Lioncor Carlisle LRD
Kimmage
Dublin 12

Microclimatic Wind Analysis and Pedestrian Comfort Report

IN2 Project No. D2124

28/03/2025

REV00

Revision History

Date	Revision	Description
28/03/2025	00	Issued for review

Table of Contents

1.0 Executive Summary

This report compiles the results of Microclimatic Wind Analysis and Comfort Conditions undertaken by IN2 Engineering Design Partnership for the proposed residential development at Carlisle, Kimmage, Dublin 12, based on 3D modelling information received from BKD Architects, comprising of assessments for predicted Wind Conditions to the local environment.

The proposed development consists of four residential blocks, and it is surrounded by low level suburban residential developments to all sides. These varying terrain types have been accounted for within the wind simulations undertaken, with the 3D modelling information of the neighbouring buildings being provided by VUCity.

The report summarises the analysis undertaken, and conclusions determined from simulations performed with regards to Wind/ Pedestrian Comfort, in all cases validating results in accordance with robust Best Practice Guidelines to ensure compliance in accordance with the methodologies described in Section 2.0.

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 determined 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 (Lawson LDDC Comfort) Methodology - an assessment method for Pedestrian Comfort to predict activity suitability (sitting/ standing etc.) for persons in the vicinity of the development as outlined in Section 2.2.

The wind conditions at the ground level were predicted to be comfortable, with the majority of the area deemed suitable for “Pedestrian Standing” or better. The addition of the proposed landscaping to the analysis allowed for additional sheltering, improving predicted conditions for the occupants.

All balconies were determined to be well sheltered, providing good conditions for resident usage.

The majority of the podium area was predicted to be comfortable, but some areas of acceleration were identified along the access stairways between Blocks 1 and 2, and Blocks 2 and 3. To further shelter these spaces, the proposed landscaping was assessed. This was determined to provide improved conditions and minimise the region of acceleration.

Overall, the proposed development was determined to not negatively impact its receiving environment, and all amenity spaces were predicted to be comfortable with regards to wind microclimate.

2.0 Methodology

2.1 Microclimatic 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 at Carlisle, Kimmage is seen to be inside the sheltered area as highlighted in Fig 2.1.1. On a macro level, the site is surrounded by low level suburban developments to all sides.

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 "Towns, villages, agricultural land with many or high hedges, forests and very rough and uneven terrain (z_0=0.4m 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 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 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.

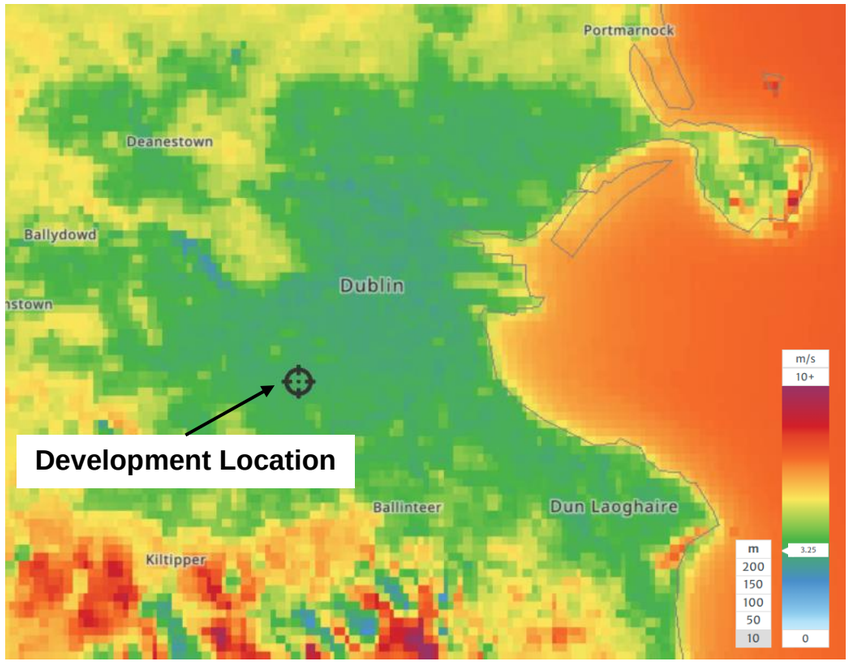


Fig 2.1.1 – Mean Wind Speeds across Dublin – Global Wind Atlas

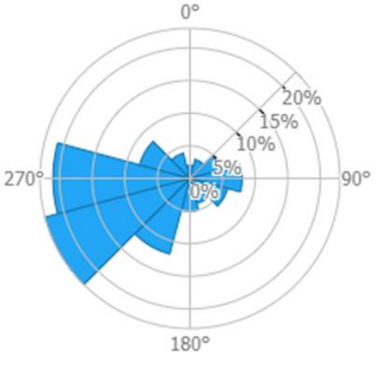


Fig 2.1.2 – Wind Frequency Rose for Carlisle – Global Wind Atlas

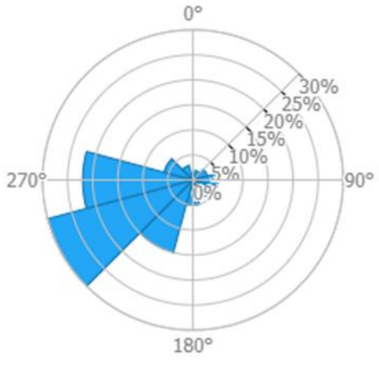


Fig 2.1.3 – Wind Speed Rose for Carlisle – Global Wind Atlas

2.1 Microclimate 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 analysis included representational models of adjacent commercial and residential buildings as provided by VUCity.

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 south-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.

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.

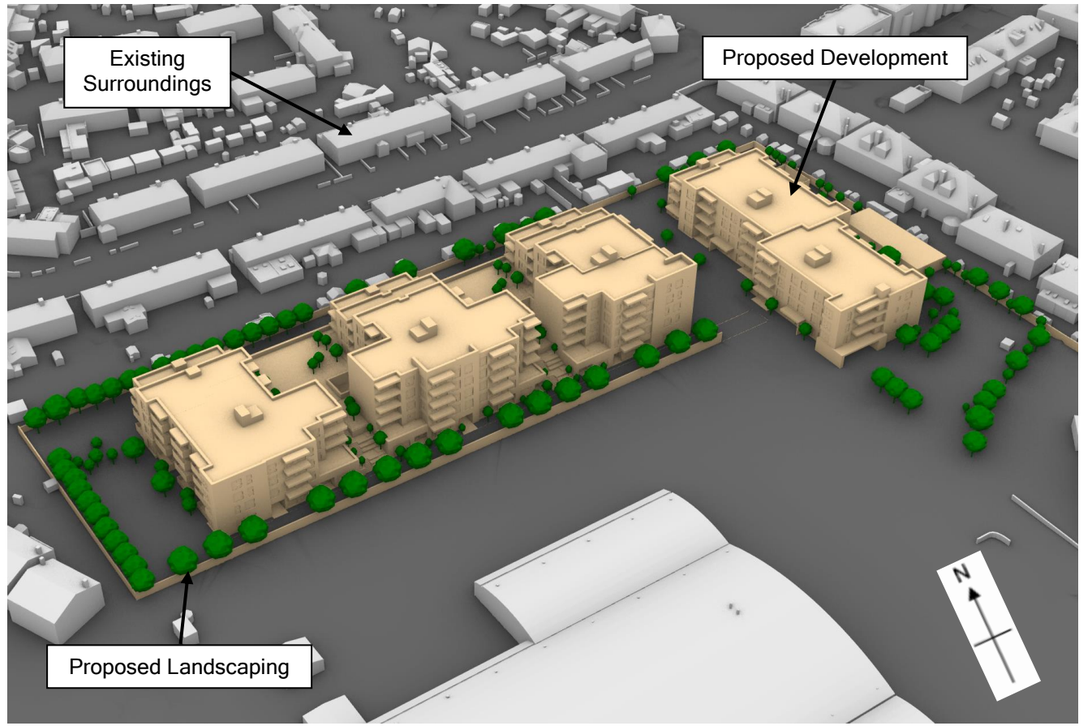


Fig 2.1.4 – 3D Model of Proposed Development and Neighbouring Buildings

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 (termed LDDC Lawson Comfort Scale), 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

