IN2
ENGINEERING DESIGN PARTNERSHIP
Dublin | London | Belfast | Athlone

# D1861
# 42A Parkgate Street
# Dublin 8

## Site Wind Analysis

3rd December 2019

rev08

## CONTENTS

# 1.0 EXECUTIVE SUMMARY

The predicted effects of wind were determined for the proposed development and surrounding site in order to assess Pedestrian Comfort and duly inform design for amenity spaces and balconies. Analysis was based on drawing and 3D information as received from Reddy Architecture + Urbanism.

Site Wind Analysis was undertaken utilising Computational Fluid Dynamics (CFD) software (Phoenics/ Flair). CFD originated in the aeronautics industry but can be applied to the built environment in order to enable assessment of wind effects on buildings in a “virtual wind tunnel”.

The CFD analysis involved creating a 3D representational model of the proposed Parkgate Street buildings in the context of their surrounding urban environment and adjacent buildings. Wind profile boundary layers were applied, applicable to urban terrain, for varying wind speeds and directions.

Predicted pressures and velocity vectors in the vicinity of the buildings were calculated for varying wind speeds and directions, accounting for turbulence effect, with derived parameters determined for Pedestrian Comfort (Lawson Criteria).

The Parkgate Street analysis was carried out for three amenity types, namely: ground level, roof top amenity and tower balconies.

The results of the ground level assessment indicate no areas of excessive predicted wind speeds identified as “Not Suitable for Pedestrian Comfort” under the Lawson Criteria.  The ground level results of the analysis were used to inform the landscaping strategy and the positioning of seating to the amenity areas.

The rooftop amenity spaces were each assessed to determine suitability for intended use. The results indicated that no areas “not suitable for pedestrian comfort would be present”.

An analysis of average wind velocities for Dublin were utilised to determine optimum locations for the balconies on the tower. Analysis determined that by siting balconies only on the East aspect of the tower, balconies remained in a sheltered environment for the entire height of the tower. Conversely, balconies sited on the south west façade, were found to experience greater than average wind speeds. These areas were not counted as amenity space.

