VIRUTAL (CFD) ANALYSIS OF THE WODEN VILLAGE DEVELOPMENT PEDESTRIAN WIND SAFETY AND COMFORT

by

J. Kostas

SUMMARY

Virtual (CFD) modelling has been conducted on the Woden Village development to assess the pedestrian wind impacts and assist with built form design changes, if required, to minimise wind effects in the key pedestrian activation spaces.

A full-scale virtual (CFD) model was developed and analysed in a simulated upstream boundary layer of the natural wind to determine the likely pedestrian wind conditions. The model did not include any landscaping. The pedestrian wind conditions have been combined with the wind climate data for Canberra and compared with the wind safety and comfort criteria defined in Schedule 1 of the ACT ZS2 Planning Scheme Assessment Outcome 23.11.

The pedestrian safety and comfort level requirements were shown to have been met in the ground level pedestrian realm. The rooftop communal areas have been shown to achieve wind comfort conditions within the 16m/s threshold.

Wind safety and comfort exceedances were localised to the northeast and southeast corner balconies of the northern residential tower. It would be recommended to incorporate a full height screen on one aspect of these corner balconies, or equivalently, move them inboard, away from the building corners. All other areas were shown to achieve the safety criterion.

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Report 25066A-CFD-ENV00

WODEN VILLAGE
VIRTUAL ENVIRONMENTAL WIND CONDITIONS MODELLING

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PREPARED FOR:
UbnDG

Contact: Nathan Ross
Ph: +61 417 428 071

PREPARED BY:
MEL Consultants Pty Ltd
22 Cleeland Road
South Oakleigh VIC 3167

Contact: Jim Kostas
Ph: +61 3 8516 9680

PREPARED BY:

J. Kostas
Director
Date: 11 July 2025

REVIEWED BY:

M. Eaddy
Managing Director
Date: 14 July 2025

RELEASED BY:

M. Eaddy
Managing Director
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1. INTRODUCTION

A virtual (CFD) study was commissioned by UrbnDG to evaluate the expected pedestrian wind safety and comfort around the Woden Village site and in the surrounding streetscapes. The virtual study was conducted in July 2025.