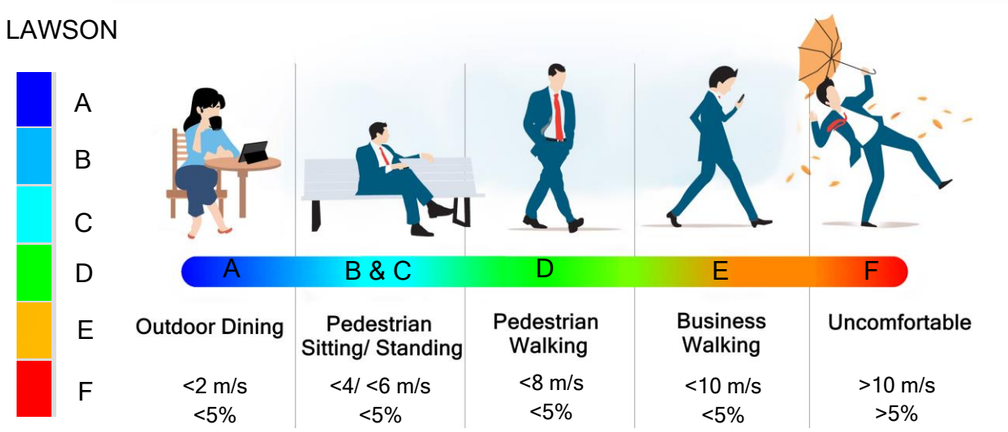


Fig 2.2.2 LDDC Lawson Comfort Scale

2.3 Areas of Assessment

All outdoor spaces where there is expected to be pedestrian activity have been assessed for pedestrian comfort.

For the Pedestrian Comfort Analysis, the assessed spaces have been grouped into the following sections:

1. Ground level surroundings: all ground areas surrounding the development where pedestrians will be walking and / or entering the buildings (highlighted in blue in Fig 2.3.1). This includes private and communal open spaces.

2. Balconies: private amenity area for each apartment for resident usage (highlighted in pink in Fig 2.3.1).

3. Podiums: elevated communal open space between Blocks 1-3 (highlighted in green in Fig 2.3.1).

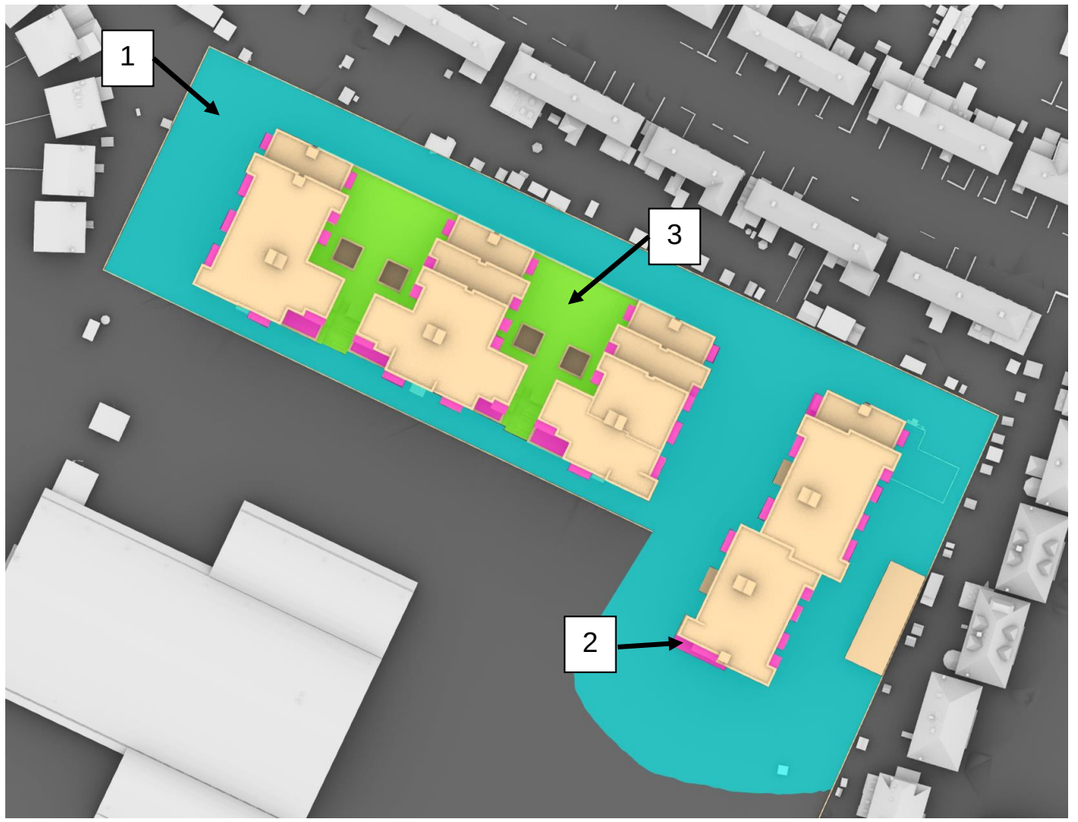


Fig 2.3.1 Assessed External Amenity Spaces

3.0 Wind Analysis – Prevailing Winds

3.1 Ground Level Amenity and Open Space

Figure 3.1.1 illustrates the predicted wind flow onto the podiums between Blocks 2 and 3 under the prevailing 240° (south-westerly) wind direction.

It was determined that a region of accelerated wind exists along the access stairway to the podium, which can be identified by the red / orange colours in the streamlines. As illustrated in Section 4.0, this acceleration was not predicted to be severe enough to cause discomfort.

However, to improve conditions the proposed landscaping was assessed, with results presented in Fig 3.1.2. The landscaping was determined to successfully decrease the acceleration across the stairway, lowering the average wind velocity from the SW direction and improving conditions for occupants.

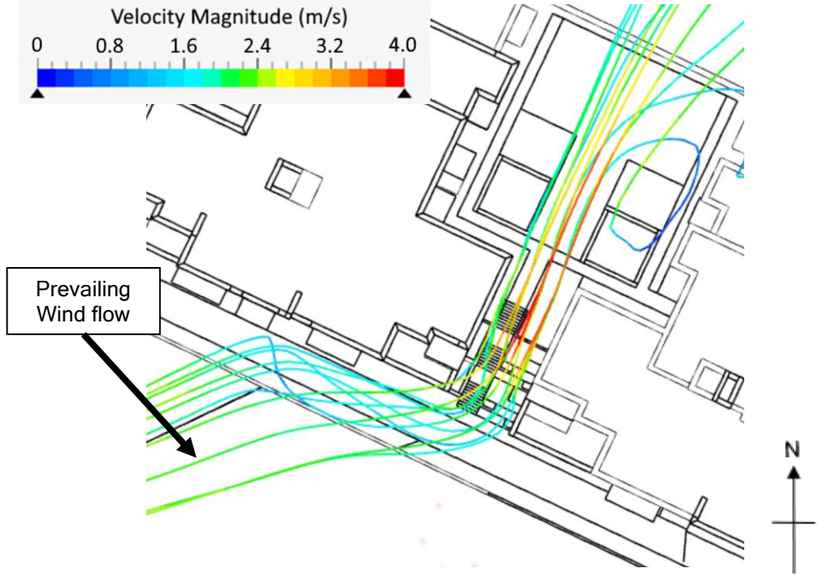


Fig. 3.1.1 – Wind velocity streamlines from prevailing SW wind direction onto the podium between Blocks 2 and 3 excluding proposed landscaping.

