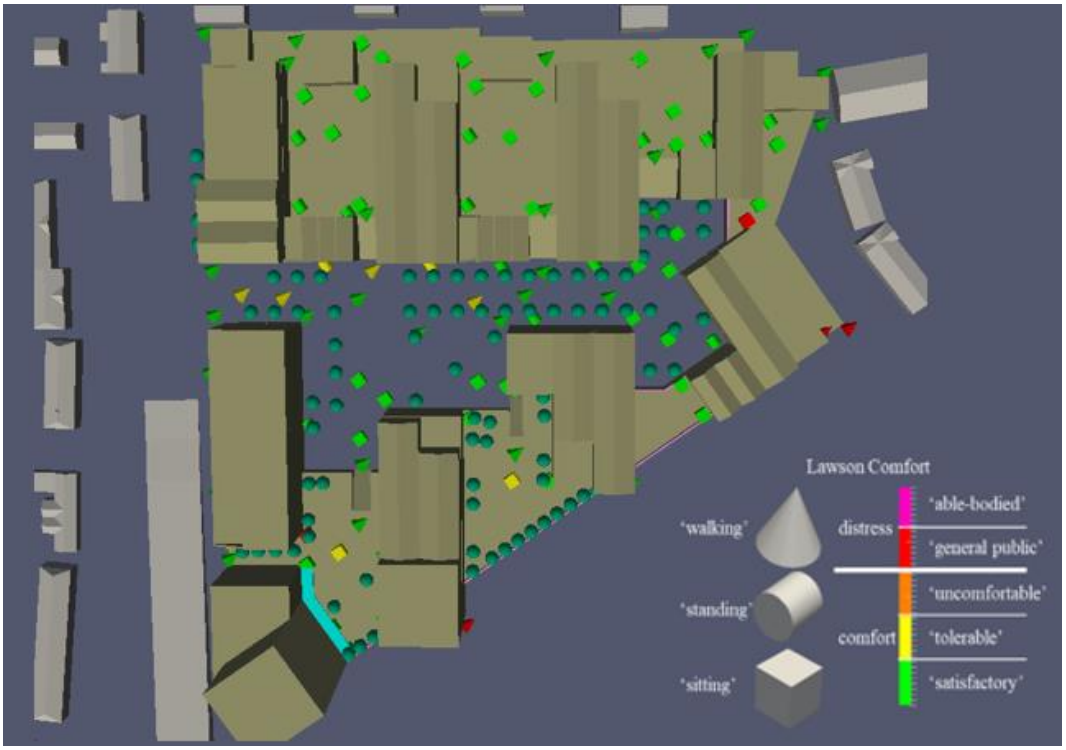


Figure 6.1: Lawson comfort criteria at main walkway following mitigation.

6.1 East Road

6.1.1 Thoroughfare

The initial model did not contain any soft landscape features. The introduction of these features into the model reveal that they act to further disrupt the wind. In general, the wind conditions along the East Road will be suitable for pedestrian 'walking' with the provision of suitable landscaping.

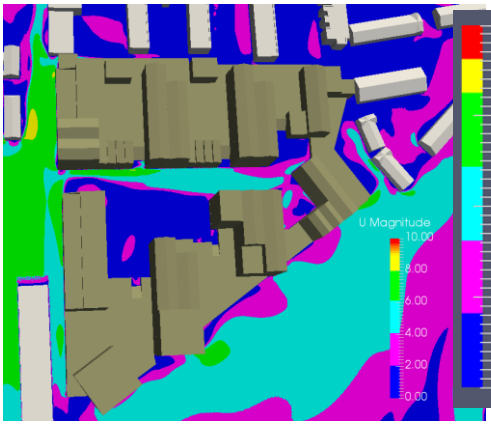


Figure 6.2: Wind speed (m/sec) due to Southwest winds before mitigation.

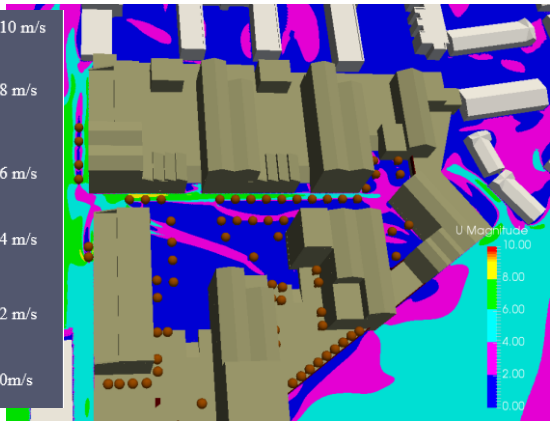


Figure 6.3: Wind speed (m/sec) due to Southwest winds following mitigation.

