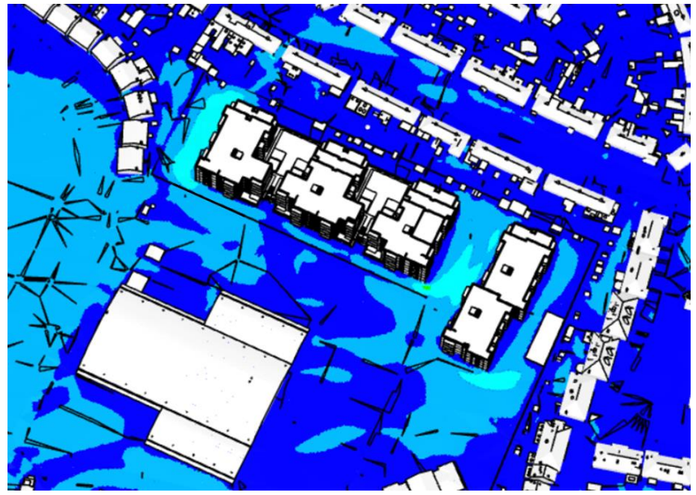
Carlisle Residential LRD,

Kimmage,
Dublin 12
For
1 Terenure Land Limited



Microclimatic Wind Analysis and Pedestrian Comfort Report

IN2 Project No. D2124
03/11/2022

Revision History

Date	Revision	Description
17/08/2021	00	Issue for review
11/10/2021	01	Updated for comments
03/02/2022	02	Updated for revised building design
04/03/2022	03	Revised to reflect comments
09/03/2022	04	Revised to reflect comments
03/11/2022	05	Updated for planning

Table of Contents

1.0 Executive Summary

This report compiles the results of Microclimatic Wind Analysis undertaken by IN2 Engineering Design Partnership for the Proposed Residential Development at Carlisle, Dublin 12, based on 3D modelling information received from BKD Architects, comprising of assessments for predicted Wind conditions to the local environment.

Permission was granted, under ABP 313043 on the 22/09/2022, for an SHD on the subject site comprising 208 no. apartment units in 5 no. blocks. The current proposed LRD application provides the same layout and quantum of units as this permitted development. The proposed LRD wind microclimate is determined to be the same as permitted in the SHD application, as the site layout and building massing remain unchanged from a wind microclimate perspective.

The report summarises the analysis undertaken, and conclusions determined from sophisticated Building Simulations performed with regards to Wind/ Pedestrian Comfort, in all cases validating results in accordance with robust Best Practice Guidelines to ensure compliance.

Detailed assessment of predicted Wind conditions and associated Pedestrian Comfort were undertaken in Sections 2.0 and 3.0, respectively.

Wind Analysis was assessed utilising Airflow Simulation techniques, calculating predicted pressures and velocities throughout the proposed development site and its surroundings.

These wind simulations were then compiled and assessed against Lawson Criteria Methodology- an assessment method for Pedestrian Comfort in order to predict activity suitability (sitting/ standing etc.) for persons in the vicinity of the development.

As per the Urban Development and Building Heights Guidelines (2018), the analysis undertaken identified that the proposed development was determined to not unduly impact on the local wind micro-climate, with no instances of down-draft effects predicted to be introduced to the receiving environment.

Ground level spaces within the proposed development are determined to be predominantly suited to “Pedestrian Sitting/ Standing”, in accordance with the Lawson Criteria methodology utilised. Similarly, Podium level spaces are deemed to be suited to “Pedestrian Sitting/Standing”, and therefore suited to their intended use as amenity spaces.

All balconies within the proposed development are predicted by the Lawson Criteria methodology utilised to be suited to “Outdoor Dining/ Pedestrian Sitting”, and therefore suited to their intended use as private amenity spaces.

The proposed development is determined to not negatively impact on neighbouring developments in terms of wind microclimate and pedestrian comfort.

2.0 Wind Analysis

2.1 Methodology

In order to determine the predicted wind patterns around the proposed development, airflow simulations were undertaken using Computational Fluid Dynamics (CFD) software (Phoenics / Flair). This enabled an assessment of the site wind conditions: highlighting zones of high pressure, negative pressure, and air movement for varying wind conditions.

An initial 3D representational model of the existing buildings and their immediate surroundings was created, and simulations undertaken for 12 cardinal wind directions.

Wind Climate Data was taken from the Global Wind Atlas. This utilises a microscale modelling system, enabling localised wind data to be obtained for high resolution (250m grid) topography, such as hills, ridges, and land use, including urban environments.

Fig 2.1.1 illustrates Global Wind Atlas data for the general Dublin area, indicating average wind speed at 10m height. The relative sheltering of the Urban area can be seen, in contrast to Dublin Airport to the North, and Dublin/ Wicklow mountains to the South, and exposed coastal locations.

Recorded wind speeds for Dublin Airport are relatively high- in what is one of Europe's windier meteorological weather station locations, however, the particular site location at Carlisle is identified, which is an area relatively sheltered on a macro level, on the outskirts of the Dublin City area.