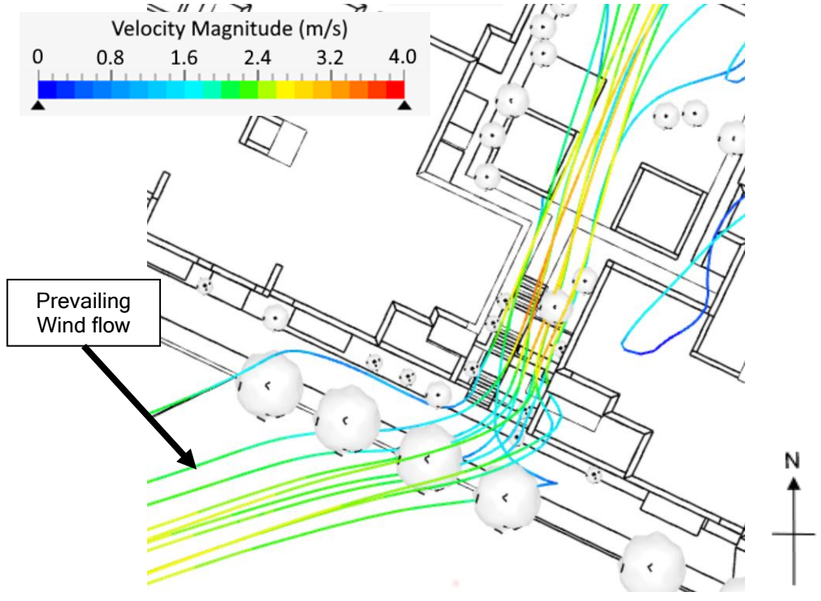


Fig. 3.1.2 – Wind velocity streamlines from prevailing SW wind direction onto the podium between Blocks 2 and 3 including proposed landscaping.

4.0 Pedestrian Comfort

4.1 Ground Level Open Space

The Pedestrian Comfort at the ground level for the proposed development and its surrounding areas was assessed by predicting the 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”.

The Lawson Criteria results for ground level are presented in Fig 4.1.2. As shown, the majority of the area was determined to be sheltered, with some areas of “Pedestrian Walking” identified. With the addition of the proposed landscaping the predicted comfort levels were determined to be improved as illustrated in Fig 4.1.3. The number of “Pedestrian Walking” regions were reduced, enhancing the usability of the space for occupants.

All doorways were determined to be sheltered as well, allowing for ease of access to the proposed buildings. The creche amenity space was predicted to be entirely suitable for “Outdoor Dining” providing excellent conditions for the occupants.

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

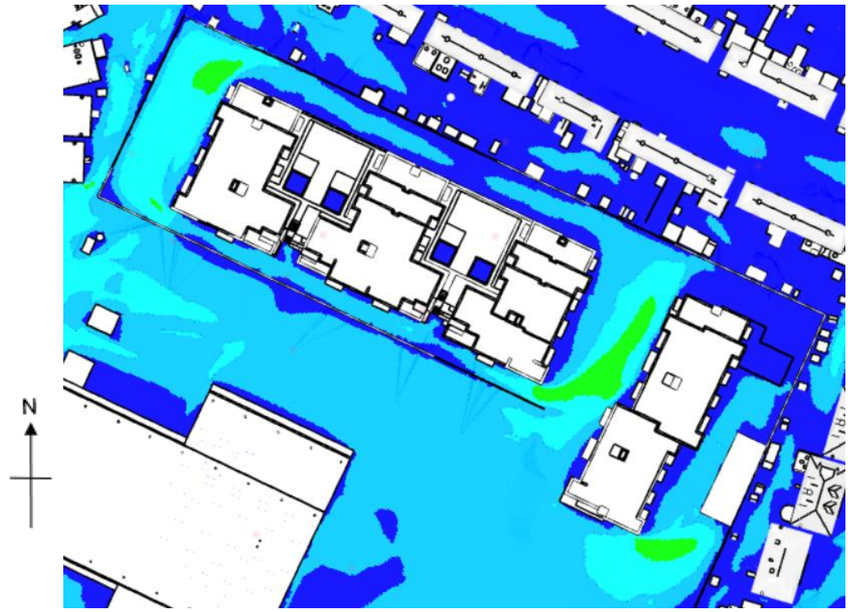


Fig. 4.1.2 – Lawson Criteria Results at 1.5m above ground level.

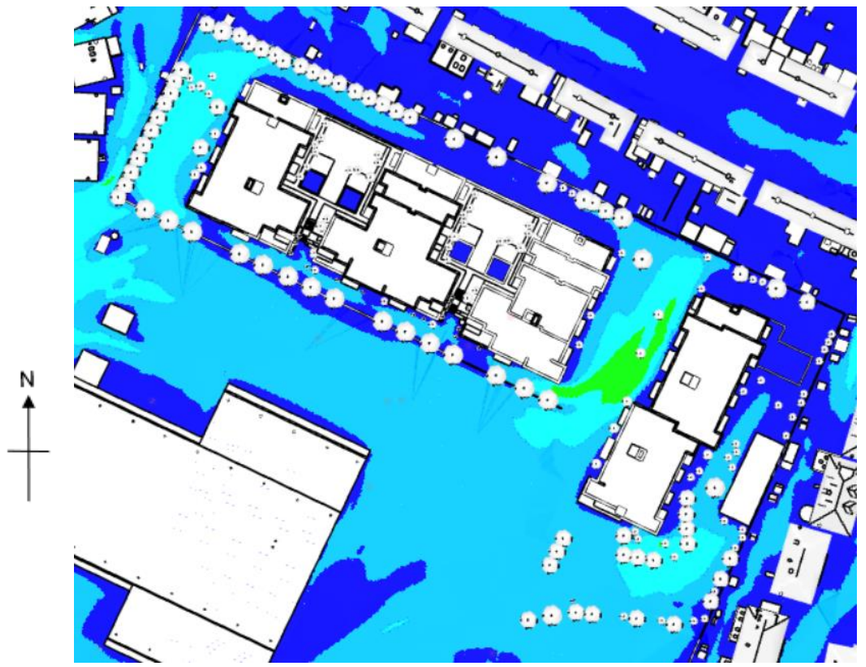


Fig. 4.1.3 – Lawson Criteria Results at 1.5m above ground level including landscaping.

4.2 Balcony Amenity Spaces

Figure 4.2.2 illustrates the Lawson Criteria Results for a subset of the balconies on Block 1, with full results for all balconies available in Appendix A.

All balconies were predicted to be suitable for “Outdoor Dining / Pedestrian Sitting”. There were small regions of “Pedestrian Standing / Walking” identified on the edge of some balconies, but these areas were not expected to negatively affect the usability of the space.

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

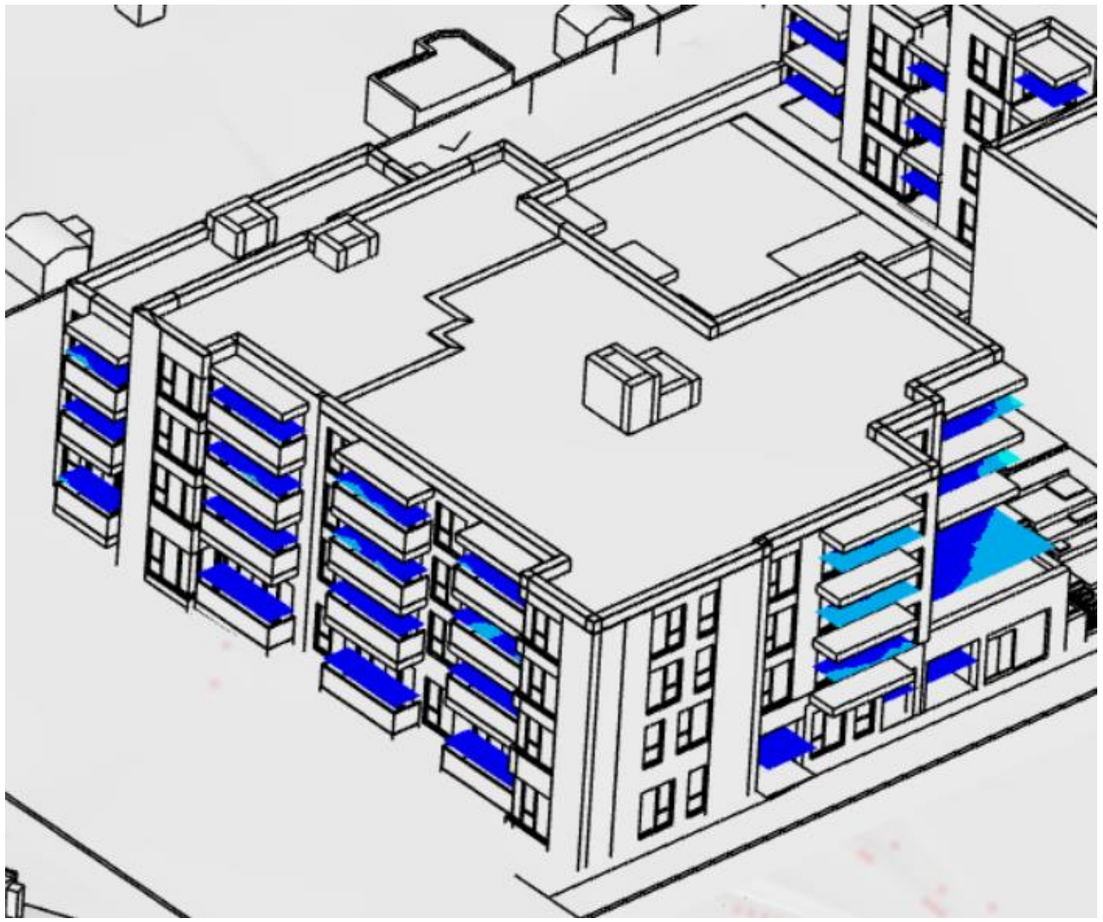


Fig. 4.2.2 – Lawson Criteria results at 1.5m above balcony amenity on Block 1.

