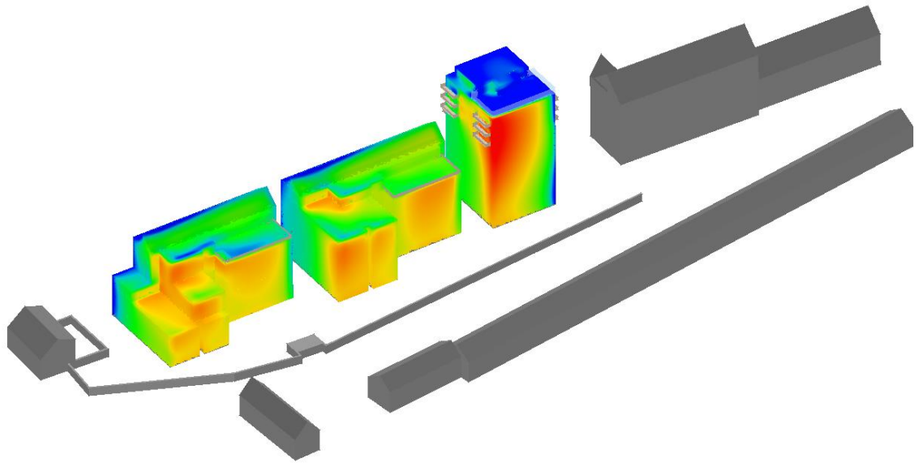
Crossguns Bridge Residential,

Phibsborough,
Dublin 7



Microclimatic Wind Analysis and Pedestrian Comfort Report

IN2 Project No. D2062
15/01/2021
REV02

Revision History

Date	Revision	Description
19/11/2020	00	Initial issue for review
01/12/2020	01	Updated to address comments
15/01/2021	02	Updated Figures

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1.0 Executive Summary

This report compiles the results of Microclimatic Wind Analysis undertaken by IN2 Engineering Design Partnership for the Proposed Crossguns Bridge Residential development in Phibsborough, Dublin 7, comprising of assessments for predicted Wind conditions to the local and surrounding 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.

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, with the Proposed Development found to be generally well sheltered.

These wind simulations were then compiled and assessed against Lawson Criteria Methodology- an assessment method for Pedestrian Comfort adopted internationally as National Standards/ City Guidelines (Netherlands/ London respectively) that enables utilisation of recorded meteorological station data of annual hourly averaged wind speed and direction (in this case from Dublin Airport), terrain effects, surface roughness and the form of the proposed built environment in order to predict activity suitability (sitting/ standing etc.) for persons in the vicinity of the development.

This analysis undertaken identified that the proposed development was determined to not introduce any adverse wind effects to the receiving environment.

The majority of ground level amenity spaces across the proposed development are determined to be suited to “Long/Short Term Sitting” in accordance with the Lawson Criteria methodology utilised.

Similarly, all roof terrace amenity spaces and balconies are deemed to be suited to “Long/Short Term Sitting”, and therefore well suited to their intended use as amenity spaces. Minor mitigation measures in the form of 2m balustrades are required at Level 11 roof terrace, as detailed in Section 3.3.

