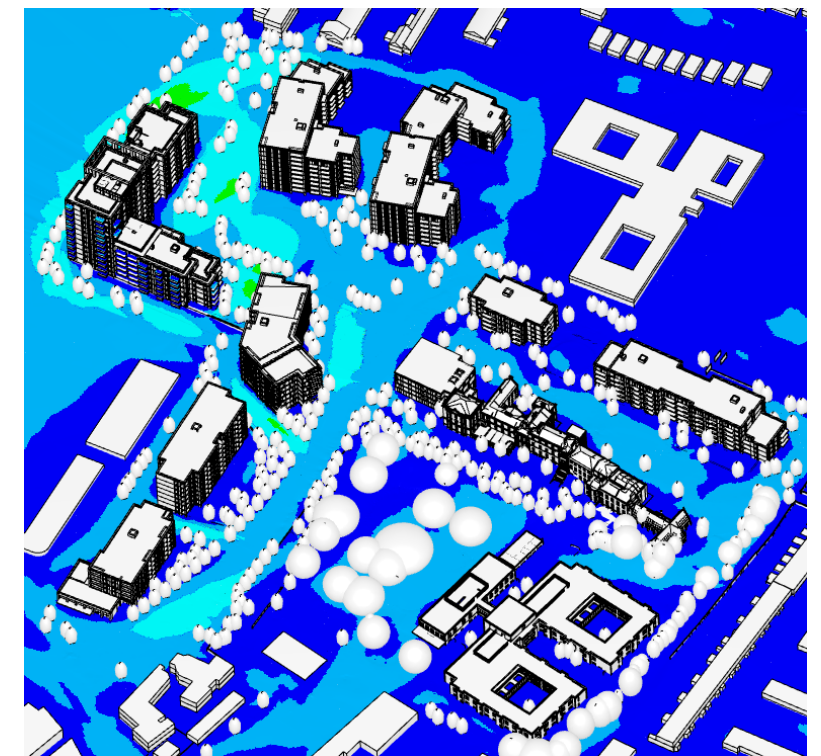


St Vincent's Hospital Redevelopment, Fairview, Dublin 3



Microclimatic Wind Analysis and Pedestrian Comfort Report

IN2 Project No. D2116

24/02/2023

REV00

Revision History

Date	Revision	Description
24/02/2023	00	Issued for Planning Review

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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 mixed use and mental health facility development at St Vincent's, Fairview based on 3D modelling information received from Scott Tallon Walker Architects, comprising of assessments for predicted Wind conditions to the local environment.

The proposed development site is located in a suburban area to the north of Dublin City Centre. The site terrain is primarily low lying with suburban housing to the north, east and south of the proposed development. There are sports fields and open parklands to the southwest and west of the site which opens the proposed development to the prevailing westerly winds.

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 the prevailing westerly winds.

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 "Outdoor Dining/Pedestrian Sitting" across the majority of the proposed development which presents excellent sheltered conditions for its intended use as amenity spaces. Certain regions around Building DE were predicted to be slightly less comfortable as they were suited more for "Pedestrian Walking".

The outdoor seating area between Building DE and C was identified to require a wind mitigation measure, the original design presented conditions suited predominantly to "Pedestrian walking" which was less desirable for its intended use. Many design options were looked in conjunction with Scott Tallon Walker and Niall Montgomery & Partners.

The final solution used strategically places landscaping and hedging to now provide more comfortable conditions for the seating areas.

Roof terrace level amenity spaces were also assessed for pedestrian wind comfort. The report confirms that all roof terrace amenity spaces on Buildings C and DE assessed are determined to be predominantly suitable for "Outdoor Dining" and are therefore suitable for their intended use.

The balconies on all buildings in the proposed site were assessed. Originally with the exception of 10 balconies on Building DE, the remaining balconies were predicted to be suitable for "Outdoor Dining". The 10 balconies on the SW façade of Building DE, outlined in Section 4.13, were determined to be suitable for "Pedestrian Standing/ Walking", and therefore uncomfortable for their intended use.

1.1m high solid balustrades were assessed as part of the design solution and found to have significantly improved the pedestrian comfort of those balconies to be primarily suitable for "Outdoor Dining". The final design now incorporated these into the building design and provides comfortable sheltered conditions.

Overall, the proposed development was determined to not negatively impact on its receiving environment in terms of wind microclimate, allowing for the mitigation measures that were identified through the process of analysing microclimatic effects.

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, 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 Fairview is identified, which is an area relatively sheltered on a macro level, situated to the north 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 ($z_0=0.4\text{m}$ height)" was utilised, derived from GIS survey analysis¹.

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 Fairview. 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.

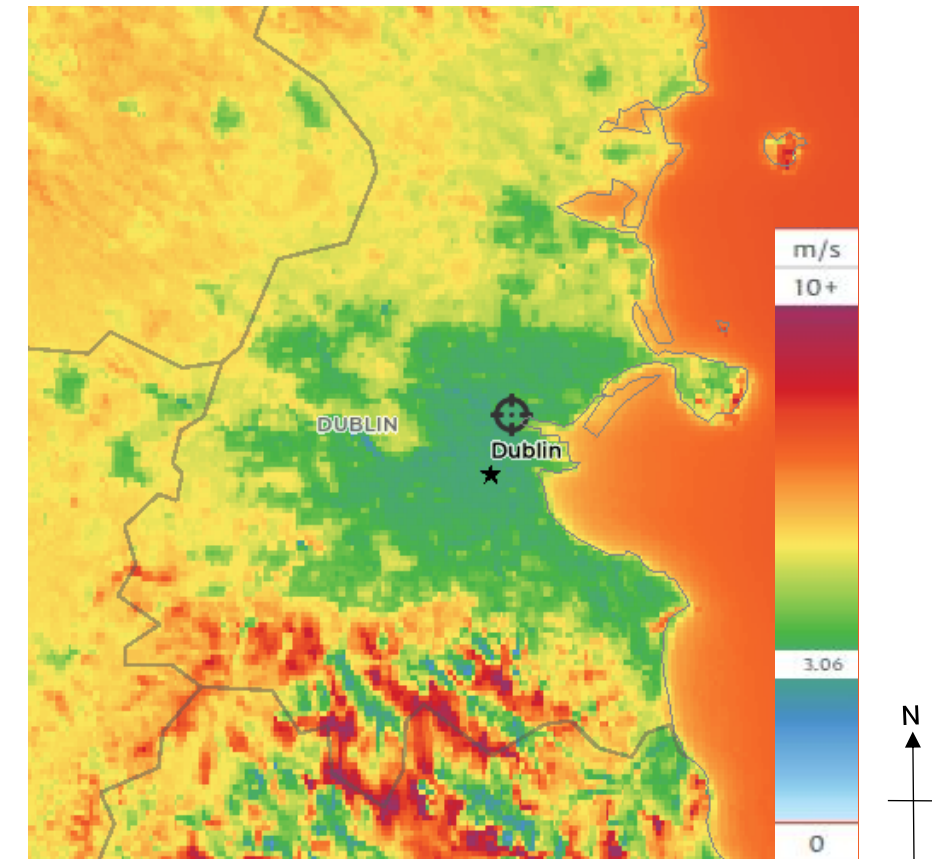


Fig 2.1.1 – Mean Wind Speeds across Dublin – Global Wind Atlas

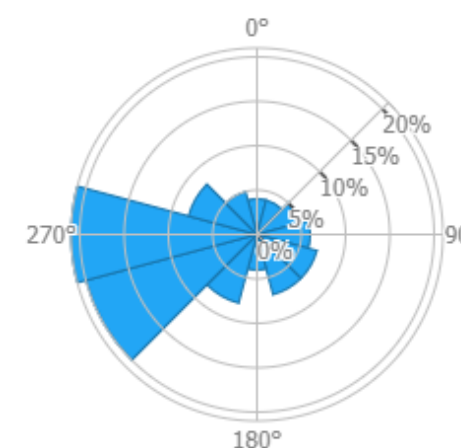


Fig 2.1.2 – Wind Frequency Rose for Fairview – Global Wind Atlas

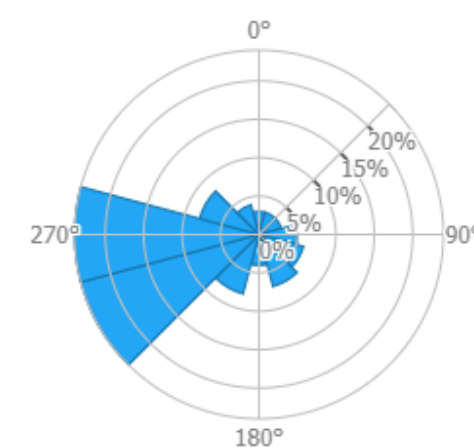


Fig 2.1.3 – Wind Speed Rose for Fairview – Global Wind Atlas

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 Westerly 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.

In addition, the methodology assesses wind conditions on an individual basis without accounting for other comfort effects such as ambient temperature and solar radiation.

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)).

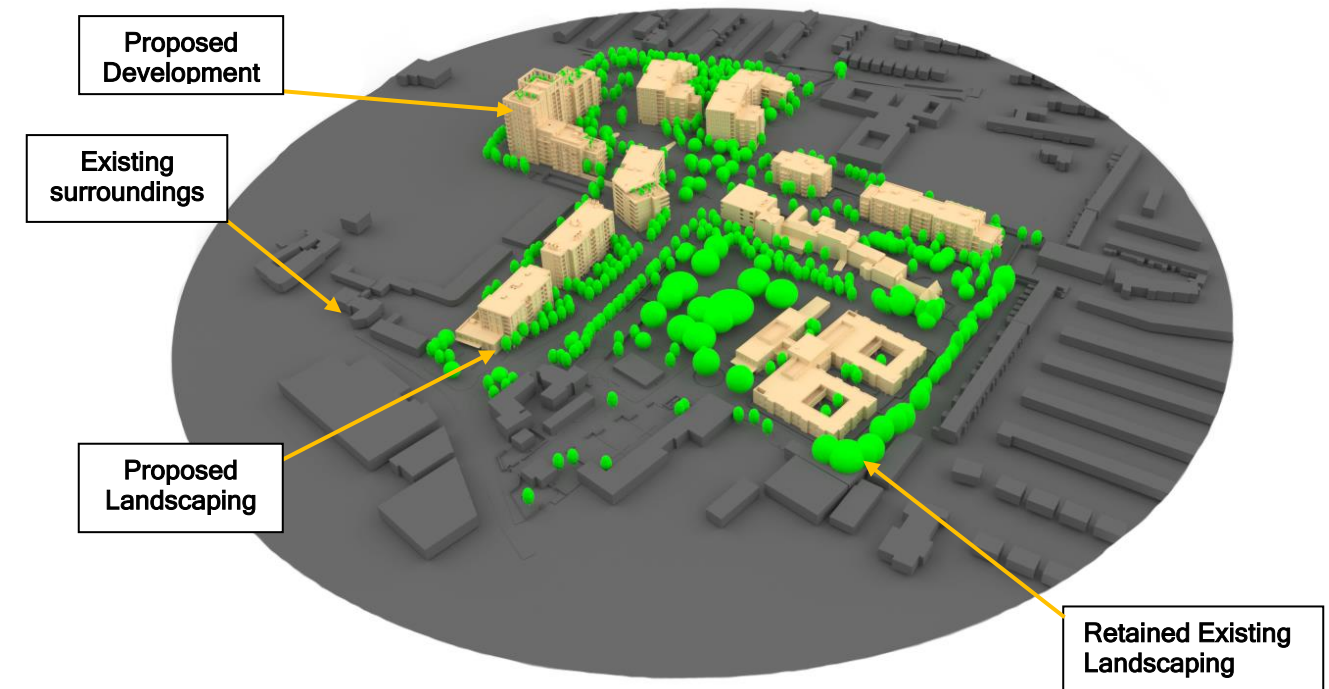


Fig 2.1.4 – 3D Model of Proposed St Vincent's Hospital Redevelopment and Neighbouring Buildings

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 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 2.2.1 Beaufort Scale

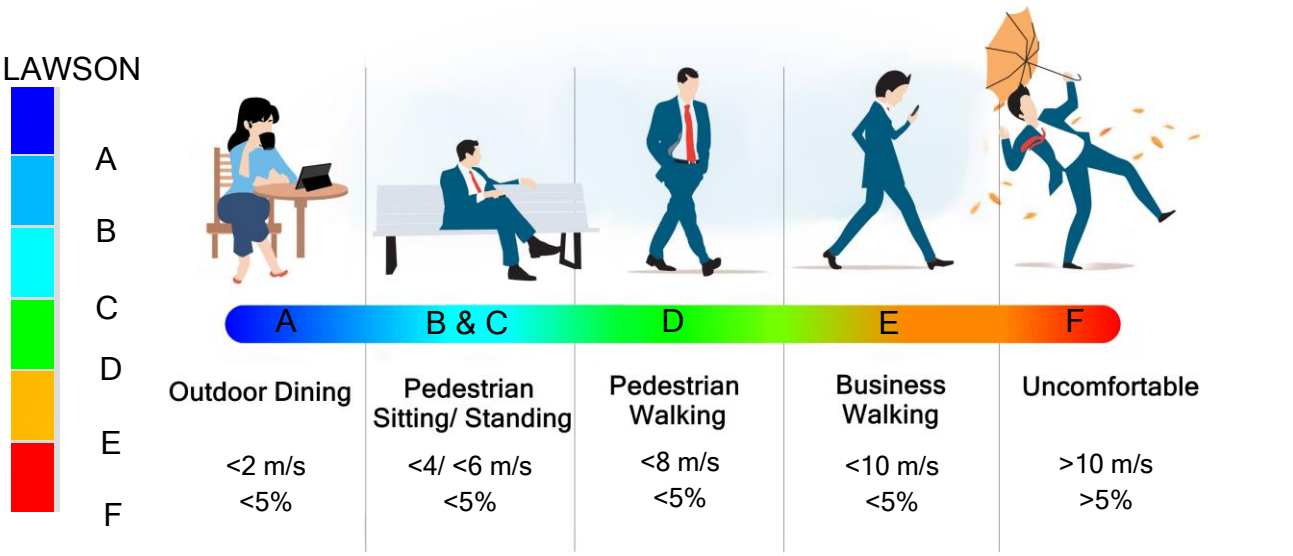


Fig 2.2.2 Lawson Scale

3.0 Wind Analysis

3.1 Wind Analysis Results – Wind Pressures

Figure 3.1.1 illustrates the predicted wind pressures across the development under prevailing westerly wind conditions at 10m above ground level, with the proposed landscaping.

Figure 3.1.1 shows a high-pressure region forming around the windward facing side on Building DE along with a low-pressure zone on the leeward side. The pressure difference causes partial flow of the prevailing winds to be directed into the low-pressure zone, illustrated by vector arrows.

Air will flow from regions of high pressure to regions of low pressure, resulting in some acceleration of winds around the corners of Building DE, and into the low-pressure region on the leeward side. Resultant wind velocities are presented in Section 3.2 overleaf.

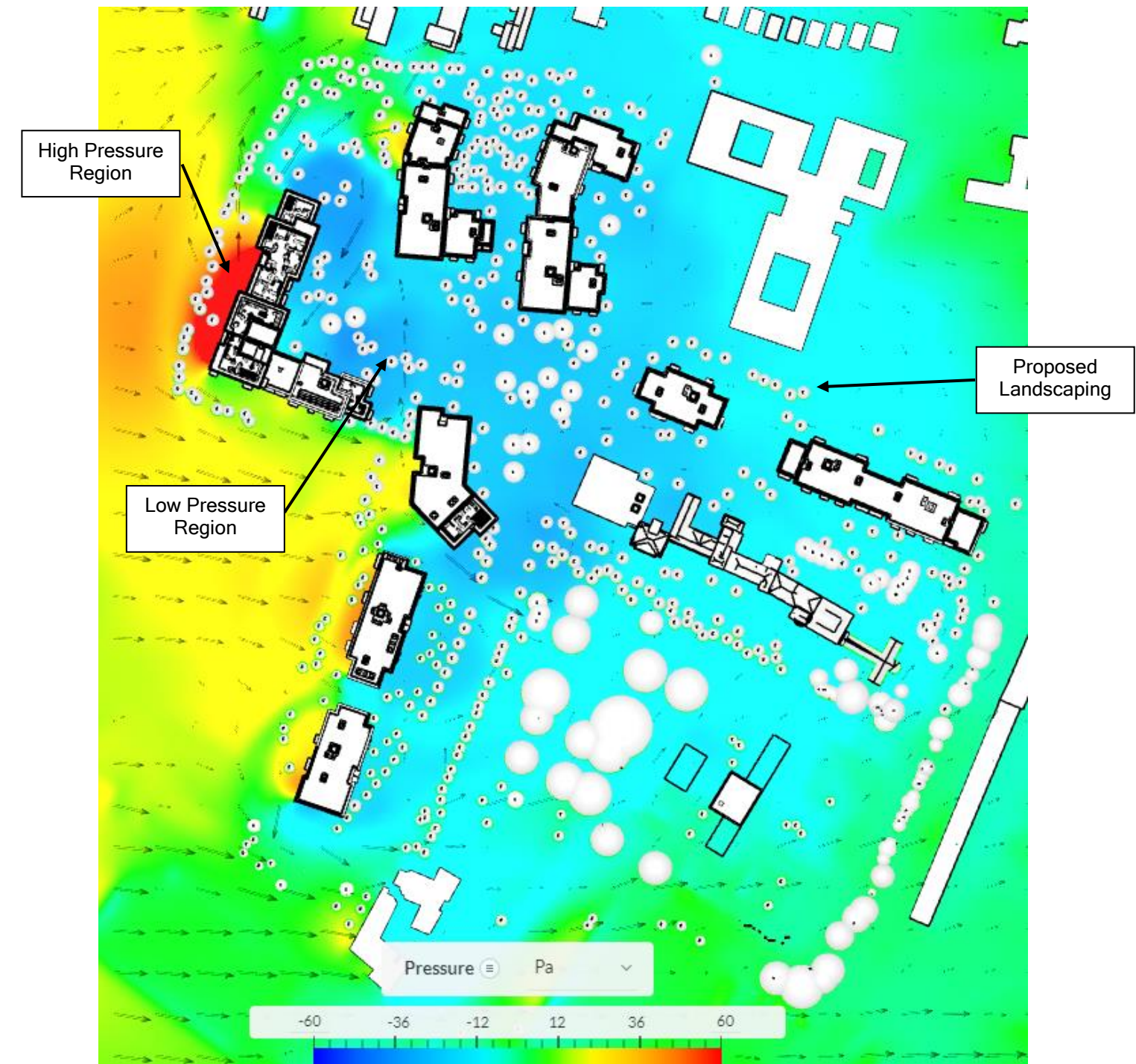


Fig. 3.1.1 – Wind Pressures at 10m Above Ground Level With Proposed Landscaping

3.0 Wind Analysis

3.2 Wind Analysis Results – Wind Velocities

Figures 3.2.1 illustrates predicted wind velocities across the proposed development under prevailing westerly wind conditions at 10m above ground level, with proposed landscaping.

The wind analysis in Figure 3.2.1 illustrates the prevailing winds flowing in from the western front (Buildings A, B, C, D and E) are relatively higher compared to the wind speeds on the East of the development. This is due to the low density of development to the southwest of the site, winds accelerate across open sports fields and parklands to the W/ SW of the proposed site.

Winds speeds to the North and East of the site are predicted to be relatively benign, as these regions are sheltered by buildings on the western edge of the site.