4.3 Podium Spaces

Figure 4.3.2 illustrates the pedestrian comfort results for the podiums between Block 1, 2, and 3 without landscaping. It was determined that the majority of the podium is sheltered, with areas of slight acceleration identified in the spaces between Block 1 and 2 and Blocks 2 and 3.

In these accelerated areas, the predicted comfort level was “Pedestrian / Business Walking”, which is not excessive for the intended use. However, through the addition of landscaping the average wind speed can be reduced, improving the predicted comfort level as shown in Fig 4.3.3. Overall, the podiums were determined to be suitably comfortable for their intended use.

	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

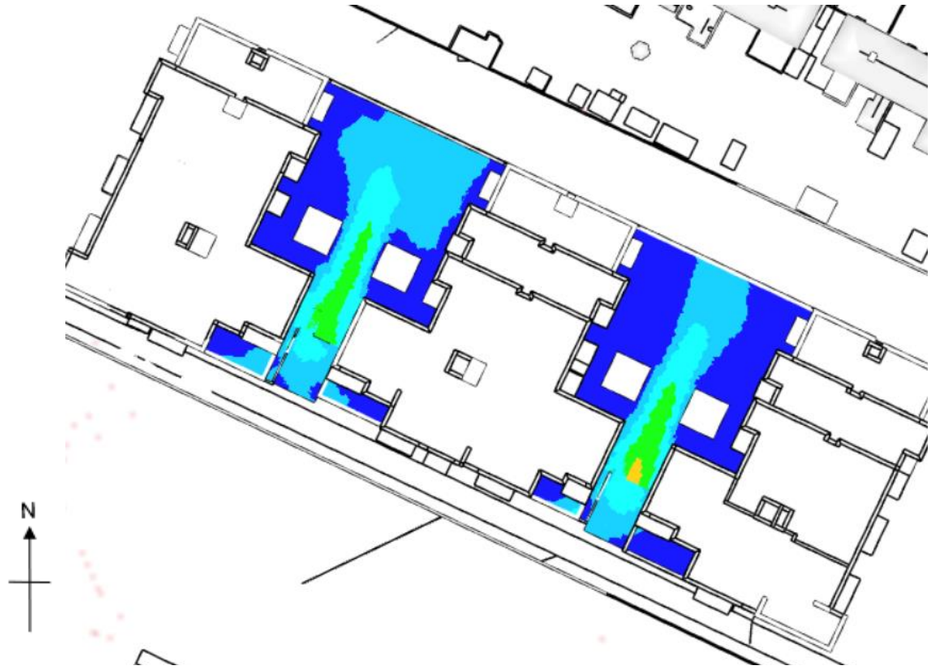


Fig. 4.3.2 – Lawson Criteria results at 1.5m above podiums.

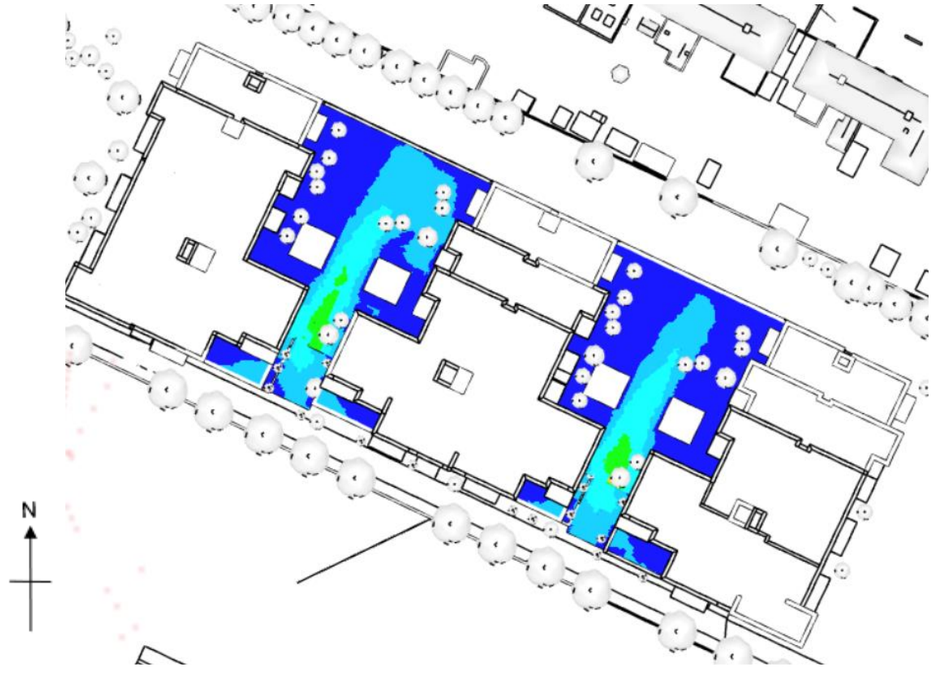
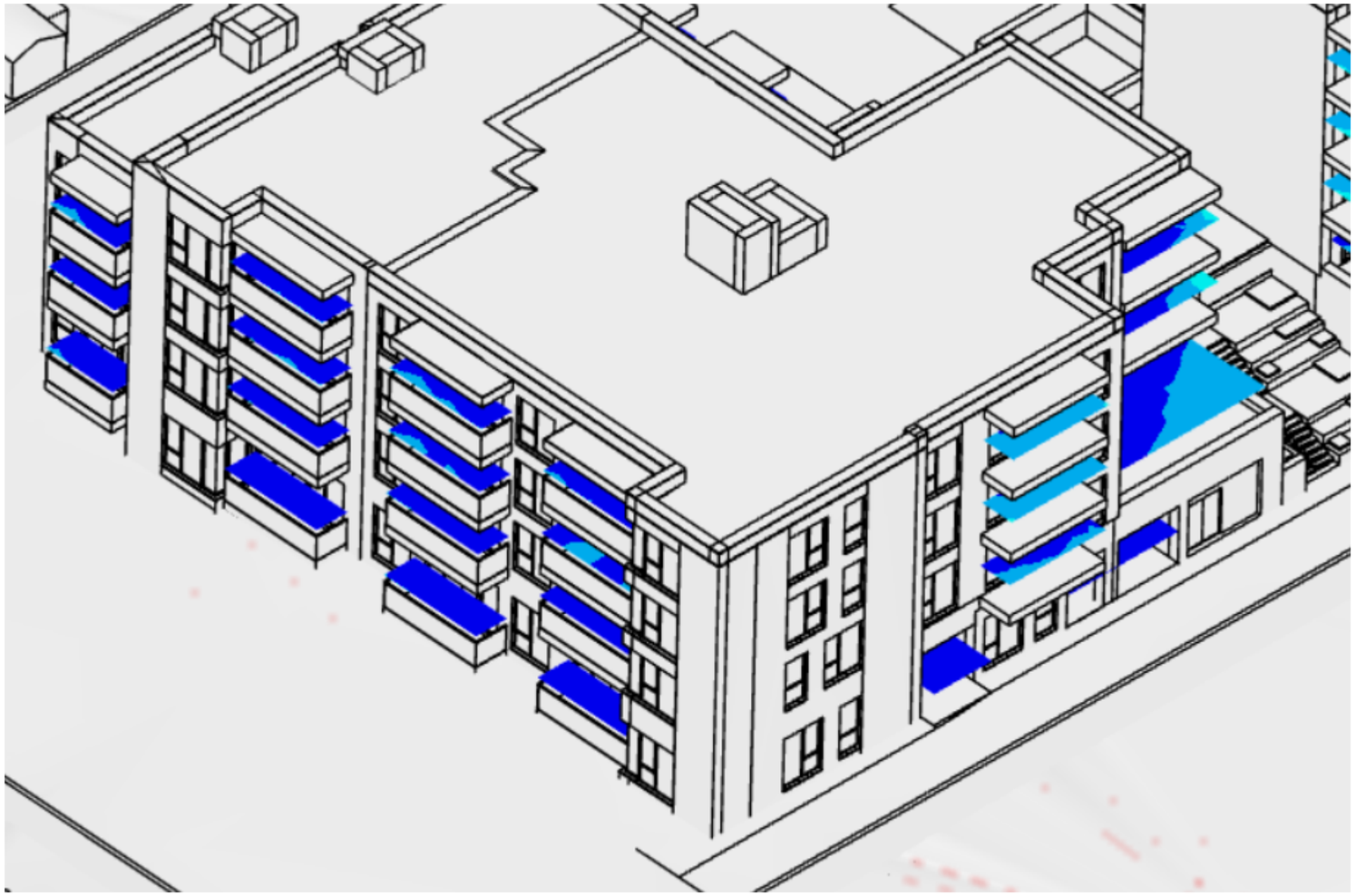