The CFD simulations utilised wind profiles accounting for terrain effects. Allowing for the nature of the site and location, a surface roughness layer profile representative of "Urban Terrain (z_0=0.4m height)" was utilised, derived from GIS survey analysis[1].

Figures 2.1.2 and 2.1.3 indicates the long-term annual "Wind Rose" obtained from the Global Wind Atlas for the site at Carlisle, Dublin 12. The rose diagrams illustrate the frequency that wind will be from a certain direction and at what speed. It can be seen how the prevailing Westerly South-Westerly winds entirely predominate due to the Atlantic gulf stream, with only lower occurrence from other directions.

[1] European Space Agency's Climate Change Initiative Land Cover (CCI-LC) dataset v2.0.7.

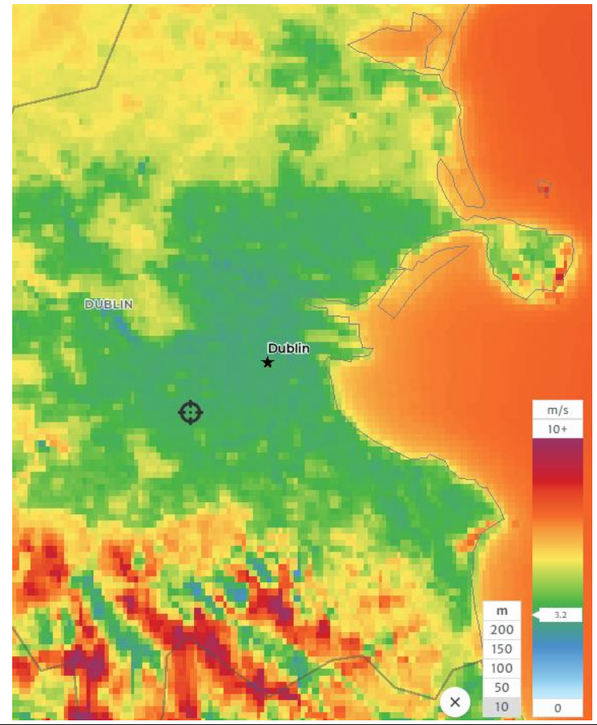


Fig 2.1.1 – Mean Wind Speeds across Dublin – Global Wind Atlas

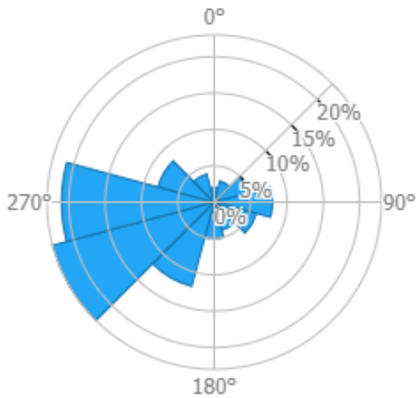


Fig 2.1.2 – Wind Frequency Rose for Carlisle – Global Wind Atlas

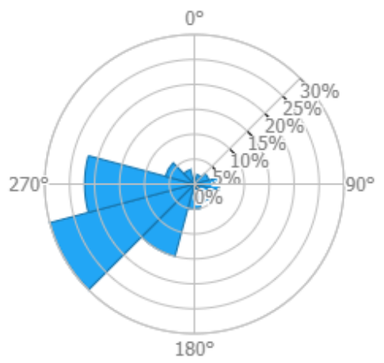


Fig 2.1.3 – Wind Speed Rose for Carlisle– Global Wind Atlas

2.0 Wind Analysis

2.1 Methodology (Cont'd)

As per Fig 2.1.4, 3D representational model of the proposed development and its surroundings was created, and simulations undertaken for 12 cardinal wind directions.

The CFD simulations form the basis of the Pedestrian Wind Comfort Analysis undertaken, which is described in detail in Section 3.0.

The methodology calculates predicted airflow patterns around buildings for all wind orientations and calculates average velocity applying weighting based on probability of occurrence throughout the year. It should be noted that wind effects around buildings for prevailing SW wind conditions are deemed to have more of a potential impact to pedestrian discomfort, as these will occur on a more regular occurrence.

However, it should be noted that the methodology assesses averaged (hourly) wind conditions for the purposes of general pedestrian comfort and does not intend to predict gusting, abnormal nor potential future climate change conditions.

Nevertheless, the Lawson Criteria methodology basis, as described in detail below, has been proven to be a robust means of analysing Pedestrian Comfort and its basis has been successfully adapted and implemented in both National Standards (Netherlands NEN.8100) and Design Guidelines (City of London – Wind Microclimate Guidelines (2019)).