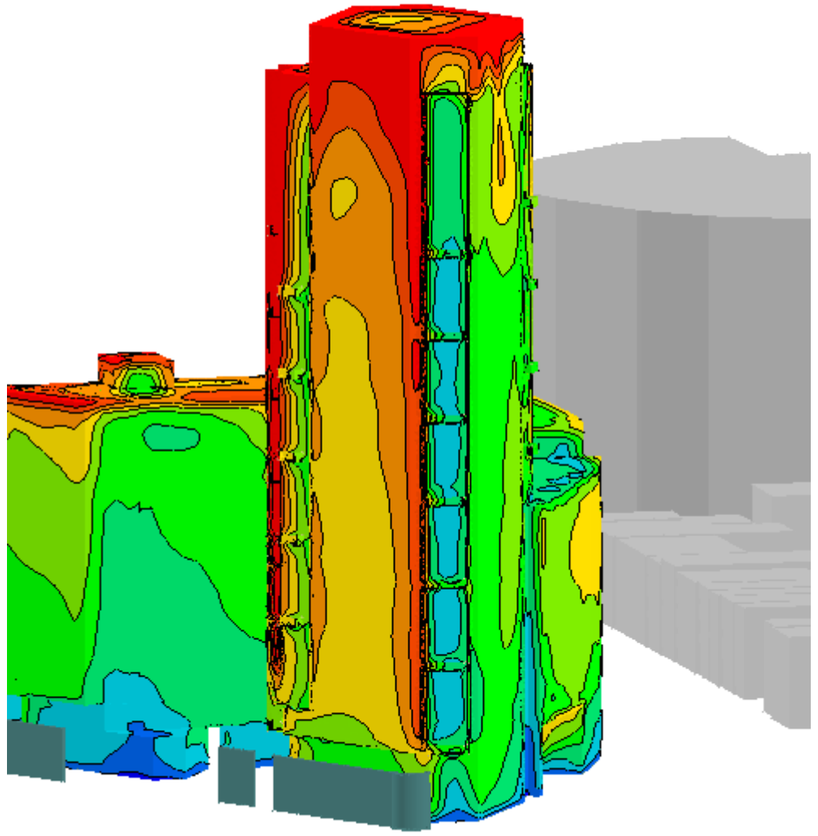

*Figure 1.1 - Averaged Dublin Wind Velocities to Tower*

# 2.0 WIND ANALYSIS

## 2.1 Methodology

In order to determine the predicted wind patterns around the proposed development, airflow simulations were undertaken using Computational Fluid Dynamics (CFD) software (Phoenics / Flair).

This enabled an assessment of the site wind conditions, calculating zones of high pressure, negative pressure, and predicted air velocities/directions for varying wind conditions.

An initial 3D representational model of the proposed buildings and their immediate surroundings was created (Figure 2.1.1), representing the proposed development and existing neighbouring buildings.

The CFD simulations utilised wind profiles accounting for terrain effects. Allowing for the urban nature of the site, a boundary layer profile representative of suburban terrain was utilised.

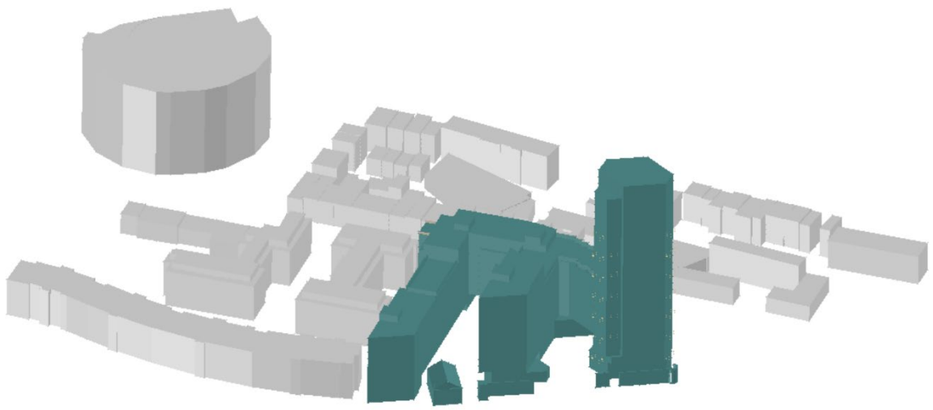

Fig 2.1.1 – 3D Model of Proposed Parkgate Street Development & Neighbouring Environment

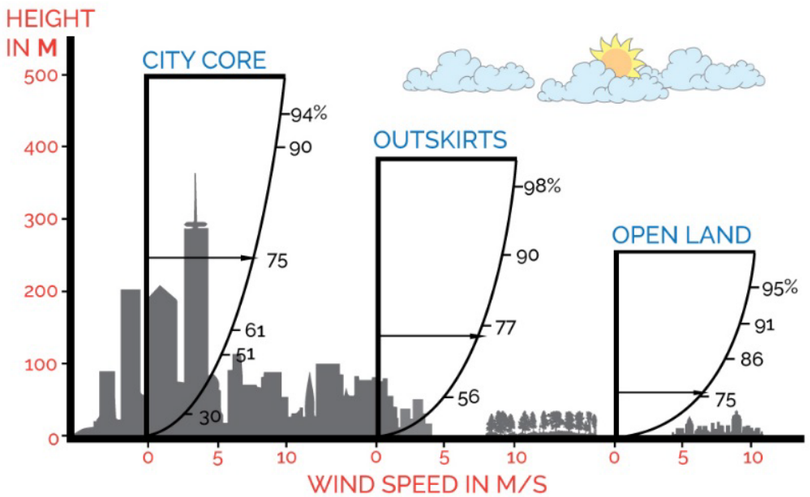


Fig 2.1.2 – Wind Profiles Accounting for Terrain Effects

# 2.0 PEDESTRIAN WIND COMFORT

## 2.1 Methodology

Pedestrian Wind Comfort was assessed utilising the "Lawson Criteria" scale, which has been developed as a means of assessing the long term suitability of urban areas for walking or sitting, accounting for both microclimatic wind effects (i.e. site location and prevailing winds) and microclimatic air movement associated with wind forces influenced by the localised built environment form. Figure 2.1.1 illustrates the Lawson Criteria scale; which ranges from areas deemed suitable for long term sitting through to regions not suitable for pedestrian comfort, as wind effects and associated air velocities would be too excessive for significant periods of the year.