Fig. 4.3.2 – Lawson Criteria results at 1.5m above podiums including proposed landscaping.

5.0 Appendix A: Additional Balcony Lawson Criteria Results



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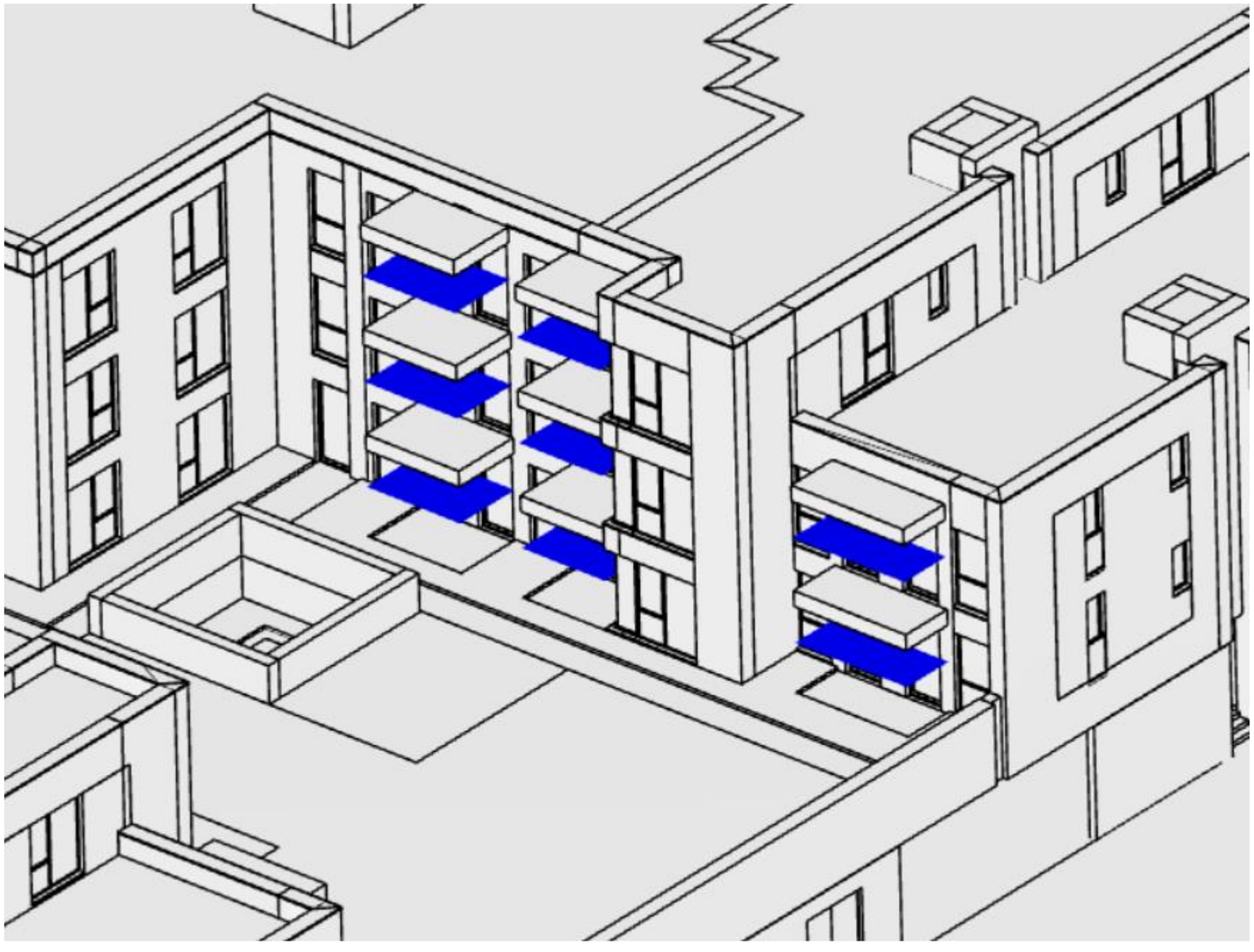
D	8 m/s	< 5%	Pedestrian Walking
E	10 m/s	< 5%	Business Walking
U	10 m/s	> 5%	Uncomfortable



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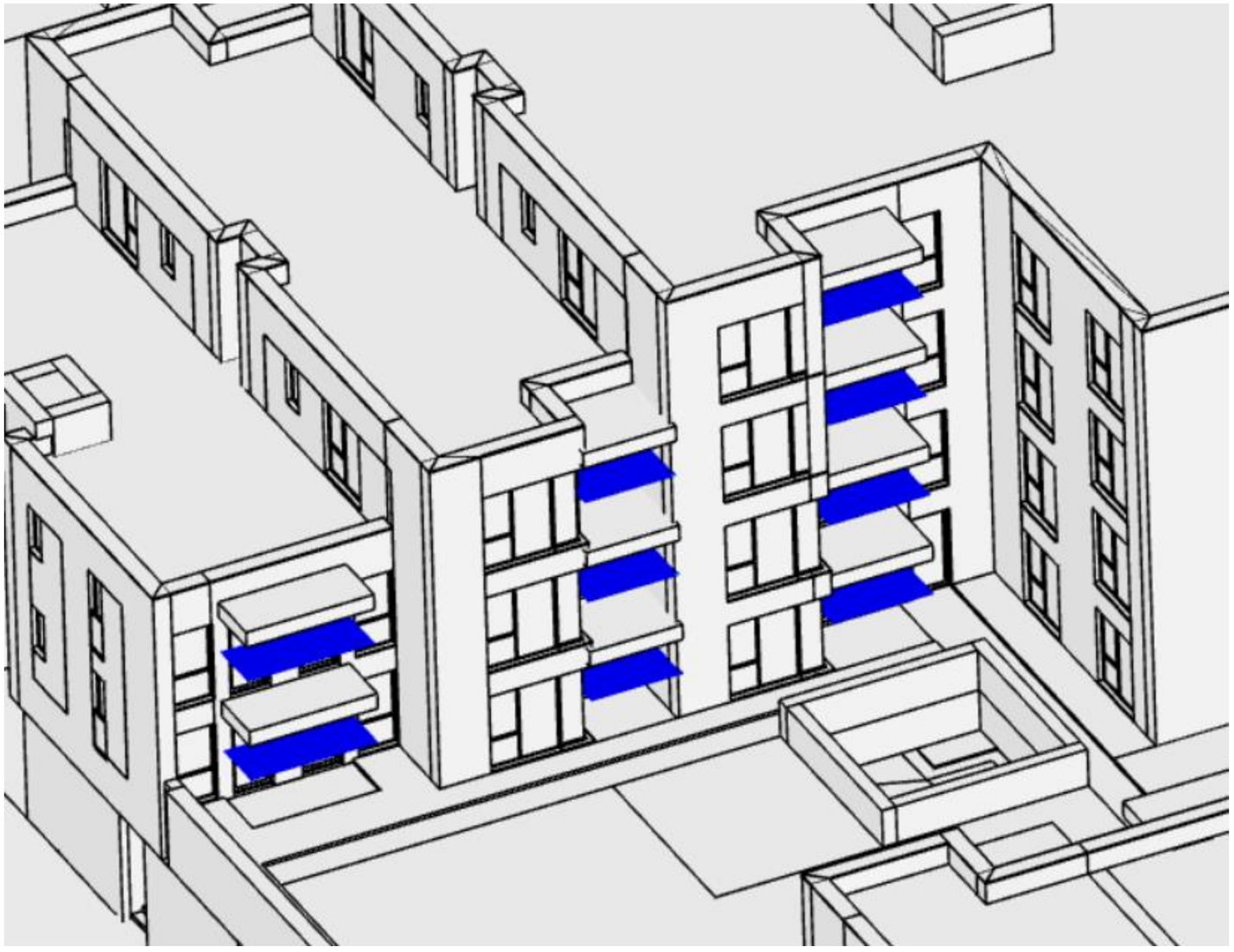
U	10 m/s	> 5%	Uncomfortable