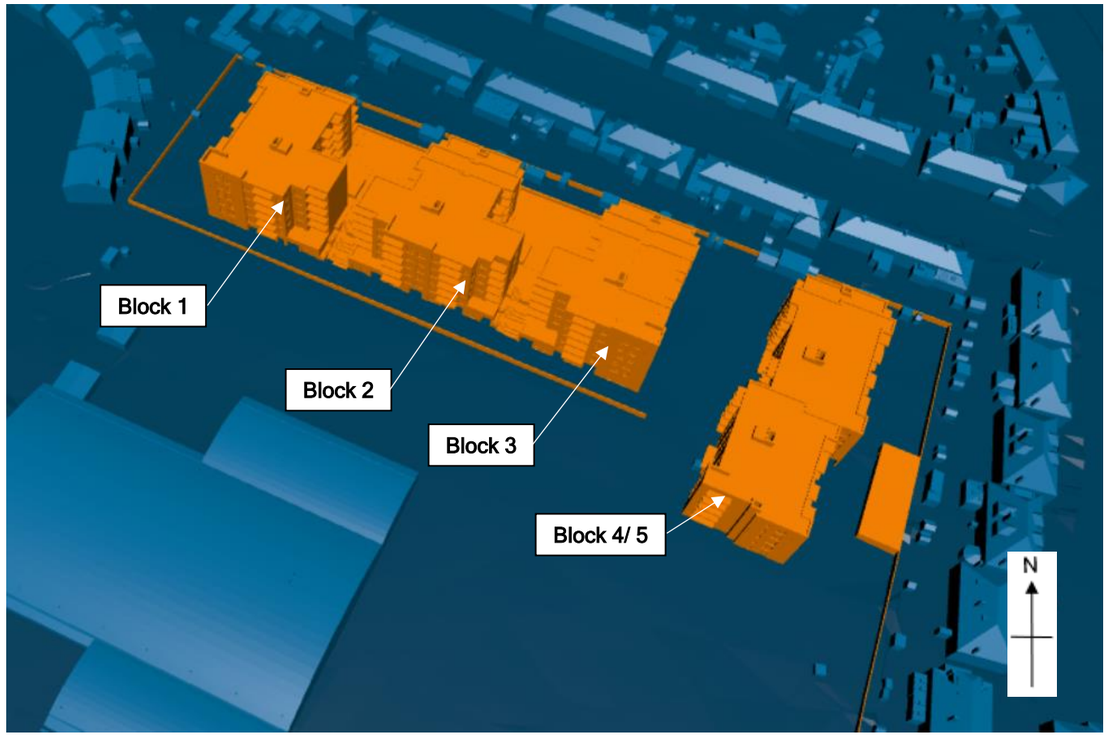


Fig 2.1.4 – 3D Model of Proposed Carlisle Development and Neighbouring buildings

2.0 Wind Analysis

2.2 Results

Figure 2.2.1 illustrates predicted wind velocities across the development under prevailing SW wind conditions, at 1.5m above ground level.

Wind velocities across the proposed development are predicted to be relatively benign.

The results illustrate some acceleration of winds around the corners of Block 1 and Block 3, and between Block 3 and 4. However, owing to the relatively low building heights and wide separation between the building blocks, this is not excessive.

The CFD simulations form the basis of the Pedestrian Comfort Analysis undertaken, which is described in detail in Section 3.0 below.

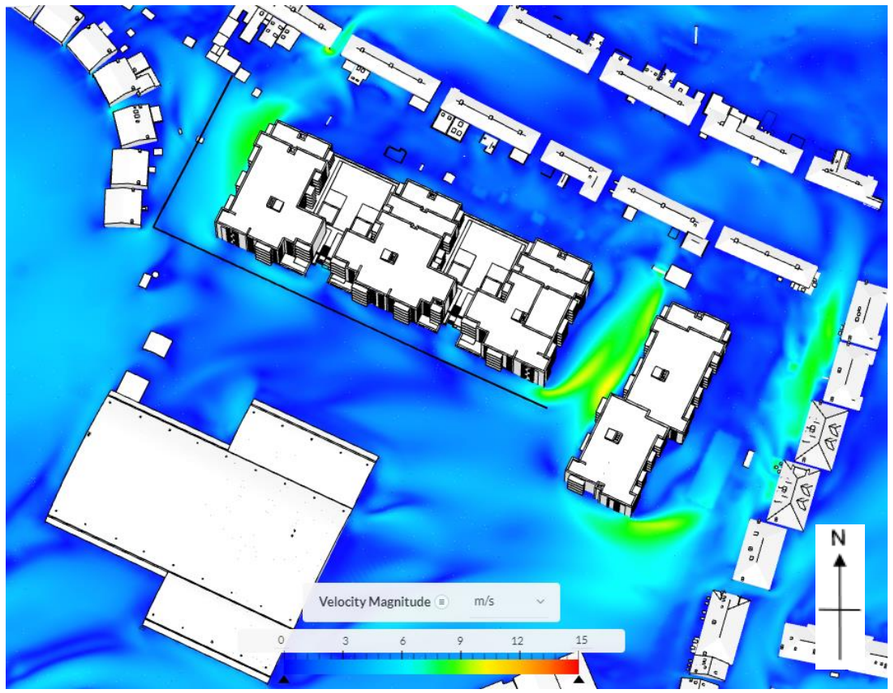


Fig. 2.2.1 - Wind Velocity at 1.5m above Ground Level

3.0 Pedestrian Comfort

3.1 Methodology

Pedestrian Wind Comfort was assessed utilising the “Lawson Criteria” scale, which has been developed as a means of assessing the long term suitability of urban areas for walking or sitting, accounting for both microclimatic wind effects (i.e. site location and prevailing winds) and microclimatic air movement associated with wind forces influenced by the localised built environment forms and landscaping effects.