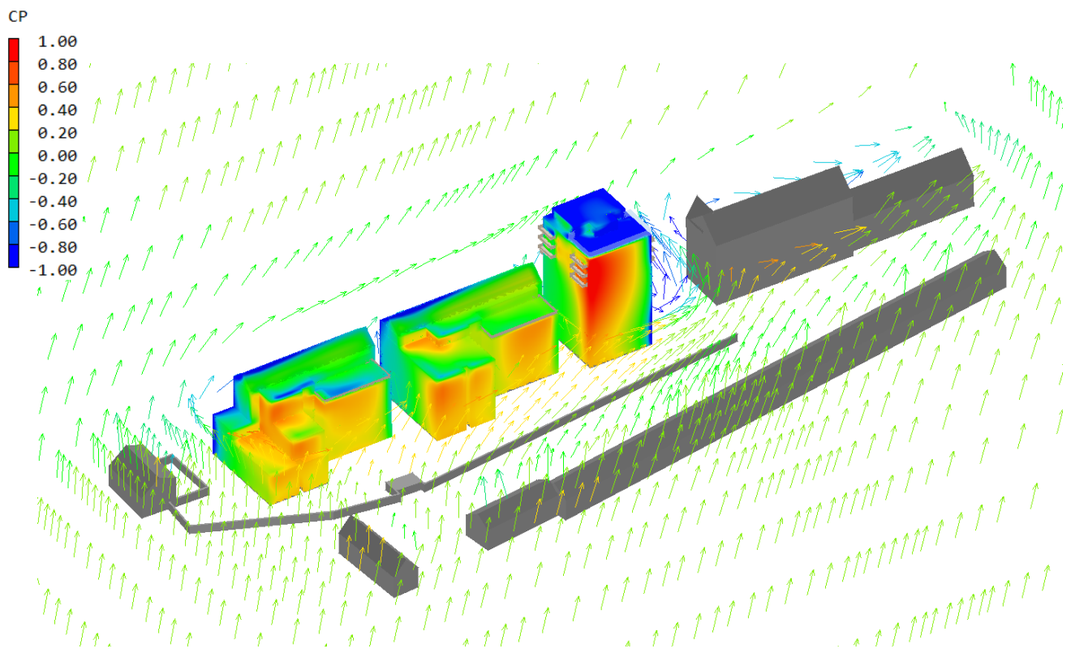

Fig 1.1 – Surface Pressure Coefficients on Proposed Crossguns Development

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 proposed buildings and their immediate surroundings was created, and simulations undertaken for 12 cardinal wind directions.

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].

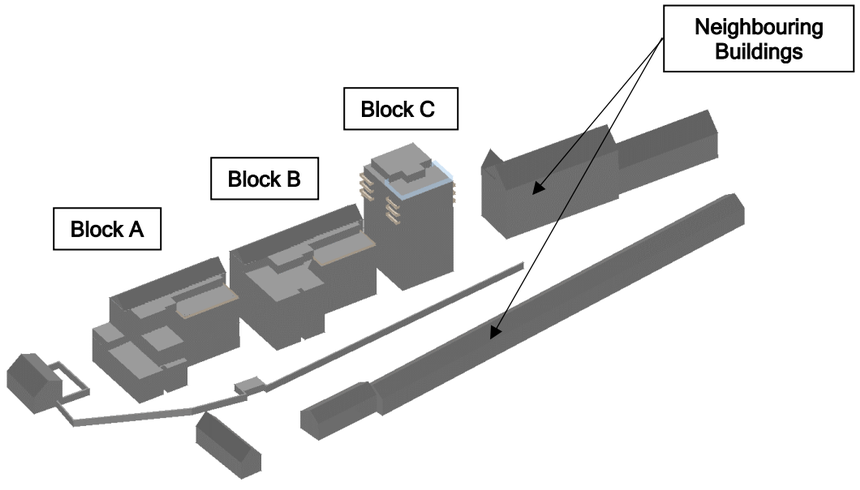

Fig 2.1.1 – 3D Model of Proposed Crossguns Development

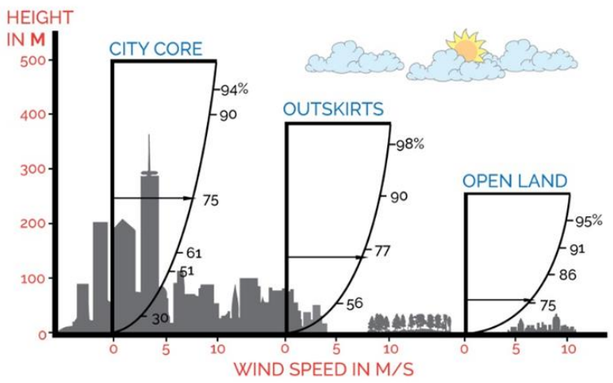

Fig 2.1.2 – Wind Profiles accounting for Terrain Effects

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

2.0 Wind Analysis

2.2 Results

Figure 2.2.1 indicates predicted pressure co-efficient contours for the prevailing 240° wind direction. Red contours indicate regions of positive pressure, green as neutral and blue negative.