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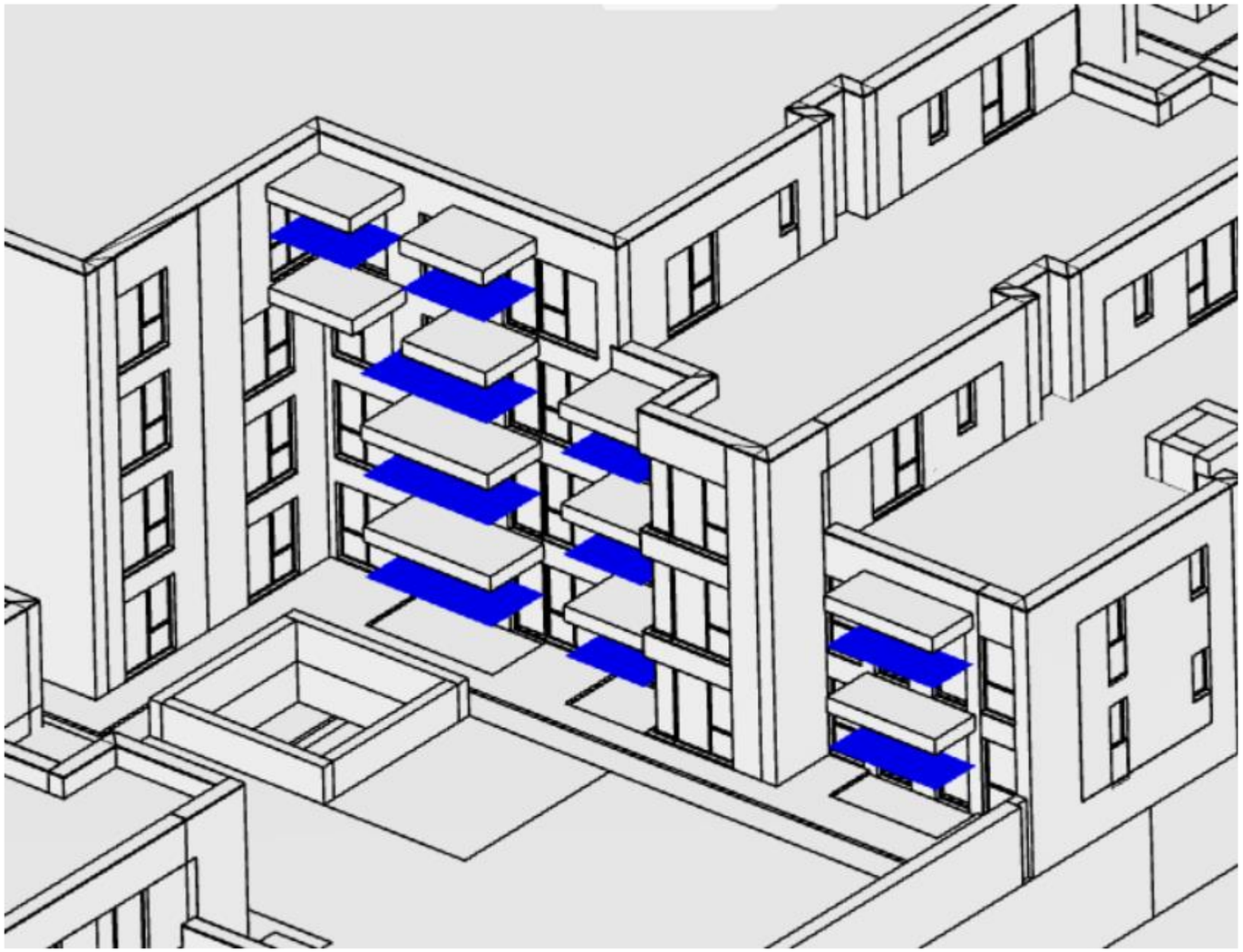

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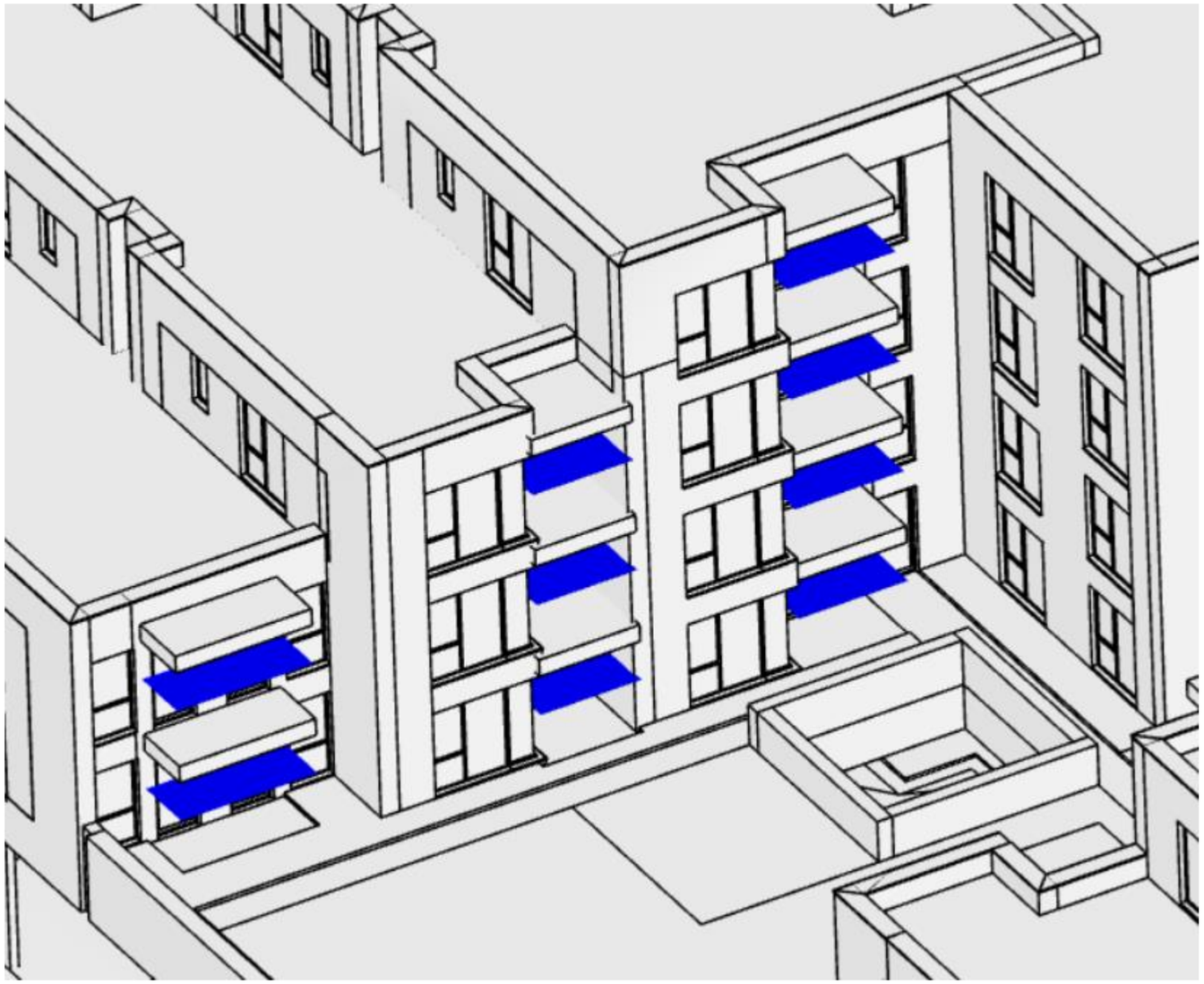

