

UPPER BROOK STREET, 1ST FLOOR TERRACE

FOR MCLAREN CONSTRUCTION (MIDLANDS AND NORTH) LTD.
SO18435 R01 REV_A

Executive Summary

PDSVISION UK Ltd (formerly Wilde Analysis Ltd) has previously conducted a wind microclimate study for the proposed development at Upper Brook St, Manchester. This was a formal assessment against the Lawson comfort criteria, but geometry was based on a massing model. Planning Condition 57 refers to general wind mitigation throughout the scheme and requests that final planting and landscaping details be submitted for approval. Street-level mitigation was addressed in an earlier report and shown to be effective. However, recently, attention has focussed on the first-floor terrace of the North Building where we expected some local wind acceleration which could impact on comfort levels for outdoor seating.

PDSVISION UK has undertaken localised simulation of a single potentially problematic condition that might lead to discomfort here, with a view to showing how parapet design and landscaping would provide suitable mitigation. Wind approaching from directions around 190° comprise the largest potential contributor to discomfort and as such it is this wind direction that has been assessed.

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DOCUMENT INFORMATION

Report Reference Number: SO18435 R01 RevA

Revision History:

Revision	Description	Created By	Checked By	Approved By	Date
A	First Release	D Fava	S Leefe	S Leefe	6 th Feb 2025

The contents of this report are classified as *Client's Discretion* and can be distributed at the discretion of the client subject to contractual agreement.

PDSVISION UK have provided analysis services and design support in connection with this project in an advisory capacity. The application of our studies and the final decision on the fitness of purpose and performance of the design in service remains the responsibility of the client.

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1. INTRODUCTION

The document has been prepared by PDSVISION UK on behalf of McLaren Construction (Midlands and North). Previous work has been conducted by PDSVISION UK (formerly Wilde Analysis) to support the planning application for a Sci-Tech and purpose-built student accommodation (PBSA) scheme (hereafter referred to as the 'Proposed Development') situated on Upper Brook Street [1].

Following this previous work a number of Planning Conditions were raised. One of these, Planning Condition 57, states that “.....prior to any above ground works associated with a plot of the development, full and final details of the wind mitigation measures shall be submitted for approval in writing by the City Council, as Local Planning Authority. This shall include siting, scale and appearance of any screens, siting, scale and species of any trees, hedges and planting.....” The street-level mitigation was addressed in the earlier report [1] and proposed planting and landscaping shown to be effective. However, recently, attention has focussed on the first-floor terrace of the North Building where we expected some local wind acceleration which could impact on comfort levels for outdoor seating. Given the wording of Condition 57, the undertaking of a full quantitative assessment against the Lawson criteria at this location is not required. The most onerous conditions here were identified as being wind from the 190° direction, with this being one of the most common wind directions and one which sees relatively high likelihood of strong winds. It was therefore decided that any wind mitigation measures and further assessment should concentrate on this condition.

The assessment detailed in this report focuses on three terrace cases. In all cases a 'Zoom-In' model has been utilised. Allowing for the Computational Fluid Dynamics (CFD) model to be reduced, with focus retained on the impact of landscaping and parapet design on the first-floor podium of the Proposed Development. The three cases considered are a 'Baseline' case, in which no mitigation is included, a 'semi-open' parapet design, including landscaping and a 'glass' parapet design, again including landscaping. The baseline case is essentially a “zoomed in” reproduction of the earlier work, using massing model geometry, and provides a basis of comparison for the other two cases.

The effectiveness of the mitigation can therefore be assessed and recommendations for podium landscaping and parapet design added to those already made for street level landscaping, to support fulfilment of Condition 57.

2. GEOMETRY

2.1 Geometry Description

A zoom-in model approach has been taken when considering the geometry of the Proposed Development and its surroundings. This method makes use of the previous work, including street-level landscaping, [1], by considering a small region of the overall domain, focussing on the Proposed Development (Figure 1).

Small modifications have been made to the Proposed Development geometry in line with the most recent elevations provided [2]. Landscaping has been included, including the positions of benching, pergolas, doorways, trees and hedges (Figure 2) [3]. Details of proposed parapet design are provided in ref. 4. In one option a solid glass parapet 1.8 m high is considered. In the other an open (porous) design is considered which more closely resembles ornate railings.