6.2 Central Thoroughfare

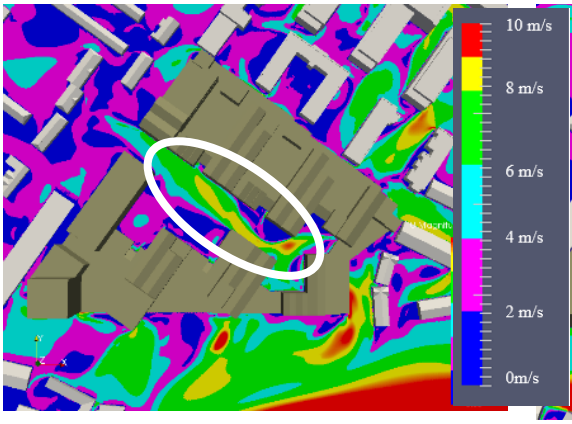


Figure 6.4: Wind speed (m/s) due to East winds at ground level before mitigation

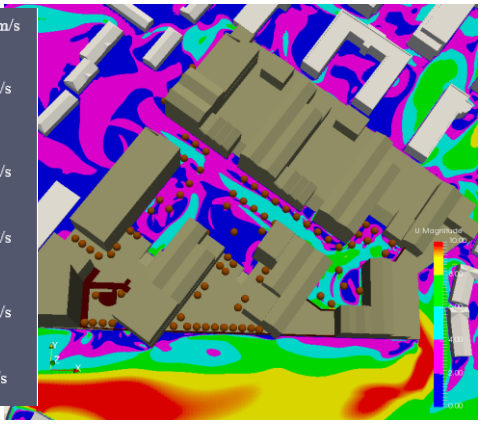


Figure 6.5: Wind speed (m/s) due to East winds at ground level following mitigation

6.2.1 Public Spaces

The results reveal that the wind conditions along the main promenade are mostly in ‘sitting’ or ‘standing’ range and therefore, is considered acceptable for its intended use.

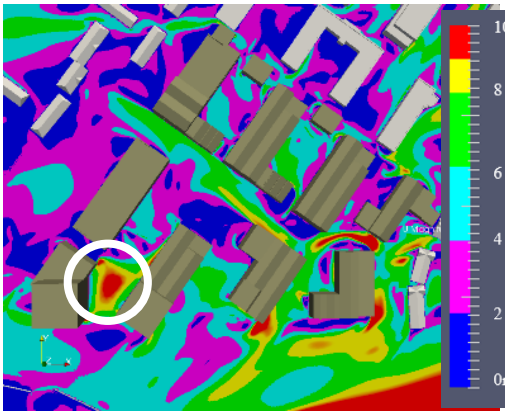


Figure 6.6: Wind speed (m/s) due to East wind before mitigation.

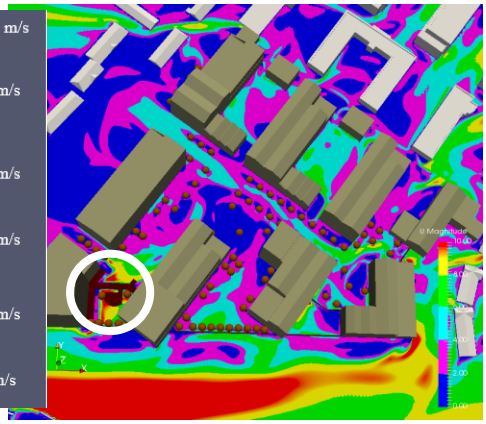


Figure 6.7: Wind speed (m/s) due to East wind following mitigation.

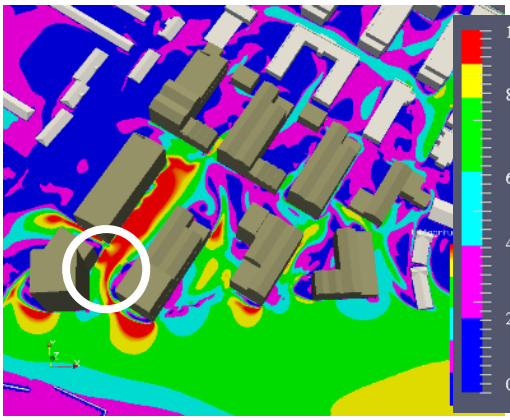


Figure 6.8: Wind speed (m/s) due to Southeast wind before mitigation.