The original Lawson Criteria (as described in Building Aerodynamics, Tom Lawson, Imperial College Press, 2001) assesses probability of wind discomfort based on the Beaufort Scale as referenced in Figure 3.1.1.

Figure 3.1.2 illustrates the Lawson Criteria scale, as developed and implemented to the City of London Guidelines as utilised and assessed within the report, which ranges from areas deemed suitable for long term sitting through to regions uncomfortable for pedestrian comfort. “Pedestrian Walking” areas, for example, are defined as areas that would not experience wind velocities in excess of 8m/s for more than 5% of the year, whereas uncomfortable areas would experience averaged wind velocities greater than 10m/s for more than 5% of the year.

The assessment identifies area where potential wind occurrence, based on probability of wind direction and speed, would either be mitigated (Outdoor Dining/ Pedestrian Sitting and Standing) or exacerbated (Business Walking/ Uncomfortable) due to proposed massing from potential developments.

However, it should be noted that in terms of pedestrian comfort, the Lawson Criteria assesses solely for wind/associated air velocity effects. Therefore, other environmental aspects that may influence a space’s microclimate, such as exposure to sunlight and envisaged temperature variation throughout the year are not accounted for within this methodology.

Beaufort Force	Hourly-Average Windspeed m/s	Description of Wind	Noticable Effect of Wind
0	<0.45	Calm	Smoke rises vertically
1	0.45 - 1.55	Light	Direction shown by Smoke drift but not by vanes
2	1.55 - 3.35	Light	Wind felt on faces: leaves rustle: wind vane moves
3	3.35 - 5.60	Light	Leaves and twigs in motion: wind extends a flag
4	5.60 - 8.25	Moderate	Raises dust and loose paper: small branches move
5	8.25 - 10.95	Fresh	Small trees in leaf sway
6	10.95 - 14.10	Strong	Large branches begin to move: telephone wires whistle
7	14.10 - 17.20	Strong	Whole trees in motion

Fig 3.1.1 Beaufort Scale

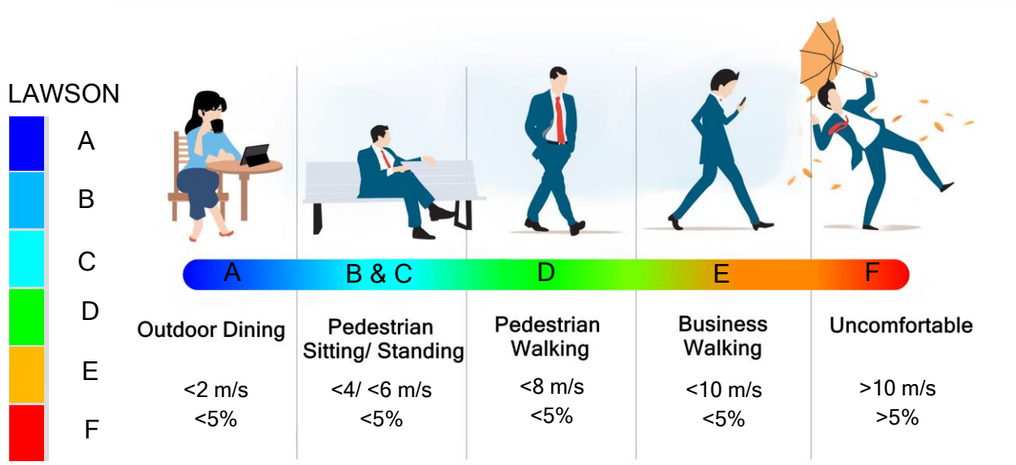


Fig 3.1.2 Lawson Scale

3.0 Pedestrian Comfort

3.2 Ground Level Results

CFD simulations were undertaken to determine the Lawson Criteria results for the proposed development.

Pedestrian comfort at ground level was assessed by predicting Lawson Criteria values at 1.5m above ground level.

Figure 3.2.1 outlines the Lawson Criteria Scale utilised. Blue contours illustrate the most sheltered regions, areas deemed “Suitable for Outdoor Dining”. Light Blue/ Cyan contours indicate regions “Suitable for Pedestrian Sitting” and “Pedestrian Standing” respectively. Green contours indicate areas “Suitable for Pedestrian Walking”, with orange illustrative of being “Suitable for Business Walking”. Red areas highlight zones as “Uncomfortable”.

As per Fig. 3.2.2, conditions at ground level have been determined to be predominantly suitable for “Pedestrian Sitting/ Standing”, as illustrated by blue/ cyan contours.

The results determined that the proposed development does negatively impact on pedestrian comfort conditions at ground level within neighbouring developments.