Pressure co-efficients across the development are not excessive, with no regions of extreme positive or negative pressures.

Figure 2.2.2 illustrates predicted wind velocities across the development, at 10m above ground level, under prevailing wind conditions.

Wind speeds are predicted to be relatively low, with some acceleration of air around the corners of buildings, but not resulting in adverse wind conditions.

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

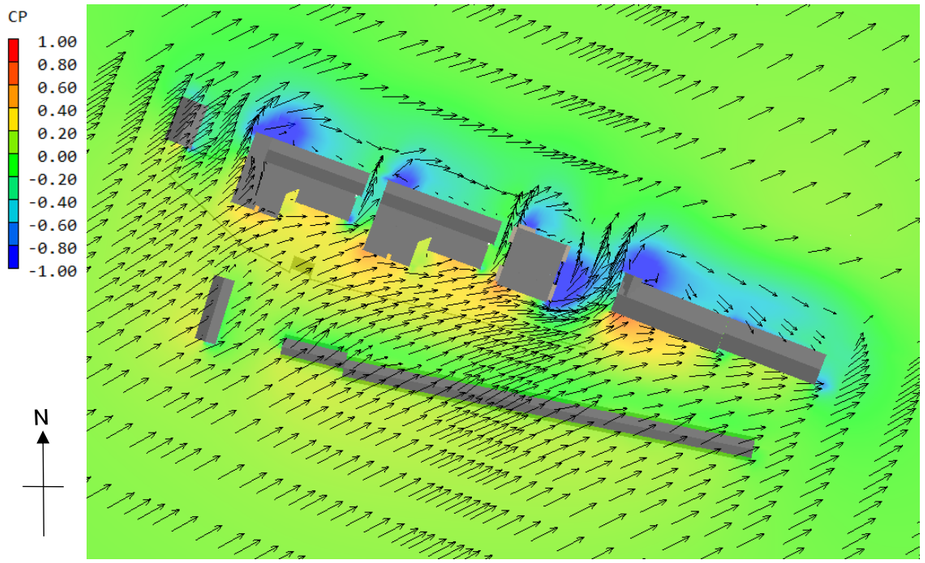

Fig 2.2.1 - Pressure Coefficients at 10m above Ground Level

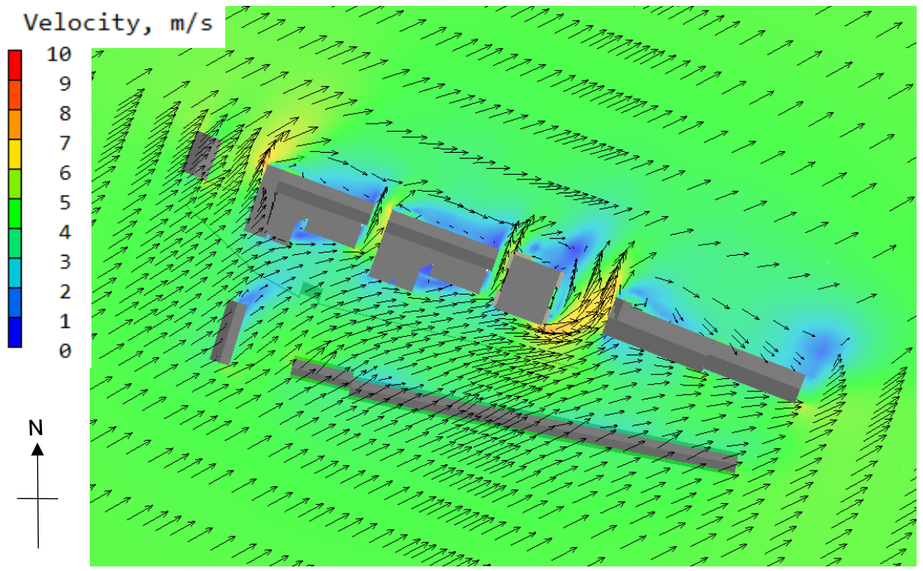

Fig. 2.2.2 Wind Velocity at 10m above Ground Level

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 form.