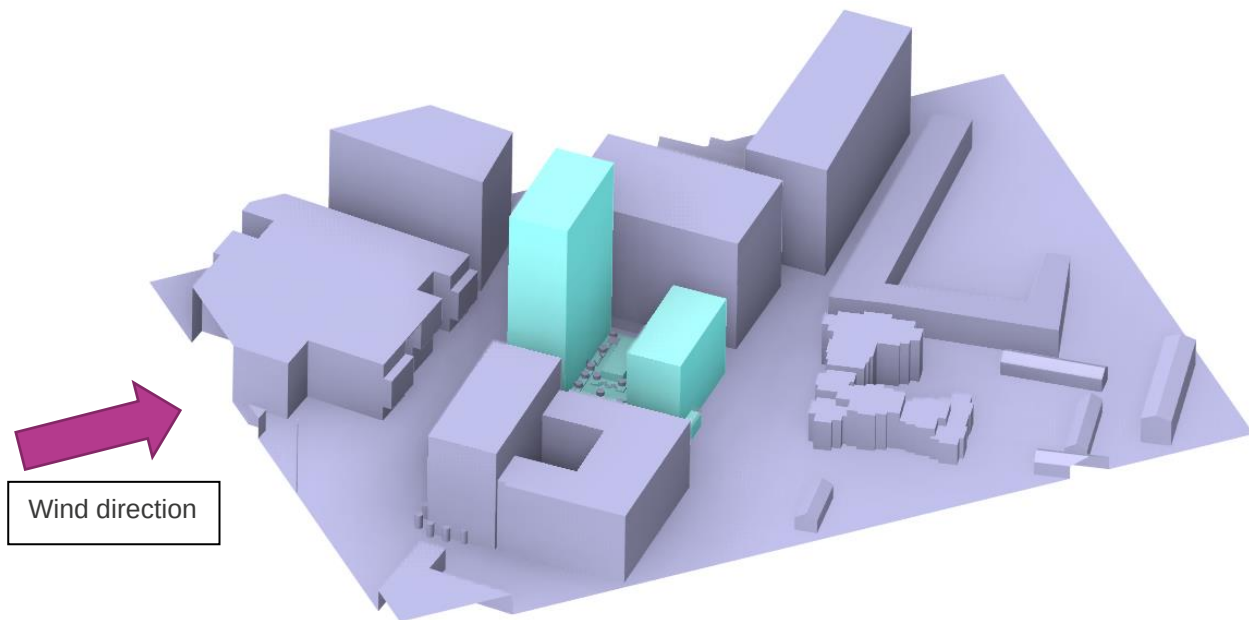


Figure 1 - Zoom-In model geometry with Proposed Development highlighted.

