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MULTIDISCIPLINARY CONSULTING ENGINEERS

S1078: **INDEPENDENT HOUSE**

WIND & MICROCLIMATE STUDY

For
Summix IHD Developments Ltd.

13 March 2025

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1 EXECUTIVE SUMMARY

This report outlines the predicted climatic wind conditions experienced within and surrounding the proposed development located between Princes Street North and Middle Abbey Street, Dublin 1.

Local climate conditions are largely responsible for the exceedance of a comfort class, especially when buildings are located close to open, flat ground, or adjacent to the coast or where there is little to no obstruction of the wind, as may be considered the case in certain areas of this development.

A conscious effort was made by the design team during the design stages to mitigate the risk of localised increased wind speed conditions due to the proposed development. The shape of the developments massing and building façade plays a key role in helping to mitigate excessive wind speed around the proposed development. The positioning of the terraces and massing of the building allows for wind to gently move and eventually dissipate while a combination of protrusions and set backs of key locations further encourages the dissipation of wind speeds.

Based on the CFD modelling results, the proposed development will be a comfortable environment for occupants. The only area on the roof terraces that would be considered uncomfortable for sitting would be on the north elevation terrace along the perimeter but the areas highlighted within the report are proposed as walkways so no issues in regards to the proposed layouts from this perspective. Additionally the modelling doesn't take into account the full proposed landscape elements which will act as a damper to any prevailing wind conditions and improve the results.

Overall, the proposed development may be classified as a high-quality, comfortable environment for occupants throughout the year.

2 INTRODUCTION

The intention of this report is to outline the predicted climatic wind conditions experienced within and surrounding the proposed development Independent House, located between Princes Street North and Middle Abbey Street, Dublin 1

The proposed method for compliance validation is via the industry best practice standard for pedestrian comfort (Lawson Criteria). The Lawson Criteria sets acceptable levels of wind speed and velocity for various human activities. The frequency of occurrences is used here as an indicator of the likely duration of certain wind speeds. The Lawson criteria indicates that the threshold mean hourly wind speed for each pedestrian activity should not be exceeded for more than 5% of the time to maintain pedestrian comfort.

Given the specific location of the building within the development, as well as recorded metrological data available for the area, and standard interpolation calculation procedures, it is possible to predict the expected wind speeds and their annual occurrence.

3 PROPOSED DEVELOPMENT

Summix IHD Developments Limited intend to apply to Dublin City Council for a permission for a large-scale residential development principally comprising student accommodation at a c. 0.3 Ha site at Nos. 87-93 Middle Abbey Street, Dublin 1, D01 NH70 (known collectively as 'Independent House'). The site is generally bound by Prince's Street North to the north, William's Lane and Nos. 94-96 Middle Abbey Street to the west, Middle Abbey Street to the south, and Nos. 35-39 O'Connell Street Lower (known as 'Penneys') to the east. The site comprises 6 No. interconnecting, long-standing vacant structures as follows: (a) a principally part 5 No. to part 6 No. storey above basement level building fronting Middle Abbey Street, known as Independent House, with a single storey workshop building to the rear; (b) a 5 No. storey (above basement level) building at the corner of Middle Abbey Street and William's Lane, known as Emerald Chambers; (c) a triple height (at basement level) structure towards the centre of the site, known as the 'Printing Hall'; (d) a 2 No. storey (above basement level) warehouse and office fronting William's Lane; (e) a part 3 No. to part 4 No. storey (above basement level) loading bay and office fronting Prince's Street North; and (f) a 3 No. storey (above basement level) office in the eastern portion of the site, bounded by Penneys. The site includes 2 No. Protected Structures (RPS Ref. Nos. 18 & 8797).

The development's surface water and foul water drainage network shall discharge from the site into the existing combined sewer located along Prince's Street North to the north-west of the site. A new pedestrian crossing and upgrade works to the footpath and kerb along Prince's Street North are proposed. Public realm improvements are also proposed to William's Lane. The development site area, drainage works, road works and public realm improvements will provide a total application site area of c. 0.33 Ha.

The development will principally consist of: the retention and refurbishment of part of the building façade along Prince's Street North; the demolition of the 3 No. former warehouses and offices (c. 5,270 sq m) and the lowering of part of the basement level thereat; the demolition of part of the adjoining wall to the north-east of the site, bounding the Penneys loading bay; the partial demolition of the Printing Hall (c. 457 sq m) and the rear of Emerald Chambers (c. 150 sq m) and Independent House (c. 100 sq m); the removal of the existing concrete roof slab at Emerald Chambers to facilitate an increase in floor-to-ceiling height at fourth floor level; the lowering of part of the ground floor level in Independent House and Emerald Chambers for universal access; refurbishment works to the Protected Structures including general internal and external works for conservation repairs, maintenance, change of use and upgrading of the buildings; and the construction of a part 1 No. to part 9 No. storey over basement building connecting into the retained structures and principally comprising 316 No. Student Accommodation bedspaces (267 No. standard rooms, 5 No. accessible rooms, 2 No. twin studios (4 No. bedspaces), 10 No. accessible studios and 30 No. single studios) with associated facilities, which will be utilised for short-term let during student holiday periods. The 272 No. standard and accessible rooms are provided in 42 No. clusters ranging in size from 5 No. bedspaces to 8 No. bedspaces, and all clusters are served by a communal living/kitchen/dining room.

The development also provides: ancillary internal and external communal student amenity spaces and support facilities; cultural and community floor space (c. 644 sq m); 3 No. retail units (c. 216 sq m); a café/restaurant (c. 254 sq m); bicycle stores at basement and ground floor levels; visitor cycle parking spaces; bin stores; ESB substation; hard and soft landscaping; green/blue roofs; new telecommunications infrastructure at roof level, together with all associated equipment; boundary treatments; PV panels; plant; lift overruns; and all associated works above and below ground.

The gross floor area of the development is c. 15,413 sq m comprising c. 12,751 sq m above basement level.

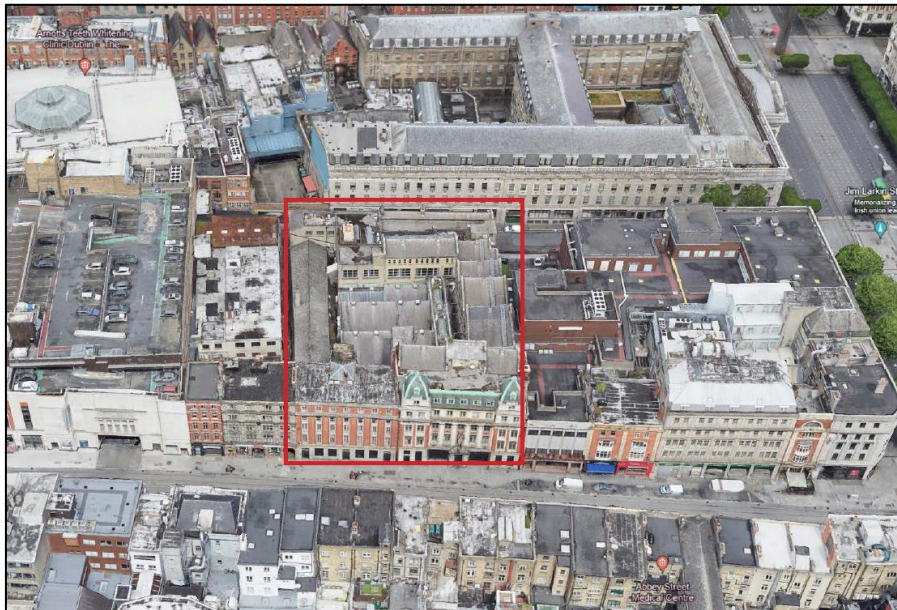


Figure 1: Existing Site Layout

4 PEDESTRIAN COMFORT COMPLIANCE

The Lawson criteria gives guidance to quantify the effect of wind velocity on pedestrian comfort and safety. The Lawson recommended guidance indicates that for the comfort and safety assessment of the wind environment, it is not only the velocity of wind that is considered but also the frequency of occurrence of these velocities. The frequency of occurrences is used here as an indicator of the likely duration of certain wind speeds. The Lawson criteria indicates that the threshold mean hourly wind speed for each pedestrian activity should not be exceeded for more than 5% of the time to maintain pedestrian comfort.

Table 1: Lawson Criteria for Pedestrian Comfort

Pedestrian activity	Threshold mean hourly wind speed not to be exceeded for more than 5% of the time [m/s]
Business Walking	10
Leisure Walking	8
Standing or Short Term Sitting	6
Long Term Sitting	4

5 ASSESSMENT METHODOLOGY

The methodology adopted for the study combines the use of Computational Fluid Dynamics (CFD) to predict air flow patterns and wind velocities around the proposed development, the use of wind data from the nearest suitable meteorological station and the recommended comfort and safety standards (The Lawson Criteria).