Figure 3.1.1 illustrates the Lawson Criteria scale, which ranges from areas deemed suitable for long term sitting through to regions uncomfortable for pedestrian comfort. Walking leisurely areas, for example, are defined as areas that would not experience wind velocities in excess of 5.3m/s for more than 2% of the year, whereas uncomfortable areas would experience averaged wind velocities greater than 7.6m/s for more than 2% of the year.

The 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 3.1.2.

The band indicated as “Suitable for short term sitting / standing” (cyan contours) corresponds to that of that for the vast majority of time (94%) throughout the year, winds will be “Light” at a Beaufort Force of B3 (average hourly wind speeds 3.35-5.60 m/s) defined as “Leaves and twigs in motion: wind extends a flag”. For only 4% of the time are average winds predicted to be in excess of this: i.e. “Moderate” B4 Beaufort Force described as “Raises dust and loose paper: small branches move”.

The assessment identifies area where potential wind occurrence, based on probability of wind direction and speed, would either be mitigated (long term sitting/ short term sitting) or exacerbated (walking fast / 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.

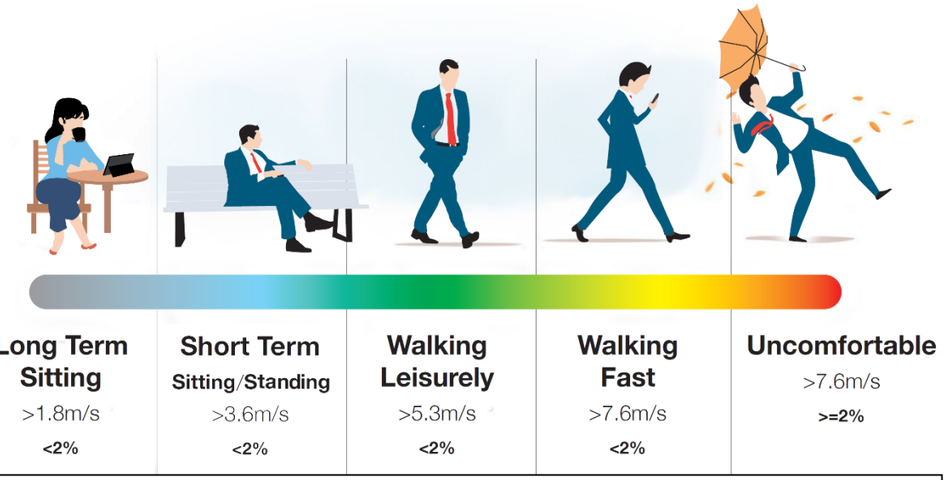

Fig 3.1.1 Lawson Scale

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

	USE SYMBOL	UNACCEPTABLE	TOLERABLE	CRITERIA
Roads and Car Parks	A	6% > B5	2% > B5	10 9
People Around Buildings	B	2% > B5	2% > B4	9 7
Pedestrian Walk-through	C	4% > B4	6% > B3	8 6
Pedestrian Standing	D	6% > B3	6% > B2	6 4
Entrance Doors	E	6% > B3	4% > B2	6 3
Sitting	F	1% > B3	4% > B2	5 3

Fig 3.1.2 Beaufort Scale and Classic Wind Comfort Definitions

3.0 Pedestrian Comfort

3.1 Methodology (Cont'd)

In terms of microclimate assessment, wind data for the nearest meteorological station at Dublin Airport was utilised. Analysis is based on frequency of hourly wind speeds and direction data included in European Wind Atlas for Dublin Airport. Wind data and subsequent analysis is therefore based on hourly averages and does not include for example, intermittent gusting effects.

Figure 3.1.3 indicates the long-term annual "Wind Rose" for Dublin Airport. The rose diagram illustrates 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. Recorded wind speeds are also high- in what is one of Europe's windier meteorological weather stations.