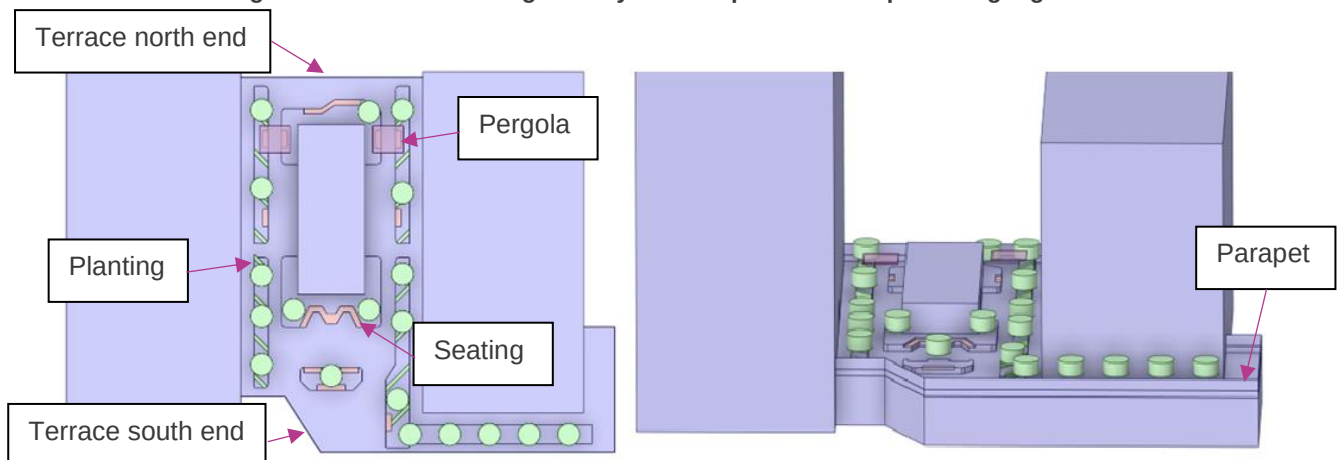


Figure 2 - Proposed Development with 1st floor podium landscaping shown. Seating is shown in red, while significant planting such as trees and hedges are shown in green.

3. PHYSICS AND BOUNDARY CONDITIONS

3.1 Boundary Conditions

The wind direction for the zoom-in model has been specified as 190° as this has been identified as the most onerous wind direction in the previous analysis undertaken [1]. A reference wind speed of 10 m/s has been utilised in line with the study conducted previously.

Where landscaping has been included, for example pergolas, trees and hedges, these have been treated as porous media with appropriate directional loss coefficients defined [5, 6].

When considering the parapet two discrete approaches have been considered. In the case of the porous parapet appropriate loss coefficients have been determined relative to the open area fraction of the parapet and these are defined in the model [6]. In the case of the glass parapet, the parapet has been treated as a solid wall, such that no flow can pass through.

All other walls in the model have been defined as non-slip boundaries, such that flow velocity is zero at the boundaries.

The inlet has been implemented using results from the previous analysis including street-level landscaping [1]. The flow conditions on a plane corresponding to the inlet location of the zoom-in model have been extracted and are used as the inlet conditions for the zoom-in model. This ensures the flow entering the zoom-in model is representative of the larger domain previously considered. This approach has been validated through comparison of results between the baseline cases.

4. RESULTS

4.1 Assessment Method

The assessment will consist of looking at the speed-up factors (i.e. wind speed as a factor of reference wind speed) in the three considered cases and comparing between them. This will allow for assessment of the impact of the mitigation included in the form of landscaping and the parapet. Contours will be included showing the speed-up factor at a height of 6m from ground level, or 1.06m above the terrace, approximately in line with seated level. Of particular interest will be speed-up in the locations of the benching and loose seating on the terrace. In all following images of results, dark red and orange colours indicate wind speed is greater than that of the oncoming wind (i.e. accelerated wind), whereas yellow to blue colours indicate the wind speed is decreased locally. Successful mitigation is indicated where significant locally decreased speeds (yellow to blue) coincide with seating locations.

Streamlines showing flow patterns on the terrace will also be included to display the wind patterns across the terrace.

4.2 Results – Baseline

The baseline assessment is representative of the geometry assessed in the previous work [1] and includes no parapet or landscaping. This allows for a baseline assessment against which the mitigation can be assessed.

The speed-up factors shown (Figure 3) indicate regions of higher wind velocities at several bench locations, primarily on the south side of the terrace. There area of loose seating on the south edge of the terrace can be seen to encounter higher wind speeds, potentially leading to discomfort. Several other seating locations can also be seen to be exposed to higher wind speeds. These results confirm that mitigation is required.