The study considered the following factors:

- The effect of the geometry, height and massing of the proposed development and existing surroundings on local wind speed and direction;
- The wind speed as a function of the local environment such as topography, ground roughness and nearby obstacles (buildings, bridges, etc.);
- The effects of site location (open field, inner city, etc.);
- Orientation of the buildings relative to the prevailing wind direction; and
- The pedestrian activity to be expected (long term sitting, standing or short term sitting, leisure and business walking).

The wind analysis focuses on the potential variation of the wind velocities from the reference wind data due to the proposed development.

5.1 EXTENT OF CFD STUDY AREA

The extent of the built area that is represented in the computational domain is dependent on the influence of the features on the region of interest which includes the site and its nearby surroundings. The analytical CFD model analyses the proposed development. It also includes existing buildings surrounding the development with the extent of the buildings included in the study area illustrated in Figure 2.

The analytical CFD model is assessed against the full Lawson Criteria to identify the pedestrian comfort and safety conditions surrounding the development.

The analytical CFD model has been constructed based on the information provided below:

- Plans, sections and elevations received from Henry J Lyons Architects;
- Topographical survey drawings available of surrounding buildings;
- Available aerial photographic data via Google Maps;
- Meteorological wind data closest to the site - Dublin Airport.
- Ordnance Survey Modelling Maps

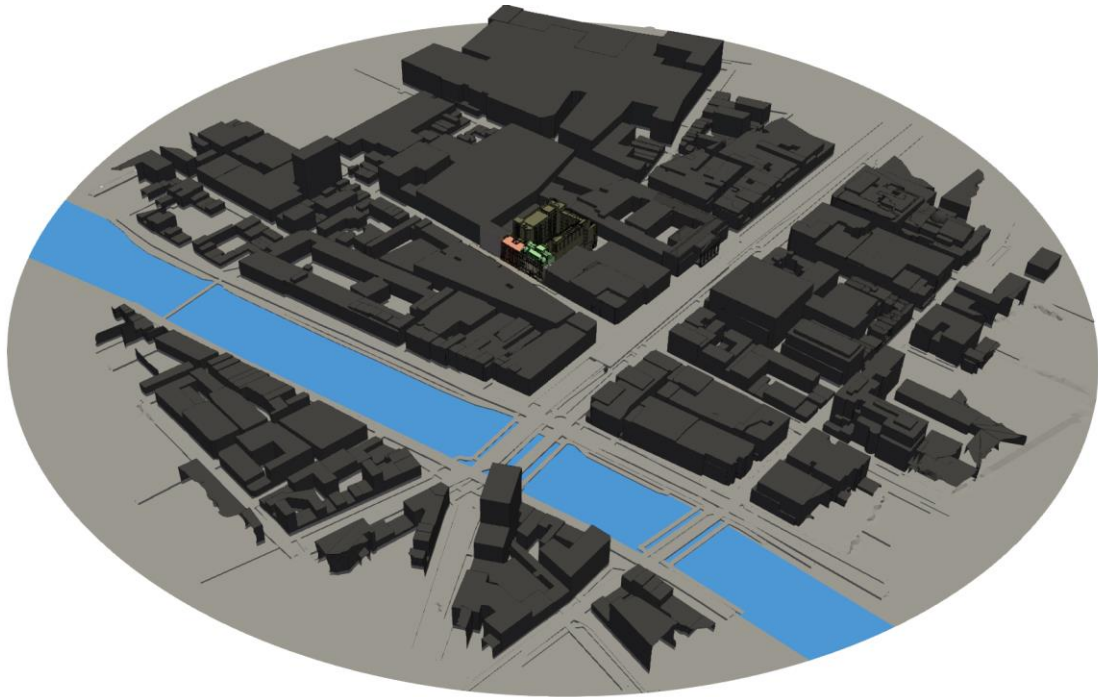


Figure 2: Extent of CFD Study Area



Figure 3: Rendering of CFD Model

5.2 WIND CLIMATE

The wind climate analysis is based on the wind data obtained from the Dublin Airport weather station which incorporates hourly wind data over a 30-year period (1994 until 2024). Figure 4 illustrates the percentage of hours per wind direction over a period of 30 years for 12 no. wind directions.

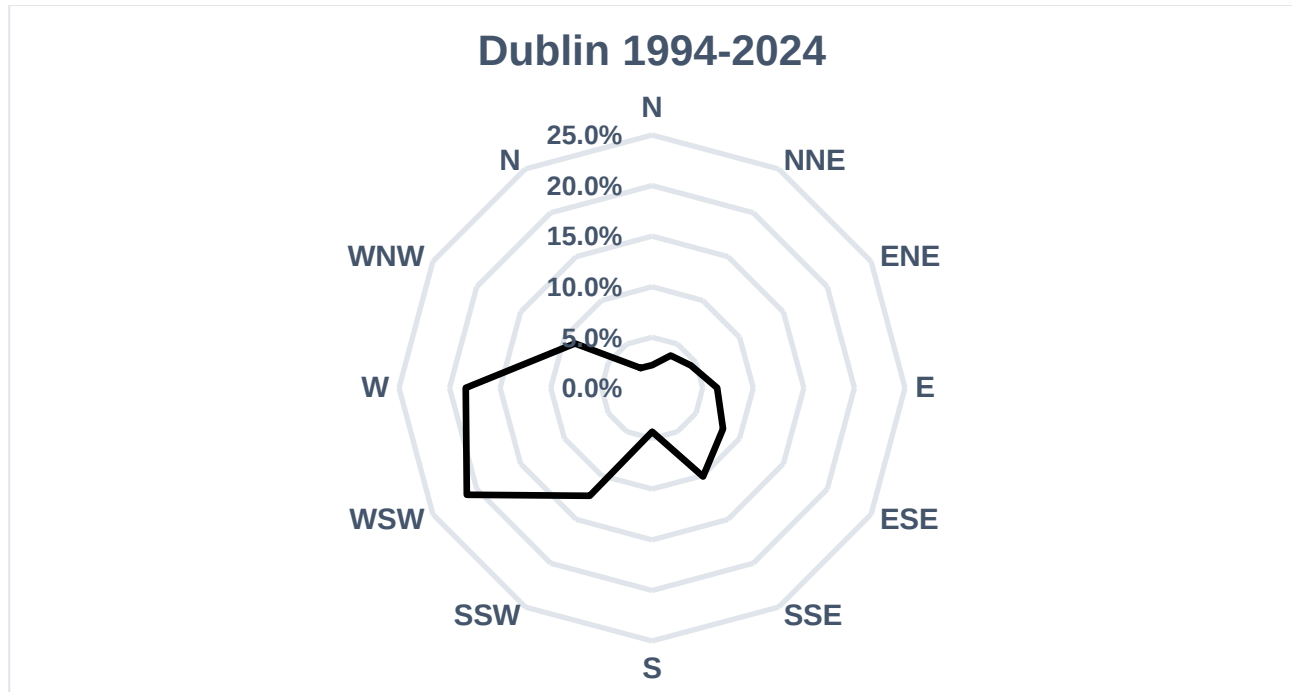


Figure 4: Percentage of Hours per Wind Direction over 30 years

The hourly wind data is the basis for the wind climate analysis. The number of hours that wind occurs from a given wind direction and velocity influences the local wind climate. The CFD simulation is used to calculate the wind-factor (local wind velocity relative to reference wind velocity). The wind-factor is a measure to calculate the number of hours that a given threshold wind velocity is exceeded based on statistical wind data. The yearly average frequency of a wind velocity occurrence per wind direction is outlined in Table 2.

Table 2: Frequency of Wind Velocity Occurrence per Wind Direction

Wind dir.	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW
	0	30	60	90	120	150	180	210	240	270	300
Speed [m/s]	[hrs]	[hrs]	[hrs]	[hrs]	[hrs]	[hrs]	[hrs]	[hrs]	[hrs]	[hrs]	[hrs]
0-1	18	6	2	7	9	10	6	6	7	8	9
1-2	31	31	15	41	65	61	38	39	45	49	53
2-3	39	55	44	92	116	121	60	95	131	127	96
3-4	31	57	68	116	136	138	54	133	220	206	145
4-5	26	48	75	93	121	139	45	151	259	247	143
5-6	18	40	60	67	90	124	42	153	260	245	117
6-7	13	31	43	45	59	91	37	138	234	196	77
7-8	8	22	30	31	39	69	30	112	195	155	49
8-9	5	13	19	24	25	43	22	84	153	116	28
9-10	3	7	12	17	13	30	17	58	113	87	17
10-11	1	4	7	10	9	19	10	37	76	57	9
11-12	1	2	3	5	5	11	5	22	49	40	6
12-13	0	2	1	3	3	5	3	12	29	21	3
13-14	0	0	0	1	1	4	1	7	18	10	1
14-15	0	0	0	1	1	1	1	4	10	7	1
15-16	0	0	0	1	0	1	0	2	5	4	0
16-17	0	0	0	0	0	0	0	0	2	2	0
17-18	0	0	0	0	0	0	0	0	2	1	0
18-19	0	0	0	0	0	0	0	0	0	0	0
19-20	0	0	0	0	0	0	0	0	0	0	0

5.3 WIND PROFILE

An atmospheric boundary layer wind profile (v_{wind}) is applied to the boundaries of the computational model. To incorporate the effect of small height differences and small objects at street level, which are not explicitly included in the model, a roughness has been applied to the ground surface of the detailed CFD model. For the wind profile a roughness length (z_0) of 0.4 m has been estimated.