A	2 m/s	< 5%	Outdoor Dining
B	4 m/s	< 5%	Pedestrian Sitting
C	6 m/s	< 5%	Pedestrian Standing
D	8 m/s	< 5%	Pedestrian Walking
E	10 m/s	< 5%	Business Walking
U	10 m/s	> 5%	Uncomfortable

Fig. 3.2.1 – Lawson Criteria

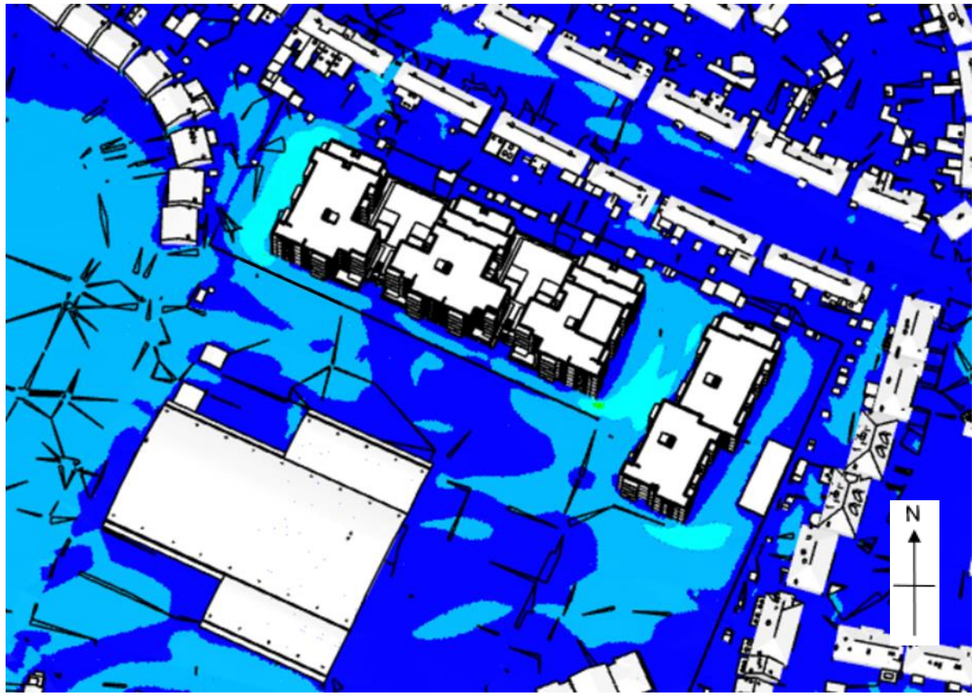


Fig. 3.2.2 – Lawson Criteria Results at 1.5m Above Ground Level

3.0 Pedestrian Comfort

3.3 Podium Level Results

Figure 3.3.2 illustrates results of pedestrian comfort results at podium levels within the proposed development.

Podium levels across the development are predominantly determined by the Lawson methodology utilised to be suitable for “Pedestrian Sitting/ Standing” (light blue/ cyan contours), with some more sheltered regions deemed suitable for “Outdoor Dining” (dark blue contours) towards the outer regions of the courtyards.

Slightly accelerated wind speeds are predicted to occur between Blocks 1 & 2 and Blocks 2 & 3, resulting in pedestrian comfort conditions more suited to “Pedestrian Walking”. However, these wind speeds are not deemed to be excessive, and suited for the intended use of the amenity area.

Overall, the podium level spaces analysed are predicted to be suitable for their intended use as amenity spaces.

A	2 m/s	< 5%	Outdoor Dining
B	4 m/s	< 5%	Pedestrian Sitting
C	6 m/s	< 5%	Pedestrian Standing
D	8 m/s	< 5%	Pedestrian Walking
E	10 m/s	< 5%	Business Walking
U	10 m/s	> 5%	Uncomfortable