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. Therefore, wind effects around buildings for prevailing wind conditions are deemed to have more of a potential impact to pedestrian discomfort, as these will occur on a more regular occurrence.

However, it may 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.

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

Figure 2.1.2 indicates the long-term annual "Wind Rose" for Dublin Airport. The rose diagram illustrates the frequency that wind will be from a certain direction and at what speed. It can be seen how the prevailing South Westerly winds entirely predominate for Dublin due to Atlantic gulf stream, with only lower occurrence from other directions- notably South East, which tend to occur during warm summer weather due to offshore breeze effects.

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

| Lawson Criteria | Colour |
|---|---|
| Suitable for long term Sitting | |
| Suitable for Standing or short term Sitting | |
| Suitable for Walking and Strolling | |
| Suitable for Business Walking | |
| Not Suitable for Pedestrian Comfort | |

*Figure 2.1.1 - Lawson Criteria Scale*

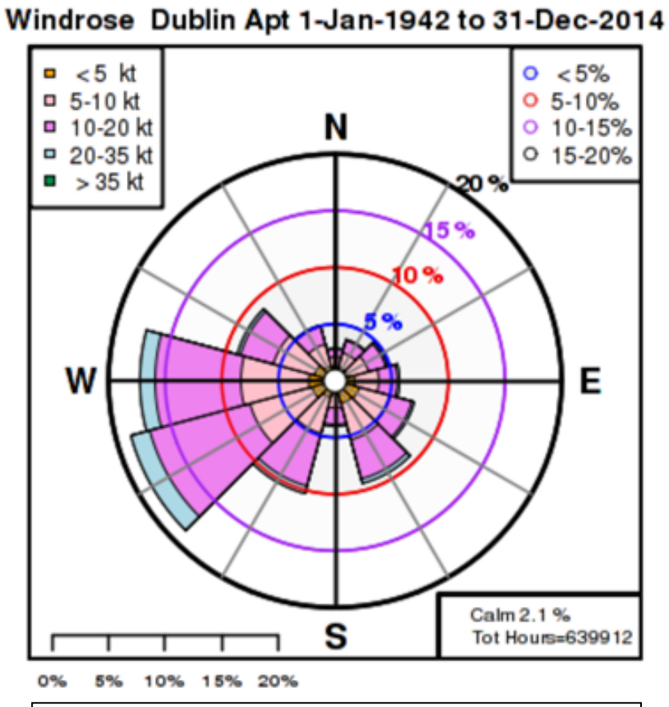


*Figure 2.1.2 - Windrose (Dublin Airport)*

# 2.0 PEDESTRIAN WIND COMFORT

## 2.2 Ground Level

CFD simulations were undertaken for the proposed building configurations as illustrated in fig 2.2.1 & 2.2.2.

Pedestrian comfort at ground level was assessed by predicting Lawson Criteria values at 1m above ground level (indicative of average height sitting/ standing).

Grey/ cyan contours illustrate areas deemed “suitable for long term sitting” and “suitable for standing or short term sitting” respectively as well as standing. Green contours indicate areas “suitable for walking and strolling”, with yellow illustrative of being “suitable for business walking”. Red areas highlight zones as “not suitable for pedestrian comfort”.

Figure 2.2.1 indicates predicted Lawson Criteria at Ground Level for the building configuration does not identify any areas of red (which would indicate excessive pedestrian wind speeds).

An area of yellow contours (suitable for brisk business walking) is only in evidence in part in the throughway into the amenity space beside the tower.

