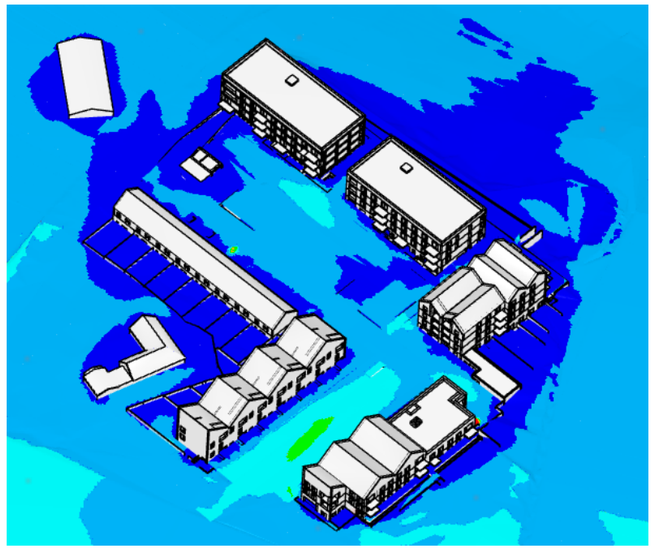
790 Cherrywood,
Co. Dublin



Microclimatic Wind Analysis and Pedestrian Comfort Report

IN2 Project No. D2416

11/04/2024

Revision History

Date	Revision	Description
28/03/2024	00	Issued for Review
11/04/2024	01	Issued For Submission

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 Development at Cherrywood, based on 3D modelling information received from ABK Architects, comprising of assessments for predicted Wind conditions to the local environment.

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.

Wind Analysis was assessed utilising Airflow Simulation techniques through Computational Fluid Dynamics (CFD) Simscale software, for the proposed development as detailed in Section 3.0. This determines regions of positive and negative pressures and associated predicted wind velocities for the proposed development for varying wind speeds and directions.

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 shown in Section 4.0.

The analysis illustrated how conditions for pedestrians at ground level were predicted to be suitable for “Pedestrian Sitting/ Standing” across the majority of the proposed development which presents excellent sheltered conditions for its intended use as outdoor garden and amenity spaces. An area between Block 4 & 5 was predicted to be suited more for “Pedestrian Walking”, however the majority of this occurs on the roadways where there is less pedestrian activity.

All balconies on all Blocks in the proposed development were assessed. All of the balconies were predicted to be suitable for “Outdoor Dining/Pedestrian Sitting”.

Overall, the proposed development was determined to not negatively impact on its receiving environment in terms of wind microclimate.

2.0 Methodology

2.1 Wind Analysis

In order to determine the predicted wind patterns around the proposed development, airflow simulations were undertaken using Computational Fluid Dynamics (CFD) software (Simscale). 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, including representation of both natural landscaping such as hills, ridges, as well as 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. The identified site in Cherrywood, Dublin is also seen to be an area of relatively high wind speeds as highlighted in Fig 2.1.1.

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 "Low Crops, occasional large obstacles (z_0=0.1m height)" was utilised, derived from GIS survey analysis[1].

Figures 2.1.2 and 2.1.3 indicates the modelled long-term annual "Wind Rose" obtained from the Global Wind Atlas for the site at Cherrywood. 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 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.