Fig. 3.3.1 – Lawson Criteria

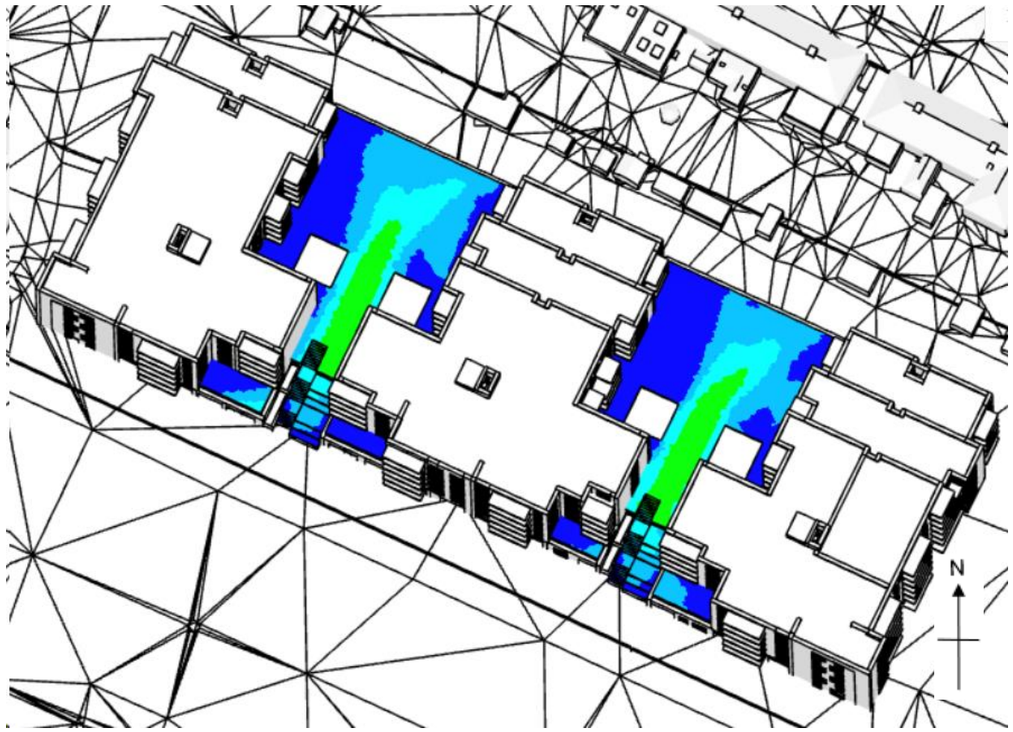


Fig. 3.3.2 – Lawson Criteria Results at Podium Level

3.0 Pedestrian Comfort

3.4 Balcony Level Results – Block 1

All balconies throughout the development were assessed for pedestrian comfort utilising the Lawson Criteria. Figs. 3.4.2 and 3.4.3 illustrate Lawson results for balconies of Block 1.

The analysis determined that all balconies throughout the development were situated in zones suitable for “Outdoor Dining/ Pedestrian Sitting” (blue contours) as defined within the methodology and are therefore well suited to their intended use as private amenity spaces.

A	2 m/s	< 5%	Outdoor Dining
B	4 m/s	< 5%	Pedestrian Sitting
C	6 m/s	< 5%	Pedestrian Standing
D	8 m/s	< 5%	Pedestrian Walking
E	10 m/s	< 5%	Business Walking
U	10 m/s	> 5%	Uncomfortable

Fig. 3.4.1 – Lawson Criteria

Fig. 3.4.2 – Lawson Criteria Results at Balconies of Block 1, view from South

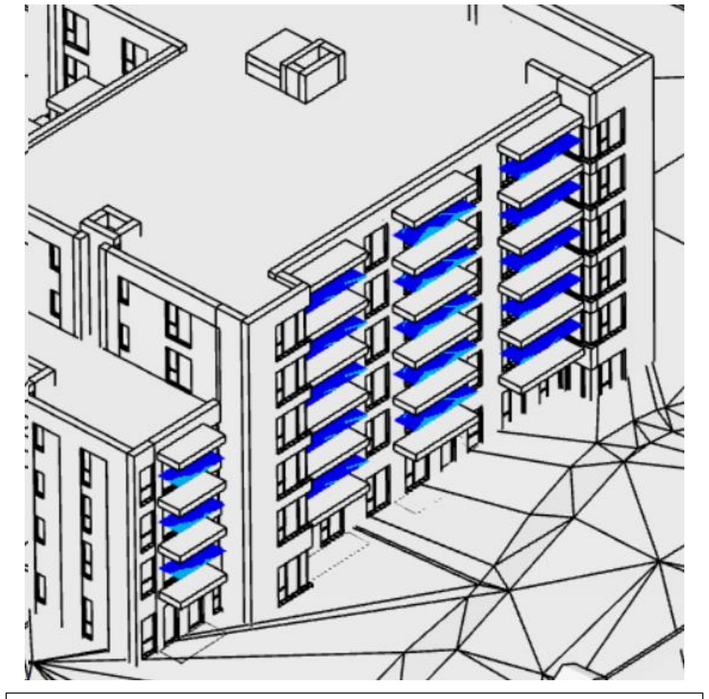


Fig. 3.4.3 – Lawson Criteria Results at Balconies of Block 1, view from North

3.0 Pedestrian Comfort

3.5 Balcony Level Results – Block 2

Figs 3.5.2 – 3.5.4 illustrate Lawson results for balconies of Block 2.

The analysis determined that all balconies are suitable for “Outdoor Dining/ Pedestrian Sitting” (blue contours) as defined within the methodology and are therefore well suited to their intended use as private amenity spaces.