The analysis determined the optimum location for siting suitable amenity spaces such as outdoor seating areas located in the grey zones.

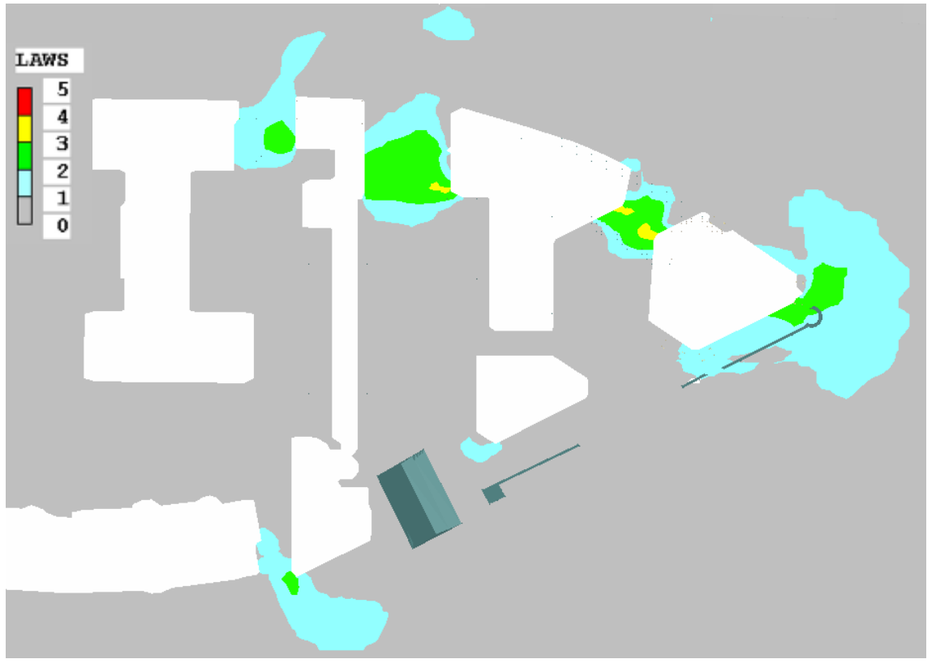


*Figure 2.2.1 - Plan Layout*

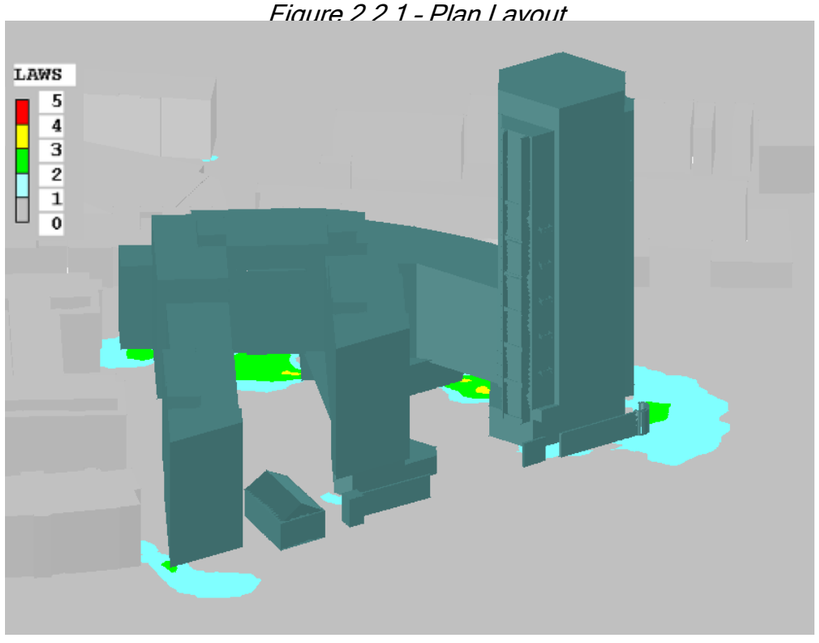


*Figure 2.2.2 - 3D Model*

# 2.0 PEDESTRIAN WIND COMFORT

## 2.3 Rooftop Amenity

The rooftop amenities were assessed for the three various levels at 1m above floor level incorporating a 1.5m high balustrade. The analysis allowed identification of potential use for each amenity space from more sheltered spaces suitable for long term sitting to more active spaces for social gatherings, season use etc..