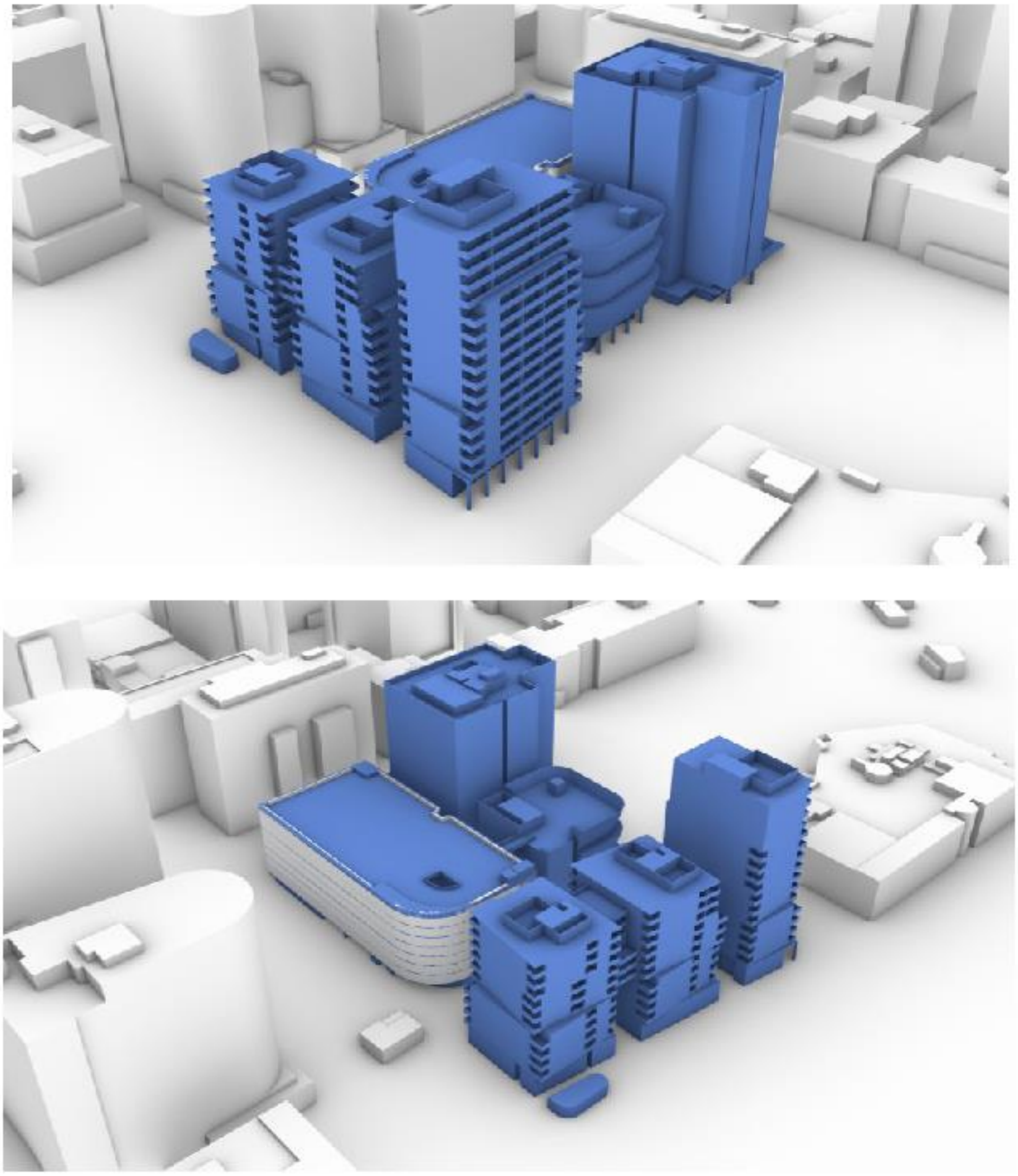


Figure 1: Woden Village proposed development viewed from the north-east (above) and south-east (below).

2. ENVIRONMENTAL WIND CRITERIA

The advancement of wind tunnel testing techniques, using large boundary layer flows to simulate the natural wind, has facilitated the prediction of wind speeds likely to be induced around a Development. To assess whether the predicted wind conditions are likely to be acceptable or not, some forms of criteria are required. Schedule 1 of the ACT ZS2 Planning Scheme defines the wind comfort and safety criteria in Assessment Outcome 23.11. It states that for a building of greater than 28m height the wind patterns associated with the proposed building will not unreasonably reduce the safety and comfort of people in the public spaces or other open spaces associated with the development and do not exceed the following:

Comfortable wind conditions

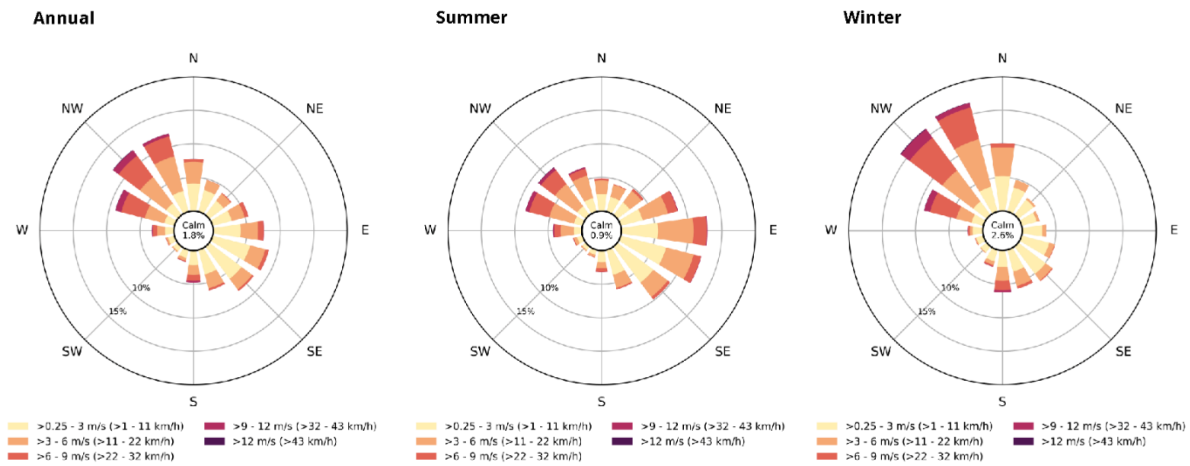
a) Adjacent main pedestrian areas and routes (as defined in the relevant precinct code) - 10m/s.
b) All other adjacent streets and public places - 16 m/s.