Furthermore, higher wind speeds (which accentuate pedestrian discomfort) occur for prevailing Westerly conditions and therefore will predominate in terms of the potential impact on pedestrian comfort as analysed 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 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 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)).

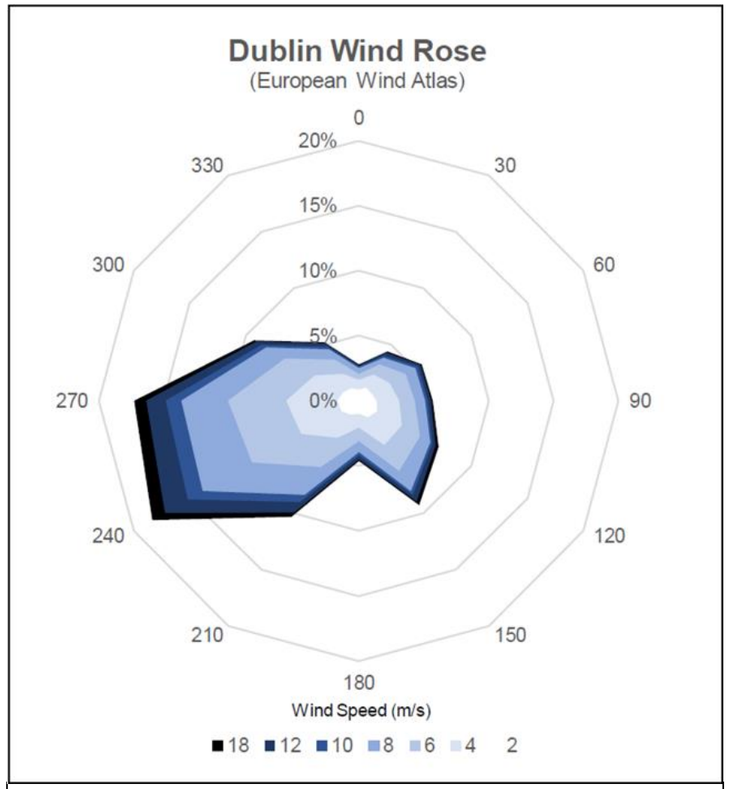

Fig. 3.1.3 - Dublin Wind Rose

3.2 Pedestrian Comfort

3.2 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.

Grey/ cyan contours illustrate areas deemed “Suitable for Long Term Sitting” and “Suitable for Short Term Sitting” respectively as well as standing. Green contours indicate areas “Suitable for Walking and Strolling”, with yellow illustrative of being “Suitable for Business Walking”. Red areas highlight zones as “Not Suitable for Pedestrian Comfort”.

Fig. 3.2.1 and 3.2.2 indicate sheltered wind conditions at ground level, with the majority of the site determined by the methodology to be suitable for “Short/Long Term Sitting”.

As illustrated by grey/blue contours, the proposed development does not unduly impact on wind or pedestrian comfort conditions within neighbouring Royal Canal Way.

The analysis undertaken therefore determined that pedestrian comfort throughout the site could be expected to be good. The proposed development is determined to not negatively impact on neighbouring buildings, or its surroundings.