As above, the grey/ cyan contours illustrate areas deemed “suitable for long term sitting” and “suitable for standing or short term sitting” respectively as well as standing. Green contours indicate areas “suitable for walking and strolling”, with yellow illustrative of being “suitable for business walking”. Red areas highlight zones as “not suitable for pedestrian comfort”.

Figures 2.3.1, 2.3.2 and 2.3.3 illustrate the results as assessed for the Lawson Criteria for each amenity space. With the exception of a small area on the amenity space on the 9th floor, no other areas of “not suitable for pedestrian comfort” were identified. This minor area identified could be mitigated through the use of localised planting.

The amenity space located on the 8th floor was determined to have the majority of its areas as “suitable for long term sitting” (grey). This is due to this space being sheltered from the prevailing winds from the south west. No areas designated as “not suitable for pedestrian comfort” were determined for the amenity space on the 8th floor.

The amenity space located on the 9th floor was determined to predominantly be “suitable for standing or short term sitting” with a mix of “suitable for long term sitting” and “suitable for walking and strolling” lending the intended use as a more social space. The minor areas of “suitable for business walking” would be mitigated through the use of localised planting and a canopy located at the base of the tower to prevent downdraft.

Due to the negative pressures as a result of the shape and orientation of the tower against the prevailing winds, the amenity space of the 25th floor was found to be “suitable for long term sitting”.