Based on the reference velocity, reference height, and roughness length, a wind profile can be defined. The wind profile (v_{wind}) is defined as follows.

$$v_{wind} = v_{ref} \left(\frac{\ln\left(\frac{z}{z_0}\right)}{\ln\left(\frac{z_{ref}}{z_0}\right)} \right)$$

Where:

v_{wind}	Wind velocity	[m/s]
v_{ref}	Reference velocity	[m]
z	Height above the ground	[m]
z_0	Roughness length	[m]
z_{ref}	Reference height	[m]

5.4 WIND FACTOR

The CFD simulations are used to calculate the wind factor. The wind factor is a factor which indicates if the wind speed is locally increased (wind factor > 1.0) or decreased (wind factor < 1.0) due to buildings (or other geometry), relative to the applied reference wind speed at 10m height. The wind factor is independent of the magnitude of the reference wind speed at 10m height, making the obtained wind factor valid for all wind speeds in a specific wind direction range. Hence, one simulation can be applied per wind direction covering all wind speeds in this direction.

To explain the wind factor in more detail, the wind factor results for the 0-degree wind direction (i.e. North) are illustrated in Figure 5. The wind factor arrows that are coloured green, cyan or dark blue indicate that the local wind speed has been reduced (wind factor < 1.0), while wind factor arrows which are coloured light Orange/ Red indicate the local wind speed has increased (wind factor > 1.0). Using the wind factors, the quantity of hours that a wind speed is exceeded can be calculated (per wind direction) which is then used to assess compliance against the Lawson Criteria.

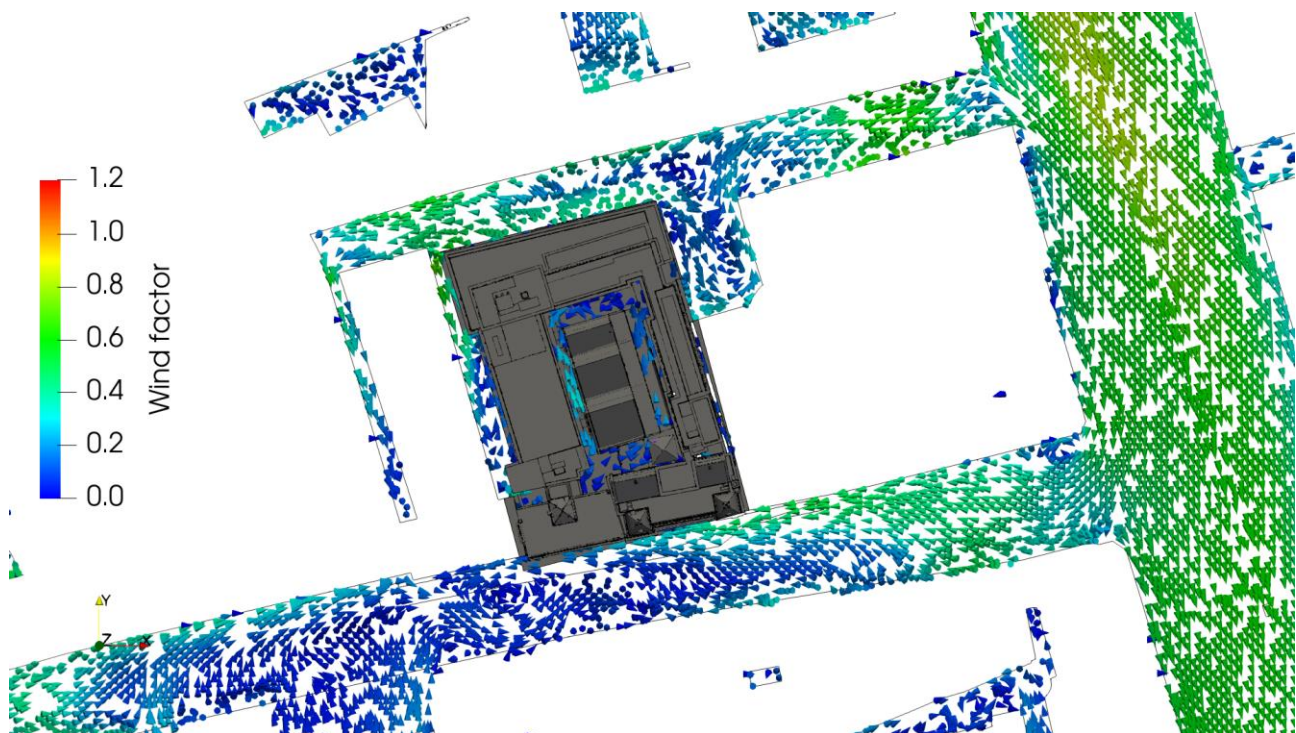


Figure 5: Wind Factor - 0 Degree (N) Wind Orientation

The wind factor results for all 12 no. wind directions are included in Appendix A.

5.5 CFD MODELLING

The CFD simulation has been performed using the software package ANSYS CFX version 2024 R1. This software package can be used for a large range of applications and has been extensively validated.

A full 3D CFD model of the proposed development and surrounding buildings was created and split into a large number of control volumes or cells. The standard equations for fluid motion and energy transport are applied to each cell. The equations are then solved using numerical techniques. The CFD settings used for the analysis are summarised in Table 3.

Table 3: Summary of CFD Model Settings

CFD settings	Description
Grid type	Hybrid, mixture of tetrahedrons, pyramids and prisms
Cell size	Dynamic, ranging from 0.025 up to 2 m at the building surfaces and streets, growing to 10 m in the volume
Number of cells	28.4 million
Simulation type	Steady state
Convergence	$< 1 \cdot 10^{-4}$
Simulation time	1500 s
Fluid	Air fixed properties
Turbulence model	RANS, RNG Kappa-Epsilon model
Walls	Smooth, no slip
Wind volume	Profile for velocity and turbulence
Roughness	Volumetric sources for momentum and turbulence
Vegetation	Volumetric loss coefficient

5.6 ASSUMPTIONS AND LIMITATIONS

Computational Fluid Dynamic (CFD) is a widely recognised method for modelling airflow problems and as computer power develops, it increasingly improves its applicability. However, there are some limitations with CFD in relation to the modelling of wind environments. The method uses mean hourly wind values and presents a limitation to capture gusts.

The Lawson criteria for pedestrian comfort focus on the effect of wind and do not factor in other environmental variables such as air temperature, solar radiation and relative humidity. However, overlaying all these factors would be a complex process and Lawson's simplified method presents the best available methodology for anticipating wind effects in the built environment.

The buildings were modelled as blocks, i.e. with smooth surfaces and sharp corners, which is generally sufficient detail to represent buildings in airflow modelling. This assumption is industry accepted as further detail to the model such as the window reveals and façade texture would add an impractical and unnecessary complexity to the model without adding greater quality results. Certain landscaping features, such as pergolas and trellis structures as examples, are not generally modelled within the simulation as they would provide an extra level of complexity to an otherwise large CFD model. Incorporating all landscape additions, such as all trees and hedges, would be impractical on a model this size.

6 WIND MITIGATION MEASURES

The following are common strategies to mitigate excessive wind speeds associated with building developments¹.

- When wind hits the windward face of a building, the building deflects the wind downwards (downwashing), causing accelerated wind speeds at pedestrian level and around the corners of the building. By introducing a base building or podium, the downward wind flow can be deflected, resulting in a reduction of wind speed at pedestrian level.
- When the leeward face of a low building faces the windward face of a tall building, it causes an increase in the downward wind flow. By landscaping the base building roof, wind speeds can be further reduced.
- Wind speed is accelerated when wind is funnelled between two buildings. A horizontal canopy on the windward face of a base building can improve pedestrian comfort conditions.

The following specific mitigation measures have been incorporated into the proposed design to prevent excessive wind speeds.

- The roof terraces are all provided with balustrades to help mitigate wind speeds and increase comfort.
- Landscaping elements on the roof terraces, while not fully modelled within the assessment, naturally provide shelter and barriers to wind speeds experienced so will further reduce the positive results achieved within this development.
- The primary roof terrace/amenity space is showing as comfortable for sitting according to the Lawson Scale without the aforementioned landscape elements modelled.

¹ *Pedestrian Wind Comfort and Safety Studies*, (City of Mississauga, 2014).

6.1 WIND/ MICROCLIMATE COMFORT RESULTS

The number of hours for all wind directions are summed to calculate the total number of hours that a given pedestrian activity class exceeds the 5% yearly threshold with the results for Ground/ Podium level presented in Figure, and rooftop terrace spaces summarised in Figure 6.