Unsafe wind conditions

These conditions are not defined in the planning scheme and as such the wind safety criterion, utilised by the Australian Wind Engineering Society, of 23m/s will be adopted.

While not explicitly stated, it is inferred that the above wind speeds are gust wind speeds. From our knowledge of the basis of these criteria, these wind speeds are assumed to relate to a probability of exceedance of 0.1%, which relates approximately to the annual maximum wind speed occurrence for each wind direction. The assessment is based upon the summation of probabilities of exceedance across all wind directions to determine whether a location passes or fails the threshold criterion.

The Canberra wind climate is presented in a wind rose format in Figure 2. The data has been collected from the Canberra Airport anemometer and analysed to present both annual and seasonal wind roses. While the strength of the wind varies across the year, the prevailing wind directions do not vary significantly, with dominant winds incident typically from the north-west and south-east sector.



Location: Canberra Airport
Years: 2001 to 2021
Data Set: BOM 1 Minute
Corrected to: TC2 @ 10m

Figure 2: Annual and seasonal wind roses for the Canberra region.

3. CFD TECHNIQUES

A virtual model of the development at full scale was created from digital drawings provided by Metier 3 in June, 2025. The terrain and buildings surrounding the development were modelled out to a radius of 900m and included the current and under construction surrounding buildings as shown in the modelled domain for the Woden Village development of Figure 3.

Figure 3: CFD Domain modelled for the Woden Village development. The development is shown in blue.

The development was laterally centred in the computational domain, which was large enough to ensure the blockage ratio (ratio of frontal area of the context model to the area of the domain inlet) was less than 3%. It also ensured that the domain boundaries were sufficiently far from the proposed development and surrounding buildings to have a negligible effect on the wind flow in the area of interest.

The wind flow around the development was modelled using a customised version of OpenFOAM-v2012 software. The Reynolds-Averaged Navier-Stokes (RANS) equations were solved to obtain the average wind flow-field. The standard k-ε turbulence model was used.

For all wind directions, the boundary layer was modelled as Terrain Category 3 (TC3) – as defined in AS/NZS 1170.2:2021 (Figure A.1). For the quality assurance process, a CFD simulation in an empty domain (i.e., without buildings) was performed to verify a TC3 boundary layer was maintained throughout the computational domain. The simulated boundary layer had a deviation of less than 3.5% from the AS/NZS 1170.2:2021 and ISO 4354:2009 profiles.

In wind tunnel tests, a time-averaged velocity magnitude (or mean wind speed) is determined from probe measurements. This measurement is indicative of the effects of wind on pedestrians (i.e., pedestrians are sensitive to the wind speed, not direction). The time-averaged velocity magnitude (or mean wind speed), V_a, is calculated as

$$V_a = \langle\sqrt{U^2 + V^2 + W^2}\rangle, \qquad (1)$$

where U, V, and W are the components of velocity and the angle brackets ($\langle\,\rangle$) indicate a time average.

Distinct from wind tunnel probe measurements, the RANS simulations only provide the individual mean components of velocity, from which the absolute mean velocity magnitude (V_m) can be calculated as

$$V_m = \sqrt{\langle U\rangle^2 + \langle V\rangle^2 + \langle W\rangle^2}. \qquad (2)$$

The mean wind speed (V_a) cannot be directly calculated from the RANS simulations. In this assessment, a correction has been made to the V_m extracted from the RANS simulations to obtain an estimate of V_a.

The safety criterion (described in Section 2) requires assessment of a 3-second gust wind speed. As the RANS simulations used in this assessment provide average results only, the peak gust wind speed cannot be directly extracted. Instead, the gust wind speed can be calculated using

$$U_g = V_a + K\left(\frac{\sigma}{V_a}\right). \qquad (3)$$

where U_g is the gust wind speed, K is the gust factor, and σ is the standard deviation of the wind speed. To convert the mean wind speed to a 3-second gust, a gust factor of $K = 3$ is used. The standard deviation of wind speed can be calculated using

$$\sigma = \sqrt{\frac{2}{3}k}\,, \tag{4}$$

where k is the turbulent kinetic energy (extracted from the RANS simulations).