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

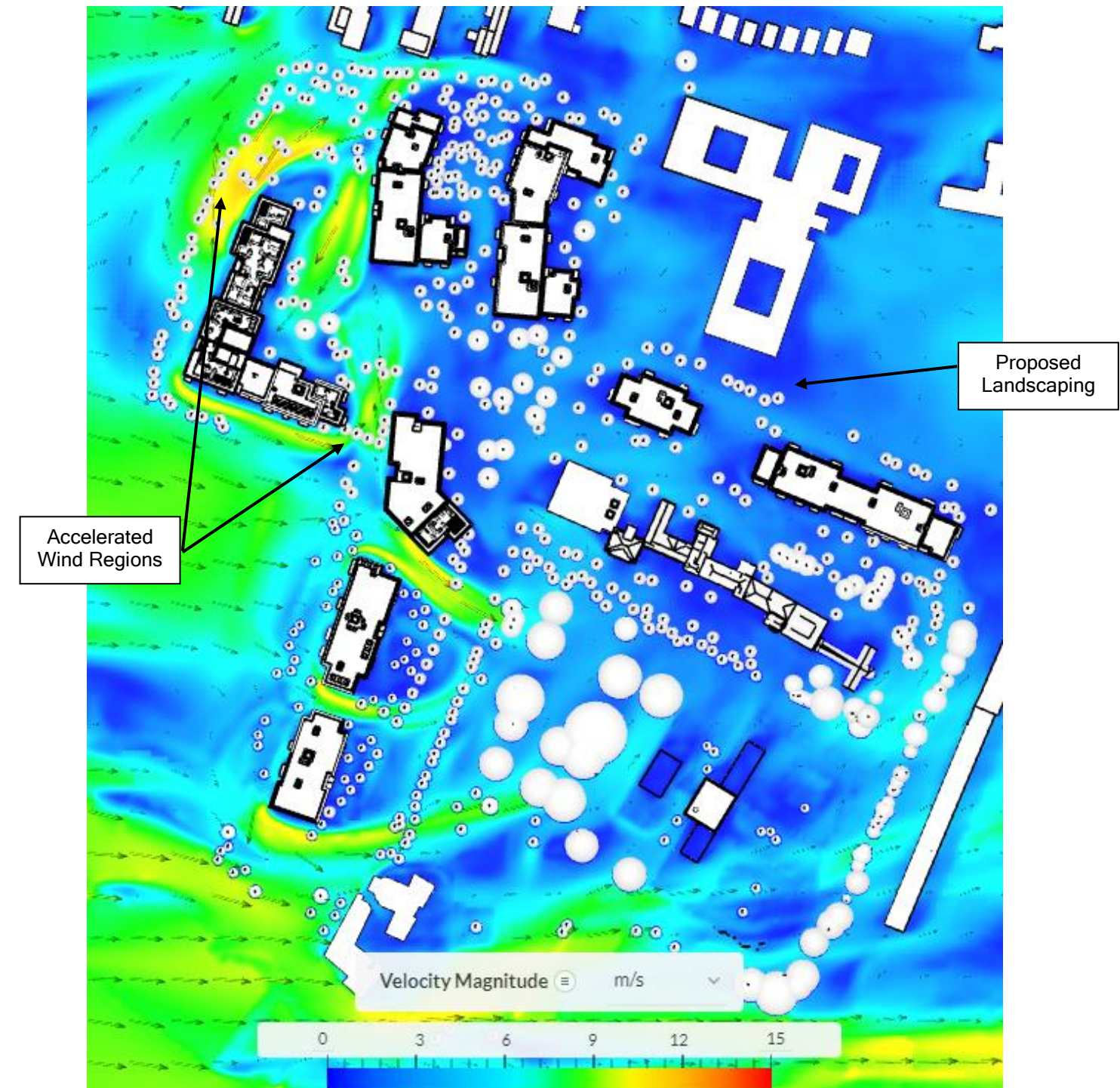


Fig. 3.2.1 – Wind Velocity at 10m above Ground Level with Proposed Landscaping

4.0 Pedestrian Comfort

4.1 Ground Level – Original Landscape design

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 illustrates the Lawson criteria for the across the proposed development. The majority of the proposed development site to the North, East and South (surrounding Buildings A, B, F, G, H, L, and J) is determined to be predominantly suitable for “Outdoor Dining/ Pedestrian sitting” and therefore well suited to its intended use as amenity spaces. Similarly, surrounding grounds of the proposed hospital building to the southeast of the site are predicted to be well sheltered, suitable for “Outdoor Dining/Pedestrian sitting”.

Regions of lower pedestrian comfort due to accelerated winds were predicted to occur around Buildings DE and C. As highlighted in Fig 4.1.2, the outdoor seating space is predicted to be suitable for “Pedestrian Walking” which was less desirable for its intended use.

As part of the design process to mitigate against this accelerated wind region, many different design options were assessed in conjunction with Scott Tallon Walker Architects and Niall Montgomery & Partners. The final chosen design is further explained in section 4.2 along with the final Lawson Criteria conditions across the proposed site in section 4.3.

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

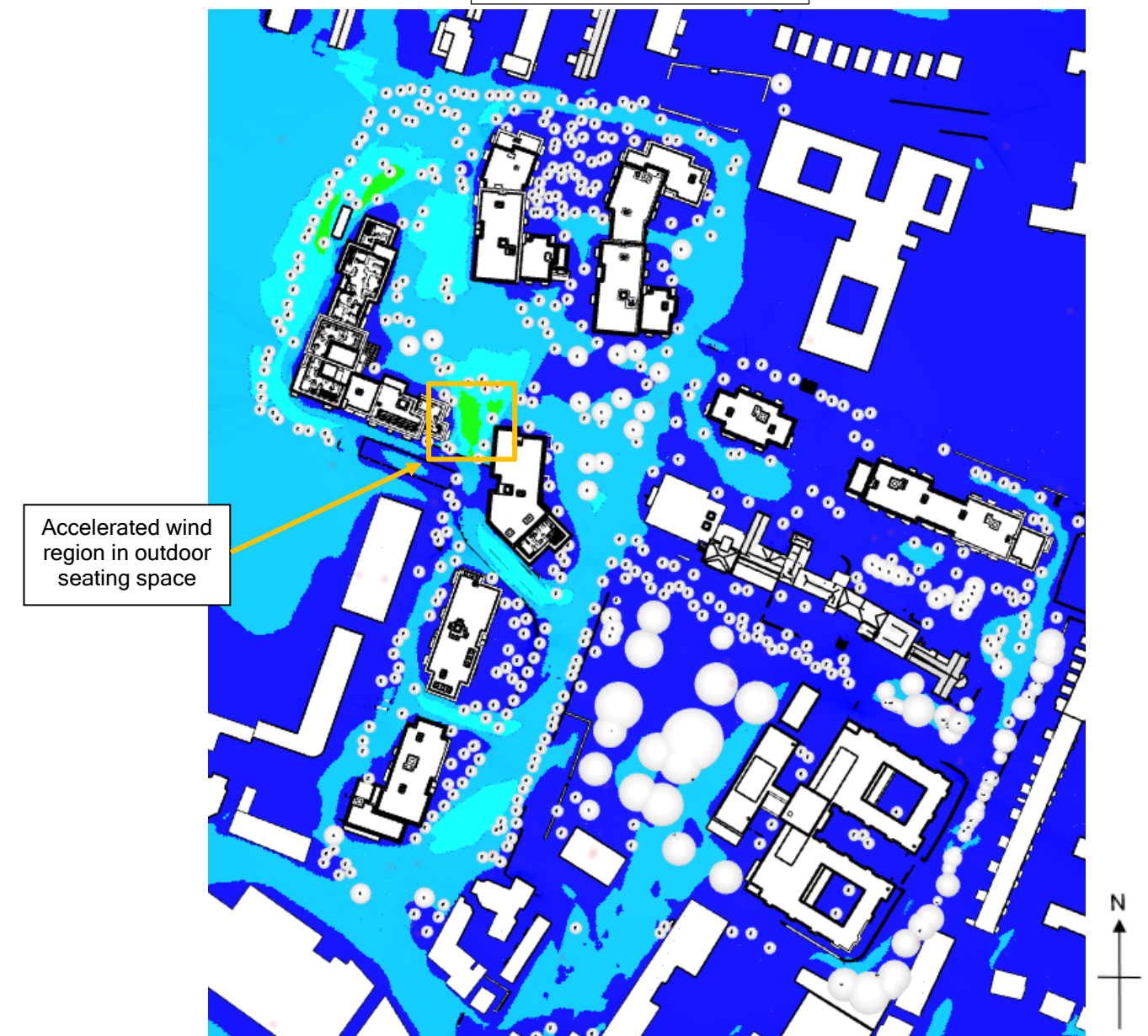


Fig. 4.1.2 – Lawson Criteria Results at 1.5m Above Ground Level Across Proposed Development with the original landscaping design

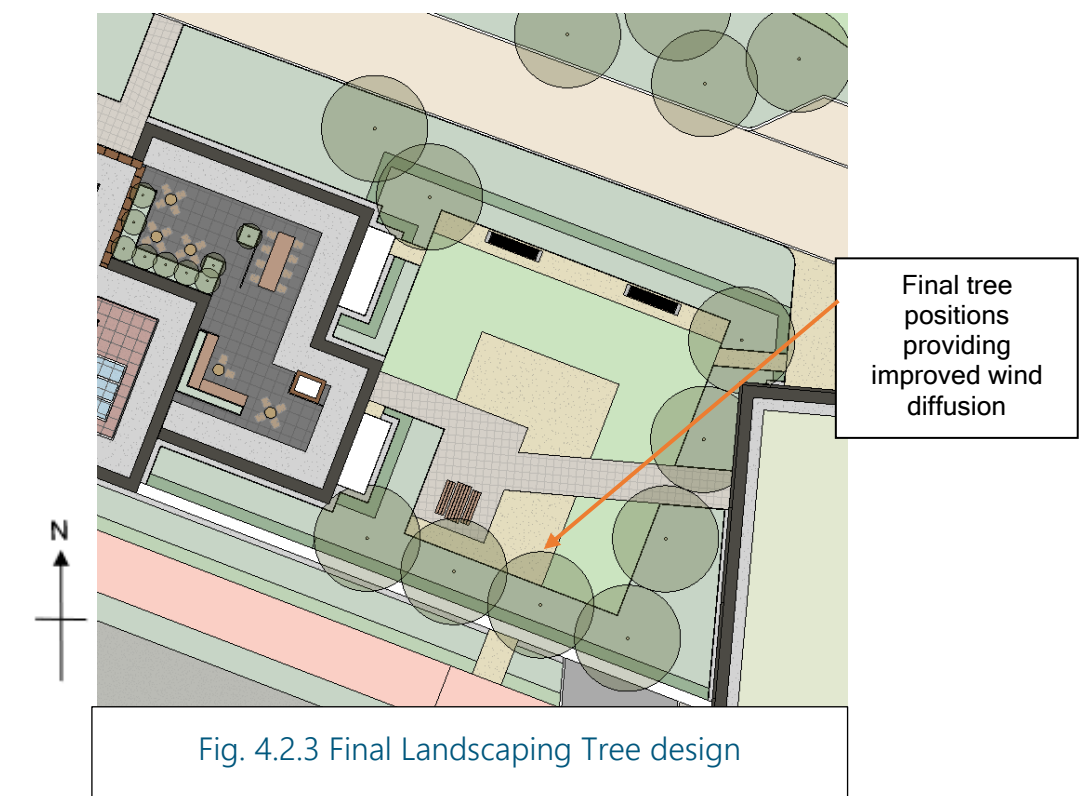
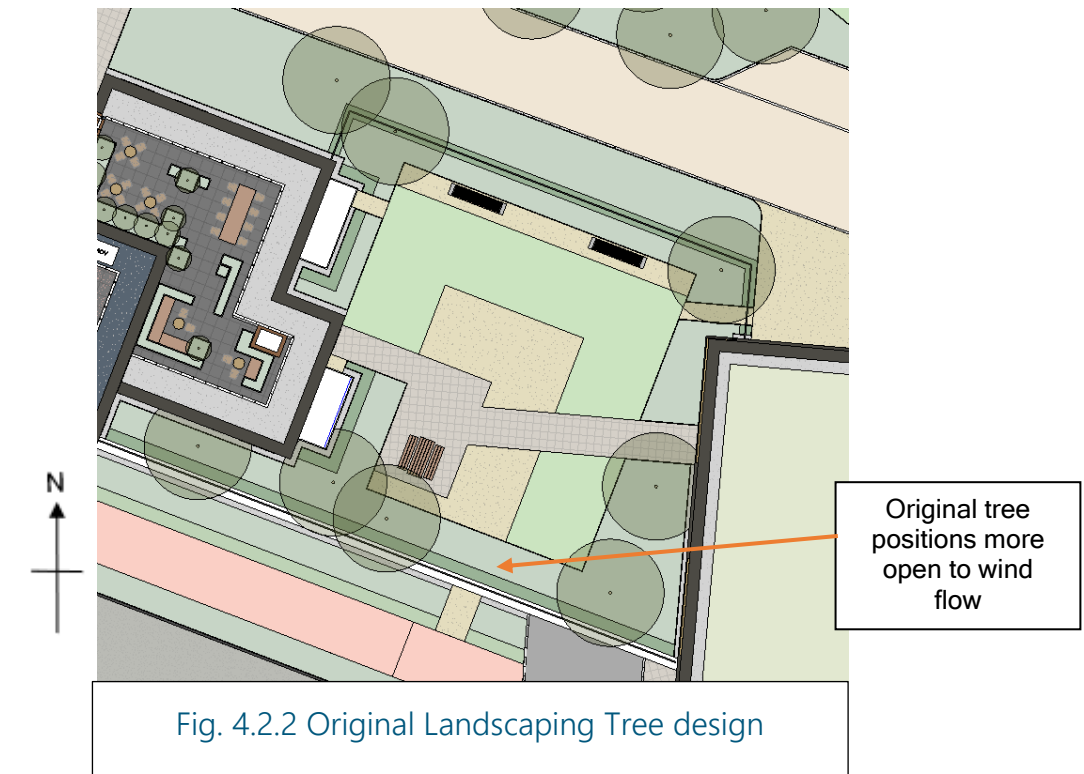
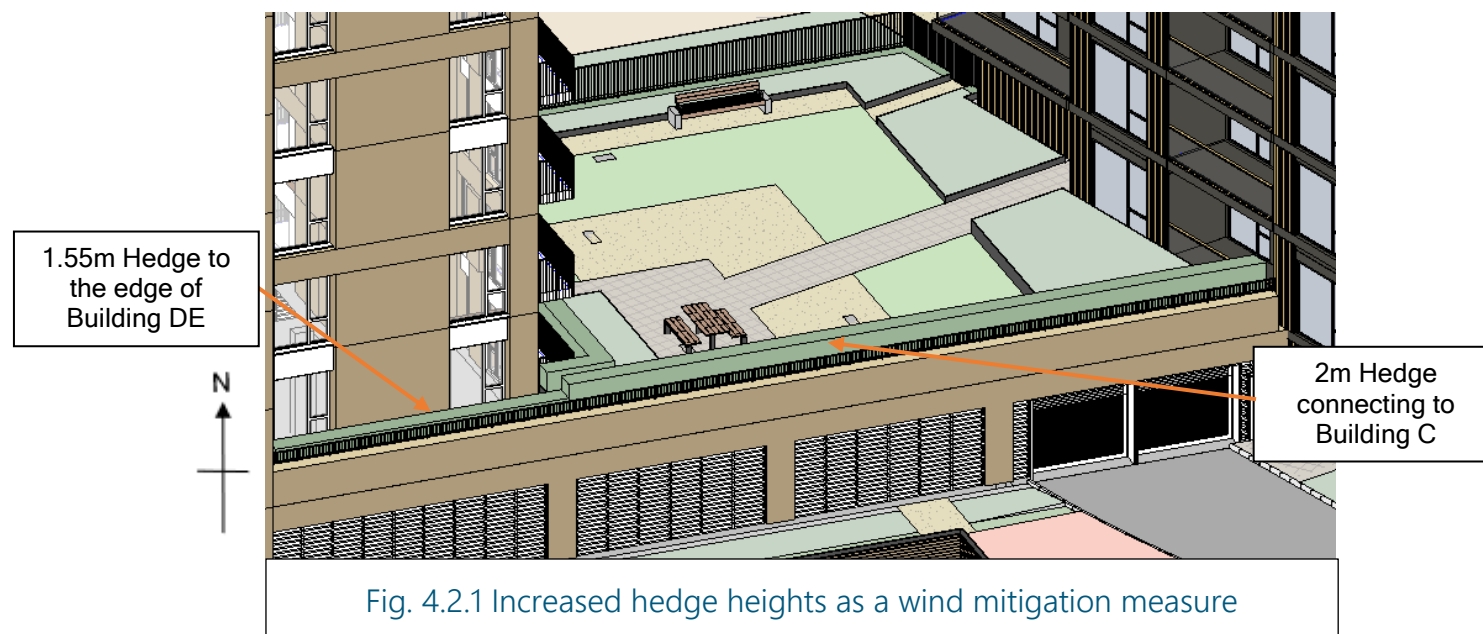
4.2 Ground Level – Final Design Solution

As part of the design process to implement wind mitigation measures at the identified outdoor seating area, many design options were tested, primarily consisting of altering hedging locations and heights along with positions of landscaping trees. This was undertaken in conjunction with Scott Tallon Walker Architects and Niall Montgomery & Partners.

The final design incorporates two alterations to the original design:

- Increasing hedge heights along the south wall of the seating area to 1.55m up to the edge of Building DE and a 2m above ground level connecting to Building C, to form a protection against winds deflecting from adjacent Building C. This is outlined in Figure 4.2.1.
- Relocation of landscaping trees towards Building DE to diffuse more of the airflow entering the open area. This is shown in Figures 4.2.2 and 4.2.3

This design reduces the overall wind acceleration to the outdoor seating area and presents comfortable conditions for people to use. The Lawson Criteria across the proposed development with the final design is shown in section 4.3. A localised comparison of the original and final design option is also shown in section 4.4.



4.3 Ground Level – Final Design Solution

Figure 4.3.2 displays the Lawson Criteria at 1.5m above ground level across the proposed development for the final landscape design.

Similar to the Lawson Criteria results for the original design in section 4.1, the majority of the proposed development site to the North, East and South (surrounding Buildings A, B, F, G, H, L, J, and proposed hospital) was determined to be predominantly suitable for “Outdoor Dining/ Pedestrian sitting” and therefore well suited to its intended use as amenity spaces.

In addition, the new landscaping design at the outdoor seating area between Building DE and C now has a significant increase in areas suited to “Pedestrian Standing/Sitting” as opposed to previously only suitable for “Pedestrian Walking”, including a larger area suitable for outdoor seating.

A comparison of the original and final design Lawson Criteria results is available in Section 4.4.

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. 4.3.1 – Lawson Criteria

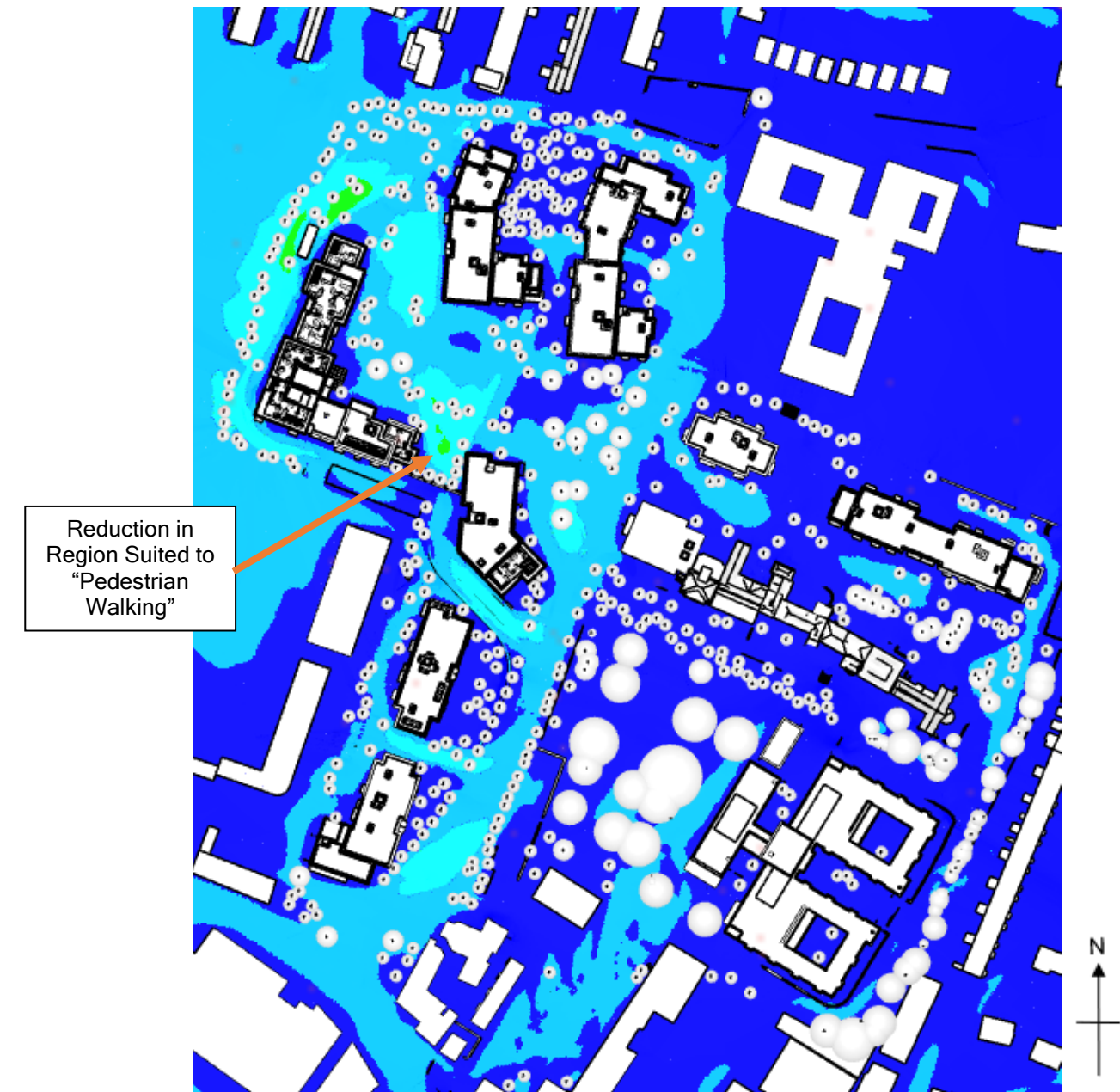


Fig. 4.3.2 – Lawson Criteria Results at 1.5m Above Ground Level Across Proposed Development with the original landscaping design

4.4 Comparison of Original and Final Design at Building DE/C Seating Area

Figures 4.4.2 and 4.4.3 display the Lawson Criteria at 1.5m above ground level at the outdoor seating area as analysed above in Sections 4.1 and 4.3 between Building DE and C. The images display how a comparable improvement was determined for wind conditions and associated pedestrian comfort allowing for the proposed mitigation features summarised in Section 4.2.