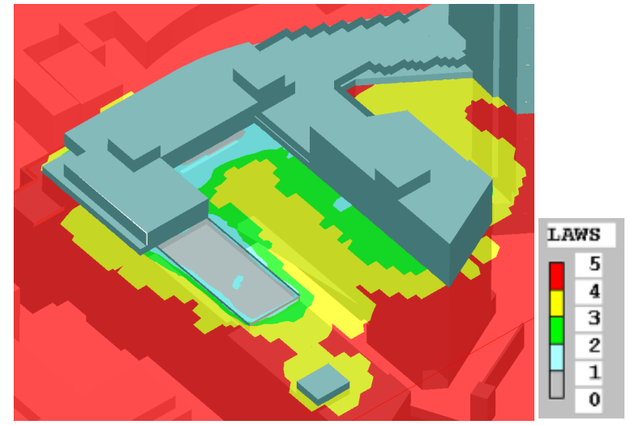


*Figure 2.3.1 - Amenity Space 8th floor*

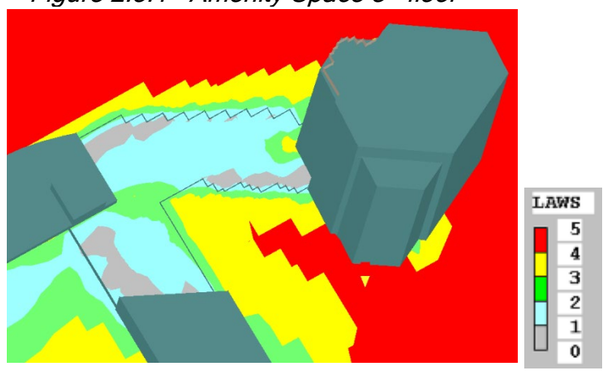


*Figure 2.3.2 - amenity Space 9th Floor*

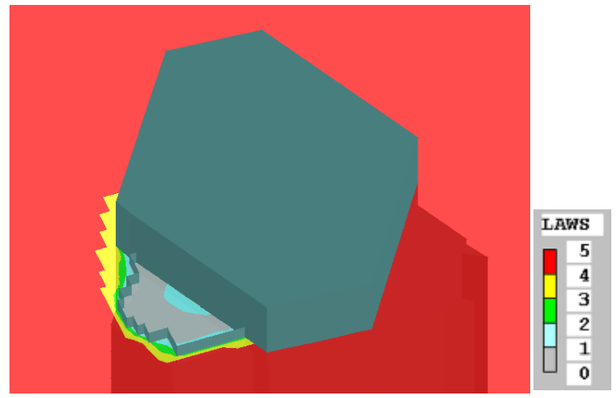


*Figure 2.3.3 - Amenity Space 25th Floor*

# 2.0 PEDESTRIAN WIND COMFORT

## 2.4 Tower Balconies

The balconies on the tower were assessed to determine if there would be any risk to habitual excessive wind speeds as a result of the building's height.

The tower was assessed for the annual predicted average wind velocities and directions for Dublin (VAV). Figure 2.4.1 illustrates the tower as seen from north west, south and east showing where average velocities would be low to medium low (blue to green) and medium to high (yellow to red) onto the building. It can be seen from these images that careful placement of the balconies on the east aspect of the tower places them in a low to medium average wind velocity zone. Conversely, balconies sited on either of the other two triangle points would be in positions of medium to high average wind velocities and therefore potentially unsuitable for habitual use.

As assessed under the Lawson Criteria, the analysis determined, fig 2.4.2 & table over, that all balconies on this façade all contain some element of grey contours signifying that they would be "suitable for long term" sitting based on the probability of wind direction and wind speeds for Dublin.

As a result of this analysis, any balcony deemed to be not suitable for sitting were removed from the overall quantum of amenity spaces.

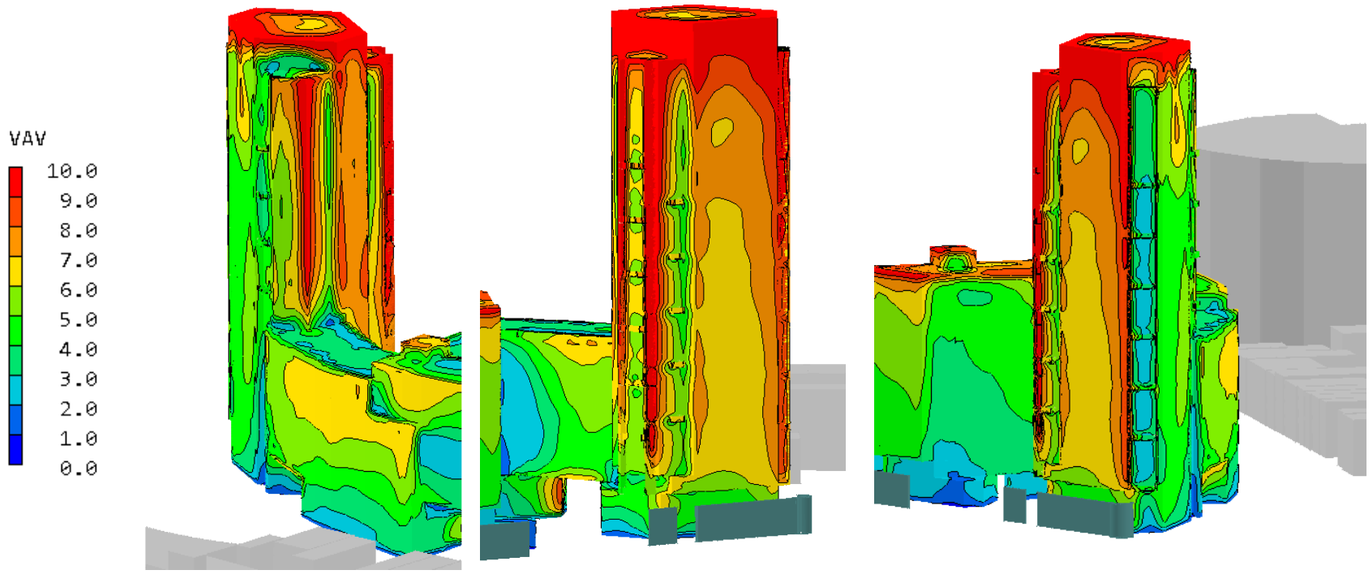


*Figure 2.4.1 - Average Dublin Wind Velocities on North West, South and East Aspects of Tower*