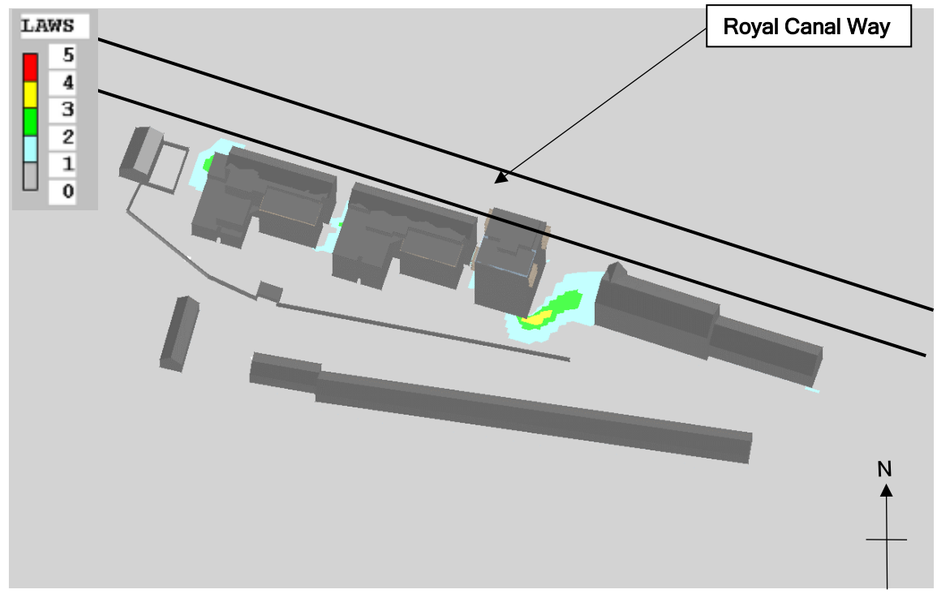

Fig. 3.2.1 - Lawson Criteria at 1.5m above Ground Level – 3D View

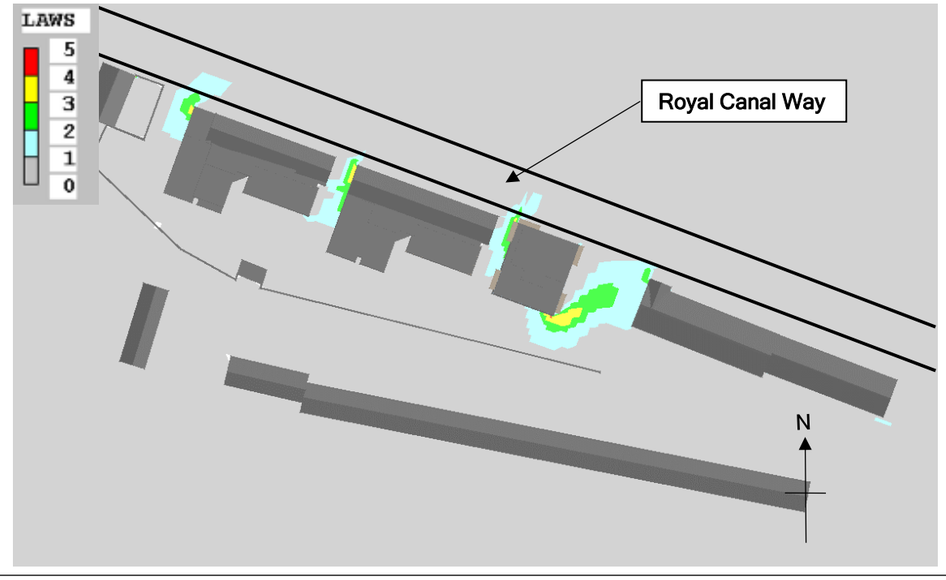

Fig. 3.2.2 - Lawson Criteria at 1.5m above Ground Level – Plan View

3.0 Pedestrian Comfort

3.3 Roof Terrace 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 roof terrace levels on the 6th and 11th floor levels.

Grey/ cyan contours illustrate areas deemed “Suitable for Long Term Sitting” and “suitable for standing or short term sitting” respectively as well as standing. Green contours indicate areas “Suitable for Walking and Strolling”, with yellow illustrative of being “Suitable for Business Walking”. Red areas highlight zones as “Not Suitable for Pedestrian Comfort”.

Fig. 3.3.1 indicates generally good wind conditions at roof terrace levels, with practically all of the proposed spaces determined by the methodology to be suitable for “Short/Long Term Sitting”.

As per Fig 3.3.2 and 3.3.3, the integration of a 2m high balustrade, rather than 1m high, aids in mitigating uncomfortable wind conditions at Level 11 roof terrace level, breaking up the flow of air, and deflecting winds away from the occupied zone. Without this mitigation measure a significant area of the roof terrace would be deemed suitable for standing but not sitting, but with a higher balustrade height, all of the roof terrace is determined to be suitable for sitting.