A	2 m/s	< 5%	Outdoor Dining
B	4 m/s	< 5%	Pedestrian Sitting
C	6 m/s	< 5%	Pedestrian Standing
D	8 m/s	< 5%	Pedestrian Walking
E	10 m/s	< 5%	Business Walking
U	10 m/s	> 5%	Uncomfortable

Fig. 3.5.1 – Lawson Criteria

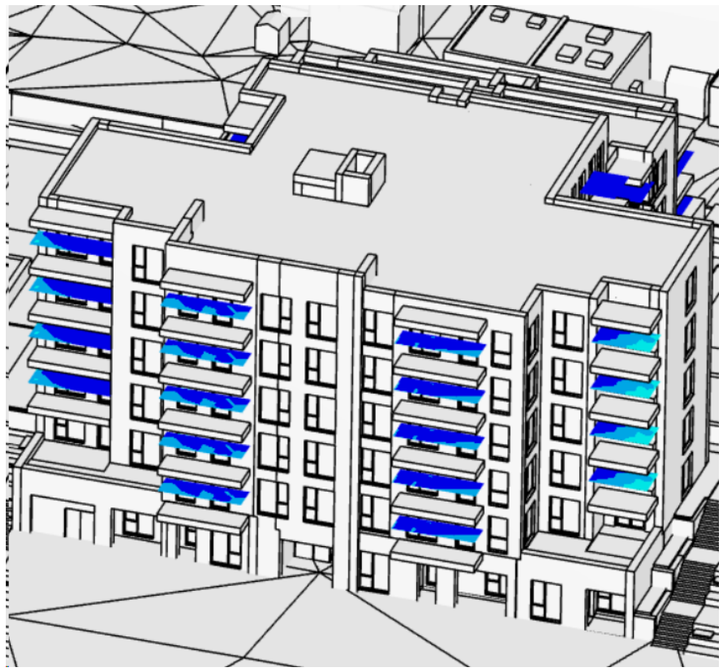


Fig. 3.5.2 – Lawson Criteria Results at Balconies of Block 2, view from South

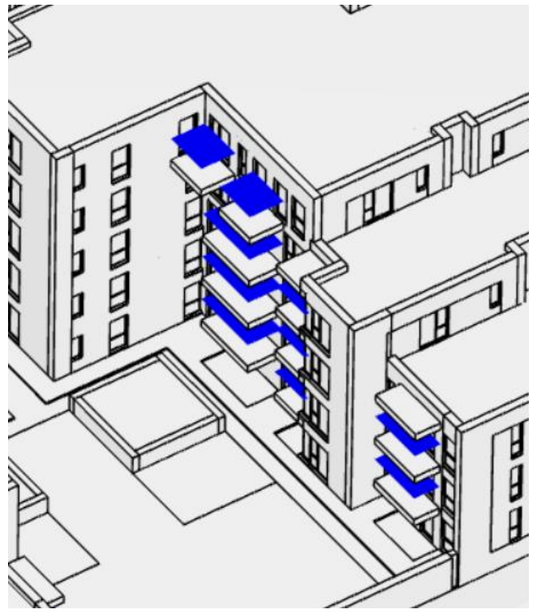


Fig. 3.5.3 – Lawson Criteria Results at Balconies of Block 2, view from Northeast

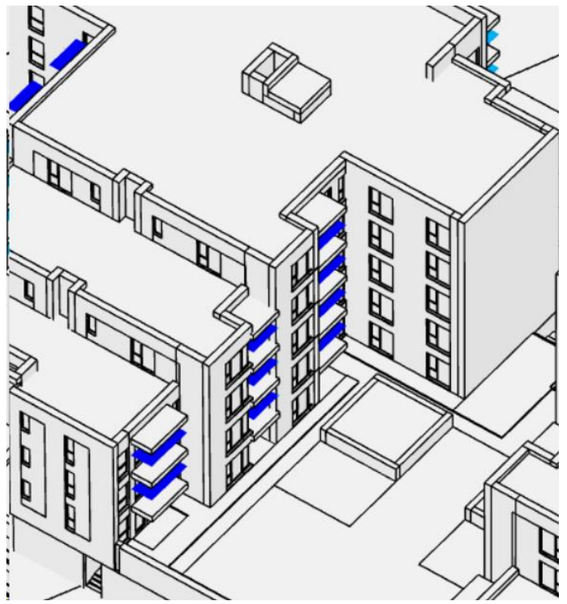


Fig. 3.5.4 – Lawson Criteria Results at Balconies of Block 2, view from Northwest

3.0 Pedestrian Comfort

3.6 Balcony Level Results – Block 3

Figs 3.6.2 – 3.6.3 illustrate Lawson results for balconies of Block 3.

The analysis determined that all balconies throughout the development were situated in zones suitable for “Outdoor Dining/ Pedestrian Sitting” (blue contours) as defined within the methodology and are therefore well suited to their intended use as private amenity spaces.