Likewise, to calculate the gust equivalent mean wind speed (U_{GEM}) for assessment of the comfort criteria, the 3-second gust wind speed (calculated from Equation (3)) is required. The gust equivalent mean wind speed is determined using

$$U_{GEM} = \frac{U_g}{1.85}. \tag{5}$$

The CFD techniques used have been previously correlated with wind tunnel studies to ensure validity. The CFD environmental wind studies undertaken satisfy, and in most cases exceed, applicable AWES-QAM-1-2019 and AWES Guidelines for Pedestrian Wind Effects Criteria (2014) guidance.

AWES-QAM-1-2019 (C.5) states that wind speeds should be determined for at least 16 wind directions.

4. DISCUSSION OF RESULTS

The CFD results presented hereon are based on steady, or time-averaged, CFD RANS simulation which calculate an equivalent gust wind speed from the data, as described in Section 3.

Colour contour plots of the pedestrian safety and comfort wind conditions will be presented at both ground level and elevated areas and allow for a quick visual evaluation of where the high and low wind conditions lie both within and outside the site.

4.1 Pedestrian Safety

The pedestrian safety at ground level is presented for in Figure 4a. The analysis indicates there is no real risk of exceeding the safety criterion within the 200m radius indicated in the Figure.

At the elevated communal areas on the podium the analysis indicates no safety issues.

The terraces on the north-east and south-east corners of the northern residential tower show conditions exceeding the safety criterion. It would be recommended to incorporate a full height screen on one aspect of these corner balconies, or equivalently, move them inboard, away from the building corners.

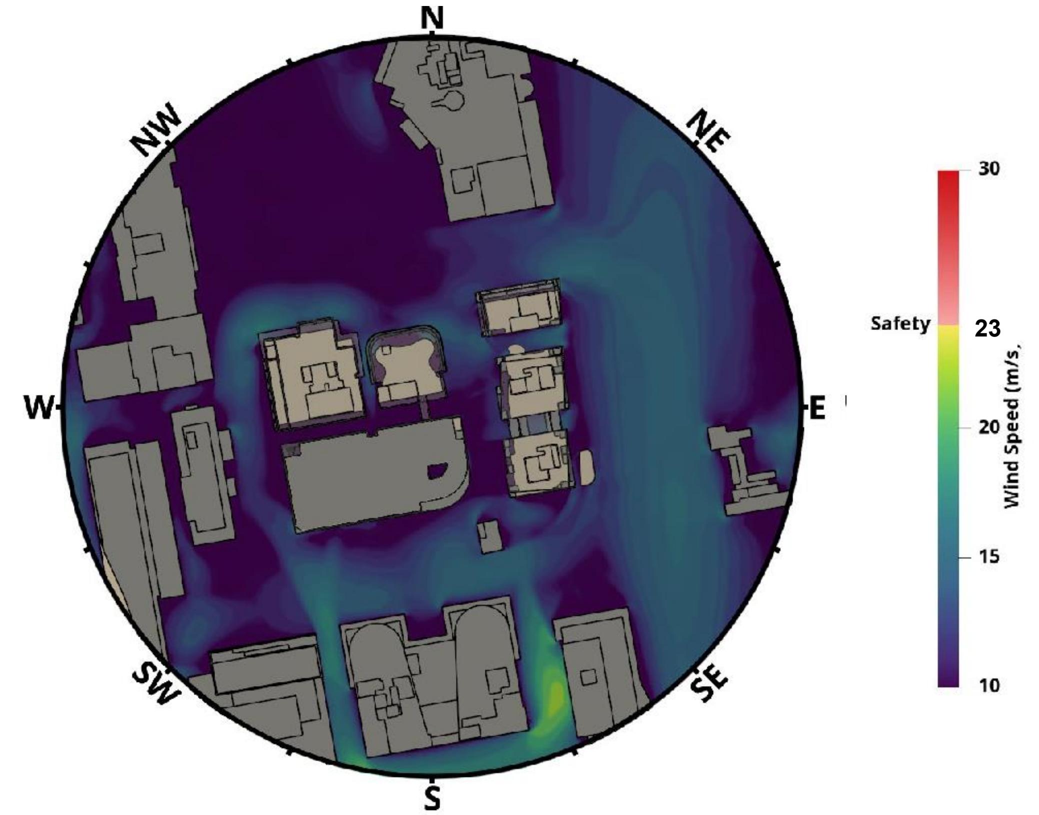


Figure 4a: Ground Level Pedestrian Safety. 200m radius shown.