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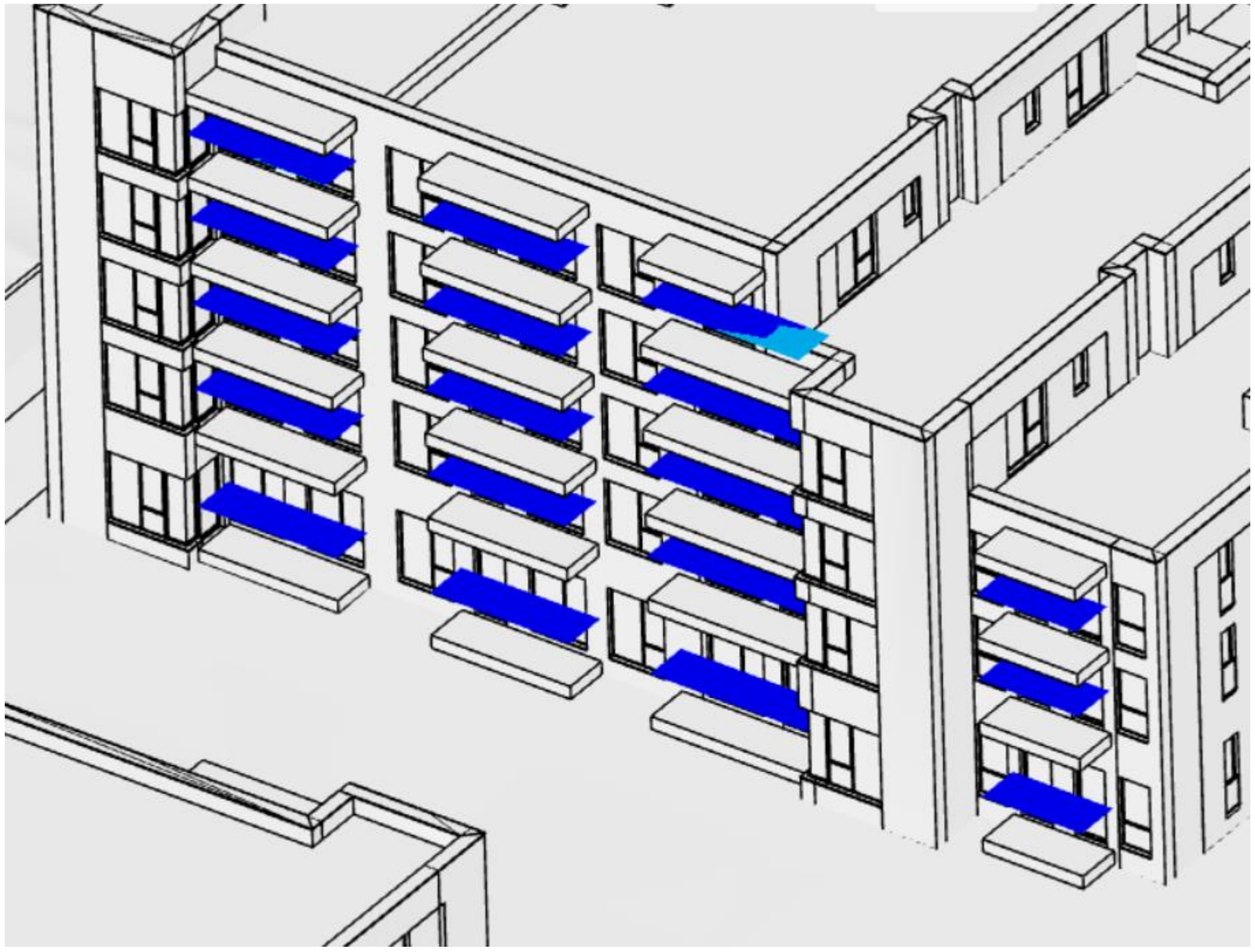

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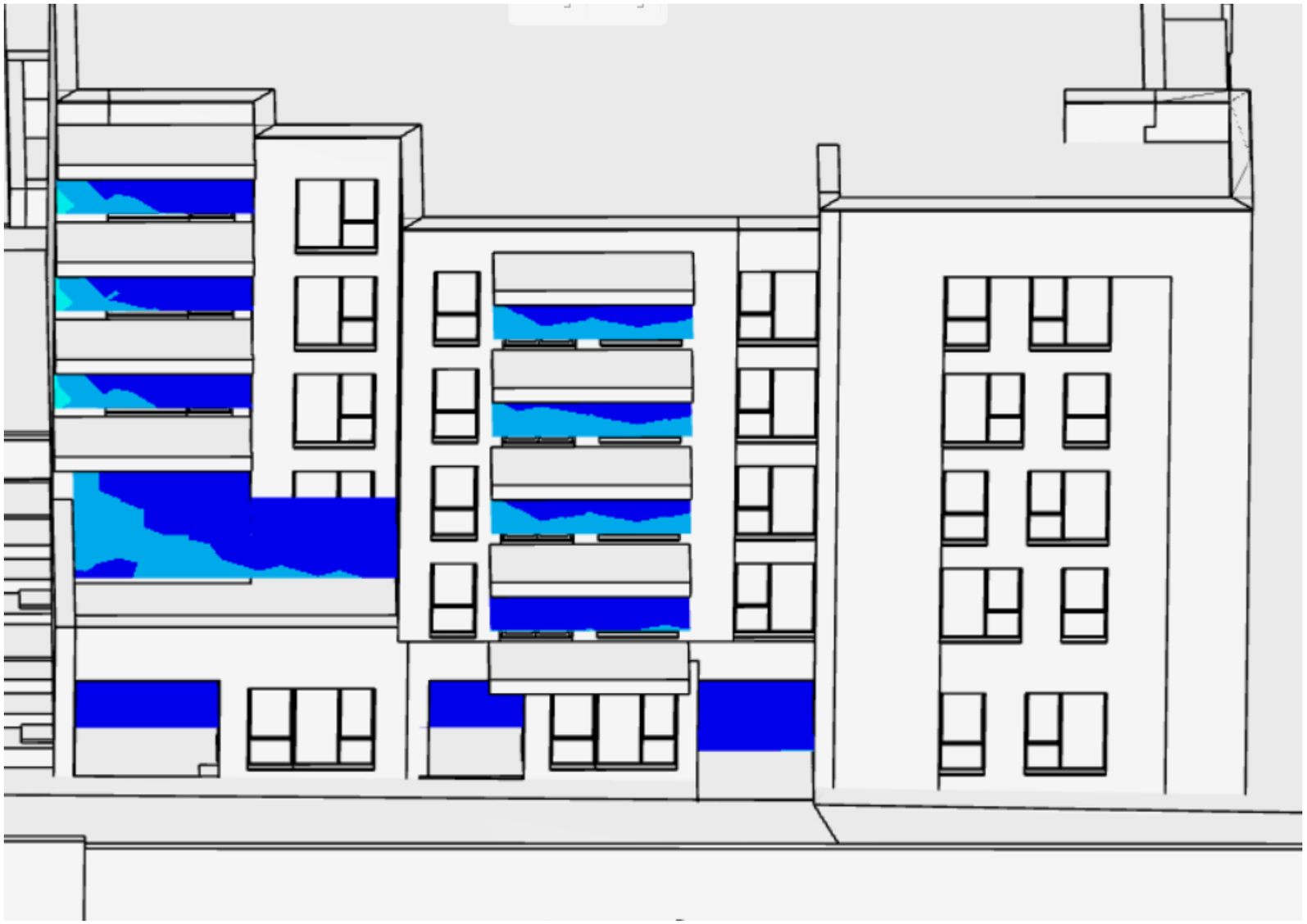