A	2 m/s	< 5%	Outdoor Dining
B	4 m/s	< 5%	Pedestrian Sitting
C	6 m/s	< 5%	Pedestrian Standing
D	8 m/s	< 5%	Pedestrian Walking
E	10 m/s	< 5%	Business Walking
U	10 m/s	> 5%	Uncomfortable

Fig. 3.6.1 – Lawson Criteria

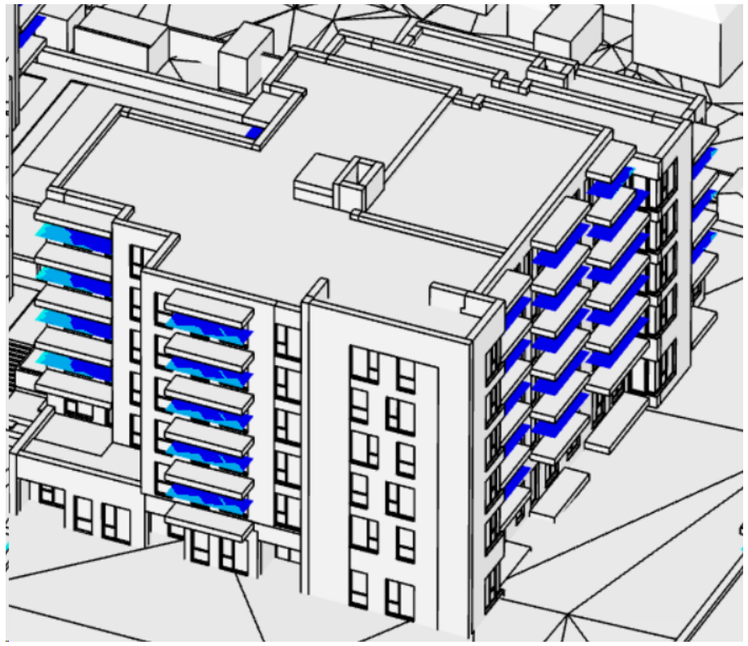


Fig. 3.6.2 – Lawson Criteria Results at Balconies of Block 3, view from South

Fig. 3.6.3 – Lawson Criteria Results at Balconies of Block 3, view from North

3.0 Pedestrian Comfort

3.7 Balcony Level Results – Blocks 4/ 5

Figs 3.7.2 – 3.7.3 illustrate Lawson results for balconies of Blocks 4/ 5..

The analysis determined that all balconies throughout the development were situated in zones suitable for “Outdoor Dining/ Pedestrian Sitting” (blue contours) as defined within the methodology and are therefore well suited to their intended use as private amenity spaces.

A	2 m/s	< 5%	Outdoor Dining
B	4 m/s	< 5%	Pedestrian Sitting
C	6 m/s	< 5%	Pedestrian Standing
D	8 m/s	< 5%	Pedestrian Walking
E	10 m/s	< 5%	Business Walking
U	10 m/s	> 5%	Uncomfortable

Fig. 3.7.1 – Lawson Criteria

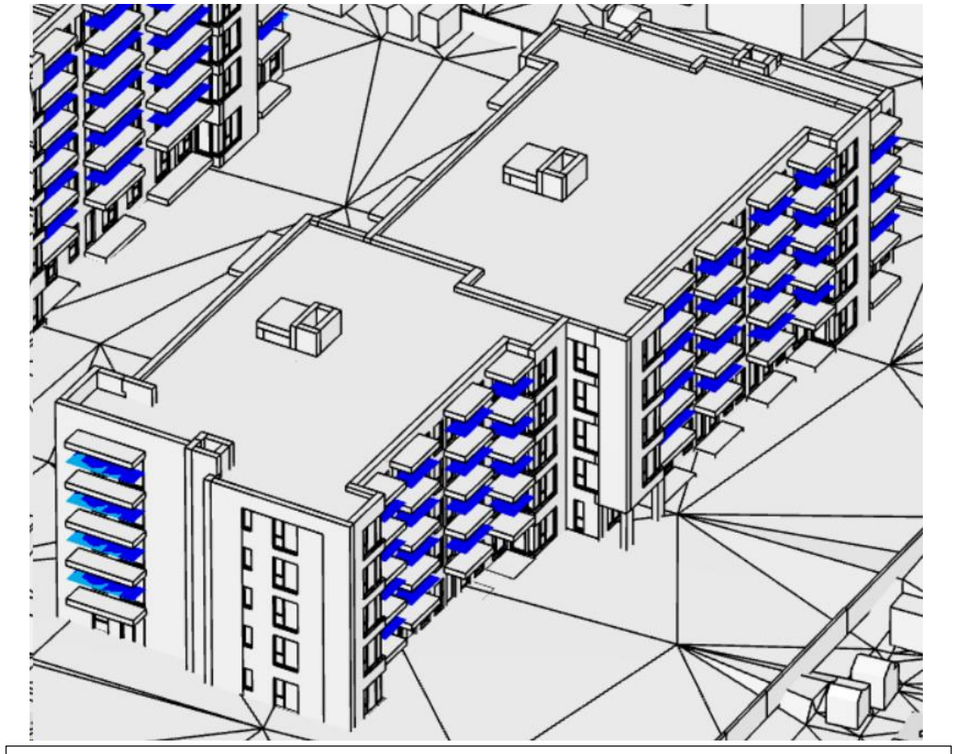


Fig. 3.7.2 – Lawson Criteria Results at Balconies of Blocks 4/ 5, view from South

Fig. 3.7.3 – Lawson Criteria Results at Balconies of Blocks 4/ 5, view from North

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