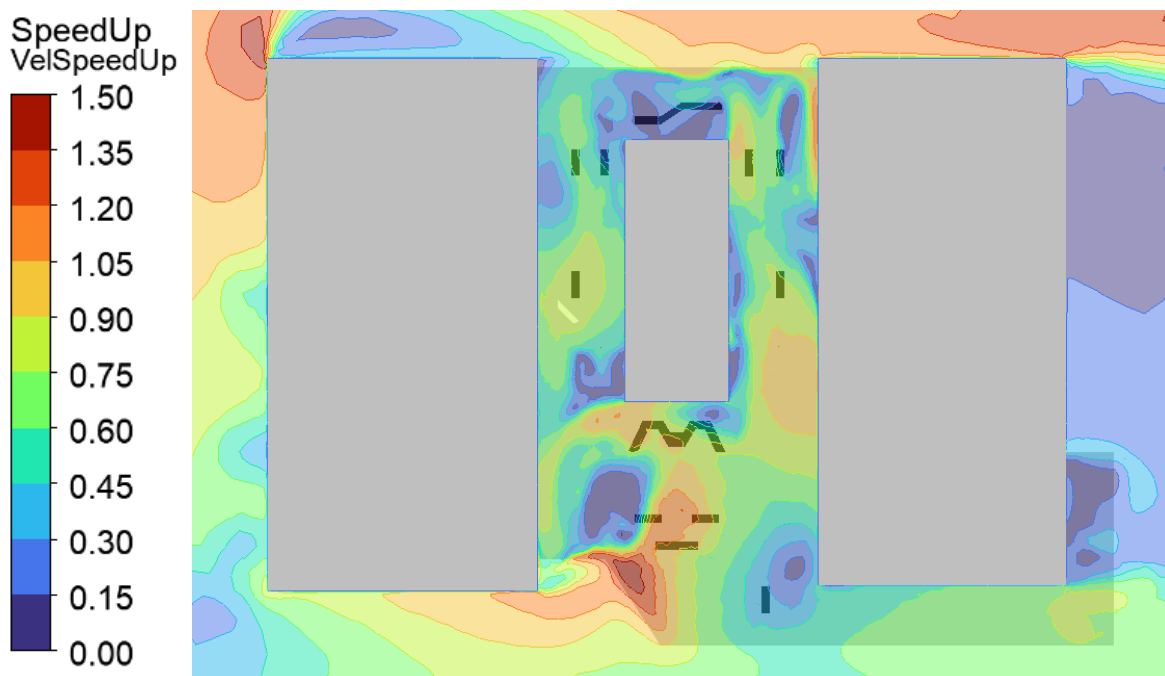


Figure 3 - Baseline results, contours of speed-up factor.

Streamlines showing the flow patterns in the vicinity of the terrace show that a significant portion of wind is diverted over the terrace (Figure 4).

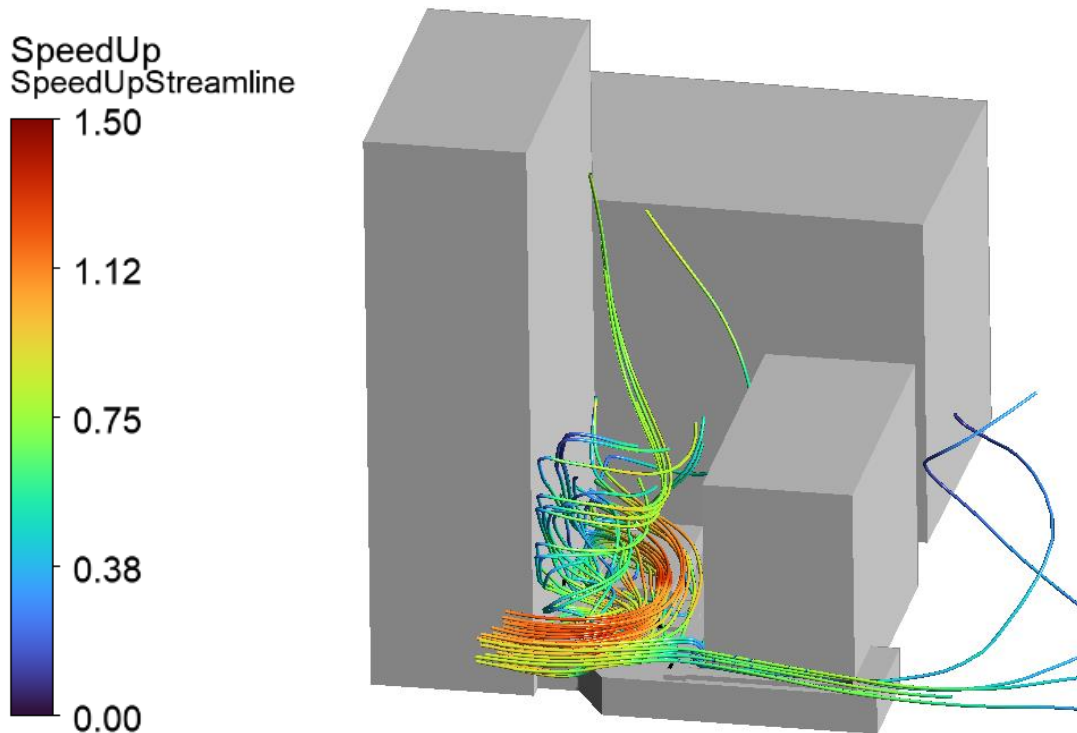


Figure 4 - Baseline results, streamlines coloured by speed-up factor.