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. 4.4.1 – Lawson Criteria

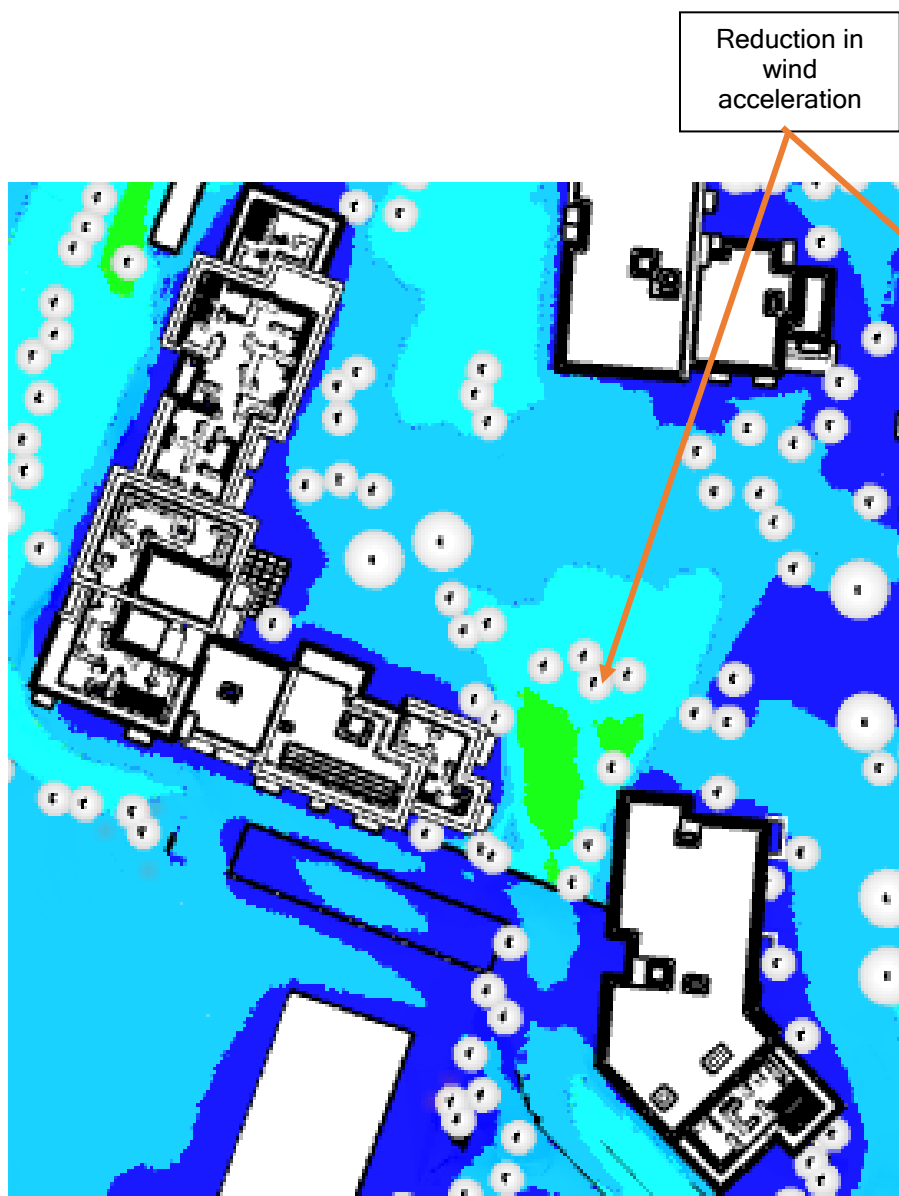


Fig. 4.4.2 – Lawson Criteria Results at 1.5m Above Ground Level Across Proposed Development without mitigation measures

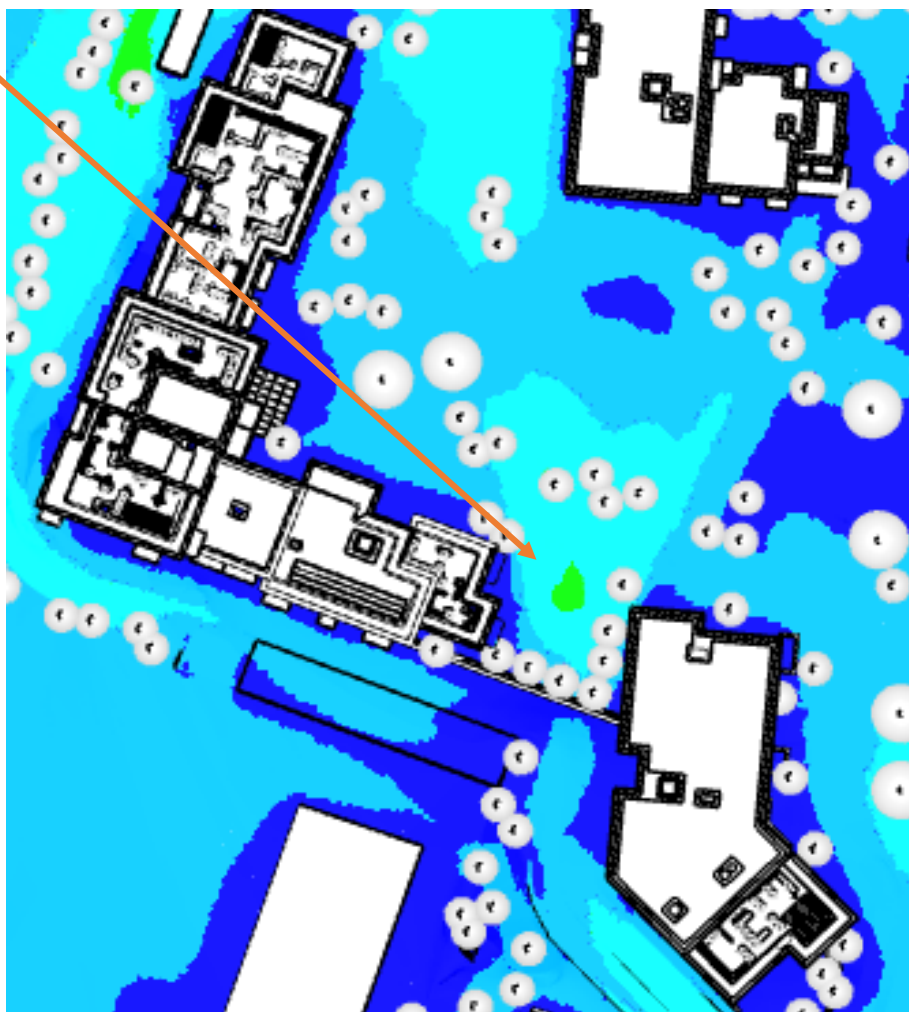


Fig. 4.4.3 – Lawson Criteria Results at 1.5m Above Ground Level Across Proposed Development with proposed mitigation measures

4.5 Roof Terraces – Building C

Building C roof terrace spaces were assessed for pedestrian comfort by predicting Lawson Criteria values at 1.5m above each terrace space.

Figure 4.5.3 illustrates the Lawson criteria results for Building C. The terraces are predominantly suited to “Outdoor Dining” and therefore suited to their use as amenity spaces.

This is due to the proposed 1.8m tall balustrades surrounding enclosing each roof terrace, providing excellent shelter from winds.

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. 4.5.2 – Lawson Criteria

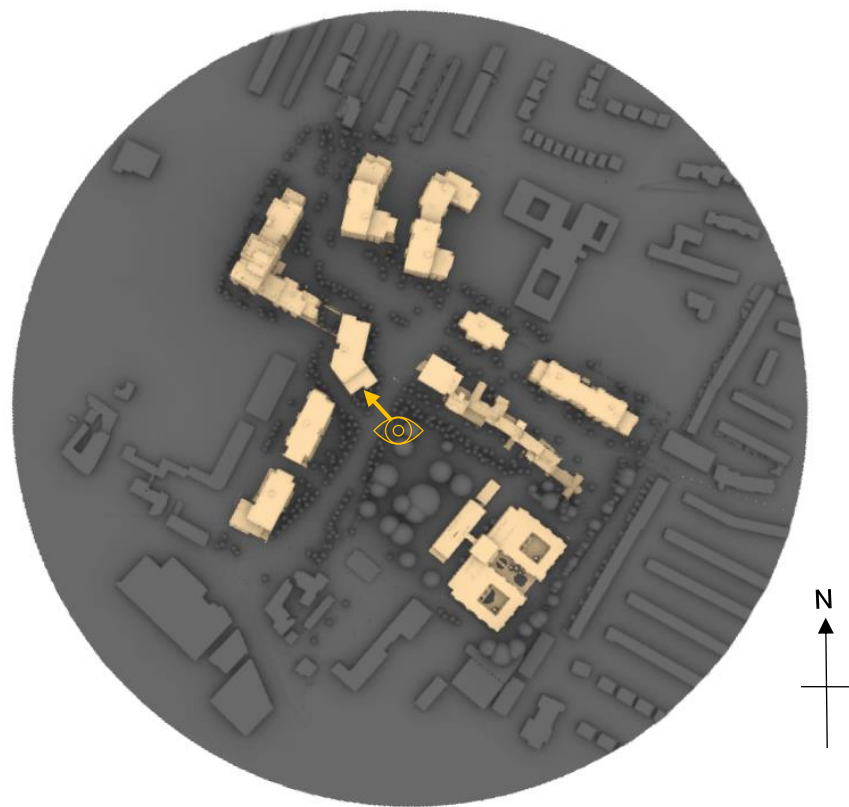


Fig. 4.5.1 – View Key for Building Image Direction

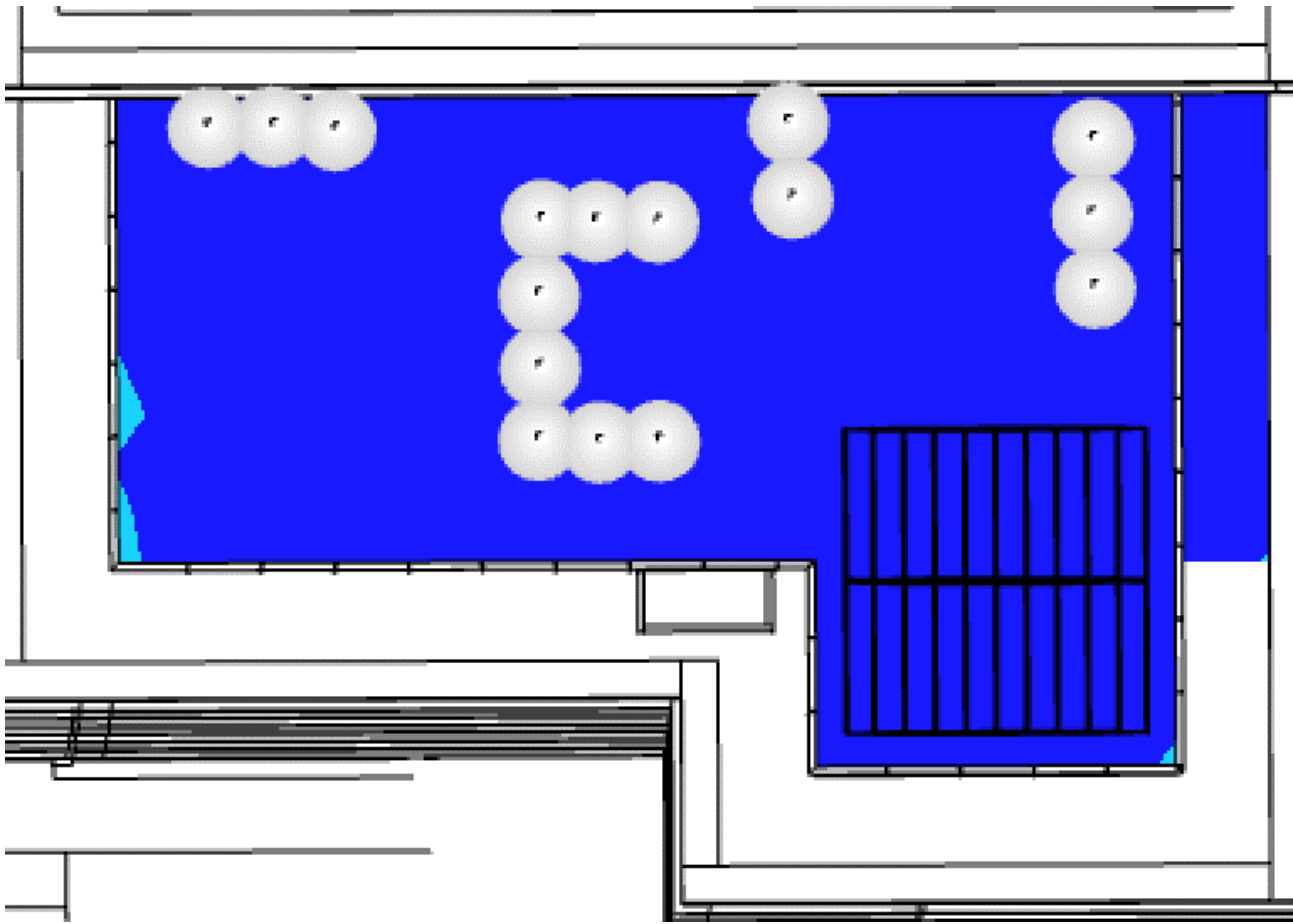


Fig. 4.5.3 – Lawson Criteria Results for Building C Roof Terraces

4.6 Roof Terraces – Building DE

Building DE roof terrace spaces were assessed for pedestrian comfort by predicting Lawson Criteria values at 1.5m above each terrace space.

Figure 4.6.3 illustrates the Lawson criteria results for Building DE. The terraces are predominantly suited to “Outdoor Dining” and therefore suited to their use as amenity spaces.

This is due to the proposed 1.8m tall balustrades surrounding enclosing each roof terrace, providing excellent shelter from winds.

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. 4.6.2 – Lawson Criteria

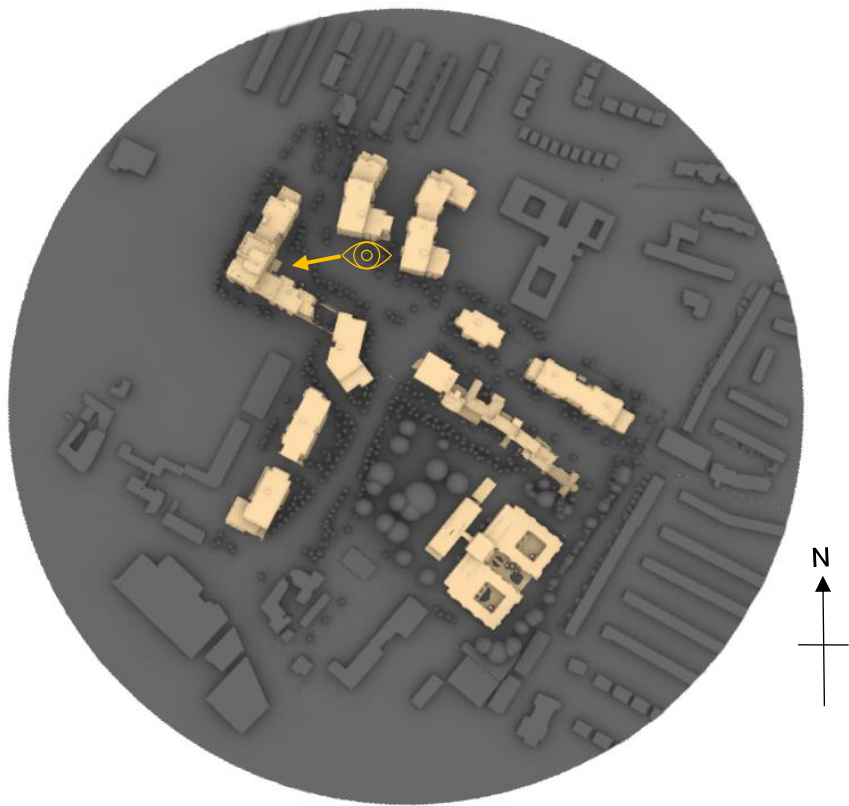


Fig. 4.6.1 – View Key for Building Image Direction

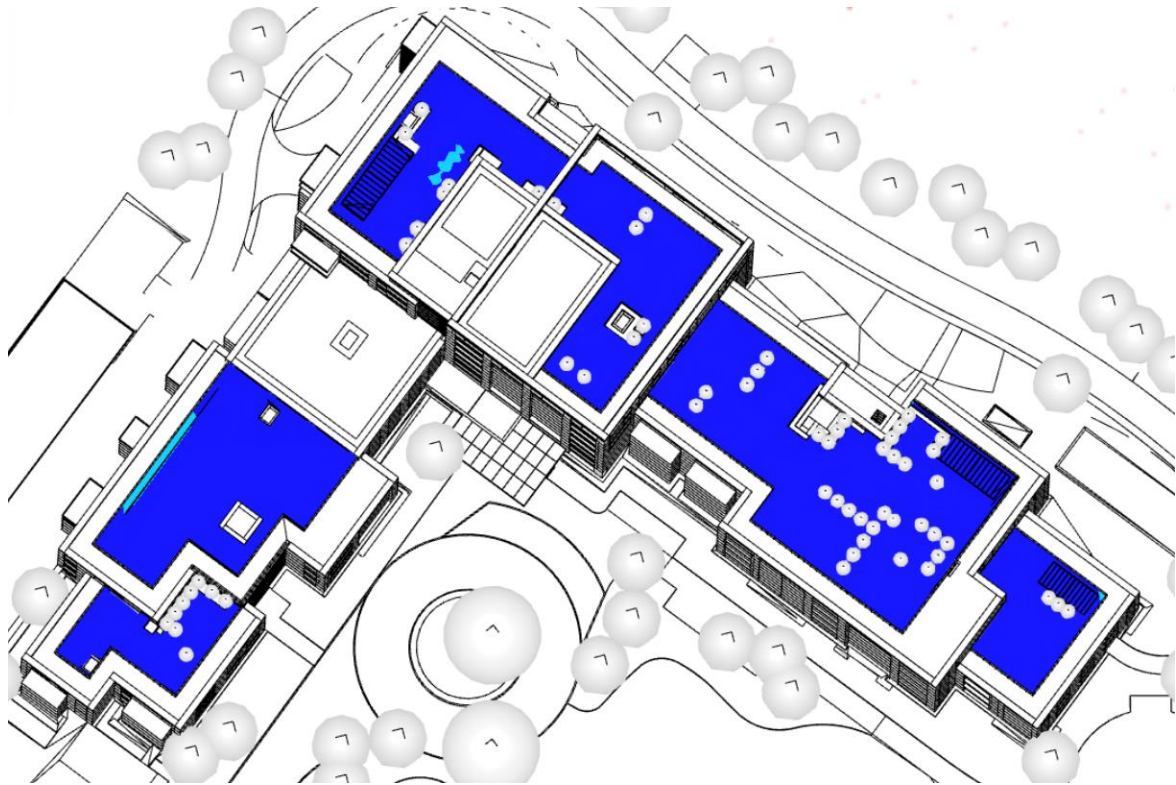


Fig. 4.6.3 – Lawson Criteria Results for Building DE Roof Terraces

4.7 Building A Balconies

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

The scale in Fig 4.7.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.7.3 illustrates results for balconies while Figure 4.7.1 shows the direction and location of the balconies