Figure 6: Wind/ Microclimate Comfort Results – Ground Floor



Figure 7: Wind/ Microclimate Comfort Results – Rooftop Terraces

The results of the simulations are explained as follows:

- Ground Floor/ Podium Areas:** The majority of the ground floor areas comply with either the “Long Term Sitting” or “Short Term Sitting” class. The only proposed area of sitting on the ground floor will be along Williams Lane and this is well sheltered and suitable for long terms sitting thus, this can be classified as a comfortable area for occupants year-round.
- Roof Terraces:** The majority of the roof terrace complies with the “Long Term Sitting” and “Short Term Sitting” class. Small areas at the South-East and North-West of the roof terraces will experience wind outside this range however these areas have no long term seating areas proposed and additional planting and seating within the terrace will mitigate increased wind speeds in this area and provide a comfortable environment for occupants year-round, as is proposed in the landscape design.

It should also be noted that a pedestrian activity class is only a statistical assessment of the local wind climate. When a region does not meet a certain criterion (e.g. sitting), this does not mean that one can never do this activity in this region. It only means that for more than 5% of the time per year the wind speed for this activity is exceeded. The remaining time of the year this activity is possible.

Finally, the wind speed threshold for a certain pedestrian class is only meant to provide guidance on where to locate certain areas where a certain type of activity is expected to be performed. In practice, the experience of the outdoor climate depends on more than just wind speed. Other factors such as clothing, air temperature, solar irradiation, age and relative humidity must also be considered.

7 CONCLUSION

This report outlines the predicted climatic wind conditions experienced within and surrounding the proposed development at Independent House, Dublin 1.

As part of this assessment, the industry accepted standard of the Lawson Criteria was utilised. The Lawson Criteria gives guidance to quantify the effect of wind velocity on pedestrian comfort and safety. The wind climate analysis is based on the wind data obtained from the Dublin Airport weather station which incorporates hourly wind data over a 30-year period (1994 until 2024).

A conscious effort was made by the design team during the design stages to mitigate the risk of localised increased wind speed conditions due to the proposed development. The introduction of mitigation measures such as the corridor spaces between buildings, building line, façade protrusions, solid balcony balustrades, as well as the strategic location of extensive landscaping, all assist in reducing the potential development of local increased wind speed and the negative impact on local climatic conditions.

Based on the CFD modelling results, the proposed development will be a comfortable environment for occupants. Certain areas have been highlighted as experiencing minor discomfort for a limited period of time, such as certain areas at ground floor level. However, these concerns have been largely addressed through the incorporation of detailed landscaping which will mitigate excessive wind speeds in these areas.

Overall, the proposed development may be classified as a high-quality, comfortable environment for occupants throughout the year.

Appendix A CFD SIMULATION RESULTS

The CFD wind factor results included in this section are for all 12 No. wind directions as referenced within the body of the report. The wind directions referenced in the wind rose below correspond to the wind directions referenced in the CFD results.

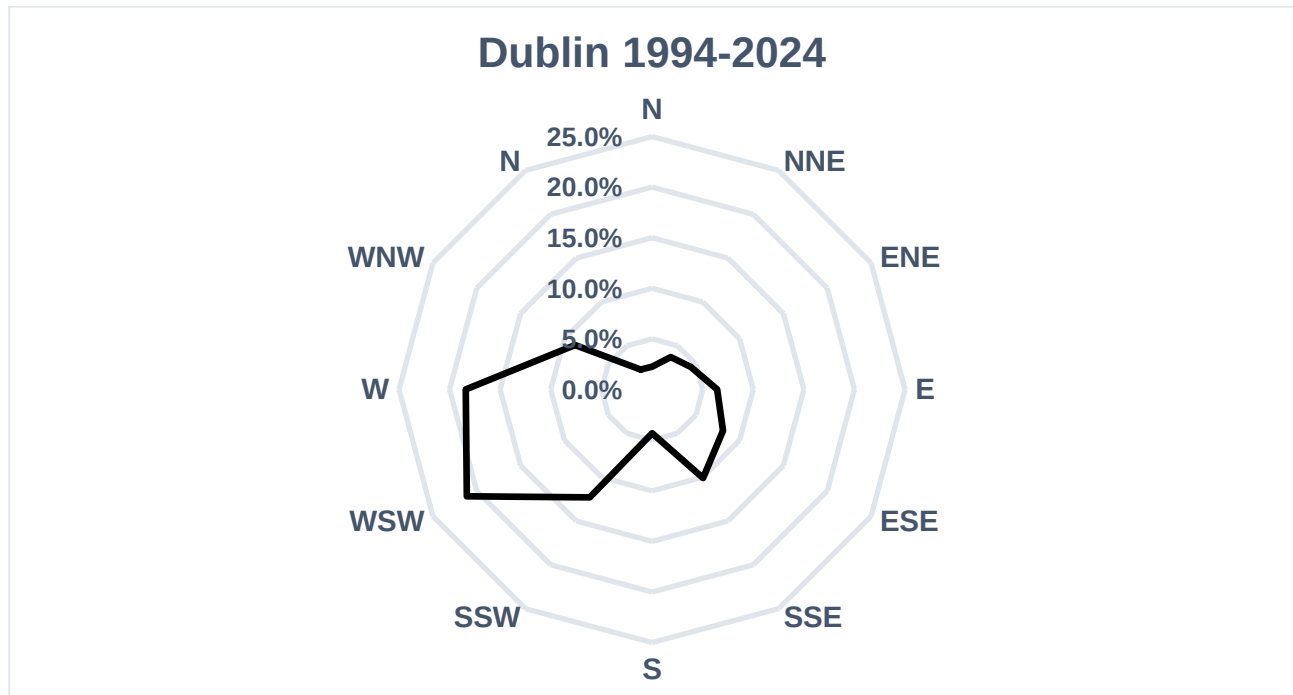


Figure 8: Dublin Airport Wind Rose Data (1989 - 2019)