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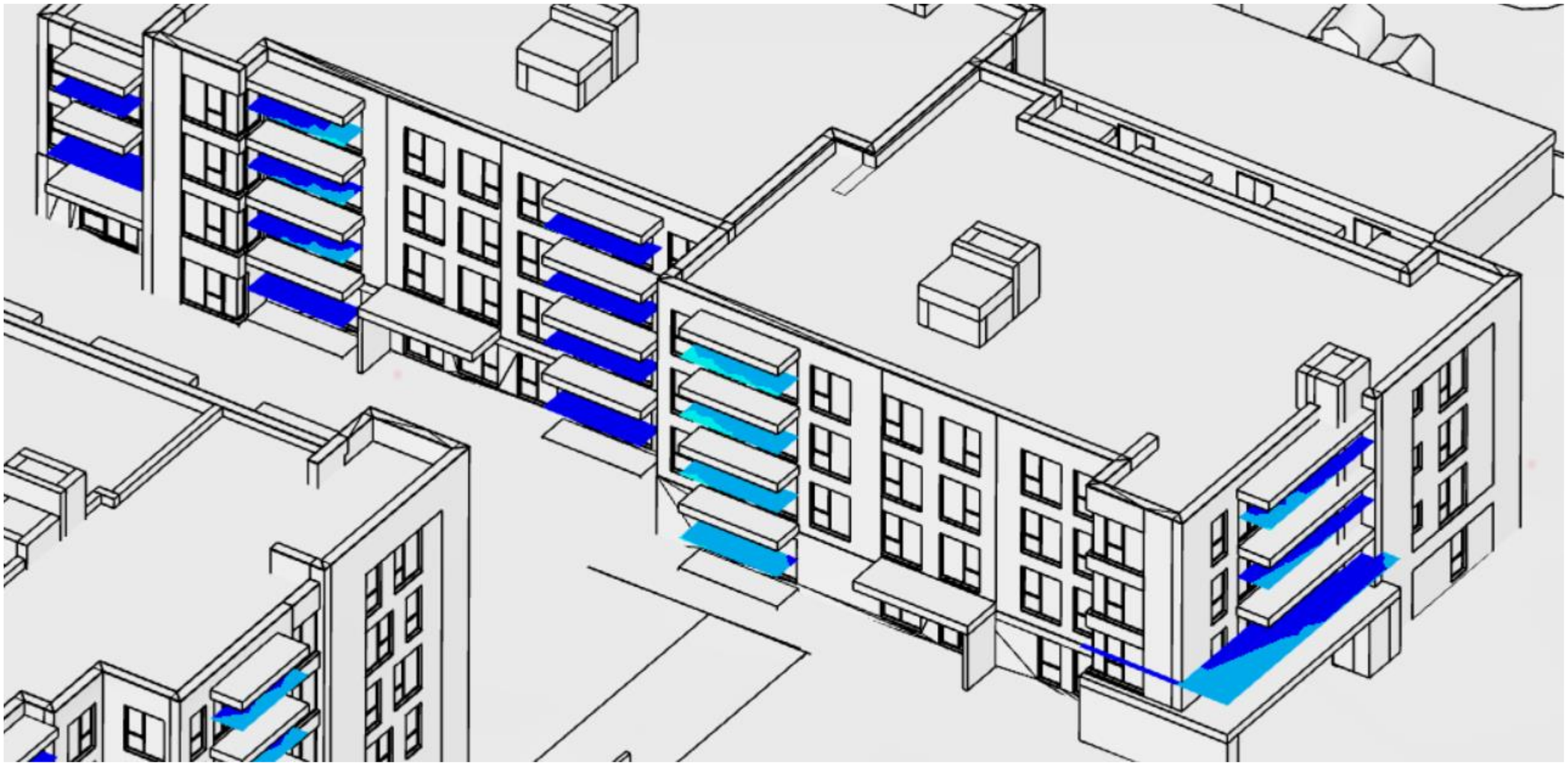

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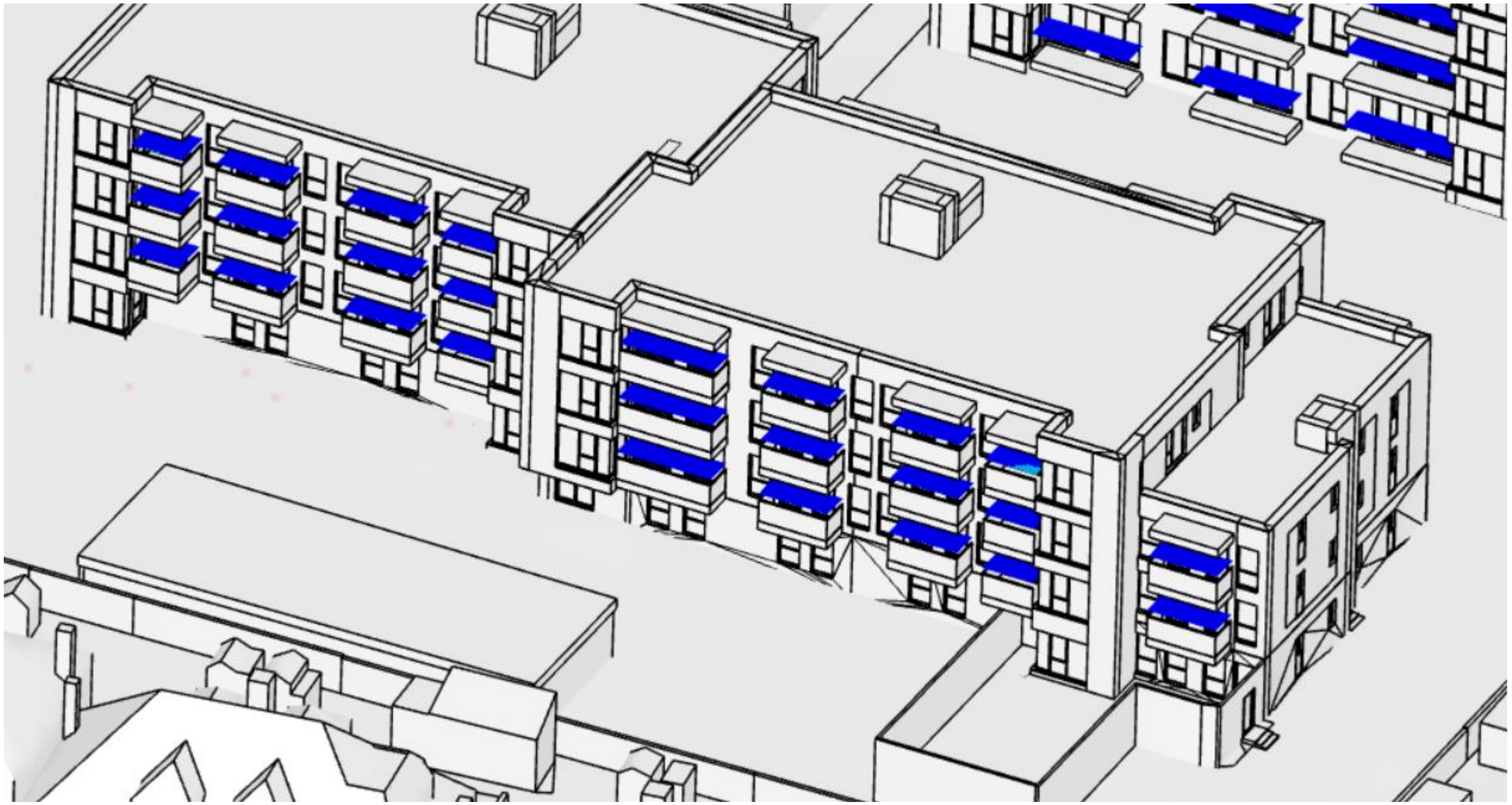

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