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. 4.7.2 – Lawson Criteria

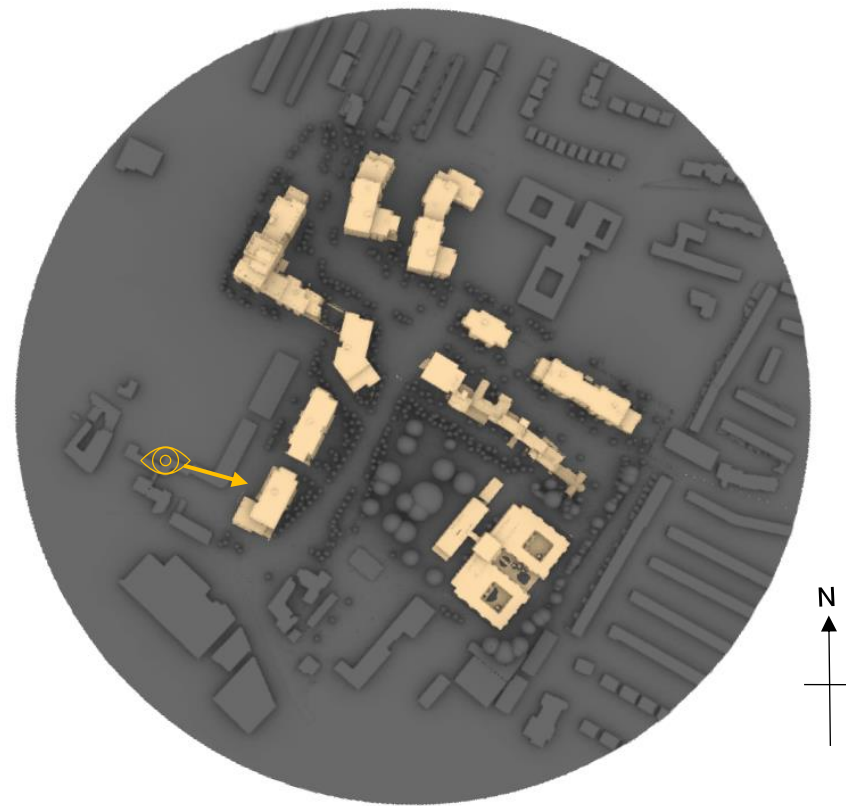


Fig. 4.7.1 – View Key for Building Image Direction

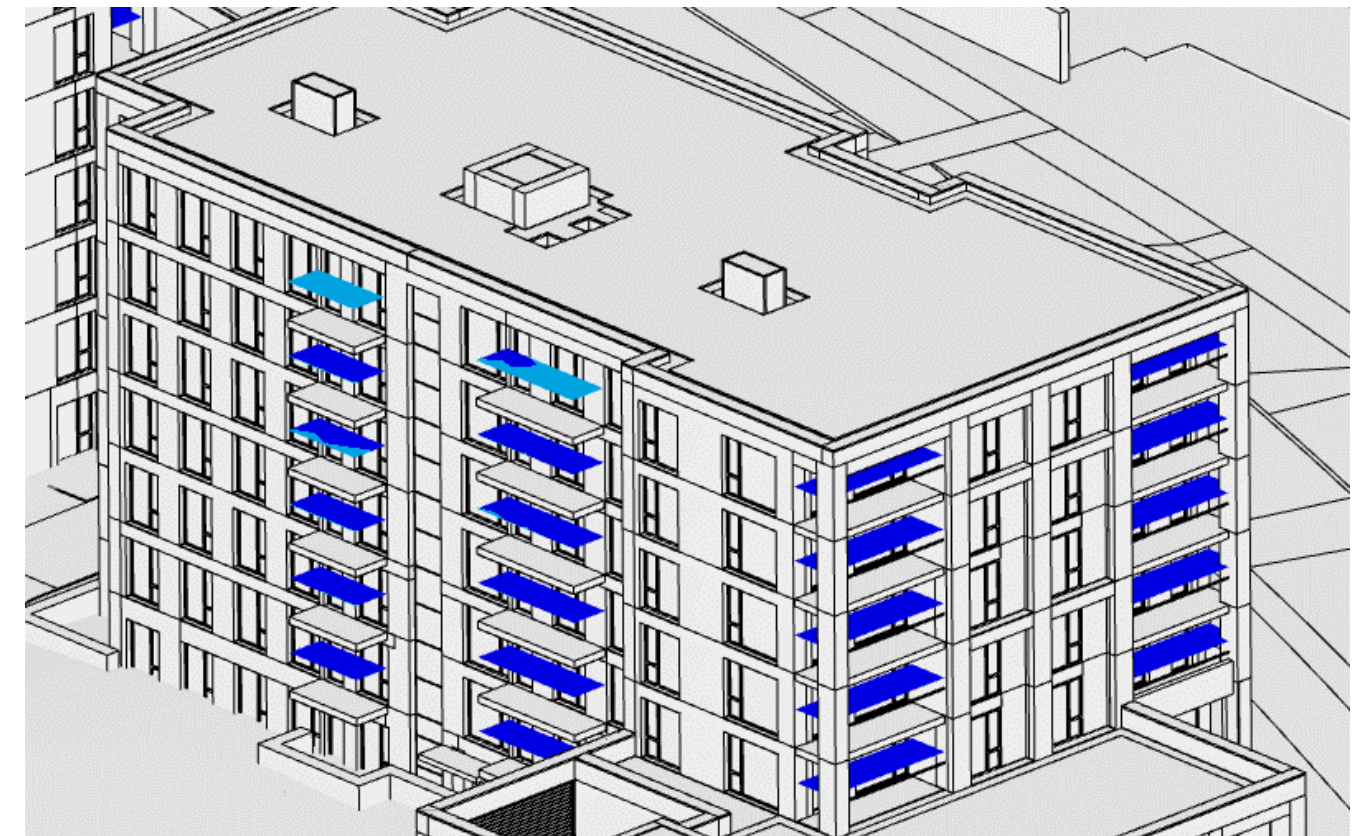


Fig. 4.7.3 – Lawson Criteria Results for Balconies

4.8 Building A Balconies

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

The scale in Fig 4.8.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.8.3 illustrates results for balconies while Figure 4.8.1 shows the direction and location of the balconies.

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. 4.8.2 – Lawson Criteria

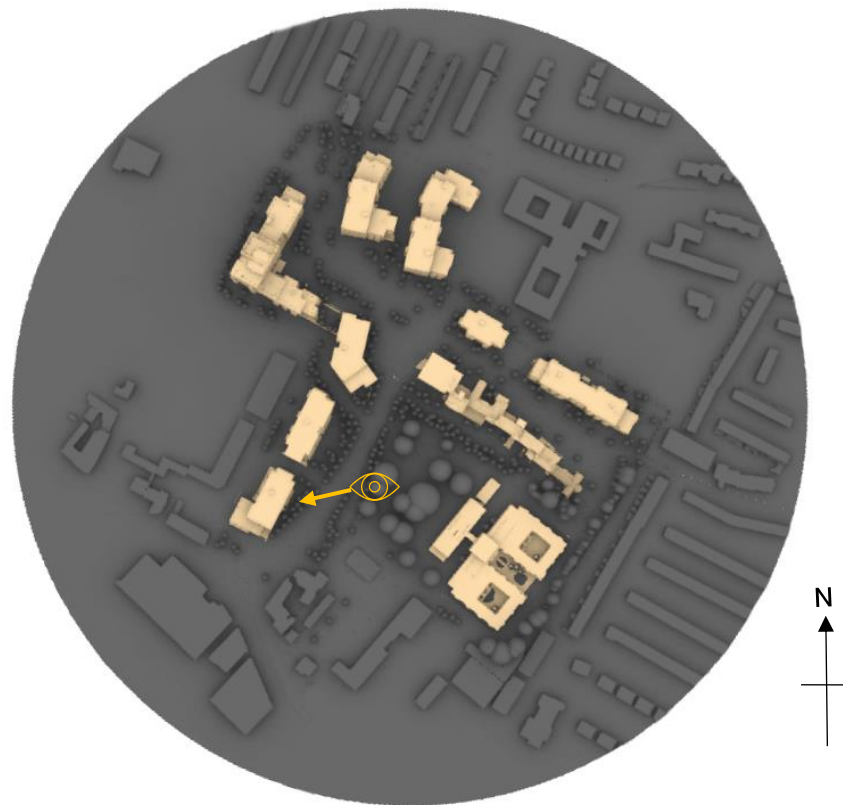


Fig. 4.8.1 – View Key for Building Image Direction



Fig. 4.8.3 – Lawson Criteria Results for Balconies

4.9 Building B Balconies

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

The scale in Fig 4.9.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.9.3 illustrates results for balconies while Figure 4.9.1 shows the direction and location of the balconies.

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. 4.9.2 – Lawson Criteria

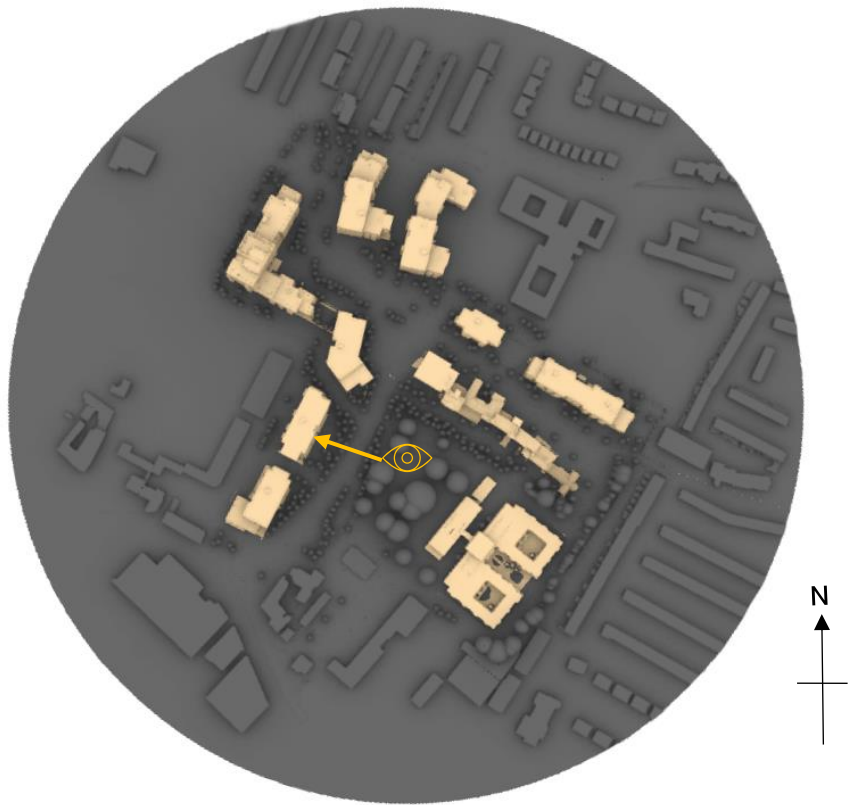


Fig. 4.9.1 – View Key for Building Image Direction



Fig. 4.9.3 – Lawson Criteria Results for Balconies

4.10 Building B Balconies

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

The scale in Fig 4.10.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.10.3 illustrates results for balconies while Figure 4.10.1 shows the direction and location of the balconies.

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. 4.10.2 – Lawson Criteria

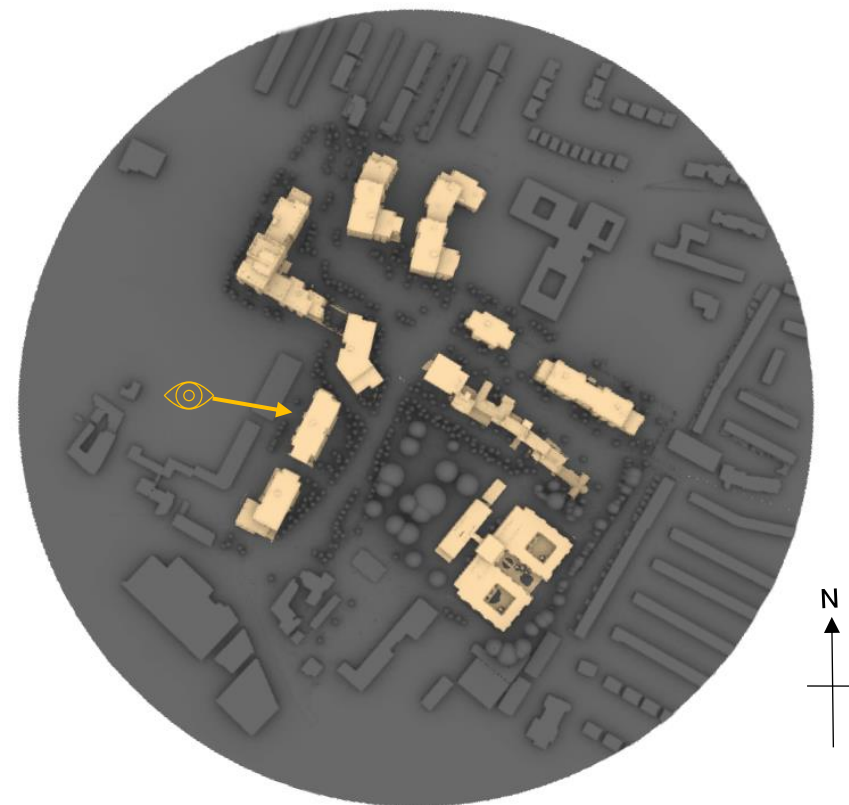


Fig. 4.10.1 – View Key for Building Image Direction



Fig. 4.10.3 – Lawson Criteria Results for Balconies

4.11 Building C Balconies

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

The scale in Fig 4.11.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.11.3 illustrates results for balconies while Figure 4.11.1 shows the direction and location of the balconies.

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. 4.11.2 – Lawson Criteria

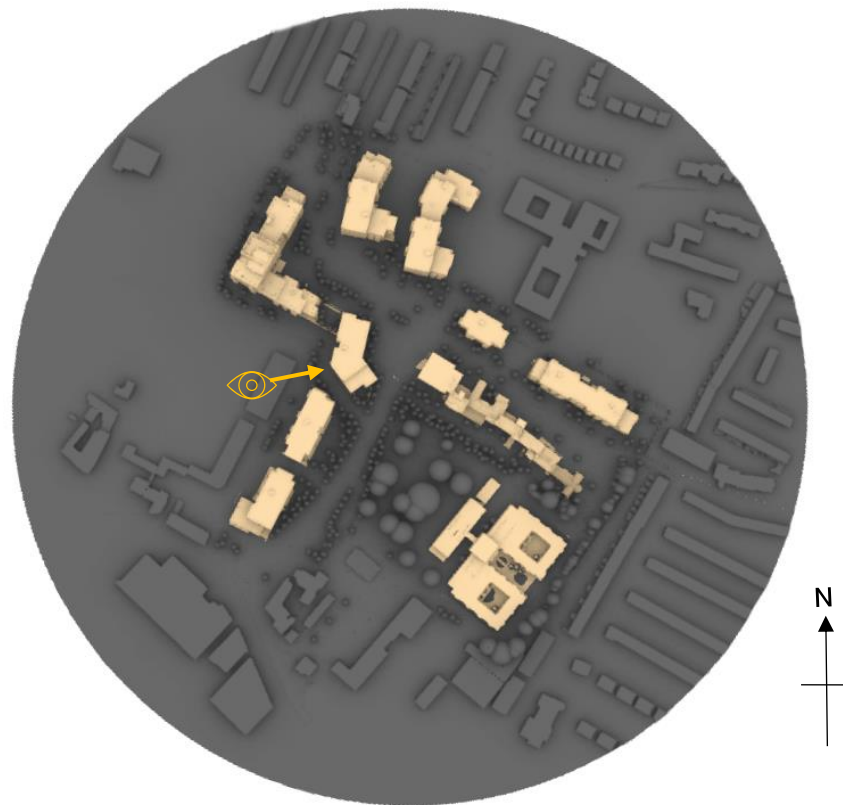


Fig. 4.11.1 – View Key for Building Image Direction

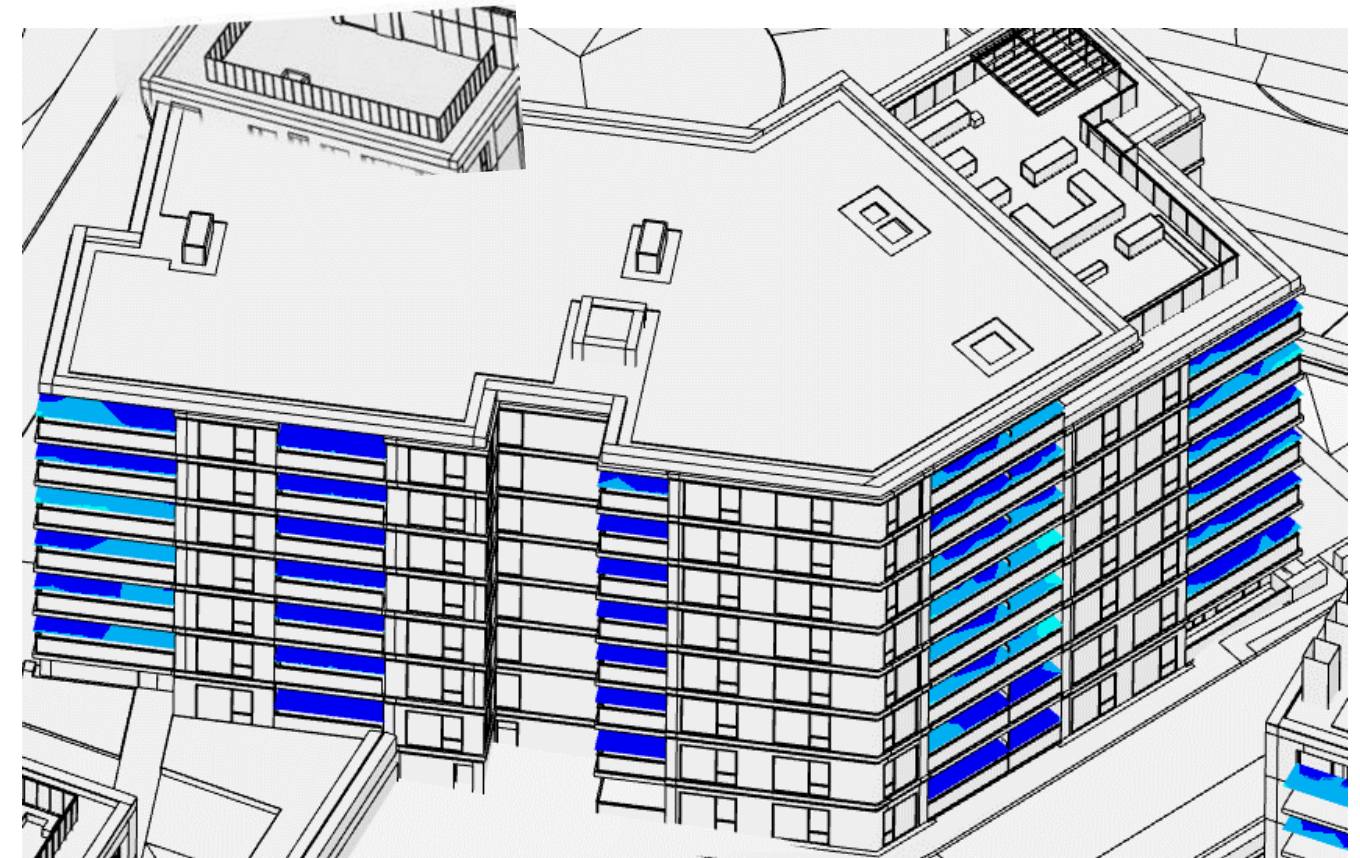


Fig. 4.11.3 – Lawson Criteria Results for Balconies

4.12 Building C Balconies

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

The scale in Fig 4.12.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.12.3 illustrates results for balconies while Figure 4.12.1 shows the direction and location of the balconies.