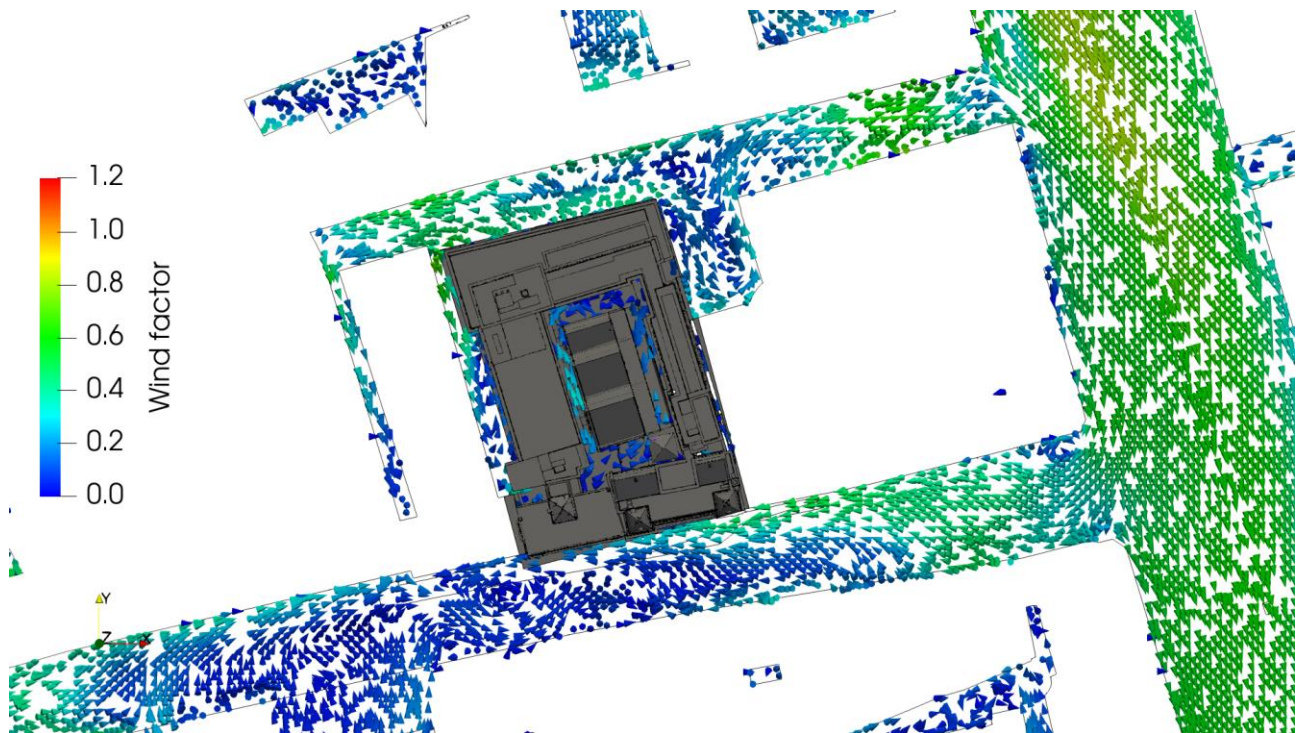


Figure 9: Wind Factor - 0 Degree (N) Wind Direction

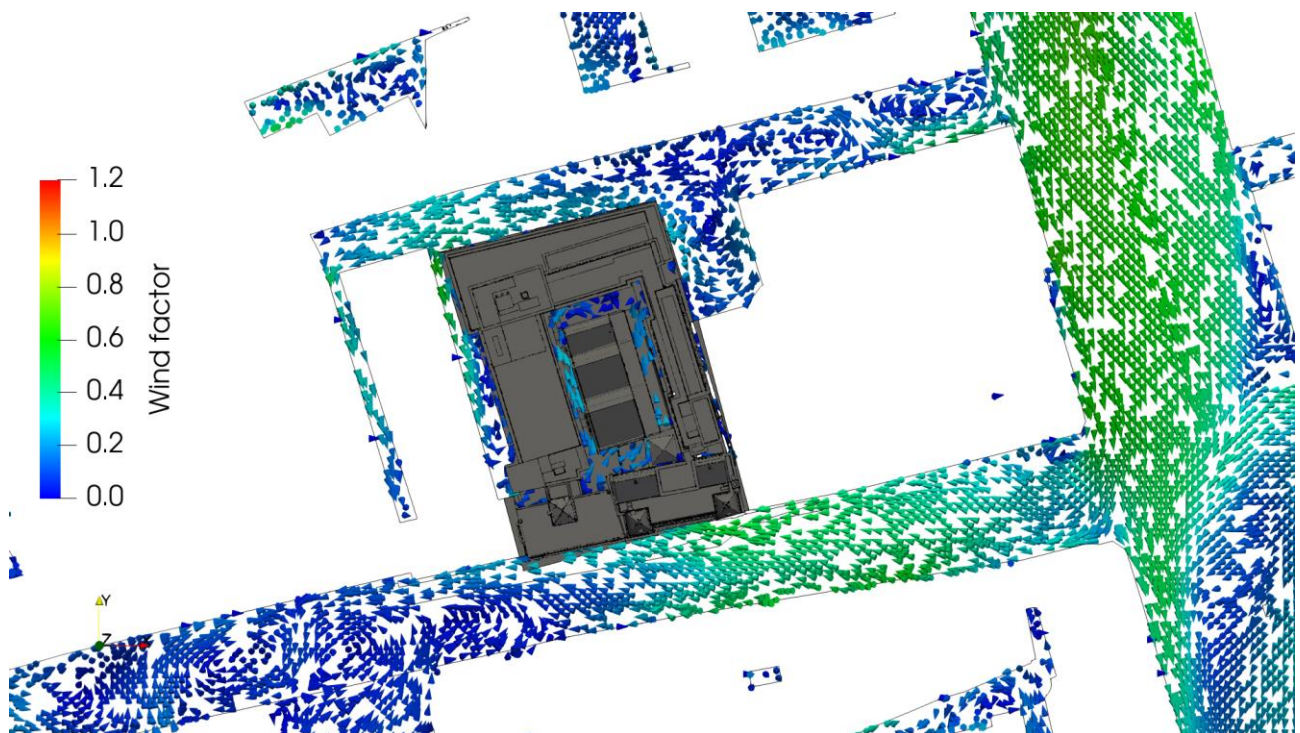


Figure 10: Wind Factor - 30 Degree (NNE) Wind Direction

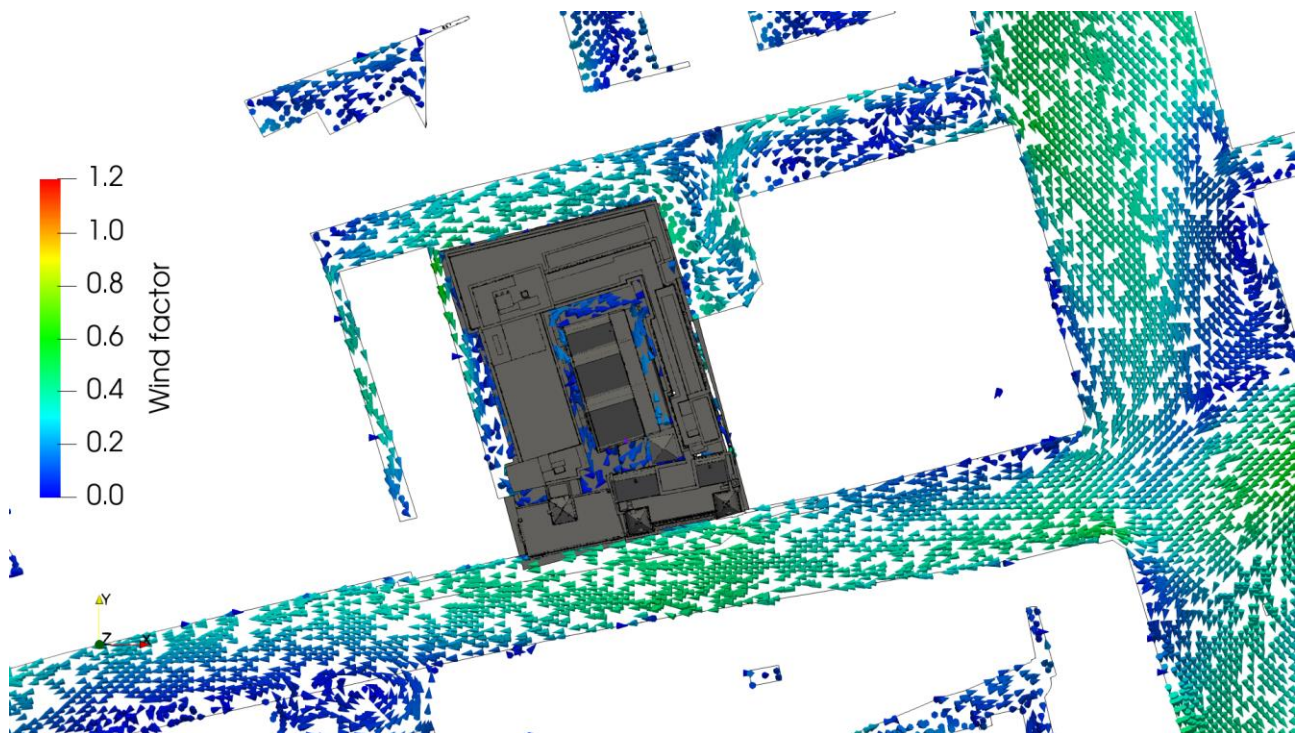


Figure 11: Wind Factor - 60 Degree (ENE) Wind Direction