4.3 Results – Porous Parapet

Following the baseline assessment the landscaping was introduced to the model and the parapet included. The parapet consists of two portions, the bottom part, of 0.69m being an 81% open area section, with the top portion, of 1.12m being 90% open area (Figure 5) [4]. The impact of this can be seen, with reduced wind speeds observed in the sitting areas towards the north of the terrace (Figure 6). However, it can be seen that the impact of the parapet is minimal, with regions of higher velocity wind still existing towards the south of the terrace. This is due to the large open area proportions of the parapet, along with the fact the wind direction is effectively normal to the parapet in regions. Considering these two combined factors, the parapet included is not sufficient to prevent potentially uncomfortable sitting conditions in various areas on the terrace, in particular in the loose seating area towards the south end of the terrace.

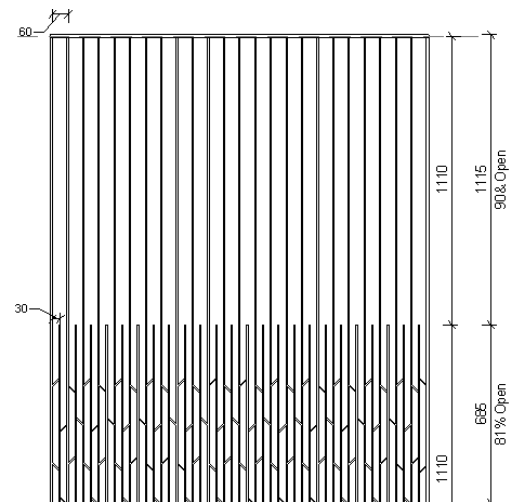


Figure 5 - Porous parapet design [4]

The velocity streamline plot shows a similar story to the speed-up contours, with very similar flow patterns to those observed in the baseline case. Here it is again apparent that the high open area of the parapet provides insufficient flow resistance to significantly alter the flow patterns at the south end of the terrace, with higher velocity winds still being observed.

The two results displayed indicate that the inclusion of the landscaping does mitigate wind speeds towards the north of the terrace (Figure 6), however, to mitigate the higher velocity wind at the south of the terrace a more substantial barrier than the porous parapet is required (Figures 6 & 7).