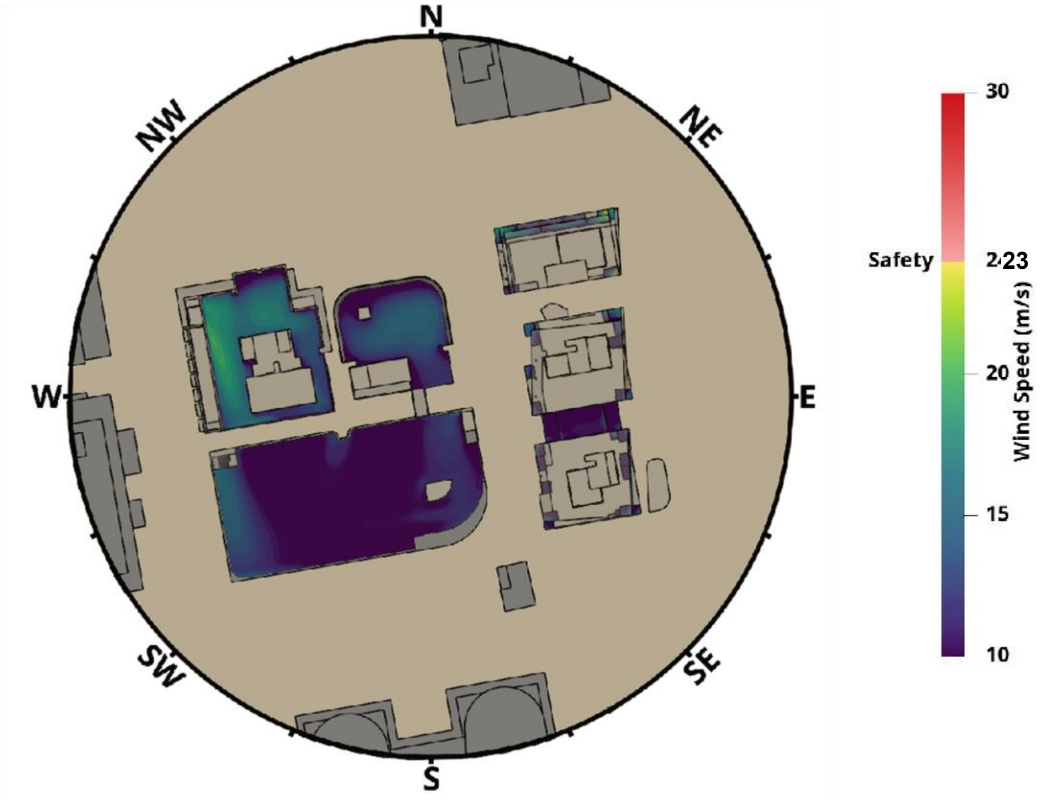


Figure 4b: Elevated areas Pedestrian Safety. 200m radius shown.

4.2 Pedestrian Comfort

Plots of pedestrian wind comfort are shown in Figures 5a and 5b for ground level and elevated areas, respectively. The ground level areas show relatively good comfort levels and achieve wind conditions below 10m/s for most areas, with some localised areas achieving conditions between 10 and 13m/s. Within the Woden Village site only very small areas at the northern most corners of the buildings show wind conditions within 13m/s – 16m/s. No ground level areas were evident in having wind comfort conditions above 16m/s.

Figure 5b presents the wind comfort levels on the elevated areas and balconies. The open communal areas show higher levels of wind conditions on the western side of the commercial tower, with conditions between 13m/s – 16m/s. No areas within these large communal spaces show elevated wind conditions above 16m/s.