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. 4.12.2 – Lawson Criteria

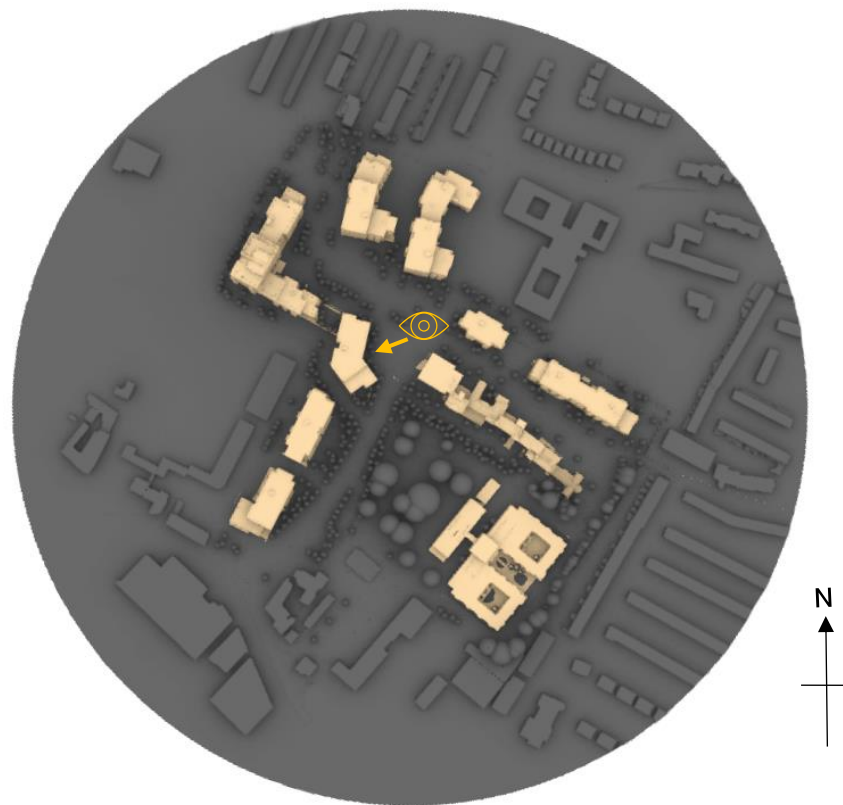


Fig. 4.12.1 – View Key for Building Image Direction

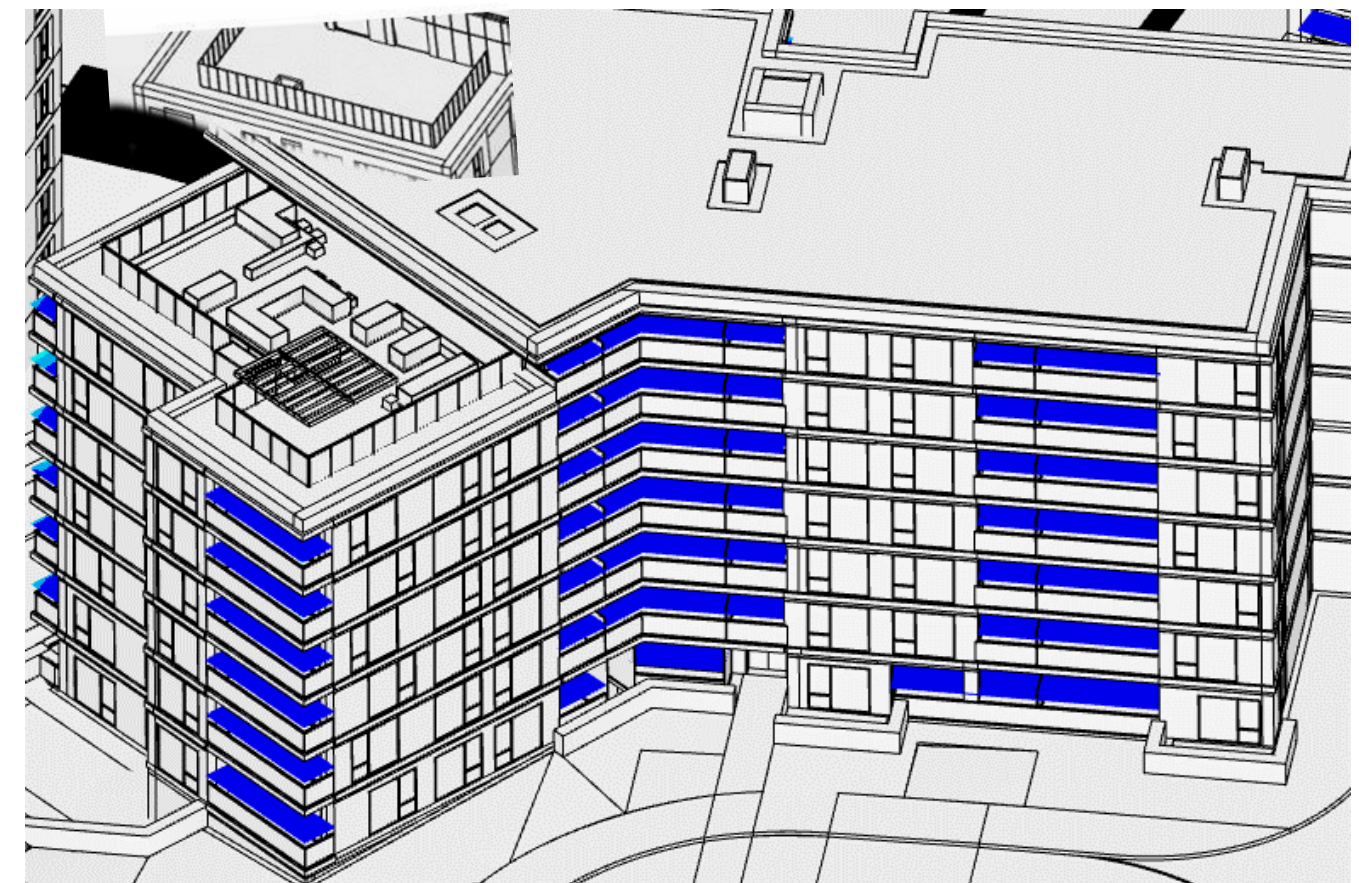


Fig. 4.12.3 – Lawson Criteria Results for Balconies

4.13 Building DE Balconies – Original Design

The scale in Fig 4.13.1 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.

The majority of balconies across the southwest façade of Building DE are determined to be suitable for “Outdoor Dining/ Pedestrian Sitting”.

However, 10 balconies on the SW façade of Building DE, outlined in Figure 4.13.3 were determined to be suitable for “Pedestrian Standing/ Walking” (cyan/ green contours) and therefore unsuitable for their intended use. Conditions suitable for “Outdoor Dining/ Pedestrian Sitting” are desirable at balconies.

Balconies were analysed with railings, as per architectural design. From an airflow perspective, railings are effectively “open”, and did not provide any shelter on balconies from winds.

As part of the design solution, to mitigate against the accelerated wind conditions, different design options with solid balustrades were assessed in conjunction with models provided by Scott Tallon Walker.

The final chosen design is further explained in section 4.14 along with the final Lawson Criteria conditions across the southwest façade in section 4.15.

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. 4.13.1 – Lawson Criteria

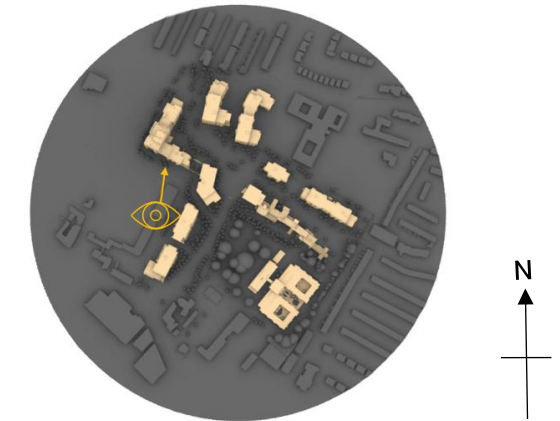


Fig. 4.13.2 – View Key for Balcony Image



Fig. 4.13.3 – Lawson Criteria Results for Balconies

4.14 Building DE Balconies – Final Design Solution

As part of the design solution, to mitigate against the accelerated wind conditions, different design options were assessed in conjunction with models provided by Scott Tallon Walker.

For the chosen final design option, a 1.1m high solid balustrade around the balconies shown in Figure 4.14 is implemented. These solid balustrades provide shelter to the balcony from accelerated wind speeds.

The solid balustrades were found to improve the comfort conditions at the balconies. The Lawson Criteria results for with the final design is shown overleaf in section 4.15.

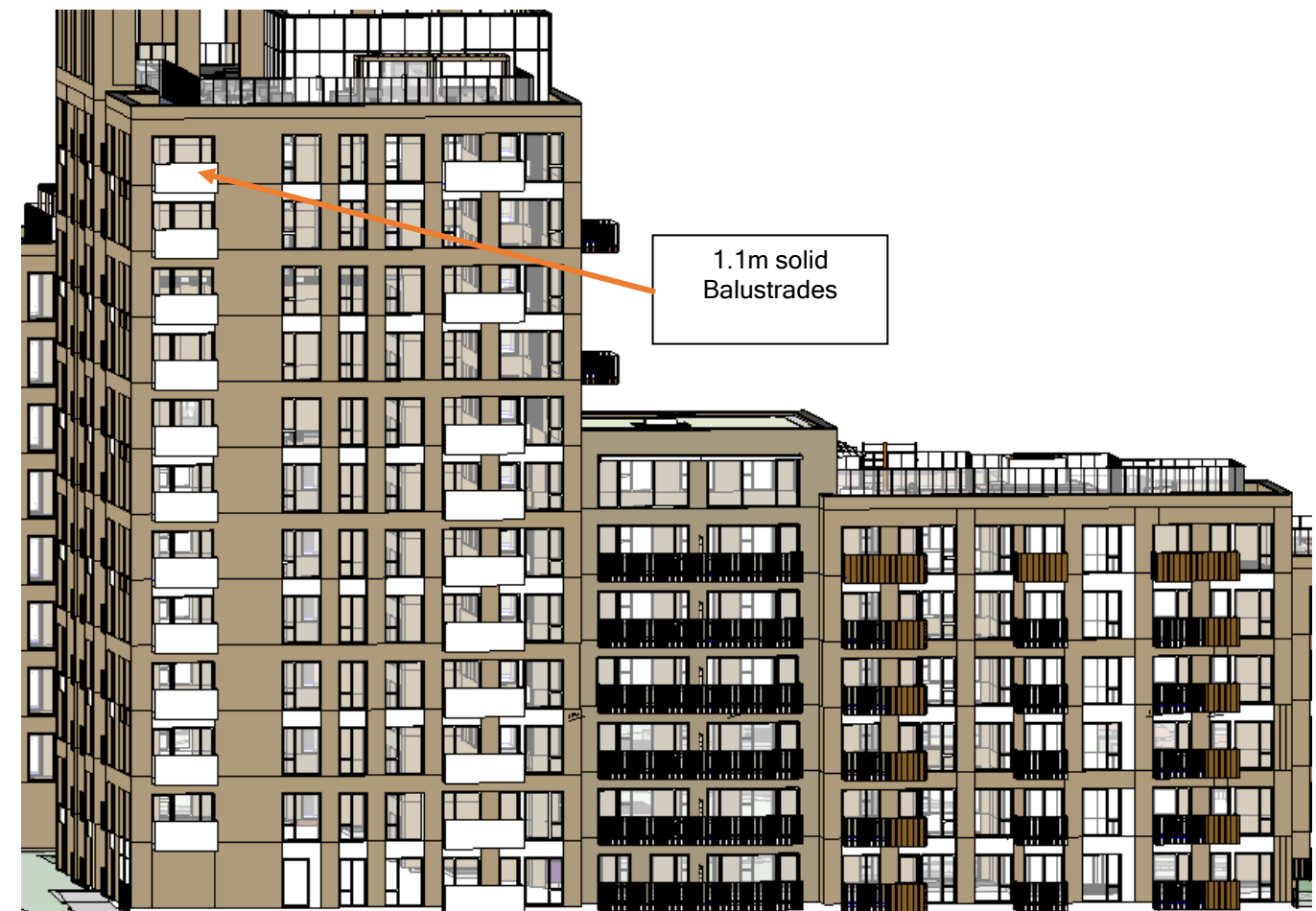


Fig. 4.14 – Lawson Criteria Results for Balconies

4.15 Building DE Balconies- Final Design Solution

Figure 4.15.2 displays the Lawson Criteria at 1.5m above ground level across the southwest façade balconies on Building DE with the final balcony design.

As illustrated in Fig 4.15.3, the majority of balconies are suited to “Outdoor Dining” providing excellent shelter for its intended use as private amenity spaces.

The highlighted balconies where were previously identified to have conditions for “Pedestrian Walking/ Standing” are now predominantly suited to “Pedestrian Sitting”. These conditions are now more suitable for its usage due to the shelter provided from solid balustrades.

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. 4.15.1 – Lawson Criteria

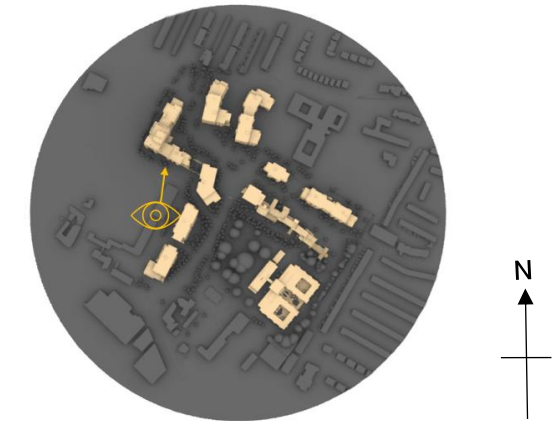


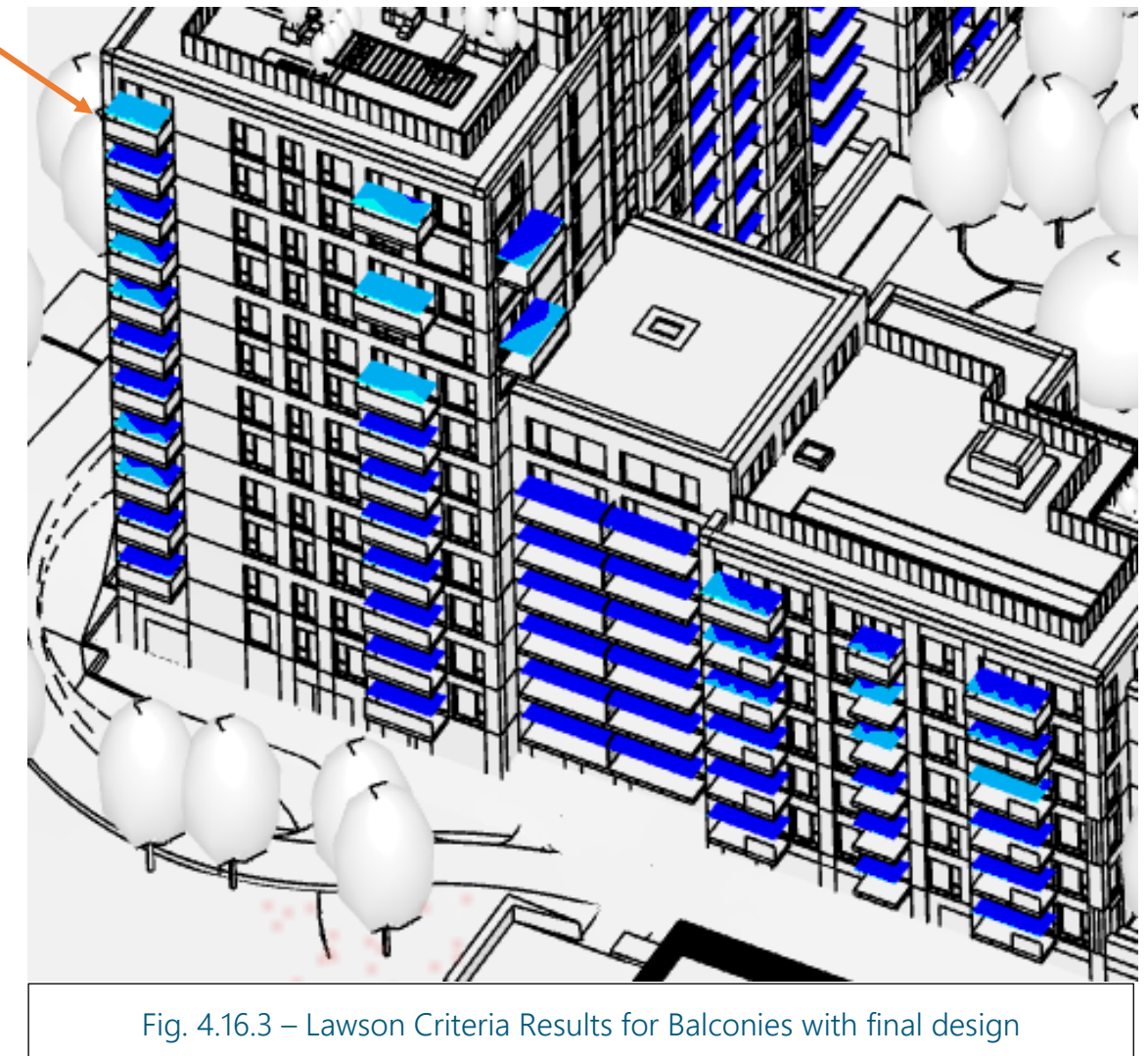
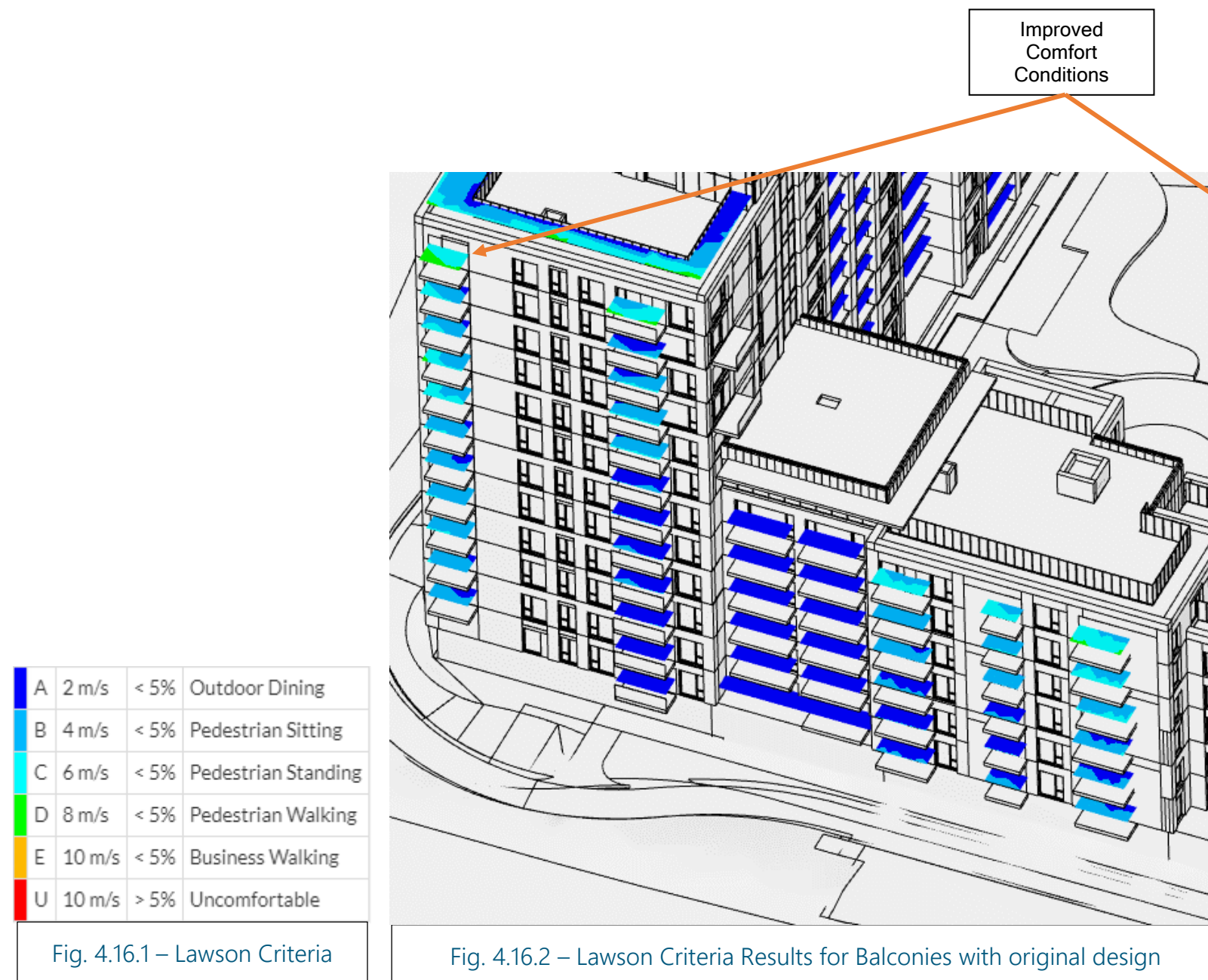
Fig. 4.15.2 – View Key for Balcony Image



Fig. 4.15.3 – Lawson Criteria Results for Balconies

4.16 Building DE Balconies – Original and Final Design Lawson Criteria Comparison

Figures 4.16.2 and 4.16.3 illustrate the Lawson Comfort Criteria at the southwest façade balconies with the original design with railings and final design with solid balustrades, as analysed above in Sections 4.13 and 4.15. The images display how a comparable improvement was determined for wind conditions and associated pedestrian comfort allowing for the proposed mitigation measures summarised in Section 4.14



4.17 Building DE Balconies

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

The scale in Fig 4.17.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.4.3 illustrates results for balconies while Figure 4.4.1 shows the direction and location of the balconies.