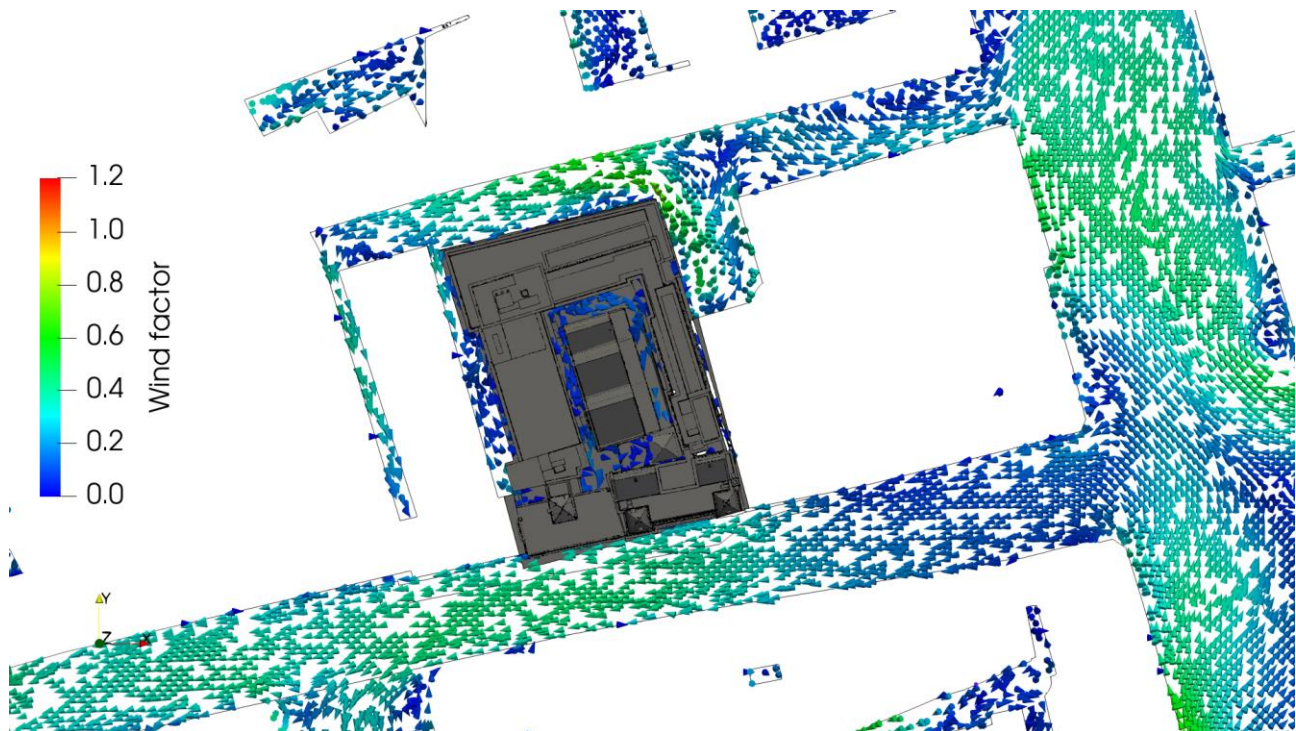


Figure 12: Wind Factor - 90 Degree (E) Wind Direction

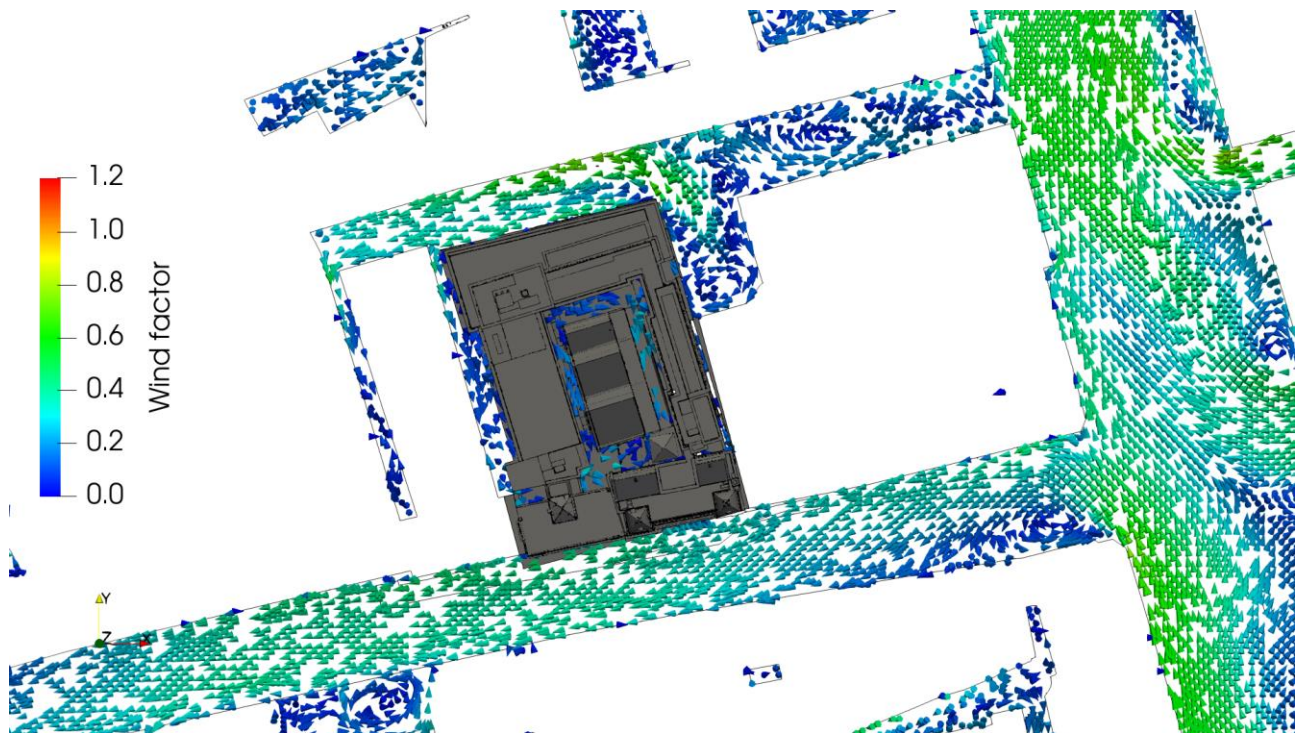


Figure 13: Wind Factor - 120 Degree (ESE) Wind Direction

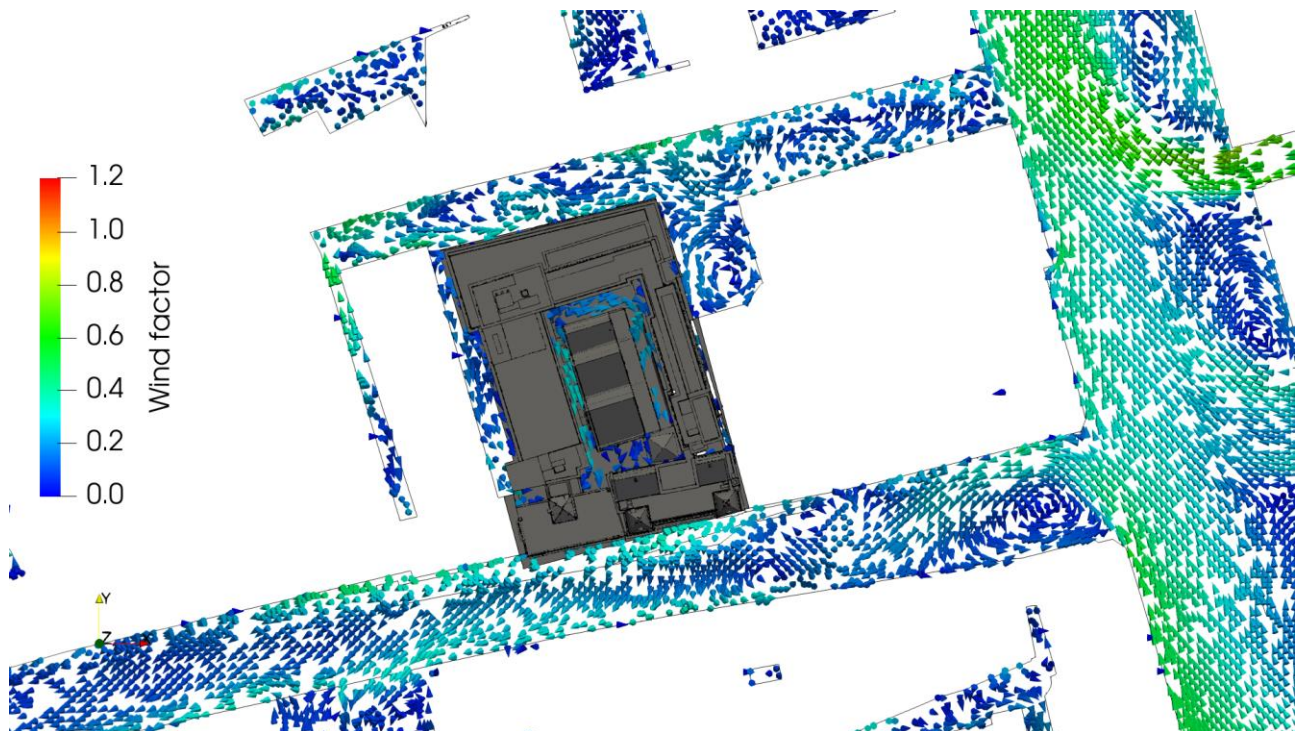


Figure 14: Wind Factor - 150 Degree (SSE) Wind Direction

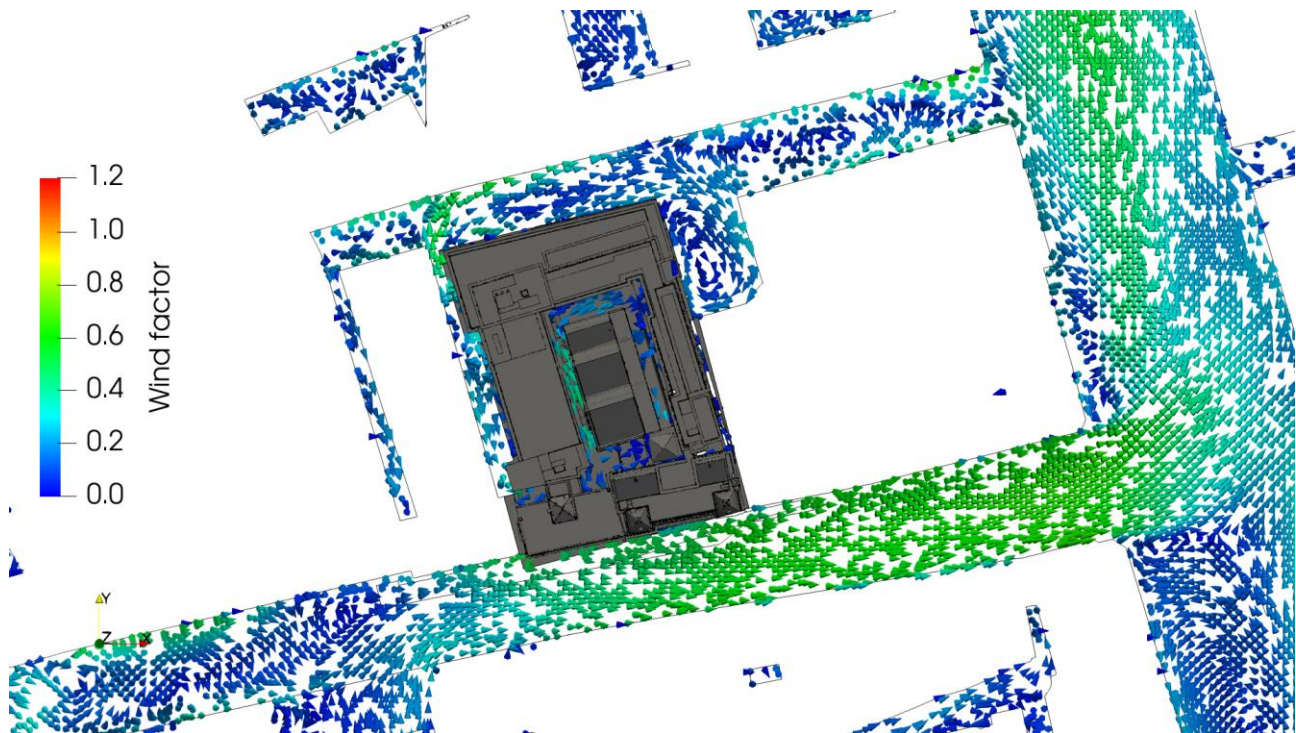