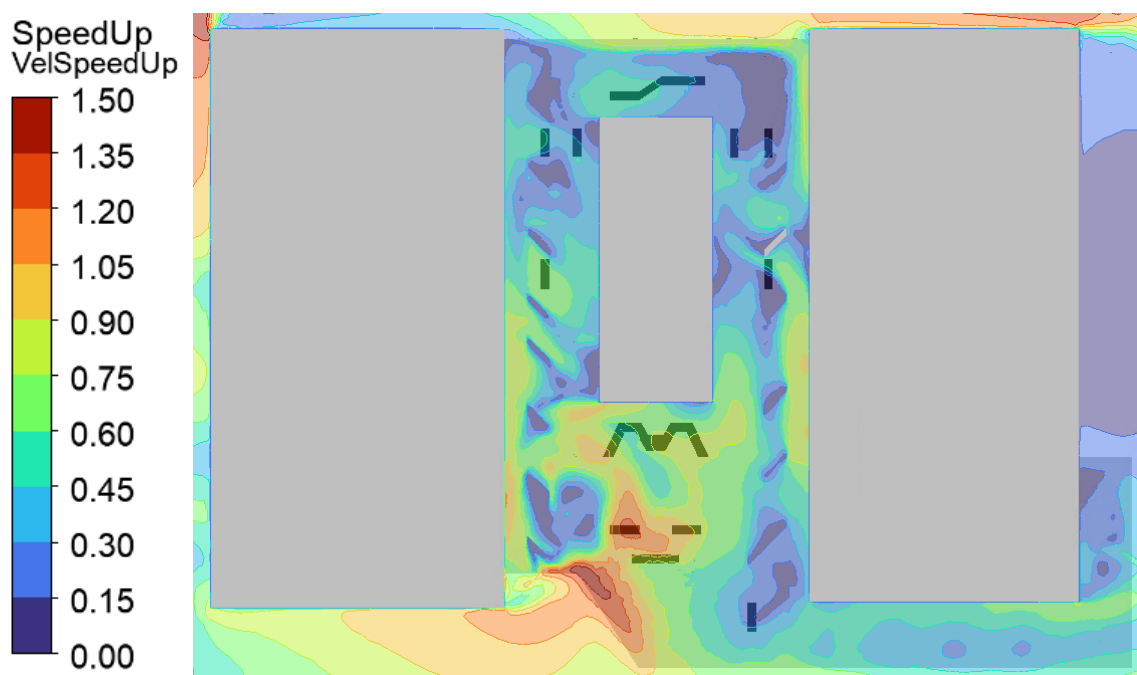


Figure 6 - Porous parapet, contours of speed-up factor.

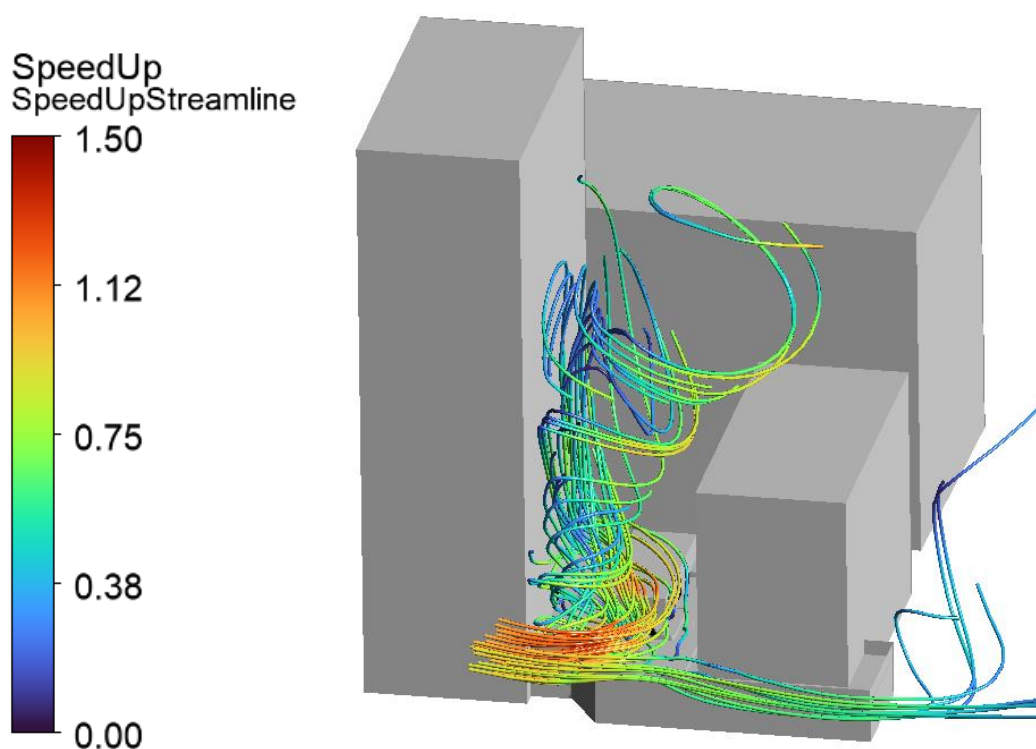


Figure 7 - Porous parapet, streamlines coloured by speed-up factor.

4.4 Results – Glass Parapet

The final iteration of the analysis builds on the assessment conducted in the porous parapet assessment through the inclusion of a more substantial flow barrier in the form of a glass parapet. From the speed-up contours (Figure 8) it can immediately be seen that through the combination of the glass parapet and the landscaping the wind speeds across the terrace are reduced relative to those observed in the baseline case. The glass parapet can be seen to form an effective barrier, sheltering the seating area at the south of the terrace from the oncoming winds, and likely increasing comfort levels in this area.

The benched seating areas in these locations can also be seen to be further sheltered from the oncoming winds.