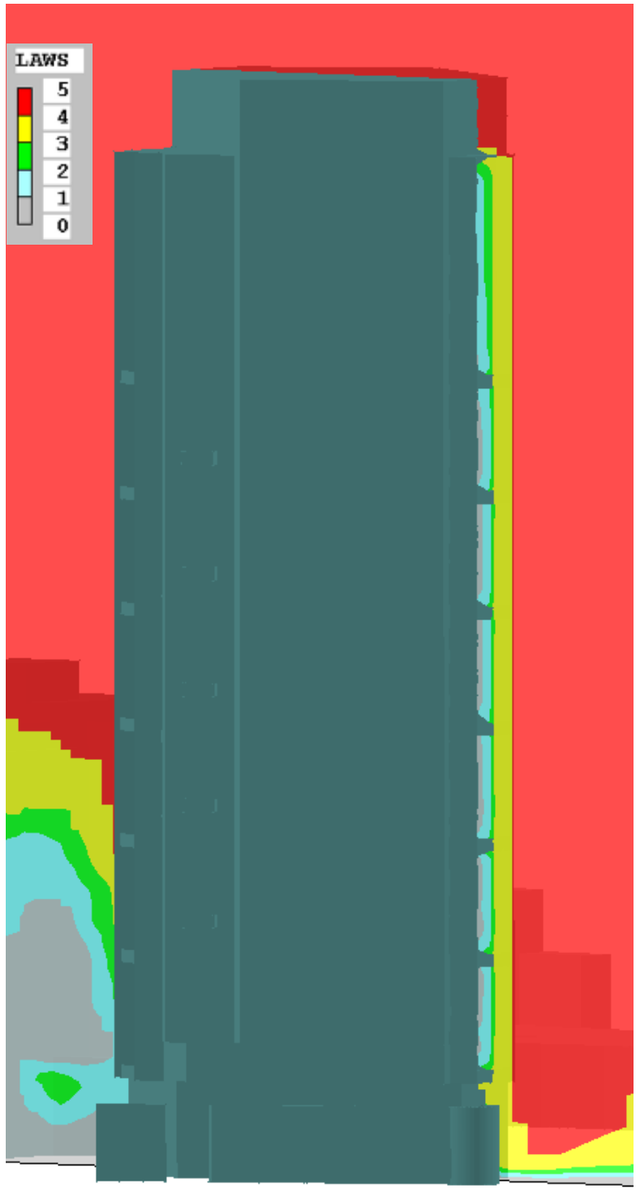


*Figure 2.4.2 - Balcony Comfort - Section Through Tower Balconies from South East*