The analysis undertaken therefore determined that pedestrian comfort across each of the roof terraces within the proposed development could be expected to be favourable, and these amenity spaces would be well suited to their intended use.

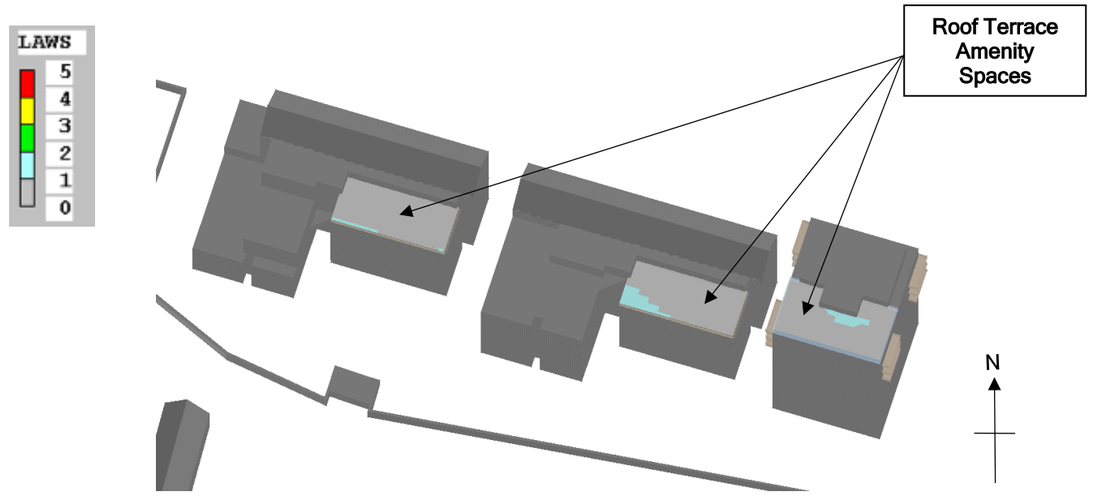

Fig. 3.3.1 - Lawson Criteria at 1.5m above Rooftop Level

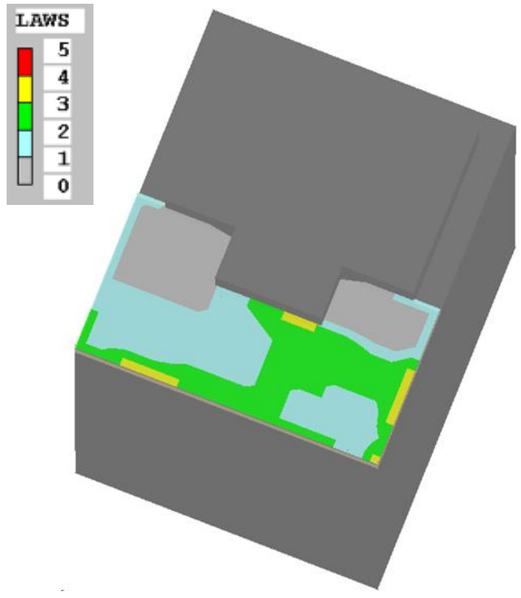

Fig. 3.3.2 – Block C Level 11 Roof Terrace – 1m Balustrade

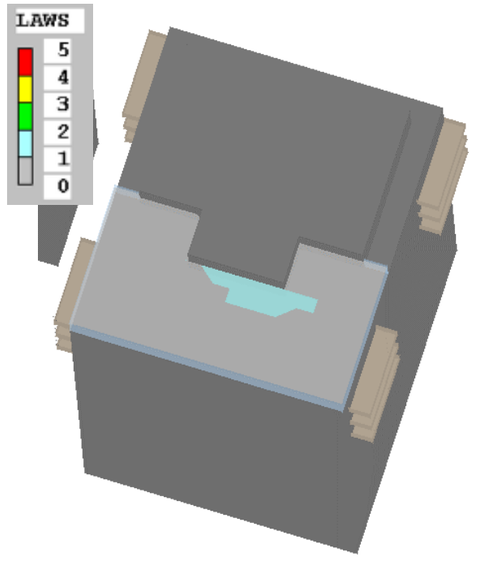

Fig. 3.3.3 – Block C Level 11 Roof Terrace – 2m Balustrade

3.0 Pedestrian Comfort

3.4 Balconies

Pedestrian comfort was assessed for all balconies within the proposed development, by predicting Lawson Criteria values at 1.5m above each balcony.

Grey/ cyan contours illustrate areas deemed “Suitable for Long Term Sitting” and “Suitable for Short Term Sitting” respectively as well as standing. Green contours indicate areas “Suitable for Walking and Strolling”, with yellow illustrative of being “Suitable for Business Walking”. Red areas highlight zones as “Not Suitable for Pedestrian Comfort”.