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. 4.17.2 – Lawson Criteria

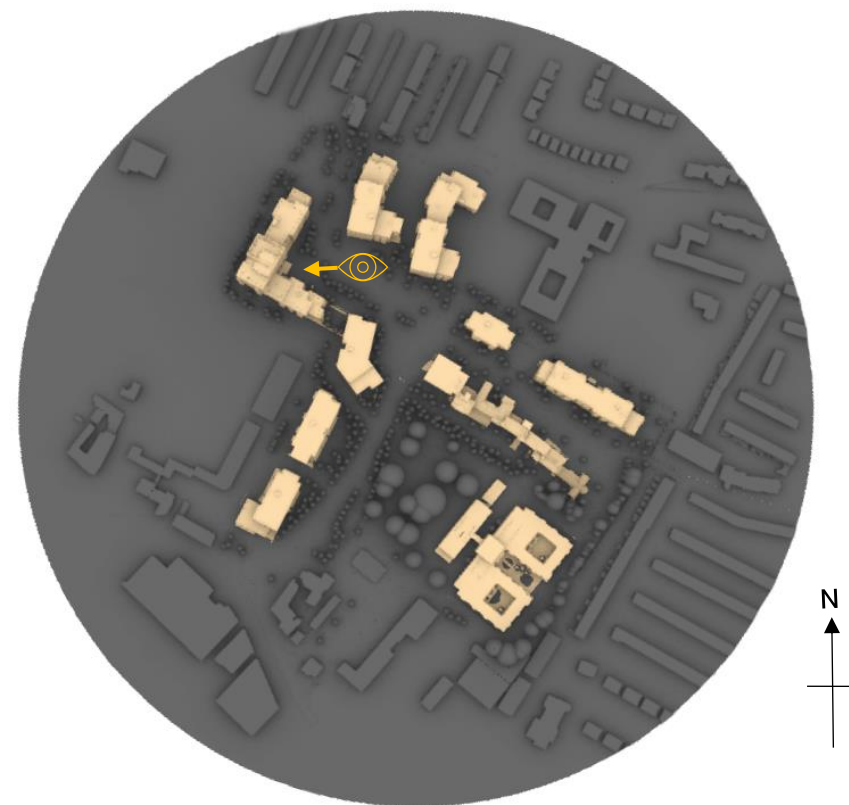


Fig. 4.17.1 – View Key for Building Image Direction



Fig. 4.17.3 – Lawson Criteria Results for Balconies

4.18 Building DE Balconies

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

The scale in Fig 4.18.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.18.3 illustrates results for balconies while Figure 4.18.1 shows the direction and location of the balconies.

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. 4.18.2 – Lawson Criteria

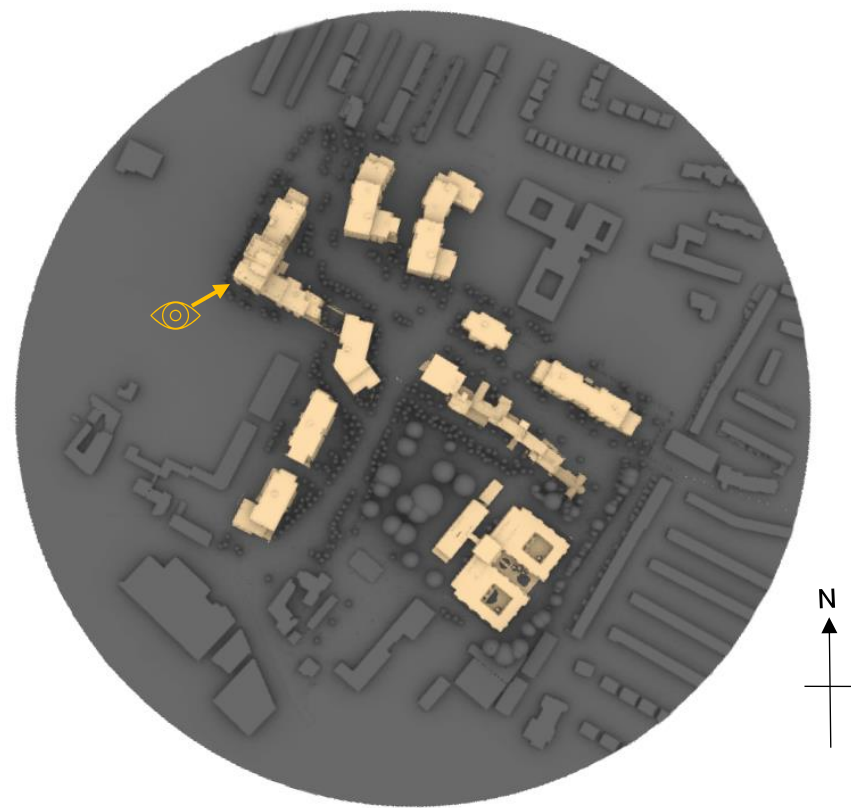


Fig. 4.18.1 – View Key for Building Image Direction

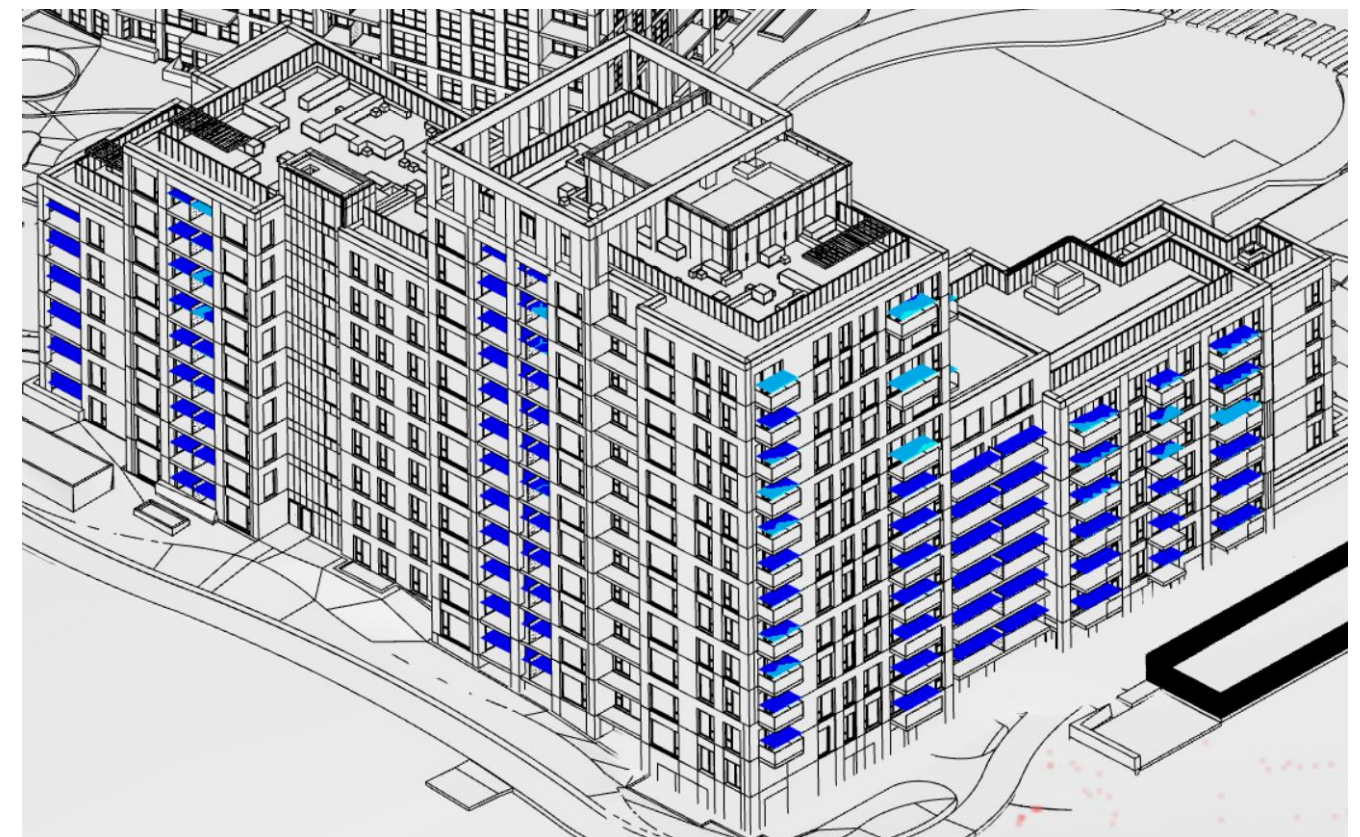


Fig. 4.18.3 – Lawson Criteria Results for Balconies

4.19 Building F Balconies

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

The scale in Fig 4.19.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.19.3 illustrates results for balconies while Figure 4.19.1 shows the direction and location of the balconies.

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. 4.19.2 – Lawson Criteria

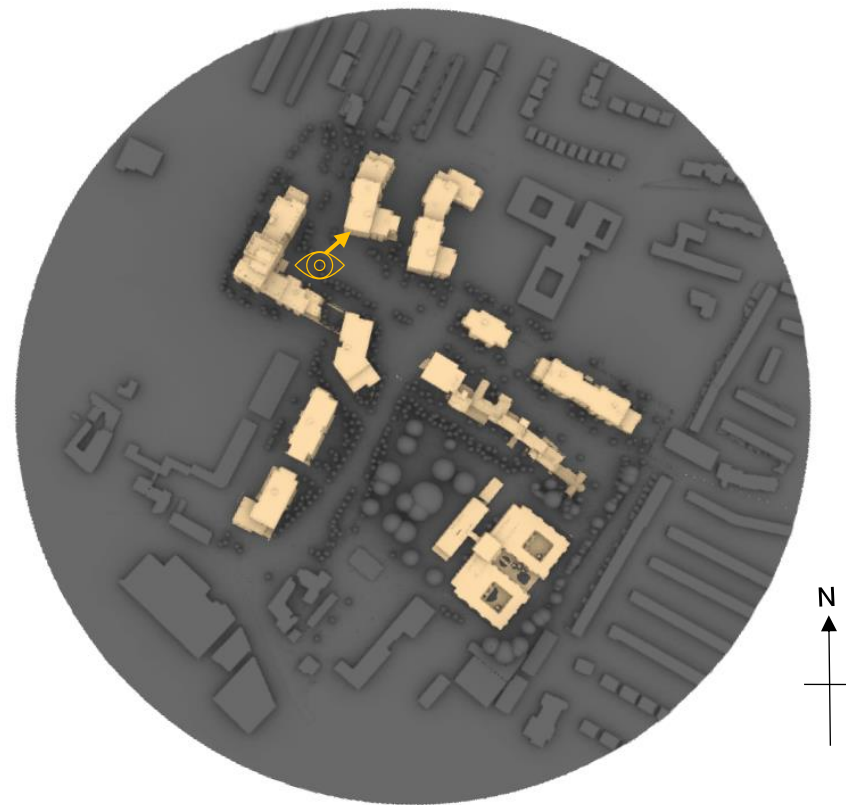


Fig. 4.19.1 – View Key for Building Image Direction



Fig. 4.19.3 – Lawson Criteria Results for Balconies

4.20 Building F Balconies

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

The scale in Fig 4.20.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.20.3 illustrates results for balconies while Figure 4.20.1 shows the direction and location of the balconies.

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. 4.20.2 – Lawson Criteria

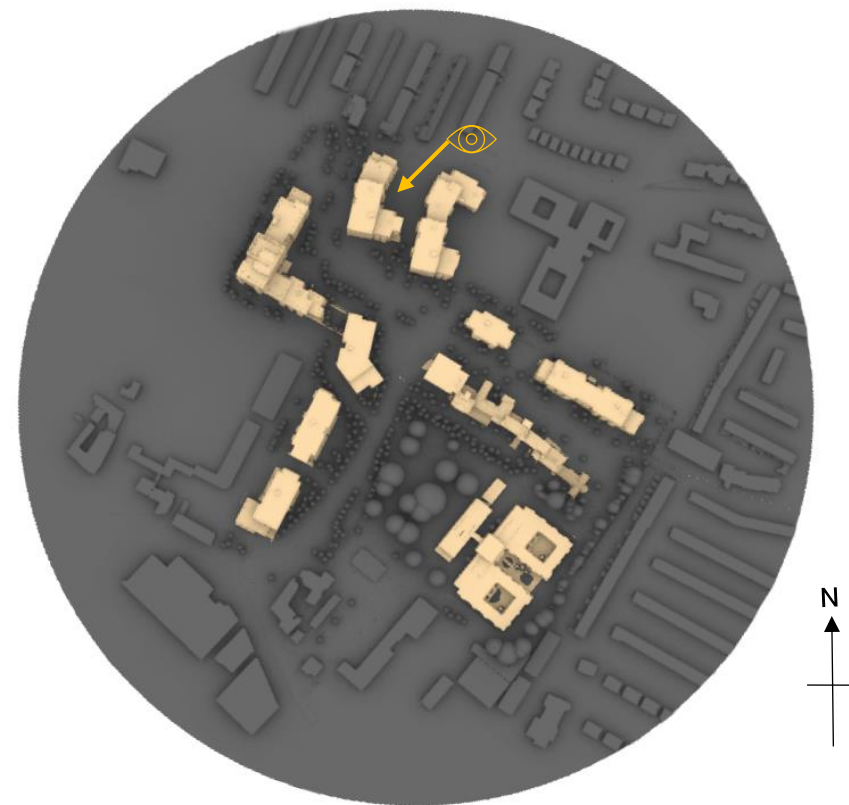


Fig. 4.20.1 – View Key for Building Image Direction

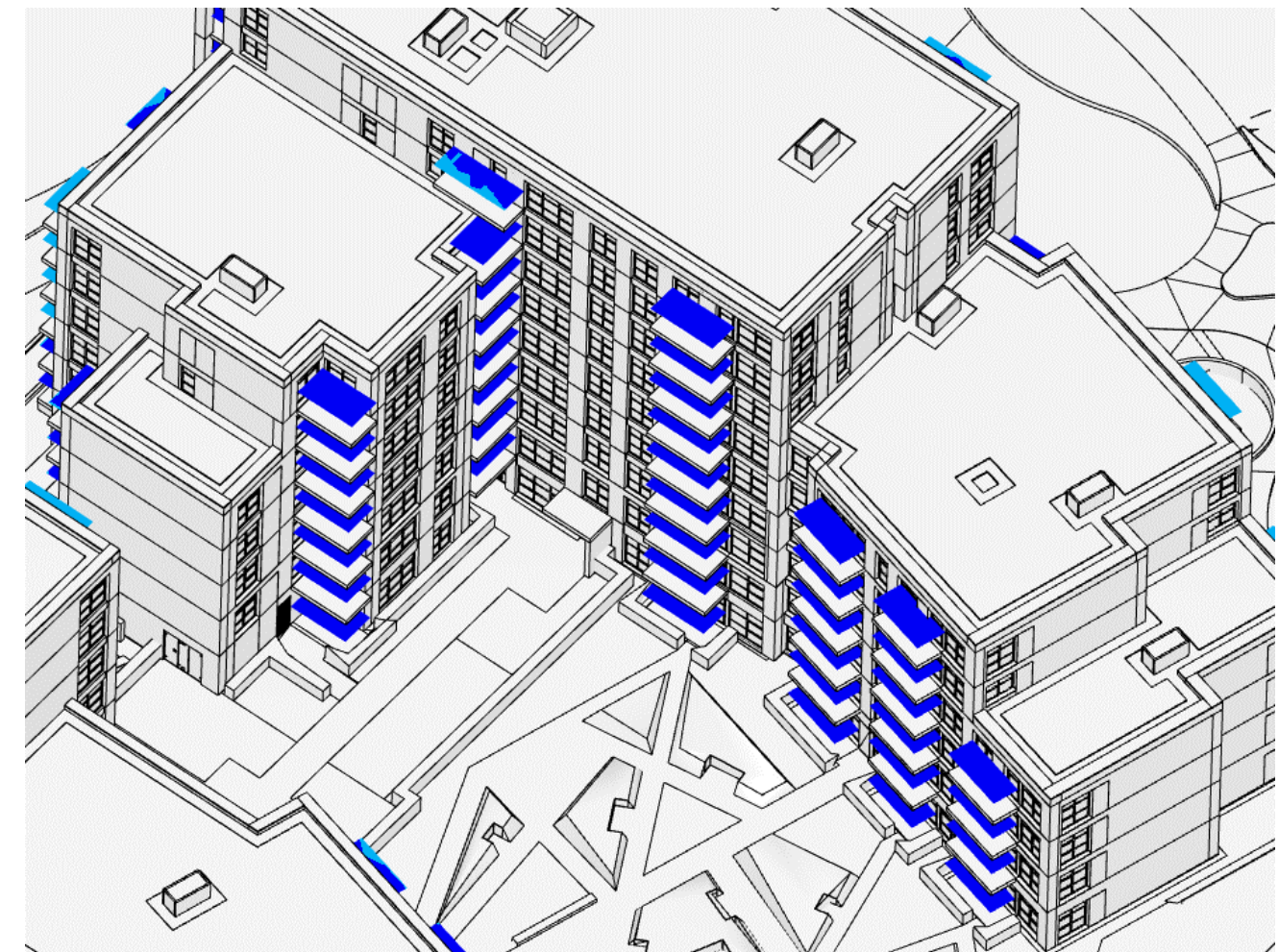


Fig. 4.20.3 – Lawson Criteria Results for Balconies

4.21 Building G Balconies

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

The scale in Fig 4.21.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.21.3 illustrates results for balconies while Figure 4.21.1 shows the direction and location of the balconies.

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. 4.21.2 – Lawson Criteria

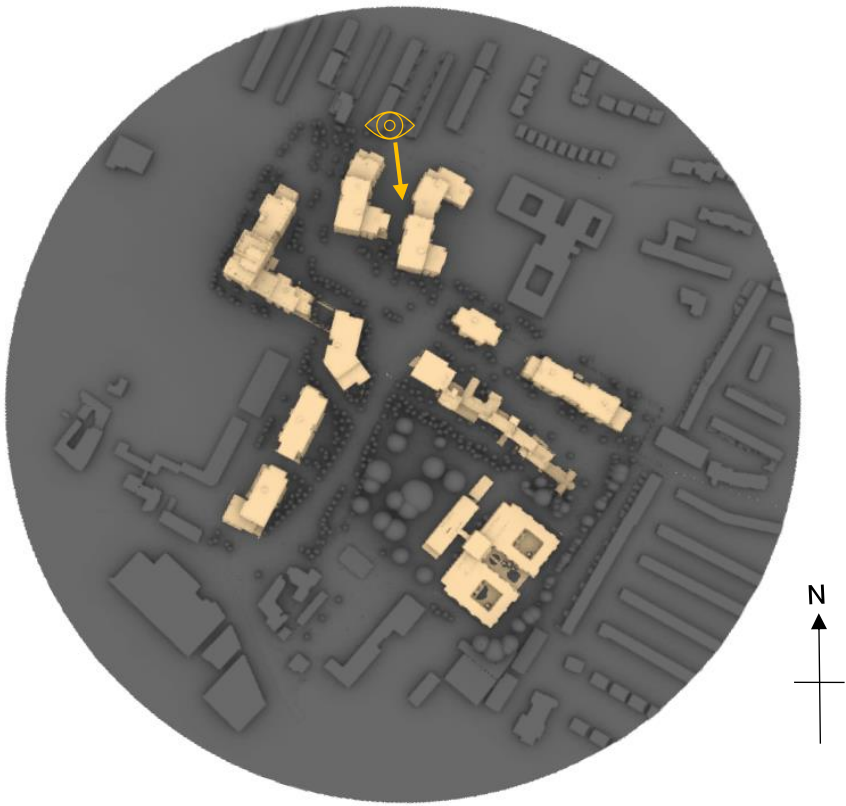


Fig. 4.21.1 – View Key for Building Image Direction

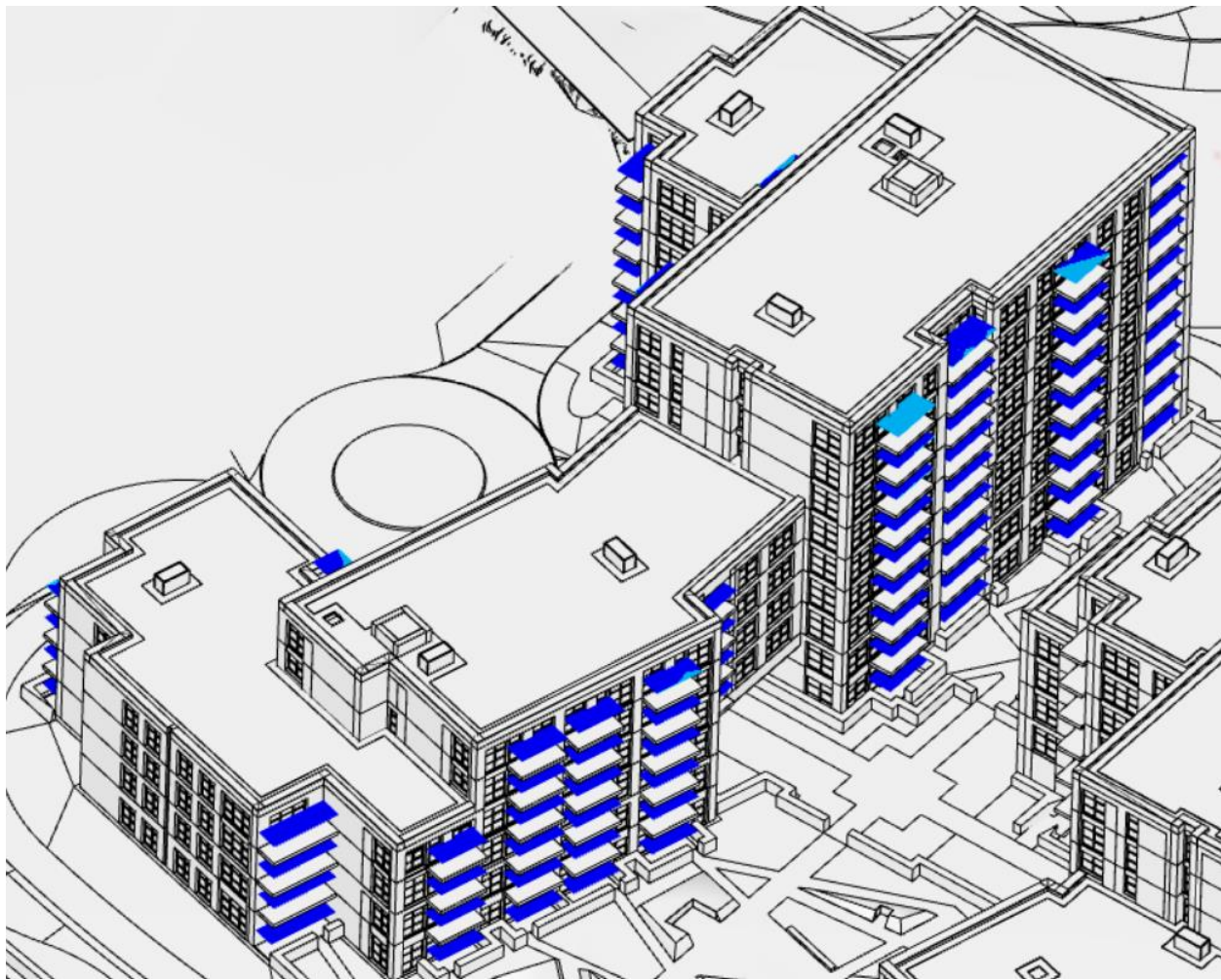


Fig. 4.21.3 – Lawson Criteria Results for Balconies

4.22 Building G Balconies

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

The scale in Fig 4.22.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.22.3 illustrates results for balconies while Figure 4.22.1 shows the direction and location of the balconies.