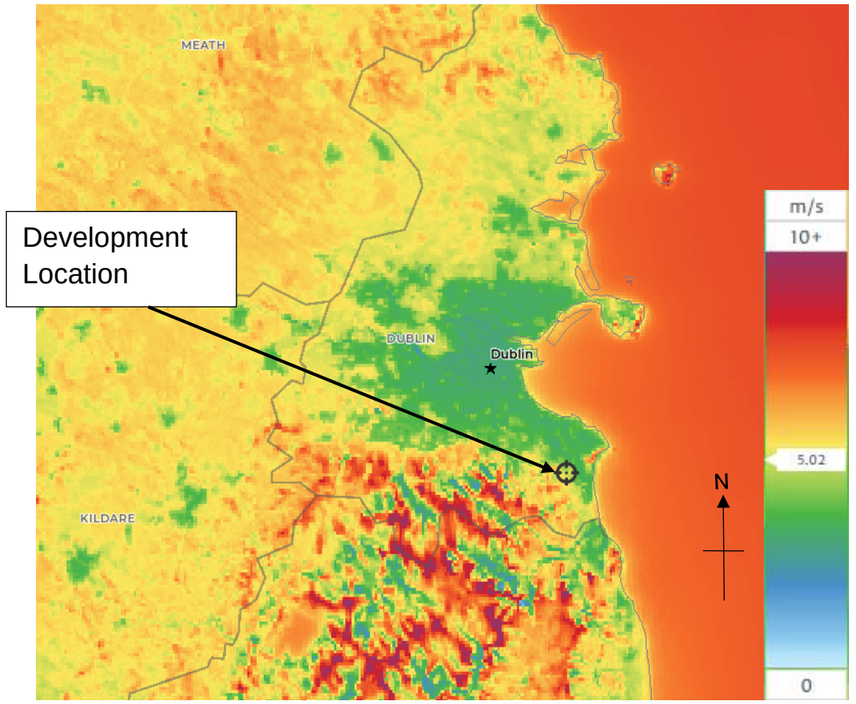


Fig 2.1.1 – Mean Wind Speeds across Dublin – Global Wind Atlas

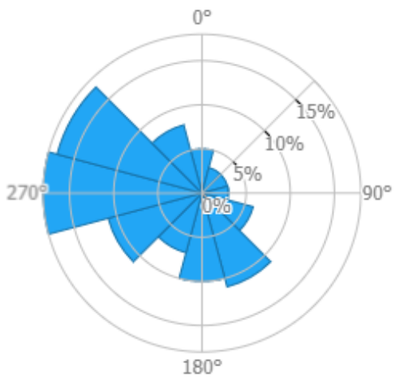


Fig 2.1.2 – Wind Frequency Rose for Cherrywood – Global Wind Atlas

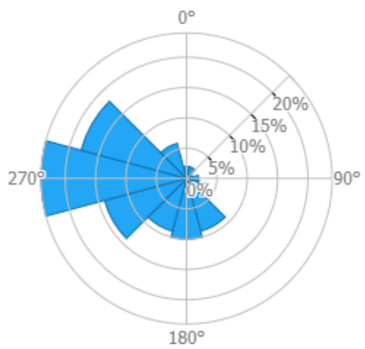


Fig 2.1.3 – Wind Speed Rose for Cherrywood – Global Wind Atlas

2.0 Methodology

2.1 Wind Analysis (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 2.2 below.

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 W 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)). There are currently no Irish or European Standards for Pedestrian Comfort.