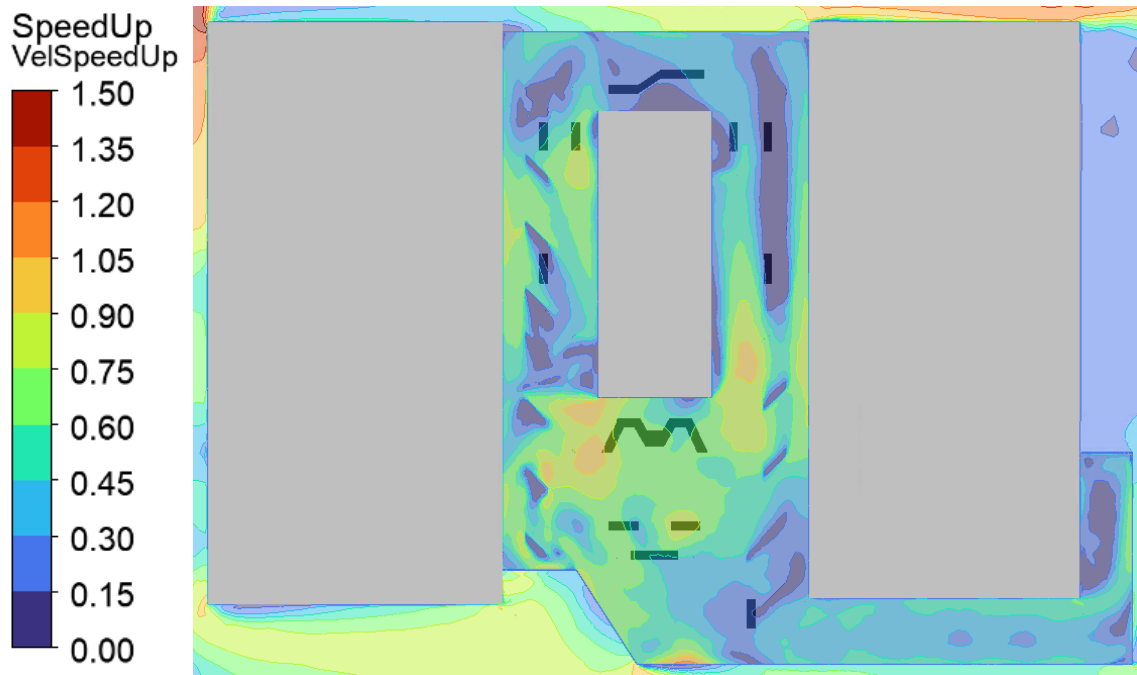


Figure 8 - Glass parapet, contours of speed-up factor.

The streamline plot (Figure 9) further reinforces the conclusions made through assessment of the contours.