Fig. 3.4.1 illustrates results for the 11th floor balconies on Block C, representative of the “worst case scenario” for balconies across the development, with all others at lower levels predicted to experience similar or better wind conditions.

As illustrated by grey/blue contours, the proposed balconies have been determined to be suited to “Long/Short Term Sitting”.

All winter gardens on the north-facing facades of each block are well sheltered by the building massing and are predicted by the methodology utilised to experience comfortable wind conditions, suitable for sitting, in both their “open” and “closed” configurations.

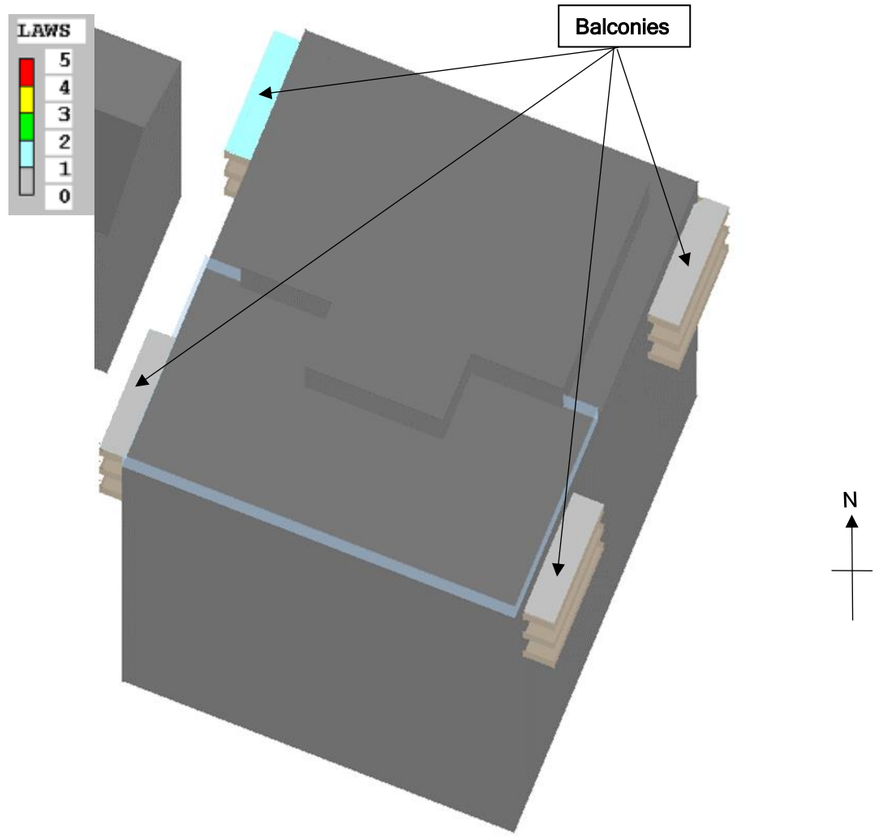

Fig. 3.4.1 - Lawson Criteria at 11th Floor Level Balconies – 3D View

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