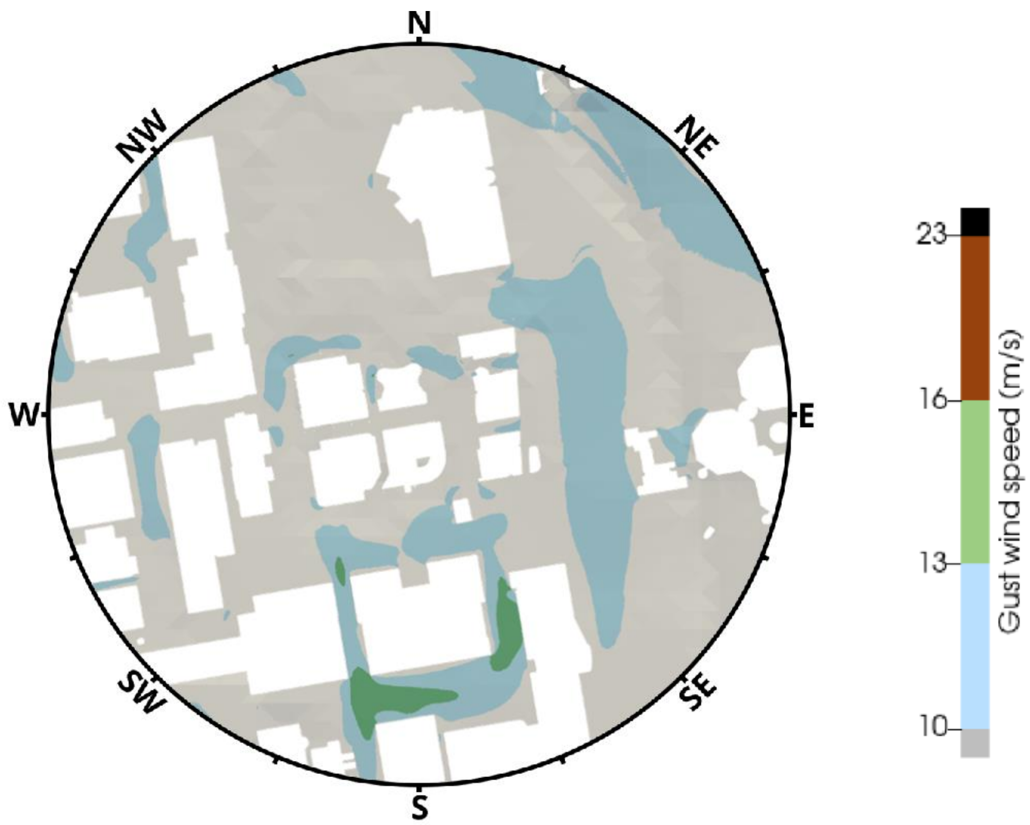


Figure 5a: Ground Level Pedestrian Comfort. 200m radius shown.

However, on the residential towers the wind conditions on the corner balconies (especially the north-east and south-east corners of the northern most tower) have been shown to experience wind comfort conditions above the 16m/s threshold and the safety criterion, as noted earlier. The wind comfort conditions on the balconies of the other, more southern, residential towers are shown to have conditions within the 16m/s comfort threshold.