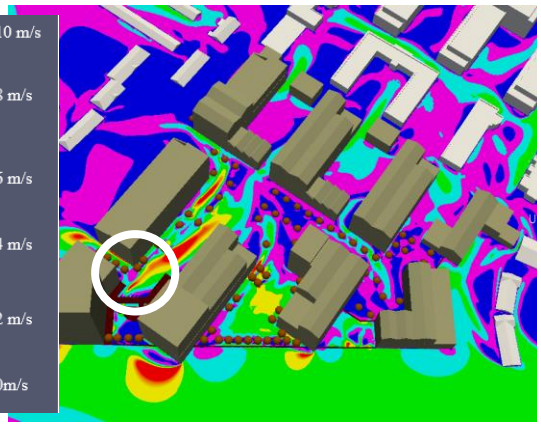


Figure 6.9: Wind speed (m/s) due to Southeast wind following mitigation.

6.2.2 Entrances

The provision of landscape features along the main thoroughfare does not significantly impact the wind conditions near entrances. The results reveal that the wind conditions are tolerable for ‘standing’ and therefore, they are considered acceptable for their proposed use.

6.2.3 Thoroughfare

In general, the wind conditions along the thoroughfare around will be suitable for pedestrian ‘walking’. Trees and planting will be beneficial in roughening the terrain and providing more localised shelter.

6.3 Southern Plazas and Creche Outdoor Play Area (Blocks B2, C1, C2, D1 and D2)

6.3.1 Public Spaces

The results reveal that the wind conditions on the elevated plazas are typically acceptable for their intended use, although there are a few locations within the plazas that are only tolerable for ‘sitting’.

The provision of a canopy limits the high level easterly winds reaching the elevated plaza between Blocks C2 and DT2. The canopy all acts to maintain the southeasterly winds at a higher level across the plaza in conjunction with the 2.1m wind screens and soft landscaping along the southern edge of the plaza. While some areas of windiness remain, the outcome is a calmer and more attractive plaza for pedestrians, as shown in Figures 6.5, 6.7 and 6.9. Similarly, the provision of 2.1m wind screens and soft landscaping, as appropriate, in the other southern plazas is also beneficial in producing a calmer and more comfortable environment for pedestrians and occupants.

6.3.2 Entrances

The entrances benefit from the calmer wind microclimate in the southern plazas due to the provision of the canopy, screens and landscaping. The entrance to the tall tower (Block DT2) shelters the entrance from the downdraft. It is anticipated that the wind conditions are suitable for ‘standing’ and therefore, they are considered acceptable for their proposed use.

6.3.3 Thoroughfare

The thoroughfares benefit from the calmer wind microclimate in the southern plazas due to the provision of the canopy, screens and landscaping. The canopy provides a sheltered route for pedestrians through the plaza. It is anticipated that the wind conditions are suitable for ‘walking’ and therefore, they are considered acceptable for their proposed use.

7 Conclusions

The conclusions of the East Road development wind microclimate study are as follows:

- The critical wind directions for this development in terms of pedestrian comfort are the East, Southeast, Southwest and West;
- In general, the proposed development is likely to provide a comfortable and an attractive environment for pedestrians and occupants;
- Without suitable mitigation, the winds can produce wind conditions that pedestrians may find distressing in certain areas of the site, which include:
    - The pedestrian walkway along the East Road near the main access to the development;
    - The main pedestrian and vehicular access into the development from East Road;
    - The public realm near Blocks B1 and B2 at eastern extent of the main thoroughfare through the development;
    - The elevated plazas on the southern side of the development, including the outdoor play area for the creche.
- Focused wind mitigation measures have been incorporated into the design to alleviate distress and these include:
    - Provision of planting and soft landscape features at ground level along the main thoroughfare;
    - Provision of planting and soft landscape features along the East Road;
    - Provision of planting and soft landscape features at podium level along the gap between Blocks D1 and D2;
    - Provision of 2.1m high wind screen at podium level between Blocks B1 and B2 to provide shelter to the public realm at ground level below;
    - Provision of 2.1m high wind screens on either side of the outdoor play area for the creche;
    - Provision of 2.1m high wind screens in conjunction with planting along the edge of the southern plazas;
    - Provision of canopy between Block DT2 and Block C2 to provide shelter against the downdraft occurring at the southwest plaza.
- It is anticipated that the proposed mitigation measures will help alleviate distress that could be encountered on occasion in certain areas of the site;
- Overall, it is anticipated that the wind conditions within the proposed development are considered within suitable limits with the adoption of appropriate mitigation measures and therefore, it is likely to provide a wind microclimate suitable for its intended use.

8 References

[1] Lawson, TV, 2001, 'Building Aerodynamics', Imperial College Press, London.