# 2.0 PEDESTRIAN WIND COMFORT

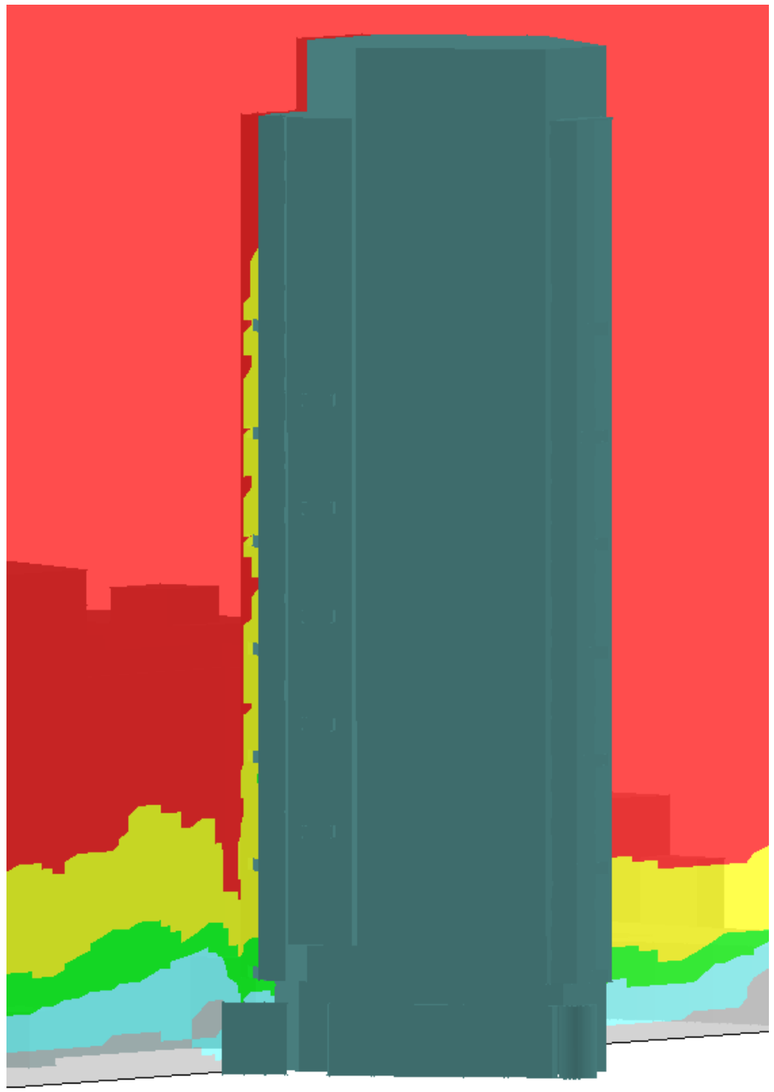

*Figure 2.4.3 - Balcony Comfort - Section Through Tower Balconies from South*

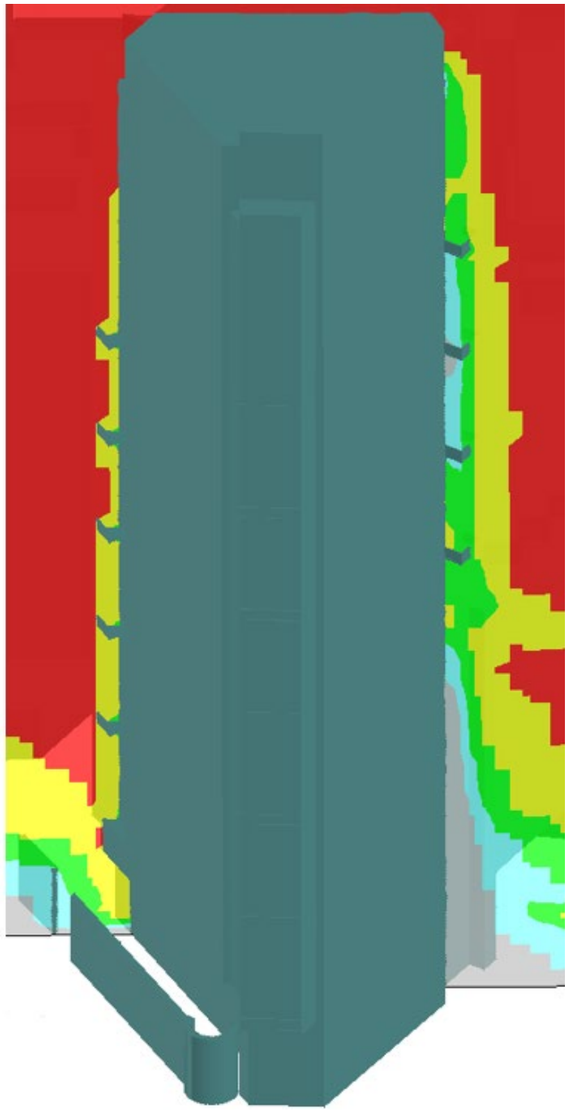

*Figure 2.4.4- Balcony Comfort - Section Through Tower Balconies from East*

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