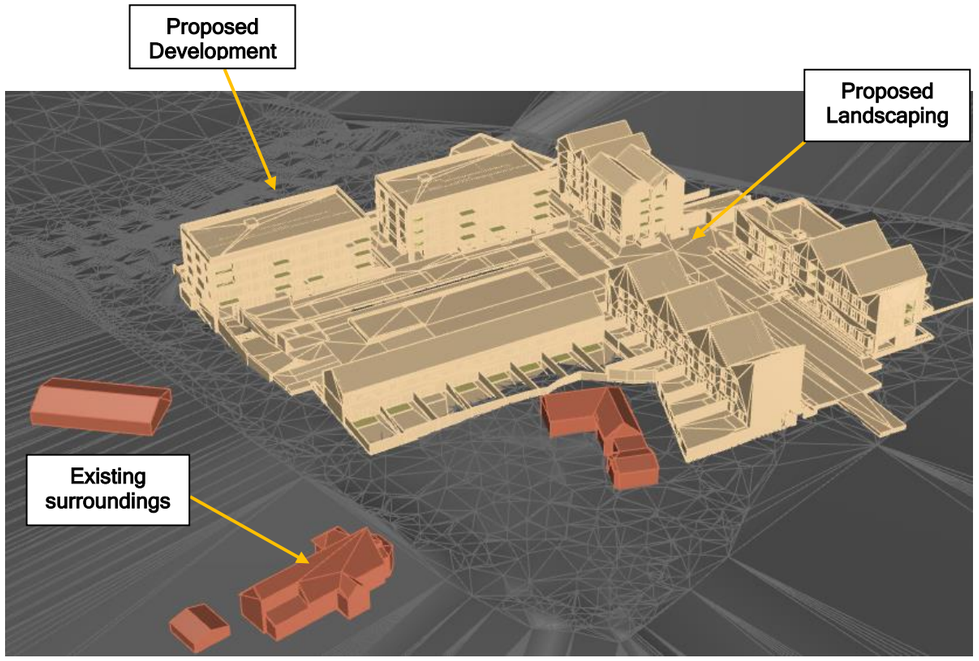


Fig 2.1.4 – 3D Model of Proposed Cherrywood Development and Neighbouring buildings

2.0 Methodology

2.2 Pedestrian Comfort

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 2.2.1.

Figure 2.2.2 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 areas 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 2.2.1 Beaufort Scale

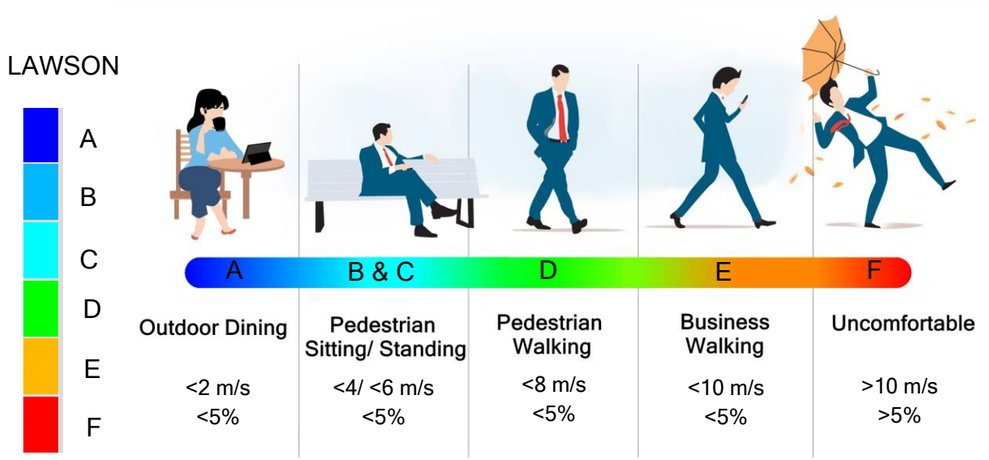


Fig 2.2.2 Lawson Scale

3.0 Wind Analysis

3.1 270° Wind Analysis Results – Wind Pressures and Velocities

Figures 3.1.1 and 3.1.2 illustrate the predicted wind pressures and velocities across the development under prevailing 270° (West) wind direction at 1.5m above ground level with the proposed landscaping design.

The wind pressures in Fig 3.1.1 exhibit high-pressure zones forming at the West facades of Blocks and zones of low-pressure is seen on the East façades. Air will flow from a region of high pressure to low pressure, as illustrated by the vector arrows. Therefore, the regions with pressure differences will show prevailing winds being accelerated around corners.

Fig 3.1.2 displays the prevailing winds flowing in from the western front. The majority of the wind speeds around the development are predicted to be relatively benign. There is one accelerated wind reign seen, between Block 4 & 5, however, the majority of this occurs on the roadway where there is minimal pedestrian activity.

These CFD simulations form the basis of the Pedestrian Comfort Analysis undertaken, which is described in Section 4.0