Figure 15: Wind Factor - 180 Degree (S) Wind Direction

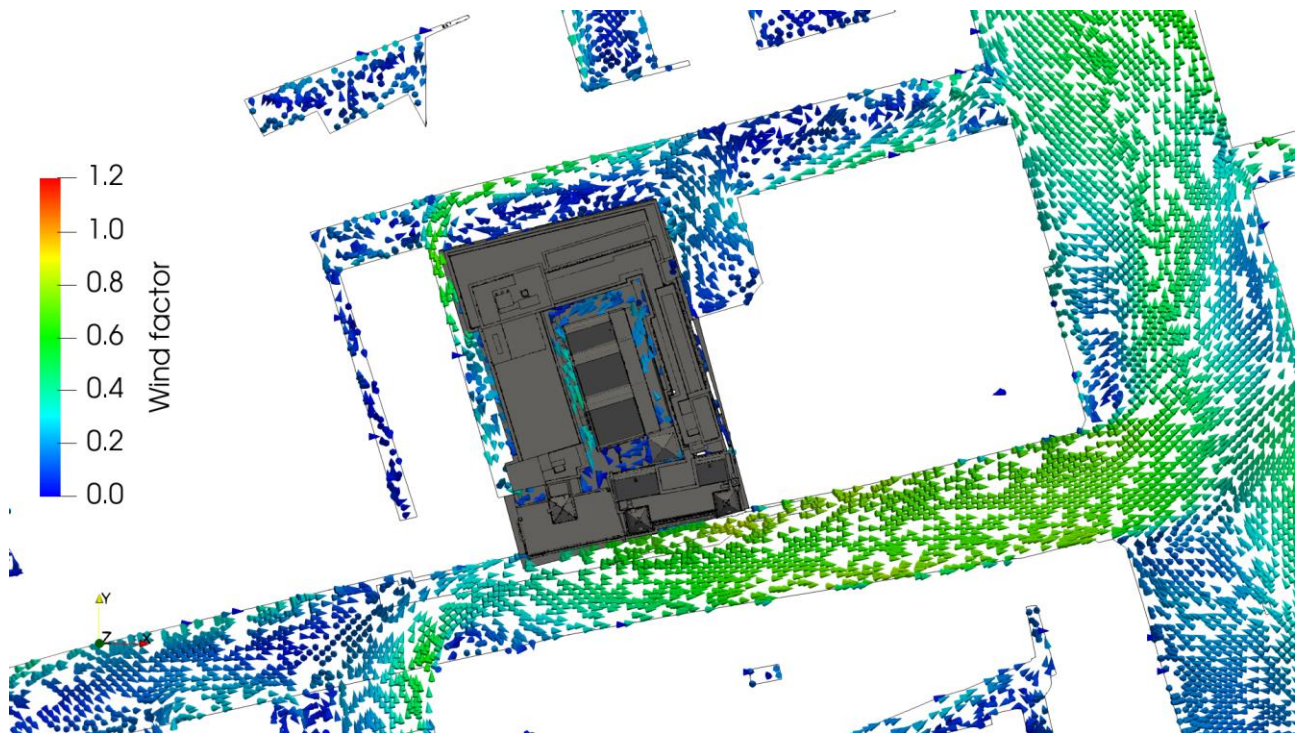


Figure 16: Wind Factor - 210 Degree (SSW) Wind Direction

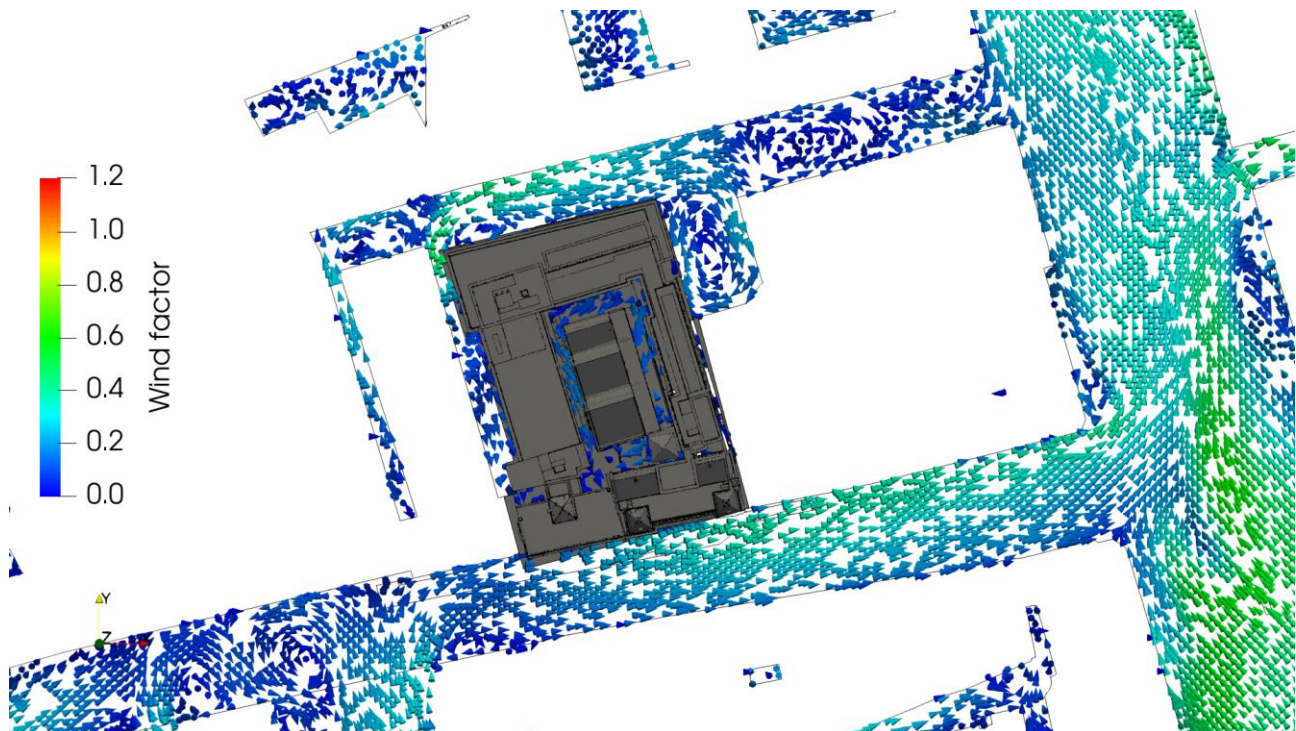


Figure 17: Wind Factor - 240 Degree (WSW) Wind Direction

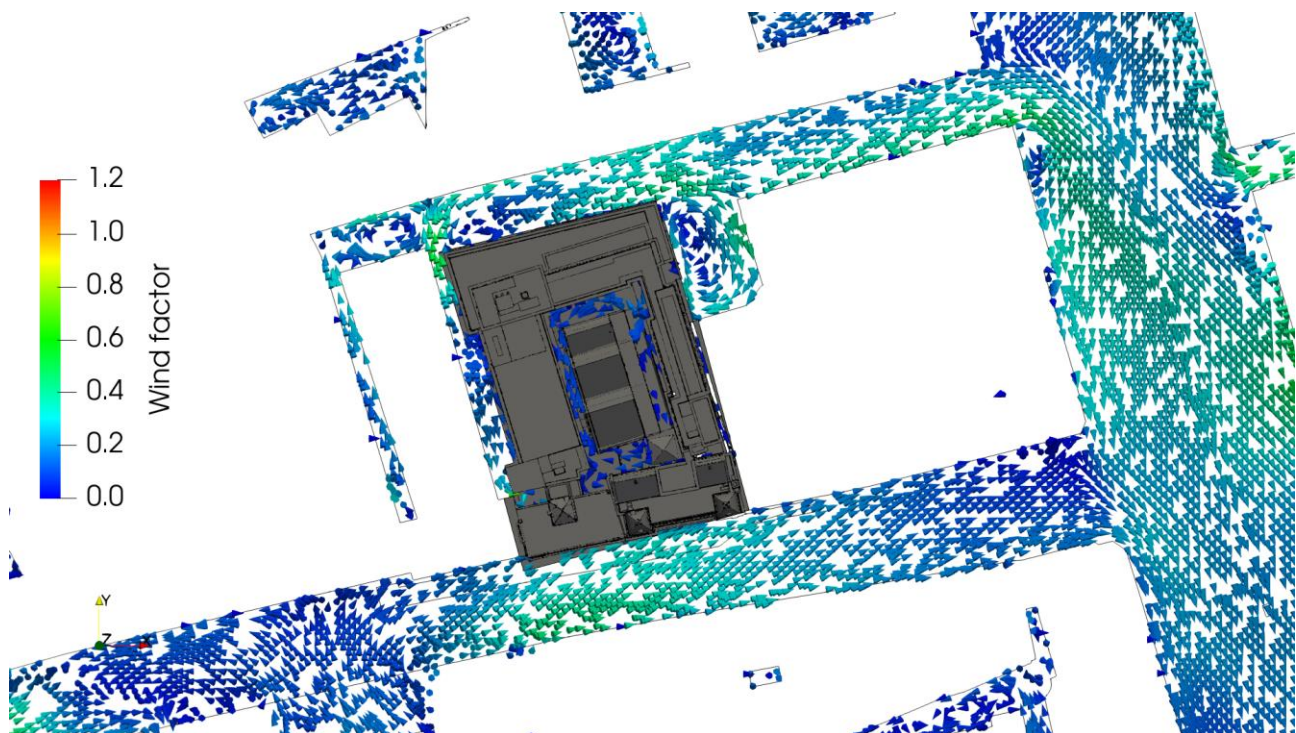