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. 4.22.2 – Lawson Criteria

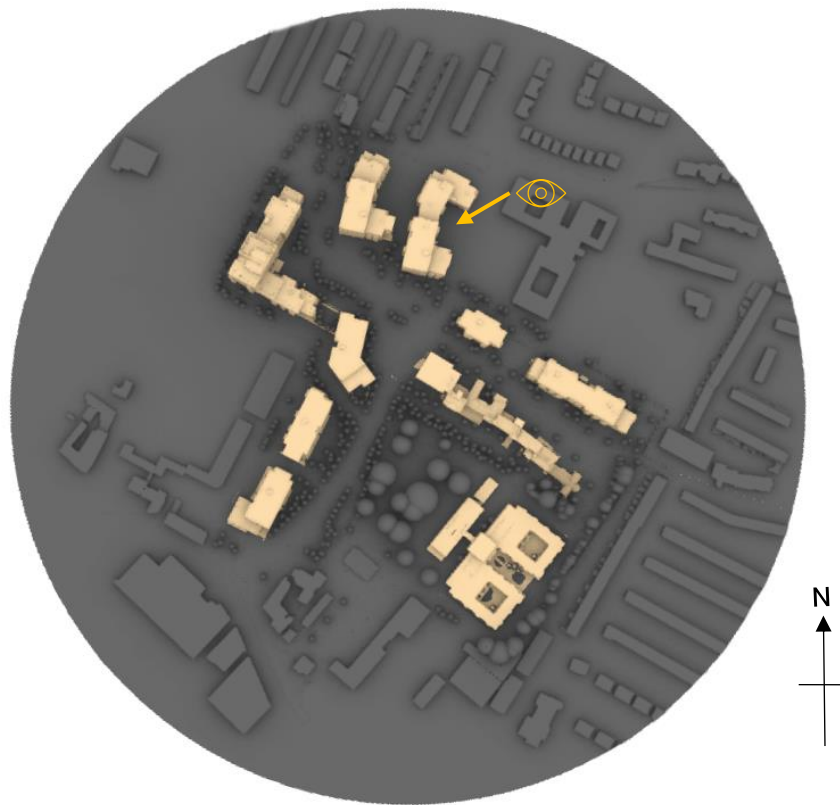


Fig. 4.22.1 – View Key for Building Image Direction



Fig. 4.22.3 – Lawson Criteria Results for Balconies

4.23 Building G Balconies

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

The scale in Fig 4.2.1 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.23.3 illustrates results for balconies while Figure 4.23.1 shows the direction and location of the balconies.

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. 4.23.2 – Lawson Criteria

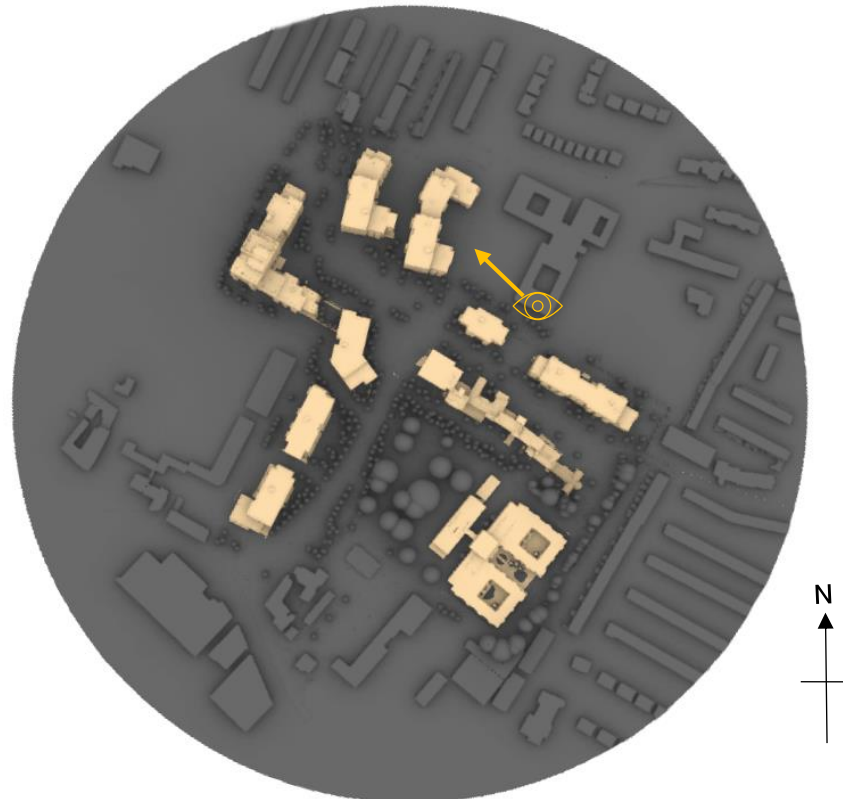


Fig. 4.3.1 – View Key for Building Image Direction

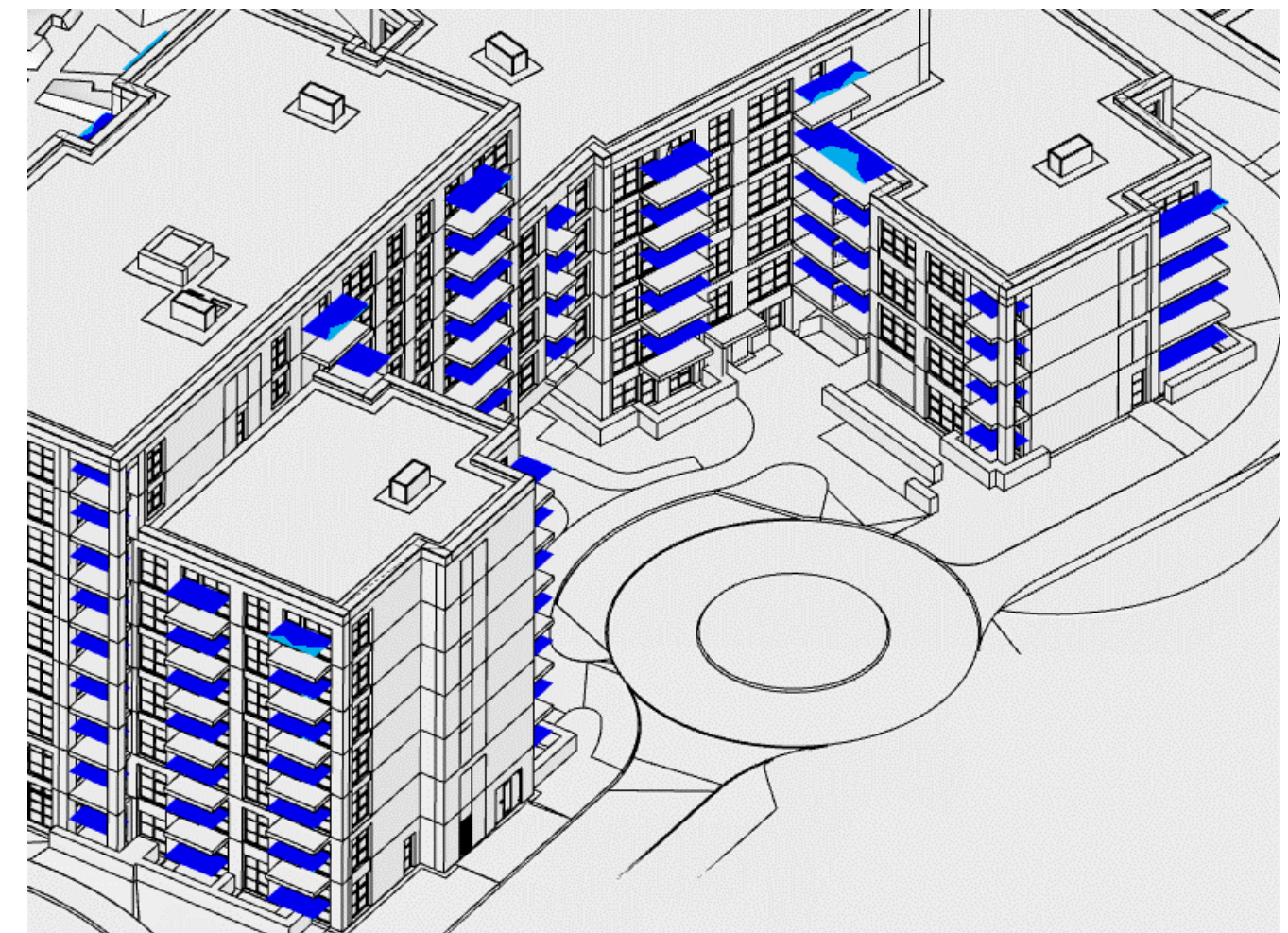


Fig. 4.23.3 – Lawson Criteria Results for Balconies

4.24 Building H Balconies

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

The scale in Fig 4.24.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.24.3 illustrates results for balconies while Figure 4.24.1 shows the direction and location of the balconies.

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. 4.24.2 – Lawson Criteria

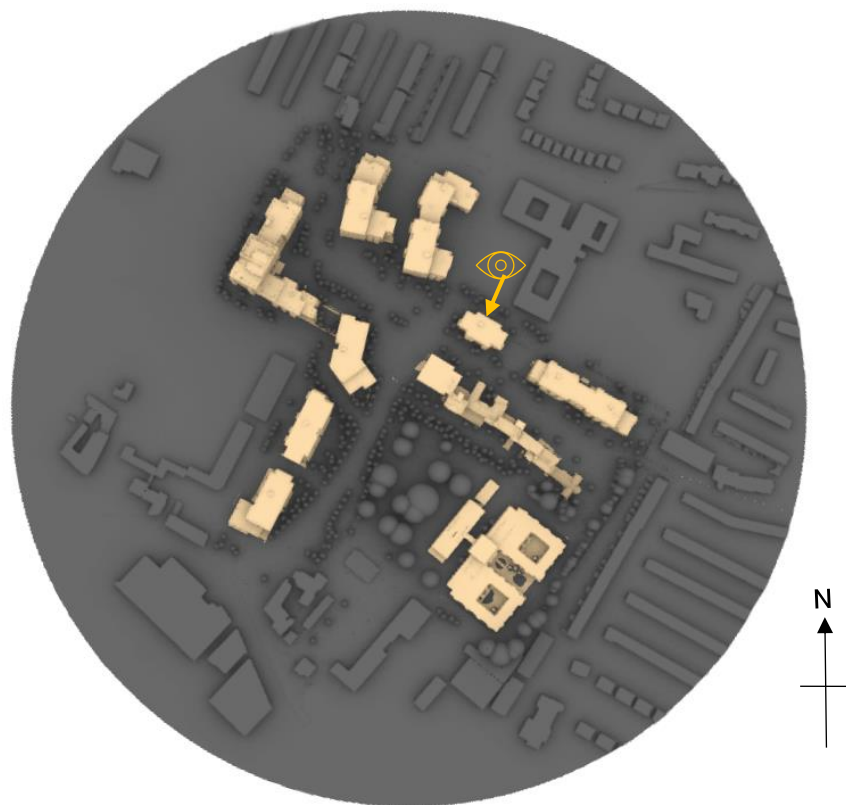


Fig. 4.24.1 – View Key for Building Image Direction

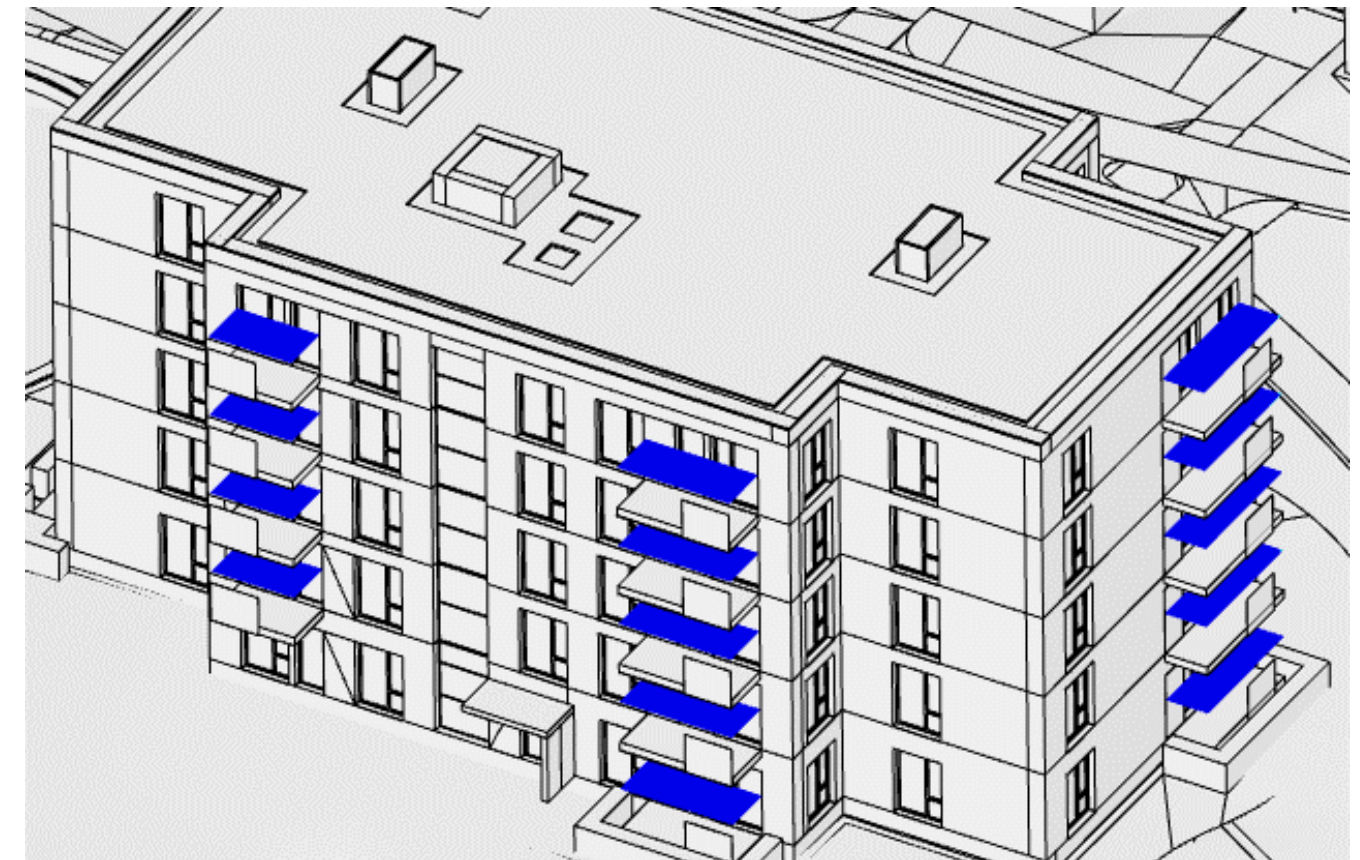


Fig. 4.24.3 – Lawson Criteria Results for Balconies

4.25 Building H Balconies

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

The scale in Fig 4.25.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.25.3 illustrates results for balconies while Figure 4.25.1 shows the direction and location of the balconies.

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. 4.25.2 – Lawson Criteria

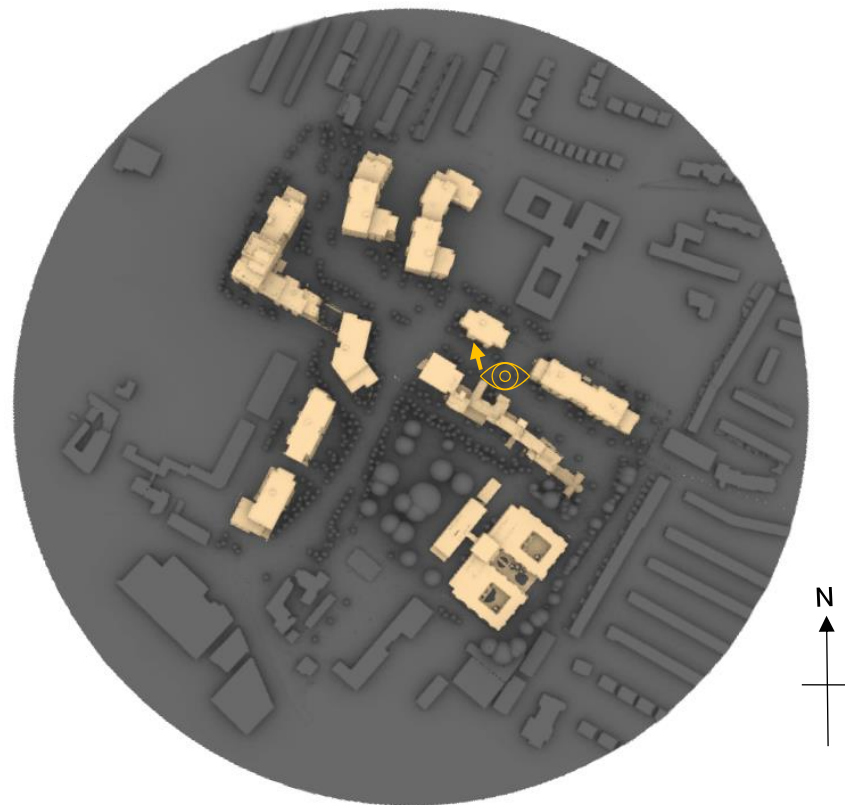


Fig. 4.25.1 – View Key for Building Image Direction

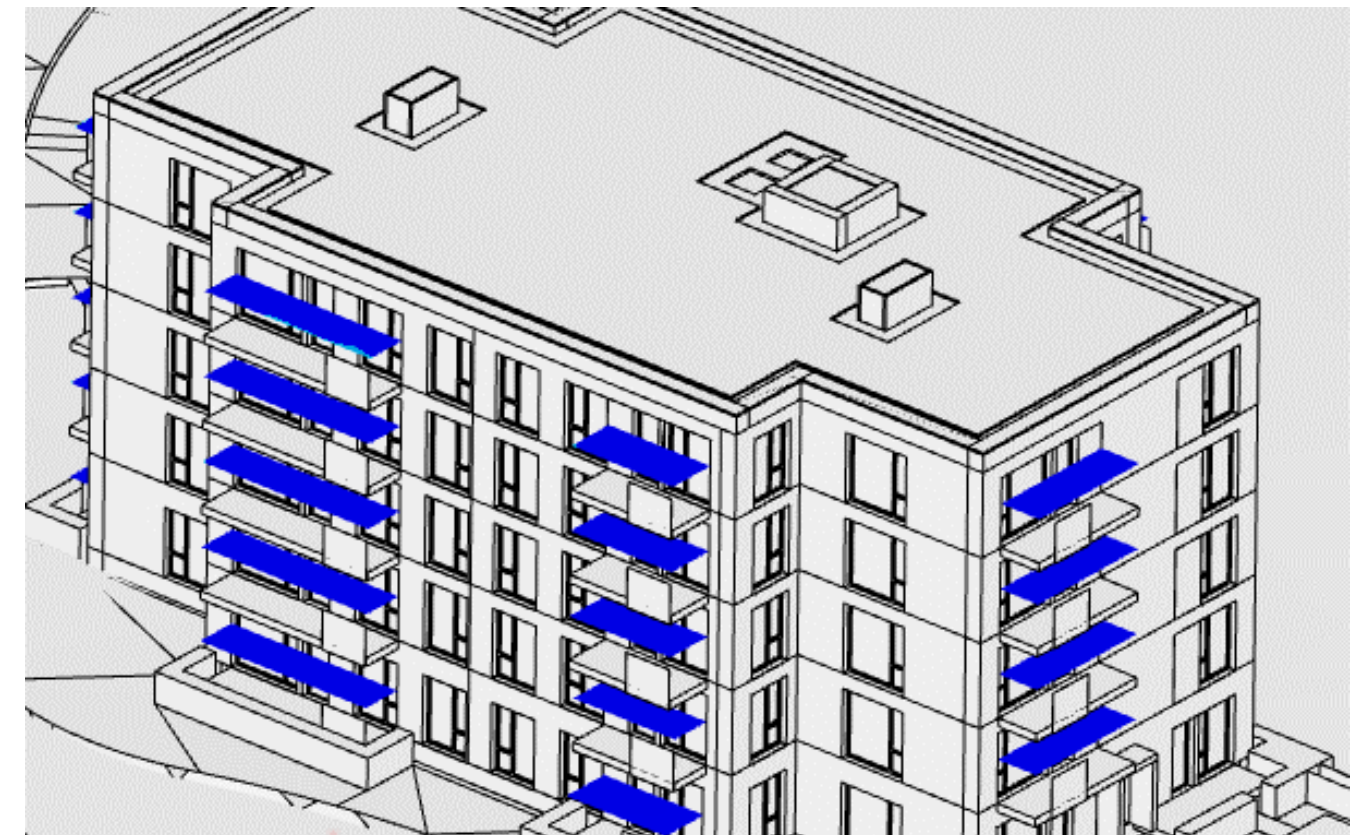


Fig. 4.25.3 – Lawson Criteria Results for Balconies

4.26 Building J Balconies

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

The scale in Fig 4.26.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.26.3 illustrates results for balconies while Figure 4.26.1 shows the direction and location of the balconies.