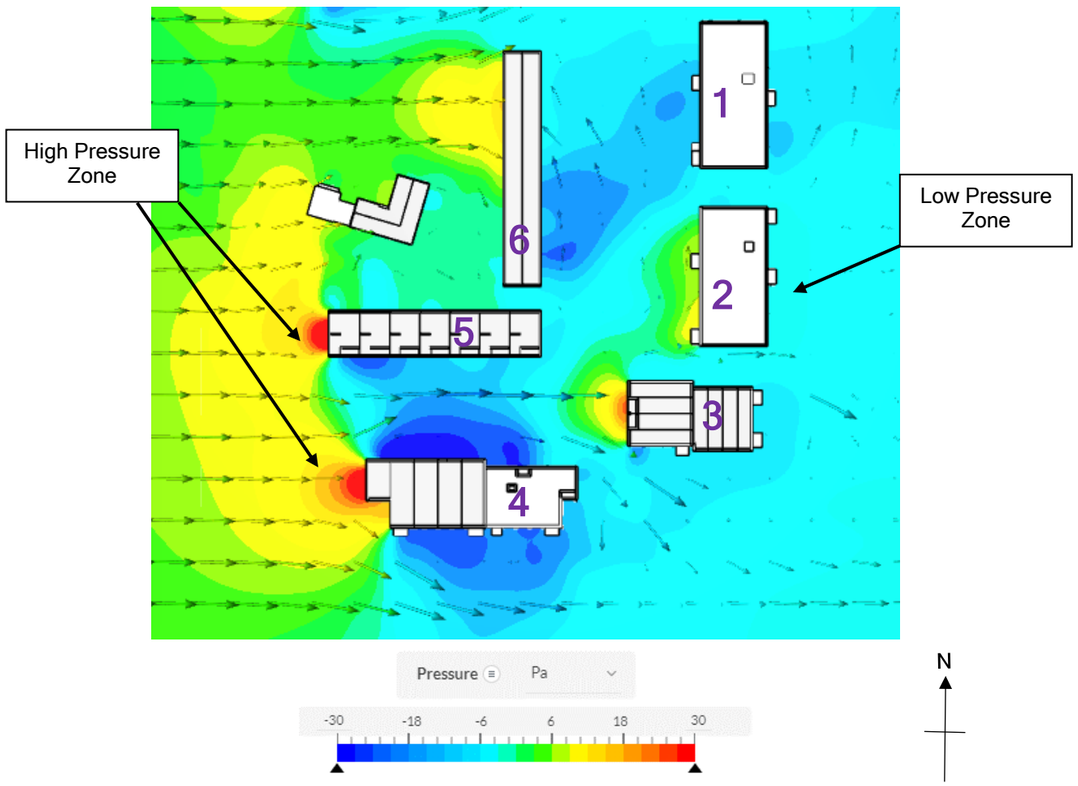


Fig. 3.1.1 - Wind Pressures at 1.5m Above Ground Level

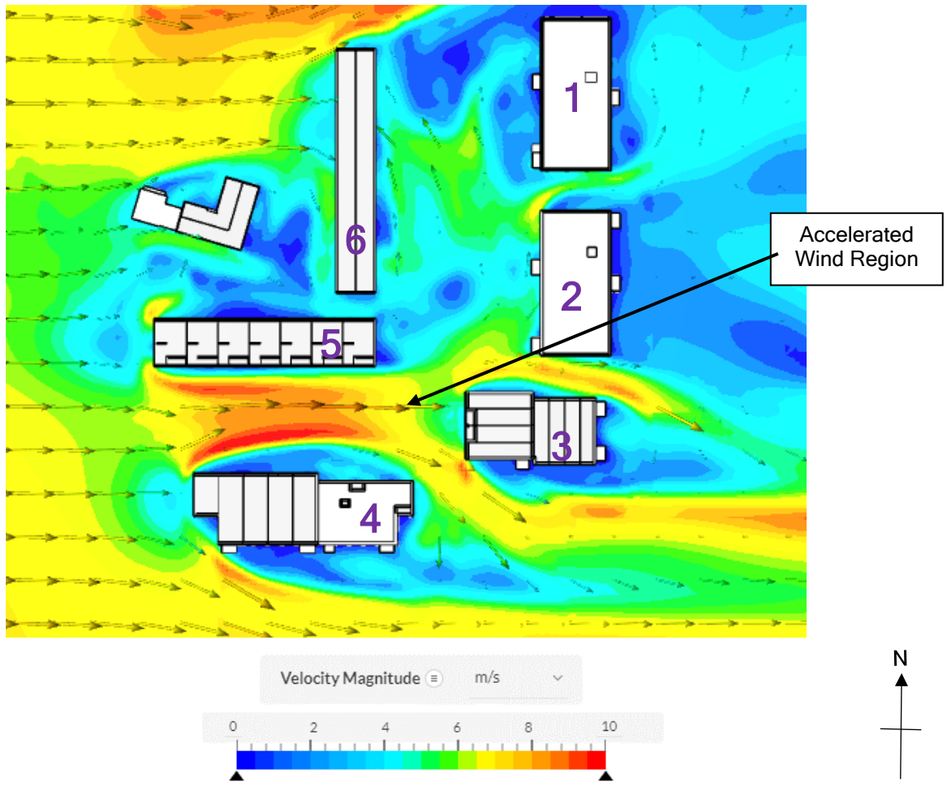


Fig. 3.1.2 - Wind Velocities at 1.5m Above Ground Level

4.0 Pedestrian Comfort

4.1 Ground Level

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.

The scale in Fig 4.1.1 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”.

Figure 4.1.2 illustrated the Lawson Criteria across the proposed development. The majority of the site is determined to be predominantly suited to “Pedestrian Sitting/Standing” with well sheltered areas around Block 5 & 6 that are suited to “Outdoor dining”. This is well suited to its intended use as outdoor garden amenity spaces.

As highlighted, the region between Block 4 & 5 is deemed suited to “Pedestrian Walking”. However, most of this occurs on the roadway where there is minimal pedestrian activity.