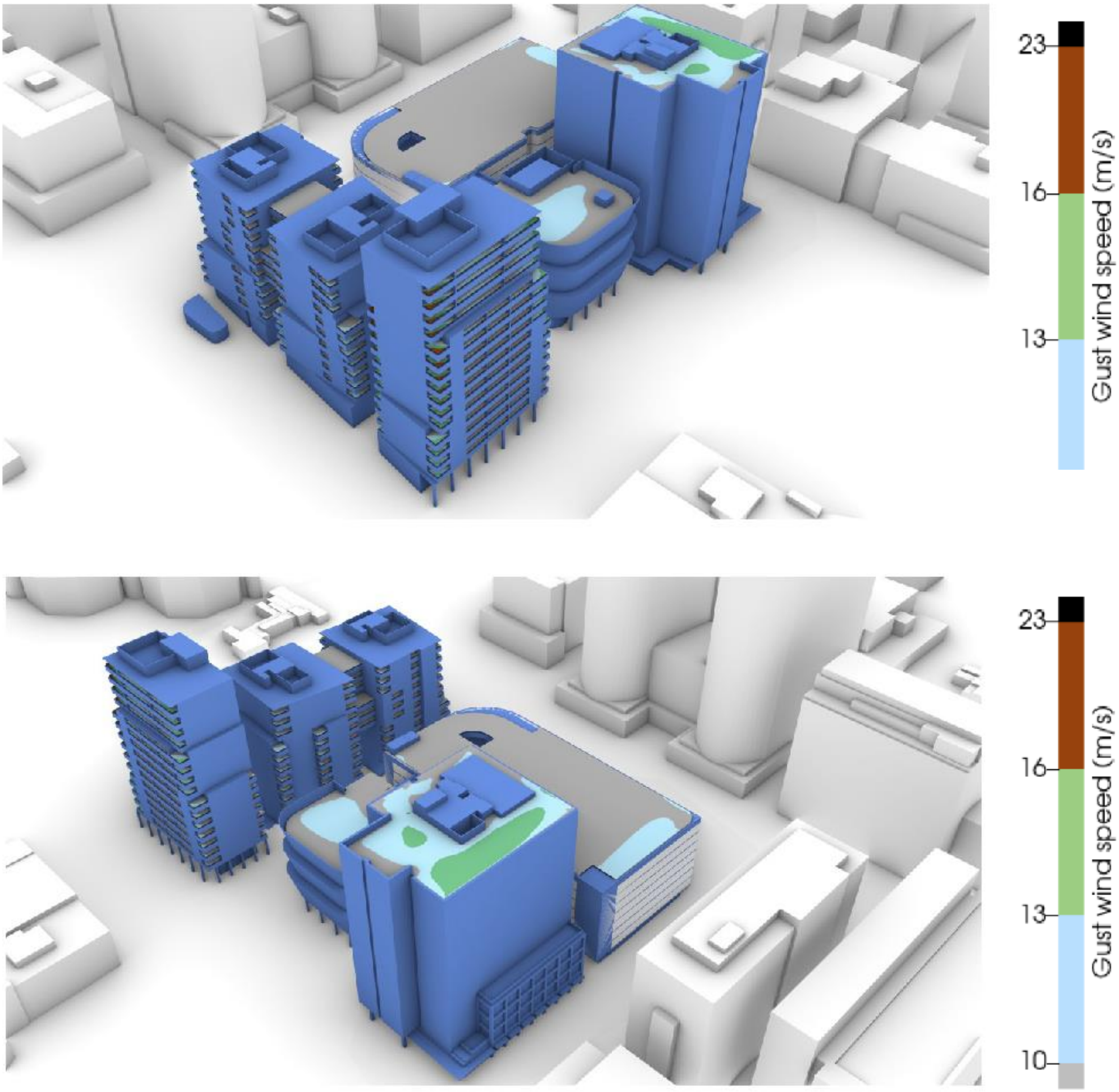


Figure 5b: Elevated and terrace areas pedestrian Comfort. Above NE view; Below NW view.

APPENDIX A – SUPPLEMENTARY FIGURES

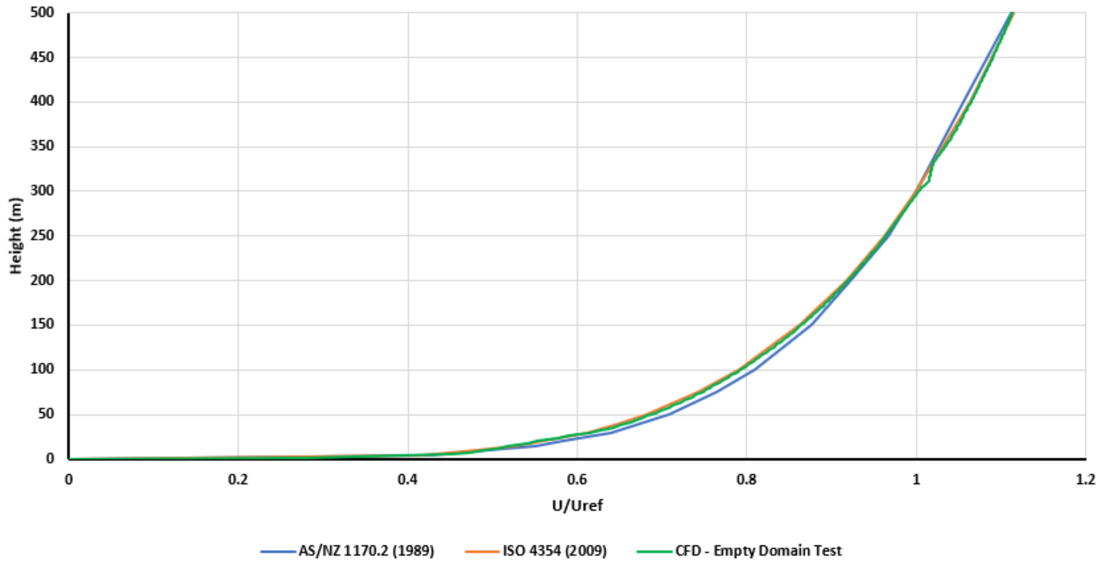


Figure A. 1: Full-scale TC3 boundary layer mean velocity profile.