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. 4.26.2 – Lawson Criteria



Fig. 4.26.1 – View Key for Building Image Direction

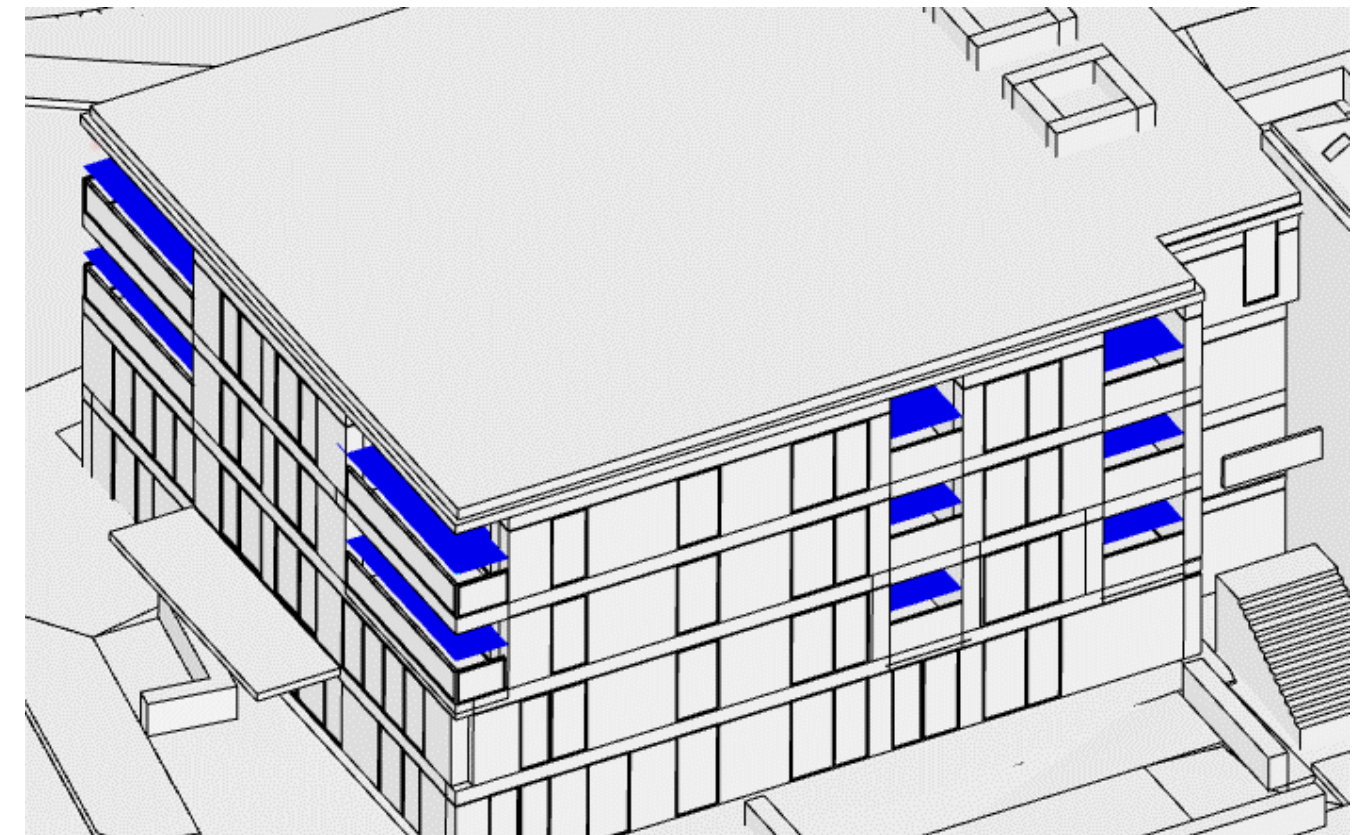


Fig. 4.26.3 – Lawson Criteria Results for Balconies

4.27 Building J Balconies

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

The scale in Fig 4.27.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.27.3 illustrates results for balconies while Figure 4.27.1 shows the direction and location of the balconies.

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. 4.27.2 – Lawson Criteria

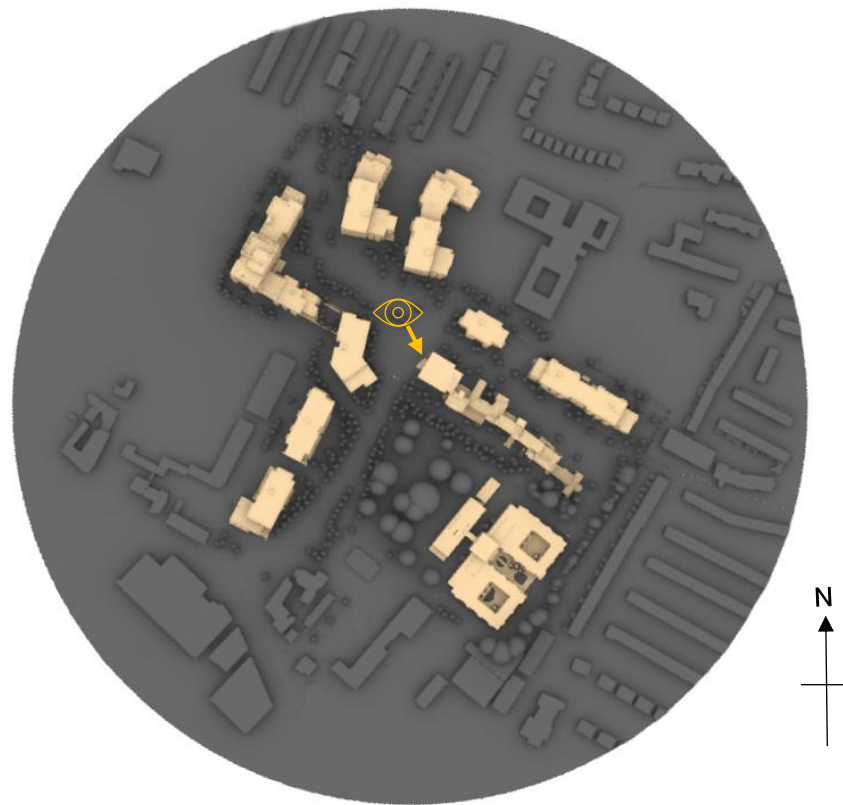


Fig. 4.27.1 – View Key for Building Image Direction

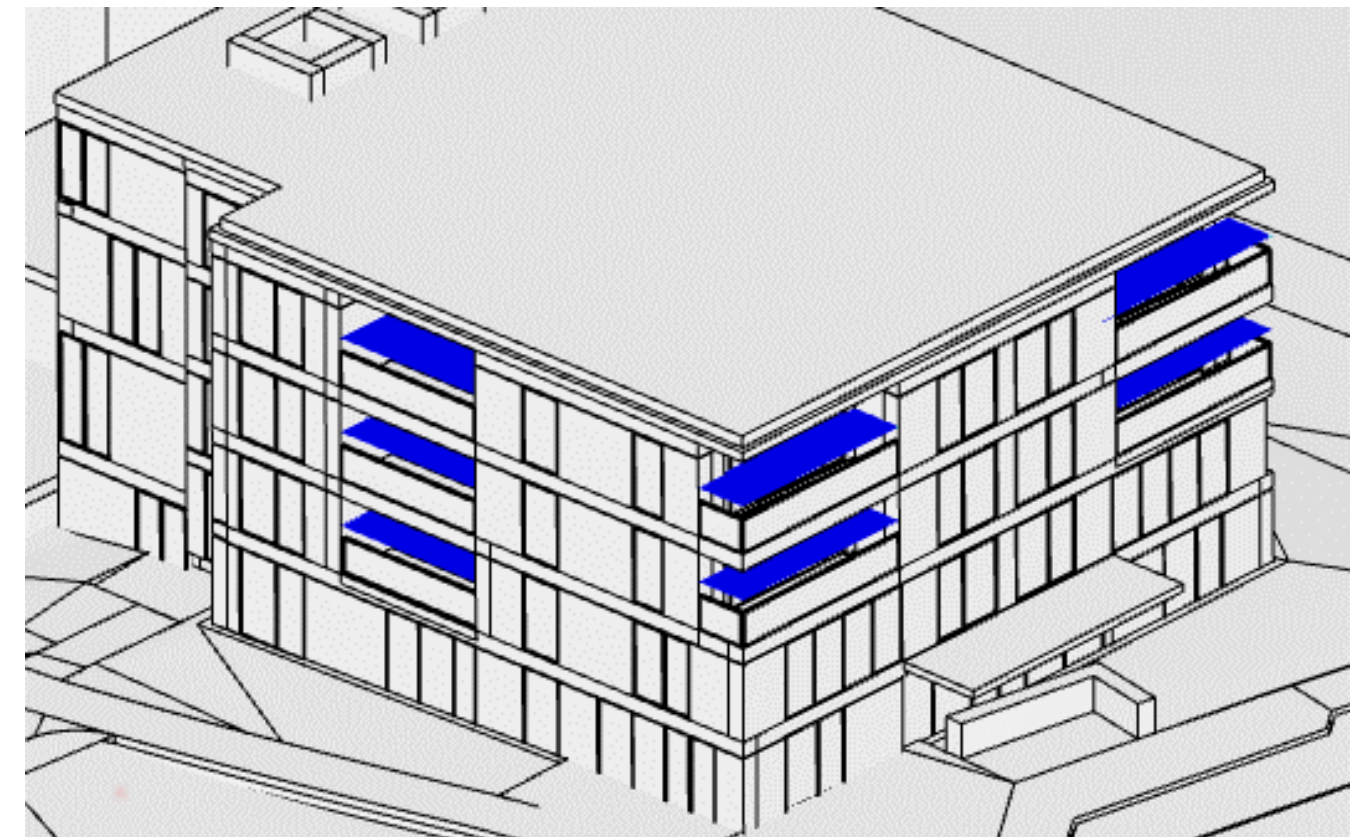


Fig. 4.27.3 – Lawson Criteria Results for Balconies

4.28 Building L Balconies

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

The scale in Fig 4.28.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.28.3 illustrates results for balconies while Figure 4.28.1 shows the direction and location of the balconies.

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. 4.28.2 – Lawson Criteria

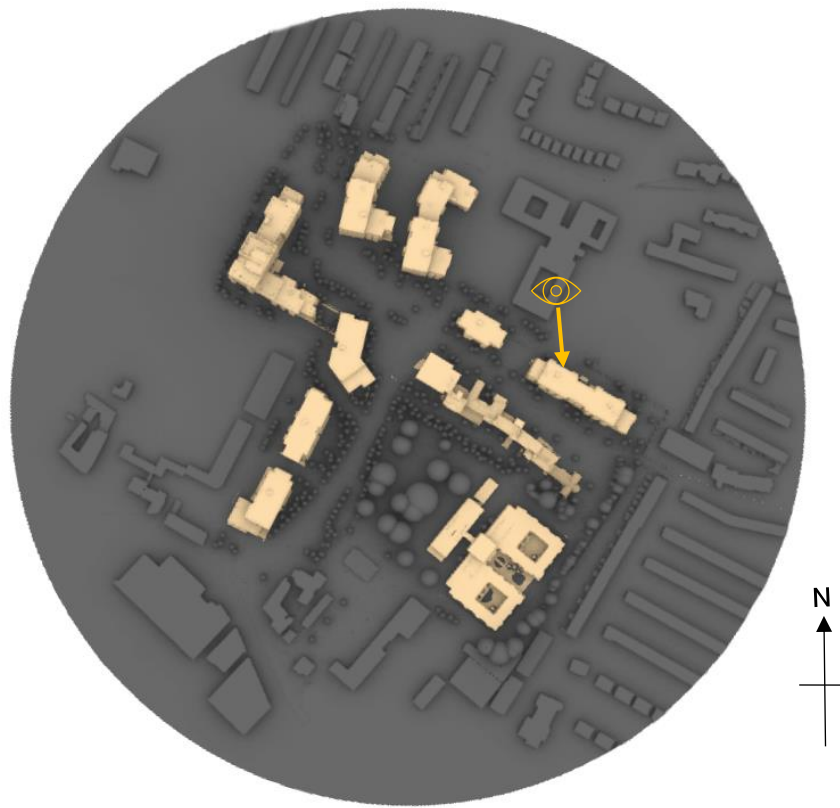


Fig. 4.28.1 – View Key for Building Image Direction



Fig. 4.28.3 – Lawson Criteria Results for Balconies

4.29 Building L Balconies

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

The scale in Fig 4.29.2 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.

Balconies across the proposed development were determined to be predominantly suitable for “Outdoor Dining/Pedestrian Sitting” and therefore well suited to their intended use as private amenity spaces. Fig 4.29.3 illustrates results for balconies while Figure 4.29.1 shows the direction and location of the balconies.

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. 4.29.2 – Lawson Criteria

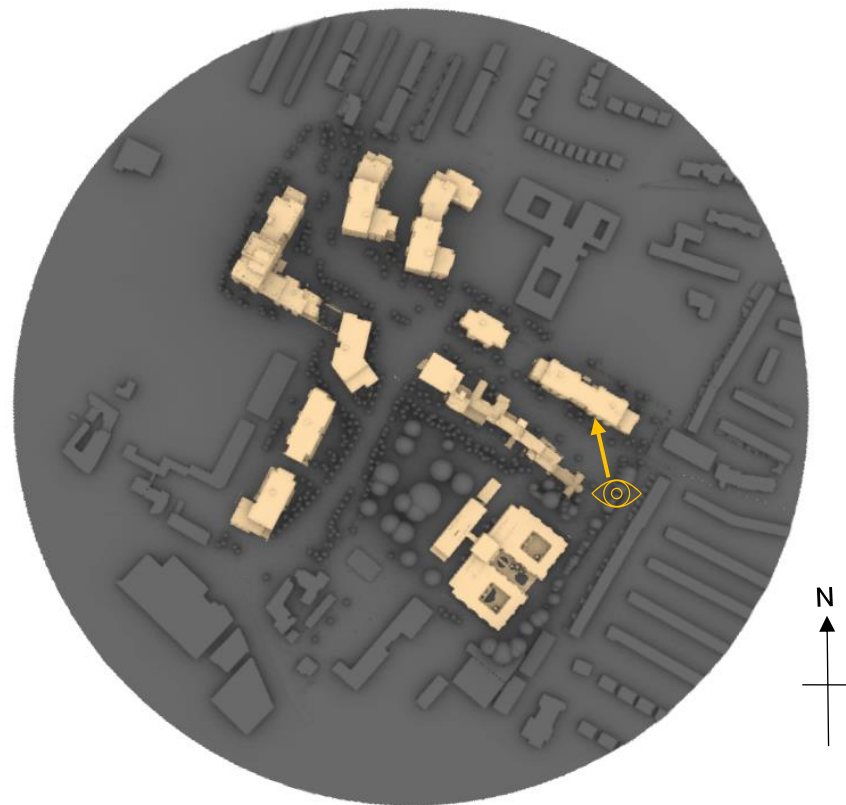


Fig. 4.29.1 – View Key for Building Image Direction

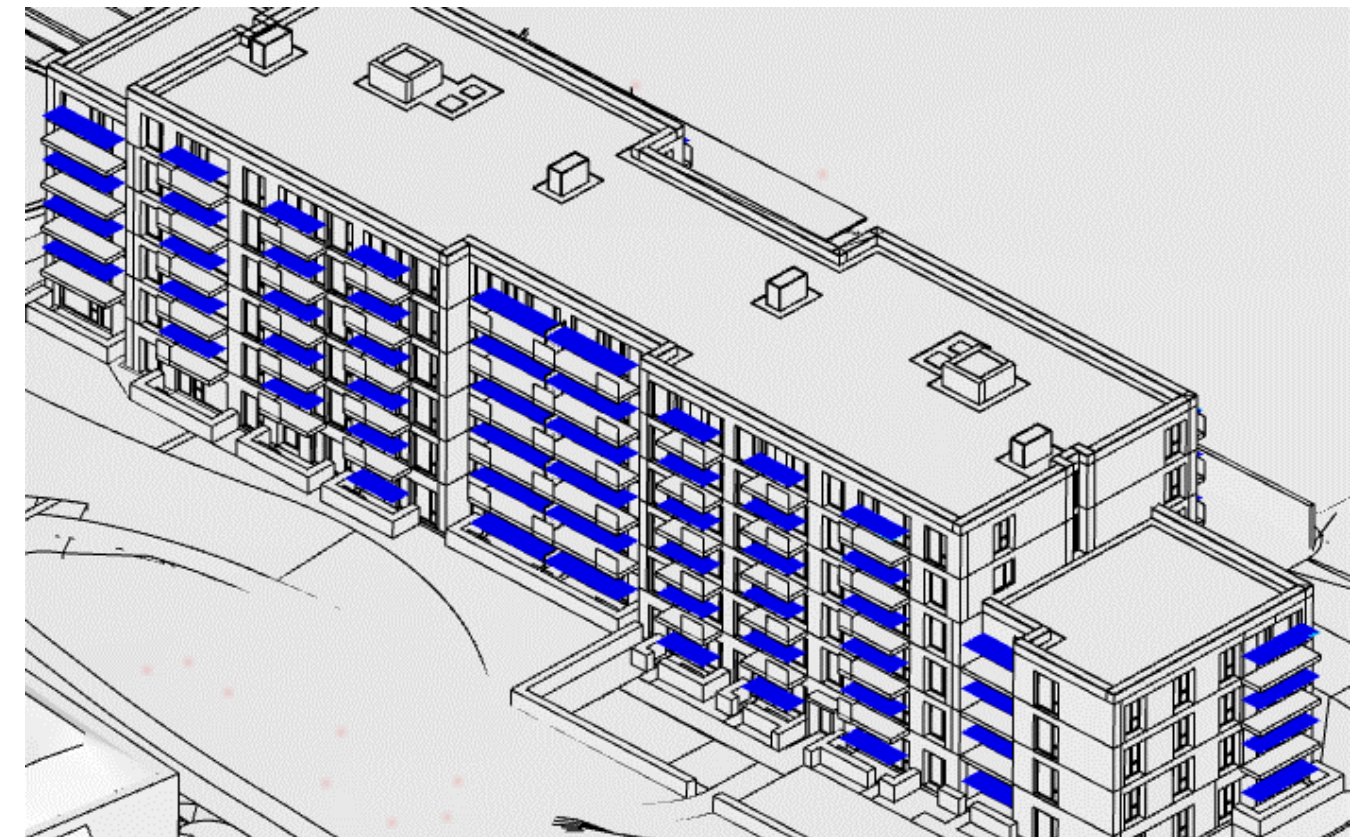


Fig. 4.29.3 – Lawson Criteria Results for Balconies



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