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. 4.1.1 – Lawson Criteria

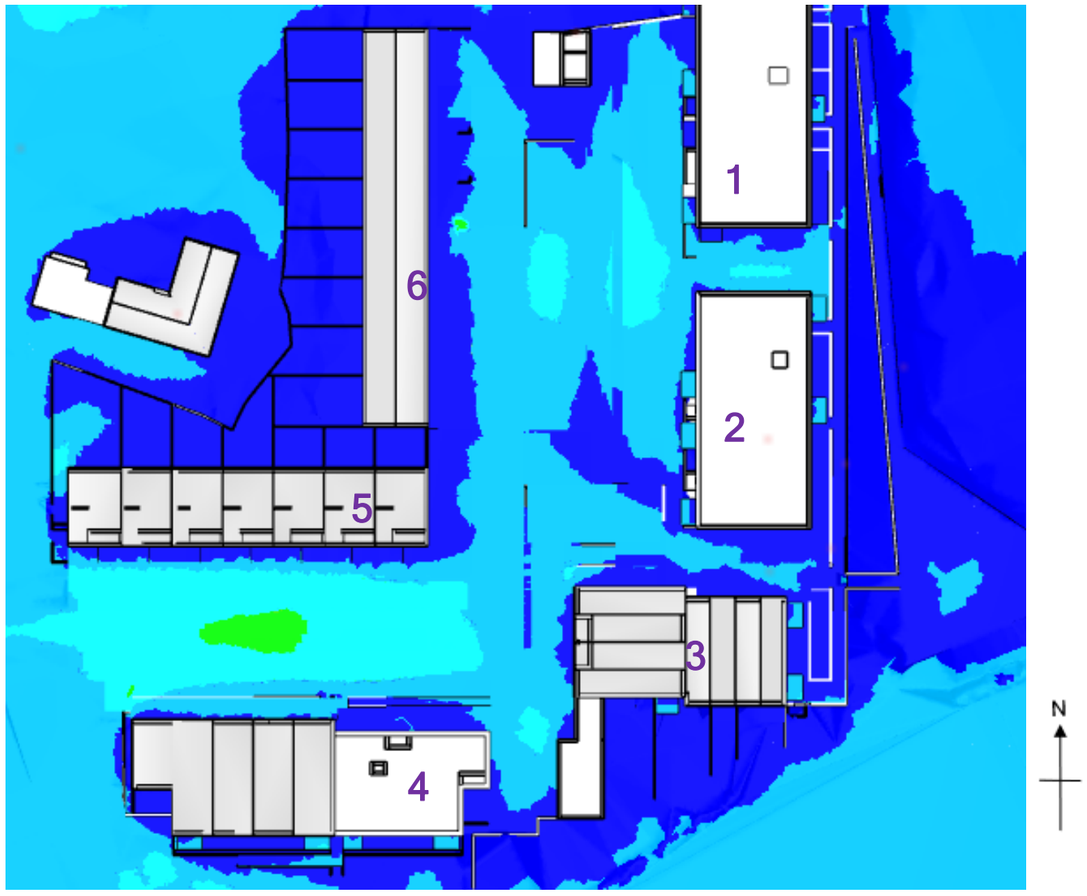


Fig. 4.1.2 – Lawson Criteria Across the Proposed Development

4.2 Balconies

All balcony amenity spaces across the proposed development were assessed for pedestrian comfort by predicting the Lawson Criteria at 1.5m above each balcony.

The scale in Figure 4.2.1 outlines the Lawson Criteria Scale utilised. Blue contours suitable for “Outdoor Dining” illustrate the most sheltered regions. Light Blue/Cyan contours show suitability for “Pedestrian Sitting” and “Pedestrian Standing” respectively.

All balconies across the site are determined to be suitable for “Outdoor Dining/Pedestrian Sitting”.

Any balconies with railings have been analysed as such, as per architectural design, as seen in Fig 4.2.3. From an airflow perspective, railings are