Figure 18: Wind Factor - 270 Degree (W) Wind Direction

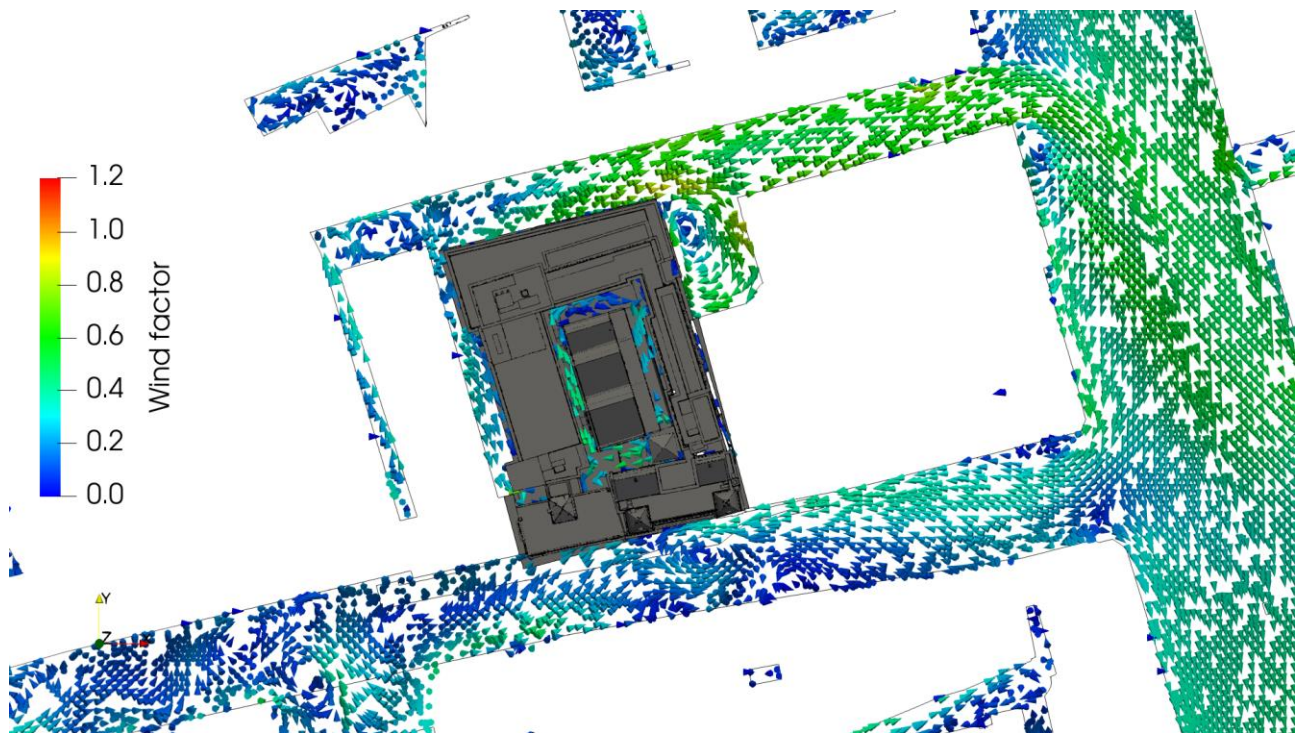


Figure 19: Wind Factor - 300 Degree (WNW) Wind Direction

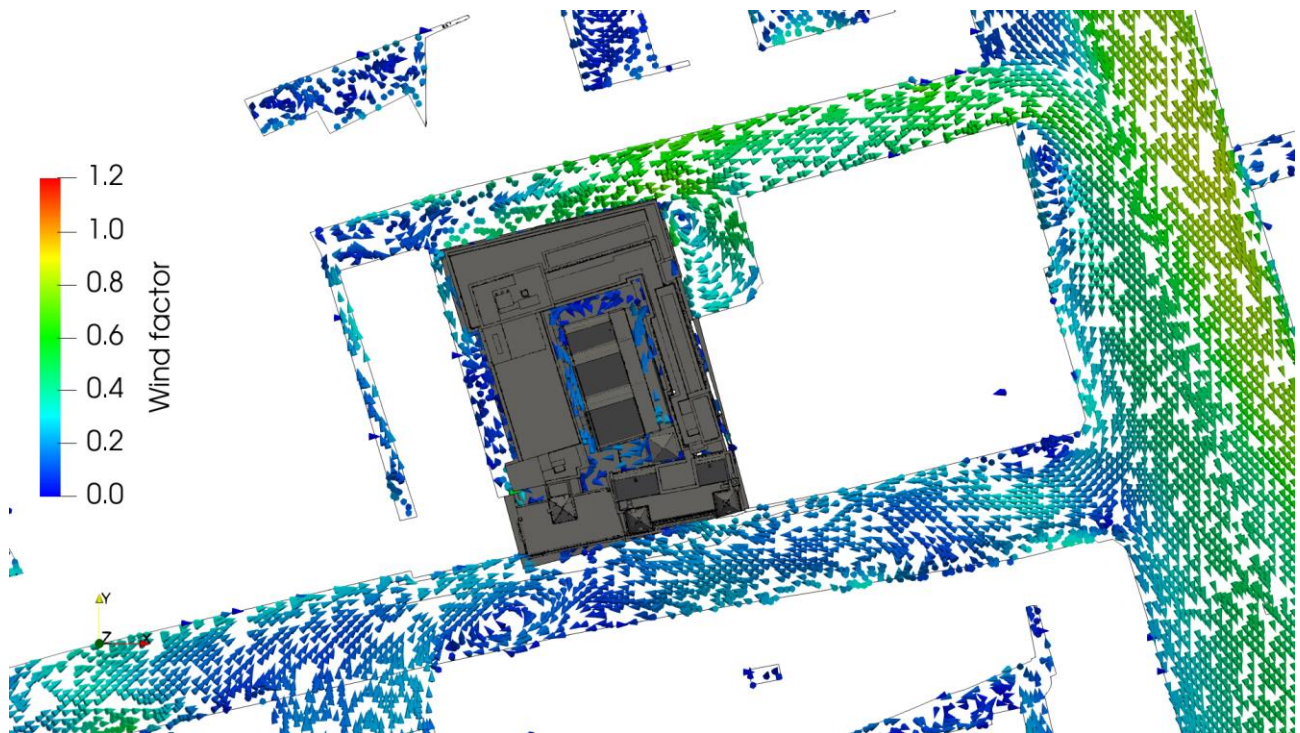


Figure 50: Wind Factor - 330 Degree (NNW) Wind Direction



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