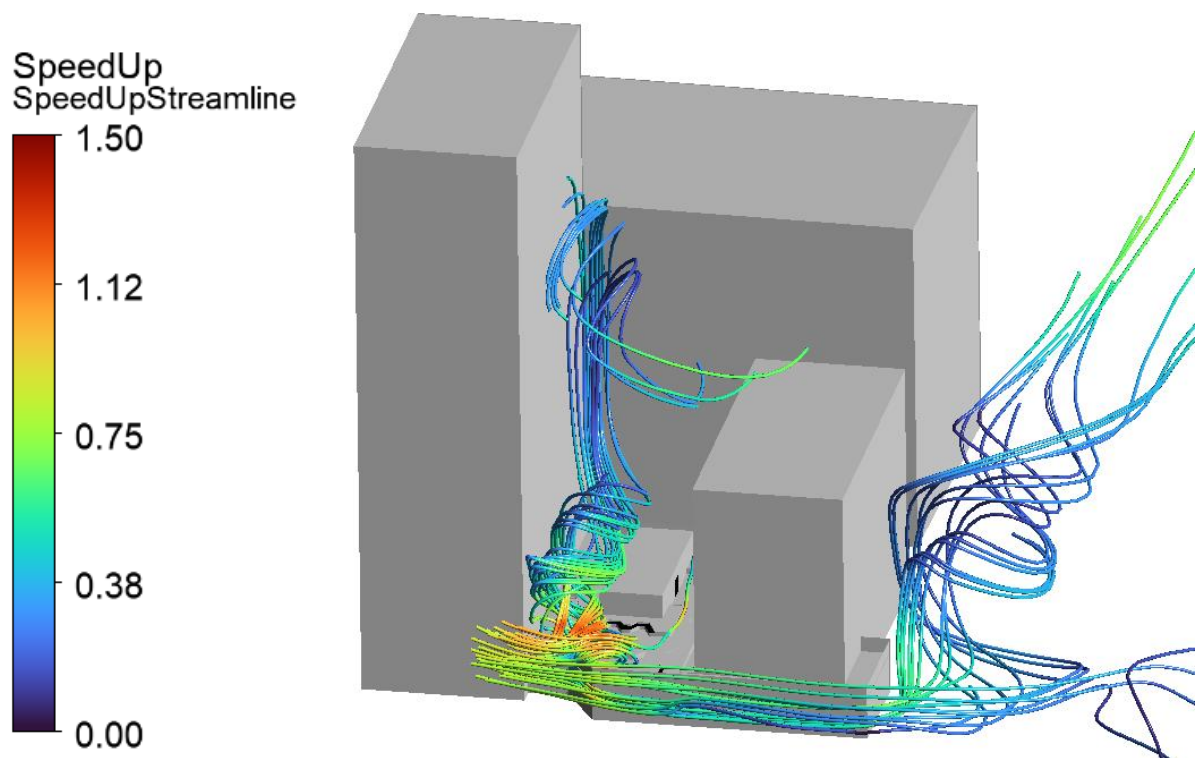


Figure 9 - Glass parapet, streamlines coloured by speed-up factor.

5. CONCLUSIONS AND RECOMMENDATIONS

A Computational Fluid Dynamics (CFD) assessment has been conducted looking at the effectiveness of the mitigation factors proposed at the Proposed Development, with specific focus on the first-floor terrace, when considering a wind direction of 190°.

Two mitigating approaches have been considered, these being the inclusion of a parapet around the outside of the terrace and the introduction of landscaping on the terrace. The effectiveness of these mitigating measures is assessed through comparison with a baseline scenario. Two parapet designs are considered.

The baseline analysis reflected the massing model geometry used in earlier work [1], with no parapet or terrace landscaping included. It highlights specific regions on the terrace with wind speeds that may lead to discomfort. Several of the benched seating regions and the loose furniture both at the front and back of the terrace are liable to encountering higher velocity winds. This confirms the requirement for mitigation.

The assessment of the porous parapet, with significant open area, indicates the landscaping introduced is effective in reducing the wind speeds at the north of the terrace, with the previously exposed benching and loose seating this area having improved sheltering. However, due to the wind direction and the openness of the parapet, the porous parapet provides an insufficient barrier at the south of the terrace, with the loose seating and benches in this region still being exposed to elevated wind speeds.

The glass parapet assessment indicates a significant improvement in all areas of the terrace, with reduced wind velocities observed throughout. The solid barrier to the wind at the south of the terrace provides significantly improved sheltering in this region. The glass barrier is seen to mitigate the winds effectively.

This assessment completes assessment of the mitigations proposed for the terrace and highlights their effectiveness in support of Planning Condition 57.

6. REFERENCES

Number	Description	Reference
1	Previous work	F2314 101 R01 RevE Upper Brook Street, Manchester Wind Microclimate Study
2	Building elevations	MAUBS-SRA-XX-XX-DR-AR-21302_External Walls East Elevation_P09
3	Planting plan	MAUBS-RFM-XX-01-DR-LS-0104_Level 01 Roof Terrace General Arrangement_P05 MAUBS-RFM-XX-01-DR-LS-0105_Level 01 Roof Terrace Planting Plan_P01
4	Parapet open areas	Email from McLaren (R. Aitken) to PDSVISION UK (S. Leefe) with subject ' <i>RE: 1911 UBS Curtain Walling Cost Engineering Meeting</i> ' dated 10/01/2025
5	Flow resistance of trees and pergola	Touma, J.S., 1977, <i>Dependence of the wind profile power law on stability for various locations</i> , J. Air Pollution Control Association, Vol. 27, pp. 863-866
6	Parapet loss coefficient	Miller, D.S., Internal Flow Systems (2 nd edition)



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