effectively “open”, and do not provide any wind shelter to balconies. Some balconies were designed with part solid screening to provide shelter and mitigate wind conditions.

Fig. 4.2.2 – View direction

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. 4.2.1 – Lawson Criteria

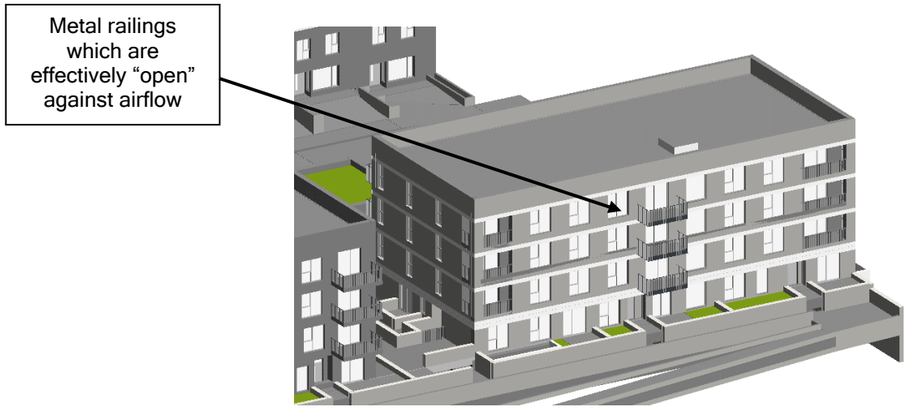


Fig. 4.2.3 – Balcony Design

Fig. 4.2.1 – Block 1 – East Facade

Fig. 4.2.2 – Block 1 – West Facade

Fig. 4.2.3 – Block 2 – East Facade

Fig. 4.2.4 – Block 2 – West Facade

Fig. 4.2.5 – Block 3 – East Facade

Fig. 4.2.6 – Block 3 – South Facade

Fig. 4.2.7 – Block 3 – West Facade

Fig. 4.2.8 – Block 4 – West Facade

Fig. 4.2.10 – Key Plan

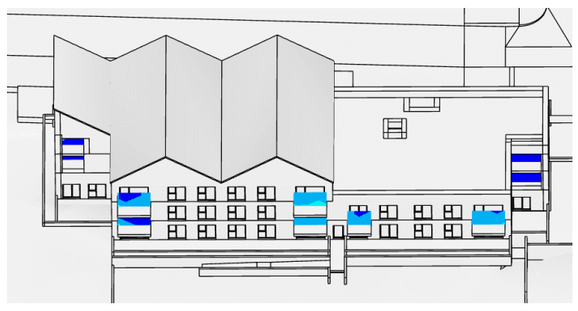


Fig. 4.2.9 – Block 4 – South Facade

IN2 Engineering Design
Unit E&F
Mount Pleasant Business Park
Upper Mount Pleasant Avenue
Dublin 6
(01) 496 0900

info@in2.ie